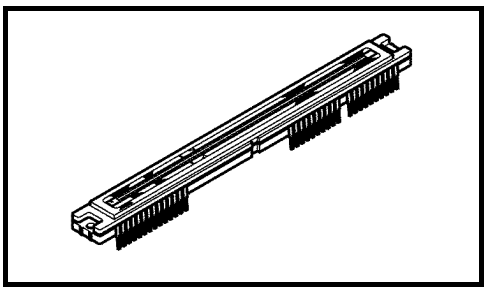
TOSHIBA CCD Linear Image Sensor CCD (Charge Coupled Device)

TCD2719DG

The TCD2719DG is a high sensitive and low dark current 7300 pixels × 3 line CCD color image sensor.
The sensor is designed for color scanner.
The device contains a row of 7300 pixels × 3 line photodiodes which provide a 24 lines/mm across a A3 size paper. The device is operated by 5-V pulse, and 10-V power supply.

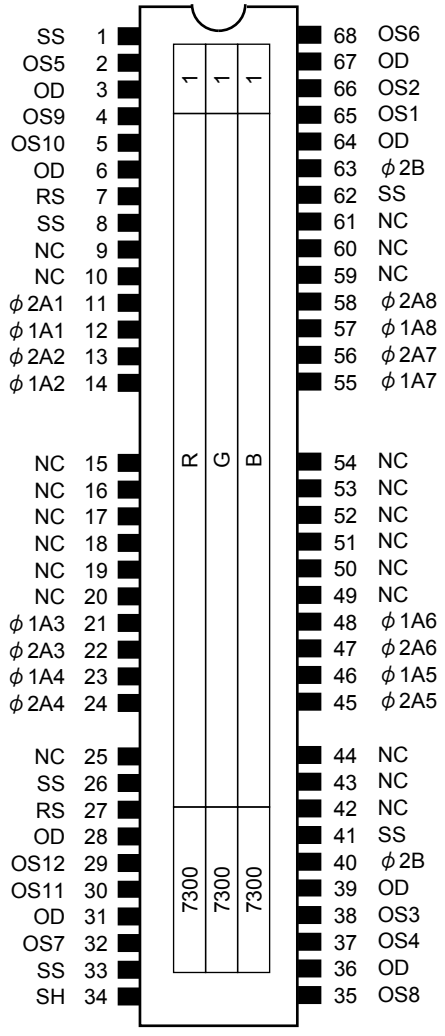


Weight: 16.0 g (typ.)

Features

- Number of image sensing pixels
  : 21900 pixels (7300 pixels × 3 line)
- Image sensing pixels size
  : 10 μm by 10 μm on 10 μm center
- Photo sensing region: High sensitive pn photodiode
- Clock: 2-phase (5 V)
- Distance between photodiode array
  : Pixel R to pixel G: 40 μm (4 lines)
  Pixel G to pixel B: 40 μm (4 lines)
- Internal circuit: Clamp circuit, Sample hold circuit
- Package: 68-pin CERDIP
- Color filter: Red, Green, Blue

Pin Connection (top view)

