

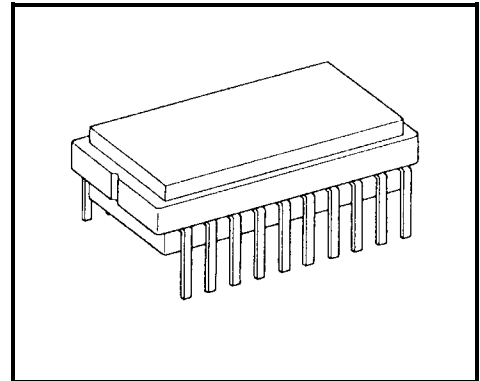
TCD2000P

The TCD2000P is a high sensitive and low dark current 480-elements color linear image sensor which includes CCD drive circuit, clamp circuit and sample & hold circuit.

The CCD drive circuit consists of the pulse generator. therefore it is possible to easy drive by applying simple pulses. The sensor is designed for scanner.

FEATURES

- Number of Image Sensing Elements : 480 elements (160×3 color sequential)
- Image Sensing Element Size : 11μm×33μm on 33μm centers
- Photo Sensing Region : High sensitive pn photodiode
- Clock : 3 Input pulses 5V
- Internal Circuit : Sample & Hold circuit, Clamp circuit
- Package : 20 pin
- Color Filter : Red, Green, Blue



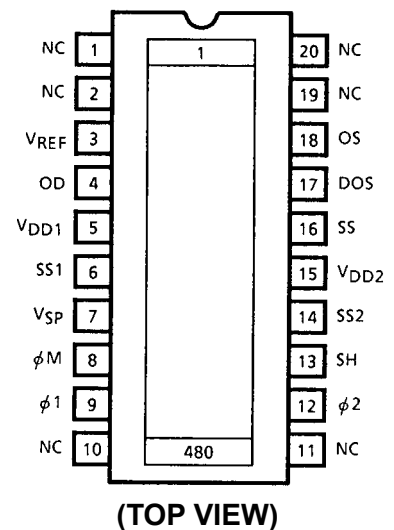
Weight: 1.0g (Typ.)

MAXIMUM RATINGS

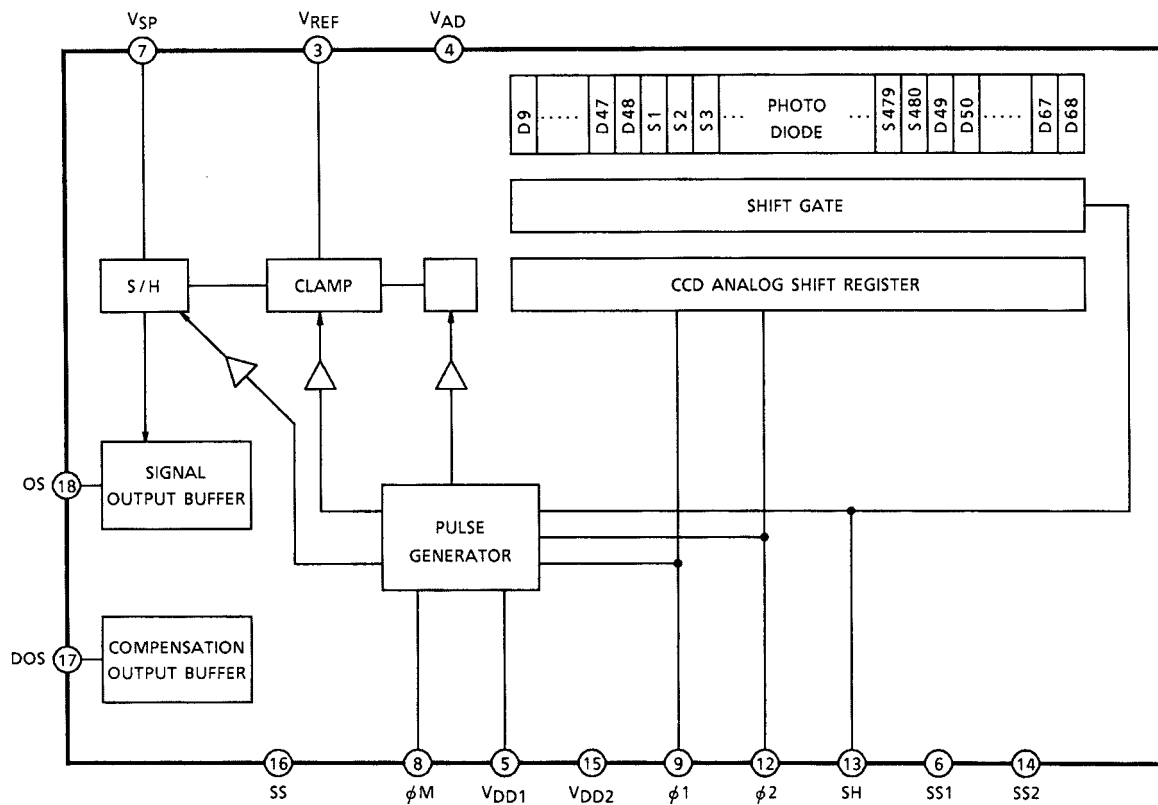
| CHARACTERISTIC | SYMBOL | RATING | UNIT |
|--------------------------------|------------------------|---------|------|
| Master Clock Voltage | $V_{\phi M}$ | -0.3~8 | V |
| Clock Pulse Voltage | V_{ϕ} | | |
| Shift Pulse Voltage | V_{SH} | | |
| Reference Voltage | V_{REF} | -0.3~15 | V |
| Power Supply Voltage (Analog) | V_{AD} | | |
| Power Supply Voltage (Digital) | V_{DD1} V_{DD2} | | |
| Sample & Hold Switch Voltage | V_{SP} | -0.3~15 | V |
| 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).

