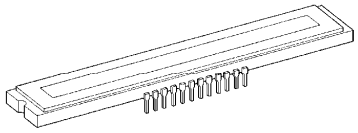
TENTATIVE TOSHIBA CCD LINEAR IMAGE SENSOR CCD (Charge Coupled Device)

TCD2701C

The TCD2701C is a high sensitive and low dark current 7500 elements × 3 line CCD color image sensor.
The sensor is designed for color scanner.
The device contains a row of 7500 elements × 3 line photodiodes which provide a 24 lines / mm across a A3 size paper. The device is operated by 5 V pulse, and 12 V power supply.



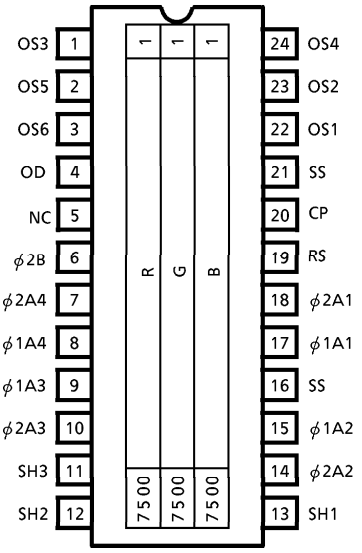
WDIP24-C-600-2.54 (E)

Weight : 17.1 g (Typ.)

FEATURES

- Number of Image Sensing Elements : 7500 elements × 3 line
- Image Sensing Element Size : 9.325 μm by 9.325 μm on 9.325 μm centers
- Photo Sensing Region : High sensitive pn photodiode
- Clock : 2 phase (5 V)
- Distance Between Photodiode Array : 37.3 μm (4 Lines)
- Internal Circuit : Clamp circuit
- Package : 24 pin DIP
- Color Filter : Red, Green, Blue

PIN CONNECTIONS



(TOP VIEW)

MAXIMUM RATINGS (Note 1)

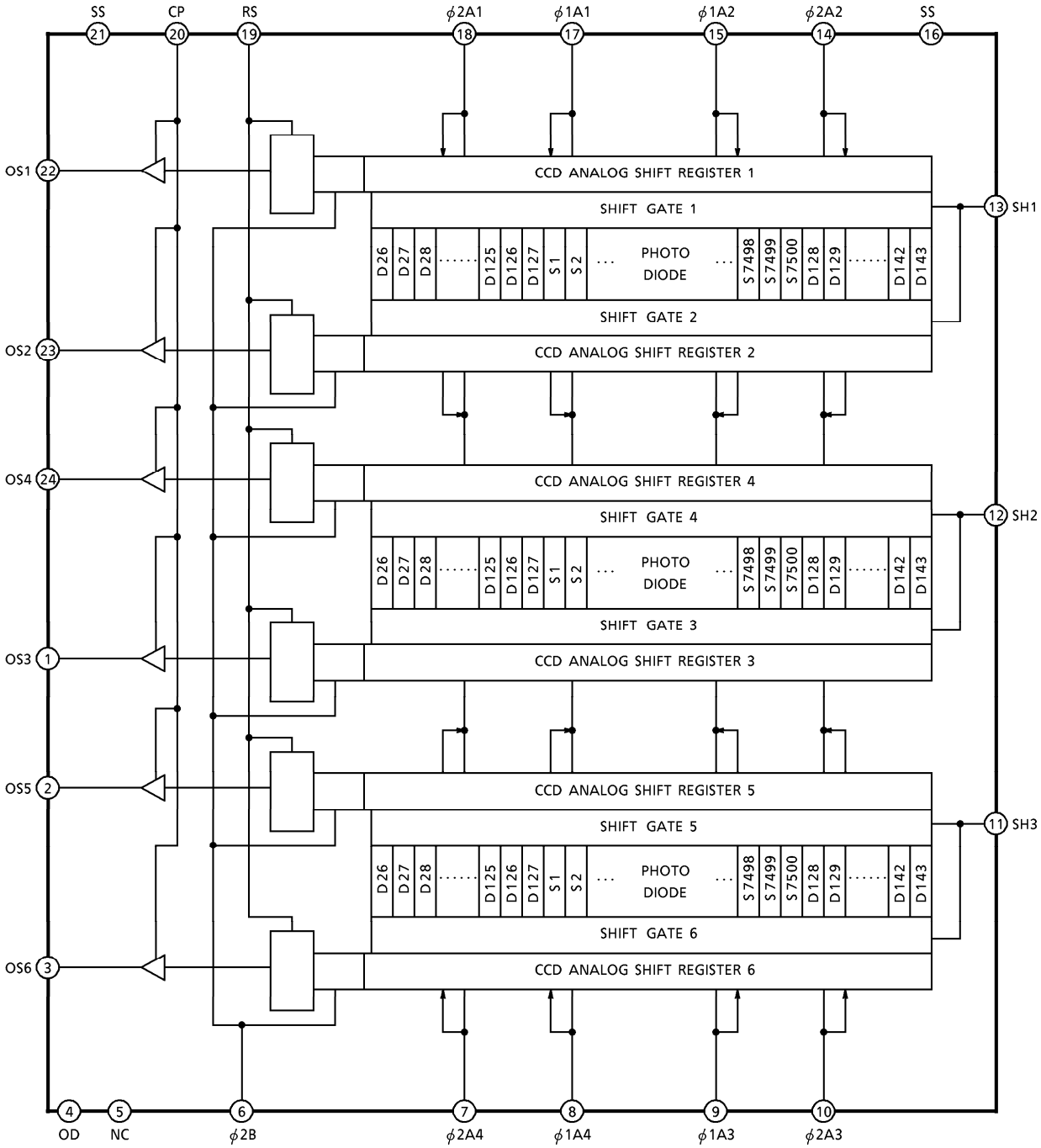
CHARACTERISTIC	SYMBOL	RATING	UNIT
Clock Pulse Voltage	V_ϕ	−0.3~8	V
Shift Pulse Voltage	V_{SH}		
Reset Pulse Voltage	V_{RS}		
Clamp Pulse Voltage	V_{CP}		
Power Supply Voltage	V_{OD}	−0.3~15	V
Operating Temperature	T_{opr}	0~60	°C
Storage Temperature	T_{stg}	−25~85	°C

