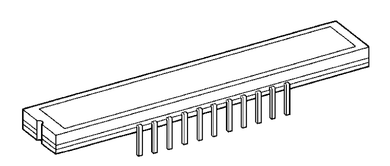
TENTATIVE TOSHIBA CCD LINEAR IMAGE SENSOR CCD (Charge Coupled Device)

TCD1209D

The TCD1209D is a high speed and low dark current 2048 elements CCD image sensor.
The sensor is designed for facsimile, imagescanner and OCR.
The device contains a row of 2048 elements photodiodes which provide a 8 lines / mm (200 DPI) across a B4 size paper. The device is operated by 5 V (pulse), and 12 V power supply.

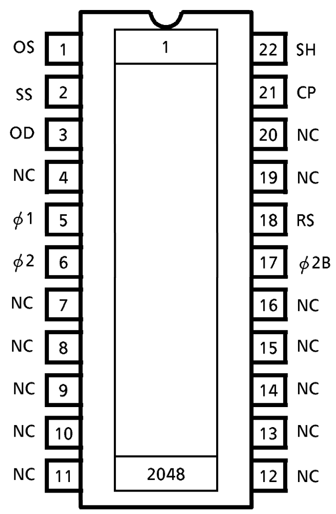


WDIP22-G-400-2.54A (A)

FEATURES

- Number of Image Sensing Elements : 2048 elements
- Image Sensing Element Size
  : 14 μm by 14 μm on 14 μm centers
- Photo Sensing Region : High sensitive and low voltage dark signal pn photodiode
- Clock : 2 phase (5 V)
- Package : 22pin Cerdip

PIN CONNECTIONS



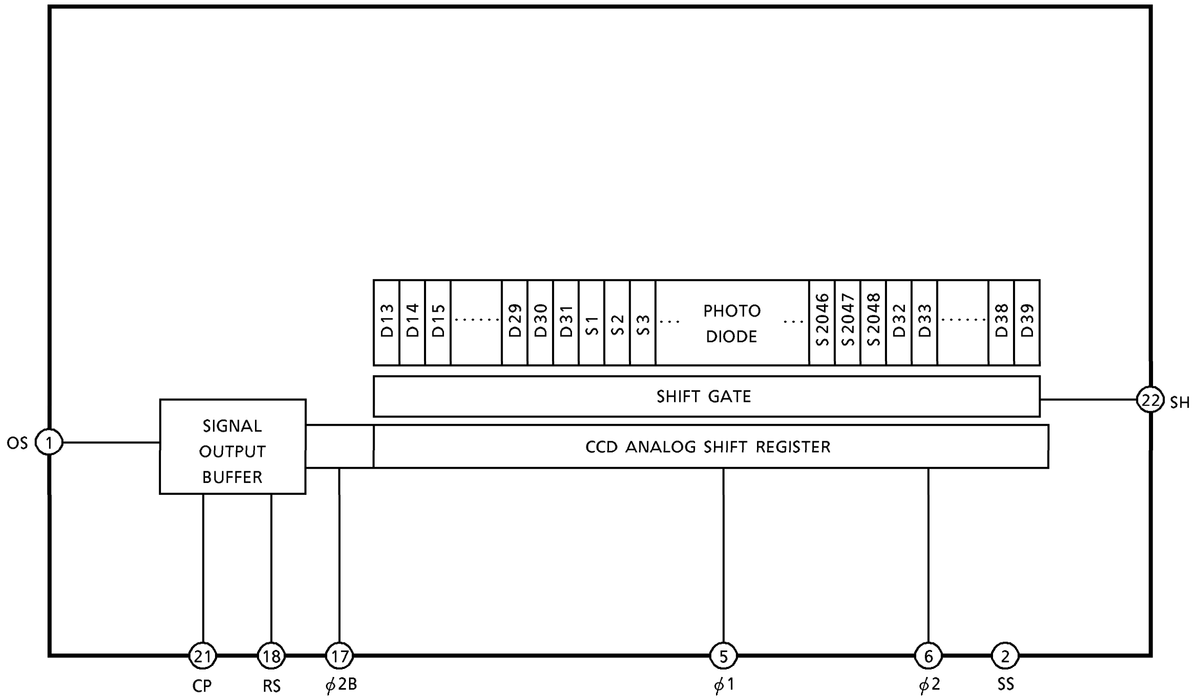
(TOP VIEW)

MAXIMUM RATINGS (Note 1)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Clock Pulse Voltage	V_ϕ	−0.3~8	V
Shift Pulse Voltage	V_{SH}		
Reset Pulse Voltage	V_{RS}		
Clamp Pulse Voltage	V_{CP}		
Power Supply Voltage	V_{OD}	−0.3~15	
Operating Temperature	T_{opr}	−25~60	°C
Storage Temperature	T_{stg}	−40~100	°C

(Note 1) All voltage are with respect to SS terminals (Ground).

