TOSHIBA

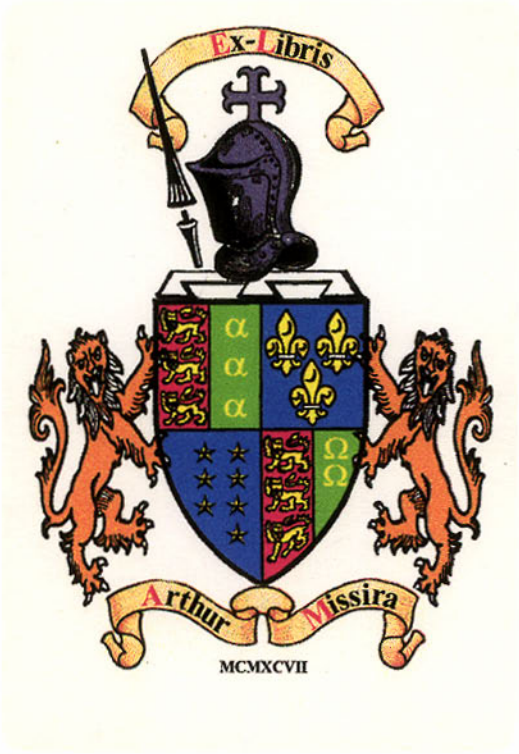
OPTOELECTRONIC SEMICONDUCTORS

Mar. 1984

TOSHIBA CORPORATION

TOSHIBA OPTOELECTRONIC SEMICONDUCTORS

Mar. 1984



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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TOSHIBA OPTOELECTRONIC SEMICONDUCTORS

INTRODUCTION

We thank you for your continued favors towards our semiconductor products and take this opportunity of assure you that in order to meet the multiform needs of today's electronic equipment and applied equipment, we are constantly exerting all efforts to provide a highly reliable and substantial lineup of photo semiconductor devices. Needless to say, these products are backed up by an abundance of experience and by actual performances.

Provided here for your convenience and effective use according to your own design of such equipment, is the technical data of our photo semiconductor devices and their applications.

For further detailed data, please send us your request for individual materials separately.

APRIL 1984

TOSHIBA CORPORATION
SEMICONDUCTOR GROUP
Tsuyoshi Kawanishi
Group Executive

TOSHIBA CORPORATION

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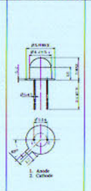
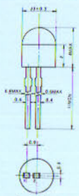
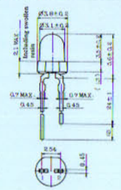
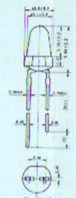
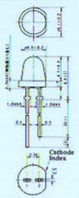
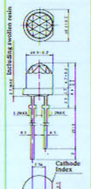
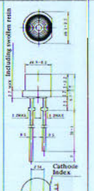
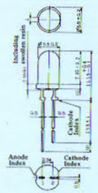
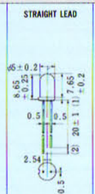
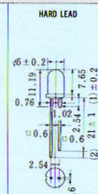
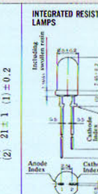
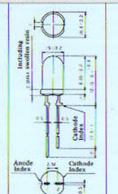
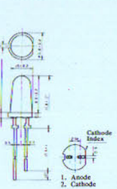
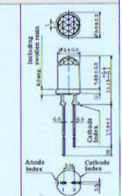
Toshiba LED Lamps Selection Guide

Diameter of Lens (mm)		φ4.2	φ3		φ3.1						φ4.9						φ5												
OUT LINE (mm)																													
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Red	Red clear				TLRI23	TLSI23	TLURI23				TLRI43	TLSI43			TLRI45	TLRI47	TLRII3A	TLSII3	TLURII3			TLRII3AR				TLRI53		TLRII5A
	Light Red clear			TLSI08A				TLSI63	TLURI63				TLURI43						TLURI20	TLRII3AP	TLRII3AQ		TLS255		TLSI53	TLURI53		
	Red diffused	TLRI01	TLRI02A		TLRI24	TLSI24	TLURI24				TLRI44	TLSI44					TLRII4A	TLSII4	TLURII4	TLRII4AP	TLRII4AQ	TLRII4AR							
	Light Red diffused							TLSI64	TLURI64				TLURI44												TLSI54	TLURI54		
	Colorless clear		TLRI08A								TLRI40						TLRI20A							TLURI30		TLURI50		
	Milky diffused		TLRI09A								TLRI46						TLRII6A											
Green	Green clear				TLGI23A							TLGI43	TLUGI43		TLGI45	TLGI47	TLGII3A					TLGII3AR						TLGII5A
	Light Green clear		TLGI08A					TLGI63	TLUGI63	TLPGI63				TLPGI43						TLGII3AP	TLGII3AQ		TLG255		TLGI53	TLUGI53	TLPGI53	
	Green diffused		TLGI02A		TLGI24A												TLGII4A			TLGII4AP	TLGII4AQ	TLGII4AR						
	Colorless clear																											
	Light Green diffused							TLGI64	TLUGI64	TLPGI64		TLGI44	TLUGI44	TLPGI44											TLGI54	TLUGI54	TLPGI54	
Yellow	Yellow clear				TLYI23											TLYI47	TLYII3A					TLYII3AR						
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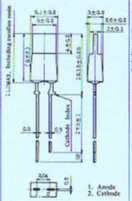
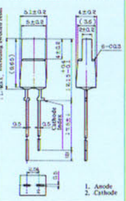
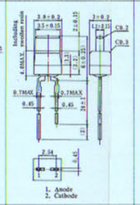
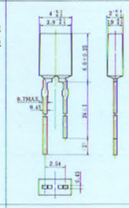
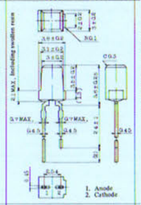
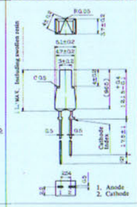
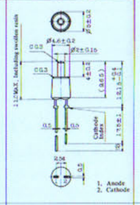
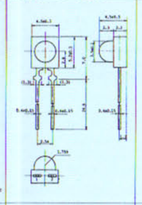
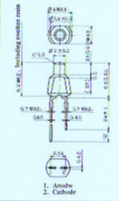
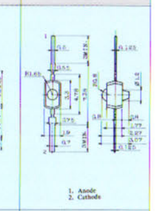
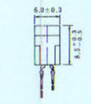
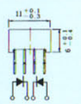
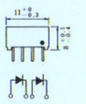
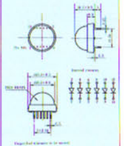
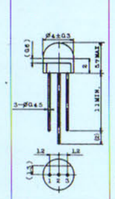
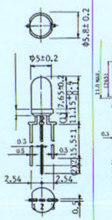
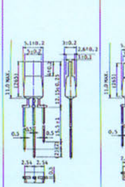
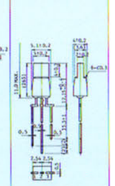
	Yellow diffused		TLYI02A		TLYI24					TLPYI64				TLPYI44			TLYII4A			TLYII4AP	TLYII4AQ	TLYII4AR					TLPYI54	
	Light Yellow diffused							TLYI64	TLUYI64			TLYI44	TLUYI44												TLYI54	TLUYI54		
Orange	Orange clear				TLOI23												TLOII3A					TLOII3AR						
	Light Orange clear		TLOI08A					TLOI63				TLOI43								TLOII3AP	TLOII3AQ		TLO255		TLOI53			
	Orange diffused		TLOI02A		TLOI24												TLOII4A			TLOII4AP	TLOII4AQ	TLOII4AR						
	Light Orange diffused							TLOI64				TLOI44													TLOI54			

Diameter of Lens (mm)		1×5	2×5	1.2×3.5	2×4	3×3	3×4×4	φ2		mini φ2	
OUT LINE (mm)											
		Standard Bright	Standard Bright	Standard Bright	Standard Bright	Standard Bright	Standard Bright	Standard Bright	Standard Bright	Standard Bright	Standard Bright
Red	Red clear								TLR223		TLR122
	Light Red clear										
	Red diffused	TLR205	TLR208	TLR210	TLR211	TLR209	TLR207	TLR206	TLR224	TLR226	
	Light Red diffused										
	Colorless clear										TLR121
	Milky diffused										
Green	Green clear								TLG223		TLG122
	Light Green clear										
	Green diffused	TLG205	TLG208	TLG210	TLG211	TLG209	TLG207	TLG206	TLG224	TLG226	
	Colorless clear										TLG121
	Light Green diffused										
Yellow	Yellow clear								TLY223		
	Light Yellow clear										
	Yellow diffused	TLY205	TLY208	TLY210	TLY211	TLY209	TLY207	TLY206	TLY224	TLY226	
	Light Yellow diffused										
Orange	Orange clear										
	Light Orange clear										
	Orange diffused										
	Light Orange diffused										

Diameter of Lens (mm)	LARGE-SIZED LAMPS			
	□6×6	□5×11	□6.5×11	φ20
OUT LINE (mm)				
Red	TLR250	TLS251	TLS253	TLS200
Green	TLG250	TLG251	TLG253	TLG200
Yellow	TLY250	TLY251	TLY253	TLY200
Orange	TLO250	TLO251	TLO253	—

Diameter of Lens (mm)		DUAL COLOR LAMPS			
		φ4	φ5	□1×5	2×5
OUTLINE (mm)					
R/G	Milky diffused	TLRG101	TLSG116	TLSG205	TLSG208
Y/G	Light Yellow diffused	—	TLYG116	TLYG205	TLYG208
O/G	Light Green diffused	—	TLOG116	TLOG205	TLOG208

TOSHIBA

LED Displays

DEVICE NO.	DISPLAY	CHARACTER HEIGHT	COLOR	COMMON	PHOTOS
TLR332/TLR332T		7.62mm (0.3")	RED	Cathode	
TLR333/TLR333T				Anode	
TLR334/TLR334T				—	
TLR335/TLR335T				Anode	TLR332 TLR332T
TLG332/TLG332T			GREEN	Cathode	
TLG333/TLG333T				Anode	
TLG334/TLG334T				—	
TLG335/TLG335T				Anode	TLG332 TLG332T
TLR342/TLR342T		10.9mm (0.43")	RED	Cathode	
TLR343/TLR343T				Anode	
TLR344/TLR344T				—	
TLR345/TLR345T				Anode	TLR342 TLR342T
TLG342/TLG342T			GREEN	Cathode	
TLG343/TLG343T				Anode	
TLG344/TLG344T				—	
TLG345/TLG345T				Anode	TLG342 TLG342T
TLR358/TLR358T		13.46mm (0.53")	RED	Cathode	
TLR359/TLR359T				Anode	
TLR368/TLR368T				Cathode	
TLR369/TLR369T				Anode	
TLR328/TLR328T				Cathode	
TLR329/TLR329T				Anode	TLR358 TLR358T
TLG358/TLG358T			GREEN	Cathode	
TLG359/TLG359T				Anode	
TLG368/TLG368T				Cathode	
TLG369/TLG369T				Anode	
TLG328/TLG328T				Cathode	
TLG329/TLG329T				Anode	TLG358 TLG358T

DEVICE NO.	DISPLAY	CHARACTER HEIGHT	COLOR	COMMON	PHOTOS
TLR362/TLR362T		14.22mm (0.56")	RED	Cathode	
TLR363/TLR363T				Anode	
TLR364/TLR364T				Cathode	
TLR365/TLR365T				Anode	
TLR366/TLR366T				Cathode	
TLR367/TLR367T				Anode	TLR362 TLR362T
TLG362/TLG362T			GREEN	Cathode	
TLG363/TLG363T				Anode	
TLG364/TLG364T				Cathode	
TLG365/TLG365T				Anode	TLG366
TLG366/TLG366T				Cathode	
TLG367/TLG367T				Anode	TLG366T
TLR312		8.3mm	RED	Cathode	
TLR313				Anode	
TLG312A			GREEN	Cathode	
TLG313A				Anode	TLR312
TLR314		7.5mm	RED	Anode	
TLR315				Cathode	
TLG314A			GREEN	Anode	
TLG315A				Cathode	TLR315
TLR352		12.7mm	RED	Cathode	
TLR353				Anode	
TLG352			GREEN	Cathode	
TLG353				Anode	TLR352
TLR306		15mm	RED	Anode	
TLR308				Cathode	
TLG306			GREEN	Anode	
TLG308				Cathode	TLR306

DEVICE NO.	DISPLAY	CHARACTER HEIGHT	COLOR	COMMON	PHOTOS
TLR307		9.4mm	RED	Anode	
TLR309				Cathode	
TLG307			GREEN	Anode	
TLG309				Cathode	TLR309
TLR370		12.7mm	RED	Cathode	
TLR371				Anode	
TLG370			GREEN	Cathode	
TLG371				Anode	TLR371
TLR322		7.6mm	RED	Cathode	
TLR323				Anode	
TLG322			GREEN	Cathode	
TLG323				Anode	TLR322
TLR320		10mm	RED	Cathode	
TLR321				Anode	
TLG320			GREEN	Cathode	
TLG321				Anode	TLR321
TLR324		12.7mm	RED	Cathode	
TLR325				Anode	
TLG324			GREEN	Cathode	
TLG325				Anode	TLR325
TLR326			RED	Cathode	
TLR327				Anode	
TLG326			GREEN	Cathode	
TLG327				Anode	TLR327

FOUR DIGITS LED DISPLAYS WITH WEEKLY DISPLAY

Character Height	Color: Display Font	Red: Common Cathode	Red: Photos (Package)	Green: Common Cathode	Green: Photos (Package)	Connection
Weekly 4㎜	SUN·····SAT :88:88	TLR3040	10	TLG3040	12	Static
		TLR3040WG	11	TLG3040WR	13	
Clock 15㎜	SUN·····SAT :88:88.	TLR3020	10	TLG3020	12	Duplex
		TLR3020WG	11	TLG3020WR	13	
	SUN·····SAT :88:88.	TLR3010	10	TLG3010	12	Duplex
		TLR3010WG	11	TLG3010WR	13	

FOUR DIGITS LED DISPLAYS

Character Height	Color: Display Font	Red: Common Cathode	Red: Common Anode	Green: Common Cathode	Green: Common Anode	Photos (Package)	Connection
6.3mm(0.25inch) even digit spase	:1.8:8.8	TLR2380	TLR2370	TLG2380	TLG2370	3	Dynamic
	:8.8:8.8	TLR4385	TLR4375	TLG4385	TLG4375		
7.6mm(0.3inch) even digit spase	:1.8:8.8	TLR2120	TLR2110	TLG2120	TLG2110	4	
	:8.8:8.8	TLR4125	TLR4115	TLG4125	TLG4115		
15mm(0.6inch)	:18:88	TLR2207	TLR2177	TLG2207	TLG2177	5	Staic
	:88:88	TLR4202	TLR4172	TLG4202	TLG4172		
15mm(0.6inch) even digit spase	:1.8:8.8	TLR2229	TLR2259	TLG2229	TLG2259	5	
	:8.8:8.8	TLR4224	TLR4254	TLG4224	TLG4254		
15mm(0.6inch)	:18:88.	TLR2168	TLR2218	TLG2168	TLG2218	7	Dynamic
	:88:88.	TLR4163	TLR4213	TLG4163	TLG4213		
15mm(0.6inch) even digit spase	:1.8:8.8.	TLR2281	TLR2231	TLG2281	TLG2231	5	
	:8.8:8.8.	TLR4286	TLR4236	TLG4286	TLG4236		
15mm(0.6inch)	:18:88.	TLR2248	TLR2098A	TLG2248	TLG2098A	6	Duplex
	:88:88.	TLR4243	TLR4093	TLG4243	TLG4093A		
	:18:88.	TLR2268	TLR2198	TLG2268	TLG2198	6	
	:88:88.	TLR4262	TLR4192	TLG4262	TLG4192		
23mm(0.9inch)	:18:88.	TLR2087A	TLR2057A	TLG2087A	TLG2057A	8	Static
	:88:88.	TLR4082A	TLR4052A	TLG4082A	TLG4052A		
23mm(0.9inch)	:18:88.	TLR2187	TLR2157	—	—	9	Dynamic
	:88:88.	TLR4182	TLR4152				
	:18:88.	TLR2307	TLR2297				

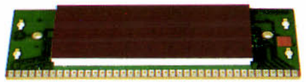
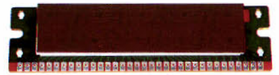
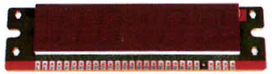
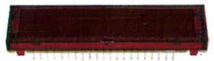
LARGE-SIZED LED DISPLAYS

Character Height	Device NO.	Display	Common	Photos (Package)
45mm (1.8")	TLR380	8.	Cathode	1
	TLS380			
	TLG380			
	TLR2327	:18:88.		2
	TLR4322	:88:88.		

FIVE DIGITS LED DISPLAYS FOR DIGITAL TUNING SYSTEM

Character Height	Device NO.	Display	Common	Photos (Package)
10mm	TLR5001	FM AM :18.8.8 MHz KHz	Anode	14
	TLR5002	FM MW LW :18.8.8 MHz KHz		
	TLG5001	FM AM :18.8.8 MHz KHz		15
	TLG5002	FM MW LW :18.8.8 MHz KHz		

	PHOTOS
1	
2	

	PHOTOS		PHOTOS
3		10	
4		11	
5		12	
6		13	
7		14	
8		15	
9			

TOSHIBA
Photo Couplers

The photo coupler is most suitable for interface of various control equipment, isolation of terminal equipment, ignition of medium power thyristor, and control of small power load, because it is excellent in conversion efficiency, sensibility, and isolation voltage in addition to reliability and service life.

PHOTO TRANSISTOR OUTPUT

: UL Recognized, File No. E67349 TUV : TUV Recognized

Type NO.	CTR rank	Photo	Internal Circuit	Outline Dimensions (Unit in mm)	Features	Applications	Ratings: Isolation Voltage(V) (at 1 min)	Ratings: V_{CEO}(V)	Ratings: I_C(mA)	Current Transfer Ratio (%): Min	Current Transfer Ratio (%): Max	Response Time(μ s) Typ	Saturation Voltage(V) Max
TLP521-1 (UL, TÜV)	A				General	Industrial coutrols	AC2500 (RMS)	35	50	50	600	6	0.4
	YG				CTR selected	Computer I/O Sequence controller input				50	300		
	GB					SSR Sequence controller output				100	600		
	Y				High speed	Switching regulator Motor control Monitering circuit				50	150	4	
	GR				High CTR	Switching regulator Analog isolation				100	300	6	
	BL				Very high CTR	SSR (Solid State Relay)				200	600		
TLP521-2 (UL, TÜV)	A				General, small packge size	Industrial controls	AC2500 (RMS)	35	50	50	600	6	0.4
	GB				High CTR	Line/cable server				100	600		
TLP521-3 (UL, TÜV)	A				General, small package size	Industrial control	AC2500 (RMS)	35	50	50	600	6	0.4
	GB				High CTR	Line/cable server				100	600		
TLP521-4 (UL, TÜV)	A				General, small package size	Line/cable server	AC2500 (RMS)	35	50	50	600	6	0.4
	GB				High CTR	Industrial controls				100	600		
TLP621-1 (UL)	A				High Isolation	Industrial controls	AC5000 (RMS)	55	50	50	600	6	0.4
	GB									100	600		
TLP621-2 (UL)	A				High Isolation	Industrial controls	AC5000 (RMS)	55	50	50	600	6	0.4
	GB									100	600		
TLP621-4 (UL)	A				High Isolation	Line/cable server	AC5000 (RMS)	55	50	50	600	6	0.4
	GB									100	600		
TLP504A (UL)	—				General, small package size	Industrial controls	AC2500 (RMS)	35	50	50	600	6	0.4

Type NO.	CTR rank	Photo	Internal Circuit	Outline Dimensions (Unit in mm)	Features	Applications	Ratings: Isolation Voltage(V) (at 1 min)	Ratings: V_{CEO}(V)	Ratings: I_C(mA)	Current Transfer Ratio (%): Min	Current Transfer Ratio (%): Max	Response Time(μ s) Typ	Saturation Voltage(V) Max
TLP531 (UL, TÜV)	A				General	Industrial control	AC2500 (RMS)	35	50	50	600	6	0.4
	YG				CTR selected	Computer I/O Sequence controller Input				50	300		
	GB					SSR Sequence controller output				100	600		
	Y				High speed	Switching Regulator Moter control Monitering circuit				50	150	4	
	GR				High CTR	Switching regulator Analog isolation				100	300	6	
	BL				Very high CTR	SSR (Solid State Relay)				200	600		
TLP532 (UL, TÜV)	A				General	Industrial controls	AC2500 (RMS)	35	50	50	600	6	0.4
	YG				CTR selected	Computer I/O Sequence controller Input				50	300		
	GB					Sequence controller output				100	600		
	Y				High speed	Switching regulator, Motor control, Computer I/O				50	150	4	
	GR				High CTR	Switching regulator, Analog isolation				100	300	6	
	BL				Very high CTR	SSR (Solid State Relay)				200	600		
TLP631 (UL)	A				High Isolation	SSR (Solid State Relay) Switching Regulator	AC5000 (RMS)	55	50	50	600	6	0.4
	GB									100	600		
TLP632 (UL)	A									50	600		
	GB									100	600		
TLP535 (UL)	—				High CTR	SSR (Solid State Relay)	AC2500 (RMS)	35	100	50	—	5	0.3
TLP581 (BSI)	—				High Isolation	Medical instrumentation Switching power supply	AC5000 (RMS)	35	50	25	—	6	0.4
TLP620-1	—				AC Input	I/O Module Telephone SSR	AC5000 (RMS)	55	50	50	600	6	0.4
TLP620-2	—				AC Input	I/O Module Telephone SSR	AC5000 (RMS)	55	50	50	600	6	0.4
TLP620-4	—				AC Input	I/O Module Industrial Control	AC5000 (RMS)	55	50	50	600	6	0.4
TLP630	—				AC Input Base connection	I/O Module Industrial Control	AC5000 (RMS)	55	50	50	600	6	0.4
4N25 (UL)	—				General	Industrial controls	AC2500 (Peak)	30	100	20	—	2	0.5
4N25A (UL)	—						AC1775 (RMS)						
4N35 (UL)	—				High CTR	SSR (Solid State Relay)	AC2500 (RMS)	30	100	100	—	5	0.3

PHOTO DARLINGTON TRANSISTOR OUTPUT

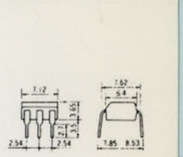
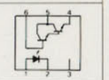
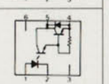
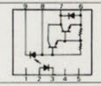
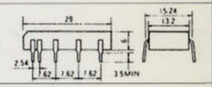
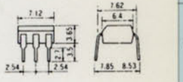
Type NO.	Photo	Internal Circuit	Outline Dimensions (Unit in mm)	Features	Applications	Isolation Voltage (at 1 min.) (V)	Rusponse Time ton (Tye) (μs)	Rusponse Time tf Typ) (μs)	Current Transfer Ratio I_C/I_F(Min) (%)	Saturation Voltage V_{CE}(Sat) (Max) (V)
TLP570 (Ⓤ, TÜV)				Ultra-high CTR	Relay driver NC machine Seqence controller Copier	AC2500 (RMS)	3	300	1000	1.2
TLP571 (Ⓤ)							3	300		1.0
TLP572 (Ⓤ, TÜV)				High CTR With R_{BE}	Reley driver NC machine Sequence controller Copier	AC2500 (RMS)	3	80	500	1.0
TLP573 (Ⓤ)				High power DC control	Sequence controller Numerical controller Copier	AC2500 (RMS)	0.6	2	8000	1.5
TLP575				General Base conection	Sequence controller DC-SSR	AC2500 (RMS)	50	50	200	1.0
4N29 (Ⓤ)				General	DC-SSR	AC2500 (peak)	5	40	100	1.0
4N29A (Ⓤ)						AC1775 (RMS)				
4N32 (Ⓤ)				High CTR	Triac Drive DC-SSR	AC2500 (RMS)	5	100	500	1.0
4N32A (Ⓤ)						AC1775 (RMS)				

PHOTO IC OUTPUTS

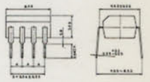
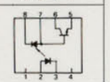
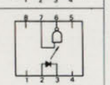
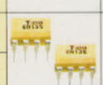
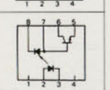
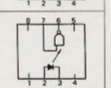
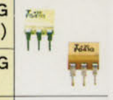
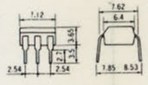
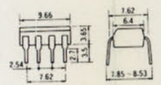
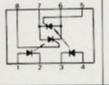
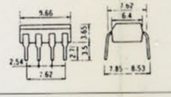
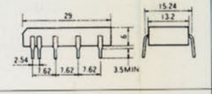
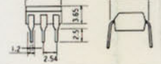
Type NO.	Photo	Internal Circuit	Outline Dimensions (Unit in mm)	Features	Applications	Isolation Voltage (V)	Response Time t_{PHL}, t_{PLH} (Typ) (μs)	Current Transfer Ratio I_C/I_F(Min) (%)	Saturation Voltage V_{OL} (Max) (V)
TLP550 (Ⓤ)				High speed Output noise reduction	Motor control Numerical controller Measurement instrument Inverter	AC2500 RMS (at 1min.) DC3000 (at 5s)	1	10	0.4
TLP551 (Ⓤ)				High Speed Base connection	Video Signal Interface	AC2500 (RMS)	1	10	0.4
TLP552 (Ⓤ)				Very High speed	Data Communication Computer I/O	AC2500 (RMS)	0.06	1000 (Typ.)	0.6
6N135 (Ⓤ)				High speed Base connection	Data communication Computer I/O	DC3000 (at 5s)	0.7	7	0.4
6N136 (Ⓤ)								19	
6N137 (Ⓤ)				Very High speed	Data communication Computer I/O		0.06	1000 (Typ.)	0.6

PHOTO THYRISTOR AND TRIAC OUTPUT

Type NO.	Photo	Internal Circit	Outline Dimensions (Unit in mm)	Featurec	Applications	Isolation Voltage (at 1 min.) (V)	Repetitive Peek Off-State Voltage (Min) (V)	Trigger Current I_{FT} (Max) (mA)	ON Voltage V_T (Max) (V)
TLP541G (Ⓤ, TUV)				Small package size $I_{T(RMS)}$=150mA	SSR (Solid State Relay) for 120V AC line Switching regulator	AC2500 (RMS)	400	7	1.3
TLP641G (Ⓤ)						AC5000 (RMS)			
TLP545J (Ⓤ, TUV)				High Voltage $I_{T(RMS)}$=150mA	SSR (Solid State Relay) for 240V AC line	AC2500 (RMS)	600	10	1.3
TLP641J (Ⓤ)						AC5000 (RMS)			
TLP542G (Ⓤ, TÜV)				Long distance between Anode and Cathode of SCR $I_{T(RMS)}$=150mA	For 120V AC line Copier Microwave oven	AC2500 (RMS)	400	7	1.3
TLP543J (Ⓤ, TÜV)				High Voltage $I_{T(RMS)}$=150mA	For 240V AC line Sequence controller	AC2500 (RMS)	600	10	1.3
TLP511GA (Ⓤ)				Bi-directional control $I_{T(RMS)}$=200mA	Sequence controller Copier Numerical controller	AC2500 (RMS)	400	7	1.3
TLP611J						AC5000 (RMS)	600	10	
TLP546G (Ⓤ, TÜV)				High power AC control $I_{T(RMS)}$=1A	Sequence controller Copier	AC2500 (RMS)	400	10	1.6
TLP560G				Bi-directional control $I_{T(RMS)}$=100mA	Power-triac driver	AC2500 (RMS)	400	10	3.0

Ⓤ : UL Recognized, File No. E67349
TÜV : TÜV Recognized

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Toshiba Photo Sensors

PHOTO INTERRUPTERS

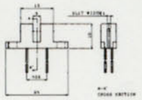
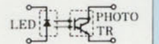
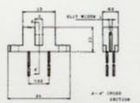
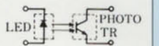
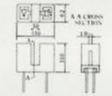
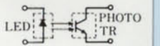
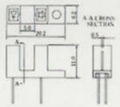
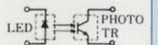
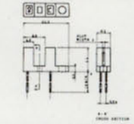
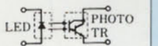
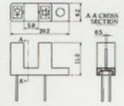
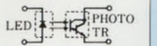
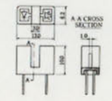
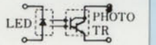
Type NO.	Photo	OUTLINE (Unit in mm)	INTERNAL CIRCUIT	CHARACTERISTICS (Ta=25°C) Current Transfer Ratio I_C/I_F (%) V_{CE}, I_F		Dark Current I_d (nA) V_{CE} (V), I_F=0		Collector-Emitter Voltage V_{CEO}(V)	FEATURE
TLP507A				2V 10mA	300 (MIN. 30)	16	30 (MAX. 250)	30	•High CTR
TLP800A				5V 20mA	40 (MIN. 10)	24	5 (MAX. 100)	30	•High Speed
TLP801A				5V 20mA	40 (MIN. 10)	24	5 (MAX. 100)	30	•High Speed
TLP802				5V 20mA	8 (MIN. 2)	24	5 (MAX. 100)	30	•High Speed •Small Sensing Area 0.5mm
TLP850				2V 10mA	250 (MIN. 40)	16	30 (MAX. 250)	30	•With Visible Light Cut Filter •High CTR
TLP851				2V 10mA	130 (MIN. 20)	16	30 (MAX. 250)	30	•With Visible Light Cut Filter •Small Sensing Area 0.5mm
TLP852				2V 10mA	250 (MIN. 30)	16	30 (MAX. 250)	30	•With Visible Light Cut Filter •High CTR

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PHOTO INTERRUPTERS (Inflared LED+Photo IC Type)

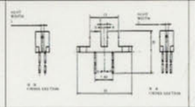
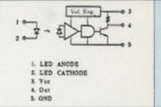
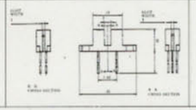
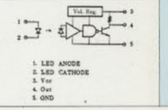
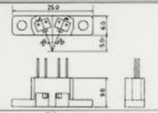
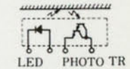
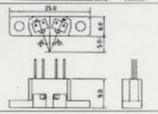
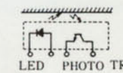
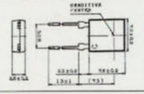
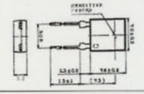
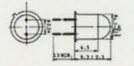
Type NO.	Photo	OUTLINE (Unit in mm)	INTERNAL CIRCUIT	CHARACTERISTICS (Ta=25°C) LED Threshold Current (mA)	Supply Voltage V_{CC}(V)	Propagation Delay (μs), R_L=280Ω t_{PLH}	t_{PHL}	FEATURE
TLP1000 ※				(I_{FLH}) MAX. 5	4.5~16	3	5	• With Visible Light Cut Filter • High Speed • Logic Output
TLP1001 ※				(I_{FHL}) MAX. 5	4.5~16	8	5	• With Visible Light Cut Filter • High Speed • Logic Output

PHOTO REFLECTIVE SENSORS

Type NO.	Photo	OUTLINE (Unit in mm)	INTERNAL CIRCUIT	CHARACTERISTICS (Ta=25°C) Collector Current I_C (μA) V_{CE}, I_F	(Note 1)	Dark Current I_D (nA) V_{CE}(V), I_F=0		Collector-Emitter Voltage V_{CEO}(V)	FEATURE
TLP903 ※				5V 10mA	1,000 (MIN. 200)	16	30 (MAX. 250)	30	• With Visible Light Cut Filter • High CTR
TLP904 ※				5V 20mA	200 (MIN. 70)	24	5 (MAX. 100)	30	• High Speed

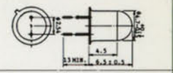
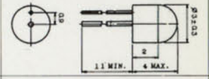
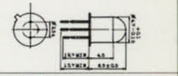
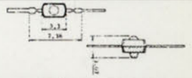
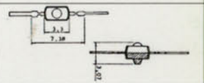
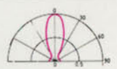
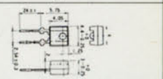
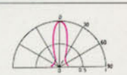
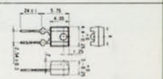
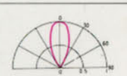
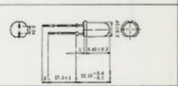
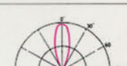
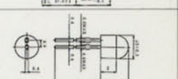
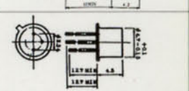
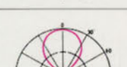
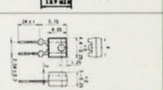
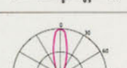
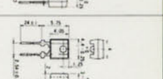
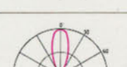
Note 1. Detective Distance 5mm, Reflective Efficiency 90% White Paper.
※ New Products

PHOTO DIODES

Type NO.	Photo	OUTLINE (Unit in mm)	CHARACTERISTICS (Ta=25°C) Short Circuit Current E(mW/cm²) (Note 3)	I_{SC} (μA)	Dark Current I_D (nA) V_R (V)		Rerese Voltage V_R (V)	DIRECTIONAL SENSITIVITY	PAIR EMITTER DEVICE NO.
TPS703			0.1	1.5 (MIN. 0.9)	10	10	20		TLN105A TLN110 TLN205
TPS703A			0.1	0.9 (MIN. 0.5)	10	10	20		TLN105A TLN110
TPS708 ※ (Note 2)			0.1	2 (MIN. 0.5)	10	10	20		TLN101A TLN108 TLN201

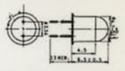
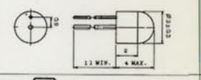
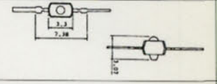
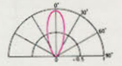
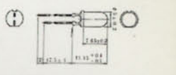
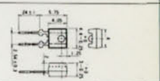
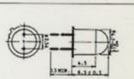
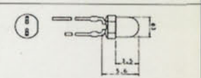
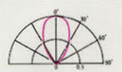
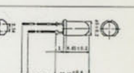
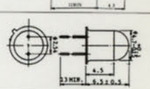
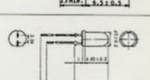
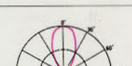
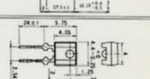
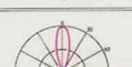
Note 2. Hermetic Sealing (Glass-to-Metal)

PHOTO TRANSISTORS

Type NO.	Photo	OUTLINE (Unit in mm)	CHARACTERISTICS (Ta=25°C) Light Current I_L (μA) E(mW/cm²) (Note 5)		Dark Current I_D (nA) V_{CE}(V)		Collector-Emitter Voltage V_{CEO}(V)	DIRECTIONAL SENSITIVITY	PAIR EMITTER DEVICE NO.
TPS601A (Note 3)			0.1	300 (MIN. 60)	30	10	40		TLN101A TLN108 TLN201
TPS603			0.1	20 (MIN. 15)	10	10	20		TLN103 TLN109
TPS604 (Note 3,6)			0.1	300 (MIN. 60)	30	10	40		TLN101A TLN108 TLN201
TPS605 (Note 4)			0.01	1000 (MIN. 150)	16	30	30		TLN104
TPS606			0.1	20 (MIN. 2)	10	10	20		TLN104
TPS607A (Note 4)			0.1	2000 (MIN. 600)	16	30	30		TLN107A TLR215A
TPS608A			0.1	100 (MIN. 30)	24	5	30		TLN107A TLR215A
TPS610 ※			0.1	100	24	5	30		TLN105A TLN110 TLN205
TPS613 ※			0.1	330	10	10	20		TLN113
TPS614 ※ (Note 3)			10	1500	30	10	40		TLN101A TLN108 TLN201
TPS617 ※ (Note 4,7)			0.1	1400 (MIN. 400)	16	30	30		TLN107A
TPS618 ※ (Note 7)			0.1	70 (MIN. 20)	24	5	30		TLN107A

Note 3. Hermetic Sealing (Glass-to-Metal)
Note 4. Darlington Transistor
Note 5. Color temperature=2870°K Tungsten Lamp
Note 6. With Base terminal
※ New Products
Note 7. Visible Cut Mold λp=870nm

INFRARED EMITTERS

Type NO.	Photo	OUTLINE (Unit in mm)	Stem	Material	CHARACTERISTICS (Ta=25°C) Radiant Power P_O (mW) I_F(mA)		Radiant Intensity I_E (mW/sr) I_F(mA)		Forward Voltage V_F(mA) I_F(mA)		RADIATION PATTERN	PAIR DETECTOR DEVICE NO.
TLN101A (Note 3)			Metal	GaAs	50	1.8	50	10	50	1.3		TPS601A TPS604 TPS614 TPS708
TLN103			Ceramic	GaAs	20	2.5	20	1.2	10	1.1		TPS603
TLN104			Mold	GaAs	20	3.0	20	1.5	10	1.1		TPS605 TPS606
TLN105A			Mold	GaAs	50	9.0	50	15 (MIN.7)	100	1.3		TPS610 TPS703 TPS703A
TLN107A			Mold	GaAs	20	2.0	20	2.0 (MIN.0.7)	10	1.15		TPS607A TPS608A TPS617 TPS618
TLN108 (Note 3)			Metal	GaAs	50	3	50	20 (MIN.10)	50	1.3		TPS601A TPS604 TPS614 TPS708
TLN109 ※			Mold	GaAs	20	2.5	20	3	20	1.2		TPS603
TLN110			Mold	GaAs	50	9.0	50	30 (MIN.15)	100	1.3		TPS610 TPS703 TPS703A
TLN113 ※			Resin	GaAs	20	2.5	20	2	10	1.15		TPS613
TLN201 ※ (Note 3)			Metal	GaAlAs	50	5	50	40 (MIN.20)	50	1.5		TPS601A TPS604 TPS614 TPS708
TLN205 ※			Mold	GaAlAs	50	8	50	30	50	1.45		TPS703 TPS610
TLR215A (Note 8)			Mold	GaP	20	0.2	20	0.3 (MIN.0.1)	15	2.0		TPS607A

Note 8. Red LED
※ New Products

TOSHIBA
TOSHIBA CORPORATION

Printed in Jap

I. TECHNICAL DATA

TLR101

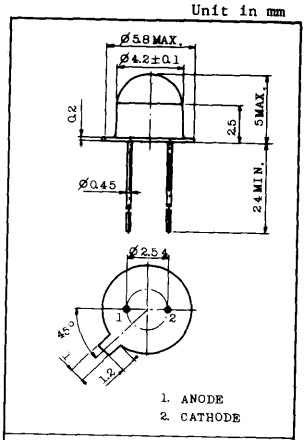
GaP RED LIGHT EMISSION

4.2mm DIAMETER

FEATURES:

- Metal Stem Type : Red Lusterless Lens.
- Low Drive Current, High Intensity Red Light Emission.
  Recommended Forward Current : I_F=10 ~ 15mA(DC)
- Wide Viewing Angle, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	4-4A1A

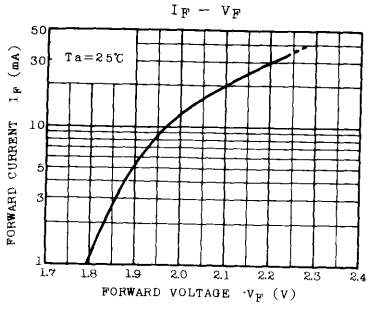
Weight : 0.20g

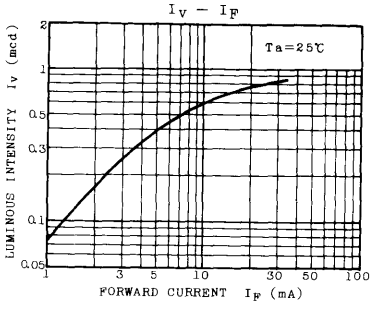
MAXIMUM RATINGS (Ta =25℃)

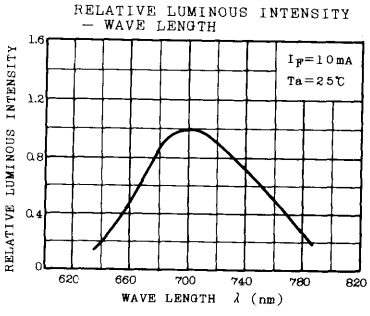
CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	35	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	100	mW
Operating Temperature Range	Topr	-20 ~ 75	℃
Storage Temperature Range	Tstg	-30 ~ 100	℃

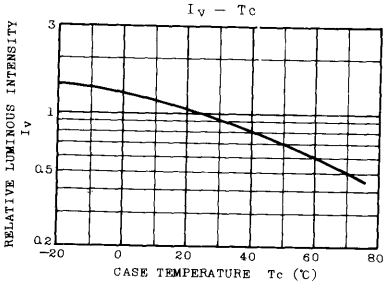
ELECTRO-OPTICAL CHARACTERISTICS (Ta =25℃)

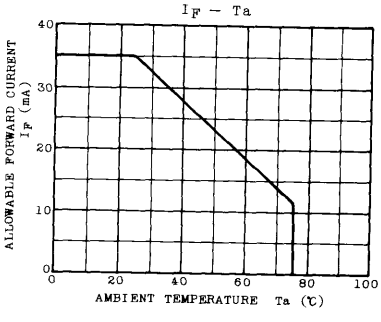
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=30mA	-	2.2	2.8	V
Reverse Current	I_R	V_R=4V	-	-	5	μA
Luminous Intensity	I_V	I_F=15mA	0.2	0.7	-	mcd
Peak Emission Wave Length	λ_P	I_F=10mA	-	700	-	nm
Spectral Line Half Width	$\Delta\lambda$	I_F=10mA	-	100	-	nm

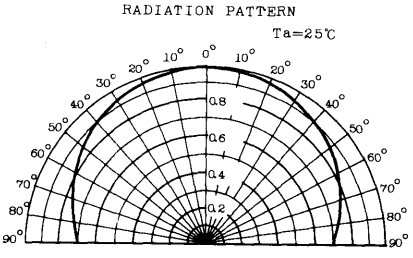












STANDARD BRIGHT LAMP

TLR102A, TLR108A, TLR109A

GaP RED LIGHT EMISSION

3mm DIAMETER(T1)

FEATURES:

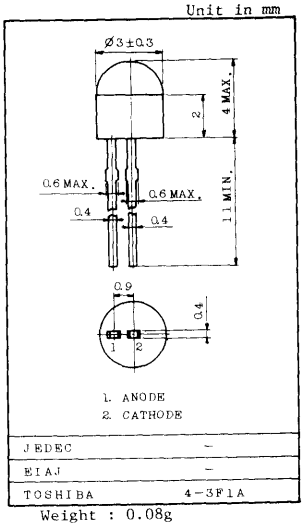
. Resin Stem Type
  TLR102A : Red Lusterless Lens
  TLR108A : Colorless Transparent Lens
  TLR109A : Milky Lusterless Lens

. Low Drive Current, High Intensity Red Light Emission.
  Recommended Forward Current : I_F=5~10mA(DC)

. Wide Viewing Angle, Provides an Excellent ON-OFF Contrast Ratio.

. Fast Response Time, Capable of Pulse Operation.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	4-3F1A

Weight : 0.08g

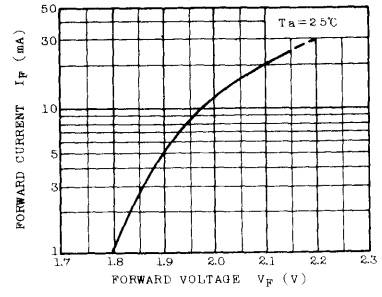
MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	T_{opr}	-20~75	°C
Storage Temperature Range	T_{stg}	-30~100	°C

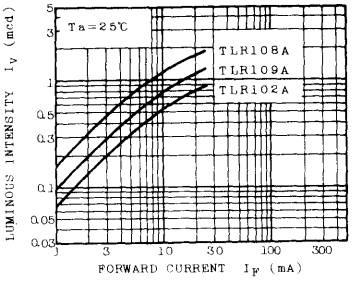
ELECTRO-OPTICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current		I_R	V_R=4V	-	-	5	μA
Luminous Intensity	TLR102A	I_V	I_F=15mA	0.2	0.7	-	mcd
	TLR108A			0.4	1.5	-	
	TLR109A			0.3	1.0	-	
Peak Emission Wave Length		λ_P	I_F=15mA	-	700	-	nm
Spectral Line Half Width		$\Delta\lambda$	I_F=15mA	-	100	-	nm

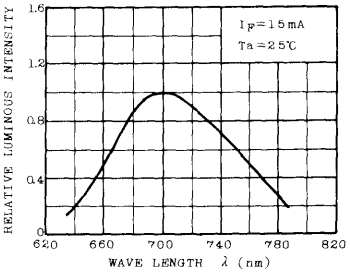
$I_F - V_F$



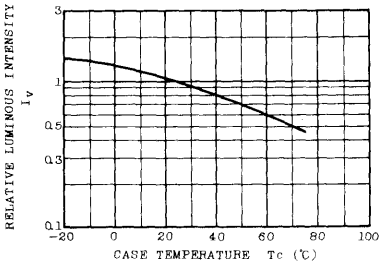
$I_V - I_F$



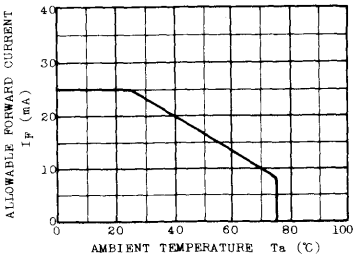
RELATIVE LUMINOUS INTENSITY - WAVE LENGTH



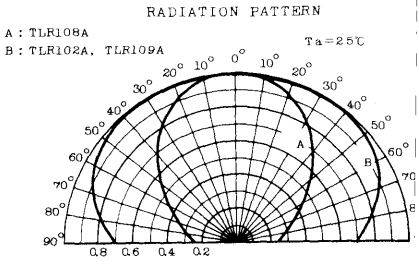
$I_V - T_C$



$I_F - T_a$



RADIATION PATTERN



TLR113A, TLR114A, TLR115A, TLR116A, TLR120A

GaP RED LIGHT EMISSION

5mm DIAMETER(T 1 3/4)

FEATURES:

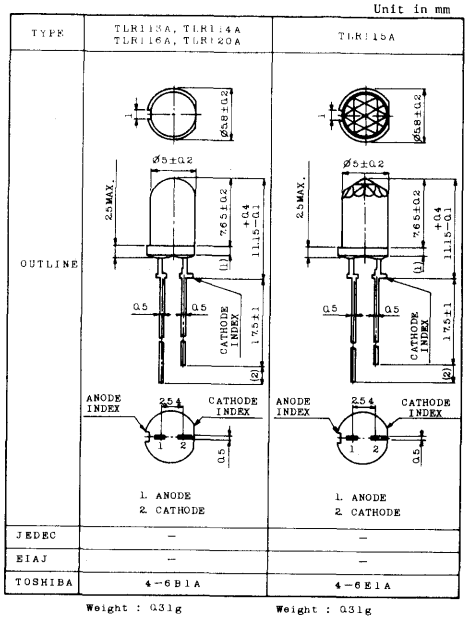
. All Plastic Mold Type
  TLR113A : Red Transparent Lens
  TLR115A : Red Transparent Lens of DIAMOND Cut
  TLR120A : Colorless Transparent Lens
  TLR114A : Red Lusterless Lens
  TLR116A : Milky Lusterless Lens

. Low Dive Current, High Intensity Red Light Emission.
  Recommended Forward Current : I_F=10 ~ 15mA(DC)

. All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.

. Fast Response Time, Capable of Pulse Operation.

Unit in mm



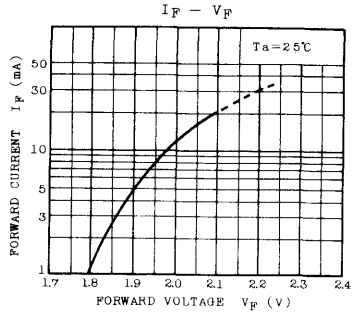
MAXIMUM RATINGS (Ta =25℃)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	20	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	90	mW
Operating Temperature Range	T_{opr}	-20 ~ 75	℃
Storage Temperature Range	T_{stg}	-30 ~ 100	℃

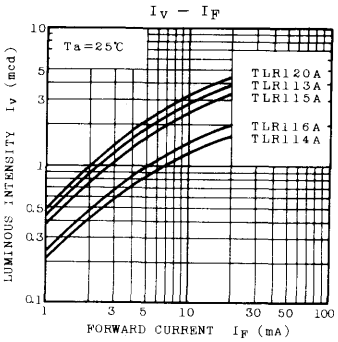
ELECTRO-OPTICAL CHARACTERISTICS (Ta =25℃)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current		I_R	V_R=4V	-	-	5	μA
Luminous Intensity	TLR113A	I_V	I_F=15mA	0.8	3.5	-	mcd
	TLR114A			0.5	1.5	-	
	TLR115A			0.6	3.0	-	
	TLR116A			0.5	1.8	-	
	TLR120A			1.0	4.0	-	
Peak Emission Wave Length		λ_P	I_F=15mA	-	700	-	nm
Spectral Line Half Width		$\Delta\lambda$	I_F=15mA	-	100	-	nm

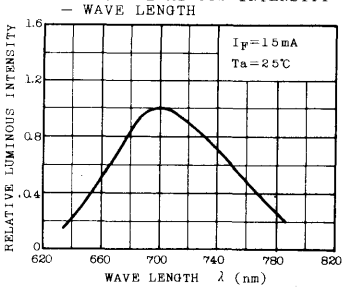
$I_F - V_F$



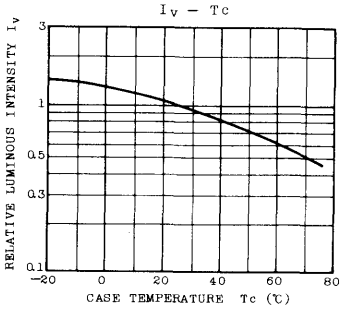
$I_V - I_F$



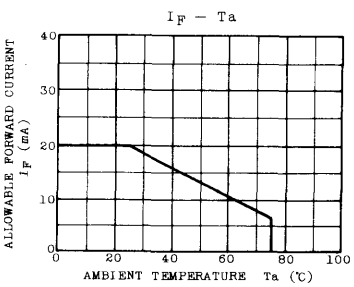
RELATIVE LUMINOUS INTENSITY — WAVE LENGTH



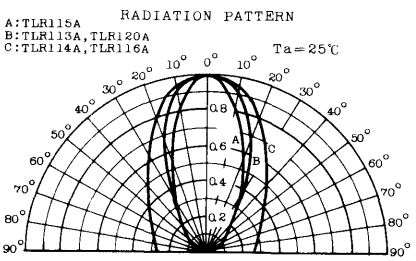
$I_V - Tc$



$I_F - Ta$



RADIATION PATTERN



TLR113AP, TLR114AP

GaP RED LIGHT EMISSION

PANEL CIRCUIT INDICATOR

FEATURES:

- All Plastic Mold Type

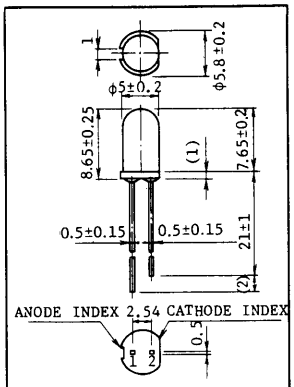
  TLR113AP: Red Transparent Lens
  TLR114AP: Red Lusterless Lens

- Low Drive Current, High Intensity Red Light Emission
  Recommended Forward Current: $I_F = 10 \sim 15$ mA(DC)

- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.

- Fast Response Time, Capable of Pulse Operation.

Unit in mm



1. ANODE
2. CATHODE

JEDEC	-
EIAJ	-
TOSHIBA	

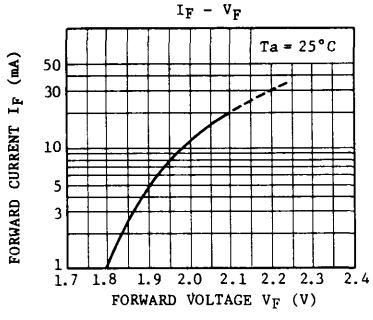
Weight: 0.31 g

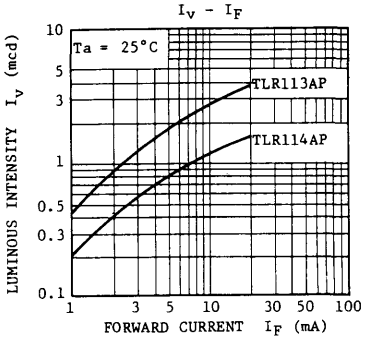
MAXIMUM RATINGS (Ta = 25°C)

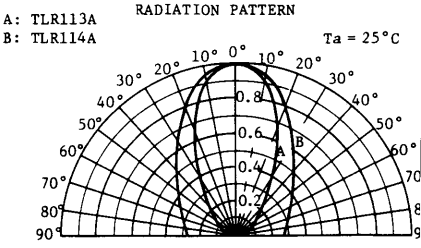
CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	20	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	100	mW
Operating Temperature Range	T_{opr}	-20 ~ 75	°C
Storage Temperature Range	T_{stg}	-30 ~ 100	°C

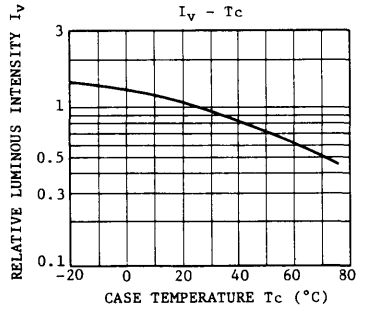
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25°C)

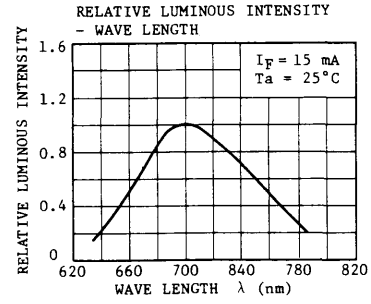
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F = 20 mA	-	2.1	2.8	V
Reverse Current		I_R	V_R = 4 V	-	-	5	μA
Luminous Intensity	TLR113AP	I_v	I_F = 15 mA	0.6	3.5	-	mcd
	TLR114AP			0.4	1.5	-	
Peak Emission Wave Length		λ_p	I_F = 15 mA	-	700	-	nm
Spectral Line Half Width		$\Delta\lambda$	I_F = 15 mA	-	100	-	nm

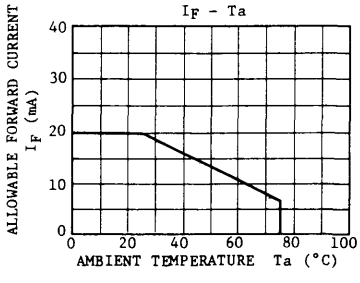












TLR113AQ, TLR114AQ TLR116AQ, TLR120AQ

GaP RED LIGHT EMISSION

PANEL CIRCUIT INDICATOR

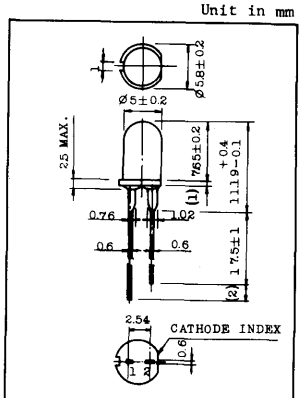
FEATURES:

- All Plastic Mold Type

  TLR113AQ: Red Transparent Lens
  TLR114AQ: Red Lusterless Lens
  TLR116AQ: Milky Lusterless Lens
  TLR120AQ: Colorless Transparent Lens

- Low Drive Current, High Intensity Red Light Emission
  Recommended Forward Current: I_F=10 ∿ 15mA(DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.
- Wire Wrappable Leads.

Unit in mm



JEDEC	
EIAJ	
TOSHIBA	4-6B4A

Weight: 0.35g

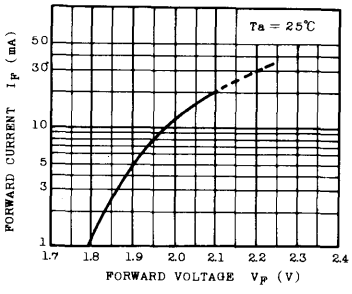
MAXIMUM RATINGS (Ta = 25 °C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	20	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	56	mW
Operating Temperature Range	T_{opr}	-20 ∿ 75	°C
Storage Temperature Range	T_{stg}	-30 ∿ 100	°C

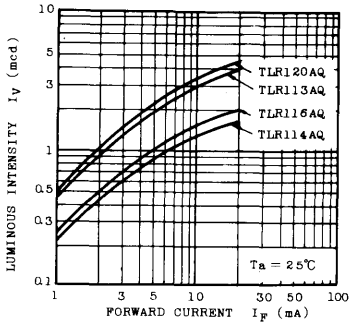
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25 °C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current		I_R	V_R=4V	-	-	5	μA
Luminous Intensity	TLR113AQ	I_V	I_F=15mA	0.6	3.5	-	mcd
	TLR114AQ			0.4	1.5	-	
	TLR116AQ			0.5	1.8	-	
	TLR120AQ			1.0	4.0	-	
Peak Emission Wave Length		λp	I_F=15mA	-	700	-	nm
Spectral Line Half Width		Δλ	I_F=15mA	-	100	-	nm

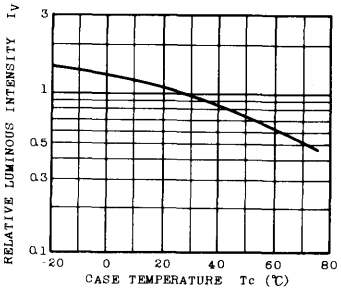
I_F - V_F



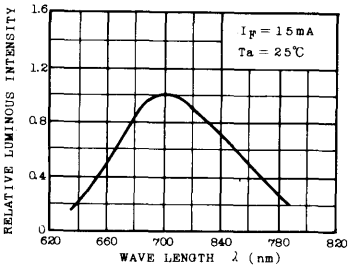
I_V - I_F



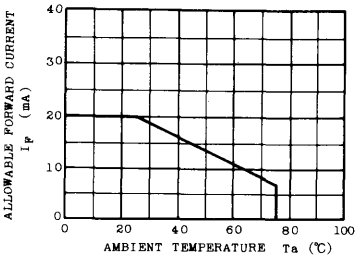
I_V - Tc



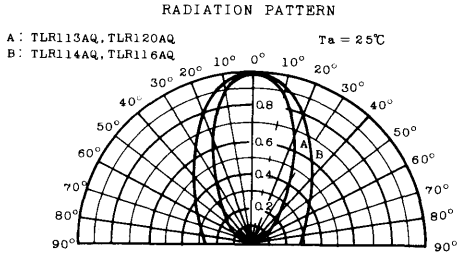
RELATIVE LUMINOUS INTENSITY - WAVE LENGTH



I_F - Ta



RADIATION PATTERN



TLR113AR, TLR114AR

GaP RED LIGHT EMISSION

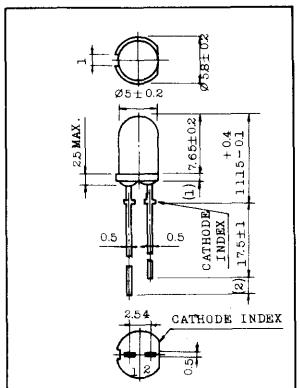
PANEL CIRCUIT INDICATOR

FEATURES:

- Current Limiting Resistor Built in Type
- All Plastic Mold Type

  TLR113AR: Red Transparent Lens
  TLR114AR: Red Lusterless Lens
- Capable of Direct Drive with Constant Voltage Supply.
  Recommended Forward Voltage Supply: V_F=4.5 ~ 5V(DC)
- All Plastic Molded Lens Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.

Unit in mm



JEDEC	–
EIAJ	–
TOSHIBA	4-6B1A

Weight: 0.33g

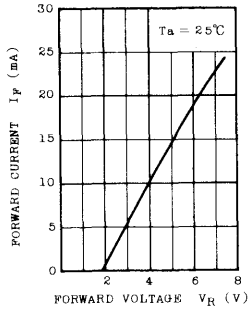
MAXIMUM RATINGS (Ta = 25 °C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Voltage (DC)	V_F	7.5	V
Reverse Voltage	V_R	6	V
Operating Temperature Range	T_{opr}	-20 ~ 75	°C
Storage Temperature Range	T_{stg}	-30 ~ 100	°C

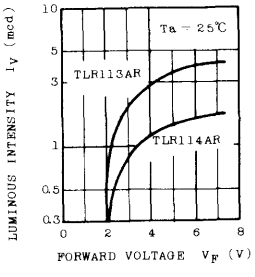
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25 °C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Current		I_F	V_F=5V	–	13	20	mA
Reverse Current		I_R	V_R=6V	–	–	100	μA
Luminous Intensity	TLR113AR	I_V	V_F=5V	0.8	3.5	–	mcd
	TLR114AR			0.5	1.5	–	
Peak Emission Wave Length		λp	V_F=5V	–	700	–	nm
Spectral Line Half Width		Δλ	V_F=5V	–	100	–	nm

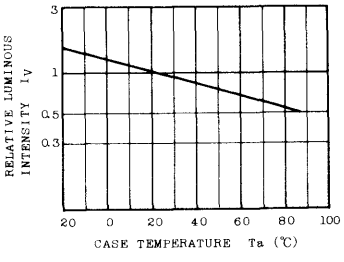
I_F – V_F



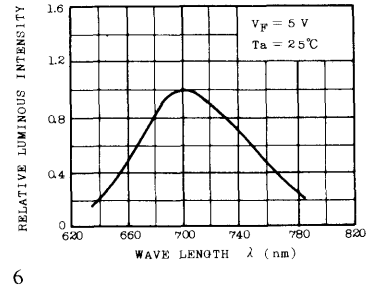
I_V – V_F



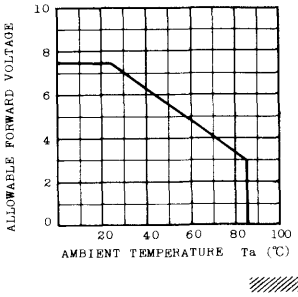
I_V – Tc



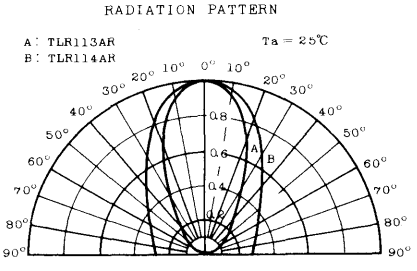
RELATIVE LUMINOUS INTENSITY – WAVE LENGTH



V_F – Ta



RADIATION PATTERN



TLR121, TLR122

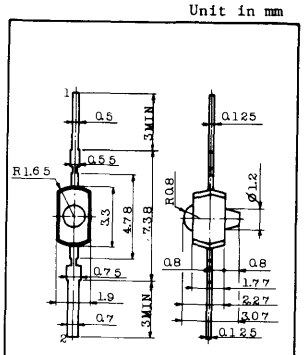
GaP RED LIGHT EMISSION

SUBMINIATURE

FEATURES:

- All Plastic Mold Type
  TLR121 : Colorless Transparent Lens
  TLR122 : Red Transparent Lens
- Low Drive Current, High Intensity Red Light Emission.
  Recommended Forward Current : I_F=5~10mA(DC)
- All Plastic Molded Lens, Provides an Excellent Point Source.
- Fast Response Time, Capable of Pulse Operation.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	4-2A1A

Weight : 0.03g

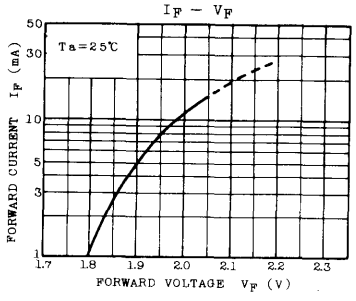
MAXIMUM RATINGS (Ta =25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	15	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	60	mW
Operating Temperature Range	T_{opr}	-20 ~ 75	°C
Storage Temperature Range	T_{stg}	-30 ~ 80	°C

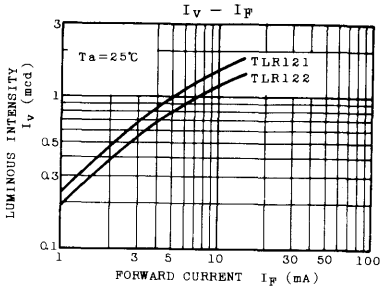
ELECTRO-OPTICAL CHARACTERISTICS (Ta =25°C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=15mA	-	2.05	2.6	V
Reverse Current		I_R	V_R=4V	-	-	5	μA
Luminous Intensity	TLR121	I_V	I_F=10mA	0.4	1.5	-	mcd
	TLR122			0.3	1.2	-	
Radiant Power Output		P_O	I_F=10mA	200	-	-	μW
Peak Emission Wave Length		λ_P	I_F=10mA	-	700	-	nm
Spectral Line Half Width		$\Delta\lambda$	I_F=10mA	-	100	-	nm

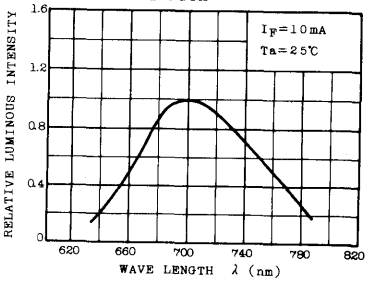
$I_F - V_F$



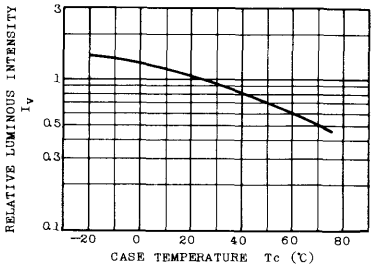
$I_V - I_F$



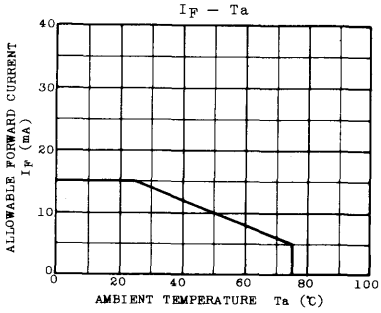
RELATIVE LUMINOUS INTENSITY — WAVE LENGTH



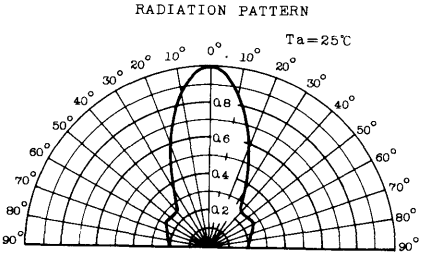
$I_V - T_C$



$I_F - T_a$



RADIATION PATTERN



TLR123, TLR124

GaP RED LIGHT EMISSION

3.1mm DIAMETER(T1)

FEATURES:

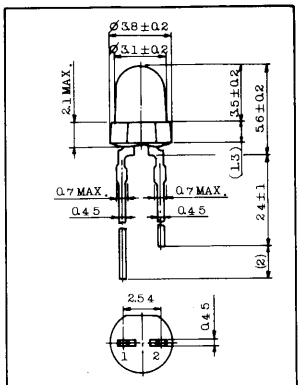
. All Plastic Mold Type
  TLR123 : Red Transparent Lens
  TLR124 : Red Lusterless Lens

. Low Drive Current, High Intensity Red Ligh Emission.
  Recommended Forward Current : I_F=5~10mA(DC)

. All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.

. Fast Response Time, Capable of Pulse Operation.

Unit in mm



1. ANODE
2. CATHODE

JEDEC	—
EIAJ	—
TOSHIBA	4-4E1A

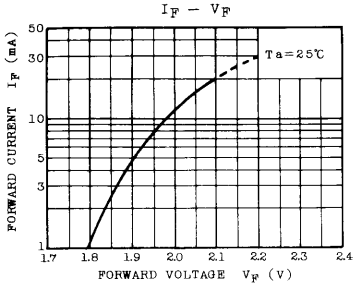
Weight : 0.14g

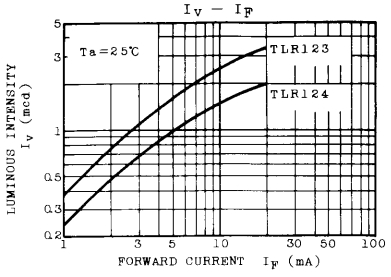
MAXIMUM RATINGS (Ta =25°C)

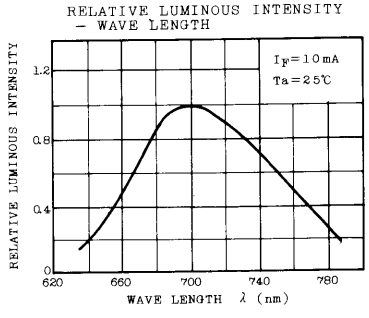
CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	20	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	60	mW
Operating Temperature Range	T_{opr}	-20~75	°C
Storage Temperature Range	T_{stg}	-30~100	°C

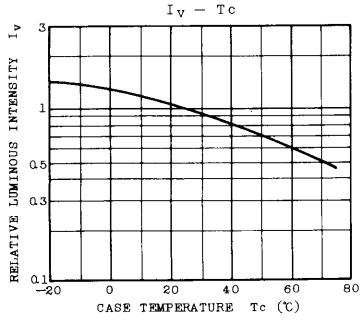
ELECTRO-OPTICAL CHARACTERISTICS (Ta =25°C)

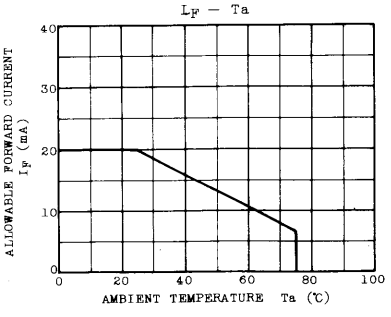
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current		I_R	V_R=4V	-	-	5	μA
Luminous Intensity	TLR123	I_V	I_F=10mA	0.5	2.5	-	mcd
	TLR124			0.4	1.5	-	
Peak Emission Wave Length		λ_P	I_F=10mA	-	700	-	nm
Spectral Line Half Width		$\Delta\lambda$	I_F=10mA	-	100	-	nm

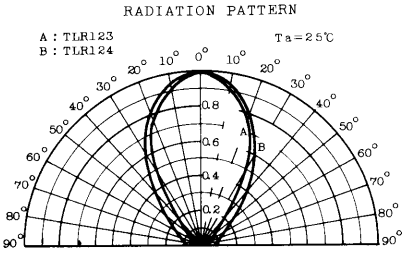












STANDARD BRIGHT LAMP

TLR140, TLR143, TLR144, TLR145, TLR146, TLR147

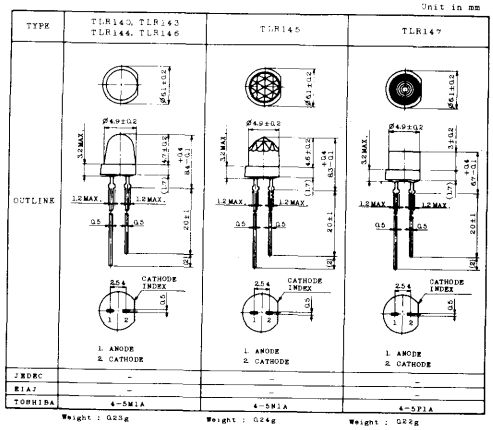
GaP RED LIGHT EMISSION

4.9mm DIAMETER(T 3/4, LOW PROFILE)

FEATURES:

- All Plastic Mold Type
  TLR140 : Colorless Transparent Lens
  TLR144 : Red Lusterless Lens
  TLR146 : Milky Lusterless Lens
  TLR143 : Red Transparent Lens
  TLR145 : Red Transparent Lens of DIAMOND Cut
  TLR147 : Red Transparent Lens of Spiral
- Low Drive Current, High Intensity Red Light Emission.
  Recommended Forward Current : I_F=10~15mA(DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.

Unit in mm

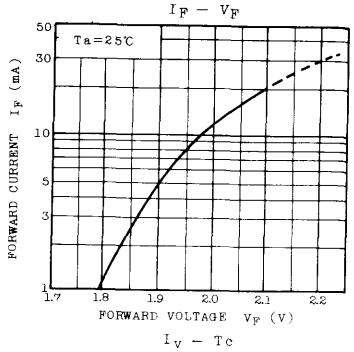


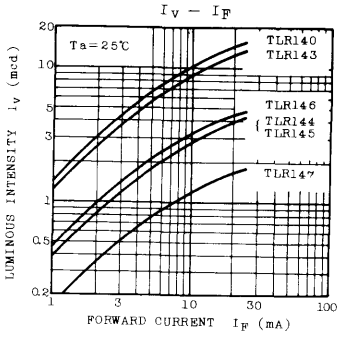
MAXIMUM RATINGS (Ta=25°C)

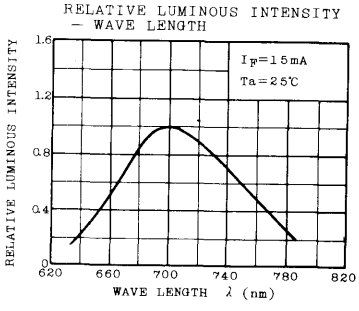
CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	T_{opr}	-20~75	°C
Storage Temperature Range	T_{stg}	-30~100	°C

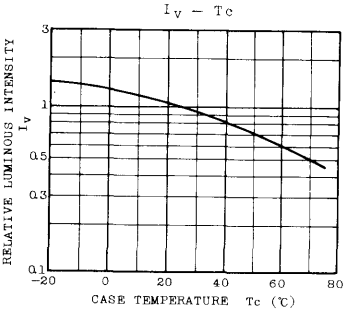
ELECTRO-OPTICAL CHARACTERISTICS (Ta=25°C)

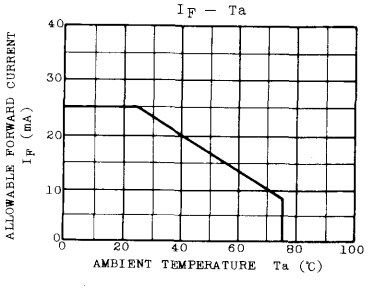
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current		I_R	V_R=4V	-	-	5	μA
Luminous Intensity	TLR140	I_V	I_F=15mA	3.5	13	-	mcd
	TLR143			3.0	11	-	
	TLR144			1.0	3.5	-	
	TLR145			1.0	3.5		
	TLR146			1.2	4.0	-	
	TLR147			0.5	1.5	-	
Peak Emission Wave Length		λ_P	I_F=15mA	-	700	-	nm
Spectral Line Half Width		$\Delta\lambda$	I_F=15mA	-	100	-	nm

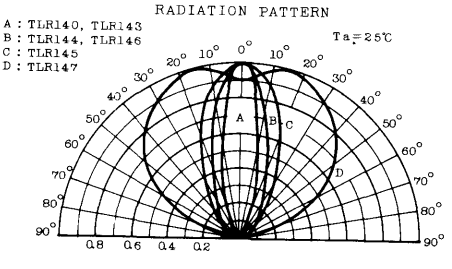












STANDARD BRIGHT LAMP

TLR205, TLR206, TLR207, TLR208

GaP RED LIGHT EMISSION

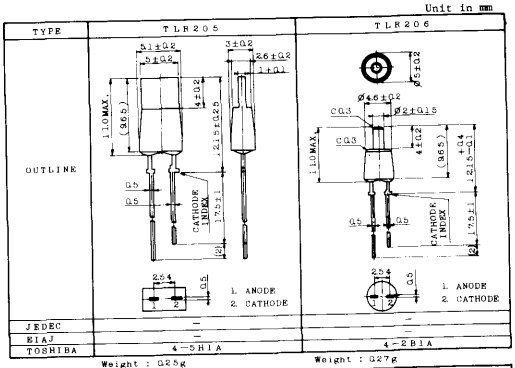
FEATURES:

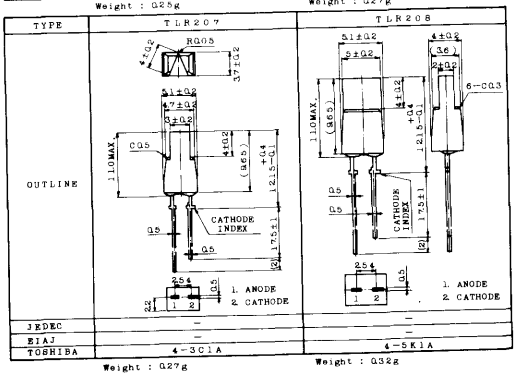
. Red All Plastic Mold Type
  TLR205 : Rectangular Type (Surface Size 1 × 5mm)
  TLR206 : Convex Type (Surface Size ϕ2mm)
  TLR207 : Triangular Type (Surface Size 3 × 4 × 4mm)
  TLR208 : Rectangular Type (Surface Size 2 × 5mm)

. Low Drive Current, High Intensity Red Light Emission.
  Recommended Forward Current : IF=10 ~ 15mA(DC)

. Fast Response Time, Capable of Pulse Operation.

Unit in mm



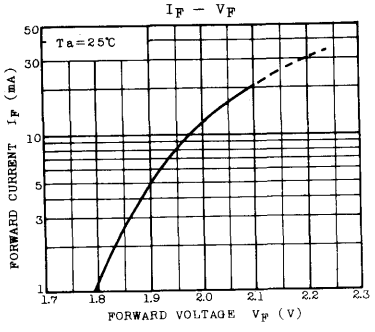


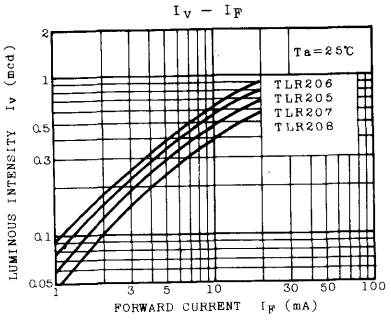
MAXIMUM RATINGS (Ta =25°C)

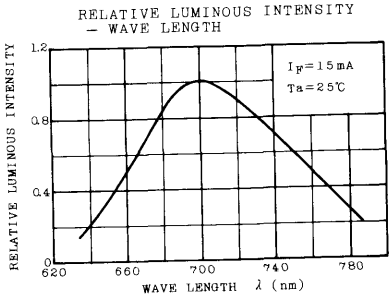
CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	20	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	56	mW
Operating Temperature Range	T_{opr}	-20 ~ 75	°C
Storage Temperature Range	T_{stg}	-30 ~ 100	°C

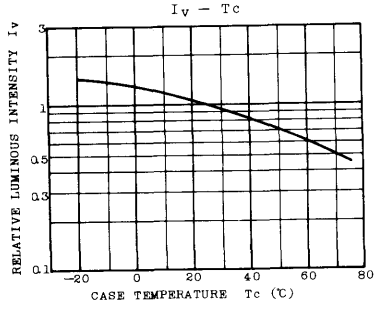
ELECTRO-OPTICAL CHARACTERISTICS (Ta =25°C)

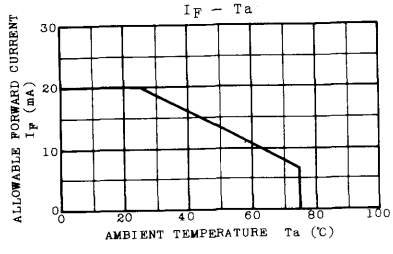
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current		I_R	V_R=4V	-	-	5	μA
Luminous Intensity	TLR205	I_V	I_F=15mA	0.4	0.7	-	mcd
	TLR206			0.4	0.8	-	
	TLR207			0.3	0.6	-	
	TLR208			0.3	0.5	-	
Peak Emission Wave Length		λ_P	I_F=15mA	-	700	-	nm
Spectral Line Half Width		$\delta\lambda$	I_F=15mA	-	100	-	nm











TLR209

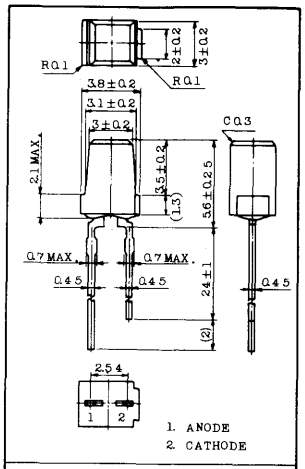
GaP RED LIGHT EMISSION

3×3mm RECTANGULAR

FEATURES:

- Red All Plastic Mold Type
- Rectangular Type (Surface Size 3×3mm)
- Low Drive Current, High Intensity Red Light Emission.
  Recommended Forward Current : I_F=5~10mA(DC)
- Fast Response Time, Capable of Pulse Operation.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	4-3D1A

Weight : 0.13g

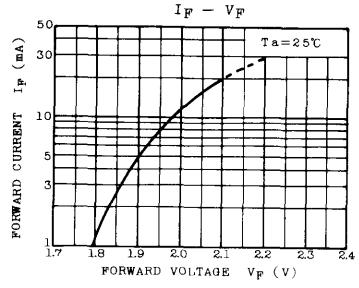
MAXIMUM RATINGS (Ta=25℃)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	20	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	56	mW
Operating Temperature Range	T_{opr}	-20~75	°C
Storage Temperature Range	T_{stg}	-30~100	°C

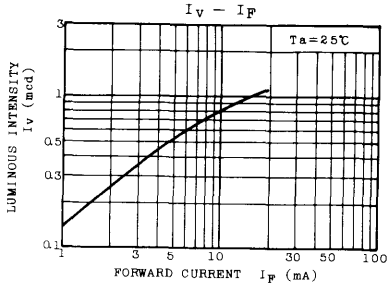
ELECTRO-OPTICAL CHARACTERISTICS (Ta=25℃)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current	I_R	V_R=4V	-	-	5	μA
Luminous Intensity	I_V	I_F=10mA	0.4	0.8	-	mcd
Peak Emission Wave Length	λ_P	I_F=10mA	-	700	-	nm
Spectral Line Half Width	$\Delta\lambda$	I_F=10mA	-	100	-	nm

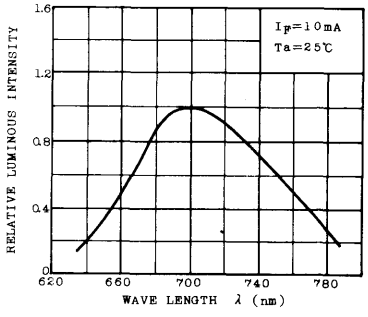
$I_F - V_F$



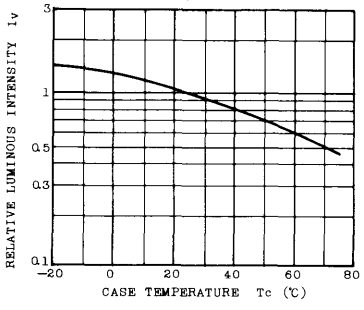
$I_V - I_F$



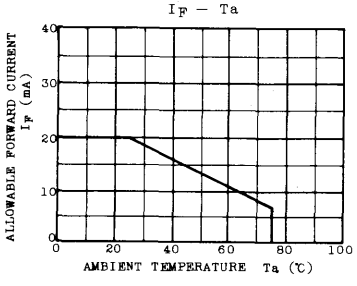
RELATIVE LUMINOUS INTENSITY — WAVE LENGTH



I_V — Tc



I_F — Ta



TLR210

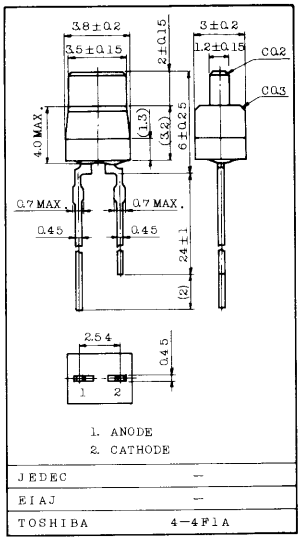
GaP RED LIGHT EMISSION

1.2×3.5mm RECTANGULAR

FEATURES:

- Red All Plastic Mold Type
- Rectangular Type (Surface Size 1.2×3.5mm)
- Low Drive Current, High Intensity Red Light Emission.
  Recommended Forward Current : I_F=5～10mA(DC)
- Fast Response Time, Capable of Pulse Operation.

Unit in mm



Weight : 0.13g

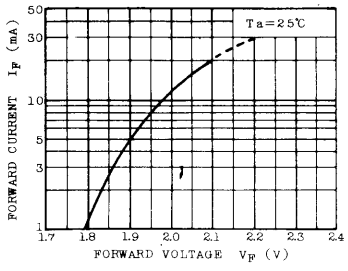
MAXIMUM RATINGS (Ta =25℃)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	20	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	56	mW
Operating Temperature Range	T_{opr}	-20～75	°C
Storage Temperature Range	T_{stg}	-30～100	°C

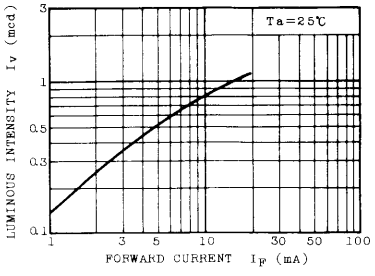
ELECTRO-OPTICAL CHARACTERISTICS (Ta =25℃)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current	I_R	V_R=4V	-	-	5	μA
Luminous Intensity	I_V	I_F=10mA	0.4	0.8	-	mcd
Peak Emission Wave Length	λ_P	I_F=10mA	-	700	-	nm
Spectral Line Half Width	$\Delta\lambda$	I_F=10mA	-	100	-	nm

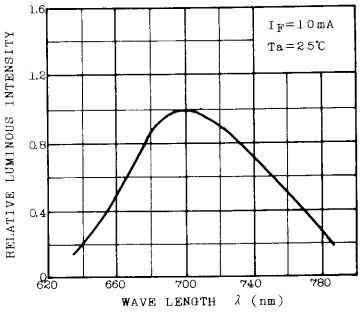
$I_F - V_F$



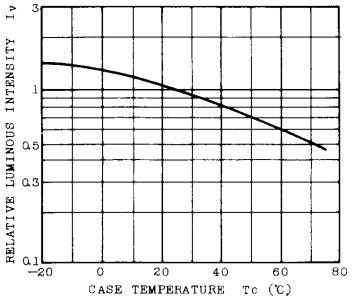
$I_V - I_F$



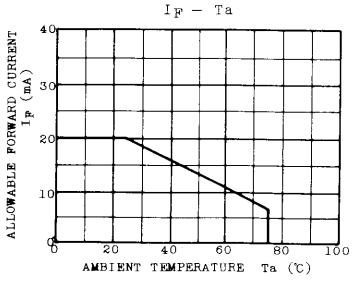
RELATIVE LUMINOUS INTENSITY — WAVE LENGTH



$I_V - T_C$



$I_F - T_a$



TLR211

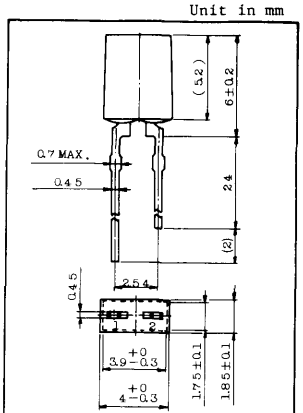
GaP RED LIGHT EMISSION

2×4mm RECTANGULAR

FEATURES:

- Red All Plastic Mold Type
- Rectangular Type (Surface Size 2 × 4mm)
- Low Drive Current, High Intensity Red Light Emission.
  Recommended Forward Current : I_F=10 ~ 15mA(DC)
- Fast Response Time, Capable of Pulse Operation.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	4-4G1A

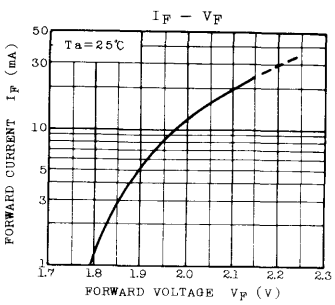
Weight :

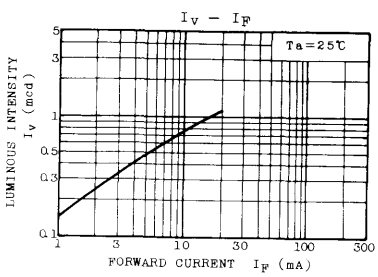
MAXIMUM RATINGS (Ta = 25°C)

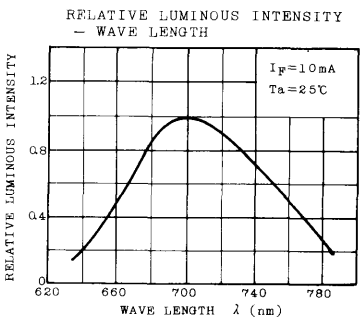
CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	20	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	56	mW
Operating Temperature Range	T_{opr}	−20 ~ 75	°C
Storage Temperature Range	T_{stg}	−30 ~ 100	°C

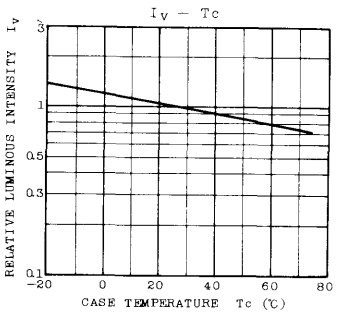
ELECTRO-OPTICAL CHARACTERISTICS (Ta = 25°C)

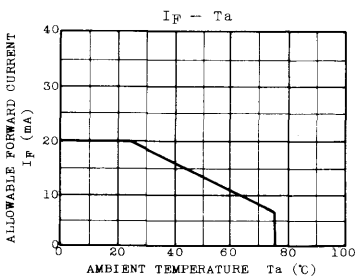
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=20mA	–	2.1	2.8	V
Reverse Current	I_R	V_R=4V	–	–	5	μA
Luminous Intensity	I_V	I_F=20mA	0.5	1.2	–	mcd
Peak Emission Wave Length	λ_P	I_F=10mA	–	700	–	nm
Spectral Line Half Width	$\Delta\lambda$	I_F=10mA	–	100	–	nm











TLR226

GaP RED LIGHT EMISSION

DOT INDICATOR

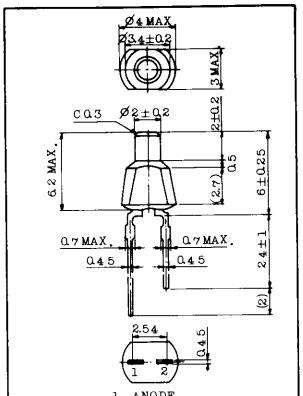
FEATURES:

. All Plastic Mold Type : Red Lusterless Lens.

. Low Drive Current, High Intensity Red Light Emission.
  Recommended Forward Current : I_F=5 ~10mA(DC)

. Fast Response Time, Capable of Pulse Operation.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	4-2C1A

Weight : 0.12g

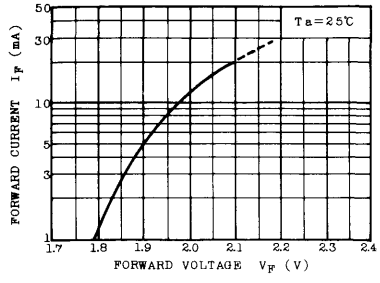
MAXIMUM RATINGS (Ta =25℃)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	20	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	56	mW
Operating Temperature Range	T_{opr}	-20 ~ 75	°C
Storage Temperature Range	T_{stg}	-30 ~ 100	°C

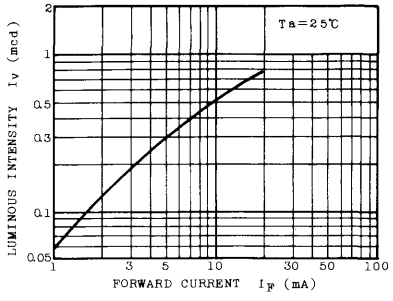
ELECTRO-OPTICAL CHARACTERISTICS (Ta =25℃)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current	I_R	V_R=4V	-	-	5	μA
Luminous Intensity	I_V	I_F=10mA	0.15	0.5	-	mcd
Peak Emission Wave Length	λ_P	I_F=10mA	-	700	-	nm
Spectral Line Half Width	$\Delta\lambda$	I_F=10mA	-	100	-	nm

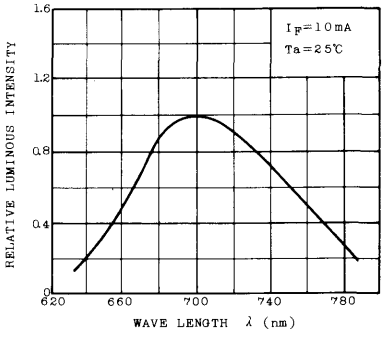
$I_F - V_F$



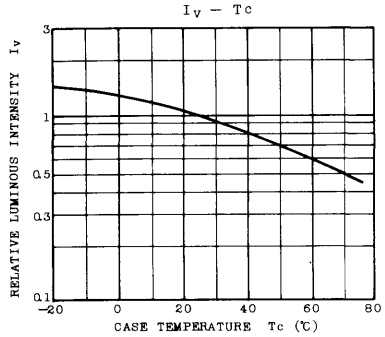
$I_V - I_F$



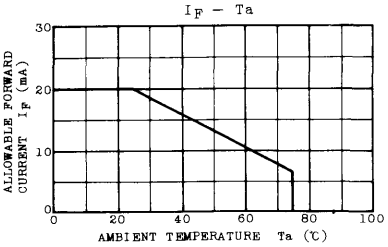
RELATIVE LUMINOUS INTENSITY — WAVE LENGTH



$I_V - T_C$



$I_F - T_a$



TLG102A, TLG108A

GaP GREEN LIGHT EMISSION

3mm DIAMETER(T1)

FEATURES:

. Resin Stem Type

TLG102A : Green Lusterless Lens

TLG108A : Light Green Transparent Lens

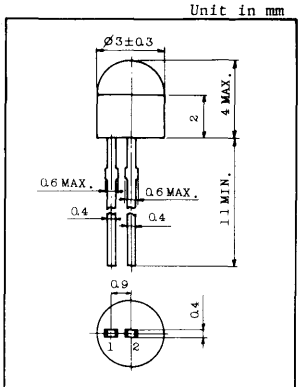
. Low Drive Current, High Intensity Green Light Emission.

Recommended Forward Current : I_F=15~20mA(DC)

. Wide Viewing Angle, Provides an Excellent ON-OFF Contrast Ratio.

. Fast Response Time, Capable of Pulse Operation.

Unit in mm



1. ANODE
2. CATHODE

JEDEC	–
EIAJ	–
TOSHIBA	4-3F1A

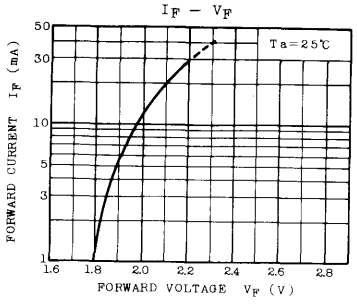
Weight : 0.08g

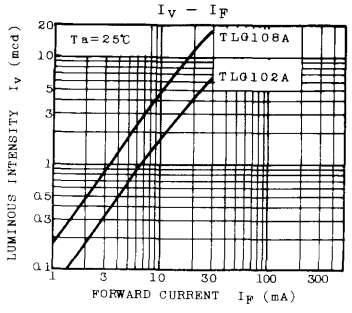
MAXIMUM RATINGS (Ta =25°C)

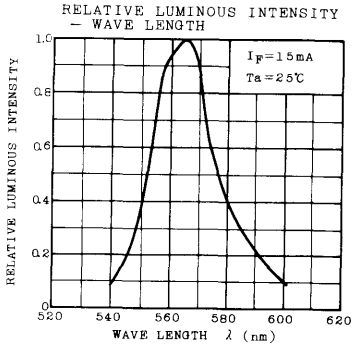
CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	30	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	85	mW
Operating Temperature Range	T_{opr}	-20~75	°C
Storage Temperature Range	T_{stg}	-30~100	°C

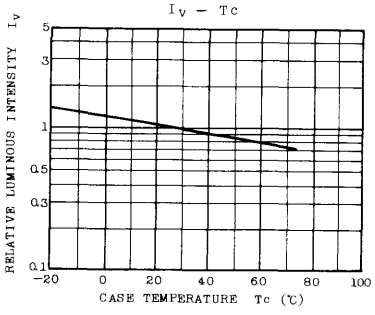
ELECTRO-OPTICAL CHARACTERISTICS (Ta =25°C)

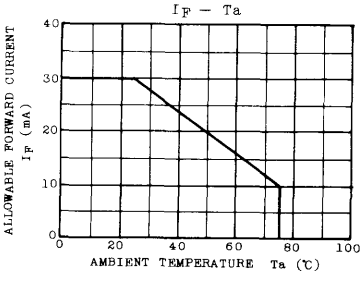
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	–	2.1	2.8	V
Reverse Current		I_R	V_R=4V	–	–	5	μA
Luminous Intensity	TLG102A	I_V	I_F=15mA	0.8	3.0	–	mcd
	TLG108A			1.4	8.0	–	
Peak Emission Wave Length		λ_P	I_F=15mA	–	565	–	nm
Spectral Line Half Width		$\Delta\lambda$	I_F=15mA	–	25	–	nm

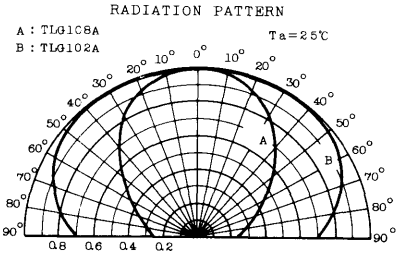












STANDARD BRIGHT LAMP

TLG113A, TLG114A, TLG115A

GaP GREEN LIGHT EMISSION

5mm DIAMETER(T 13/4)

FEATURES:

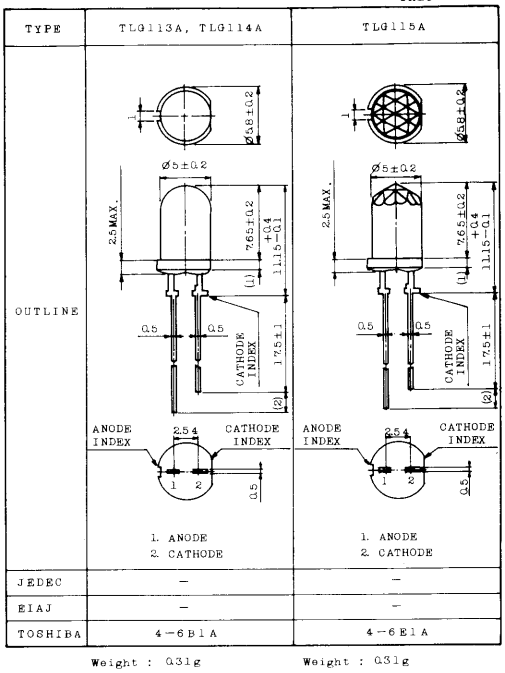
. All Plastic Mold Type. TLG113A : Green Transparent Lens
TLG114A : Green Lusterless Lens
TLG115A : Green Transparent Lens of DIAMOND Cut

. Low Drive Current, High Intensity Green Light Emission.
Recommended Forward Current : I_F=15~20mA(DC)

. All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.

. Fast Response Time, Capable of Pulse Operation.

Unit in mm

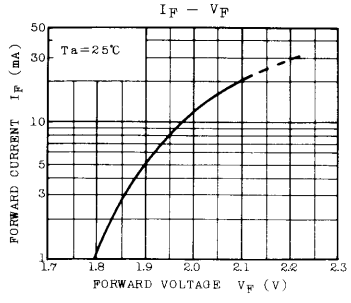


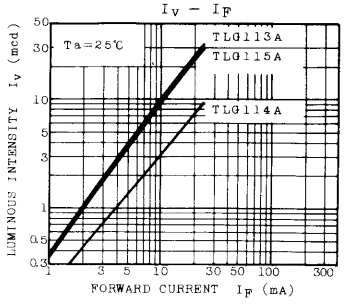
MAXIMUM RATINGS (Ta=25°C)

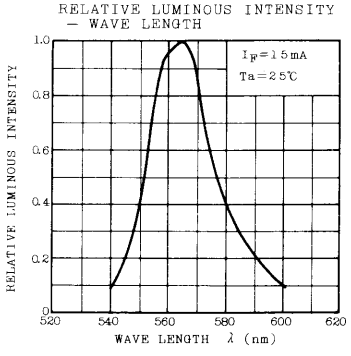
CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	100	mW
Operating Temperature Range	T_{opr}	-20~75	°C
Storage Temperature Range	T_{stg}	-30~100	°C

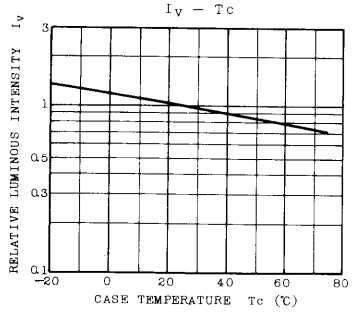
ELECTRO-OPTICAL CHARACTERISTICS (Ta=25°C)

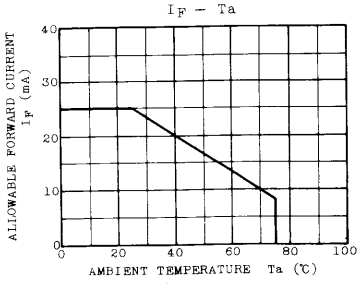
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current		I_R	V_R=4V	-	-	5	μA
Luminous Intensity	TLG113A	I_V	I_F=15mA	3	17	-	mcd
	TLG114A			0.8	5	-	
	TLG115A			3	16	-	
Peak Emission Wave Length		λ_P	I_F=15mA	-	565	-	nm
Spectral Line Half Width		$d\lambda$	I_F=15mA	-	25	-	nm

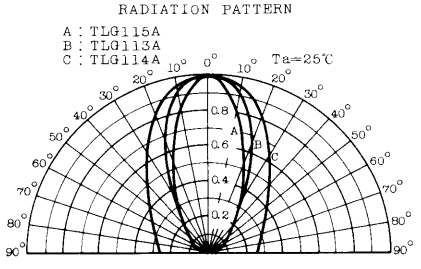












TLG113AP, TLG114AP

GaP GREEN LIGHT EMISSION

PANEL CIRCUIT INDICATOR

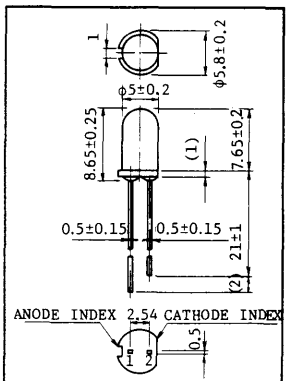
FEATURES:

- All Plastic Mold Type

  TLG113AP: Green Transparent Lens
  TLG114AP: Green Lusterless Lens

- Low Drive Current, High Intensity Green Light Emission.
  Recommended Forward Current: I_F = 15 ∿ 20 mA(DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.

Unit in mm



1. ANODE
2. CATHODE

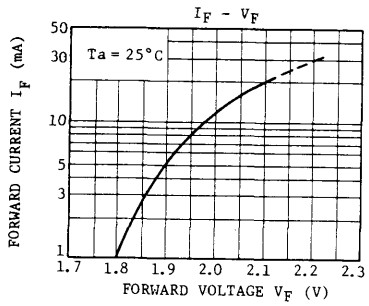
JEDEC	–
EIAJ	–
TOSHIBA	

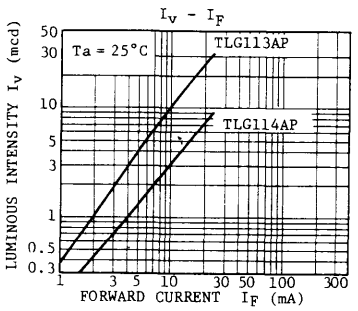
MAXIMUM RATINGS (Ta = 25 °C)

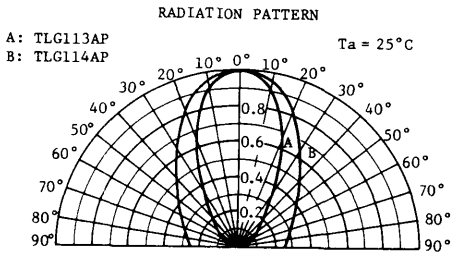
CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	100	mW
Operating Temperature Range	T_{opr}	-20 ∿ 75	°C
Storage Temperature Range	T_{stg}	-30 ∿ 100	°C

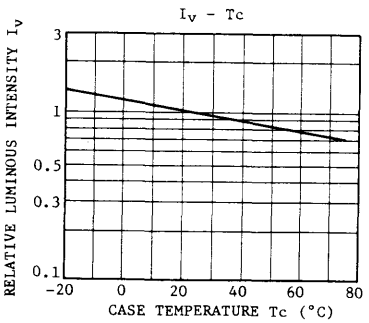
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25 °C)

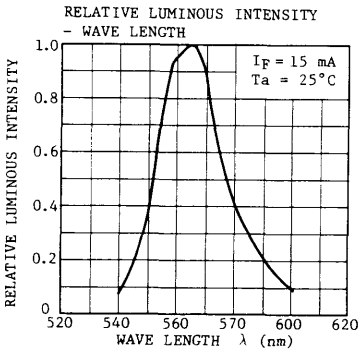
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F = 20 mA	–	2.1	2.8	V
Reverse Current		I_R	V_R = 4 V	–	–	5	μA
Luminous Intensity	TLG113AP	I_V	I_F = 15 mA	3	17	–	
	TLG114AP			0.8	5	–	
						–	
Peak Emission Wave Length		λ_p	I_F = 15 mA	–	565	–	nm
Spectral Line Half Width		$\Delta\lambda$	I_F = 15 mA	–	25	–	nm

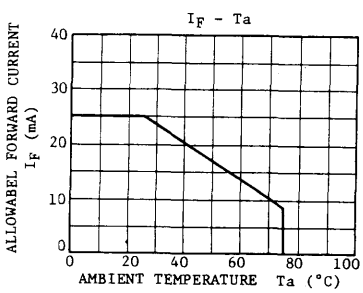












TLG113AQ, TLG114AQ

GaP GREEN LIGHT EMISSION

PANEL CIRCUIT INDICATOR

FEATURES:

- All Plastic Mold Type

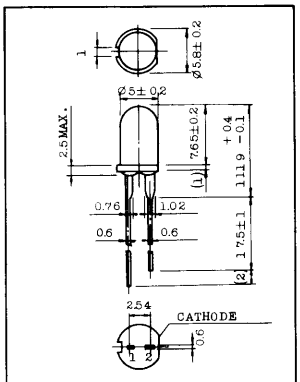
  TLG113AQ: Green Transparent Lens
  TLG114AQ: Green Lusterless Lens

- Low Drive Current, High Intensity Green Light Emission Recommended Forward Current:

  I_F=15 ∿ 20mA(DC)

- All Plastic Molded Lens, Provides and Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.
- Wire Wrappable Leads.

Unit in mm



1. ANODE
2. CATHODE

JEDEC	–
EIAJ	–
TOSHIBA	4-6B4A

Weight: 0.35g

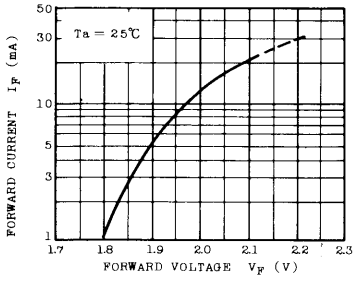
MAXIMUM RATINGS (Ta = 25 ℃)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	T_{opr}	-20 ∿ 75	°C
Storage Temperature Range	T_{stg}	-30 ∿ 100	°C

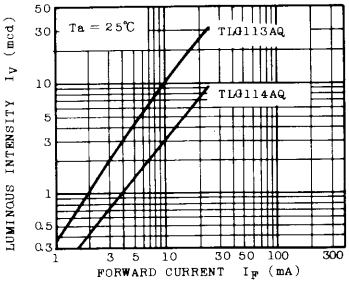
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25 ℃)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	–	2.1	2.8	V
Reverse Current		I_R	V_R=4V	–	–	5	μA
Luminous Intensity	TLG113AQ	I_V	I_F=15mA	0.3	17	–	mcd
	TLG114AQ			0.8	5	–	
Peak Emission Wave Length		λP	I_F=15mA	–	565	–	nm
Spectral Line Half Width		Δλ	I_F=15mA	–	25	–	nm

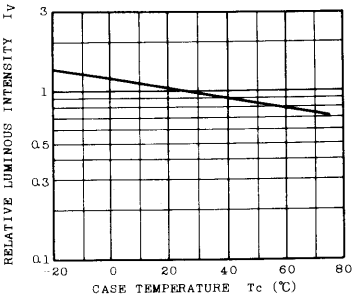
I_F – V_F



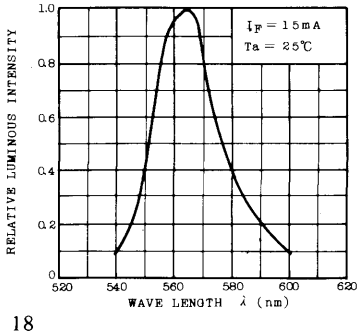
I_V – I_F



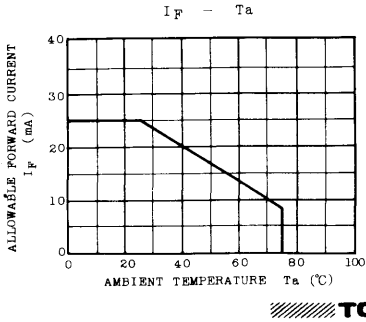
I_V – Tc



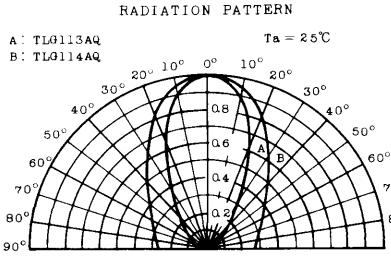
RELATIVE LUMINOUS INTENSITY – WAVE LENGTH



I_F – Ta



RADIATION PATTERN



TLG113AR, TLG114AR

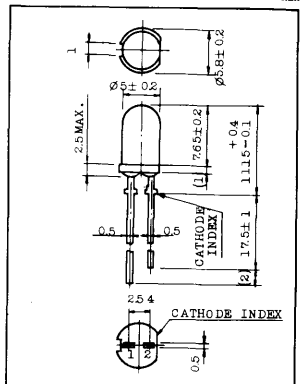
GaP GREEN LIGHT EMISSION

PANEL CIRCUIT INDICATOR

FEATURES:

- Current Limiting Resistor Built in Type
- All Plastic Mold Type
  TLG113AR: Green Transparent Lens
  TLG114AR: Green Lusterless Lens
- Capable of Direct Drive with Constant Voltage Supply
  Recommended Forward Voltage Supply: V_F=4.5 ∿ 5V(DC)
- All Plastic Molded Lens Provides an Excellent ON-OFF Contrast Ratio
- Fast Response Time, Capable of Pulse Operation

Unit in mm



1. ANODE
2. CATHODE

JEDEC	–
EIAJ	–
TOSHIBA	4-6B1A

Weight: 0.33g

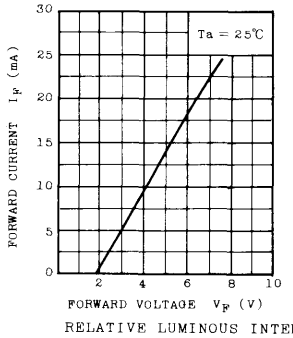
MAXIMUM RATINGS (Ta = 25 °C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Voltage (DC)	V_F	7.5	V
Reverse Voltage	V_R	6	V
Operating Temperature Range	T_{opr}	-20 ∿ 75	°C
Storage Temperature Range	T_{stg}	-30 ∿ 100	°C

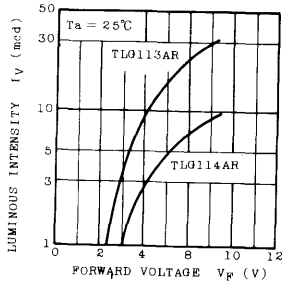
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25 °C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Current		I_F	V_F=5V	–	13	20	mA
Reverse Current		I_R	V_R=6V	–	–	100	μA
Luminous Intensity	TLG113AR	I_V	V_F=5V	3	17	–	mcd
	TLG114AR			0.8	5	–	
Peak Emission Wave Length		λP	V_F=5V	–	565	–	nm
Spectral Line Half Width		Δλ	V_F=5V	–	25	–	nm

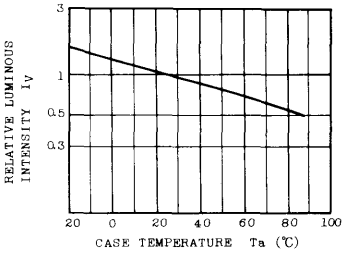
I_F – V_F



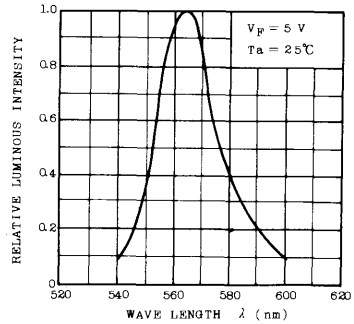
I_V – V_F



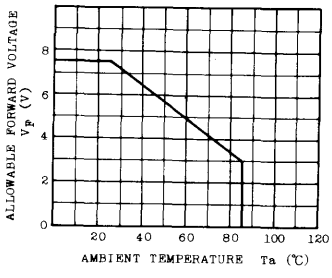
I_V – Tc



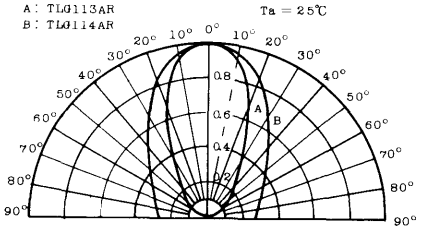
RELATIVE LUMINOUS INTENSITY – WAVE LENGTH



V_F – Ta



RADIATION PATTERN

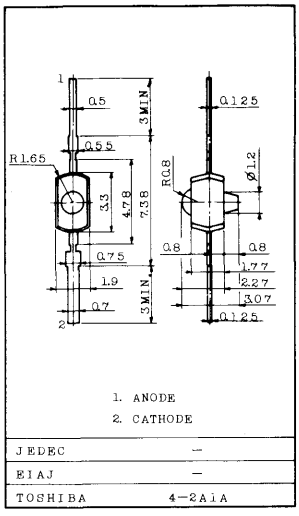


STANDARD BRIGHT LAMP

TLG121, TLG122

GaP GREEN LIGHT EMISSION

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	4-2A1A

Weight : 0.03g

SUBMINIATURE

FEATURES:

- All Plastic Mold Type
  TLG121 : Colorless Transparent Lens
  TLG122 : Green Transparent Lens
- Low Drive Current, High Intensity Green Light Emission.
  Recommended Forward Current : I_F=10 ~ 15mA(DC)
- All Plastic Molded Lens, Provides an Excellent Point Source.
- Fast Response Time, Capable of Pulse Operation.

