HAMAMATSU

PHOTON IS OUR BUSINESS

CMOS linear image sensors

S11637 series

Built-in electronic shutter function and gain switching function

The S11637 series is a CMOS linear image sensor with electronic shutter function and gain switching function. The S11637 series has a pixel pitch that is one-half that of our previous type (S10453 series).

Features

- **Electronic shutter function**
- **Gain switching function**
- **Pixel size: 12.5 × 500 µm**
- **Readout speed: 10 MHz max.**
- **Voltage output type**
- **5 V single power supply operation**
- **Simultaneous charge integration for all pixels**
- **Built-in timing generator allows operation with only start and clock pulse inputs.**
- **Spectral response range: 200 to 1000 nm**

Applications

- **Spectrophotometers**
- **Image reading**

Structure

Parameter	S11637-1024Q	S11637-2048Q	Unit
Number of total pixels	1024	2048	-
Number of effective pixels	1024	2048	-
Fill factor	100		%
Pixel pitch	12.5		µm
Pixel height	500		µm
Photosensitive area length	12.8	25.6	mm
Package	Ceramic		-
Window material*1 *2	Quartz (without AR coating)		-

*1: Resin sealing
*2: Refractive index=1.46

Absolute maximum ratings

Parameter	Symbol	Condition	Value	Unit
Supply voltage	Vdd	Ta=25 °C	-0.3 to +6	V
Gain selection terminal voltage	Vg	Ta=25 °C	-0.3 to +6	V
Clock pulse voltage	V(CLK)	Ta=25 °C	-0.3 to +6	V
Start pulse voltage	V(ST)	Ta=25 °C	-0.3 to +6	V
Operating temperature*3	Topr		-5 to +65	°C
Storage temperature*3	Tstg		-10 to +85	°C

*3: No dew condensation
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: 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	4.75	5	5.25	V
Gain selection terminal voltage	High gain	Vg	0	-	0.4	V
	Low gain		Vdd - 0.25	Vdd	Vdd + 0.25	
Clock pulse voltage	High level	V(CLK)	Vdd - 0.25	Vdd	Vdd + 0.25	V
	Low level		0	-	0.4	
Start pulse voltage	High level	V(ST)	Vdd - 0.25	Vdd	Vdd + 0.25	V
	Low level		0	-	0.4	

Input terminal capacitance (Ta=25 °C, Vdd=5 V)

Parameter	Symbol	Min.	Typ.	Max.	Unit
Gain selection input terminal capacitance	C(Vg)	-	5	-	pF
Clock pulse input terminal capacitance	C(CLK)	-	5	-	pF
Start pulse input terminal capacitance	C(ST)	-	5	-	pF

Electrical characteristics [Ta=25 °C, Vdd=5 V, V(CLK)=V(ST)=5 V]

Parameter		Symbol	Min.	Typ.	Max.	Unit
Clock pulse frequency		f(CLK)	200 k	-	10 M	Hz
Video data rate		VR	-	f(CLK)	-	Hz
Line rate	S11637-1024Q	LR	-	-	9487	lines/s
	S11637-2048Q		-	-	4812	
Output impedance		Zo	-	80	-	Ω
Current consumption*4	S11637-1024Q	I	-	55	70	mA
	S11637-2048Q		-	95	125	

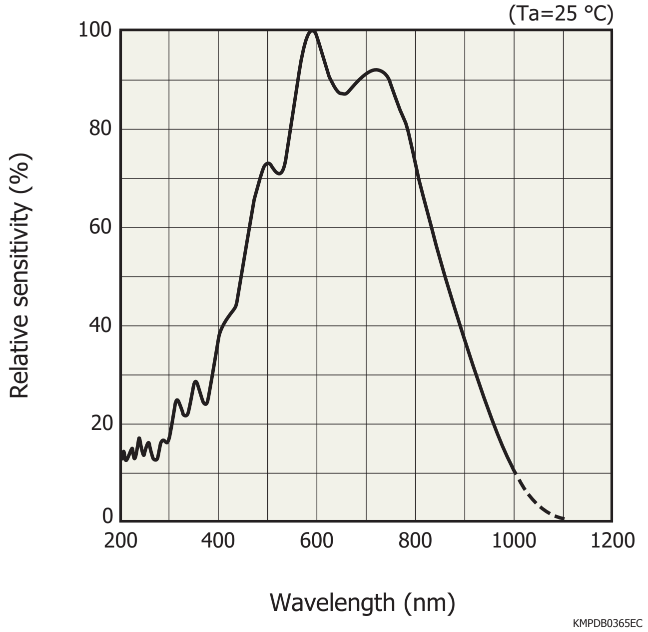
*4: f(CLK)=10 MHz, dark state

Electrical and optical characteristics [Ta=25 °C, Vdd=5 V, V(CLK)=V(ST)=5 V, f(CLK)=10 MHz]

