

TOSHIBA CCD LINEAR IMAGE SENSOR CCD(Charge Coupled Device)

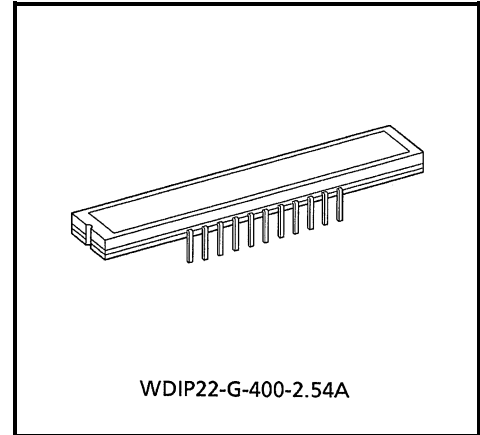
# TCD1252AP

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.

## 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



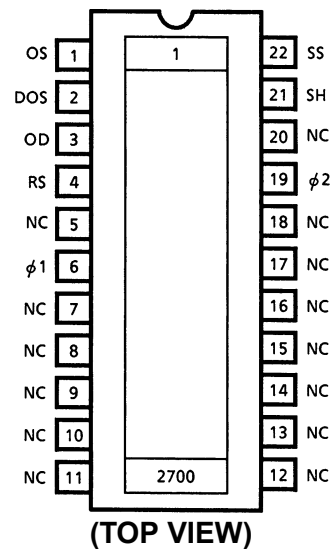
Weight: 2.7g (Typ.)

## MAXIMUM RATINGS (Note 1)

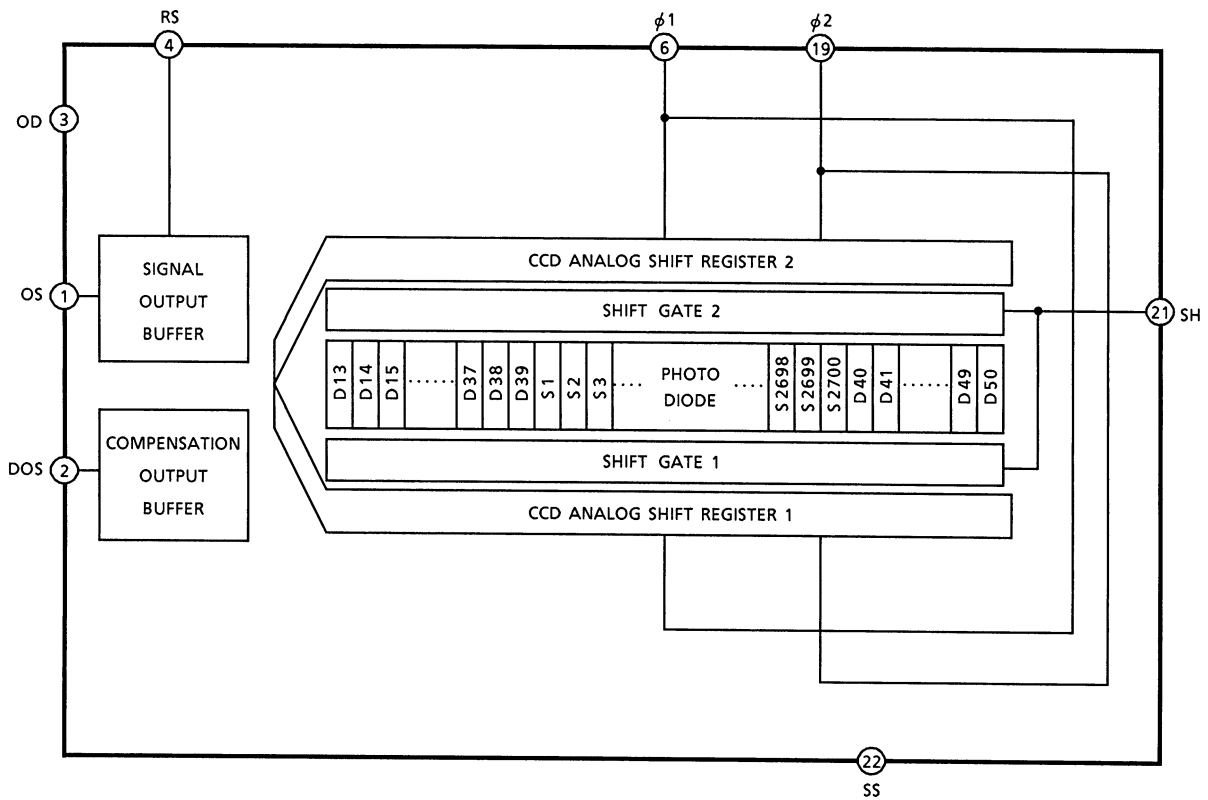
CHARACTERISTIC	SYMBOL	RATING	UNIT
Clock Pulse Voltage	$V_{\phi}$	-0.3~8	V
Shift Pulse Voltage	$V_{SH}$		
Reset Pulse Voltage	$V_{RS}$		
Power Supply Voltage	$V_{OD}$		
Operating Temperature	$T_{opr}$	-25~60	°C
Storage Temperature	$T_{stg}$	-40~100	°C

