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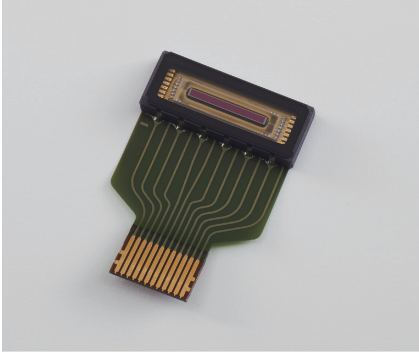
InGaAs linear image sensors



G13913 series

Near infrared image sensors for portable analytical instruments

The compact low-cost near infrared linear image sensors are designed for portable analytical instruments. They consume less current than the previous product (DIP package products: G11620 series). They are suitable for integration into compact thin devices because they employ a compact LCC package with a flexible board.

Features

- **Compact (with flexible board)**
- **3.3 V drive**
- **Low current consumption: 15 mA (G13913-128FB)**
- **Low cost**
- **128 pixels (50 × 250 µm/pixel): G13913-128FB**
  256 pixels (25 × 250 µm/pixel): G13913-256FG
- **Selectable from two conversion efficiency levels**
- **Built-in anti-saturation circuit**
- **Easy operation (built-in timing generator*1)**
- **High resolution: 25 µm pitch (G13913-256FG)**

Applications

- **Portable analytical instruments**

*1: Previously, multiple timing signals were applied using external PLD (programmable logic device) or the like to run the shift register. This image sensor has a built-in CMOS circuit for timing generation. All timing signals are generated inside the image sensor by simply applying CLK and RESET signals.

Selection guide

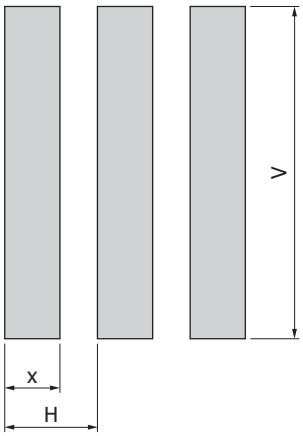
Type no.	Cooling	Image size (mm)	Total number of pixels	Number of effective pixels
G13913-128FB	Non-cooled	6.4 × 0.25	128	128
G13913-256FG			256	256

Structure

Type no.	Pixel size [µm (H) × µm (V)]	Pixel pitch (µm)	Package	Window material
G13913-128FB	50 × 250	50	Ceramic with flexible board (refer to dimensional outline)	Borosilicate glass*2 (no anti-reflective coating)
G13913-256FG	25 × 250	25		

*2: Windowless types are also available.

Enlarged view of photosensitive area (unit: μm)



Type no.	x	H	V
G13913-128FB	30	50	250
G13913-256FG	10	25	250

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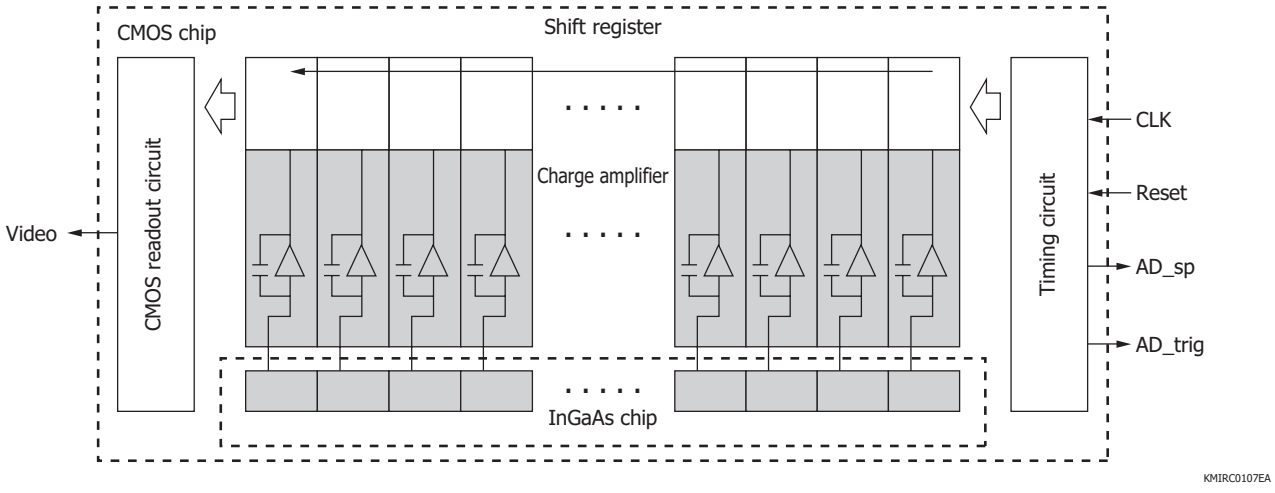
Block diagram



