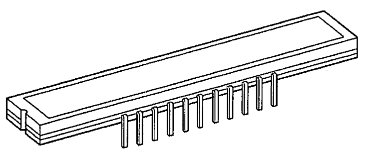
TOSHIBA CCD LINEAR IMAGE SENSOR CCD(Charge Coupled Device)

TCD1252AP

The TCD1252AP is a high sensitive and low dark current 2700−elements linear image sensor. The sensor can be used for facsimile, imagescanner and OCR. The device contains a row of 2700 photodiodes, which provide a 8 lines / mm (200 DPI) across a A3 size paper and a 12 lines / mm (300DPI) across a A4 size paper. The device is operated by 5V (pulse), and 12V power supply.


WDIP22-G-400-2.54A

Weight: 2.7g (Typ.)

FEATURES

- Number of Image Sensing Elements : 2700
- Image Sensing Element Size : 11μm by 11μm on 11μm centers
- Photo Sensing Region : High sensitive low dark current
- Clock : 2 phase (5V)
- Package : 22 pin DIP (T−CAPP)

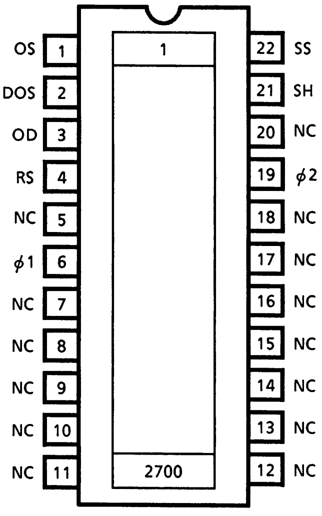
TOSHIBA−CCD−ADVANCED−PLASTIC-PACKAGE

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).

PIN CONNECTION



(TOP VIEW)

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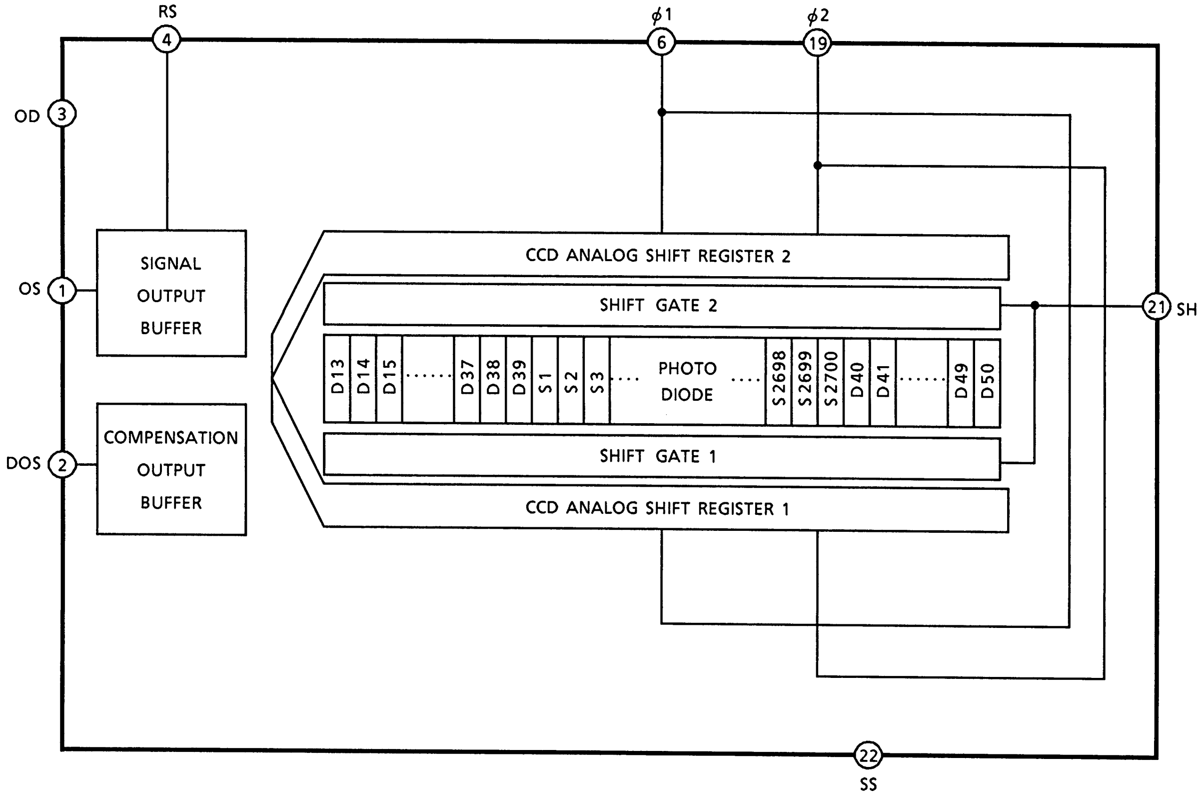
CIRCUIT DIAGRAM



