TOSHIBA

OPTOELECTRONIC SEMICONDUCTORS

PHOTO SENSORS DATA BOOK

3rd Edition August '86

INERARED LEDS
PHOTO TRANSISTORS
PHOTO DIODES
PHOTO INTERRUPTERS
PHOTO REFLECTIVE SENSORS
FIBER OPTIC DEVICES
LASER DIODE

TOSHIBA CORPORATION

IMPORTANT NOTICES

The circuit examples illustrated herein are presented only as a guide for the performances or the applications of our products.

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PREFACE

Recently, process and sequential controls using micro computers have become employed by a wide range of machines and apparatus to ensure smooth operation of these controls, various sensors are being used. That is, not only detection of spatial signal propagation, existence of substances, speed, etc. but also detection and measurement of position accuracy, concentration, turbidity, etc. have contributed to improvement of accuracy and resolution of control systems.

Semiconductor optical sensors, using infrared light emitting diode and silicon light detecting device, are available in transmission type or reflection type for detecting applications. These types are selectable according to characteristics and properties of substances to be detected and they feature detecting distance and accuracy that can be changed or expanded freely according to types of circuits.

This technical manual has been prepared to help users to understand these features of semiconductor optical sensors and to further extend the range of applications. We hope this manual is helpful to users.

TOSHIBA CORPORATION
SEMICONDUCTOR GROUP
Tsuyoshi Kawanishi
Group Executive

TOSHIBA CORPORATION

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** Under Development

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2–1–1 Classification Guide

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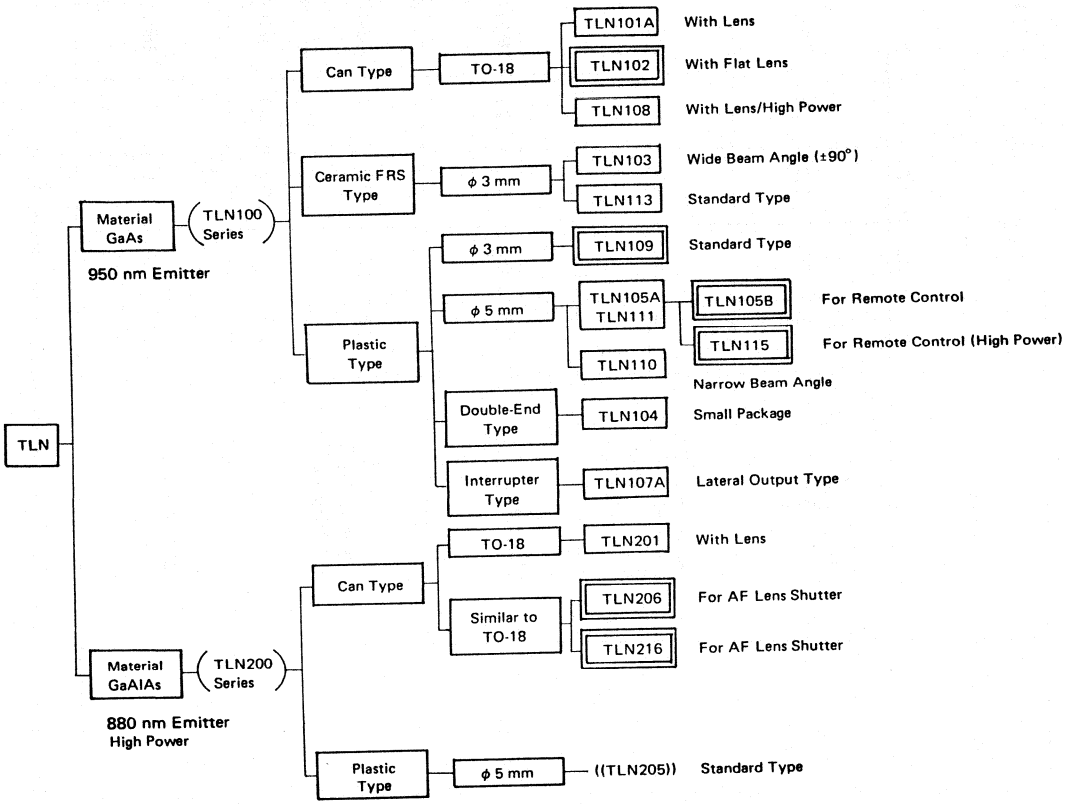
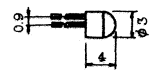
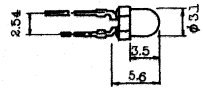
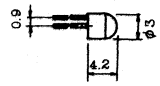
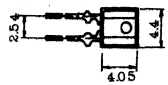
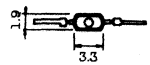
(( )) : Under Development



2–1 Infrared Emitters

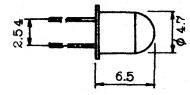
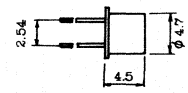
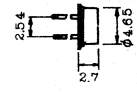
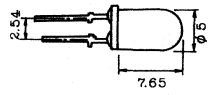
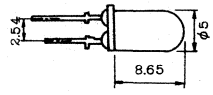
2–1–2 Specification Guide (Continued)

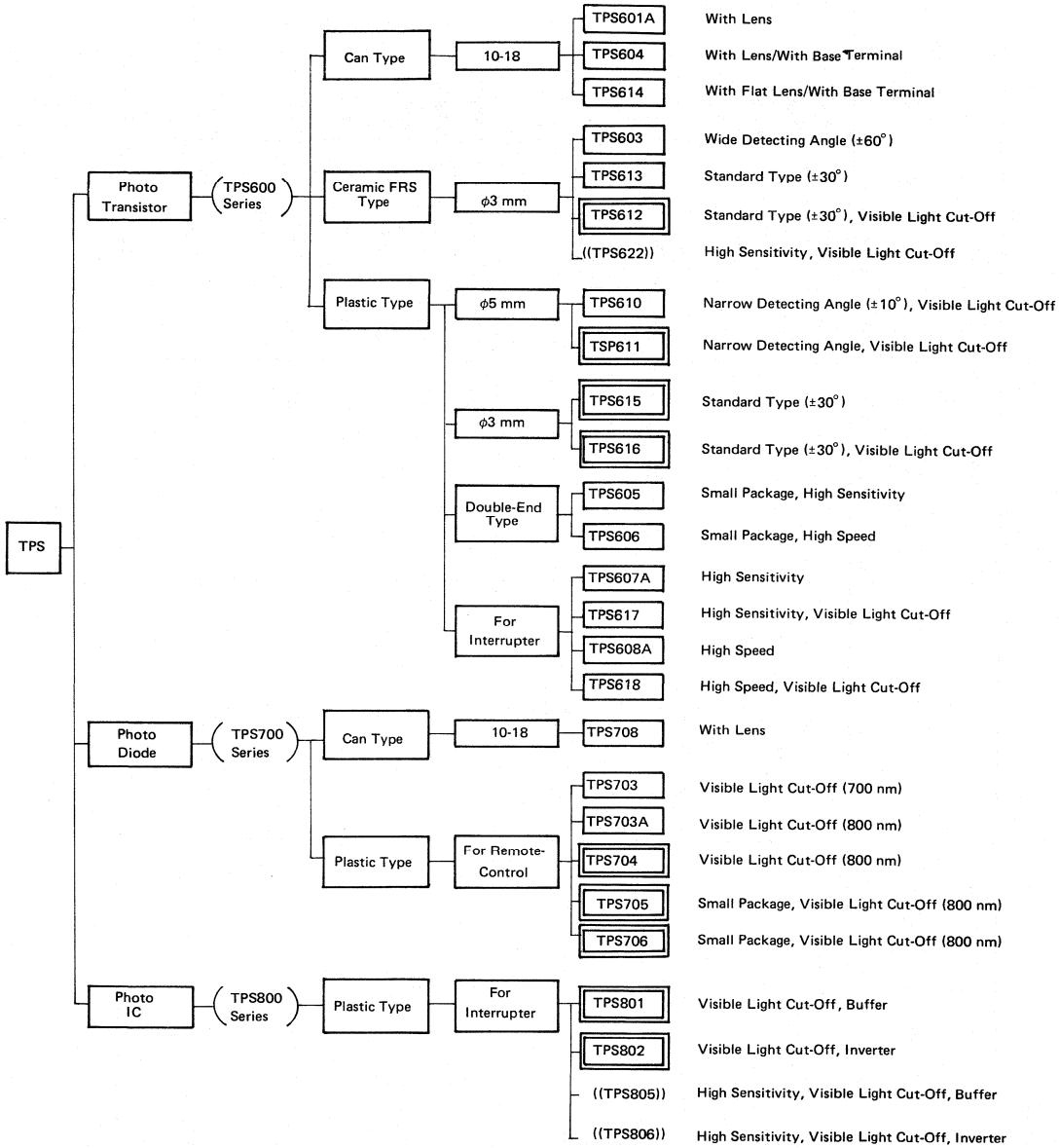
Classification	Type No.	Status	Package	Outline	Characteristics (Ta = 25°C)						Matched Detectors
					P_O (mW)	I_F (mA)	I_e (mW/Sr)	$^*I_F$ (mA)	λ_P (nm)	θ (deg.)	
3ϕ Package	TLN103		Ceramic Stem		2.5	20	0.7	20	950	>180	TPS603
	TLN109	*	Plastic		2.5	20	1.5	20	950	60	TPS615 TPS616
	TLN113				2.5	20	2	20	950	80	TPS612 TPS613
Lateral output	TLN107A				2.0	20	2.0	20	950	30	TPS607A TPS608A TPS617 TPS618
	TLR215A				0.2	20	0.3	20	700		TPS607A TPS608A
Double-End Type	TLN104				3.0	20	1.5	20	950	40	TPS605 TPS606

P_O: Radiant Power λ_P: Peak Emission Wave Length I_e: Radiant Intensity θ: Half Beam Angle

2–1 Infrared Emitters

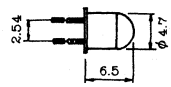
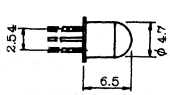
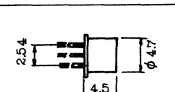
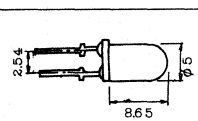
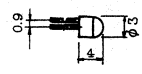
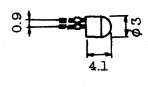
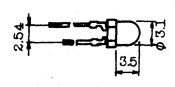
2–1–2 Specification Guide

Classification	Type No.	Status	Package	Outline	Characteristics (Ta = 25°C)						Matched Detectors
					P_O (mW)	I_F (mA)	I_e (mW/Sr)	I_F (mA)	λ_P (nm)	θ (deg.)	
5ϕ Package	TLN101A		Metal TO-18		1.8	50	15	50	950	8	TPS601A
	TLN108				3	50	20	50	950	16	TPS604
	TLN201				5	50	35	50	880	14	TPS614 TPS708
	TLN102	*			4.2	50	4	50	950	62	
	TLN206	*			14	300	–	–	875	52	–
	TLN216	*			14	300	–	–	875	37.5	
	TLN105A		Plastic		9.0	50	15	50	950	42	TPS610
	TLN105B	*			11	50	20	50	950	50	TPS611
	TLN111				10	50	24	50	950	38	TPS703
	TLN115	*			13	50	26	50	950	42	TPS703A
	TLN205	**			10	50	40	50	880	78	TPS704
	TLN110				9.0	50	30	50	950	16	


TPS
Photo Transistor
TPS600 Series
Can Type
10-18
TPS601A
With Lens
TPS604
With Lens/With Base Terminal
TPS614
With Flat Lens/With Base Terminal
Ceramic FRS Type
φ3 mm
TPS603
Wide Detecting Angle (±60°)
TPS613
Standard Type (±30°)
TPS612
Standard Type (±30°), Visible Light Cut-Off
((TPS622))
High Sensitivity, Visible Light Cut-Off
Plastic Type
φ5 mm
TPS610
Narrow Detecting Angle (±10°), Visible Light Cut-Off
TSP611
Narrow Detecting Angle, Visible Light Cut-Off
φ3 mm
TPS615
Standard Type (±30°)
TPS616
Standard Type (±30°), Visible Light Cut-Off
Double-End Type
TPS605
Small Package, High Sensitivity
TPS606
Small Package, High Speed
For Interrupter
TPS607A
High Sensitivity
TPS617
High Sensitivity, Visible Light Cut-Off
TPS608A
High Speed
TPS618
High Speed, Visible Light Cut-Off
Photo Diode
TPS700 Series
Can Type
10-18
TPS708
With Lens
Plastic Type
For Remote-Control
TPS703
Visible Light Cut-Off (700 nm)
TPS703A
Visible Light Cut-Off (800 nm)
TPS704
Visible Light Cut-Off (800 nm)
TPS705
Small Package, Visible Light Cut-Off (800 nm)
TPS706
Small Package, Visible Light Cut-Off (800 nm)
Photo IC
TPS800 Series
Plastic Type
For Interrupter
TPS801
Visible Light Cut-Off, Buffer
TPS802
Visible Light Cut-Off, Inverter
((TPS805))
High Sensitivity, Visible Light Cut-Off, Buffer
((TPS806))
High Sensitivity, Visible Light Cut-Off, Inverter

2–2 Detectors

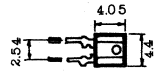
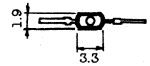
2–2–2 Photo Transistor Specification Guide (Continued)

Classification	Type No.	Status	Package	Outline	Transistor Type S	Transistor Type D	Characteristic (Ta = 25°C) I_C (μA)	E (mW/cm²)	I_D (nA)	V_{CE} (V)	V_{CEO} (V)	θ (deg.)	Visible Light Cut-off	Matched Emitter
φ5 Package	TPS601A		Metal TO-18		○		200	0.1	10	30	40	20	×	TLN101A TLN102 TLN108 TLN201
	TPS604				○		200	0.1	10	30	40	20	×	
	TPS614				○		1500	10	10	30	40	86	×	
	TPS610		Plastic		○		250	0.1	5	24	30	16	×	TLN105B TLN110 TLN115 TLN205
	TPS611	*			○		120	0.1					○	
φ3 Package	TPS603		Ceramic Stem		○		10	0.1	10	10	20	126	×	TLN103
	TPS612	*	Plastic		○		30	0.1				60	○	TLN113
	TPS613						45	0.1					×	
	TPS622	**					600	0.01	30	16	20	40	○	
	TPS615	*			○		45	0.1	10	24	30	60	×	TLN109
	TPS616	*					30	0.1					○	

(Note) * : New Product ** : Under Development

2–2 Detectors

2–2–2 Photo Transistor Specification Guide

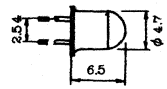
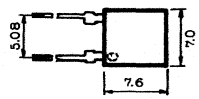
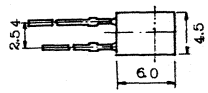
Classification	Type No.	Status	Package	Outline	Transistor Type S	Transistor Type D	Characteristic (Ta = 25°C) I_C (μA)	E (mW/cm²)	I_D (nA)	V_{CE} (V)	V_{CEO} (V)	θ (deg.)	Visible Light Cut-off	Matched Emitter
Lateral Output Type	TPS607A		Plastic			O	2000	0.1	30	16	30	34	X	TLN107A TLR215A
	TPS617					O	1400	0.1					O	TLN107A
	TPS608A				O		100	0.1	5	24			X	TLN107A TLR215A
	TPS618				O		70	0.1					O	TLN107A
Double End Type	TPS605					O	1000	0.01	30	16	30	40	X	TLN104
	TPS606				O		20	0.1	10	10	20	40	X	

(Note) I_L : Light Current θ : Half Detecting Angle E : Radiant Incidence S : Single Photo Transistor

I_D : Dark Current D : Darlington Photo Transistor V_{CE} : Collector Emitter Voltage

2–2 Detectors

2–2–3 Photo Diode Specification Guide

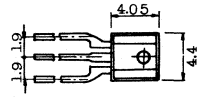
Classification	Type No.	Status	Package	Outline	Characteristic (Ta = 25°C)						Visible Light Cut-off	Metched Emitter
					I_{SC} (μA)	E (mW/cm²)	I_D (nA)	V_R (V)	V_R (V)	θ (deg.)		
φ 5 Package	TPS708		Metal TO-18		1.5	0.1	10	10	20	30	X	TLN101A TLN102 TLN108 TLN201
For Remote Control	TPS703		Plastic		1.5	0.1	10	10	20	130	λ > 700 (nm)	TLN105B TLN110 TLN111 TLN115 TLN205
	TPS703A		Plastic + Filter		0.9	0.1					λ > 800 (nm)	TLN105B TLN110 TLN111 TLN115
	TPS704	*	Plastic									
	TPS705	*	Plastic		0.9	0.1	10	10	20	150	λ > 800 (nm)	TLN105B TLN110 TLN111 TLN115
	TPS706				1.5							

(Note) I_{SC} : Short Circuit Current V_R : Reverse Voltage E : Radiant Incidence θ : Half Detecting Angle I_D : Dark Current

** : Under Development * : New Product

2–2 Detectors

2–2–4 Photo IC Specification Guide

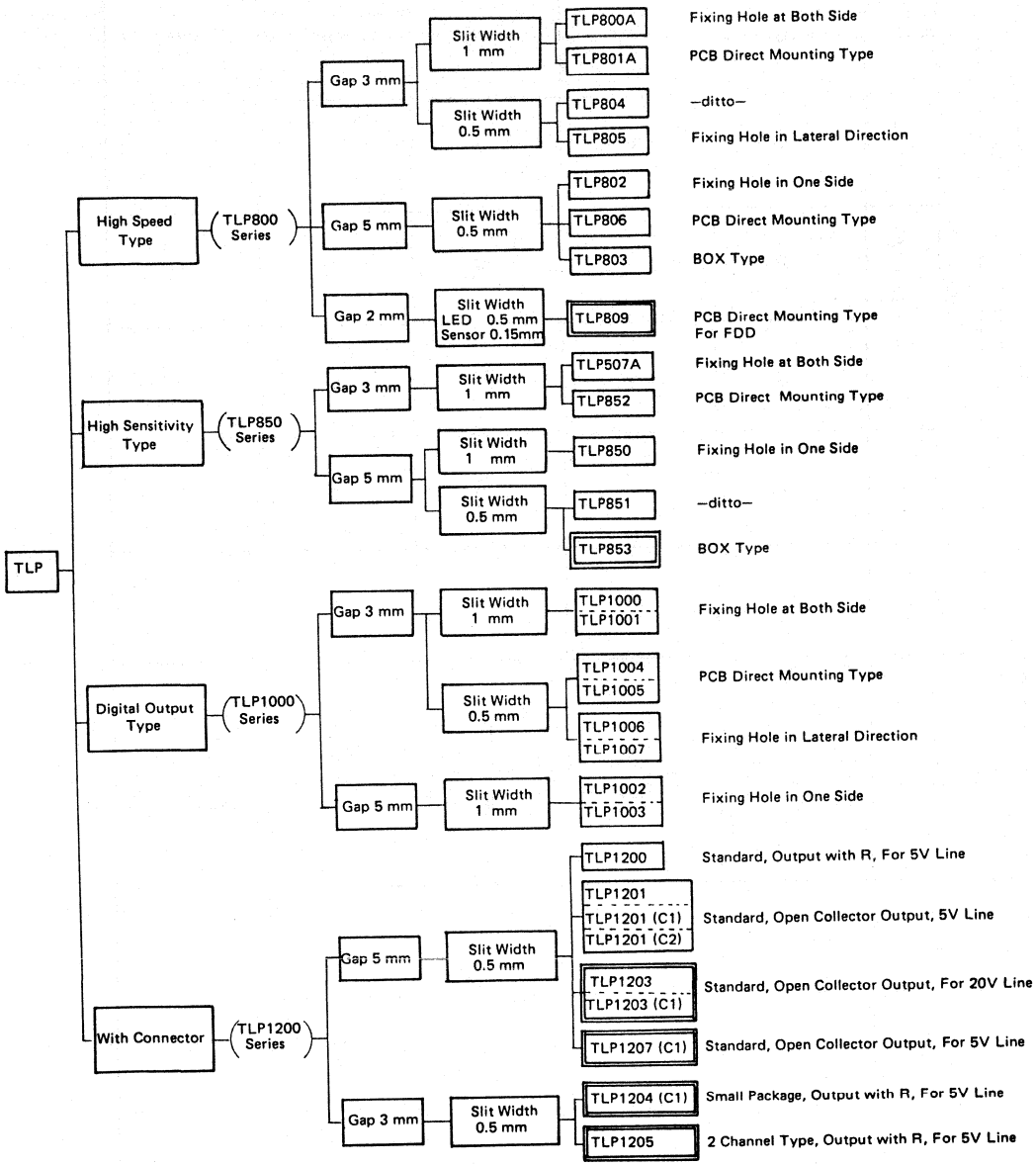
Classification	Type No.	Status	Package	Outline	Characteristic (Ta = 25°C)					Visible Light Cut-off	Matched Emitter
					–	MAX V_{CC} (V)	E_{FLH} (E_{FHL}) (mW/cm²)	t_{PHL} (μs)	t_{PLH} (μs)		
Lateral Output Type	TPS801	*	Plastic		Buf.	16	0.5	5	3	○	TLN107A
	TPS802	*			Inv.	16	0.5	5	8	○	
	TPS805	**			Buf.	16	0.2	4	4	○	
	TPS806	**			Inv.	16	0.2	4	4	○	

(Note) * : New Product ** : Under Development

2–3 Photo Interrupters

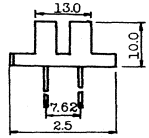
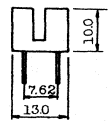
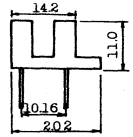
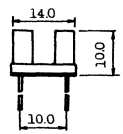
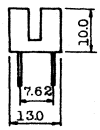
2–3–1 Classification Guide

: New Products



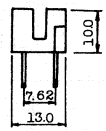
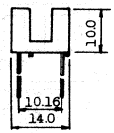
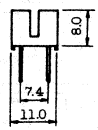
2–3 Photo Interrupters

2–3–2 Specification Guide (Continued)

Classification	Type No.	Status	Outline	Characteristic (Ta = 25°C)						
				Gap (mm)	Slit Width (mm)	I_C/I_F (%)			V_{CEO} (V)	I_D (nA)
							I_F (mA)	V_{CE} (V)		
Single Transistor	TLP800A			3	1	40	20	5	30	5
	TLP801A			3	1	40	20	5	30	5
	TLP802			5	0.5	8	20	5	30	5
	TLP803			5	0.5	10	20	5	35	5
	TLP804			3	0.5	10	20	5	30	5

2–3 Photo Interrupters

2–3–2 Specification Guide (Continued)

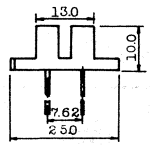
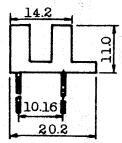
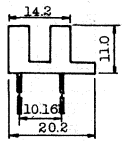
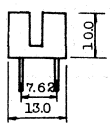
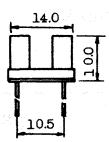
Classification	Type No.	Status	Outline	Characteristic (Ta = 25°C)						
				Gap (mm)	Slit Width (mm)	I_C/I_F (%)	I_F (mA)	V_{CE} (V)	V_{CEO} (V)	I_D (nA)
Single Transistor	TLP805			3	0.5	10	20	5	30	5
	TLP806			5	0.5	10	20	5	35	5
	TLP809	*		2	Emitter Side 0.5 / Detector Side 0.15	3 (MIN.)	20	5	35	5

(Note) I_C/I_F : Transfer Ratio V_{CE} : Collector Emitter Voltage I_D : Dark Current

* : New Product

2–3 Photo Interrupters

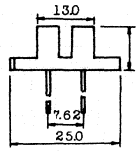
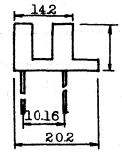
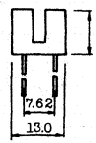
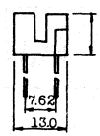
2–3–2 Specification Guide (Continued)

Classification	Type No.	Status	Outline	Characteristic (Ta = 25° C)						
				Gap (mm)	Slit Width (mm)	I_C/I_F (%)	I_F(mA)	V_{CE}(V)	V_{CEO} (V)	I_D (nA)
Darlington Transistor	TLP507A			3	1	300	10	2	30	30
	TLP850			5	1	200	10	2	30	30
	TLP851			5	0.5	100	10	2	30	30
	TLP852			3	1	200	10	2	30	30
	TLP853			5	0.5	100	10	2	30	30

(Note) I_C/I_F : Transfer Ratio V_{CE} : Collector Emitter Voltage I_D : Dark Current

2–3 Photo Interrupters

2–3–2 Specification Guide (Continued)

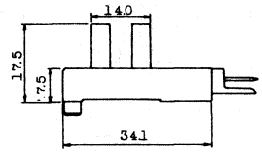
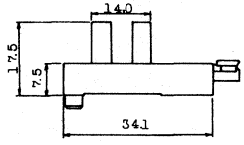
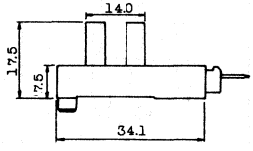
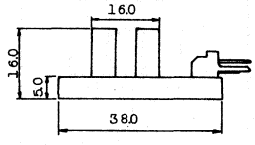
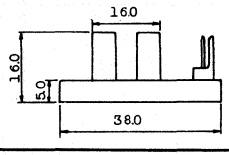
Classification	Type No.	Status	Outline	Characteristic (Ta = 25°C)				
				–	Gap (mm)	Slit Width (mm)	Max. I_{FLH}(I_{FHL}) (mA)	Max. V_{CC} (V)
Photo IC	TLP1000			N.OFF	3	1	5	16
	TLP1001			N.ON			(5)	
	TLP1002			N.OFF	5	1	11	16
	TLP1003			N.ON			(11)	
	TLP1004			N.OFF	3	0.5	15	16
	TLP1005			N.ON			(15)	
	TLP1006			N.OFF	3	0.5	15	16
	TLP1007			N.ON			(15)	

(Note) I_{FT} : LED Threshold Current N.OFF (Normally OFF)

V_{CC} : Operation Supply Voltage N.ON (Normally ON)

2–3 Photo Interrupters

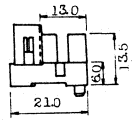
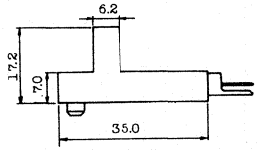
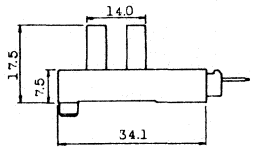
2–3–2 Specification Guide

Classification	Type No.	Status	Outline	Characteristic (Ta = 25°C)				
				–	Gap (mm)	Slit Width (mm)	MAX I_{OL} (mA)	MAX V_{CC} (V)
Photo IC with Connector	TLP1200			N.OFF	5.0	0.5	50	6
	TLP1201	*		N.ON				
	TLP1201 (C1)	*		N.ON	5.0	0.5	50	6
	TLP1201 (C2)	*		N.ON	5.0	0.5	50	6
	TLP1203	*		N.ON	5.0	0.5	50	30
	TLP1203 (C1)	*		N.ON	5.0	0.5	50	30

(Note) * : New Product

2–3 Phote Interrupters

2–3–2 Specification Guide

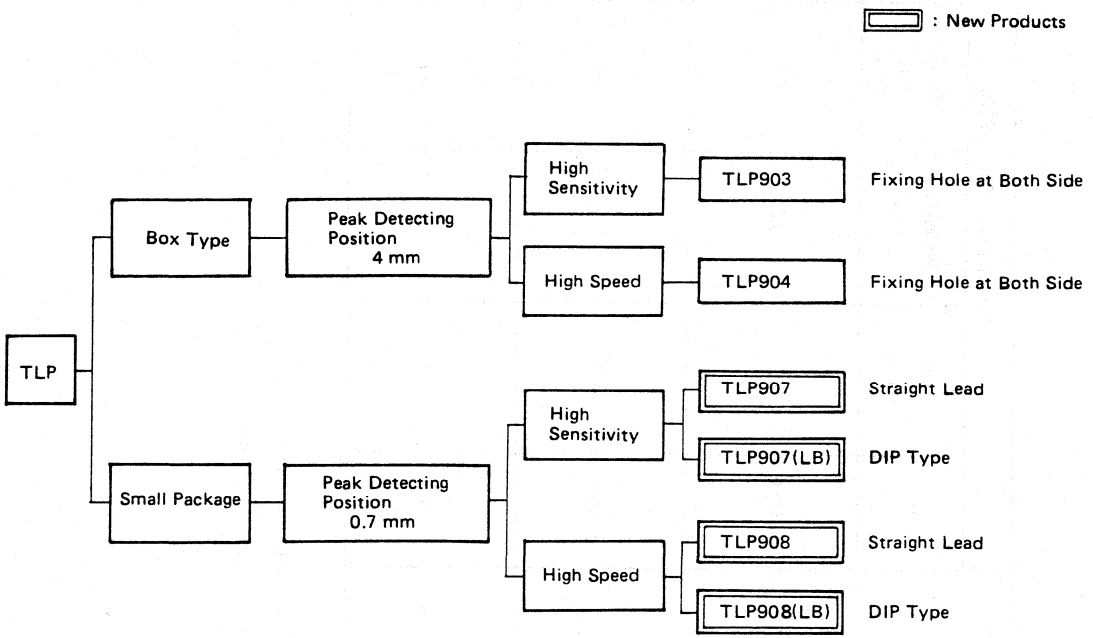
Classification	Type No.	Status	Outline	Characteristic (Ta = 25°C)				
				—	Gap (mm)	Slit Width (mm)	MAX I_{OL} (mA)	MAX V_{CC} (V)
Photo IC with Connector	TLP1204 (C1)	*		N.OFF	3.0	0.5	50	6
	TLP1205	*		N.OFF	3.0	0.5	50	6
	TLP1201 (C2)	*		N.OFF	5.0	0.5	50	6

(Note) I_{OL}: Low Level Output Current
V_{CC}: Operation Supply Voltage
*: New Product

N.OFF (Normally OFF)
N.ON (Normally ON)

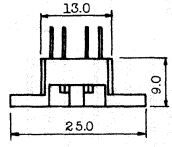
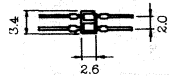
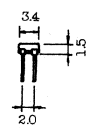
2–4 Reflective Sensors

2–4–1 Classification Guide



2–4 Reflective Sensors

2–4–2 Specification Guide

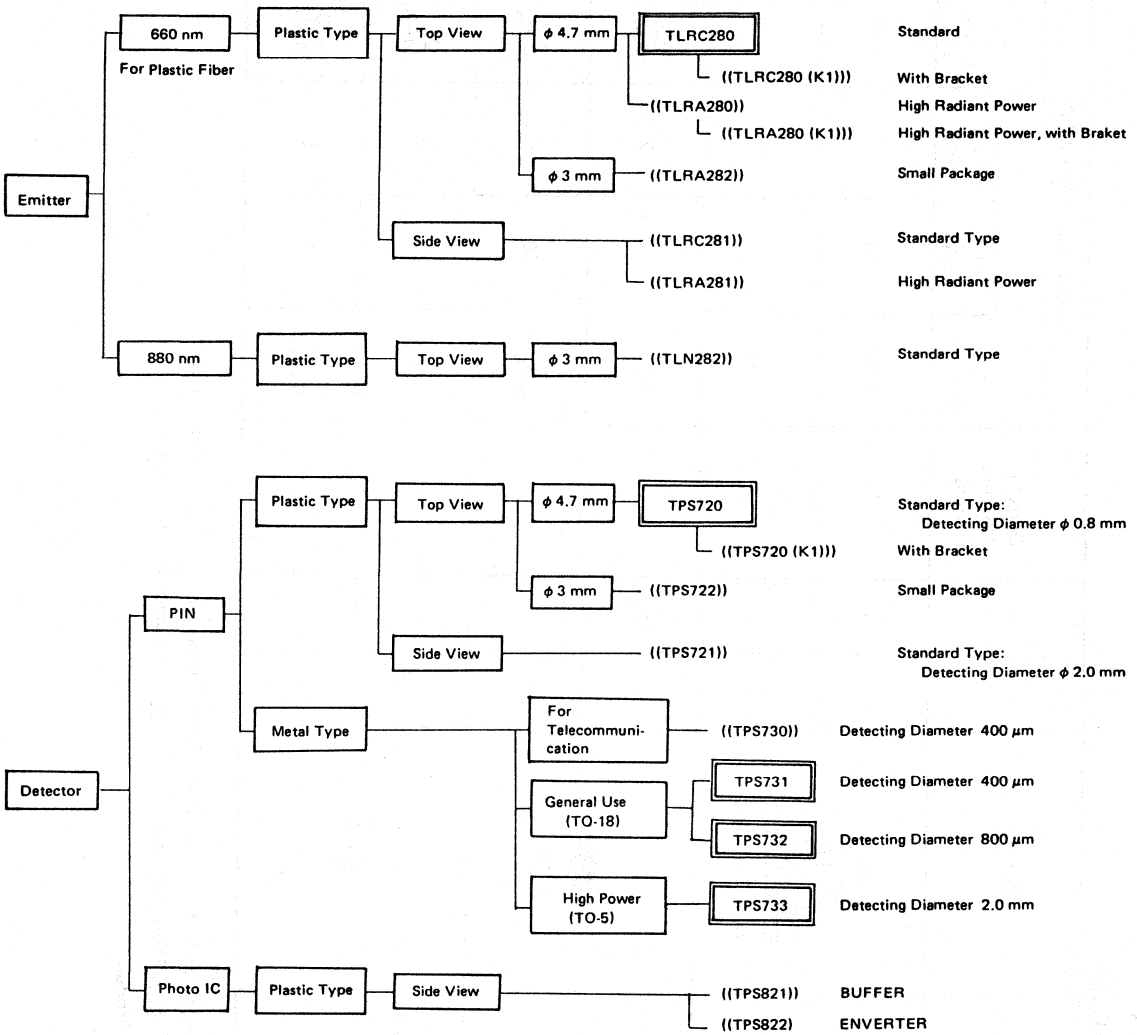
Type No.	Status	Outline	S	D	Characteristic (Ta = 25°C)					
					Detecting Distance (mm)	I_C (μA)	I_F (mA)	V_{CE} (V)	I_D (nA)	V_{CEO} (V)
TLP903				O	3.8	1000	10	2	30	30
TLP904			O			200	20	5	5	
TLP907	*			O	0.7	3000	4	2	250 (MAX.)	30
TLP908	*		O			50 (MIN.)	10	5	100 (MAX.)	
TLP907(LB)	*			O	0.7	3000	4	2	250 (MAX.)	30
TLP908(LB)	*		O			50 (MIN.)	10	5	100 (MAX.)	

Note: I_C: Collector Current S: Single Photo Transistor I_D: Dark Current
D: Darlington Photo Transistor V_{CE}: Collector Emitter Voltage
*: New Product

2–5 Fiber Optic Devices

2–5–1 Classification Guide

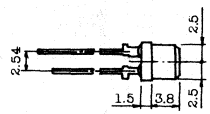
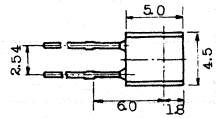
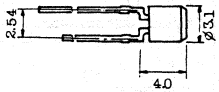
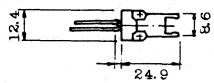
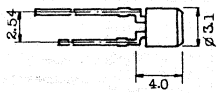
▭ : New Products
(( )) : Under Development



2–5 Fiber Optic Devices

2–5–1 Emitter Specification Guide

* New Product, ** Under Development

Classification	Type No.	Status	Outline	Characteristic (Ta = 25°C)						
				P_f (dBm)	I_F (mA)	V_F (V)	I_F (mA)	C_T (pF)	f_c (MHz)	
660 nm	TLRC280			– 8.5	30	1.85	30	80	7	Note 2
	TLRA280	**		– 4.0	30	1.9	30	80	3	
	TLRC281	**		– 8.5	30	1.85	30	80	7	
	TLRA281	**		– 4.0	30	1.9	30	80	3	
	TLRA282	**		– 5.0	30	1.9	30	80	2	
	TLRC280(K1)	**		– 8.5	30	1.85	30	80	7	
	TLRA280(K1)	**		– 4.0	30	1.9	30	80	3	
880 nm	TLN282	**		– 9	30	1.45	30	40	–	

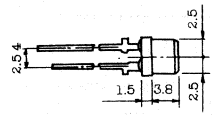
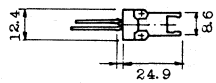
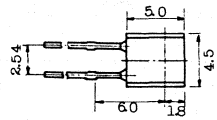
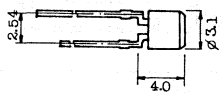
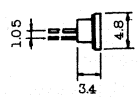
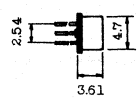
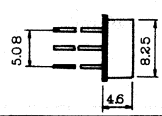
(Note 1) P_f : Fiber Coupled Power V_F : Forward Voltage Drop λp : Peak Emission Wave Length

C_T : Total Capacitance f_c : Cut-Off Frequency

(Note 2) Measuring Condition I_F = 30 mA DC + 6 mAp-p Output: – 3dB down from 100 kHz point

2–5–3 Detector Specification Guide (Continued)

* New Product, ** Under Development

Classification	Type No.	Status	Outline	Characteristic (Ta = 25°C)							
				S_f (A/W)	V_R(V)	I_D (nA)	V_R (V)	C_T (pF)	V_R (V)	f_c (MHz)	
PIN PD	TPS720	*		0.26	10	0.2	10	2.5	10	160	Note 2
	TPS720 (K1)	**									
	TPS721	**		0.55	10	0.5	10	11	10	200	
	TPS722	**		0.07	10	0.2	10	2.0	10	200	
				η (%)	λ (nm)	I_D (nA)	V_R(V)	C_T (pF)	V_R (V)	f_c (MHz)	
PIN PD	TPS730	**		85	850	0.1	20	1	20	600	
	TPS731	*		85	850	0.1	20	1.1	20	600	
	TPS732	*		85	850	0.2	20	2.5	20	400	
	TPS733	*		85	850	0.5	20	11.0	20	200	Note 3

(Note 1) S_f : Fiber Coupled Sensitivity I_D : Dark Current η : Quantum Efficiency

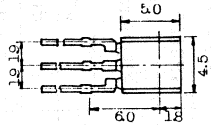
(Note 2) Measuring Condition V_R = 10V, R_L = 50 Ω Output: –3dB down from 100 kHz point

(Note 3) Measuring Condition V_R = 20V, R_L = 50 Ω Output: –3dB down from 100 kHz point

2–5 Fiber Optic Devices

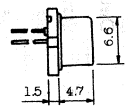
2–5–3 Detector Specification Guide

** Under Development

Classification	Type No.	Status	Outline	Characterisitc				
				Type dBm	Pin (min)	t_{PHL}, t_{PLH} (μS)		RL(Ω)
Photo IC	TPS821	**		Buffer	−18	3	5	280
	TPS822	**		Inverter	−18	8	5	280

2–6 Laser Diode

** Under Development

Classification	Type No.	Status	Outline	P_o (mW)	I_{th} (mA)	λP (nm)	I_F(mA)	I_m (mA)	P_o(mW)
LD	TOLD500	**		30 (pulse)	60	830	10	10	10

(Note 1) P_o : Radiant Power I_{th} : Threshold Current λ_P : Peak Emission Wave Length I_m : Monitor Current

2–7 Mounting Equipment, Application and Recommended Devices (Continued)

Group	Mounting Equipment	Applications	Recommended Devices
Audio-Group	TV set	Remote control	TLN105B → TPS703 TPS704 TPS705 TPS706 TLN115
	VTR, Video disc	Detection of rotation, position	All photo-interrupters, TLP907, TPS605
	Stereo system	Remote control	TLN115 → TPS704 TPS705 TPS706
	Player	o Disc record size detection	TLN104 → TPS605 TPS606
		o Tone arm position detection	TLN107A → TPS617 TPS618
	Tape	o	TLN104 → TPS605 TPS606
		o	TLP907
Household Appliance	Fire alarm (Smoke detection)	Detection of irregular reflection	TLN201 → TPS708
	Air conditioner	Remote control	TLN115 → TPS703 TPS704
	Automatic switch	Detection of ambient light	TPS603 , TPS613
	Electric washer	Detection of rinsing degree	TLN201 → TPS601A
	Auto dimmer	Detection of ambient light	TPS603 , TPS613
	Health machines & apparatus	Detection of internal mechanism position	All photo-interrupters
	Sewing machine	Detection of end breakage	ditto
Automobile	Tachometer	Detection of number of revolutions	ditto
	Speedometer	Detection of pointer position	ditto
	Automobile doors	Confirmation of door lock safety	TLN108 → TPS601A
Control & Measurement	Fiber sensor	Emitting/detecting light source	TLRC280 , TPS720
	Photoelectric switch	Emitting/detecting light source	TLN102 TLN201 → TPS708
	Rotary encoder	Detection of rotation	TLN104 → TPS606 TLN113 → TPS612
	Surveying instrument	Detection of distance	TLN201 → TPS708
	Level	Detection of water surface position	TLP903 , TLP907
	Auto production equipment	Detection of internal mechanism position	All photo-interrupters
	Industrial robot	Detection of substance	TLN108 → TPS601A

2–7 Mounting Equipment, Application and Recommended Devices

Group	Mounting Equipment	Applications		Recommended Devices
Information, Vending Machines, Office Machines	PPC	Detection of internal mechanism position, Paper detection		All photo-interrupters with connector
	Printer	Print timing detection Home position detection		ditto
	Vending machine	Coin detection		TLN108 → TPS601A
	Auto ticketing machine	Coin detection		TLN108 → TPS601A
	Tape reader	Code reading		TLN113 → TPS612
	Optical disc file	Code reading, write/read to/from optical disc		TOLD500
	Facsimile	Detection of end of paper		TLP903
	Floppy disk	o Disk in detection o Track "00" detection		TLN113 → TPS613 TLP907, TLP809, TLP805
Precision Machines	Camera	o Detection of distance to object (Automatic focusing)		TLN206
		o Detection of ambient light (Exposure meter)		TPS613
	Stroboscope	Detection of flashlight quantity		TPS613
Tele-Communication Equipment	Telephone	Hook sensor		TLP802
	Photo telephone	Information transmission		TLN115 → TPS703 TPS704
	Optical communication	For plastic fiber		TLRC280 → TPS720
		For PCF fiber	General use	– → TPS731 TPS732 TPS761
		For quartz fiber	High efficiency	– → TPS703 TPS704
Others	Amusement equipment (Pinball/game machines, etc.)	Coin detection		TLN108 → TPS601A
	Toys (Rifle game) (Remote control robots)	Remote control		TLN115 → TPS703 TPS704
	Garage doors	Remote control		TLN115 → TPS703 TPS704
	Electric car doors	Door lock safety confirmation		TLN108 → TPS601A

2–8 Features of Discrete Devices

2–8–1 Emitters - Detectors Matching Example (Continued)

	Light Emitting Device Sales Point	Light Emitting Device → Light Detecting Device	Light Detecting Devices Sales Point
Metal Package	Narrow radiation angle	TLN101A ⇒ TPS601A	Narrow acceptance angle
	Wide radiation angle	TLN102 ⇒ TPS604	Narrow acceptance angle with base terminal
	High radiant power (About 50% of TLN101A)	TLN108 ⇒ TPS614	Wide acceptance angle with base terminal flat lens
	Improved coupling factor with detecting device (About 3 times of TLN101A)	TLN201 ⇒ TPS708	High-speed, low dark current photo diode
	Designed for camera auto focusing	TLN206	
φ3 Package	Wide radiation angle → Less fluctuation of radiant power on shaft when mounted	TLN103 ⇒ TPS603	Wide acceptance angle → Less fluctuation of light sensitivity on shaft when mounted
	Increased radiant power on shaft; about double of TLN103	TLN109 ⇒ TPS615	Proper acceptance angle
		TLN109 ⇒ TPS616	Visible light cut-off product of TPS615
	Proper radiation angle	TLN113 ⇒ TPS613	Proper angle of direction
		TLN113 ⇒ TPS612	Visible light cut-off product of TPS613
Double-End Type	Micro type (Visible light type is also available: TLR121)	TLN104 ⇒ TPS605	Micro type, high sensitivity
		TLN104 ⇒ TPS606	Micro type, high speed
φ5 Package	General use product	TLN105A ⇒ TPS610, TPS611	General use product
	Higher radiant power product (About 2 times of TLN105A)	TLN111 ⇒ TPS610, TPS611	
	Narrow directivity product	TLN110 ⇒ TPS610, TPS611	
	Improved coupling factor with receiving light (About 3 times of TLN105A)	TLN205 ⇒ TPS610, TPS611	
	Exclusive use for light remote control	TLN105B, TLN115 ⇒ TPS703*, TPS703A*, TPS704*, TPS705*, TPS706*	High-speed response, high sensitive with a visible light shut-off filter High-speed response, high sensitive with a visible light shut-off filter Fluorescent lamp Irregular light proof product

2–8 Features of Discrete Devices

2–8–1 Emitters - Detectors Matching Example

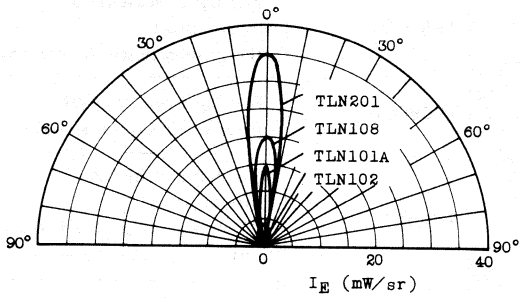
	Light Emitting Device Sales Point	Light Emitting Device → Light Receiving Device	Light Receiving Device Sales Point
Lateral Output Package	Interrupter's light source (Visible light)	TLR215A ⇒ TPS607A, TPS608A	For light receiving of interrupters (High sensitivity, low-speed)
			For light receiving of interrupters (high-speed)
	Interrupter's emitting source (Infrared rays)	TLN107A ⇒ TPS617, TPS618	For light receiving of interrupters (Visible light shut-off, high sensitivity, low-speed)
			For light detecting of interrupters (Visible light shut-off)
		TPS801, TPS802, TPS805, TPS806	For light detecting of interrupters (Photo IC, Visible light shut-off, high-speed)

* : Outline is different from that of the light emitting device.

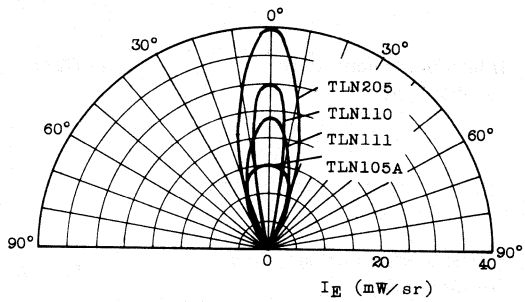
2–8 Features of Discrete Devices

2–8–2 Infrared Emitters Radiation Pattern Comparison

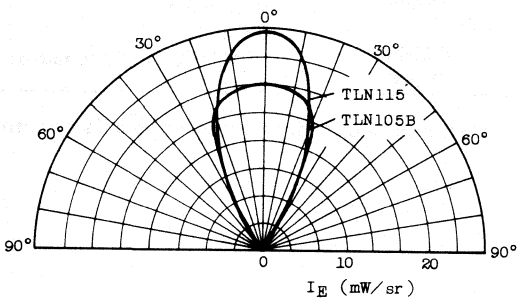
Metal Package



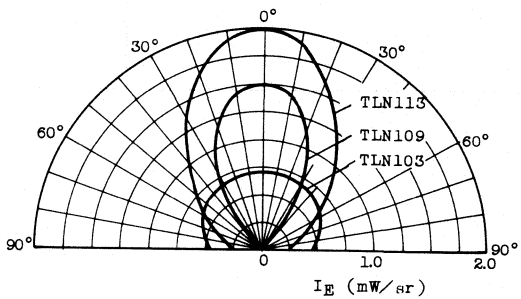
ϕ 5 Package



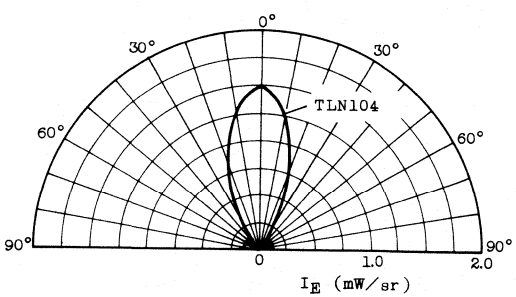
For Remote Control



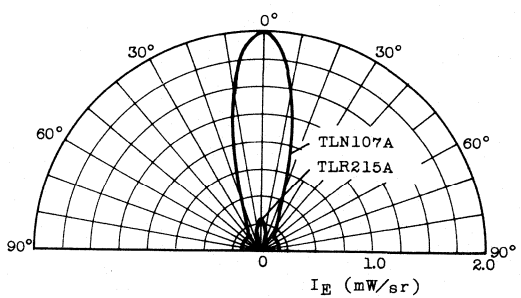
ϕ 3 Package



Double-End Type Package



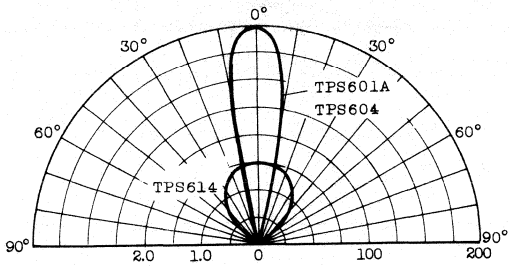
Vertical Type Package



2–8 Features of Discrete Devices

2–8–3 Photo Transistor Relative Directional Sensitivity

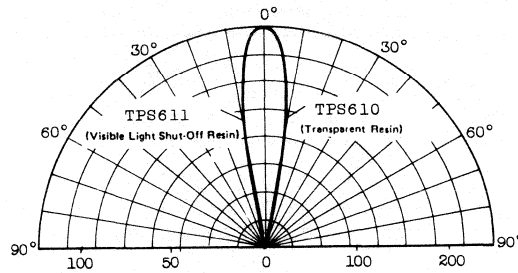
Metal Package



TPS614 I_C (mA) at E=10mW/cm²

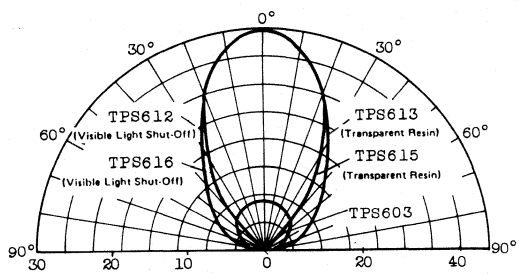
TPS601A I_C (μA) TPS604 at E=0.1mW/cm²

φ 5 Package



TPS611 I_C (μA) TPS610 I_C (μA)

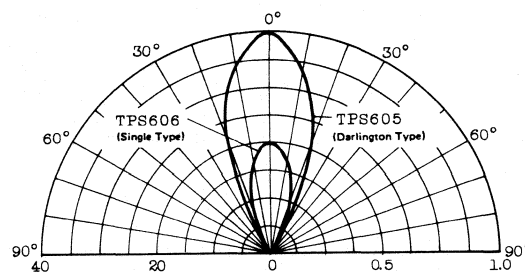
φ 3 Package



TPS612 I_C (μA) TPS616

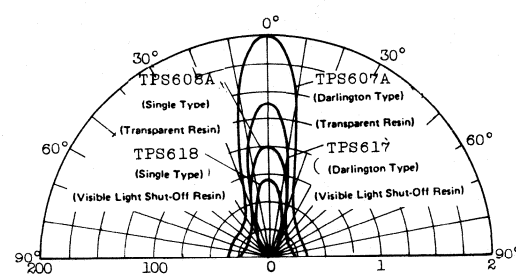
TPS603 I_C (μA) TPS613 TPS615

Double-End Type Package



TPS606 I_C (μA) TPS605 I_C (mA)

Vertical Type Package

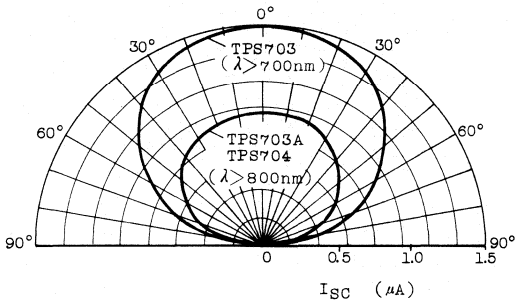


Single Type Darlington Type

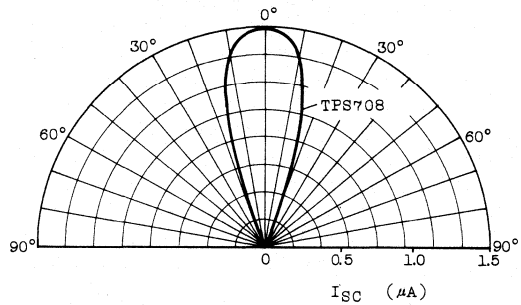
2–8 Features of Discrete Devices

2–8–4 Photo Diode Relative Directional Sensitivity

For Remote Control



Metal Package



3 Data Sheets

■ Infrared LED

Note: Red LED

* New Product

** Under Development

INFRARED LED
GaAs INFRARED EMITTER

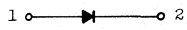
TLN101A

INFRARED LED FOR PHOTO SENSOR

- o OPTICAL SWITCH
- o ENCODERS
- o TAPE, CARD READERS

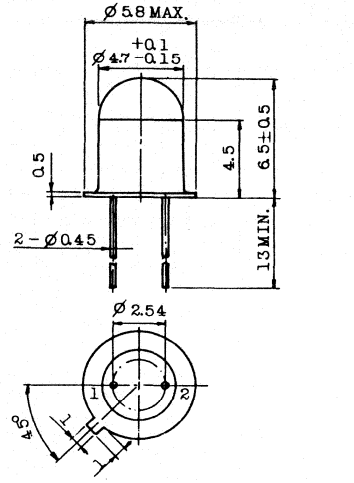
- Output Spectrally Compatible with Silicon Sensor
- TPS601A, TPS604
- High Radiant Power : P_O=1.8mW(Typ.)
- High Radiant Intensity
- Glass-to-Metal-Seal Header

PIN CONNECTION



1. ANODE
2. CATHODE

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	4-5Q1A

Weight : 0.39g

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current	I_F	100	mA
Pulse Forward Current (Note)	I_{FP}	1	A
Reverse Forward Current(Note)	V_R	5	V
Forward Current Derating	$\Delta I_F/°C$	-1.0	mA/°C
Operating Temperature Range	T_{opr}	-40∿125	°C
Storage Temperature Range	T_{stg}	-55∿150	°C

Note : Pulse Width ≦100μs, Repetitive Frequency=100Hz.

OPTO-ELECTRICAL CHARACTERISTICS (Ta=25°C)

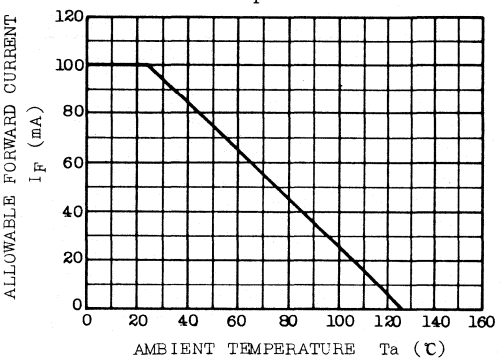
CHARACTERISTICS	SYMBOL	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=50mA		-	1.3	1.4	V
Reverse Current	I_R	V_R=5V		-	-	10	μA
Radiant Power	P_O	I_F=50mA	TLN101A	0.5	1.8	-	mW
			TLN101A-C	1.5	-	4.5	
Capacitance	C_T	V_R=0, f=1MHz		-	30	-	pF
Peak Emission Wave Length	λp	I_F=50mA		-	940	-	nm
Spectral Line Half Width	Δλ	I_F=50mA		-	50	-	nm

PRECAUTION

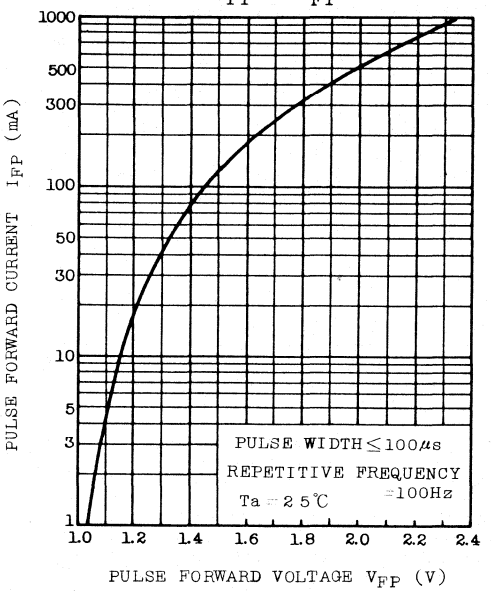
Please be careful of the followings.

1. Soldering temperature: 260°C MAX.
   Soldering time: 5 sec MAX.
   (Soldering portion of lead: up to 1.5mm from the body of the device)
2. If the lead is formed, the lead should be formed at a distance of 2mm from the body of the device.
   Soldering shall be performed after lead forming.
3. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   ∘ Freon TE or TF ∘ Dai-Fron Solvents S3 or S3-E

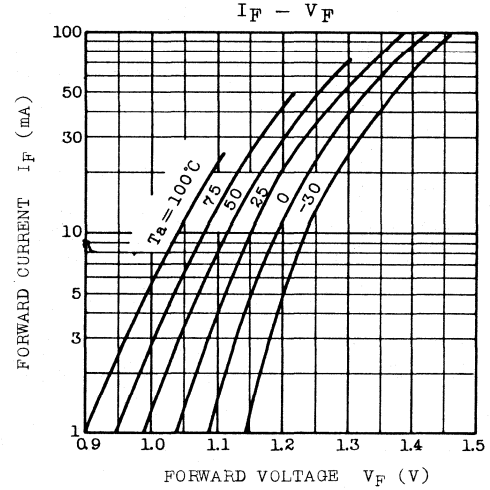
$I_F - Ta$



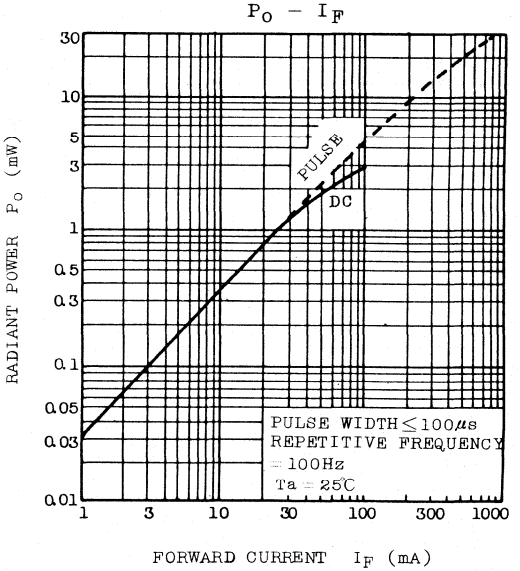
$I_{PP} - V_{FP}$



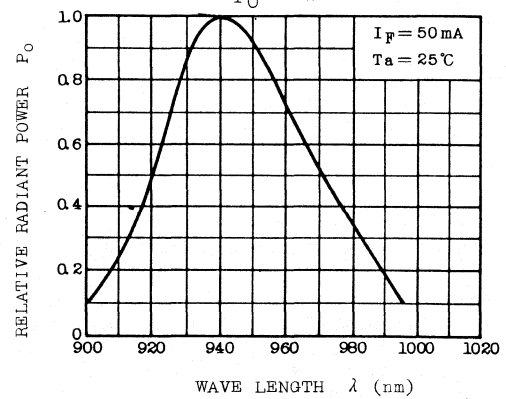
$I_F - V_F$



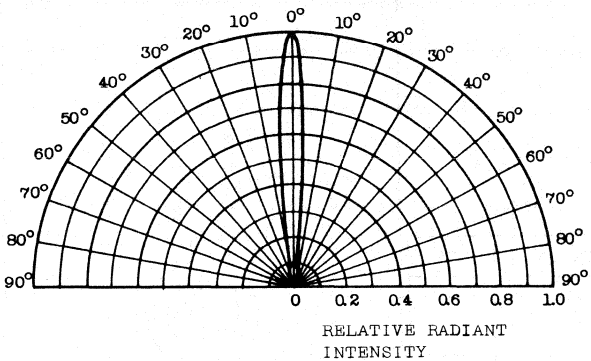
$P_O - I_F$



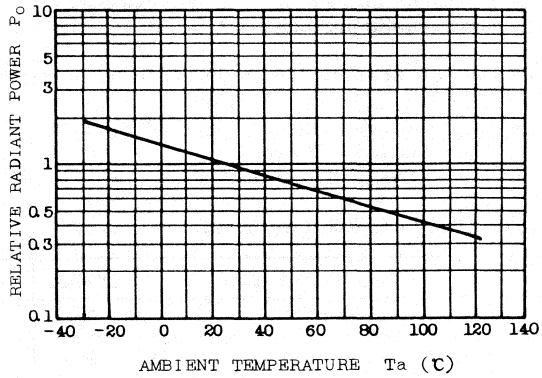
$P_O - \lambda$



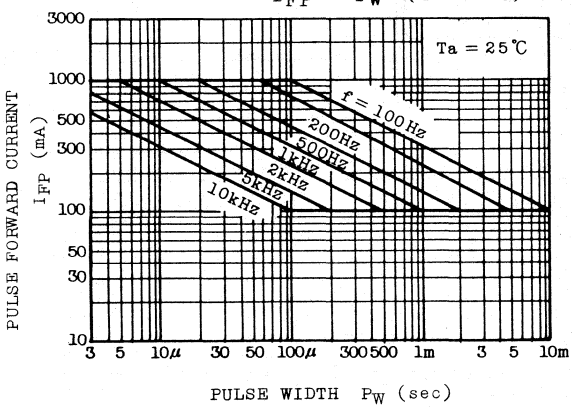
RADIATION PATTERN(Ta=25℃)



P_O – Ta



I_{FP} – P_W (Ta=25℃)



TLN102

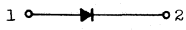
INFRARED LED
GaAs INFRARED EMITTER

INFRARED LED FOR PHOTO SENSOR

- o OPTICAL SWITCH
- o ENCODERS
- o TAPE, CARD READERS

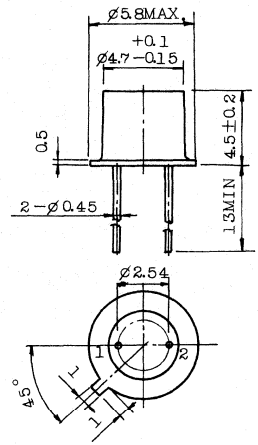
- Output Spectrally Compatible with Silicon Senser TPS601A, TPS604, TPS614
- High Radiant Power: P_O=4.2 MW (Typ.)
- High Radiant Intensity
- Glass-to-Metal-Seal Header

PIN CONNECTION



1. ANODE
2. CATHODE

Unit in mm



JEDEC	–
EIAJ	–
TOSHIBA	–

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current	I_F	100	mA
Pulse Forward Current (Note)	I_{FP}	1	A
Reverse Voltage	V_R	5	V
Forward Current Derating	ΔI_F/°C	-1.0	mA/°C
Operating Temperature Range	T_{opr}	-40 ∿125	°C
Storage Temperature Range	T_{stg}	-55 ∿125	°C

Note: Pulse width ≦100μs. Repetitive frequency=100 Hz.

OPTO-ELECTRICAL CHARACTERISTICS (Ta=25°C)

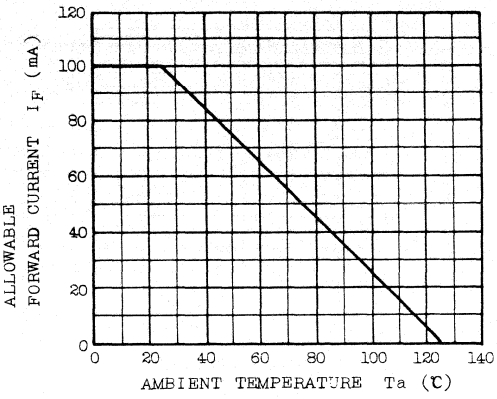
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=50mA	-	1.3	1.4	V
Reverse Current	I_R	V_R=5V	-	-	10	μA
Radiant Power	P_O	I_F=50mA	-	4.2	-	mW
Radiant Intensity	I_E	I_F=50mA	2	4	-	mW/sr
Capacitance	C_T	V_R=0, f=1MHz	-	30	-	pF
Peak Emission Wave Length	λp	I_F=50mA	-	940	-	nm
Spectral Line Half Width	Δλ	I_F=50mA	-	50	-	nm

PRECAUTION

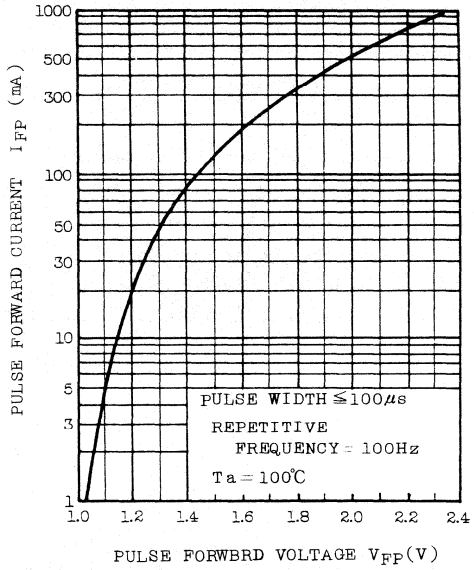
Please be careful of the followings.

1. Soldering temperature: 260°C MAX.
   Soldering time: 5 sec MAX.
   (Soldering portion of lead: up to 1.5 mm from the body of the device)
2. If the lead is formed, the lead should be formed at a distance of 2mm from the body of the device.
   Soldering shall be perfomed after lead forming.
3. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   * ∘ Freon TE or TF ∘ Dai-Fron Solvents S3 or S3-E

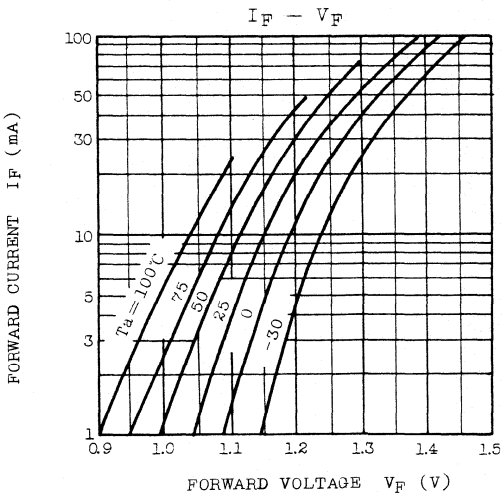
$I_F - Ta$



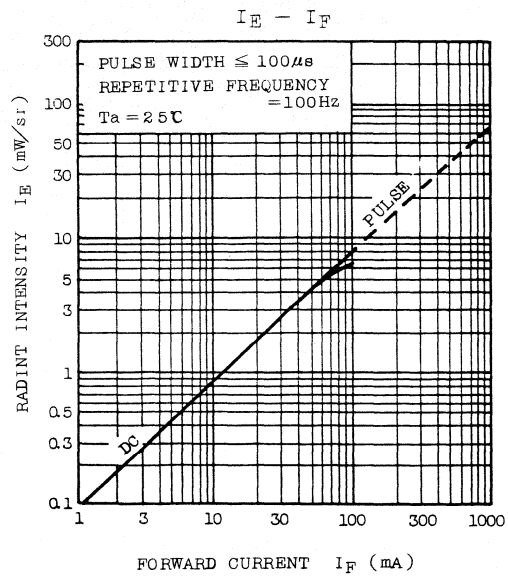
$I_{FP} - V_{FP}$

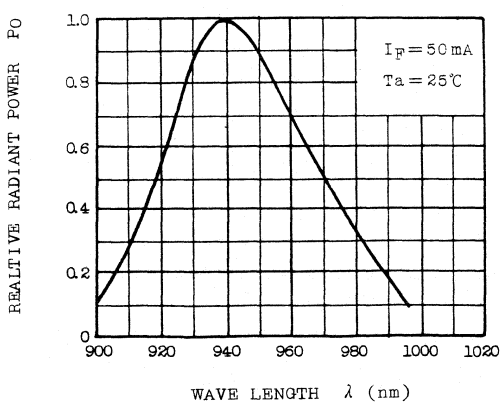


$I_F - V_F$

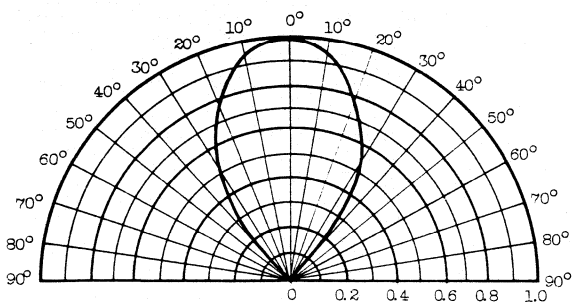


$I_E - I_F$



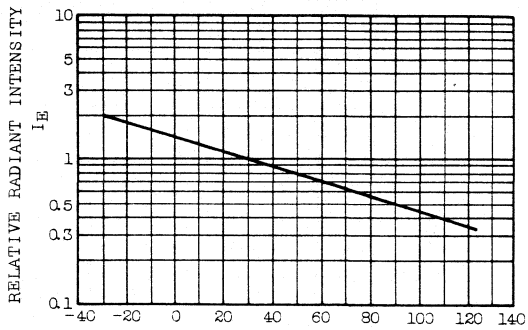


RADIATION PATTERN (Ta = 25℃)



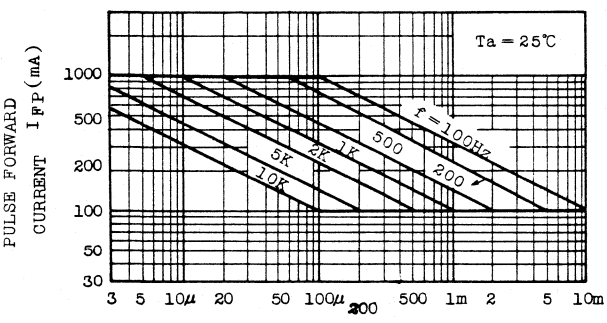
RELATIVE RADIANT INTENSITY

I_E — Ta



AMBIENT TEMPERATURE Ta (℃)

I_{FP} — P_W



PULSE WIDTH P_W (sec)

INFRARED LED
GaAs INFRARED EMITTER

TLN103

INFRARED LED FOR PHOTO SENSOR.

. OPTICAL SWITCH . ENCORDERS

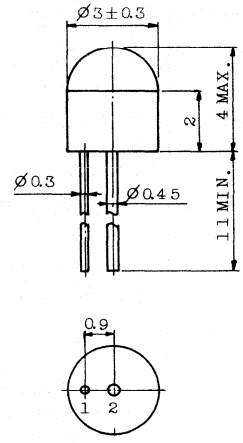
. TAPE, CARD READERS

. Output Spectrally Compatible with Silicon Sensor TPS603

. High Radiant Power : P_O=2.5mW (Typ.)

. Wide Viewing Angle

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	4-3A1A

Weight : 0.08g

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current	I_F	40	mA
Pulse Forward Current (Note)	I_{FP}	400	mA
Reverse Voltage	V_R	5	V
Forward Current Derating	$\Delta I_F/^oC$	-0.53	mA/°C
Operating Temperature Range	T_{opr}	-20 ~ 75	°C
Storage Temperature Range	T_{stg}	-30 ~ 100	°C

Note : Pulse width≦100μs, Repetitive frequency=100Hz

OPTO-ELECTRICAL CHARACTERISTICS (Ta=25°C)

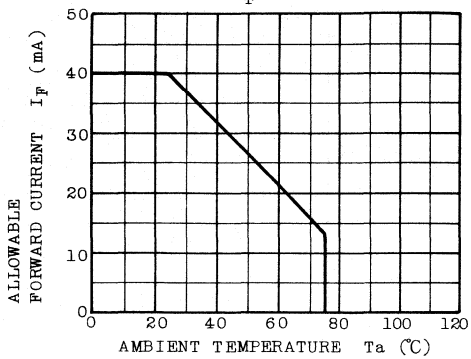
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=10mA	-	1.15	1.35	V
Reverse Current	I_R	V_R=5V	-	-	10	μA
Radiant Power	P_O	I_F=20mA	0.5	2.5	-	mW
Capacitance	C_T	V_R=0, f=1MHz	-	30	-	pF
Peak Emission Wave Length	λ_P	I_F=20mA	-	940	-	nm
Spectral Line Half Width	$\Delta\lambda$	I_F=20mA	-	50	-	nm

PRECAUTION

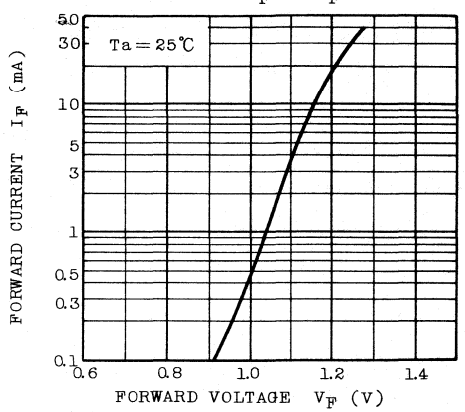
Please be careful of the followings.

1. Soldering temperature: 260°C MAX.
   Soldering time: 3 sec MAX.
   (Soldering portion of lead: up to 2mm from the body of the device)
2. If the lead is formed, the lead should be formed at a distance of 2mm from the body of the device.
   Soldering shall be performed after lead forming.
3. Avoid using the Solvents except for the follows, when wasing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   o Freon TE or TF o Dai-Fron Solvents S3 or S3-E

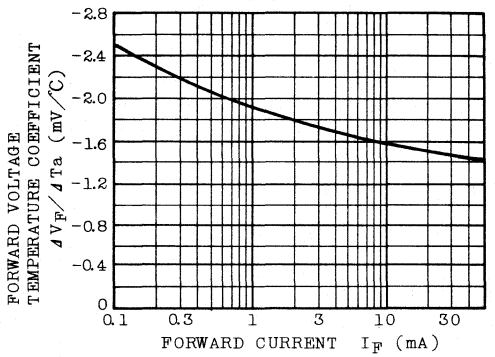
I_F — Ta



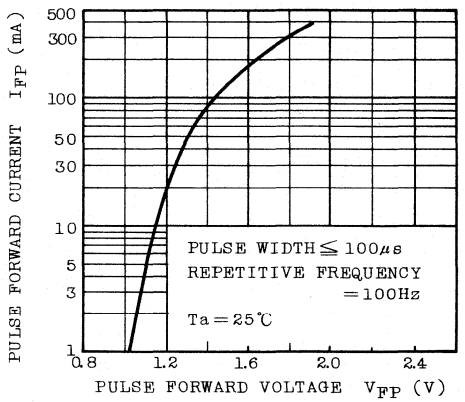
I_F — V_F



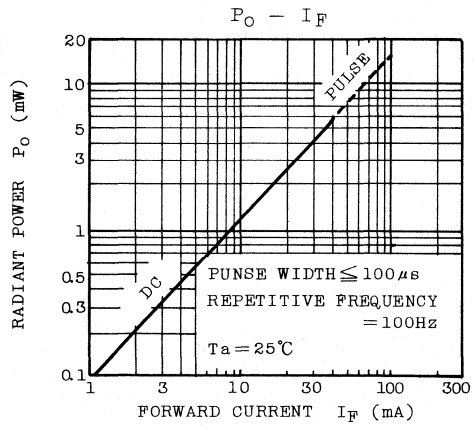
$\Delta V_F/\Delta Ta$ — I_F



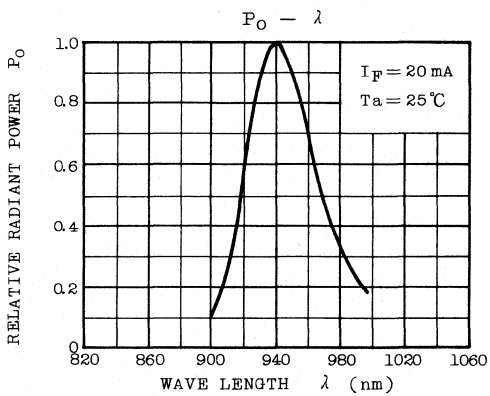
I_{FP} — V_{FP}



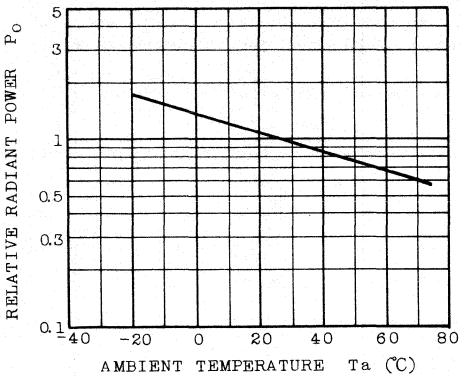
P_O — I_F



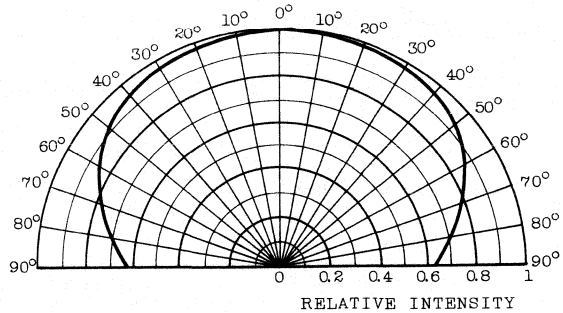
P_O — λ



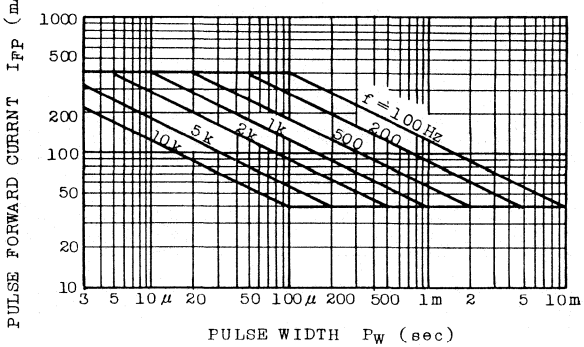
P_O – Ta



RADIATION PATTERN (Ta = 25℃)



I_{FP} – P_W (Ta=25℃)



TLN104

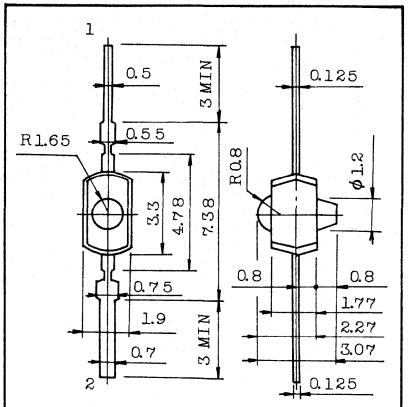
INFRARED LED
GaAs INFRARED EMITTER

INFRARED LED FOR PHOTO SENSOR

- OPTICAL SWITCH
- ENCODERS
- TAPE, CARD READERS

- Output Spectrally Compatible with Silicon Sensor TPS606, TPS605
- High Radiant Power: P_O=3.0mW (Typ.)
- Small Size Package

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	4-2A1A

Weight: 0.02g

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current	I_F	40	mA
Pulse Forward Current (Note)	I_{FP}	400	mA
Reverse Voltage	V_R	5	V
Forward Current Derating	$\Delta I_F/°C$	-0.53	mA/°C
Operating Temperature Range	T_{opr}	-20 ∿ 75	°C
Storage Temperature Range	T_{stg}	-30 ∿ 80	°C

Note: Pulse width ≦ 100μs, Repetitive frequency=100Hz.

OPTO-ELECTRICAL CHARACTERISTICS (Ta=25°C)

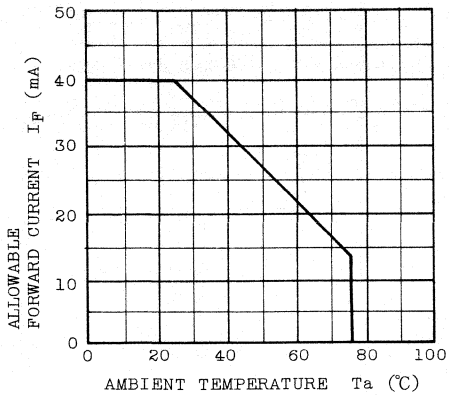
CHARACTERISTIC	SYMBOL	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=10mA		-	1.13	1.35	V
Reverse Current	I_R	V_R=5V		-	-	10	μA
Radiant Power	P_O	I_F=20mA	TLN104	1.5	-	-	mW
			TLN104-A	1.5	-	3.5	
			TLN104-B	2.5	-	6.0	
Capacitance	C_T	V_R=0, f=1MHz		-	50	-	pF
Peak Emission Wave Length	λ_P	I_F=20mA		-	940	-	nm
Spectral Line Half Width	Δ_λ	I_F=20mA		-	50	-	nm

PRECAUTION

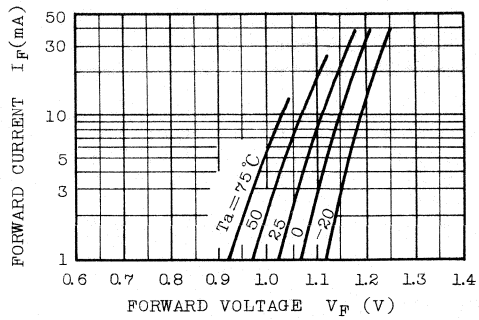
Please be careful of the followings.

1. Soldering temperature: 260°C MAX. Soldering time: 3 sec MAX.
   (Soldering portion of lead: up to 2mm from the body of the device)
2. If the lead is formed, the lead should be formed at a distance of 0.8mm from the body of the device.
   Soldering shall be performed after lead forming.
3. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   ∘ Freon TE or TF ∘ Dai-Fron Solvents S3 or S3-E

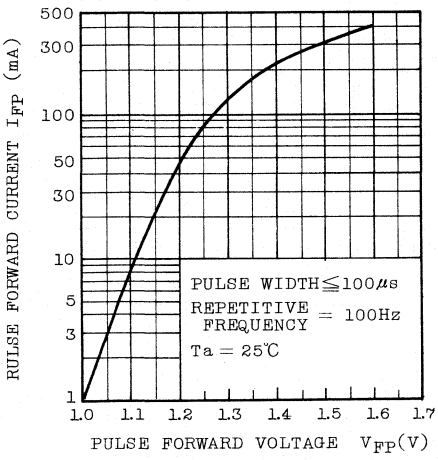
I_F — Ta



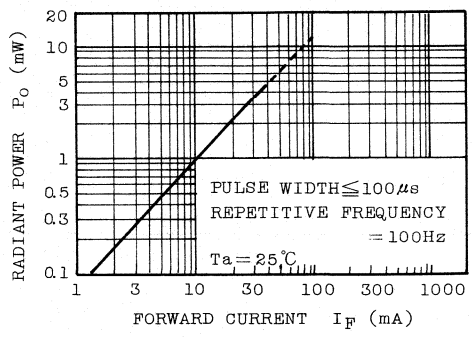
I_F — V_F



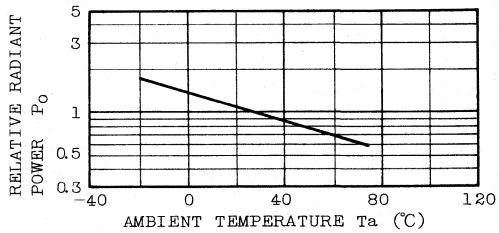
I_{FP} — V_{FP}



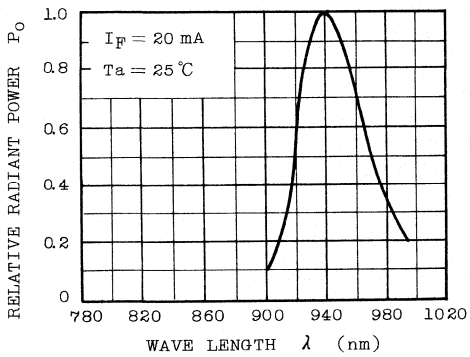
P_O — I_F



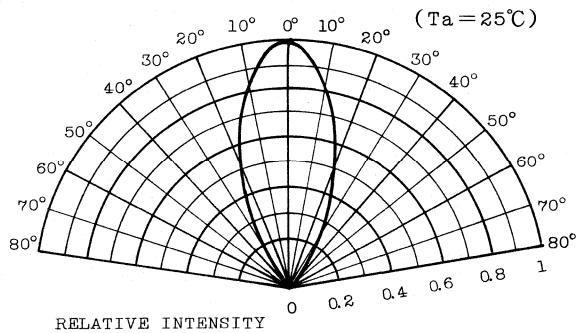
P_O — Ta



P_O — λ



RADIATION PATTERN



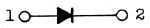
TLN105A

INFRARED LED
GaAs INFRARED EMITTER

INFRARED LED FOR PHOTO SENSOR.

. REMOTE CONTROL SYSTEM
. OPTICAL SWITCH

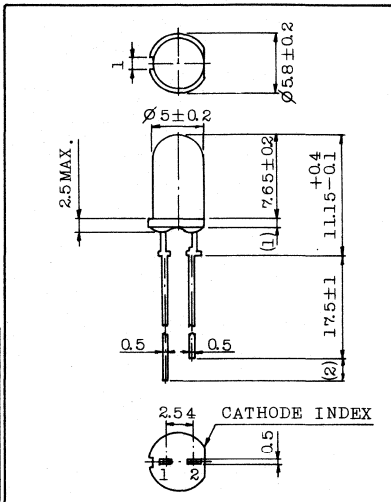
PIN CONNECTION



1. ANODE
2. CATHODE

- Output Spectrally Compatible with Silicon Sensor TPS703, TPS703A, TPS704, TPS705, TPS706
- High Radiant Power
- Radiant Intensity: I_E=15mW/sr (Typ.)

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	4−6B1A

Weight : 0.30g

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current	I_F	100	mA
Pulse Forward Current (Note 1)	I_{FP}	1	A
Reverse Voltage	V_R	5	V
Power Dissipation	P_D	150	mW
Operating Temperature Range	T_{opr}	-20 ~ 75	°C
Storage Temeprature Range	T_{stg}	-30 ~ 100	°C

Note 1: Pulse Width ≦100μs, Repetitive frequency=100Hz.

OPTO-ELECTRICAL CHARACTERISTICS (Ta=25°C)

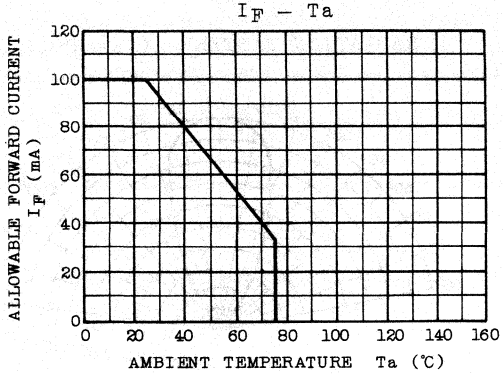
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=100mA	-	1.35	1.5	V
Reverse Current	I_R	V_R=5V	-	-	10	μA
Radiant Intensity	I_E	I_F=50mA	7	15	-	mW/sr
Radiant Power	P_O	I_F=50mA	-	9	-	mW
Capacitance	C_T	V_R=0, f=1MHz	-	20	-	pF
Peak Emission Wave Length	λ_P	I_F=50mA	-	940	-	nm
Spectral Line Half Width	$\Delta\lambda$	I_F=50mA	-	45	-	nm

PRECAUTION

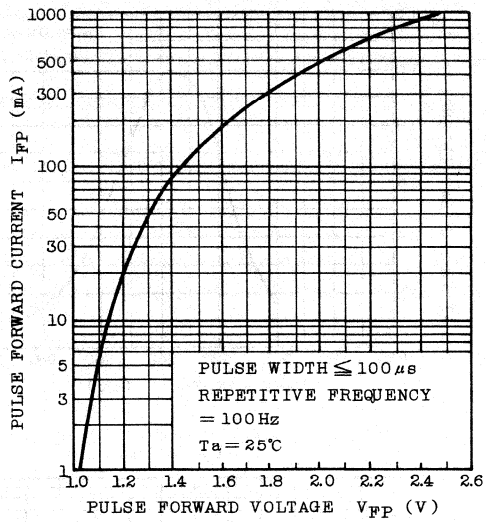
Please be careful of the followings.

1. Soldering temperature: 260°C MAX. Soldering time: 5 sec MAX.
   (Soldering portion of lead: at below the lead stopper.)
2. If the lead is formed, the lead should be formed at below the lead stopper.
   Soldering shall be performed after lead forming.
3. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   o Freon TE or TF o Dai-Fron Solvent S3-E or S3

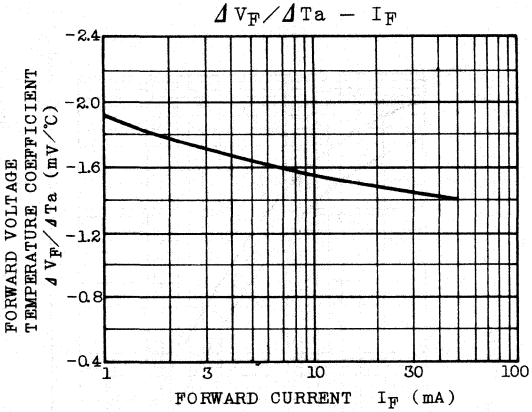
I_F – Ta



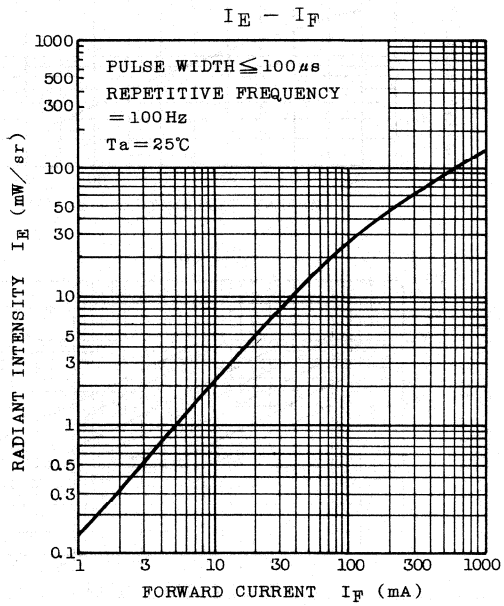
I_{FP} – V_{FP}



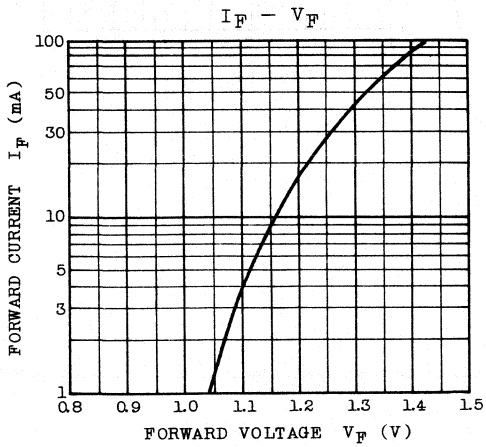
$\Delta V_F / \Delta Ta$ – I_F



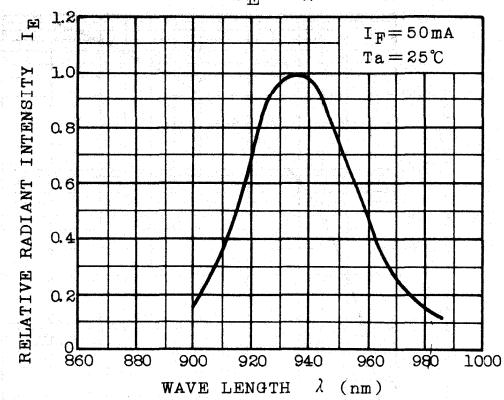
I_E – I_F



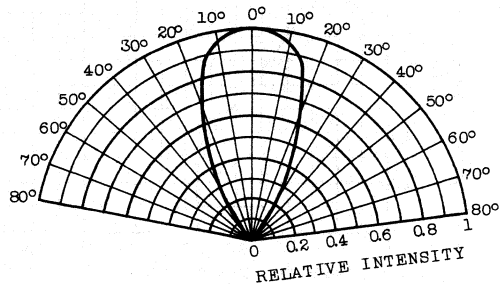
I_F – V_F



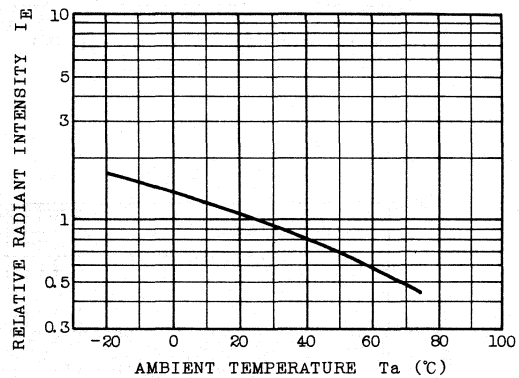
$I_E - \lambda$



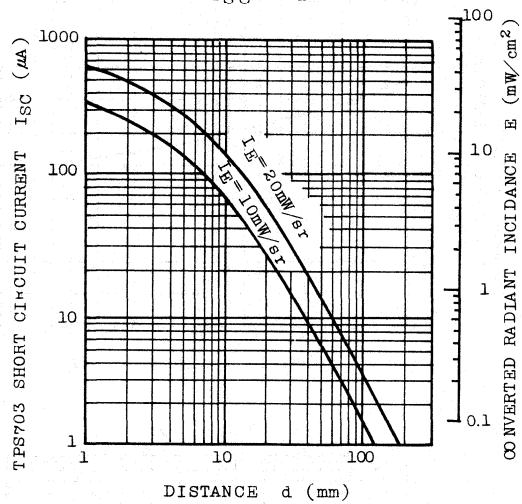
RADIATION PATTERN (Ta=25℃)



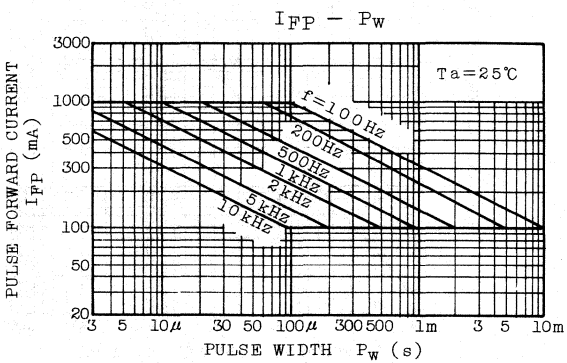
$I_E - Ta$

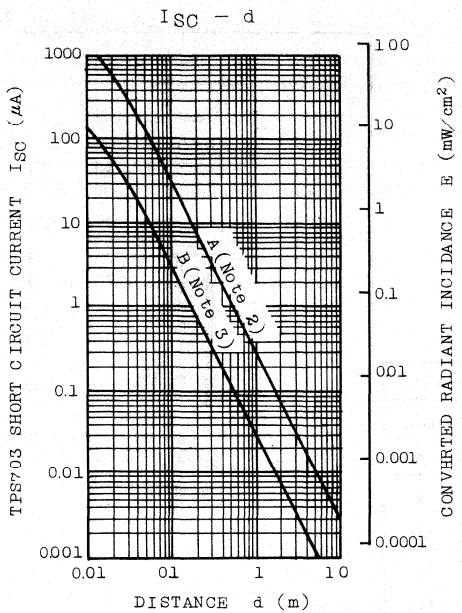


$I_{SC} - d$



$I_{FP} - P_W$





Note 2 : I_{EP} = 200mW/sr at I_{FP} ~ 200mA,
f = 100Hz, P_W = 100μs

Note 3 : I_E = 20mW/sr at I_F ~ 33mA

TLN105B

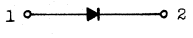
INFRARED LED
GaAs INFRARED EMITTER

GaAs INFRARED EMITTER

INFRARED LED FOR PHOTO SENSOR.

- REMOTE CONTROL SYSTEM
- OPTICAL SWITCH

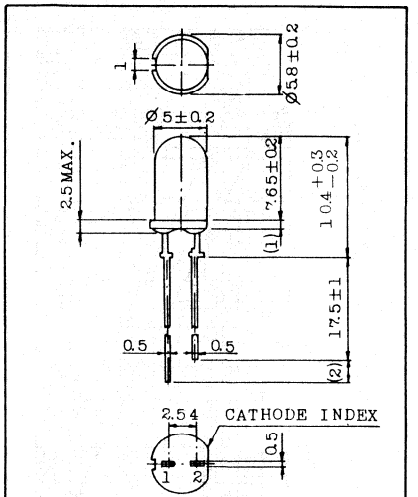
PIN CONNECTION



1. ANODE
2. CATHODE

- Output Spectrally Compatible with Siliccon Sensor TPS703, TPS703A, TPS704, TPS705, TPS706
- Wide Radiant Angle θ=±23.5°(Typ.)
- High Radiant Intensity: I_E=20mW/sr (Typ.)

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	4−6B1A

Weight : 0.30g

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTICS	SYMBOL	RATING	UNIT
Forward Current	I_F	100	mA
Pulse Forward Current (Note 1)	I_{FP}	1	A
Reverse Voltage	V_R	5	V
Power Dissipation	P_D	150	mW
Operating Temperature Range	T_{opr}	-20 ∿ 75	°C
Storage Temperature Range	T_{stg}	-30 ∿ 100	°C

Note 1: Pulse Width ≦100μs, Repetitive frequency=100Hz.

OPTO-ELECTRICAL CHARACTERISTICS (Ta=25°C)

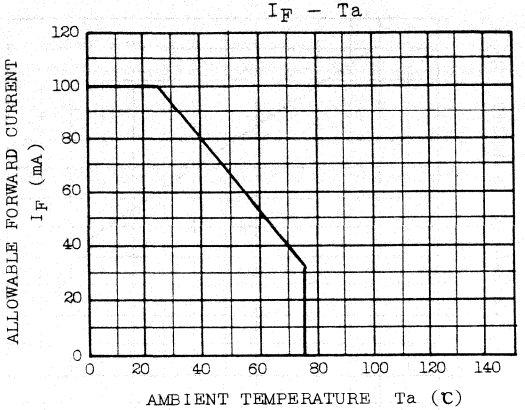
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=100mA	-	1.35	1.5	V
Reverse Current	I_R	V_R=5V	-	-	10	μA
Radiant Intensity	I_E	I_F=50mA	12	20	-	mW/sr
Radiant Power	P_o	I_F=50mA	-	11	-	mW
Capacitance	C_T	V_R=0, f=1MHz	-	20	-	pF
Peak Emission Wave Length	λp	I_F=50mA	-	950	-	nm
Spectral Line Half Width	Δλ	I_F=50mA	-	50	-	nm

PRECAUTION

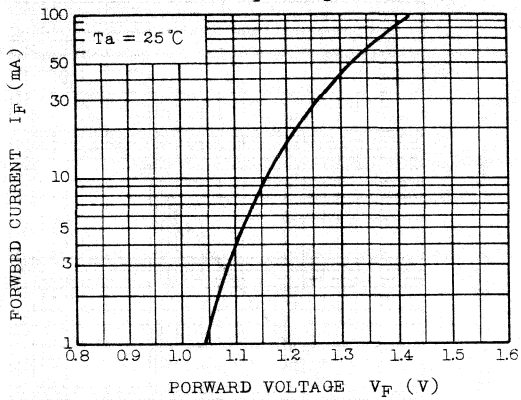
Please be careful of the followings.

1. So ldering temperature: 260°C MAX. Soldering time: 5 sec MAX.
   (Soldering portion of lead: at below the lead stopper.)
2. If the lead is forward, the lead should be formed at below the lead stopper
   Soldering shall be performed after lead forming.
3. Avoid using the Solvents except for the follows, when washing off flus and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAXw
   ∘ Freon TE or TF ∘ Dai-Fron Solvent S3-E or S3

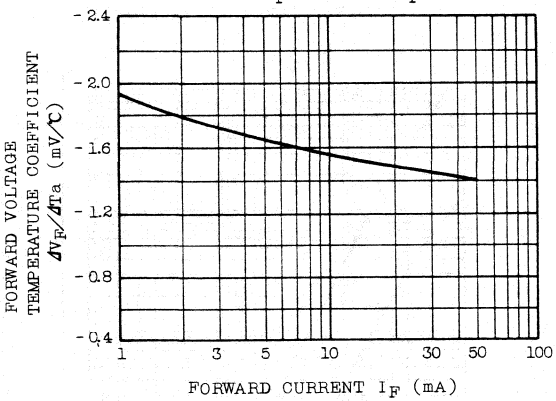
I_F – Ta



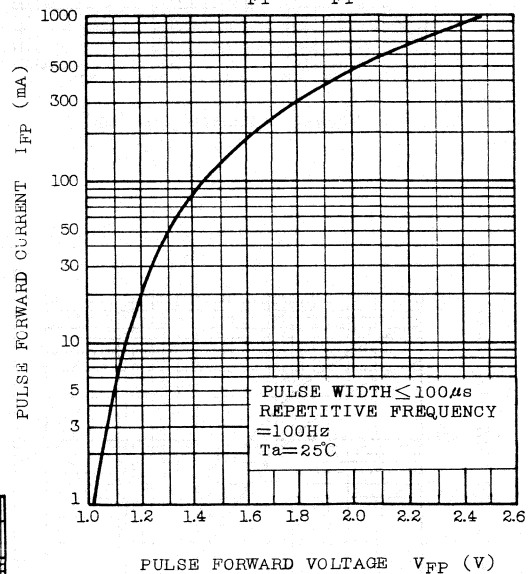
I_F – V_F



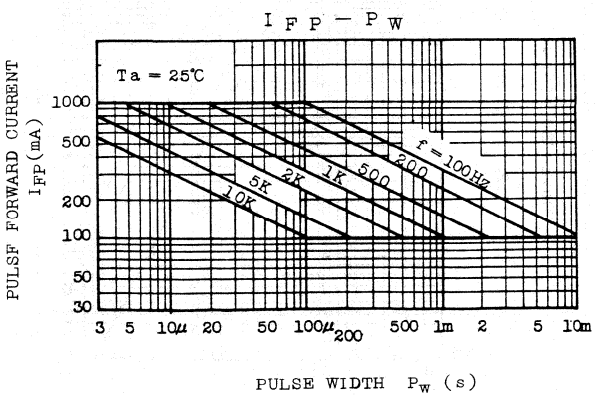
$\Delta V_F / \Delta Ta$ – I_F



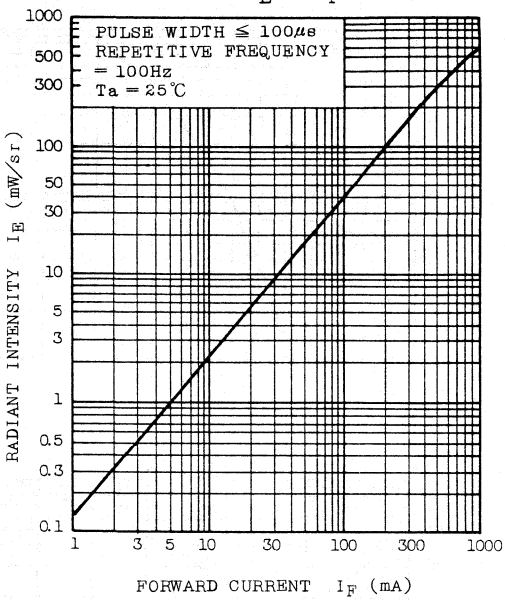
I_{FP} – V_{FP}



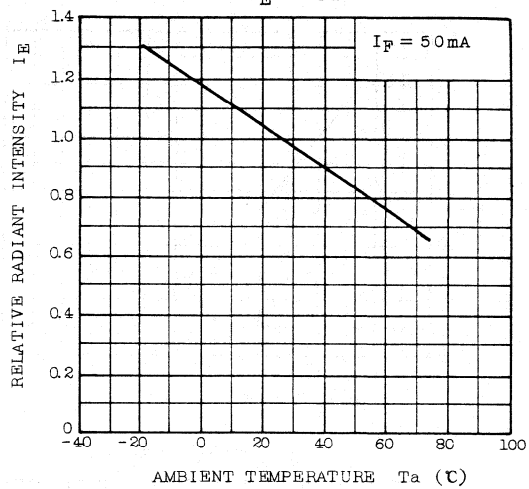
I_{FP} – P_W



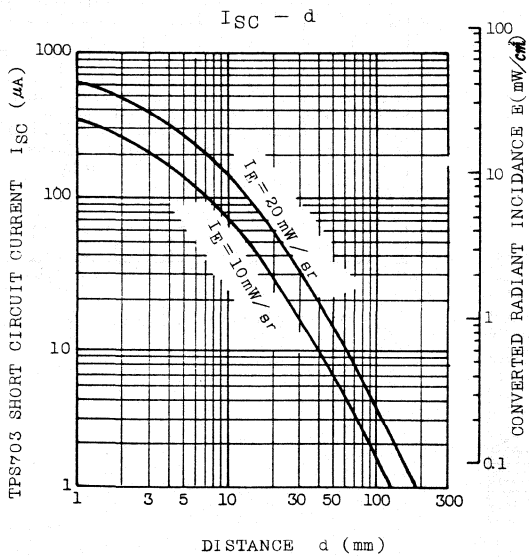
$I_E - I_F$



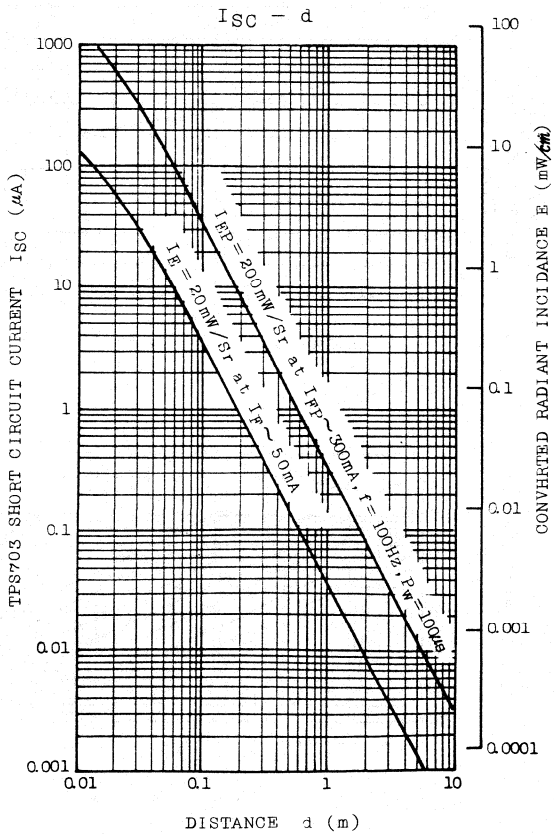
$I_E - Ta$



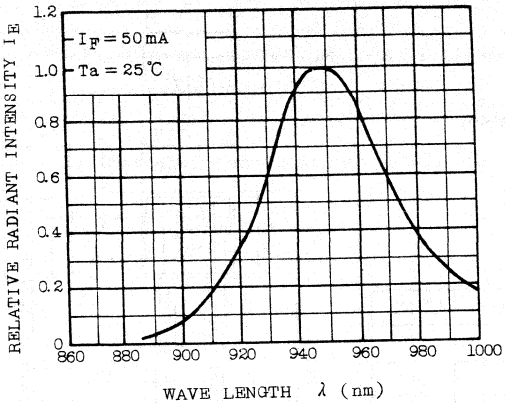
$I_{SC} - d$



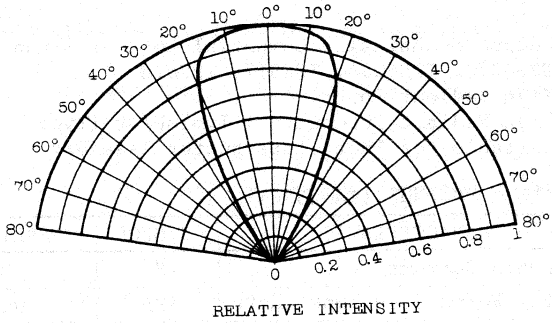
$I_{SC} - d$



$I_E - \lambda$



RADIATION PATTERN (Ta = 25°C)



TLN107A

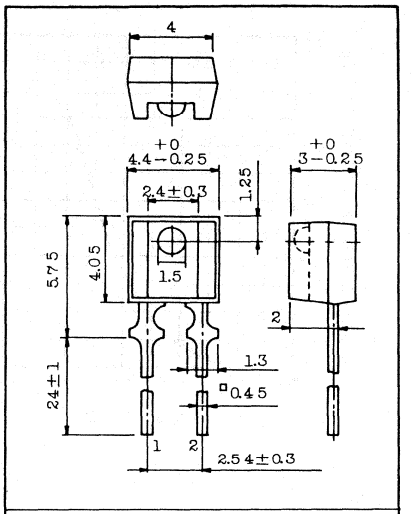
INFRARED LED
GaAs INFRARED EMITTER

INFRARED LED FOR PHOTO SENSOR.

- OPTICAL SWITCH
- TAPE, CARD READERS

- Output Mechnically Compatible with Silicon Sensor TPS607A, TPS609A, TPS617, TPS618
- High Radiant Power
- High Radiant Intensity : I_E=2mW/sr (Typ.)
- Suitable for Photo Interrupter Assembly

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	4−4H1A

Weight : 0.16g

MAXIMUM RATINGS (Ta=25°C)

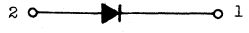
CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current	I_F	50	mA
Pulse Forward Current (Note)	I_{FP}	600	mA
Reverse Voltage	V_R	5	V
Forward Current Derating	$\Delta I_F/°C$	-0.33	mA/°C
Operating Temperature Range	T_{opr}	-25 ∿ 85	°C
Storage Temperature Range	T_{stg}	-40 ∿ 100	°C

Note: Pulse Width ≦ 100μs, Repetitive frequency=100Hz.

OPTO-ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=10mA		1.0	1.15	1.3	V
Reverse Current	I_R	V_R=5V		-	-	10	μA
Radiant Intensity	I_E	I_F=20mA	TLN107A	0.8	-	-	mW/sr
			TLN107A-A	0.8	-	3.0	
			TLN107A-B	2.0	-	7.5	
Radiant Power	P_O	I_F=20mA		-	2.0	-	mW
Capacitance	C_T	V_R=0, f=1MHz		-	30	-	pF
Peak Emission Wave Length	λP	I_F=20mA		-	940	-	nm
Spectral Line Half Width	Δλ	I_F=20mA		-	50	-	nm

PIN CONNECTION



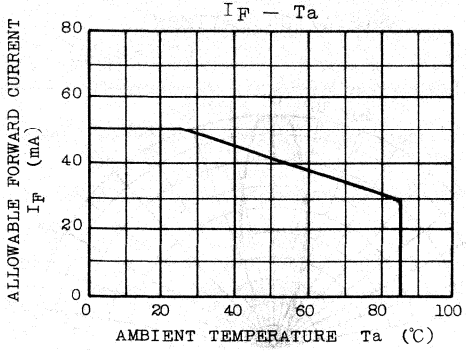
1. CATHODE
2. ANODE

PRECAUTION

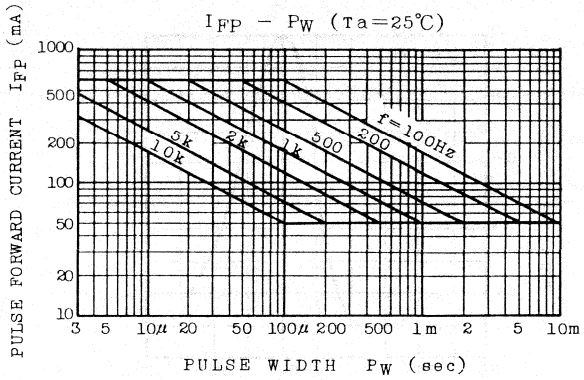
Please be careful of the followings.

1. Soldering temperature: 260°C MAX. Soldering time: 5 sec MAX.
   (Soldering portion of lead: up to 2mm from the body of the device)
2. If the lead is formed, the lead should be formed at a distance of 2mm from the body of the device. Soldering shall be performed after lead forming.
3. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   ∘ Freon TE or TF ∘ Dai-Fron Solvents S3 or S3-E

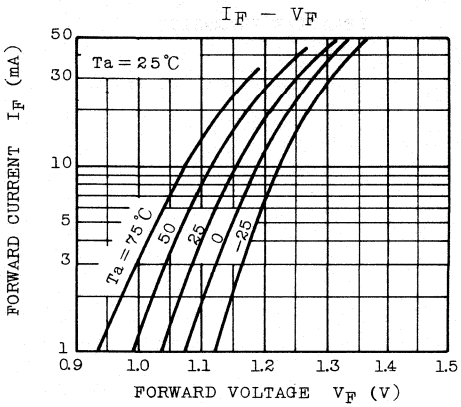
I_F — Ta



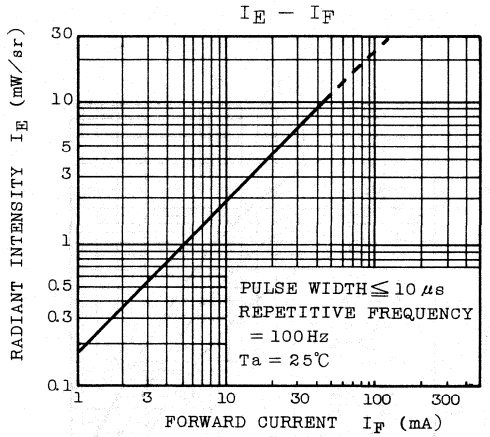
I_{FP} — P_W (Ta=25℃)



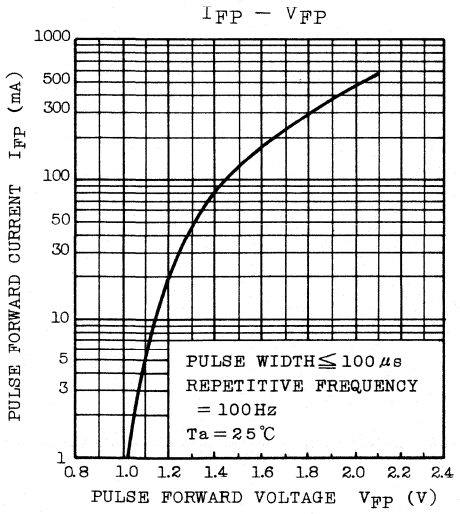
I_F — V_F



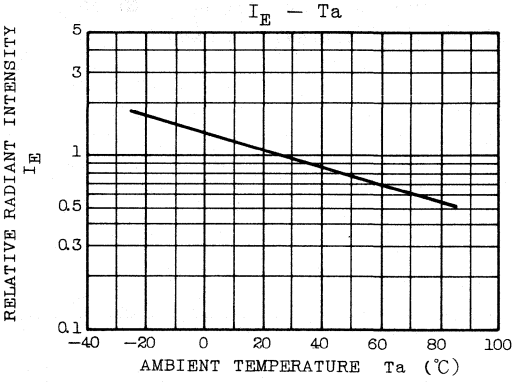
I_E — I_F



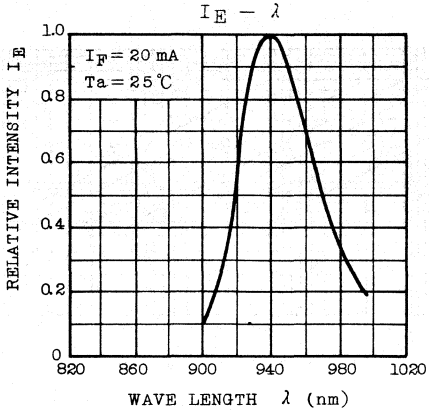
I_{FP} — V_{FP}



I_E — Ta

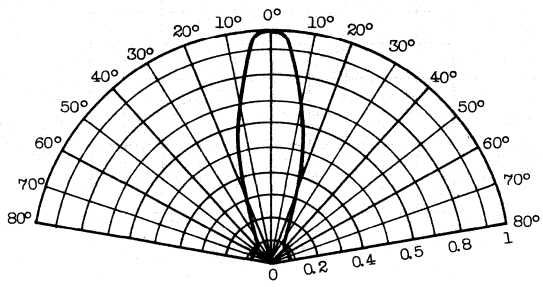


$I_E - \lambda$

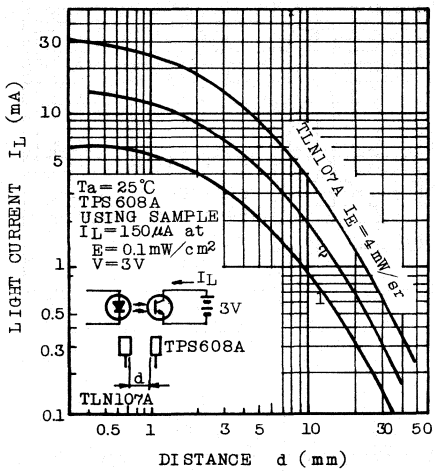


RADIATION PATTERN

(Ta = 25°C)



$I_L - d$



INFRARED LED
GaAs INFRARED EMITTER

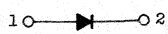
TLN108

TENTATIVE

INFRARED LED FOR PHOTO SENSOR.

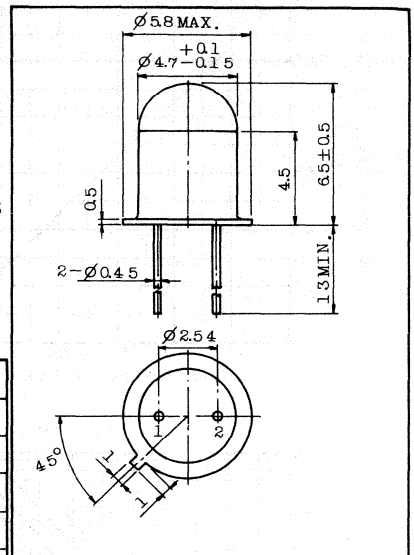
- OPTICAL SWITCH
- TAPE, CARD READER
- AUTOMOBILE POSITION SENSOR
- PHOTO ISOLATOR

PIN CONNECTION



1. ANODE
2. CATHODE

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	4 — 5Q1A

- Output Spectrally Compatible with Silicon Sensor TPS708
- High Radiant Intensity : I_E=20mW/sr(Typ.)
- High Radiant Power
- Glass-to-Metal-Seal Header

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current	I_F	100	mA
Pulse Forward Current (Note)	I_{FP}	1	A
Reverse Voltage	V_R	5	V
Operating Temperature Range	T_{opr}	-40 ~ 125	°C
Storage Temperature Range	T_{stg}	-55 ~ 150	°C

Note : Pulse Width ≦100μs, Repetitive frequency=100Hz

OPTO-ELECTRICAL CHARACTERISTICS (Ta=25°C)

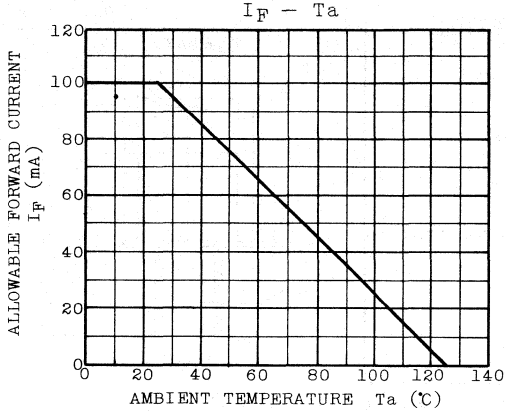
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=50mA	-	1.3	1.4	V
Pulse Forward Voltage	V_{FP}	I_{FP}=1A	-	2.4	-	V
Reverse Current	I_R	V_R=5V	-	-	10	μA
Radiant Intensity	I_E	I_F=50mA	10	20	-	mW/sr
Radiant Power	P_O	I_F=50mA	-	3	-	mW
Capacitance	C_T	V_R=0, f=1MHz	-	30	-	pF
Peak Emission Wave Length	λ_p	I_F=50mA	-	940	-	nm
Spectral Line Half Width	$\Delta\lambda$	I_F=50mA	-	50	-	nm

PRECAUTION

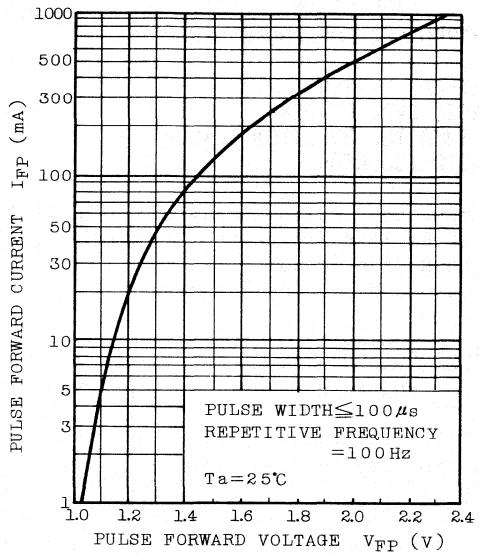
Please be careful of the followings.

1. Soldering temperature: 260°C MAX. Soldering time: 5 sec MAX.
   (Soldering portion of lead: up to 1.5mm from the body of the device).
2. If the lead is formed, the lead should be formed at a distance of 2mm from the body
   Soldering shall be performed after lead forming.
3. Avoid using the Solvents except for the follows, when washing off flux and wiping
   off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   o Freon TE or TF o Dai-Fron Solvent S3-E

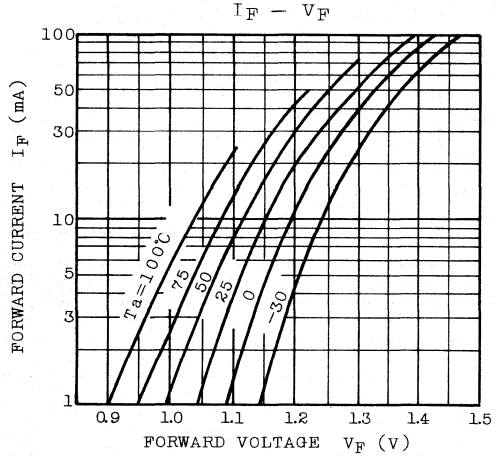
I_F – Ta



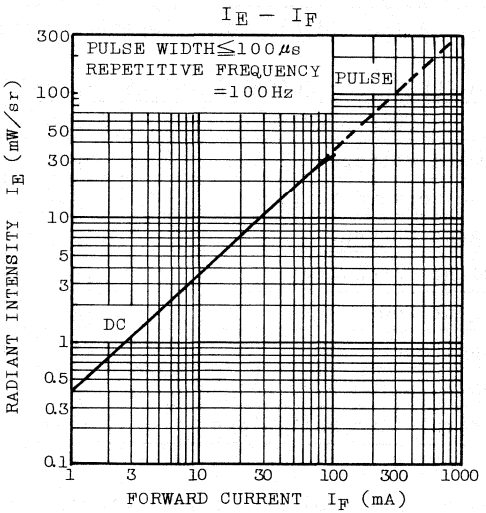
I_{FP} – V_{FP}



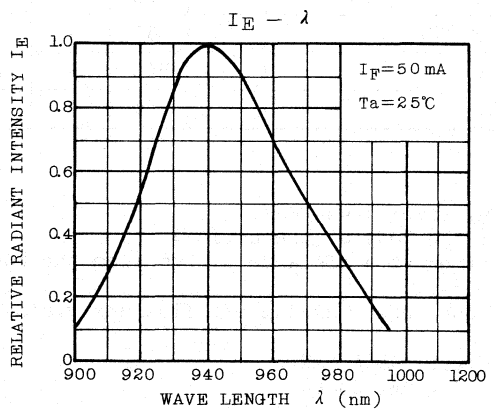
I_F – V_F



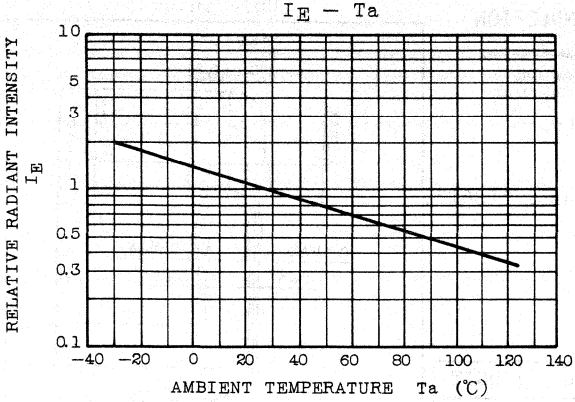
I_E – I_F



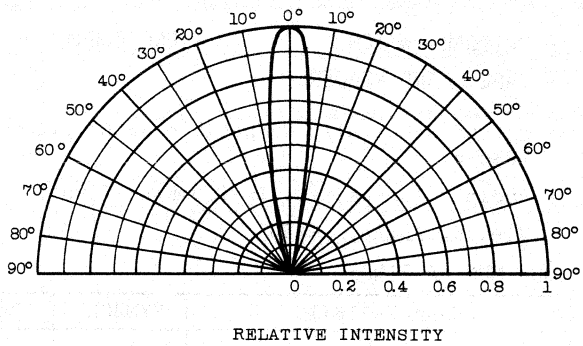
I_E – λ



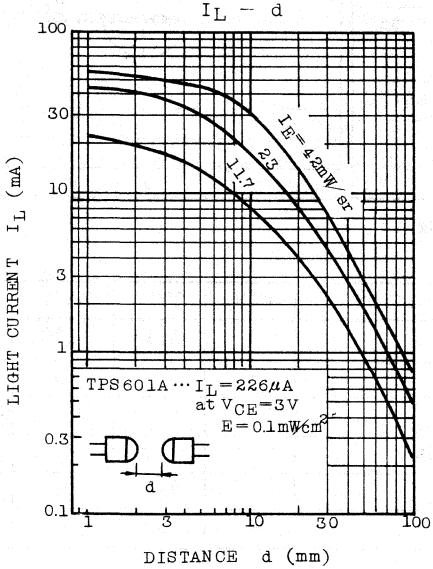
I_E – Ta



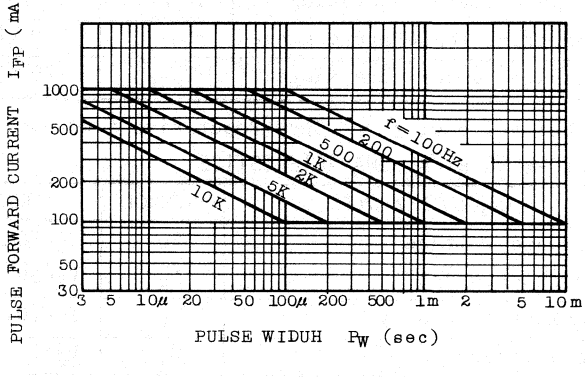
RADIATION PATTERN (Ta = 25℃)



I_L – d



I_{FP} – P_W (Ta=25℃)

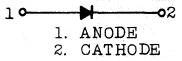


TLN109

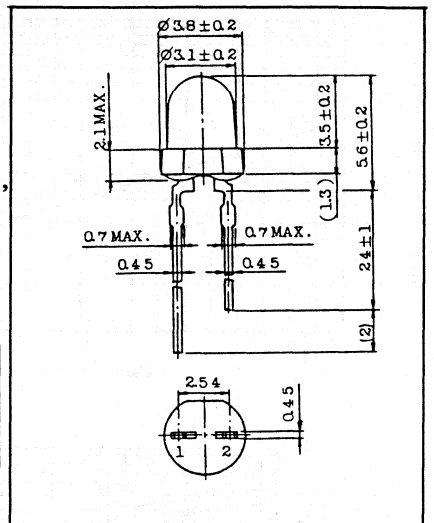
INFRARED LED
GaAs INFRARED EMITTER

TENTATIVE DATA

PIN CONNECTION



Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	4-4E1A

○ INFRARED LED FOR PHOTO SENSOR

- OPTICAL SWITCH
- ENCORDERS
- TAPE, CARD READERS

- Output Spectrally Compatible with Silicon Sensor TPS615, TPS616
- Radiant Intensity : I_E=1.5mW/sr (Typ.)
- Viewing Angle: θ=56°

MUXIMUM RA TINGS

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current	I_F	50	mA
Pulse Forward Current (Note 1)	I_{FP}	500	mA
Reverse Voltage	V_R	5	V
Forward Current Derating	ΔI_F/°C	-0.67	mA/°C
Operating Temperature Range	T_{opr}	-20 ∿ 85	°C
Storage Temperature Range	T_{stg}	-20 ∿ 100	°C

Note: Pulse width ≦ 100μs, Repetitive frequency=100Hz

OPTO-ELECTRICAL CHARACTERISTICS

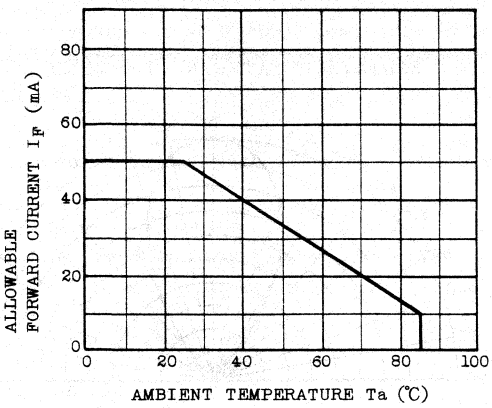
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=10mA	-	1.15	1.30	V
Reverse Current	I_R	V_R=5V	-	-	10	μA
Radiant Intensity	I_E	I_F=10mA	0.5	1.5	-	mW/sr
Capacitance	C_T	V_R=0, f=1MHz	-	20	-	pF
Peak Emission Wave Length	λP	I_F=10mA	-	940	-	nm
Spectral Line Half Width	Δλ	I_F=10mA	-	50	-	nm

PRECAUTION

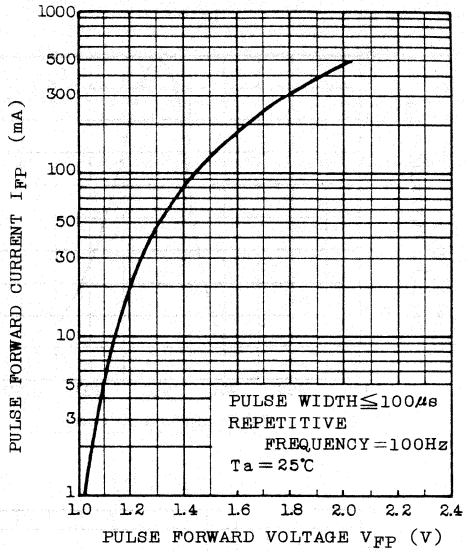
Please be careful of the followings.

1. Soldering temperature: 260°C MAX.
   Soldering time: 3 sec MAX.
   (Soldering portion of lead: up to 2mm from the body of the device)
2. If the lead is formed, the lead should be formed at a distance of 5mm from the body of the device.
   Soldering shall be performed after lead forming
3. Avoid using the Solvents except for the follows, when washing off flux and wiping off station on the device.
   Washing time: 30 sec MAX. Solvent temperature: 45°C MAX.
   ∘ Freon TE or TF ∘ Dai-fron Solvents S3 or S3-E

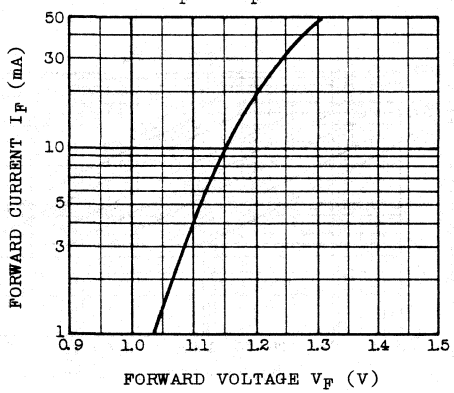
I_F – Ta



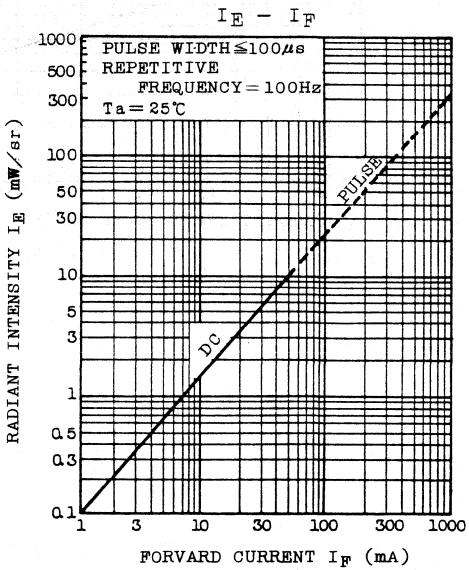
I_{FP} – V_{FP}



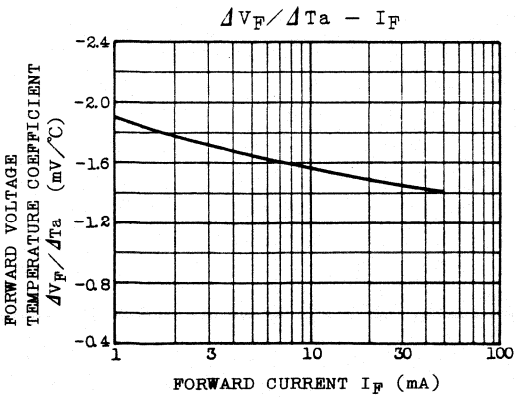
I_F – V_F



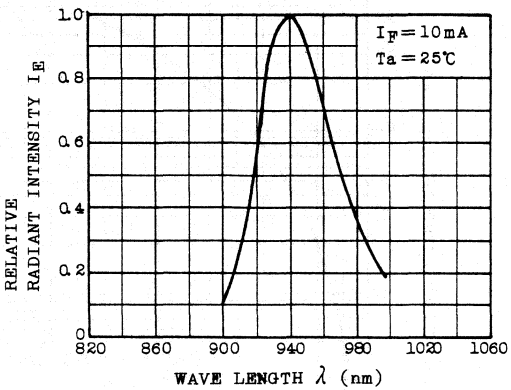
I_E – I_F



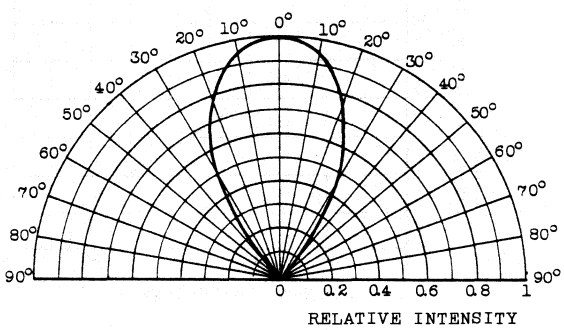
$\Delta V_F/\Delta Ta$ – I_F



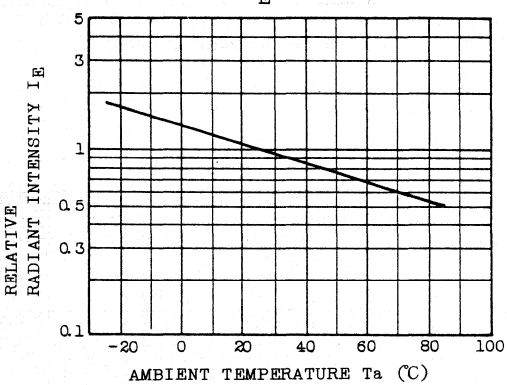
$I_E - \lambda$



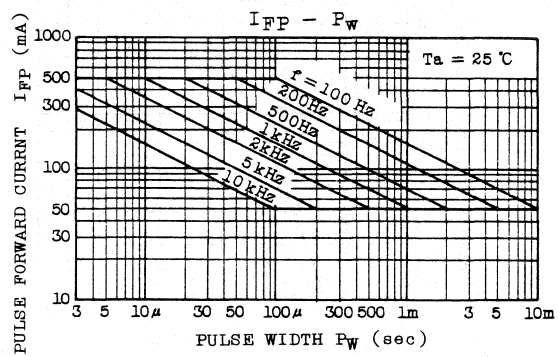
RADIATION PATTERN (Ta=25℃)



$I_E - Ta$



$I_{FP} - P_W$



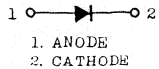
INFRARED LED
GaAs INFRARED EMITTER

TLN110

INFRARED LED FOR PHOTO SENSOR

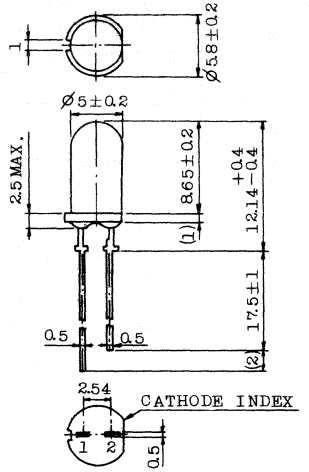
. REMOTE CONTROL SYSTEM
. OPTICAL SWITCH

PIN CONNECTION



- Output Spectrally Compatible with Silicon Sensor TPS703, TPS703A, TPS704, TPS705, TPS706
- High Radiant Power
- High Radiant Intensity: I_E=30mW/sr

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	4−6C1A

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current	I_F	100	mA
Pulse Forward Current (Note 1)	I_{FP}	1	A
Reverse Voltage	V_R	5	V
Diode Power Dissipation	P_D	150	mW
Operating Temperature Range	T_{opr}	−20 ~ 75	°C
Storage Temperature Range	T_{stg}	−30 ~ 100	°C

Note 1: Pulse Width ≦100μs, Repetitive frequency=100Hz

OPTO-ELECTRICAL CHARACTERISTICS (Ta=25°C)

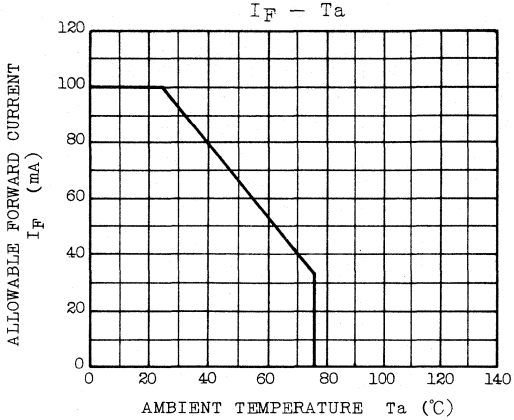
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=100mA	−	1.35	1.5	V
Reverse Current	I_R	V_R=5V	−	−	10	μA
Radiant Intensity	I_E	I_F=50mA	15	30	−	mW/sr
Radiant Power	P_O	I_F=50mA	−	9	−	mW
Capacitance	C_T	V_R=0, f=1MHz	−	20	−	pF
Peak Emission Wave Length	λ_p	I_F=50mA	−	940	−	nm
Spectral Line Half Width	$\Delta\lambda$	I_F=50mA	−	45	−	nm

PRECAUTION

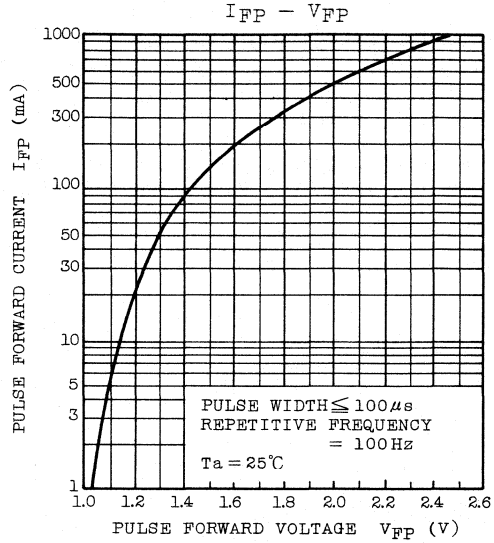
Please be careful of the followings.

