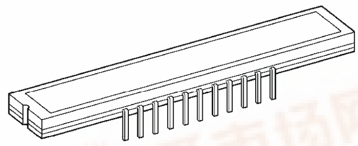
TOSHIBA CCD LINEAR IMAGE SENSOR CCD(Charge Coupled Device)

TCD1208AP

The TCD1208AP is a high sensitive and low dark current 2160-element image sensor. The sensor can be used for facsimile, imagescanner and OCR. The device contains a row of 2160 photodiodes, which provide a 8 lines / mm (200 DPI) across a B4 size paper. The device is operated by 5V (pulse), and 5V power supply.



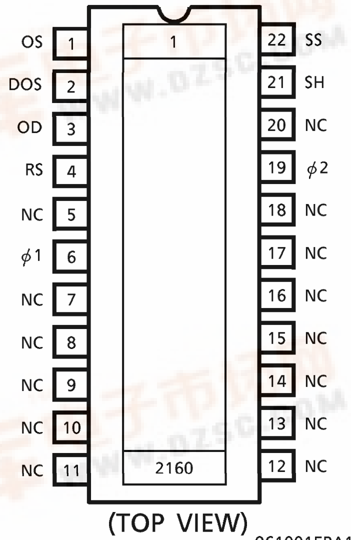
WDIP22-G-400-2.54A

Weight : 2.7g (Typ.)

FEATURES

- Number of Image Sensing Elements : 2160
- Image Sensing Element Size : 14μm by 14μm on 14μm centers
- Photo Sensing Region : High sensitive, Low dark current
- Clock : 2 phase (5V)
- Package : 22 pin DIP (T-CAPP) TOSHIBA-CCD-ADVANCED-PLASTIC-PACKAGE

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}		
Power Supply Voltage	V_{OD}		
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).

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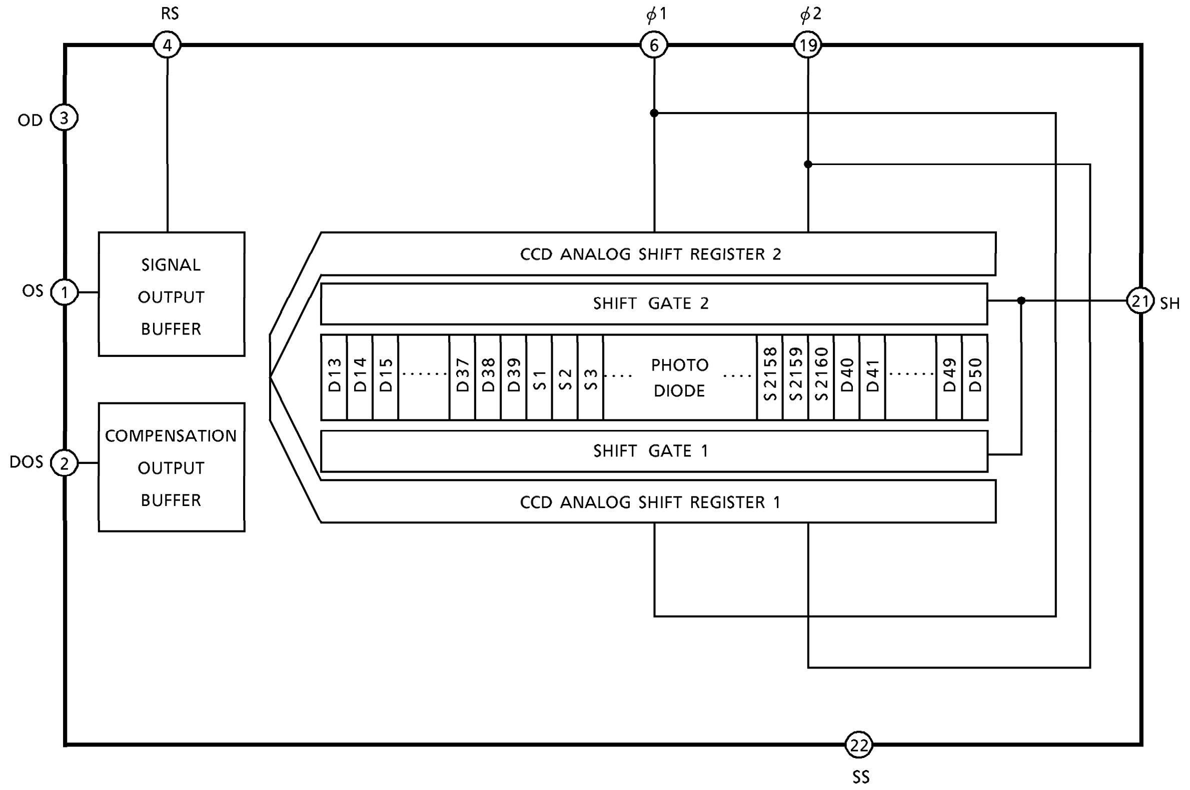
CIRCUIT DIAGRAM



