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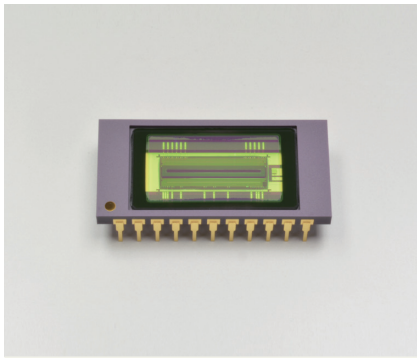
InGaAs linear image sensors

G14714 series

High-speed line rate near infrared sensor (0.95 to 1.7 µm)

The G14714 series are InGaAs linear image sensors designed for foreign object detection. The CMOS chip consists of charge amplifiers, shift registers, and timing generator. Charge amplifiers are configured with CMOS transistor array and are bump-bonded to each pixel of the InGaAs photodiode array. Since the signal from each pixel is read out in charge integration mode, high sensitivity and stable operation are attained in a wide spectral response range.

The signal processing circuit on the CMOS chip enables the selection of an optimum conversion efficiency (CE) for your application from the available four types using external voltage.

Features

- **High-speed line rate: 40000 lines/s max.**
- **High-speed data rate: 15 MHz max.**
- **Selectable from four conversion efficiency types**
- **Built-in timing generator**
- **Built-in temperature sensor**
- **Room temperature operation**

Applications

- **Foreign object detection**
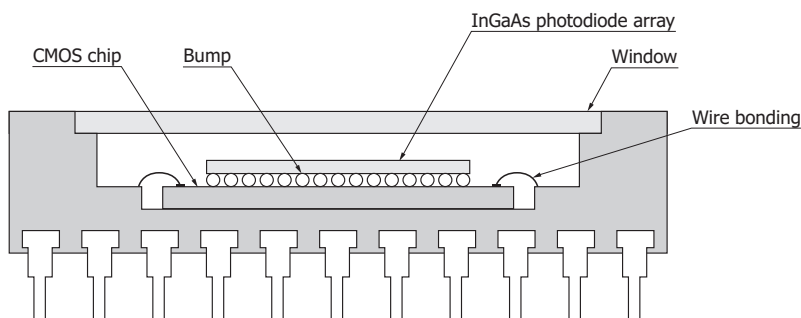- **Farm product inspection**
- **Spectrophotometry**

Structure

Parameter	G14714-512DE	NEW G14714-1024DG	G14714-1024DK	Unit
Cooling	Non-cooled type			-
Total number of pixels	512	1024	1024	pixels
Number of effective pixels	512	1024	1024	pixels
Image size*1	12.8 × 0.025	12.8 × 0.25	12.8 × 0.0125	mm
Pixel size*2 (H × V)	25 × 25	12.5 × 250	12.5 × 12.5	µm
Pixel pitch	25	12.5	12.5	µm
Package	22-pin ceramic (see dimensional outline)			-
Window material	Borosilicate glass (AR coated)			-

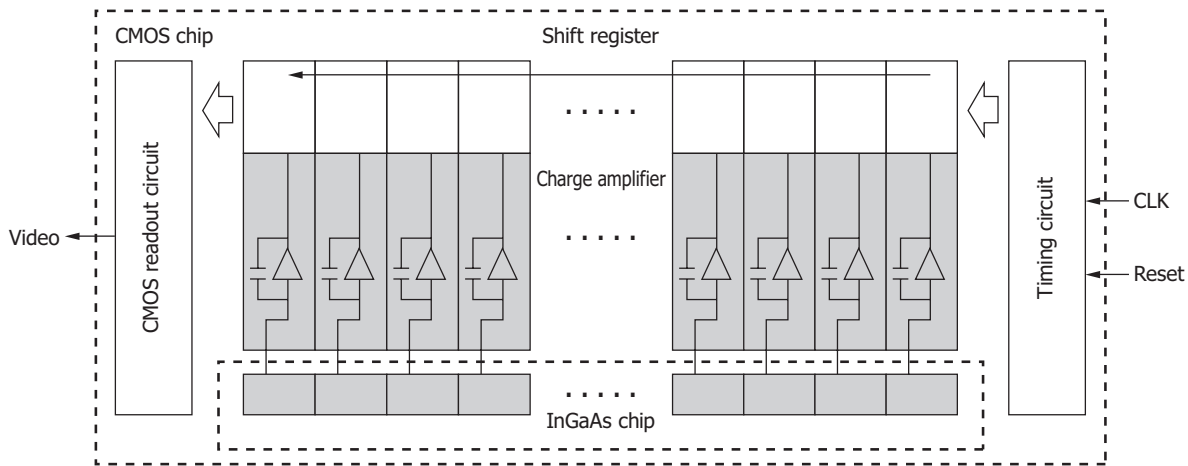*1: Actual sensitivity region G14714-512DE: 12.8 × 0.045 mm, G14714-1024DG: 12.8 × 0.27 mm, G14714-1024DK: 12.8 × 0.0325 mm
*2: Actual sensitivity region G14714-512DE: 25 × 45 µm, G14714-1024DG: 12.5 × 270 µm, G14714-1024DK: 12.5 × 32.5 µm

