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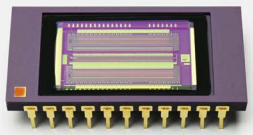
NEW

InGaAs linear image sensors



G17225 series

High-speed line rate near infrared sensor (0.9 µm to 1.7 µm)

The G17225 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 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 range.
By changing the external voltage, an appropriate value for your application is selectable from four types of conversion efficiency (CE).

Features

- **High-speed line rate: 50 klines/s max.**
- **High-speed data rate: 20 MHz max.**
- **Selectable from four conversion efficiency types**
- **Built-in temperature sensor**
- **Room temperature operation**

Applications

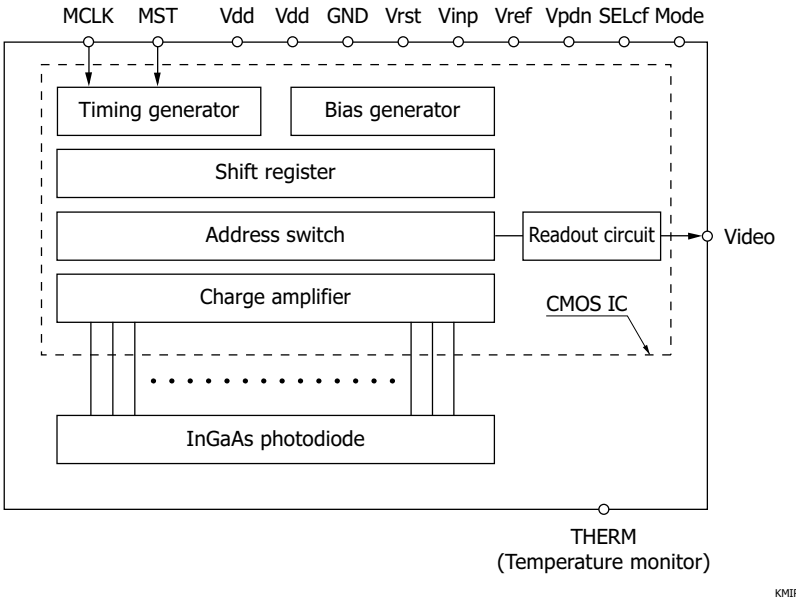
- **Foreign object detection (G17225-512DE/-1024DK)**
- **Farm product inspection (G17225-512DE/-1024DK)**
- **SD-OCT (G17225-1024DG)**

Structure

Parameter	G17225-512DE	G17225-1024DK	G17225-1024DG	Unit
Image size	12.8 × 0.025	12.8 × 0.0125	12.8 × 0.25	mm
Pixel size (H × V)	25 × 25	12.5 × 12.5	12.5 × 250	µm
Pixel pitch	25	12.5	12.5	µm
Total number of pixels	544	1088	1088	pixels
Number of effective pixels	512	1024	1024	pixels
Light-shielding pixels	16	32	32	pixels
Dummy pixels*1	16	32	32	pixels
Package	22-pin ceramic			-
Window material	Borosilicate glass with anti-reflective coating			-
Cooling	Non-cooled			-

*1: Pixels between light-shielding pixels and number of effective pixels.

Block diagram



Absolute maximum ratings

Parameter	Symbol	Condition	Value	Unit
Supply voltage*2	Vs	Ta=25 °C	-0.3 to +4.2	V
Digital input signal voltage*3	Vi	Ta=25 °C	-0.3 to +4.2	V
Operating temperature*4	Topr	No dew condensation*4	-10 to +60	°C
Storage temperature*4	Tstg	No dew condensation*4	-20 to +70	°C

*2: Vdd1, Vdd2, Vinp, Vref, Vpdn
*3: MCLK, MST, SELcf1, SELcf2, Mode
*4: 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 (Ta=25 °C)

Parameter		Symbol	Min.	Typ.	Max.	Unit
Power supply voltage		Vdd1	3.2	3.3	3.4	V
		Vdd2	3.2	3.3	3.4	V
Video line reset voltage		Vrst	1.5	1.6	1.7	V
Charge amplifier reset voltage		Vinp	2.4	2.5	2.6	V
CDS stage reference voltage		Vref	2.6	2.7	2.8	V
Photodiode cathode bias voltage*5		Vpdn	-	Vinp +0.1	-	V
Digital input signal voltage*6	High	Vi	Vdd2 -0.4	Vdd2	Vdd2 +0.4	V
	Low		-	0	0.4	
Ground		GND	-	0	-	V

*5: Set Vpdn to a higher voltage than Vinp.
*6: MCLK, MST, SELcf1, SELcf2, Mode

Electrical characteristics (Ta=25 °C)

