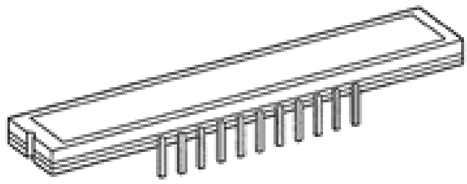
TOSHIBA CCD Linear Image Sensor CCD (Charge Coupled Device)

TCD1209DG

TOSHIBA CCD LINEAR IMAGE SENSOR CCD(Charge Coupled Device)

TCD1209DG

The TCD1209DG is a high sensitive and low dark current 2048 elements linear image sensor.
The sensor is designed for facsimile, image scanner and OCR.
The device contains a row of 2048 elements photodiodes which provide 8lines / mm (200 DPI) resolution across a B4 size paper.
The device is operated by 5V pulses and 12V power supply.



WDIP22-G-400-2.54H

Weight: 3.7g(Typ.)

FEATURES

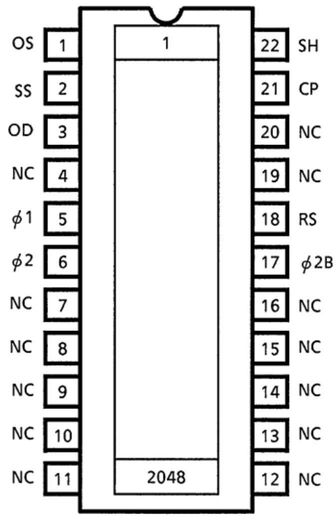
- Pixel Number : 2048
- Pixel Size : 14μm × 14μm (14μm pitch)
- Photo Sensing element
  : High Sensitive & Low Dark Current pn Photodiode
- Clock : 2 phase (5V)
- Package : 22 Pin CERDIP

ABSOLUTE MAXIMUM RATINGS (Note 1)

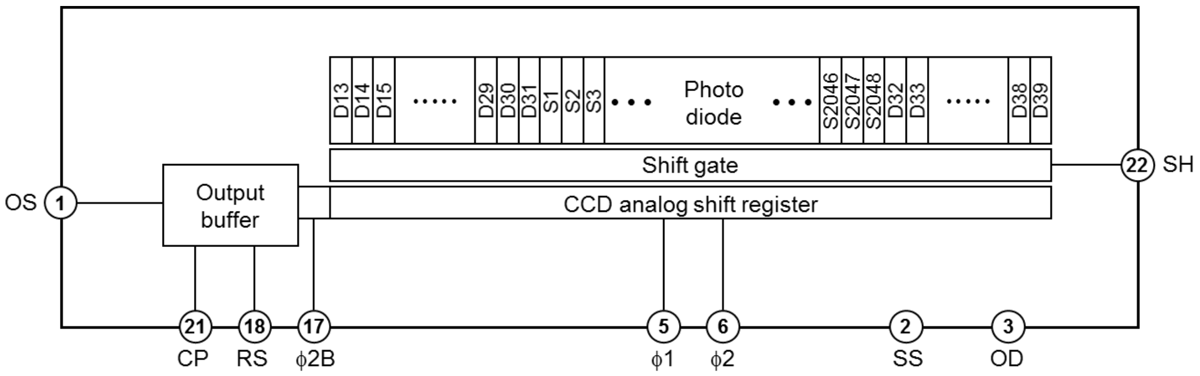
CHARACTERISTIC	SYMBOL	RATING	UNIT
Clock Pulse Voltage	V_ϕ	−0.3 to +8.0	V
Shift Pulse Voltage	V_{SH}		
RS Pulse Voltage	V_{RS}		
Clamp Pulse Voltage	V_{CP}		
Power Supply Voltage	V_{OD}	-0.3 to +15.0	V
Operating Temperature	T_{opr}	−25 to +60	°C
Storage Temperature	T_{stg}	−40 to +100	°C

Note 1: All voltage are with respect to SS terminals. (Ground)
None of the ABSOLUTE MAXIMUM RATINGS must be exceeded, even instantaneously.
If any one of the ABSOLUTE MAXIMUM RATINGS is exceeded, the electrical characteristics, reliability and life time of the device cannot be guaranteed.
If the ABSOLUTE MAXIMUM RATINGS are exceeded, the device can be permanently damaged or degraded.
Create a system design in such a manner that any of the ABSOLUTE MAXIMUM RATINGS will not be exceeded under any circumstances.

