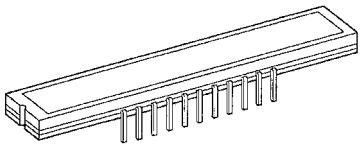
TOSHIBA CCD LINEAR IMAGE SENSOR CCD(Charge Coupled Device)

Preliminary

# TCD1201DG

The TCD1201DG is a high sensitive and low dark current 2048−elements linear image sensor. The sensor can be used for POS handscanner.
The device is operated by only 5V power supply, and mounted in 22−pin cerdip package with hermetic sealed optical glass window



WDIP22-G-400-2.54A (A)

Weight: (3.5g (Typ.))

## FEATURES

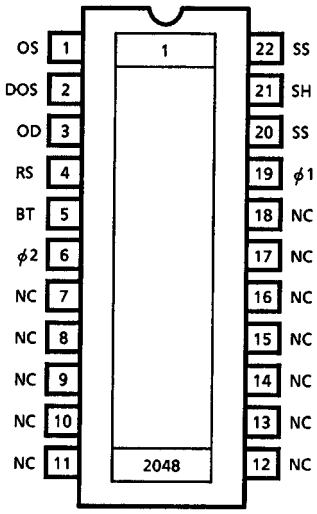
- Number of Image Sensing Elements : 2048
- Image Sensing Element Size : 14μm by 200μm on 14μm centers
- Photo Sensing Region : High sensitive and low dark current pn photodiode
- Clock : 2 phase (5V)
- Package : 22 pin cerdip

## MAXIMUM RATINGS (Note 1)

| CHARACTERISTIC | SYMBOL | RATING | UNIT |
|---|---|---|---|
| Clock Pulse Voltage | $V_{\varphi}$ | −0.3~8 | V |
| Shift Pulse Voltage | $V_{SH}$ | | V |
| Reset, Boost Pulse Voltage | $V_{RS}$, $V_{BT}$ | | V |
| Power Supply Voltage | $V_{OD}$ | | V |
| 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).