CIRCUIT DIAGRAM



PIN NAME

φ1	Clock (Phase 1)
φ2	Clock (Phase 2)
φ2B	Final Stage Clock (Phase 2)
SH	Shift Gate
RS	Reset Gate
CP	Clamp Gate
OS	Signal Output
OD	Power
SS	Ground
NC	Non Connection

OPTICAL / ELECTRICAL CHARACTERISTICS

(Ta = 25°C, V_{OD} = 12 V, $V\phi$ = V_{SH} = V_{RS} = V_{CP} = 5 V (PULSE), $f\phi$ = 1 MHz,
t_{INT} (INTEGRATION TIME) = 10 ms, LIGHT SOURCE = DAYLIGHT FLUORESCENT LAMP,
LOAD RESISTANCE = 100 kΩ)

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTE
Sensitivity	R	25	31	37	V / lx·s	
Photo Response Non Uniformity	PRNU	—	3	10	%	(Note 2)
	PRNU (3)	—	4	10	mV	(Note 8)
Saturation Output Voltage	V_{SAT}	1.5	2.0	—	V	(Note 3)
Saturation Exposure	SE	0.04	0.06	—	lx·s	(Note 4)
Dark Signal Voltage	V_{DRK}	—	1.0	2.5	mV	(Note 5)
Dark Signal Non Uniformity	DSNU	—	1.0	2.5	mV	(Note 5)
DC Power Dissipation	P_D	—	160	400	mW	
Total Transfer Efficiency	TTE	92	98	—	%	
Output Impedance	Z_o	—	0.2	1	kΩ	
Dynamic Range	DR	—	2000	—	—	(Note 6)
DC Signal Output Voltage	V_{OS}	4.0	5.5	7.0	V	(Note 7)
Random Noise	$ND\sigma$	—	0.6	—	mV	(Note 9)

(Note 2) Measured at 50% of SE (Typ.)

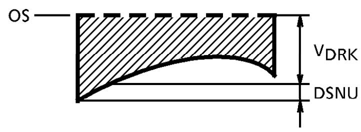
Definition of PRNU : $PRNU = \frac{\Delta\chi}{\overline{\chi}} \times 100\ (\%)$

Where $\overline{\chi}$ is average of total signal outputs and $\Delta\chi$ is maximum deviation from $\overline{\chi}$ under uniform illumination.

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

(Note 4) Definition of SE : $SE = \frac{V_{SAT}}{R}$ (lx·s)

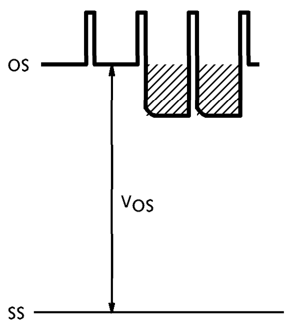
(Note 5) V_{DRK} is defined as average dark signal voltage of all effective pixels.
DSNU is defined as different voltage between V_{DRK} and V_{MDK} when V_{MDK} is maximum dark signal voltage.



(Note 6) Definition of DR : DR = $\frac{V_{SAT}}{V_{DRK}}$

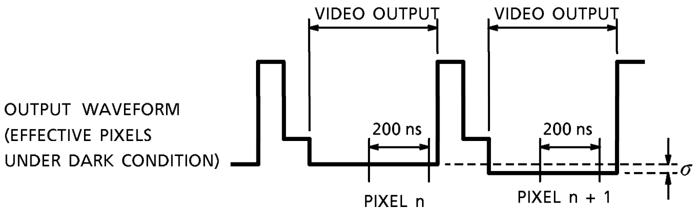
V_{DRK} is proportional to t_{INT} (Integration Time).
So the shorter t_{INT} condition makes wider DR values.

(Note 7) DC signal output voltage and DC compensation output voltage are defined as follows:



(Note 8) PRNU (3) is defined as maximum voltage with next pixel, where measured 5% of SE (Typ.)

