

CMOS linear image sensor

S10077

Digital output, built-in 8/10-bit AD converter, single power supply operation



S10077 is a CMOS linear image sensor designed for image input applications. The signal processing circuit has a charge amplifier with excellent input/output characteristics. The circuit also includes a 8-bit/10-bit AD converter.

Features

- Pixel pitch: 14 μm
Pixel height: 50 μm
- Number of pixels: 1024 ch
- Single power supply operation: 3.3 to 5 V
- On-chip charge amplifier with excellent input/output characteristics
- Built-in timing generator allows operation with only start and clock pulse inputs
- Video data rate: 1 MHz Max.
- Spectral response range: 400 to 1000 nm
- Digital output
- 8-bit/10-bit switchable ADC
- Simultaneous all-pixel integration and variable integration time function
- Low power consumption

Applications

- Analytical instrument
- Position detection
- Image reading

■ Absolute maximum ratings

Parameter	Symbol	Value	Unit
Supply voltage	Vdd	-0.3 to +6	V
AD mode selection voltage	Vsel	-0.3 to +6	V
Clock pulse voltage	V (CLK)	-0.3 to +6	V
Start pulse voltage	V (ST)	-0.3 to +6	V
Operating temperature *1	Topr	-5 to +50	°C
Storage temperature	Tstg	-10 to +60	°C

*1: No condensation

■ Shape specifications

Parameter	Specification	Unit
Number of pixels	1024	-
Pixel pitch	14	μm
Pixel height	50	μm
Active area length	14.336	mm
Window material	TENPAX	-

■ Recommended terminal voltage

Parameter		Symbol	Min.	Typ.	Max.	Unit
Supply voltage		Vdd	3.3	5	5.25	V
AD mode selection voltage	10-bit	Vsel	Vdd - 0.25	Vdd	Vdd + 0.25	V
	8-bit		0	-	0.4	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 (Ta=25 °C)

Parameter		Symbol	Min.	Typ.	Max.	Unit
Clock pulse frequency	10-bit	f (CLK)	1	-	6	MHz
	8-bit		1	-	12	
Video data rate		VR	-	f (CLK)/12	-	Hz

■ Electrical and optical characteristics (Ta=25 °C)

Parameter		Symbol	Min.	Typ.	Max.	Unit
Spectral response range		λ	400 to 1000			nm
Peak sensitivity wavelength		λ_p	-	700	-	nm
Photo sensitivity *2		RES	-	42	-	V/ μJcm^2
Photo response non-uniformity *3 *4		PRNU	-	-	± 10	%
Power consumption	Vdd=3.3 V	8-bit *5	-	30	-	mW
		10-bit *6	-	30	-	
	Vdd=5 V	8-bit *5	-	70	-	
		10-bit *6	-	70	-	
Saturation output voltage *7	Vdd=3.3 V	8-bit *5	255	-	-	digit
		10-bit *6	1023	-	-	
	Vdd=5 V	8-bit *5	255	-	-	
		10-bit *6	1023	-	-	
Offset output voltage	Vdd=3.3 V	8-bit *5	11	29	41	digit
		10-bit *6	44	116	164	
	Vdd=5 V	8-bit *5	7	19	27	
		10-bit *6	28	76	108	
Dark output *8	Vdd=3.3 V	8-bit *5	-	0.04	0.6	digit
		10-bit *6	-	0.16	2.4	
	Vdd=5 V	8-bit *5	-	0.03	0.6	
		10-bit *6	-	0.12	2.4	
Readout noise	Vdd=3.3 V	8-bit *5	-	0.7	2	digit
		10-bit *6	-	2.8	8	
	Vdd=5 V	8-bit *5	-	0.7	2	
		10-bit *6	-	2.8	8	

*2: $\lambda=700$ nm

*3: Photo response non-uniformity (PRNU) is measured under the condition that the device is uniformly illuminated by light which is 50% of the saturation exposure level, using 1022 pixels excluding the pixels at both ends. PRNU is defined as follows:

$$\text{PRNU} = \frac{\Delta X}{X} \times 100 (\%)$$

Where X is the average output of all pixels and ΔX is the difference between the maximum or minimum output and X with the offset subtracted.

*4: Measured with a tungsten lamp of 2856 K

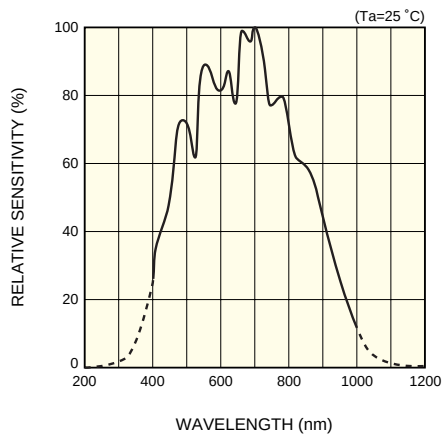
*5: f (CLK)=12 MHz, T2 (ST)=13200 CLK=1.1 ms

*6: f (CLK)=6 MHz, T2 (ST)=13200 CLK=2.2 ms

*7: Absolute value with respect to 0 V

*8: Output difference from Vo when the integration time is set to 10 ms.

