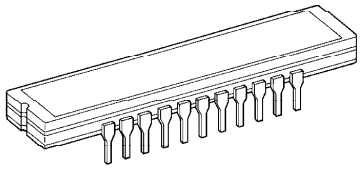
**TENTATIVE** TOSHIBA CCD LINEAR IMAGE SENSOR CCD(Charge Coupled Device)

# TCD136C-2

The TCD136C-2 is 520-elements × 3 color (1560 elements) CCD color linear image sensor. CCD chip covered with Red, Green and Blue Color Filters.
The sensor can be used for color copy M/C and color image scanner.



WDIP22-C-400-2.54A

Weight : 4.9g (Typ.)

## FEATURES

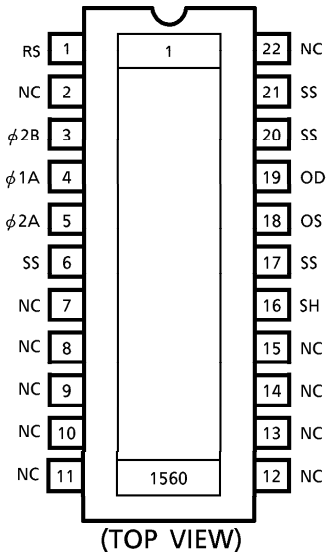
- Number of Image Sensing Elements : 1560 (520 × 3 color sequential)
- Image Sensing Element Size : 12$\mu$m by 47$\mu$m on 63.5$\mu$m centers
- Photo Sensing Region : High sensitive pn photodiode
- Clock : 2 phase
- Package : 22 pin DIP
- Color Filter : Red, Green, Blue

## MAXIMUM RATINGS (Note 1)

| CHARACTERISTIC | SYMBOL | RATING | UNIT |
|---|---|---|---|
| Clock Pulse Voltage | $V_\phi$ | −0.3~15 | V |
| Shift Pulse Voltage | $V_{SH}$ | | V |
| Reset Pulse Voltage | $V_{RS}$ | | V |
| Power Supply Voltage | $V_{OD}$ | | 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).

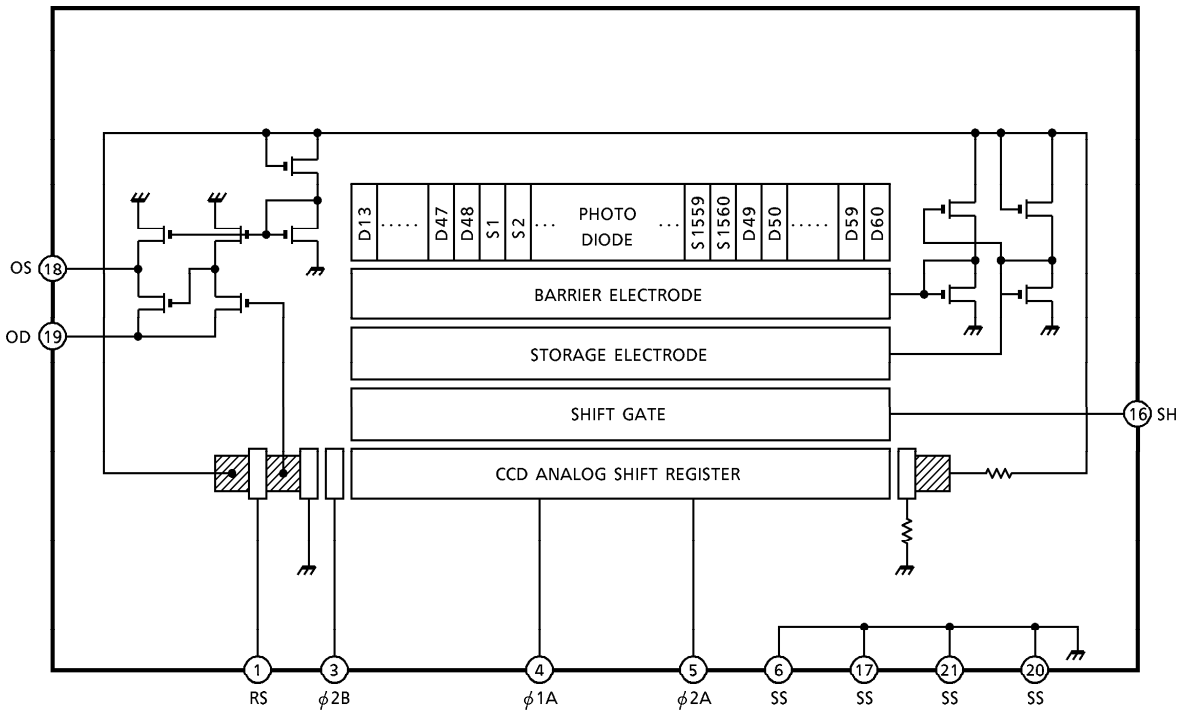
## PIN CONNECTIONS




(TOP VIEW)

