

10600 PIXELS $\times$ 3 COLOR CCD LINEAR IMAGE SENSOR

The μ PD3719 is a color CCD (Charge Coupled Device) linear image sensor which changes optical images to electrical signal and has the function of color separation.

The μ PD3719 has 3 rows of 10600 pixels, and each row has a single-sided readout type of charge transfer register. It has reset feed-through level clamp circuits and voltage amplifiers. Moreover, a large dynamic range is realized by using a large saturation voltage and a low-noise amplifier. Therefore, it is suitable for 1200 dpi/A4 professional color image scanners and so on.

FEATURES

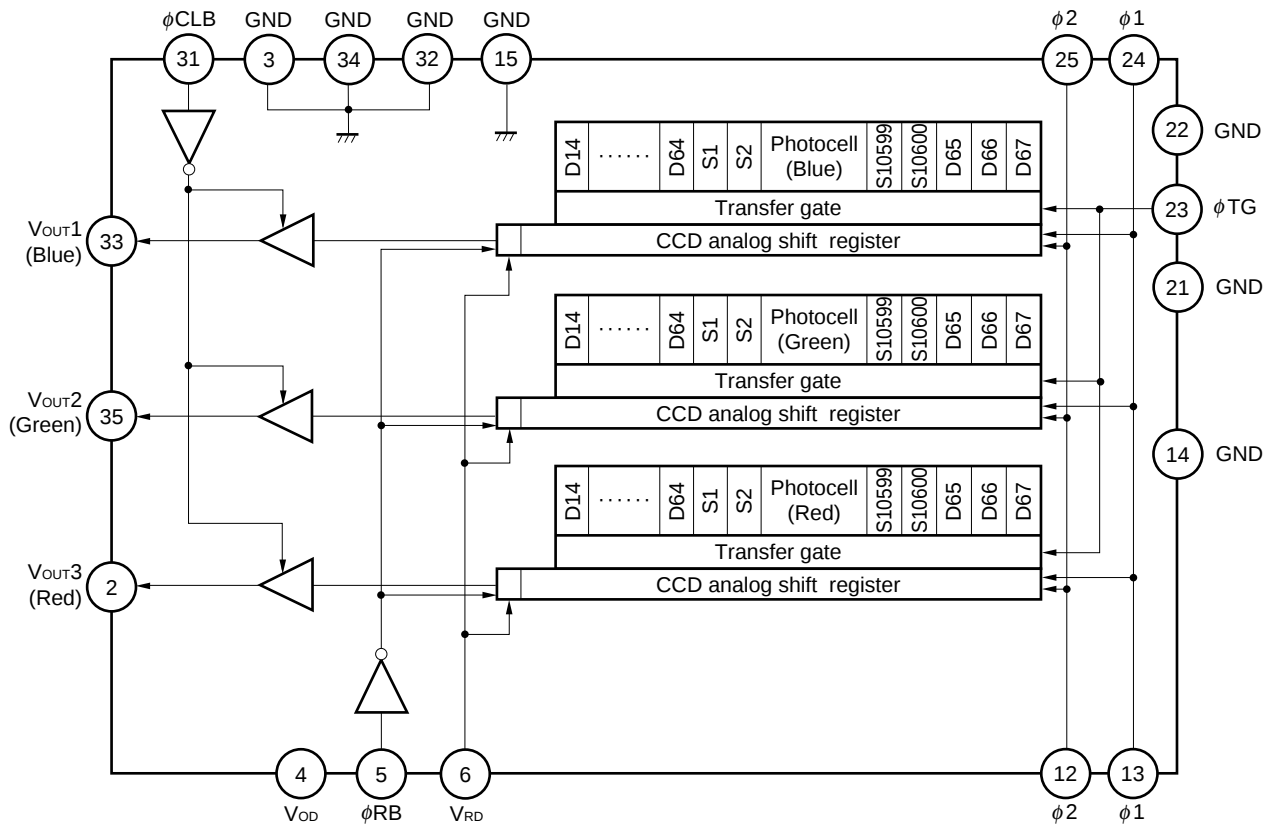
- Valid photocell : 10600 pixels $\times$ 3
- Photocell's pitch : 7 μ m
- Line spacing : 70 μ m (10 lines) Red line-Green line, Green line-Blue line
- Color filter : Primary colors (red, green and blue), pigment filter (with light resistance 10^7 lx $\cdot$ hour)
- Resolution : 48 dot/mm A4 (210 $\times$ 297 mm) size (shorter side)
1200 dpi US letter (8.5" $\times$ 11") size (shorter side)
- Drive clock level : CMOS output under 5 V operation
- Data rate : 2 MHz MAX.
- Power supply : +15 V
- On-chip circuits : Reset feed-through level clamp circuits
Voltage amplifiers

ORDERING INFORMATION

Part Number	Package
μ PD3719D	CCD linear image sensor 36-pin ceramic DIP (600 mil)