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_{φ} = V_{SH} = V_{RS} = 5V (PULSE), f_{φ} = 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	44	63	82	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}	1.0	1.5	—	V	(Note 5)
Saturation Exposure	SE	—	0.02	—	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	—	35	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}	2.5	3.5	4.5	V	(Note 9)
DC Compensation Output Voltage	V_{DOS}	2.5	3.5	4.5	V	(Note 9)
DC Mismach Voltage	$\|V_{OS}-V_{DOS}\|$	—	50	100	mV	(Note 9)
Random Noise	ND_{σ}	—	1.5	—	mV	(Note 11)

Note 2: Sensitivity for 2856K W−Lamp is 105V / lx·s (Typ.)
Sensitivity for LED (567nm) is 22.7V / lx·s (Typ.)

Note 3: Measured at 50% of SE (Typ.)

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

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

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

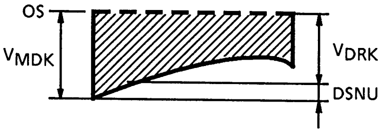
$$\mathrm{RI} = \frac{\sum_{n=1}^{2699} |\chi n - \chi n+1|}{2699 \times \bar{\chi}} \times 100(\%)$$

Where χ n and χ n+1 are signal outputs of each pixel. $\bar{\chi}$ V 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 : = $\frac{V_{SAT}}{R}(\mathrm{lx \cdot s})$

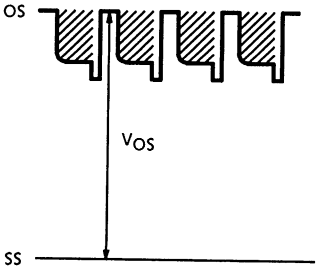
Note 7: V_{DRK} is defined as average dark signal voltage of all effective pixels. DSNU is defined as different voltage between V_{DRK} and V_{MDK} when V_{MDK} is maximum dark signal voltage.

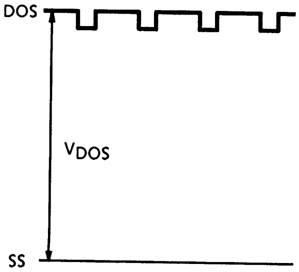


Note 8: Definition of DR : $DR = \frac{V_{SAT}}{V_{DRK}}$

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

Note 9: DC signal output voltage and DC compensation output voltage are defined as follows:





VDD = 4.7V DC Mismatch Voltage.

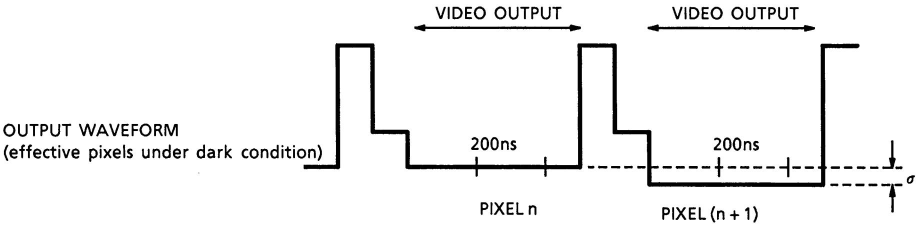
Note 10: PRNU (3) is defined as maximum voltage with next pixel where measured 5% of SE (Typ.).

Note 11:

1. DEFINITION

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

2. CALCULATION PROCEDUREThe 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 periodto 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).

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

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 the following.

