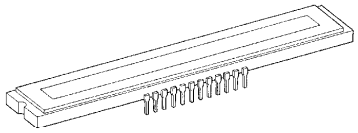
TOSHIBA CCD LINEAR IMAGE SENSOR CCD(Charge Coupled Device)

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.



WDIP24-C-600-2.54 (A)

Weight : 17.1 g (Typ.)

FEATURES

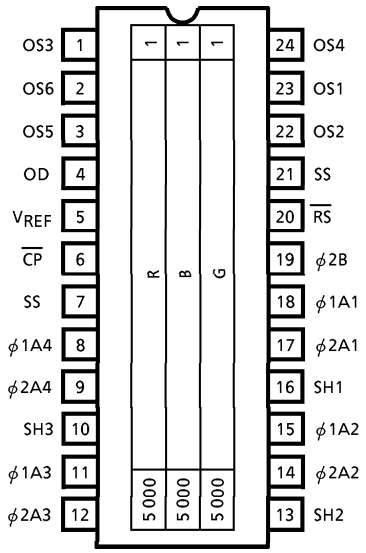
- Number of Image Sensing Elements : 5000 elements × 3 lines
- Image Sensing Element Size : 14 μm by 14 μm on 14 μm centers
- Photo Sensing Region : High sensitive pn photodiode
- Distance Between Photodiode Array : 84 μm (6 Lines)
- Clock : 2 phase (5 V)
- Package : 24 pin DIP
- Clock Filter : Red, 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	$V_{\overline{RS}}$		
Clamp Pulse Voltage	$V_{\overline{CP}}$		
Power Supply Voltage	V_{OD}	−0.3~15	
	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).