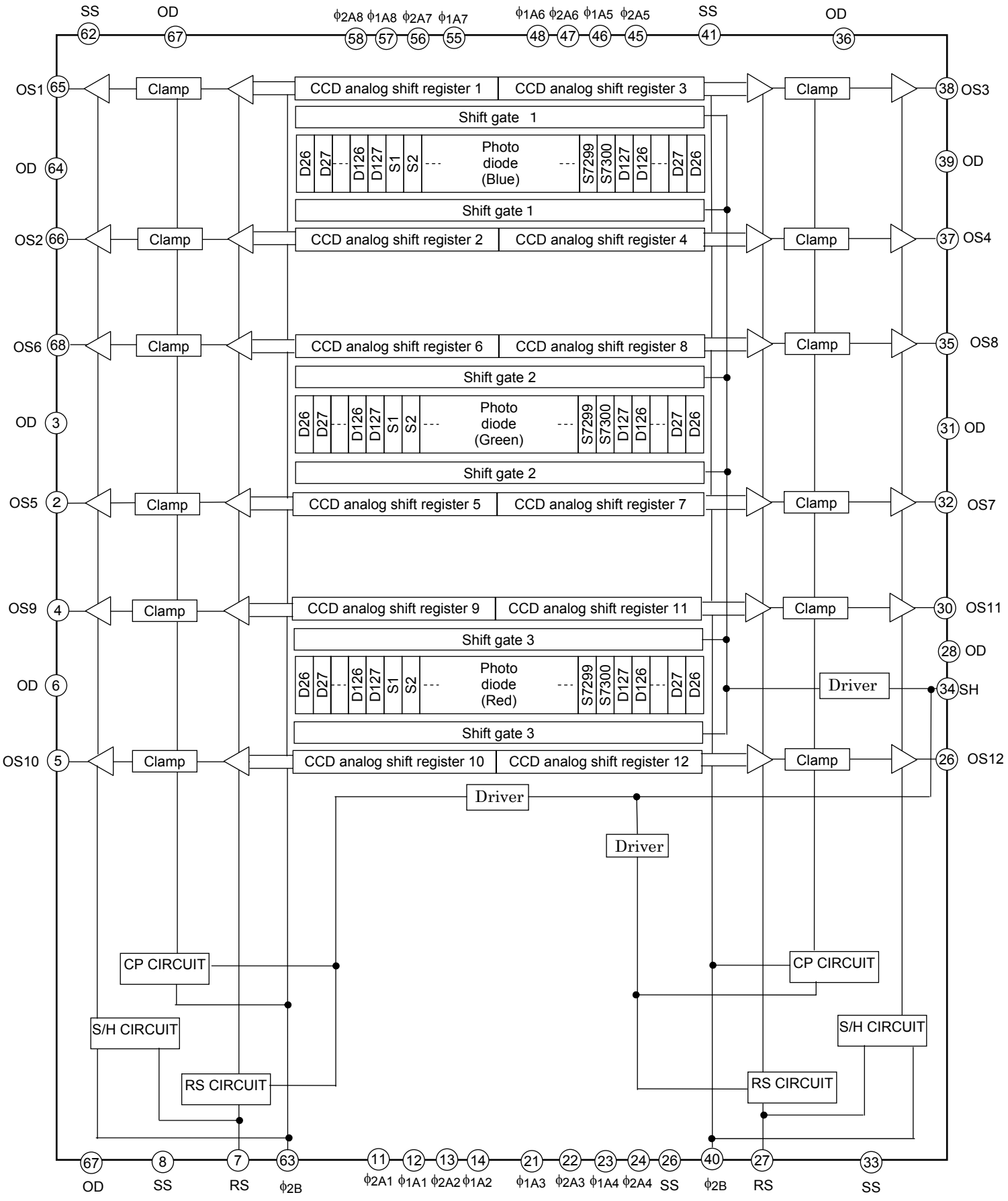


ABSOLUTE MAXIMUM RATINGS (Note 1)

Characteristics	Symbol	Rating	Unit
Clock pulse voltage	$V_{\phi A}$	−0.3 to 8.0	V
Last stage clock pulse voltage	$V_{\phi B}$		
Shift pulse voltage	V_{SH}		
Reset pulse voltage	V_{RS}		
Clamp pulse voltage	V_{OD}		
Power supply voltage	T_{opr}	−0.3 to 13.5	V
Operating temperature	T_{stg}	0 to 60	°C
Storage temperature	$V_{\phi A}$	−30 to 85	°C

Note 1: All voltages are with respect to SS pins (ground).
None of the ABSOLUTE MAXIMUM RATINGS must be exceeded, even instantaneously.
If any one of the ABSOLUTE MAXIMUM RATINGS is exceeded, the electrical characteristics,
reliability and life time of the device cannot be guaranteed.
If the ABSOLUTE MAXIMUM RATINGS are exceeded,
the device can be permanently damaged or degraded.
Create a system design in such a manner that
any of the ABSOLUTE MAXIMUM RATINGS will not be exceeded under any circumstances.