Cross section

KMIRC0053EA

Block diagram

KMIRC0119EA

Absolute maximum ratings

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply voltage	Vdd, DVdd, INP Vinp, PDN	Ta=25 °C	-0.3	-	+4.2	V
Clock pulse voltage	Vclk	Ta=25 °C	-0.3	-	+4.2	V
Reset pulse voltage	Vres	Ta=25 °C	-0.3	-	+4.2	V
Gain selection terminal voltage	Vcfsel	Ta=25 °C	-0.3	-	+4.2	V
Operating temperature	Topr	No dew condensation[3]	-10	-	+60	°C
Storage temperature	Tstg	No dew condensation[3]	-20	-	+70	°C
Soldering conditions	-		260 °C or less, 5 seconds or less			-
Thermistor power dissipation	Pd_th	Ta= 25 °C	-	-	400	mW

[3]: When there is a temperature difference between a product and the surrounding area in high humidity environments, dew condensation may occur on the product surface. Dew condensation on the product may cause deterioration in characteristics and reliability.

Note: Absolute maximum ratings indicate values that must not be exceeded. 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, DVdd	3.2	3.3	3.4	V
Video line reset voltage		Vinp	2.4	2.5	2.6	V
Input stage amplifier reference voltage		INP	2.4	2.5	2.6	V
Pixel voltage[4]		PDN	2.5	2.6	2.7	V
Ground		GND	-	0	-	V
Clock pulse voltage	High	Vclk	Vdd - 0.4	Vdd	Vdd + 0.4	V
	Low		-	0	0.4	
Reset pulse voltage	High	Vres	Vdd - 0.4	Vdd	Vdd + 0.4	V
	Low		-	0	0.4	

[4]: Set the pixel voltage about 0.1 V higher than the input stage amplifier reference voltage.

▣ Electrical and optical characteristics (Ta=25 °C, Vdd, Dvdd=3.3 V, INP, Vinp=2.5 V, PDN=2.6 V, fop=15 MHz, per pixel)

Parameter	Symbol	Condition	G14714-512DE			NEW G14714-1024DG			G14714-1024DK			Unit
			Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
Spectral response range	λ		-	0.95 to 1.7	-	-	0.95 to 1.7	-	-	0.95 to 1.7	-	µm
Peak sensitivity wavelength	λ_p		1.45	1.55	1.65	1.45	1.55	1.65	1.45	1.55	1.65	µm
Photosensitivity	S	$\lambda=\lambda_p$	0.7	0.82	-	0.7	0.82	-	0.7	0.82	-	A/W
Conversion efficiency	CE	Cf=1.25 pF	-	0.128	-	-	0.128	-	-	0.128	-	µV/e⁻
		Cf=0.13 pF	-	1.23	-	-	1.23	-	-	1.23	-	
		Cf=0.04 pF	-	4.0	-	-	4.0	-	-	4.0	-	
		Cf=0.02 pF	-	8.0	-	-	8.0	-	-	8.0	-	
Saturation charge[5]	Csat		0.2	0.219	-	0.2	0.213	-	0.2	0.213	-	Me⁻
Saturation output voltage[5]	Vsat		1.6	1.75	-	1.6	1.7	-	1.6	1.7	-	V
Photoresponse nonuniformity[6]	PRNU		-	±5	±20	-	±5	±20	-	±5	±20	%
Dark current[5]	I_D		-0.1	0.5	5	-1	5	50	-0.1	0.5	5	pA
Dark output[5]	V_D		-5	25	250	-7.7	38	385	-5	25	250	V/s
Readout noise	Nread	CE=1.23 µV/e⁻	-	1.5	3	-	1.5	3	-	1.2	2	mV rms
		CE=8.0 µV/e⁻	-	10	15	-	14	20	-	8	13	
Dynamic range	Drange	CE=1.23 µV/e⁻	533	1167	-	533	1133	-	800	1417	-	-
		CE=8.0 µV/e⁻	107	175	-	80	121	-	123	213	-	
Defective pixels[7]	-		-	-	1	-	-	1	-	-	1	%