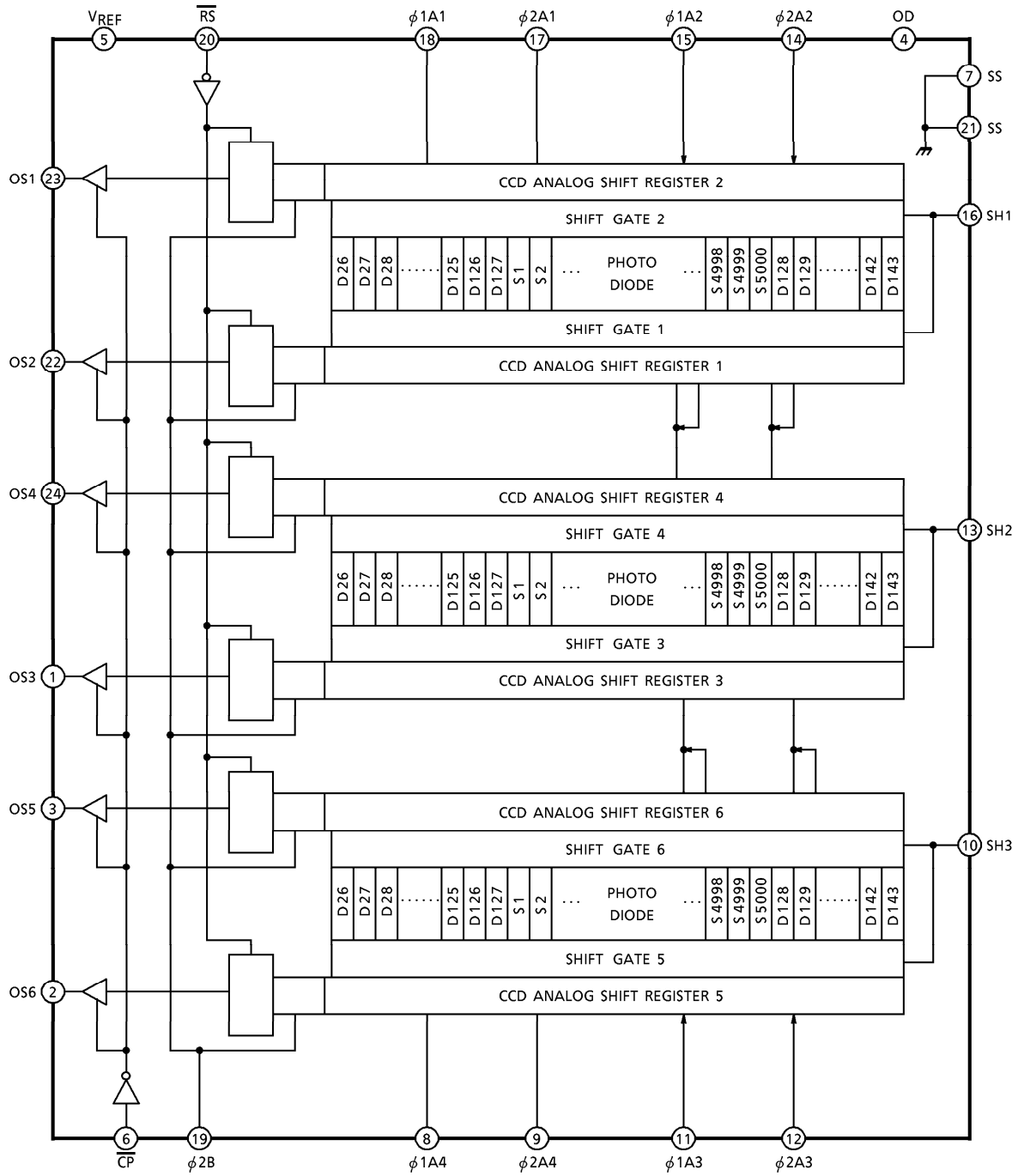
PIN CONNECTIONS



(TOP VIEW)

980910EBA2

CIRCUIT DIAGRAM



PIN NAMES

ϕ1A1 ,2, 3, 4	Clock 1	OS1	Signal Output 1 (Green)
ϕ2A1 ,2, 3, 4	Clock 2	OS2	Signal Output 2 (Green)
ϕ2B	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

(Ta = 25°C, V_{OD} = 12 V, V_ϕ = $V_{\overline{RS}}$ = $V_{\overline{CP}}$ = V_{SH} = 5 V (pulse), f_ϕ = 1.0 MHz, $f_{\overline{RS}}$ = 1.0 MHz,
LOAD RESISTANCE = 100 kΩ, t_{INT} (INTEGRATION TIME) = 10 ms,
LIGHT SOURCE = A LIGHT SOURCE + CM500S FILTER (t = 1.0 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	kΩ	
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.

$$PRNU\ (1) = \frac{\Delta\chi}{\overline{\chi}} \times 100\ (\%)$$

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

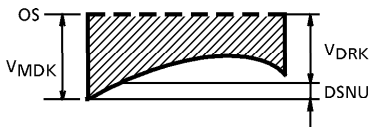
(Note 4) : PRNU (3) is defined as maximum voltage with next pixel, where measured 5% of SE (Typ.).

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

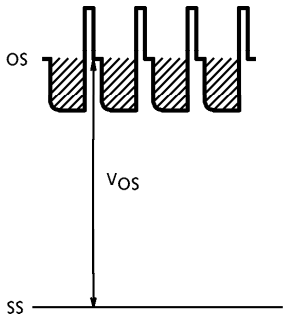
(Note 6) : Definition of SE : $SE = \frac{V_{SAT}}{R_G}$

