TOSHIBA PHOTO-INTERRUPTER INFRARED LED + PHOTODARLINGTON TRANSISTOR

TLP507A

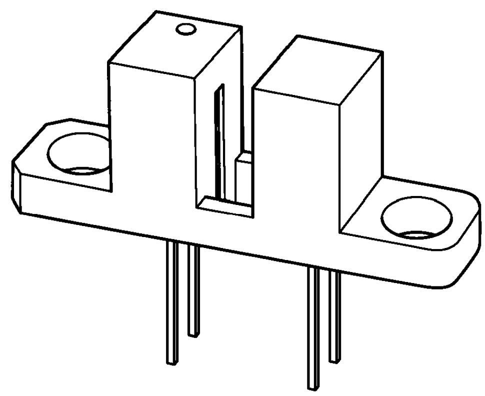
HIGH-POWER AMPLIFIER APPLICATIONS

AUTOMATIC CONTROL UNITS

POSITION AND ROTATIONAL SPEED SENSORS

The TLP507A photo-interrupter features a high current transfer ratio (I_C / I_F).

- Gap : 3 mm
- Resolution : Slit width = 0.5 mm
- High current transfer ratio: I_C / I_F = 30% (min)
- Dark current : I_D = 0.25 μA (max)
- Package material : Polycarbonate



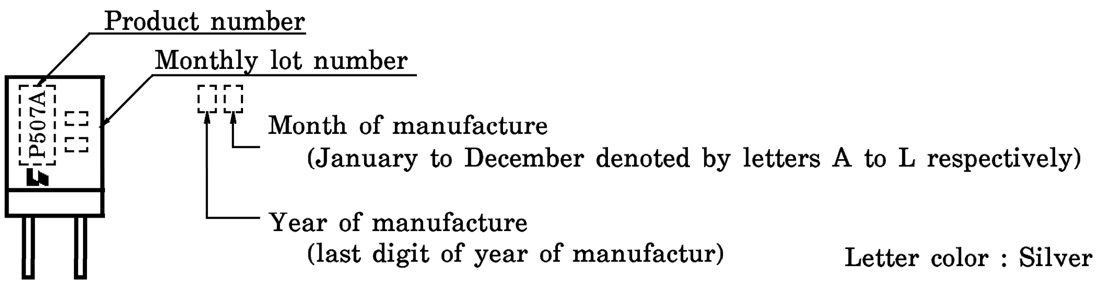
TOSHIBA 11-13D1

Weight : 0.83 g (typ.)

MAXIMUM RATINGS (Ta = 25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	50	mA
LED	Forward Current Derating (Ta > 25°C)	ΔI_F / °C	−0.33	mA / °C
LED	Reverse Voltage	V_R	5	V
DETECTOR	Collector-Emitter Voltage	V_{CEO}	30	V
DETECTOR	Emitter-Collector Voltage	V_{ECO}	5	V
DETECTOR	Collector Power Dissipation	P_C	75	mW
DETECTOR	Collector Power Dissipation Derating (Ta > 25°C)	ΔP_C / °C	−1	mW / °C
DETECTOR	Collector Current	I_C	50	mA
Operating Temperature Range		T_{opr}	−25~85	°C
Storage Temperature Range		T_{stg}	−30~100	°C

MARKINGS



OPTICAL AND ELECTRICAL CHARACTERISTICS (Ta = 25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	Min	Typ.	Max	UNIT
LED	Forward Voltage	V_F	$I_F = 10\,mA$	1.00	1.15	1.30	V
LED	Reverse Current	I_R	$V_R = 5\,V$	—	—	10	μA
LED	Peak Emission Wavelength	λ_P	$I_F = 10\,mA$	—	940	—	nm
DETECTOR	Dark Current	I_D (I_{CEO})	$V_{CE} = 16\,V$, $I_F = 0$	—	—	0.25	μA
DETECTOR	Peak Sensitivity Wavelength	λ_P	—	—	800	—	nm
COUPLED	Current Transfer Ratio	I_C / I_F	$V_{CE} = 2\,V$, $I_F = 10\,mA$	30	—	440	%
COUPLED	Rise Time	t_r	$V_{CC} = 5\,V$, $I_C = 10\,mA$, $R_L = 100\,\Omega$	—	200	—	μs
COUPLED	Fall Time	t_f		—	200	—	

PRECAUTIONS

The following points must be borne in mind.