1. Soldering temperature: 260°C MAX. Soldering time: 5 sec MAX.
   (Soldering portion of lead: at below the lead stopper.)
2. If the lead is formed, the lead should be formed at below the lead stopper.
   Soldering shall be performed after lead forming.
3. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the deivce.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   o Freon TE or TF o Dai-Fron Solvent S3-E or S3

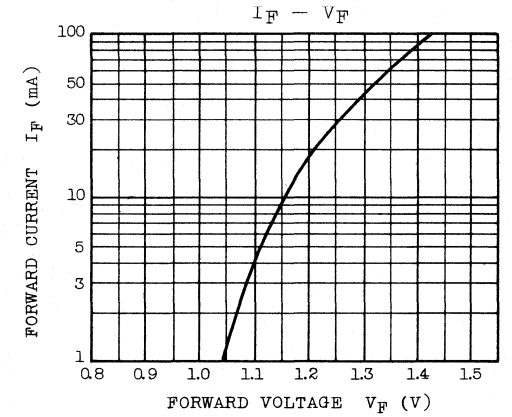
I_F — Ta



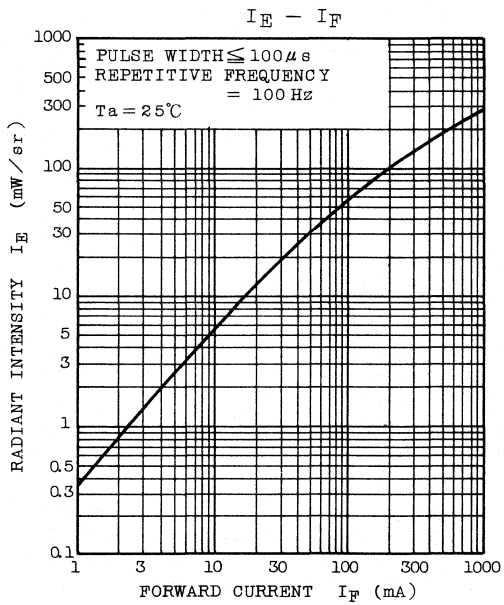
I_{FP} — V_{FP}



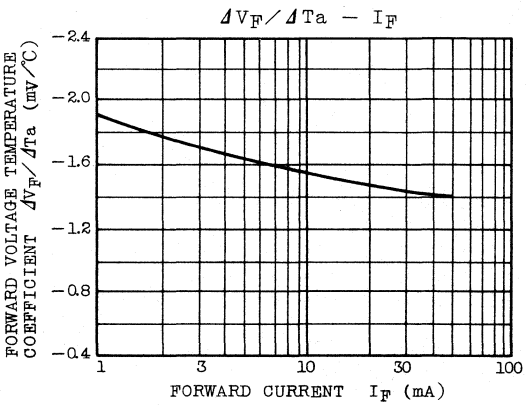
I_F — V_F



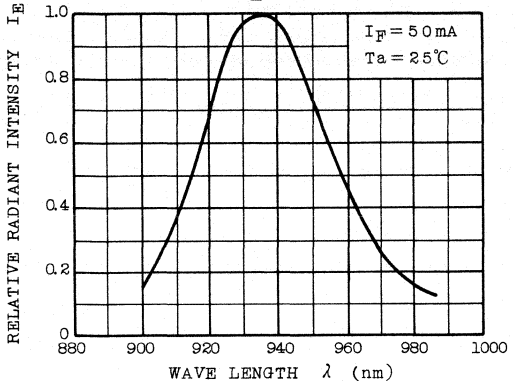
I_E — I_F



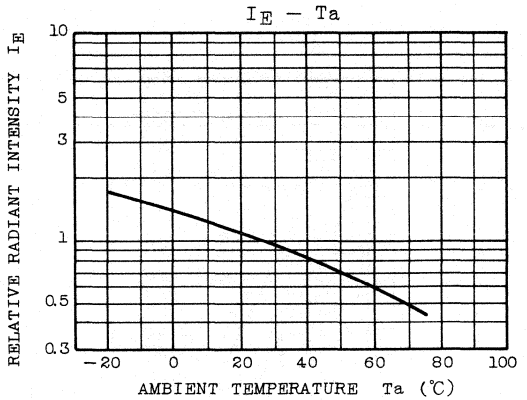
$\Delta V_F / \Delta Ta$ — I_F



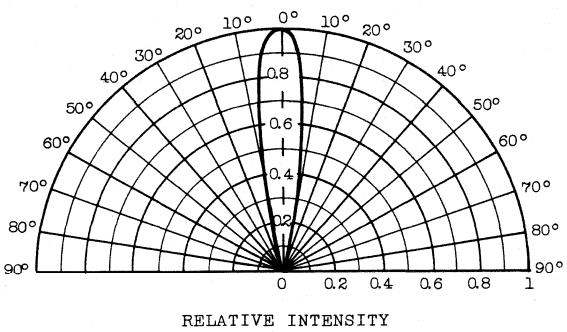
$I_E - \lambda$



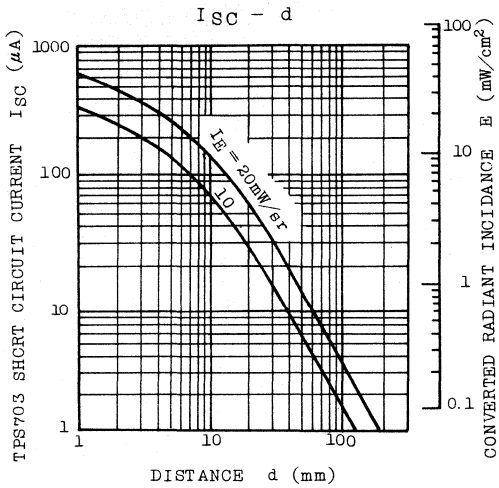
I_E – Ta



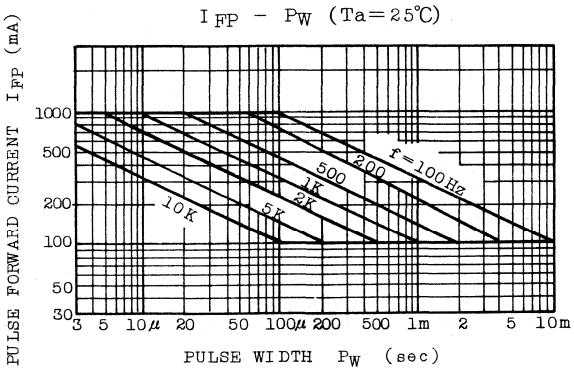
RADIATION PATTERN (Ta = 25℃)

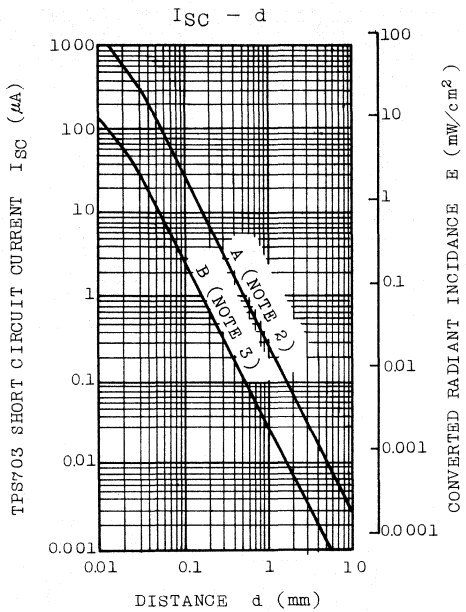


I_{SC} – d



I_{FP} – P_W (Ta = 25℃)





Note 2 : I_{EP} = 200mW/sr at I_{FP} ~ 200mA. f = 100Hz, P_W = 100μs

Note 3 : I_E = 20mW/sr at I_F ~ 33mA

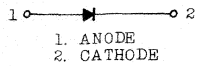
INFRARED LED
GaAs INFRARED EMITTER

TLN111

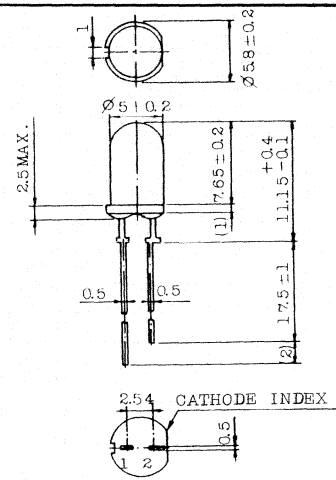
INFRARED LED FOR PHOTO SENSOR

- REMOTE CONTROL SYSTEM
- OPTICAL SWITCH

PIN CONNECTION



- High Radiant Intensity: I_{EP} = 60mW/sr (MIN.)
- High Radiant Power
- Output Spectrally Compatible with Silicon Sensor TPS703, TPS703A, TPS704, TPS705, TPS706



JEDEC	—
EIAJ	—
TOSHIBA	4-6B1A

MAXIMUM RATINGS (Ta=25°C)

CHA RACTERISTIC	SYMBOL	RATING	UNIT
Forward Current	I_F	100	mA
Pulse Forward Current (NOTE)	I_{FP}	1	A
Reverse Voltage	V_R	5	V
Power Dissipation	P_D	150	mW
Operating Temperature Range	T_{opr}	-20 ∿ 75	°C
Storage Temperature Range	T_{stg}	-30 ∿ 100	°C

(NOTE) Pulse Width 100μs, Repetitive frequency=100Hz.

OPTO-ELECTRICAL CHARACTERISTICS (Ta=25°C)

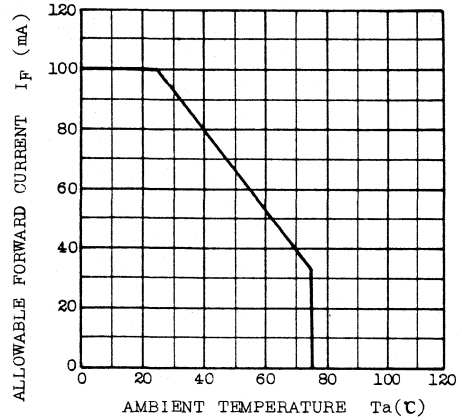
CHARACTERISTIC	SYMBOL	TEST CURRENT	MIN.	TYP.	MAX	UNIT
Forward Voltage	V_F	I_F=100mA	-	1.35	-	V
Reverse Current	I_R	V_R=5V	-	-	10	μA
Radiant Intensity	I_E	I_F=50mA	-	24	-	mW/sr
Radiant Power	P_o	I_F = 50mA	-	10	-	mW
Capacitance	C_T	V_R=0, f=1MHz	-	20	-	pF
Peak Emmision Wave Length	λP	I_F=50mA	-	940	-	nm
Spectral Line Half Width	Δλ	I_F=50mA	-	50	-	nm
Pulse forward Voltage	V_{FP}	I_{FP}=300mA, T=10ms	-	1.65	2.0	V
Pulse Radiant Intensity	I_{EP}	I_{FP}=300mA, T=10ms	60	-	-	mW/sr
Em ission Angle at Half Power Points	θ	I_F=50mA	30	38	-	°

PRECAUTIO N

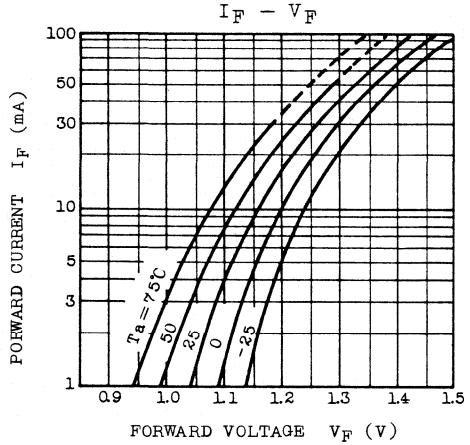
Please be care ful of the followings

1. Soldering temperature: 260°C MAX. Soldering time: 3 sec MAX.
   (Soldering portion of lead: up to 2mm form the body of the device)
2. If the lead is formed, the lead should be formed at adistance of 2mm form the body of the device. Soldering shall be performed after lead forming.
3. Avoid using the Solvent except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   ° Freon TE or TF ° Dai-Fron Solvent S3 or S3-E

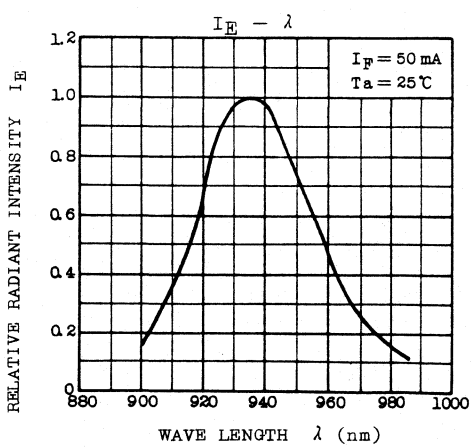
$I_F - Ta$



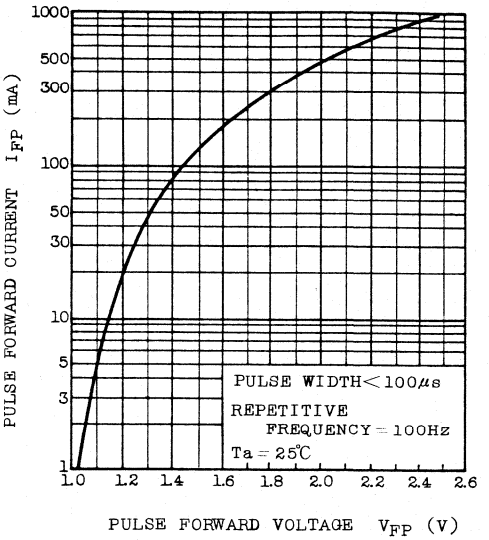
$I_F - V_F$



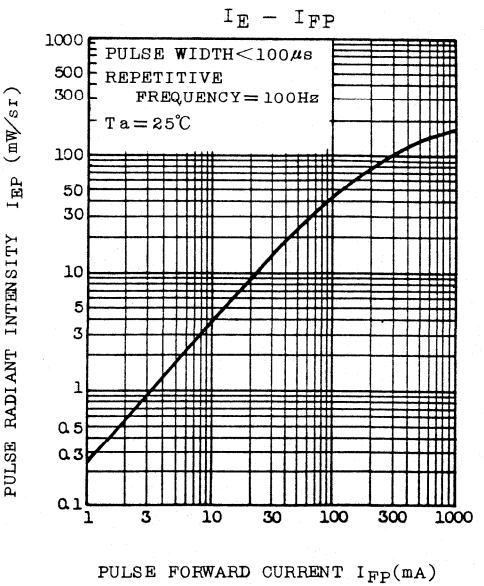
$I_E - \lambda$



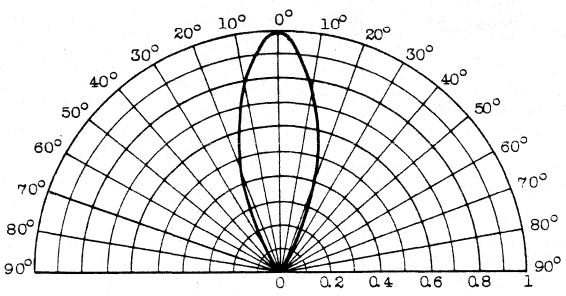
$I_{FP} - V_{FP}$



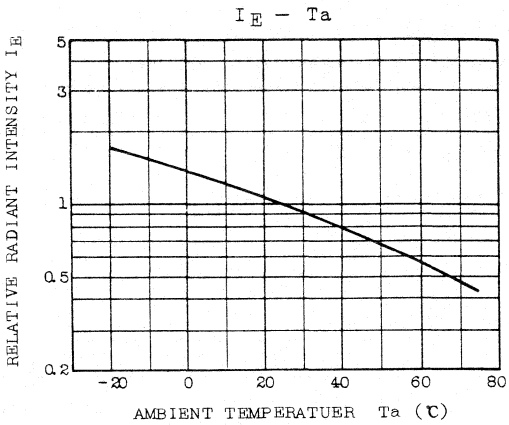
$I_E - I_{FP}$



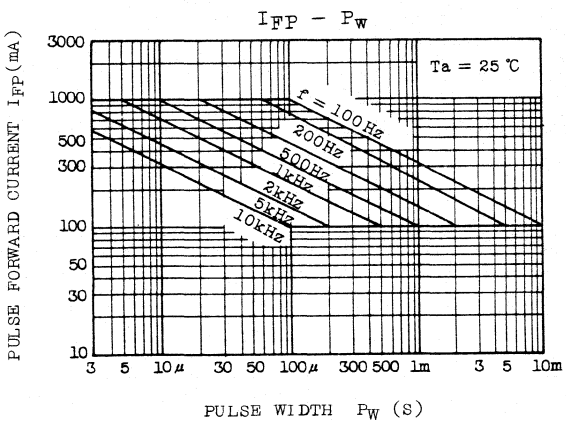
RADIATION PATTERN (Ta = 25℃)



I_E – Ta



I_{FP} – P_W



TLN113

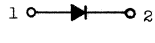
INFRARED LED
GaAs INFRARED EMITTER

TENTATIVE DATA

INFRARED LED FOR PHOTO SENSOR

- OPTICAL SWITCH
- ENCORDERS
- TAPE, CARD READERS

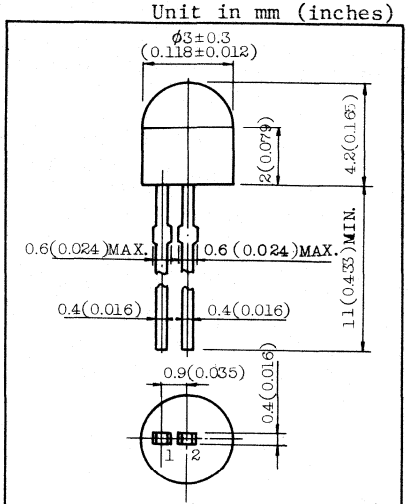
PIN CONNECTION



1. ANODE
2. CATHODE

- Output Spectrally Compatible with Silicon Sensor TPS613
- High Radiant Power: P_O=2.5mW (Typ.)
- Wide Viewing Angle

Unit in mm (inches)



JEDEC	–
EIAJ	–
TOSHIBA	4-3G1A

Weight : 0.08g

MAXIMUM RATINGS

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current	I_F	40	mA
Pulse Forward Current(Note 1)	I_{FP}	400	mA
Reverse Voltage	V_R	5	V
Forward Current Derating	$\Delta I_F/°C$	-0.53	mA/°C
Operating Temperature Range	T_{opr}	-20 ∿ 75	°C
Storage Temperature Range	T_{stg}	-30 ∿ 100	°C

Note 1: Pulse width ≦100μs, Repetitive frequency=100Hz

OPTO-ELECTRICAL CHARACTERISTICS

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=10mA	-	1.15	1.30	V
Reverse Current	I_R	V_R=5V	-	-	10	μA
Radiant Power	P_O	I_F=20mA	-	2.5	-	mW
Radiant Intensity	I_E(Note 2)	I_F=20mA	0.8	2		mW/sr
Capacitance	C_T	V_R=0, f=1MHz	-	30	-	pF
Peak Emission Wave Length	λP	I_F=20mA	-	940	-	nm
Spectral Line Half Width	Δλ	I_F=20mA	-	50	-	nm

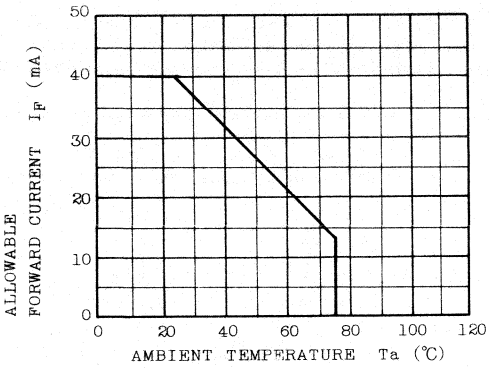
Note 2: I_E Classification AB:0.8∿3.0, BC:1.25∿4.8, A:0.8∿2.0, B:1.25∿3.0, C:2.0∿4.8

PRECAUTION

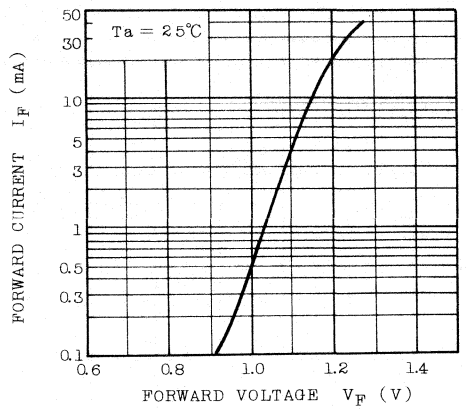
Please be careful of the followings.

1. Soldering temperature: 260°C MAX.
   Soldering time: 3 sec MAX.
   (Soldering portion of lead: up to 2mm from the body of the device)
2. If the lead is formed, the lead should be formed at a distance of 2mm from the body of the device.
   Soldering shall be performed after lead forming.
3. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   o Freon TE or TF o Dai-Fron Solvents S3 or S3-E

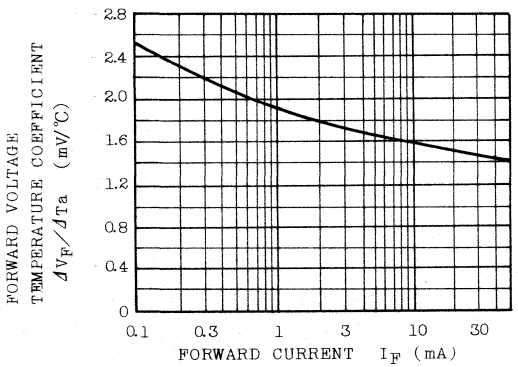
I_F – Ta



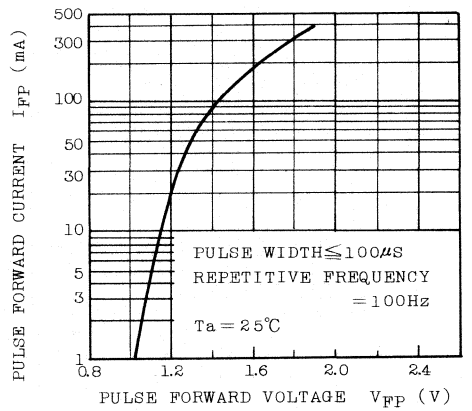
I_F – V_F



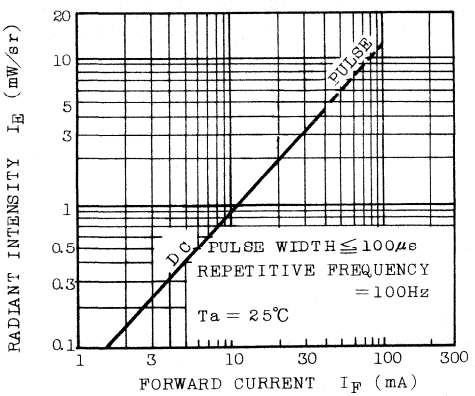
$\Delta V_F/\Delta Ta$ – I_F



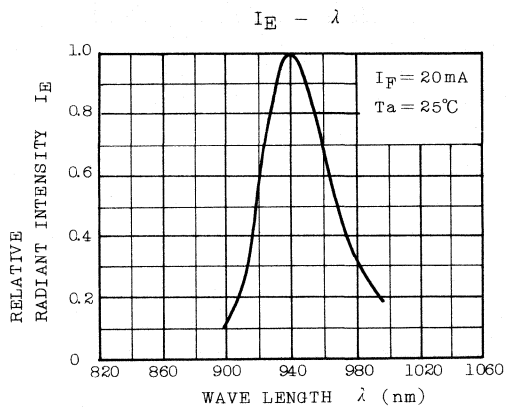
I_{FP} – V_{FP}



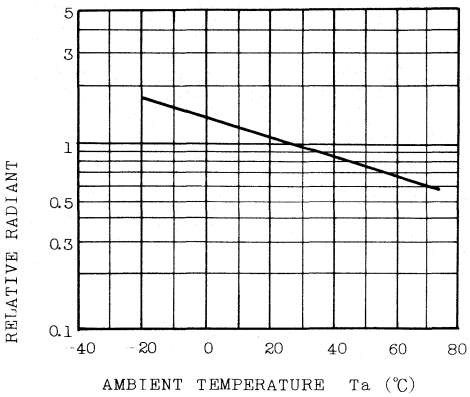
I_E – I_F



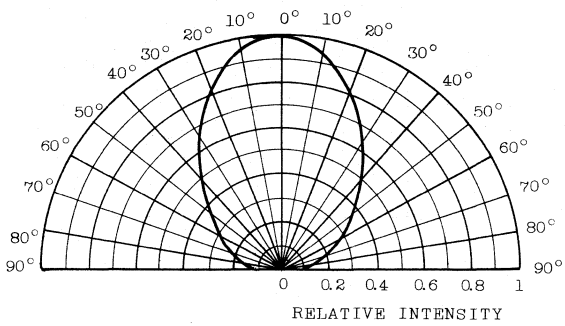
I_E – λ



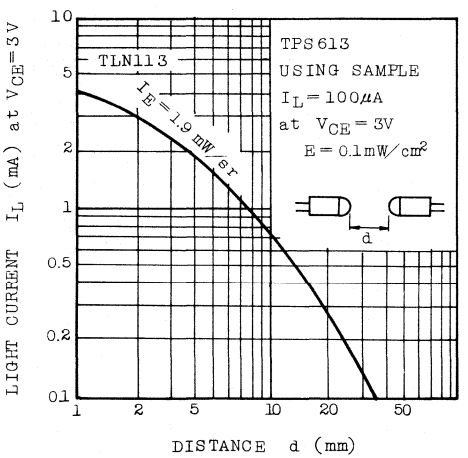
– Ta



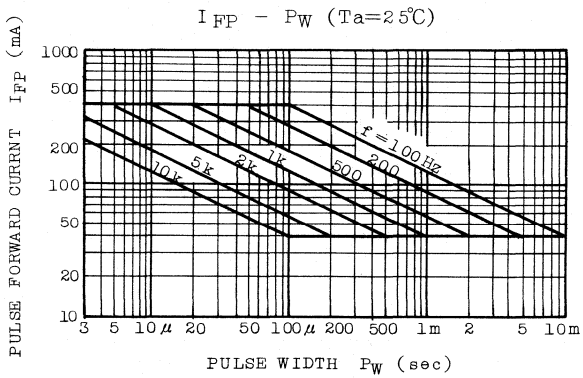
RADIATION PATTERN (Ta = 25℃)



I_L – d



I_{FP} – P_W (Ta=25℃)



INFRARED LED
GaAs INFRARED EMITTER

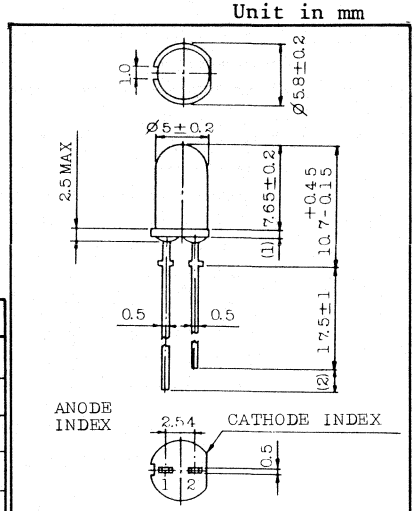
TLN115

INFRARED LED FOR PHOTO SENSOR

- o REMOTE CONTROL FOR PHOTO SENSOR
- o OPTICAL SWITCH

- Output Spectrally Compatible with Silicon Sensor TPS703, TPS703A, TPS704, TPS705, TPS706
- High Radiant Intensity: I_E=26mW/sr (Typ.)
- Suitable Emission Angle for Remote Control: θ=42°(Typ)

Unit in mm



JEDEC	–
EIAJ	–
TOSHIBA	–

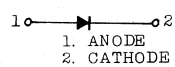
Weight : 0.30g

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current	I_F	100	mA
Pulse Forward Current (Note)	I_{FP}	1	A
Reverse Voltage	V_R	5	V
Forward Current Derating	ΔI_F/°C	-1.34	mA/°C
Operating Temperature Range	T_{opr}	-20 ∿ 75	°C
Storage Temperature Range	Tstg	-30 ∿ 100	°C

Note : Pulse Width ≦100μs, Repetitive frequency=100Hz.

PIN CONNECTION



1. ANODE
2. CATHODE

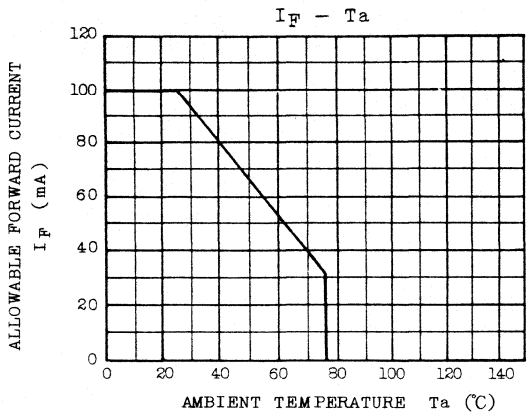
OPTO-ELEC TRICAL CHARACTERISTICS (Ta=25°C)

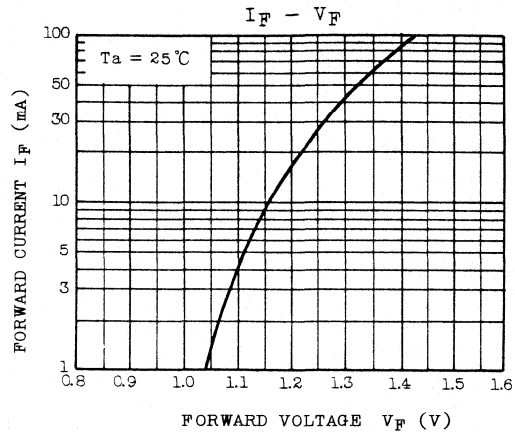
CHARACTERISTIC	SYMBOL	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=100mA		–	1.35	1.5	V
Pulse Forward Voltage	V_{FP}	I_{FP}=500mA, T=10ms		–	1.75	–	V
Reverse Current	I_R	V_R=5V		–	–	10	μA
Radiant Intensity	I_E	I_F=50mA	TLN115	15	–	–	mW/sr
			TLN115-B	19	–	–	
Radiant Power	P_o	I_F=50mA		–	13	–	nW
Capacitance	C_T	V_R=0, f=1MHz		–	20	–	pF
Peak Emission Wave Length	λp	I_F=50mA		–	950	–	nm
Spectral Line Half Width	Δλ	I_F=50mA		–	50	–	nm
Emission Angle at Half Power Points	θ	I_F=50mA		–	42	–	°

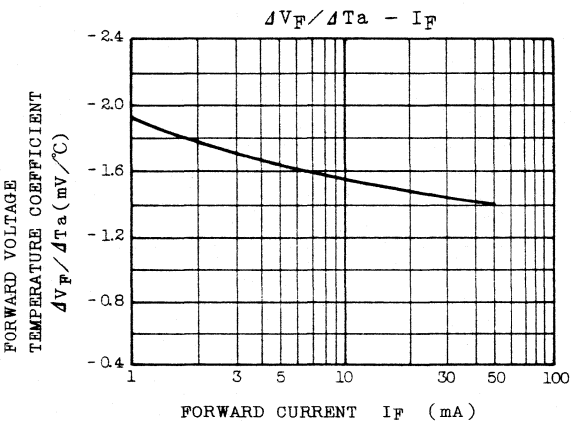
PRECAUTION

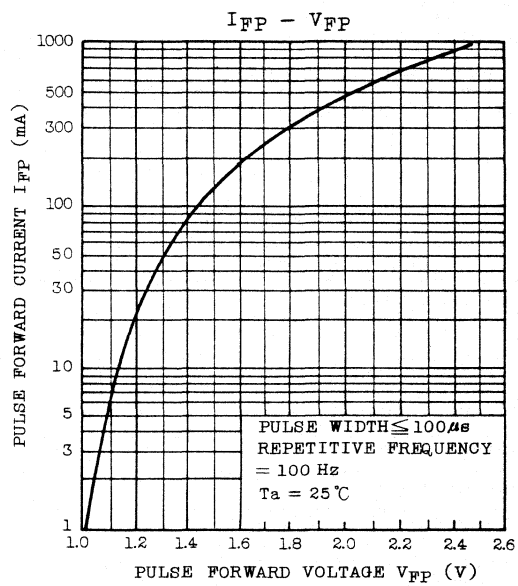
Please be careful of the followings.

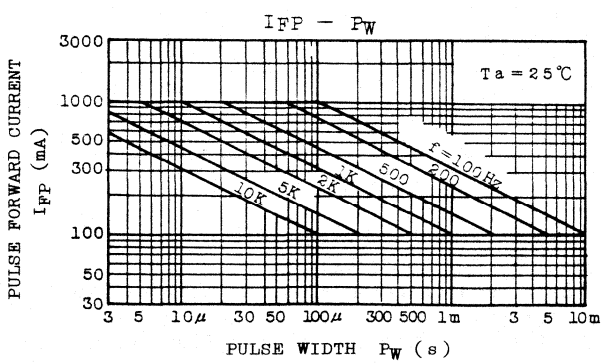
1. Soldering temperature: 260°C MAX. Soldering time: 5 sec MAX.
   (Soldering portion of lead: at below from the CATHOD INDEX)
2. If the lead is formed, the lead should be formed at below from the CATHODE INDEX.
   Soldering shall be performed after lead forming.
3. A void using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   ° Freon TE ° Dai-Fron Solvent S3-E or S3


I_F – Ta
ALLOWABLE FORWARD CURRENT I_F (mA)
120
100
80
60
40
20
0
0 20 40 60 80 100 120 140
AMBIENT TEMPERATURE Ta (℃)

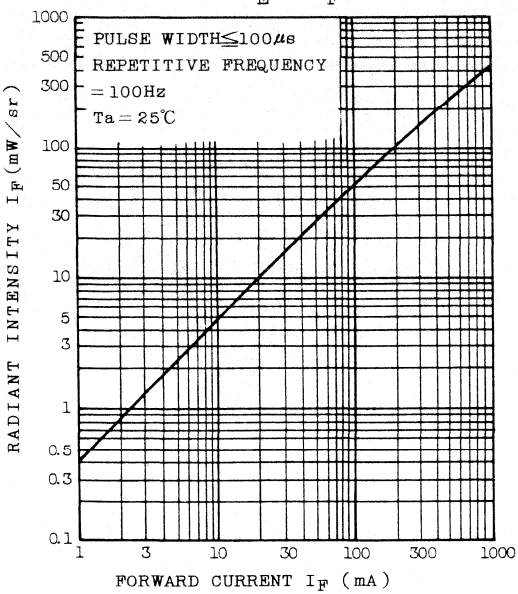

I_F – V_F
Ta = 25℃
FORWARD CURRENT I_F (mA)
100
50
30
10
5
3
1
0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6
FORWARD VOLTAGE V_F (V)


$\Delta V_F/\Delta Ta$ – I_F
FORWARD VOLTAGE TEMPERATURE COEFFICIENT $\Delta V_F/\Delta Ta$ (mV/℃)
-2.4
-2.0
-1.6
-1.2
-0.8
-0.4
1 3 5 10 30 50 100
FORWARD CURRENT I_F (mA)

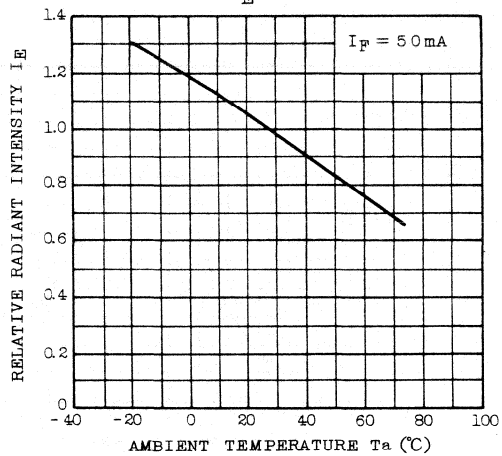

I_{FP} – V_{FP}
PULSE FORWARD CURRENT I_{FP} (mA)
1000
500
300
100
50
30
10
5
3
1
PULSE WIDTH≦100μs
REPETITIVE FREQUENCY
= 100 Hz
Ta = 25℃
1.0 1.2 1.4 1.6 1.8 2.0 2.2 2.4 2.6
PULSE FORWARD VOLTAGE V_{FP} (V)


I_{FP} – P_W
PULSE FORWARD CURRENT I_{FP} (mA)
3000
1000
500
300
100
50
30
Ta = 25℃
f = 100 Hz
200
500
2K
5K
10K
3 5 10μ 30 50 100μ 300 500 1m 3 5 10m
PULSE WIDTH P_W (s)

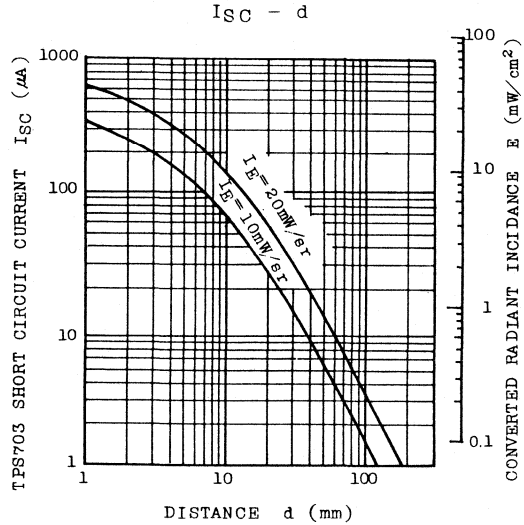
$I_E - I_F$



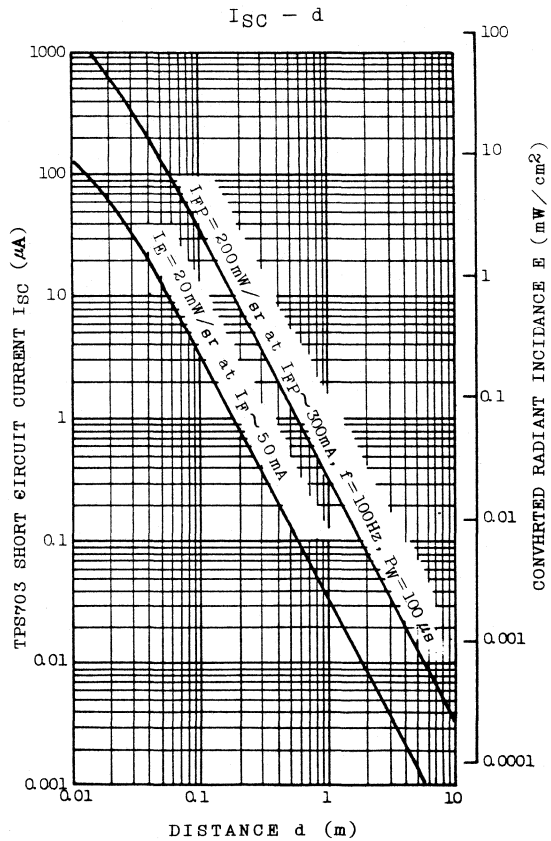
$I_E - Ta$



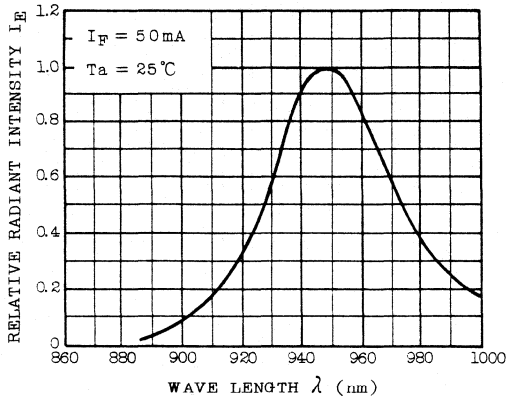
$I_{SC} - d$



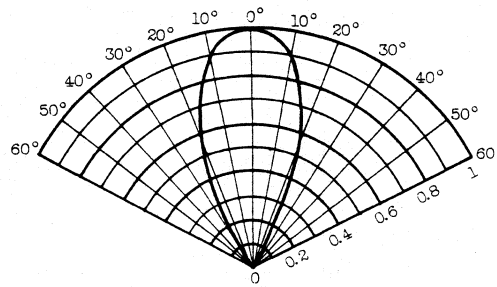
$I_{SC} - d$



$I_E - \lambda$



RADIATION PATTERN (Ta=25℃)



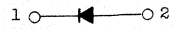
INFRARED LED
GaAlAs INFRARED EMITTER

TLN201

TENTATIVE

INFRARED LED FOR PHOTO SENSOR.

PIN CONNECTION

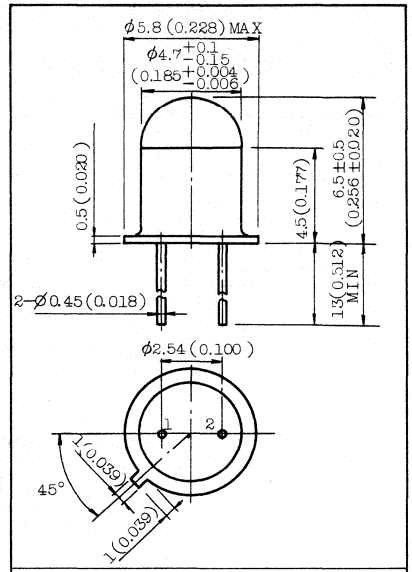


1. CATHODE
2. ANODE

- OPTICAL SWITCH
- TAPE, CARD READER
- AUTOMOBILE POSITION SENSOR
- PHOTO ISOLATOR

- Output Spectrally Compatible with Silicon Sensor TPS708
- High Radiant Intensity: I_E=35mW/sr (Typ.)
- High Radiant Power : P_O=5mW(Typ.)
- Glass-to-Metal-Seal Header

Unit in mm (inches)



JEDEC	-
EIAJ	-
TOSHIBA	4-5Q1B

MAXIMUM RATINGS

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current	I_F	100	mA
Pulse Forward Current (Note)	I_{FP}	1	A
Reverse Voltage	V_R	5	V
Operating Temperature Range	T_{opr}	-40 ~ 125	°C
Storage Temperature Range	T_{stg}	-55 ~ 150	°C

Note: Pulse Width ≦100μs, Repetitive frequency=100Hz

OPTO-ELECTRICAL CHARACTERISTICS

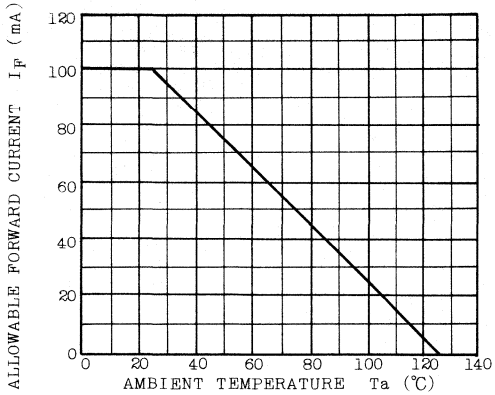
CHARACTERISTICS	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=50mA	-	1.5	1.9	V
Pulse Forward Voltage	V_{FP}	I_{FP}=1A	-	5.0	-	V
Reverse Current	I_R	V_R=5V	-	-	10	μA
Radiant Intensity	I_E	I_F=50mA	20	35	-	mW/sr
Radiant Power	P_O	I_F=50mA	-	5	-	mW
Capacitance	C_T	V_R=0, f=1MHz	-	17	-	pF
Peak Emission Wave Length	λ_P	I_F=50mA	-	880	-	nm
Spectral Line Half Width	$\Delta\lambda$	I_F=50mA	-	80	-	nm

PRECAUTION

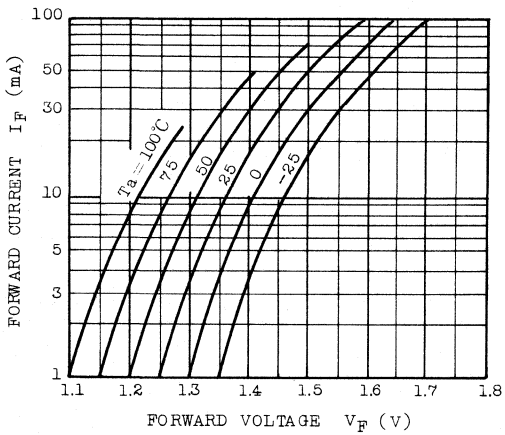
Please be careful of the followings.

1. Soldering temperature: 260°C MAX. Soldering time: 5 sec MAX.
   (Soldering portion of lead: up to 1.5mm from the body of the device).
2. If the lead is formed, the lead should be formed at a distance of 2mm from the body. Soldering shall be performed after lead forming.
3. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   o Freon TE or TF o Dai-Fron Solvent S3 or S3-E

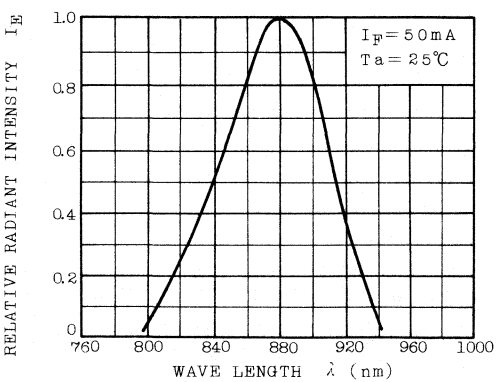
I_F – Ta



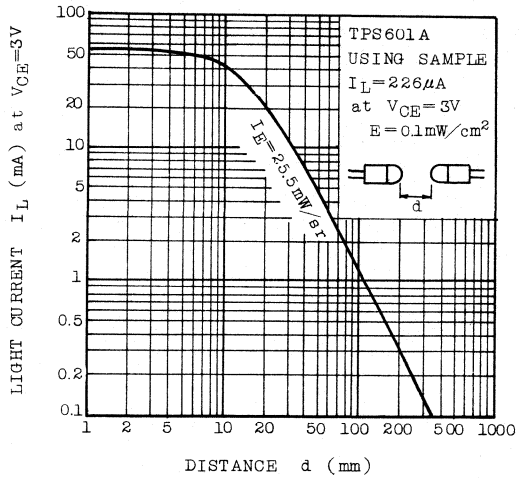
I_F – V_F



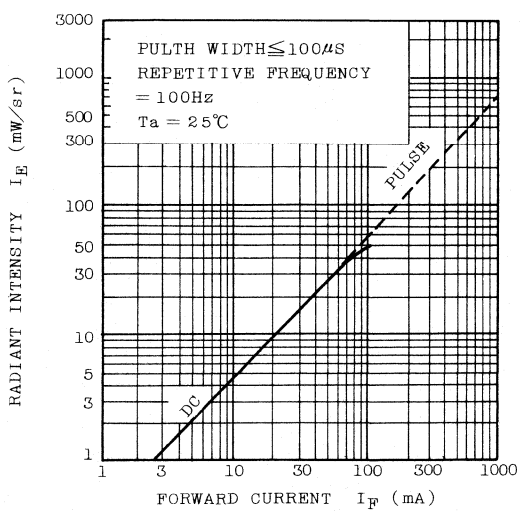
I_E – λ



I_L – d

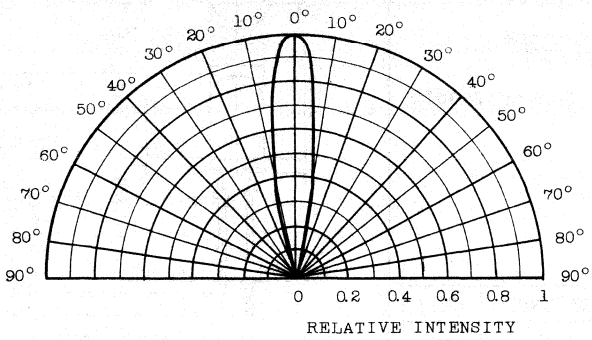


I_E – I_F

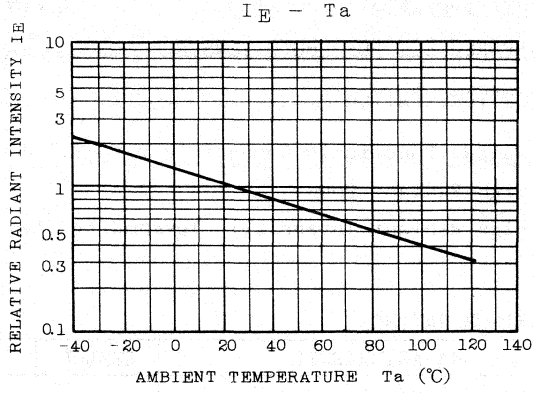


RADIATION PATTERN

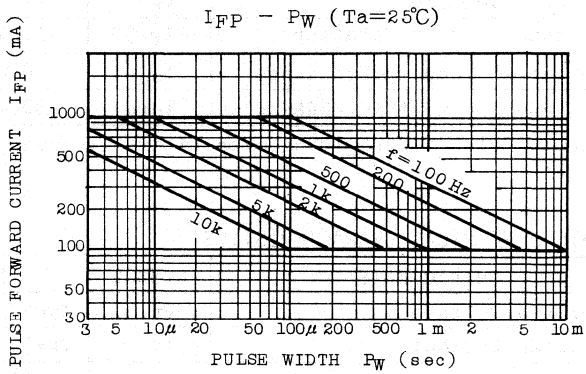
(Ta = 25℃)



I_E – Ta



I_{FP} – P_W (Ta=25℃)



TLN205

INFRARED LED
GaAlAs INFRARED EMITTER

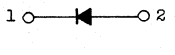
UNDER DEVELOPMENT

TENTATIVE DATA

INFRARED LED FOR PHOTO SENSOR

- OPTICAL SWITCH

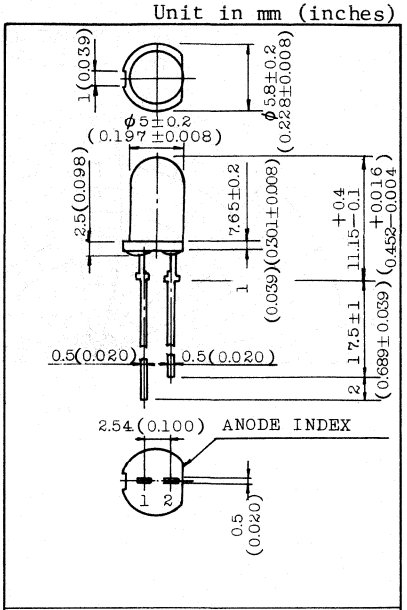
PIN CONNECTION



1. CATHODE
2. ANODE

- Output Spectrally Compatible with Silicon Sensor TPS610
- High Radiant Power
- High Radiant Intensity: I_E=40mW/sr (Typ.)

Unit in mm (inches)



JEDEC	—
EIAJ	—
TOSHIBA	4−6B1A

Weight: 0.30g

MAXIMUM RATINGS

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current	I_F	100	mA
Pulse Forward Current (Note)	I_{FP}	1	A
Reverse Voltage	V_R	5	V
Forward Current Derating	ΔI_F/°C	-1.34	mA/°C
Operating Temperature Range	T_{opr}	-20 ∿ 75	°C
Storage Temperature Range	T_{stg}	-30 ∿ 100	°C

Note: Pulse Width ≦100μs, Repetitive frequency=100Hz

OPTO-ELECTRICAL CHARACTERISTICS

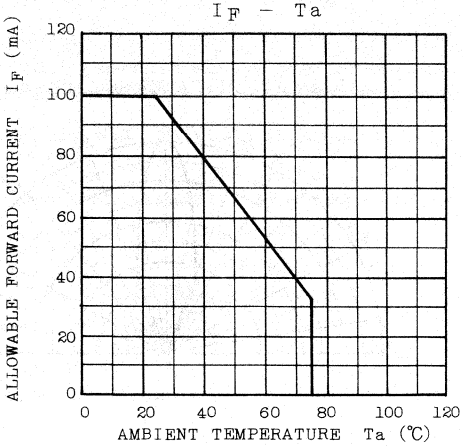
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=50mA	-	1.5	1.9	V
Reverse Current	I_R	V_R=5V	-	-	10	μA
Radiant Intensity	I_E	I_F=50mA	14	40	-	mW/sr
Radiant Power	P_O	I_F=50mA	-	10	-	mW
Capacitance	C_T	V_R=0, f=1MHz	-	17	-	pF
Peak Emission Wave Length	λP	I_F=50mA	-	880	-	nm
Spectral Line Half Width	Δλ	I_F=50mA	-	80	-	nm

PRECAUTION

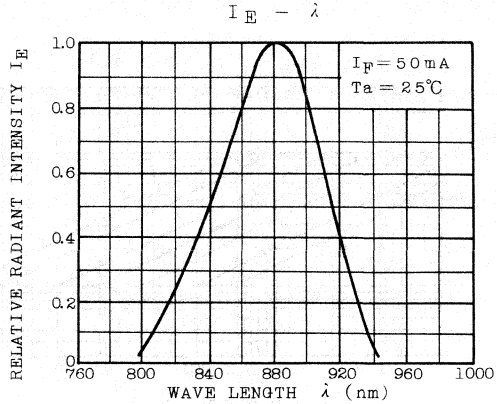
Please be careful of the followings.

1. Soldering temperature: 260°C MAX.
   Soldering time: 3 sec MAX.
   (Soldering portion of lead: at below the lead stopper.)
2. If the lead is formed, the lead should be formed at below the lead stopper.
   Soldering shall be performed after lead forming.
3. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   o Freon TE or TF o Dai-Fron Solvent S3-E or S3.

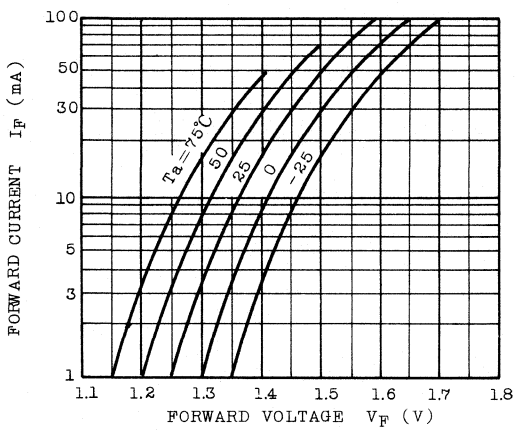
I_F – Ta



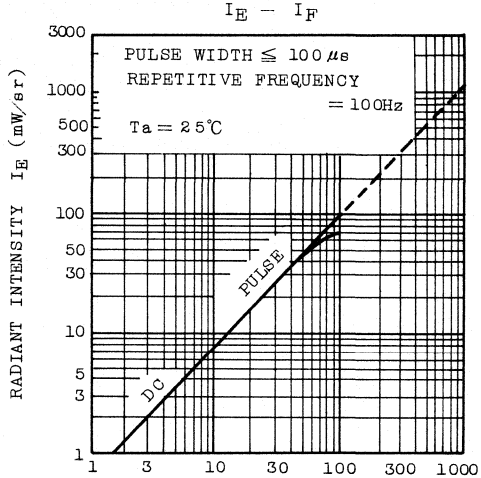
I_E – λ



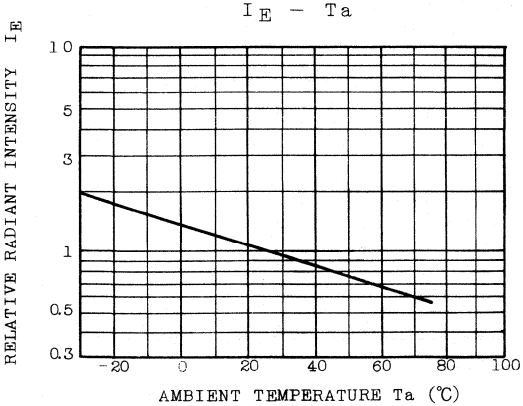
I_F – V_F

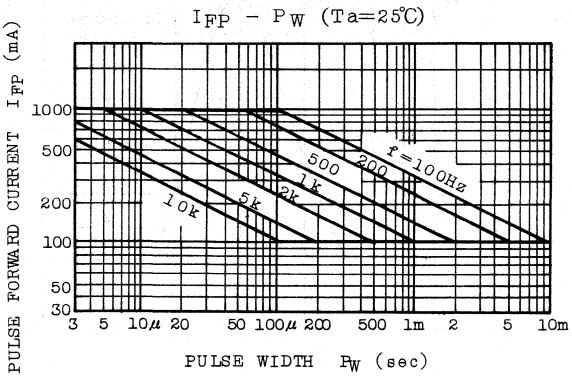


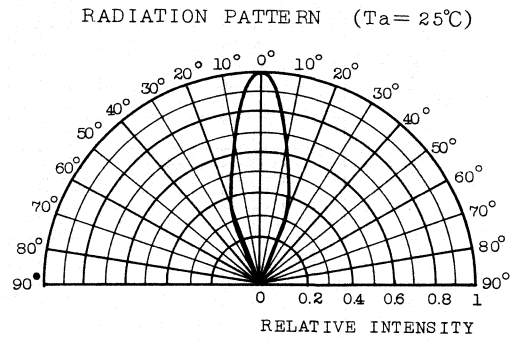
I_E – I_F



I_E – Ta




I_{FP} - P_W (Ta=25℃)
PULSE FORWARD CURRENT I_{FP} (mA)
1000
500
200
100
50
30
3 5 10μ 20 50 100μ 200 500 1m 2 5 10m
PULSE WIDTH P_W (sec)
f=100Hz
200
500
1k
2k
5k
10k


RADIATION PATTERN (Ta= 25℃)
0° 10° 20° 30° 40° 50° 60° 70° 80° 90°
0 0.2 0.4 0.6 0.8 1
RELATIVE INTENSITY

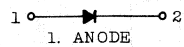
INFRARED LED
GaAs INFRARED EMITTER

TLN206

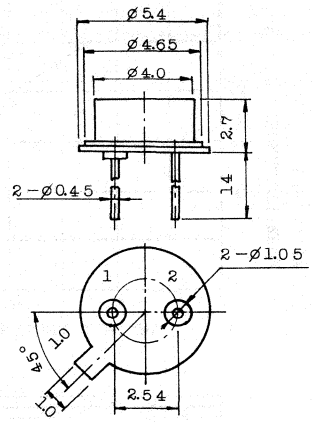
- LIGHT SOURCE OF AUTO FOCUS
- STILL-CAMERA

  - Radiant Diameter is 250μm (Typ.)
  - Radiant Power is suitable for Solid Angle 0.665 sr (θ=±26.6°)
  - Pulse Forward Voltage is fittable of 2 Electric Battery, V_{CC}=3V.
  - At Controlling of Constant Voltage, Radiant Power vs. Temperature is almost flat.

PIN CONNECTION



1. ANODE
2. CATHODE



JEDEC	—
EIAJ	—
TOSHIBA	

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current	I_F	50	mA
Pulse Forward Current	I_{FP}(NOTE)	350	mA
Reverse Voltage	V_R	1	V
Operating Temperature Range	T_{opr}	-20 ∿60	°C
Storage Temperature Range	T_{stg}	-40 ∿90	°C

(NOTE) Frequency 10kHz, Duty Ratio 50%, 0.1 sec ON, 0.4 sec OFF, t=4Hrs.

OPTO-ELECTRICAL CHARACTERISTICS (Ta=25°C)

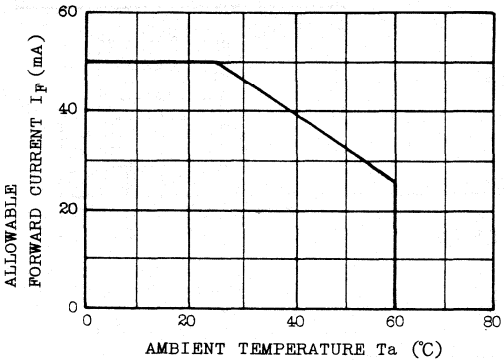
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=50mA	-	1.35	-	V
Pulse Forward Voltage	V_{FP}	I_{FP}=300mA, T=10ms	-	1.75	1.95	V
Reverse Current	I_R	V_R=1V	-	-	100	μA
Radiant Diameter	-		-	250	-	μm
Radiant Power	P_O	I_F=300mA, t=10ms	6	14	-	mW
Emission Angle at Half Power Points	θ	I_F=50mA	-	52	-	°
Peak Emission Wave Length	λp	I_F=50mA	-	875	-	nm
Spectral Line Half Width	Δλ	I_F=50mA	-	40	-	nm

PRECAUTION

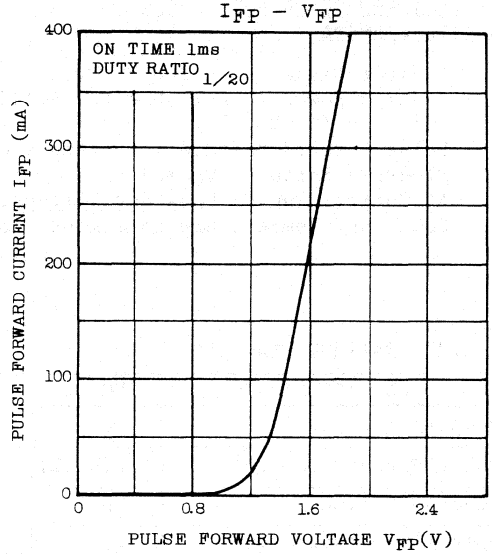
Please be careful of the followings.

1. Soldering temperature: 260°C MAX. Soldering time: 5 sec MAX. (Soldering portion of lead: up to 1.5mm form the body of the device)
2. If the lead is formed, the lead should be formed at a distance of 2mm form the body of the device. Soldering shall be performed after lead forming.
3. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   - Freon TE or TF
   - Dai-Fron Solvent S3 or S3-E

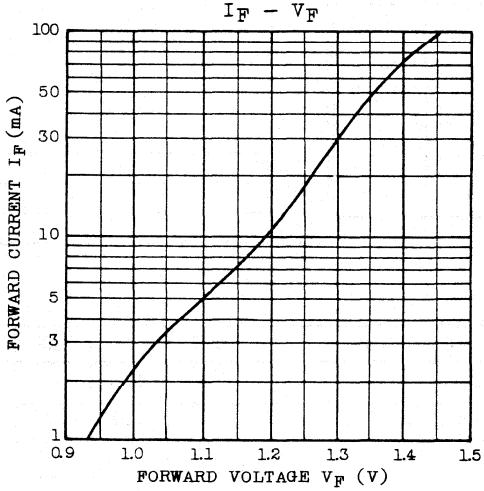
I_F – Ta



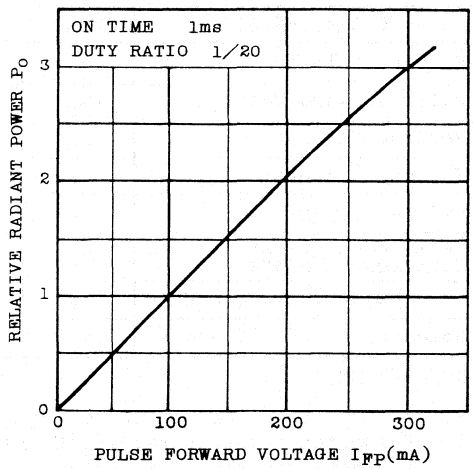
I_{FP} – V_{FP}



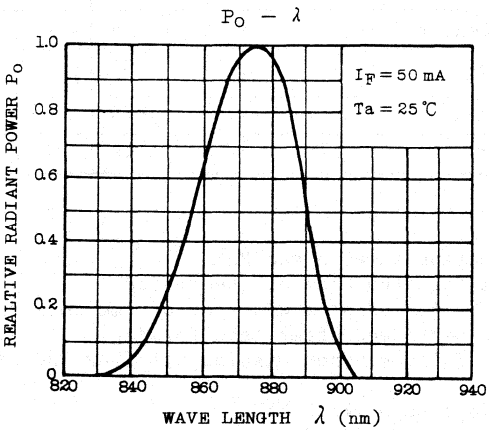
I_F – V_F



P_O – I_{FP}

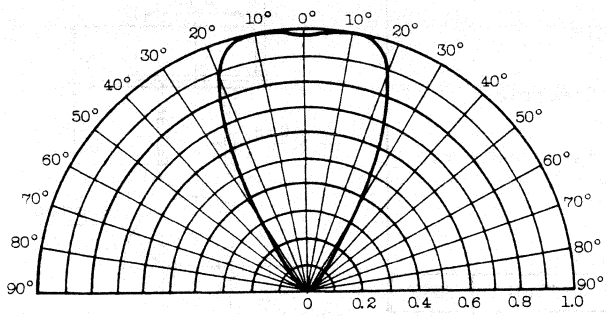


P_O – λ



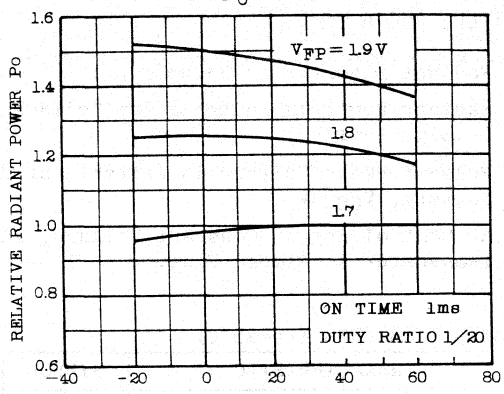
RADIATION PATTERN

(Ta = 25℃)

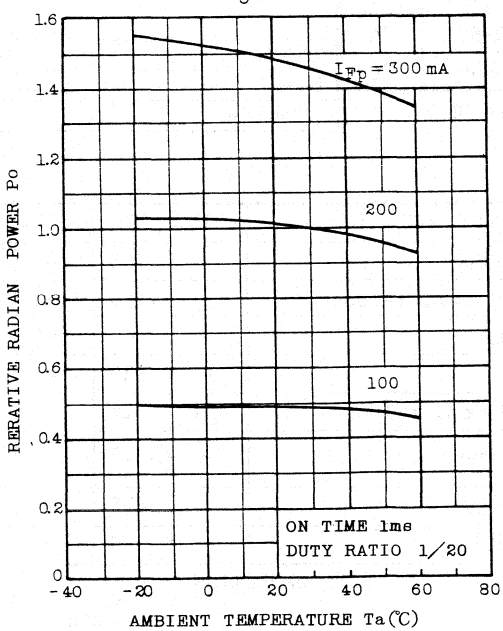


RELATIVE RADIANT INTENSITY

P_O – Ta



P_O – Ta



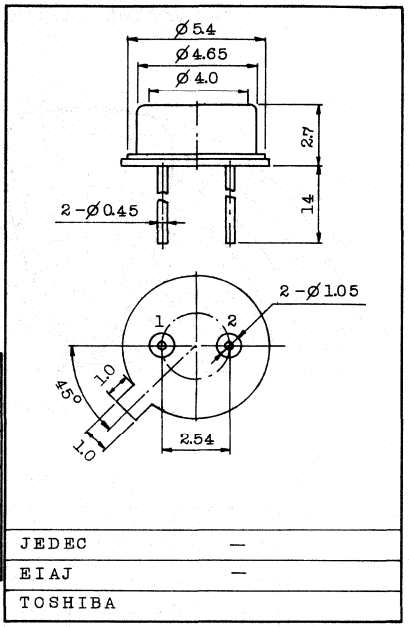
TLN216

INFRARED LED
GaAs INFRARED EMITTER

LIGHT SOURCE OF AUTO FOCUS
STILL-CAMERA

- Radiant Diameter is 380μm(Typ.)
- Radiant Power is Suitable for Solid Angle 0.187sr (θ=±14°)
- Pulse Forward Voltage is Fittable of 2 Electric Battery, V_{CC}=3V
- At Controlling of Constant Voltage, Radiant Power vs. Temperater is Almost Flat.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current	I_F	50	mA
Pulse Forward Current (Note)	I_{FP}	350	mA
Reverse Voltage	V_R	1	V
Operating Temperature Range	T_{opr}	-20~60	°C
Storage Temperature Range	T_{stg}	-40~90	°C

Note : Frequency 10kHz, Duty Ratio 50%, 0.1sec ON, 0.4sec OFF, t=4Hrs.

OPTO-ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=50mA	-	1.35	-	V
Pulse Forward Voltage	V_{FP}	I_{FP}=300mA, t=10ns	-	1.75	1.95	V
Reverse Current	I_R	V_R=1V	-	-	100	μA
Radiant Diameter	-		-	380	-	μm
Radiant Power	P_O	I_F=300mA, t=10ms	6	14	-	mW
Emission Angle at Half Power Points	θ	I_F=50mA	-	37.5	-	°
Peak Emission Wave Length	λ_P	I_F=50mA	-	875	-	nm
Spectral Line Half Width	$\Delta\lambda$	I_F=50mA	-	40	-	nm

PRECAUTION

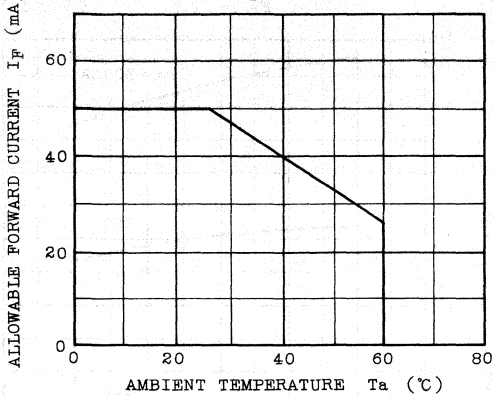
Please be careful of the followings

1. Soldering temperature: 260°C MAX. Soldering time: 5 sec MAX. (Soldering portion of lead: up to 1.5mm from the body of the device)
2. If the lead is formed, the lead should be formed at a distance of 2mm form the body of the device. Soldering shall be performed after lead forming.
3. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   o Freon TE or TF o Dai-Fron Solvetn S3 or S3-E

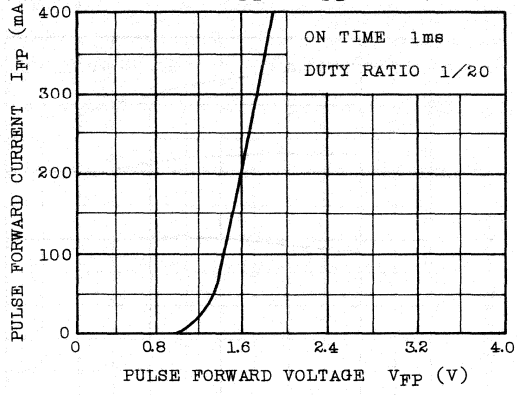
PIN CONNECTION

1. ANODE
2. CATHODE

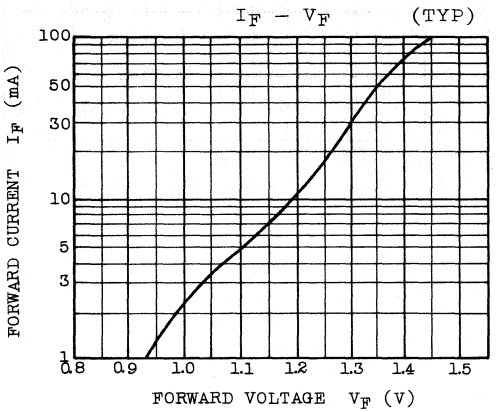
I_F – Ta



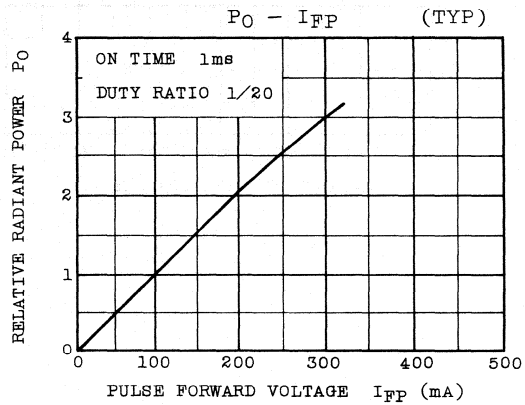
I_{FP} – V_{FP} (TYP)



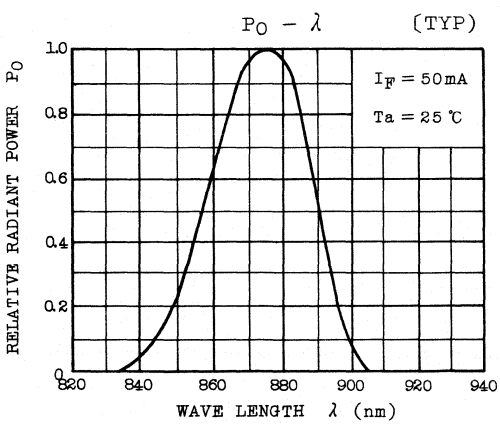
I_F – V_F (TYP)



P_O – I_{FP} (TYP)

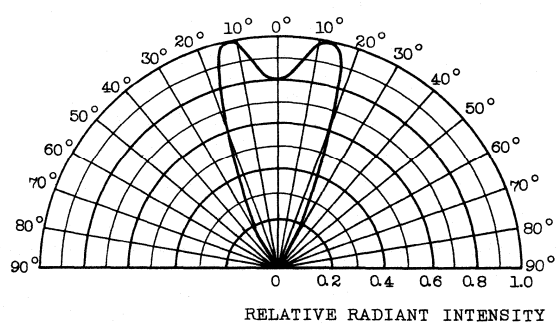


P_O – λ (TYP)

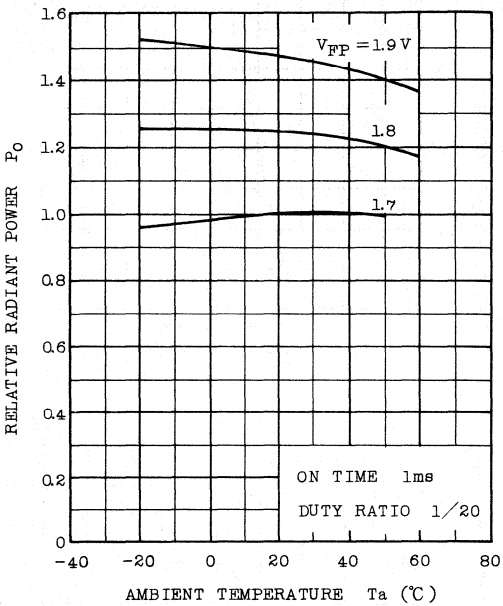


RADIATION PATTERN (TYP)

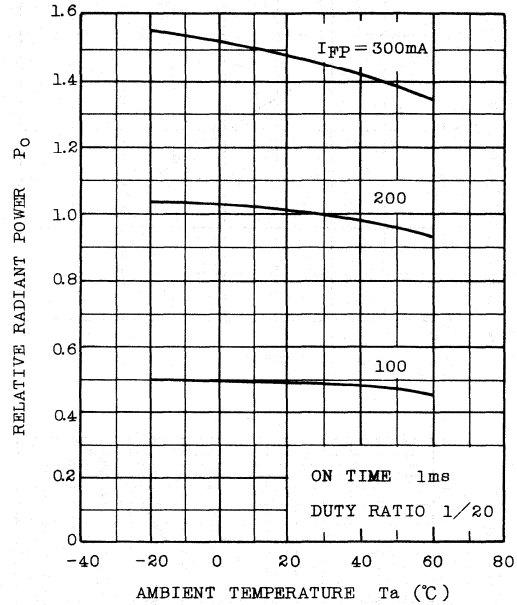
(Ta = 25 ℃)



P_O - Ta (TYP)



P_O - Ta (TYP)



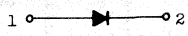
LED LAMP
GaP EMITTER

TLR215A

LED FOR PHOTO SENSOR

- OPTICAL SWITCH
- TAPE, CARD READERS

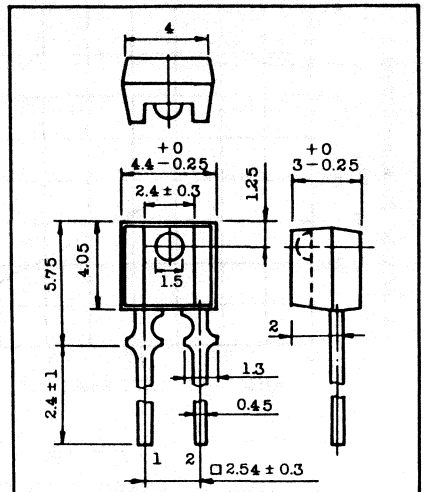
PIN CONNECTION



1. CATHODE
2. ANODE

- Output Spectrally Compatible with Silicon Sensor TPS607A, TPS608A.
- High Radiant Intensity: I_E=0.3mW/sr (Typ.)
- Suitable for Photo Interrupter Assembly

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	4−4H1A

Weight: 0.16g

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current	I_F	20	mA
Reverse Voltage	V_R	4	V
Forward Current Derating	ΔI_F/°C	-0.26	mA/°C
Operating Temperature Range	T_{opr}	-25 ∿ 85	°C
Storage Temperature Range	T_{stg}	-30 ∿ 100	°C

OPTO-ELECTRICAL CHARACTERISTICS (Ta=25°C)

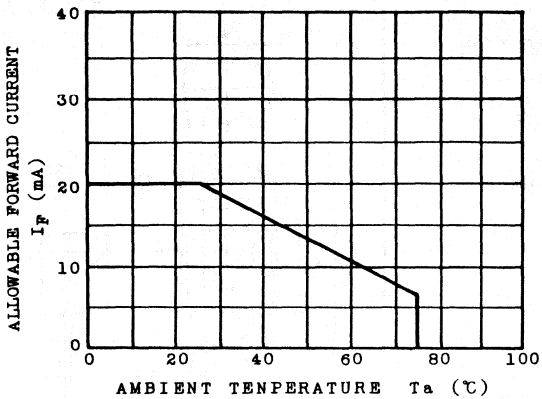
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=10mA	-	1.97	2.6	V
Reverse Current	I_R	V_R=4V	-	-	5	μA
Radiant Intensity	I_E	I_F=10mA	0.1	0.3	-	mW/sr
Capacitance	C_T	V_R=0, f=1MHz	-	50	-	pF
Peak Emission Wave Length	λP	I_F=10mA	-	700	-	nm
Spectral Line Half Width	Δλ	I_F=10mA	-	100	-	nm

PRECAUTION

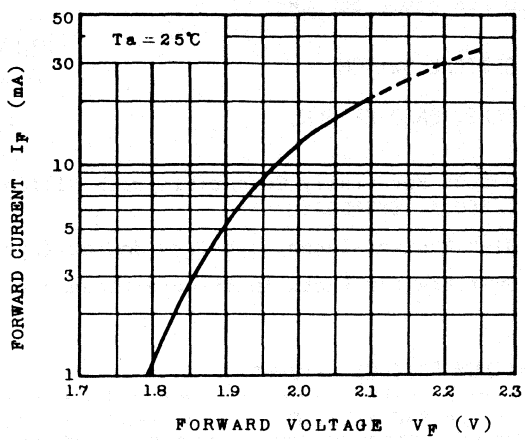
Please be careful of the followings.

1. Soldering temperature: 260°C MAX.
   Soldering time: 3 sec MAX.
   (Soldering portion of lead: at below from the seating plane)
2. If the lead is formed, the lead should be formed at below from the seating plane. Soldering shall be performed after lead forming.
2. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   • Freon TE or TF • Dai-Fron Solvents S3 or S3-E

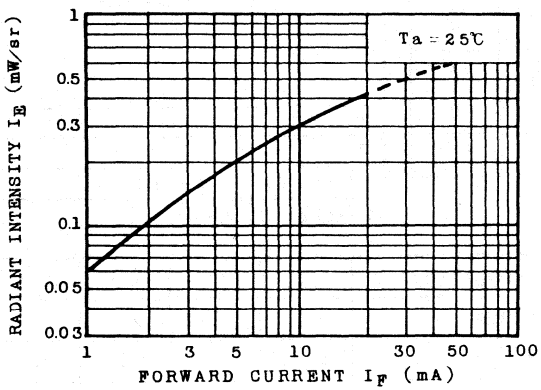
I_F — Ta



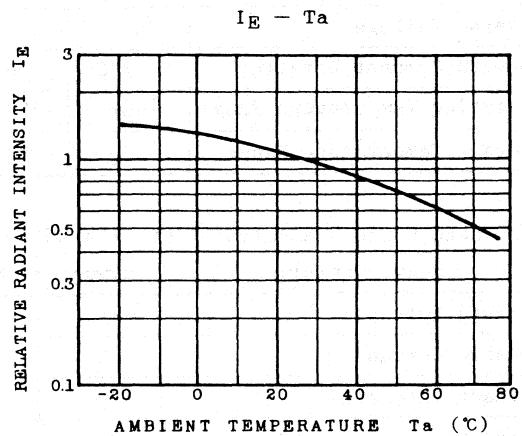
I_F — V_F



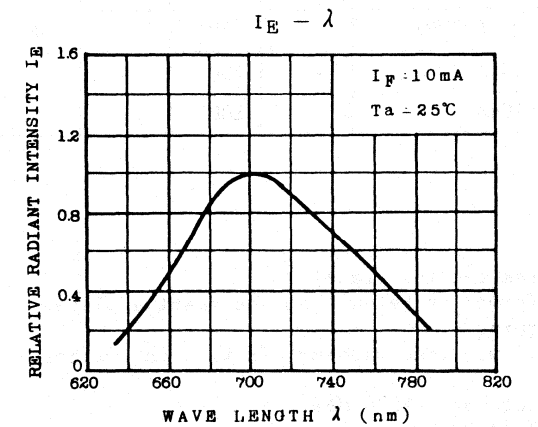
I_E — I_F



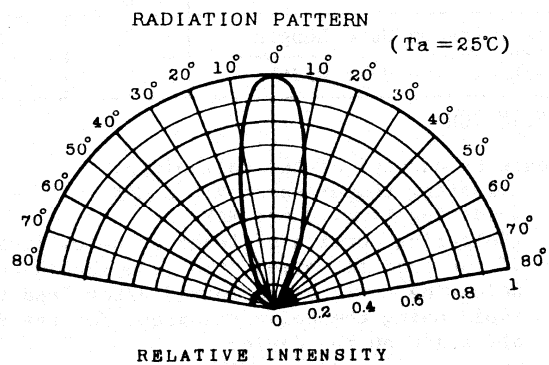
I_E — Ta



I_E — λ



RADIATION PATTERN



■ Photo Transistor

* New Product
** Under Development

PHOTO TRANSISTOR
SILICON NPN EPITAXIAL PLANER

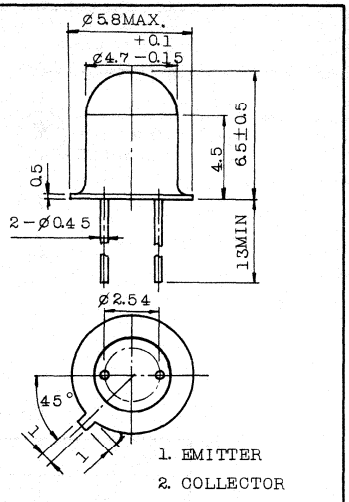
TPS601A

SILICON PHOTO TRANSISTOR FOR PHOTO SENSOR

- o OPTICAL SWITCH
- o TAPE, CARD READERS
- o VELOCITY SENSOR

- High Sensitivity :
- Spectrally and Mechanically Matched with IR Emitter TLN101A
- Glass-to-Metal-Seal Header
- Saturation Level Directly Compatible with Most TTL

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Emitter Voltage	V_{CEO}	40	V
Emitter-Collector Voltage	V_{ECO}	5	V
Collector Current	$I_C(I_L)$	50	mA
Collector Power Dissipation	P_C	150	mW
Collector Power Dissipation Derating	PC/°C	-1.2	mW/°C
Operating Temperatre	T_{opr}	-40 ∿ 125	°C
Storage Temperature	T_{stg}	-55 ∿ 150	°C



JEDEC	—
EIAJ	—
TOSHIBA	0−5A2A

Weight : 0.39g

CHARACTERISTIC		SYMBOL	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Dark Current		$I_C(I_{CEO})$	V_{CE}=30V, E=0		-	10	200	nA
Light Current		I_L	V_{CE}=3V, E=0.1mW/cm		100	-	-	µA
				rank A	100	-	300	
				B	200		600	
				C	400	-	1200	
Collector-Emitter Saturation Voltage		$V_{CE(sat)}$	I_C=30µA, E=0.1mW/cm (Note)		-	0.25	0.4	V
Switching Time	Rise Time	t_r	V_{CC}=5V, I_C=10mA, R_L=100 (Fig. 1)		-	2	-	µs
	Fall Time	t_f			-	2	-	

Note: Color Temperature=2870°K Standard Tungsten Lamp.

PIN CONNECTION

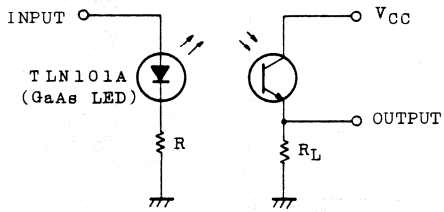
1. EMITTER
2. COLLECTOR

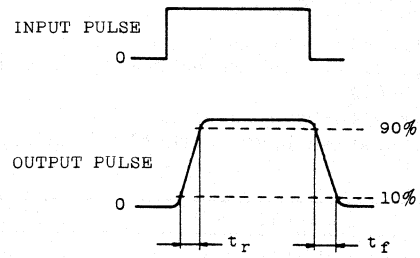
PRECUATION

Please be careful of the followings.

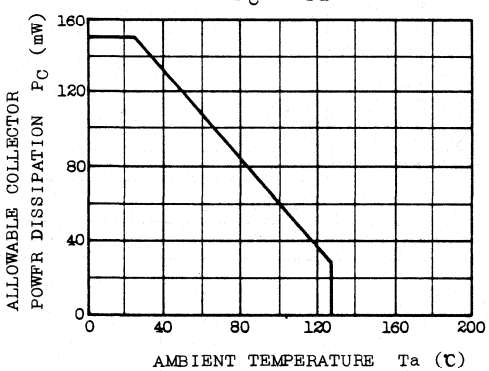
1. Soldering temperature: 260°C MAX.
   Soldering time: 5 sec MAX.
   (Soldering portion of lead: up to 1.5 mm from the body of the device)
2. If the lead is formed, the lead should be formed at a distance of 2mm from the body of the device.
   Soldering shall be performed after lead forming.
3. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   ° Freon TE or TF ° Dai-Fron Solvents S3 or S3-E

Fig.1 SWITCHING TIME TEST CIRCUIT

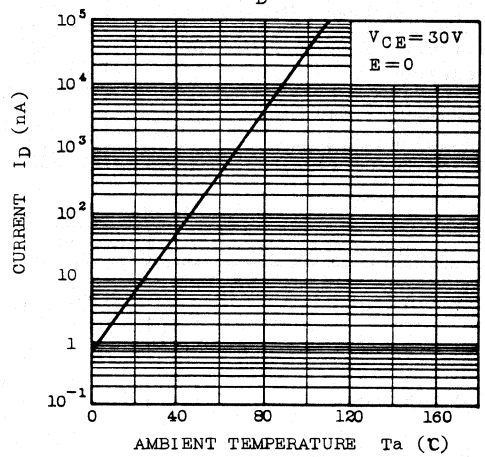




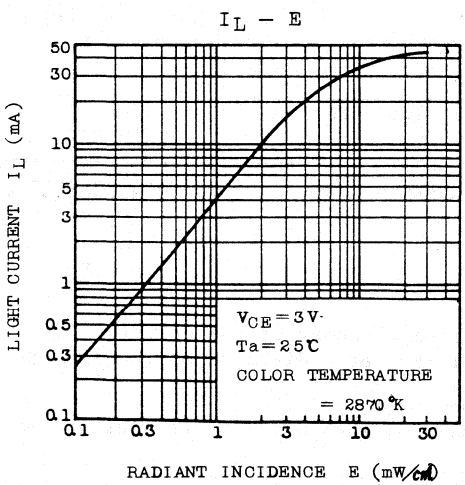
P_C – Ta



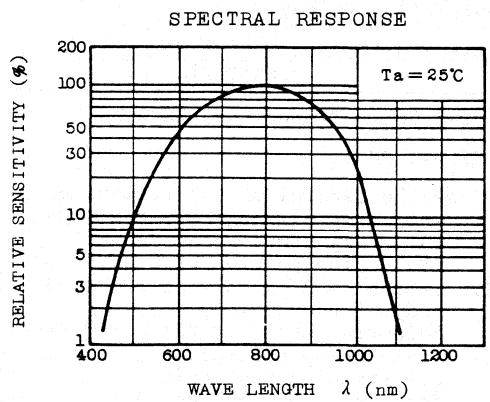
I_D – Ta



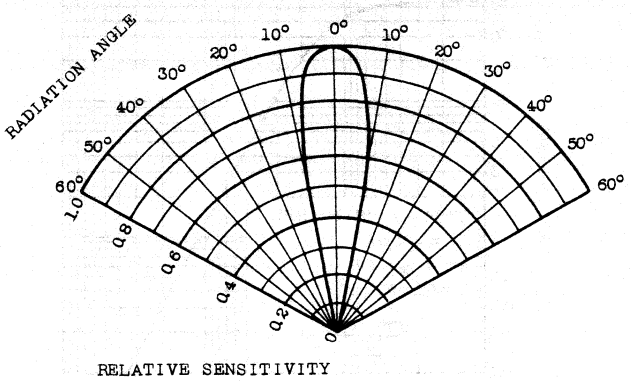
I_L – E



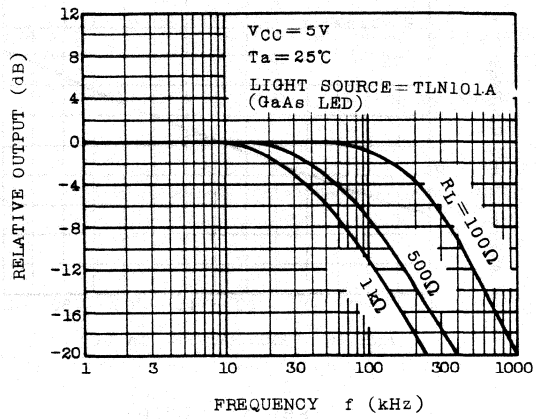
SPECTRAL RESPONSE



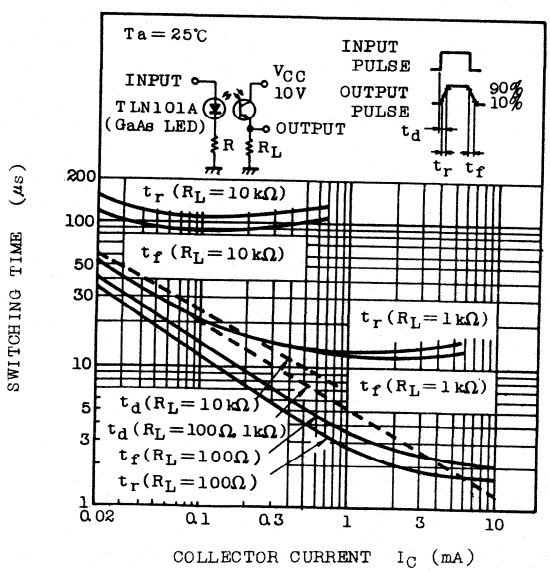
RELATIVE DIRECTIONAL SENSITIVITY
(Ta = 25°C)



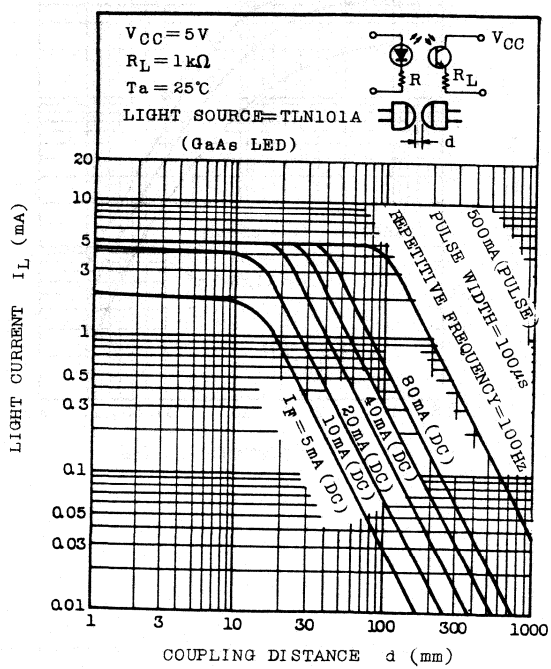
FREQUENCY CHARACTERISTICS



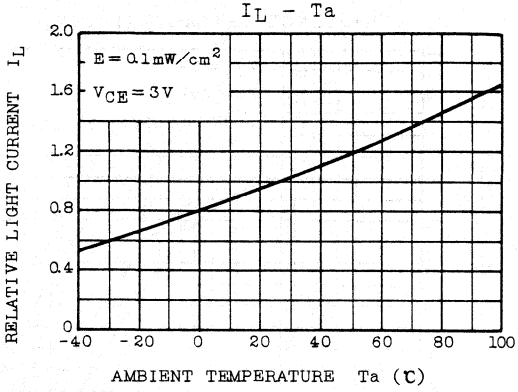
SWITCHING CHARACTERISTICS



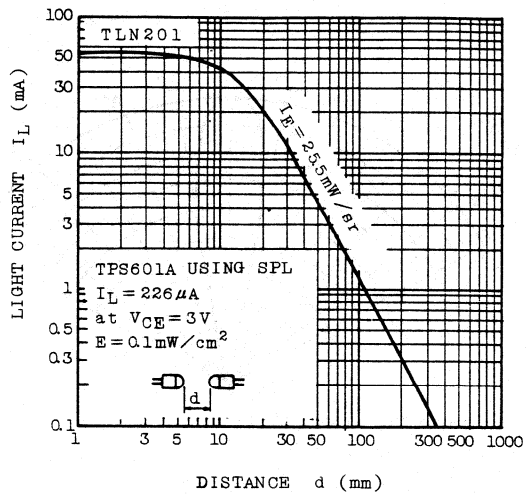
COUPLING CHARACTERISTICS



I_L – Ta



TPS601A – TLN201



TPS601A – TLN108

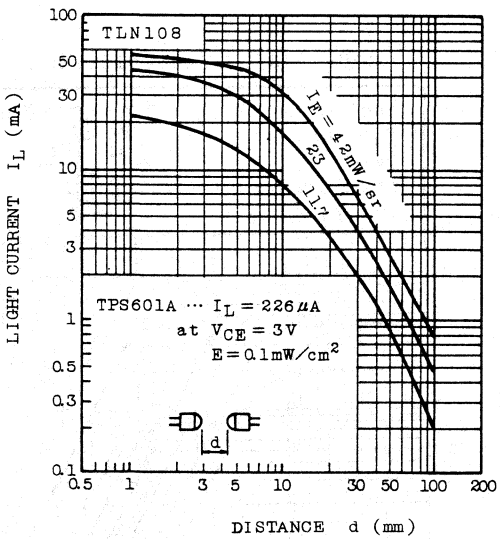


PHOTO TRANSISTOR
SILICON NPN EPITAXIAL PLANER

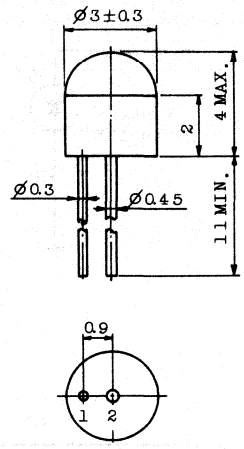
TPS603

SILICON PHOTO TRANSISTOR FOR PHOTO SENSOR.

- . OPTICAL SWITCH
- . POSITION SENSOR
- . TAPE, CARD READERS
- . ENCODERS

- . Spectrally and Mechanically Matched with IR Emitter TLN103
- . Wide Viewing Angle
- . Saturation Level Directly Compatible with Most TTL

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	0-3A1A

Weight : 0.02g

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Emitter Voltage	V_{CEO}	20	V
Emitter-Collector Voltage	V_{ECO}	5	V
Collector Current	I_C	20	mA
Collector Power Dissipation	P_C	75	mW
Collector Power Dissipation Derating	$\Delta P_C/°C$	-1.0	mW/°C
Operating Temperature Range	T_{opr}	-20 ~ 75	°C
Storage Temperature Range	T_{stg}	-30 ~ 100	°C

OPTO-ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Dark Current		$I_D(I_{CEO})$	V_{CE}=10V, E=0	-	10	100	nA
Light Current		$I_L(I_C)$	V_{CE}=3V, E=0.1mW/cm² (Note)	1.5	10	-	μA
Collector-Emitter Saturation Voltage		$V_{CE(sat)}$	I_C=0.8μA, E=0.1mW/cm²(Note)	-	0.2	0.4	V
Switching Time	Rise Time	t_r	V_{CC}=10V, I_C=1mA, R_L=100Ω (Fig.1)	-	3	-	μs
	Fall Time	t_f		-	2	-	μs

Note : Color temperature=2870°K Standard Tungsten Lamp.

PIN CONNECTION

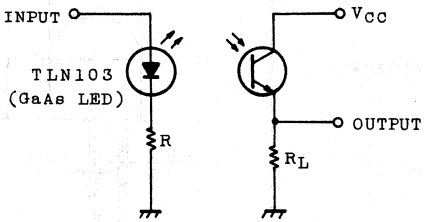
1. EMITTER
2. COLLECTOR

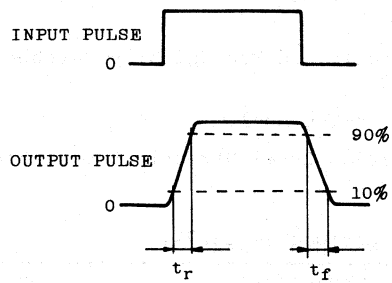
PRECAUTION

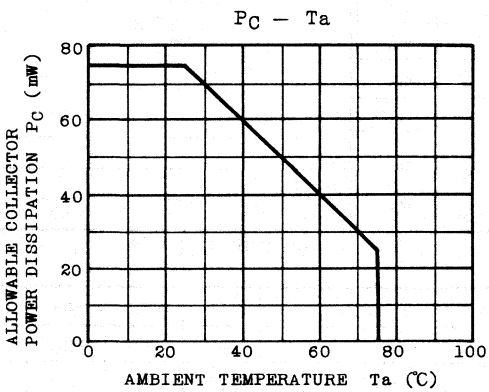
Please be careful of the followings.

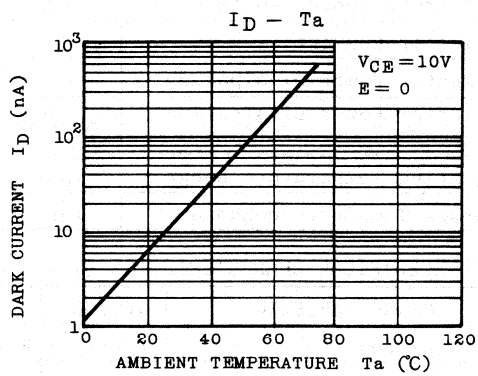
1. Soldering temperature: 260°C MAX. Soldering time: 3 sec MAX.
   (Soldering portion of lead: up to 1.5mm from the body of the device)
2. If the lead is formed, the lead should be formed at a distance of 2mm from the body of the device.
   Soldering shall be performed after lead forming.
3. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   o Freon TE or TF o Dai-Fron Solvents S3 or S3-E

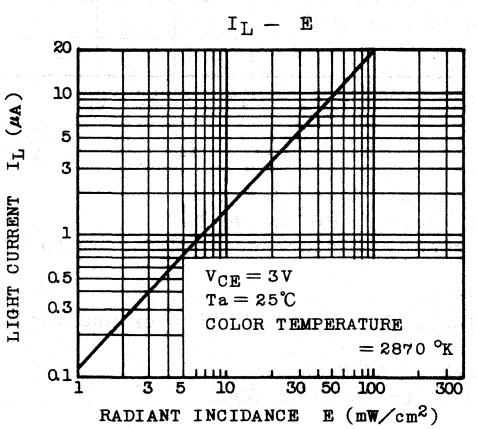
Fig. 1 SWITCHING TIME TEST CIRCUIT

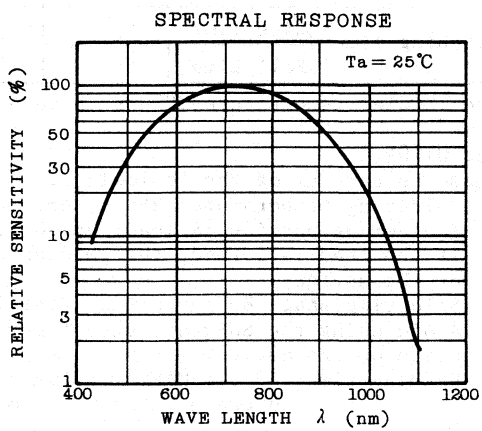






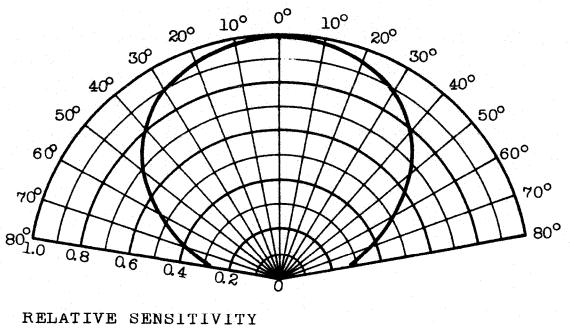




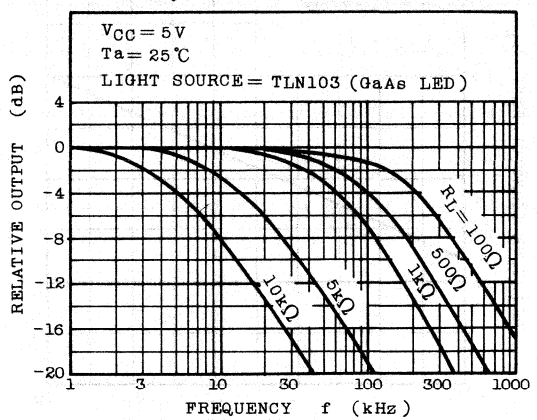


RELATIVE DIRECTIONAL SENSITIVITY

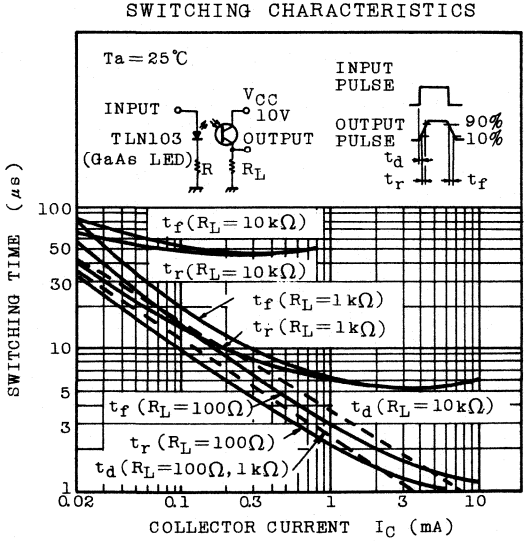
(Ta = 25℃)



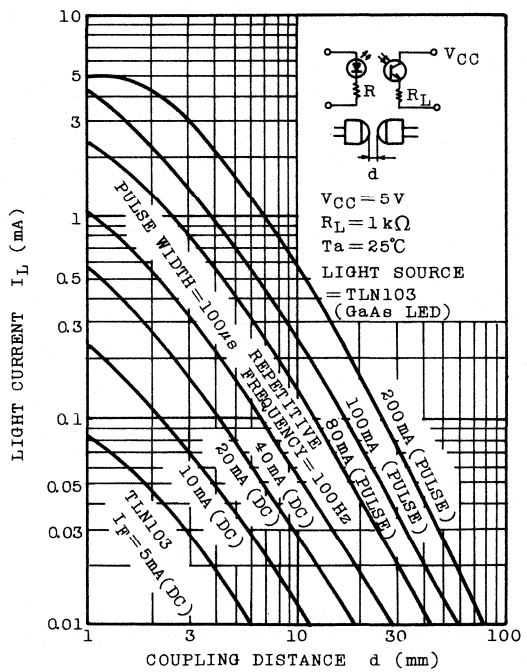
FREQUENCY CHARACTERISTICS



SWITCHING CHARACTERISTICS



COUPLING CHARACTERISTICS



I_L – Ta

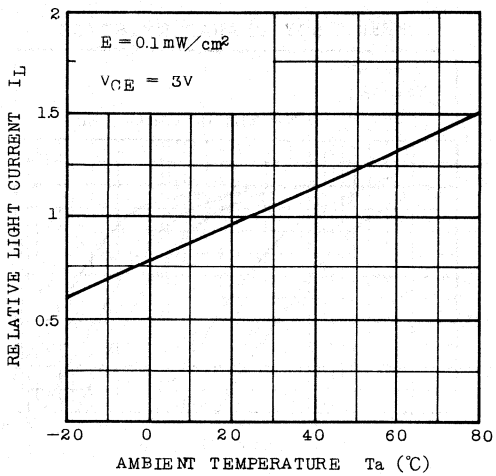

E = 0.1 mW/cm²
V_{CE} = 3V
RELATIVE LIGHT CURRENT I_L
2
1.5
1
0.5
–20
0
20
40
60
80
AMBIENT TEMPERATURE Ta (℃)

PHOTO TRANSISTOR
SILICON NPN EPITAXIAL PLANER

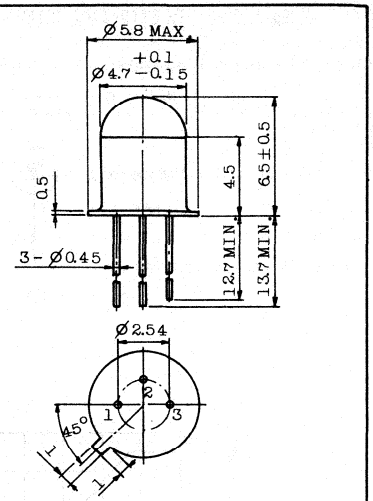
TPS604

SILICON PHOTO TRANSISTOR FOR PHOTO SENSOR

. OPTICAL SWITCH. TAPE, CARD READERS. VELOCITY SENSOR

. High Sensitivity : I_L=200μA (Typ.)
. Spectrally and Mechanically Matched with IR Emitter TLN101A
. Glass-to-Metal-Seal Header
. Base Contact Externally Available
. Saturation Level Directly Compatible with Most TTL

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	0-5B1A

Weight : 0.37g

MAXIMUM RATINGS (Ta=25°C)

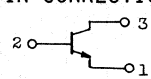
CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Emitter Voltage	V_{CEO}	40	V
Collector-Base Voltage	V_{CBO}	50	V
Emitter-Base Voltage	V_{EBO}	5	V
Emitter-Collector Voltage	V_{ECO}	5	V
Collector Current	I_C	50	mA
Collector Power Dissipation	P_C	150	mW
Collector Power Dissipation Derating	$\Delta P_C/^\circ C$	-1.2	mW/°C
Operating Temperature Range	T_{opr}	-40 ~ 125	°C
Storage Temperature Range	T_{stg}	-55 ~ 150	°C

OPTO-ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Dark Current		$I_D(I_{CEO})$	V_{CE}=30V, E=0	-	10	200	nA
Light Current		$I_L(I_C)$	V_{CE}=3V, E=0.1mW/cm^2 (Note)	60	200	-	μA
Collector-Emitter Saturation Voltage		$V_{CE(sat)}$	I_C=30μA, E=0.1mW/cm^2 (Note)	-	0.25	0.4	V
Switching Time	Rise Time	t_r	V_{CC}=5V, I_C=10mA, R_L=100Ω (Fig.1)	-	2	-	μs
	Fall Time	t_f		-	2	-	μs

Note : Color temperature=2870°K Standard Tungsten Lamp.

PIN CONNECTION



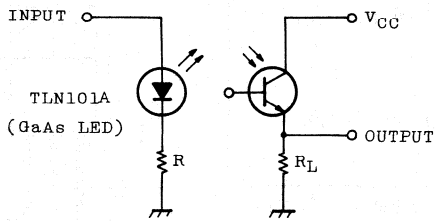
1. EMITTER
2. BASE
3. COLLECTOR

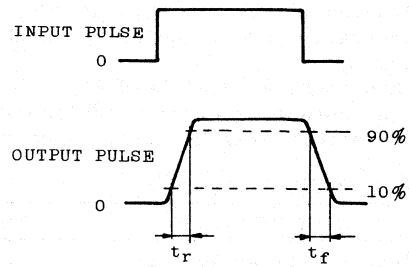
PRECAUTION

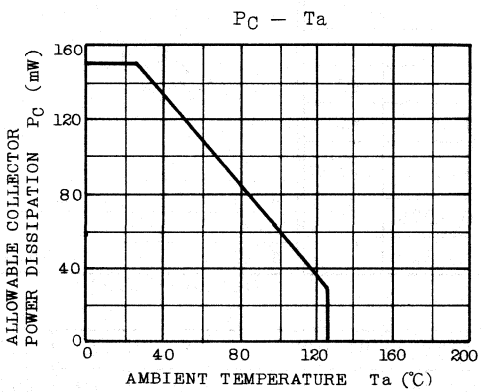
Please be careful of the followings.

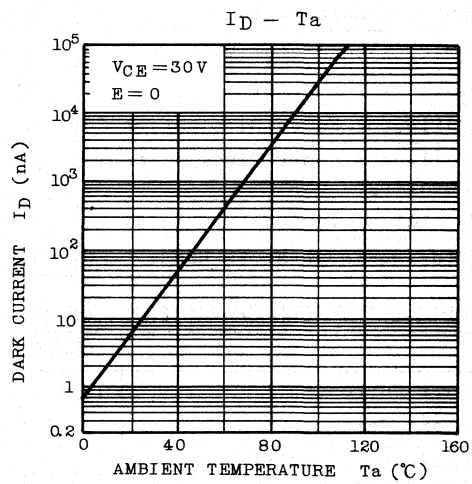
1. Soldering temperature: 260°C MAX. Soldering time: 3 sec MAX.
   (Soldering portion of lead: up to 1.5mm from the body of the device)
2. If the lead is formed, the lead should be formed at a distance of 2mm from the body of the device.
   Soldering shall be performed after lead forming.
3. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   o Freon TE or TF o Dai-Fron Solvents S3 or S3-E
   o Chlorothene

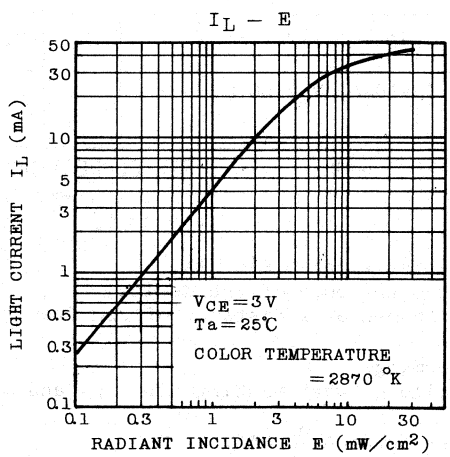
Fig. 1 SWITCHING TIME TEST CIRCUIT

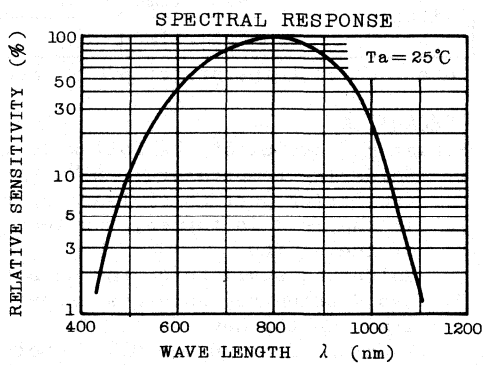




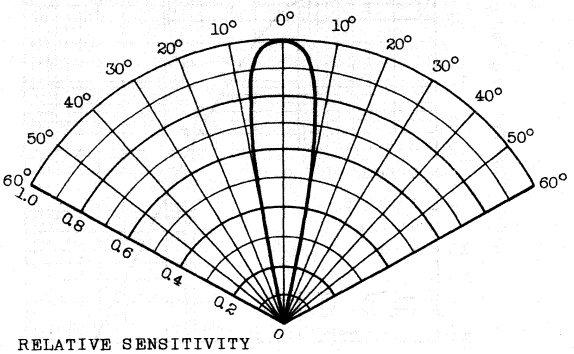




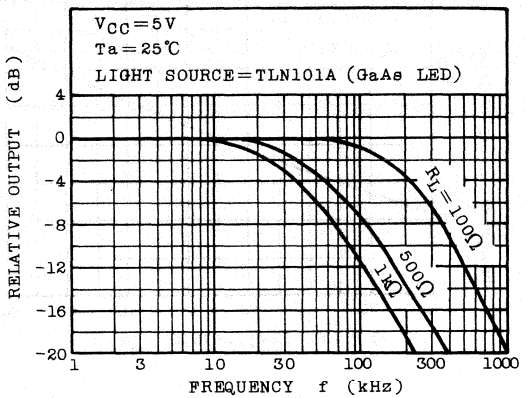




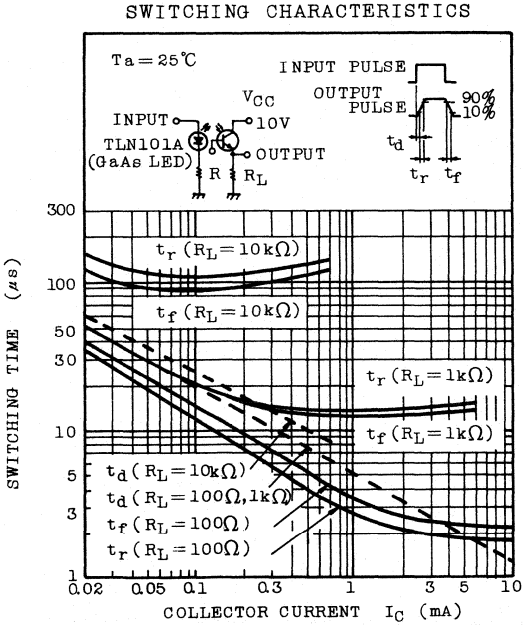
RELATIVE DIRECTIONAL SENSITIVITY
(Ta = 25℃)



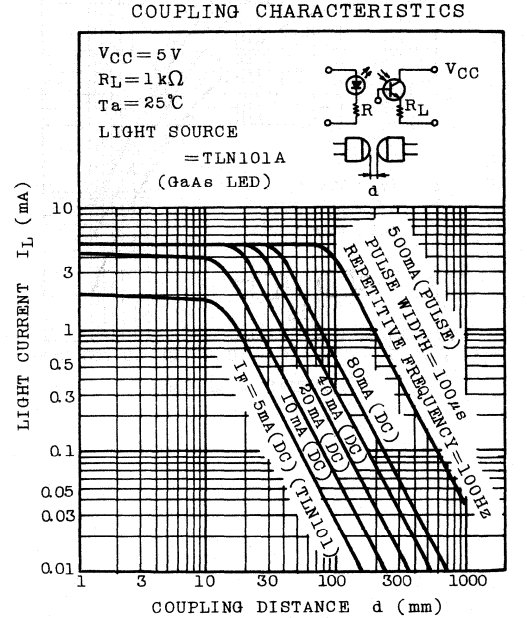
FREQUENCY CHARACTERISTICS



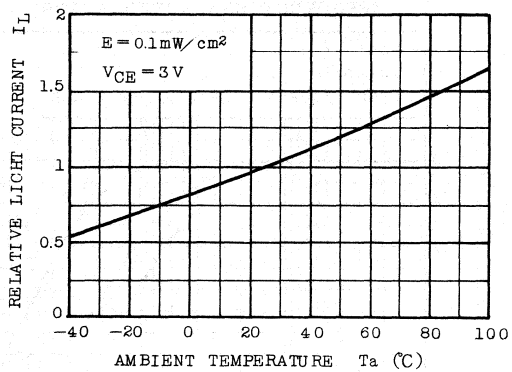
SWITCHING CHARACTERISTICS



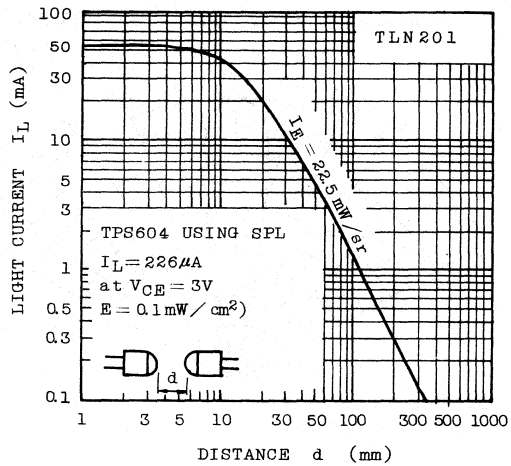
COUPLING CHARACTERISTICS



I_L — Ta



TPS604 — TLN201



TPS604 — TLN108

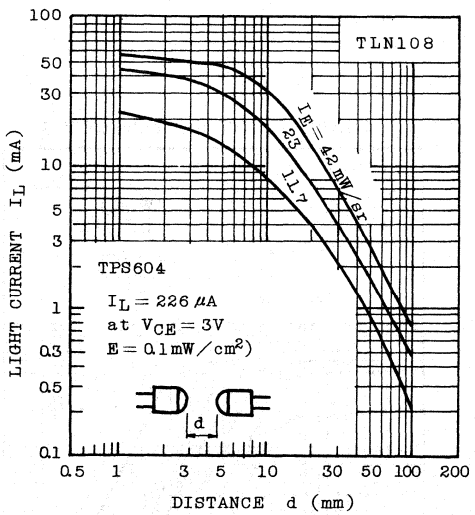


PHOTO DARLINGTON TRANSISTOR
SILICON NPN EPITAXIAL PLANER

TPS605

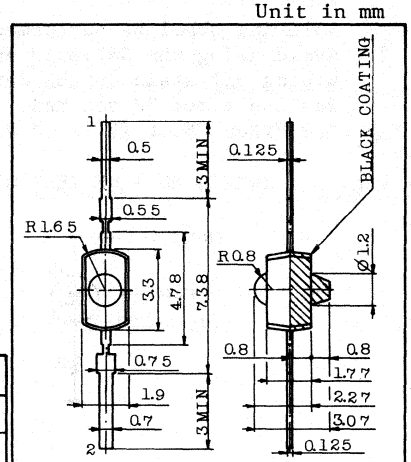
SILICON PHOTO TRANSISTOR FOR PHOTO SENSOR

. OPTICAL SWITCH TAPE, CARD READERS

. POSITION SENSOR

. High Sensitivity
. Spectrally and Mechanically Matched with IR Emitter TLN104
. Small Size Package
. Saturation Level Directly Compatible with MOS-IC

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	0-2C1A

Weight : 0.08g

MAXIMUM RATINGS (Ta=25°C)

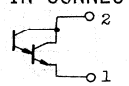
CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Emitter Voltage	V_{CEO}	30	V
Emitter-Collector Voltage	V_{ECO}	5	V
Collector Current	I_C	40	mA
Collector Power Dissipation	P_C	75	mW
Collector Power Dissipation Derating	$\Delta P_C/°C$	-1.0	mW/°C
Operating Temperature Range	T_{opr}	-25 ~ 85	°C
Storage Temperature Range	T_{stg}	-30 ~ 100	°C

OPTO-ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC		SYMBOL	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Dark Current		$I_D(I_{CEO})$	V_{CE}=16V, E=0		-	30	250	nA
Light Current		$I_L(I_C)$	V_{CE}=3V, E=0.01mW/cm^2		0.2	-	-	mA
				rank A	0.2	-	1.2	
				B	0.8	-	4.8	
Collector-Emitter Saturation Voltage		$V_{CE(sat)}$	I_C=0.08mA, E=0.01mW/cm^2 (Note)		-	0.9	1.2	V
Switching Time	Rise Time	t_r	V_{CC}=5V, I_C=10mA, R_L=100Ω (Fig. 1)		-	0.2	-	ms
	Fall Time	t_f			-	0.1	-	

Note: Color temperature=2870°K Standard Tungsten Lamp.

PIN CONNECTION



1. EMITTER
2. COLLECTER

PRECAUTION

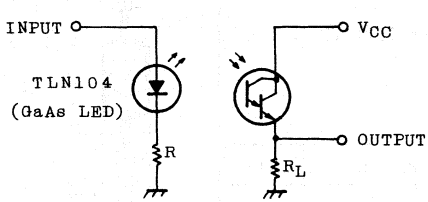
Please be careful of the followings.

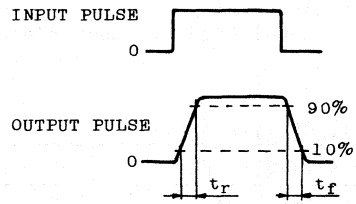
1. Soldering temperature: 260°C MAX. Soldering time: 3 sec MAX.
   (Soldering portion of lead: up to 2mm from the body of the device)
2. If the lead is formed, the lead should be formed at a distance of 0.8mm from the body of the device.

Solering shall be performed after lead forming.

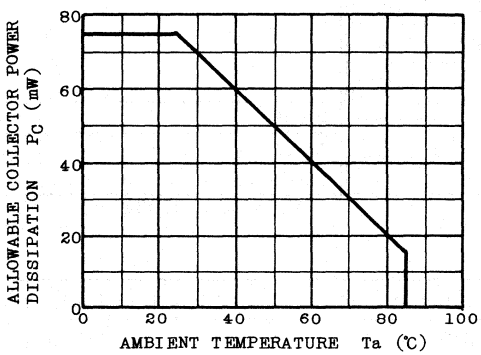
3. Avoid using the Solvents except for the follows, when washing off slux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   ∘ Freon TE or TF ∘ Dai-Fron Solvents S3 or S3-E

Fig. 1 SWITCHING TIME TEST CIRCUIT

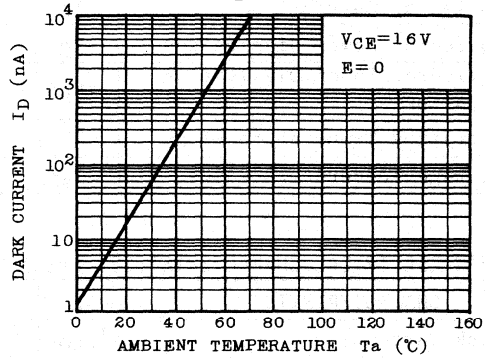




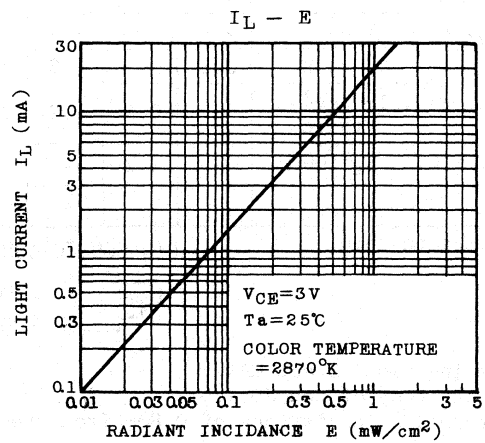
P_C — Ta



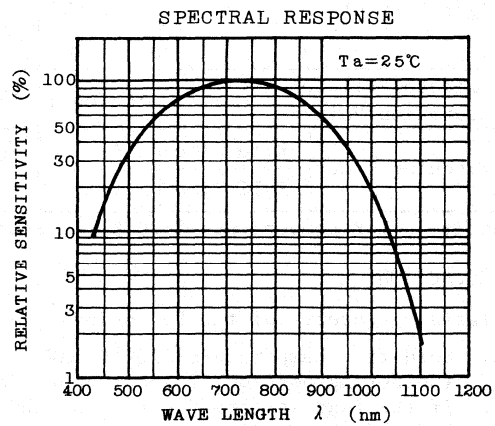
I_D — Ta



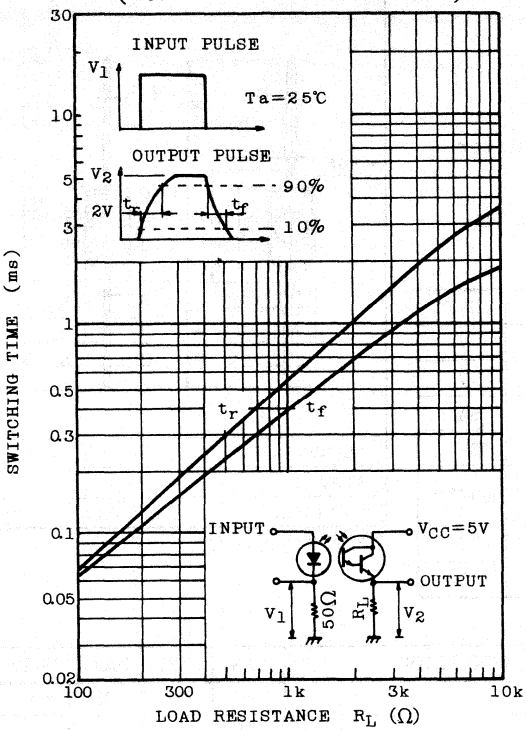
I_L — E



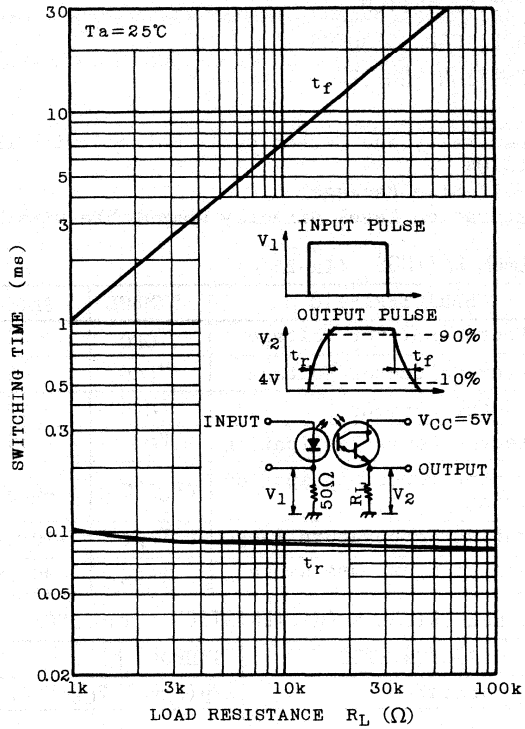
SPECTRAL RESPONSE



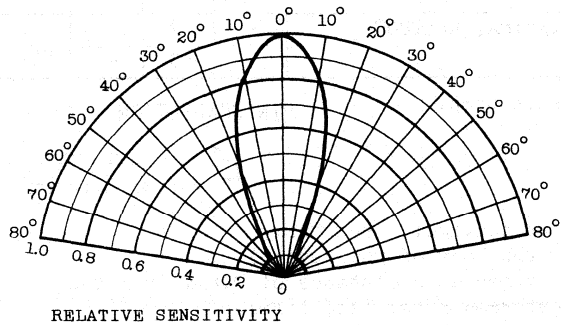
SWITCHING CHARACTERISTICS
(NON SATURATED OPERATION)



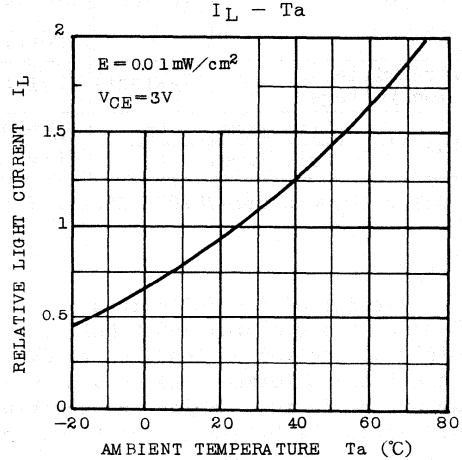
SWITCHING CHARACTERISTICS
(SATURATED OPERATION)



RELATIVE DIRECTIONAL SENSITIVITY
(Ta=25℃)



I_L – Ta



TPS606

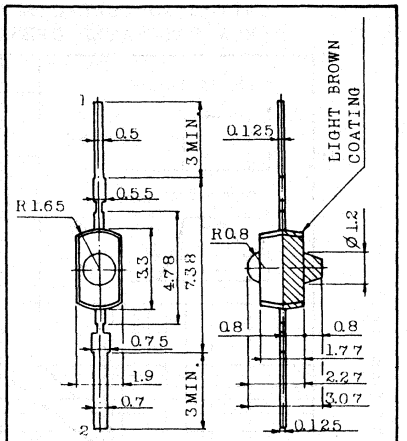
PHOTO TRANSISTOR
SILICON NPN EPITAXIAL PLANER

SILICON PHOTO TRANSISTOR FOR PHOTO SENSOR.

- OPTICAL SWITCH
- TAPE, CARD READERS
- POSITION SENSOR

- Spectrally and Mechanically Matched with IR Emitter TIN104
- Small Size Package
- Saturation Level Directly Compatible with Most TTL

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	C-2C1A

Weight: 0.08g

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Emitter Voltage	V_{CEO}	20	V
Emitter-Collector Voltage	V_{ECO}	5	V
Collector Current	I_C	20	mA
Collector Power Dissipation	P_C	50	mW
Collector Power Dissipation Derating	$\Delta P_C/°C$	-0.9	mW/°C
Operating Temperature Range	T_{opr}	-20 ∿ 75	°C
Storage Temperature Range	T_{stg}	-30 ∿ 80	°C

OPTO-ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC		SYMBOL	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Dark Current		$I_D(I_{CEO})$	V_{CE}=10V, E=0		-	10	100	nA
Light Current		$I_L(I_C)$	V_{CE}=3V, E=0.1mW/cm² (Note)		10	-	-	μA
				rank B	10	-	30	
				C	20	-	60	
				D	40	-	125	
Collector-Emitter Saturation Voltage		$V_{CE}(sat)$	I_C=1μA, E=0.1mW/cm² (Note)		-	0.2	0.4	V
Switching Time	Rise Time	t_r	V_{CC}=10V, I_C=1mA, R_L=100Ω (Fig. 1)		-	2	-	μs
	Fall Time	t_f			-	3	-	

Note: Color temperature=2870°K Standard Tungsten Lamp.

PIN CONNECTION

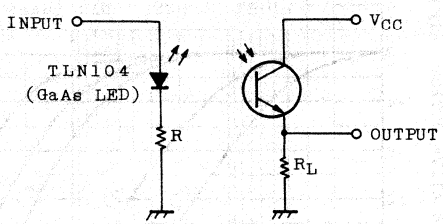
1. EMITTER
2. COLLDCTOR

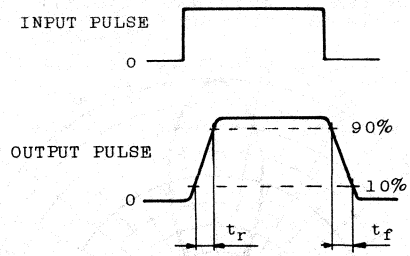
PRECAUTION

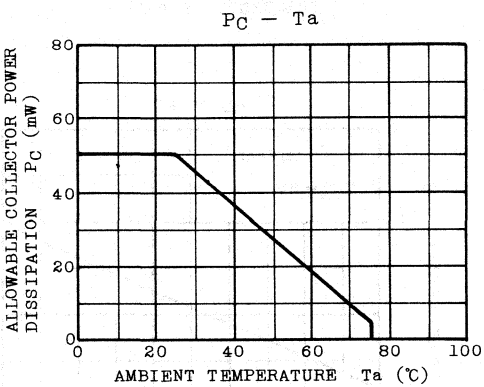
Please be careful of the followings.

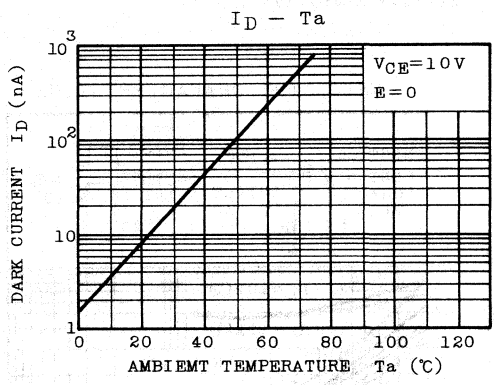
1. Soldering temperature: 260°C MAX. Soldering time: 3 sec MAX.
   (Soldering portion of lead: up to 2mm from the body of the device)
2. If the lead is formed, the lead should be formed at a distance of 0.8mm from the body of the device. Soldering shall be performed after lead forming.
3. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   ∘ Freon TE or TF ∘ Dai-Fron Solvents S3 or S3-E

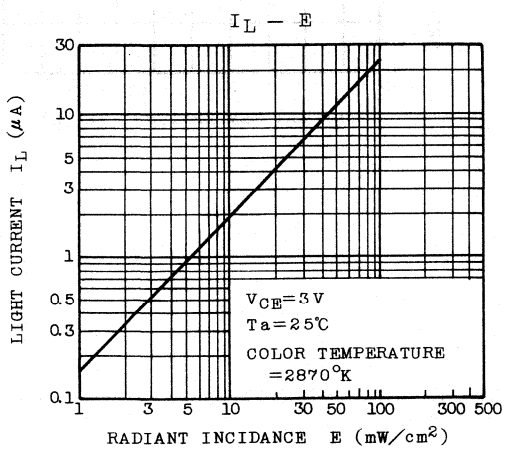
Fig. 1 SWITCHING TIME TEST CIRCUIT

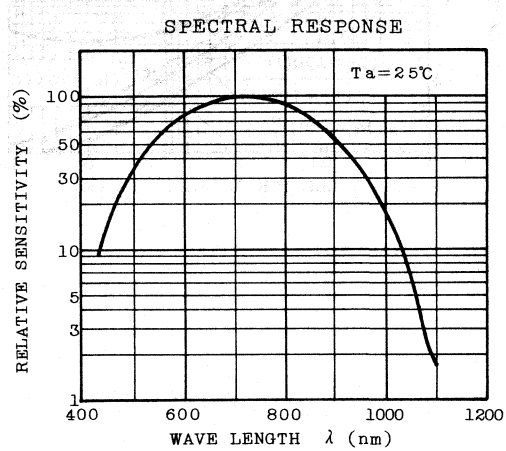






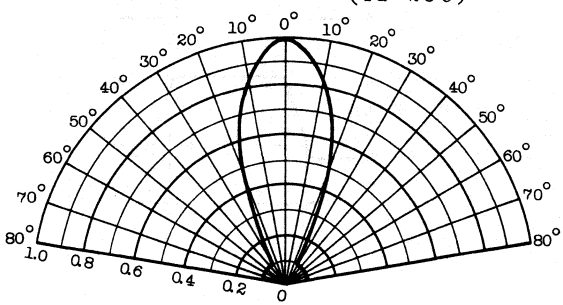




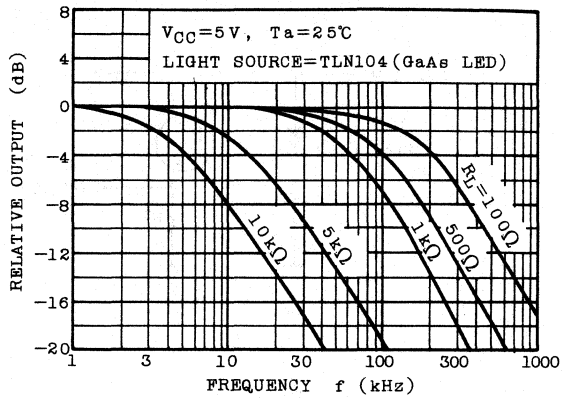


RELATIVE DIRECTIONAL SENSITIVITY

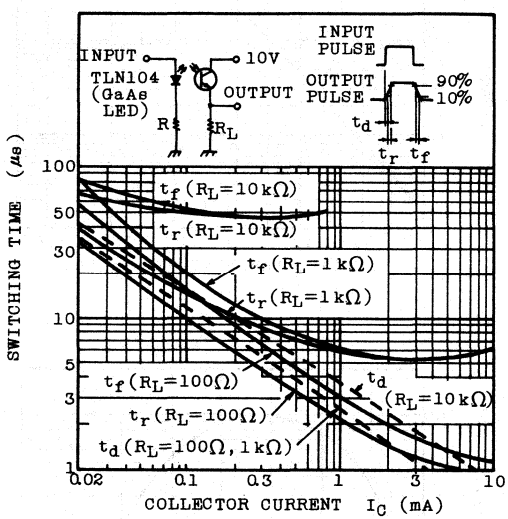
(Ta=25℃)



FREQUENCY CHARACTERISTICS



SWITCHING CHARACTERISTICS



I_L − Ta

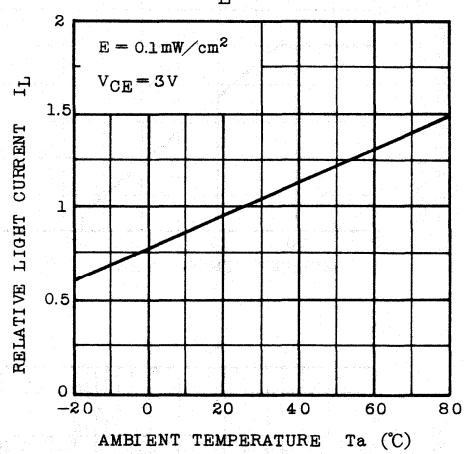


PHOTO DARLINGTON TRANSISTOR
SILICON NPN EPITAXIAL PLANER

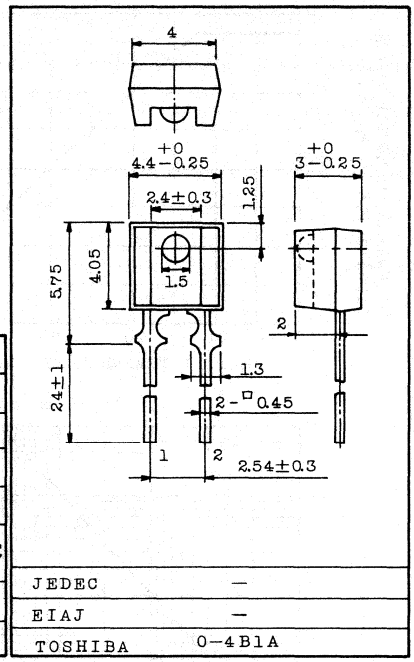
TPS607A

SILICON PHOTO TRANSISTOR FOR PHOTO SENSOR.

- OPTICAL SWITCH
- INTERRUPTER
- TAPE, CARD READERS

- High Sensitivity : I_L=2mA(Typ.)
- Spectrally and Mechanically Matched with IR Emitter TLN107A.
- Saturation Level is Compatible with MOS-IC.
- Suitable for Photo Interrupter Assembly

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	0-4B1A

Weight : 0.16g

MAXIMUM RATINGS (Ta=25°C)

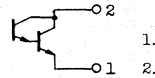
CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Emitter Voltage	V_{CEO}	30	V
Emitter-Collector Voltage	V_{ECO}	5	V
Collector Current	I_C	50	mA
Collector Power Dissipation	P_C	75	mW
Collector Power Dissipation Derating	ΔP_C/°C	-1.0	mW/°C
Operating Temperature Range	T_{opr}	-25~85	°C
Storage Temperature Range	T_{stg}	-40~100	°C

OPTO-ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Dark Current		$I_D(I_{CEO})$	V_{CE}=16V, E=0	-	30	250	nA
Light Current		$I_L(I_C)$	V_{CE}=3V, E=0.1mW/cm^2 (Note)	0.6	2	-	mA
Collector-Emitter Saturation Voltage		$V_{CE(sat)}$	I_C=0.3mA, E=0.1mW/cm^2 (Note)	-	0.9	1.2	V
Switching Time	Rise Time	t_r	V_{CC}=5V, I_C=10mA, R_L=100Ω	-	200	-	μs
	Fall Time	t_f		-	100	-	μs

Note : Color temperature=2870°K Standard Tungsten Lamp.

PIN CONNECTION



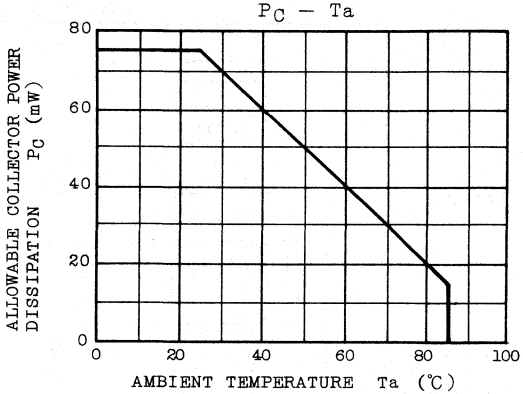
1. EMITTER
2. COLLECTOR

PRECAUTION

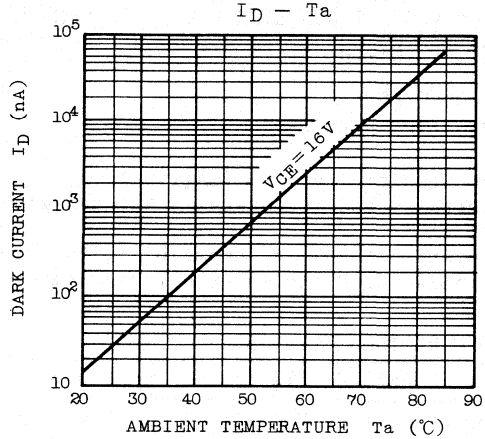
Please be careful of the followings.

1. Soldering temperature: 260°C MAX.
   Soldering time: 5 sec MAX.
   (Soldering portion of lead: up to 2mm from the body of the device)
2. If the lead is formed, the lead should be formed at a distance of 2mm from the body of the device.
   Soldering shall be performed after lead forming.
3. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   o Freon TE or TF o Dai-Fron Solvents S3 or S3-E

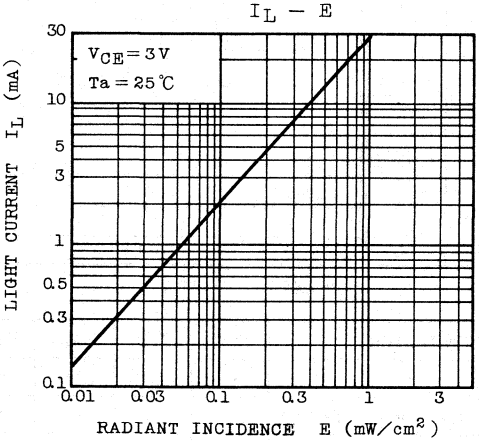
P_C — Ta



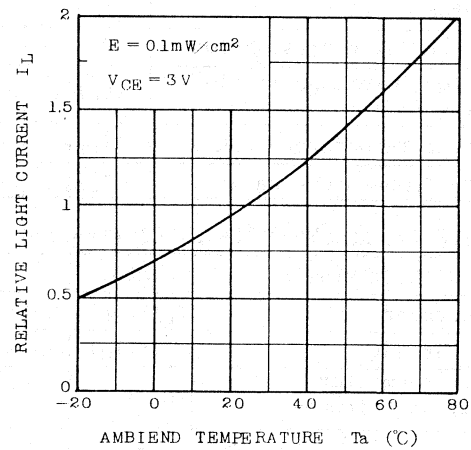
I_D — Ta



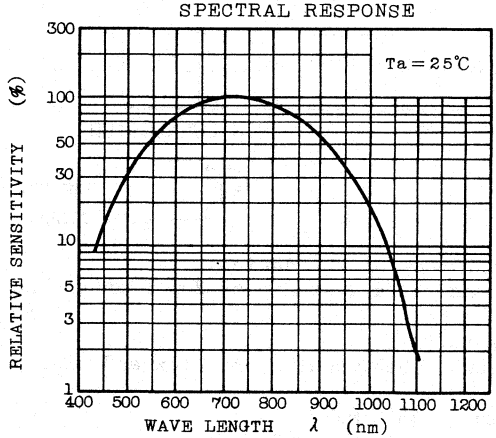
I_L — E



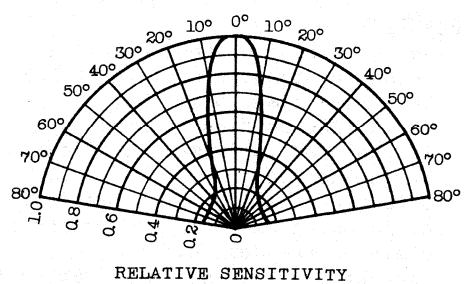
I_L — Ta



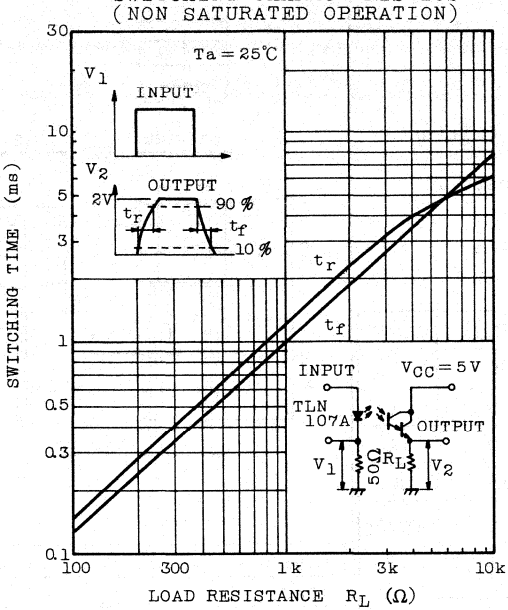
SPECTRAL RESPONSE



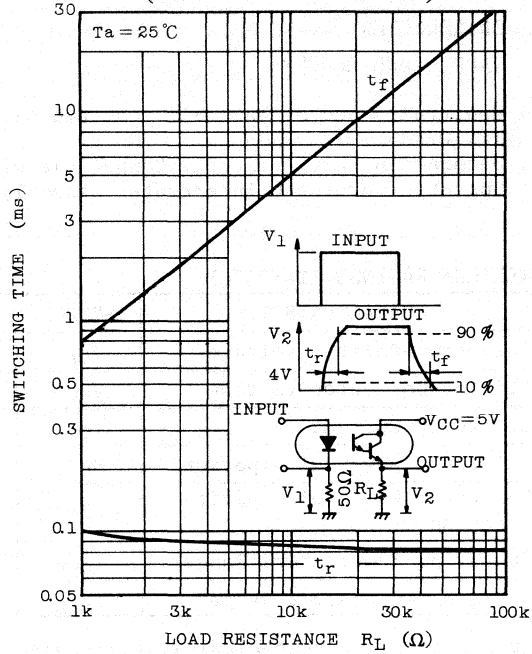
RELATIVE DIRECTIONAL SENSITIVITY
(Ta = 25℃)



SWITCHING CHARACTERISTICS
(NON SATURATED OPERATION)



SWITCHING CHARACTERISTICS
(SATURATED OPERATION)



TPS608A

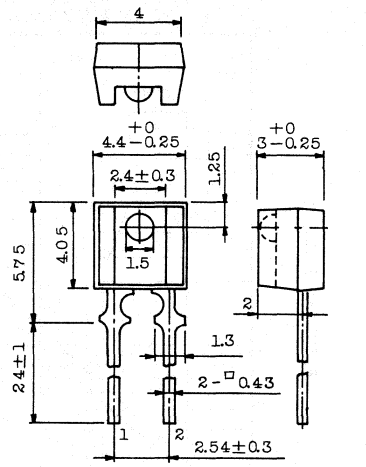
PHOTO TRANSISTOR
SILICON NPN EPITAXIAL PLANER

SILICON PHOTO TRANSISTOR FOR PHOTO SENSOR.

- . OPTICAL SWITCH
- . INTERRUPTER
- . TAPE, CARD READERS

- . Spectrally and Mechanically Matched with IR Emitter TLN107A.
- . Saturation Level Directly Compatible with Most TTL.
- . Suitable for Photo Interrupter Assembly.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	0-4B1A

Weight : 0.16g

MAXIMUM RATINGS (Ta=25°C)

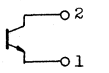
CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Emitter Voltage	V_{CEO}	30	V
Emitter-Collector Voltage	V_{ECO}	5	V
Collector Current	I_C	50	mA
Collector Power Dissipation	P_C	75	mW
Collector Power Dissipation Derating	$\Delta P_C/°C$	-1.0	mW/°C
Operating Temperature Range	T_{opr}	-25 ~ 85	°C
Storage Temperature Range	T_{stg}	-40 ~ 100	°C

OPTO-ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Dark Current		$I_D(I_{CEO})$	V_{CE}=24V, E=0	-	5	100	nA
Light Current		$I_L(I_C)$	V_{CE}=3V, E=0.1mW/cm^2 (Note)	30	100	-	μA
Collector-Emitter Saturation Voltage		$V_{CE(sat)}$	I_C=15μA, E=0.1mW/cm^2 (Note)	-	0.15	0.4	V
Switching Time	Rise Time	t_r	V_{CC}=5V, I_C=2mA, R_L=100Ω	-	6	-	μs
	Fall Time	t_f		-	6	-	μs

Note : Color temperature=2870°K Standard Tungsten Lamp.

