LINEAR IMAGE SENSOR IC FOR CONTACT IMAGE SENSOR S-8603AWI

The S-8603AWI is a suitable linear image sensor for a multichip-type contact image sensor with a resolution of 8 dots per mm. This IC integrates a 64dots photo-transistor array and a CMOS scanning circuit. Picture signals are output one after another in analog signals, synchronized with a clock signal.

■ Features

- Adjustable scanning length for various sizes of paper : 8mm.
  …Various sizes of paper can be read by simply changing the number of chips aligned in a line.
- 2-input signals : SI, CLK.
  …Only these two input signals, start and clock, make the scanning easily.
- High sensitivity : High sensitive photo transistor.
- Low current consumption : 5V single power supply and CMOS scanning circuit.

■ Terminal functions

Table-1

Terminal No.	Symbol	Name	Operation
1	SI	Start input pin	Shift register data input pin
2	CLK	Clock input pin	Shift register clock input pin
3	VDD	Power supply pin	Normally +5V
4	GND	Ground pin	Normally 0V
5	SIG	Video signal output pin	Picture image analog signal output pin
6	N.C.	—	—
7	SO	Start output pin	Shift register data output pin

■ Circuit diagram

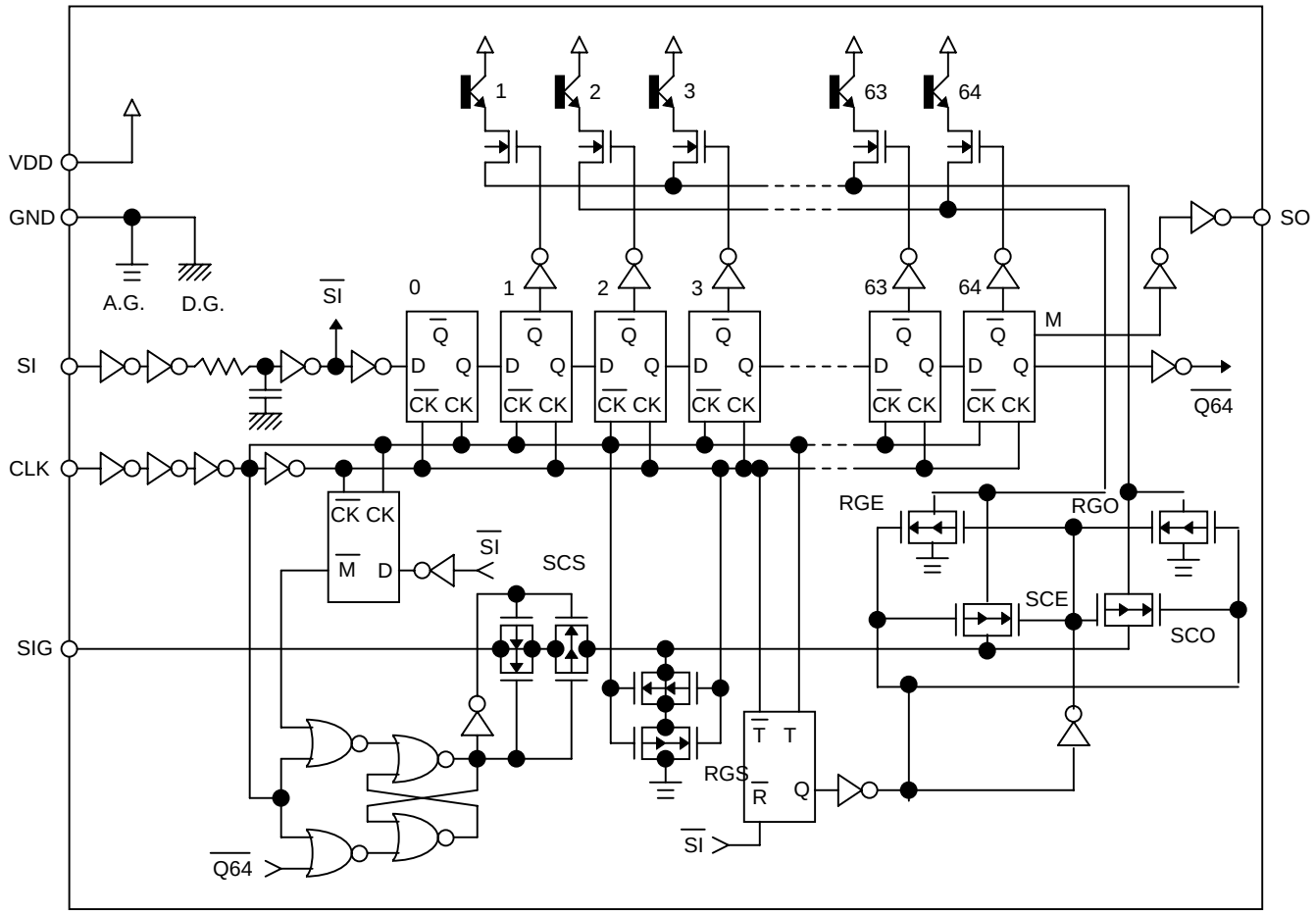

Figure-1

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■ Timing chart

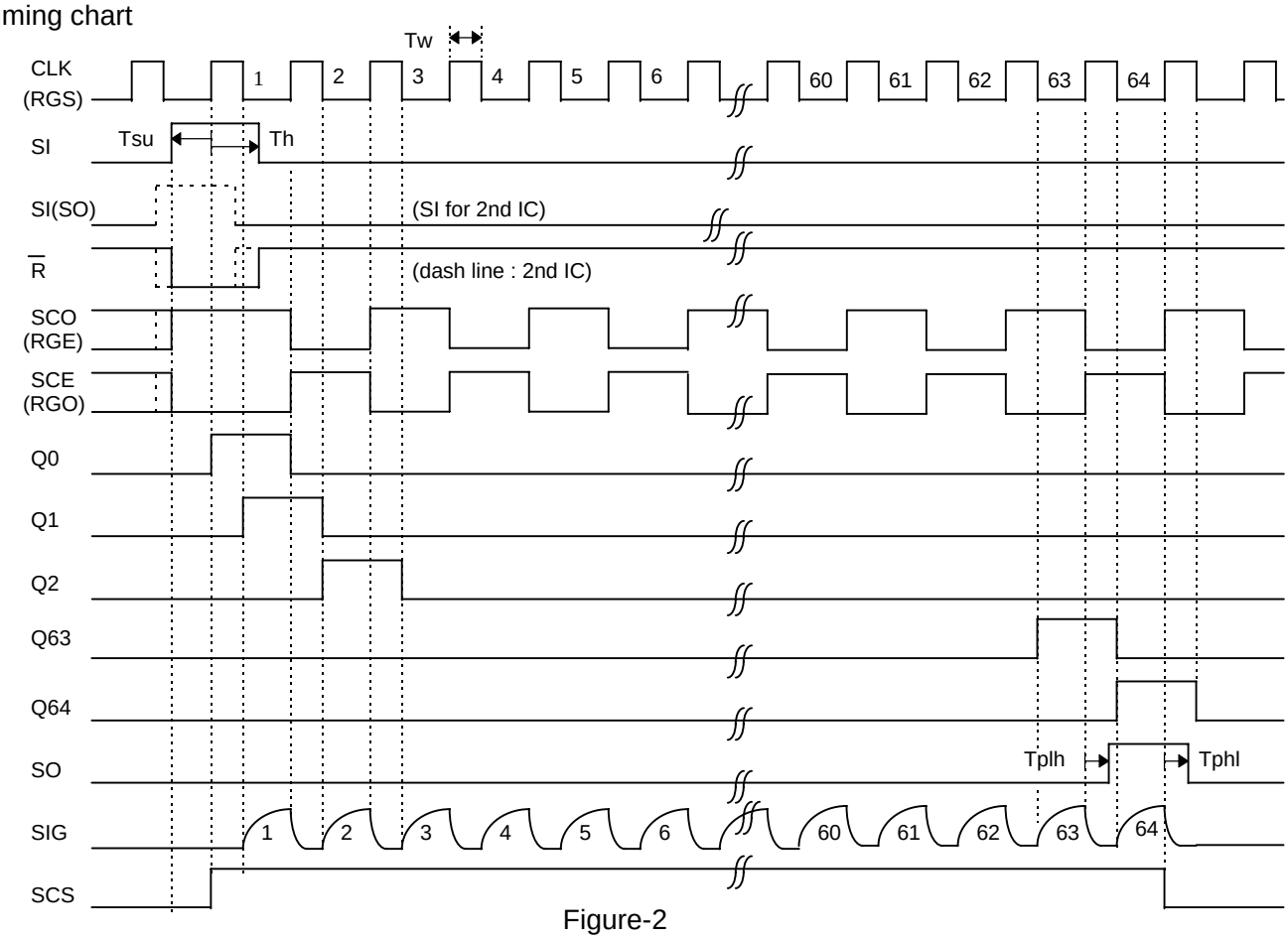

Figure-2

■ Absolute maximum ratings

Table-2

Parameter	Symbol	Condition	Rating	Unit
Power supply voltage	VDD	VDD-GND	-0.4 ~ +7.0	V
Input voltage	VIN	SI, CLK	-0.4 ~ V_{DD}+0.4	V
Output voltage	VOUT	SO, SIG	-0.4 ~ V_{DD}+0.4	V
Operating temperature	TOPR	—	-5 ~ +85	°C
Storage temperature	TSTR	—	-40 ~ +125	°C

■ Electric characteristics

1) DC characteristics

Table-3 V_{DD}=5V±10%, T_{OPR}=typ.55°C

Parameter	Symbol	Condition	Rating			Unit
			min.	typ.	max.	
Input voltage	V_{IH}	SI, CLK	2.4	—	—	V
	V_{IL}		—	—	0.8	
Input current	I_{IH}	SI, CLK	—	—	0.5	µA
	I_{IL}		-0.5	—	—	
Output voltage	V_{OH}	I_{OH} = -100µA	3.8	—	—	V
	V_{OL}	I_{OL} = 100µA	—	—	0.4	
Current consumption	I_{DD}	fck = 1 MHz	—	0.2	3.0	mA
Leak current	I_S	VDD-GND	—	—	0.2	µA

2) Switching characteristics

Table-4 V_{DD}=5V±10%, T_{OPR}=typ.55°C