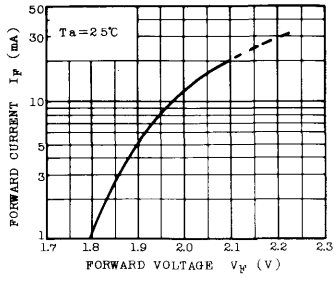
MAXIMUM RATINGS (Ta =25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	20	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	60	mW
Operating Temperature Range	Topr	-20 ~ 75	°C
Storage Temperature Range	Tstg	-30 ~ 80	°C

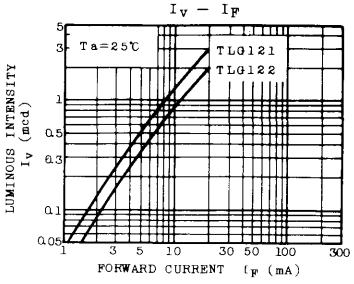
ELECTRO-OPTICAL CHARACTERISTICS (Ta =25°C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	-	2.1	2.6	V
Reverse Current		I_R	V_R=4V	-	-	5	μA
Luminous Intensity	TLG121	I_V	I_F=20mA	0.5	3.0	-	mcd
	TLG122			0.5	2.0	-	
Peak Emission Wave Length		λ_P	I_F=20mA	-	565	-	nm
Spectral Line Half Width		$\Delta\lambda$	I_F=20mA	-	25	-	nm

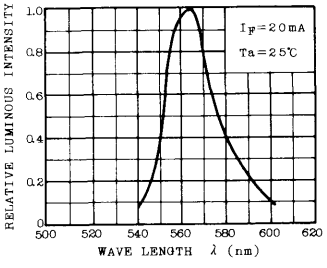
$I_F - V_F$



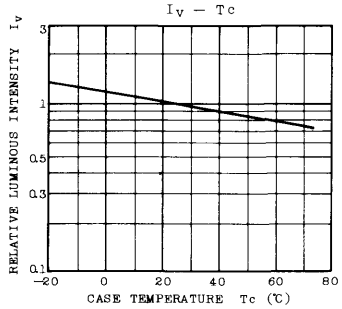
$I_V - I_F$



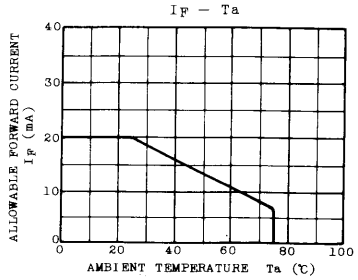
RELATIVE LUMINOUS INTENSITY — WAVE LENGTH



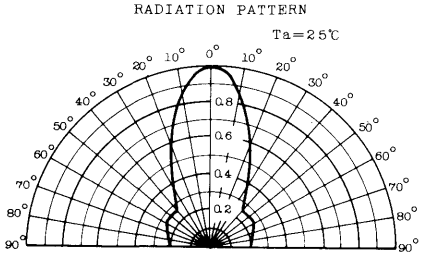
$I_V - Tc$



$I_F - Ta$



RADIATION PATTERN



TLG123A, TLG124A

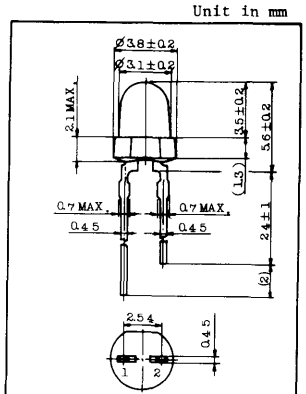
GaP GREEN LIGHT EMISSION

3.1mm DIAMETER(T1)

FEATURES:

- All Plastic Mold Type.
  TLG123A : Green Transparent Lens
  TLG124A : Green Lusterless Lens
- Low Drive Current, High Intensity Green Light Emission.
  Recommended Forward Current : I_F=10~15mA(DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.

Unit in mm



1. ANODE
2. CATHODE

JEDEC	—
EIAJ	—
TOSHIBA	4-4E1A

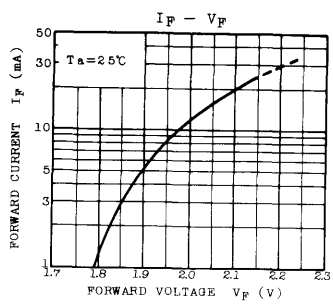
Weight : 0.14g

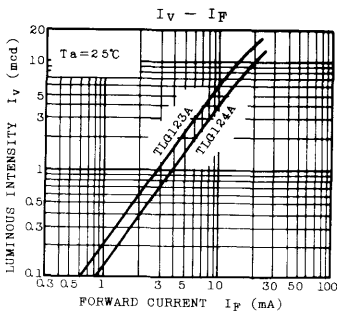
MAXIMUM RATINGS (Ta=25℃)

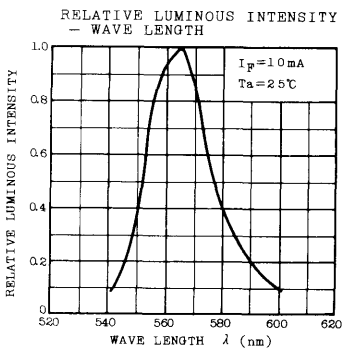
CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	Topr	-20~75	°C
Storage Temperature Range	Tstg	-30~100	°C

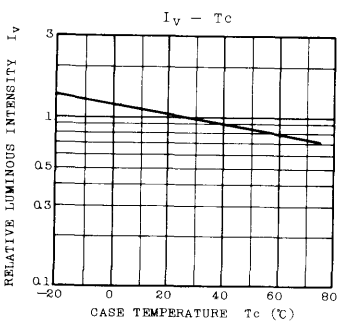
ELECTRO-OPTICAL CHARACTERISTICS (Ta=25℃)

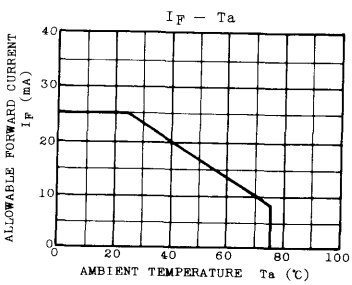
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current		I_R	V_R=4V	-	-	5	μA
Luminous Intensity	TLG123A	I_V	I_F=10mA	1	6	-	mcd
	TLG124A			0.8	4	-	
Peak Emission Wave Length		λ_P	I_F=10mA	-	565	-	nm
Spectral Line Half Width		$\Delta\lambda$	I_F=10mA	-	25	-	nm

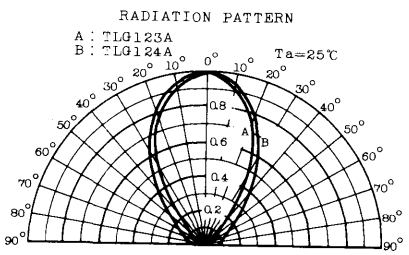












TLG145, TLG147

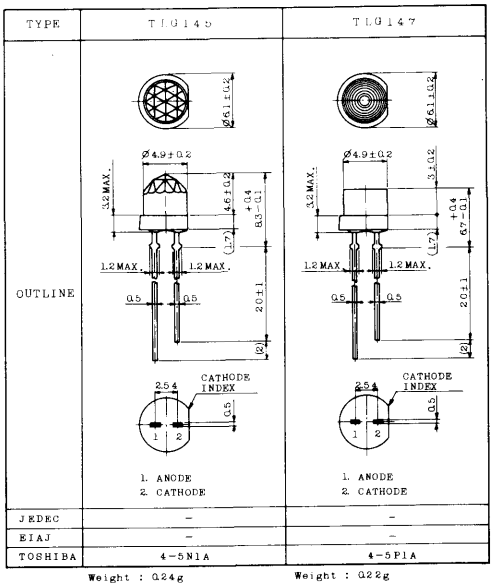
GaP GREEN LIGHT EMISSION

4.9mm DIAMETER(T 1 3/4, LOW PROFILE)

FEATURES:

- All Plastic Mold Type — TLG145 : Green Transparent Lens of DIAMOND Cut; TLG147 : Green Transparent Lens of Spiral
- Low Drive Current, High Intensity Green Light Emission.
  Recommended Forward Current : I_F=15~20mA(DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.

Unit in mm

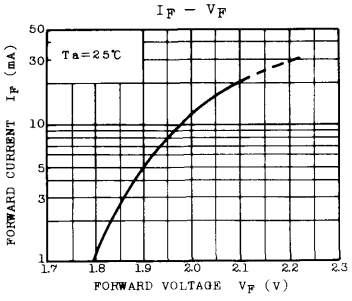


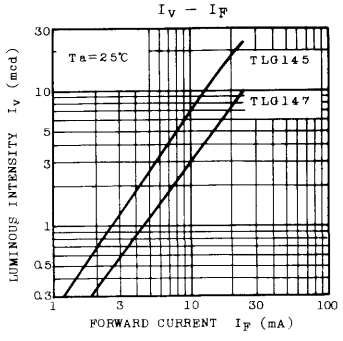
MAXIMUM RATINGS (Ta =25°C)

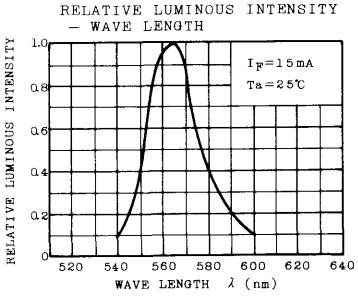
CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	T_{opr}	-20~75	°C
Storage Temperature Range	T_{stg}	-30~100	°C

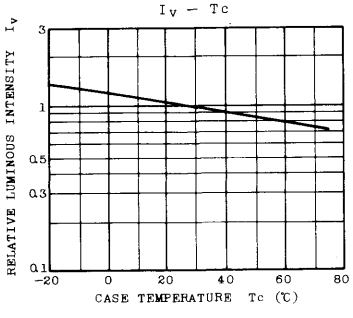
ELECTRO-OPTICAL CHARACTERISTICS (Ta =25°C)

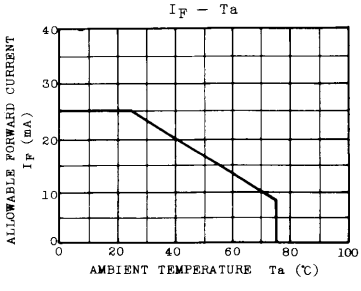
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current		I_R	V_R=4V	-	-	5	μA
Luminous Intensity	TLG145	I_V	I_F=15mA	2.5	12	-	mcd
	TLG147			1.4	5	-	
Peak Emission Wave Length		λ_P	I_F=15mA	-	565	-	nm
Spectral Line Half Width		$\Delta\lambda$	I_F=15mA	-	25	-	nm

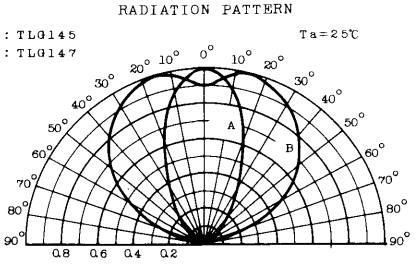












TLG205, TLG206, TLG207, TLG208

GaP GREEN LIGHT EMISSION

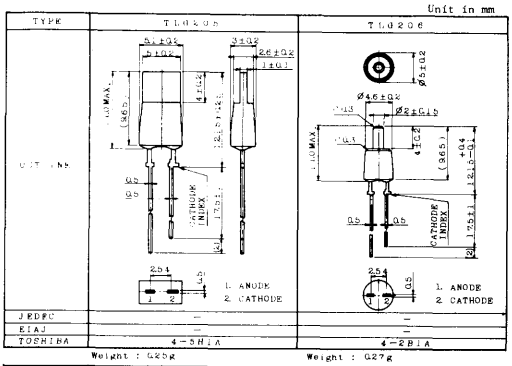
FEATURES:

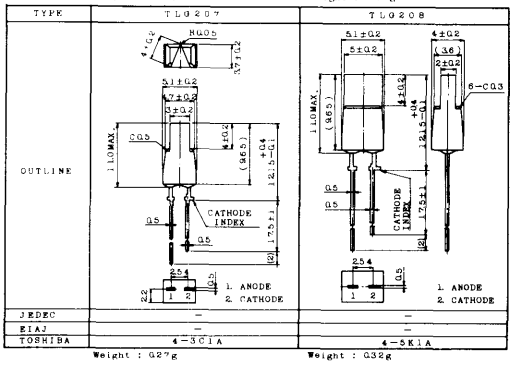
. Green All Plastic Mold Type
  - TLG205 : Rectangular Type (Surface Size 1 × 5mm)
  - TLG206 : Convex Type (Surface Size φ2mm)
  - TLG207 : Triangular Type (Surface Size 3 × 4 × 4mm)
  - TLG208 : Rectangular Type (Surface Size 2 × 5mm)

. Low Drive Current, High Intensity Green Light Emission.
  Recommended Forward Current : I_F=15 ~ 20mA(DC)

. Fast Response Time, Capable of Pulse Operation.

Unit in mm



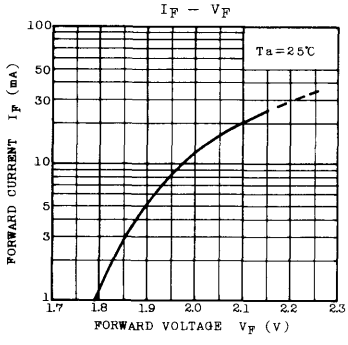


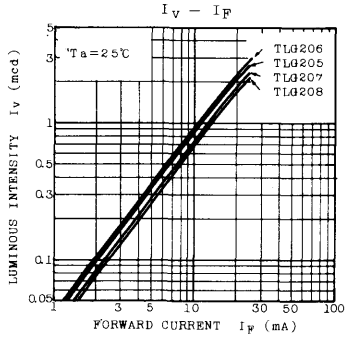
MAXIMUM RATINGS (Ta =25℃)

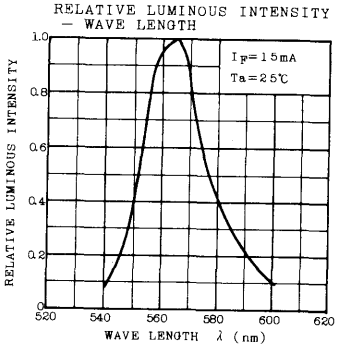
CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	T_{opr}	-20 ~ 75	°C
Storage Temperature Range	T_{stg}	-30 ~ 100	°C

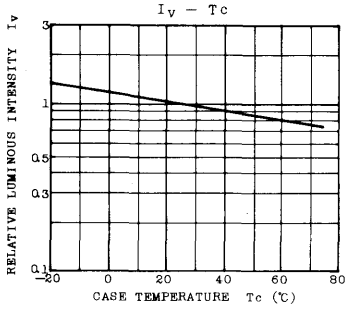
ELECTRO-OPTICAL CHARACTERISTICS (Ta =25℃)

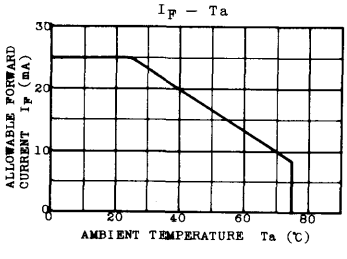
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current		I_R	V_R=4V	-	-	5	μA
Luminous Intensity	TLG205	I_V	I_F=15mA	0.5	1.5	-	mcd
	TLG206			0.5	1.6	-	
	TLG207			0.5	1.3	-	
	TLG208			0.5	1.2	-	
Peak Emission Wave Length		λ_P	I_F=15mA	-	565	-	nm
Spectral Line Half Width		$\Delta\lambda$	I_F=15mA	-	25	-	nm











TLG209

GaP GREEN LIGHT EMISSION

3×3mm RECTANGULAR

FEATURES:

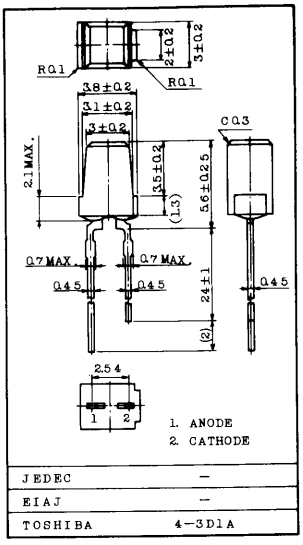
. Green All Plastic Mold Type

. Rectangular Type (Surface Size 3 × 3mm)

. Low Drive Current, High Intensity Green Light Emission.
Recommended Forward Current : I_F=10 ~ 15mA(DC)

. Fast Response Time, Capable of Pulse Operation.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	4-3D1A

Weight : 0.13g

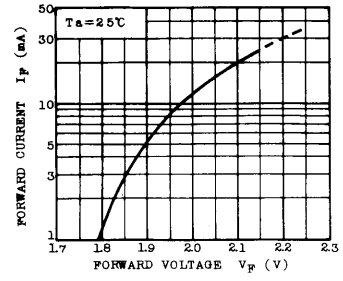
MAXIMUM RATINGS (Ta =25℃)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	T_{opr}	-20 ~ 75	°C
Storage Temperature Range	T_{stg}	-30 ~ 100	°C

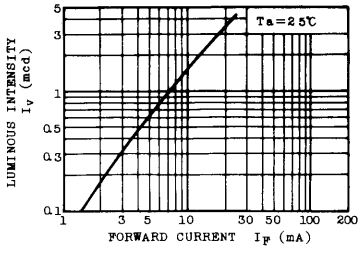
ELECTRO-OPTICAL CHARACTERISTICS (Ta =25℃)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current	I_R	V_R=4V	-	-	5	μA
Luminous Intensity	I_V	I_F=10mA	0.8	1.5	-	mcd
Peak Emission Wave Length	λ_P	I_F=10mA	-	565	-	nm
Spectral Line Half Width	$\Delta\lambda$	I_F=10mA	-	25	-	nm

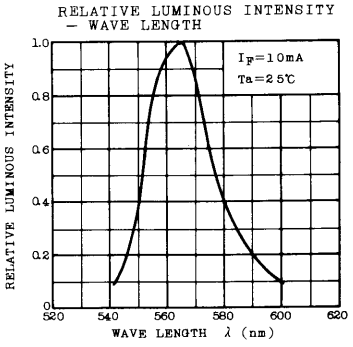
$I_F - V_F$



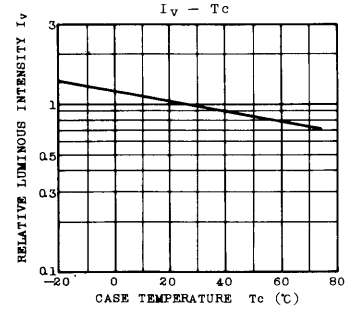
$I_V - I_F$



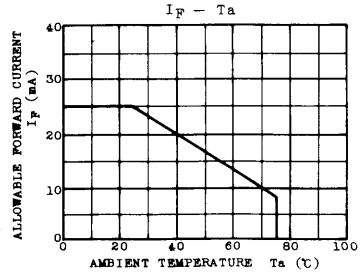
RELATIVE LUMINOUS INTENSITY — WAVE LENGTH



$I_V - T_C$



$I_F - T_a$



TLG210

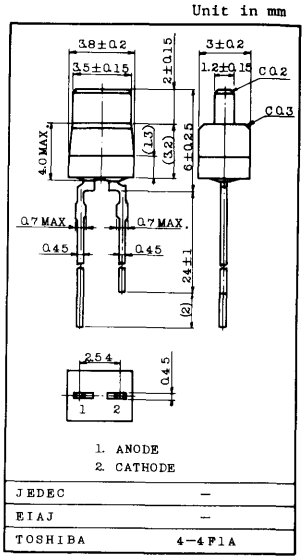
GaP GREEN LIGHT EMISSION

1.2×3.5mm RECTANGULAR

FEATURES:

- Green All Plastic Mold Type
- Rectangular Type (Surface Size 1.2 x 3.5mm)
- Low Drive Current, High Intensity Green Light Emission.
  Recommended Forward Current : I_F=10 ~ 15mA(DC)
- Fast Response Time, Capable of Pulse Operation.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	4-4F1A

Weight : 0.13g

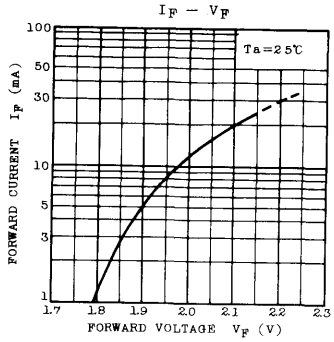
MAXIMUM RATINGS (Ta =25℃)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	T_{opr}	-20 ~ 75	°C
Storage Temperature Range	T_{stg}	-30 ~ 100	°C

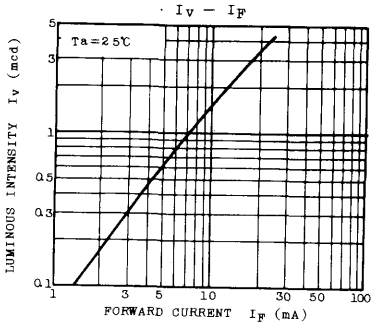
ELECTRO-OPTICAL CHARACTERISTICS (Ta =25℃)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current	I_R	V_R=4V	-	-	5	μA
Luminous Intensity	I_V	I_F=10mA	0.8	1.5	-	mcd
Peak Emission Wave Length	λ_P	I_F=10mA	-	565	-	nm
Spectral Line Half Width	$\Delta\lambda$	I_F=10mA	-	25	-	nm

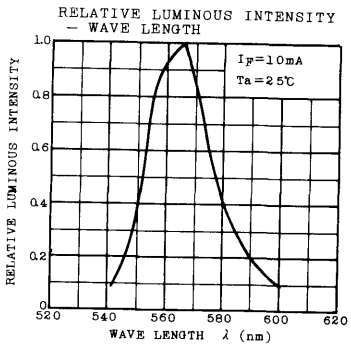
$I_F - V_F$



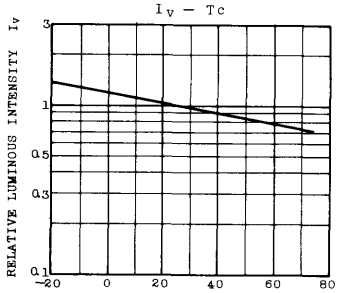
$I_V - I_F$



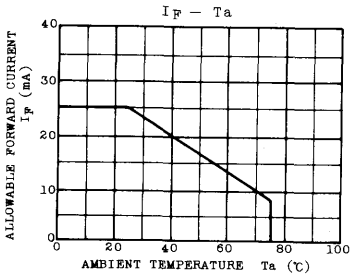
RELATIVE LUMINOUS INTENSITY — WAVE LENGTH



$I_V - Tc$



$I_F - Ta$



TLG211

GaP GREEN LIGHT EMISSION

2×4mm RECTANGULAR

FEATURES:

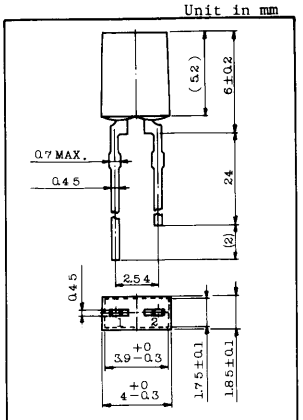
. Green All Plastic Mold Type

. Rectangular Type (Surface Size 2×4mm)

. Low Drive Current, High Intensity Green Light Emission.
  Recommended Forward Current : I_F=10~15mA(DC)

. Fast Response Time, Capable of Pulse Operation.

Unit in mm



JEDEC	–
EIAJ	–
TOSHIBA	4-4G1A

Weight :

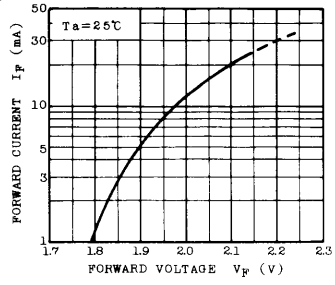
MAXIMUM RATINGS (Ta =25℃)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	T_{opr}	-20~75	°C
Storage Temperature Range	T_{stg}	-30~100	°C

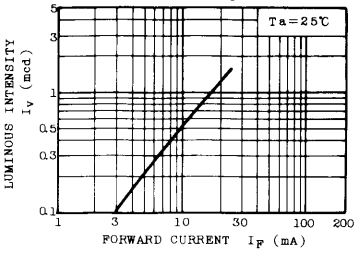
ELECTRO-OPTICAL CHARACTERISTICS (Ta =25℃)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current	I_R	V_R=4V	-	-	5	μA
Luminous Intensity	I_V	I_F=20mA	0.5	1.2	-	mcd
Peak Emission Wave Length	λ_P	I_F=10mA	-	565	-	nm
Spectral Line Half Width	$\Delta\lambda$	I_F=10mA	-	25	-	nm

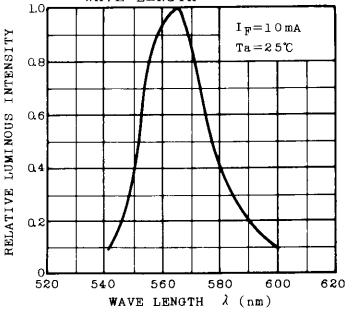
$I_F - V_F$



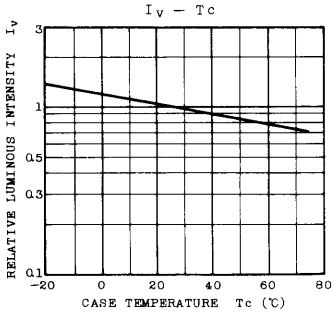
$I_V - I_F$



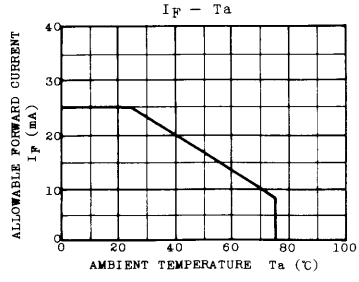
RELATIVE LUMINOUS INTENSITY — WAVE LENGTH



$I_V - T_C$



$I_F - T_a$



TLG226

GaP GREEN LIGHT EMISSION

DOT INDICATOR

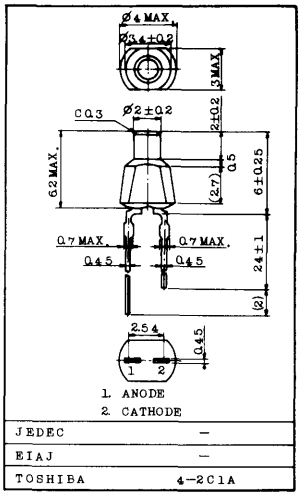
FEATURES:

. All Plastic Mold Type : Green Lusterless Lens.

. Low Drive Current, High Intensity Green Light Eimssion.
  Recommended Forward Current : I_F=10～15mA(DC)

. Fast Response Time, Capable of Pulse Operation.

Unit in mm



Weight : 0.12g

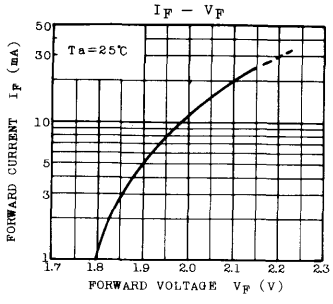
MAXIMUM RATINGS (Ta =25℃)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	T_{opr}	-20～75	°C
Storage Temperature Range	T_{stg}	-30～100	°C

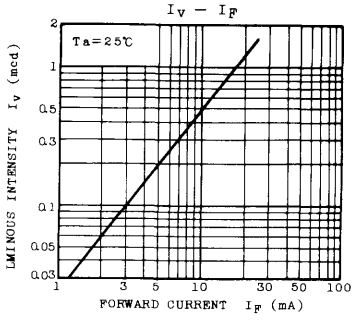
ELECTRO-OPTICAL CHARACTERISTICS (Ta =25℃)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current	I_R	V_R=4V	-	-	5	μA
Luminous Intensity	I_V	I_F=10mA	0.15	0.5	-	mcd
Peak Emission Wave Length	λ_P	I_F=10mA	-	565	-	nm
Spectral Line Half Width	$\Delta\lambda$	I_F=10mA	-	25	-	nm

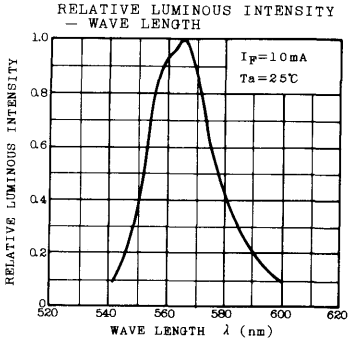
$I_F - V_F$



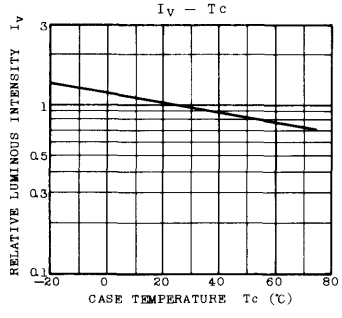
$I_V - I_F$



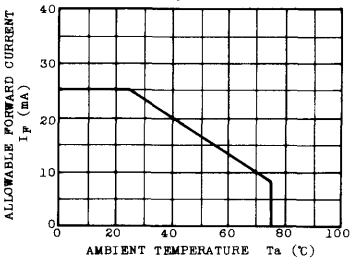
RELATIVE LUMINOUS INTENSITY — WAVE LENGTH



$I_V - T_C$



$I_F - T_a$



TLG255

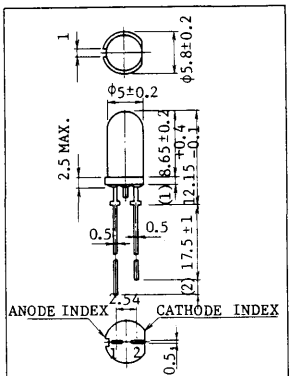
GaP GREEN LIGHT EMISSION

2 CHIP LED LAMP FOR BACK LIGHTING

FREATURES:

- 2 chip series connection
- All Plastic Mold Type: Light Green Transparent Lens
- Low Drive Current, High Intensity Green Light Emission
  Recommended Forward Current: I_F = 15∿20 mA (DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.
- Wide Radiation - Suitable for Back Lighting

Unit in mm



1. ANODE
2. CATHODE

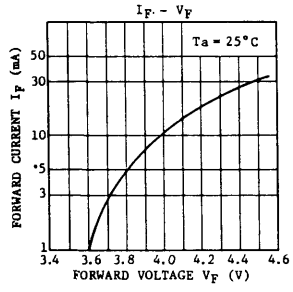
JEDEC	-
EIAJ	
TOSHIBA	

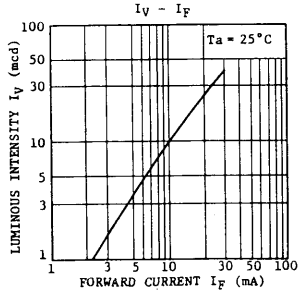
MAXIMUM RATINGS (Ta = 25 °C)

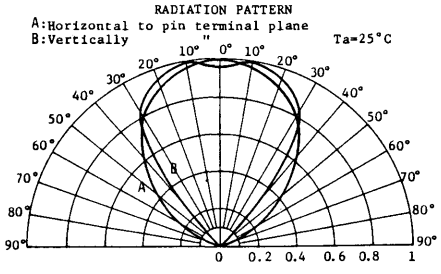
CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	30	mA
Reverse Voltage	V_R	8	V
Operating Temperature Range	T_{opr}	-20 ∿ 75	°C
Storage Temperature Range	T_{stg}	-30 ∿ 100	°C

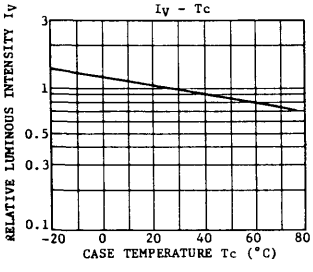
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25 °C)

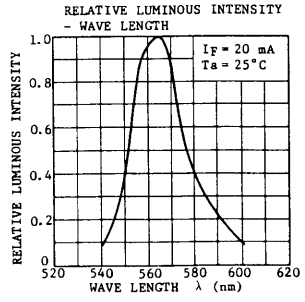
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F = 20 mA	-	4.2	5.4	V
Reverse Current	I_R	V_R = 8V	-	-	100	μA
Luminous Intensity	I_V	I_F = 20 mA	4	25	-	mcd
Peak Emission Wave Length	λ_p	I_F = 20 mA	-	565	-	nm
Spectral Line Half Width	$\Delta\lambda$	I_F = 20 mA	-	25	-	nm

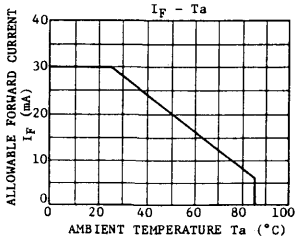












TLY102A, TLY108A

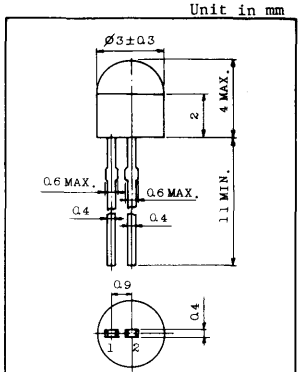
GaAsP YELLOW LIGHT EMISSION

3mm DIAMETER(T1)

FEATURES:

- Resin Stem Type
  - TLY102A : Yellow Lusterless Lens
  - TLY108A : Yellow Transparent Lens
- Low Drive Current, High Intensity Yellow Light Emission
  - Recommended Forward Current : I_F=15 ~ 20mA(DC)
- Wide Viewing Angle, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.

Unit in mm



1. ANODE
2. CATHODE

JEDEC	—
EIAJ	—
TOSHIBA	4-3F1A

Weight : 0.08g

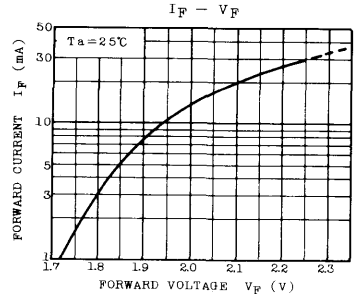
MAXIMUM RATINGS (Ta =25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	30	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	85	mW
Operating Temperature Range	T_{opr}	-20 ~ 75	°C
Storage Temperature Range	T_{stg}	-30 ~ 100	°C

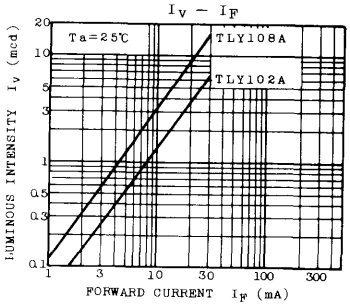
ELECTRO-OPTICAL CHARACTERISTICS (Ta =25°C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current		I_R	V_R=4V	-	-	100	μA
Luminous Intensity	TLY102A	I_V	I_F=15mA	0.6	2.5	-	mcd
	TLY108A			1.0	6.0	-	
Peak Emission Wave Length		λ_P	I_F=15mA	-	585	-	nm
Spectral Line Half Width		$\Delta\lambda$	I_F=15mA	-	32	-	nm

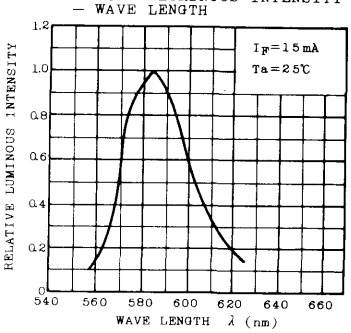
$I_F - V_F$



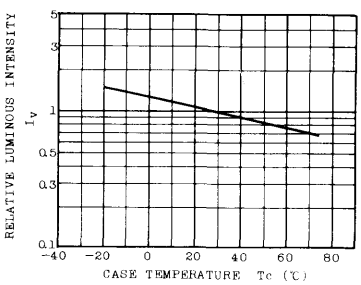
$I_V - I_F$



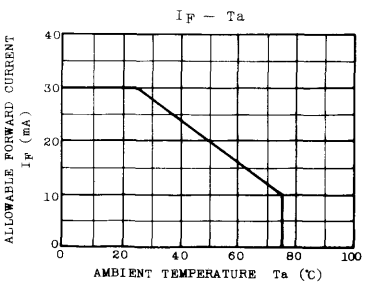
RELATIVE LUMINOUS INTENSITY — WAVE LENGTH



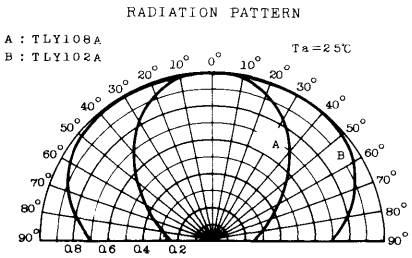
$I_V - Tc$



$I_F - Ta$



RADIATION PATTERN



TLY113A, TLY114A

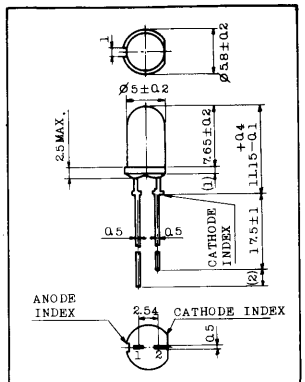
GaAsP YELLOW LIGHT EMISSION

5mm DIAMETER(T/(T 13/4)

FEATURES:

- All Plastic Mold Type
  TLY113A : Yellow Transparent Lens
  TLY114A : Yellow Lusterless Lens
- Low Drive Current, High Intensity Yellow Light Emission
  Recommended Forward Current : I_F=15~20mA(DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.

Unit in mm



1. ANODE
2. CATHODE

JEDEC	—
EIAJ	—
TOSHIBA	4-6B1A

Weight : 0.31g

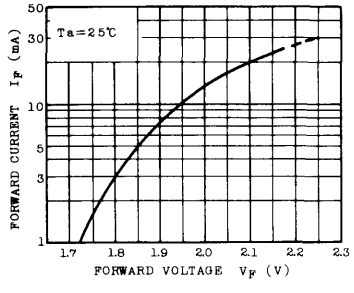
MAXIMUM RATINGS (Ta =25℃)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	100	mW
Operating Temperature Range	T_{opr}	-20~75	°C
Storage Temperature Range	T_{stg}	-30~100	°C

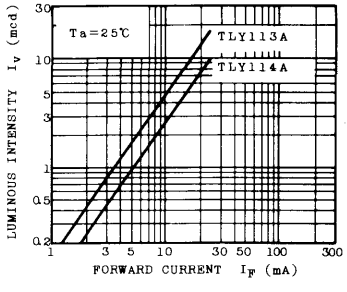
ELECTRO-OPTICAL CHARACTERISTICS (Ta =25℃)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current		I_R	V_R=4V	-	-	100	μA
Luminous Intensity	TLY113A	I_V	I_F=15mA	1	9	-	mcd
	TLY114A			0.8	5	-	
Peak Emission Wave Length		λ_P	I_F=15mA	-	585	-	nm
Spectral Line Half Width		$\Delta\lambda$	I_F=15mA	-	32	-	nm

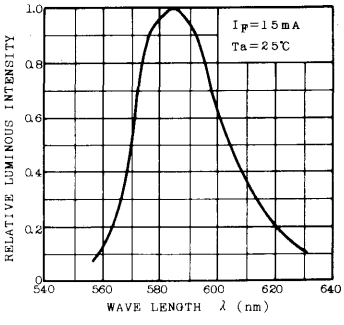
$I_F - V_F$



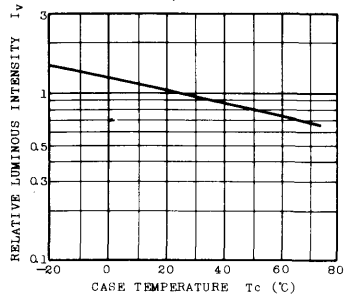
$I_V - I_F$



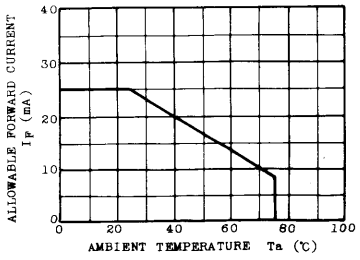
RELATIVE LUMINOUS INTENSITY − WAVE LENGTH



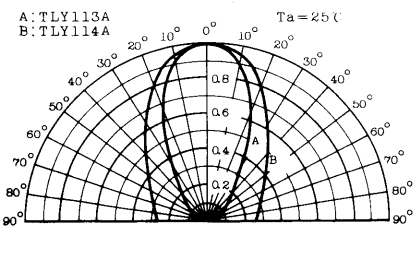
I_V − Tc



I_F − Ta



RADIATION PATTERN



TLY113AP, TLY114AP

GaAsP YELLOW LIGHT EMISSION

PANEL CIRCUIT INDICATOR

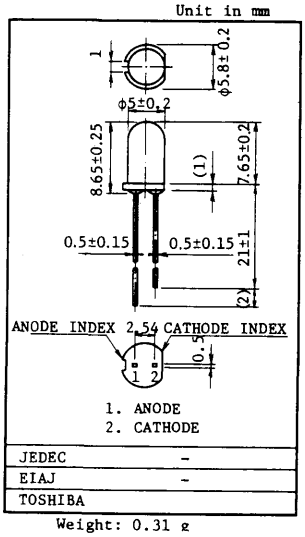
FEATURES:

- All Plastic Mold Type

  TLY113AP: Yellow Transparent Lens
  TLY114AP: Yellow Lusterless Lens

- Low Drive Current, High Intensity Yellow Light Emission
  Recommended Forward Current: I_F = 15∿ 20 mA(DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable for Pulse Operation.

Unit in mm



JEDEC	-
EIAJ	-
TOSHIBA	

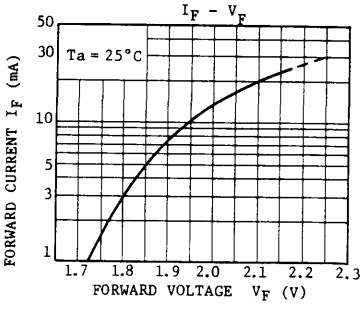
Weight: 0.31 g

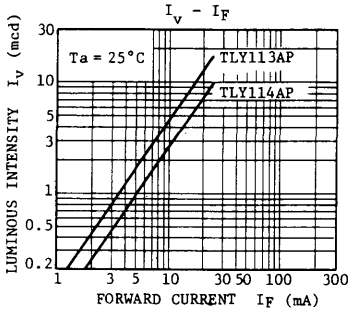
MAXIMUM RATINGS (Ta = 25 °C)

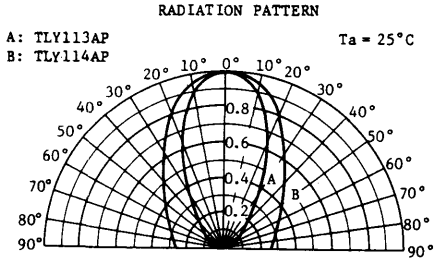
CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	100	mW
Operating Temperature Range	T_{opr}	-20 ∿ 75	°C
Storage Temperature Range	T_{stg}	-30 ∿ 100	°C

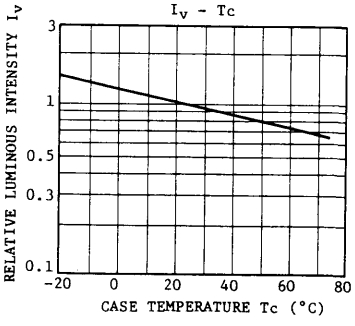
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25 °C)

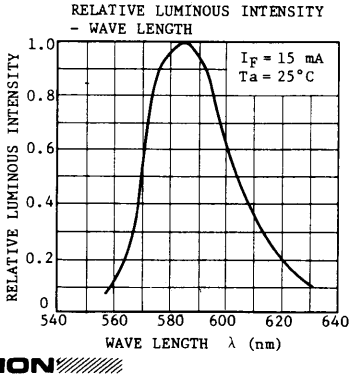
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F = 20 mA	-	2.1	2.8	V
Reverse Current		I_R	V_R = 4 V	-	-	100	μA
Luminous Intensity	TLY113AP	I_v	I_F = 15 mA	1	9	-	mcd
	TLY114AP			0.8	5	-	
Peak Emission Wave Length		λ_p	I_F = 15 mA	-	585	-	nm
Spectral Line Half Width		Δλ	I_F = 15 mA	-	32	-	nm

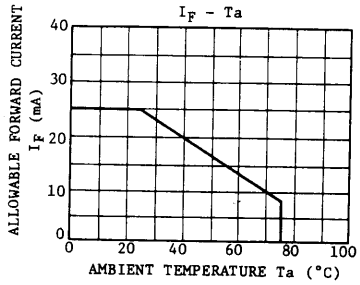












TLY113AQ, TLY114AQ

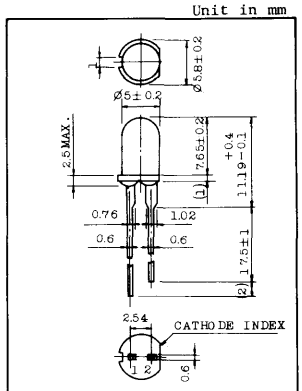
GaAsP YELLOW LIGHT EMISSION

PANEL CIRCUIT INDICATOR

FEATURES:

- All Plastic Mold Type
  TLY113AQ: Yellow Transparent Lens
  TLY114AQ: Yellow Lusterless Lens
- Low Drive Current, High Intensity Yellow Light Emission.
  Recommended Forward Current: I_F=15 ~ 20mA(DC)
- All Plastic Molded Lens, Provides and Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable for Pulse Operation.
- Wire Wrappable Leads

Unit in mm



1. ANODE
2. CATHODE

JEDEC	–
EIAJ	–
TOSHIBA	4-6B4A

Weight: 0.35g

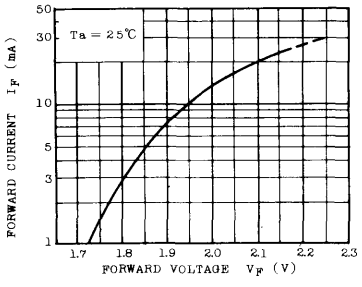
MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25.	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	T_{opr}	-20 ~ 75	°C
Storage Temperature Range	T_{stg}	-30 ~ 100	°C

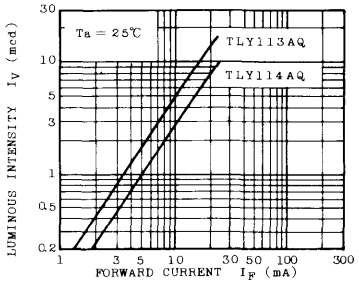
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current		I_R	V_R=4V	-	-	100	μA
Luminous Intensity	TLY113AQ	I_V	I_F=15mA	1	9	-	mcd
	TLY114AQ			0.8	5	-	
Peak Emission Wave Length		λP	I_F=15mA	-	585	-	nm
Spectral Line Half Width		Δλ	I_F=15mA	-	32	-	nm

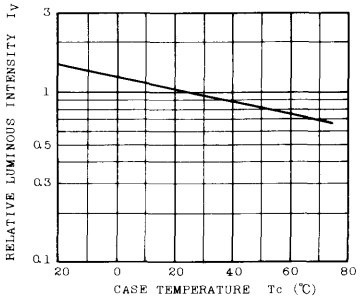
I_F – V_F



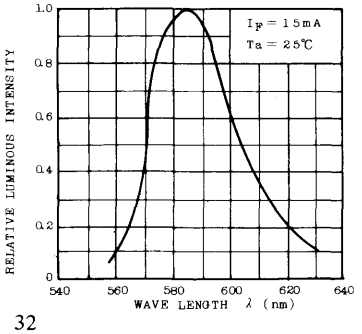
I_V – I_F



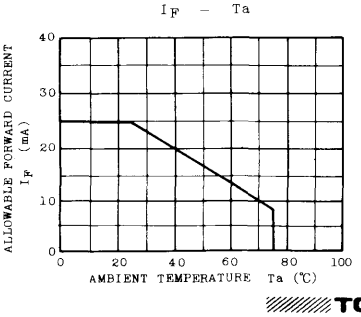
I_V – Tc



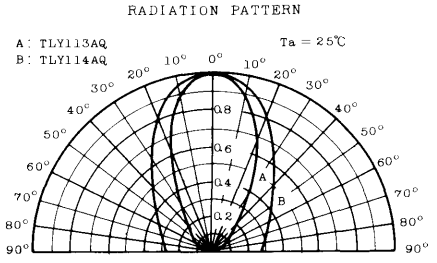
RELATIVE LUMINOUS INTENSITY – WAVE LENGTH



I_F – Ta



RADIATION PATTERN



TLY113AR, TLY114AR

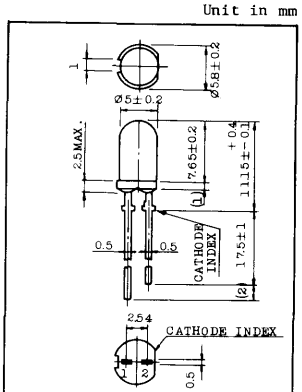
GaAsP YELLOW LIGHT EMISSION

PANEL CIRCUIT INDICATOR

FEATURES:

- Current Limiting Resistor Built in Type
- All Plastic Mold Type
  TLY113AR: Yellow Transparent Lens
  TLY114AR: Yellow Lusterless Lens
- Capable of Direct Drive whith Constant Voltage Supply.
  Recommended Forward Voltage Supply: V_F=4.5 ~ 5V(DC)
- All Plastic Molded Lens Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation

Unit in mm



1. ANODE
2. CATHODE

JEDEC	–
EIAJ	–
TOSHIBA	4-6B1A

Weight: 0.33g

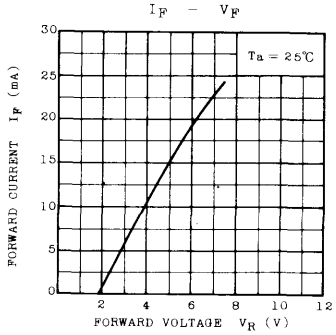
MAXIMUM RATINGS (Ta = 25 °C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Voltage (DC)	V_F	7.5	V
Reverse Voltage	V_R	6	V
Operating Temperature Range	T_{opr}	-20 ~ 75	°C
Storage Temperature Range	T_{stg}	-30 ~ 100	°C

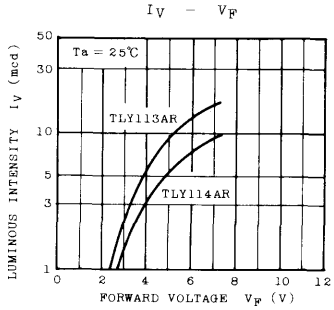
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25 °C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Current		I_F	V_F=5V	–	13	20	mA
Reverse Current		I_R	V_R=6V	–	–	100	μA
Luminous Intensity	TLY113AR	I_V	V_F=5V	1	9	–	mcd
	TLY114AR			0.8	5	–	
Peak Emission Wave Length		λP	V_F=5V	–	585	–	nm
Spectral Line Half Width		Δλ	V_F=5V	–	32	–	nm

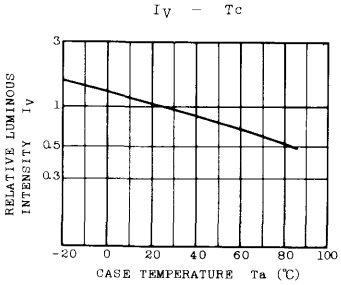
I_F – V_F



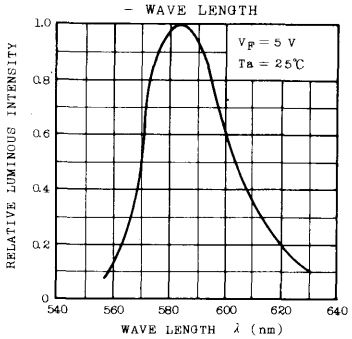
I_V – V_F



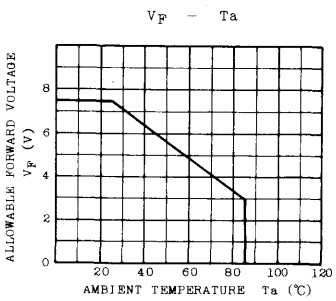
I_V – Tc



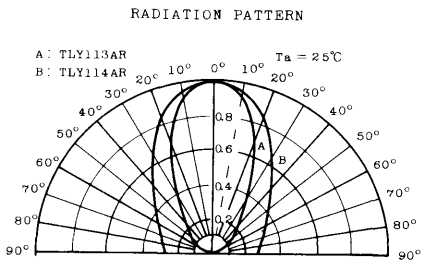
RELATIVE LUMINOUS INTENSITY – WAVE LENGTH



V_F – Ta



RADIATION PATTERN



TLY123, TLY124

GaAsP YELLOW LIGHT EMISSION

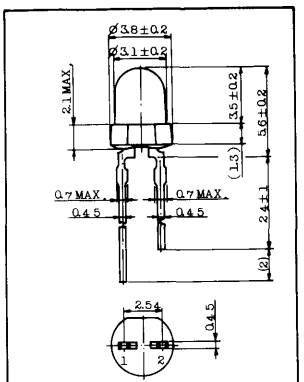
3.1mm DIAMETER(T1)

FEATURES:

- All Plastic Mold Type
  TLY123 : Yellow Transparent Lens
  TLY124 : Yellow Lusterless Lens
- Low Drive Current, High Intensity Yellow Light Emission.

  Recommended Forward Current : I_F=10~15mA(DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.

Unit in mm



1. ANODE
2. CATHODE

JEDEC	—
EIAJ	—
TOSHIBA	4-4E1A

Weight : 0.14g

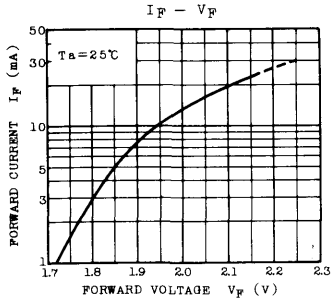
MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	T_{opr}	-20~75	°C
Storage Temperature Range	T_{stg}	-30~100	°C

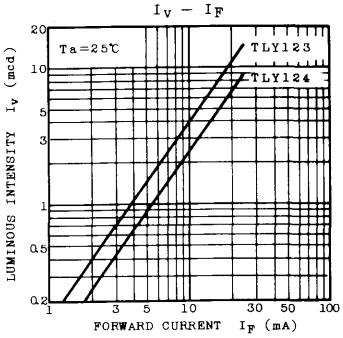
ELECTRO-OPTICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current		I_R	V_R=4V	-	-	100	μA
Luminous Intensity	TLY123	I_V	I_F=10mA	0.5	4.0	-	mcd
	TLY124			0.4	2.5	-	
Peak Emission Wave Length		λ_P	I_F=10mA	-	585	-	nm
Spectral Line Half Width		$\Delta\lambda$	I_F=10mA	-	32	-	nm

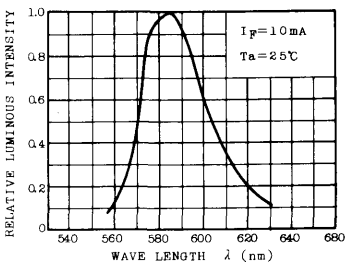
$I_F - V_F$



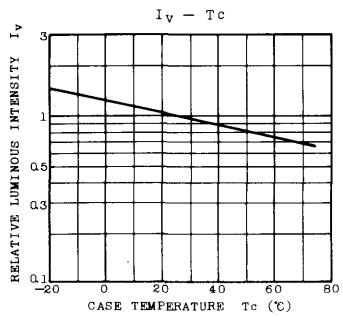
$I_V - I_F$



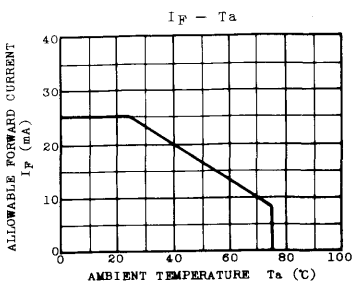
RELATIVE LUMINOUS INTENSITY — WAVE LENGTH



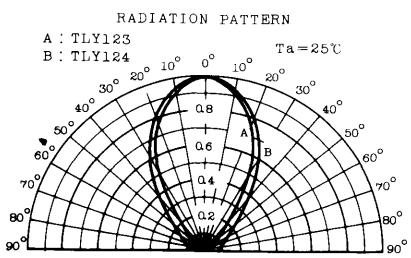
$I_V - Tc$



$I_F - Ta$



RADIATION PATTERN



TLY147

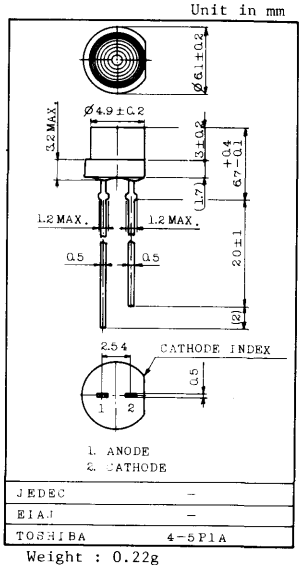
GaAsP YELLOW LIGHT EMISSION

4.9mm DIAMETER(T 1 3/4)

FEATURES:

- All Plastic Mold Type :
  Yellow Transparent Lens of Spiral.
- Low Drive Current, High Intensity Yellow Light Emission.
  Recommended Forward Current : I_F=15 ~ 20mA(DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	4-5F1A

Weight : 0.22g

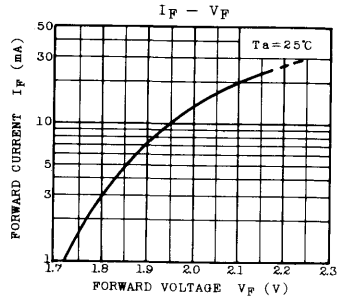
MAXIMUM RATINGS (Ta =25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	T_{opr}	-20 ~ 75	°C
Storage Temperature Range	T_{stg}	-30 ~ 100	°C

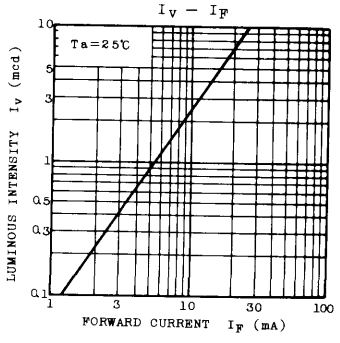
ELECTRO-OPTICAL CHARACTERISTICS (Ta =25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current	I_R	V_R=4V	-	-	100	μA
Luminous Intensity	I_V	I_F=15mA	0.8	4.5	-	mcd
Peak Emission Wave Length	λ_P	I_F=15mA	-	585	-	nm
Spectral Line Half Width	$\Delta\lambda$	I_F=15mA	-	32	-	nm

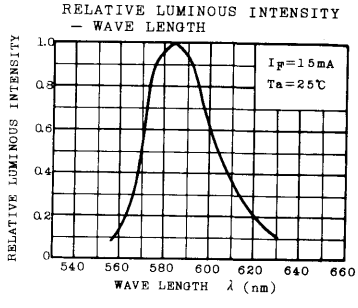
I_F — V_F



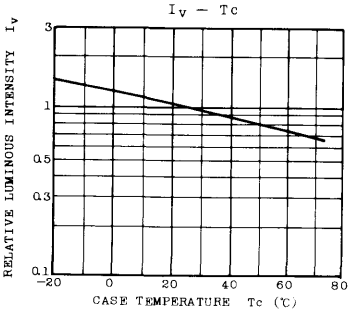
I_V — I_F



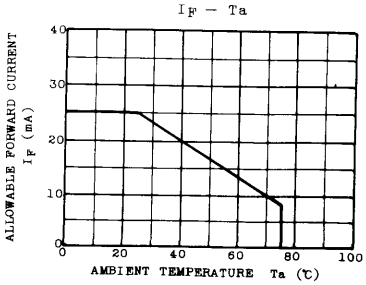
RELATIVE LUMINOUS INTENSITY — WAVE LENGTH



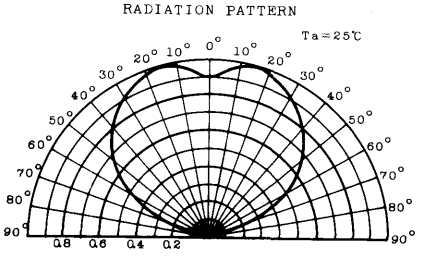
I_V — Tc



I_F — Ta



RADIATION PATTERN



STANDARD BRIGHT LAMP

TLY205, TLY206, TLY207, TLY208

GaAsP YELLOW LIGHT EMISSION

FEATURES:

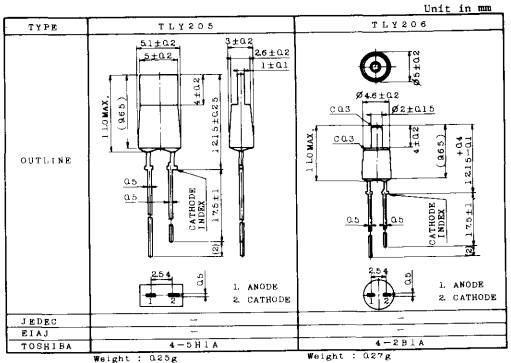
. Yellow All Plastic Mold Type

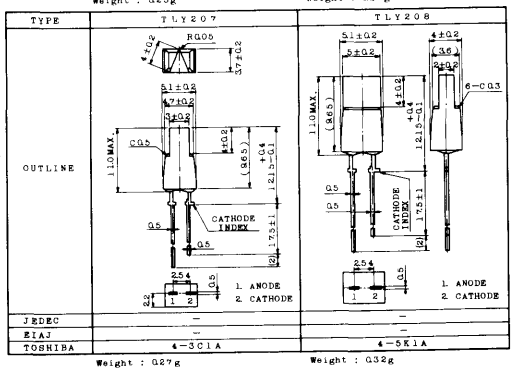
TLY205 : Rectangular Type (Surface Size 1 × 5mm)
TLY206 : Convex Type (Surface Size φ2mm)
TLY207 : Triangular Type (Surface Size 3 × 4 × 4mm)
TLY208 : Rectangular Type (Surface Size 2 × 5mm)

. Low Drive Current, High Intensity Yellow Light Emission.
Recommended Forward Current : I_F=15 ~ 20mA(DC)

. Fast Response Time, Capable of Pulse Operation.

Unit in mm



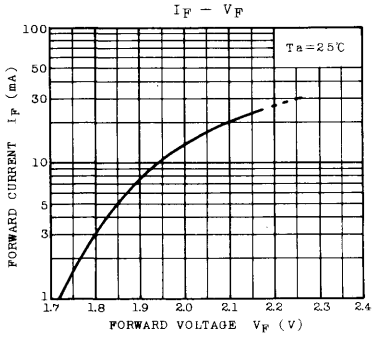


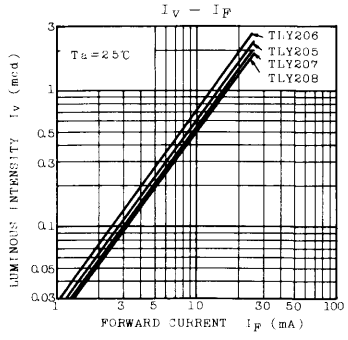
MAXIMUM RATINGS (Ta = 25°C)

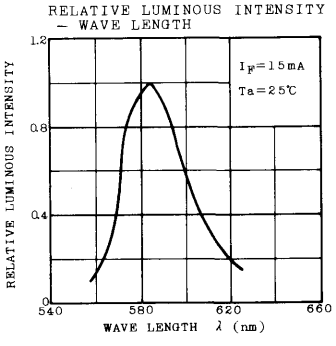
CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	T_{opr}	-20 ~ 75	°C
Storage Temperature Range	T_{stg}	-30 ~ 100	°C

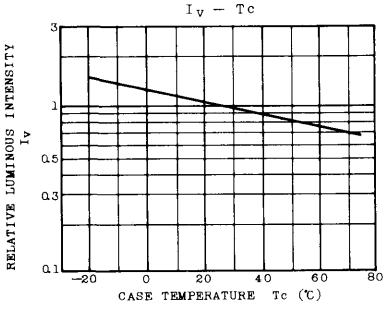
ELECTRO-OPTICAL CHARACTERISTICS (Ta = 25°C)

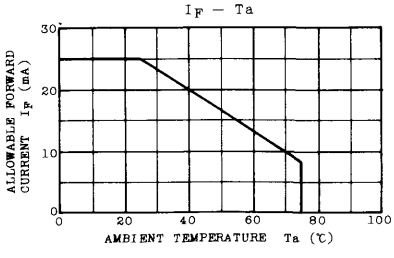
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current		I_R	V_R=4V	-	-	100	μA
Luminous Intensity	TLY205	I_V	I_F=15mA	0.4	1.1	-	mcd
	TLY206			0.5	1.3	-	
	TLY207			0.5	1.0	-	
	TLY208			0.4	0.9	-	
Peak Emission Wave Length		λ_P	I_F=15mA	-	585	-	nm
Spectral Line Half Width		$\Delta\lambda$	I_F=15mA	-	32	-	nm











TLY209

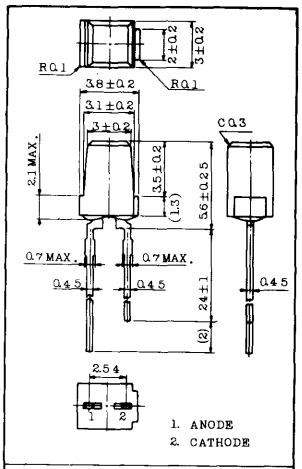
GaAsP YELLOW LIGHT EMISSION

3×3mm RECTANGLAR

FEATURES:

- Yellow All Plastic Mold Type
- Rectangular Type (Surface Size 3 × 3mm)
- Low Drive Current, High Intensity Yellow Light Emission
  Recommended Forward Current : I_F=10 ~ 15mA(DC)
- Fast Response Time, Capable of Pulse Operation.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	4-3D1A

Weight : 0.13g

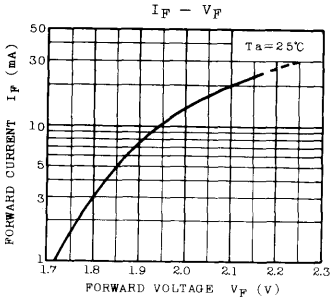
MAXIMUM RATINGS (Ta =25℃)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	Topr	-20 ~ 75	°C
Storage Temperature Range	Tstg	-30 ~ 100	°C

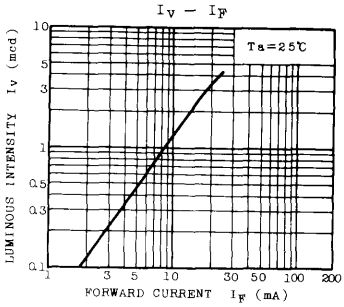
ELECTRO-OPTICAL CHARACTERISTICS (Ta =25℃)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current	I_R	V_R=4V	-	-	100	μA
Luminous Intensity	I_V	I_F=10mA	0.5	1.3	-	mcd
Peak Emission Wave Length	λ_P	I_F=10mA	-	585	-	nm
Spectral Line Half Width	$\Delta\lambda$	I_F=10mA	-	32	-	nm

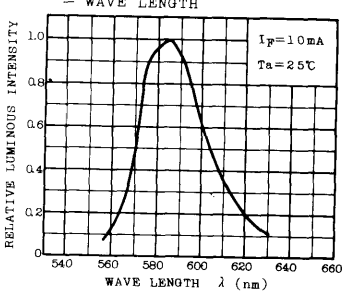
$I_F - V_F$



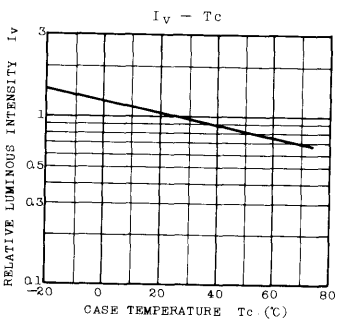
$I_V - I_F$



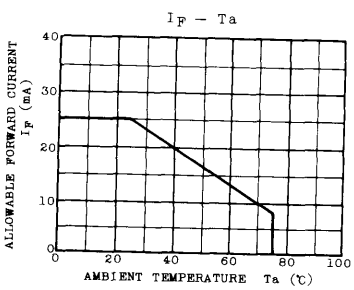
RELATIVE LUMINOUS INTENSITY — WAVE LENGTH



$I_V - T_C$



$I_F - Ta$



STANDARD BRIGHT LAMP

TLY210

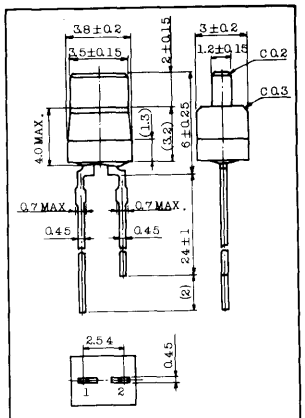
GaAsP YELLOW LIGHT EMISSION

1.2×3.5mm RECTANGULAR

FEATURES:

- Yellow All Plastic Mold Type
- Rectangular Type (Surface Size 1.2× 3.5mm)
- Low Drive Current, High Intensity Yellow Light Emission.
  Recommended Forward Current : I_F=10～15mA(DC)
- Fast Response Time, Capable of Pulse Operation.

Unit in mm



1. ANODE
2. CATHODE

JEDEC	—
EIAJ	—
TOSHIBA	4-4F1A

Weight : 0.13g

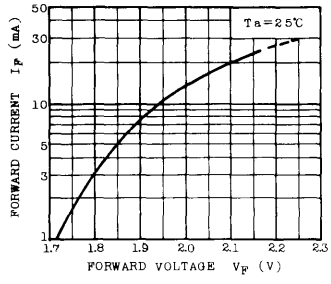
MAXIMUM RATINGS (Ta =25℃)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	T_{opr}	-20～75	°C
Storage Temperature Range	T_{stg}	-30～100	°C

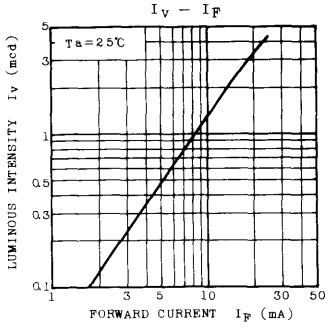
ELECTRO-OPTICAL CHARACTERISTICS (Ta =25℃)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current	I_R	V_R=4V	-	-	100	μA
Luminous Intensity	I_V	I_F=10mA	0.5	1.3	-	mcd
Peak Emission Wave Length	λ_P	I_F=10mA	-	585	-	nm
Spectral Line Half Width	$\Delta\lambda$	I_F=10mA	-	32	-	nm

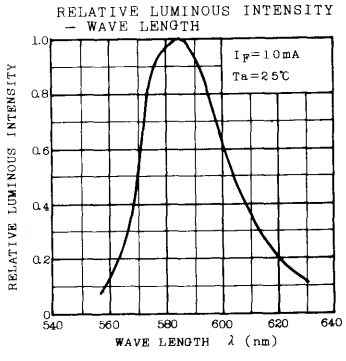
$I_F - V_F$



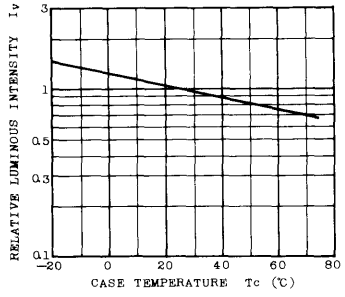
$I_V - I_F$



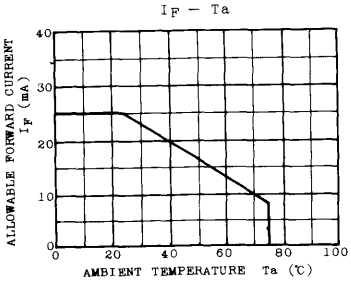
RELATIVE LUMINOUS INTENSITY — WAVE LENGTH



$I_V - T_C$



$I_F - T_a$



TLY211

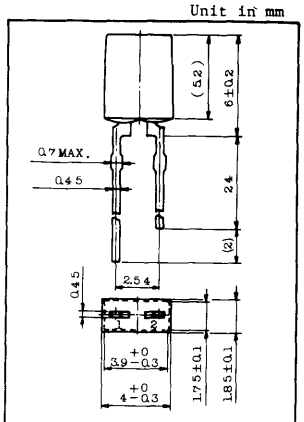
GaAsP YELLOW LIGHT EMISSION

2×4mm RECTANGULAR

FEATURES:

- Yellow All Plastic Mold Type
- Rectangular Type (Surface Size 2 × 4mm)
- Low Drive Current, High Intensity Yellow Light Emission.
  Recommended Forward Current : I_F=10 ~ 15mA(DC)
- Fast Response Time, Capable of Pulse Operation.

Unit in mm



1. ANODE
2. CATHODE

JEDEC	–
EIAJ	–
TOSHIBA	4-4G1A

Weight :

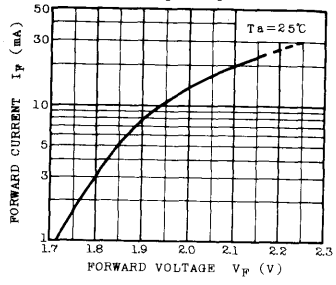
MAXIMUM RATINGS (Ta =25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	T_{opr}	-20 ~ 75	°C
Storage Temperature Range	T_{stg}	-30 ~ 100	°C

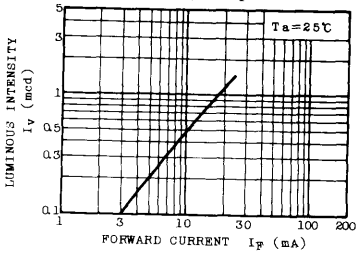
ELECTRO-OPTICAL CHARACTERISTICS (Ta =25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current	I_R	V_R=4V	-	-	100	μA
Luminous Intensity	I_V	I_F=20mA	0.5	1.2	-	mcd
Peak Emission Wave Length	λ_P	I_F=10mA	-	585	-	nm
Spectral Line Half Width	$\Delta\lambda$	I_F=10mA	-	32	-	nm

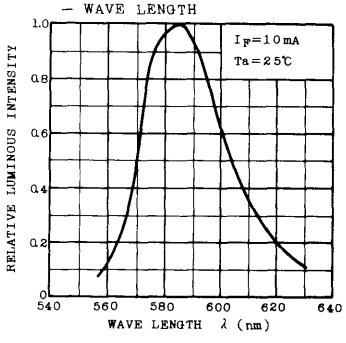
$I_F - V_F$



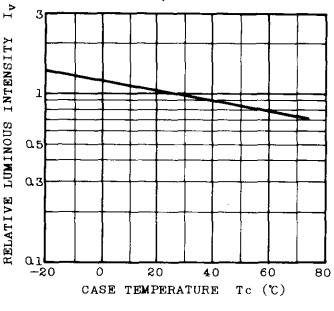
$I_V - I_F$



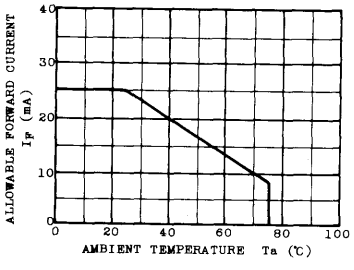
RELATIVE LUMINOUS INTENSITY − WAVE LENGTH



$I_V - T_C$



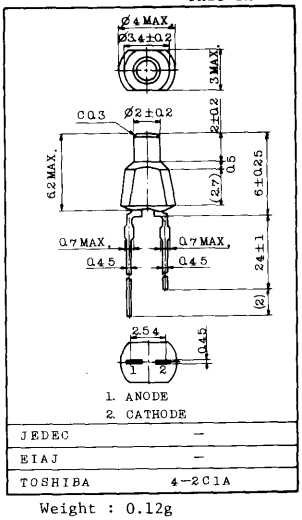
$I_F - T_a$



TLY226

GaAsP YELLOW LIGHT EMISSION

Unit in mm



Weight : 0.12g

DOT INDICATOR

FEATURES:

. All Plastic Mold Type : Yellow Lusterless Lens.

. Low Drive Current, High Intensity Yellow Light Emission
  Recommended Forward Current : I_F=10~15mA(DC)

. Fast Response Time, Capable of Pulse Operation.

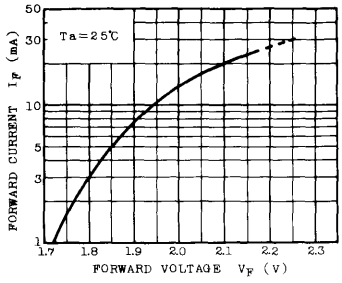
MAXIMUM RATINGS (Ta =25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	T_{opr}	-20~75	°C
Storage Temperature Range	T_{stg}	-30~100	°C

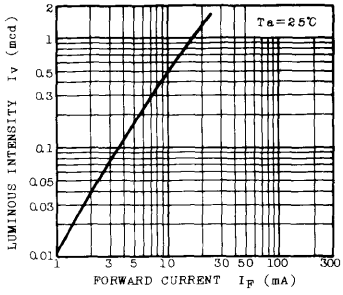
ELECTRO-OPTICAL CHARACTERISTICS (Ta =25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current	I_R	V_R=4V	-	-	100	μA
Luminous Intensity	I_V	I_F=10mA	0.15	0.5	-	mcd
Peak Emission Wave Length	λ_P	I_F=10mA	-	585	-	nm
Spectral Line Half Width	$\Delta\lambda$	I_F=10mA	-	32	-	nm

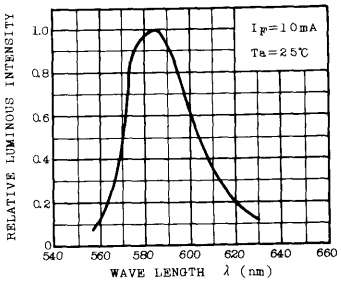
$I_F - V_F$



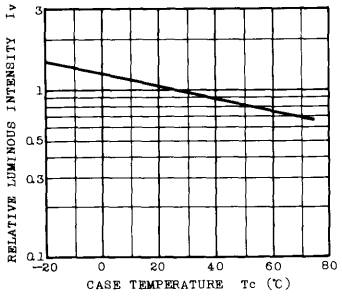
$I_V - I_F$



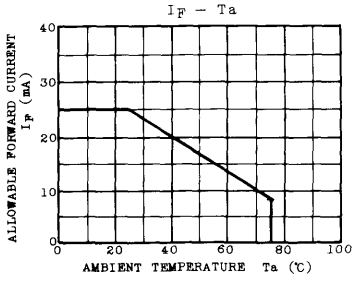
RELATIVE LUMINOUS INTENSITY — WAVE LENGTH



I_V — Tc



I_F — Ta



TLY255

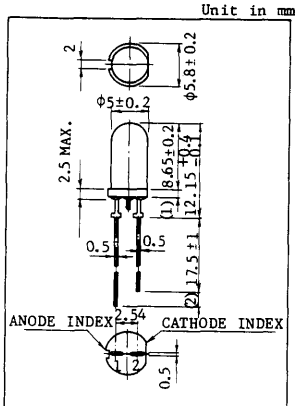
GaAsP YELLOW LIGHT EMISSION

2 CHIP LED LAMP FOR BACK LIGHTING

FEATURES:

- 2 chip series connection
- All Plastic Mold Type: Light Yellow Transparent Lens
- Low Drive Current, High Intensity Yellow Light Emission
  Recommended Forward Current: I_F = 15∿20 mA (DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.
- Wide Radiation - Suitable for Back Lighting

Unit in mm



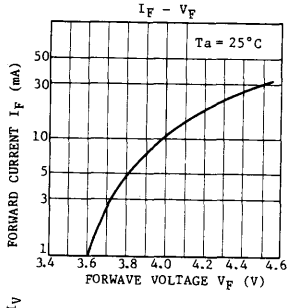
JEDEC	-
EIAJ	-
TOSHIBA	

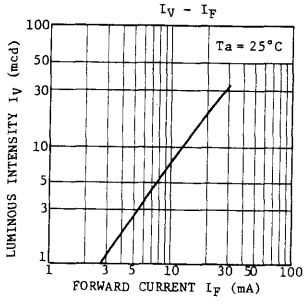
MAXIMUM RATINGS (Ta = 25 °C)

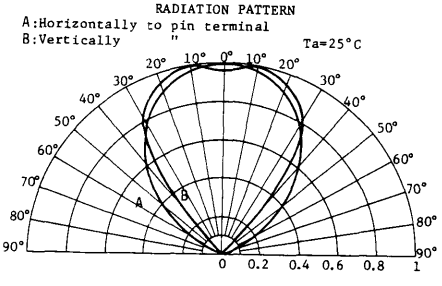
CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	30	mA
Reverse Voltage	V_R	8	V
Operating Temperature Range	T_{opr}	-20 ∿ 75	°C
Storage Temperature Range	T_{stg}	-30∿ 100	°C

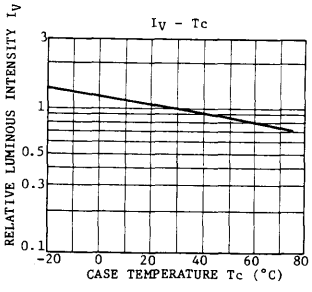
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25 °C)

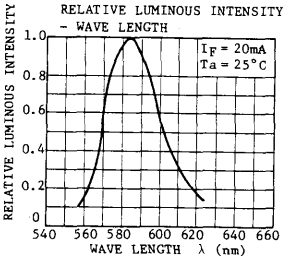
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F = 20 mA	-	4.2	5.4	V
Reverse Current	I_R	V_R = 8 V	-	-	100	μA
Luminous Intensity	I_V	I_F = 20 mA	3	20	-	mcd
Peak Emission Wave Length	λ_p	I_F = 20 mA	-	585	-	nm
Spectral Line Half Width	$\Delta\lambda$	I_F = 20 mA	-	32	-	nm

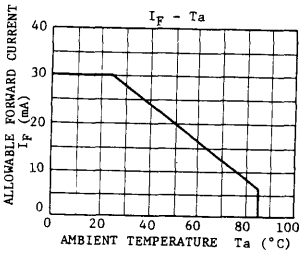












TL0102A. TL0108A

GaAsP ORANGE LIGHT EMISSION

3mm DIAMETER(TI)

FEATURES:

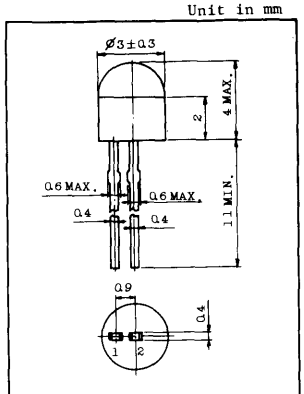
. Resin Stem Type
  TL0102A : Orange Lusterless Lens
  TL0108A : Orange Transparent Lens

. Low Drive Current, High Intensity Orange Light Emission.
  Recommended Forward Current : I_F=15~20mA(DC)

. Wide Viewing Angle, Provides an Excellent ON-OFF Contrast Ratio.

. Fast Response Time, Capable of Pulse Operation.

Unit in mm



1. ANODE
2. CATHODE

JEDEC	—
EIAJ	—
TOSHIBA	4-3F1A

Weight : 0.08g

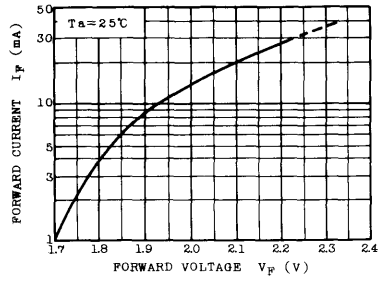
MAXIMUM RATINGS (Ta =25℃)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	30	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	85	mW
Operating Temperature Range	T_{opr}	-20~75	°C
Storage Temperature Range	T_{stg}	-30~100	°C

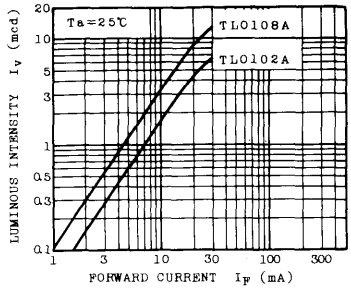
ELECTRO-OPTICAL CHARACTERISTICS (Ta =25℃)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current		I_R	V_R=4V	-	-	100	μA
Luminous Intensity	TL0102A	I_V	I_F=15mA	0.6	3.0	-	mcd
	TL0108A			1.0	6.0	-	
Peak Emission Wave Length		λ_P	I_F=15mA	-	610	-	nm
Spectral Line Half Width		$\Delta\lambda$	I_F=15mA	-	35	-	nm

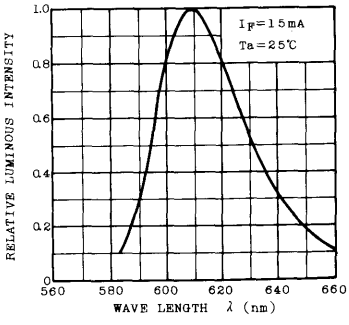
$I_F - V_F$



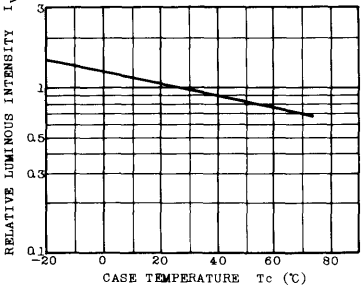
$I_V - I_F$



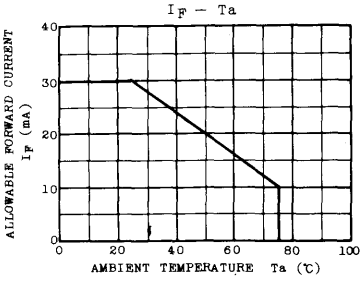
RELATIVE LUMINOUS INTENSITY — WAVE LENGTH



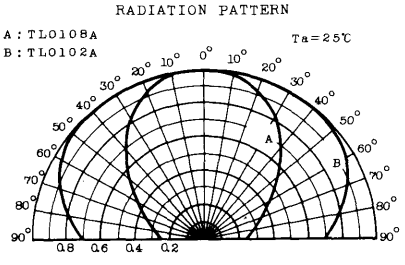
I_V — Tc



I_F — Ta



RADIATION PATTERN



TL0113A TL0114A

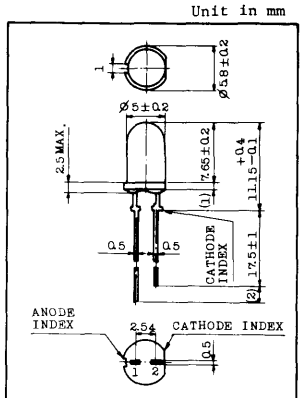
GaAsP ORANGE LIGHT EMISSION

5mm DIAMETER(T 13/4)

FEATURES:

- All Plastic Mold Type
  TL0113A : Orange Transparent Lens
  TL0114A : Orange Lusterless Lens
- Low Drive Current, High Intensity Orange Light Emission.
  Recommended Forward Current : I_F=15~20mA(DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	4-6B1A

Weight : 0.31g

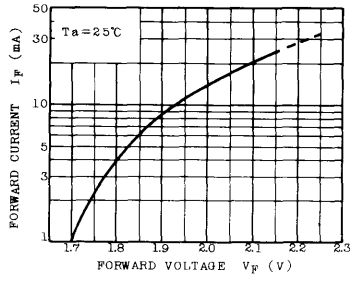
MAXIMUM RATINGS (Ta =25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	100	mW
Operating Temperature Range	T_{opr}	-20~75	°C
Storage Temperature Range	T_{stg}	-30~100	°C

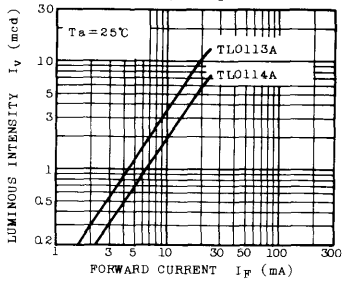
ELECTRO-OPTICAL CHARACTERISTICS (Ta =25°C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current		I_R	V_R=4V	-	-	100	μA
Luminous Intensity	TL0113A	I_V	I_F=15mA	1	8	-	mcd
	TL0114A			0.8	4	-	
Peak Emission Wave Length		λ_P	I_F=15mA	-	610	-	nm
Spectral Line Half Width		$\Delta\lambda$	I_F=15mA	-	35	-	nm

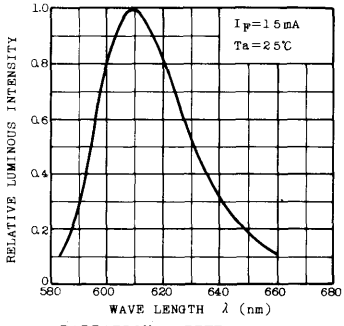
$I_F - V_F$



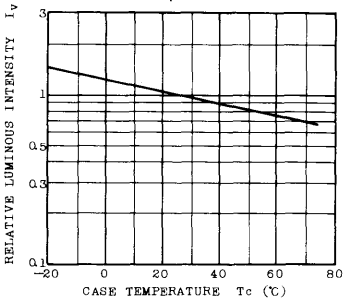
$I_V - I_F$



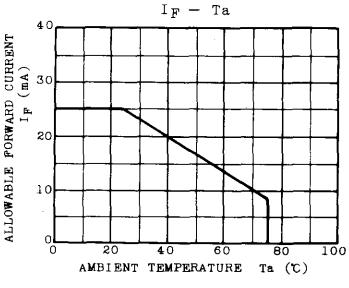
RELATIVE LUMINOUS INTENSITY — WAVE LENGTH



$I_V - T_C$

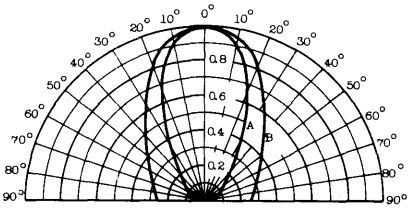


$I_F - T_a$



RADIATION PATTERN

A : TL0113A
B : TL0114A
Ta=25°C



TLO113AP, TLO114AP

GaAsP ORANGE LIGHT EMISSION

PANEL CIRCUIT INDICATOR

FEATURES:

- All Plastic Mold Type

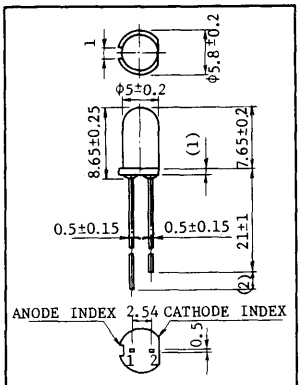
  TLO113AP: Orange Transparent Lens
  TLO114AP: Orange Lusterless Lens

- Low Drive Current, High Intensity Orange Light Emission
  Recommended Forward Current: $I_F = 15 \sim 20$ mA(DC)

- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.

- Fast Response Time, Capable of Pulse Operation.

Unit in mm



1. ANODE
2. CATHODE

JEDEC	-
EIAJ	-
TOSHIBA	

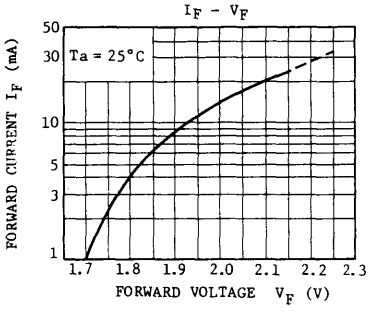
Weight: 0.31 g

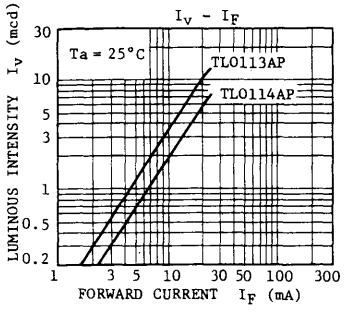
MAXIMUM RATINGS (Ta = 25°C)

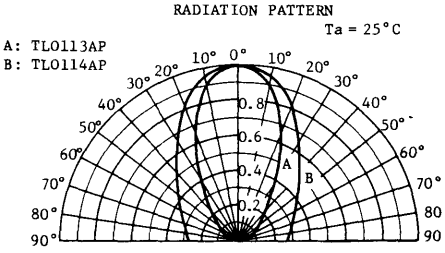
CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	100	mW
Operating Temperature Range	T_{opr}	-20 ~ 75	°C
Storage Temperature Range	T_{stg}	-30 ~ 100	°C

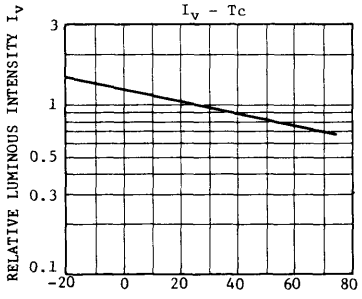
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25°C)

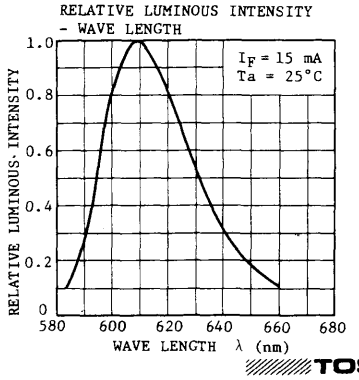
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F = 20 mA	-	2.1	2.8	V
Reverse Current		I_R	V_R = 4 V	-	-	100	μA
Luminous Intensity	TLO113AP	I_v	I_F = 15 mA	1	8	-	mcd
	TLO114AP			0.8	4	-	
Peak Emission Wave Length		λ_p	I_F = 15 mA	-	610	-	nm
Spectral Line Half Width		$\Delta\lambda$	I_F = 15 mA	-	35	-	nm

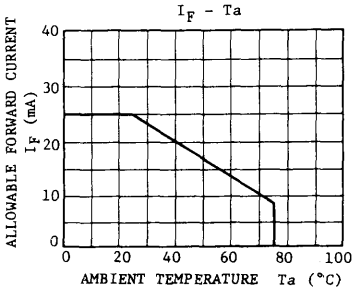












TL0113AQ, TL0114AQ

GaAsP ORANGE LIGHT EMISSION

PANEL CIRCUIT INDICATOR

FEATURES:

- All Plastic Mold Type

  TL0113AQ: Orange Transparent Lens
  TL0114AQ: Orange Lusterless Lens

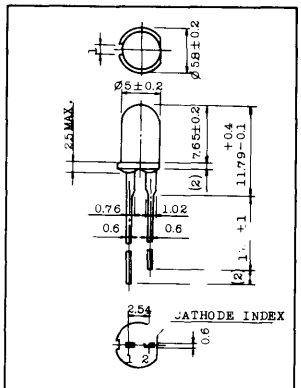
- Low Drive Current, High Intensity Orange Light Emission.
  Recommended Forward Current: I_F=15 ∿ 20mA(DC)

- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.

- Fast Response Time, Capable of Pulse Operation.

- Wire Wrappable Leads.

Unit in mm



JEDEC	-
EIAJ	-
TOSHIBA	4-6B4A

Weight: 0.35g

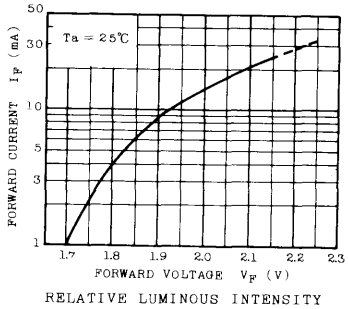
MAXIMUM RATINGS (Ta = 25 °C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	100	mW
Operating Temperature Range	T_{opr}	-20 ∿ 75	°C
Storage Temperature Range	T_{stg}	-30 ∿ 100	°C

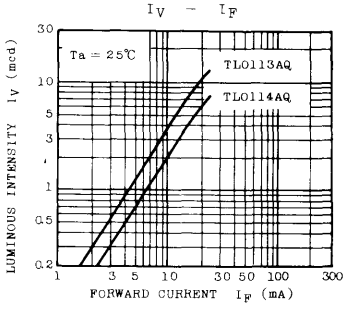
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25 °C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current		I_R	V_R=4V	-	-	100	μA
Luminous Intensity	TL0113AQ	I_V	I_F=15mA	1	8	-	mcd
	TL0114AQ			0.8	4	-	
Peak Emission Wave Length		λP	I_F=15mA	-	610	-	nm
Spectral Line Half Width		Δλ	I_F=15mA	-	35	-	nm

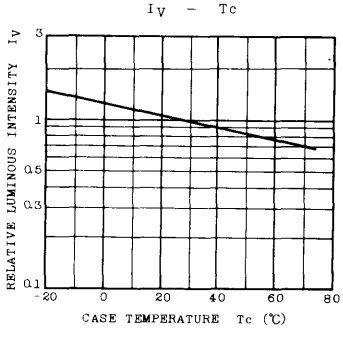
I_F – V_F



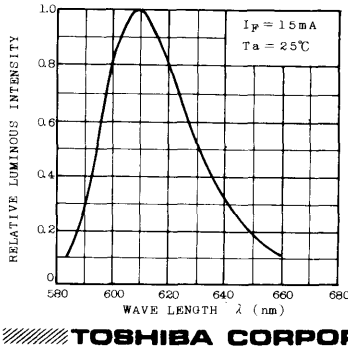
I_V – I_F



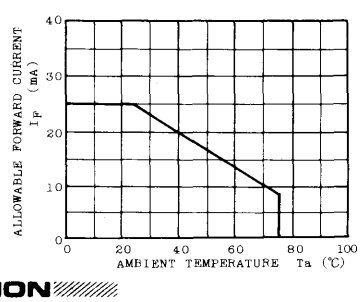
I_V – Tc



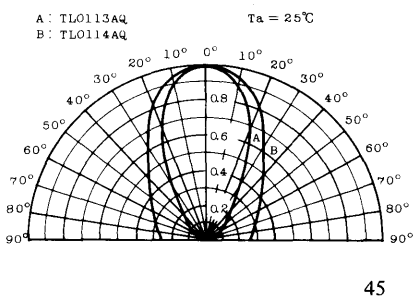
RELATIVE LUMINOUS INTENSITY – WAVE LENGTH



I_F – Ta



RADIATION PATTERN



TLO113AR, TLO114AR

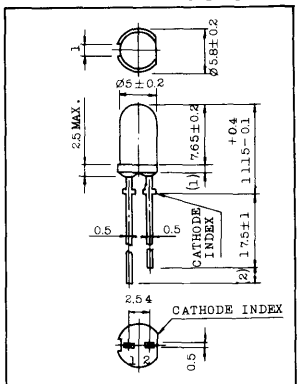
GaAsP ORANGE LIGHT EMISSION

PANEL CIRCUIT INDICATOR

FEATURES:

- Current Limiting Resistor Built in Type
- All Plastic Mold Type
  TLO113AR: Orange Transparent Lens
  TLO114AR: Orange Lusterless Lens
- Capable of Direct Drive with Constant Voltage Supply
  Recommended Forward Voltage Supply: V_F=4.5 ∿ 5V(DC)
- All Plastic Molded Lens Provides an Excellent ON-OFF Contrast Ratio
- Fast Response Time, Capable of Pulse Operation

Unit in mm



1. ANODE
2. CATHODE

JEDEC	–
EIAJ	–
TOSHIBA	4-6B1A

Weight: 0.33g

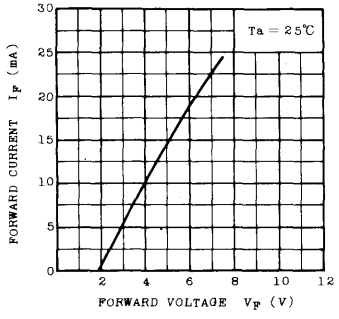
MAXIMUM RATINGS (Ta = 25 °C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Voltage (DC)	V_F	7.5	V
Reverse Voltage	V_R	6	V
Operating Temperature Range	T_{opr}	−20 ∿ 75	°C
Storage Temperature Range	T_{stg}	−30 ∿ 100	°C

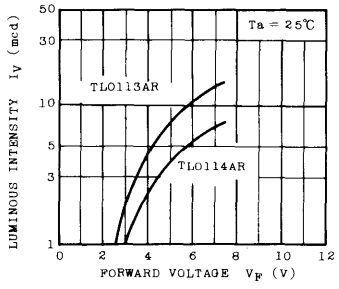
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25 °C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Current		I_F	V_F=5V	–	13	20	mA
Reverse Current		I_R	V_R=6V	–	–	100	μA
Luminous Intensity	TLO113AR	I_V	V_F=5V	1	8	–	mcd
	TLO114AR			0.8	4	–	
Peak Emission Wave Length		λP	V_F=5V	–	610	–	nm
Spectral Line Half Width		Δλ	V_F=5V	–	35	–	nm

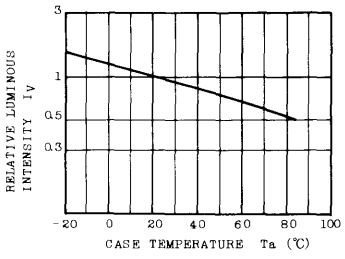
I_F – V_F



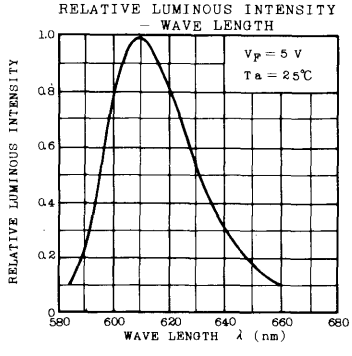
I_V – V_F



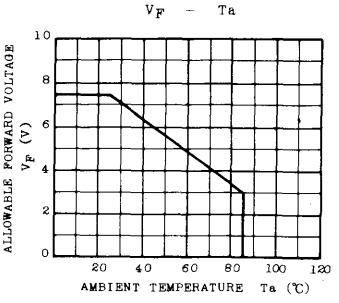
I_V – Tc



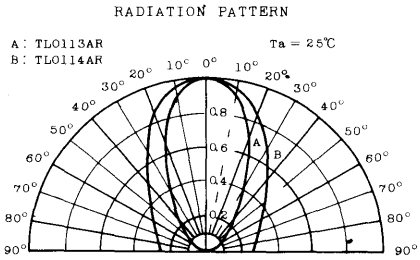
RELATIVE LUMINOUS INTENSITY – WAVE LENGTH



V_F – Ta



RADIATION PATTERN



TL0123, TL0124

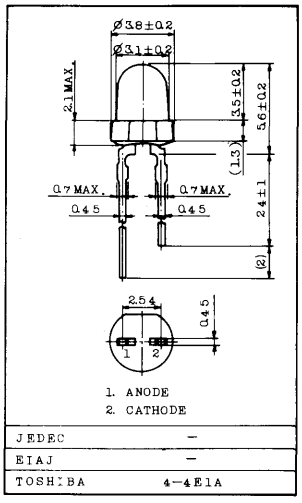
GaAsP ORANGE LIGHT EMISSION

3.1mm DIAMETER(T1)

FEATURES:

- All Plastic Mold Type
  TL0123 : Orange Transparent Lens
  TL0124 : Orange Lusterless Lens
- Low Drive Current, High Intensity Orange Light Emission.
  Recommended Forward Current : I_F=10~15mA(DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	4-4E1A

Weight : 0.14g

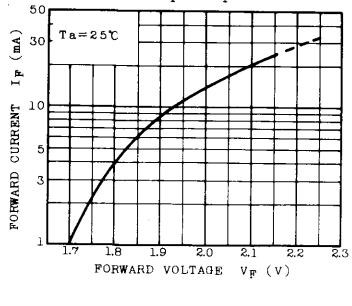
MAXIMUM RATINGS (Ta =25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	T_{opr}	-20~75	°C
Storage Temperature Range	T_{stg}	-30~100	°C

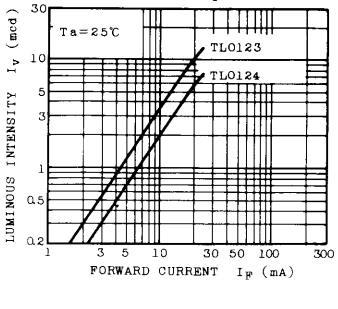
ELECTRO-OPTICAL CHARACTERISTICS (Ta =25°C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current		I_R	V_R=4V	-	-	100	μA
Luminous Intensity	TL0123	I_V	I_F=10mA	0.5	3.5	-	mcd
	TL0124			0.4	2.0	-	
Peak Emission Wave Length		λ_P	I_F=10mA	-	610	-	nm
Spectral Line Half Width		$\Delta\lambda$	I_F=10mA	-	35	-	nm

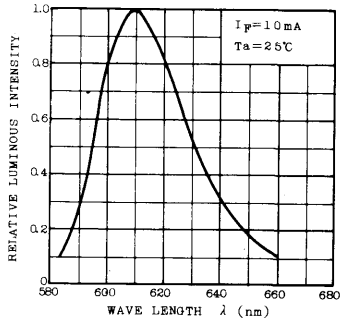
$I_F - V_F$



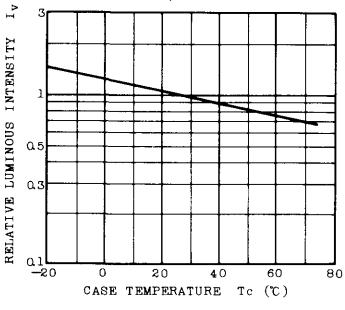
$I_V - I_F$



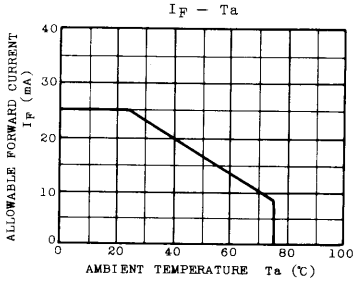
RELATIVE LUMINOUS INTENSITY — WAVE LENGTH



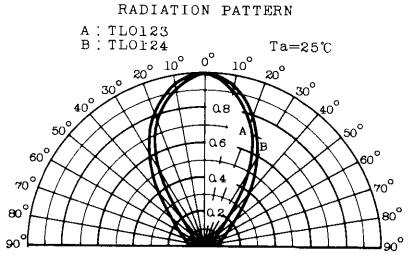
$I_V - T_C$



$I_F - T_a$



RADIATION PATTERN



TL0205, TL0208

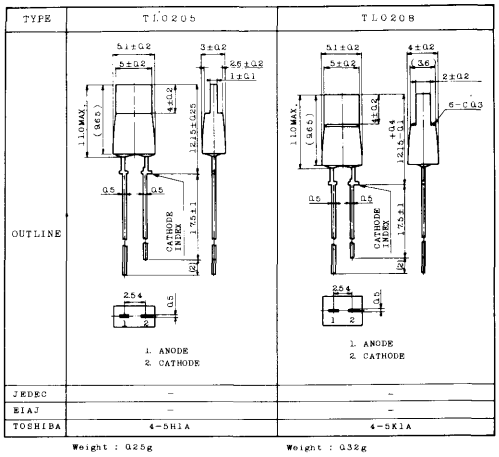
GaAsP ORANGE LIGHT EMISSION

RECTANGULAR 1×5mm, 2×5mm

FEATURES:

. Orange All Plastic Mold Type
  TL0205 : Rectangular Type (Surface Size 1×5mm)
  TL0208 : Rectangular Type (Surface Size 2×5mm)
. Low Drive Current, High Intensity Orange Light Emission.
  Recommended Forward Current : I_F=15~20mA(DC)
. Fast Response Time, Capable of Pulse Operation.

Unit in mm

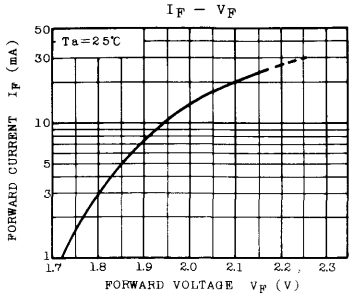


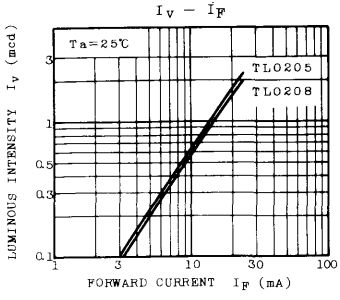
MAXIMUM RATINGS (Ta=25°C)

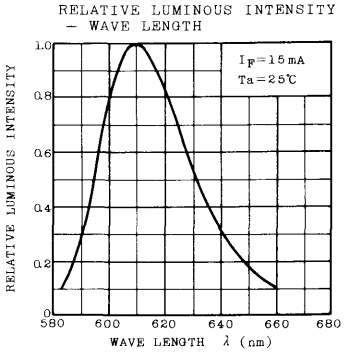
CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	T_{opr}	-20~75	°C
Storage Temperature Range	T_{stg}	-30~100	°C

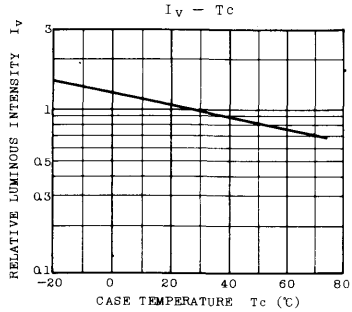
ELECTRO-OPTICAL CHARACTERISTICS (Ta=25°C)

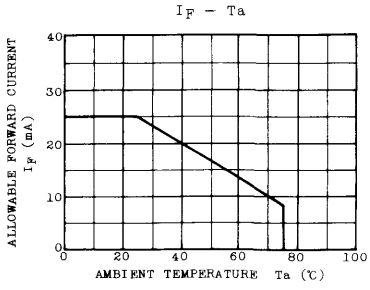
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current		I_R	V_R=4V	-	-	100	μA
Luminous Intensity	TL0205	I_V	I_F=15mA	0.5	1.1	-	mcd
	TL0208			0.5	1.0	-	
Peak Emission Wave Length		λ_P	I_F=15mA	-	610	-	nm
Spectral Line Half Width		$\Delta\lambda$	I_F=15mA	-	35	-	nm











TL0211

GaAsP ORANGE LIGHT EMISSION

2×4mm RECTANGULAR

FEATURES:

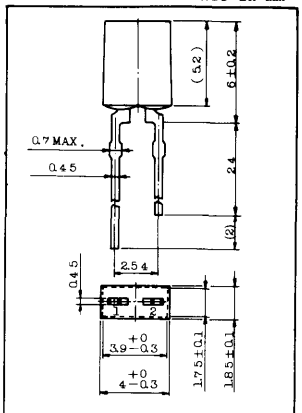
Orange All Plastic Mold Type

. Rectangular Type (Surface Size 2 × 4mm)

. Low Drive Current, High Intensity Orange Light Emission.
  Recommended Forward Current : I_F=10～15mA(DC)

. Fast Response Time, Capable of Pulse Operation.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	4-4G1A

Weight : 0.12g

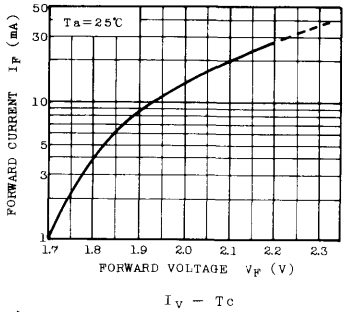
MAXIMUM RATINGS (Ta =25℃)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	T_{opr}	-20～75	°C
Storage Temperature Range	T_{stg}	-30～100	°C

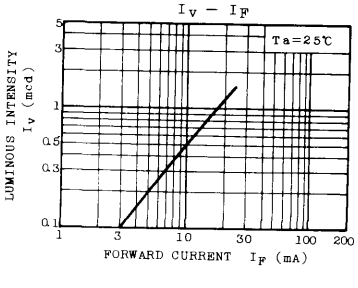
ELECTRO-OPTICAL CHARACTERISTICS (Ta =25℃)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current	I_R	V_R=4V	-	-	100	μA
Luminous Intensity	I_V	I_F=20mA	0.5	1.2	-	mcd
Peak Emission Wave Length	λ_P	I_F=10mA	-	610	-	nm
Spectral Line Half Width	$\Delta\lambda$	I_F=10mA	-	35	-	nm

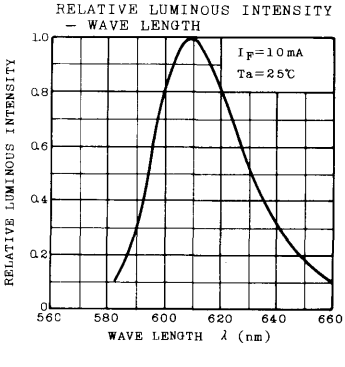
$I_F - V_F$



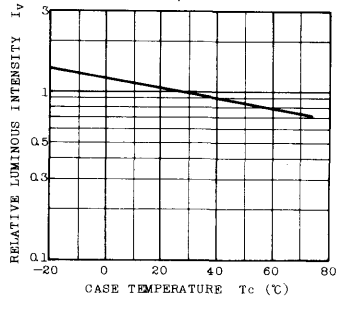
$I_V - I_F$



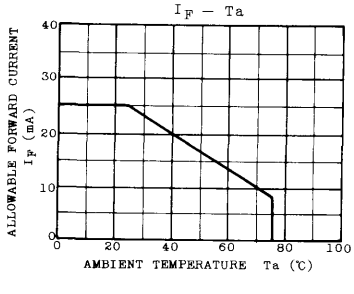
RELATIVE LUMINOUS INTENSITY − WAVE LENGTH



$I_V - T_C$



$I_F - T_a$



TL0255

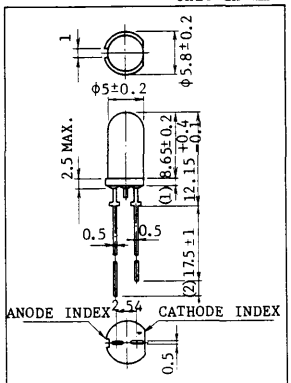
GaAsP ORANGE LIGHT EMISSION

2 CHIP LED LAMP FOR BACK LIGHTING

FEATURES:

- 2 chip series connection
- All Plastic Mold Type: Light Orange Transparent Lens
- Low Drive Current, High Intensity Orange Light Emission
  Recommended Forward Current: $I_F = 15 \sim 20$ mA (DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.
- Wide Radiation - Suitable for Back Lighting

Unit in mm



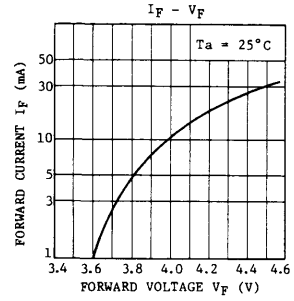
JEDEC	-
EIAJ	-
TOSHIBA	

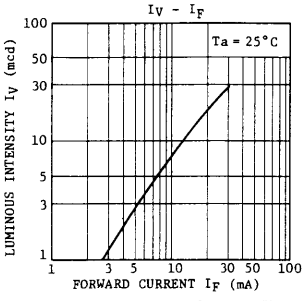
MAXIMUM RATINGS (Ta = 25°C)

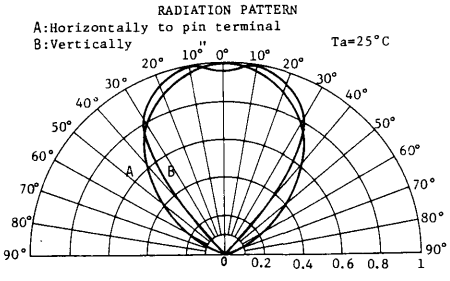
CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	30	mA
Reverse Voltage	V_R	8	V
Operating Temperature Range	T_{opr}	-20 ∿ 75	°C
Storage Temperature Range	T_{stg}	-30 ∿ 100	°C

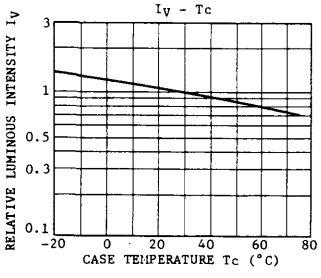
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25°C)

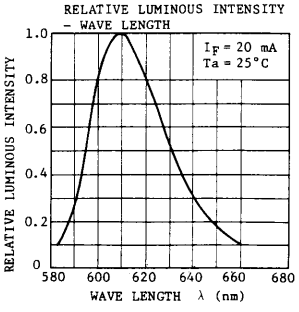
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F = 20 mA	-	4.2	5.4	V
Reverse Current	I_R	V_R = 8V	-	-	100	A
Luminous Intensity	I_V	I_F = 20 mA	3	20	-	mcd
Peak Emission Wave Length	λ_p	I_F = 20 mA	-	610	-	nm
Spectral Line Half Width	$\Delta\lambda$	I_F = 20 mA	-	35	-	nm

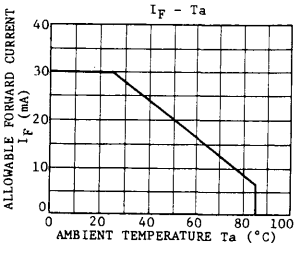












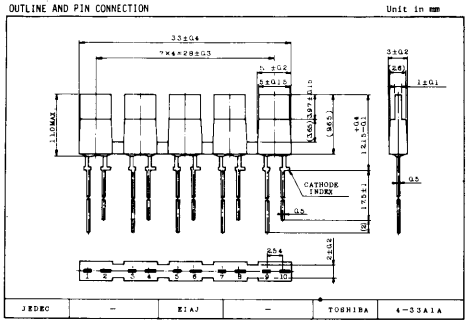
TLR205-5, TLG205-5, TLY205-5

GaP RED, GaP GREEN, GaAsP YELLOW

FEATURES:
. All Plastic Mold Type
TLR205-5 : Red Light Emission
TLG205-5 : Green Light Emission
TLY205-5 : Yellow Light Emission
. Bar Point Size 1 × 5mm, Each Bar Point are Displayed with Diffused and Uniformly.

