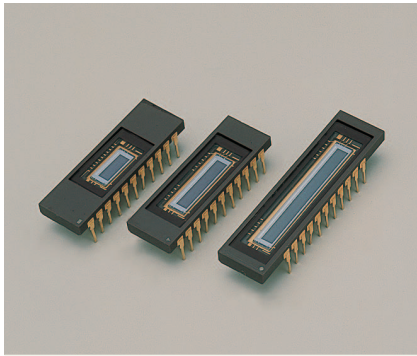


# NMOS linear image sensor



S8380/S8381 series

## NMOS linear image sensors with high IR sensitivity

S8380/S8381 series are designed to have higher sensitivity in the infrared and soft X-ray regions when compared to standard NMOS linear image sensors. The peak sensitivity wavelength is in the near IR region ( $\lambda_p=750$  nm). The photodiodes of S8380 series have a height of 2.5 mm and are arrayed in a row at a spacing of 50  $\mu\text{m}$ . The photodiodes of S8381 series also have a height of 2.5 mm but are arrayed at a spacing of 25  $\mu\text{m}$ . The photodiodes are available in 3 different pixel quantities for each series, 128 (S8380-128Q), 256 (S8380-256Q, S8381-256Q) and 512 (S8380-512Q, S8381-512Q) and 1024 (S8381-1024Q). Quartz glass is the standard window material.

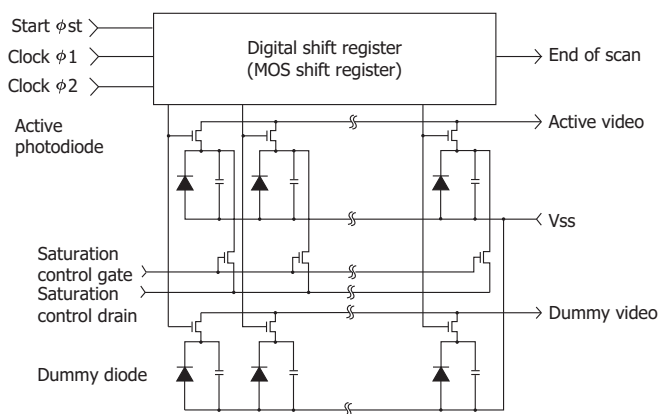
### Features

- High sensitivity in the IR and soft X-ray regions
- Wide active area  
Pixel pitch: 50  $\mu\text{m}$  (S8380 series)  
25  $\mu\text{m}$  (S8381 series)  
Pixel height: 2.5 mm
- High UV sensitivity with good stability
- Low dark current and high saturation charge allow a long integration time and a wide dynamic range at room temperature
- Excellent output linearity and sensitivity spatial uniformity
- Lower power consumption: 1 mW max.
- Start pulse and clock pulses are CMOS logic compatible

### Applications

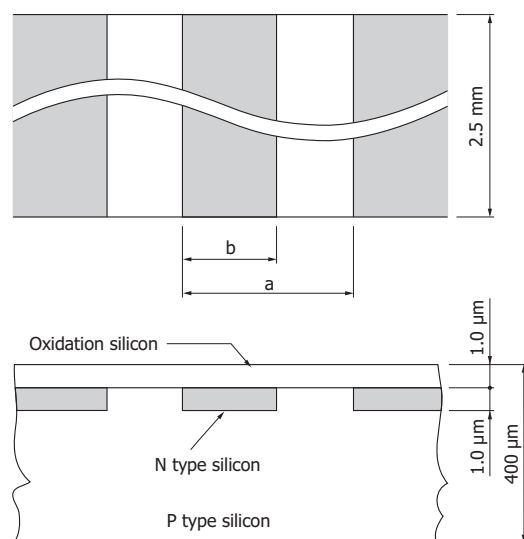
- Multichannel spectrophotometry
- Image readout system

### Equivalent circuit



KMPDC0020EA

### Active area structure



S8380 series:  $a=50$   $\mu\text{m}$ ,  $b=45$   $\mu\text{m}$   
S8381 series:  $a=25$   $\mu\text{m}$ ,  $b=20$   $\mu\text{m}$

KMPDA0125EA

▣ Absolute maximum ratings

Parameter	Symbol	Value	Unit
Input pulse ( $\phi_1$ , $\phi_2$ , $\phi_{st}$ ) voltage	$V\phi$	15	V
Power consumption*1	P	1	mW
Operating temperature*2	Topr	-40 to +65	°C
Storage temperature	Tstg	-40 to +85	°C