Parameter		Symbol	Min.	Typ.	Max.	Unit
Power supply current	-512DE	Ivdd1	-	60	100	mA
	-1024DK/DG		-	110	150	mA
	-512DE	Ivdd2	-	5	7.5	mA
	-1024DK/DG		-	10	15	mA
Video line reset current		Ivrst	-	-	10	mA
Charge amplifier reset current		Ivinp	-	-	10	mA
CDS stage reference current		Ivref	-	-	10	mA
Photodiode cathode bias current		Ivpdn	-	-	20	mA
Master clock frequency		f(MCLK)	0.1	-	20	MHz
Data rate		DR	-	f(MCLK)	-	MHz
Line rate		LR(IWR)	-	-	40*7	kl/s
		LR(ITR)	-	-	50*8	
Video output voltage	Dark	Video(dark)	-	2.5	2.8	V
	Saturation	Video(sat)	0.8	1	-	
Output offset voltage		Voffset	-	Vinp	-	V
Output impedance		Zo	-	5	-	kΩ

*7: Integration time 18.7 µs, f(MCLK)=20 MHz
*8: Integration time 3.5 µs, f(MCLK)=20 MHz

Electrical and optical characteristics [Ta=25 °C, Vdd1=Vdd2=3.3 V, Vrst=1.6 V, Vinp=2.5 V, Vref=2.7 V, Vpdn=2.6 V, f(MCLK)=20 MHz]

Parameter		Symbol	Condition	G17225 series			Unit
				Min.	Typ.	Max.	
Spectral response range		λ		-	0.9 to 1.7	-	μm
Peak sensitivity wavelength		λp		1.45	1.55	1.65	μm
Photosensitivity		S	λ=λp	0.85	0.95	-	A/W
Conversion efficiency*9		CE	Cf=1.25 pF	-	0.128	-	μV/e⁻
			Cf=0.13 pF	-	1.23	-	
			Cf=0.040 pF	-	4.0	-	
			Cf=0.016 pF	-	10.0	-	
Saturation charge		Csat	CE=0.128 μV/e⁻	-	11.7	-	Me⁻
			CE=1.23 μV/e⁻	-	1.22	-	
			CE=4.0 μV/e⁻	-	0.38	-	
			CE=10.0 μV/e⁻	-	0.15	-	
Saturation output voltage*10	-512DE	Vsat	CE=4.0 μV/e⁻	1.4	1.5	-	V
	-1024DK						
	-1024DG		CE=1.23 μV/e⁻				
Photoresponse nonuniformity*11	-512DE	PRNU	CE=4.0 μV/e⁻, t=1 ms	-	±5	±20	%
	-1024DK						
	-1024DG		CE=1.23 μV/e⁻				
Dark current	-512DE	ID	CE=4.0 μV/e⁻	-0.1	0.5	5	pA
	-1024DK		t=1 ms, 0.1 ms	-0.1	0.5	5	
	-1024DG		CE=1.23 μV/e⁻, t=1 ms, 0.1 ms	-1	5	50	
Dark output	-512DE	VD	CE=4.0 μV/e⁻	-3	13	125	V/s
	-1024DK			-3	13	125	
	-1024DG		CE=1.23 μV/e⁻	-7.7	38	385	
Readout noise	-512DE	Nread	CE=0.128 μV/e⁻ t=1 ms	-	0.5	1.0	mVrms
	-1024DK						
	-1024DG						
	-512DE		CE=1.23 μV/e⁻ t=1 ms	-	0.8	1.6	
	-1024DK			-	0.8	1.6	
	-1024DG			-	1.0	2.0	
	-512DE		CE=4.0 μV/e⁻ t=1 ms	-	2.0	4.0	
	-1024DK			-	2.0	4.0	
	-1024DG			-	2.5	5.0	
	-512DE		CE=10.0 μV/e⁻ t=1 ms	-	6.0	12	
	-1024DK			-	6.0	12	
	-1024DG			-	8.0	16	
Dynamic range	-512DE	Drange	CE=0.128 μV/e⁻	1400	3000	-	-
	-1024DK						
	-1024DG						
	-512DE		CE=1.23 μV/e⁻	875	1875	-	
	-1024DK			875	1875	-	
	-1024DG			700	1500	-	
	-512DE		CE=4.0 μV/e⁻	350	750	-	
	-1024DK			350	750	-	
	-1024DG			280	600	-	
	-512DE		CE=10.0 μV/e⁻	116	250	-	
	-1024DK			116	250	-	
	-1024DG			87	187	-	
Image lag*12		Lag		-	-	1	%
Defective pixels*13		-		-	-	1	%
Number of good pixels between Defective pixels*13		-		2	-	-	pixels

*9: Cf=1.25 pF: SELcf1=0 V, SELcf2=0 V, Cf=0.13 pF: SELcf1=0 V, SELcf2=3.3 V, Cf=0.040 pF: SELcf1=3.3 V, SELcf2=0 V, Cf=0.016 pF: SELcf1=3.3 V, SELcf2=3.3 V

