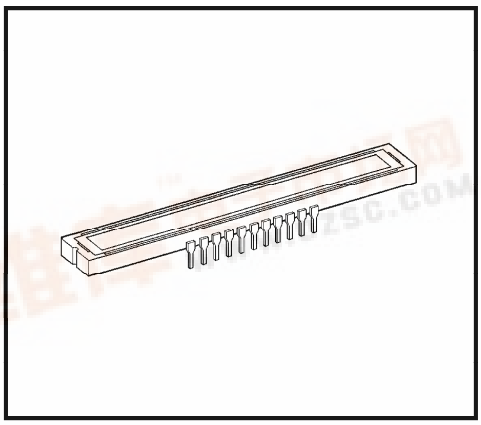
TENTATIVE TOSHIBA CCD LINEAR IMAGE SENSOR CCD(Charge Coupled Device)

TCD1702C

The TCD1702C is a high sensitive and low dark current 7500 elements CCD image sensor.
The sensor is designed for facsimile, imagescanner and OCR.
The device contains a row of 7500 elements photodiodes which provide a 24 lines / mm (600DPI) across a A3 size paper. The device is operated by 5V (pulse), and 12V power supply.



Weight : 6.6g (Typ.)

FEATURES

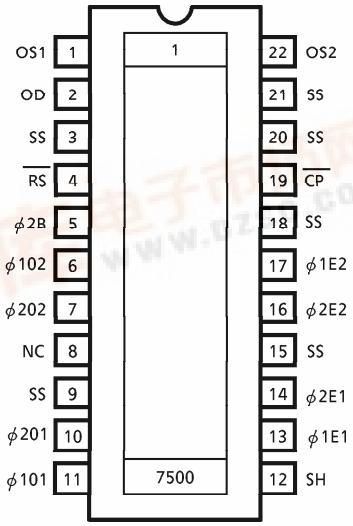
- Number of Image Sensing Elements : 7500 elements
- Image Sensing Element Size : 7μm by 7μm on 7μm centers
- Photo Sensing Region : High sensitive and low voltage dark signal pn photodiode
- Clock : 2 phase (5V)
- Package : 22pin DIP

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	
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).