\*1:  $V\phi=5.0$  V

\*2: No dew condensation

▣ Shape specifications

Parameter	S8380-128Q	S8380-256Q	S8380-512Q	S8381-256Q	S8381-512Q	S8381-1024Q	Unit
Number of pixels	128	256	512	256	512	1024	-
Package length	31.75		40.6	31.75		40.6	mm
Number of pin	22			22			-
Window material*3	Quartz			Quartz			-
Weight	3.0		3.5	3.0		3.5	g

\*3: Fiber optic plate is available (excluding the S8380-128Q, S8381-256Q).

▣ Specifications (Ta=25 °C)

Parameter	Symbol	S8380 series			S8381 series			Unit
		Min.	Typ.	Max.	Min.	Typ.	Max.	
Pixel pitch	-	-	50	-	-	25	-	μm
Pixel height	-	-	2.5	-	-	2.5	-	mm
Spectral response range (10 % of peak)	$\lambda$	200 to 1000			200 to 1000			nm
Peak sensitivity wavelength	$\lambda_p$	-	750	-	-	750	-	nm
Photodiode dark current*4	ID	-	0.2	0.6	-	0.1	0.3	pA
Photodiode capacitance*4	Cph	-	20	-	-	10	-	pF
Saturation exposure*4 *5	Esat	-	90	-	-	90	-	mlx · s
Saturation output charge*4	Qsat	-	50	-	-	25	-	pC
Photo response non-uniformity*6	PRNU	-	-	±3	-	-	±3	%

\*4:  $V_b=2.0$  V,  $V\phi=5.0$  V

\*5: 2856 K, tungsten lamp

\*6: 50% of saturation, excluding the start pixel and last pixel

Electrical characteristics (Ta=25 °C)

Parameter	Symbol	Condition	S8380 series			S8381 series			Unit
			Min.	Typ.	Max.	Min.	Typ.	Max.	
Clock pulse (φ1, φ2) voltage	High	Vφ1, Vφ2 (H)	4.5	5	10	4.5	5	10	V
	Low	Vφ1, Vφ2 (L)	0	-	0.4	0	-	0.4	V
Start pulse (φst) voltage	High	Vφst (H)	4.5	Vφ1	10	4.5	Vφ1	10	V
	Low	Vφst (L)	0	-	0.4	0	-	0.4	V
Video bias voltage*7	Vb		1.5	Vφ - 3.0	Vφ - 2.5	1.5	Vφ - 3.0	Vφ - 2.5	V
Saturation control gate voltage	Vscg		-	0	-	-	0	-	V
Saturation control drain voltage	Vscd		-	Vb	-	-	Vb	-	V
Clock pulse (φ1, φ2) rise / fall time*8	trφ1, trφ2 tfφ1, tfφ2		-	20	-	-	20	-	ns
Clock pulse (φ1, φ2) pulse width	tpwφ1, tpwφ2		200	-	-	200	-	-	ns
Start pulse (φst) rise / fall time	trφst, tfφst		-	20	-	-	20	-	ns
Start pulse (φst) pulse width	tpwφst		200	-	-	200	-	-	ns
Start pulse (φst) and clock pulse (φ2) overlap	tφov		200	-	-	200	-	-	ns
Clock pulse space*8	X1, X2		trf - 20	-	-	trf - 20	-	-	ns
Data rate*9	f		0.1	-	2000	0.1	-	2000	kHz
Video delay time	tvd	50% of saturation *9 *10	-	80 (-128 Q)	-	-	100 (-256 Q)	-	ns
			-	120 (-256 Q)	-	-	150 (-512 Q)	-	ns
			-	160 (-512 Q)	-	-	200 (-1024 Q)	-	ns
Clock pulse (φ1, φ2) line capacitance	Cφ	5 V bias	-	21 (-128 Q)	-	-	27 (-256 Q)	-	pF
			-	36 (-256 Q)	-	-	50 (-512 Q)	-	pF
			-	67 (-512 Q)	-	-	100 (-1024 Q)	-	pF
Saturation control gate (Vscg) line capacitance	Cscg	5 V bias	-	12 (-128 Q)	-	-	14 (-256 Q)	-	pF
			-	20 (-256 Q)	-	-	24 (-512 Q)	-	pF
			-	35 (-512 Q)	-	-	45 (-1024 Q)	-	pF
Video line capacitance	Cv	2 V bias	-	7 (-128 Q)	-	-	10 (-256 Q)	-	pF
			-	11 (-256 Q)	-	-	16 (-512 Q)	-	pF
			-	20 (-512 Q)	-	-	30 (-1024 Q)	-	pF

\*7: Vφ is input pulse voltage (refer to P.6 "Video bias voltage margin").