(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.

$$\Delta V = V_n - V_{n+1}$$

4) The standard deviation of ΔV is calculated after procedure 2) and 3) are repeated 30 times (30 readings).

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

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

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

6) $\overline{\sigma}$ 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.

$$\text{Random noise} = \frac{1}{\sqrt{2}}\,\overline{\sigma}$$

OPERATING CONDITION

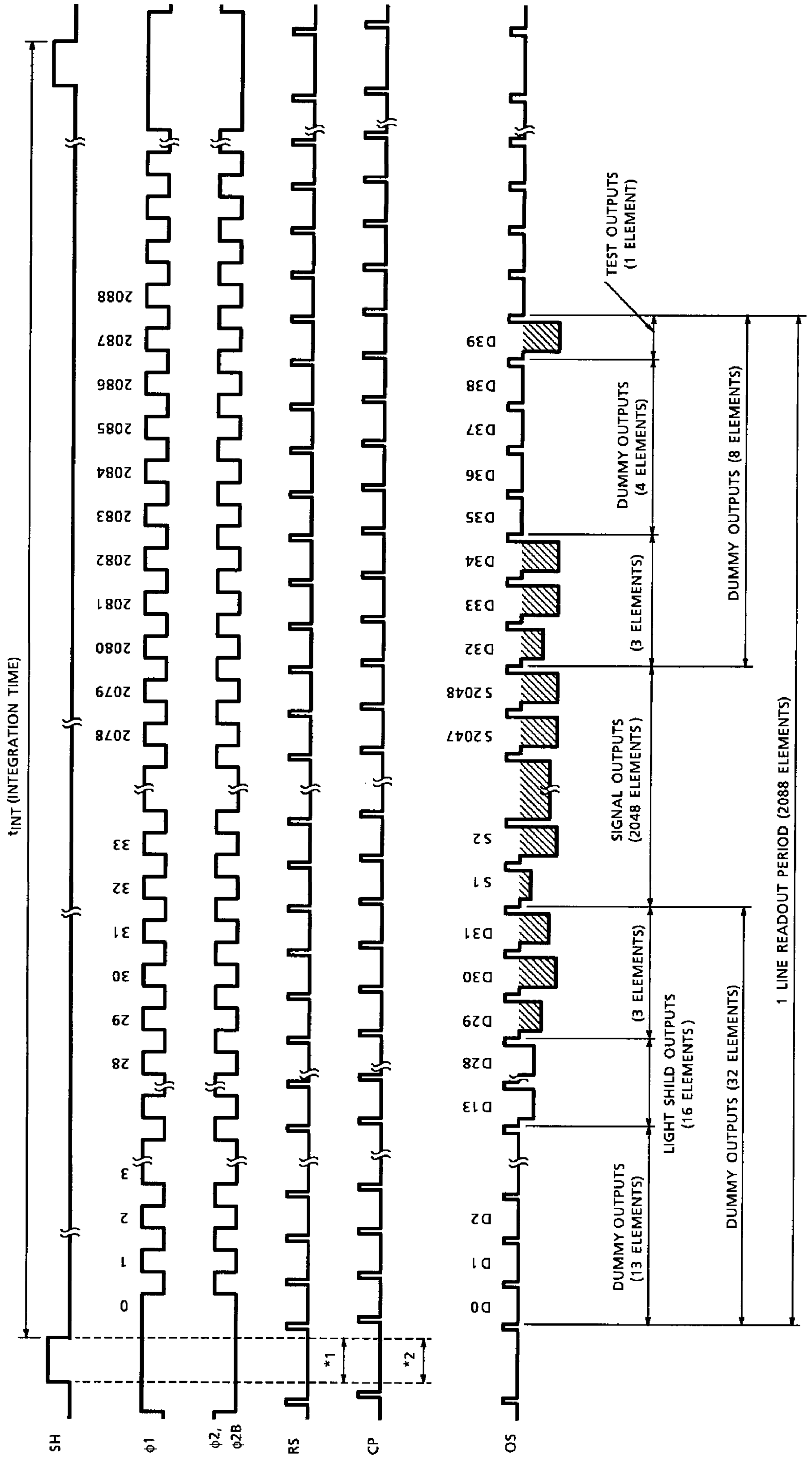
CHARACTERISTIC		SYMBOL	MIN.	TYP.	MAX.	UNIT
Clock Pulse Voltage	"H" Level	$V\phi1$	4.5	5	5.5	V
	"L" Level	$V\phi2$	0	—	0.5	
Final Stage Clock Voltage	"H" Level	$V\phi2B$	4.5	5	5.5	V
	"L" Level		0	—	0.5	
Shift Pulse Voltage	"H" Level	V_{SH}	4.5	5	5.5	V
	"L" Level		0	—	0.5	
Reset Pulse Voltage	"H" Level	V_{RS}	4.5	5	5.5	V
	"L" Level		0	—	0.5	
Clamp Pulse Voltage	"H" Level	V_{CP}	4.5	5	5.5	V
	"L" Level		0	—	0.5	
Power Supply Voltage		V_{OD}	11.4	12.0	13.0	V