PIN CONNECTION



CIRCUIT DIAGRAM



PIN NAMES

| | | | |
|-----------|-------------------------|-----------|------------------------|
| ϕ_M | Master Clock | V_{AD} | Power (Analog) |
| ϕ_1 | Clock (Phase 1) | V_{DD1} | Power (Digital, 12V) |
| ϕ_2 | Clock (Phase 2) | V_{DD2} | Power (Digital, 12V) |
| SH | Shift Gate | SS | Ground (Analog) |
| OS | Signal Output | SS1 | Ground (Digital, 12V) |
| DOS | Compensation Output | SS2 | Ground (Digital, 12V) |
| V_{REF} | Reference Voltage Input | V_{SP} | Sample and Hold Switch |
| NC | Non Connection | | |

OPTICAL / ELECTRICAL CHARACTERISTICS

(Ta = 25°C V_{REF} = V_{AD} = V_{DD1} = V_{DD2} = 12V, V_{φM} = V_φ = V_{SH} = 5V (PULSE), f_φ = 1.0MHz, t_{INT} (INTEGRATION TIME) = 10ms, LIGHT SOURCE = A LIGHT SOURCE+CM500S FILTER, LOAD RESISTANCE = 100Ω)

| CHARACTERISTIC | SYMBOL | MIN | TYP. | MAX | UNIT | NOTE |
|-----------------------------------|-----------------------------------|-----|------|------|----------|----------|
| Sensitivity | RB | 3.7 | 5.3 | 6.9 | V / lx·s | |
| | RG | 8.4 | 12.0 | 15.6 | | |
| | RR | 4.6 | 6.6 | 8.7 | | |
| Photo Response Non Uniformity | PRNU (1) | — | 10 | 20 | % | (Note 2) |
| | PRNU (3) | — | 3 | 12 | mV | (Note 3) |
| Saturation Output Voltage | V _{SAT} | 1.2 | 2.0 | — | V | (Note 4) |
| Saturation Exposure | SE | — | 0.17 | — | lx·s | (Note 5) |
| Dark Signal Voltage | V _{DRK} | — | 12 | 25 | mV | (Note 6) |
| Dark Signal Non Uniformity | DSNU | — | 5 | 10 | mV | (Note 6) |
| Analog Current Dissipation | I _{AD} | — | 12 | 18 | mA | |
| Digital Current Dissipation | I _{DD1} | — | — | 1 | mA | |
| | I _{DD2} | — | 13.5 | 20 | mA | |
| Input Current of V _{REF} | I _{REF} | — | — | 1 | mA | |
| Total Transfer Efficiency | TTE | 92 | — | — | % | |
| Output Impedance | Z _O | — | 0.5 | 1.0 | kΩ | |
| DC Signal Output Voltage | V _{OS} | 4.5 | 6.0 | 7.5 | V | (Note 7) |
| DC Compensation Output Voltage | V _{DOS} | 4.5 | 6.0 | 7.5 | V | (Note 7) |
| DC Differential Error Voltage | V _{OS} -V _{DOS} | 0 | — | 100 | mV | |