[5]: CE=8.0 µV/e⁻
[6]: CE=1.23 µV/e⁻, measured at 50% saturation after subtracting the dark output, excluding the first and last pixels
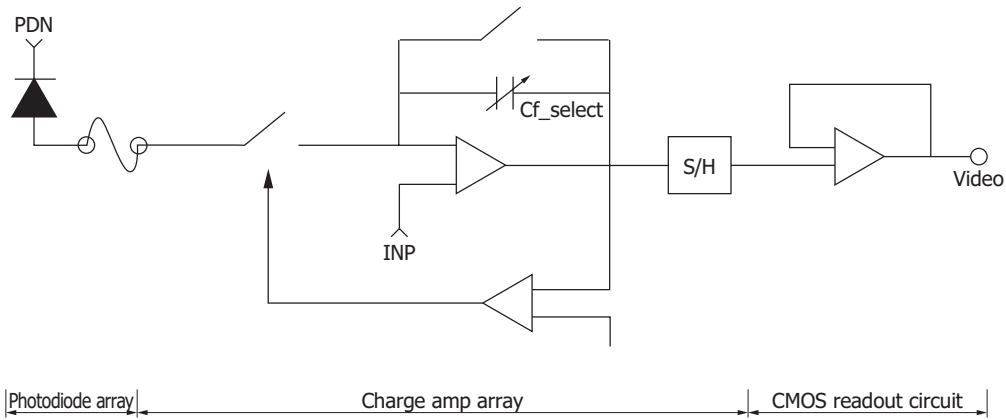[7]: Pixels whose photoresponse nonuniformity, dark current, or readout noise is outside the specifications

▣ Electrical characteristics (Ta=25 °C)

