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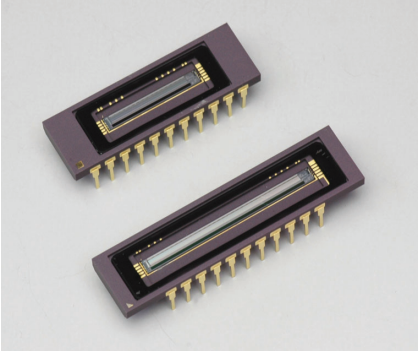
CMOS linear image sensors



S10453 series

10 MHz readout, voltage output type

The S10453 series is a voltage output type CMOS linear image sensor that operates at a video data rate of 10 MHz. This CMOS linear image sensor has a pixel size of 25 × 500 µm and is available in two types of 512 pixels (S10453-512Q) or 1024 pixels (S10453-1024Q).

Features

- **Video data rate: 10 MHz max.**
- **Voltage output type**
- **5 V single supply operation**
- **Simultaneous charge integration**
- **Shutter function**
- **Built-in timing generator allows operation with only start and clock pulse inputs.**
- **Spectral response range: 200 to 1000 nm**
- **Pixel size: 25 (H) × 500 (V) µm**

Applications

- **Position detection**
- **Image reading**

Structure

Parameter	S10453-512Q	S10453-1024Q	Unit
Number of pixels	512	1024	-
Pixel pitch	25		µm
Pixel height	500		µm
Photosensitive area length	12.8	25.6	mm
Package	Ceramic		-
Window material	Quartz		-

Absolute maximum ratings

Parameter	Symbol	Condition	Value	Unit
Supply voltage	Vdd	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*1	Topr		-5 to +65	°C
Storage temperature*1	Tstg		-10 to +85	°C

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.
*1: No condensation

Recommended terminal voltage

Parameter		Symbol	Min.	Typ.	Max.	Unit
Supply voltage		Vdd	4.75	5	5.25	V
Clock pulse voltage	High	V(CLK)	Vdd - 0.25	Vdd	Vdd + 0.25	V
	Low		0	-	0.4	V
Start pulse voltage	High	V(ST)	Vdd - 0.25	Vdd	Vdd + 0.25	V
	Low		0	-	0.4	V

Electrical characteristics

Parameter		Symbol	Min.	Typ.	Max.	Unit
Clock pulse frequency		f(CLK)	2 M	-	10 M	Hz
Video data rate		VR	-	f(CLK)	-	MHz
Consumption current*2	S10453-512Q	I	25	34	43	mA
	S10453-1024Q		42	52	62	
Conversion efficiency		CE	1.4	1.6	1.8	μV/e-

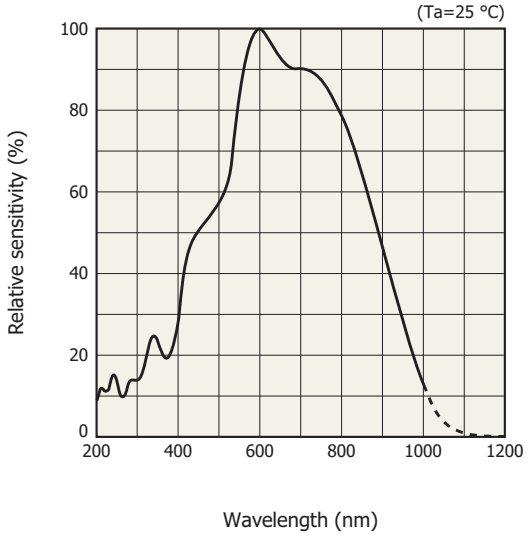
*2: Ta=25 °C, Vdd=5 V, f(CLK)=10 MHz

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	540	600	660	nm
Dark output voltage*3	Vd	-	3	30	mV
Saturation output voltage*4	Vsat	2.8	3.2	-	V
Noise	Nr	-	1.1	2.0	mV rms
Offset output voltage	Vo	0.5	0.7	0.9	V
Photoresponse nonuniformity*5 *6	PRNU	-	-	±10	%