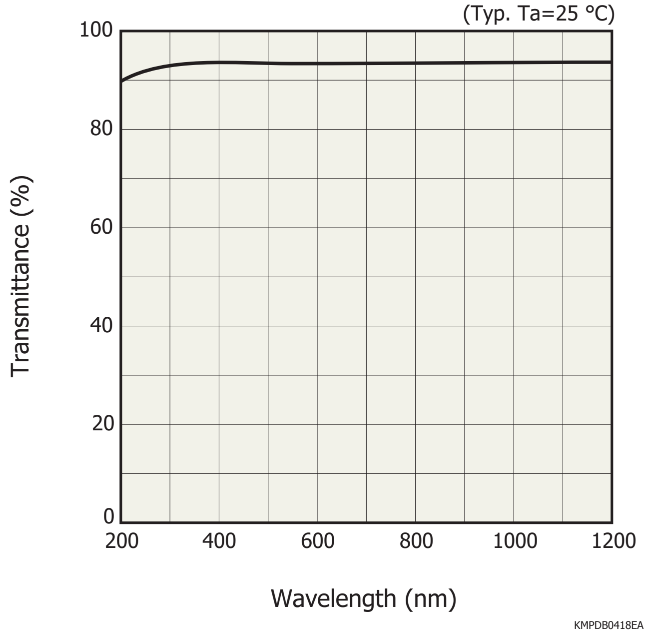
Parameter		Symbol	Min.	Typ.	Max.	Unit
Spectral response range		λ	200 to 1000			nm
Peak sensitivity wavelength		λp	-	600	-	nm
Photosensitivity*5	High gain	S	122	153	-	V/(lx·s)
	Low gain		31	38	-	
Conversion efficiency*6	High gain	CE	0.95	1.18	-	μV/e-
	Low gain		0.24	0.30	-	
Output offset voltage		Voffset	0.3	0.6	0.9	V
Saturation charge	High gain	Qsat	-	0.45	-	pC
	Low gain		-	1.77	-	
Dark output voltage*7	High gain	Vd	-	5	50	mV
	Low gain		-	1.4	14	
Dark output nonuniformity*7 *8		DSNU	-	-	±200	%
Temperature coefficient of dark output		ΔTd	-	1.1	-	times/°C
Saturation output voltage*9		Vsat	2.7	3.3	-	V
Saturation exposure	High gain	Esat	-	22	-	mlx·s
	Low gain		-	86	-	
Readout noise	High gain	Nread	-	1.5	2.5	mV rms
	Low gain		-	0.7	1.2	
Photoresponse nonuniformity*5 *10		PRNU	-	-	±10	%
Dynamic range*11	High gain	DR	-	2200	-	-
	Low gain		-	4714	-	

*5: Measured with a 2856 K tungsten lamp
*6: Output voltage generated per one electron
*7: Integration time=10 ms
*8: Dark output nonuniformity (DSNU) is the output nonuniformity of dark output voltage. DSNU is measured using pixels excluding pixels each at both ends, and is defined as follows:
DSNU = ΔY/Y × 100 [%]
Y: average dark output voltage of all pixels, ΔY: difference between Y and maximum dark output voltage or minimum dark output voltage
*9: Voltage difference from Voffset
*10: Photoresponse nonuniformity (PRNU) is the output nonuniformity that occurs when the entire photosensitive area is uniformly illuminated by light which is 50% of the saturation exposure level. PRNU is measured using pixels excluding pixels each at both ends, and is defined as follows:
PRNU = ΔX/X × 100 [%]
X: average output of all pixels, ΔX: difference between X and maximum output or minimum output
*11: DR=Vsat/Nread