Parameter	Symbol	Condition	Rating			Unit	A *1)	B *2)
			min.	typ.	max.			
Clock pulse width	Tw	High period of CLK	100	—	(1/ fck) -100	nsec	○	
Data set up time	Tsu		100	—	1/ fck	nsec	○	
Data hold time	Th		0	—	(1/ fck) -200	nsec	○	
Clock frequency	fck	Assurance of shift-register operation	—	—	2.5	MHz	○	
CLK-SO L-H delay time	Tplh	fck = 2.5MHz CL = 10 pF	—	—	150	nsec	○	
CLK-SO H-L delay time	Tphl	fck = 2.5 MHz CL = 10 pF	—	—	150	nsec	○	
Output stable time 1 *3)	Tpd1		—	—	900	nsec		○
Output stable time 2 *3)	Tpd2		—	—	300	nsec		○

*1) All products are tested.
*2) Extracted products are examined.
*3) At measuring light level of photoelectric conversion characteristics.

(Note)

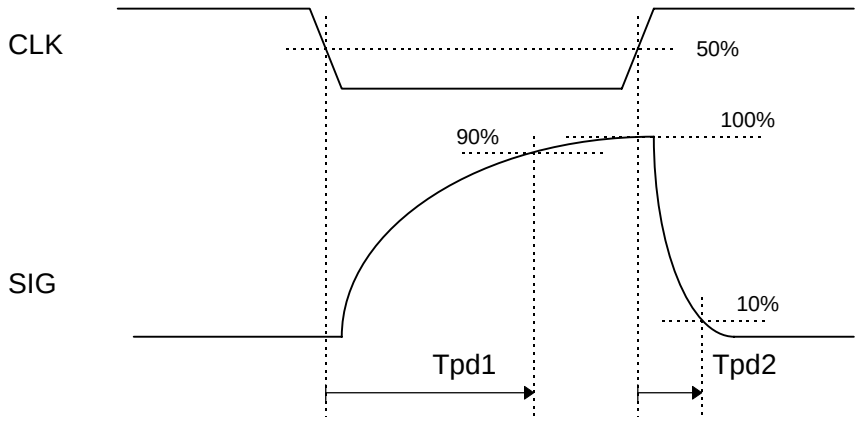

Figure-3

3) Photoelectric conversion characteristics

Condition : V_{DD}=5V, T_{OPR}=55°C, fck=500 kHz(duty=50%)
Read period RT=5 msec, load capacitor CL=100pF
Light source LED
(λ =570 nm, half width $\Delta\lambda \cong$ 30nm, illuminance 12 lx)
Connecting a capacitor of 0.1μF between VDD and GND.
Vp is measured using the measurement circuit of Figure-4.