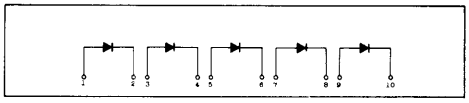
OUTLINE AND PIN CONNECTION

Unit in mm



JEDEC	–	EIAJ	–	TOSHIBA	4-33A1A

PIN No.	CONNECTION	PIN No.	CONNECTION
1	ANODE	6	CATHODE
2	CATHODE	7	ANODE
3	ANODE	8	CATHODE
4	CATHODE	9	ANODE
5	ANODE	10	CATHODE



Weight : 1.25g

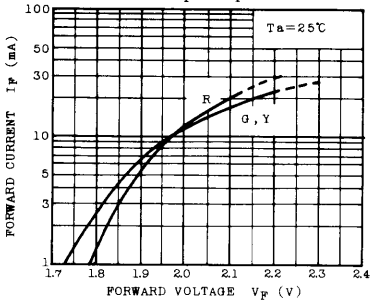
MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC		SYMBOL	RATING	UNIT
Forward Current (Diode)	TLR205-5	I_F/Diode	20	mA
	TLG205-5, TLY205-5		25	
Reverse Voltage		V_R	4	V
Power Dissipation (Diode)	TLR205-5	P_D/Diode	56	mW
	TLG205-5, TLY205-5		70	
Operating Temperature Range		T_{opr}	-20 ~ 75	°C
Storage Temperature Range		T_{stg}	-30 ~ 100	°C

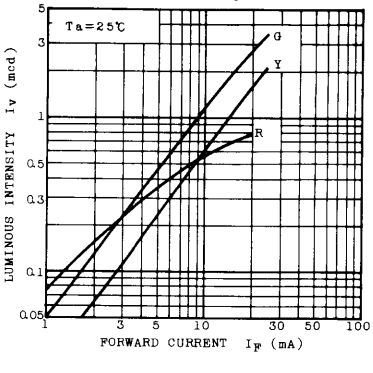
ELECTRO-OPTICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	TLR205-5	V_F	I_F=20mA	–	2.1	2.8	V
	TLG205-5, TLY205-5			–	2.2	2.8	
Reverse Current		I_R	V_R=4V	–	–	100	μA
Luminous Intensity	TLR205-5	I_V	I_F=15mA	0.4	0.7	–	mcd
	TLG205-5			1.0	2.0	–	
	TLY205-5			0.5	1.1	–	
Peak Emission Wave Length	TLR205-5	λ_P	I_F=15mA	–	700	–	nm
	TLG205-5			–	565	–	
	TLY205-5			–	585	–	
Spectral Line Half Width	TLR205-5	$\Delta\lambda$	I_F=15mA	–	100	–	nm
	TLG205-5			–	25	–	
	TLY205-5			–	32	–	

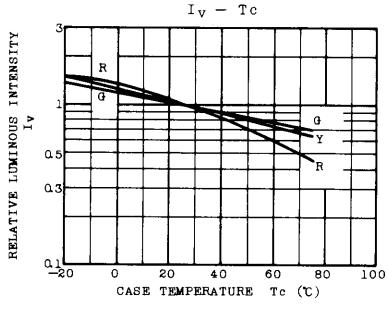
$I_F - V_F$



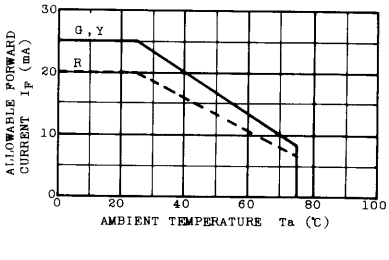
$I_V - I_F$



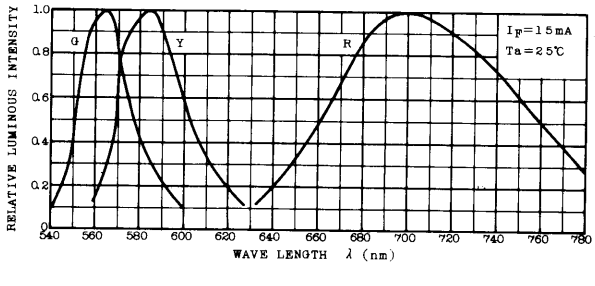
$I_V - T_C$



$I_F - Ta$



RELATIVE LUMINOUS INTENSITY – WAVE LENGTH



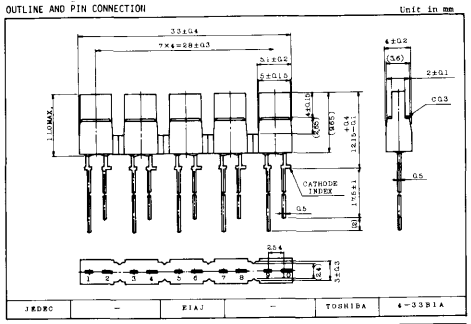
STANDARD BRIGHT LAMP

TLR208-5, TLG208-5, TLY208-5

GaP RED, GaP GREEN, GaAsP YELLOW

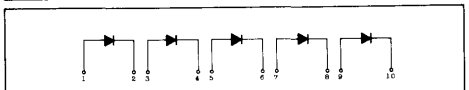
FEATURES:
. All Plastic Mold Type
TLR208-5 : Red Light Emission
TLG208-5 : Green Light Emission
TLY208-5 : Yellow Light Emission
. Bar Point Size 2 × 5mm, Each Bar Point are Displayed with Diffused and Uniformly.

OUTLINE AND PIN CONNECTION Unit in mm



JEDEC	–	EIAJ	–	TOSHIBA	4-33B1A

PIN No.	CONNECTION	PIN No.	CONNECTION
1	ANODE	6	CATHODE
2	CATHODE	7	ANODE
3	ANODE	8	CATHODE
4	CATHODE	9	ANODE
5	ANODE	10	CATHODE



Weight : 1.6g

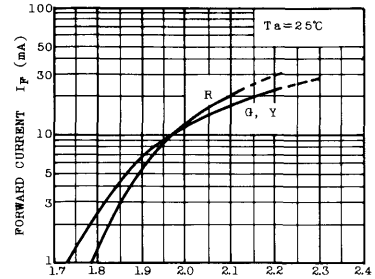
MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC		SYMBOL	RATING	UNIT
Forward Current (Diode)	TLR208-5	I_F/Diode	20	mA
	TLG208-5, TLY208-5		25	
Reverse Voltage		V_R	4	V
Power Dissipation (Diode)	TLR208-5	P_D/Diode	56	mW
	TLG208-5, TLY208-5		70	
Operating Temperature Range		T_{opr}	-20 ~ 75	°C
Storage Temperature Range		T_{stg}	-30 ~ 100	°C

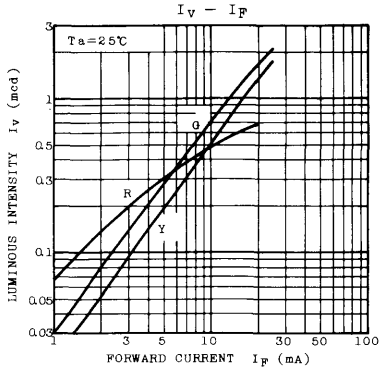
ELECTRO-OPTICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	TLR208-5	V_F	I_F=20mA	–	2.1	2.8	V
	TLG208-5, TLY208-5			–	2.2	2.8	
Reverse Current		I_R	V_R=4V	–	–	100	μA
Luminous Intensity	TLR208-5	I_V	I_F=15mA	0.3	0.6	–	mcd
	TLG208-5			0.5	1.2		
	TLY208-5			0.5	0.9	–	
Peak Emission Wave Length	TLR208-5	λ_P	I_F=15mA	–	700	–	nm
	TLG208-5			–	565	–	
	TLY208-5			–	585	–	
Spectral Line Half Width	TLR208-5	$\Delta\lambda$	I_F=15mA	–	100	–	nm
	TLG208-5			–	25	–	
	TLY208-5			–	32	–	

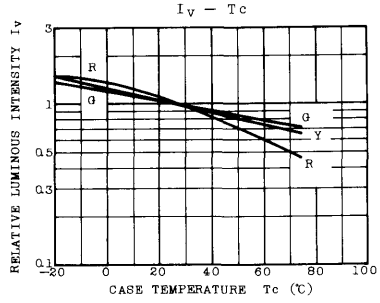
$I_F - V_F$



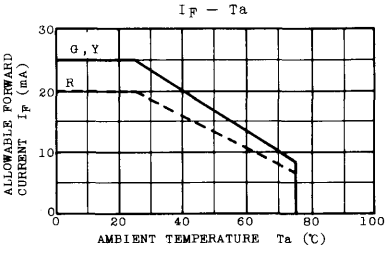
$I_V - I_F$



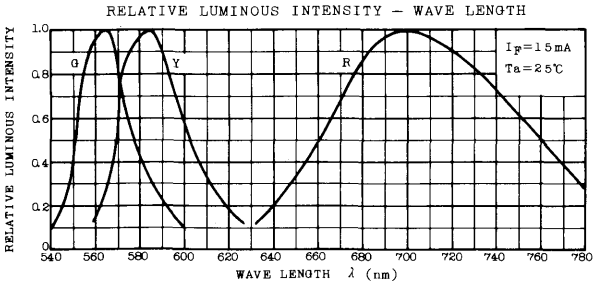
$I_V - Tc$



$I_F - Ta$



RELATIVE LUMINOUS INTENSITY – WAVE LENGTH



TLS108A, TLS109A

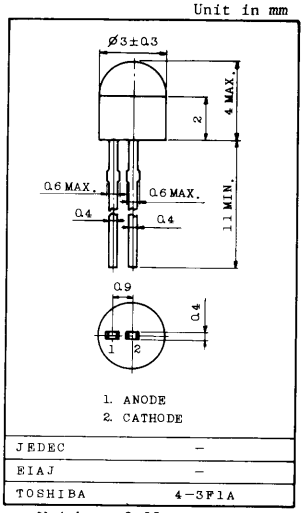
GaAsP RED LIGHT EMISSION

3mm DIAMETER(T1)

FEATURES:

- SUPER-BRIGHT
- Resin Stem Type
  TLS108A : Light Red Transparent Lens
  TLS109A : Milky Light Red Lusterless Lens
- Low Drive Current, High Intensity Red Light Emission.
  Recommended Forward Current : I_F=15~20mA(DC)
- Wide Viewing Angle, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	4-3F1A

Weight : 0.08g

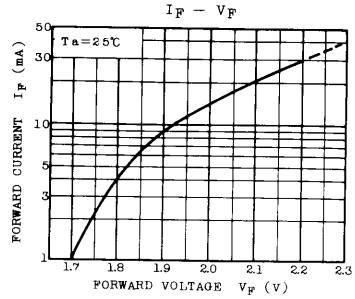
MAXIMUM RATINGS (Ta =25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	30	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	85	mW
Operating Temperature Range	T_{opr}	-20~75	°C
Storage Temperature Range	T_{stg}	-30~100	°C

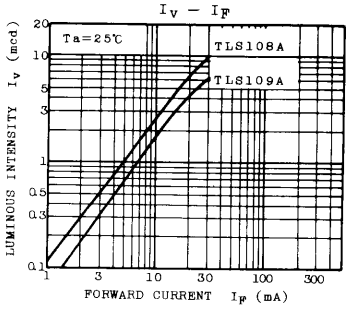
ELECTRO-OPTICAL CHARACTERISTICS (Ta =25°C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current		I_R	V_R=4V	-	-	100	μA
Luminous Intensity	TLS108A	I_V	I_F=15mA	1.5	4.5	-	mcd
	TLS109A			1.0	3.0	-	
Peak Emission Wave Length		λ_P	I_F=15mA	-	635	-	nm
Spectral Line Half Width		$\Delta\lambda$	I_F=15mA	-	40	-	nm

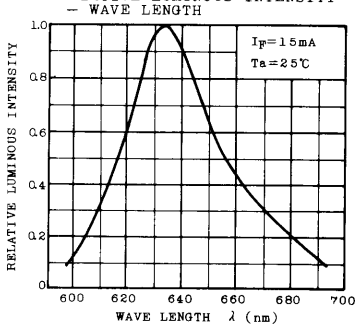
$I_F - V_F$



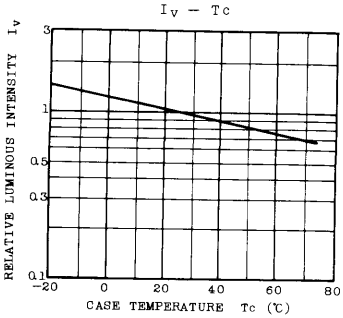
$I_V - I_F$



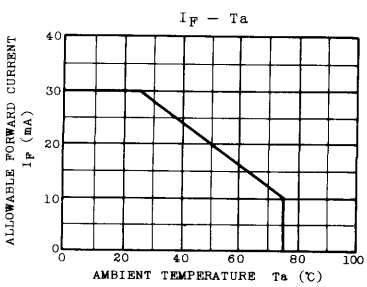
RELATIVE LUMINOUS INTENSITY - WAVE LENGTH



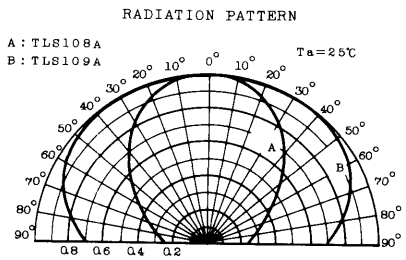
$I_V - Tc$



$I_F - Ta$



RADIATION PATTERN



TLS113, TLS114

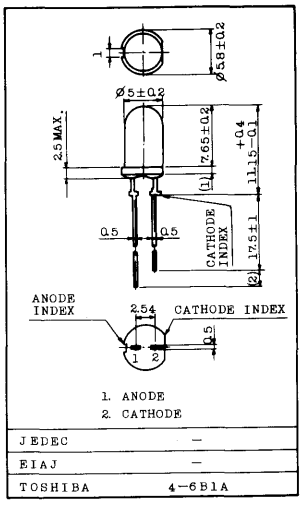
GaAsP RED LIGHT EMISSION

5mm DIAMETER(T 13/4)

FEATURES:

- Super-Bright
- All Plastic Mold Type.
  TLS113 : Red Transparent Lens
  TLS114 : Red Lusterless Lens
- Low Drive Current, High Intensity Red Light Emission.
  Recommended Forward Current : I_F=15~20mA(DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	4-6B1A

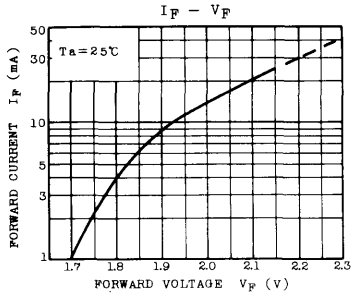
Weight : 0.31g

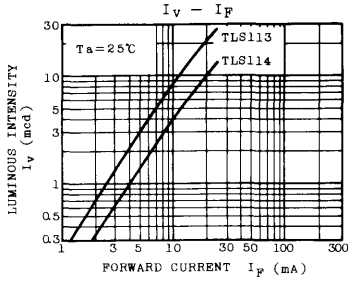
MAXIMUM RATINGS (Ta =25°C)

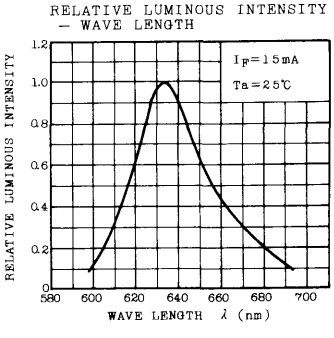
CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	100	mW
Operating Temperature Range	Topr	-20~75	°C
Storage Temperature Range	Tstg	-30~100	°C

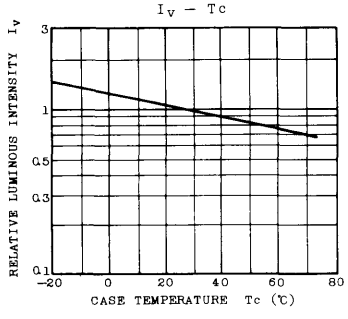
ELECTRO-OPTICAL CHARACTERISTICS (Ta =25°C)

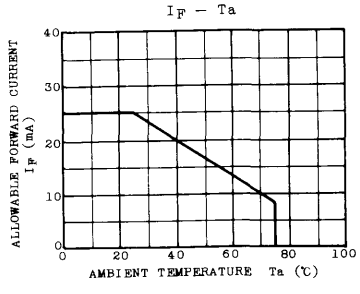
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current		I_R	V_R=4V	-	-	100	μA
Luminous Intensity	TLS113	I_V	I_F=15mA	5	15	-	mcd
	TLS114			3	7	-	
Peak Emission Wave Length		λp	I_F=15mA	-	635	-	nm
Spectral Line Half Width		Δλ	I_F=15mA	-	40	-	nm

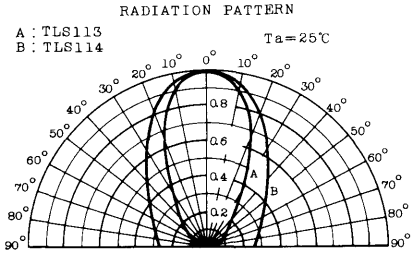












TLS113Q, TLS114Q

GaAsP RED LIGHT EMISSION

PANEL CIRCUIT INDICATOR

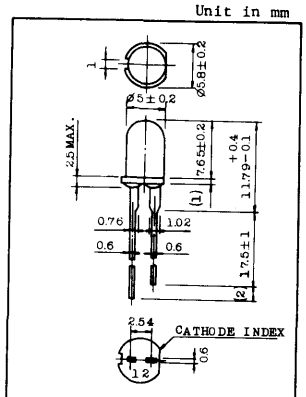
FEATURES:

- Super-Bright
- All Plastic Mold Type.

  TLS113Q: Red Transparent Lens
  TLS114Q: Red Lusterless Lens
- Low Drive Current, High Intensity Red Light Emission.

  Recommended Forward Current: I_F=15 ∿ 20mA(DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.
- Wire Wrappable Leads.

Unit in mm



1. ANODE
2. CATHODE

JEDEC	–
EIAJ	–
TOSHIBA	4-6B4A

Weight: 0.35g

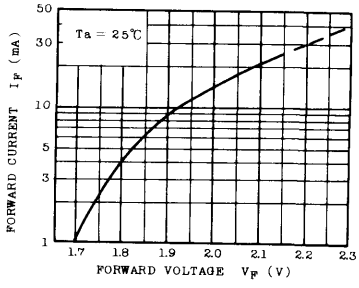
MAXIMUM RATINGS (Ta = 25 °C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	100	mW
Operating Temperature Range	T_{opr}	-20 ∿ 75	°C
Storage Temperature Range	T_{stg}	-30 ∿ 100	°C

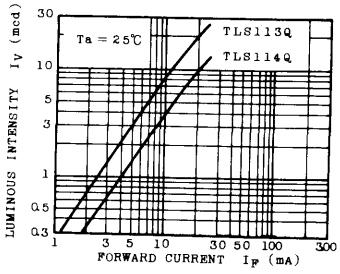
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25 °C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	–	2.1	2.8	V
Reverse Current		I_R	V_R=4V	–	–	100	μA
Luminous Intensity	TLS113Q	I_V	I_F=15mA	3	15	–	mcd
	TLS114Q			2	70	–	
Peak Emission Wave Length		λP	I_F=15mA	–	635	–	nm
Spectral Line Half Width		Δλ	I_F=15mA	–	40	–	nm

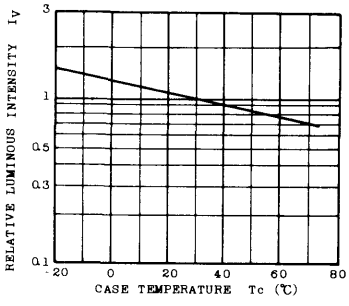
I_F – V_F



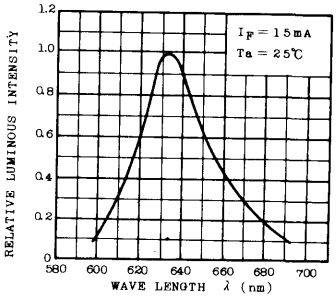
I_V – I_F



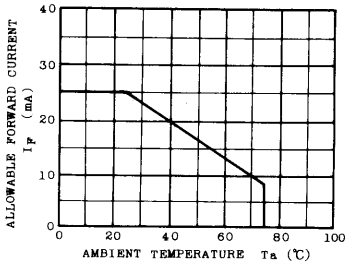
I_V – Tc



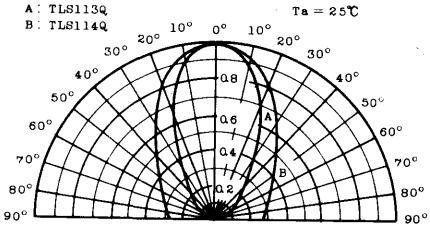
RELATIVE LUMINOUS INTENSITY – WAVE LENGTH



I_F – Ta



RADIATION PATTERN



NO STAND OFF LEAD LAMP

TLS113P, TLS114P

GaAsP RED LIGHT EMISSION

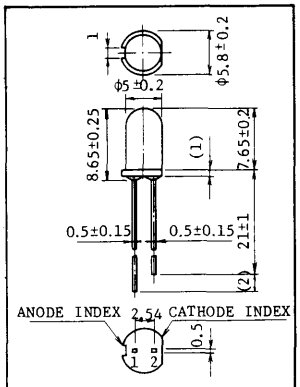
PANEL CIRCUIT INDICATOR

FEATURES:

- Super-Bright
- All Plastic Mold Type

  TLS113P: Red Transparent Lens
  TLS114P: Red Lusterless Lens
- Low Drive Current, High Intensity Red Light Emission.
  Recommended Forward Current: $I_F = 15 \sim 20$ mA (DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.

Unit in mm



1. ANODE
2. CATHODE

JEDEX	-
EIAJ	-
TOSHIBA	

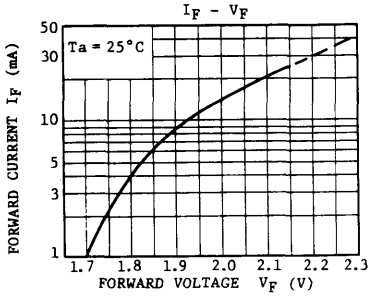
Weight: 0.31 g

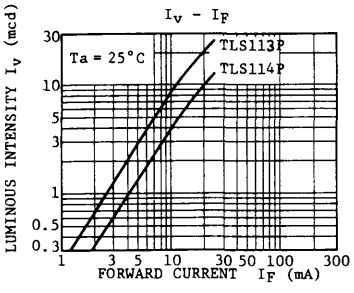
MAXIMUM RATINGS (Ta = 25 °C)

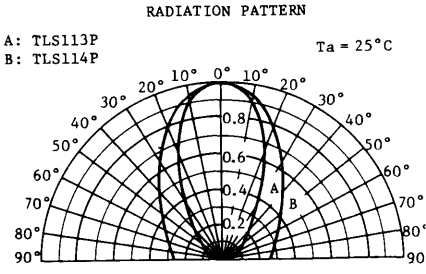
CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	100	mW
Operating Temperature Range	T_{opr}	-20 ~ 75	°C
Storage Temperature Range	T_{stg}	-30 ~ 100	°C

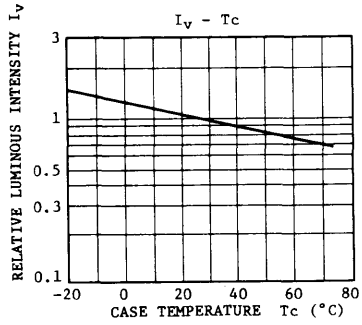
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25 °C)

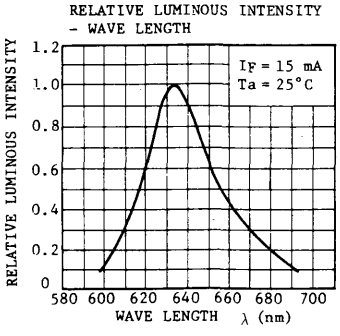
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F = 20 mA	-	2.1	2.8	V
Reverse Current		I_R	V_R = 4 V	-	-	100	μA
Luminous Intensity	TLS113P	I_v	I_F = 15 mA	5	15	-	mcd
	TLS114P			3	7	-	
Peak Emission Wave Length		λ_p	I_F = 15 mA	-	635	-	nm
Spectral Line Half Width		$\Delta\lambda$	I_F = 15 mA	-	40	-	nm

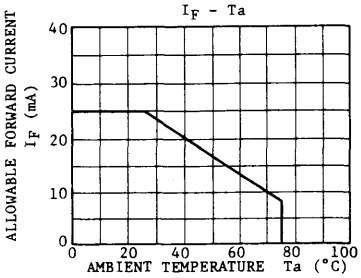












TLS123, TLS124

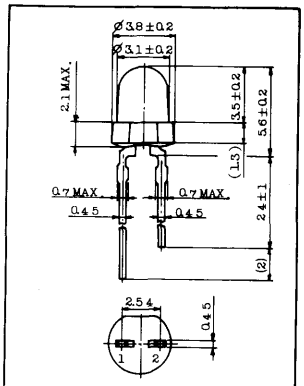
GaAsP RED LIGHT EMISSION ION

3.1mm DIAMETER(T1)

FEATURES:

- Super-Bright
- All Plastic Mold Type
  TLS123 : Red Transparent Lens
  TLS124 : Red Lusterless Lens
- Low Drive Current, High Intensity Red Light Emission.
  Recommended Forward Current : I_F=15~20mA(DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.

Unit in mm



1. ANODE
2. CATHODE

JEDEC	—
EIAJ	—
TOSHIBA	4-4E1A

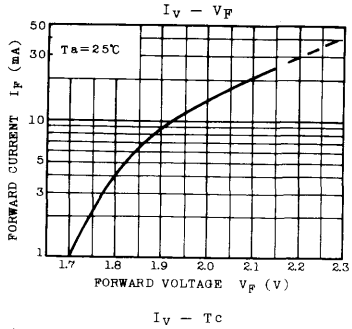
Weight : 0.14g

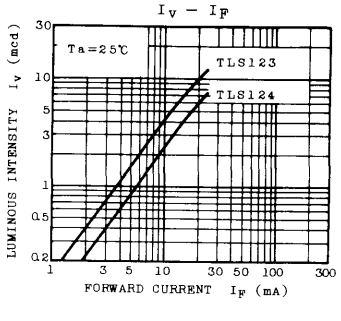
MAXIMUM RATINGS (Ta=25°C)

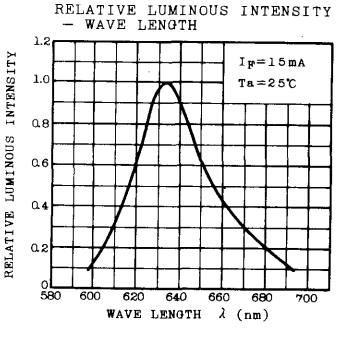
CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	Topr	-20~75	°C
Storage Temperature Range	Tstg	-30~100	°C

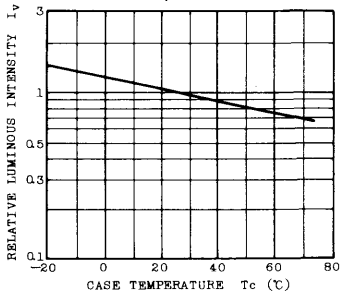
ELECTRO-OPTICAL CHARACTERISTICS (Ta=25°C)

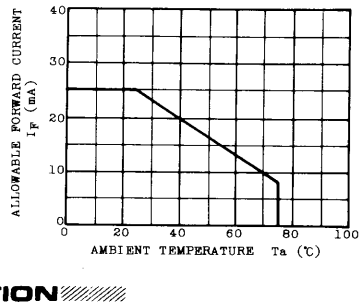
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current		I_R	V_R=4V	-	-	100	μA
Luminous Intensity	TLS123	I_V	I_F=15mA	4	7	-	mcd
	TLS124			2.5	4	-	
Peak Emission Wave Length		λ_P	I_F=15mA	-	635	-	nm
Spectral Line Half Width		$\Delta\lambda$	I_F=15mA	-	40	-	nm

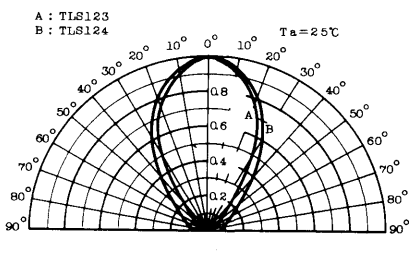












TLS143, TLS144

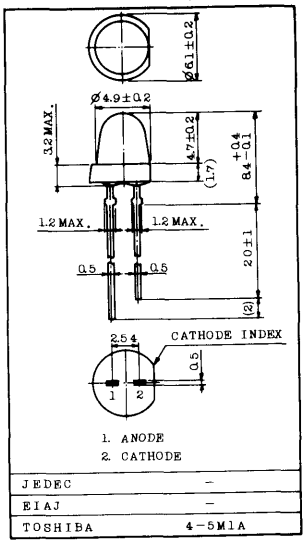
GaAsP RED LIGHT EMISSION

4.9mm DIAMETER(T 1¾, Low Profile)

FEATURES:

- SUPER-BRIGHT
- All Plastic Mold Type
  TLS143 : Red Transparent Lens
  TLS144 : Red Lusterless Lens
- Low Drive Current, High Intensity Red Light Emission.
  Recommended Forward Current : I_F=15~20mA(DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.

Unit in mm



JEDEC	–
EIAJ	–
TOSHIBA	4-5M1A

Weight : 0.23g

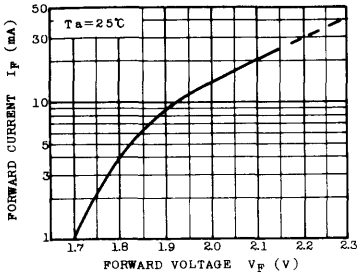
MAXIMUM RATINGS (Ta =25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	T_{opr}	-20~75	°C
Storage Temperature Range	T_{stg}	-30~100	°C

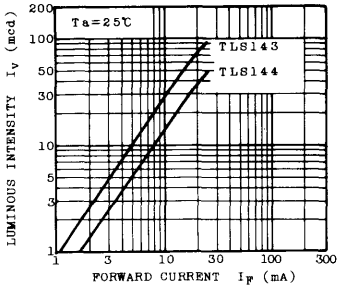
ELECTRO-OPTICAL CHARACTERISTICS (Ta =25°C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	–	2.1	2.8	V
Reverse Current		I_R	V_R=4V	–	–	100	μA
Luminous Intensity	TLS143	I_V	I_F=15mA	10	50	–	mcd
	TLS144			5	25	–	
Peak Emission Wave Length		λ_P	I_F=15mA	–	635	–	nm
Spectral Line Half Width		$\Delta\lambda$	I_F=15mA	–	40	–	nm

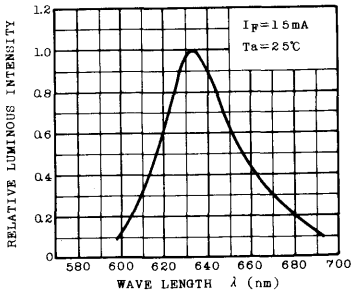
$I_F - V_F$



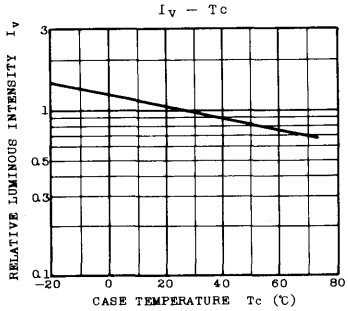
$I_V - I_F$



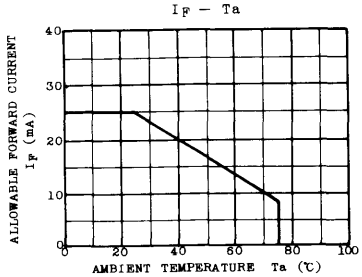
RELATIVE LUMINOUS INTENSITY – WAVE LENGTH



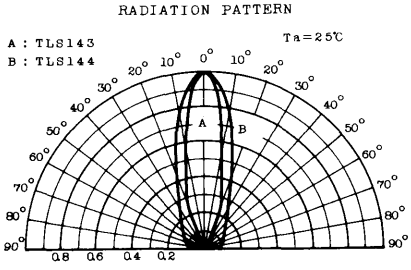
$I_V - T_C$



$I_F - T_a$



RADIATION PATTERN



TLS153, TLS154

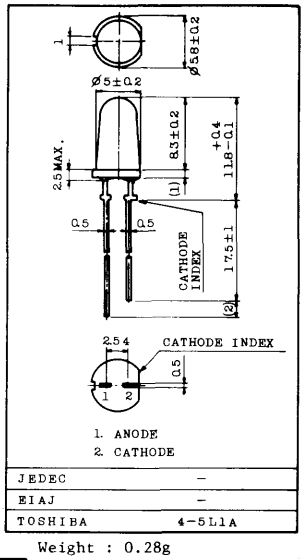
GaAsP RED LIGHT EMISSION

5mm DIAMETER(T 1 3/4)

FEATURES:

- SUPER-BRIGHT
- All Plastic Mold Type
  TLS153 : Light Red Transparent Lens
  TLS154 : Light Red Lusterless Lens
- Low Drive Current, High Intensity Red Light Emission.
  Recommended Forward Current : I_F=15~20mA(DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	4-5L1A

Weight : 0.28g

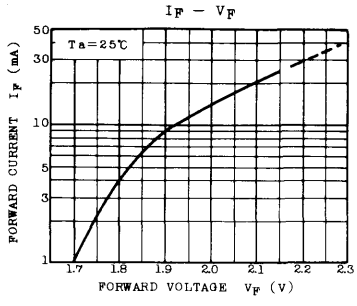
MAXIMUM RATINGS (Ta=25℃)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	T_{opr}	-20~75	°C
Storage Temperature Range	T_{stg}	-30~100	°C

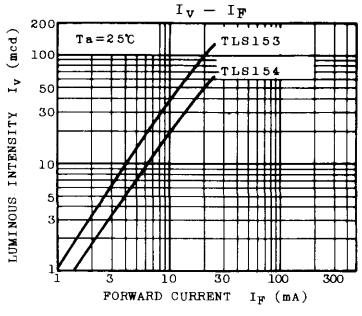
ELECTRO-OPTICAL CHARACTERISTICS (Ta=25℃)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current		I_R	V_R=4V	-	-	100	μA
Luminous Intensity	TLS153	I_V	I_F=20mA	20	100	-	mcd
	TLS154			10	50	-	
Peak Emission Wave Length		λ_P	I_F=20mA	-	635	-	nm
Spectral Line Half Width		$\Delta\lambda$	I_F=20mA	-	40	-	nm

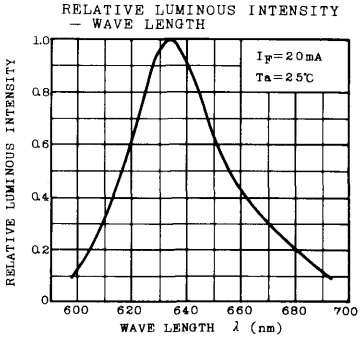
$I_F - V_F$



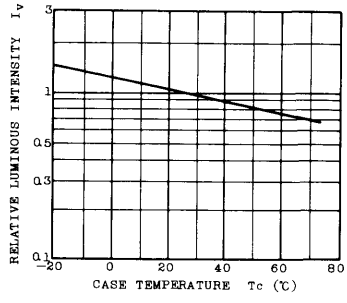
$I_V - I_F$



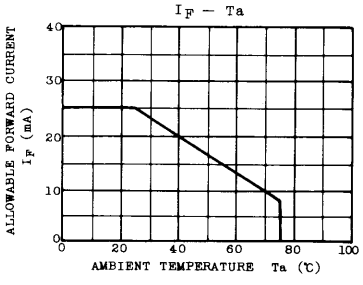
RELATIVE LUMINOUS INTENSITY — WAVE LENGTH



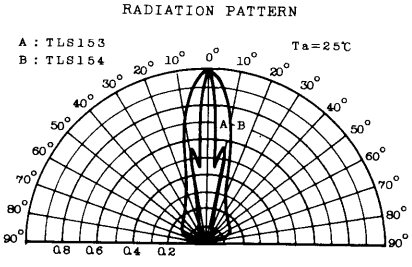
$I_V - Tc$



$I_F - Ta$



RADIATION PATTERN



TLS153Q, TLS154Q

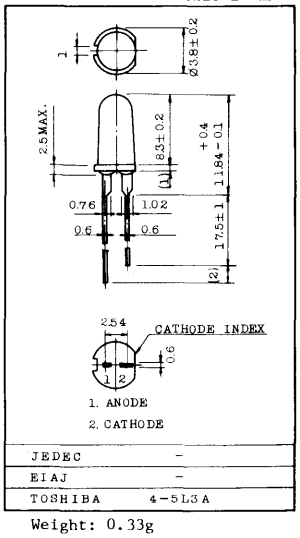
GaAsP RED LIGHT EMISSION

PANEL CIRCUIT INDICATOR

FEATURES:

- SUPER-BRIGHT
- All Plastic Mold Type
  TLS153Q: Light Red Transparent Lens
  TLS154Q: Light Red Lusterless Lens
- Low Drive Current, High Intensity Red Light Emission.
  Recommended Forward Current: I_F=15 ∿ 20mA(DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.
- Wire Wrappable Leads.

Unit in mm



JEDEC	–
EIAJ	–
TOSHIBA	4-5L3A

Weight: 0.33g

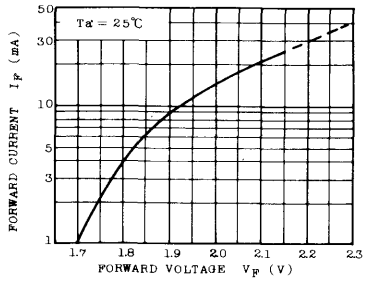
MAXIMUM RATINGS (Ta = 25 °C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	T_{opr}	-20 ∿ 75	°C
Storage Temperature Range	T_{stg}	-30 ∿ 100	°C

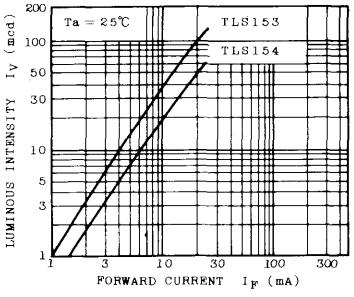
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25 °C)

CHRACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	–	2.1	2.8	V
Reverse Current		I_R	V_R=4V	–	–	100	μA
Luminous Intensity	TLS153Q	I_V	I_F=20mA	8	50	–	mcd
	TLS154Q			5	20	–	
Peak Emission Wave Length		λP	I_F=20mA	–	635	–	nm
Spectral Line Half Width		Δλ	I_F=20mA	–	40	–	nm

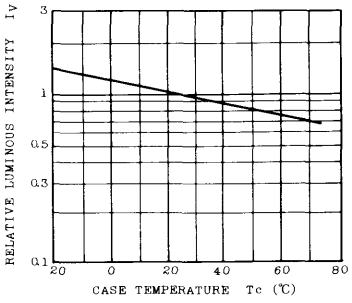
I_F – V_F



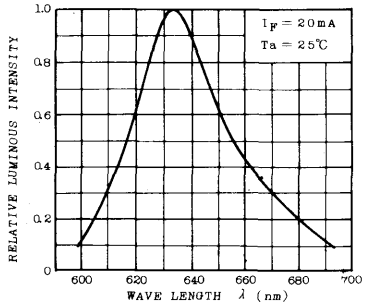
I_V – I_F



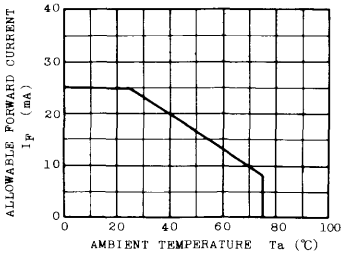
I_V – Tc



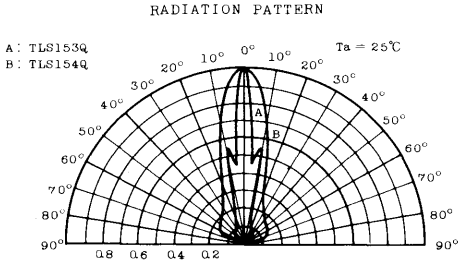
RELATIVE LUMINOUS INTENSITY – WAVE LENGTH



I_F – Ta



RADIATION PATTERN



TLS163, TLS164

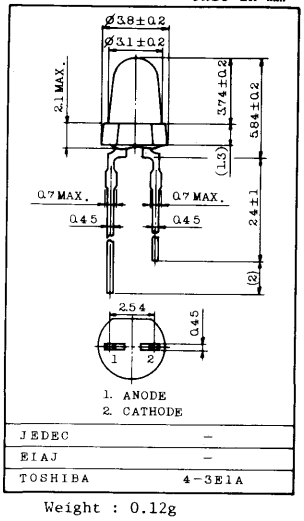
GaAsP RED LIGHT EMISSION

3.1mm DIAMETER(T1)

FEATURES:

- SUPER-BRIGHT
- All Plastic Mold Type
  TLS163 : Light Red Transparent Lens
  TLS164 : Light Red Lusterless Lens
- Low Drive Current, High Intensity Red Light Emission.
  Recommended Forward Current : I_F=15~20mA(DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	4-3E1A

Weight : 0.12g

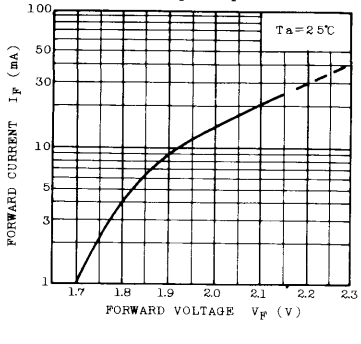
MAXIMUM RATINGS (Ta=25℃)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	T_{opr}	-20~75	°C
Storage Temperature Range	T_{stg}	-30~100	°C

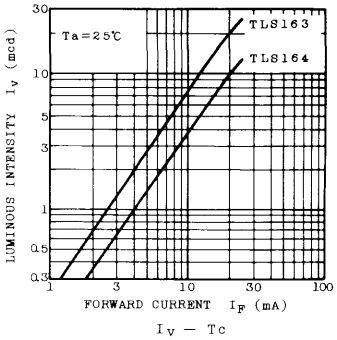
ELECTRO-OPTICAL CHARACTERISTICS (Ta=25℃)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current		I_R	V_R=4V	-	-	100	μA
Luminous Intensity	TLS163	I_V	I_F=20mA	10	20	-	mcd
	TLS164			5	10	-	
Peak Emission Wave Length		λ_P	I_F=20mA	-	635	-	nm
Spectral Line Half Width		$\Delta\lambda$	I_F=20mA	-	40	-	nm

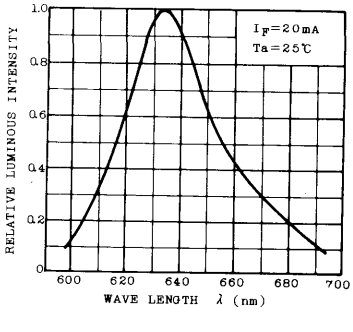
$I_F - V_F$



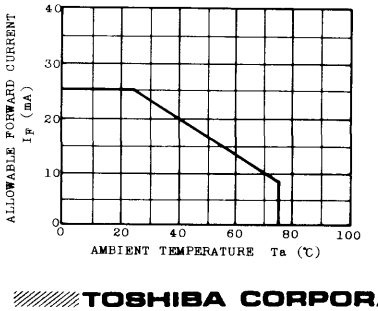
$I_V - I_F$



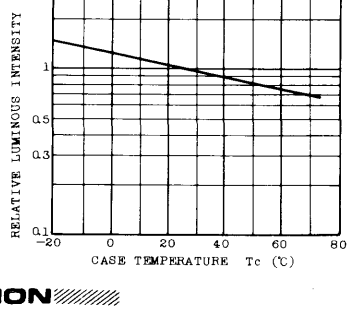
RELATIVE LUMINOUS INTENSITY — WAVE LENGTH



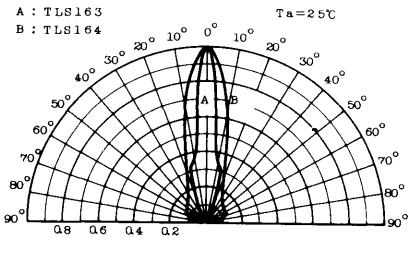
$I_F - Ta$



$I_V - Tc$



RADIATION PATTERN



TLS255

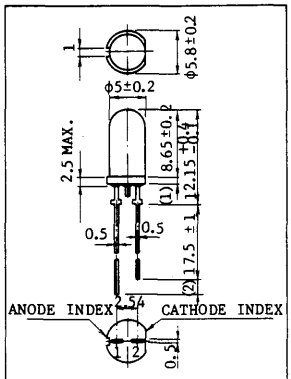
GaAsP RED LIGHT EMISSION

2 CHIP LED LAMP FOR BACK LIGHTING

FEATURES:

- 2 Chip series connection
- All Plastic Mold Type: Light Red Transparent Lens
- Low Drive Current, High Intensity Red Light Emission
  Recommended Forward Current: I_F = 15∿20 mA (DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.
- Wide Radiation - Suitable for Back Lighting

Unit in mm



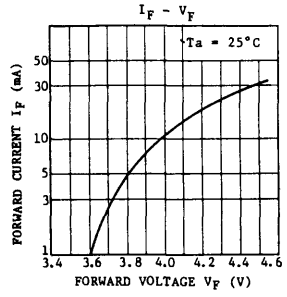
JEDEC	-
EIAJ	-
TOSHIBA	

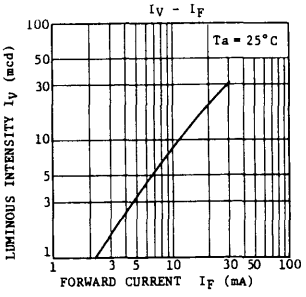
MAXIMUM RATINGS (Ta = 25°C)

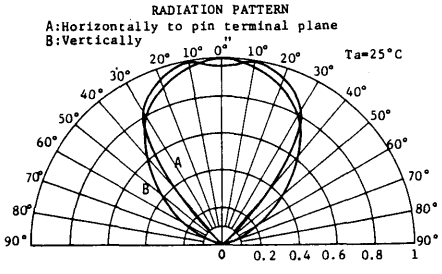
CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	30	mA
Reverse Voltage	V_R	8	V
Operating Temperature Range	T_{opr}	-20∿75	°C
Storage Temperature Range	T_{stg}	-30∿100	°C

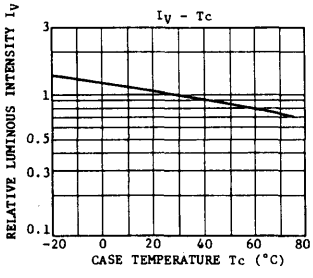
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25°C)

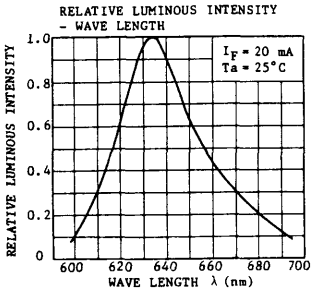
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F = 20 mA	-	4.2	5.4	V
Reverse Current	I_R	V_R = 8 V	-	-	100	μA
Luminous Intensity	I_V	I_F = 20 mA	3	20	-	mcd
Peak Emission Wave Length	λ_p	I_F = 20 mA	-	635	-	nm
Spectral Line Half Width	$\Delta\lambda$	I_F = 20 mA	-	40	-	nm

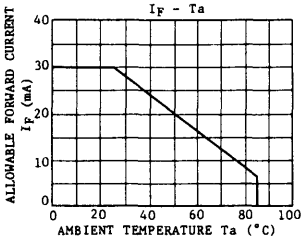












TLG143, TLG144

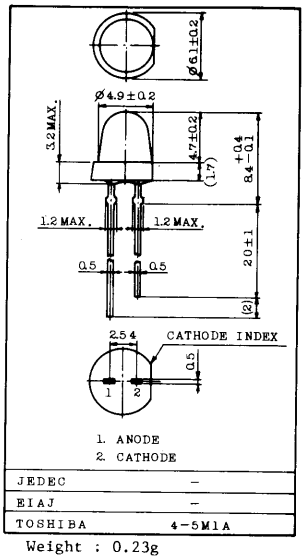
GaP GREEN LIGHT EMISSION

4.9mm DIAMETER(T1 3/4, Low Profile)

FEATURES:

- SUPER-BRIGHT
- All Plastic Mold Type
  TLG143 : Green Transparent Lens
  TLG144 : Green Lusterless Lens
- Low Drive Current, High Intensity Green Light Emission.
  Recommended Forward Current : I_F=15~20mA(DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.

Unit in mm



1. ANODE
2. CATHODE

JEDEC	—
EIAJ	—
TOSHIBA	4-5M1A

Weight : 0.23g

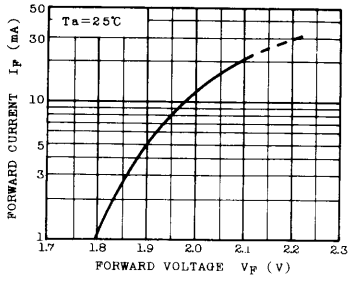
MAXIMUM RATINGS (Ta =25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	T_{opr}	-20~75	°C
Storage Temperature Range	T_{stg}	-30~100	°C

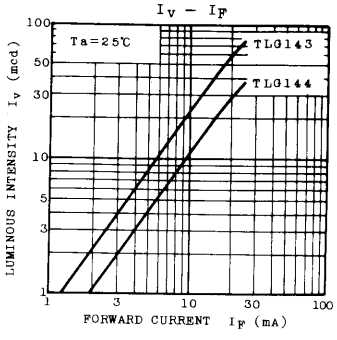
ELECTRO-OPTICAL CHARACTERISTICS (Ta =25°C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current		I_R	V_R=4V	-	-	5	μA
Luminous Intensity	TLG143	I_V	I_F=15mA	10	40	-	mcd
	TLG144			5	20	-	
Peak Emission Wave Length		λ_P	I_F=15mA	-	565	-	nm
Spectral Line Half Width		$\Delta\lambda$	I_F=15mA	-	25	-	nm

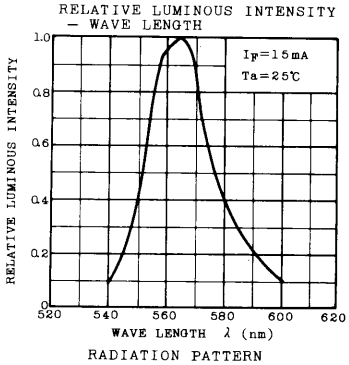
$I_F - V_F$



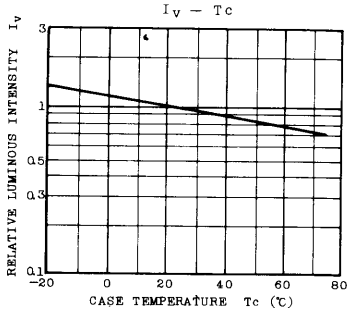
$I_V - I_F$



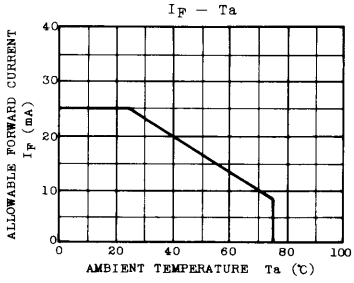
RELATIVE LUMINOUS INTENSITY — WAVE LENGTH



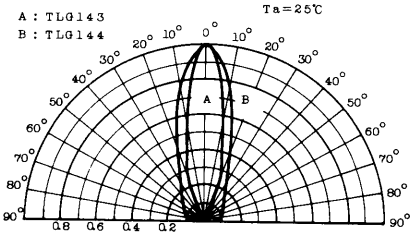
$I_V - Tc$



$I_F - Ta$



RADIATION PATTERN



TLG153, TLG154

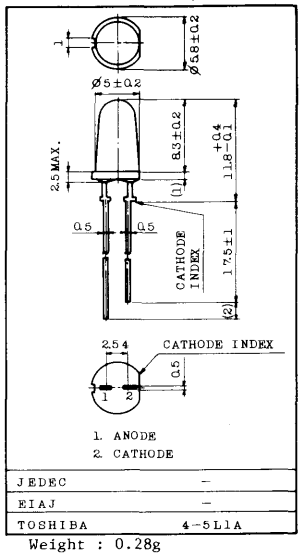
GaP GREEN LIGHT EMISSION

5mm DIAMETER(T 1 3/4)

FEATURES:

- SUPER-BRIGHT
- All Plastic Mold Type
  TLG153 : Light Green Transparent Lens
  TLG154 : Light Green Lusterless Lens
- Low Drive Current, High Intensity Green Light Emission.
  Recommended Forward Current : I_F=15~20mA(DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	4-5L1A

Weight : 0.28g

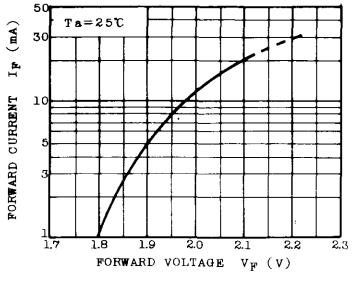
MAXIMUM RATINGS (Ta =25℃)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	T_{opr}	-20~75	°C
Storage Temperature Range	T_{stg}	-30~100	°C

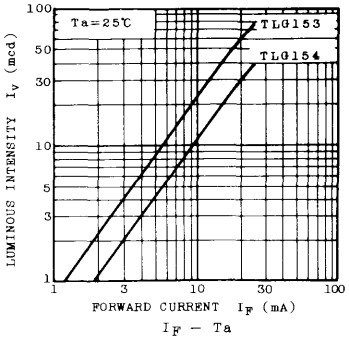
ELECTRO-OPTICAL CHARACTERISTICS (Ta =25℃)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current		I_R	V_R=4V	-	-	5	μA
Luminous Intensity	TLG153	I_V	I_F=20mA	20	60	-	mcd
	TLG154			8	30	-	
Peak Emission Wave Length		λ_P	I_F=20mA	-	565	-	nm
Spectral Line Half Width		$\Delta\lambda$	I_F=20mA	-	25	-	nm

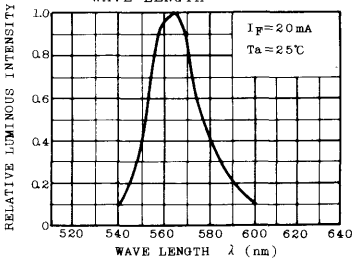
I_F – V_F



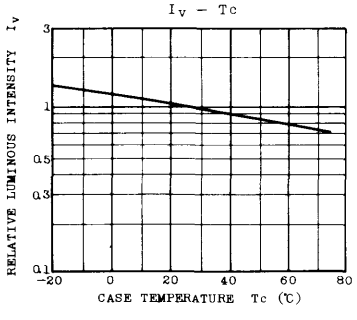
I_V – I_F



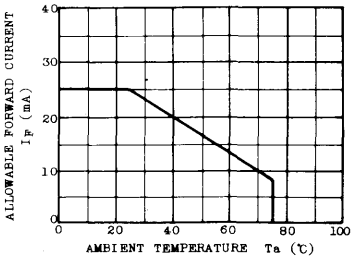
RELATIVE LUMINOUS INTENSITY – WAVE LENGTH



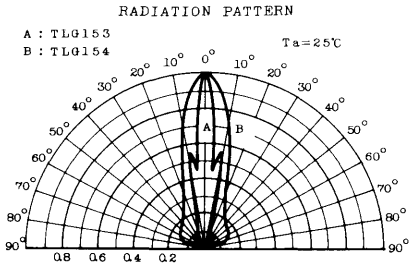
I_V – Tc



I_F – Ta



RADIATION PATTERN



TLG153Q, TLG154Q

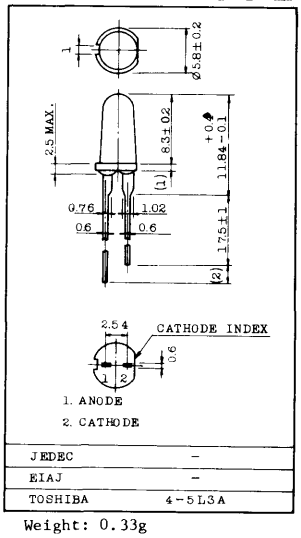
GaP GREEN LIGHT EMISSION

PANEL CIRCUIT INDICATOR

FEATURES:

- PURE COLOR
- All Plastic Mold Type
  TLG153Q: Light Green Transparent Lens
  TLG154Q: Light Green Lusterless Lens
- Low Drive Current, High Intensity Green Light Emission.
  Recommended Forward Current: I_F=15∿20mA(DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.
- Wire Wrappable Leads

Unit in mm



JEDEC	–
EIAJ	–
TOSHIBA	4-5L3A

Weight: 0.33g

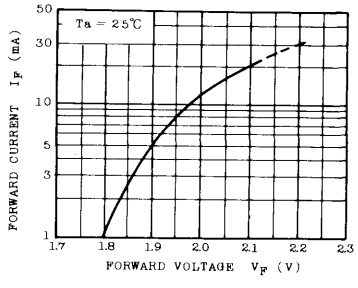
MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature	T_{opr}	-20∿75	°C
Storage Temperature Range	T_{stg}	-30∿100	°C

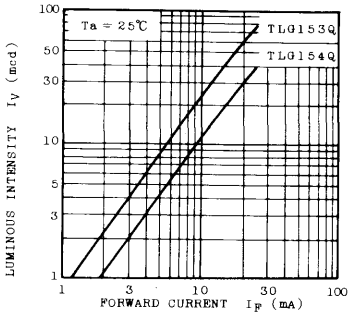
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	–	2.1	2.8	V
Reverse Current		I_R	V_R=4V	–	–	5	μA
Luminous Intensity	TLG153Q	I_V	I_F=20mA	20	60	–	mcd
	TLG154Q			8	30	–	
Peak Emission Wave Length		λP	I_F=20mA	–	565	–	nm
Spectral Line Half Width		Δλ	I_F=20mA	–	25	–	nm

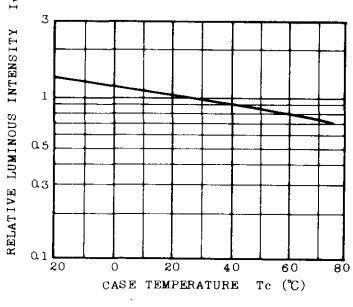
I_F – V_F



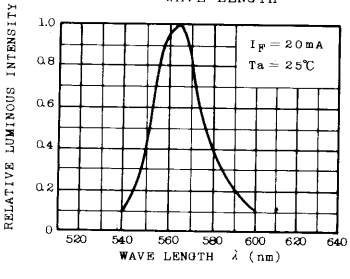
I_V – I_F



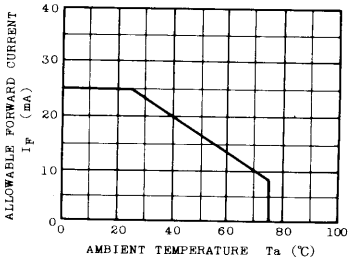
I_V – Tc



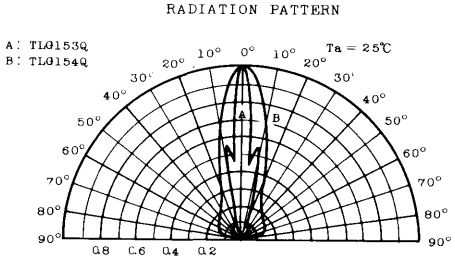
RELATIVE LUMINOUS INTENSITY – WAVE LENGTH



I_F – Ta



RADIATION PATTERN



TLG163, TLG164

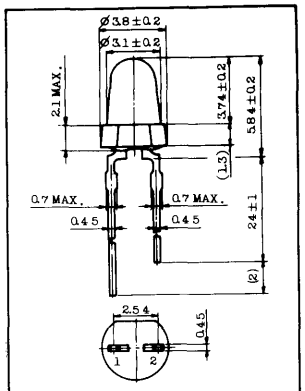
GaP GREEN LIGHT EMISSION

3.1mm DIAMETER(T1)

FEATURES:

- SUPER-BRIGHT
- All Plastic Mold Type
  TLG163 : Light Green Transparent Lens
  TLG164 : Light Green Lusterless Lens
- Low Drive Current, High Intensity Green Light Emission.
  Recommended Forward Current : I_F=15~20mA(DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.

Unit in mm



JEDEC	–
EIAJ	–
TOSHIBA	4-3E1A

Weight : 0.12g

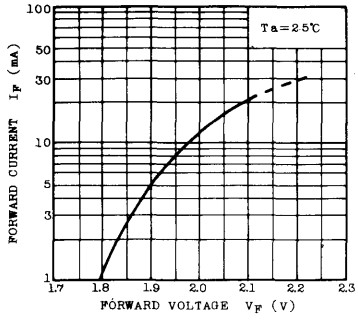
MAXIMUM RATINGS (Ta =25℃)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	T_{opr}	-20~75	°C
Storage Temperature Range	T_{stg}	-30~100	°C

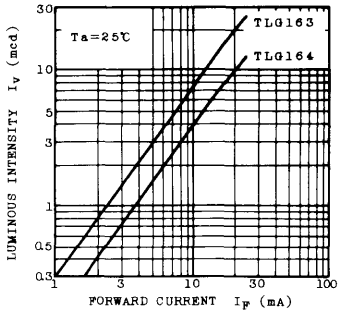
ELECTRO-OPTICAL CHARACTERISTICS (Ta =25℃)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Froward Voltage		V_F	I_F=20mA	–	2.1	2.8	V
Reverse Current		I_R	V_R=4V	–	–	5	μA
Luminous Intensity	TLG163	I_V	I_F=20mA	10	20	–	mcd
	TLG164			5	10	–	
Peak Emission Wave Length		λ_P	I_F=20mA	–	565	–	nm
Spectral Line Half Width		$\Delta\lambda$	I_F=20mA	–	25	–	nm

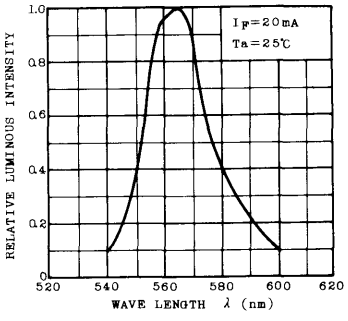
$I_F - V_F$



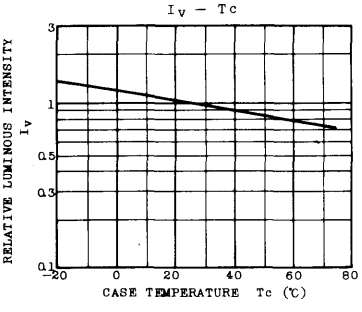
$I_V - I_F$



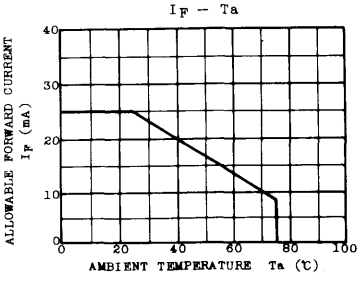
RELATIVE LUMINOUS INTENSITY – WAVE LENGTH



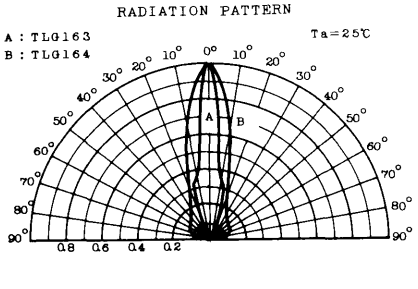
$I_V - Tc$



$I_F - Ta$



RADIATION PATTERN



TLY143, TLY144

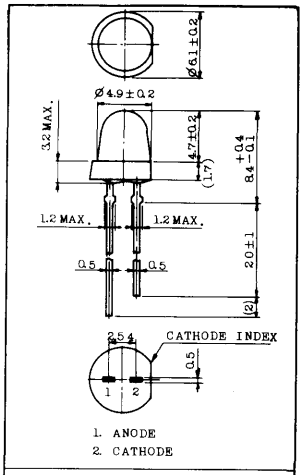
GaAsP YELLOW LIGHT EMISSION

4.9mm DIAMETER(T 1 3/4, Low Profile)

FEATURES:

- SUPER-BRIGHT
- All Plastic Mold Type
  TLY143 : Yellow Transparent Lens
  TLY144 : Yellow Lusterless Lens
- Low Drive Current, High Intensity Yellow Light Emission.
  Recommended Forward Current : I_F=15~20mA(DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	4-5M1A

Weight : 0.23g

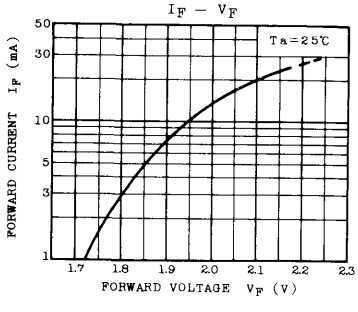
MAXIMUM RATINGS (Ta =25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	T_{opr}	-20~75	°C
Storage Temperature Range	T_{stg}	-30~100	°C

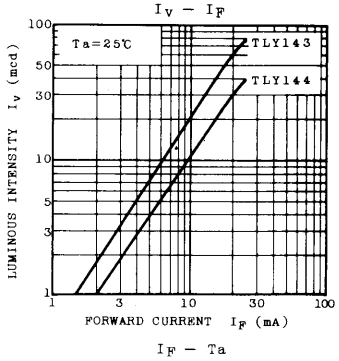
ELECTRO-OPTICAL CHARACTERISTICS (Ta =25°C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current		I_R	V_R=4V	-	-	100	μA
Luminous Intensity	TLY143	I_V	I_F=15mA	10	40	-	mcd
	TLY144			5	20	-	
Peak Emission Wave Length		λ_P	I_F=15mA	-	585	-	nm
Spectral Line Half Width		$\Delta\lambda$	I_F=15mA	-	32	-	nm

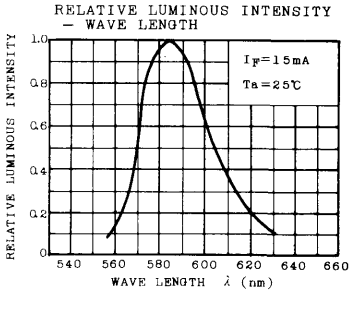
$I_F - V_F$



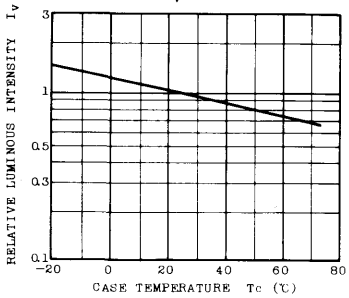
$I_V - I_F$



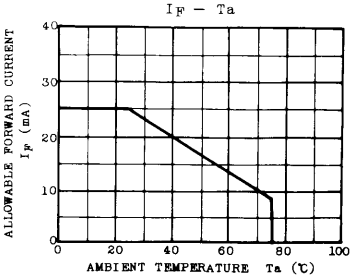
RELATIVE LUMINOUS INTENSITY — WAVE LENGTH



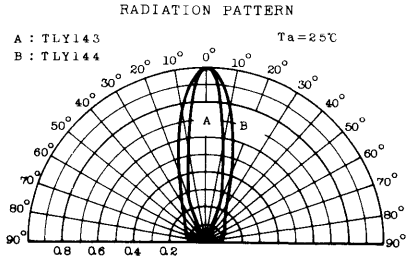
$I_V - T_C$



$I_F - T_a$



RADIATION PATTERN



TLY153, TLY154

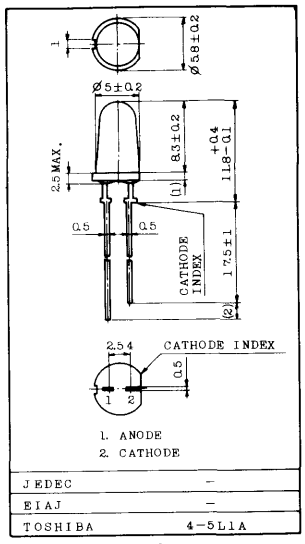
GaAsP YELLOW LIGHT EMISSION

5mm DIAMETER(T 13/4)

FEATURES:

- SUPER-BRIGHT
- All Plastic Mold Type
  TLY153 : Light Yellow Transparent Lens
  TLY154 : Light Yellow Lusterless Lens
- Low Drive Current, High Intensity Yellow Light Emission.
  Recommended Forward Current : I_F=15~20mA(DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	4-5L1A

Weight : 0.28g

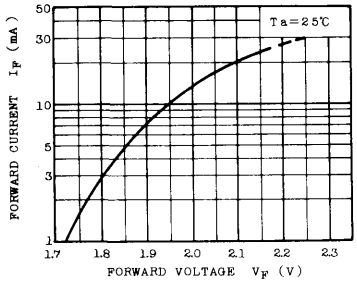
MAXIMUM RATINGS (Ta =25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	Topr	-20~75	°C
Storage Temperature Range	Tstg	-30~100	°C

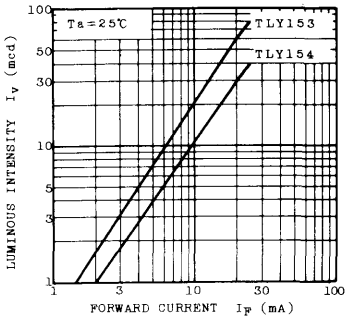
ELECTRO-OPTICAL CHARACTERISTICS (Ta =25°C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current		I_R	V_R=4V	-	-	100	μA
Luminous Intensity	TLY153	I_V	I_F=20mA	20	60	-	mcd
	TLY154			8	30	-	
Peak Emission Wave Length		λ_P	I_F=20mA	-	585	-	nm
Spectral Line Half Width		$\Delta\lambda$	I_F=20mA	-	32	-	nm

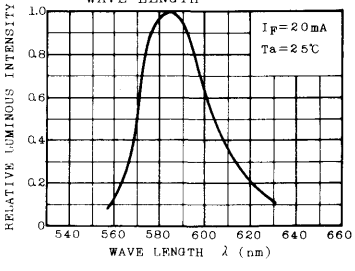
$I_F - V_F$



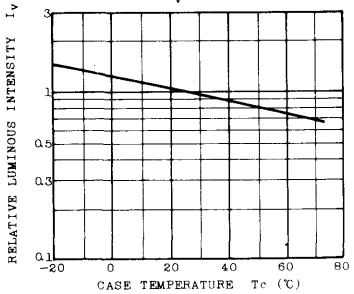
$I_V - I_F$



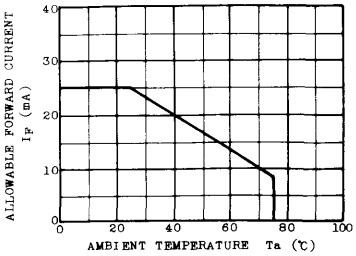
RELATIVE LUMINOUS INTENSITY — WAVE LENGTH



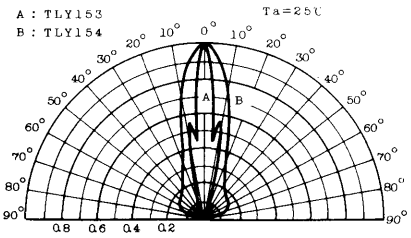
$I_V - T_C$



$I_F - T_a$



RADIATION PATTERN



TLY153Q, TLY154Q

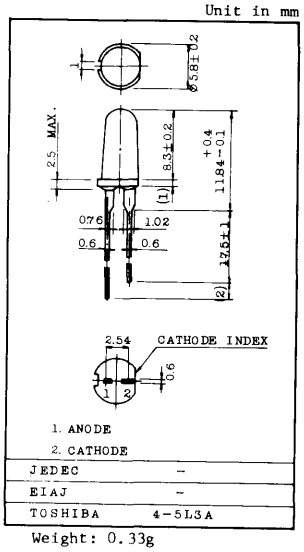
GaAsP YELLOW LIGHT EMISSION

PANEL CIRCUIT INDICATOR

FEATURES:

- SUPER-BRIGHT
- All Plastic Mold Type
  TLY153Q: Light Yellow Transparent Lens
  TLY154Q: Light Yellow Lusterless Lens
- Low Drive Current, High Intensity Yellow Light Emission.
  Recommended Forward Current: I_F=15 ~ 20mA(DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.
- Wire Wrappable Leads

Unit in mm



1. ANODE
2. CATHODE

JEDEC	–
EIAJ	–
TOSHIBA	4-5L3A

Weight: 0.33g

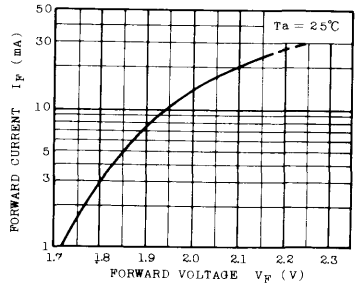
MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	T_{opr}	-20 ~ 75	°C
Storage Temperature Range	T_{stg}	-30 ~ 100	°C

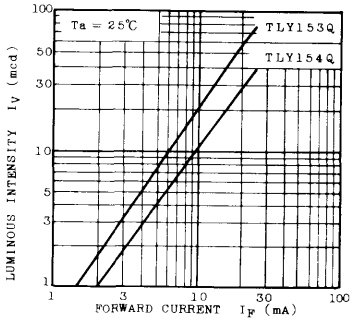
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	–	2.1	2.8	V
Reverse Current		I_R	V_R=4V	–	–	100	μA
Luminous Instensity	TLY153Q	I_V	I_F=20mA	20	60	–	mcd
	TLY154Q			8	30	–	
Peak Emission Wave Length		λP	I_F=20mA	–	585	–	nm
Spectral Line Half Width		Δλ	I_F=20mA	–	32	–	nm

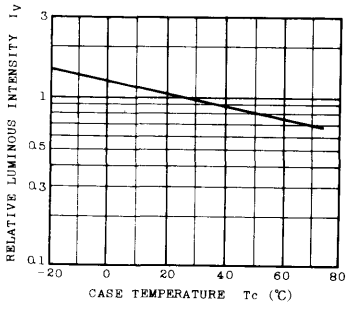
I_F – V_F



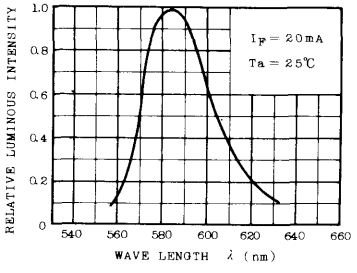
I_V – I_F



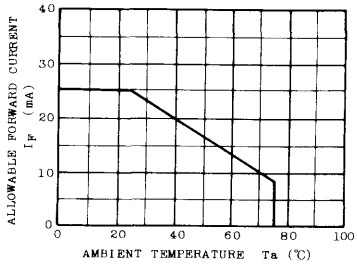
I_V – Tc



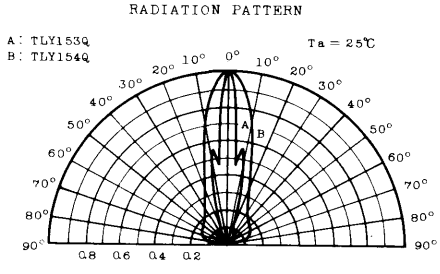
RELATIVE LUMINOUS INTENSITY – WAVE LENGTH



I_F – Ta



RADIATION PATTERN



TLY163, TLY164

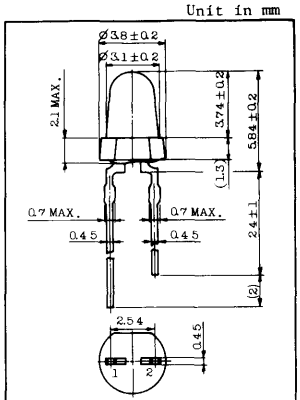
GaAsP YELLOW LIGHT EMISSION

3.1mm DIAMETER(T1)

FEATURES:

- SUPER-BRIGHT
- All Plastic Mold Type
  TLY163 : Light Yellow Transparent Lens
  TLY164 : Light Yellow Lusterless Lens
- Low Drive Current, High Intensity Yellow Light Emission.
  Recommended Forward Current : I_F=15 ~ 20mA(DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.

Unit in mm



1. ANODE
2. CATHODE

JEDEC	–
EIAJ	–
TOSHIBA	4-3E1A

Weight : 0.12g

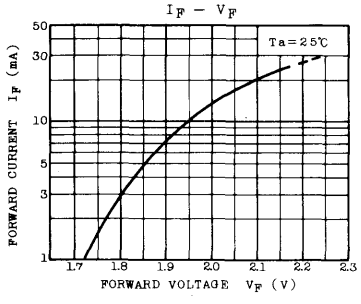
MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	T_{opr}	-20 ~ 75	°C
Storage Temperature Range	T_{stg}	-30 ~ 100	°C

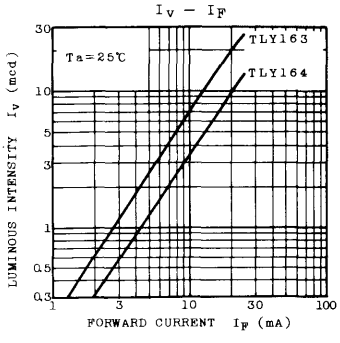
ELECTRO-OPTICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	–	2.1	2.8	V
Reverse Current		I_R	V_R=4V	–	–	100	μA
Luminous Intensity	TLY163	I_V	I_F=20mA	10	20	–	mcd
	TLY164			5	10	–	
Peak Emission Wave Length		λ_P	I_F=20mA	–	585	–	nm
Spectral Line Half Width		$\Delta\lambda$	I_F=20mA	–	32	–	nm

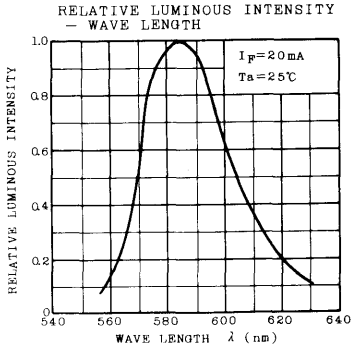
I_F – V_F



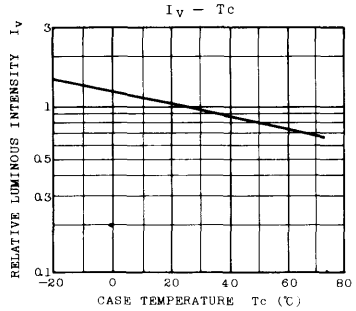
I_V – I_F



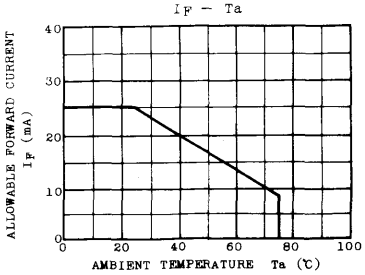
RELATIVE LUMINOUS INTENSITY – WAVE LENGTH



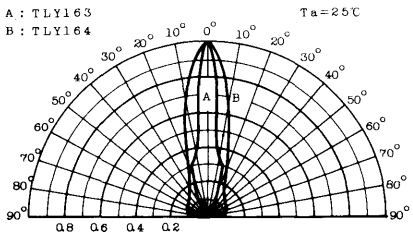
I_V – Tc



I_F – Ta



RADIATION PATTERN



TLO143, TLO144

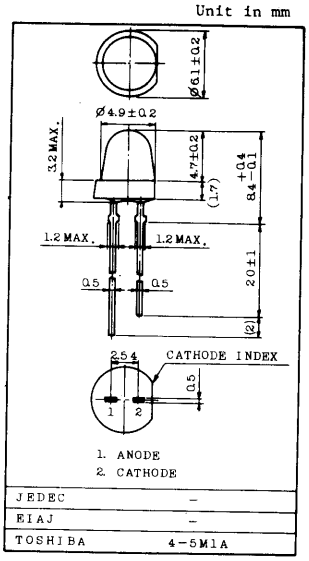
GaAsP ORANGE LIGHT EMISSION

4.9mm DIAMETER(T 13/4, LOW PROFILE)

FEATURES:

- SUPER-BRIGHT
- All Plastic Mold Type
  TLO143 : Orange Transparent Lens
  TLO144 : Orange Lusterless Lens
- Low Drive Current, High Intensity Orange Light Emission.
  Recommended Forward Current : I_F=15~20mA(DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	4-5M1A

Weight : 0.23g

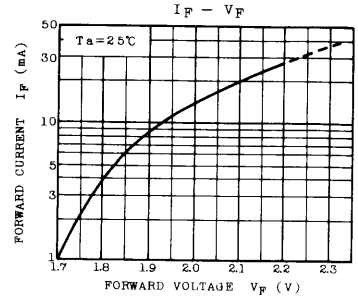
MAXIMUM RATINGS (Ta =25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	T_{opr}	-20 ~ 75	°C
Storage Temperature Range	T_{stg}	-30 ~ 100	°C

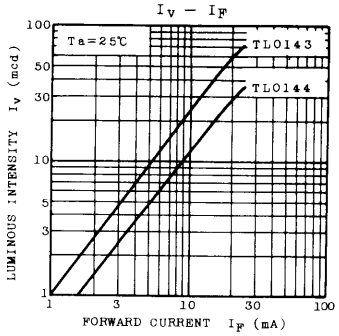
ELECTRO-OPTICAL CHARACTERISTICS (Ta =25°C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current		I_R	V_R=4V	-	-	100	μA
Luminous Intensity	TLO143	I_V	I_F=15mA	10	40	-	mcd
	TLO144			5	20	-	
Peak Emission Wave Length		λ_P	I_F=15mA	-	610	-	nm
Spectral Line Half Width		$\Delta\lambda$	I_F=15mA	-	35	-	nm

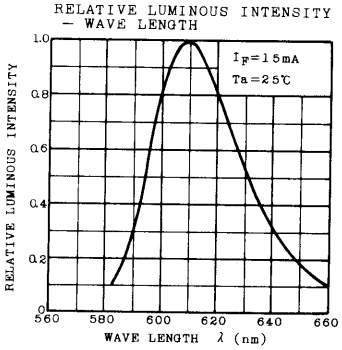
$I_F - V_F$



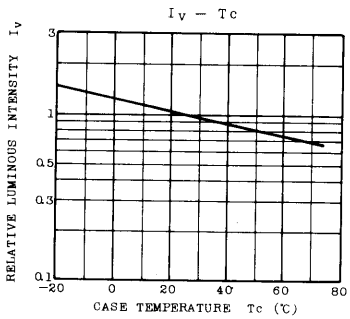
$I_V - I_F$



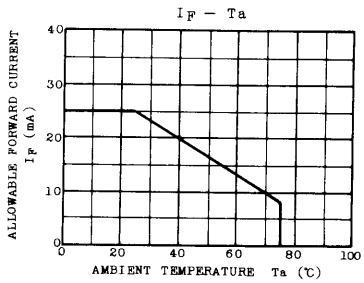
RELATIVE LUMINOUS INTENSITY — WAVE LENGTH



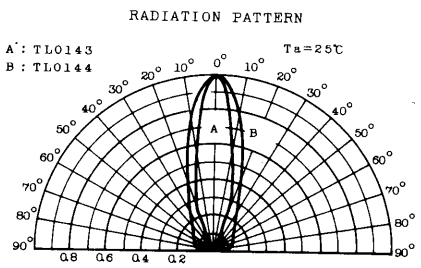
$I_V - T_C$



$I_F - T_a$



RADIATION PATTERN



TL0153, TL0154

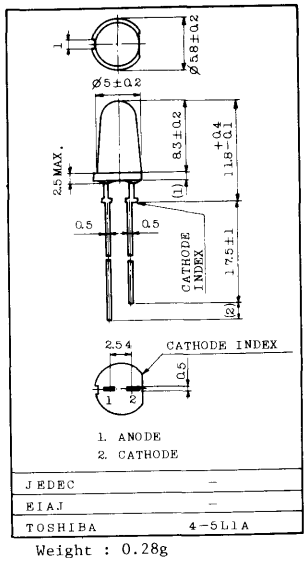
GaAsP ORANGE LIGHT EMISSION

5mm DIAMETER(T 13/4)

FEATURES:

- SUPER-BRIGHT
- All Plastic Mold Type
  TL0153 : Light Orange Transparent Lens
  TL0154 : Light Orange Lusterless Lens
- Low Drive Current, High Intensity Orange Light Emission
  Recommended Forward Current : I_F=15~20mA(DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	4-5L1A

Weight : 0.28g

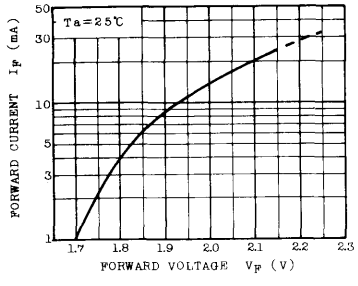
MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	T_{opr}	-20~75	°C
Storage Temperature Range	T_{stg}	-30~100	°C

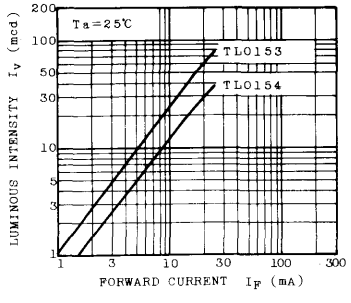
ELECTRO-OPTICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current		I_R	V_R=4V	-	-	100	μA
Luminous Intensity	TL0153	I_V	I_F=20mA	20	60	-	mcd
	TL0154			8	30	-	
Peak Emission Wave Length		λ_P	I_F=20mA	-	610	-	nm
Spectral Line Half Width		$\Delta\lambda$	I_F=20mA	-	35	-	nm

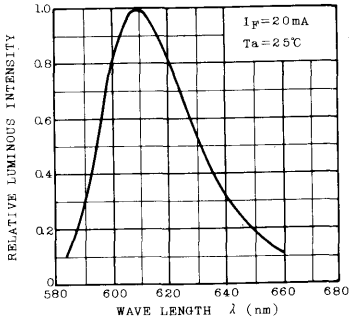
$I_F - V_F$



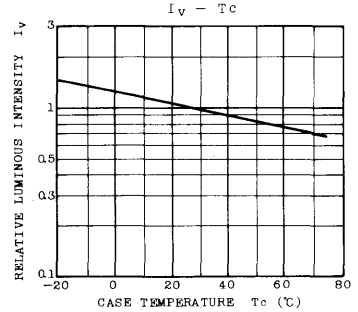
$I_V - I_F$



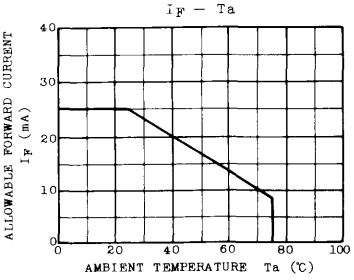
RELATIVE LUMINOUS INTENSITY — WAVE LENGTH



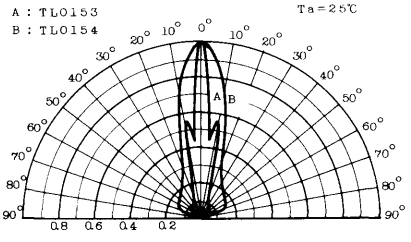
$I_V - T_C$



$I_F - T_a$



RADIATION PATTERN



TLO153Q, TLO154Q

GaAsP ORANGE LIGHT EMISSION

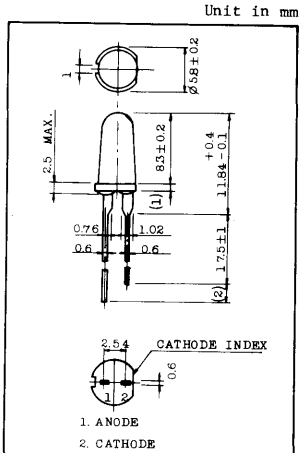
PANEL CIRCUIT INDICATOR

FEATURES:

- SUPER-BRIGHT
- All Plastic Mold Type

  TLO153Q: Light Orange Transparent Lens
  TLO154Q: Light Orange Lusterless Lens
- Low Drive Current, High Intensity Orange Light Emission.
  Recommended Forward Current: I_F=15 ~ 20mA(DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.
- Wire Wrappable Leads.

Unit in mm



JEDEC	–
EIAJ	–
TOSHIBA	4-5L3A

Weight: 0.33g

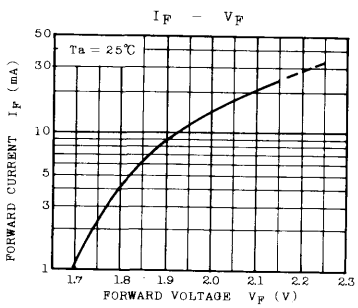
MAXIMUM RATINGS (Ta = 25 °C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	T_{opr}	-20 ~ 75	°C
Storage Temperature Range	T_{stg}	-30 ~ 100	°C

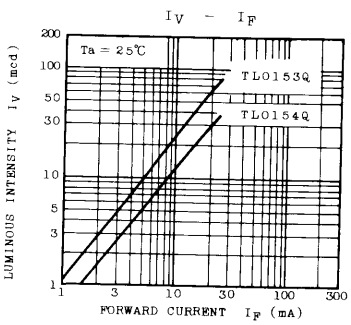
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25 °C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	–	2.1	2.8	V
Reverse Current		I_R	V_R=4V	–	–	100	μA
Luminous Intensity	TLO153Q	I_V	I_F=20mA	20	60	–	mcd
	TLO154Q			8	30	–	
Peak Emission Wave Length		λP	I_F=20mA	–	610	–	nm
Spectral Line Half Width		Δλ	I_F=20mA	–	35	–	nm

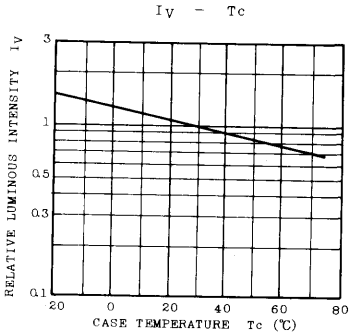
I_F – V_F



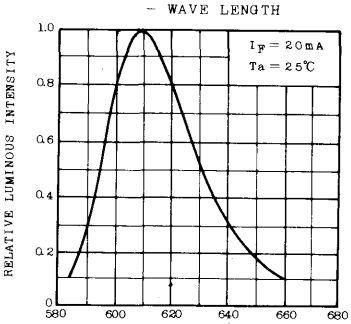
I_V – I_F



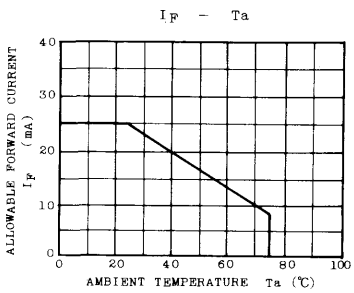
I_V – Tc



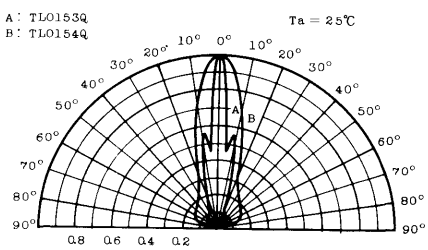
RELATIVE LUMINOUS INTENSITY – WAVE LENGTH



I_F – Ta



RADIATION PATTERN



TL0163, TL0164

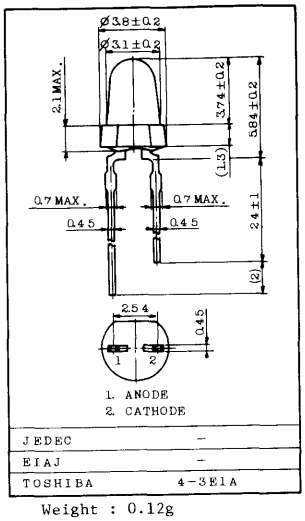
GaAsP ORANGE LIGHT EMISSION

3.1mm DIAMETER(T1)

FEATURES:

- SUPER-BRIGHT
- All Plastic Mold Type
  TL0163 : Light Orange Transparent Lens
  TL0164 : Light Orange Lusterless Lens
- Low Drive Current, High Intensity Orange Light Emission
  Recommended Forward Current : I_F=15~20mA(DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.

Unit in mm



JEDEC	–
EIAJ	–
TOSHIBA	4-3E1A

Weight : 0.12g

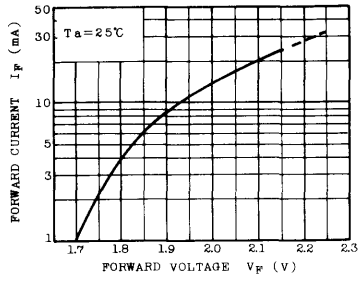
MAXIMUM RATINGS (Ta=25℃)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	T_{opr}	-20~75	°C
Storage Temperature Range	T_{stg}	-30~100	°C

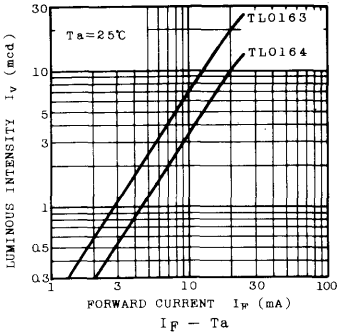
ELECTRO-OPTICAL CHARACTERISTICS (Ta=25℃)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	–	2.1	2.8	V
Reverse Current		I_R	V_R=4V	–	–	100	μA
Luminous Intensity	TL0163	I_V	I_F=20mA	10	20	–	mcd
	TL0164			5	10	–	
Peak Emission Wave Length		λ_P	I_F=20mA	–	610	–	nm
Spectral Line Half Width		$\Delta\lambda$	I_F=20mA	–	35	–	nm

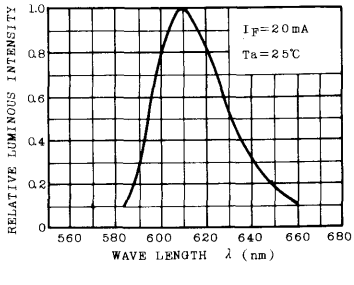
$I_F - V_F$



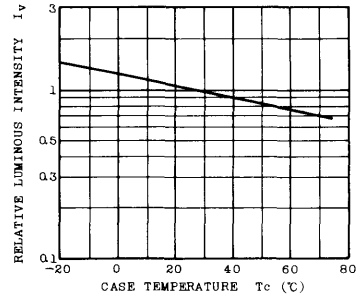
$I_V - I_F$



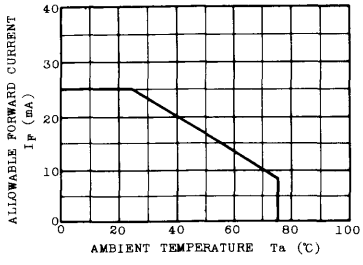
RELATIVE LUMINOUS INTENSITY — WAVE LENGTH



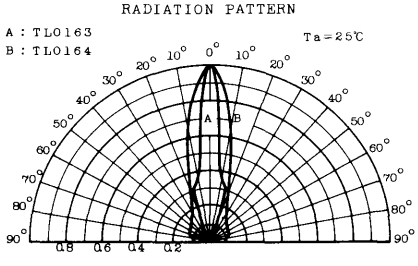
$I_V - T_C$



$I_F - Ta$



RADIATION PATTERN



TLUR113, TLUR114, TLUR120

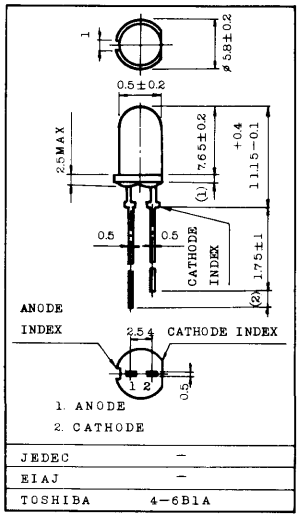
GaAlAs RED LIGHT EMISSION

PANEL CIRCUIT INDICATOR

FEATURES:

- ULTRA-BRIGHT
- All Plstic Mold Type
  TLUR113: Red Clear Lens
  TLUR114: Red Diffused Lens
  TLUR120: Light Red Clear Lens
- Low Drive Current, High Intensity Red Light Emission.
  Recommended Forward Current: I_F=15 ∿ 20mA(DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	4-6B1A

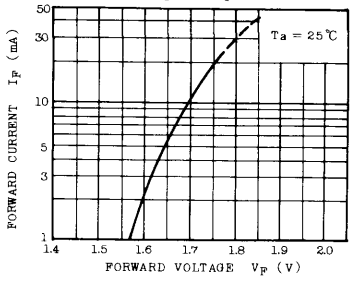
MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	55	mW
Operating Temperature Range	T_{opr}	-20 ∿ 75	°C
Storage Temperature Range	T_{stg}	-30 ∿ 100	°C

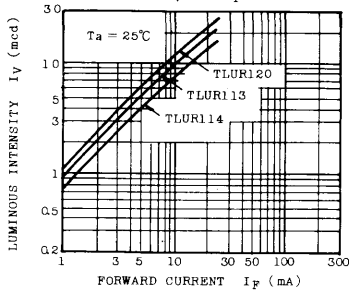
ELECTRO-OPTICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	-	1.75	2.2	V
Reverse Current		I_R	V_R=4V	-	-	100	μA
Luminous Intensity	TLUR113	I_V	I_F=20mA	-	20	-	mcd
	TLUR114			-	15	-	
	TLUR120			-	22	-	
Peak Emission Wave Length		λ_P	I_F=20mA	-	660	-	nm
Spectral Line Half Width		$\Delta\lambda$	I_F=20mA	-	25	-	nm

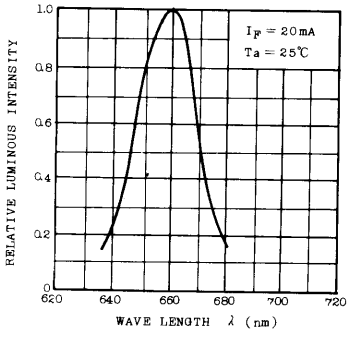
I_F - V_F



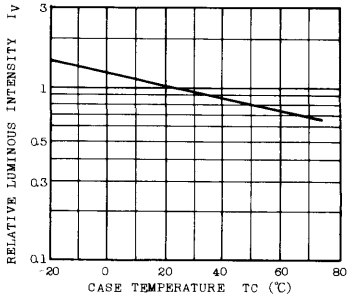
I_V - I_F



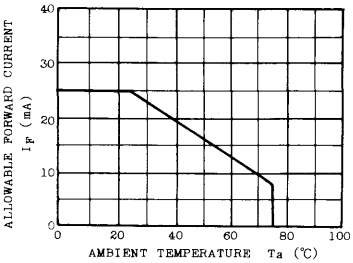
RELATIVE LUMINOUS INTENSITY - WAVE LENGTH



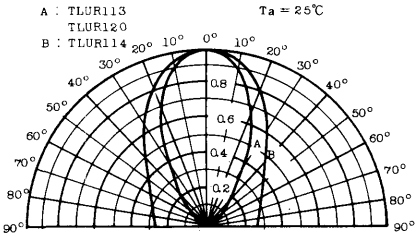
I_V - Tc



I_F - Ta



RADIATION PATTERN



TLUR113Q, TLUR114Q

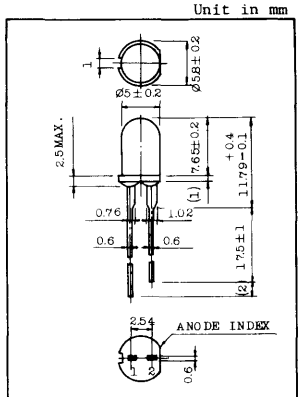
GaAlAs RED LIGHT EMISSION

PANEL CIRCUIT INDICATOR

FEATURES:

- ULTRA-BRIGHT
- All Plastic Mold Type
  TLUR113Q: Red Transparent Lens
  TLUR114Q: Red Lusterless Lens
- Low Drive Current, High Intensity Red Light Emission.
  Recommended Forward Current: I_F=15 ∿ 20mA(DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.
- Wire Wrappable Leads.

Unit in mm



JEDEC	-
EIAJ	-
TOSHIBA	4-6B4B

Weight: 0.35g

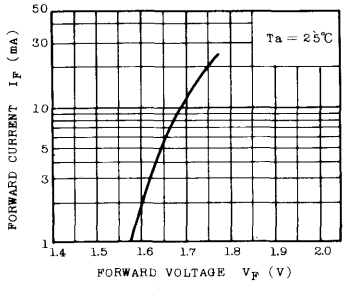
MAXIMUM RATINGS (Ta = 25 °C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	55	mW
Operating Temperature Range	T_{opr}	-20 ∿ 75	°C
Storage Temperature Range	T_{stg}	-30 ∿ 100	°C

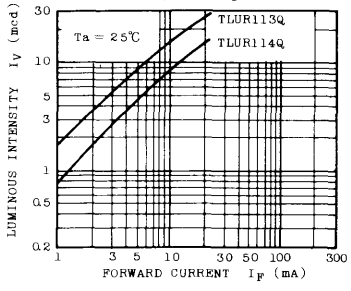
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25 °C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	-	1.75	2.2	V
Reverse Current		I_R	V_R=4V	-	-	100	μA
Luminous Intensity	TLUR113Q	I_V	I_F=15mA	5	20	-	mcd
	TLUR114Q			4	12	-	
Peak Emission Wave Length		λ_P	I_F=20mA	-	660	-	nm
Spectral Line Half Widht		$\Delta\lambda$	I_F=20mA	-	25	-	nm

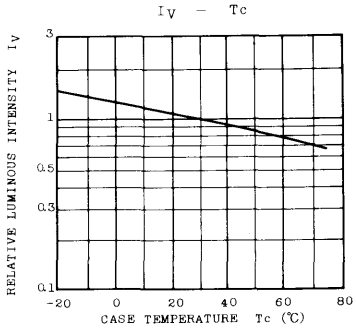
I_F – V_F



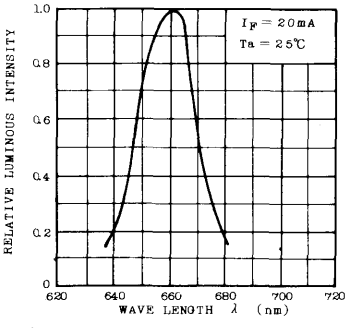
I_V – I_F



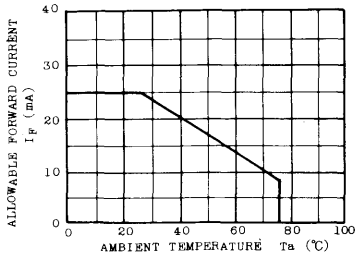
I_V – Tc



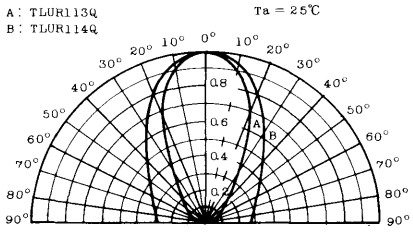
RELATIVE LUMINOUS INTENSITY – WAVE LENGTH



I_F – Ta



RADIATION PATTERN



TLUR123, TLUR124

GaAlAs RED LIGHT EMISSION

PANEL CIRCUIT INDICATOR

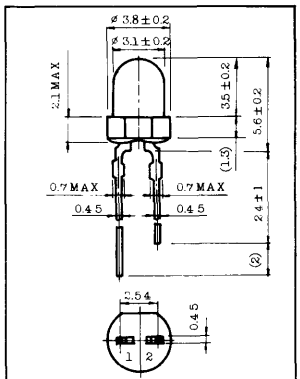
FEATURES:

- ULTRA-BRIGHT
- All Plastic Mold Type

  TLUR123: Red Clear Lens
  TLUR124: Red Diffused Lens
- Low Drive Current, High Intensity Red Light Emission.

  Recommended Forward Current: I_F=15 ∿ 20mA(DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.

Unit in mm



1. ANODE
2. CATHODE

JEDEC	—
EIAJ	—
TOSHIBA	4-4E1A
EIAJ	—
TOSHIBA	4-5L1A

Weight: 0.28g

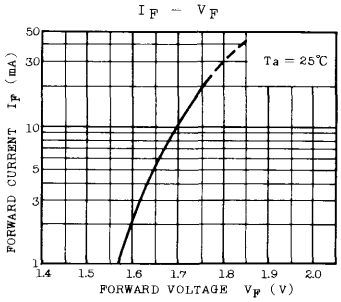
MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	55	mW
Operating Temperature Range	T_{opr}	-20 ∿ 75	°C
Storage Temperature Range	T_{stg}	-30 ∿ 100	°C

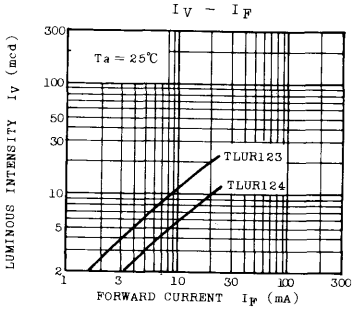
ELECTRO-OPTICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	-	1.75	2.2	V
Reverse Current		I_R	V_R=4V	-	-	100	μA
Luminous Intensity	TLUR123	I_V	I_F=20mA			-	mcd
	TLUR124					-	
Peak Emission Wave Length		λp	I_F=20mA	-	600	-	nm
Spectral Line Half Width		Δλ	I_F=20mA	-	25	-	nm

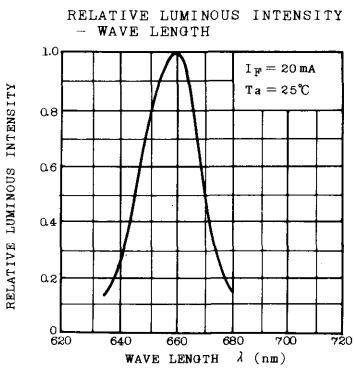
I_F – V_F



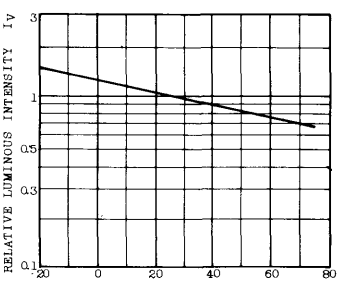
I_V – I_F



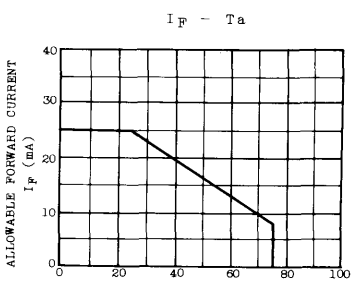
RELATIVE LUMINOUS INTENSITY – WAVE LENGTH



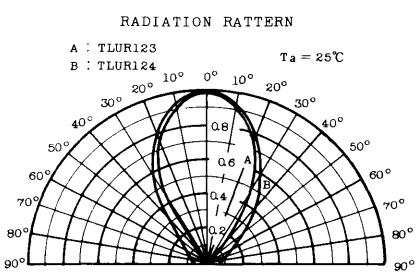
I_V – TC



I_F – Ta



RADIATION RATTERN



TLUR130

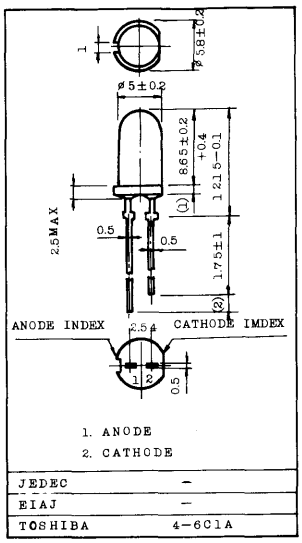
GaAlAs RED LIGHT EMISSION

PANEL CIRCUIT INDICATOR

FEATURES:

- ULTRA-BRIGHT
- All Plastic Mold Type
  TLUR130: Colorless Clear Lens
- Low Drive Current, High Intensity Red Light Emission.
  Recommended Forward Current: I_F=15 ∿ 20mA(DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	4−6C1A

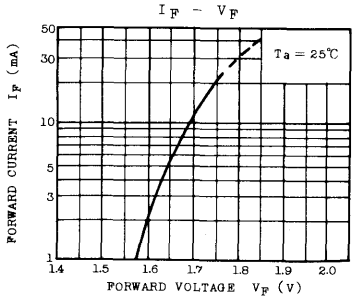
MAXIMUM RATINGS (Ta = 25 ℃)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	55	mW
Operating Temperature Range	T_{opr}	-20 ∿ 75	°C
Storage Temperature Range	T_{stg}	-30 ∿ 100	°C

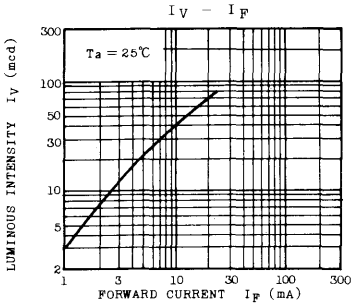
ELECTRO-OPTICAL CHARACTERISTICS (Ta = 25 ℃)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=20mA	-	1.75	2.2	V
Reverse Current	I_R	V_R=4V	-	-	100	μA
Luminous Intensity	I_V	I_F=20mA	-	70	-	mcd
Peak Emission Wave Length	λp	I_F=20mA	-	660	-	nm
Spectral Line Half Width	Δλ	I_F=20mA	-	25	-	nm

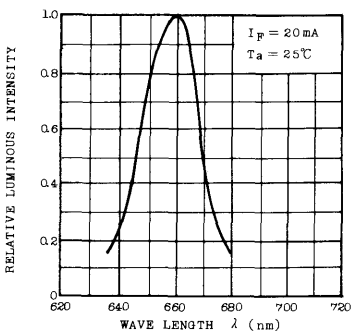
I_F − V_F



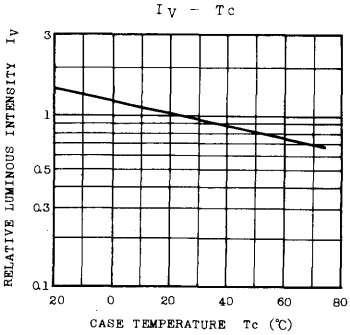
I_V − I_F



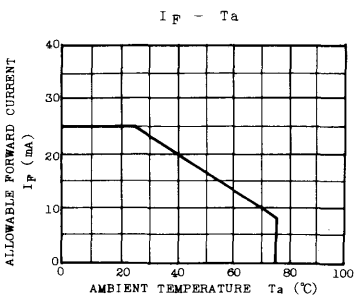
RELATIVE LUMINOUS INTENSITY − WAVE LENGTH



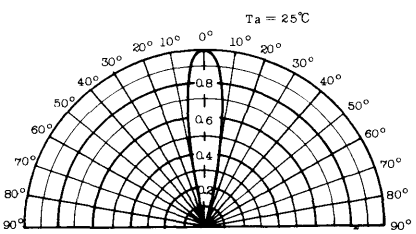
I_V − Tc



I_F − Ta



RADIATION PATTERN



TLUR143, TLUR144

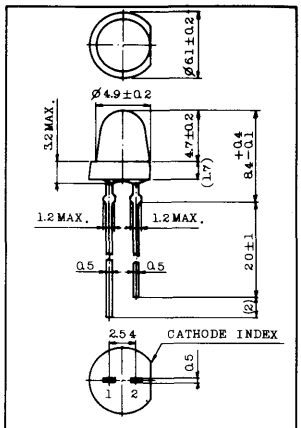
GaAlAs RED LIGHT EMISSION

4.9mm DIAMETER(T 13/4), LOW PROFILE)

FEATURES:

- ULTRA-BRIGHT
- All Plastic Mold Type
  TLUR143 : Light Red Transparent Lens
  TLUR144 : Light Red Lusterless Lens
- Low Drive Current, High Intensity Red Light Emission.
  Recommended Forward Current : I_F=15~20mA(DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	4-5M1A

Weight : 0.23g

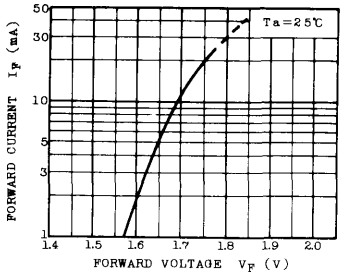
MAXIMUM RATINGS (Ta=25℃)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	55	mW
Operating Temperature Range	T_{opr}	-20~75	°C
Storage Temperature Range	T_{stg}	-30~100	°C

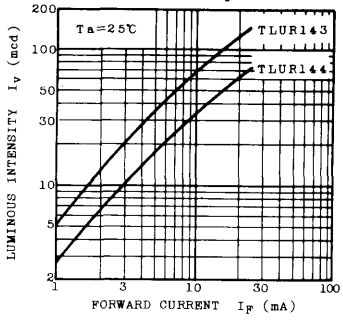
ELECTRO-OPTICAL CHARACTERISTICS (Ta=25℃)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forwad Voltage		V_F	I_F=20mA	-	1.75	2.2	V
Reverse Current		I_R	V_R=4V	-	-	100	μA
Luminous Intensity	TLUR143	I_V	I_F=15mA	30	100	-	mcd
	TLUR144			10	50	-	
Peak Emission Wave Length		λ_P	I_F=15mA	-	660	-	nm
Spectral Line Half Width		$\Delta\lambda$	I_F=15mA	-	25	-	nm

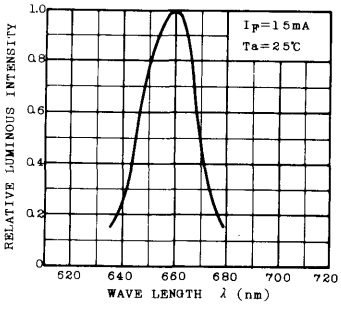
$I_F - V_F$



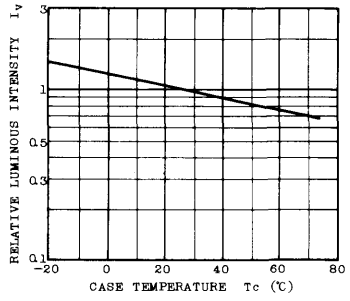
$I_V - I_F$



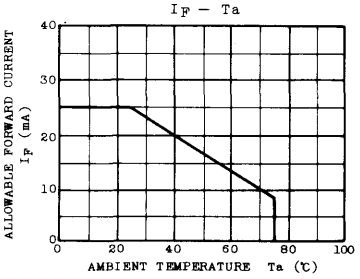
RELATIVE LUMINOUS INTENSITY — WAVE LENGTH



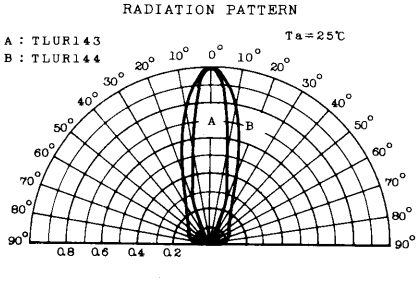
$I_V - Ta$



$I_F - Ta$



RADIATION PATTERN



TLUR150

GaAlAs RED LIGHT EMISSION

PANEL CIRCUIT INDICATOR

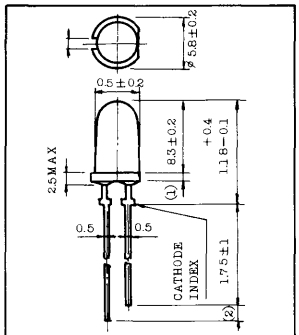
FEATURES:

- ULTRA-BRIGHT
- All Plastic Mold Type

  TLUR 150: Colorless Clear Lens
- Low Drive Current, High Intensity Red Light Emission.