PIN CONNECTION



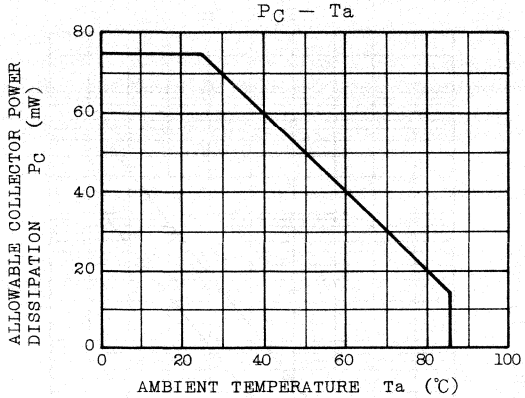
1. EMITTER
2. COLLECTOR

PRECAUTION

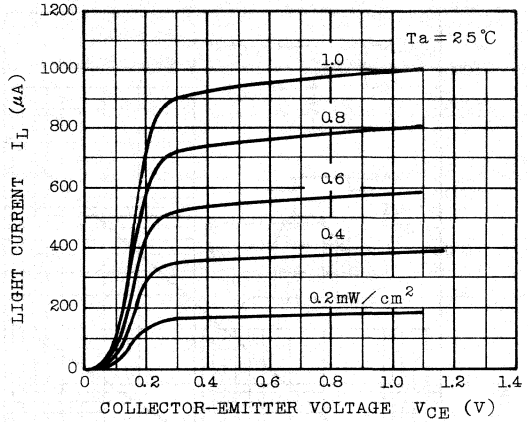
Please be careful of the followings.

1. Soldering temperature: 260°C MAX.
   Soldering time: 5 sec MAX.
   (Soldering portion of lead: up to 2mm from the body of the device)
2. If the lead is formed, the lead should be formed at a distance of 2mm from the body of the device.
   Soldering shall be performed after lead forming.
3. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   o Freon TE or TF o Dai-Fron Solvents S3 or S3-E

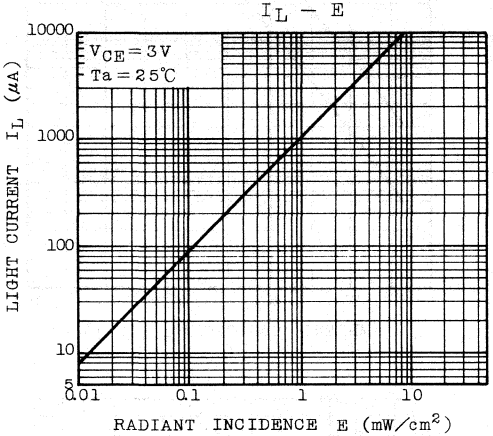
P_C — Ta



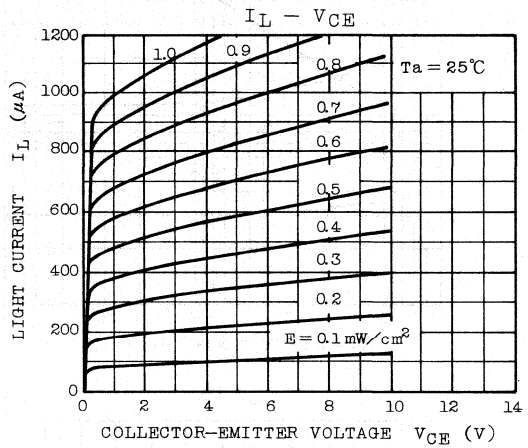
I_L — V_{CE} (LOW VOLTAGE REGION)



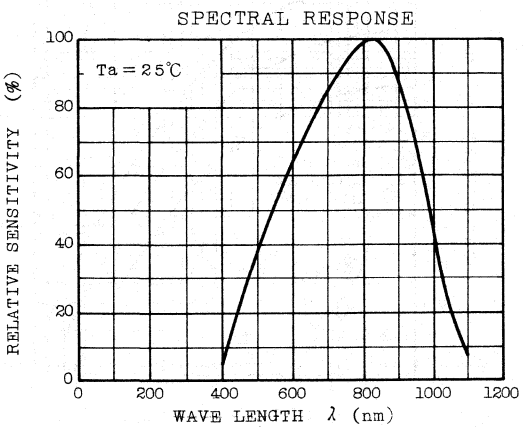
I_L — E



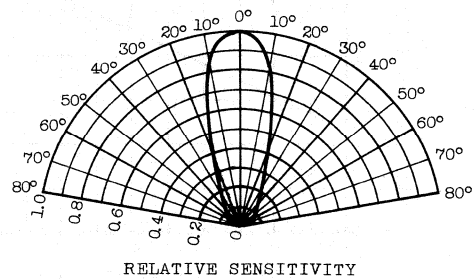
I_L — V_{CE}



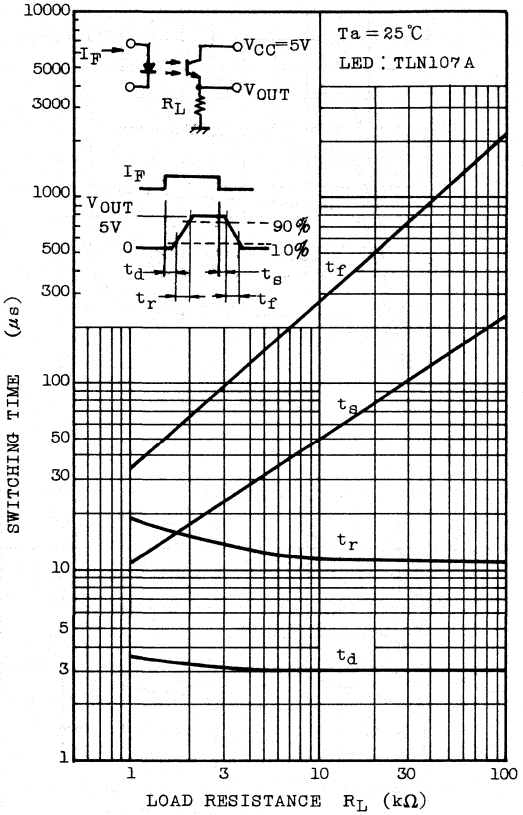
SPECTRAL RESPONSE



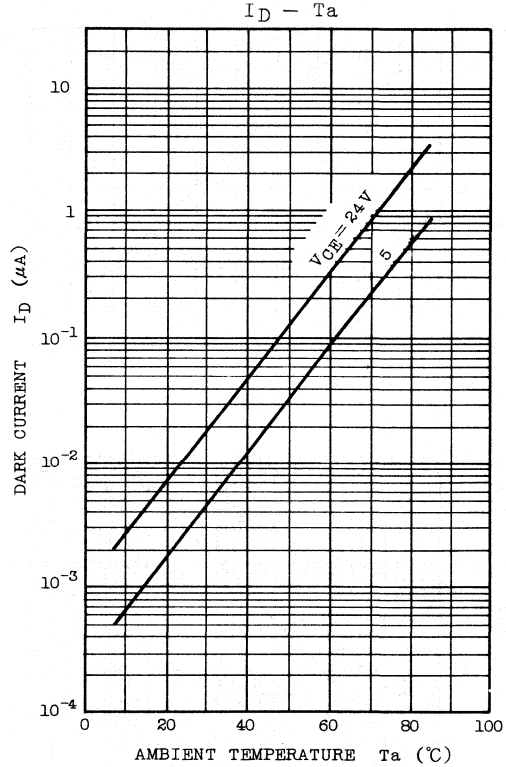
RELATIVE DIRECTIONAL SENSITIVITY
(Ta = 25℃)



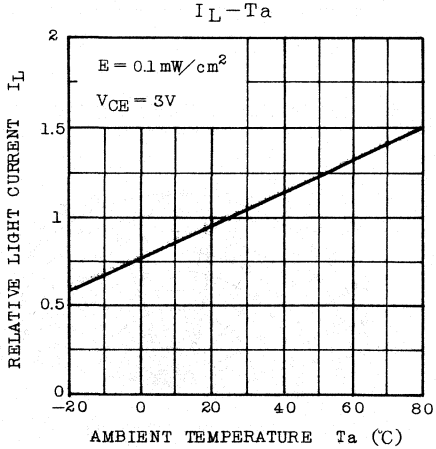
SWITCHING CHARACTERISTICS



I_D – Ta



I_L – Ta



I_L – d

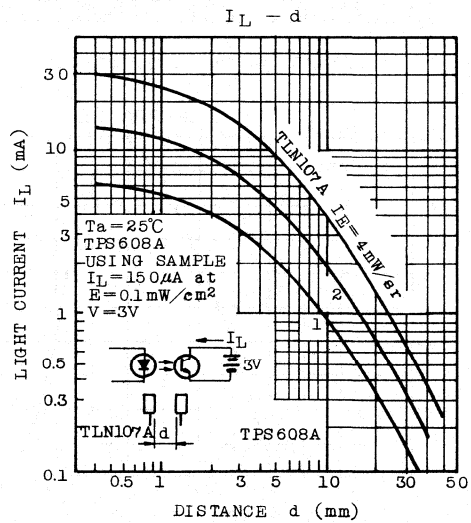


PHOTO TRANSISTOR
SILICON NPN EPITAXIAL PLANER

TPS610

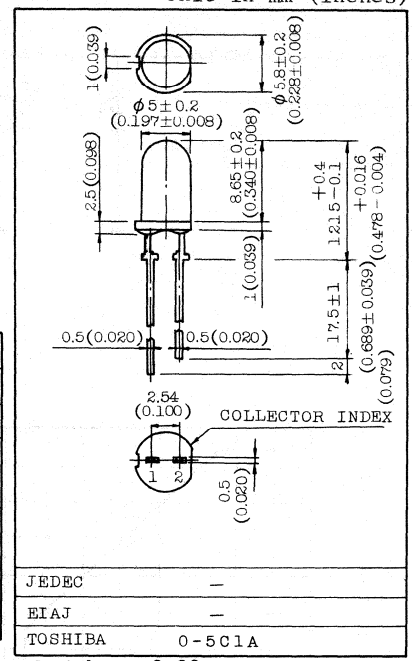
TENTATIVE DATA

SILICON PHOTO TRANSISTOR FOR PHOTO SENSOR

- OPTICAL SWITCH
- TAPE, CARD READERS
- VELOCITY SENSOR

- High Sensitivity: I_L=250μA (Typ.)
- Spectrally and Mechanically Matched with IR Emitter
  TLN105A, TLN110, TLN111, TLN205
- Glass-to-Metal-Seal Header
- Saturation Level Directly Compatible with Most TTL

Unit in mm (inches)



JEDEC	—
EIAJ	—
TOSHIBA	0-5C1A

Weight : 0.30g

MAXIMUM RATINGS (Ta=25°C)

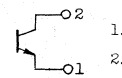
CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Emitter Voltage	V_{CEO}	30	V
Emitter-Collector Voltage	V_{ECO}	5	V
Collector Current	I_C	50	mA
Collector Power Dissipation	P_C	150	mW
Collector Power Dissipation Derating	ΔP_C/°C	-2.0	mW/°C
Operating Temperature Range	T_{opr}	-20 ∿ 75	°C
Storage Temperature Range	T_{stg}	-30 ∿ 100	°C

OPTO-ELECTRICAL CHARACTERISTICS

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Dark Current		$I_D(I_{CEO})$	V_{CE}=24V, E=0	-	5	100	nA
Light Current		$I_L(I_C)$	V_{CE}=3V, E=0.1mW/cm (Note)	100	250	-	μA
Collector-Emitter Saturation Voltage		$V_{CE(sat)}$	I_C=50μA, E=0.1mW/cm	-	0.25	0.4	V
Switching Time	Rise Time	t_r	V_{CC}=5V, I_C=2mA, R_L=100Ω (Fig. 1)	-	6	-	μs
	Fall Time	t_f		-	6		

Note: Color temperature = 2870°K Standard Tungsten Lamp.

PIN CONNECTION



1. EMITTER
2. COLLECTOR

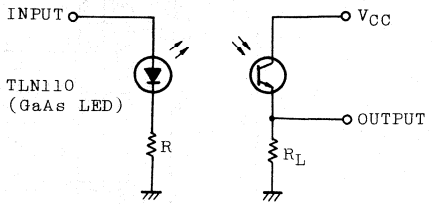
PRECAUTION

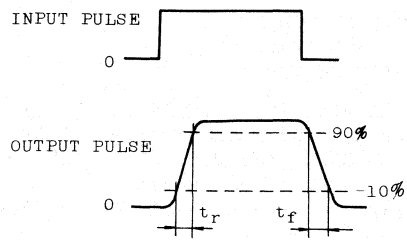
Please be careful of the followings

1. Soldering temperature: 260°C MAX. Soldering time: 5 sec MAX.
   (Soldering portion of lead: up to 2 mm from the body of the device)
2. If the lead is formed, the lead should be formed at below the lead stopper.

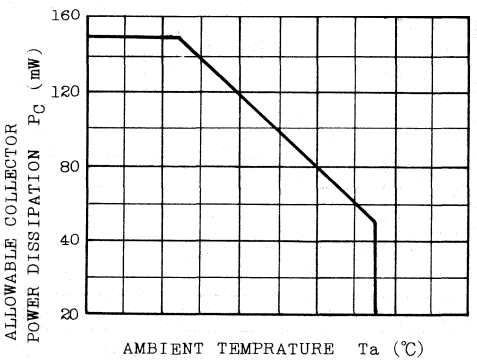
   Soldering shall be performed after lead forming.
3. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   o Freon TE or TF o Dai-Fron Solvents S3 or S3-E

Fig.1 SWITCHING TIME TEST CIRCUIT

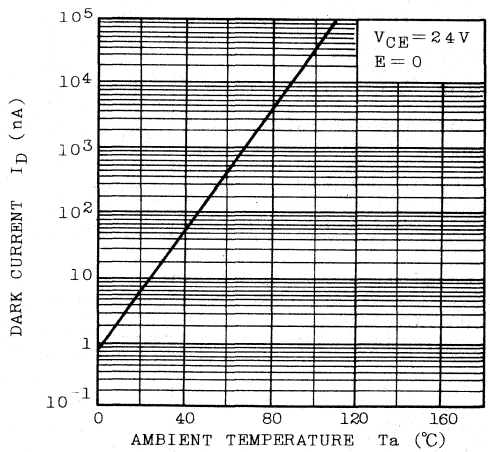




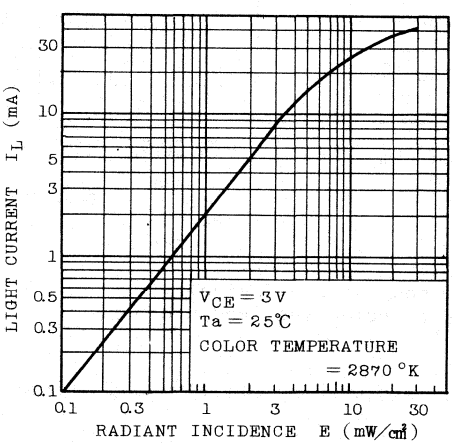
P_C – Ta



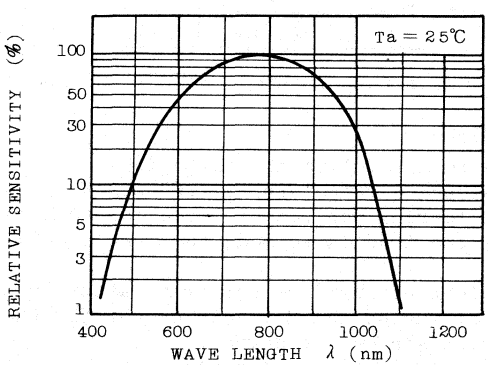
I_D – Ta



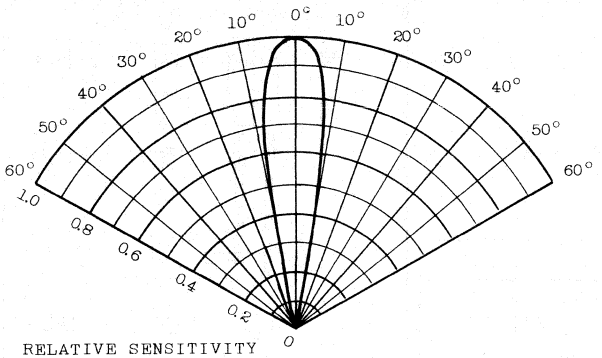
I_L – E



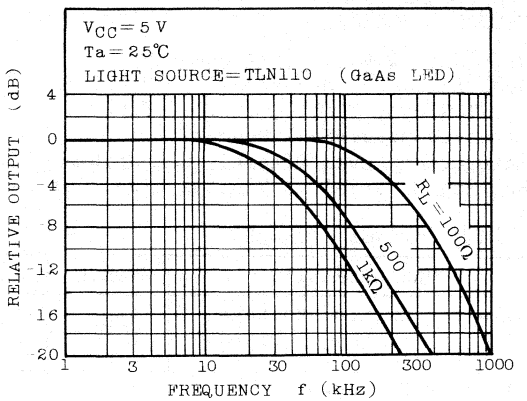
SPECTRAL RESPONSE



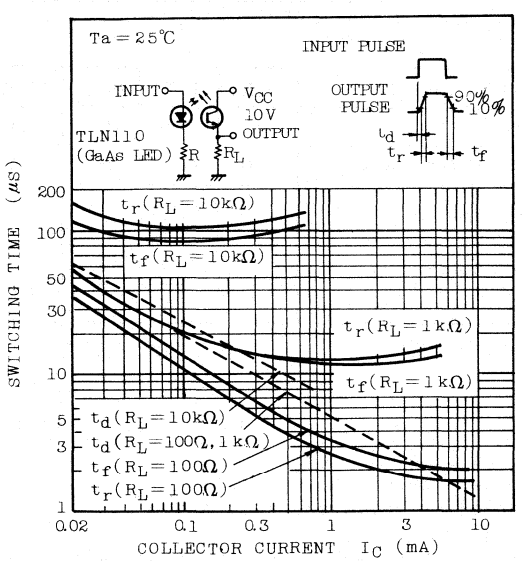
RELATIVE DIRECTIONAL SENSITIVITY
(Ta = 25℃)



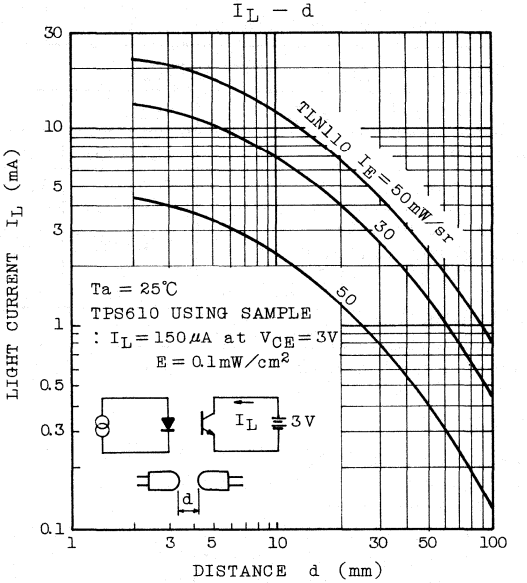
FREQUENCY CHARACTERISTICS



SWITCHING CHARACTERISTICS



I_L – d



TPS611

PHOTO TRANSISTOR
SILICON NPN EPITAXIAL PLANER

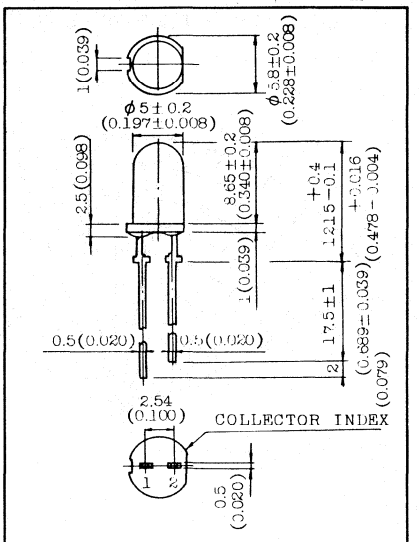
TENTATIVE DATA

SILICON PHOTO TRANSISTOR FOR PHOTO SENSOR

- OPTICAL SWITCH
- TAPE, CARD READERS
- VELOCITY SENSOR

- High Sensitivity: I_L=120μA (Typ.)
- Spectrally and Mechnically Matched with IR Emitter
  TLN105A, TLN110, TLN111, TLN205
- Glass-to-Metal-Seal Header
- Saturation Level Directly Compatible with Most TTL
- Housing Material is Visible Light cut one.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	0-5C1A

Weight : 0.30g

MAXIMUM RATINGS (Ta=25°C)

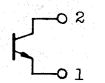
CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Emitter Voltage	V_{CEO}	30	V
Emitter-Collector Voltage	V_{ECO}	5	V
Collector Current	I_C	50	mA
Collector Power Dissipation	P_C	150	mW
Collector Power Dissipation Detating	ΔP_C/°C	-2.0	mW/°C
Operating Temperature Range	T_{opr}	-20 ∿75	°C
Storage Temperature Range	T_{stg}	-30 ∿150	°C

OPTO-ELECTRICAL CHARACTERISTICS

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Dark Current		$I_L(I_{CEO})$	V_{CE}=24V,E=0	-	5	100	nA
Light Current		$I_L(I_C)$	V_{CE}=3V,E=0.1mW/cm (Note)	30	120	-	μA
Collector-Emitter Saturation Voltage		V_{CE}(sat)	I_C=50μA,E=0.1mW/cm	-	0.25	0.4	V
Switching Time	Rise Time	t_r	V_{CC}=5V,I_C=2mA,R_L=100Ω (Fig. 1)	-	6	-	μs
	Fall Time	t_f		-	6	-	

Note: Color temperature = 2870°K Standard Tungsten Lamp

PIN CONNECTION



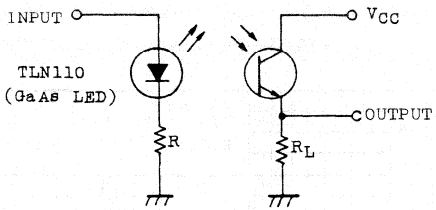
1. EMITTER
2. COLLECTOR

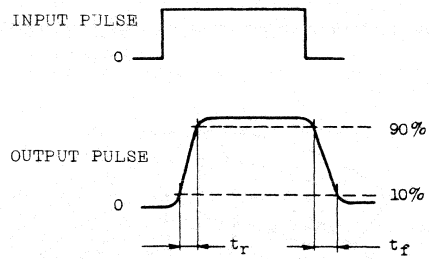
PRECAUTION

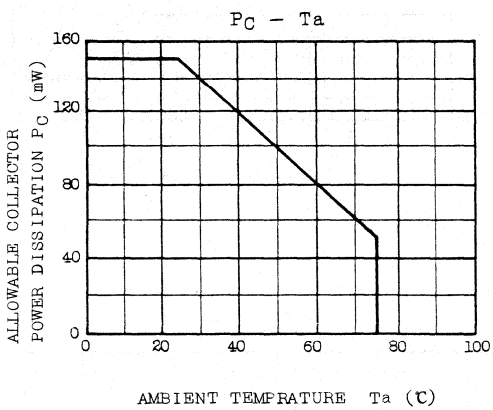
Please be careful of the followings

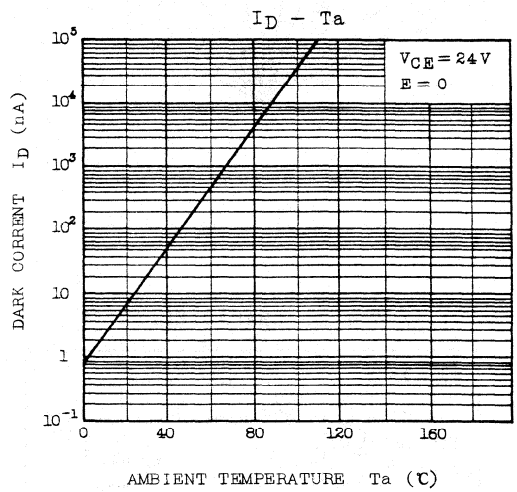
1. Soldering temperature: 260°C MAX. Soldering time: 5 sec MAX.
   (Soldering portion of lead: up to 2 mm from the body of the device)
2. If the lead is formed, the lead should be formed at below the lead stopper.
   Soldering shall be performed after lead forming.
3. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   ∘ Freon TEor TF ∘ Dai-Fron Solvents S3 or S3-E

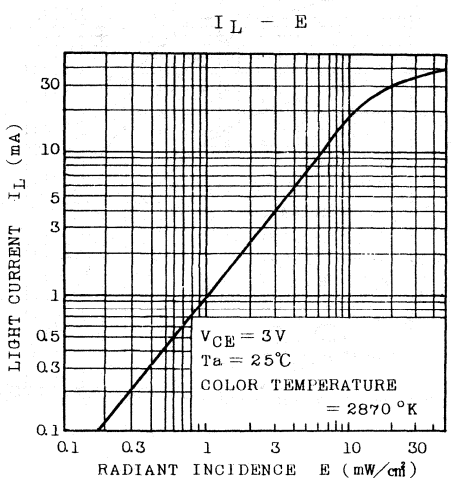
Fig.1 SWITCHING TIME TEST CIRCUIT

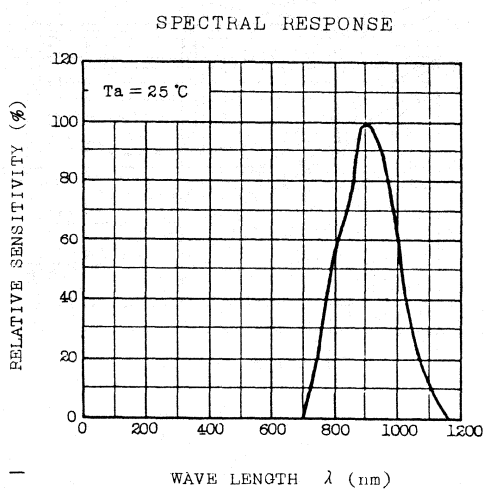




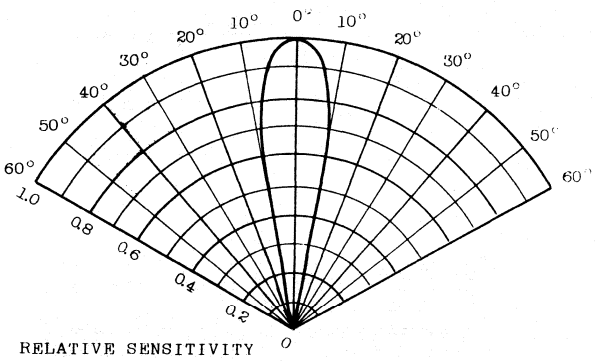




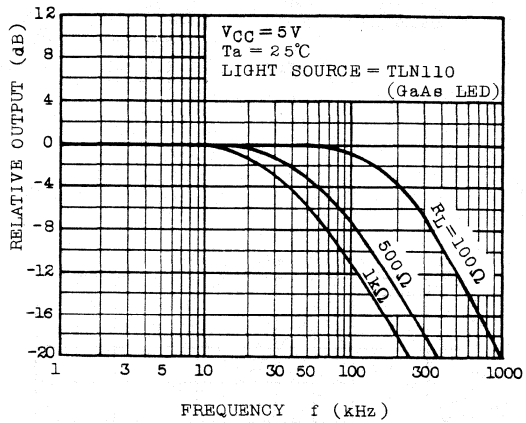




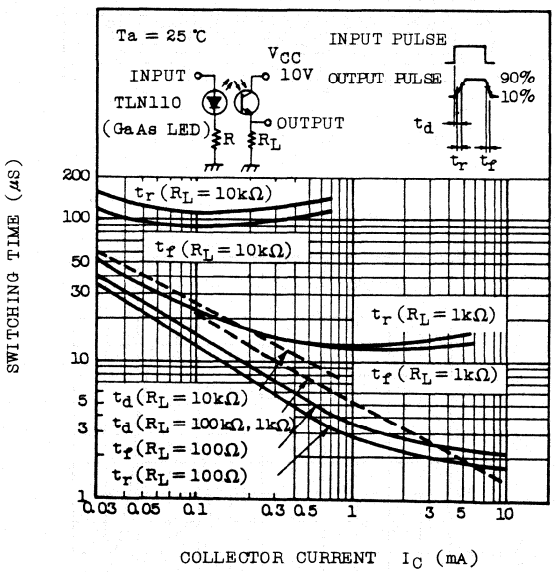
RELATIVE DIRECTIONAL SENSITIVITY
(Ta = 25°C)



FREQUENCY CHARACTERISTICS



SWITCHING CHARACTERISTICS



I_L – d

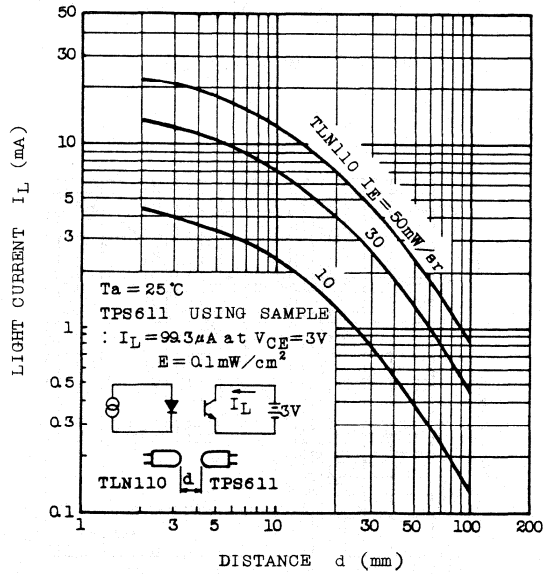


PHOTO TRANSISTOR
SILICON NPN EPITAXIAL PLANER

TPS612

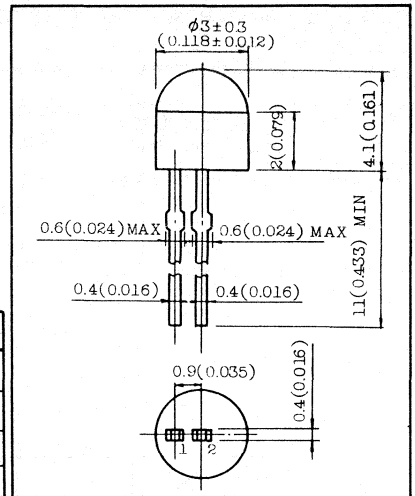
TENTATIVE DATA

SILICON PHOTO TRANSISTOR FOR PHOTO SENSOR

- OPTICAL SWITCH
- POSITION SENSOR
- TAPE, CARD READERS
- ENCODERS

- Spectrally and Mechanically Matched with IR Emitter TLN113
- Housing Material is Visible Light cut one.

Unit in mm (inches)



JEDEC	—
EIAJ	—
TOSHIBA	0-3C1A

Weight : 0.08g

MAXIMUM RATINGS

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Emitter Voltage	V_{CEO}	20	V
Emitter-Collector Voltage	V_{ECO}	5	V
Collector Current	I_C	20	mA
Collector Power Dissipation	ΔP_C	75	mW
Collector Power Dissipation Derating	P_C/°C	-1.0	mW/°C
Operating Temperature Range	T_{opr}	-20 ∿ 75	°C
Storage Temperature Range	T_{stg}	-30 ∿ 100	°C

OPTO-ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Dark Current		$I_D(I_{CEO})$	V_{CE}=10V,E=0	-	10	100	nA
Light Current		$I_L(IC)$ (Note 2)	V_{CE}=3V,E=0.1mW/cm^2 (Note 1)	14	-	180	μA
Collector-Emitter Saturation Voltage		$V_{CE}(sat)$	I_C=7μA,E=0.1mW/cm^2 (Note 1)	-	0.2	0.4	V
Siitching Time	Rise Time	t_r	V_{CC}=10V,I_C=1mA,R_L=100Ω (Fig. 1)	-	4	-	μs
	Fall Time	t_f		-	3	-	

Note 1: Color temperature=2870°K Standard Tungsten Lamp
Note 2: I Classification AB: 14∿16,BC: 24∿105,
A: 14∿35,B: 24∿60,C: 42∿150,

PIN CONNECTION

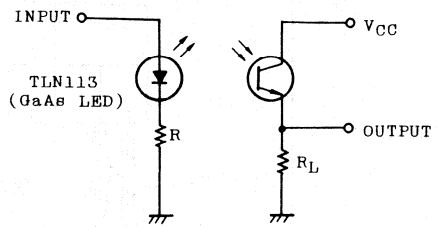
1. EMITTER
2. COLLECTOR

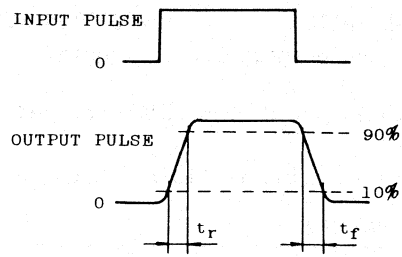
PRECAUTION

Please be careful of the followings

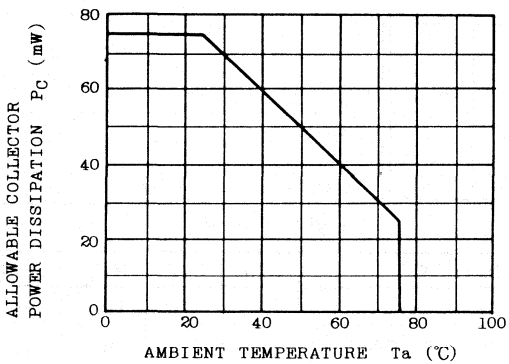
1. Soldering temperature: 260°C MAX. Soldering time: 3 sec MAX.
   (Soldering portion of lead: up to 1.5mm from the body of the device)
2. If the lead is formed, the lead should be formed at a distance of 2mm from the body of the device.
   Soldering shall be performed after lead forming.
3. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   ◦ Freon TE or TF ◦ Dai-Fron Solvents S3 or S3-E

Fig.1 SWITCHING TIME TEST CIRCUIT

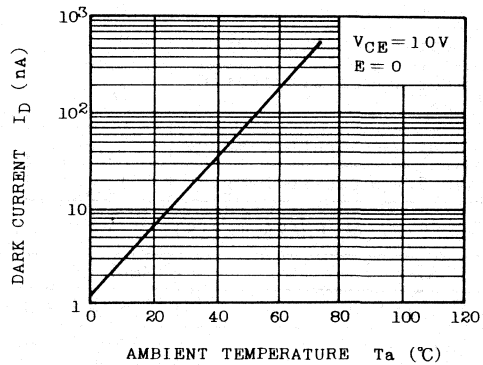




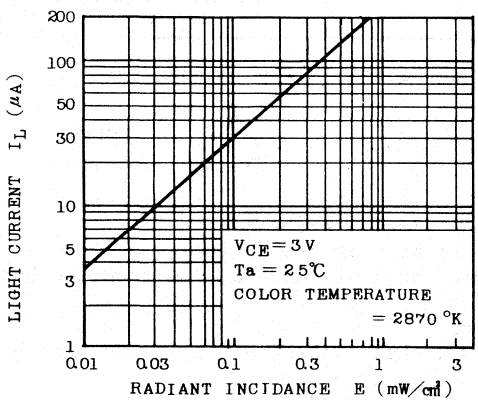
P_C – Ta



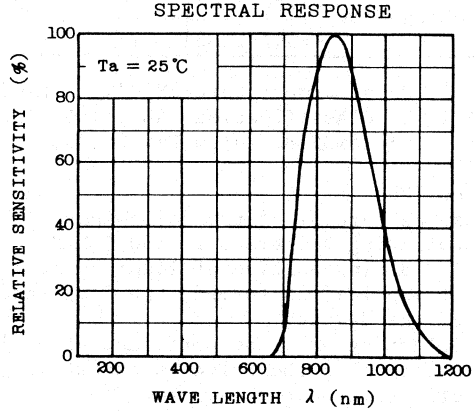
I_D – Ta



I_L – E

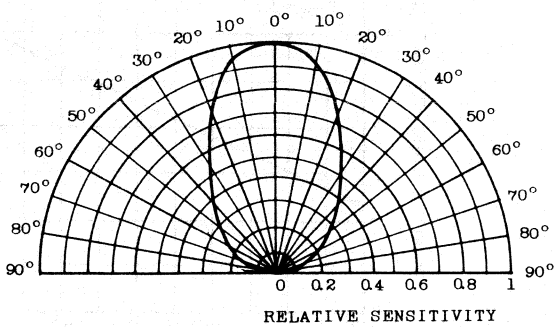


SPECTRAL RESPONSE

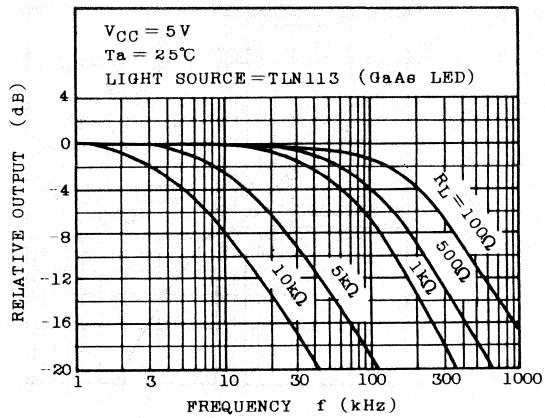


RELATIVE DIRECTIONAL SENSITIVITY

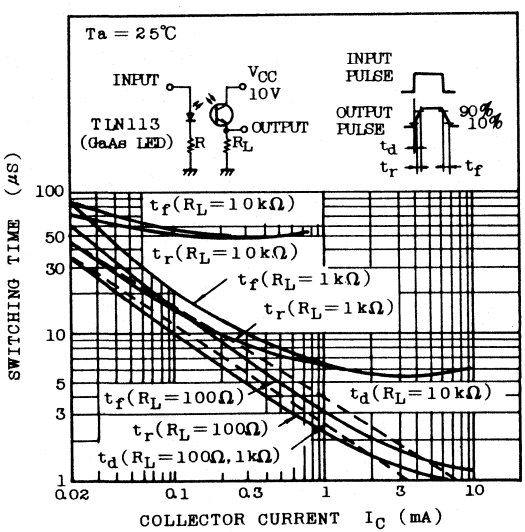
(Ta = 25℃)



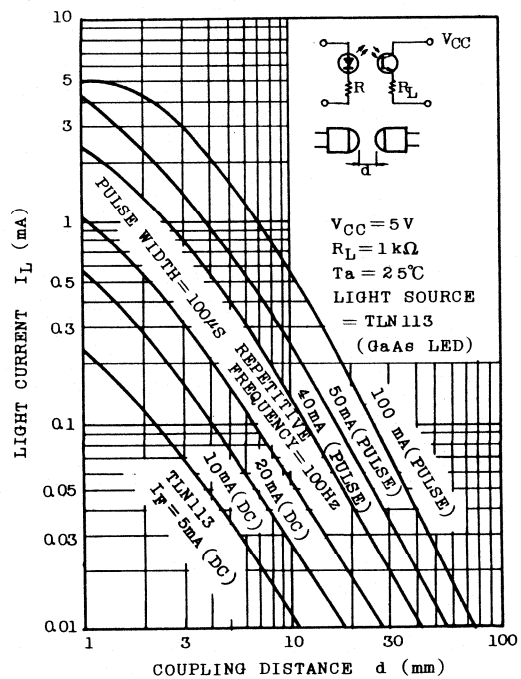
FREQUENCY CHARACTERISTICS



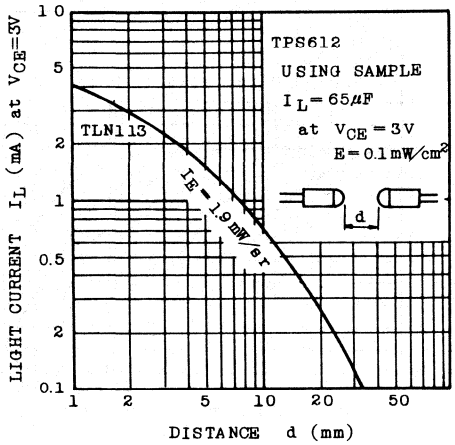
SWITCHING CHARACTERISTICS



COUPLING CHARACTERISTICS



I_L – d


TPS612
USING SAMPLE
I_L = 65μF
at V_{CE} = 3V
E = 0.1mW/cm²
TLN113
IE = 1.9mW/sr
d
LIGHT CURRENT I_L (mA) at V_{CE}=3V
10
5
2
1
0.5
2
0.1
1
2
5
10
20
50
DISTANCE d (mm)

I_L – Ta

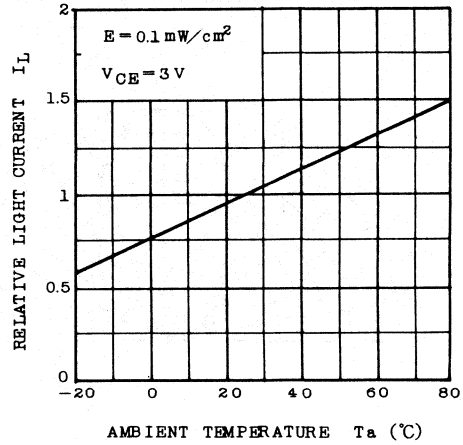

E = 0.1mW/cm²
V_{CE} = 3V
RELATIVE LIGHT CURRENT I_L
2
1.5
1
0.5
0
−20
0
20
40
60
80
AMBIENT TEMPERATURE Ta (℃)

PHOTO TRANSISTOR
SILICON NPN EPITAXIAL PLANER

TPS613

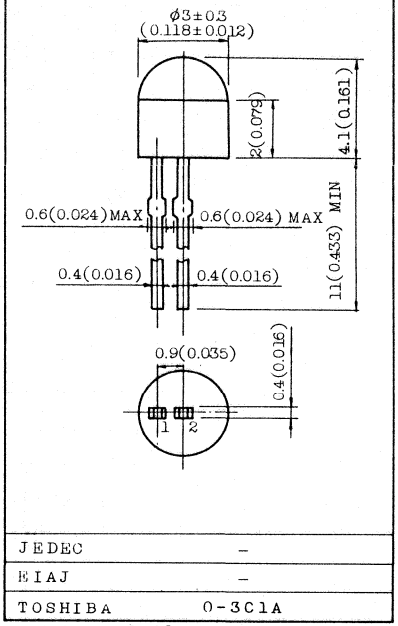
TENTATIVE DATA

SILICON PHOTO TRANSISTOR FOR PHOTO SENSOR

- OPTICAL SWITCH
- POSITION SENSOR
- TAPE, CARD READERS
- ENCODERS

- Spectrally and Mechanically Matched with IR Emitter TLN113

Unit in mm (inches)



JEDEC	–
EIAJ	–
TOSHIBA	0-3C1A

Weight : 0.08g

MAXIMUM RATINGS

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Emitter Voltage	V_{CEO}	20	V
Emitter-Collector Voltage	V_{ECO}	5	V
Collector Current	I_C	20	mA
Collector Power Dissipation	P_C	75	mW
Collector Power Dissipation Derating	$\Delta P_C/°C$	-1.0	mW/°C
Operating Temperature Range	T_{opr}	-20 ∿ 75	°C
Storage Temperature Range	T_{stg}	-30 ∿ 100	°C

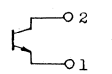
OPTO-ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Dark Current		$I_D(I_{CEO})$	V_{CE}=10V, E=0	–	10	100	nA
Light Current		$I_L(I_C)$ (Note 2)	V_{CE}=3V, E=0.1mW/cm² (Note 1)	20	–	260	μA
Collector-Emitter Saturation Voltage		$V_{CE(sat)}$	I_C=10μA, E=0.1mW/cm² (Note 1)	–	0.2	0.4	V
Switching Time	Rise Time	t_r	V_{CC}=10V, I_C=1mA, R_L=100Ω (Fig.1)	–	4	–	μs
	Fall Time	t_f		–	3	–	

Note 1: Color temperature=2870°K Standard Tungsten Lamp

Note 2: I_L Classification AB: 20∿85, BC: 34∿150, A: 20∿50
B: 34∿85, C: 60∿150

PIN CONNECTION

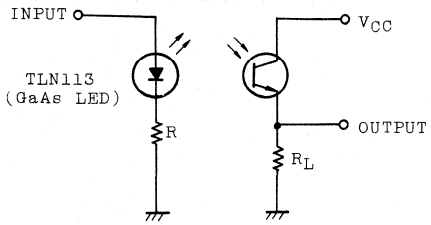


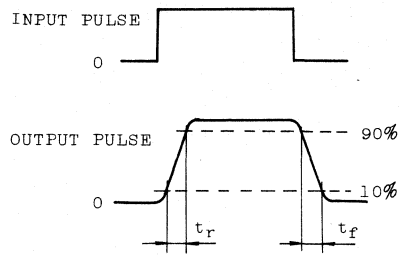
1. EMITTER
2. COLLECTOR

PRECAUTION

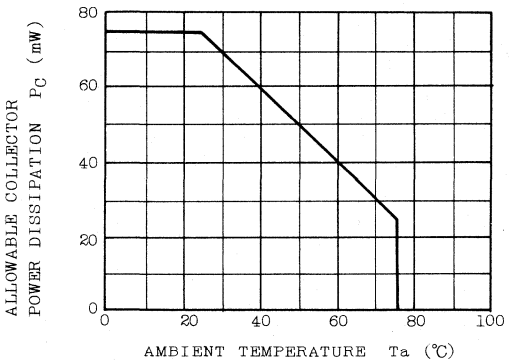
Please be careful of the followings

1. Soldering temperature: 260°C MAX. Soldering time: 3 sec MAX.
   (Soldering portion of lead: up to 1.5mm from the body of the device)
2. If the lead is formed, the lead should be formed at a distance of 2mm from the body of the device.
   Soldering shall be performed after lead forming.
3. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   o Freon TE or TF o Dai-Fron Solvents S3 or S3-E

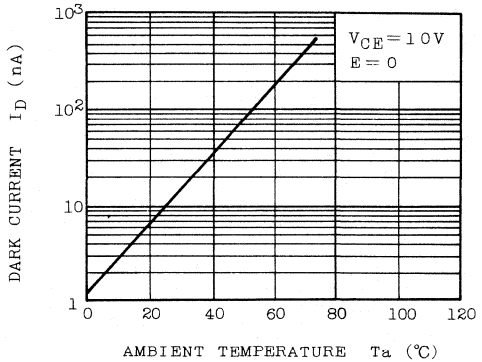




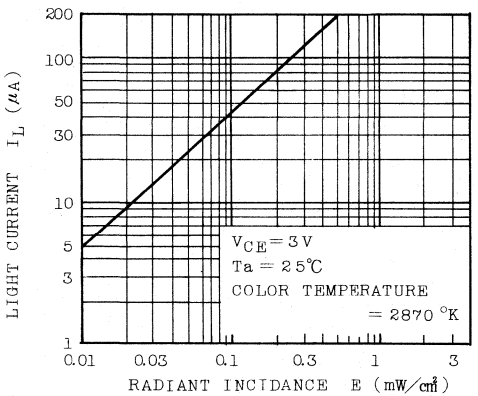
P_C – Ta



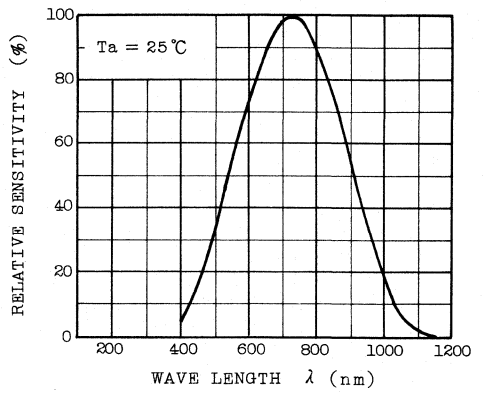
I_D – Ta



I_L – E

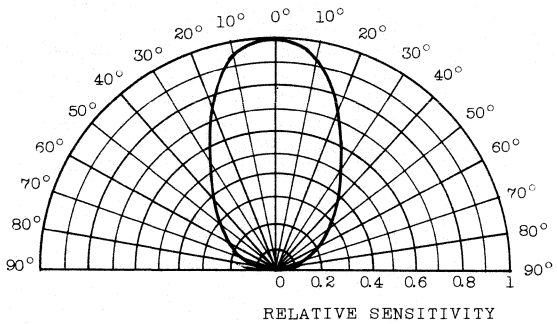


SPECTRAL RESPONSE

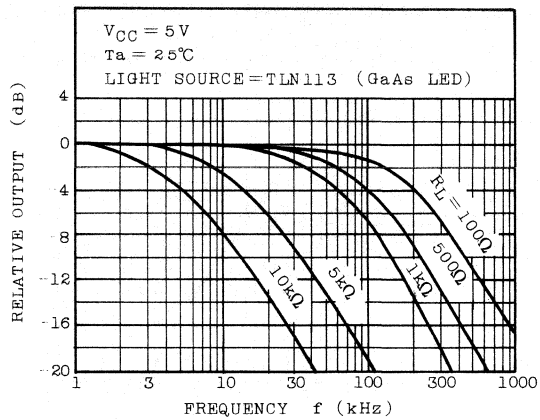


RELATIVE DIRECTIONAL SENSITIVITY

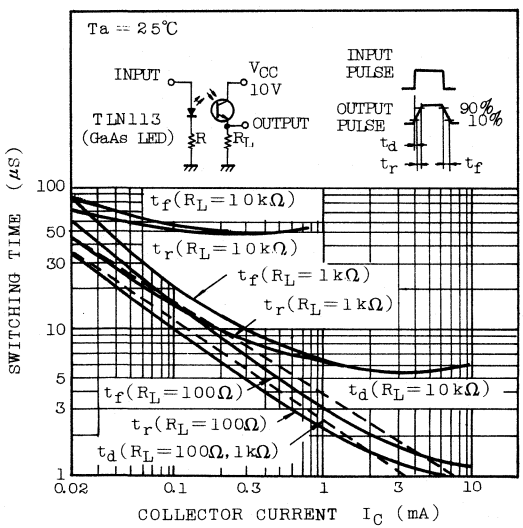
(Ta = 25℃)



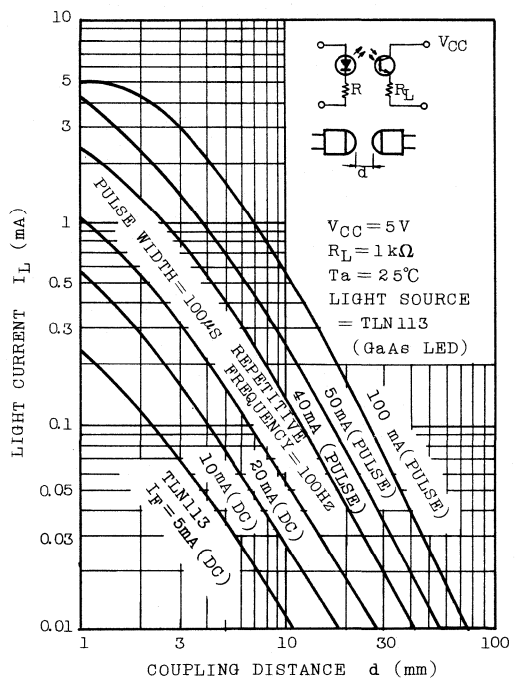
FREQUENCY CHARACTERISTICS



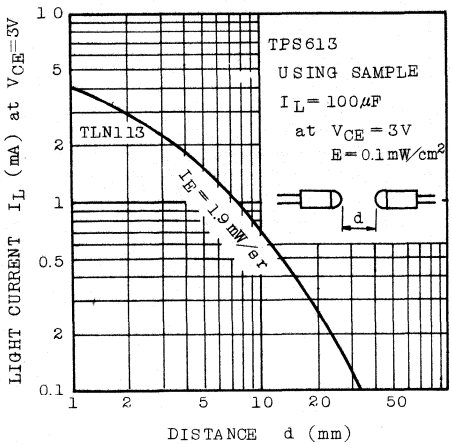
SWITCHING CHARACTERISTICS



COUPLING CHARACTERISTICS



I_L – d


LIGHT CURRENT I_L (mA) at V_{CE}=3V
10
5
2
1
0.5
2
0.1
1
2
5
10
20
50
DISTANCE d (mm)
TPS613
USING SAMPLE
I_L= 100μF
at V_{CE} = 3V
E=0.1mW/cm²
TLN113
IE = 1.9mW/cm²
d

I_L – Ta

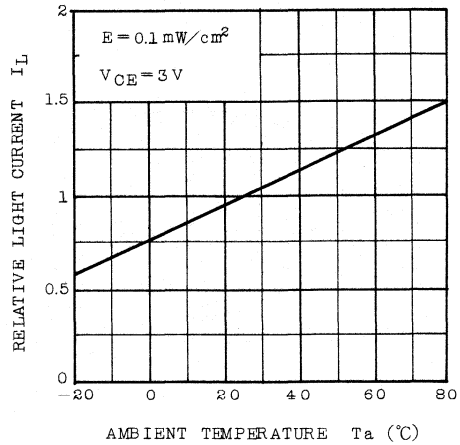

RELATIVE LIGHT CURRENT I_L
2
1.5
1
0.5
0
−20
0
20
40
60
80
AMBIENT TEMPERATURE Ta (℃)
E = 0.1 mW/cm²
V_{CE} = 3 V

PHOTO TRANSISTOR
SILICON NPN EPITAXIAL PLANER

TPS614

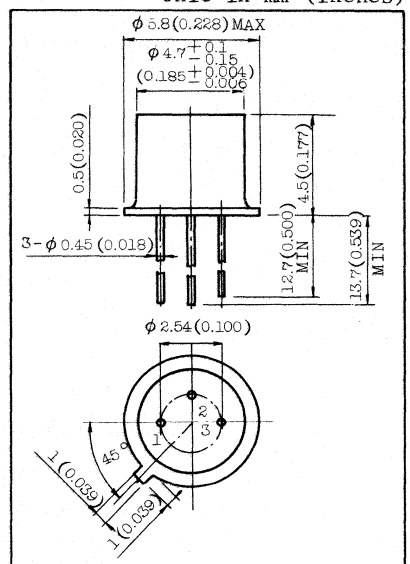
TENTATIVE DATA

SILICON PHOTO TRANSISTOR FOR PHOTO SENSOR

- OPTICAL SWITCH
- TAPE, CARD READERS
- VELOCITY SENSOR

- High Sensitivity: I_L=1.5mA (Typ.)
- Spectrally and Mechanically Matched with IR Emitter TLN108
- Glass-to-Metal-Seal Header
- Saturation Level Directly Compatible with Most TTL

Unit in mm (inches)



JEDEC	—
EIAJ	—
TOSHIBA	0-5D1A

Weight: 0.27g

MAXIMUM RATINGS (Ta=25°C)

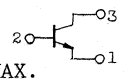
CHARACERISTIC	SYMBOL	RATING	UNIT
Collector-Emitter Voltage	V_{CEO}	40	V
Emitter-Collector Voltage	V_{ECO}	5	V
Collector Current	I_C	50	mA
Collector Power Dissipation	P_C	150	mW
Collector Power Dissipation Derating	ΔP_C/°C	-1.2	mW/°C
Operating Temperature Range	T_{opr}	-40 ∿ 125	°C
Storage Temperature Range	T_{stg}	-55 ∿ 150	°C

OPTO-ELECTRICAL CHARACTERISTICS

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Dark Current		I_D(I_{CEO})	V_{CE}=30V, E=0	-	10	200	nA
Light Current		I_L(I_C)	V_{CE}=3V, E=10mW/cm^2 (Note)	0.6	1.5	-	mA
Collector-Emitter Saturation Voltage		$V_{CE(sat)}$	I_C=0.3mA, E=10mW/cm^2	-	0.25	0.4	V
Switching Time	Rise Time	t_r	V_{CC}=5V, I_C=10mA, R_L=100Ω	-	2	-	μs
	Fall Time	t_f	(Fig. 1)	-	2	-	

Note: Color temperature = 2870°K Standard Tungsten Lamp.

PIN CONNECTION

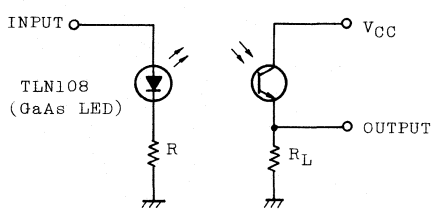


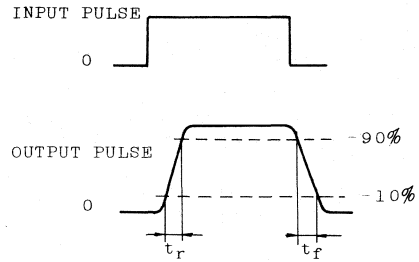
1. EMITTER
2. BASE
3. COLLECTOR

PRECAUTION

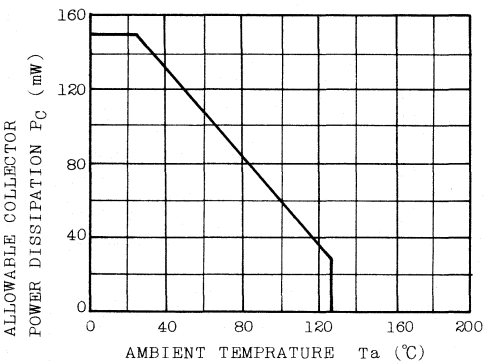
1. Soldering temperature: 260°C MAX. Soldering time: 5 sec MAX.
   (Soldering portion of lead: up to 1.5 mm from the body of the device)
2. If the lead is formed, the lead should be formed at a distance of 2 mm from the body of the device.
   Soldering shall be performed after lead forming.
3. Avoid using the Solvents except for the followings, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   o Freon TE or TF o Dai-Fron Solvents S3 or S3-E o Chlorothene

Fig.1 SWITCHING TIME TEST CIRCUIT

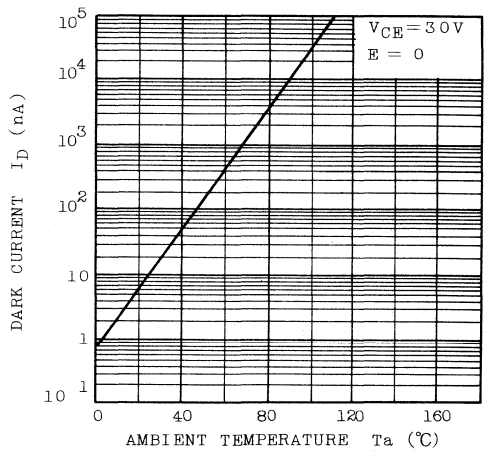




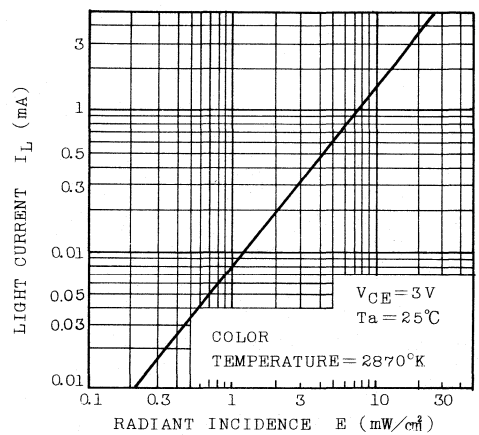
P_C – Ta



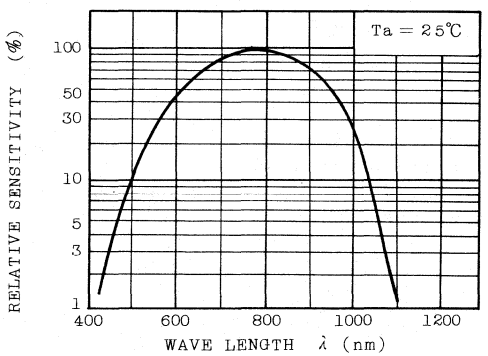
I_D – Ta



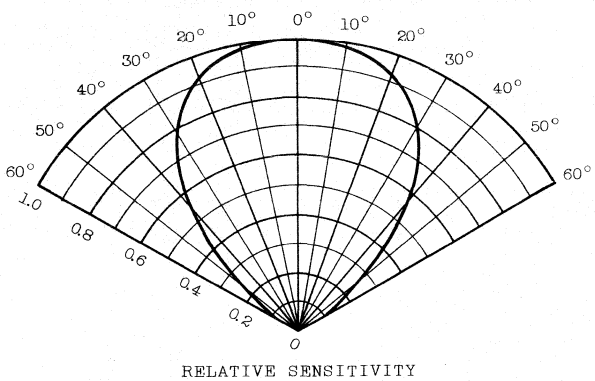
I_L – E



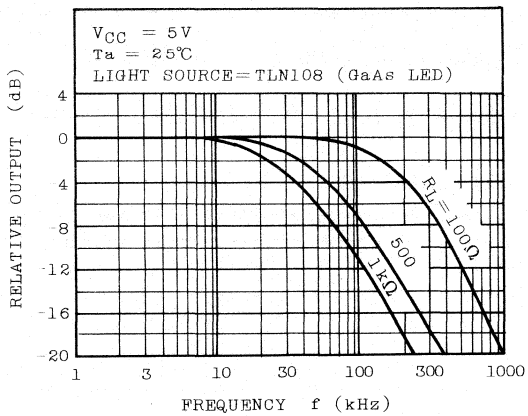
SPECTRAL RESPONSE



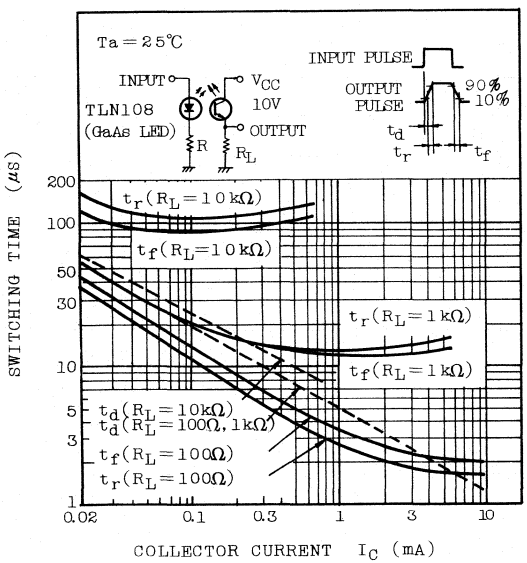
RELATIVE DIRECTIONAL SENSITIVITY
(Ta = 25℃)



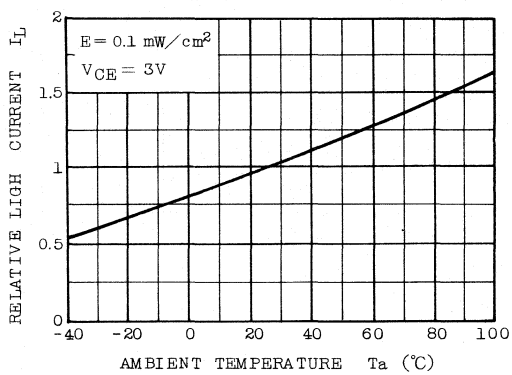
FREQUENCY CHARACTERISTICS



SWITCHING CHARACTERISTICS



I_L – Ta



TPS615

PHOTO TRANSISTOR
SILICON NPN EPITAXIAL PLANER

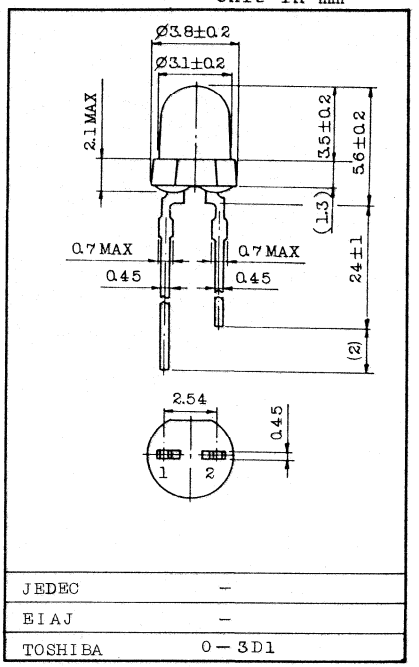
TENTATIVE DATA

SILICON PHOTO TRANSISTOR FOR PHOTO SENSOR

- OPTICAL SWITCH
- POSITION SENSOR
- TAPE, CARD READERS
- ENCODERS

- Spectrally and Mechanically Matched with IR Emitter TLN109

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	0—3D1

MAXIMUM RATINGS

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Emitter Voltage	V_{CEO}	30	V
Emitter-Collector Voltage	V_{ECO}	5	V
Collector Current	I_C	20	mA
Collector Power Dissipation	P_C	75	mW
Collector Power Dissipation Derating	$\Delta P_C/°C$	-1.0	mW/°C
Operating Temperature Range	T_{opr}	-30 ∿ 85	°C
Storage Temperature Range	T_{stg}	-30 ∿ 100	°C

OPTO-ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Dark Current		$I_D(I_{CEO})$	V_{CE}=24V, E=0	-	10	100	nA
Light Current		I_L(IC)	V_{CE}=3V, E=0.1mW/cm^2 (Note 1)	20	45	-	μA
Collector-Emitter Saturation Voltage		V_{CE}(sat)	I_C=10μA, E=0.1mW/cm^2(Note 1)	-	0.2	0.4	V
Switching Time	Rise Time	t_r	V_{CC}=10V, I_C=1mA, R_L=1kΩ (Fig. 1)	-	9	-	μs
	Fall Time	t_f		-	10	-	

Note 1: Color temperature=2870°K Standard Tangsten Lamp

PIN CONNECTION

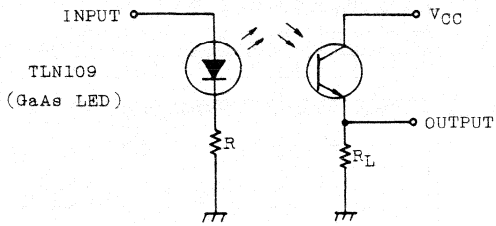
1. EMITTER
2. COLLECTOR

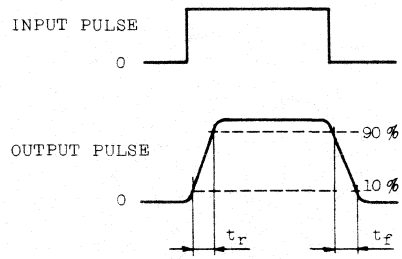
PRECAUTION

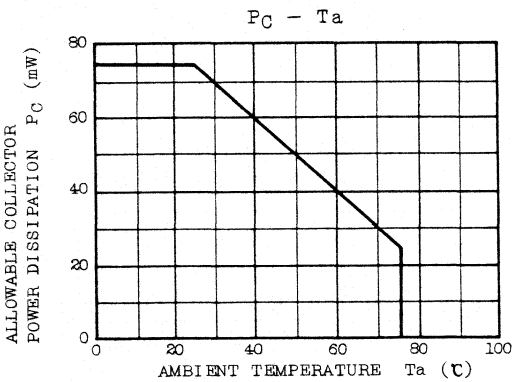
Please be careful of the following

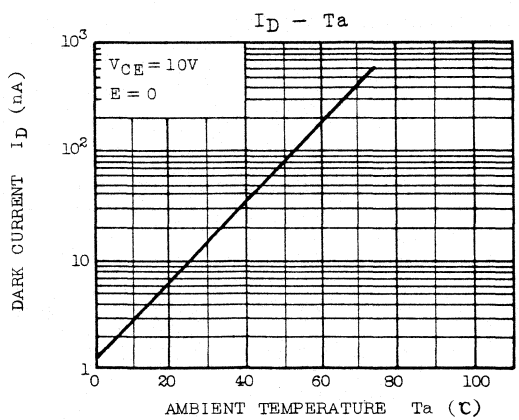
1. Soldering temperature: 260°C MAX. Soldering time: 3 sec MAX.
   (Soldering portion of lead: up to 1.5mm from the body of the device)
2. If the lead is formed, the lead should be formed at a distance of 2mm from the body of the device.
   Soldering shall be performed after lead forming.
3. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   ∘ Freon TE or TF ∘ Dai-Fron Solvents S3 or S3-E

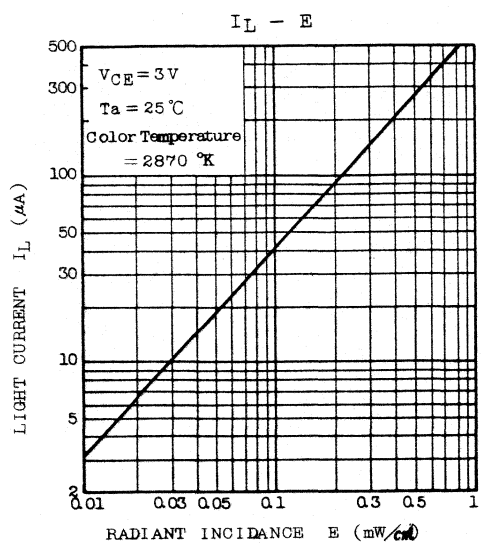
Fig.1 SWITCHING TIME TEST CIRCUIT

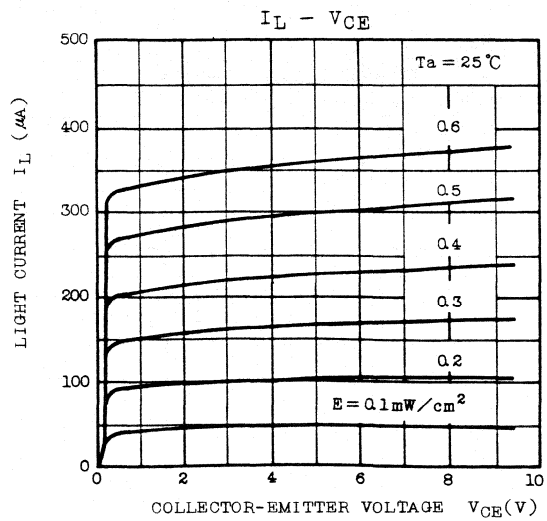




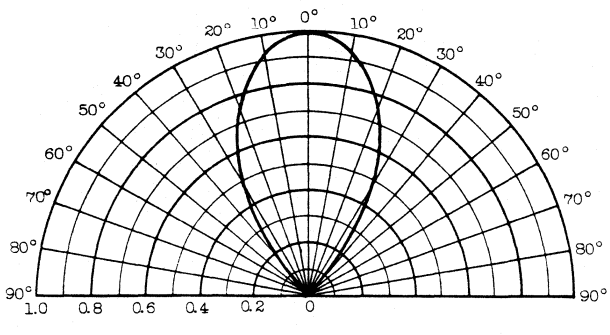






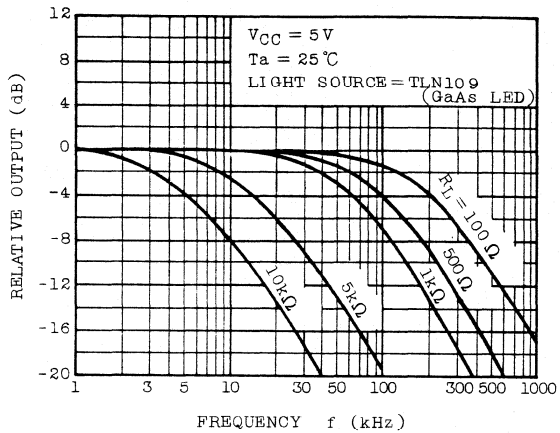


RELATIVE DIRECTIONAL SENSITIVITY
(Ta = 25℃)

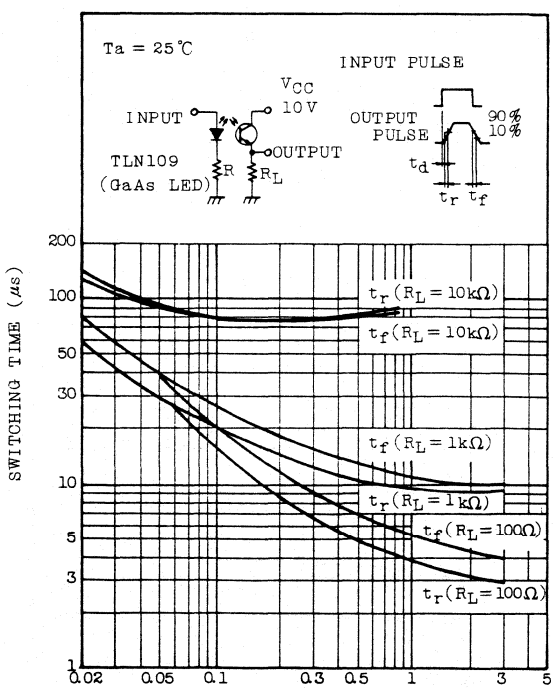


RELATIVE SENSITIVITY

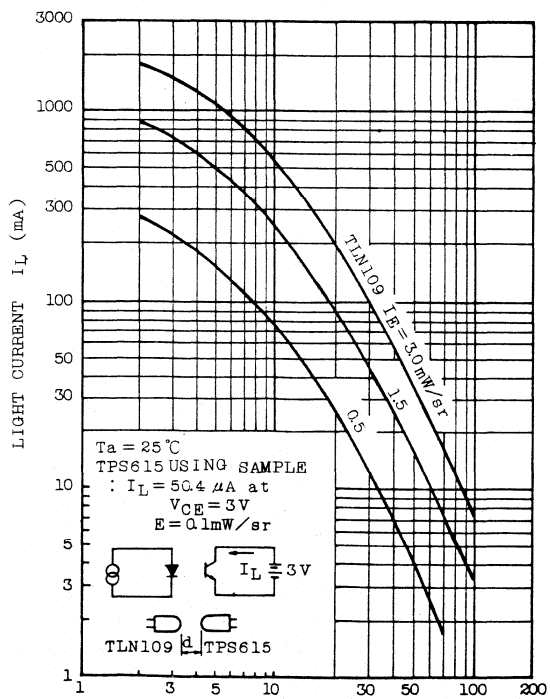
FREQUENCY CHARACTERISTICS



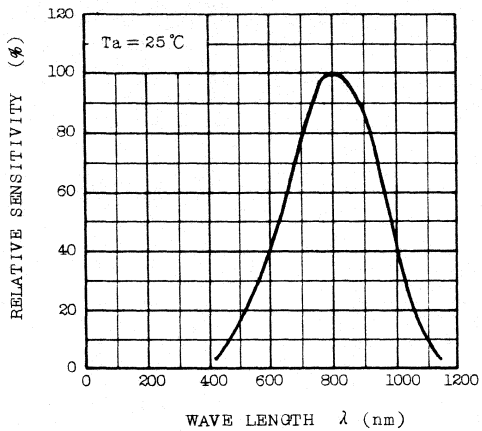
SWITCHING CHARACTERISTICS



COUPLING CHARACTERISTICS
TLN109 and TPS615



SPECTRAL RESPONSE



TPS616

PHOTO TRANSISTOR
SILICON NPN EPITAXIAL PLANER

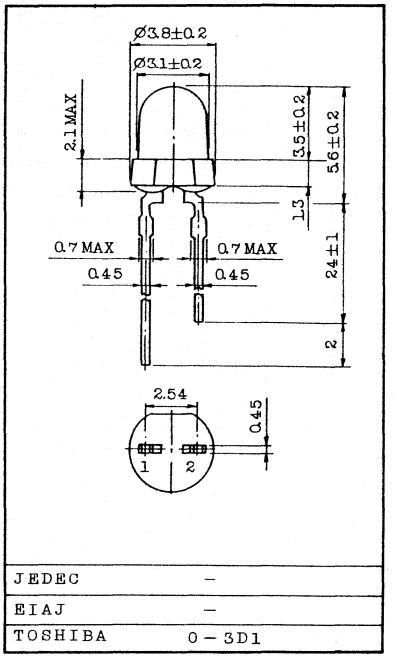
TENTATIVE DATA

SILICON PHOTO TRANSISTOR FOR PHOTO SENSOR

- ○ OPTICAL SWITCH
- ○ POSITION SENSOR
- ○ TAPE, CARD READERS
- ○ ENCODERS

- Spectrally and Mechanically Matched with IR Emitter TLN109
- Saturation Level Directly Compatible with Most TTL

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	0-3D1

MAXIMUM RATINGS

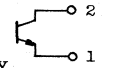
CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Emitter Voltage	V_{CEO}	30	V
Emitter-Collector Voltage	V_{ECO}	5	V
Collector Current	I_C	20	mA
Collector Power Dissipation	P_C	75	mW
Collector Power Dissipation Derating	$\Delta P_C/°C$	-1.0	mW/°C
Operating Temperature Range	T_{opr}	-30 ∿ 85	°C
Storage Temperature Range	T_{stg}	-30 ∿ 100	°C

OPTO-ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Dark Current		$I_D(I_{CEO})$	V_{CE}=24V, E=0	-	10	100	nA
Light Current		$I_L(I_C)$	V_{CE}=3V, E=0.1mW/cm^2 (Note 1)	10	30	-	μA
Collector-Emitter Saturation Voltage		$V_{CE(sat)}$	I_C=5μA, E=0.1mW/cm^2 (Note 1)	-	0.2	0.4	V
Switching Time	Rise Time	t_r	V_{CC}=10V, I_C=1mA, R_L=1kΩ	-	9	-	μs
	Fall Time	t_f	(Fig.1)	-	10	-	

Note 1: Color temperature=2870°K Standard Tungstem Lamp

PIN CONNECTION



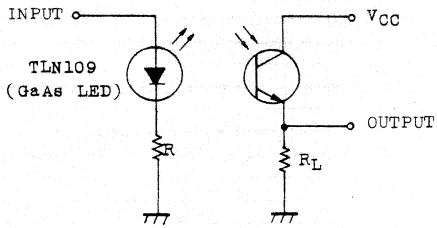
1. EMITTER
2. COLLECTOR

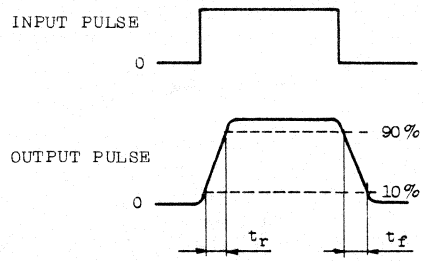
PRECAUTION

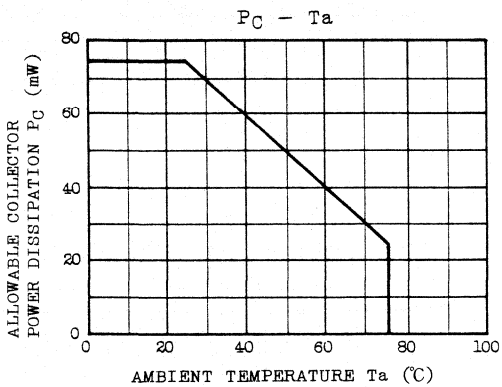
Please be careful of the followings

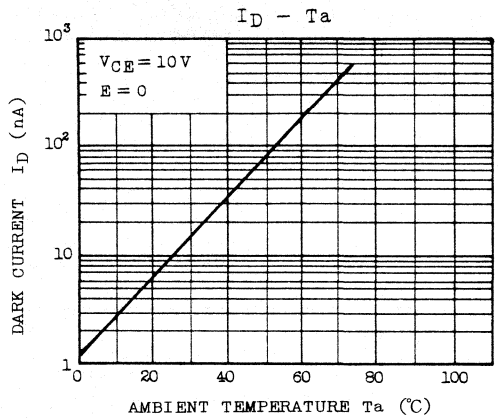
1. Soldering temperature: 260°C MAX. Soldering time: 3 sec MAX.
   (Soldering portion of lead: up to 1.5mm from the body of the device)
2. If the lead is formed, the lead should be formed at a distance of 2mm from the body of the device.
   Soldering shall be performed after lead forming.
3. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   ∘ Freon TE or TF ∘ Dai-Fron Solvents S3 or S3-E

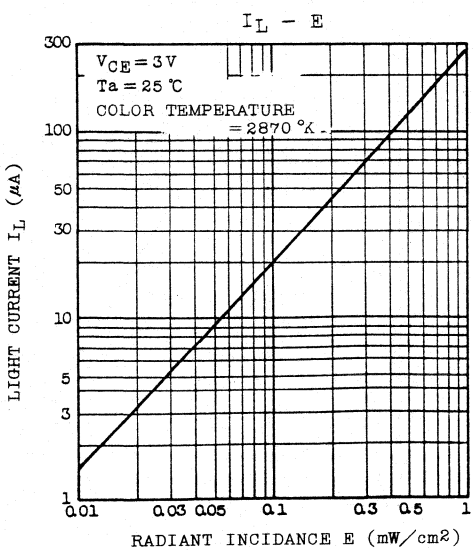
Fig.1 SWITCHING TIME TEST CIRCUIT

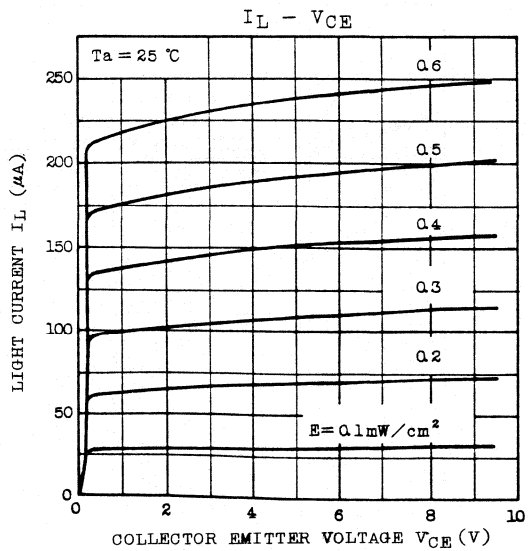




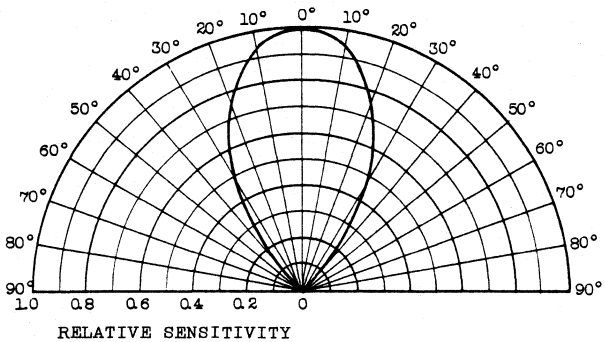




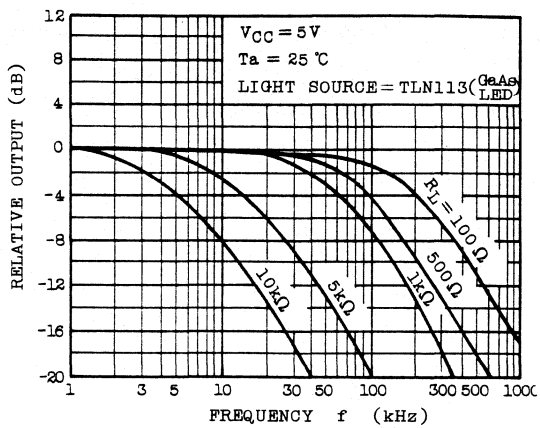




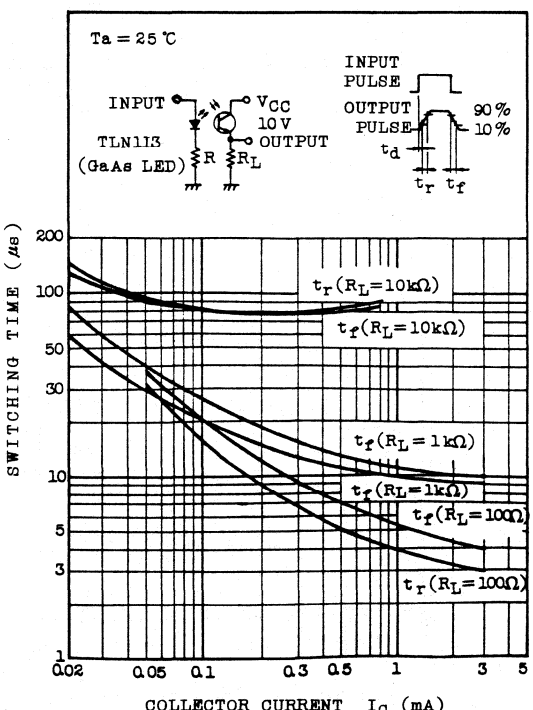
RELATIVE DIRECTIONAL SENSITIVITY
(Ta = 25℃)



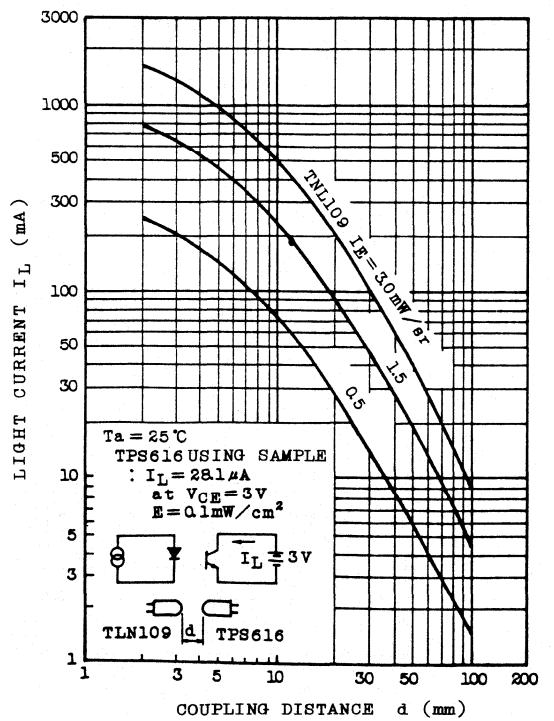
FREQUENCY CHARACTERISTICS



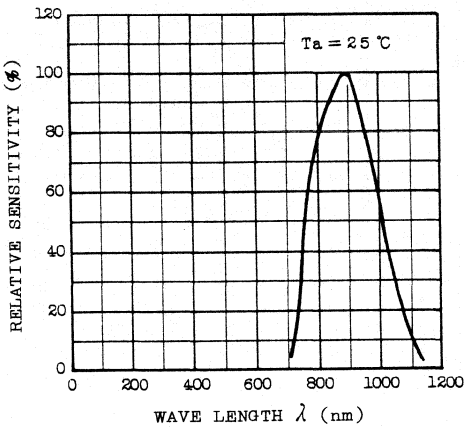
SWITCHING CHARACTERISTICS



COUPLING CHARACTERISTICS
TLN109 and TPS616



SPECTRAL RESPONSE



TPS617

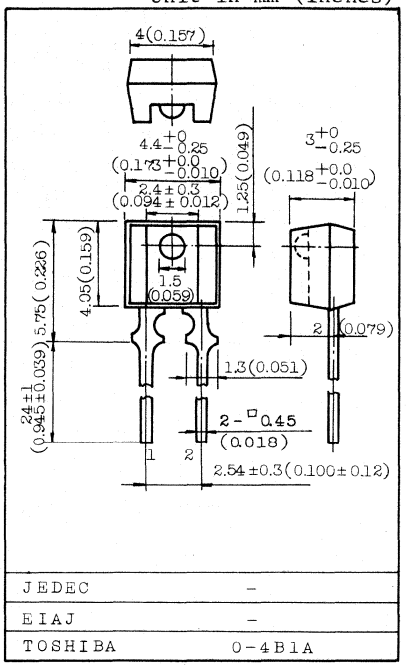
PHOTO DARLINGTON TRANSISTOR
SILICON NPN EPITAXIAL PLANER

SILICON PHOTO TRANSISTOR FOR PHOTO SENSOR

OPTICAL SWITCH
INTERRUPTER
TAPE, CARD READERS

- High Sensitivity: I_L=1.4mA(Typ.)
- Spectrally and Mechanically Matched with IR Emitter TLN107A
- Saturation Level is Compatible with MOS-IC
- Suitable for Photo Interrupter Assembly
- Housing Material is Visible Light cut one.

Unit in mm (inches)



JEDEC	-
EIAJ	-
TOSHIBA	0-4B1A

Weight : 0.16g

MAXIMUM RATINGS

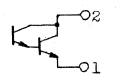
CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Emitter Voltage	V_{CEO}	30	V
Emitter-Collector Voltage	V_{ECO}	5	V
Collector Current	I_C	50	mA
Collector Power Dissipation	P_C	75	mW
Collector Power Dissipation Derating	$\Delta P_C/°C$	-1.0	mW/°C
Operating Temperature Range	T_{opr}	-25 ∿85	°C
Storage Temperature Range	T_{stg}	-40 ∿100	°C

OPTO-ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Dark Current		$I_D(I_{CEO})$	V_{CE}=16V, E=0	-	30	250	nA
Light Current		$I_L(I_C)$	V_{CE}=3V, E=0.1mW/cm^2 (Note)	0.4	1.4	-	mA
Collector-Emitter Saturation Voltage		$V_{CE(sat)}$	I_C=0.2mA, E=0.1mW/cm^2 (Note)	-	0.9	1.2	V
Switching Time	Rise Time	t_r	V_{CC}=5V, I_C=10mA, R_L=100Ω	-	200	-	μs
	Fall Time	t_f		-	100	-	

Note: Color temperature=2870°K Standard Tungsten Lamp.

PIN CONNECTION



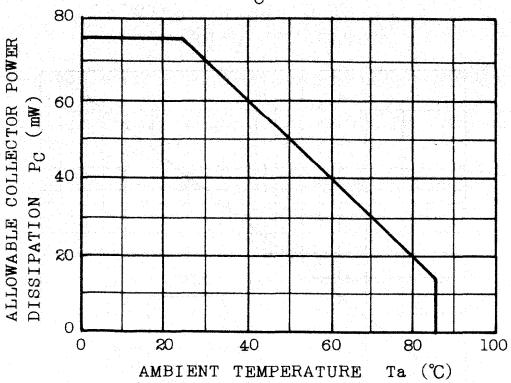
1. EMITTER
2. COLLECTOR

PRECAUTION

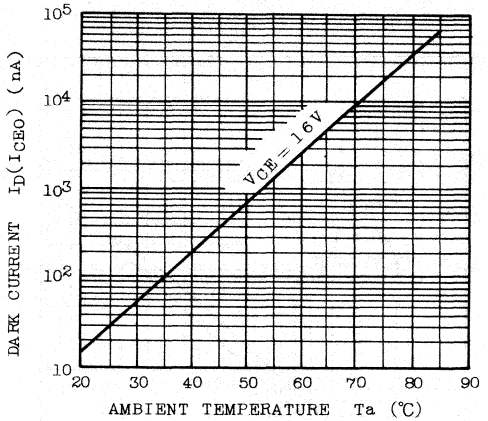
Please be careful of the followings.

1. Soldering temperature: 260°C MAX.
   Soldering time: 5 sec MAX.
   (Soldering portion of lead: up to 2mm from the body of the device)
2. If the lead is formed, the lead sould be formed at a distance of 2mm from the body of the device.
   Soldering shall be performed after lead forming.
3. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   o Freon TE or TF o Dai-Fron Solvents S3 or S3-E

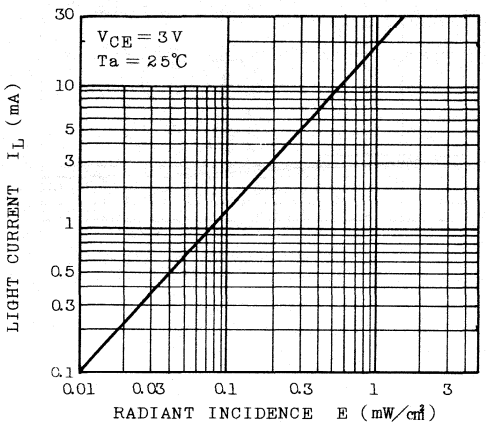
P_C – Ta



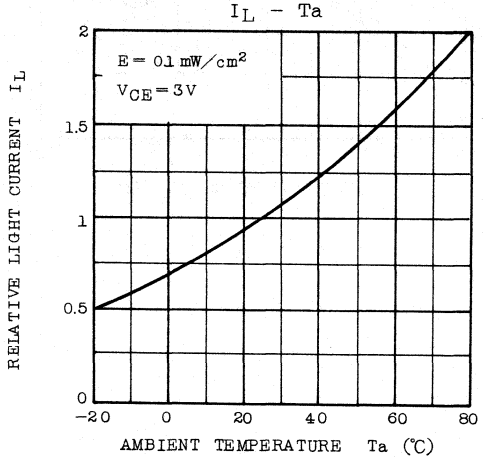
$I_D(I_{CEO})$ – Ta



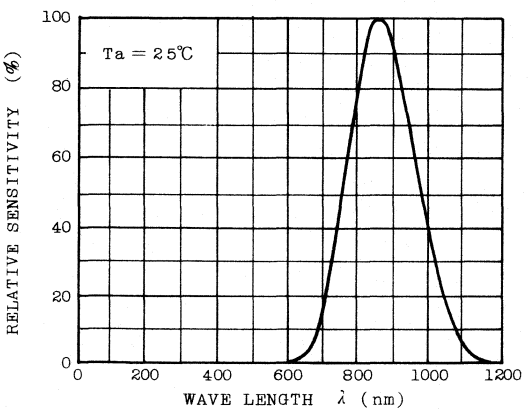
I_L – E



I_L – Ta

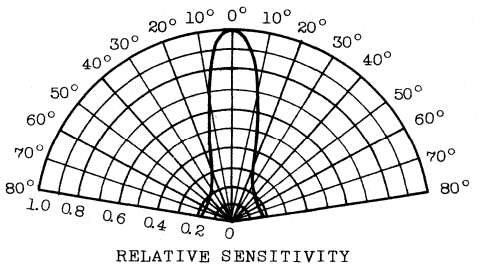


SPECTRAL RESPONSE

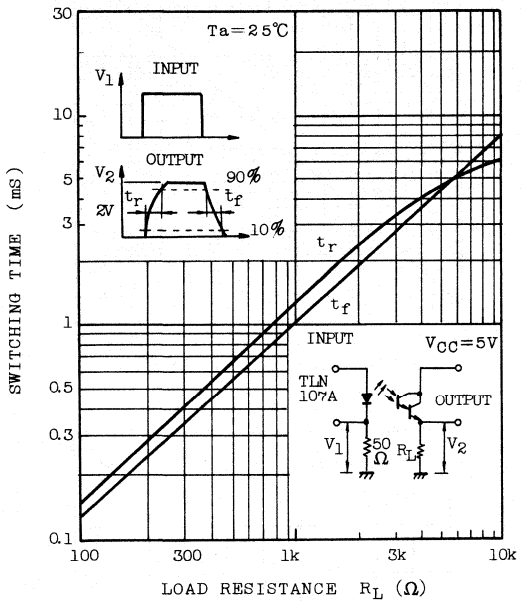


RELATIVE DIRECTIONAL SENSITIVITY

(Ta = 25℃)



SWITCHING CHARACTERISTICS
(NON SATURATED OPERATION)



SWITCHING CHARACTERISTICS
(SATURATED OPERATION)

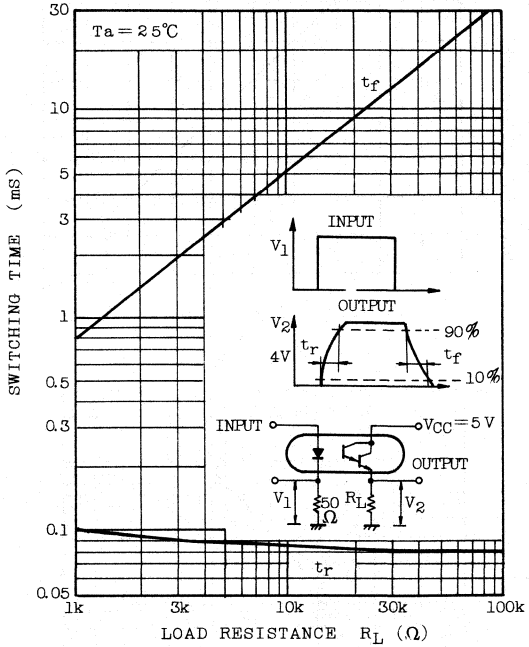


PHOTO TRANSISTOR
SILICON NPN EPITAXIAL PLANER

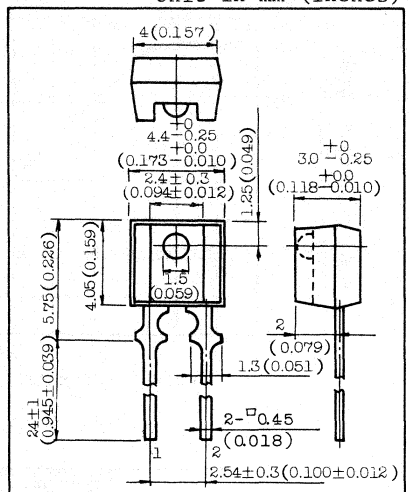
TPS618

SILICON PHOTO TRANSISTOR FOR PHOTO SENSOR.

- OPTICAL SWITCH
- INTERRUPTER
- TAPE, CARD READERS

- Spectrally and Mechanically Matched with IR Emitter TLN107A.
- Saturation Level Directly Compatible with Most TTL.
- Suitable for Photo Interrupter Assembly.
- Housing Material is Visible Light cut one.

Unit in mm (inches)



JEDEC	—
EIAJ	—
TOSHIBA	0-4B1A

Weight : 0.16g

MAXIMUM RATINGS

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Emitter Voltage	V_{CEO}	30	V
Emittter-Collector Voltage	V_{ECO}	5	V
Collector Current	I_C	50	mA
Collector Power Dissipation	P_C	75	mW
Collector Power Dissipation Derating	$\Delta P_C/°C$	-1.0	mW/°C
Operating Temperature Range	T_{opr}	-25 ∿85	°C
Storage Temperature Range	T_{stg}	-40 ∿100	°C

OPTO-ELECTRICAL CHARACTERISTICS

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Dark Current		$I_D(I_{CEO})$	V_{CE}=24V, E=0	-	5	100	nA
Light Current		$I_L(I_C)$	V_{CE}=3V, E=0.1mW/cm^2 (Note)	20	70	-	μA
Collector-Emitter Saturation Voltage		$V_{CE(sat)}$	V_C=10μA, E=0.1mW/cm^2 (Note)	-	0.15	0.4	V
Switching Time	Rise Time	t_r	V_{CC}=5V, I_C=2mA, R_L=100Ω	-	6	-	μs
	Fall Time	t_f		-	6	-	

Note: Color temperature=2870°K Standard Tungsten Lamp.

PIN CONNECTION

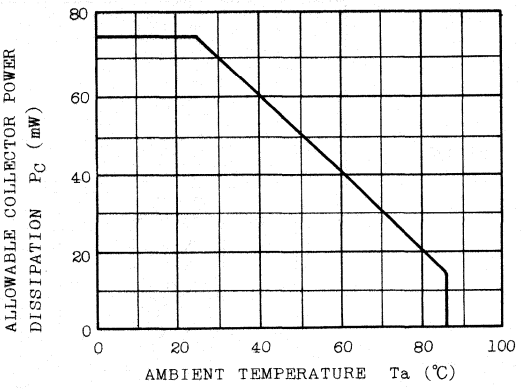
1. EMITTER
2. COLLECTOR.

PRECAUTION

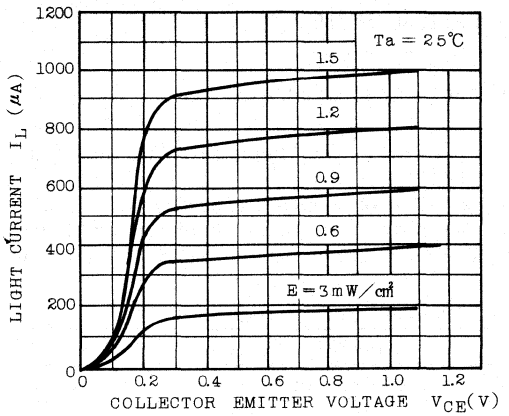
Please be careful of the followings.

1. Soldering temperature: 260°C MAX.
   Soldering time: 5 sec Max.
   (Soldering portion of lead: up to 2mm from the body of the device)
2. If the lead is formed, the lead should be formed at a distance of 2mm from the body of the device.
   Soldering shall be performed after lead forming.
3. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   o Freon TE or TF o Dai-Fron Solvents S3 or S3-E

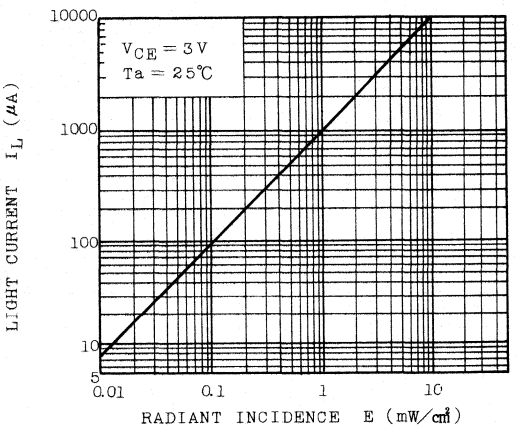
P_C – Ta



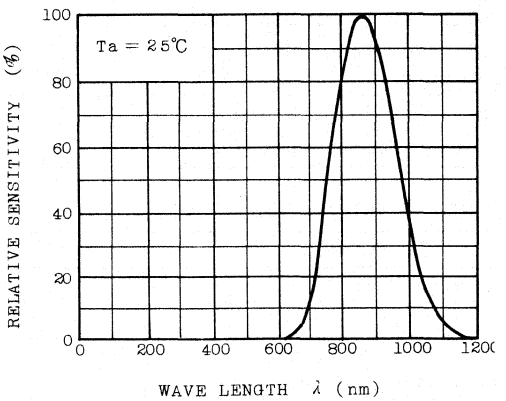
I_L – V_{CE}



I_L – E

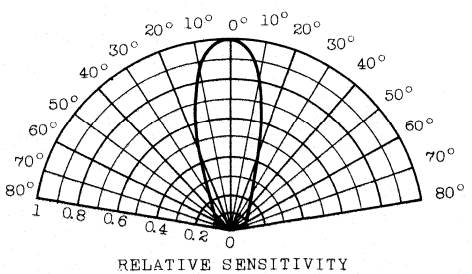


SPECTRAL RESPONSE

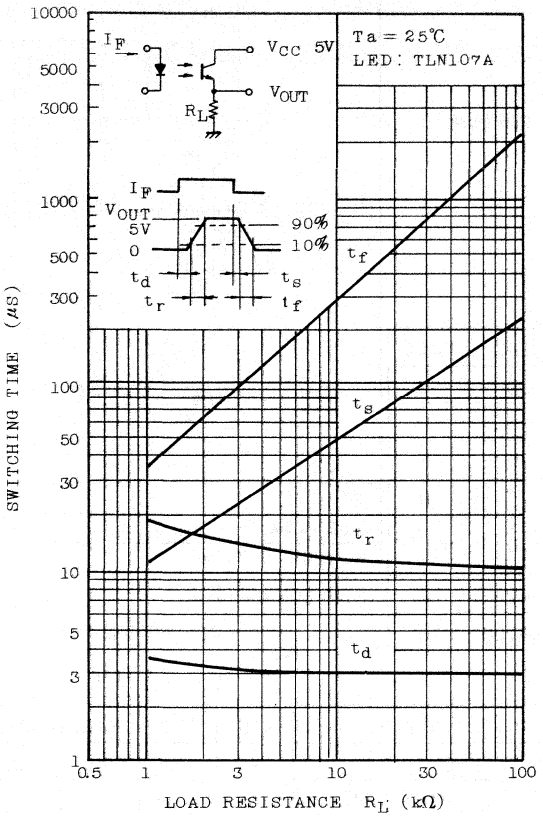


RELATIVE DIRECTIONAL SENSITIVITY

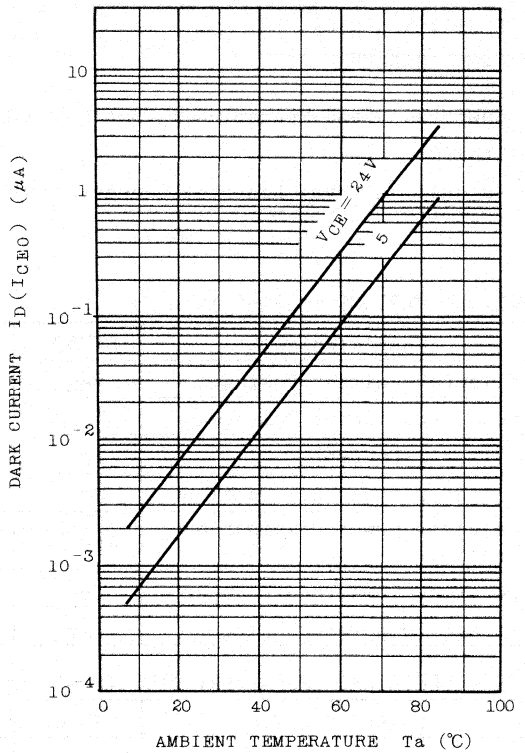
(Ta = 25℃)



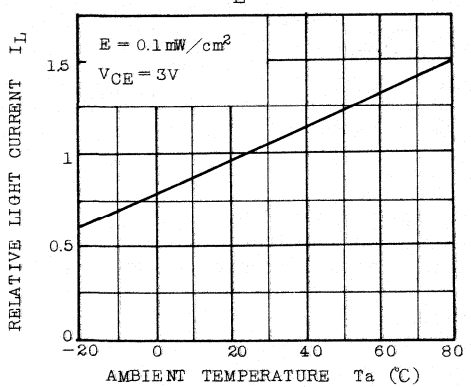
SWITCHING CHARACTERISTICS



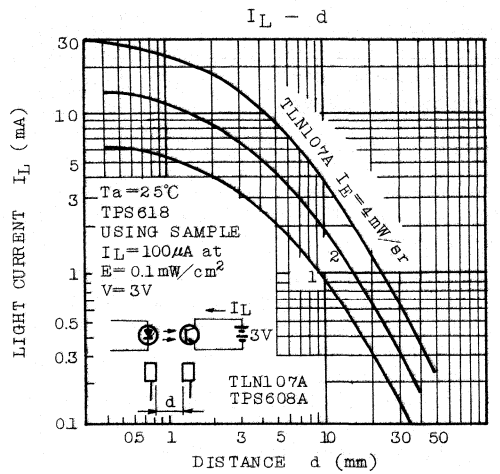
$I_D(I_{CEO})$ – Ta



I_L – Ta



I_L – d



TPS622

PHOTO DARLINGTON TRANSISTOR SILICON NPN EPITAXIAL PLANER

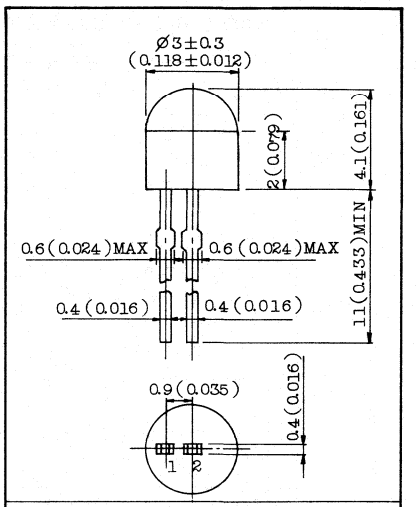
TENTATIVE DATA UNDER DEVELOPMENT

SILICON PHOTO TRANSISTOR FOR PHOTO SENSOR

- . OPTICAL SWITCH
- . POSITION SENSOR
- . TAPE, READERS

- . Spectrally and Mechanically Matched with IR Emitter TLN113.
- . Saturation Level Directly Compatible with MOS-IC.

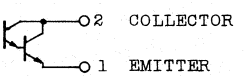
Unit in mm (inches)



JEDEC	—
EIAJ	—
TOSHIBA	

Weight : 0.08g

PIN CONNECTION



MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Emitter Voltage	V_{CEO}	20	V
Emitter-Collector Voltage	V_{ECO}	5	V
Collector Current	I_C	20	mA
Collector Power Dissipation	P_C	75	mW
Collector Power Dissipation Derating	$\Delta P_C/°C$	-1.0	mW/°C
Operating Temperature Range	T_{opr}	-20~75	°C
Storage Temperature Range	T_{stg}	-30~100	°C

OPTO-ELECTRICAL CHARACTERISTICS (Ta=25°C)

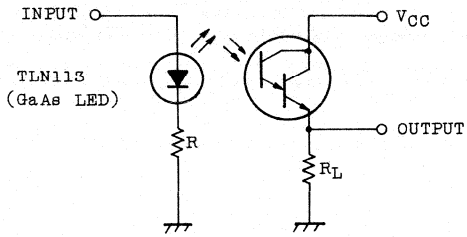
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Dark Current		$I_D(I_{CEO})$	V_{CE}=10V, E=0	-	30	250	nA
Light Current		$I_L(I_C)$	V_{CE}=3V, E=0.01mW/cm^2 (Note 2)	-	0.6	-	mA
Collector-Emitter Saturation Voltage		$V_{CE(sat)}$	I_C=0.08mA, E=0.01mW/cm^2 (Note 1)	-	0.9	1.2	V
Switching Time	Rise Time	t_r	V_{CC}=5V, I_C=10mA	-	200	-	μs
	Fall Time	t_f	R_L=100Ω (Fig.1)	-	100	-	

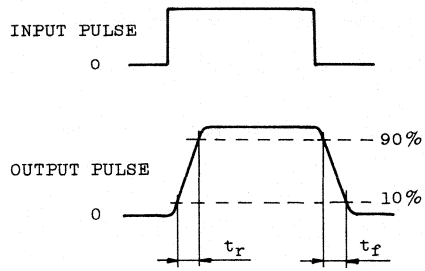
Note 1 : Color Temperature=2870°K Standard Tungsten Lamp.

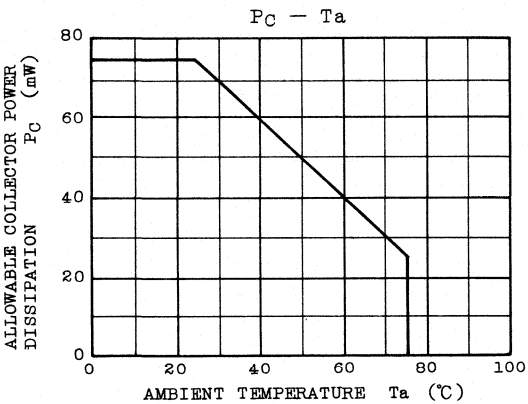
PRECAUTION

Please be careful of the followings

1. Soldering temperature: 260°C MAX. Soldering time: 3 sec MAX.
   (Soldering portion of lead: up to 1.5mm from the body of the device)
2. If the lead is formed, the lead should be formed at a distance of 2mm from the body of the device.
   Soldering shall be performed after lead forming.
3. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   o Freon TE or TF o Dai-Fron Solvents S3 or S3-E


INPUT
TLN113
(GaAs LED)
R
V_{CC}
OUTPUT
R_L


INPUT PULSE
0
OUTPUT PULSE
0
90%
10%
t_r
t_f


P_C — Ta
ALLOWABLE COLLECTOR POWER DISSIPATION P_C (mW)
80
60
40
20
0
0
20
40
60
80
100
AMBIENT TEMPERATURE Ta (℃)

■ Photo Diode

* New Product
** Under Development

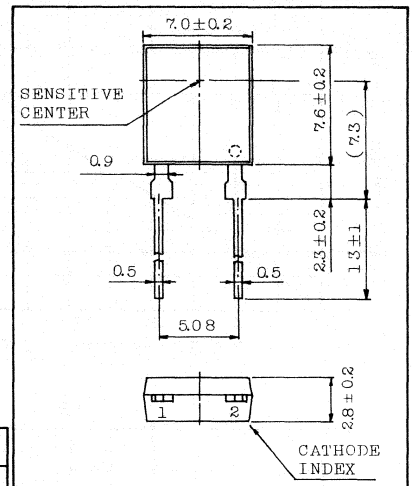
TPS703

SILICON PIN PHOTO DIODE

- REMOTE CONTROL SYSTEM
- OPTICAL SWITCH

- High Sensitivity : I_{SC}=1.5μA(Typ.)
- Small Dark Current : I_D=1nA(Typ.) (V_R=10V)
- High Speed : t_r,t_f=100ns(Typ.)
- Non Sensitivity for Visible Light
- Spectrally Matched with IR Emitter TLN105B, TLN115

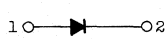
Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	0-7B1A

Weight : 0.31g

PIN CONNECTION



1. ANODE
2. CATHODE

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	20	V
Power Dissipation	P_D	150	mW
Operating Temperature Range	Topr	-30~80	°C
Storage Temperature Range	Tstg	-40~90	°C

ELECTRO-OPTICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Dark Current		I_D	V_R=10V, E=0	-	1	30	nA
Short Circuit Current		I_{SC}	E=0.1mW/cm^2 (Note)	0.9	1.5	-	μA
Open Circuit Voltage		V_{OP}	E=0.1mW/cm^2 (Note)	150	250	-	mV
Capacitance		C_T	V_R=3V, f=1MHz	-	20	-	pF
Peak Sensitivity Wave Length		λ_P	-	-	960	-	nm
Switching Time	Rise Time	t_r	V_R=10V, R_L=1kΩ	-	100	-	ns
	Fall Time	t_f		-	100	-	

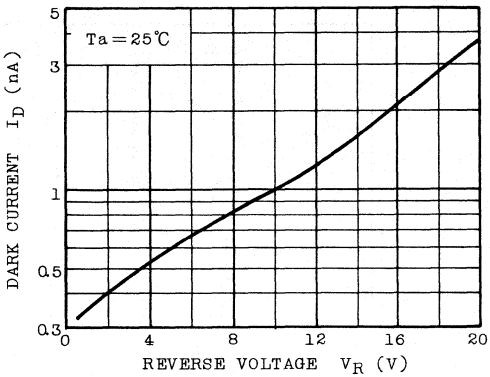
Note : Color temperature=2870°K Standard Tungsten Lamp.

PRECAUTION

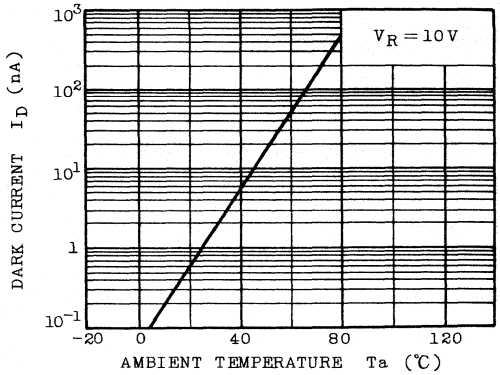
Please be careful of the followings.

1. Soldering temperature: 260°C MAX. Soldering time: 3 sec MAX.
   (Soldering portion of lead: up to 2.3mm from the body of the device)
2. If the lead is formed, the lead should be formed at a distance of 2.3mm from the body of the device.
   Soldering shall be performed after lead forming.
3. Avoid using the Solvetns except for the follows, when washing off flux and wiping off stain on the deivce.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   o Freon TE or TF o Dai-Fron Solvents S3 or S3-E

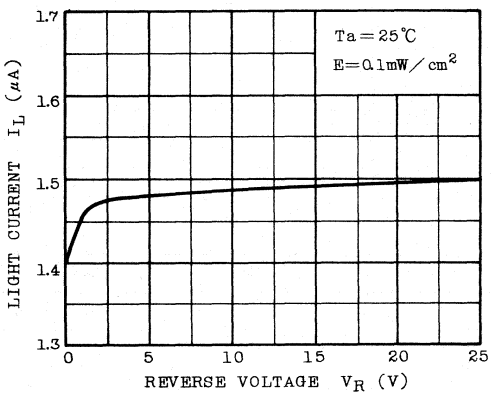
$I_D - V_R$



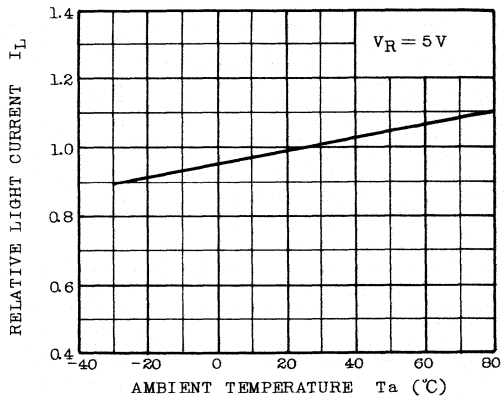
$I_D - Ta$



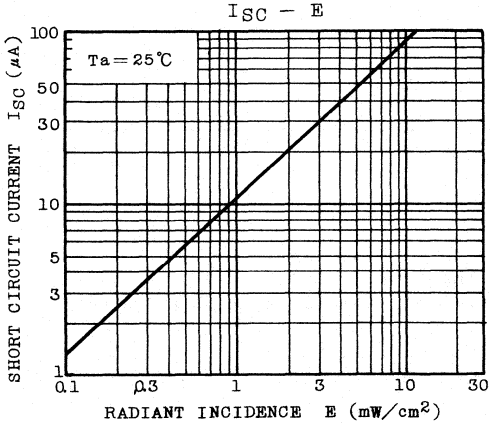
$I_L - V_R$



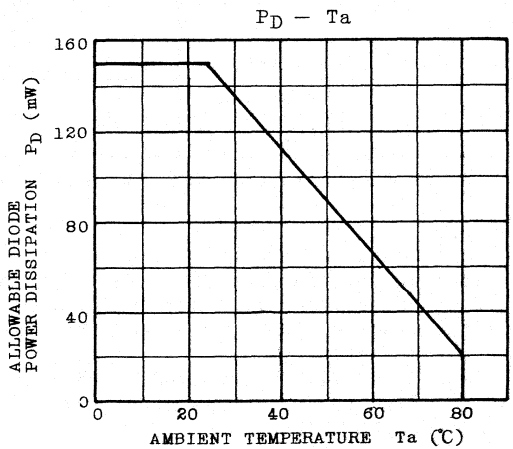
$I_L - Ta$



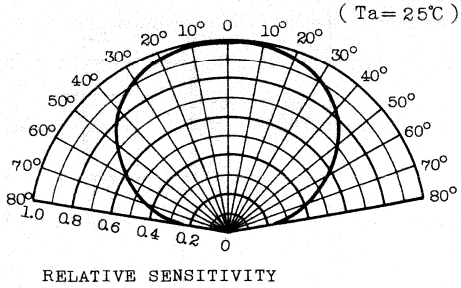
$I_{SC} - E$



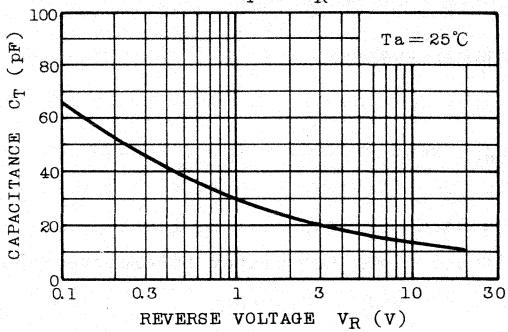
$P_D - Ta$



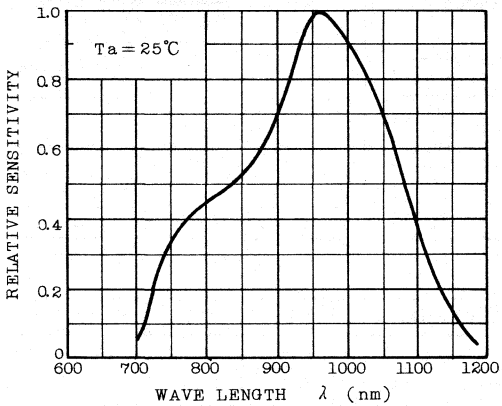
RELATIVE DIRECTIONAL SENSITIVITY



$C_T - V_R$



SPECTRAL RESPONSE



TPS703A

PHOTO DIODE
SILICON PIN TYPE

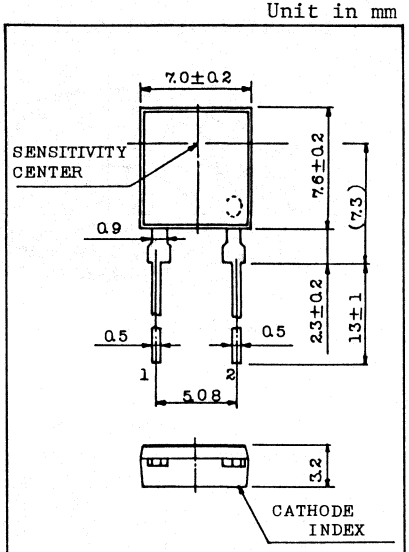
- REMOTE CONTROL SYSTEM
- OPTICAL SWITCH

- High Speed Switching : t_r, t_f=100ns (Typ.)
- High Sensitivity : I_{SC}=0.9μA (Typ.)
- Low Dark Current : I_D=1nA (Typ.) (V_R=10V)
- Visible Light Cut Filter is Employed ≦ 800nm (Typ.)
- Wide Radiation Pattern

PIN CONNECTION

1. ANODE 2. CATHODE

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	0-7C1A

MAXIMUM RATINGS

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	20	V
Power Dissipation	P_D	150	mW
Operating Temperature	T_{opr}	-30 ∿ 60	°C
Storage Temperature	T_{stg}	-40 ∿ 60	°C

ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Dark Current	I_D	V_R=10V	-	1	30	nA
Short Circuit Current	I_{SC}	E=0.1mW/cm^2 (Note)	0.5	0.9	-	μA
Capacitance	C_T	V_R=3V, f=1MHz	-	20	-	pF
Peak Sensitivity Wavelength	λ_P		-	1000	-	nm
Rise Time, Fall Time	t_r, t_f	V_R=10V, R_L=1kΩ	-	100	-	ns

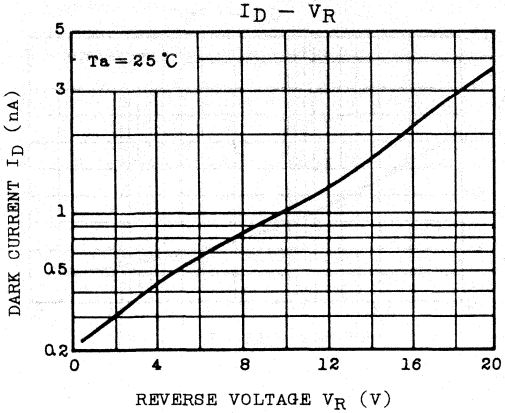
Note: Color Temperature=2870°K

PRECAUTION

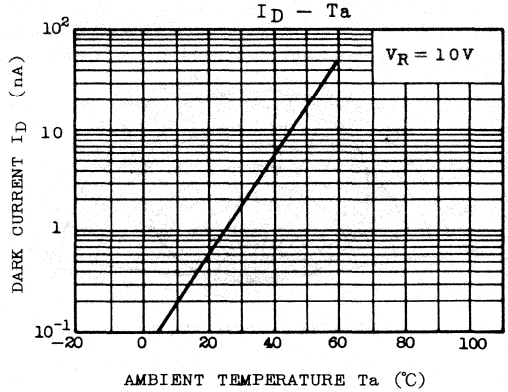
Please be careful of the followings.

1. Soldering temperature: 260°C MAX. Soldering time: 3 sec MAX.
   (Soldering portion of lead: up to 2.3mm from the body of the device.)
2. If the lead is formed, the lead should be formed at 2.3mm from the neck of the lead. Soldering should be performed after lead forming.
3. Avoid using the solvents except for the following in the case of washing off flux and wiping off stain on the device lead. Don't wash the detecting surface of the device.
   Wasing time: 30 sec. MAX.
   ∘ Freon TE or TF ∘ Dai-Fron Solvent S3-E or S3

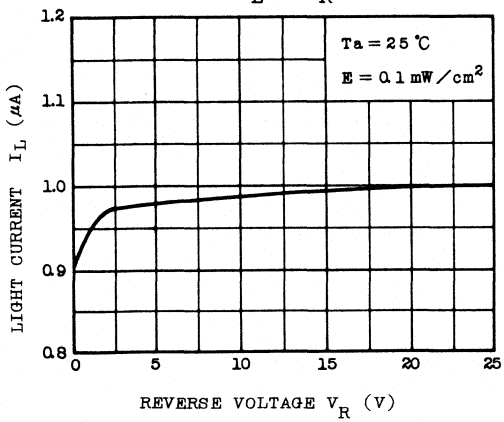
$I_D - V_R$



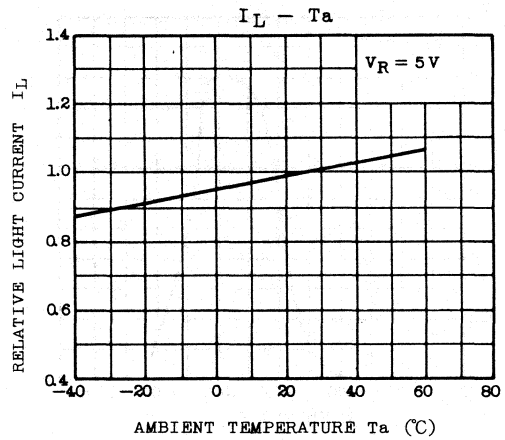
$I_D - Ta$



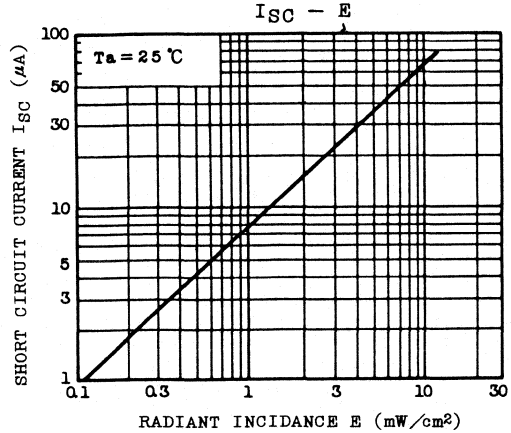
$I_L - V_R$



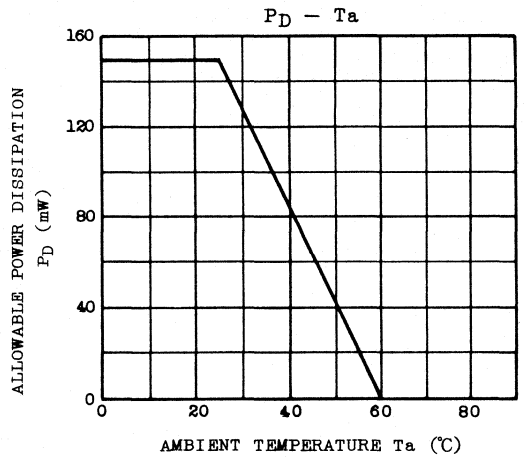
$I_L - Ta$



$I_{SC} - E$

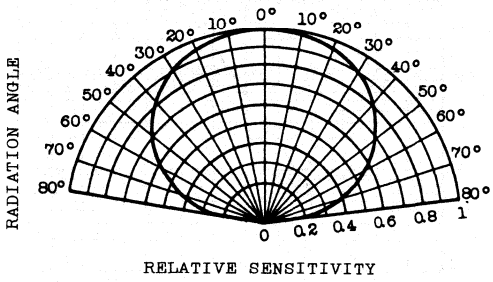


$P_D - Ta$

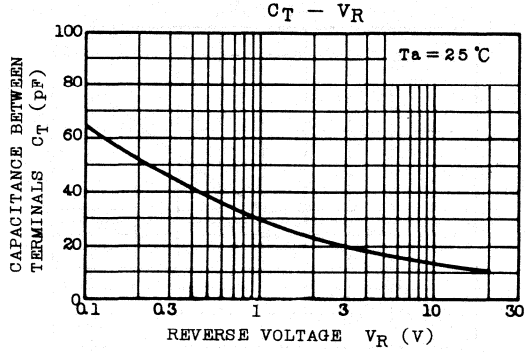


RADIATION PATTERN (TYP)

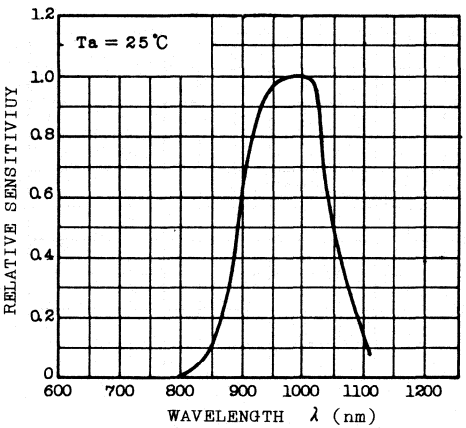
(Ta=25℃)



$C_T - V_R$



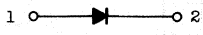
SPECTRAL RESPONSE



TENTATIVE

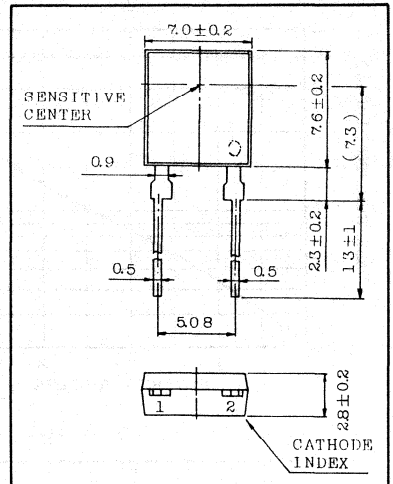
- ○ REMOTE CONTROL SYSTEM
- ○ OPTICAL SWITCH
- • High Speed : t_r, t_f = 100 ns (TYP)
- • High Sensitivity: I_{SC} = 0.9 μA (TYP)
- • Low Dark Current: I_D = 1 nA (TYP)
- • Visible light cut is employed ≦800 nm (TYP)
- • Wide Radiation Pattern
- • Body does not have Film.

PIN CONNECTION



1. ANODE
2. CATHODE

SILICON PIN Unit : mm



JEDEC	
EIAJ	
TOSHIBA	

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	20	V
Power Dissipation	P_D	150	mW
Operating Temperature	T_{opr}	-30∿60	°C
Storage Temperature	T_{stg}	-40∿60	°C

ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Dark Current	I_D	V_R=10V	-	1	30	nA
Short Circuit Current	I_{SC}	(Note) E=0.1mW/cm^2	0.5	0.9	-	μA
Capacitance Under Voltage	C_T	V_R=3V, f=1MHz	-	20	-	pF
Peak Sesitivity Wavelength	λ_P		-	970	-	nm
Rise Time, Fall Time	t_r, t_f	V_R=10V, R_L=1KΩ	-	100	-	ns

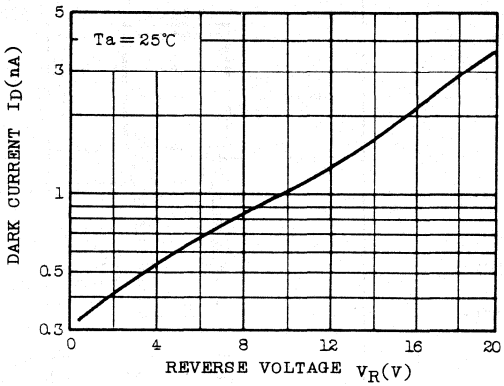
(Note): Color Temperature = 2870°K

PRECAUTION

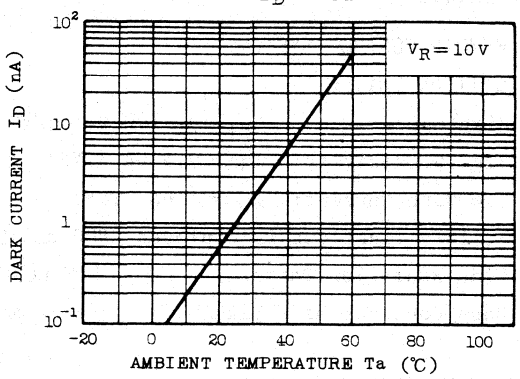
Please be careful of the followings.

1. Soldering temperature: 260°C MAX.
   Soldering time: 3 sec MAX.
   (Soldering portion of lead ; up to 2.3 mm from the body of the device.)
2. If the lead is formed, the lead should be formed at 2.3 mm from the neck of the lead.
   Soldering should be performed after lead forming.
3. Avoid using the solvents except for the followings in the case of washing off flux and wiping off stain on the device lead. don't wash the detecting surface of the device.
   Washing time: 30 sec. MAX.
   - ○ Freon TE or TF
   - ○ Dai-Fron Solvent S3-E or S3

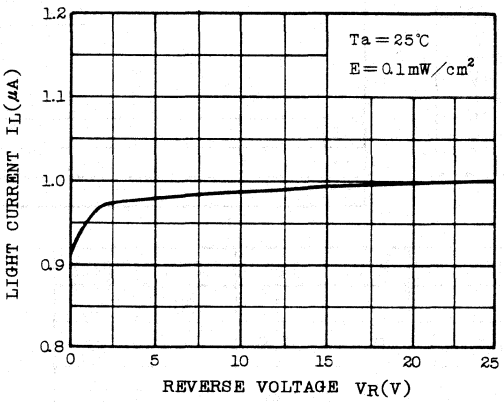
$I_D - V_R$



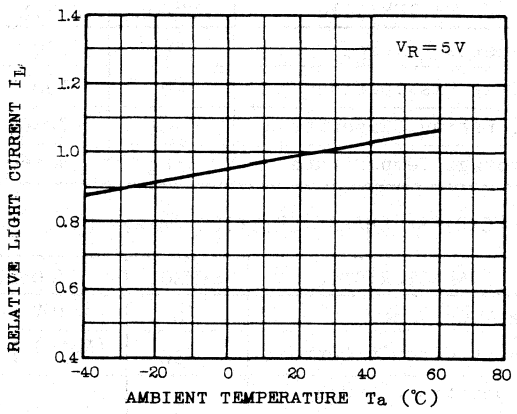
$I_D - Ta$



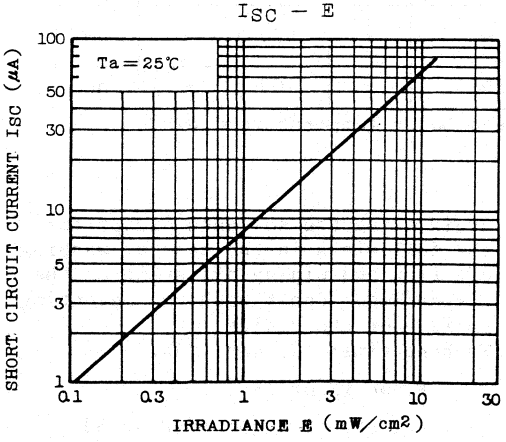
$I_L - V_R$



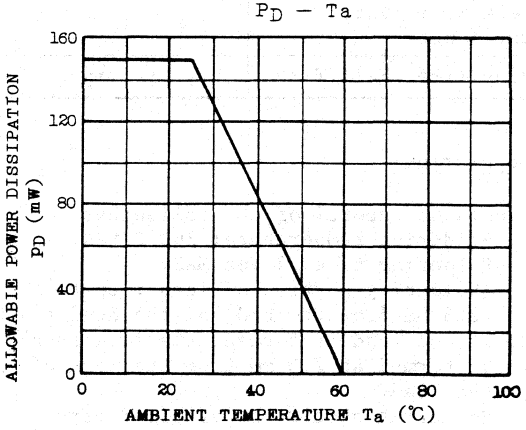
$I_L - Ta$



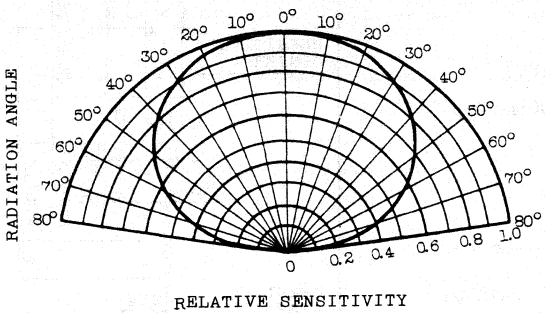
$I_{SC} - E$



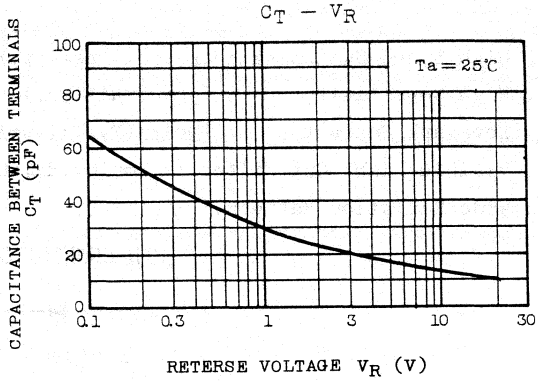
$P_D - Ta$



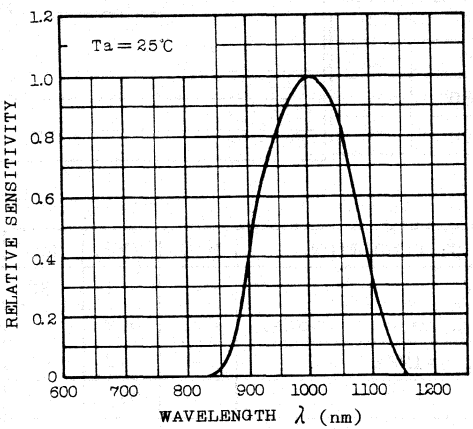
RADIATION PATTERN (TYP) (Ta=25℃)



$C_T - V_R$



SPECIAL RESPONSE



TPS705

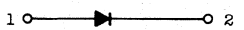
PHOTO DIODE
SILICON PIN

REMOTE CONTROL SYSTEM.

OPTICAL SWITCH.

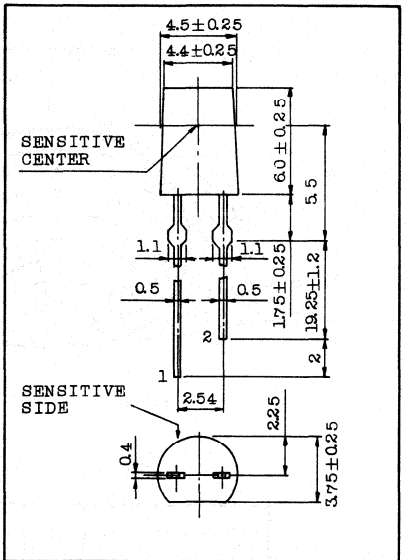
- High Speed Switching : t_r, t_f=100ns(Typ.)
- High Sensitivity : I_{SC}=0.9μA(Typ.)
- Low Dark Current : I_D=1nA(Typ.)(V_R=10V)
- Visible Light Cut Filter is Employed≦800nm(Typ.)
- Wide Radiation Pattern.

PIN CONNECTION



1. ANODE 2. CATHODE

Unit in mm



JEDEC	
EIAJ	
TOSHIBA	

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	20	V
Power Dissipation	P_D	150	mW
Operating Temperature	Topr	-30~80	°C
Storage Temperature	Tstg	-40~90	°C

ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Dark Current	I_D	V_R=10V	-	1	30	nA
Short Circuit Current	I_{SC}	E=0.1mW/cm² (Note)	0.5	0.9	-	μA
Capacitance	C_T	V_R=3V, f=1MHz	-	12	-	pF
Peak Sensitivity Wavelength	λ_P		-	970	-	nm
Rise Time, Fall Time	t_r, t_f	V_R=10V, R_L=1kΩ	-	100	-	ns

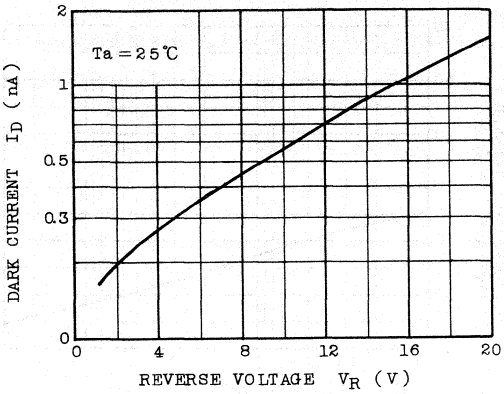
Note : Color Temperature=2870°K

PRECAUTION

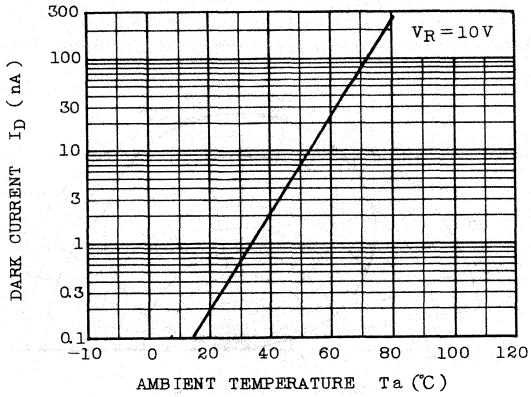
Please be careful of the followings.

1. Soldering temperature: 260°C MAX. Soldering time: 3 sec MAX.
   (Soldering portion of lead: up to 2.5mm from the body of the device.)
2. If the lead is formed, the lead should be formed at 2.5mm from the neck of the lead. Soldering should be performed after lead forming.
3. Avoid using the Solvents except for the following in the case of washing off flux and wiping off stain on the device lead. Don't wash the detecting surface of the device.
   Washing time: 30 sec MAX.
   o Freon TE or TF oDai-Fron Solvent S3-E or S3

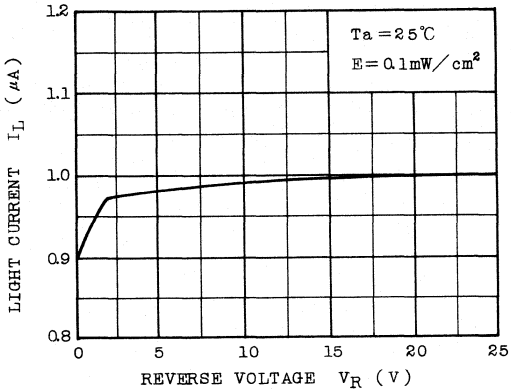
I_D – V_R (TYP.)



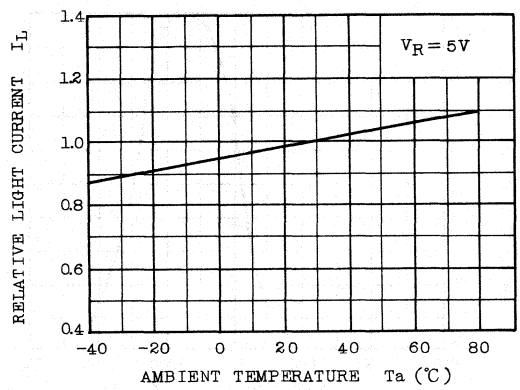
I_D – Ta (TYP.)



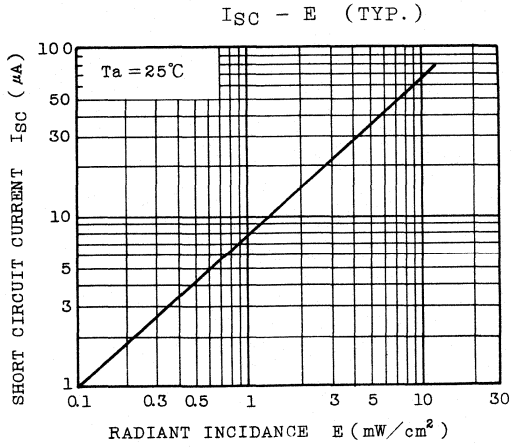
I_L – V_R (TYP.)



