

# InGaAs linear image sensor G9201 to G9204 series

## Image sensor for DWDM wavelength monitor



G9201 to G9204 series InGaAs linear image sensors are specifically designed as detectors for monitoring WDM in optical communications. These linear image sensors consist of an InGaAs photodiode array with each pixel connected to a charge amplifier array comprised of CMOS transistors, a CDS circuit, an offset compensation circuit, a shift register and a timing generator. These sensors deliver high sensitivity and stable operation in the near infrared spectral range. The package is hermetically sealed for high reliability and the window has an anti-reflective coating for efficient light detection.

Signal processing circuits on the CMOS chip allow selecting a feedback capacitance (Cf) of 10 pF or 0.5 pF by supplying an external voltage. The image sensor operates over a wide dynamic range when Cf=10 pF and delivers high gain when Cf=0.5 pF.

### Features

- Wide dynamic range
- Low noise and low dark current
- Selectable gain
- Anti-saturation circuit
- CDS circuit \*1
- Offset compensation circuit
- Simple operation (by built-in timing generator) \*2
- High resolution: 25  $\mu\text{m}$  pitch (512 ch)
- Low cross-talk
- 256 ch: 1 video line  
512 ch: 2 video lines

### Applications

- DWDM wavelength monitor
- Optical spectrum analyzer

### Accessories (Optional)

- InGaAs multichannel detector head C8061-01, C8062-01 \*3
- Multichannel detector head controller C7557 \*3

### Selection guide

Type No.	Cooling	Number of pixels	Pixel pitch ( $\mu\text{m}$ )	Pixel size [ $\mu\text{m}$ (H) $\times$ $\mu\text{m}$ (V)]	Spectral response range ( $\mu\text{m}$ )	Defective pixel
G9201-256R	Non-cooled	256	50	50 $\times$ 250	0.9 to 1.7 (25 $^{\circ}\text{C}$ )	0
G9201-256S	One-stage TE-cooled				0.9 to 1.67 (-10 $^{\circ}\text{C}$ )	
G9202-512R	Non-cooled	512	25	25 $\times$ 250	0.9 to 1.7 (25 $^{\circ}\text{C}$ )	
G9202-512S	One-stage TE-cooled				0.9 to 1.67 (-10 $^{\circ}\text{C}$ )	
G9203-256D *4	Non-cooled	256	50	50 $\times$ 500	0.9 to 1.7 (25 $^{\circ}\text{C}$ )	
G9203-256R					0.9 to 1.67 (-10 $^{\circ}\text{C}$ )	
G9203-256S	One-stage TE-cooled	512	25	25 $\times$ 500	0.9 to 1.7 (25 $^{\circ}\text{C}$ )	
G9204-512D *4	Non-cooled				0.9 to 1.67 (-10 $^{\circ}\text{C}$ )	
G9204-512R					0.9 to 1.7 (25 $^{\circ}\text{C}$ )	
G9204-512S	One-stage TE-cooled				0.9 to 1.67 (-10 $^{\circ}\text{C}$ )	

#### \*1: CDS (Correlated Double Sampling) circuit

A major source of noise in charge amplifiers is the reset noise generated when the integration capacitance is reset. A CDS circuit greatly reduces this reset noise by holding the signal immediately after reset to find the noise differential.

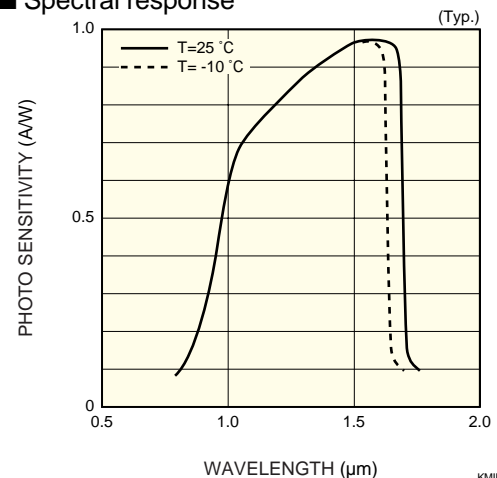
#### \*2: Timing generator

Different signal timings must be properly set in order to operate a shift register. In conventional image sensor operation, external PLDs (Programmable Logic Devices) are used to input the required timing signals. However, G9201 to G9204 series image sensors internally generate all timing signals on the CMOS chip just by supplying CLK and RESET pulses. This makes it simple to set the timings.