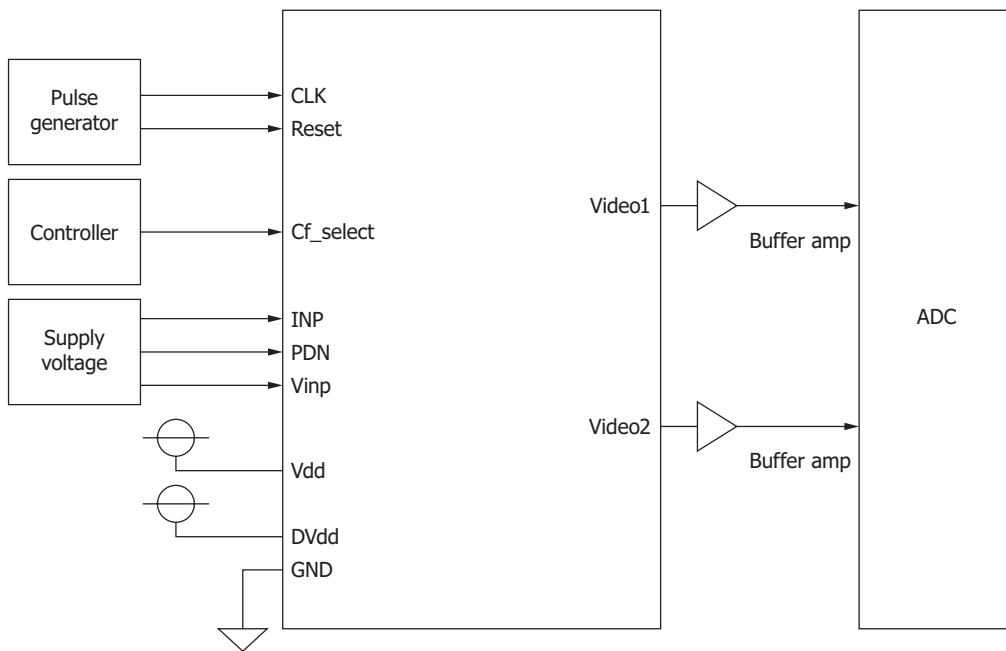| Parameter		Symbol	G14714-512DE			G14714-1024DG/DK			Unit
			Min.	Typ.	Max.	Min.	Typ.	Max.	
Supply current		Ivdd	-	60	100	-	85	120	mA
		Idvdd	-	10	15	-	10	15	
Video line reset current		Ivinp	-	-	10	-	-	10	mA
Input stage amplifier reference current		Iinp	-	-	10	-	-	10	mA
Pixel current		Ipdn	-	-	20	-	-	20	mA
Output voltage	Dark	Video(dark)	-	2.6	2.9	-	2.55	2.9	V
	Saturation	Video(sat)	0.6	0.85	-	0.6	0.85	-	
Clock frequency		fop	0.1	-	15	0.1	-	15	MHz
Output offset voltage		Vos	-	Vinp	-	-	Vinp	-	V
Output impedance		Zo	-	5	-	-	5	-	kΩ
Data rate		DR	-	fop	-	-	fop	-	MHz
Thermistor resistance		Rth	-	10	-	-	10	-	kΩ
Thermistor B constant[8]		B	-	3950	-	-	3950	-	K