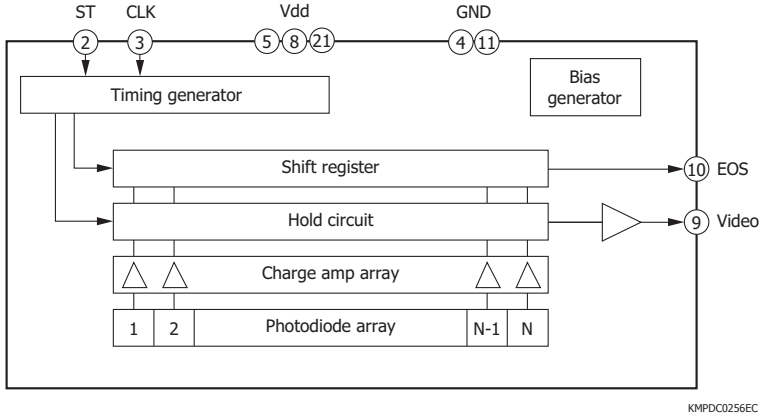
*3: Integration time Ts=10 ms
*4: Difference from Vo
*5: Photoresponse nonuniformity (PRNU) is the output nonuniformity that occurs when the entire photosensitive area is uniformly illuminated by light which is 50% of the saturation exposure level. PRNU is measured using pixels excluding pixels each 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
*6: Excluding the start pixel and last pixel

Spectral response (typical example)



KMPDB0273EA

Block diagram



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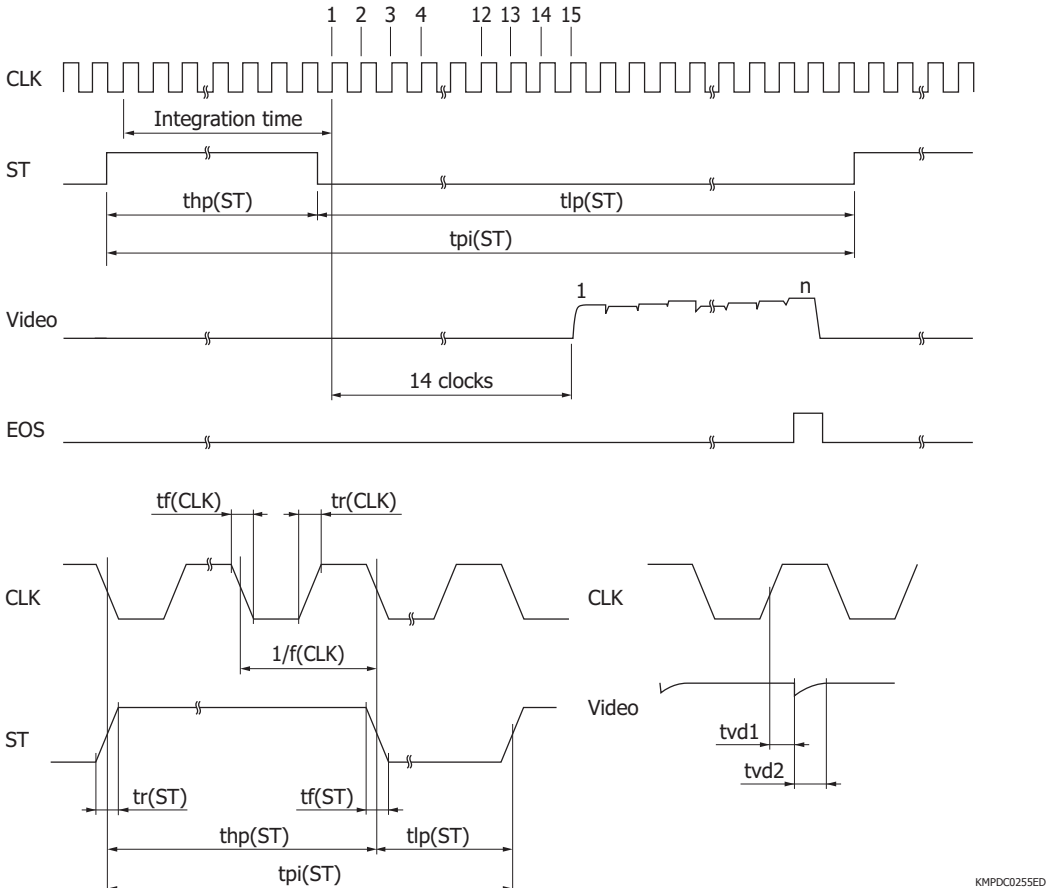
Timing chart