CLOCK CHARACTERISTICS (Ta = 25°C)

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

(Note 10) $V_{OD} = 12$ V

TIMING CHART

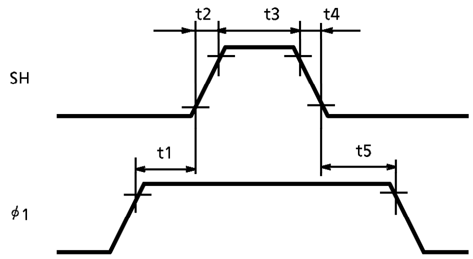


*1 RS Period
*2 CP Period

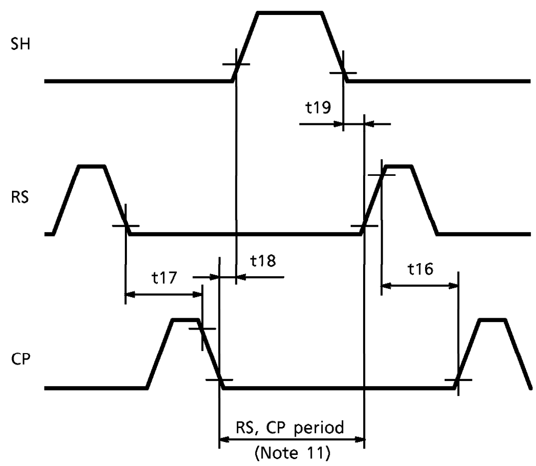
TCD1209D—7

TIMING REQUIREMENTS

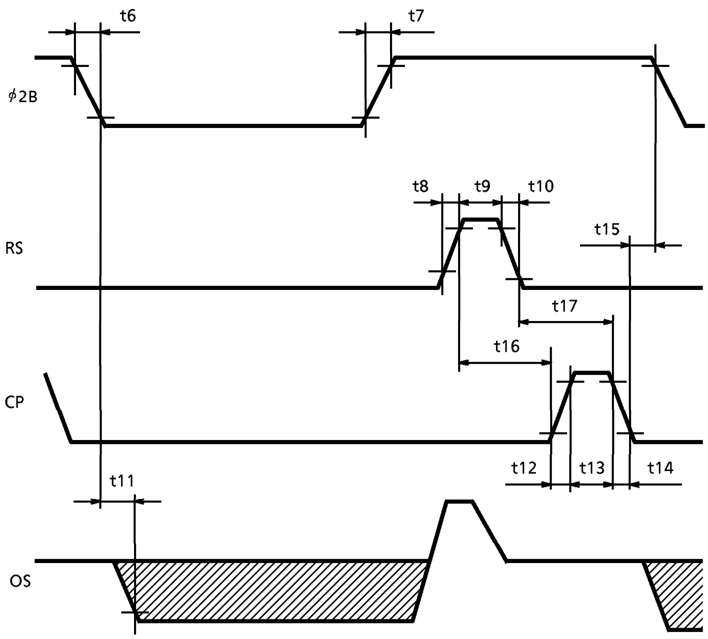
SH, φ1 Timing



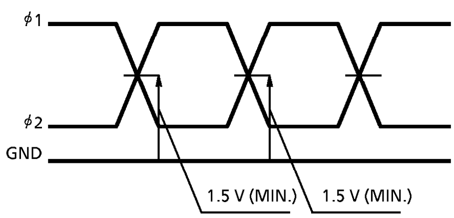
SH, RS, CP Timing



φ2, RS, CP, OS Timing



φ1, φ2 CROSS POINT



(Note 11) Each RS and CP pins put to Low level during this period.

