

TOSHIBA CCD LINEAR IMAGE SENSOR CCD(Charge Coupled Device)

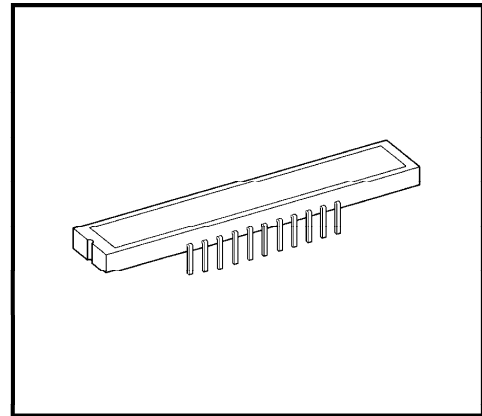
TCD1304AP

The TCD1304AP is a high sensitive and low dark current 3648-elements linear image sensor. The sensor can be used for POS handscanner.

The device is consist of sensitivity CCD chip.

The TCD1304AP has electronic shutter function (ICG).

Electronic shutter function can keep always output voltage constant that vary with the intensity of lights.



Weight : 2.7g (Typ.)

FEATURES

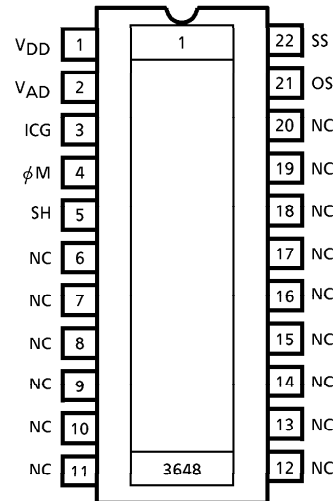
- Pixel Number : 3648
- Pixel Size : 8μm × 200μm
- Photo Sensing Region : High Sensitive & Low Dark Current pn Photodiode
- Internal Circuit : CCD Drive Circuit
- Power Supply : Only 3.0V Drive (MIN.)
- Function : Electronic Shutter
Sample and Hold Circuit
- Package : 22 Pin DIP (T-CAPP)
TOSHIBA-CCD-ADVANCED-PLASTIC-PACKAGE

MAXIMUM RATINGS (Note 1)

| CHARACTERISTIC | SYMBOL | RATING | UNIT |
|----------------------------|--------------|----------|------|
| Master Clock Pulse Voltage | $V_{\phi M}$ | - 0.3~7 | V |
| SH Pulse Voltage | V_{SH} | | |
| ICG Pulse Voltage | V_{ICG} | | |
| Digital Power Supply | V_{DD} | | |
| Analog Power Supply | V_{AD} | | |
| Operating Temperature | T_{opr} | - 25~60 | °C |
| Storage Temperature | T_{stg} | - 40~100 | °C |