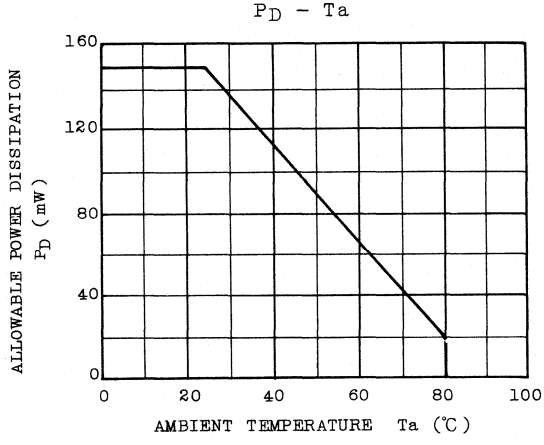
I_L – Ta (TYP.)



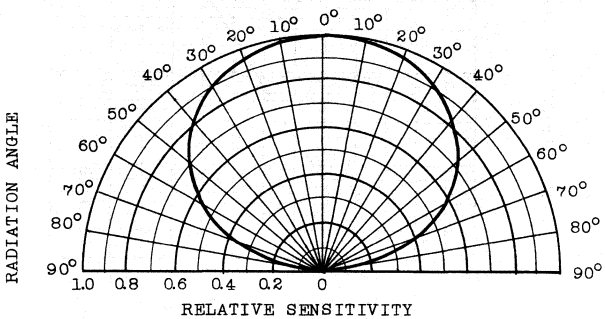
I_{SC} – E (TYP.)



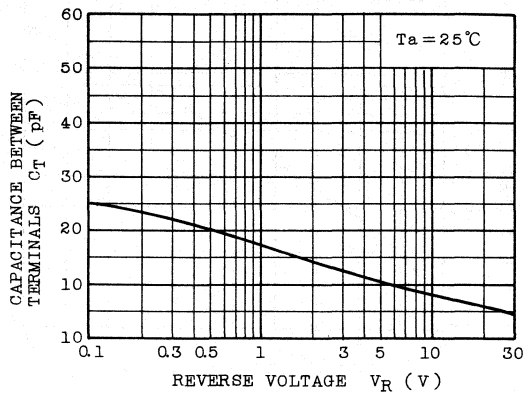
P_D – Ta



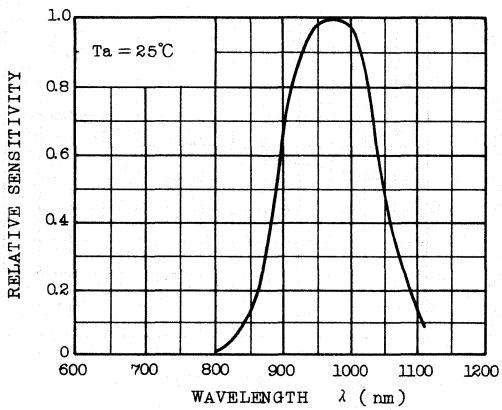
RADIATION PATTERN (TYP)
(Ta = 25°C)



$C_T - V_R$ (TYP.)



SPECTRAL RESPONSE (TYP.)

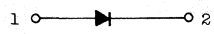


REMOTE CONTROL SYSTEM.

OPTICAL SWITCH.

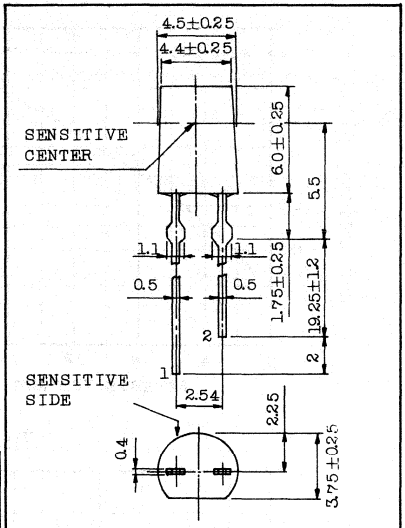
- High Speed Switching : t_r, t_f=100ns(Typ.)
- High Sensitivity : I_{SC}=0.9μA(Typ.)
- Low Dark Current : I_D=1nA(Typ.) (V_R=10V)
- Visible Light Cut Filter is Employed ≦800nm(Typ.)
- Wide Radiation Pattern

PIN CONNECTION



1. ANODE 2. CATHODE

Unit in mm



JEDEC	
EIAJ	
TOSHIBA	

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	20	V
Power Dissipation	P_D	150	mW
Operating Temperature	T_{opr}	-30∿80	°C
Storage Temperature	T_{stg}	-40∿90	°C

ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Dark Current	I_D	V_R=10V	-	1	30	nA
Short Circuit Current	I_{SC}	E=0.1mW/cm^2 (Note)	1.0	1.5	-	μA
Capacitance	C_T	V_R=3V, f=1MHz	-	23	-	pF
Peak Sensitivity Wavelength	λ_P		-	970	-	nm
Rise Time, Fall Time	t_r, t_f	V_R=10V, R_L=1kΩ	-	100	-	ns

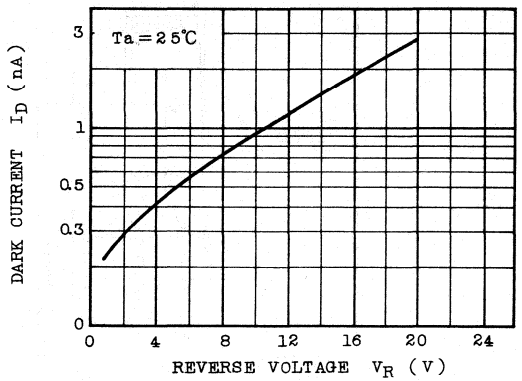
Note : Color Temperature=2870°K

PRECAUTION

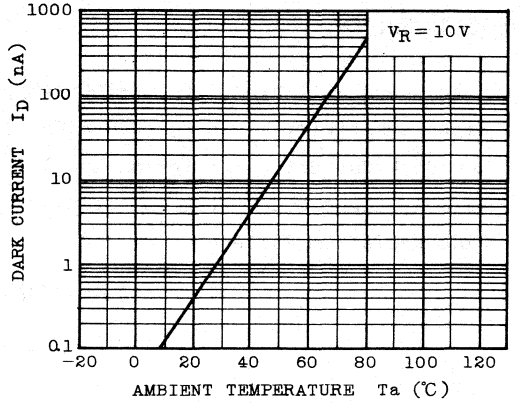
Please be careful of the followings.

1. Soldering temperature: 260°C MAX. Soldering time: 3 sec MAX.
   (Soldering portion of lead: up to 2.5mm from the body of the device.)
2. If the lead is formed, the lead should be formed at 2.5mm from the neck of the lead. Soldering should be performed after lead forming.
3. Avoid using the Solvents except for the following in the case of washing off flux and wiping off stain on the device lead. Don't wash the detecting surface of the device.
   Washing time: 30 sec MAX.
   o Freon TE or TF o Dai-Fron Solvent S3-E or S3

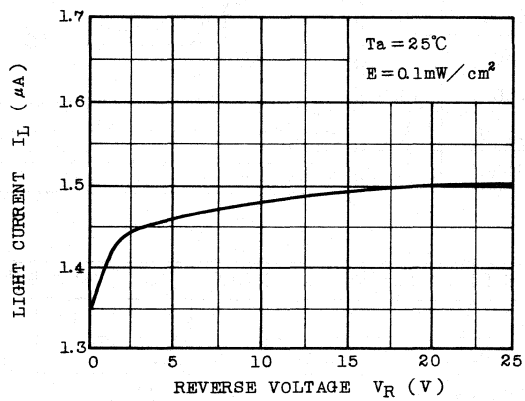
I_D – V_R (TYP.)



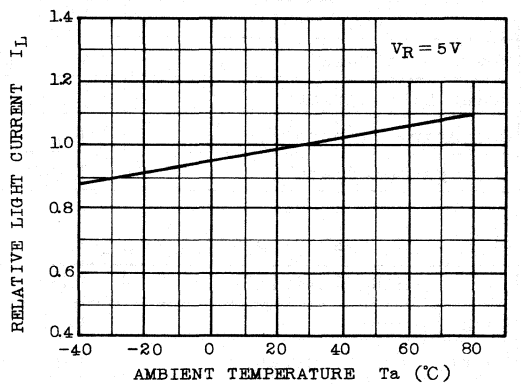
I_D – Ta (TYP.)



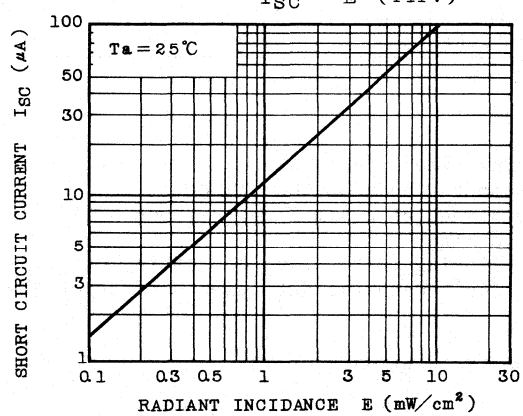
I_L – V_R (TYP.)



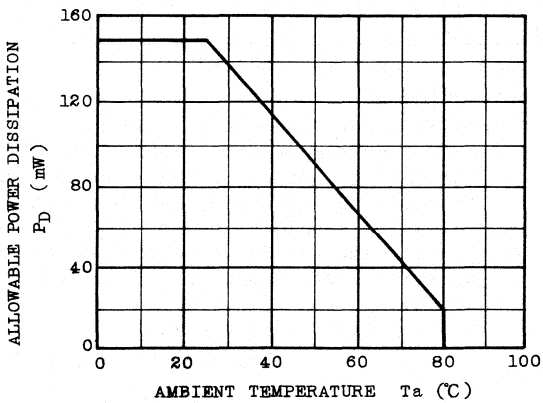
I_L – Ta (TYP.)



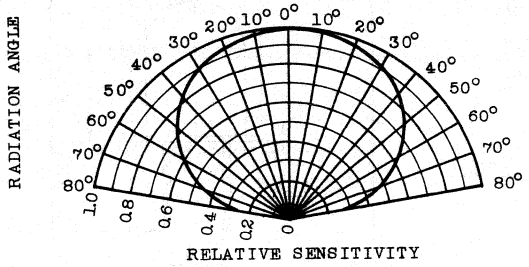
I_{SC} – E (TYP.)



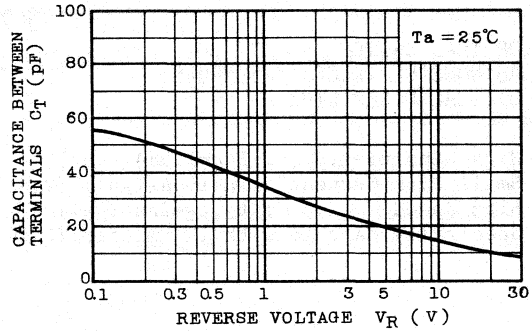
P_D – Ta



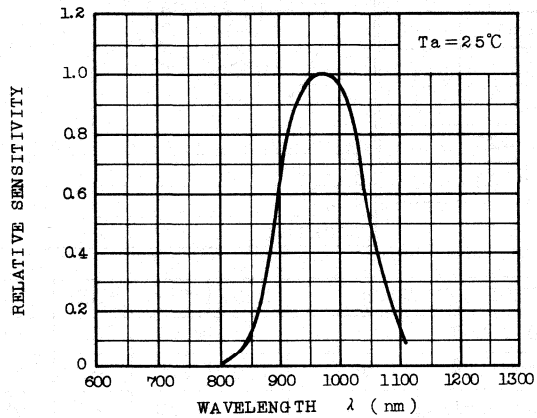
RADIATION PATTERN (TYP)
(Ta=25℃)



C_T - V_R (TYP.)



SPECTAL RESPONSE (TYP.)



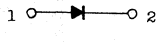
TPS708

PHOTO DIODE
SILICON PIN

TENTATIVE DATA

Unit in mm

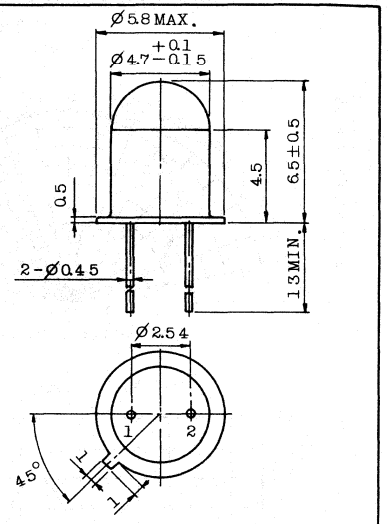
PIN CONNECTION



1. ANODE
2. CATHODE

. OPTICAL SWITCH
. AUTOMOBILE VELOCITY SENSORS
. OPTICAL FIBER LINK

. High Sensitivity : I_{SC}=1.5μA(Typ.)
. Small Dark Current : I_D=10pA(Typ.) (V_R=10V)
. High Speed : t_r, t_f=2ns(Typ.)
. Spectrally Matched with IR Emitter TLN108, TLN201



JEDEC	—
EIAJ	—
TOSHIBA	0-5A1B

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	30	V
Power Dissipation	P_D	100	mW
Operating Temperature Range	T_{opr}	-40 ~ 125	°C
Storage Temperature Range	T_{stg}	-55 ~ 150	°C

OPTO-ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Dark Current		I_D	V_R=10V, E=0	-	0.01	60	nA
Short Circuit Current		I_{SC}	E=0.1mW/cm^2 (Note)	1.0	1.5	-	μA
Capacitance		C_T	V_R=10V, f=1MHz	-	50	-	pF
Peak Sensitivity Wave Length		λ_p	-	-	850	-	nm
Switching Time	Rise Time	t_r	V_{CC}=20V, R_L=50Ω	-	2	-	ns
	Fall Time	t_f		-	2	-	ns

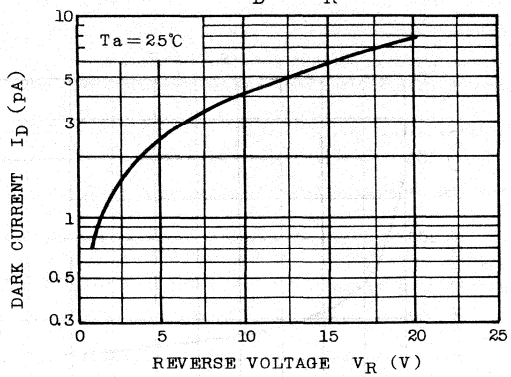
Note : Color temperature=2870°K Standard Tungsten Lamp.

PRECAUTION

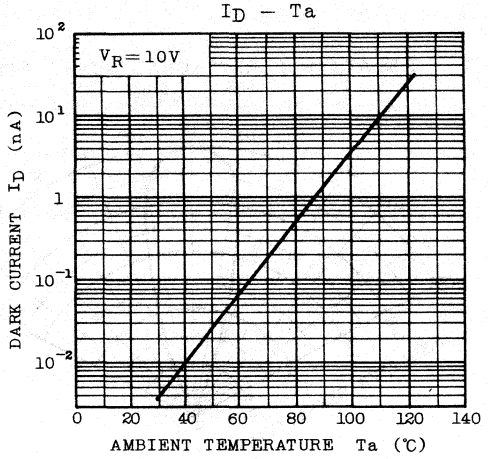
Please be careful of the followings.

1. Soldering temperature: 260°C MAX. Soldering time: 5 sec MAX.
   (Soldering portion of lead: up to 1.5mm from the body of the device)
2. If the lead is formed, the lead should be formed at a distance of 2.0mm from the body of the device.
   Soldering shall be performed after lead forming.
3. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   o Freon TE or TF o Dai-Fron Solvents S3 or S3-E

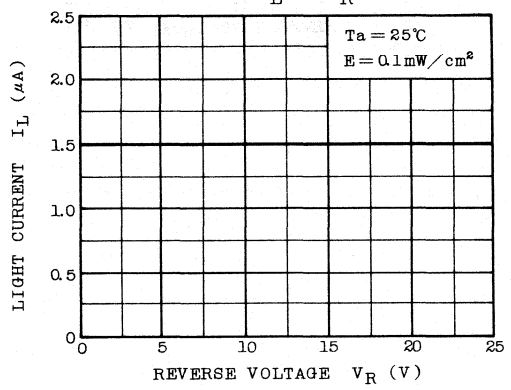
$I_D - V_R$



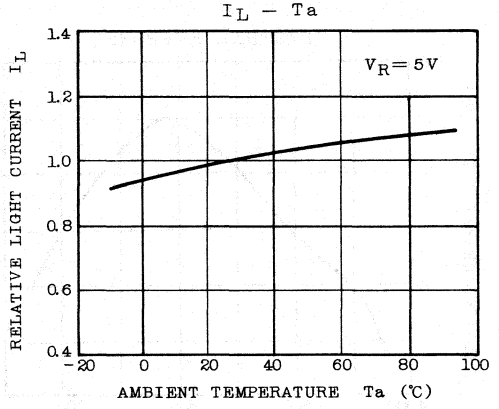
$I_D - Ta$



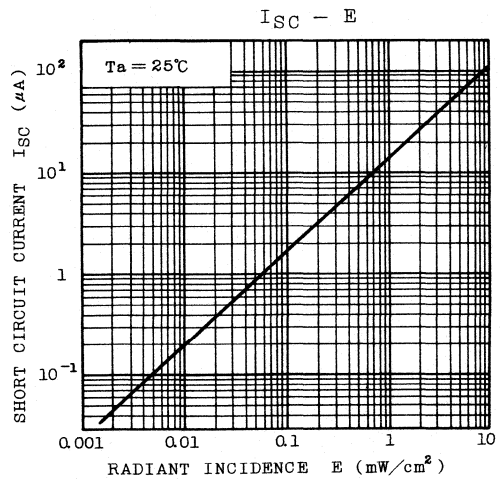
$I_L - V_R$



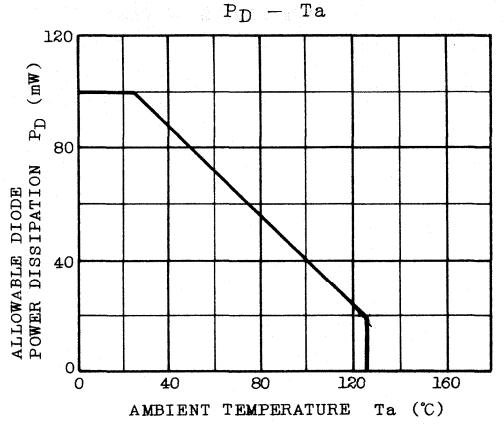
$I_L - Ta$



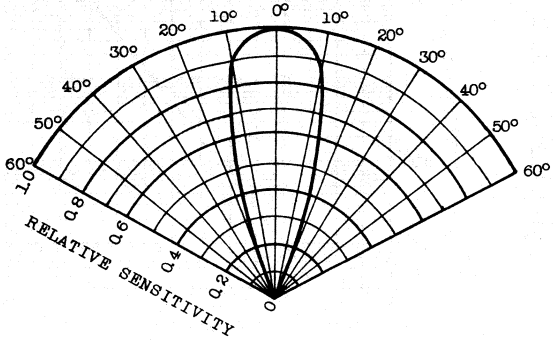
$I_{SC} - E$



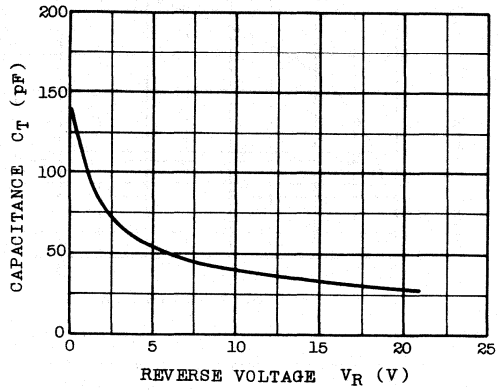
$P_D - Ta$



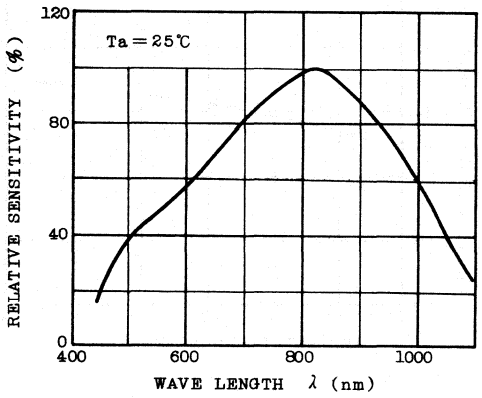
RELATIVE DIRECTIONAL SENSITIVITY
(Ta = 25℃)



$C_T - V_R$



SPECTRAL RESPONSE



■ Photo IC

* New Product
** Under Development

PHOTO IC
SILICON EPITAXIAL PLANER

TPS801

TENTATIVE DATA

- o OPTICAL SWITCH
- o INTERRUPTER
- o COUNTER

. TPS801 Contrains Photo diode, Amplifier, Shumit Trigger and Output Circuit in 1 Chip.

. Housing Material is Visible Light Cut One.

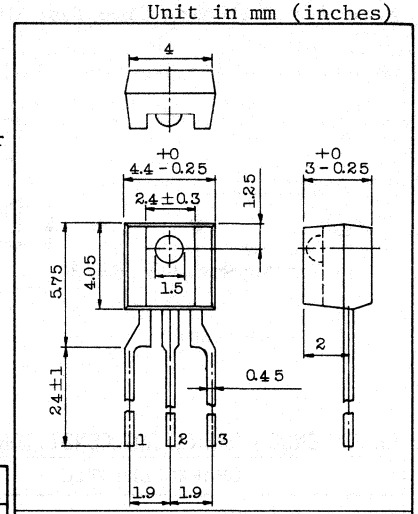
. Wide Adaptable Supply Voltage : V_{CC}=4.5~16V

. High Speed : t_{on}=3μs(Typ.), t_{off}=5μs(Typ.)

. Including Diode for Surge Current at Output.

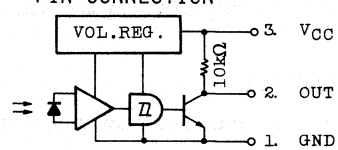
. Compatible for TTL, MOS-IC.

Unit in mm (inches)



JEDEC	—
EIAJ	—
TOSHIBA	0-4C1

PIN CONNECTION



MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage	V_{CC}	16	V
Low Level Output Current	I_{OL}	50	mA
Total Power Dissipation	P_O	250	mW
Operating Temperature Range	T_{opr}	-25~85	°C
Storage Temperature Range	T_{stg}	-40~100	°C

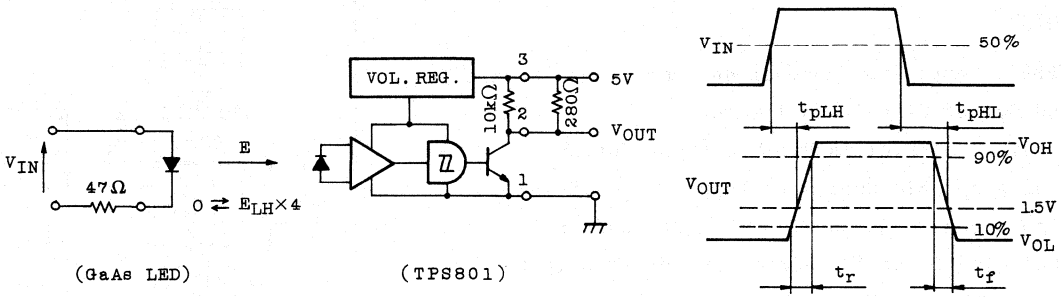
OPTO-ELECTRICAL CHARACTERISTICS

(Ta=0∿70°C, unless otherwise spesified)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}	Ta=25°C	4.5	-	16	V
Low Level Output Voltage	V_{OL}	I_{OL}=16mA, V_{CC}=5V, E=0	-	0.1	0.4	V
High Level Output Voltage	V_{OH}	V_{CC}=5V, E=2mW/cm²	4.0	-	-	V
Low Level Supply Current	I_{CCL}	V_{CC}=5V, E=0	-	6	15	mA
High Level Supply Current	I_{CCH}	V_{CC}=5V, E=2mW/cm²	-	4	10	mA
"L"→"H" Threshold Radiant Incidence (Note 1)	E_{LH}	V_{CC}=5V, Ta=25°C	-	0.5	1.2	mW/cm²
		V_{CC}=5V	-	-	1.6	
Hysterisis Ratio	E_{HL}/E_{LH}	Ta=25°C, V_{CC}=5V	-	0.9	-	
Peak Detective Wave Length	λ_P	-	-	900	-	nm
Propagation Delay "L"→"H"	t_{pLH}	Ta=25°C, V_{CC}=5V E=0↔2mW/cm² R_L=280Ω (Note 2)	-	3	-	μs
Propagation Delay "H"→"L"	t_{pHL}		-	5	-	
Rise Time	t_r		-	0.1	-	
Fall Time	t_f		-	0.05	-	

Note 1 : Color Temperature=2870°K Standard Tungsten Lamp.

Note 2 : Switching Time Test Circuit and Voltage Waveform



RECOMMENDED OPERATING CONDITION

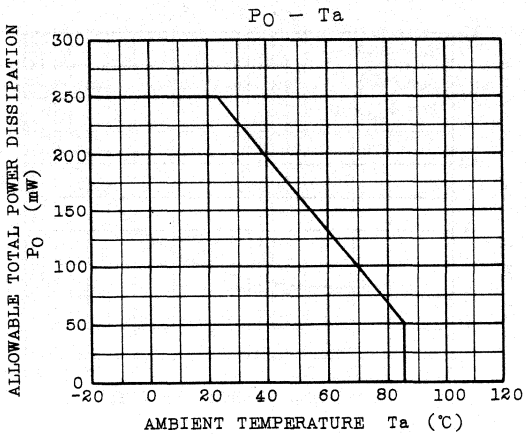
CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}	4.5	5	(Note) 16	V
Radiant Incidence	E	2	-	-	mW/cm^2
Operating Temperature	Topr	0	-	70	°C

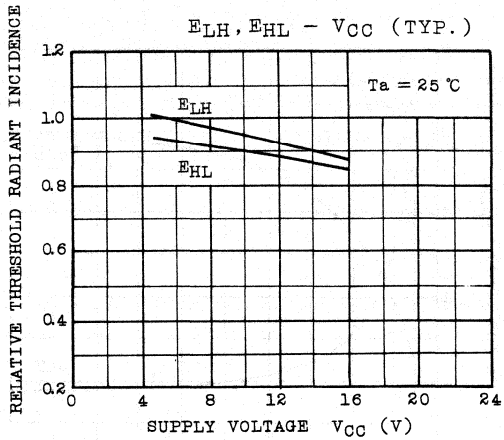
Note : At V_{CC}=10V, $R_L \geqq 1$ kΩ. At V_{CC}=15V, $R_L > 500$kΩ

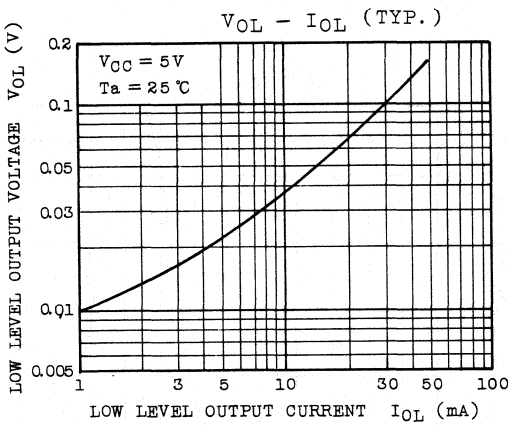
PRECAUTION

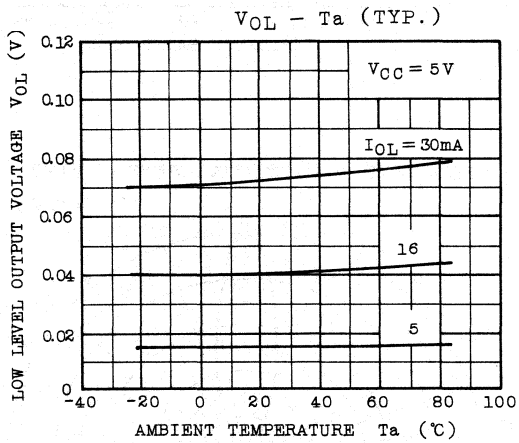
Please be carefull of the followings

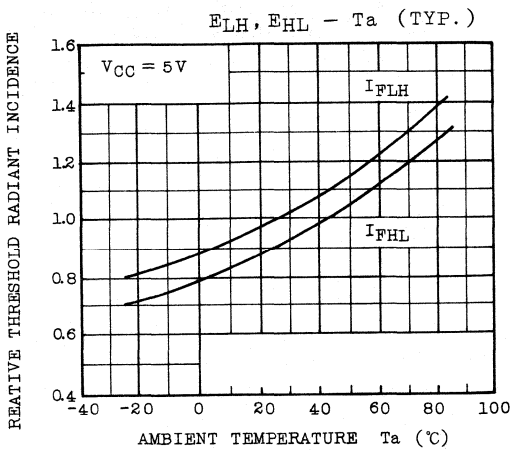
1. Soldering temperature: 260°C MAX. Soldering time: 3 sec MAX.
   (Soldering portion of lead: up to 2mm from the body of the device)
2. If the lead is formed, the lead should be formed at a distance of 2mm from the body of the device.
   Soldering shall be performed after lead forming.
3. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   o Freon TE or TF o Dai-Fron Solvents S3 or S3-E
4. During 100μs after turning ON V_{CC}, output voltage changes at random, becouse of inner circuit's stability.
5. Pin surge voltage: MAX 150V at C=200pF.

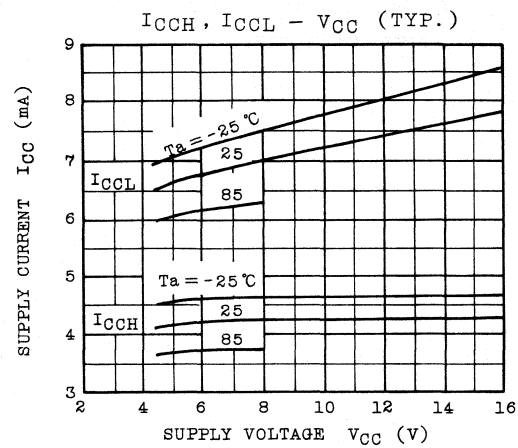

P_O – Ta
ALLOWABLE TOTAL POWER DISSIPATION P_O (mW)
300
250
200
150
100
50
0
-20
0
20
40
60
80
100
120
AMBIENT TEMPERATURE Ta (℃)


E_{LH}, E_{HL} – V_{CC} (TYP.)
RELATIVE THRESHOLD RADIANT INCIDENCE
1.2
1.0
0.8
0.6
0.4
0.2
Ta = 25 ℃
E_{LH}
E_{HL}
0
4
8
12
16
20
24
SUPPLY VOLTAGE V_{CC} (V)

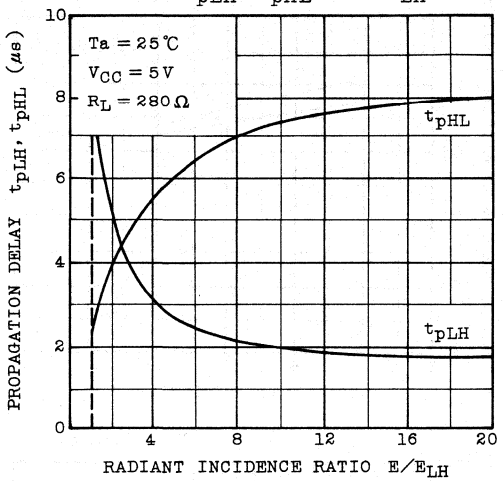

V_{OL} – I_{OL} (TYP.)
LOW LEVEL OUTPUT VOLTAGE V_{OL} (V)
V_{CC} = 5V
Ta = 25 ℃
0.2
0.1
0.05
0.03
0.01
0.005
1
3
5
10
30
50
100
LOW LEVEL OUTPUT CURRENT I_{OL} (mA)


V_{OL} – Ta (TYP.)
LOW LEVEL OUTPUT VOLTAGE V_{OL} (V)
0.12
0.10
0.08
0.06
0.04
0.02
0
V_{CC} = 5V
I_{OL} = 30mA
16
5
-40
-20
0
20
40
60
80
100
AMBIENT TEMPERATURE Ta (℃)

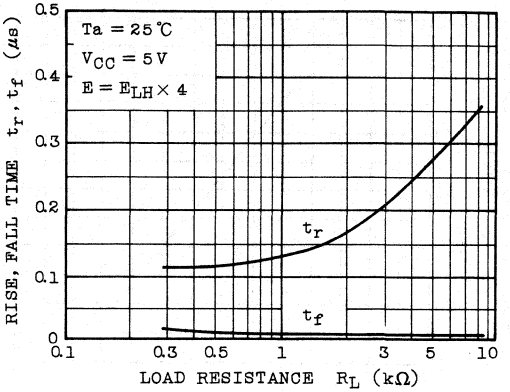

E_{LH}, E_{HL} – Ta (TYP.)
REATIVE THRESHOLD RADIANT INCIDENCE
1.6
1.4
1.2
1.0
0.8
0.6
0.4
V_{CC} = 5V
I_{FLH}
I_{FHL}
-40
-20
0
20
40
60
80
100
AMBIENT TEMPERATURE Ta (℃)


I_{CCH}, I_{CCL} – V_{CC} (TYP.)
SUPPLY CURRENT I_{CC} (mA)
9
8
7
6
5
4
3
Ta = -25 ℃
25
85
I_{CCL}
Ta = -25 ℃
25
85
I_{CCH}
2
4
6
8
10
12
14
16
SUPPLY VOLTAGE V_{CC} (V)

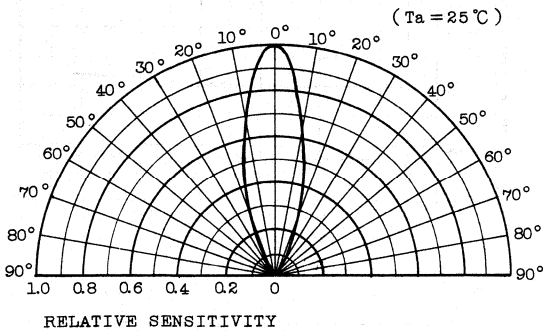
$t_{pLH}, t_{pHL} - E/E_{LH}$



$t_r, t_f - R_L$



RELATIVE DIRECTIONAL SENSITIVITY



SPECTRAL RESPONSE

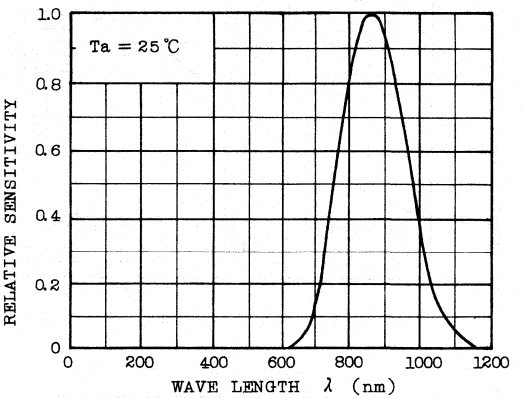


PHOTO IC
SILICON EPITAXIAL PLANER

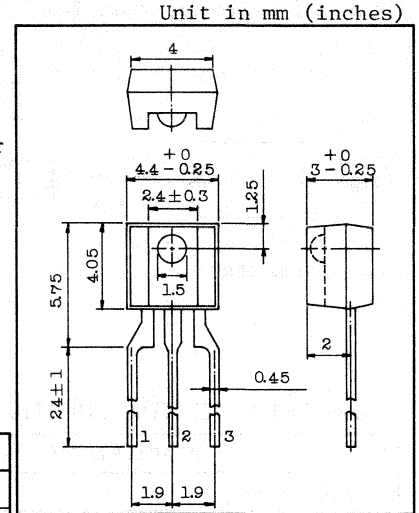
TPS802

TENTATIVE DATA

- ○ OPTICAL SWITCH
- ○ INTERRUPTER
- ○ COUNTER

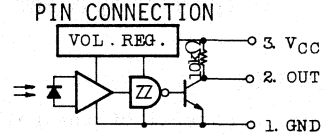
. TPS802 Contrains Photo diode, Amplifier Shumit Trigger and Output Circuit in 1 Chip.
. Housing Material is Visible Light Cut One.
. Wide Adaptable Supply Voltage : V_{CC}=4.5~16V
. High Speed : t_{on}=8μs(Typ.), t_{off}=5μs(Typ.)
. Including Diode for Surge Current at Output.
. Compatible for TTL, MOS-IC.

Unit in mm (inches)



JEDEC	-
EIAJ	-
TOSHIBA	0-4C1

PIN CONNECTION



MAXIMUM RATINGS (Ta=25°C)

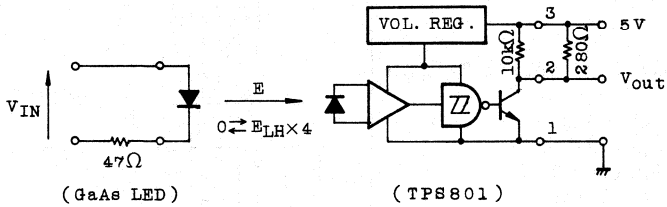
CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage	V_{CC}	16	V
Low Level Output Current	I_{OL}	50	mA
Total Power Dissipation	P_O	250	mW
Operating Temperature Range	T_{opr}	-25~85	°C
Storage Temperature Range	T_{stg}	-40~100	°C

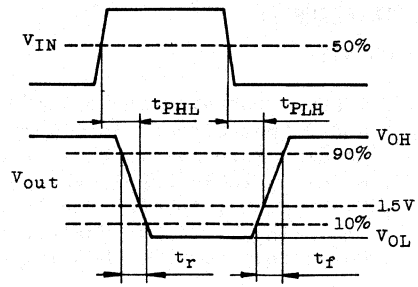
OPTO-ELECTRICAL CHARACTERISTICS (Ta=0 ∿ 70°C, unless otherwise specified)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}	Ta=25°C	4.5	-	16	V
Low Level Output Voltage	V_{OL}	I_{OL}=16mA, V_{CC}=5V, E=0	-	0.1	0.4	V
High Level Output Voltage	V_{OH}	V_{CC}=5V, E=2mW/cm²	4.0	-	-	V
Low Level Supply Current	I_{CCL}	V_{CC}=5V, E=0	-	6	15	mA
High Level Supply Current	I_{CCH}	V_{CC}=5V, E=2mW/cm²	-	4	10	mA
"L"→"H" Threshold Radiant Incidence (Note 1)	E_{LH}	V_{CC}=5V, Ta=25°C	-	0.5	1.2	mW/cm²
		V_{CC}=5V	-	-	1.6	
Hysterisis Ratio	E_{HL}/E_{LH}	Ta=25°C, V_{CC}=5V	-	0.9	-	
Peak Detective Wave Length	λ_P	-	-	900	-	nm
Propagation Delay "L"→"H"	t_{pLH}	Ta=25°C, V_{CC}=5V E=0↔2mW/cm² R_L=280Ω (Note 2)	-	8	-	μs
Propagation Delay "H"→"L"	t_{pHL}		-	5	-	
Rise Time	t_r		-	0.1	-	
Fall Time	t_f		-	0.05	-	

Note 1 : Color Temperature=2870°K Standard Tungsten Lamp.

Note 2 : Switching Time Test Circuit and Voltage Waveform





RECOMMENDED OPERATING CINDITION

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}	4.5	5	(Note) 16	V
Radiant Incidence	E	2	-	-	mW/cm^2
Operating Temperature	T_{opr}	0	-	70	°C

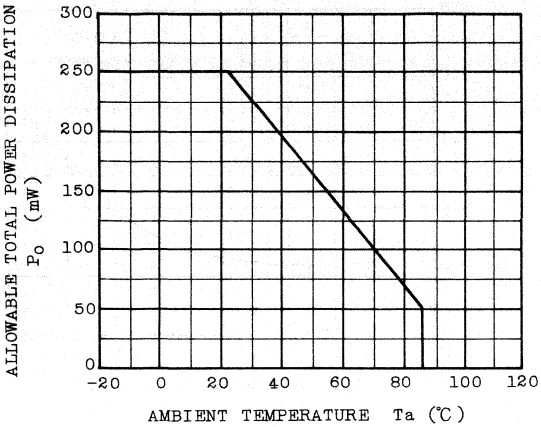
Note : at V_{CC}=10V, $R_L \geqq 1k\Omega$. , at V_{CC}=15V, $R_L > 500k\Omega$

PRECAUTION

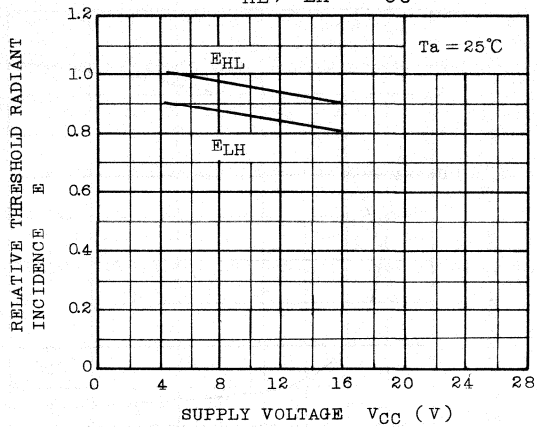
Please be careful of the followings

1. Soldering temperature: 260°C MAX. Soldering time: 3 sec MAX.
   (Soldering portion of lead: up to 2mm from the body of the device)
2. If the lead is formed, the lead should be formed at a distance of 2mm from the body of the device.
   Soldering shall be performed after lead forming.
3. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   o Freon TE or TF o Dai-Fron Solvents S3 or S3-E
4. During 100μs after turning ON V_{CC}, output voltage changes at random, because of inner circuit's stability.
5. Pin surge voltage: MAX 150V at C=200pF

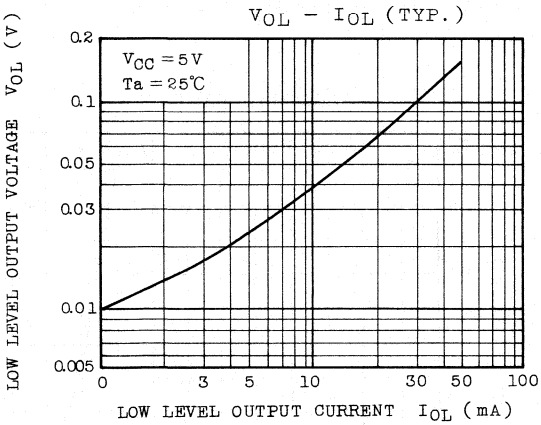
P_O – Ta



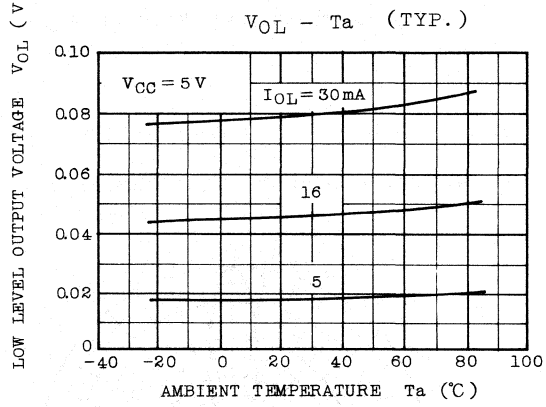
E_{HL}, E_{LH} – V_{CC} (TYP.)



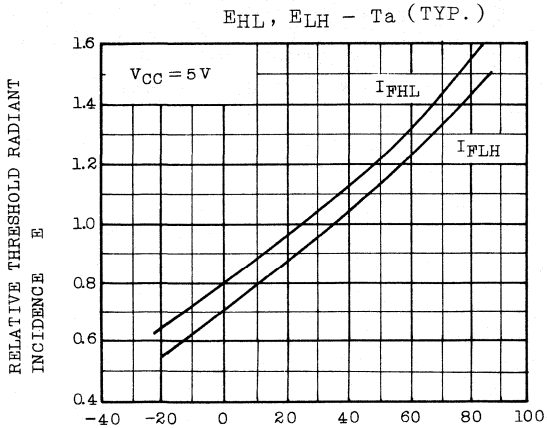
V_{OL} – I_{OL} (TYP.)



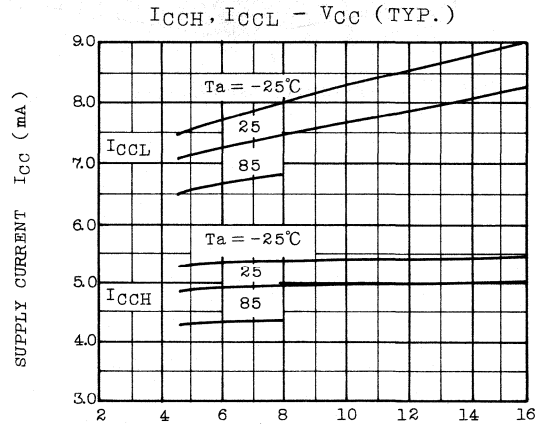
V_{OL} – Ta (TYP.)



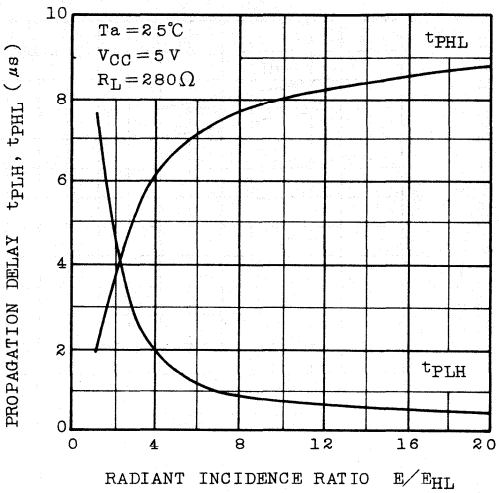
E_{HL}, E_{LH} – Ta (TYP.)



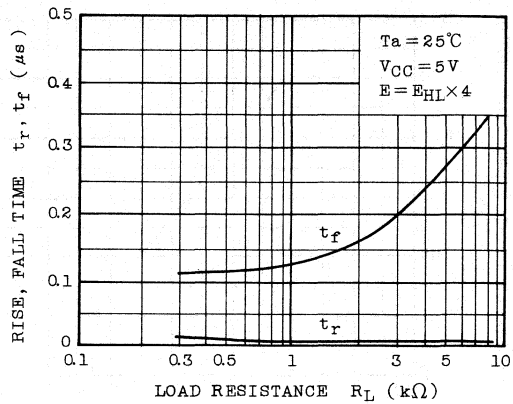
I_{CCH}, I_{CCL} – V_{CC} (TYP.)



t_{PHL}, t_{PLH} – E/E_{HL}

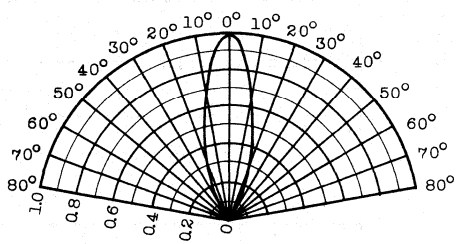


t_r, t_f – R_L



RELATIVE DIRECTIONAL SENSITIVITY

(Ta = 25℃)



SPECTRAL RESPONSE

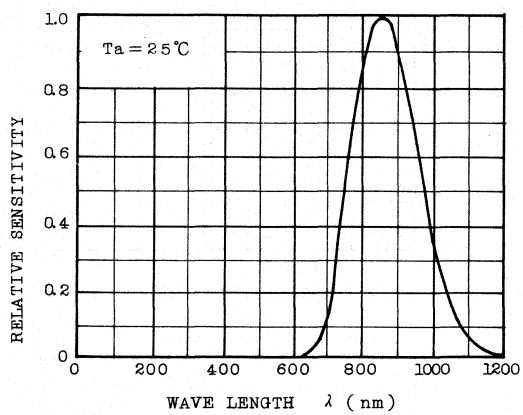


PHOTO IC
SILICON EPITAXIAL PLANER

TPS805

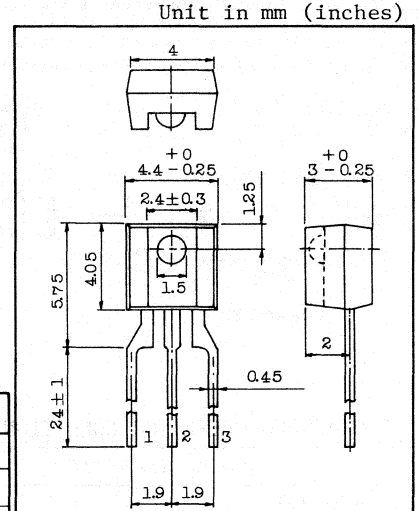
TENTATIVE DATA

UNDER DEVELOPMENT

- ○ OPTICAL SWITCH
- ○ INTERRUPTER
- ○ COUNTER

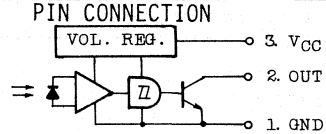
. TPS805 Contrans Photo diode, Amplifier, Shumit Trigger and Output Circuit in 1 Chip.
. Housing Material is Visible Light Cut One.
. Wide Adaptable Supply Voltage : V_{CC}=4.5~16V
. Wide Adaptable Output Voltage : V_O<30V
. Low Supply Current
. Compatible for TTL, MOS-IC.

Unit in mm (inches)



JEDEC	-
EIAJ	-
TOSHIBA	0-4C1

PIN CONNECTION



MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage	V_{CC}	17	V
High Level Output Voltage	V_{OH}	30	V
Low Level Output Current	I_{OL}	50	mA
Total Power Dissipation	P_o	250	mW
Operating Temperature Range	T_{opr}	-25~85	°C
Storage Temperature Range	T_{stg}	-40~100	°C

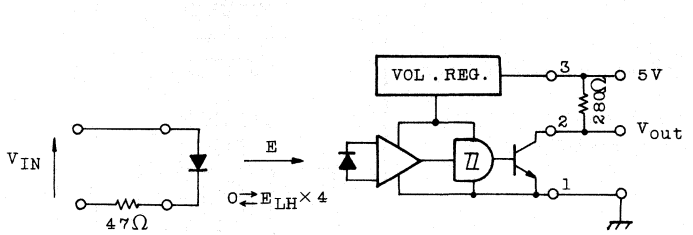
OPTO-ELECTRICAL CHARACTERISTICS

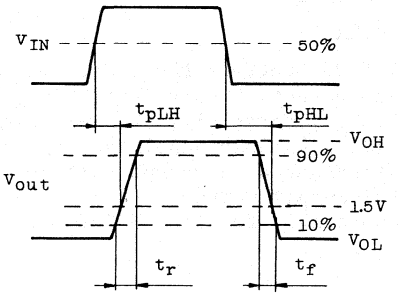
(Ta=0 ∿ 70°C, unless otherwise specified)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}	Ta=25°C	4.5	-	17	V
Low Level Output Voltage	V_{OL}	I_{OL}=16mA, V_{CC}=5V, E=0	-	0.1	0.4	V
High Level Output Current	I_{OH}	V_{CC}=5V, V_{OH}=30V E=2mW/cm²	-	-	100	μA
Low Level Supply Current	I_{CCL}	V_{CC}=5V, E=0	-	2.5	5	mA
High Level Supply Current	I_{CCH}	V_{CC}=5V, E=2mW/cm²	-	1.2	3	mA
"L"→"H" Threshold Raidant Incidence (Notel)	E_{LH}	V_{CC}=5V, Ta=25°C	-	0.2	0.5	mW/cm²
		V_{CC}=5V	-	-	0.8	
Hysterisis Ratio	E_{HL}/E_{LH}	Ta=25°C, V_{CC}=5V	-	0.65	-	
Peak Detective Wave Length	λ_P	-	-	870	-	nm
Propagation Delay "L"→"H"	t_{pLH}	Ta=25°C, V_{CC}=5V E=0↔2mW/cm² R_L=280Ω (Note 2)	-	7	-	μs
Propagation Delay "H"→"L"	t_{pHL}		-	2	-	
Rise Time	t_r		-	0.1	-	
Fall Time	t_f		-	0.05	-	

Note 1 : Color Temperature=2870°K Standard Tungsten Lamp.

Note 2 : Switching Time Test Circuit and Voltage Waveform





RECOMMENDED OPERATING CONDITION

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}	4.5	5	16	V
High Level Output Supply Voltage	V_{OH}	4.5	-	27	V
Radiant Incidence	E	1	-	-	mW/cm^2
Operating Temperature	T_{opr}	0	-	70	°C

PRECAUTION

Please be careful of the followings

1. Soldering temperature: 260°C MAX. Soldering time: 3 sec MAX.
   (Soldering portion of lead: up to 2mm from the body of the device)
2. If the lead is formed, the lead should be formed at a distance of 2mm from the body of the device.
   Soldering shall be performed after lead forming.
3. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   o Freon TE or TF o Dai-Fron Solvents S3 or S3-E
4. During 100μs after turning ON V_{CC}, output voltage changes at random, because of inner circuit's stability.
5. Pin surge voltage: MAX 150V at C=200pF.

PHOTO IC
SILICON EPITAXIAL PLANER

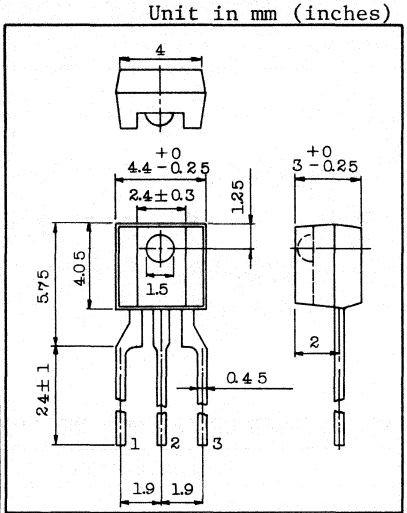
TPS806

TENTATIVE DATA UNDER DEVELOPMENT

- o OPTICAL SWITCH
- o INTERRUPTER
- o COUNTER

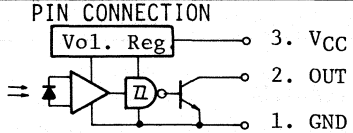
. TPS806 Contains Photo diode, Amplifier, Shumit Trigger and Output Circuit in 1 chip.
. Housing Material is Visible light cut one.
. Wide Adaptable Supply Voltage : V_{CC}=4.5~16V
. Wide Adaptable Output Voltage : V_O <30V
. Low Supply Current
. Compatible for TTL, MOS-IC.

Unit in mm (inches)



JEDEC	—
EIAJ	—
TOSHIBA	0-4C1

PIN CONNECTION



MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage	V_{CC}	17	V
High Level Output Voltage	V_{OH}	30	V
Low Level Output Current	I_{OL}	50	mA
Total Power Dissipation	P_O	250	mW
Operating Temperature Range	T_{opr}	-25~85	°C
Storage Temperature Range	T_{stg}	-40~100	°C

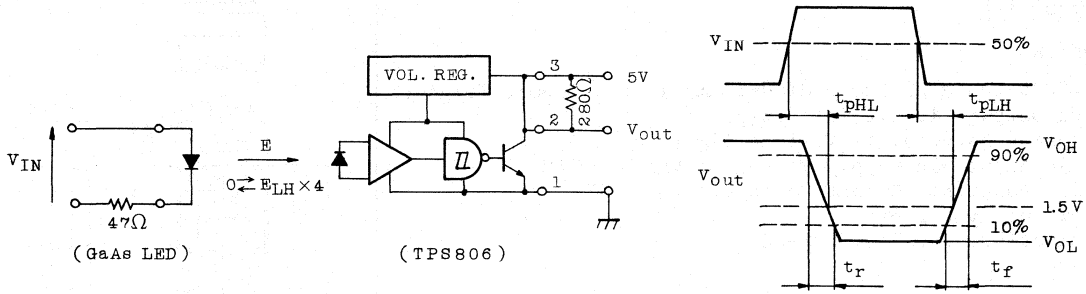
OPTO-ELECTRICAL CHARACTERISTICS

(Ta=0∿70°C, unless otherwise specified)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}	Ta=25°C	4.5	-	17	V
Low Level Output Voltage	V_{OL}	I_{OL}=16mA, V_{CC}=5V, E=2mW/cm²	-	0.1	0.4	V
High Level Output Current	I_{OH}	V_{CC}=5V, V_{OH}=30V, E=0	-	-	100	μA
Low Level Supply Current	I_{CCL}	V_{CC}=5V, E=2mW/cm²	-	2.5	5	mA
High Level Supply Current	I_{CCH}	V_{CC}=5V, E=0mW/cm²	-	1.2	3	mA
"H"→"L" Threshold Radiant Incidence (Note 1)	E_{HL}	V_{CC}=5V, Ta=25°C	-	0.2	0.5	mW/cm²
		V_{CC}=5V	-	-	0.8	
Hysterisis Ratio	E_{LH}/E_{HL}	Ta=25°C, V_{CC}=5V	-	0.65	-	
Peak Detective Wave Length	λ_P	-	-	870	-	nm
Propagation Delay "L"→"H"	t_{pLH}	Ta=25°C, V_{CC}=5V, E=0↔2mW/cm², R_L=280Ω (Note 2)	-	3	-	μs
Propagation Delay "H"→"L"	t_{pHL}		-	5	-	
Rise Time	t_r		-	0.1	-	
Fall Time	t_f		-	0.05	-	

Note 1 : Color Temperature=2870°K Standard Tungsten Lamp.

Note 2 : Switching Time Test Circuit and Voltage Waveform



RDCOMMENDED OPERATING CONDITION

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}	4.5	5	16	V
High Level Output Supply Voltage	V_{OH}	4.5	-	27	V
Radiant Incidence	E	1	-	-	mW/cm^2
Operating Temperature	T_{opr}	0	-	70	°C

PRECAUTION

Please be careful of the followings

1. Soldering temperature: 260°C MAX. Soldering time: 3 sec MAX.
   (Soldering portion of lead: up to 2mm from the body of the device)
2. If the lead is formed, the lead should be formed at a distance of 2mm from the body of the device.
   Soldering shall be performed after lead forming.
3. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   o Freon TE or TF o Dai-Fron Solvents S3 or S3-E
4. During 100μs after turning ON V_{CC}, output voltage changes at random, because of inner circuit's stability.
5. Pin surge voltage: MAX 150V at C=200pF.

■ Photo Interrupter

* New Product
** Under Development

PHOTO INTERRUPTER
INFRARED LED + PHOTO DARLINGTON TRANSISTOR

TLP507A

HIGH SENSITIVE OPTICAL SENSOR.

. OPTICAL SWITCH

. SHAFT POSITION AND VELOCITY SENSOR

. High Current Transfer Ratio : I_C/I_F=30%(Min.)

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	50	mA
	Reverse Voltage	V_R	5	V
	Forward Current Derating	$\Delta I_F/°C$	-0.33	mA/°C
DETECTOR	Collector-Emitter Voltage	V_{CEO}	30	V
	Emitter-Collector Voltage	V_{ECO}	5	V
	Collector Power Dissipation	P_C	75	mW
	Collector Power Dissipation Derating	$\Delta P_C/°C$	-1.0	mW/°C
	Collector Current	I_C	50	mA
Operating Temperature Range		T_{opr}	-25~85	°C
Storage Temperature Range		T_{stg}	-30~100	°C

ELECTRICAL CHARACTERISTICS (Ta=25°C)

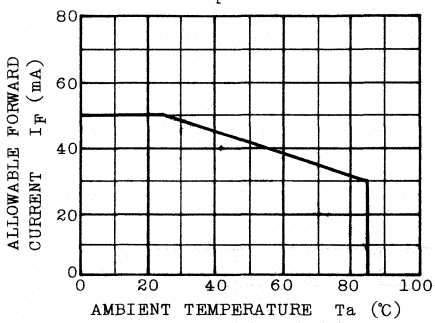
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.00	1.15	1.30	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0 , f=1MHz	-	30	-	pF
DETECTOR	Capacitance	C_T	V=0 , f=1MHz	-	6	-	pF
	Dark Current	$I_D(I_{CEO})$	V_{CE}=16V, I_F=0	-	30	250	nA
Coupled	Current Transfer Ratio	I_C/I_F	V_{CE}=2V, I_F=10mA	30	-	-	%

PRECAUTION

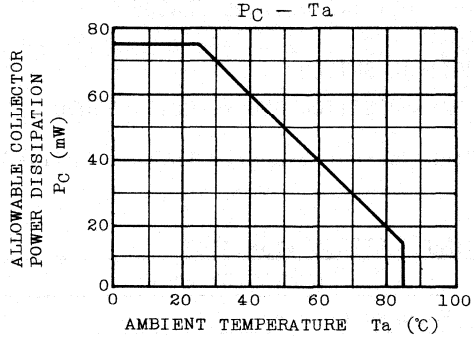
Please be careful of the followings.

1. Soldering temperature: 260°C MAX.
   Soldering time: 3 sec MAX.
   (Soldering portion of lead: up to 1.5mm from the body of the device)
2. If the lead is formed, Soldering shall be performed after lead forming.
3. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   o Freon TE or TF o Dai-Fron Solvents S3 or S3-E

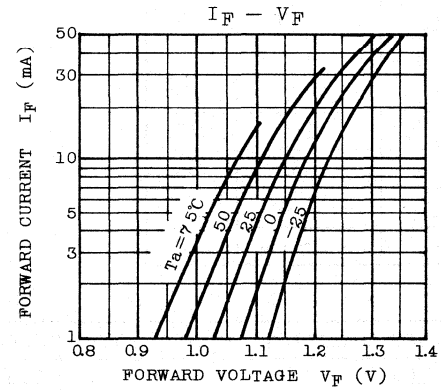
I_F – Ta



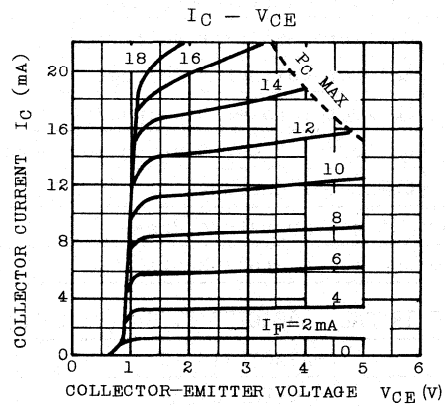
P_C – Ta



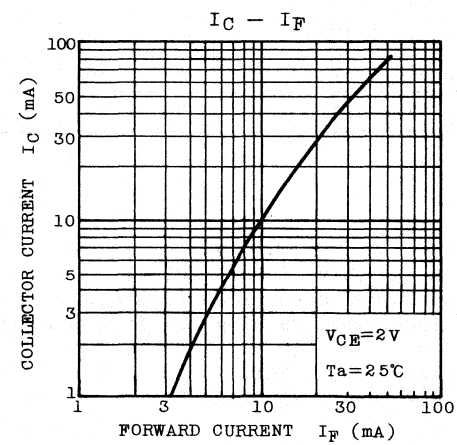
I_F – V_F



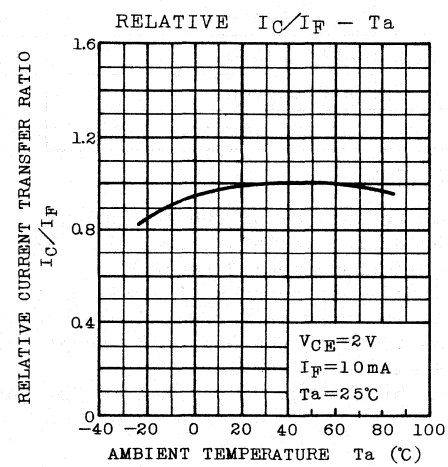
I_C – V_{CE}



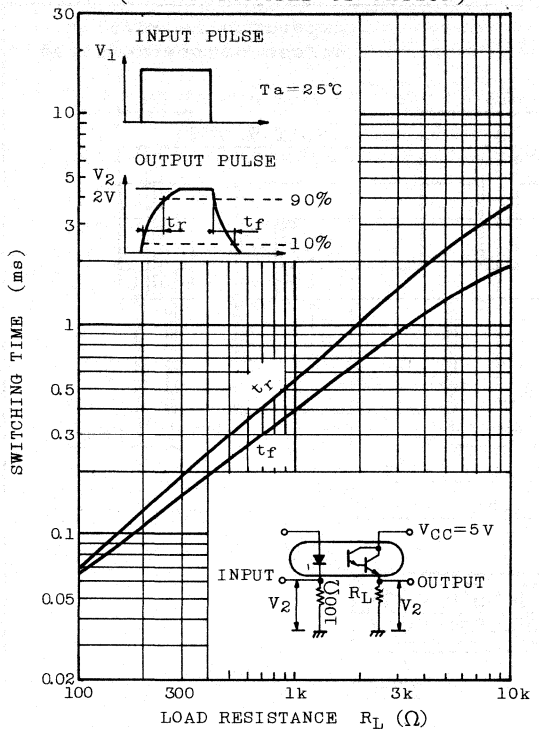
I_C – I_F



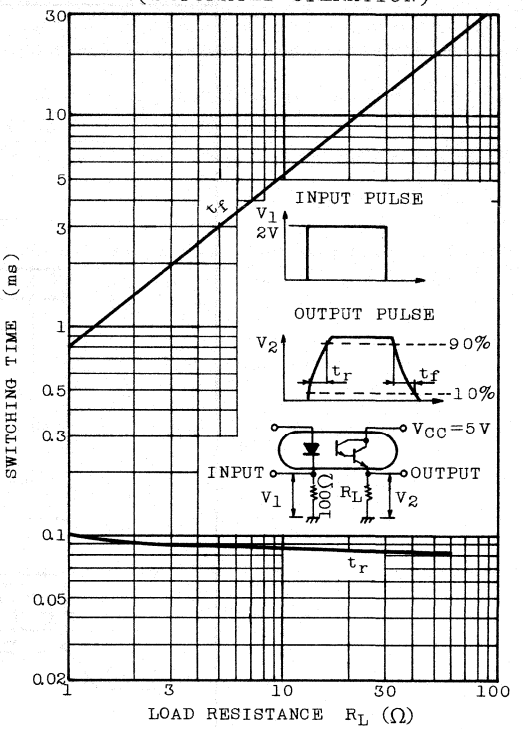
RELATIVE I_C/I_F – Ta



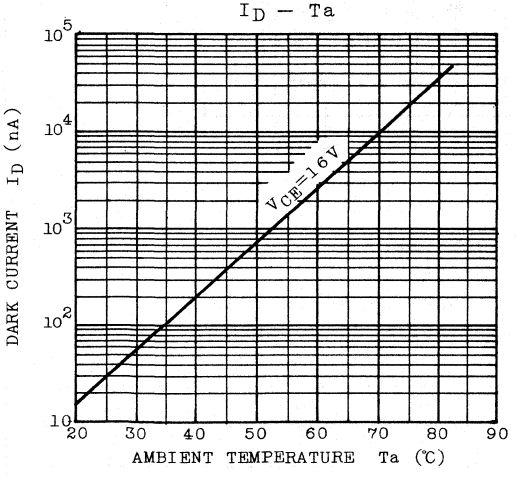
SWITCHING CHARACTERISTICS
(NON SATURATED OPERATION)



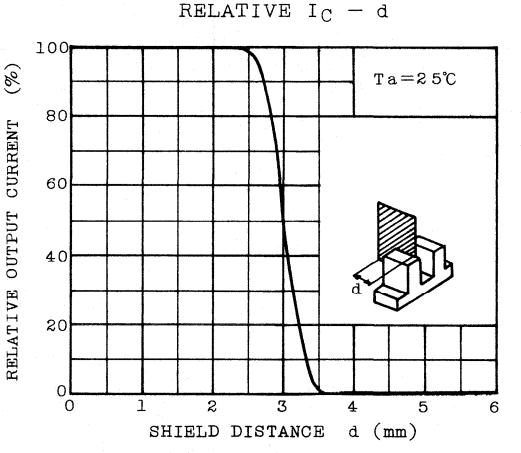
SWITCHING CHARACTERISTICS
(SATURATED OPERATION)



I_D — Ta



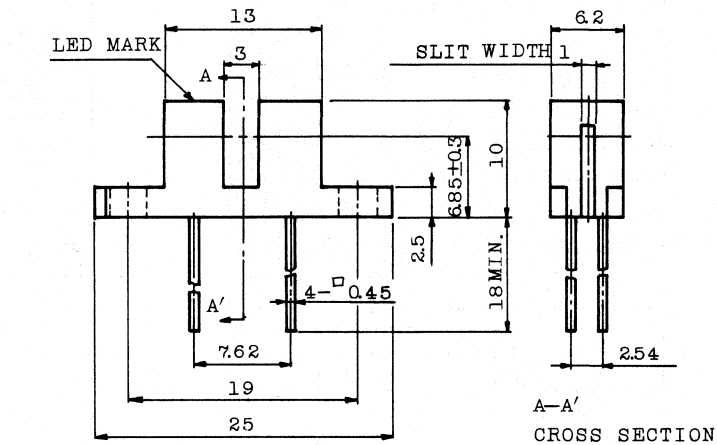
RELATIVE I_C — d

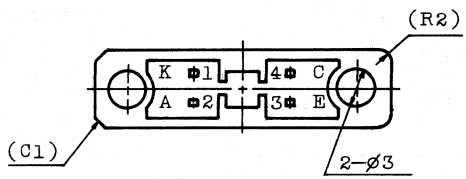


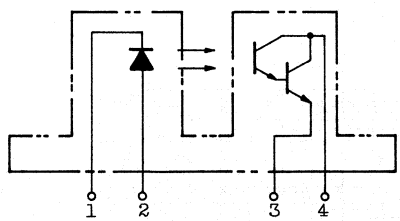
OUTLINE AND DIMENSION

Unit in mm

Tolerance is ±0.25
unless otherwise noted.







1. LED CATHODE
2. LED ANODE
3. PHOTO TRANSISTOR EMITTER
4. PHOTO TRANSISTOR COLLECTOR

JEDEC	—
EIAJ	—
TOSHIBA	11–13B1A

Weight : 0.84g

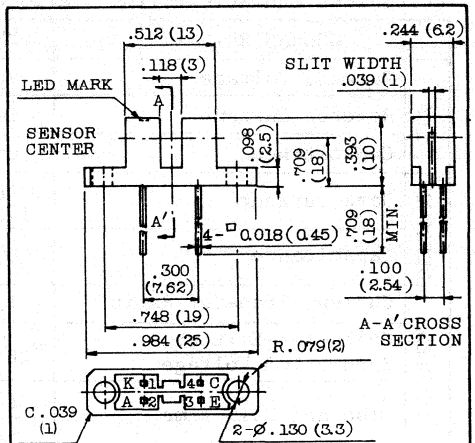
PHOTO INTERRUPTER
INFRARED LED + PHOTO TRANSISTOR

TLP800A

OPTICAL SHAFT POSITION AND VELOCITY MONITOR USING A DIGITALLY ENCODED DISC MOUNTED ON A SHAFT.
OPTICAL SENSING OF HOLES IN PAPER, PAPER TAPE, IBM CARD, OR MAGNETIC TAPE.
END OF TAPE SENSOR USING A TRANSPARENT SECTION OF TAPE, A HOLE IN THE TAPE.
LIMIT SWITCH FOR MECHANICAL TRAVEL SUCH AS CAM SWITCHES, PRESSURE SWITCHES, MACHINE TOOL LIMIT SWITCHES, FOOT PEDAL SWITCHES, SAFTY INTERLOCK SWITCHES.

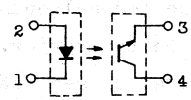
- Both chips face each other across a 0.118 inche air gap.
- Small slit width 0.039 inch.
- Either side mounting flange.
- Fits standerd dual-in-line package socket.
- No contact switching, therefore high reliability.
- Plastic case.
- Transistor detector offers faster switching speeds than darlington detectors.

Dimensions in inches (mm)



JEDEC	—
EIAJ	—
TOSHIBA	11-13D1B

PIN CONNECTION



1. CATHODE
2. ANODE
3. EMITTER
4. COLLECTOR

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	50	mA
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 Current	I_C	50	mA
Operating Temperature Range		T_{opr}	-25~85	°C
Storage Temperature Range		T_{stg}	-40~100	°C

ELECTRICAL CHARACTERISTICS (Ta=25°C)

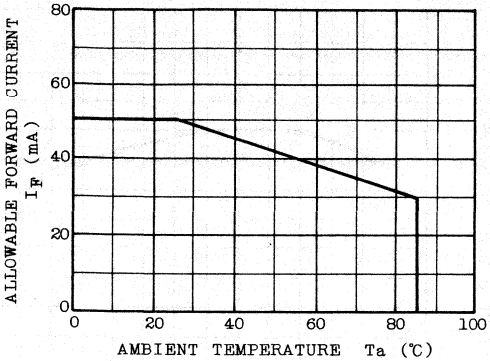
	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.00	1.15	1.30	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	Dark Current	I_D (I_{CEO})	V_{CE}=24V, I_F=0	-	5	100	nA
	Capacitance	C_T	V=0, f=1MHz	-	13	-	pF
COUPLED	Current Transfer Ratio	I_C/I_F	V_{CE}=5V, I_F=20mA	10	40	-	%
	Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	I_F=20mA, I_C=1mA	-	0.15	0.4	V
	Rise and Fall Time	t_r	V_{CC}=5V, I_C=2mA R_L=100Ω	-	6	-	μs
		t_f		-	6	-	μs

PRECAUTION

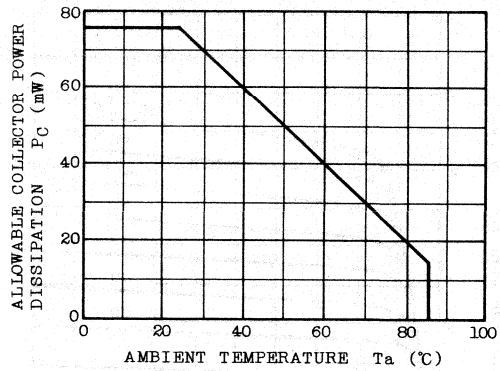
Please be careful of the followings.

1. Soldering temperature: 260°C MAX.
   Soldering time: 5 sec MAX.
   (Soldering portion of lead: up to 1.5mm from the body of the device.)
2. If the lead is formed, Soldering shall be performed after lead forming.
3. Avoid using the solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvent temperature: 45°C MAX.
   o Freon TE or TF o Dai-Fron Solvents S3 or S3-E

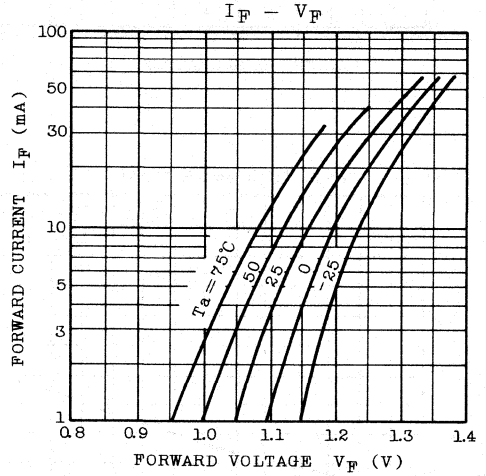
I_F – Ta



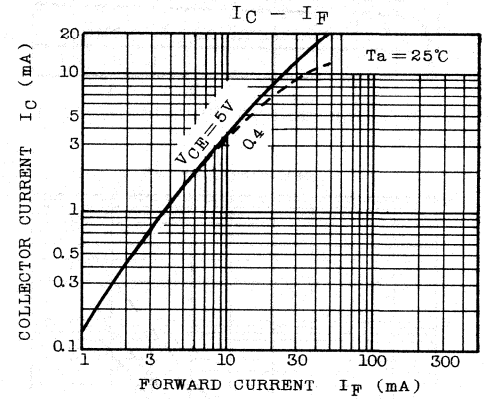
P_C – Ta



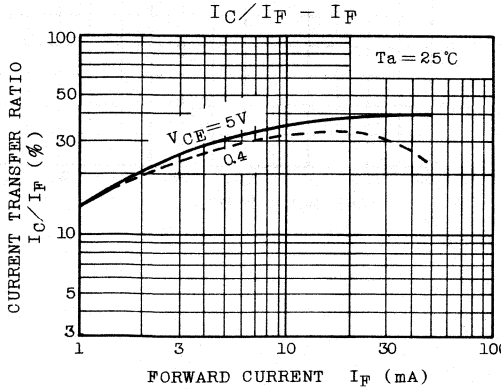
I_F – V_F



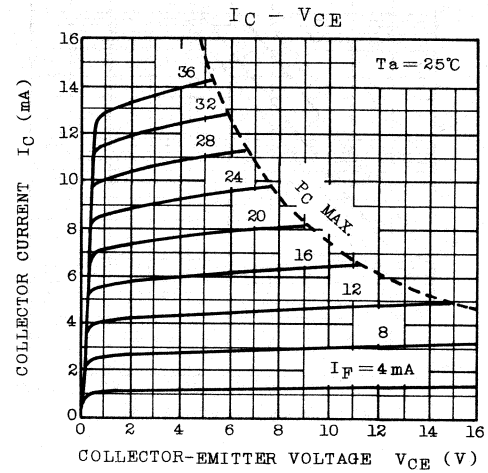
I_C – I_F



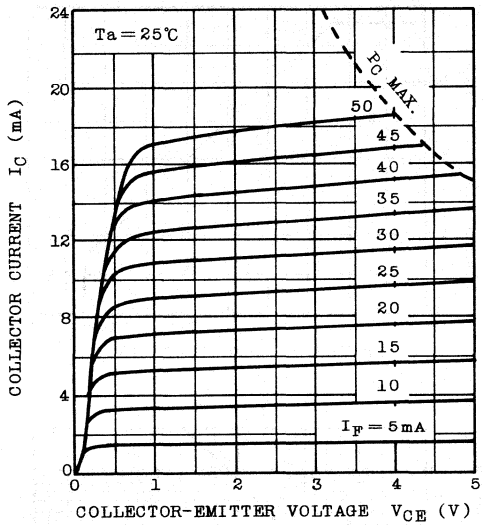
I_C / I_F – I_F



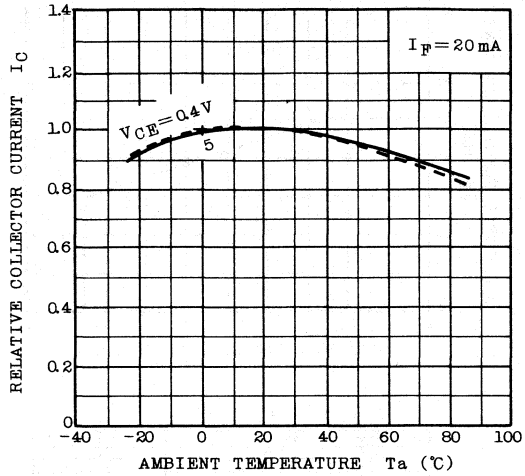
I_C – V_{CE}



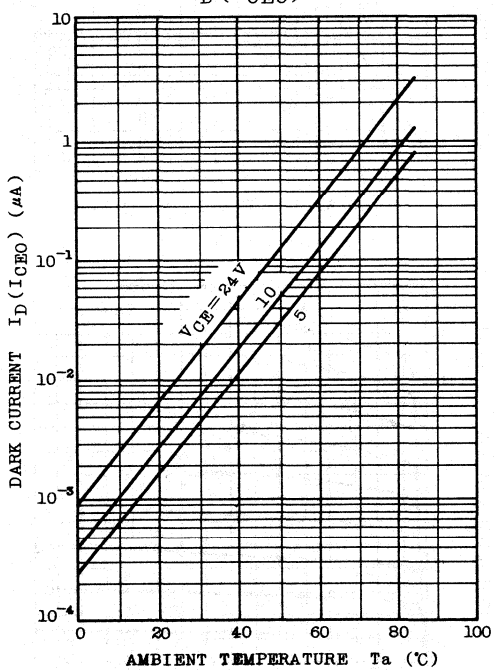
$I_C - V_{CE}$



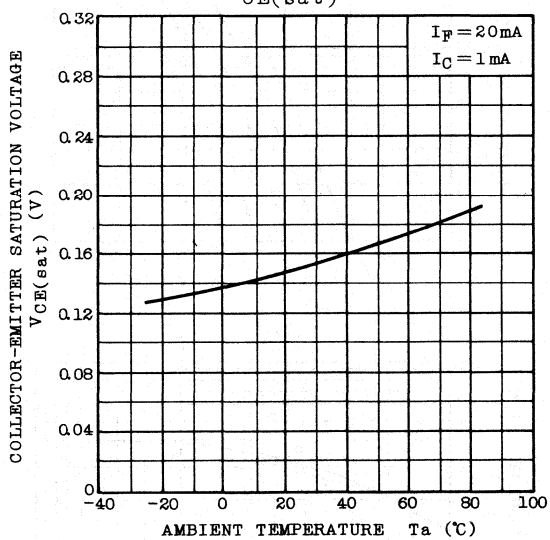
RELATIVE I_C — Ta



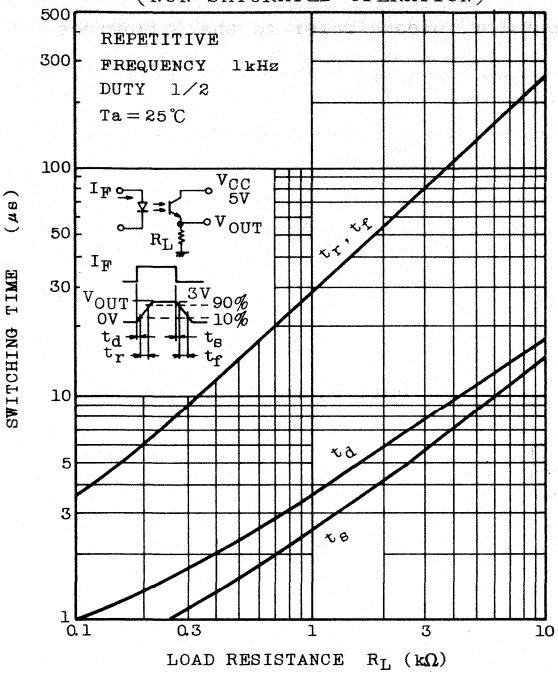
$I_D (I_{CEO})$ — Ta



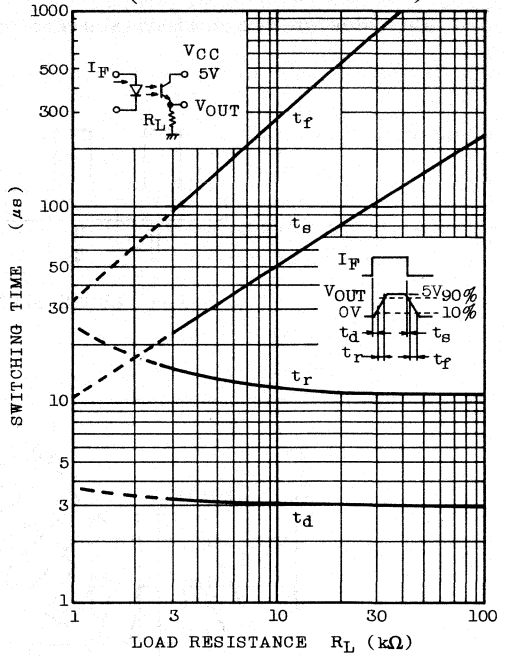
$V_{CE(sat)}$ — Ta



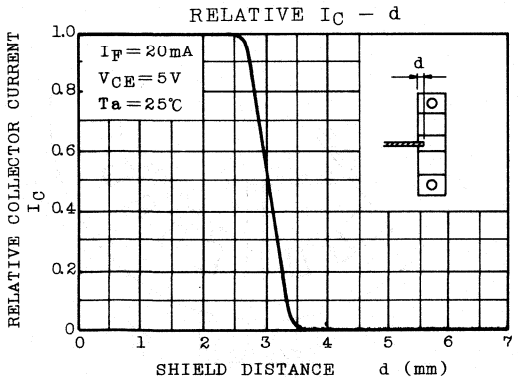
SWITCHING CHARACTERISTICS
(NON-SATURATED OPERATION)



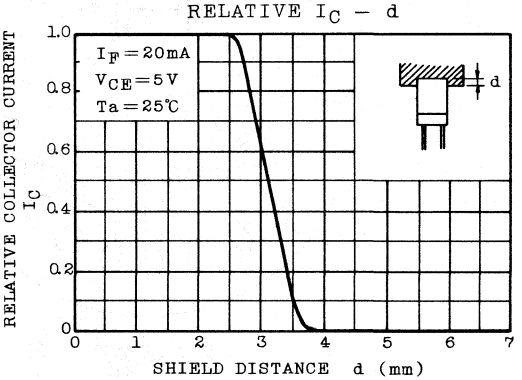
SWITCHING CHARACTERISTICS
(SATURATED OPERATION)



RELATIVE I_C — d

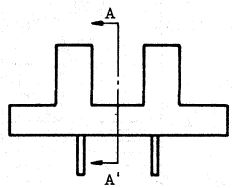


RELATIVE I_C — d



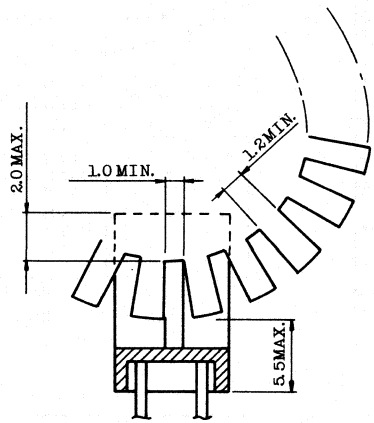
EXAMPLES FOR OPTICAL SHUTTER DESIGN

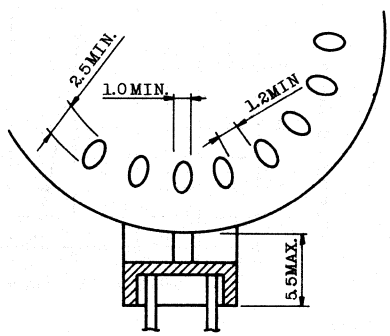
When design the optical shutter of rotator, please refer to the followings.



A-A' CROSS SECTION

Unit in mm





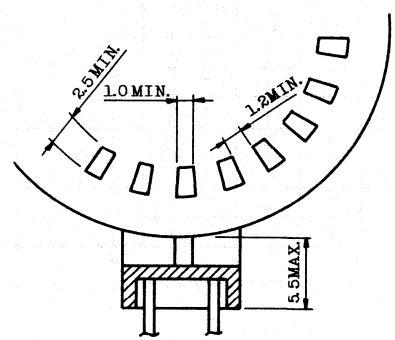


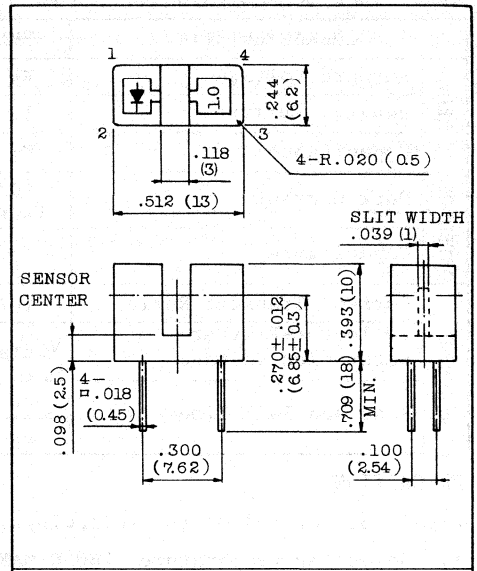
PHOTO INTERRUPTER
INFRARED LED + PHOTO TRANSISTOR

TLP801A

OPTICAL SHAFT POSITION AND VELOCITY MONITOR USING A DIGITALLY ENCODED DISC MOUNTED ON A SHAFT.
OPTICAL SENSING OF HOLES IN PAPER, PAPER TAPE, IBM CARD, OR MAGNETIC TAPE.
END OF TAPE SENSOR USING A TRANSPARENT SECTION OF TAPE, A HOLE IN THE TAPE.
LIMIT SWITCH FOR MECHANICAL TRAVEL SUCH AS CAM SWITCHED, PRESSURE SWITCHES, MACHINE TOOL LIMIT SWITCHES, FOOT PEDAL SWITCHES, SAFETY INTERLOCK SWITCHES.

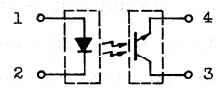
- Both chips face each other across a 0.118 inche air gap.
- Small slit width 0.039 inch.
- Fits standard dual-in-line package socket.
- No contact switching, therefore high reliability.
- Plastic case.
- Transistor detector offers faster switching speeds than darlington detectors.

Dimensions in inches (mm)



JEDEC	-
EIAJ	-
TOSHIBA	11-13D2A

PIN CONFIGURATIONS



1. ANODE
2. CATHODE
3. COLLECTOR
4. EMITTER

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	50	mA
	Reverse Voltage	V_R	5	V
DETECTOR	Collector-Emitter Voltage	V_{CEO}	30	V
	Emitter-Collector Voltage	V_{ECO}	5	V
	Collector Power Dissipation	P_C	75	mW
	Collector Current	I_C	50	mA
Operating Temperature Range		T_{opr}	-25~85	°C
Storage Temperature Range		T_{stg}	-40~100	°C

ELECTRICAL CHARACTERISTICS (Ta=25°C)

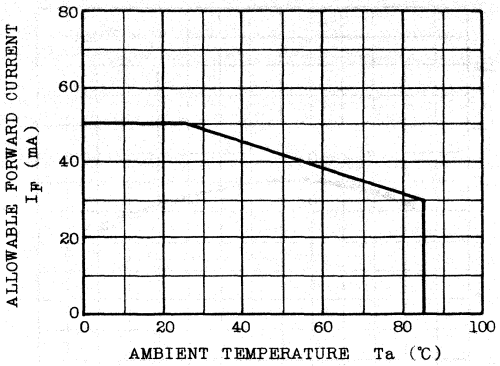
	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.00	1.15	1.30	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	Dark Current	I_D (I_{CEO})	V_{CE}=24V, I_F=0	-	5	100	nA
	Capacitance	C_T	V=0, f=1MHz	-	13	-	pF
COUPLED	Current Transfer Ratio	I_C/I_F	V_{CE}=5V, I_F=20mA	10	40	-	%
	Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	I_F=20mA, I_C=1mA	-	0.15	0.4	V
	Rise and Fall Time	t_r	V_{CC}=5V, I_C=2mA R_L=100Ω	-	6	-	μs
		t_f		-	6	-	μs

PRECAUTION

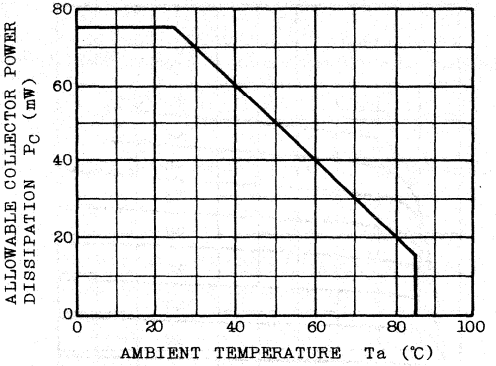
Please be careful of the followings.

1. Soldering temperature: 260°C MAX.
   Soldering time: 5 sec MAX.
   (Soldering portion of lead: up to 1.5mm from the body of the device.)
2. If the lead is formed, Soldering shall be performed after lead forming.
3. Avoid using the solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvent temperature: 45°C MAX.
   o Freon TE or TF o Dai-Fron Solvent S3 or S3-E

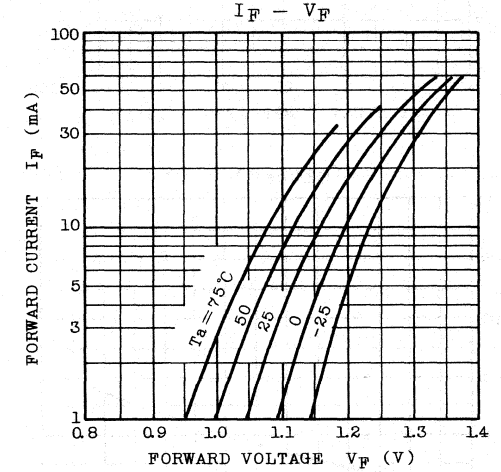
I_F – Ta



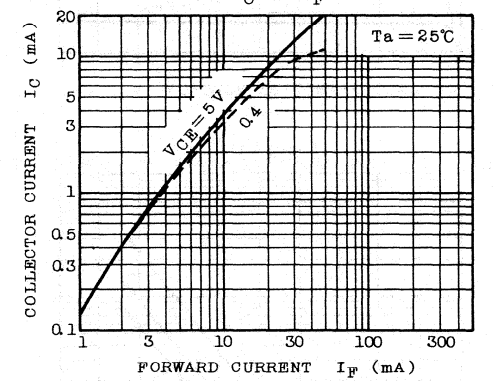
P_C – Ta



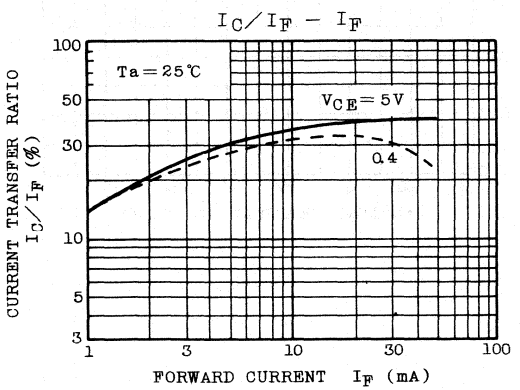
I_F – V_F



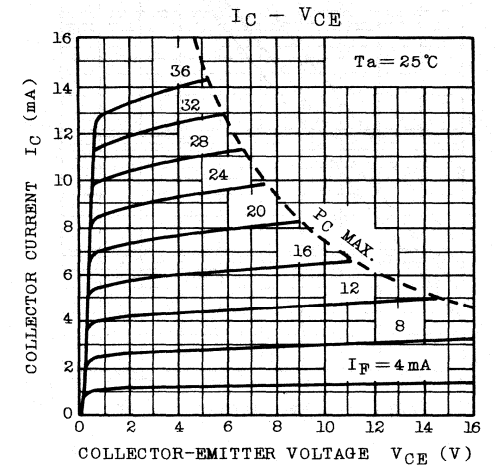
I_C – I_F



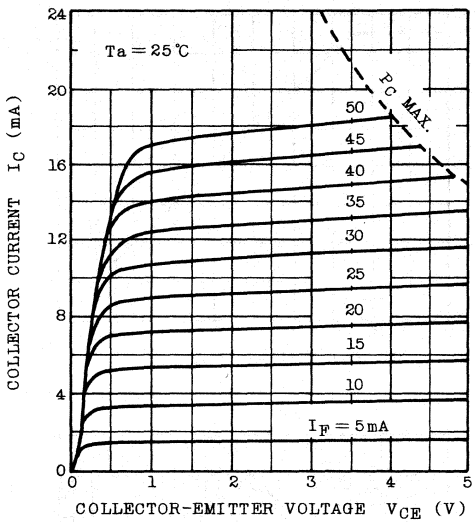
I_C/I_F – I_F



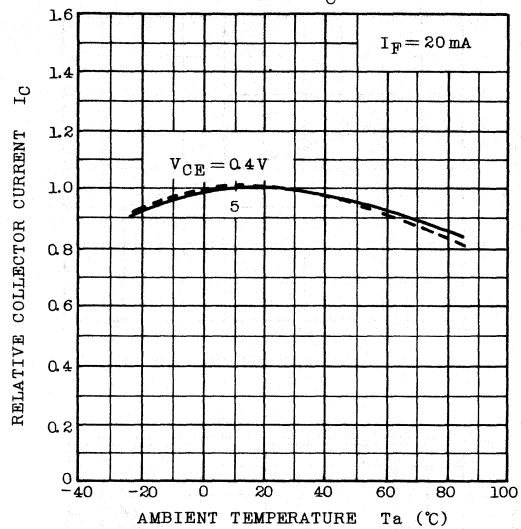
I_C – V_{CE}



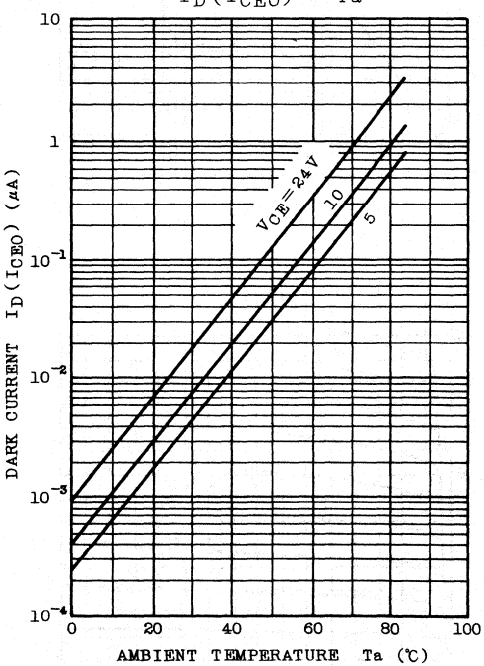
$I_C - V_{CE}$



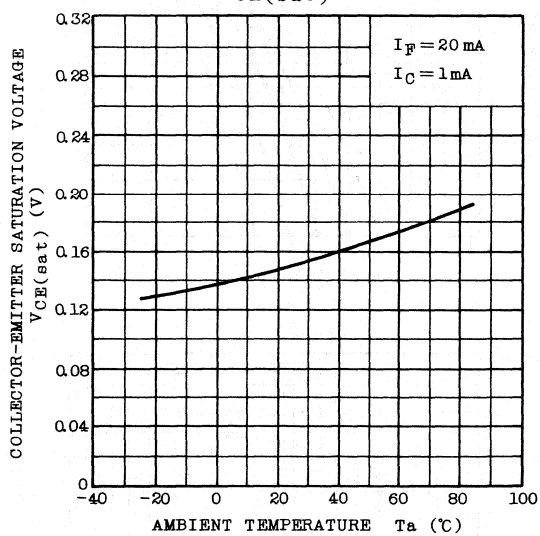
RELATIVE I_C – Ta



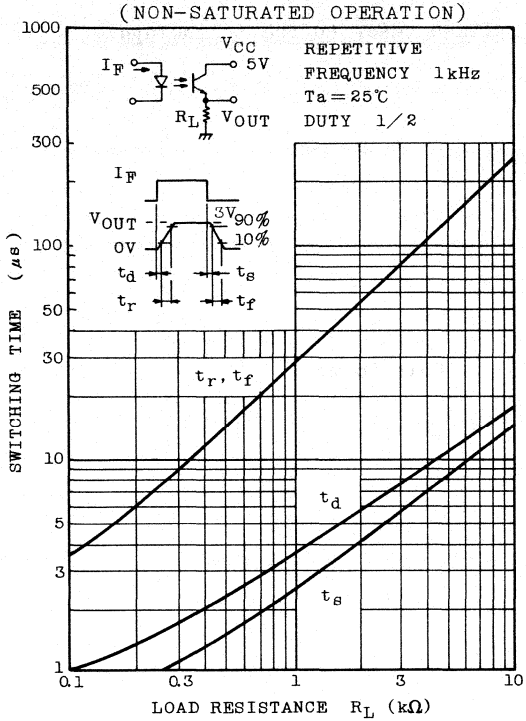
$I_D (I_{CEO})$ – Ta



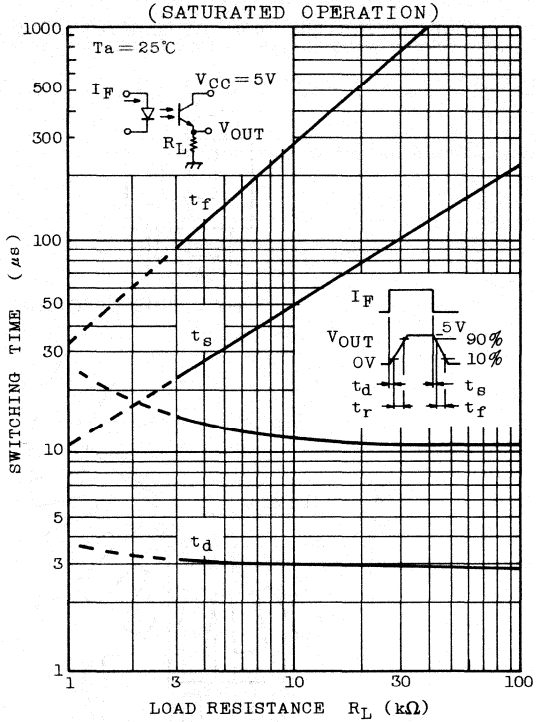
$V_{CE(sat)}$ – Ta



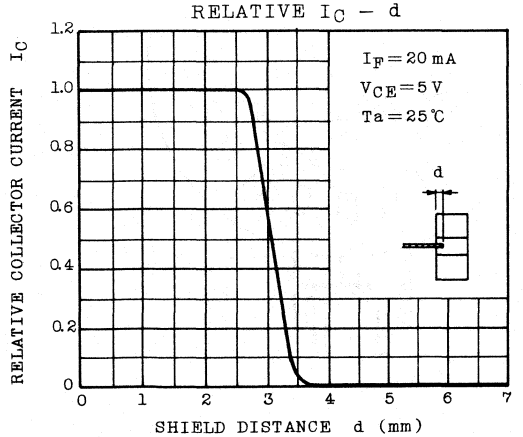
SWITCHING CHARACTERISTICS
(NON-SATURATED OPERATION)



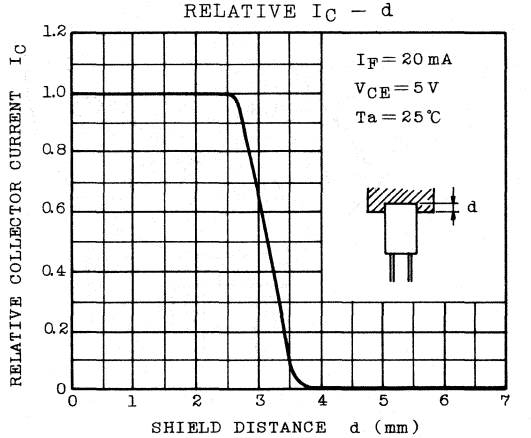
SWITCHING CHARACTERISTICS
(SATURATED OPERATION)



RELATIVE I_C — d

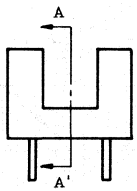


RELATIVE I_C — d



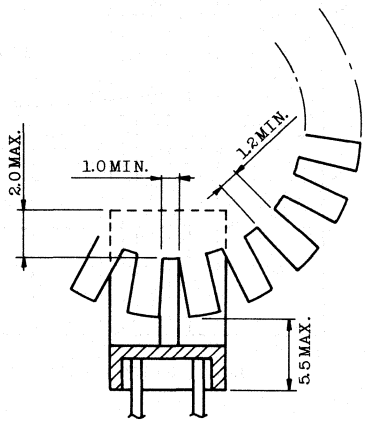
EXAMPLES FOR OPTICAL SHUTTER DESIGN

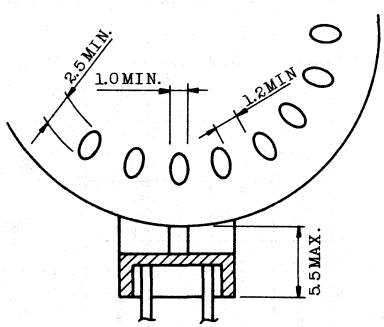
When design the optical shuffer of rotator, please refer to the followings.



A-A' CROSS SECTION

Unit in mm





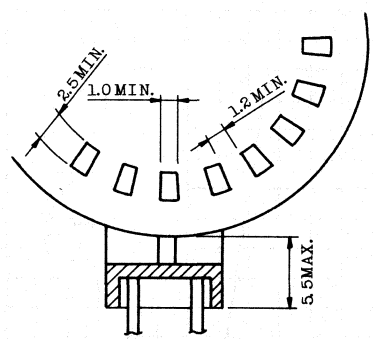


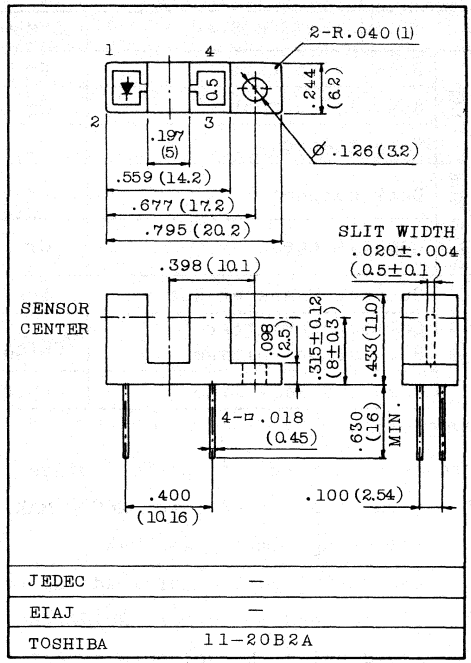
PHOTO INTERRUPTER
INFRARED LED + PHOTO TRANSISTOR

TLP802

OPTICAL SHAFT POSITION AND VELOCITY MONITOR USING A DIGITALLY ENCODED DISC MOUNTED ON A SHAFT.
OPTICAL SENSING OF MARKS ON PAPER, PAPER TAPE OR IBM CARD.
END OF TAPE SENSOR USING A TRANSPARENT SECTION OF TAPE, A HOLE IN THE TAPE.
LIMIT SWITCH FOR MECHANICAL TRAVEL SUCH AS CAM SWITCHES, PRESSURE SWITCHES, MACHINE TOOL LIMIT SWITCHES, FOOT PEDAL SWITCHES, SAFETY INTERLOCK SWITCHES.

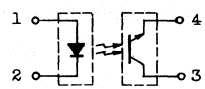
- Both chips face each other across a 0.197 inche air gap.
- Small slit width 0.020 inch.
- One side mounting flange.
- Fits standard dual-in-line package socket.
- No contact switching, therefore high reliability.
- Plastic case.
- Transistor detector offers faster switching speed than darlington detectors.

Dimensions in inches (mm)



JEDEC	—
EIAJ	—
TOSHIBA	11-20B2A

PIN CONFIGURATIONS



1. ANODE
2. CATHODE
3. COLLECTOR
4. EMITTER

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	50	mA
	Reverse Voltage	V_R	5	V
DETECTOR	Collector-Emitter Voltage	V_{CEO}	30	V
	Emitter-Collector Voltage	V_{ECO}	5	V
	Collector Power Dissipation	P_C	75	mW
	Collector Current	I_C	50	mA
Operating Temperature Range		T_{opr}	-25~85	°C
Storage Temperature Range		T_{stg}	-40~100	°C

ELECTRICAL CHARACTERISTICS (Ta=25°C)

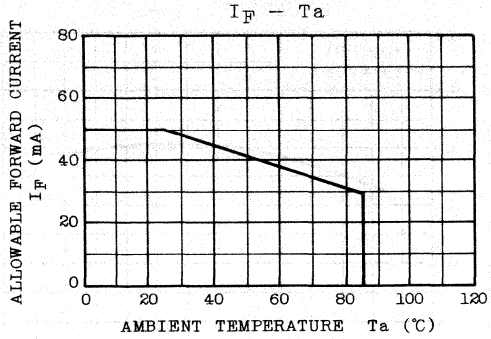
	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.00	1.15	1.30	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	Dark Current	I_D (I_{CEO})	V_{CE}=24V, I_F=0	-	5	100	nA
	Capacitance	C_T	V=0, f=1MHz	-	13	-	pF
COUPLED	Current Transfer Ratio	I_C/I_F	V_{CE}=5V, I_F=20mA	2	8	-	%
	Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	I_F=20mA, I_C=0.2mA	-	0.1	0.4	V
	Rise and Fall Time	t_r, t_f	V_{CC}=5V, I_C=2mA, R_L=100Ω	-	6	-	μs

PRECAUTION

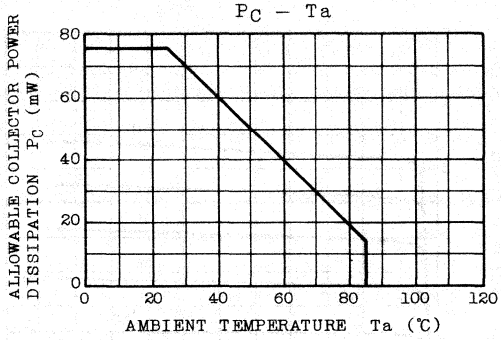
Please be careful of the followings.

1. Soldering temperature: 260°C MAX.
   Soldering time: 5 sec MAX.
   (Soldering portion of lead: up to 1.5mm from the body of the device)
2. If the lead is formed, Soldering shall be performed of the lead forming.
3. Avoid using the solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvent temperature: 45°C MAX.
   o Freon TE or TF o Dai-Fron Solvents S3 or S3-E

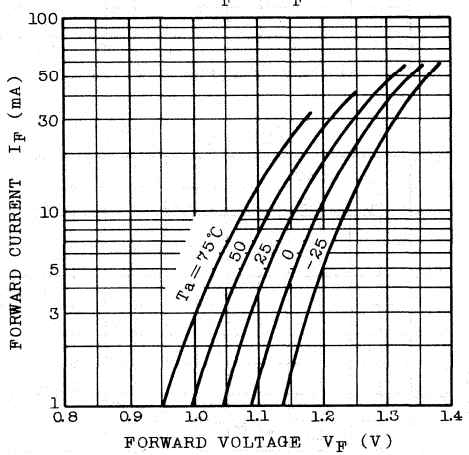
I_F – Ta



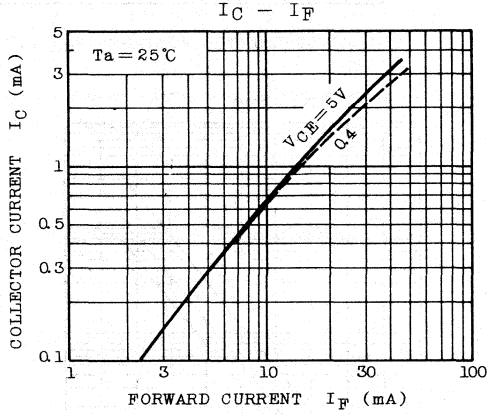
P_C – Ta



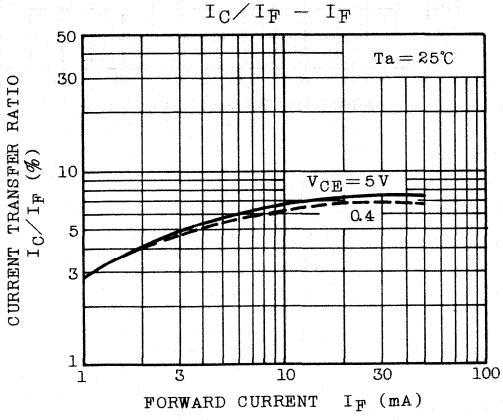
I_F – V_F



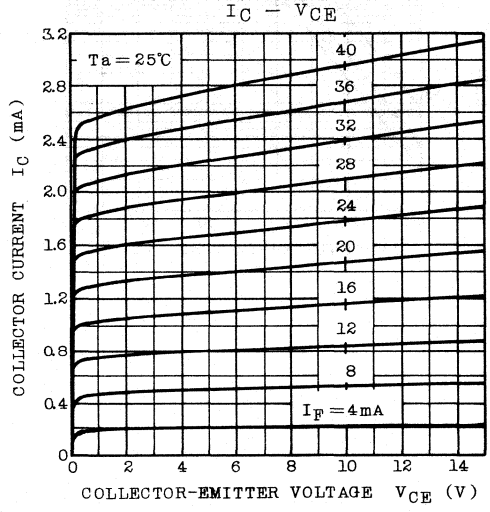
I_C – I_F



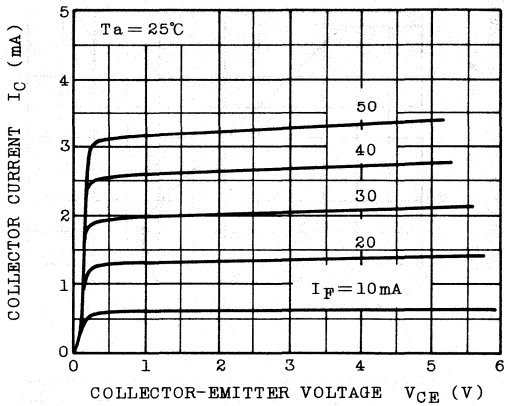
I_C / I_F – I_F



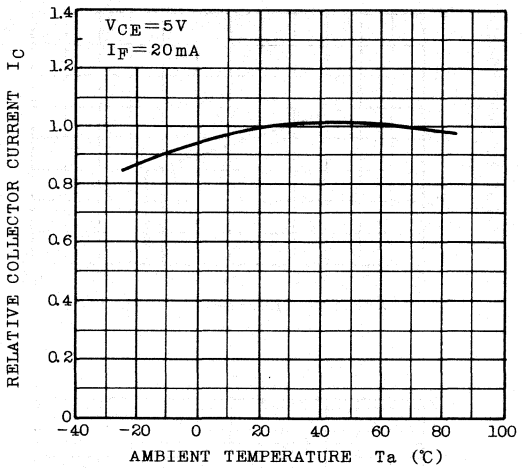
I_C – V_{CE}



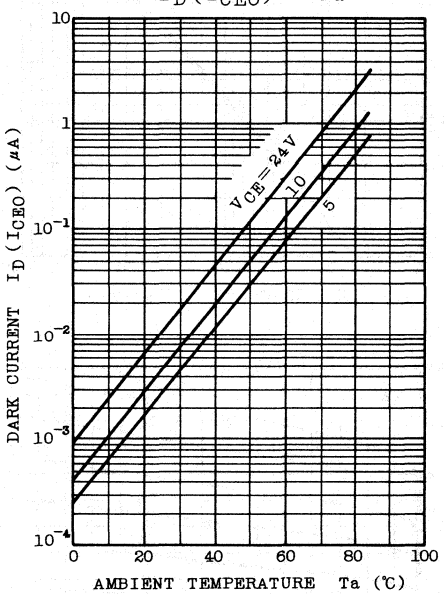
$I_C - V_{CE}$



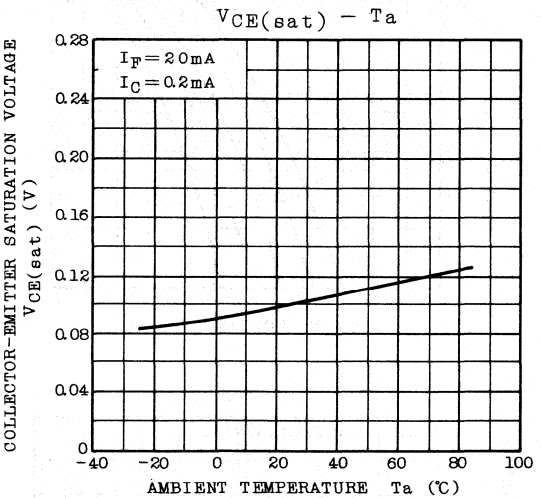
RELATIVE I_C − Ta



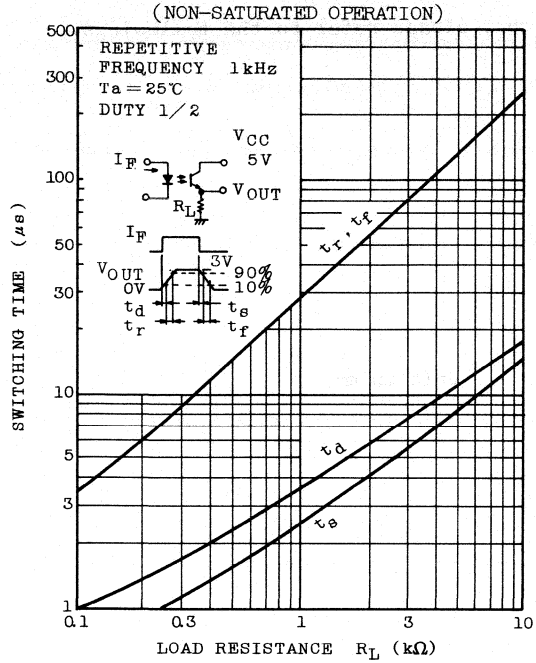
$I_D(I_{CEO})$ − Ta



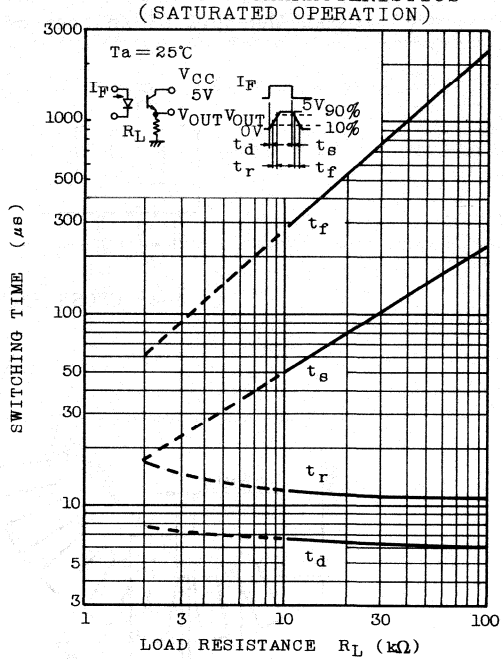
$V_{CE(sat)}$ − Ta



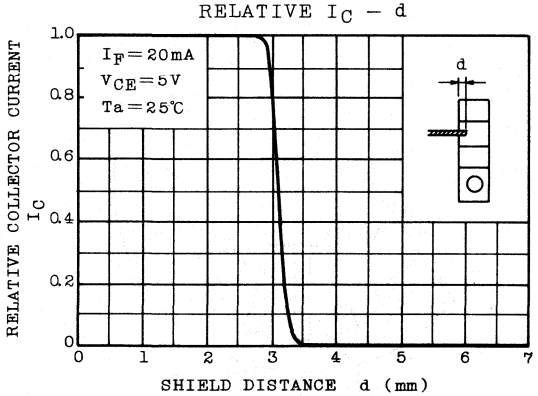
SWITCHING CHARACTERISTICS
(NON-SATURATED OPERATION)



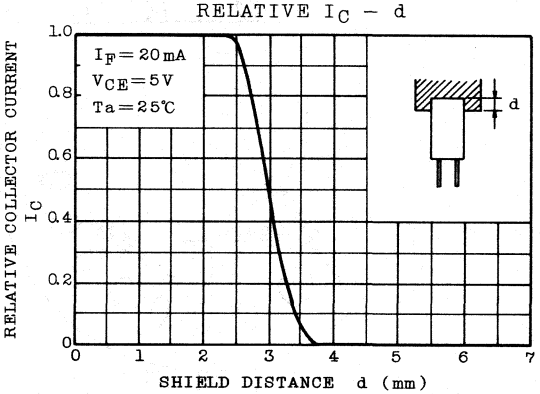
SWITCHING CHARACTERISTICS
(SATURATED OPERATION)



RELATIVE I_C — d

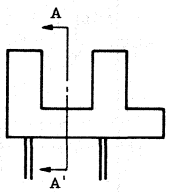


RELATIVE I_C — d



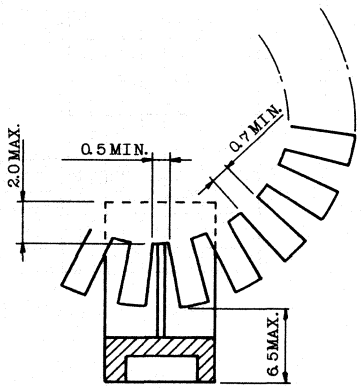
EXAMPLES FOR OPTICAL SHUTTER DESIGN

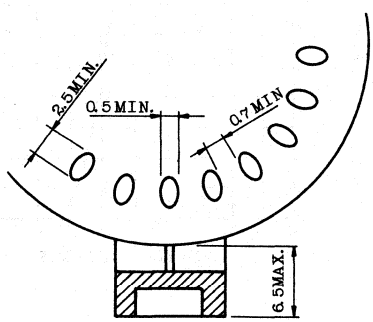
When design the optical shutter of rotator, please refer to the followings.



A-A' CROSS SECTION

Unit in mm





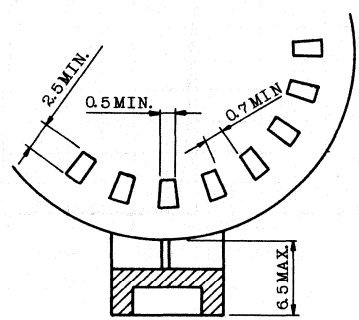
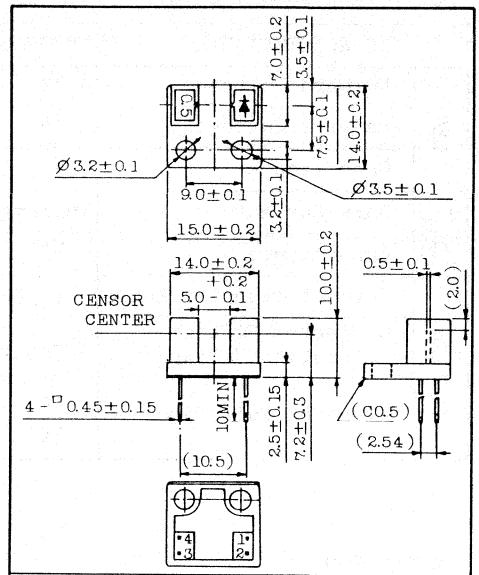


PHOTO INTERRUPTER
INFRARED LED + PHOTO TRANSISTOR

TLP803

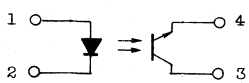
- TIMING SENSER FOR PRINTER AND ELECTRONIC TYPE WRITER
- EDGE AND POSITION SENSOR
- POSITION AND VEROCITY SENSOR
  - High sensing accuracy : slit width 5mm
  - Wide gap between LED and detector : 5mm
  - High speed response : t_r, t_f = 6μs (TYP.)

Unit in mm



JEDEC	—
EJAJ	—
TOSHIBA	11-14D1

PIN CONNECTION



1. ANODE
2. CATHODE
3. COLLECTOR
4. EMITTER

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	50	mA
LED	Reverse Voltage	V_R	5	V
DETECTOR	Collector-Emitter Voltage	V_{CEO}	35	V
DETECTOR	Emitter-Collector Voltage	V_{ECO}	5	V
DETECTOR	Collector Power Dissipation	P_C	75	mW
DETECTOR	Collector Current	I_C	50	mA
Operating Temperature Range		T_{opr}	-25 ∿ 85	°C
Storage Temperature Range		T_{stg}	-40 ∿ 100	°C

ELECTRICAL CHARACTERISTICS (Ta=25°C)

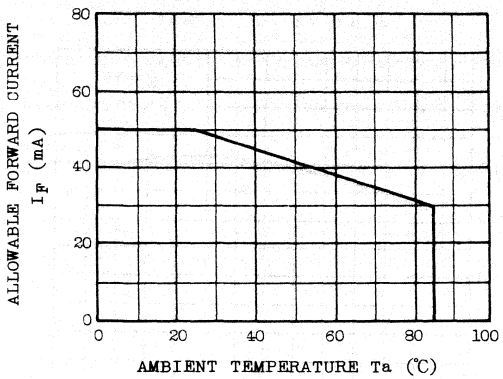
	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.00	1.15	1.30	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETE-CTOR	Dark Current	$I_D(I_{CEO})$	V_{CE}=24V, I_F=0	-	-	0.1	μA
	Capacitance	C_T	V=0, f=1MHz	-	13	-	pF
COUPLED	Current Transfer Ratio	I_C/I_F	V_{CE}=5V, I_F=20mA	2.5	10	-	%
	Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	I_F=20mA, I_C=0.25mA	-	0.1	0.4	V
	Rise and Fall Time	t_r	V_{CC}=5V, I_C=2mA	-	6	-	μs
		t_f	R_L=100Ω	-	6	-	

PRECAUTION

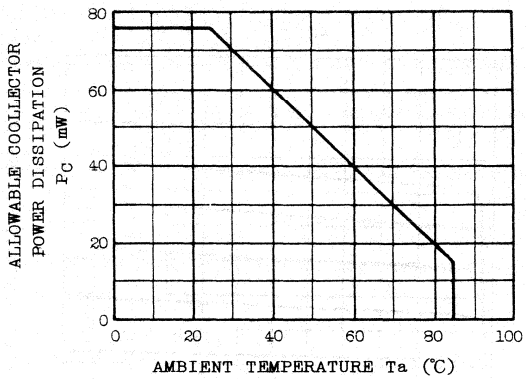
Please be careful of the followings.

1. Soldering tmeperature: 260°C MAX.
   Soldering time: 5 sec MAX.
   (Soldering portion of lead: up to 1.5mm from the body of the device.)
2. If the lead is formed, Soldering shall be performed after lead forming.
3. Avoid using the solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvent temperature: 45°C MAX.
   ∘ Freon TE or TF ∘ Dai-Fron Solvents S3 or S3-E

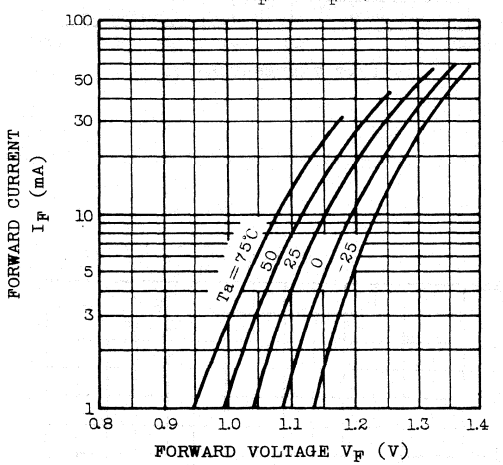
I_F — Ta



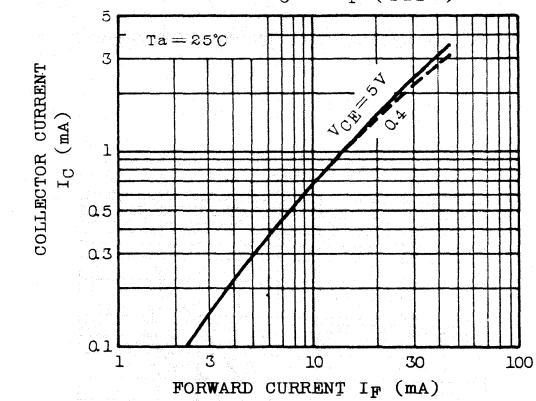
P_C — Ta



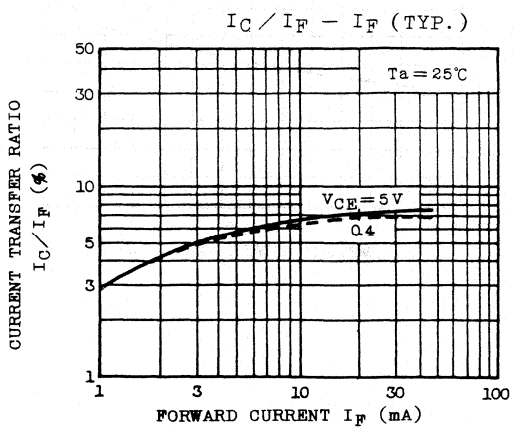
I_F — V_F (TYP.)



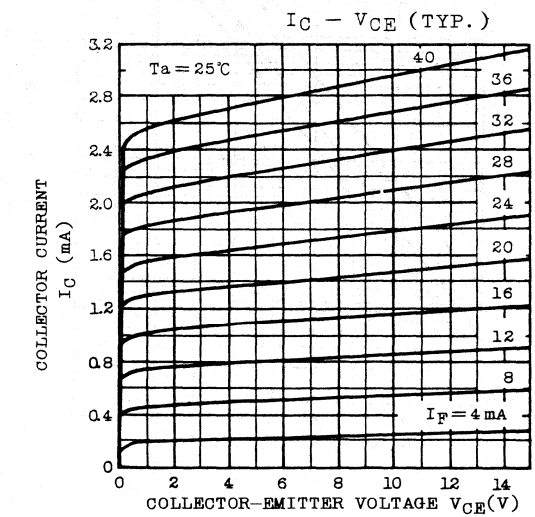
I_C — I_F (TYP.)



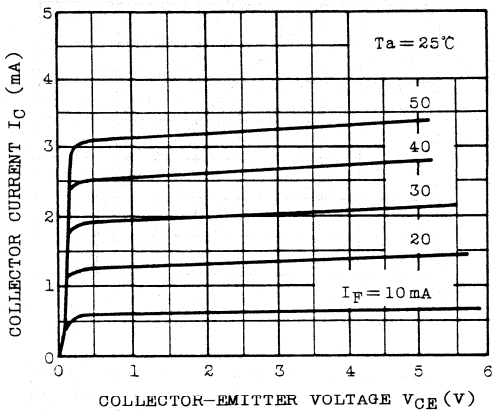
I_C / I_F — I_F (TYP.)



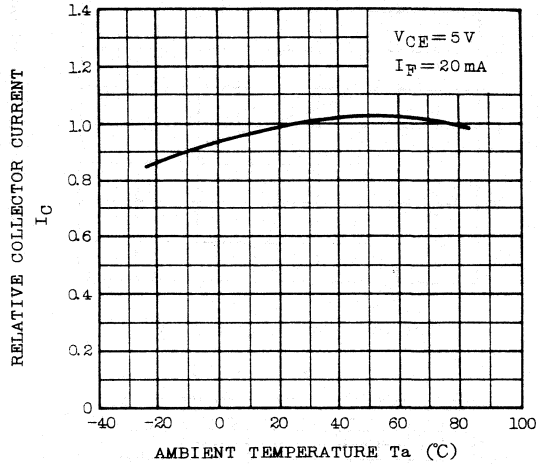
I_C — V_{CE} (TYP.)



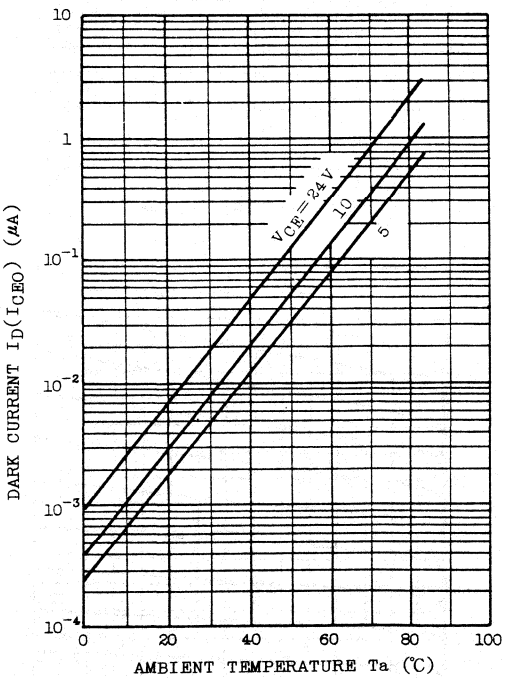
$I_C - V_{CE}$ (TYP.)



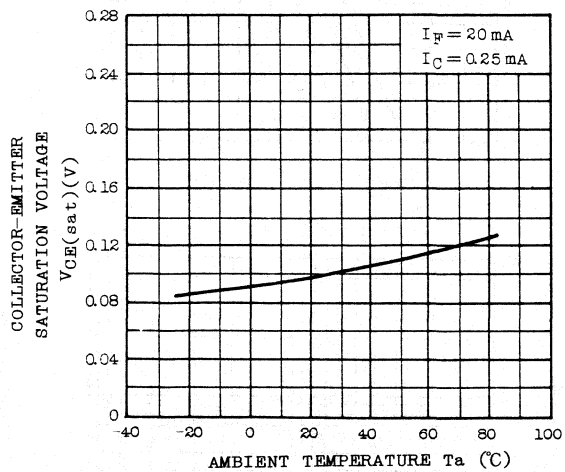
RELATIVE I_C - Ta(TYP.)



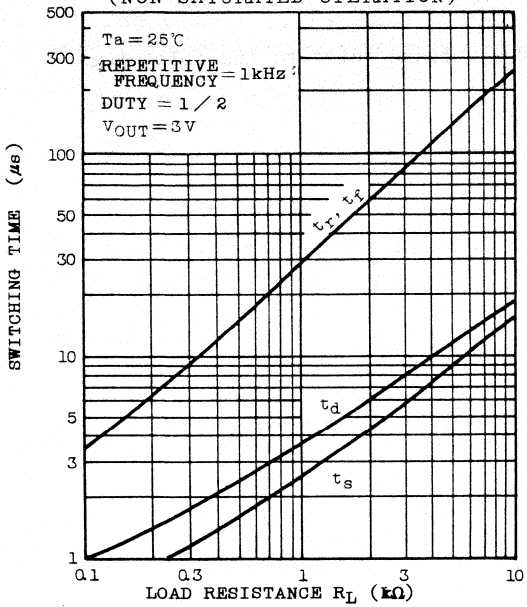
$I_D(I_{CEO})$ - Ta(TYP.)



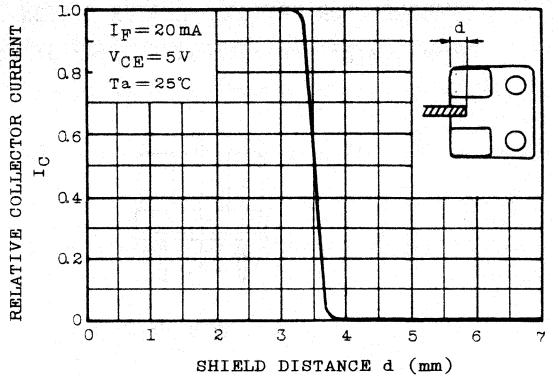
$V_{CE(sat)}$ - Ta(TYP.)



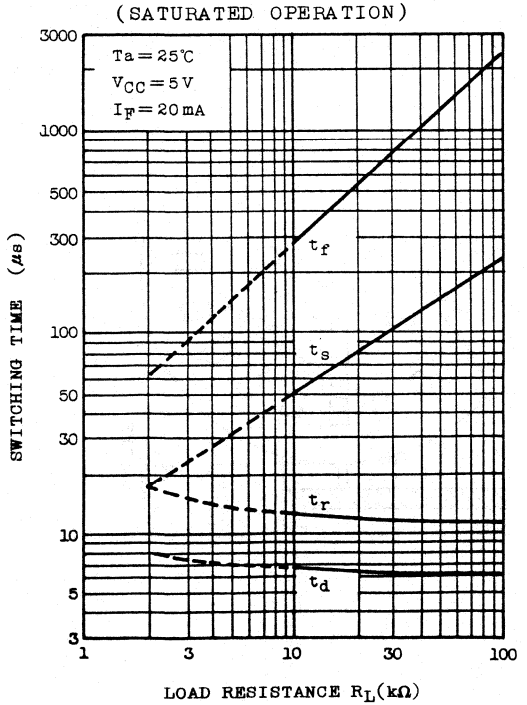
SWITCHING CHARACTERISTICS(TYP.)
(NON SATURATED OPERATION)



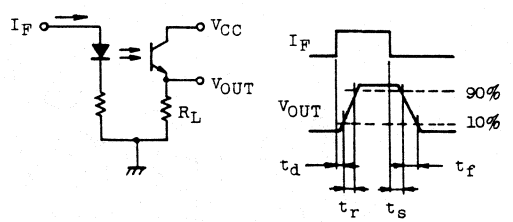
RELATIVE I_C – d (1)(TYP.)



SWITCHING CHARACTERISTICS(TYP.)
(SATURATED OPERATION)

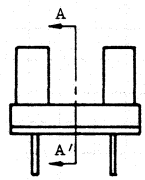


SWITCHING TIME TEST CIRCUIT



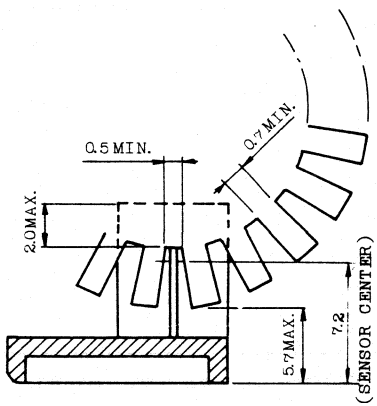
- EXAMPLES FOR OPTICAL SHUTTER DESIGN

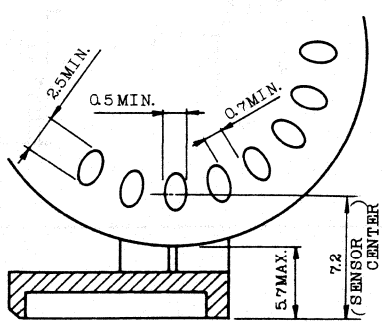
When design the optical shutter of rotator, please refer to the followings.



A–A' CROSS SECTION

Unit in mm





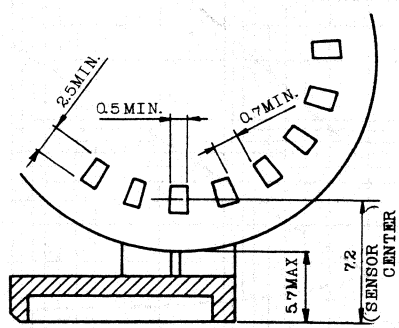


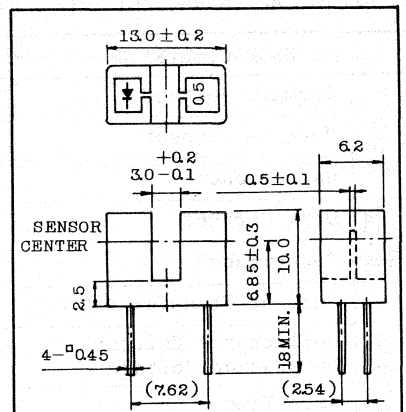
PHOTO INTERRUPTER
INFRARED LED + PHOTO TRANSISTOR

TLP804

- o OPTICAL SWITCH
- o SHAFT POSITION AND VELOCITY SENSOR

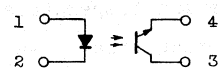
Both chips face each other across a 3mm air gap.
Small slit width 0.5mm.
Fits standerd dual-in- line package socket.
No contact switching, therefore high reliability.
Plastic case.
Transistor detecter offers faster switching speeds than darlington detecter.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11−13K1A

PIN CONNECTION



1. ANODE
2. CATHODE
3. COLLECTOR
4. EMITTER

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	50	mA
LED	Reverse Voltage	V_R	5	V
DETECTER	Collector-Emitter Voltage	V_{CEO}	35	V
DETECTER	Emitter-Collector Voltage	V_{ECO}	5	V
DETECTER	Collector Power Dissipation	P_C	75	mW
DETECTER	Collector Current	I_C	50	mA
Operating Temperature Range		T_{opr}	-25∿85	°C
Storage Temperature Range		T_{stg}	-40∿100	°C

ELECTRICAL CHARACTERISTIC (Ta=25°C)

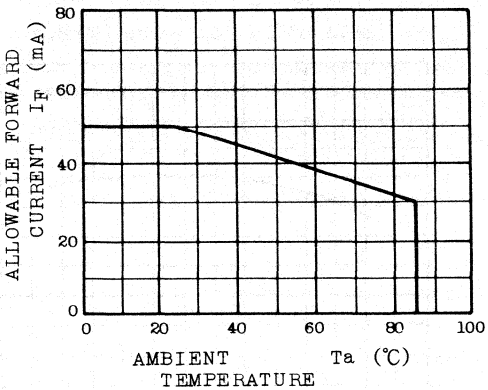
	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.00	1.15	1.30	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DET-ECTER	Dark Current	I_D(I_{CEO})	V_{CE}=24V, I_F=0	-	5	100	nA
	Capacitance	C_T	V=0, f=1MHz	-	13	-	pF
COUPLED	Current Transfer Ratio	I_C/I_F	V_{CE}=5V, I_F=20mA	2.5	10	-	%
	Collector - Emitter Saturation Voltage	$V_{CE(sat)}$	I_F=20mA, I_C=0.25mA	-	0.1	0.4	V
	Rise Time	t_r	V_{CC}=5V, I_C=2mA, R_L=100Ω	-	6	-	μs
	Fall Time	t_f		-	6	-	μs

PRECAUTION

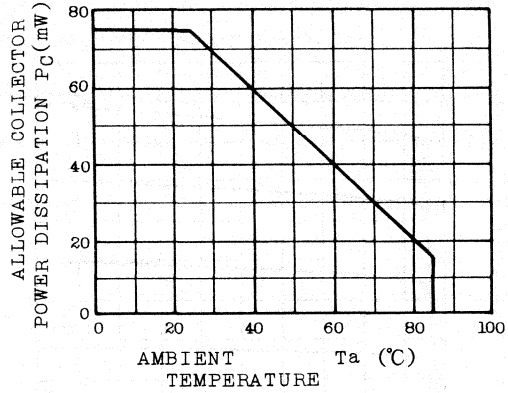
Please be careful of the followings.

1. Soldering temperature: 260°C MAX.
   Soldering time: 5 sec MAX.
   (Soldering portion of lead: up to 1.5mm from the body of the device.)
2. If the lead is formed, Soldering shall be performed after lead forming.
3. Avoid using the solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvent temperature: 45°C MAX.
   - Freon TE or TF
   - Dai-Fron Solvents S3 or S3-E

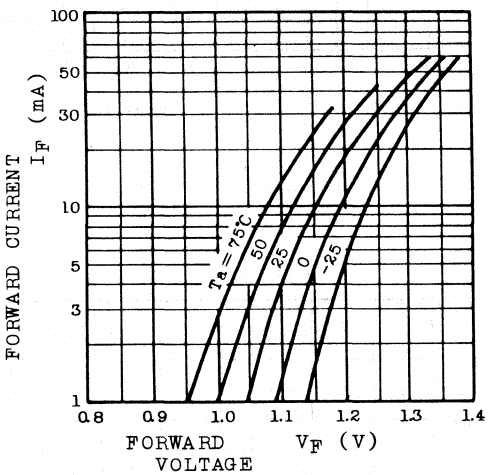
I_F – Ta



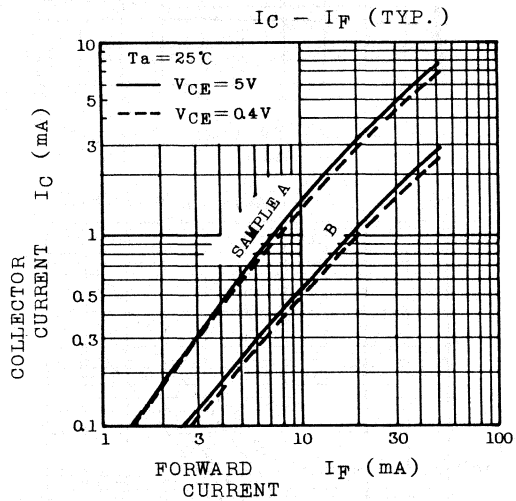
P_C – Ta



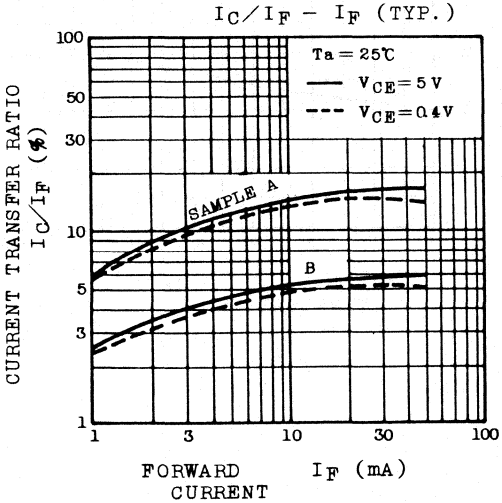
I_F – V_F (TYP.)



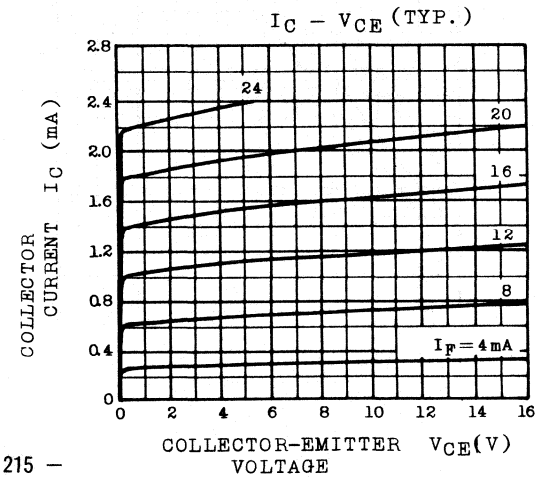
I_C – I_F (TYP.)