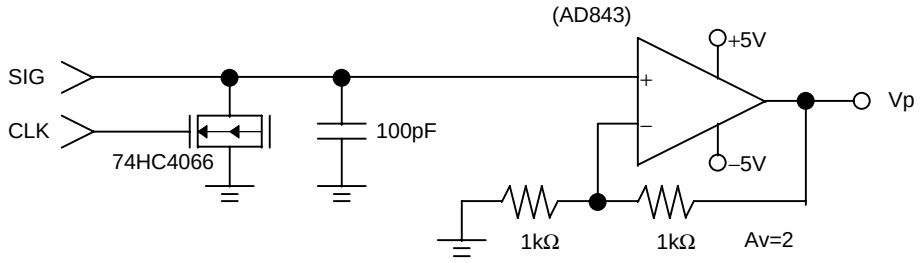

Figure-4 Measurement circuit

Table-5

Parameter	Symol	Condition	Rating			Unit	Note	A *1)	B *2)
			min.	typ.	max.				
Light level	Vpave	Exposure value Ep = 0.06lx·sec	0.570	—	1.268	V	3)-2	○	
Light level deviation	dV1	Read period RT = 5 msec	-6.0	—	+6.0	%	3)-1	○	
	dV2		-6.0	—	+6.0	%		○	
	dV3		0.0	—	+7.5	%		○	
	dV4	〃, i = 2 ~ 62	-7.0	—	+7.0	%		○	
		〃, i = 1 , 64	-15.0	—	+15.0	%		○	
	dV1 +dV2	RT = 5 msec	-10.0	—	+10.0	%		○	
Dark level 1	Vd1	RT = 5 msec fck = 500 kHz	—	24	60	mV		○	
Dark level 2	Vd2	RT = 32 msec fck = 2 kHz	—	—	240	mV		○	
Dark level deviation inside the wafer *4)	Δ dark	RT = 5 msec fck = 500 kHz	0	—	9	mV		○	
Linearity	γ		0.95	1.1	1.2		3)-3		○
Image lag	R_{IL}	measuring Vpave	—	—	40	%	3)-1	○	
Light response	R_{IR}	measuring Vpave	35	—	—	%	3)-1	○	

*1) All products are tested.
*2) Extracted products are examined.
*4) The deviation of the average value of Vd1(1~64bit) inside a wafer.

3)-1 Parameter definition

- $Vpave$: average of all bit output
- $Vp\max$: maximum output
- $Vave1$: average of 2 ~ 10bit
- $Vp\min$: Fminimum output
- $Vave2$: average of 28 ~ 36bit
- $Vp(i)$: i bit output (i =1~63)
- $Vave3$: average of 55 ~ 63bit
- $\Delta V1 = Vave2 - Vave1$
- $\Delta V2 = Vave3 - Vave2$
- $dV1 = \frac{\Delta V1}{Vpave} \times 100$ (%)
- $dV2 = \frac{\Delta V2}{Vpave} \times 100$
- $dV3 = \frac{Vp\max - Vp\min}{Vp\max + Vp\min} \times 100$
- $dV4 = \frac{Vp(i) - Vp(i+1)}{Vpave} \times 100$
- $dV1 + dV2 = \frac{Vave3 - Vave1}{Vpave} \times 100$
- *RIL* : Image lag (cf. Figure-5)
- *RIR* : Light response (cf. Figure-5)

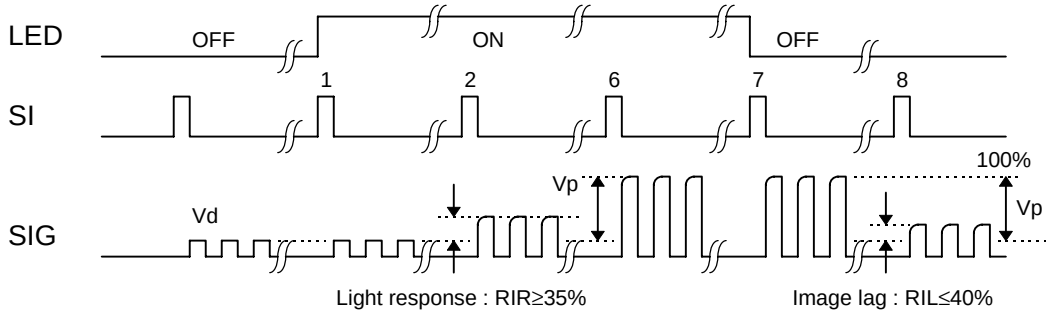

Figure-5

3)-2 Light level ranking

Table-6 (Vpave(typ) ± 2.5 %)