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Absolute maximum ratings

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply voltage	Vdd, INP, Fvref Vhold, PDN	Ta=25 °C	-0.3	-	+4.2	V
Clock pulse voltage	Vclk	Ta=25 °C	-0.3	-	+4.2	V
Reset pulse voltage	V(RES)	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

*3: 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: 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 (Ta=25 °C)

Parameter		Symbol	Min.	Typ.	Max.	Unit
Supply voltage		Vdd	3.0	3.3	3.6	V
Differential reference voltage		Fvref	2.4	2.5	2.6	V
Sample hold voltage		Vhold	2.4	2.5	2.6	V
Input stage amplifier reference voltage		INP	2.4	2.5	2.6	V
Photodiode cathode voltage		PDN	2.4	2.5	2.6	V
Ground		GND	-	0	-	V
Clock pulse voltage	High	Vclk	Vdd - 0.25	Vdd	Vdd + 0.25	V
	Low		-	0	+0.25	
Reset pulse voltage	High	V(RES)	Vdd - 0.25	Vdd	Vdd + 0.25	V
	Low		-	0	+0.25	

Electrical characteristics (Ta=25 °C)

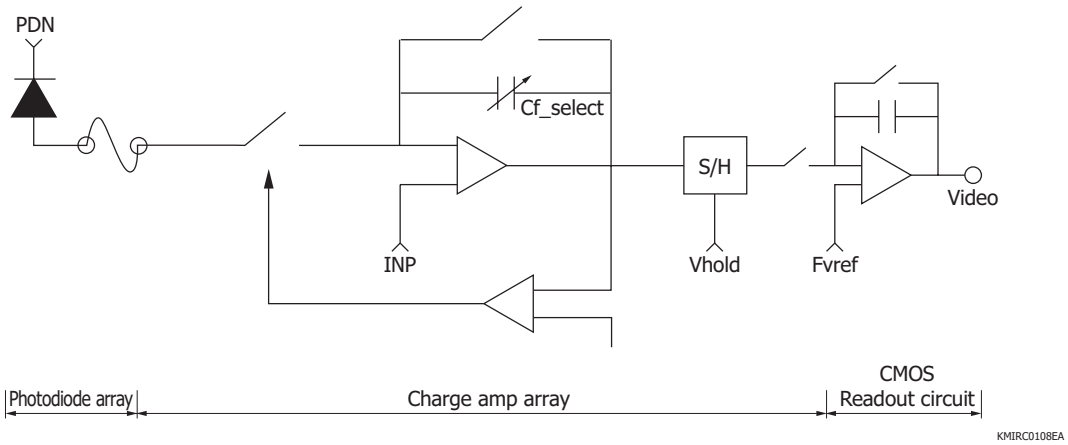
Parameter		Symbol		Min.	Typ.	Max.	Unit
Current consumption		I(Vdd)	G13913-128FB	-	15	25	mA
			G13913-256FG	-	20	30	
		Ifvref		-	-	1	
		Ivhold		-	-	1	
		Iinp		-	-	1	
		Ipdn		-	-	1	
Clock frequency		fop		0.1	1	2	MHz
Data rate		DR		-	fop	-	MHz
Video output voltage	Dark	Vdark		-	2.5	2.9	V
	Saturation	Vsat		0.2	0.3	-	
Output offset voltage		Vos		-	Fvref	-	V
Output impedance		Zo		-	6	-	kΩ
AD_trig, AD_sp Pulse voltage	High	Vtrig, Vsp		-	Vdd	-	V
	Low			-	GND	-	