PIN CONNECTION (TOP VIEW)



CIRCUIT DIAGRAM



PIN NAMES

PIN No.	SYMBOL	NAME	PIN No.	SYMBOL	NAME
1	OS	Signal Output	22	SH	Shift Gate
2	SS	Ground	21	CP	Clamp Gate
3	OD	Power	20	NC	Non Connection
4	NC	Non Connection	19	NC	Non Connection
5	ϕ1	Clock (Phase 1)	18	RS	Reset Gate
6	ϕ2	Clock (Phase 2)	17	ϕ2B	Final Stage Clock (Phase 2)
7	NC	Non Connection	16	NC	Non Connection
8	NC	Non Connection	15	NC	Non Connection
9	NC	Non Connection	14	NC	Non Connection
10	NC	Non Connection	13	NC	Non Connection
11	NC	Non Connection	12	NC	Non Connection

OPTICAL / ELECTRICAL CHARACTERISTICS

Ta = 25°C, V_{OD} = 12V, V_{ϕ} = V_{SH} = V_{RS} = V_{CP} =5V (PULSE), f_{ϕ} = 1MHz,
t_{INT} (INTEGRATION TIME) = 10ms, LIGHT SOURCE = DAYLIGHT FLUORESCENT LAMP

CHARACTERISTIC	SYMBOL	MIN	TYP.	MAX	UNIT	NOTE
Sensitivity	R	25	31	37	V/lx·s	
Photo Response Non Uniformity	PRNU(1)	—	3	10	%	(Note2)
	PRNU (3)	—	4	10	mV	(Note8)
Saturation Output Voltage	V_{SAT}	1.5	2.0	—	V	(Note3)
Saturation Exposure	SE	0.04	0.06	—	lx·s	(Note4)
Dark Signal Voltage	V_{DRK}	—	1.0	2.5	mV	(Note5)
Dark Signal Non Uniformity	DSNU	—	1.0	2.5	mV	(Note5)
DC Power Dissipation	P_D	—	160	400	mW	
Total Transfer Efficiency	TTE	92	98	—	%	
Output Impedance	Z_O	—	0.2	1.0	kΩ	
Dynamic Range	DR	—	2000	—	—	(Note6)
DC Signal Output Voltage	V_{OS}	4.0	5.5	7.0	V	(Note7)
Random Noise	NDσ	—	0.6	—	mV	(Note9)

Note 2: Measured with 500mV signal output (typ.)

Definition of PRNU (1)

$$\text{PRNU (1)} = \frac{\Delta\chi}{\bar{\chi}} \times 100\ (\%)$$

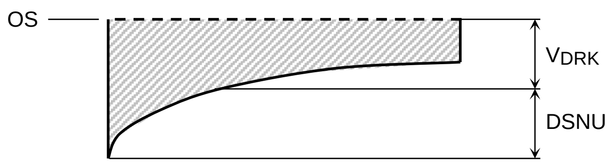
$\bar{\chi}$: Average of total signal outputs
$\Delta\chi$: The maximum deviation from $\bar{\chi}$.

Note 3: V_{SAT} is defined as the minimum saturation output voltage of all effective pixels.

Note 4: Definition of SE

$$SE = \frac{V_{SAT}}{R}\ (\text{lx} \cdot \text{s})$$

Note 5: V_{DRK} is defined as average dark signal voltage of all effective pixels.



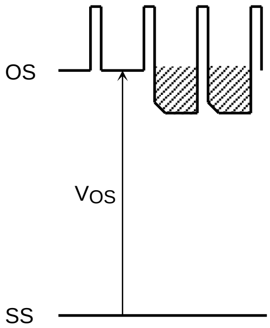
DSNU is defined by the difference between average value (V_{DRK}) and the maximum value of the dark voltage.

Note 6: Definition of DR

$$DR = \frac{V_{SAT}}{V_{DRK}}$$

V_{DRK} is proportional to tINT (Integration time).
So the shorter integration time makes wider dynamic range.