[8]: T_1=25 °C, T_2=50 °C

Equivalent circuit
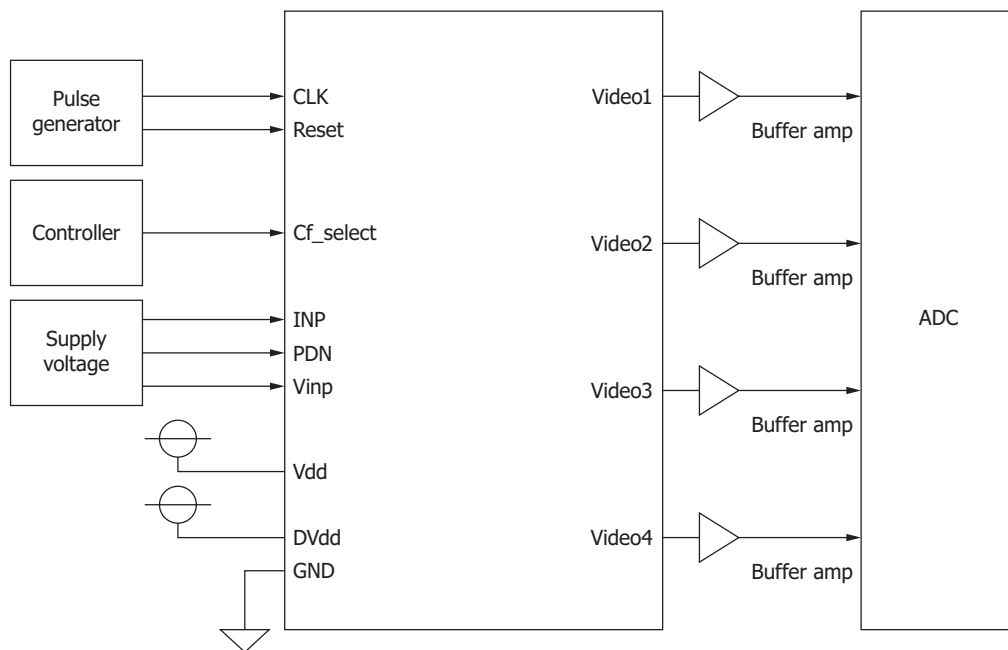

KMIRC0120EA

Connection examples

G14714-512DE
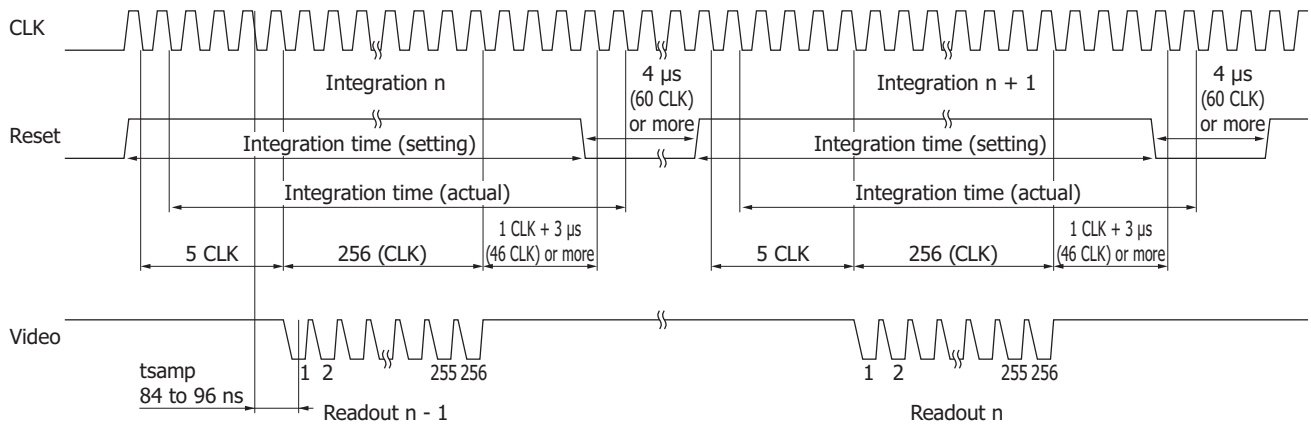
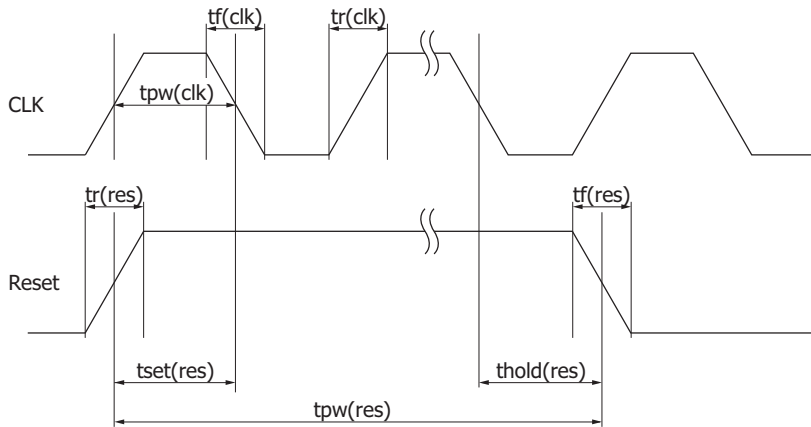Note: buffer amp example: LT1818

KMIRC0125EA

G14714-1024DG/DK

Note: buffer amp example: LT1818
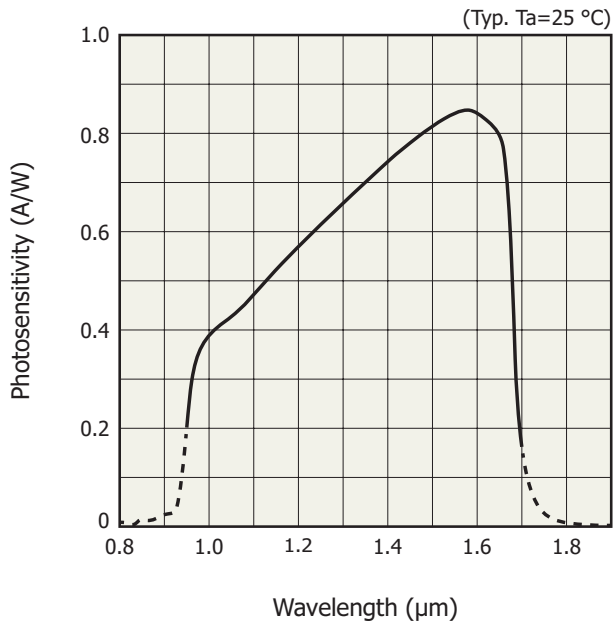
KMIRC0122EA