961001EBA2

## CIRCUIT DIAGRAM




## PIN NAMES

| | |
|---|---|
| $\phi$1A | Clock (Phase 1) |
| $\phi$2A | Clock (Phase 2) |
| $\phi$2B | Final Stage Clock (Phase 2) |
| SH | Shift Gate |
| RS | Reset Gate |
| OS | Signal Output |
| OD | Power |
| SS | Ground |
| NC | Non Connection |

**OPTICAL / ELECTRICAL CHARACTERISTICS**

(Ta = 25°C, $V_{OD}$ = 12V, $V_\phi = V_{RS} = V_{SH}$ = 12V (PULSE), $f_\phi$ = 1MHz, $t_{INT}$ (INTEGRATION TIME) = 10ms, LIGHT SOURCE = A LIGHT SOURCE + CM500S FILTER (t = 1.0mm), LOAD RESISTANCE = 100kΩ)

| CHARACTERISTIC | SYMBOL | MIN. | TYP. | MAX. | UNIT | NOTE |
|---|---|---|---|---|---|---|
| Sensitivity (Red) | $R_R$ | 1.7 | 2.5 | 3.3 | V / lx·s | (Note 2) |
| Sensitivity (Green) | $R_G$ | 1.6 | 2.3 | 3.0 | V / lx·s | (Note 2) |
| Sensitivity (Blue) | $R_B$ | 0.6 | 0.9 | 1.2 | V / lx·s | (Note 2) |
| Photo Response Non Uniformity | PRNU | — | — | 10 | % | (Note 3) |
| Saturation Output Voltage | $V_{SAT}$ | 0.8 | 1.0 | — | V | (Note 4) |
| Saturation Exposure | SE | — | 0.4 | — | lx·s | (Note 5) |
| Dark Signal Voltage | $V_{DRK}$ | — | 5 | 10 | mV | (Note 6) |
| Dark Signal Non Uniformity | DSNU | — | — | 5 | mV | (Note 7) |
| DC Power Dissipation | $P_D$ | — | 80 | 150 | mW | |
| Total Transfer Efficiency | TTE | 92 | 95 | — | % | |
| Output Impedance | $Z_O$ | — | 0.4 | 1.0 | kΩ | |
| Dynamic Range | DR | — | 160 | — | | (Note 8) |
| DC Signal Output Voltage | $V_{OS}$ | 3.0 | — | 8.0 | 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 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 1 and uniform color temperature.

$$PRNU = \frac{\Delta\chi}{\overline{\chi}} \times 100\ (\%)$$

Where $\overline{\chi}$ is average of referred outputs and $\Delta\chi$ is the maximum deviation from $\overline{\chi}$.
The amount of the incident light is shown below.

$$Red = \frac{1}{2}\ SE$$

$$Green = \frac{1}{2}\ SE$$

$$Blue = \frac{1}{4}\ SE$$

(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·s)

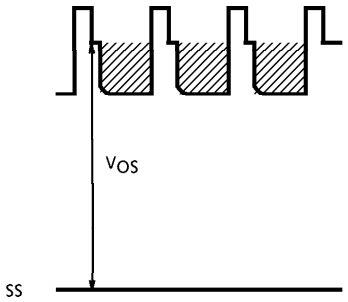
(Note 6) $V_{DRK}$ is defined as average dark signal voltage of all effective pixels.

(Note 7) 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 $t_{INT}$ gets condition makes wider DR value.