1. Soldering temperature : 260°C max
   Soldering time : 5 s max
   (Soldering must be performed 1.5 mm under the package body.)
2. Clean only the soldered part of the leads. Do not immerse the entire package in the cleaning solvent.
3. Mount the device on a level surface.
4. Screws should be tightened to a clamping torque of 0.59 N·m.
5. The package is made of polycarbonate. Polycarbonate is usually stable with acid, alcohol and aliphatic hydrocarbons, however, with petrochemicals (such as benzene, toluene and acetone), alkalis, aromatic hydrocarbons, or chloric hydrocarbons, polycarbonate may crack, swell or melt. Please take this into account when chosing a packaging material by refering to the table below.

<Chemicals which should not be used with polycarbonate>

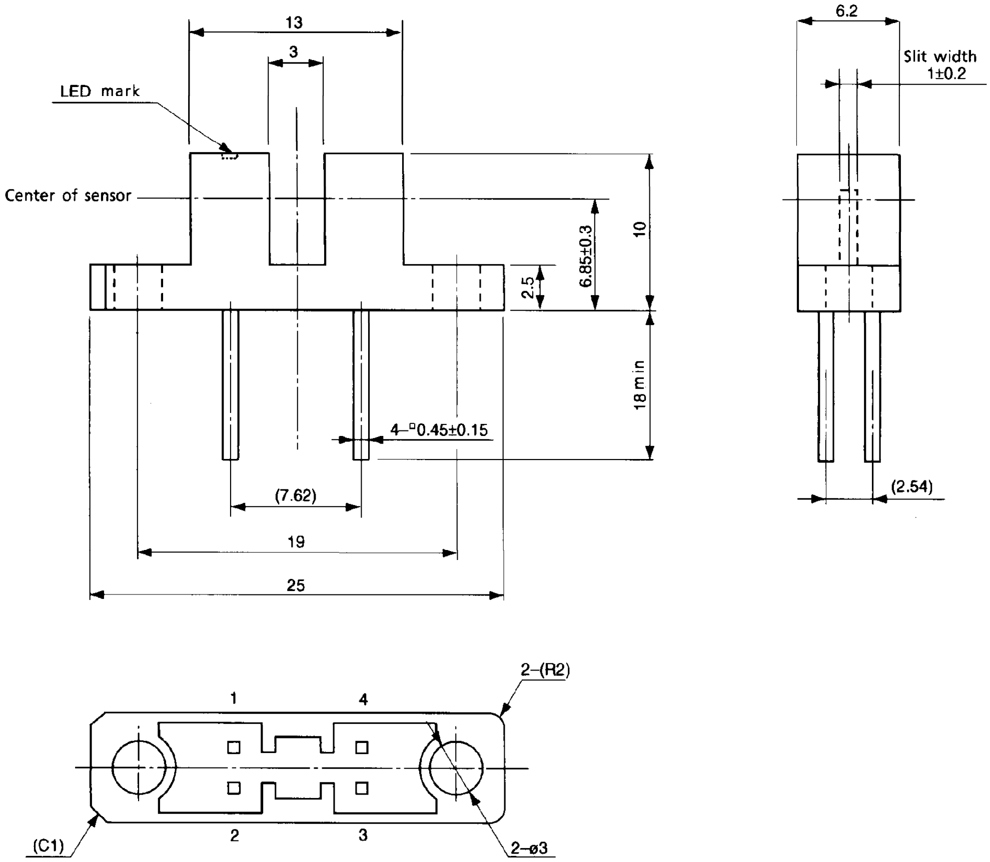
	PHENOMENON	CHEMICALS
A	Staining and slight deterioration	• Nitric acid (diluted), hydrogen peroxide, chlorine
B	Cracking, crazed or swelling	• Acetic acid (70% or more) • Gasoline • Methyl ethyl ketone, ethyl acetate, butyl acetate • Ethyl methacrylate, ethyl ether, MEK • Acetone, m-amino alcohol, carbon tetrachloride • Carbon disulfide, trichloroethylene, cresol • Thinners, oil of turpentine • Triethanolamine, TCP, TBP
C	Melting { } : Used as solvent	• Concentrated sulfuric acid • Benzene • Styrene, acrylonitrile, vinyl acetate • Ethylenediamine, diethylenediamine • {Chloroform, methyl chloride, tetrachloromethane, dioxane, 1, 2-dichloroethane}
D	Decomposition	• Ammonia water • Other alkalis