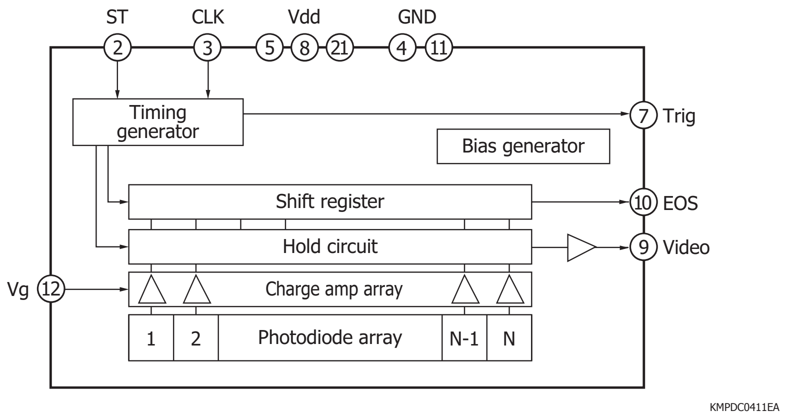
Spectral response (typical example)



Spectral transmittance characteristics of window material

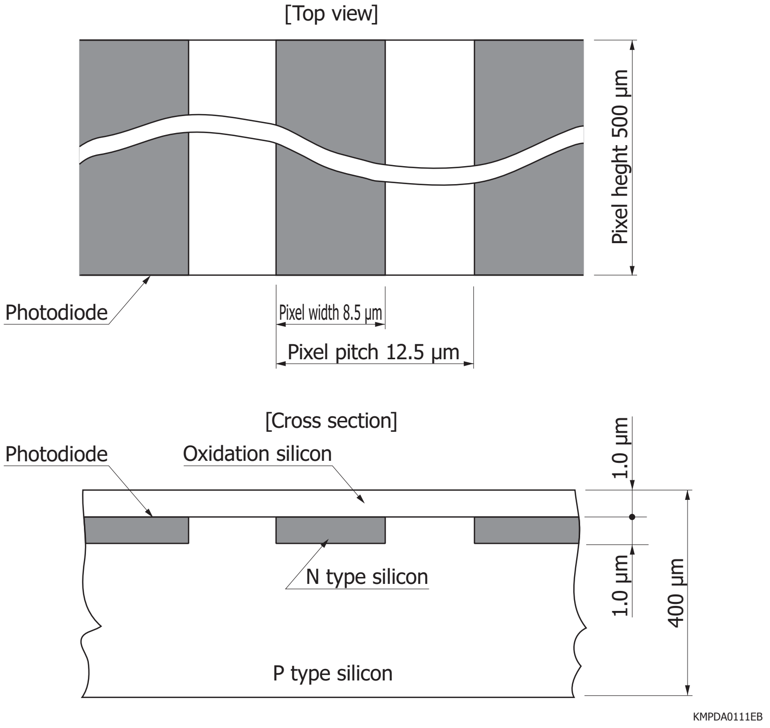


Block diagram

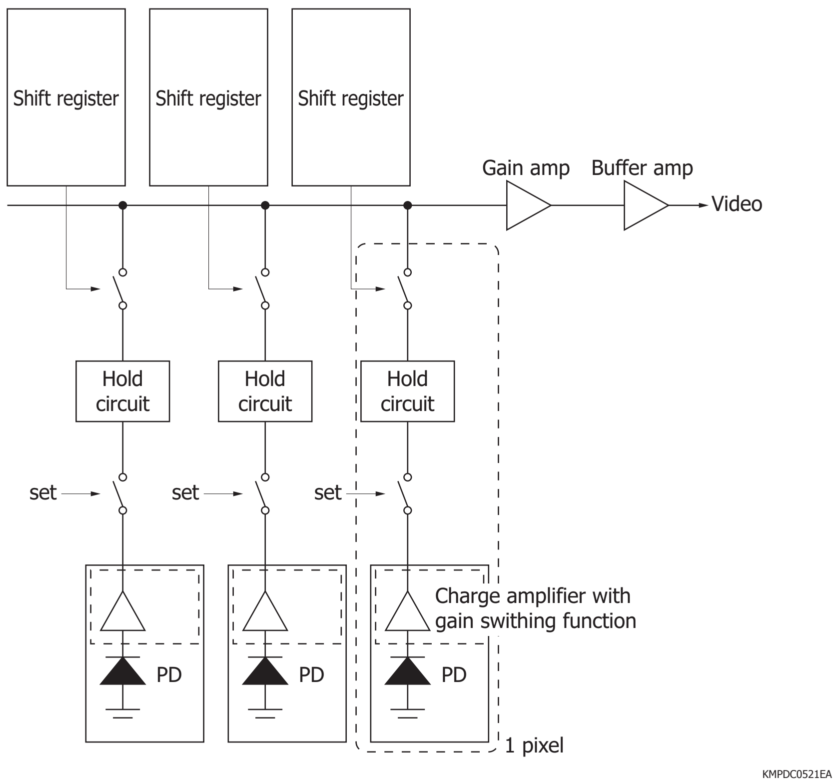


Device structure

■ Details of photosensitive area (front-illuminance type photodiode)



