

TOSHIBA Photointerrupter Infrared LED + Photo IC

# TLP1032(F), TLP1033A(F)

Lead(Pb)-Free

Domestic electrical appliances such as VTRs and CD players

Office equipment such as photocopiers, printers and fax machines

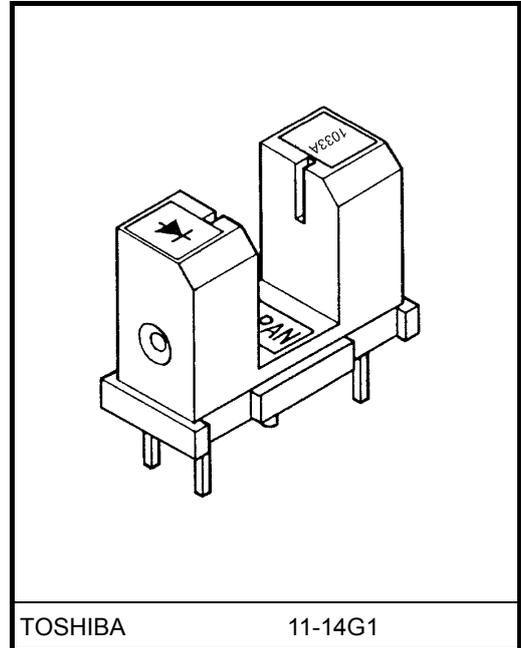
Vending machines

Position detectors

The TLP1032(F)/TLP1033A(F) is a high-withstanding-voltage photo-interrupter for digital output. The device combines a high-optical-output GaAs infrared LED with a high-sensitivity, high-gain Si photo-IC. The photo-IC, which supports a wide range of systems (3.3 V to 12 V), enables the device to consume less power than conventional devices. The device also features a narrow slit width and high resolution.

The short lead package allows automatic mounting.

- Designed for direct mounting on printed circuit boards (positioning pins included)
- The short lead package allows automatic mounting:
  - Lead length of  $3.4 \pm 0.3$  mm
- Permissible board thickness: 1.6 mm or less
- Gap: 5 mm
- Resolution: Slit width of 0.5 mm
- Digital output (open-collector)
  - TLP1032(F) : Low-level output at shielding
  - TLP1033A(F): High-level output at shielding
- Direct connection to logic IC
- Power supply voltage:  $V_{CC} = 2.7 \text{ V} \sim 15 \text{ V}$
- High-speed response
- Detector impermeable to visible light
- Package material: Polybutylene-terephthalate (UL94V-0, black)



Weight: 0.6 g (typ.)

## Absolute Maximum Ratings (Ta = 25°C)

Characteristic		Symbol	Rating	Unit	
LED	Forward current	$I_F$	50	mA	
	Forward current derating	$\Delta I_F/^\circ\text{C}$	(Ta > 25°C)	-0.33	mA/°C
			(Ta > 85°C)	-2	
Reverse voltage		$V_R$	5	V	
Detector	Supply voltage	$V_{CC}$	15	V	
	Output voltage	$V_O$	15	V	
	Low-level output current (Ta = T <sub>opr</sub> )	$I_{OL}$	16	mA	
Operating temperature		$T_{opr}$	-30~95	°C	
Storage temperature		$T_{stg}$	-40~100	°C	
Soldering temperature (5 s) (Note 1)		$T_{sol}$	260	°C	

Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings and the operating ranges.

Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

Note 1: Soldering is performed 1.5 mm from the bottom of the package.

## Operating Ranges

Characteristic	Symbol	Min	Typ.	Max	Unit
LED forward current	$I_F$	8 (Note 2)	—	20	mA
Supply voltage	$V_{CC}$	2.7	3.3	13.2	V
Output voltage	$V_O$	—	—	13.2	V
Low-level output current	$I_{OL}$	—	—	16	mA
Operating temperature	$T_{opr}$	-25	—	95	°C

Note 2: The value 8 mA allows for a 50% optical fluctuation in the LED. The initial value of the threshold input current is 4 mA or less.