■ Spectral response (typical example)



AD converter specifications (Ta=25 °C)

Parameter	Symbol	Specification	Unit
Digital output format	-	Serial output	-
Resolution *9	10-bit mode	RESO	10
	8-bit mode		
Conversion voltage range *10	Vdd=5 V	-	0 to 3.3
	Vdd=3.3 V		

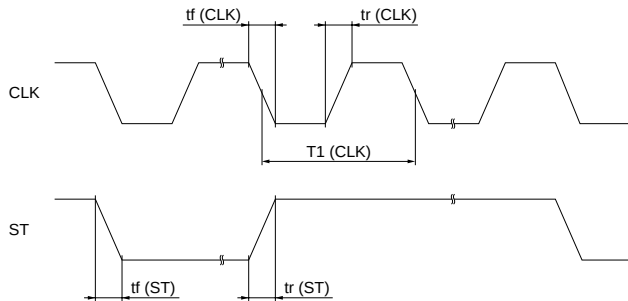
*9: Vsel=5 V (10-bit mode), 0 V (8-bit mode)

*10: Digital output is available from MSB as serial output.

10-bit mode: D9 to D0

8-bit mode: D7 to D0

Timing chart



KMPDC0224EA

Parameter	Symbol	Min.	Typ.	Max.	Unit
Clock pulse rise and fall time	tr (CLK), tf (CLK)	0	20	30	ns
Start pulse time cycle	T2 (ST)	12339	-	120000	CLK
Start pulse low time	T3 (ST)	45	-	-	CLK
Start pulse high time *11	T4 (ST)	6000	-	-	CLK
Start pulse rise and fall time	tr (ST), tf (ST)	0	20	30	ns

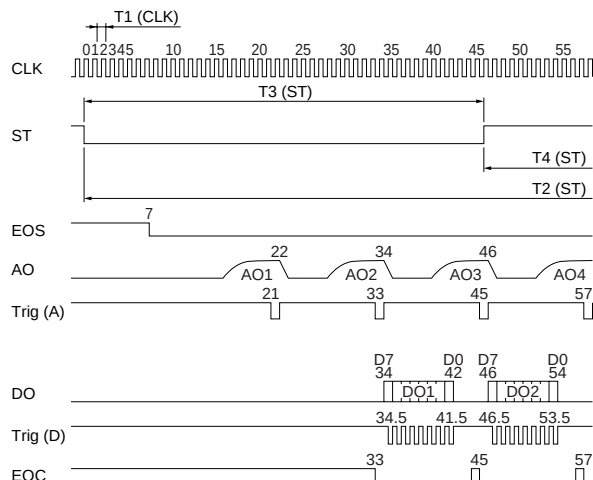
*11: Signal charge integration time equals the High period of start pulse + 7 CLK cycles.

The shift register operation starts at the rise of CLK pulse immediately after ST pulse sets to low.

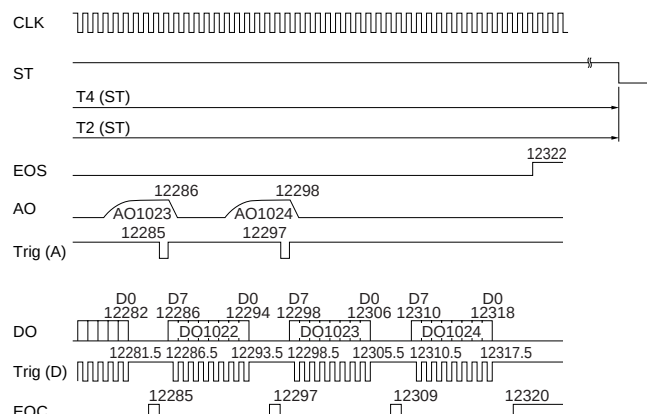
Integration time can be changed by changing the High-to-Low ratio of ST pulses.