PIN NAMES

φ1	Clock (Phase 1)
φ2	Clock (Phase 2)
SH	Shift Gate
RS	Reset Gate
OS	Signal Output
DOS	Compensation Output
OD	Power
SS	Ground
NC	Non Connection

OPTICAL / ELECTRICAL CHARACTERISTICS

(Ta = 25°C, V_{OD} = 5V, $V\phi$ = V_{SH} = V_{RS} = 5V (PULSE), $f\phi$ = 0.5MHz, f_{RS} = 1MHz, LOAD RESISTANCE = 100kΩ, t_{INT} (INTEGRATION TIME) = 10ms, LIGHT SOURCE = DAYLGIHT FLUORESCENT LAMP)

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTE
Sensitivity	R	82	110	138	V / lx·s	(Note 2)
Photo Response Non Uniformity	PRNU (1)	—	—	10	%	(Note 3)
	PRNU (3)	—	7	16	mV	(Note 10)
Register Imbalance	RI	—	—	3	%	(Note 4)
Saturation Output Voltage	V_{SAT}	0.6	1.5	—	V	(Note 5)
Saturation Exposure	SE	—	0.01	—	lx·s	(Note 6)
Dark Signal Voltage	V_{DRK}	—	2	6	mV	(Note 7)
Dark Signal Non Uniformity	DSNU	—	3	7	mV	(Note 7)
DC Power Dissipation	P_D	—	50	100	mW	
Total Transfer Efficiency	TTE	92	—	—	%	
Output Impedance	Z_O	—	—	1	kΩ	
Dynamic Range	DR	—	750	—	—	(Note 8)
DC Signal Output Voltage	V_{OS}	3	3.5	4.5	V	(Note 9)
DC Compensation Output Voltage	V_{DOS}	3	3.5	4.5	V	(Note 9)
DC Mismatch Voltage	$\|V_{OS}-V_{DOS}\|$	—	50	100	mV	(Note 11)
Random Noise	ND_σ	—	1.7	—	mV	(Note 12)

(Note 2) Sensitivity for 2854K W-Lamp is 330V / lx·s (Typ.)
Sensitivity for LED (567nm) is 71V / lx·s (Typ.)

(Note 3) 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 the maximum deviation from $\overline{\chi}$ under uniform illumination.

(Note 4) Measured at 50% of SE (Typ.)
RI is defined as follows:

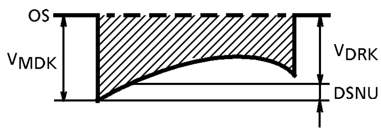
$$RI = \frac{\sum_{n=1}^{2159} |\chi n - \chi n+1|}{2159 \times \overline{\chi}} \times 100\,(\%)$$

Where χn and $\chi n+1$ are signal outputs of each pixel. $\overline{\chi}$ is average of total signal outputs.

(Note 5) V_{SAT} is defined as minimum Saturation Output Voltage of all effective pixels.

