

TOSHIBA**TCD2502C-1**

TOSHIBA CCD LINEAR IMAGE SENSOR CCD(Charge Coupled Device)

TCD2502C-1

The TCD2502C-1 is a high sensitive and low dark current 5000 elements × 3 lines CCD color image sensor.

The sensor is designed for digital color copying machine and color scanner.

The device contains a row of 5000 elements × 3 lines photodiodes which provide a 16 lines/mm across a A3 size paper. The device is operated by 5V pulse, and 12 V power supply.

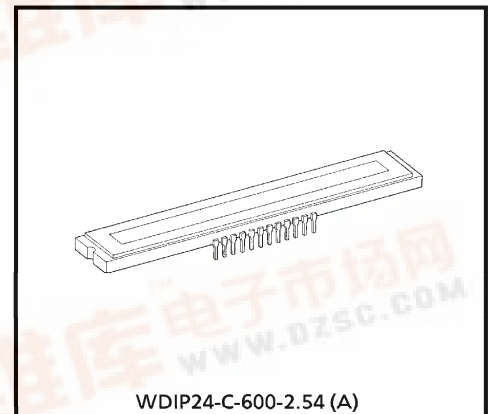
FEATURES

- Number of Image Sensing Elements : 5000 elements × 3 lines
- Image Sensing Element Size : 14 μm by 14 μm on 14 μm centers
- Photo Sensing Region : High sensitive pn photodiode
- Distance Between Photodiode Array : 84 μm (6 Lines)
- Clock : 2 phase (5 V)
- Package : 24 pin DIP
- Clock Filter : Red, Green, Blue

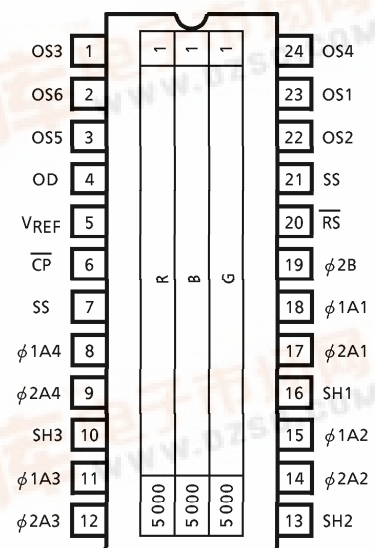
MAXIMUM RATINGS (Note 1)

| 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 | V |
| | V_{REF} | | |
| Operating Temperature | T_{opr} | 0~60 | °C |
| Storage Temperature | T_{stg} | - 25~85 | °C |

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



Weight : 17.1 g (Typ.)