(Note 1) : All voltage are with respect to SS terminals (Ground).

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- The information contained herein is subject to change without notice.

CIRCUIT DIAGRAM



PIN NAMES

PIN No.	SYMBOL	NAME	PIN No.	SYMBOL	NAME
1	OS3	Signal Output 3 (Green)	13	SH1	Shift Gate 1
2	OS5	Signal Output 5 (Red)	14	ϕ2A2	Clock 2 (Phase 2)
3	OS6	Signal Output 6 (Red)	15	ϕ1A2	Clock 2 (Phase 1)
4	OD	Power	16	SS	Ground
5	NC	Non Connection	17	ϕ1A1	Clock 1 (Phase 1)
6	ϕ2B	Final Stage Clock (Phase 2)	18	ϕ2A1	Clock 1 (Phase 2)
7	ϕ2A4	Clock 4 (Phase 2)	19	RS	Reset Gate
8	ϕ1A4	Clock 4 (Phase 1)	20	CP	Clamp Gate
9	ϕ1A3	Clock 3 (Phase 1)	21	SS	Ground
10	ϕ2A3	Clock 3 (Phase 2)	22	OS1	Signal Output 1 (Blue)
11	SH3	Shift Gate 3	23	OS2	Signal Output 2 (Blue)
12	SH2	Shift Gate 2	24	OS4	Signal Output 4 (Green)