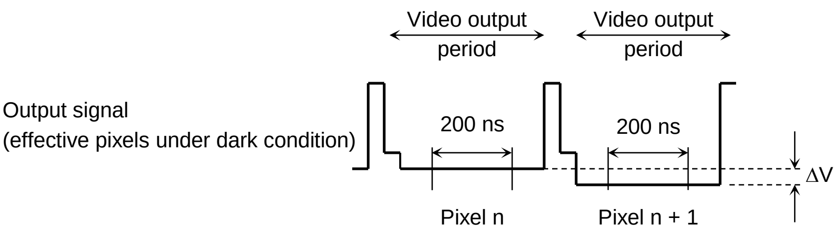
Note 7: DC signal output voltage is defined as follows:



Note 8: Measured with 50mV signal output (typ.)

PRNU (3) is defined as the maximum output level difference between two adjacent effective pixels.

Note 9: Random noise is defined as the standard deviation (sigma) of the output level difference between two adjacent effective pixels under no illumination (i.e. dark condition) calculated by the following procedure.



1) Two adjacent pixels (pixel n and n + 1) in one reading are fixed as measurement points.
2) Each of the output levels at video output periods averaged over 200 nanosecond period to get Vn and Vn + 1.
3) Vn + 1 is subtracted from Vn to get ΔV.
   $\Delta V = Vn - Vn + 1$
4) The standard deviation of ΔV is calculated after procedure 2) and 3) are repeated 30 times (30 readings).

$$\overline{\Delta V} = \frac{1}{30}\sum_{i=1}^{30} |\Delta Vi| \qquad \sigma = \sqrt{\frac{1}{30}\sum_{i=1}^{30}\left(|\Delta Vi| - \overline{\Delta V}\right)^2}$$

5) Procedure 2), 3) and 4) are repeated 10 times to get 10 sigma values.

$$\bar{\sigma} = \frac{1}{10}\sum_{j=1}^{10} \sigma j$$

6) $\bar{\sigma}$ value calculated using the above procedure is observed $\sqrt{2}$ times larger than that measured relative to the ground level. So we specify the random noise as follows.

   Random noise $= \frac{1}{\sqrt{2}}\bar{\sigma}$

OPERATING CONDITION

For best performance, the device should be used within the Recommended Operating Conditions.

CHARACTERISTIC		SYMBOL	MIN	TYP.	MAX	UNIT
Clock Pulse Voltage	"H" Level	$V_{\phi1}$ $V_{\phi2}$	4.5	5.0	5.5	V
	"L" Level		0	—	0.5	
Final Stage Clock Voltage	"H" Level	$V_{\phi2B}$	4.5	5.0	5.5	V
	"L" Level		0	—	0.5	
Shift Pulse Voltage	"H" Level	V_{SH}	4.5	5.0	5.5	V
	"L" Level		0	—	0.5	
Reset Pulse Voltage	"H" Level	V_{RS}	4.5	5.0	5.5	V
	"L" Level		0	—	0.5	
Clamp Pulse Voltage	"H" Level	V_{CP}	4.5	5.0	5.5	V
	"L" Level		0	—	0.5	
Power Supply Voltage		V_{OD}	11.4	12.0	13.0	V