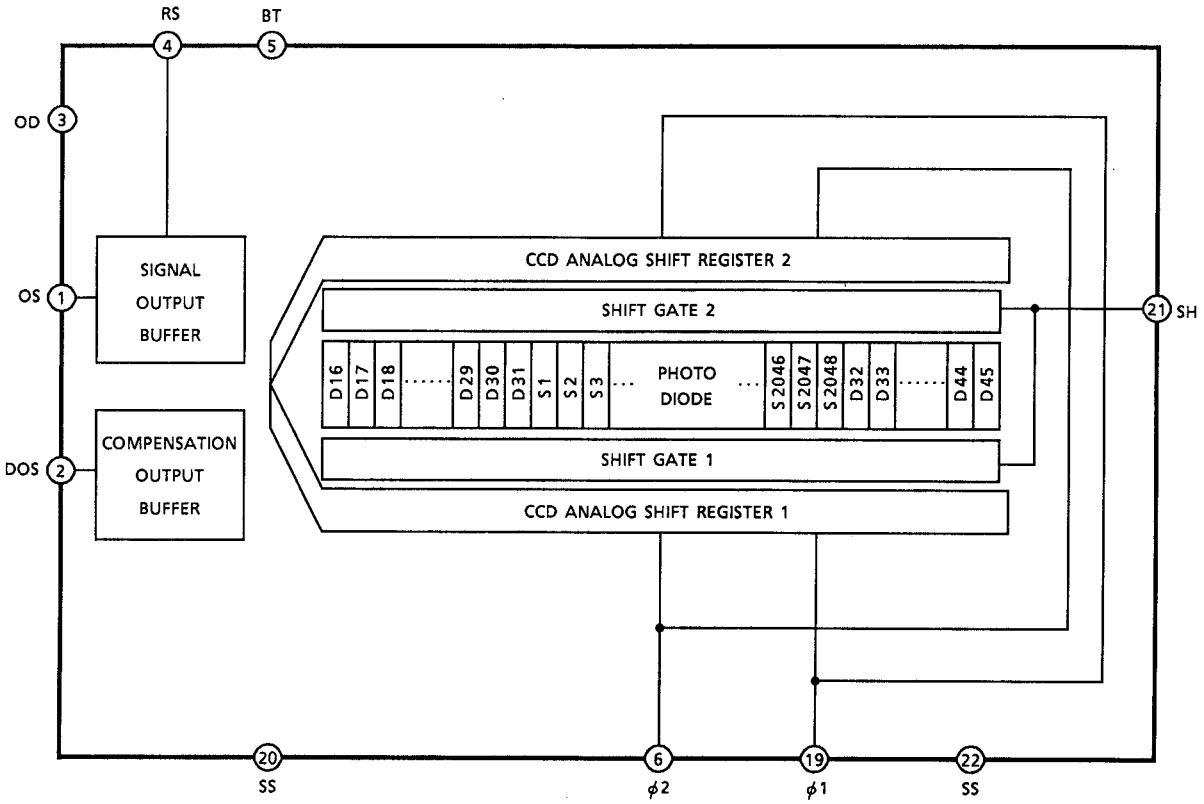
## PIN CONNECTION




**(TOP VIEW)**

000707EBA2

## CIRCUIT DIAGRAM




## PIN NAMES

| | |
|---|---|
| φ1 | Clock (Phase 1) |
| φ2 | Clock (Phase 2) |
| BT | Boost Pulse |
| 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, $V_{OD}$ = 12V, $V_{\varphi}$ = $V_{SH}$ = $V_{RS}$ = $V_{BT}$ = 5V (PULSE), $f_{\varphi}$ = 0.5MHz, $f_{RS}$ = 1MHz, Load Resistance = 100kΩ, $t_{INT}$ (Integration Time) = 10ms, Light Source = Daylight Fluorescent Lamp)**

| CHARACTERISTIC | SYMBOL | MIN | TYP. | MAX | UNIT | NOTE |
|---|---|---|---|---|---|---|
| Sensitivity | R | 64 | 80 | 96 | V / lx·s | (Note 2) |
| Photo Response Non Uniformity | PRNU | — | — | 10 | % | (Note 3) |
| Saturation Output Voltage | $V_{SAT}$ | 0.6 | 0.8 | — | V | (Note 4) |
| Saturation Exposure | SE | 0.006 | 0.01 | — | lx·s | (Note 5) |
| Dark Signal Voltage | $V_{MDK}$ | — | 2 | 5 | mV | (Note 6) |
| Analog Current Dissipation | $I_{OD}$ | — | 3 | 5 | mA | $V_{OD}$ = 5V |
| Total Transfer Efficiency | TTE | 92 | 95 | — | % | |
| Output Impedance | $Z_O$ | — | 0.5 | 1 | kΩ | |
| Dynamic Range | DR | — | 400 | — | | (Note 7) |
| DC Signal Output Voltage | $V_{OS}$ | 1.5 | 3.0 | 4.5 | V | (Note 8) |
| DC Compensation Output Voltage | $V_{DOS}$ | 1.5 | 3.0 | 4.5 | V | (Note 8) |
| DC Mismatch Voltage | $\lvert V_{OS}-V_{DOS}\rvert$ | — | — | 100 | mV | |

Note 2: Sensitivity for LED (660nm) is 600V / lx·s (Typ.)

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

Definition of PRNU : 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: $V_{SAT}$ is defined as minimum saturation output voltage of all effective pixels.