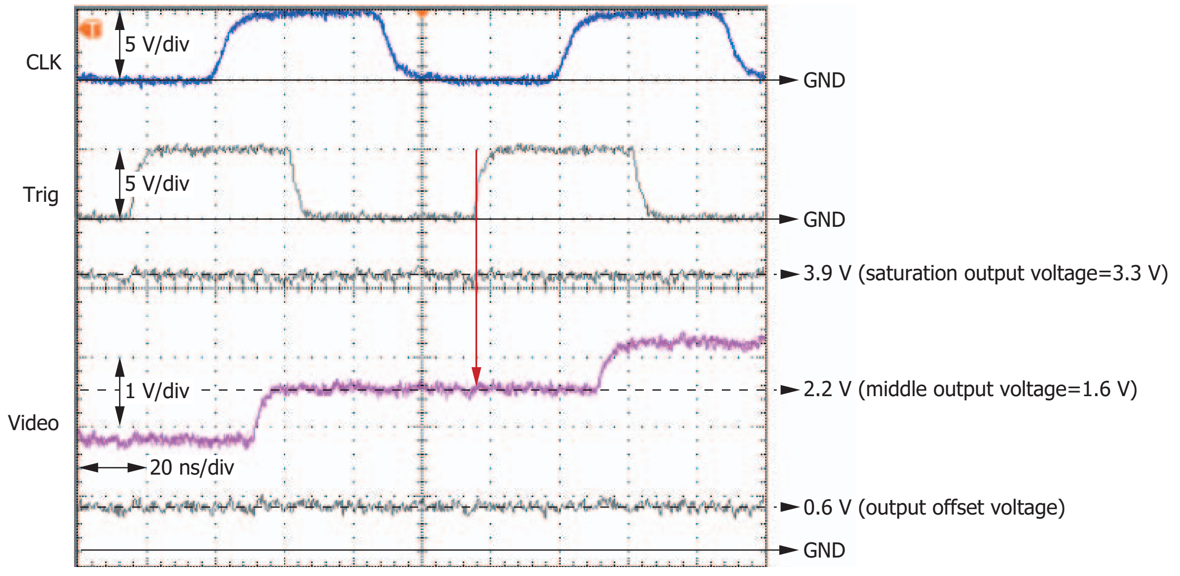
■ Overall structure



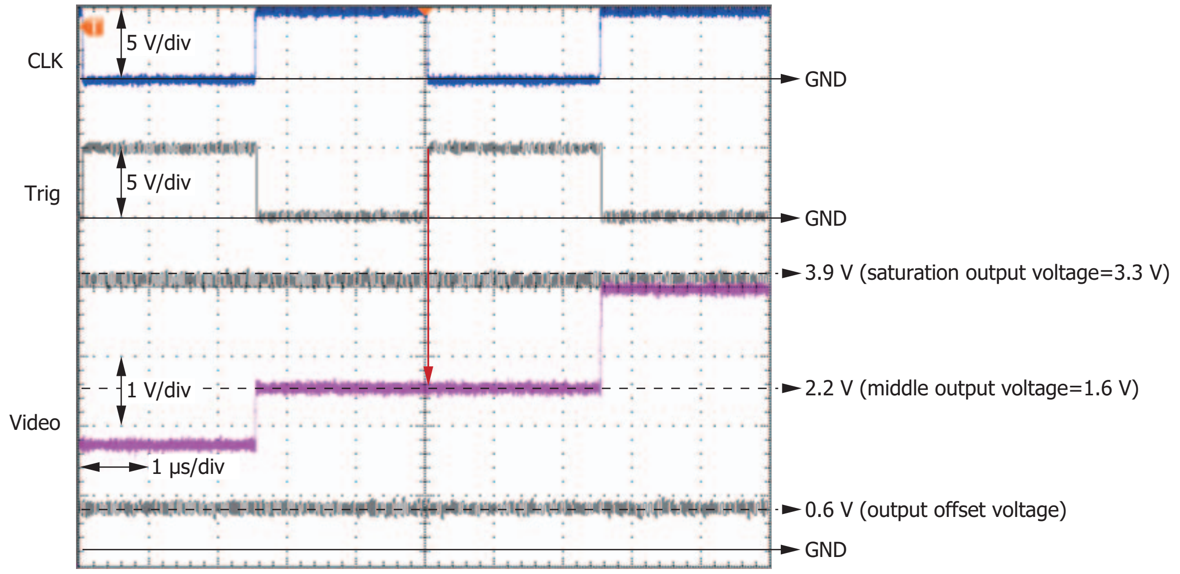
Output waveform examples of one pixel

The timing for acquiring the Video signal is synchronized with the rising edge of a trigger pulse (see red arrows below).

CLK=10 MHz