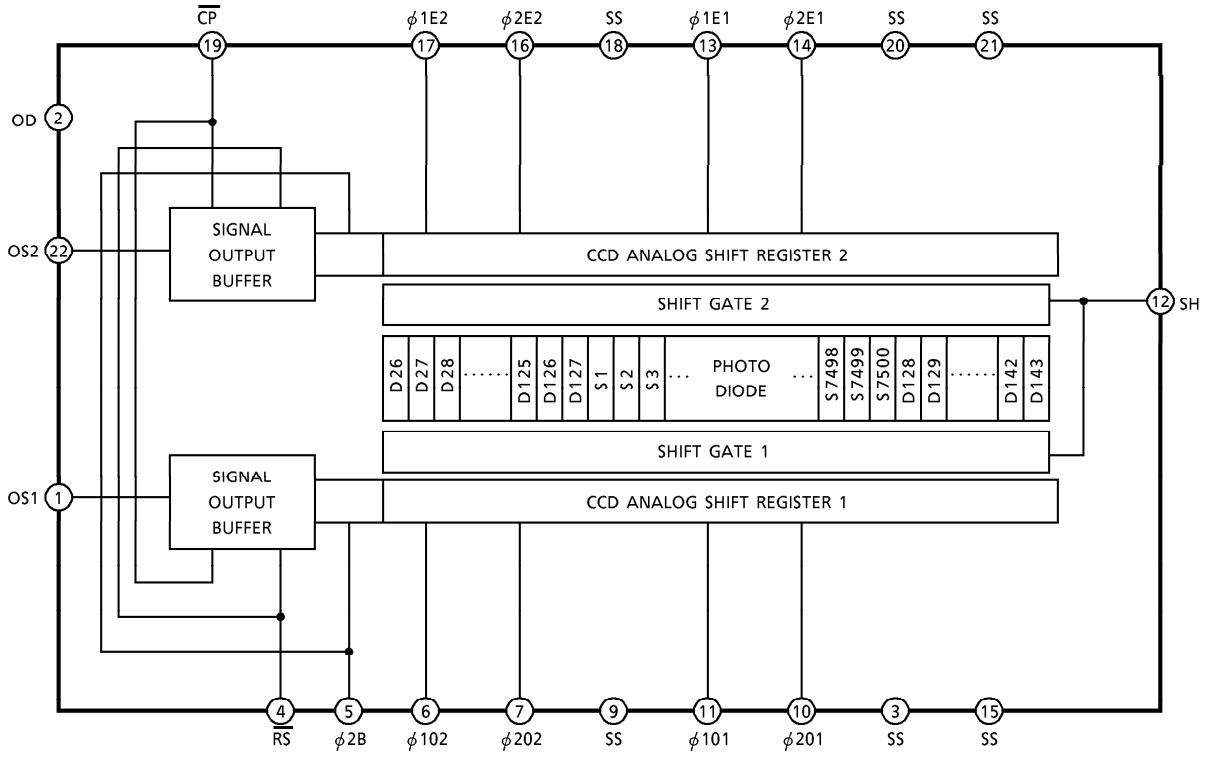
PIN CONNECTIONS



(TOP VIEW)

961001EBA2

CIRCUIT DIAGRAM



PIN NAME

ϕ1E, O	Clock (Phase 1)
ϕ2E, O	Clock (Phase 2)
ϕ2B	Final Stage Clock (Phase 2)
SH	Shift Gate
$\overline{RS}$	Reset Gate
$\overline{CP}$	Clamp Gate
OS1	Signal Output 1
OS2	Signal Output 2
OD	Power
SS	Ground
NC	Non Connection

OPTICAL / ELECTRICAL CHARACTERISTICS
(Ta = 25°C, V_{OD} = 12V, V_{ϕ} = V_{SH} = $V_{\overline{RS}}$ = $V_{\overline{CP}}$ = 5V, f_{ϕ} = 1MHz,
t_{INT} (INTEGRATION TIME) = 10ms, LIGHT SOURCE = DAYLIGHT FLUORESCENT LAMP
LOAD RESISTANCE = 100kΩ)

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTE
Sensitivity	R	7.2	9	10.8	V / lx·s	
Photo Response Non Uniformity	PRNU	—	—	10	%	(Note 2)
	PRNU (3)	—	4	8	mV	(Note 8)
Saturation Output Voltage	V_{SAT}	1.5	2	—	V	(Note 3)
Saturation Exposure	SE	0.14	0.22	—	lx·s	(Note 4)
Dark Signal Voltage	V_{DRK}	—	1	2.5	mV	(Note 5)
Dark Signal Non Uniformity	DSNU	—	1	2.5	mV	(Note 5)
DC Power Dissipation	P_D	—	300	364	mW	
Total Transfer Efficiency	TTE	92	—	—	%	
Output Impedance	Z_o	—	0.5	1	kΩ	
Dynamic Range	DR	—	2000	—	—	(Note 6)
DC Signal Output Voltage	V_{OS1}	3.5	4.5	6	V	(Note 7)
	V_{OS2}	3.5	4.5	6	V	(Note 7)
DC Differential Error Voltage	$\lvert V_{OS1}-V_{OS2}\rvert$	—	—	300	mV	

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

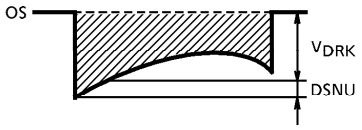
Definition of PRNU : PRNU = $\frac{\Delta\chi}{\overline{\chi}} \times 100\ (\%)$

Where $\overline{\chi}$ is average of total signal outputs and $\Delta\chi$ is maximum deviation from $\overline{\chi}$ under uniform illumination. (Channel 1)
In the case of 3750 elements (Channel 2), the condition is the same as above too.

(Note 3) V_{SAT} is defined as minimum saturation output voltage of all effective pixels.