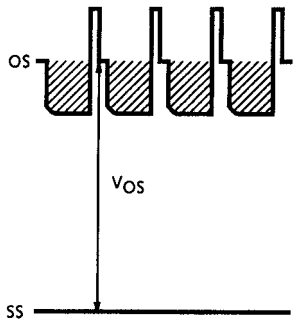
Note 5: Definition of SE : SE = $\frac{V_{SAT}}{R}(lx \cdot s)$

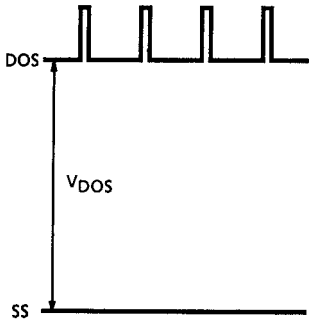
Note 6: $V_{MDK}$ is defined as maximum dark signal voltage of all effective pixels.

Note 7: Definition of DR : DR = $\frac{V_{SAT}}{V_{MDK}}$

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

Note 8: DC signal output voltage and DC compensation output voltage are defined as follows:



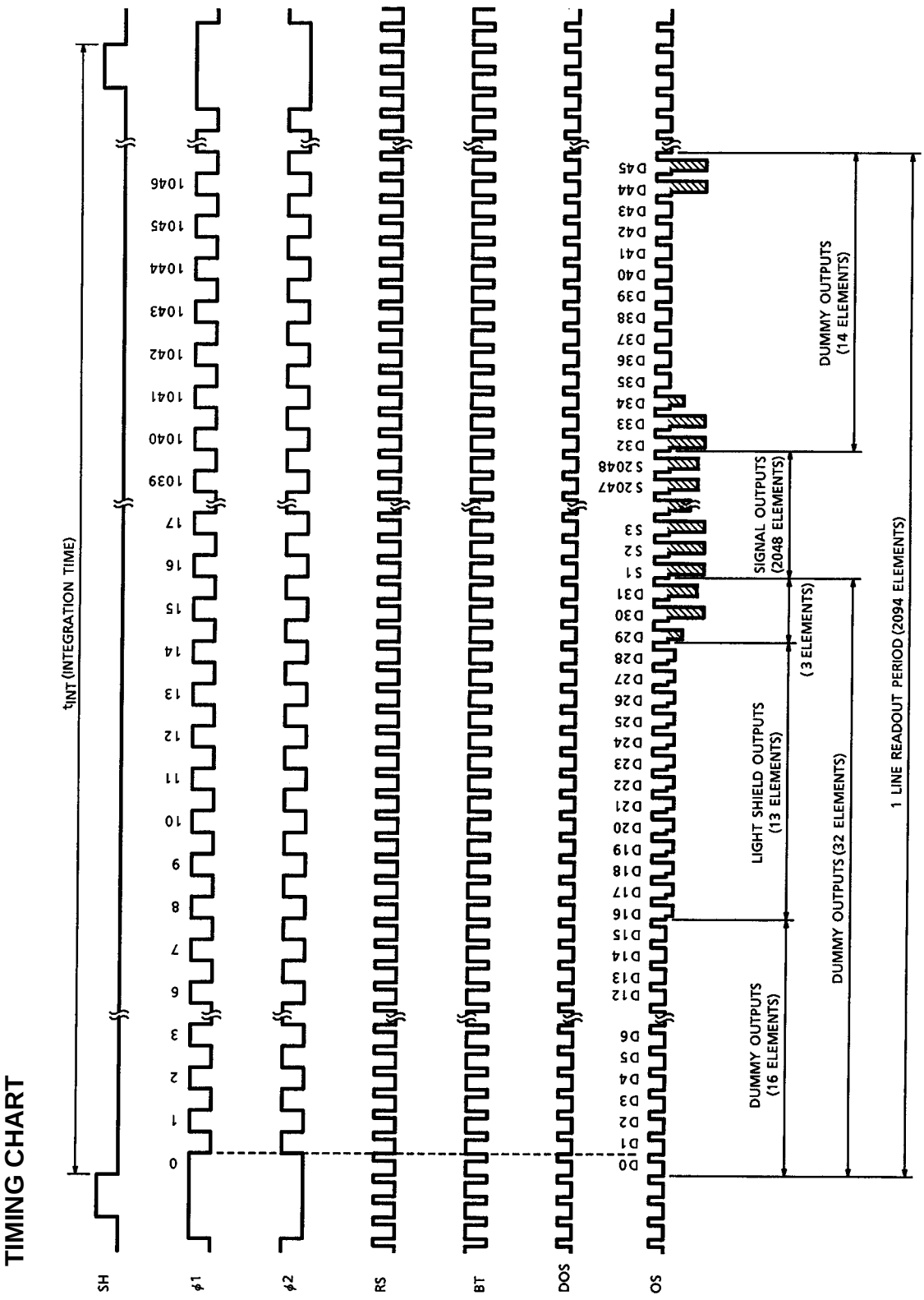
## OPERATING CONDITION

| CHARACTERISTIC | | SYMBOL | MIN | TYP. | MAX | UNIT |