(Note 9) DC output voltage is defined as follows:



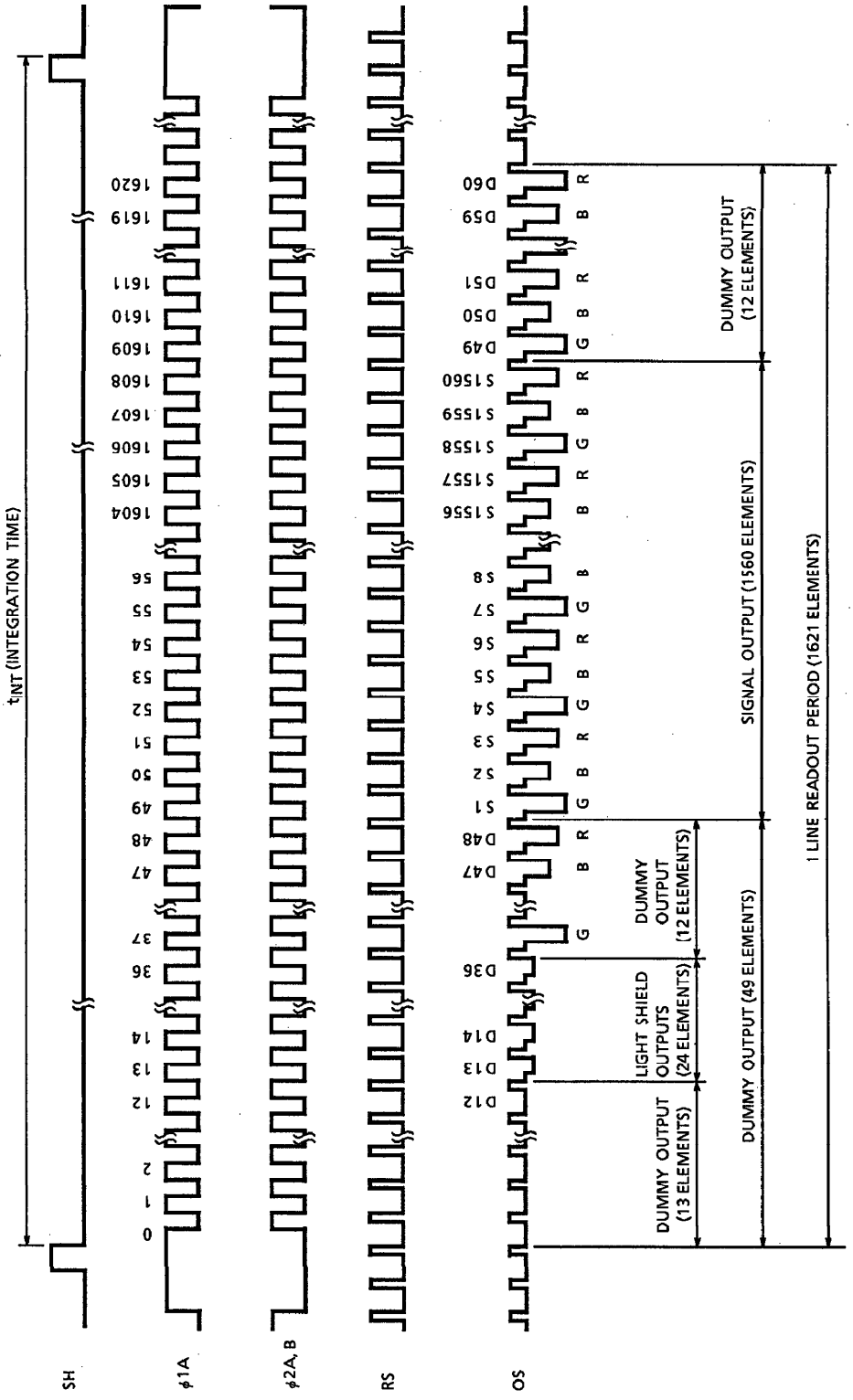
**OPERATING CONDITION**

| CHARACTERISTIC | | SYMBOL | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Clock Pulse Voltage | "H" Level | $V_{\phi 1A}$ | 11 | 12 | 13 | V |
| | "L" Level | $V_{\phi 2A}$ | 0 | 0.5 | 0.8 | |
| Final Stage Clock Pulse Voltage | "H" Level | $V_{\phi 2B}$ | 11 | 12 | 13 | V |
| | "L" Level | | 0 | 0.5 | 0.8 | |
| Shift Pulse Voltage | "H" Level | $V_{SH}$ | 11 | 12 | 13 | V |
| | "L" Level | | 0 | 0.5 | 0.8 | |
| Reset Pulse Voltage | "H" Level | $V_{RS}$ | 11 | 12 | 13 | V |
| | "L" Level | | 0 | 0.5 | 0.8 | |
| Power Supply Voltage | | $V_{OD}$ | 11.4 | 12 | 13 | V |