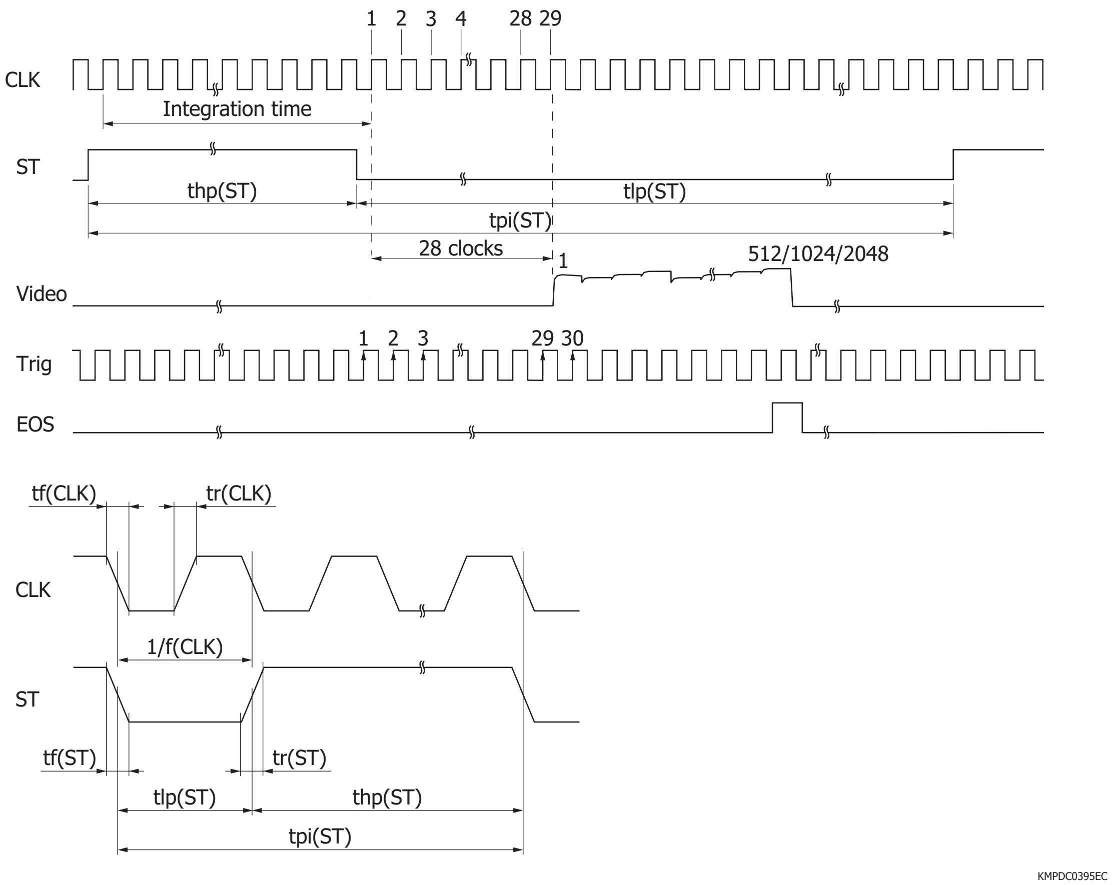


CLK=200 kHz



Note: On the waveform of the middle output voltage shown above, in order to make it easier to identify the output of each pixel, the light was input so that the outputs of the adjacent pixels appeared in a step form.