(Note 6) Definition of SE : $$SE = \frac{V_{SAT}}{R}$$

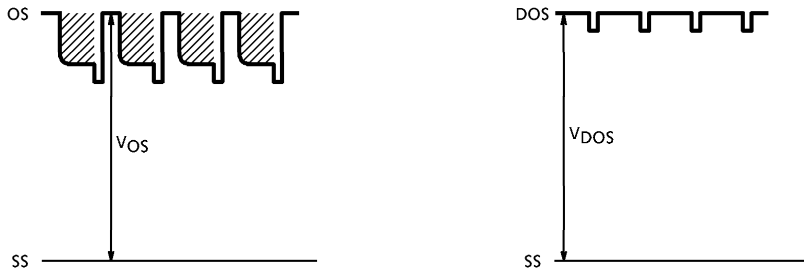
(Note 7) V_{DRK} is defined as average dark signal voltage of all effective pixels. DSNU is defined as different voltage between V_{DRK} and V_{MDK}, when V_{MDK} is maximum dark voltage.



(Note 8) Definition of DR : $DR = \frac{V_{SAT}}{V_{DRK}}$

V_{DRK} is proportional to t_{INT} (Integration time). So the shorter t_{INT} is, the wider DR is.

(Note 9) DC Signal Output Voltage and DC Compensation Output Voltage are defined as follows:



(Note 10) PRNU (3) is defined as maximum voltage with next pixel where measured 5% of SE (Typ.).

(Note 11) $V_{OD} = 4.7V$ DC Mismatch Voltage.

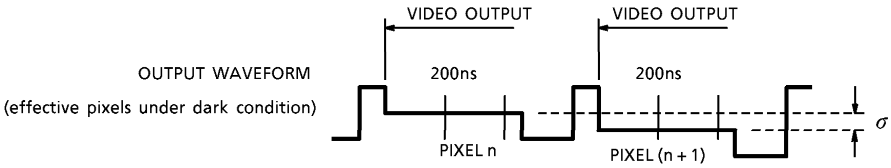
(Note 12)

1. DEFINITION

   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.

2. CALCULATION PROCEDURE

   The following is the calculation procedure of random noise.



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 period is 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).

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

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 the following.