CHARACTERISTIC	SYMBOL	MIN.	TYP. (Note 12)	MAX.	UNIT
Pulse Timing of SH and ϕ1	t1, t5	200	500	—	ns
SH Pulse Rise Time, Fall Time	t2, t4	0	50	—	ns
SH Pulse Width	t3	1000	1500	—	ns
ϕ2B Pulse Rise Time, Fall Time	t6, t7	0	100	—	ns
RS Pulse Rise Time, Fall Time	t8, t10	0	20	—	ns
RS Pulse Width	t9	10	100	—	ns
Video Data Delay Time (Note 13)	t11	—	15	—	ns
CP Pulse Rise Time, Fall Time	t12, t14	0	20	—	ns
CP Pulse Width	t13	10	100	—	ns
Pulse Timing of ϕ2B and CP	t15	0	50	—	ns
Pulse Timing of RS and CP	t16	0	100	—	ns
	t17	10	100	—	
Pulse Timing of SH and CP	t18	200	—	—	ns
Pulse Timing of SH and RS	t19	200	—	—	ns

(Note 12) TYP. is the case of f_{RS} = 1.0 MHz
(Note 13) Load Resistance is 100 kΩ

PRECAUTIONS FOR USE OF CCD IMAGE SENSOR

1. Static Electricity

   This device has some weakly terminals for static electricity. Therefor, please pay attention to treat this device.

   CCD Image Sensor is protected against static electricity, but inferior puncture mode device due to static electricity is sometimes detected. In handling 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 plier or pincette.
      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.

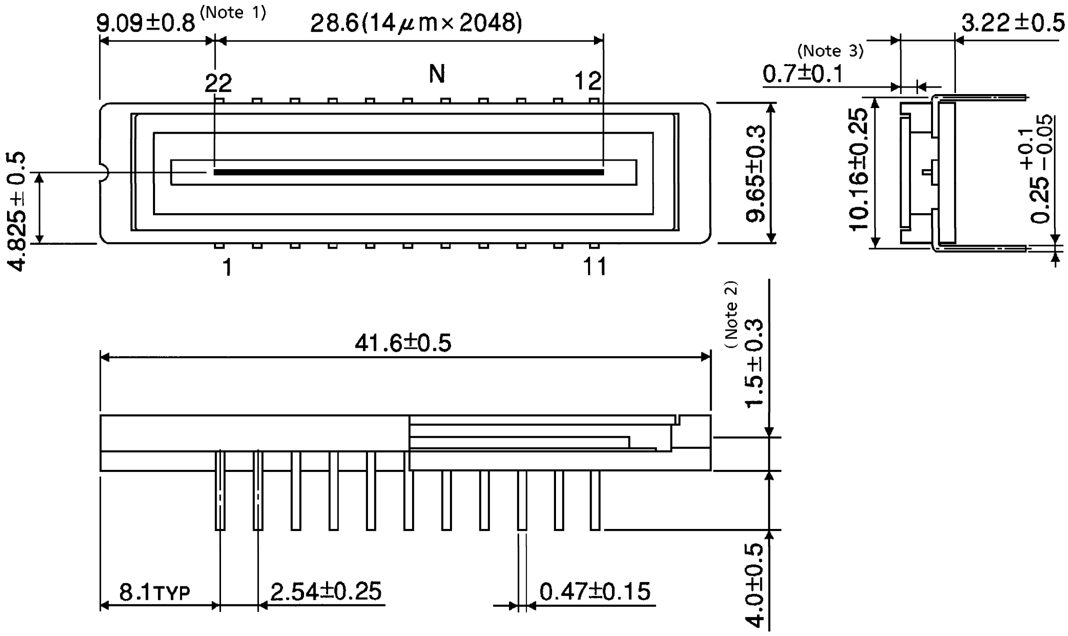
2 Window Glass

   As the dust and station on the glass window of the package will cause black flow on the picture, never fail to clean the glass surface before using. (Blow compressed vapor, and wipe off the dust, and dirt with soft cloth or paper slightly moistened with alcohol).
   Fully take care for the handling of the device as the window glass will break or a strong friction is given to the window glass surface.

3. Incident Light

   CCD image sensor has sensitivity in a wide range zone of light wave length, but its characteristics will sometimes widely change when used with long wave length input light outside the visual light zone.

OUTLINE DRAWING
WDIP22-G-400-2.54A (A) Unit : mm



(Note 1) No. 1 SENSOR ELEMENT (S1) TO EDGE OF PACKAGE.
(Note 2) TOP OF CHIP TO BOTTOM OF PACKAGE.
(Note 3) GLASS THICKNES (n = 1.5)