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

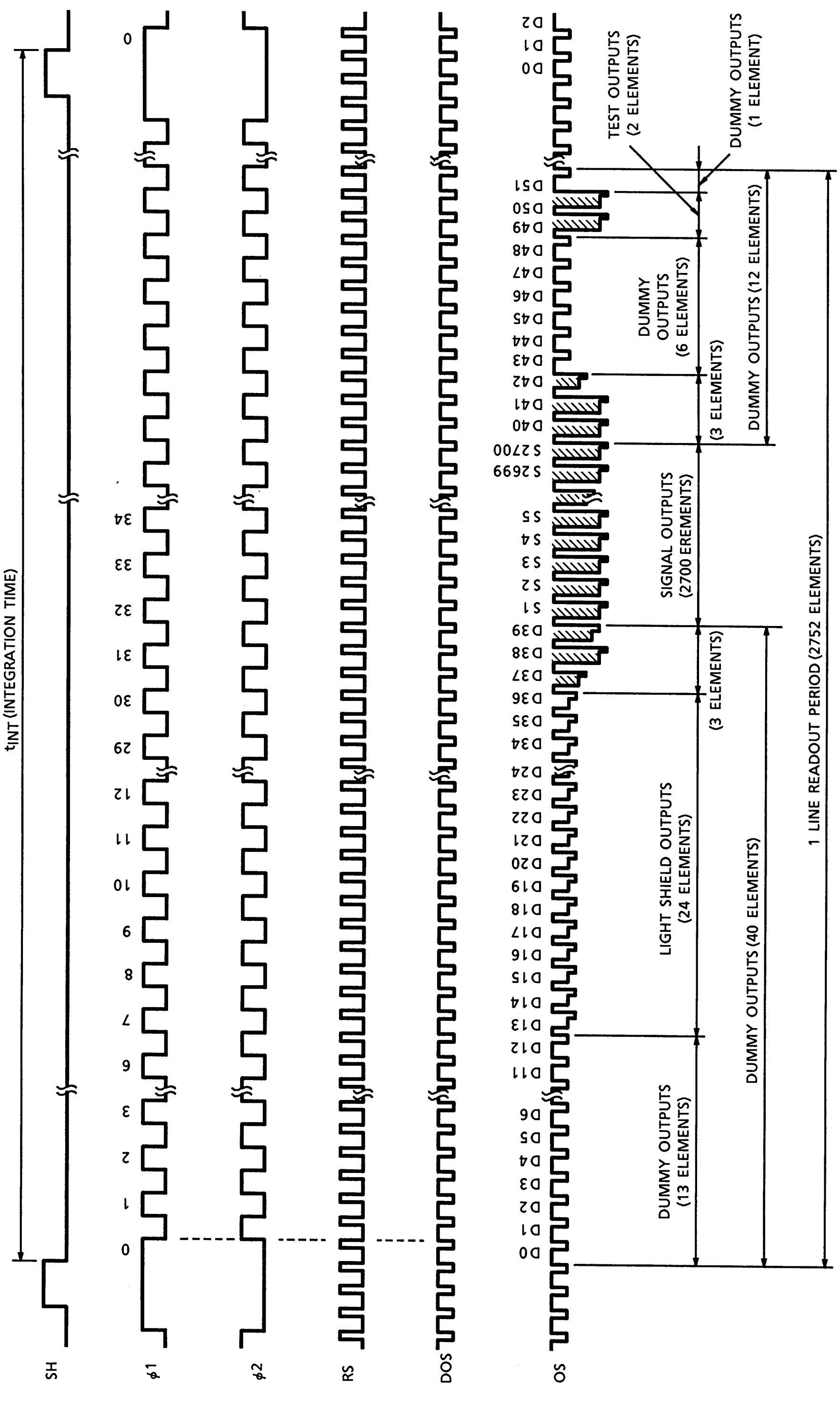
OPERATING CONDITION

CHARACTERISTIC		SYMBOL	MIN	TYP.	MAX	UNIT
Clock Pulse Voltage	"H" Level	V_φ	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_{DD}	4.7	5.0	5.3	V

CLOCK CHARACTERISTICS (Ta = 25°C)

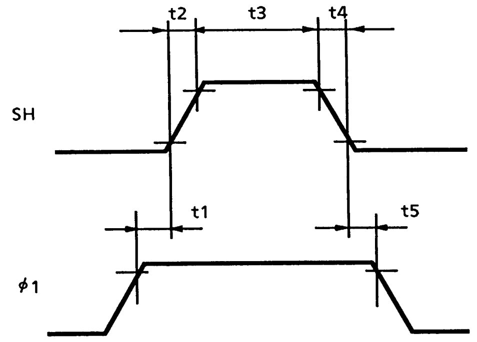
CHARACTERISTIC	SYMBOL	MIN	TYP.	MAX	UNIT
Clock Pulse Frequency	f_φ	0.15	0.5	1.5	MHz
Reset Pulse Frequency	f_{RS}	0.3	1	3	MHz
Clock Capacitance	C_φ	—	200	300	pF
Shift Gate Capacitance	C_{SH}	—	100	200	pF
Reset Gate Capacitance	C_{RS}	—	10	30	pF