RANK	Vpave(V)			RANK	Vpave(V)		
	min.(≤)	typ.	max.(<)		min.(≤)	typ.	max.(<)
0	0.570	0.584	0.599	8	0.850	0.872	0.893
1	0.599	0.614	0.630	9	0.893	0.916	0.939
2	0.630	0.646	0.662	A	0.939	0.963	0.987
3	0.662	0.679	0.696	B	0.987	1.013	1.038
4	0.696	0.714	0.731	C	1.038	1.065	1.091
5	0.731	0.750	0.769	D	1.091	1.119	1.147
6	0.769	0.789	0.808	E	1.147	1.177	1.206
7	0.808	0.829	0.850	F	1.206	1.237	1.268

3)-3 Linearity

γ value is achieved using the non-linear regression based on the following equation, measuring Vp every 0.01 Lx·sec from dark status to 0.06 Lx·sec.

$$Vpave = A + B \bullet Ep^{\gamma}$$ (A,B: constant , Ep: exposure value)

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■ Pad configuration

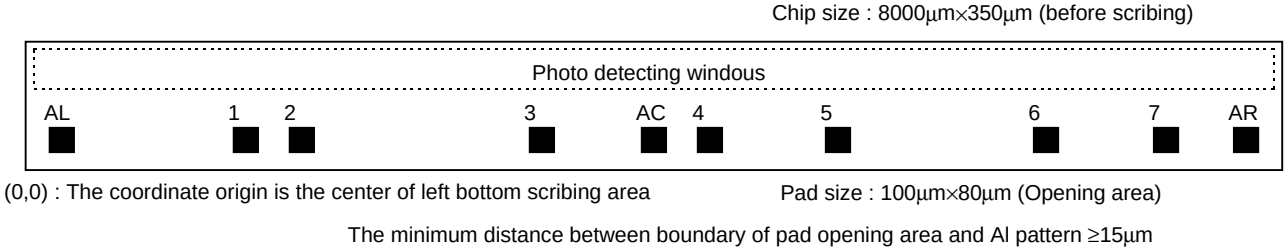


Figure-6

Table-7 Unit : μm

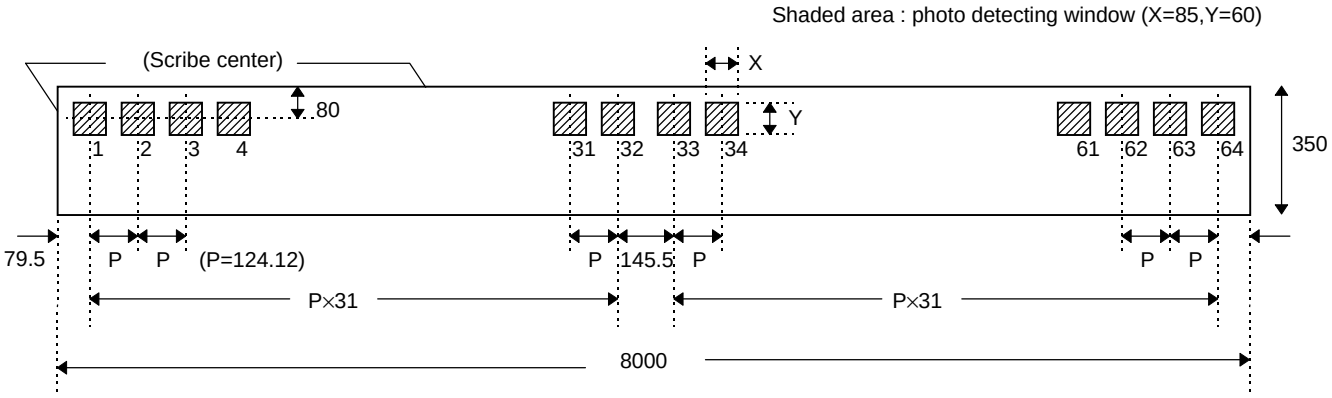
PAD No.	Name	Coordinate		PAD No.	Name	Coordinate	
		X	Y			X	Y
1	SI	1431	102	5	SIG	4870	102
2	CK	1832	102	6	N.C.	6223	102
3	VDD	3182	102	7	SO	7021	102
4	GND	4245	102				

Table-8 Unit:μm

Alignment mark name	Coordinate	
	X	Y
AL	240	102
AC	4000	102
AR	7790	102

Note : The coordinate value is the center coordinate of the pad and the alignment mark .