## Electrical and Optical Characteristics

(unless otherwise specified:  $T_a = -30\sim 95^\circ\text{C}$ ,  $V_{CC} = 2.7\sim 15\text{ V}$ )

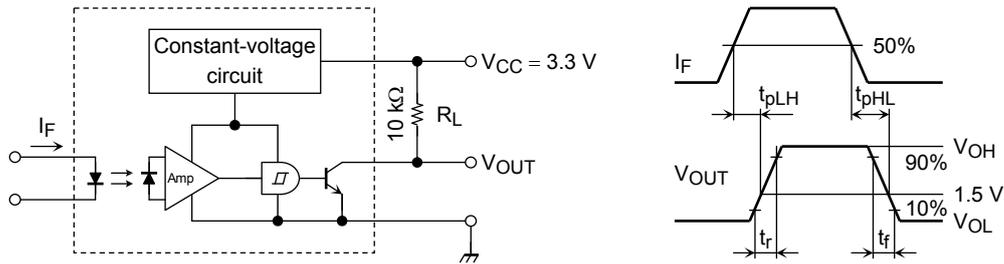
Characteristic		Symbol	Test Conditions	Min	Typ.	Max	Unit	
LED	Forward voltage	$V_F$	$I_F = 10\text{ mA}$ , $T_a = 25^\circ\text{C}$	1.00	1.15	1.30	V	
	Reverse current	$I_R$	$V_R = 5\text{ V}$ , $T_a = 25^\circ\text{C}$	—	—	10	$\mu\text{A}$	
	Peak emission wavelength	$\lambda_P$	$I_F = 15\text{ mA}$ , $T_a = 25^\circ\text{C}$	—	940	—	nm	
Detector	Operating supply voltage	$V_{CC}$	—	2.7	—	15	V	
	Low-level supply current	$I_{CCL}$	$I_F = *1$ , $T_a = 25^\circ\text{C}$	—	—	1.6	mA	
			$I_F = *1$	—	—	2.0		
	High-level supply current	$I_{CCH}$	$I_F = *2$ , $T_a = 25^\circ\text{C}$	—	—	1.1	mA	
			$I_F = *2$	—	—	1.2		
	Low-level output voltage	$V_{OL}$	$I_{OL} = 16\text{ mA}$ , $I_F = *1$ $T_a = 25^\circ\text{C}$	—	0.05	0.3	V	
			$I_{OL} = 16\text{ mA}$ , $I_F = *1$	—	—	0.4		
High-level output current	$I_{OH}$	$I_F = *2$ , $V_O = 15\text{ V}$	—	—	6.3	$\mu\text{A}$		
Peak sensitivity wavelength	$\lambda_P$	$T_a = 25^\circ\text{C}$	—	900	—	nm		
Propagation characteristics	L → H threshold input current	$I_{FLH}$	$T_a = 25^\circ\text{C}$	TLP1032(F)	—	—	3	mA
					—	—	4	
	H → L threshold input current	$I_{FHL}$	$T_a = 25^\circ\text{C}$	TLP1033A(F)	—	—	3	mA
					—	—	4	
	Hysteresis	$I_{FHL}/I_{FLH}$	—	TLP1032(F)	—	0.67	—	—
				TLP1033A(F)	—	1.5	—	
	Propagation delay time (L → H)	$t_{pLH}$	$V_{CC} = 3.3\text{ V}$ $I_F = 15\text{ mA}$ $R_L = 10\text{ k}\Omega$ $T_a = 25^\circ\text{C}$	TLP1032(F)	—	—	9	$\mu\text{s}$
				TLP1033A(F)	—	—	15	
	Propagation delay time (H → L)	$t_{pHL}$		TLP1032(F)	—	—	15	
				TLP1033A(F)	—	—	9	
Rise time	$t_r$	TLP1032(F)		—	0.02	0.5		
		TLP1033A(F)		—	0.8	3		
Fall time	$t_f$	TLP1032(F)		—	0.8	3		
		TLP1033A(F)		—	0.02	0.5		

\*1 0 mA for the TLP1032(F); 15 mA for the TLP1033A(F).

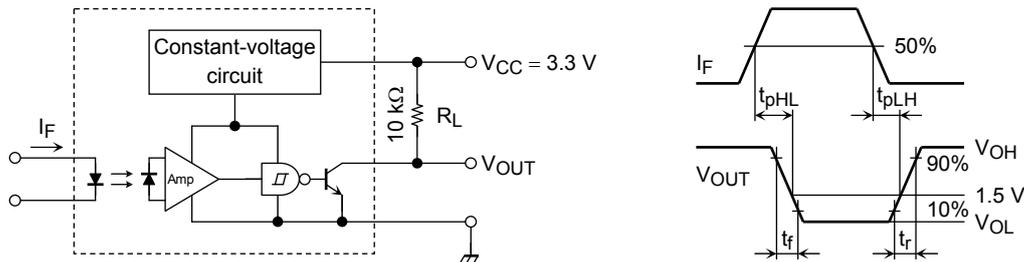
\*2 15 mA for the TLP1032(F); 0 mA for the TLP1033A(F).