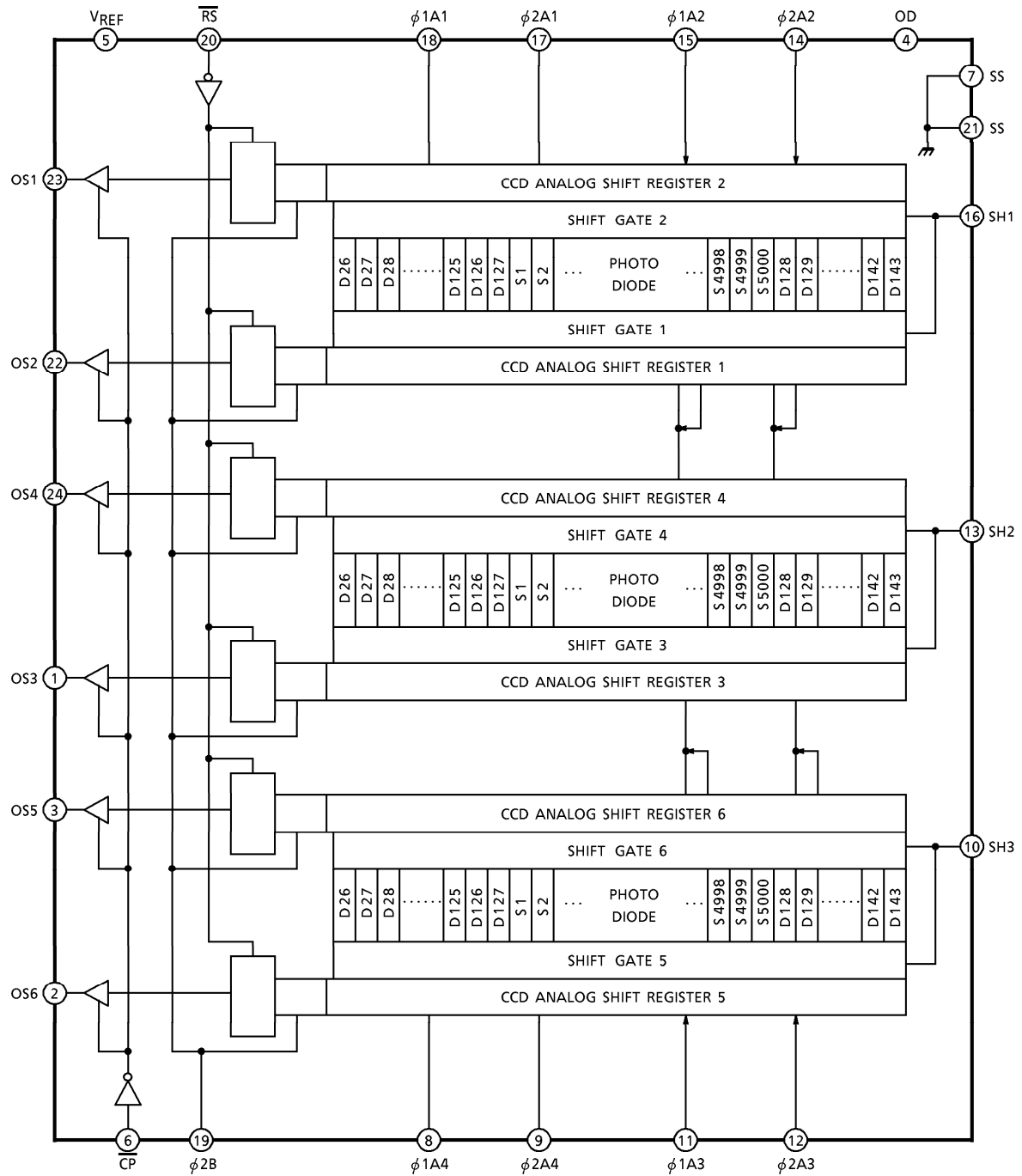
PIN CONNECTIONS

(TOP VIEW)

980910EBA2

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CIRCUIT DIAGRAM



PIN NAMES

| | | | |
|---------------------|-------------------|-----------------|-------------------------|
| $\phi 1A1, 2, 3, 4$ | Clock 1 | OS1 | Signal Output 1 (Green) |
| $\phi 2A1, 2, 3, 4$ | Clock 2 | OS2 | Signal Output 2 (Green) |
| $\phi 2B$ | Final Stage Clock | OS3 | Signal Output 3 (Blue) |
| \overline{RS} | Reset Gate | OS4 | Signal Output 4 (Blue) |
| SS | Ground | OS5 | Signal Output 5 (Red) |
| OD | Power Supply | OS6 | Signal Output 6 (Red) |
| SH | Shift Gate | V_{REF} | Clamp Reference Voltage |
| | | \overline{CP} | Clamp Gate |