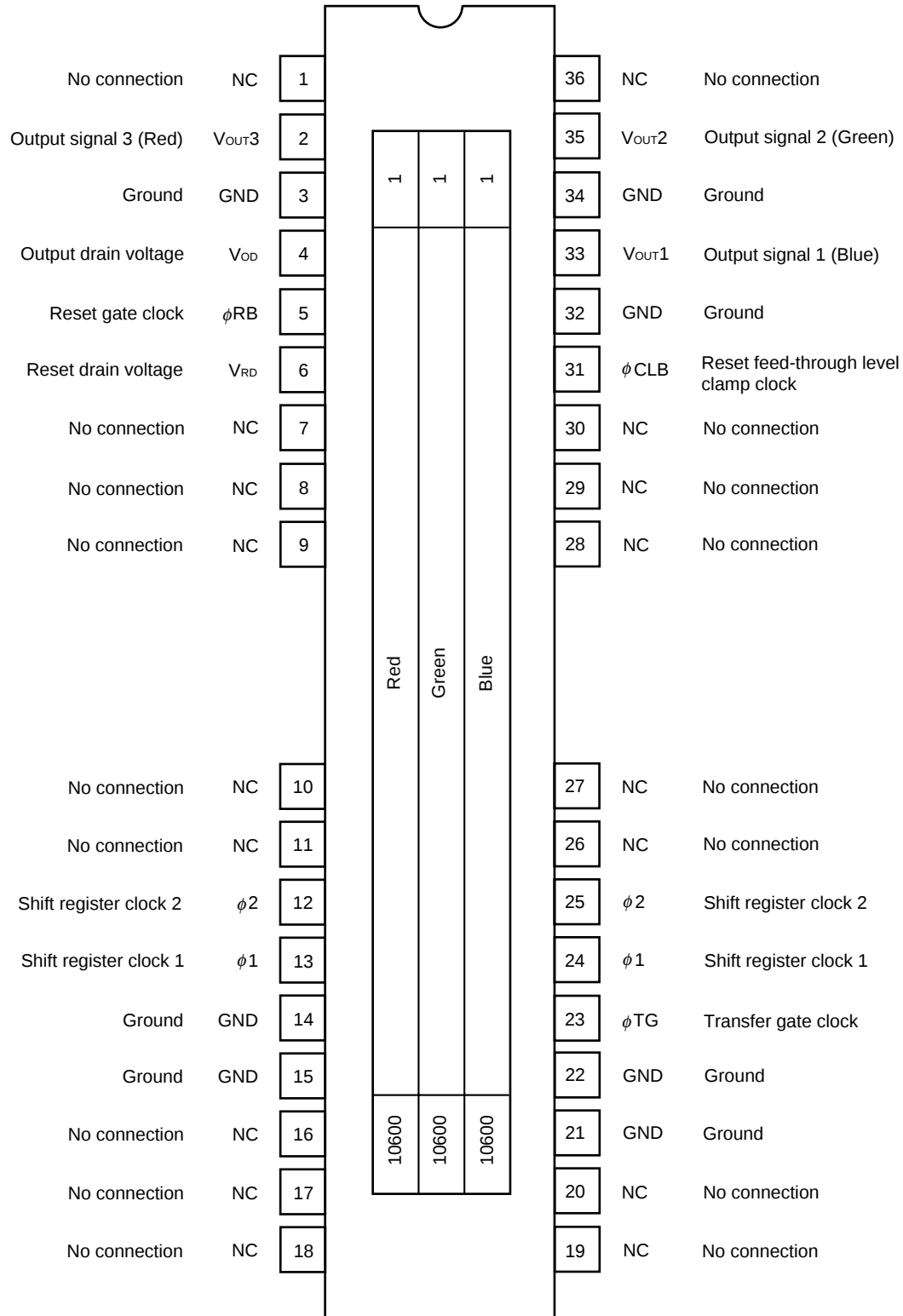
The information in this document is subject to change without notice.

BLOCK DIAGRAM

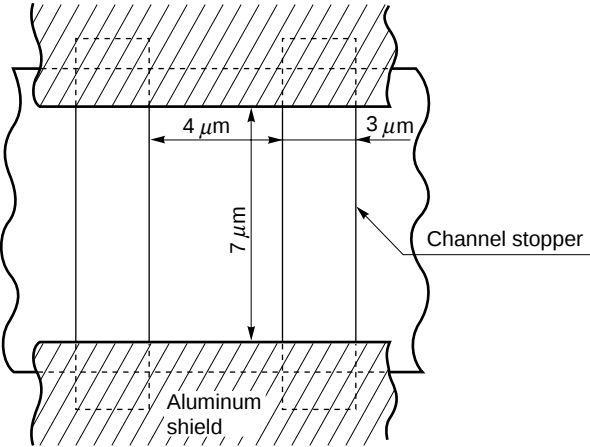


PIN CONFIGURATION (Top View)

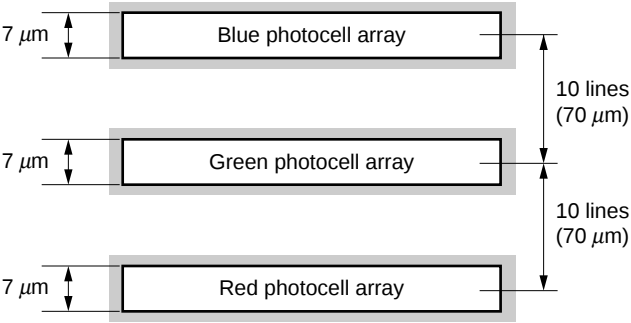
CCD linear image sensor 36-pin ceramic DIP (600 mil)



PHOTOCELL STRUCTURE DIAGRAM



PHOTOCELL ARRAY STRUCTURE DIAGRAM
(Line spacing)



ABSOLUTE MAXIMUM RATINGS (T_A = +25 °C)

Parameter	Symbol	Ratings	Unit
Output drain voltage	V _{OD}	−0.3 to +16	V
Reset drain voltage	V _{RD}	−0.3 to +16	V
Shift register clock voltage	V _{φ1} , V _{φ2}	−0.3 to +8	V
Reset gate clock voltage	V _{φRB}	−0.3 to +8	V
Reset feed-through level clamp clock voltage	V _{φCLB}	−0.3 to +8	V
Transfer gate clock voltage	V _{φTG}	−0.3 to +8	V
Operating ambient temperature	T _A	−25 to +60	°C
Storage temperature	T _{stg}	−40 to +100	°C

Caution Exposure to ABSOLUTE MAXIMUM RATINGS for extended periods may affect device reliability; exceeding the ratings could cause permanent damage. The parameters apply independently.

RECOMMENDED OPERATING CONDITIONS (T_A = +25 °C)

Parameter	Symbol	MIN.	TYP.	MAX.	Unit
Output drain voltage	V _{OD}	14.0	15.0	16.0	V
Reset drain voltage	V _{RD}	14.0	V _{OD}	V _{OD}	V
Shift register clock high level	V _{φ1H} , V _{φ2H}	4.5	5.0	5.5	V
Shift register clock low level	V _{φ1L} , V _{φ2L}	−0.3	0	+0.5	V
Reset gate clock high level	V _{φRBH}	4.5	5.0	5.5	V
Reset gate clock low level	V _{φRBL}	−0.3	0	+0.5	V
Reset feed-through level clamp clock high level	V _{φCLBH}	4.5	5.0	5.5	V
Reset feed-through level clamp clock low level	V _{φCLBL}	−0.3	0	+0.5	V
Transfer gate clock high level	V _{φTGH}	4.5	V _{φ1H} ^{Note}	V _{φ1H} ^{Note}	V
Transfer gate clock low level	V _{φTGL}	−0.3	0	+0.3	V
Data rate	f _{φRB}	—	1	2	MHz

Note When Transfer gate clock high level (V_{φTGH}) is higher than Shift register clock high level (V_{φ1H}), Image lag can increase.