  Recommended Forward Current: I_F=15 ∿ 20mA(DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	4−5L1A

Weight: 0.28g

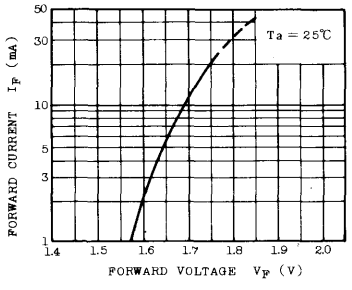
MAXIMUM RATINGS (Ta = 25 °C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	55	mW
Operating Temperature Range	T_{opr}	-20 ∿ 75	°C
Storage Temperature Range	T_{stg}	-30 ∿ 100	°C

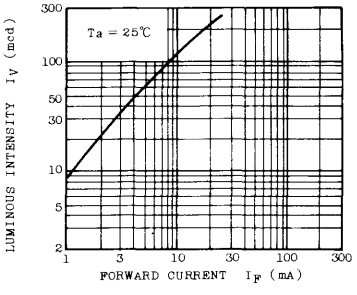
ELECTRO-OPTICAL CHARACTERISTICS (Ta = 25 °C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=20mA	-	1.75	2.2	V
Reverse Current	I_R	V_R=4V	-	-	100	μA
Luminous Intensity	I_V	I_F=20mA	50	220	-	mcd
Peak Emission Wave Length	λp	I_F=20mA	-	660	-	nm
Spectral Line Half Width	Δλ	I_F=20mA	-	25	-	nm

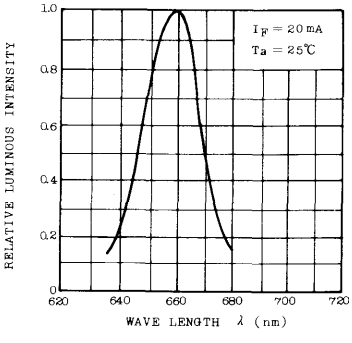
I_F - V_F



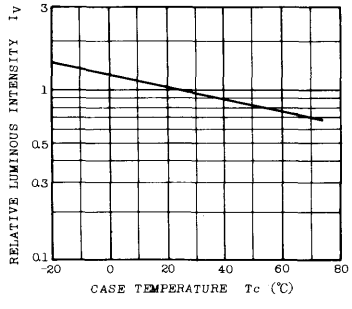
I_V - I_F



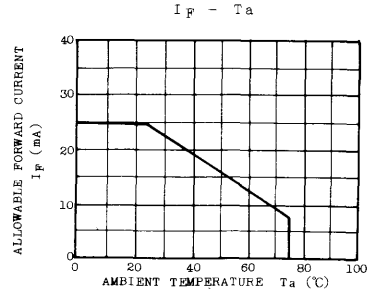
RELATIVE LUMINOUS INTENSITY - WAVE LENGTH



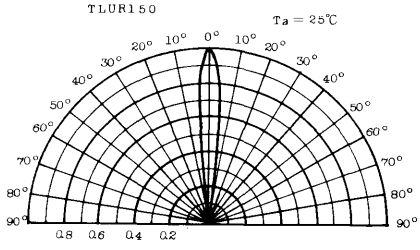
I_V - Tc



I_F - Ta



RADIATION PATTERN



TLUR153. TLUR154

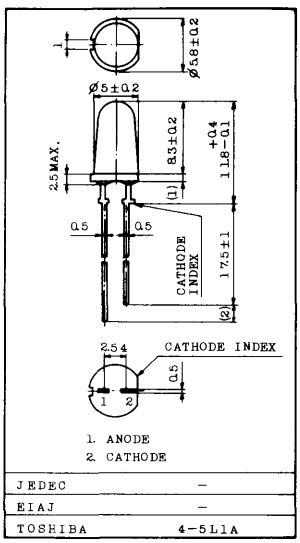
GaAlAs RED LIGHT EMISSION

5mm DIAMETER(T 13/4)

FEATURES:

- ULTRA-BRIGHT
- All Plastic Mold Type
  TLUR153 : Light Red Transparent Lens
  TLUR154 : Light Red Lusterless Lens
- Low Drive Current, High Intensity Red Light Emission.
  Recommended Forward Current : I_F=15 ~ 20mA(DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	4-5L1A

Weight : 0.28g

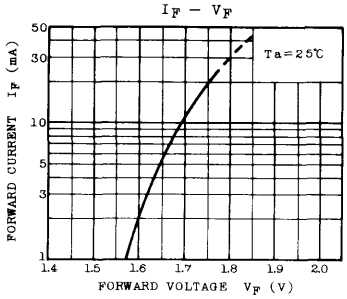
MAXIMUM RATINGS (Ta =25℃)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	55	mW
Operating Temperature Range	T_{opr}	-20 ~ 75	°C
Storage Temperature Range	T_{stg}	-30 ~ 100	°C

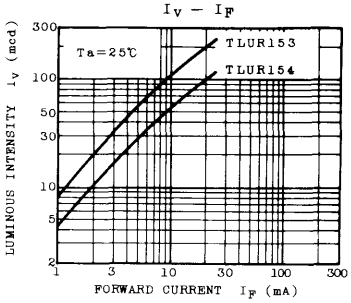
ELECTRO-OPTICAL CHARACTERISTICS (Ta =25℃)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	-	1.75	2.2	V
Reverse Current		I_R	V_R=4V	-	-	100	μA
Luminous Intensity	TLUR153	I_V	I_F=20mA	50	200	-	mcd
	TLUR154			15	100	-	
Peak Emission Wave Length		λ_P	I_F=20mA	-	660	-	nm
Spectral Line Half Width		$\Delta\lambda$	I_F=20mA	-	25	-	nm

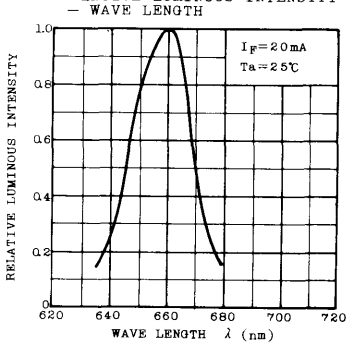
$I_F - V_F$



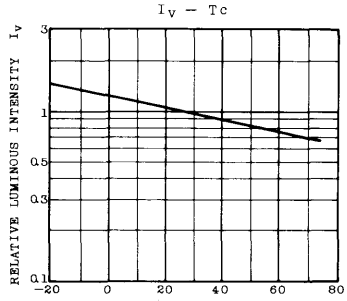
$I_V - I_F$



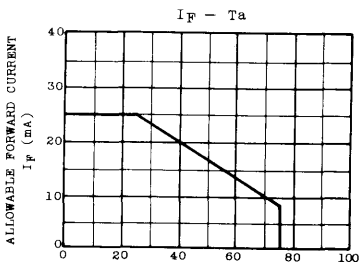
RELATIVE LUMINOUS INTENSITY — WAVE LENGTH



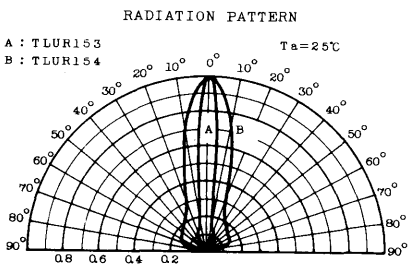
I_V — Tc



I_F — Ta



RADIATION PATTERN



TLUR153Q, TLUR154Q

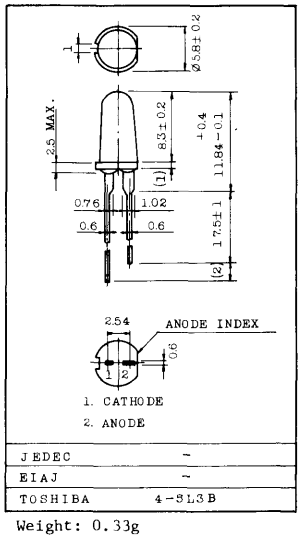
GaAlAs RED LIGHT EMISSION

PANEL CIRCUIT INDICATOR

FEATURES:

- ULTRA-BRIGHT
- All Plastic Mold Type
  TLUR153Q: Light Red Transparent Lens
  TLUR154Q: Light Red Lusterless Lens
- Low Drive Current, High Intensity Red Light Emission.
  Recommended Forward Current: I_F=15 ∿ 20mA(DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.
- Wire Wrappable Leads.

Unit in mm



JEDEC	–
EIAJ	–
TOSHIBA	4-3L3B

Weight: 0.33g

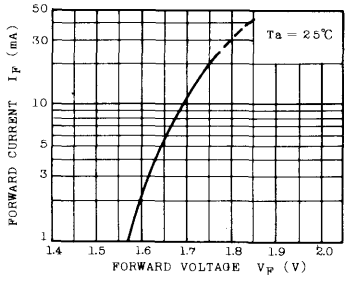
MAXIMUM RATINGS (Ta = 25 °C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	55	mW
Operating Temperature Range	T_{opr}	-20 ∿ 75	°C
Storage Temperature Range	T_{stg}	-30 ∿ 100	°C

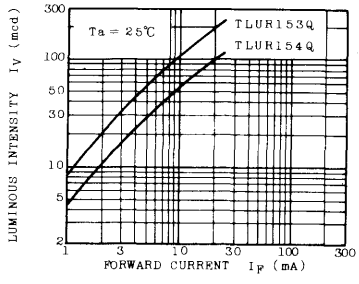
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25 °C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	–	1.75	2.2	V
Reverse Current		I_R	V_R=4V	–	–	100	μA
Luminous Intensity	TLUR153Q	I_V	I_F=20mA	50	200	–	mcd
	TLUR154Q			15	100	–	
Peak Emission Wave Length		λP	I_F=20mA	–	660	–	nm
Spectral Line Half Width		Δλ	I_F=20mA	–	25	–	nm

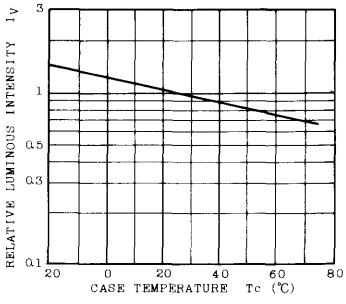
I_F – V_F



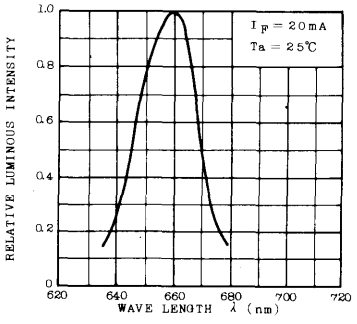
I_V – I_F



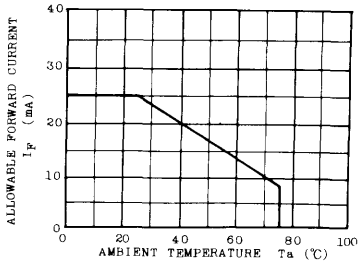
I_V – Tc



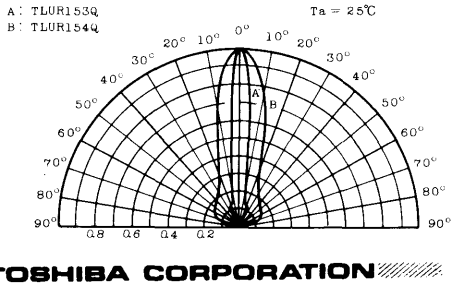
RELATIVE LUMINOUS INTENSITY – WAVE LENGTH



I_F – Ta



RADIATION PATTERN



TLUR163, TLUR164

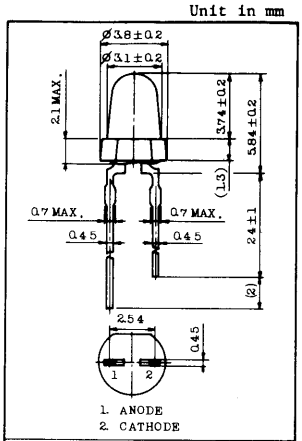
GaAlAs RED LIGHT EMISSION

3.1mm DIAMETER(T1)

FEATURES:

- ULTRA-BRIGHT
- All Plastic Mold Type
  TLUR163 : Light Red Transparent Lens
  TLUR164 : Light Red Lusterless Lens
- Low Drive Current, High Intensity Red Light Emission.
  Recommended Forward Current : I_F=15~20mA(DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.

Unit in mm



JEDEC	–
EIAJ	–
TOSHIBA	4-3E1A

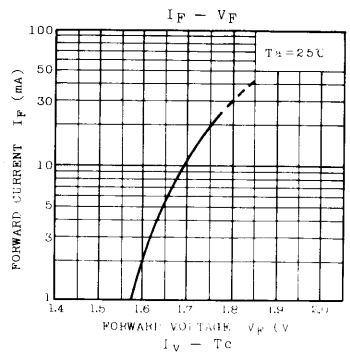
Weight : 0.12g

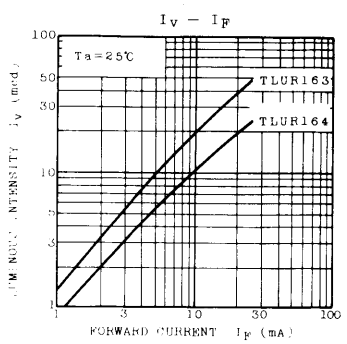
MAXIMUM RATINGS (Ta =25°C)

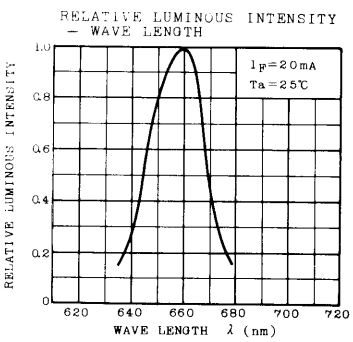
CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	55	mW
Operating Temperature Range	T_{opr}	-20~75	°C
Storage Temperature Range	T_{stg}	-30~100	°C

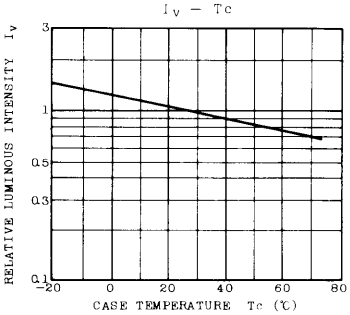
ELECTRO-OPTICAL CHARACTERISTICS (Ta =25°C)

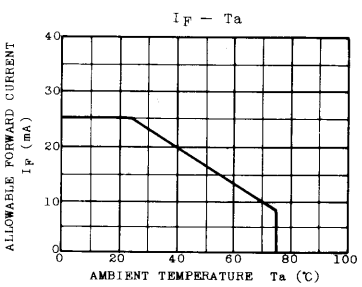
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	-	1.75	2.2	V
Reverse Current		I_R	V_R=4V	-	-	100	μA
Luminous Intensity	TLUR163	I_V	I_F=20mA	20	40	-	mcd
	TLUR164			10	20	-	
Peak Emission Wave Length		λ_P	I_F=20mA	-	660	-	nm
Spectral Line Half Width		$\Delta\lambda$	I_F=20mA	-	25	-	nm

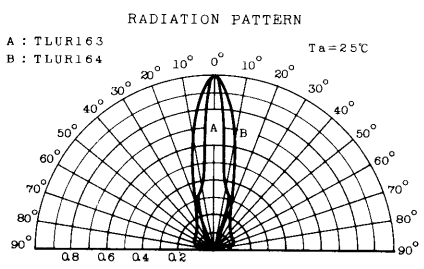












TLUG143, TLUG144

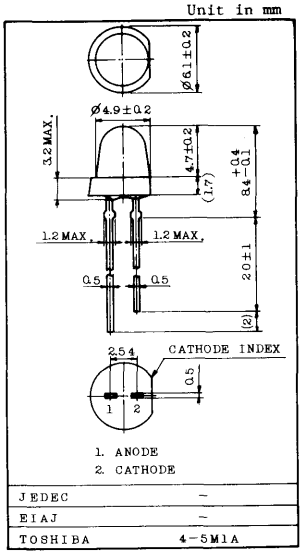
GaP GREEN LIGHT EMISSION

4.9mm DIAMETER(T 1 3/4, LOW PROFILE)

FEATURES:

- ULTRA-BRIGHT
- All Plastic Mold Type
  TLUG143 : Green Transparent Lens
  TLUG144 : Green Lusterless Lens
- Low Drive Current, High Intensity Green Light Emission.
  Recommended Forward Current : I_F=15 ~ 20mA(DC)
- All Plastic Molded Lens, Porvides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	4-5M1A

Weight : 0.23g

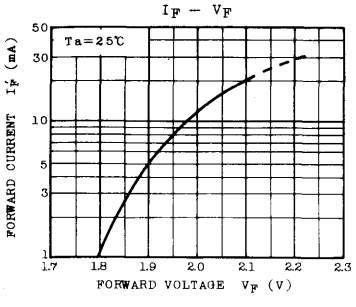
MAXIMUM RATINGS (Ta =25℃)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	T_{opr}	-20 ~ 75	°C
Storage Temperature Range	T_{stg}	-30 ~ 100	°C

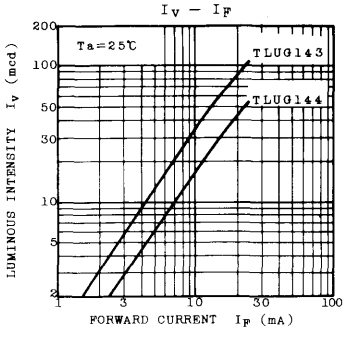
ELECTRO-OPTICAL CHARACTERISTICS (Ta =25℃)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current		I_R	V_R=4V	-	-	5	μA
Luminous Intensity	TLUG143	I_V	I_F=15mA	30	60	-	mcd
	TLUG144			10	30	-	
Peak Emission Wave Length		λ_P	I_F=15mA	-	565	-	nm
Spectral Line Half Width		$\Delta\lambda$	I_F=15mA	-	25	-	nm

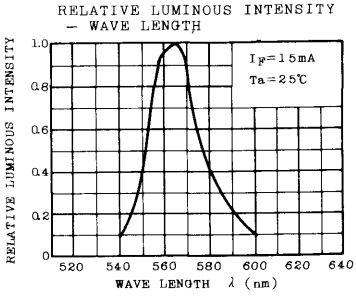
I_F – V_F



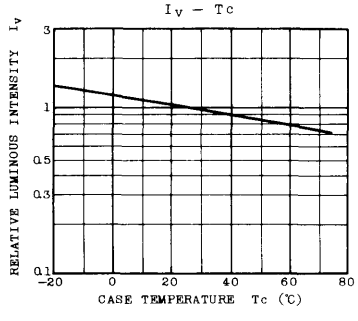
I_V – I_F



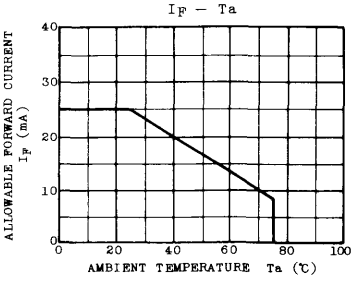
RELATIVE LUMINOUS INTENSITY – WAVE LENGTH



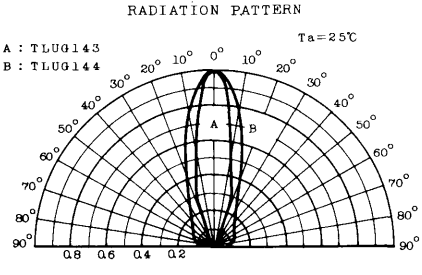
I_V – Tc



I_F – Ta



RADIATION PATTERN



TLUG153, TLUG154

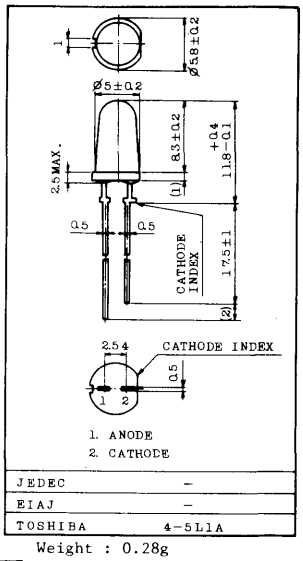
GaP GREEN LIGHT EMISSION

5mm DIAMETER(T 13/4)

FEATURES:

- ULTRA-BRIGHT
- All Plastic Mold Type
  TLUG153 : Light Green Transparent Lens
  TLUG154 : Light Green Lusterless Lens
- Low Drive Current, High Intensity Green Light Emission.
  Recommended Forward Current : I_F=15~20mA(DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.

Unit in mm



JEDEC	–
EIAJ	–
TOSHIBA	4-5L1A

Weight : 0.28g

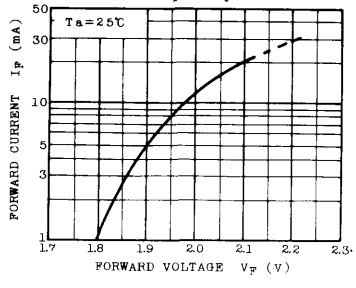
MAXIMUM RATINGS (Ta=25℃)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	T_{opr}	-20~75	°C
Storage Temperature Range	T_{stg}	-30~100	°C

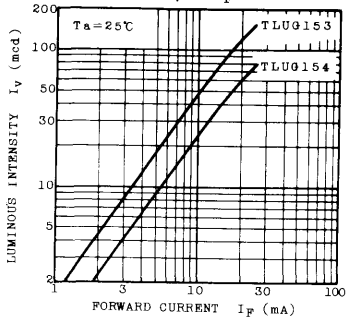
ELECTRO-OPTICAL CHARACTERISTICS (Ta=25℃)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	–	2.1	2.8	V
Reverse Current		I_R	V_R=4V	–	–	5	μA
Luminous Intensity	TLUG153	I_V	I_F=20mA	60	120	–	mcd
	TLUG154			20	60	–	
Peak Emission Wave Length		λ_P	I_F=20mA	–	565	–	nm
Spectral Line Half Width		$\Delta\lambda$	I_F=20mA	–	25	–	nm

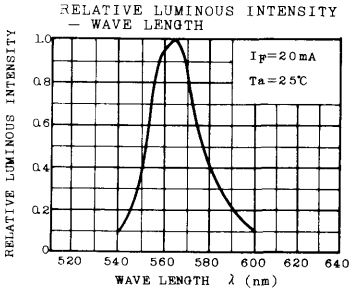
$I_F - V_F$



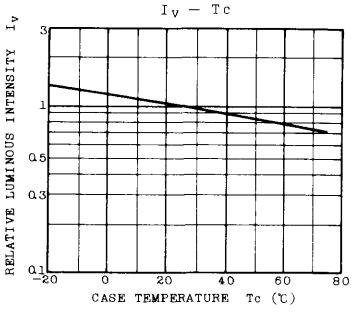
$I_V - I_F$



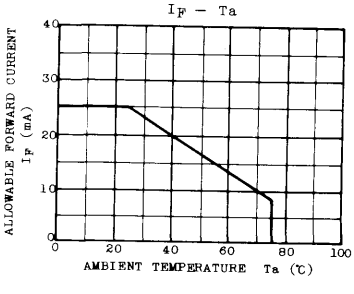
RELATIVE LUMINOUS INTENSITY — WAVE LENGTH



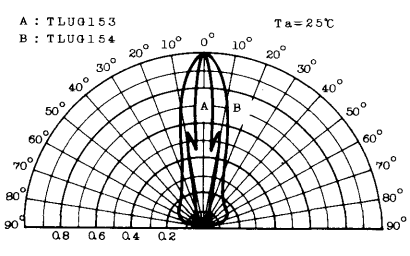
$I_V - T_C$



$I_F - T_a$



RADIATION PATTERN



TLUG153Q, TLUG154Q

GaP GREEN LIGHT EMISSION

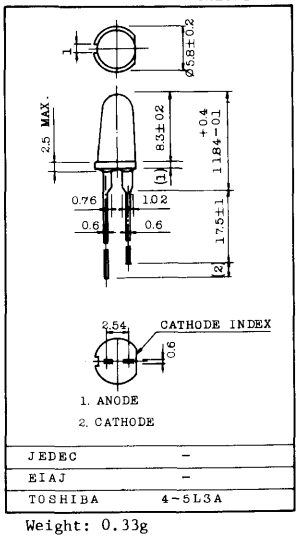
PANEL CIRCUIT INDICATOR

FEATURES:

- ULTRA-BRIGHT
- All Plastic Mold Type

  TLUG153Q: Light Green Transparent Lens
  TLUG154Q: Light Green Lusterless Lens
- Low Drive Current, High Intensity Green Light Emission.
  Recommended Forward Current: I_F=15 ∿ 20mA(DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.
- Wire Wrappable Leads.

Unit in mm



JEDEC	–
EIAJ	–
TOSHIBA	4-5L3A

Weight: 0.33g

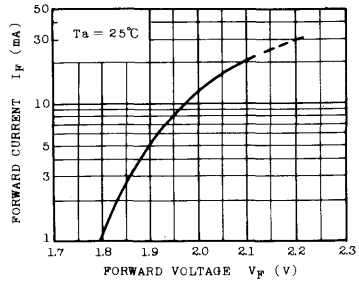
MAXIMUM RATINGS (Ta = 25 °C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	T_{opr}	-20 ∿ 75	°C
Storage Temperature Range	T_{stg}	-30 ∿ 100	°C

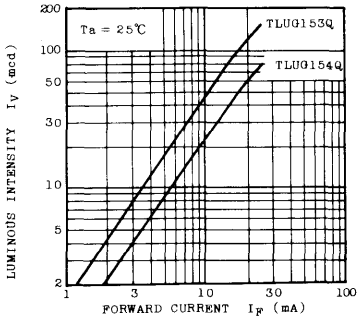
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25 °C)

CHARACTERISITC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	–	2.1	2.8	V
Reverse Current		I_R	V_R=4V	–	–	5	μA
Luminous Intensity	TLUG153Q	I_V	I_F=20mA	60	120	–	mcd
	TLUG154Q			20	60	–	
Peak Emission Wave Length		λP	I_F=20mA	–	565	–	nm
Spectral Line Half Width		Δλ	I_F=20mA	–	25	–	nm

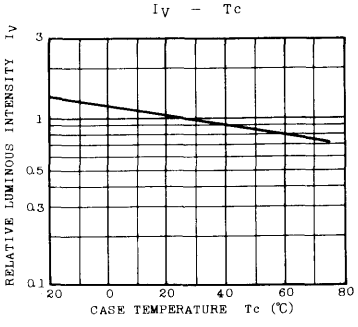
I_F – V_F



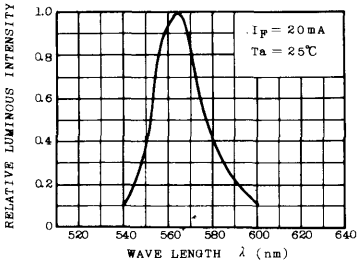
I_V – I_F



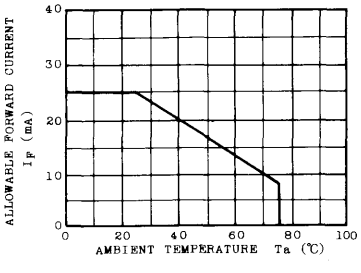
I_V – Tc



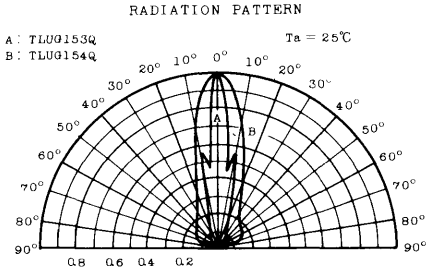
RELATIVE LUMINOUS INTENSITY – WAVE LENGTH



I_F – Ta



RADIATION PATTERN



TLUG163, TLUG164

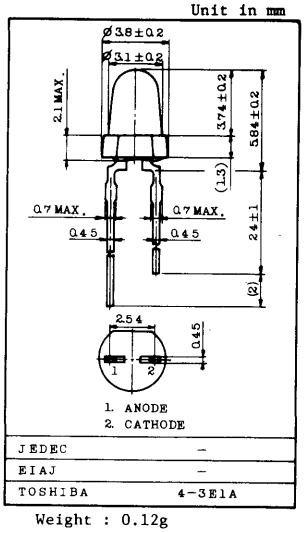
GaP GREEN LIGHT EMISSION

3.1mm DIAMETER(T1)

FEATURES:

- ULTRA-BRIGHT
- All Plastic Mold Type
  TLUG163 : Light Green Transparent Lens
  TLUG164 : Light Green Lusterless Lens
- Low Drive Current, High Intensity Green Light Emission.
  Recommended Forward Current : I_F=15~20mA(DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.

Unit in mm



JEDEC	–
EIAJ	–
TOSHIBA	4-3E1A

Weight : 0.12g

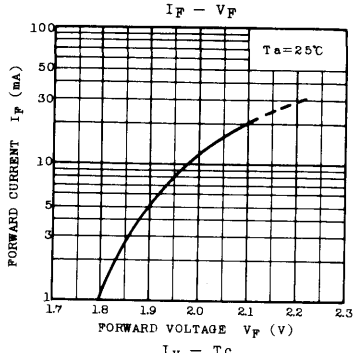
MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	T_{opr}	-20~75	°C
Storage Temperature Range	T_{stg}	-30~100	°C

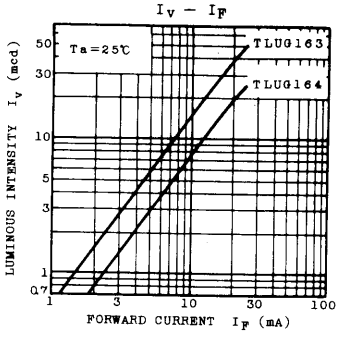
ELECTRO-OPTICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current		I_R	V_R=4V	-	-	5	μA
Luminous Intensity	TLUG163	I_V	I_F=20mA	20	40	-	mcd
	TLUG164			10	20	-	
Peak Emission Wave Length		λ_P	I_F=20mA	-	565	-	nm
Spectral Line Half Width		$\Delta\lambda$	I_F=20mA	-	25	-	nm

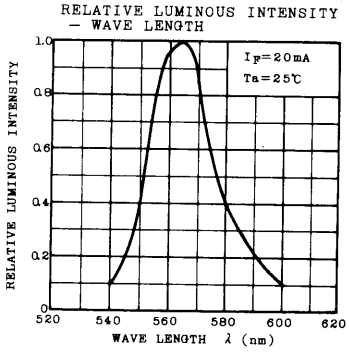
$I_F - V_F$



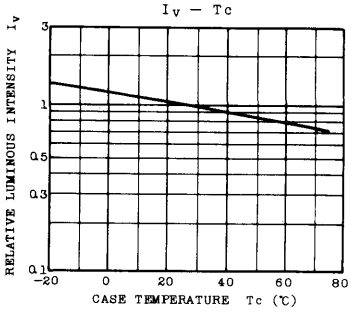
$I_V - I_F$



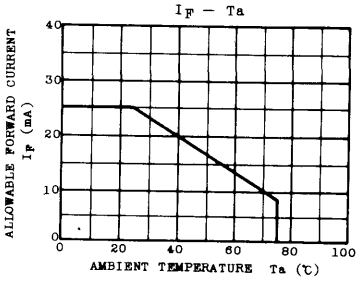
RELATIVE LUMINOUS INTENSITY – WAVE LENGTH



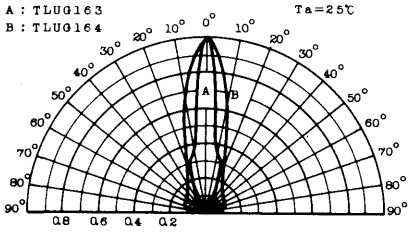
$I_V - Tc$



$I_F - Ta$



RADIATION PATTERN



TLUY143, TLUY144

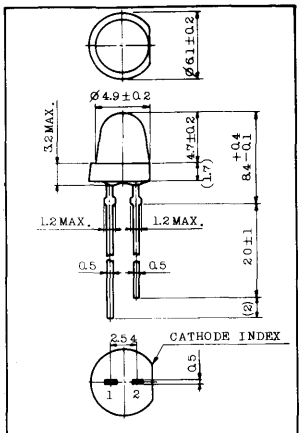
GaAsP YELLOW LIGHT EMISSION

4.9mm DIAMETER(T 13/4, LOW PROFILE)

FEATURES:

- ULTRA-BRIGHT
- All Plastic Mold Type
  TLUY143 : Yellow Transparent Lens
  TLUY144 : Yellow Lusterless Lens
- Low Drive Current, High Intensity Yellow Light Emission.
  Recommended Forward Current : I_F=15 ~ 20mA(DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	4-5M1A

Weight : 0.23g

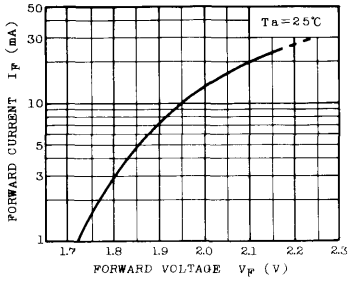
MAXIMUM RATINGS (Ta =25℃)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	T_{opr}	-20 ~ 75	°C
Storage Temperature Range	T_{stg}	-30 ~ 100	°C

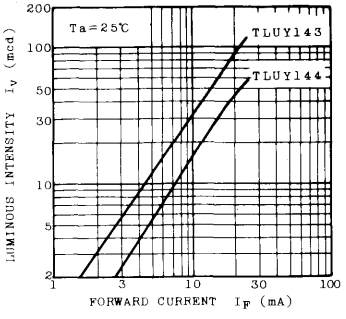
ELECTRO-OPTICAL CHARACTERISTICS (Ta =25℃)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current		I_R	V_R=4V	-	-	100	μA
Luminous Intensity	TLUY143	I_V	I_F=15mA	30	60	-	mcd
	TLUY144			10	30	-	
Peak Emission Wave Length		λ_P	I_F=15mA	-	585	-	nm
Spectral Line Half Width		$\Delta\lambda$	I_F=15mA	-	32	-	nm

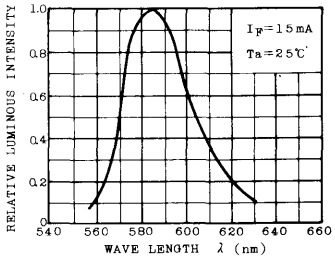
I_F — V_F



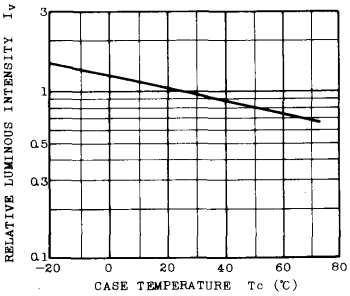
I_V — I_F



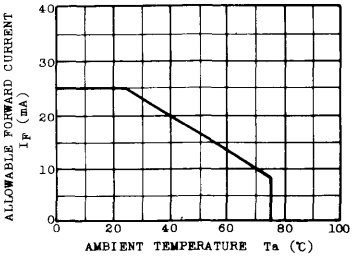
RELATIVE LUMINOUS INTENSITY — WAVE LENGTH



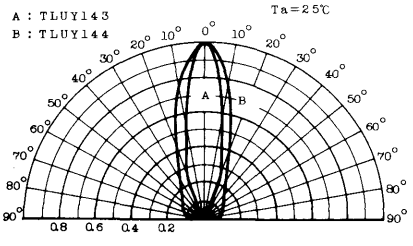
I_V — Tc



I_F — Ta



RADIATION PATTERN



TLUY153, TLUY154

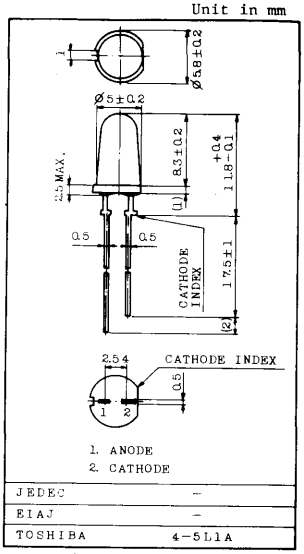
GaAsP YELLOW LIGHT EMISSION

5mm DIAMETER(T 13/4)

FEATURES:

- ULTRA-BRIGHT
- All Plastic Mold Type
  TLUY153 : Light Yellow Transparent Lens
  TLUY154 : Light Yellow Lusterless Lens
- Low Drive Current, High Intensity Yellow Light Emission.
  Recommended Forward Current : I_F=15~20mA(DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	4-5L1A

Weight : 0.28g

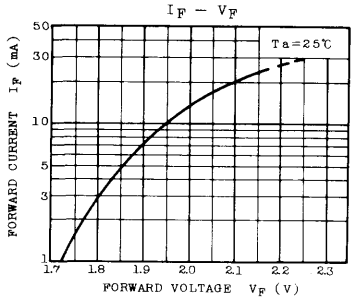
MAXIMUM RATINGS (Ta =25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	T_{opr}	-20~75	°C
Storage Temperature Range	T_{stg}	-30~100	°C

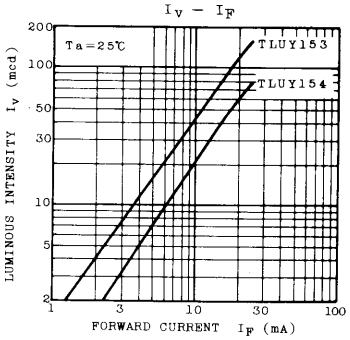
ELECTRO-OPTICAL CHARACTERISTICS (Ta =25°C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current		I_R	V_R=4V	-	-	100	μA
Luminous Intensity	TLUY153	I_V	I_F=20mA	60	120	-	mcd
	TLUY154			20	60	-	
Peak Emission Wave Length		λ_P	I_F=20mA	-	585	-	nm
Spectral Line Half Width		$\Delta\lambda$	I_F=20mA	-	32	-	nm

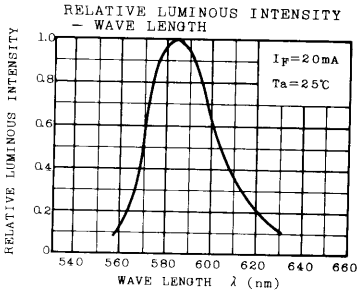
$I_F - V_F$



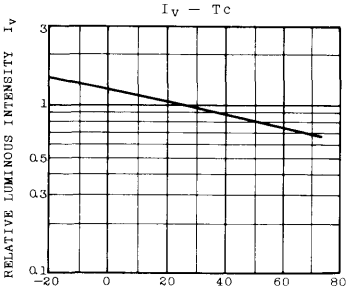
$I_V - I_F$



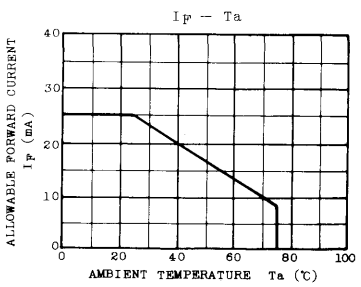
RELATIVE LUMINOUS INTENSITY — WAVE LENGTH



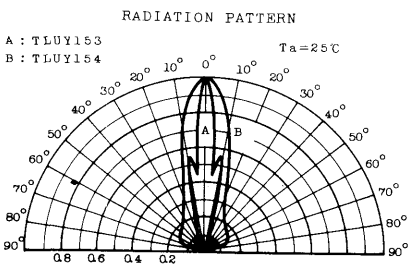
$I_V - T_C$



$I_F - T_a$



RADIATION PATTERN



TLUY153Q, TLUY154Q

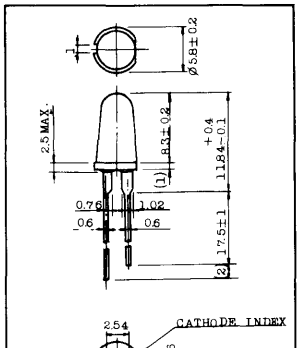
GaAsP YELLOW LIGHT EMISSION

PANEL CIRCUIT INDICATOR

FEATURES:

- ULTRA-BRIGHT
- All Plastic Mold Type
  TLUY153Q: Light Yellow Transparent Lens
  TLUY154Q: Light Yellow Lusterless Lens
- Low Drive Current, High Intensity Yellow Light Emission.
  Recommended Forward Current: I_F=15 ∿ 20mA(DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.
- Wire Wrappable Leads.

Unit in mm



JEDEC	–
EIAJ	–
TOSHIBA	4-5L3A

Weight: 0.33g

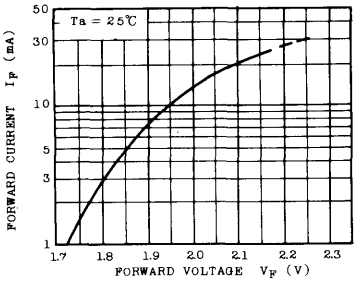
MAXIMUM RATINGS (Ta = 25 °C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	T_{opr}	-20 ∿ 75	°C
Storage Temperature Range	T_{stg}	-30 ∿ 100	°C

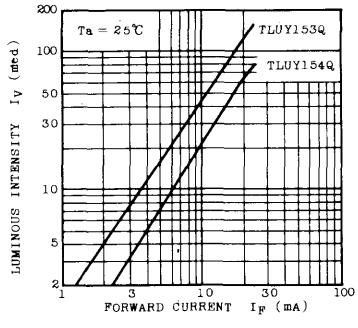
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25 °C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	–	2.1	2.8	V
Reverse Current		I_R	V_R=4V	–	–	100	μA
Luminous Intensity	TLUY153Q	I_V	I_F=20mA	60	120	–	mcd
	TLUY154Q			20	60	–	
Peak Emission Wave Length		λP	I_F=20mA	–	585	–	nm
Spectral Line Half Width		Δλ	I_F=20mA	–	32	–	nm

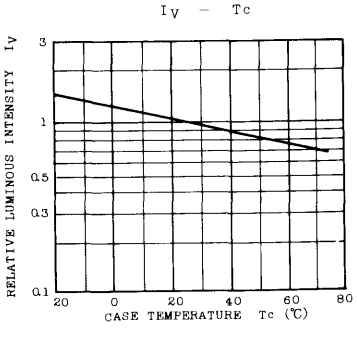
I_F – V_F



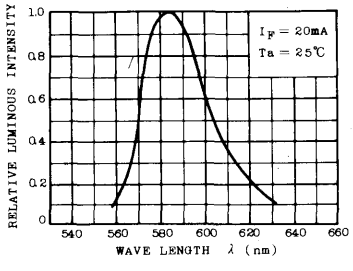
I_V – I_F



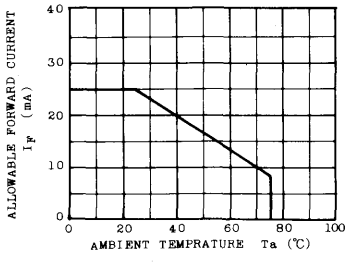
I_V – Tc



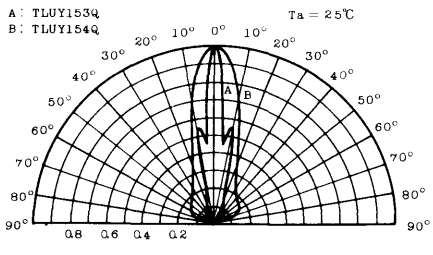
RELATIVE LUMINOUS INTENSITY – WAVE LENGTH



I_F – Ta



RADIATION PATTERN



TLUY163, TLUY164

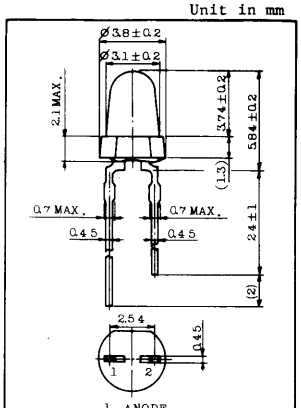
GaAsP YELLOW LIGHT EMISSION

3.1mm DIAMETER(T1)

FEATURES:

- ULTRA-BRIGHT
- All Plastic Mold Type
  TLUY163 : Light Yellow Transparent Lens
  TLUY164 : Light Yellow Lusterless Lens
- Low Drive Current, High Intensity Yellow Light Emission
  Recommended Forward Current : I_F=15~20mA(DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.

Unit in mm



JEDEC	–
EIAJ	–
TOSHIBA	4-3E1A

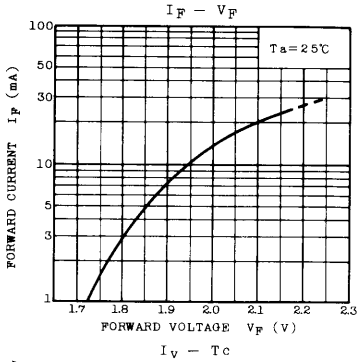
Weight : 0.12g

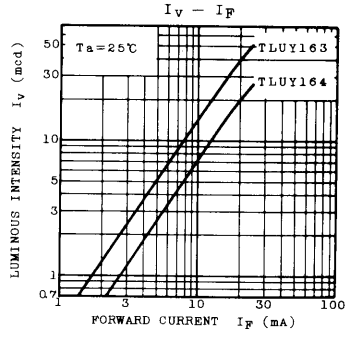
MAXIMUM RATINGS (Ta =25°C)

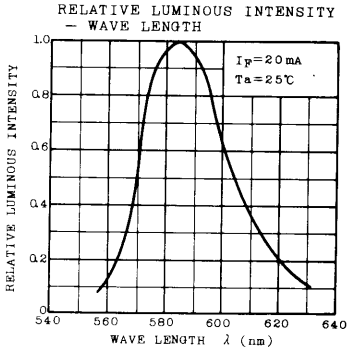
CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	T_{opr}	-20~75	°C
Storage Temperature Range	T_{stg}	-30~100	°C

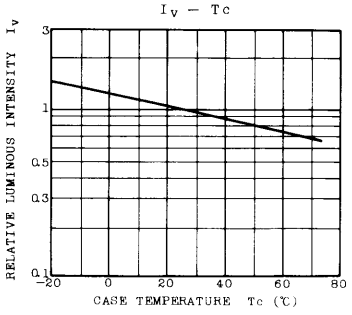
ELECTRO-OPTICAL CHARACTERISTICS (Ta =25°C)

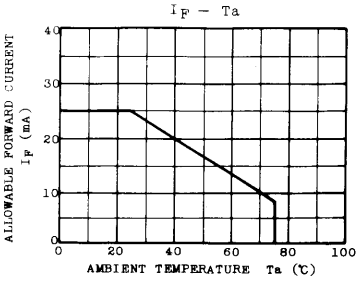
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current		I_R	V_R=4V	-	-	100	μA
Luminous Intensity	TLUY163	I_V	I_F=20mA	20	40	-	mcd
	TLUY164			10	20	-	
Peak Emission Wave Length		λ_P	I_F=20mA	-	585	-	nm
Spectral Line Half Width		$\Delta\lambda$	I_F=20mA	-	32	-	nm

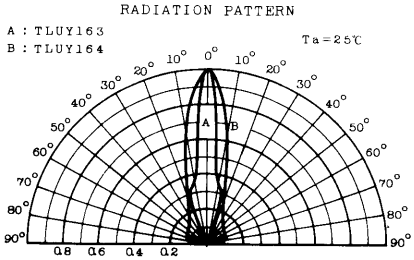












TLPG143, TLPG144

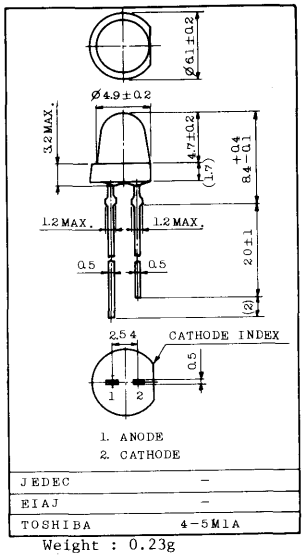
GaP GREEN LIGHT EMISSION

4.9mm DIAMETER(T 13/4, LOW PROFILE)

FEATURES:

- PURE COLOR
- All Plastic Mold Type
  TLPG143 : Light Green Transparent Lens
  TLPG144 : Light Green Lusterless Lens
- Low Drive Current, High Intensity Green Light Emission.
  Recommended Forward Current : I_F=15 ~ 20mA(DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.

Unit in mm



JEDEC	–
EIAJ	–
TOSHIBA	4-5M1A

Weight : 0.23g

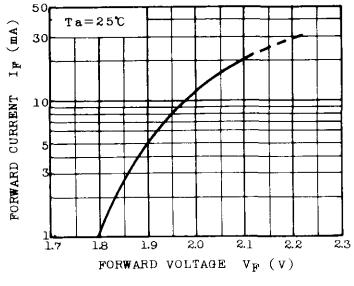
MAXIMUM RATINGS (Ta =25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	T_{opr}	-20 ~ 75	°C
Storage Temperature Range	T_{stg}	-30 ~ 100	°C

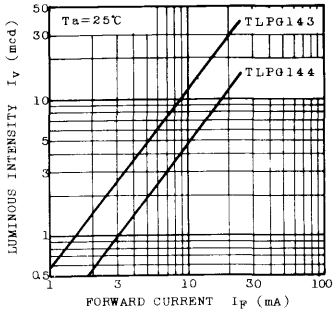
ELECTRO-OPTICAL CHARACTERISTICS (Ta =25°C)

CHARACTERISTC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	–	2.1	2.8	V
Reverse Current		I_R	V_R=4V	–	–	5	μA
Luminous Intensity	TLPG143	I_V	I_F=15mA	5	20	–	mcd
	TLPG144			2	8	–	
Peak Emission Wave Length		λ_P	I_F=15mA	–	555	–	nm
Spectral Line Half Width		$\Delta\lambda$	I_F=15mA	–	20	–	nm

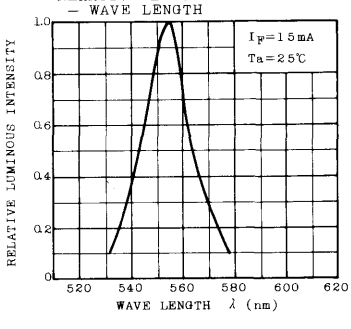
$I_F - V_F$



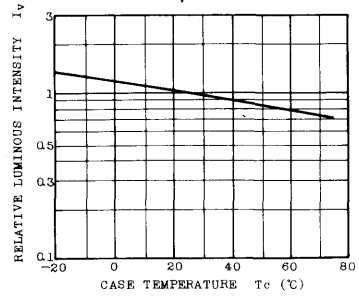
$I_V - I_F$



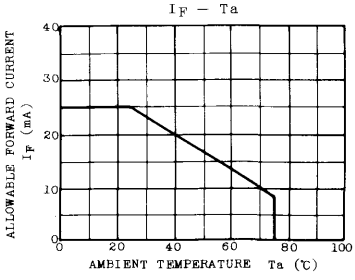
RELATIVE LUMINOUS INTENSITY – WAVE LENGTH



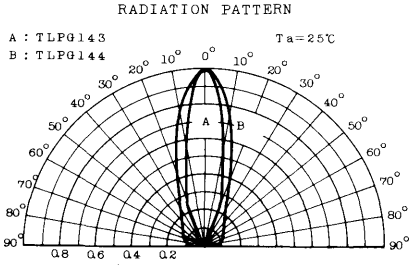
$I_V - T_C$



$I_F - T_a$



RADIATION PATTERN



TLPG153, TLPG154

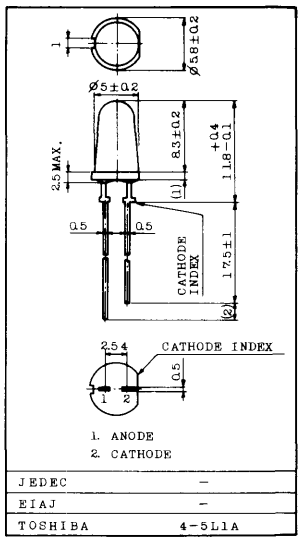
GaP GREEN LIGHT EMISSION

5mm DIAMETER(T 13/4)

FEATURES:

- PURE COLOR
- All Plastic Mold Type
  TLPG153 : Light Green Transparent Lens
  TLPG154 : Light Green Lusterless Lens
- Low Drive Current, High Intensity Green Light Emission.
  Recommended Forward Current : I_F=15 ~ 20mA(DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	4-5L1A

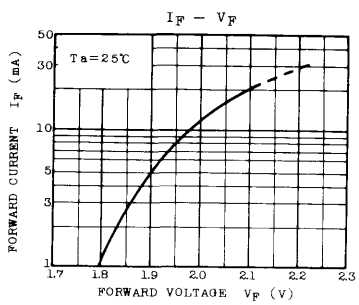
Weight : 0.28g

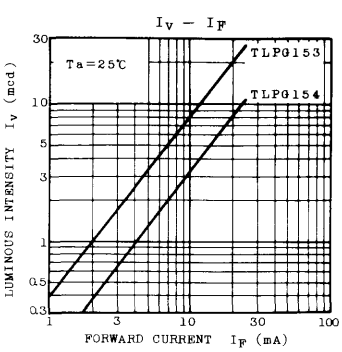
MAXIMUM RATINGS (Ta =25°C)

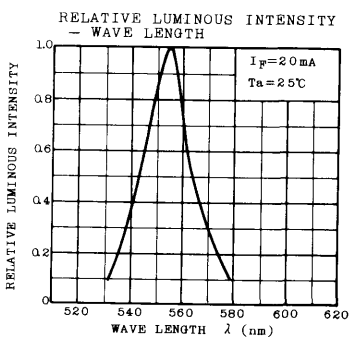
CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	T_{opr}	-20 ~ 75	°C
Storage Temperature Range	T_{stg}	-30 ~ 100	°C

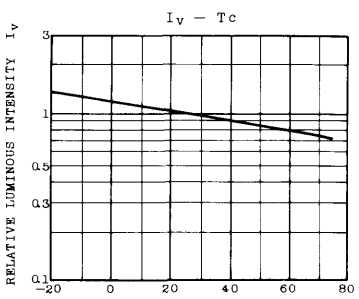
ELECTRO-OPTICAL CHARACTERISTICS (Ta =25°C)

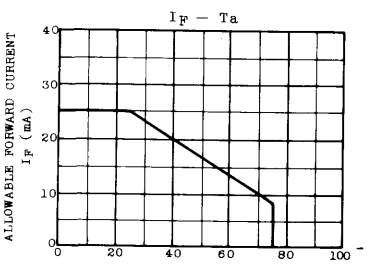
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current		I_R	V_R=4V	-	-	5	μA
Luminous Intensity	TLPG153	I_V	I_F=20mA	10	20	-	mcd
	TLPG154			4	8	-	
Peak Emission Wave Length		λ_P	I_F=20mA	-	555	-	nm
Spectral Line Half Width		$\Delta\lambda$	I_F=20mA	-	20	-	nm

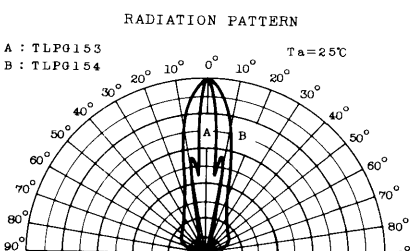












TLPG153Q, TLPG154Q

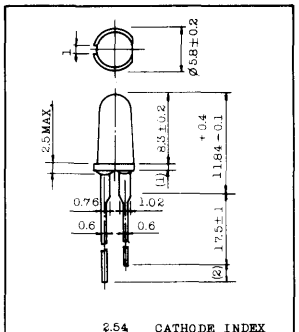
GaP GREEN LIGHT EMISSION

PANEL CIRCUIT INDICATOR

FEATURES:

- PURE COLOR
- All Plastic Mold Type
  TLPG153Q: Light Green Transparent Lens
  TLPG154Q: Light Green Lusterless Lens
- Low Drive Current, High Intensity Green Light Emission.
  Recommended Forward Current: I_F=15 ∿ 20mA(DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.
- Wire Wrappable Leads.

Unit in mm



JEDEC	–
EIAJ	–
TOSHIBA	4-5L3A

Weight: 0.33g

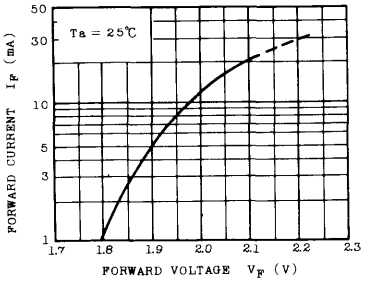
MAXIMUM RATINGS (Ta = 25 °C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	T_{opr}	-20 ∿ 75	°C
Storage Temperature Range	T_{stg}	-30 ∿ 100	°C

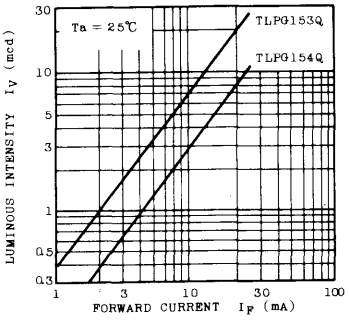
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25 °C)

CHARACTERISITC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	–	2.1	2.8	V
Reverse Current		I_R	V_R=4V	–	–	5	μA
Luminous Intensity	TLPG153Q	I_V	I_F=20mA	10	20	–	mcd
	TLPG154Q			4	8	–	
Peak Emission Wave Length		λP	I_F=20mA	–	555	–	nm
Spectral Line Half Width		Δλ	I_F=20mA	–	20	–	nm

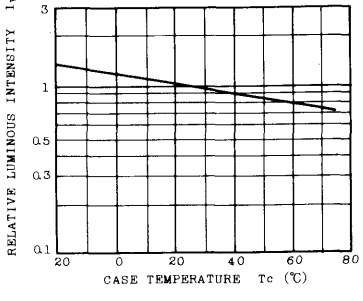
I_F – V_F



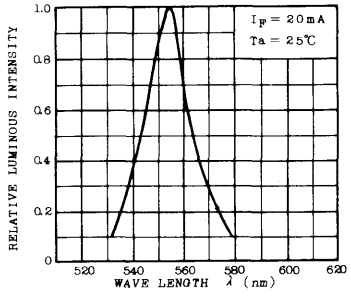
I_V – I_F



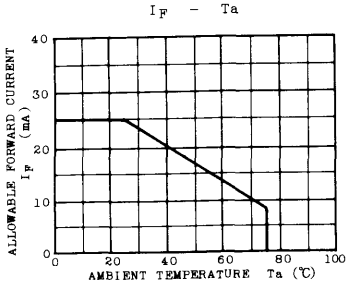
I_V – Tc



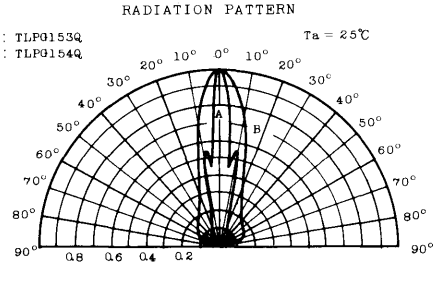
RELATIVE LUMINOUS INTENSITY – WAVE LENGTH



I_F – Ta



RADIATION PATTERN



TLPG163, TLPG164

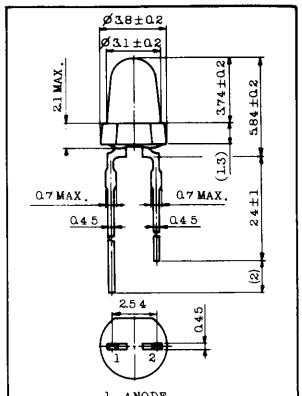
GaP GREEN LIGHT EMISSION

3.1mm DIAMETER(T1)

FEATURES:

- PURE COLOR
- All Plastic Mold Type
  TLPG163 : Light Green Transparent Lens
  TLPG164 : Light Green Lusterless Lens
- Low Drive Current, High Intensity Green Light Emission.
  Recommended Forward Current : I_F=15~20mA(DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.

Unit in mm



1. ANODE
2. CATHODE

JEDEC	–
EIAJ	–
TOSHIBA	4-3E1A

Weight : 0.12g

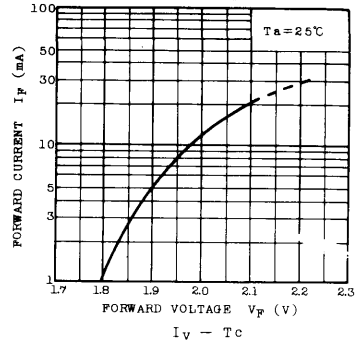
MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	T_{opr}	-20~75	°C
Storage Temperature Range	T_{stg}	-30~100	°C

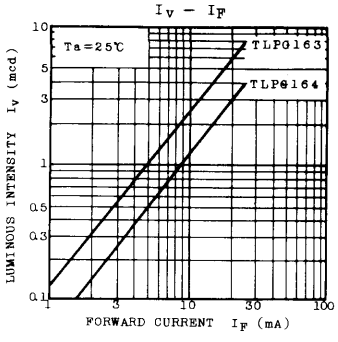
ELECTRO-OPTICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current		I_R	V_R=4V	-	-	5	μA
Luminous Intensity	TLPG163	I_V	I_F=20mA	3	6	-	mcd
	TLPG164			1.5	3	-	
Peak Emission Wave Length		λ_P	I_F=20mA	-	555	-	nm
Spectral Line Half Width		$\Delta\lambda$	I_F=20mA	-	20	-	nm

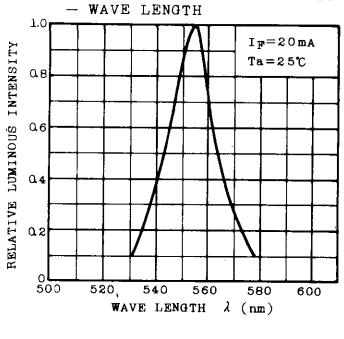
$I_F - V_F$



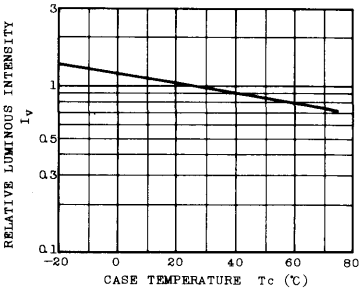
$I_V - I_F$



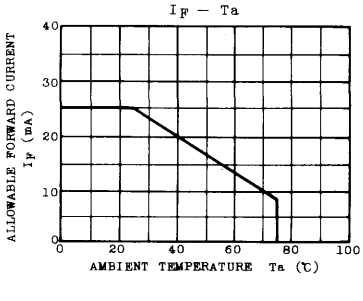
RELATIVE LUMINOUS INTENSITY — WAVE LENGTH



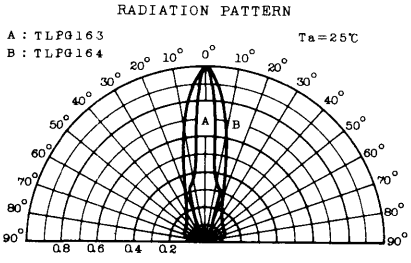
$I_V - T_C$



$I_F - T_a$



RADIATION PATTERN



TLPY144

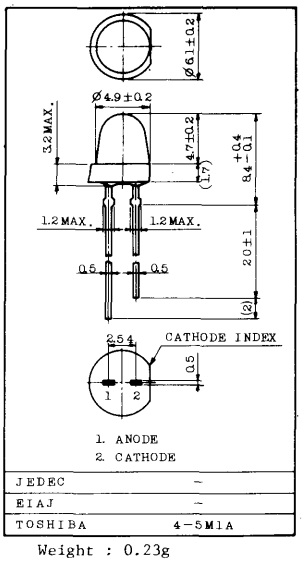
GaP YELLOW LIGHT EMISSION

4.9mm DIAMETER(T 13/4, LOW PROFILE)

FEATURES:

- PURE COLOR
- All Plastic Mold Type : Yellow Lusterless Lens
- Low Drive Current, High Intensity Yellow Light Emission
  Recommended Forward Current : I_F=15~20mA(DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pluse Operation.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	4-5M1A

Weight : 0.23g

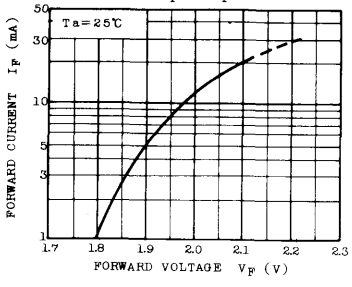
MAXIMUM RATINGS (Ta =25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	T_{opr}	-20~75	°C
Storage Temperature Range	T_{stg}	-30~100	°C

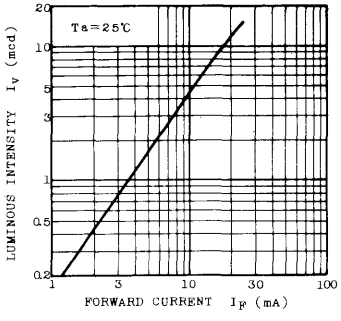
ELECTRO-OPTICAL CHARACTERISTICS (Ta =25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current	I_R	V_R=4V	-	-	100	μA
Luminous Intensity	I_V	I_F=15mA	3	8	-	mcd
Peak Emission Wave Length	λ_P	I_F=15mA	-	570	-	nm
Spectral Line Half Width	$\Delta\lambda$	I_F=15mA	-	25	-	nm

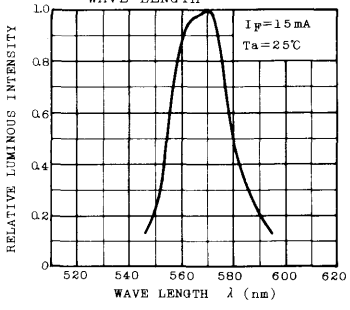
$I_F - V_F$



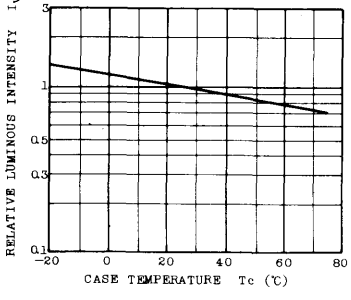
$I_V - I_F$



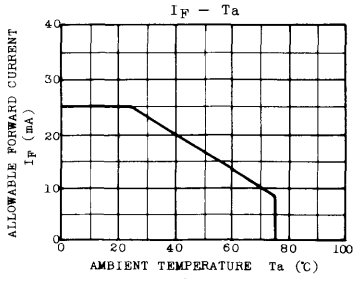
RELATIVE LUMINOUS INTENSITY — WAVE LENGTH



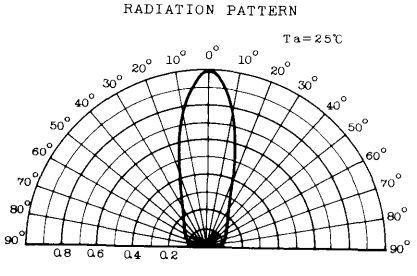
$I_V - T_C$



$I_F - T_a$



RADIATION PATTERN



TLPY154

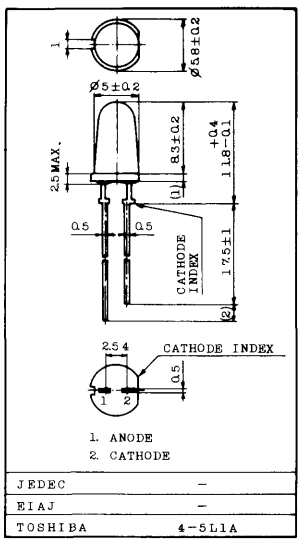
GaP YELLOW LIGHT EMISSION

5mm DIAMETER(T 1 3/4)

FEATURES:

- PURE COLOR
- All Plastic Mold Type : Yellow Lusterless Lens
- Low Drive Current, High Intensity Yellow Light Emission
  Recommended Forward Current : I_F=15 ~ 20mA(DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	4-5L1A

Weight : 0.28g

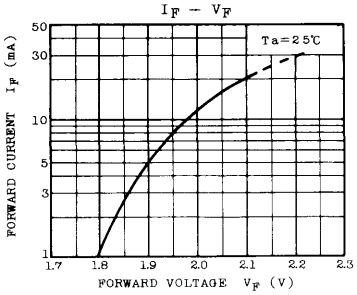
MAXIMUM RATINGS (Ta =25℃)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	T_{opr}	-20 ~ 75	°C
Storage Temperature Range	T_{stg}	-30 ~ 100	°C

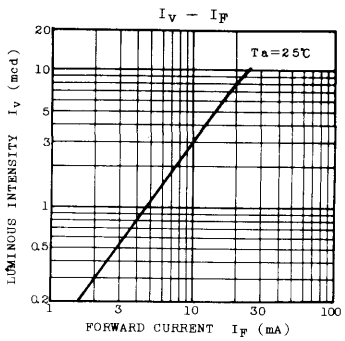
ELECTRO-OPTICAL CHARACTERISTICS (Ta =25℃)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current	I_R	V_R=4V	-	-	100	μA
Luminous Intensity	I_V	I_F=20mA	4	8	-	mcd
Peak Emission Wave Length	λ_P	I_F=20mA	-	570	-	nm
Spectral Line Half Width	$\Delta\lambda$	I_F=20mA	-	25	-	nm

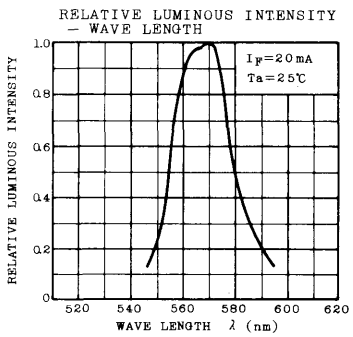
I_F – V_F



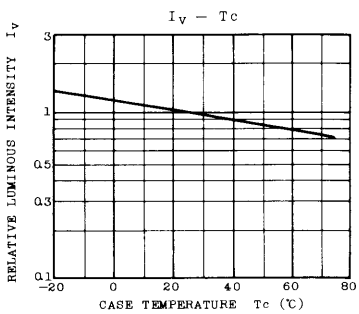
I_V – I_F



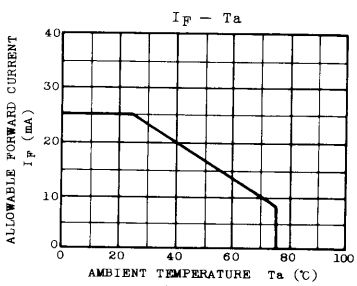
RELATIVE LUMINOUS INTENSITY – WAVE LENGTH



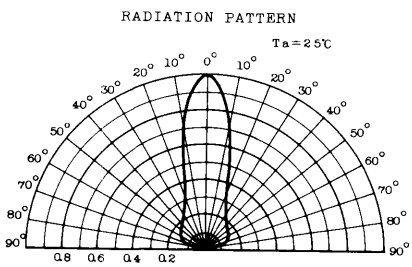
I_V – Tc



I_F – Ta



RADIATION PATTERN



TLPY154Q

GaP YELLOW LIGHT EMISSION

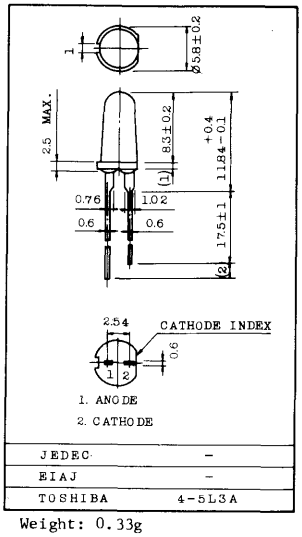
PANEL CIRCUIT INDICATOR

FEATURES:

PURE COLOR

- All Plastic Mold Type: Yellow Lusterless Lens
- Low Drive Current, High Intensity Yellow Light Emission.
  Recommended Forward Current: I_F=15 ∿ 20mA(DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.
- Wire Wrappable Leads.

Unit in mm



JEDEC	–
EIAJ	–
TOSHIBA	4-5L3A

Weight: 0.33g

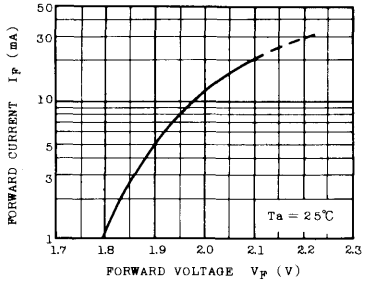
MAXIMUM RATINGS (Ta = 25 °C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	T_{opr}	-20 ∿ 75	°C
Storage Temperature Range	T_{stg}	-30 ∿ 100	°C

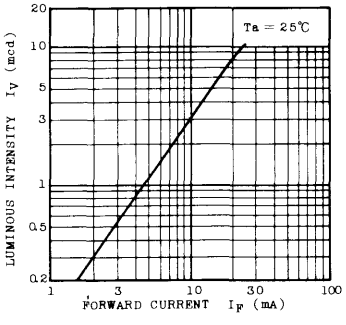
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25 °C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=20mA	–	2.1	2.8	V
Reverse Current	I_R	V_R=4V	–	–	100	μA
Luminous Intensity	I_V	I_F=20mA	4	8	–	mcd
Peak Emission Wave Length	λP	I_F=20mA	–	570	–	nm
Spectral Line Half Width	Δλ	I_F=20mA	–	25	–	nm

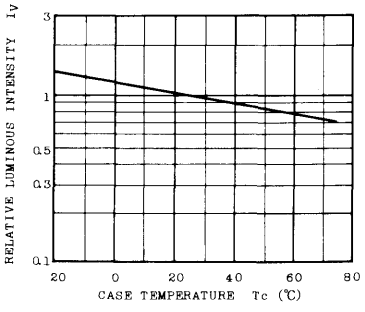
I_F – V_F



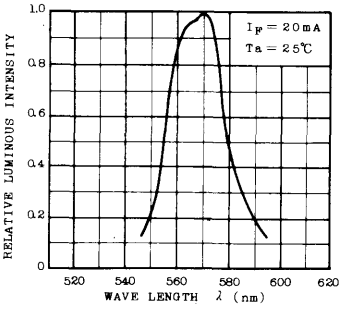
I_V – I_F



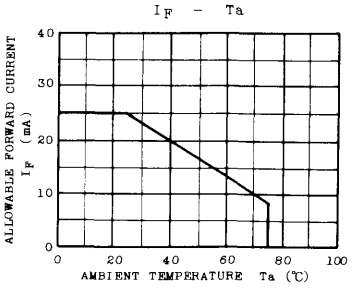
I_V – Tc



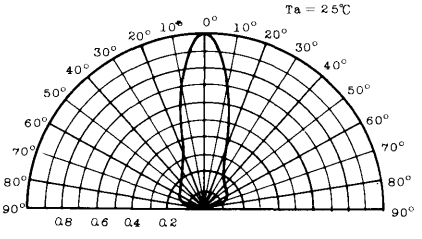
RELATIVE LUMINOUS INTENSITY – WAVE LENGTH



I_F – Ta



RADIATION PATTERN



TLPY164

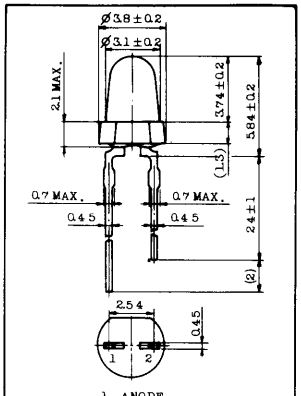
GaP YELLOW LIGHT EMISSION

3.1mm DIAMETER(T1)

FEATURES:

- PURE COLOR
- All Plastic Mold Type : Yellow Lusterless Lens
- Low Drive Current, High Intensity Yellow Light Emission.
  Recommended Forward Current : I_F=15~20mA(DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.

Unit in mm



1. ANODE
2. CATHODE

JEDEC	–
EIAJ	–
TOSHIBA	4-3E1A

Weight : 0.12g

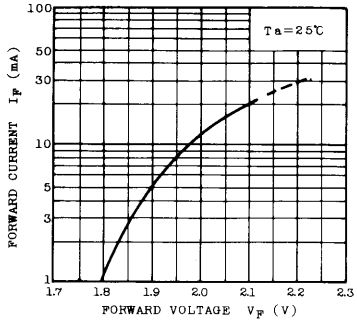
MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	T_{opr}	-20~75	°C
Storage Temperature Range	T_{stg}	-30~100	°C

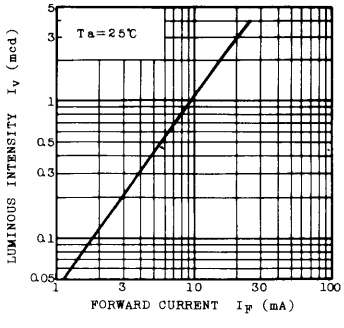
ELECTRO-OPTICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current	I_R	V_R=4V	-	-	100	μA
Luminous Intensity	I_V	I_F=20mA	1.5	3	-	mcd
Peak Emission Wave Length	λ_P	I_F=20mA	-	570	-	nm
Spectral Line Half Width	$\Delta\lambda$	I_F=20mA	-	25	-	nm

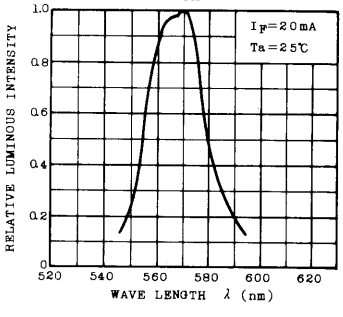
$I_F - V_F$



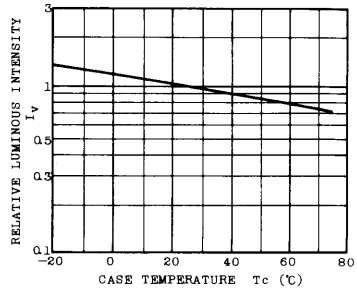
$I_V - I_F$



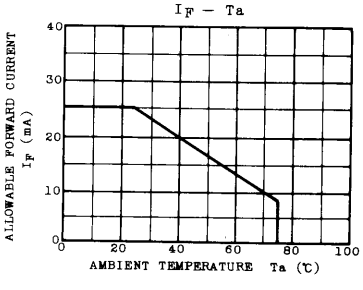
RELATIVE LUMINOUS INTENSITY — WAVE LENGTH



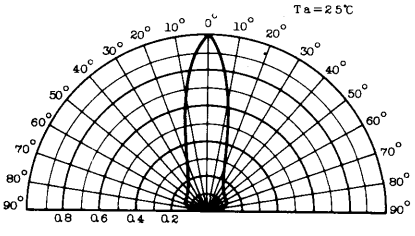
$I_V - Tc$



$I_F - Ta$



RADIATION PATTERN



TLRG101

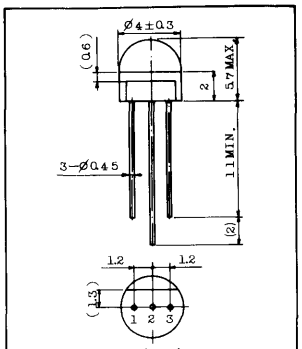
GaP RED/GREEN LIGHT EMISSION

4mm DIAMETER

FEATURES:

- Ceramic Stem Type : Milky Lusterless Lens
- Low Drive Current, High Intensity Red or Green Light Emission.
  Recommended Forward Current { Red : I_F=10~15mA(DC) / Green : I_F=15~20mA(DC)
- Wide Viewing Angle, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.

Unit in mm



1. ANODE (RED)
2. CATHODE (COMMON)
3. ANODE (GREEN)

JEDEC	—
EIAJ	—
TOSHIBA	4-4D1A

Weight : 0.16g

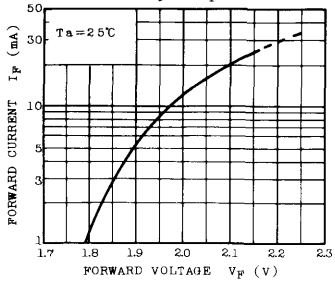
MAXIMUM RATINGS (Ta =25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	75	mW
Operating Temperature Range	Topr	-20~75	°C
Storage Temperature Range	Tstg	-30~100	°C

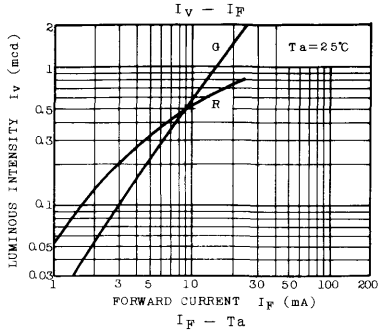
ELECTRO-OPTICAL CHARACTERISTICS (Ta =25°C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	-	2.1	2.6	V
Reverse Current		I_R	V_R=4V	-	-	5	μA
Luminous Intensity	Red	I_V	I_F=20mA	0.5	0.75	-	mcd
	Green			0.5	1.5	-	
Peak Emission Wave Length	Red	λp	I_F=20mA	-	700	-	nm
	Green			-	565	-	
Spectral Line Half Width	Red	Δλ	I_F=20mA	-	100	-	nm
	Green			-	25	-	

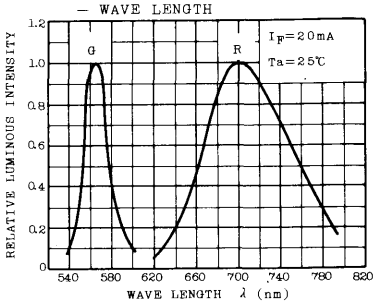
$I_F - V_F$



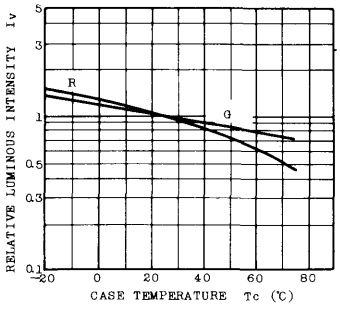
$I_V - I_F$



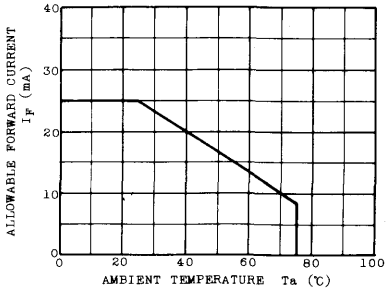
RELATIVE LUMINOUS INTENSITY — WAVE LENGTH



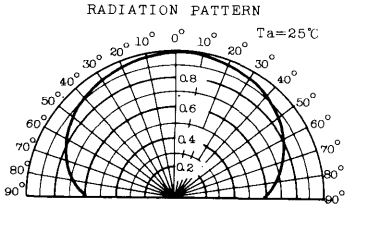
$I_V - Tc$



$I_F - Ta$



RADIATION PATTERN



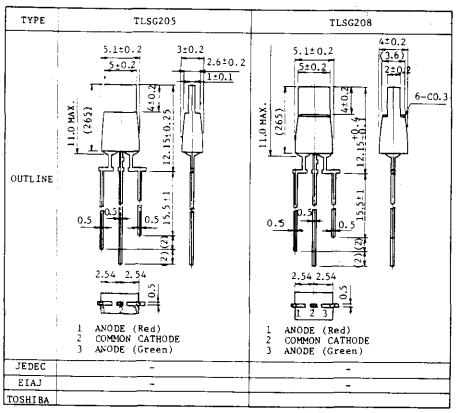
TLSG205, TLSG208

GaAsP RED/GaP GREEN LIGHT EMISSION

DUAL COLOR PANEL CIRCUIT INDICATOR

FEATURES:

- All Plastic Mold Type, Milky Lusterless Lens
  TLSG205: Rectangular Type (Surface Size 1 x 5 mm)
  TLSG208: Rectangular Type (Surface Size 2 x 5 mm)
- Low Drive Current, High Intensity Red or Green Light Emission
  Recommended Forward Current: I_F = 15 ~ 20 mA (DC)
- Fast Response Time, Capable of Pulse Operation.

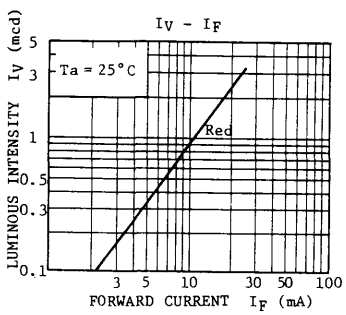


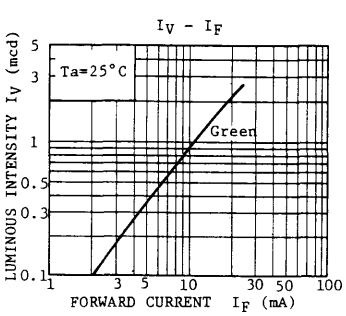
MAXIMUM RATINGS (Ta = 25°C)

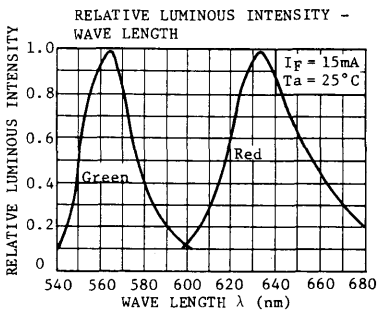
CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	75	mW
Operating Temperature Range	T_{opr}	-20 ~ 75	°C
Storage Temperature Range	T_{stg}	-30 ~ 100	°C

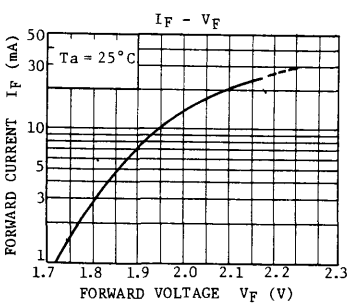
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25°C)

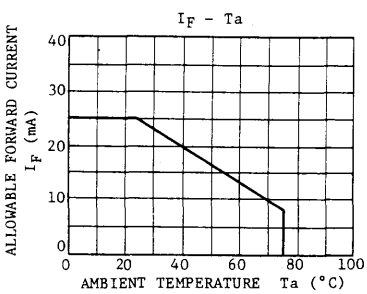
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F = 20 mA	-	2.1	2.8	V
Reverse Current		I_R	V_R = 4 V	-	-	100	μA
Luminous Intensity	Red	I_V	I_F = 15 mA	0.5	1.5	-	mcd
	Green			0.5	1.5	-	
Peak Emission Wave Length	Red	λ_p	I_F = 15 mA	-	635	-	nm
	Green			-	565	-	
Spectral Line Half Width	Red	$\Delta\lambda$	I_F = 15 mA	-	40	-	nm
	Green			-	25	-	

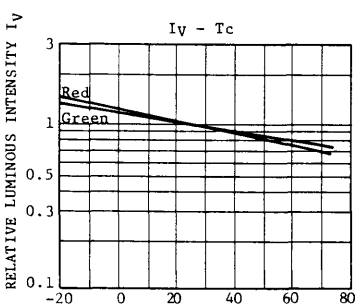












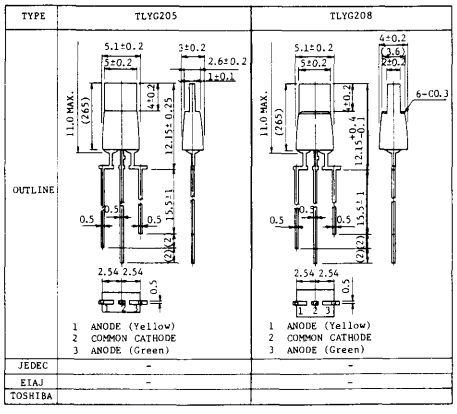
TLYG205, TLYG208

GaAsP YELLOW/GaP GREEN LIGHT EMISSION

DUAL COLOR PANEL CIRCUIT INDICATOR

FEATURES:

- All Plastic Mold Type, Light Yellow Lusterless Lens — TLYG205: Rectangular Type (Surface size 1 x 5 mm); TLYG208: Rectangular Type (Surface size 2 x 5 mm)
- Low Drive Current, High Intensity Yellow or Green Light Emission. Recommended Forward Current: I_F = 15 ~ 20 mA (DC)
- Fast Response Time, Capable of Pulse Operation.

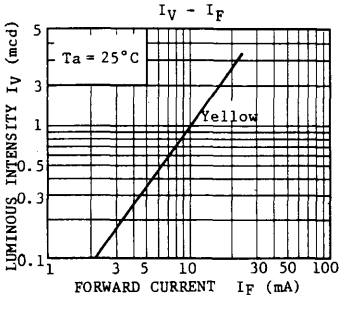


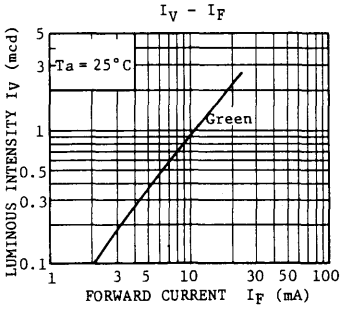
MAXIMUM RATINGS (Ta = 25 °C)

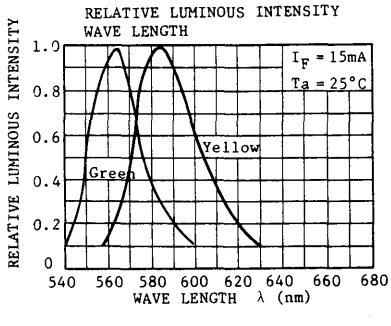
CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	75	mW
Operating Temperature Range	T_{opr}	-20 ~ 75	°C
Storage Temperature Range	T_{stg}	-30 ~ 100	°C

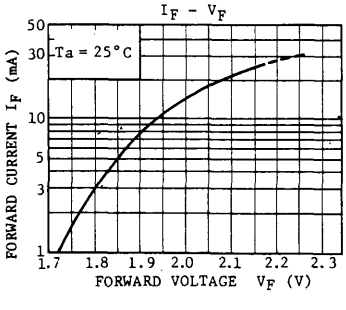
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25 °C)

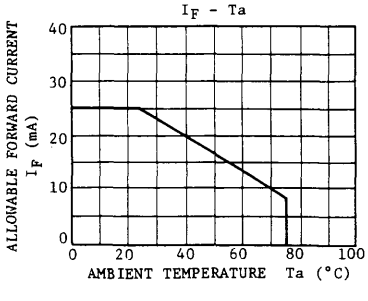
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F = 20 mA	-	2.1	2.8	V
Reverse Current		I_R	V_R = 4 V	-	-	100	μA
Luminous Intensity	Yellow	I_V	I_F = 15 mA	0.5	1.5	-	mcd
	Green			0.5	1.5	-	
Peak Emission Wave Length	Yellow	λ_p	I_F = 15 mA	-	585	-	nm
	Green			-	565	-	
Spectral Line Half Width	Yellow	$\Delta\lambda$	I_F = 15 mA	-	32	-	nm
	Green			-	25	-	

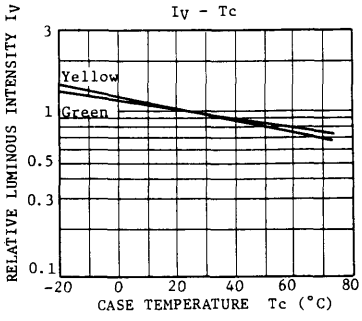












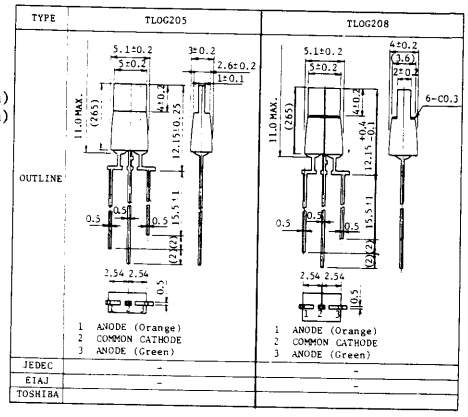
TLOG205, TLOG208

GaAsP ORANGE/GaP GREEN LIGHT EMISSION

DUAL COLOR PANEL CIRCUIT INDICATOR

FEATURES:

- All Plastic Mold Type
  Light Green Lusterless Lens
  TLOG205: Rectangular Type (Surface Size 1 x 5 mm)
  TLOG208: Rectangular Type (Surface Size 2 x 5 mm)
- Low Drive Current, High Intensity Orange or Green Light Emission.
  Recommended Forward Current: I_F = 15 ∿ 20 mA (DC)
- Fast Response Time, Capable of Pulse Operation

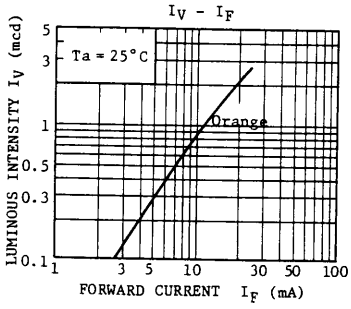


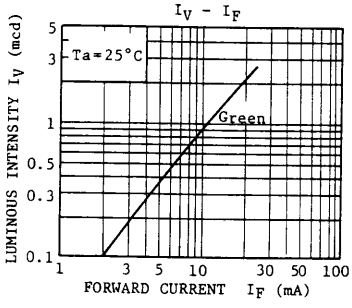
MAXIMUM RATINGS (Ta = 25 °C)

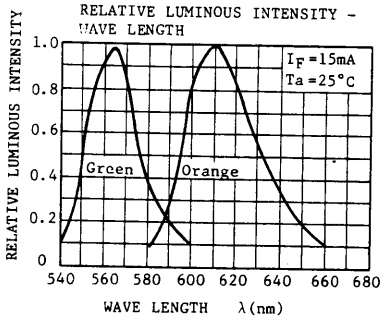
CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	75	mW
Operating Temperature Range	T_{opr}	-20 ∿ 75	°C
Storage Temperature Range	T_{stg}	-30 ∿ 100	°C

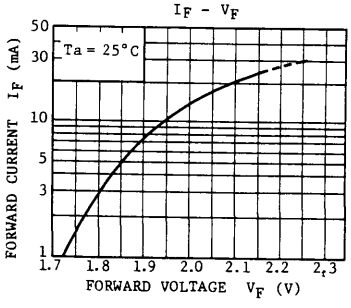
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25 °C)

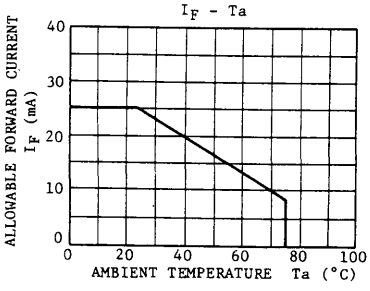
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F = 20 mA	-	2.1	2.0	V
Reverse Current		I_R	V_R = 4 V	-	-	100	μA
Luminous Intensity	Orange	I_F	I_F = 15 mA	0.5	1.5	-	mcd
	Green			0.5	1.5	-	
Peak Emission Wave Length	Orange	λ_p	I_F = 15 mA	-	610	-	nm
	Green			-	565	-	
Spectral Line Half Width	Orange	Δλ	I_F = 15 mA	-	35	-	nm
	Green			-	25	-	

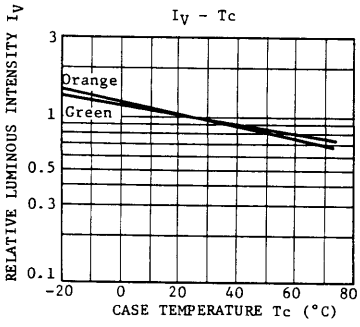












DUAL COLOR LAMP

TLSG116

GaAsP RED/GaP GREEN LIGHT EMISSION

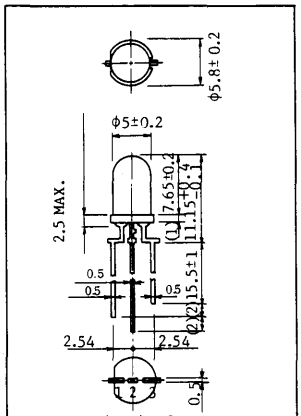
DUAL COLOR PANEL CIRCUIT INDICATOR

5 mm DIAMETER (T 1 3/4)

FEATURES:

- All Plastic Mold Type
  Milky Lusterless Lens
- Low Drive Current, High Intensity Red or
  Green Light Emission
  Recommended Forward Current: $I_F = 15 \sim 20$ mA (DC)
- Fast Response Time, Capable of Pulse Operation

Unit in mm



1. ANODE (Red), 2. COMMON CATHODE, 3. ANODE (Green)

JEDEC	-
EIAJ	-
TOSHIBA	-

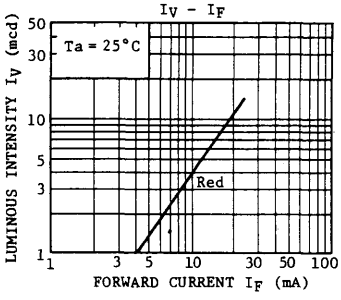
Weight: g

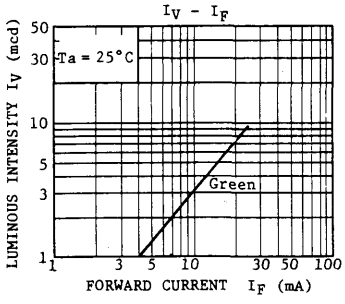
MAXIMUM RATINGS (Ta = 25°C)

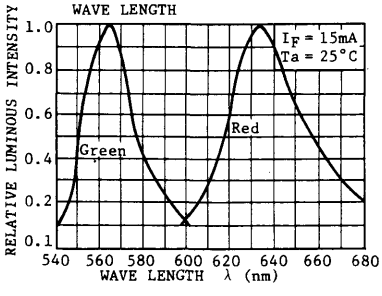
CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Curretn (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	75	mW
Operating Temperature Range	T_{opr}	-20 ~ 75	°C
Storage Temperature Range	T_{stg}	-30 ~ 100	°C

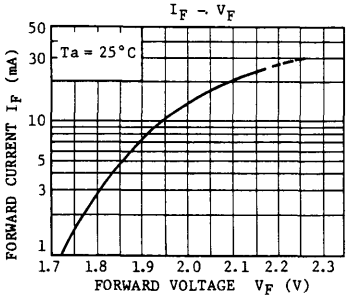
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25°C)

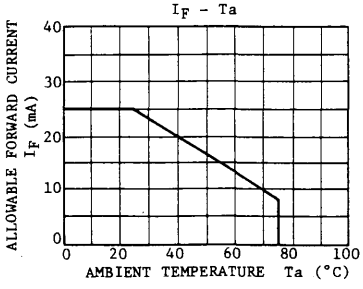
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F = 20 mA	-	2.1	2.8	V
Reverse Current		I_R	V_R = 4 V	-	-	100	μA
Luminous Intensity	Red	I_V	I_F = 15 mA	1.5	7.0	-	mcd
	Green			1.5	5	-	
Peak Emission Wave Length	Red	λ_p	I_F = 15 mA	-	635	-	nm
	Green			-	565	-	
Spectral Line Half Width	Red	$\Delta\lambda$	I_F = 15 mA	-	40	-	nm
	Green			-	25	-	

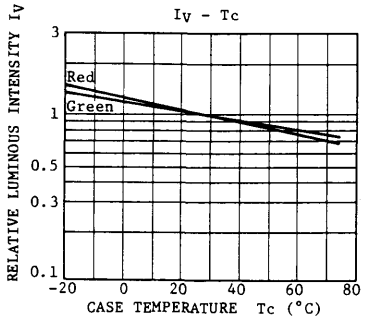












TLYG116

GaAsP YELLOW/GaP GREEN LIGHT EMISSION

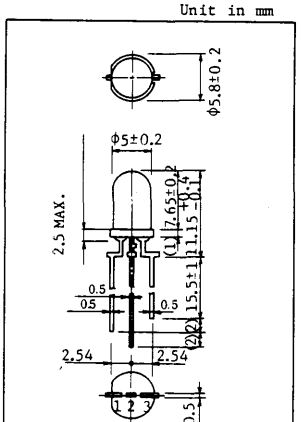
DUAL COLOR PANEL CIRCUIT INDICATOR

5 mm DIAMETER (T 1 3/4)

FEATURES:

- All Plastic Mold Type
  Light Yellow Lusterless Lens
- Low Drive Current, High Intensity Yellow or
  Green Light Emission
  Recommended Forward Current: $I_F = 15 \sim 20$ mA (DC)
- Fast Response Time, Capable of Pulse Operation.

Unit in mm



1. ANODE (Yellow), 2. COMMON CATHODE, 3. ANODE (Green)

JEDEC	-
EIAJ	-
TOSHIBA	-

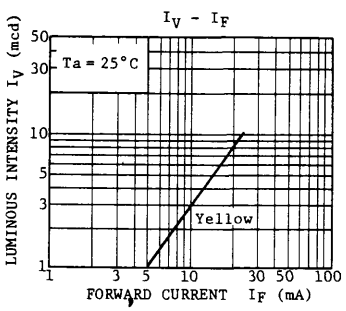
Weight: g

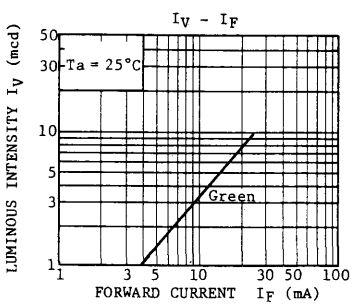
MAXIMUM RATINGS (Ta = 25 °C)

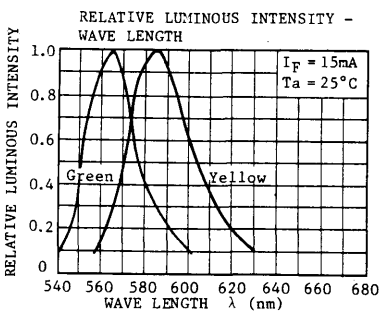
CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	75	mW
Operating Temperature Range	T_{opr}	-20 ~ 75	°C
Storage Temperature Range	T_{stg}	-30 ~ 100	°C

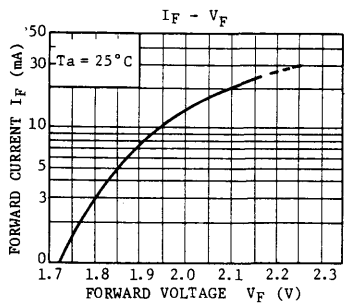
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25 °C)

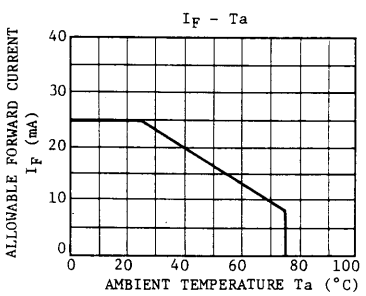
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F = 20 mA	-	2.1	2.7	V
Reverse Current		I_R	V_R = 4 V	-	-	100	μA
Luminous Intensity	Yellow	I_V	I_F = 15 mA	1.5	5	-	mcd
	Green			1.5	5	-	
Peak Emission Wave Length	Yellow	λ_p	I_F = 15 mA	-	585	-	nm
	Green			-	565	-	
Spectral Line Half Width	Yellow	Δλ	I_F = 15 mA	-	32	-	nm
	Green			-	25	-	

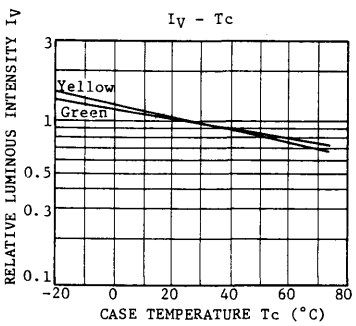












TLOG116

GaAsP ORANGE/GaP GREEN LIGHT EMISSION

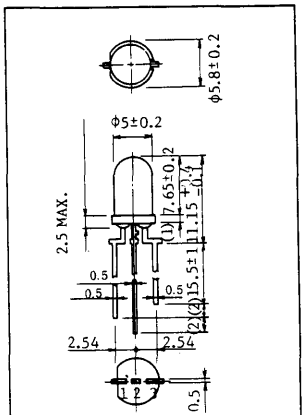
DUAL COLOR PANEL CIRCUIT INDICATOR

5 mm DIAMETER (T 1 3/4)

FEATURES:

- All Plastic Mold Type
  Light Green Lusterless Lens
- Low Drive Current, High Intensity Orange or Green Light Emission
  Recommended Forward Current: $I_F = 15 \sim 20$ mA (DC)
- Fast Response Time, Capable of Pulse Operation.

Unit in mm



1. ANODE (Orange), 2. COMMON CATHODE, 3. ANODE (Green)

JEDEC	-
EIAJ	-
TOSHIBA	-

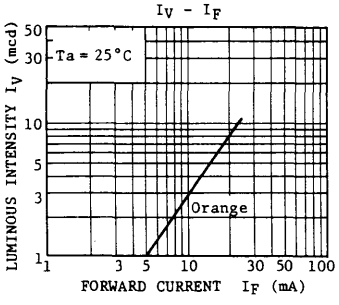
Weight: g

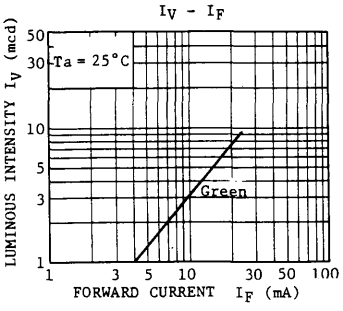
MAXIMUM RATINGS (Ta = 25°C)

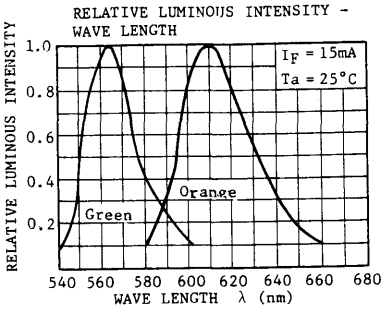
CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	75	mW
Operating Temperature Range	T_{opr}	-20 ~ 75	°C
Storage Temperature Range	T_{stg}	-30 ~ 100	°C

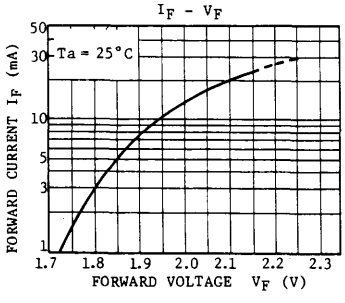
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25°C)

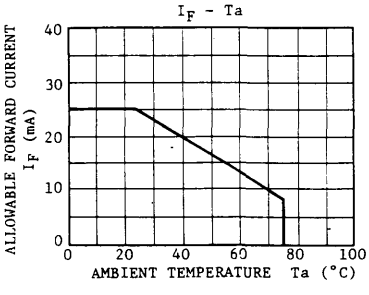
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F = 20 mA	-	2.1	2.8	V
Reverse Current		I_R	V_R = 4 V	-	-	100	μA
Luminous Intensity	Orange	I_V	I_F = 15 mA	1.5	5	-	mcd
	Green			1.5	5	-	
Peak Emission Wave Length	Orange	λ_P	I_F = 15 mA	-	610	-	nm
	Green			-	565	-	
Spectral Line Half Width	Orange	$\Delta\lambda$	I_F = 15 mA	-	35	-	nm
	Green			-	25	-	

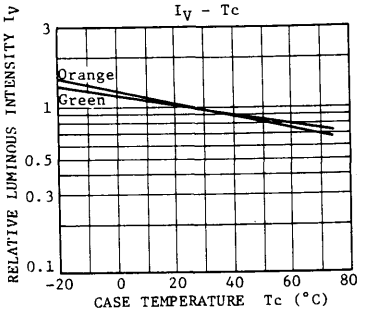












- TENTATIVE -

TLR223, TLR224

GaP RED LIGHT EMISSION

PANEL CIRCUIT INDICATOR

FEATURES:

- All Plastic Mold Type

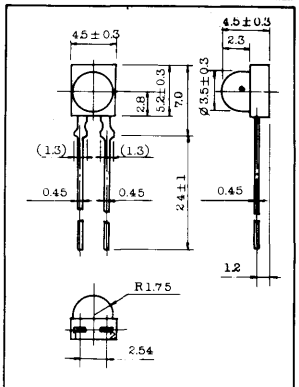
  TLR223: Red Transparent Lens
  TLR224: Red Lusterless Lens

- Low Drive Current, High Intensity Red Light Emission.
  Recommended Forward Current: I_F=10 ∿ 15mA(DC)

- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.

- Fast Response Time, Capable of Pulse Operation.

Unit in mm



JEDEC	-
EIAJ	-
TOSHIBA	4-5R1A

Weight: 0.28g

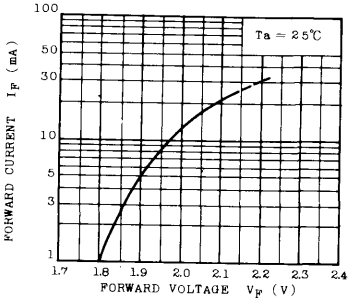
MAXIMUM RATINGS (Ta = 25 °C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	T_{opr}	-20 ∿ 75	°C
Storage Temperature Range	T_{stg}	-30 ∿ 100	°C

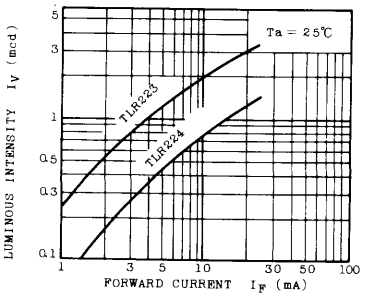
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25 °C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current		I_R	V_R=4V	-	-	5	μA
Luminous Intensity	TLR223	I_V	I_F=15mA	-	2.5	-	mcd
	TLR224			-	1.0	-	
Peak Emission Wave Length		λP	I_F=15mA	-	700	-	nm
Spectral Line Half Width		Δλ	I_F=15mA	-	100	-	nm

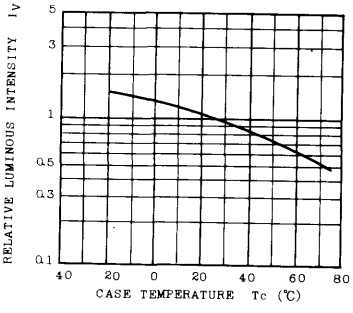
I_F - V_F



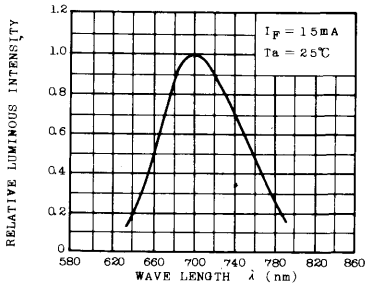
I_V - I_F



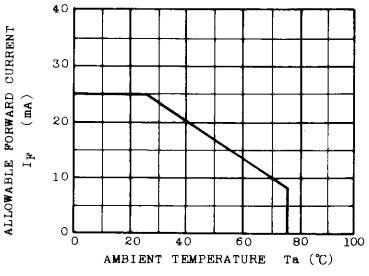
I_V - Tc



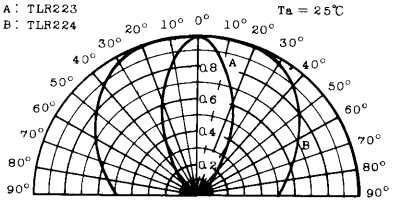
RELATIVE LUMINOUS INTENSITY - WAVE LENGTH



I_F - Ta



RADIATION PATTERN



TLG223, TLG224

GaP GREEN LIGHT EMISSION

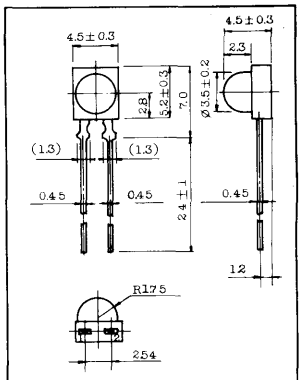
- TNETATIVE -

PANEL CIRCUIT INDICATOR

FEATURES:

- All Plastic Mold Type
  TLG223: Green Transparent Lens
  TLG224: Green Lusterless Lens
- Low Drive Current, High Intensity Green Light Emission.
  Recommended Forward Current: I_F=10 ∿ 15mA(DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.
- Fast Response Time, Capable of Pulse Operation.