|---|---|---|---|---|---|---|
| Clock Pulse Voltage | "H" Level | $V_{\varphi}$ | 4.5 | 5.0 | 5.5 | V |
| | "L" Level | | 0 | 0.2 | 0.5 | |
| Shift Pulse Voltage | "H" Level | $V_{SH}$ | 4.5 | 5.0 | 5.5 | V |
| | "L" Level | | 0 | 0.2 | 0.5 | |
| Reset Boost Pulse Voltage | "H" Level | $V_{RS}$ | 4.5 | 5.0 | 5.5 | V |
| | "L" Level | $V_{BT}$ | 0 | 0.2 | 0.5 | |
| Power Supply Voltage | | $V_{OD}$ | 4.5 | 5.0 | 5.5 | V |

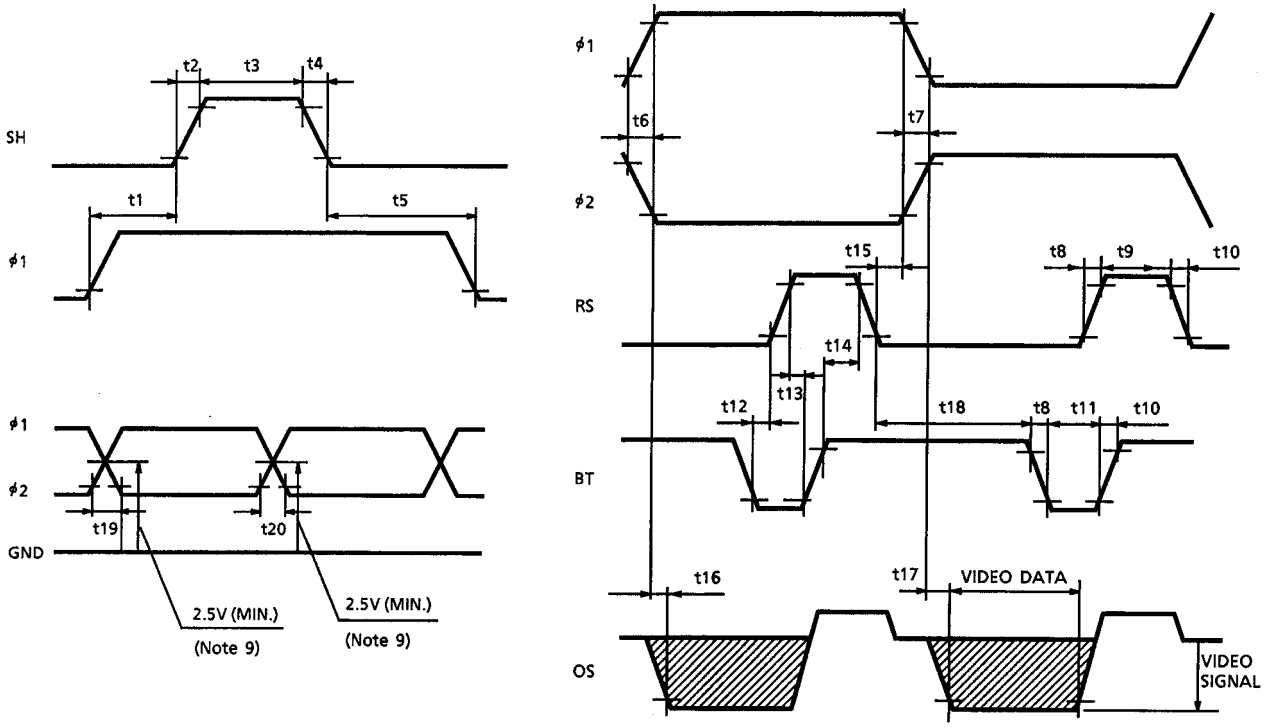
## CLOCK CHARACTERISTICS (Ta = 25°C)