OPTICAL / ELECTRICAL CHARACTERISTICS

($T_a = 25^\circ\text{C}$, $V_{OD} = 12\text{ V}$, $V_\phi = V_{\overline{RS}} = V_{\overline{CP}} = V_{SH} = 5\text{ V}$ (pulse), $f_\phi = 1.0\text{ MHz}$, $f_{\overline{RS}} = 1.0\text{ MHz}$,
 LOAD RESISTANCE = $100\text{ k}\Omega$, t_{INT} (INTEGRATION TIME) = 10 ms ,
 LIGHT SOURCE = A LIGHT SOURCE + CM500S FILTER ($t = 1.0\text{ mm}$))

| CHARACTERISTIC | SYMBOL | MIN. | TYP. | MAX. | UNIT | NOTE |
|-------------------------------|-----------------|------|------|------|------------------|----------|
| Sensitivity (Red) | RR | 4.6 | 6.7 | 8.8 | V / lx·s | (Note 2) |
| Sensitivity (Green) | RG | 5.8 | 8.4 | 11.0 | | |
| Sensitivity (Blue) | RB | 1.9 | 2.8 | 3.7 | | |
| Photo Response Non Uniformity | PRNU (1) | — | 10 | 35 | % | (Note 3) |
| | PRNU (3) | — | 10 | 15 | mV | (Note 4) |
| Saturation Output Voltage | $V_{SAT}(B)$ | 1.0 | 1.2 | — | V | (Note 5) |
| | $V_{SAT}(R, G)$ | 2.0 | 2.5 | — | | |
| Saturation Exposure | SE | 0.18 | 0.30 | — | lx·s | (Note 6) |
| Dark Signal Voltage | V_{DRK} | — | 1 | 5 | mV | (Note 7) |
| Dark Signal Non Uniformity | DSNU | — | 2 | 10 | mV | (Note 8) |
| Total Transfer Efficiency | TTE | 92 | — | — | % | |
| Output Impedance | Z_o | — | 0.5 | 1.0 | $\text{k}\Omega$ | |
| Current Dissipation | I_{OD} | — | 30 | 45 | mA | |
| | I_{REF} | — | 20 | 30 | | |
| DC Offset Voltage | V_{OS} | 4.5 | 6.0 | 7.5 | V | (Note 9) |

(Note 2) : Sensitivity is defined for each color of signal outputs average when the photosensitive surface is applied with the light of uniform illumination and uniform color temperature.

(Note 3) : PRNU (1) is defined for each color on a single chip by the expressions below when the photosensitive surface is applied with the light of uniform illumination and uniform color temperature.

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

Where \bar{x} is average of total signal outputs and $\Delta\bar{x}$ is the maximum deviation from \bar{x} .

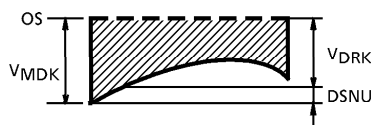
(Note 4) : PRNU (3) is defined as maximum voltage with next pixel, where measured 5% of SE (Typ.).

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

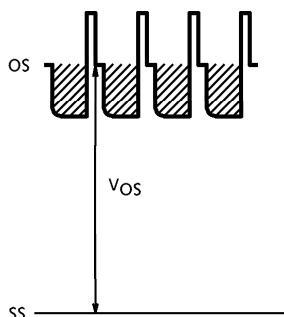
(Note 6) : Definition of SE : $SE = \frac{V_{SAT}}{R_G}$

(Note 7) : V_{DRK} is defined as average dark signal voltage of all effective pixels.

(Note 8) : DSNU is defined as different voltage between V_{DRK} and V_{MDK} , when V_{MDK} is maximum dark voltage.



(Note 9) : DC Signal Output Voltage is defined as follows :