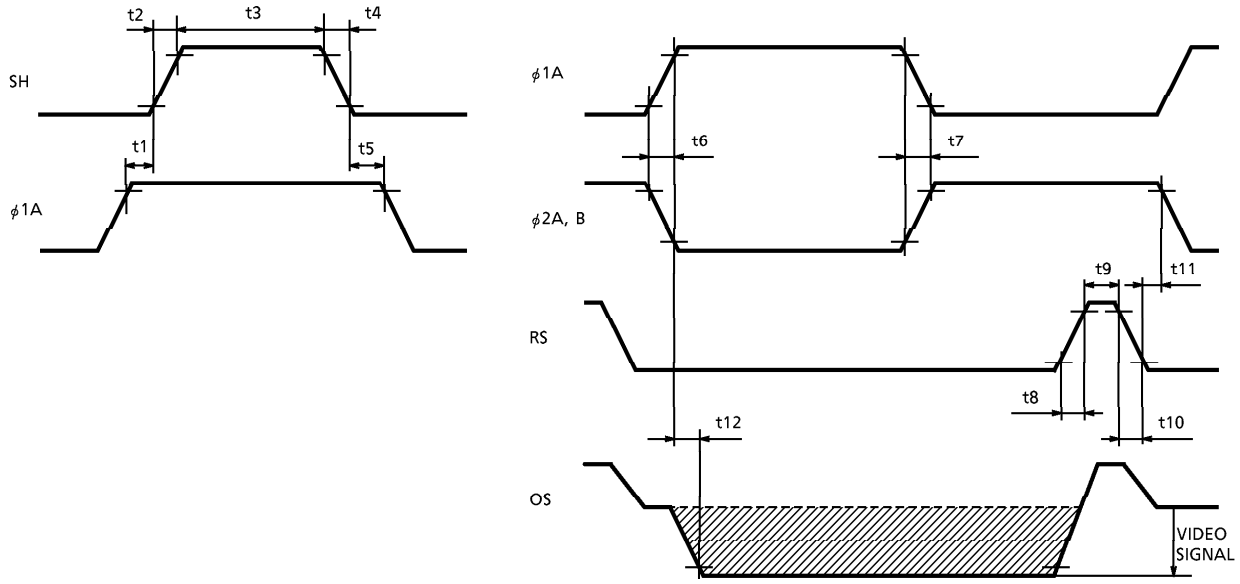
**CLOCK CHARACTERISTICS** (Ta = 25°C)

| CHARACTERISTIC | SYMBOL | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|
| Clock Pulse Frequency | $f_{\phi}$ | — | 1 | 5 | MHz |
| Reset Pulse Frequency | $f_{RS}$ | — | 1 | 5 | MHz |
| Clock Capacitance | $C_{\phi A}$ | — | 450 | 700 | pF |
| Final Stage Clock Capacitance | $C_{\phi B}$ | — | 20 | 40 | pF |
| Shift Gate Capacitance | $C_{SH}$ | — | 200 | 300 | pF |
| Reset Gate Capacitance | $C_{RS}$ | — | 10 | 20 | pF |

TIMING CHART



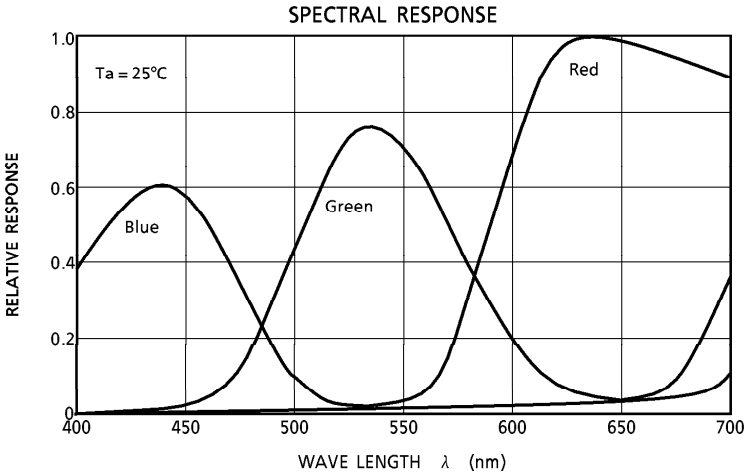
**TIMING REQUIREMENTS**




| CHARACTERISTIC | SYMBOL | MIN. | TYP. (Note 10) | 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 | 1000 | 5000 | — | ns |
| $\phi$1A, $\phi$2A, B Pulse Rise Time, Fall Time | t6, t7 | 0 | 100 | — | ns |
| RS Pulse Rise Time, Fall Time | t8, t10 | 0 | 50 | — | ns |
| RS Pulse Width | t9 | 40 | 250 | — | ns |
| Pulse Timing of $\phi$2B and RS | t11 | 0 | 250 | — | ns |
| Video Data Delay Timing (Note 11) | t12 | — | 50 | — | ns |