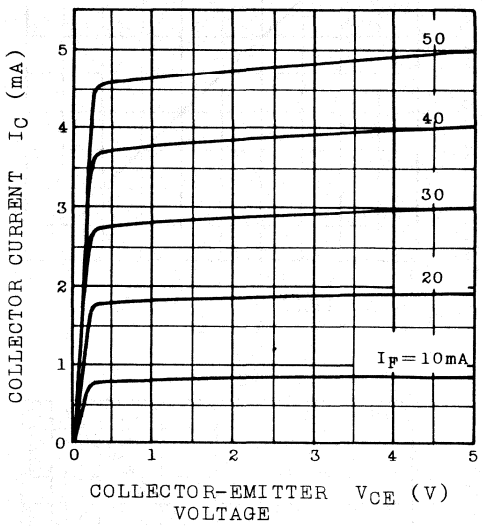
I_C/I_F – I_F (TYP.)



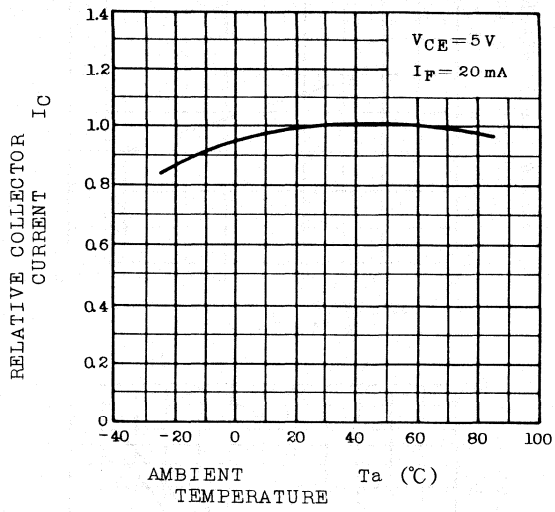
I_C – V_{CE} (TYP.)



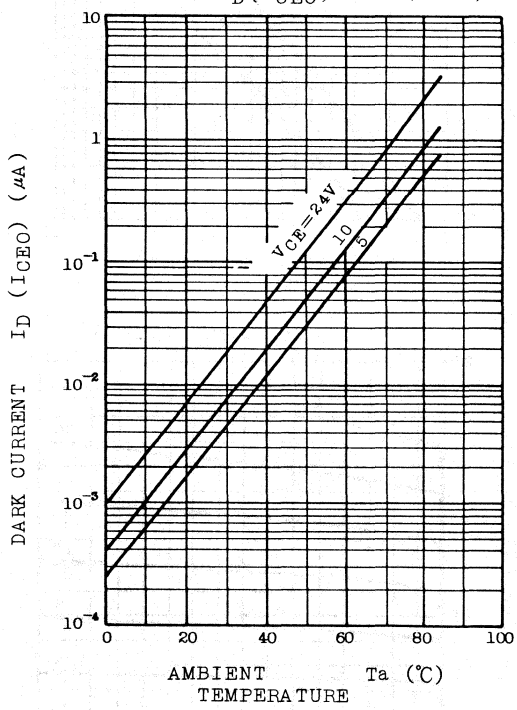
$I_C - V_{CE}$ (TYP.)



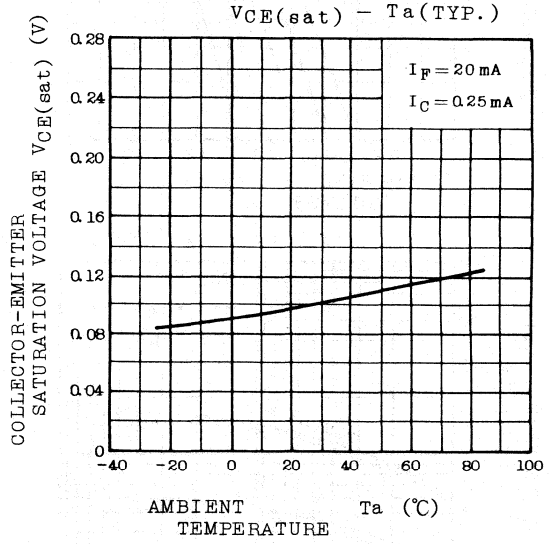
RELATIVE I_C - Ta (TYP.)



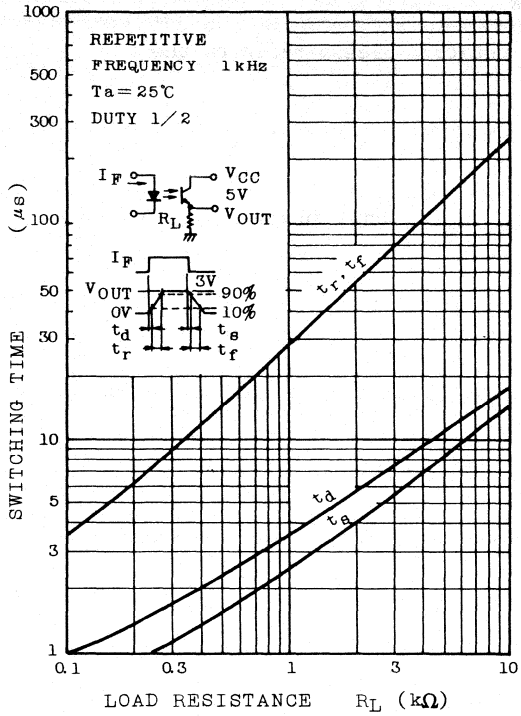
$I_D(I_{CEO})$ - Ta (TYP.)



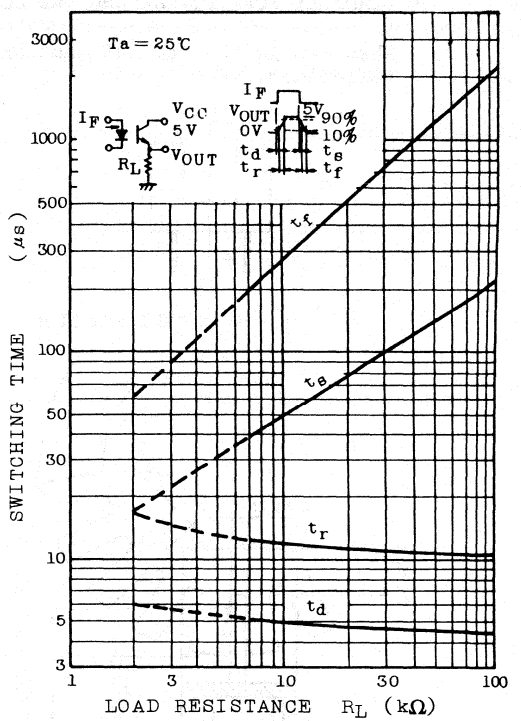
$V_{CE(sat)}$ - Ta (TYP.)



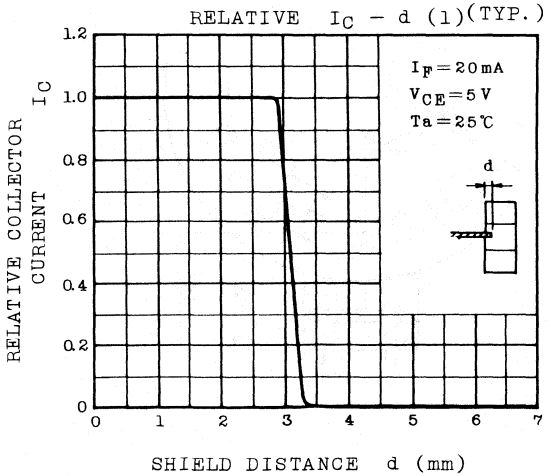
SWITCHING CHARACTERISTICS(TYP.)
(NON-SATURATED OPERATION)



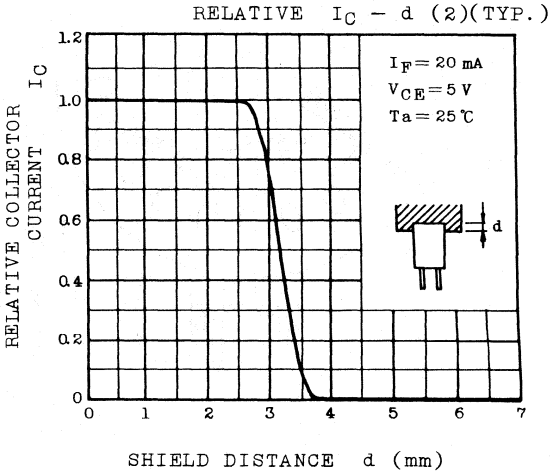
SWITCHING CHARACTERISTICS(TYP.)
(SATURATED OPERATION)



RELATIVE I_C – d (1)(TYP.)

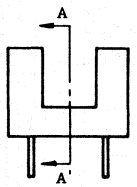


RELATIVE I_C – d (2)(TYP.)



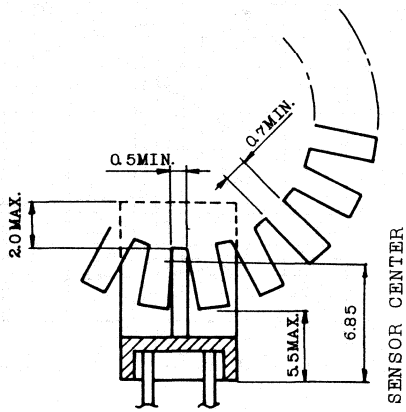
- EXAMPLES FOR OPTICAL SHUTTER DESIGN

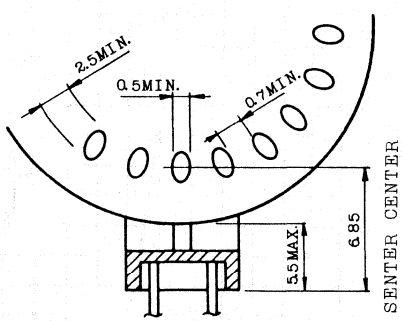
When design the optical shutter of rotator, please refer to the followings.



A — A′ CROSS SECTION

Unit in mm





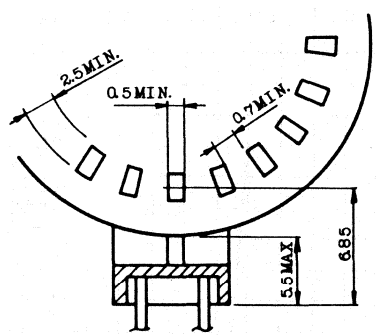


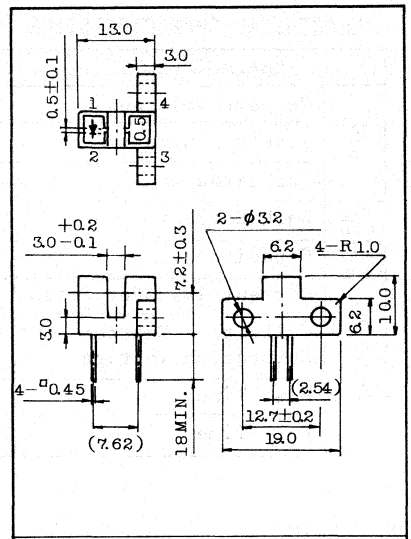
PHOTO INTERRUPTER
INFRARED LED + PHOTO TRANSISTOR

TLP805

Unit in mm

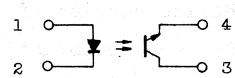
- OPTICAL SWITCH
- SHAFT POSITION AND VELOCITY SENSOR

Both chips face each other across a 3mm air gap.
Small slit width 0.5mm.
Fits standerd dual-in- line package socket.
No contact switching, therefore high reliability.
Plastic case.
Transistor detecter offers faster switching speeds than darlington detecter.



JEDEC	—
EIAJ	—
TOSHIBA	11-13J1A

PIN CONNECTOR



1. ANODE
2. CATHODE
3. COLLECTOR
4. EMITTER

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	50	mA
LED	Reverse Voltage	V_R	5	V
DETECTER	Collector-Emitter Voltage	V_{CEO}	35	V
DETECTER	Emitter-Collector Voltage	V_{ECO}	5	V
DETECTER	Collector Power Dissipation	P_C	75	mW
DETECTER	Collector Current	I_C	50	mA
Operating Temperature Range		T_{opr}	-25∿85	°C
Storage Temperature Range		T_{stg}	-40∿100	°C

ELECTRICAL CHARACTERISTICS (Ta=25°C)

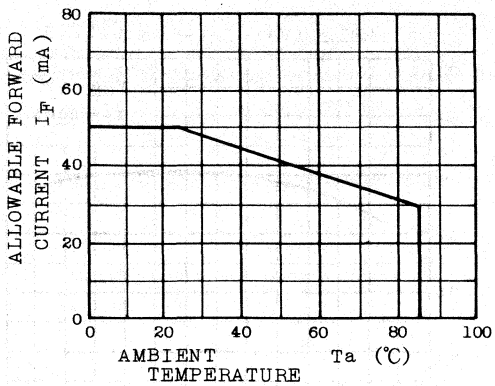
	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.00	1.15	1.30	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DET-ECTER	Dark Current	$I_D(I_{CEO})$	V_{CE}=24V, I_F=0	-	5	100	nA
	Capacitance	C_T	V=0, f=1MHz	-	13	-	pF
COUPLED	Current Transfer Ratio	I_C/I_F	V_{CE}=5V, I_F=20mA	2.5	10	-	%
	Collector- Emitter Saturation Voltage	$V_{CE(sat)}$	I_F=20mA, I_C=0.25mA	-	0.1	0.4	V
	Rise Time	t_r	V_{CC}=5V, I_C=2mA, R_L=100Ω	-	6	-	μs
	Fall Time	t_r		-	6	-	μs

PRECAUTION

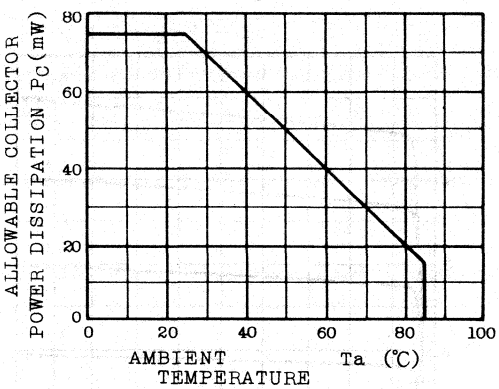
Please be careful of the followings.

1. Soldering temperature : 260°C MAX.
   Soldering time : 5 sec MAX.
   (Soldering portion of lead : up to 1.5mm from the body of the device.)
2. If the lead is formed, Soldering shall be performed after lead forming.
3. Avoid using the solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time : 30 sec MAX. Solvent temperature : 45°C MAX.
   ∘ Freon TE or TF ∘ Dai-Fron Solvents S3 or S3-E

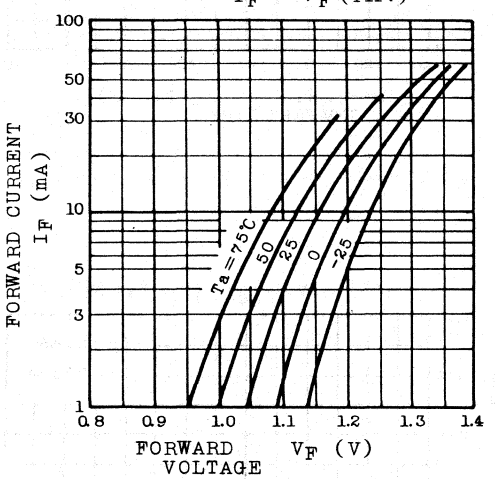
I_F – Ta



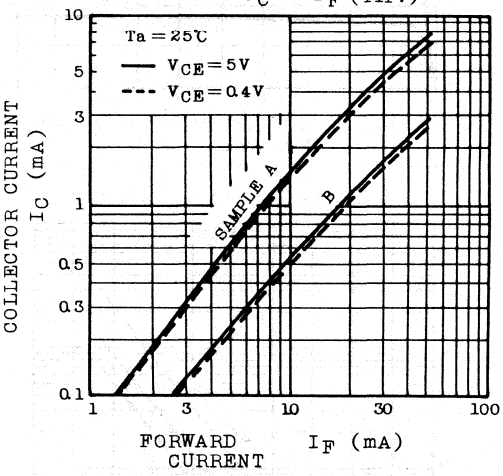
P_C – Ta



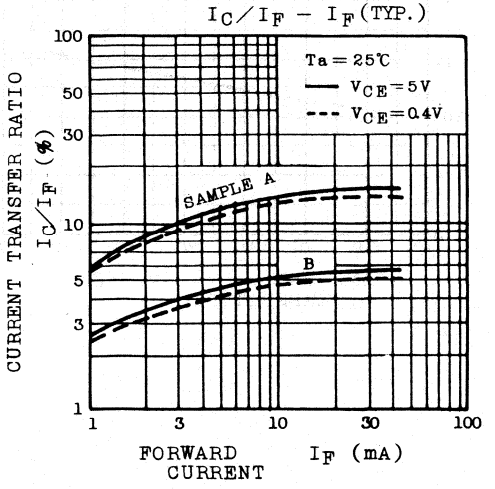
I_F – V_F (TYP.)



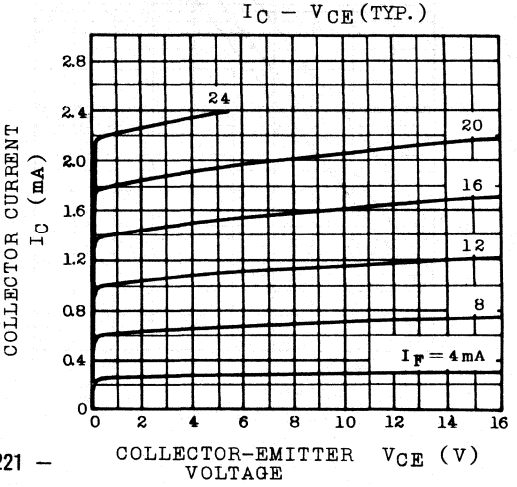
I_C – I_F (TYP.)



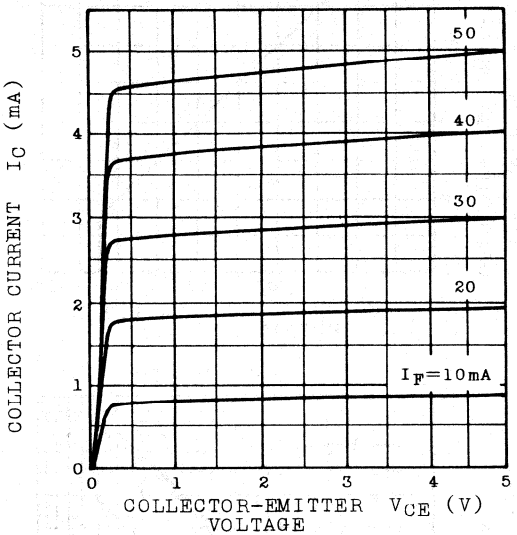
I_C / I_F – I_F (TYP.)



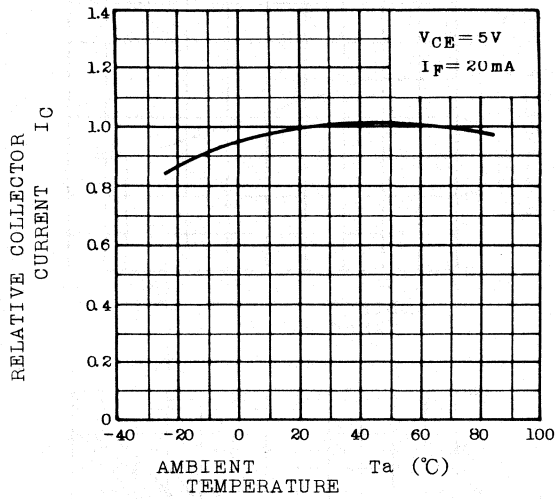
I_C – V_{CE} (TYP.)



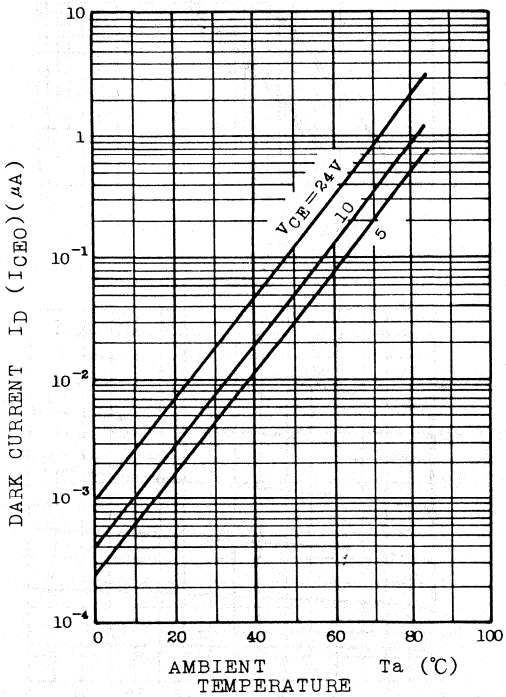
$I_C - V_{CE}$ (TYP.)



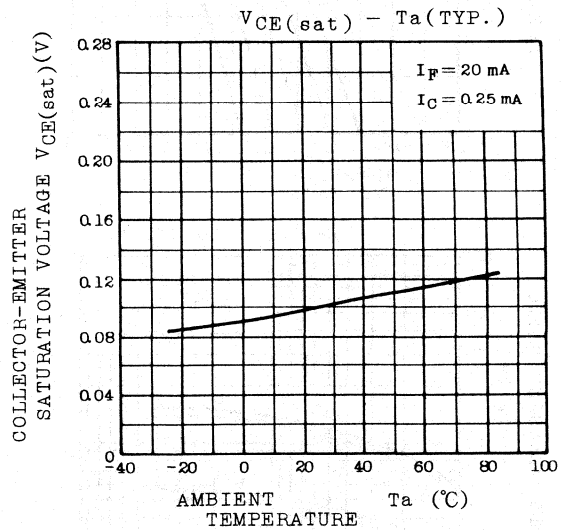
RELATIVE I_C – Ta (TYP.)



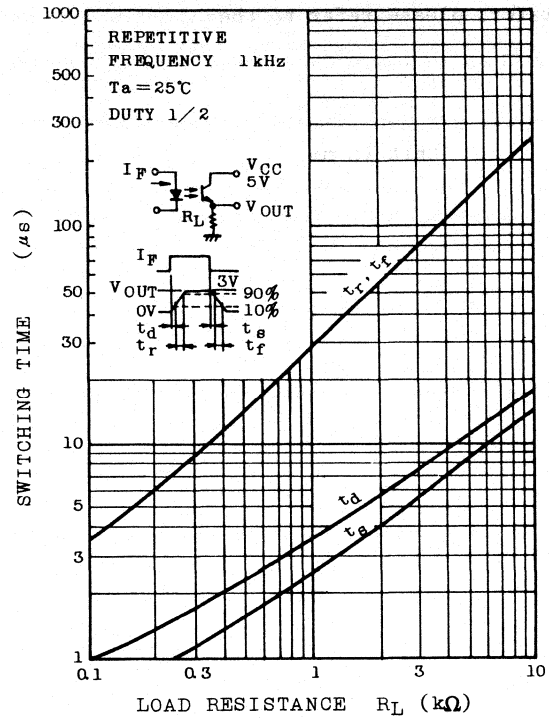
$I_D(I_{CEO})$ – Ta (TYP.)



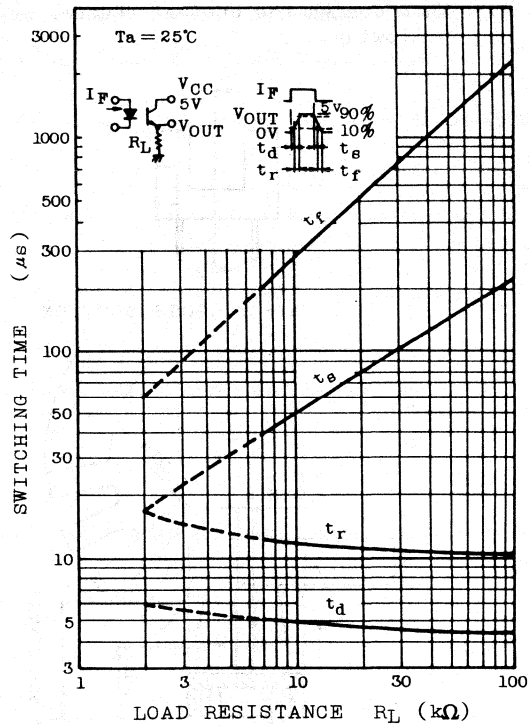
$V_{CE(sat)}$ – Ta(TYP.)



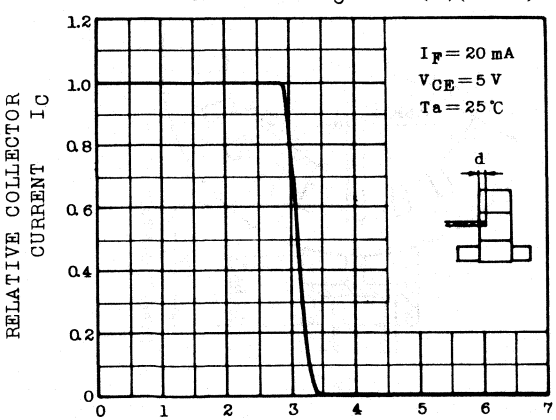
SWITCHING CHARATERISTICS(TYP.)
(NON-SATURATED OPERATION)



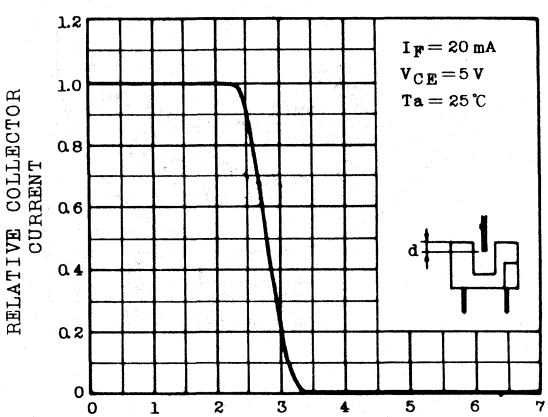
SWITCHING CHARACTERISTICS(TYP.)
(SATURATED OPERATION)



RELATIVE I_C – d (1)(TYP.)

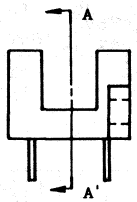


ELATIVE I_C – d (2)(TYP.)



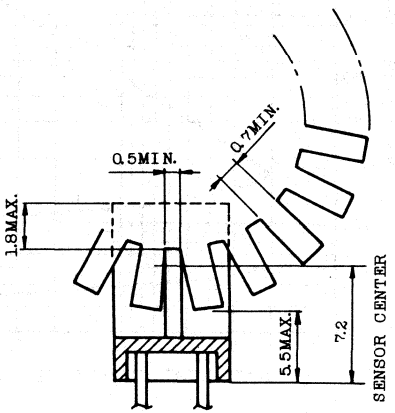
- EXAMPLES FOR OPTICAL SHUTTER DESIGN

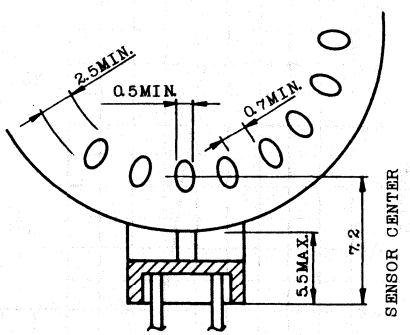
When design the optical shutter of rotator, please refer to the followings.



A - A'CROSS SECTION

Unit in mm





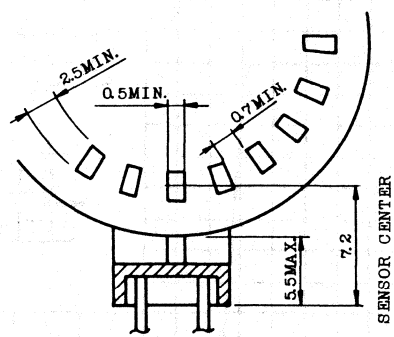
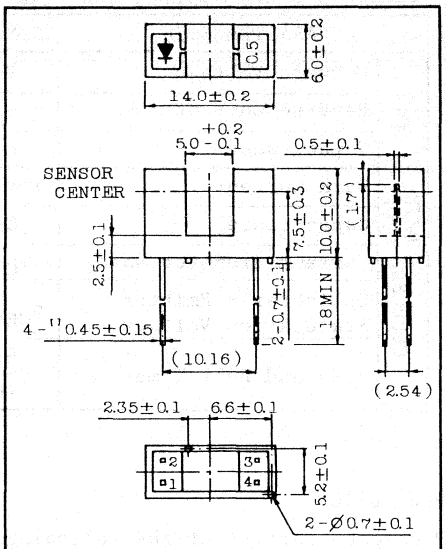


PHOTO INTERRUPTER
INFRARED LED + PHOTO TRANSISTOR

TLP806

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11-14A1

- o OPTICAL SWITCH
- o SHAFT POSITION AND VELOCITY SENSOR

Both chips face each other across a 5mm air gap.

Small slit width 0.5mm.

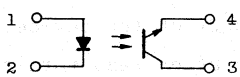
Fits standerd dual-in- line package socket.

No contact switching, therefore high reliability.

Plastic case.

Transistor detecter offers faster switching speeds than darlington detecter.

PIN CONNECTION



1. ANODE
2. CATHODE
3. COLLECTOR
4. EMITTER

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	50	mA
LED	Reverse Voltage	V_R	5	V
DETECTER	Collector-Emitter Voltage	V_{CEO}	35	V
DETECTER	Emitter-Collector Voltage	V_{ECO}	5	V
DETECTER	Collector Power Dissipation	P_C	75	mW
DETECTER	Collector Current	I_C	50	mA
Operating Temperature Range		T_{opr}	-25∿85	°C
Storage Temperature Range		T_{stg}	-40∿100	°C

ELECTRICAL CHARACTERISTICS (Ta=25°C)

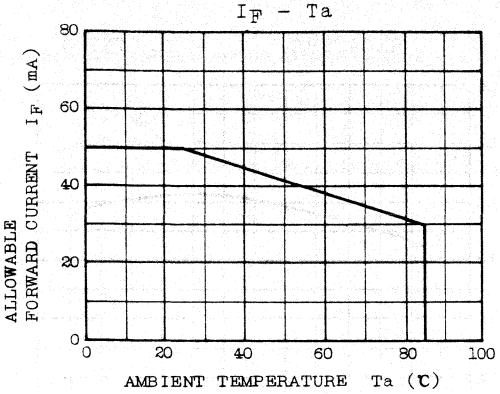
	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.00	1.15	1.30	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETE-CTOR	Dark Current	$I_D(I_{CEO})$	V_{CE}=24V, I_F=0	-	5	100	nA
	Capacitance	C_T	V=0, f=1MHz	-	13	-	pF
COUPLED	Current Transfer Ratio	I_C/I_F	V_{CE}=5V, I_F=20mA	2.5	10	-	%
	Collecter - Emitter Staturation Voltage	$V_{CE(sat)}$	I_F=20mA, I_C=0.25mA	-	0.1	0.4	V
	Rise and Fall Time	t_r	V_{CC}=5V, I_C=2mA	-	6	-	μs
		t_f	R_L=100Ω	-	6	-	μs

PRECAUTION

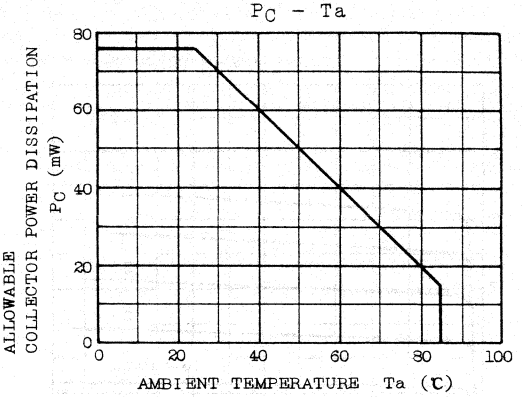
Please be careful of the followings.

1. Soldering temperature : 260°C MAX.
   Soldering time : 5 sec MAX.
   (Soldering portion of lead : up to 1.5mm from the body of the device.)
2. If the lead is formed, Soldering shall be performed after lead forming.
3. Avoid using the solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time : 30 sec MAX. Solvent temperature : 45°C MAX.
   ∘ Freon TE or TF ∘ Dai-Fron Solvents S3 or S3-E

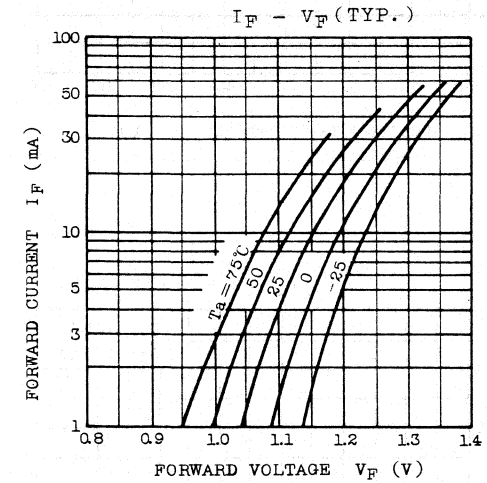
I_F – Ta



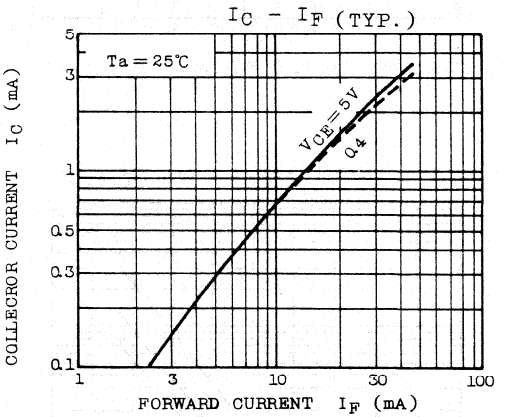
P_C – Ta



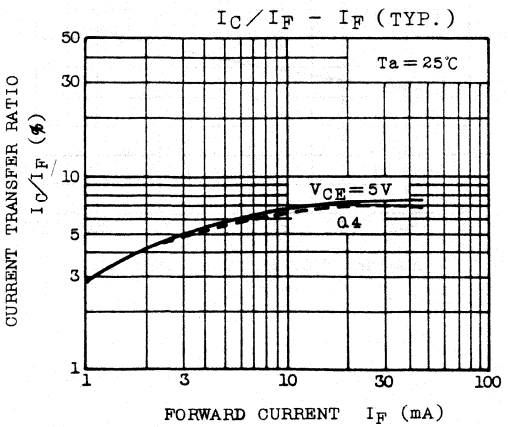
I_F – V_F (TYP.)



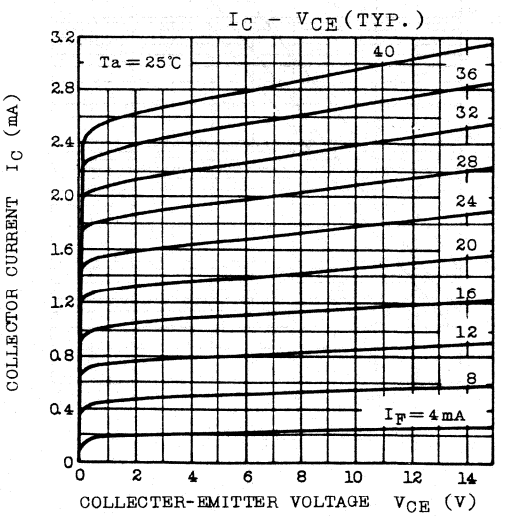
I_C – I_F (TYP.)



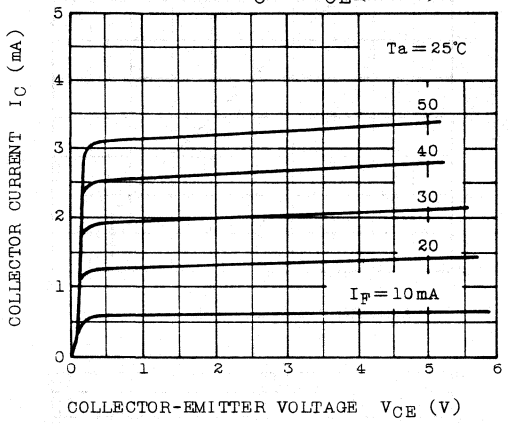
I_C / I_F – I_F (TYP.)



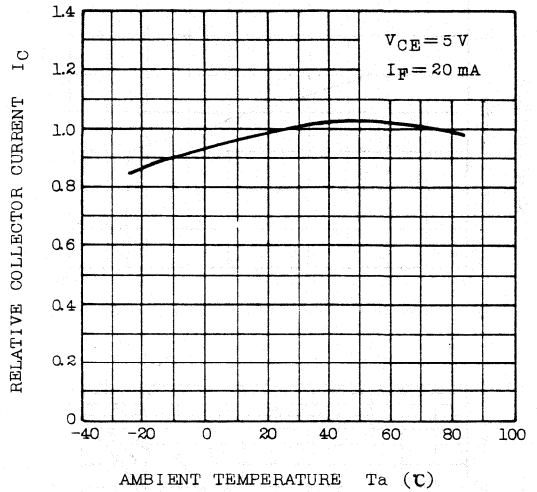
I_C – V_{CE} (TYP.)



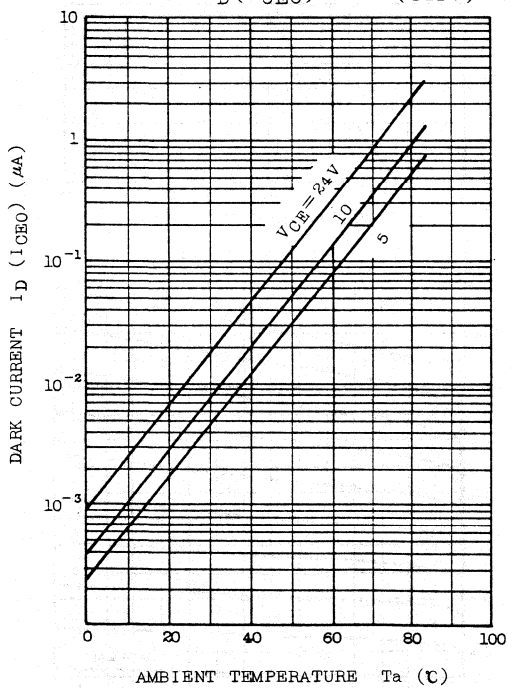
$I_C - V_{CE}$ (TYP.)



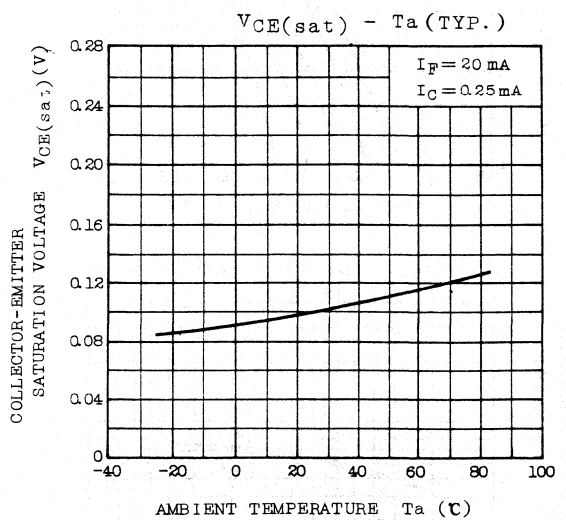
RELATIVE I_C - Ta (TYP.)



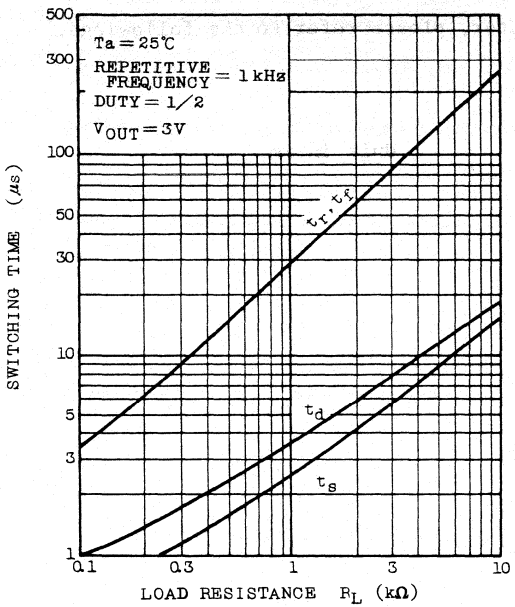
$I_D(I_{CEO})$ - Ta (TYP.)



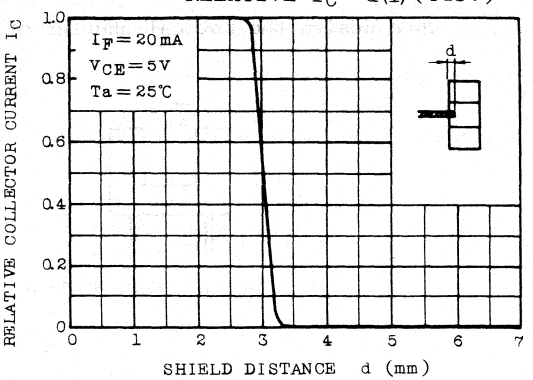
$V_{CE(sat)}$ - Ta (TYP.)



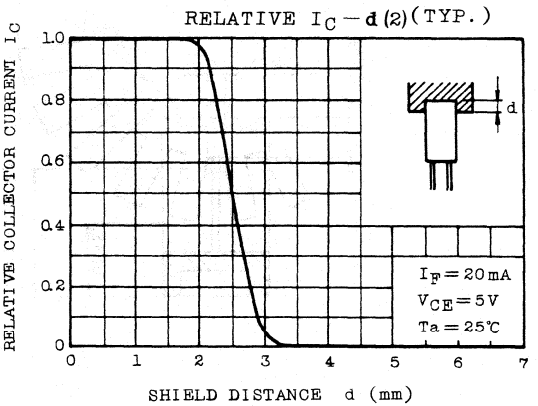
SWITCHING CHARACTERISTICS (TYP.)
(NON-SATURATED OPERATION)



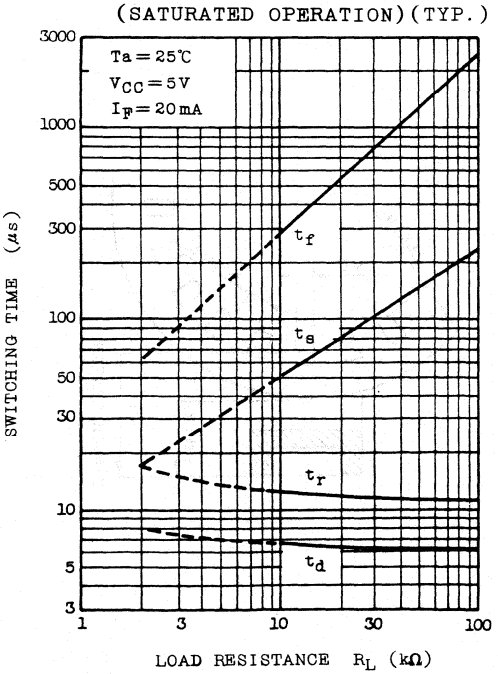
RELATIVE I_C – d (1) (TYP.)



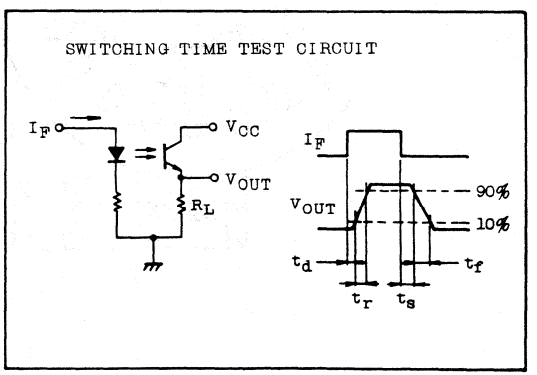
RELATIVE I_C – d (2) (TYP.)



SWITCHING CHARACTERISTICS
(SATURATED OPERATION) (TYP.)

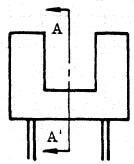


SWITCHING TIME TEST CIRCUIT



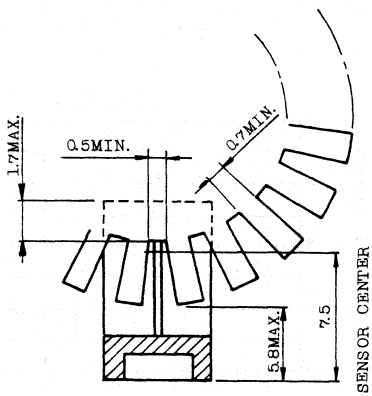
- EXAMPLES FOR OPTICAL SHUTTER DESIGN

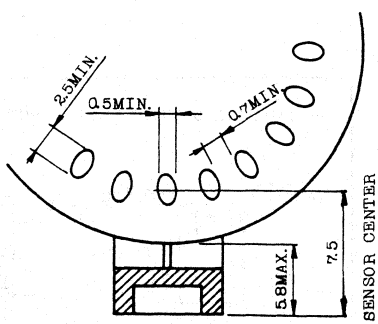
When design the optical shutter of rotator, please refer to the followings.



A – A' CROSS SECTION

Unit in mm





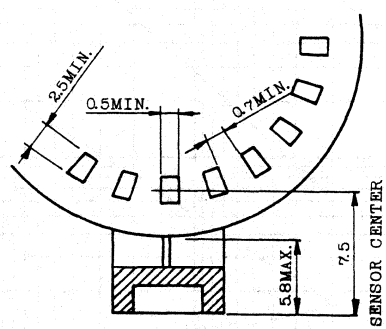
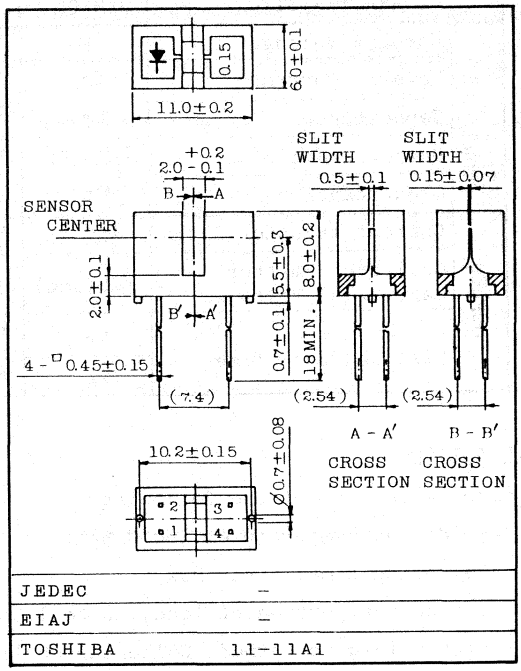


PHOTO INTERRUPTER
INFRARED LED + PHOTO TRANSISTOR

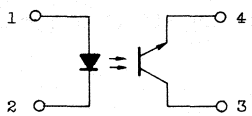
TLP809

- TRACK "00" SENSOR FOR FLOPPY DISK DRIVE
- TIMING SENSOR FOR PRINTER AND ELECTRONIC TYPE WRITER
  - High sensing accuracy :
    slit width 0.5mm (LED)
    slit width 0.15mm (Tr)
  - High speed response : t_r, t_f= 6μs (TYP.)
  - PWB direct mounting type package
  - Small package

Unit in mm



PIN CONNECTION



1. ANODE
2. CATHODE
3. COLLECTOR
4. EMITTER

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	Forward Current	I_F	50	mA
	Reverse Voltage	V_R	5	V
DETECTOR	Collector-Emitter Voltage	V_{CEO}	35	V
	Emitter-Collector Voltage	V_{ECO}	5	V
	Collector Power Dissipation	P_C	75	mW
	Collector Current	I_C	50	mA
Operating Temperature Range		T_{opr}	-25 ∿ 85	°C
Storage Temperature Range		T_{stg}	-40 ∿ 1000	°C

ELECTRICAL CHARACTERISTICS (Ta=25°C)

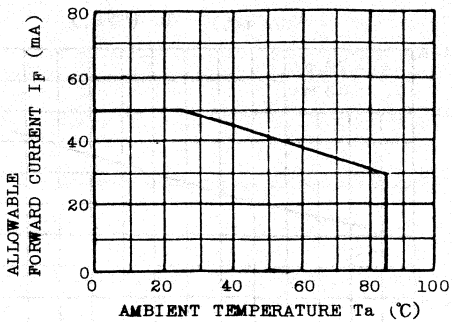
	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.00	1.15	1.30	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETE-CTOR	Dark Current	I_D(I_{CEO})	V_{CE}=24V, I_F=0	-	-	0.1	μA
	Capacitance	C_T	V=0, f=1MHz	-	13	-	pF
COUPLED	Current Transfer Ratio	I_C/I_F	V_{CE}=5V, I_F=20mA	3	-	-	%
	Collecter-Emitter Saturation Voltage	V_{CE}(sat)	I_F=20mA, I_C=0.3mA	-	0.1	0.4	V
	Rise and Fall Time	t_r	V_{CC}=5V, I_C=2mA	-	6	-	μs
		t_f	R_L=100Ω	-	6	-	μs

PRECAUTION

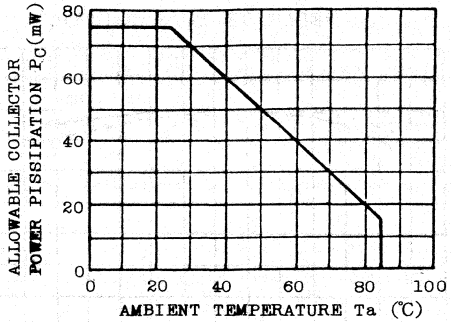
Please be careful of the followings.

1. Soldering temperature: 260°C MAX.
   Soldering time: 5 sec Max.
   (Soldering portion of lead: up to 1.5mm from the body of the device.)
2. If the lead is formed, Soldering shall be performed after lead forming.
3. Avoid using the solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvent temperature: 45°C MAX.
   ∘ Freon TE or TF ∘ Dai-Fron Solvents S3 or S3-E

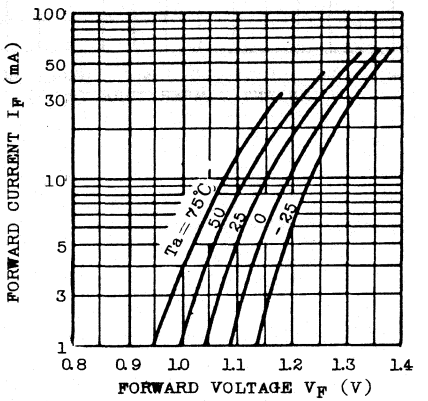
I_F — Ta



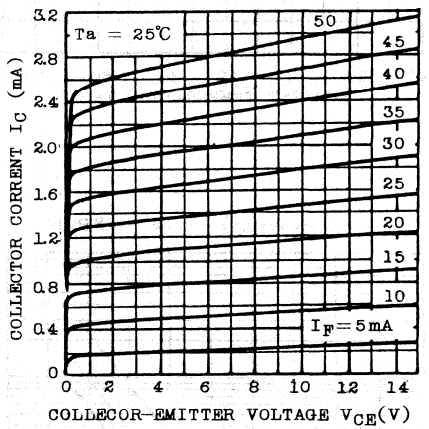
P_C — Ta



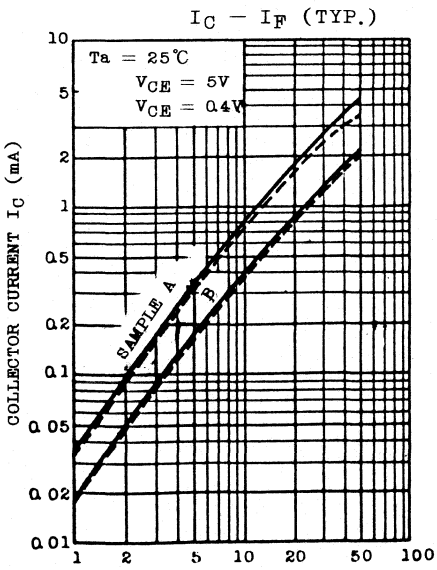
I_F — V_F (TYP.)



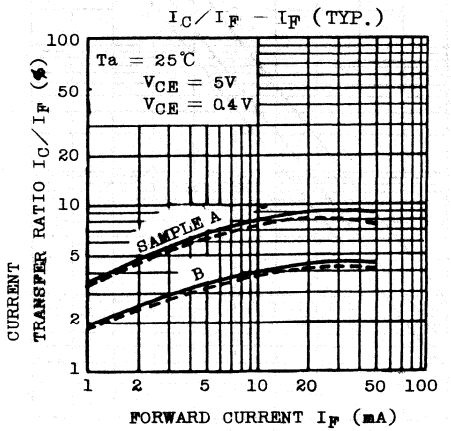
I_C — V_{CE} (TYP.)



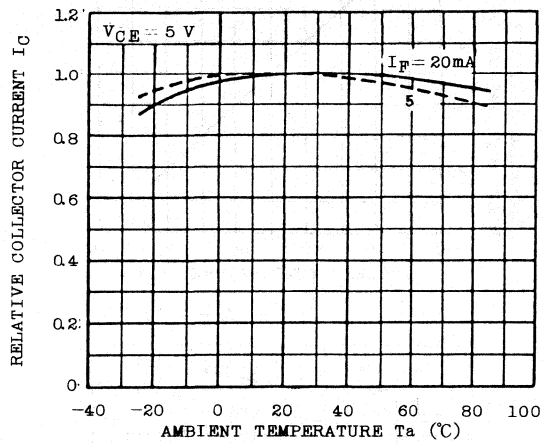
I_C — I_F (TYP.)



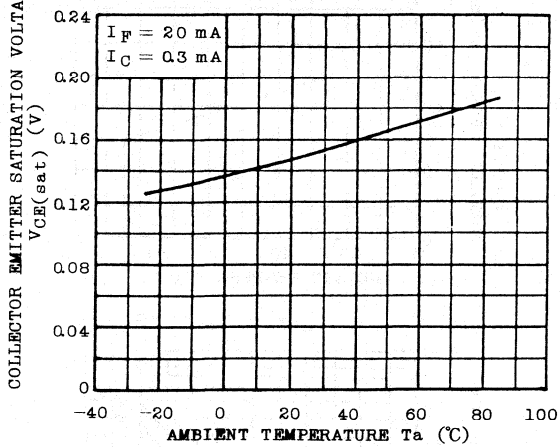
I_C/I_F — I_F (TYP.)



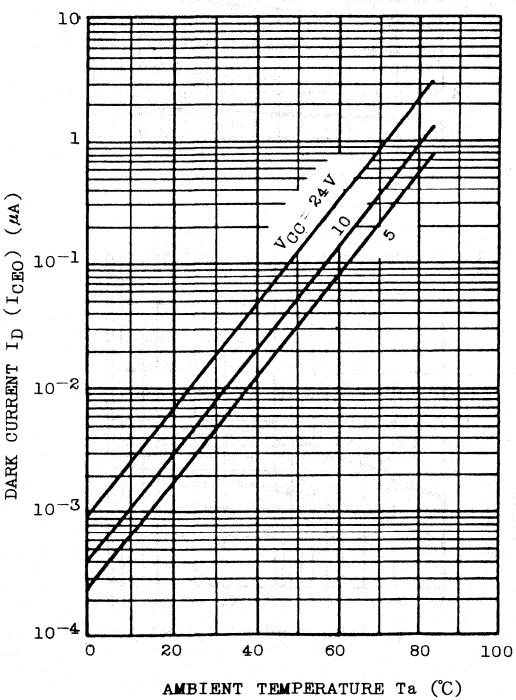
RELATIVE I_C — Ta(TYP.)



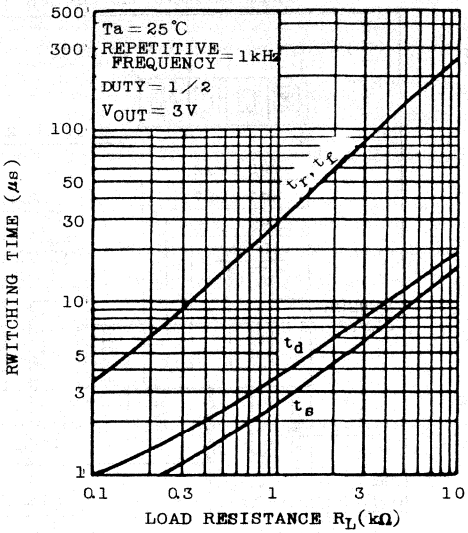
$V_{CE(sat)}$ — Ta (TYP.)



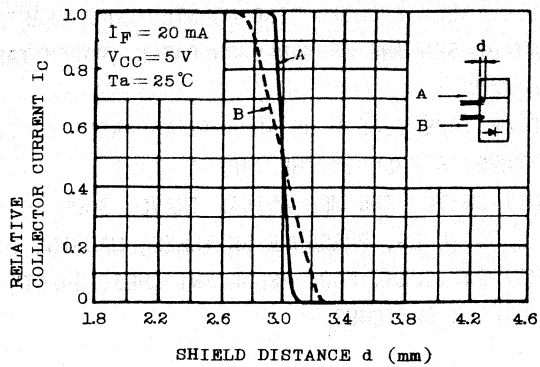
$I_D(I_{CEO})$ — Ta (TYP.)



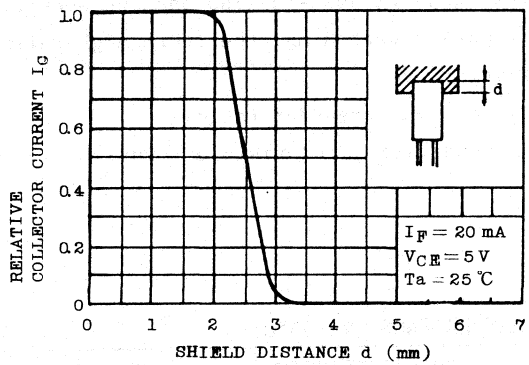
SWITCHING CHARACTERISTICS(TYP.)
(NON SATURATED OPERATION)



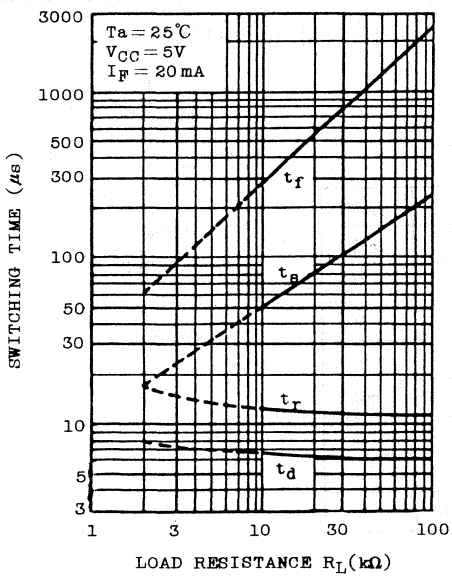
RELATIVE I_C — d (1) (TYP.)

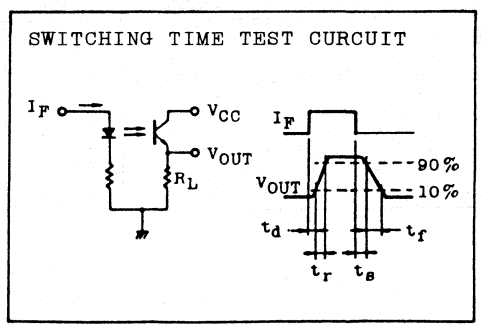


RELATIVE I_C — d (2) (TYP.)



SWITCHING CHARACTERISTICS
(SATURATED OPERATION) (TYP.)





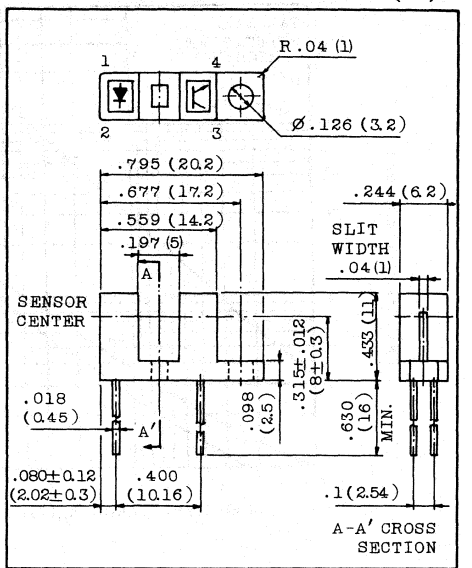
TLP850

PHOTO INTERRUPTER
INFRARED LED + PHOTO DARLINGTON TRANSISTOR

OPTICAL SHAFT POSITION AND VELOCITY MONITOR USING A DIGITALLY ENCODED DISC MOUNTED ON A SHAFT.
OPTICAL SENSING OF MARKS ON PAPER, PAPER TAPE OR IBM CARD.
END OF TAPE SENSOR USING A TRANSPARENT SECTION OF TAPE, A HOLE IN THE TAPE.
LIMIT SWITCH FOR MECHANICAL TRAVEL SUCH AS CAME SWITCHES, PRESSURE SWITCHES, MACHINE TOOL LIMIT SWITCHES, FOOT PEDAL SWITCHES, SAFETY INTERLOCK SWITCHES.

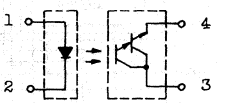
- Both chips face each other across a 0.118 inche air gap.
- One side mounting flange.
- Fits standard dual-in-line package socket.
- No contact switching, therefore high reliability.
- Plastic case.
- High current transfer ratio.
- Non sensitivity for visible light.

Dimensions in inches (mm)



JEDEC	—
EIAJ	—
TOSHIBA	11-20B1A

PIN CONFIGURATIONS



1. ANODE
2. CATHODE
3. COLLECTOR
4. EMITTER

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	50	mA
	Reverse Voltage	V_R	5	V
DETECTOR	Collector-Emitter Voltage	V_{CEO}	30	V
	Emitter-Collector Voltage	V_{ECO}	5	V
	Collector Power Dissipation	P_C	75	mW
	Collector Current	I_C	50	mA
Operating Temperature Range		T_{opr}	-25 ~ 85	°C
Storage Temperature Range		T_{stg}	-40 ~ 100	°C

ELECTRICAL CHARACTERISTICS (Ta=25°C)

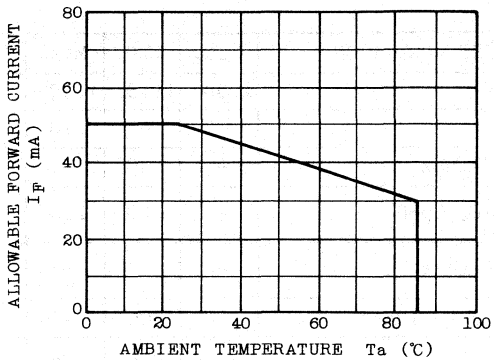
	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.00	1.15	1.30	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	Dark Current	I_D (I_{CEO})	V_{CE}=16V, I_F=0	-	30	250	nA
	Capacitance	C_T	V=0, f=1MHz	-	7	-	pF
COUPLED	Current Transfer Ratio	I_C/I_F	V_{CE}=2V, I_F=10mA	40	200	-	%
	Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	I_F=10mA, I_C=2mA	-	0.9	1.2	V
	Rise and Fall Time	t_r	V_{CC}=5V, I_C=10mA R_L=100Ω	-	200	-	μs
		t_f		-	150	-	μs

PRECAUTION

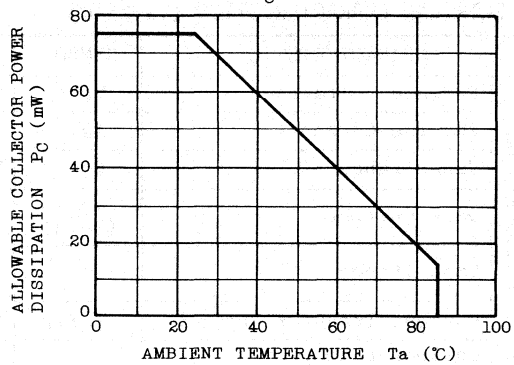
Please be careful of the followings.

1. Soldering temperature: 260°C MAX.
   Soldering time: 5 sec MAX.
   (Soldering portion of lead: up to 1.5mm from the body of the device.)
2. If the lead is formed, Soldering shall be performed after lead forming.
3. Avoid using the solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvent temperature: 45°C MAX.
   o Freon TE or TF o Dai-Fron Solvent S3 or S3-E

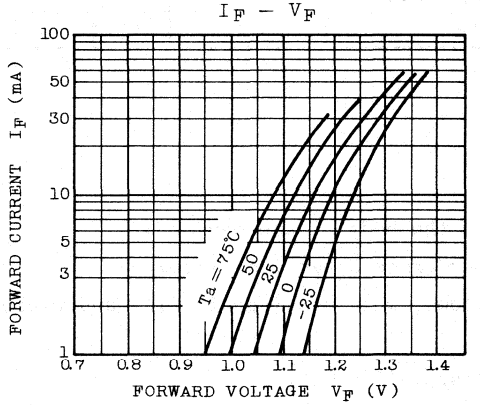
$I_F - Ta$



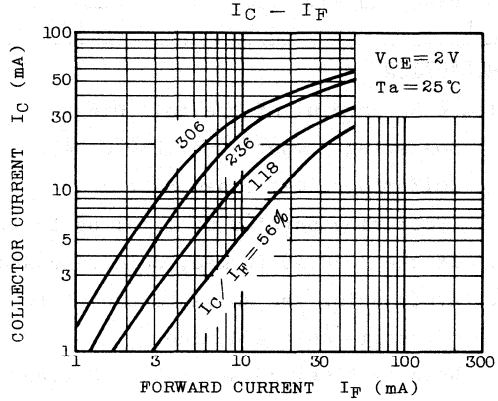
$P_C - Ta$



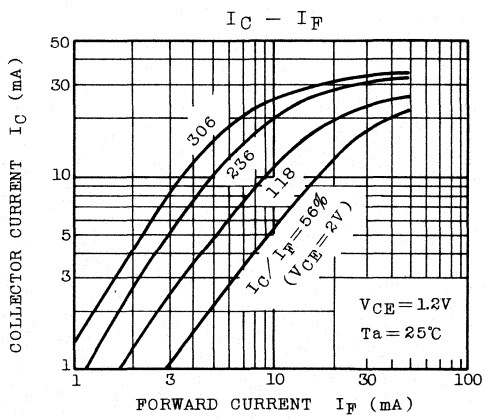
$I_F - V_F$



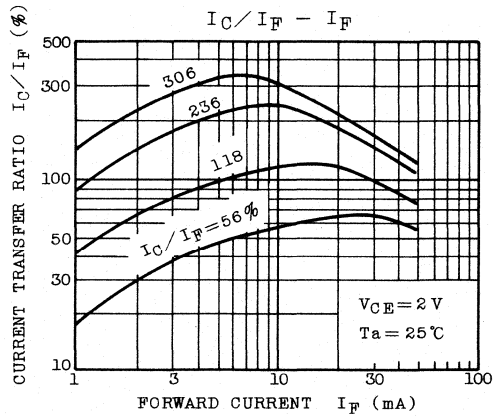
$I_C - I_F$



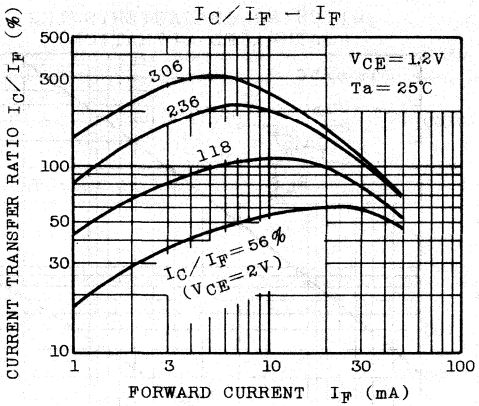
$I_C - I_F$



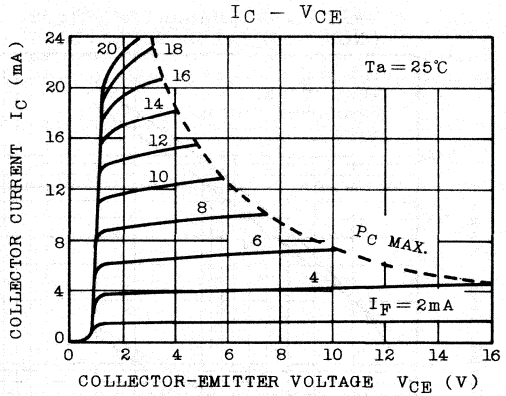
$I_C / I_F - I_F$



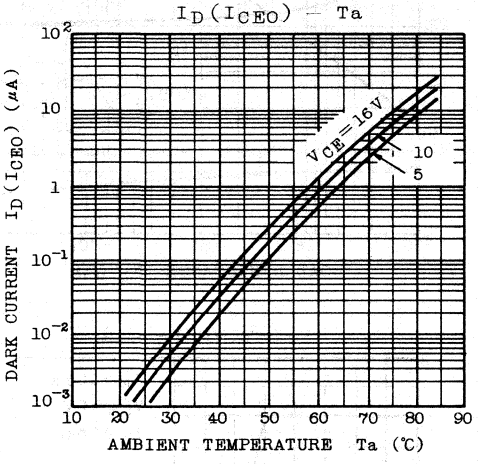
$I_C / I_F - I_F$



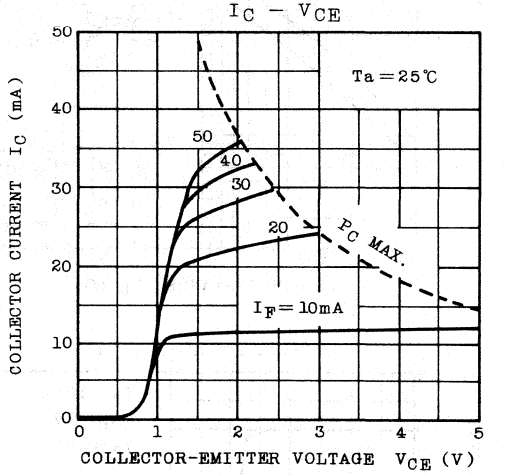
$I_C - V_{CE}$



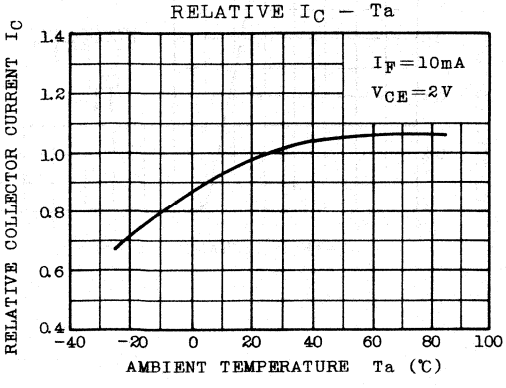
$I_D (I_{CEO}) - Ta$



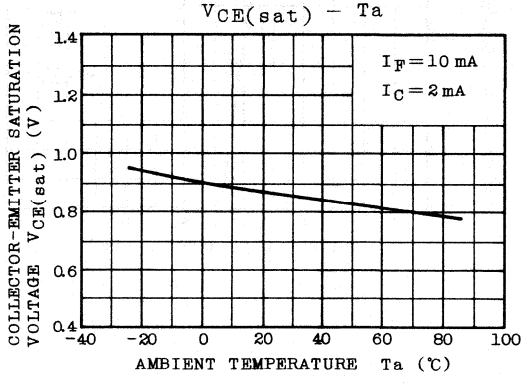
$I_C - V_{CE}$



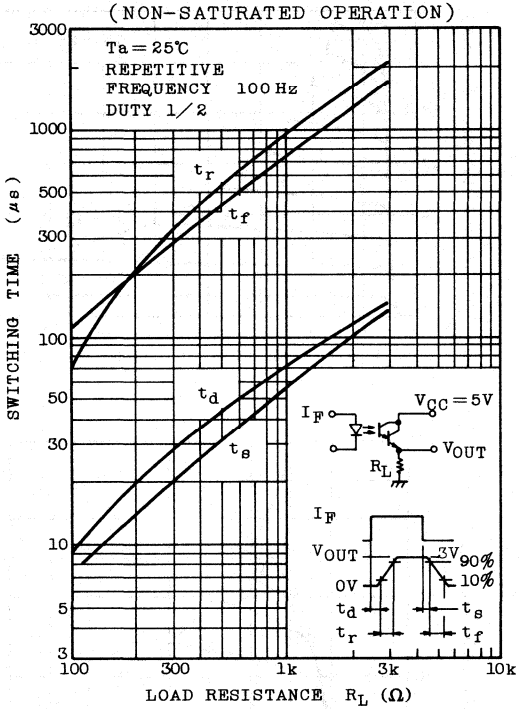
RELATIVE I_C — Ta



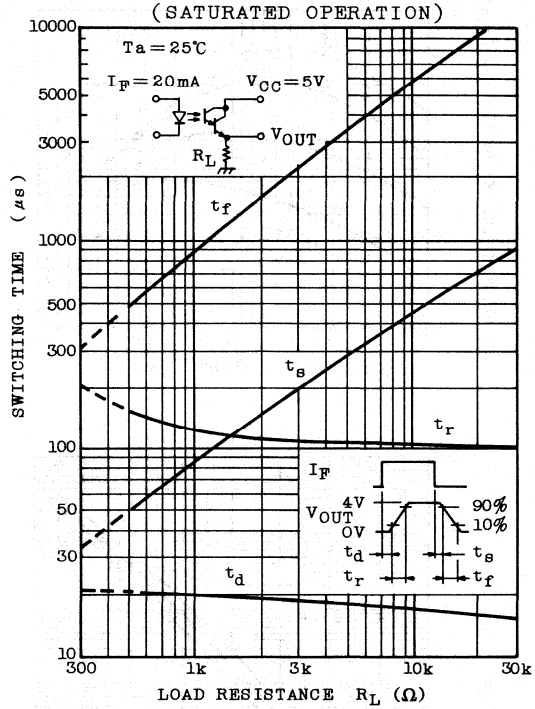
$V_{CE(sat)} - Ta$



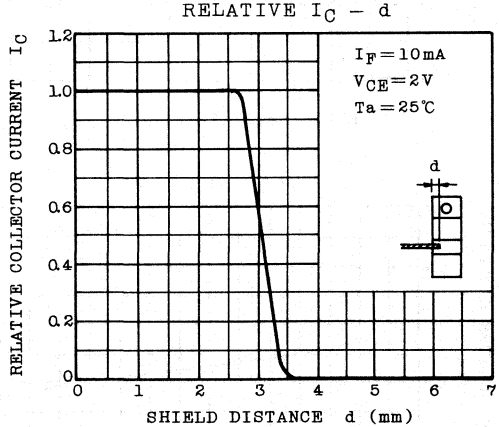
SWITCHING CHARACTERISTICS
(NON-SATURATED OPERATION)



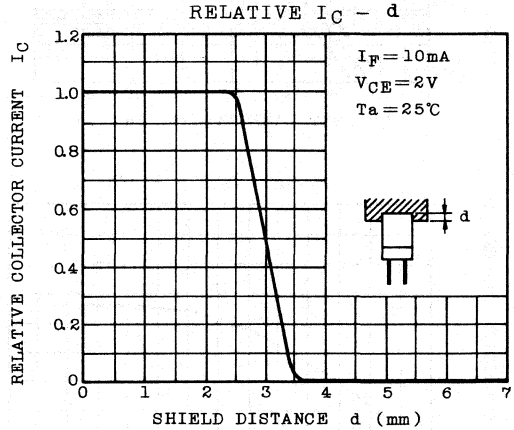
SWITCHING CHARACTERISTICS
(SATURATED OPERATION)



RELATIVE I_C – d

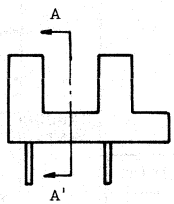


RELATIVE I_C – d



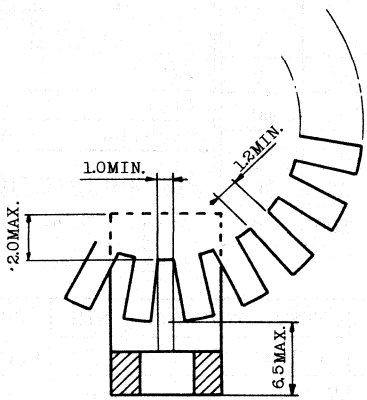
EXAMPLES FOR OPTICAL SHUTTER DESIGN

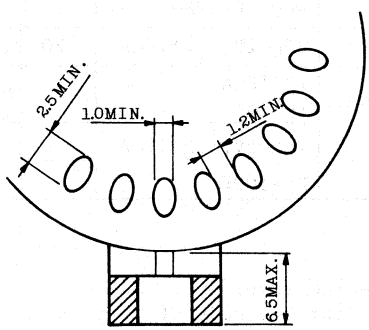
When design the optical shutter of rotator, please refer to the followings.

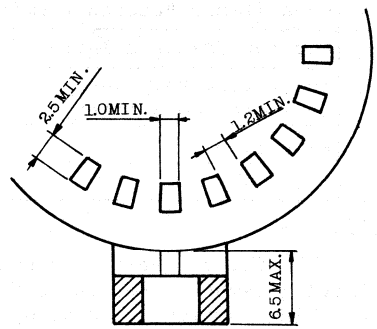


A-A' CROSS SECTION

Unit in mm







TLP851

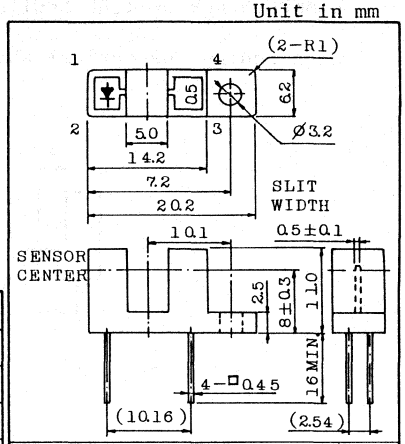
PHOTO INTERRUPTER
INFRARED LED + PHOTO DARLINGTON TRANSISTOR

OPTICAL SWITCH

SHAFT POSITION AND VELOCITY SENSOR

- High Current Transfer Ratio : I_C/I_F=20%(Min.)
- Fits Standard Dual-In-Line-Package Socket
- Photo Detector is not Sensitive for Visible Light Disturbance.

Unit in mm



JEDEC	–
EIAJ	–
TOSHIBA	11-20B2A

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	50	mA
	Reverse Voltage	V_R	5	V
DETECTOR	Collector to Emitter Voltage	V_{CEO}	30	V
	Emitter to Collector Voltage	V_{ECO}	5	V
	Collector Power Dissipation	P_C	75	mW
	Collector Current	I_C	50	mA
Operating Temperature		T_{opr}	-25~85	°C
Storage Temperature		T_{stg}	-40~100	°C

PIN CONFIGURATIONS

1. ANODE
2. CATHODE
3. COLLECTOR
4. EMITTER

ELECTRICAL CHARACTERISTICS (Ta=25°C)

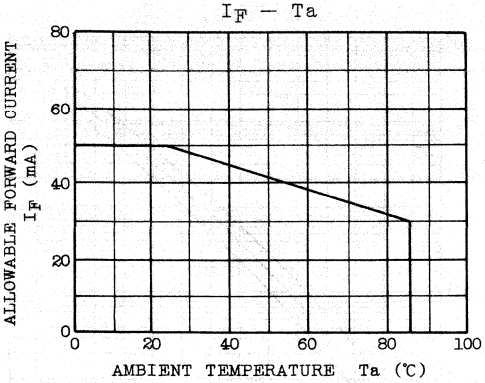
	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.00	1.15	1.30	V
	Reverse Current	I_R	V_R=5V	–	–	10	μA
	Capacitance Between Terminals	C_T	V=0, f=1MHz	–	30	–	pF
Detector	Dark Current	$I_D(I_{CEO})$	V_{CE}=16V, I_F=0	–	30	250	nA
	Capacitance Between Terminals	C_T	V=0, f=1MHz	–	7	–	pF
Coupled	Current Transfer Ratio	I_C/I_F	V_{CE}=2V, I_F=10mA	20	100	–	%
	Saturation Voltage Collector to Emitter	$V_{CE(sat)}$	I_F=10mA I_C=1mA	–	0.85	1.2	V
	Rise Time	t_r	V_{CC}=5V, I_C=10mA	–	200	–	μs
	Fall Time	t_f	R_L=100Ω	–	150	–	μs

PRECAUTION

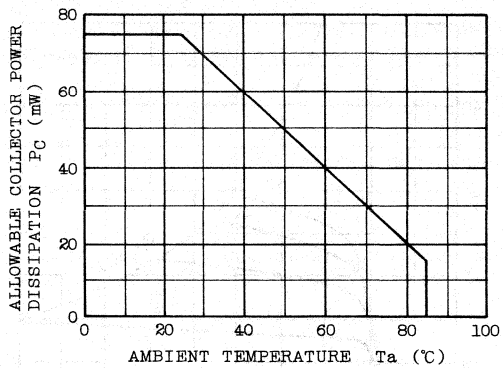
Please be careful of the followings.

1. Soldering temperature: 260°C MAX. Soldering time: 5 sec MAX.
   (Soldering portion of lead: up to 1.5mm from the body of the device)
2. If the lead is formed, Soldering shall be performed after lead forming.
3. Avoid using the Solvetns except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   o Freon TE or TF o Dai-Fron Solvents S3 or S3-E

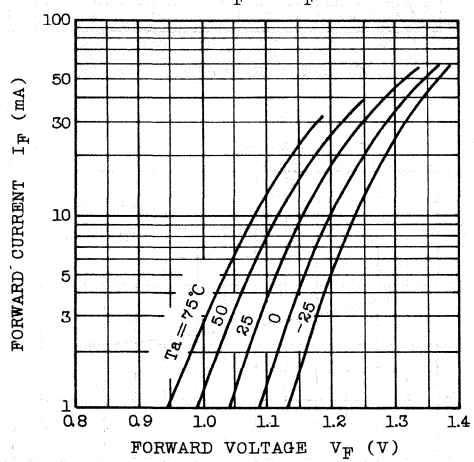
I_F — Ta



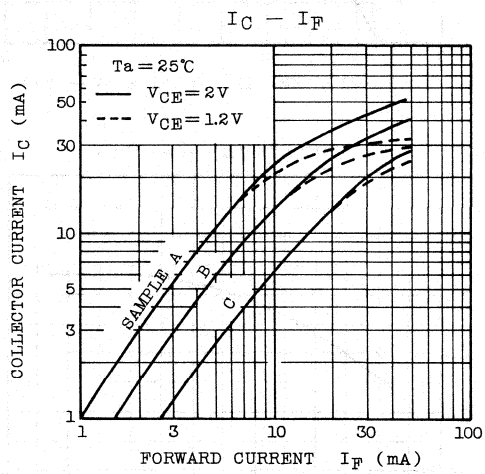
P_C — Ta



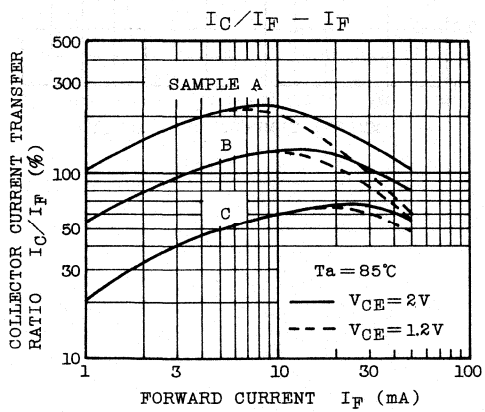
I_F — V_F



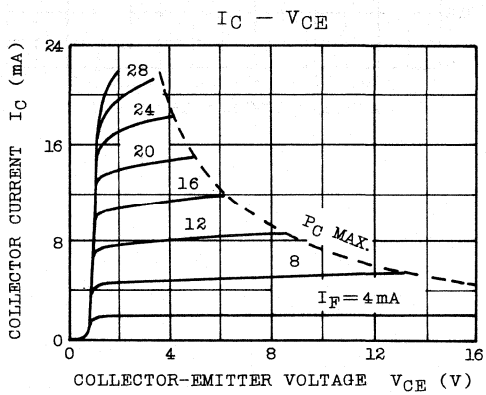
I_C — I_F



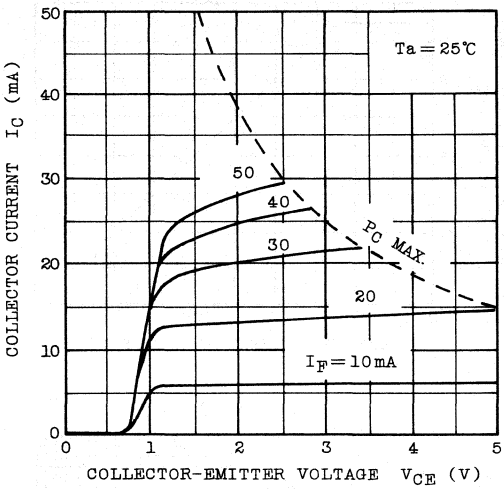
I_C/I_F — I_F



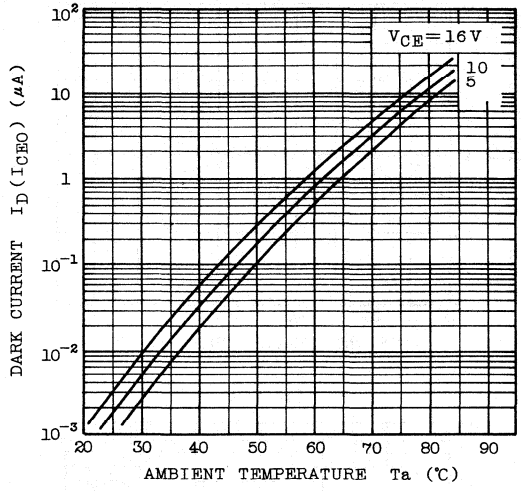
I_C — V_{CE}



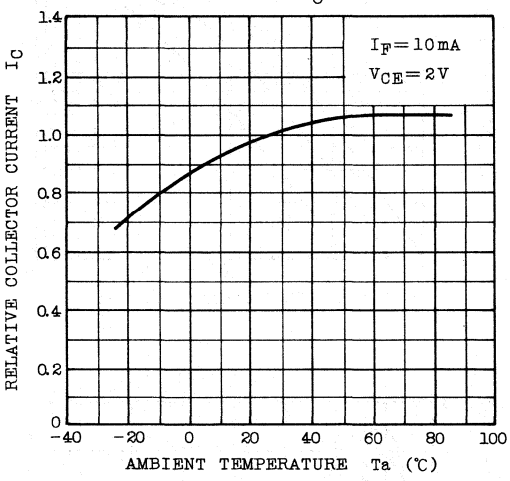
$I_C - V_{CE}$



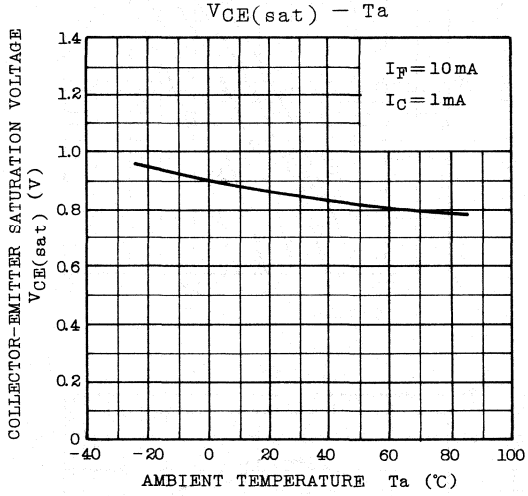
$I_D (I_{CEO})$ — Ta



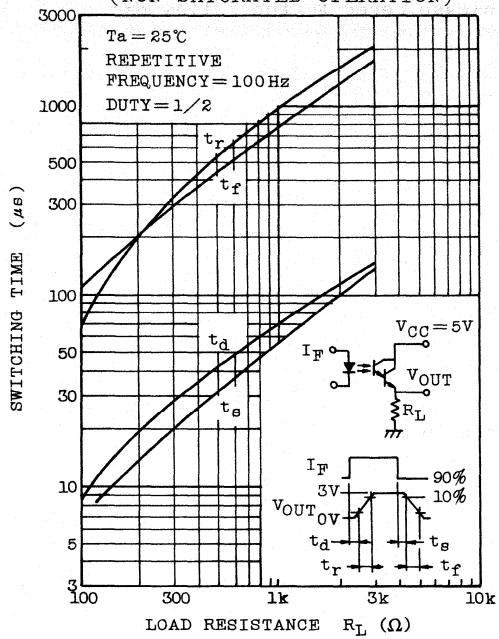
RELATIVE I_C — Ta



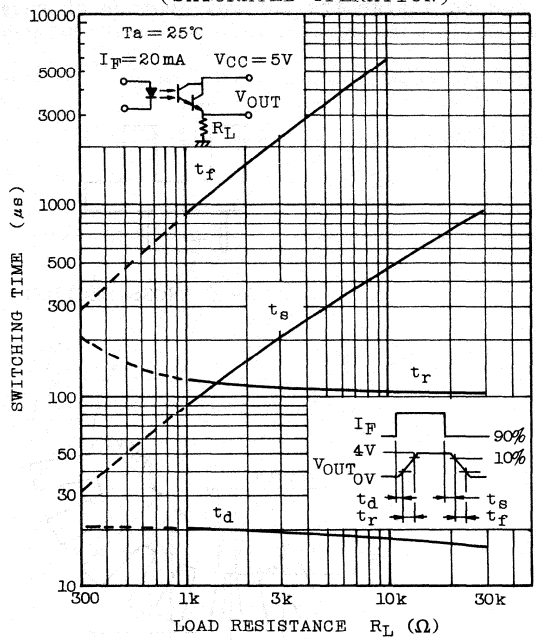
$V_{CE(sat)}$ — Ta



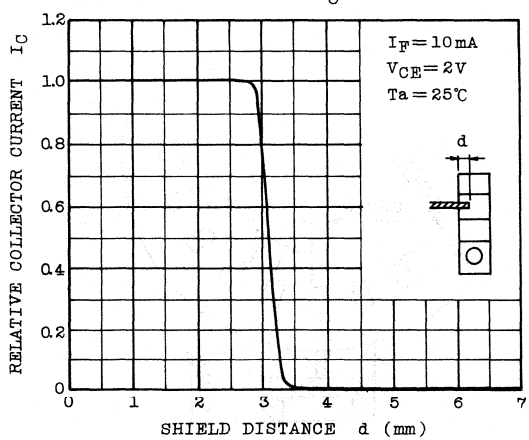
SWITCHING CHARACTERISTICS
(NON-SATURATED OPERATION)



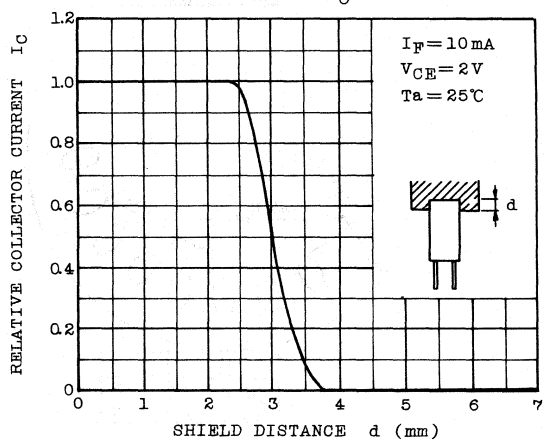
SWITCHING CHARACTERISTICS
(SATURATED OPERATION)



RELATIVE I_C — d

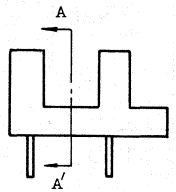


RELATIVE I_C — d

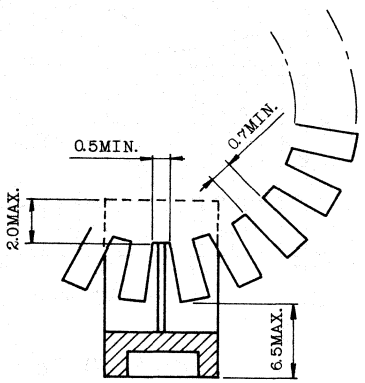


° EXAMPLES FOR OPRICAL SHUTTER DESIGN

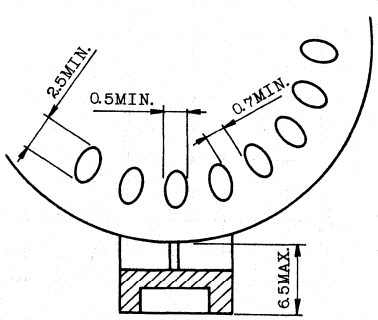
When design the optical shutter of rotator, please refer to the followings.



A-A' CROSS SECTION



Unit in mm



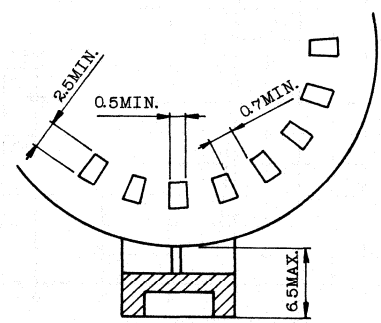


PHOTO INTERRUPTER
INFRARED LED + PHOTO DARLINGTON TRANSISTOR

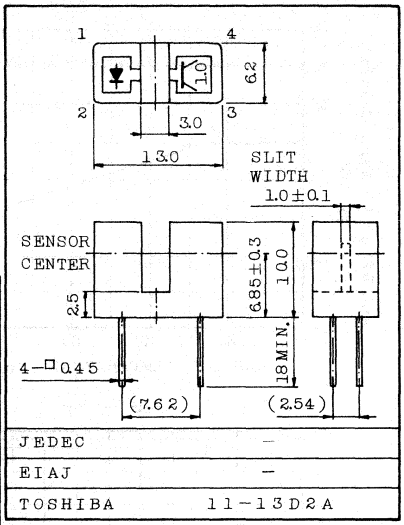
TLP852

OPTICAL SWITCH

SHAFT POSITION AND VELOCITY SENSOR

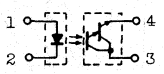
- High Current Transfer Ratio : I_C/I_F=30%(Min.)
- Fits Standard Dual-In-Line-Package Socket
- Photo Detector is not Sensitive for Visible Light Disturbance.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11-13D2A

PIN CONFIGURATIONS



1. ANODE
2. CATHODE
3. COLLECTOR
4. EMITTER

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	Forward Current	I_F	50	mA
	Reverse Voltage	V_R	5	V
DETECTOR	Collector to Emitter Voltage	V_{CEO}	30	V
	Emitter to Collector Voltage	V_{ECO}	5	V
	Collector Power Dissipation	P_C	75	mW
	Collector Current	I_C	50	mA
Operating Temperature		T_{opr}	-25~85	°C
Storage Temperature		T_{stg}	-40~100	°C

ELECTRICAL CHARACTERISTICS (Ta=25°C)

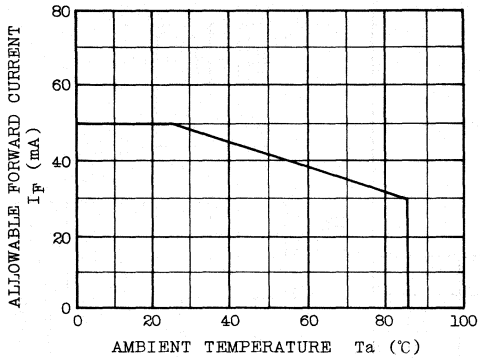
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.00	1.15	1.30	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance Between Terminals	C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	Dark Current	$I_D(I_{CEO})$	V_{CE}=16V, I_F=0	-	30	250	nA
	Capacitance Between Terminals	C_T	V=0, f=1MHz	-	7	-	pF
COUPLED	Current Transfer Ratio	I_C/I_F	V_{CE}=2V, I_F=10mA	30	200	-	%
	Saturation Voltage Collector to Emitter	$V_{CE(sat)}$	I_F=10mA I_C=1.5mA	-	0.85	1.2	V
	Rise Time	t_r	V_{CC}=5V, I_C=10mA	-	200	-	μs
	Fall Time	t_f	R_L=100Ω	-	150	-	μs

PRECAUTION

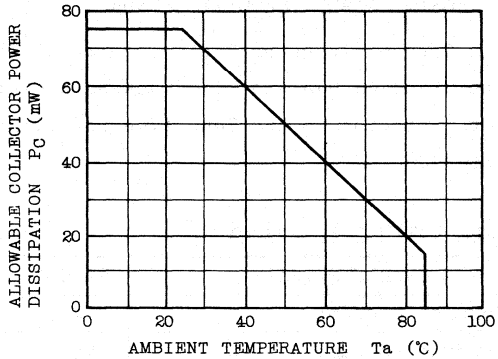
Please be careful of the followings.

1. Soldering temperature: 260°C MAX. Soldering time: 5 sec MAX.
   (Soldering portion of lead: up to 1.5mm from the body of the device)
2. If the lead is formed, Soldering shall be performed after lead forming.
3. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   o Freon TE or TF o Dai-Fron Solvents S3 or S3-E

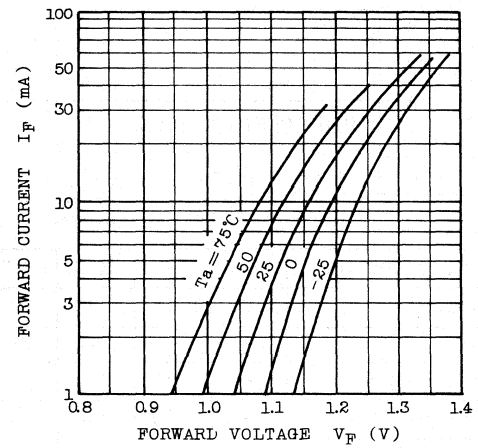
I_F — Ta



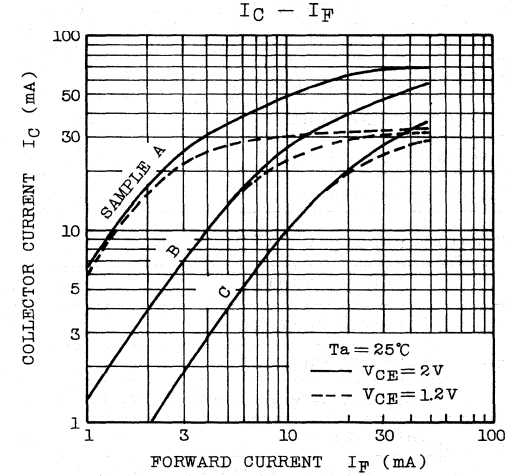
P_C — Ta



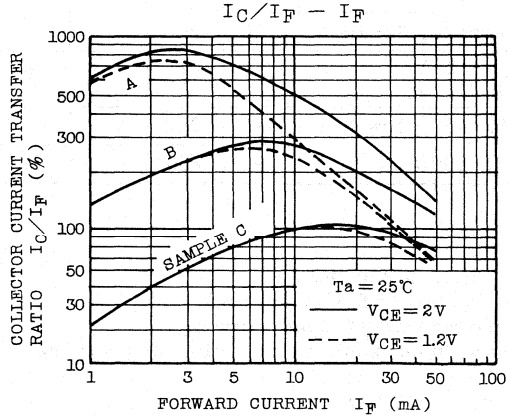
I_F — V_F



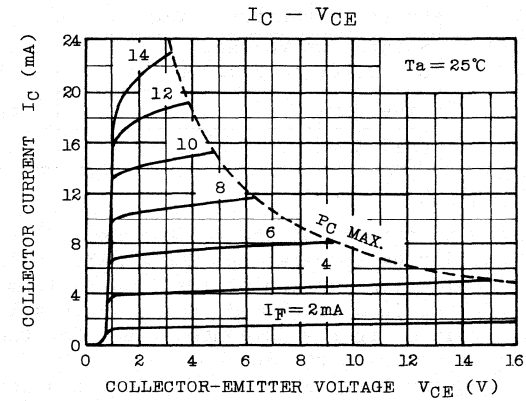
I_C — I_F



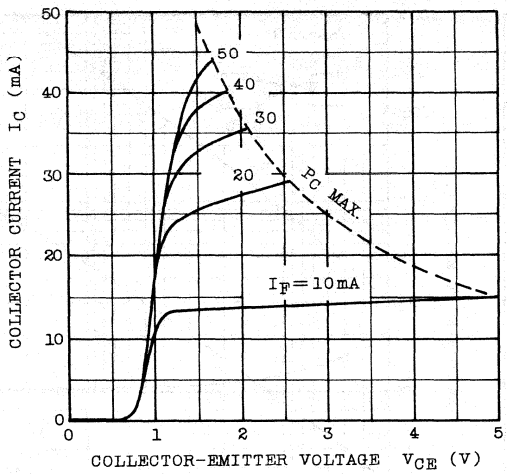
I_C/I_F — I_F



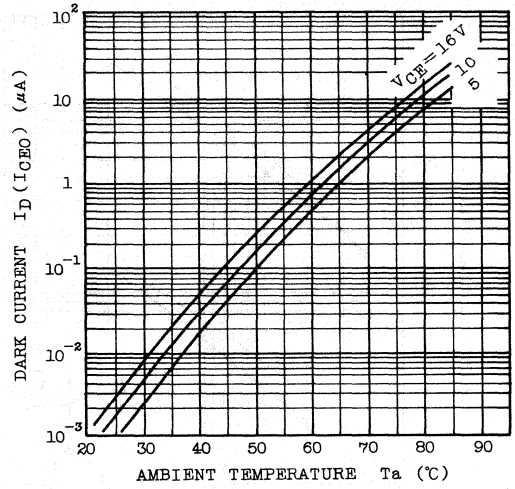
I_C — V_{CE}



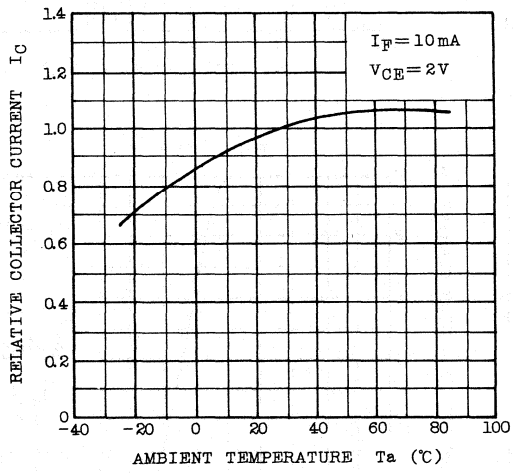
$I_C - V_{CE}$



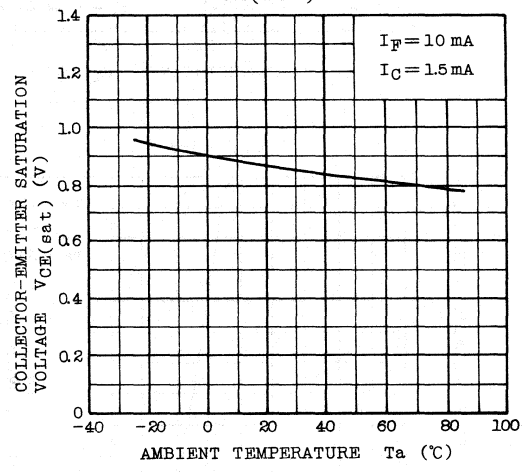
$I_D(I_{CEO})$ — Ta



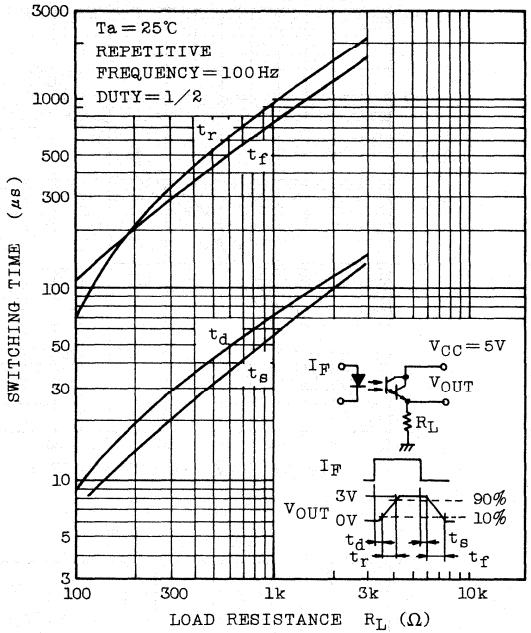
RELATIVE I_C — Ta



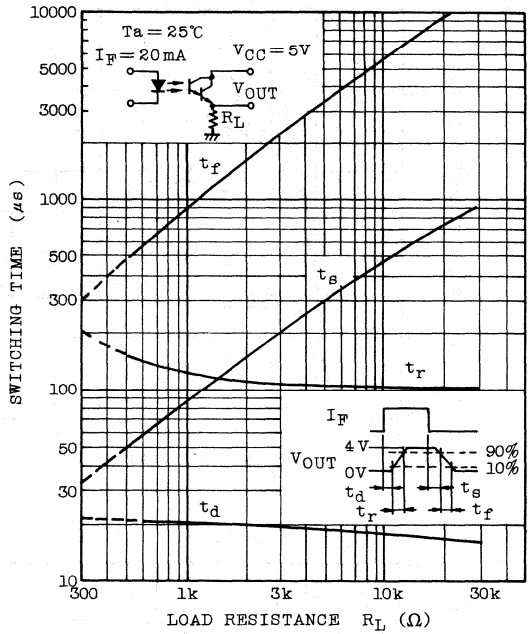
$V_{CE(sat)}$ — Ta



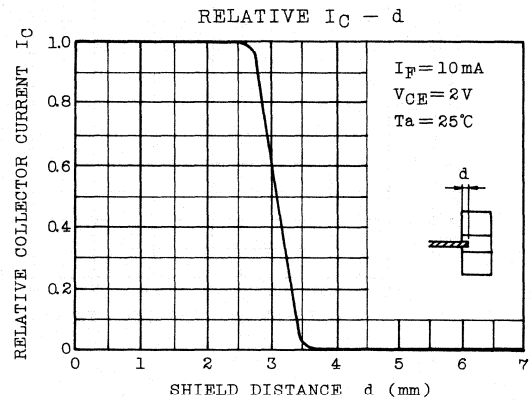
SWITCHING CHARACTERISTICS
(NON-SATURATED OPERATION)



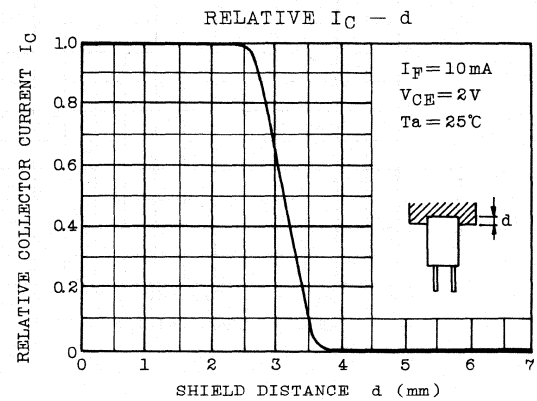
SWITCHING CHARACTERISTICS
(SATURATED OPERATION)



RELATIVE I_C — d

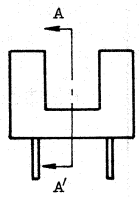


RELATIVE I_C — d



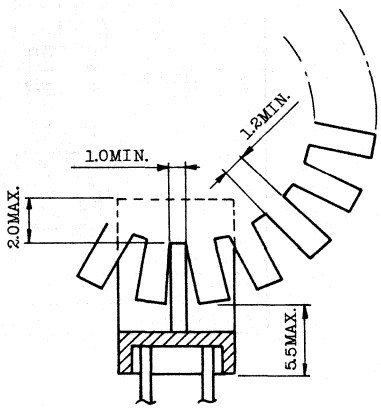
° EXAMPLES FOR OPTICAL SHUTTER DESIGN

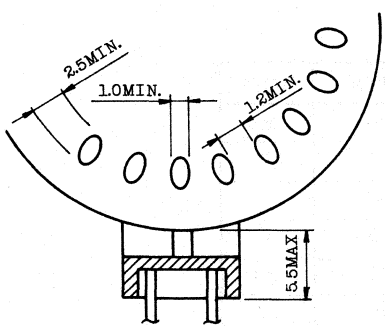
When design the optical shutter of rotator, please refer to the followings.

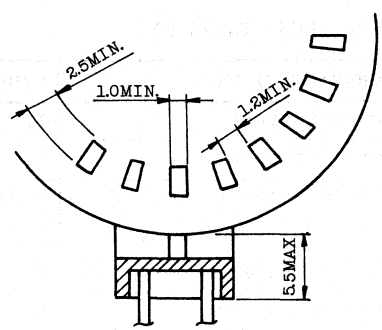


A-A' CROSS SECTION

Unit in mm





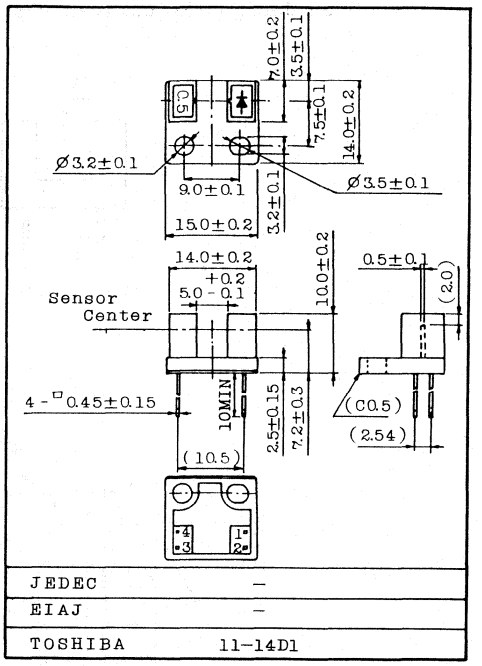


TLP853

PHOTO INTERRUPTER
INFRARED LED + PHOTO DARLINGTON TRANSISTOR

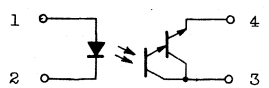
- TIMING SENSOR FOR ELECTRONIC SEWING MACHINE
- EDGE SENSOR
- POSITION AND VELOCITY SENSOR
  - High sensing accuracy : slit width 0.5mm
  - Wide gap between LED and detector : 5mm
  - High current transfer ratio : I_C/I_F=20% (MIN.)
  - Visible light cut-off type

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11-14D1

PIN CONNECTION



1. ANODE
2. CATHODE
3. COLLECTOR
4. EMITTER

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	Forward Current	I_F	50	mA
	Reverse Voltage	V_R	5	V
DETECTOR	Collector-Emitter Voltage	V_{CEO}	30	V
	Emitter-Collector Voltage	V_{ECO}	5	V
	Collector Power Dissipation	P_C	75	mW
	Collector Current	I_C	50	mA
Operating Temperature Range		T_{opr}	-25 ∿ 85	°C
Storage Temperature Range		T_{stg}	-40 ∿ 100	°C

ELECTRICAL CHARACTERISTICS (Ta=25°C)

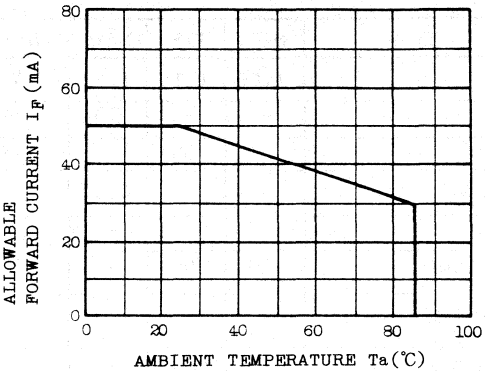
	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.00	1.15	1.30	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETE-CTOR	Dark Current	$I_D(I_{CEO})$	V_{CE}=16V, I_F=0	-	-	0.25	μA
	Capacitance	C_T	V=0, f=1MHz	-	7	-	pF
COUPLED	Current Transfer Ratio	I_C/I_F	V_{CE}=2V, I_F=10mA	20	100	-	%
	Collecter-Emitter Saturation Voltage	$V_{CE(sat)}$	I_F=10mA, I_C=1mA	-	0.85	1.2	V
	Rise and Fall Time	t_r	V_{CC}=5V, I_C=10mA	-	200	-	μs
		t_f	R_L=100	-	150	-	μs

PRECAUTION

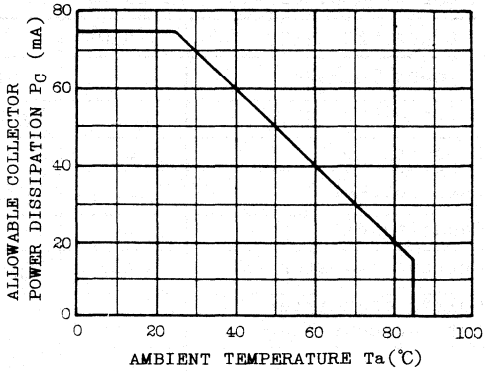
Please be careful of the followings.

1. Soldering temperature: 260°C MAX.
   Soldering time: 5 sec MAX.
   (Soldering portion of lead: up to 1.5mm from the body of the device.)
2. If the lead is formed, Soldering shall be performed after lead forming.
3. Avoid using the solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvent temperature: 45°C MAX.
   o Freon TE or TF o Dai-Fron Solvents S3 or S3-E

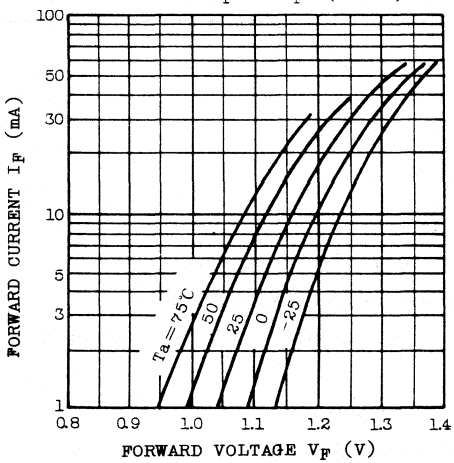
I_F – Ta



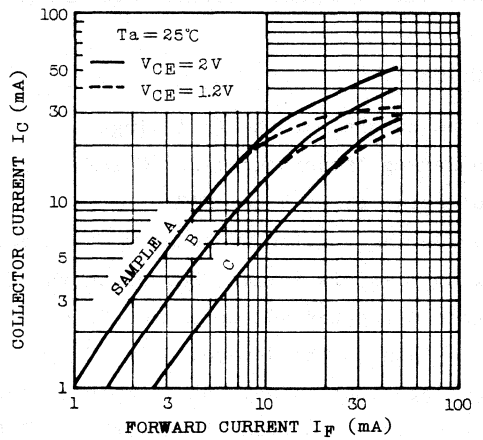
P_C – Ta



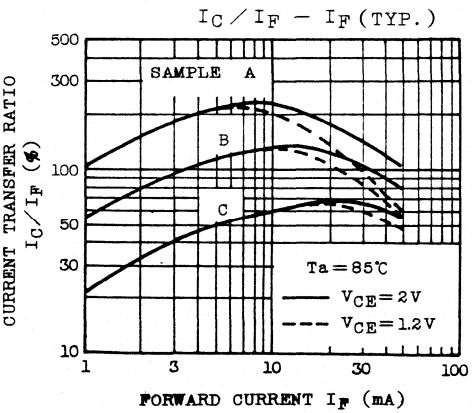
I_F – V_F (TYP.)



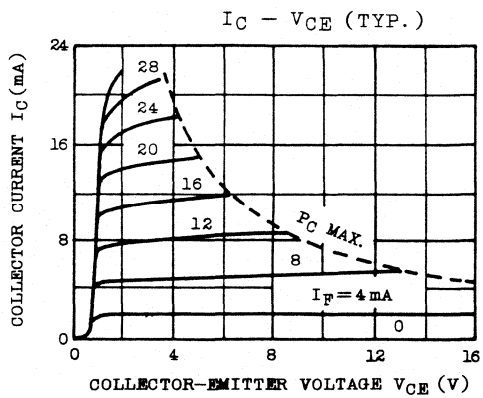
I_C – I_F (TYP.)



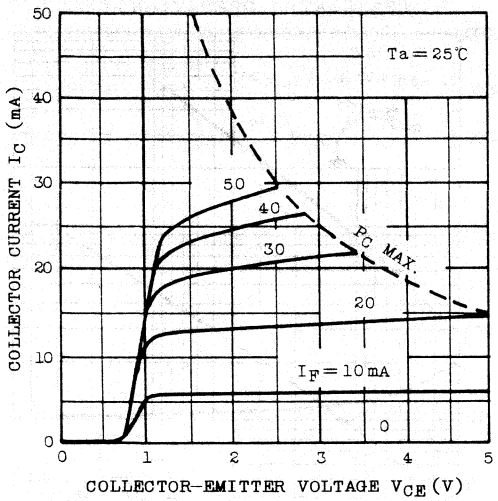
I_C / I_F – I_F (TYP.)



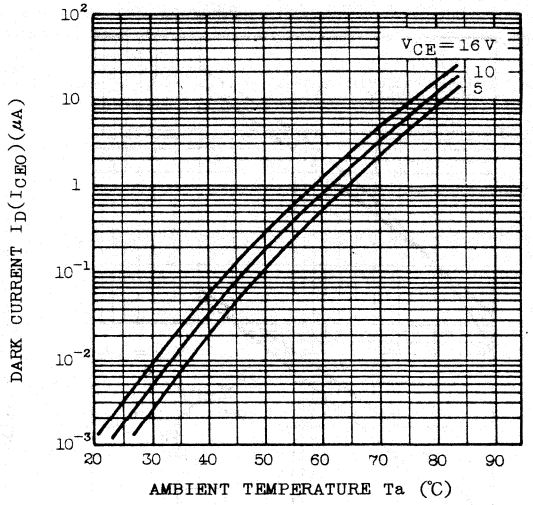
I_C – V_{CE} (TYP.)



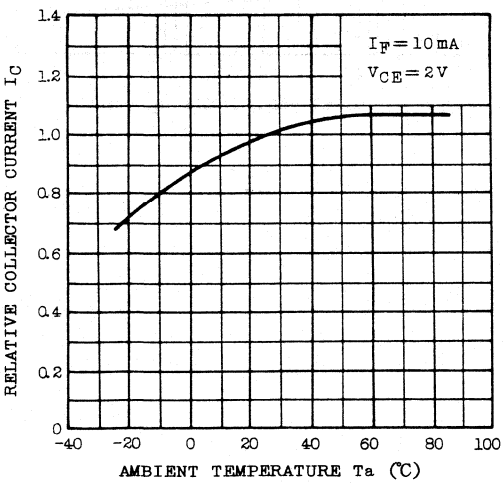
$I_C - V_{CE}$ (TYP.)



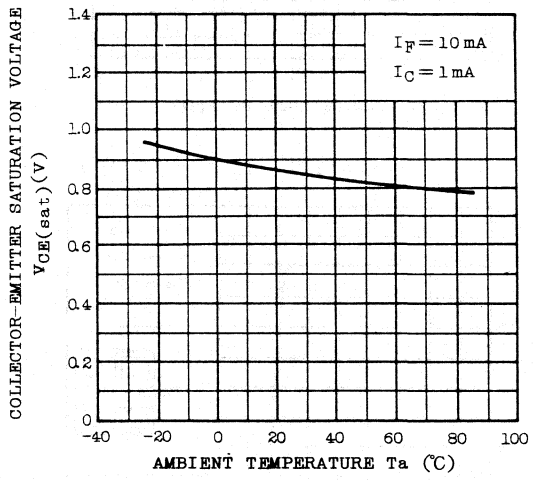
$I_D (I_{CEO})$ – Ta (TYP.)



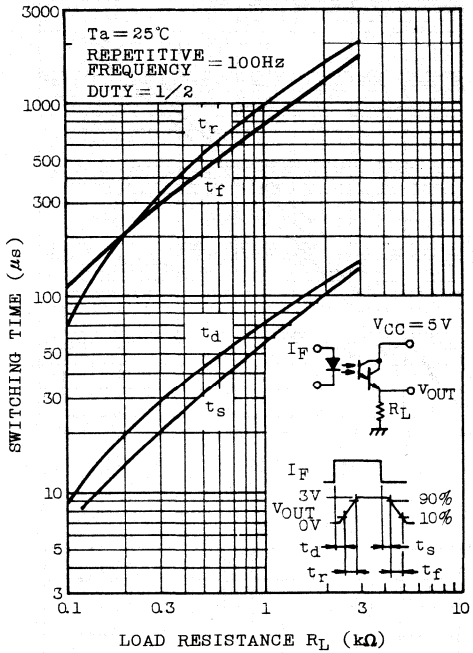
RELATTE I_C – Ta (TYP.)



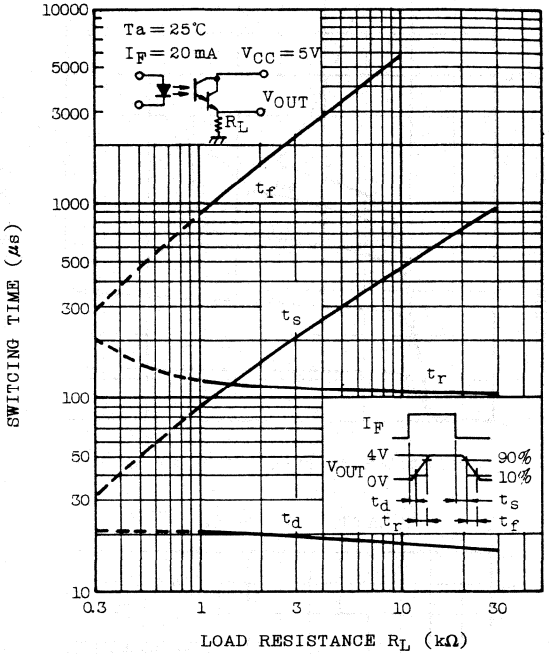
$V_{CE(sat)}$ – Ta (TYP.)



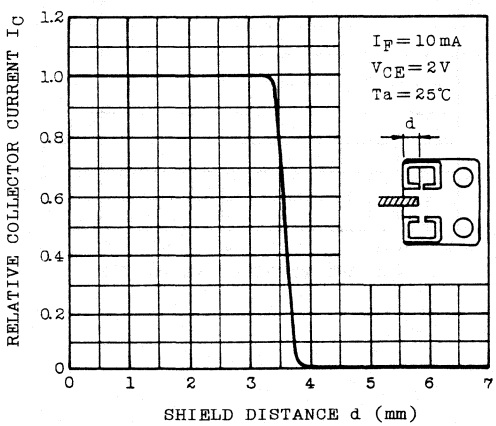
SWITCHING CHARACTERISTICS(TYP.)
(NON SATURATED OPERATION)



SWITCHING CHARACTERISTICS
(SATURATED OPERATION) (TYP.)

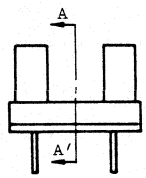


RELATIVE I_C – d (TYP.)



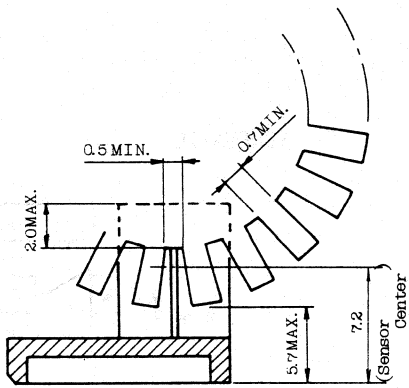
◦ EXAMPLES FOR OPTICAL SHUTTER DESIGN

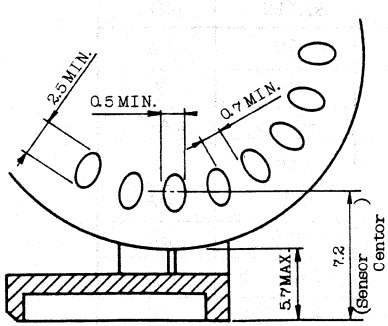
When design the optical shutter of rotator, please refer to the followings.

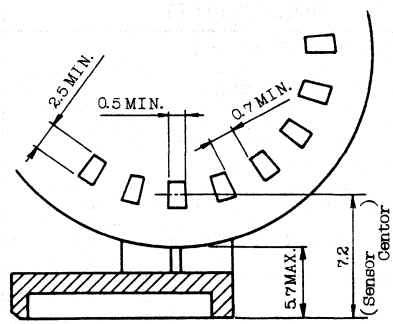


A–A' CROSS SECTION

Unit in mm







TLP1000, 1002, 1004, 1006

PHOTO INTERRUPTER INFRARED LED + PHOTO IC

TENTATIVE

FEATURES

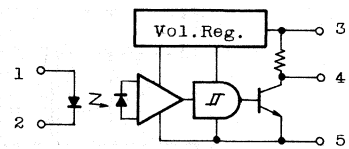
- OPTICAL SWITCH
- SHAFT POSITION AND VELOCITY SENSOR

DESCRIPTION

TLP 1000, 1003, 1004, 1006, contains agallium arsenie infrared emitting diode coupled to a monolithic integrated circuit, which incorporates a photodiode, a liners amplifier and Schmitt trigger on a single silicon chip.

- TTL, LSTTL compatible
- Wide Supply Voltage (V_{CC}=4.5 ∿16 V)
- Non Sensitivity for Visible Light
- High Speed (t_{on} 3 μs, t_{off} 5 μs typ.)
- Output Terminal contains a high voltage limitting diode.

SCHEMATIC



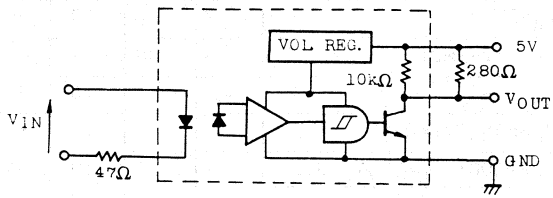
MAXIMUM RATINGS (Ta=25°C)

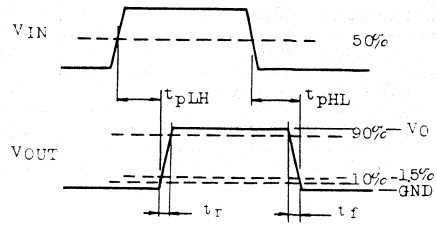
	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Curreint	I_F	50	mA
	Reverse Voltage	V_R	5	V
	Forward Current Derating	ΔI_F/°C	-0.33	mA/°C
DETECTOR	Supply Voltage	V_{CC}	16	V
	Low Level Output Current	I_{OL}	50	mA
	Total Output Power Dissipation	P_O	250	mW
Operating Temperature Range		T_{opr}	-25 ∿ 85	°C
Storage Temperature Range		T_{stg}	-40∿100	°C
Soldering Temp. and Time		T_{sol}	260°C • 5 sec	

ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC		SYMBOL	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage		V_F	I_F=10mA		1.00	1.15	1.3	V
	Reverse Current		I_R	V_R=5V		-	-	10	μA
	Capacitance		C_T	V=0, f=1MHz		-	30	-	pF
DETECTOR	Supply Voltage		V_{CC}	-		4.5	-	16	V
	Low Level Supply Current		I_{CCL}	V_{CC}=5V, I_F=0		-	6	15	mA
	High Level Supply Current		I_{CCH}	TLP1000	V_{CC}=5V, I_F=8mA	-	4	10	mA
				TLP1002	V_{CC}=5V, I_F=15mA				
				TLP1004	V_{CC}=5V, I_F=21mA				
				TLP1006	V_{CC}=5V, I_F=21mA				
	Low Level Output Voltage		V_{OL}	I_{OL}=16mA, V_{CC}=5V, I_F=0		-	0.15	0.4	V
	High Level Output Voltage		V_{OH}	TLP1000	V_{CC}=5V, I_F=8mA	4.0	-	-	V
				TLP1002	V_{CC}=5V, I_F=15mA				
				TLP1004	V_{CC}=5V, I_F=21mA				
				TLP1006	V_{CC}=5V, I_F=21mA				
COUPLED	"L → H" LED Threshold Current		I_{FLH}	TLP1000	V_{CC}=5V	-	2	5	mA
				TLP1002		-	3.5	11	
				TLP1004		-	6	15	
				TLP1006		-	6	15	
	Hysteresis Ratio		$\frac{I_{FHL}}{I_{FLH}}$	V_{CC}=5V		-	0.9	-	
	Propagation Delay (NOTE 1)	L → H	t_{pLH}	Ta=25°C, V_{CC}=5V, R_L=280Ω (NOTE 1)		-	3	-	μs
		H → L	t_{pHL}			-	5	-	
	Raise Time		t_r			-	0.1	-	
	Fall Time		t_f			-	0.05	-	

NOTE 1: Switching Time Test Circuit and Voltage Waveform



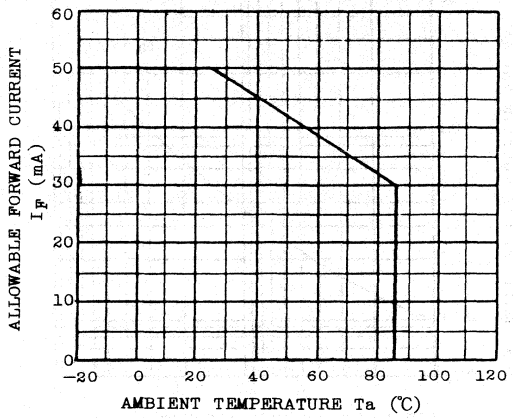


PRECAUTION

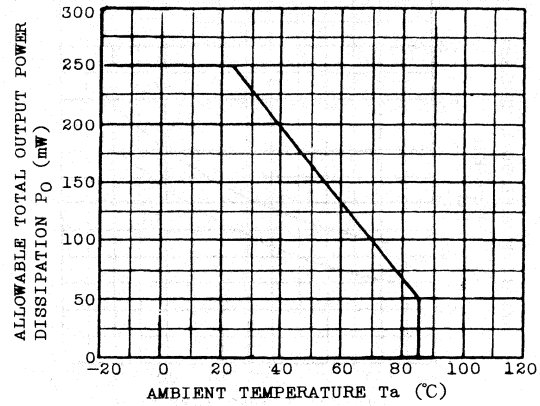
Please be careful of the followings.

1. Soldering temperature: 260°C MAX.
   Soldering time: 5 sec MAX.
   (Soldering portion of lead: up to 1.5 mm from the body of the device)
2. If the lead is formed, Soldering shall be performed after lead forming.
3. Avoid using the Solvent except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvent temperature: 45°C MAX.
   ° Freon TE or TF ° Dai-From Solvent S3 or S3-E

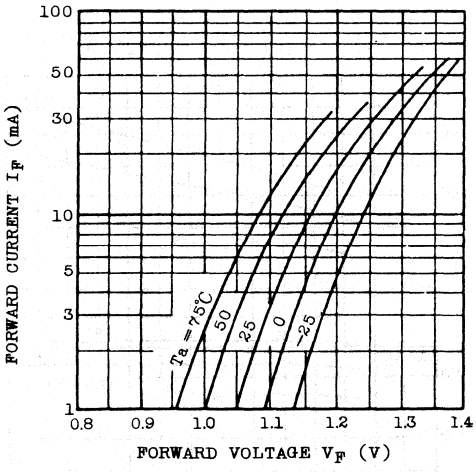
I_F – Ta



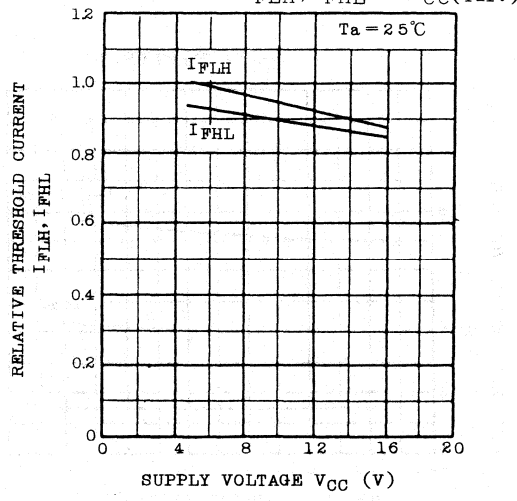
P_O – Ta



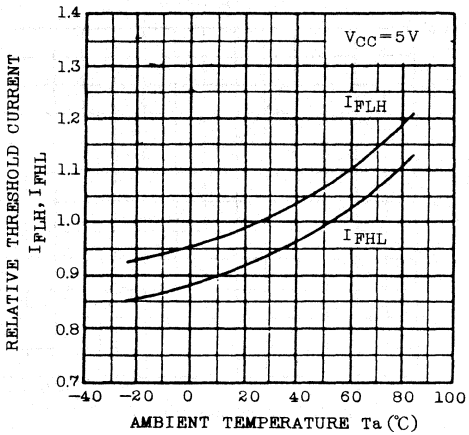
I_F – V_F (TYP.)



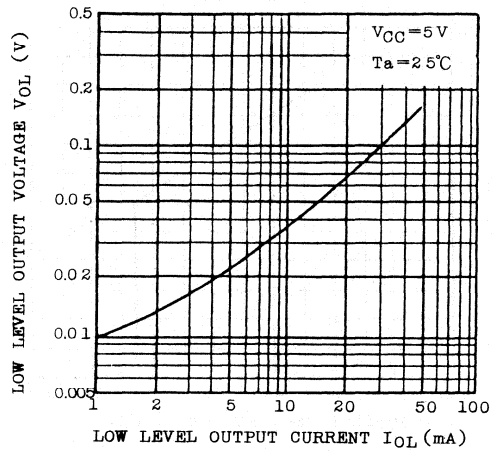
RELATIVE I_{FLH}, I_{FHL} – V_{CC} (TYP.)



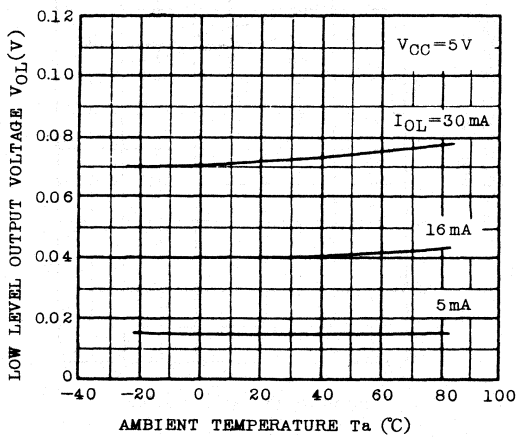
RELATIVE I_{FLH}, I_{FHL} – Ta(TYP.)



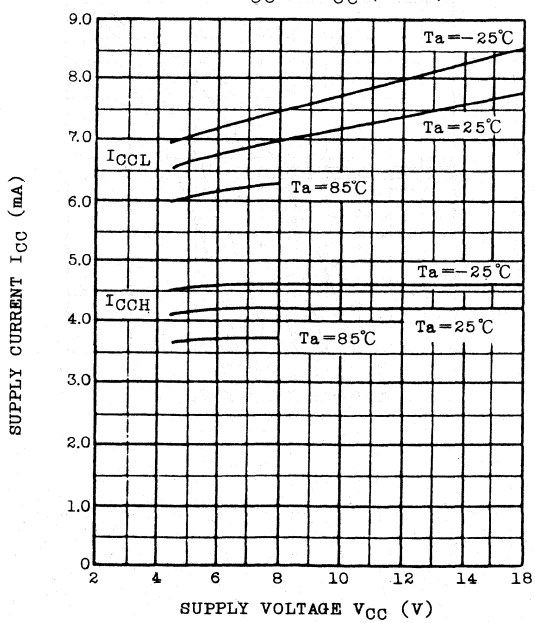
V_{OL} – I_{OL} (TYP.)



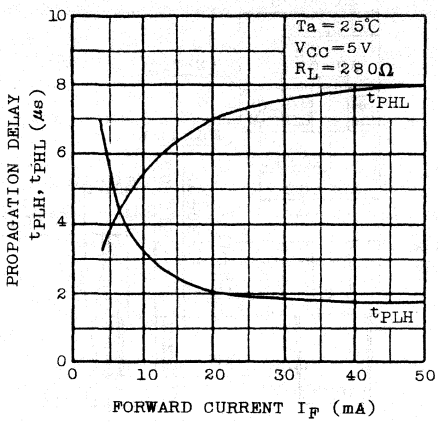
V_{OL} – Ta(TYP.)



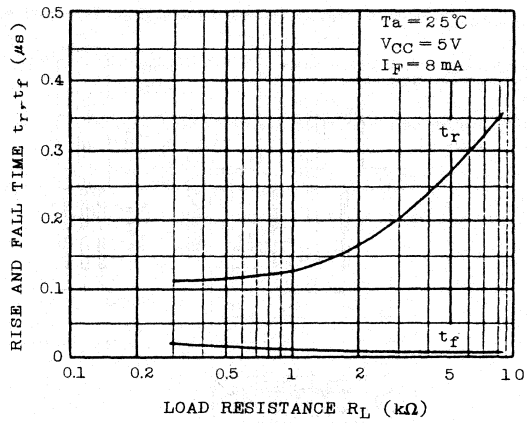
I_{CC} – V_{CC} (TYP.)



t_{PLH}, t_{PHL} – I_F (TYP.)

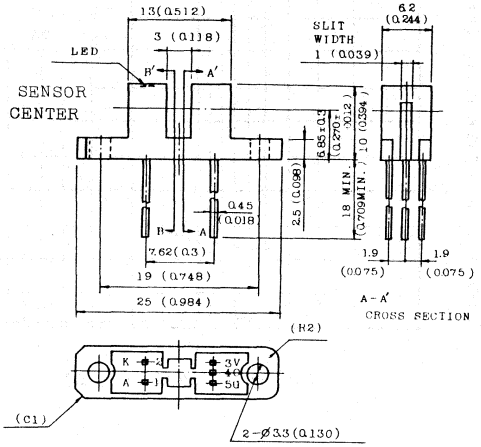


t_r, t_f – R_L (TYP.)

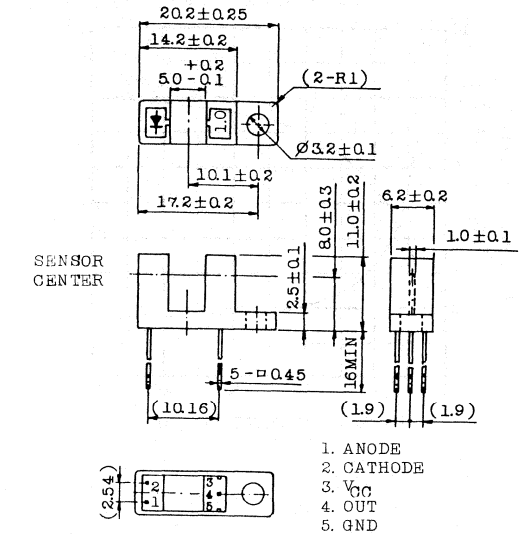


TLP1000, 1002, 1004, 1006

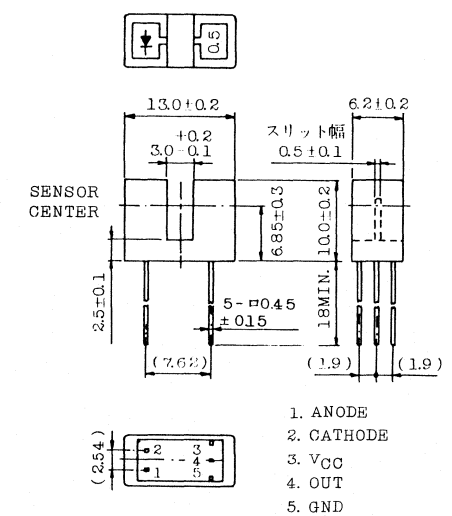
OUTLINE (Unit in mm)



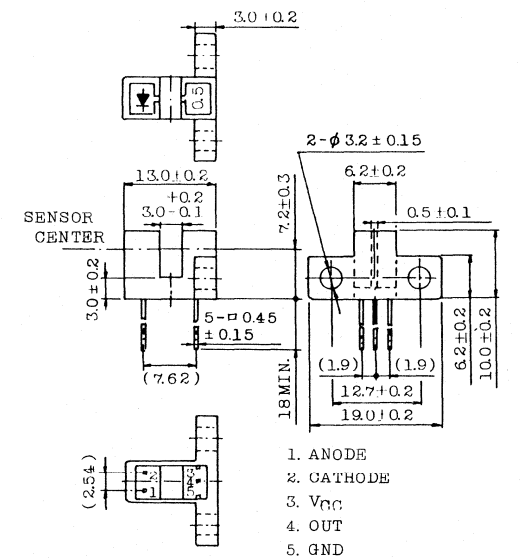
1. ANODE
2. CATHODE
3. V_{CC}
4. OUT
5. GND



1. ANODE
2. CATHODE
3. V_{CC}
4. OUT
5. GND



1. ANODE
2. CATHODE
3. V_{CC}
4. OUT
5. GND



1. ANODE
2. CATHODE
3. V_{CC}
4. OUT
5. GND

PHOTO INTERRUPTER
INFRARED LED + PHOTO IC

TLP1001, 1003, 1005, 1007

FEATURES

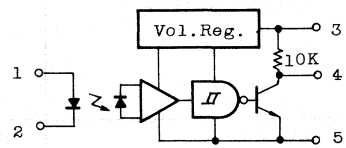
- OPTICAL SWITCH
- SHAFT POSITION AND VELOCITY SENSOR

DESCRIPTION

TLP 1001, 1003, 1005, 1007 contains a gallium arsenide infrared emitting diode coupled to a monolithic integrated circuit, which incorporates a photodiode, a linear amplifier and Schmitt trigger on a single silicon chip.

- TTL, LSTTL compatible
- Wide Supply Voltage (V_{CC}=4.5 ∿ 16V)
- Non Sensitivity for Visible Light
- High Speed (t_{on} 8 μs, t_{off} 5 μs typ.)
- Output Terminal contains a high voltage limitting diode.