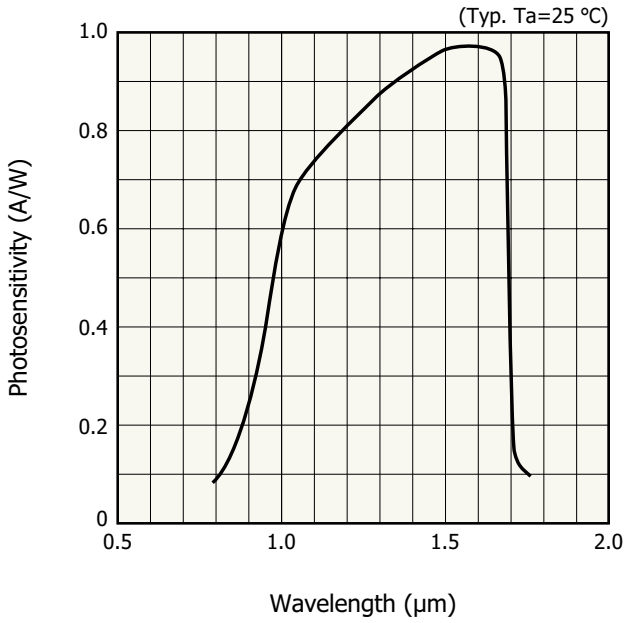
*10: Vsat = Saturation output signal Video(sat) - Dark output signal Video(dark)

*11: Measured at 50% saturation and 1 ms integration time after subtracting the dark output, excluding the first and last pixels.

*12: The signal component of the previous data that remains after data is read out under saturation output conditions.The image lag increases if the output exceeds the saturation voltage.

*13: Pixels whose photoresponse nonuniformity, readout noise, or dark current is outside the specifications

Spectral response



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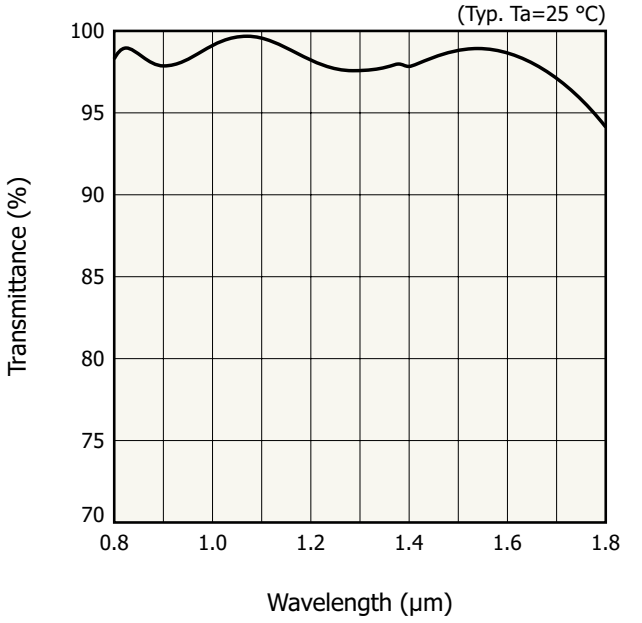
Spectral transmittance of window material



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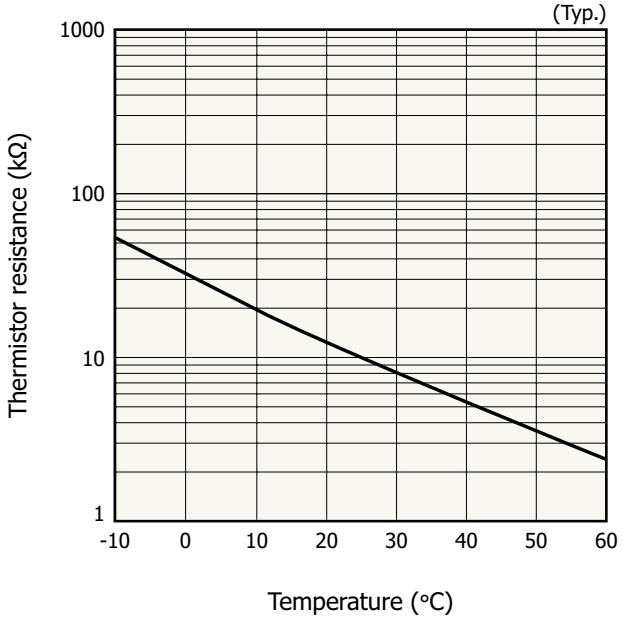
Thermistor temperature characteristics