Note 2: PRNU (1) is measured at 50% of SE (Typ.)

$$\text{Definition of PRNU : PRNU} = \frac{\Delta\bar{\chi}}{\bar{\chi}} \cdot 100 (\%)$$

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

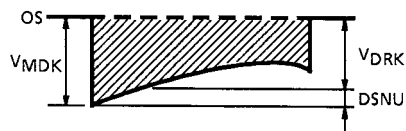
Note 3: PRNU (3) is defined as maximum voltage with next pixel where measured 5% of SE (Typ.)

Note 4: V_{SAT} is defined as minimum Saturation Output Voltage of all effective pixels.

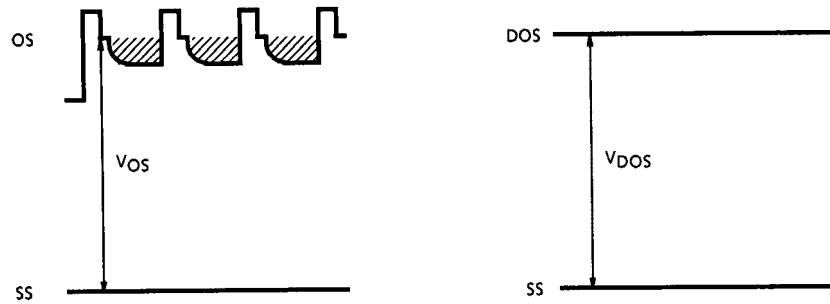
$$\text{Note 5: Definition of SE : SE} = \frac{V_{SAT}}{R} \text{ (lx·s)}$$

Note 6: 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 7: DC signal output voltage and DC compensation output voltage are defined as follows:.