(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

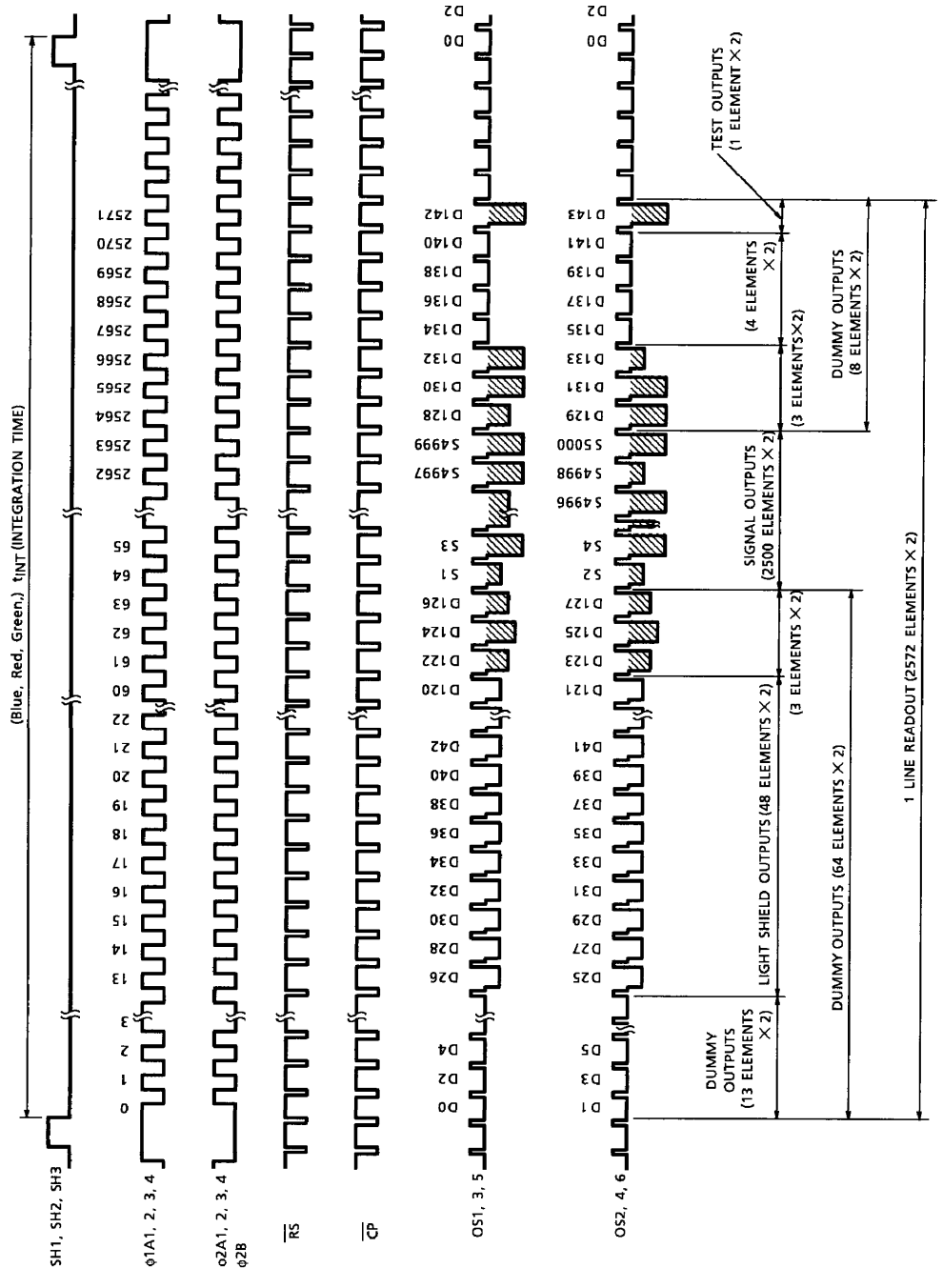
CHARACTERISTIC		SYMBOL	MIN.	TYP.	MAX.	UNIT
Clock Pulse Voltage	"H" Level	$V_{\phi A}$	4.5	5.0	5.5	V
	"L" Level		0	—	0.5	
Final Stage Clock Pulse Voltage	"H" Level	$V_{\phi B}$	4.5	5.0	5.5	V
	"L" Level		0	—	0.5	
Shift Pulse Voltage (Note 10)	"H" Level	V_{SH}	$V_{\phi A}$"H" − 0.5	$V_{\phi A}$"H"	$V_{\phi A}$"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) : $V_{\phi A}$"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