OPTICAL / ELECTRICAL CHARACTERISTICS

(Ta = 25°C, V_{OD} = 12 V, Vϕ = V_{SH} = V_{RS} = V_{CP} = 5 V (PULSE), fϕ = 1 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	R_R	5.0	7.2	9.4	V / lx·s	(Note 2)
	Green	R_G	6.3	9.1	11.9		
	Blue	R_B	2.8	4.0	5.2		
Photo Response Non Uniformity		PRNU (1)	—	10	20	%	(Note 3)
		PRNU (3)	—	3	12	mV	(Note 4)
Saturation Output Voltage		V_{SAT}	1.0	1.5	—	V	(Note 5)
Saturation Exposure		SE	0.07	0.14	—	lx·s	(Note 6)
Dark Signal Voltage		V_{DRK}	—	2.5	5	mV	(Note 7)
Dark Signal Non Uniformity		DSNU	—	8	12	mV	(Note 8)
DC Power Dissipation		PD	—	800	1200	mW	
Total Transfer Efficiency		TTE	92	—	—	%	
Output Impedance		Z_o	—	0.2	0.5	kΩ	
DC Signal Output Voltage		V_{OS}	3.0	6.0	8.0	V	(Note 9)
Random Noise		$N_{D\sigma}$	—	1.0	—	mV	(Note 10)

(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.

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

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

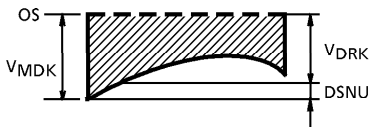
(Note 4) : PRNU (3) is defined as maximum voltage with next pixel, where measured 5% of SE (Typ.).

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

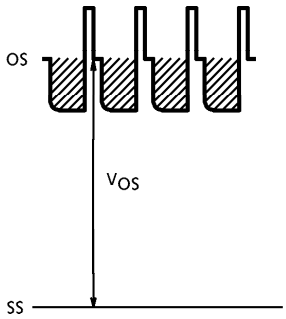
(Note 6) : Definition of SE : $SE = \frac{V_{SAT}}{R_G}$

(Note 7) : V_{DRK} is defined as average dark signal voltage of all effective pixels.

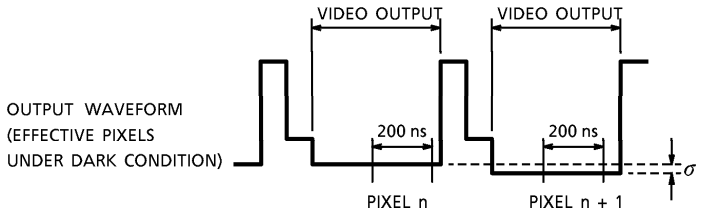
(Note 8) : DSNU is defined as different voltage between V_{DRK} and V_{MDK}, when V_{MDK} is maximum dark voltage.



(Note 9) : DC Signal Output Voltage is defined as follows :



(Note 10) : Random noise is defined as the standard deviation (sigma) of the output level difference between two adjacent effective pixels under no illumination (i.e. dark condition) calculated by the following procedure.



1) Two adjacent pixels (pixel n and n + 1) in one reading are fixed as measurement points.
2) Each of the output levels at video output periods averaged over 200 nanosecond period to get Vn and Vn + 1.
3) Vn + 1 is subtracted from Vn to get ΔV.

   $\Delta V = Vn - Vn + 1$

4) The standard deviation of ΔV is calculated after procedure 2) and 3) are repeated 30 times (30 readings).

$$\overline{\Delta V} = \frac{1}{30}\sum_{i=1}^{30}|\Delta Vi| \qquad \sigma = \sqrt{\frac{1}{30}\sum_{i=1}^{30}(|\Delta Vi| - \overline{\Delta V})^2}$$

5) Procedure 2), 3) and 4) are repeated 10 times to get 10 sigma values.

$$\overline{\sigma} = \frac{1}{10}\sum_{j=1}^{10}\sigma j$$

6) $\overline{\sigma}$ value calculated using the above procedure is observed $\sqrt{2}$ times larger than that measured relative to the ground level. So we specify the random noise as follows.

$$\text{Random noise} = \frac{1}{\sqrt{2}}\overline{\sigma}$$

OPERATING CONDITION

CHARACTERISTIC		SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTE
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	"H" Level	V_{SH}	$V\phi A$"H"-0.5	$V\phi A$"H"	$V\phi A$"H"	V	(Note 11)
	"L" Level		0	—	0.5		
Reset Pulse Voltage	"H" Level	V_{RS}	4.5	5.0	5.5	V	
	"L" Level		0	—	0.5		
Clamp Pulse Voltage	"H" Level	V_{CP}	4.5	5.0	5.5	V	
	"L" Level		0	—	0.5		
Power Supply Voltage		V_{OD}	11.4	12.0	13.0	V	