$$\text{Random noise } (N_{D\sigma}) = \frac{1}{\sqrt{2}} \overline{\sigma}$$

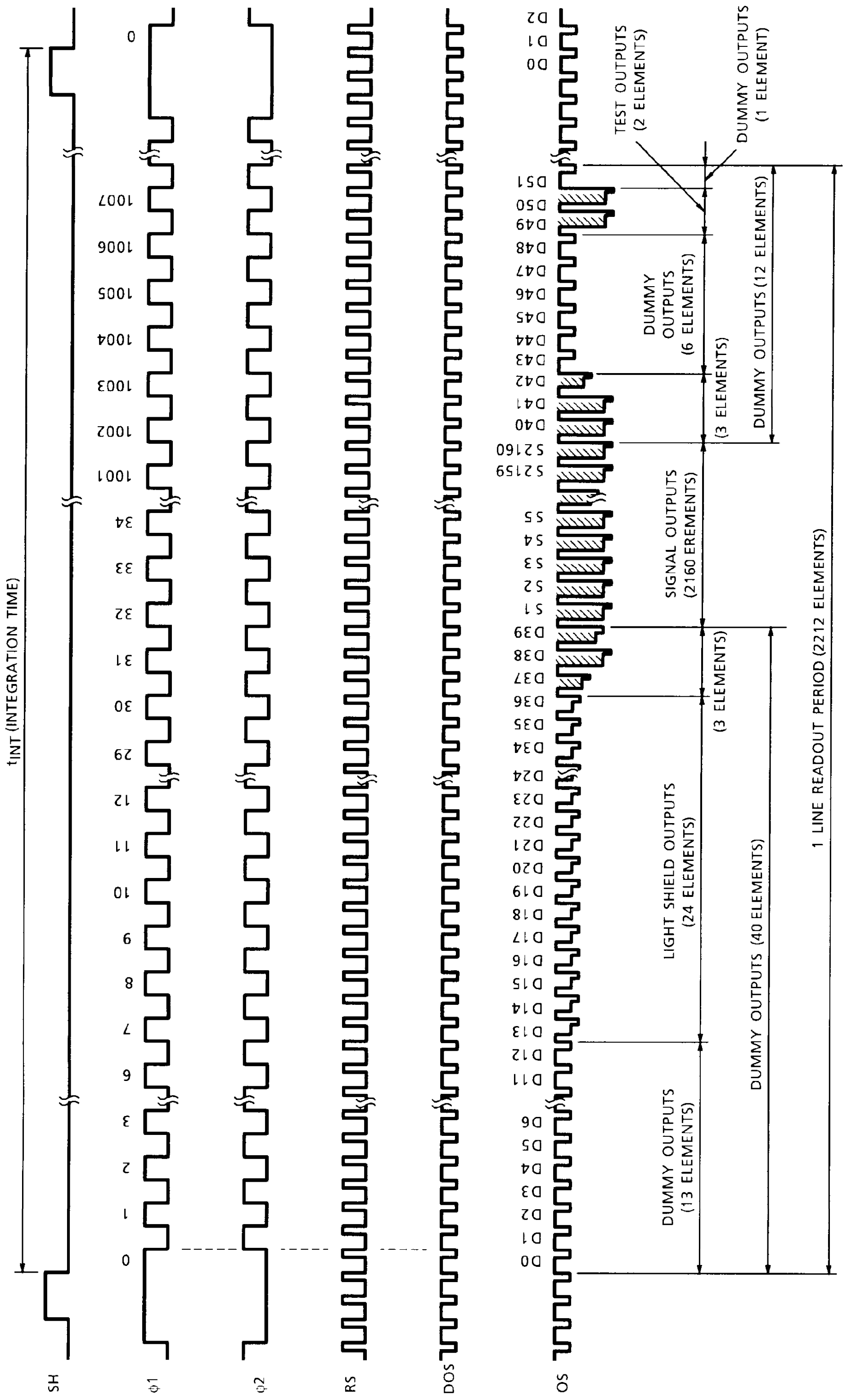
OPERATING CONDITION

CHARACTERISTIC		SYMBOL	MIN.	TYP.	MAX.	UNIT
Clock Pulse Voltage	"H" Level	$V\phi$	4.5	5	5.5	V
	"L" Level		0	0	0.3	
Shift Pulse Voltage	"H" Level	V_{SH}	4.5	5	5.5	V
	"L" Level		0	0	0.3	
Reset Pulse Voltage	"H" Level	V_{RS}	4.7	5	5.5	V
	"L" Level		0	0	0.3	
Power Supply Voltage		V_{OD}	4.7	5.0	5.3	V

CLOCK CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Clock Pulse Frequency	$f\phi$	0.15	0.5	1.0	MHz
Reset Pulse Frequency	f_{RS}	0.3	1.0	2.0	MHz
Clock Capacitance	$C\phi$	—	200	300	pF
Shift Gate Capacitance	C_{SH}	—	100	200	pF
Reset Gate Capacitance	C_{RS}	—	10	30	pF