Unit in mm



JEDEC	-
HIAJ	-
TOSHIBA	4-5R1A

Weight: 0.28g

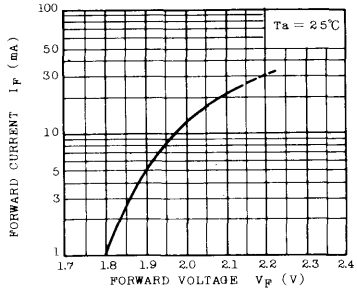
MAXIMUM RATINGS (Ta = 25 °C)

CHARACTERISITC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	T_{opr}	-20 ∿ 75	°C
Storage Temperature Range	T_{stg}	-30 ∿ 100	°C

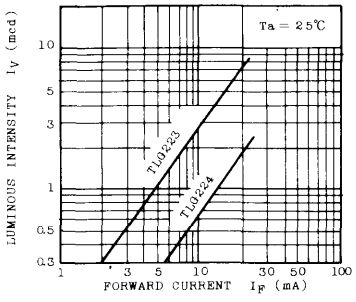
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25 °C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current		I_R	V_R=4V	-	-	5	μA
Luminous Intensity	TLG223	I_V	I_F=15mA	-	4.0	-	mcd
	TLG224			-	1.0	-	
Peak Emission Wave Length		λP	I_F=15mA	-	565	-	nm
Spectral Line Half Width		Δλ	I_F=15mA	-	25	-	nm

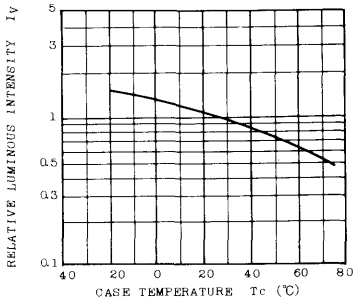
I_F - V_F



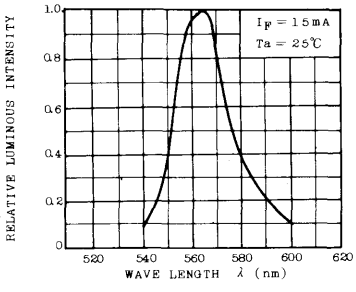
I_V - I_F



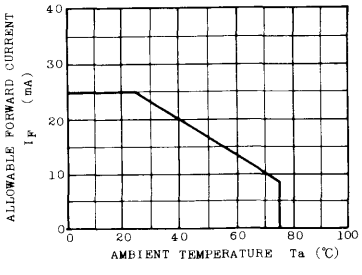
I_V - Tc



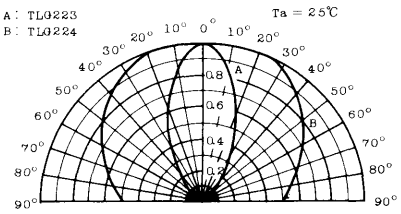
RELATIVE LUMINOUS INTENSITY - WAVE LENGTH



I_F - Ta



RADIATION PATTERN



TLY223, TLY224

- TENTATIVE -

GaAsP YELLOW LIGHT EMISSION

PANEL CIRCUIT INDICATOR

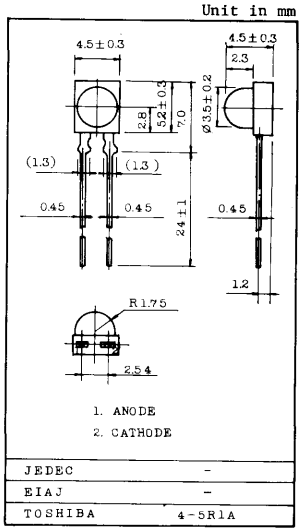
FEATURES:

- All Plastic Mold Type

  TLY223: Yellow Transparent Lens
  TLY224: Yellow Lusterless Lens

- Low Drive Current, High Intensity Yellow Light Emission.
  Recommended Forward Current: I_F=10 ∿ 15mA(DC)
- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio
- Fast Response Time, Capable of Pulse Operation

Unit in mm



JEDEC	-
EIAJ	-
TOSHIBA	4-5R1A

Weight: 0.28g

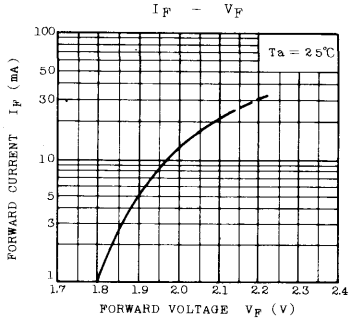
MAXIMUM RATINGS (Ta = 25 °C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	T_{opr}	-20 ∿ 75	°C
Storage Temperature Range	T_{srg}	-30 ∿ 100	°C

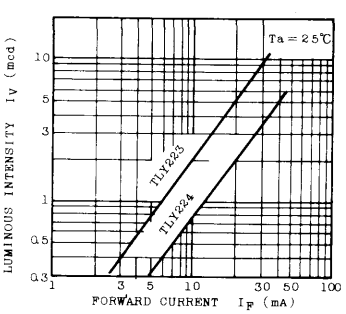
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25 °C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	-	2.1	2.8	V
Reverse Current		I_R	V_R=4V	-	-	100	μA
Luminous Intensity	TLY223	I_V	I_F=15mA	-	40	-	mcd
	TLY224			-	15	-	
Peak Emission Wave Length		λ_P	I_F=15mA	-	585	-	nm
Spectral Line Hlaf Width		$\Delta\lambda$	I_F=15mA	-	32	-	nm

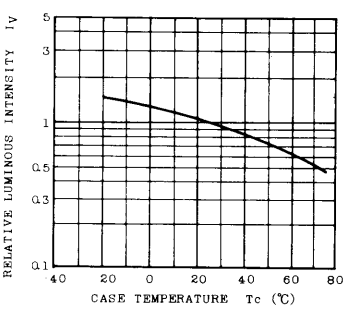
I_F - V_F



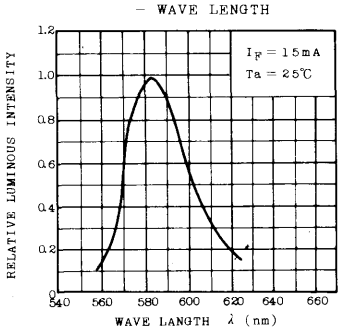
I_V - I_F



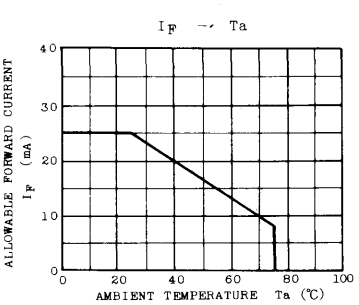
I_V - Tc



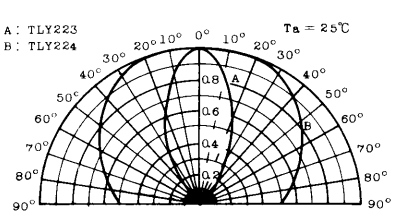
RELATIVE LUMINOUS INTENSITY - WAVE LENGTH



I_F - Ta



RADIATION PATTERN



TL0223, TL0224

- TENTATIVE -

GaAsP ORANGE LIGHT EMISSION

PANEL CIRCUIT INDICATOR

FEATURES:

- All Plastic Mold Type

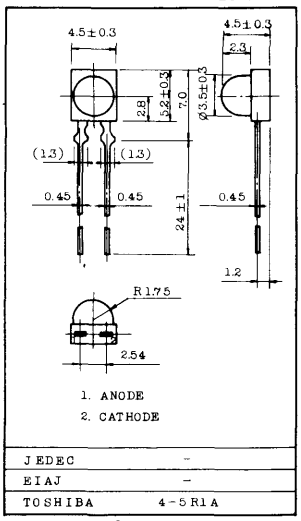
  TL0223: Orange Transparent Lens
  TL0224: Orange Lusterless Lens

- Low Drive Current, High Intensity Orange Light Emission.
  Recommended Forward Current: I_F=10 ~ 15mA(DC)

- All Plastic Molded Lens, Provides an Excellent ON-OFF Contrast Ratio.

- Fast Response Time, Capable of Pulse Operation.

Unit in mm



JEDEC	–
EIAJ	–
TOSHIBA	4-5R1A

Weight: 0.28g

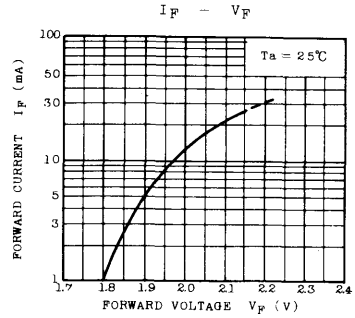
MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	T_{opr}	-20 ~ 75	°C
Storage Temperature Range	T_{stg}	-30 ~ 100	°C

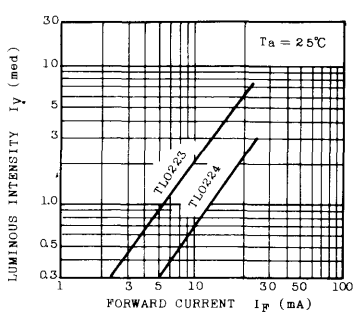
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=20mA	–	2.1	2.8	V
Reverse Current		I_R	V_R=4V	–	–	100	μA
Luminous Intensity	TL0223	I_V	I_F=15mA	–	4.0	–	mcd
	TL0224			–	1.5	–	
Peak Emission Wave Length		λP	I_F=15mA	–	610	–	nm
Spectral Line Half Width		Δλ	I_F=15mA	–	35	–	nm

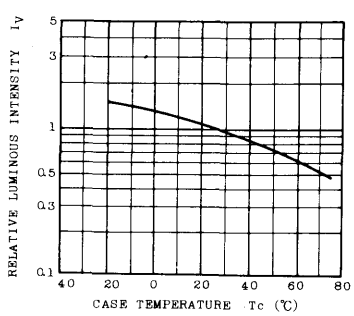
I_F – V_F



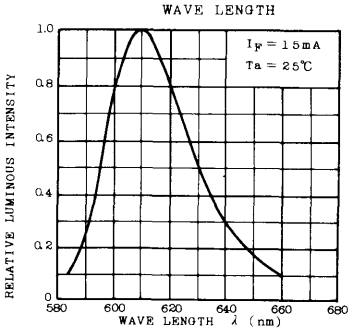
I_V – I_F



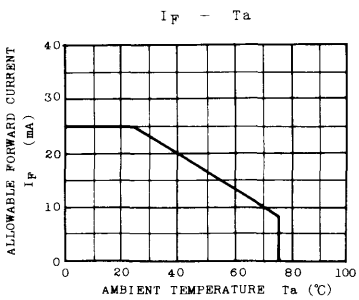
I_V – Tc



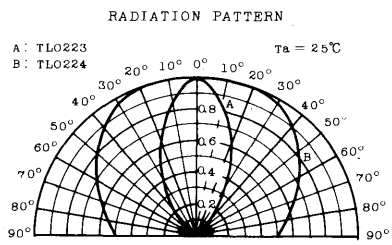
RELATIVE LUMINOUS INTENSITY
WAVE LENGTH



I_F – Ta



RADIATION PATTERN



TLR250

GaP RED LIGHT EMISSION

RECTANGULAR, 6×6mm

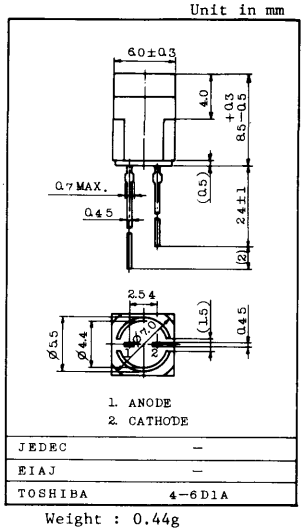
FEATURES:

. Plastic Mold Type.

. Rectangular Type (Surface Size 6×6mm)

. Fast Response Time, Capable of Pulse Operation.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	4-6D1A

Weight : 0.44g

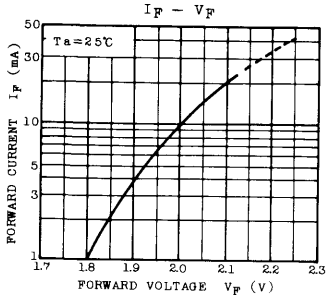
MAXIMUM RATINGS (Ta =25℃)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	70	mW
Operating Temperature Range	T_{opr}	-20~75	°C
Storage Temperature Range	T_{stg}	-30~100	°C

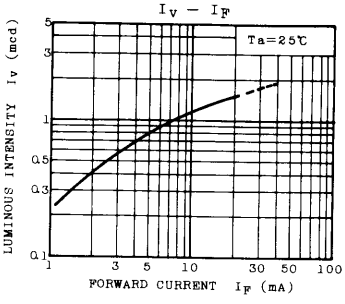
ELECTRO-OPTICAL CHARACTERISTICS (Ta =25℃)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=25mA	-	2.1	2.8	V
Reverse Current	I_R	V_R=4V	-	-	10	μA
Luminous Intensity	I_V	I_F=20mA	0.7	1.4	-	mcd
Peak Emission Wave Length	λ_P	I_F=20mA	-	700	-	nm
Spectral Line Half Width	$\Delta\lambda$	I_F=20mA	-	100	-	nm

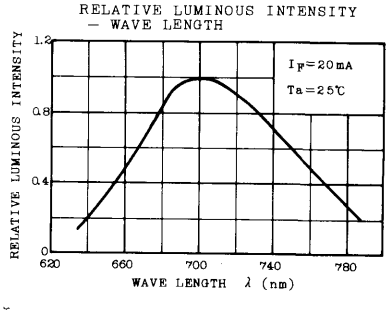
$I_F - V_F$



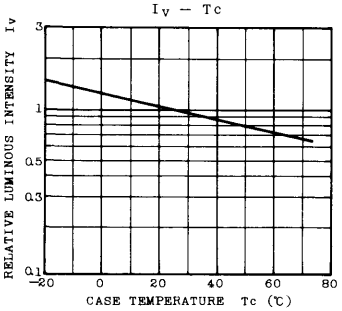
$I_V - I_F$



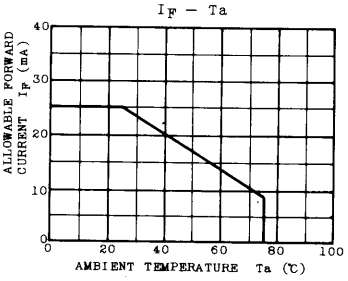
RELATIVE LUMINOUS INTENSITY — WAVE LENGTH



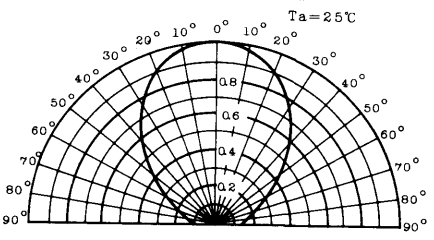
$I_V - T_C$



$I_F - T_a$



RADIATION PATTERN



LARGE-SIZED SURFACE LAMP

TLG250

GaP GREEN LIGHT EMISSION

RECTANGULAR, 6×6mm

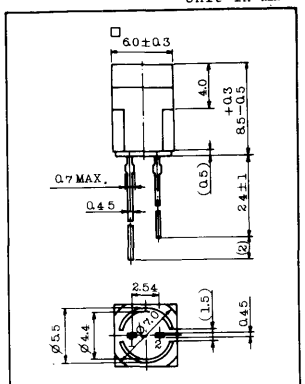
FEATURES:

. Plastic Mold Type.

. Rectangular Type (Surface Size 6×6mm)

. Fast Response Time, Capable of Pulse Operation.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	4−6D1A

Weight : 0.44g

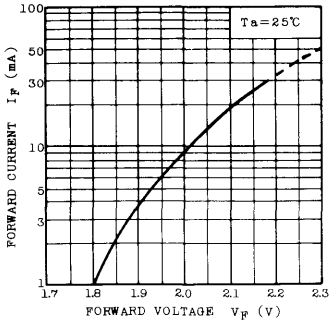
MAXIMUM RATINGS (Ta =25℃)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	30	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	85	mW
Operating Temperature Range	T_{opr}	−20 ~ 75	°C
Storage Temperature Range	T_{stg}	−30 ~ 100	°C

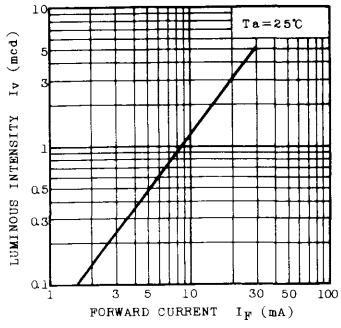
ELECTRO-OPTICAL CHARACTERISTICS (Ta =25℃)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=30mA	-	2.4	2.8	V
Reverse Current	I_R	V_R=4V	-	-	10	μA
Luminous Intensity	I_V	I_F=20mA	1.5	3.0	-	mcd
Peak Emission Wave Length	λ_P	I_F=20mA	-	565	-	nm
Spectral Line Half Width	$\Delta\lambda$	I_F=20mA	-	30	-	nm

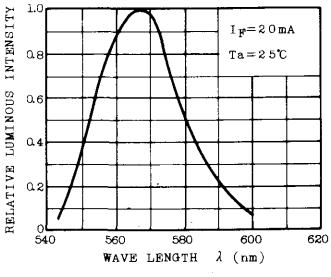
$I_F - V_F$



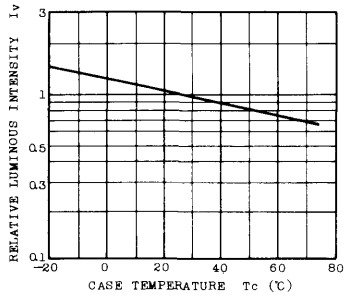
$I_V - I_F$



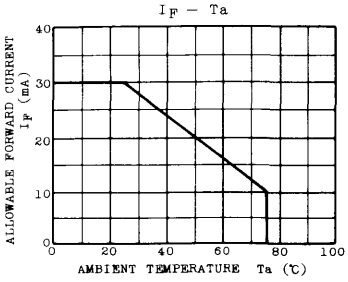
RELATIVE LUMINOUS INTENSITY − WAVE LENGTH



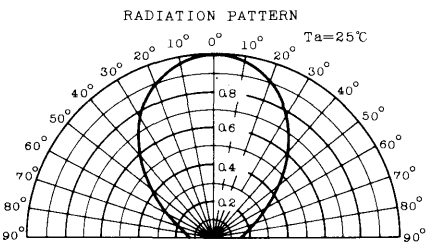
$I_V - T_C$



$I_F - T_a$



RADIATION PATTERN



TLY250

GaAsP YELLOW LIGHT EMISSION

RECTANGLAR, 6×6mm

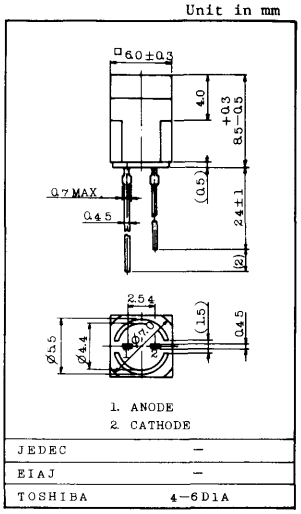
FEATURES:

. Plastic Mold Type

. Rectangular Type (Surface Size 6 × 6mm)

. Fast Response Time, Capable of Pulse Operation.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	4−6D1A

Weight : 0.44g

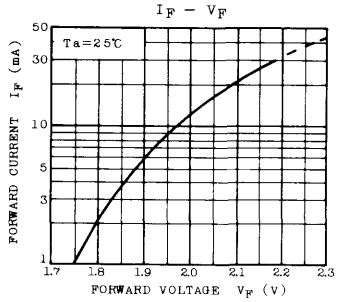
MAXIMUM RATINGS (Ta =25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	30	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	85	mW
Operating Temperature Range	T_{opr}	−20 ~ 75	°C
Storage Temperature Range	T_{stg}	−30 ~ 100	°C

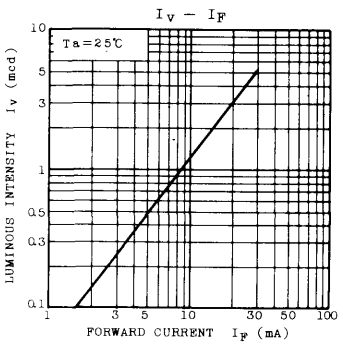
ELECTRO-OPTICAL CHARACTERISTICS (Ta =25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=30mA	−	2.4	2.8	V
Reverse Current	I_R	V_R=4V	−	−	10	μA
Luminous Intensity	I_V	I_F=20mA	1.5	3.0	−	mcd
Peak Emission Wave Length	λ_P	I_F=20mA	−	585	−	nm
Spectral Line Half Width	$\Delta\lambda$	I_F=20mA	−	30	−	nm

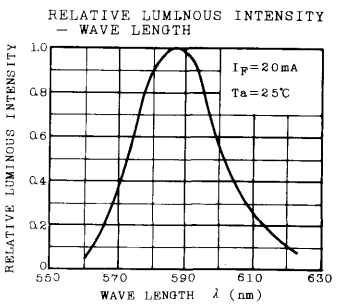
$I_F - V_F$



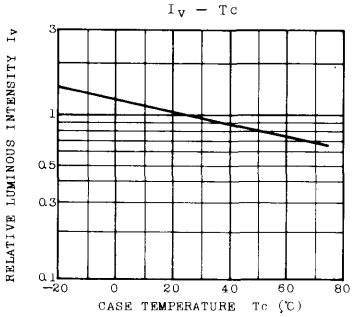
$I_V - I_F$



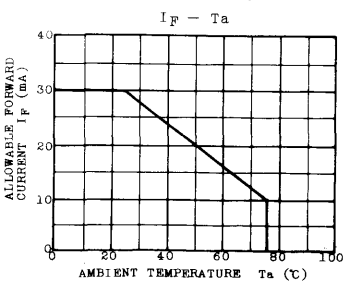
RELATIVE LUMINOUS INTENSITY − WAVE LENGTH



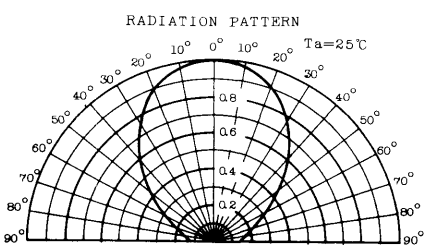
$I_V - T_C$



$I_F - T_a$



RADIATION PATTERN



LARGE-SIZED SURFACE LAMP

TL0250

GaAsP ORANGE LIGHT EMISSION

RECTANGULAR, 6×6mm

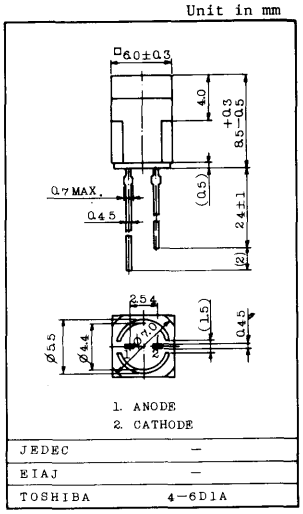
FEATURES:

. Plastic Mold Type.

. Rectangular Type (Surface Size 6×6mm)

. Fast Response Time, Capable of Pulse Operation.

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	4−6D1A

Weight : 0.44g

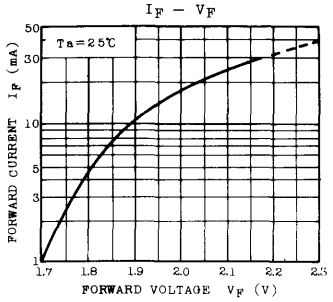
MAXIMUM RATINGS (Ta =25℃)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (DC)	I_F	30	mA
Reverse Voltage	V_R	4	V
Power Dissipation	P_D	85	mW
Operating Temperature Range	T_{opr}	−20 ~ 75	°C
Storage Temperature Range	T_{stg}	−30 ~ 100	°C

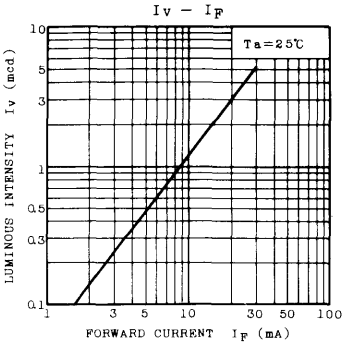
ELECTRO-OPTICAL CHARACTERISTICS (Ta =25℃)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=30mA	-	2.4	2.8	V
Reverse Current	I_R	V_R=4V	-	-	10	μA
Luminous Intensity	I_V	I_F=20mA	1.5	3.0	-	mcd
Peak Emission Wave Length	λ_P	I_F=20mA	-	610	-	nm
Spectal Line Half Width	$\Delta\lambda$	I_F=20mA	-	30	-	nm

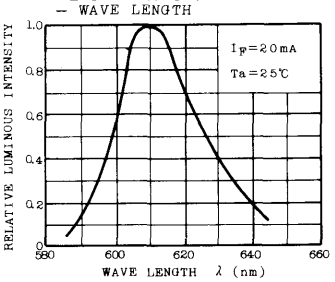
$I_F - V_F$



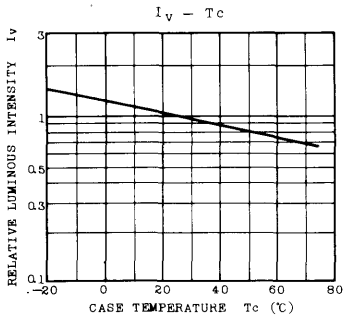
$I_V - I_F$



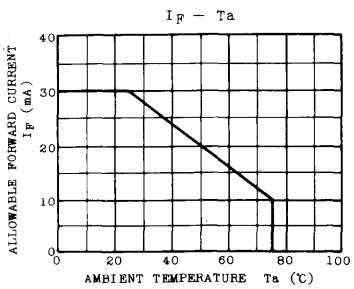
RELATIVE LUMINOUS INTENSITY − WAVE LENGTH



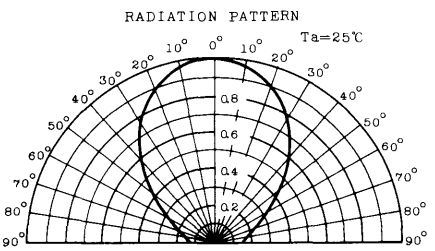
$I_V - Tc$



$I_F - Ta$



RADIATION PATTERN



LARGE-SIZED SURFACE LAMP

TLG251 , TLY251 , TLO251 , TLS251

RECTANGULAR, 11×5mm

FEATURES:

. Plastic Mold Type
TLG251 : Green Light Emission
TLY251 : Yellow Light Emission
TLO251 : Orange Light Emission
TLS251 : Red Light Emission

. Large-Sized Rectangular Type (Surface Size 11×5mm)

. Fast Response Time, Capable of Pulse Operation.

MAXIMUM RATINGS (Ta = 25°C)

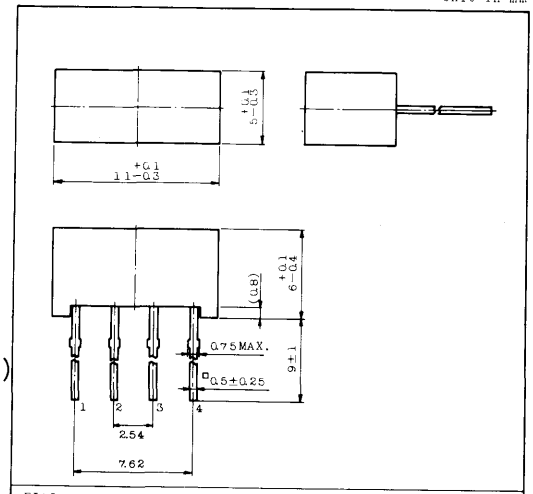
CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (Diode)	I_F/Diode	25	mA
Reverse Voltage	V_R	4	V
Power Dissipation (Diode)	P_D/Diode	70	mW
Operating Temperature Range	T_{opr}	-20 ~ 75	°C
Storage Temperature Range	T_{stg}	-30 ~ 100	°C

ELECTRO-OPTICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=25mA	-	2.1	2.8	V
Reverse Current	TLG251	I_R	V_R=4V	-	-	10	μA
	TLY251, TLO251, TLS251			-	-	100	
Luminous Intensity	TLG251	I_V	I_F=15mA	3.4	9.0	-	mcd
	TLY251, TLO251, TLS251			2.1	5.0	-	
Peak Emission Wave Length	TLG251	λ_P	I_F=15mA	-	565	-	nm
	TLY251			-	585	-	
	TLO251			-	610	-	
	TLS251			-	635	-	
Spectral Line Half Width	TLG251	$\Delta\lambda$	I_F=15mA	-	30	-	nm
	TLY251			-	30	-	
	TLO251			-	30	-	
	TLS251			-	40	-	

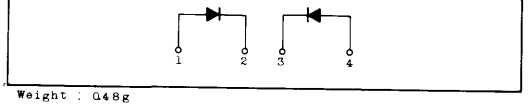
OUTLINE AND PIN CONNECTION

Unit in mm

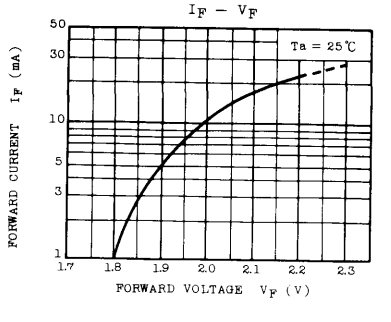


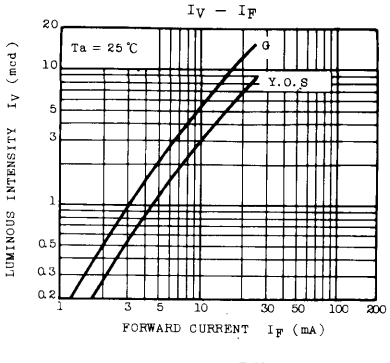
EIAJ	—
TOSHIBA	4-11A1A

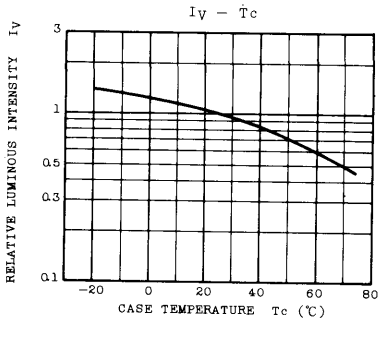
PIN No.	CONNECTION	PIN No.	CONNECTION
1	ANODE	3	CATHODE
2	CATHODE	4	ANODE

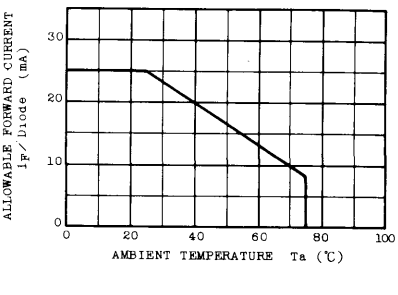


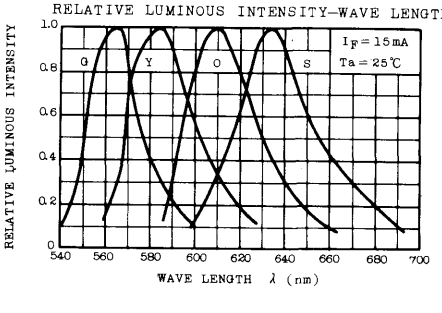
Weight : 0.48g











LARGE-SIZED SURFACE LAMP

TLG253, TLY253, TLO253, TLS253

RECTANGULAR, 11×6.5mm

FEATURES:
. Plastic Mold Type
TLG253 : Green Light Emission
TLY253 : Yellow Light Emission
TLO253 : Orange Light Emission
TLS253 : Red Light Emission
. Large-Sized Rectangular Type (Surface Size 11×6.5mm)
. Fast Response Time, Capable of Pulse Operation.

MAXIMUM RATINGS (Ta=25℃)

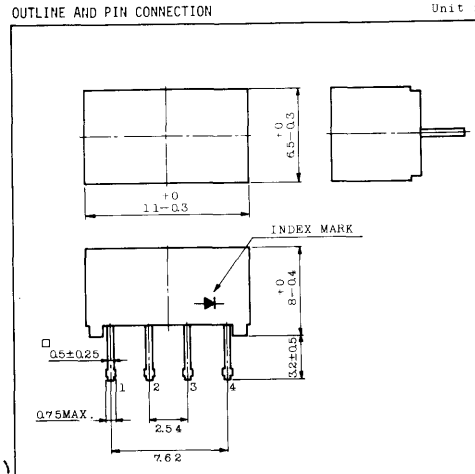
CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current (Diode)	I_F/Diode	30	mA
Reverse Voltage	V_R	4	V
Power Dissipation (Diode)	P_D/Diode	70	mW
Operating Temperature Range	T_{opr}	-20~75	℃
Storage Temperature Range	T_{stg}	-30~100	℃

ELECTRO-OPTICAL CHARACTERISTICS (Ta=25℃)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F=30mA	-	2.3	2.8	V
Reverse Current		I_R	V_R=4V	-	-	100	μA
Luminous Intensity	TLG253	I_V	I_F=15mA	5.5	10.0	-	mcd
	TLY253 TLO253 TLS253			3.4	6.0	-	
Peak Emission Wave Length	TLG253	λ_P	I_F=15mA	-	565	-	nm
	TLY253			-	585	-	
	TLO253			-	610	-	
	TLS253			-	635	-	
Spectral Line Half Width	TLG253	$\Delta\lambda$	I_F=15mA	-	30	-	nm
	TLY253			-	30	-	
	TLO253			-	30	-	
	TLS253			-	40	-	

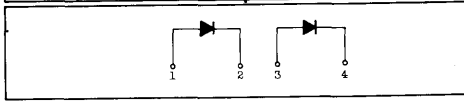
OUTLINE AND PIN CONNECTION

Unit in mm

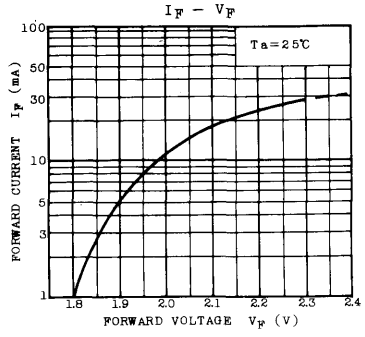


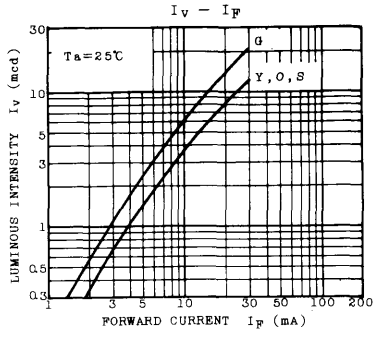
EIAJ	–
TOSHIBA	4-11B1A

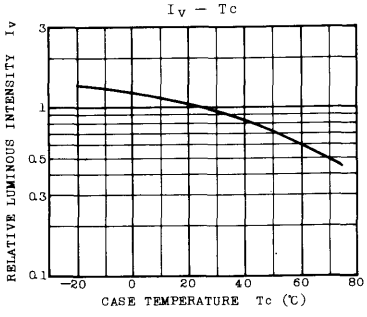
PIN No.	CONNECTION	PIN No.	CONNECTION
1	ANODE	3	ANODE
2	CATHODE	4	CATHODE

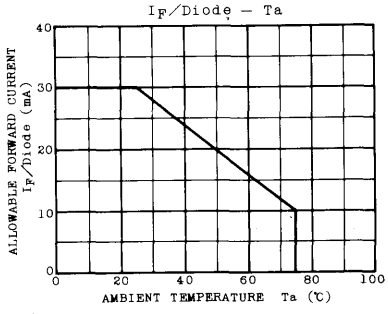


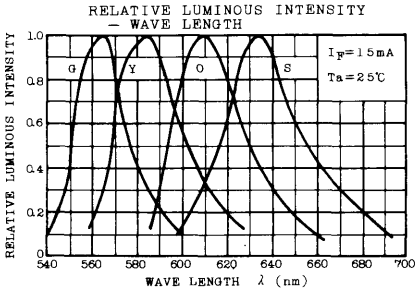
Weight : 0.67g











0.6 INCH RED SEVEN SEGMENT DISPLAY

TLR306, TLR307, TLR308, TLR309

RED COLOR 1 DIGIT LED DISPLAY

- 15mm Character Height Red Color Numerical and Polarity Display.
- High Efficiency Electro Luminescence from GaP Diodes, which Emit Red Light in All Directions Provides High Luminance and Low Power Requirements.
- Operates with Standard TTL, IC by Same Power Supply.
- Fast Response-Suitable for Time-Shared Operation.

Refer to page 118 for the figure.

TYPE NO. vs FULLY DISPLAYED FONT

COMMON CATHODE	COMMON ANODE	FULLY DISPLAY FONT
TLR308	TLR306	
TLR309	TLR307	

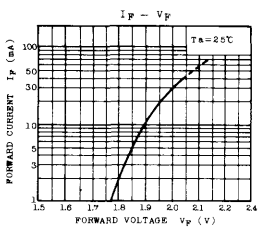
MAXIMUM RATINGS (Ta = 25°C)

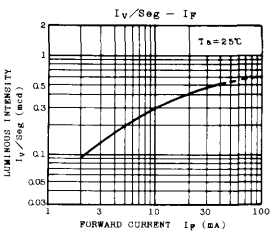
CHARACTERISTIC		SYMBOL	RATING	UNIT
DC Forward Current/Segment		$I_{F(DC)}$/Seg	35	mA
Pulse Forward Current/Seg. (Note)		$I_{F(Pulse)}$/Seg	90	mA
Reverse Voltage		V_R	3	V
Power Dissipation	TLR306, TLR308	P_D	750	mW
	TLR307, TLR309		400	
Operating Temperature Range		T_{opr}	-20 ~ 75	°C
Storage Temperature Range		T_{stg}	-30 ~ 80	°C

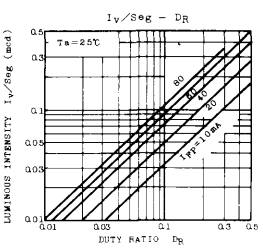
Note : Pulse Width=10ms, Duty Ratio=1/10

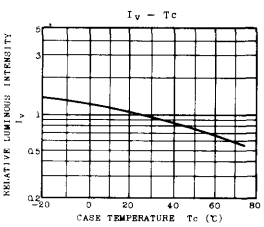
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25°C)

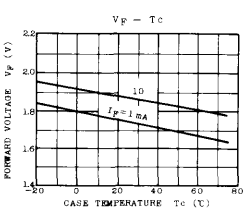
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=30mA	1.8	2.0	2.8	V
Reverse Current	I_R	V_R=3V	-	-	5	μA
Luminous Intensity/Segment	I_V/Seg	I_F=10mA	0.07	0.3	-	mcd
Peak Emission Wave Length	λP	I_F=10mA	-	700	-	nm
Spectral Half Line Width	Δλ	I_F=10mA	-	100	-	nm
Terminal Between Capacitance	C_T	V_R=0, f=1MHz	-	100	-	pF

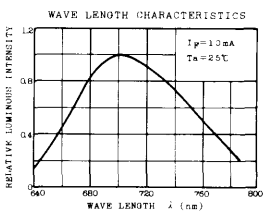


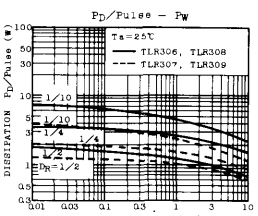


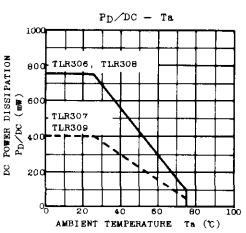




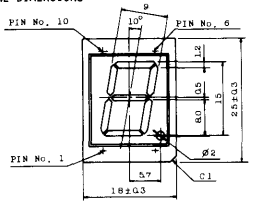


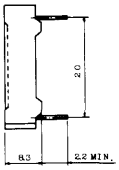






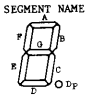
OUTLINE DIMENSIONS

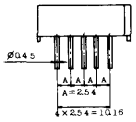




Note : Tolerance is ±0.25 unless otherwise noted.

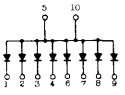
SEGMENT NAME

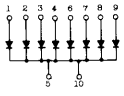




PIN CONNECTION*

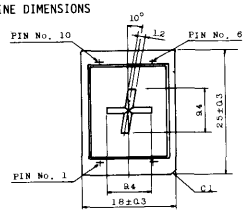
TLR306	TLR308
PIN No. 1. CATHODE E 2. CATHODE D 3. CATHODE C 4. CATHODE Dp 5. COMMON ANODE 6. CATHODE B 7. CATHODE A 8. CATHODE G 9. CATHODE F 10. COMMON ANODE	PIN No. 1. ANODE E 2. ANODE D 3. ANODE C 4. ANODE Dp 5. COMMON CATHODE 6. ANODE B 7. ANODE A 8. ANODE G 9. ANODE F 10. COMMON CATHODE
EIAJ – TOSHIBA 4-18A1A	EIAJ – TOSHIBA 4-18A1B

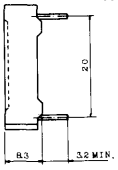




OUTLINE DIMENSIONS

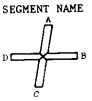
Unit in mm

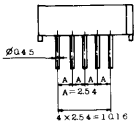




Note : Tolerance is ±0.25 unless otherwis noted.

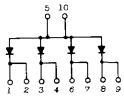
SEGMENT NAME

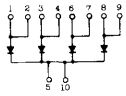




PIN CONNECTION

TLR307	TLR309
PIN No. 1. CATHODE C 2. CATHODE C 3. CATHODE B 4. CATHODE B 5. COMMON ANODE 6. CATHODE A 7. CATHODE A 8. CATHODE D 9. CATHODE D 10. COMMON ANODE	PIN No. 1. ANODE C 2. ANODE C 3. ANODE B 4. ANODE B 5. COMMON CATHODE 6. ANODE A 7. ANODE A 8. ANODE D 9. ANODE D 10. COMMON CATHODE
EIAJ – TOSHIBA 4-18A1C	EIAJ – TOSHIBA 4-18A1D





TLR312, TLR313, TLR314, TLR315

RED COLOR 1 DIGIT LED DISPLAY

- 8.3mm Character Height Red Color Numerical and with Polarity Display.
- High Efficiency Electro Luminescence from GaP Diodes, Which Emit Red Light in All Directions Provides High Luminance and Low Power Require-ments.
- Luminous Intensity Ranking Performed Uniform Display at the Multi-Digit Drive.
- Operates with Standard TTL, DTL-IC by Same Power Supply.
- Fast Response-Suitable for Time-Shared Operation.

Refer to page 120 for the figure.

TYPE NO. vs FULLY DISPLAYED FONT

COMMON CATHODE	COMMON ANODE	FULLY DISPLAY FONT
TLR312	TLR313	8.
TLR315	TLR314	4.

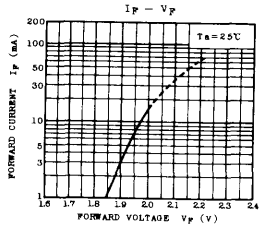
MAXIMUM RATINGS (Ta = 25°C)

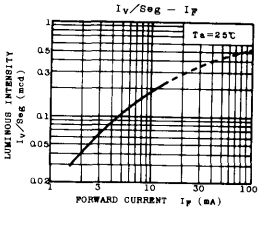
CHARACTERISTIC		SYMBOL	RATING	UNIT
DC Forward Current/Segment		$I_{F(DC)}$/Seg	15	mA
Pulse Forward Current/Seg. (Note)		$I_{F(Pulse)}$/Seg	80	mA
Reverse Voltage		V_R	3	V
Power Dissipation	TLR312, TLR313	P_D	350	mW
	TLR314, TLR315		170	
Operating Temperature Range		Topr	-20 ~ 75	°C
Storage Temperature Range		Tstg	-30 ~ 80	°C

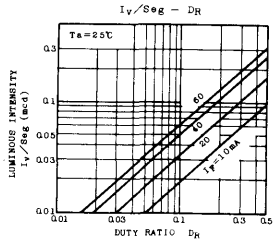
Note : Pulse Width=1ms, Duty Ratio=1/10

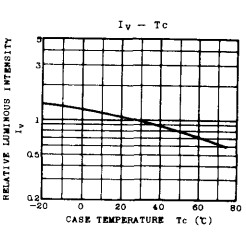
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25°C)

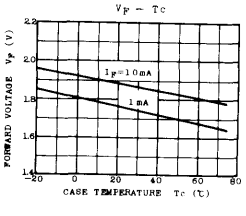
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=15mA	1.8	1.9	2.4	V
Reverse Current	I_R	V_R=3V	-	-	5.0	μA
Luminous Intensity/Segment	I_V/Seg	I_F=5mA	0.04	0.11	-	mcd
Peak Emission Wave Length	λ_P	I_F=10mA	-	700	-	nm
Spectral Half Line Width	$\Delta\lambda$	I_F=10mA	-	100	-	nm
Terminal Between Capacitance	C_T	V_R=0, f=1MHz	-	100	-	pF

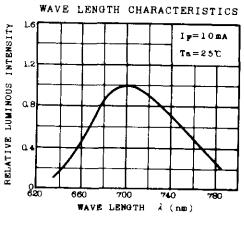


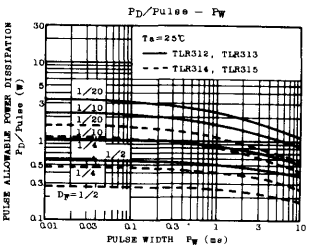


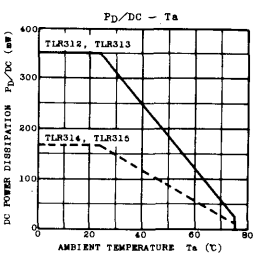








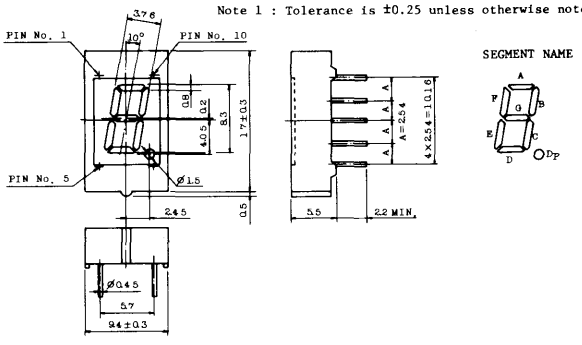




OUTLINE DIMENSIONS

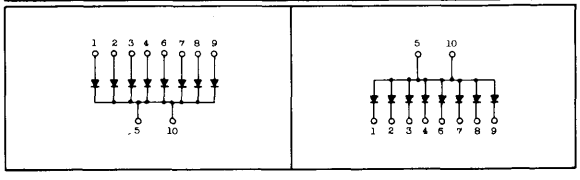
Unit in mm

Note 1 : Tolerance is ±0.25 unless otherwise noted.



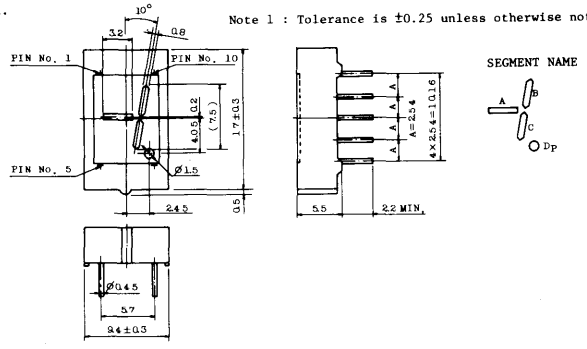
PIN CONNECTION

TLR312	TLR313
PIN No.	PIN No.
1. ANODE A	1. CATHODE A
2. ANODE F	2. CATHODE F
3. ANODE E	3. CATHODE E
4. ANODE D	4. CATHODE D
5. COMMON CATHODE	5. COMMON ANODE
6. ANODE C	6. CATHODE C
7. ANODE Dp	7. CATHODE Dp
8. ANODE G	8. CATHODE G
9. ANODE B	9. CATHODE B
10. COMMON CATHODE	10. COMMON ANODE
EIAJ –	EIAJ –
TOSHIBA 4-9B1B	TOSHIBA 4-9B1A



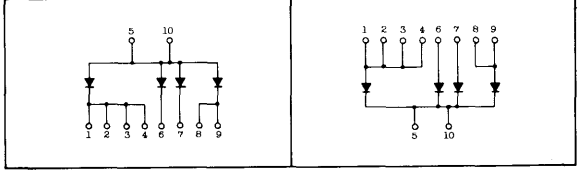
OUTLINE DIMENSIONS

Note 1 : Tolerance is ±0.25 unless otherwise noted.



PIN CONNECTION

TLR314	TLR315
PIN No.	PIN No.
1. CATHODE A	1. ANODE A
2. CATHODE A	2. ANODE A
3. CATHODE A	3. ANODE A
4. CATHODE A	4. ANODE A
5. COMMON ANODE	5. COMMON CATHODE
6. CATHODE Dp	6. ANODE Dp
7. CATHODE C	7. ANODE C
8. CATHODE B	8. ANODE B
9. CATHODE B	9. ANODE B
10. COMMON ANODE	10. COMMON CATHODE
EIAJ –	EIAJ –
TOSHIBA 4-9B1C	TOSHIBA 4-9B1D



TLG312A, TLG313A, TLG314A, TLG315A

GREEN COLOR 1 DIGIT LED DISPLAY

- 8.3mm Character Height Green Color Numerical and with Polarity Display.
- High Efficiency Electro Luminescence from GaP Diodes, Which Emit Green Light in all Directions Provides High Luminance and Low Power Require-ments.
- Operates with Standard TTL, DTL IC by Same Power Supply.
- Luminous Intensity Ranking Performed Uniform Display at the Multi-Digit Drive.
- Fast Response-Suitable for Time-Shared Operation.

Refer to page 122 for the figure.

TYPE NO. vs FULLY DISPLAYED FONT

COMMON CATHODE	COMMON ANODE	FULLY DISPLAY FONT
TLG312A	TLG313A	8.
TLG315A	TLG314A	-1.

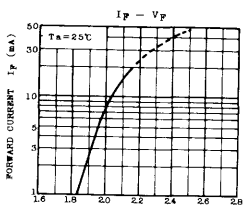
MAXIMUM RATINGS (Ta = 25°C)

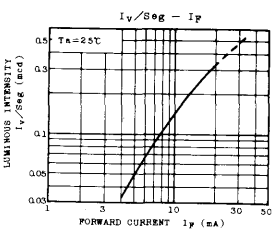
CHARACTERISTIC		SYMBOL	RATING	UNIT
DC Forward Current/Segment		$I_{F(DC)}$/Seg	20	mA
Pulse Forward Current/Seg. (Note)		$I_{F(Pulse)}$/Seg	150	mA
Reverse Voltage		V_R	6	V
Power Dissipation	TLG312A, TLG313A	P_D	400	mW
	TLG314A, TLG315A		200	
Operating Temperature Range		T_{opr}	-20~75	°C
Storage Temperature Range		T_{stg}	-30~80	°C

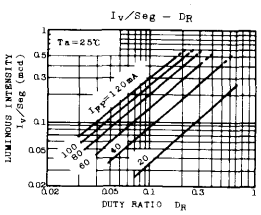
Note : Pulse Width=1ms, Duty Ratio=1/10

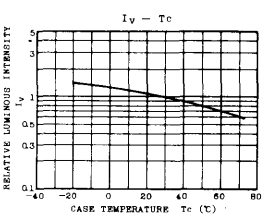
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25°C)

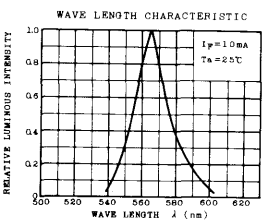
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=10mA	1.8	2.0	2.5	V
Reverse Current	I_R	V_R=6V	-	-	5	μA
Luminous Intensity/Segment	I_V/Seg	I_F=10mA	0.07	0.14	-	mcd
Luminous Intensity Matching Ratio	I_V-M	I_F=5mA	-	-	2.3	-
Peak Emission Wave Length	λ_P	I_F=10mA	-	565	-	nm
Spectral Half Line Width	$\Delta\lambda$	I_F=10mA	-	30	-	nm

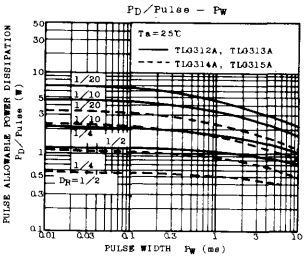


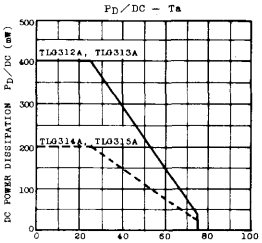








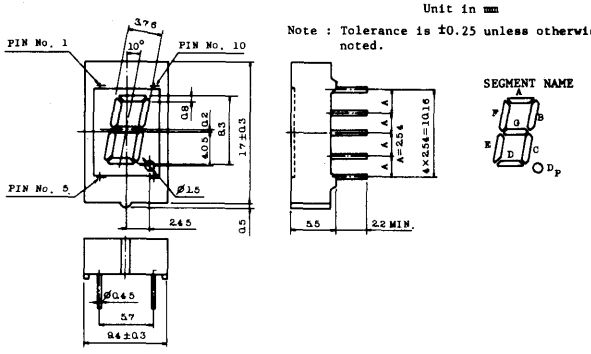




OUTLINE DIMENSIONS

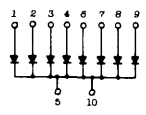
Unit in mm

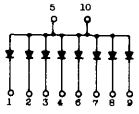
Note : Tolerance is ±0.25 unless otherwise noted.



PIN CONNECTION

TLG312A	TLG313A
PIN No. 1. ANODE A 2. ANODE F 3. ANODE E 4. ANODE D 5. COMMON CATHODE 6. ANODE C 7. ANODE DP 8. ANODE C 9. ANODE B 10. COMMON CATHODE	PIN No. 1. CATHODE A 2. CATHODE F 3. CATHODE E 4. CATHODE D 5. COMMON ANODE 6. CATHODE C 7. CATHODE DP 8. CATHODE C 9. CATHODE B 10. COMMON ANODE
EIAJ – TOSHIBA 4-9B1B	EIAJ – TOSHIBA 4-9B1A

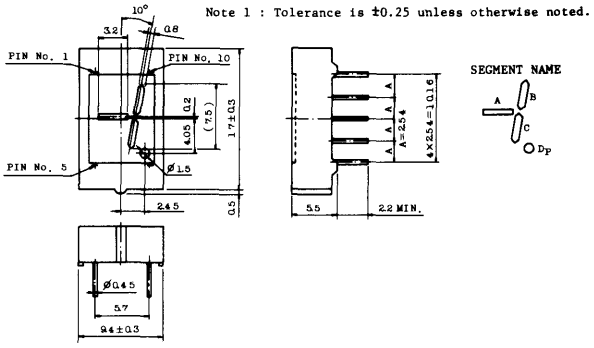




OUTLINE DIMENSIONS

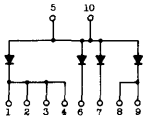
Unit in mm

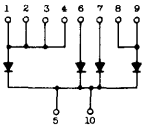
Note 1 : Tolerance is ±0.25 unless otherwise noted.



PIN CONNECTION

TLG314A	TLG315A
PIN No. 1. CATHODE A 2. CATHODE A 3. CATHODE A 4. CATHODE A 5. COMMON ANODE 6. CATHODE DP 7. CATHODE C 8. CATHODE B 9. CATHODE B 10. COMMON ANODE	PIN No. 1. ANODE A 2. ANODE A 3. ANODE A 4. ANODE A 5. COMMON CATHODE 6. ANODE DP 7. ANODE C 8. ANODE B 9. ANODE B 10. COMMON CATHODE
EIAJ – TOSHIBA 4-9B1C	EIAJ – TOSHIBA 4-9B1D





0.4 INCH RED 2-DIGITS SEVEN SEGMENT DISPLAY

TLR320, TLR321

RED COLOR 2 DIGITS LED DISPLAY

- Red Color 10mm Character Height 2 Dight Numerical Display.
- Available Both Polarity of Connections, Common Cathode or Common Anode.
- Applications: Transceiver or TV Channel Display, and Instrument Display etc.

Refer to page 124 for the figure.

TYPE NO. VS FUIIY DISPIAYED FONT

COMMON CATHODE	COMMON ANODE	FULLY DISPLAY FONT
TLR320	TLR321	88

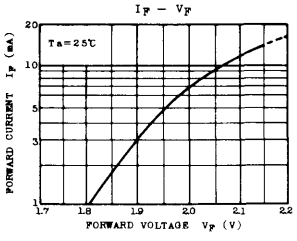
MAXIMUM RATINGS (Ta = 25°C)

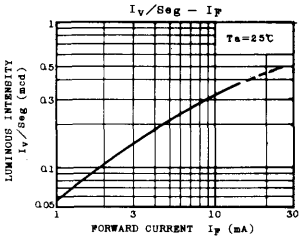
CHARACTERISTIC	SYMBOL	RATING	UNIT
DC Forward Current/Segment	$I_{F(DC)}$/Seg	15	mA
Pulse Forward Current/Segment	$I_{F(Pulse)}$/Seg	80	mA
Reverse Voltage	V_R	3	V
Operating Temperature Range	T_{opr}	-30 ~ 75	°C
Storage Temperature Range	T_{stg}	-30 ~ 90	°C

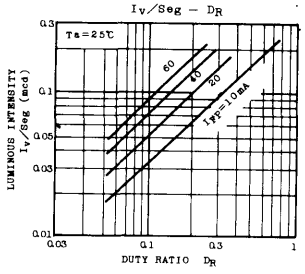
Note : Pulse Width=1ms, Duty Ratio=1/10

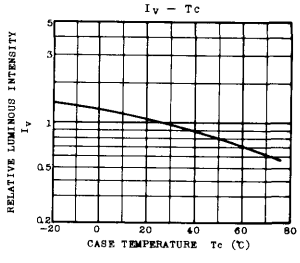
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25°C)

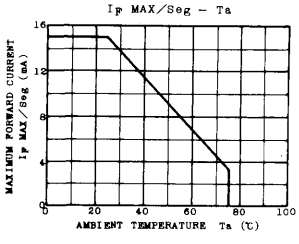
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=15mA	1.8	2.15	2.5	V
Reverse Current	I_R	V_R=3V	-	-	5	μA
Luminous Intensity/Segment	I_V/Seg	I_F=5mA	0.13	0.22	-	mcd
Luminous Intensity Matching Ratio	I_V-M	I_F=5mA	-	-	2.5	-
Peak Emission Wave Length	λp	I_F=10mA	-	700	-	nm
Spectral Half Line Width	$\Delta\lambda$	I_F=10mA	-	100	-	nm







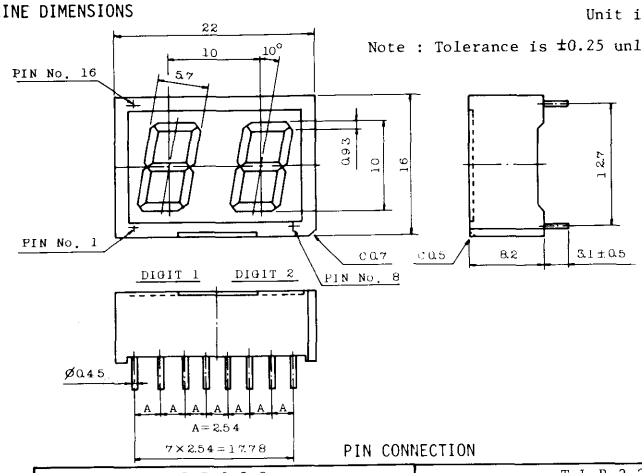




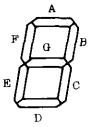
OUTLINE DIMENSIONS

Unit in mm

Note : Tolerance is ±0.25 unless otherwise noted.

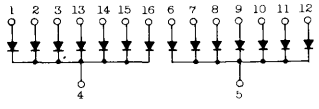


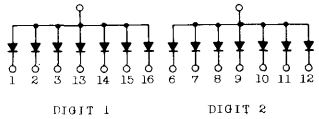
SEGMENT NAME



PIN CONNECTION

TLR320	TLR321
PIN No.	PIN No.
1. DIGIT 1 ANODE C	1. DIGIT 1 CATHODE C
2. DIGIT 1 ANODE E	2. DIGIT 1 CATHODE E
3. DIGIT 1 ANODE D	3. DIGIT 1 CATHODE D
4. DIGIT 1 COMMON CATHODE	4. DIGIT 1 COMMON ANODE
5. DIGIT 2 COMMON CATHODE	5. DIGIT 2 COMMON ANODE
6. DIGIT 2 ANODE D	6. DIGIT 2 CATHODE D
7. DIGIT 2 ANODE E	7. DIGIT 2 CATHODE E
8. DIGIT 2 ANODE C	8. DIGIT 2 CATHODE C
9. DIGIT 2 ANODE G	9. DIGIT 2 CATHODE G
10. DIGIT 2 ANODE A	10. DIGIT 2 CATHODE A
11. DIGIT 2 ANODE F	11. DIGIT 2 CATHODE F
12. DIGIT 2 ANODE B	12. DIGIT 2 CATHODE B
13. DIGIT 1 ANODE B	13. DIGIT 1 CATHODE B
14. DIGIT 1 ANODE F	14. DIGIT 1 CATHODE F
15. DIGIT 1 ANODE A	15. DIGIT 1 CATHODE A
16. DIGIT 1 ANODE G	16. DIGIT 1 CATHODE G





TLG320, TLG321

GREEN COLOR 2 DIGITS LED DISPLAY

. Green Color, 10mm Character Height 2 Digit Numerical Display.
. Available Both Polarity of Connections, Common Cathode or Common Anode.
. Applications: Transceiver or TV Channel Display, and Instrument Display etc.

Refer to page 126 for the figure.

TYPE NO. VS FUIIY DISPIAYED FONT

COMMON CATHODE	COMMON ANODE	FULLY DISPLAY FONT
TLG320	TLG321	88

MAXIMUM RATINGS (Ta = 25°C)

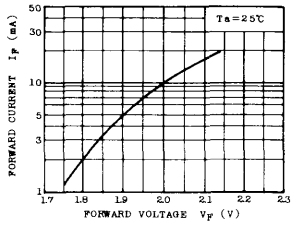
CHARACTERISTIC	SYMBOL	RATING	UNIT
DC Forward Current/Segment	$I_{F(DC)}$/Seg	20	mA
Pulse Forward Current/Segment	$I_{F(Pulse)}$/Seg	150	mA
Reverse Voltage	V_R	6	V
Operating Temperature Range	T_{opr}	-30 ~ 75	°C
Storage Temperature Range	T_{stg}	-30 ~ 90	°C

Note : Pulse Width=1ms, Duty Ratio=1/10

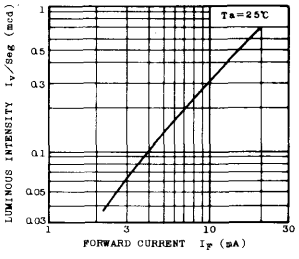
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=10mA	1.8	2.0	2.5	V
Reverse Current	I_R	V_R=6V	-	-	5	μA
Luminous Intensity/Segment	I_V/Seg	I_F=10mA	0.13	0.30	-	mcd
Luminous Intensity Matching Ratio	I_V-M	I_F=5mA	-	-	2.3	-
Peak Emission Wave Length	λ_P	I_F=10mA	-	565	-	nm
Spectral Half Line Width	$\Delta\lambda$	I_F=10mA	-	30	-	nm

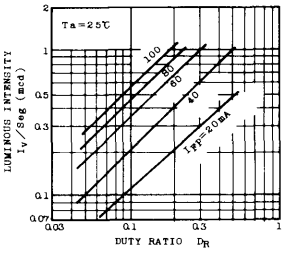
$I_F - V_F$



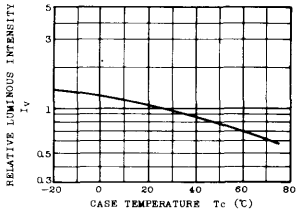
I_V/Seg − I_F



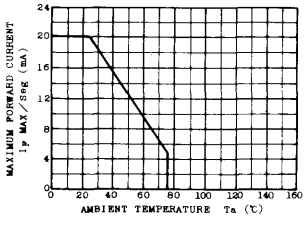
I_V/Seg − D_R



I_V − Tc



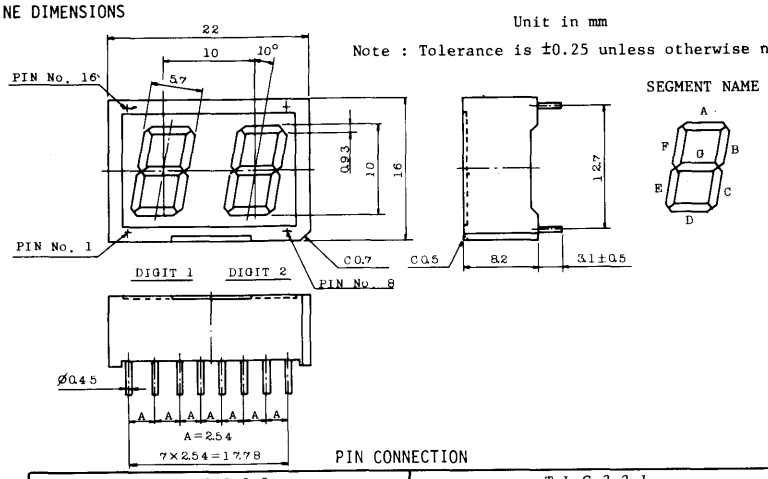
I_F MAX/Seg − Ta



OUTLINE DIMENSIONS

Unit in mm

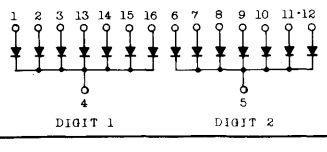
Note : Tolerance is ±0.25 unless otherwise noted.

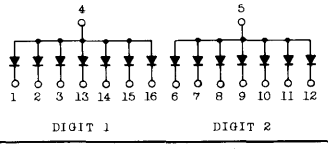


SEGMENT NAME

PIN CONNECTION

TLG320	TLG321
PIN No.	PIN No.
1. DIGIT 1 ANODE C	1. DIGIT 1 CATHODE C
2. DIGIT 1 ANODE E	2. DIGIT 1 CATHODE E
3. DIGIT 1 ANODE D	3. DIGIT 1 CATHODE D
4. DIGIT 1 COMMON CATHODE	4. DIGIT 1 COMMON ANODE
5. DIGIT 2 COMMON CATHODE	5. DIGIT 2 COMMON ANODE
6. DIGIT 2 ANODE D	6. DIGIT 2 CATHODE D
7. DIGIT 2 ANODE E	7. DIGIT 2 CATHODE E
8. DIGIT 2 ANODE C	8. DIGIT 2 CATHODE C
9. DIGIT 2 ANODE G	9. DIGIT 2 CATHODE G
10. DIGIT 2 ANODE A	10. DIGIT 2 CATHODE A
11. DIGIT 2 ANODE F	11. DIGIT 2 CATHODE F
12. DIGIT 2 ANODE B	12. DIGIT 2 CATHODE B
13. DIGIT 1 ANODE B	13. DIGIT 1 CATHODE B
14. DIGIT 1 ANODE F	14. DIGIT 1 CATHODE F
15. DIGIT 1 ANODE A	15. DIGIT 1 CATHODE A
16. DIGIT 1 ANODE G	16. DIGIT 1 CATHODE G
EIAJ –	EIAJ –
TOSHIBA 4-22A1A	TOSHIBA 4-22A1B





0.3 INCH RED 2-DIGITS SEVEN SEGMENT DISPLAY

TLR322, TLR323

RED COLOR 2 DIGITS LED DISPLAY

- Red Color 2 Digit Display for Multiplex Drive Use, 7.6 × 4mm Character Size.
- Lighted Appearance is Performed with Diffused and Unifomly.
- Common Cathode Type or Common Anode Type Available.
- Applications : Transceiver or TV Channel Display

Refer to page 128 for the figure.

TYPE NO. vs FULLY DISPLAYED FONT

COMMON CATHODE	COMMON ANODE	FULLY DISPLAY FONT
TLR322	TLR323	88

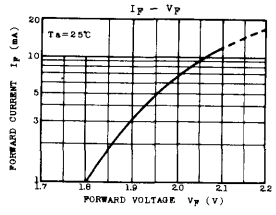
MAXIMUM RATINGS (Ta = 25°C)

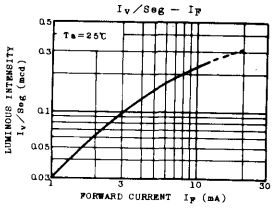
CHARACTERISTIC	SYMBOL	RATING	UNIT
DC Forward Current/Segment	$I_{F(DC)}$/Seg	13	mA
Pulse Forward Current/Segment	$I_{F(Pulse)}$/Seg	50	mA
Reverse Voltage	V_R	3	V
Operating Temperature Range	T_{opr}	-30 ~ 75	°C
Storage Temperature Range	T_{stg}	-30 ~ 80	°C

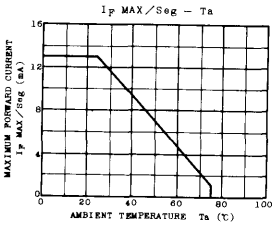
Note : Pulse Width=1ms, Duty Ratio=1/4

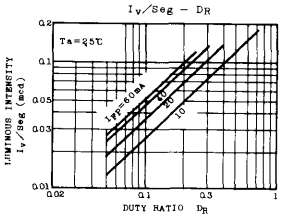
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25°C)

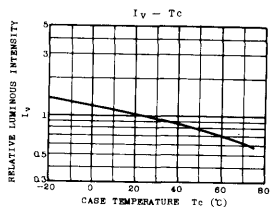
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=13mA	1.8	2.1	2.5	V
Reverse Current	I_R	V_R=3V	-	-	5	μA
Luminous Intensity/Segment	I_V/Seg	I_F=5mA	0.07	0.15	-	mcd
Luminous Intensity Matching Ratio	I_V-M	I_F=5mA	-	-	2.5	-
Peak Emission Wave Length	λP	I_F=10mA	-	700	-	nm
Spectral Half Line Width	Δλ	I_F=10mA	-	100	-	nm









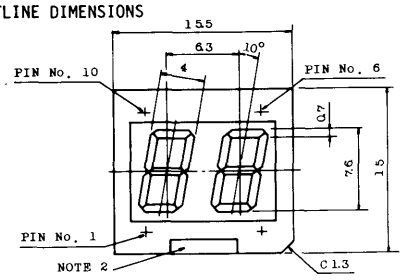


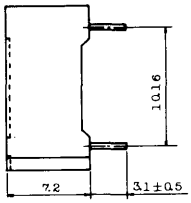
TLR322, TLR323

OUTLINE DIMENSIONS

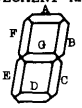
Unit in mm

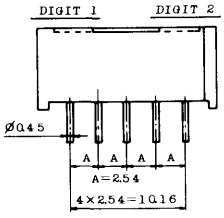
Note : Tolerance is ±0.25
unless otherwise noted.





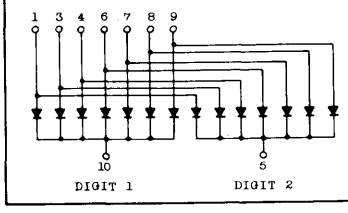
SEGMENT NAME

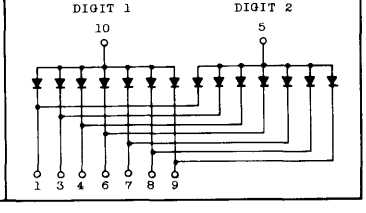




PIN CONNECTION

T L R 3 2 2	T L R 3 2 3
PIN No. 1. ANODE G 2. NO PIN 3. ANODE A 4. ANODE F 5. DIGIT 2 COMMON CATHODE 6. ANODE D 7. ANODE E 8. ANODE C 9. ANODE B 10. DIGIT 1 COMMON CATHODE	PIN No. 1. CATHODE G 2. NO PIN 3. CATHODE A 4. CATHODE F 5. DIGIT 2 COMMON ANODE 6. CATHODE D 7. CATHODE E 8. CATHODE C 9. CATHODE B 10. DIGIT 1 COMMON ANODE
EIAJ –	EIAJ –
TOSHIBA 4-16A1A	TOSHIBA 4-16A1B





0.5 INCH RED 1-DIGIT & 2-DIGITS SEVEN SEGMENT DISPLAY

TLR324, TLR325, TLR326, TLR327, TLR352, TLR353

RED COLOR 1 DIGIT AND 2 DIGITS LED DISPLAY

- 12.7mm Character Height Red Color Numerical and with Polarity Display.
- Available Both Polarity of Connections, Common Cathode or Common Anode.
- Applications: Transceiver or TV Channel Display, Clock Display and Instrument Display etc.
- Luminous Intensity Ranking Performed Uniform Display at Multi-Digit Display.
- Terminal Location of Each Segment are Designed for Easy Connection on One Side Board at Time Sharing Operation.

Refer to page 130 for the figure.

TYPE NO. vs FULLY DISPLAYED FONT

COMMON CATHODE	COMMON ANODE	FULLY DISPLAY FONT
TLR324	TLR325	
TLR326	TLR327	
TLR352	TLR353	

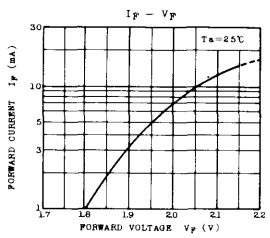
MAXIMUM RATINGS (Ta = 25°C)

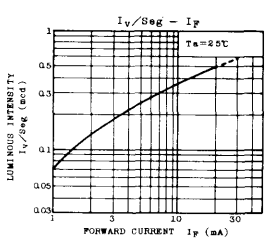
CHARACTERISTIC	SYMBOL	RATING	UNIT
DC Forward Current	$I_{F(DC)}$/Seg	20	mA
Pulse Forward Current/Seg. (Note)	$I_{F(Pulse)}$/Seg	80	mA
Reverse Voltage	V_R	3	V
Operating Temperature Range	T_{opr}	-30 ~ 75	°C
Storage Temperature Range	T_{stg}	-30 ~ 90	°C

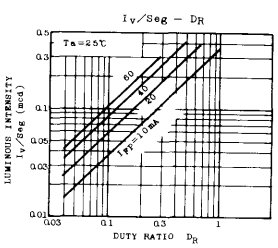
Note : Pulse Width=1ms, Duty Ratio=1/10

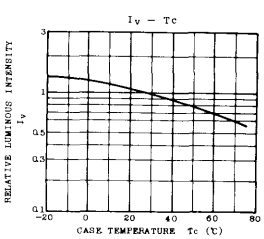
ELECTRICAL OPTICAL CHARACTERISTICS (Ta = 25°C)

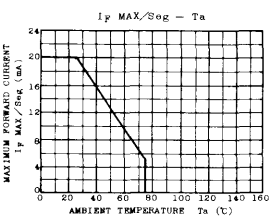
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=15mA	1.8	2.15	2.5	V
Reverse Current	I_R	V_R=3V	-	-	5	μA
Luminous Intensity/Segment	I_V/Seg	I_F=5mA	0.13	0.25	-	mcd
Luminous Intensity Matching Ratio	I_V-M	I_F=5mA	-	-	2.5	-
Peak Emission Wave Length	λp	I_F=10mA	-	700	-	nm
Spectral Half Line Width	Δλ	I_F=10mA	-	100	-	nm





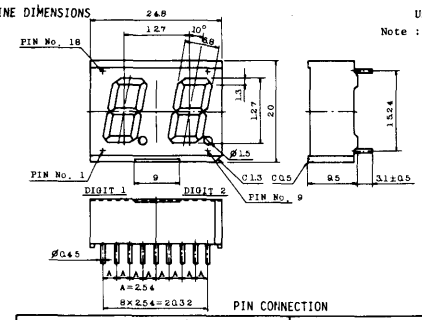






TLR324, TLR325, TLR326, TLR327, TLR352, TLR353

OUTLINE DIMENSIONS

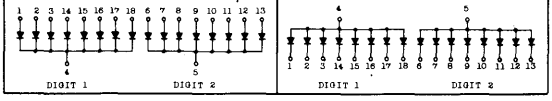


Unit in mm

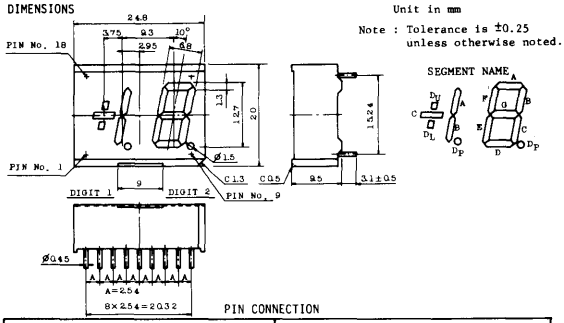
Note : Tolerance is ±0.25 unles otherwise noted.

PIN CONNECTION

TLR324		TLR325	
PIN No.		PIN No.	
1.	DIGIT 1 ANODE C	1.	DIGIT 1 CATHODE C
2.	DIGIT 1 ANODE E	2.	DIGIT 1 CATHODE E
3.	DIGIT 1 ANODE D	3.	DIGIT 1 CATHODE D
4.	DIGIT 1 COMMON CATHODE	4.	DIGIT 1 COMMON ANODE
5.	DIGIT 2 COMMON CATHODE	5.	DIGIT 2 COMMON ANODE
6.	DIGIT 2 ANODE D	6.	DIGIT 2 CATHODE D
7.	DIGIT 2 ANODE E	7.	DIGIT 2 CATHODE E
8.	DIGIT 2 ANODE C	8.	DIGIT 2 CATHODE C
9.	DIGIT 2 ANODE DP	9.	DIGIT 2 CATHODE DP
10.	DIGIT 2 ANODE G	10.	DIGIT 2 CATHODE G
11.	DIGIT 2 ANODE A	11.	DIGIT 2 CATHODE A
12.	DIGIT 2 ANODE F	12.	DIGIT 2 CATHODE F
13.	DIGIT 2 ANODE B	13.	DIGIT 2 CATHODE B
14.	DIGIT 1 ANODE B	14.	DIGIT 1 CATHODE B
15.	DIGIT 1 ANODE F	15.	DIGIT 1 CATHODE F
16.	DIGIT 1 ANODE A	16.	DIGIT 1 CATHODE A
17.	DIGIT 1 ANODE G	17.	DIGIT 1 CATHODE G
18.	DIGIT 1 ANODE DP	18.	DIGIT 1 CATHODE DP
EIAJ	–	EIAJ	–
TOSHIBA	4-25A1A	TOSHIBA	4-25A1B



OUTLINE DIMENSIONS

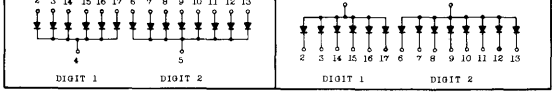


Unit in mm

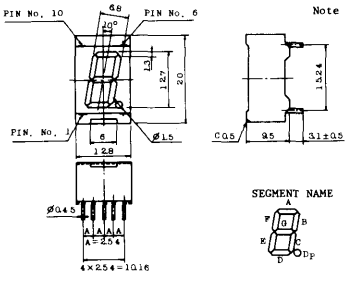
Note : Tolerance is ±0.25 unless otherwise noted.

PIN CONNECTION

TLR326		TLR327	
PIN No.		PIN No.	
1.	NC	1.	NC
2.	DIGIT 1 ANODE DP	2.	DIGIT 1 CATHODE DP
3.	DIGIT 1 ANODE B	3.	DIGIT 1 CATHODE B
4.	DIGIT 1 COMMON CATHODE	4.	DIGIT 1 COMMON ANODE
5.	DIGIT 2 COMMON CATHODE	5.	DIGIT 2 COMMON ANODE
6.	DIGIT 2 ANODE D	6.	DIGIT 2 CATHODE D
7.	DIGIT 2 ANODE E	7.	DIGIT 2 CATHODE E
8.	DIGIT 2 ANODE C	8.	DIGIT 2 CATHODE C
9.	DIGIT 2 ANODE DP	9.	DIGIT 2 CATHODE DP
10.	DIGIT 2 ANODE G	10.	DIGIT 2 CHATODE G
11.	DIGIT 2 ANODE A	11.	DIGIT 2 CATHODE A
12.	DIGIT 2 ANODE F	12.	DIGIT 2 CATHODE F
13.	DIGIT 2 ANODE B	13.	DIGIT 2 CATHODE B
14.	DIGIT 1 ANODE A	14.	DIGIT 1 CATHODE A
15.	DIGIT 1 ANODE DL	15.	DIGIT 1 CATHODE DL
16.	DIGIT 1 ANODE C	16.	DIGIT 1 CATHODE C
17.	DIGIT 1 ANODE DU	17.	DIGIT 1 CATHODE DU
18.	NC	18.	NC
EIAJ	–	EIAJ	–
TOSHIBA	4-25B1A	TOSHIBA	4-25B1B



OUTLINE DIMENSIONS

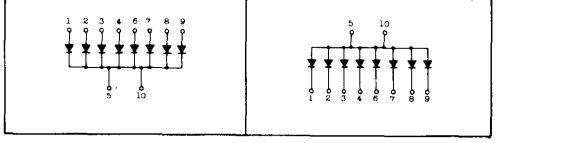


Unit in mm

Note : Tolerance is ±0.25 unless otherwise noted.

PIN CONNECTION

TLR352		TLR353	
PIN No.		PIN No.	
1.	ANODE E	1.	CATHODE E
2.	ANODE D	2.	CATHODE D
3.	ANODE C	3.	CATHODE C
4.	ANODE DP	4.	CATHODE DP
5.	COMMON CATHODE	5.	COMMON ANODE
6.	ANODE B	6.	CATHODE B
7.	ANODE A	7.	CATHODE A
8.	ANODE G	8.	CATHODE G
9.	ANODE F	9.	CATHODE F
10.	COMMON CATHODE	10.	COMMON ANODE
EIAJ	–	EIAJ	–
TOSHIBA	4-13A1A	TOSHIBA	4-13A1B



0.5 INCH GREEN 1-DIGIT & 2-DIGITS SEVEN SEGMENT DISPLAY

TLG324, TLG325, TLG326, TLG327, TLG352, TLG353

GREEN COLOR 1 DIGIT AND 2 DIGITS LED DISPLAY

- 12.7mm Character Height Green Color Numerical and with Polarity Display.
- Available Both Polarity of Connections, Common Cathode or Common Anode.
- Applications: Transceiver or TV Channel Display, Clock Display and Instrument Display etc.
- Luminous Intensity Ranking Performed for Uniform Dispaly at Multi-Digit Display.
- Terminal Location of Each Segment is Designed for Easy Connection on One Side Board at Dynamic Operation.

Refer to page 132 for the figure.

TYPE NO. vs FULLY DISPLAY FONT

COMMON CATHODE	COMMON ANODE	FULLY DISPLAY FONT
TLG324	TLG325	
TLG326	TLG327	
TLG352	TLG353	

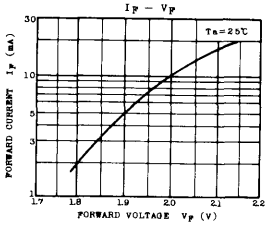
MAXIMUM RATINGS (Ta = 25°C)

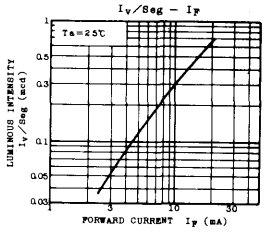
CHARACTERISTIC	SYMBOL	RATING	UNIT
DC Forward Current	I_F(DC)/Seg	20	mA
Pulse Forward Current/Seg. (Note)	I_F(Pulse)/Seg	150	mA
Reverse Voltage	V_R	6	V
Operating Temperature Range	T_{opr}	-30 ~ 75	°C
Storage Temperature Range	T_{stg}	-30 ~ 90	°C

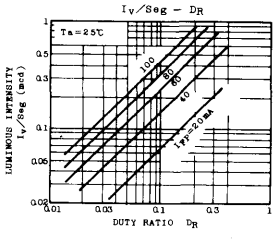
Note : Pulse Width=1ms, Duty Ratio=1/10

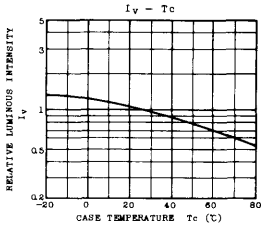
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25°C)

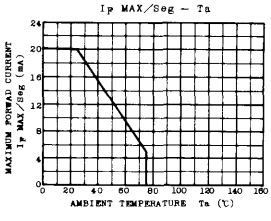
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=10mA	1.8	2.0	2.5	V
Reverse Current	I_R	V_R=6V	-	-	5	μA
Luminous Intensity/Segment	I_V/Seg	I_F=10mA	0.13	0.3	-	mcd
Luminous Intensity Matching Ratio	I_V-M	I_F=5mA	-	-	2,3	-
Peak Emission Wave Length	λP	I_F=10mA	-	565	-	nm
Spectral Half Line Width	dλ	I_F=10mA	-	30	-	nm







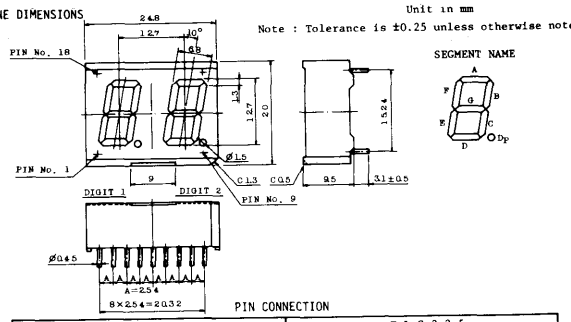




OUTLINE DIMENSIONS

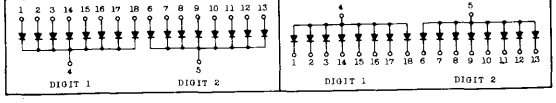
Unit in mm

Note : Tolerance is ±0.25 unless otherwise noted.



PIN CONNECTION

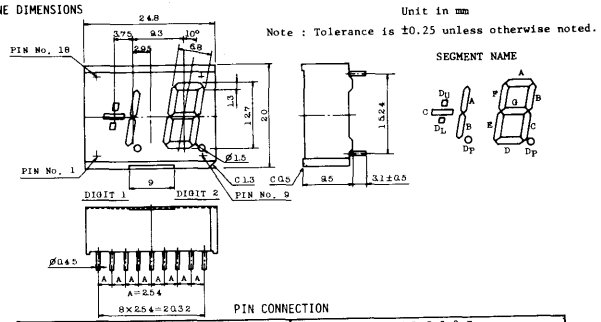
TLG324		TLG325	
PIN No.		PIN No.	
1.	DIGIT 1 ANODE C	1.	DIGIT 1 CATHODE C
2.	DIGIT 1 ANODE E	2.	DIGIT 1 CATHODE E
3.	DIGIT 1 ANODE D	3.	DIGIT 1 CATHODE D
4.	DIGIT 1 COMMON CATHODE	4.	DIGIT 1 COMMON ANODE
5.	DIGIT 2 COMMON CATHODE	5.	DIGIT 2 COMMON ANODE
6.	DIGIT 2 ANODE D	6.	DIGIT 2 CATHODE D
7.	DIGIT 2 ANODE E	7.	DIGIT 2 CATHODE E
8.	DIGIT 2 ANODE C	8.	DIGIT 2 CATHODE C
9.	DIGIT 2 ANODE Dp	9.	DIGIT 2 CATHODE Dp
10.	DIGIT 2 ANODE G	10.	DIGIT 2 CATHODE G
11.	DIGIT 2 ANODE A	11.	DIGIT 2 CATHODE A
12.	DIGIT 2 ANODE F	12.	DIGIT 2 CATHODE F
13.	DIGIT 2 ANODE B	13.	DIGIT 2 CATHODE B
14.	DIGIT 1 ANODE B	14.	DIGIT 1 CATHODE B
15.	DIGIT 1 ANODE F	15.	DIGIT 1 CATHODE F
16.	DIGIT 1 ANODE A	16.	DIGIT 1 CATHODE A
17.	DIGIT 1 ANODE G	17.	DIGIT 1 CATHODE G
18.	DIGIT 1 ANODE Dp	18.	DIGIT 1 CATHODE Dp
EIAJ	–	EIAJ	–
TOSHIBA	4-25A1A	TOSHIBA	4-25A1B



OUTLINE DIMENSIONS

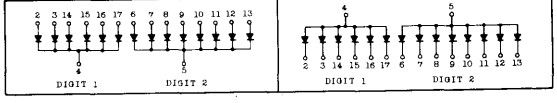
Unit in mm

Note : Tolerance is ±0.25 unless otherwise noted.



PIN CONNECTION

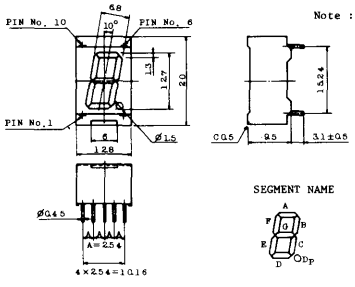
TLG326		TLG327	
PIN No.		PIN No.	
1.	NC	1.	NC
2.	DIGIT 1 ANODE Dp	2.	DIGIT 1 CATHODE Dp
3.	DIGIT 1 ANODE B	3.	DIGIT 1 CATHODE B
4.	DIGIT 1 COMMON CATHODE	4.	DIGIT 1 COMMON ANODE
5.	DIGIT 2 COMMON CATHODE	5.	DIGIT 2 COMMON ANODE
6.	DIGIT 2 ANODE D	6.	DIGIT 2 CATHODE D
7.	DIGIT 2 ANODE E	7.	DIGIT 2 CATHODE E
8.	DIGIT 2 ANODE C	8.	DIGIT 2 CATHODE C
9.	DIGIT 2 ANODE Dp	9.	DIGIT 2 CATHODE Dp
10.	DIGIT 2 ANODE G	10.	DIGIT 2 CATHODE G
11.	DIGIT 2 ANODE A	11.	DIGIT 2 CATHODE A
12.	DIGIT 2 ANODE F	12.	DIGIT 2 CATHODE F
13.	DIGIT 2 ANODE B	13.	DIGIT 2 CATHODE B
14.	DIGIT 1 ANODE A	14.	DIGIT 1 CATHODE A
15.	DIGIT 1 ANODE D_L	15.	DIGIT 1 CATHODE D_L
16.	DIGIT 1 ANODE C	16.	DIGIT 1 CATHODE C
17.	DIGIT 1 ANODE D_U	17.	DIGIT 1 CATHODE D_U
18.	NC	18.	NC
EIAJ	–	EIAJ	–
TOSHIBA	4-25B1A	TOSHIBA	4-25B1B



OUTLINE DIMENSIONS

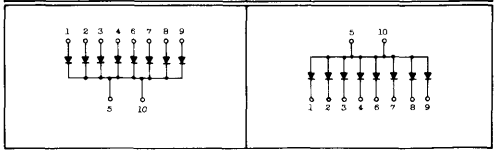
Unit in mm

Note : Tolerance is ±0.25 unless otherwise noted.



PIN CONNECTION

TLG352		TLG353	
PIN No.		PIN No.	
1.	ANODE E	1.	CATHODE E
2.	ANODE D	2.	CATHODE D
3.	ANODE C	3.	CATHODE C
4.	ANODE Dp	4.	CATHODE Dp
5.	COMMON CATHODE	5.	COMMON ANODE
6.	ANODE B	6.	CATHODE B
7.	ANODE A	7.	CATHODE A
8.	ANODE G	8.	CATHODE G
9.	ANODE F	9.	CATHODE F
10.	COMMON CATHODE	10.	COMMON ANODE
EIAJ	–	EIAJ	–
TOSHIBA	4-13A1A	TOSHIBA	4-13A1B



0.3 INCH 1-DIGITS SEVEN SEGMENT DISPLAY

TLR332, TLR333, TLR335, TLR334

- Red Color, 7.62 mm (0.3") Character Height Numerical and with Polarity Display
- Applications: Transceiver or TV Channel Display, and Instrument Display etc.

Refer to page 135 for the figure.

FIG. 1 TYPE NO. VS FULLY DISPLAYED FONT

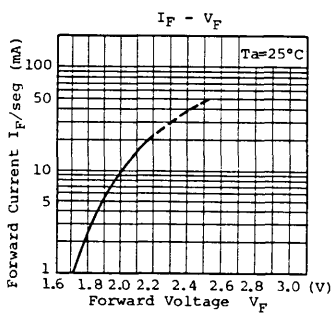
Type No.		Fully Displayed Font
Common Cathode	Common Anode	
TLR332	TLR333	
—	TLR335	
TLR334		

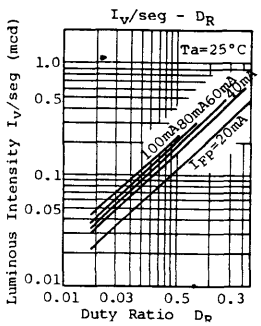
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25°C)

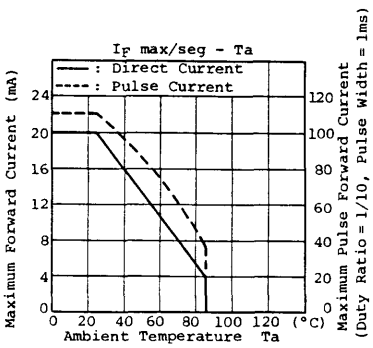
CHARACTERISTIC	SYMBOL	RATING	UNIT
DC Forward Current/Seg	I_F DC/Seg	20	mA
Reverse Voltage/Seg	V_R	6	V
Operating Temperature Range	T_{opr}	-40 ~ 85	°C
Storage Temperature Range	T_{stg}	-40 ~ 85	°C

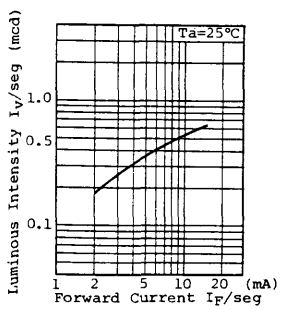
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25°C)

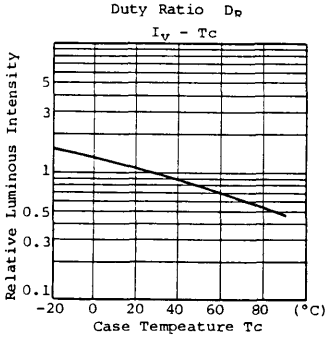
CHARACTERISTIC	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F = 10 mA	1.7	2.0	2.5	V
Reverse Current	I_R	V_R = 6 V	-	-	5	μA
Luminous Intensity/Seg	I_V	I_F = 5 mA	0.1	0.35	-	mcd
Luminous Intensity Matching Ratio	I_V-M	I_F = 10 mA	-	-	2.3	-
Peak Wave Length	λ_p	I_F = 10 mA	-	700	-	nm
Spectral Line Half Width	$\Delta\lambda$	I_F = 10 mA	-	100	-	nm

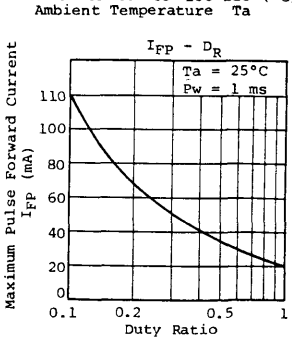












0.3 INCH 1-DIGITS SEVEN SEGMENT DISPLAY

TLG332, TLG333, TLG335, TLG334

- Green Color, 7.6 mm (0.3") Character Height Numerical and with Polarity Display.
- Applications: Transceiver or TV Channel Display, and Instrument Display etc.

Refer to page 135 for the figure.

FIG. 1 TYPE NO. VS FUIIY DISPIAYED FONT

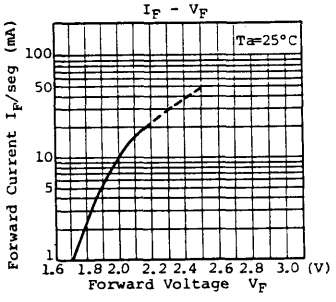
Type No.		Fully Displayed Font
Common Cathode	Common Anode	
TLG332	TLG333	
—	TLG335	
TLG334		

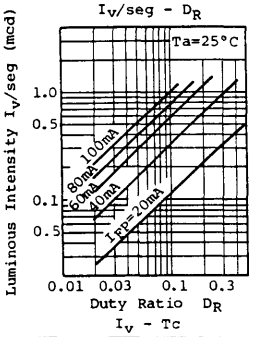
ABSOLUTE MAXIMUM RATINGS(Ta=25℃)

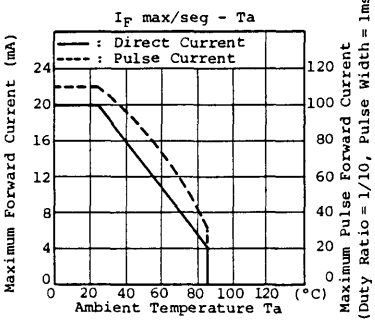
CHARACTERISTIC	SYMBOL	RATING	UNIT
DC Forward Current/Seg	I_F DC/Seg	20	mA
Reverse Voltage/Seg	V_R	6	V
Operating Temperature Range	T_{opr}	-40 ∿ 85	°C
Storage Temperature Range	T_{stg}	-40 ∿ 85	°C

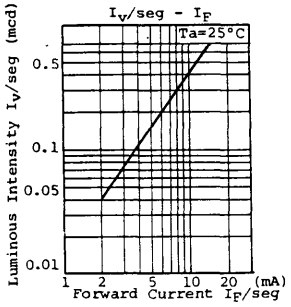
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25 ℃)

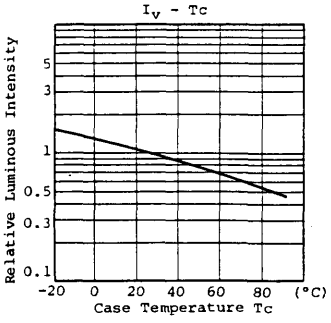
CHARACTERISTIC	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F = 10 mA	1.7	2.0	2.5	V
Reverse Current	I_R	V_R = 6 V	-	-	5	μA
Luminous Intensity/Seg	I_V	I_F = 10 mA	0.13	0.4	-	mcd
Luminous Intensity Matching Ratio	I_V-M	I_F = 10 mA	-	-	2.3	-
Peak Wave Length	λ_P	I_F = 10 mA	-	565	-	nm
Spectral Line Half Width	$\Delta\lambda$	I_F = 10 mA	-	30	-	nm

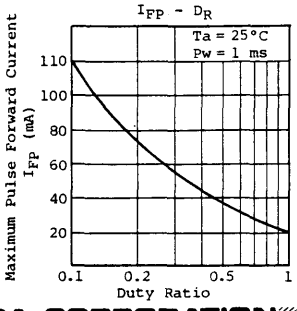




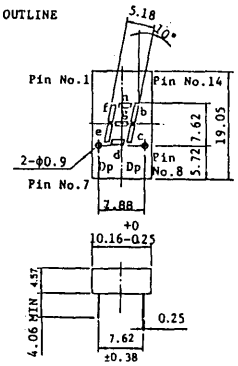




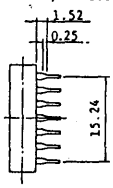




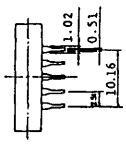
OUTLINE



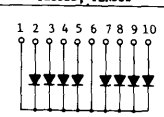
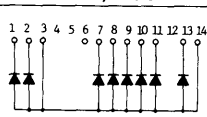
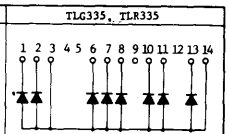
TLR333, TLR335



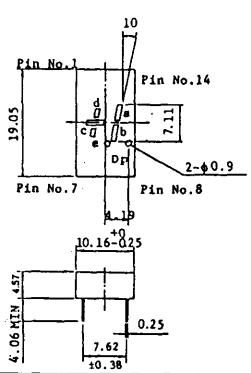
TLR332

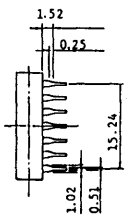


Unit in mm
Tolerance is ±0.25
Unless otherwise noted

TLG332, TLR332		TLG333, TLR333		TLG335, TLR335	
					
Pin No.	CONNECTION	Pin No.	CONNECTION	Pin No.	CONNECTION
1	Common Cathode	1	Cathode a	1	Cathode a
2	Anode f	2	Cathode f	2	Cathode f
3	Anode g	3	Common Anode	3	Common Anode
4	Anode e	4	No Pin	4	No Pin
5	Anode d	5	No Pin	5	No Pin
6	Common Cathode	6	No Connection	6	Cathode Dp (Left Hand)
7	Anode dp (Right Hand)	7	Cathode e	7	Cathode e
8	Anode c	8	Cathode d	8	Cathode d
9	Anode b	9	Cathode dp(Right Hand)	9	No Connection
10	Anode a	10	Cathode c	10	Cathode c
		11	Cathode g	11	Cathode g
		12	No Pin	12	No Pin
		13	Cathode b	13	Cathode b
		14	Common Anode	14	Common Anode

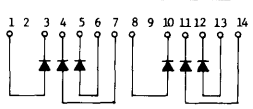
OUTLINE





Unit in mm
Tolerance is ±0.25
Unless otherwise noted

TLG334, TLR334



Pin No.	CONNECTION	Pin No.	CONNECTION
1	Anode d	8	Anode dp (Right Hand)
2	No Pin	9	No Pin
3	Cathode d	10	Cathode dp (Right Hand)
4	Cathode c	11	Cathode b
5	Cathode e	12	Cathode a
6	Anode e	13	Anode a
7	Anode c	14	Anode b

0.43 INCH 1-DIGIT SEVEN SEGMENT DISPLAY

TLR342, TLR343, TLR345, TLR344

- Red Color, 10.9 mm (0.43") Character Height Numerical and with Polarity Display.
- Applications: Transeiver or TV Channel Display, and Instrument Display etc.

Refer to page 138 for the figure.

FIG. 1 TYPE NO. VS FUIIY DISPIAYED FONT

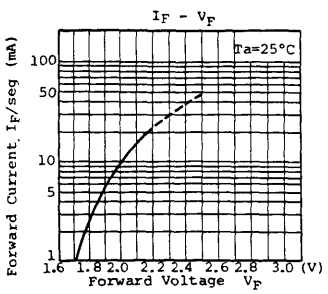
Type No.		Fully Displayed Font
Common Cathode	Common Anode	
TLR342	TLR343	
—	TLR345	
TLR344		

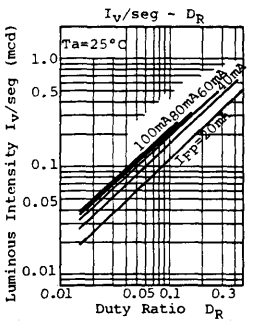
ABSOLUTE MAXIMUM RATINGS (Ta = 25°C)

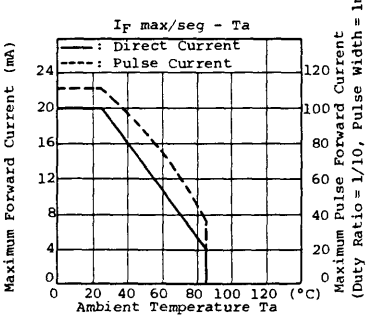
CHARACTERISTIC	SYMBOL	RATING	UNIT
DC Forward Current/Seg	I_F DC/Seg	20	mA
Reverse Voltage/Seg	V_R	6	V
Operating Temperature Range	T_{opr}	-40 ~ 85	°C
Storage Temperature Range	T_{stg}	-40 ~ 85	°C

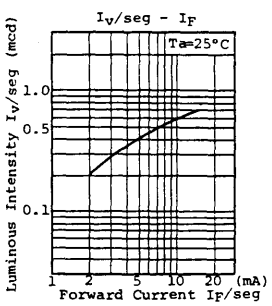
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25°C)

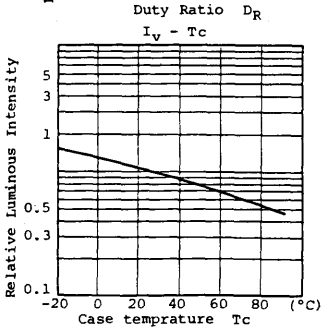
CHARACTERISTIC	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F = 10 mA	1.7	2.0	2.5	V
Reverse Current	I_R	V_R = 6 V	-	-	5	μA
Luminous Intensity/Seg	I_V	I_F = 5 mA	0.13	0.4	-	mcd
Luminous Intensity Matching Ratio	I_{V-M}	I_F = 10 mA	-	-	2.3	-
Peak Wave Length	λ_p	I_F = 10 mA	-	700	-	nm
Spectral Line Half Width	$\Delta\lambda$	I_F = 10 mA	-	100	-	nm

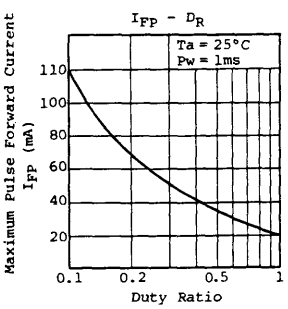












TLG342, TLG343 TLG345, TLG344

GaP RED LIGHT EMISSION

- Green Color, 10.9 mm (0.43") Character Height Numerical and with Polarity Display.
- Applications: Transceiver or TV Channel Display, and Instrument Display etc.

FIG. 1 TYPE NO. VS FUIIY DISPIAYED FONT

Type No.		Fully Display Font
Common Cathode	Common Anode	
TLG342	TLG343	
—	TLG345	
TLG344		

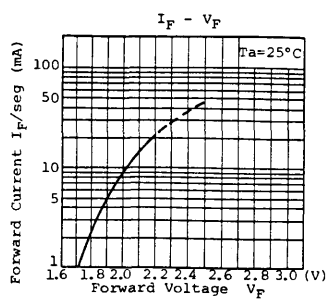
Refer to page 138 for the figure.

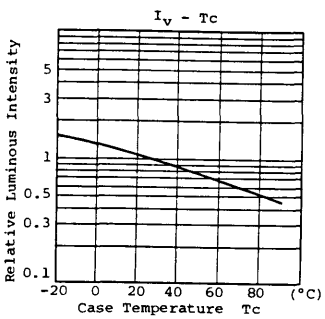
ABSOLUTE MAXIMUM RATINGS (Ta = 25°C)

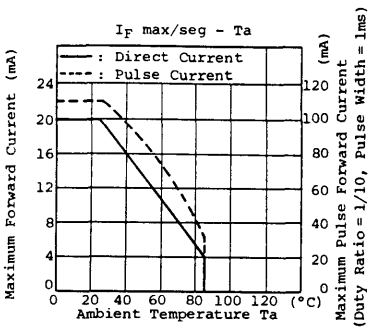
CHARACTERISTIC	SYMBOL	RATING	UNIT
DC Forward Current/Seg	I_F DC/Seg	20	mA
Reverse Voltage/Seg	V_R	6	V
Operating Temperature Range	T_{opr}	-40 ~ 85	°C
Storage Temperature Range	T_{stg}	-40 ~ 85	°C

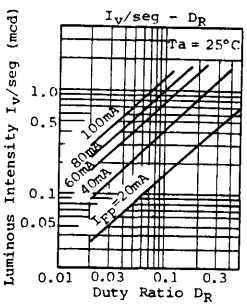
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25°C)

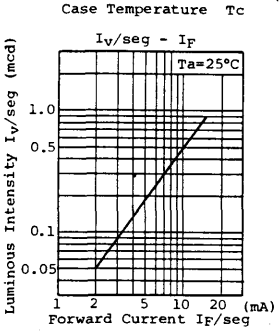
CHARACTERISTIC	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F = 10 mA	1.7	2.0	2.5	V
Reverse Current	I_R	V_R = 6 V	-	-	5	μA
Luminous Intensity/Seg	I_V	I_F = 10 mA	0.2	0.5	-	mcd
Luminous Intensity Matching Ratio	I_V-M	I_F = 10 mA	-	-	2.3	-
Peak Wave Length	λ_p	I_F = 10 mA	-	565	-	nm
Spectral Line Half Width	$\Delta\lambda$	I_F = 10 mA	-	30	-	nm

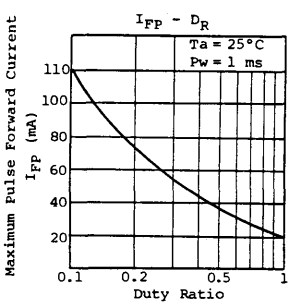




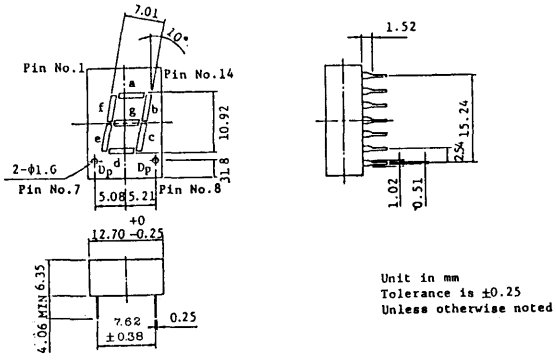




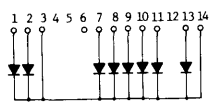
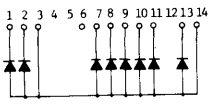
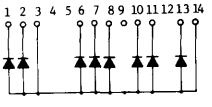




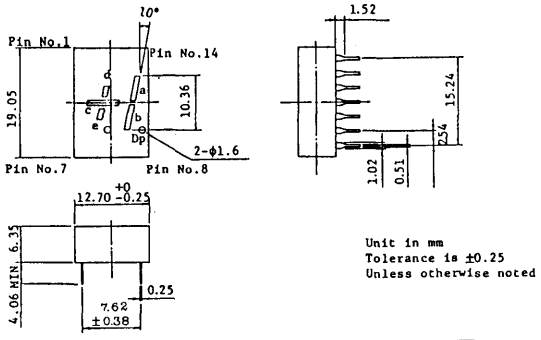
OUTLINE



Unit in mm
Tolerance is ±0.25
Unless otherwise noted

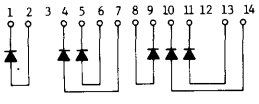
TLG342, TLR342		TLG343, TLR343		TLG345, TLR345	
					
Pin No.	CONNECTION	Pin No.	CONNECTION	Pin No.	CONNECTION
1	Anode a	1	Cathode a	1	Cathode a
2	Anode f	2	Cathode f	2	Cathode f
3	Common Cathode	3	Common Anode	3	Common Anode
4	No Pin	4	No Pin	4	No Pin
5	No Pin	5	No Pin	5	No Pin
6	No Connection	6	No Connection	6	Cathode Dp(Left Hand)
7	Anode e	7	Cathode e	7	Cathode e
8	Anode d	8	Cathode d	8	Cathode d
9	Anode Dp (Right Hand)	9	Cathode Dp(Right Hand)	9	No Connection
10	Anode c	10	Cathode c	10	Cathode c
11	Anode g	11	Cathode g	11	Cathode g
12	No Pin	12	No Pin	12	No Pin
13	Anode b	13	Cathode b	13	Cathode b
14	Common Cathode	14	Common Anode	14	Common Anode

OUTLINE



Unit in mm
Tolerance is ±0.25
Unless otherwise noted

TLG344, TLR344



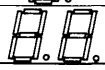
Pin No.	CONNECTION	Pin No.	CONNECTION
1	Cathode d	8	Anode dp (Right Hand)
2	Anode d	9	Cathode dp (")
3	No Pin	10	Cathode b
4	Cathode c	11	Cathode a
5	Cathode e	12	No Pin
6	Anode e	13	Anode a
7	Anode c	14	Anode b

TLR358, TLR359, TLR328, TLR329

- RED Color, 13.5mm(0.53")Character Height Numerical Display.
- Pin Connections for Static Drive
- Available Both Polarity of Connections, Common Cathode or Common Anode.
- Applications: Transceiver or TV Channel Display, and Instrument Display etc.

Refer to page 141 for the figure.

FIG. 1 TYPE NO. VS FUIIY DISPIAYED FONT

Type No.		Fully Displayed Font
Common Cathode	Common Anode	
TLR358	TLR359	
TLR328	TLR329	

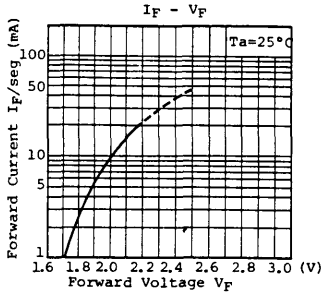
ABSOLUTE MAXIMUM RATINGS (Ta = 25°C)

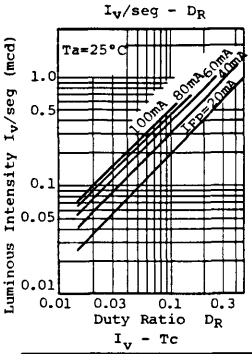
CHARACTERISTIC	SYMBOL	RATING	UNIT
DC Forward Current/Seg	I_F DC/Seg	20	mA
Reverse Voltage/Seg	V_R	6	V
Operating Temperature Range	T_{opr}	-35 ~ 85	°C
Storage Temperature Range	T_{stg}	-40 ~ 85	°C

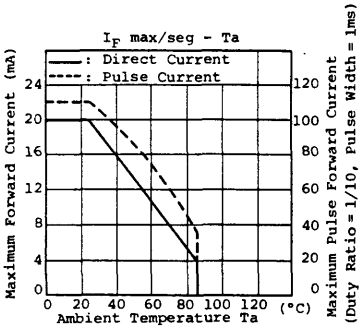
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25°C)

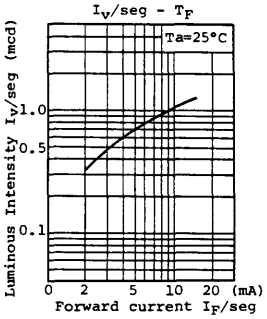
CHARACTERISTIC	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F = 10 mA	1.7	2.0	2.5	V
Reverse Current	I_R	V_R = 6 V	-	-	5	μA
Luminous Intensity/Seg	I_V	I_F = 5 mA	0.26 (0.16)	0.7 (0.43)	-	mcd
Luminous Intensity Matching Ratio	I_V-M	I_F = 5 mA	-	-	2.3	-
Peak Wave Length	λ_p	I_F = 10 mA	-	700	-	nm
Spectral Line Half Width	$\Delta\lambda$	I_F = 10 mA	-	30	-	nm

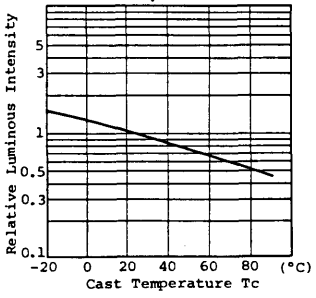
( ): TLR328/TLR329

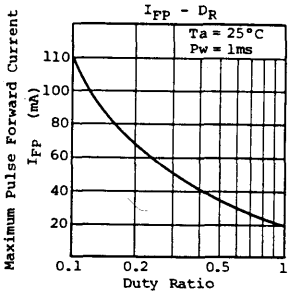












TLG358, TLG359, TLG328, TLG329

GaP RED LIGHT EMISSION

- Green Color, 13.5mm(0.53")Character Height Numerical Display.
- Pin Connections for Static Drive
- Available Both Polarity of Connections, Common Cathode or Common Anode.
- Applications: Transceiver or TV Channel Display, and Instrument Display etc.

Refer to page 141 for the figure.