TIMING CHART

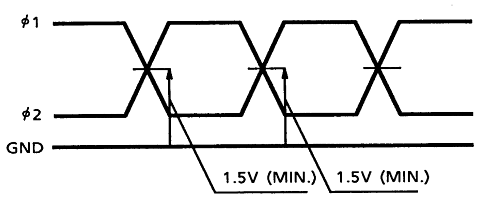


TIMING REQUIREMENTS

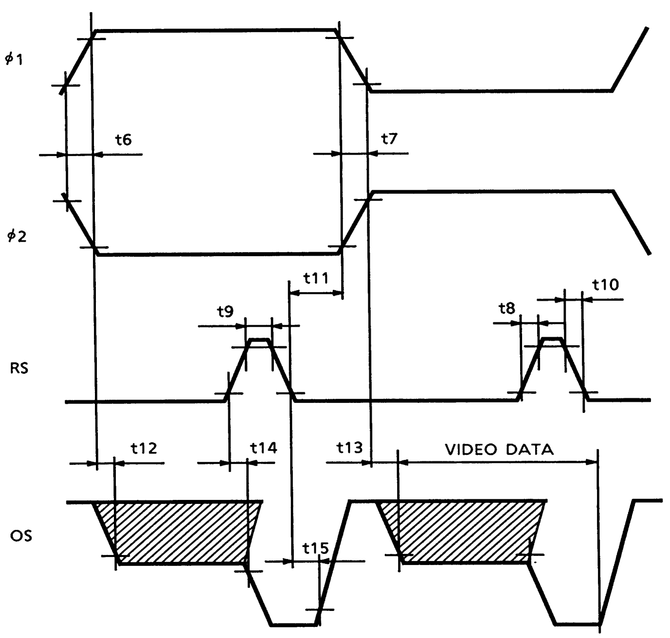
SH, φ1 Timing



φ1, φ2 Cross Point



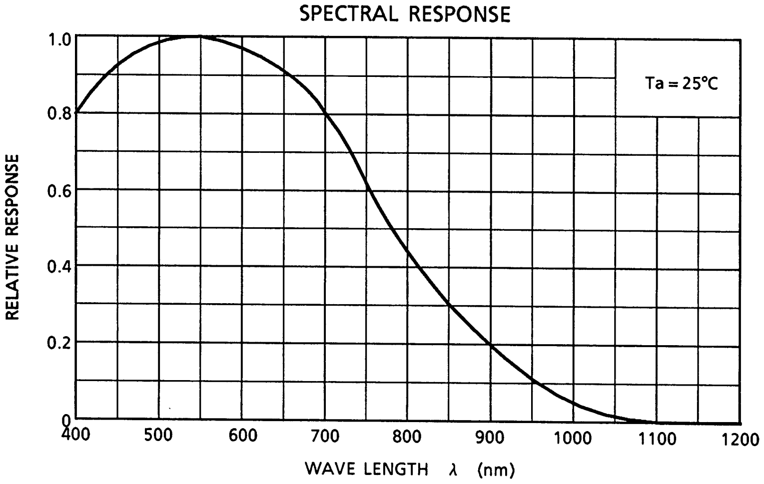
φ1, φ2, RS, OS Timing

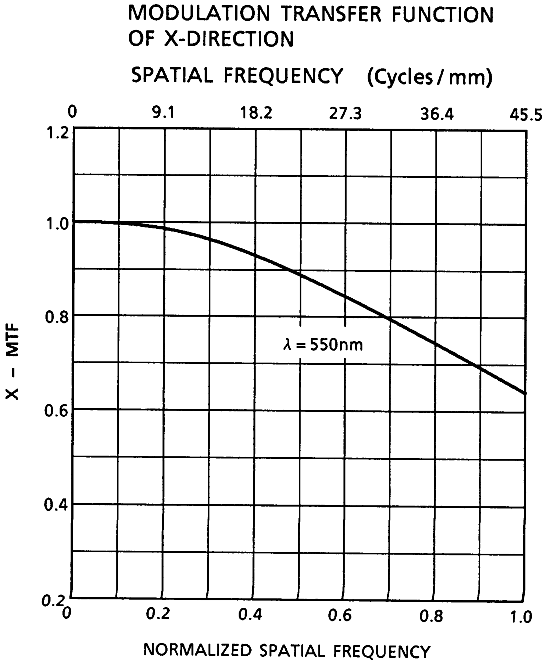


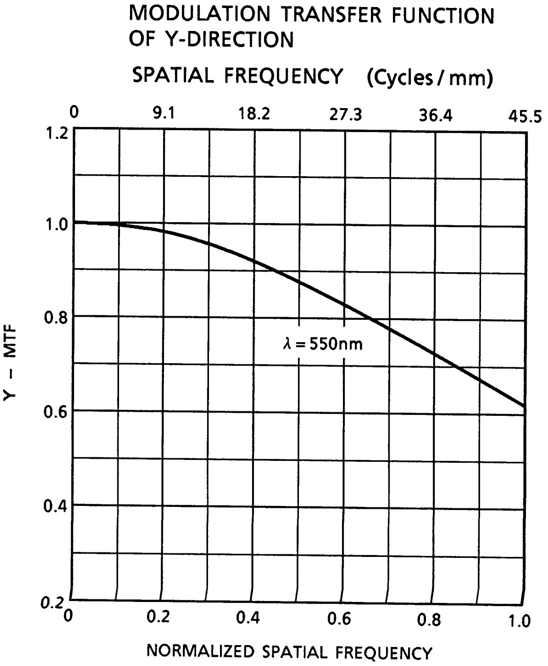
CHARACTERISTIC	SYMBOL	MIN	TYP. (Note12)	MAX	UNIT
Pulse Timing of SH and φ1 (Note 14)	t1, t5	500	1000	—	ns
SH Pulse Rise Time, Fall Time	t2, t4	0	50	—	ns
SH Pulse Width (Note 14)	t3	1000	2000	—	ns
φ1, φ2 Pulse Rise Time, Fall Time	t6, t7	0	100	—	ns
RS Pulse Rise Time, Fall Time	t8, t10	0	20	60	ns
RS Pulse Width	t9	40	250	—	ns
Pulse Timing ofφ1, φ2 and RS	t11	230	—	—	ns
Video Data Delay Time (Note 13)	t12, t13	—	120	—	ns
RS Noise Delay Time	t14	—	10	—	ns
	t15	—	200	—	ns

Note 12: TYP. is the case of f_{RS}=1MHz
Note 13: Load Resistance is 100kΩ
Note 14: This condition is SHR=0Ω