8-bit mode

● In the neighborhood of start pixel



● In the neighborhood of last pixel



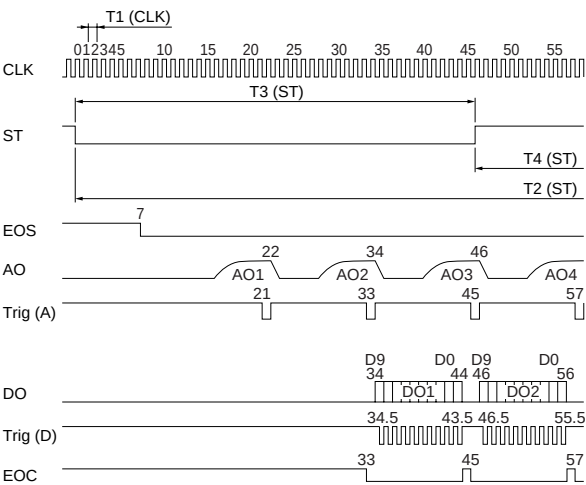
KMPDC0225EA

Note) When using analog output AO, read the AO output at the falling edge of Trig (A).

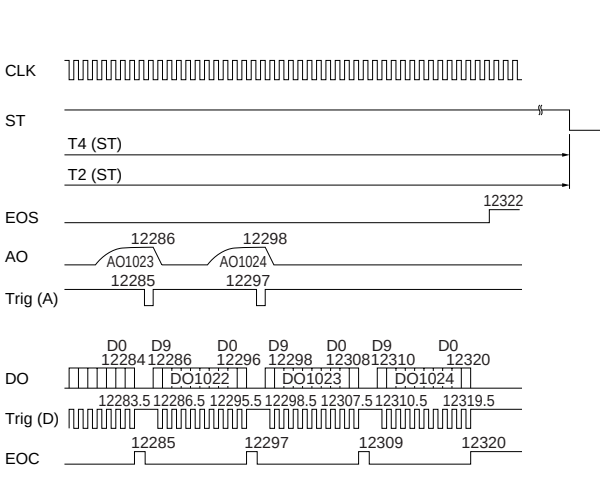
When using digital output DO, read the DO output at the falling edge of Trig (D).

10-bit mode

● In the neighborhood of start pixel

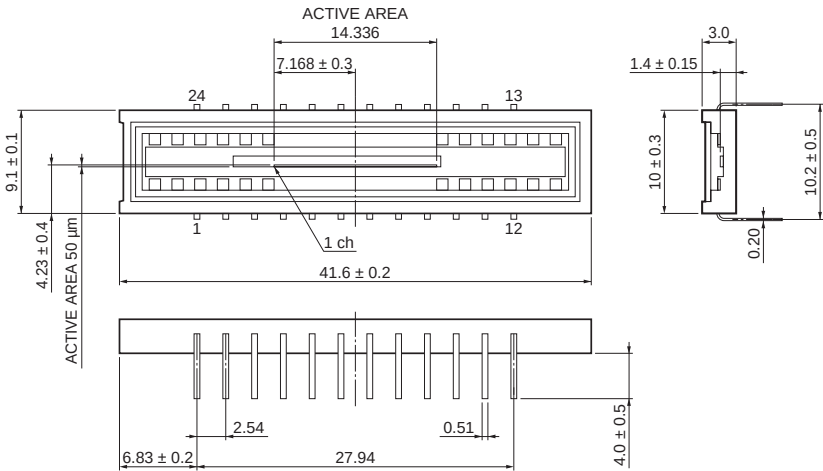


● In the neighborhood of last pixel



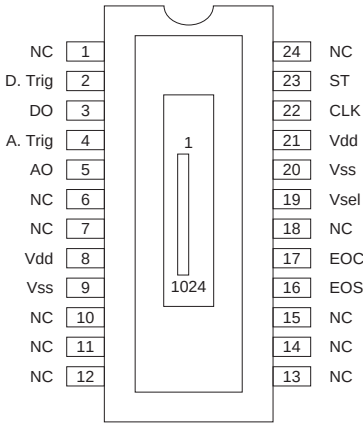
KMPDC0226EA

■ Dimensional outline (unit: mm, tolerance unless otherwise noted: ± 0.1)



Package: LCP (Liquid Crystalline Polymer)

■ Pin connection



KMPDA0202EB

KMPDC0231EA

Pin No.	Symbol	Discription	Pin No.	Symbol	Discription
1	NC	No connection	13	NC	No connection
2	D. Trig	Trigger signal for digital output	14	NC	No connection
3	DO	Digital output	15	NC	No connection
4	A. Trig	Trigger signal for analog output	16	EOS	End of scan signal
5	AO	Analog output	17	EOC	Digital conversion end signal
6	NC	No connection	18	NC	No connection
7	NC	No connection	19	Vsel	AD mode selection voltage
8	Vdd	Supply voltage	20	Vss	GND
9	Vss	GND	21	Vdd	Supply voltage
10	NC	No connection	22	CLK	Clock signal
11	NC	No connection	23	ST	Start signal
12	NC	No connection	24	NC	No connection

■ Precautions during use

(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.