SCHEMATIC



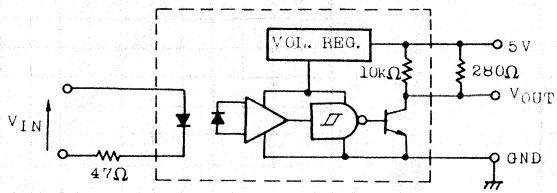
MAXIMUM RATINGS (Ta=25°C)

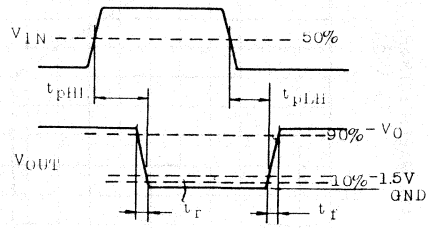
	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	50	mA
	Reverse Voltage	V_R	5	V
	Forward Current Derating	ΔI_F/°C	-0.33	mA/°C
DETECTOR	Supply Voltage	V_{CC}	16	V
	Low Level Output Current	I_{OL}	50	mA
	Total Output Power Dissipation	P_O	250	mW
Operating Temperature Range		T_{opr}	-25 ∿ 85	°C
Storage Temperature Range		T_{stg}	-40 ∿ 100	°C
Soldering Temp. and Time		T_{sol}	260°C • 5 sec	

ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC		SYMBOL	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage		V_F	I_F=10mA		1.00	1.15	1.30	V
	Reverse Current		I_R	V_R=5V, Ta=25°C		-	-	10	μA
	Capacitance		C_T	V=0, f=1MHz, Ta=25°C		-	30	-	pF
DETECTOR	Supply Voltage		V_{CC}	Ta=25°C		4.5	-	16	V
	Low Level Supply Current		I_{CCL}	TLP1001	V_{CC}=5V, I_F=8mA	-	6	15	mA
				TLP1003	V_{CC}=5V, I_F=15mA				
				TLP1005	V_{CC}=5V, I_F=21mA				
				TLP1007	V_{CC}=5V, I_F=21mA				
	High Level Supply Current		I_{CCH}	V_{CC}=5V, I_F=0		-	7	20	mA
	Low Level Output Voltage		V_{OL}	TLP1001	I_{OL}=16mA, V_{CC}=5V, I_F=8mA	-	0.15	0.4	V
				TLP1003	I_{OL}=16mA, V_{CC}=5V, I_F=15mA				
				TLP1005	I_{OL}=16mA, V_{CC}=5V, I_F=21mA				
				TLP1007	I_{OL}=16mA, V_{CC}=5V, I_F=21mA				
	High Level Output Voltage		V_{OH}	V_{CC}=5V, I_F=0		4.0	-	-	V
COUPLED	"H → L" LED Threshold Current		I_{FHL}	TLP1001	V_{CC}=5V	-	2	5	mA
				TLP1003		-	3.5	11	
				TLP1005		-	6	15	
				TLP1007		-	6	15	
	Hysteresis Ratio		$\frac{I_{FHL}}{I_{FLH}}$	V_{CC}=5V		-	1.1	-	
	Propagation Dealy (NOTE 1)	L → H	t_{pLH}	Ta=25°C, V_{CC}=5V, R_L=280Ω (NOTE 1)		-	8	-	μs
		H → L	t_{pHL}			-	5	-	
	Rise Time		t_r			-	0.1	-	
	Fall Time		t_f			-	0.05	-	

NOTE 1: Switching Time Test Circuit and Voltage Waveform



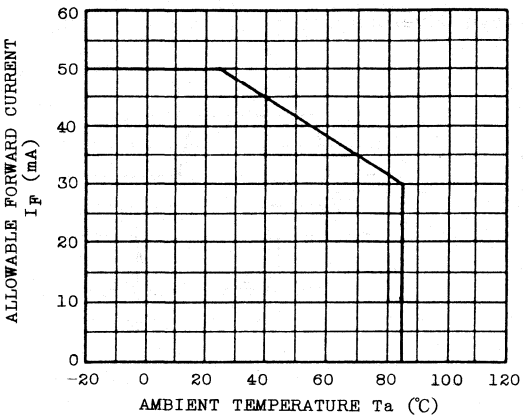


PRECAUTION

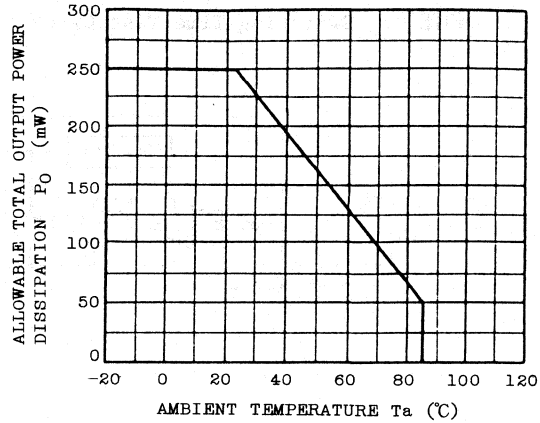
Please be careful of the followings.

1. Soldering temperature: 260°C MAX.
   Soldering time: 5 sec MAX.
   (Soldering portion of lead: up to 1.5 mm from the body of the device)
2. If the lead is formed, Soldering shall be performed after lead forming.
3. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvent temperature: 45°C MAX.
   ° Freon TE or TF ° Dai-Fron Solvents S3 or S3-E

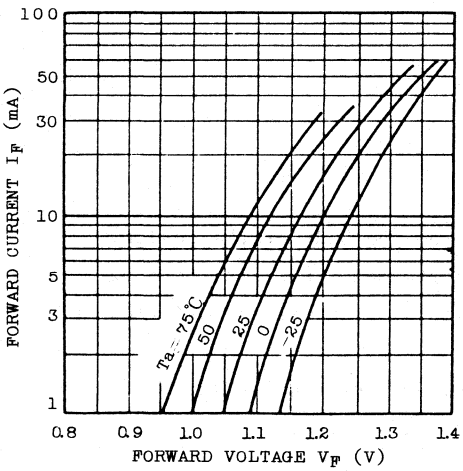
I_F – Ta



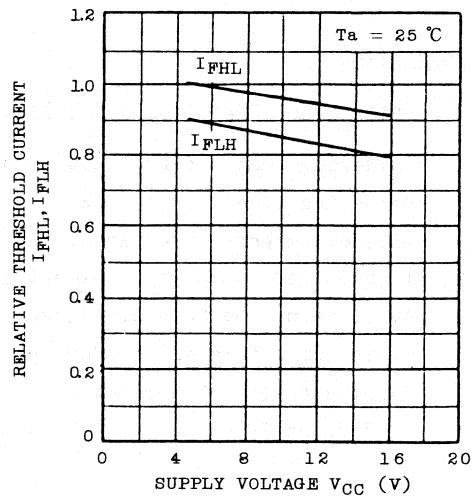
P_O – Ta



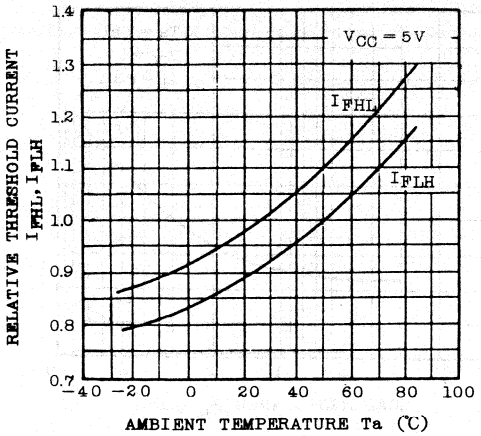
I_F – V_F (TYP.)



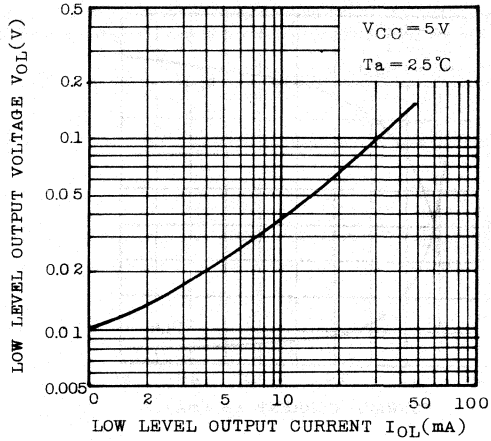
RELATIVE I_{FHL}, I_{FLH} – V_{CC} (TYP.)



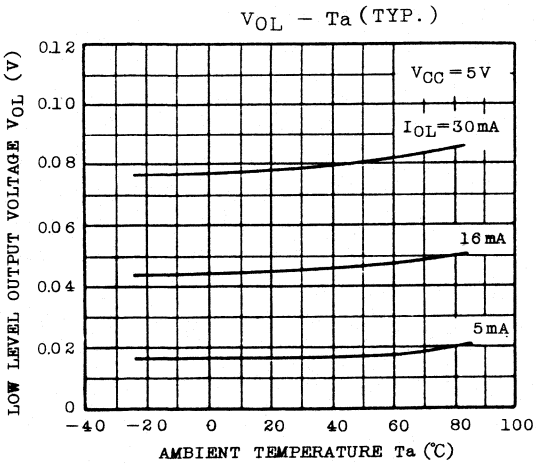
RELATIVE I_{FHL}, I_{FLH} – Ta (TYP.)



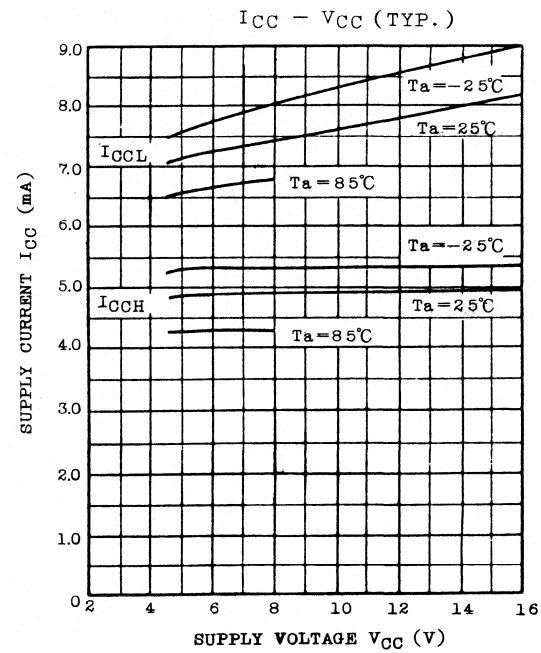
V_{OL} – I_{OL} (TYP.)



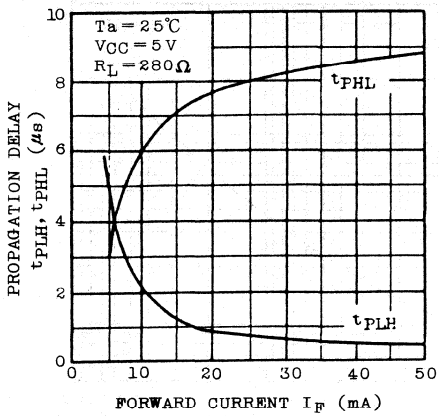
V_{OL} – Ta (TYP.)



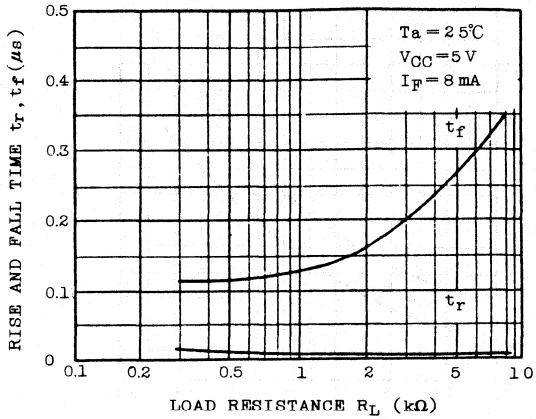
I_{CC} – V_{CC} (TYP.)



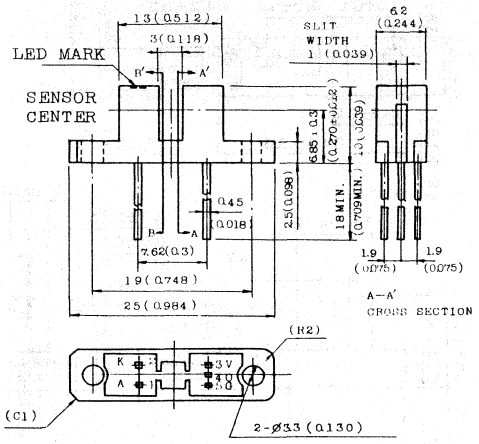
t_{PHL} , t_{PLH} − I_F (TYP.)



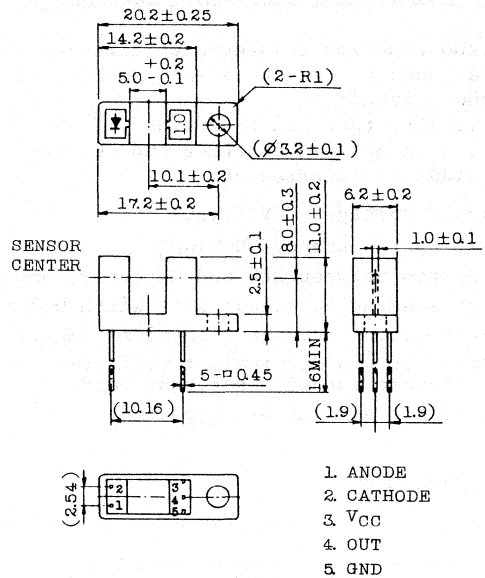
t_r , t_f − R_L (TYP.)



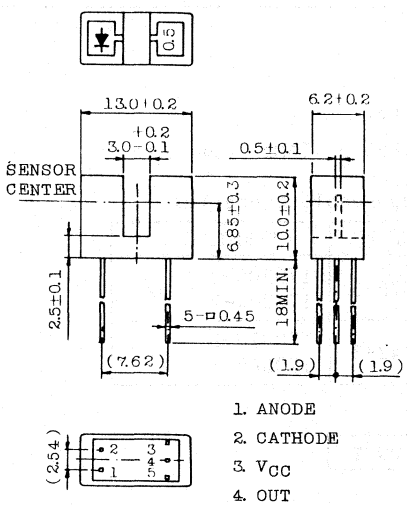
OUTLINE (Unit in mm)



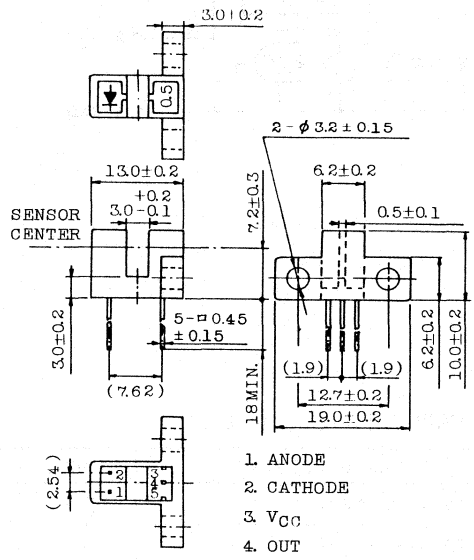
1. ANODE
2. CATHODE
3. V_{CC}
4. OUT
5. GND



1. ANODE
2. CATHODE
3. V_{CC}
4. OUT
5. GND



1. ANODE
2. CATHODE
3. V_{CC}
4. OUT
5. GND



1. ANODE
2. CATHODE
3. V_{CC}
4. OUT
5. GND

TLP1200

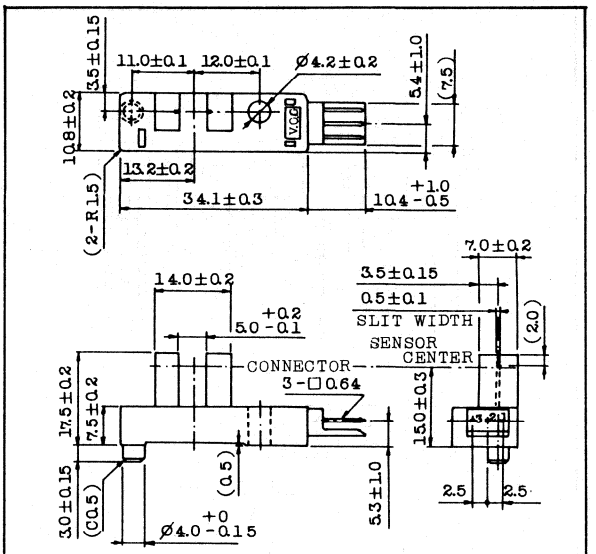
PHOTO INTERRUPTER
INFRARED LED + PHOTO IC

- TIMING SENSOR FOR COPIER AND FACSIMATE AND ELECTRONIC PRINTER
- EDGE SENSOR, OPTO-ELECTRONIC SWITCHES

TLP1200 contains a integrated circuit and a connector which is easy to connect another circuit.
Low level output can be otained if the light beem between emitting and detecting sides is interrupted.

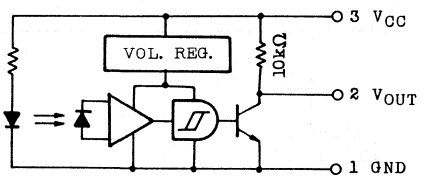
- Supply voltage : 5V (Typ.)
- Pull up resistance 10kΩ output
- Wide gap between LED and detector: 5mm
- High sensing accuracy: slit width 0.5 mm
- Large output current : I_{OL}=50mA (MAX.)
- Connector pin terminals facilitate the connection with external lead.
- Visible light cut-off type.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11-14C1

PIN CONNECTION



Connector

171825-3 (AMP Japan Ltd.)

Correspondable connector

HOUSING	TERMINAL
171822-3	170205-2 or 170204-2
172142-3	170370-1 or 170369-1

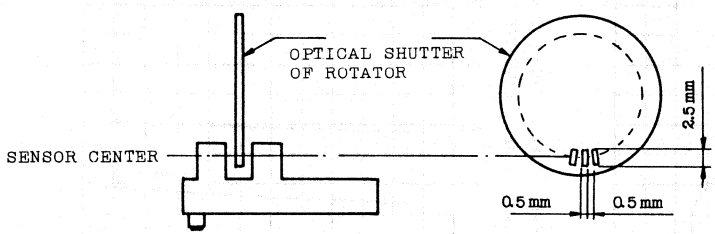
MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	GATING	UNIT
Supply Voltage	V_{CC}	6	V
Output Voltage	V_{OUT}	V_{CC} + 0.5	V
Low Level Output Current	I_{OL}	50	mA
Operating Temperature Range	T_{opr}	-25∿75	°C
Storage Temperature Range	T_{stg}	-40∿85	°C

ELECTRICAL CHARACTERISTICS (Ta=25°C, V_{CC}=5±0.5V)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}		4.5	5	6	V
Low Level Supply Current	I_{CCL}	Shutter In	-	-	35	mA
High Level Supply Current	I_{CCH}	Without Shutter	-	-	35	mA
Loe Level Output Voltage	V_{OL}	Shutter In, I_{OL}=16mA	-	-	0.4	V
High Level Output Voltage	V_{OH}	Without Shutter	V_{CC}×0.8	-	-	V
Frequency	f	$V_{OUT}=V_{CC}$ ×0.8 (NOTE 1)	2000	-	-	Hz

(NOTE 1) : Test Figure of Frequency



RECOMMENDED OPERATING CONDITION

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT.
Supply Voltage	V_{CC}	4.5	5	5.5	V
Low Level Output Current	I_{OL} (NOTE 2)	-	-	16	mA
Frequency	f	-	-	2000	Hz
Operating Temperature	T_{opr}	-10	25	60	°C

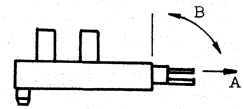
(NOTE 2) : V_{OL} = 0.4V

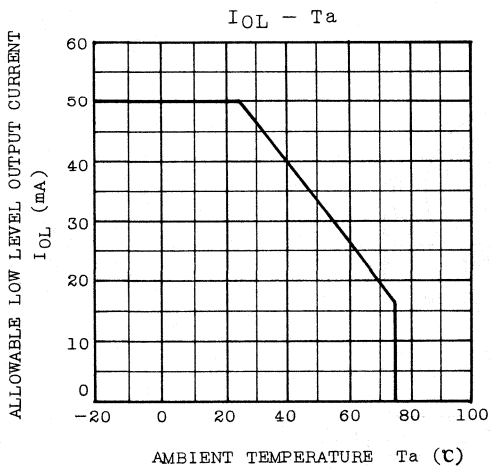
PRECAUTION

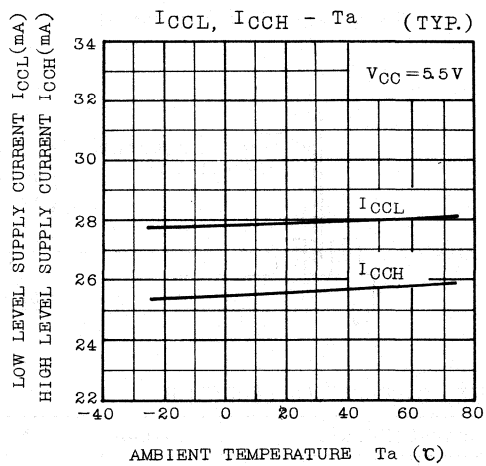
- Output Voltage is irregular within 100μs after V_{CC} turn on. The reason is stability opto-integrated circuit.
- Pin surge voltage : 150V MAX. at C = 200pF, 2 terminals at will.
- Torque of nut : 6 kg·cm MAX.

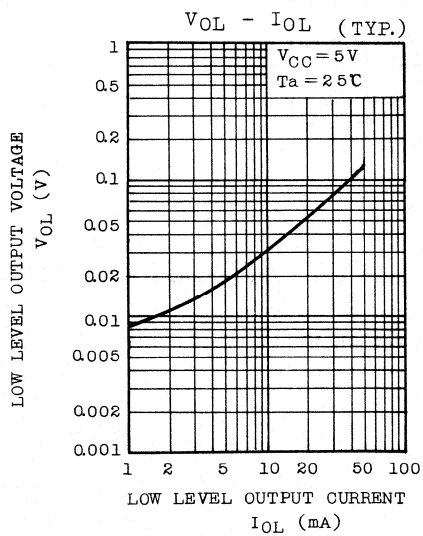
TERMINAL STRENGTH

CHARACTERISTIC	TEST CONDITION		LIMIT
PULL	DIRECTION	A	NO DEFECT OF ELECTRICAL CHARACTERISTICS.
	WEIGHT	2kg	
	TIME	5sec/ONCE	
BEND	DIRECTION	B	
	WEIGHT	1kg	
	TIME	5sec/THRICE	

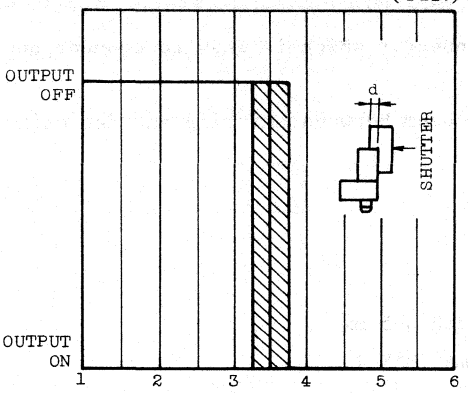




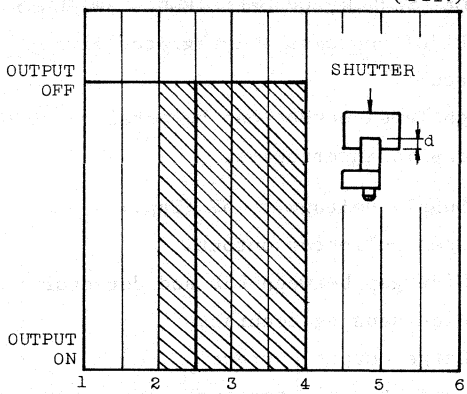




DETECTING POSITION CHARACTERISTICS (1) (TYP.)



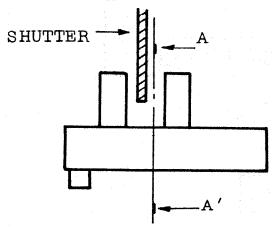
DETECTING POSITION CHARACTERISITCS (2) (TYP.)

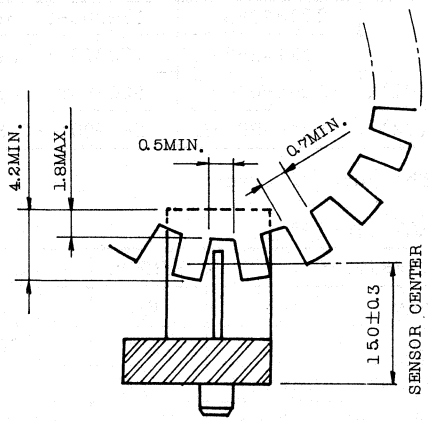


EXAMPLES FOR OPTICAL SHUTTER DESIGN

When design the optical shutter of rotator, please refer to the followings.

Unit in mm





A - A' CROSS SECTION

TLP1201

PHOTO INTERRUPTER INFRARED LED + PHOTO IC

o TIMING SENSOR FOR COPIER AND FACSIMILE AND ELECTRONIC PRINTER

o EDGE SENSOR, OPTOELECTRONIC SWITCHES

TLP1201 contains a integrated circuit and a connector which is easy to connect another circuit.

High level output can be obtained if the light beem between emitting and detecting sides is interrupted.

- Supply voltage : 5V (Typ.)
- Open collector output
- Wide gap between LED and detector : 5 mm
- High sensing accuracy : Slit width 0.5 mm
- Large output current : I_{OL}= 50mA (MAX.)
- Connector pin terminals facilitate the connection with external lead.
- Connector

  TLP1201 ..... 171825-3 (AMP Japan Ltd.)

  TLP1201(C1) ..... 5267-03A (Molex Japan)

  TLP1201(C2) ..... B3P-SHF-1AA (Japan Solderless Terminal MFG.)
- Correspondable connector

TYPE	HOUSING	TERMINAL
TLP1201	171822-3	170205-2 or 170204-2
	172142-3	170370-1 or 170369-1
TLP1201(C1)	5264-03	5263PBT or 5263PBTL
TLP1201(C2)	H3P-SHF-AA	SHF-001T-0.8BS or SHF-002T-0.8BS

- Visible light cut-off type.

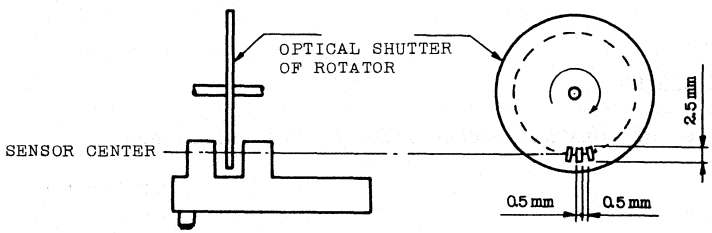
MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage	V_{CC}	6	V
Output Voltage	V_{OUT}	28	V
Low level Output Current	I_{OL}	50	mA
Operating Temperature Range	T_{opr}	-25 ∿ 75	°C
Storage Temperature Range	T_{stg}	-40 ∿ 85	°C

ELECTRICAL CHARACTERISTICS (Ta=25°C, V_{CC}=5±0.5V)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}		4.5	5	5.5	V
Low Level Supply Current	I_{CCL}	Without Shutter	-	-	35	mA
High Level Supply Current	I_{CCH}	Shutter In	-	-	35	mA
Low Level Output Voltage	V_{OL}	Without Shutter, I_{OL}=16mA	-	-	0.35	V
High Level Output Voltage	V_{OH}	Shutter In, R_L=47kΩ	V_{CC}×0.8	-	-	V
Frequency	f	V_{OUT}=V_{CC}×0.8, R_L=47kΩ(NOTE 1)	3000	-	-	Hz

(NOTE 1) : Test Figure of Frequency.



RECOMMENDED OPERATING CONDITIONS

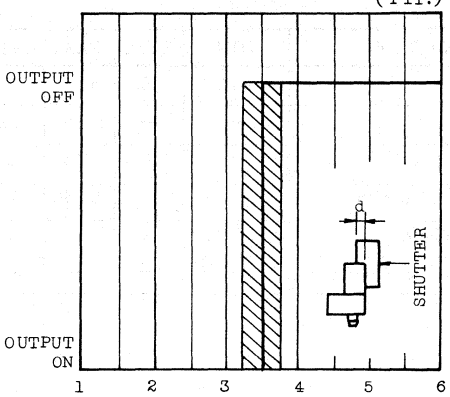
CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}	4.5	5	5.5	V
Low Level Output Current	I_{OL} (NOTE 2)	-	-	17	mA
Frequency	f	-	-	3000	Hz
Operating Temperature Range	T_{opr}	-10	25	75	°C

(NOTE 2) : V_{OL} = 0.4V

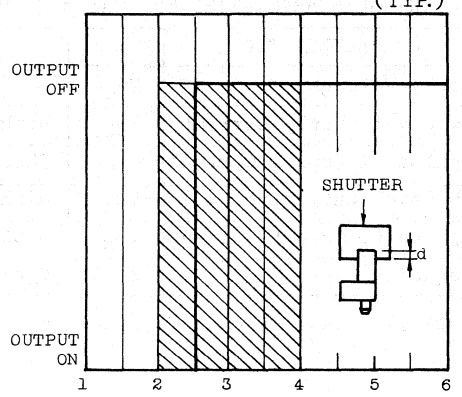
PRECAUTION

- Output Voltage is irregular within 100μs after V_{CC} turn on. The reason is stability opto-integrated circuit.
- Pin surge voltage: 150V MAX. at C=200pF, 2 terminals at will.
- Torque of nut : 6kg·cm MAX.

DETECTING POSITION CHARACTERISTICS (1) (TYP.)



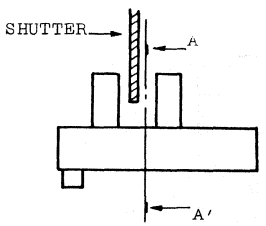
DETECTING POSITION CHARACTERISTICS (2) (TYP.)

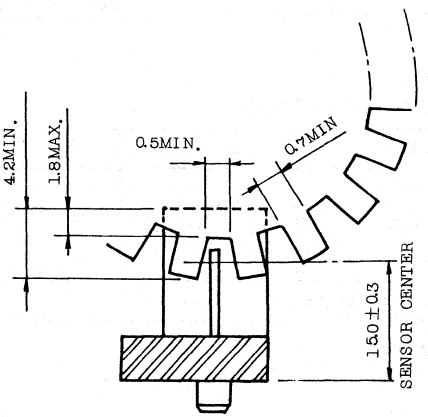


EXAMPLES FOR OPTICAL SHUTTER DESIGN

When design the optical shutter of rotator, please refer to the followings.

Unit in mm

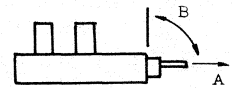


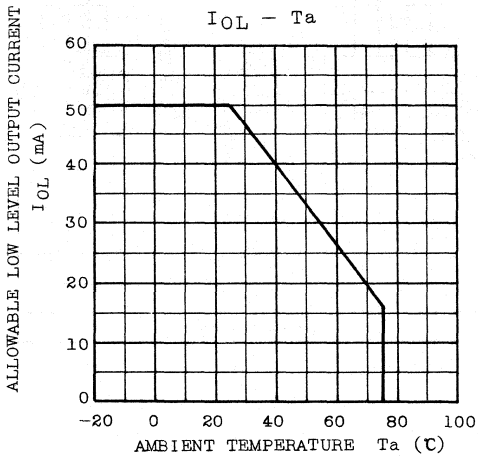


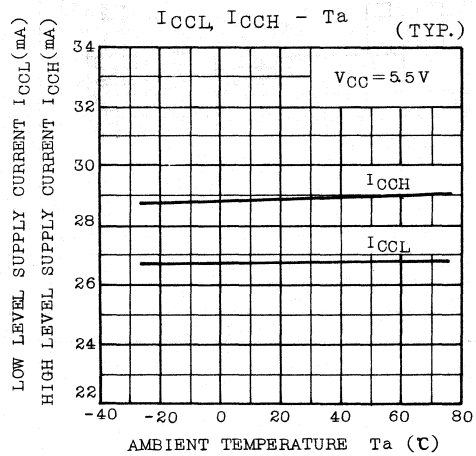
A — A' CROSS SECTION

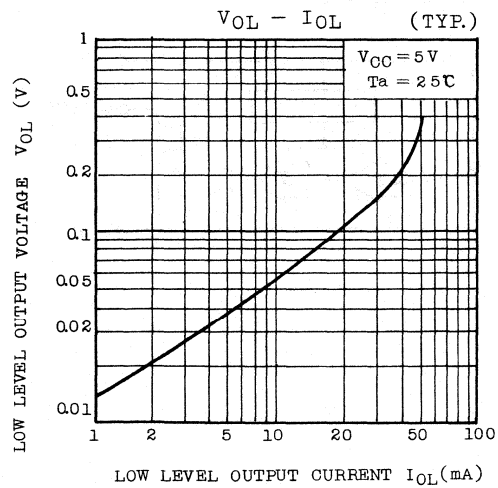
TERMINAL STRENGTH

CHARACTERISTIC	TEST CONDITION		LIMIT
PULL	DIRECTION	A	NO DEFECT OF ELECTRICAL CHARACTERISTICS
	WEIGHT	2kg	
	TIME	5sec/ONCE	
BEND	DIRECTION	B	
	WEIGHT	1kg	
	TIME	5sec/THRICE	





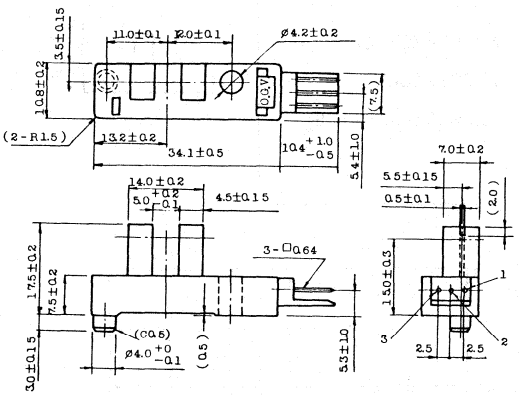




OUTLINE

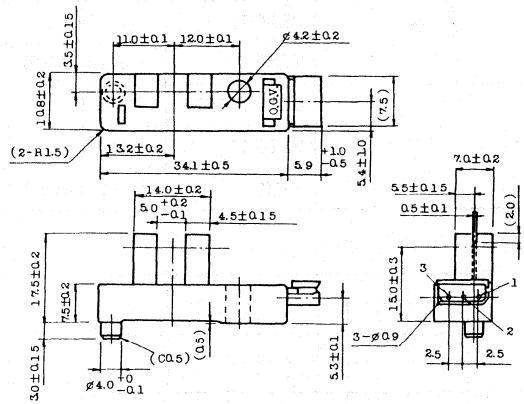
Unit in mm

TLP1201



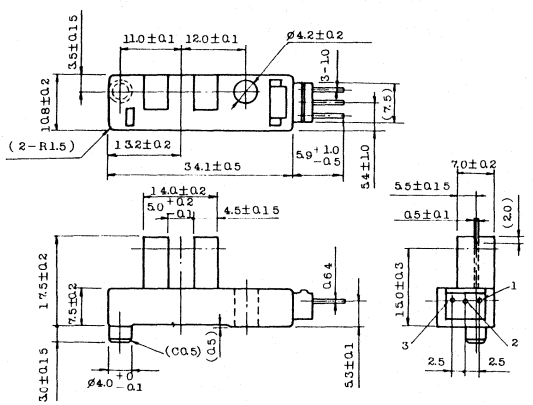
JEDEC	—
EIAJ	—
TOSHIBA	11 – 14C2

TLP1201(C1)



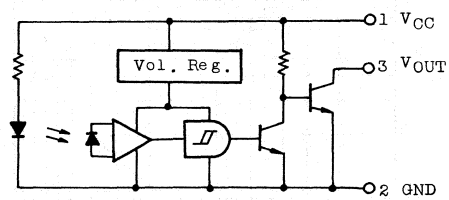
JEDEC	—
EIAJ	—
TOSHIBA	11 – 14C3

TLP1201(C2)



JEDEC	—
EIAJ	—
TOSHIBA	11 – 14C4

PIN CONNECTION



o TIMING SENSOR FOR COPIER AND FACSIMILE AND ELECTRONIC PRINTER

o EDGE SENSOR, OPTOELECTRONIC SWITCHES

TLP1203 contains a integrated circuit and a connector which is easy to connect another circuit.

High level output can be obtained if thelight beem between emitting and detecting sides is interrupted.

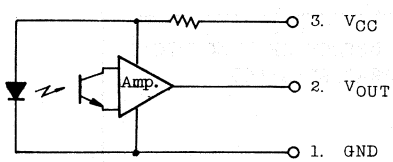
- Supply voltage : 5V (Typ.)
- Open collector output
- Wide gap between LED and detector : 5 mm
- High sensing accuracy : Slit width 0.5 mm
- Large output current : I_{OL} = 50mA (MAX.)
- Connector pin terminals facilitate the connection with external lead.
- Connector

  TLP1203 ..... 171826-3 (AMP Japan Ltd.)

  TLP1203(C1) ..... 171825-3 (AMP Japan Ltd.)
- Correspondable connector

HOUSING	TERMINAL
171822-3	170205-2 or 170204-2
172142-3	170370-1 or 170369-1

PIN CONNECTION



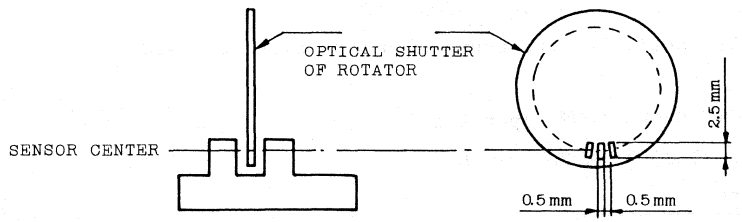
MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage	V_{CC}	30	V
Output Voltage	V_{OUT}	40	V
Low Level Output Current	I_{OL}	50	mA
Operating Temperature Range	T_{opr}	0 ∿ 85	°C
Storage Temperature Range	T_{stg}	-20 ∿ 95	°C

ELECTRICAL CHARACTERISTICS (Ta=25°C, V_{CC}=21 ∿ 26V)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}		21	24	26	V
Low Level Supply Current	I_{CCL}	Without Shutter	-	-	15	mA
High Level Supply Current	I_{CCH}	Shutter In	-	-	15	mA
Low Level Output Voltage	V_{OL}	Without Shutter, I_{OL}=16mA	-	0.06	0.4	V
High Level Output Voltage	V_{OH}	Shutter In, R_L=10kΩ, V_{CC}=26V	25.8	-	-	V
Frequency	f	R_L=1.5kΩ (NOTE)	1000	-	-	Hz

(NOTE): Test Figure of Frequency



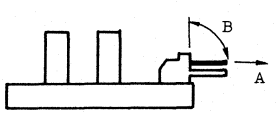
PRECAUTION

• Torque of nut : 6 kg·cm MAX.

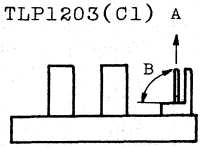
TERMINAL STRENGTH

CHARACTERISTIC	TEST CONDITION		LIMIT
PULL	DIRECTION	A	NO DEFECT OF ELECTRICAL CHARACTERISTICS
	WEIGHT	2 kg	
	TIME	5 sec/Once	
BEND	DIRECTION	B	
	WEIGHT	1 kg	
	TIME	5 sec/Thrice	

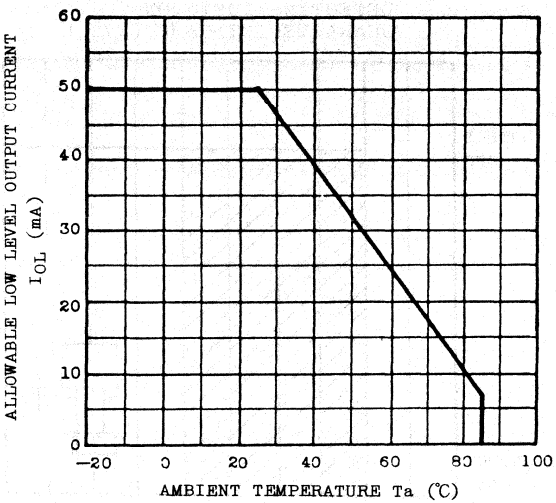
TLP1203



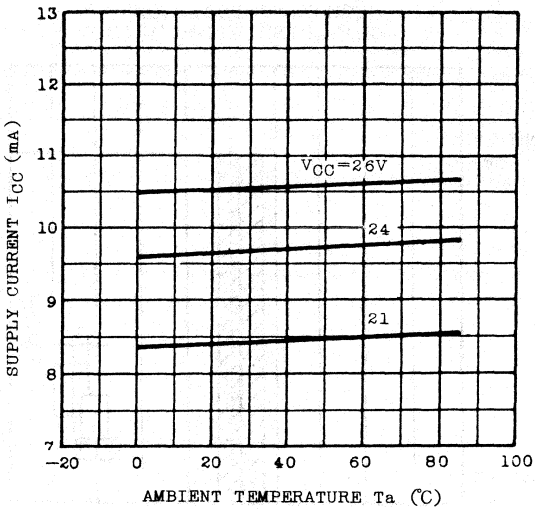
TLP1203(C1) A



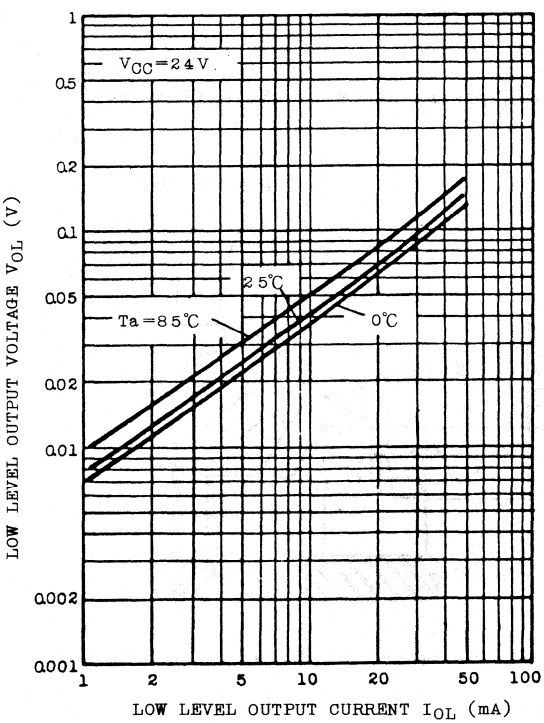
I_{OL} — Ta



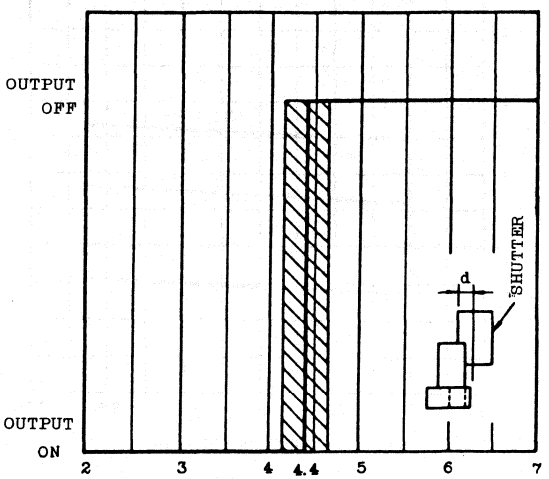
I_{CC} — Ta (TYP.)



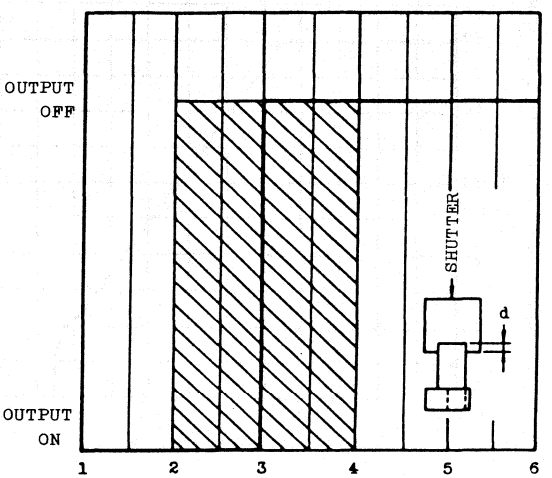
V_{OL} — I_{OL} (TYP.)



DETECTING POSITION CHARACTERISTICS (1) (TYP.)



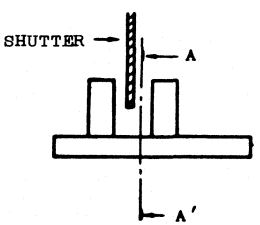
DETECTING POSITION CHARACTERISTICS (2) (TYP.)

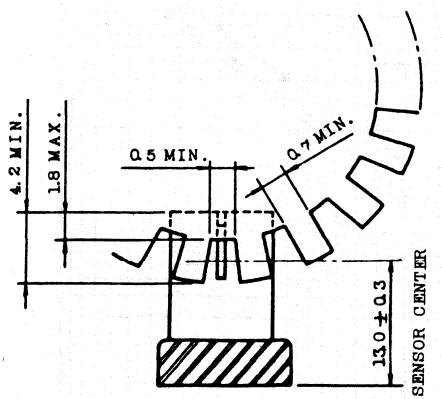


EXAMPLES FOR OPTICAL SHUTTER DESIGN

When design the optical shutter of rotator, please refer to the followings.

Unit in mm

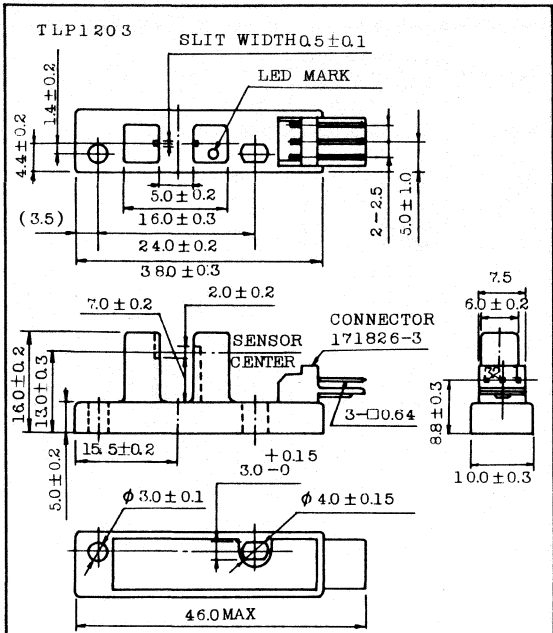




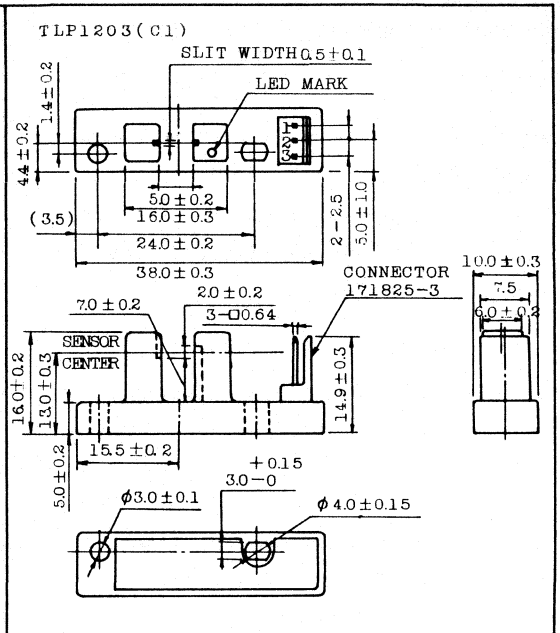
A – A' CROSS SECTION

OUTLINE

Unit in mm



JEDEC	–
EIAJ	–
TOSHIBA	11-16A1



JEDEC	–
EIAJ	–
TOSHIBA	11-16A2

TLP1204(C1)

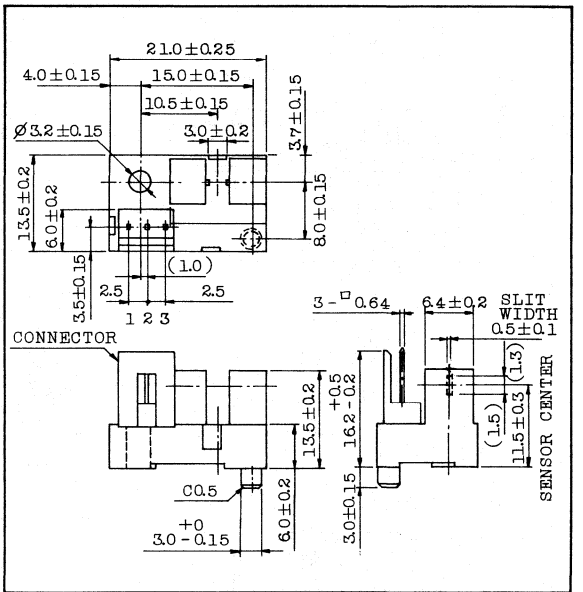
PHOTO INTERRUPTER
INFRARED LED + PHOTO IC

- TIMING SENSOR FOR COPIER AND FACSIMILE AND ELECTRONIC PRINTER.
- EDGE SENSOR, OPTOELECTRONIC SWITCHES.

TLP1204(C1) contains a integrated circuit and a connector which is easy to connect another circuit.
Low level output can be obtained if the light beem between emitting and detecting sides is interrupted.

- Supply Voltage : 5V(Typ.)
- Pull up Resistance 10kΩ output
- Gap Between LED and Detector: 3mm
- High Sensing Accuracy : Slit width 0.5mm
- Large Output Current : I_{OL}=50mA(Max.)
- Connector Pin Terminals Facilitate the Connection with External Lead.
- Visible Light Cut-off Type.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11-21A2

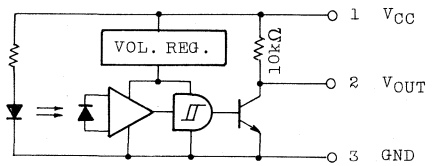
CONNECTOR

171825-3(AMP Japan Ltd.)

CORRESPONDABLE CONNECTOR

HOUSING	TERMINAL
171822-3	170205-2 or 170204-2
172142-3	170370-1 or 170369-1

PIN CONNECTION



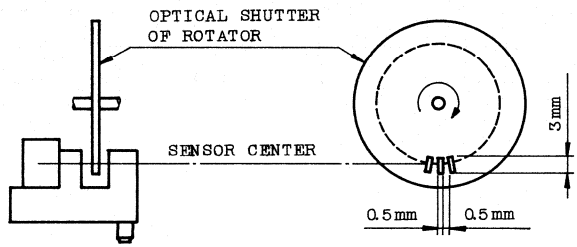
MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage	V_{CC}	6	V
Output Voltage	V_{OUT}	V_{CC}+0.5	V
Low Level Output Current	I_{OL}	50	mA
Operating Temperature Range	T_{opr}	-25~75	°C
Storage Temperature Range	T_{stg}	-40~85	°C

ELECTRICAL CHARACTERISTICS (Ta=25°C, V_{CC}=5±0.5V)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}		4.5	5	5.5	V
Low Level Supply Current	I_{CCL}	Shutter In	-	-	35	mA
High Level Supply Current	I_{CCH}	Without Shutter	-	-	35	mA
Low Level Output Voltage	V_{OL}	Shutter In I_{OL}=16mA	-	-	0.4	V
High Level Output Voltage	V_{OH}	Without Shutter	V_{CC}×0.8	-	-	V
Frequency	f	$V_{OUT}=V_{CC}\times 0.8$ (Note)	2000	-	-	Hz

Note : Test Figure of Frequency



PRECAUTION

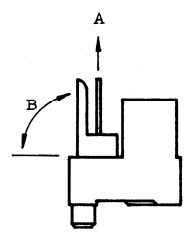
. Output voltage is irregular within 100μs after V_{CC} turn on. The reason is stability opto-integrated circuit.

. Pin surge voltage: 150V MAX. at C=200pF, 2 terminals at will.

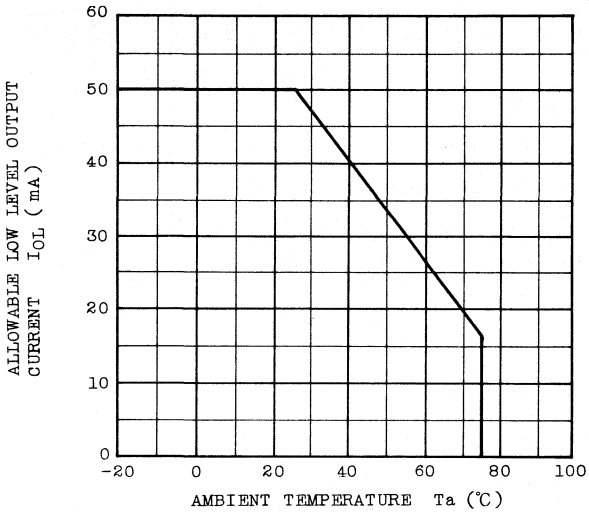
. Torgue of nut: 6kg·cm MAX.

TERMINAL STRENGTH

CHARACTERISTIC	TEST CONDITION		LIMIT
Pull	Direction	A	No defect of electrical characteristics.
	Weight	2kg	
	Time	5sec/once	
Bend	Direction	B	
	Weight	1kg	
	Time	5sec/thrice	

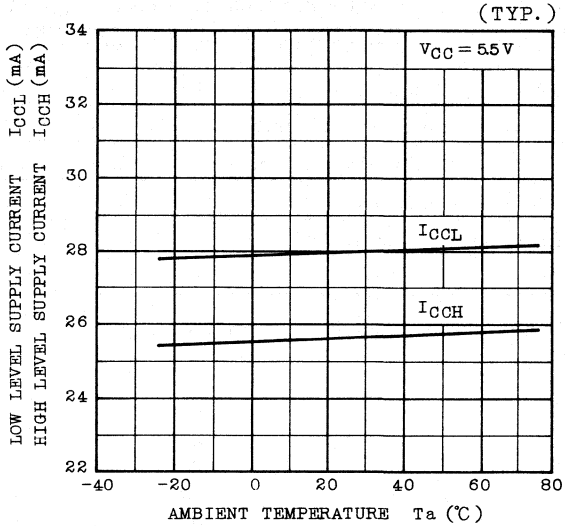


I_{OL} – Ta



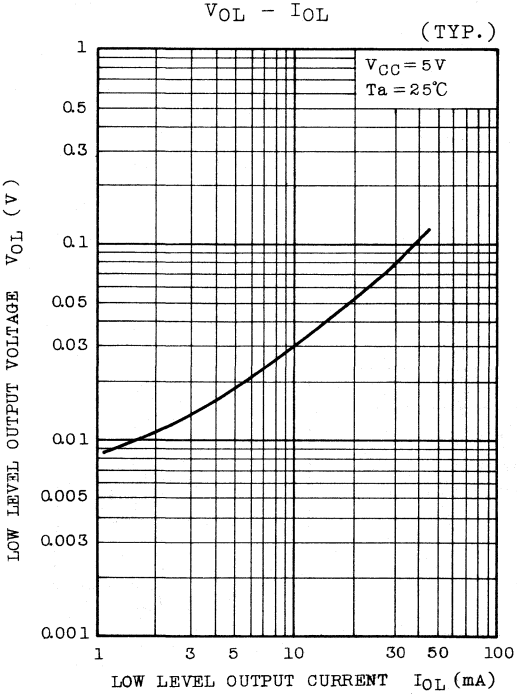
I_{CCL}, I_{CCH} – Ta

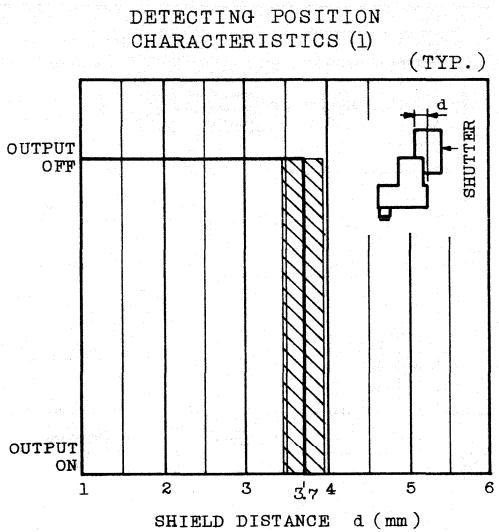
(TYP.)

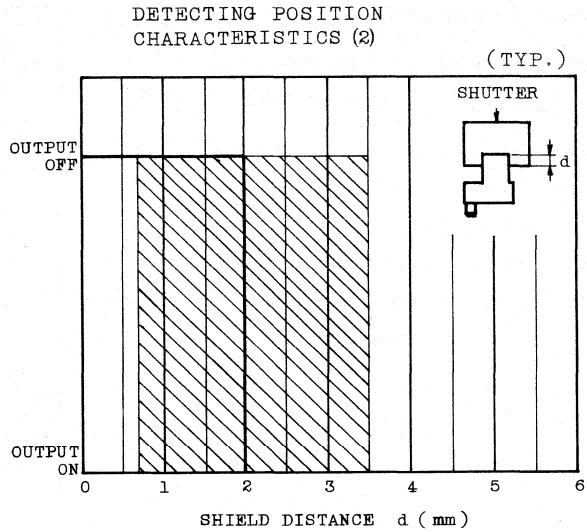


V_{OL} – I_{OL}

(TYP.)



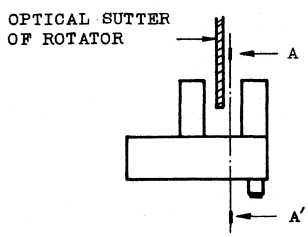


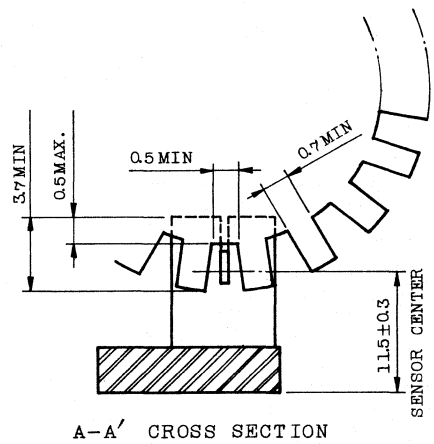


EXAMPLES FOR OPTICAL SHUTTER DESIGN

When disgn the optical shutter of rotator, please refer to the followings.

Unit in mm





A-A' CROSS SECTION

TLP1205

PHOTO INTERRUPTER
INFRARED LED + PHOTO IC

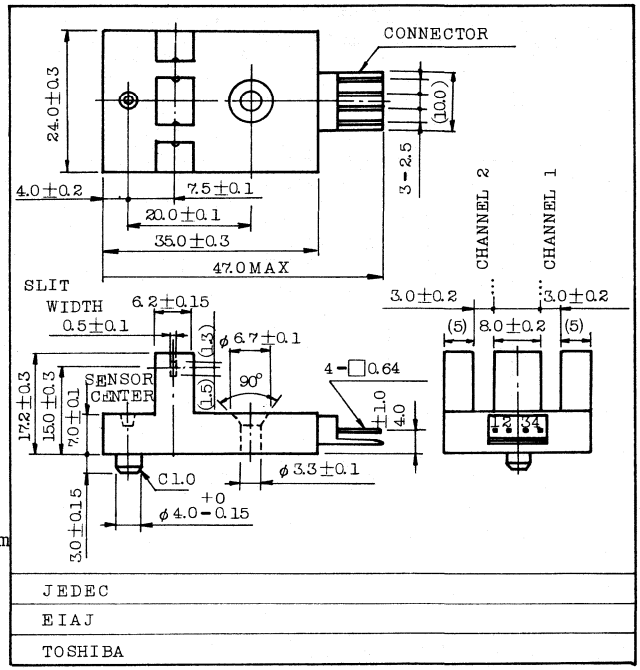
- TIMING SENSOR FOR COPIER AND FACSIMILE AND ELECTRONIC PRINTER.
- EDGE SENSOR, OPTOELECTRONIC SWITCHES.

TLP1205 contains a integrated circuit and a connector which is easy to connect another circuit.

Low level output can be obtained if the light beem between emitting and detecting sides is interrupted.

- 2 channel type.
- Supply voltage: 5V (Typ.)
- Pull up resistance 10kΩ output
- Gap between LED and detector : 3mm
- High sensing accuracy: slit width 0.5mm
- Large output current : I_{OL}=50mA (MAX.)
- Connector pin terminals facilitate the connection with external lead.
- Visible light cut-off type.

Unit in mm



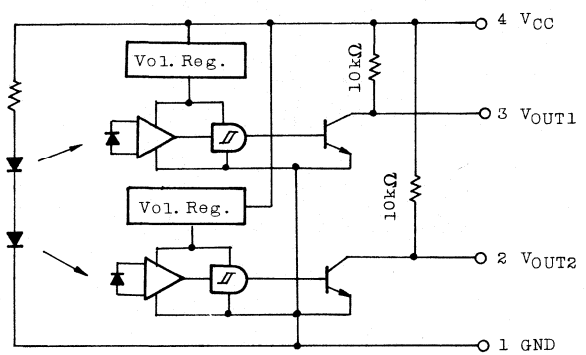
Connector

171824-4 (AMP Jappan Ltd.)

Correspondable connector

HOUSING	TERMINAL
171822-4	170205-2 or 170204-2
172142-4	170370-1 or 170369-1

PIN CONNECTION



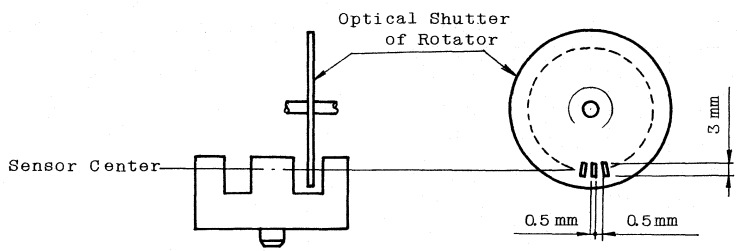
MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage	V_{CC}	6	V
Output Current	V_{OUT}	V_{CC}+0.5	
Low Level Output Current	I_{OL}	50	mA
Operating Temperature Range	T_{opr}	-25 ∿ 75	°C
Storage Temperature Range	T_{stg}	-40 ∿ 85	

ELECTRICAL CHARACTERISTICS (Ta=25°C, V_{CC}=5±0.5V)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}		4.5	-	5.5	V
Low Level Supply Current	I_{CCL}	Shutter In	-	-	65	mA
High Level Supply Current	I_{CCH}	Without Shutter	-	-	65	
Low Level Output Voltage 1	V_{OL1}	Shutter In, I_{OL}=16mA	-	-	0.4	V
Low Level Output Voltage 2	V_{OL2}	Shutter In, I_{OL}=16mA	-	-	0.4	
High Level Output Voltage 1	V_{OH1}	Without Shutter	V_{CC}×0.8	-	-	
High Level Output Voltage 2	V_{OH2}	Without Shutter	V_{CC}×0.6	-	-	
Frequency	f	V_{OUT}=V_{CC}×0.8 (NOTE)	2000	-	-	Hz

(NOTE) : Test Figure of Frequency

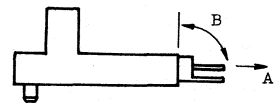


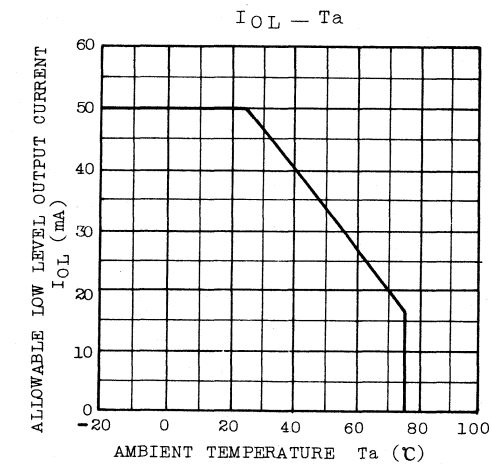
PRECAUTION

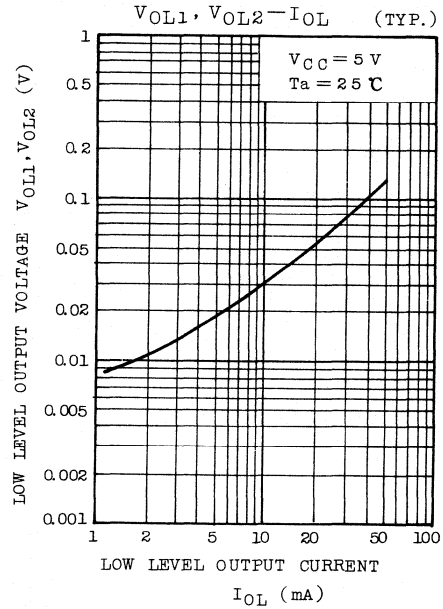
- Output voltage is irregular within 100μs after V_{CC} turn on. The reason is stability opto-integrated circuit.
- Pin surge voltage: 150V MAX. at C=200pF, 2 terminals at will.
- Torque of nut : 6 kg·cm MAX.

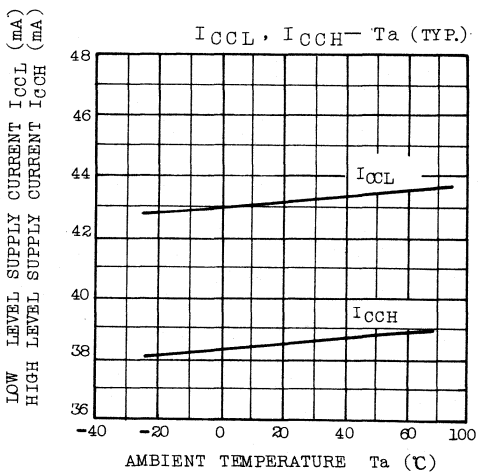
TERMINAL STRENGTH

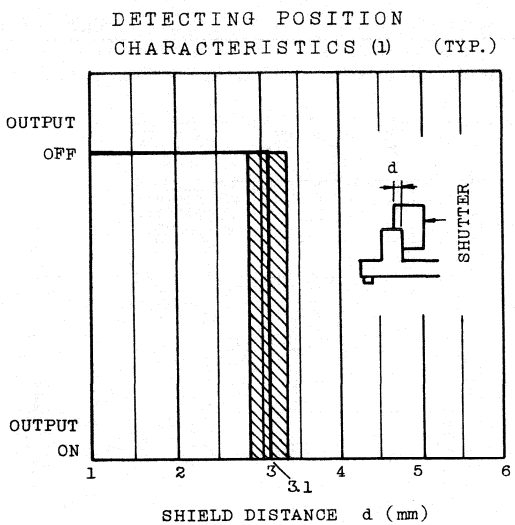
CHARACTERISTIC	TEST CONDITION		LIMIT
PULL	DIRECTION	A	NO DEFECT OF ELECTRICAL CHARACTERISTICS.
	WEIGHT	2 kg	
	TIME	5sec./ONCE	
BEND	DIRECTION	B	
	WEIGHT	1 kg	
	TIME	5sec./THRICE	

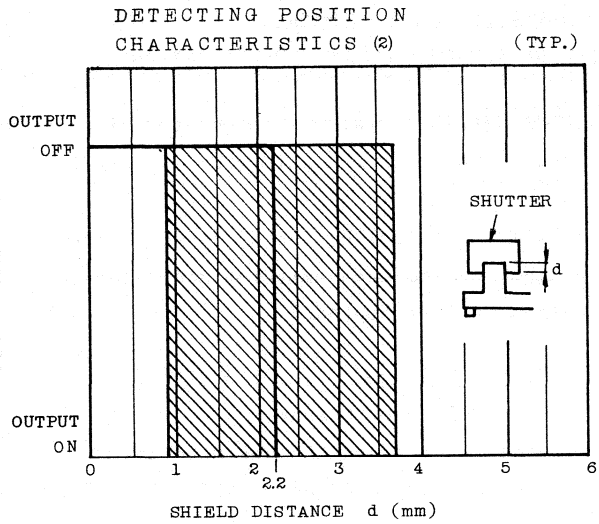






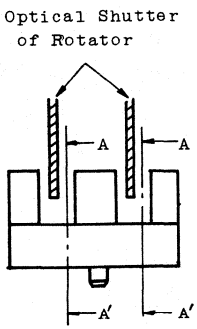


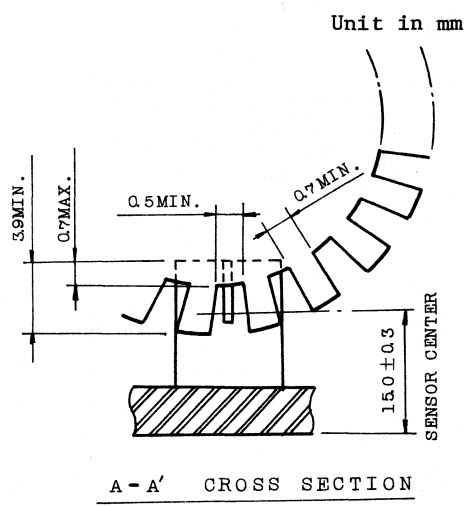




EXAMPLES FOR OPTICAL SHUTTER DESIGN

When design the optical shutter of rotator, please refer to the followings.





TLP1207(C2)

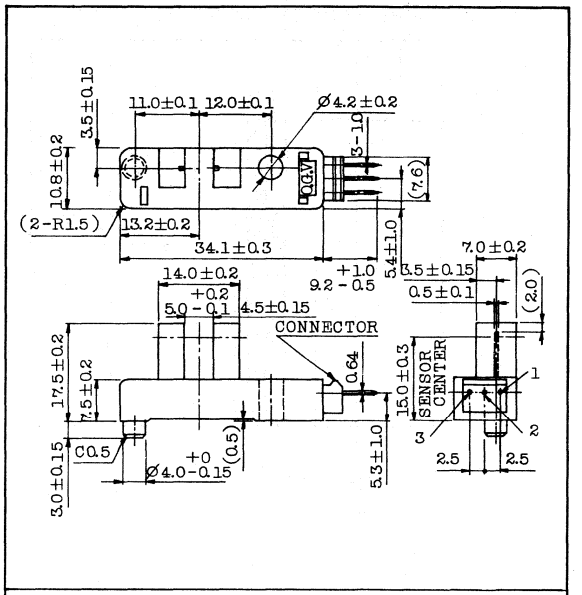
PHOTO INTERRUPTER
INFRARED LED + PHOTO IC

- o TIMING SENSOR FOR COPIER AND FACSIMILE AND ELECTRONIC PRINTER.
- o EDGE SENSOR, OPROELECTRONIC SWITCHES.

TLP1207(C2) contains a integrated circuit and a connector which is easy to connect another circuit.
Low level output can be obtained if the light beem between emitting and detecting sides is interrupted.

- . Supply Voltage : 5V(Typ.)
- . Open Collector Output
- . Wide Gap Between LED and Detector
- . High Sensing Accuracy : slit width 0.5mm
- . Large Output Current : I_{OL}=50mA(Max.)
- . Connector Pin Terminals Facilitate the Connection with External Lead.
- . Visible Light Cut-off Type.

Unit in mm



JEDEC
EIAJ
TOSHIBA

CONNECTOR

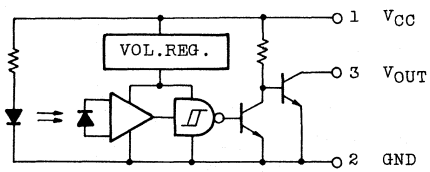
B3P-SHF-1AA (Japan solderless terminal MFG.)

CORRESPONDABLE CONNECTOR

HOUSING : H3P-SHF-AA

TERMINAL : SHF-001T-0.8BS or SHF-002T-0.8BS

PIN CONNECTION



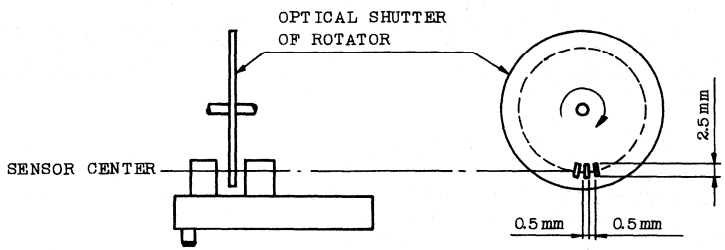
MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage	V_{CC}	6	V
Output Voltage	V_{OUT}	28	V
Low Level Output Current	I_{OL}	50	mA
Operating Temperature Range	T_{opr}	-25~75	°C
Storage Temperature Range	T_{stg}	-40~85	°C

ELECTRICAL CHARACTERISTICS (Ta=25°C, V_{CC}=5±0.5V)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}		4.5	5	5.5	V
Low Level Supply Current	I_{CCL}	Shutter In	-	-	35	mA
High Level Supply Current	I_{CCH}	Without Shutter	-	-	35	mA
Low Level Output Voltage	V_{OL}	Shutter In, I_{OL}=16mA	-	-	0.35	V
High Level Output Voltage	V_{OH}	Without Shutter R_L=47kΩ	V_{CC}×0.8	-	-	V
Frequency (Note)	f	V_{OUT}=V_{CC}×0.8, R_L=47kΩ	3000	-	-	Hz

Note : Test Figure of Frequency



PRECAUTION

. Output voltage is irregular within 100μs after V_{CC} turn on. The reason is stability opto-integrated circuit.

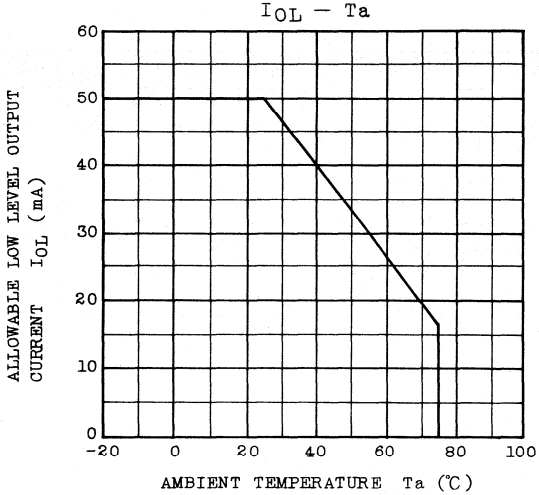
. Pin sarge voltage : 150V MAX. at C=200pF, 2 terminals at will.

. Torque of nut : 6kg·cm MAX.

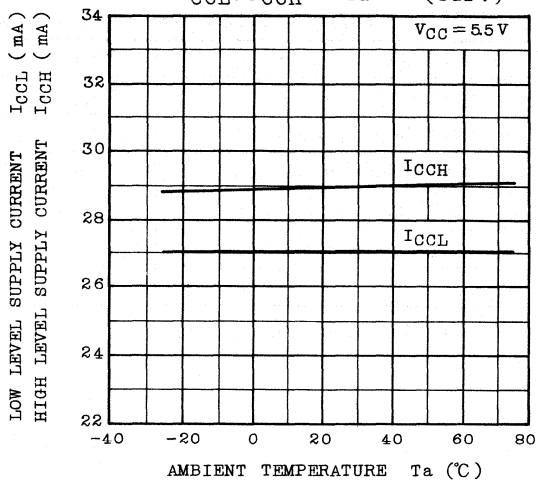
TERMINAL STRENGTH

CHARACTERISTIC	TEST CONDITION		LIMIT
Pull	Direction	A	No defect of electrical characteristics.
	Weight	2kg	
	Time	5sec. once	
Bend	Direction	B	
	Weight	1kg	
	Time	5sec./thrice	

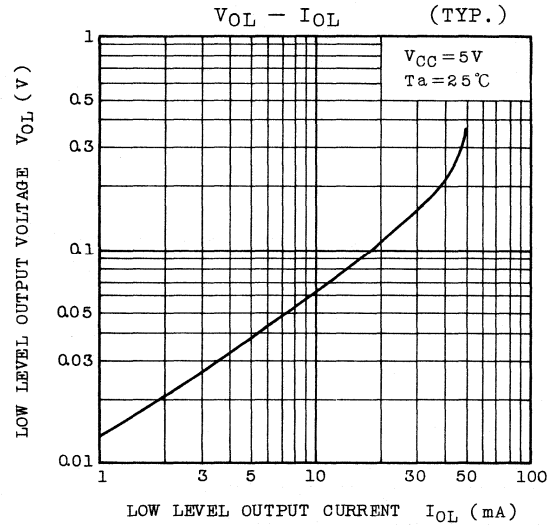
I_{OL} – Ta



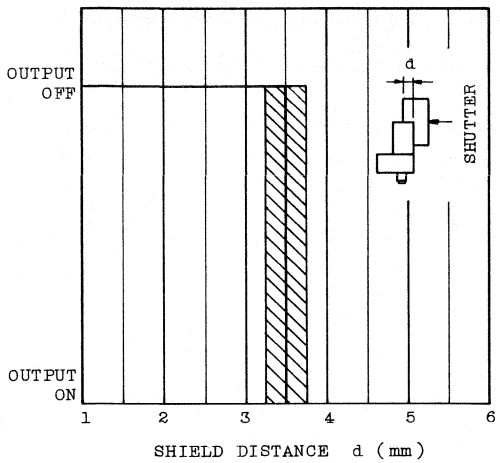
I_{CCL}, I_{CCH} – Ta (TYP.)



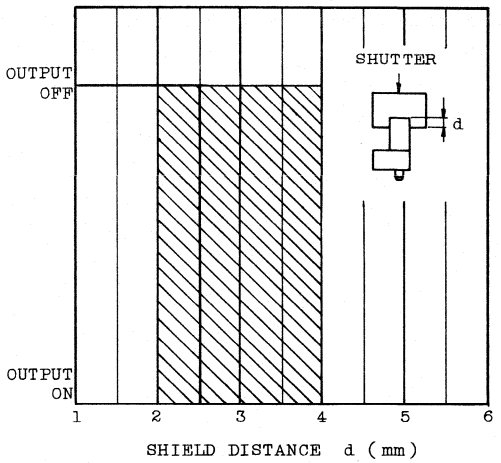
V_{OL} – I_{OL} (TYP.)



DETECTING POSITION CHARACTERISTICS (1) (TYP.)



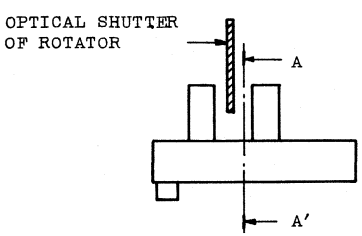
DETECTING POSITION CHARACTERISTICS (2) (TYP.)

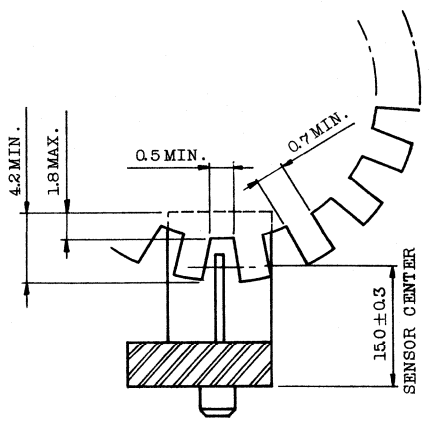


EXAMPLES FOR OPTICAL SHUTTER DESIGN

When design the optical shutter of rotator, please refer to the followings.

Unit in mm





A – A′ CROSS SECTION

■ Photo Reflective Sensor

* New Product
** Under Development

PHOTO REFLECTIVE SENSOR
INFRARED LED + PHOTO DARLINGTON TRANSISTOR

TLP903

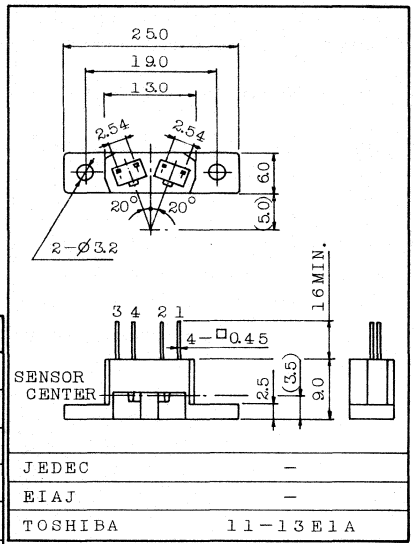
TENTATIVE

HIGH SENSITIVE OPTICALLY REFLECTIVE SENSOR

- OPTICAL SWITCH
- TAPE EDGE SENSOR
- COPIER PAPER SENSOR

- High Sensitivity
- Non Sensitivity for Visible Light

OUTLINE AND DIMENSION Unit in mm



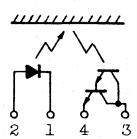
JEDEC	—
EIAJ	—
TOSHIBA	11-13E1A

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	50	mA
LED	Pulse Forward Current (Note 1)	I_{FP}	600	mA
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 Current	I_C	50	mA
DETECTOR	Collector Power Dissipation	P_C	75	mW
Operating Temperature Range		Topr	-25~85	°C
Storage Temperature Range		Tstg	-40~100	°C

Note 1 : Pulse width $\leqq 100\mu s$, Repetitive frequency=100Hz

PIN CONFIGURATIONS



1. CATHODE
2. ANODE
3. COLLECTOR
4. EMITTER

ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	-	1.15	1.30	V
LED	Reverse Current	I_F	V_R=5V	-	-	10	μA
LED	Term'nal Between Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	Dark Current	$I_D(I_{CEO})$	V_{CE}=16V, I_F=0	-	30	250	nA
COUPLED	Collector Current (Note 2)	I_C	V_{CE}=2V, I_F=10mA	200	1000	-	μA
COUPLED	Rise Time, Fall Time	t_r,tf	V_{CC}=5V, I_C=10mA R_L=100Ω	-	200	-	μs

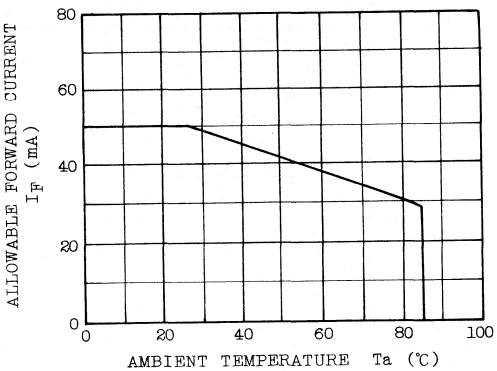
Note 2 : Reflective Efficiency 90% White Paper, Detective Distance 5mm.

PRECAUTION

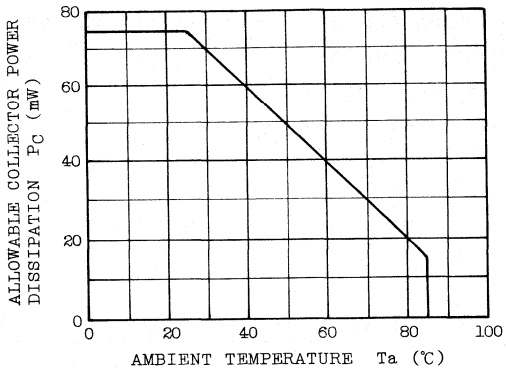
Please be careful of the followings.

1. Soldering temperature: 260°C MAX. Soldering time: 5 sec MAX.
   (Soldering portion of lead: up to 1.5mm from the body of the device)
2. If the lead is formed, Soldering shall be performed after lead forming.
3. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   o Freon TE or TF o Dai-Fron Solvents S3 or S3-E

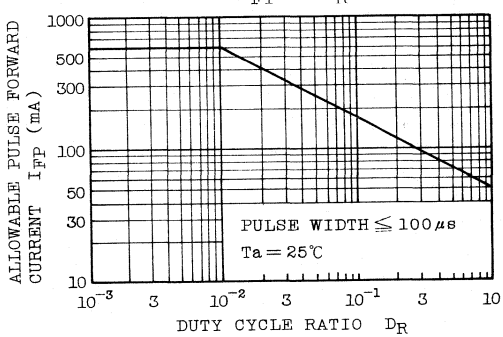
I_F — Ta



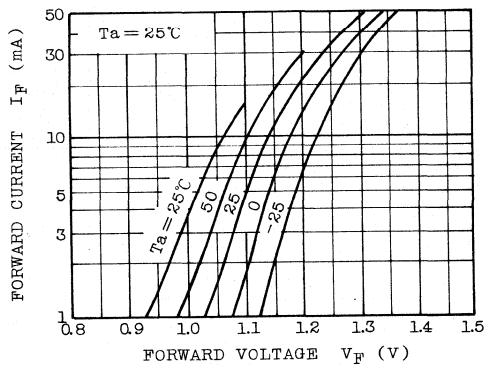
P_C — Ta



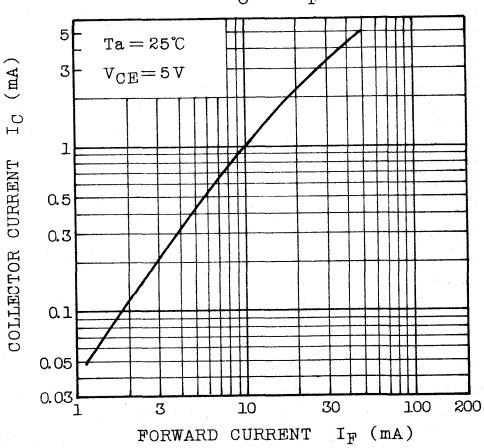
I_{FP} — D_R



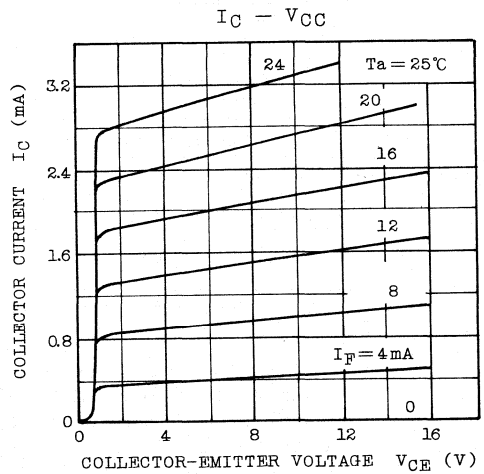
I_F — V_F



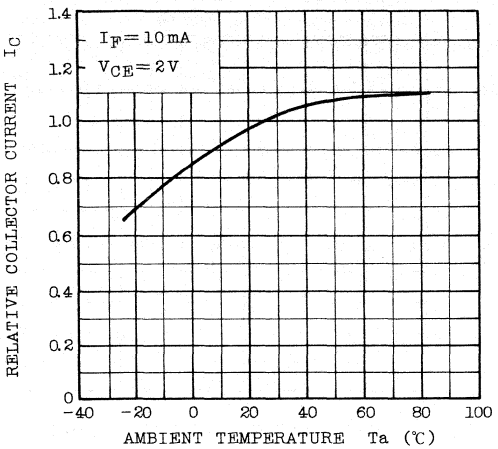
I_C — I_F



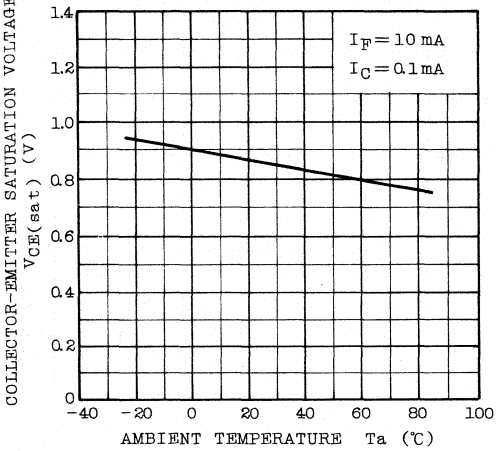
I_C — V_{CC}



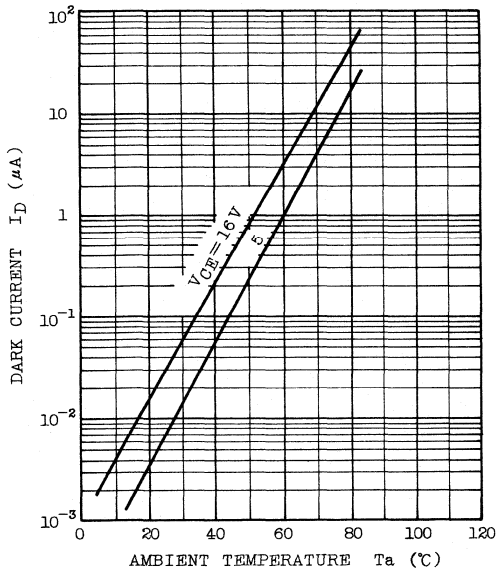
I_C — Ta



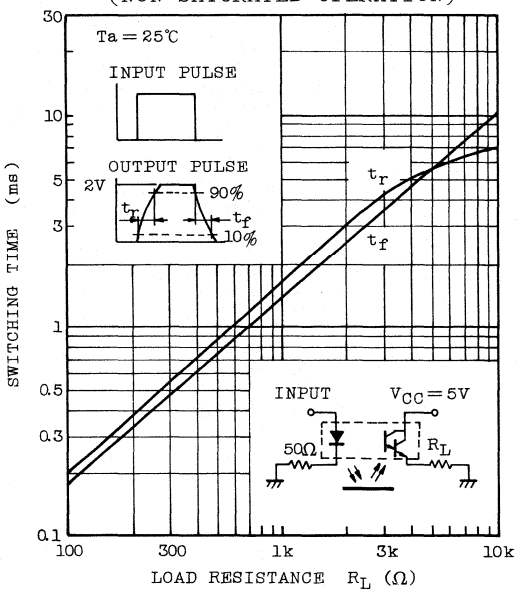
$V_{CE(sat)}$ — Ta



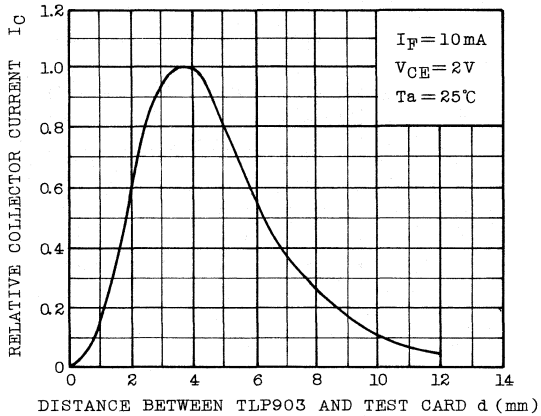
I_D — Ta



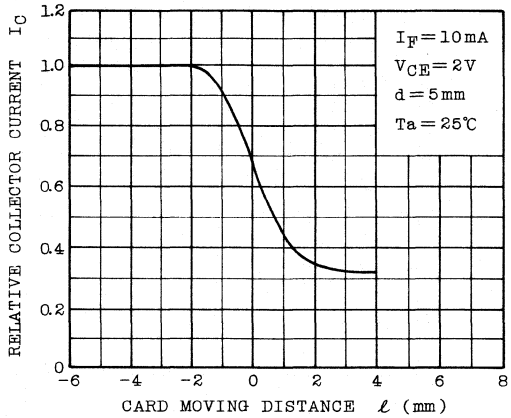
SWITCHING CHARACTERISTICS
(NON SATURATED OPERATION)

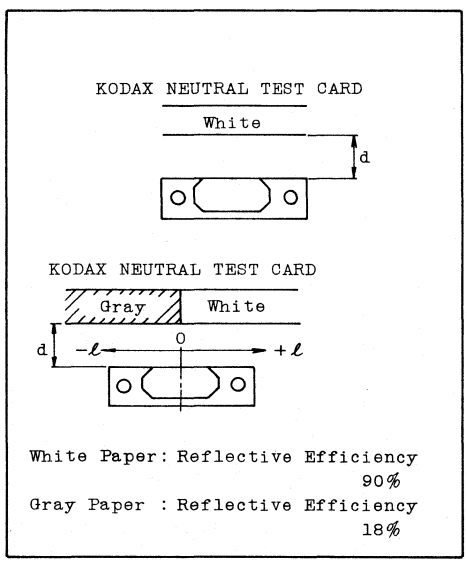


RELATIVE COLLECTOR CURRENT – DISTANCE BETWEEN TLP903 AND CARD



RELATIVE COLLECTOR CURRENT – CARD MOVING DISTANCE





White Paper: Reflective Efficiency 90%

Gray Paper : Reflective Efficiency 18%

PHOTO REFLECTIVE SENSOR
INFRARED LED + PHOTO TRANSISTOR

TLP904

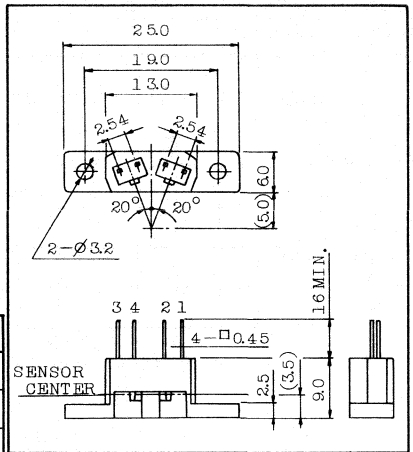
TENTATIVE

HIGH SENSITIVE OPTICALLY REFLECTIVE SENSOR

- OPTICAL SWITCH
- TAPE EDGE SENSOR
- COPIER PAPER SENSOR

- High Sensitivity
- Non Sensitivity for Visible Light

OUTLINE AND DIMENSION Unit in mm



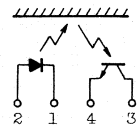
JEDEC	—
EIAJ	—
TOSHIBA	11-13E1A

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	50	mA
	Pulse Forward Current (Note 1)	I_{FP}	600	mA
	Reverse Voltage	V_R	5	V
DETECTOR	Collector-Emitter Voltage	V_{CEO}	30	V
	Emitter-Collector Voltage	V_{ECO}	5	V
	Collector Current	I_C	50	mA
	Collector Power Dissipation	P_C	75	mW
Operating Temperature Range		T_{opr}	-25~85	°C
Storage Temperature Range		T_{stg}	-40~100	°C

Note 1 : Pulse width $\leqq 100\mu s$, Repetitive frequency=100Hz

PIN CONFIGURATIONS



1. CATHODE
2. ANODE
3. COLLECTOR
4. EMITTER

ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	-	1.15	1.30	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Terminal Between Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	Dark Current	$I_D(I_{CEO})$	V_{CE}=24V, I_F=0	-	5	100	nA
COUPLED	Collector Current (Note 2)	I_C	V_{CE}=5V, I_F=20mA	70	200	-	μA
	Rise Time, Fall Time	t_r, t_f	V_{CC}=5V, I_C=2mA, R_L=100Ω	-	6	-	μs

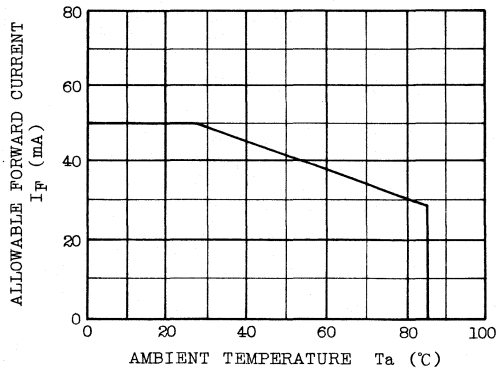
Note 2 : Reflective Efficiency 90% White Paper, Detective Distance 5mm.

PRECAUTION

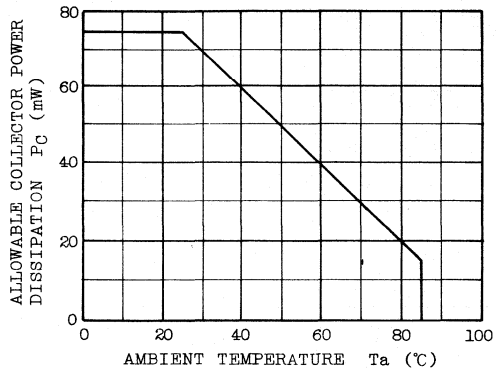
Please be careful of the followings.

1. Soldering temperature: 260°C MAX. Soldering time: 5 sec MAX.
   (Soldering portion of lead: up to 1.5mm from the body of the device)
2. If the lead is formed, Soldering shall be performed after lead forming.
3. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   o Freon TE or TF o Dai-Fron Solvents S3 or S3-E

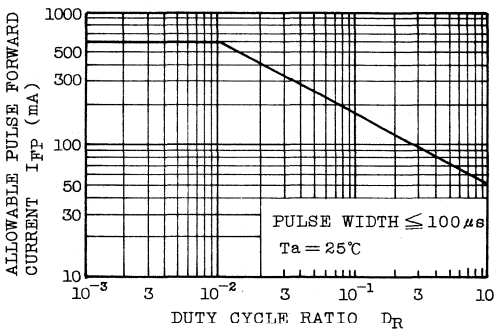
I_F — Ta



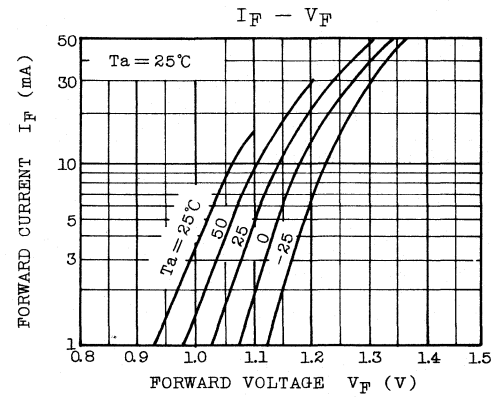
P_C — Ta



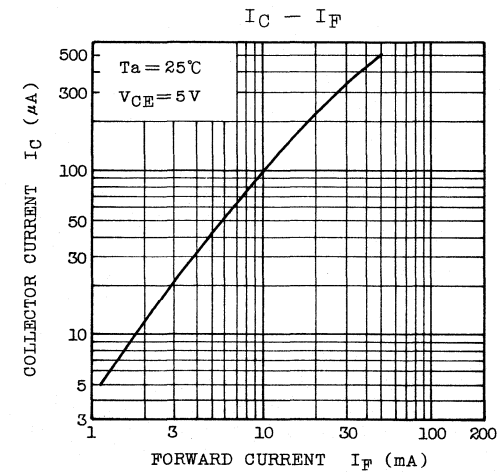
I_{FP} — D_R



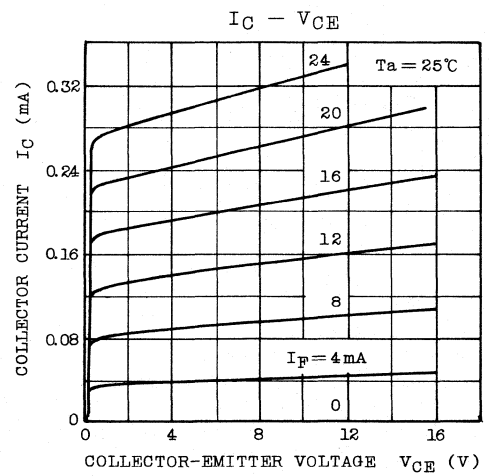
I_F — V_F



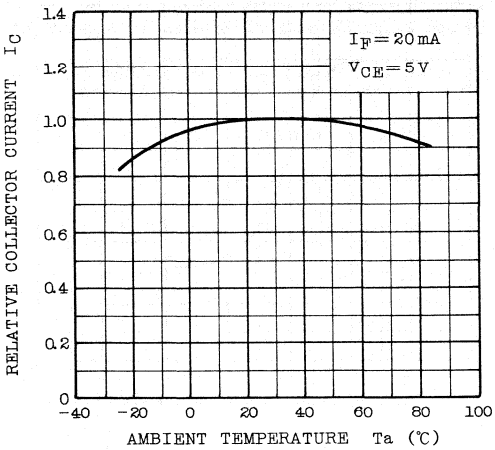
I_C — I_F



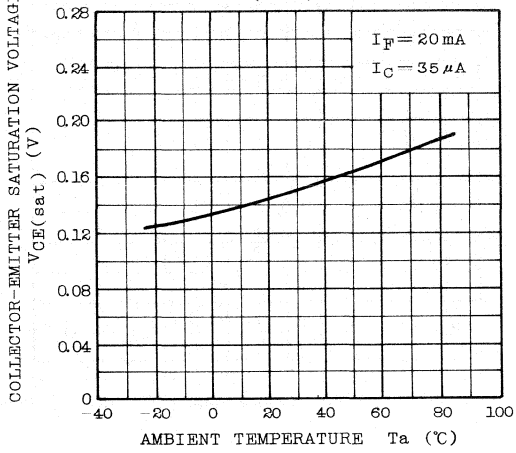
I_C — V_{CE}



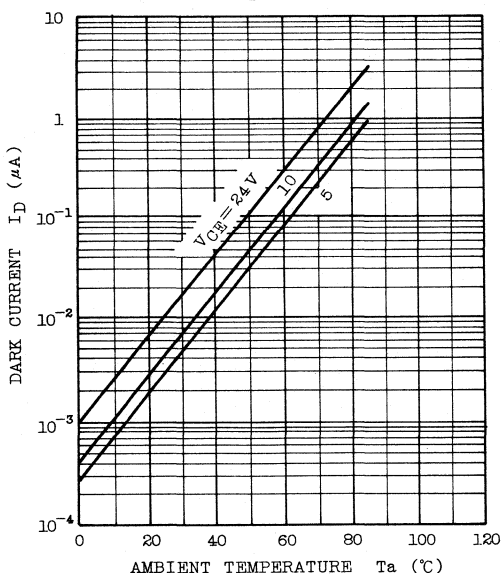
I_C — Ta



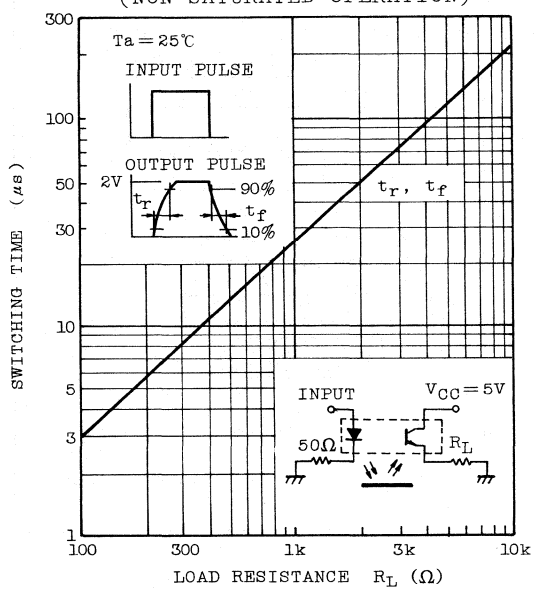
$V_{CE(sat)}$ — Ta



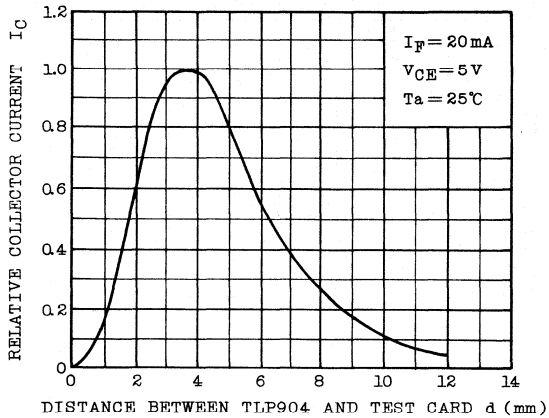
I_D — Ta



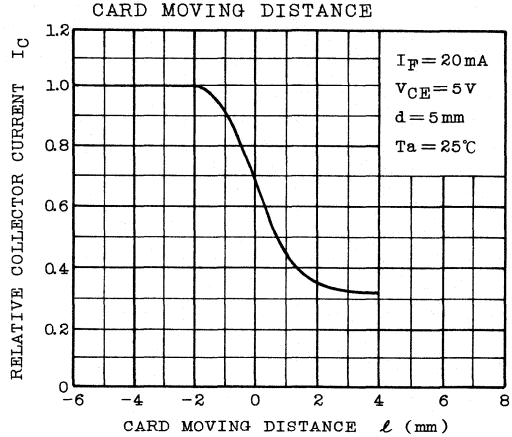
SWITCHING CHARACTERISTICS
(NON SATURATED OPERATION)

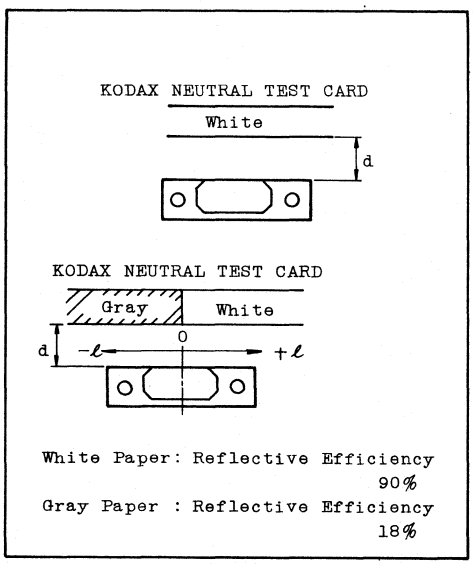


RELATIVE COLLECTOR CURRENT – DISTANCE BETWEEN TLP904 AND CARD



RELATIVE COLLECTOR CURRENT – CARD MOVING DISTANCE





White Paper: Reflective Efficiency 90%

Gray Paper : Reflective Efficiency 18%

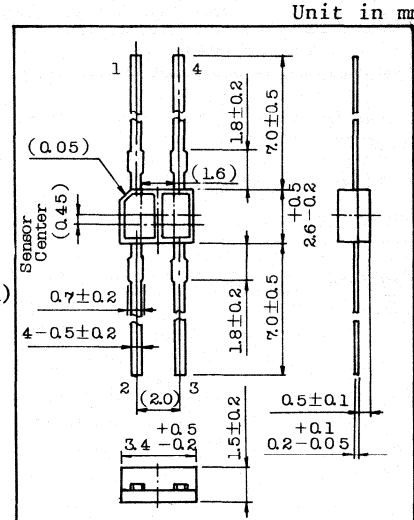
PHOTO REFLECTIVE SENSOR
INFRARED LED + PHOTO DARLINGTON TRANSISTOR

TLP907

- START AND END MARK SENSOR FOR VIDEO AND AUDIO TAPE RECORDER.
- REVOLUTION SENSOR IN THE REEL FOR VIDEO TAPE RECORDER. INEX SENSOR, WRITE PROTECT SENSOR, DISK IN SENSOR FOR FLOPPY DISK DRIVE.
- TIMING SENSOR FOR ELECTRONIC PRINTER AND TYPE WRITER.
- DX CORD READER FOR CAMERA

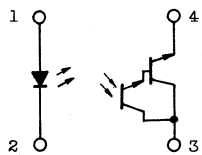
- Small Package Size : 2.6 × 3.4 mm (Height 1.5 mm)
- Optimal detection distance: 0.5 ∿ 1.5 mm
- High sensitivity : I_C=3 mA (Typ.)
- Visible light cut-off type

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11−4B1

PIN CONNECTION



1. ANODE
2. CATHODE
3. COLLECTOR
4. EMITTER

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	Foward Current	I_F	50	mA
	Pulse Forward Current (NOTE 1)	I_{FP}	400	
	Reverse Voltage	V_R	5	V
DETECTOR	Collector-Emitter Voltage	V_{CEO}	30	
	Emitter-Collector Voltage	V_{ECO}	5	
	Collector Power Dissipation	P_C	50	mW
	Collector Current	I_C	20	mA
Operating Temperature Range		T_{opr}	−25 ∿ 85	°C
Storage Temperature Range		T_{stg}	−30 ∿ 100	

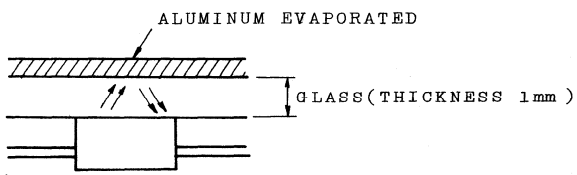
(NOTE 1): Pulse Width ≦ 100μs, Repetitive Frequency = 100Hz

ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage		V_F	I_F=10mA	1.00	1.15	1.30	V
	Reverse Current		I_R	V_R=5V	-	-	10	μA
	Capacitance		C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	Dark Current		$I_D(I_{CEO})$	V_{CE}=16V, I_F=0	-	-	0.25	μA
	Capacitance		C_T	V=0, f=1MHz	-	7	-	pF
COUPLED	Collector Current (NOTE 2)		I_C	V_{CE}=2V, I_F=4mA (NOTE 3)	0.5	3	15	mA
	Leakage Current		I_{LEAK}	V_{CE}=2V, I_F=4mA (NOTE 4)	-	-	0.25	μA
	Collector Emitter Saturation Voltage		$V_{CE(sat)}$	I_F=4mA, I_C=0.25mA	-	0.85	1.2	V
	Switching Time	Rise Time	t_r	V_{CC}=5V, I_C=10mA	-	100	-	μs
		Fall Time	t_f	R_L=100Ω	-	100	-	

(NOTE 2) I_C crassification R : 0.5∿1.9 mA, O : 1.45∿5.4 mA, Y : 4.5∿15 mA

(NOTE 3) TEST CONDITION



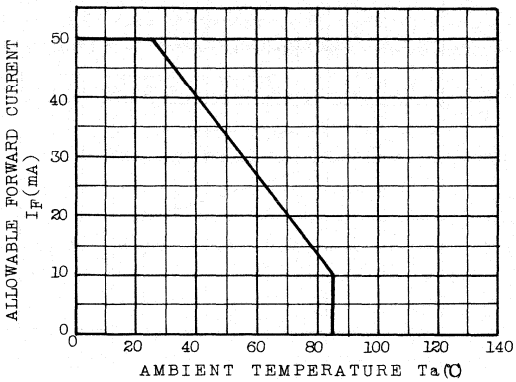
(NOTE 4) No Reflecting Surface

PRECAUTION

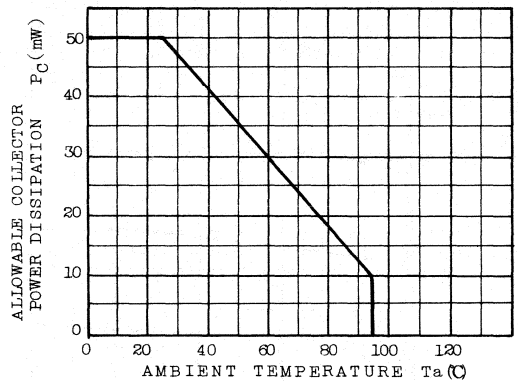
Please be careful of the followings.

1. Soldering temperature: 260°C MAX.
   Soldering time: 5 sec MAX.
   (Soldering portion of lead: up to 1.8mm from the body of the device.)
2. If the lead is formed, Soldering shall be performed after lead forming.
3. Avoid using the solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvent temperature: 45°C MAX.
   - Freon TE or TF
   - Dai-Fron Solvent S3 or S3-E

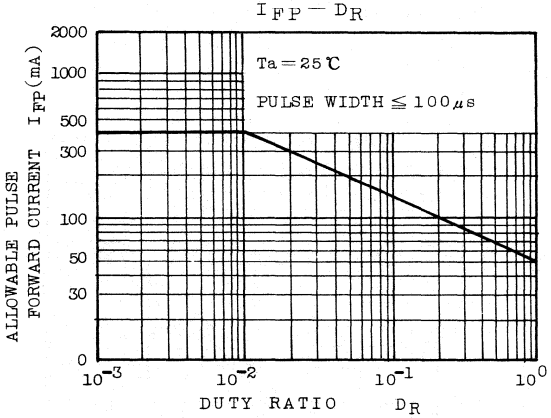
$I_F - T_a$



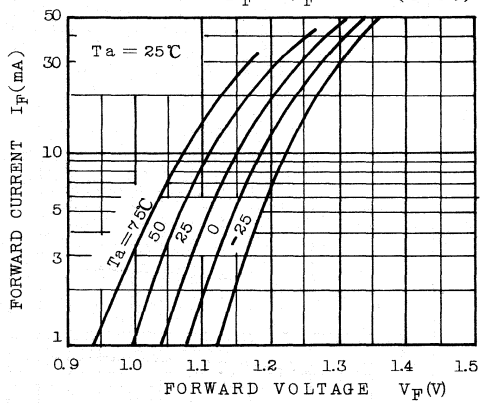
$P_C - T_a$



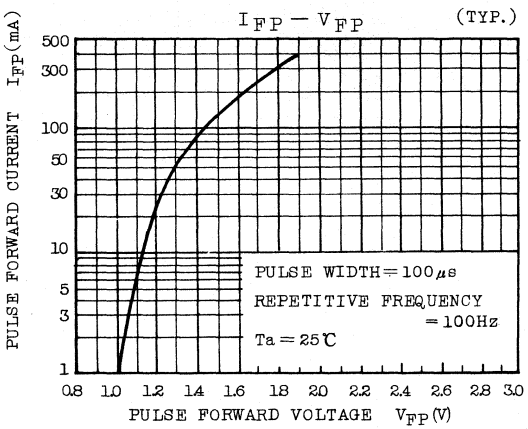
$I_{FP} - D_R$



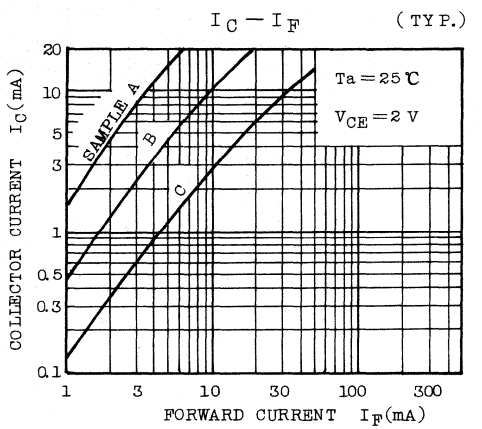
$I_F - V_F$ (TYP.)



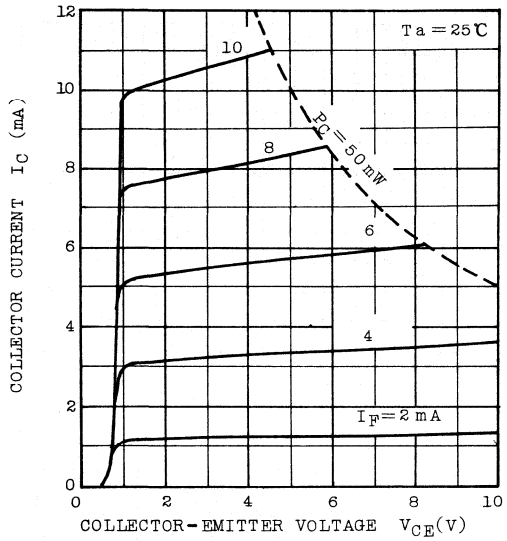
$I_{FP} - V_{FP}$ (TYP.)



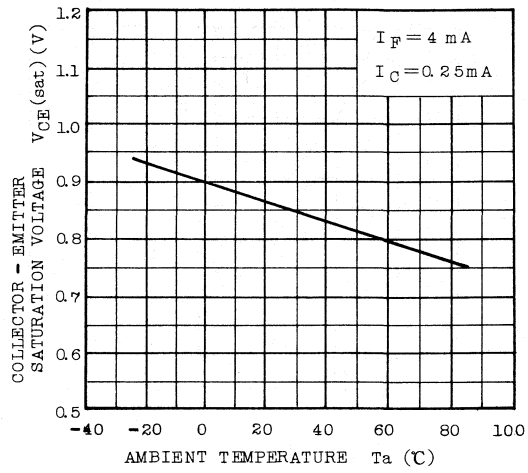
$I_C - I_F$ (TYP.)



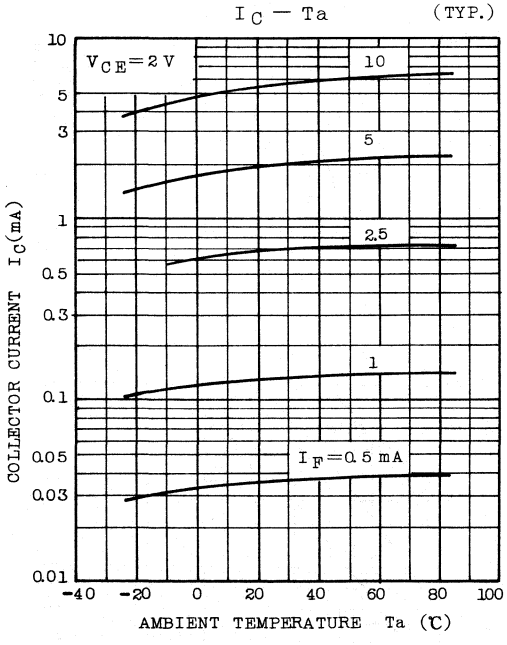
$I_C - V_{CE}$ (TYP.)



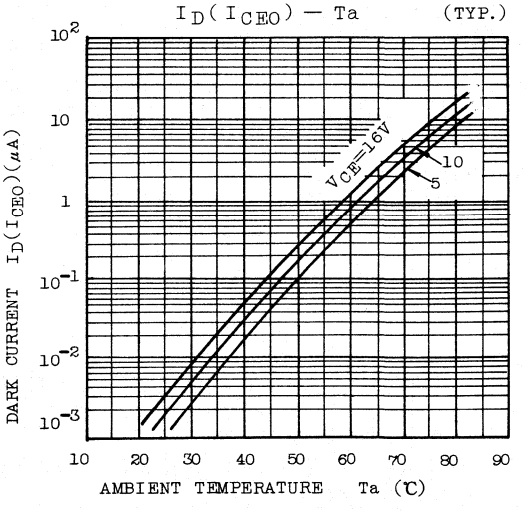
$V_{CE(sat)} - Ta$ (TYP.)



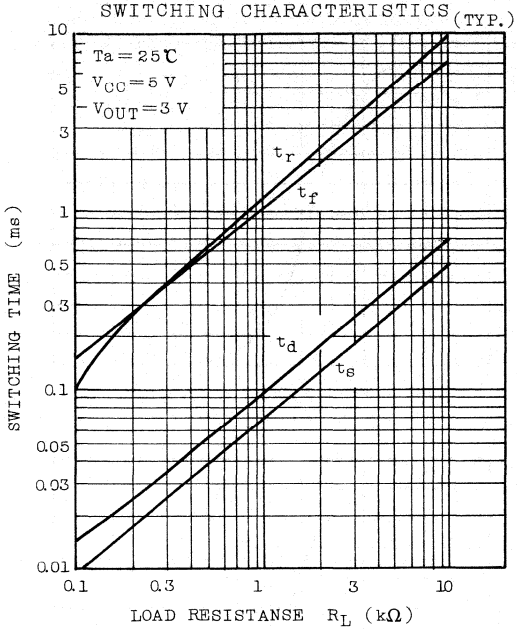
$I_C - Ta$ (TYP.)



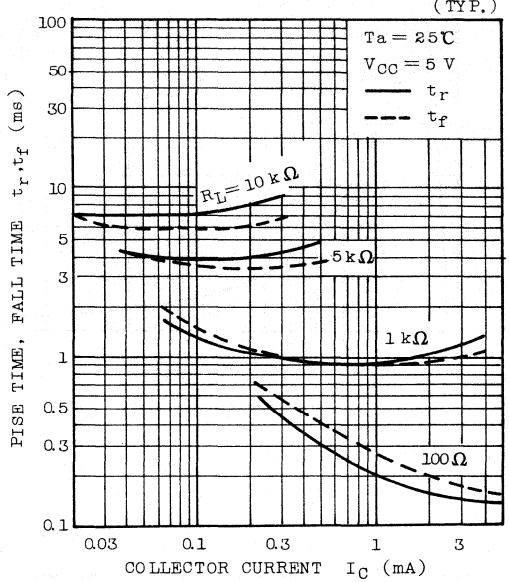
$I_D(I_{CEO}) - Ta$ (TYP.)



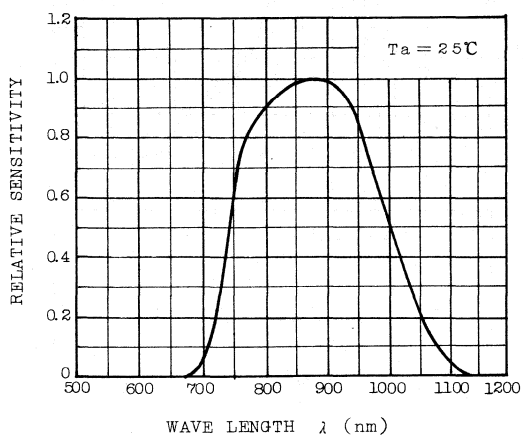
SWITCHING CHARACTERISTICS (TYP.)



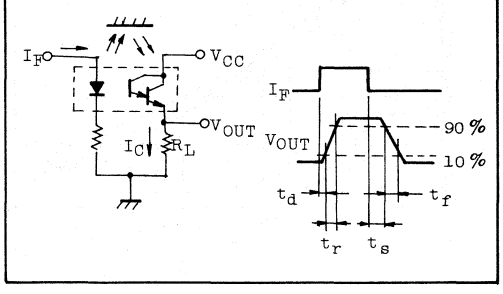
$t_r, t_f - I_C$ (TYP.)



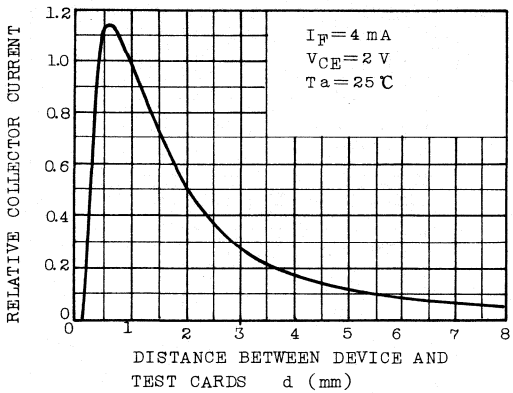
SPECTRAL RESPONSE (Tr) (TYP.)



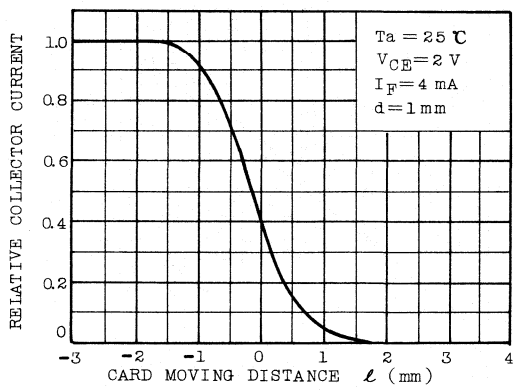
SWITCHING TIME TEST OIRCUIT



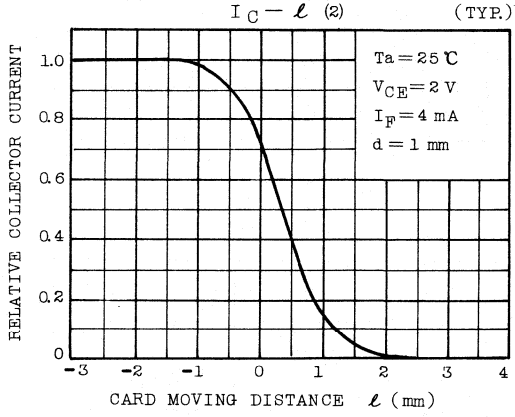
I_C — d (1) (TYP.)



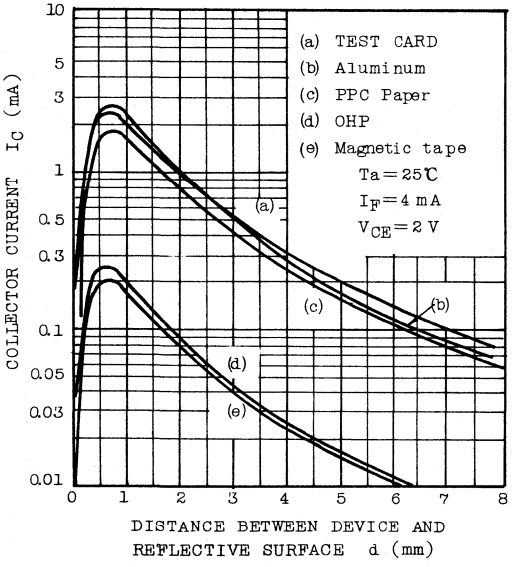
I_C — ℓ (1) (TYP.)



I_C — ℓ (2) (TYP.)

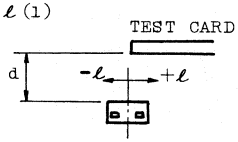


I_C — d (2) (TYP.)

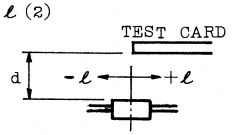


TEST CONDITION

I_C — ℓ (1)



I_C — ℓ (2)



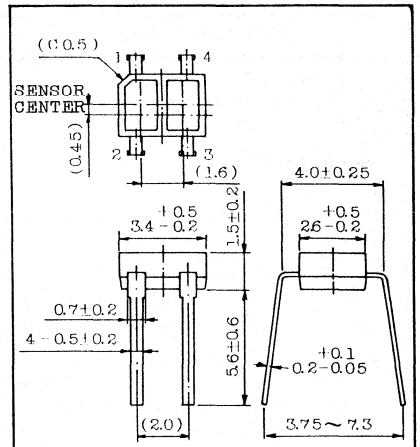
TEST CARD: KODAK NEUTRAL TEST CARD

PHOTO REFLECTIVE SENSOR
INFRARED LED + PHOTO DARLINGTON TRANSISTOR

TLP907(LB)

- START AND END MARK SENSOR FOR VIDEO AND AUDIO TAPE RECORDER.
- REVOLUTION SENSOR IN THE REEL FOR VIDEO TAPE RECORDER.
- INEX SENSOR, WRITE PROTECT SENSOR, DISK IN SENSOR FOR FLOPPY DISK DRIVE.
- TIMING SENSOR FOR ELECTRONIC PRINTER AND TYPE WRITER.
- DX CORD READER FOR CAMERA

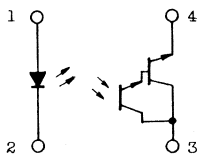
Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11-4B101

- Small Package Size : 2.6 × 3.4 mm (Height 1.5 mm)
- Optimal detection distance: 0.5 ∿ 1.5 mm
- High sensitivity : I_C=3 mA (Typ.)
- Visible light cut-off type

PIN CONNECTION



1. ANODE
2. CATHODE
3. COLLECTOR
4. EMITTER

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Foward Current	I_F	50	mA
LED	Pulse Forward Current (NOTE 1)	I_{FP}	400	mA
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	50	mW
DETECTOR	Collector Current	I_C	20	mA
Operating Temperature Range		T_{opr}	-25 ∿ 85	°C
Storage Temperature Range		T_{stg}	-30 ∿ 100	°C

(NOTE 1): Pulse Width ≦ 100μs, Repetitive Frequency = 100Hz

TLP907(LB)

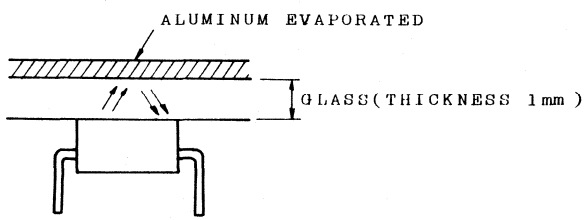
ELECTRICAL CHARACTERISTICS (Ta=25°C)

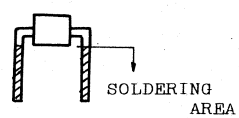
	CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage		V_F	I_F=10mA	1.00	1.15	1.30	V
	Reverse Current		I_R	V_R=5V	-	-	10	μA
	Capacitance		C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	Dark Current		$I_D(I_{CEO})$	V_{CE}=16V, I_F=0	-	-	0.25	μA
	Capacitance		C_T	V=0, f=1MHz	-	7	-	pF
COUPLED	Collector Current (NOTE 2)		I_C	V_{CE}=2V, I_F=4mA (NOTE 3)	0.5	3	15	mA
	Leakage Current		I_{LEAK}	V_{CE}=2V, I_F=4mA (NOTE 4)	-	-	0.25	μA
	Collector Emitter Saturation Voltage		$V_{CE(sat)}$	I_F=4mA, I_C=0.25mA	-	0.85	1.2	V
	Switching Time	Rise Time	t_r	V_{CC}=5V, I_C=10mA R_L=100Ω	-	100	-	μs
		Fall Time	t_f		-	100	-	

(NOTE 2) I_C crassification R : 0.5∿1.9 mA, O : 1.45∿5.4 mA, Y : 4.5∿15 mA

(NOTE 4) No Reflecting Surface

(NOTE 3) Test Condition





PRECAUTION

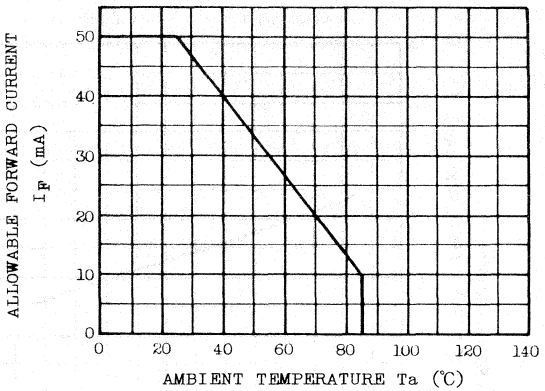
Please be careful of the followings.

1. Soldering temperature: 260°C MAX.
   Soldering time: 3 sec MAX.

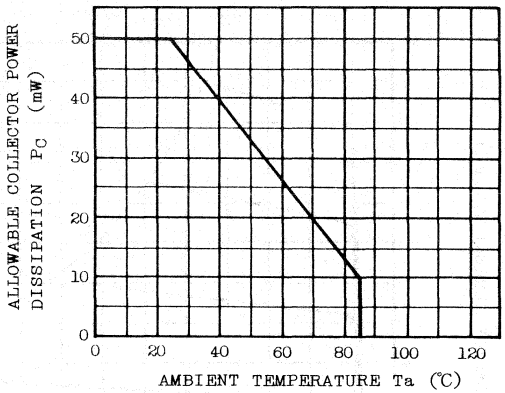
2. If the lead is formed, Soldering shall be performed after lead forming.

3. Avoid using the solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvent temperature: 45°C MAX.
   - Freon TE or TF
   - Dai-Fron Solvent S3 or S3-E

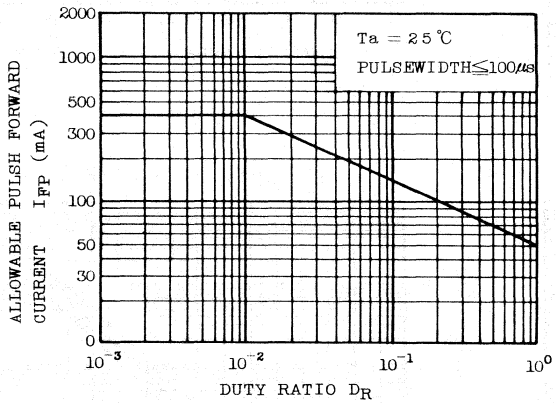
I_F – Ta



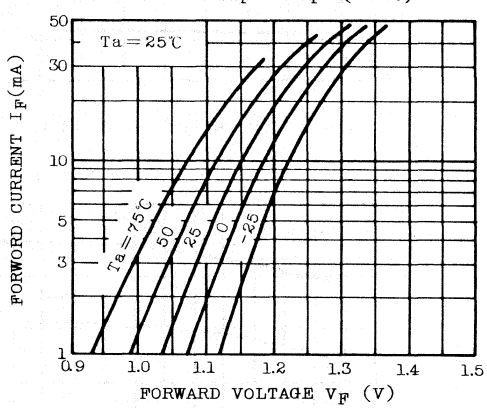
P_C – Ta



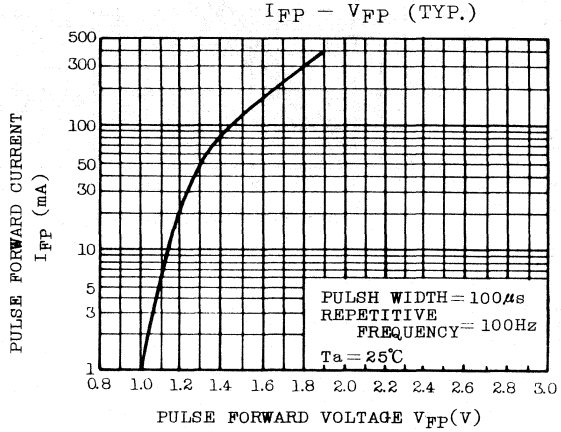
I_{FP} – D_R



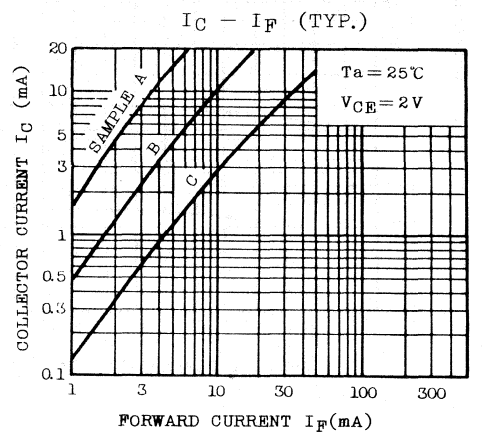
I_F – V_F (TYP.)



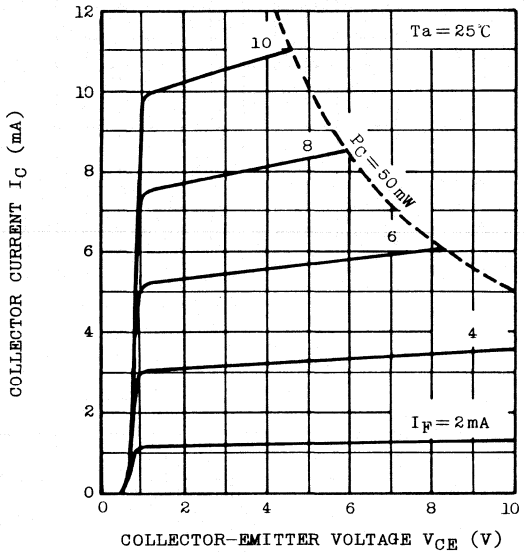
I_{FP} – V_{FP} (TYP.)



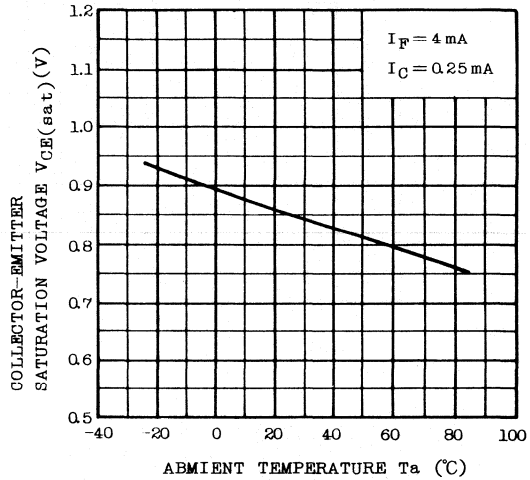
I_C – I_F (TYP.)



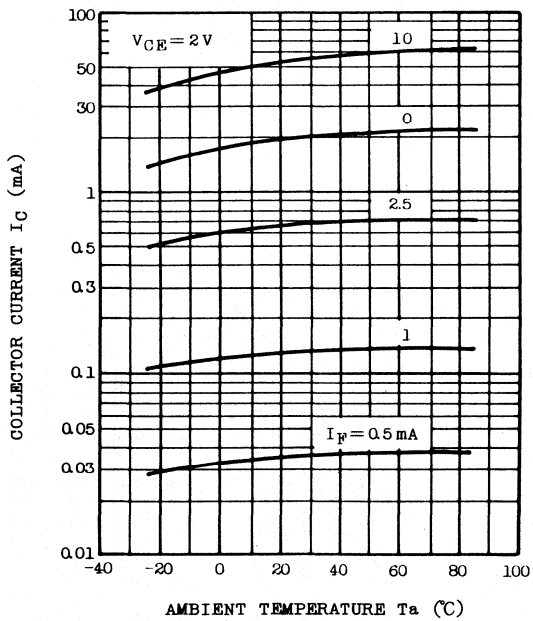
$I_C - V_{CE}$ (TYP.)



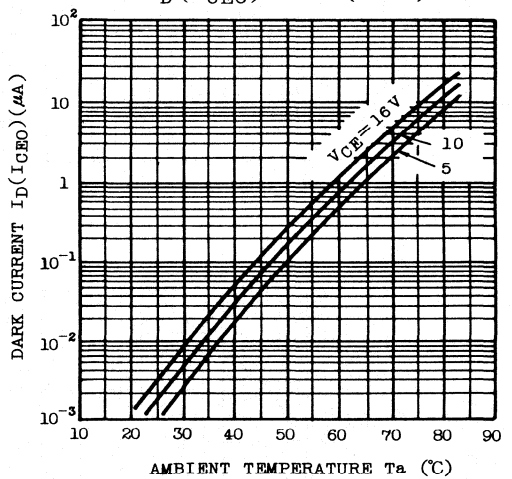
$V_{CE(sat)}$ – Ta (TYP.)



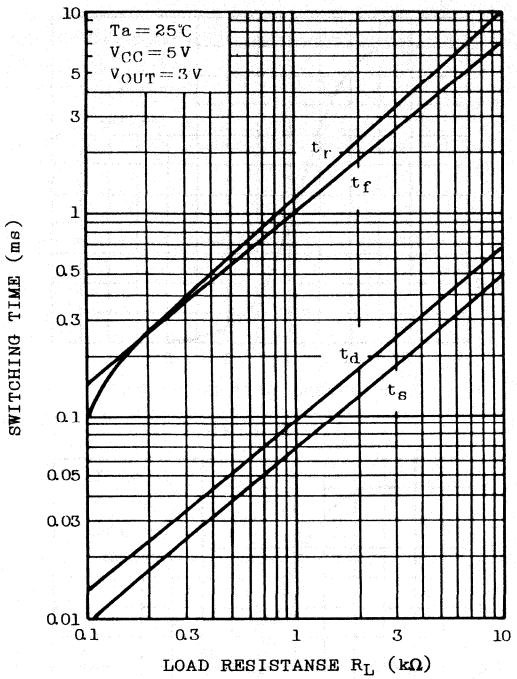
I_C – Ta (TYP.)



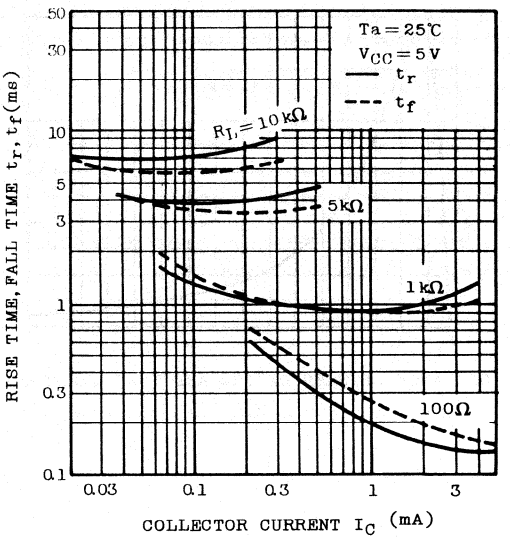
$I_D(I_{CEO})$ – Ta (TYP.)



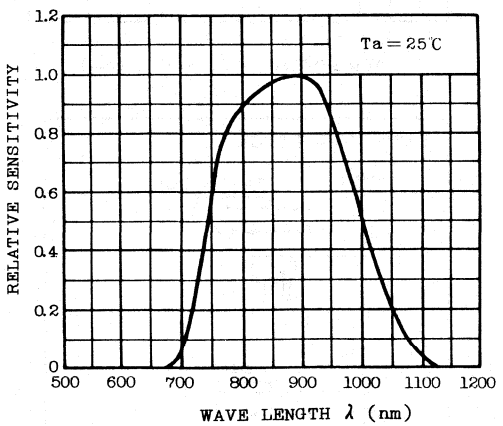
SWITCHING CHARACTERISTICS(TYP.)



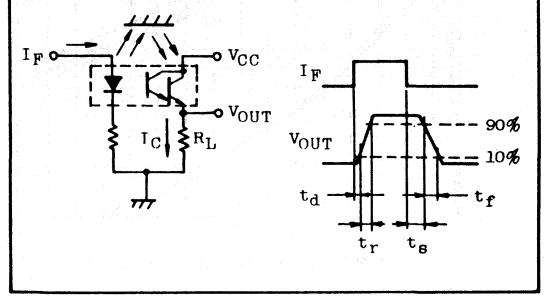
t_r , t_f – I_C (TYP.)



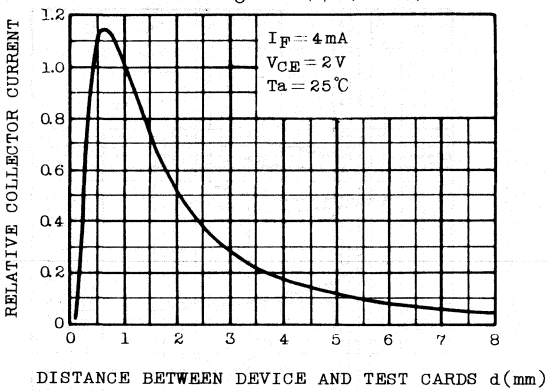
SPECTRAL RESPONSE(T_r) (TYP.)



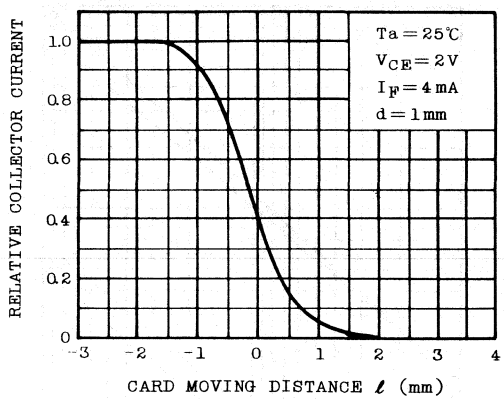
SWITCHING TIME TEST CIRCUIT



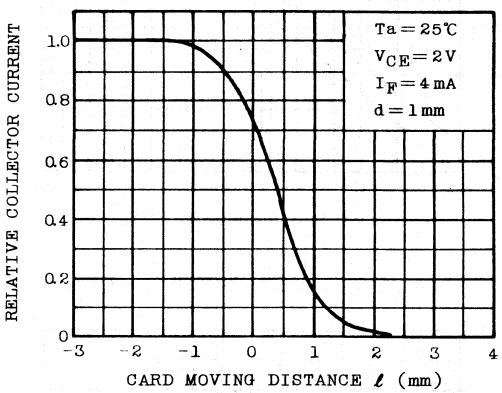
I_C — d(1) (TYP.)



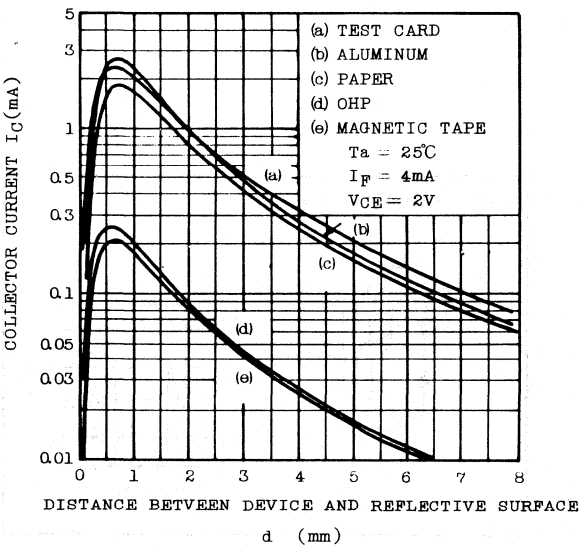
I_C — ℓ (TYP.)



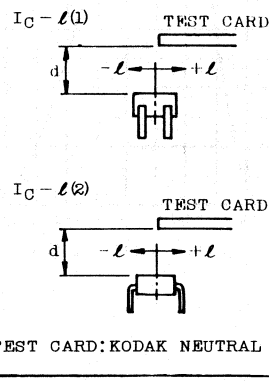
I_C — ℓ (TYP.)



I_C — d (2) (TYP.)



TEST CONDITION



TEST CARD: KODAK NEUTRAL TEST CARD

PHOTO REFLECTIVE SENSOR
INFRARED LED + PHOTO TRANSISTOR

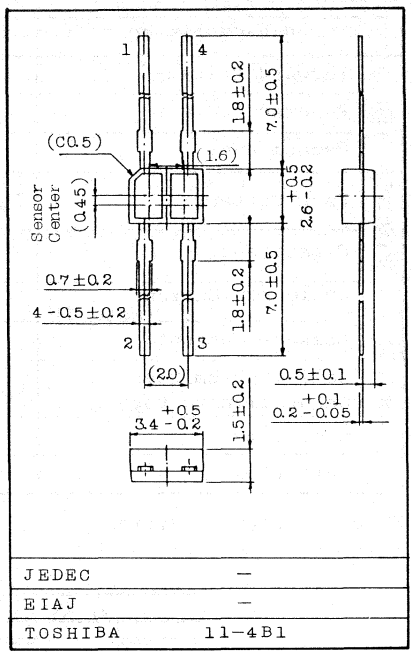
TLP908

TENTATIVE DATA

- START AND END MARK SENSOR FOR VIDEO AND AUDIO TAPE RECORDER.
- REVOLUTION SENSOR IN THE REEL FOR VIDEO TAPE RECORDER.
- INDEX SENSOR FOR FLOPPY DISK DRIVE.
- PAPER POSITION SENSOR FOR ELECTRONIC PRINTER AND FACSIMILE.