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

PIN CONNECTIONS

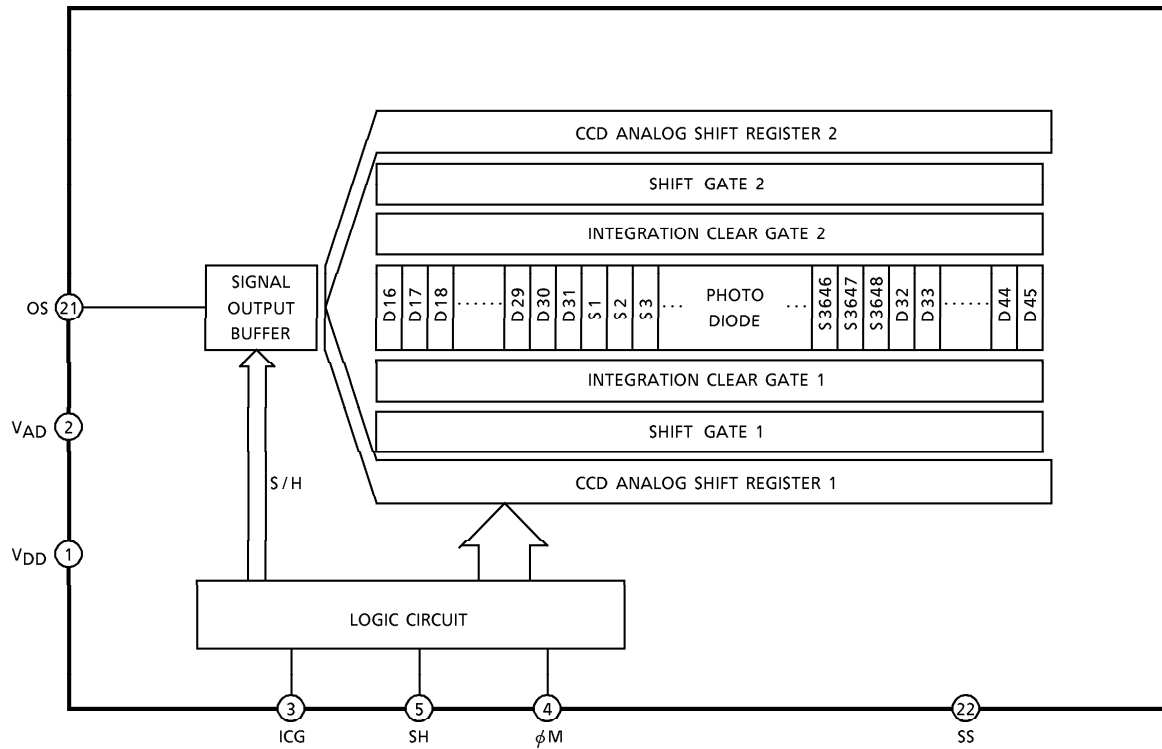


(TOP VIEW)

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CIRCUIT DIAGRAM



PIN NAMES

| | |
|----------|------------------------|
| ϕM | Master Clock |
| SH | Shift Gate |
| ICG | Integration Clear Gate |
| VAD | Power (Analog) |
| VDD | Power (Digital) |
| SS | Ground |
| NC | Non Connection |

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OPTICAL / ELECTRICAL CHARACTERISTICS

(Ta = 25°C, V ϕ = 4.0V (PULSE), f ϕ = 0.5MHz, t $_{INT}$ (INTEGRATION TIME) = 10ms,
LOAD RESISTANCE = 100k Ω , V $_{AD}$ = V $_{DD}$ = 4.0V, LIGHT SOURCE = DAYLIGHT FLUORESCENT LAMP)

| CHARACTERISTIC | SYMBOL | MIN. | TYP. | MAX. | UNIT | NOTE |
|---------------------------------|------------|------|-------|------|------------|------------------------------|
| Sensitivity | R | 110 | 160 | — | V / lx·s | |
| Photo Response Non Uniformity | PRNU | — | — | 10 | % | (Note 2) |
| Register Imbalance | RI | — | — | 3 | % | (Note 3) |
| Saturation Output Voltage | V $_{SAT}$ | 450 | 600 | — | mV | V $_{OD}$ = 3.0V (Note 4) |
| Dark Signal Voltage | V $_{MDK}$ | — | 2 | 5 | mV | (Note 5) |
| Total Transfer Efficiency | TTE | 92 | 95 | — | % | |
| Dynamic Range | DR | — | 300 | — | — | (Note 6) |
| Saturation Exposure | SE | — | 0.004 | — | lx·s | (Note 7) |
| DC Power Dissipation | PD | — | 25 | 75 | mW | |
| DC Signal Output Voltage | V $_{OS}$ | 1.5 | 2.5 | 3.5 | V | (Note 8) |
| Output Impedance | Z $_{o}$ | — | 0.5 | 1.0 | k Ω | |
| Image Lag of Electronic Shutter | VLAGICG | — | — | 10 | mV | T $_{int}$ = 100 μ s |

(Note 2) Measured at 50% of SE (Typ.)

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

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

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

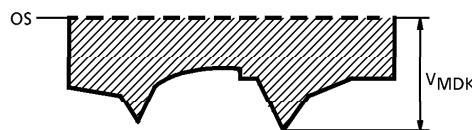
RI is defined as follows:

$$RI = \frac{\sum_{n=1}^{3647} |\chi_n - \chi_{n+1}|}{3647 \cdot \bar{x}} \times 100 (\%)$$

Where χ_n and χ_{n+1} are signal outputs of each pixel. \bar{x} is average of total signal outputs.

(Note 4) V $_{SAT}$ is defined as minimum saturation output voltage of all effective pixels.

(Note 5) V $_{MDK}$ is defined as maximum dark signal voltage of all effective pixels.



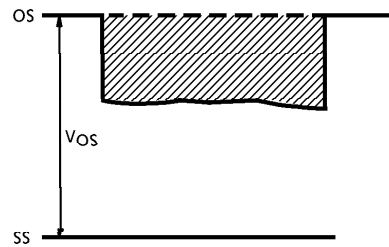
(Note 6) Definition of DR : $DR = \frac{V_{SAT}}{V_{MDK}}$

V_{MDK} is proportional to t_{INT} (Integration time).