・Circuit Diagram



Pin Names

Pin No.	Symbol	Name	Pin No.	Symbol	Name
1	SS	Ground	35	OS8	Output signal 8 (Green(Even)-L)
2	OS5	Output signal 5 (Green(Odd)-F)	36	OD	Power supply
3	OD	Power supply	37	OS4	Output signal 4 (Blue(Even)-L)
4	OS9	Output signal 9 (Red(Odd)-F)	38	OS3	Output signal 3 (Blue(Odd)-L)
5	OS10	Output signal 10 (Red(Even)-F)	39	OD	Power supply
6	OD	Power supply	40	ϕ2B	Last stage clock (phase 2)
7	RS	Reset gate	41	SS	Ground
8	SS	Ground	42	NC	No connect
9	NC	No connect	43	NC	No connect
10	NC	No connect	44	NC	No connect
11	ϕ2A1	Transfer clock 1(phase 2)	45	ϕ2A5	Transfer clock 5(phase 2)
12	ϕ1A1	Transfer clock 1(phase 1)	46	ϕ1A5	Transfer clock 5(phase 1)
13	ϕ2A2	Transfer clock 2(phase 2)	47	ϕ2A6	Transfer clock 6(phase 2)
14	ϕ1A2	Transfer clock 2(phase 1)	48	ϕ1A6	Transfer clock 6(phase 1)
15	NC	No connect	49	NC	No connect
16	NC	No connect	50	NC	No connect
17	NC	No connect	51	NC	No connect
18	NC	No connect	52	NC	No connect
19	NC	No connect	53	NC	No connect
20	NC	No connect	54	NC	No connect
21	ϕ1A3	Transfer clock 3(phase 1)	55	ϕ1A7	Transfer clock 7(phase 1)
22	ϕ2A3	Transfer clock 3(phase 2)	56	ϕ2A7	Transfer clock 7(phase 2)
23	ϕ1A4	Transfer clock 4(phase 1)	57	ϕ1A8	Transfer clock 8(phase 1)
24	ϕ2A4	Transfer clock 4(phase 2)	58	ϕ2A8	Transfer clock 8(phase 2)
25	NC	No connect	59	NC	No connect
26	SS	Ground	60	NC	No connect
27	RS	Reset gate	61	NC	No connect
28	OD	Power supply	62	SS	Ground
29	OS12	Output signal 12 (Red(Even)-L)	63	ϕ2B	Last stage clock (phase 2)
30	OS11	Output signal 11 (Red(Odd)-L)	64	OD	Power supply
31	OD	Power supply	65	OS1	Output signal 1 (Blue(Odd)-F)
32	OS7	Output signal 7 (Green(Odd)-L)	66	OS2	Output signal 2 (Blue(Even)-F)
33	SS	Ground	67	OD	Power supply
34	SH	Shift gate	68	OS6	Output signal 6 (Green(Even)-F)

Optical/Electrical Characteristics (bit clamp)

(Ta = 25°C, V_{OD} = 10 V, V_{ϕ} = V_{RS} = V_{SH} = V_{CP} = 5 V (pulse), f_{ϕ} = 1 MHz, load resistance = 100 kΩ, t_{INT} (integration time) = 10 ms, light source = A light source + CM500S filter (t = 1.0 mm))

Characteristics		Symbol	Min	Typ.	Max	Unit	Note
Sensitivity	Red	R (R)	8.05	11.5	14.95	V/lx·s	(Note 2)
	Green	R (G)	7.49	10.7	13.91		
	Blue	R (B)	3.36	4.8	6.24		
Photo response non uniformity		PRNU (1)	—	10	20	%	(Note 3)
		PRNU (3)	—	3	12	mV	(Note 4)
Saturation output voltage		V_{SAT}	1.2	1.5	—	V	(Note 5)
Saturation exposure		SE	0.08	0.14	—	lx·s	(Note 6)
Dark signal voltage		V_{DRK}	—	2	6	mV	(Note 7)
Dark signal non uniformity		DSNU	—	8	12	mV	(Note 8)
Dc power dissipation		P_D	—	1750	2685	mW	—
Total transfer efficiency		TTE	92	97	—	%	—
Output impedance		Z_O	—	0.2	0.5	kΩ	—
Dc signal output voltage		V_{OS}	3.5	5.0	6.5	V	(Note 9)
Random noise		$N_{D\sigma}$	—	0.8	—	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.

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

$\bar{\chi}$: Average of total signal outputs
$\Delta\chi$: The maximum deviation from $\bar{\chi}$.