Parameter	Symbol	Min.	Typ.	Max.	Unit
Start pulse interval	tpi(ST)	23/f(CLK)	-	1100 m	s
Start pulse high period	thp(ST)	8/f(CLK)	-	1000 m	s
Start pulse low period	tlp(ST)	15/f(CLK)	-	100 m	s
Start pulse rise and fall times	tr(ST), tf(ST)	0	20	30	ns
Clock pulse duty ratio	-	45	50	55	%
Clock pulse rise and fall times	tr(CLK), tf(CLK)	0	20	30	ns
Video delay time 1*7	tvd1	5	13	18	ns
Video delay time 2*7	tvd2	5	20	28	ns

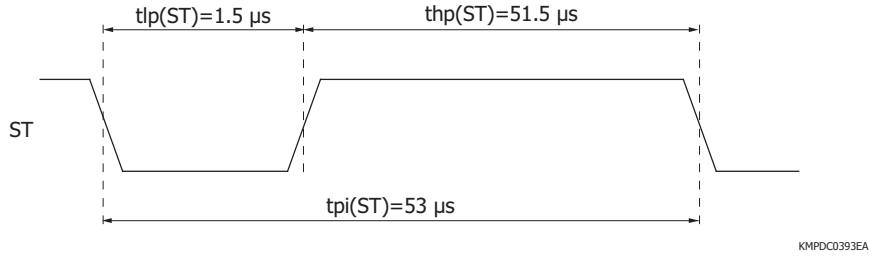
*7: Ta=25 °C, f(CLK)=10 MHz

Note: The internal timing generator starts operation at the rising edge of CLK immediately after ST goes low. The rising edge of this CLK is regarded as "1".
The integration time equals the high period of ST.
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.
The integration time can be changed by changing the ratio of the high and low periods of ST.

Operation example

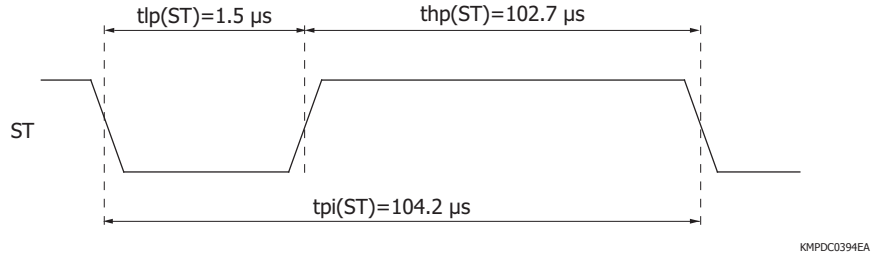
S10453-512Q

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 512 channels)
Clock pulse frequency = Video data rate = 10 MHz
Start pulse cycle = 530/f(CLK) = 530/10 MHz = 53 µs
Start pulse high period = Start pulse cycle - Minimum start pulse low period
= 530/f(CLK) - 15/f(CLK) = 530/10 MHz - 15/10 MHz = 51.5 µs
Integration time is equal to the start pulse high period, so it will be 51.5 µs.