(Note 4) Definition of SE : SE = $\frac{V_{SAT}}{R}$ (lx·s)

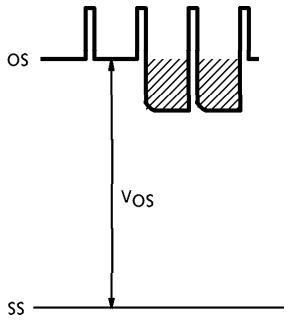
(Note 5) V_{DRK} is defined as average dark signal voltage of all effective pixels.
DSNU is defined as different voltage between V_{DRK} and V_{MDK} when V_{MDK} is maximum dark signal voltage.



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

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

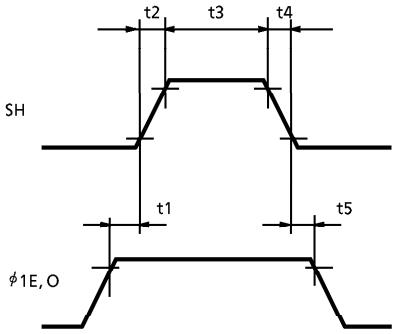
(Note 7) DC signal output voltage and DC compensation output voltage are defined as follows:



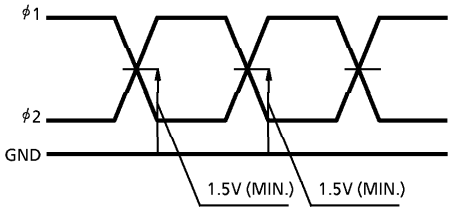
(Note 8) PRNU (3) is defined as maximum voltage with next pixel, where measured 5% of SE (Typ.)

TIMING REQUIREMENTS

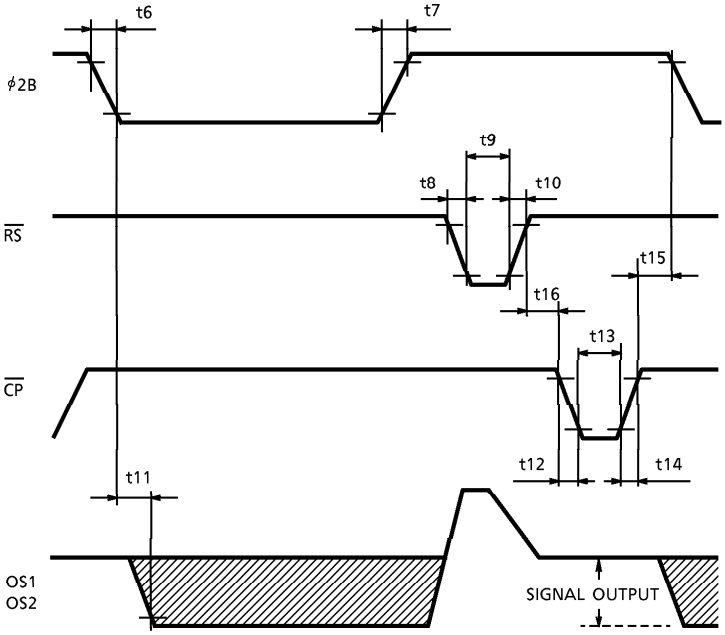
SH, ϕ1 Timing



ϕ1, ϕ2 Cross Point



ϕ2, $\overline{RS}$, $\overline{CP}$, OS Timing



CHARACTERISTIC	SYMBOL	MIN.	TYP. (Note 9)	MAX.	UNIT
Pulse Timing of SH and ϕ10, E	t1, t5	150	300	—	ns
SH Pulse Rise Time, Fall Time	t2, t4	0	50	—	ns
SH Pulse Width	t3	500	1000	—	ns
ϕ2 Pulse Rise Time, Fall Time	t6, t7	0	100	—	ns
$\overline{RS}$ Pulse Rise Time, Fall Time	t8, t10	0	20	—	ns
$\overline{RS}$ Pulse Width	t9	20	250	—	ns
Video Data Delay Time (Note 10)	t11	—	20	—	ns
$\overline{CP}$ Pulse Rise Time, Fall Time	t12, t14	0	20	—	ns
$\overline{CP}$ Pulse Width	t13	20	—	—	ns
Pulse Timing of ϕ2B and $\overline{CP}$	t15	0	—	—	ns
Pulse Timing of $\overline{RS}$ and $\overline{CP}$	t16	0	—	—	ns