(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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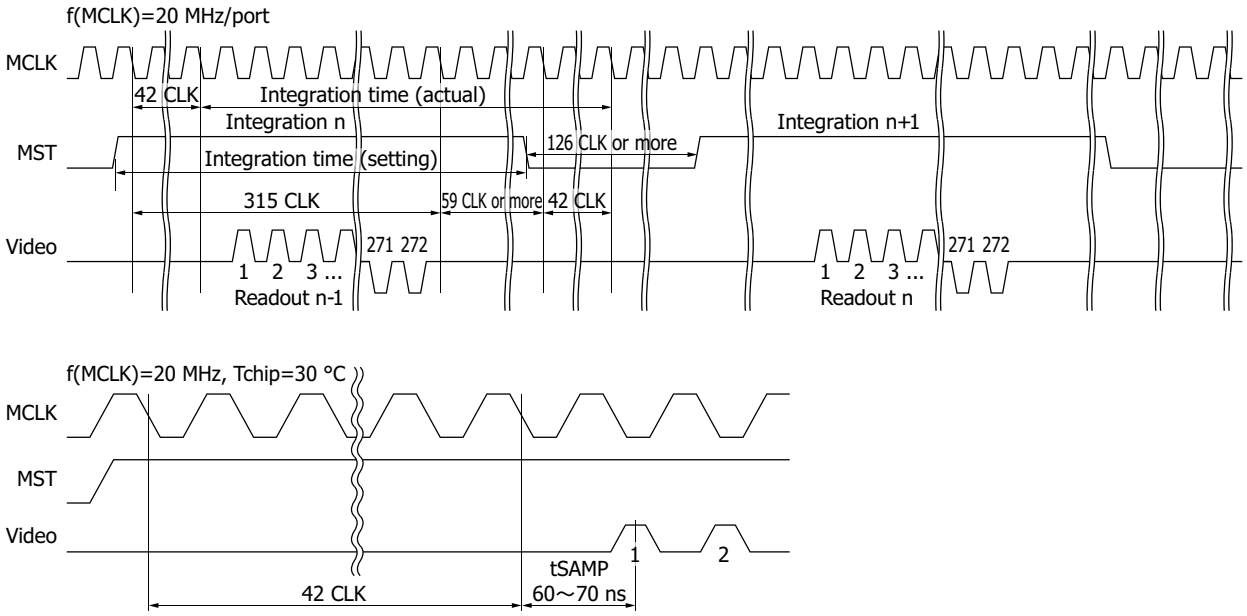
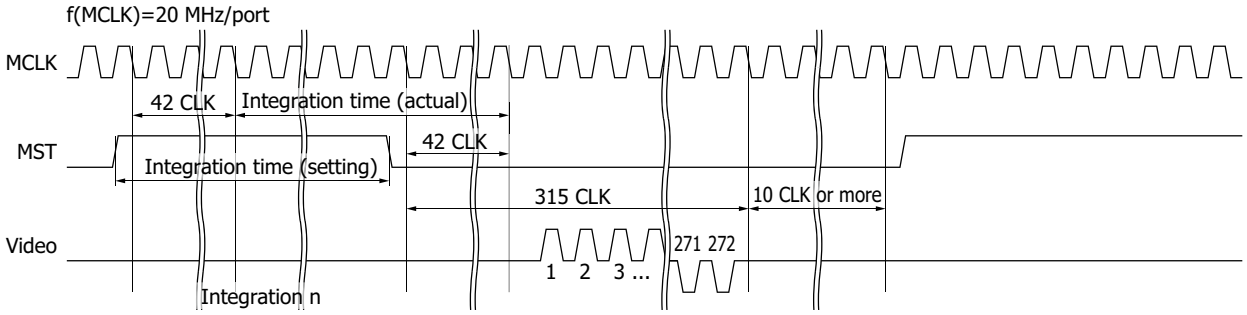
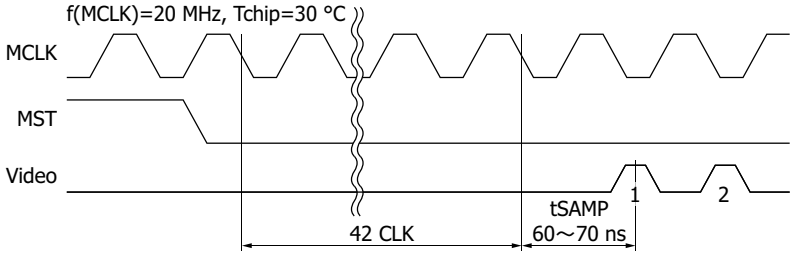
Timing chart

■ Integration while readout mode (IWR mode)



■ Readout mode after integration (ITR mode)





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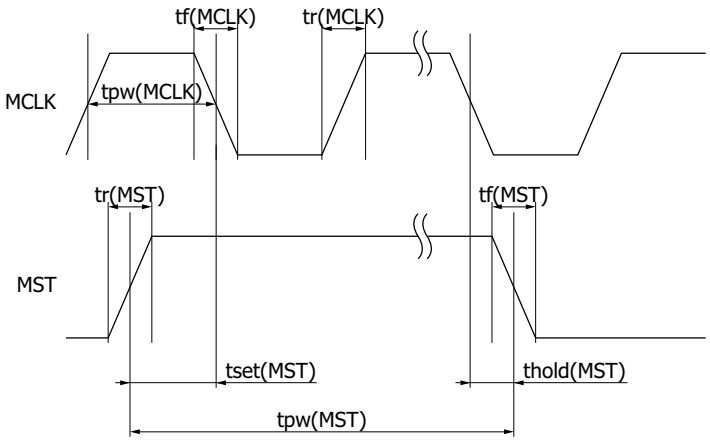
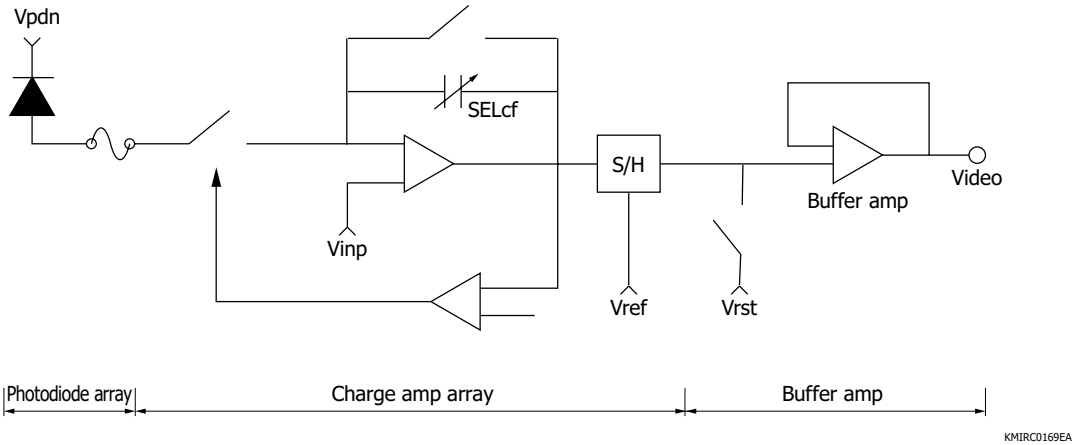