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

## PIN CONNECTION



## CIRCUIT DIAGRAM



## PIN NAMES

$\phi 1$	Clock (Phase 1)
$\phi 2$	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<sub>OD</sub> = 5V, V<sub>φ</sub> = V<sub>SH</sub> = V<sub>RS</sub> = 5V (PULSE), f<sub>φ</sub> = 0.5MHz, f<sub>RS</sub> = 1MHz),  
**LOAD RESISTANCE=100kΩ, t<sub>INT</sub> (INTEGRATION TIME) = 10ms LIGHT SOURCE = DAYLIGHT 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 <sub>SAT</sub>	1.0	1.5	—	V	(Note 5)
Saturation Exposure	SE	—	0.02	—	lx·s	(Note 6)
Dark Signal Voltage	V <sub>DRK</sub>	—	2	6	mV	(Note 7)
Dark Signal Non Uniformity	DSNU	—	3	7	mV	(Note 7)
DC Power Dissipation	P <sub>D</sub>	—	35	100	mW	
Total Transfer Efficiency	TTE	92	—	—	%	
Output Impedance	Z <sub>O</sub>	—	—	1	kΩ	
Dynamic Range	DR	—	750	—	—	(Note 8)
DC Signal Output Voltage	V <sub>OS</sub>	2.5	3.5	4.5	V	(Note 9)
DC Compensation Output Voltage	V <sub>DOS</sub>	2.5	3.5	4.5	V	(Note 9)
DC Mismatch Voltage	V <sub>OS</sub> -V <sub>DOS</sub>	—	50	100	mV	(Note 9)
Random Noise	ND <sub>σ</sub>	—	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.)

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

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

Note 4: Measured at 50% of SE (Typ.)

RI is defined as follows:

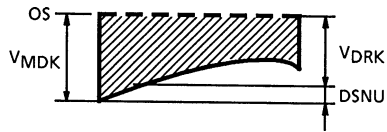
$$\text{RI} = \frac{\sum_{n=1}^{2699} |\chi^n - \chi^{n+1}|}{2699 \times \bar{\chi}} \times 100(\%)$$

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

Note 5: V<sub>SAT</sub> is defined as minimum saturation output voltage of all effective pixels.