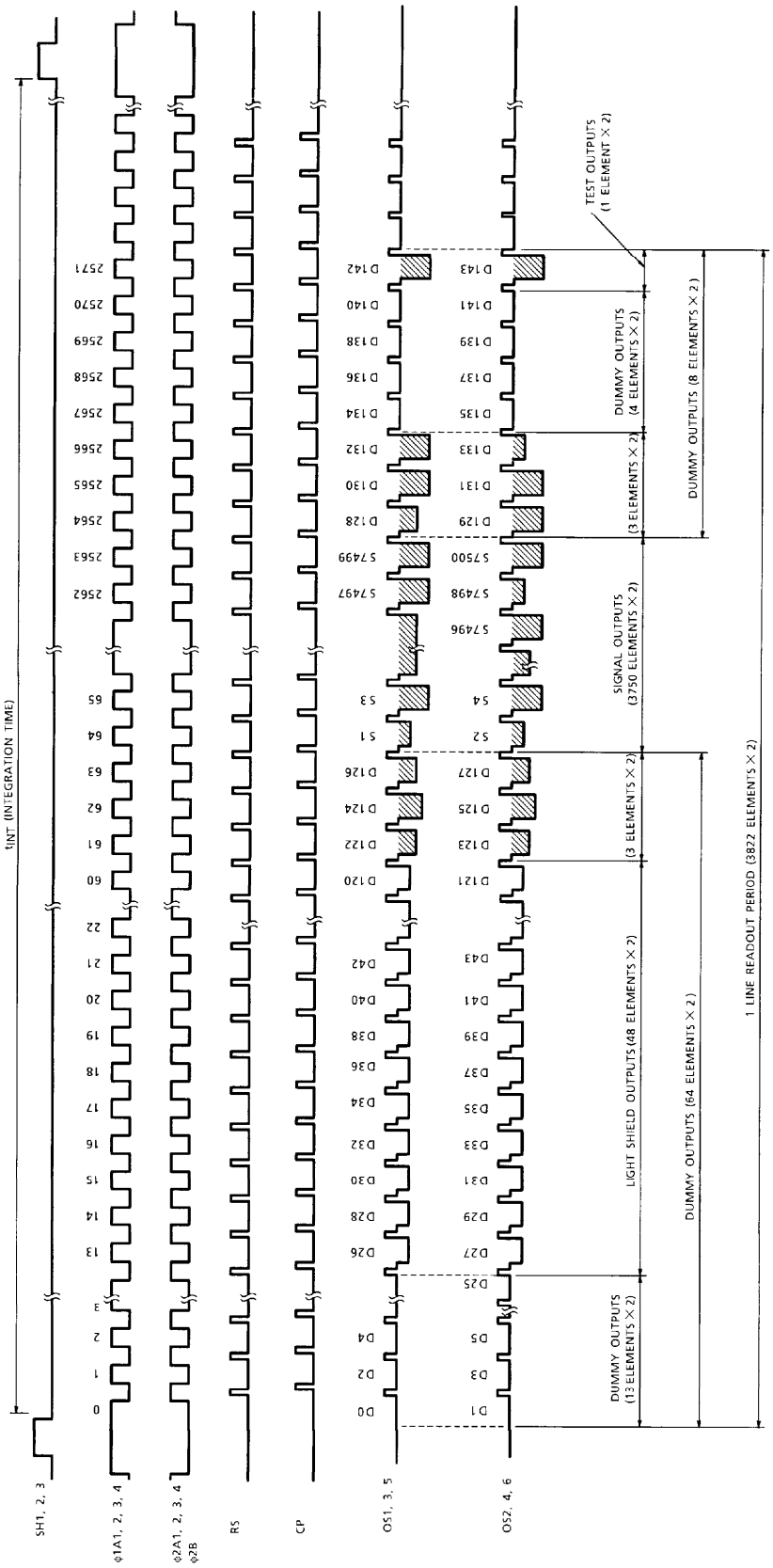
(Note 11) : $V\phi A$"H" means the high level voltage of $V\phi A$ when SH pulse is high level.