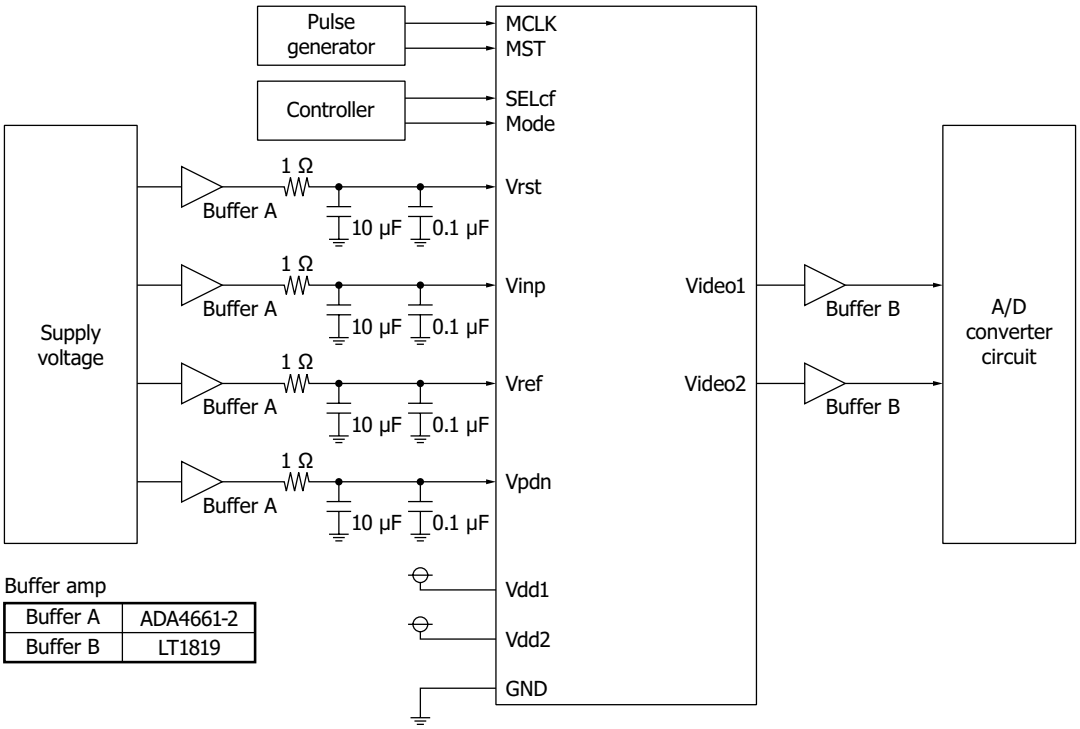
Parameter			Symbol	Min.	Typ.	Max.	Unit
Master clock frequency			f(MCLK)	0.1	-	20	MHz
Master clock pulse width			tpw(MCLK)	25	-	5000	ns
Master clock pulse rise/fall times			tr(MCLK), tf(MCLK)	-	5	10	ns
Master start pulse width	IWR mode	High	tpw(MST)	374	-	-	clks
		Low		126	-	-	
	ITR mode	High		70	-	-	
		Low		326	-	-	
Master start pulse rise/fall times			tr(MST), tf(MST)	-	10	20	ns
Setup time			tset(MST)	10	-	-	ns
Hold time			thold(MST)	10	-	-	ns

