TOSHIBA CCD LINEAR IMAGE SENSOR CCD(Charge Coupled Device)

# TCD1001P

The TCD1001P is a high sensitive and low dark current 128-elements linear image sensor which includes CCD drive circuit, clamp circuit and sample & hold circuit. The CCD drive circuit consists of the pulse generator therefore it is possible to easy drive by applying simple pulses. The sensor is designed for scanner.



• Number of Image Sensing Elements: 128 elements

• Image Sensing Element Size :  $32\mu$ m  $\times$   $32\mu$ m on  $32\mu$ m

centers

Photo Sensing Region : High sensitive pn photodiode

Clock : 3 Input pulses 5V

Internal Circuit : Sample & Hold circuit, Clamp circuit

Package : 20 pin

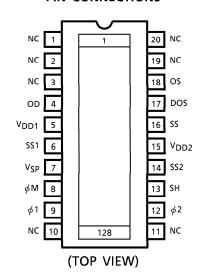
Weight: 1.0g (Typ.)

# **MAXIMUM RATINGS**

CHARACTERISTIC	SYMBOL	RATING	UNIT	
Master Clock Voltage	V∳M			
Clock Pulse Voltage	Vφ	-0.3~8	v	
Shift Pulse Voltage	V <sub>SH</sub>			
Power Supply Voltage (Analog)	$V_{AD}$			
Power Supply Voltage (Digital)	V <sub>DD1</sub>	-0.3~15	V	
l ower supply voltage (Digital)	$V_{DD2}$			
Sample & Hold Switch Voltage	$V_{SP}$	-0.3~8	V	
Operating Temperature	T <sub>opr</sub>	<b>- 25∼60</b>	°C	
Storage Temperature	T <sub>stg</sub>	- 25~85	°C	

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

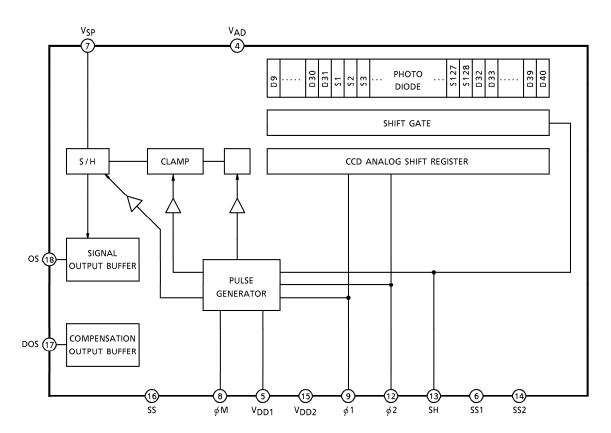
#### PIN CONNECTIONS



#### 961001EBA2

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# **CIRCUIT DIAGRAM**



# **PIN NAMES**

φM	Master Clock	V <sub>AD</sub>	Power (Analog)
φ1	Clock (Phase 1)	V <sub>DD1</sub>	Power (Digital, 12V)
φ <b>2</b>	Clock (Phase 2)	V <sub>DD2</sub>	Power (Digital, 12V)
SH	Shift Gate	SS	Ground (Analog)
OS	Signal Output	SS1	Ground (Digital, 12V)
DOS	Compensation Output	SS2	Ground (Digital, 12V)
NC	Non Connection	V <sub>SP</sub>	Sample and Hold Switch

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#### **OPTICAL / ELECTRICAL CHARACTERISTICS**

(Ta = 25°C,  $V_{REF} = V_{AD} = V_{DD1} = V_{DD2} = 12V$ ,  $V_{\phi M} = V_{\phi} = V_{SH} = 5V$  (PULSE),  $f_{\phi} = 1.0$ MHz,  $t_{INT}$  (INTEGRATION TIME) = 10ms, LIGHT SOURCE = DAYLIGHT FLUORESCENT LAMP, LOAD RESISTANCE =  $100\Omega$ )