CLOCK CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTE
Clock Pulse Frequency	$f\phi$	—	1	20	MHz	
Reset Pulse Frequency	f_{RS}	—	1	20	MHz	
Clamp Pulse Frequency	f_{CP}	—	1	20	MHz	
Clock Capacitance (Note 12)	$C\phi A$	—	150	—	pF	
Final Stage Clock Capacitance	$C\phi B$	—	20	—	pF	
Reset Gate Capacitance	C_{RS}	—	20	—	pF	
Shift Gate Capacitance	C_{SH}	—	40	—	pF	
Clamp Gate Capacitance	C_{CP}	—	20	—	pF	

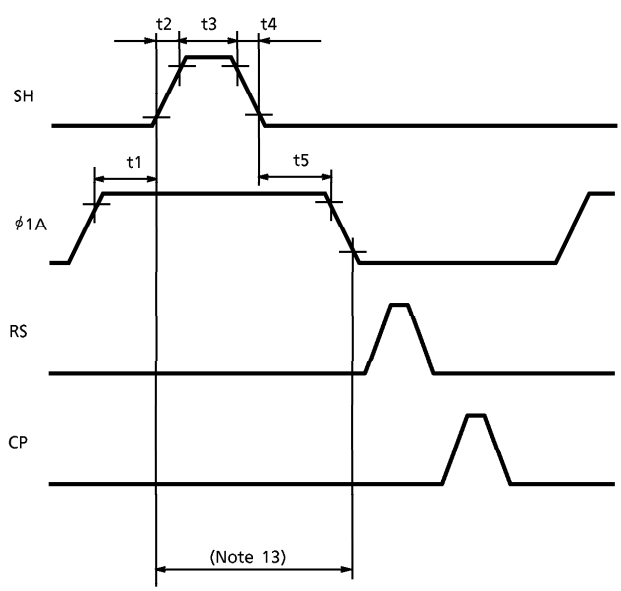
(Note 12) : V_{OD} = 12 V

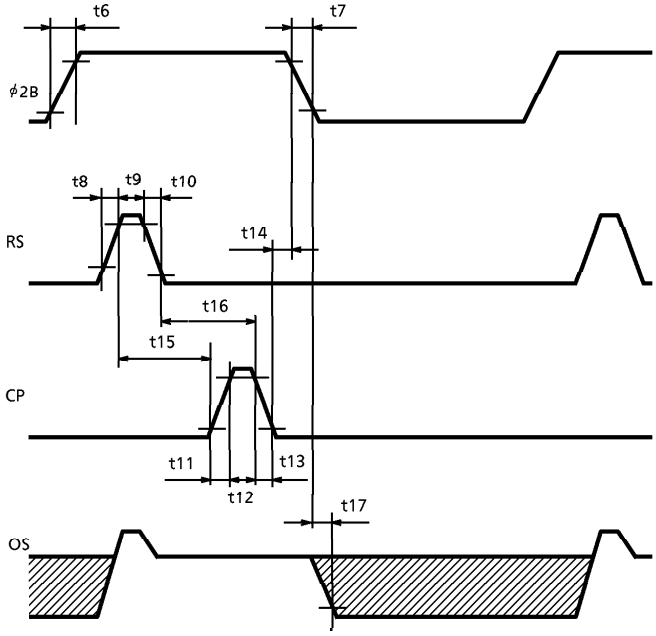
TIMING CHART



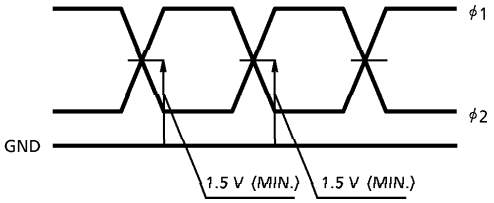
TCD2701C—7

TIMING REQUIREMENTS





CROSS POINT

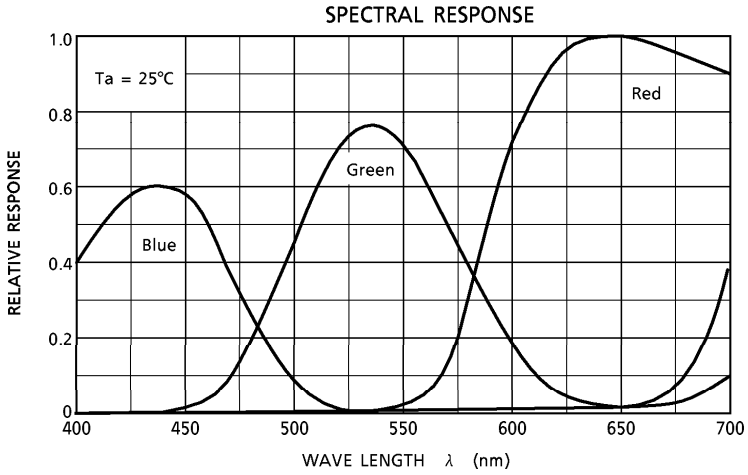