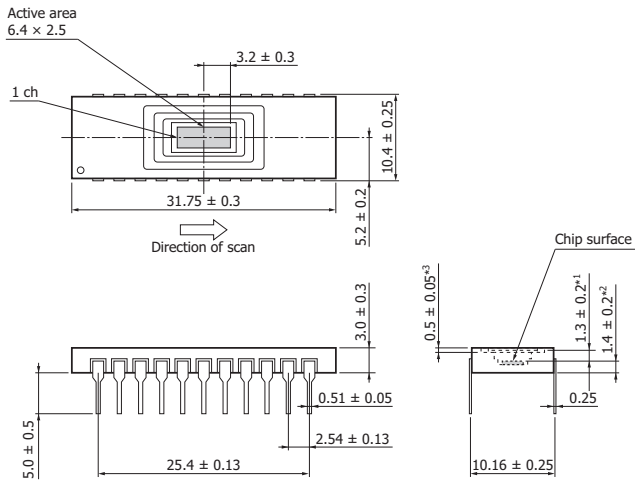
\*8: trf is the clock pulse rise or fall time. A clock pulse space of "rise time/fall time - 20 " ns or more should be input if the clock pulse rise or fall time is longer than 20 ns (refer to P.6 "Timing chart for driver circuit").

\*9: Vb=2.0 V, Vφ=5.0 V

\*10: Measured with C7883 driver circuit.

**Dimensional outlines (unit: mm)**

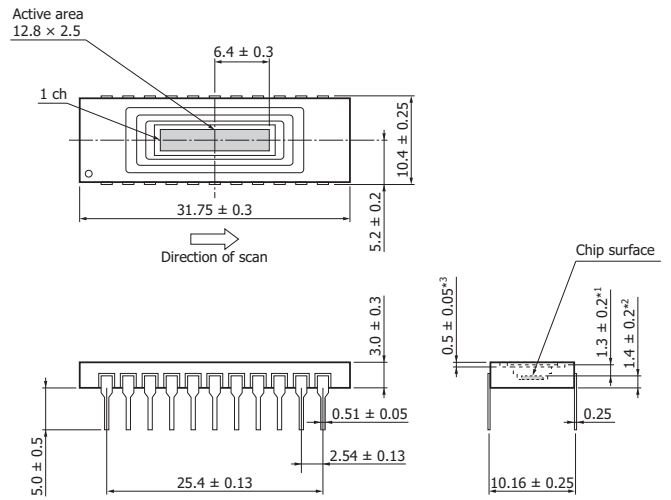
S8380-128Q, S8381-256Q



\*1: Distance from upper surface of quartz window to chip surface  
 \*2: Distance from chip surface to bottom of package  
 \*3: Window thickness

KMPDA0060ED

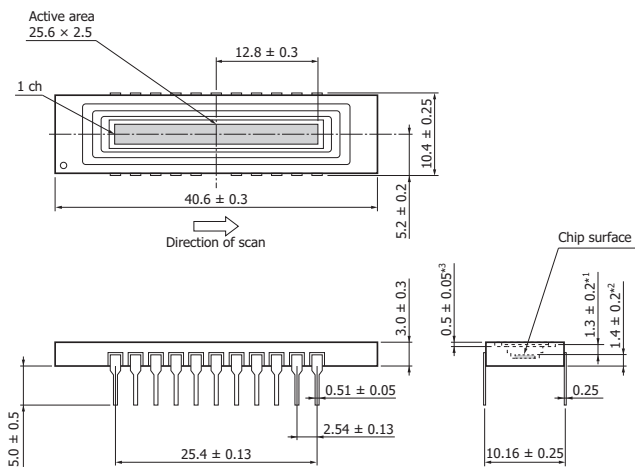
S8380-256Q, S8381-512Q



\*1: Distance from upper surface of quartz window to chip surface  
 \*2: Distance from chip surface to bottom of package  
 \*3: Window thickness