OPERATING CONDITION

| CHARACTERISTIC | | SYMBOL | MIN. | TYP. | MAX. | UNIT |
|-----------------------------------|-----------|---------------------|---------------------------------|---------------------------|---------------------------|------|
| Clock Pulse Voltage | "H" Level | $V_{\phi A}$ | 4.5 | 5.0 | 5.5 | V |
| | "L" Level | | 0 | — | 0.5 | |
| Final Stage Clock Pulse Voltage | "H" Level | $V_{\phi B}$ | 4.5 | 5.0 | 5.5 | V |
| | "L" Level | | 0 | — | 0.5 | |
| Shift Pulse Voltage (Note 10) | "H" Level | V_{SH} | $V_{\phi A} \text{ "H" } - 0.5$ | $V_{\phi A} \text{ "H" }$ | $V_{\phi A} \text{ "H" }$ | V |
| | "L" Level | | 0 | — | 0.5 | |
| Reset Pulse Voltage | "H" Level | $V_{\overline{RS}}$ | 4.5 | 5.0 | 5.5 | V |
| | "L" Level | | 0 | — | 0.5 | |
| Clamp Pulse Voltage | "H" Level | $V_{\overline{CP}}$ | 4.5 | 5.0 | 5.5 | V |
| | "L" Level | | 0 | — | 0.5 | |
| Clamp Reference Voltage (Note 11) | | V_{REF} | 11.4 | 12.0 | V_{OD} | V |
| Power Supply Voltage (Note 11) | | V_{OD} | 11.4 | 12.0 | 13.0 | V |

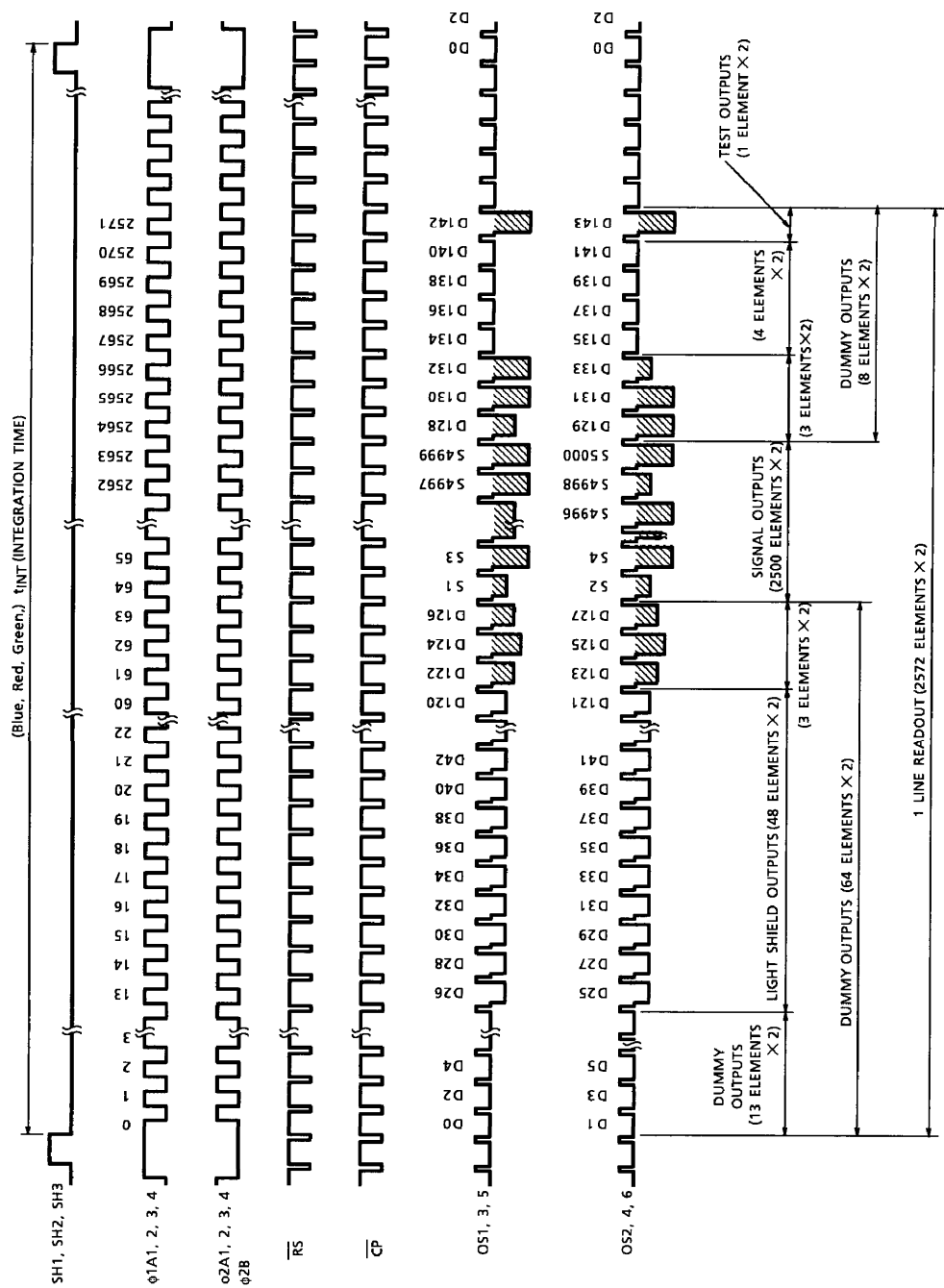
(Note 10) : $V_{\phi A} \text{ "H" }$ means the high-level voltage of $V_{\phi A}$ when SH pulse is high level.