#### \*3: G9203-256D and G9204-512D are not available for C7557.

#### \*4: For G9203-256D and G9204-512D specifications, see the separate data sheets available from Hamamatsu.

#### Spectral response



## ■ Absolute maximum ratings

Parameter	Symbol	Value	Unit
Clock pulse voltage	$V_{\phi}$	5.5	V
Operating temperature *1	$T_{opr}$	-40 to +70	°C
Storage temperature *1	$T_{stg}$	-40 to +85	°C

\*1: Non condensation

## ■ Electrical characteristics (Ta=25 °C, $V_{\phi}$ =5 V)

Parameter	Symbol	Min.	Typ.	Max.	Unit	
Supply voltage	$V_{dd}$	4.9	5.0	5.1	V	
	$V_{ref}$	-	1.26	-		
Ground	$V_{ss}$	-	0	-	V	
Element bias	INP	4.4	4.5	4.6	V	
Clock frequency	f	0.01	-	4	MHz	
Clock pulse voltage	$V_{\phi}$	high	4.5	$V_{\phi}$	5.5	V
		low	0	0	0.4	V
Clock pulse rise/fall times	$t_{r\phi}$	0	20	100	ns	
	$t_{f\phi}$					
Clock pulse width	$tpw_{\phi}$	200	-	-	ns	
Reset pulse voltage	V (RES)	high	4.5	$V_{\phi}$	5.5	V
		low	0	0	0.4	V
Reset pulse rise/fall times	$t_r$ (RES)	0	20	100	ns	
	$t_f$ (RES)					
Reset pulse width	$tpw$ (RES)	6000	-	-	ns	
Video output voltage	high	$V_H$	-	4.4	INP	V
	low	$V_L$	-	1.26	-	
Data rate	$f_v$	-	f/8	-	Hz	

## ■ Electrical and optical characteristics

### General ratings (T=25 °C)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Peak sensitivity wavelength	$\lambda_p$		-	1.55	-	$\mu\text{m}$
Saturation charge *2	$Q_{sat}$	$V_p=5\text{ V}$	-	30	-	pC
RMS noise voltage (readout noise)	N	Standard deviation Number of integration: 50	-	180	300	$\mu\text{V}_{rms}$
Photo response non-uniformity *3	PRNU	Integration time: 10 msec	-	-	$\pm 5$	%
Saturation voltage	$V_{sat}$		3.0	3.2	-	V

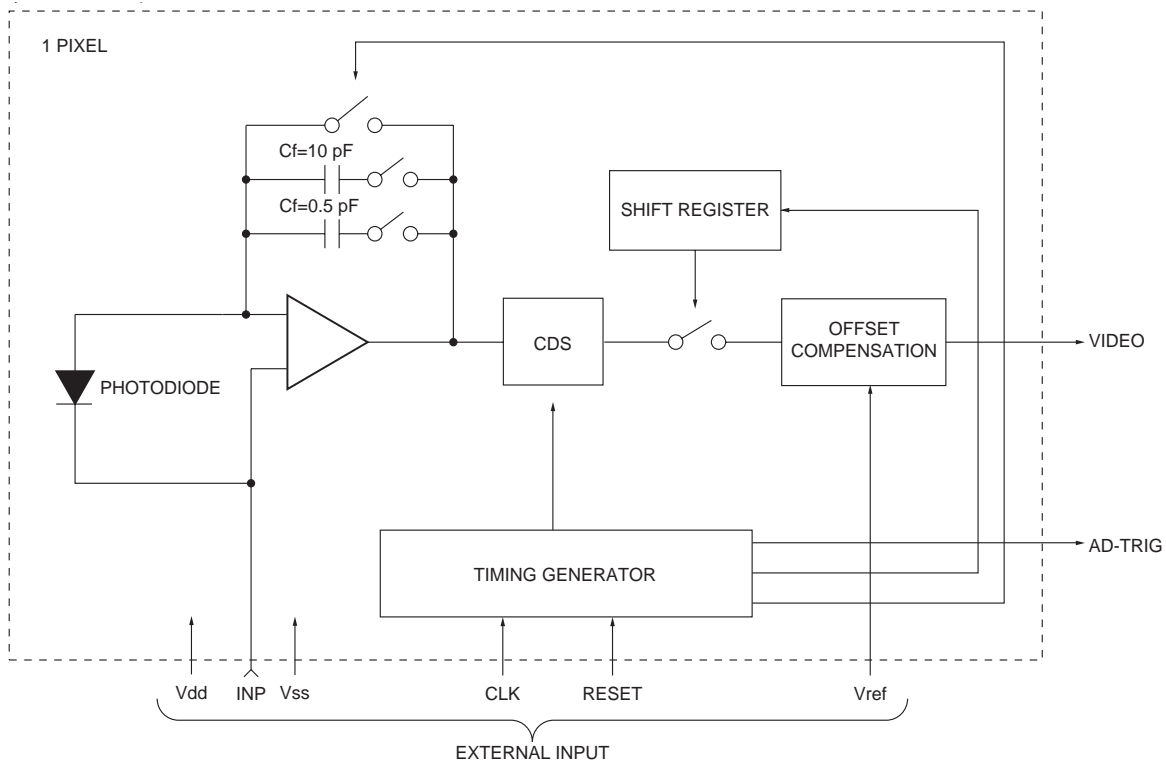
\*2:  $V_{\phi}=5\text{ V}$ ,  $C_f=10\text{ pF}$