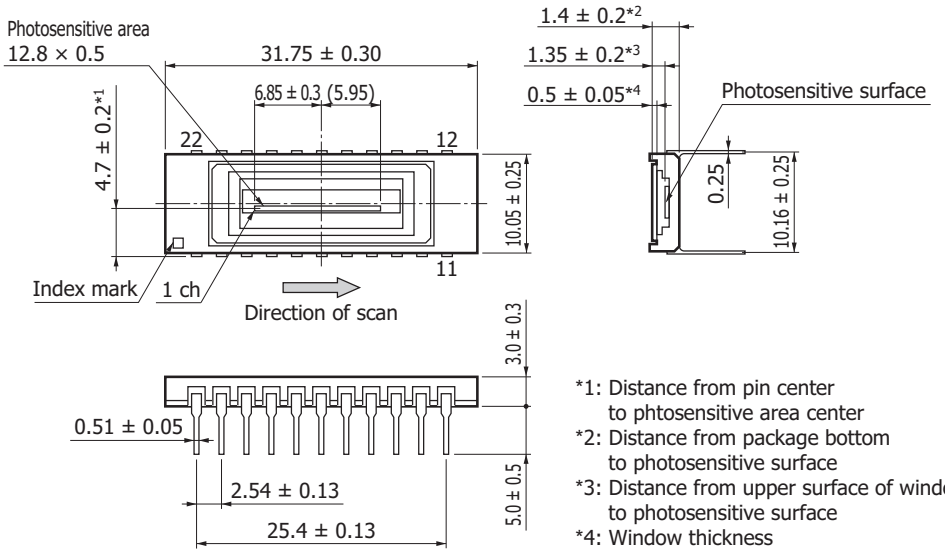
S10453-1024Q

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 = 1042/f(CLK) = 1042/10 MHz = 104.2 µs
Start pulse high period = Start pulse cycle - Minimum start pulse low period
= 1042/f(CLK) - 15/f(CLK) = 1042/10 MHz - 15/10 MHz = 102.7 µs
Integration time is equal to the start pulse high period, so it will be 102.7 µs.



Dimensional outline (unit: mm)

S10453-512Q



*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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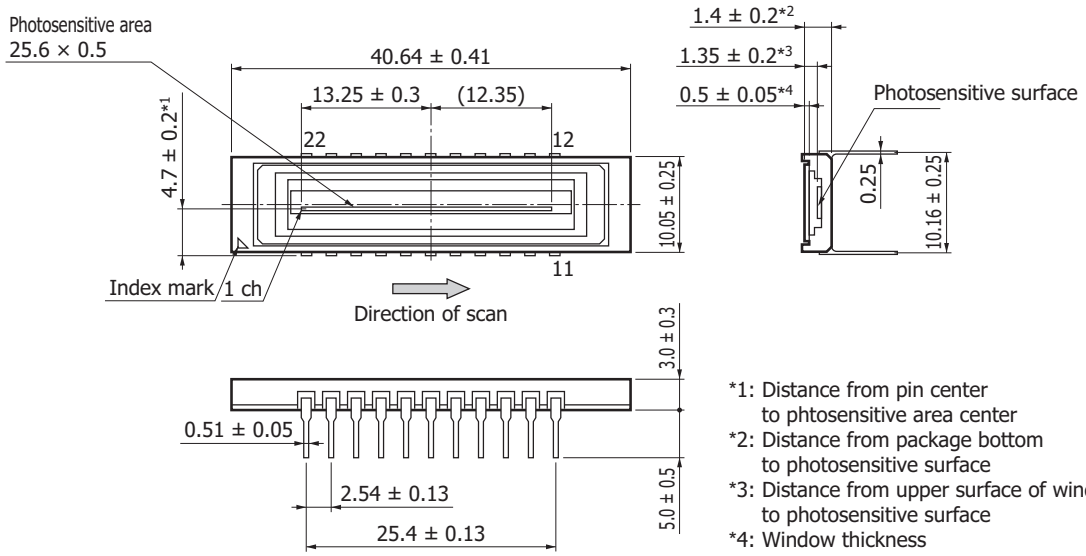
S10453-1024Q