Note 3: The switching time measurement circuit and waveform are as follows:

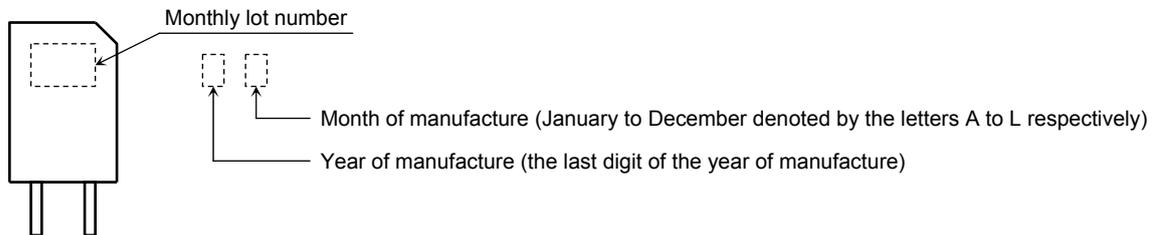
### TLP1032(F)



### TLP1033A(F)



## Markings



## Precautions

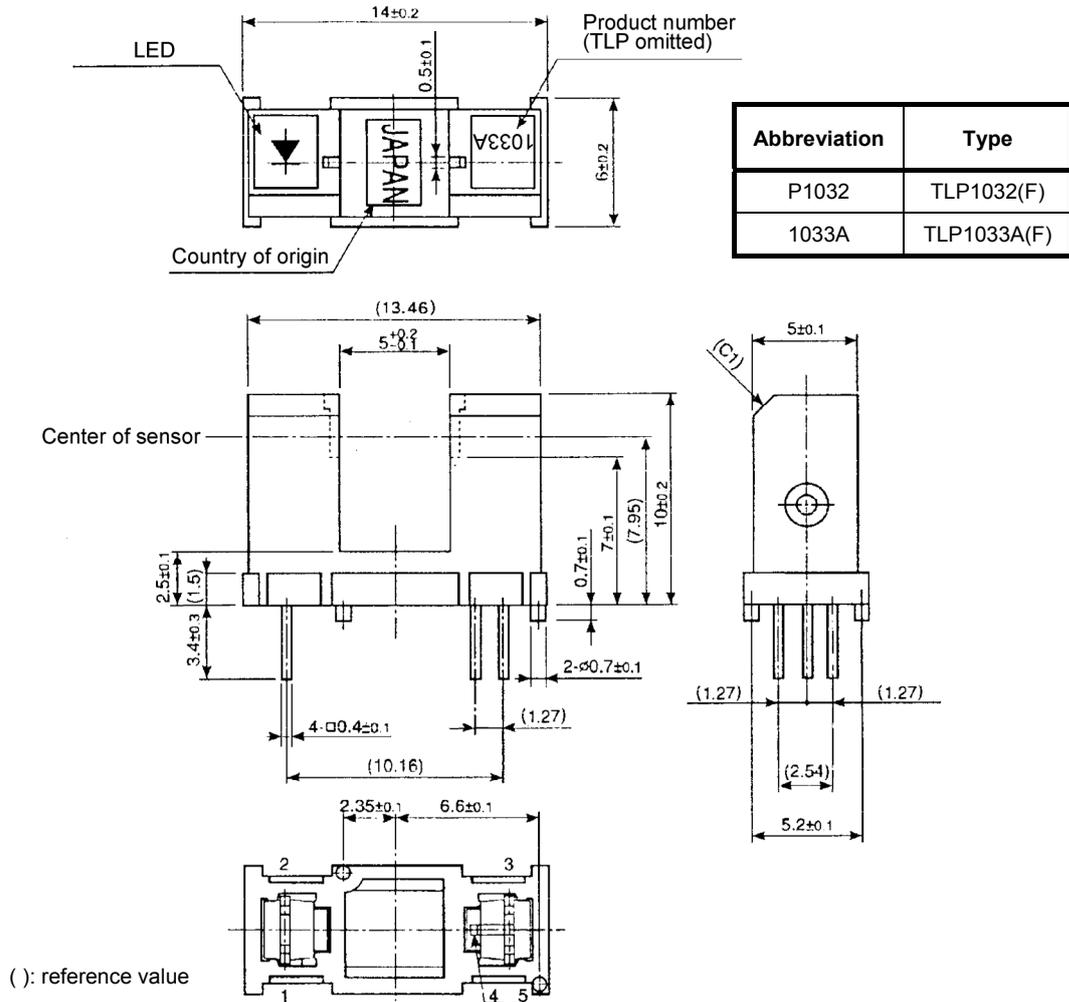
- When removing flux with chemicals after soldering, clean only the soldered part of the leads. Do not immerse the entire package in the cleaning solvent. Chemical residue on the LED emitter or the photodetector inside the photo-IC case may adversely affect the optical characteristics of the device and may drastically reduce the threshold input current.
- The case is made of polybutylene-terephthalate. Oil or chemicals may cause the package to melt or crack. Care should be taken regarding the environment in which the device is to be installed.
- Mount the device on a level surface.
- Output fluctuates for 100 μs after power-on while the internal circuit stabilizes.
- To stabilize the power line, insert a bypass capacitor of up to 0.01 μF between VCC and GND, close to the device.
- The threshold input current increases over time due to current flowing in the infrared LED. The design of circuits that are to incorporate the device must take into account the change in threshold input current over time. The change in threshold input current is equal to the reciprocal of the change in LED infrared optical output.