(Note 13) : Each RS and CP pins put to Low level during this period.

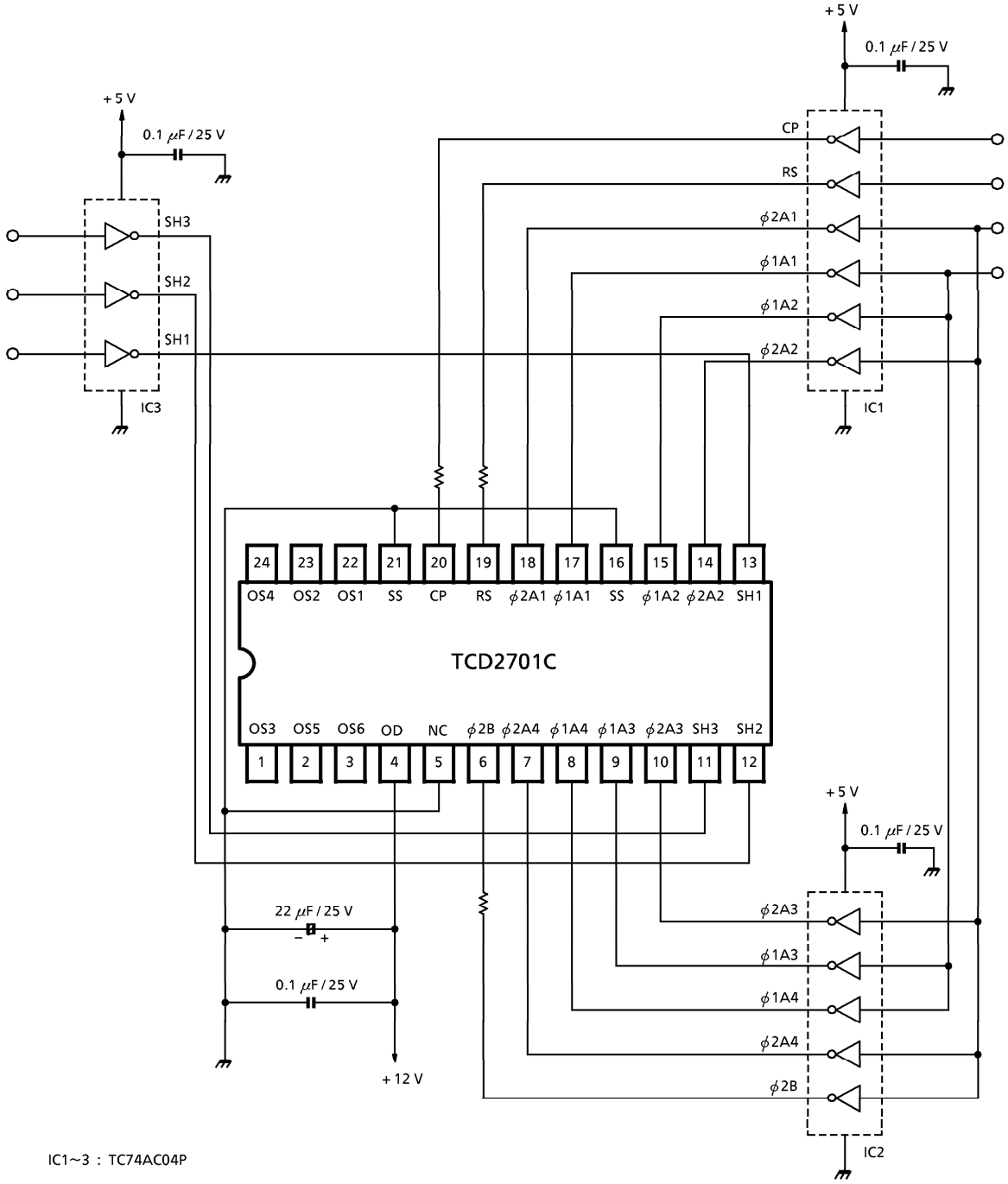
CHARACTERISTIC	SYMBOL	MIN.	TYP. (Note 14)	MAX.	UNIT
Pulse Timing of SH and φ1A	t1	60	1000	—	ns
	t5	500	1000	—	
SH Pulse Rise Time, Fall Time	t2, t4	0	50	—	ns
SH Pulse Width	t3	1000	2000	—	ns
φ1, φ2 Pulse Rise Time, Fall Time	t6, t7	0	50	—	ns
RS Pulse Rise Time, Fall Time	t8, t10	0	20	—	ns
RS Pulse Width	t9	10	100	—	ns
CP Pulse Rise Time, Fall Time	t11, t13	0	20	—	ns
CP Pulse Width	t12	10	100	—	ns
Pulse Timing of φ2B and CP	t14	5	40	—	ns
Pulse Timing of RS and CP	t15	0	100	—	ns
	t16	10	100	—	
Video Data Delay Time (Note 15)	t17	—	15	—	ns