OPERATING CONDITION

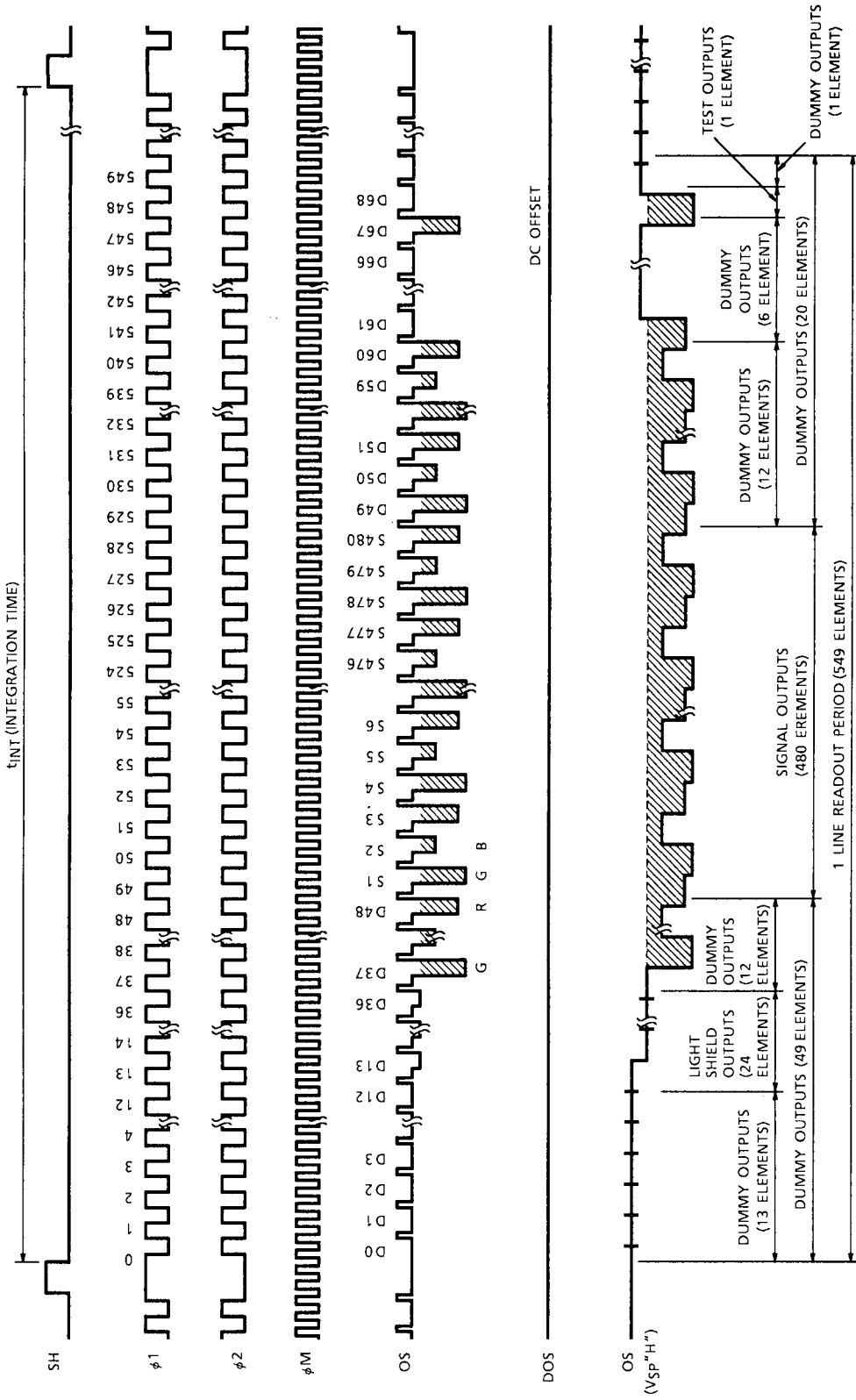
| CHARACTERISTIC | | SYMBOL | MIN | TYP. | MAX | UNIT |
|---------------------------------|-----------|------------------|---------------------|----------------|----------------|------|
| Master Clock Pulse Voltage | “H” Level | V _{φM} | 4.5 | 5.0 | 5.5 | V |
| | “L” Level | | 0 | — | 0.5 | |
| Clock Pulse Voltage | “H” Level | V _{φ1} | 4.5 | 5.0 | 5.5 | V |
| | “L” Level | V _{φ2} | 0 | — | 0.5 | |
| Shift Pulse Voltage | “H” Level | V _{SH} | V _φ -0.5 | V _φ | V _φ | V |
| | “L” Level | | 0 | — | 0.5 | |
| Sample and Hold Switch Voltage* | “H” Level | V _{SP} | 4.5 | 5.0 | 13.0 | V |
| | “L” Level | | 0 | — | 0.5 | |
| Reference Voltage | | V _{REF} | 11.4 | 12.0 | 13.0 | V |
| Power Supply Voltage (Analog) | | V _{AD} | 11.4 | 12.0 | 13.0 | V |
| Power Supply Voltage (Digital) | | V _{DD1} | 11.4 | 12.0 | 13.0 | V |
| | | V _{DD2} | 11.4 | 12.0 | 13.0 | |

(*) Supply “H” Level to V_{SP} terminal when sample-and-hold circuit is used, when sample-and-hold circuit is not used supply “L” Level to V_{SP} terminal.