(Note 9) TYP. is the case of f_{RS} = 1.0MHz
(Note 10) Load Resistance is 100kΩ

OPERATING CONDITION

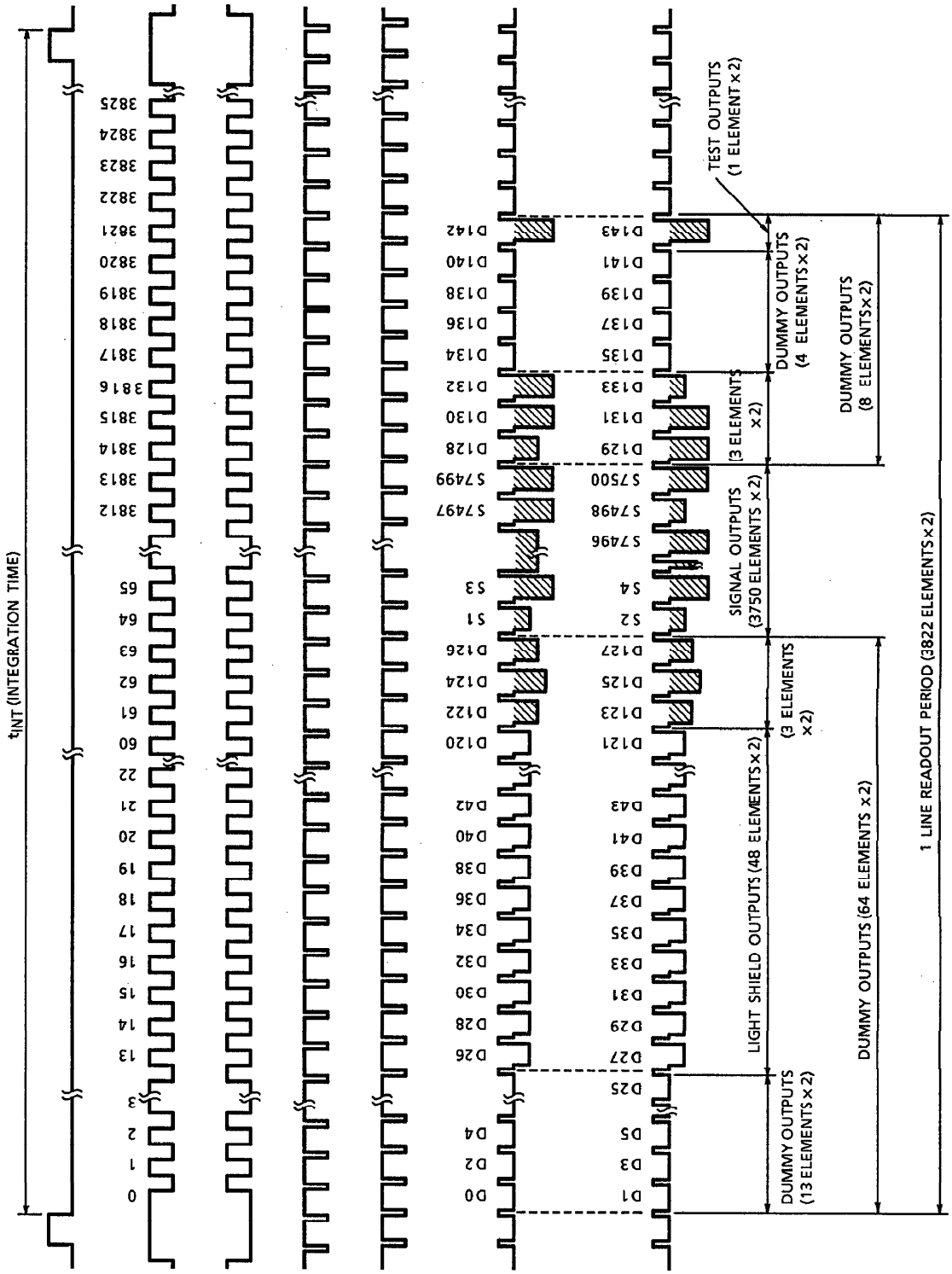
CHARACTERISTIC		SYMBOL	MIN.	TYP.	MAX.	UNIT
Clock Pulse Voltage	"H" Level	$V_{\phi 1E, O}$	4.5	5	5.5	V
	"L" Level	$V_{\phi 2E, O}$	0	—	0.5	
Final Stage Clock Voltage	"H" Level	$V_{\phi 2B}$	4.5	5	5.5	V
	"L" Level		0	—	0.5	
Shift Pulse Voltage	"H" Level	(Note) V_{SH}	$V_{\phi E}$, 0"H" − 0.5	$V_{\phi E}$, 0"H"	$V_{\phi E}$, 0"H"	V
	"L" Level		0	—	0.5	
Reset Pulse Voltage	"H" Level	$V_{\overline{RS}}$	4.5	5	5.5	V
	"L" Level		0	—	0.5	
Clamp Pulse Voltage	"H" Level	$V_{\overline{CP}}$	4.5	5	5.5	V
	"L" Level		0	—	0.5	
Power Supply Voltage		V_{OD}	11.4	12	13	V