So the shorter t_{INT} condition makes wider DR value.

(Note 7) Definition of SE : $SE = \frac{V_{SAT}}{R} (lx \cdot s)$

(Note 8) DC signal output voltage is defined as follows:



OPERATING CONDITION

| CHARACTERISTIC | | SYMBOL | MIN. | TYP. | MAX. | UNIT |
|----------------------------|-----------|--------------|------|------|------|------|
| Master Clock Pulse Voltage | "H" Level | $V_{\phi M}$ | 3.0 | 4.0 | 5.5 | V |
| | "L" Level | | 0 | 0 | 0.44 | |
| SH Pulse Voltage | "H" Level | V_{SH} | 3.0 | 4.0 | 5.5 | V |
| | "L" Level | | 0 | 0 | 0.44 | |
| ICG Pulse Voltage | "H" Level | V_{ICG} | 3.0 | 4.0 | 5.5 | V |
| | "L" Level | | 0 | 0 | 0.44 | |
| Digital Power Supply | | V_{DD} | 3.0 | 4.0 | 5.5 | V |
| Analog Power Supply | | V_{AD} | 3.0 | 4.0 | 5.5 | V |

(Note) $V_{AD} = V_{DD}$
 MAX. Voltage of Pulse Voltage "H" Level = V_{DD}
 MIN. Voltage of Pulse Voltage "H" Level = $V_{DD} - 0.5V$

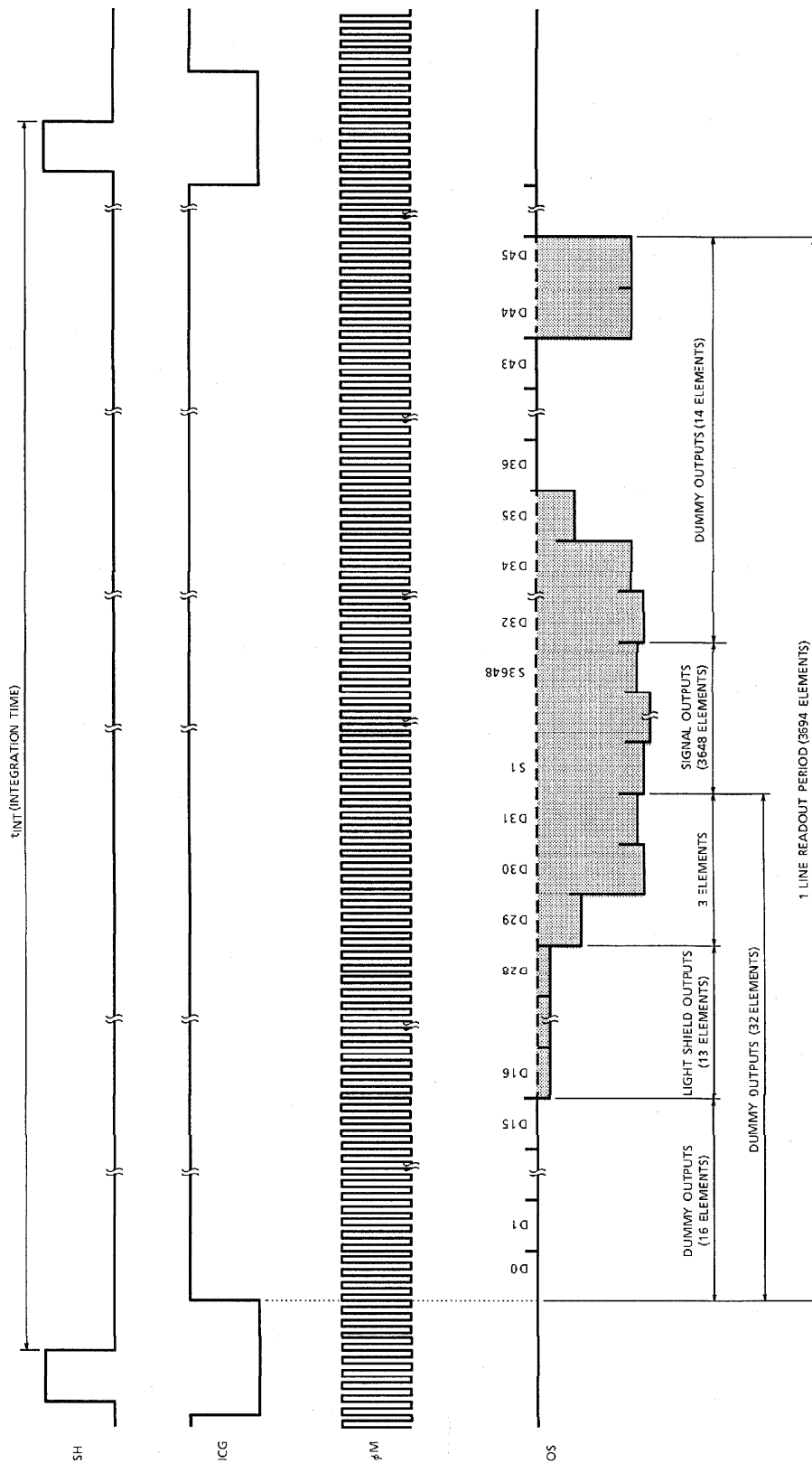
CLOCK CHARACTERISTICS (Ta = 25°C) ($V_{AD} = V_{DD} \geq 4.0V$)