| CHARACTERISTIC | SYMBOL | MIN | TYP. | MAX | UNIT |
|---|---|---|---|---|---|
| Clock Pulse Frequency | $f_{\varphi}$ | 0.01 | 0.5 | 1.0 | MHz |
| Reset Pulse Frequency | $f_{RS}$ | 0.02 | 1.0 | 2.0 | MHz |
| Clock Capacitance | $C_{\varphi A}$ | — | 400 | 500 | pF |
| BT Gate Capacitance | $C_{BT}$ | — | 10 | 25 | pF |
| Shift Gate Capacitance | $C_{SH}$ | — | 200 | 250 | pF |
| Reset Gate Capacitance | $C_{RS}$ | — | 10 | 25 | pF |

## TIMING CHART



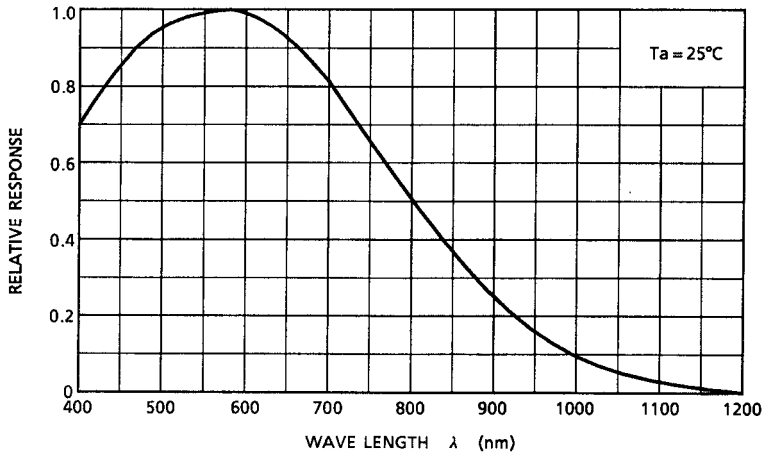
## TIMING REQUIREMENTS




| CHARACTERISTIC | SYMBOL | MIN | TYP. | MAX | UNIT |
|---|---|---|---|---|---|
| Pulse Timing of SH and φ1, φ2 | t1 | 0 | 100 | — | ns |
| | t5 | 2000 | 3000 | — | ns |
| SH Pulse Rise, and Fall Time | t2, t4 | 0 | 50 | — | ns |
| SH Pulse Width | t3 | 1000 | 2000 | — | ns |
| φ1, φ2 Pulse Rise and Fall Time | t6, t7 | 0 | 60 | — | ns |
| RS, BT Pulse Rise and Fall Time | t8, t10 | 0 | 20 | — | ns |
| RS Pulse Width | t9 | 60 | 250 | — | ns |
| BT Pulse Width | t11 | 70 | 250 | — | ns |
| Pulse Timing of RS and BT | t12 | 50 | 100 | — | ns |
| | t13 | 20 | — | — | ns |
| | t14 | 40 | — | — | ns |
| | t18 | 200 | — | — | ns |
| Pulse Timing of φ1, φ2, RS | t15 | 20 | — | — | ns |
| Video Data Delay Time | t16, t17 | — | 80 | — | ns |