Equivalent circuit



Connection examples

G17225-512DE



Buffer amp

Buffer A	ADA4661-2
Buffer B	LT1819

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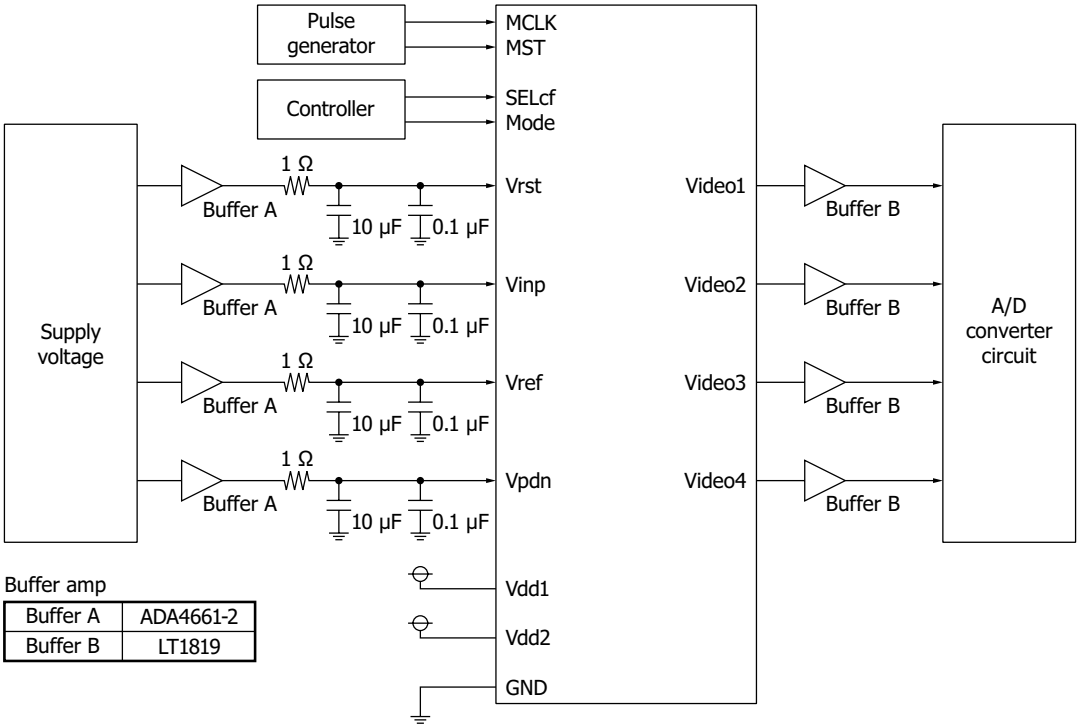
G17225-1024DK/-1024DG



Buffer amp

Buffer A	ADA4661-2
Buffer B	LT1819

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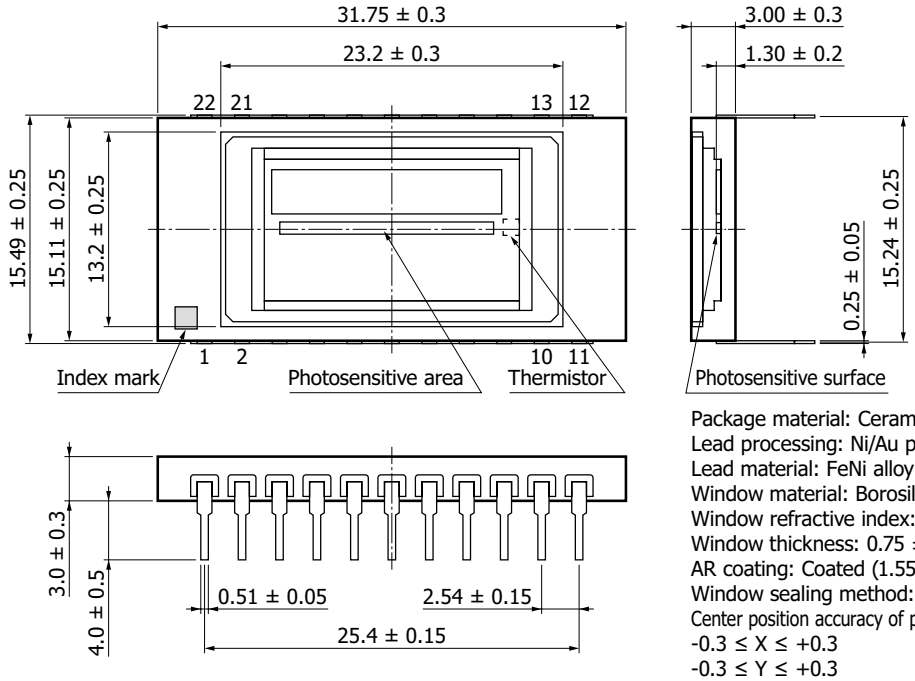
Dimensional outline (unit: mm)