\*3: 50 % of saturation, 10 ms integration time, after dark output subtraction, excluding first and last pixels.

### Dark current characteristics (T=25 °C)

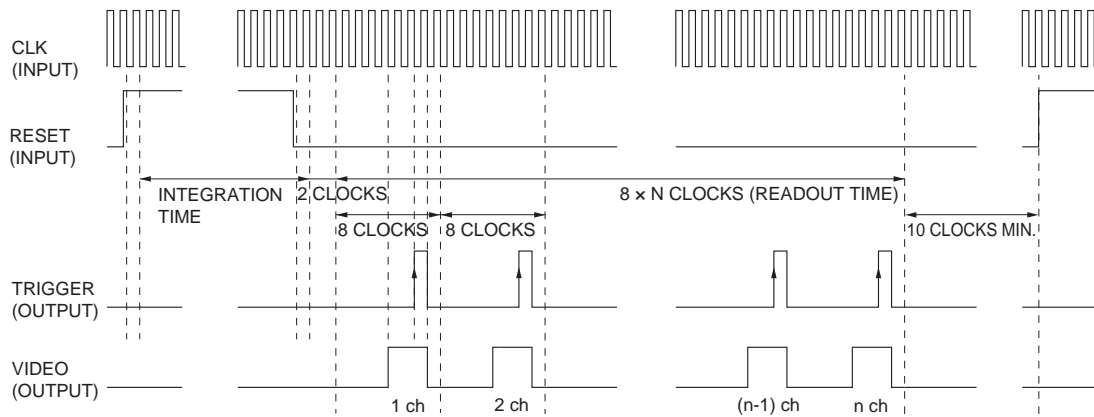
Parameter	Symbol	Min.	Typ.	Max.	Unit
G9201 series	ID	-	2	10	pA
G9202 series		-	1	5	
G9203 series		-	4	20	
G9204 series		-	1	5	