| CHARACTERISTIC | SYMBOL | MIN. | TYP. | MAX. | UNIT |
|--------------------------|--------------|------|------|------|------|
| Master Clock Frequency | $f_{\phi M}$ | 0.8 | 2 | 4 | MHz |
| Data Rate | f_{DATA} | 0.2 | 0.5 | 1 | MHz |
| Master Clock Capacitance | $C_{\phi M}$ | — | 10 | — | pF |
| Shift Pulse Capacitance | C_{SH} | — | 600 | — | pF |
| ICG Pulse Capacitance | C_{ICG} | — | 250 | — | pF |

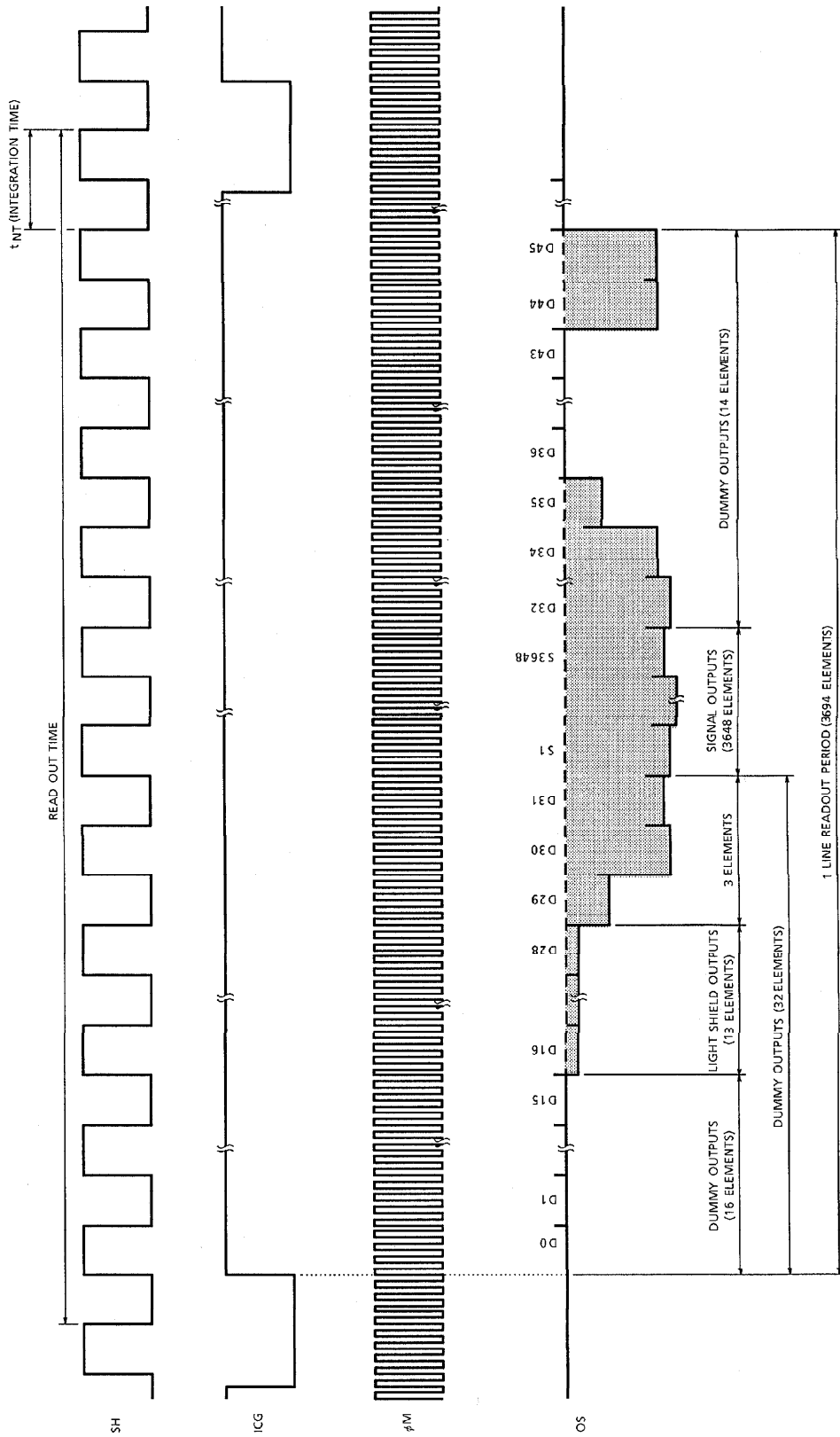
CLOCK CHARACTERISTICS (Ta = 25°C) ($4.0V > V_{AD} = V_{DD} \geq 3.0V$)