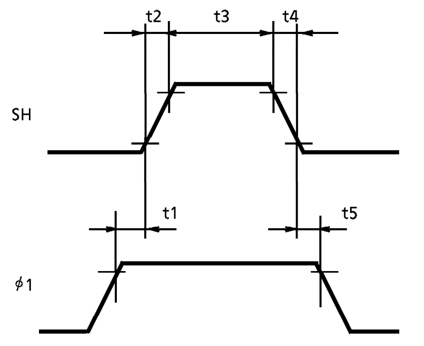
TIMING CHART



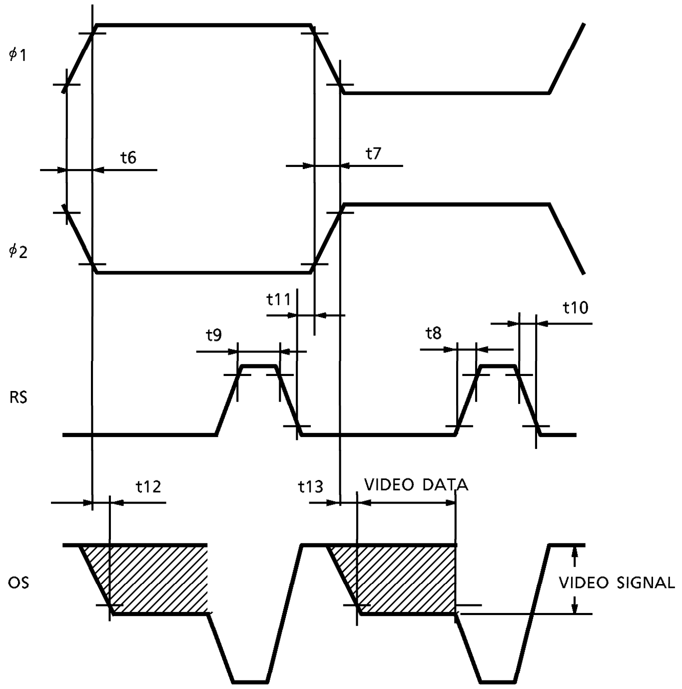
TCD1208AP—7

TIMING REQUIREMENS

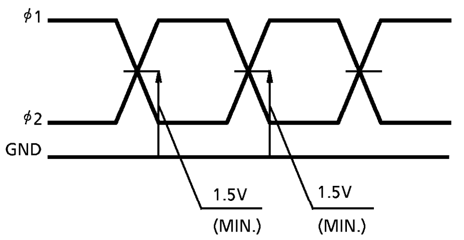
SH, $\phi 1$ Timing



$\phi 1$, $\phi 2$, RS, OS Timing



$\phi 1$, $\phi 2$ Cross Point



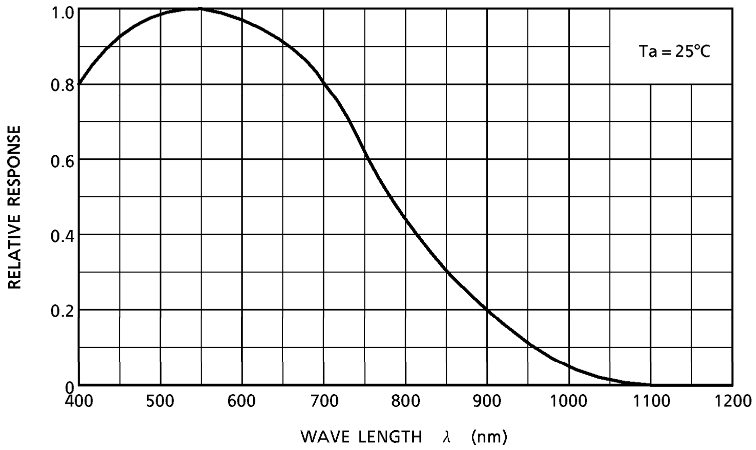
CHARACTERISTIC	SYMBOL	MIN.	TYP. (Note 13)	MAX.	UNIT
Pulse Timing of SH and $\phi 1$	t1, t5	0	100	—	ns
SH Pulse Rise Time, Fall Time	t2, t4	0	50	—	ns
SH Pulse Width	t3	500	1000	—	ns
$\phi 1$ $\phi 2$ Pulse Rise Time, Fall Time	t6, t7	0	60	100	ns
RS Pulse Rise Time, Fall Time	t8, t10	0	20	—	ns
RS Pulse Width	t9	40	250	—	ns
Pulse Timing of $\phi 1$, $\phi 2$ and RS	t11	230	—	—	ns
Video Data Delay Time (Note 14)	t12, t13	—	150	—	ns