(Note 14) : TYP. is the case of f_{RS} = 1 MHz.
(Note 15) : Load Resistance is 100 kΩ.

TYPICAL SPECTRAL RESPONSE

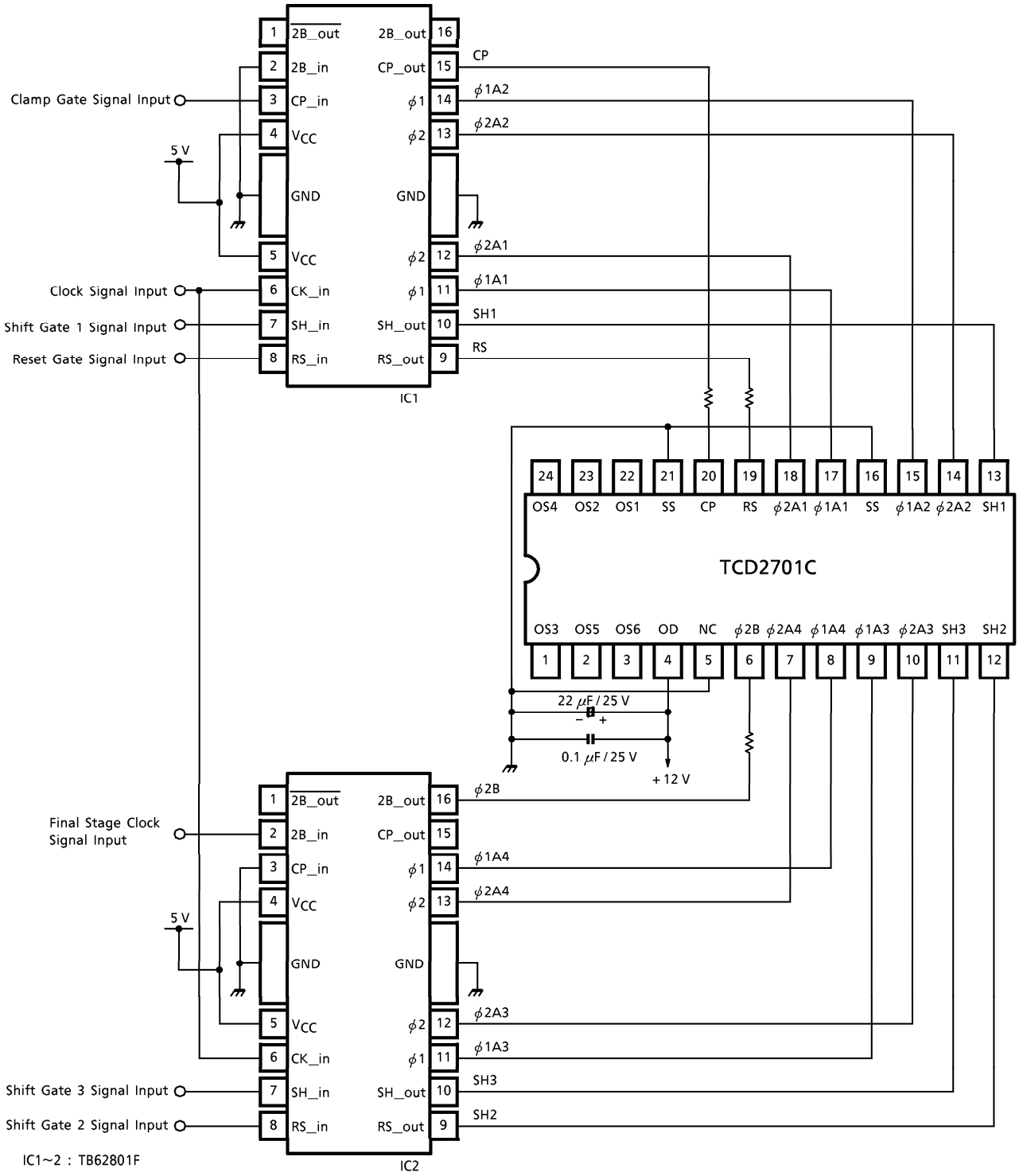


TYPICAL DRIVE CIRCUIT



IC1~3 : TC74AC04P

TYPICAL DRIVE CIRCUIT



IC1~2 : TB62801F

PRECAUTIONS FOR USE OF CCD IMAGE SENSOR

1. Static Electricity

   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

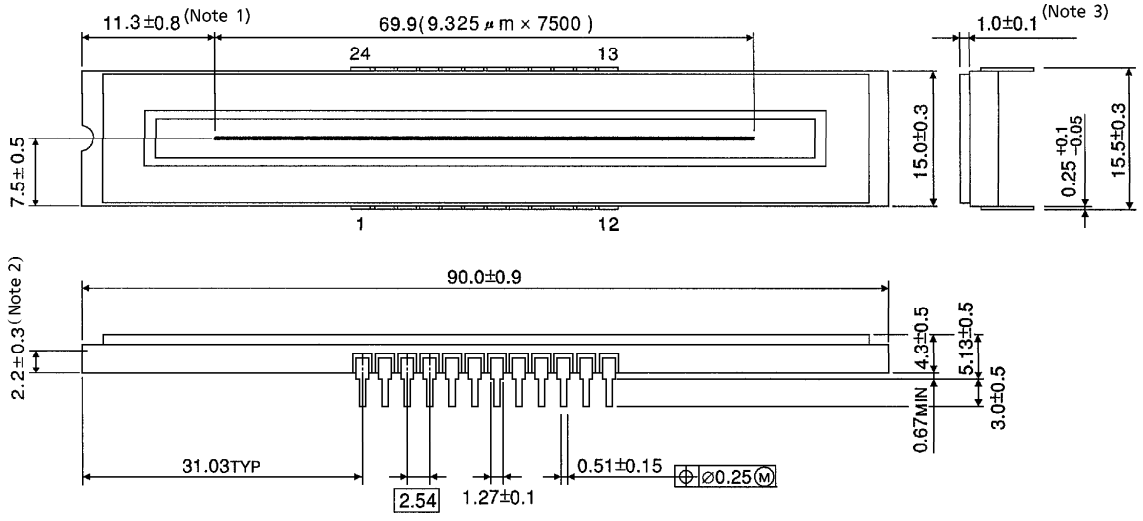
   As the dust and station on the glass window of the package will cause black flow on the picture, never fail to clean the glass surface before using. (Blow compressed vapor, and wipe off the dust, and dirt with soft cloth or paper slightly moistened with alcohol).
   Fully take care for the handling of the device as the window glass will break or a strong friction is given to the window glass surface.

3. Incident Light

   CCD image sensor has sensitivity in a wide range zone of light wave length, but its characteristics will sometimes widely change when used with long wave length input light outside the visual light zone.

OUTLINE DRAWING

WDIP24-C-600-2.54 (E) 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.)