$$\frac{I_{FHL}(t)}{I_{FHL}(0)} = \left( \frac{P_O(t)}{P_O(0)} \right)^{-1}$$

- Choose a high-quality shutter material that is impermeable to light. If the material is of inferior quality, light from the LED may pass through the shutter, causing the device to malfunction.

## Package Dimensions: TOSHIBA 11-14G1

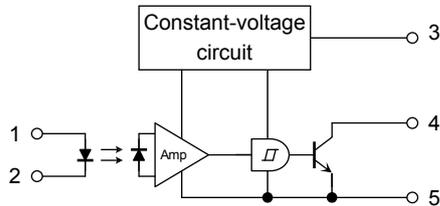
Unit: mm



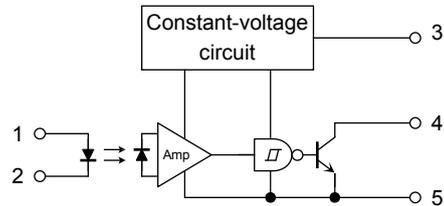
Weight: 0.6 g (typ.)

## Pin Connections

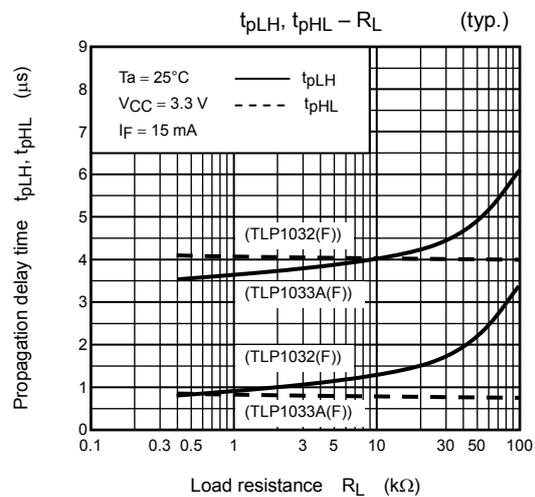
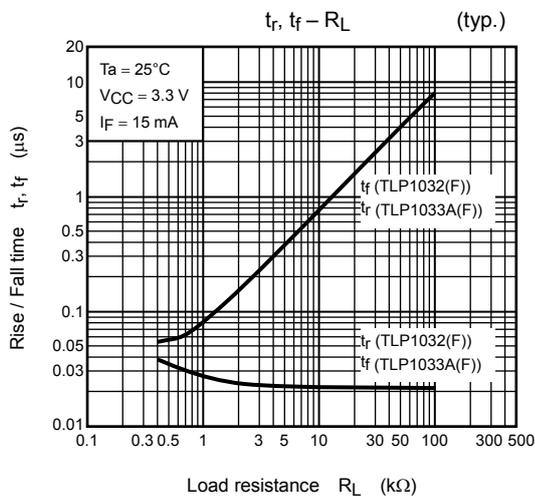
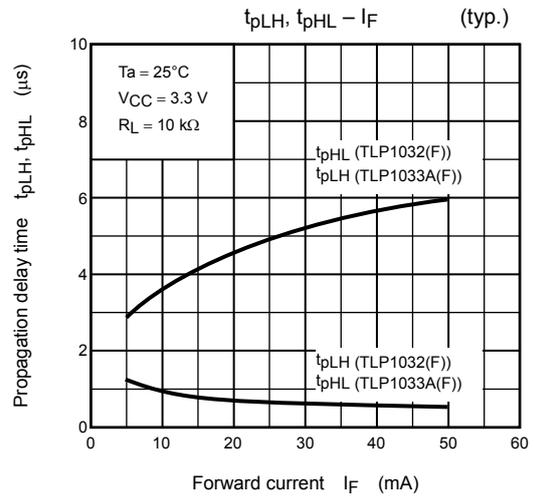
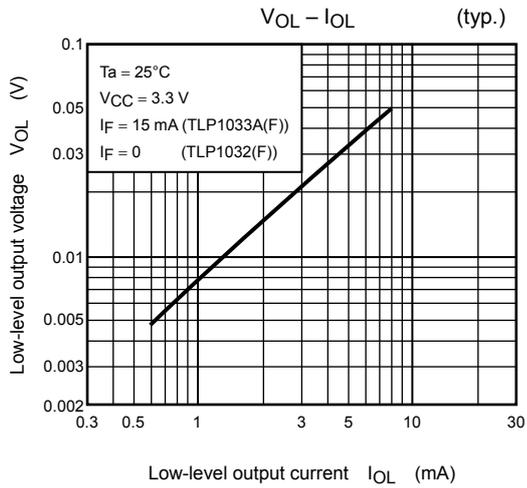
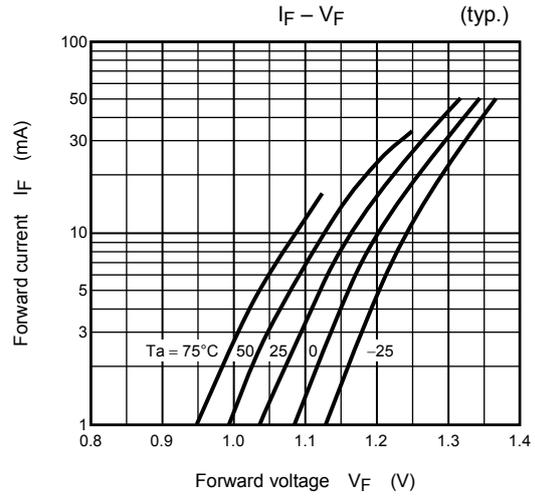
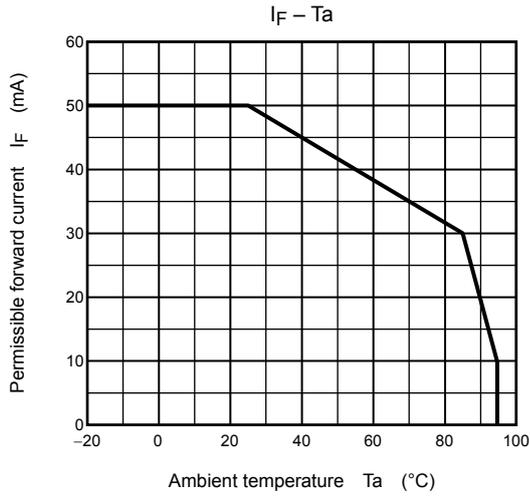
TLP1032(F)



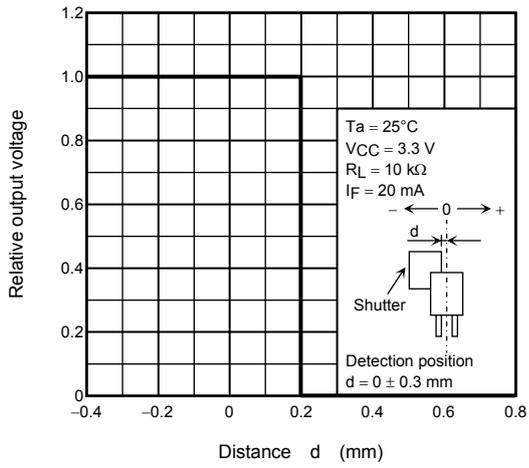
TLP1033A(F)