| CHARACTERISTIC | SYMBOL | MIN. | TYP. | MAX. | UNIT |
|------------------------|--------------|------|------|------|------|
| Master Clock Frequency | $f_{\phi M}$ | 0.8 | 2 | 2.4 | MHz |
| Data Rate | f_{DATA} | 0.2 | 0.5 | 0.6 | MHz |

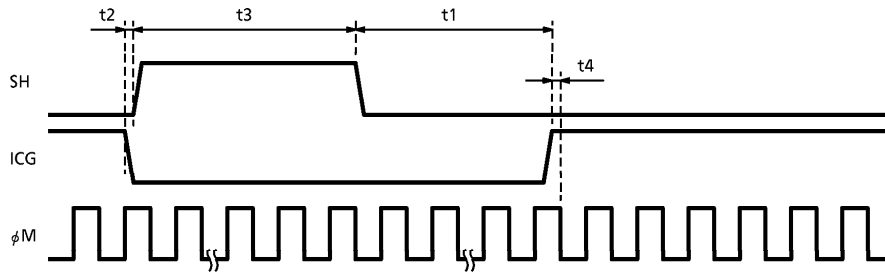
TIMING CHART



TIMING CHART (Use electric shutter function)



TIMING REQUIREMENTS



| CHARACTERISTIC | SYMBOL | MIN. | TYP. | MAX. | UNIT |
|----------------------------------|--------|------|------|------|------|
| ICG Pulse DELAY | t1 | 1000 | 5000 | — | ns |
| Pulse Timing of ICG and S H | t2 | 100 | 500 | 1000 | ns |
| SH Pulse Width | t3 | 1000 | — | — | ns |
| Pulse Timing of ICG and ϕM | t4 | 0 | 20 | * | ns |

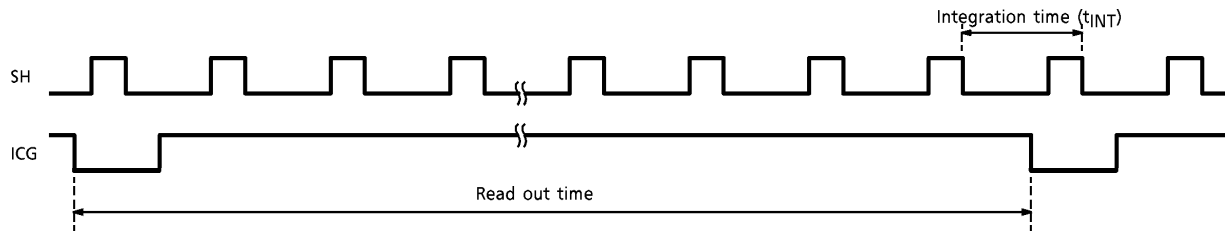
* : You keep ϕM "High" Level.