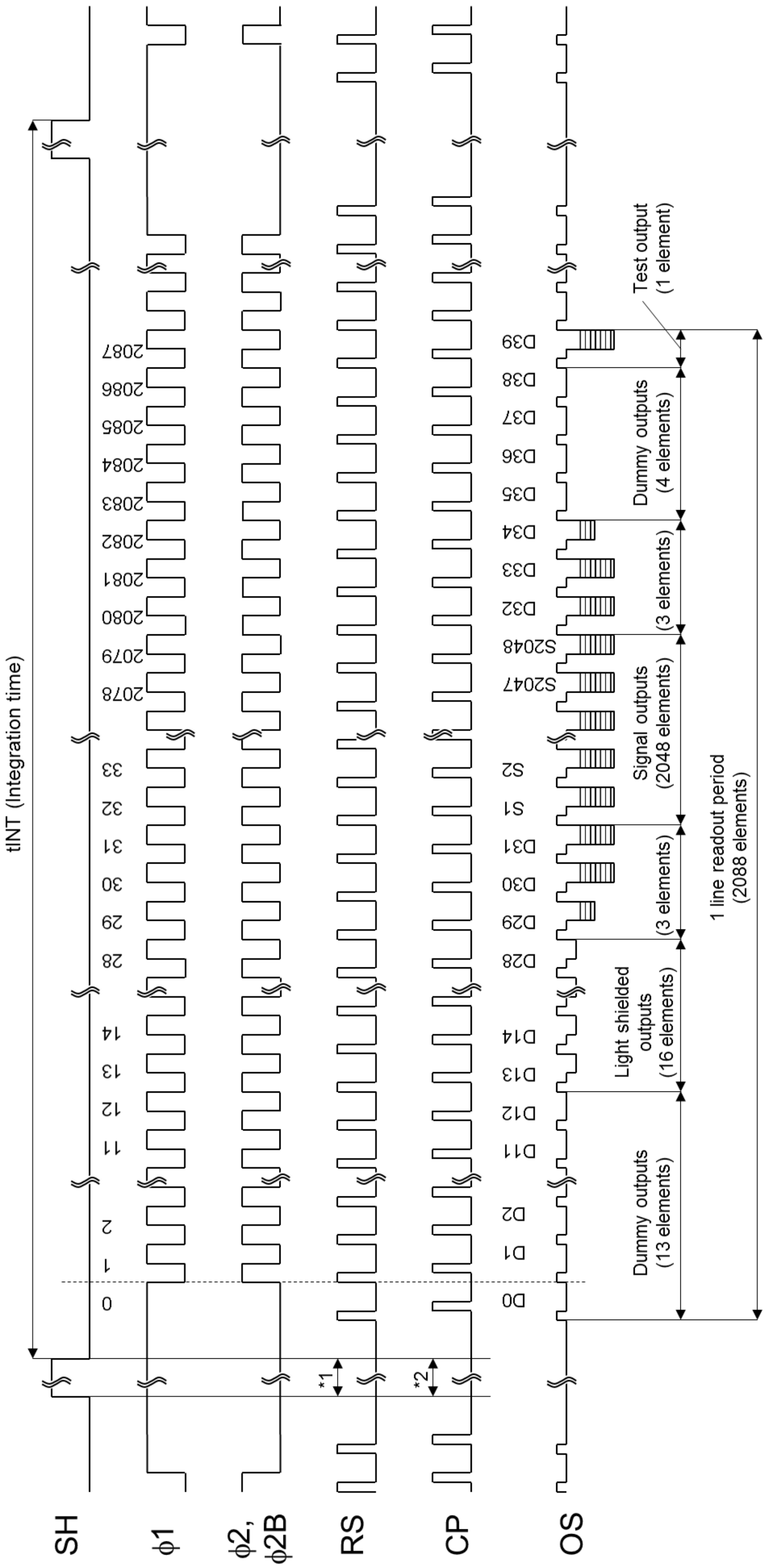
CLOCK CHARACTERISTICS

For best performance, the device should be used within the Recommended Operating Conditions.

CHARACTERISTIC	SYMBOL	MIN	TYP.	MAX	UNIT
Clock Pulse Frequency	f_{ϕ}	—	1	20	MHz
Reset Pulse Frequency	f_{RS}	—	1	20	MHz
Clock Capacitance (Note10)	$C_{\phi1}$	—	200	—	pF
	$C_{\phi2}$	—	200	—	
Final Stage Clock Capacitance	$C_{\phi2B}$	—	10	20	pF
Shift Gate Clock Capacitance	C_{SH}	—	30	—	pF
Reset Gate Clock Capacitance	C_{RS}	—	10	20	pF
Clamp Gate Clock Capacitance	C_{CP}	—	10	20	pF