ELECTRICAL CHARACTERISTICS

($T_A = +25\text{ }^{\circ}\text{C}$, $V_{OD} = 15\text{ V}$, $V_{RD} = 15\text{ V}$, data rate ($f_{\phi RB}$) = 2 MHz, storage time = 5.5 ms,
light source: 3200 K halogen lamp +C-500S (infrared cut filter, $t = 1\text{ mm}$), input signal clock = 5 V_{p-p})

Parameter		Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Saturation voltage		V_{sat}		4.0	5.0	—	V
Saturation exposure	Red	SER			0.52		lx•s
	Green	SEG			0.57		lx•s
	Blue	SEB			0.94		lx•s
Photo response non-uniformity		PRNU	$V_{OUT} = 2.5\text{ V}$		6	20	%
Average dark signal		ADS	Light shielding		0.8	3.0	mV
Dark signal non-uniformity		DSNU	Light shielding		1.5	5.0	mV
Power consumption		P_W			400	600	mW
Output impedance		Z_O			0.5	1	k Ω
Response	Red	R_R		6.8	9.7	12.6	V/lx•s
	Green	R_G		6.2	8.8	11.4	V/lx•s
	Blue	R_B		3.8	5.3	6.8	V/lx•s
Image lag		IL	$V_{OUT} = 2.5\text{ V}$		2.0	5.0	%
Offset level Note1		V_{OS}		8.8	10.8	12.8	V
Output fall delay time Note2		t_d	$V_{OUT} = 2.5\text{ V}$		70		ns
Total transfer efficiency		TTE	$V_{OUT} = 2.5\text{ V}$	92	98		%
Response peak	Red				630		nm
	Green				540		nm
	Blue				460		nm
Dynamic range	DR1	$V_{sat} / DSNU$			3333		times
	DR2	V_{sat} / σ			10000		times
Reset feed-through noise Note1		RFTN	Light shielding	0	1500	2500	mV
Random noise		σ	Light shielding	—	0.5	—	mV

Notes 1. Refer to **TIMING CHART 2**.

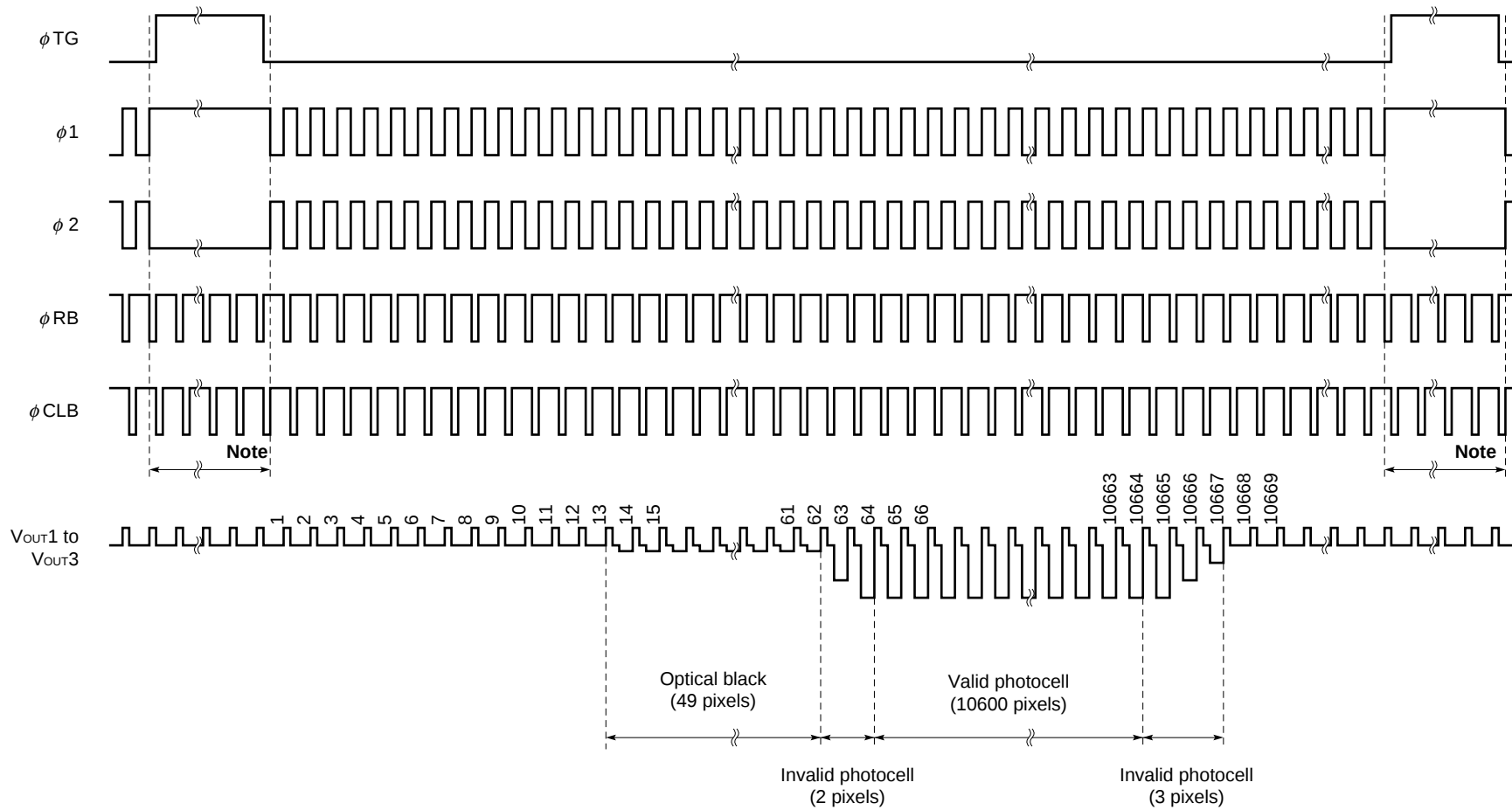
2. When the fall time of $\phi 1$ (t_1) is the TYP. value (refer to **TIMING CHART 2**).