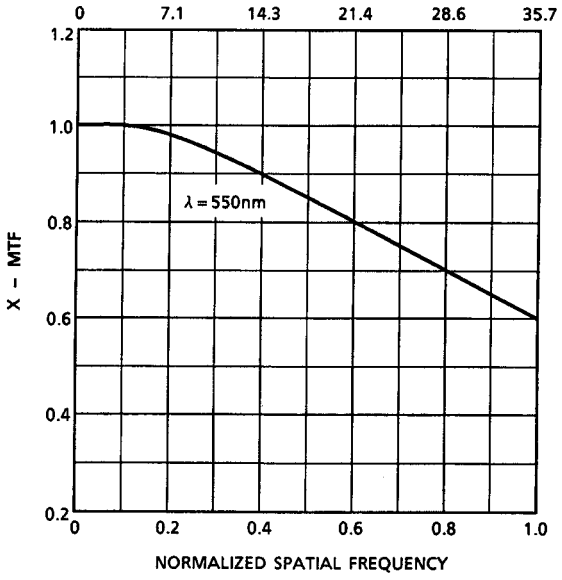
Note 9: If φ1 & φ2 pulse cross point could't be kept over 2.5V, it should be 1.5V and t19 and t20 should be 60ns.

TYPICAL SPECTRAL RESPONSE

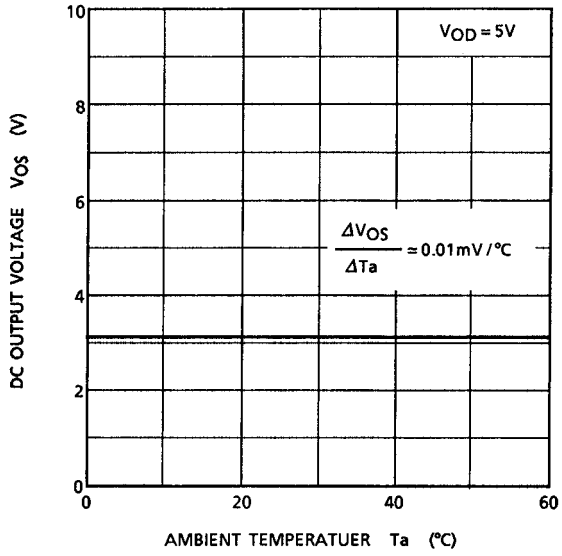



MODULATION TRANSFER FUNCTION
OF X-DIRECTION

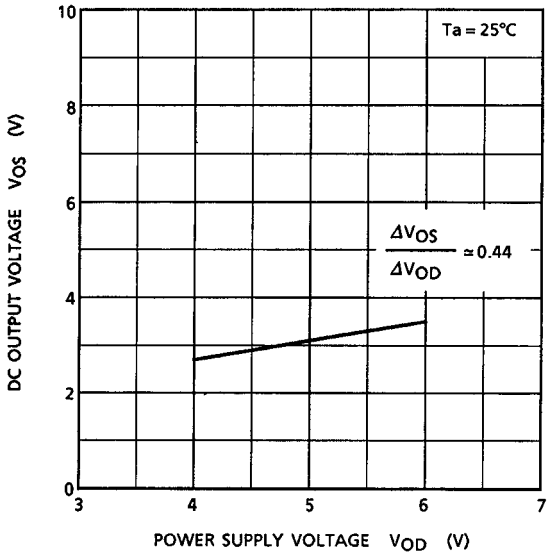
SPATIAL FREQUENCY (Cycles / mm)