(Note) : If you use electronic shutter function. $t_{INT} (MIN.) = 10\mu s$

USE ELECTRONIC SHUTTER

Pulse Timing of SH and ICG

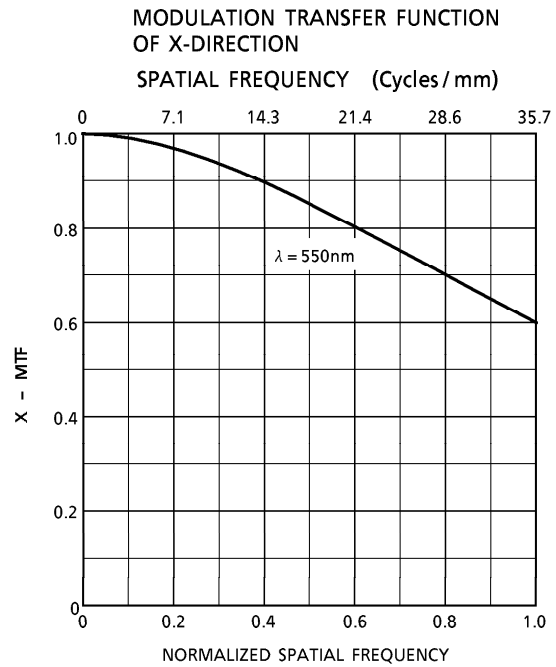
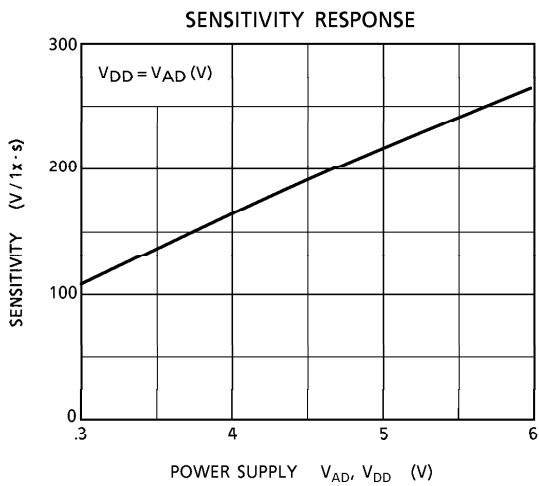
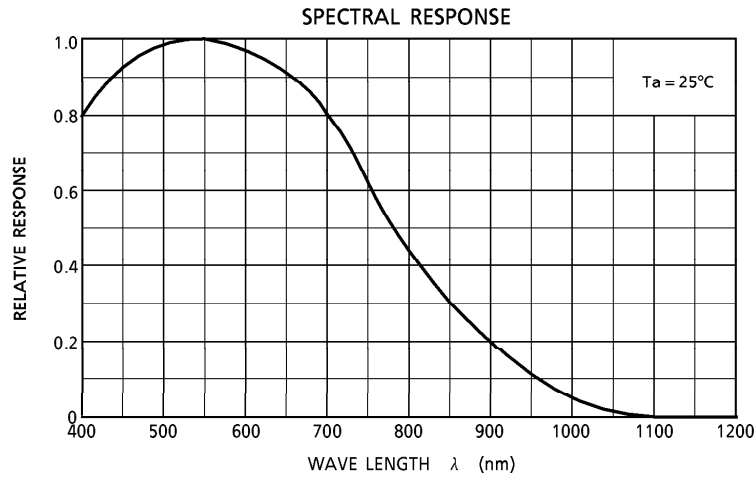
- SH cycle = Tint