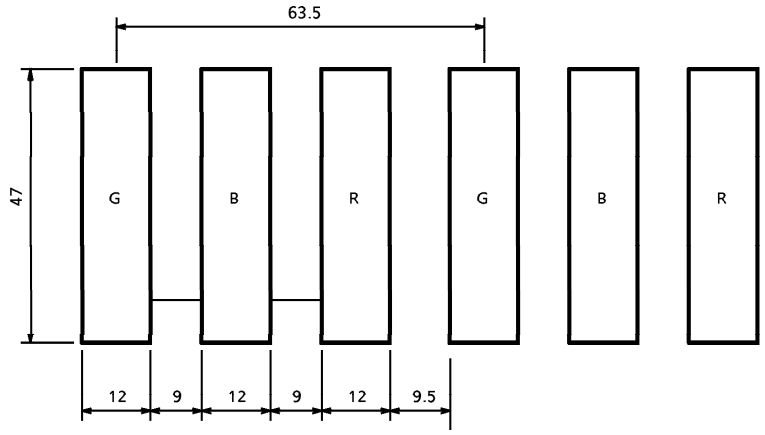
(Note 10) TYP, is the case of $f_{RS}$ = 1MHz.
(Note 11) Load Resistance is 100kΩ.

## TYPICAL PERFORMANCE CURVES




## ELEMENT SHAPE

Unit in mm



**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 $N_2$.
   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.

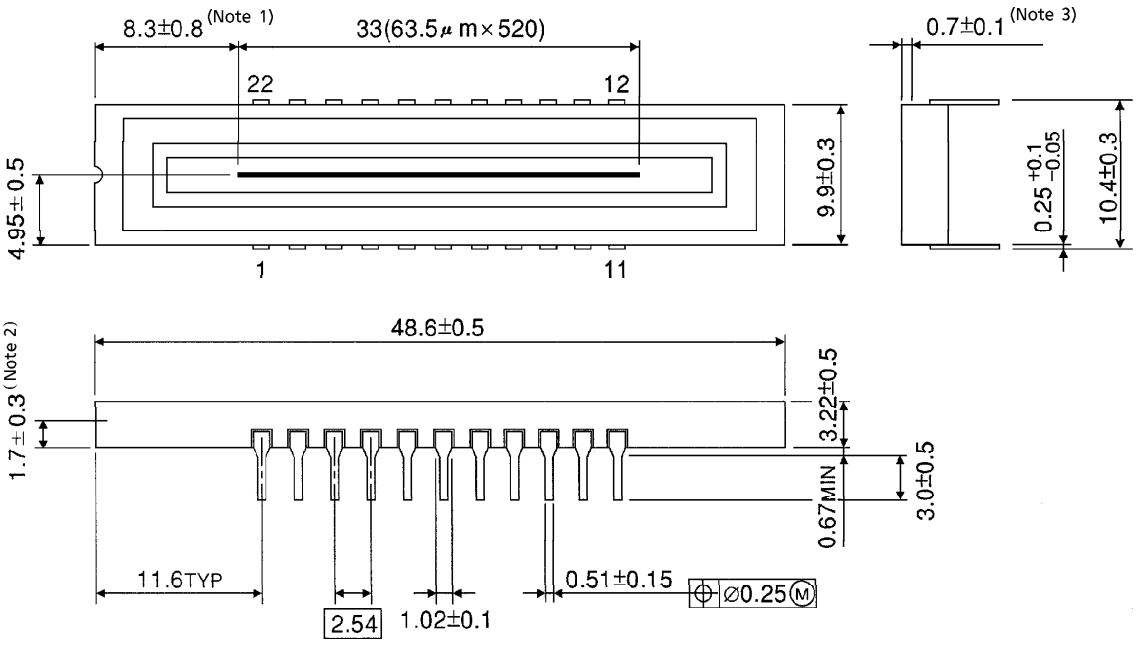
3. Incident Light

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

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.

**OUTLINE DRAWING**

WDIP22-C-400-2.54A (A) 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 : 4.9g (Typ.)