INPUT PIN CAPACITANCE ($T_A = +25\text{ }^{\circ}\text{C}$, $V_{OD} = V_{RD} = 15\text{ V}$)

Parameter	Symbol	Pin name	Pin No.	MIN.	TYP.	MAX.	Unit
Shift register clock pin capacitance 1	$C_{\phi 1}$	$\phi 1$	13		1600		pF
			24		1600		pF
Shift register clock pin capacitance 2	$C_{\phi 2}$	$\phi 2$	12		1600		pF
			25		1600		pF
Reset gate clock pin capacitance	$C_{\phi RB}$	ϕRB	5		15		pF
Reset feed-through level clamp clock pin capacitance	$C_{\phi CLB}$	ϕCLB	31		15		pF
Transfer gate clock pin capacitance	$C_{\phi TG}$	ϕTG	23		200		pF

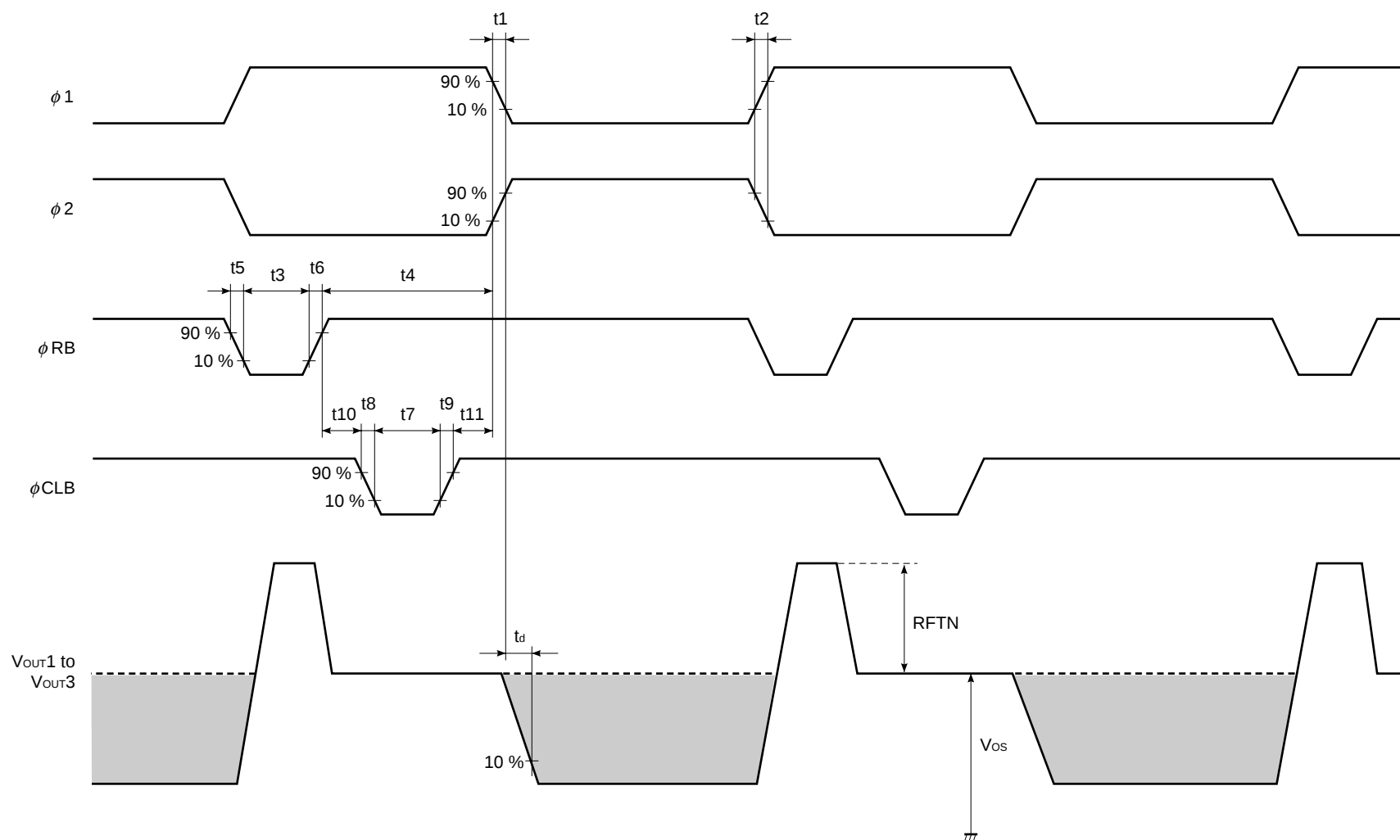
Remark Pins 13 and 24 ($\phi 1$), 12 and 25 ($\phi 2$) are each connected inside of the device.

TIMING CHART 1 (for each color)

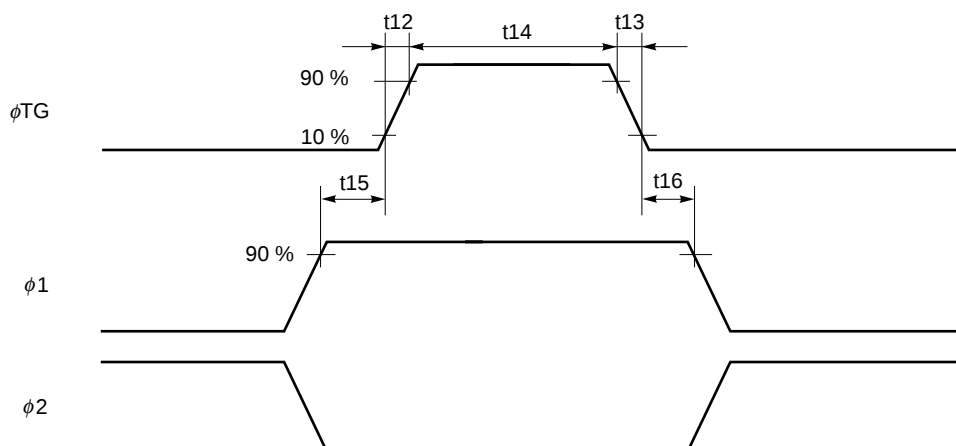


Note Input the ϕ RB and ϕ CLB pulses continuously during this period, too.