Timing chart



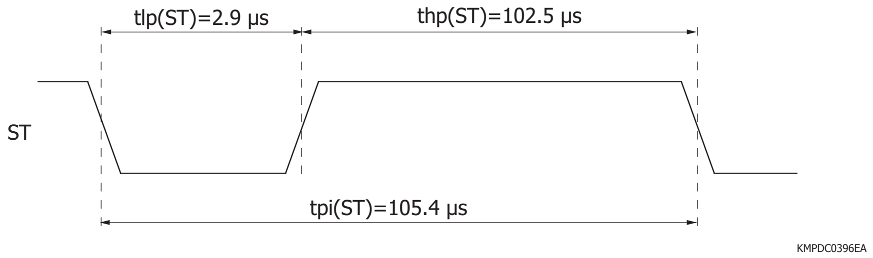
Parameter	Symbol	Min.	Typ.	Max.	Unit
Start pulse cycle	tpi(ST)	37/f(CLK)	-	-	s
Start pulse high period	thp(ST)	8/f(CLK)	-	-	s
Start pulse low period	tlp(ST)	29/f(CLK)	-	-	s
Start pulse rise and fall times	tr(ST), tf(ST)	0	10	30	ns
Clock pulse duty ratio	-	45	50	55	%
Clock pulse rise and fall times	tr(CLK), tf(CLK)	0	10	30	ns

Note: Dark output increases if the start pulse high period is lengthened.
The internal timing generator starts operation at the rising edge of CLK immediately after ST goes low.
The integration time equals the high period of ST.
If the first Trig pulse after ST goes low is counted as the first pulse, the Video signal of the first pixel is acquired at the rising edge of the 30th Trig pulse.
When the ST pulse is set to low while the shift register is operating, the operation of the shift register is reset and the next shift register operation will start.

Operation examples

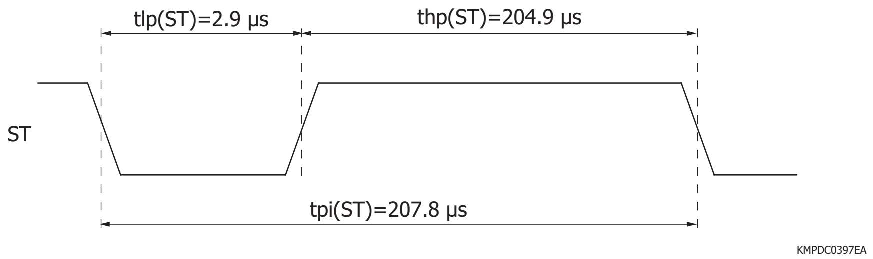
S11637-1024Q

When the clock pulse frequency is maximized (video data rate is also maximized), the time of one scan is minimized, and the integration time is maximized (for outputting signals from all 1024 channels)
Clock pulse frequency = Video data rate = 10 MHz
Start pulse cycle = 1054/f(CLK) = 1054/10 MHz = 105.4 μs
High period of start pulse = Start pulse cycle - Start pulse's low period min.
= 1054/f(CLK) - 29/f(CLK) = 1054/10 MHz - 29/10 MHz = 102.5 μs
Integration time is equal to the high period of start pulse, so it will be 102.5 μs.