(Note 11) : $V_{OD} - V_{REF}$ should be 0.5 V or less.

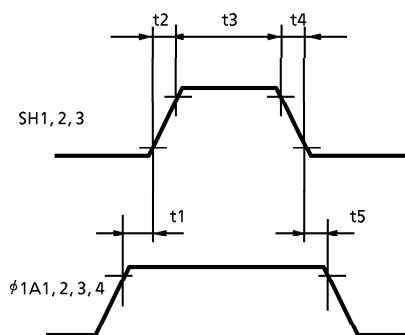
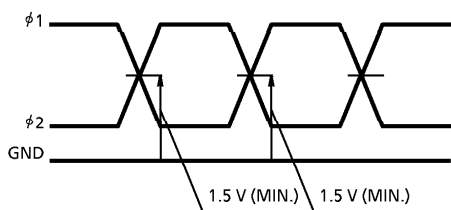
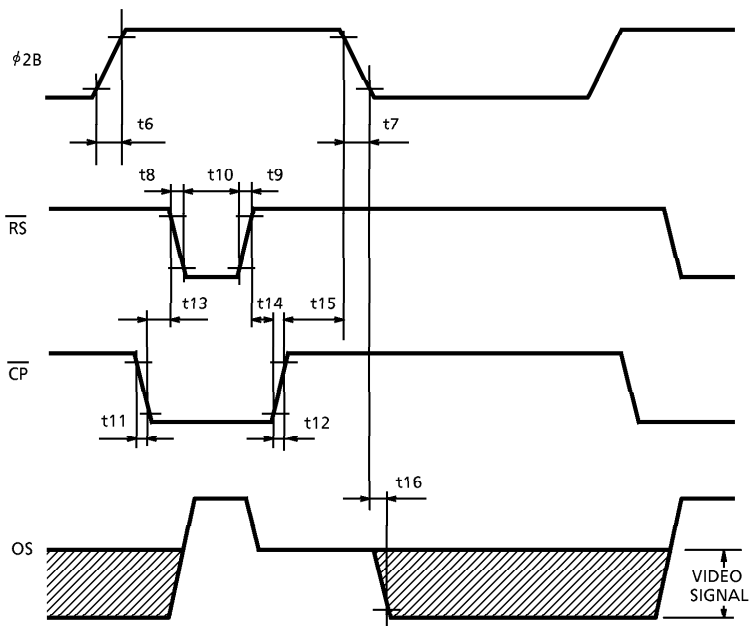
CLOCK CHARACTERISTICS (Ta = 25°C)

| CHARACTERISTIC | SYMBOL | MIN. | TYP. | MAX. | UNIT |
|-------------------------------|---------------------|------|------|------|------|
| Clock Pulse Frequency | f_{ϕ} | — | 1.0 | 8 | MHz |
| Reset Pulse Frequency | $f_{\overline{RS}}$ | — | 1.0 | 8 | MHz |
| Clamp Pulse Frequency | $f_{\overline{CP}}$ | — | 1.0 | 8 | MHz |
| Clock Capacitance | $C_{\phi A1, 4}$ | — | 500 | — | pF |
| | $C_{\phi A2, 3}$ | — | 400 | — | |
| Final Stage Clock Capacitance | $C_{\phi B}$ | — | 40 | — | pF |
| Reset Gate Capacitance | $C_{\overline{RS}}$ | — | 40 | — | pF |
| Shift Gate Capacitance | C_{SH} | — | 250 | — | pF |
| Clamp Gate Capacitance | $C_{\overline{CP}}$ | — | 40 | — | pF |