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

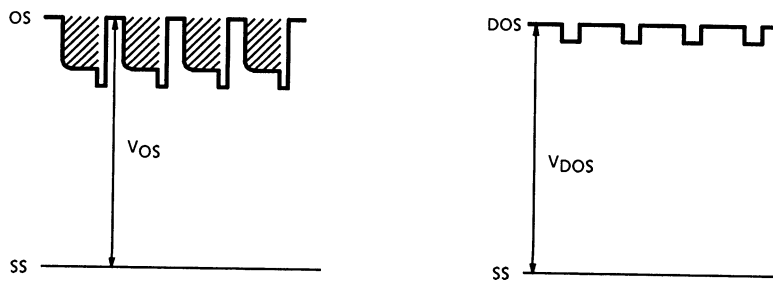
Note 7:  $V_{DRK}$  is defined as average dark signal voltage of all effective pixels.  $DSNU$  is defined as different voltage between  $V_{DRK}$  and  $V_{MDK}$  when  $V_{MDK}$  is maximum dark signal voltage.



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:



$V_{DD} = 4.7V$  DC Mismatch Voltage.

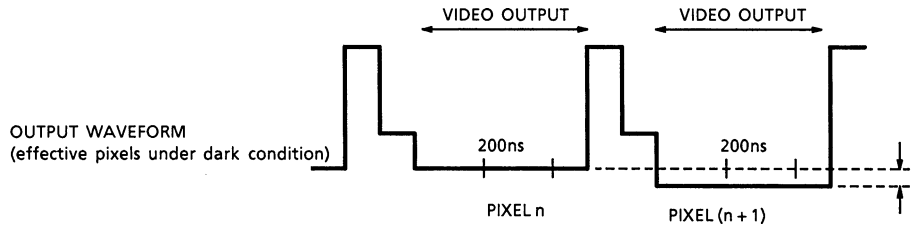
Note 10: PRNU (3) is defined as maximum voltage with next pixel where measured 5% of SE (Typ.).

Note 11:

1. DEFINITION

Random noise is defined as the standard deviation (sigma) of the output level 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  $V_n$  and  $V_{n+1}$ .
- 3)  $V_{n+1}$  is subtracted from  $V_n$  to get  $\Delta V$ .  

$$\Delta V = V_n - V_{n+1}$$
- 4) The standard deviation of  $\Delta V$  is calculated after procedure 2) and 3) are repeated 30 times (30 readings).

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

- 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 the following.