(Note 13) TYP. is the case of $f_{RS} = 1MHz$

(Note 14) Load Resistance is $100k\Omega$

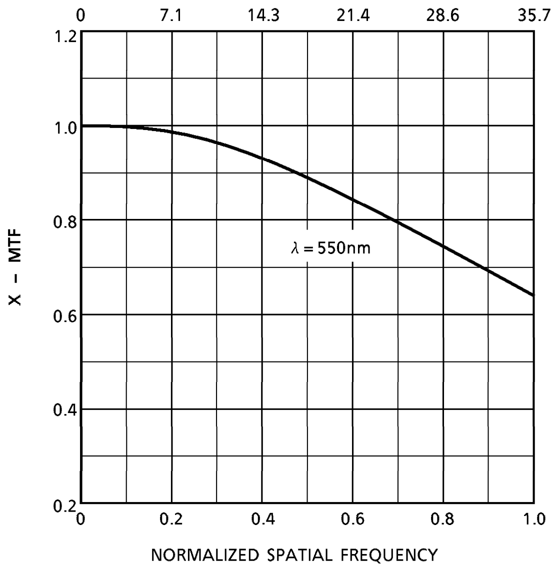
TYPICAL PERFORMANCE CURVES

SPECTRAL RESPONSE



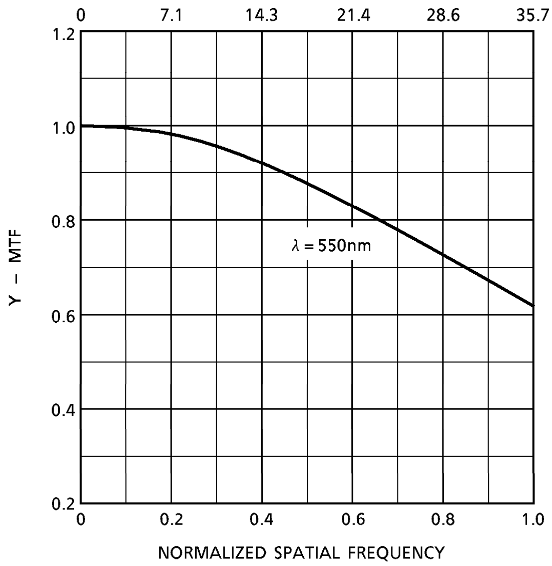
MODULATION TRANSFER FUNCTION
OF X-DIRECTION

SPATIAL FREQUENCY (Cycles / mm)



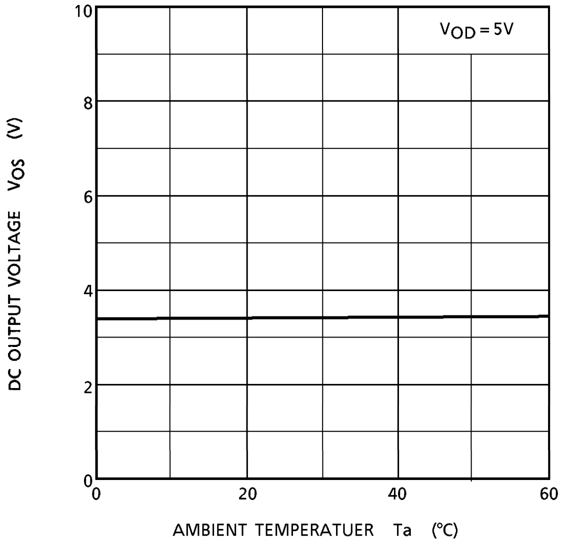
MODULATION TRANSFER FUNCTION
OF Y-DIRECTION

SPATIAL FREQUENCY (Cycles / mm)