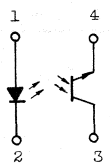
- Small Package Size : 2.6 × 3.4mm (Height 1.5mm)
- Fast Switching Speed : t_r, t_f=10μs
- Visible light cut-off type

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11-4B1

PIN CONNECTION



1. ANODE
2. CATHODE
3. COLLECTOR
4. EMITTER

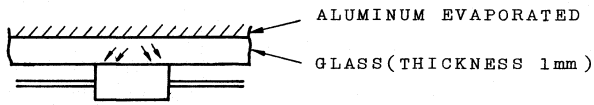
MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	Forward Current	I_F	50	mA
	Reverse Voltage	V_R	5	V
DETECTOR	Collector-Emitter Voltage	V_{CEO}	30	V
	Emitter-Collector Voltage	V_{ECO}	5	V
	Collector Power Dissipation	P_C	50	mW
	Collector Current	I_C	20	mA
Operating Temperature Range		T_{opr}	-25 ∿ 85	°C
Storage Temperature Range		T_{stg}	-30 ∿ 100	°C

ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.00	1.15	1.30	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	Dark Current	$I_D(I_{CEO})$	V_{CE}=10V, I_F=0	-	-	0.1	μA
	Capacitance	C_T	V=0. f=1MHz	-	13	-	pF
COUPLED	Collector Current (Note 3)	I_C	V_{CE}=5V, I_F=10mA (Note 1)	50	-	750	μA
	Leakage Current	I_{LEAK}	V_{CE}=5V, I_F=10mA (Note 2)	-	-	0.1	μA
	Collector-Emitter Saturation Voltage	$V_{CE}(sat)$	I_F=10mA, I_C=25μA	-	0.1	0.4	V
	Rise Time	t_r	V_{CC}=10V, I_C=1mA R_L=100kΩ	-	10	-	μs
	Fall Time	t_f		-	10	-	μs

Note 1 : Test Condition



Note 2 : No Reflecting Surface

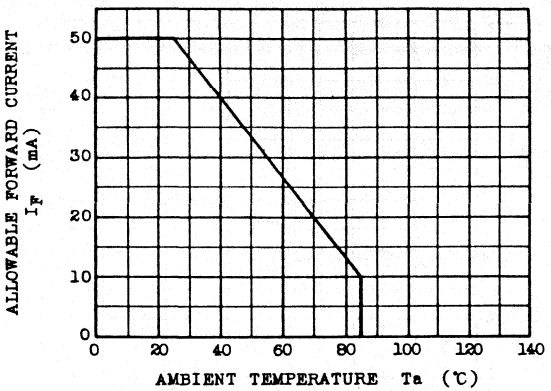
Note 3 : I_C crassification R : 50 ∿ 150μA, O : 110 ∿ 330μA, Y : 250 ∿ 750μA

PRECAUTION

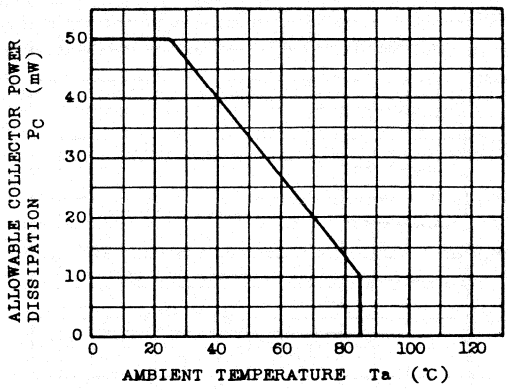
Please be careful of the followings.

1. Soldering temperature: 260°C MAX.
   Soldering time : 5 sec MAX.
   (Soldering portion of lead: up to 1.8mm from the body of the device.)
2. If the lead is formed, Soldering shall be performed after lead forming.
3. Avoid u sing the solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvent temperature: 45°C MAX.
   ° Freon TE or TF ° Dai-Fron S3 or S3-E

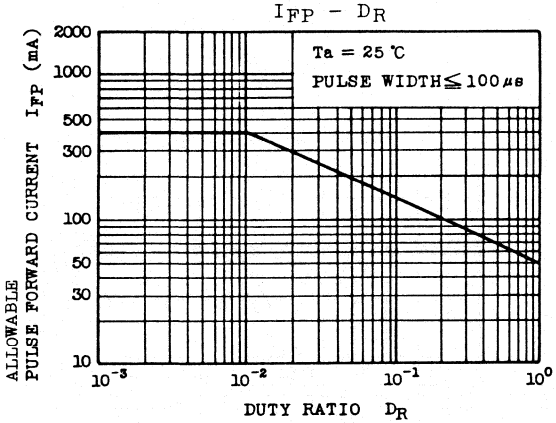
I_F – Ta



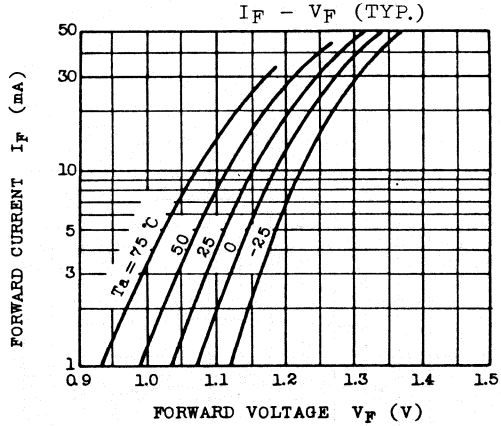
P_C – Ta



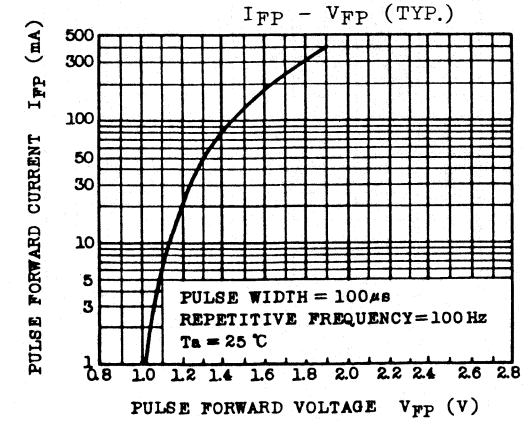
I_{FP} – D_R



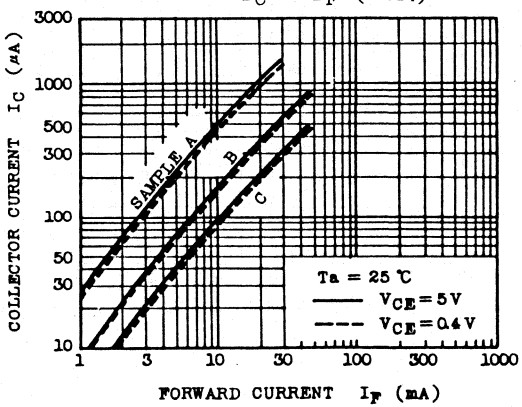
I_F – V_F (TYP.)



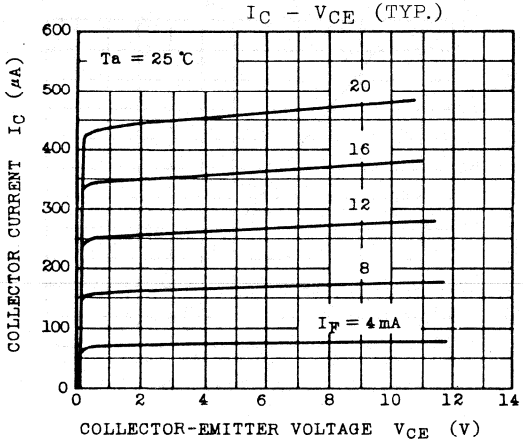
I_{FP} – V_{FP} (TYP.)



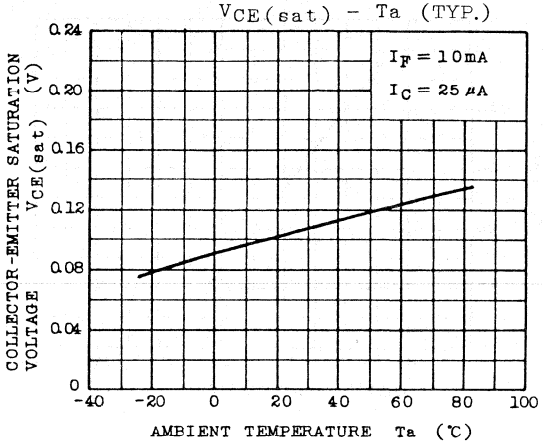
I_C – I_F (TYP.)



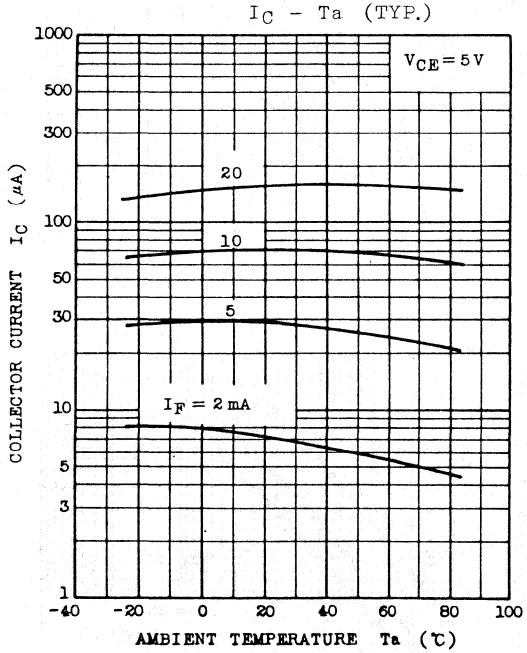
I_C – V_{CE} (TYP.)



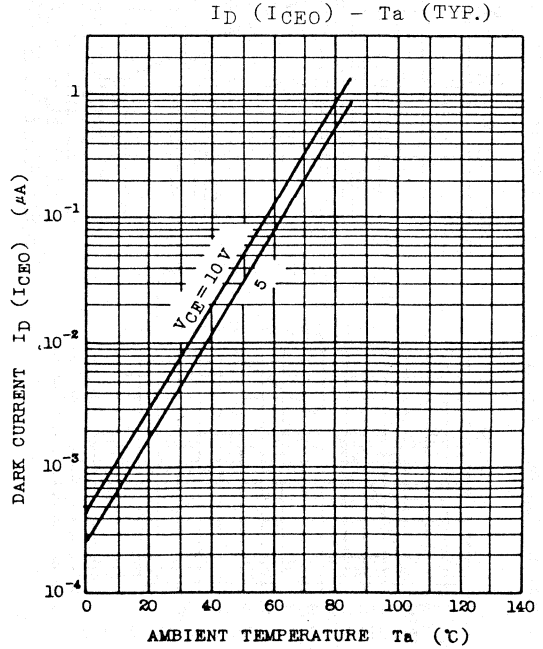
$V_{CE(sat)}$ – Ta (TYP.)



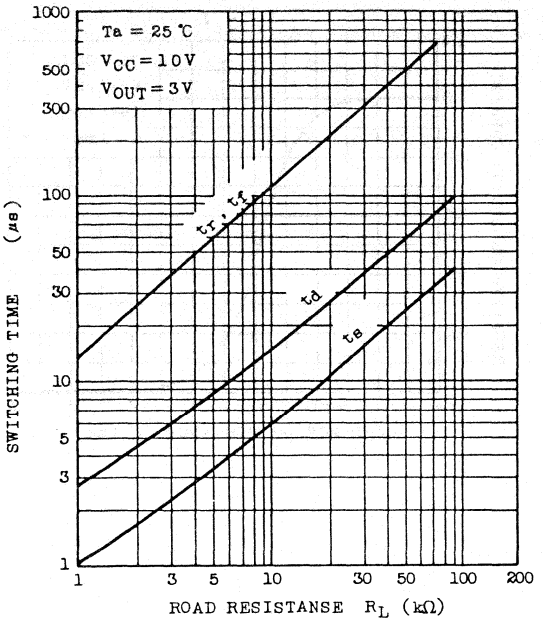
I_C – Ta (TYP.)



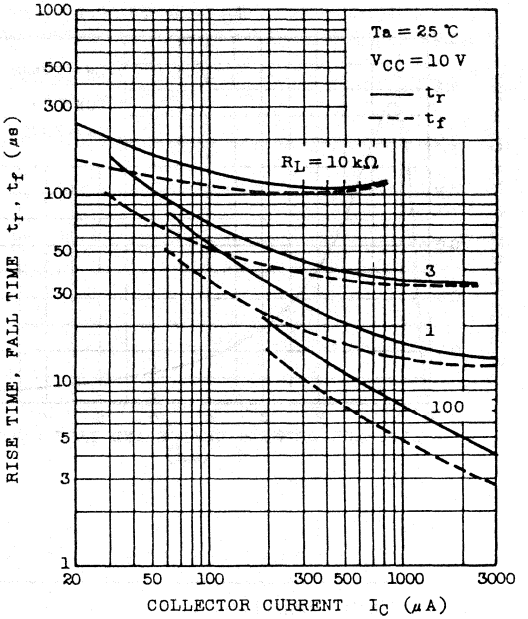
I_D (I_{CEO}) – Ta (TYP.)



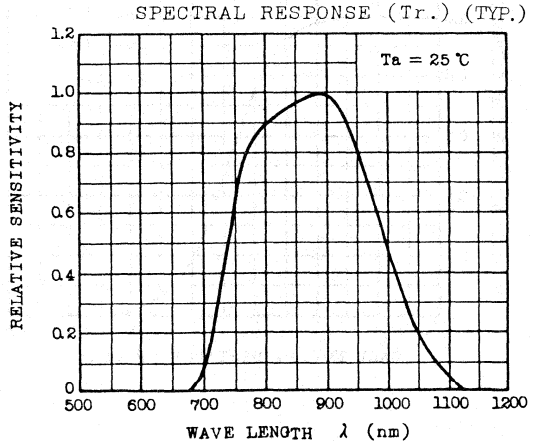
SWITCHING CHARACTERISTICS (TYP.)



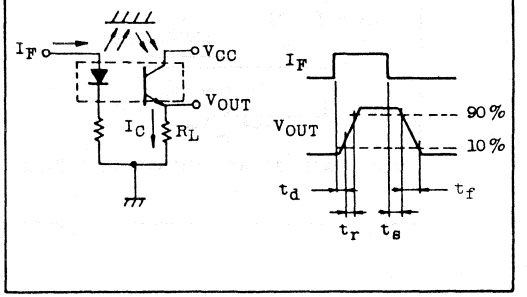
t_r, t_f – I_C (TYP.)



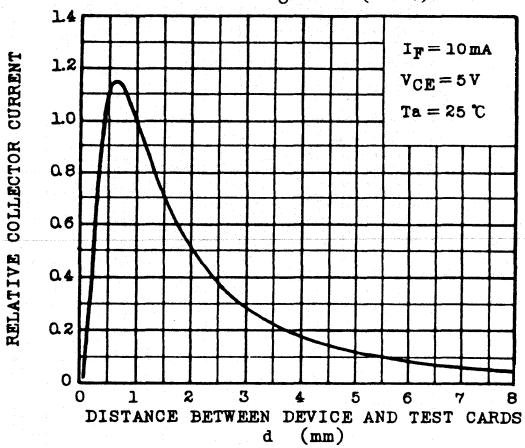
SPECTRAL RESPONSE (Tr.) (TYP.)



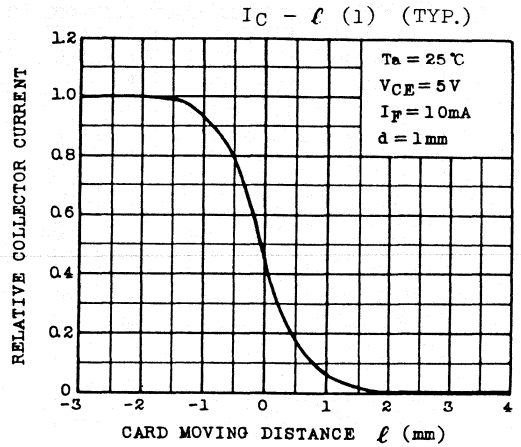
SWITCHING TIME TEST CIRCUIT



I_C – d (TYP.)

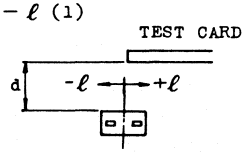


I_C – ℓ (1) (TYP.)

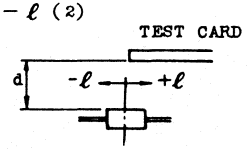


TEST CONDITION

I_C – ℓ (1)



I_C – ℓ (2)



TEST CARD : KODAK NEUTRAL TEST CARD

I_C – ℓ (2) (TYP.)

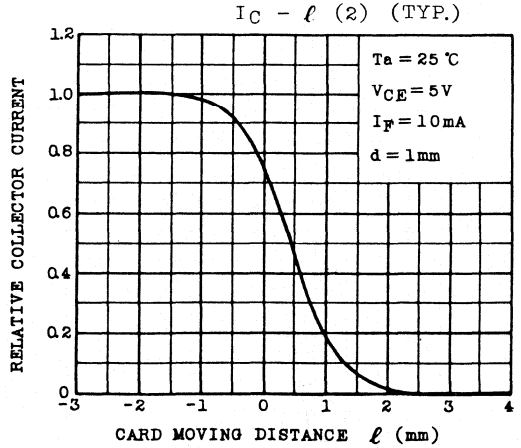


PHOTO REFLECTIVE SENSOR
INFRARED LED + PHOTO TRANSISTOR

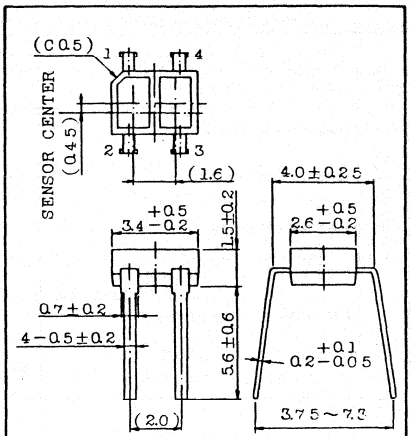
TLP908(LB)

TENTATIVE DATA

Unit in mm

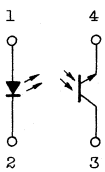
- START AND END MARK SENSOR FOR VIDEO AND AUDIO TAPE RECORDER.
- REVOLUTION SENSOR IN THE REEL FOR VIDEO TAPE RECORDER.
- INDEX SENSOR FOR FLOPPY DISK DRIVE.
- PAPER POSITION SENSOR FOR ELECTRONIC PRINTER AND FACSIMILE.

- Small Package Size : 2.6 × 3.4mm (Height 1.5mm)
- Fast Switching Speed : t_r, t_f=10μs
- Visible light cut-off type.



JEDEC	—
EIAJ	—
TOSHIBA	11-4B101

PIN CONNECTION



1. ANODE
2. CATHODE
3. COLLECTOR
4. EMITTER

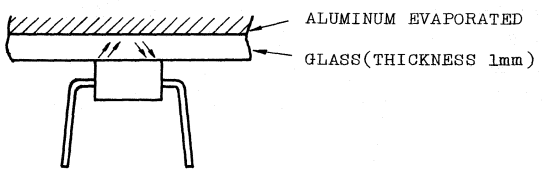
MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	Forward Current	I_F	50	mA
	Reverse Voltage	V_R	5	V
DETECTOR	Collector-Emitter Voltage	V_{CEO}	30	V
	Emitter-Collector Voltage	V_{ECO}	5	V
	Collector Power Dissipation	P_C	50	mW
	Collector Current	I_C	20	mA
Operating Temperature Range		T_{opr}	-25~85	°C
Storage Temperature Range		T_{stg}	-30~100	°C

ELECTRICAL CHARACTERISTICS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.00	1.15	1.30	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	Dark Current	$I_D(I_{CED})$	V_{CE}=10V, I_F=0	-	-	0.1	μA
	Capacitance	C_T	V=0, f=1MHz	-	13	-	pF
COUPLED	Collector Current (Note 3)	I_C	V_{CE}=5V, I_F=10mA (Note 1)	50	-	750	μA
	Leakage Current	I_{LEAK}	V_{CE}=5V, I_F=10mA (Note 2)	-	-	0.1	μA
	Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	I_F=10mA, I_C=25 A	-	0.1	0.4	V
	Rise Time	t_r	V_{CC}=10V, I_C=1mA	-	10	-	μs
	Fall Time	t_f	R_L=1kΩ	-	10	-	μs

Note 1 : Test Condition



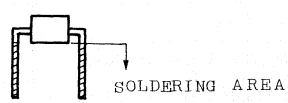
Note 2 : No Reflecting Surface

Note 3 : I_C crassification R : 50 ∿ 150μA, O : 110 ∿ 330μA, Y : 250 ∿ 750μA

PRECAUTION

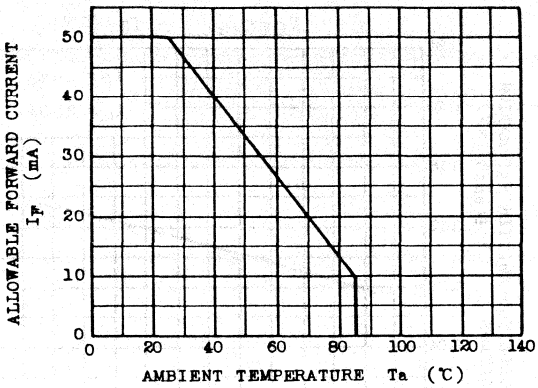
Please be careful of the followings.

1. Soldering temperature: 260°C MAX.
   Soldering time : 3 sec MAX.

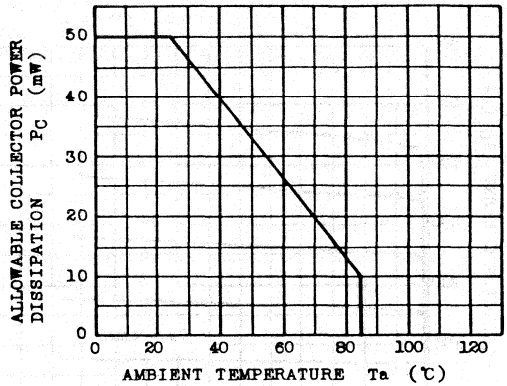


2. If the lead is formed, Soldering shall be performed after lead forming.
3. Avoid using the solvents except for the follows, when washing off flux and wiping off stain on the device.
   washing time: 30 sec MAX. Solvent temperature: 45°C MAX.
   ° Freon TE or TF ° Dai-Fron Solvent S3 or S3-E

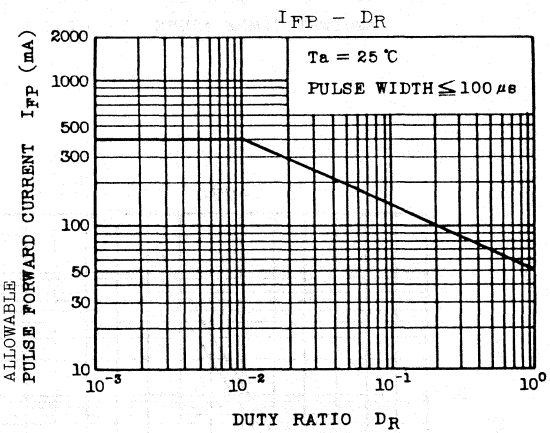
I_F – Ta



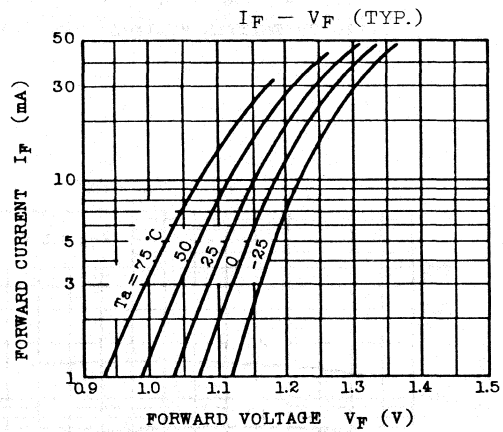
P_C – Ta



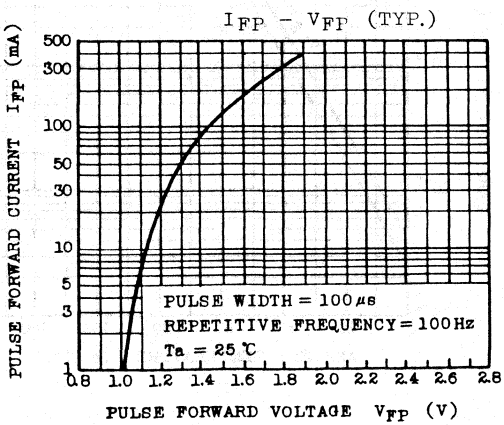
I_{FP} – D_R



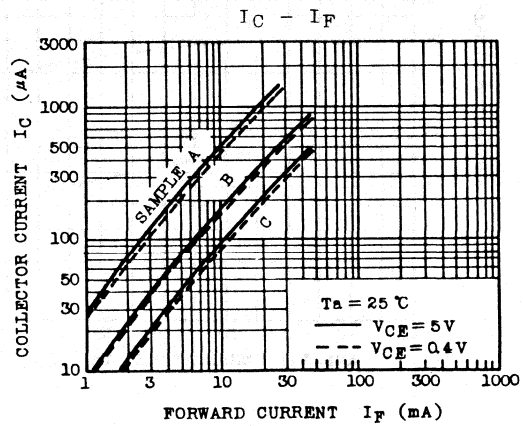
I_F – V_F (TYP.)



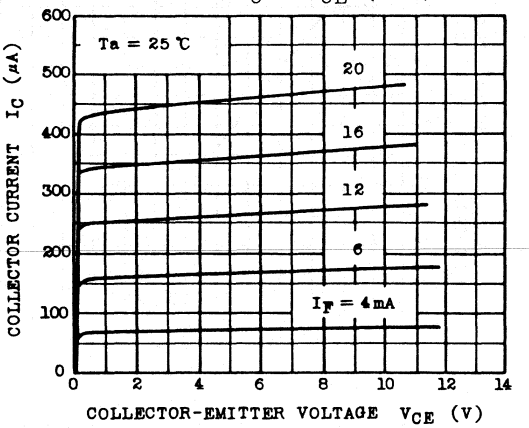
I_{FP} – V_{FP} (TYP.)



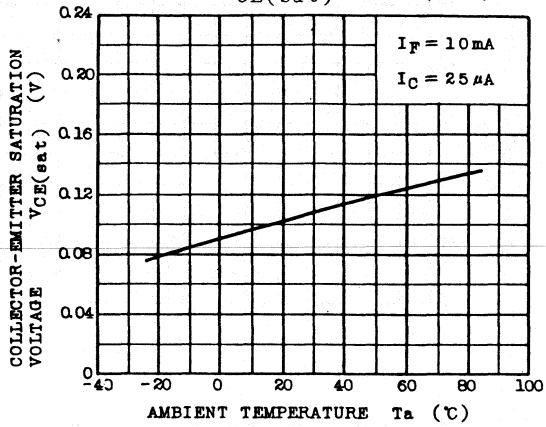
I_C – I_F



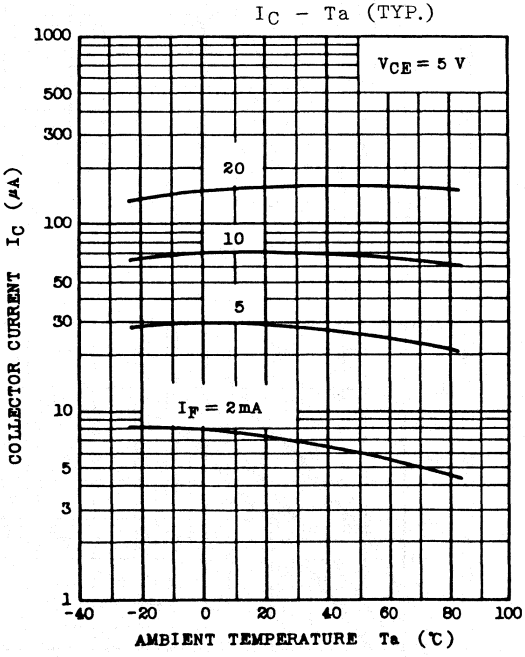
I_C – V_{CE} (TYP.)



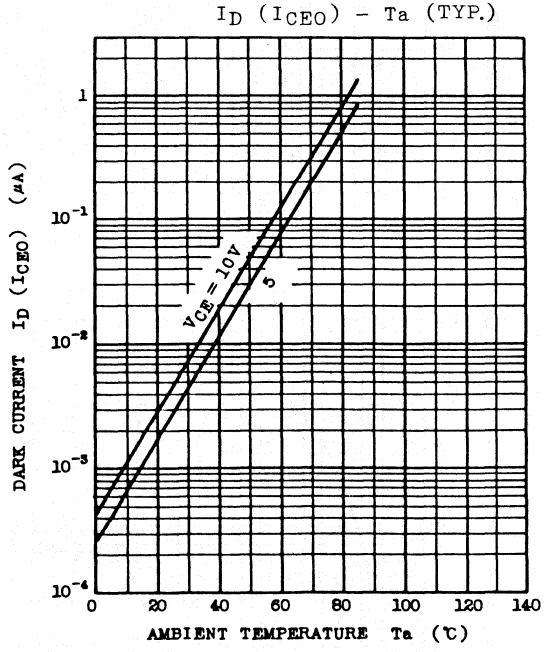
$V_{CE(sat)}$ – Ta (TYP.)



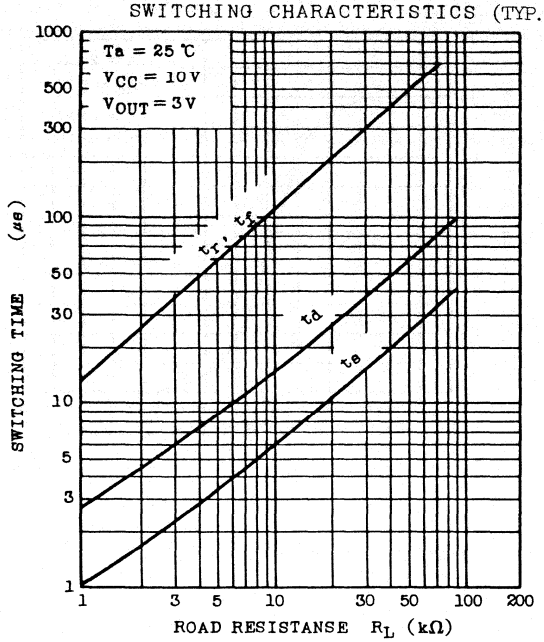
I_C – Ta (TYP.)



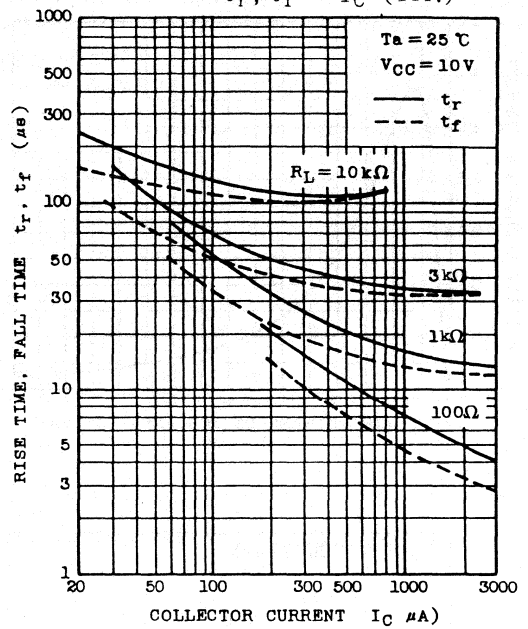
I_D (I_{CEO}) – Ta (TYP.)



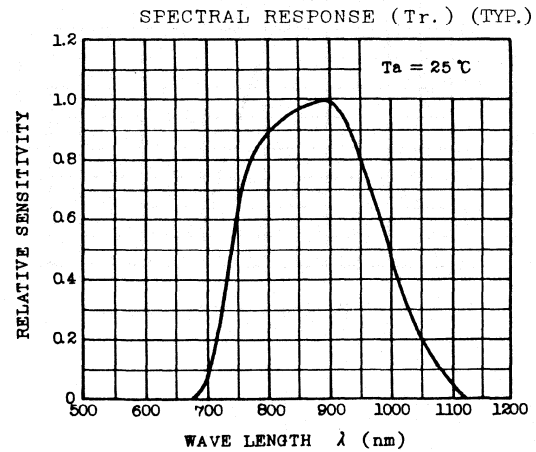
SWITCHING CHARACTERISTICS (TYP.)



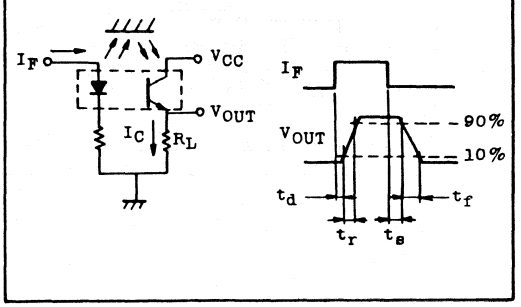
t_r, t_f - I_C (TYP.)



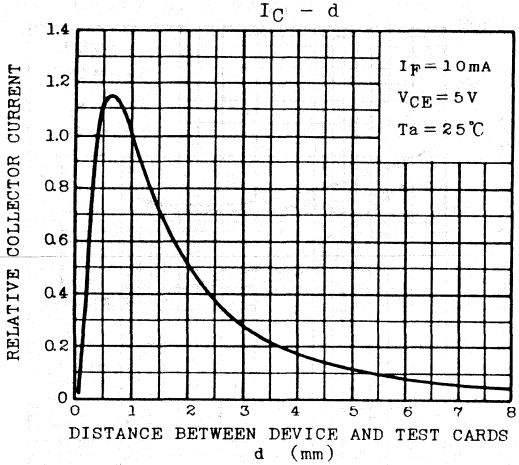
SPECTRAL RESPONSE (Tr.) (TYP.)



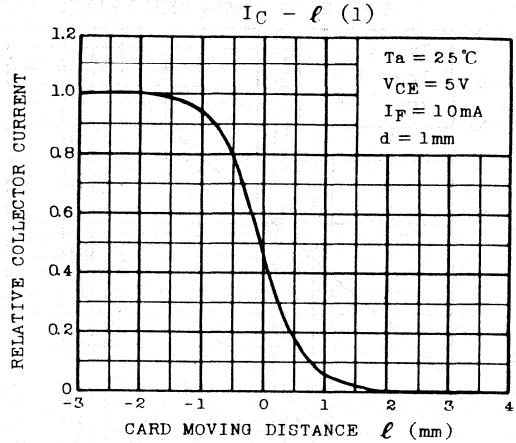
SWITCHING TIME TEST CIRCUIT



I_C – d

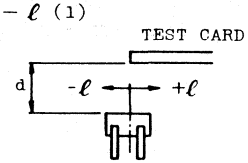


I_C – ℓ (1)

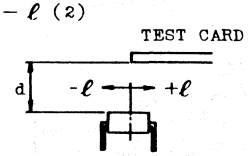


TEST CONDITION

I_C – ℓ (1)

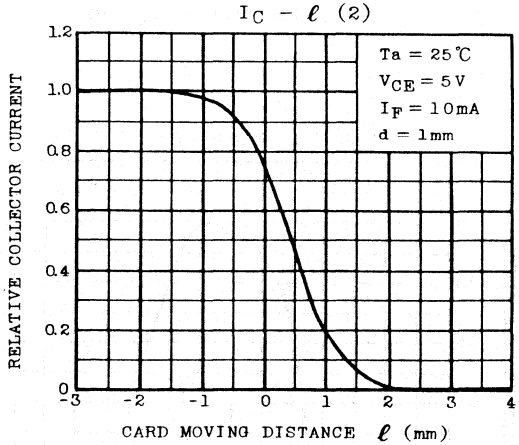


I_C – ℓ (2)



TEST CARD : KODAK NEUTRAL TEST CARD

I_C – ℓ (2)



■ Fiber Optic Devices

■ Emitter

■ Detector

■ Laser Diode

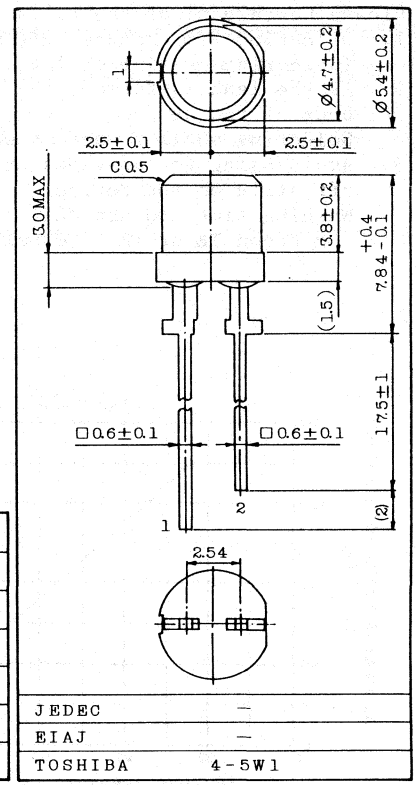
* New Product
** Under Development

LED LAMP
GaAlAs RED LIGHT EMISSION

TLRC280

TENTATIVE DATA

Unit in mm



LED FOR FIBER OPTIC SYSTEM

FEATURES:

- 660nm Emitter Optimized for Plastic Fiber Cable
  λ_p=660nm(Typ.)
- High Output Optical Power Coupled Into Plastic Fiber
  Pf=-8.5dBm(Typ.)
- Mechanically Matched with PIN PHOTODIODE TPS720

PIN CONNECTION

1. ANODE
2. CATHODE

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Power Dissipation	P_D	140	mW
Forward Current (DC)	I_F	70	mA
Forward Current (Pulse)(Note)	I_{FP}	300	mA
Reverse Voltage	V_R	4	V
Operating Temperature	T_{opr}	-30 ~ 85	°C
Storage Temperature	T_{stg}	-40 ~ 85	°C

Note. Pulse width=1ms,Duty=1/20

OPTICAL-ELECTRICAL CHARACTERISTICS (Ta=25°C)

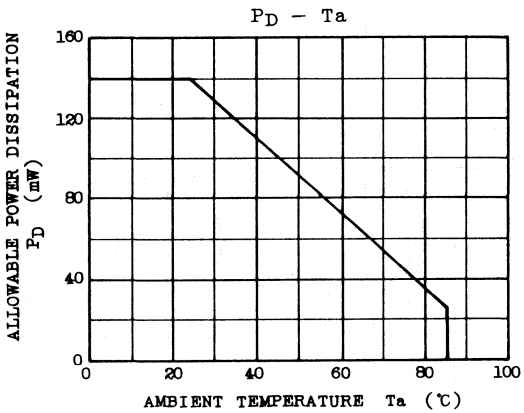
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Fiber Coupled Power (Note)	P_f	I_F=30mA	-11.5	-8.5	-	dBm
Reverse Current	I_R	V_R=4V	-	-	100	μA
Forward Voltage	V_F	I_F=30mA	-	1.85	2	V
Peak Emission Wavelength	λ_p	I_F=30mA	-	660	-	nm
Spectral Line Half Width	$\Delta\lambda$	I_F=30mA	-	30	-	nm
Radiation Half Angle	θ	I_F=30mA	-	±40	-	deg.
Total Capacitance	C_T	V=0V, f=1MHz	-	80	100	pF
Cutoff Frequency	f_c	I_F=30mA$_{DC}$+6mAp-p Output;3dB down to 100kHz	5	7	-	MHz

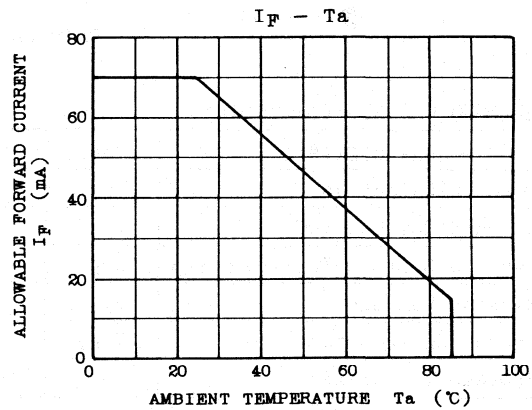
Note. Using plastic fiber cable, Fiber length=0.5m, Core Diameter=980μm, NA=0.5
P_f(dBm)=10·log[P(μW)/1000(μW)]

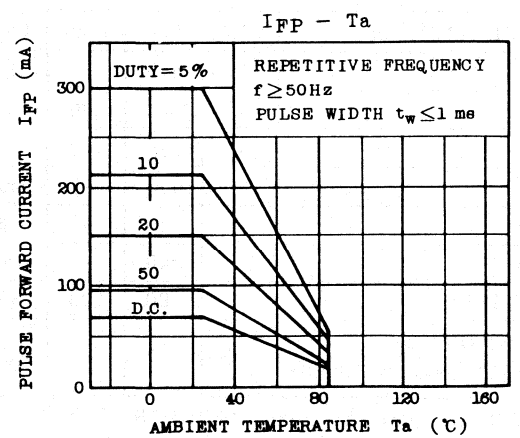
PRECAUTION

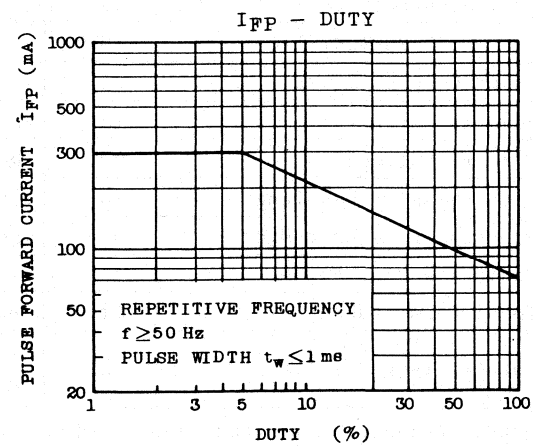
Please be careful of the followings.

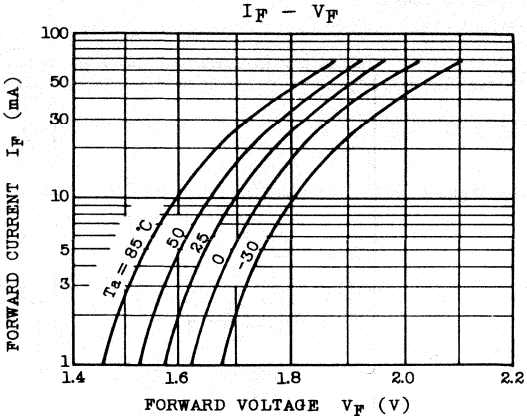
1. Soldering temperature: 260°C MAX. Soldering time: 3 sec MAX.
   (Soldering portion of lead: up to 2.5mm from the body of the device)
2. If the lead is formed, the lead should be formed at a distance of 2.5mm from the body of the device.
   Soldering shall be performed after lead forming.
3. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   o Freon TE or TF o Dai-Fron Solvent S3 or S3-E

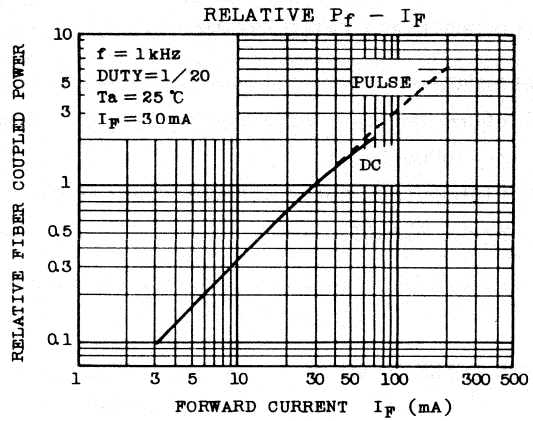


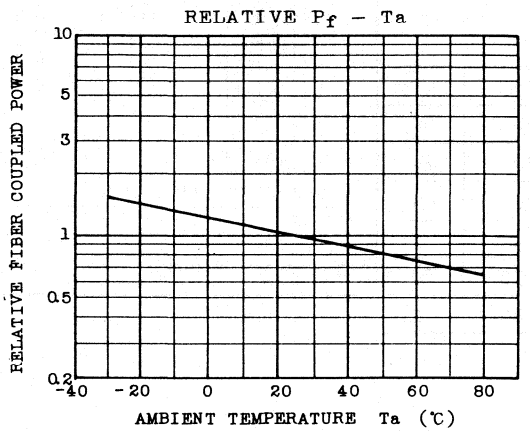


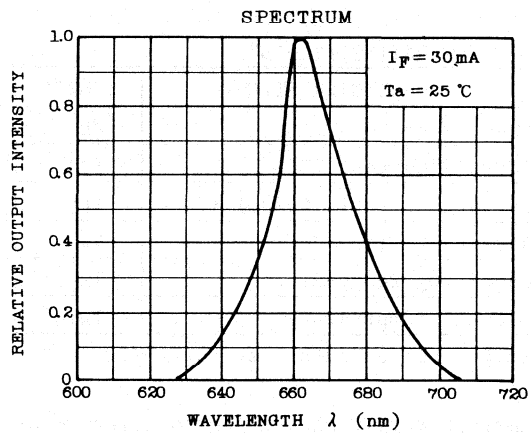


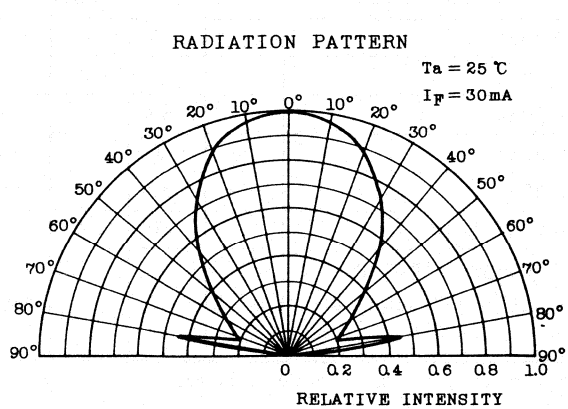


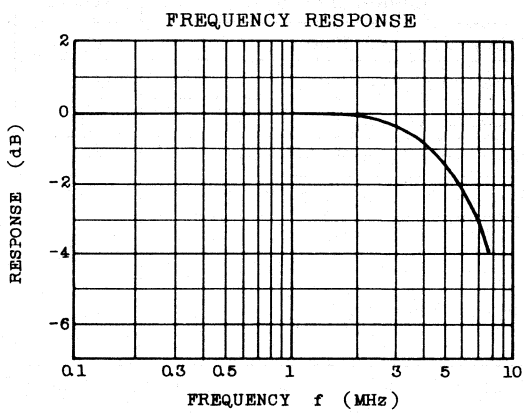

$I_F - V_F$
FORWARD CURRENT I_F (mA)
100
50
30
10
5
3
1
Ta = 85 ℃
50
25
0
-30
1.4
1.6
1.8
2.0
2.2
FORWARD VOLTAGE V_F (V)


RELATIVE $P_f - I_F$
RELATIVE FIBER COUPLED POWER
10
5
3
1
0.5
0.3
0.1
f = 1kHz
DUTY=1/20
Ta = 25 ℃
I_F = 30mA
PULSE
DC
1
3
5
10
30
50
100
300
500
FORWARD CURRENT I_F (mA)


RELATIVE P_f - Ta
RELATIVE FIBER COUPLED POWER
10
5
3
1
0.5
0.2
-40
-20
0
20
40
60
80
AMBIENT TEMPERATURE Ta (℃)


SPECTRUM
RELATIVE OUTPUT INTENSITY
1.0
0.8
0.6
0.4
0.2
0
I_F = 30mA
Ta = 25 ℃
600
620
640
660
680
700
720
WAVELENGTH λ (nm)


RADIATION PATTERN
Ta = 25 ℃
I_F = 30mA
0°
10°
20°
30°
40°
50°
60°
70°
80°
90°
0
0.2
0.4
0.6
0.8
1.0
RELATIVE INTENSITY


FREQUENCY RESPONSE
RESPONSE (dB)
2
0
-2
-4
-6
0.1
0.3
0.5
1
3
5
10
FREQUENCY f (MHz)

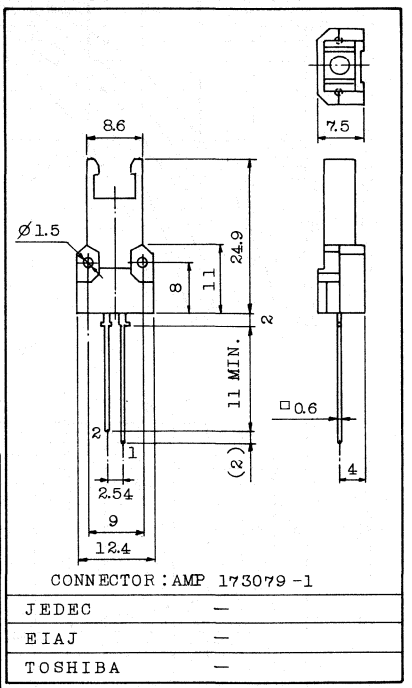
TLRC280(K1)

LED LAMP
GaAlAs RED LIGHT EMISSION

TENTATIVE DATA UNDER DEVELOPMENT

LED FOR FIBER OPTIC SYSTEM

Unit in mm



CONNECTOR : AMP 173079-1

JEDEC	—
EIAJ	—
TOSHIBA	—

FEATURES:

. 660nm Emitter Optimized for Plastic Fiber Cable
  λ_P=660nm(Typ.)

. High Output Optical Power Coupled Into Plastic Fiber
  P_f=-8.5dBm(Typ.)

PIN CONNECTION

1. ANODE
2. CATHODE

MAXIMUM RATINGS(Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Power Dissipation	P_D	140	mW
Forward Current (DC)	I_F	70	mA
Forward Current (Pulse) (Note)	I_{FP}	300	mA
Reverse Voltage	V_R	4	V
Operating Temperature	T_{opr}	-20~70	°C
Storage Temperature	T_{stg}	-40~80	°C

Note : Pulse Width=1ms, Duty=1/20

OPTICAL-ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Fiber Coupled Power (Note)	P_f	I_F=30mA	-11.5	-8.5	-	dBm
Reverse Current	I_R	V_R=4V	-	-	100	μA
Forward Voltage	V_F	I_F=30mA	-	1.85	2	V
Peak Emission Wavelength	λ_P	I_F=30mA	-	660	-	nm
Spectral Line Half Width	$\Delta\lambda$	I_F=30mA	-	30	-	nm
Total Capacitance	C_T	V=0V, f=1MHz	-	80	100	pF
Cutoff Frequency	f_c	I_F=30mA$_{DC}$ + 6mAp-p Output : 3dB down to 100kHz	5	7	-	MHz

Note : Using plastic fiber cable, Fiber length=0.5m, Core Diameter=980μm, NA=0.5

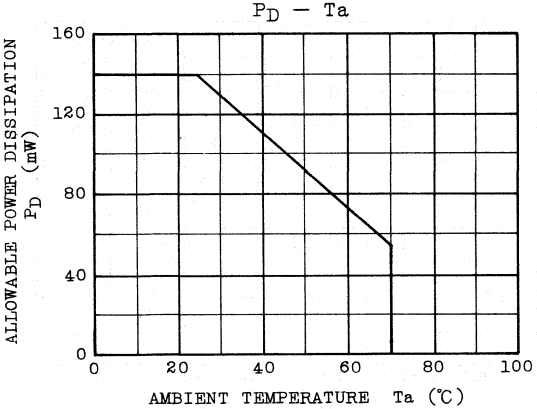
$P_f(dBm)=10\cdot\log[P(\mu W)/1000(\mu W)]$

PRECAUTION

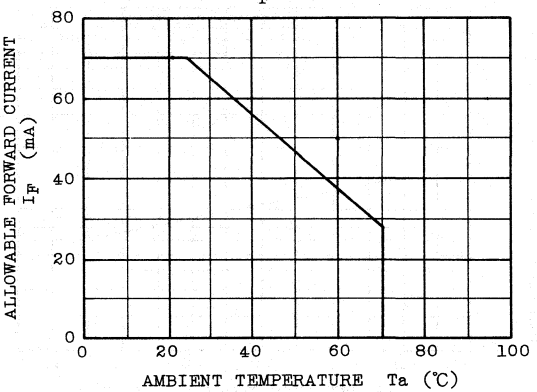
Please be careful of the followings.

1. Soldering temperature: 260°C MAX. Soldering time: 3 sec MAX.
   (Soldering portion of lead: up to 2.5mm from the body of the device)
2. If the lead is formed, the lead should be formed at a distance of 2.5mm from the body of the device. Soldering shall be performed after lead forming.
3. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   o Freon TE or TF o Dai-Fron Solvent S3 or S3-E

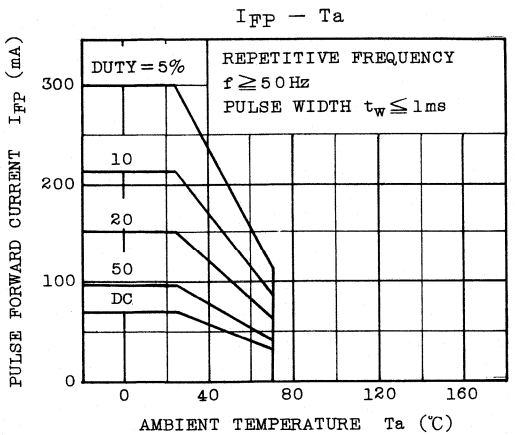
P_D — Ta



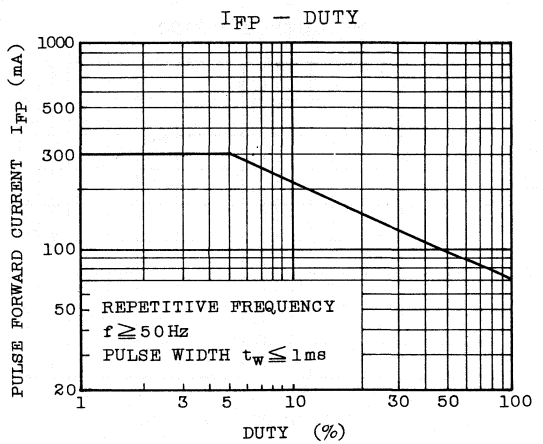
I_F — Ta



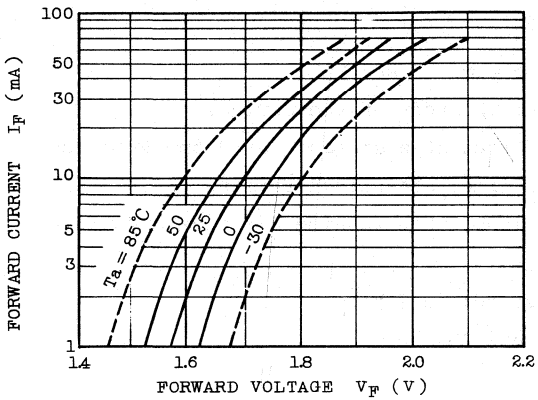
I_{FP} — Ta



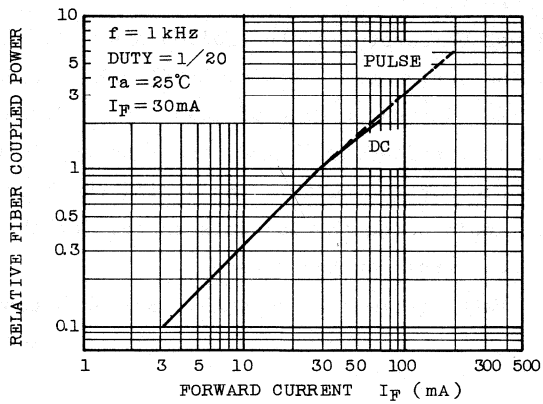
I_{FP} — DUTY



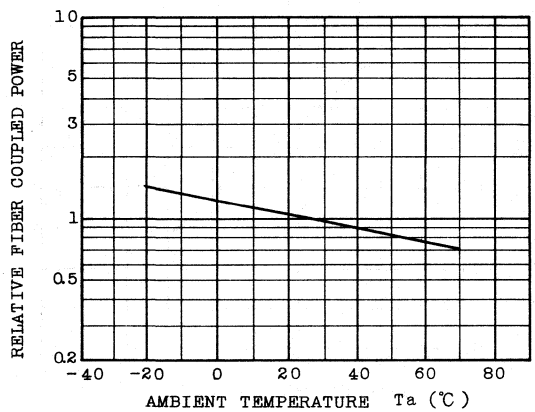
$I_F - V_F$



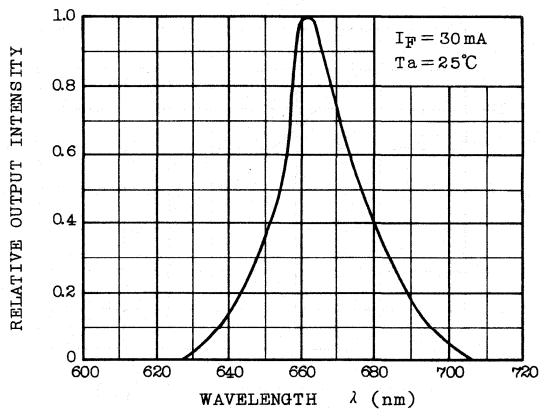
RELATIVE $P_f - I_F$



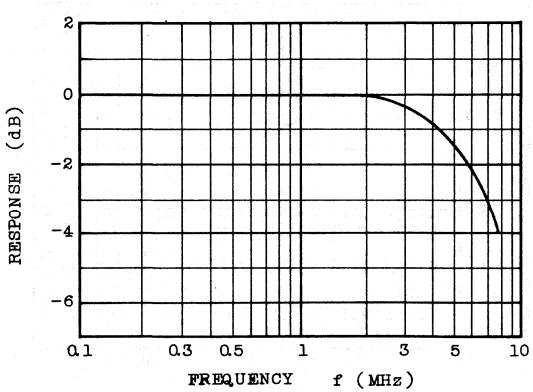
RELATIVE P_f - Ta



SPECTRUM



FREQUENCY RESPONSE



LED LAMP
GaAlAs RED LIGHT EMISSION

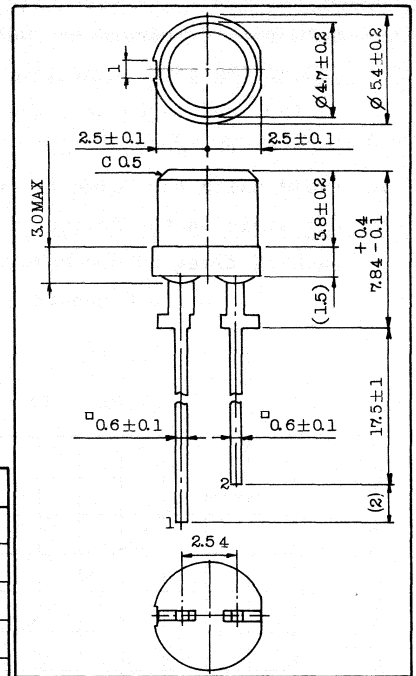
TLRA280

TENTATIVE DATA

UNDER DEVELOPMENT

LED FOR FIBER OPTIC SYSTEM

Unit in mm



FEATURES:

- 660nm Emitter Optimized for Plastic Fiber Cable
  λ_P=660nm(Typ.)
- High Output Optical Power Coupled Into Plastic Fiber
  P_f=-4.0dBm(Typ.)
- Mechanically Matched with PIN PHOTODIODE TPS720.

PIN CONNECTION

1. ANODE
2. CATHODE

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Power Dissipation	P_D	130	mW
Forward Current (DC)	I_F	50	mA
Forward Current (Pulse)*	I_{FP}	200	mA
Reverse Voltage	V_R	4	V
Operating Temperature	Topr	-30~85	°C
Storage Temperature	Tstg	-40~90	°C

* Pulse Width=1msec., Duty=1/20

OPTICAL-ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Fiber Coupled Power (Note)	P_f	I_F=30mA	-7.0	-4.0	-	dBm
			200	400	-	μW
Reverse Current	I_R	V_R=4V	-	-	100	μA
Forward Voltage	V_F	I_F=30mA	-	1.9	2.5	V
Peak Emission Wavelength	λ_P	I_F=30mA	-	660	-	nm
Spectral Line Half Width	$\Delta\lambda$	I_F=30mA	-	25	-	nm
Total Capacitance	C_T	V=0V, f=1MHz	-	80	-	pF
Cutoff Frequency	f_c	I_F=30mA$_{DC}$ + 6mAp-p Output : 3dB down to 100kHz	-	3	-	MHz

Note : Using plastic fiber cable, Fiber length=0.5m, Core Diameter=980μm, NA=0.5

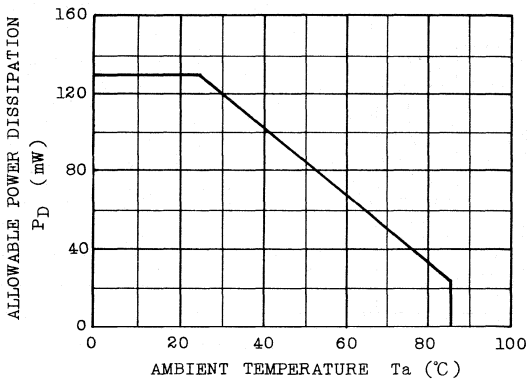
$P_f(dBm)=10\cdot\log[P(\mu W)/1000(\mu W)]$

PRECAUTION

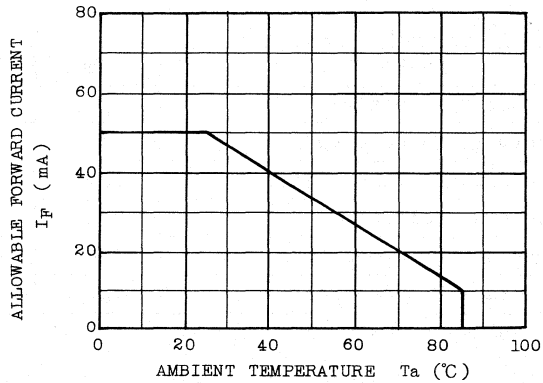
Please be careful of the followings.

1. Soldering temperature: 260°C MAX. Soldering time: 3 sec MAX.
   (Soldering portion of lead: up to 2.5mm from the body of the device)
2. If the lead is formed, the lead should be formed at a distance of 2.5mm from the body of the device. Soldering shall be performed after lead forming.
3. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   o Freon TE or TF o Dai-Fron Solvent S3 or S3-E

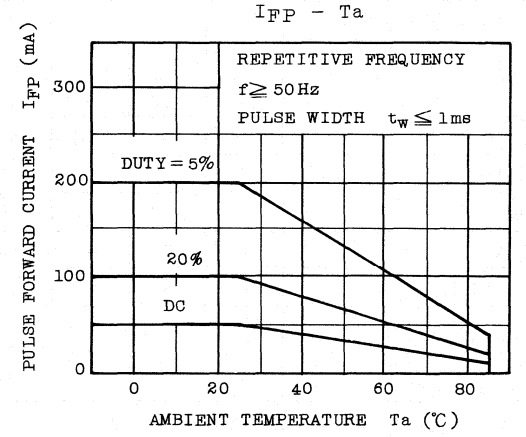
P_D – Ta



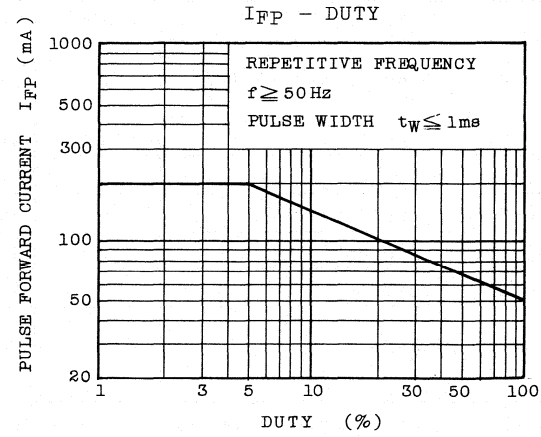
I_F – Ta



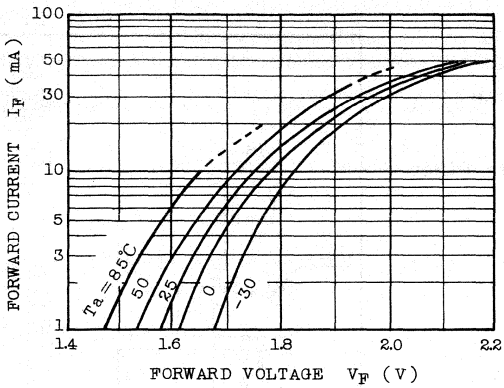
I_{FP} – Ta



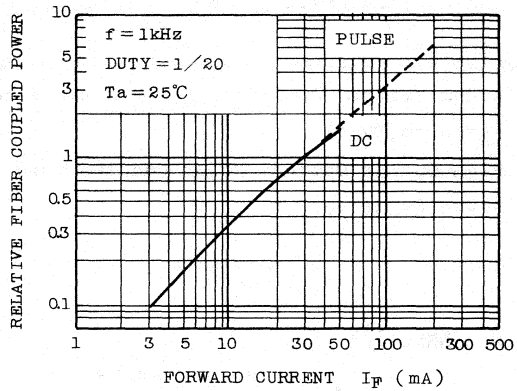
I_{FP} – DUTY



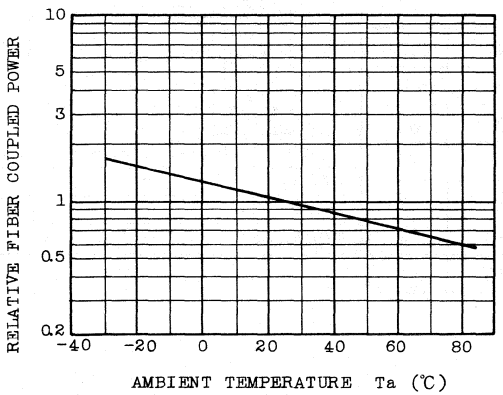
$I_F - V_F$



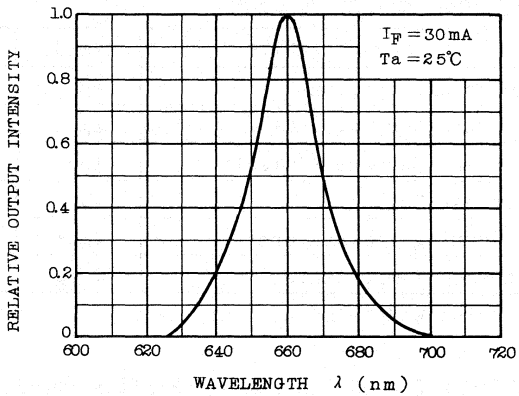
RELATIVE $P_f - I_F$



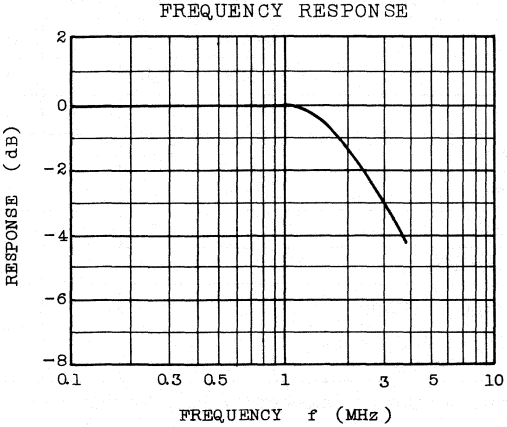
RELATIVE P_f - Ta



EMISSION SPECTRUM



FREQUENCY RESPONSE



TLRA280(K1)

LED LAMP
GaAlAs RED LIGHT EMISSION

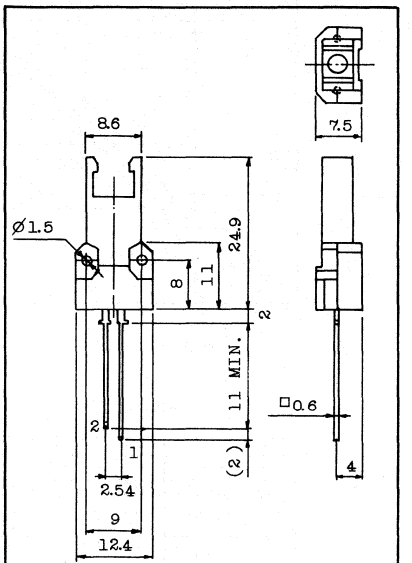
TENTATIVE DATA

LED FOR FIBER OPTIC SYSTEM

Unit in mm

FEATURES:

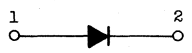
- 660nm Emitter Optimized for Plastic Fiber Cable
  λ_P=660nm(Typ.)
- High Output Optical Power Coupled Into Plastic Fiber
  P_f=-4.0dBm(Typ.)



CONNECTOR : AMP 173079-1

JEDEC	—
EIAJ	—
TOSHIBA	—

PIN CONNECTION



1. ANODE
2. CATHODE

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Power Dissipation	P_D	130	mW
Forward Current (DC)	I_F	50	mA
Forward Current (Pulse)*	I_{FP}	200	mA
Reverse Voltage	V_R	4	V
Operating Temperature	Topr	-20~70	°C
Storage Temperature	Tstg	-40~80	°C

* Pulse Width=1msec,. Duty=1/20

OPTICAL-ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Fiber Coupled Power (Note)	P_f	I_F=30mA	-7.0	-4.0	-	dBm
			200	400	-	μW
Reverse Current	I_R	V_R=4V	-	-	100	μA
Forward Voltage	V_F	I_F=30mA	-	1.9	2.5	V
Peak Emission Wavelength	λ_P	I_F=30mA	-	660	-	nm
Spectral Line Half Width	$\Delta\lambda$	I_F=30mA	-	25	-	nm
Total Capacitance	C_T	V=0V, f=1MHz	-	80	-	pF
Cutoff Frequency	f_c	I_F=30mA$_{DC}$ + 6mAp-p Output : 3dB down to 100kHz	-	3	-	MHz

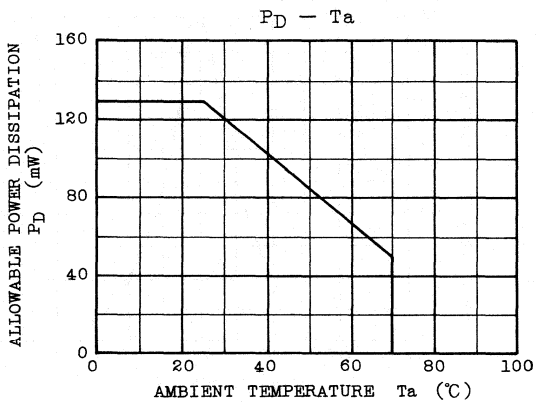
Note : Using plastic fiber cable, Fiber length=0.5m, Core Diameter=980μm, NA=0.5

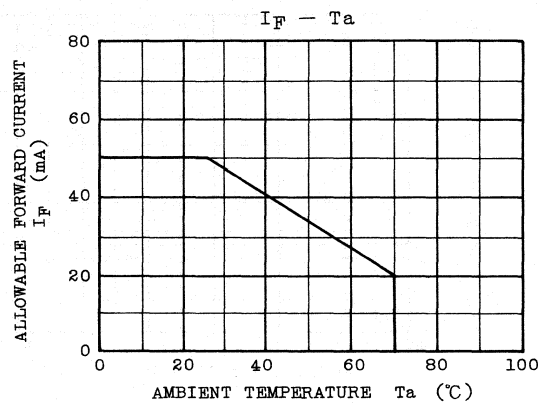
$P_f(dBm)=10\cdot\log[P(\mu W)/1000(\mu W)]$

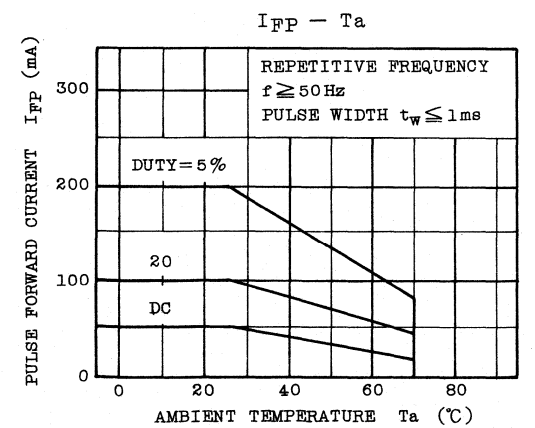
PRECAUTION

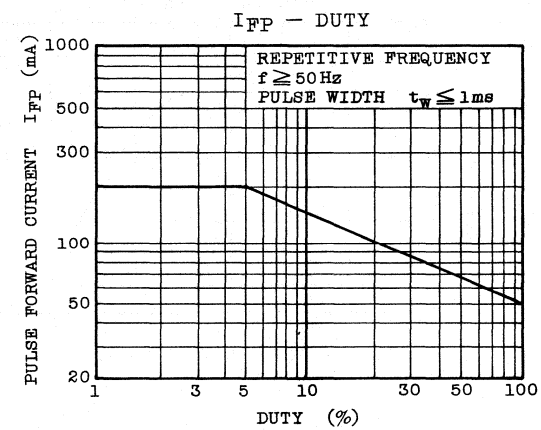
Please be careful of the followings.

1. Soldering temperature: 260°C MAX. Soldering time: 3 sec MAX.
   (Soldering portion of lead: up to 2.5mm from the body of the device)
2. If the lead is formed, the lead should be formed at a distance of 2.5mm from the body of the device. Soldering shall be performed after lead forming.
3. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   o Freon TE or TF o Dai-Fron Solvent S3 or S3-E

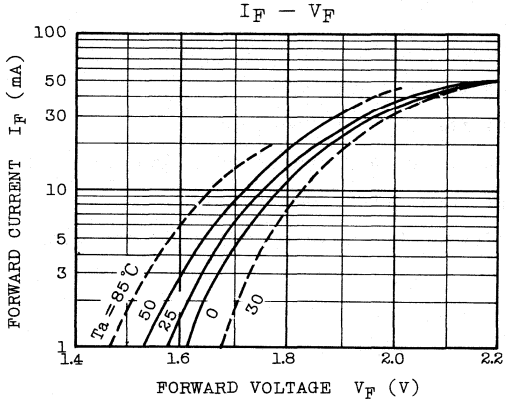




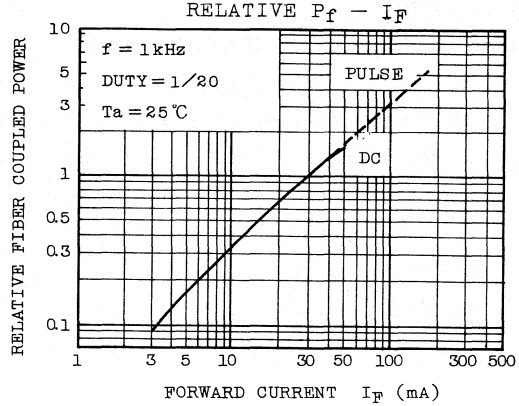




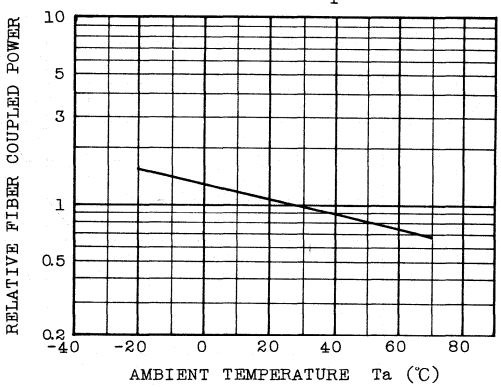
$I_F - V_F$



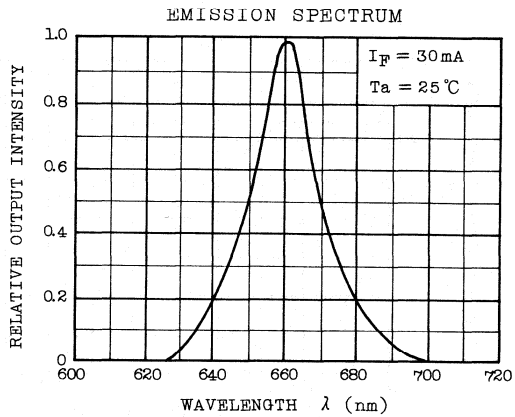
RELATIVE $P_f - I_F$



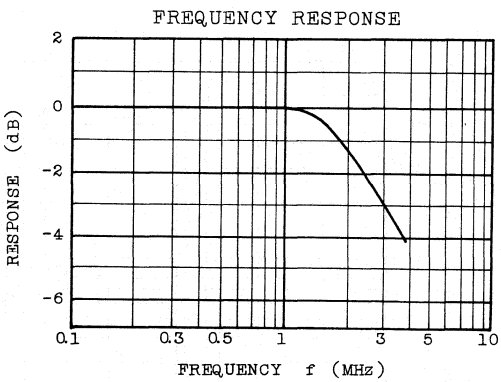
RELATIVE P_f — Ta



EMISSION SPECTRUM



FREQUENCY RESPONSE



LED LAMP
GaAlAs RED LIGHT EMISSION

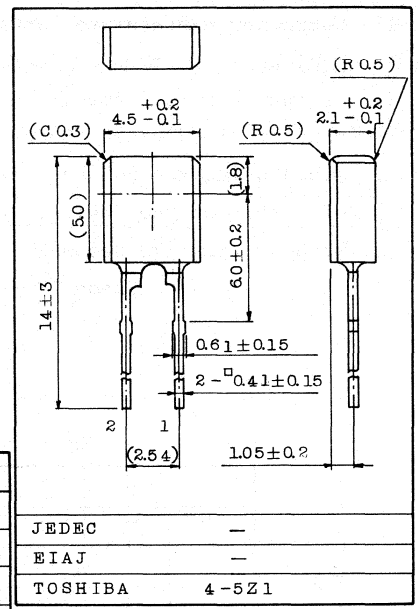
TLRC281

TENTATIVE DATA

UNDER DEVELOPMENT

LED FOR FIBER OPTIC SYSTEM

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	4-5Z1

FEATURES:

- 660nm Emitter Optimized for Plastic Fiber Cable
  λ_P=660nm(Typ.)
- High Output Optical Power Coupled Into Plastic Fiber
  Pf=-8.5dBm(Typ.)
- Mechanically Matched with PIN PHOTODIODE TPS721.

PIN CONNECTION

1. ANODE
2. CATHODE

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Power Dissipation	P_D	140	mW
Forward Current (DC)	I_F	70	mA
Forward Current (Pulse)*	I_{FP}	300	mA
Reverse Voltage	V_R	4	V
Operating Temperature	T_{opr}	-30~85	°C
Storage Temperature	T_{stg}	-40~85	°C

* Pulse Width=1ms, Duty=1/20

OPTICAL-ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Fiber Coupled Power (Note)	Pf	I_F=30mA	-11.5	-8.5	-	dBm
			70	140	-	μW
Reverse Current	I_R	V_R=4V	-	-	100	μA
Forward Voltage	V_F	I_F=30mA	-	1.85	2	V
Peak Emission Wavelength	λ_P	I_F=30mA	-	660	-	nm
Spectral Line Half Width	$\Delta\lambda$	I_F=30mA	-	30	-	nm
Total Capacitance	C_T	V=0V, f=1MHz	-	80	100	pF
Cutoff Frequency	f_c	I_F=30mA$_{DC}$ + 6mAp-p Output : 3dB down to 100kHz	5	7	-	MHz

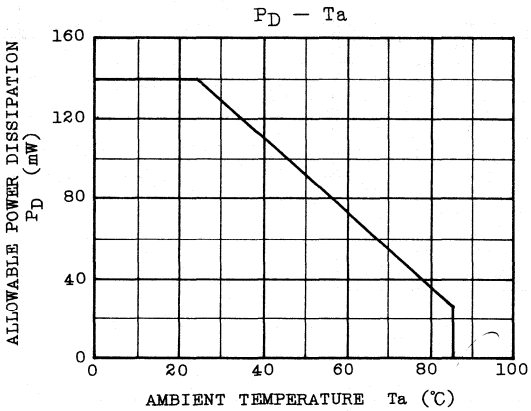
Note : Using plastic fiber cable, Fiber length=0.5m, Core Diameter=980μm, NA=0.5

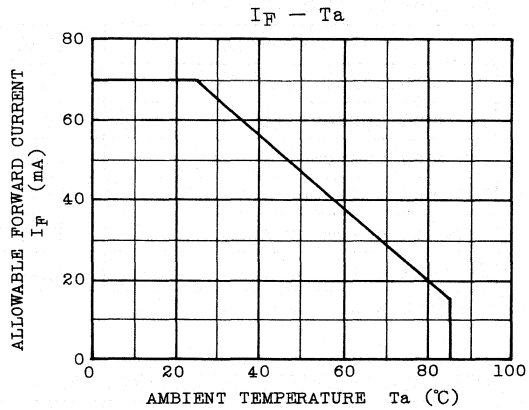
$Pf(dBm)=10\cdot\log[P(\mu W)/1000(\mu W)]$

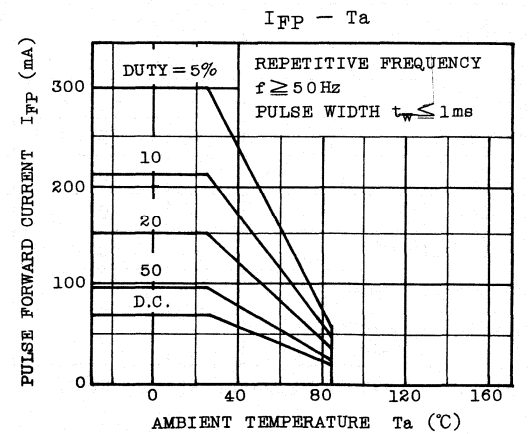
PRECUATION

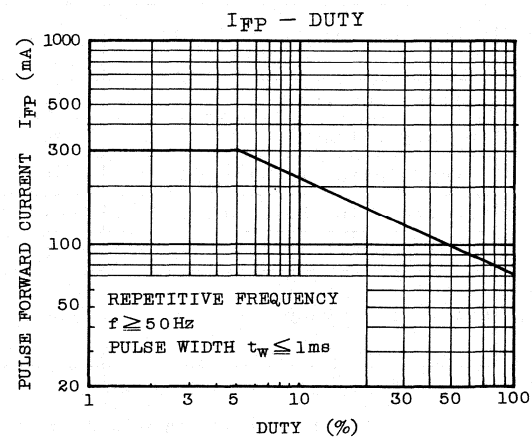
Please be careful of the followings.

1. Soldering temperature: 260°C MAX. Soldering time: 3 sec MAX.
   (Soldering portion of lead: up to 2.5mm from the body of the device)
2. If the lead is formed, the lead should be formed at a distance of 2.5mm from the body of the device. Soldering shall be performed after lead forming.
3. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   o Freon TE or TF o Dai-Fron Solvent S3 or S3-E

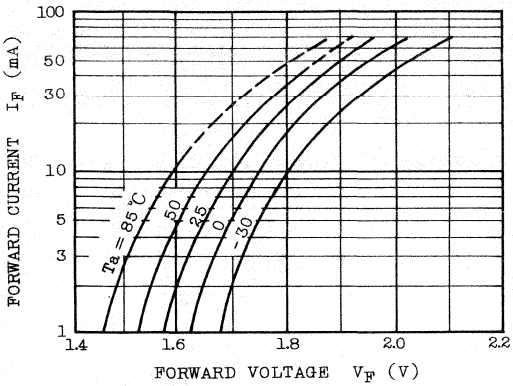




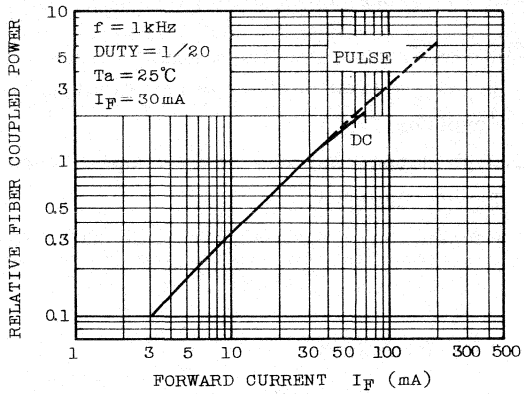




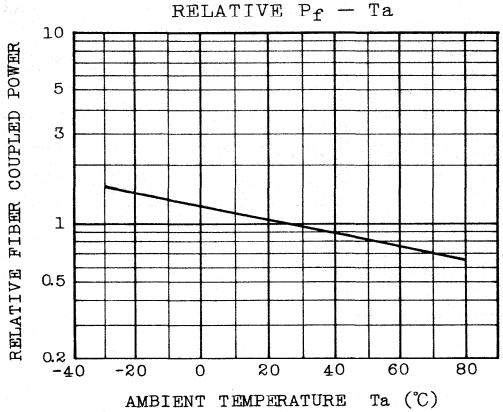
$I_F - V_F$



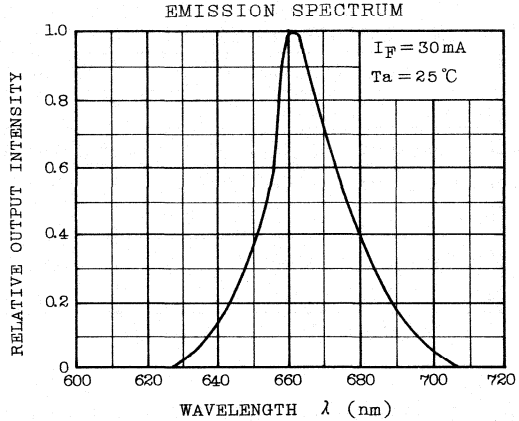
RELATIVE $P_f - I_F$



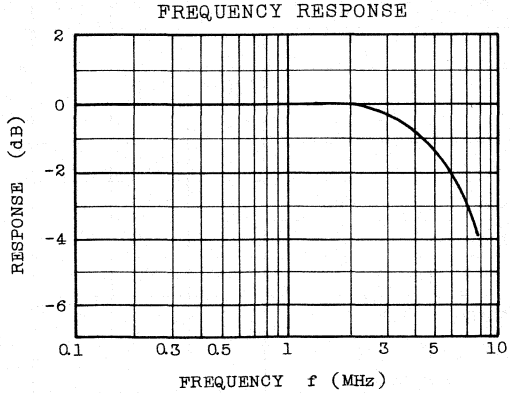
RELATIVE P_f — Ta



EMISSION SPECTRUM



FREQUENCY RESPONSE



TLRA281

LED LAMP
GaAlAs RED LIGHT EMISSION

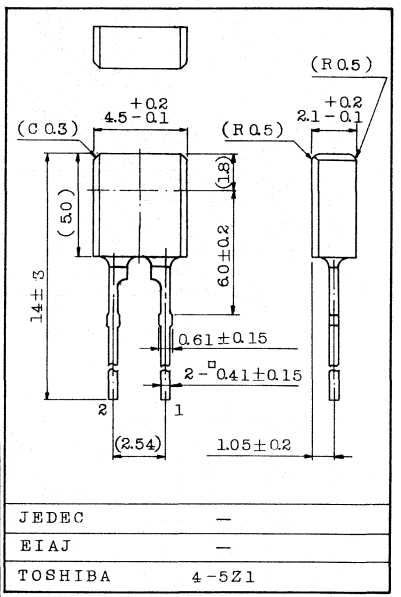
TENTATIVE DATA UNDER DEVELOPMENT

LED FOR FIBER OPTIC SYSTEM

FEATURES:

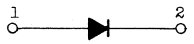
- 660nm Emitter Optimized for Plastic Fiber Cable
  λ_P=660nm(Typ.)
- High Output Optical Power Coupled Into Plastic Fiber
  P_f=-4.0dBm(Typ.)
- Mechanically Matched with PIN PHOTODIODE TPS721.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	4-5Z1

PIN CONNECTION



1. ANODE
2. CATHODE

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Power Dissipation	P_D	130	mW
Forward Current (DC)	I_F	50	mA
Forward Current (Pulse)*	I_{FP}	200	mA
Reverse Voltage	V_R	4	V
Operating Temperature	T_{opr}	-30~85	°C
Storage Temperature	T_{stg}	-40~90	°C

* Pulse Width=1msec., Duty=1/20

OPTICAL-ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Fiber Coupled Power (Note)	P_f	I_F=30mA	-7.0	-4.0	-	dBm
			200	400	-	μW
Reverse Current	I_R	V_R=4V	-	-	100	μA
Forward Voltage	V_F	I_F=30mA	-	1.9	2.5	V
Peak Emission Wavelength	λ_P	I_F=30mA	-	660	-	nm
Spectral Line Half Width	$\Delta\lambda$	I_F=30mA	-	25	-	nm
Total Capactiance	C_T	V=0V, f=1MHz	-	80	-	pF
Cutoff Frequency	f_C	I_F=30mA$_{DC}$ + 6mAp-p Output : 3dB dwon to 100kHz	-	3	-	MHz

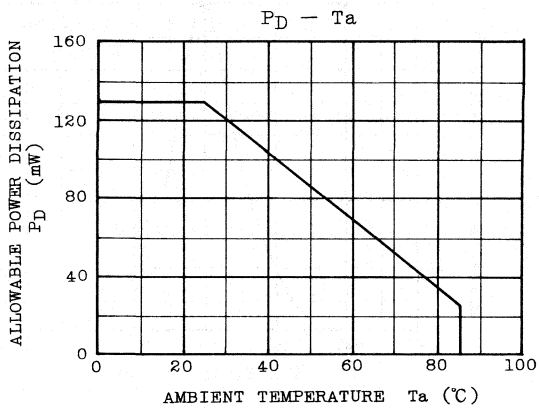
Note : Using plastic fiber cable, Fiber length=0.5m, Core Diameter=980μm, NA=0.5

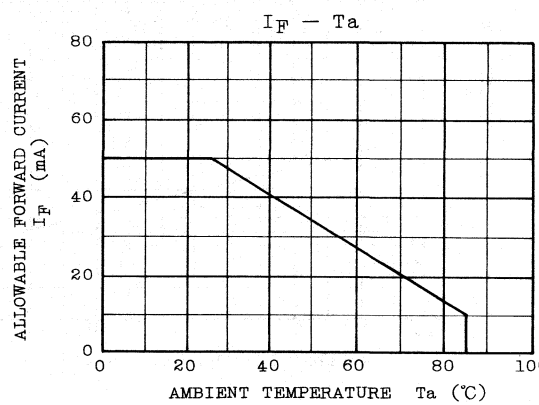
P_f(dBm)=10·log[P(μW)/1000(μW)]

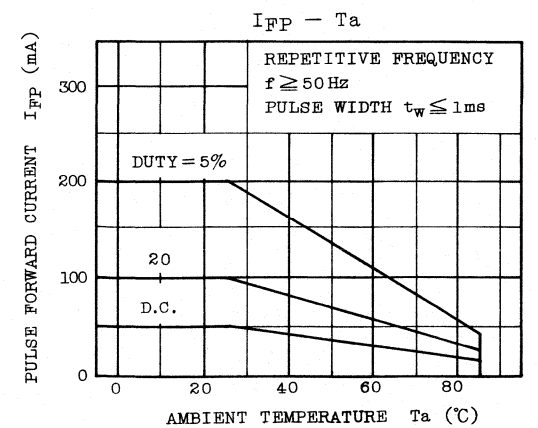
PRECAUTION

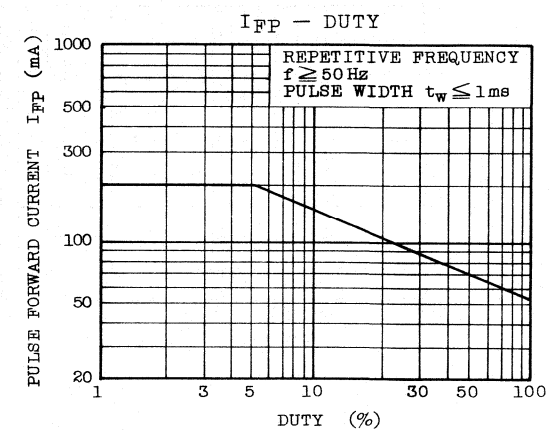
Please be careful of the followings.

1. Soldering temperature: 260°C MAX. Soldering time: 3 sec MAX.
   (Soldering portion of lead: up to 2.5mm from the body of the device)
2. If the lead is formed, the lead should be formed at a distance of 2.5mm from the body of the device. Soldering shall be performed after lead forming.
3. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   o Freon TE or TF o Dai-Fron Solvent S3 or S3-E

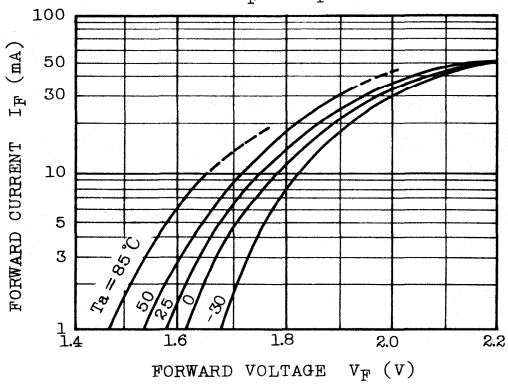




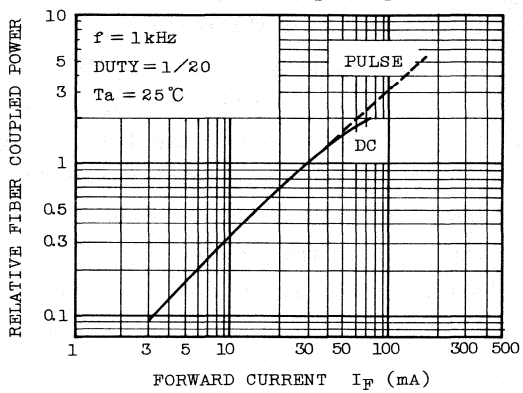




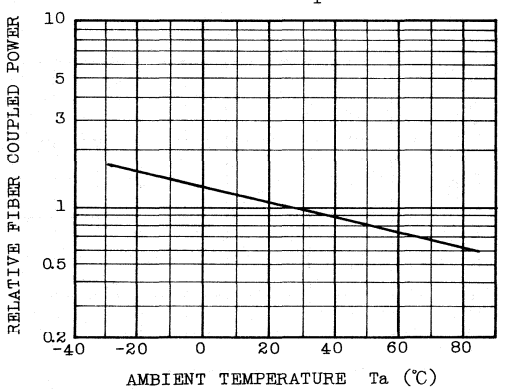
$I_F - V_F$



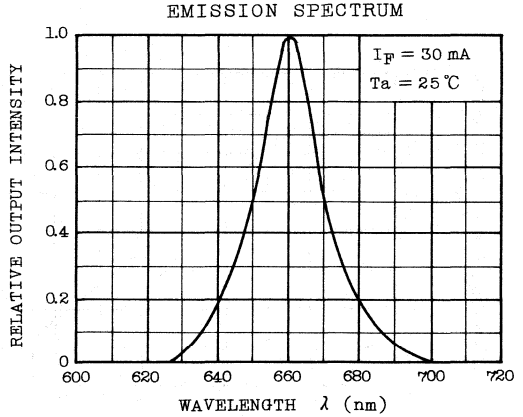
RELATIVE $P_f - I_F$



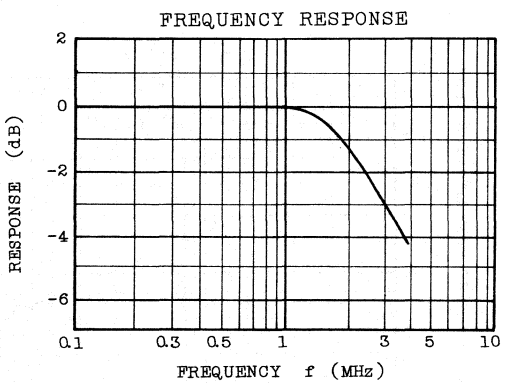
RELATIVE P_f — Ta



EMISSION SPECTRUM



FREQUENCY RESPONSE



LED LAMP
GaAlAs RED LIGHT EMISSION

TLRA282

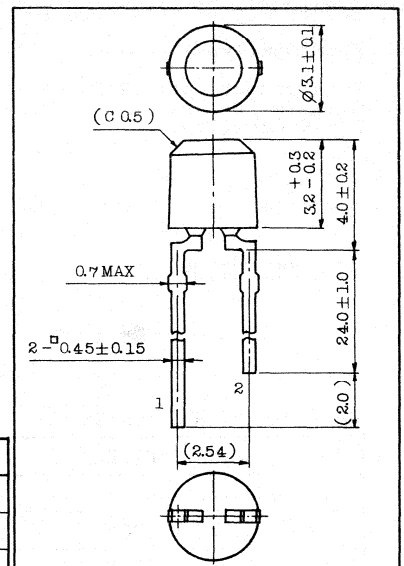
TENTATIVE DATA UNDER DEVELOPMENT

LED FOR FIBER OPTIC SYSTEM

FEATURES:

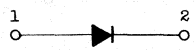
- 660nm Emitter Optimized for Plastic Fiber Cable
  λ_P=660nm(Typ.)
- High Output Optical Power Coupled Into Plastic Fiber
  Pf=-6.0dBm(Typ.)

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	4-3M1

PIN CONNECTION



1. ANODE
2. CATHODE

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Power Dissipation	P_D	130	mW
Forward Current (DC)	I_F	50	mA
Forward Current (Pulse)*	I_{FP}	200	mA
Reverse Voltage	V_R	4	V
Operating Temperature	T_{opr}	-30~85	°C
Storage Temperature	T_{stg}	-40~90	°C

* Pulse Width=1msec., Duty=1/20

OPTICAL-ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Fiber Coupled Power (Note)	P_f	I_F=30mA	-10	-6	-	dBm
			100	250	-	μW
Reverse Current	I_R	V_R=4V	-	-	100	μA
Forward Voltage	V_F	I_F=30mA	-	1.9	2.5	V
Peak Emission Wavelength	λ_P	I_F=30mA	-	660	-	nm
Spectral Line Half Width	$\Delta\lambda$	I_F=30mA	-	25	-	nm
Total Capacitance	C_T	V=0V, f=1MHz	-	80	-	pF
Cutoff Frequency	f_c	I_F=30mA$_{DC}$ + 6mAp-p Output : 3dB down to 100kHz	-	3	-	MHz

Note : Using plastic fiber cable, Fiber length=0.5m, Core Diamemter=980μm, NA=0.5

$P_f(dBm)=10\cdot\log[P(\mu W)/1000(\mu W)]$

TLN282

INFRARED LED
GaAlAs INFRARED EMITTER

TENTATIVE DATA

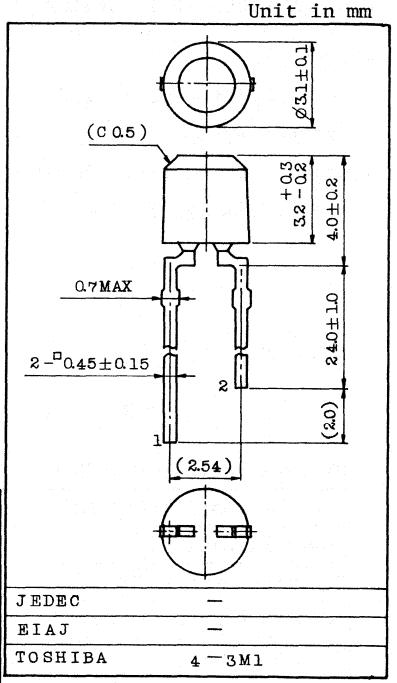
LED FOR FIBER SENSOR SYSTEM

FEATURES:

. 880nm Emitter Optimized for Fiber Sensor
  λ_P=880nm(Typ.)

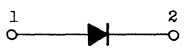
. High Output Optical Power Coupled Into Plastic Fiber
  Pf=-9.0dBm(Typ.)

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	4-3M1

PIN CONNECTION



1. ANODE
2. CATHODE

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Power Dissipation	P_D	150	mW
Forward Current (DC)	I_F	70	mA
Forward Current (Pulse)*	I_{FP}	250	mA
Reverse Voltage	V_R	4	V
Operating Temperature	T_{opr}	-30~85	°C
Storage Temperature	T_{stg}	-40~90	°C

* Pulse Width=1msec., Duty=1/20

OPTICAL-ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Fiber Coupled Power (Note)	Pf	I_F=30mA	-12	-9	-	dBm
			63	126	-	μW
Reverse Current	I_R	V_R=4V	-	-	100	μA
Forward Voltage	V_F	I_F=30mA	-	1.45	1.9	V
Peak Emission Wavelength	λ_P	I_F=30mA	-	880	-	nm
Spectral Line Half Width	$\Delta\lambda$	I_F=30mA	-	80	-	nm
Total Capacitance	C_T	V=0V, f=1MHz	-	40	-	pF

Note : Using plastic fiber cable, Fiber length=0.5m, Core Diameter=980μm, NA=0.5

$P_f(dBm)=10\cdot\log[P(\mu W)/1000(\mu W)]$

PHOTO DIODE
SILICON PIN

TPS720

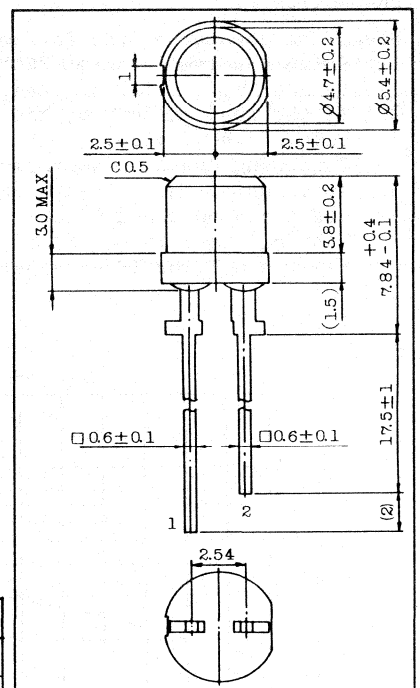
TENTATIVE DATA

PIN PHOTODIODE FOR FIBER OPTIC SYSTEM

FEATURES:

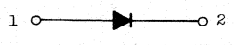
- Small Dark Current : I_D=0.2nA (Typ.)
- High Sensitivity : S_f=0.26A/W (Typ.)
- High Speed : f_c=160MHz (Typ.)
- Mechanically Matched with 660nm Emitter TLRC280

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	0-5E1

PIN CONNECTION



1. ANODE
2. CATHODE

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	50	V
Power Dissipation	P_D	150	mW
Operating Temperature	T_{opr}	-30 ∿80	°C
Storage Temperature	T_{stg}	-40 ∿100	°C

OPTICAL-ELECTRICAL CHARACTERISTICS (Ta=25°C)

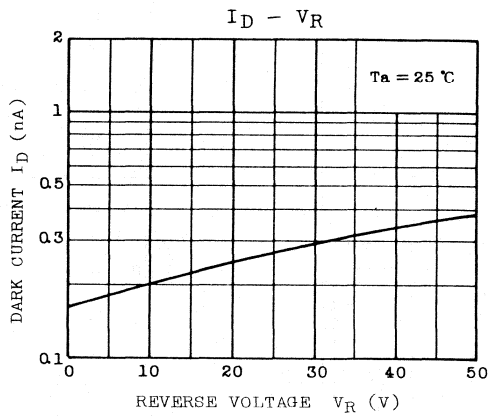
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Dark Current	I_D	V_R=10V	-	0.2	3.0	nA
Sensitivity	S	V_R=10V, λ=660nm	0.38	0.44	-	A/W
Fiber Coupled Sensitivity (Note)	S_f	V_R=10V, λ=660nm, P_f=1μW	0.20	0.26	-	A/W
Peak Sensitivity Wavelength	λp	V_R=10V	-	840	-	nm
Total Capacitance	C_T	V_R=10V, f=1MHz	-	2.5	4.0	pF
Cutoff Frequency	f_c	V_R=10V, R_L=50Ω Output: 3dB down ot 100kHz	100	160	-	MHz

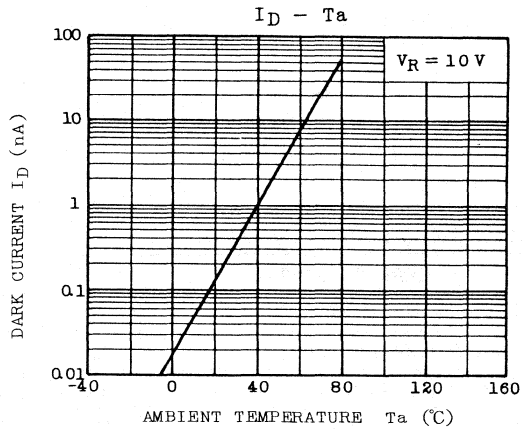
Note: Using plastic fiber cable, Fiber length=0.5m, Core Diameter=980μm, NA=0.5

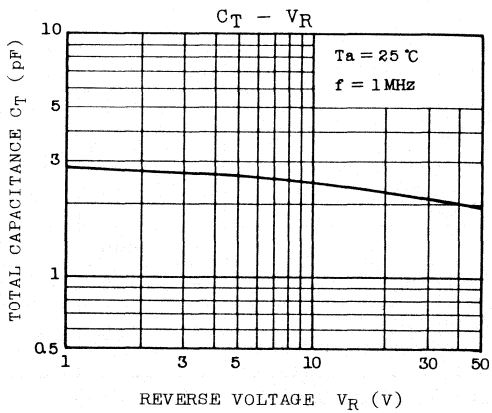
PRECAUTION

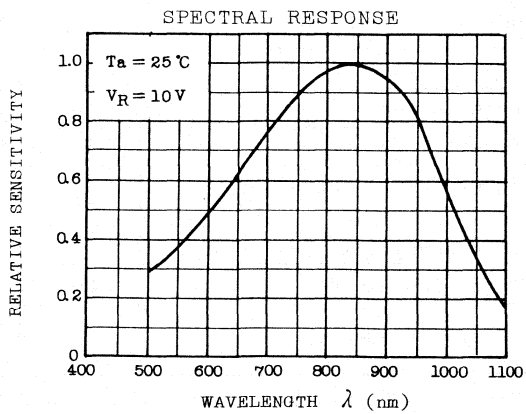
Please be careful of the followings.

1. Soldering temperature: 260°C MAX. Soldering time: 3 sec MAX.
   (Soldering portion of lead: up to 2.5mm from the body of the device)
2. If the lead is formed, the lead should be formed at a distance of 2.5mm from the body of the device.
   Soldering shall be performed after lead forming.
3. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   ∘ Freon TE or TF ∘ Dai-Fron Solvent S3 or S3-E

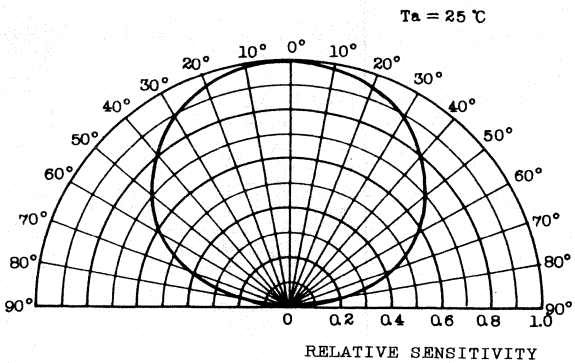




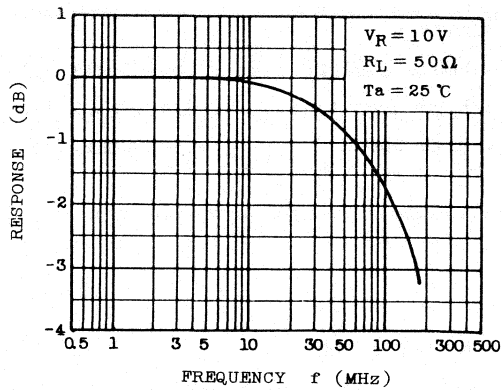




RELATIVE DIRECTIONAL SENSITIVITY



FREQUENCY RESPONSE



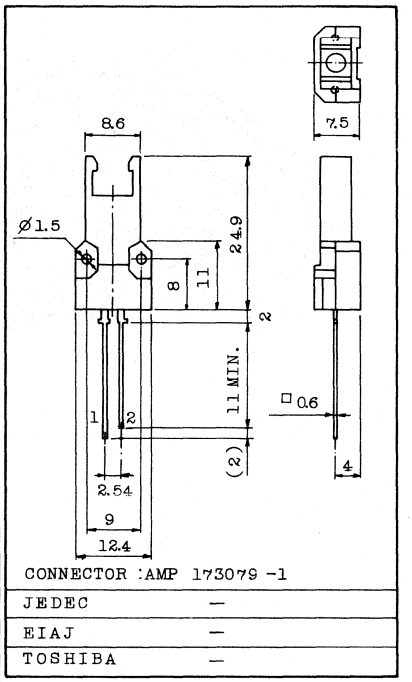
TPS720(K1)

PHOTO DIODE
SILICON PIN

TENTATIVE DATA UNDER DEVELOPMENT

PIN PHOTODIODE FOR FIBER OPTIC SYSTEM

Unit in mm



CONNECTOR :AMP 173079 -1

JEDEC	—
EIAJ	—
TOSHIBA	—

FEATURES:

- Small Dark Current : I_D=0.2nA(Typ.)
- High Sensitivity : S_f=0.26A/W(Typ.)
- High Speed : f_c=160MHz(Typ.)

PIN CONNECTION

1. ANODE
2. CATHODE

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	50	V
Power Dissipation	P_D	150	mW
Operating Temperature	T_{opr}	-20~70	°C
Storage Temperature	T_{stg}	-40~80	°C

OPTICAL-ELECTRICAL CHARACTERISTICS (Ta=25°C)

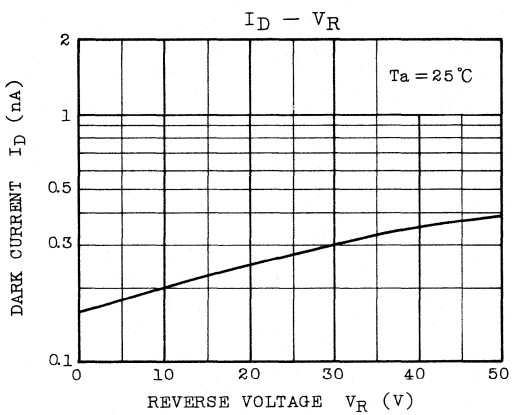
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Dark Current	I_D	V_R=10V	-	0.2	3.0	nA
Fiber Coupled Sensitivity (Note)	S_f	V_R=10V, λ=660nm P_f=1μW	0.20	0.26	-	A/W
Peak Sensitivity Wavelength	λ_P	V_R=10V	-	840	-	nm
Total Capacitance	C_T	V_R=10V, f=1MHz	-	2.5	4.0	pF
Cutoff Frequency	f_c	V_R=10V, R_L=50Ω Output : 3dB down to 100kHz	100	160	-	MHz

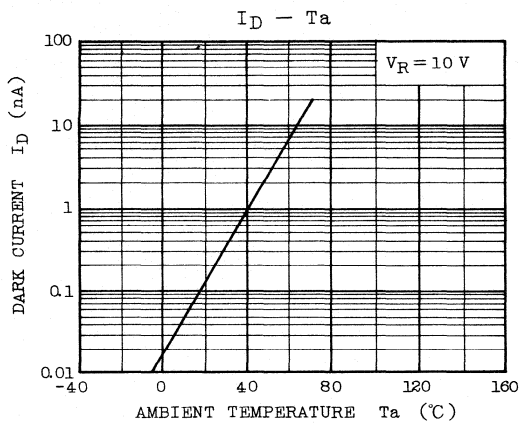
Note : Using plastic fiber cable, Fiber length=0.5m, Core Diameter=980μm, NA=0.5

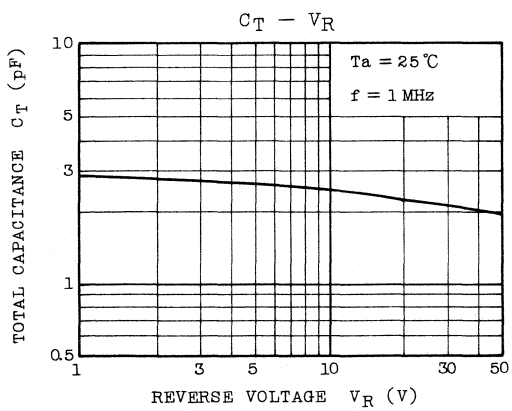
PRECAUTION

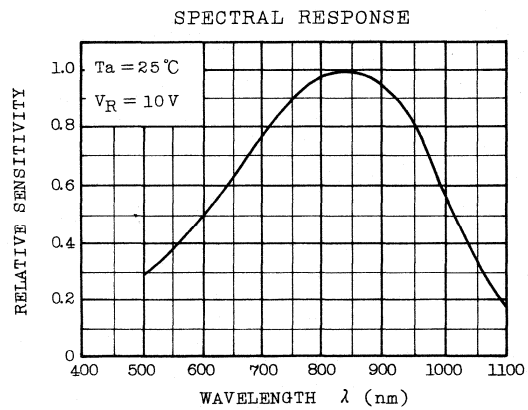
Please be careful of the followings.

1. Soldering temperature: 260°C MAX. Soldering time: 3 sec MAX.
   (Soldering portion of lead: up to 2.5mm from the body of the device)
2. If the lead is formed, the lead should be formed at a distance of 2.5mm from the body of the device. Soldering shall be performed after lead forming.
3. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   o Freon TE or TF o Dai-Fron Solvent S3 or S3-E

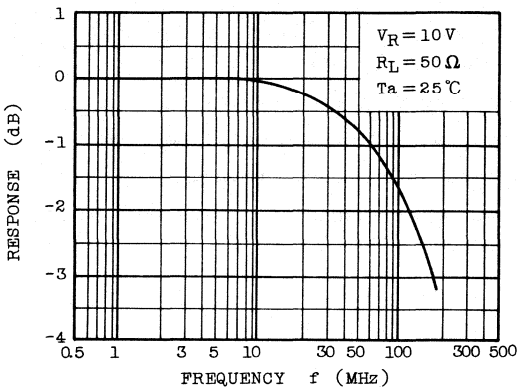








FREQUENCY RESPONSE



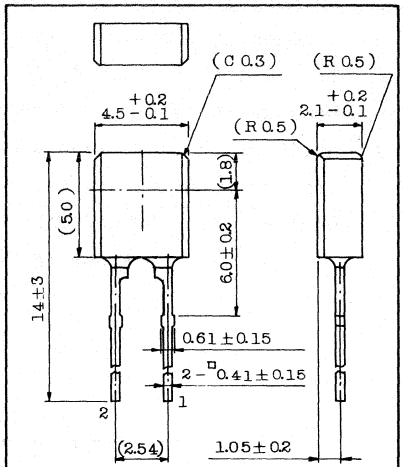
TENTATIVE DATA UNDER DEVELOPMENT

PIN PHOTODIODE FOR FIBER OPTIC SYSTEM

FEATURES:

- Small Dark Current : I_D=0.5nA(Typ.)
- High Sensitivity : S_f=0.40A/W(Typ.)
- High Speed : f_c=200MHz(Typ.)
- Mechanically Matched with 660nm Emitter TLRC281,TLRA281

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	0-5H1

PIN CONNECTION

2. ANODE
1. CATHODE

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	50	V
Power Dissipation	P_D	150	mW
Operating Temperature	T_{opr}	-30~80	°C
Storage Temperature	T_{stg}	-40~100	°C

OPTICAL-ELECTRICAL CHARACTERISTICS (Ta=25°C)

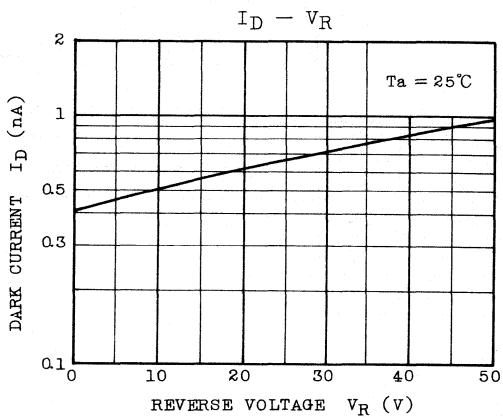
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Dark Current	I_D	V_R=10V	-	0.5	8.0	nA
Fiber Coupled Sensitivity (Note)	S_f	V_R=10V, λ=660nm P_f=1μW	0.35	0.40	-	A/W
Peak Sensitivity Wavelength	λ_P	V_R=10V	-	840	-	nm
Total Capacitance	C_T	V_R=10V, f=1MHz	-	11	20	pF
Cutoff Frequency	f_c	V_R=10V, R_L=50Ω Output : 3dB dwon to 100kHz	100	200	-	MHz

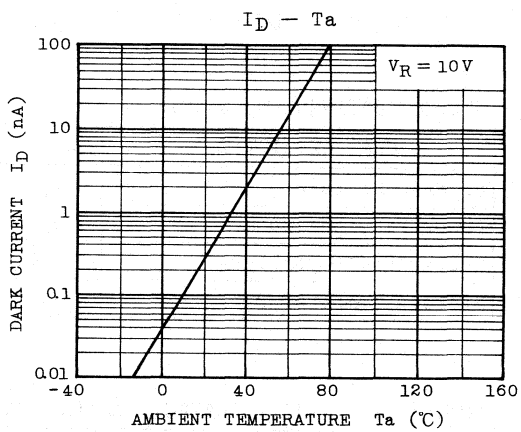
Note : Using plastic fiber cable, Fiber length=0.5m, Core Diameter=980μm, NA=0.5

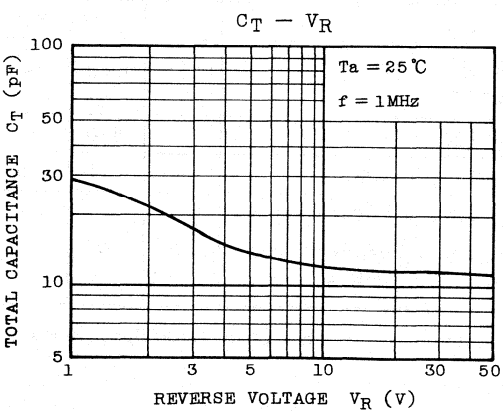
PRECAUTION

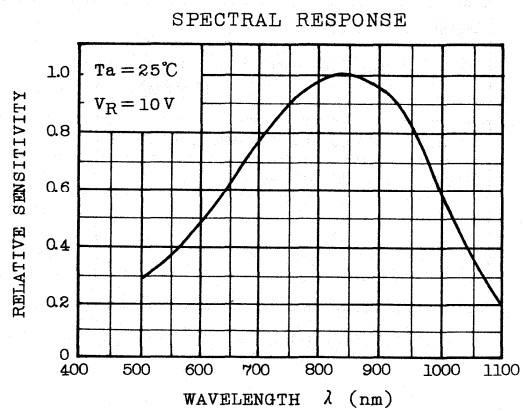
Please be careful of the followings.

1. Soldering temperature: 260°C MAX. Soldering time: 3 sec MAX.
   (Soldering portion of lead: up to 2.5mm from the body of the device)
2. If the lead is formed, the lead should be formed at a distance of 2.5mm from the body of the device. Soldering shall be performed after lead forming.
3. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   o Freon TE or TF o Dai-Fron Solvent S3 or S3-E

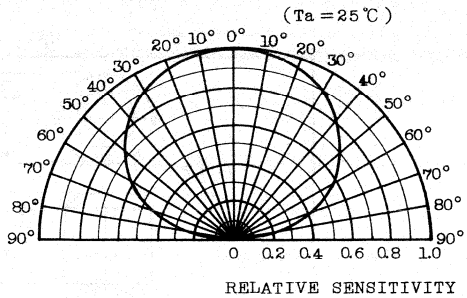




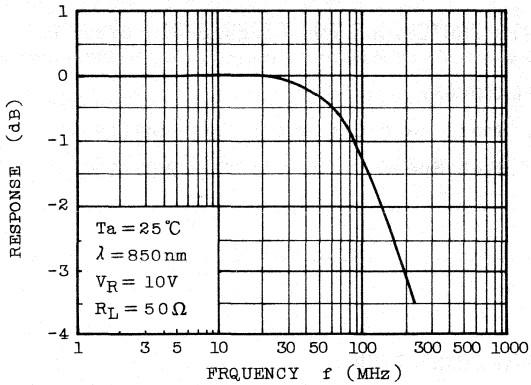




RELATIVE DIRECTIONAL SENSYTIVITY



FREQUENCY RESPONSE



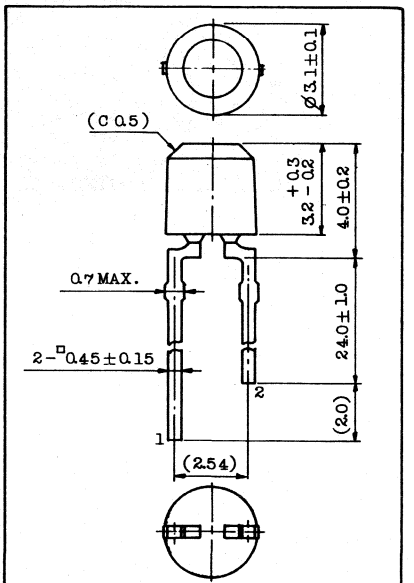
TPS722

PHOTO DIODE
SILICON PIN

TENTATIVE DATA UNDER DEVELOPMENT

PIN PHOTODIODE FOR FIBER OPTIC SYSTEM

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	0−3E1

FEATURES:

. Small Dark Current : I_D=0.2nA(Typ.)

. High Speed : f_C=40MHz(Typ.)

PIN CONNECTION

1. ANODE
2. CATHODE

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	30	V
Power Dissipation	P_D	100	mW
Operating Temperature	Topr	-30~80	°C
Storage Temperature	Tstg	-40~100	°C

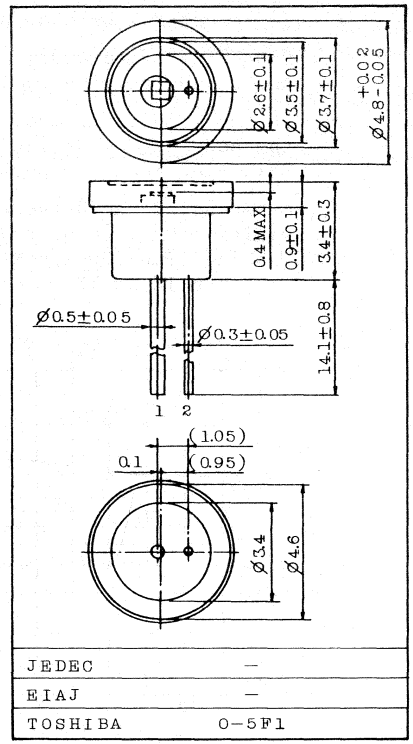
OPTICAL-ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Dark Current	I_D	V_R=10V	-	0.2	-	nA
Fiber Coupled Sensitivity (Note)	Sf	V_R=10V, λ=660nm P_f=1μW	-	0.1	-	A/W
Peak Sensitivity Wavelength	λ_P	V_R=10V	-	840	-	nm
Total Capacitance	C_T	V_R=10V, f=1MHz	-	2.5	-	pF
Cutoff Frequency	f_C	V_R=10V, R_L=50Ω Output : 3dB down to 100kHz	-	200	-	MHz

Note : Using plastic fober cable, Fiber length=0.5m, Core Diameter=980μm, NA=0.5

UNDER DEVELOPMENT

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	0-5F1

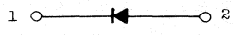
TENTATIVE DATA

PIN PHOTODIODE FOR FIBER OPTIC SYSTEM

FEATURES:

- Active Area Diameter : $\phi 0.4$ mm
- High Quantum Efficiency : $\eta = 85\%$ (Typ.)
- Small Dark Current : $I_D = 0.1$ nA (Typ.)
- High Speed : $f_c = 600$ MHz (Typ.)

PIN CONNECTION



1. CATHODE
2. ANODE

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	50	V
Forward Current	I_F	100	mA
Operating Temperature	T_{opr}	-40 ∿ 80	°C
Storage Temperature	T_{stg}	-65 ∿ 150	°C

OPTICAL-ELECTRICAL CHARACTERISTICS (Ta=25°C)

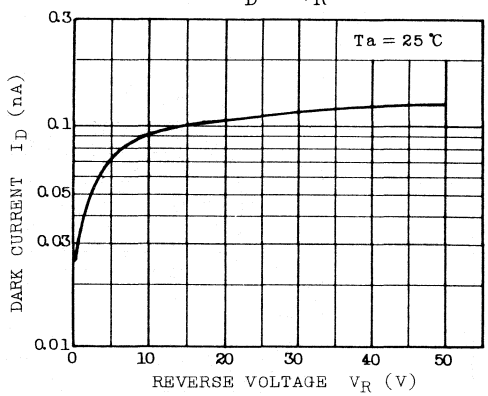
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Dark Current	I_D	$V_R = 20V$	-	0.1	1.5	nA
Quantum Efficiency	η	$V_R = 5V$, $\lambda = 850$ nm	70	85	-	%
Peak Sensitivity Wavelength	λp	$V_R = 20V$	-	840	-	nm
Total Capacitance	C_T	$V_R = 20V$, f = 1MHz	-	1	2	pF
Cutoff Frequency	f_c	$V_R = 20V$, $R_L = 50\Omega$ Output: 3 dB down to 100 kHz	200	600	-	MHz

PRECAUTION

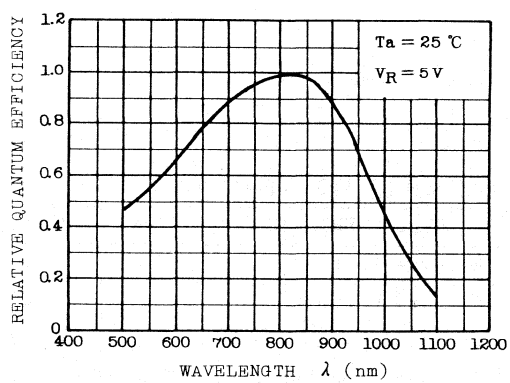
Please be careful of the followings.

1. Soldering temperature: 260°C MAX. Soldering time: 5 sec MAX.
   (Soldering portion of lead: up to 2 mm from the body of the device)
2. If the lead is formed, the lead should be formed at a distance of 2 mm from the body of the device.
   Soldering shall be performed after lead forming.
3. Avoid using the Solvents except for the followings, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   ∘ Freon TE or TF ∘ Dai-Fron Solvent S3 or S3-E

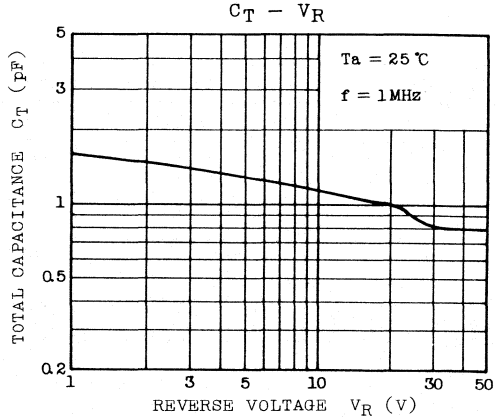
$I_D - V_R$



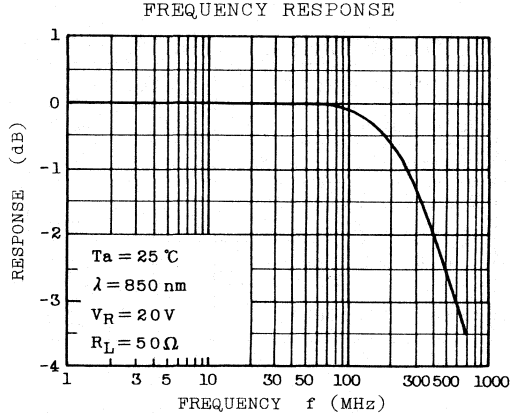
SPECTRAL RESPONSE



$C_T - V_R$



FREQUENCY RESPONSE

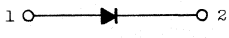


TENTATIVE DATA

PIN PHOTODIODE FOR FIBER OPTIC SYSTEM

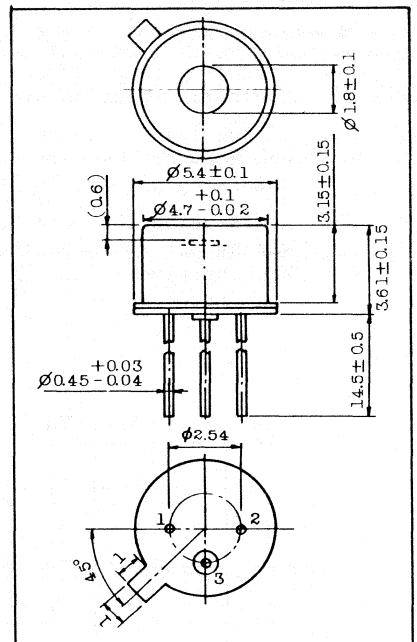
FEATURES:

Active Area Diameter	:	ϕ0.4 mm
High Quantum Efficiency	:	η = 85% (Typ.)
Small Dark Current	:	I_D = 0.1 nA (Typ.)
High Speed	:	f_c = 600 MHz (Typ.)



1. ANODE
2. CATHODE
3. CASE

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	0-5G1

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Votlage	V_R	50	V
Forward Current	I_F	100	mA
Operating Temperature	T_{opr}	-40 ∿ 80	°C
Storage Temperature	T_{stg}	-65 ∿ 150	°C

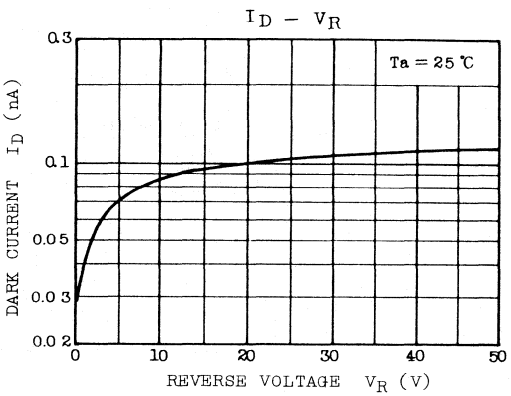
OPTICAL-ELECTRICAL CHARACTERISTICS (Ta=25°C)

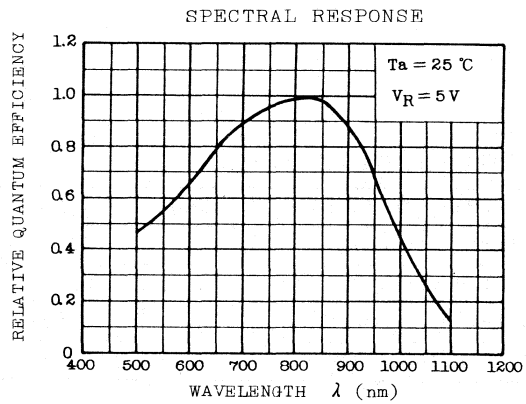
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Dark Current	I_D	V_R = 20V	-	0.1	1.5	nA
Quantum Efficiency	η	V_R = 5V, λ = 850 nm	70	85	-	%
Peak Sensitivity Wavelength	λp	V_R = 20V	-	840	-	nm
Total Capacitance	C_T	V_R = 20V, f = 1 MHz	-	1.1	3.0	pF
Cutoff Frequency	f_c	V_R = 20V, R_L = 50Ω Output: 3 dB down to 100 kHz	200	600	-	MHz

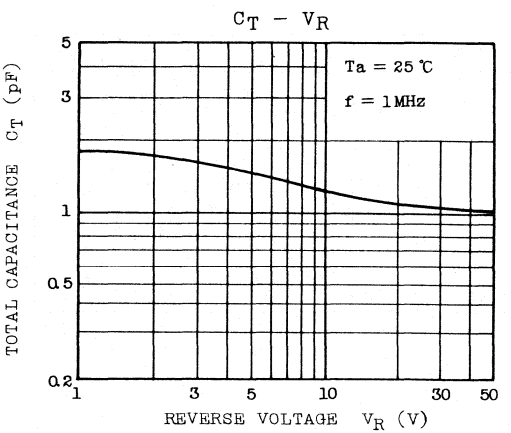
PRECAUTION

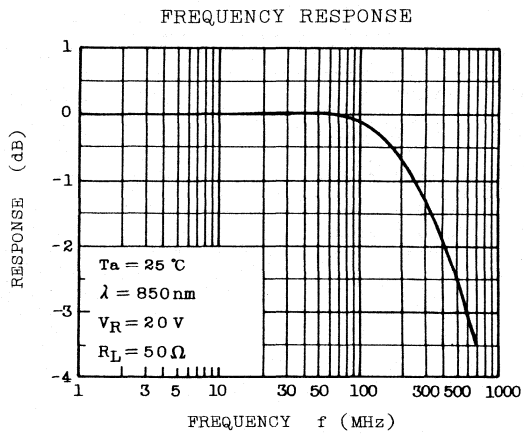
Please be careful of the followings.

1. Soldering temperature: 260°C MAX. Soldering time: 5 sec MAX.
   (Soldering portion of lead: up to 2 mm from the body of the device)
2. If the lead is formed, the lead should be formed at a distance of 2 mm from the body of the device.
   Soldering shall be performed after lead forming.
3. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   ∘ Freon TE or TF ∘ Dai-Fron Solvent S3 or S3-E









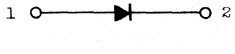
TENTATIVE DATA

PIN PHOTODIODE FOR FIBER OPTIC SYSTEM

FEATURES:

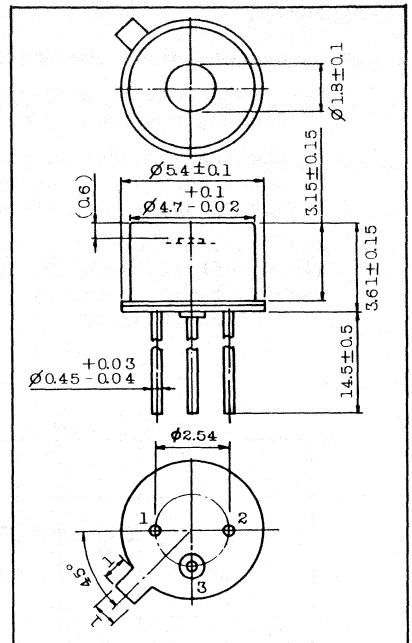
- Active Area Diameter : ϕ0.8 mm
- High Quantum Efficiency : η = 85% (Typ.)
- Small Dark Current : I_D = 0.2 nA (Typ.)
- High Speed : f_c = 400 MHz (Typ.)

PIN CONNECTION



1. ANODE
2. CATHODE
3. CASE

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	0-5G1

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	50	V
Forward Current	I_F	100	mA
Operating Temperature	T_{opr}	-40 ∿ 80	°C
Storage Temperature	T_{stg}	-65 ∿ 150	°C

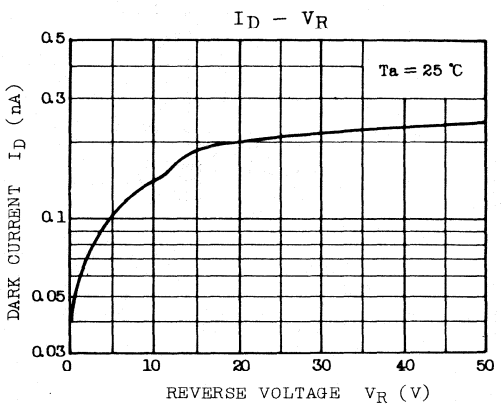
OPTICAL-ELECTRICAL CHARACTERISTICS (Ta=25°C)

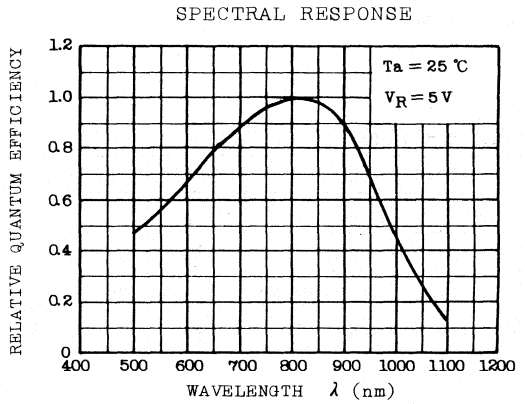
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Dark Current	I_D	V_R = 20V	-	0.2	3.0	nA
Quantum Efficiency	η	V_R = 5V, λ = 850 nm	70	85	-	%
Peak Sensitivity Wavelength	λp	V_R = 20V	-	840	-	nm
Total Capacitance	C_T	V_R = 20V, f = 1 MHz	-	2.5	4.0	pF
Cutoff Frequency	f_c	V_R = 20V, R_L = 50Ω Output: 3 dB down to 100 kHz	100	400	-	MHz

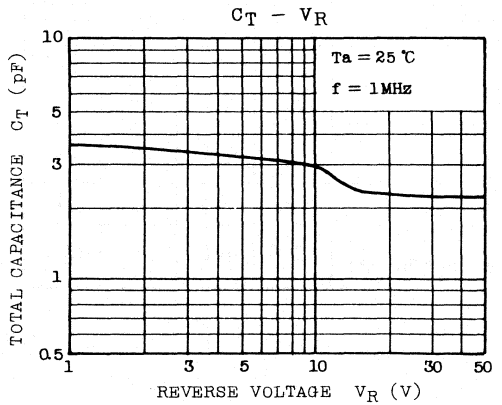
PRECAUTION

Please be careful of the followings.

1. Soldering temperature: 260°C MAX. Soldering time: 5 sec MAX.
   (Soldering portion of lead: up to 2 mm from the body of the device)
2. If the lead is formed, the lead should be formed at a distance of 2 mm from the body of the device.
   Soldering shall be performed after lead forming.
3. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   - Freon TE or TF
   - Dai-Fron Solvent S3 or S3-E







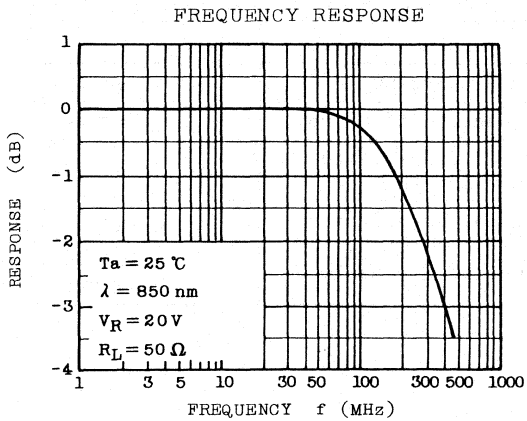


PHOTO DIODE
SILICON PIN

TPS733

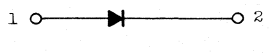
TENTATIVE DATA

PIN PHOTODIODE FOR FIBER OPTIC SYSTEM

FEATURES:

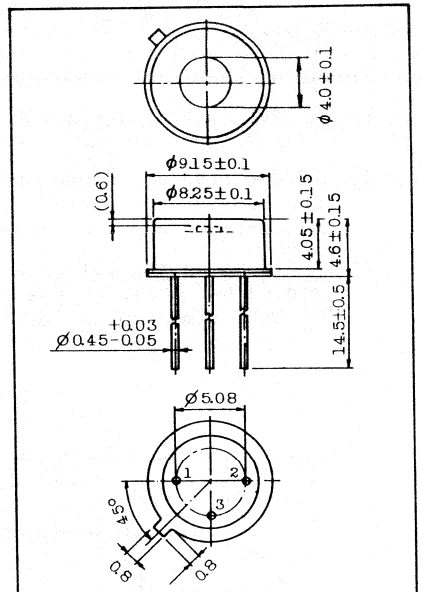
- Active Area Diameter : ϕ2.0 mm
- High Quantum Efficiency : η = 85% (Typ.)
- Small Dark Current : I_D = 0.5 nA (Typ.)
- High Speed : f_c = 200 MHz (Typ.)

PIN CONNECTION



1. ANODE
2. CATHODE
3. CASE

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	0-8C1

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	50	V
Forward Current	I_F	100	mA
Operating Temperature	T_{opr}	-40 ∿ 80	°C
Storage Temperature	T_{stg}	-65 ∿ 150	°C

OPTICAL-ELECTRICAL CHARACTERISTICS (Ta=25°C)

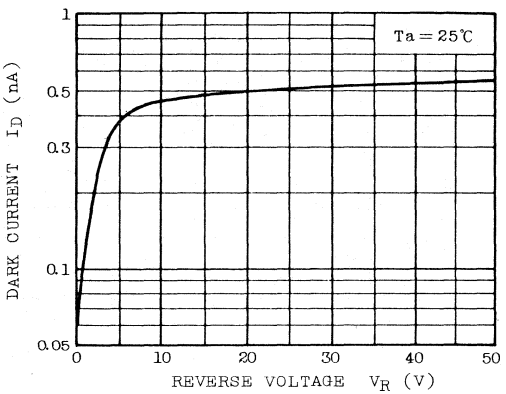
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Dark Current	I_D	V_R = 20V	-	0.5	8.0	nA
Quantum Efficiency	η	V_R = 5V, λ = 850 nm	70	85	-	%
Peak Sensitivity Wavelength	λp	V_R = 20V	-	840	-	nm
Total Capacitance	C_T	V_R = 20V, f = 1 MHz	-	11.0	20.0	pF
Cutoff Frequency	f_c	V_R = 20V, R_L = 50Ω Output: 3 dB down to 100kHz	70	200	-	MHz

PRECAUTION

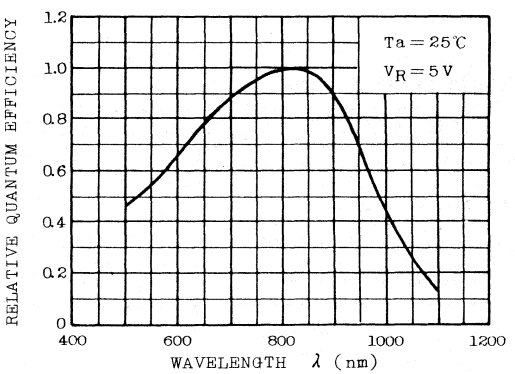
Please be careful of the followings.