TIMING CHART



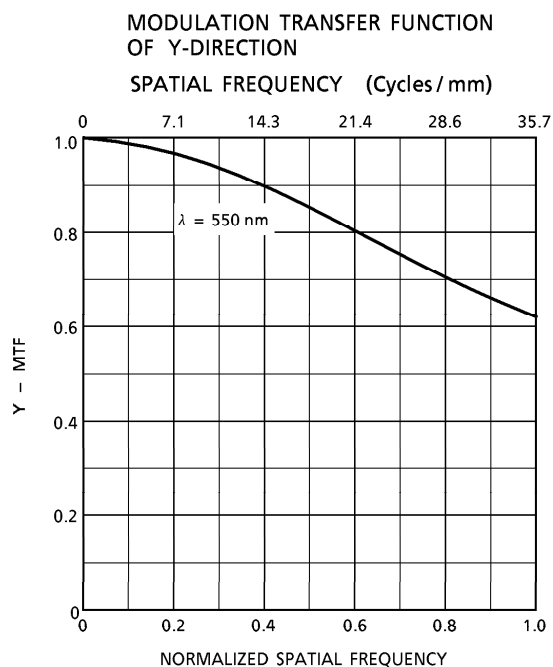
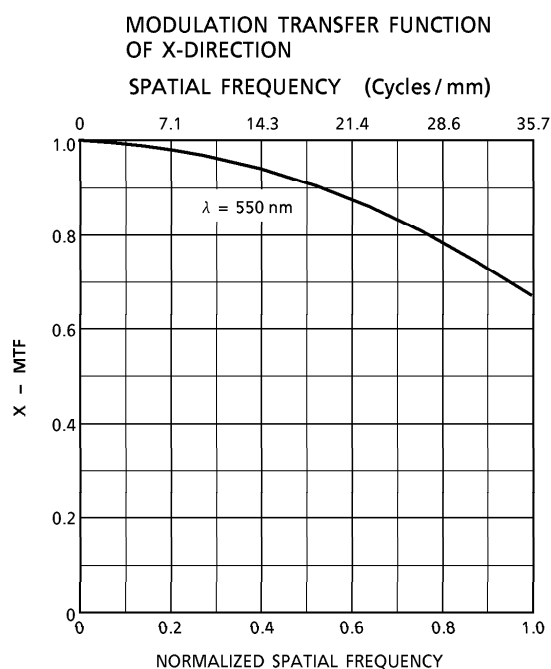
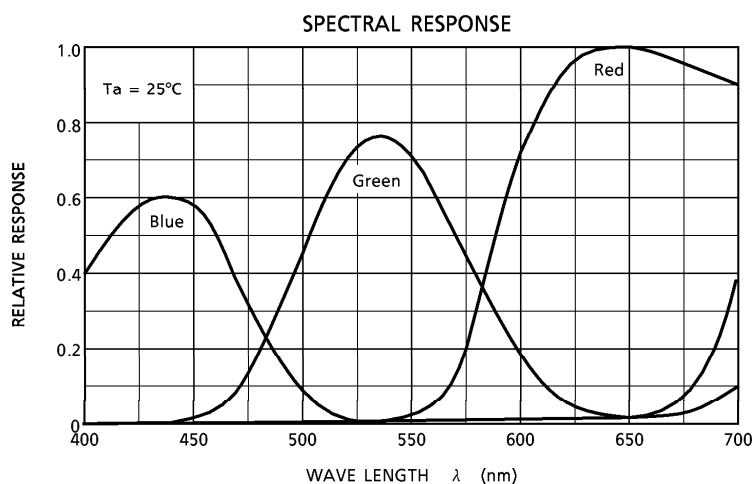
TIMING REQUIREMENTS