TYPICAL PERFORMANCE CURVES

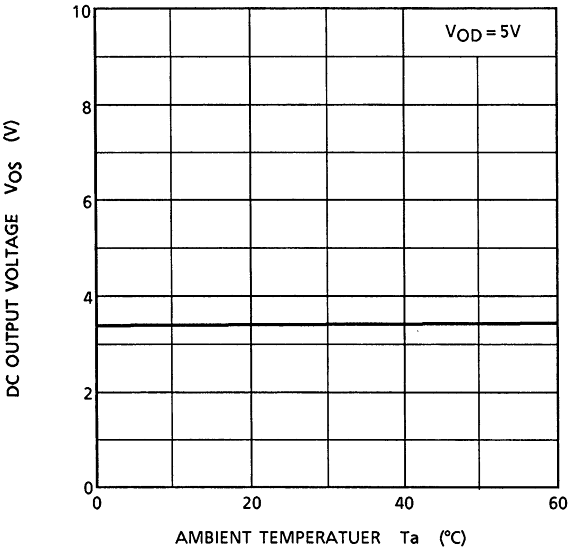




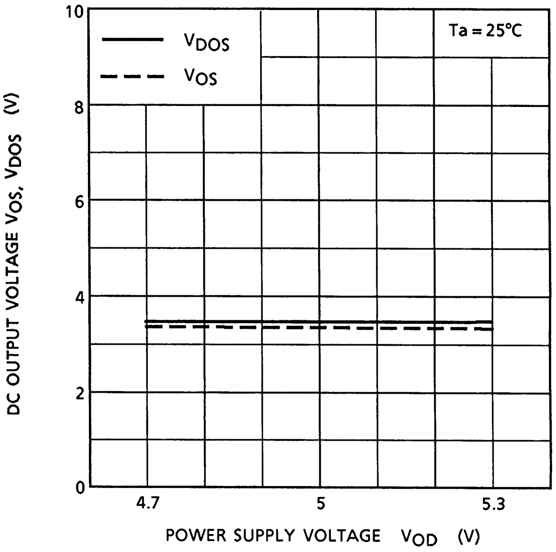


TYPICAL PERFOMANCE CURVES