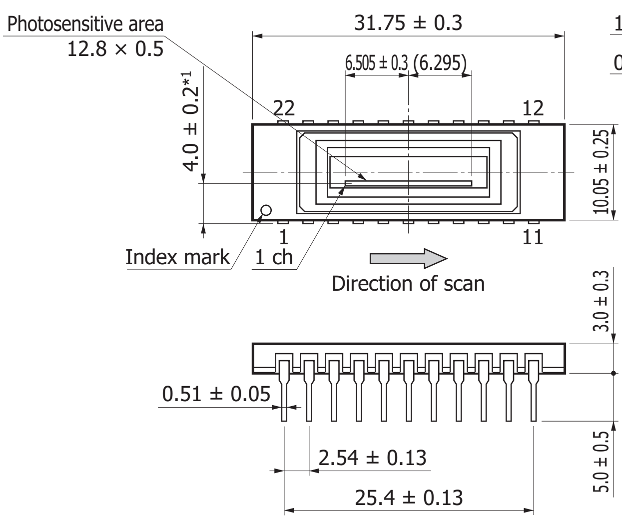
S11637-2048Q

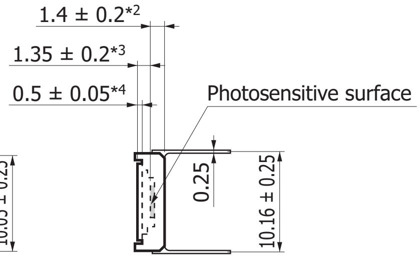
When the clock pulse frequency is maximized (video data rate is also maximized), the time of one scan is minimized, and the integration time is maximized (for outputting signals from 2048 channels)
Clock pulse frequency = Video data rate = 10 MHz
Start pulse cycle = 2078/f(CLK) = 2078/10 MHz = 207.8 μs
High period of start pulse = Start pulse cycle - Start pulse's low period min.
= 2078/f(CLK) - 29/f(CLK) = 2078/10 MHz - 29/10 MHz = 204.9 μs
Integration time is equal to the high period of start pulse, so it will be 204.9 μs.



Dimensional outlines (unit: mm)

S11637-1024Q





Angle accuracy of effective pixels: ±2°
Lead treatment: Ni/Au plating
Lead material: FeNi alloy
Weight: 3 g

Tolerance unless otherwise noted: ±0.2
*1: Distance from pin center to phtosensitive area center
*2: Distance from package bottom to photosensitive surface
*3: Distance from upper surface of window to photosensitive surface
*4: Window thickness

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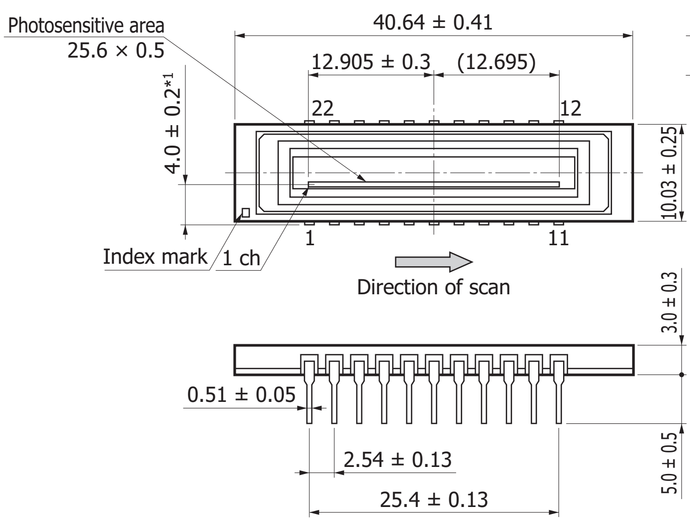
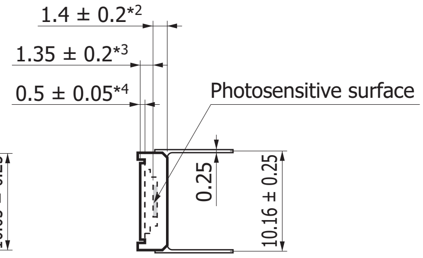
S11637-2048Q





Angle accuracy of effective pixels: ±2°
Lead treatment: Ni/Au plating
Lead material: FeNi alloy
Weight: 3.6 g

Tolerance unless otherwise noted: ±0.2
*1: Distance from pin center to phtosensitive area center
*2: Distance from package bottom to photosensitive surface
*3: Distance from upper surface of window to photosensitive surface
*4: Window thickness