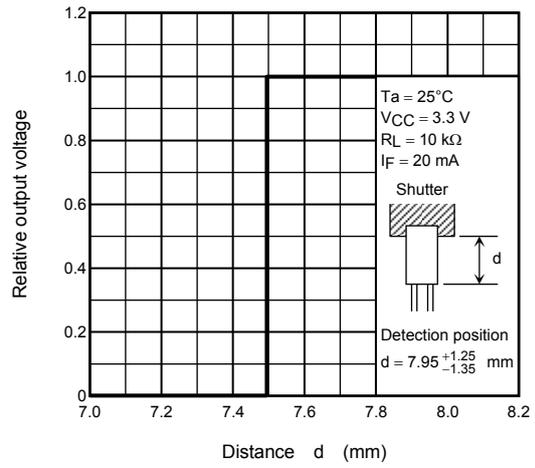
- 1: Anode
- 2: Cathode
- 3: VCC
- 4: OUT
- 5: GND



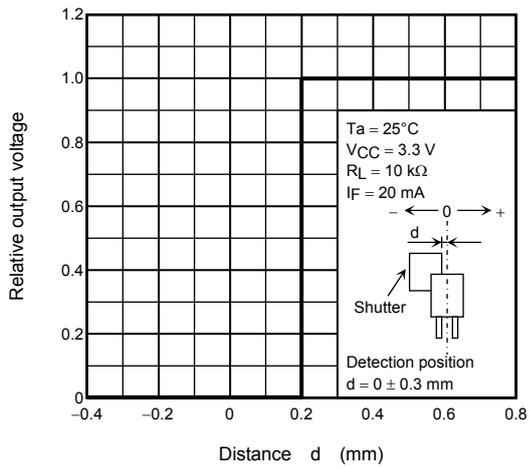
TLP1032(F) Detection position characteristic (1) (typ.)



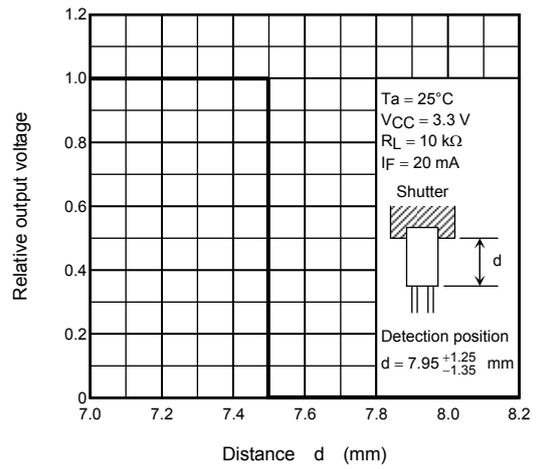
TLP1032(F) Detection position characteristic (2) (typ.)



TLP1033A(F) Detection position characteristic (1) (typ.)

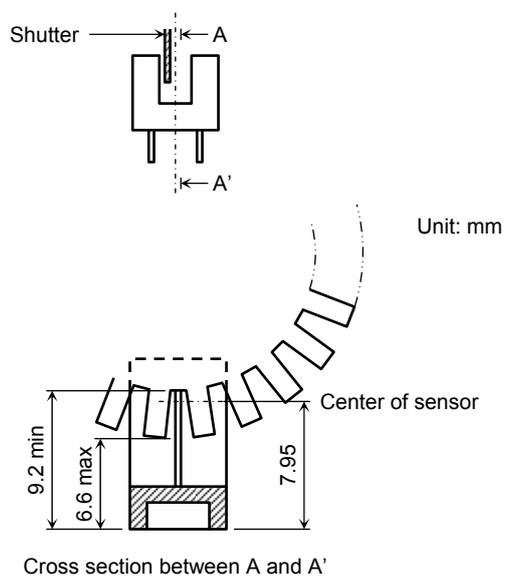


TLP1033A(F) Detection position characteristic (2) (typ.)



**Relative Positioning of Shutter and Device**

For normal operation, position the shutter and the device as shown in the figure below. Take into account the detection direction characteristic and switching time of the device in determining the shutter slit width and pitch.



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