$$\text{Random noise } (N_D \sigma) = \frac{1}{\sqrt{2}} \bar{\sigma}$$

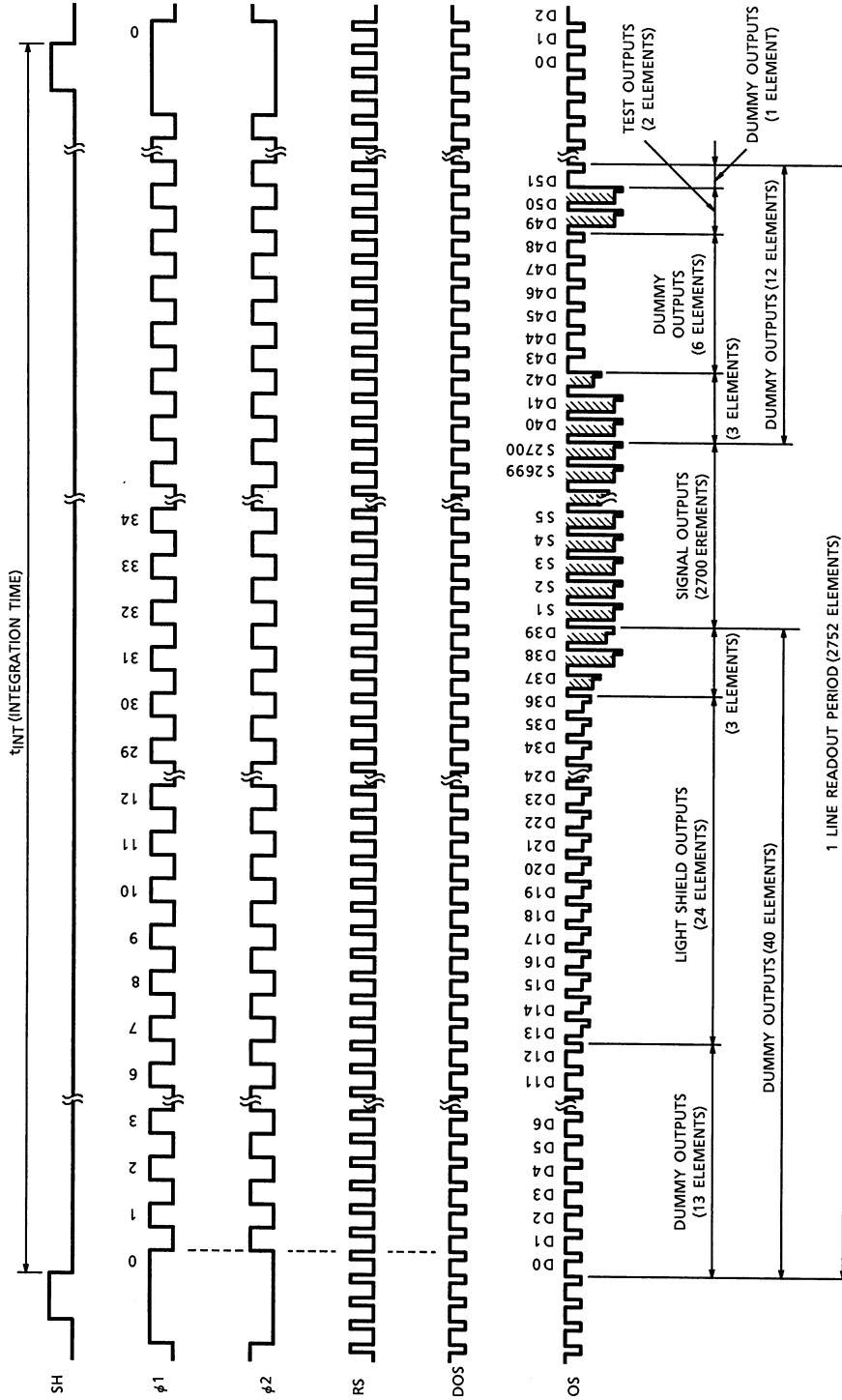
## OPERATING CONDITION

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		$V_{DD}$	4.7	5.0	5.3	V

## CLOCK CHARACTERISTICS (Ta = 25°C)

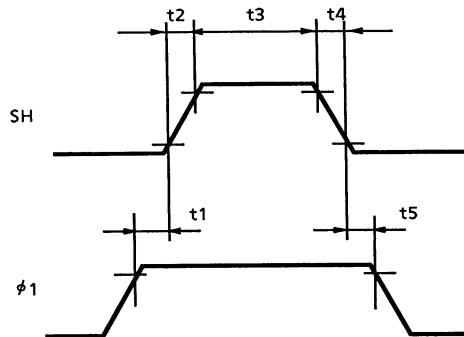
CHARACTERISTIC	SYMBOL	MIN	TYP.	MAX	UNIT
Clock Pulse Frequency	$f_{\phi}$	0.15	0.5	1.5	MHz
Reset Pulse Frequency	$f_{RS}$	0.3	1	3	MHz
Clock Capacitance	$C_{\phi}$	—	200	300	pF
Shift Gate Capacitance	$C_{SH}$	—	100	200	pF
Reset Gate Capacitance	$C_{RS}$	—	10	30	pF