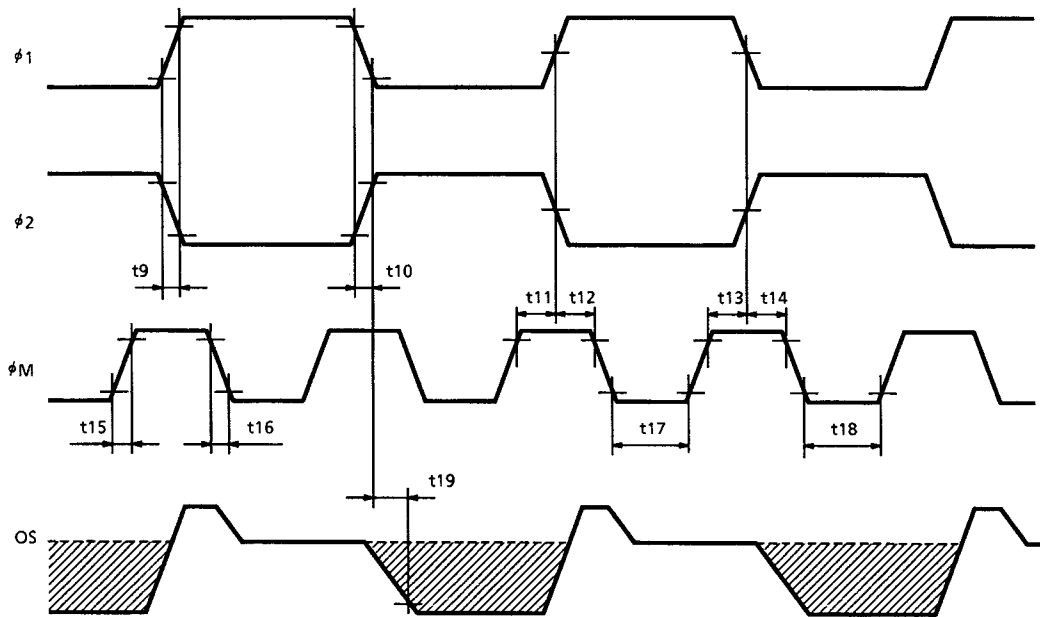
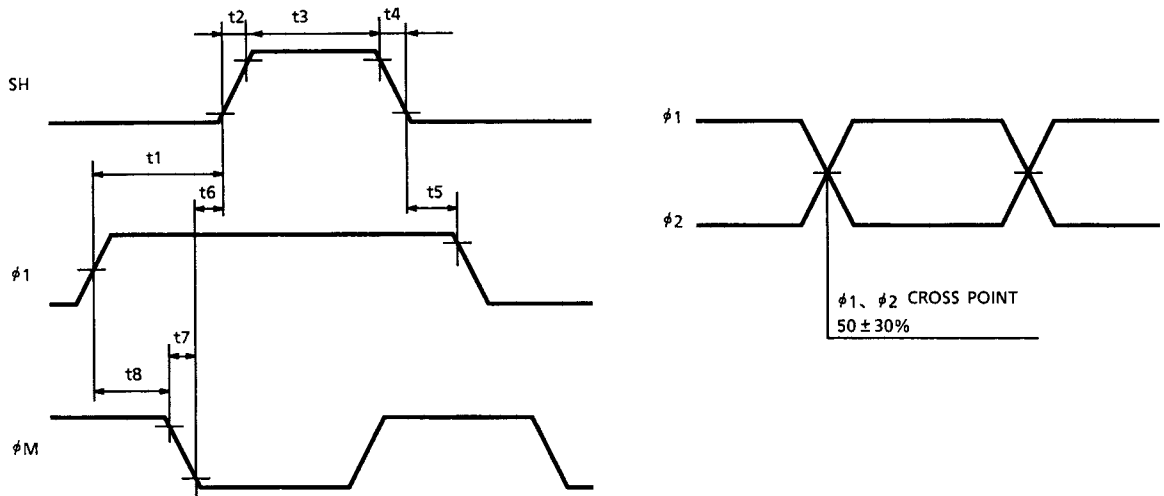
CLOCK CHARACTERISTICS (Ta = 25°C)