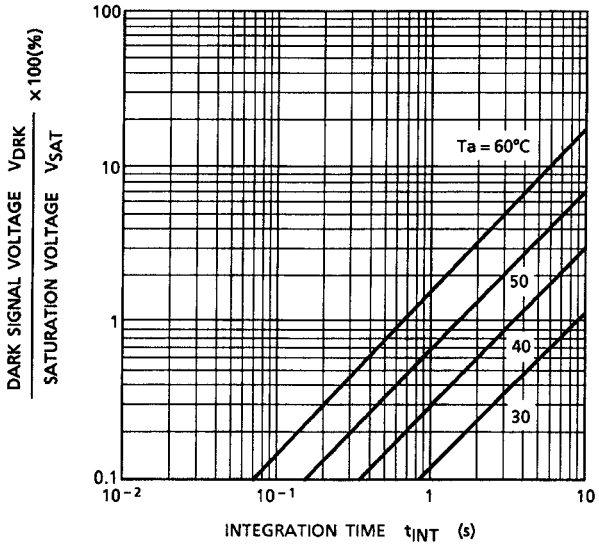
DC OUTPUT VOLTAGE – AMBIENT TEMPERATUER (TYPICAL)



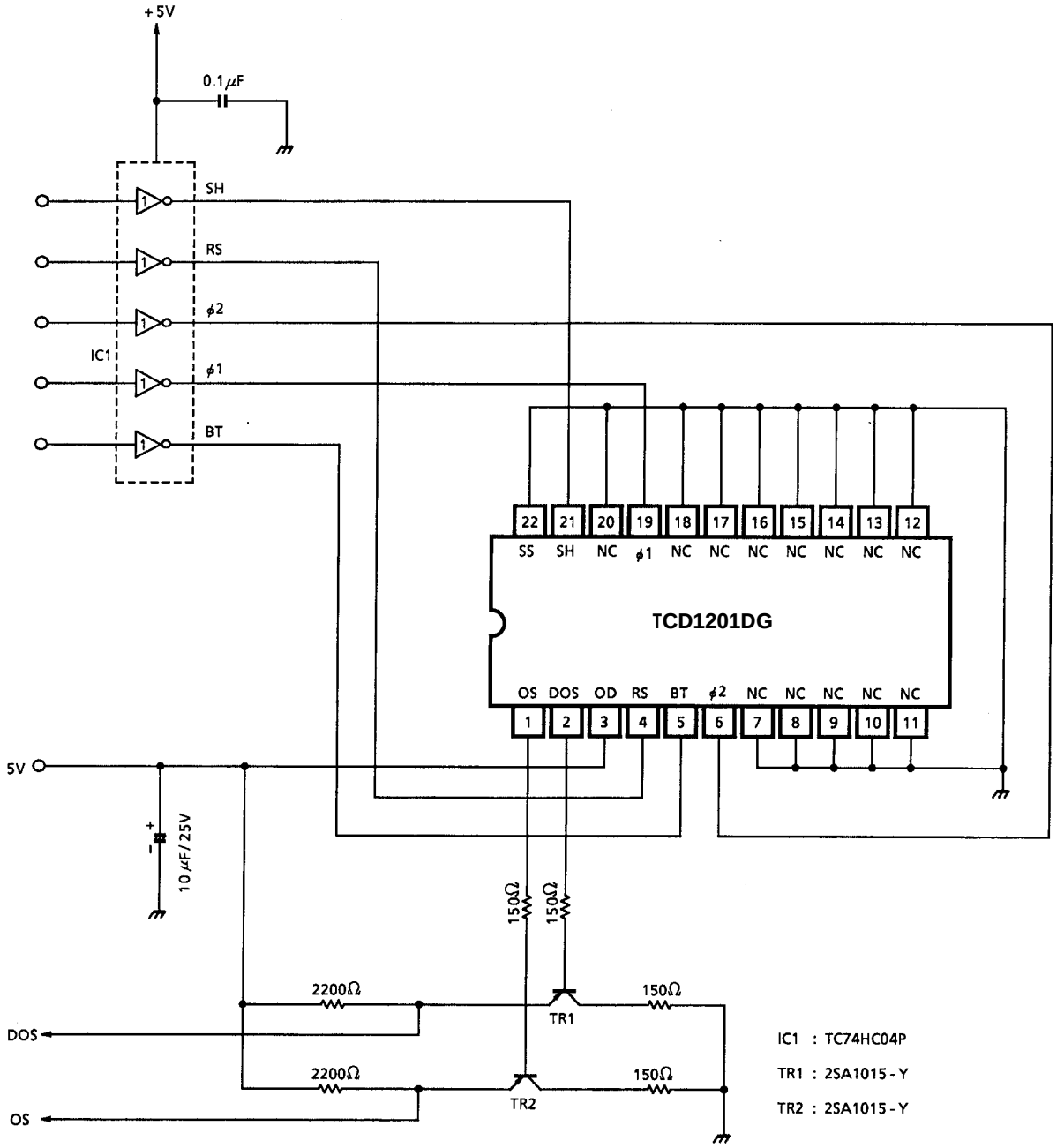

DC OUTPUT VOLTAGE – POWER SUPPLY VOLTAGE (TYPICAL)




DARK SIGNAL VOLTAGE – INTEGRATION TIME (TYPICAL)



## 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 