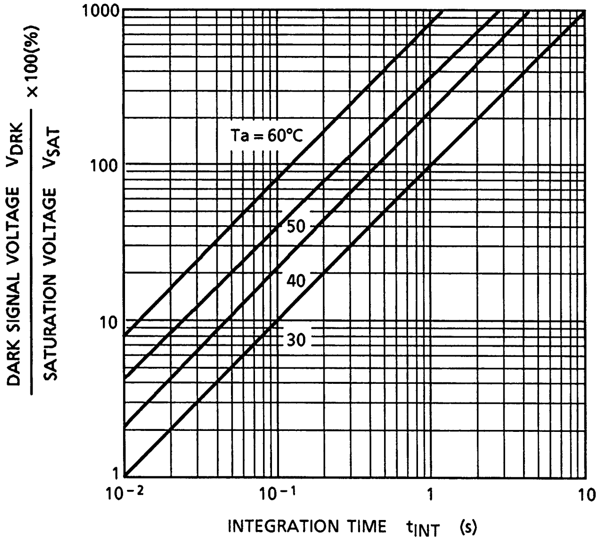
DC OUTPUT VOLTAGE – AMBIENT TEMPERATUER



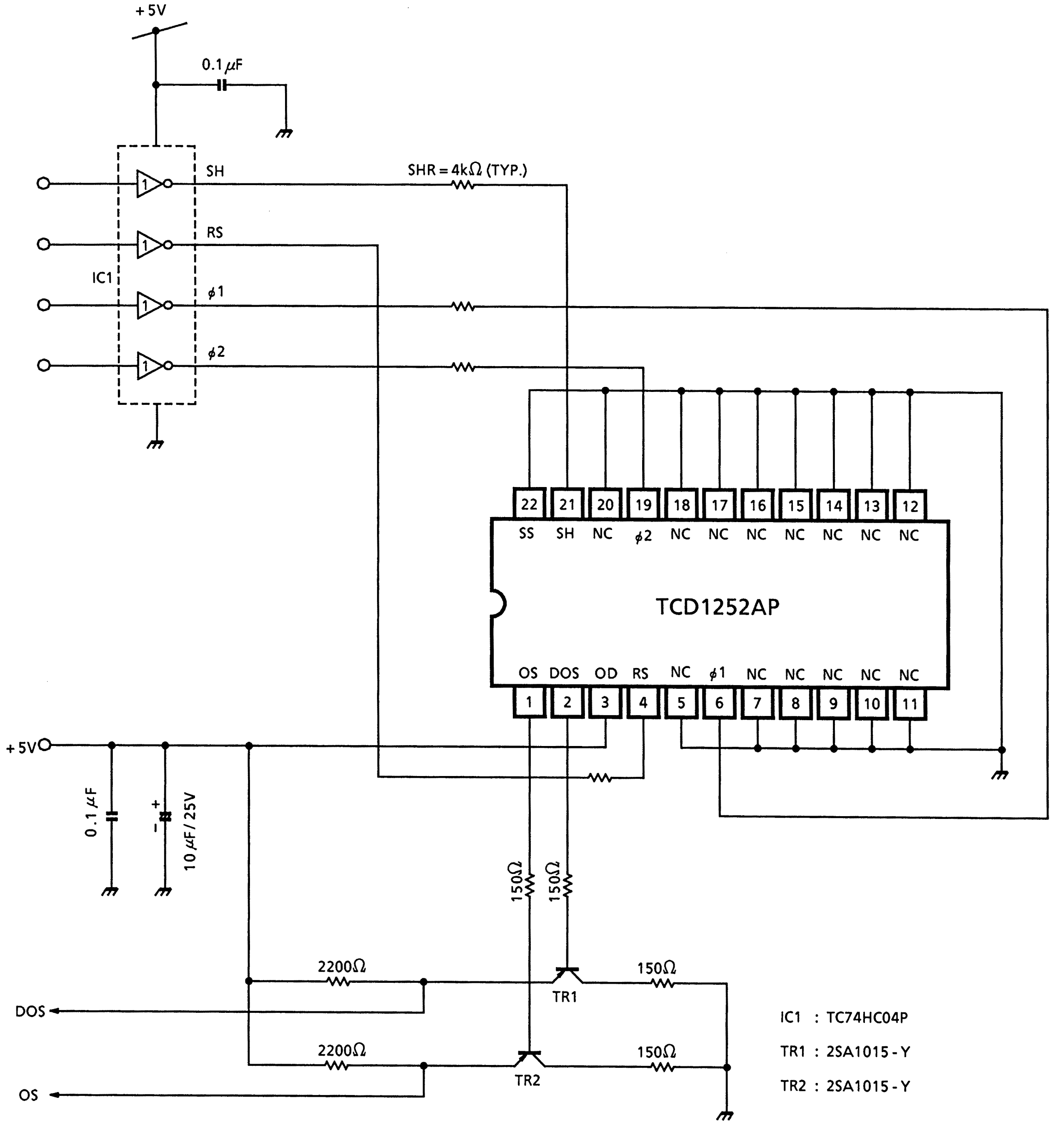
DC OUTPUT VOLTAGE – POWER SUPPLY VOLTAGE