G17225-512DE



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

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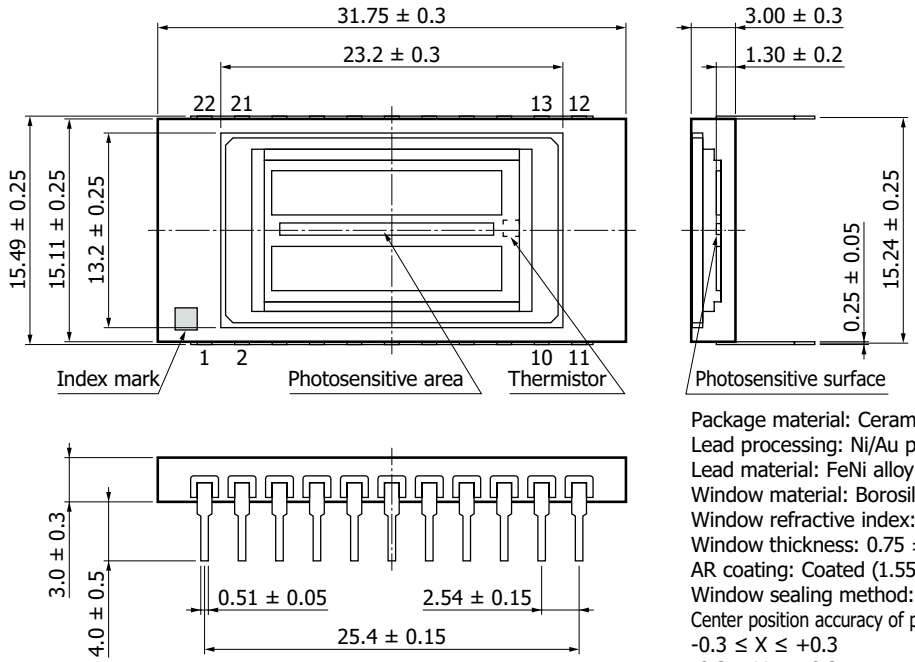
G17225-1024DK/-1024DG



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

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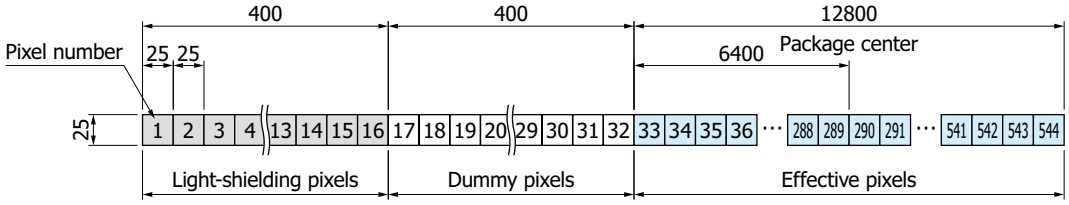
Enlarged view of photosensitive area (unit: µm)

G17225-512DE



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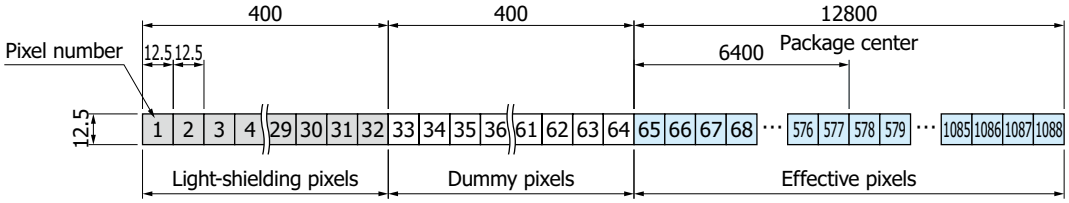
G17225-1024DK



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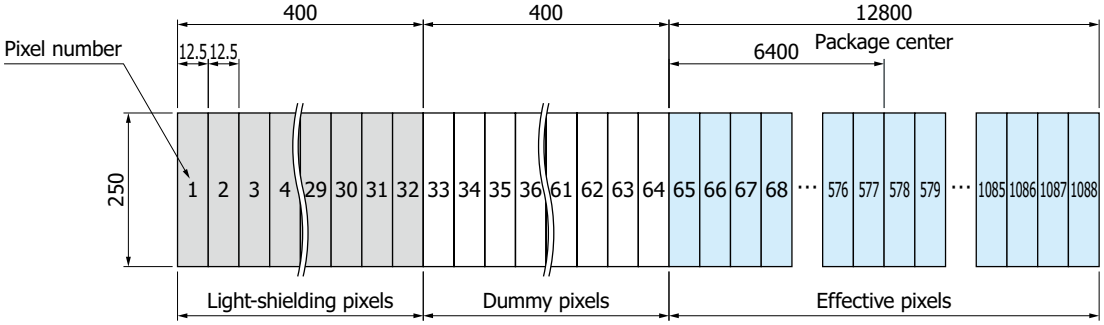
G17225-1024DG



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Pin connections

G17225-512DE

Pin no.	Symbol	Input/output	Function	Note
1	NC	-	-	-
2	NC	-		-
3	Mode	Input	Readout mode selection signal (IWR or ITR)	0 V or 3.3 V*14
4	NC	-	-	-
5	NC	-	-	-
6	NC	-	-	-
7	NC	-	-	-
8	GND	-	Ground	0 V
9	Vdd1	Input	Analog supply voltage	3.3 V
10	THERM	Output	Thermistor	-
11	THERM	Output	Thermistor	-
12	Vpdn	Input	Photodiode cathode bias voltage	2.6 V*16
13	Vinp	Input	Charge amplifier reset voltage	2.5 V*16
14	Vref	-	CDS stage reference voltage	2.7 V
15	Vrst	-	Video line reset voltage	1.6 V
16	Video2	Output	Video output*15	2.5 V to 1.0 V (Typ.)
17	Video1	Output	Video output*15	2.5 V to 1.0 V (Typ.)
18	Vdd2	Input	Digital supply voltage	3.3 V
19	SELcf1	Input	Gain selection signal	0 V or 3.3 V*17
20	SELcf2	Input	Gain selection signal	0 V or 3.3 V*17
21	MCLK	Input	Master start signal	0 V to 3.3 V
22	MST	Input	Master clock signal	0 V to 3.3 V

*14: The readout mode is determined by the supply voltage to the Mode terminal as follows.