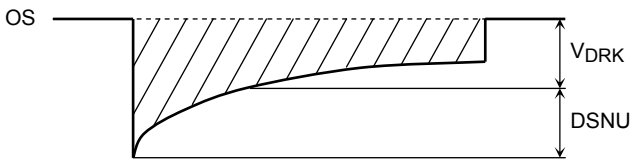
Note 4: PRNU (3) is defined as maximum voltage with next pixel, where measured 5% of SE (typ.).

Note 5: V_{SAT} is defined as minimum saturation output voltage of all effective pixels.

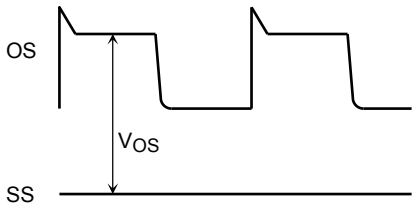
Note 6: Definition of SE: $\text{SE} = \frac{V_{SAT}}{RG}$

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

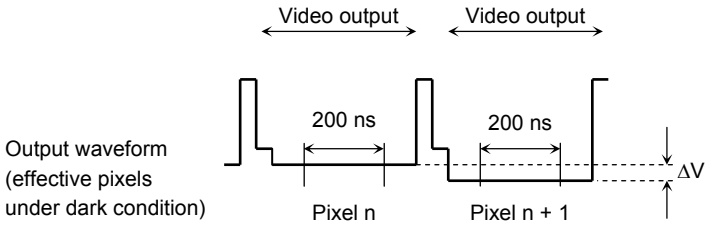
Note 8: DSNU is defined by the difference between average value (V_{DRK}) and the maximum value of the dark voltage.



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).

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

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

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

6) $\bar{\sigma}$ 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.

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

Operating Condition (Ta = 25°C)

For best performance, the device should be used within the Recommended Operating Conditions.

Characteristics		Symbol	Min	Typ.	Max	Unit
Clock pulse voltage	High level	$V_{\phi 1A}$, $V_{\phi 2A}$	4.75	5.0	6.3	V
	Low level		0	—	0.25	
Final stage clock pulse voltage	High level	$V_{\phi 2B}$	4.75	5.0	6.3	V
	Low level		0	—	0.25	
Shift pulse voltage	High level	V_{SH}	4.75	5.0	6.3	V
	Low level		0	—	0.25	
Reset pulse voltage	High level	V_{RS}	4.75	5.0	6.3	V
	Low level		0	—	0.25	
Power supply voltage		V_{OD}	9.5	10.0	10.5	V