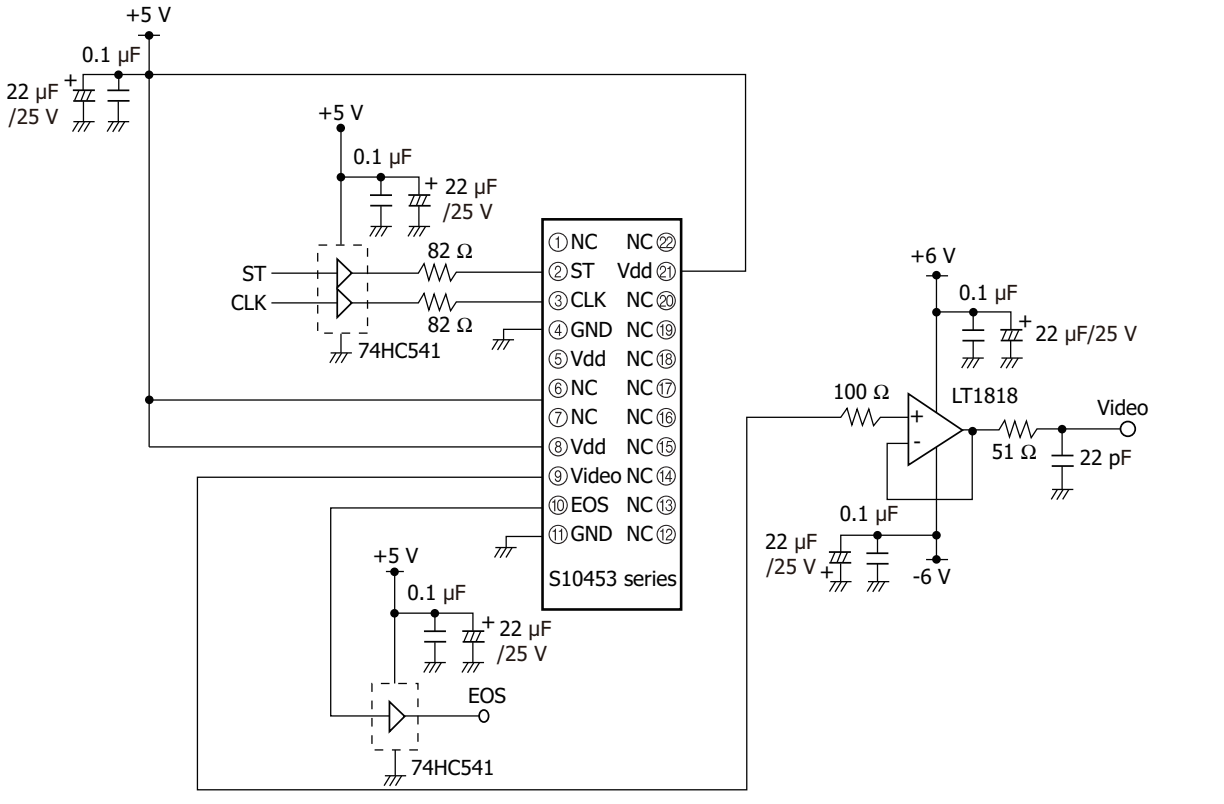
*1: Distance from pin center to phtosensitive area center
*2: Distance from package bottom to photosensitive surface
*3: Distance from upper surface of window to photosensitive surface
*4: Window thickness

KMPDA0312EA

Pin connections

Pin no.	Symbol	I/O	Function
1	NC		No connection
2	ST	I	Start pulse
3	CLK	I	Clock pulse
4	GND		Ground
5	Vdd	I	Supply voltage
6	NC		No connection
7	NC		No connection
8	Vdd	I	Supply voltage
9	Video	O	Video output
10	EOS	O	End of scan
11	GND		Ground
12	NC		No connection
13	NC		No connection
14	NC		No connection
15	NC		No connection
16	NC		No connection
17	MC		No connection
18	NC		No connection
19	NC		No connection
20	NC		No connection
21	Vdd	I	Supply voltage
22	NC		No connection

Application circuit example



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) Incident window
If dust or dirt gets on the light incident window, it will show up as black blemishes on the image. When cleaning, avoid rubbing the window surface with dry cloth or dry cotton swab, 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
Handle the device within the temperature range specified in 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
The 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 cemented portion between the ceramic base and the glass.

Related information

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

■ Precautions
- Notice
- Image sensors/Precautions

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