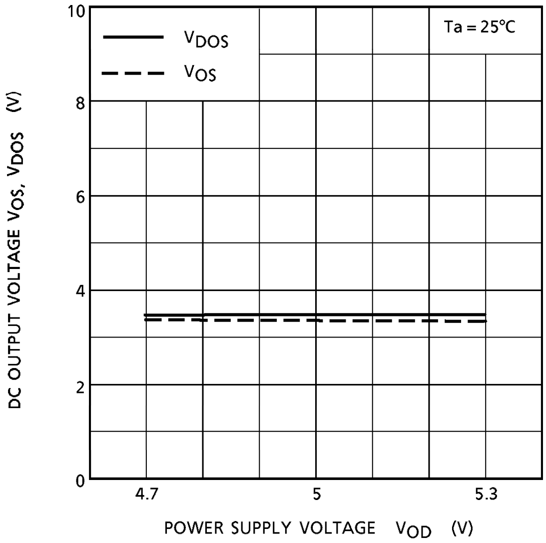


TYPICAL PERFORMANCE CURVES

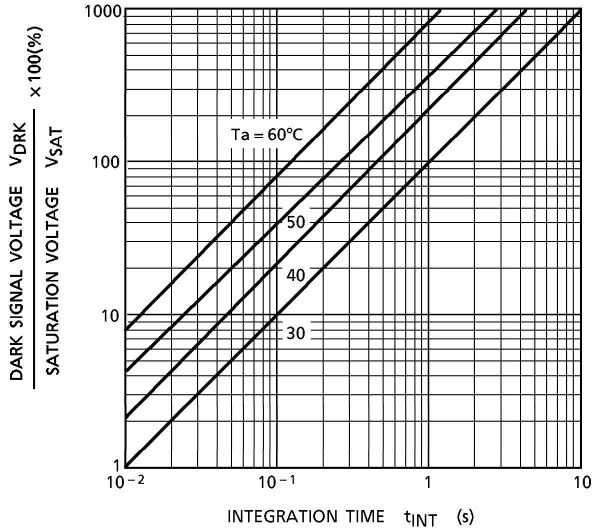
DC OUTPUT VOLTAGE – AMBIENT TEMPERATUER



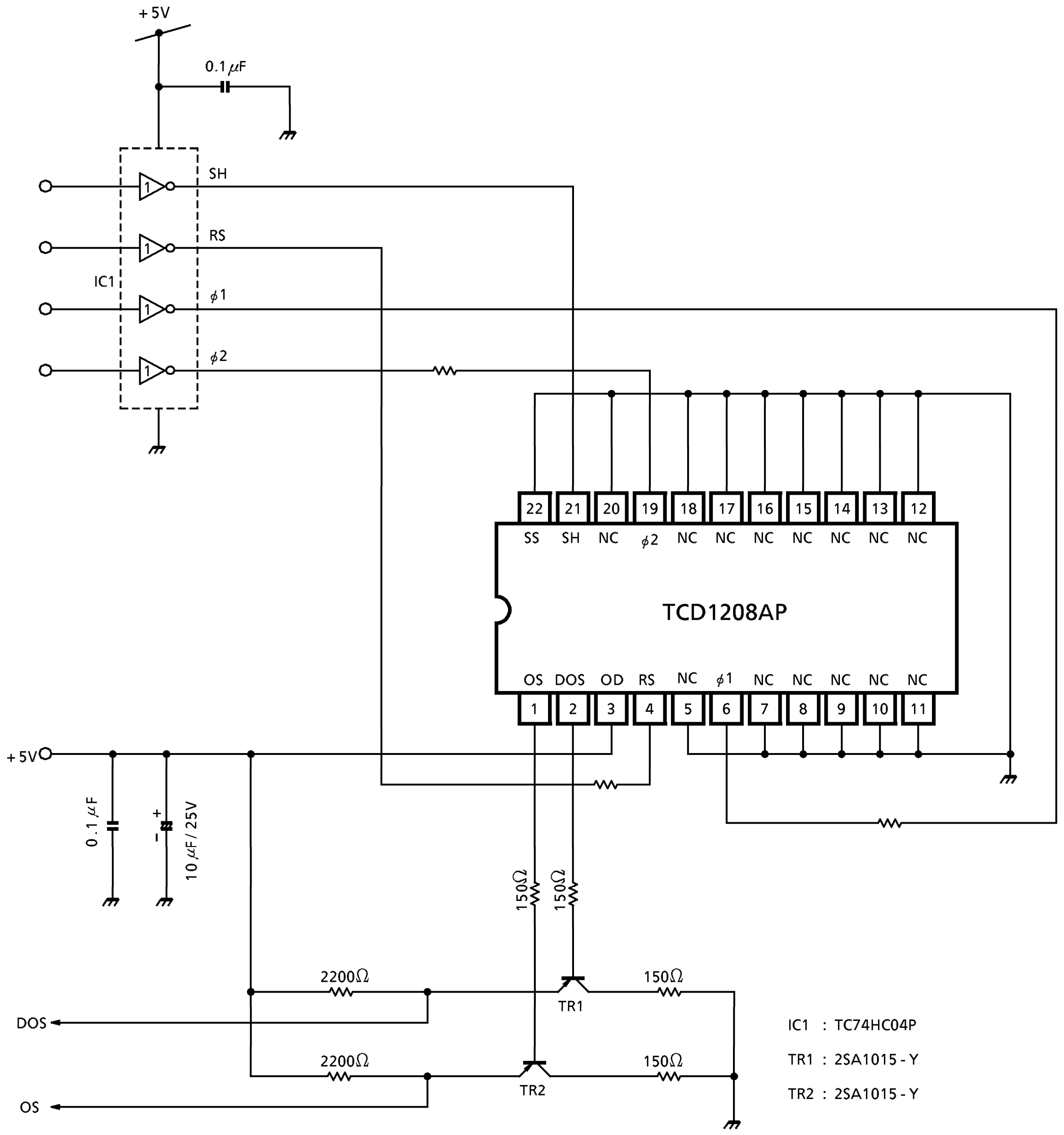
DC OUTPUT VOLTAGE – POWER SUPPLY VOLTAGE