Timing chart (fop=15 MHz, 256 ch/port)

CLK

Integration n — 4 µs (60 CLK) or more — Integration n + 1 — 4 µs (60 CLK) or more

Reset

Integration time (setting) — Integration time (setting)

Integration time (actual) — Integration time (actual)

5 CLK | 256 (CLK) | 1 CLK + 3 µs (46 CLK) or more — 5 CLK | 256 (CLK) | 1 CLK + 3 µs (46 CLK) or more

Video

tsamp 84 to 96 ns

1 2 ... 255 256 — 1 2 ... 255 256

Readout n - 1 — Readout n

Integration time (actual)=Reset high period

CLK

tf(clk) tr(clk) tpw(clk)

Reset

tr(res) tf(res) tset(res) thold(res) tpw(res)

KMIRC0121EC

Parameter		Symbol	Min.	Typ.	Max.	Unit
Operating frequency		fop	0.1	-	15	MHz
Clock pulse width		tpw(clk)	33.3	-	5000	ns
Clock pulse rise/fall times		tr(clk), tf(clk)	0	5	10	ns
Reset pulse width	High	tpw(res)	262 CLK + 3 µs	-	-	-
	Low		4 µs	-	-	
Reset pulse rise/fall times		tr(res), tf(res)	0	10	20	ns
Clock setup time		tset(res)	10	-	-	ns
Clock hold time		thold(res)	10	-	-	ns

Spectral response

(Typ. Ta=25 °C)

Photosensitivity (A/W) vs Wavelength (μm)

KMIRB0051EC

Spectral transmittance of window material

(Typ. Ta=25 °C)

Transmittance (%) vs Wavelength (μm)

KMIRB0090EA

Thermistor temperature characteristics

(Typ.)

Thermistor resistance (kΩ) vs Temperature (°C)

KMIRB0059EA

(Typ.)

Temperature	Thermistor resistance (kΩ)
-10	53.0
-5	41.2
0	32.1
5	25.1
10	19.8
15	15.7
20	12.5
25	10.0
30	8.06
35	6.53
40	5.32
45	4.36
50	3.59
55	2.97
60	2.47