Readout mode	Mode
IWR	Low
ITR	High

Low: 0 V (GND), High: 3.3 V (Vdd2)

*15: The pixel arrangement for each video output terminal is as follows.

■ G17225-512DE

	Light-shielding pixels (1st ～ 16th pixel)				Dummy pixels (17th ～ 32nd pixel)				Effective pixels (33rd ～ 544th pixel)			
Video1	1	3	···	15	17	19	···	31	33	35	···	543
Video2	2	4	···	16	18	20	···	32	34	36	···	544

*16: We recommend making the potential of Vpdn at least 0.1 V higher than that of Vinp.

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

Conversion efficiency	SELcf1	SELcf2
0.128 μV/e⁻	Low	Low
1.23 μV/e⁻	Low	High
4.0 μV/e⁻	High	Low
10.0 μV/e⁻	High	High

Low: 0 V (GND), High: 3.3 V (Vdd2)

G17225-1024DK/-1024DG

Pin no.	Symbol	Input/output	Function	Note
1	MST	Input	Master clock signal	0 V to 3.3 V
2	MCLK	Input	Master start signal	0 V to 3.3 V
3	Mode	Input	Readout mode selection signal (IWR or ITR)	0 V or 3.3 V*18
4	NC	-	-	-
5	NC	-	-	-
6	Video2	Output	Video output*19	2.5 V to 1.0 V (Typ.)
7	Video4	Output	Video output*19	2.5 V to 1.0 V (Typ.)
8	GND	-	Ground	0 V
9	Vdd1	Input	Analog supply voltage	3.3 V
10	THERM	Output	Thermistor	-
11	THERM	Output	Thermistor	-
12	Vpdn	Input	Photodiode cathode bias voltage	2.6 V*20
13	Vinp	Input	Charge amplifier reset voltage	2.5 V*20
14	Vref	-	CDS stage reference voltage	2.7 V
15	Vrst	-	Video line reset voltage	1.6 V
16	Video3	Output	Video output*19	2.5 V to 1.0 V (Typ.)
17	Video1	Output	Video output*19	2.5 V to 1.0 V (Typ.)
18	Vdd2	Input	Digital supply voltage	3.3 V
19	SELcf1	Input	Gain selection signal	0 V or 3.3 V*21
20	SELcf2	Input	Gain selection signal	0 V or 3.3 V*21
21	MCLK	Input	Master start signal	0 V to 3.3 V
22	MST	Input	Master clock signal	0 V to 3.3 V

*18: The readout mode is determined by the supply voltage to the Mode terminal as follows.

Readout mode	Mode
IWR	Low
ITR	High

Low: 0 V (GND), High: 3.3 V (Vdd2)

*19: The pixel arrangement for each video output terminal is as follows.

■ G17225-1024DK/-1024DG

	Light-shielding pixels (1st ～ 32th pixel)				Dummy pixels (33th ～ 64th pixel)				Effective pixels (65th ～ 1088th pixel)			
Video1	1	5	…	29	33	37	…	61	65	69	…	1085
Video2	2	6	…	30	34	38	…	62	66	70	…	1086
Video3	3	7	…	31	35	39	…	63	67	71	…	1087
Video4	4	8	…	32	36	40	…	64	68	72	…	1088

*20: We recommend making the potential of Vpdn at least 0.1 V higher than that of Vinp.

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

Conversion efficiency	SELcf1	SELcf2
0.128 μV/e-	Low	Low
1.23 μV/e-	Low	High
4.0 μV/e-	High	Low
10.0 μV/e-	High	High

Low: 0 V (GND), High: 3.3 V (Vdd2)

Precautions

(1) 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.

(2) Input window
If dust or stain adheres to the surface of the input window glass, it will appear as black spots on the image. When cleaning, avoid rubbing the window surface with dry cloth, dry cotton swab or the like, since doing so may generate static electricity. Use soft cloth, paper, a cotton swab, or the like moistened with alcohol to wipe off dust and stain. Then blow compressed air so that no stain remains.

(3) Soldering
Soldering temperature: 260 °C max. (10 s or less, once)
Solder the leads at a point at least 1 mm away from the package body.
Note: When you set soldering conditions, check that problems do not occur in the product by testing out the conditions in advance.

(4) Operating and storage environments
Use the device within the rated temperature range.
Operating or storing the device at an excessively high temperature and humidity may cause variations in performance characteristics and must be avoided.

Related information

www.hamamatsu.com/sp/ssd/doc_en.html

■ Precautions
· Disclaimer
· Safety consideration / Opto-semiconductors
· Precautions / Image sensors

■ Catalogs
· Selection guide / InGaAs image sensors
· Technical note / InGaAs linear image sensors

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