Electrical and optical characteristics (Ta=25 °C, Vdd=3.3 V, INP=Fvref=Vhold=PDN=2.5 V, Vclk=3.3 V, fop=1 MHz)

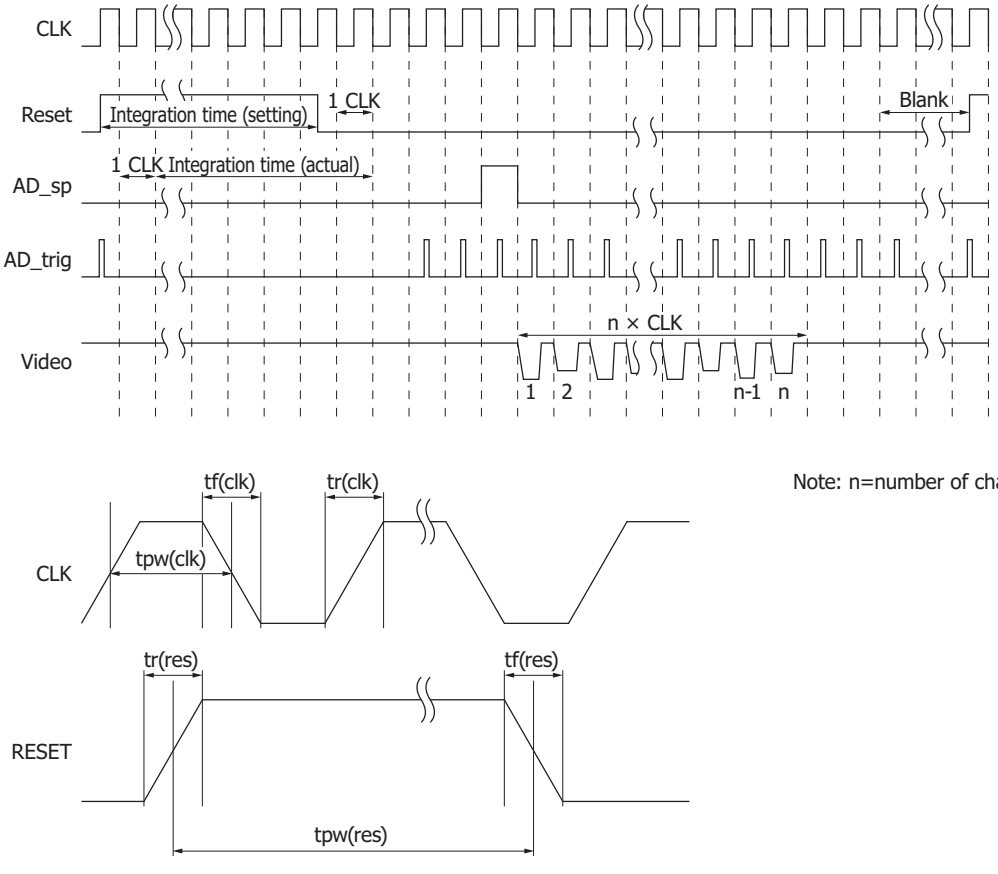
Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Spectral response range	λ		-	0.95 to 1.7	-	μm
Peak sensitivity wavelength	λp		-	1.55	-	μm
Photosensitivity	S	λ=λp	0.7	0.82	-	A/W
Conversion efficiency*4	CE	Cf=10 pF	-	16	-	nV/e⁻
		Cf=1 pF	-	160	-	
Photoresponse nonuniformity*5	PRNU	CE=16 nV/e⁻	-	±5	±10	%
Saturation charge	Csat	CE=16 nV/e⁻	125	137.5	-	Me⁻
		CE=160 nV/e⁻	12.5	13.75	-	
Saturation output voltage	Vsat	t=20 ms	2.0	2.2	-	V
Dark output	VD	CE=16 nV/e⁻	-	±0.1	±1	V/s
Dark current	ID	CE=16 nV/e⁻	-	±1	±10	pA
Temperature coefficient of dark output (dark current)	-		-	1.1	-	times/°C
Readout noise*6	Nread	CE=16 nV/e⁻	-	150	400	μV rms
		CE=160 nV/e⁻	-	300	500	
Dynamic range	Drange	CE=16 nV/e⁻	5000	14667	-	-
Defect pixels*7	-	CE=16 nV/e⁻	-	-	1	%