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Pin connections

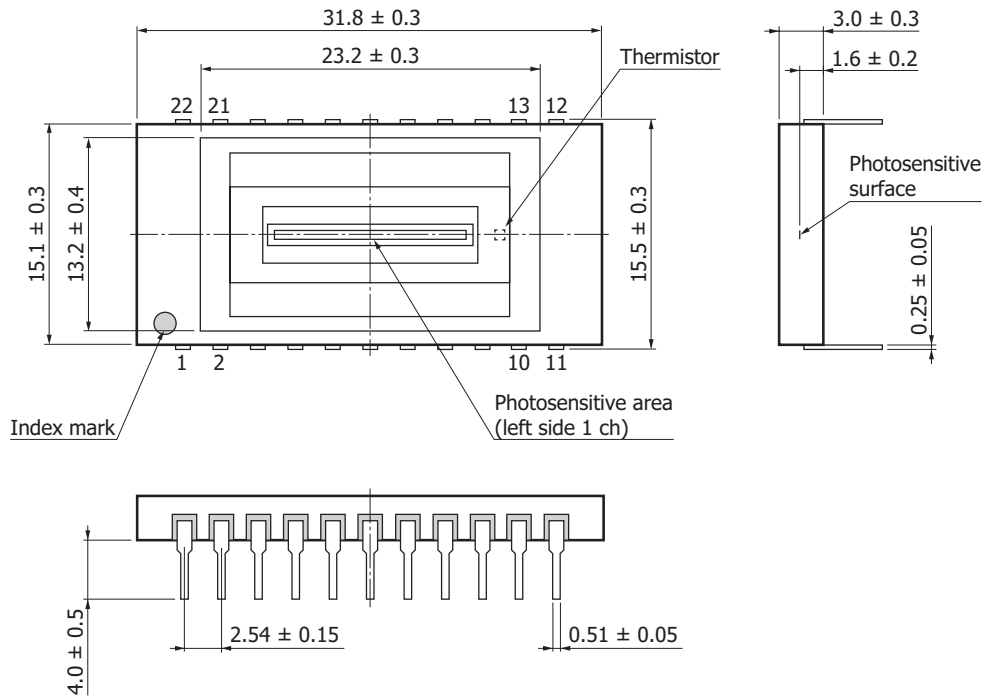| Terminal name	Input/output	Function and recommended connection	Note
PDN	Input	InGaAs photodiode's cathode bias terminal. Set it about 0.1 V higher than the INP terminal.	2.6 V
Cf_select[9]	Input	Signal for selecting the feedback capacitance (conversion efficiency) on the CMOS chip	0 V or 3.3 V
Reset	Input	Reset pulse for initializing the feedback capacitance in the charge amplifier formed on the CMOS chip. Integration time is determined by the high level period of the pulse.	0 to 3.3 V
CLK	Input	Clock pulse for operating the CMOS shift register	0 to 3.3 V
INP	Input	Charge amplifier reset voltage. This is the supply voltage for operating the signal processing circuit on the CMOS chip.	2.5 V
Vinp	Input	Video line reset voltage. This is the supply voltage for operating the signal processing circuit on the CMOS chip.	2.5 V
Video	Output	Analog video signal. The polarity is negative.	G14714-512DE: 0.85 to 2.6 V G14714-1024DG/DK: 0.85 to 2.55 V
DVdd	Input	Supply voltage for operating the digital signal processing circuit on the CMOS chip	3.3 V
Vdd	Input	Supply voltage for operating the analog signal processing circuit on the CMOS chip	3.3 V
GND	-	Ground for the signal processing circuit on the CMOS chip	0 V
Therm	Output	Thermistor terminal for monitoring the package temperature	-

*9: The conversion efficiency is determined by the supply voltage to the Cf_select terminal as follows.

Conversion efficiency	Cf_select1	Cf_select2
0.128 µV/e⁻	Low	Low
1.23 µV/e⁻	Low	High
4.0 µV/e⁻	High	Low
8.0 µV/e⁻	High	High

Low: 0 V (GND), High: 3.3 V (Vdd)

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Dimensional outline (unit: mm)

Index mark

Thermistor

Photosensitive area
(left side 1 ch)

Photosensitive surface

Pin no.	G14714-512DE	G14714-1024DG/DK
1	NC	
2	NC	
3	Vdd	
4	NC	Video1
5	Video1	Video2
6	Vinp	
7	NC	Video3
8	Video2	Video4
9	PDN	
10	NC	
11	NC	
12	Therm	
13	Therm	
14	INP	
15	Cf_select2	
16	Cf_select1	
17	GND	
18	DVdd	
19	NC	
20	NC	
21	Reset	
22	CLK	

Package material: Ceramic
Lead processing: Ni/Au plating
Lead material: FeNi alloy
Window material: Borosilicate glass
Window thickness: 0.75 ± 0.05 mm
Window refractive index: nd=1.47
AR coat: Coated (1.55 µm peak)
Window sealing method: Resin adhesion
Center position accuracy of photosensitive area: $-0.3 \leq X \leq +0.3$
$-0.3 \leq Y \leq +0.3$
Angle accuracy of photosensitive area: $-5° \leq \theta \leq +5°$

Note: Leave NC open; do not connect to GND.

Output of pixels at each video output
[G14714-512DE]
Video1=1 to 256 ch, Video2=257 to 512 ch
[G14714-1024DG/DK]
Video1=1 to 256 ch, Video2=257 to 512 ch,
Video3=513 to 768 ch, Video4=769 to 1024 ch

KMIRA0039ED

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. 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

■ Technical information
· InGaAs linear image sensors / Technical note

Information described in this material is current as of March 2022.

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