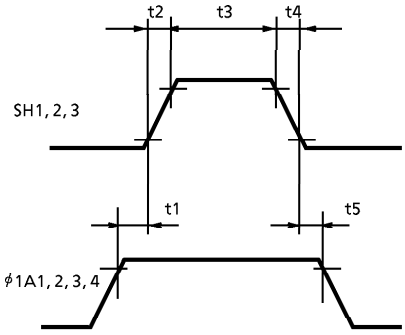
TIMING CHART



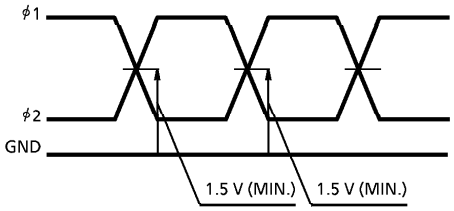
TCD2502C-1—6

TIMING REQUIREMENTS

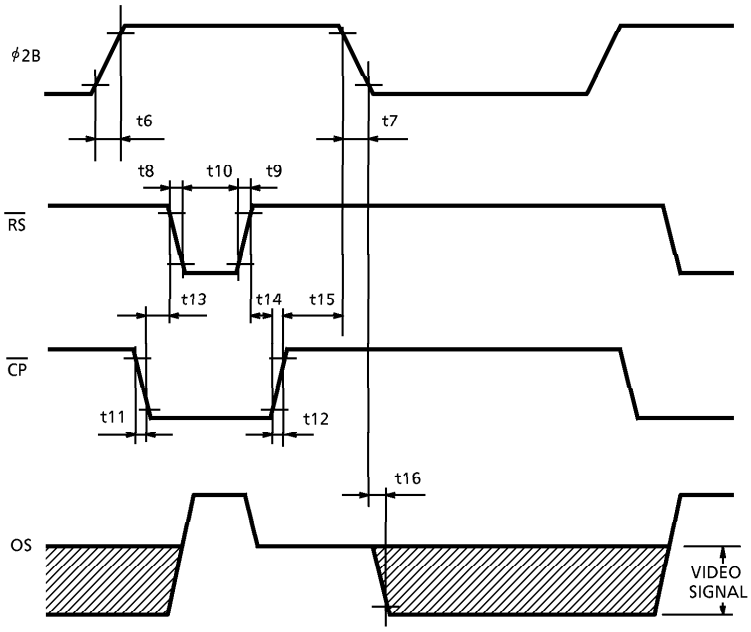
SH, ϕ1 TIMING



ϕ1, ϕ2 CROSS POINT



ϕ2B, $\overline{RS}$, $\overline{CP}$, OS, TIMING

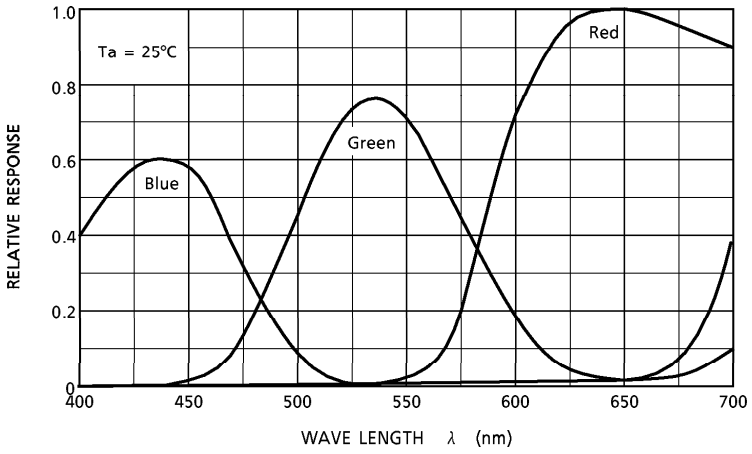


CHARACTERISTIC	SYMBOL	MIN.	TYP. (Note 12)	MAX.	UNIT
Pulse Timing of SH and ϕ1A	t1, t5	0	100	—	ns
SH Pulse Rise Time, Fall Time	t2, t4	0	50	—	ns
SH Pulse Width	t3	800	1000	—	ns
ϕ2B Pulse Rise Time, Fall Time	t6, t7	0	100	—	ns
$\overline{RS}$ Pulse Rise Time, Fall Time	t8, t9	0	20	—	ns
$\overline{RS}$ 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 ϕ2B	t15	20	50	—	ns
Video Data Delay Time (Note 13)	t16	—	30	—	ns