*4: For switching the conversion efficiency, see the pin connections.
*5: Measured at 50% saturation and 10 ms integration time after subtracting the dark output, excluding the first and last pixels
*6: Integration time when CE=16nV/e⁻ is 10 ms. Integration time when CE=160 nV/e⁻ is 1 ms.
*7: Pixels whose photoresponse nonuniformity, readout noise, or dark current is outside the specifications

Equivalent circuit



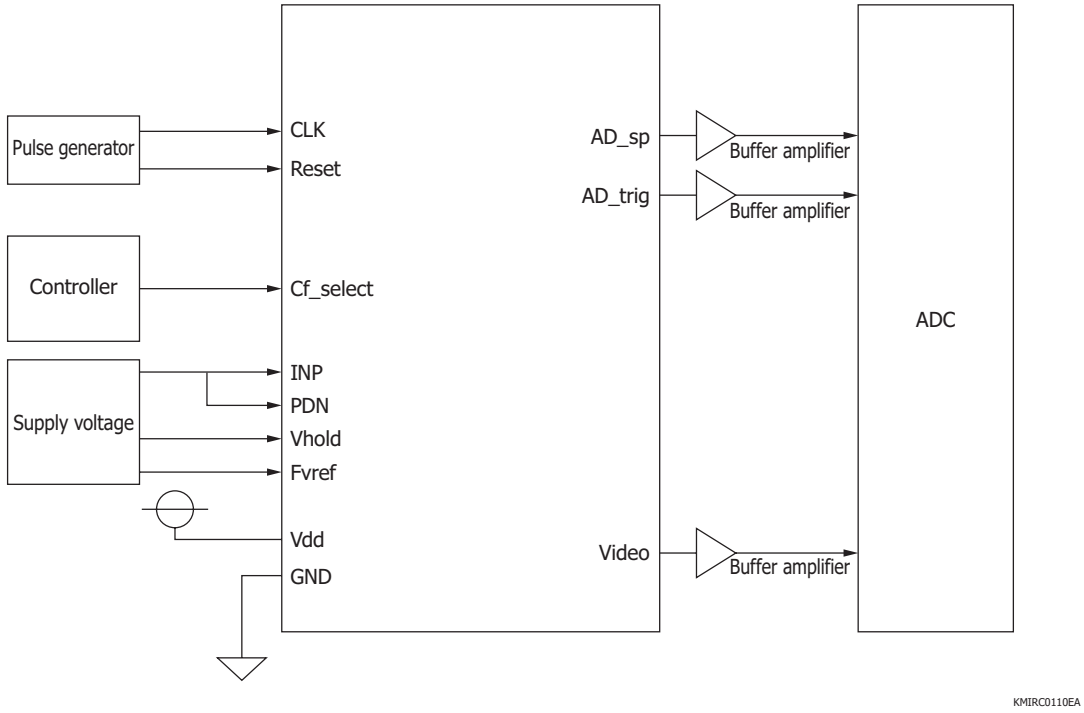
Timing chart



Note: n=number of channels

Parameter		Symbol	Min.	Typ.	Max.	Unit
Clock pulse frequency		fop	0.1	1	2	MHz
Clock pulse width		tpw(clk)	150	-	5000	ns
Clock pulse rise/fall times		tr(clk), tf(clk)	0	20	30	ns
Reset pulse width	High	tpw(res)	2	-	-	clocks
	Low		Number of pixels + 16	-	-	
Reset pulse rise/fall times		tr(res), tf(res)	0	20	30	ns