■ Chip size and sensor arrangement diagram



Unit : μm

Figure-7

■ Wafer form

Note: The arrangement of IC is subject to change without notes.

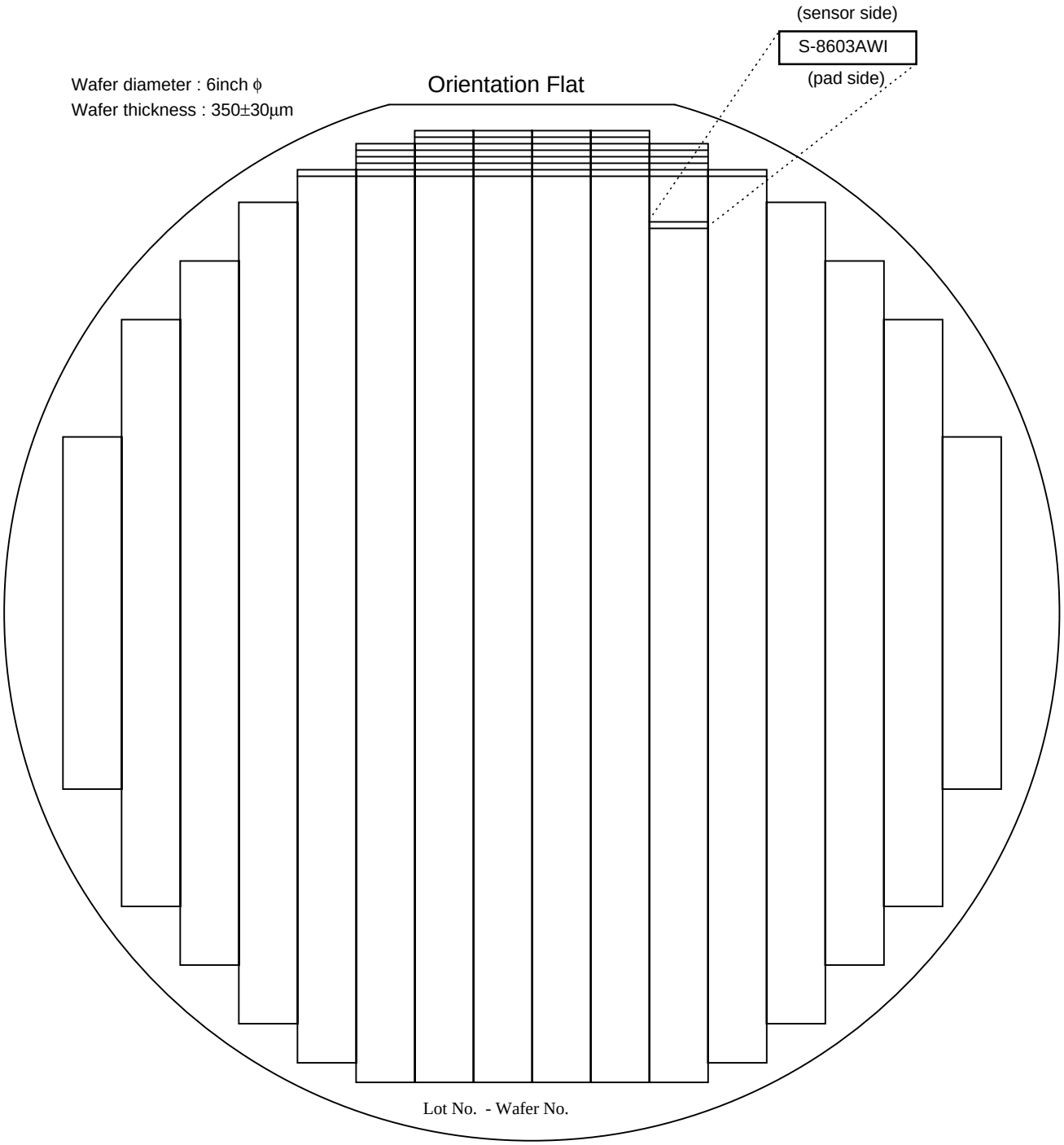


Figure-8

■ Scribe line

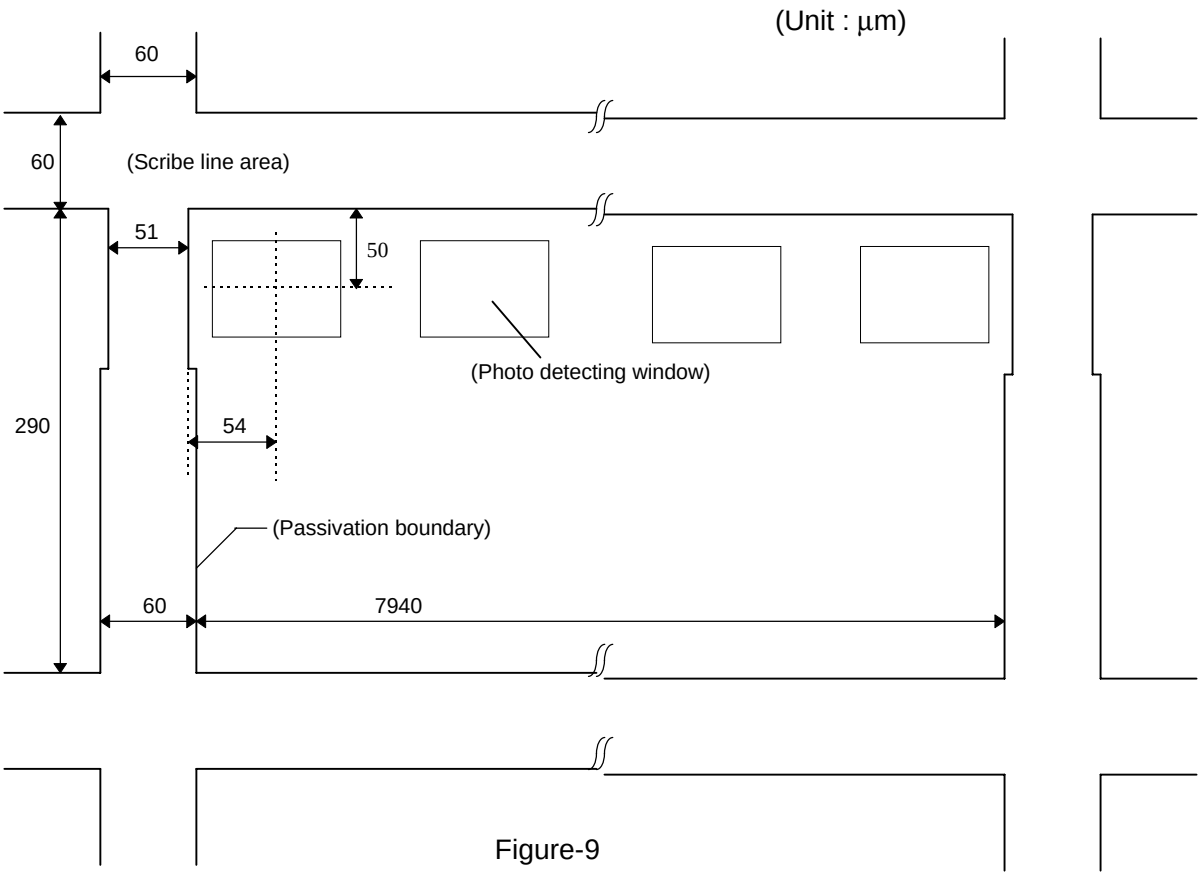
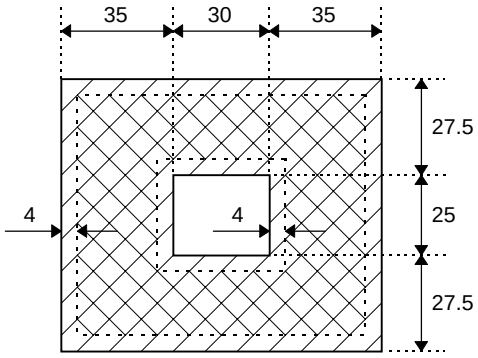
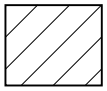


Figure-9

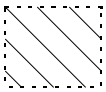
■ Alignment mark

(Unit : μm)





Al pattern



Passivasion opening

The minimum distance between boundary of pad opening area and Al pattern area has to be 15μm or more.

Figure-10