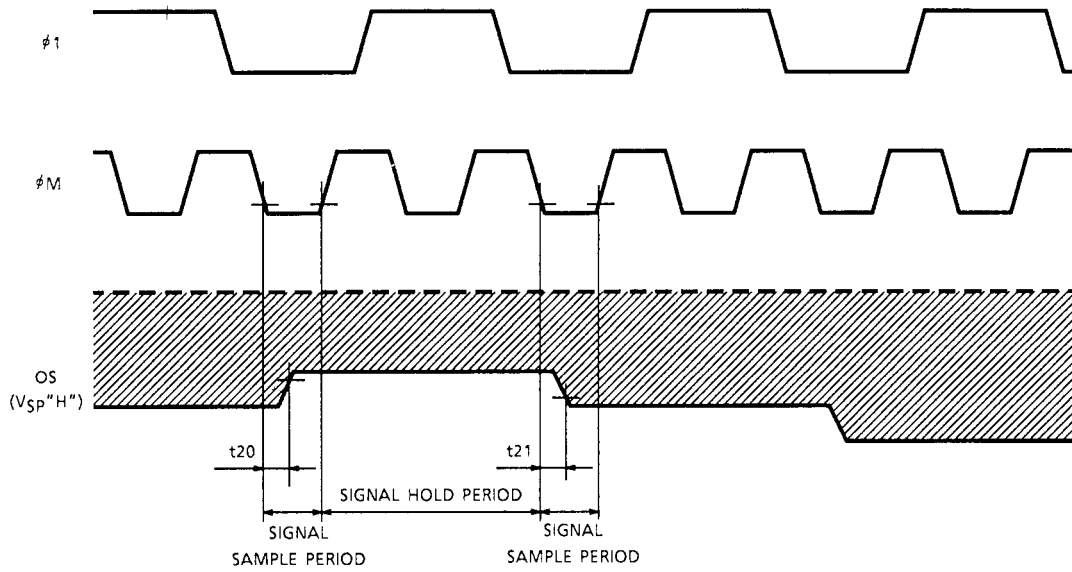
| CHARACTERISTIC | SYMBOL | MIN | TYP. | MAX | UNIT |
|--------------------------------|-----------------|-----|------|-----|------|
| Master Clock Pulse Frequency | f _{φM} | — | 2.0 | 6.0 | MHz |
| Clock Pulse Frequency | f _φ | — | 1.0 | 3.0 | MHz |
| Master Clock Pulse Capacitance | C _{φM} | — | 10 | 20 | pF |
| Clock Capacitance | C _φ | — | 100 | 200 | pF |
| Shift Gate Capacitance | C _{SH} | — | 50 | 100 | pF |

TIMING CHART



TIMING REQUIREMENTS



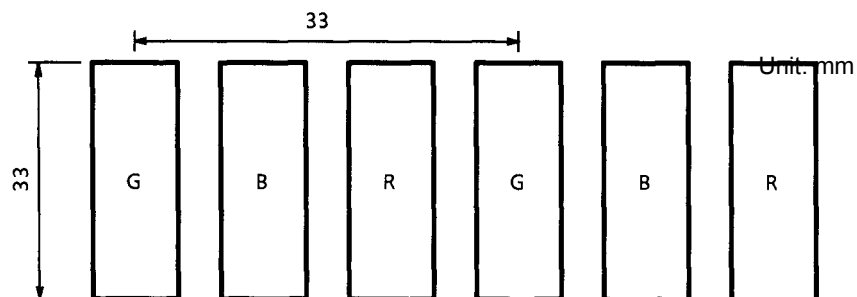


| CHARACTERISTIC | SYMBOL | MIN | TYP. (Note 2) | MAX | UNIT |
|---|--------------|-----|------------------|-----|------|
| Pulse Timing of SH and ϕ_1, ϕ_2 | t1 | 60 | 300 | — | ns |
| | t5 | 0 | 300 | — | ns |
| SH Pulse Rise Time, Fall Time | t2, t4 | 0 | 50 | — | ns |
| SH Pulse Width | t3 | 300 | 1000 | — | ns |
| Pulse Timing of SH and ϕ_M | t6 | 20 | 50 | — | ns |
| ϕ_1, ϕ_2 Pulse Rise Time, Fall Time | t9, t10 | 0 | 20 | — | ns |
| Pulse Timing of ϕ_1, ϕ_2 and ϕ_M | t11, t13 | 20 | 100 | — | ns |
| | t8, t12, t14 | 40 | 100 | — | ns |
| ϕ_M Pulse Rise Time, Fall Time | t7, t15, t16 | 0 | 20 | — | ns |
| ϕ_M Pulse Width | t17, t18 | 80 | 250 | — | ns |
| Video Data Delay Time (Note 3) | t19 | — | 45 | — | ns |
| S / H Video Data Delay Time | t20, t21 | — | 70 | — | ns |