KMPDA0061ED

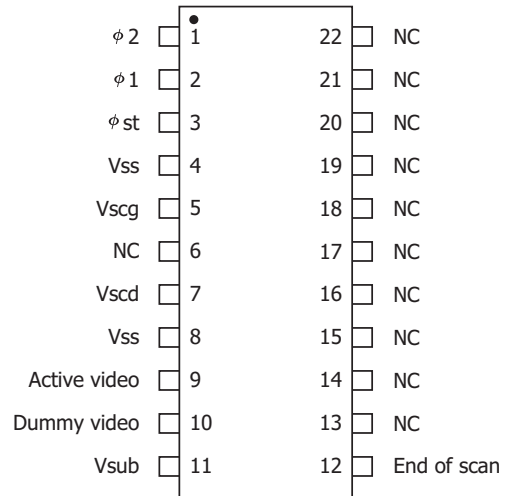
S8380-512Q, S8381-1024Q



\*1: Distance from upper surface of quartz window to chip surface  
 \*2: Distance from chip surface to bottom of package  
 \*3: Window thickness

KMPDA0062ED

**Pin connection**



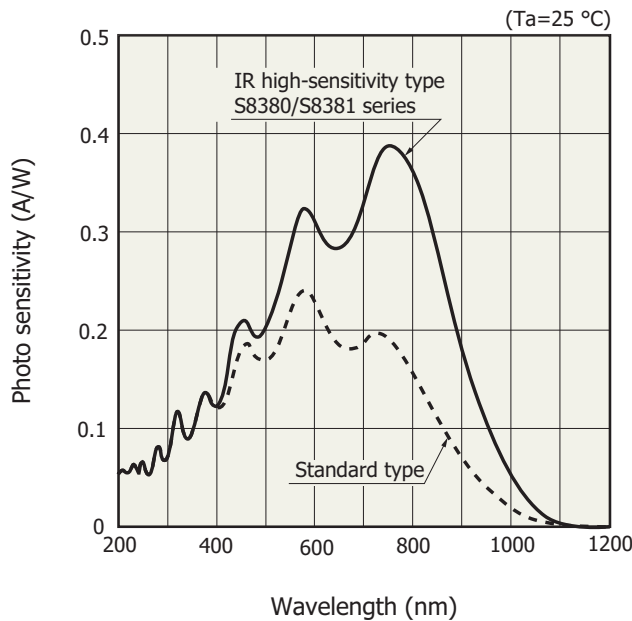
Vss, Vsub and NC should be grounded.