1. Soldering temperature: 260°C MAX. Soldering time: 5 sec MAX.
   (Soldering portion of lead: up to 2 mm from the body of the device)
2. If the lead is formed, the lead should be formed at a distance of 2 mm from the body of the device.
   Soldering shall be performed after lead forming.
3. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   - Freon TE or TF
   - Dai-Fron Solvent S3 or S3-E

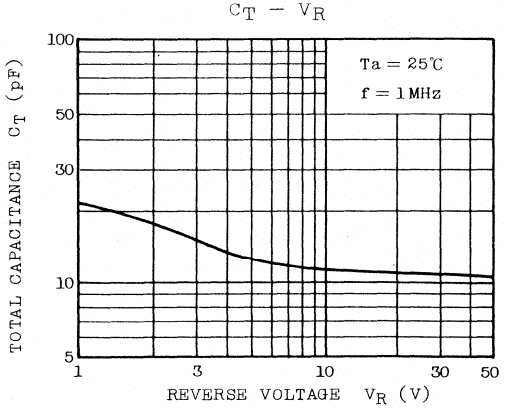
$I_D - V_R$



SPECTRAL RESPONSE



$C_T - V_R$



FREQUENCY RESPONSE

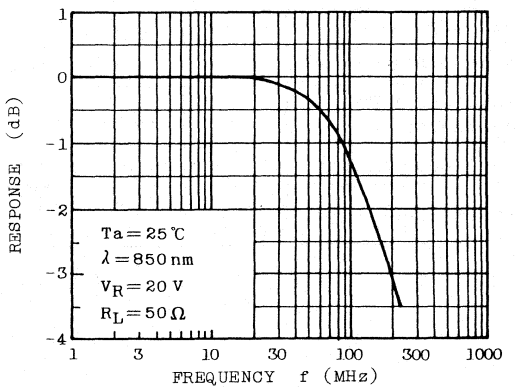


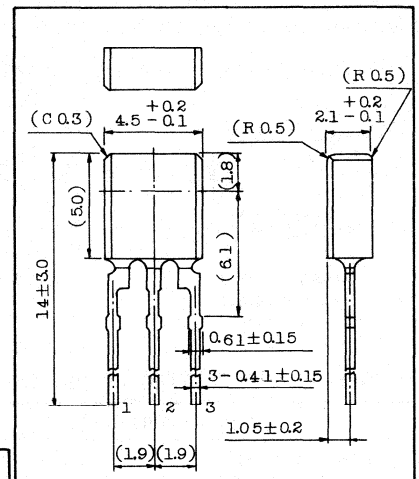
PHOTO IC
SILICON EPITAXIAL PLANER

TPS821

TENTATIVE DATA UNDER DEVELOPMENT

- TTL, LSTTL, CMOS Compatible Output.
- Wide Operating Supply Voltage Range. (V_{CC}=4.5V~16V)
- TPS821 Contains Photodiode, Amplifier, Shumit Trigger and Output Circuit on 1 Chip IC.
- Including Surge Absorbing Diode in Output Circuit.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	0 — 5H2

PIN CONNECTION

1. GND
2. V_{OUT}
3. V_{CC}

MAXIMUM RATINGS (Ta=25°C)

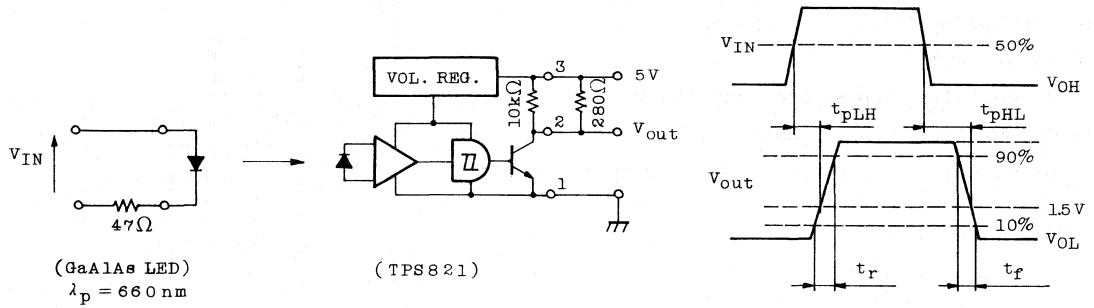
CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage	V_{CC}	16	V
Low Level Output Current	I_{OL}	50	mA
Allowable Power Dissipation	P_O	250	mW
Operating Temperature	T_{opr}	-25~85	°C
Storage Temperature	T_{stg}	-40~100	°C
Lead Soldering Cycle	T_{sol}	260°C, 3 sec	

OPTICAL-ELECTRICAL CHARACTERISTICS (Ta=0~70°C, Unless otherwise specified)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Voltage		V_{CC}	Ta=25°C	4.5	-	16	V
Low Level Output Voltage		V_{OL}	I_{OL}=16mA, V_{CC}=5V	-	0.1	0.4	V
High Level Output Voltage		V_{OH}	V_{CC}=5V	4.0	-	-	V
Low Level Supply Current		I_{CCL}	V_{CC}=5V	-	6	15	mA
High Level Supply Current		I_{CCH}	V_{CC}=5V	-	4	10	mA
Input Power Level Logic "L" → "H"		P_{fLH}	V_{CC}=5V, Ta=25°C λ_P=660nm (Note 1)	-23	-19	-15	dBm
				5.0	12.0	30.0	μW
Switching Time	Propagation Delay "L"→"H"	t_{pLH}	Ta=25°C, V_{CC}=5 R_L=280Ω (Note 2)	-	3	-	μs
	Propagation Delay "H"→"L"	t_{pHL}		-	5	-	
	Rise Time	t_r		-	0.1	-	
	Fall Time	t_f		-	0.05	-	

Note 1 : Using Plastic fiber cable, Core Diameter=980μm, NA=0.5

Note 2 : Switching Time Test Circuit and Voltage Waveform



RECOMMENDED OPERATING CONDITION

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}	4.5	5	(Note) 16	V
Operating Temperature	Topr	0	-	70	°C

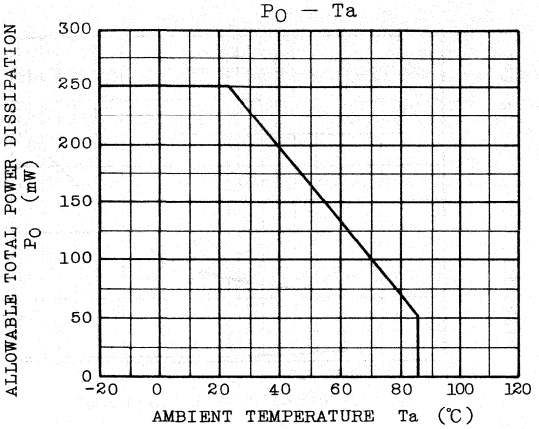
Note : At V_{CC}=10V, $R_L \geqq 1k\Omega$. At V_{CC}=15V, $R_L > 500k\Omega$.

PRECAUTION

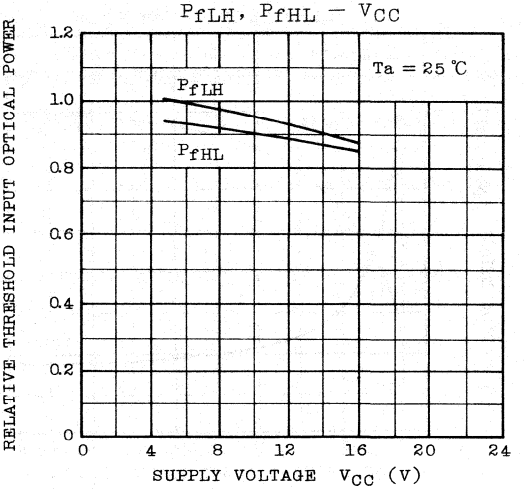
Please be careful of the followings

1. Soldering temperature: 260°C MAX. Soldering time: 3 sec MAX.
   (Soldering portion of lead: up to 2mm from the body of the device)
2. If the lead is formed, the lead should be formed at a distance of 2mm from the body of the device.
   Soldering shall be performed after lead forming.
3. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   o Freon TE or TF o Dai-Fron Solvent S3 or S3-E
4. During 100μs after turning ON V_{CC}, output voltage changes at random, because of inner circuit's stability.
5. Pin surge voltage MAX. 150V at C=200pF.

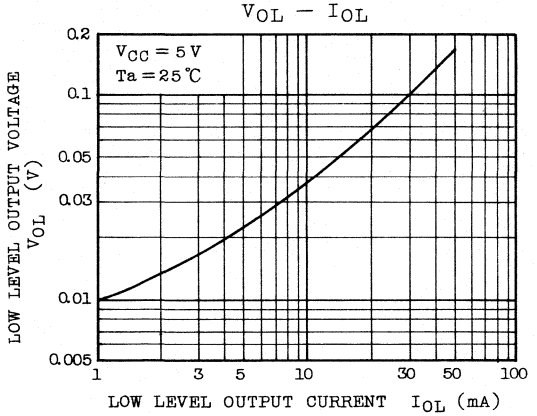
P_O — Ta



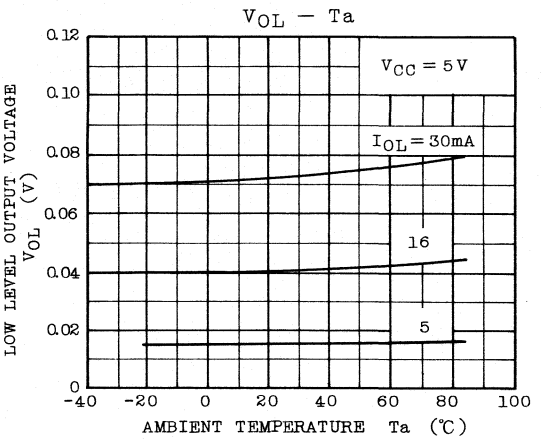
P_{fLH}, P_{fHL} — V_{CC}



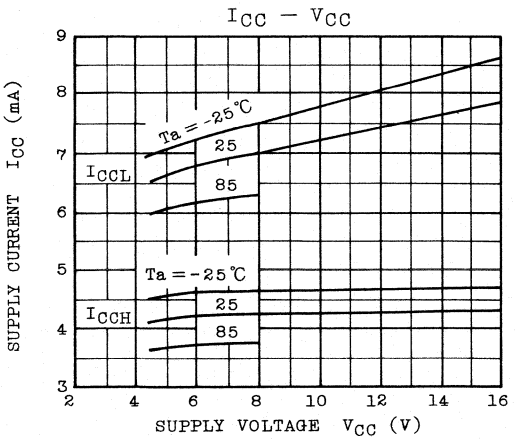
V_{OL} — I_{OL}

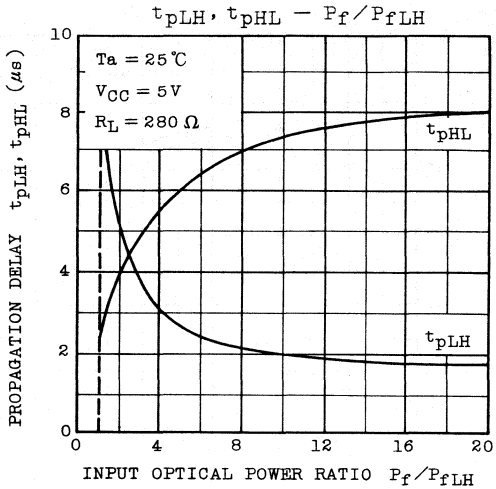


V_{OL} — Ta



I_{CC} — V_{CC}




$t_{pLH}, t_{pHL} - P_f/P_{fLH}$
Ta = 25℃
V_{CC} = 5V
R_L = 280 Ω
t_{pHL}
t_{pLH}
PROPAGATION DELAY t_{pLH}, t_{pHL} (μs)
INPUT OPTICAL POWER RATIO P_f/P_{fLH}
0
2
4
6
8
10
0
4
8
12
16
20

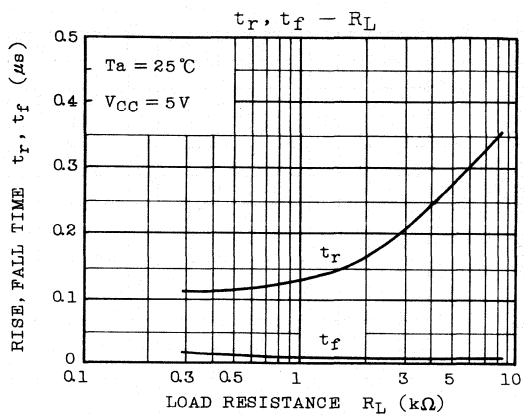

$t_r, t_f - R_L$
Ta = 25℃
V_{CC} = 5V
t_r
t_f
RISE, FALL TIME t_r, t_f (μs)
LOAD RESISTANCE R_L (kΩ)
0
0.1
0.2
0.3
0.4
0.5
0.1
0.3
0.5
1
3
5
10

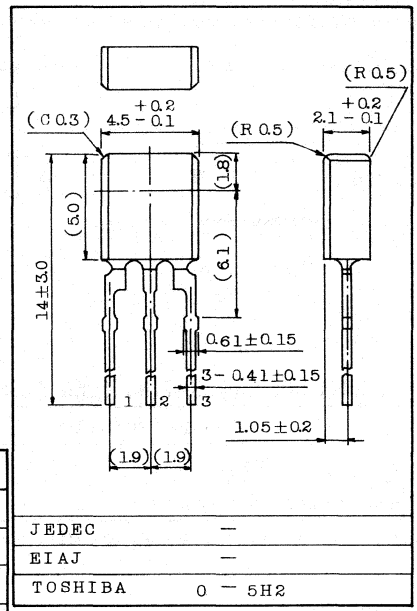
PHOTO IC
SILICON EPITAXIAL PLANER

TPS822

TENTATIVE DATA UNDER DEVELOPMENT

- TTL, LSTTL, CMOS Compatible Output.
- Wide Operating Supply Voltage Range. (V_{CC}=4.5V~16V)
- TPS822 Contains Photodiode, Amplifier, Shumit Trigger and Output Circuit on 1 Chip IC.
- Including Surge Absorbing Diode in Output Circuit.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	0 − 5H2

PIN CONNECTION

1. GND
2. V_{OUT}
3. V_{CC}

MAXIMUM RATINGS (Ta=25°C)

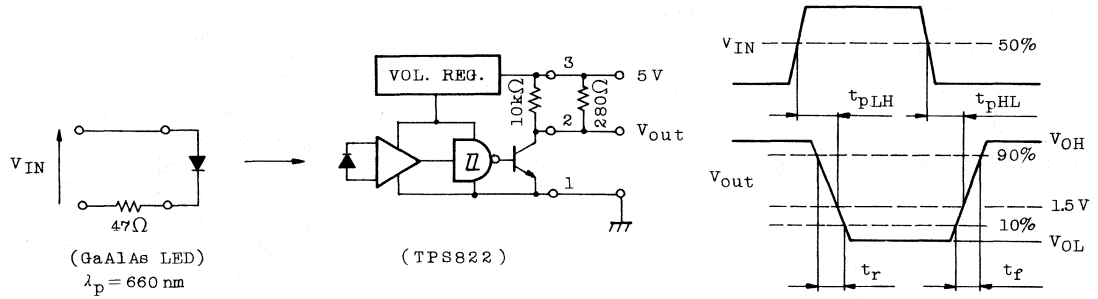
CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage	V_{CC}	16	V
Low Level Output Current	I_{OL}	50	mA
Allowable Power Dissipation	P_O	250	mW
Operating Temperature	T_{opr}	-25~85	°C
Storage Temperature	T_{stg}	-40~100	°C
Lead Soldering Cycle	T_{sol}	260°C, 3 sec	

OPTICAL-ELECTRICAL CHARACTERISTICS (Ta=0~70°C, Unless otherwise specified)

CHARACTERISTIC			SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Voltage			V_{CC}	Ta=25°C	4.5	-	16	V
Low Level Output Voltage			V_{OL}	I_{OL}=16mA, V_{CC}=-V	-	0.1	0.4	V
High Level Output Voltage			V_{OH}	V_{CC}=5V	4.0	-	-	V
Low Level Supply Current			I_{CCL}	V_{CC}=5V	-	6	15	mA
High Level Supply Current			I_{CCH}	V_{CC}=5V	-	4	10	mA
Input Power Level Logic "H" "L"			P_{fHL}	V_{CC}=5V, Ta=25°C λ_P=660nm (Note 1)	-23	-19	-15	dBm
					5.0	12.0	30.0	μW
Switching Time	Propagation Delay	"L"→"H"	t_{pLH}	Ta=25°C, V_{CC}=5V R_L=280Ω (Note 2)	-	8	-	μs
		"H"→"L"	t_{pHL}		-	5	-	
	Rise Time		t_r		-	0.1	-	
	Fall Time		t_f		-	0.05	-	

Note 1 : Using Plastic fiber cable, Core Diameter=980μm, NA=0.5

Note 2 : Switching Time Test Circuit and Voltage Waveform



RECOMMENDED OPERATING CONDITION

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}	4.5	5	(Note) 16	V
Operating Temperature	T_{opr}	0	-	70	°C

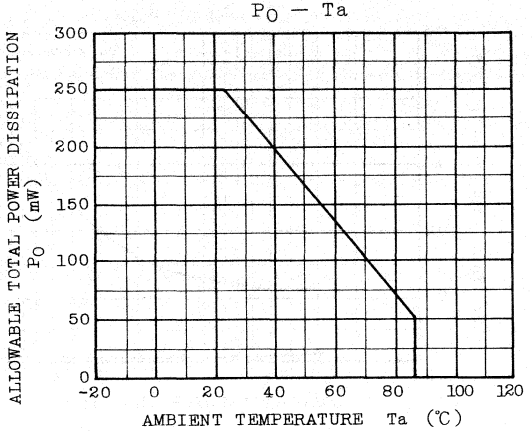
Note : At V_{CC}=10V, $R_L \geqq 1k\Omega$. At V_{CC}=15V, $R_L > 500k\Omega$.

PRECAUTION

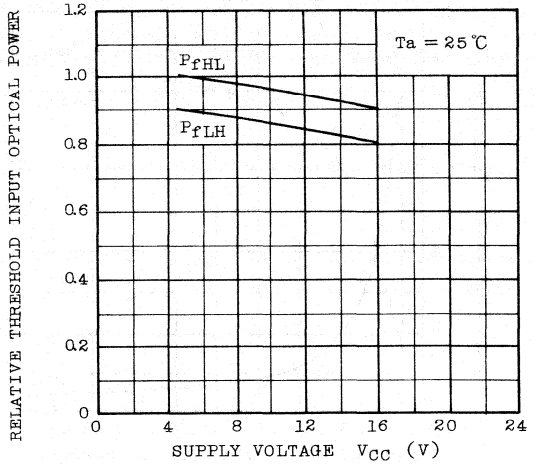
Please be careful of the followings

1. Soldering temperature: 260°C MAX. Soldering time: 3 sec MAX.
   (Soldering portion of lead: up to 2mm from the body of the device)
2. If the lead is fromed, the lead should be formed at a distance of 2mm from the body of the device.
   Soldering shall be performed after lead forming.
3. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   o Freon TE or TF o Dai-Fron Solvent S3 or S3-E
4. During 100μs after turning ON V_{CC}, output voltage changes at random, because of inner circuit's stability.
5. Pin surge voltage MAX. 150V at C=200pF.

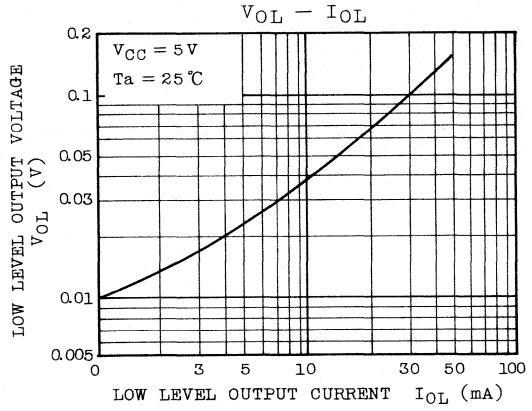
P_O — Ta



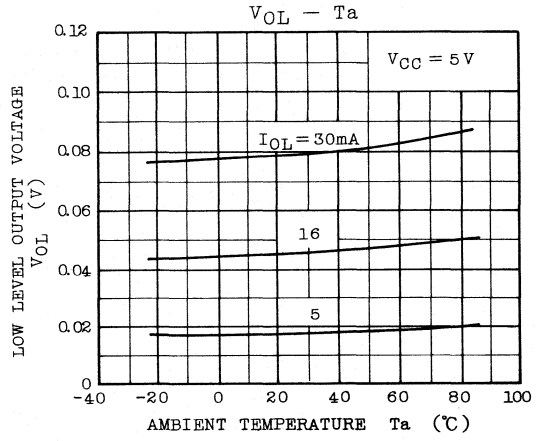
P_{fHL}, P_{fLH} — V_{CC}



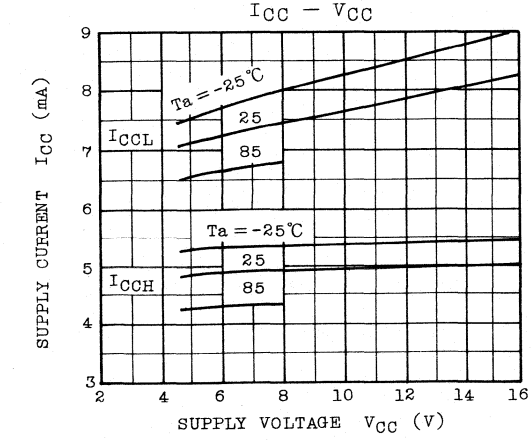
V_{OL} — I_{OL}

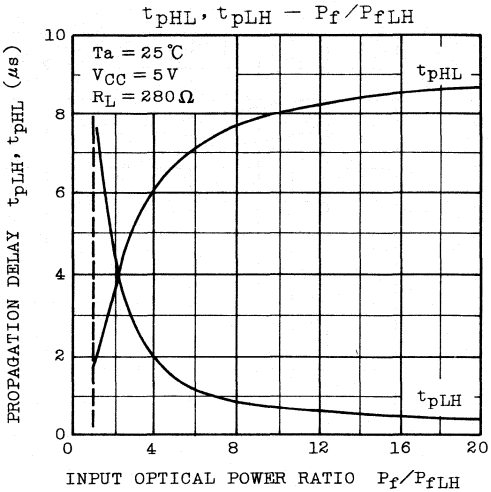


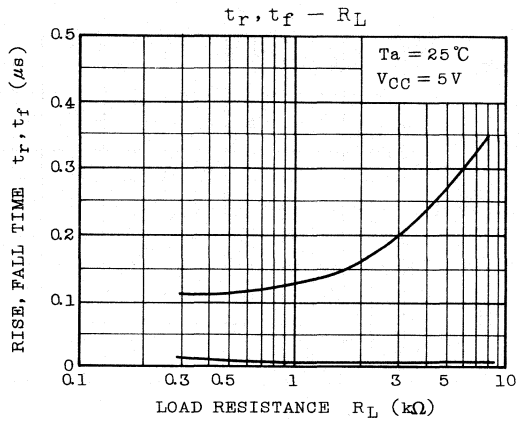
V_{OL} — Ta



I_{CC} — V_{CC}




$t_{pHL}, t_{pLH} - P_f/P_{fLH}$
Ta = 25℃
V_{CC} = 5V
R_L = 280Ω
t_{pHL}
t_{pLH}
PROPAGATION DELAY t_{pLH}, t_{pHL} (μs)
0
2
4
6
8
10
0
4
8
12
16
20
INPUT OPTICAL POWER RATIO P_f/P_{fLH}


$t_r, t_f - R_L$
Ta = 25℃
V_{CC} = 5V
RISE, FALL TIME t_r, t_f (μs)
0
0.1
0.2
0.3
0.4
0.5
0.1
0.3
0.5
1
3
5
10
LOAD RESISTANCE R_L (kΩ)

TOLD500

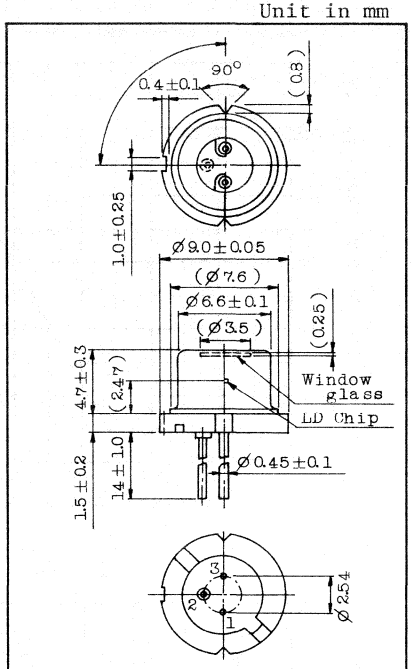
TENTATIVE DATA UNDER DEVELOPMENT

LASER DIODE FOR OPTICAL MEMORY DISC

FEATURES:

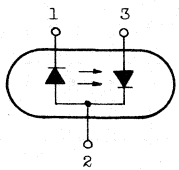
- Emitting Wavelength : λ_P=830nm(Typ.)
- High Optical Output Power : P_O=30mW(Pulse)
- Stable Single Transverse Mode.
- Provided with a PIN-PD for Monitoring.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	15-7A1

PIN CONNECTION



1. LASER DIODE CATHODE
2. LASER DIODE ANODE
   PHOTODIODE CATHODE
3. PHOTODIODE ANODE

MAXIMUM RATINGS (Ta=25°C)

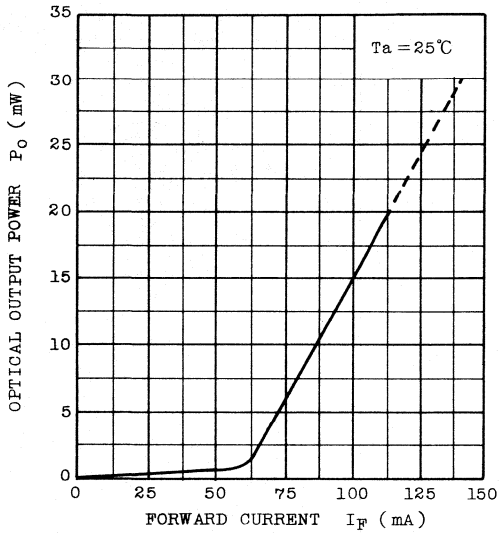
CHARACTERISTIC	SYMBOL	RATING	UNIT
Optical Output Power	P_O	20	mW
Optical Output Power *	P_O(pulse)	30	mW
LD Reverse Voltage	$V_{R(LD)}$	2	V
PD Reverse Voltage	$V_{R(PD)}$	30	V
Operating Temperature	T_{opr}	-10∿50	°C
Storage Temperature	T_{stg}	-40∿80	°C

* Pulse width : 150nsec. duty 30%.

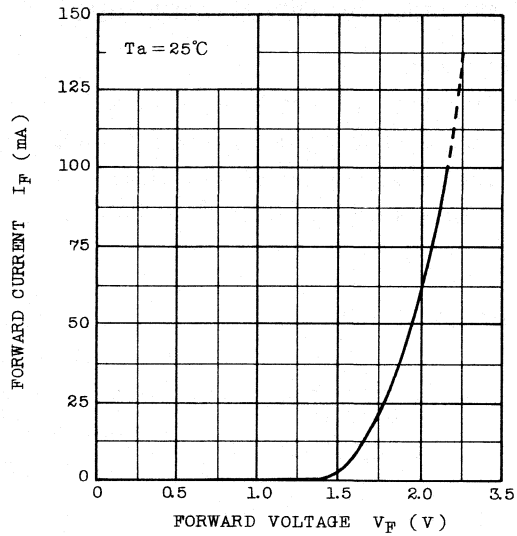
OPTICAL-ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Optical Output Power	P_O	Kink free (CW)	20	-	-	mW
Threshold Current	I_{th}	CW operating	-	60	90	mA
Peak Wavelength	λ_P	P_O=10mW	-	830	-	nm
Beam Divergence	$\theta_{//}$	P_O=10mW	-	15	-	deg.
	$\theta_{\perp}$	P_O=10mW	-	30	-	
Monitor Current	I_m	P_O=10mW	0.4	1.0	-	mA
PD Dark Current	$I_{D(PD)}$	V_R=10V	-	-	100	nA
PD Total Capacitance	$C_{T(PD)}$	V_R=10V, f=1MHz	-	1.5	4.0	pF

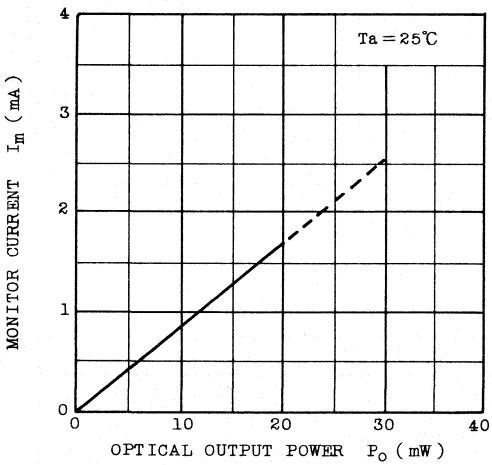
$P_O - I_F$



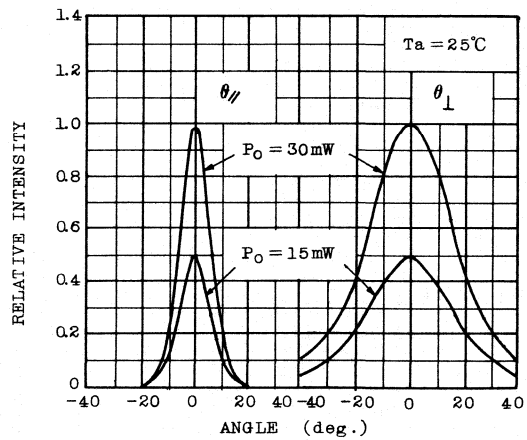
$I_F - V_F$



$I_m - P_O$



TYPICAL FAR - FIELD PATTERNS



4 Application Note

1. Optical Terms of Photo Sensors

With the expansion of applications of optical sensing devices, it has become necessary to learn terms and unit of optical measurement. There are two ways of optical measurements; radiometry and photometry. The latter handles wavelength in a visible area (380 ~ 750 mm), which is equivalent to human visual power. In application design of photo sensing devices, it is better to use the radiometry as both light emission and receiving are required for all wavelengths (i.e., ultraviolet rays, visible rays and infrared rays) of optical spectrum. In view of above, the radiometry is used for optical measurement of optical sensing devices.

The basic farmulas and units of the radiometry are shown in Table 1-1 and definitions of terms in Table 1-2.

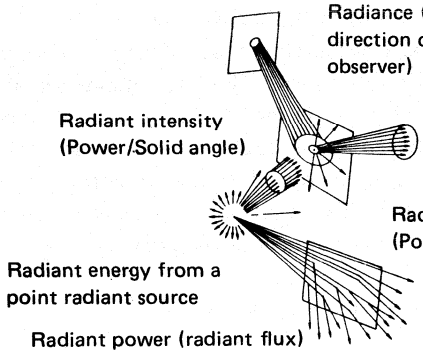
Table 1–1 Basic Formulas and Units of Radiometry

Definition	Basic Formula	Radiometry	
		Term	Unit · (SI)
Energy	Q	Radiant Energy	Joule (J)
Energy/Hour =Power=Flux	$\phi = dQ/dt$	Radiant Power	Watt (W)
Input Power/ Area	$E = d\phi/dA$	Radiant Incidence.	Watt/m^2 (W/m^2)
Power/Area	$M = d\phi/dA$	Radiant Emittance	Watt/m^2 (W/m^2)
Power/Solid Angle	$I = d\phi/d\Omega$	Radiant Intensity	Watt/Steradian (W/Sterad)
Power/Solid Angle• Projected Area	$L = dI$ $(dA \cos\theta)$	Radiance	Watt/Steradian·m^2 (W/Sterad·m^2)

Table 1–2 Definitions of Terms

Radiometry

Radiance (Power/Solid angle/Projected area perpendicular to direction of radiant energy going toward observer)



Radiant Energy
Energy propagated in the form of electromagnetic wave (J)

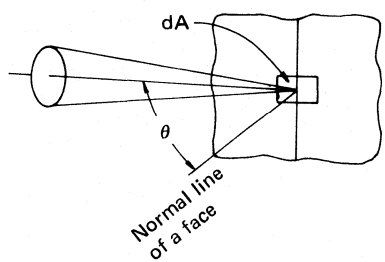
Radiant Power (Radiant Flux)
Volume of radiant energy flowing per unit time (J/s) or (W)

Radiant Incidence
Radiant power per unit area coming on a face (W/m^2)

Radiant Emittance
Radiant power per unit area radiated from a face, passed that face or reflected from that face. (W/m^2)

Radiant Intensity
Radiant power per unit solid angle propagated in a fixed direction. (W/sr)
(One steradian (sr) is solid angle formed when a 1 m^2 area is estimated on the surface of a sphere with a radius of 1 m from its center)

Radiance
Radiant intensity per unit area leaving a face in the fixed direction, passing that face or arriving at that face.
Unit area that is used here refers to unit area of a face formed by projecting a certain actual face on a face perpendicular to a fixed direction (that is, the direction toward observer).



$$\text{Radiance} = \frac{d'}{dA\cos\theta} = \frac{d^2\phi}{dAd\Omega\cos\theta}$$

Units which are especially important when handling optical sensing devices are described in the following.

- Light Emitting Devices
  Radiant Intensity (mW/sr):
  This is defined to be radiants power per unit solid angle propagating is a fixed direction. In actual operation, it is obtained by measuring power radiating a solid angle at approx. 0.01 sr in the mechanical axial direction of the lens unit of the device and by calculating a ratio of the measured power to the solid angle.

  In the combined application with a light detecting device, optical output or radiant power Po is a meaningless unit as Po indicates total radiant power from the device and therefore, if a radiation pattern is different, quantity of light on an opposite light detecting device differs, and theoretical calculation of quantity of light becomes difficult. In particular, radiant intensity ratio I_E becomes important for products with narrow radiant angle.

- Light Detecting Devices
  Light Detecting Sensitivity I_L (μA):
  Since the measuring system of the light emitting devices is the radiometry, radiant incidence E (mW/cm^2) is adopted as a unit for measuring light receiving sensitivity. As the basic unit of light emitting and receiving is watt (W), it becomes easy to grasp coupling characteristic. Light receiving sensitivity I_L is measured based on radiant incidence E and applied voltage.

2. Design Procedures for Detection Circuits and Precautions

2–1 Characteristics of Light Emitting and Defecting Devices and Precautions

(a) Characteristics of Light Emitting Diode (LED)
LED features small size, long life, high speed and high luminous efficacy. At present, due to compatibility of defecting light spectral sensitivity and luminous wavelength of photo diode and photo transistor, GaAs infrared LED is used extensively. Luminous wavelength of GaAs Infrared LED TLN108 and detecting light spectral sensitivity characteristic of Si photo Diode TPS708 are shown in Fig. 2–1.1. In recent years, GaAlAs Infrared LED TLN201 having more higher degree of coupling has been merchandised and improvement of sensint distance is expected.

Photo transistors including Si Photo Diode TPS708 are generally sensitive to light of wavelength 500 ~ 550 mm. Although signal output is obtained from photo transistor when other LED's (GaP, GaAsP, etc.) is used, it should be aware that output will become small due to lower luminous efficacy.

Shown in Fig. 2–1.2 is the relationship between radiant intensity I_E and driving forward current I_F of TLN108 and TLN201. From this figure it is seen that radiant intensity increases with the increase of I_F. As mentioned previously, radiant intensity I_E here indicates optical output on the shaft; that is, quantity of optical output that is more close to actual working condition than total radiant power Po.

Fig. 2–1.3 shows directional characteristics of optical outputs of TLN108 and TLN103. On such a device having narrow radiant angle as TLN108, axial radiant intensity I_E becomes large and signal output from a light receiving device also becomes large. However, it tilted by 10°, optical output I_E decreases by 70% and signal output also becomes small and it is therefore necessary to pay attention not to cause axial shifting when mounted.

On the other hand, in case of such devices which radiate in any direction as TLN103, they have wide radiant angle and even when somewhat tilted, signal output of a light detecting device does not change but it is necessary to be aware that their radiant intensity I_E becomes smaller than that of TLN108 when radiant power Po is the same and output of a light detecting device also becomes small.

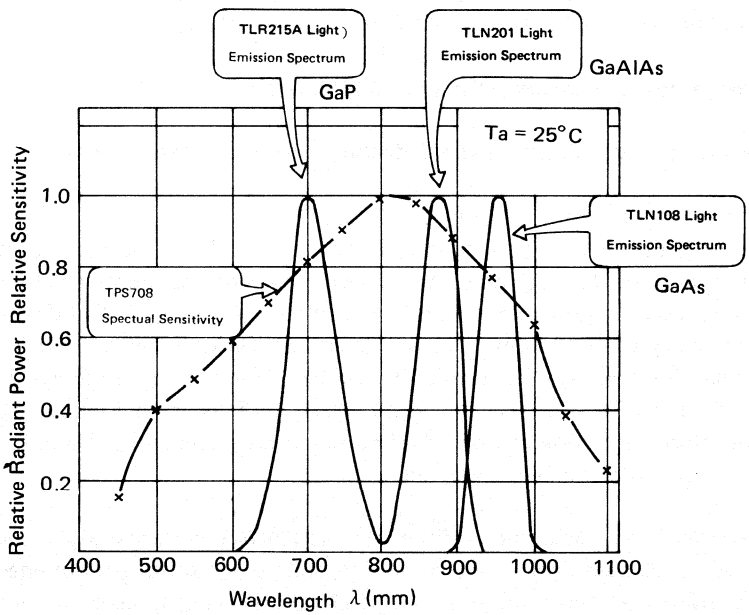


Fig. 2–1.1 Light Emission Spectrum vs. Spectual Sensitivity

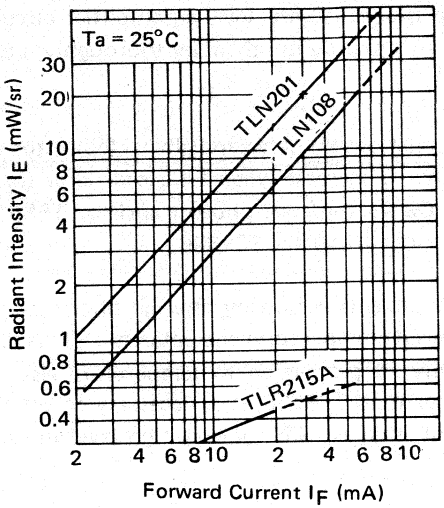


Fig. 2–1.2 I_E–I_F Characteristic

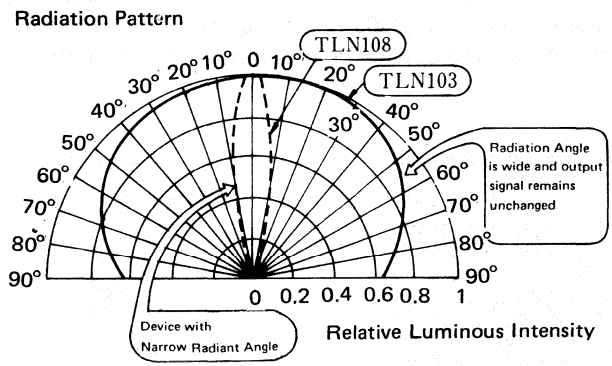


Fig. 2–1.3 Radiation Pattern of TLN103 and TLN108

(b) Characteristics of Photo Transistor (Photo Diode)
Photo transistor can be regarded to be equivalent with photo diode plus transistor stage amplification and there are two types; single type and Darlignton type.

As optical sensity of photo diodes is very low, an amplifier circuit becomes necessary and it is required to properly use them by thoroughly anderstanding characteristics of each device.

Shown in Fig. 2–1.4 is the relationship between light I_L (collector current I_C) and radiance incidence E, and I_L increase when E become large (bright). As a matter of course, I_L of the Darlignton type photo transistor TPS605 is larger than that of the single type photo transistor TSP606.

Very small current Id (dark current) is flowing through photo transistor even in the dark. Fig. 2–1.5 shows its temperature characteristic. This dark current becomes large logarithmically in propartion to temperature rise. As photo sensitivity of TPS605 is larger than TPS606, it is necessary to set the ratio of dark current to light current, that is, S/N ratio at high level in esigning high temperature operation.

Light directional sensitivity of photo transistor is dientical to that shown in Fig. 2–1.3, and light current, I_L of TPS601A (the same package as TLN108) having a narrow acceptance angle on the optical axis is larger than that of TPS603 (the same package as TLN103) having a wide acceptance angle may become samller than that of TPS603 if tilted a little. It is therefore necessary to select devices according to application and mounting conditions.

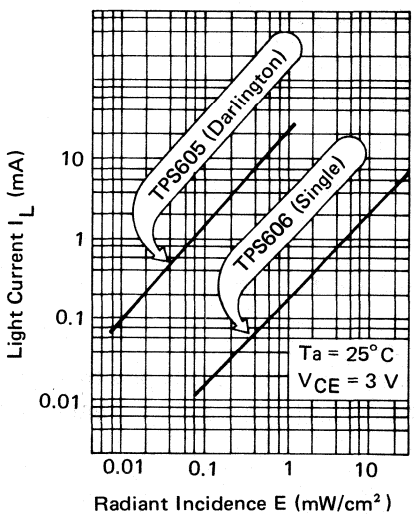


Fig. 2–1.4 I_L–E Characteristic of Photo Transistor

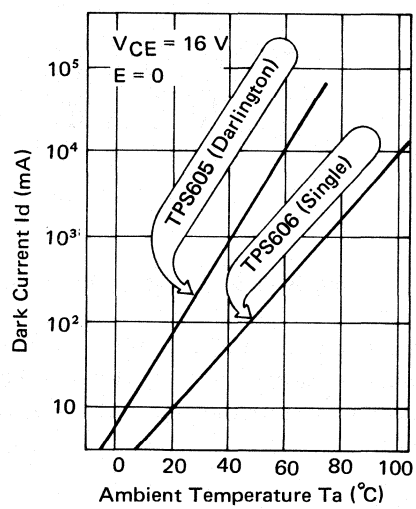


Fig. 2–1.5 Id–Ta Characteristic of Photo Transistor

(c) Coupling Characteristic of Emitter and Detector

Current transfer ratio CTR (I_C/I_F) is the most important characteristic of the devices when they are used and is equivalent to h_{FE} of transistor Darlignton type photo transistor has higher CTR than single type photo transistor as it has higher photo sensitivity than single type photo transistor. CTR temperature characteristic is shown in Fig. 2–1.6 and CTR variation in performance test is shown in Fig. 2–1.7. Since radiant power of LED has a negative slope against temperature are light current of photo transistor has a positive slope, the coupled CTR drops at low temperature as well as high temperature as shown in Fig. 2–1.6. The primary factor for gradual drop of CTR shown in Fig. 2–1.7 is photo electric output drop of LED.

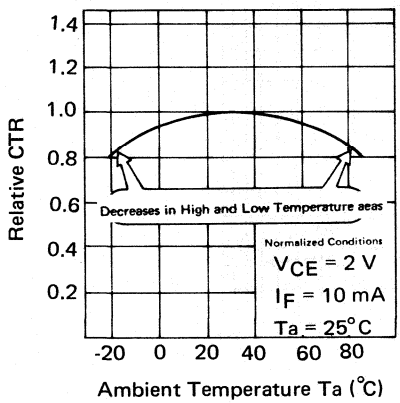


Fig. 2–1.6 CTR–Ta Characteristic of TLP850

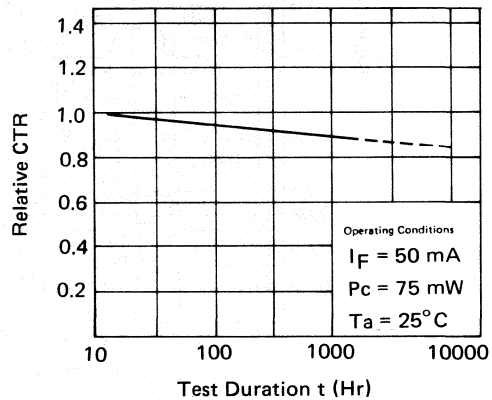


Fig. 2–1.7 Variation of CTR in Operation Test

As can be seen in Fig. 2–1.8, response of Dalington type photo transistor (TLP850) is slower than that of single type (TLP800A) under the same load condition; however, as it is related to the basic operating conditions (described later) with next stage, t_{OFF} will become small when load becomes small, that is, speed will become fast.

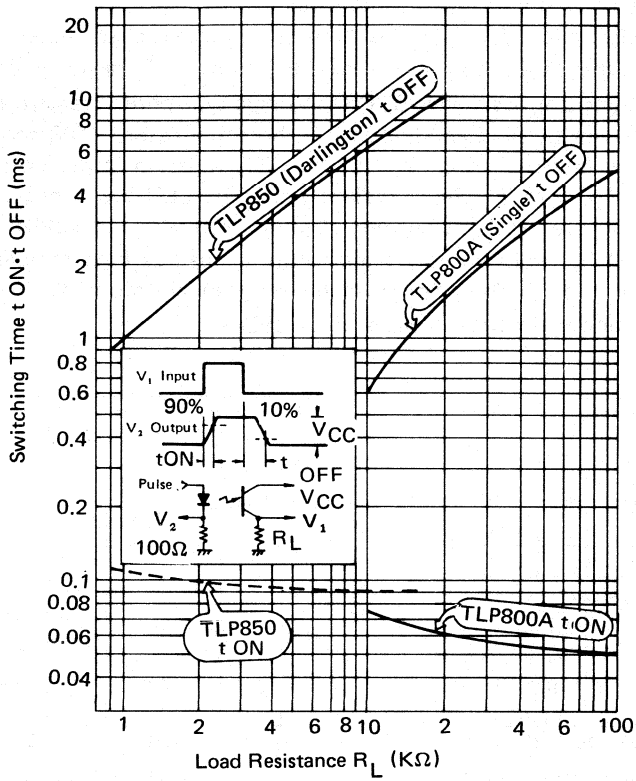


Fig. 2–1.8 Switching Time vs. Load Resistance (Saturated Operation) of Photo Interrupters

2–2 Principle of Operation of Optical Sensors

The basic circuit of an optical sensor is shown in Fig. 2–2.1 (a). The anode of LED is connected to the power line V_{CC} via resistor R_E and the cathod is grounded. Forward current I_F is flowing through LED and is emitting light but is not visible as a GaAs LED emits infrared light.

The collector of a photo transistor is connected to the power line V_{CC} via resistor R_L and the emitter is grounded. Further, the collector is to be connected to the input terminal of a comparator or I_C of next stage.

Light emitting and detecting devices are arranged as shown in Fig. 2–2.1 (b). When a light cut-off plate, that is, a target to be detected comes in, potential at the collector rises. On the other hand, when it goes out, the potential drops. In other words, existence of a substance is detected and converted into electric signal

without contacting it. Normally, this electric signal is input to a succeeding signal processing circuit of next stage to control various peripheral functions.

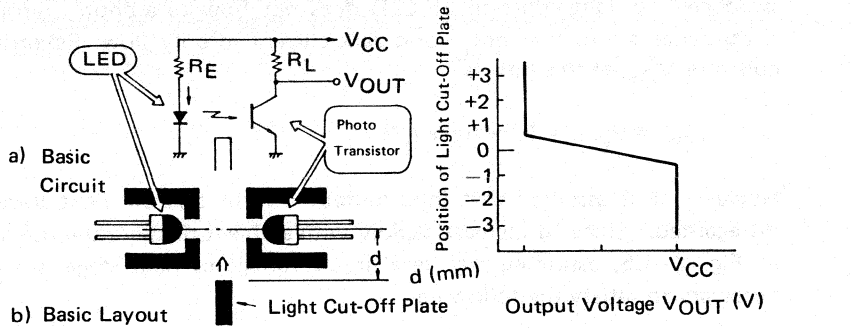


Fig. 2–2.1 Principle of Operation of Optical Sensor

2–3 Design Procedures for Optical Sensor Circuits

First, obtain values of R_E and R_L.

(a) Proper Value of R_E
In Fig. 2–2.1 (a), when forward voltage drop of LED is V_F, current I_F flowing to LED is given by

$$I_F = \frac{V_{CC} - V_F}{R_E} \tag{1}$$

and it is necessary to satisfy

$$I_F \leqq I_{F\,(MAX)} \quad (Ta = Topr_{\,(MAX)}) \tag{2}$$

From (1) and (2), R_E is given by the following formula:

$$I_F \geqq \frac{V_{CC} - V_F}{I_{F\,(MAX)}} \tag{3}$$

As can be seen in Fig. 2–1.2, the larger I_F is, the more large optical output I_E will be obtained and therefore, it is necessary to calculate $I_{F\,(MIN)}$ by taking fluctuation of allowable loss of I_F and I_E into consideration after deciding R_E.

(b) Proper Value of R_L

Obtain the upper limit value of R_L.

In Fig. 2–2.1 (b), when a light cut-off plate is inside, photo electric current I_L produced by light emission of LED does not flow to a photo transistor but disturbance photo current I_L' and dark current Id only flow. Patential of the collector V_{OH} at this time is

$$V_{OH} = V_{CC} - R_L \times (Id + I_L')$$

However, it is assumed that inptu/output current to/from next stage can be disregarded. Since Id increase rapidly with ambient temperature rise as shown in Fig. 2–1.5, assuming high level input voltage of next stage is V_{IH}, it is necessary to satisfy the following

$$V_{IH} < V_{OH}$$

at $Ta = Topr_{(MAX)}$

$$R_L \leqq \frac{V_{CC} - V_{IH}}{Id + I_L}$$

Then, obtain the lower limit value of R_L.

When light cut-off plate is not inside, light is received by the photo transistor and light current I_L and the above-mentioned $Ib + I_L'$ flow to the photo transistor. Normally, unless

$$I_L \geqq Id + I_L'$$

it becomes difficult to discriminate existance of a light cut-off plate from the viewpoint of S/N ratio, the collector potential V_{OL} at this time is

$$V_{OL} = V_{CC} - R_L (I_L + Id + I_L') \qquad (4)$$

Assuming that low level input voltage to next stage is V_{IL}, it is necessary to satisfy

$$V_{IL} > V_{OL} \qquad (5)$$

Formulas (4) and (5) must be satisfied even at the lower limit value of I_L.

The lower limit value $I_{L\ (MIN)}$ is

$$I_{L\ (MIN)} = CTR_{\ (MIN)} \times Dt \times D_{Ta} \times Dn$$

$CTR_{\ (MIN)} : I_C/I_F\ (MIN)$

Dt : CTR degradation factor in the operation test (Fig. 2–1.7)

D_{Ta}: CTR temperature variation (Fig. 2–1.6)

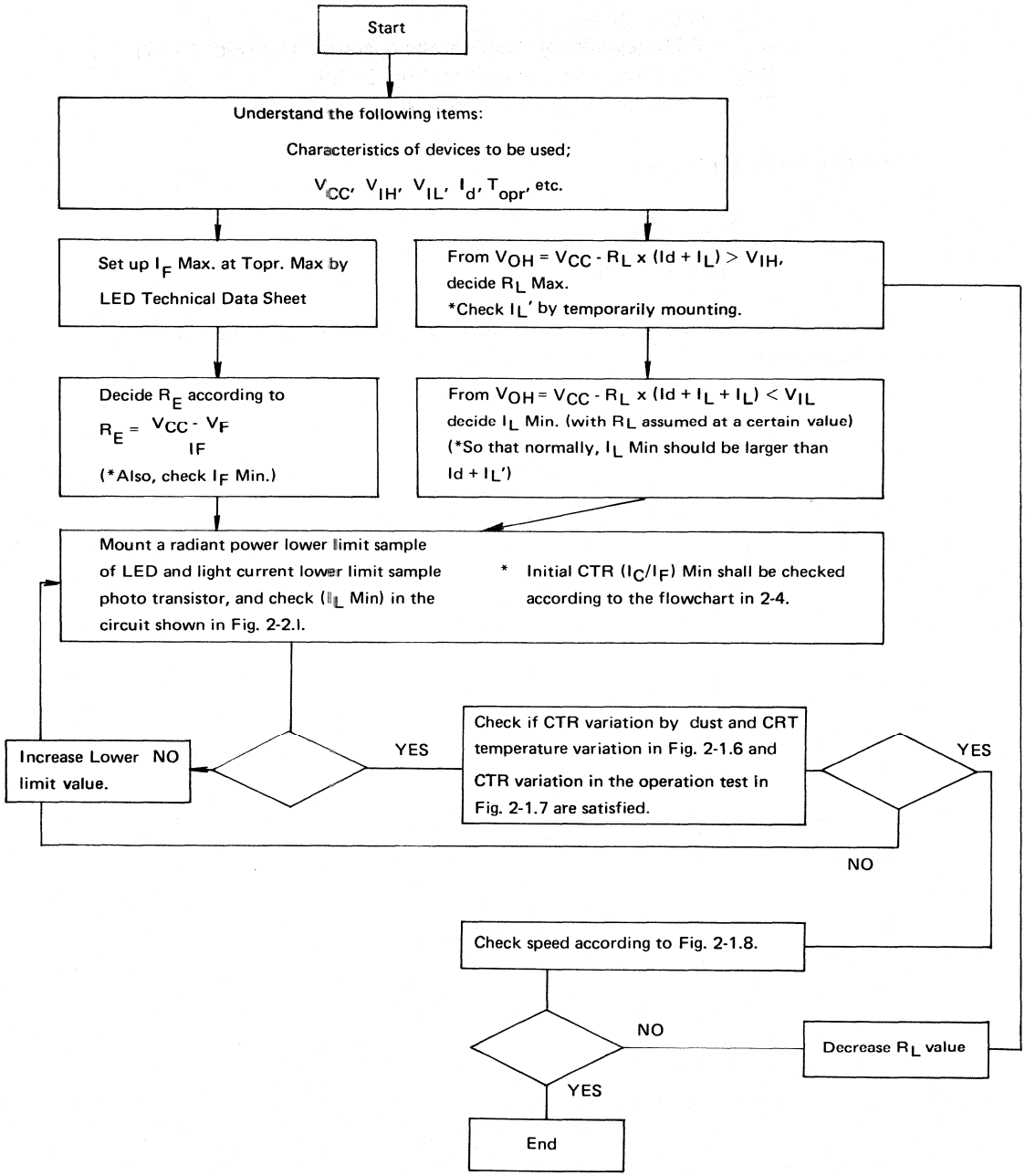
Dn : CTR variation by dust and dirt

From formulas (4) and (5),

$$R_L \geqq \frac{V_{CC} - V_{IL}}{I_{L\ (MIN)} + Id + I_L'}$$

As can be seen from Fig. 2–1.8, the smaller R_L is, the shorter the switching time will become.

Detection Circuit Design Flow Chart



2–4 How to Obtain Coupling Characteristics of Light Emitting and Receiving Devices

In applications of optical sensors, a required package is an important factor but a function to detect substances or a function to transmit optical signal in formation cannot be disregarded. It is first necessary to check whether light emitting and detecting devices are coupled and the light detecting side can get signal.

In the following, coupling characteristics of light emitting and detecting devices are calculated as the initial design to see if they are applicable. Then, as the second step, obtaining parts actually, a method to check actual operation, etc. is presented.

(a) Initial Design

Coupling characteristics of representative product are shown in Figures 2–4.1 ~ 2–4.3. Such characteristic diagrams as these are somewhat different individually depending upon a combination of light emitting and detecting devices. Generally, when $d > 1$ cm or more in the following calculating method, these characteristics can be obtained roughly without investigating them individually.

First, read radiant in tensity $I_{E\ (MIN)}$ of a light emitting device and light current $I_{L\ (MIN)}$ of a light detecting device according to conditions shown in the table of the data sheet.

As radiant intensity I_E (mW/sr) is equivalent to radiant incidence E_O (mW/cm^2) radiated on an area 1 cm^2 at distance 1 cm, obtainable radiant incident E (actual) at a distance d cm is obtained by the following formula:

$$E\ (Actual) \cong I_E/d^2 \quad (mW/cm^2)$$

Assuming that radiant incidance of light defecting device at the light detecting sensitivity conditions is E light currnet I_L (actual) in the coupled state is obtained as follows:

$$I_L\ (actual) = I_L \times \frac{E\ (actual)}{E}$$

When received light current is very small and it is difficult to design the latter stage circuit, increase DC forward current I_F of a light emitting device or increase radiant intensity I_E (mW/sr) by pulse forward current.

As an example, make an examination under the following conditions:

Emitter : $I_{E\ (MIN)} = 1$ mW/sr at $I_F = 20$ mA
Detector : $I_{L\ (MIN)} = 20\ \mu A$ at $E = 0.1$ mW/cm^2, $V_{CE} = 3$ V
Distance between Emitter and Detector : $d = 1.5$ cm

$$E\ (\text{actual})_{(MIN)} = I_E/d^2$$

$$= 1 \times \frac{1}{1.5^2} = 0.44\ \text{mW/cm}^2\ (\text{MIN})$$

$$\therefore I_L\ (\text{actual})_{(MIN)} \approx \frac{\text{Eactual}}{E} \times I_L\ (\text{MIN})$$

$$= \frac{0.44}{0.1} \times 20\ \mu\text{A}$$

$$= 88\ \mu\text{A}$$

As I_L (actual) $_{(MIN)}$ is 88 μA, it is not possible to drive TTL directly, but C–MOS IC can be connected.

Then, while load on a light receiving device is decided according to supply voltage, its switching speed depends strongly uppon a value of load and it is necessary to check it in advance. Refer to the other application check as there is a design method for realizing high-speed operation.

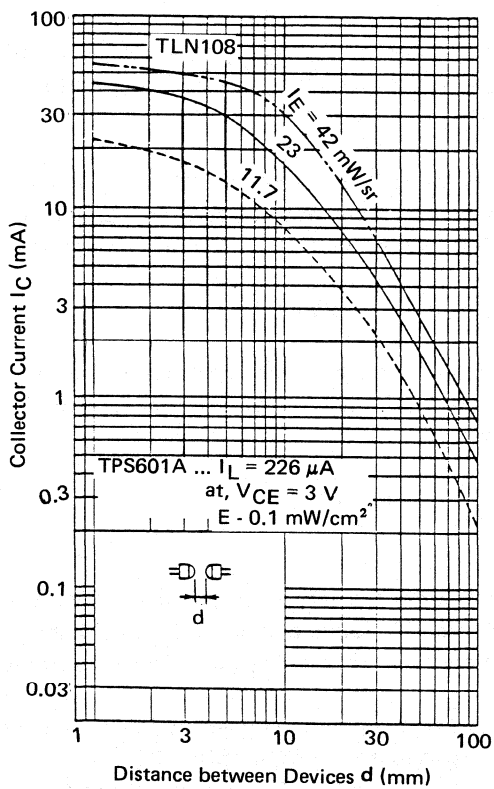


Fig. 2–4.1 TLN108 & TPS601A Coupling Characteristics

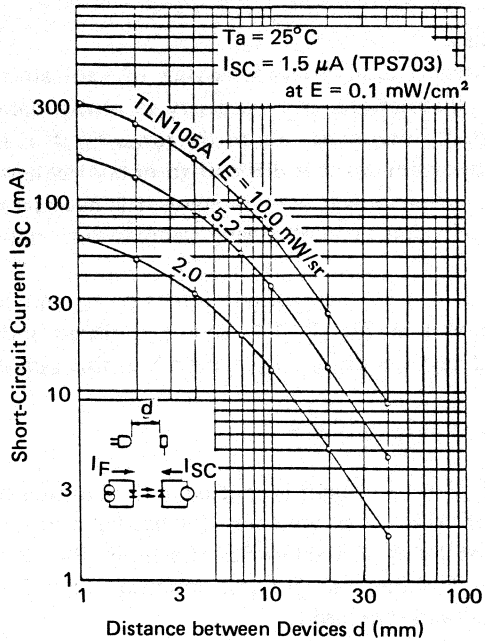


Fig. 2–4.2 TLN105A & TPS703 Coupling Characteristics

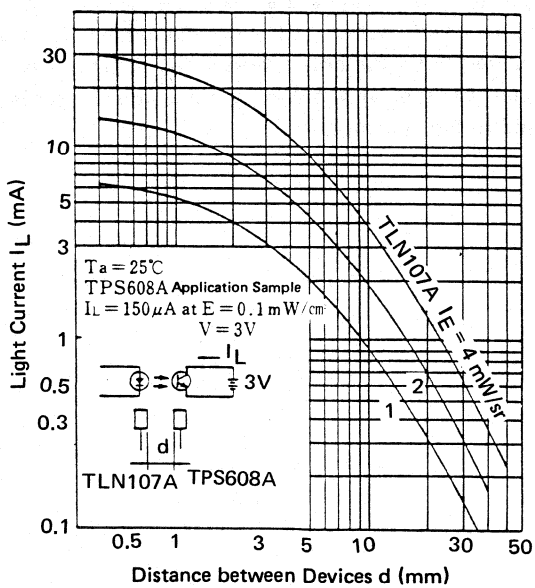


Fig. 2–4.3 TLN107A & TPS608A Coupling Characteristics

(b) Actual Design Stage

In order to get true coupling characteristics of light emitting and detecting devices and their fluctuations, it is necessary to obtain data distributions with both devices actually mounted. As to the lower limit of light current which becomes most important (as it is difficult to obtain radiant power lower limit sample and light current lower limit sample), it is necessary to estimate based on distribution of value or check using samples with data as shown below.

Now, assume that a LED has radiant intensity I_E and forward current I_F characteristics shown in Fig. 2–4.4, and it is tested and controlled at the Toshiba standard test condition (I_F = 10 mA in this sample) and standard is

$$I_E \geqq 5 \text{ mW/sr at } I_F = 10 \text{ mA}$$

on No. 1 sample with data, light is emitted at the Toshiba standard test condition 12 mW/sr. Further, a photo transistor has light current I_L–radiant incidence E (incident light) characteristics shown in Fig. 2–4.5, is tested and controlled at the Toshiba standard test condition (E = 0.1 mW/cm^2, V_{CE} = 3 V in this sample) and standard is

$$I_L \geqq 0.46 \text{ mA} \qquad \text{at } V_{CE} = 3\text{V}, \ E = 0.1 \text{ mW/cm}^2$$

on No. 2 sample with data, light that becomes I_L = 1.3 mA at the standard test condition is received. When LED's driving current I_F is set at 8 mA, on a product with lower limit radiant intensity, I_E is estimated to be 4 mW/sr. This radiant intensity state of 4 mW/sr will become the same state when I_F = 3.1 mA is applied to No. 1 sample.

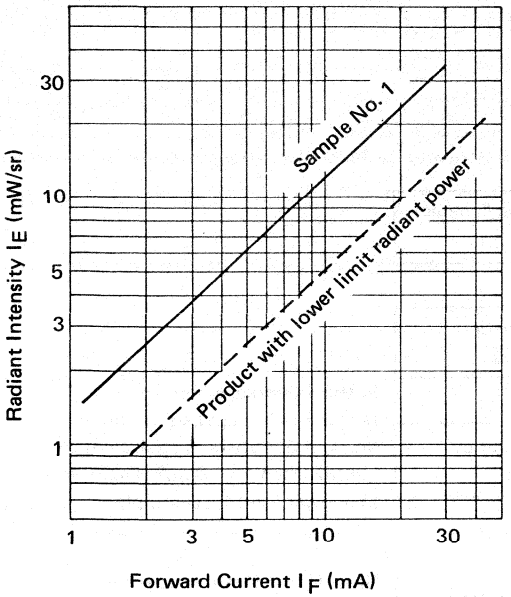


Fig. 2–4.4 I_E–I_F Characteristic of Infrared LED

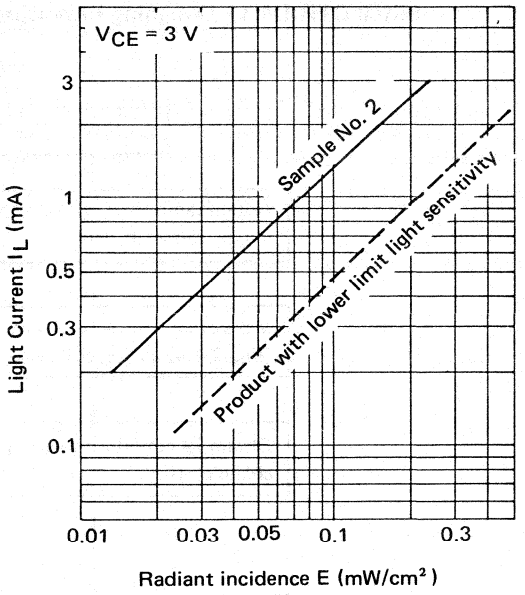


Fig. 2–4.5 I_L–E Characteristic of of Photo Transistor

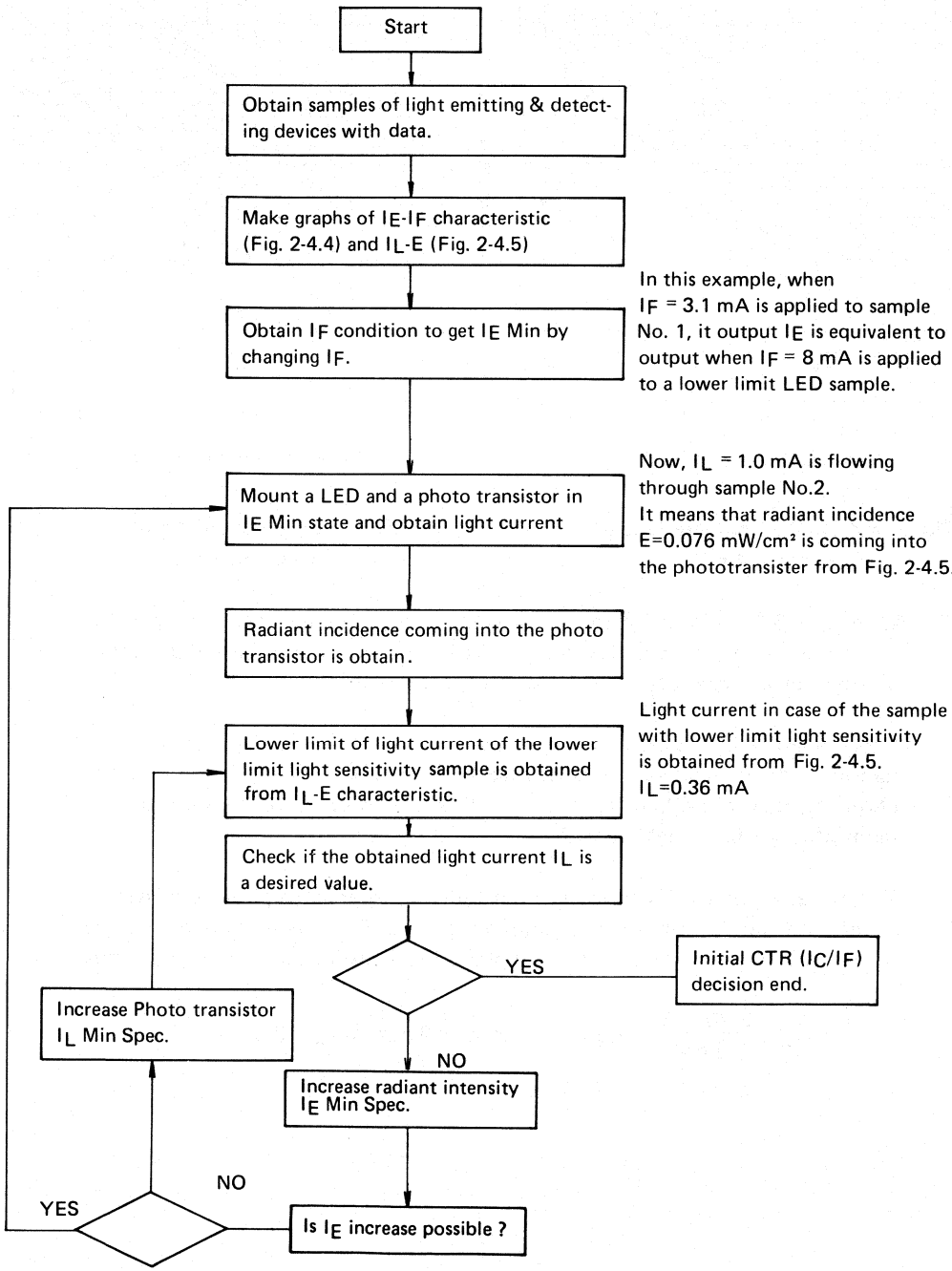
With I_F = 3.1 mA applied to No. 1 sample, that is, in the state where set driving current I_F = 8 mA is flowing to a LED with lower limit luminous output, photo electric current I_L of a photo transistor is seen.

Now, when it is assumed that light current I_L = 1 mA is obtained on No. 2 sample, radiant incidence (incident light) E = 0.076 mW/cm² is radiated to a photo transistor and light current I_L = 0.36 mA is obtained on a photo transistor of lower limit hight sensitivity.

Therefore, when a LED of lower limit radiant power and a photo transistor of lower limit lihgt sensitivity are mounted, a lower limit value (minimum value) of current transfer ratio of this combination is estimated to be as follows:

$$I_C/I_F = \frac{0.36\ \text{mA}}{8\ \text{mA}} = 4.5\% \qquad \text{at } I_F = 8\ \text{mA}, V_{CE} = 3\ \text{V}$$

Initial CTR (Min.) Designing Flow Chart



3. Application Circuits of Photo Sensors

3–1 Application Circuits of Infrared LED

As luminous output Po of an infrared LED depends on LED forward current I_F, ON–OFF of luminous output can be easily realized through control of forward current. Representative lighting methods such as DC lighting, pulse lighting, AC lighting, etc. and precautions for design are expained here.

(a) DC Driving

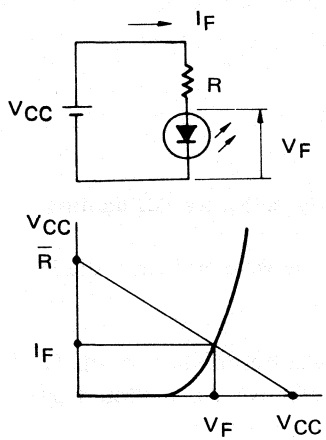


Fig. 3–1.1 DC Drive Circuit

Shown in Fig. 3–1.1 is the basic circuit for lighting when DC power is used. I_F in this case is expressed by the following formula:

$$I_F = \frac{V_{CC} - V_F}{R}$$

V_{CC} : Supply voltage
V_F : Forward voltage of LED
I_F : Forward current flowing to LED

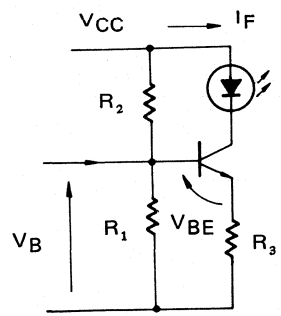


Fig. 3–1.2 Constant Current Drive Circuit

Shown in Fig. 3–1.2 is a circuit covering variation of V_F of LED with Tr. I_F in this circuit is expressed by the following formula:

$$I_F = \frac{V_B - V_{BE}}{R_3}$$

V_B : Base voltage
V_{BE} : Base to emitter voltage
R_3 : Emitter resistance

Further, it is possible to reduce temperature dependency of luminous output by properly setting of V_{BE} and V_B in this circuit.

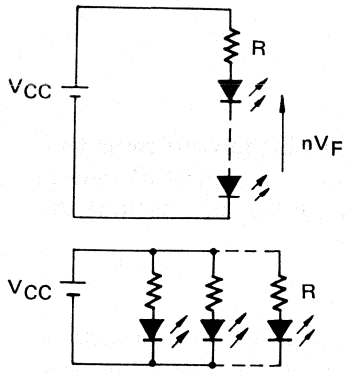


Fig. 3–1.3 Multi LED Drive Circuit

When luminous output power is insufficient as a light receiving device is located far away, it is possible to cover it through series or parallel connection shown in Fig. 3–1.3. In this case,

$$I_F = \frac{V_{CC} - nV_F}{R} \qquad \text{(series connection)}$$

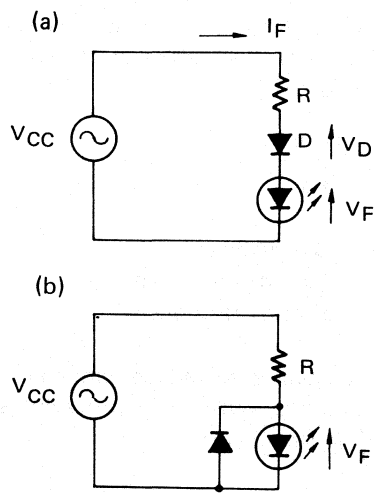
$$I_F = \frac{V_{CC} - V_F}{R} \qquad \text{(parallel connection)}$$

(b) AC Driving

Shown in Fig. 3–1.4 are the basic circuits for nearly half-wave AC lighting.

Generally, there are two driving methods. Both of them use a protective diode to protect LED from voltage about reverse voltage.

In (1), this protective diode is of reverse voltage type corresponding to supply voltage V_{CC}, and in (2), reverse voltage of the protective diode should be about twice forward voltage of an infrared LED.



$$I_F = \frac{V_{CC} - V_F - V_D}{R}$$

$$I_F = \frac{V_{CC} - V_F}{R}$$

Fig. 3–1.4 AC Current Drive Circuit

In the above circuit, circuit constant R that is suited to rated voltage is used according to supply voltage V_{CC}. Furhter, R is decided so that it is limited to a rated value of forward current I_F of an infrared LED at a point where supply voltage V_{CC} becomes maximum.

(c) Pulse Driving

As advantages obtainable when optical signal is changed to pulse modulated light by pulse lighting, the followings are considered:

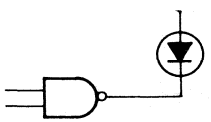
1) When duty ratio of pulse modulated signal is mode small, instantaneous light output of a light emitting device increases, optical signal is discriminated from disturbance light and S/N ratio improvement is ensured.

2) When a battery is used as power source, power consumption of a device can be reduced and herefare, service life of battery is extended.

3) RC coupling with next stage in the light receiving section becomes possible and effect of dark current increase resulted from temperature rise can be avoided.

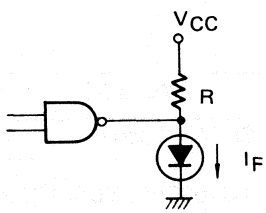
(d) Pulse Driving Circuit

This pulse driving system is designed in conbination with TTL or C–MOS and Tr, etc.



(Turn ON at Low Level)

$$I_F = \frac{V_{CC} - V_F - V_{OL}}{R}$$



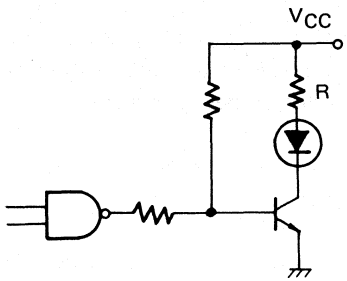
(Turn ON at High Level)

$$I_F = \frac{V_{CC} - V_F}{R}$$

Fig. 3–1.5 Driving Circuit with IC

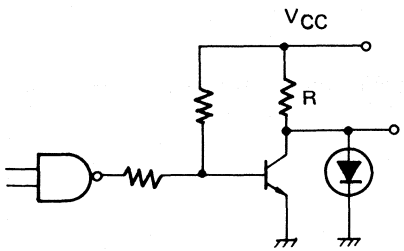
In the circuit shown in Fig. 3–1.5, it is necessary to pay attention to electrical characteristic of I_{OL} of TTL or C–MOS and excessively large current cannot be applied to satisfy $I_F < I_{OL}$.

To apply large current, it is necessary to use a buffer IC with large output current capacity as shown in Fig. 3–1.6 or install a transistor externally.



$$I_F = \frac{V_{CC} - V_F - V_{CE(sat)}}{R}$$

(Turn ON at High Level)



$$I_F = \frac{V_{CC} - V_F}{R}$$

(Turn ON at Low Level)

Fig. 3–1.6 Light Circuit with IC Plus Buffer Transistor

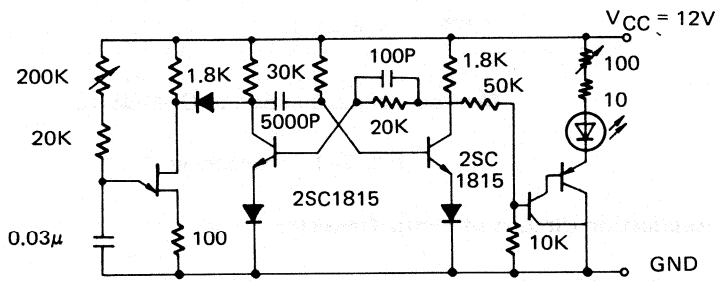
I_{OL} and V_{OL} characteristics of TTL, C–MOS and buffer IC are shown for reference.

Classification	V_{OL}	I_{OL}	Type No.
TTL	0.4 V	16 mA	SN74XX series
C–MOS	0.4 V	3.2 mA V_{DD} = 5 V, Ta = 25°C	TC4009BP, TC4010BP, TC4049BP, TC4050BP
Buffer IC	1.3 V Ta = 25°C	200 mA	TD62000P, TD62003P, TD62004P

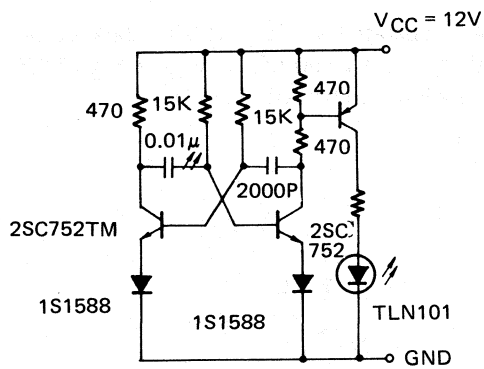
(e) Other Pulse Driving Circuits

Various pulse generating circuits can be considered for a pulse driving circuit. A pulse lighting circuit can be composed easily when a multiple-vibrator/UJT is used.

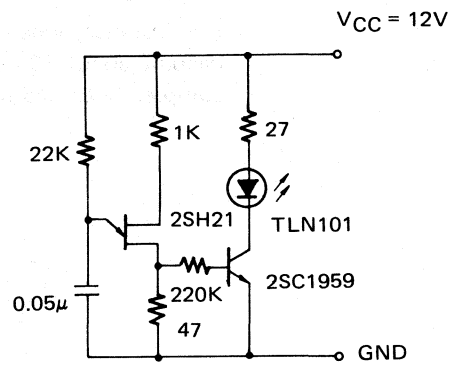
Examples of various pulse driving circuit are shown in Fig. 3–1.7.



UJT oscillation single stable multivibrator

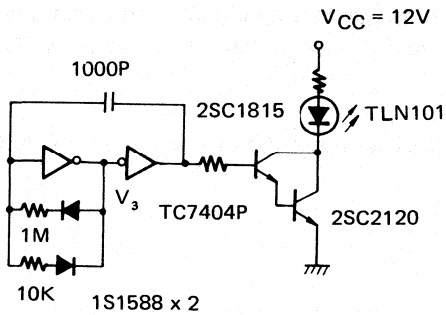


Method using transistor multivibrator



Method using UJT

Fig. 3–1.7 Pulse Luminous Driving Circuit



Method using oscillation of C–MOS/IC

Fig. 3–1.7 continued

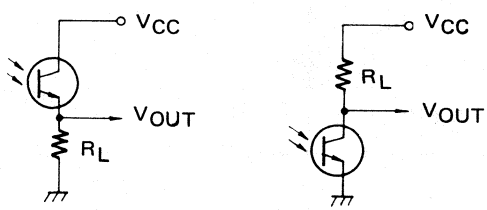
3–2 Application Circuits of Photo Transistor

(a) Basic Circuit

The basic circuit of photo transistor is shown in Fig. 3–2.1.

Road resistance R_L is decided by taking dark current temperature characteristic of photo transistor into consideration. If R_L is too large, a photo transistor may be turned ON only by dark current at high temperature.

For instance, when TPS601A is operated at Ta = 100°C, dark current may become about 100 μA. When R_L is set at 50 kΩ at V_{CC} = 5 V, TPS601A is completely turned to ON state by increase of dark current.



(1) Collector grounded (2) Emitter grounded

Fig. 3–2.1 Basic Circuit of Photo Transistor

(b) Bias Circuit of Photo Transistor with Base Terminal

Effects of a base to emitter resistor R_{BE} on dark current as well as light current are shown in Fig. 3–2.2 (a) and (b).

Normally, dark current of a photo transistor is as small as several nA to several ten nA at normal temperature and it is possible to reduce dark current further by about one figure by inserting a resistor R_{BE} between the base and emitter to bypass leakage current through the collector to base junction point. If R_{BE} is made excessively small, apparent h_{FE} of a photo transistor is reduced and required light current I_L cannot be obtained therefore, R_{BE} of more than 1 MΩ is appropriate.

Further, it is possible to set the operating point of a photo transistor at a proper point to mix with optical signal by use of the base terminal. Fig. 3–2.3 shows illuminance to photo electric current characteristic when constant-current is applied to the base.

Linearity of illumination-light current characteristic in this case has been improved considerably when compared with a case where base bias current is zero.

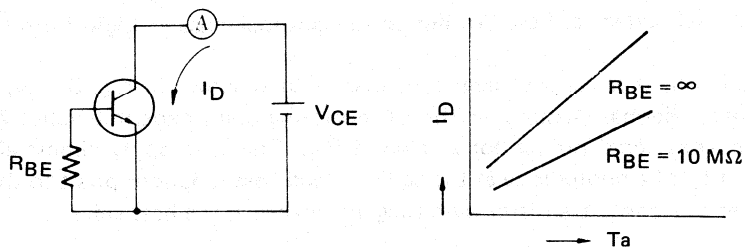


Fig. 3–2.2 (a) Decrease of Dark Current by R_{BE}

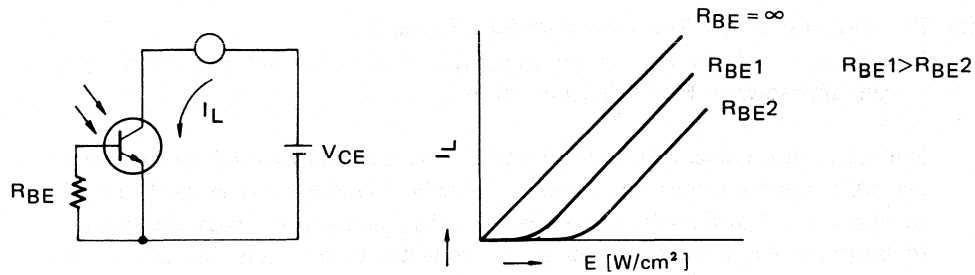


Fig. 3–2.2 (b) Change of Light Current by R_{BE}

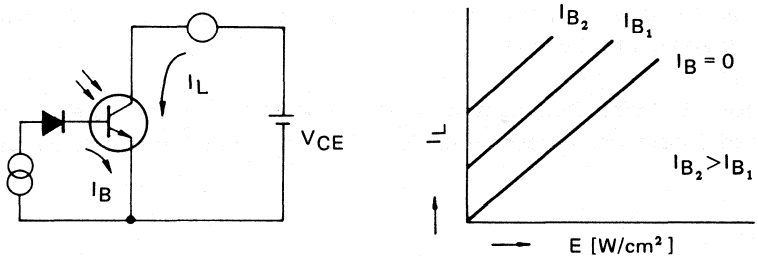


Fig. 3–2.2 (c) Effect of Base Current on Radiant Incidence vs. Light Current Characteristic

In addition, there is a bleeder type bias method shown in Fig. 3–2.4, which improves thermal stability at the DC operating point experimentally, 2 ~ 10 MΩ is considered proper for a value of R_B. This is to apply almost all light current I_L of a photodiode at the collector and base junctions point to the base emitter of a photo transistor by raising impedance at the base side.

(c) Temperature Compensating Circuit

Light current I_L and dark current I_D of a photo transistor have positive temperature coefficient. In particular, dark current increases exponential functionally as shown in the individual technical data sheets. Therefore, to expect stabilityed operation at ambient temperature of 50 ~ 60°C, temperature compensation for dark current and photo electric current of a photo transistor becomes necessary.

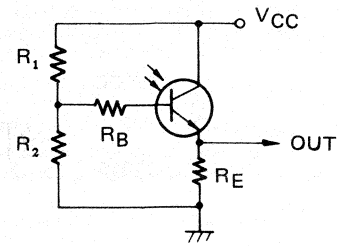


Fig. 3–2.4 Bleeder Type Bias Method

The bleeder type circuit is mentioned in the above as an example of this circuit. In addition, there is a compensation circuit shown in Fig. 3–2.5, which uses negative temperature coefficient retained by forward voltage V_F of a diode. When a photo transistor having no base terminal is used, a method to compensate output voltage by reducing load resistance of a photo transistor by a thermister Th at time of temperature rise as shown in Fig. 3–2.6 is available.

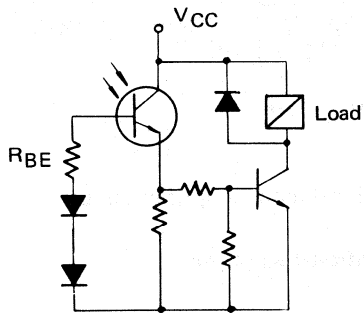


Fig. 3–2.5 Temperature Compensation Circuit Using Resistance Diode

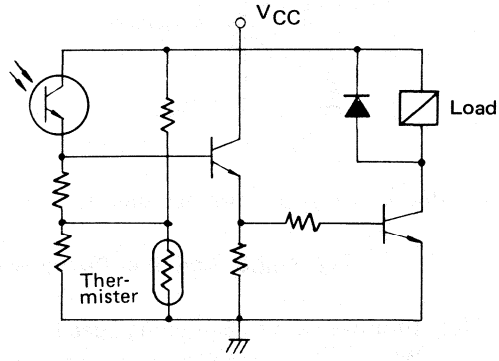
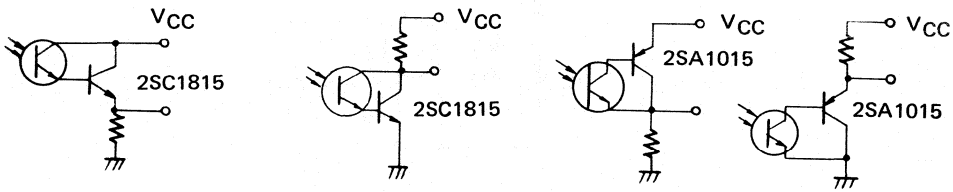


Fig. 3–2.6 Temperature Compensation Circuit Using Thermister

(d) Basic Amplifier Circuit

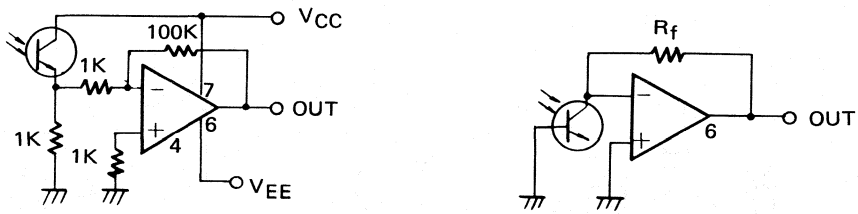
Shown in Fig. 3–2.7 (a) is Darlington connection by NPN transistor and Fig. 3–2.7 (b) is Darlington connection by PNP transistor. in both circuits, light current is increased by h_{FE} times and output current I_C becomes $h_{FE} \cdot I_L$.



(a) NPN transistor (b) PNP transistor

Fig. 3–2.7 Amplifier Circuit for Photo Transistor

Fig. 3–2.8 shows examples of the basic circuits using amplification by an operational amplifier.



(a) Photo transistor amplifier circuit (b) Photo diode amplifier circuit

Fig. 3–2.8 Amplifier Circuit with Operational Amplifier

(e) Improvement of Switching Speed

When voltage amplification degree is raised by increasing load impedance as light current of a photo transistor is small, switching speed characteristic may be sacrificed as a reverse effect. As a remedy. There are methods to obtain switching speed characteristic which is relatively indipendently of size of load by converting impedance through PNP transistor base earthed circuit (Fig. 3–2.9 (a)) or cascade connection of NPN transistor (Fig. 3–2.9 (b)). There methods are applicable to a high speed pulse modulated light detection circuit for a photo electric switch/high speed tape reader.

(a) Base grounding (b) Cascade connection

Fig. 3–2.9 Examples of Frequency Characteristic Improvement

(f) Steady-state Light Detecting Circuit

The steady-state light receiving circuit shown in Fig. 3–2.10 amplifies received photo signal through Darlington connection of TPS601A for ensuring an operation as a switching device and further connect is to R–S flip-flop to ensure output level.

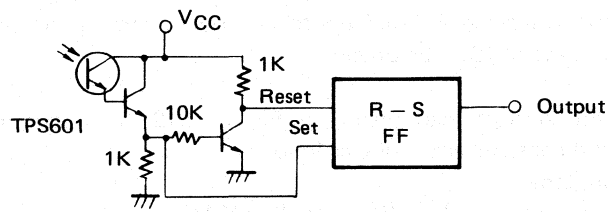


Fig. 3–2.10 Steady-state Light Detecting Circuit

(g) Pulse modulated Light Detecting Circuit

When pulse modulated light is used as photo signal, there are merits that S/N ratio with disturbance light is raised and a distance is extended some circuit examples are shown in Fig. 3–2.11.

When the optical axis of the optical sensor is aligned and pulse modulated light is received by a photo transistor, drift components of steady-state light and dark durrent by disturbance light are cut by a coupling capacitor C_1 and signal components only are detected, turning Tr_1 and Tr_2 ON.

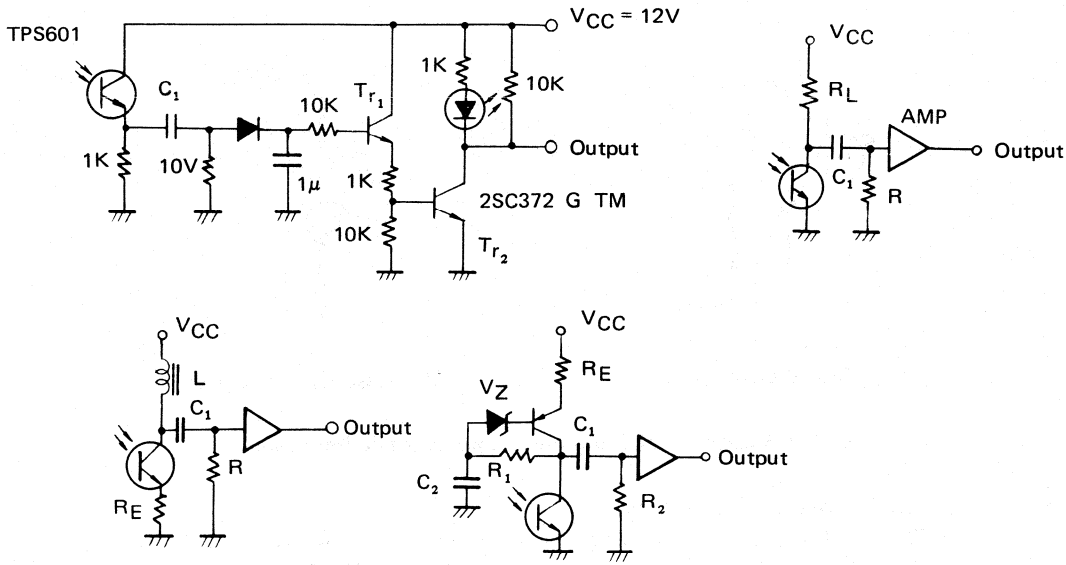


Fig. 3–2.11 Modulated Light Detecting Circuit

(h) Connection with Digital IC

When driving a digital IC (TTL, HTL, C^2–MOS, etc.) by a photo transistor, values of load resistance R_L and photo electric current I_L are restricted depending upon type of IC to be driven.

In case of the emitter load shown in Fig. 3–2.12 (a), restrictions of load resister R_L and light current I_L are as follows:

Photo Transistor

ON condition ; $R_L \times (I_L - |I_{IH}|) > V_{IH}$

OFF condition ; $R_L \times (Id + |I_{IL}|) < V_{IL}$

where, R_L ; Load resistance

I_L ; Light current

I_D ; Dark current

I_{IH} ; High level input current of IC

I_{IL} ; Low level input current of IC

V_{IH} ; High level input voltage of IC

V_{IL} ; Low level input voltage of IC

Shown in Fig. 3–2.12 (b) is an IC driving circuit is case of collector load and it is necessary to satisfy the following conditions as that output from a photo transistor is obtained at "L" level when light current I_L flows through this circuit:

Photo Transistor

ON condition ; $V_{CC} - R_L \times (I_L - |I_{IL}|) < V_{IL}$

OFF condition ; $V_{CC} - R_L \times (I_d + I_{IH}) > V_{IH}$

(a) Emitter load (b) Collector load

Fig. 3–2.12 Digital IC Driving Circuit

(i) Waveform Shaping Circuit

When driving a digital IC by output from a photo transistor, malfunction is taken place unless IC is driven after waveform shaping. This is because IC at the latter stage transmits signal during ON–OFF operation as change of signal ends (tr, tf) is slow. In particular, if a long cable is used between a sensor and a logic, induced noise is added and waveform is disturbed, making the possibility for causing malfunction large.

When a schmitt trigger circuit is added to the output terminal of a photo transistor for waveform shaping, troubles are reduced.

Further, when a single pulse is needed for either ON or OFF of a photo transistor, a monostable multiple vibrator shall be added.

Shown in Fig. 3–2.13 (a) and (b) are examples of schmitt circuit composing of a photo transistor and a transistor circuit.

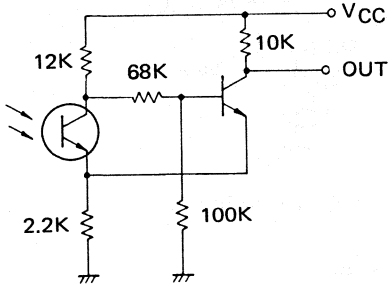
Fig. 3–2.13 (c) (d) and (e) shown circuits using IC, the circuits in (d) and (e) become effective only when photo electric current of a photo transistor is large as input impedance to IC is low. In these examples, it is necessary to decide circuit constants to fit V_{IL} and V_{IH} conditions of IC by referring to 3–1 (h) connection with digital IC.

Shown in Fig. 3–2.13 (f) is a circuit using an operational amplifier. In this circuit, a value of collector current at which output is turned ON/OFF is obtained by the following formulas:

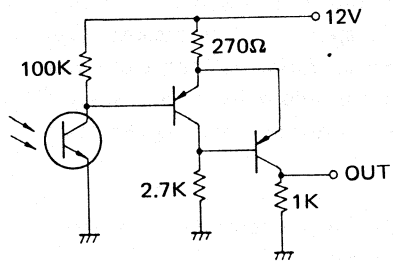
TH is inverter's threshold value

$$I_{C\,(OFF\rightarrow ON)} \fallingdotseq \frac{R_3}{R_3 + R_4} \times \frac{R_1 + R_4}{R_1 - R_4} V_{CC}$$

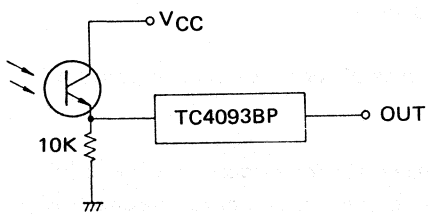
$$I_{C\,(ON\rightarrow OFF)} \fallingdotseq \frac{R_3}{R_3 + R_4} \times \frac{R_1 - R_4}{R_1 + R_4} V_{CC}$$



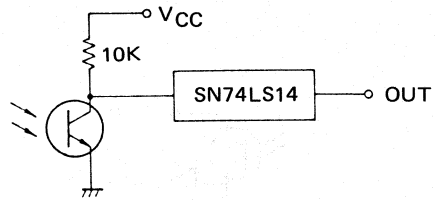
(a) Transistor Shumit Trigger Circuit



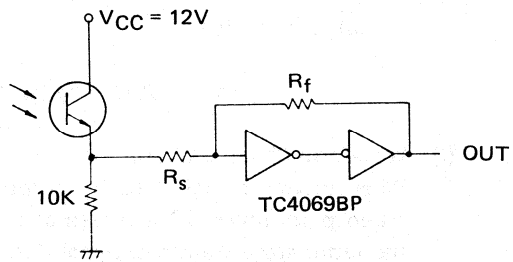
(b) Transistor Shumit Trigger Circuit



(c) C-MOS Shumit IC



(d) TTL Shumit IC



(e) Shumit Trigger for Using Gate – IC

$$V_{IH} = \left(\frac{R_s + R_f}{R_f}\right) V_{TH}$$

$$V_{IL} \fallingdotseq \left(\frac{R_s + R_f}{R_f}\right) V_{TH} - \left(\frac{R_s}{R_f}\right) V_{CC}$$

$$R_{IN} \fallingdotseq R_s + R_f$$

V_{TH} : Threshold Voltage

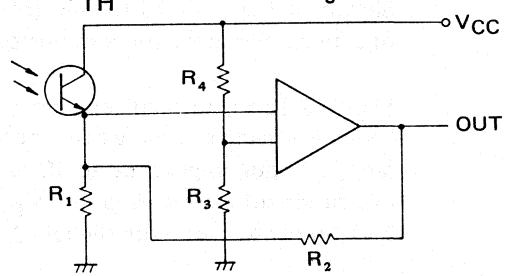


Fig. 3–2.13 Waveform Shaping Circuit

(j) Analog Usage

Photo transistors provide higher sensitivity than photo diode as they are equipped with an amplification function internally; however, sensitivity fluctuates largely depending upon a difference in amplification factors. Especially, use of Darlington type photo transistor must be avoided. Therefore, it is necessary to use a variable resistor to correct sensitivity or sensitivity selection by product side.

Shown in Fig. 3–2.14 (a) is a circuit by controling current of a transistor amplifier. Collector current of a photo transistor controls the base of next stage transistor of which emitter is earthed. Fluctuation in photo transistor's sensitivity is connected by a feedback resistor R_E in the emitter circuit.

Shown in Fig. 3–2.14 (b) is a circuit by controling voltage of a transistor amplifier. Collector current of a photo transistor generates voltage for controling a latter stage transistor by a variable resistor. A transistor is an emitter follower and fluctuations between individual photo transistors are corrected by a variable resistor R_A. Therefore, photo transistor's switching time is changed by R_A.

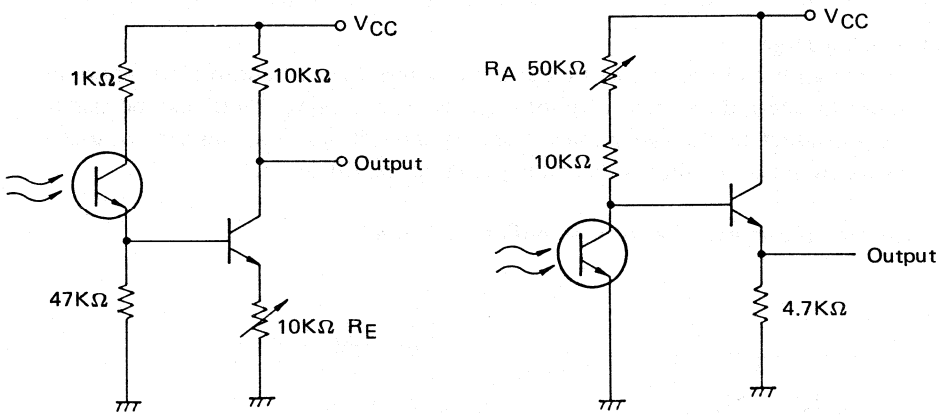


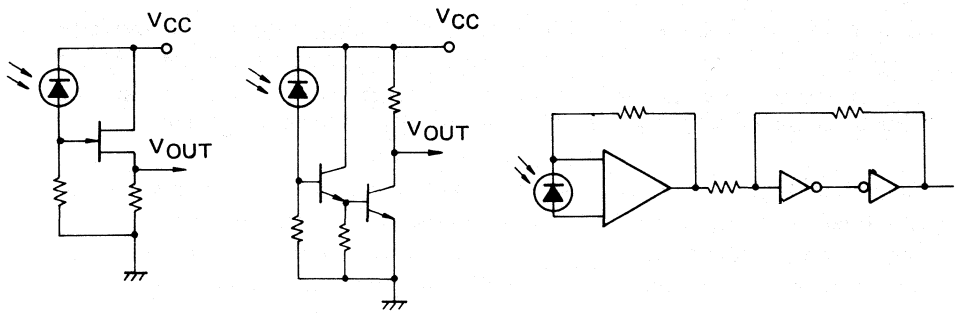
Fig. 3–2.14

3–3 Application Circuits of Photo Diode

In combination with infrared LED, photo diode is used in two ways; a digital specification to detect existance of light and an analog specification to detect quantity of light linearly.

(a) Digital Usage

As response speed is fast, photo diode is suitable for high speed switching. On the other hand, however, as light current is small, it is necessary to use an FET with high input impedance as shown in Fig. 3–3.1 (a) or a circuit with high amplification factor as shown in Fig. 3–3.1 (b). To raise amplification factor, an operational amplifier is used. When high speed response is required, it is necessary to select an amplifier for high speed applications.



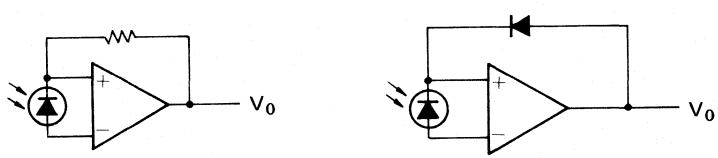
(a) FET amp. (b) Transistor amp. (c) Operational amplifier

Fig. 3–3.1 Amplifier Circuit of Photo Diode (Digital Usage)

(b) Analog usage

Illuminance and photo electric current characteristics of photo diode are more close to linear than those of photo transistor, and photo diode can be said to be a product that is easily used in analog applications. For this type of usage, there are linear amplification and logarithmic amplification.

In case of cameras, the latter amplification is used.



(a) Linear amplification (b) Logarithmic amplification

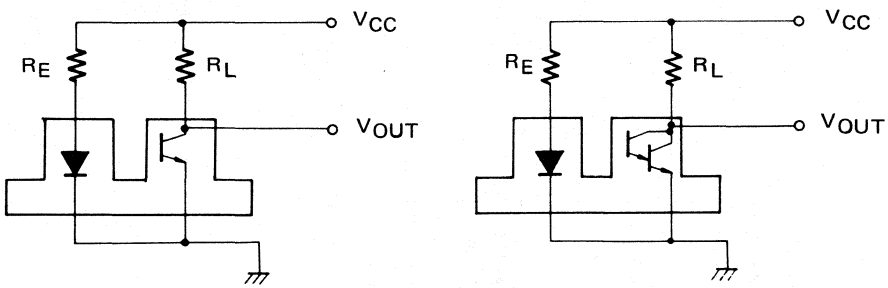
Fig. 3–3.2 Amplifier Circuits of Photo Diode (Analog Usage)

3–4 Application Circuits of Photo Interrupters

Photo interrupter consists of a combination of LED and light detecting device and is used in wide applications including detection of number of revalutions of rotating body, detection of position of substance, etc.

Generally, an infrared high photo output LED in used at the light emission side and a photo transistor or Darlington photo transistor at the light receiving side. A distance between the light emission and receiving sides is 3 ~ 5 mm and a light detecting device is turned ON/OFF by passing a substance to be detected through this slit.

(a) Basic Circuit
The application circuit of photo interrupter is shown in Fig. 3–4.1.
When a light receiving device is transistor output, this circuit is used to detect number of revolutions of a disk shape rotary body rotating at high speed and when it is Darlignton transistor output, it is used for controlling large loads by making the most of high conversion efficiency (I_C/I_F).



TLP800 TLP507A

(a) Transistor Output (b) Darlington Transistor Output

Fig. 3–4.1 Basic Circuits of Photo Interrupter

On a photo interrupter, the light emission and receiving sides are away each other and photo electric current of the light receiving device is small, and therefore, an amplifier circuit may be used.

In addition, when an amplifier circuit is used, the switching characteristic is improved. It is necessary to design circuits by taking rotation and moving speed, etc. of substance to be detected into consideration.

(b) Examples of Application Circuits

Generally, when driving digital IC (TTL, HTL, C^2-MOS, etc.), IC that can be used is determined by V_{CE} (sat) (collector to emitter saturated voltage) of a photo transistor which is a light receiving device when output is Darlington transistor, V_{CE} (sat) is approx. 1.0V and V_{IL} of TTL is approx. 0.8V and therefore, direct driving by TTL is not feasible.

Shown in Fig. 3–4.2 (a) is a design example with a speed at ~ 200 bits/sec. Shown in Fig. 3–4.2 (b) and (c) are circuit design examples for speeds at ~ 1 Kbits/sec. and ~ 10 Kbits/sec., respectively.

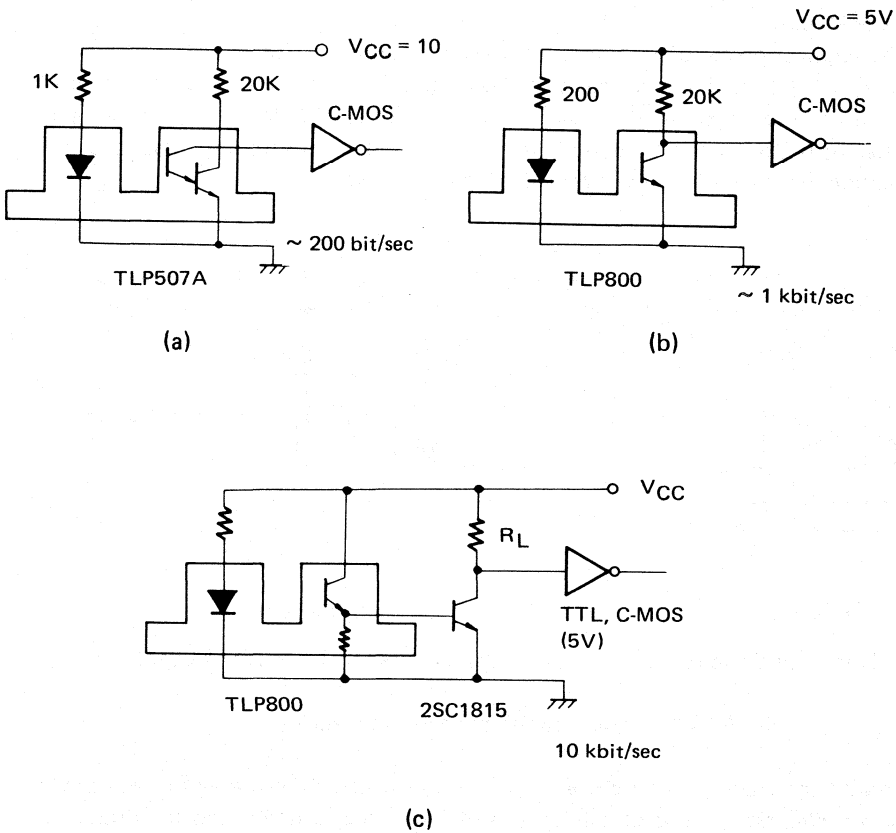


Fig. 3–4.2 Application Circuits of Photo Interrupter

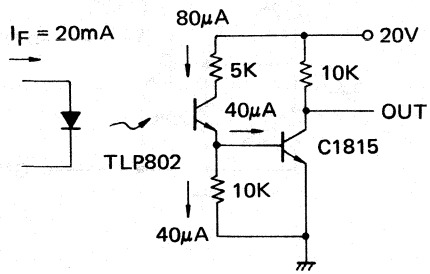
Flexibility of application can be further promoted by using single photo transistor interrupters for high speed specification and Darlington transistor interrupters for low speed specification.

(c) Actual High Speed Response Design

2 examples of high speed response design are shown below.

Design Example 1

[Circuit] Registors are all 1/4W.



[Design Check] (at Topr 60°C max.)

TLP802 Loss • I_F = 20 mA ..... OK

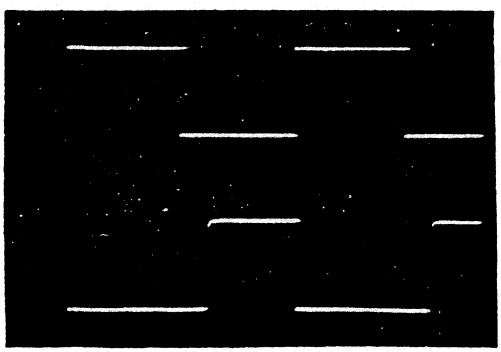
• $P_C = \frac{1}{4} \cdot \frac{20V^2}{5K}$

2SC1815 P = 20 mW ..... OK

2SC1815 Loss P_C: There is no problem because of saturation operation.

I_C of TLP802 has been designed at 80 μA ~ 10 mA.

[Operation Waveform] **Photo 3–4.1**



T = 1 ms

duty = 1/2

Upper waveform

Vertical 10 mA/div

(I_F)

Horizontal 200 μs/div

Lower waveform

Vertical 10 V/div

(V_{out})

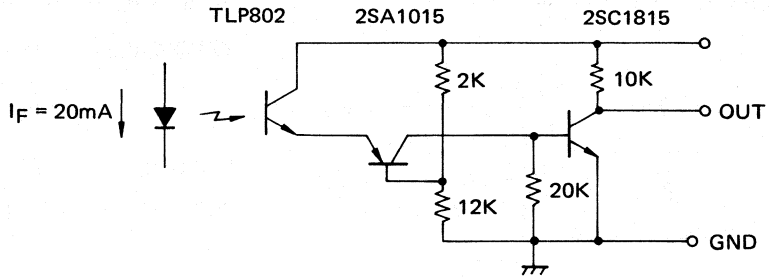
Horizontal 200 μs/div

[Result]

In this design, $t_{on} \approx 10\ \mu s$ and $t_{off} \approx 130\ \mu s$ are obtained and operation at f=2 kHz is possible.

Design Example 2

[Circuit] Resistors are all 1/4W.



[Design Check] (at Topr 60°C max.)

TLP802 Loss • I_F = 20 mA ..... OK

• $P_C < 20V \times \frac{2}{14} \times$ (~MAX 10 mA)

= 28 mW ..... OK

2SA1015 Loss $P_C < 20V \times \frac{12}{14} \times$ (MAX 10 mA)

= 172 mW ..... Ta = OK up to 80°C

2SC1815 Loss P_C : There is no problem because of saturation operation.

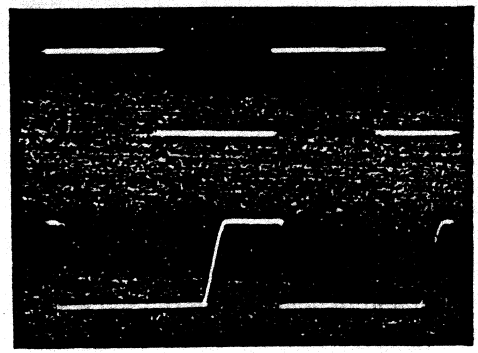
For circuit operation, I_C (MIN) of TLP802 is

$$I_{C(MIN)} = \frac{V_{BE(2SC1815)}}{20K} + I_{B(2SC1815)}$$

$$< \frac{1V}{20K} + \frac{2\,mA}{70} = 0.08\,mA \text{ ..... OK}$$

[From $I_C/I_{F(MIN)}$ of TLP802, $I_{C(MIN)} > 0.4$ mA]

[Operation Waveform] **Photo 3–4.2**



T = 100 μs

duty = 1/2

Upper waveform

Vertical : 10 mA/div

(I_F)

Horizontal : 20 μs/div

Lower waveform

Vertical : 10 V/div

(V_{out})

Horizontal : 20 μs/div

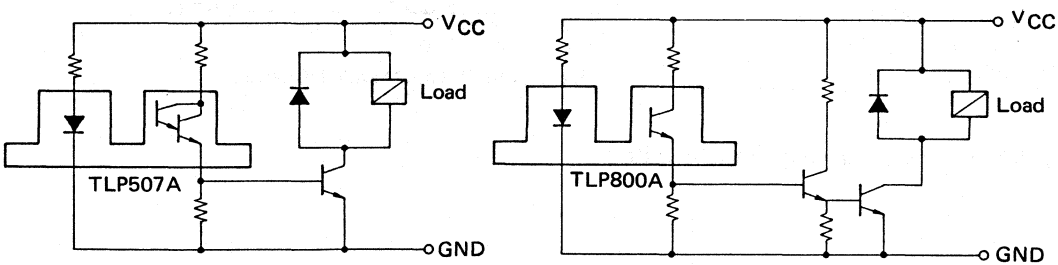
[Result]

In this design, $t_{on} \approx 5$ μs and $t_{off} \approx 30$ μs are obtained and operation at f=10 kHz is possible.

(d) Control of Large Capacitive Load

It is possible to control a large capacitive load using switching characteristic of photo interrupter.

Shown in Figs. 3–4.3 and 3–4.4 are examples of circuit to drive a power transistor and thyristor for load driving.



(a) (In Case of Low Speed) (b) (In Case of High Speed)

Fig. 3–4.3 Large Load Control Circuits (Examples of Power Transistor)

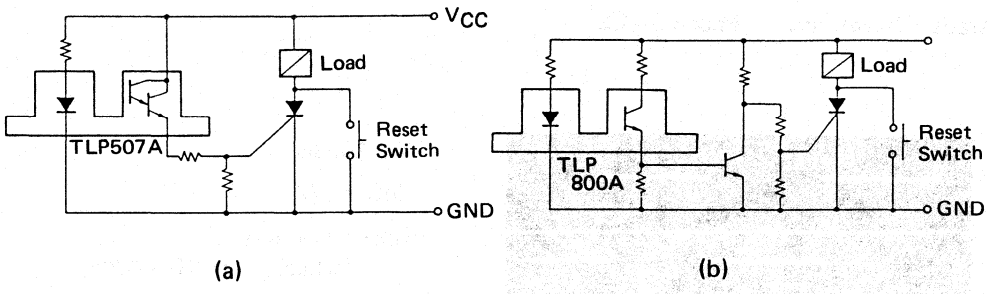
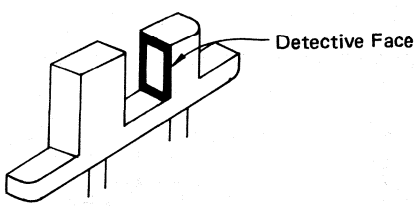


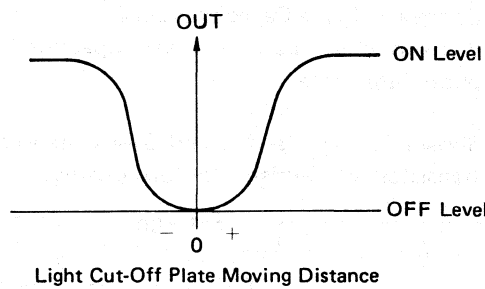
Fig. 3–4.4 Large Load Control Circuits (Examples of Thyristor)

(e) Design of Light Cut-off Plate

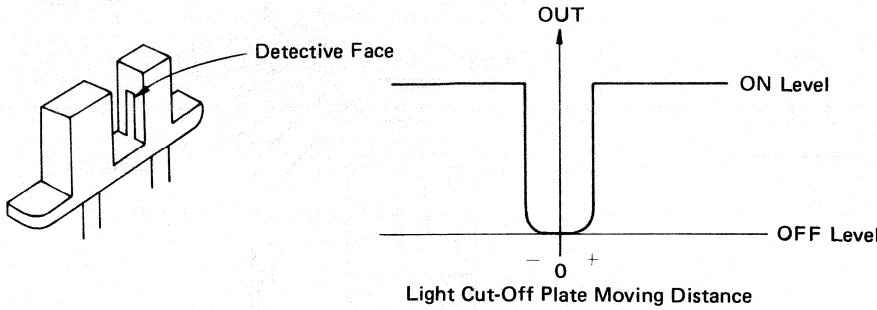
When a photo interrupter is used for detection of number of revolutions, etc., it is necessary to use a light cut-off plate at the rotor of a rotary body to shade the photo interrupter. Light emission and receiving areas come to appear as a shifting time from open (ON) to shading (OFF), that is, switching accuracy.

Shown in Fig. 3–4.5 (a) and (b) are different light receiving areas (slit widths) and corresponding switching accuracy.





(a) When a light receiving area (slit width) is large.



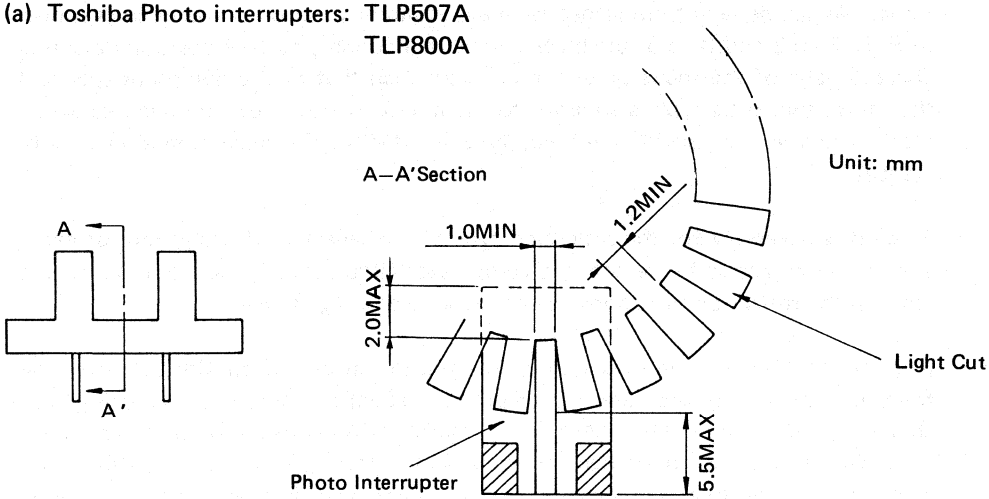
(b) When a light receiving area (slit width) is small.

Fig. 3–4.5 Slit Widths and Output Characteristic

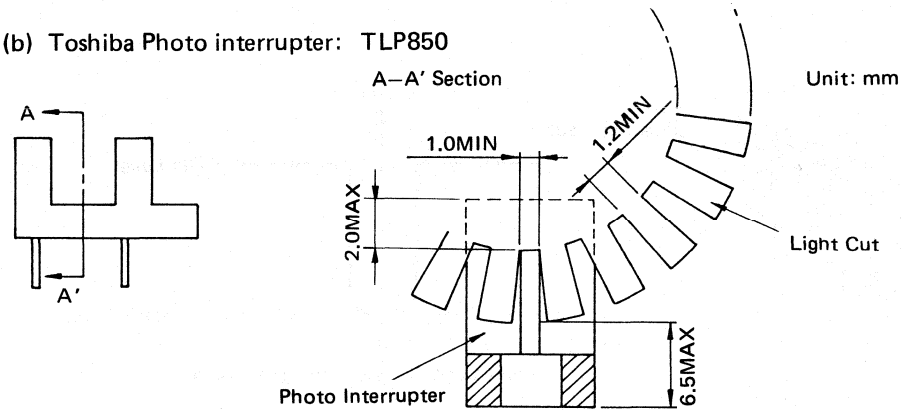
When the light receiving area (slit width) is small, switching accuracy is surely improved but on the other hand, there comes out a demerit that output becomes small.

- Recommended Example of Light Cut-off Plate Design
  In case of Toshiba's photo interrupters, it is recommended to design the slit of a rotary disk referring to Fig. 3–4.6.

(a) Toshiba Photo interrupters: TLP507A
TLP800A



(b) Toshiba Photo interrupter: TLP850



Slit hole width shall be designed by thoroughly considering open and closing times and interrupter's frequency response when the disk is rotated.

Fig. 3–4.6 Example of Light Cut-off Plate Design

3–5 Application Circuits of Reflection Type Photo Sensor

Shown in Fig. 3–5.1 is a basic detection circuit of reflection type photo sensor and reflected light from the reflection surface is detected by a photo transistor and output to Vout terminal as voltage.

The reflection type photo sensor is available in 2 types; focus type and non-focus type (TLP903/904). These 2 types should be properly used according to applications. As can be seen from respective basic detecting position characteristics shown in Figs. 3–5.2 and 3–5.3, the black and white boundary surface position detecting characteristic of the focus type is more sharp than that of the non-focus type and therefore, the focus type is superior to the non-focus type for bar code like detection. However, the small non-focus type is effective for close detection of substances.

Since it is necessary for the reflection type photo sensor to digitally output existence of an object to be detected, a comparator circuit is connected at next output stage of the reflection type photo sensor as shown in Fig. 3–5.4.

Application design of the reflection type photo sensor is more difficult than the transmission type photo sensor because 1 reflection factors of reflecting substances are different each other, 2 distances of reflecting substances are easily controllable, and 3 both light emitting and detecting surfaces are on the same plane and susceptible to effect of external light, and leakage current increases. Therefore, it may be said it is better to design a transmission type photo sensor as could as possible.

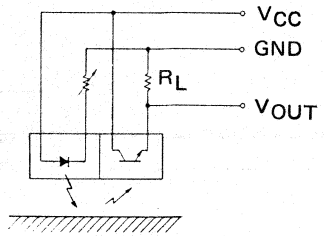


Fig. 3–5.1 Reflection Type Photo Sensor Basic Detection Circuit

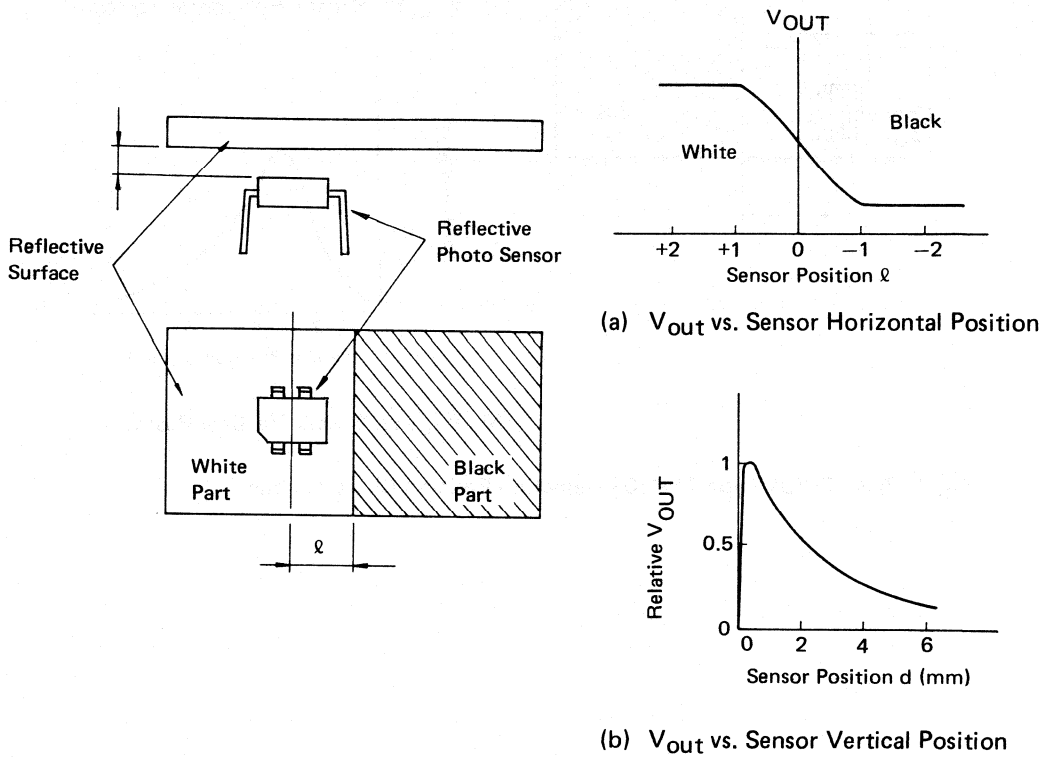


Fig. 3–5.2 Example of Non-Focus Type Detection Position Characteristic

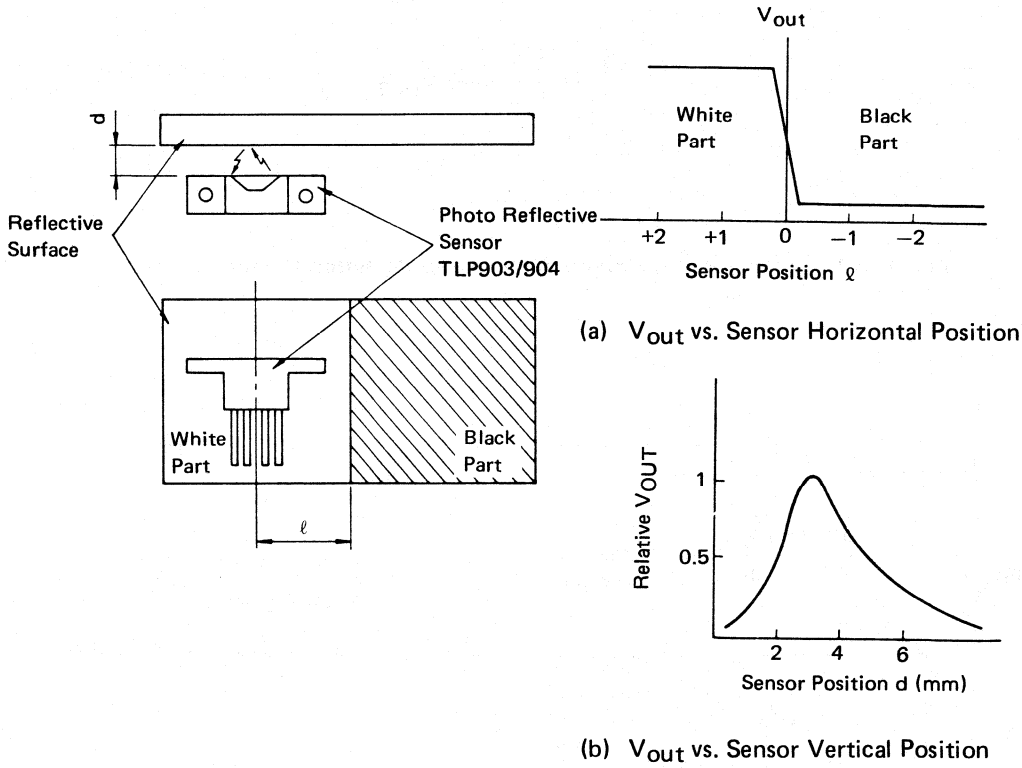


Fig. 3–5.3 Focus Type TLP903 Detection Position Characteristic

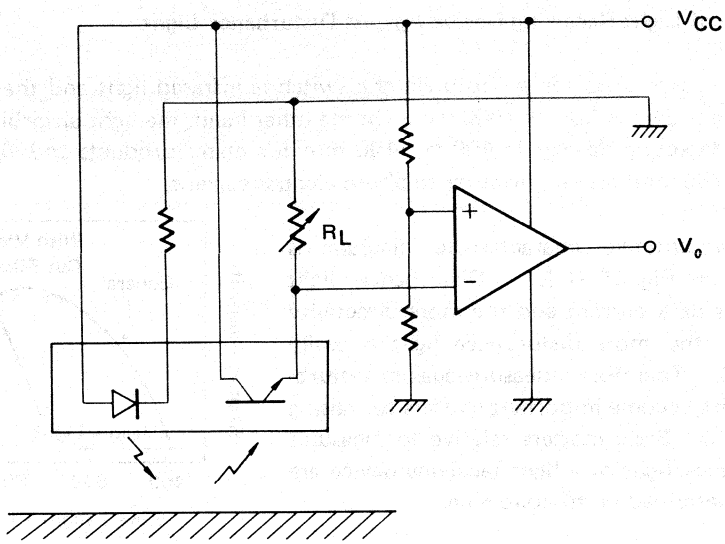


Fig. 3–5–4 Connection Circuit of Reflection Type Photo Sensor with Comparator

4. Precautions for Mounting

4–1 Measure of Light Receiving Device Against Disturbance Light

A light source used for a photo electric switch is infrared light and the luminous wavelength area is 900 ~ 1000 mm. On the other hand, the light absorbing area of a light detecting devices is 400 ~ 1100 mm for many products and visible light (380 ~ 750 mm) also contributes to photo electric current.

(A representative characteristic diagram is shown in Fig. 4–1.1.) Disturbance light increases dark current and the more directivity is wide, the more disturbance light is easily received. Therefore, measure against disturbance light become important matters for raising S/N ratio. Basic matters relative to measures disturbance light of a light receiving device are briefly described in the following.

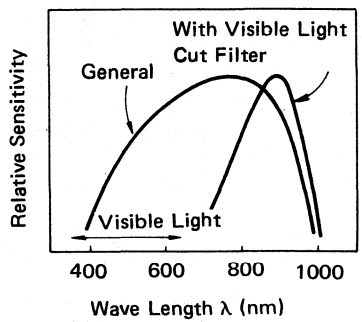
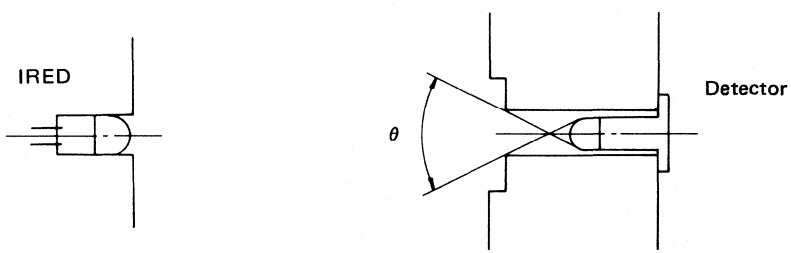
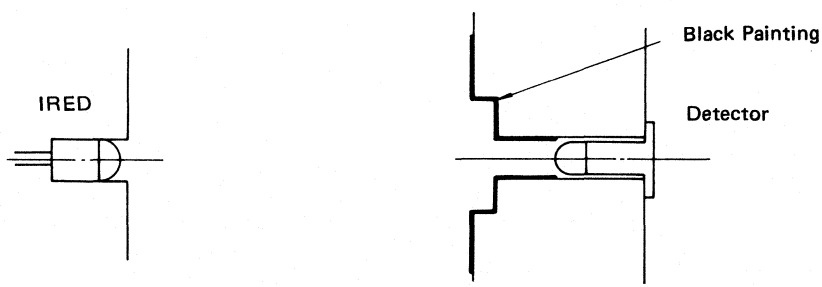


Fig. 4–1.1 Photo Sencitivity Spectrum

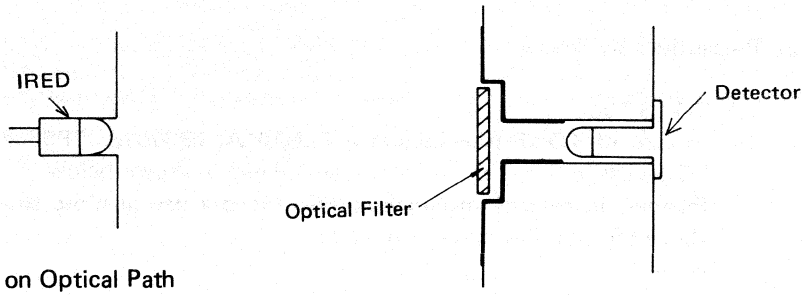
(a) First, reduce incoming disturbance light by making angle of θ of light coming into a light detecting device small.



(b) Coat black color around the light detecting device or use mold resin for visible light cutting. The purpose of this is to prevent scattering or reflection of light.



(c) Provide a filter to cut wavelengths other than infrared spectrum. One example of this filter is Fuji Filter's IR84 which allows infrared rays only to pass.



(d) Dust on Optical Path
Dust attached on the optical path between the light emitting and detecting sides reduces photo electric current and makes operating life of a system short.

4–2 Mounting to Printed Circuit Board (PC Board)

Representative object for mounting of infrared light emitting/receiving devices and photo interrupters may be said to be printed circuit board. Recommended mounting methods and several cautions for mounting by shape of product are descrived here.

(1) Soldering Work Conditions

Unless otherwise specified in the individual technical data, the soldering work shall be performed under the following conditions:

Soldering temperature	below 260°C
Soldering time	less than 3 sec.
Soldering place	more than 2 mm from the terminal base

(Caution) Temperature at the end of a soldering iron will become approx. 320°C at 30W and 400°C at 40W. Therefore, adjust input voltage so that temperature at the end of a soldering iron is limited to 260°C or below. Further, in case of a soldering iron of 30W, proper input voltage is approx. 80% of rated voltage.

Soldering under the above conditions prevents such troubles as remarkable reduction of quantity of light, open, short-circuit, mold damage, etc. at solder heating.

However, when the above mentioned conditions cannot be observed due to matters relative to space and balance with other parts, take a working method

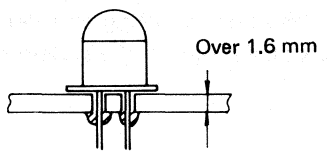
to prevent temperature rise of PCB (above the bases of leads) so that no stress is applied between the leads during soldering work.

(2) Precautions by Shape

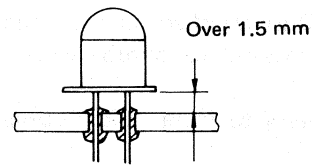
(a) TO-18 Type

In case of TO-18 type including TLN101A, TPS601A, TPS604, etc., use PC boards in thickness of more than 1.6 mm as shown below.

Further, in case of throughhole PCB, keep a device more than 1.5 mm above the board as solder is built up.



(General PC Board)

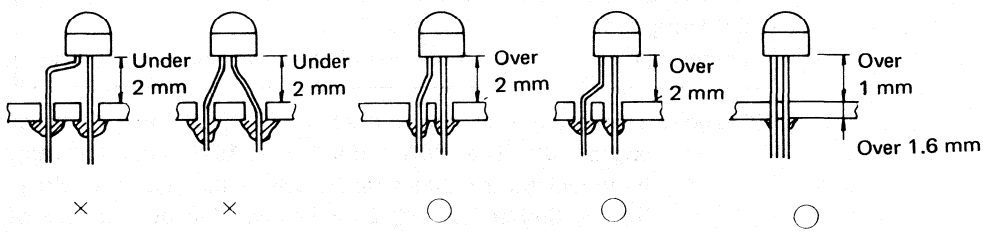


(Throughhole Board)

(b) ϕ3 Ceramic Type

Lead-to-lead distance of ϕ3 ceramic type such as TLN103, TPS603, etc. is 0.9 mm. When mounting them on a 2.54 mm pitch standard PCB, solder them keeping away 2 mm or more from the base of lead.

Further, be careful not to press down devices too strongly. Keep them more than 1 mm from PC board. In case of a throughhole PC board, mount devices afloat more than 2 mm.



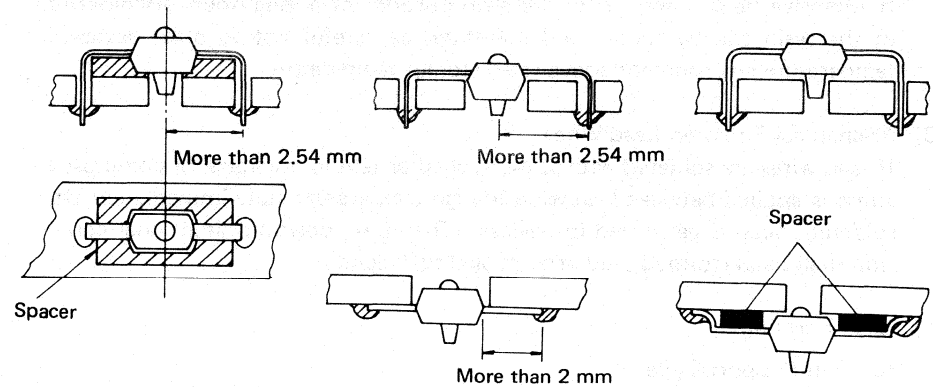
(c) Double-End Type

In case double-end type such as TLN104, TPS605, TPS606, etc., differing from self-supporting type, there are two mounting methods; (a) a method to mount them on the front surface of PC board and (b) a method to mount from the back of PC board as illustrated below.

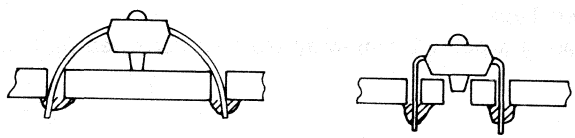
In the former method, it is better to position a device by providing a hole for containing the resin bottom on PC board and minimize shift of the optical axis as could as possible.

However, it should be avoided to solder a device by forcing it into the hole or with mechanical stress applied.
Further, as this type of device is small, temperature of resin rises quickly at time of soldering. Therefore, it is recommended to radiate heat by holding lead wires with pliers, pincette, etc. as could as possible during the soldering work.

(Good Examples)



(Bad Examples)



4–3 Adhesion to Panel

When an LED is combined with a photo transistor and used as a photo electric switch or a photo transistor is used as a sensor of quantity of light, these devices may be embedded in a panel and fixed using a bonding agent. Precautions required are described in the following.

(Precautions)

- Avoid such a practice to push the molded or metal part into a hole on a panel by force as an internal strain may be caused, making a device defective.
- If a bonding agent is much used, the lens surface may become dirty or resin may be deformed by the attached bonding agent. Therefore, quantity of a bonding agent to be used shall be properly controlled.
- Select a proper bonding agent according to type of panel and adhesiveness with a device. In addition, it is considered that a bonding agent may be softened by temperature rise and flow out to the lens section. Therefore, it is necessary to pay attention to this point.

4—4 Precautions for Handling

(1) Abrasion Resistance
Molded products use resin of relatively low handness as it requires transparency of a lens. Therefore, avoid to rub devices intentionally with a metal or a finger nail. There will be generally no problem to handle devices with fingers.

(2) Heat Resistance
If intensive heat is applied to the resin portion for a long hour, discoloration of the resin can be caused and therefore, be careful not to place devices in temperature environment above rated storage temperature.

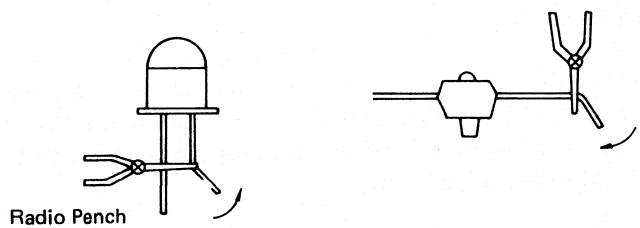
(3) Mechanical Stress on Lead Wires
If lead wires are soldered with stress applied or tensile, torsional or compressive stress is applied between lead wires in high temperature state immediately after soldered, open is generated in devices. Therefore, position/directional correction shall be performed only after cooled sufficiently.

(4) Lead Forming

(a) Self-Support Type
With a lead held at near its base with pliers so that no stress is left at the base of the lead, bend the lead at a point 2 mm away from the base.

(b) Double-End Type
Bend a lead at a point 2 mm away from its narrowed part or the base of mold.

(Example)



Radio Pench

(5) Ultrasonic Cleaning
If chemicals other than specified ones are used for ultrasonic cleaning or brushing using solvent to remove flux after completion of soldering, resin of a device package may be corroded. Precautions required in this case are provided below.

(Precautions)

- Stress applied to a device at time of ultrasonic cleaning varies largely depending upon size of a cleaning tank, output of an ultrasonic oscillator, size of a mounting PC board, device mounting method and the like. It is recommended to perform the cleaning after a test under actual using conditions.
  Further, the ultrasonic cleaning shall be performed at output 300W or below for 30 sec. or less although varying depending upon sizes of a cleaning tank and PC board.
- In addition to chemicals specified in the individual data, the following chemicals may be used. Further, temperature of chemicals for solvent clipping or ultrasonic cleaning shall be kept at 45°C or below.

Usable chemicals . . . . Freon TE, Freon TF, Solvent S3 or S3-E

- It is recommended to avoid brushing as stamped marks may be erased and the surface of LED, in particular, the lens can be scored.

CROSS REFERENCE TABLE

INFRARED LED

Industry Type No.	Toshiba Similar or Recommendable
GENERAL ELECTRIC	
LED55B	TLN101A
LED55C	TLN108
LED56	TLN108
1N6264	TLN101A
1N6266	TLN108
CQX14	TLN108
CQX16	TLN108
H23A1	TLN107A
F5F1	TLN107A
F5D1 ~ 3	TLN201
GENERAL INSTRUMENTS	
ME61	TLN104
ME7024	TLN110
ME7161	TLN104
CQY99	TLN105A
HONEYWELL – SPECTRONICS	
SE5453	TLN101A
SE5455	TLN108
SEP8503	TLN105A
SEP8504	TLN107A
SEP8505	TLN109
SEP8506	TLN107A
OPTEK	
K6250	TLN108
K6251	TLN108
K6252	TLN108
K6253	TLN108
K6550	TLN107A
K6551	TLN107A
K6552	TLN107A
K6553	TLN107A
K6554	TLN107A
K6555	TLN107A
SIEMENS	
CQY17	TLN101A
CQY77	TLN108
IRL-60	TLN104
LD261	TLN104
LD271	TLN105A
LD272	TLN107A
SFA401-3	TLN108
SFH401-1	TLN101A
SFH409	TLN109
TEXAS INSTRUMENTS	
TIL31B	TLN108
TIL32	TLN109
TIL34B	TLN101A
TIL39	TLN110
TIL40	TLN107A
TIL41	TLN104
TIL903	TLN201
TRW OPTRON	
OP130 ~ 133	TLN108
OP135 ~ 136	TLN108
OP140	TLN107A
OP230 ~ 233	TLN201

Photo Transistor

Industry Type No.	Toshiba Similar or Recommendable
GENERAL ELECTRIC	
LI4G	TPS604
LI4R	TPS607A
LI4Q	TPS608A
GENERAL INSTRUMENTS	
MT1	TPS614
MT2	TPS604
HONEWELL – SPECTRONICS	
SD3443	TPS614
SD5443	TPS604
SDP8106-1	TPS607A
SDP8107-1	TPS605
SDP8406-1	TPS608A
SDP8407-1	TPS606
OPTEK	
K-5200 ~ 02	TPS614
K-5210 ~ 11	TPS614
K-5250	TPS604
K-5253 ~ 56	TPS604
SIEMENS	
BP102	TPS604
BP103	TPS604
BP103B	TPS610
BPX38	TPS614
BPX43	TPS604
BPX81	TPS605
SFH500	TPS614

Industry Type No.	Toshiba Similar or Recommendable
TEXAS INSTRUMENTS	
TIL81	TPS604
TIL99	TPS614
TIL414	TPS610
TIL415	TPS600A
TIL416	TPS607A
TIL621	TPS601A
TRW OPTRON	
OP550	TPS608A
OP560	TPS607A
OP800 ~ 05	TPS604
OP841 ~ 45	TPS604
OP800W~02W	TPS614
OP841W~45W	TPS614

Photo Diode

Industry Type No.	Toshiba Similar or Recommendable
OPTEK	
K-7250	TPS708
SIEMENS	
BPX104	TPS703
BPX65	TPS708
SFH206	TPS703
TRW OPTRON	
OP915F	TPS703

Industry Type No.	Toshiba Similar or Recommendable

Photo Interrupter

Industry Type No.	Toshiba Similar or Recommendable
ATG – TELEFUNKEN	
TCST1103	TLP801A
TCST1202	TLP800A
TCSS2100	TLP1001
TCSS2110	TLP1000
TCST2103	TLP800A
TCSS4100	TLP1003
TCSS4110	TLP1002
TCSS4120	TLP1005
TCSS4211	TLP1004
GENERAL ELECTRIC	
CNY28	TLP800A
CNY29	TLP507A
H21A1	TLP800A
H21A2	TLP800A
H21B1	TLP507A
H21L2	TLP1001
H22A1	TLP801A
H22A2	TLP801A
H22B1	TLP852
H22L2	TLP1005
GENERAL INSTRUMENTS	
CNY36	TLP804
CNY37	TLP800A
MSA8	TLP507A
MCT8	TLP800A
HONEYWELL – SPECTRONICS	
HOA1812-11	TLP804
HOA1812-12	TLP801A
HOA1872-13	TLP852
HOA1874-12	TLP800A

Industry Type No.	Toshiba Similar or Recommendable
HOA1874-13	
HOA1878-12	TLP800A
HOA1878-13	TLP507A
HOA2001	TLP1000
HOA2002	TLP1000
MOTOROLA	
H21A1	TLP800A
H21A2	TLP800A
H22A1	TLP801A
H22A2	TLP801A
MOC7811	TLP800A
MOC7812	TLP800A
MOC7821	TLP801A
MOC7822	TLP801A
TEXAS INSTRUMENTS	
TIL143	TLP800A
TIL144	TLP800A
TIL145	TLP507A
TIL146	TLP507A
TIL158	TLP801A
TIL159	TLP804
TIL160	TLP852
TIL161	TLP852
TIL169-1	TLP804
TIL169-2	TLP801A
TIL170-1	TLP852
TIL170-2	TLP852
TRW – OPTRON	
CNY36	TLP801A
OPB706C	TLP908 (LB)
OPB707C	TLP907 (LB)
OPB804	TLP801A

Photo Interrupter

Industry Type No.	Toshiba Similar or Recommendable
OPB814	TLP800A
OPB816	TLP800A
OPB817	TLP800A
OPB818	TLP806
OPB820	TLP803
OPB825	TLP801A
OPB825A	TLP802
OPB825B	TLP800A
OPB87X-T	TLP800A
OPB87X-N	TLP801A
OPB87X-P	TLP802
OPB948	TLP1005
OPB971-N	TLP1004
OPB971-P	TLP1002
OPB971-T	TLP1000
OPB973-N	TLP1005
OPB973-P	TLP1003
OPB973-T	TLP1001

Industry Type No.	Toshiba Similar or Recommendable

6 Alphanumeric Index

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