6. Conversion efficiency falls over time due to the current which flows in the infrared LED.
   When designing a circuit, take into account this change in conversion efficiency over time.
   The ratio of fluctuation in conversion efficiency to fluctuation in infrared LED optical output is 1 : 1.

$$\frac{I_C / I_F(t)}{I_C / I_F(0)} = \frac{P_O(t)}{P_O(0)}$$

PACKAGE DIMENSIONS
11-13D1

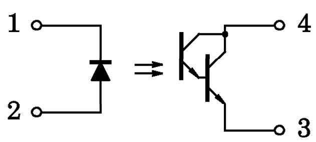
Unit : mm



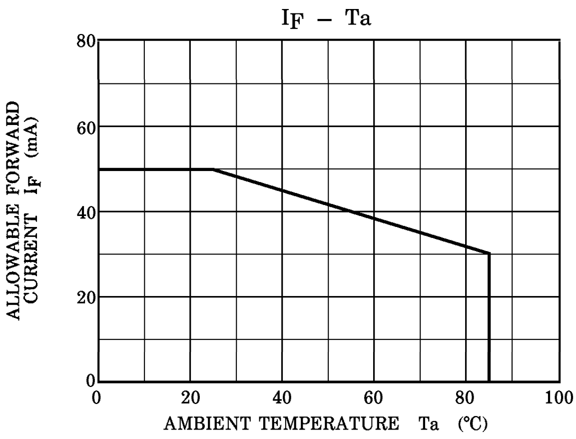
Tolerance unless otherwise specified : ±0.25
( ) : Reference value

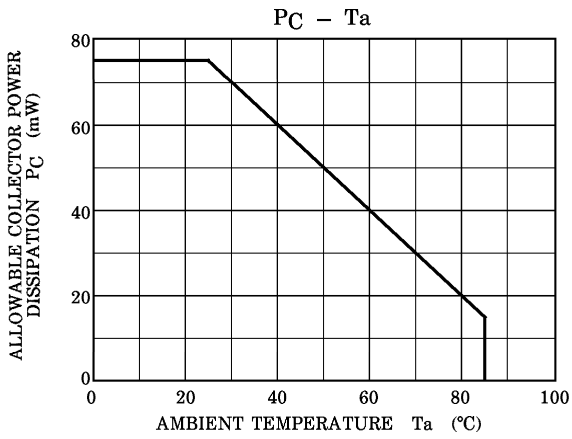
Weight : 0.83 g (typ.)