KMPDC0056EA

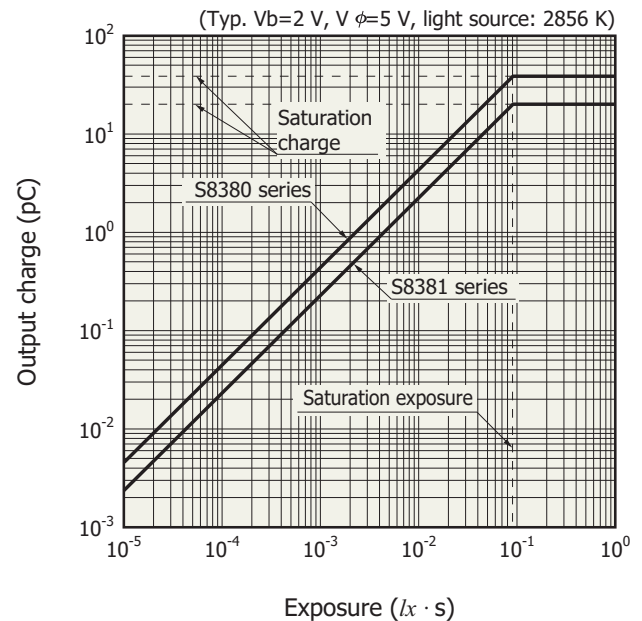
Recommended operating conditions

Terminal	Input or output	Description
$\phi 1, \phi 2$	Input (CMOS logic compatible)	Pulses for operating the MOS shift register. The video data rate is equal to the clock pulse frequency since the video output signal is obtained synchronously with the rise of $\phi 2$ pulse.
$\phi st$	Input (CMOS logic compatible)	Pulse for starting the MOS shift register operation. The time interval between start pulses is equal to the signal accumulation time.
Vss	-	Connected to the anode of each photodiode. This should be grounded.
Vscg	Input	Used for restricting blooming. This should be grounded.
Vscd	Input	Used for restricting blooming. This should be biased at a voltage equal to the video bias voltage.
Active video	Output	Video output signal. Connects to photodiode cathodes when the address is on. A positive voltage should be applied to the video line in order to use photodiodes with a reverse voltage. When the amplitude of $\phi 1$ and $\phi 2$ is 5 V, a video bias voltage of 2 V is recommended.
Dummy video	Output	This has the same structure as the active video, but is not connected to photodiodes, so only spike noise is output. This should be biased at a voltage equal to the active video or left as an open-circuit when not needed.
Vsub	-	Connected to the silicon substrate. This should be grounded.
End of scan	Output (CMOS logic compatible)	This should be pulled up at 5 V by using a 10 k $\Omega$ resistor. This is a negative going pulse that appears synchronously with the $\phi 2$ timing right after the last photodiode is addressed.
NC	-	Should be grounded.

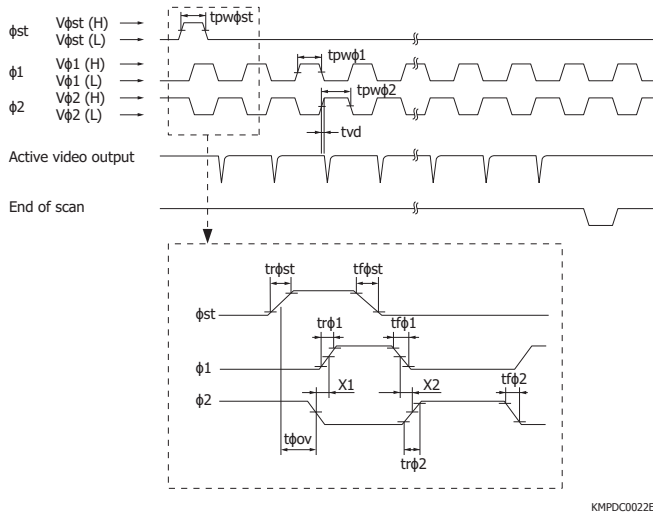
Spectral response (typical example)



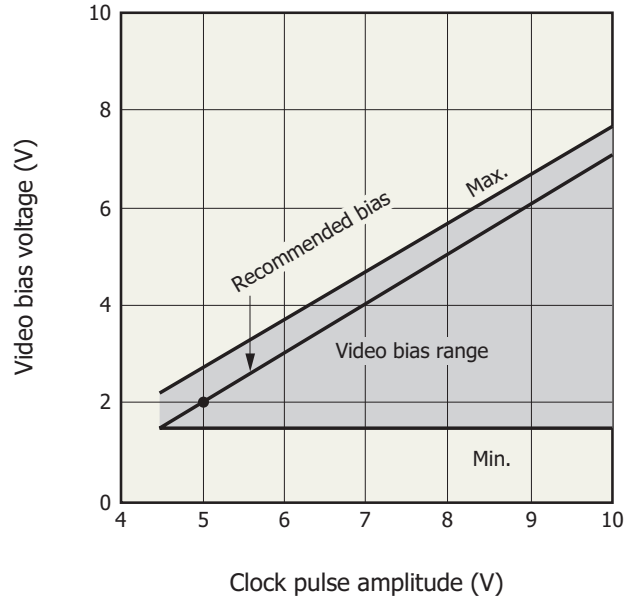
Output charge vs. exposure



**Timing chart for driver circuit**



**Video bias voltage margin**



**Related information**

[www.hamamatsu.com/sp/ssd/doc\\_en.html](http://www.hamamatsu.com/sp/ssd/doc_en.html)

**Precautions**

- Disclaimer
- Image sensors

Information described in this material is current as of February 2017.

Product specifications are subject to change without prior notice due to improvements or other reasons. This document has been carefully prepared and the information contained is believed to be accurate. In rare cases, however, there may be inaccuracies such as text errors. Before using these products, always contact us for the delivery specification sheet to check the latest specifications.

The product warranty is valid for one year after delivery and is limited to product repair or replacement for defects discovered and reported to us within that one year period. However, even if within the warranty period we accept absolutely no liability for any loss caused by natural disasters or improper product use. Copying or reprinting the contents described in this material in whole or in part is prohibited without our prior permission.