(Note) $V_{\phi E}$, 0"H" means the value of high level voltage at $V_{\phi E}$, 0, when SH pulse is high level.

CLOCK CHARACTERISTICS (Ta = 25°C)

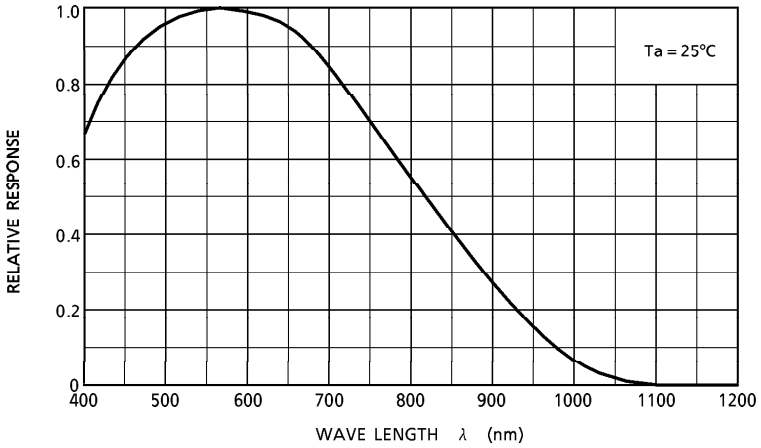
CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Clock Pulse Frequency	f_{ϕ}	—	1	10	MHz
Reset Pulse Frequency	$f_{\overline{RS}}$	—	1	10	MHz
Clock Capacitance	$C_{\phi E}$	—	350	450	pF
	$C_{\phi O}$	—	350	450	pF
Final Stage Clock Capacitance	$C_{\phi B}$	—	10	20	pF
Shift Gate Capacitance	C_{SH}	—	350	450	pF
Reset Gate Capacitance	$C_{\overline{RS}}$	—	10	20	pF
Clamp Gate Capacitance	$C_{\overline{CP}}$	—	10	20	pF