Connection example



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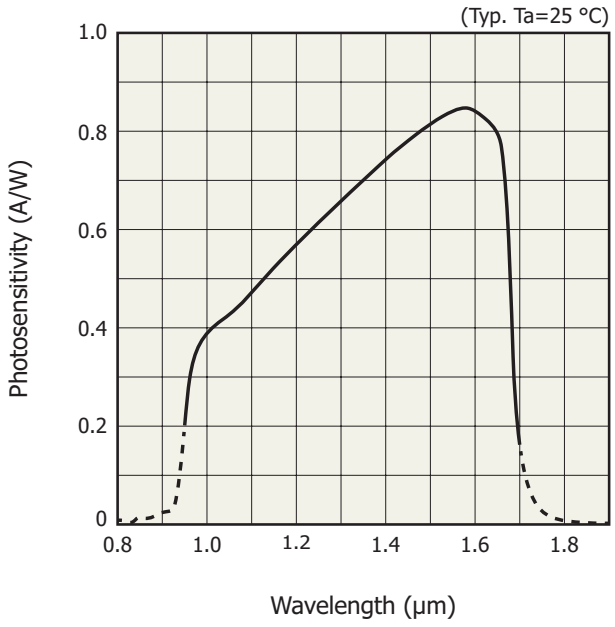
Spectral response (typical example)



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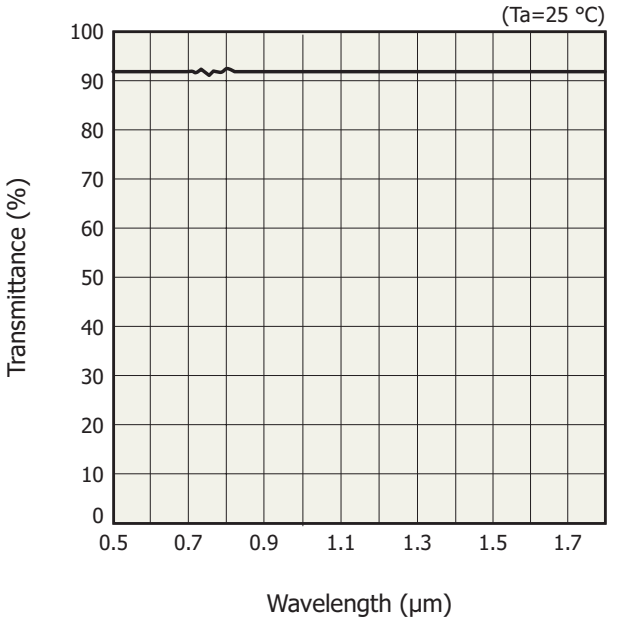
Spectral transmittance of window material (typical example)