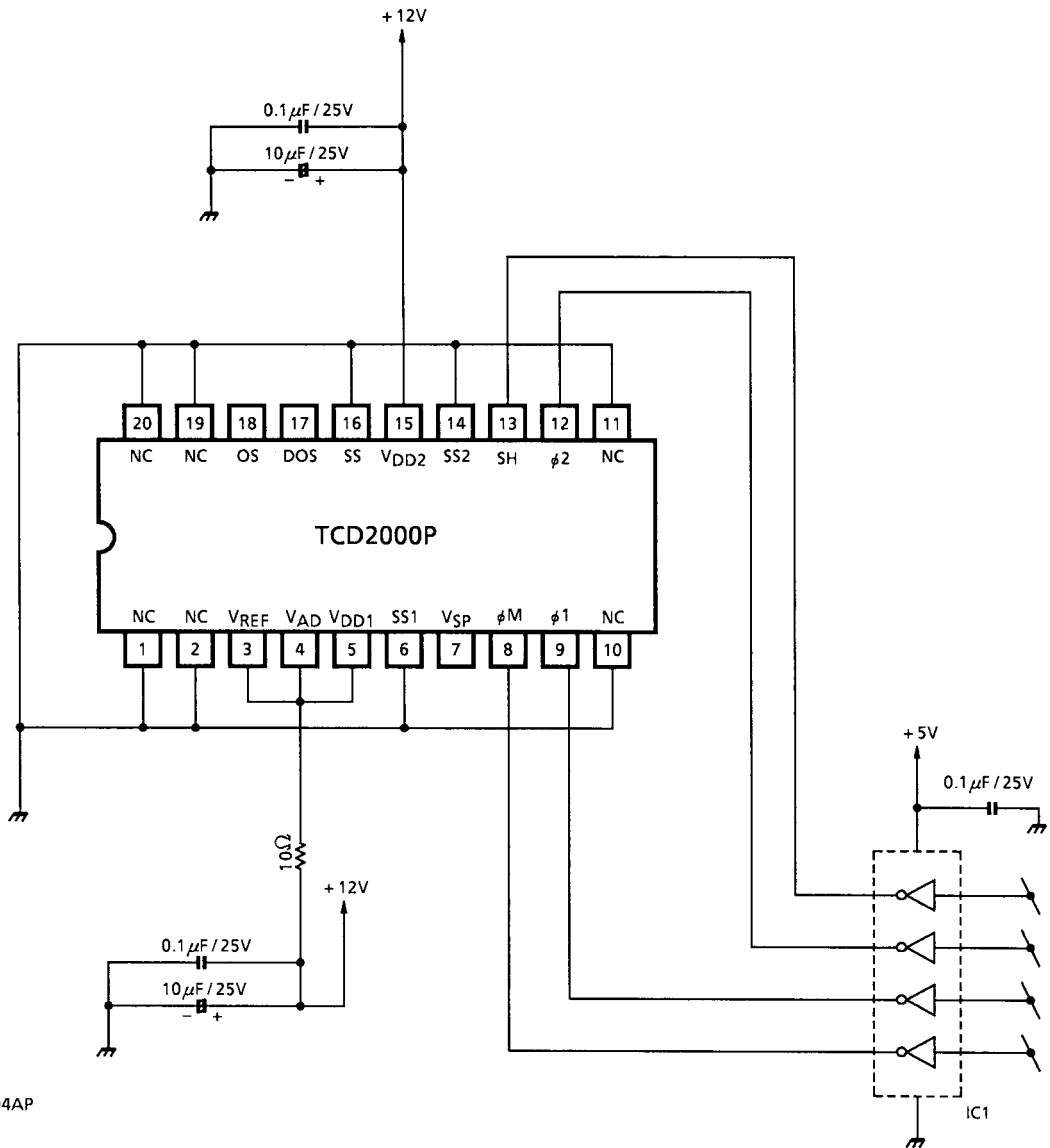
Note 2: TYP. is the case of $f_{\phi}=1\text{MHz}$.

Note 3: Load Resistance is 100k Ω .

ELEMENT SHAPE



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.

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 or 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.

RESTRICTIONS ON PRODUCT USE

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