TIMING CHART

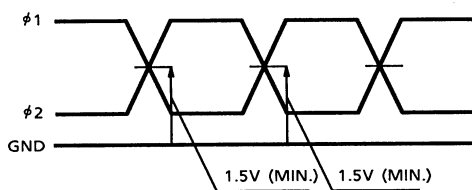


## TIMING REQUIREMENTS

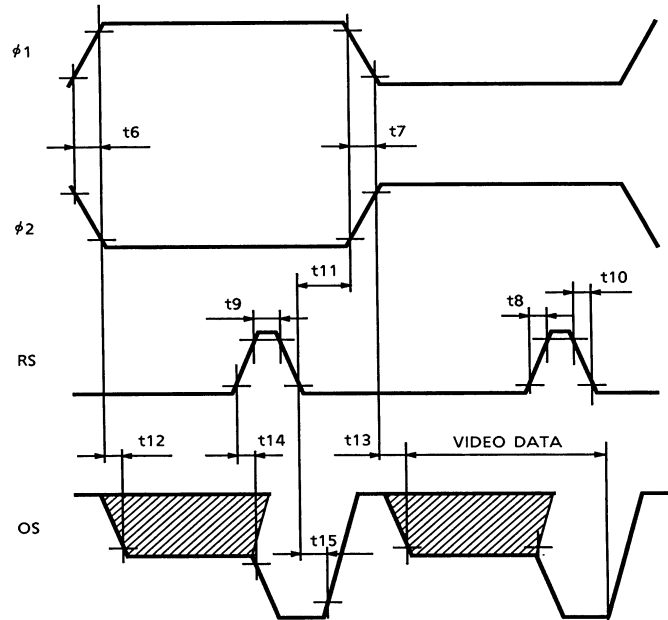
### SH, $\phi 1$ Timing



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



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



CHARACTERISTIC	SYMBOL	MIN	TYP. (Note12)	MAX	UNIT
Pulse Timing of SH and $\phi 1$ (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
$\phi 1$ , $\phi 2$ 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 of $\phi 1$ , $\phi 2$ 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

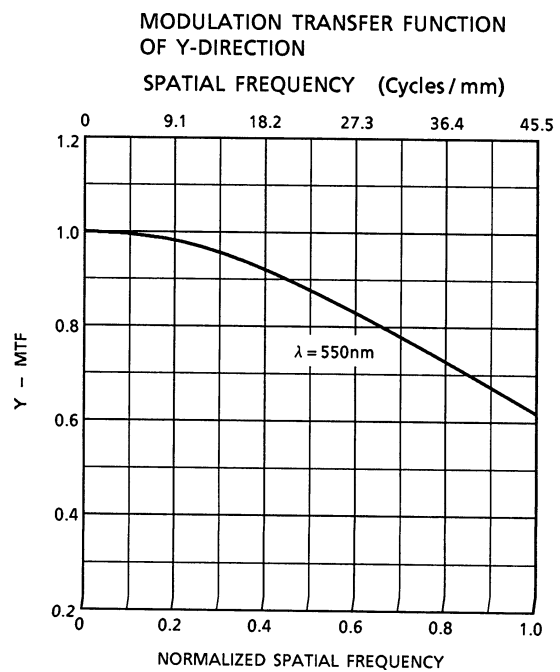
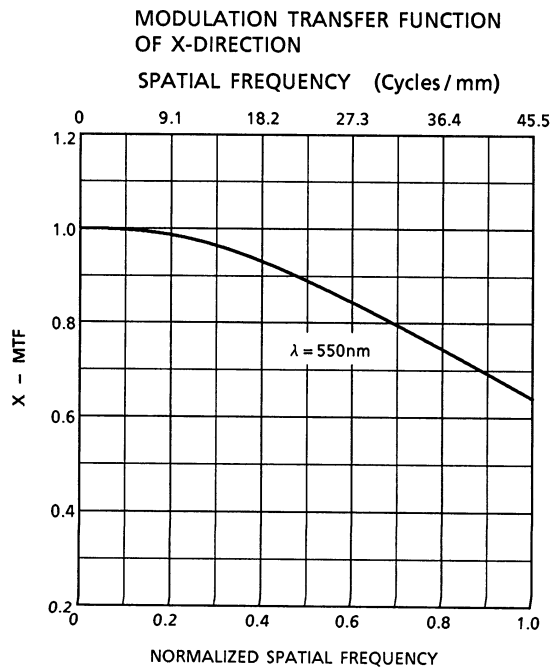
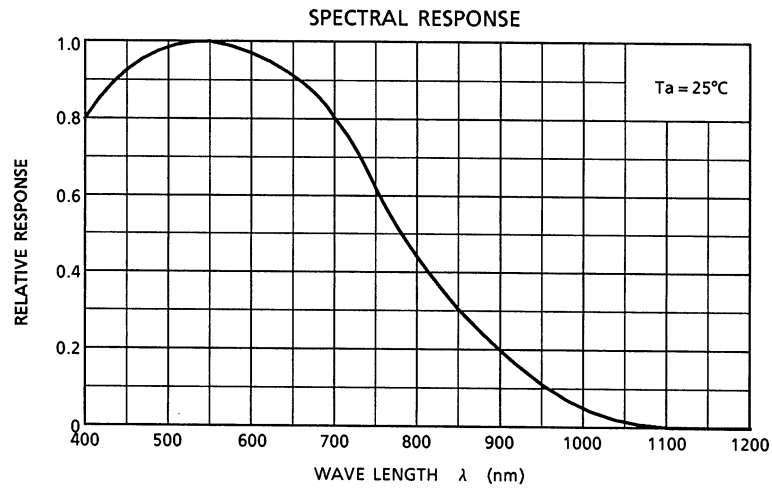
Note 12: TYP. is the case of  $f_{RS}=1\text{MHz}$