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTE
Sensitivity	R	63.7	85	106	V / lx·s	
Photo Possones Non Uniformity	PRNU (1)	_	_	10	%	(Note 2)
Photo Response Non Uniformity	PRNU (3)	_	3	12	mV	(Note 3)
Saturation Output Voltage	V <sub>SAT</sub>	1.2	2.0	_	V	(Note 4)
Saturation Exposure	SE	_	0.02	_	lx·s	(Note 5)
Dark Signal Voltage	$V_{DRK}$	_	4	8	mV	(Note 6)
Dark Signal Non Uniformity	DSNU	_	2	5	mV	(Note 6)
Analog Current Dissipation	I <sub>AD</sub>	_	8.0	12	mA	
Digital Current Dissipation	I <sub>DD1</sub>	_	_	1	mA	
Digital Current Dissipation	I <sub>DD2</sub>	_	10.0	15	mA	
Total Transfer Efficiency	TTE	92	_	_	%	
Output Impedance	ZO	_	0.5	1.0	kΩ	
DC Signal Output Voltage	Vos	3.5	5.0	6.5	V	(Note 7)
DC Compensation Output Voltage	V <sub>DOS</sub>	3.5	5.0	6.5	V	(Note 7)
DC Differential Error Voltage	Vos-V <sub>DOS</sub>	_	_	400	mV	

(Note 2) PRNU (1) is measured at 50% of SE (Typ.)

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

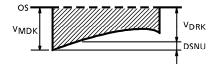
Where  $\overline{\chi}$  is average of total signal outputs and  $\Delta \chi$  is the maximum deviation from  $\overline{\chi}$  under uniform illumination.

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

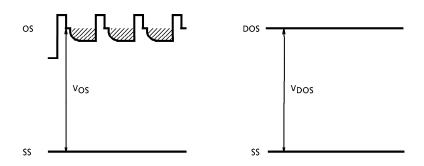
(Note 4) V<sub>SAT</sub> is defined as minimum Saturation Output Voltage of all effective pixels.

(Note 5) Definition of SE : SE =  $\frac{V_{SAT}}{R}$  (Ix·s)

(Note 6)  $V_{DRK}$  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 7) DC signal output voltage and DC compensation output voltage are defined as follows:



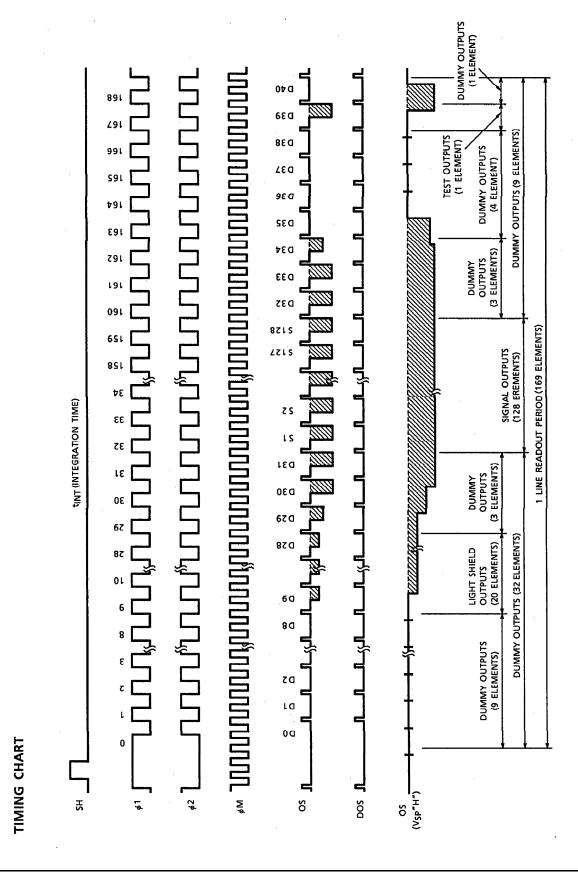
# **OPERATING CONDITION**

CHARACTERISTIC		SYMBOL	MIN.	TYP.	MAX.	UNIT
Master Clask Bulse Valtage	"H"Level	V	4.5	5.0	5.5	W
Master Clock Pulse Voltage	"L" Level	$V_{\phi}M$	0	_	0.5	V
Clask Bulsa Valtaga	"H"Level	V <sub>φ1</sub>	4.5	5.0	5.5	.,,
Clock Pulse Voltage	"L" Level	$V_{\phi 2}$	0	_	0.5	V
Shift Pulse Voltage	"H"Level	V <sub>SH</sub>	$V_{\phi} - 0.5$	$V_\phi$	$V_\phi$	V
	"L" Level		0	_	0.5	
Sample and Hold Switch Voltage*	"H"Level	VSP	4.5	5.0	5.5	V
Sample and Hold Switch Voltage*	"L" Level		0	_	0.5	
Poset Bulse Valtage	"H"Level	V <sub>RS</sub>	4.5	5.0	5.5	V
Reset Pulse Voltage	"L" Level		0	_	0.5	
Power Supply Voltage (Analog)	•	$V_{AD}$	11.4	12.0	13.0	V
Dower Supply Voltage (Digital)		V <sub>DD1</sub>	11.4	12.0	13.0	V
Power Supply Voltage (Digital)		V <sub>DD2</sub>	11.4	12.0	13.0	V

<sup>(\*)</sup> Supply "H" Level to  $V_{SP}$  terminal when sample-and-hold circuit is used, when sample-and-hold circuit is not used supply "L" Level to  $V_{SP}$  terminal.

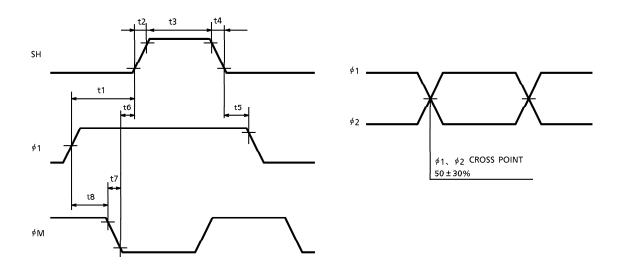
# **CLOCK CHARACTERISTICS** (Ta = 25°C)

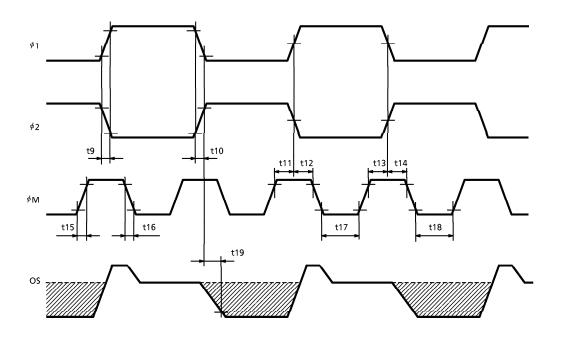
CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Master Clock Pulse Frequency	f <sub>øM</sub>	_	2.0	6.0	MHz
Clock Pulse Frequency	$f_{\phi}$	_	1.0	3.0	MHz
Master Clock Pulse Capacitance	C <sub>øM</sub>	_	10	20	pF
Clock Capacitance	$C_\phi$	_	100	200	pF
Shift Gate Capacitance	CSH	_	50	100	pF