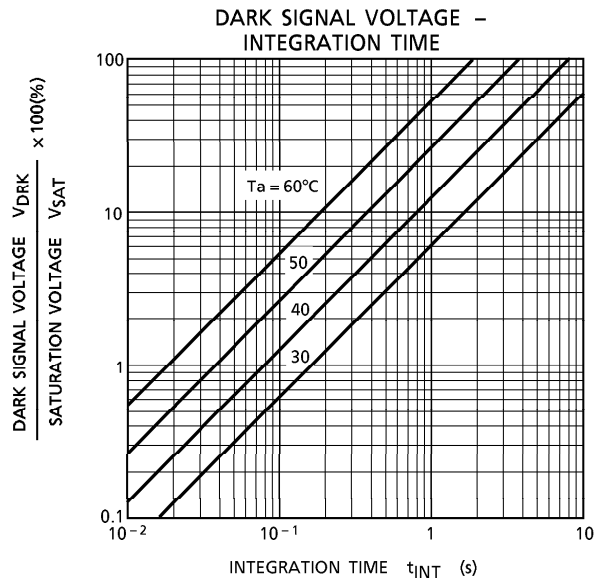
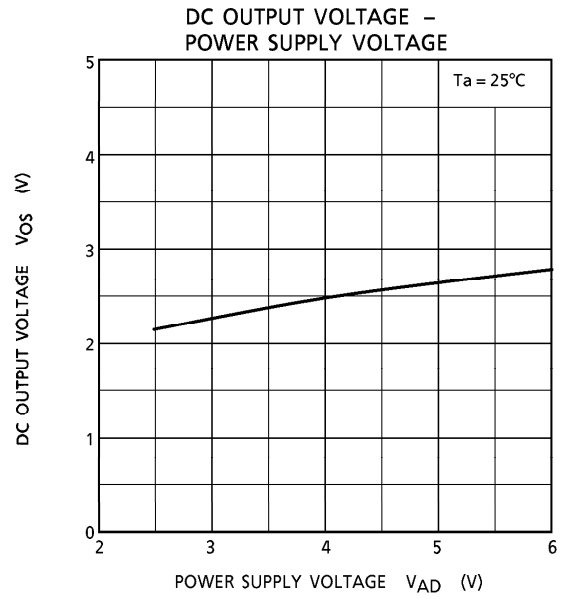
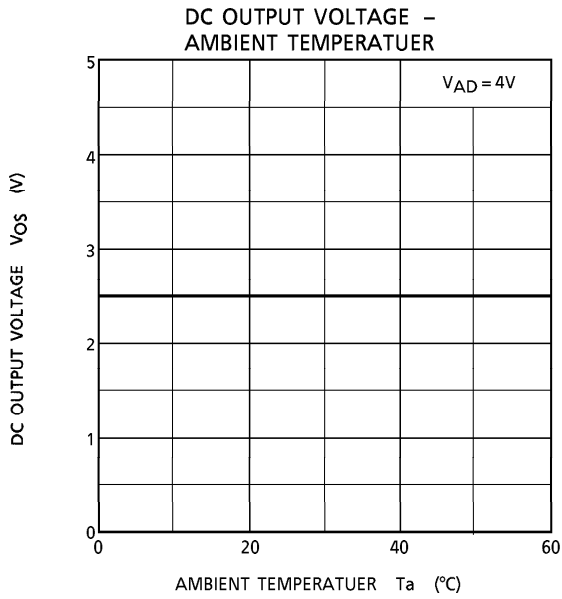
$t_{INT} (MIN.) = 10 \mu s$

You have always same SH pulse width (t3).