Note 13: Load Resistance is  $100\text{k}\Omega$

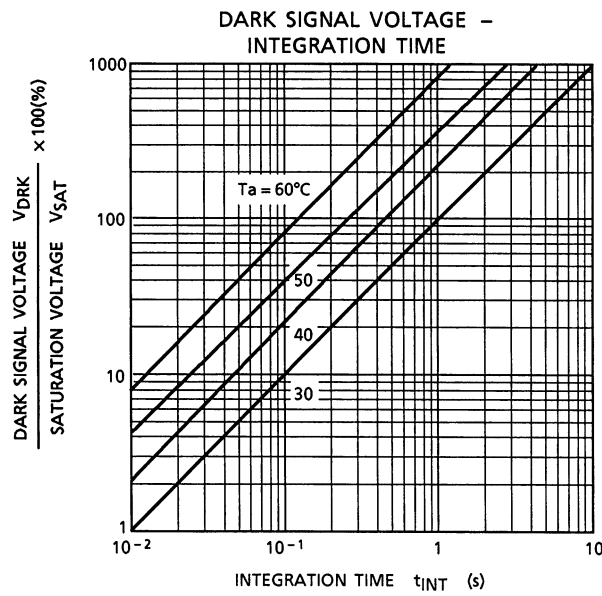
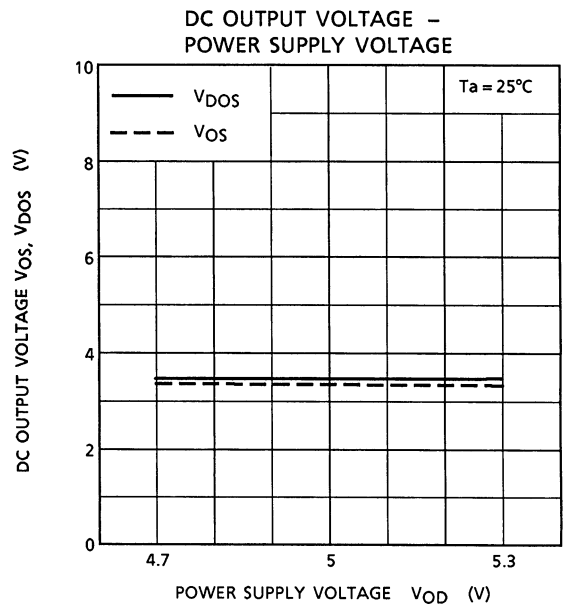
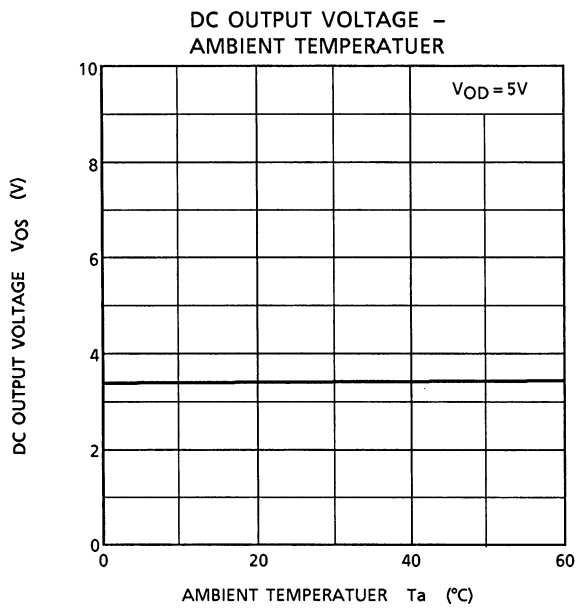
Note 14: This condition is  $\text{SHR}=0\Omega$