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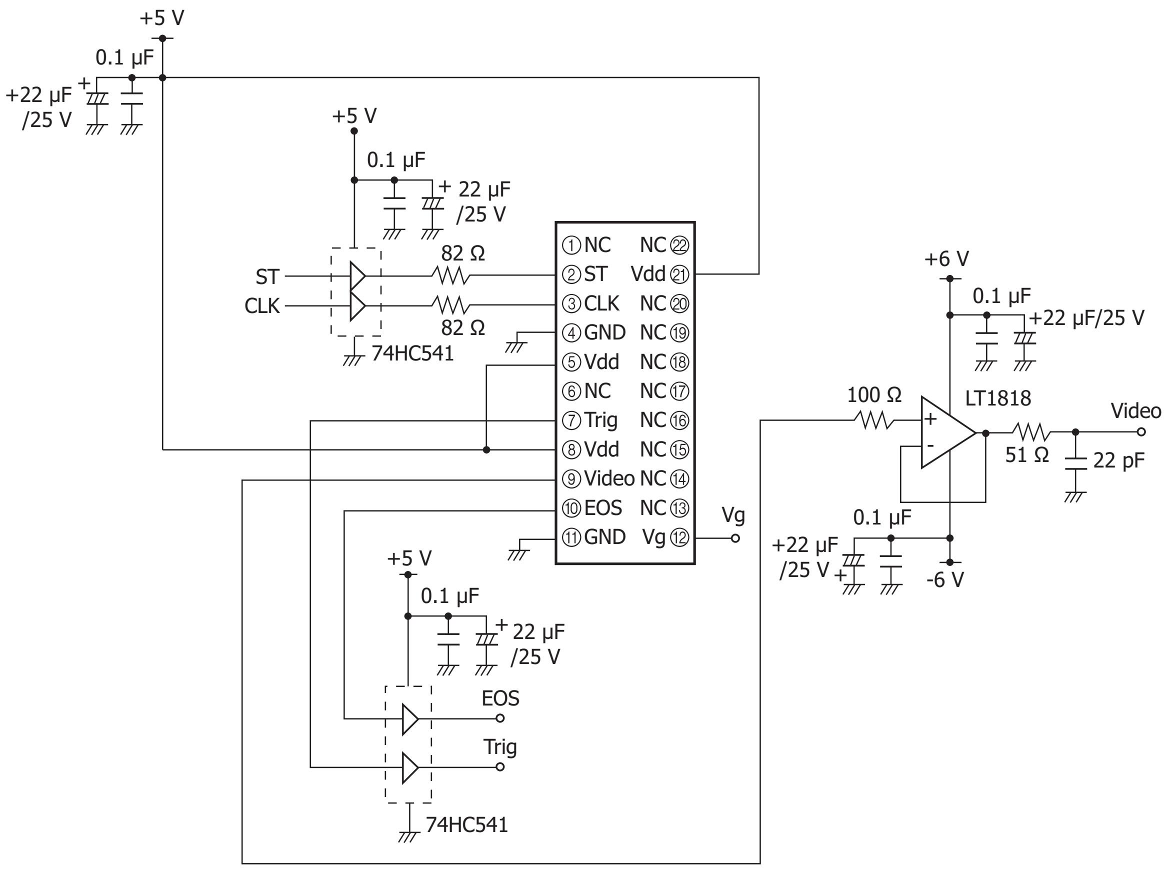
Pin connections

Pin no.	Symbol	I/O	Pin name
1	NC		No connection
2	ST	I	Start pulse
3	CLK	I	Clock pulse
4	GND		GND
5	Vdd	I	Supply voltage
6	NC		No connection
7	Trig	O	Trigger pulse for video signal acquisition
8	Vdd	I	Supply voltage
9	Video	O	Video output
10	EOS	O	End of scan
11	GND		GND
12	Vg	I	Gain selection terminal
13	NC		No connection
14	NC		No connection
15	NC		No connection
16	NC		No connection
17	NC		No connection
18	NC		No connection
19	NC		No connection
20	NC		No connection
21	Vdd	I	Supply voltage
22	NC		No connection

Note: Leave the "NC" terminals open and do not connect them to GND.
Connect a buffer amplifier for impedance conversion to the video output terminal so as to minimize the current flow.

Application circuit example



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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) Light input window
If dust or dirt gets on the light input window, it will show up as black blemishes 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 or a cotton swab moistened with alcohol to wipe dust and dirt off the window surface. Then blow compressed air onto the window surface so that no spot or stain remains.

(3) Soldering
To prevent damaging the device during soldering, take precautions to prevent excessive soldering temperatures and times. Soldering should be performed within 5 seconds at a soldering temperature below 260 °C.

(4) Operating and storage environments
Operate and store the product within the temperature range defined by the absolute maximum ratings. Operating or storing the device at an excessively high temperature and humidity may cause variations in performance characteristics and must be avoided.

(5) UV exposure
This device is designed to suppress performance deterioration due to UV exposure. Even so, avoid unnecessary UV exposure to the device. Also, be careful not to allow UV light to strike the sealed portion of the glass.

Related information

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

■ Precautions

· Disclaimer
· Image sensors

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