SH, $\phi 1$ TIMING $\phi 1$, $\phi 2$ CROSS POINT $\phi 2B$, \overline{RS} , \overline{CP} , OS, TIMING

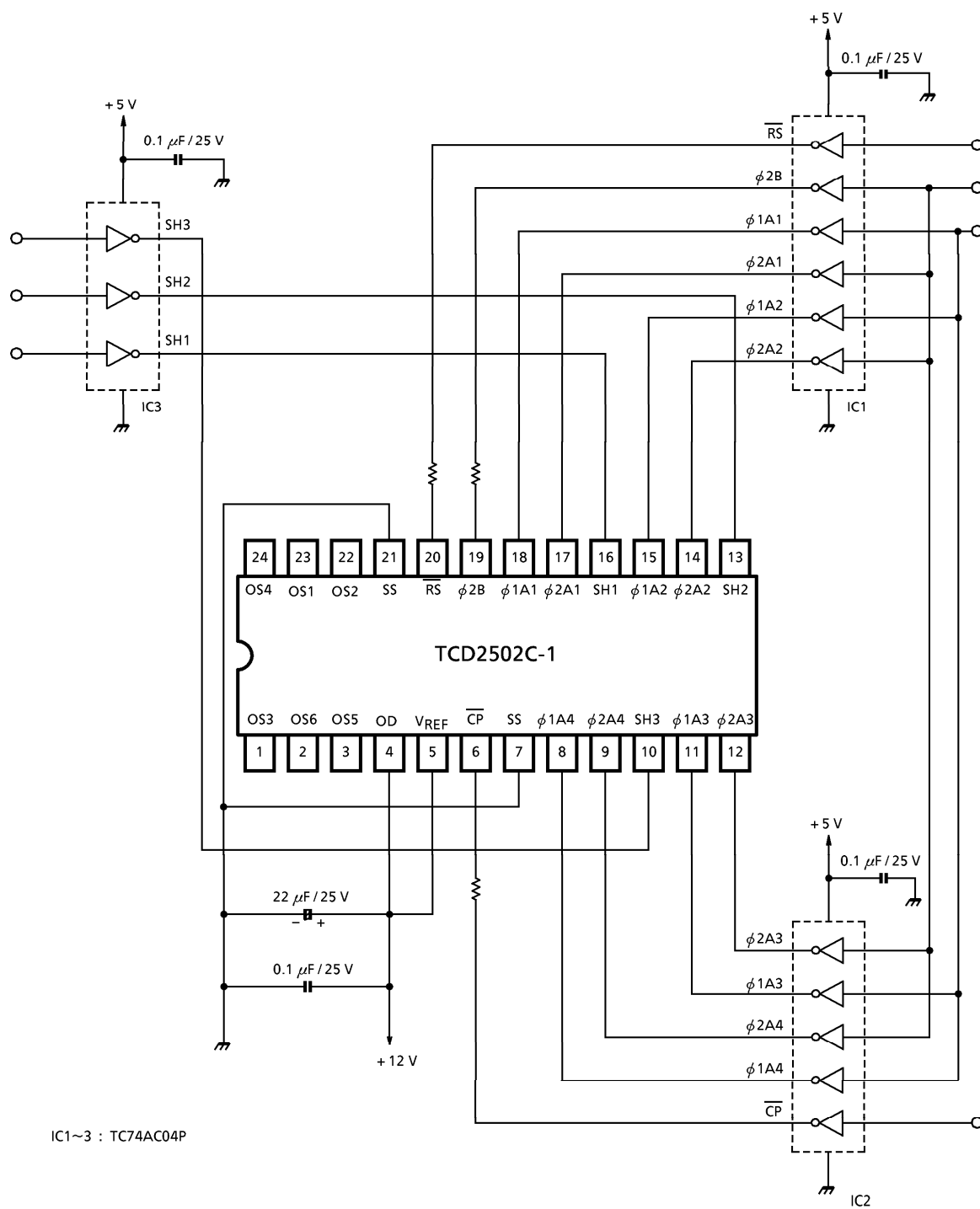
| CHARACTERISTIC | SYMBOL | MIN. | TYP. (Note 12) | MAX. | UNIT |
|---|----------|------|-------------------|------|------|
| Pulse Timing of SH and $\phi 1A$ | t1, t5 | 0 | 100 | — | ns |
| SH Pulse Rise Time, Fall Time | t2, t4 | 0 | 50 | — | ns |
| SH Pulse Width | t3 | 800 | 1000 | — | ns |
| $\phi 2B$ Pulse Rise Time, Fall Time | t6, t7 | 0 | 100 | — | ns |
| \overline{RS} Pulse Rise Time, Fall Time | t8, t9 | 0 | 20 | — | ns |
| \overline{RS} Pulse Width | t10 | 25 | 50 | — | ns |
| \overline{CP} Pulse Rise Time, Fall Time | t11, t12 | 0 | 20 | — | ns |
| Pulse Timing of \overline{RS} and \overline{CP} | t13 | 0 | 20 | — | ns |
| | t14 | 25 | 50 | — | |
| Pulse Timing of \overline{CP} and $\phi 2B$ | t15 | 20 | 50 | — | ns |
| Video Data Delay Time (Note 13) | t16 | — | 30 | — | ns |