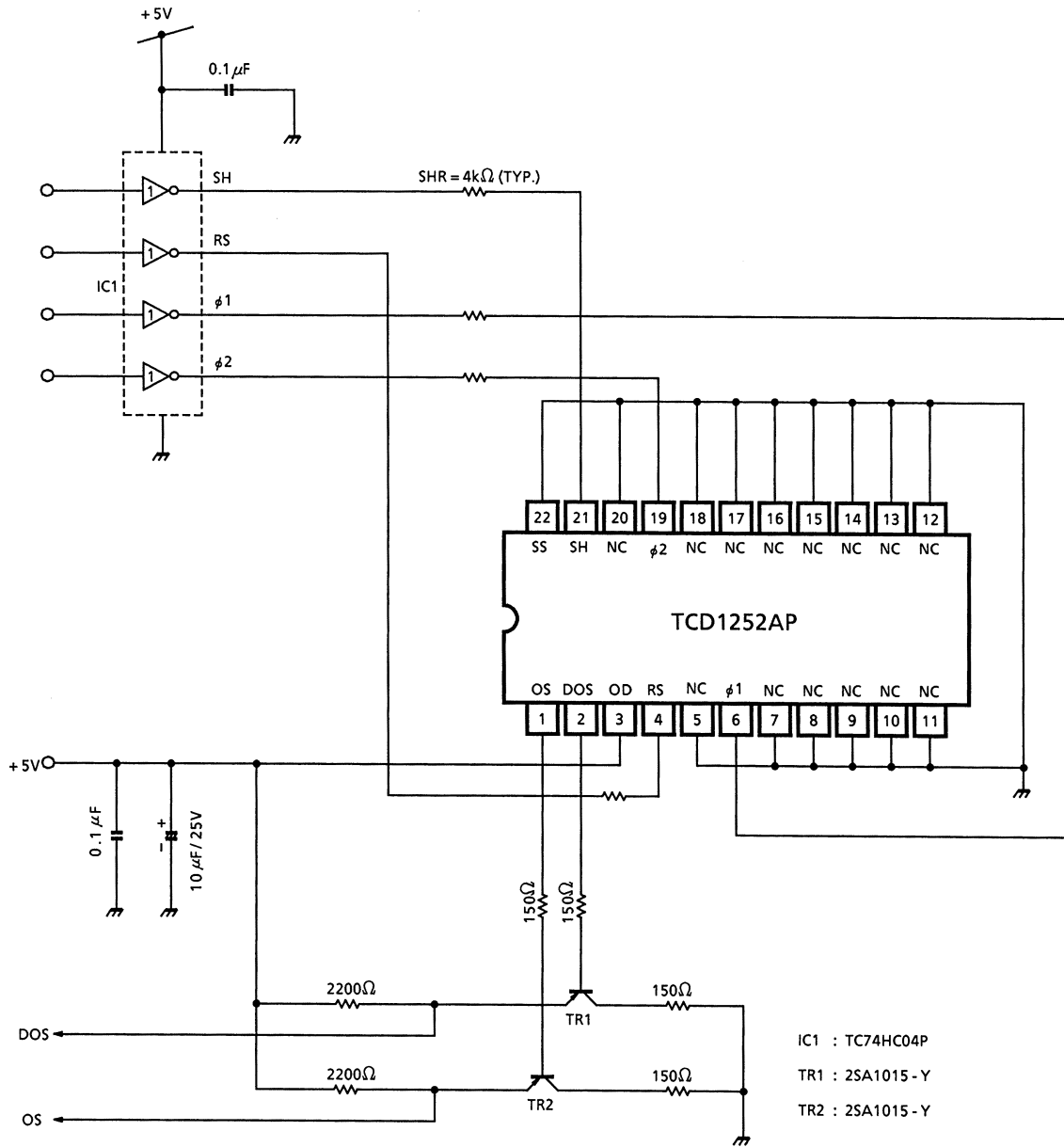
## TYPICAL PERFORMANCE CURVES



**TYPICAL PERFORMANCE CURVES**



## 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<sub>2</sub>. 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**

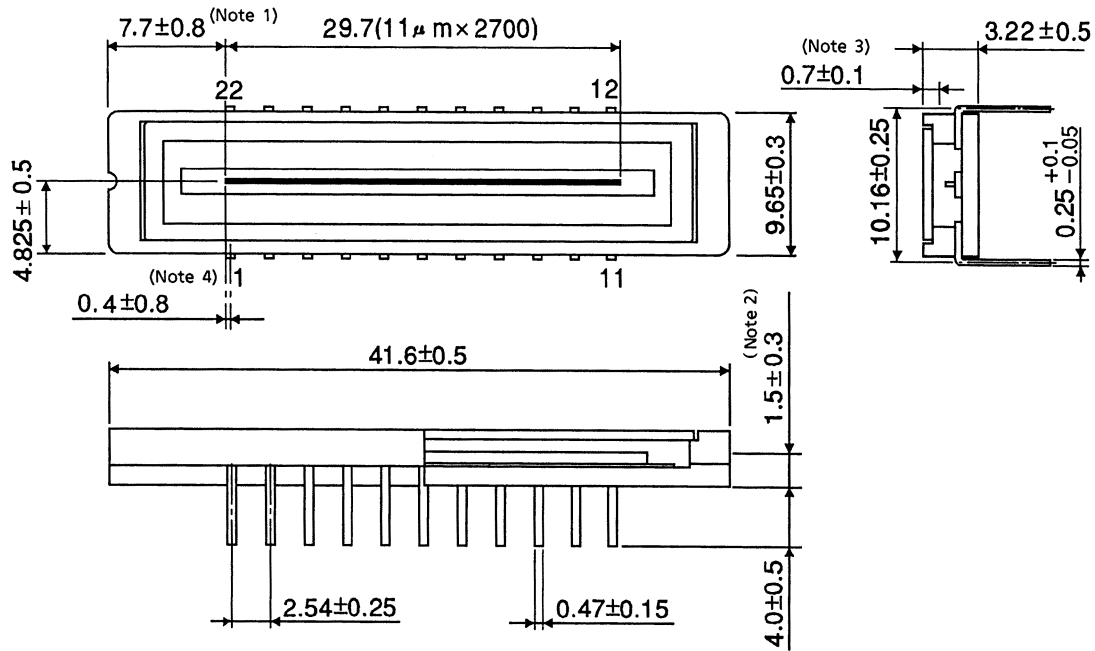
Soldering by the solder flow method cannot be guaranteed because this method may have deleterious effects on prevention of window glass soiling and heat resistance.

Using a soldering iron, complete soldering within ten seconds for lead temperatures of up to 260°C, or within three seconds for lead temperatures of up to 350°C.

**PACKAGE DIMENSIONS**

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.)

**RESTRICTIONS ON PRODUCT USE**

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