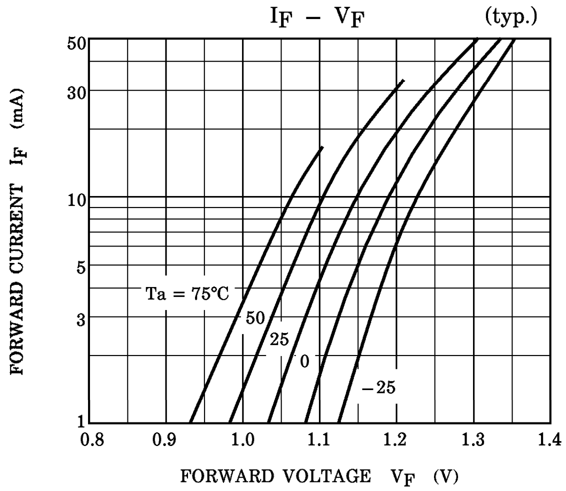
PIN CONNECTION

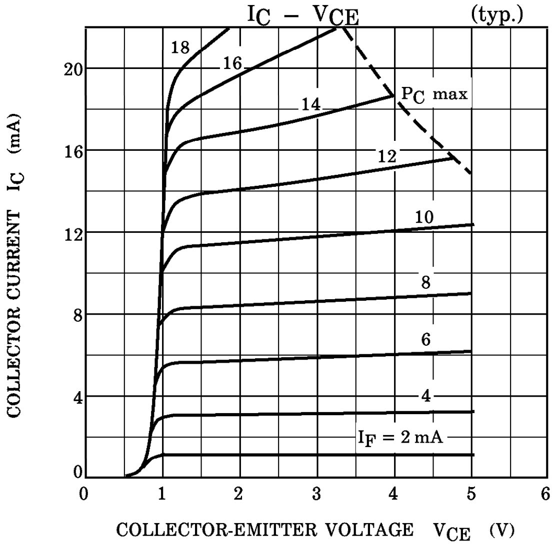


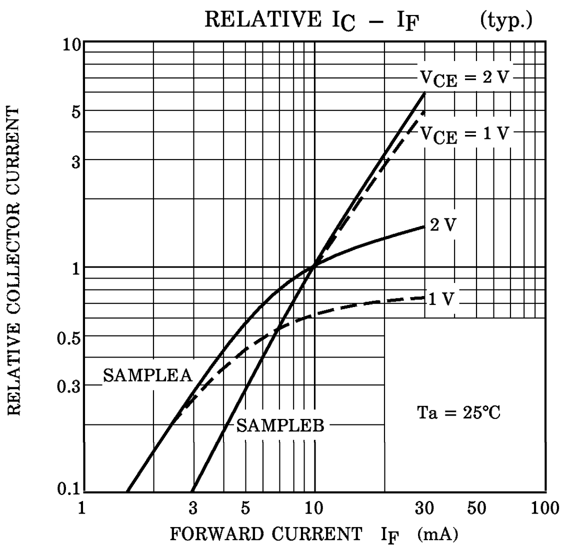
1. Cathode
2. Anode
3. Emitter
4. Collector

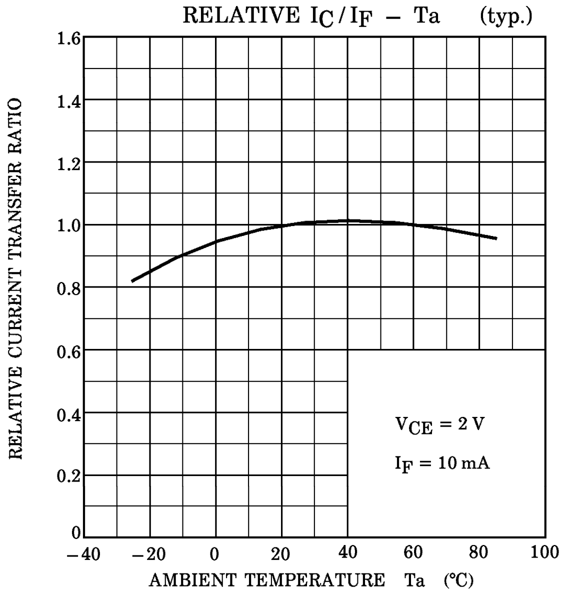

IF – Ta
ALLOWABLE FORWARD CURRENT IF (mA)
0
20
40
60
80
0
20
40
60
80
100
AMBIENT TEMPERATURE Ta (°C)