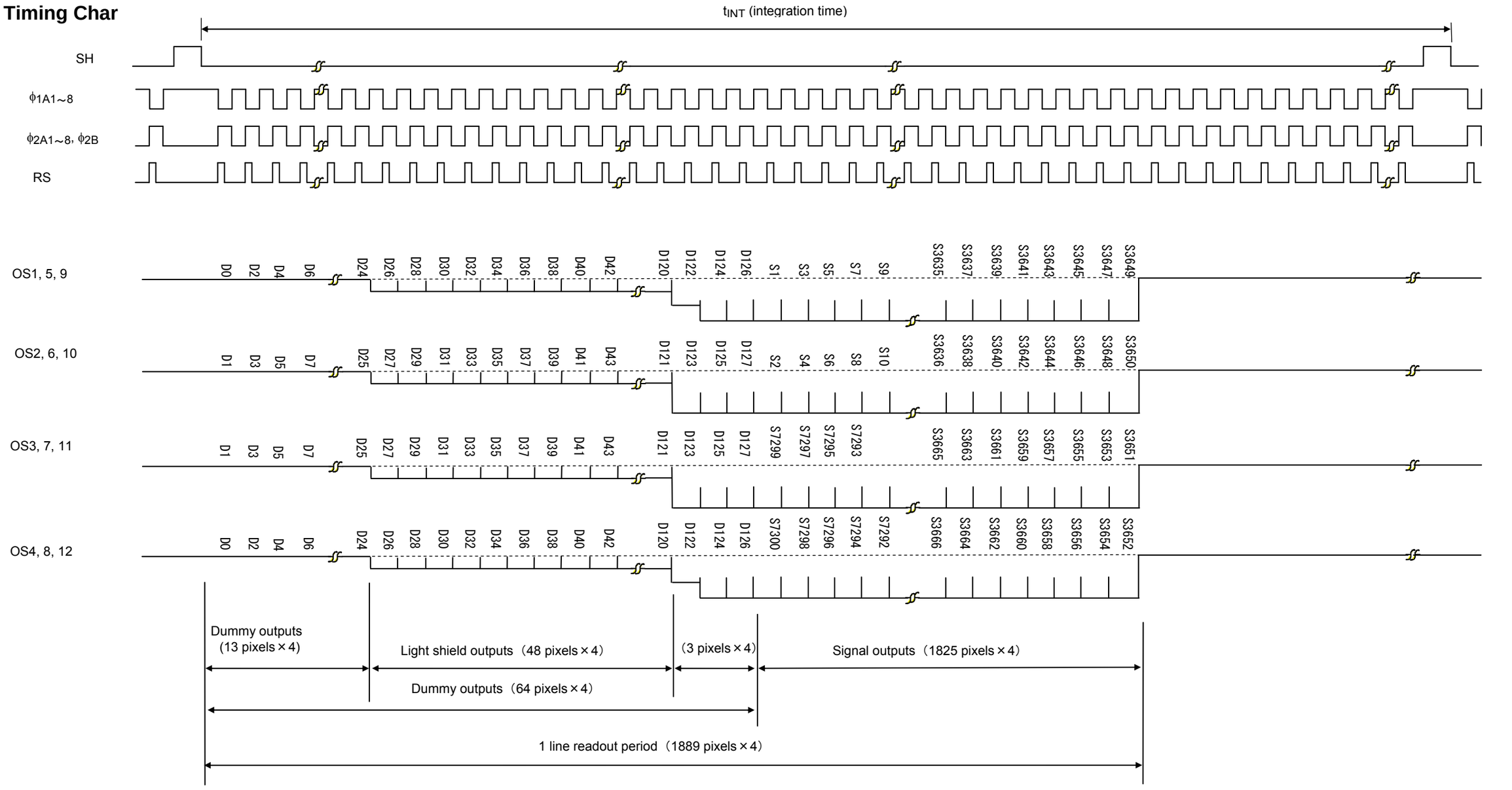
Clock Characteristics (Ta = 25°C)

For best performance, the device should be used within the Recommended Operating Conditions.

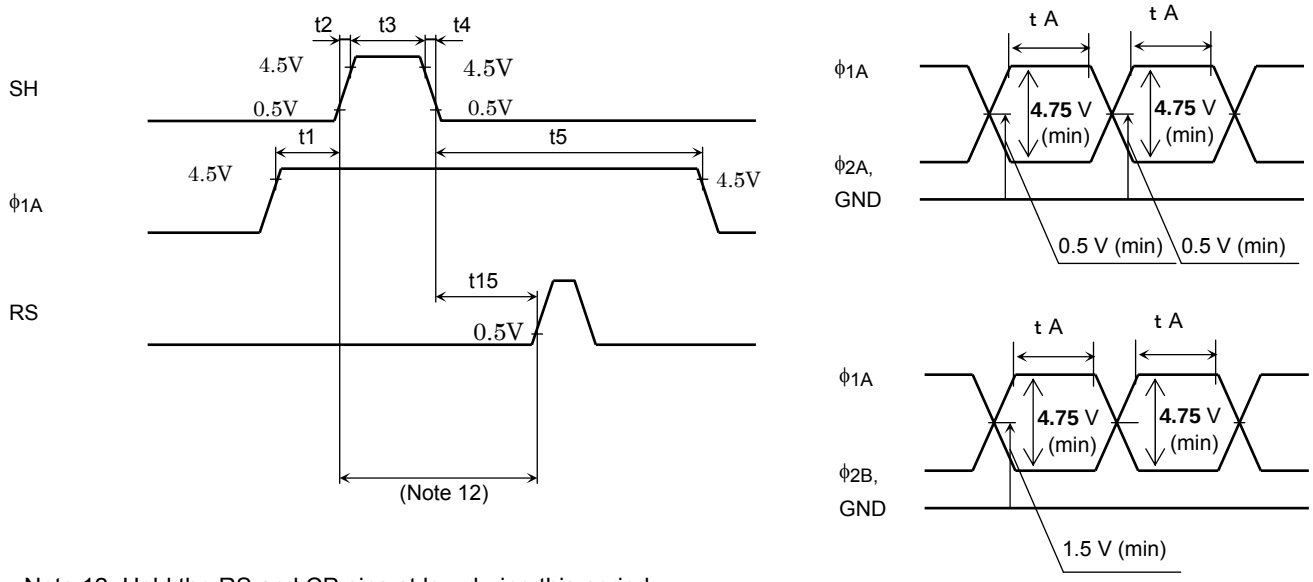
Characteristics	Symbol	Min	Typ.	Max	Unit
Clock pulse frequency	f_{ϕ}	0.2	1.0	35	MHz
Reset pulse frequency	f_{RS}	0.2	1.0	35	MHz
Clock capacitance (Note 11)	$C_{\phi 1A}$	69	87	105	pF
	$C_{\phi 2A}$	68	86	104	
Final stage clock capacitance	$C_{\phi B}$	5	10	15	pF
Shift gate capacitance	C_{SH}	30	35	40	pF
Reset gate capacitance	C_{RS}	4	9	14	pF