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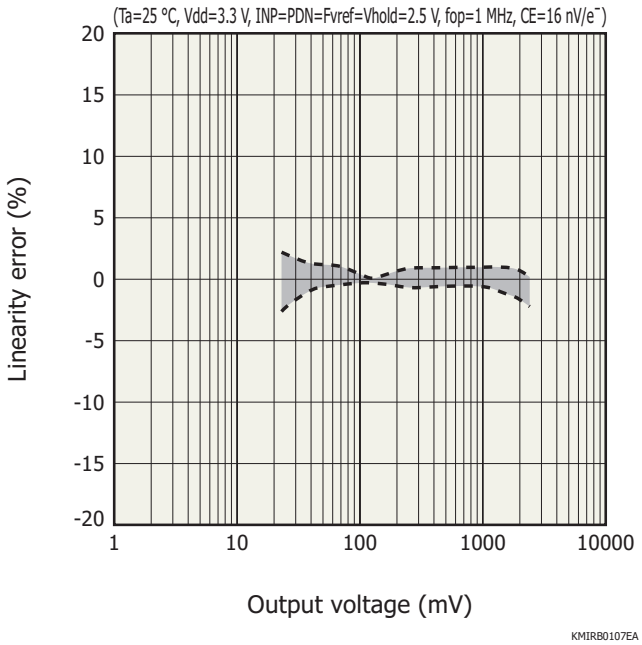
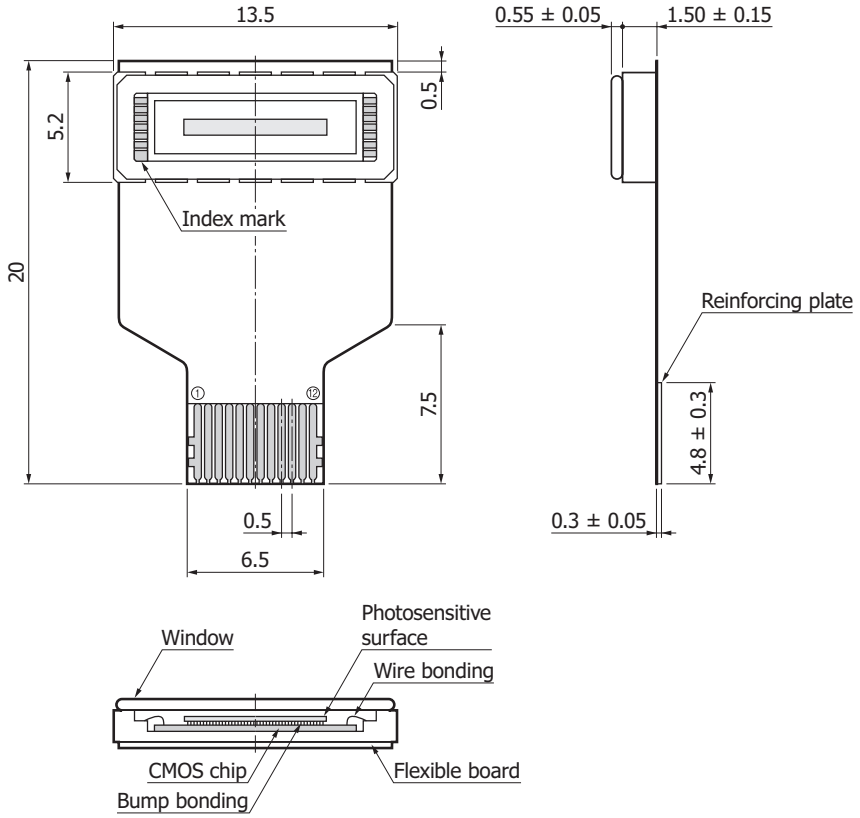
Linearity error



Dimensional outline (unit: mm)



1	AD_trig	7	Fvref
2	GND	8	Video
3	AD_sp	9	PDN*
4	Vhold	10	INP*
5	CLK	11	Vdd
6	Reset	12	Cf_select

Tolerance unless otherwise noted: ±0.25
Window refractive index: 1.47
Window thickness: 0.55 ± 0.05
Window sealing method: Resin adhesion
Center position accuracy of photosensitive area
-0.3≤X≤+0.3
-0.3≤Y≤+0.3
-2°≤θ≤+2°

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Pin connections

Terminal name	Input/ output	Function and recommended connection	Note
PDN	Input	InGaAs photodiode's cathode bias terminal. Set to the same potential as INP.	2.5 V
AD_sp	Output	Digital start signal for A/D conversion	0 to 3.3 V
Cf_select	Input*8	Signal for selecting the feedback capacitance (integration capacitance) on the CMOS chip	0 to 3.3 V
AD_trig	Output	Sampling sync signal for A/D conversion	0 to 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 this pulse.	0 to 3.3 V
CLK	Input	Clock pulse for operating the CMOS shift register	0 to 3.3 V
INP	Input	Input stage amplifier reference voltage. This is the supply voltage for operating the signal processing circuit on the CMOS chip. Set to the same potential as PDN.	2.5 V
Vhold	Input	Reference voltage for sample-and-hold circuit. This is the supply voltage for operating the signal processing circuit on the CMOS chip.	2.5 V
Fvref	Input	Differential amplifier reference voltage. This is the supply voltage for operating the signal processing circuit on the CMOS chip.	2.5 V
Video	Output	Differential amplifier output. This is an analog video signal. Nagative polarity.	0.3 to 2.5 V
Vdd	Input	Supply voltage for operating the signal processing circuit on the CMOS chip (+3.3 V)	3.3 V
GND	Input	Ground for the signal processing circuit on the CMOS chip (0 V)	0 V

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

Conversion efficiency	Cf_select
16 nV/e$^-$ (low gain)	Low
160 nV/e$^-$ (high gain)	High

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

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 precautions
· Image sensors

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