TIMING CHART 2 (for each color)



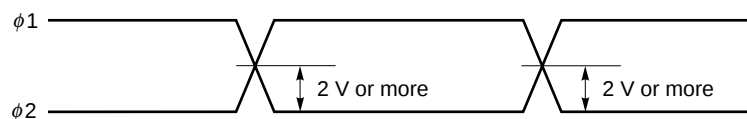
φTG, φ1, φ2 TIMING CHART



Symbol	MIN.	TYP.	MAX.	Unit
t1, t2	0	25	—	ns
t3	30	50	—	ns
t4	70	150	—	ns
t5, t6	0	25	—	ns
t7	30	75	—	ns
t8, t9	0	25	—	ns
t10	10	20	—	ns
t11	5	10	—	ns
t12, t13	0	50	—	ns
t14	3000	10000	—	ns
t15, t16	900	1000	—	ns

Remark TYP. is an example of at 1 MHz data rate ($f_{\phi RB}$) operation.

φ1, φ2 cross points



Remark Adjust cross points of φ1 and φ2 with input resistance of each pin.

DEFINITIONS OF CHARACTERISTIC ITEMS

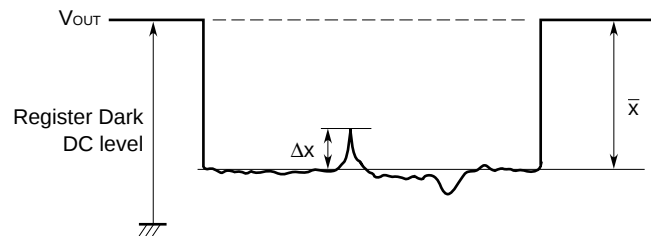
1. Saturation voltage: V_{sat}
Output signal voltage at which the response linearity is lost.
2. Saturation exposure: SE
Product of intensity of illumination (I_x) and storage time (s) when saturation of output voltage occurs.
3. Photo response non-uniformity: PRNU
The output signal non-uniformity of all the valid pixels when the photosensitive surface is applied with the light of uniform illumination. This is calculated by the following formula.

$$PRNU (\%) = \frac{\Delta x}{\bar{x}} \times 100$$

Δx : maximum of $|x_j - \bar{x}|$

$$\bar{x} = \frac{\sum_{j=1}^{10600} x_j}{10600}$$

x_j : Output voltage of valid pixel number j



4. Average dark signal: ADS
Average output signal voltage of all the valid pixels at light shielding. This is calculated by the following formula.

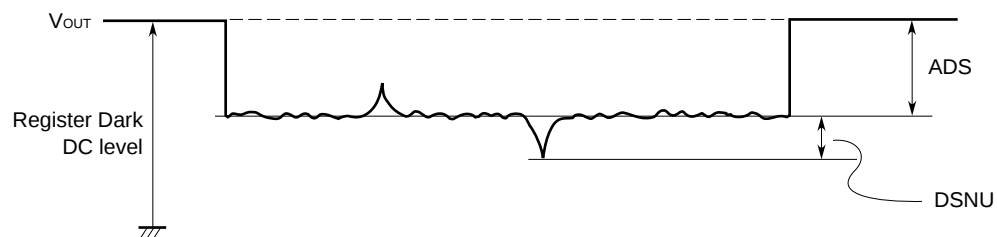
$$ADS (mV) = \frac{\sum_{j=1}^{10600} d_j}{10600}$$

d_j : Dark signal of valid pixel number j

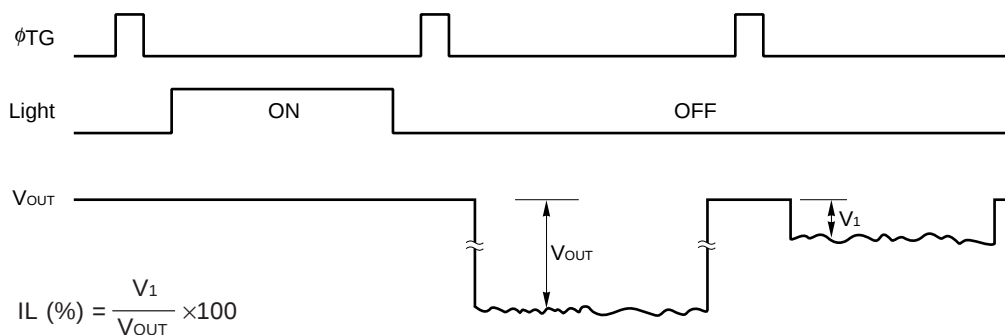
5. Dark signal non-uniformity: DSNU
Absolute maximum of the difference between ADS and voltage of the highest or lowest output pixel of all the valid pixels at light shielding. This is calculated by the following formula.

DSNU (mV) : maximum of $|d_j - ADS|_{j=1 \text{ to } 10600}$

d_j : Dark signal of valid pixel number j



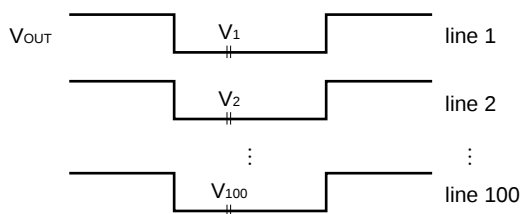
6. Output impedance: Z_o
Impedance of the output pins viewed from outside.
7. Response: R
Output voltage divided by exposure ($I \times s$).
Note that the response varies with a light source (spectral characteristic).
8. Image Lag: IL
The rate between the last output voltage and the next one after read out the data of a line.