Note 11: V_{OD} = 10 V

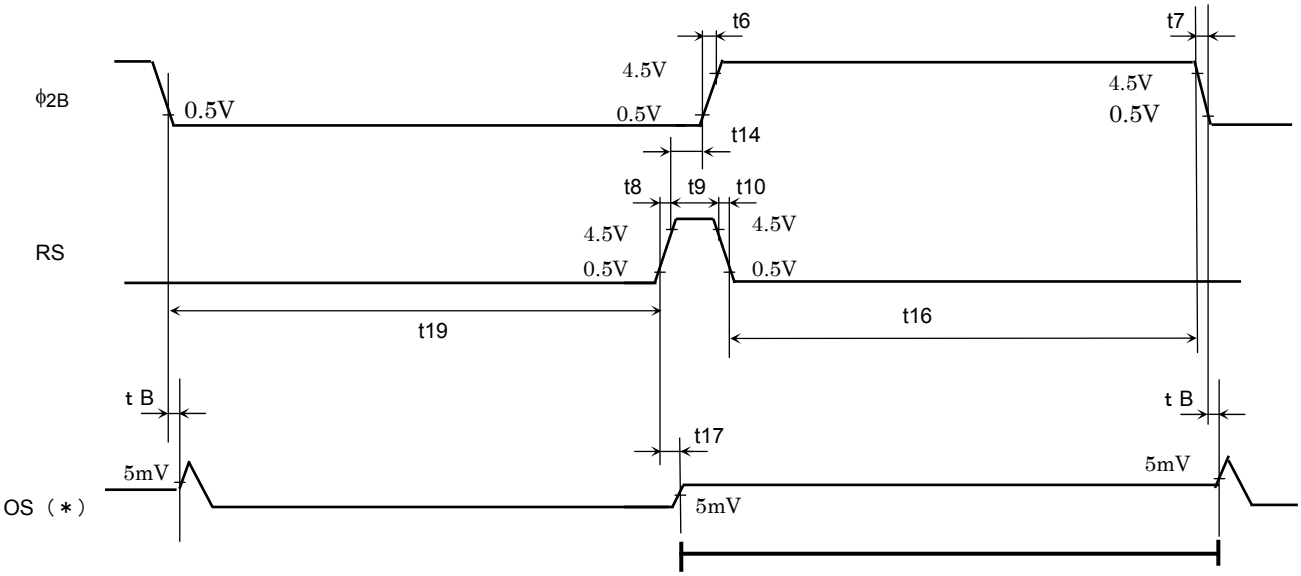
Timing Char


tINT (integration time)
SH
ϕ1A1～8
ϕ2A1～8, ϕ2B
RS
OS1, 5, 9
D0 D2 D4 D6 D24 D26 D28 D30 D32 D34 D36 D38 D40 D42 D120 D122 D124 D126 S1 S3 S5 S7 S9 S3635 S3637 S3639 S3641 S3643 S3645 S3647 S3649
OS2, 6, 10
D1 D3 D5 D7 D25 D27 D29 D31 D33 D35 D37 D39 D41 D43 D121 D123 D125 D127 S2 S4 S6 S8 S10 S3636 S3638 S3640 S3642 S3644 S3646 S3648 S3650
OS3, 7, 11
D1 D3 D5 D7 D25 D27 D29 D31 D33 D35 D37 D39 D41 D43 D121 D123 D125 D127 S7299 S7297 S7295 S7293 S3665 S3663 S3661 S3659 S3657 S3655 S3653 S3651
OS4, 8, 12
D0 D2 D4 D6 D24 D26 D28 D30 D32 D34 D36 D38 D40 D42 D120 D122 D124 D126 S7300 S7298 S7296 S7294 S7292 S3666 S3664 S3662 S3660 S3658 S3656 S3654 S3652
Dummy outputs (13 pixels × 4)
Light shield outputs（48 pixels × 4）
（3 pixels × 4）
Signal outputs（1825 pixels × 4）
Dummy outputs（64 pixels × 4）
1 line readout period（1889 pixels × 4）

Timing Requirements



Note 12: Hold the RS and CP pins at low during this period.



（＊）The definition of 5mV of OS is the amount of Video Signal at the 500mV time.