(Note 12) : TYP. is the case of $f_{\overline{RS}} = 1 \text{ MHz}$.(Note 13) : Load Resistance is $100 \text{ k}\Omega$.

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 N₂.

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

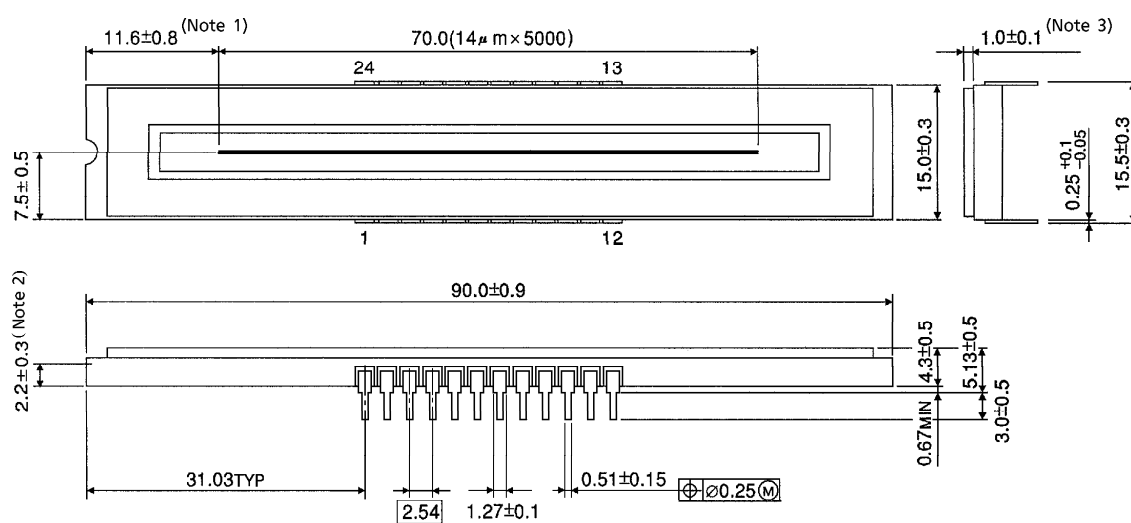
CCD sensor is sensitive to infrared light.

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

OUTLINE DRAWING

WDIP24-C-600-2.54 (A)

Unit in 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)

Weight : 17.1 g (Typ.)