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

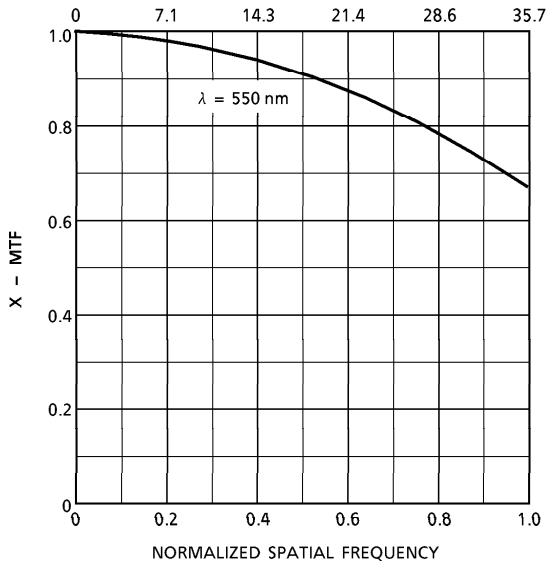
TYPICAL PERFORMANCE CURVES

SPECTRAL RESPONSE



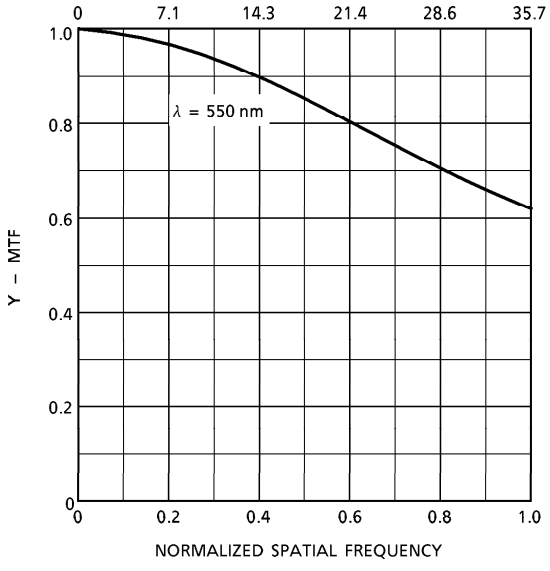
MODULATION TRANSFER FUNCTION
OF X-DIRECTION

SPATIAL FREQUENCY (Cycles / mm)