FIG. 1 TYPE NO. VS FUIIY DISPIAYED FONT

Type No.		Fully Displayed Font
Common Cathode	Common Anode	
TLG358	TLG359	
TLG328	TLG329	

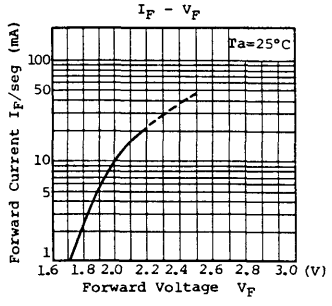
ABSOLUTE MAXIMUM RATINGS(Ta=25°C)

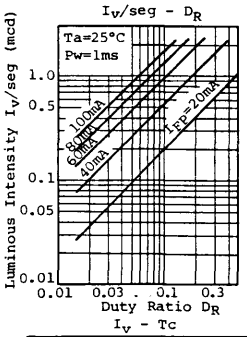
CHARACTERISTIC	SYMBOL	RATING	UNIT
DC Forward Current/Seg	I_F DC/Seg	20	mA
Reverse Voltage/Seg	V_R	6	V
Operating Temperature Range	T_{opr}	-35 ∿ 85	°C
Storage Temperature Range	T_{stg}	-40 ∿ 85	°C

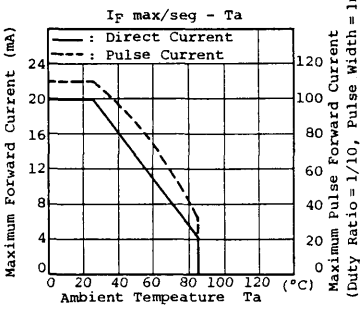
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25°C)

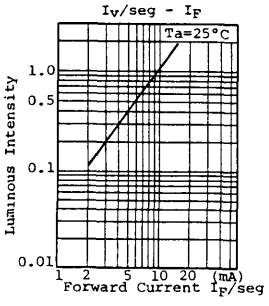
CHARACTERISTIC	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F = 10 mA	1.7	2.0	2.5	V
Reverse Current	I_R	V_R = 6 V	-	-	5	μA
Luminous Intensity/Seg	I_V	I_F = 10 mA	0.4 (0.23)	1.0 (0.58)	-	mcd
Luminous Intensity Matching Ratio	I_V-M	I_F = 10 mA	-	-	2.3	-
Peak Wave Length	λ_p	I_F = 10 mA	-	565	-	nm
Spectral Line Half Width	$\Delta\lambda$	I_F = 10 mA	-	30	-	nm

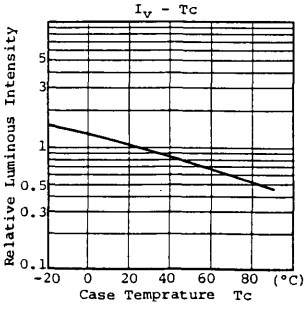
( ): TLG328/TLG329

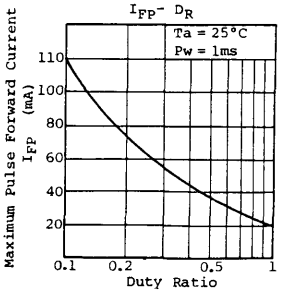




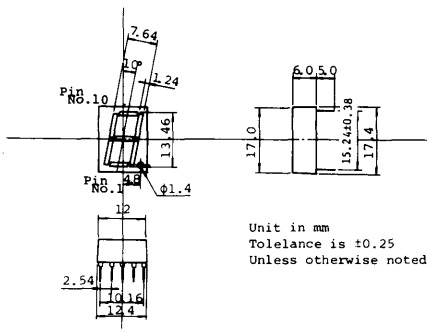








OUTLINE AND PINCONNECTION

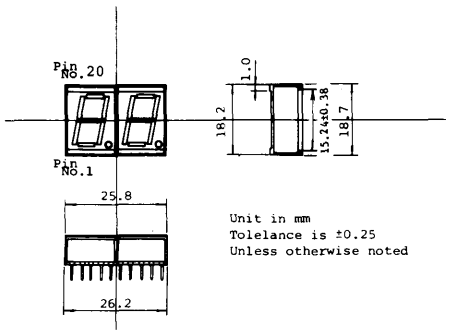


Unit in mm
Tolelance is ±0.25
Unless otherwise noted

TLG358, TLR358		TLG359, TLR359	
1	Anode E	1	Cathode E
2	Anode D	2	Cathode D
3	Anode C	3	Cathode C
4	Anode Dp	4	Cathode Dp
5	Common Cathode	5	Common Anode
6	Common Cathode	6	Common Anode
7	Anode B	7	Cathode B
8	Anode A	8	Cathode A
9	Anode G	9	Cathode G
10	Anode F	10	Cathode F

OUTLINE AND PINCONNECTION

TLG328, TLG329 TLR328, TLR329



Unit in mm
Tolelance is ±0.25
Unless otherwise noted

TLG328, TLR328				TLG329, TLR329			
1	Anode F	11	Common Cathode	1	Cathode F	11	Common Anode
2	Anode D	12	Anode B	2	Cathode D	12	Cathode B
3	Anode C	13	Anode A	3	Cathode C	13	Cathode A
4	Anode Dp	14	Anode G	4	Cathode Dp	14	Cathode G
5	Common Cathode	15	Anode F	5	Common Anode	15	Cathode F
6	Anode E	16	Common Cathode	6	Cathode E	16	Common Anode
7	Anode D	17	Anode B	7	Cathode D	17	Cathode B
8	Anode C	18	Anode A	8	Cathode C	18	Cathode A
9	Anode Dp	19	Anode G	9	Cathode Dp	19	Cathode G
10	Common Cathode	20	Anode F	10	Common Anode	20	Cathode F

TLR362, 363, 364, 365, 366, 367

TENTATIVE

- Red Color, 14.2mm (0.56") Character Height Numerical Display.
- Pin Connections for Static Drive
- Available Both Polarity of Connections, Common Cathode or Common Anode.
- Applications: Transceiver or TV Channel Display, and Instrument Display etc.

Refer to page 144 for the figure.

FIG. 1 TYPE NO. VS FUIIY DISPIAYED FONT

Type No.		Fully Displayed Font
Common Cathode	Common Anode	
TLR362	TLR363	8.
TLR364	TLR365	±1.
TLR366	TLR367	88.

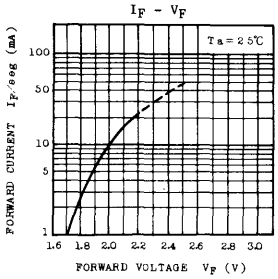
ABSOLUTE MAXIMUM RATINGS (Ta = 25°C)

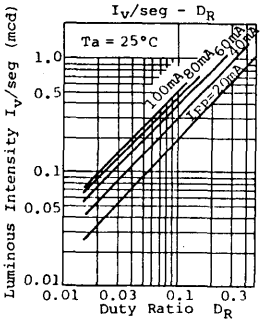
CHARACTERISTIC	SYMBOL	RATING	UNIT
DC Forward Current/Seg	I_F DC/Seg	20	mA
Pulse Forward Current/Seg	I_{FP}/Seg	110(note)	mA
Reverse Voltage/Seg	V_R	6	V
Operating Temperature Range	T_{opr}	-40 ∿ 85	°C
Storage Temperature Range	T_{stg}	-40 ∿ 85	°C

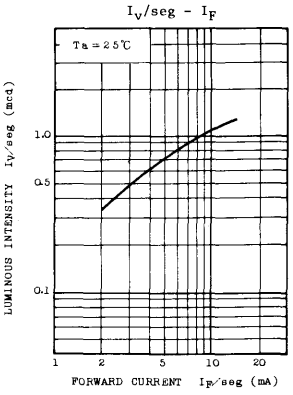
Note: Duty Ratio=1/10, Pulse Width=1ms

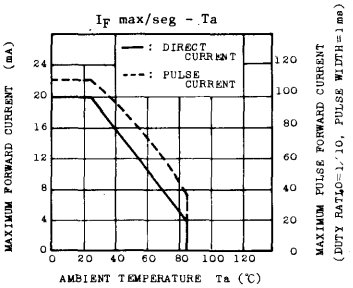
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25°C)

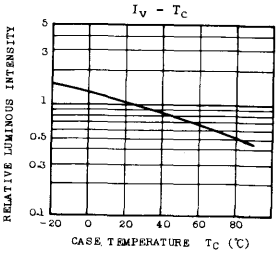
CHARACTERISTIC	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=10mA	1.7	2.0	2.5	V
Reverse Current	I_R	V_R=6V	-	-	5	μA
Luminous Intensity/Seg	I_V	I_F=5mA	0.26	0.7	-	mcd
Luminous Intensity Matching Ratio	I_V-M	I_F=5mA	-	-	2.3	-
Peak Wave Length	λp	I_F=10mA	-	700	-	nm
Spectral Line Half Width	Δλ	I_F=10mA	-	100	-	nm











0.56INCH GREEN 1 DIGIT & 2GIGITS SEVEN SEGMENT DISPLAY

TLG362, 363, 364, 365, 366, 367

TENTATIVE

- Green Color, 14.2mm (0.56") Character Height Numerical Display.
- Pin Connections for Static Drive
- Available Both Polarity of Connections, Common Cathode or Common Anode.
- Applications: Transceiver or TV Channel Display, and Instrument Display etc.

Refer to page 144 for the figure.

FIG. 1 TYPE NO. VS FUIIY DISPIAYED FONT

Type No.		Fully Displayed Font
Common Cathode	Common Anode	
TLG362	TLG363	8.
TLG364	TLG365	±1.
TLG366	TLG367	88.

ABSOLUTE MAXIMUM RATINGS (Ta = 25°C)

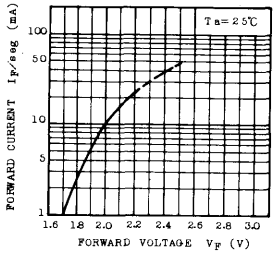
CHARACTERISTIC	SYMBOL	RATING	UNIT
DC Forward Current/Seg	I_F DC/Seg	20	mA
Pulse Forward Current/Seg	I_{FP}/Seg	110(note)	mA
Reverse Voltage/Seg	V_R	6	V
Operating Temperature Range	T_{opr}	-40 ~ 85	°C
Storage Temperature Range	T_{stg}	-40 ~ 85	°C

Note: Duty Ratio=1/10, Pulse Width=1ms

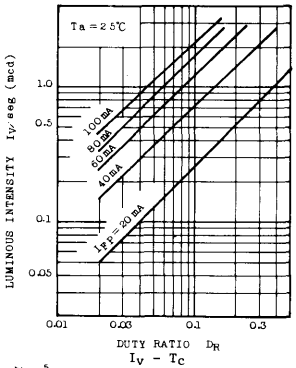
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTICS	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=10mA	1.7	2.0	2.5	V
Reverse Current	I_R	V_R=6V	-	-	5	μA
Luminous Intensity/Seg	I_V	I_F=10mA	0.4	1.0	-	mcd
Luminous Intensity Matching Ratio	I_{V-M}	I_F=10mA	-	-	2.3	-
Peak Wave Length	λp	I_F=10mA	-	565	-	nm
Spectral Line Half Width	Δλ	I_F=10mA	-	30	-	nm

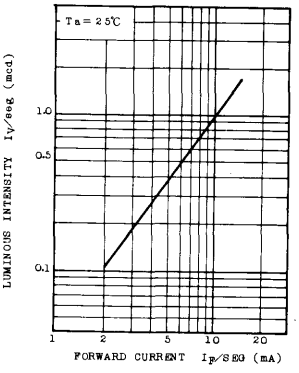
I_F - V_F



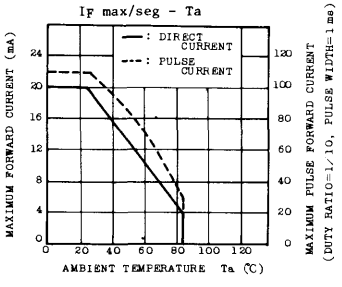
I_V/seg - D_R



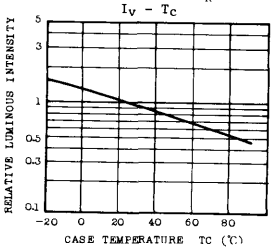
I_V/seg - I_F



IF max/seg - Ta

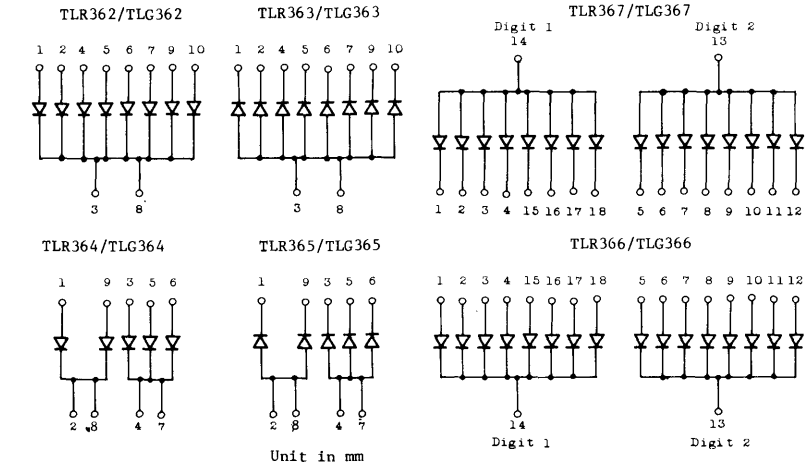


I_V - T_C

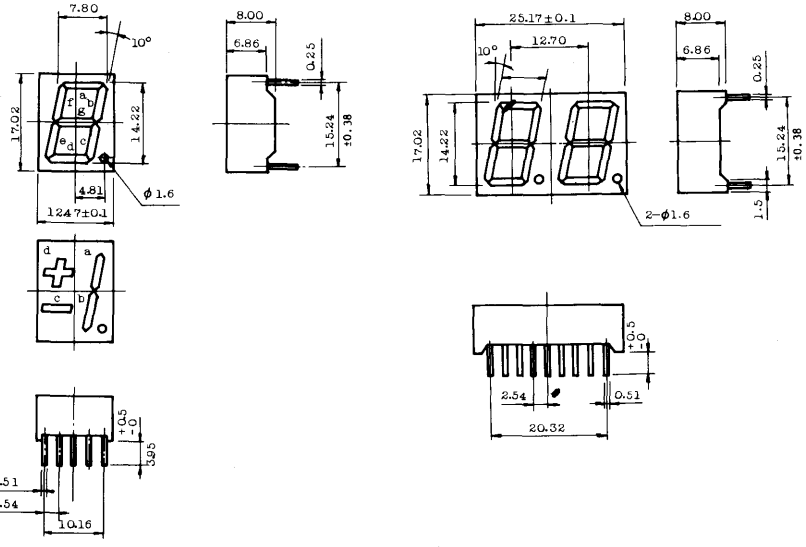


Pin Connection

PIN NO.	PIN CONNECTION								
	TLR363 TLG363	TLR362 TLG362	TLR365 TLG365	TLR364 TLG364	TLR366/TLR367 TLG366/TLG367				
1	e	e	c	c	1	E Digit 1	11	A Digit 2	
2	d	d	Anode c,d	Cathode c,d	2	D "	12	F "	
3	Common Anode	Common Cathode	b	b	3	C "	13	Digit 2 Common	
4	c	c	Anode a,b,Dp	Cathode a,b,Dp	4	Dp "	14	Digit 1 Common	
5	Dp	Dp	Dp	Dp	5	E Digit 2	15	B Digit 1	
6	b	b	a	a	6	D "	16	A "	
7	a	a	Anode a,b,Dp	Cathode a,b,Dp	7	G "	17	G "	
8	Common Anode	Common Cathode	Anode c,d	Cathode c,d	8	C "	18	F "	
9	f	f	d	d	9	Dp "			
10	g	g	No Pin	No Pin	10	B "			



Unit in mm
Tolerance is ±0.25 Unless otherwise noted.



TLR368, TLR369

TENTATIVE

- RED Color, 13.46 mm (0.53") Character Height Numerical Display.
- Available Both Polarity of Connections, Common Cathode or Common Anode.
- Applications: Transceiver or TV Channel Display, and Instrument Display etc.

FIG. 1 TYPE NO. VS FUIIY DISPIAYED FONT

Type No.		Fully Displayed Font
Common Cathode	Common Anode	
TLR368	TLR369	

Refer to page 147 for the figure.

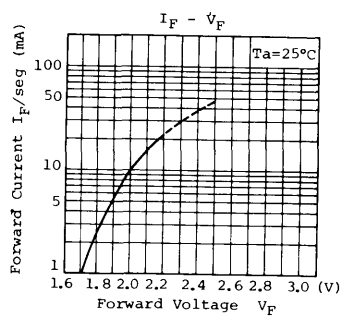
ABSOLUTE MAXIMUM RATINGS (Ta = 25°C)

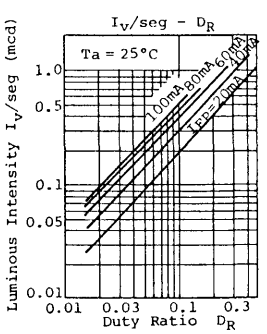
CHARACTERISTIC	SYMBOL	RATING	UNIT
DC Forward Current/Seg	I_F DC/Seg	20	mA
Pulse Forward Current/Seg	I_{FP}/Seg	110(note)	mA
Reverse Voltage/Seg	V_R	6	V
Operating Temperature Range	T_{opr}	-35 ∿ 85	°C
Storage Temperature Range	T_{stg}	-40 ∿ 85	°C

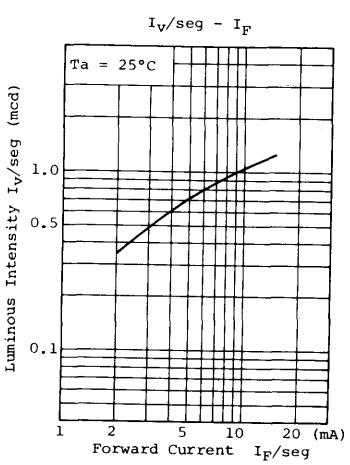
Note: Duty Ratio = 1/10, Pulse Width = 1 ms

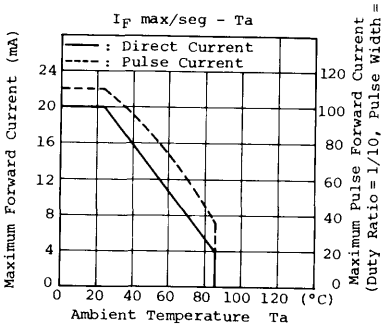
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25°C)

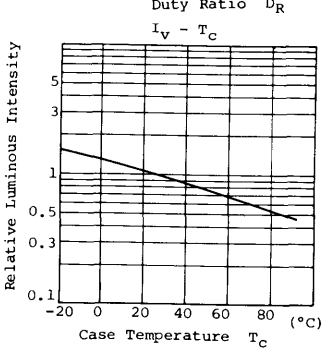
CHARACTERISTIC	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F = 10 mA	1.7	2.0	2.5	V
Reverse Current	I_R	V_R = 6 V	-	-	5	μA
Luminous Intensity/Seg	I_V	I_F = 5 mA	0.26	0.7	-	mcd
Luminous Intensity Matching Ratio	I_V-M	I_F = 5 mA	-	-	2.3	-
Peak Wave Length	λ_p	I_F = 10 mA	-	700	-	nm
Spectral Line Half Width	$\Delta\lambda$	I_F = 10 mA	-	100	-	nm











TLG368, TLG369

TENTATIVE

- Green Color, 13.46 mm (0.53") Character Height Numerical Display.
- Available Both Polarity of Connections, Common Cathode or Common Anode.
- Applications: Transceiver or TV Channel Display, and Instrument Display etc.

FIG. 1 TYPE NO. VS FUIIY DISPIAYED FONT

Type No.		Fully Displayed Font
Common Cathode	Common Anode	
TLG368	TLG369	

Refer to page 147 for the figure.

ABSOLUTE MAXIMUM RATINGS (Ta = 25°C)

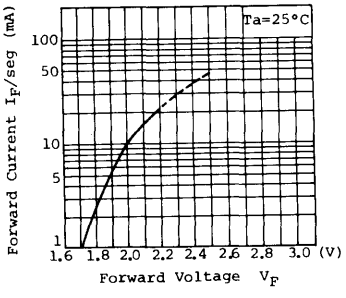
CHARACTERISTIC	SYMBOL	RATING	UNIT
DC Forward Current/Seg	I_F DC/Seg	20	mA
Pulse Forward Current/Seg	I_{FP}/Seg	110(Note)	mA
Reverse Voltage/Seg	V_R	6	V
Operating Temperature Range	T_{opr}	-35 ∿ 85	°C
Storage Temperature Range	T_{stg}	-40 ∿ 85	°C

Note: Duty Ratio = 1/10, Pulse width = 1 ms

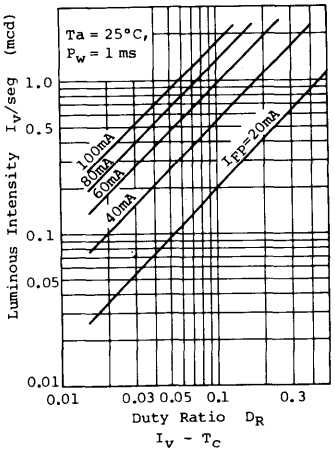
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F = 10 mA	1.7	2.0	2.5	V
Reverse Current	I_R	V_R = 6 V	-	-	5	μA
Luminous Intensity/Seg	I_V	I_F = 10 mA	0.4	1.0	-	mcd
Luminous Intensity Matching Ratio	I_V-M	I_F = 10 mA	-	-	2.3	-
Peak Wave Length	λ_P	I_F = 10 mA	-	565	-	nm
Spectral Line Half Width	$\Delta\lambda$	I_F = 10 mA	-	30	-	nm

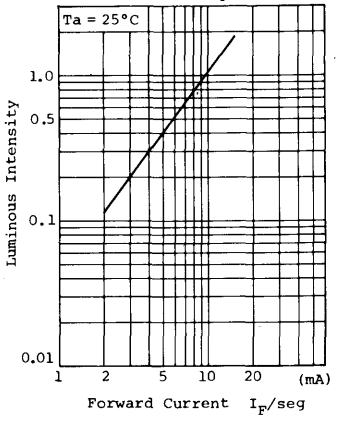
I_F - V_F



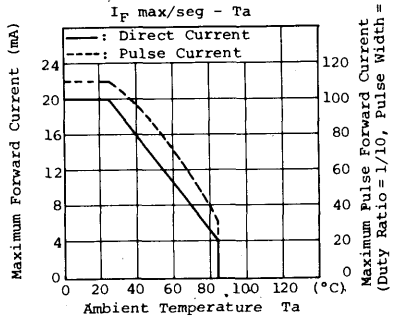
I_V/seg - D_R



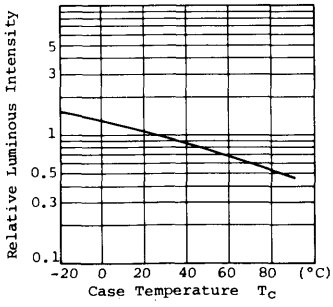
I_V/seg - I_F



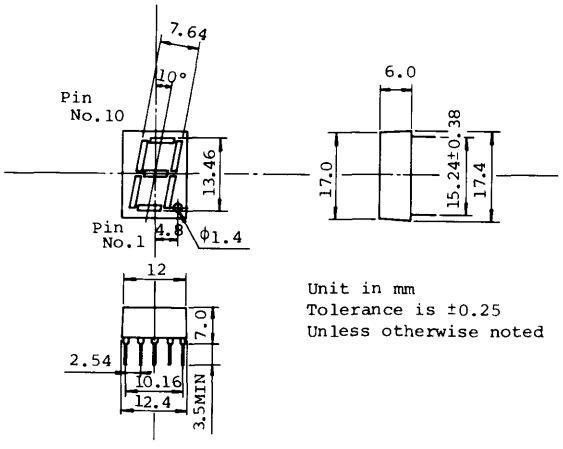
I_F max/seg - Ta



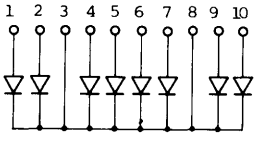
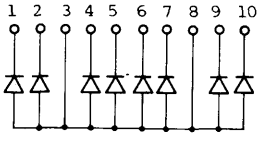
I_V - T_C



OUTLINE AND PINCONNECTION



Unit in mm
Tolerance is ±0.25
Unless otherwise noted

TLR368/ TLG368		TLR369/ TLG369	
			
1	Anode E	1	Cathode E
2	Anode D	2	Cathode D
3	Common Cathode	3	Common Anode
4	Anode C	4	Cathode C
5	Anode D_p	5	Cathode D_p
6	Anode B	6	Cathode B
7	Anode A	7	Cathode A
8	Common Cathode	8	Common Anode
9	Anode F	9	Cathode F
10	Anode G	10	Cathode G

TLR370, TLR371

RED COLOR 1 DIGIT ALPHANUMERIC LED DISPLAY

. 12.7mm Character Height Red Color ALPHANUMERIC Display.
. Available Both Polarity of Connections, Common Cathode or Common Anode.
. Applications: Computer Peripherals and Terminals Display, and Automotive Instrument Panel Dispaly etc.

Refer to page 149 for the figure.

TYPE NO. vs FULLY DISPLAYED FONT

COMMON CATHODE	COMMON ANODE	FULLY DISPLAY FONT
TLR370	TLR371	

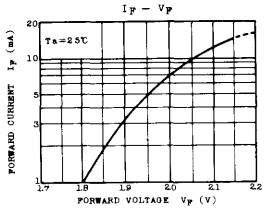
MAXIMUM RATINGS (Ta = 25°C)

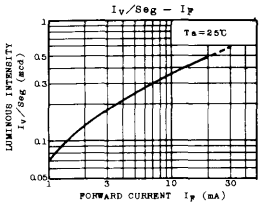
CHARACTERISTIC	SYMBOL	RATING	UNIT
DC Forward Current/Segment	$I_{F(DC)}$/Seg	15	mA
Pulse Forward Current/Seg (Note)	$I_{F(Pulse)}$/Seg	80	mA
Reverse Voltage	V_R	3	V
Operating Temperature Range	Topr	-30~75	°C
Storage Temperature Range	Tstg	-30~90	°C

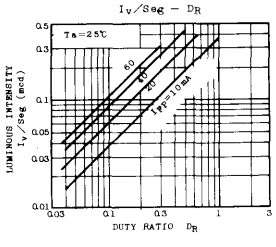
Note : Pulse Width=1ms, Duty Ratio=1/10

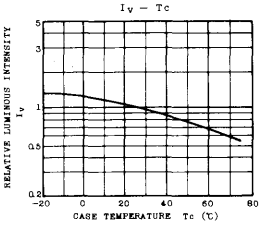
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25°C)

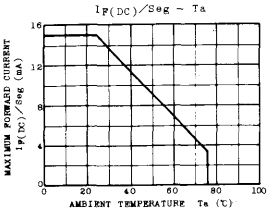
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=15mA	1.8	2.15	2.5	V
Reverse Current	I_R	V_R=3V	-	-	5	μA
Luminous Intensity/Segment	I_V/Seg	I_F=5mA	0.13	0.25	-	mcd
Luminous Intensity Matching Ratio	I_V-M	I_F=5mA	-	-	2.5	-
Peak Emission Wave Length	λp	I_F=5mA	-	700	-	nm
Spectral Half Line Width	Δλ	I_F=5mA	-	100	-	nm



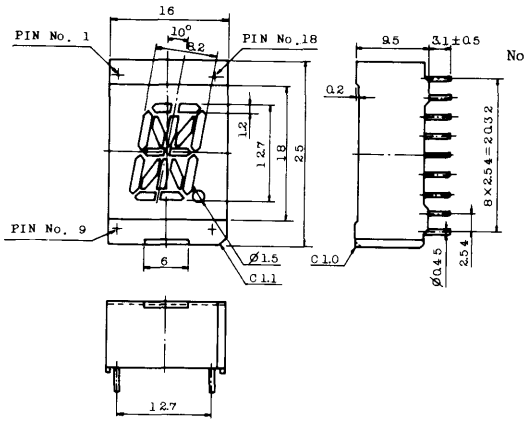








OUTLINE DIMENSIONS



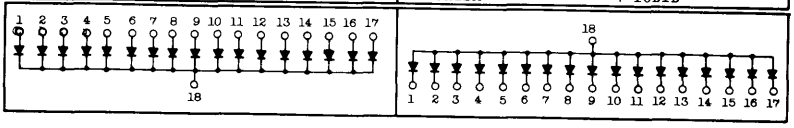
Unit in mm

Note : Tolerance is ±0.25 unless otherwise noted.

SEGMENT NAME

PIN CONNECTION

T L R 3 7 0	T L R 3 7 1
PIN No.	PIN No.
1. ANODE B	1. CATHODE B
2. ANODE A	2. CATHODE A
3. ANODE M	3. CATHODE M
4. ANODE K	4. CATHODE K
5. ANODE H	5. CATHODE H
6. ANODE G	6. CATHODE G
7. ANODE T	7. CATHODE T
8. ANODE F	8. CATHODE F
9. ANODE E	9. CATHODE E
10. ANODE Dp	10. CATHODE Dp
11. ANODE S	11. CATHODE S
12. ANODE R	12. CATHODE R
13. ANODE D	13. CATHODE D
14. ANODE U	14. CATHODE U
15. ANODE P	15. CATHODE P
16. ANODE C	16. CATHODE C
17. ANODE N	17. CATHODE N
18. COMMON CATHODE	18. COMMON ANODE
EIAJ –	EIAJ –
TOSHIBA 4-16B1A	TOSHIBA 4-16B1B



TLG370, TLG371

GREEN COLOR 1 DIGIT ALPHANUMERIC LED DISPLAY

. 12.7mm Character Height Green Color ALPHANUMERIC Display.
. Available Both Polarity of Connections, Common Cathode or Common Anode.
. Applications: Computer Peripherals and Terminals Display, and Automotive Instrument Panel Display etc.

Refer to page 151 for the figure.

TYPE NO. vs FULLY DISPLAY FONT

COMMON CATHODE	COMMON ANODE	FULLY DISPLAY FONT
TLG370	TLG371	

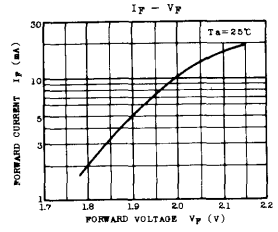
MAXIMUM RATINGS (Ta = 25°C)

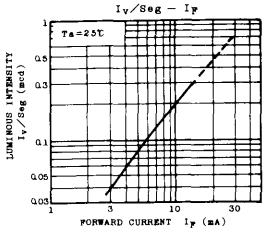
CHARACTERISTIC	SYMBOL	RATING	UNIT
DC Forward Current/Segment	$I_{F(DC)}$/Seg	15	mA
Pulse Forward Current/Seg. (Note)	$I_{F(Pulse)}$/Seg	80	mA
Reverse Voltage	V_R	6	V
Operating Temperature Range	T_{opr}	-30 ~ 75	°C
Storage Temperature Range	T_{stg}	-30 ~ 90	°C

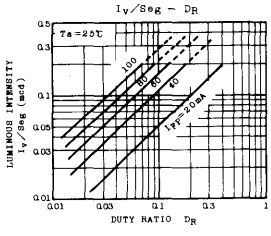
Note : Pulse Width=1ms, Duty Ratio=1/10

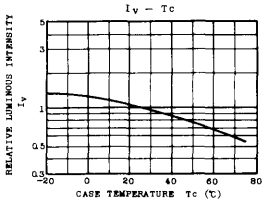
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25°C)

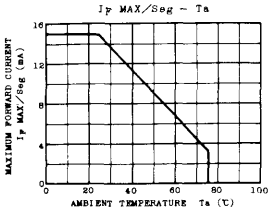
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=10mA	1.8	2.0	2.5	V
Reverse Current	I_R	V_R=6V	-	-	5	μA
Luminous Intensity/Segment	I_V/Seg	I_F=10mA	0.06	0.20	-	mcd
Luminous Intensity Matching Ratio	I_V-M	I_F=5mA	-	-	2.3	-
Peak Emission Wave Length	λp	I_F=10mA	-	565	-	nm
Spectral Half Line Width	Δλ	I_F=10mA	-	30	-	nm







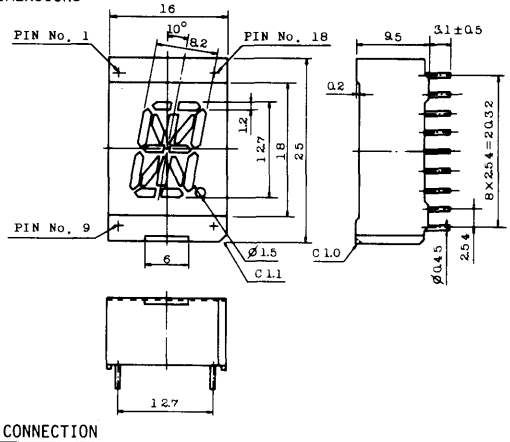




OUTLINE DIMENSIONS

Unit in mm

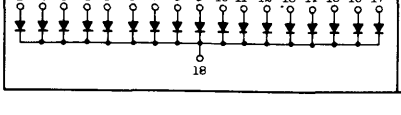
Note : Tolerance is ±0.25 unless otherwise noted.

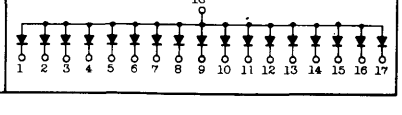


SEGMENT NAME

PIN CONNECTION

T L G 3 7 0	T L G 3 7 1
PIN No.	PIN No.
1. ANODE B	1. CATHODE B
2. ANODE A	2. CATHODE A
3. ANODE M	3. CATHODE M
4. ANODE K	4. CATHODE K
5. ANODE H	5. CATHODE H
6. ANODE G	6. CATHODE G
7. ANODE T	7. CATHODE T
8. ANODE F	8. CATHODE F
9. ANODE E	9. CATHODE E
10. ANODE Dp	10. CATHODE Dp
11. ANODE S	11. CATHODE S
12. ANODE R	12. CATHODE R
13. ANODE D	13. CATHODE D
14. ANODE U	14. CATHODE U
15. ANODE P	15. CATHODE P
16. ANODE C	16. CATHODE C
17. ANODE N	17. CATHODE N
18. COMMON CATHODE	18. COMMON ANODE
EIAJ –	EIAJ –
TOSHIBA 4-16B1A	TOSHIBA 4-16B1B





TLR372, TLR373 TLG372, TLG373

— PRELIMINARY —

• 5 x 7 DOT MATRIX LED DISPLAY

- ·6.0 mm high character. (0.24 inch)
- ·High efficiency at lower current. (Light emitting's materials: GaP)
- ·X-Y matrix connection. (Multiplex drive)
- ·36 light emitting diodes including decimal point.
- ·Capable of displaying full ASCII characters.
- ·Pin for pin compatibility with MAN2A, DL-57.
- ·Application Keyboard verifier, Computer peripheral display, Information display.

Refer to page 153 for the figure.

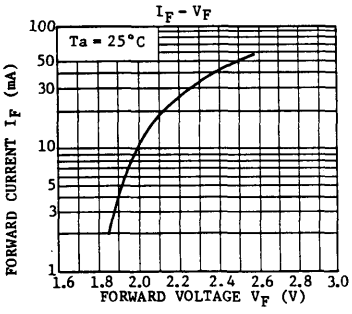
MAXIMUM RATING (Ta = 25°C)

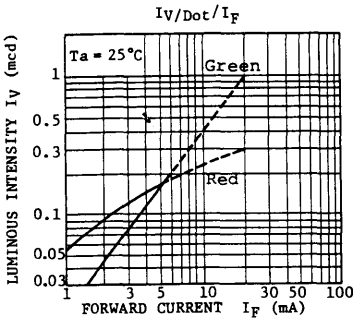
CHARACTERISTIC	SYMBOL	RATING	UNIT
Pulse Forward Current (Note 1)	I_{FP}/Dot	30	mA
Reverse Voltage	V_R	6	V
Storage Temperature Range	T_{stg}	-30∿100	°C
Operating Temperature Range	T_{opr}	-30∿ 85	°C

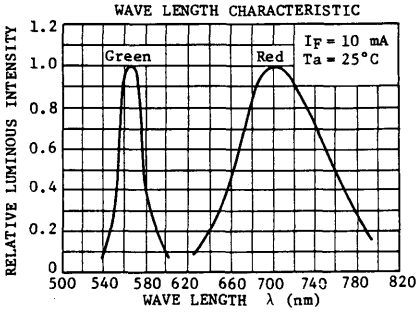
Note 1. Duty Ratio = 1/7, Pulse width = 1 (ms)

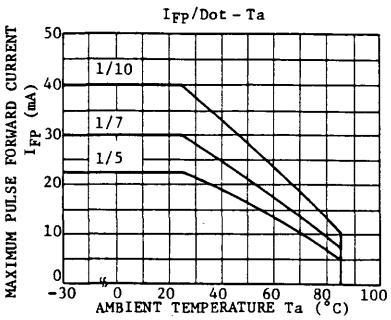
ELECTRICAL-OPTICAL CHARACTERSITICS (Ta = 25°C)

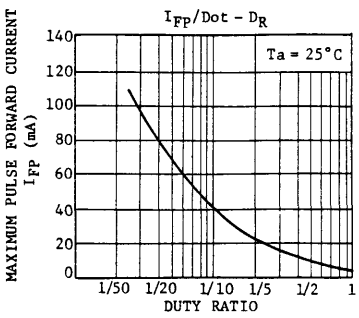
CHARACTERISTICS		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_{FP} = 20 mA	1.8	2.15	2.75	V
Reverse Current		I_R	V_R = 6 V	-	-	5	μA
Luminous Intensity	Red	I_{V1}/Dot	I_{FP} = 20 mA Duty Ratio = 1/7	-	0.045	-	mcd
	Green	I_{V2}/Dot		-	0.14	-	mcd
Luminous Intensity Matching		I_{V-M}	I_{FP}=20mA, Duty Ratio=1/7	-	-	2.0	-
Peak Emission Wave length	Red	λ_{P1}	I_F = 10 mA	-	700	-	nm
	Green	λ_{P2}		-	565	-	nm
Spectral Line Half Width	Red	$\Delta\lambda_1$	I_F = 10 mA	-	100	-	nm
	Green	$\Delta\lambda_2$		-	25	-	nm
Thermal luminous Intensity		ΔIv	—	-	-1.0	-	%/°C
Thermal Resistance		Rthj-a/Dot	—	-	6.3	-	°C/mW





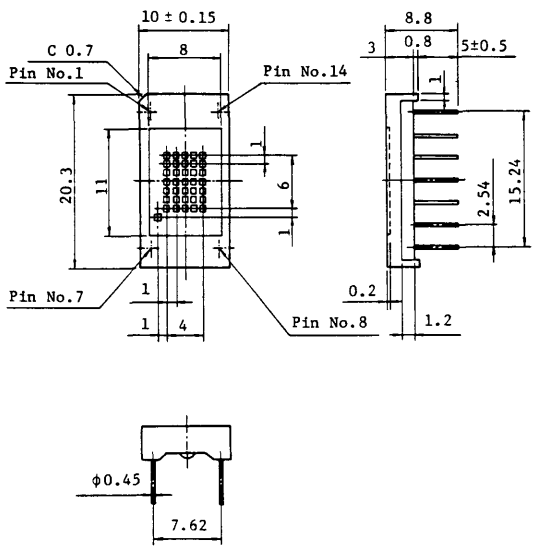






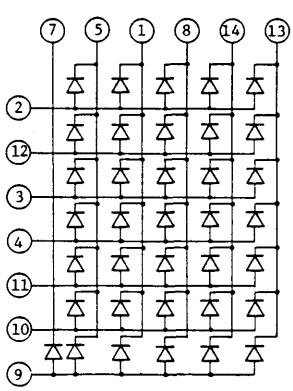
OUTLINE DIMENSIONS

Unit: mm
Tolerance is ±0.25
Unless otherwise noted

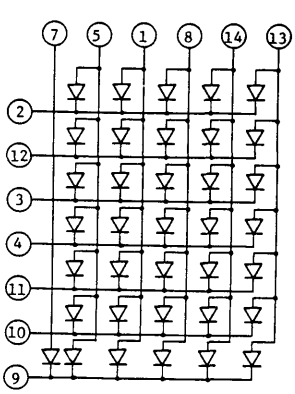


PIN CONNECTION

PIN NO.	CONNECTION		PIN NO.	CONNECTION	
	TLR372 TLG372	TLR373 TLG373		TLR372 TLG372	TLR373 TLG373
1	Column 2 Cathode	Column 2 Anode	8	Column 3 Cathode	Column 3 Anode
2	Row 1 Anode	Row 1 Cathode	9	Row 7 Anode	Row 7 Cathode
3	Row 3 Anode	Row 3 Cathode	10	Row 6 Anode	Row 6 Cathode
4	Row 4 Anode	Row 4 Cathode	11	Row 5 Anode	Row 5 Cathode
5	Column 1 Cathode	Column 1 Anode	12	Row 2 Anode	Row 2 Cathode
6	Omitted	Omitted	13	Column 5 Cathode	Column 5 Anode
7	Decimal Cathode	Decimal Anode	14	Column 4 Cathode	Column 4 Anode

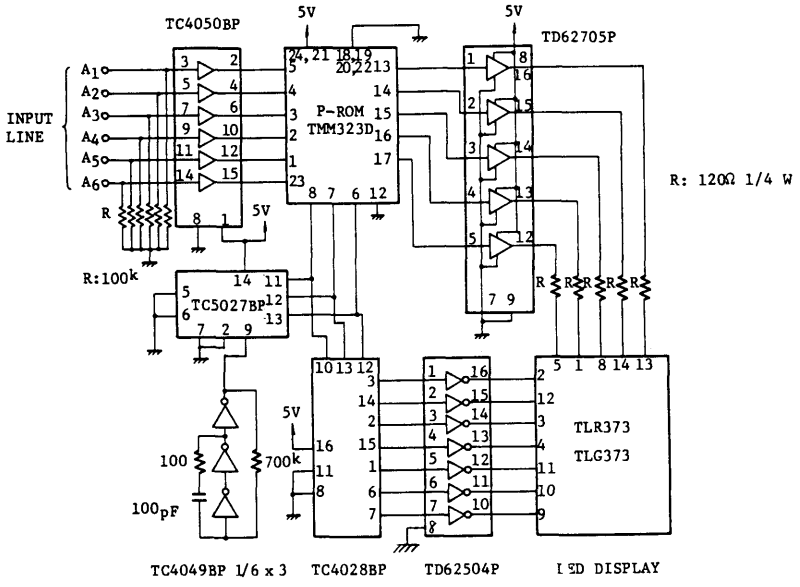


(TLR372/TLG372)



(TLR373/TLG373)

TYPICAL APPLICATION



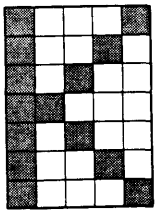
(Fig. 1)

Fig. 1 shows an example of 5 x 7 Dot Matrix application circuit.
The application circuit is capable of displaying alhabet, numbers, other signs.
These are shown in Fig. 2 as function of six bit input A_1 - A_6.

Resultant displays with ASCII code input data

A_6	A_5	A_4	A_3	A_2	A_1	Resultant Display	A_6	A_5	A_4	A_3	A_2	A_1	Resultant Display
0	0	0	0	0	0	@	1	0	0	0	0	0	
0	0	0	0	0	1	A	1	0	0	0	0	1	!
0	0	0	0	1	0	B	1	0	0	0	1	0	"
0	0	0	0	1	1	C	1	0	0	0	1	1	#
0	0	0	1	0	0	D	1	0	0	1	0	0	$
0	0	0	1	0	1	E	1	0	0	1	0	1	%
0	0	0	1	1	0	F	1	0	0	1	1	0	&
0	0	0	1	1	1	G	1	0	0	1	1	1	'
0	0	1	0	0	0	H	1	0	1	0	0	0	(
0	0	1	0	0	1	I	1	0	1	0	0	1	)
0	0	1	0	1	0	J	1	0	1	0	1	0	*
0	0	1	0	1	1	K	1	0	1	0	1	1	+
0	0	1	1	0	0	L	1	0	1	1	0	0	,
0	0	1	1	0	1	M	1	0	1	1	0	1	-
0	0	1	1	1	0	N	1	0	1	1	1	0	.
0	0	1	1	1	1	O	1	0	1	1	1	1	/
0	1	0	0	0	0	P	1	1	0	0	0	0	ϕ
0	1	0	0	0	1	Q	1	1	0	0	0	1	1
0	1	0	0	1	0	R	1	1	0	0	1	0	2
0	1	0	0	1	1	S	1	1	0	0	1	1	3
0	1	0	1	0	0	T	1	1	0	1	0	0	4
0	1	0	1	0	1	U	1	1	0	1	0	1	5
0	1	0	1	1	0	V	1	1	0	1	1	0	6
0	1	0	1	1	1	W	1	1	0	1	1	1	7
0	1	1	0	0	0	X	1	1	1	0	0	0	8
0	1	1	0	0	1	Y	1	1	1	0	0	1	9
0	1	1	0	1	0	Z	1	1	1	0	1	0	:
0	1	1	0	1	1	[	1	1	1	0	1	1	;
0	1	1	1	0	0	\	1	1	1	1	0	0	<
0	1	1	1	0	1	]	1	1	1	1	0	1	=
0	1	1	1	1	0	^	1	1	1	1	1	0	>
0	1	1	1	1	1	-	1	1	1	1	1	1	?

(Fig. 2)



(Display of "K")

1.8 INCH RED & GREEN SEVEN SEGMENT DISPLAY

TLR380 TLG380 TLS380

- 45mm(1.8") character height numerical display.
- Outer Color filter provides high contrast, complete practical at 10mA Per Segments.
- APPLICATIONS: Counter etc.

TLR380

ABSOLUTE MAXIMUM RATINGS (Ta = 25℃)

CHARACTERISTIC	SYMBOL	Rating	UNIT
DC Forward Current/Seg	$I_{F(DC)}$/Seg	20	mA
Reverse Voltage/Seg	V_R	6	V
Storage Temperature Range	T_{stg}	-20∿75	°C
Operating Temperature Range	T_{opr}	-20∿60	°C
Soldering Temperature (Note)	T_{solder}	260	°C

(Note) Within 3 seconds at 2mm from the Reflector Edge

ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25℃)

CHARACTERISTIC	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F = 10mA	3.4	4.0	5.0	V
Reverse Current	I_R	V_R = 6V			5	μA
Luminous Intensity/Seg	I_V/Seg	I_F =10mA		1.0		mcd
Luminous Intensity Matching Ratio	I_{V-M}	I_F =5mA			2.5	
Peak Wave Length	λ_p	I_F =10mA		700		nm
Spectral Line Half Width	$\Delta\lambda$	I_F =10mA		100		nm

TLG380

ABSOLUTE MAXIMUM RATINGS (Ta = 25℃)

CHARACTERISTIC	SYMBOL	Rating	UNIT
DC Forward Current/Seg	$I_{F(DC)}$/Seg	20	mA
Reverse Voltage/Seg	V_R	6	V
Storage Temperature Range	T_{stg}	-20∿75	°C
Operating Temperature Range	T_{opr}	-20∿60	°C
Soldering Temperature (Note)	T_{solder}	260	°C

(Note) Within 3 seconds at 2mm from the Reflector Edge

ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25℃)

CHARACTERISTIC	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F = 10mA	3.4	4.0	5.0	V
Reverse Current	I_R	V_R = 6V			5	μA
Luminous Intensity/Seg	I_V/Seg	I_F = 10mA		0.8		mcd
Luminous Intensity Matching Ratio	I_{V-M}	I_F = 5mA			2.5	
Peak Wave Length	λ_p	I_F = 10mA		565		nm
Spectral Line Half Width	$\Delta\lambda$	I_F = 10mA		30		nm

TLS380

ABSOLUTE MAXIMUM RATINGS (Ta = 25℃)

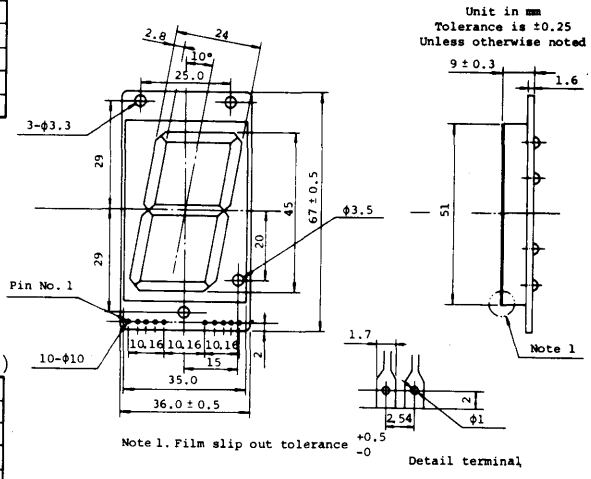
CHARACTERISTIC	SYMBOL	Rating	UNIT
DC Forward Current/Seg	$I_{F(DC)}$/Seg	20	mA
Reverse Voltage/Seg	V_R	6	V
Storage Temperature Range	T_{stg}	-20∿75	°C
Operating Temperature Range	T_{opr}	-20∿60	°C
Soldering Temperature (Note)	T_{solder}	260	°C

(Note) Within 3 seconds at 2mm from the Reflector Edge

ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25℃)

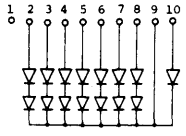
CHARACTERISTIC	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F = 10mA	3.4	4.0	5.0	V
Reverse Current	I_R	V_R = 6V			5	μA
Luminous Intensity/Seg	I_V/Seg	I_F = 10mA		1.0		mcd
Luminous Intensity Matching Ratio	I_{V-M}	I_F = 5mA			2.5	
Peak Wave Length	λ_p	I_F = 10mA		635		nm
Spectral Line Half Width	$\Delta\lambda$	I_F = 10mA				nm

PHYSICAL DIMENSION



PIN CONNECTION

Pin No.	CONNECTION
1	N・C
2	Anode E
3	Anode F
4	Anode G
5	Anode D
6	Anode A
7	Anode B
8	Anode C
9	Common cathod
10	Dot anode



0.9 INCH RED 4-DIGITS DISPLAY (STATIC DRIVE)

TLR2057A, TLR4052A TLR2087A, TLR4082A

RED COLOR 4 DIGITS LED DISPLAY

- For Use of static drive connections and available both polarity common anode or common cathode.
- 23 mm (0.9") character height, each segment is diffused and uniformly display.
- Outer color filter provides high contrast, complete practical Use at 7 mA per segments.
- Arrow edge shape of each segment represents not mosaic but look like arabic numerals.
- Selectable both type 12 or 24 hours of display.

Refer to page 158 for the figure.

TYPE NO. VS. DISPLAY FONT

COMMON ANODE	FULLY DISPLAY FONT	COMMON CATHODE
TLR2057A	°18:88.	TLR2087A
TLR4052A	°88:88.	TLR4082A

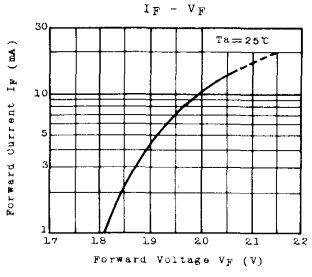
MAXIMUM RATINGS (Ta = 25 °C)

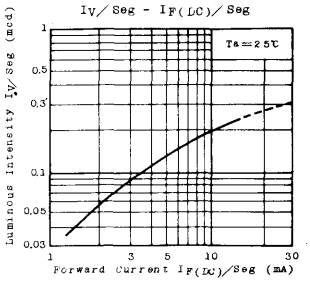
CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current/Seg.	$I_{F(DC)}$/Seg	15	mA
Reverse Voltage	V_R	3	V
Storage Temperature Range	T_{stg}	-20 ∿ 75	°C
Operating Temperature Range	Topr	-20 ∿ 60	°C
Soldering Temperature (Note)	Tsolder	260	°C

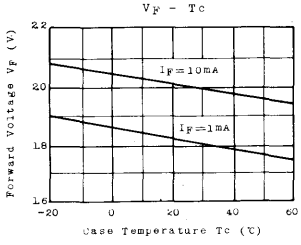
Note: Within 3 Seconds at 2 mm from the Reflector Edge.

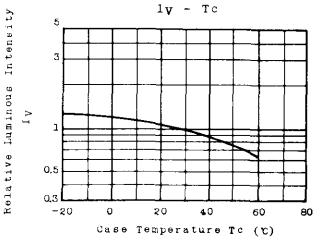
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25 °C)

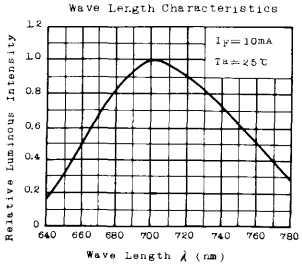
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F = 10mA	1.7	2.0	2.5	V
Reverse Current	I_R	V_R = 3V	-	-	5	μA
Luminous Intensity/Seg.	I_V/Seg	I_F = 10mA	0.1	0.2	-	mcd
Luminous Intensity Matching Ratio	Iv-M	I_F = 5mA	-	-	2.5	-
Peak Emission Wave Length	λp	I_F = 10mA	-	700	-	nm
Spectral Half Line Width	Δλ	I_F = 10mA	-	100	-	nm

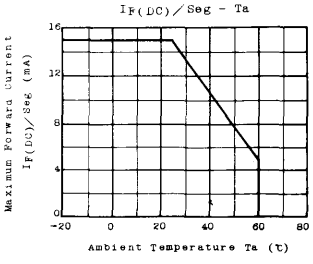












0.9 INCH GREEN 4-DIGITS DISPLAY (STATIC DRIVE)

TLG2057A, TLG4052A, TLG2087A, TLG4082A

GREEN COLOR 4 DIGITS LED DISPLAY

- For Use of static drive connections and available both polarity common anode or common cathode.
- 23 mm (0.9") character height, each segment is diffused and uniformly display.
- Outer color filter provides high contrast, complete practical use at 14 mA per segments.
- Arrow edge shape of each segment represents not mosaic but look like Arabic numerals.
- Selectable both type 12 or 24 Hours of Display.

Refer to page 158 for the figure.

TYPE NO. VS DISPIAYED FONT

COMMON ANODE	COMMON CATHODE	FULLY DISPLAY FONT
TLG2057A	TLG2087A	°18:88.
TLG4052A	TLG4082A	°88:88.

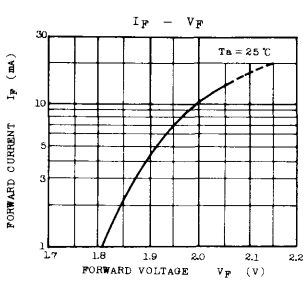
MAXIMUM RATINGS (Ta = 25 °C)

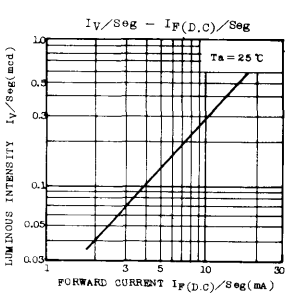
CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current/Seg.	$I_{F(DC)}$/Seg	20	mA
Reverse Voltage	V_R	3	V
Storage Temperature Range	T_{stg}	-20~75	°C
Operating Temperature Range	T_{opr}	-20~60	°C
Soldering Temperature (Note)	T_{solder}	260	°C

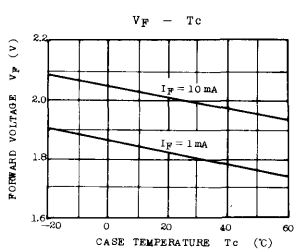
Note: Within 3 second at 2 mm from the reflector edge.

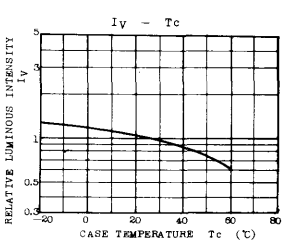
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25 °C)

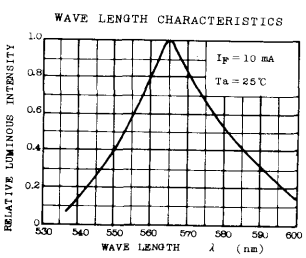
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=10mA	1.8	2.0	2.5	V
Reverse Current	I_R	V_R=3V	-	-	5	mA
Luminous Intensity/Seg.	I_V/Seg	I_F=10mA	0.08	0.3	-	mcd
Luminous Intensity Matching Ratio	I_{V-M}	I_F=5mA	-	-	2.5	
Peak Emission Wave Length	λ_P	I_F=10mA	-	565	-	nm
Spectral Half Line Width	$\Delta\lambda$	I_F=10mA	-	30	-	nm

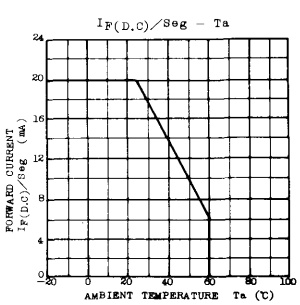








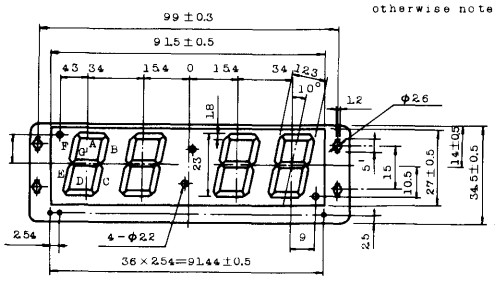




PHYSICAL DIMENSIONS

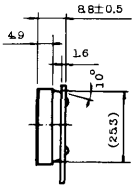
Unit : mm

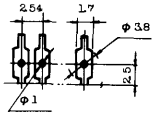
Tolerance is ±0.25 unless otherwise noted



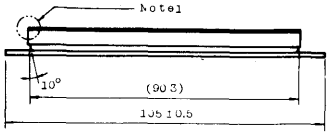
10's & Unit Hour 10's & Unit Min.

AM/PM Colons Alram/Sleep





Detail terminal

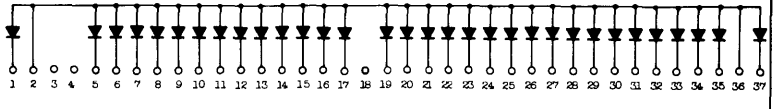


Note1 : Film slip out tolerance +0.5 -0

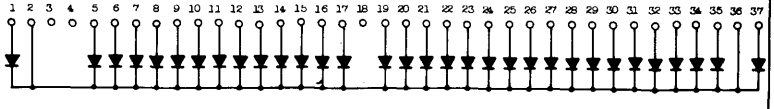
TERMINAL CONNECTION (○: CONNECTION, × : NO CONNECTION)

TERMINAL No.	CONNECTION	TLG2057A TLG2087A TLR2057A TLR2087A	TLG4052A TLG4082A TLR4052A TLR4082A	TERMINAL No.	CONNECTION	TLG2057A TLG2087A TLR2057A TLR2087A	TLG4052A TLG4082A TLR4052A TLR4082A
1	AM/PM	○	○	20	Upper Colon	○	○
2	Common			21	Lower Colon	○	○
3		×	×	22	10's Min. F	○	○
4		×	×	23	10's Min. G	○	○
5	10's Hour A	×	○	24	10's Min. A	○	○
6	10's Hour F	×	○	25	10's Min. B	○	○
7	10's Hour G	×	○	26	10's Min. D	○	○
8	10's Hour E	×	○	27	10's Min. E	○	○
9	10's Hour D	×	○	28	10's Min. C	○	○
10	10's Hour C	○	○	29	Unit Min. F	○	○
11	10's Hour B	○	○	30	Unit Min. G	○	○
12	Unit Hour F	○	○	31	Unit Min. A	○	○
13	Unit Hour G	○	○	32	Unit Min. B	○	○
14	Unit Hour A	○	○	33	Unit Min. E	○	○
15	Unit Hour B	○	○	34	Unit Min. D	○	○
16	Unit Hour E	○	○	35	Unit Min. C	○	○
17	Unit Hour D	○	○	36	Common		
18		×	×				
19	Unit Hour C	○	○	37	Alam/Sleep		

TLG2057A/TLR2057A, TLG4052A/TLR4052A (COMMON ANODE)



TLG2087A/TLR2087A, TLG4082A/TLR4082A (COMMON CATHODE)



0.6 INCH RED 4-DIGITS DISPLAY (DUPLEX DRIVE)

TLR2098A, TLR4093A TLR2248, TLR4243

RED COLOR 4 DIGITS LED DISPLAY

- For Duplex drive connections and available both polarity common anode or common cathode.
- 15 mm (0.6") character Height, each segment represents diffused and Univormly display.
- Outer color filter provides high contrast, practical brightness are obtained at about 20mA (with 50 per cent duty ratio) per segments.
- Arrow edge shape of each segment represents not mosaic but look like Arabic numerals.
- Selectable both type 12 or 24 hours of display.

Refer to page 161 for the figure.

TYPE NO. VS. DISPLAY FONT

COMMON ANODE	COMMON CATHODE	FULLY DISPLAY FONT
TLR2098A	TLR2248	18:88
TLR4093A	TLR4243	88:88

MAXIMUM RATINGS (Ta = 25°C)

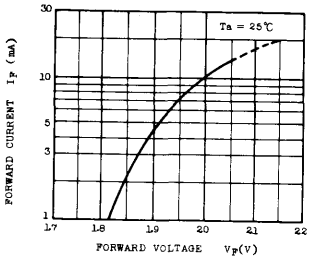
CHARACTERISTIC	SYMBOL	RATING	UNIT
Pulse Forward Current (Note 1)	I_F(Pulse)/Seg	30	mA
Reverse Voltage	V_R	3	V
Storage Temperature Range	Tstg	-20~75	°C
Operating Temperature Range	Topr	-20~60	°C
Soldering Temperature (Note 2)	Tsolder	260	°C

Note 1: Duty ratio = 1/2
2: Within 3 seconds at 2 mm from the reflector edge

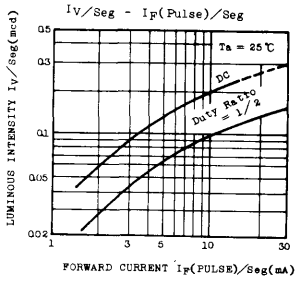
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTICS	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=20mA	1.8	2.15	2.75	V
Reverse Current	I_R	V_R=3V	-	-	5	μA
Luminous Intensity/Seg.	I_V/Seg.	I_F=10mA	0.1	0.2	-	mcd
Luminous Intensity Matching Ratio	I_{V-M}	I_F=5mA	-	-	2.5	-
Peak Emission Wave Length	λp	I_F=10mA	-	700	-	nm
Spectral Half Line Width	Δλ	I_F=10mA	-	100	-	nm

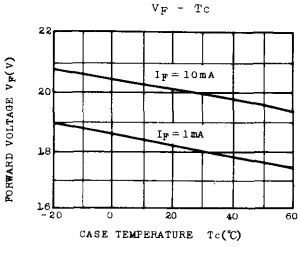
I_F - V_F



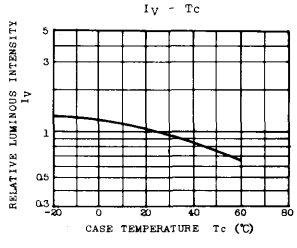
I_V/Seg - I_F(Pulse)/Seg



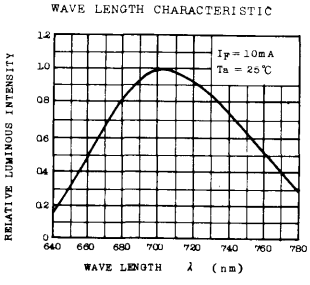
V_F - Tc



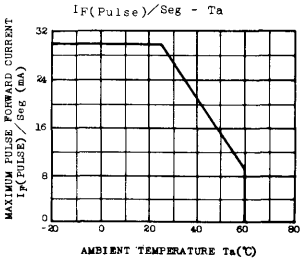
I_V - Tc



WAVE LENGTH CHARACTERISTIC



I_F(Pulse)/Seg - Ta



0.6 INCH GREEN 4-DIGITS DISPLAY(DUPLEX DRIVE)

TLG2098A, TLG4093A TLG2248, TLG4243

GREEN COLOR 4 DIGITS LED DISPLAY

- For Duplex drive connections and available both polarity common anode or common cathode.
- 15 mm (0.6") character height, each segment represents diffused and uniformly display.
- Outer color filter provides high contrast, practical brightness are obtained at about 20 mA (with 50 per cent duty ratio) per segments.
- Arrow edge shape of each segment represents not mosaic but look like Arabic numerals.
- Selectable both type 12 or 24 hours of display.

Refer to page 161 for the figure.

TYPE NO. VS DISPIAYED FONT

COMMON ANODE	COMMON CATHODE	FULLY DISPLAY FONT
TLG2098A	TLG2248	18:88
TLG4093A	TLG4243	88:88

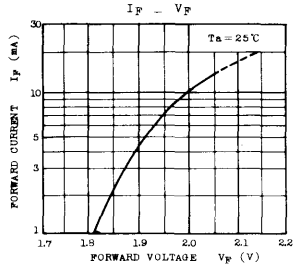
MAXIMUM RATINGS (Ta = 25 °C)

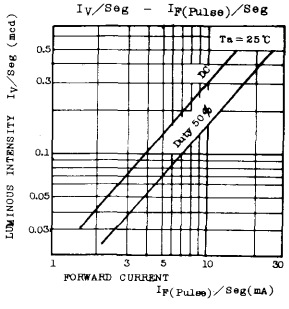
CHARACTERISTIC	SYMBOL	RATING	UNIT
Pulse Forward Current	$I_{F(Pulse)/Seg}$	30	mA
Reverse Voltage (Note 1)	V_R	3	V
Storage Temperature Range	Tstg	-20~75	°C
Operating Temperature Range	Topr	-20~60	°C
Soldering Temperature (Note 2)	Tsolder	260	°C

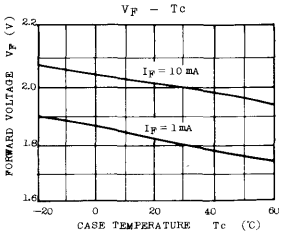
Note 1: Duty ratio = 1/2
2: Within 3 seconds at 2 mm from the reflector edge

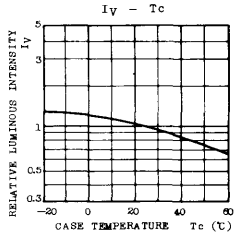
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25 °C)

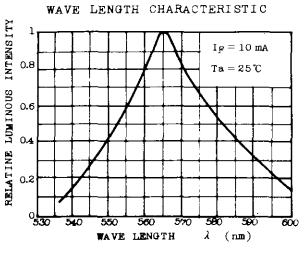
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=20mA	1.8	2.15	2.75	V
Reverse Current	I_R	V_R=3V	-	-	5	μA
Luminous Intensity/Seg.	I_V/Seg	I_F=10mA	0.08	0.3	-	mcd
Luminous Intensity Matching Ratio	I_{V-M}	I_F=5mA	-	-	2.3	-
Peak Emission Wave Length	λp	I_F=10mA	-	565	-	nm
Spectral Half Line Width	Δλ	I_F=10mA	-	30	-	nm

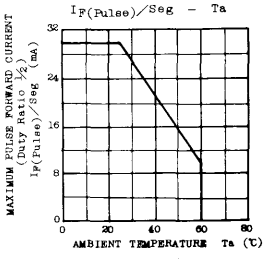








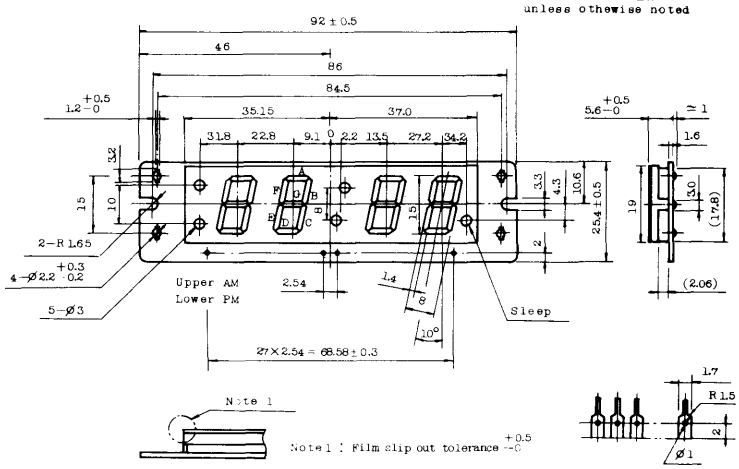




PHYSICAL DIMENSIONS

Unit in mm

Tolerances is ±0.25
unless othewise noted

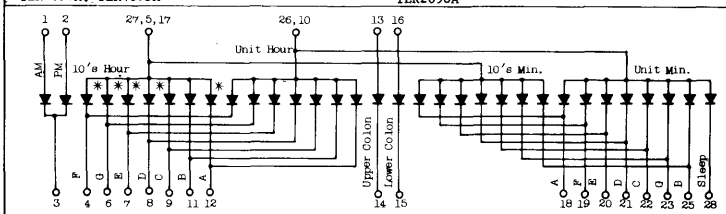


TERMINAL CONNECTION

TERMINAL No.	CONNECTION	TERMINAL No.	CONNECTION
1	AM	15	Lower Colon
2	PM	16	Lower Colon Common
3	AM, PM Common	17	10's Hour & 10's Min. Common
4	10's & Unit Hour F Segment	18	10's & Unit Min. A Segment
5	10's Hour & 10's Min Common	19	10's & Unit Min. F Segment
6	10's & Unit Hour G Segment	20	10's & Unit Min. E Segment
7	10's & Unit Hour E Segment	21	10's & Unit Min. D Segment
8	10's & Unit Hour D Segment	22	10's & Unit Min. C Segment
9	10's & Unit Hour C Segment	23	10's & Unit Min. G Segment
10	Unit Hour, Unit Min. & Sleep Common	24	N.C
11	10's & Unit Hour B Segment	25	10's & Unit Min. B Segment
12	10's & Unit Hour A Segment	26	Unit Hour, Unit Min. & Sleep Common
13	Upper Colon Common	27	10's Hour & 10's Min. Common
14	Upper Colon	28	Sleep

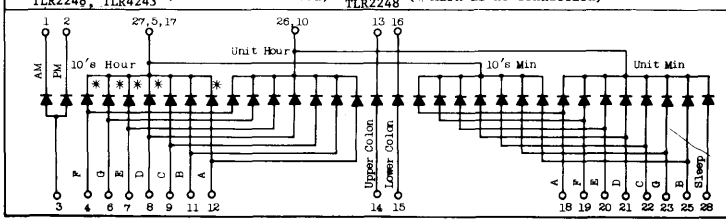
TLG2098A, TLG4093A
TLR2098A, TLR4093A (COMMON ANODE TYPE)

TLG2098A
TLR2098A (* Mark is no connection)



TLG2248, TLG4243
TLR2248, TLR4243 (COMMON CATHODE TYPE)

TLG2248
TLR2248 (*Mark is no connection)



0.3 INCH RED 4-DIGITS DISPLAY

TLR2110, TLR4115, TLR2120, TLR4125

RED COLOR 4 DIGITS LED DISPLAY

- Red Color, 7.6mm Character Height and Pin Connections for Multiplex Drive
- Even Digit Space
- Suitable for the Followings
  - Car Clock Display
  - Radio Frequency Display
  - Tape Counter Display of Recorder
- Selectable Both Types of Connection, Common Anode and Common Cathode
- Selectable Both Format of Clock Display, 12 or 24 Hours

Refer to page 164 for the figure.

TYPE NO. VS DISPIAYED FONT

COMMON ANODE	COMMON CATHODE	FULLY DISPLAY FONT
TLR2110	TLR2120	1.8:8.8
TLR4115	TLR4125	8.8:8.8

MAXIMUM RATINGS (Ta = 25°C)

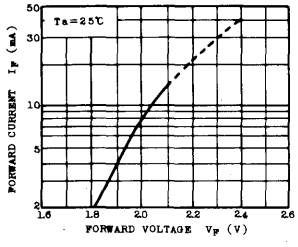
CHARACTERISTIC	SYMBOL	RATING	UNIT
DC Forward Current/Segment	$I_{F(DC)}$/Seg	15	mA
Pulse Forward Current/Seg. (Note)	$I_{F(Pulse)}$/Seg	60	mA
Reverse Voltage	V_R	6	V
Operating Temperature Range	Topr	-30 ~ 75	°C
Storage Temperature Range	Tstg	-30 ~ 90	°C

Note : Pulse Width=1ms, Duty Ratio=1/5

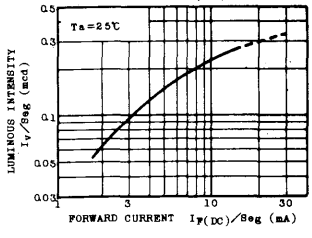
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_{FP}=40mA	2.0	2.5	3.0	V
Reverse Current	I_R	V_R=6V	-	-	5	μA
Luminous Intensity/Segment	I_V/Seg	I_{FP}=40mA, Duty Ratio=1/5	0.04	0.10	-	mcd
Luminous Intensity Matching Ratio	I_{V-M}	I_{FP}=40mA, Duty Ratio=1/12	-	-	2.5	-
Peak Emission Wave Length	λp	I_{FP}=40mA, Duty Ratio=1/5	-	700	-	nm
Spectral Half Line Width	Δλ	I_{FP}=40mA, Duty Ratio=1/5	-	100	-	nm

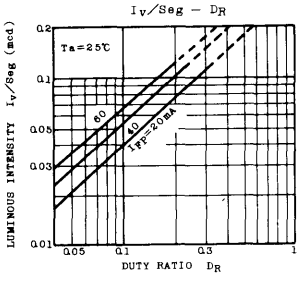
$I_F - V_F$



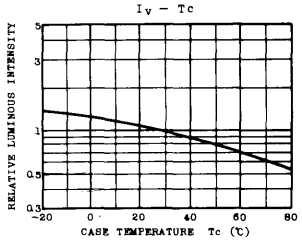
$I_V/Seg - I_{F(DC)}/Seg$



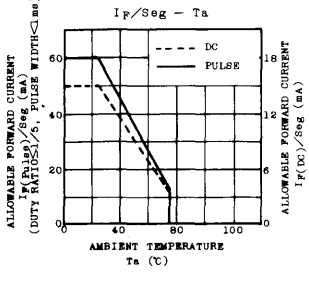
$I_V/Seg - D_R$



$I_V - Tc$



$I_F/Seg - Ta$



0.3 INCH GREEN 4-DIGITS DISPLAY

TLG2110, TLG4115, TLG2120, TLG4125

GREEN COLOR 4 DIGITS LED DISPLAY

- Green Color, 7.6mm Character Height and Pin Connections for Multiplex Drive
- Even Digit Space
- Suitable for the Followings
  - Car Clock Display
  - Radio Frequency Display
  - Tape Counter Display of Recorder
- Available Both Types of Connection, Common Anode or Common Cathode
- Available Both Format of Clock Display, 12 or 24 Hours

Refer to page 164 for the figure.

TYPE NO. VS DISPLAYED FONT

COMMON ANODE	COMMON CATHODE	FULLY DISPLAY FONT
TLG2110	TLG2120	° 1.8:8.8 °
TLG4115	TLG4125	° 8.8:8.8 °

MAXIMUM RATINGS (Ta = 25°C)

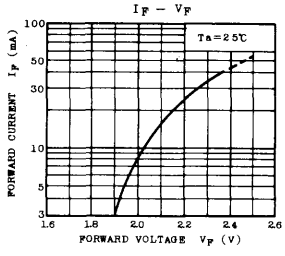
CHARACTERISTIC	SYMBOL	RATING	UNIT
DC Forward Current/Segment	$I_{F(DC)}$/Seg	15	mA
Pulse Forward Current/Seg (Note)	$I_{F(Pulse)}$/Seg	60	mA
Reverse Voltage	V_R	6	V
Operating Temperature Range	T_{opr}	-30 ~ 75	°C
Storage Temperature Range	T_{stg}	-30 ~ 90	°C

Note : Pulse Width=1ms, Duty Ratio=1/5

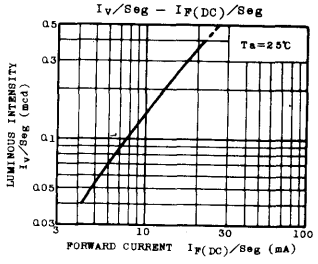
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_{FP}=40mA	2.0	2.5	3.0	V
Reverse Current	I_R	V_R=6V	-	-	5	μA
Luminous Intensity/Segment	I_V/Seg	I_{FP}=40mA, Duty Ratio=1/5	0.08	0.15	-	mcd
Luminous Intensity Matching Ratio	I_V-M	I_{FP}=40mA, Duty Ratio=1/12	-	-	2.3	-
Peak Emission Wave Length	λ_P	I_{FP}=40mA, Duty Ratio=1/5	-	565	-	nm
Spectral Half Line Width	$\Delta\lambda$	I_{FP}=40mA, Duty Ratio=1/5	-	30	-	nm

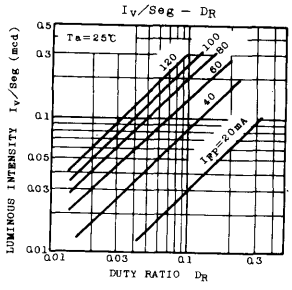
$I_F - V_F$



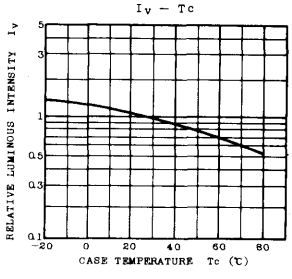
I_V/Seg − $I_{F(DC)}$/Seg



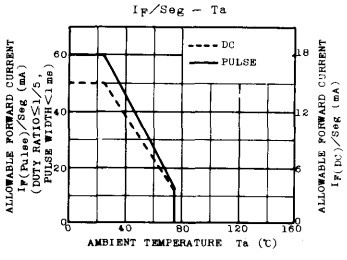
I_V/Seg − D_R



I_V − Tc



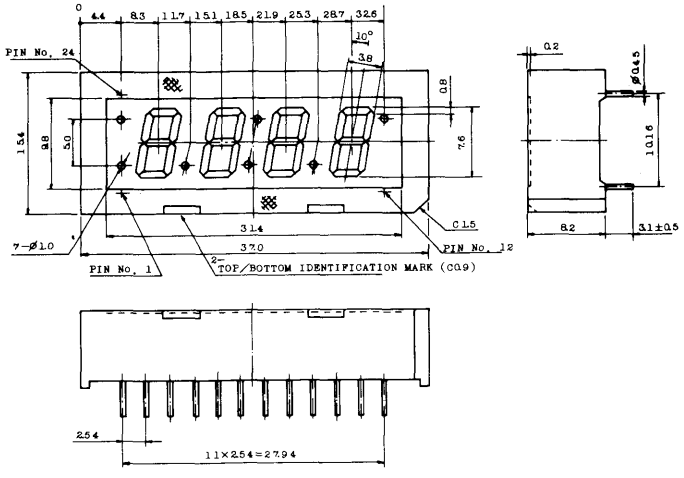
I_F/Seg − Ta



OUTLINE DIMENSION

Unit in mm

Note : Tolerance is ±0.25
unless otherwise noted.

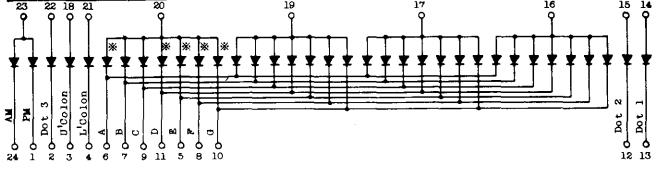


PIN CONNECTION

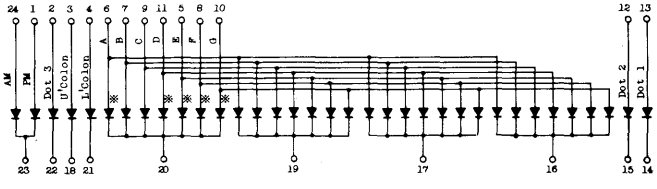
PIN No.	CONNECTION	TLG2110 TLG4115 TLR2110 TLR4115	TLG2120 TLG4125 TLR2120 TLR4125	PIN No.	CONNECTION	TLG2110 TLG4115 TLR2110 TLR4115	TLG2120 TLG4125 TLR2120 TLR4125
1	PM	Cathode	Anode	13	Dot 1	Cathode	Anode
2	Dot 3	Cathode	Anode	14	Dot 1	Anode	Cathode
3	Upper Colon	Cathode	Anode	15	Dot 2	Anode	Cathode
4	Lower Colon	Cathode	Anode	16	Unit M Common	Anode	Cathode
5	E	Cathode※	Anode※	17	10's M Common	Anode	Cathode
6	A	Cathode※	Anode※	18	Upper Colon	Anode	Cathode
7	B	Cathode	Anode	19	Unit H Common	Anode	Cathode
8	F	Cathode※	Anode※	20	10's H Common	Anode	Cathode
9	C	Cathode	Anode	21	Lower Colon	Anode	Cathode
10	G	Cathode※	Anode※	22	Dot 3	Anode	Cathode
11	D	Cathode※	Anode※	23	AM & PM Common	Anode	Cathode
12	Dot 2	Cathode	Anode	24	AM	Cathode	Anode

Note: TLG2110/TLR2110 & TLG2120/TLR2120 ※ mark segments are no connection.

TLG2110/TLR2110, TLG4115/TLR4115



TLG2120/TLR2120, TLG4125/TLR4125



TLR2157, TLR4152, TLR2187, TLR4182

RED COLOR 4 DIGITS LED DISPLAY

- Clock display for multiplex drive operation and available both polarity common anode or common cathode.
- 23 mm (0.9") character height, each segment repersents diffused and uniform display with milk white filter color.
- Practical brightness are obtained at about 60 mA with 1/6 of duty ratio.
- Arrow edge shape of each segment represents not mosaic but look like Arabic numerals.
- Selectable both type 12 or 24 hours display.

Refer to page 166 for the figure.

TYPE NO. VS. DISPLAY FONT

COMMON ANODE	COMMON CATHODE	FULLY DISPLAY FONT
TLR2157	TLR2187	18:88
TLR4152	TLR4182	88:88

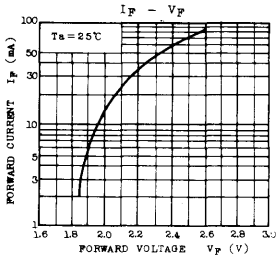
MAXIMUM RATINGS (Ta = 25 °C)

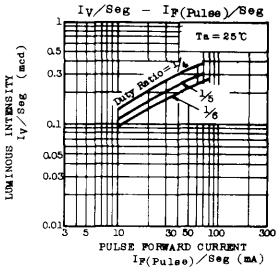
CHARACTERISTIC	SYMBOL	RATING	UNIT
Pulse Forward Current (Note 1)	I_F(Pulse)/Seg	90	mA
Reverse Voltage	V_R	3	V
Storage Temperature Range	Tstg	-20~75	°C
Operating Temperature Range	Topr	-20~60	°C
Soldering Temperature (Note 2)	Tsolder	260	°C

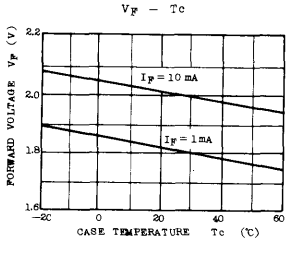
Note 1: Duty ratio=1/6
2: Within 3 second at 2 mm from the reflector edge

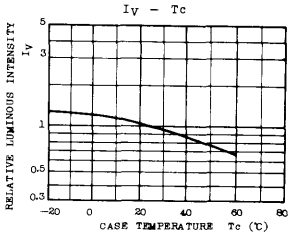
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25 °C)

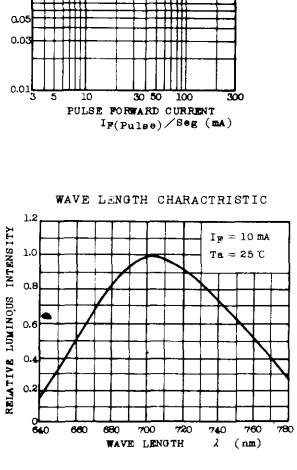
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_{FP}=60mA	1.9	2.4	3.6	V
Reverse Current	I_R	V_R=3V	-	-	5	μA
Luminous Intensity/seg.	I_V/Seg	I_{FP}=60mA Duty ratio=1/6	0.14	0.25	-	mcd
Luminous Intensity Matching Ratio	I_V-M	I_{FP}=40mA Duty ratio=1/6	-	-	2.5	-
Peak Emission Wave Length	λ_P	I_F=10mA	-	700	-	nm
Spectral Half Line Width	$\Delta\lambda$	I_F=10mA	-	100	-	nm

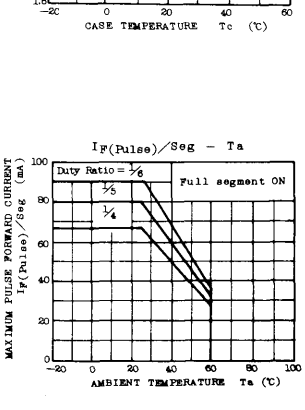








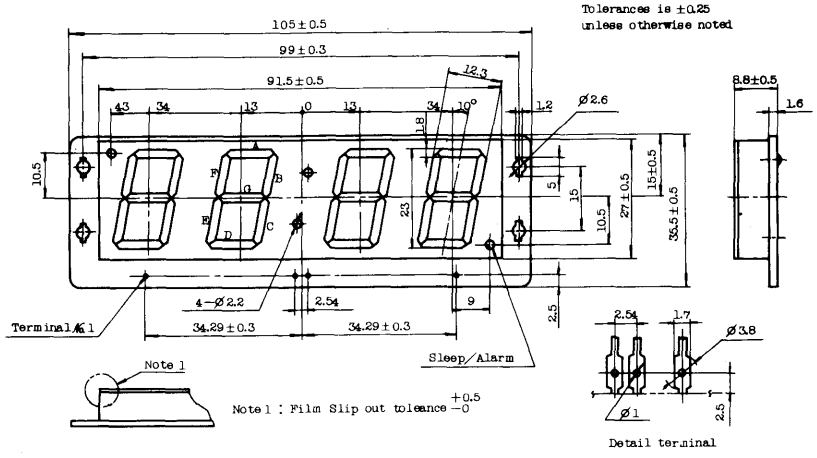




PHYSICAL DIMENSIONS

Unit in mm

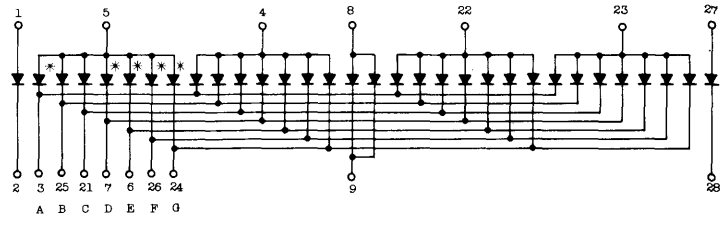
Tolerances is ±0.25
unless otherwise noted



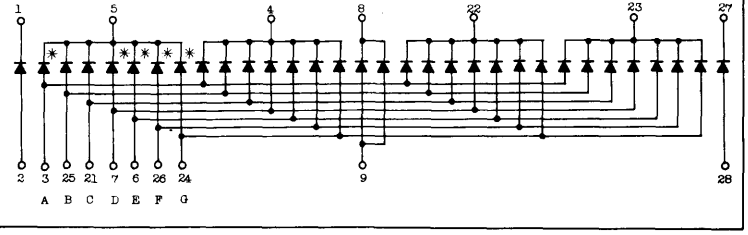
TERMINAL CONNECTION

TERMINAL №	CONNECTION	TERMINAL №	CONNECTION
1	AM/PM Common	10 ~ 20	N.C
2	AM/PM	21	C Segment
3	A Segment	22	10's Minute Common
4	Unit Hour Common	23	Unit Minute Common
5	10's Hour Common	24	G Segment
6	E Segment	25	B Segment
7	D Segment	26	F Segment
8	Colons Common	27	Sleep/Alarm Common
9	Colons	28	Sleep/Alarm

TLR2157, TLR4152 COMMON ANODE TYPE (TLR2157 * Mark is no connection)



TLR2187, TLR4182 COMMON CATHODE TYPE (TLR2187 * Mark is no connection)



TLR2177, TLR4172, TLR2207, TLR4202

RED COLOR 4 DIGITS LED DISPLAY

- For Use of static drive connections and available both polarity common anode or common cathode.
- 15 mm (0.6") character height, each segment is diffused and uniformly display.
- Outer color filter provides high contrast, complete practical use at 5 mA per segments.
- Arrow edge shape of each segment represents not mosaic but look like Arabic numerals.
- Selectable both type 12 or 24 hours display.

Refer to page 169 for the figure.

TYPE NO. vs. DISPLAY FONT

COMMON ANODE	COMMON CATHODE	FULLY DISPLAY FONT
TLR2177	TLR2207	:18:88
TLR4172	TLR4202	:88:88

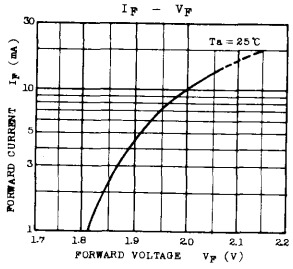
MAXIMUM RATINGS (Ta = 25 °C)

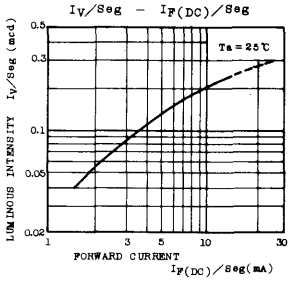
CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current/Seg.	$I_{F(DC)}$/Seg	15	mA
Reverse Voltage	V_R	3	V
Storage Temperature Range	Tstg	-20~75	°C
Operating Temperature Range	Topr	-20~60	°C
Soldering Temperature (Note)	Tsolder	260	°C

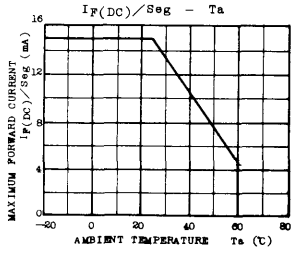
Note: Within 3 second 2 mm at from the reflector edge.

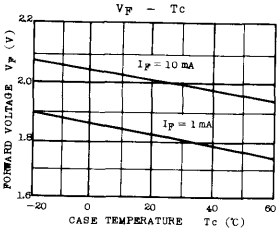
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25 °C)

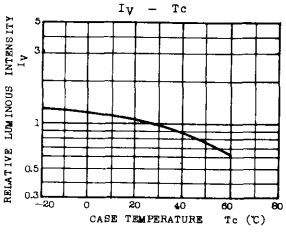
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=10mA	1.7	2.0	2.5	V
Reverse Current	I_R	V_R=3V	-	-	5	μA
Luminous Intensity/Seg.	Iv/Seg	I_F=10mA	0.1	0.2	-	mcd
Luminous Intensity Matching Ratio	Iv-M	I_F=5mA	-	-	2.5	-
Peak Emission Wave Length	λp	I_F=10mA	-	700	-	nm
Spectral Half Line Width	Δλ	I_F=10mA	-	100	-	nm

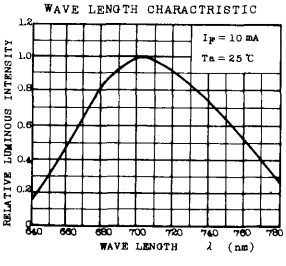












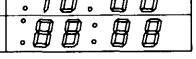
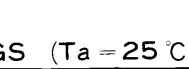
TLG2177, TLG4172, TLG2207, TLG4202

GREEN COLOR 4 DIGITS LED DISPLAY

- For use of Static drive connections and available both polarity common anode or common cathode.
- 15 mm (0.6") character height, each segment is diffused and uniformly display.
- Outer color filter provides high contrast, complete practical use at 10 mA per segments.
- Arrow edge shape of each segment represents not mosaic but look like Arabic numerals.
- Selectable both type 12 or 24 hours of display.

Refer to page 169 for the figure.

TYPE NO. VS. DISPLAY FONT

COMMON ANODE	COMMON CATHODE	FULLY DISPLAY FONT
TLG2177	TLG2207	
TLG4172	TLG4202	

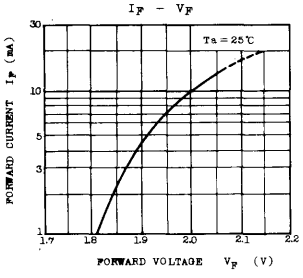
MAXIMUM RATINGS (Ta = 25 °C)

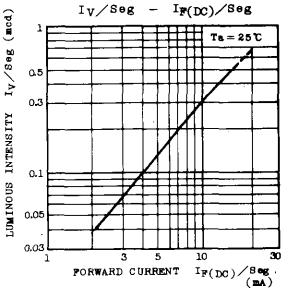
CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current/Seg.	I_F(DC)/Seg.	15	mA
Reverse Voltage	V_R	3	V
Storage Temperature Range	Tstg	-20~75	°C
Operating Temperature Range	Topr	-20~60	°C
Soldering Temperature (Note)	Tsolder	260	°C

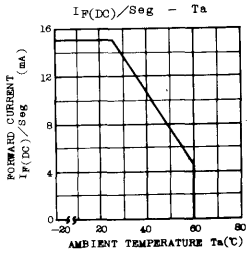
Note: Within 3 second at 2 mm from the reflector edge.

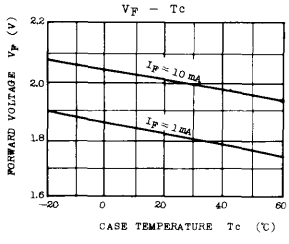
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25 °C)

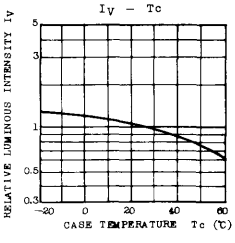
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=10mA	1.8	2.0	2.5	V
Reverse Current	I_R	V_R=3V	-	-	5	μA
Luminous Intensity/Seg.	I_V/Seg.	I_F=10mA	0.08	0.3	-	mcd
Luminous Intensity Matching Ratio	I_V-M	I_F=5mA	-	-	2.3	
Peak Emission Wave Length	λ_P	I_F=10mA	-	565	-	nm
Spectral Half Line Width	$\Delta\lambda$	I_F=10mA	-	30	-	nm

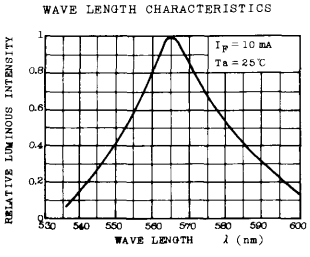




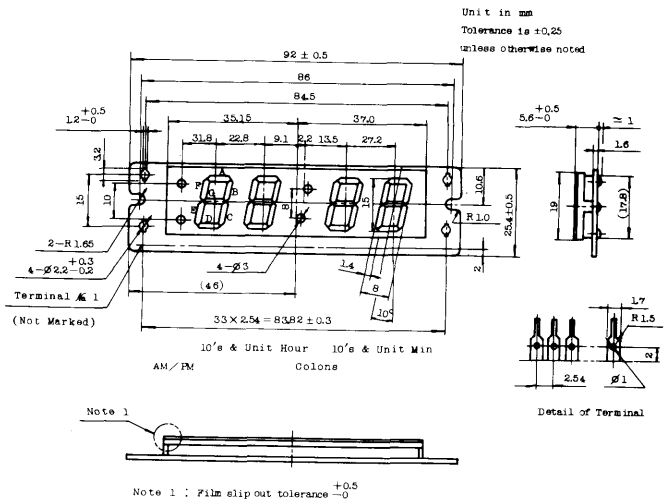








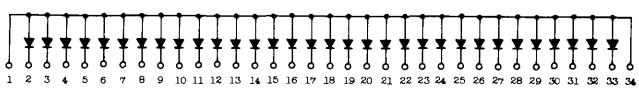
PHYSICAL DIMENSIONS



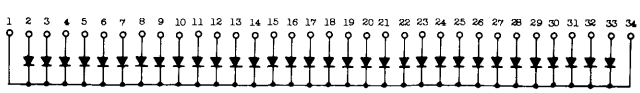
TERMINAL CONNECTION (○ : CONNECTION, × : NO CONNECTION)

TERMINAL №	CONNECTION	TLG2177 TLG2207 TLR2177 TLR2207	TLG4172 TLG4202 TLR4172 TLR4202	TERMINAL №	CONNECTION	TLG2177 TLG2207 TLR2177 TLR2207	TLG4172 TLG4202 TLR4172 TLR4202
1	Common			18	Upper Colon	○	○
2	PM	○	○	19	Lower Colon	○	○
3	AM	○	○	20	10's Min. F	○	○
4	10's Hour A	×	○	21	10's Min. G	○	○
5	10's Hour F	×	○	22	10's Min. A	○	○
6	10's Hour G	×	○	23	10's Min. B	○	○
7	10's Hour E	×	○	24	10's Min. D	○	○
8	10's Hour D	×	○	25	10's Min. E	○	○
9	10's Hour C	○	○	26	10's Min. C	○	○
10	10's Hour B	○	○	27	Unit Min. F	○	○
11	Unit Hour F	○	○	28	Unit Min. G	○	○
12	Unit Hour G	○	○	29	Unit Min. A	○	○
13	Unit Hour A	○	○	30	Unit Min. B	○	○
14	Unit Hour B	○	○	31	Unit Min. E	○	○
15	Unit Hour E	○	○	32	Unit Min. D	○	○
16	Unit Hour D	○	○	33	Unit Min. C	○	○
17	Unit Hour C	○	○	34	Common		

TLG2177/TLR2177, TLG4172/TLR4172 COMMON ANODE TYPE



TLG2207/TLR2207, TLR4202/TLR4202 COMMON CATHODE TYPE



TLR2198, TLR4192, TLR2268, TLR4262

RED COLOR 4 DIGITS LED DISPLAY

- For Duplex Drive connection and available both polarity common anode or common cathode.
- 15 mm (0.6") character height, each segment represents diffused and uniformly display.
- Outer color filter provides high contrast, practical brightness are obtained at about 20 mA (with 50 per cent duty ratio) per segments.
- Arrow edge shape of each segment represents not mosaic but look like Arabic numerals.
- Selectable both type 12 or 24 hours of display.

Refer to page 172 for the figure.

TYPE NO. VS. DISPLAY FONT

COMMON ANODE	COMMON CATHODE	FULLY DISPLAY FONT
TLG2198	TLG2268	18:88
TLG4192	TLG4262	88:88

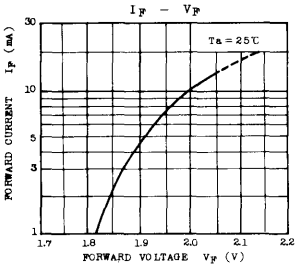
MAXIMUM RATINGS (Ta = 25°C)

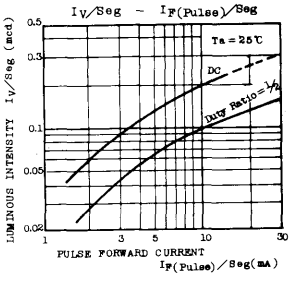
CHARACTERISTIC	SYMBOL	RATING	UNIT
Pulse Forward Current (Note 1)	$I_{F(Pulse)/Seg}$	30	mA
Reverse Voltage	V_R	3	V
Storage Temperature Range	T_{stR}	-20~75	°C
Operating Temperature Range	T_{opr}	-20~60	°C
Soldering Temperature (Note 2)	T_{solder}	260	°C

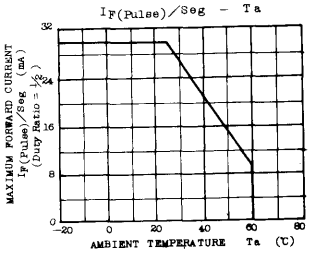
Note 1: Duty ratio = 1/2
2: Within 3 second at 2 mm from the reflector edge.

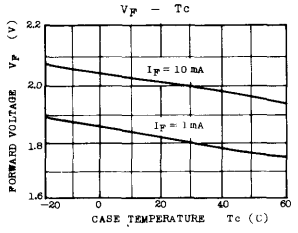
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25°C)

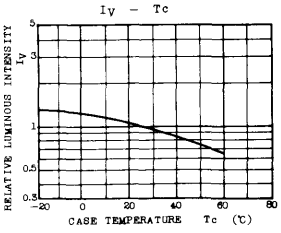
CHARACTERISTICS	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=20mA	1.8	2.15	2.75	V
Reverse Current	I_R	V_R=3V	-	-	5	μA
Luminous Intensity/Seg.	I_V/Seg	I_F=10mA	0.1	0.2	-	mcd
Luninous Intensity Matching Ratio	I_V-M	I_F=5mA	-	-	2.5	-
Peak Emission Wave Length	λ_P	I_F=10mA	-	700	-	nm
Spectral Half Line Width	$\Delta\lambda$	I_F=10mA	-	100	-	nm

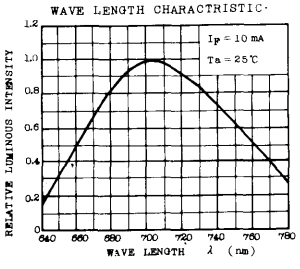












TLG2198, TLG4192, TLG2268, TLG4262

GREEN COLOR 4 DIGITS LED DISPLAY

- For Duplex drive connections and available both polarity common anode or common cathode.
- 15 mm (0.6") character height, each segment represents diffused and uniformly display.
- Outer color filter provides high contrast, practical brightness are obtained at About 20mA (with 50 per cent duty ratio) per segments.
- Arrow edge shape of each segment represents not mosaic but look like arabic numerals.
- Selectable both type 12 or 24 hours of display.

Refer to page 172 for the figure.

TYPE NO. vs. DISPLAY FONT

COMMON ANODE	COMMON CATHODE	FULLY DISPLAY FONT
TLR2198	TLR2268	18:88.
TLR4192	TLR4262	28:88.

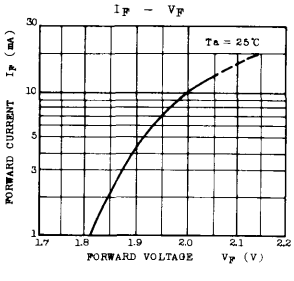
MAXIMUM RATINGS (Ta = 25 °C)

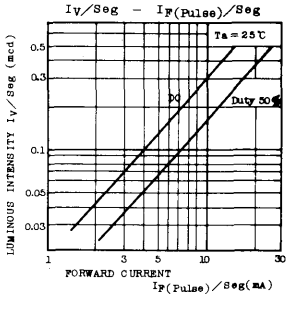
CARATERISTIC	SYMBOL	RATING	UNIT
Pulse Forward Current/Seg. (Note 1)	I_F(Pulse)/Seg.	30	mA
Reverse Voltage	V_R	3	V
Storage Temperature Range	T_{stg}	-20~75	°C
Operating Temperature Range	Topr	-20~60	°C
Soldering Temperature	T_{solder}	260	°C

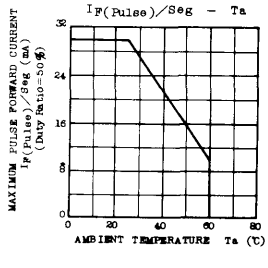
Note 1: Duty ratio = 1/2
2: Within 3 second at 2 mm from the reflector edge.

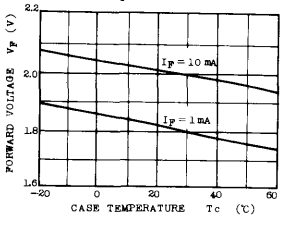
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25 °C)

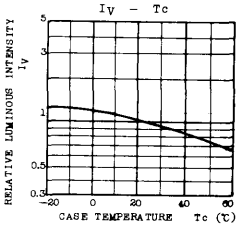
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=20mA	1.8	2.15	2.75	v
Reverse Current	I_R	V_R=3V	-	-	5	μA
Luminous Intensity/seg.	Iv/seg.	I_F=10mA	0.08	0.3	-	mcd
Luminous Intensity Matching Ratio	Iv-M	I_F=5mA	-	-	2.3	-
Peak Emission Wave Length	λp	I_F=10mA	-	565	-	nm
Spectral Half Line Width	Δλ	I_F=10mA	-	30	-	nm

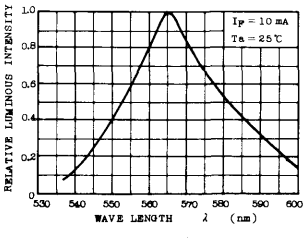




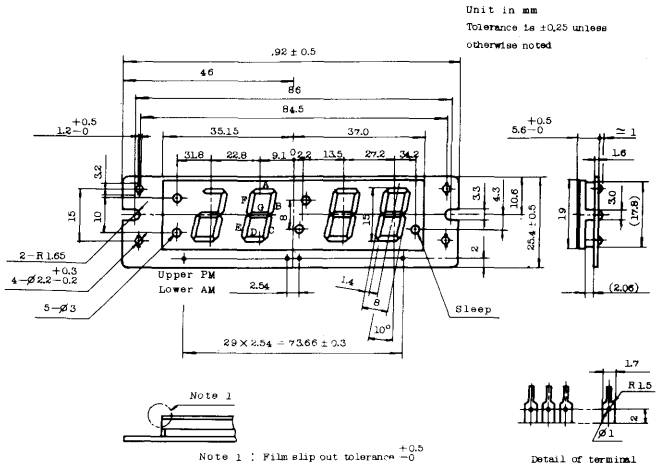






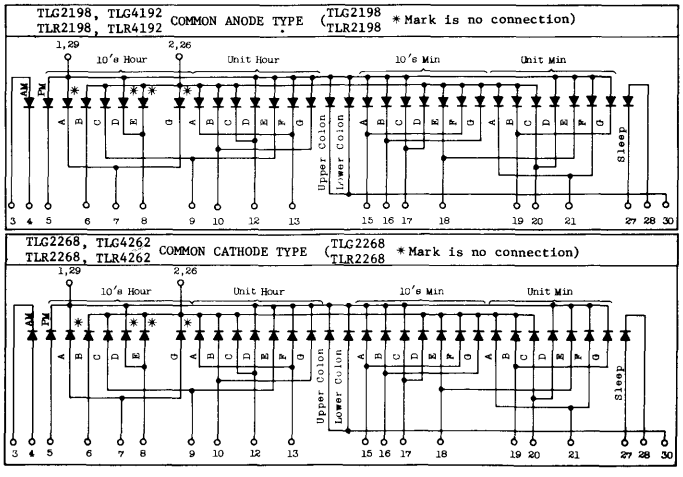


PHYSICAL DIMENSIONS



TERMINAL CONNECTION

TERMINAL №	CONNECTION	TERMINAL №	CONNECTION
1 , 29	PM, 10's Hour A.D. Unit Hour D.E.F.G, Colon, 10's Min A.B.C, & Unit Min D.E.F.G, Common	12	Unit Hour C,D
		13	Unit Hour A,F
		14	N.C
2 , 26	10's Hour B.C.E.G, Unit Hour A.B.C, & 10's Min D.E.F.G, Unit Min A.B.C, Common	15	10's Min A,F
		16	10's Min B,G
		17	10's Min C,D
3	AM Common	18	10's Min E & Unit Min E
4	AM	19	Unit Min B,G
5	PM	20	Unit Min C,D
6	10's Hour B	21	Unit Min A,F
7	10's Hour A,G	22 , 23 24 , 25	N.C
8	10's Hour D,E		
9	10's Hour C & Unit Hour E	27	Sleep
10	Unit Hour B,G	28	Sleep Common
11	N.C	30	Colon



TLR2218, TLR4213, TLR2168, TLR4163

RED COLOR 4 DIGITS LED DISPLAY

- Clock display for mutiplex drive operation and available both polarity common anode or common cathode.
- 15 mm (0.6") character high, each segment represents diffused and uniform display with milk white filter color.
- Practical brightness are obtained at about 40 mA with 1/6 of duty ratio.
- Arrow edge shape of each segment represents not mosaic but look like Arabic numerals.
- Selectable both type 12 or 24 hours of display.

TYPE NO. vs. DISPLAY FONT

COMMON ANODE	COMMON CATHODE	FULLY DISPLAY FONT
TLR2218	TLR2168	
TLR4213	TLR4163	

Refer to page 175 for the figure.

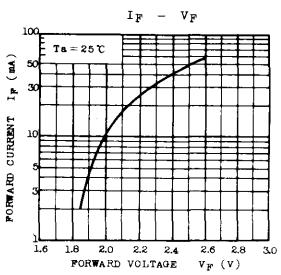
MAXIMUM RATINGS (Ta = 25 °C)

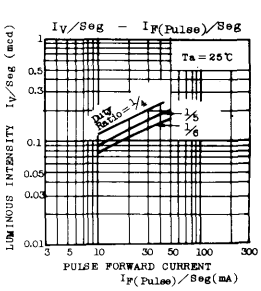
CHARACTERISTIC	SYMBOL	RATING	UNIT
Pulse Forward Current (Note 1)	I_F(Pulse)/Seg	60	mA
Reverse Voltage	V_R	3	V
Storage Temperature Range	T_{stg}	-20~75	°C
Operating Temperature Range	T_{opr}	-20~60	°C
Soldering Temperature (Note 2)	T_{solder}	260	°C

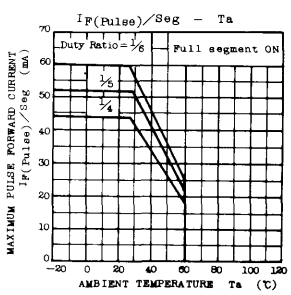
Note 1: Duty ratio = 1/6
2: Within 3 second at 2 mm from the reflector edge.

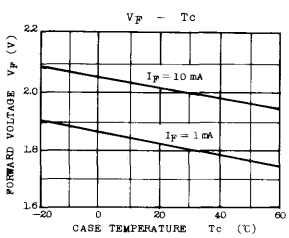
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25 °C)

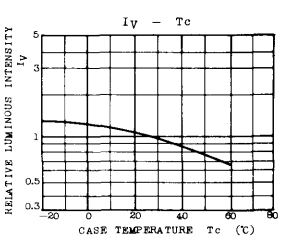
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_{FP}=40mA	1.9	2.4	3.4	V
Reverse Current	I_R	V_R=3V	-	-	5	μA
Luminous Intensity/Seg.	I_V/Seg	I_{FP}=40mA Duty Ratio=1/6	0.1	0.15	-	mcd
Luminous Intensity Matching Ratio	I_{V-M}	I_{FP}=40mA Duty Ratio=1/6	-	-	2.5	-
Peak Emission Wave Length	λP	I_F=10mA	-	700	-	nm
Spectral Half Line Width	Δλ	I_F=10mA	-	100	-	nm

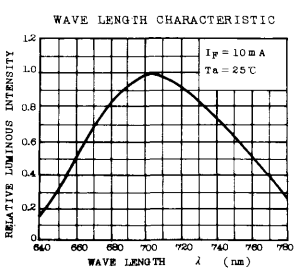












TLG2218, TLG4213, TLG2168, TLG4163

GREEN COLOR 4 DIGITS LED DISPLAY

- Clock display for multiplex drive operation and available both polarity common anode or common cathode.
- 15 mm (0.6") Character Hight, each segment represents diffused and uniform display with milk white filter color.
- Practical Brightness are obtained at about 50 mA with 1/6 of duty ratio.
- Arrow edge Shape of each segment represents not Mosaic but Look Like Arabic Numerals.
- Selectable Both Type 12 or 24 Hours of Display.

Refer to page 175 for the figure.

TYPE NO. VS. DISPLAY FONT

COMMON ANODE	COMMON CATHODE	FULLY DISPLAY FONT
TLG2218	TLG2168	18:88.
TLG4213	TLG4163	88:88.

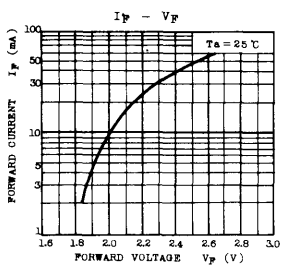
MAXIMUM RATINGS (Ta = 25 °C)

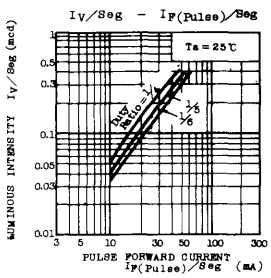
CHARACTERISTIC	SYMBOL	RATING	UNIT
Pulse Forward Current/Seg. (Note 1)	$I_{F(Pulse)/Seg}$	60	mA
Reverse Voltage	V_R	3	V
Storage Temperature Range	T_{stg}	-20~75	°C
Operating Temperature Range	T_{opr}	-20~60	°C
Soldering Temperature (Note 2)	T_{solder}	260	°C

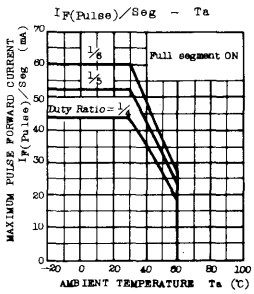
Note 1: Duty ratio = 1/6
2: Within 3 second at 2 mm from the reflector edge.

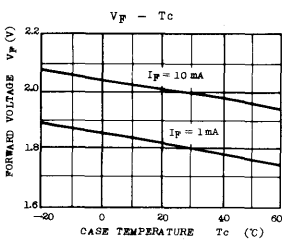
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25 °C)

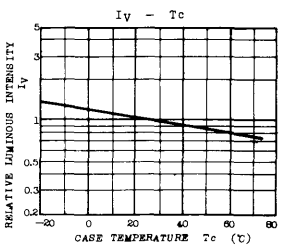
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_{FP}=50mA	1.9	2.45	3.35	V
Reverse Current	I_R	V_R=3V	-	-	5	μA
Luminous Intensity/Seg.	I_V/Seg	I_{FP}=50mA, Duty Ratio=1/6	0.16	0.30	-	mcd
Luminous Intensity Matching Ratio	I_{V-M}	I_{FP}=50mA, Duty Ratio=1/6	-	-	2.5	-
Peak Emission Wave Length	λp	I_F=10mA	-	565	-	nm
Spectral Half Line Width	Δλ	I_F=10mA	-	25	-	nm

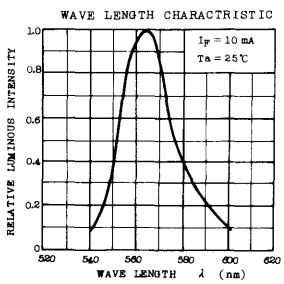




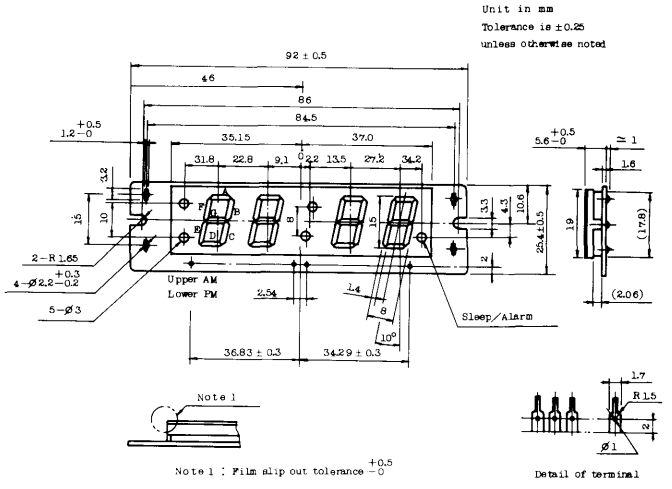








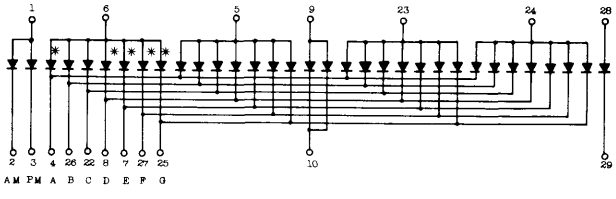
PHYSICAL DIMENSIONS



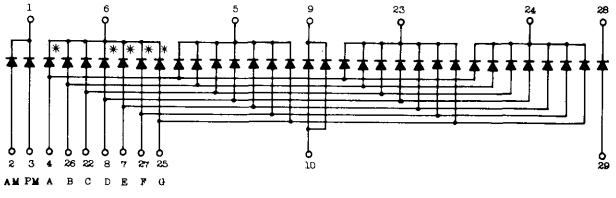
TERMINAL CONNECTION

TERMINAL No.	CONNECTION	TERMINAL No.	CONNECTION
1	AM, PM Common	11 ~ 21	N.C
2	AM		
3	PM	22	C Segment
4	A Segment	23	10's Minute Common
5	Unit Hour Common	24	Unit Minute Common
6	10's Hour Common	25	G Segment
7	E Segment	26	B Segment
8	D Segment	27	F Segment
9	Colons Common	28	Sleep/Alarm Common
10	Colons	29	Sleep/Alarm

TLG2218, TLG4213
TLR2218, TLR4213 COMMON ANODE TYPE (TLG2218, TLR2218 * mark is no connection)



TLG2168, TLG4163
TLR2168, TLR4163 COMMON CATHODE TYPE (TLG2168, TLR2168 * mark is no connection)



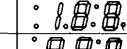
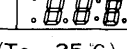
TLR2231, TLR4236, TLR2281, TLR4286

RED COLOR 4 DIGITS LED DISPLAY

- Even digit space, for use of multiplex drive connections and available both polarity common anode or common cathode.
- 15 mm (0.6") character height, each segment is diffused and uniformly display.
- Outer color filter provides high contrast, practical brightness are obtained at about 40 mA with 1/6 of duty ratio.
- Arrow edge shape of each segment represents not mosaic but look like Arabic numerals.
- Selectable both type 12 or 24 hours of display.