## Equivalent circuit



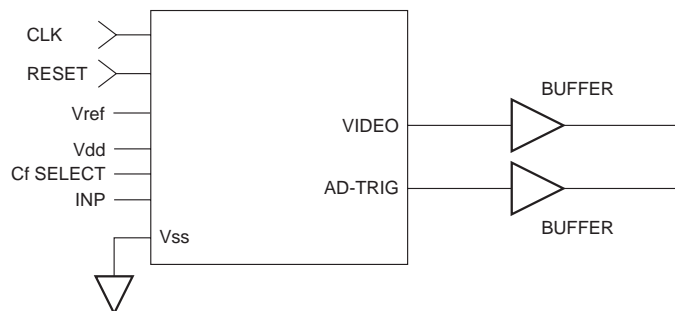
## Timing chart

KMIRC0010EB



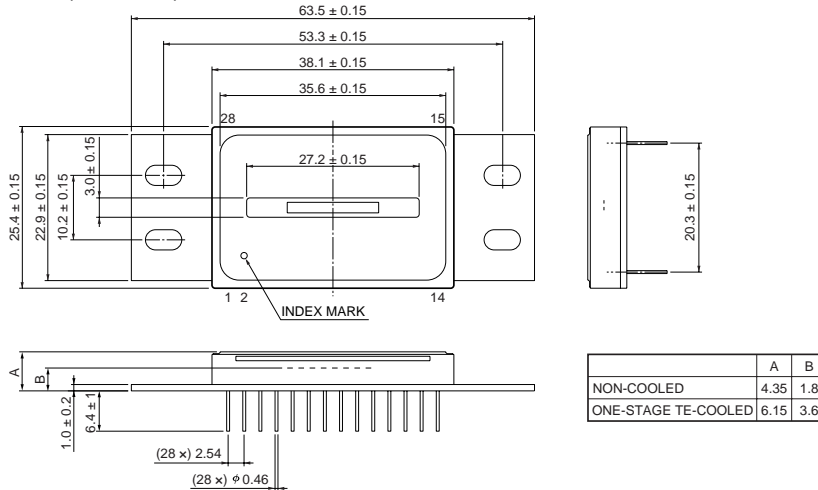
## Basic circuit connection

KMIRC0016EB



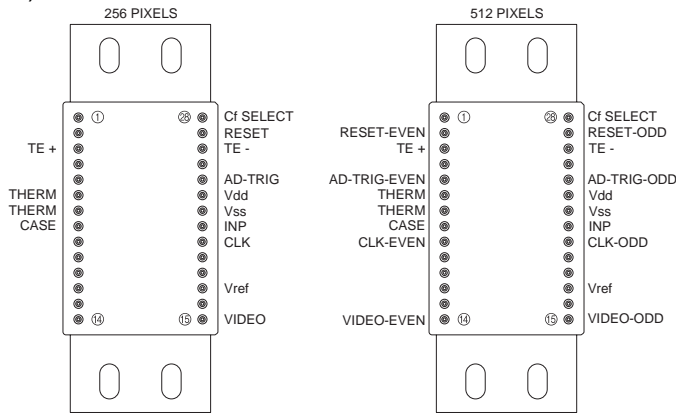
KMIRC0012EA

## Dimensional outline (unit: mm)



KMIRA0010EA

## Pin connection (top view)



KMIRC0013EA

Terminal name	Input/Output	Function and recommended connection
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 on the CMOS chip. The width of the reset pulse is 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=10 pF at 0 V, and Cf=0.5 pF at 5 V.
CASE	-	This terminal is electrically connected to the package.
THERM	-	Thermistor for monitoring temperature inside the package. No connection for room temperature operation type.
TE+, TE-	-	Power supply terminal for the thermoelectric cooler that cools the photodiode array. No connection for room temperature operation type.
AD-TRIG	Output	Digital signal for AD conversion; positive polarity
VIDEO	Output	Analog video signal; positive polarity
Vref	Input	Reset voltage for the offset compensation circuit on the CMOS chip

**HAMAMATSU**

Information furnished by HAMAMATSU is believed to be reliable. However, no responsibility is assumed for possible inaccuracies or omissions. Specifications are subject to change without notice. No patent rights are granted to any of the circuits described herein. ©2003 Hamamatsu Photonics K.K.

HAMAMATSU PHOTONICS K.K., Solid State Division

1126-1 Ichino-cho, Hamamatsu City, 435-8558 Japan, Telephone: (81) 053-434-3311, Fax: (81) 053-434-5184, <http://www.hamamatsu.com>

U.S.A.: Hamamatsu Corporation: 360 Foothill Road, P.O.Box 6910, Bridgewater, N.J. 08807-0910, U.S.A., Telephone: (1) 908-231-0960, Fax: (1) 908-231-1218

Germany: Hamamatsu Photonics Deutschland GmbH: Arzbergerstr. 10, D-82211 Herrsching am Ammersee, Germany, Telephone: (49) 08152-3750, Fax: (49) 08152-2658

France: Hamamatsu Photonics France S.A.R.L.: 8, Rue du Saule Trapu, Parc du Moulin de Massy, 91882 Massy Cedex, France, Telephone: 33-(1) 69 53 71 00, Fax: 33-(1) 69 53 71 10

United Kingdom: Hamamatsu Photonics UK Limited: 2 Howard Court, 10 Tewin Road, Welwyn Garden City, Hertfordshire AL7 1BW, United Kingdom, Telephone: (44) 1707-294888, Fax: (44) 1707-325777

North Europe: Hamamatsu Photonics Norden AB: Smidesvägen 12, SE-171 41 Solna, Sweden, Telephone: (46) 8-509-031-00, Fax: (46) 8-509-031-01

Italy: Hamamatsu Photonics Italia S.R.L.: Strada della Moia, 1/E, 20020 Arese, (Milano), Italy, Telephone: (39) 02-935-81-733, Fax: (39) 02-935-81-741