9. Random noise: σ
Random noise σ is defined as the standard deviation of a valid pixel output signal with 100 times (=100 lines) data sampling at dark (light shielding).

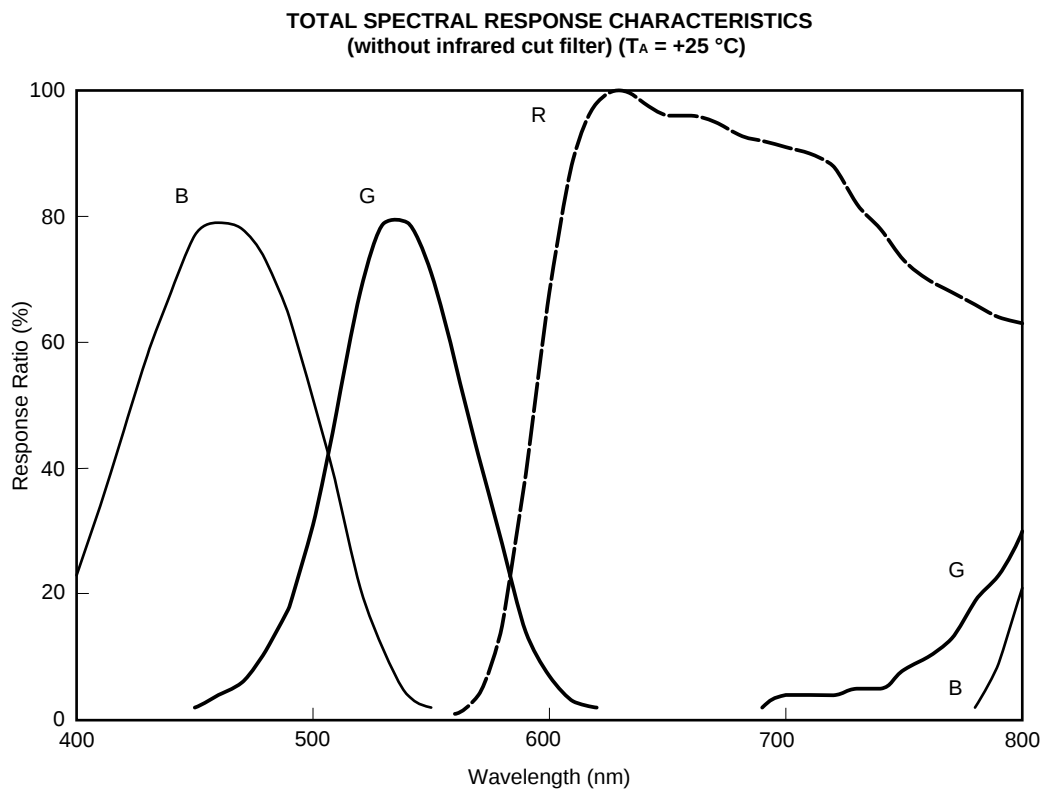
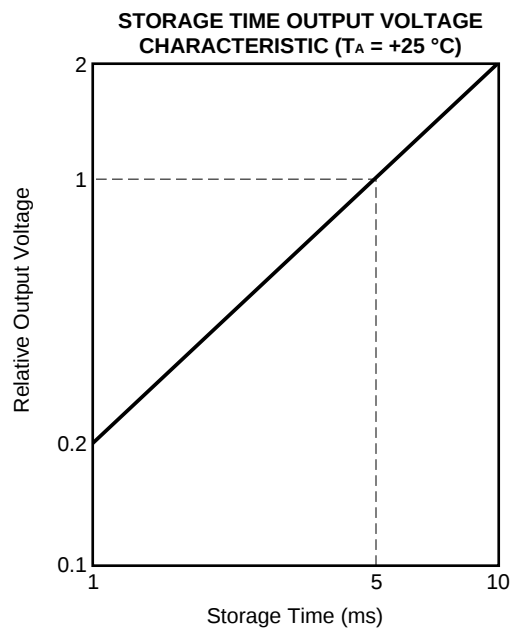
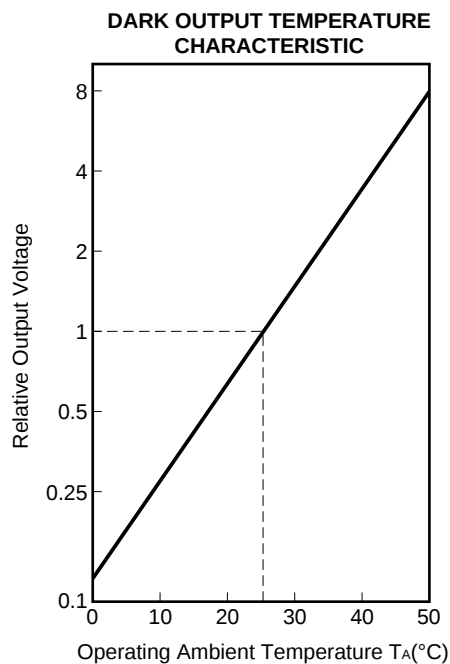
$$\sigma \text{ (mV)} = \sqrt{\frac{\sum_{i=1}^{100} (V_i - \bar{V})^2}{100}}, \quad \bar{V} = \frac{1}{100} \sum_{i=1}^{100} V_i$$