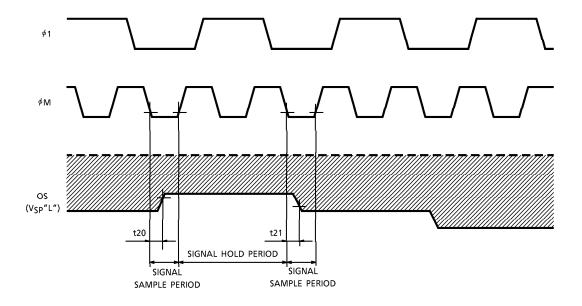


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# TIMING REQUIREMENS





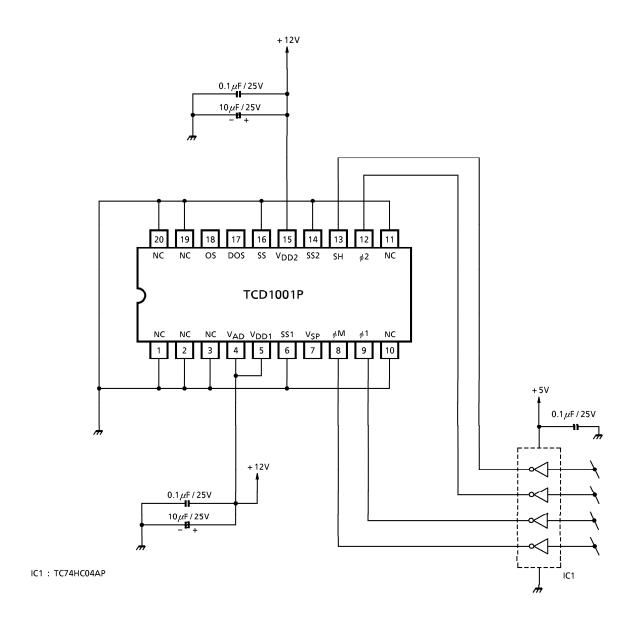


CHARACTERISTIC	SYMBOL	MIN.	TYP. (Note 2)	MAX.	UNIT
Pulse Timing of SH and $\phi$ 1, $\phi$ 2	t1	60	300	_	ns
Fulse filling of sit and $\varphi$ 1, $\varphi$ 2	t5	0	300	_	ns
SH Pulse Rise Time, Fall Time	t2, t4	0	50	_	ns
SH Pulse Width	t3	300	1000	_	ns
Pulse Timing of SH and $\phi$ M	t6	20	50	_	ns
$\phi$ 1, $\phi$ 2 Pulse Rise Time, Fall Time	t9, t10	0	20	_	ns
Dules Timing of (1, (2 and (N)	t11, t13	20	100	_	ns
Pulse Timing of $\phi$ 1, $\phi$ 2 and $\phi$ M	t8, t12, t14	40	100	_	ns
$\phi$ M Pulse Rise Time, Fall Time	t7, t15, t16	0	20		ns
$\phi$ M Pulse Width	t17, t18	80	250	_	ns
Video Data Delay Time (Note 3)	t19	_	45	_	ns
S/H Video Data Delay Time	t20, t21	_	70	_	ns

(Note 2) TYP. is the case of  $f_{\phi} = 1MHz$ .

(Note 3) Load Resistance is 100k $\Omega$ .

# **TYPICAL DRIVE CIRCUIT**



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#### **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 N2.

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.

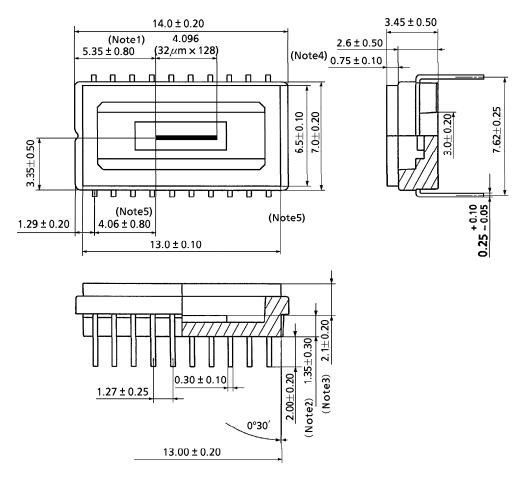
Note that infrared light component degrades resolution and PRNU of CCD sensor.

# 4. Lead Frame Forming

Since this package is not shoutagainst 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



- (Note1) No. 1 SENSOR ELEMENT (S1) TO EDGE OF PACKAGE.
- (Note2) TOP OF CHIP TO BOTTOM OF PACKAGE.
- (Note3) TOP OF CHIP TO OF PACKAGE.
- (Note4) GLASS THICKNESS (n = 1.5)
- (Note5) No. 1 SENSOR ELEMENT (S1) TO CENTER OF No. 1 PIN.

Weight: 1.0g (Typ.)