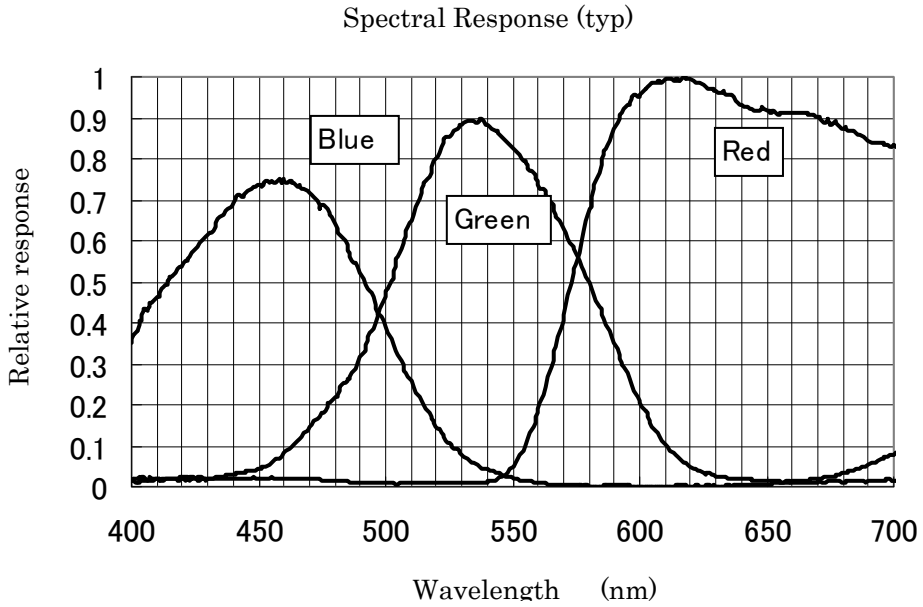
Characteristics	Symbol	Min	Typ. (Note 13)	Max	Unit
Pulse timing of SH and ϕ1A	t1	120	1000	—	ns
	t5	1000	1200	—	ns
SH pulse rise time, fall time	t2, t4	0	50	—	ns
SH pulse width	t3	1000	5000	—	ns
ϕ1, ϕ2 Pulse rise time, fall time	t6, t7	0	50	—	ns
RS pulse rise time, fall time	t8, t10	0	20	—	ns
RS pulse width	t9	2	100	—	ns
Pulse timing of SH and RS	t15	800	—	—	ns
Pulse timing of ϕ2B and RS	t14	0	0	—	ns
	t16	6	100	—	ns
	t19	8	100	—	ns
Video data delay time (Note 14)	t17	—	5.9	—	ns
ϕ1, ϕ2 pulse width (Note 15)	t A	3	15	—	ns
ϕ2B pulse , OS timing	t B	-1.6	−0.6	0.4	ns

Note 13: Measured with f_{RS} = 1 MHz.

Note 14: Load resistance is 100 kΩ.

Note 15: The amplitude difference of Φ1A-Φ2A, Φ1A-Φ2B is a period beyond 4.75V.

Typical Spectral Response



Caution

1. Electrostatic Breakdown

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.

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 pliers of or pincer.
   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

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.