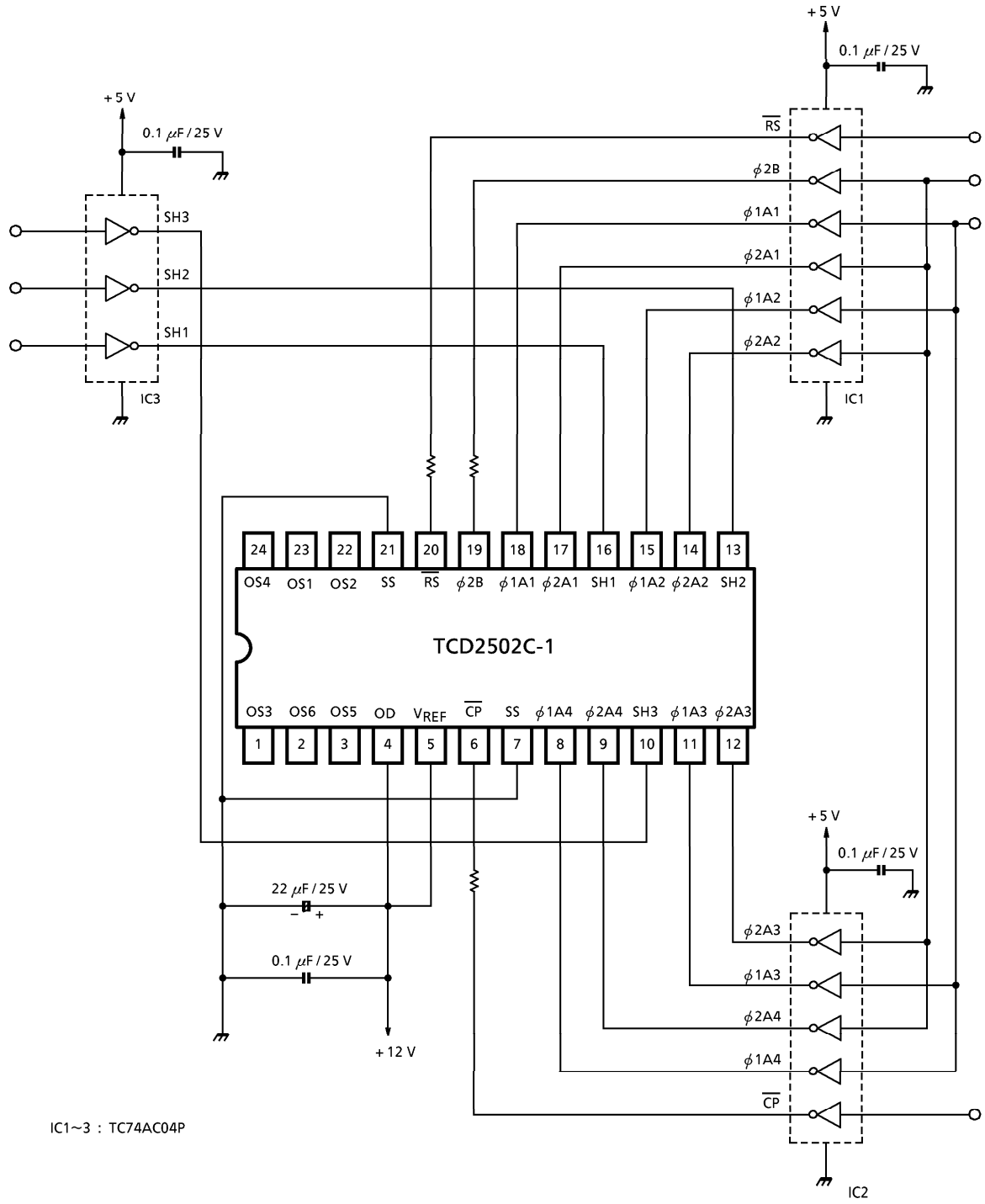


MODULATION TRANSFER FUNCTION
OF Y-DIRECTION

SPATIAL FREQUENCY (Cycles / mm)



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 N_2.
   Care should be taken to avoid mechanical or thermal shock because the glass window is easily to damage.

2. Electrostatic Breakdown

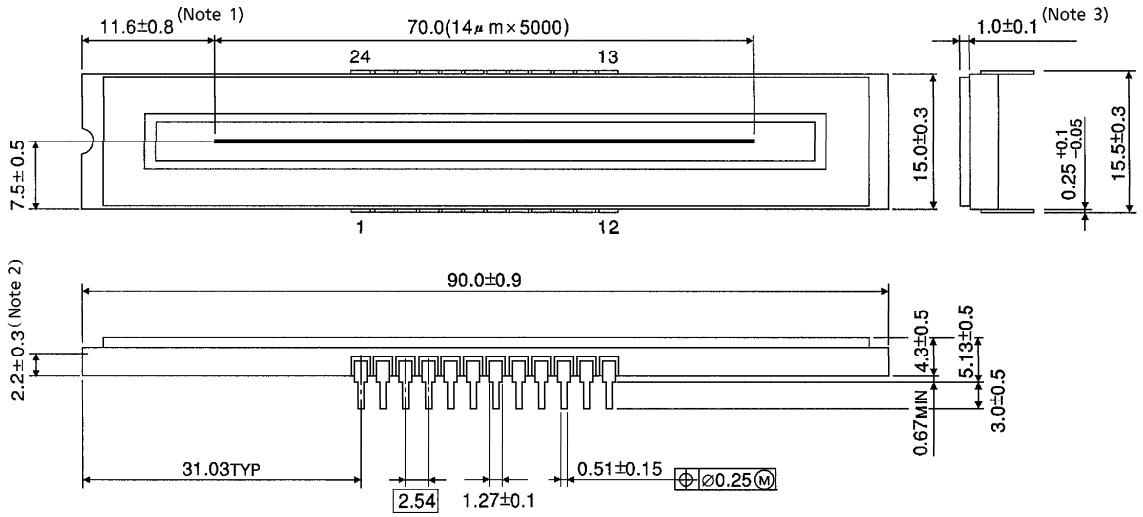
   Store in shorting clip or in conductive foam to avoid electrostatic breakdown.

3. Incident Light

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

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.)