TIMING CHART

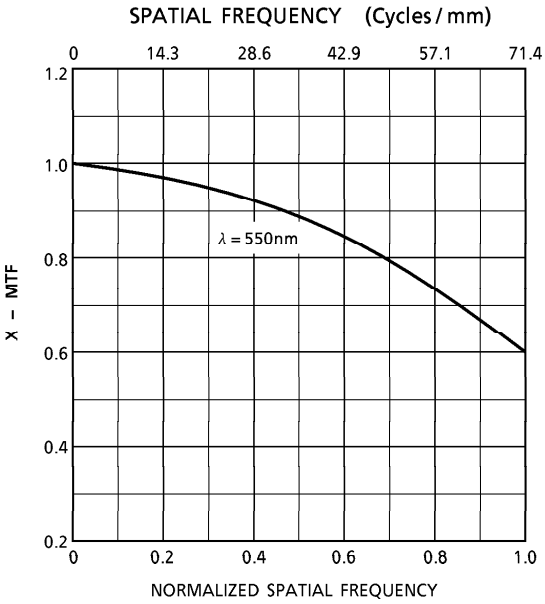


TYPICAL PERFORMANCE CURVES

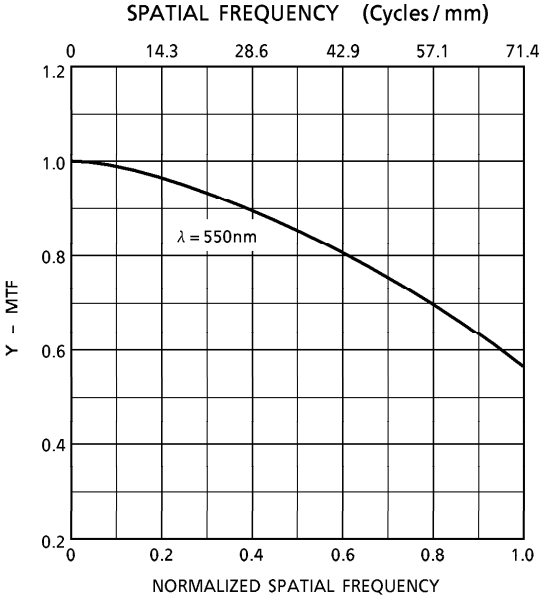
SPECTRAL RESPONSE



MODULATION TRANSFER FUNCTION OF X-DIRECTION

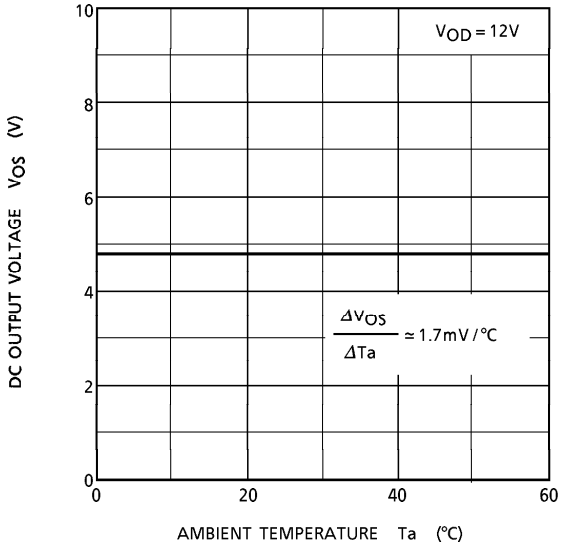


MODULATION TRANSFER FUNCTION OF Y-DIRECTION

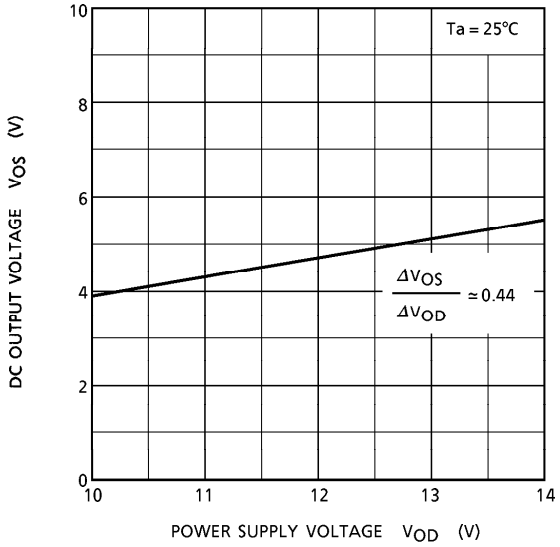


TYPICAL PERFORMANCE CURVES (Cont'd)