3. Incident Light

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

4. Mounting on a PCB

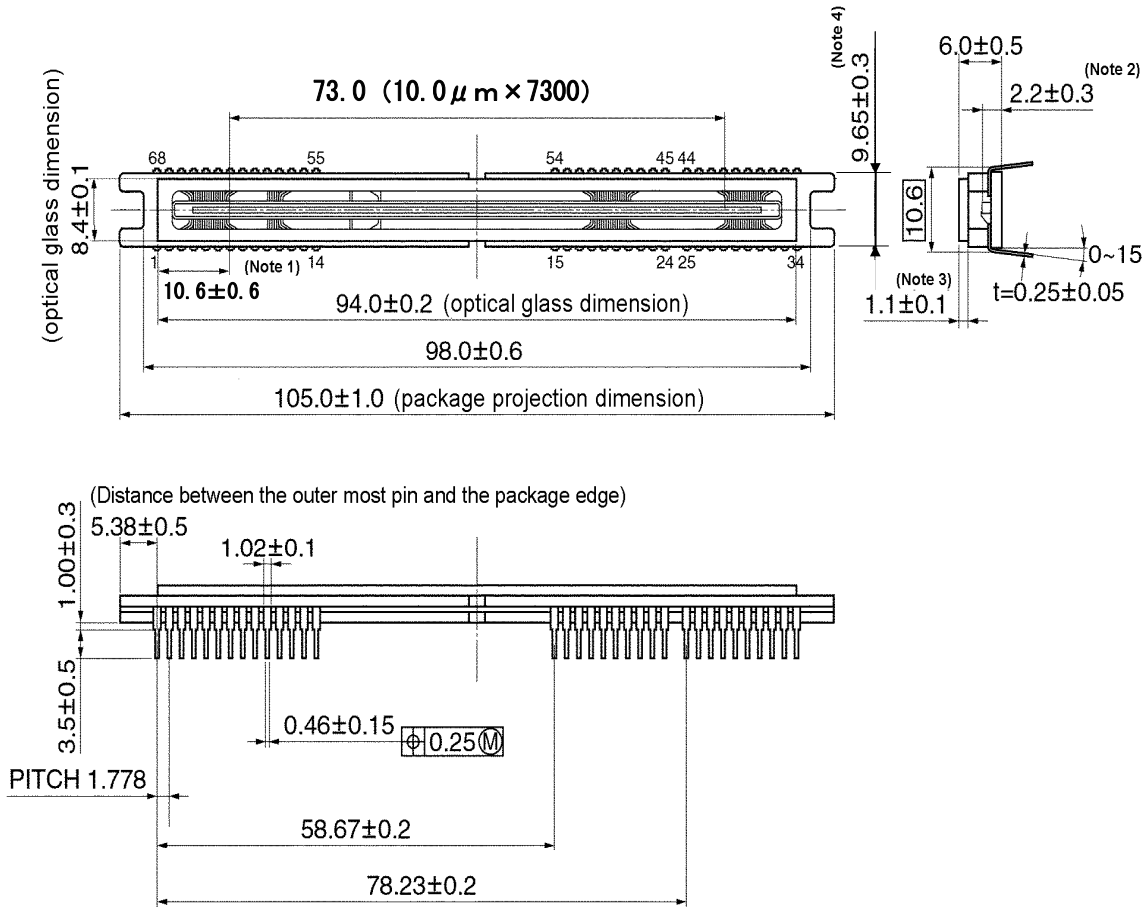
This package is sensitive to mechanical stress.
Toshiba recommends using IC inserters for mounting, instead of using lead forming equipment.

5. Soldering

Soldering by the solder flow method cannot be guaranteed because this method may have deleterious effects on prevention of window glass soiling and heat resistance.
Using a soldering iron, complete soldering within three seconds for lead temperatures of up to 380°C.

Package Dimensions WDIP68-G-400A

Unit : mm



Note 1: Distance between the center of the first pin and the first pixel (S1)
Note 2: Distance between the of the chip and bottom of the package.
Note 3: Glass thickness (n = 1.5)
Note 4: Dimensional tolerance is ±0.3 mm for the 10-mm range from each ceramic edge, ±0.4 mm for the 10-mm to 27-mm range and ±0.5 mm for the inner range.

Weight: 16.0 g (typ.)

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