DARK SIGNAL VOLTAGE – INTEGRATION TIME



TYPICAL DRIVE CIRCUIT



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.

3. Incident Light

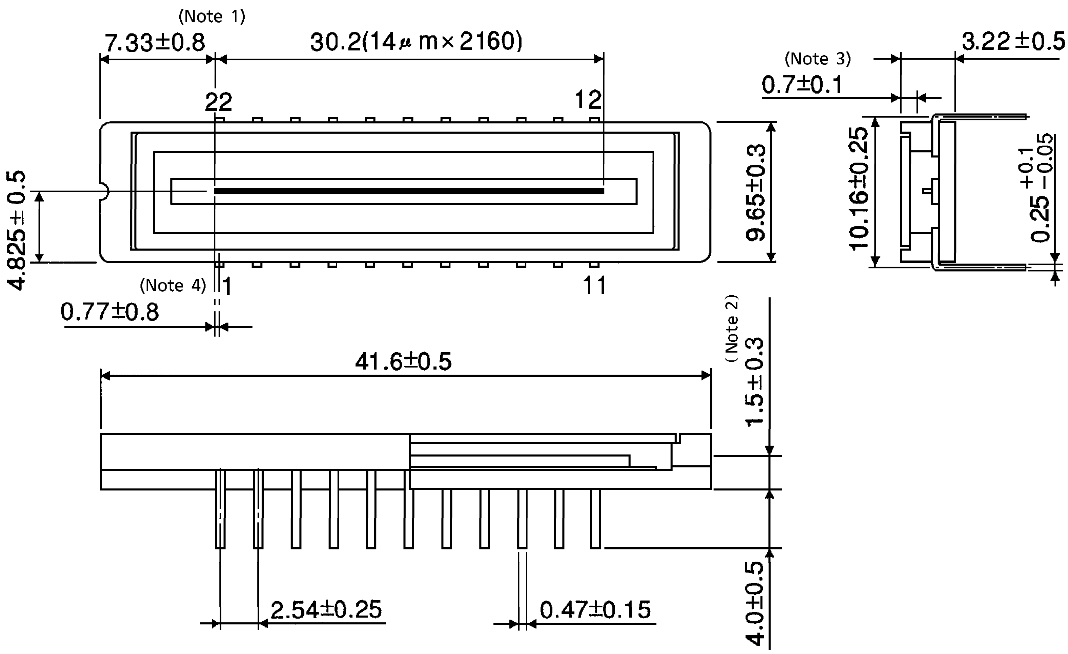
   CCD sensor is sensitive to infrared light.
   Note that infrared light component degrades resolution and PRNU of CCD sensor.

4. Lead Frame Forming

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

OUTLINE DRAWING
WDIP22-G-400-2.54A

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)
(Note 4) No. 1 SENSOR ELEMENT (S1) TO CENTER OF No. 1 PIN.

Weight : 2.7g (Typ.)