Note 10: V_{OD} = 12V

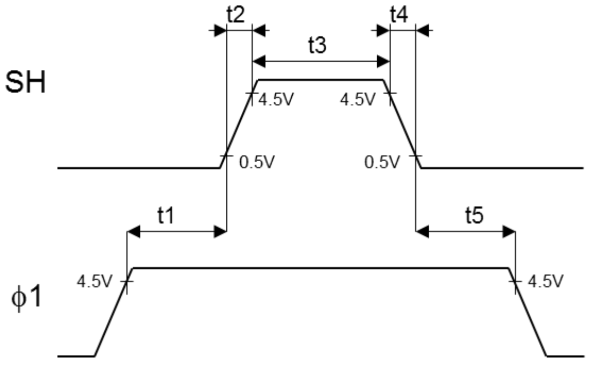
TIMING CHART



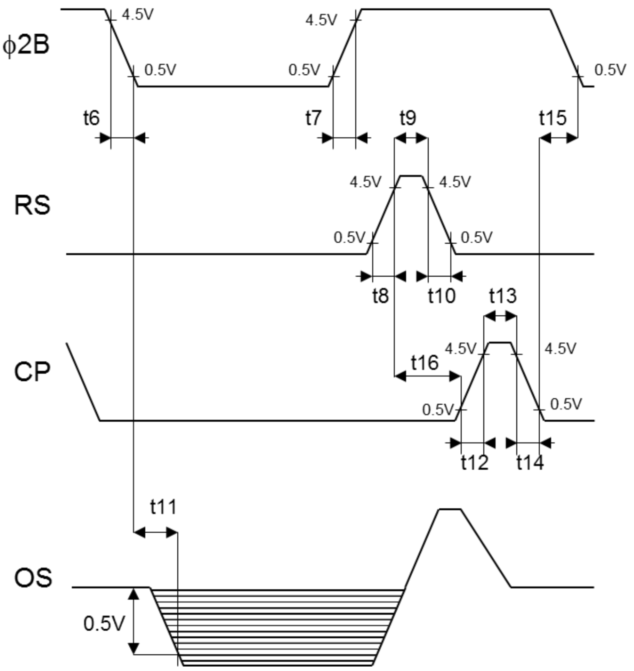
*1: RS should be kept “L” level.
*2: CP should be kept “L” level.

TIMING REQUIREMENTS

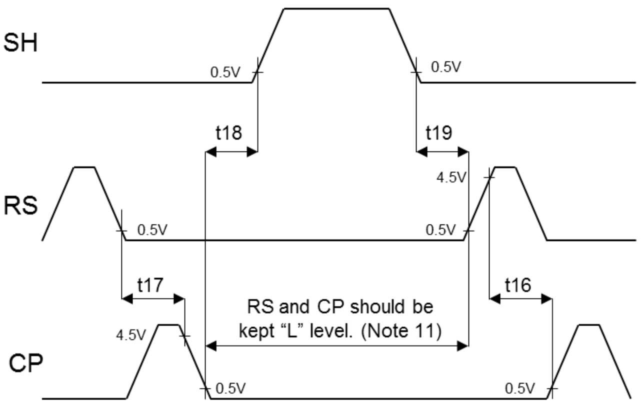
SH,φ1 Timing



φ2B, RS, CP Timing

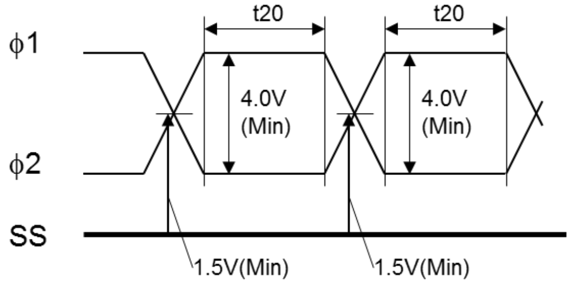


SH,RS,CP Timing



Note 11: RS and CP should be kept "L" level on this period.

φ1, φ2 Cross point



CHARACTERISTIC	SYMBOL	MIN	TYP. (Note12)	MAX	UNIT
Pulse Timing of SH and ϕ1 Pulses	t1, t5	200 +t8+t12+t13 +t14+t16	500	—	ns
Rise/Fall Time of SH Pulse	t2, t4	0	50	—	ns
"H" Level Period of SH Pulse	t3	1000	1500	—	ns
Rise/Fall Time of ϕ2B Pulse	t6, t7	0	100	—	ns
Rise/Fall Time of RS Pulse	t8, t10	0	20	—	ns
"H" Level Period of RS Pulse	t9	10	100	—	ns
Video Data Delay Time	t11	—	15	—	ns
Rise/Fall Time of CP Pulse	t12, t14	0	20	—	ns
"H" Level Period of CP Pulse	t13	10	100	—	ns
Pulse Timing of ϕ2B and CP Pulses	t15	0	50	—	ns
Pulse Timing of RS and CP Pulses	t16	0	100	—	ns
	t17	10	100	—	ns
Pulse Timing of SH and CP Pulses	t18	200	—	—	ns
Pulse Timing of SH and RS Pulses	t19	200	—	—	ns
Pulse Timing of ϕ1 and ϕ2 Pulses	t20	17	—	—	ns

Note 12: Typical condition is on the case that fϕ = 1.0MHz.