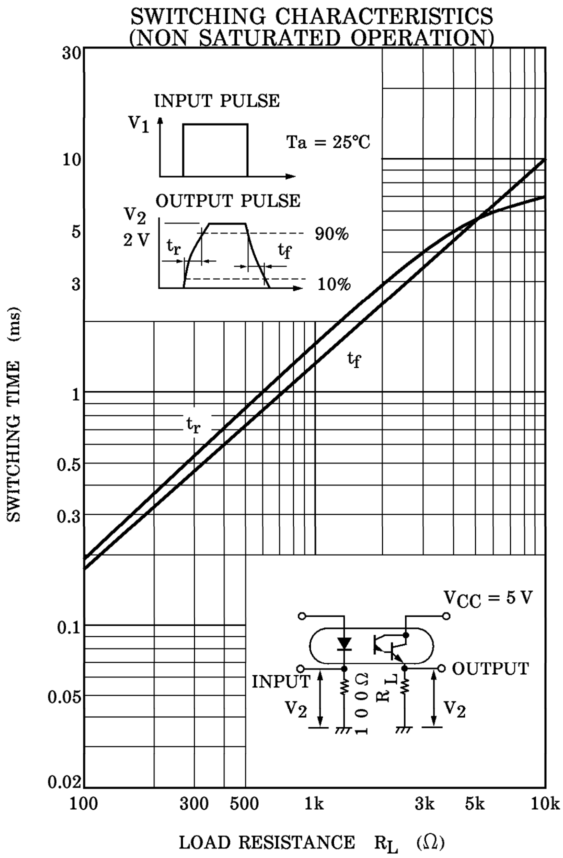

PC – Ta
ALLOWABLE COLLECTOR POWER DISSIPATION PC (mW)
0
20
40
60
80
0
20
40
60
80
100
AMBIENT TEMPERATURE Ta (°C)

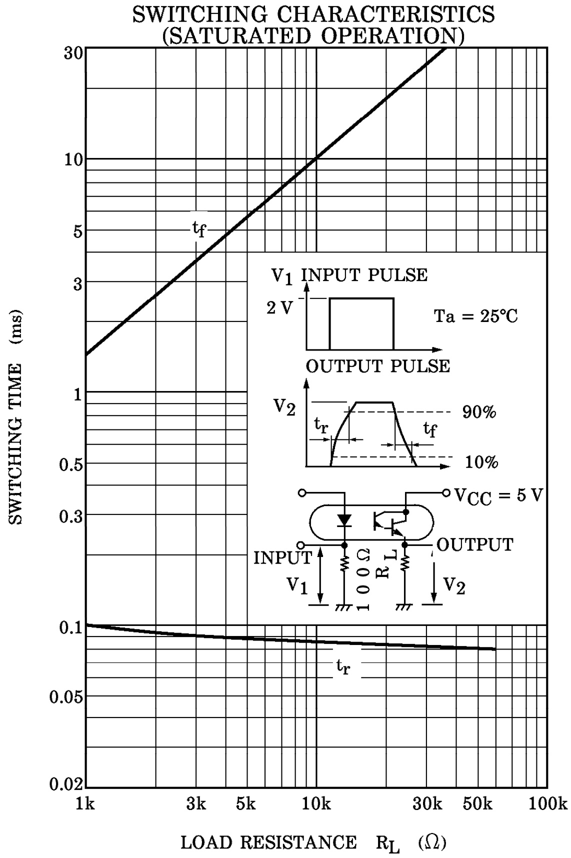

IF – VF (typ.)
FORWARD CURRENT IF (mA)
1
3
5
10
30
50
Ta = 75°C
50
25
0
−25
0.8
0.9
1.0
1.1
1.2
1.3
1.4
FORWARD VOLTAGE VF (V)