Refer to page 178 for the figure.

TYPE NO. VS DISPIAYED FONT

COMMON ANODE	COMMON CATHODE	FULLY DISPLAY FONT
TLR2231	TLR2281	
TLR4236	TLR4286	

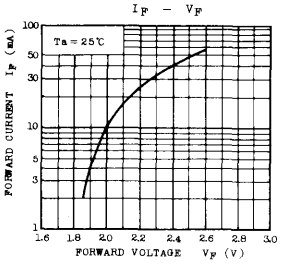
MAXIMUM RATINGS (Ta = 25°C)

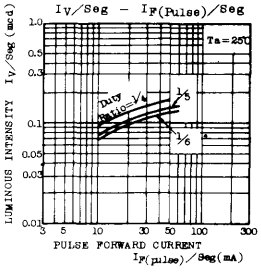
CHARACTERISTIC	SYMBOL	RATING	UNIT
Pulse Forward Current/Seg. (Note 1)	$I_{F(Pulse)/Seg}$	60	mA
Reverse Voltage	V_R	3	V
Storage Temperature Range	T_{stg}	-20~75	°C
Operating Temperature Range	T_{opr}	-20~60	°C
Soldering Temperature (Note 2)	T_{solder}	260	°C

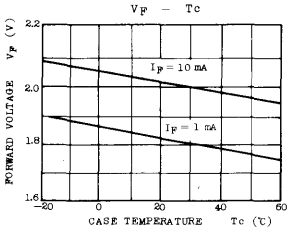
Note 1: Duty ratio = 1/6
2: Within 3 second at 2mm from the reflector edge.

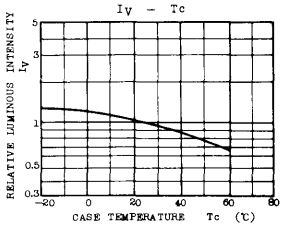
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25°C)

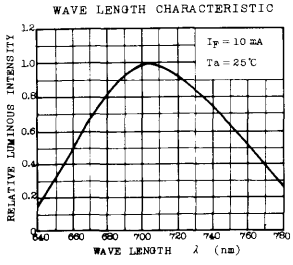
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_{FP}=40mA	1.9	2.4	3.4	V
Reverse Current	I_R	V_R=3V	-	-	5	μA
Luminous Intensity/Seg.	I_V/Seg	I_{FP}=40mA Duty 1/6	0.06	0.12	-	mcd
Luminous Intensity Matching Ratio	I_{V-M}	I_{FP}=40mA Duty 1/6	-	-	2.5	-
Peak Emission Wave Length	λ_P	I_F=10mA	-	700	-	nm
Spectral Half Line Width	$\Delta\lambda$	I_F=10mA	-	100	-	nm

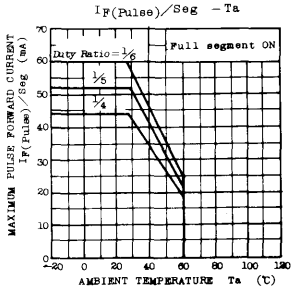












TLG2231, TLG4236, TLG2281, TLG4286

GREEN COLOR 4 DIGITS LED DISPLAY

- Even digit space for use of the multiplex drive connections and available both polarity common anode or cathode.
- 15 mm (0.6") character height, each segment is diffused and uniformly display.
- Outer color filter provides high contrast, practical brightness are obtained at about 50mA with 1/6 of duty ratio.
- Arrow edge shape of each segment represents not mosaic but look like Arabic numerals
- Selectable both type 12 or 24 hours of display.

TYPE NO. VS DISPLAYED FONT

COMMON ANODE	COMMON CATHODE	FULLY DISPLAY FONT
TLG2231	TLG2281	1.8.8.8.
TLG4236	TLG4286	8.8.8.8.

Refer to page 178 for the figure.

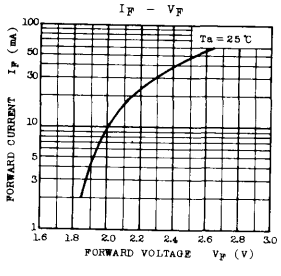
MAXIMUM RATINGS (Ta = 25°C)

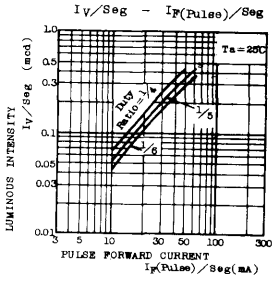
CHARACTERISTIC	SYMBOL	RATING	UNIT
Pulse Forward Current/Seg. (Note 1)	$I_{F(Pulse)/Seg}$	60	mA
Reverse Voltage	V_R	3	V
Storage Temperature Range	T_{stg}	-20~75	°C
Operating Temperature Range	T_{opr}	-20~60	°C
Soldering Temperature (Note 2)	T_{solder}	260	°C

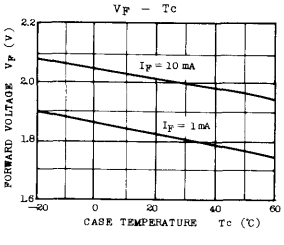
Note 1: Duty ratio = 1/6
2: Within 3 second at 2 mm from the reflector edge.

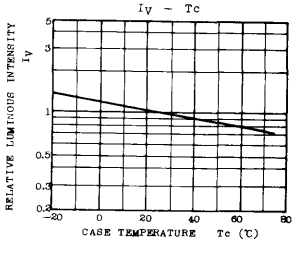
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25°C)

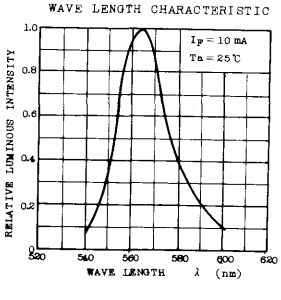
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_{FP}=50mA	1.9	2.45	3.35	V
Reverse Current	I_R	V_R=3V	-	-	5	μA
Luminous Intensity/Seg.	I_V/Seg	I_{FP}=50mA Duty 1/6	0.08	0.30	-	mcd
Luminous Intensity Matching Ratio	I_{V-M}	I_{FP}=50mA Duty 1/6	-	-	2.5	-
Peak Emission Wave Length	λ_P	I_F=10mA	-	565	-	nm
Spectral Half Line Width	$\Delta\lambda$	I_F=10mA	-	25	-	nm

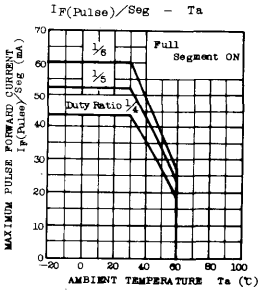








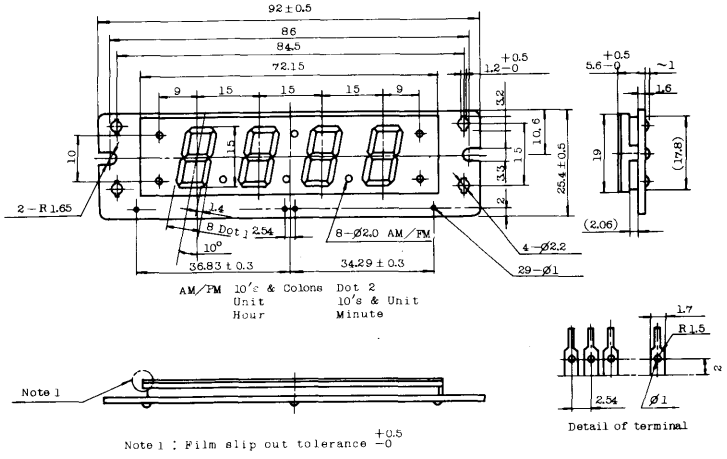




PHYSICAL DIMENSIONS

Unit in mm

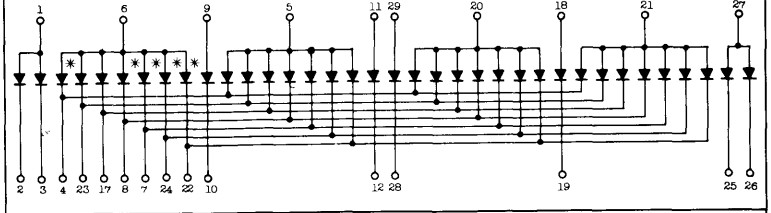
Tolerance is ±0.25 unless otherwise noted



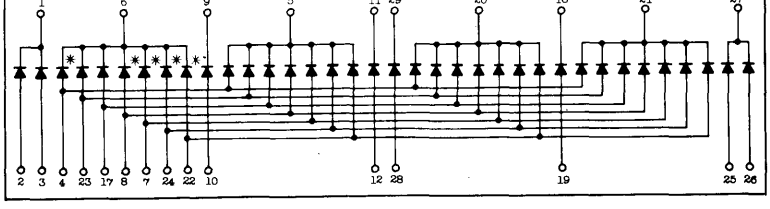
TERMINAL CONNECTION

TERMINAL №	CONNECTION	TERMINAL №	CONNECTION
1	AM, PM Common	17	C Segment
2	AM	18	Dot 2 Common
3	PM	19	Dot 2
4	A Segment	20	10's Minute Common
5	Unit Hour Common	21	Unit Minute Common
6	10's Hour Common	22	G Segment
7	E Segment	23	B Segment
8	D Segment	24	F Segment
9	Dot 1 Common	25	AM
10	Dot 1	26	FM
11	Lower Colon Common	27	AM, FM Common
12	Lower Colon	28	Upper Colon
13 ~ 16	N.C	29	Upper Colon Common

TLG2231, TLG4236
TLR2231, TLR4236 COMMON ANODE TYPE (TLG2231 / TLR2231 * Mark is no connection)



TLG2281, TLG4286
TLR2281, TLR4286 COMMON CATHODE TYPE (TLG2281 / TLR2281 * Mark is no connection)



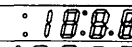
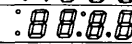
TLR2229, TLR4224, TLR2259, TLR4254

RED COLOR 4 DIGITS LED DISPLAY

- Even Digit space, for use of the static drive connections.
- 15 mm (0.6") character height, each segment is diffused and uniformly display.
- Outer color filter provides high contrast, complete practical use at 5 mA per segments.
- Arrow edge shape of each segment represents not mosaic but look like Arabic numerals.
- Selectable both type 12 or 24 hours display.

Refer to page 181 for the figure.

TYPE NO. VS DISPIAYED FONT

COMMON CATHODE	COMMON ANODE	FULLY DISPLAY FONT
TLR2229	TLR2259	
TLR4224	TLR4254	

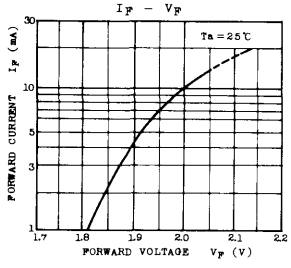
MAXIMUM RATINGS (Ta = 25°C)

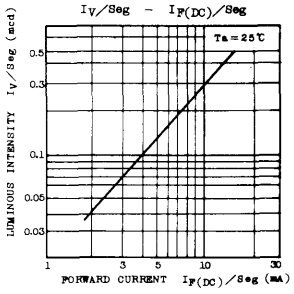
CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward current/seg.	I_F(DC)/Seg	15	mA
Reverse Voltage	V_R	3	V
Storage Temperature Range	Tstg	-20~75	°C
Operating Temperature Range	Topr	-20~60	°C
Soldering Temperature (Note)	Tsolder	260	°C

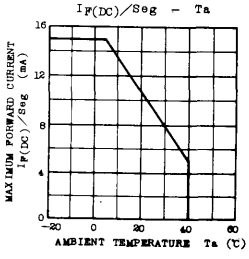
Note: Within 3 second at 2 mm from the reflector edge.

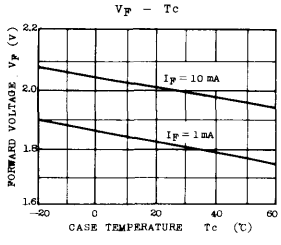
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25°C)

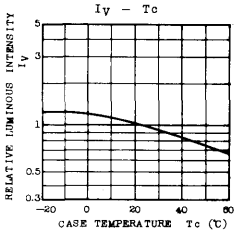
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=10mA	1.7	2.0	2.5	V
Reverse Current	I_R	V_R=3V	-	-	5	μA
Luminous Intensity/Seg.	I_V/Seg	I_F=10mA	0.1	0.2	-	mcd
Luminous Intensity Matching Ratio	Iv-M	I_F=5mA	-	-	2.5	-
Peak Emission Wave Length	λP	I_F=10mA	-	700	-	nm
Spectral Half Line Width	Δλ	I_F=10mA	-	100	-	nm

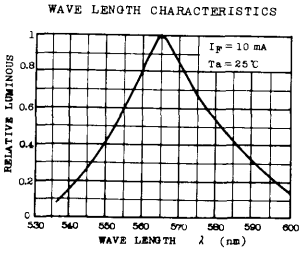












TLG2229, TLG4224, TLG2259, TLG4254

GREEN COLOR 4 DIGITS LED DISPLAY

- Even digit space, for use of the static drive connections.
- 15 mm (0.6") character height, each segment is diffused and uniformly display.
- Outer color filter provides high contrast, complete practical use at 10 mA per segments.
- Arrow edge shape of each segment represents not mosaic but look like Arabic numerals.
- Selectable both type 12 or 24 hours of display.

TYPE No. vs. DISPLAY FONT

COMMON CATHODE	COMMON ANODE	FULLY DISPLAY FONT
TLG2229	TLG2259	
TLG4224	TLG4254	

Refer to page 181 for the figure.

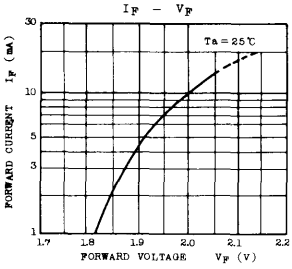
MAXIMUM RATINGS (Ta = 25 °C)

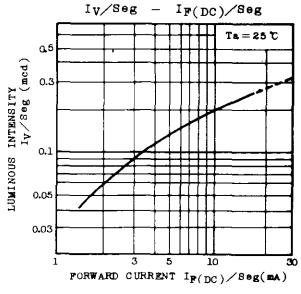
CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current/Seg.	$I_{F(DC)}$/Seg.	15	mA
Reverse Voltage	V_R	3	V
Storage Temperature Range	Tstg	-20~75	°C
Operating Temperature Range	Topr	-20~60	°C
Soldering Temperature (Note)	Tsolder	260	°C

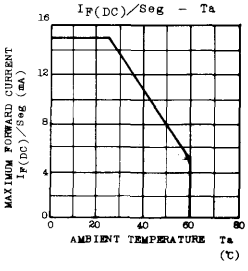
Note: Within 3 second at 2 mm from the reflector edge

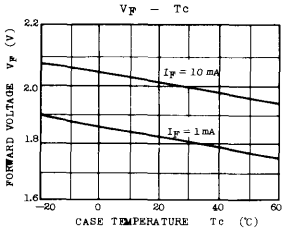
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25 °C)

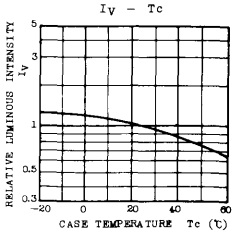
CHARACTERISTIC	SYMBOL	TEST CONDISION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=10mA	1.8	2.0	2.5	V
Reverse Current	I_R	V_R=3V	-	-	5	μA
Luminous Intensity/Seg.	I_V/Seg.	I_F=10mA	0.08	0.3	-	mcd
Luminous Intensity Matching Ratio	I_{V-M}	I_F=5mA	-	-	2.3	-
Peak Emission Wave Length	λp	I_F=10mA	-	565	-	nm
Spectral Half Line Width	Δλ	I_F=10mA	-	30	-	nm

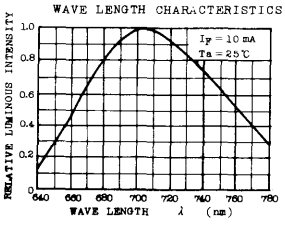




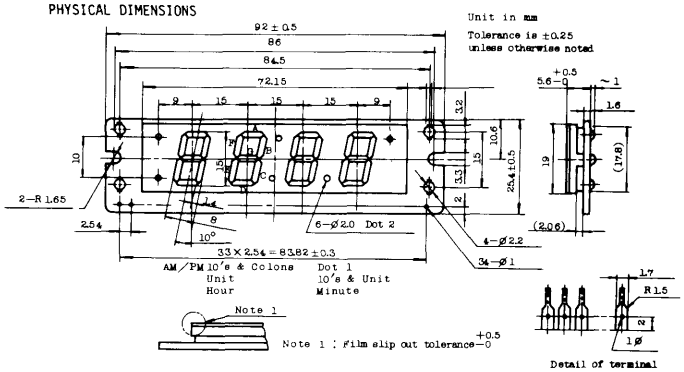








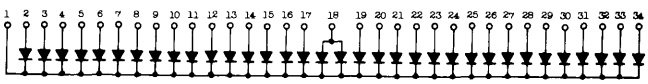
PHYSICAL DIMENSIONS



TLR2229, TLR4224, TLG2229, TLG4224

TERMINAL CONNECTION

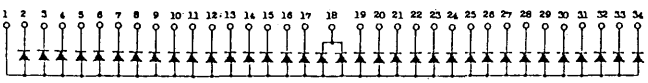
TERMINAL №	CONNECTION		TERMINAL №	CONNECTION		TERMINAL №	CONNECTION	
1	Common Cathode		13	Unit Hour	E Anode	25	10's Min. B Anode	
2	AM Anode		14		D Anode	26	Dot 1 Anode	
3	PM Anode		15		C Anode	27	Unit Min	B Anode
4	10's Hour	F Anode	16		A Anode	28		A Anode
5		G Anode	17		B Anode	29		C Anode
6		E Anode	18	Colons Anode		30		D Anode
7		D Anode	19	10's Min	F Anode	31		E Anode
8		C Anode	20		G Anode	32		G Anode
9		A Anode	21		E Anode	33		F Anode
10		B Anode	22		D Anode	34	Dot 2 Anode	
11	Unit Hour	F Anode	23		C Anode			
12		G Anode	24		A Anode			



TLR2259, TLR4254, TLG2259, TLG4254

TERMINAL CONNECTION

TERMINAL №	CONNECTION		TERMINAL №	CONNECTION		TERMINAL №	CONNECTION	
1	Common Anode		13	Unit Hour	E Cathode	25	10's Min A Cathode	
2	AM Cathode		14		D Cathode	26	Dot 1 Cathode	
3	PM Cathode		15		C Cathode	27	Unit Min	G Cathode
4	10's Hour	G Cathode	16		B Cathode	28		F Cathode
5		F Cathode	17		A Cathode	29		E Cathode
6		E Cathode	18	Colons Cathode		30		D Cathode
7		D Cathode	19	10's Min	G Cathode	31		C Cathode
8		C Cathode	20		F Cathode	32		B Cathode
9		B Cathode	21		E Cathode	33		A Cathode
10		A Cathode	22		D Cathode	34	Dot 2 Cathode	
11	Unit Hour	G Cathode	23		C Cathode			
12		F Cathode	24		B Cathode			



TLR2297, TLR4291, TLR2307, TLR4301

RED COLOR 4 DIGITS LED DISPLAY

- For Duplex drive connections and available both polarity common Anode or common cathode.
- 23 mm (0.9") character height, each segment represents Diffused and Uniformly display.
- Outer color filter provides high contrast, practical brightness are obatained at About 20 mA (with 50 per cent duty ratio) per segments.
- Arrow edge shape of each segment represents not mosaic but but look like Arabic numerals.
- Selectable both type 12 or 24 hours of display.

Refer to page 183 for the figure.

TYPE NO. VS. DISPLAY FONT

COMMON ANODE	COMMON CATHODE	FULLY DISPLAY FONT
TLR2297	TLR2307	18:88
TLR4291	TLR4301	38:88

MAXIMUM RATINGS(Ta=25℃)

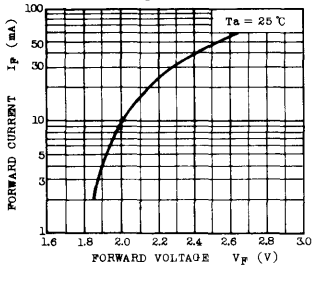
CHARACTERISTIC	SYMBOL	RATING	UNIT
Pulse Forward Current/Seg. (Note 1)	I_F(Pulse)/Seg	45	mA
Reverse Voltage	V_R	3	V
Storage Temperature Range	Tstg	-20∿75	°C
Operating temperature Range	T_{opr}	-20∿60	°C
Soldering temperature (Note 2)	Tsolder	260	°C

Note 1: Duty ratio=1/2
2: Within 3 seconds at 2 mm from the Reflector Edge.

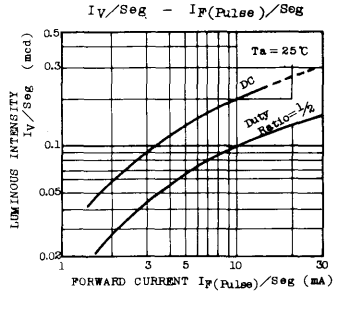
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25℃)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=20mA	1.8	2.15	2.75	V
Reverse Current	I_R	V_R=3V	-	-	5	μA
Luminous Intensity/Seg.	I_V/Seg	I_F=10mA	0.1	0.2	-	mcd
Luminous Intensity Matching Ratio	I_V-M	I_F=5mA	-	-	2.5	-
Peak Emission Wave Length	λp	I_V=10mA	-	700	-	nm
Spectral Half Line Width	Δλ	I_F=10mA	-	100	-	nm

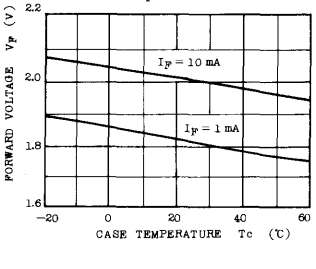
I_F – V_F



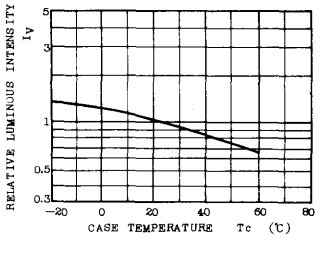
I_V/Seg – I_F(Pulse)/Seg



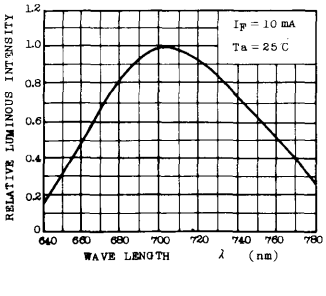
V_F – Tc



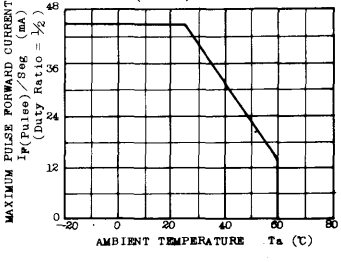
I_V – Tc



WAVE LENGTH CHARACTERISTIC



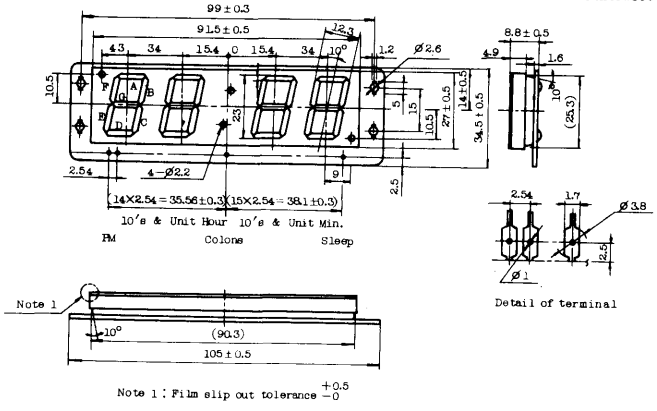
I_F(Pulse)/Seg – Ta



PHYSICAL DIMENSIONS

Unit in mm

Tolerances is ±0.25 unless otherwise noted

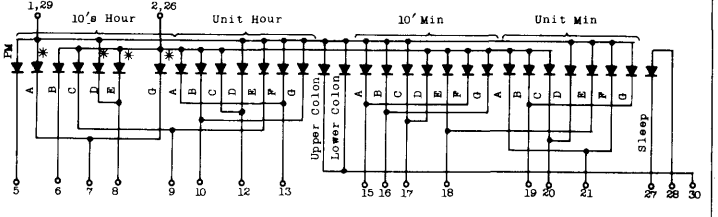


Note 1 : Film slip out tolerance $^{+0.5}_{-0}$

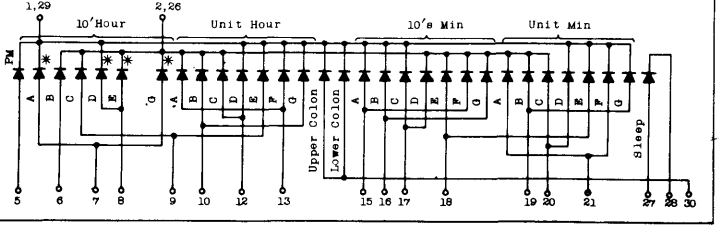
TERMINAL CONNECTION

TERMINAL No.	CONNECTION	TERMINAL No.	CONNECTION	TERMINAL No.	CONNECTION
1, 29	PM 10's Hour A.D. Unit Hour D.E.F.G, Colon, 10's Min A.B.C, & Unit Min D.E.F.G, Common	6	10's Hour B	16	10's Min B,G
		7	10's Hour A,G	17	10's Min C,D
		8	10's Hour D,E	18	10's Min E & Unit Min E
		9	10's Hour C & Unit Hour E		
2, 26	10's Hour B.C.E.G, Unit Hour A.B.C. & 10's Min D.E.F.G. Unit Min A.B.C. Common			19	Unit Min B,G
		10	Unit Hour B,G	20	Unit Min C,D
		11	N.C	21	Unit Min A,F
		12	Unit Hour C,D	22, 23, 24, 25	N.C
3	N.C	13	Unit Hour A,F	27	Sleep
4	N.C	14	N.C	28	Sleep Common
5	PM	15	10's Min A,F	30	Colon

TLR2297, TLR4291 COMMON ANODE TYPE (TLR2297 * Mark is no connection)



TLR2307, TLR4301 COMMON CATHODE TYPE (TLR2307 * Mark is no connection)



1.8INCH RED 4-DIGITS DISPLAY

TLR2327, TLR4322

RED COLOR 4 DIGITS LED DISPLAY

- For Use of static drive connections.
- 45 mm (1.8") character height, each segment is diffused and uniformly display.
- Outer color filter provides high contrast, complete practical use at 10 mA per segments.
- Arrow edge shape of each segment represents not mosaic but look like Arabic numerals.
- Selectable both type 12 or 24 hours display.

Refer to page 185 for the figure.

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current/Seg.	I_F(DC)/Seg	15	mA
Reverse Voltage	V_R	3	V
Storage Temperature	T_{stg}	-20~75	°C
Operating Temperature	T_{opr}	-20~60	°C
Soldering Temperature (Note)	T_{solder}	260	°C

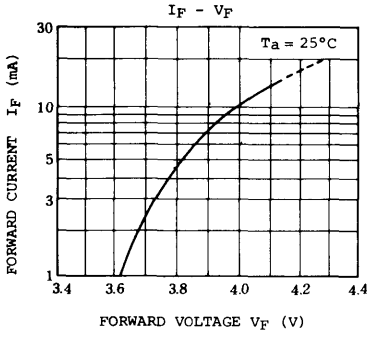
Note: Within 3 second 2 mm at from the reflector edge.

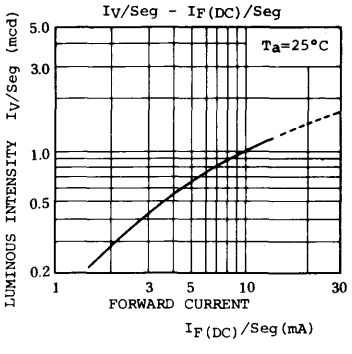
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25°C)

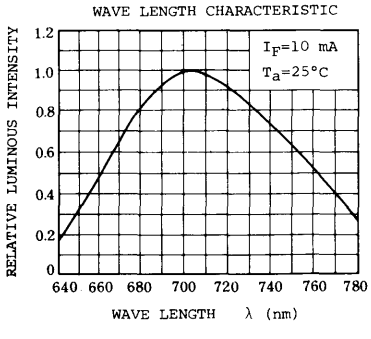
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=10mA	3.4	4.0	5.0	V
Reverse Current	I_R	V_R=6V	-	-	5	μA
Luminous Intensity/Seg.	I_V/Seg	I_F=10mA	-	1.0	-	mcd
Luminous Intensity Matching Ratio	I_{V-M}	I_F=5mA	-	-	2.5	-
Peak Emission Wave Length	λ_P	I_F=10mA	-	700	-	nm
Spectral Line Half Width	$\Delta\lambda$	I_F=10mA	-	100	-	nm

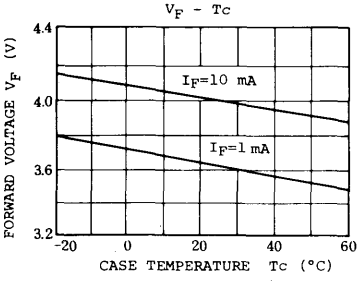
TYPE NO. VS DISPLAYED FONT

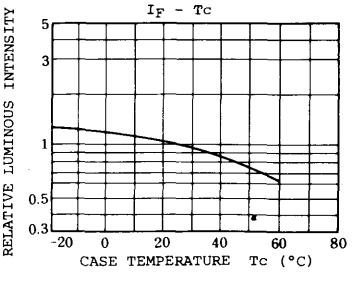
COMMON CATHODE	FULLY DISPLAY FONT
TLR2327	°18:88.
TLR4322	°88:88.

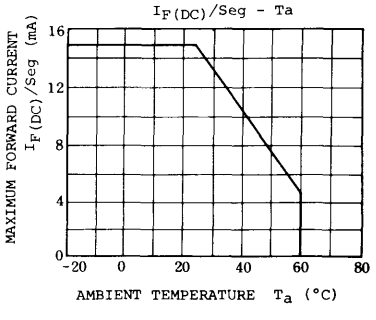






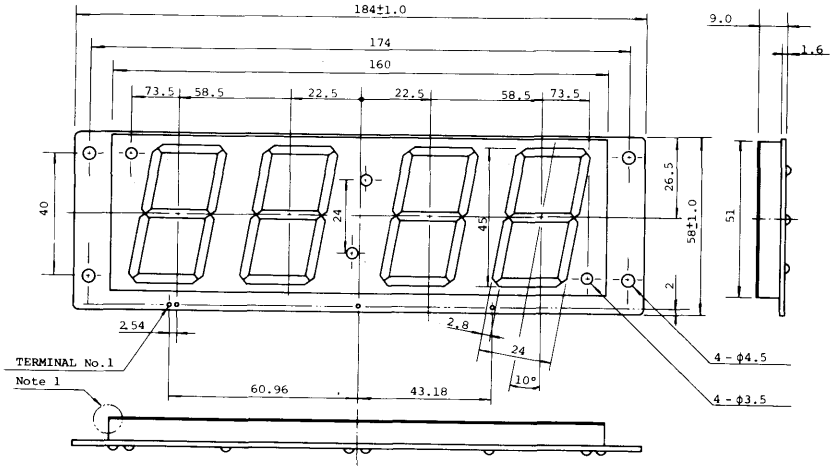






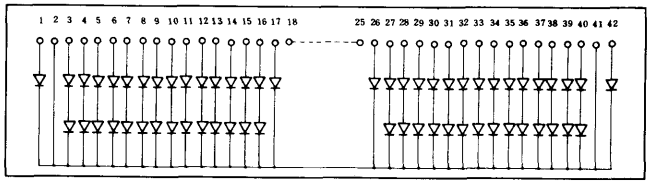
PHYSICAL DIMENSION

Unit in mm
Tolerance is ±0.5
Unless otherwise noted



Note 1 : Film slip out tolerance $^{+1.0}_{-0}$

TERMINAL CONNECTION



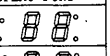
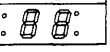
TERMINAL	ADDRESS	TERMINAL	ADDRESS	TERMINAL	ADDRESS
1	PM/AM	14	UNIT HOUR E	29	10's MIN. A
2 , 41	COMMON CATHODE	15	UNIT HOUR D	30	10's MIN. B
		16	UNIT HOUR C	31	10's MIN. E
		17	Lower Colon	32	10's MIN. D
3	10's HOUR E	18	N.C	33	10's MIN. C
4	10's HOUR D	19	N.C	34	UNIT MIN. F
5	10's HOUR C	20	N.C	35	UNIT MIN. G
6	10's HOUR G	21	N.C	36	UNIT MIN. A
7	10's HOUR F	22	N.C	37	UNIT MIN. B
8	10's HOUR B	23	N.C	38	UNIT MIN. E
9	10's HOUR A	24	N.C	39	UNIT MIN. D
10	UNIT HOUR F	25	N.C	40	UNIT MIN. C
11	UNIT HOUR G	26	Upper Colon	42	Alarm
12	UNIT HOUR A	27	10's MIN. F		
13	UNIT HOUR B	28	10's MIN. G		

TLR2349, TLR4344

RED COLOR 4 DIGITS LED DISPLAY

- For **Static** Drive connection
- 18 mm (0.7") character height, each segment represents diffused and uniformly display.
- Outer color filter provides high contrast, practical brightness are obtained **at about 5mA per segment.**
- Arrow edge shape of each segment represents not mosaic but look like Arabic numerals.
- Selectable both type 12 or 24 hours of display.

TYPE NO. VS DISPLAYED FONT

COMMON CATHODE	FULLY DISPLAY FONT
TLR2349	
TLR4344	

Refer to page 187 for the figure.

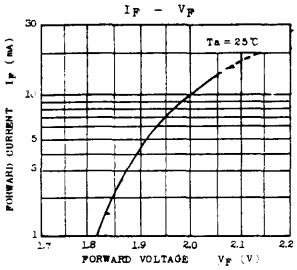
MAXIMUM RATINGS (Ta = 25°C)

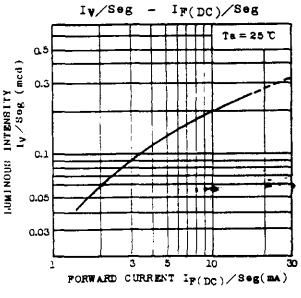
CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current	I_F/seg	15	mA
Reverse Voltage	V_R	3	V
Storage Temperature Range	T_{stg}	-20 ~ 75	°C
Operating Temperature Range	T_{opr}	-20 ~ 60	°C
Soldering Temperature (Note)	T_{solder}	260	°C

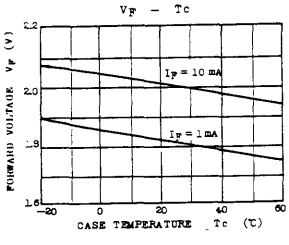
Note. Within 3 seconds at 2 mm from the reflector edge.

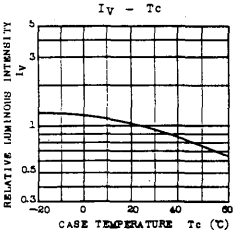
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25°C)

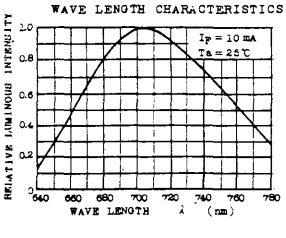
CHARACTERISTICS	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F = 10 mA	1.7	2.0	2.5	V
Reverse Current	I_R	V_R = 3 V	-	-	5	μA
Luminous Intensity/Seg.	I_V/Seg	I_F = 10 mA	0.1	0.2	-	mcd
Luminous Intensity Matching Ratio	I_V-M	I_F = 5 mA	-	-	2.5	-
Peak Emission Wave Length	λ_P	I_F = 10 mA	-	700	-	nm
Spectral Half Line Width	$\Delta\lambda$	I_F = 10 mA	-	100	-	nm

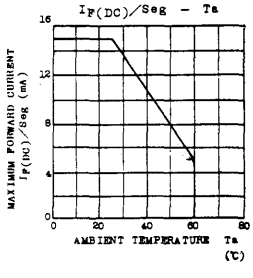






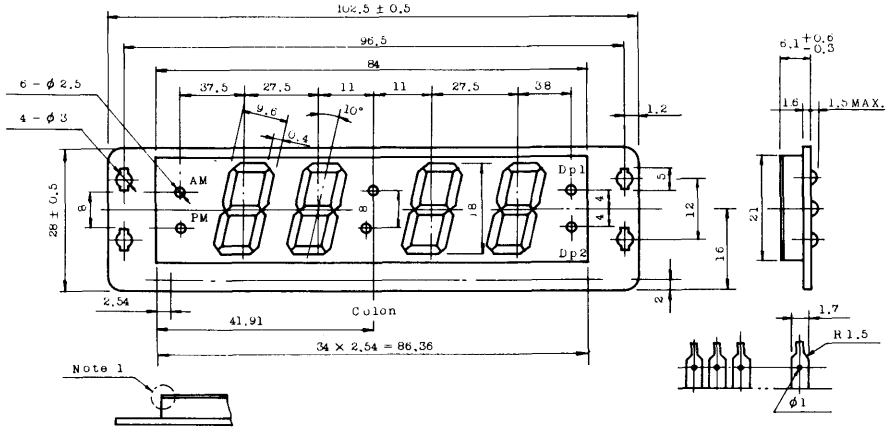






Unit in mm
Tolerance is ±0.25 unless otherwise noted

PHYSICAL DIMENSIONS

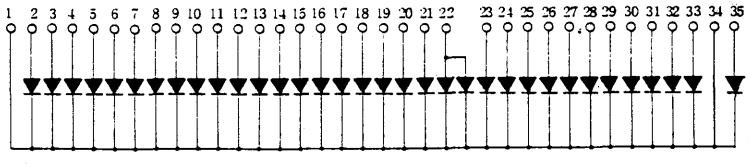


Note 1 : Film slip out tolerance $^{+0.5}_{-0}$

Detail terminal

Pin Connection (Static)

TLR2349, TLR4344



Pin No.	CONNECTION	Pin No.	CONNECTION	Pin No.	CONNECTION	Pin No.	CONNECTION
1	Common	11	Hour F	21	10's Min G	31	Min D
2	PM	12	〃 G	22	〃 A & D	32	Min C
3	AM	13	〃 A	23	〃 B	33	Dp 2
4	10's Hour A	14	〃 B	24	〃 E	34	Common
5	〃 F	15	〃 D	25	〃 C	35	Dp 1
6	〃 G	16	〃 C	26	Min F		
7	〃 E	17	〃 E	27	〃 G		
8	〃 D	18	Upper Colon	28	〃 A		
9	〃 C	19	Lower Colon	29	〃 B		
10	〃 B	20	10's Min F	30	〃 E		

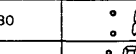
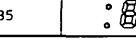
TLR2370 TLR2380 TLR4375 TLR4385

TENTATIVE

- Red Color, 6.3 mm Character Height and Pin Connections for Multiplex Drive.
- Even Digit Space
- Suitable for the Followings
  - Car Clock Display
  - Radio Frequency Display
  - Tape Counter Display of Recorder
- Available Both Types of Connection, Common Anode or Common Cathode
- Available Both Format of Clock Display, 12 or 24 Hours

Refer to page 189 for the figure.

TYPE No. vs. DISPLAY FONT

COMMON ANODE	COMMON CATHODE	FULLY DISPLAYED FONT
TLR2370	TLR2380	
TLR4375	TLR4385	

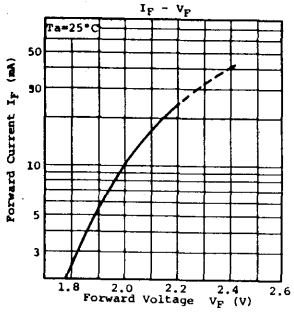
ABSOLUTE MAXIMUM RATINGS (Ta = 25°C)

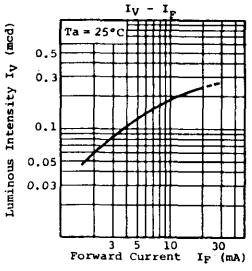
CHARACTERISTIC	SYMBOL	RATING	UNIT
DC Forward Current/Seg.	I_F DC/Seg	12	mA
Pulse Forward Current/Seg. (Note)	I_F pulse/Seg	40	mA
Reverse Voltage	V_R	6	V
Operating Temperature	Topr	-30 ∿ 75	°C
Storage Temperature	Tstg	-30 ∿ 90	°C

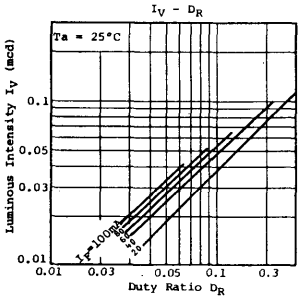
Note: Pulse Width = 1 ms, Duty Ratio = 1/5

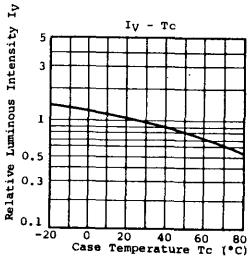
ELECTRICAL/OPTICAL CHARACTERISTICS (Ta = 25°C)

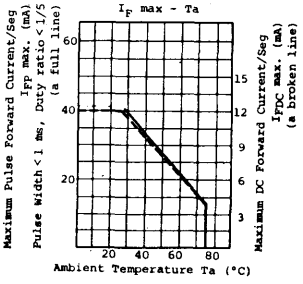
CHARACTERISTIC	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F = 40 mA	2.0	2.5	3.0	V
Reverse Current	I_R	V_R = 6 V	-	-	5	μA
Luminous Intensity/Seg	I_V/Seg	I_F = 40 mA Duty Ratio = 1/5	0.05	0.10	-	mcd
Luminous Intensity Matching Ratio	I_V-M	I_F = 40 mA Duty Ratio = 1/12	-	-	2.5	-
Peak Wave Length	λ_p	I_F = 40 mA Duty Ratio = 1/5	-	700	-	nm
Spectral Line Half Width	$\Delta\lambda$	I_F = 40 mA Duty Ratio = 1/5	-	100	-	nm





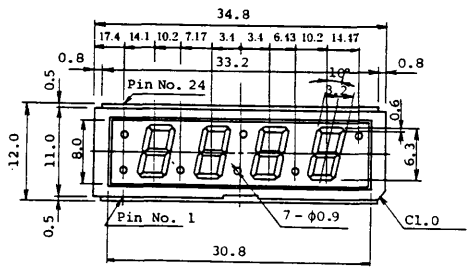


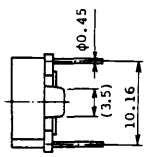


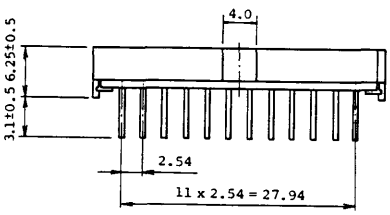


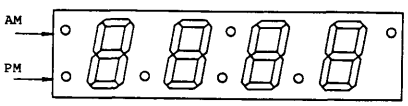
Unit in mm

Tolerance is ±0.25 unless otherwise noted.









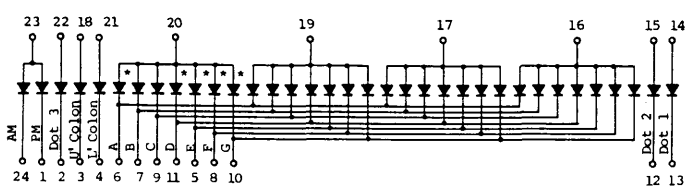
10's Hour Unit Hour 10's Min Unit Min

Dot 3 Colon Dot 2 Dot 1

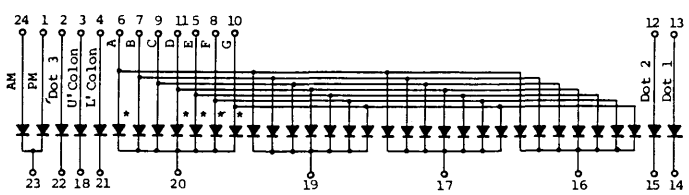
PIN No.	CONNECTION	TLR2370 TLR4375	TLR2380 TLR4385	PIN No.	CONNECTION	TLR2370 TLR4375	TLR2380 TLR4385
1	PM	Cathode	Anode	13	Dot 1	Cathode	Anode
2	Dot 3	Cathode	Anode	14	Dot 1	Anode	Cathode
3	Upper Colon	Cathode	Anode	15	Dot 2	Anode	Cathode
4	Lower Colon	Cathode	Anode	16	Unit M Common	Anode	Cathode
5	E	Cathode*	Anode*	17	10's M Common	Anode	Cathode
6	A	Cathode*	Anode*	18	Upper Colon	Anode	Cathode
7	B	Cathode	Anode	19	Unit H Common	Anode	Cathode
8	F	Cathode*	Anode*	20	10's H Common	Anode	Cathode
9	C	Cathode	Anode	21	Lower Colon	Anode	Cathode
10	G	Cathode*	Anode*	22	Dot 3	Anode	Cathode
11	D	Cathode*	Anode*	23	AM & PM Common	Anode	Cathode
12	Dot 2	Cathode	Anode	24	AM	Cathode	Anode

* TLR2370 & TLR2380: * mark segments are no connection.

TLR2370, TLR4375



TLR2380, TLR4385

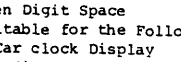
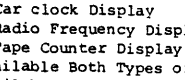


TLG2370 TLG2380 TLG4375 TLG4385

- Green Color, 6.3 mm Character Height and Pin Connections for Multiplex Drive.
- Even Digit Space
- Suitable for the Followings
  - Car clock Display
  - Radio Frequency Display
  - Tape Counter Display of Recorder
- Available Both Types of Connection, Common Anode or Common Cathode
- Available Both Format of Clock Display, 12 or 24 Hours

Refer to page 191 for the figure.

TYPE NO. vs FULLY DISPLAY FONT

COMMON ANODE	COMMON CATHODE	FULLY DISPLAYED FONT
TLG2370	TLG2380	
TLG4375	TLG4385	

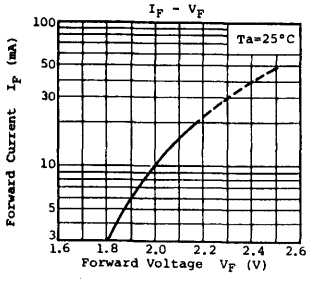
ABSOLUTE MAXIMUM RATINGS (Ta = 25°C)

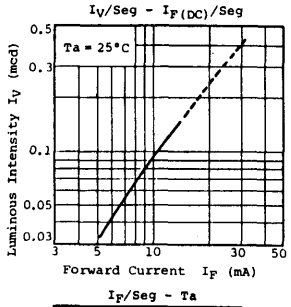
CHARACTERISTIC	SYMBOL	RATING	UNIT
DC Forward Current/Seg.	I_F DC/Seg	12	mA
Pulse Forward Current/Seg. (Note)	I_F pulse/Seg	45	mA
Reverse Voltage	V_R	6	V
Operating Temperature	T_{opr}	-30 ∿ 75	°C
Storage Temperature	T_{stg}	-30 ∿ 90	°C

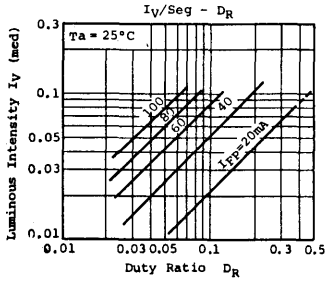
Note: Pulse Width = 1 ms, Duty Ratio = 1/5

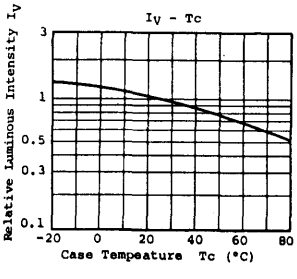
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25°C)

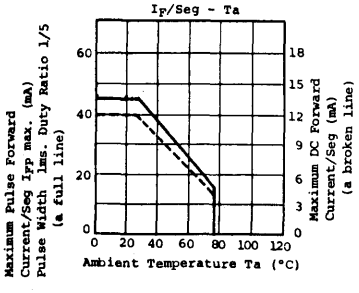
CHARACTERISTIC	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F = 40 mA	2.0	2.5	3.0	V
Reverse Current	I_R	V_R = 6 V	-	-	5	μA
Luminous Intensity/Seg	I_V/Seg	I_F = 40 mA Duty Ratio = 1/5	0.06	0.11	-	mcd
Luminous Intensity Matching Ratio	I_V-M	I_F = 40 mA Duty Ratio = 1/12	-	-	2.3	-
Peak Wave Length	λ_p	I_F = 40 mA Duty Ratio = 1/5	-	565	-	nm
Spectral Line Half Width	$\Delta\lambda$	I_F = 40 mA Duty Ratio = 1/5	-	30	-	nm



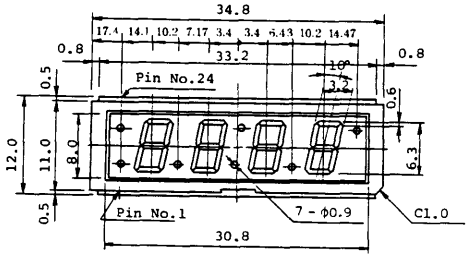


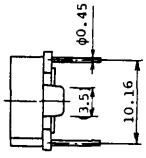


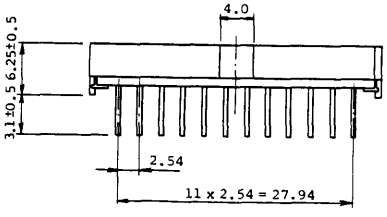


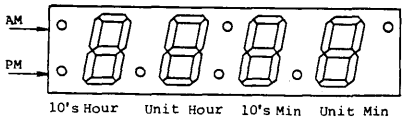


Unit in mm
Tolerance is ±0.25 unless
otherwise noted.





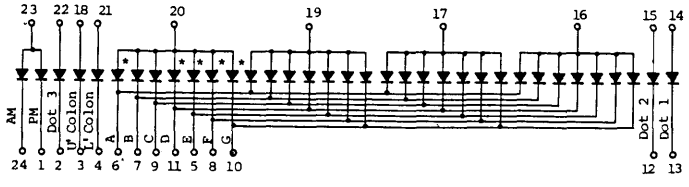




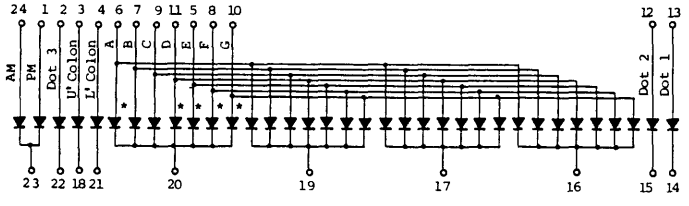
PIN No.	CONNECTION	TLG2370 TLG4375	TLG2380 TLG4385	PIN No.	CONNECTION	TLG2370 TLG4375	TLG2380 TLG4385
1	PM	Cathode	Anode	13	Dot 1	Cathode	Anode
2	Dot 3	Cathode	Anode	14	Dot 1	Anode	Cathode
3	Upper Colon	Cathode	Anode	15	Dot 2	Anode	Cathode
4	Lower Colon	Cathode	Anode	16	Unit M Common	Anode	Cathode
5	E	Cathode*	Anode*	17	10's M Common	Anode	Cathode
6	A	Cathode*	Anode*	18	Upper Colon	Anode	Cathode
7	B	Cathode	Anode	19	Unit H Common	Anode	Cathode
8	F	Cathode*	Anode*	20	10's H Common	Anode	Cathode
9	C	Cathode	Anode	21	Lower Colon	Anode	Cathode
10	G	Cathode*	Anode*	22	Dot 3	Anode	Cathode
11	D	Cathode*	Anode*	23	AM & PM Common	Anode	Cathode
12	Dot 2	Cathode	Anode	24	AM	Cathode	Anode

* TLG2370 & TLG2380: * mark segments are no connection.

TLG2370, TLG4375



TLG2380, TLG4385



0.7 INCH RED 4-DIGITS LED CLOCK DISPLAY

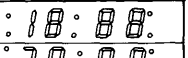
TLR2399, TLR4393, TLR2369, TLR4363

RED COLOR 4 DIGITS LED DISPLAY

- For Duplex Drive connection
- 18 mm (0.7") character height, each segment represents diffused and uniformly display.
- Outer color filter provides high contrast, practical brightness are obtained at about 20 mA (with 50 per cent duty ratio) per segments.
- Arrow edge shape of each segment represents not mosaic but look like Arabic numerals.
- Selectable both type 12 or 24 hours of display.

Refer to page 194 for the figure.

TYPE NO. VS. DISPLAY FONT

COMMON ANODE	COMMON CATHODE	FULLY DISPLAY FONT
TLR2399	TLR2369	
TLR4393	TLR4363	

MAXIMUM RATINGS (Ta = 25°C)

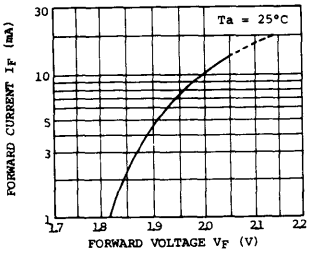
CHARACTERISTIC	SYMBOL	RATING	UNIT
Pulse Forward Current/Seg. (Note 1)	I_F(Pulse)/Seg.	30	mA
Reverse Voltage	V_R	3	V
Storage Temperature Range	T_{stg}	-20~75	°C
Operating Temperature Range	T_{opr}	-20~60	°C
Soldering Temperature	T_{solder}	260	°C

Note 1: Duty ratio = 1/2
2: Within 3 second at 2 mm from the reflector edge.

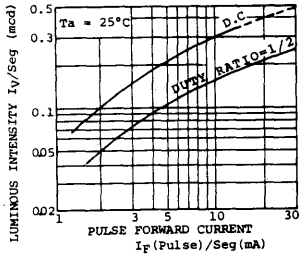
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTICS	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F = 20 mA	1.8	2.15	2.75	V
Reverse Current	I_R	V_R = 3 V	-	-	5	μA
Luminous Intensity/Seg.	I_V/Seg	I_F = 10 mA	0.15	0.3	-	mcd
Luminous Intensity Matching Ratio	Iv-M	I_F = 5 mA	-	-	2.5	-
Peak Emission Wave Length	λ_P	I_F = 10 mA	-	700	-	nm
Spectral Half Line Width	$\Delta\lambda$	I_F = 10 mA	-	100	-	nm

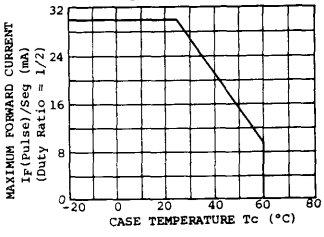
I_F - V_F



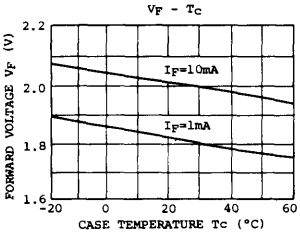
I_V/Seg - I_F(Pulse)/Seg



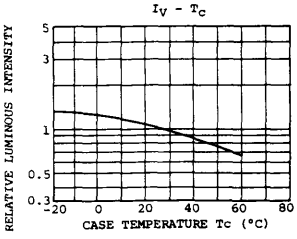
I_F(Pulse)/Seg - Ta



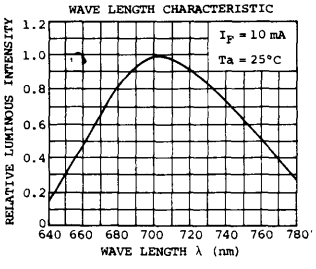
V_F - T_C



I_V - T_C



WAVE LENGTH CHARACTERISTIC



0.7 INCH GREEN 4-DIGIT DISPLAY (DUPLEX DRIVE)

TLG2399, TLG4393

GREEN COLOR 4 DIGITS LED DISPLAY

- For Duplex Drive connection
- 18 mm (0.7") character height, each segment represents diffused and uniformly display.
- Outer color filter provides high contrast, practical brightness are obtained at about 20 mA (with 50 per cent duty ratio) per segments.
- Arrow edge shape of each segment represents not mosaic but look like Arabic numerals.
- Selectable both type 12 or 24 hours of display.

Refer to page 194 for the figure.

TYPE NO. VS DISPLAYED FONT

COMMON ANODE	FULLY DISPLAY FONT
TLG2399	° 18 : 88 °
TLG4393	° 28 : 88 °

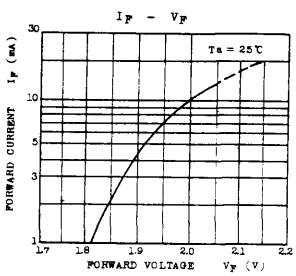
MAXIMUM RATINGS (Ta 25 C)

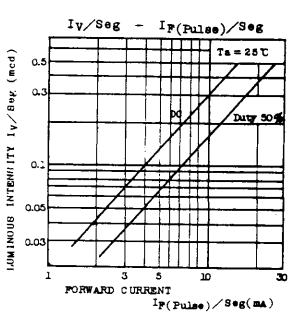
CHARACTERISTIC	SYMBOL	RATING	UNIT
Pulse Forward Current/Seg. (Note 1)	I_F(Pulse)/Seg.	30	mA
Reverse Voltage	V_R	3	V
Storage Temperature Range	T_{stg}	-20 ~ 75	°C
Operating Temperature Range	T_{opr}	-20 ~ 60	°C
Soldering Temperature	T_{solder}	260	°C

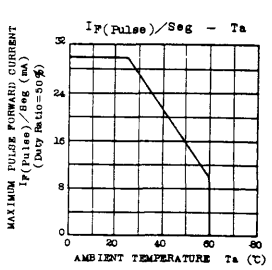
Note 1: Duty ratio = 1/2
2: Within 3 second at 2 mm from the reflector edge.

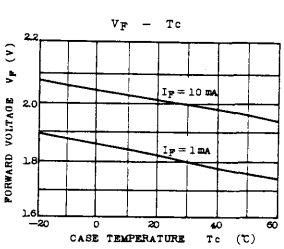
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25 °C)

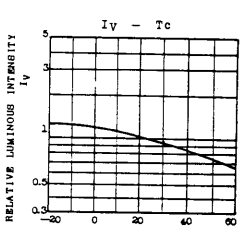
CHARACTERISTICS	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F = 20 mA	1.8	2.15	2.75	V
Reverse Current	I_R	V_R = 3 V	-	-	5	μA
Luminous Intensity/Seg.	I_V/Seg	I_F = 10 mA	-	0.3	-	mcd
Luminous Intensity Matching Ratio	Iv-M	I_F = 5 mA	-	-	2.5	-
Peak Emission Wave Length	λ_P	I_F = 10 mA	-	565	-	nm
Spectral Half Line Width	$\Delta\lambda$	I_F = 10 mA	-	30	-	nm

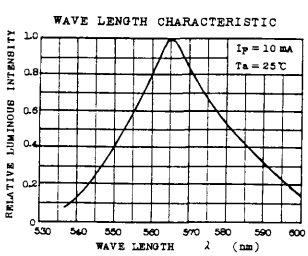






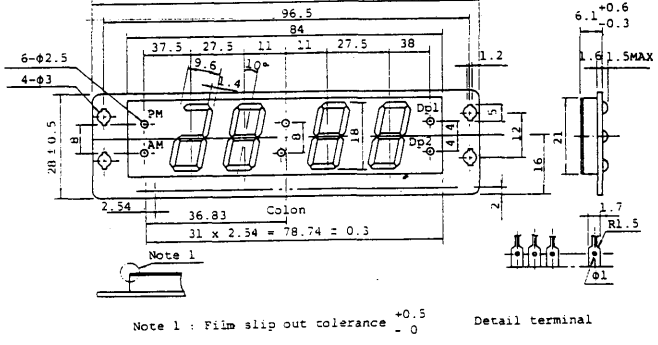






PHYSICAL DIMENSIONS

Unit in mm
Tolerance is ±0.25 unless otherwise noted

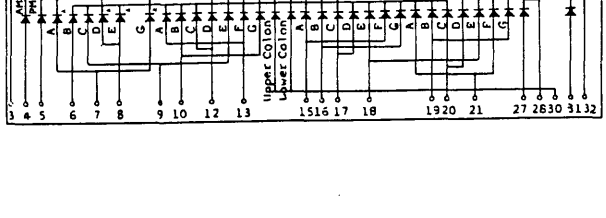


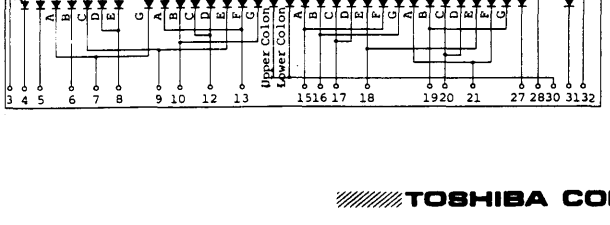
Note 1 : Film slip out colerance $^{+0.5}_{-0}$

Detail terminal

TERMINAL CONNECTION

TERMINAL No.	CONNECTION	TERMINAL No.	CONNECTION
1 , 29	PM, 10's Hour A.D. Unit Hour D.E.F.G, Colon, 10's Min A.B.C, & Unit min D.E.F.G, Common	12	Unit Hour C,D
		13	Unit Hour A,F
		14	N.C
2 , 26	10's Hour B.C.E.G, Unit Hour A.B.C, & 10's Min D.E.F.G, Unit Min A.B.C, Common	15	10's Min A,F
		16	10's Min B,G
		17	10's Min C,D
3	AM Common	18	10's Min E & Unit Min E
4	AM	19	Unit Min B,G
5	PM	20	Unit Min C,D
6	10's Hour B	21	Unit Min A,F
7	10's Hour A,G	22 , 23 24 , 25	N.C
8	10's Hour D,E		
9	10's Hour C & Unit Hour E	27	Dp2
10	Unit Hour B,G	28	Dp2 Common
11	N.C	30	Colon
		31	Dp1
		32	Dp1 Common



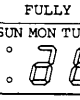


TLR3010

- RED COLOR 4 DIGIT LED CLOCK DISPLAY WITH WEEKLY DISPLAY
  - Week is displayed by 3 character.
  - Character height: 15 mm (0.6") for clock display.
    4 mm (0.16") for week display.
  - For duplex drive and connected common anode.
  - Practical Brightness are obtained at about I_{FP} = 20 mA with 1/2 of Duty Ratio.

Refer to page 197 for the figure.

TYPE NO. VS FUIIY DISPIAYED FONT

COMMON ANODE	FULLY DISPLAYED FONT
TLR3010	SUN MON TUE WED THU FRI SAT 

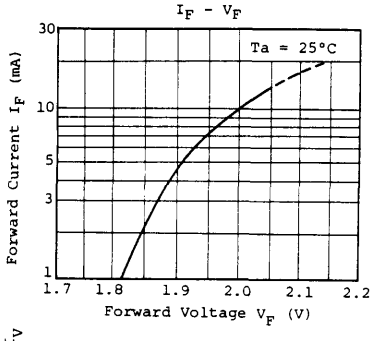
MAXIMUM RATINGS (Ta = 25°C)

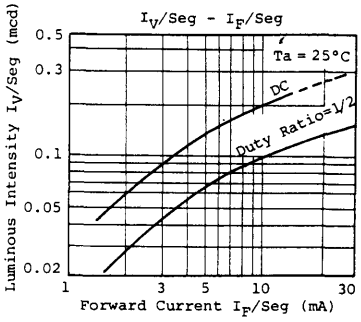
CHARACTERISTIC	SYMBOL	RATING	UNIT
Pulse Forward Current (Note 1)	$I_{F(Pulse)/Seg}$	30	mA
Reverse Voltage	V_R	3	V
Storage Temperature	Tstg	-20 ∿ 75	°C
Operating Temperature	Topr	-20 ∿ 60	°C
Soldering Temperature (Note 2)	T_{solder}	260	°C

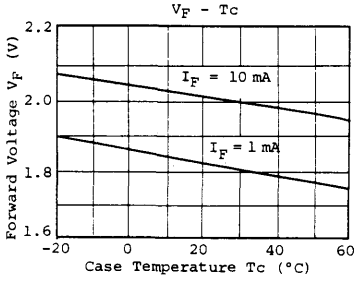
Note 1. Duty Ratio = 1/2
2. Within 3 Seconds at 2 mm from the Reflector Edge.

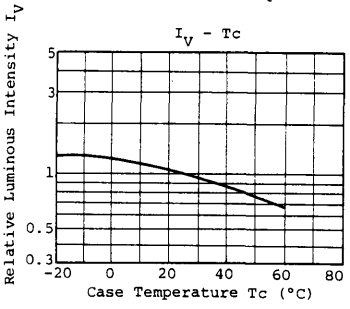
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25°C)

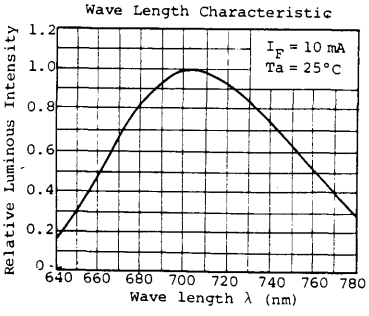
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F = 20 mA	1.8	2.15	2.75	V
Reverse Current		I_R	V_R = 3 V	-	-	5	μA
Luminous Intensity/Seg	Clock	I_V/Seg	I_F = 10 mA	0.1	0.2	-	mcd
	Week			-	0.14	-	mcd
Luminous Intensity Matching Ratio		I_{V-M}	I_F = 5 mA	-	-	2.5	
Peak Emission Wave Length		λ_p	I_F = 10 mA	-	700	-	nm
Spectral Line Half Width		$\Delta\lambda$	I_F = 10 mA	-	100	-	nm

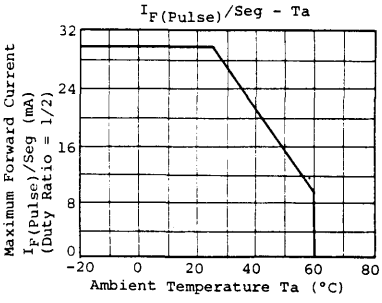












GREEN 4-DIGITS DISPLAY (WITH WEEKLY DISPLAY)

TLG3010

- GREEN COLOR 4 DIGIT LED CLOCK DISPLAY WITH WEEKLY DISPLAY
  - Week is displayed by 3 character.
  - Character height; 15 mm (0.6") for clock display.
    4 mm (0.16") for week display.
  - For duplex drive and connected common anode.
  - Practical Brightness are obtained at about I_{FP} = 20 mA with 1/2 of Duty Ratio.

Refer to page 197 for the figure.

TYPE NO. VS FULLY DISPLAYED FONT

COMMON ANODE	FULLY DISPLAYED FONT
TLG3010	SUN MON TUE WED TUE FRI SAT

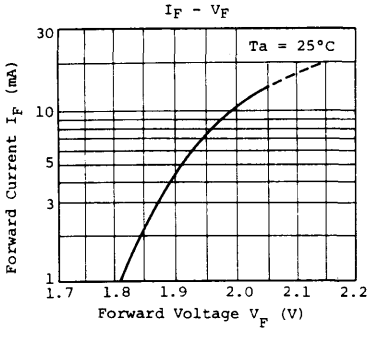
MAXIMUM RATINGS (Ta = 25°C)

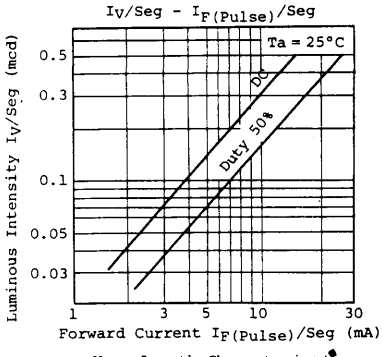
CHARACTERISTIC	SYMBOL	RATING	UNIT
Pulse Forward Current (Note 1)	$I_{F(Pulse)}$/Seg	30	mA
Reverse Voltage	V_R	3	V
Storage Temperature	T_{stg}	-20 ~ 75	°C
Operating Temperature	T_{opr}	-20 ~ 60	°C
Soldering Temperature (Note 2)	T_{solder}	260	°C

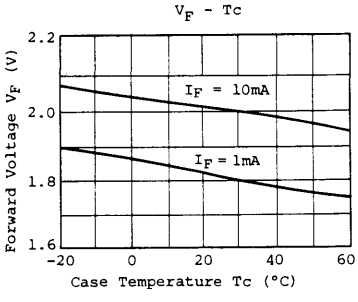
Note 1. Duty Ratio = 1/2
2. Within 3 Seconds at 2 mm from the Reflector Edge

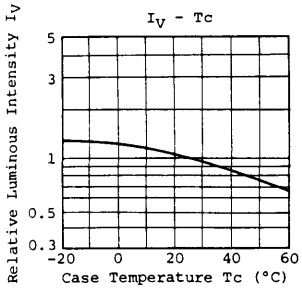
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25°C)

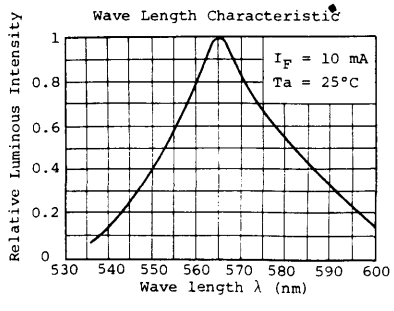
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F = 20 mA	1.8	2.15	2.75	V
Reverse Current		I_R	V_R = 3 V	-	-	5	μA
Luminous Intensity/Seg	Clock	I_V/Seg	I_F = 10 mA	0.08	0.3	-	mcd
	Week			-	0.2	-	mcd
Luminous Intensity Matching Ratio		I_{V-M}	I_F = 5 mA	-	-	2.3	
Peak Emission Wave Length		λp	I_F = 10 mA	-	565	-	nm
Spectral Line Half Width		Δλ	I_F = 10 mA	-	30	-	nm

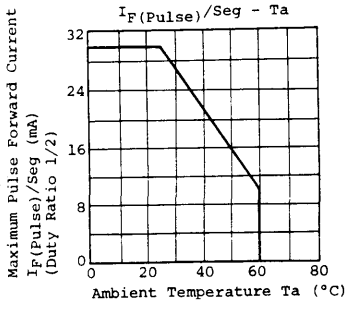






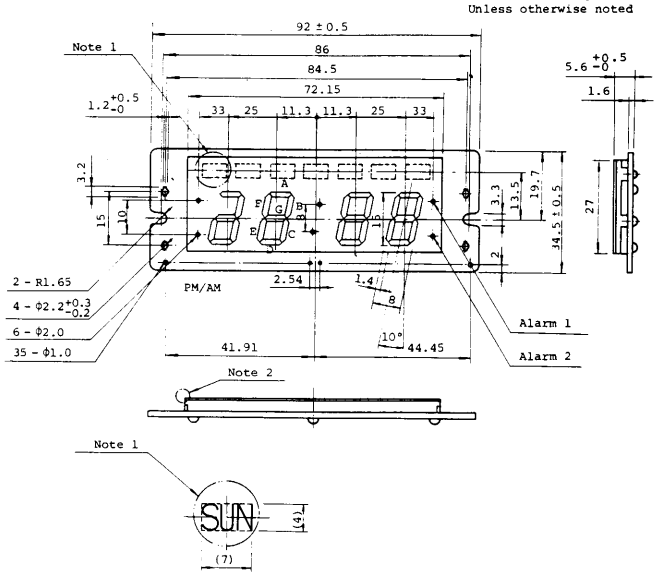






PHYSICAL DIMENSION

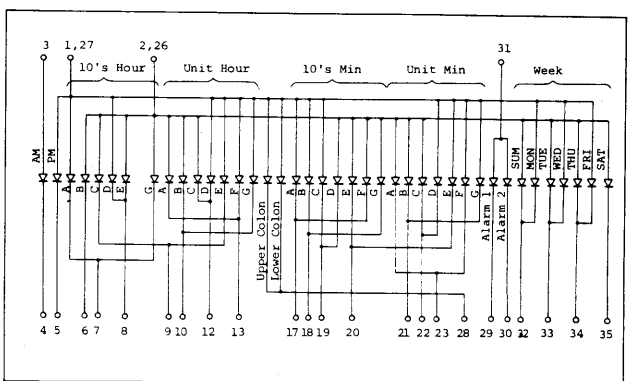
Unit in mm
Tolerances is ±0.25
Unless otherwise noted



Note 2: Film slip out tolerance $^{+0.5}_{-0}$

PIN CONNECTION

PIN NO.	CONNECTION	PIN NO.	CONNECTION
1,27	PM,10's Hour A,D Unit Hour D,E,F,G, Colon,10's MIN A,B, C Unit Min D,E,F,G, MON,WED, FRI, Common Anode	16	N, C
		17	10's MIN A, F
		18	10's MIN B, G
2,26	10's Hour B,C,F,G Unit Hour A,B,C, 10's MIN D,E,F,G Unit MIN A,B,C, SUN, TUE, THU, SAT Common Anode	19	10's MIN C, D
		20	10's MIN E & Unit MIN E
		21	Unit MIN B, G
3	AM Anode	22	Unit MIN C, D
4	AM Cathode	23	Unit MIN A, F
5	PM	24	N, C
6	10's Hour B	25	N, C
7	10's Hour A, G	28	Colon
8	10's Hour D, E	29	Alarm 1
9	10's Hour C & Unit Hour E	30	Alarm 2
10	Unit Hour B, G	31	Alarm Common Anode
11	N, C	32	SUN, MON
12	Unit Hour C, D	33	TUE, WED
13	Unit Hour A, F	34	THU, FRI
14	N, C	35	SAT
15	N, C		



4-DIGITS DISPLAY (WITH WEEKLY DISPLAY)

TLR3010WG

- Week is displayed by 3 character.
- Character height; 15 mm (0.6") for clock display,
  4 mm (0.16") for week display.
- For duplex drive and connected common anode.
- Practical Brightness are obtained at about I_{FP} = 20 mA with 1/2 of Duty Ratio.

Refer to page 199 for the figure.

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Pulse Forward Current (Note 1)	$I_{F(Pulse)}$/Seg	30	mA
Reverse Voltage	V_R	3	V
Storage Temperature	T_{stg}	-20 ∿ 75	°C
Operating Temperature	T_{opr}	-20 ∿ 60	°C
Soldering Temperature (Note 2)	T_{solder}	260	°C

Note 1. Duty Ratio = 1/2
2. Within 3 Seconds at 2 mm from the Reflector Edge.

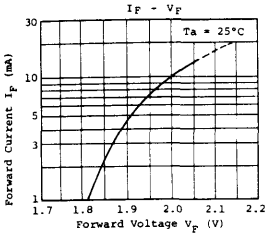
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25°C)

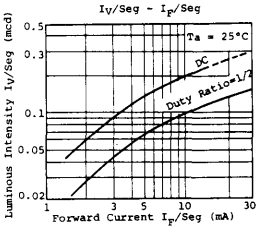
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage		V_F	I_F = 20 mA	1.8	2.15	2.75	V
Reverse Current		I_R	V_R = 3 V	-	-	5	μA
Luminous Intensity/Seg	Clock	I_V/Seg	I_F = 10 mA	0.1	0.2	-	mcd
	Week			-	0.2	-	mcd
Luminous Intensity Matching Ratio		I_V-M	I_F = 5 mA	-	-	2.5	
Peak Emission Wave Length		λ_p	I_F = 10 mA	-	700	-	nm
Spectral Line Half Width		$\Delta\lambda$	I_F = 10 mA	-	100	-	nm
Peak Emission Wave Length		λ_p	I_F = 10 mA	-	565	-	nm
Spectral Line Half Width		$\Delta\lambda$	I_F = 10 mA	-	30	-	nm

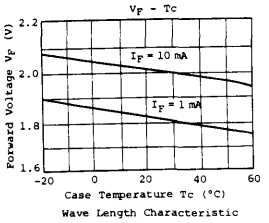
TYPE NO. VS FULLY DISPLAYED FONT

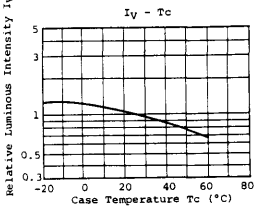
COMMON ANODE	FULLY DISPLAY FONT	CLOCK	WEEKLY
TLR3010WG	SUN MON TUE WED THU FRI SAT	RED	GREEN
TLG3010WR	88:88	GREEN	RED

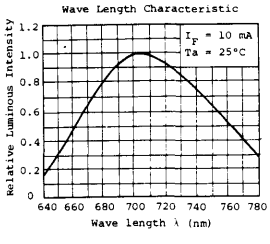
RED

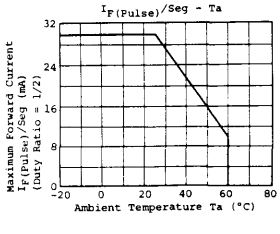




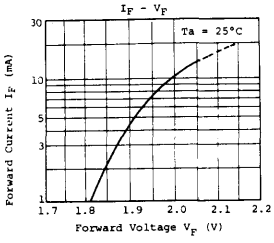


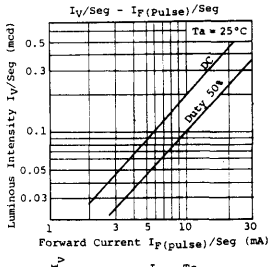


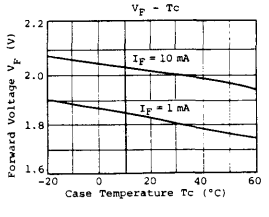


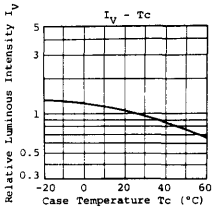


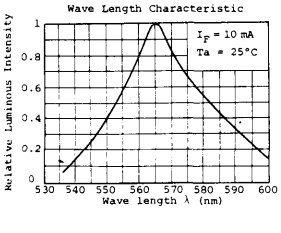
GREEN

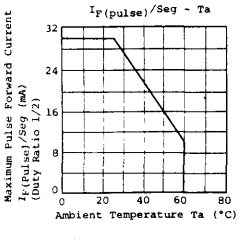






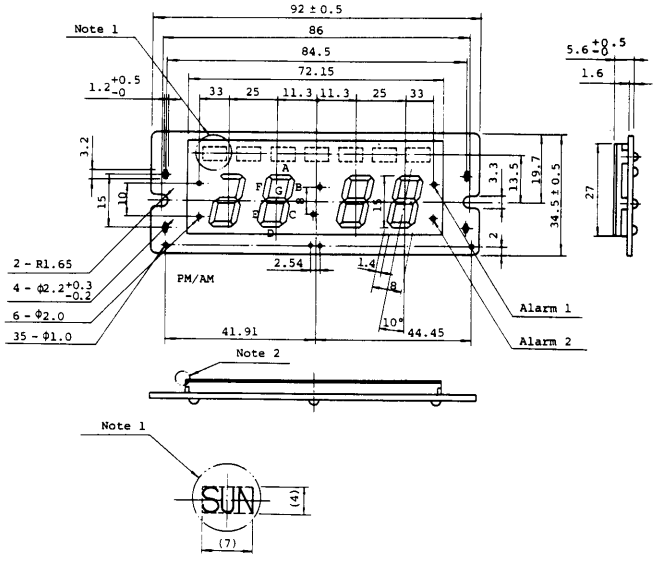






PHYSICAL DIMENSION

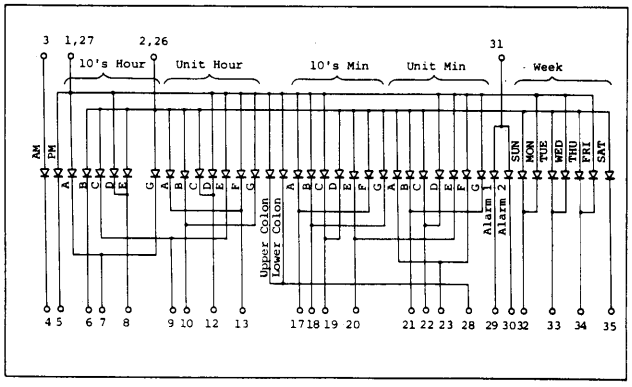
Unit in mm
Tolerances is ±0.25
Unless otherwise noted



Note 2: Film Slip out tolerance $^{+0.5}_{-0}$

PIN CONNECTION

PIN NO.	CONNECTION	PIN NO.	CONNECTION
1,27	PM, 10's Hour A,D Unit Hour D,E,F,G, Colon, 10's MIN A, B,C Unit Min D,E,F,G, MON, WED,FRI, Common Anode	16	N, C
		17	10's MIN A, F
		18	10's MIN B, G
2,26	10's Hour B,C,F,G Unit Hour A,B,C, 10's MIN D,E,F,G Unit MIN A,B,C, SUN,TUE,THU,SAT Common Anode	19	10's MIN C, D
		20	10's MIN E & Unit MIN E
		21	Unit MIN B, G
3	AM Anode	22	Unit MIN C, D
4	AM Cathode	23	Unit MIN A, F
5	PM	24	N, C
6	10's Hour B	25	N, C
7	10's Hour A, G	28	Colon
8	10's Hour D, E	29	Alarm 1
9	10's Hour C & Unit Hour E	30	Alarm 2
10	Unit Hour B, G	31	Alarm Common Anode
11	N, C	32	SUN, MON
12	Unit Hour C, D	33	TUE, WED
13	Unit Hour A, F	34	THU, FRI
14	N, C	35	SAT
15	N, C		



TLR5001, TLR5002, TLG5001, TLG5002

5 DIGITS LED DISPLAY FOR DIGITAL TUNING SYSTEM

- 10 mm (0.4") character height, each segment represents diffused and uniformly display.
- Outer color filter provides high contrast, practical brightness are obtained at about 5 mA per segments.
- Arrow edge shape of each segment represents not mosaic but look like Arabic numerals.
- Selectable both type Europe or U.S.A. (Japan)
- Recommendable LSI ; TD6301P or TD6301AP (TOSHIBA)

Refer to page 201 for the figure.

TLR5001, TLR5002

TYPE NO. vs. DISPLAY FONT

COMMON ANODE	FULLY DISPLAY FONT
TLR5001	FM / AM — MHz / kHz
TLR5002	FM / MW / LW — MHz / kHz

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current/Seg.	I_F/Seg.	15	mA
Reverse Voltage	V_R	3	V
Storage Temperature Range	T_{stg}	-30∿90	°C
Operating Temperature Range	T_{opr}	-30∿75	°C

ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F = 5 mA	1.7	1.9	2.4	V
Reverse Current	I_R	V_R = 3 V	-	-	5	μA
Luminous Intensity	I_V/Seg.	I_F = 5 mA				mcd
	D_p	I_F = 5 mA				mcd
	character	I_F = 5 mA				mcd
Luminous Intensity Matching Ratio	I_V-M	I_F = 5 mA	-	-	2.3	-
Peak Wave Length	λP	I_F = 10 mA	-	700	-	nm
Spectral Line Half Width	Δλ	I_F = 10 mA	-	100	-	nm

TLG5001, TLG5002

TYPE NO. VS DISPIAY FONT

COMMON ANODE	FULLY DISPLAY FONT
TLG5001	FM / AM — MHz / kHz
TLG5002	FM / MW / LW — MHz / kHz

MAXIMUM RATINGS (Ta = 25°C)

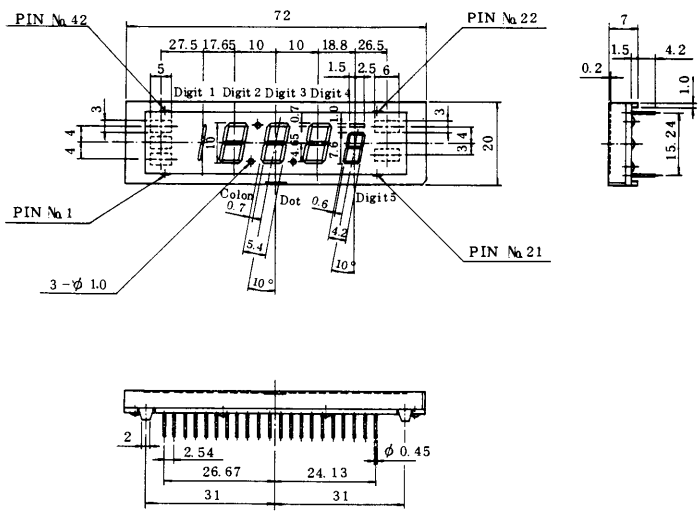
CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current/Seg.	I_F/Seg.	15	mA
Reverse Voltage	V_R	3	V
Storage Temperature Range	T_{stg}	-30∿90	°C
Operating Temperature Range	T_{opr}	-30∿75	°C

ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F = 10 mA	1.8	2.0	2.5	V
Reverse Current	I_R	V_R = 3 V	-	-	5	μA
Luminous Intensity	I_V/Seg	I_F = 10 mA				mcd
	D_p	I_F = 10 mA				mcd
	character	I_F = 10 mA				mcd
Luminous Intensity Matching Ratio	I_V-M	I_F = 10 mA	-	-	2.3	-
Peak Wave Length	λP	I_F = 10 mA	-	565	-	nm
Spectral Line Half Width	Δλ	I_F = 10 mA	-	30	-	nm

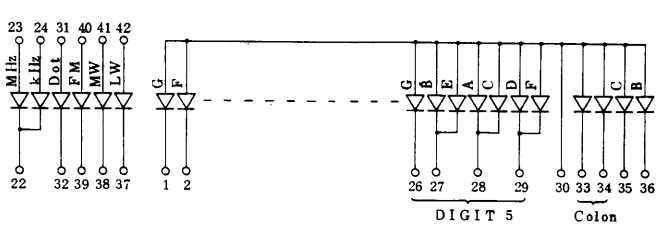
PHYSICAL DIMENSIONS

Unit: mm



PHYSICAL DIMENSIONS

PIN No.	CONNECTION	PIN No.	CONNECTION
1	DIGIT 2 G CATHODE	22	MHz , kHz CATHODE
2	〃 F 〃	23	MHz ANODE
3	〃 E 〃	24	kHz 〃
4	〃 D 〃	25	ST CATHODE
5	〃 C 〃	26	DIGIT 5 G CATHODE
6	〃 B 〃	27	〃 B, E 〃
7	〃 A 〃	28	〃 A, C 〃
8	DIGIT 3 G 〃	29	〃 D, F 〃
9	〃 F 〃	30	COMMON ANODE
10	〃 E 〃	31	Dot ANODE
11	〃 D 〃	32	〃 CATHODE
12	〃 C 〃	33	Lower Colon CATHODE
13	〃 B 〃	34	Upper Colon 〃
14	〃 A 〃	35	DIGIT 1 C 〃
15	DIGIT 4 G 〃	36	〃 B 〃
16	〃 F 〃	37	LW CATHODE
17	〃 E 〃	38	MW 〃
18	〃 D 〃	39	FM 〃
19	〃 C 〃	40	FM ANODE
20	〃 B 〃	41	MW 〃
21	〃 A 〃	42	LW 〃



BAR POINT DISPLAY

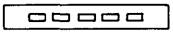
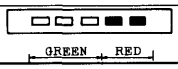
TLR8051, TLG8051, TLM8051

5-POINT 1-CHANNEL BAR POINT

. State of Displays.
  TLR8051 : Red :5-Point
  TLG8051 : Green:5-Point
  TLM8051 : Green:3-Point, Red:2-Point
. 1.5 × 5mm Segment, Each Segment Represents Diffused and Uniform Display with Masking Film.
. Common-Anode Static Connection.

Refer to page 203 for the figure.

TYPE NO. vs FULLY DISPLAYED FONT

TYPE No.	FULLY DISPLAYED FONT
TLR8051 TLG8051	
TLM8051	

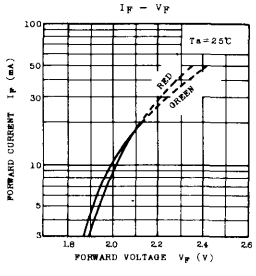
MAXIMUM RATINGS (Ta = 25°C)

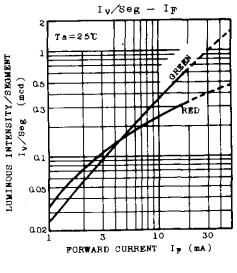
CHARACTERISTIC	SYMBOL	RATING	UNIT
DC Forward Current/Segment	$I_{F(DC)}$/Seg	20	mA
Reverse Voltage	V_R	3	V
Operating Temperature Range	Topr	-20 ~ 60	°C
Storage Temperature Range	Tstg	-30 ~ 75	°C
Soldering Temperature (Note)	Tsolder	260	°C

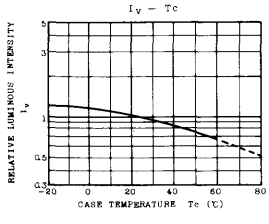
Note : Within 3 second at 2mm from the reflector edge.

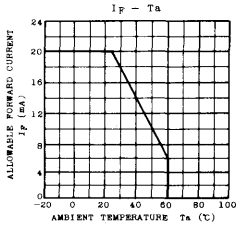
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	Green	V_F	I_F=10mA	-	2.0	2.5	V
	Red			-	2.0	2.5	
Reverse Current		I_R	V_R=3V	-	-	5	μA
Luminous Intensity/Segment	Green	I_V/Seg	I_F=10mA	0.10	0.35	-	mcd
	Red			0.10	0.25	-	
Luminous Intensity Matching Ratio		I_V-M	I_F=5mA	-	-	2.5	
Peak Emission Wave Length	Green	λp	I_F=10mA	-	567	-	nm
	Red			-	700	-	
Spectral Half Line Width	Green	Δλ	I_F=10mA	-	35	-	nm
	Red			-	100	-	





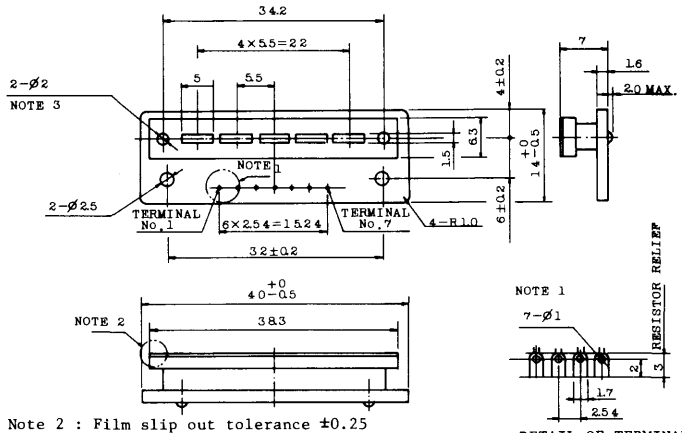




OUTLINE DIMENSION

Unit in mm

Note : Tolerance is ±0.25
unless otherwise noted.



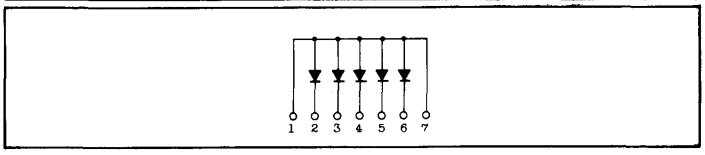
DETAIL OF TERMINAL

Note 2 : Film slip out tolerance ±0.25

3 : This is a mark for manufacturing products.
Be careful not to expose this portion at time of package design.

TERMINAL CONNECTION

TLR8051, TLG8051		TLM8051	
TERMINAL No.	CONNECTION	TERMINAL No.	CONNECTION
1	Common Anode	1	Common Anode
2	Cathode 1	2	Cathode Green 1
3	Cathode 2	3	Cathode Green 2
4	Cathode 3	4	Cathode Green 3
5	Cathode 4	5	Cathode Red 1
6	Cathode 5	6	Cathode Red 2
7	Common Anode	7	Common Anode



BAR POINT DISPLAY

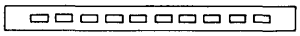
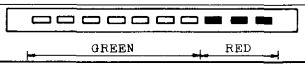
TLR8101, TLG8101, TLM8101

10-POINT 1-CHANNEL BAR POINT DISPLAY

. State of Displays.
  TLR8101 : Red :10-Point
  TLG8101 : Green:10-Point
  TLM8101 : Green:7-Point, Red:3-Point
. 1.5 × 5mm Segment, Each Segment Represents Diffused and Unifrom Display with Masking Film.

Refer to page 205 for the figure.

TYPE NO. vs FULLY DISPLAYED FONT

TYPE No.	FULLY DISPLAY FONT
TLR8101 TLG8101	
TLM8101	

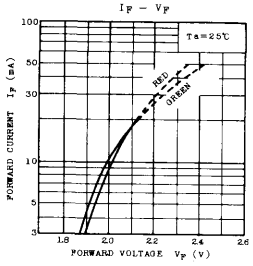
MAXIMUM RATINGS (Ta = 25°C)

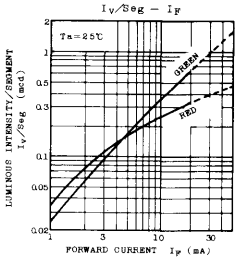
CHARACTERISTIC	SYMBOL	RATING	UNIT
DC Forward Current/Segment	$I_{F(DC)}$/Seg	20	mA
Reverse Voltage	V_R	3	V
Operating Temperature Range	T_{opr}	-20~60	°C
Storage Temperature Range	T_{stg}	-30~75	°C
Soldering Temperature (Note)	T_{solder}	260	°C

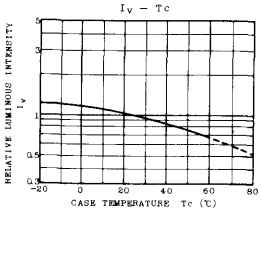
Note : Within 3 second at 2mm from the reflector edge.

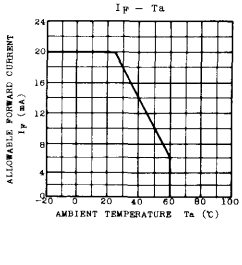
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta 25°C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	Green	V_F	I_F=10mA	-	2.0	2.5	V
	Red			-	2.0	2.5	
Reverse Current		I_R	V_R=3V	-	-	5	μA
Luminous Intensity/Segment	Green	I_V/Seg	I_F=10mA	0.10	0.35	-	mcd
	Red			0.10	0.25	-	
Luminous Intensity Matching Ratio		I_V-M	I_F=5mA	-	-	2.5	
Peak Emission Wave Length	Green	λ_P	I_F=10mA	-	567	-	nm
	Red			-	700	-	
Spectral Half Line Width	Green	$\Delta\lambda$	I_F=10mA	-	35	-	nm
	Red			-	100	-	





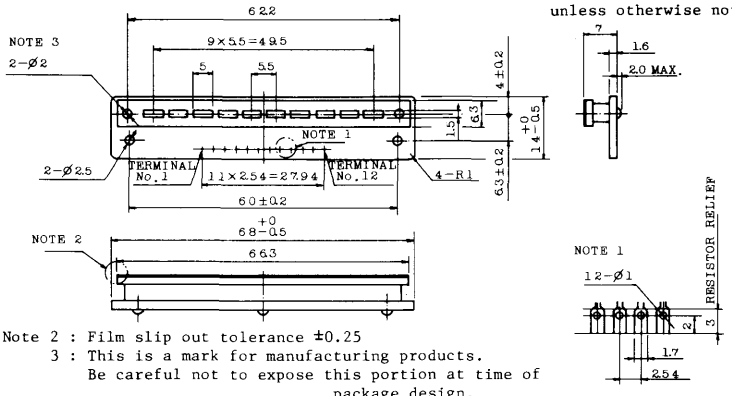




OUTLINE DIMENSION

Unit in mm

Note : Tolerance is ±0.25
unless otherwise noted.

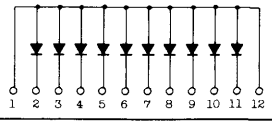


Note 2 : Film slip out tolerance ±0.25

3 : This is a mark for manufacturing products.
Be careful not to expose this portion at time of package design.

TERMINAL CONNECTION

TLR8101, TLG8101		TLM8101	
TERMINAL No.	CONNECTION	TERMINAL No.	CONNECTION
1	Common Anode	1	Common Anode
2	Cathode 1	2	Cathode Green 1
3	Cathode 2	3	Cathode Green 2
4	Cathode 3	4	Cathode Green 3
5	Cathode 4	5	Cathode Green 4
6	Cathode 5	6	Cathode Green 5
7	Cathode 6	7	Cathode Green 6
8	Cathode 7	8	Cathode Green 7
9	Cathode 8	9	Cathode Red 1
10	Cathode 9	10	Cathode Red 2
11	Cathode 10	11	Cathode Red 3
12	Common Anode	12	Common Anode



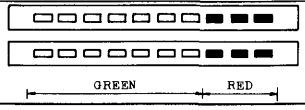
TLM8102

10-POINT 2-CHANNEL BAR POINT DISPLAY

- State of Displays
  10-Point (Green : 7-Point, Red : 3 Point), 2 Channel Display.
- 1.5 × 5mm Segment, Each Segment Represents Diffused and Uniform Display with Masking Film.
- Practical Brightness are Obtained at About 20mA with 1/2 of Duty Ratio.
- Common-Anode Multiplex Connection.

Refer to page 207 for the figure.

TYPE NO. vs FULLY DISPLAYED FONT

TYPE No.	FULLY DISPLAYED FONT
TLM8102	

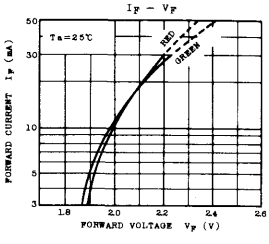
MAXIMUM RATINGS(Ta=25℃)

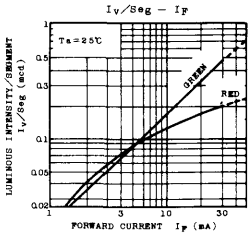
CHARACTERISTIC	SYMBOL	RATING	UNIT
DC Forward Current/Segment	$I_{F(DC)}$/Seg	20	mA
Pulse Forward Current/Seg. (Note 1)	$I_{F(Pulse)}$/Seg	30	mA
Reverse Voltage	V_R	3	V
Operating Temperature Range	T_{opr}	-20~60	°C
Storage Temperature Range	T_{stg}	-30~75	°C
Soldering Temperature (Note 2)	T_{solder}	260	°C

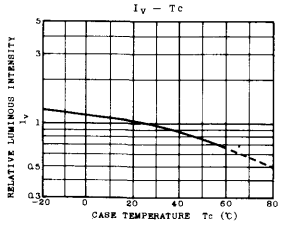
Note 1 : Pulse Width=1ms, Duty Ratio=1/2
2 : Within 3 second 2mm from refrector edge.

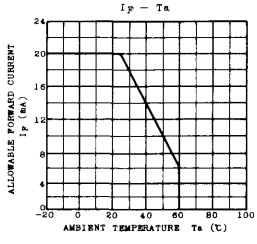
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25 ℃)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	Green	V_F	I_F=10mA	-	2.0	2.5	V
	Red			-	2.0	2.5	
Reverse Current		I_R	V_R=3V	-	-	5	μA
Luminous Intensity/Segment	Green	I_V/Seg	I_F=10mA	0.10	0.35	-	mcd
	Red			0.10	0.25	-	
Luminous Intensity Matching Ratio		I_V-M	I_F=5mA	-	-	2.5	-
Peak Emission Wave Length	Green	λp	I_F=10mA	-	567	-	nm
	Red			-	700	-	
Spectral Half Line Width	Green	Δλ	I_F=10mA	-	36	-	nm
	Red			-	100	-	





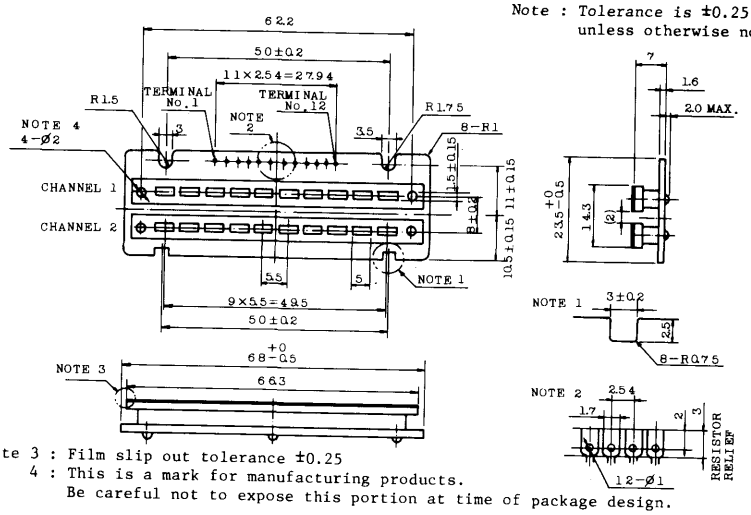




OUTLINE DIMENSION

Unit in mm

Note : *Tolerance is ±0.25 unless otherwise noted.*

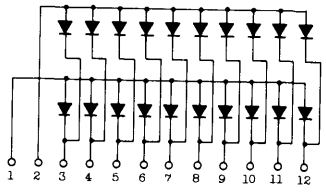


Note 3 : Film slip out tolerance ±0.25

4 : This is a mark for manufacturing products.
Be careful not to expose this portion at time of package design.

TERMINAL CONNECTION

TERMINAL No.	CONNECTION	TERMINAL No.	CONNECTION
1	Channel 2 Common Anode	7	Green 5
2	Channel 1 Common Anode	8	Green 6
3	Green 1	9	Green 7
4	Green 2	10	Red 1
5	Green 3	11	Red 2
6	Green 4	12	Red 3



BAR POINT DISPLAY

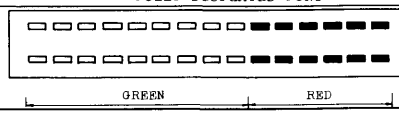
TLG8152

15-POINT 2-CHANNEL BAR POINT DISPLAY

- State of Displays
  15-Point (Green : 9-Point, Red : 6-Point), 2 Channel Display.
- 1.5 × 5mm Segment, Each Segment Represents Diffused and Uniform Display with Masking Film.
- Practical Brightness are Obtained at About 20mA with 1/2 of Duty Ratio.
- Common-Anode Multiplex Connection.

Refer to page 209 for the figure.

TYPE NO. VS. DISPLAY FONT

TYPE No.	FULLY DISPLAYED FONT
TLM8152	

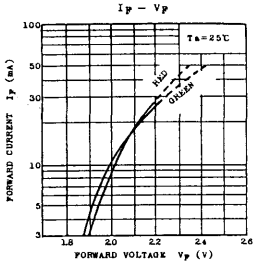
MAXIMUM RATINGS (Ta = 25°C)

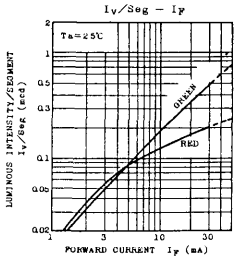
CHARACTERISTIC	SYMBOL	RATING	UNIT
DC Forward Current/Segment	$I_{F(DC)}$/Seg	20	mA
Pulse Forward Current/Seg. (Note 1)	$I_{F(Pulse)}$/Seg	30	mA
Reverse Voltage	V_R	3	V
Operating Temperature Range	T_{opr}	-20 ~ 60	°C
Storage Temperature Range	T_{stg}	-30 ~ 75	°C
Soldering Temperature (Note 2)	T_{solder}	260	°C

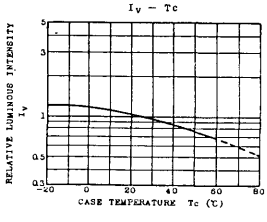
Note 1 : Pulse Width=1ms, Duty Ratio=1/2
2 : Within 3 second at 2mm from reffector edge.

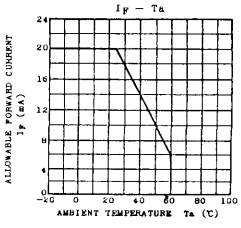
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	Green	V_F	I_F=10mA	-	2.0	2.5	V
	Red			-	2.0	2.5	
Reverse Current		I_R	V_R=3V	-	-	5	μA
Luminous Intensity/Segment	Green	I_V/Seg	I_F=10mA	0.10	0.35	-	mcd
	Red			0.10	0.25	-	
Luminous Intensity Matching Ratio		I_V-M	I_F=5mA	-	-	2.5	
Peak Emission Wave Length	Green	λ_P	I_F=10mA	-	567	-	nm
	Red			-	700	-	
Spectral Half Line Width	Green	$\Delta\lambda$	I_F=10mA	-	35	-	nm
	Red			-	100	-	





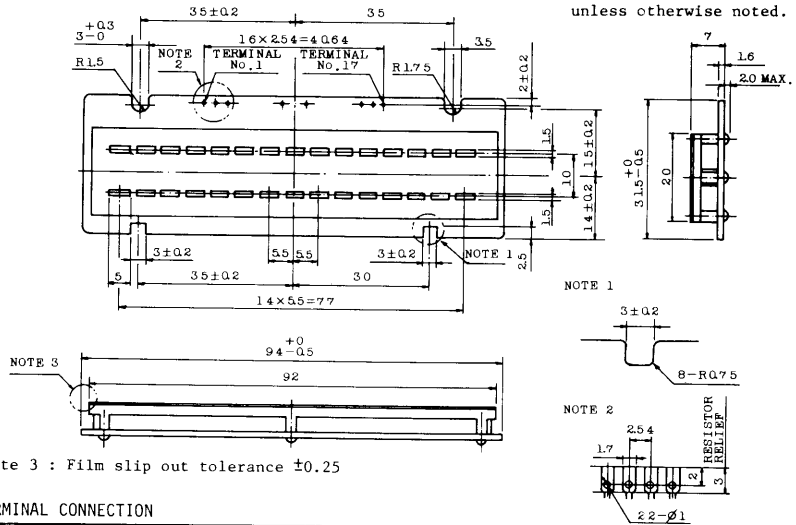




OUTLINE DIMENSION

Unit in mm

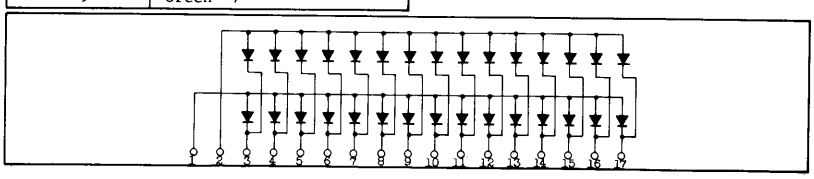
Note : Tolerance is ±0.25
unless otherwise noted.



Note 3 : Film slip out tolerance ±0.25

TERMINAL CONNECTION

TERMINAL No.	CONNECTION	TERMINAL No.	CONNECTION
1	Channel 2 Common Anode	10	Green 8
2	Channel 1 Common Anode	11	Green 9
3	Green 1	12	Red 1
4	Green 2	13	Red 2
5	Green 3	14	Red 3
6	Green 4	15	Red 4
7	Green 5	16	Red 5
8	Green 6	17	Red 6
9	Green 7		



BAR POINT DISPLAY

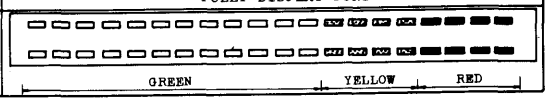
TLM8202

20-POINT 2-CHANNEL BAR POINT DISPLAY

. State of Displays
  20-Point (Green : 12-Point, Yellow : 4-Point, Red : 4-Point), 2 Channel Display.
. 1.4 × 5mm Segment, Each Segment Represents Diffused and Uniform Display with Masking Film.
. Practical Brightness are Obtained at About 10mA.

Refer to page 211 for the figure.

TYPE NO. VS FULLY DISPLAYED FONT

TYPE No.	FULLY DISPLAY FONT
TLM8202	

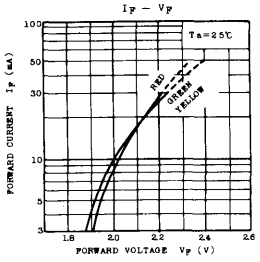
MAXIMUM RATINGS (Ta = 25 °C)

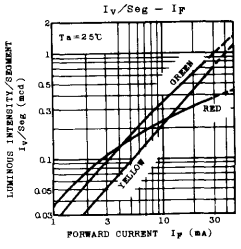
CHARACTERISTIC	SYMBOL	RATING	UNIT
DC Forward Current/Segment	$I_{F(DC)}$/Seg	20	mA
Reverse Voltage	V_R	3	V
Operating Temperature Range	T_{opr}	-20 ~ 60	°C
Storage Temperature Range	T_{stg}	-30 ~ 75	°C
Soldering Temperature (Note)	T_{solder}	260	°C

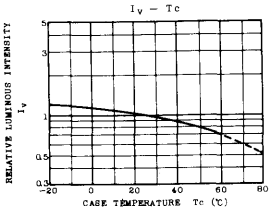
Note : Within 3 second at 2mm from the reflector edge.

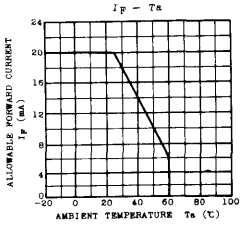
ELECTRICAL-OPTICAL CHARACTERISTICS (Ta = 25 °C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	Green	V_F	I_F=10mA	-	2.0	2.5	V
	Yellow			-	2.0	2.5	
	Red			-	2.0	2.5	
Reverse Current		I_R	V_R=3V	-	-	5	μA
Luminous Intensity/Segment	Green	I_V/Seg	I_F=10mA	0.10	0.35	-	mcd
	Yellow			0.10	0.25	-	
	Red			0.10	0.25	-	
Luminous Intensity Matching Ratio		I_V-M	I_F=5mA	-	-	2.5	-
Peak Emission Wave Length	Green	λ_P	I_F=10mA	-	567	-	nm
	Yellow			-	590	-	
	Red			-	700	-	
Spectral Half Line Width	Green	$\Delta\lambda$	I_F=10mA	-	35	-	nm
	Yellow			-	30	-	
	Red			-	100	-	





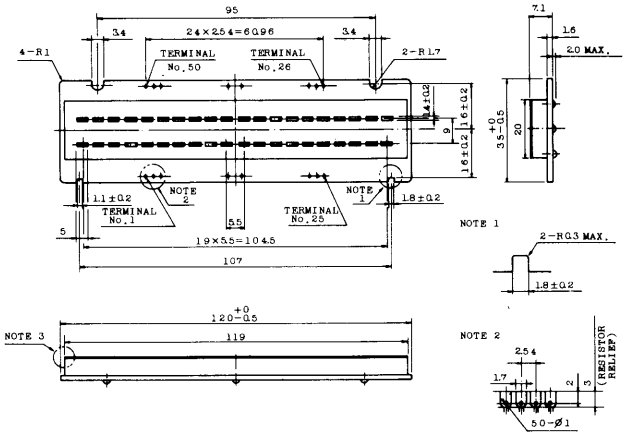




OUTLINE DIMENSION

Unit in mm

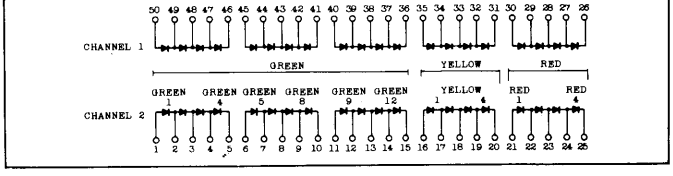
Note : Tolerance is ±0.25
unless otherwise noted.



Note 3 : Film slip out tolerance ±0.25

TERMINAL CONNECTION

TERMINAL No.	CONNECTION	TERMINAL No.	CONNECTION
1	Channel 2 Green 1 Anode	26	Channel 1 Red 4 Cathode
2	Channel 2 Green 1 Cathode Green 2 Anode	27	Channel 1 Red 4 Anode, Red 3 Cathode
3	Channel 2 Green 2 Cathode Green 3 Anode	28	Channel 1 Red 3 Anode, Red 2 Cathode
4	Channel 2 Green 3 Cathode Green 4 Anode	29	Channel 1 Red 2 Anode, Red 1 Cathode
5	Channel 2 Green 4 Cathode	30	Channel 1 Red 1 Anode
6	Channel 2 Green 5 Anode	31	Channel 1 Yellow 4 Cathode
7	Channel 2 Green 5 Cathode Green 6 Anode	32	Channel 1 Yellow 4 Anode Yellow 3 Cathode
8	Channel 2 Green 6 Cathode Green 7 Anode	33	Channel 1 Yellow 3 Anode Yellow 2 Cathode
9	Channel 2 Green 7 Cathode Green 8 Anode	34	Channel 1 Yellow 2 Anode Yellow 1 Cathode
10	Channel 2 Green 8 Cathode	35	Channel 1 Yellow 1 Anode
11	Channel 2 Green 9 Anode	36	Channel 1 Green 12 Cathode
12	Channel 2 Green 9 Cathode Green 10 Anode	37	Channel 1 Green 12 Anode Green 11 Cathode
13	Channel 2 Green 10 Cathode Green 11 Anode	38	Channel 1 Green 11 Anode Green 10 Cathode
14	Channel 2 Green 11 Cathode Green 12 Anode	39	Channel 1 Green 10 Anode Green 9 Cathode
15	Channel 2 Green 12	40	Channel 1 Green 9 Anode
16	Channel 2 Yellow 1 Anode	41	Channel 1 Green 8 Cathode
17	Channel 2 Yellow 1 Cathode Yellow 2 Anode	42	Channel 1 Green 8 Anode Green 7 Cathode
18	Channel 2 Yellow 2 Cathode Yellow 3 Anode	43	Channel 1 Green 7 Anode Green 6 Cathode
19	Channel 2 Yellow 3 Cathode Yellow 4 Anode	44	Channel 1 Green 6 Anode Green 5 Cathode
20	Channel 2 Yellow 4 Cathode	45	Channel 1 Green 5 Anode
21	Channel 2 Red 1 ANODE	46	Channel 1 Green 4 Cathode
22	Channel 2 Red 1 Cathode, Red 2 Anode	47	Channel 1 Green 4 Anode Green 3 Cathode
23	Channel 2 Red 2 Cathode, Red 3 Anode	48	Channel 1 Green 3 Anode Green 2 Cathode
24	Channel 2 Red 3 Cathode, Red 4 Anode	49	Channel 1 Green 2 Anode Green 1 Cathode
25	Channel 2 Red 4 Cathode	50	Channel 1 Green 1 Anode



TRANSISTOR COUPLER

4N25, 25A

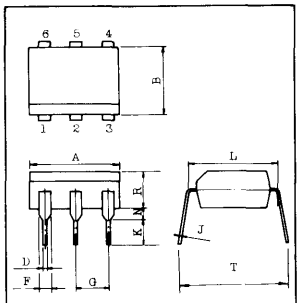
GaAs Infrared Emitting Diode & NPN Silicon Photo-Transistor

AC LINE/DIGITAL LOGIC ISOLATOR.
DIGITAL LOGIC/DIGITAL LOGIC ISOLATOR.
TELEPHONE LINE·RECEIVER.
TWISTED PAIR LINE RECEIVER.
HIGH FREQUENCY POWER SUPPLY FEEDBACK CONTROL.
RELAY CONTACT MONITOR.