CAUTION

1. Window Glass

The dust and stain on the glass window of the package degrade optical performance of CCD sensor.
Keep the glass window clean by saturating a cotton swab in alcohol and lightly wiping the surface, and allow the glass to dry, by blowing with filtered dry N_2. Care should be taken to avoid mechanical or thermal shock because the glass window is easily to damage.

2. Electrostatic Breakdown

Store in shorting clip or in conductive foam to avoid electrostatic breakdown.
CCD Image Sensor is protected against static electricity, but interior puncture mode device due to static electricity is sometimes detected. In handing the device, it is necessary to execute the following static electricity preventive measures, in order to prevent the trouble rate increase of the manufacturing system due to static electricity.

a. Prevent the generation of static electricity due to friction by making the work with bare hands or by putting on cotton gloves and non-charging working clothes.
b. Discharge the static electricity by providing earth plate or earth wire on the floor, door or stand of the work room.
c. Ground the tools such as soldering iron, radio cutting pliers of or pincer.
It is not necessarily required to execute all precaution items for static electricity.
It is all right to mitigate the precautions by confirming that the trouble rate within the prescribed range.

3. Incident Light

CCD sensor is sensitive to infrared light. Note that infrared light component degrades resolution and PRNU of CCD sensor.

4. Lead Frame Forming

Since this package is not strong against mechanical stress, you should not reform the lead frame.
We recommend to use a IC-inserter when you assemble to PCB.

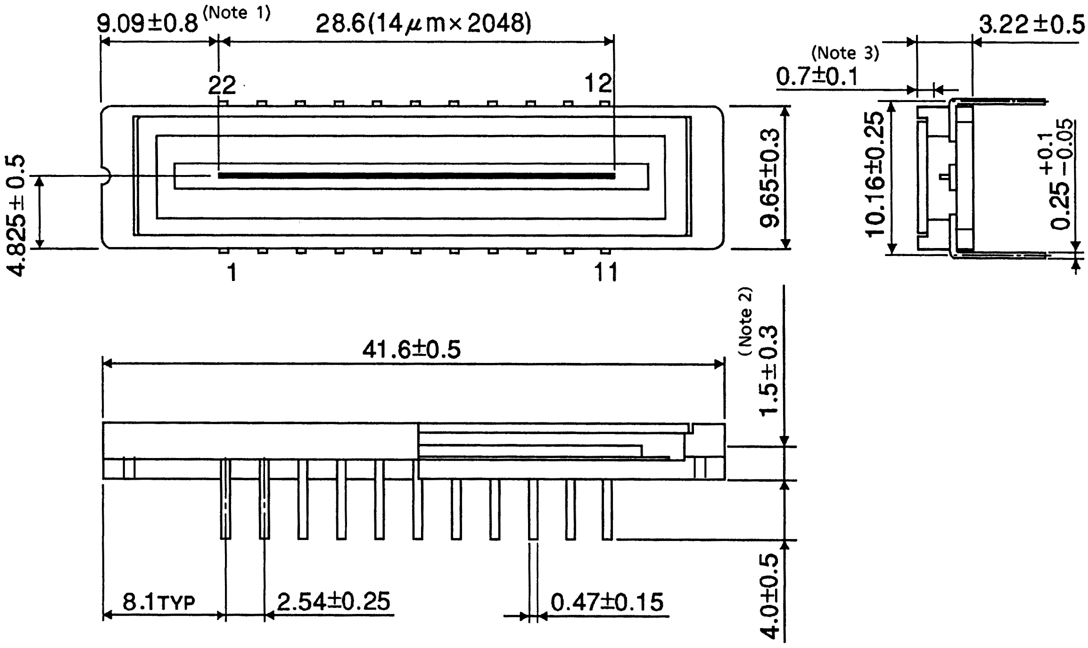
5. Soldering

Soldering by the solder flow method cannot be guaranteed because this method may have deleterious effects on prevention of window glass soiling and heat resistance.
Using a soldering iron, complete soldering within 10 seconds for lead temperatures of up to 260°C, or within 3 seconds for lead temperatures of up to 350°C.

PACKAGE DIMENSIONS

WDIP22-G-400-2.54H

Unit: mm



Note 1: 1st sensing element (S1) to the edge of the package.
Note 2: Top of the sensor chip to the bottom of the package.
Note 3: Glass thickness (n = 1.5)

Weight: 3.7g (Typ.)

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