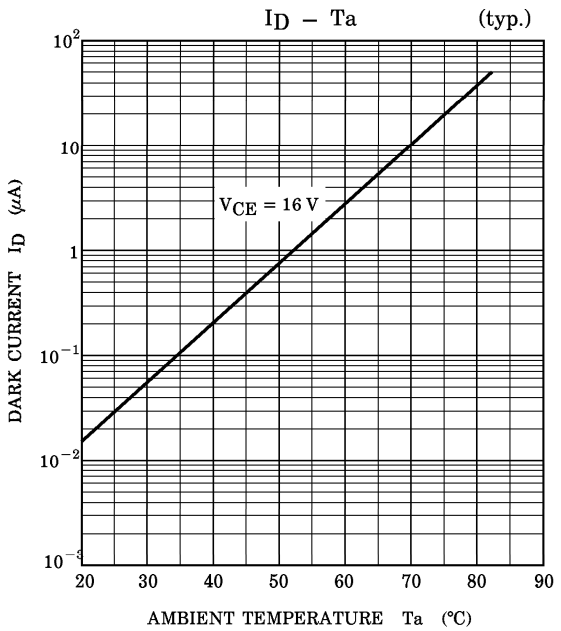

IC – VCE (typ.)
COLLECTOR CURRENT IC (mA)
0
4
8
12
16
20
18
16
14
PC max
12
10
8
6
4
IF = 2 mA
0
1
2
3
4
5
6
COLLECTOR-EMITTER VOLTAGE VCE (V)

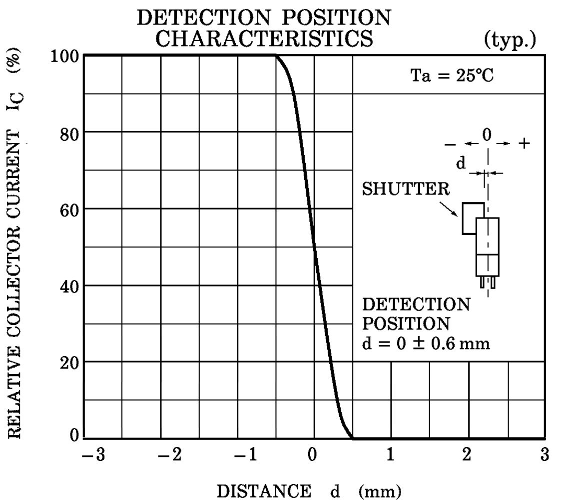

RELATIVE IC – IF (typ.)
RELATIVE COLLECTOR CURRENT
0.1
0.3
0.5
1
3
5
10
VCE = 2 V
VCE = 1 V
2 V
1 V
SAMPLEA
SAMPLEB
Ta = 25°C
1
3
5
10
30
50
100
FORWARD CURRENT IF (mA)


RELATIVE IC / IF – Ta (typ.)
RELATIVE CURRENT TRANSFER RATIO
0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
VCE = 2 V
IF = 10 mA
−40
−20
0
20
40
60
80
100
AMBIENT TEMPERATURE Ta (°C)


SWITCHING CHARACTERISTICS
(NON SATURATED OPERATION)
INPUT PULSE
V1
Ta = 25°C
OUTPUT PULSE
V2
2 V
tr
tf
90%
10%
tr
tf
VCC = 5 V
INPUT
V2
OUTPUT
V2
100 Ω
RL
SWITCHING TIME (ms)
LOAD RESISTANCE RL (Ω)
30
10
5
3
1
0.5
0.3
0.1
0.05
0.02
100
300
500
1k
3k
5k
10k

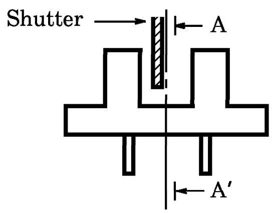

SWITCHING CHARACTERISTICS
(SATURATED OPERATION)
tf
V1 INPUT PULSE
2 V
Ta = 25°C
OUTPUT PULSE
V2
tr
tf
90%
10%
VCC = 5 V
INPUT
V1
OUTPUT
V2
100 Ω
RL
tr
SWITCHING TIME (ms)
LOAD RESISTANCE RL (Ω)
30
10
5
3
1
0.5
0.3
0.1
0.05
0.02
1k
3k
5k
10k
30k
50k
100k