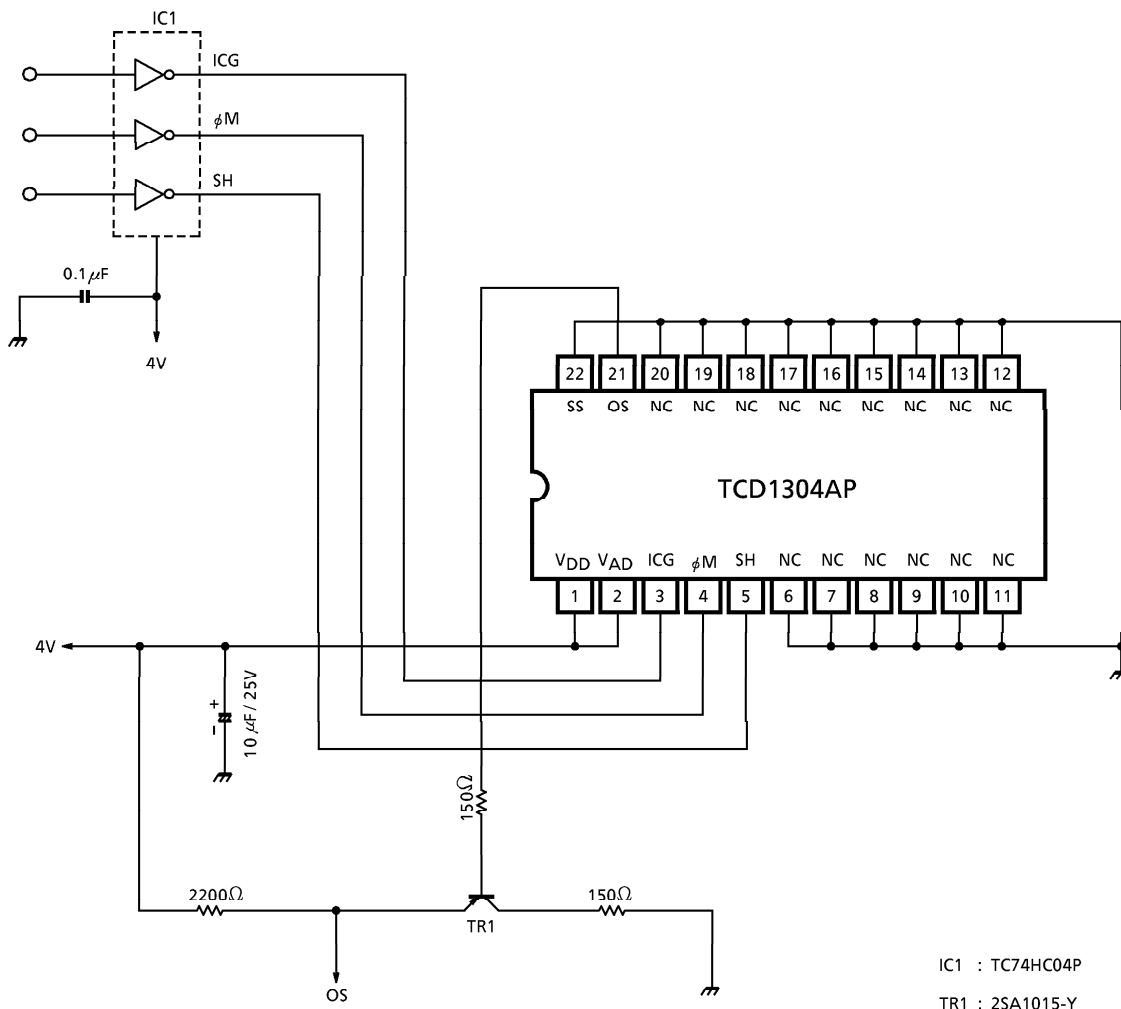
TYPICAL PERFORMANCE CURVES



TYPICAL PERFORMANCE CURVES



TYPICAL DRIVE CIRCUIT



PRECAUTIONS FOR USE OF CCD IMAGE SENSOR**1. Static Electricity**

This device has some weakly terminals for static electricity. Therefore, please pay attention to treat this device.

CCD Image Sensor is protected against static electricity, but inferior puncture mode device due to static electricity is sometimes detected. In handling 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 plier or pincette.

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.

2. Window Glass

As the dust and station on the glass window of the package will cause black flow on the picture, never fail to clean the glass surface before using. (Blow compressed vapor, and wipe off the dust, and dirt with soft cloth or paper slightly moistened with alcohol).

Fully take care for the handling of the device as the window glass will break or a strong friction is given to the window glass surface.

3. Incident Light

CCD sensor is sensitive to infrared light.

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

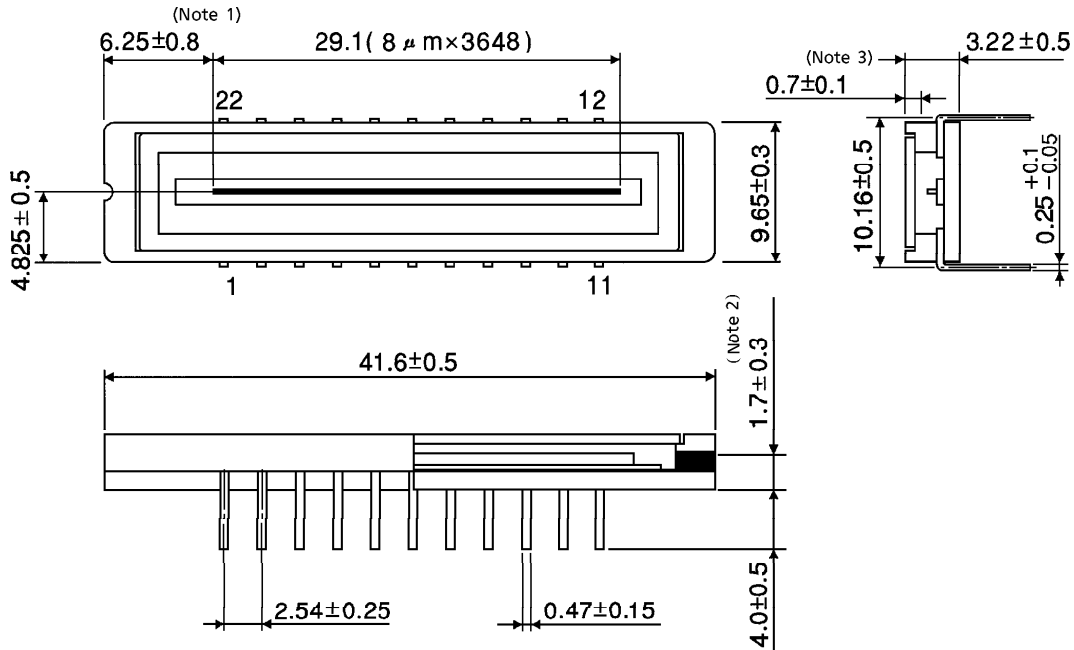
4. Lead Frame Forming

Since this package is not stout against mechanical stress, you should not reform the lead frame.

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

OUTLINE DRAWING

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)

Weight : 2.7g (Typ.)