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.

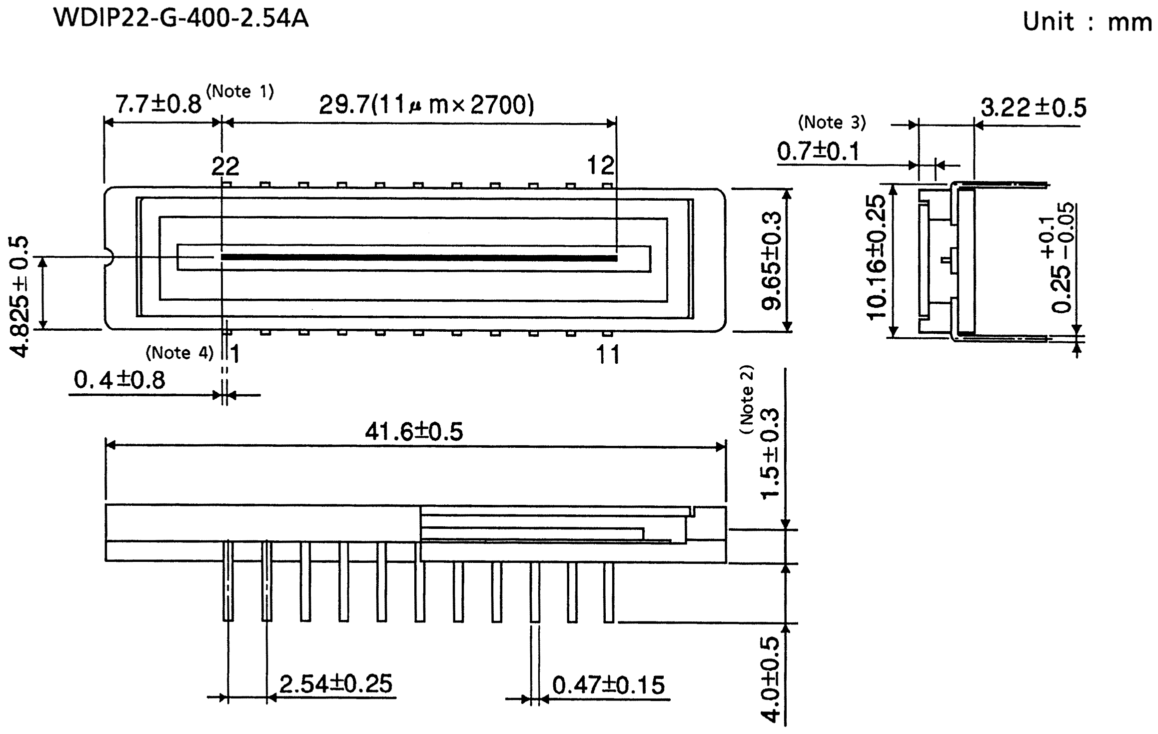
3. Incident Light

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 strong against mechanical stress, you should not reform the lead frame.
We recommend to use a IC−inserter when you assemble to PCB.

PACKAGE DIMENSIONS



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.)