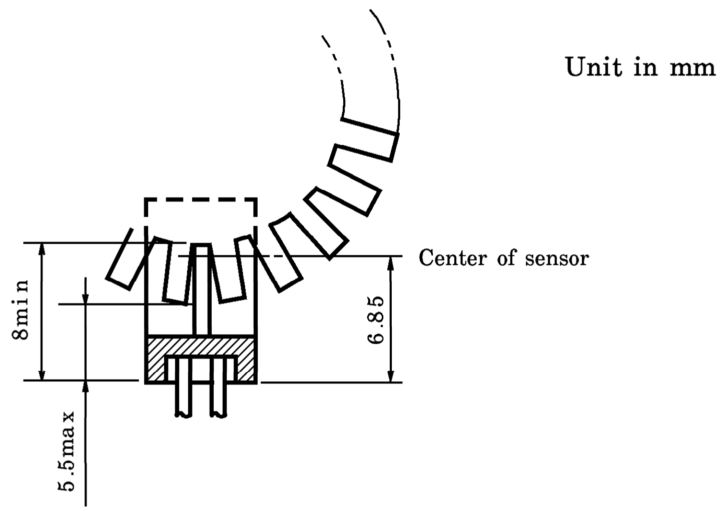

ID – Ta (typ.)
VCE = 16 V
DARK CURRENT ID (μA)
AMBIENT TEMPERATURE Ta (°C)
10^2
10
1
10^-1
10^-2
10^-3
20
30
40
50
60
70
80
90


DETECTION POSITION
CHARACTERISTICS
(typ.)
Ta = 25°C
– 0 +
d
SHUTTER
DETECTION
POSITION
d = 0 ± 0.6 mm
RELATIVE COLLECTOR CURRENT IC (%)
DISTANCE d (mm)
100
80
60
40
20
0
−3
−2
−1
0
1
2
3

RELATIVE POSITIONING OF SHUTTER AND DEVICE

For normal operation position the shutter and the device as shown in the figure below. By considering the device's detection direction characteristic and switching time, determine the shutter slit width and pitch.





Cross section between A and A′

RESTRICTIONS ON PRODUCT USE

000707EAC

- TOSHIBA is continually working to improve the quality and reliability of its products. Nevertheless, semiconductor devices in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress. It is the responsibility of the buyer, when utilizing TOSHIBA products, to comply with the standards of safety in making a safe design for the entire system, and to avoid situations in which a malfunction or failure of such TOSHIBA products could cause loss of human life, bodily injury or damage to property.
  In developing your designs, please ensure that TOSHIBA products are used within specified operating ranges as set forth in the most recent TOSHIBA products specifications. Also, please keep in mind the precautions and conditions set forth in the "Handling Guide for Semiconductor Devices," or "TOSHIBA Semiconductor Reliability Handbook" etc..
- The TOSHIBA products listed in this document are intended for usage in general electronics applications (computer, personal equipment, office equipment, measuring equipment, industrial robotics, domestic appliances, etc.). These TOSHIBA products are neither intended nor warranted for usage in equipment that requires extraordinarily high quality and/or reliability or a malfunction or failure of which may cause loss of human life or bodily injury ("Unintended Usage"). Unintended Usage include atomic energy control instruments, airplane or spaceship instruments, transportation instruments, traffic signal instruments, combustion control instruments, medical instruments, all types of safety devices, etc.. Unintended Usage of TOSHIBA products listed in this document shall be made at the customer's own risk.
- Gallium arsenide (GaAs) is a substance used in the products described in this document. GaAs dust and fumes are toxic. Do not break, cut or pulverize the product, or use chemicals to dissolve them. When disposing of the products, follow the appropriate regulations. Do not dispose of the products with other industrial waste or with domestic garbage.
- The information contained herein is presented only as a guide for the applications of our products. No responsibility is assumed by TOSHIBA CORPORATION for any infringements of intellectual property or other rights of the third parties which may result from its use. No license is granted by implication or otherwise under any intellectual property or other rights of TOSHIBA CORPORATION or others.
- The information contained herein is subject to change without notice.