V_i : A valid pixel output signal among all of the valid pixels for each color

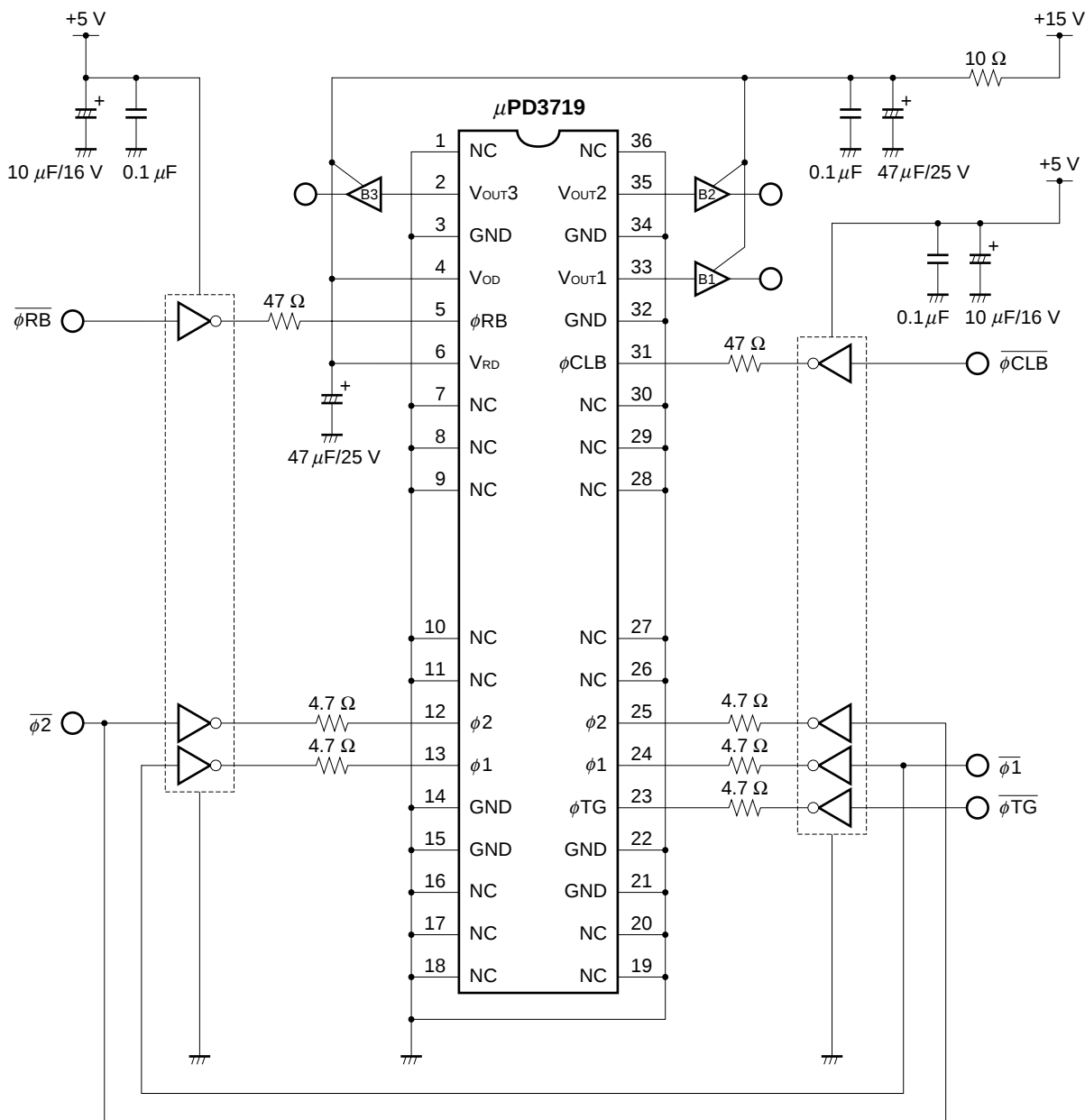


This is measured by the DC level sampling of only the signal level, not by CDS (Correlated Double Sampling).

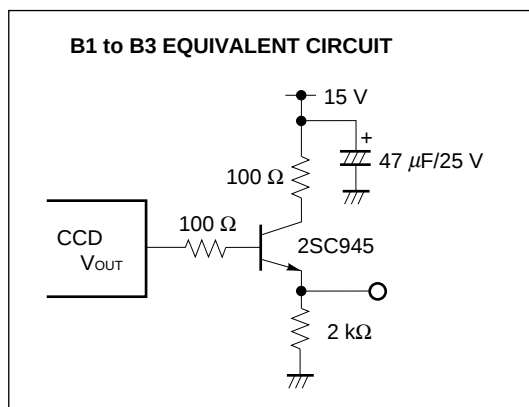
STANDARD CHARACTERISTIC CURVES



APPLICATION CIRCUIT EXAMPLE



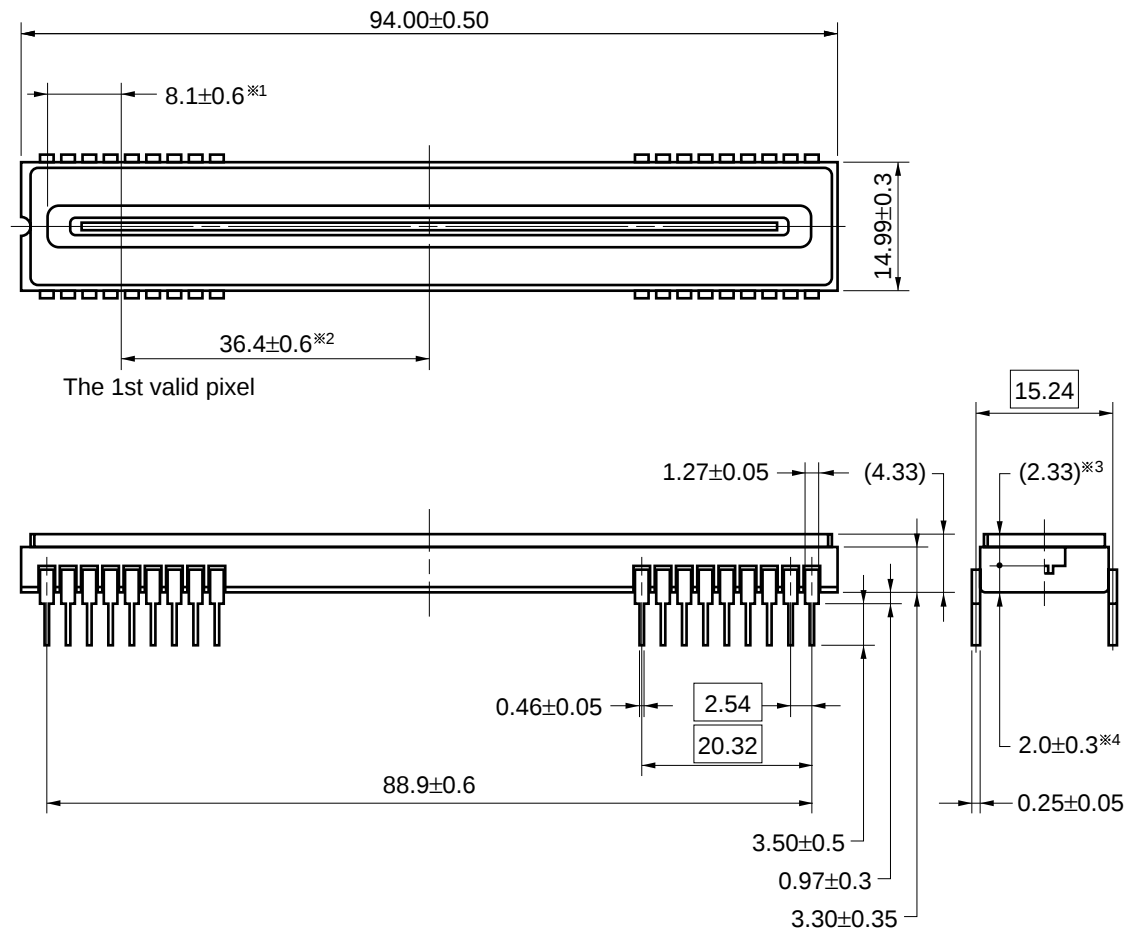
Remark The inverters shown in the above application circuit example are the 74HC04.