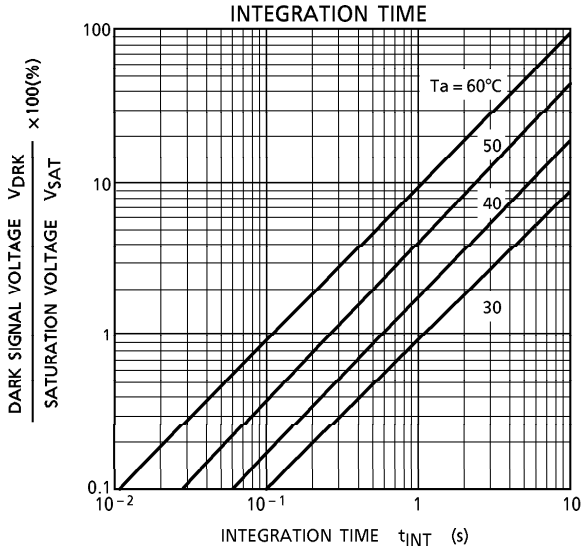
DC OUTPUT VOLTAGE vs AMBIENT TEMPERATUER



DC OUTPUT VOLTAGE vs POWER SUPPLY VOLTAGE



DARK SIGNAL VOLTAGE vs INTEGRATION TIME



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.

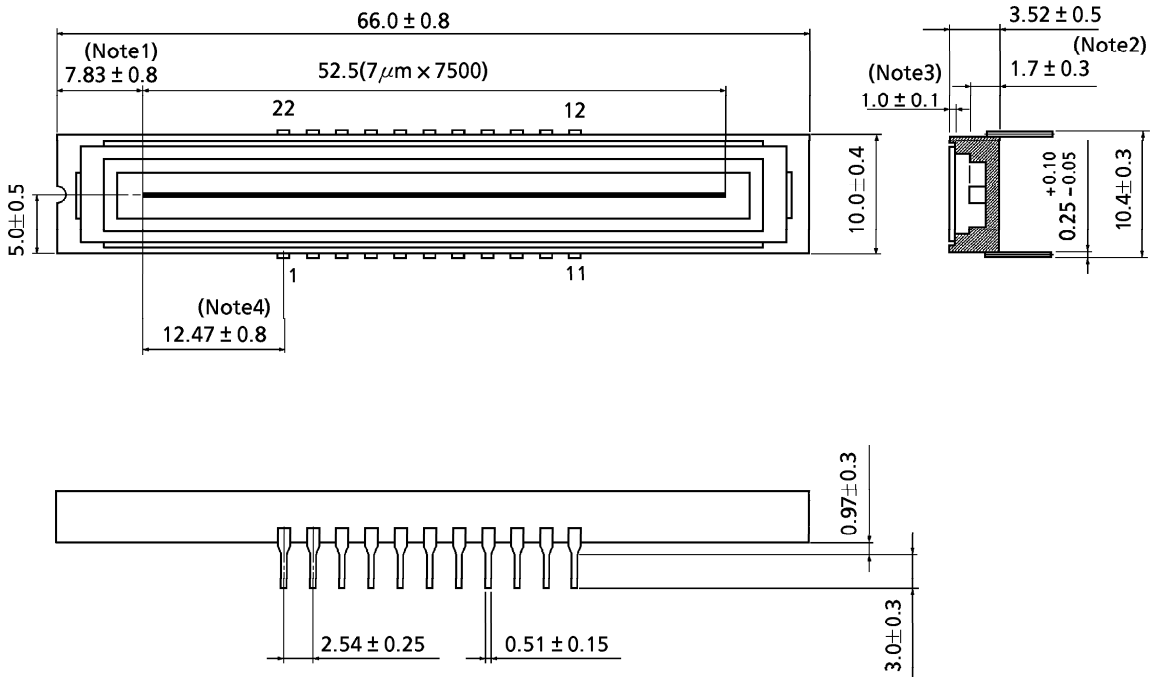
3. Incident Light

   CCD sensor is sensitive to infrared light.

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

OUTLINE DRAWING

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)
(Note 4) No. 1 SENSOR ELEMENT (S1) TO CENTER OF No. 1 PIN.

Weight : 6.6g (Typ.)