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.

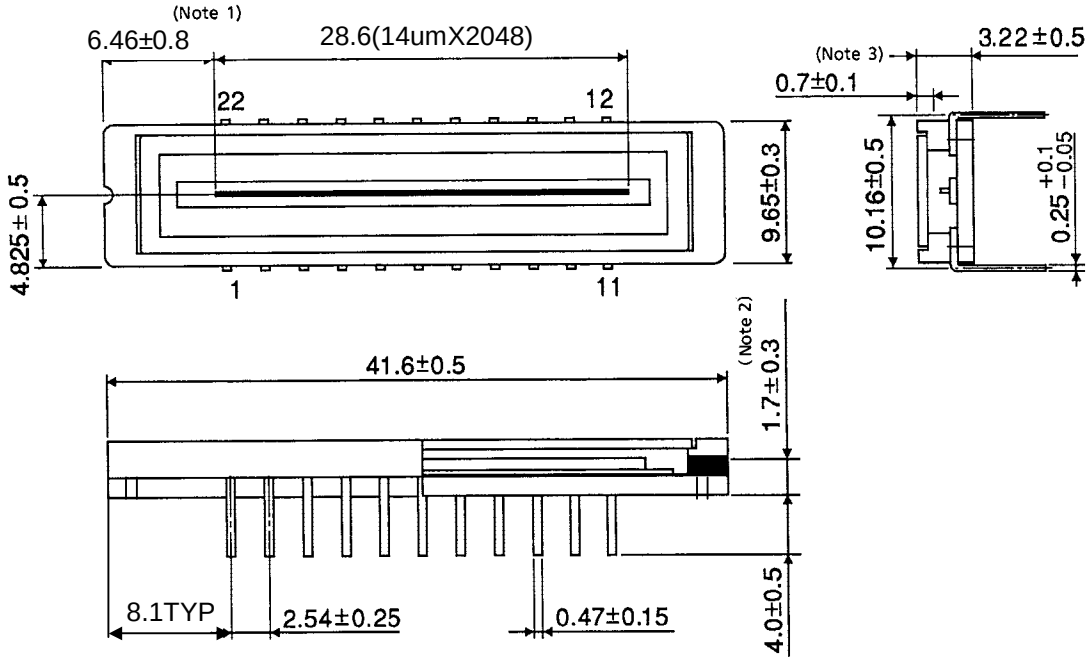
We recommend to use a IC-inserter when you assemble to PCB.

### 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




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: (3.5g (Typ.))