PACKAGE DRAWING

CCD LINEAR IMAGE SENSOR 36-PIN CERAMIC DIP (600mil)

(Unit : mm)



Name	Dimensions	Refractive index
Glass cap	$93.0 \times 13.6 \times 1.0$	1.5

- ※1 The 1st valid pixel $\longleftrightarrow$ The center of the pin1
 ※2 The 1st valid pixel $\longleftrightarrow$ The center of the package
 ※3 The surface of the chip $\longleftrightarrow$ The top of the glass cap (Reference)
 ※4 The bottom of the package $\longleftrightarrow$ The surface of the chip

36D-1CCD-PKG-1

NOTES ON THE USE OF THE PACKAGE

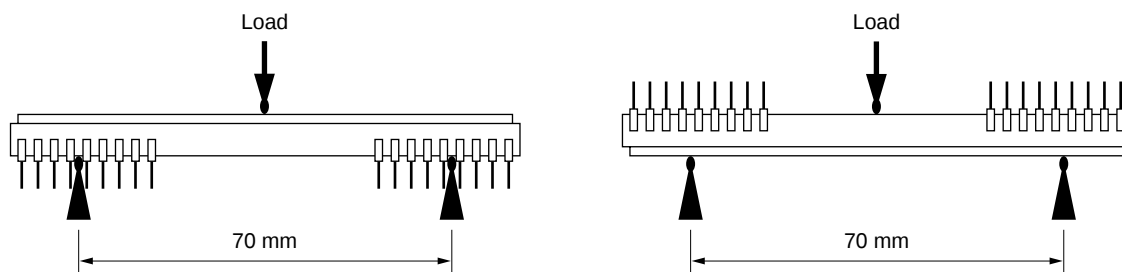
The application of an excessive load to the package may cause the package to warp or break, or cause chips to come off internally. Particular care should be taken when mounting the package on the circuit board.

When mounting the package, use a circuit board which will not subject the package to bending stress, or use a socket.

For this product, the reference value for the three-point bending strength^{Note} is 30 kg. Avoid imposing a load, however, on the inside portion as viewed from the face on which the window (glass) is bonded to the package body (ceramic).

Note Three-point bending strength test

Distance between supports: 70 mm, Support R: R 2 mm, Loading rate: 0.5 mm / min.



[MEMO]

[MEMO]

NOTES FOR CMOS DEVICES

① PRECAUTION AGAINST ESD FOR SEMICONDUCTORS

Note: Strong electric field, when exposed to a MOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop generation of static electricity as much as possible, and quickly dissipate it once, when it has occurred. Environmental control must be adequate. When it is dry, humidifier should be used. It is recommended to avoid using insulators that easily build static electricity. Semiconductor devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work bench and floor should be grounded. The operator should be grounded using wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions need to be taken for PW boards with semiconductor devices on it.

② HANDLING OF UNUSED INPUT PINS FOR CMOS

Note: No connection for CMOS device inputs can be cause of malfunction. If no connection is provided to the input pins, it is possible that an internal input level may be generated due to noise, etc., hence causing malfunction. CMOS device behave differently than Bipolar or NMOS devices. Input levels of CMOS devices must be fixed high or low by using a pull-up or pull-down circuitry. Each unused pin should be connected to V_{DD} or GND with a resistor, if it is considered to have a possibility of being an output pin. All handling related to the unused pins must be judged device by device and related specifications governing the devices.

③ STATUS BEFORE INITIALIZATION OF MOS DEVICES

Note: Power-on does not necessarily define initial status of MOS device. Production process of MOS does not define the initial operation status of the device. Immediately after the power source is turned ON, the devices with reset function have not yet been initialized. Hence, power-on does not guarantee out-pin levels, I/O settings or contents of registers. Device is not initialized until the reset signal is received. Reset operation must be executed immediately after power-on for devices having reset function.

[MEMO]

The application circuits and their parameters are for reference only and are not intended for use in actual design-ins.

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Standard: Computers, office equipment, communications equipment, test and measurement equipment, audio and visual equipment, home electronic appliances, machine tools, personal electronic equipment and industrial robots

Special: Transportation equipment (automobiles, trains, ships, etc.), traffic control systems, anti-disaster systems, anti-crime systems, safety equipment and medical equipment (not specifically designed for life support)

Specific: Aircrafts, aerospace equipment, submersible repeaters, nuclear reactor control systems, life support systems or medical equipment for life support, etc.

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Anti-radioactive design is not implemented in this product.