The TOSHIBA 4N25, 4N25A consists of a gallium arsenide infrared emitting diode coupled with a silicon photo transistor in a dual in-line package.

- Small Package Size and Low Cost
- Fast Switching Speeds : 2μs
- High DC Current Trnasfer Ratio : 50%
- High Isolation Resistance : $10^{11}\Omega$
- High Isolation Voltage : 2500 V_{RMS}
- UL Recognized : File No. E67349

Unit in mm

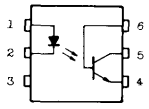


1. ANODE 4. EMITTER
2. CATHODE 5. COLLECTOR
3. NC 6. BASE

JEDEC	—
EIAJ	—
TOSHIBA	11-7A1F

SYMBOL	INCH	MM.
A	0.280±0.010	7.12±0.25
B	0.252	6.40
D	0.020	0.50
F	0.047	1.20
G	0.1(Typ)	2.54(Typ)
J	0.010	0.25
K	0.100(MIN)	2.50(MIN)
L	0.300	7.62
N	0.031	0.80
R	0.144	3.65
T	0.309~3.465	7.85~8.80

PIN CONFIGURATIONS (TOP VIEW)



ABSOLUTE MAXIMUM RATINGS (Ta = 25°C)

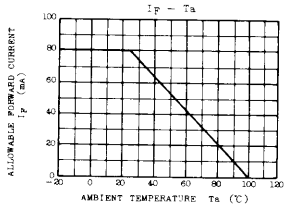
	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	80	mA
	Forward Current Derating	ΔI_F/°C	1.07*	mA/°C
	Peak Forward Current (Note)	I_{PF}	3	A
	Power Dissipation	P_D	150	mW
	Power Dissipation Derating	ΔP_D/°C	2.0*	mW/°C
	Reverse Voltage	V_R	3	V
PHOTO-TRANSISTOR	Collector-Emitter Voltage	BV_{CEO}	30	V
	Collector-Base Voltage	BV_{CBO}	70	V
	Emitter-Collector Voltage	BV_{ECO}	7	V
	Collector Current (Continuous)	I_C	100	mA
	Power Dissipation	P_C	150	mW
	Power Dissipation Derating	ΔP_C/°C	2.0*	mW/°C
COUPLED	Storage Temperature	T_{stg}	-55~150	°C
	Operating Temperature	T_{opr}	-55~100	°C
	Lead Soldering Temperature (at 10 sec.)	T_{sold}	260	°C
	Total Package Dissipation	P_T	250	mW
	Total Package Power Dissipation Derating	ΔP_T/°C	3.3*	mW/°C

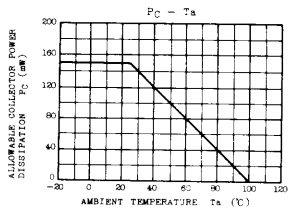
Note : Pulse width 300μs, 2% duty cycle.
* Above 25°C ambient.

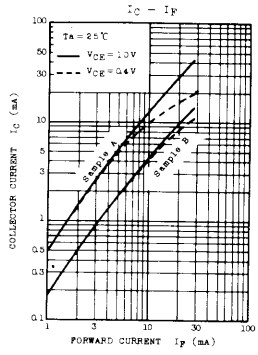
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

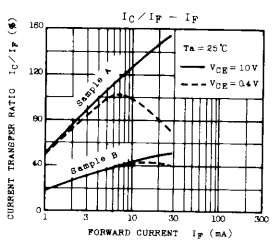
	CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage		V_F	I_F=10mA	-	1.15	1.5	V
	Reverse Current		I_R	V_R=3V	-	-	100	μA
	Capacitance		C_D	V=0, f=1MHz	-	30	-	pF
PHOTO-TRANSISTOR	DC Forward Current Gain		h_{FE}	V_{CE}=5, I_C=500μA	-	200	-	
	Collector-Emitter Breakdown Voltage		$V_{(BR)CEO}$	I_C=1mA, I_F=0	30	-	-	V
	Collector-Base Breakdown Voltage		$V_{(BR)CBO}$	I_C=100μA, I_F=0	70	-	-	V
	Emitter-Collector Breakdown Voltage		$V_{(BR)ECO}$	I_E=100μA, I_F=0	7	-	-	V
	Collector Dark Current		I_{CEO}	V_{CE}=10V, I_F=0	-	1	50	nA
	Collector Dark Current		I_{CBO}	V_{CB}=10V, I_F=0	-	0.1	20	nA
	Collector-Emitter Capacitance		C_{CE}	V=0, f=1MHz	-	10	-	pF
COUPLED	Current Transfer Ratio		I_C/I_F	I_F=10mA, V_{CE}=10V	20	100	-	%
	Saturation Voltage		$V_{CE(SAT)}$	I_F=50mA, I_C=2mA	-	0.1	0.5	V
	Capacitance Input to Output		C_S	V=0, f=1MHz	-	0.8	-	pF
	Isolation Resistance		R_S	V=500V	-	10^{11}	-	Ω
	Isolation Voltage	4N25A*	BV_S	AC 1 sec.	1775	-	-	V_{RMS}
		4N25*	BV_S	Peak	2500	-	-	V
	Rise/Fall Time		t_r/t_f	V_{CE}=10V, I_C=2mA, R_L=100Ω	-	2	-	μs
	Rise/Fall Time Photo Diode		t_r/t_f	V_{CB}=10V, I_{CB}=50μA, R_L=100Ω	-	200	-	ns

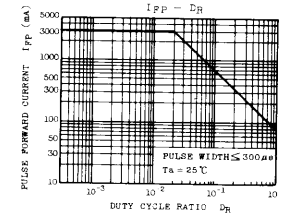
*JEDEC registered maximum BV_S is 1775 V_{RMS} (2500 V_{PK}), however, TOSHIBA specifies a minimum BV_S of 2500 V_{RMS}, 1 minute.

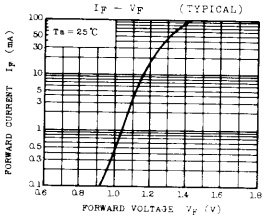

I_F – Ta
ALLOWABLE FORWARD CURRENT I_F (mA)
AMBIENT TEMPERATURE Ta (°C)

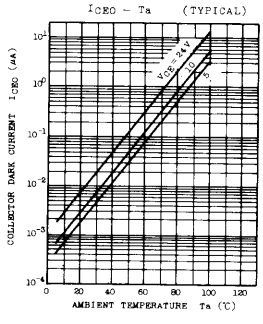

P_C – Ta
ALLOWABLE COLLECTOR POWER DISSIPATION P_C (mW)
AMBIENT TEMPERATURE Ta (°C)

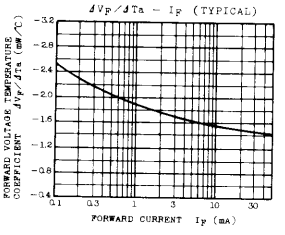

I_C – I_F
Ta = 25°C
V_{CE} = 10V
V_{CE} = 0.4V
Sample A
Sample B
COLLECTOR CURRENT I_C (mA)
FORWARD CURRENT I_F (mA)

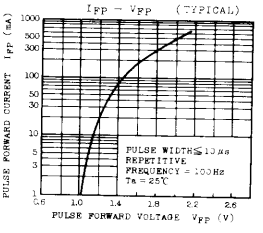

I_C / I_F – I_F
Ta = 25°C
V_{CE} = 10V
V_{CE} = 0.4V
Sample A
Sample B
CURRENT TRANSFER RATIO I_C/I_F (%)
FORWARD CURRENT I_F (mA)

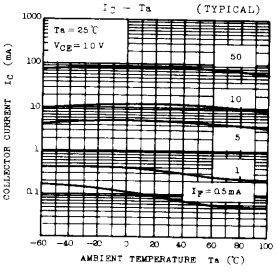

I_{FP} – D_R
PULSE WIDTH ≤ 300μs
Ta = 25°C
PULSE FORWARD CURRENT I_{FP} (mA)
DUTY CYCLE RATIO D_R

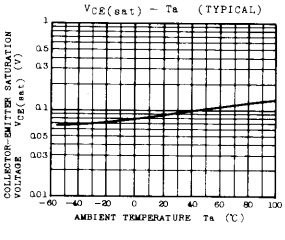

I_F – V_F (TYPICAL)
Ta = 25°C
FORWARD CURRENT I_F (mA)
FORWARD VOLTAGE V_F (V)

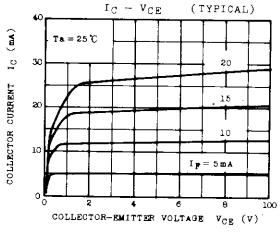

I_{CEO} – Ta (TYPICAL)
V_{CE} = 24V
10
5
COLLECTOR DARK CURRENT I_{CEO} (μA)
AMBIENT TEMPERATURE Ta (°C)

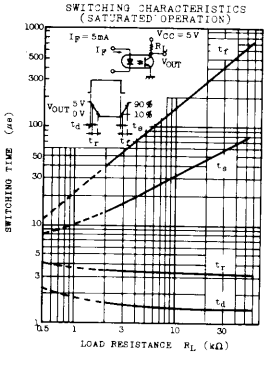

$\Delta V_F / \Delta Ta$ – I_F (TYPICAL)
FORWARD VOLTAGE TEMPERATURE COEFFICIENT $\Delta V_F/\Delta Ta$ (mV/°C)
FORWARD CURRENT I_F (mA)

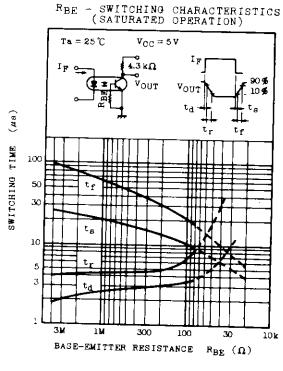

I_{FP} – V_{FP} (TYPICAL)
PULSE WIDTH ≤ 10μs
REPETITIVE
FREQUENCY = 100Hz
Ta = 25°C
PULSE FORWARD CURRENT I_{FP} (mA)
PULSE FORWARD VOLTAGE V_{FP} (V)

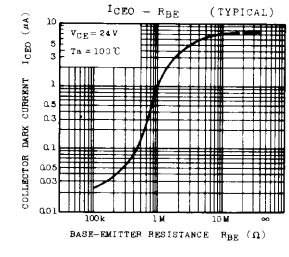

I_C – Ta (TYPICAL)
Ta = 25°C
V_{CE} = 10V
50
10
5
1
I_F = 0.5mA
COLLECTOR CURRENT I_C (mA)
AMBIENT TEMPERATURE Ta (°C)


$V_{CE(sat)}$ – Ta (TYPICAL)
COLLECTOR-EMITTER SATURATION VOLTAGE $V_{CE(sat)}$ (V)
AMBIENT TEMPERATURE Ta (°C)


I_C – V_{CE} (TYPICAL)
Ta = 25°C
20
15
10
I_F = 5mA
COLLECTOR CURRENT I_C (mA)
COLLECTOR-EMITTER VOLTAGE V_{CE} (V)


SWITCHING CHARACTERISTICS
(SATURATED OPERATION)
I_F = 5mA
V_{CC} = 5V
R_L
V_{OUT}
t_r
t_s
t_d
t_f
SWITCHING TIME (μs)
LOAD RESISTANCE R_L (kΩ)


R_{BE} – SWITCHING CHARACTERISTICS
(SATURATED OPERATION)
Ta = 25°C
V_{CC} = 5V
I_F
4.3kΩ
R_{BE}
V_{OUT}
90%
10%
t_r
t_s
t_d
t_f
SWITCHING TIME (μs)
BASE-EMITTER RESISTANCE R_{BE} (Ω)


I_{CEO} – R_{BE} (TYPICAL)
V_{CE} = 24V
Ta = 100°C
COLLECTOR DARK CURRENT I_{CEO} (μA)
BASE-EMITTER RESISTANCE R_{BE} (Ω)

DARLINGTON COUPLER

4N29, 4N29A 4N32, 4N32A

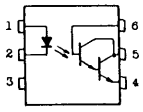
GaAs Infrared Emitting Diode & NPN Silicon Photo-Darlington

AC LINE/DIGITAL LOGIC ISOLATOR.
DIGITAL LOGIC/DIGITAL LOGIC ISOLATOR.
TELEPHONE LINE RECEIVER.
TWISTED PAIR LINE RECEIVER.
RELAY CONTACT MONITOR.

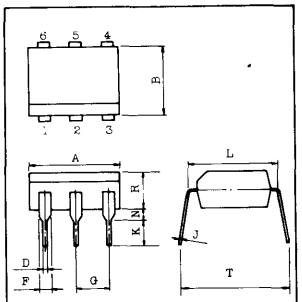
The TOSHIBA 4N29-4N29A, 4N32-4N32A consists of a gallium arsenide infrared emitting diode coupled with a silicon photo darlington in a dual in-line package.

- Small Package Size and Low Cost
- Fast Switching Speeds : 100μs
- High DC Current Transfer Ratio : 500%
- High Isolation Resistance : $10^{11}\Omega$
- High Isolation Voltage : 2500 V_{RMS}
- UL Recognized : File No. E67349

PIN CONFIGURATIONS (TOP VIEW)



Unit in mm



1. ANODE 4. EMITTER
2. CATHODE 5. COLLECTOR
3. NC 6. BASE

JEDEC	—
EIAJ	—
TOSHIBA	11-7A1F

SYMBOL	INCH	MM.
A	0.280±0.010	7.12±0.25
B	0.252	6.40
D	0.020	0.50
F	0.047	1.20
G	0.1(Typ)	2.54(Typ)
J	0.010	0.25
K	0.100(MIN)	2.50IMIN)
L	0.300	7.62
N	0.031	0.80
R	0.144	3.65
T	0.309~3.465	7.85~8.80

ABSOLUTE MAXIMUM RATINGS (Ta=25°C)

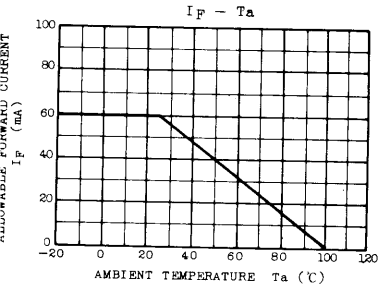
	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	80	mA
	Forward Current Derating	ΔI_F/°C	1.07*	mA/°C
	Peak Forward Current (Note)	I_{FP}	3	A
	Power Dissipation	P_D	150	mW
	Power Dissipation Derating	ΔP_D/°C	2.0*	mW/°C
	Reverse Voltage	V_R	3	V
PHOTO-DARLINGTON	Collector-Emitter Voltage	BV_{CEO}	30	V
	Collector-Base Voltage	BV_{CBO}	30	V
	Emitter-Collector Voltage	BV_{ECO}	5	V
	Collector Current	I_C	100	mA
	Power Dissipation	P_C	150	mW
	Power Dissipation Derating	ΔP_C/°C	2.0*	mW/°C
COUPLED	Storage Temperature	T_{stg}	-55~150	°C
	Operating Temperature	T_{opr}	-55~100	°C
	Lead Soldering Temperature	T_{sold}	260	°C
	Total Package Power Dissipation	P_T	250	mW
	Total Package Power Dissipation Derating	ΔP_C/°C	3.3*	mW/°C

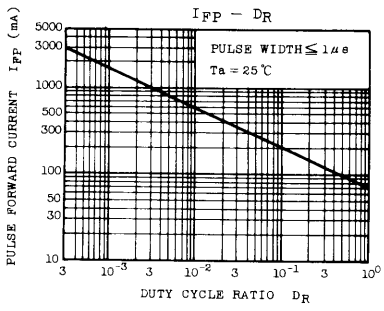
Note : Pulse width 300μs, 2% duty cycle.
* Above 25°C ambient.

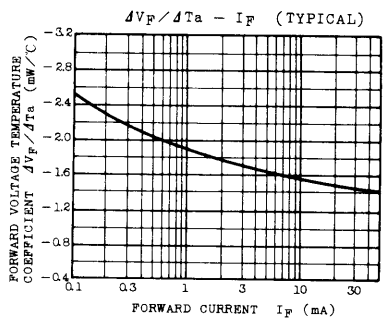
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

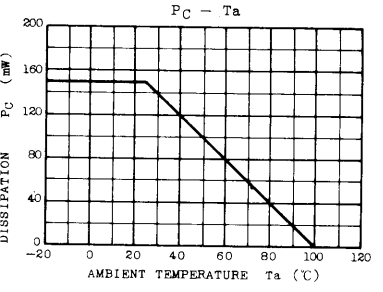
	CHARACTERISTIC		SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage		V_F	I_F=10mA	-	1.15	1.5	V
	Reverse Current		I_R	V_R=3V	-	-	100	μA
	Capacitance		C_D	V=0, f=1MHz	-	30	-	pF
PHOTO-DARLINGTON	DC Forward Current Gain		h_{FE}	V_{CE}=5, I_C=0.5mA	-	10K	-	
	Collector-Emitter Breakdown Voltage		$V_{(BR)CEO}$	I_C=1mA, I_F=0	30	-	-	V
	Collector-Base Breakdown Voltage		$V_{(BR)CBO}$	I_C=100μA, I_F=0	30	-	-	V
	Emitter-Collector Breakdown Voltage		$V_{(BR)ECO}$	I_E=100μA, I_F=0	5	-	-	V
	Collector Dark Current		I_{CEO}	V_{CE}=10V, I_F=0	-	1.0	100	nA
COUPLED	Collector Output Current 4N29-4N29A		I_C	I_F=10mA, V_{CE}=10V	10	-	-	mA
	Collector Output Current 4N32-4N32A				50	-	-	mA
	Saturation Voltage		$V_{CE(sat)}$	I_F=8mA, I_C=2mA	-	-	1.0	V
	Turn-On Time		t_{on}	I_F=200mA, V_{CC}=10V	-	-	5	μs
	Turn-Off Time	4N29, 29A	t_{off}		-	-	40	μs
		4N32, 32A					100	
	Capacitance Input to Output		C_S	V=0, f=1MHz	-	0.8	-	pF
	Isolation Resistance		R_S	V=500V	-	10^{11}	-	Ω
	Isolation Voltage	4N29, 32	*BV_S	AC	2500	-	-	V_{peak}
		4N29A, 32A			1775	-	-	V_{RMS}

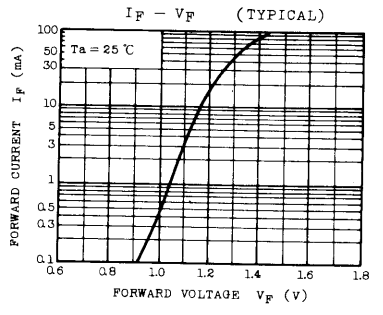
* JEDEC registered maximum BV_S is 1775 V_{RMS} (2500 V_{PK}), however, Toshiba specifies a minimum BV_S of 2500 V_{RMS}, 1 minute.

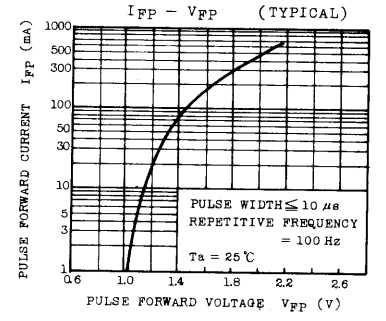

I_F – Ta
ALLOWABLE FORWARD CURRENT I_F (mA)
AMBIENT TEMPERATURE Ta (°C)

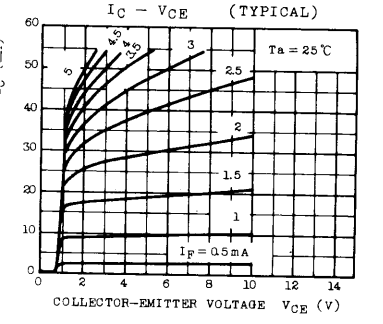

I_{FP} – D_R
PULSE WIDTH ≦ 1 μs
Ta = 25°C
PULSE FORWARD CURRENT I_{FP} (mA)
DUTY CYCLE RATIO D_R

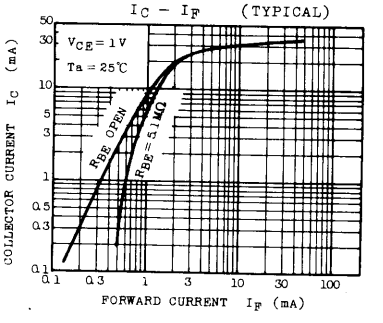

$\Delta V_F / \Delta Ta$ – I_F (TYPICAL)
FORWARD VOLTAGE TEMPERATURE COEFFICIENT $\Delta V_F / \Delta Ta$ (mV/°C)
FORWARD CURRENT I_F (mA)

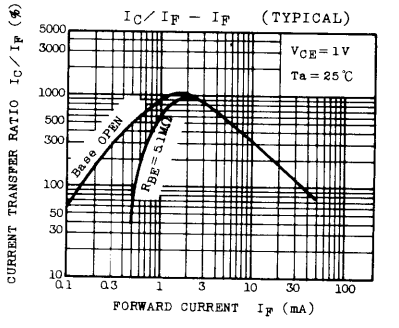

P_C – Ta
DISSIPATION P_C (mW)
AMBIENT TEMPERATURE Ta (°C)

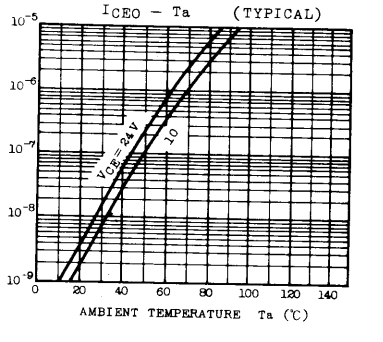

I_F – V_F (TYPICAL)
Ta = 25°C
FORWARD CURRENT I_F (mA)
FORWARD VOLTAGE V_F (V)

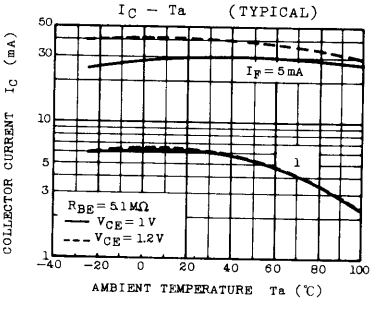

I_{FP} – V_{FP} (TYPICAL)
PULSE WIDTH ≦ 10 μs
REPETITIVE FREQUENCY = 100 Hz
Ta = 25°C
PULSE FORWARD CURRENT I_{FP} (mA)
PULSE FORWARD VOLTAGE V_{FP} (V)

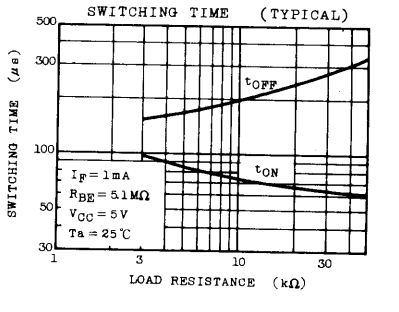

I_C – V_{CE} (TYPICAL)
Ta = 25°C
I_F = 0.5 mA
COLLECTOR–EMITTER VOLTAGE V_{CE} (V)


I_C – I_F (TYPICAL)
V_{CE} = 1 V
Ta = 25°C
R_{BE} OPEN
R_{BE} = 5.1 MΩ
COLLECTOR CURRENT I_C (mA)
FORWARD CURRENT I_F (mA)


I_C / I_F – I_F (TYPICAL)
V_{CE} = 1 V
Ta = 25°C
Base OPEN
R_{BE} = 5.1 MΩ
CURRENT TRANSFER RATIO I_C / I_F (%)
FORWARD CURRENT I_F (mA)


I_{CEO} – Ta (TYPICAL)
V_{CE} = 24 V
10
AMBIENT TEMPERATURE Ta (°C)


I_C – Ta (TYPICAL)
I_F = 5 mA
1
R_{BE} = 5.1 MΩ
V_{CE} = 1 V
V_{CE} = 1.2 V
COLLECTOR CURRENT I_C (mA)
AMBIENT TEMPERATURE Ta (°C)


SWITCHING TIME (TYPICAL)
t_{OFF}
t_{ON}
I_F = 1 mA
R_{BE} = 5.1 MΩ
V_{CC} = 5 V
Ta = 25°C
SWITCHING TIME (μs)
LOAD RESISTANCE (kΩ)

4N35

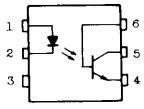
GaAs infrared Emitting Diode & NPN Silicon Photo-Transistor

AC LINE/DIGITAL LOGIC ISOLATOR.
DIGITAL LOGIC/DIGITAL LOGIC ISOLATOR.
TELEPHONE LINE RECEIVER.
TWISTED PAIR LINE RECEIVER.
HIGH FREQUENCY POWER SUPPLY FEEDBACK CONTROL.
RELAY CONTACT MONITOR.

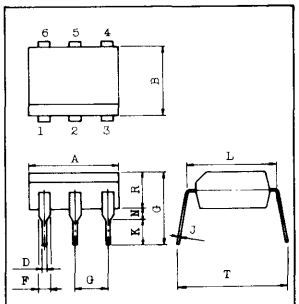
The TOSHIBA 4N35 consist of a gallium arsenide infrared emitting diode coupled with a silicon photo transistor in a dual in-line package.

- Small Package Size and Low Cost
- Fast Switching Speeds : 5μs
- High DC Current Transfer Ratio : 100%
- High Isolation Resistance : $10^{11}\Omega$
- High Isolation Voltage : 3550V (Peak)
- UL Recognized : File No. E67349

PIN CONFIGURATIONS (TOP VIEW)



Unit in mm



1. ANODE
2. CATHODE
3. NC
4. EMITTER
5. COLLECTOR
6. BASE

JEDEC	—
EIAJ	—
TOSHIBA	11-7A1F

SYMBOL	INCH	MM.
A	0.280±0.010	7.12±0.25
B	0.252	6.40
D	0.020	0.50
F	0.047	1.20
G	0.1(Typ)	2.54(Typ)
J	0.010	0.25
K	0.100(MIN)	2.50(MIN)
L	0.300	7.62
N	0.031	0.80
R	0.144	3.65
T	0.309~3.465	7.85~8.80

ABSOLUTE MAXIMUM RATINGS (Ta = 25°C)

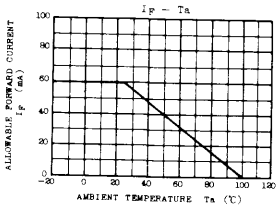
	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	60	mA
	Forward Current Derating	ΔI_F/°C	0.8*	mA/°C
	Peak Forward Current (Note)	I_{PF}	3	A
	Power Dissipation	P_D	100	mW
	Power Dissipation Derating	ΔP_D/°C	1.33*	mW/°C
	Reverse Voltage	V_R	3	V
PHOTO-TRANSISTOR	Collector-Emitter Voltage	BV_{CEO}	30	V
	Collector-Base Voltage	BV_{CBO}	70	V
	Emitter-Collector Voltage	BV_{ECO}	7	V
	Collector Current (Continuous)	I_C	100	mA
	Power Dissipation	P_C	300	mW
	Power Dissipation Derating	ΔP_C/°C	4.0*	mW/°C
COUPLED	Storage Temperature	T_{stg}	-55 ~ 150	°C
	Operating Temperature	T_{opr}	-55 ~ 100	°C
	Lead Soldering Temperature (at 10 sec.)	T_{sold}	260	°C
	Total Package Power Dissipation	P_T	250	mW
	Total Package Power Dissipation Derating	ΔP_T/°C	3.3*	mW/°C

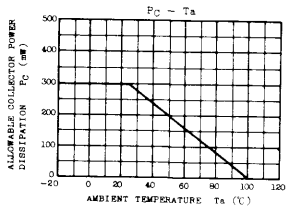
Note : Pulse width 1μs, 300pps

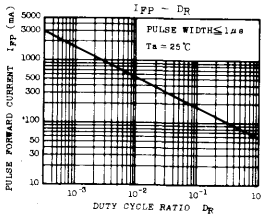
* Above 25°C ambient.

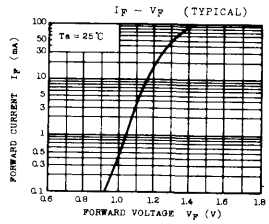
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

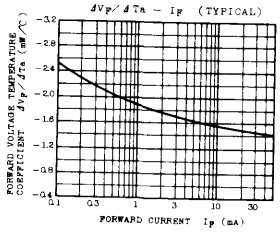
	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	-	1.15	1.5	V
			I_F=10mA, Ta=-55°C	-	-	1.7	
			I_F=10mA, Ta=100°C	-	-	1.4	
	Reverse Current	I_R	V_R=6V	-	-	10	μA
	Capacitance	C_D	V=0, f=1MHz	-	30	100	pF
PHOTO-TRANSISTOR	DC Forward Current Gain	h_{FE}	V_{CE}=5, I_C=500μA	-	200	-	
	Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C=1mA, I_F=0	30	-	-	V
	Collector-Base Breakdown Voltage	$V_{(BR)CBO}$	I_C=100μA, I_F=0	70	-	-	V
	Emitter-Collector Breakdown Voltage	$V_{(BR)ECO}$	I_E=100μA, I_F=0	7	-	-	V
	Collector Dark Current	I_{CEO}	V_{CE}=10V, I_F=0	-	1	50	nA
	Collector Dark Current	I_{CEO}	V_{CE}=30V, I_F=0 Ta=100°C	-	-	500	μA
	Collector-Emitter Capacitance	C_{CE}	V=0, f=1MHz	-	10	-	pF
COUPLED	Current Transfer Ratio	I_C/I_F	I_F=10mA, V_{CE}=10V	100	-	-	%
			I_F=10mA, V_{CE}=10V Ta=-55°C	40	-	-	
			I_F=10mA, V_{CE}=10V Ta=100°C	40	-	-	
	Saturation Voltage	$V_{CE(SAT)}$	I_F=10mA, I_C=0.5mA	-	0.1	0.3	V
	Capacitance Input to Output	C_S	V=0, f=1MHz	-	0.8	2.5	pF
	Isolation Resistance	R_S	V=500V	10^{11}	-	-	Ω
	Input to Output Isolation Current (Pulse Width=8ms)	BV_S	3550V (Peak)	-	-	100	μA
	Isolation Voltage	BV_S	AC 1 Minute	2500	-	-	V_{RMS}
	Turn on Time	t_{on}	V_{CC}=10V, I_C=2mA	-	5	10	μs
	Turn off Time	t_{off}	R_L=100Ω	-	5	10	μs

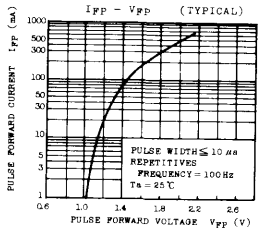

I_F – Ta
ALLOWABLE FORWARD CURRENT I_F (mA)
AMBIENT TEMPERATURE Ta (°C)

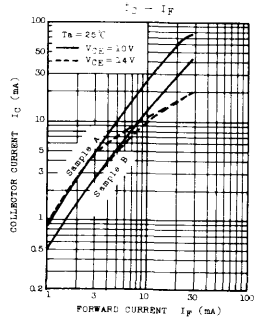

P_C – Ta
ALLOWABLE COLLECTOR POWER DISSIPATION P_C (mW)
AMBIENT TEMPERATURE Ta (°C)

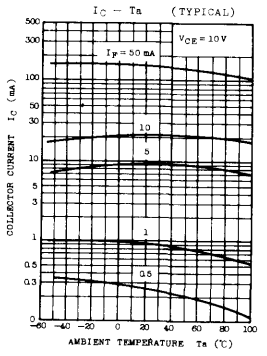

I_{FP} – D_R
PULSE WIDTH≦1 μs
Ta = 25°C
PULSE FORWARD CURRENT I_{FP} (mA)
DUTY CYCLE RATIO D_R

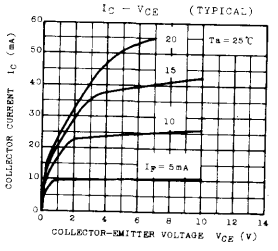

I_F – V_F (TYPICAL)
Ta = 25°C
FORWARD CURRENT I_F (mA)
FORWARD VOLTAGE V_F (V)

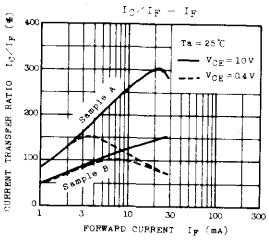

$\Delta V_F / \Delta Ta$ – I_F (TYPICAL)
FORWARD VOLTAGE TEMPERATURE COEFFICIENT $\Delta V_F / \Delta Ta$ (mV/°C)
FORWARD CURRENT I_F (mA)

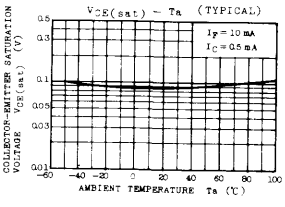

I_{FP} – V_{FP} (TYPICAL)
PULSE WIDTH≦10 μs
REPETITIVES
FREQUENCY = 100Hz
Ta = 25°C
PULSE FORWARD CURRENT I_{FP} (mA)
PULSE FORWARD VOLTAGE V_{FP} (V)

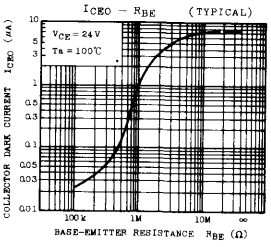

I_C – I_F
Ta = 25°C
V_{CE} = 10V
V_{CE} = 2.4V
Sample A
Sample B
COLLECTOR CURRENT I_C (mA)
FORWARD CURRENT I_F (mA)

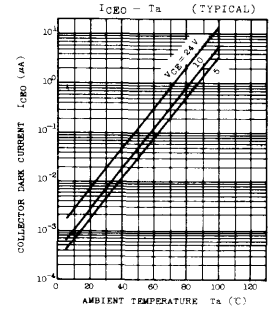

I_C – Ta (TYPICAL)
V_{CE} = 10V
I_F = 50 mA
10
5
3
0.5
COLLECTOR CURRENT I_C (mA)
AMBIENT TEMPERATURE Ta (°C)

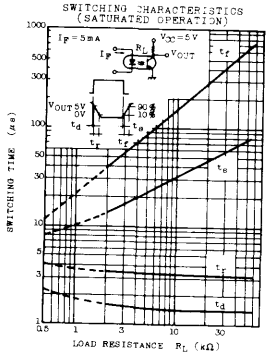

I_C – V_{CE} (TYPICAL)
Ta = 25°C
20
15
10
I_F = 5mA
COLLECTOR CURRENT I_C (mA)
COLLECTOR–EMITTER VOLTAGE V_{CE} (V)

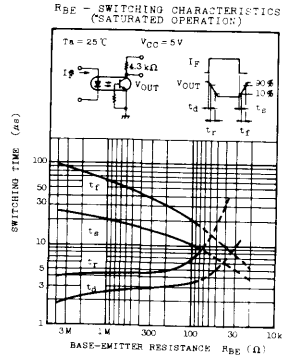

I_C / I_F – I_F
Ta = 25°C
V_{CE} = 10V
V_{CE} = 0.4V
Sample A
Sample B
CURRENT TRANSFER RATIO I_C / I_F (%)
FORWARD CURRENT I_F (mA)


V_{CE}(sat) – Ta (TYPICAL)
I_F = 10 mA
I_C = 0.5 mA
COLLECTOR–EMITTER SATURATION VOLTAGE V_{CE}(sat) (V)
AMBIENT TEMPERATURE Ta (°C)


I_{CEO} – R_{BE} (TYPICAL)
V_{CE} = 24V
Ta = 100°C
COLLECTOR DARK CURRENT I_{CEO} (μA)
BASE–EMITTER RESISTANCE R_{BE} (Ω)


I_{CEO} – Ta (TYPICAL)
V_{CE} = 24V
10
5
COLLECTOR DARK CURRENT I_{CEO} (μA)
AMBIENT TEMPERATURE Ta (°C)


SWITCHING CHARACTERISTICS (SATURATED OPERATION)
I_F = 5mA
V_{CC} = 5V
R_L
V_{OUT}
V_{OUT} 5V
0V
90%
10%
t_d
t_r
t_s
t_f
SWITCHING TIME (μs)
LOAD RESISTANCE R_L (kΩ)


R_{BE} – SWITCHING CHARACTERISTICS (SATURATED OPERATION)
Ta = 25°C
V_{CC} = 5V
4.3 kΩ
I_F
V_{OUT}
90%
10%
t_d
t_r
t_s
t_f
SWITCHING TIME (μs)
BASE–EMITTER RESISTANCE R_{BE} (Ω)

6N135, 6N136

INFRARED LED + PHOTO IC

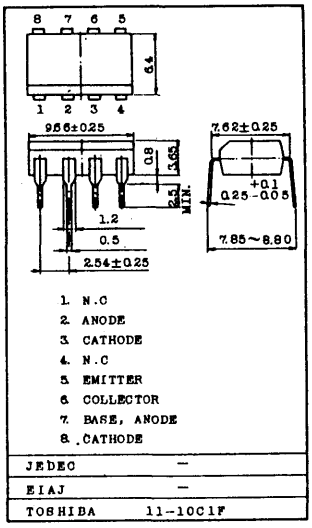
DEGITAL LOGIC ISOLATION.
LINE RECEIVER.
POWER SUPPLY CONTROL.
SWITCHING POWER SUPPLY.
TRANSISTOR INVERTER.

The TOSHIBA 6N135 and 6N136 consists of a high emitting diode and a one chip photo diode-transistor.
Each unit is 8-lead DIP package.

- High Isolation Voltage
- High Speed : t_{pHL}, t_{pLH}=0.5μs(Typ.) (R_L=1.9kΩ)
- TTL Compatible
- If Base Pin is Open, Output Signal Will be Noisy by Environmental Condition for this Case, TLP550 is Suitable.
- UL Recognized : File No. E67349

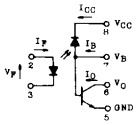
PIN CONFIGURATIONS

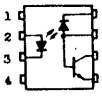
Unit in mm



1. N.C
2. ANODE
3. CATHODE
4. N.C
5. EMITTER
6. COLLECTOR
7. BASE, ANODE
8. CATHODE

JEDEC	—
EIAJ	—
TOSHIBA	11-10C1F





MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current (Note 1)	I_F	25	mA
	Pulse Forward Current (Note 2)	I_{FP}	50	mA
	Total Pulse Forward Current (Note 3)	I_{FPT}	1	A
	Reverse Voltage	V_R	5	V
	Diode Power Dissipation (Note 4)	P_D	45	mW
DETECTOR	Output Current	I_O	8	mA
	Peak Output Current	I_{OP}	16	mA
	Emitter-Base Reverse Voltage (TLP551)	V_{EB}	5	V
	Supply Voltage	V_{CC}	-0.5~15	V
	Output Voltage	V_O	-0.5~15	V
	Base Current (TLP551)	I_B	5	mA
	Output Power Dissipation (Note 5)	P_O	100	mW
Operating Temperature Range		T_{opr}	-55~100	°C
Storage Temperature Range		T_{stg}	-55~125	°C
Isolation Voltage (Note 6)		BV_S	2500	V_{rms}

Note 1 : Derate 0.8mA above 70°C.
Note 2 : 50% duty cycle, 1ms pulse width.
Derate 1.6mA/°C above 70°C.
Note 3 : Pulse width 1μs, 300pps.
Note 4 : Derate 0.9mW/°C above 70°C.
Note 5 : Derate 2mW/°C above 70°C.
Note 6 : R.H.=40~60%, AC/1 min.

ELECTRICAL CHARACTERISTICS

OVER RECOMMENDED TEMPERATURE (Ta=0°C~70°C Unless otherwise noted)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Current Transfer Ratio	6N135	CTR	I_F=16mA, V_O=0.4V, V_{CC}=4.5V, Ta=25°C (Note 1)	7	18	-	%
	6N136			19	24	-	%
	6N135	CTR	I_F=16mA, V_O=0.5V, V_{CC}=4.5V (Note 1)	5	13	-	%
	6N136			15	21	-	%
Logic Low Output Voltage	6N135	V_{OL}	I_F=16mA, I_O=1.1mA, V_{CC}=4.5V	-	0.1	0.4	V
	6N136		I_F=16mA, I_O=2.4mA, V_{CC}=4.5V	-	0.1	0.4	V
Logic High Output Current		I_{OH}	I_F=0mA, V_O=V_{CC}=5.5V, Ta=25°C	-	3	500	μA
			I_F=0mA, V_O=V_{CC}=15V, Ta=25°C	-	0.1	100	μA
		I_{OH}	I_F=0mA, V_O=V_{CC}=15V	-	-	250	μA
Logic Low Supply Current		I_{CCL}	I_F=16mA, V_O=Open, V_{CC}=15V	-	40	-	mA
Logic High Supply Current		I_{CCH}	I_F=0mA, V_O=Open, V_{CC}=15V, Ta=25°C	-	0.01	1	μA
		I_{CCH}	I_F=0mA, V_O=Open, V_{CC}=15V	-	-	2	mA
Input Forward Voltage		V_F	I_F=16mA, Ta=25°C	-	1.65	1.7	V
Temperature Coefficient of Forward Voltage		$\frac{\Delta V_F}{\Delta Ta}$	I_F=16mA	-	-1.9	-	mV/°C
Input Reverse Breakdown Voltage		BV_R	I_R=10μA, Ta=25°C	5	-	-	V
Input Capacitance		C_{IN}	f=1MHz, V_F=0	-	60	-	pF
Input-Output Insulation Leakage Current		I_{I-O}	45% Relative Humidity, t=5s, V_{I-O}=3000Vdc, Ta=25°C (Note 2)	-	-	1.0	μA
Resistance (Input-Output)		R_{I-O}	V_{I-O}=500Vdc (Note 2)	-	10^{12}	-	Ω
Capacitance (Input-Output)		C_{I-O}	f=1MHz (Note 2)	-	0.6	-	pF
Transistor DC Current Gain		h_{FE}	V_O=5V, I_O=3mA	-	80	-	-

** All typicals at Ta=25°C.

SWITCHING SPECIFICATIONS

(Unless otherwise specified. Ta=25°C, V_{CC}=5V, I_F=16mA)

CHARACTERISTIC		SYMBOL	TEST CIRCUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Propagation Dealy Time to Logic Low at Output	6N135	t_{pHL}	1	R_L=4.1kΩ	-	0.2	1.5	μs
	6N136			R_L=1.9kΩ	-	0.2	0.8	μs
Propagation Delay Time to Logic High at Output	6N135	t_{pLH}	1	R_L=4.1kΩ	-	1.0	1.5	μs
	6N136			R_L=1.9kΩ	-	0.5	0.8	μs
Common Mode Transient Immunity at Logic High Level Output (Note 3)	6N135	CM_H	2	I_F=0mA, V_{CM}=10V_{p-p}, R_L=4.1kΩ	-	1000	-	V/μs
	6N136			I_F=0mA, V_{CM}=10V_{p-p}, R_L=1.9kΩ	-	1000	-	V/μs
Common Mode Transient Immunity at Logic Low Level Output (Note 3)	6N135	CM_L	2	V_{CM}=10V_{p-p}, R_L=4.1kΩ	-	-1000	-	V/μs
	6N136			V_{CM}=10V_{p-p}, R_L=1.9kΩ	-	-1000	-	V/μs
Bandwidth (Note 4)		BW	-	R_L=100Ω	-	2	-	MHz

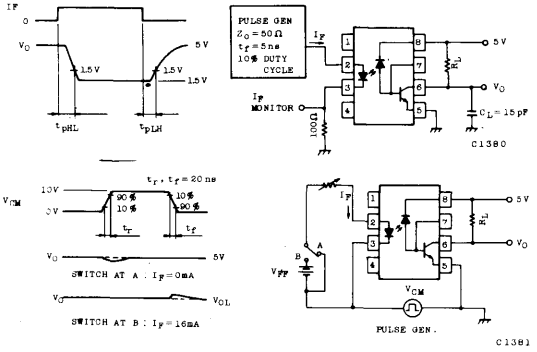
Note 1 : DC CURRENT TRANSFER RATIO is defined as the ratio of output collector current, I_O, to the forward LED input current, I_F, times 100%.

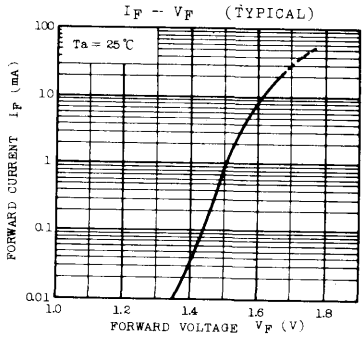
2 : Device considered a two-terminal device: Pins 1,2,3, and 4 shorted together and 5 shorted together.

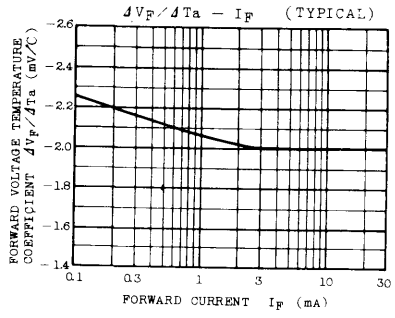
3 : Common mode transient immunity in Logic High level is the maximum tolerable (Positive) dVcm/dt on the leading edge of the common mode pulse, Vcm, to assure that the output will remain in a Logic High state (i.e., V_O>2.0V). Common mode transient immunity in Logic Low level is the maximum tolerable (negativ dVcm/dt on the trailing edge of the common mode pulse signal, Vcm, to assure that the output will remain in a Logic Low state (i.e., V_O<0.8V).

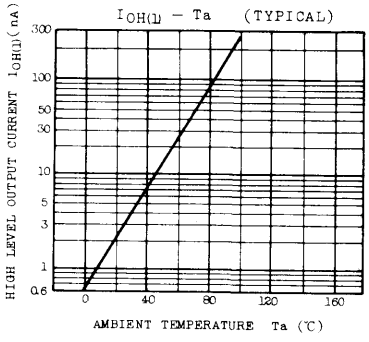
4 : The frequency at which the ac output voltage is 3dB be low the low frequency asymptote.

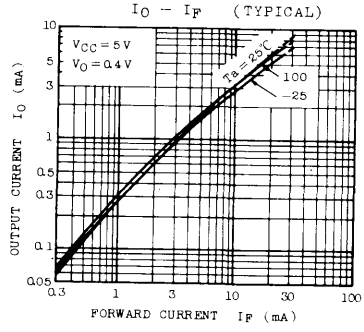
TEST CIRCUIT 2.

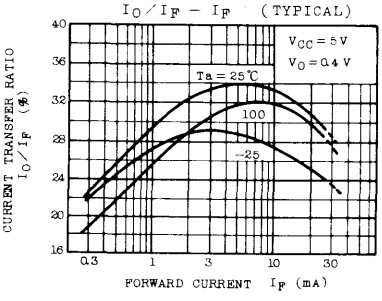


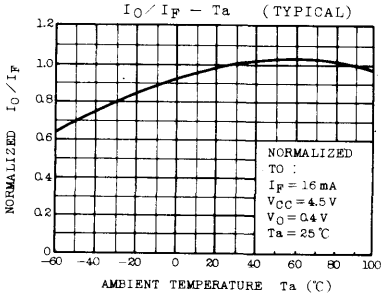

$I_F - V_F$ (TYPICAL)
Ta = 25°C
FORWARD CURRENT I_F (mA)
FORWARD VOLTAGE V_F (V)

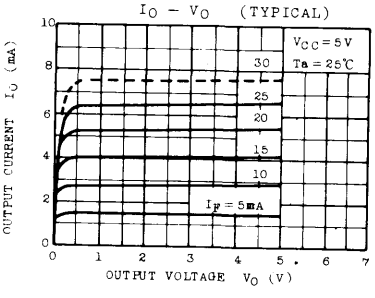

$\Delta V_F/\Delta Ta - I_F$ (TYPICAL)
FORWARD VOLTAGE TEMPERATURE COEFFICIENT $\Delta V_F/\Delta Ta$ (mV/°C)
FORWARD CURRENT I_F (mA)

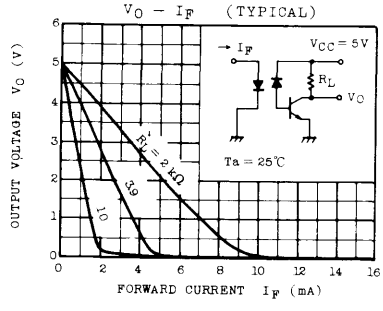

$I_{OH(1)} - Ta$ (TYPICAL)
HIGH LEVEL OUTPUT CURRENT $I_{OH(1)}$ (nA)
AMBIENT TEMPERATURE Ta (°C)

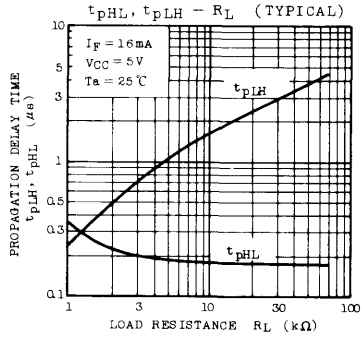

$I_O - I_F$ (TYPICAL)
V_{CC} = 5 V
V_O = 0.4 V
Ta = 25°C
100
−25
OUTPUT CURRENT I_O (mA)
FORWARD CURRENT I_F (mA)


$I_O/I_F - I_F$ (TYPICAL)
V_{CC} = 5 V
V_O = 0.4 V
Ta = 25°C
100
−25
CURRENT TRANSFER RATIO I_O/I_F (%)
FORWARD CURRENT I_F (mA)


$I_O/I_F - Ta$ (TYPICAL)
NORMALIZED I_O/I_F
NORMALIZED TO :
I_F = 16 mA
V_{CC} = 4.5 V
V_O = 0.4 V
Ta = 25°C
AMBIENT TEMPERATURE Ta (°C)


$I_O - V_O$ (TYPICAL)
V_{CC} = 5 V
Ta = 25°C
30
25
20
15
10
I_F = 5 mA
OUTPUT CURRENT I_O (mA)
OUTPUT VOLTAGE V_O (V)


$V_O - I_F$ (TYPICAL)
V_{CC} = 5 V
Ta = 25°C
R_L = 2 kΩ
0.39
0.1
OUTPUT VOLTAGE V_O (V)
FORWARD CURRENT I_F (mA)


$t_{pHL}, t_{pLH} - R_L$ (TYPICAL)
I_F = 16 mA
V_{CC} = 5 V
Ta = 25°C
t_{pLH}
t_{pHL}
PROPAGATION DELAY TIME t_{pLH}, t_{pHL} (μs)
LOAD RESISTANCE R_L (kΩ)

HIGH SPEED COUPLER

6N137

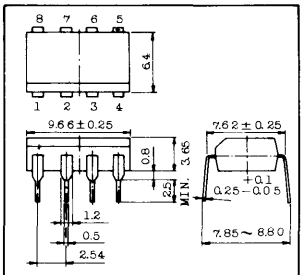
INFRARED LED + PHOTO IC

DEGITAL LOGIC ISOLATION.
TELE-COMMUNICATION.
ANALOG DATA EQUIPMENT CONTROL.

The TOSHIBA 6N137 consists of a high emitting diode and a one chip photo IC. This unit is 8-lead DIP package.

- LSTTL/TTL Compatible: 5V Supply
- Ultra High Speed: 75nS
- Guaranteed Performance over temperature
- High Isolation Voltage: 2500Vrms
- UL Recognized: File No. E6749

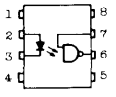
Unit in mm



1. NO CONNECTION
2. LED ANODE
3. LED CATHODE
4. NO CONNECTION
5. GND
6. OUTPUT (OPEN COLLECTOR)
7. ENABLE
8. V_{CC}

JEDC	—
EIAJ	—
TOSHIBA	11-10C1G.

PIN CONFIGURATIONS (TOP VIEW)



RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	MAX.	UNIT
Input Current, Low Level Each Channel	I_{FL}	0	250	μA
Input Current, High Level Each Channel	I_{FH}	7	20	mA
High Level Enable Voltage	V_{EH}	2.0	V_{CC}	V
Low Level Enable Voltage (Output High)	V_{EL}	0	0.8	V
Supply Voltage, Output	V_{CC}	4.5	5.5	V
Fan Out (TTL LOAD)	N	-	8	
Operating Temperature	Ta	0	70	°C

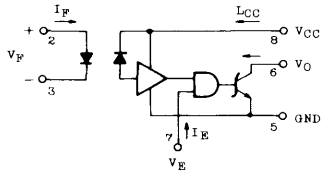
TRUTH TABLE

INPUT	ENABLE	OUTPUT
H	H	L
L	H	H
H	L	H
L	L	H

MAXIMUM RATINGS

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	20	mA
	Pulse Forward Current (Note)	I_{FP}	40	mA
	Reverse Voltage	V_R	5	V
DETECTOR	Output Current	I_O	50	mA
	Output Voltage	V_O	7	V
	Supply Voltage (1 minute Maximum)	V_{CC}	7	V
	Enable Input Voltage (Not to exceed V_{CC} by more than 500mV)	V_{EH}	5.5	V
	Output Collcetor Power Dissipation	P_O	85	mW
Operating Temperature Range		Topr	0~70	°C
Storage Temperature Range		Tstg	-55~125	°C

Note : 50% duty cycle, 1ms pulse width.



ELECTRICAL CHARACTERISTICS
OVER RECOMMENDED TEMPERATURE (Ta=0 ~ 70°C Unless otherwise noted)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	**TYP.	MAX.	UNIT
High Level Output Current	I_{OH}	V_{CC}=5.5V, V_O=5.5V, I_F=250μA, V_E=2.0V	-	1	250	μA
Low Level Output Voltage	V_{OL}	V_{CC}=5.5V, I_F=5mA, V_{EH}=2.0V, I_{OL}(Sinking)=13mA	-	0.4	0.6	V
High Level Enable Current	I_{EH}	V_{CC}=5.5V, V_E=2.0V	-	-1.0	-	mA
Low Level Enable Current	I_{EL}	V_{CC}=5.5V, V_E=0.5V	-	-1.6	-2.0	mA
High Level Supply Current	I_{CCH}	V_{CC}=5.5V, I_F=0, V_E=0.5V	-	7	15	mA
Low Level Supply Current	I_{CCL}	V_{CC}=5.5V, I_F=10mA, V_E=0.5V	-	12	18	mA
Input-Output Insulation Leakage Current (Note)	I_{I-O}	45% Relative Humidity, Ta=25°C, t=5s, V_{I-O}=3000Vdc	-	-	1.0	μA
Resistance (Input-Output) (Note)	R_{I-O}	V_{I-O}=500V, Ta=25°C	-	10^{12}	-	Ω
Capacitance (Input-Output) (Note)	C_{I-O}	f=1MHz, Ta=25°C	-	0.6	-	pF
Input Forward Voltage	V_F	I_F=10mA, Ta=25°C	-	1.65	1.75	V
Input Reverse Breakdown Voltage	BV_R	I_R=10μA, Ta=25°C	5	-	-	V
Input Capacitance	C_{IN}	V_F=0, f=1MHz	-	45	-	pF
Current Transfer Ratio	CTR	I_F=5.0mA, R_L=100Ω	-	1000	-	%

** All typical values are at V_{CC}=5V, Ta=25°C

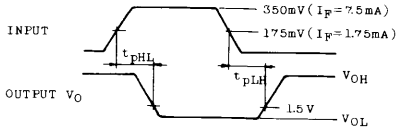
Note : Pins 1,2,3 and 4 shorted together and Pins 5,6,7 and 8 shorted together.

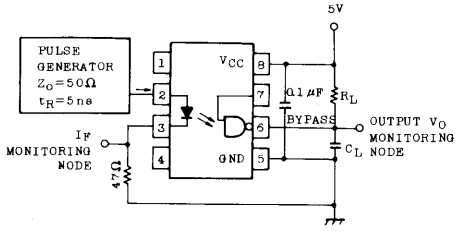
SWITCHING CHARACTERISTICS (Ta=25°C, V_{CC}=5V)

CHARACTERISTIC	SYMBOL	TEST CIRCUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Propagation Delay Time to High Output Level	t_{pLH}	1	R_L=350Ω, C_L=15pF I_F=7.5mA	-	60	75	ns
Propagation Delay Time to Low Output Level	t_{pHL}	1	R_L=350Ω, C_L=15pF I_F=7.5mA	-	60	75	ns
Output Rise-Fall Time (10-90%)	t_r, t_f	-	R_L=350Ω, C_L=15pF I_F=7.5mA	-	30	-	ns
Propagation Delay Time of Enable form V_{EH} to V_{EL}	t_{ELH}	2	R_L=350Ω, C_L=15pF I_F=7.5mA, V_{EH}=3.0V V_{EL}=0.5V	-	25	-	ns
Propagation Dealy Time of Enable from V_{EL} to V_{EH}	t_{EHL}	2	R_L=350Ω, C_L=15pF I_F=7.5mA, V_{EH}=3.0V V_{EL}=0.5V	-	25	-	ns
Common Mode Transient Immunity at Logic High Output Level	CM_H	3	V_{CM}=10V, R_L=350Ω V_O(min.)=2V I_F=0mA	-	200	-	V/μs
Common Mode Transient Immunity at Logic Low Output Level	CM_L	3	V_{CM}=10V, R_L=350Ω V_O(max.)=0.8V I_F=5mA	-	-500	-	V/μs

TEST CIRCUIT 1.

t_{pHL} and t_{pLH}

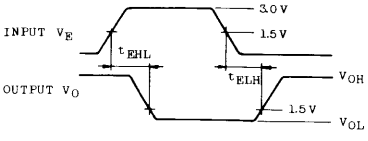


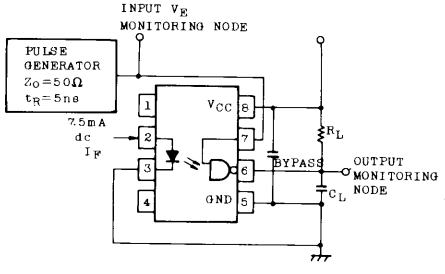


. C_L is approximately 15pF which includes probe and stray wiring capacitance.

TEST CIRCUIT 2.

t_{ELH} and t_{EHL}

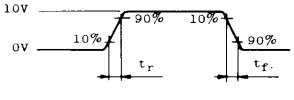


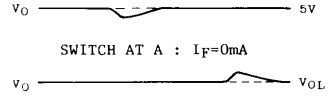


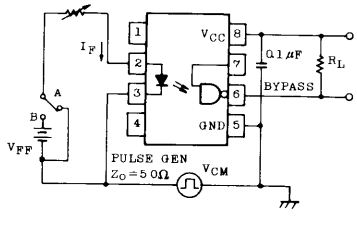
. C_L is approximately 15pF which includes prove and stray wiring capacitance.

TEST CIRCUIT 3.

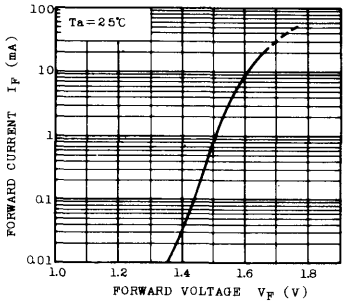
Transient Immunity and Typical Waveforms



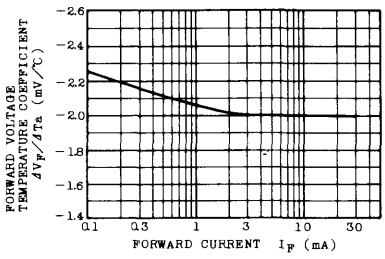




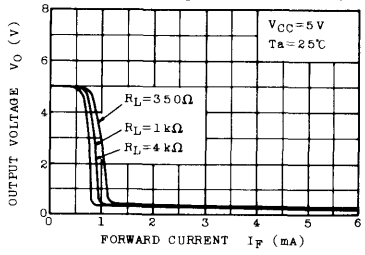
$I_F - V_F$ (TYPICAL)



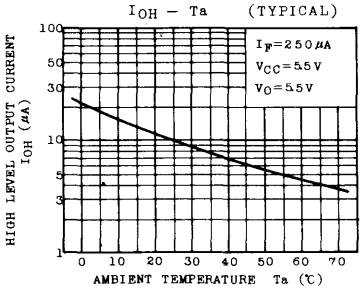
$\Delta V_F/\Delta Ta - I_F$ (TYPICAL)



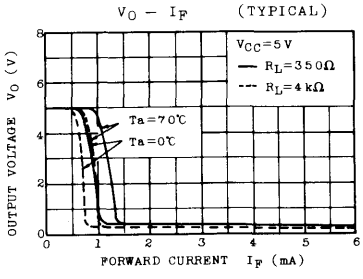
$V_O - I_F$ (TYPICAL)



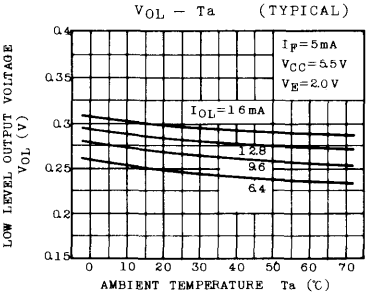
$I_{OH} - Ta$ (TYPICAL)



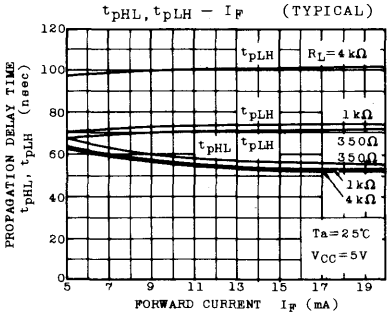
$V_O - I_F$ (TYPICAL)



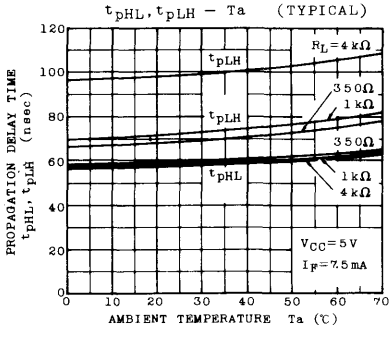
$V_{OL} - Ta$ (TYPICAL)



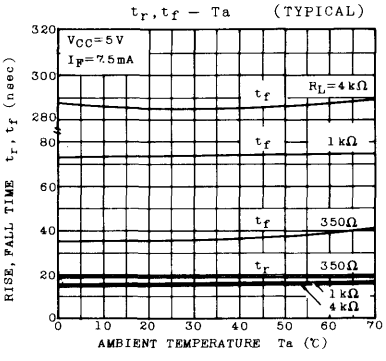
$t_{pHL}, t_{pLH} - I_F$ (TYPICAL)



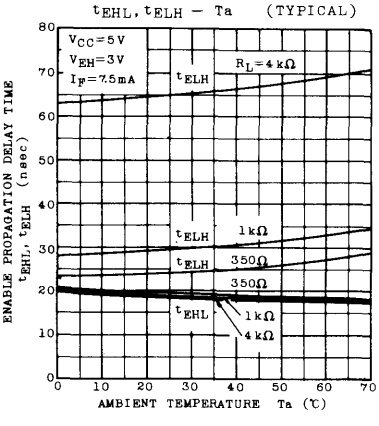
$t_{pHL}, t_{pLH} - Ta$ (TYPICAL)



$t_r, t_f - Ta$ (TYPICAL)



$t_{EHL}, t_{ELH} - Ta$ (TYPICAL)



TLP504A

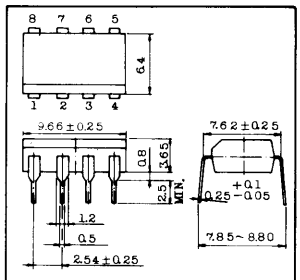
INFRARED LED + PHOTO TRANSISTOR

AC LINE/DIGITAL ISOLATOR.
PROGRAMMABLE CONTROLLERS.
SOLID STATE RELAY.

The TOSHIBA TLP504A consists of a gallium arsenide infrared emitting diode coupled with a silicone photo transistor in a dual in-line package.
The TLP504A offers two isolated channels in a eight lead plastic DIP package.

- High DC Current Transfer Ratio.....50% MIN.
- High Isolation Voltage.....2500V_{RMS}, 1 minut.
- 7400 Series TTL Compatible
- UL Recognized : File No. E67349
  Type designation P504A is identical to TLP504A.
- Direct Replacement For MCT6 and 1L-CT6A

Unit in mm



1,4 : ANODE
2,3 : CATHODE
5,8 : EMITTER
6,7 : COLLECTOR

JEDEC	—
EIAJ	—
TOSHIBA	11-10C1C

MAXIMUM RATINGS (Ta = 25°C)

	CHARACTERISTICS	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	60	mA
	Power Dissipation	P_D	100	mW
	Power Dissipation Derating	ΔP_D/°C	-1.33(Ta ≧ 25°C)	mW/°C
	Pulse Forward Current (Note 1)	I_{FP}	3	A
	Reverse Voltage	V_R	5	V
DETECTOR	Collector-Emitter Voltage	V_{CEO}	35	V
	Emitter-Collector Voltage	V_{ECO}	7	V
	Collector Current	I_C	50	mA
	Collector Power Dissipation	P_C	150	mW
	Collector Power Dissipation Derating (Ta ≧ 25°C)	ΔP_C/°C	-2	mW/°C
Operating Temperature Range		T_{opr}	-55 ~ +100	°C
Storage Temperature Range		T_{stg}	-55 ~ +150	°C
Total Power Dissipation		P_T	400	mW
Total Power Dissipation Derating (Ta ≧ 25°C)		ΔP_T/°C	-5.33	mW/°C
Isolation Voltage (Note 2)		BV_S	2500	V_{rms}

Note 1 : Pulse width 1us, 300PPS
2 : AC/1 min.

RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}	-	-	24	V
Forward Current	I_F	-	-	12	mA
Operating Temperature Range	T_{opr}	-40	-	85	°C

PRECAUTION

Please be careful of the followings.
1. Soldering temperature: 260°C MAX.
   Soldering time: 10 sec MAX.
   (Soldering portion of lead: up to 2mm from the body of the device)
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.
   o Freon TE or TF o Dai-Fron Solvents S3 or S3-E

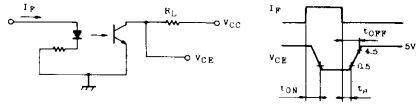
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Terminal Between Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C=0.5mA	35	-	-	V
	Emitter-Collector Breakdown Voltage	$V_{(BR)ECO}$	I_E=0.1mA	5	-	-	V
	Collector Dark Current	I_{CEO}	I_F=0, V_{CE}=24V	-	10	100	nA
			I_F=0, V_{CE}=24V, Ta=85°C	-	2	50	μA
	Terminal Between Capacitance	C_T	V_{CE}=0, f=1MHz	-	10	-	pF
COUPLED	Current Transfer Ratio	I_C/I_F	I_F=5mA, V_{CE}=5V	50	150	600	%
	Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	I_F=5mA, I_C=1mA	-	0.1	0.4	V
	Input/Output Between Stray Capacitance	C_S	V=0, f=1MHz	-	0.8	-	pF
	Isolation Voltage	R_S	R.H.=40 ~ 60%, V=1kV DC	-	10^{11}	-	Ω

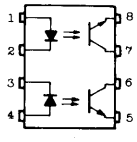
SWITCHING CHARACTERISTICS (Ta=25°C)

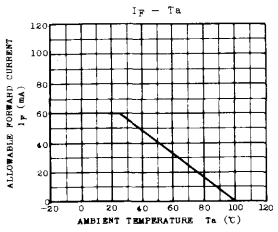
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Rise and Fall Time	t_r,t_f	V_{CC}=5V, R_L=100Ω, I_C=2mA	-	6	-	μs
Turn-on Time	t_{ON}	V_{CC}=5V, R_L=1.9kΩ, I_F=16mA	-	2	-	μs
Storage Time	t_s		-	15	-	
Turn-off Time	t_{OFF}		-	25	-	

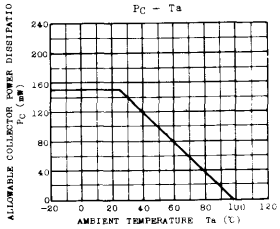
SWITCHING TIME TEST CRICUIT

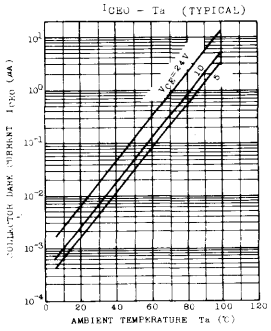


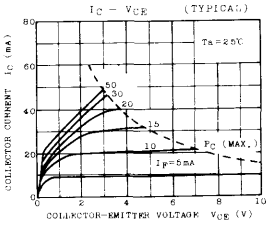
PIN CONFIGURATIONS (TOP VIEW)

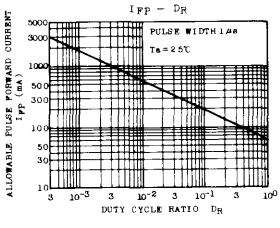


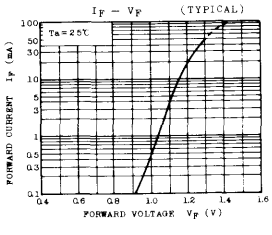

I_F – Ta
ALLOWABLE FORWARD CURRENT I_F (mA)
AMBIENT TEMPERATURE Ta (℃)

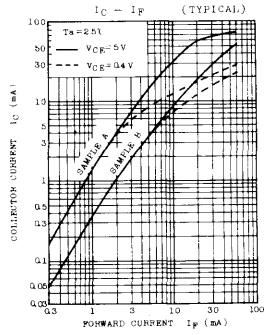

P_C – Ta
ALLOWABLE COLLECTOR POWER DISSIPATION P_C (mW)
AMBIENT TEMPERATURE Ta (℃)

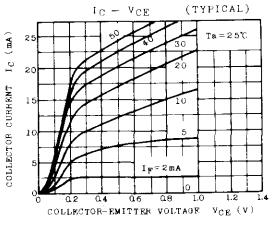

I_{CEO} – Ta (TYPICAL)
COLLECTOR DARK CURRENT I_{CEO} (nA)
V_{CE}=24V
AMBIENT TEMPERATURE Ta (℃)

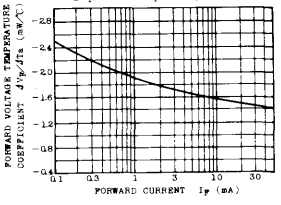

I_C – V_{CE} (TYPICAL)
Ta=25℃
P_C (MAX.)
I_F=5mA
COLLECTOR CURRENT I_C (mA)
COLLECTOR-EMITTER VOLTAGE V_{CE} (V)

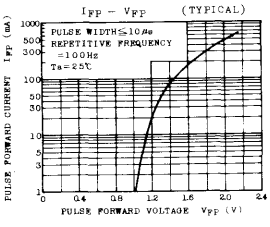

I_{FP} – D_R
PULSE WIDTH 1μs
Ta=25℃
ALLOWABLE PULSE FORWARD CURRENT I_{FP} (mA)
DUTY CYCLE RATIO D_R

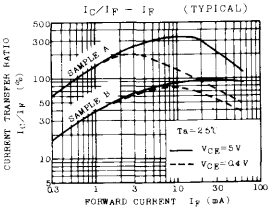

I_F – V_F (TYPICAL)
Ta=25℃
FORWARD CURRENT I_F (mA)
FORWARD VOLTAGE V_F (V)

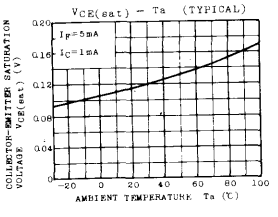

I_C – I_F (TYPICAL)
Ta=25℃
V_{CE}=5V
V_{CE}=0.4V
SAMPLE A
SAMPLE B
COLLECTOR CURRENT I_C (mA)
FORWARD CURRENT I_F (mA)

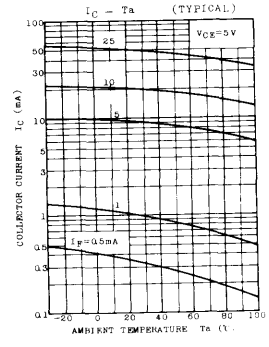

I_C – V_{CE} (TYPICAL)
Ta=25℃
I_F=2mA
COLLECTOR CURRENT I_C (mA)
COLLECTOR-EMITTER VOLTAGE V_{CE} (V)

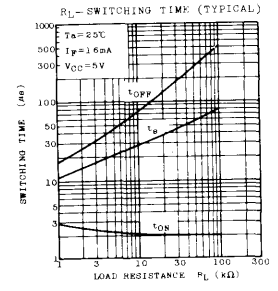

$\Delta V_F/\Delta Ta$ – I_F (TYPICAL)
FORWARD VOLTAGE TEMPERATURE COEFFICIENT $\Delta V_F/\Delta Ta$ (mV/℃)
FORWARD CURRENT I_F (mA)


I_{FP} – V_{FP} (TYPICAL)
PULSE WIDTH≦10μs
REPETITIVE FREQUENCY =100Hz
Ta=25℃
PULSE FORWARD CURRENT I_{FP} (mA)
PULSE FORWARD VOLTAGE V_{FP} (V)


I_C/I_F – I_F (TYPICAL)
SAMPLE A
SAMPLE B
Ta=25℃
V_{CE}=5V
V_{CE}=0.4V
CURRENT TRANSFER RATIO I_C/I_F (%)
FORWARD CURRENT I_F (mA)


$V_{CE(sat)}$ – Ta (TYPICAL)
I_F=5mA
I_C=1mA
COLLECTOR-EMITTER SATURATION VOLTAGE $V_{CE(sat)}$ (V)
AMBIENT TEMPERATURE Ta (℃)


I_C – Ta (TYPICAL)
V_{CE}=5V
I_F=0.5mA
COLLECTOR CURRENT I_C (mA)
AMBIENT TEMPERATURE Ta (℃)


R_L – SWITCHING TIME (TYPICAL)
Ta=25℃
I_F=16mA
V_{CC}=5V
t_{OFF}
t_S
t_{ON}
SWITCHING TIME (μs)
LOAD RESISTANCE R_L (kΩ)

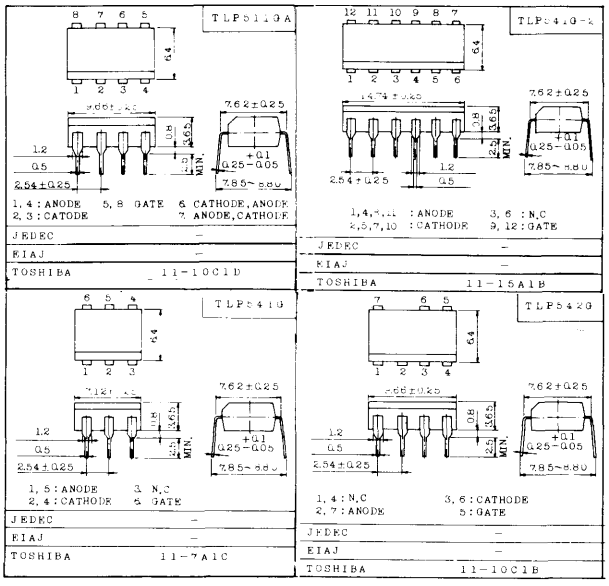
TLP511GA, 541G, 541G-2, 542G

INFRARED LED + PHOTO THYRISTOR

The TOSHIBA TLP511GA, TLP541G, TLP541G-2 and TLP542G consist of a gallium arsenide infrared emitting diode optically coupled a photo sensitive silicon controlled rectifier in a plastic dual in line package.
The TLP541G-2 provides two isolated channels per package.

- High Isolation Voltage : 2500V_{RMS}/1 min.
- Small Input Current to Trigger : 7mA
- UL Recognized : File No. E67349
  Type designations P511GA, P541G and P542G are identical to TLP511GA, TLP541G and TLP542G respectively.

Unit in mm



MAXIMUM RATINGS (Ta = 25°C)

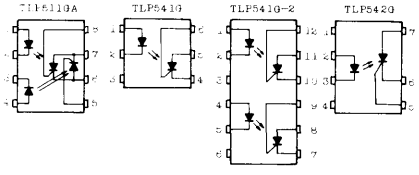
	CHARACTERISTIC	SYMBOL	RATING		UNIT
			TLP511GA	TLP541G TLP541G-2 TLP542G	
LED	Forward Current	I_F	50	70	mA
	Forward Current Derating (Ta≧25°C)	ΔI_F/°C	-0.5	-0.7	mA/°C
	Pulse Forward Current (Note 1)	I_{FP}	1		A
	Reverse Voltage	V_R	5		V
	Junction Temperature	Tj	125		°C
DETECTOR	Repetitive Peak Off-State Voltage and Repetitive Peak Reverse Voltage (R_{GK}=27kΩ)	V_{DRM} and V_{RRM}	400		V
	R.M.S. On-State Current	$I_{T(RMS)}$	200	150	mA
	On-State Current Derating	ΔI_T/°C	-2.67	-2	mA/°C
	Peak One Cycle Surge On-State Current	ΔI_{TSM}	2		A
	Peak Reverse Gate Voltage	V_{RGM}	-5		V
	Junction Temperature	Tj	100		°C
Operating Temperature Range		T_{opr}	-30 ~ +100		°C
Storage Temperature Range		T_{stg}	-55 ~ +125		°C
Isolation Voltage (Note 2)		BV_S	2500		V_{rms}

Note 1 : Pulse width ≦100μs, Repetitive frequency=100Hz
2 : AC/1 min. R.H.=40 ~ 60%

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

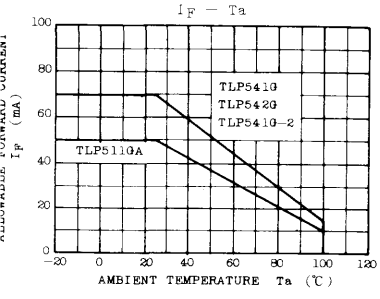
	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Terminal Between Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	Repetitive Peak Off-State Voltage and Repetitive Peak Reverse Voltage	I_{DRM} and I_{RRM}	V_{DRM}=Rated, R_{GK}=27kΩ	-	-	5	μA
			V_{DRM}=Rated, R_{GK}=27kΩ Ta=100°C	-	-	100	
	Peak On-State Voltage	V_{TM}	I_{TM}=100mA, I_F=10mA	-	0.9	1.3	V
	Holding Current	I_H	R_{GK}=27kΩ	-	0.2	1	mA
	Critical Rate of Rise of Off-State Voltage	dv/dt	V_{AK}=Rated, R_{GK}=27kΩ	5	10	-	V/μs
COUPLED	Trigger LED Current	I_{FT}	V_{AK}=6V, R_{GK}=27kΩ R_L=100Ω	1	4	7	mA
	Turn-On Time	t_{on}	I_F=50mA, R_{GK}=27kΩ	-	10	-	μs
	Input/Output Between Stray Capacitance	C_S	V=0, f=1MHz	-	0.8	-	pF
	Isolation Resistance	R_S	R.H.=40 ~ 60%, V=1kV	-	10^{11}	-	Ω

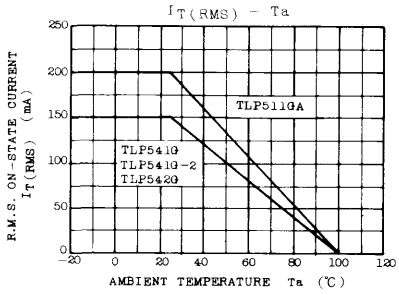
PIN CONFIGURATIONS (TOP VIEW)

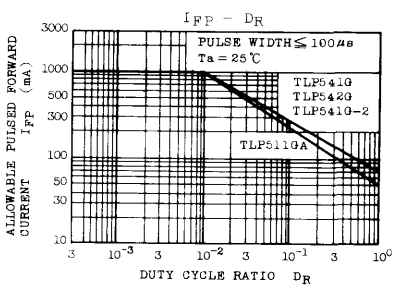


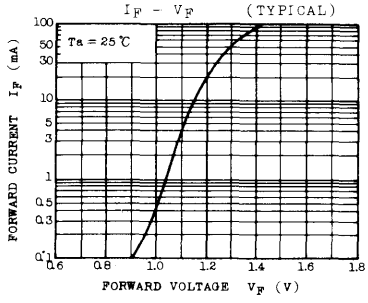
RECOMMENDED OPERATING CONDITIONS

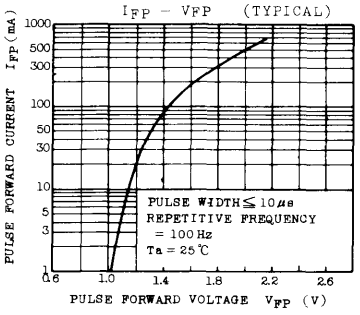
CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Working Voltage	V_{AC}	-	-	120	V_{AC}
Forward Current	I_F	16	20	30	mA
Operating Temperature Range	T_{opr}	-30	-	85	°C
Gate-Cathode Resistance	R_{GK}	-	27	33	kΩ
Gate-Cathode Capacitance	C_{GK}	-	0.01	0.1	μF

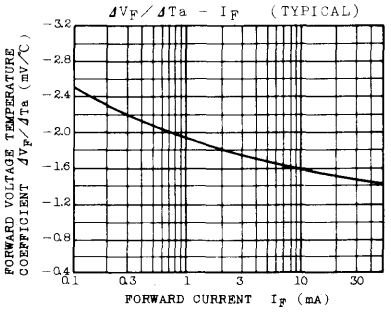


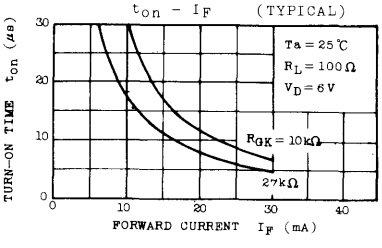


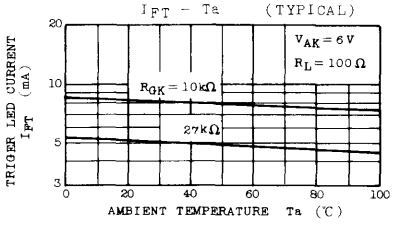


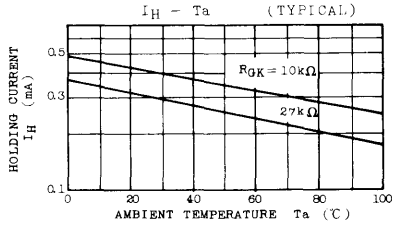

I_F – V_F (TYPICAL)
Ta = 25℃
FORWARD CURRENT I_F (mA)
FORWARD VOLTAGE V_F (V)

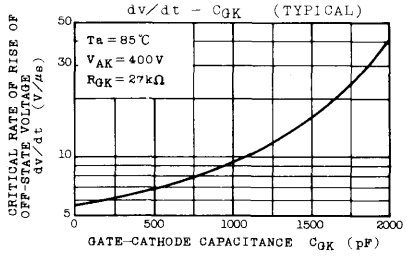

I_{FP} – V_{FP} (TYPICAL)
PULSE WIDTH ≦ 10μs
REPETITIVE FREQUENCY
= 100Hz
Ta = 25℃
PULSE FORWARD CURRENT I_{FP} (mA)
PULSE FORWARD VOLTAGE V_{FP} (V)

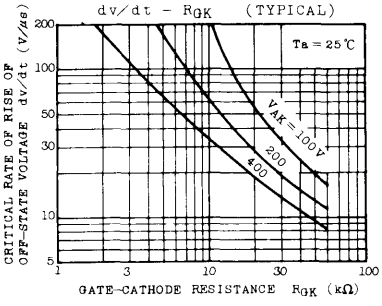

$\Delta V_F / \Delta Ta$ – I_F (TYPICAL)
FORWARD VOLTAGE TEMPERATURE COEFFICIENT $\Delta V_F / \Delta Ta$ (mV/℃)
FORWARD CURRENT I_F (mA)

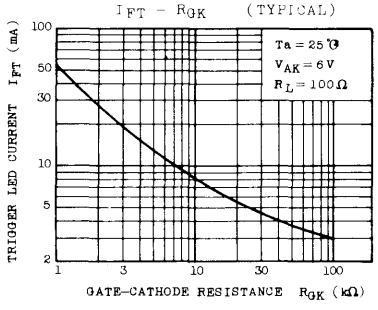

t_{on} – I_F (TYPICAL)
Ta = 25℃
R_L = 100Ω
V_D = 6V
R_{GK} = 10kΩ
27kΩ
TURN-ON TIME t_{on} (μs)
FORWARD CURRENT I_F (mA)

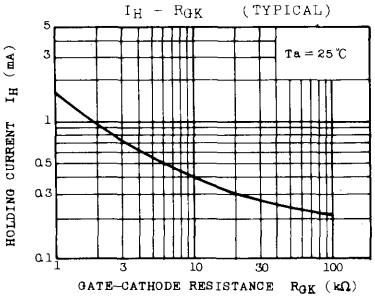

I_{FT} – Ta (TYPICAL)
V_{AK} = 6V
R_L = 100Ω
R_{GK} = 10kΩ
27kΩ
TRIGER LED CURRENT I_{FT} (mA)
AMBIENT TEMPERATURE Ta (℃)


I_H – Ta (TYPICAL)
R_{GK} = 10kΩ
27kΩ
HOLDING CURRENT I_H (mA)
AMBIENT TEMPERATURE Ta (℃)


dv/dt – C_{GK} (TYPICAL)
Ta = 85℃
V_{AK} = 400V
R_{GK} = 27kΩ
CRITICAL RATE OF RISE OF OFF-STATE VOLTAGE dv/dt (V/μs)
GATE-CATHODE CAPACITANCE C_{GK} (pF)


dv/dt – R_{GK} (TYPICAL)
Ta = 25℃
V_{AK} = 100V
200
400
CRITICAL RATE OF RISE OF OFF-STATE VOLTAGE dv/dt (V/μs)
GATE-CATHODE RESISTANCE R_{GK} (kΩ)


I_{FT} – R_{GK} (TYPICAL)
Ta = 25℃
V_{AK} = 6V
R_L = 100Ω
TRIGGER LED CURRENT I_{FT} (mA)
GATE-CATHODE RESISTANCE R_{GK} (kΩ)


I_H – R_{GK} (TYPICAL)
Ta = 25℃
HOLDING CURRENT I_H (mA)
GATE-CATHODE RESISTANCE R_{GK} (kΩ)

TLP521-1, TLP521-2, TLP521-3, TLP521-4

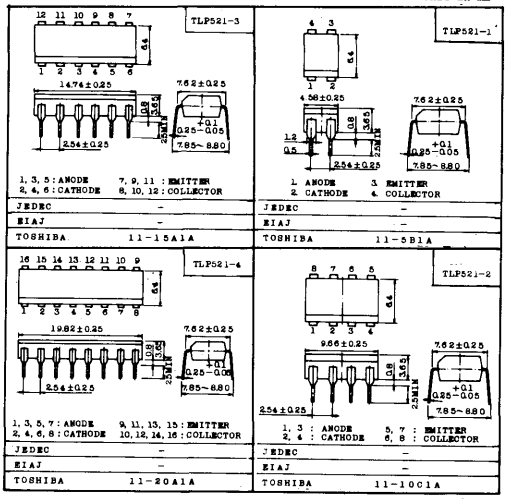
INFRARED LED + PHOTO TRANSISTOR

The TOSHIBA TLP521-1, -2, -3, -4 consist of a gallium arsenide infrared emitting diode coupled with a silicon phototransistor in a dual in-line package. The TLP521-2 offers two isolated channels in a eight lead plastic DIP package, while the TLP521-3 and TLP521-4 provide three and four isolated channels per package respectively.

- High DC Current Transfer Ratio
  .....50% MIN. CTR rank GB: 100% MIN.
  CTR rank BL: 200% MIN.
- High Isolation Voltage.....2500V_{RMS}, 1 minut.
- 7400 Series TTL Compatible
- UL Recognized : File No. E67349

  Type designations P521-1, throuth-4 are identical to TLP521-1 throuth-4.

Unit in mm



MAXIMUM RATINGS (Ta = 25°C)

	CHARACTERISTIC	SYMBOL	RATING		UNIT
			TLP521-1	TLP521-2, -3, -4	
LED	Forward Current	I_F	70	50	mA
	Forward Current Derating	ΔI_F/°C	-0.93 (Ta ≥ 50°C)	-0.5 (Ta ≥ 25°C)	mA/°C
	Pulse Forward Current (Note 1)	I_{FP}	1		A
	Reverse Voltage	V_R	5		V
DETECTOR	Collector-Emitter Voltage	V_{CEO}	35		V
	Emitter-Collector Voltage	V_{ECO}	5		V
	Collector Current	I_C	50		mA
	Collector Power Dissipation (1 Circuit)	P_C	150	100	mW
	Collector Power Dissipation Derating (1 Circuit(Ta ≥ 25°C))	ΔP_C/°C	-1.5	-1.0	mW/°C
Operating Temperature Range		Topr	-30 ~ +100		°C
Storage Temperature Range		Tstg	-55 ~ +125		°C
Total Power Dissipation		P_T	200	150	mW
Total Power Dissipation Derating (Ta ≥ 25°C)		ΔP_T/°C	-2.6	-2	mW/°C
Isolation Voltage (Note 2)		BV_S	2500		V_{rms}

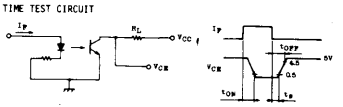
Note 1 : Pulse width ≤ 100μs, Repetitive frequency=100Hz
2 : AC/1 min. R.H.=40 ~ 60%

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

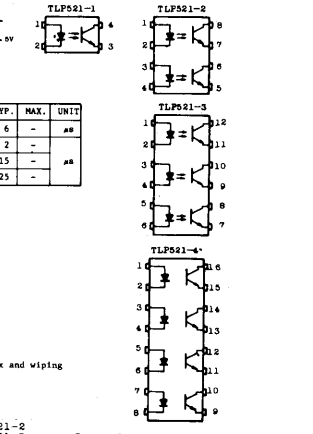
	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Terminal Between Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C=0.5mA	35	-	-	V
	Emitter-Collector Breakdown Voltage	$V_{(BR)ECO}$	I_E=0.1mA	5	-	-	V
	Collector Dark Current	I_{CEO}	I_F=0, V_{CE}=24V	-	10	100	nA
			I_F=0, V_{CE}=24V, Ta=85°C	-	2	50	μA
	Terminal Between Capacitance	C_T	V_{CE}=0, f=1MHz	-	10	-	pF
COUPLED	Current Transfer Ratio	I_C/I_F (Note)	I_F=5mA, V_{CE}=5V	50	-	600	%
	Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	I_F=5mA, I_C=1mA	-	0.1	0.4	V
	Input/Output Between Stray Capacitance	C_S	V=0, f=1MHz	-	0.8	-	pF
	Isolation Voltage	R_S	R.H.=40 ~ 60%, V=1kV DC	-	10^{11}	-	Ω

Note : CTR rank TLP521-1; A : 50 ~ 600, YG : 50 ~ 300, GB : 100 ~ 600
Y : 50 ~ 150, GR : 100 ~ 300, BL : 200 ~ 600

SWITCHING TIME TEST CIRCUIT



PIN CONFIGURATIONS (TOP VIEW)



SWITCHING CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Rise and Fall Time	t_r,t_f	V_{CC}=5V, R_L=100Ω, I_C=2mA	-	6	-	μs
Turn-on Time	t_{ON}	V_{CC}=5V, R_L=1.9kΩ	-	2	-	
Storage Time	t_s	I_F=16mA	-	15	-	μs
Turn-off Time	t_{OFF}		-	25	-	

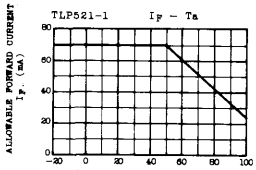
RECOMMENDED OPERATING CONDITIONS

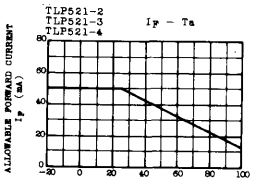
CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}	-	-	24	V
Forward Current	I_F	-	-	20(25)	mA
Operating Temperature Range	T_{opr}	-30	-	85	°C

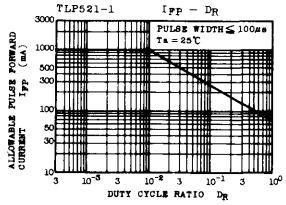
Note : ( ) is TLP521-1, TLP521-4

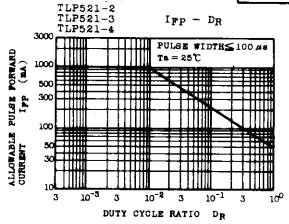
PRECAUTION

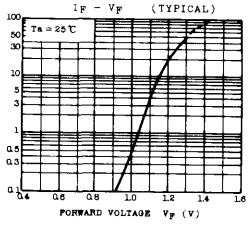
Please be careful of the followings.
1. Soldering temperature: 260°C MAX.
   Soldering time: 10 sec MAX.
   (Soldering portion of lead: up to 2mm from the body of the device)
2. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   o Freon TE or TF o Dai-Fron Solvents S3 or S3-E

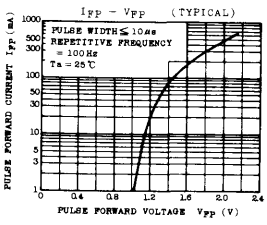


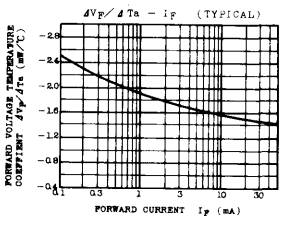


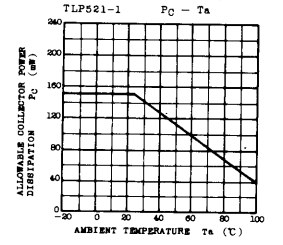






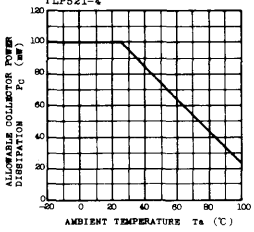




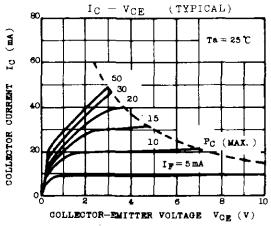


TLP521-2
TLP521-3
TLP521-4

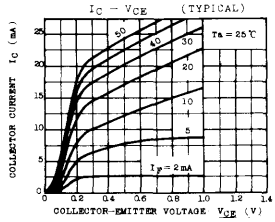
P_C – Ta



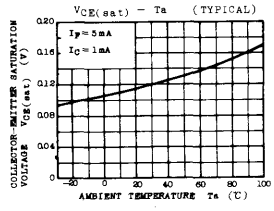
I_C – V_{CE} (TYPICAL)



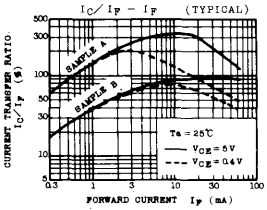
I_C – V_{CE} (TYPICAL)



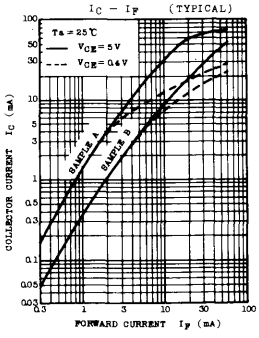
$V_{CE(sat)}$ – Ta (TYPICAL)



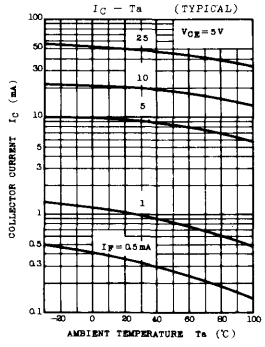
I_C / I_F – I_F (TYPICAL)



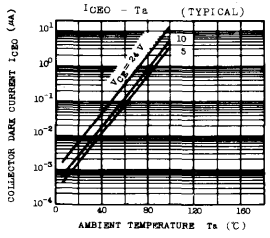
I_C – I_F (TYPICAL)



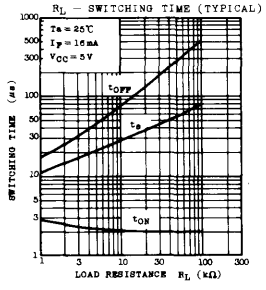
I_C – Ta (TYPICAL)



I_{CEO} – Ta (TYPICAL)



R_L – SWITCHING TIME (TYPICAL)



TLP531, TLP532

INFRARED LED + PHOTO THYRISTOR

AC LINE/DIGITAL LOGIC ISOLATOR.

DIGITAL LOGIC/DIGITAL LOGIC ISOLATOR.

TELEPHONE LINE RECEIVER.

TWISTED PAIR LINE RECEIVER.

HIGH FREQUENCY POWER SUPPLY FEEDBACK CONTROL.

RELAY CONTACT MONITOR.

The TOSHIBA Corporation TLP531 and TLP532 consist of a gallium arsenide infrared emitting diode coupled with a silicon photo transistor in a dual in-line package. TLP532 is no base connection type.

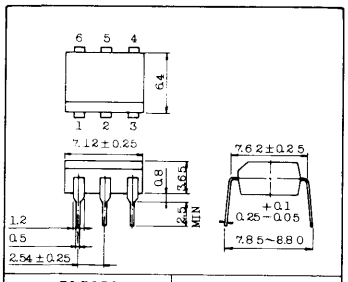
- Small Package Size and Low Cost
- Fast Switching Speeds..... 5μs
- High DC Current Transfer Ratio.....*50% Min.
- High Isolation Resistance..... $10^{11}\Omega$
- High Isolation Voltage..... 2500 V_{RMS}

*CTR Rank (@I_F=5mA, V_{CE}=5V)
Standard Type : 50% Min.
Selected Rank GB : 100% Min.
BL : 200% Min.

- UL Recognized : File No. E67349

Type designations P531 and P532 are identical to TLP531 and TLP532 respectively.

Unit in mm



TLP531	TLP532
1. ANODE 2. CATHODE 3. N.C 4. EMITTER 5. COLLECTOR 6. BASE	1. ANODE 2. CATHODE 3. N.C 4. EMITTER 5. COLLECTOR 6. N.C
JEDEC —	JEDEC —
EIAJ —	EIAJ
TOSHIBA 11-7A1A	TOSHIBA 11-7A1B

MAXIMUM RATINGS (Ta = 25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	70	mA
	Forward Current Derating (Ta≧50°C)	ΔI_F/°C	-0.93	mA/°C
	Pulse Forward Current (Note 1)	I_{FP}	1	A
	Reverse Voltage	V_R	5	V
DETECTOR	Collector-Emitter Voltage	V_{CEO}	35	V
	Collector-Base Voltage (TLP531)	V_{CBO}	50	V
	Emitter-Collector Voltage	V_{ECO}	5	V
	Emitter-Base Voltage (TLP531)	V_{EBO}	5	V
	Collector Current	I_C	50	mA
	Collector Power Dissipation	P_C	150	mW
	Collector Power Dissipation Derating (Ta≧25°C)	ΔP_C/°C	-1.5	mW/°C
Operating Temperature Range		T_{opr}	-30 ~ 100	°C
Storage Temperature Range		T_{stg}	-55 ~ 125	°C
Junction Temperature		Tj	125	°C
Total Power Dissipation		P_T	200	mW
Total Power Dissipation Derating (Ta≧25°C)		ΔP_T/°C	-2.6	mW/°C
Isolation Voltage (Note 2)		BV_S	2500	Vrms

Note 1 : Pulse width≦10μs, Repetitive frequency=100Hz
2 : AC/1 min. R.H.≦40 ~ 60%

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. 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

ELECTRC-OPTICAL CHARACTERISTICS (Ta = 25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Terminal Between Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C=0.5mA	35	-	-	V
	Emitter-Collector Breakdown Voltage	$V_{(BR)ECO}$	I_E=0.1mA	5	-	-	V
	Emitter-Base Breakdown Voltage (P531)	$V_{(BR)EBO}$	I_E=0.1mA	5	-	-	V
	Collector Dark Current	I_{CEO}	I_F=0, V_{CE}=24V	-	10	100	nA
			I_F=0, V_{CE}=24V, Ta=85°C	-	2	50	μA
	Terminal Between Capacitance	C_T	V_{CE}=0, f=1MHz	-	10	-	pF
COUPLED	Current Transfer Ratio	I_C/I_F (Note)	I_F=5mA, V_{CE}=5V	50	-	600	%
	Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	I_F=5mA, I_C=1mA	-	0.1	0.4	V
	Input/Output Between Stray Capacitance	C_S	V=0, f=1MHz	-	0.8	-	pF
	Isolation Voltage	R_S	R.H.≦40 ~ 60%, V=1kV DC	-	10^{11}	-	Ω
	Rise/Fall Time	tr,tf	V_{CC}=10V, I_C=2mA, R_L=100Ω	-	6	-	μs
	Turn-on Time	t_{on}	V_{CC}=5V, R_L=1.9kΩ	-	2 (2)	-	μs
	Storage Time	t_s	I_F=16mA, R_{BE}=220kΩ	-	12 (15)	-	
	Turn-off Time	t_{off}		-	20 (25)	-	

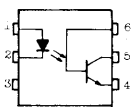
Note : A:50 ~ 600 YG:50 ~ 300, GB:100 ~ 600, Y:50 ~ 150, GR:100 ~ 300, BL:200 ~ 600 ( ) : TLP532

RECOMMENDED OPERATING CONDITIONS

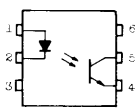
CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}	-	-	24	V
Forward Current	I_F	-	10	25	mA
Operating Temperature Range	T_{opr}	-30	-	85	°C

PIN CONFIGURATIONS

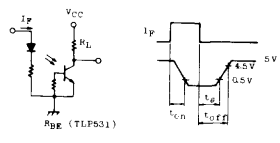
TLP531

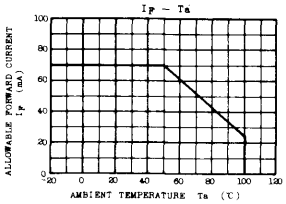


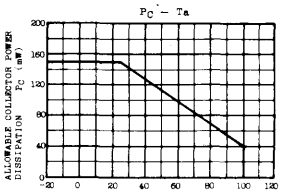
TLP532

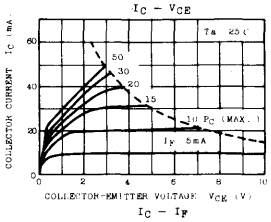


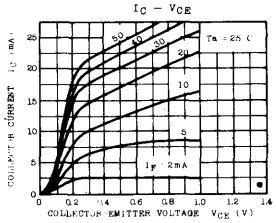
SWITCHING TIME TEST CIRCUIT

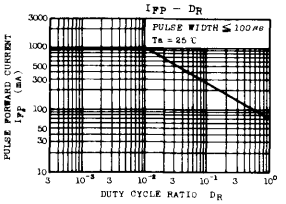


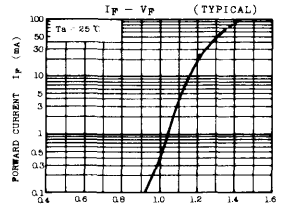

I_F – Ta
ALLOWABLE FORWARD CURRENT I_F (mA)
AMBIENT TEMPERATURE Ta (°C)

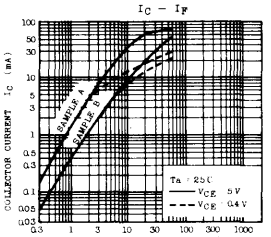

P_C – Ta
ALLOWABLE COLLECTOR POWER DISSIPATION P_C (mW)
AMBIENT TEMPERATURE Ta (°C)

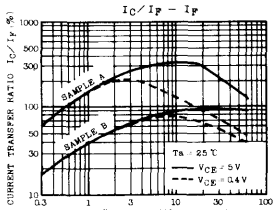

I_C – V_{CE}
COLLECTOR CURRENT I_C (mA)
Ta = 25°C
I_F = 5mA
COLLECTOR-EMITTER VOLTAGE V_{CE} (V)

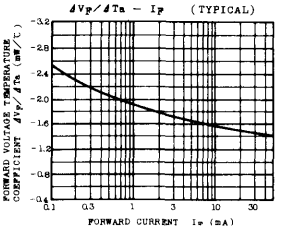

I_C – V_{CE}
COLLECTOR CURRENT I_C (mA)
Ta = 25°C
I_F = 2mA
COLLECTOR-EMITTER VOLTAGE V_{CE} (V)

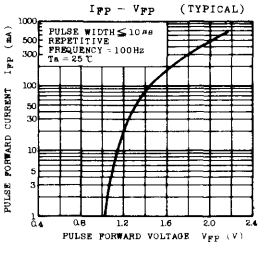

I_{FP} – D_R
PULSE FORWARD CURRENT I_{FP} (mA)
PULSE WIDTH ≦ 100μs
Ta = 25°C
DUTY CYCLE RATIO D_R

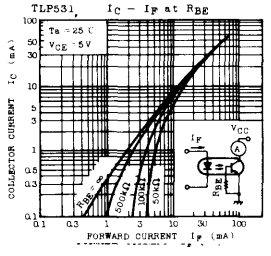

I_F – V_F (TYPICAL)
FORWARD CURRENT I_F (mA)
Ta = 25°C
FORWARD VOLTAGE V_F (V)

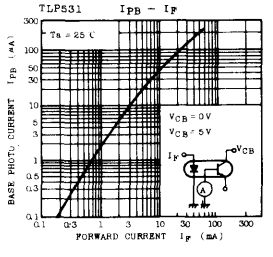

I_C – I_F
COLLECTOR CURRENT I_C (mA)
SAMPLE A
SAMPLE B
Ta = 25°C
V_{CE} = 5V
V_{CE} = 0.4V
FORWARD CURRENT I_F (mA)

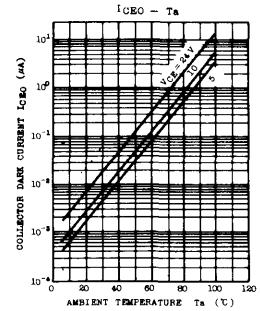

I_C / I_F – I_F
CURRENT TRANSFER RATIO I_C / I_F (%)
SAMPLE A
SAMPLE B
Ta = 25°C
V_{CE} = 5V
V_{CE} = 0.4V
FORWARD CURRENT I_F (mA)

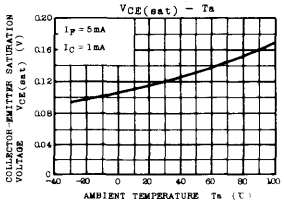

dV_F/dTa – I_F (TYPICAL)
FORWARD VOLTAGE TEMPERATURE COEFFICIENT dV_F/dTa (mV/°C)
FORWARD CURRENT I_F (mA)

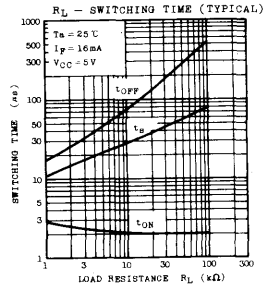

I_{FP} – V_{FP} (TYPICAL)
PULSE FORWARD CURRENT I_{FP} (mA)
PULSE WIDTH ≦ 10μs
REPETITIVE FREQUENCY = 100Hz
Ta = 25°C
PULSE FORWARD VOLTAGE V_{FP} (V)

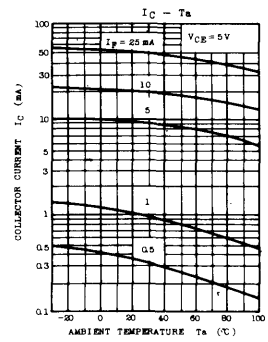

TLP531, I_C – I_F at R_{BE}
COLLECTOR CURRENT I_C (mA)
Ta = 25°C
V_{CE} = 5V
R_{BE} = ∞
500kΩ
100kΩ
50kΩ
I_F
V_{CC}
R_{BE}
FORWARD CURRENT I_F (mA)

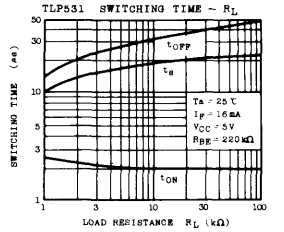

TLP531 I_{PB} – I_F
BASE PHOTO CURRENT I_{PB} (mA)
Ta = 25°C
V_{CB} = 0V
V_{CB} = 5V
I_F
V_{CB}
FORWARD CURRENT I_F (mA)

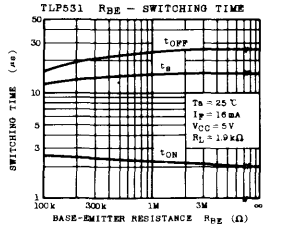

I_{CEO} – Ta
COLLECTOR DARK CURRENT I_{CEO} (mA)
V_{CE} = 24V
10
5
AMBIENT TEMPERATURE Ta (°C)


$V_{CE(sat)}$ – Ta
COLLECTOR-EMITTER SATURATION VOLTAGE $V_{CE(sat)}$ (V)
I_F = 5mA
I_C = 1mA
AMBIENT TEMPERATURE Ta (°C)


R_L – SWITCHING TIME (TYPICAL)
SWITCHING TIME (μs)
Ta = 25°C
I_F = 16mA
V_{CC} = 5V
t_{OFF}
t_s
t_{ON}
LOAD RESISTANCE R_L (kΩ)


I_C – Ta
COLLECTOR CURRENT I_C (mA)
I_F = 25mA
V_{CE} = 5V
10
5
1
0.5
AMBIENT TEMPERATURE Ta (°C)


TLP531 SWITCHING TIME – R_L
SWITCHING TIME (μs)
t_{OFF}
t_s
t_{ON}
Ta = 25°C
I_F = 16mA
V_{CC} = 5V
R_{BE} = 220kΩ
LOAD RESISTANCE R_L (kΩ)


TLP531 R_{BE} – SWITCHING TIME
SWITCHING TIME (μs)
t_{OFF}
t_s
t_{ON}
Ta = 25°C
I_F = 16mA
V_{CC} = 5V
R_L = 1.9kΩ
BASE-EMITTER RESISTANCE R_{BE} (Ω)

TLP535

GaAs infrared Emitting Diode & NPN Silicon Photo-Transistor

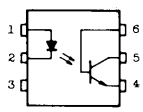
AC LINE/DIGITAL LOGIC ISOLATOR.
DIGITAL LOGIC/DIGITAL LOGIC ISOLATOR.
TELEPHONE LINE RECEIVER.
TWISTED PAIR LINE RECEIVER.
HIGH FREQUENCY POWER SUPPLY FEEDBACK CONTROL.
RELAY CONTACT MONITOR.

The TOSHIBA TLP535 consist of a gallium arsenide infrared emitting diode coupled with a silicon photo transistor in a dual in-line package.

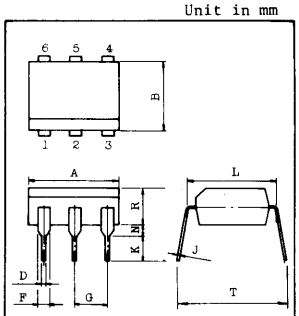
- Small Package Size and Low Cost
- Fast Switching Speeds : 5μs
- High DC Current Transfer Ratio : *50% Min.

  * CTR Rank (@I_F=10mA, V_{CE}=10V)
  Standard Type : 50% Min.
  Selected Rank GR : 100% Min.
  Selected Rank BL : 200% Min.
- High Isolation Resistance : $10^{11}\Omega$
- High Isolation Voltage : 2500 V_{RMS}
- UL Recognized*-File E67349
- Type Designation P535 is identical to TLP535.

PIN CONFIGURATIONS (TOP VIEW)



Unit in mm



1. ANODE 4. EMITTER
2. CATHODE 5. COLLECTOR
3. NC 6. BASE

JEDEC	—
EIAJ	—
TOSHIBA	11-7A1F

SYMBOL	INCH	MM.
A	0.280±0.010	7.12±0.25
B	0.252	6.40
D	0.020	0.50
F	0.047	1.20
G	0.1(TYP)	2.54(TYP)
J	0.010	0.25
K	0.100(MIN)	2.50(MIN)
L	0.300	7.62
N	0.031	0.80
R	0.144	3.65
T	0.309~3.465	7.85~8.80

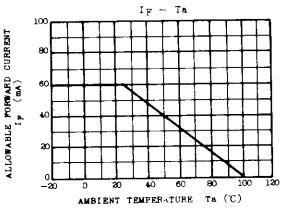
ABSOLUTE MAXIMUM RATINGS (Ta =25°C)

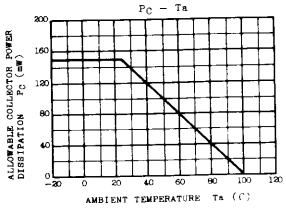
	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	60	mA
	Forward Current Derating	ΔI_F/°C	0.8*	mA/°C
	Peak Forward Current (Note)	I_{PF}	3	A
	Power Dissipation	P_D	100	mW
	Power Dissipation Derating	ΔP_D/°C	1.33*	mW/°C
	Reverse Voltage	V_R	3	V
PHOTO-TRANSISTOR	Collector-Emitter Voltage	BV_{CEO}	35	V
	Collector-Base Voltage	BV_{CBO}	70	V
	Emitter-Collector Voltage	BV_{ECO}	7	V
	Collector Current	I_C	100	mA
	Power Dissipation	P_C	150	mW
	Power Dissipation Derating	ΔP_C/°C	2.0*	mW/°C
COUPLED	Storage Temperature	T_{stg}	-55 ~ 150	°C
	Operating Temperature	T_{opr}	-55 ~ 100	°C
	Lead Soldering Temperature (at 10 sec.)	T_{sold}	260	°C
	Total Package Dissipation	P_T	200	mW
	Total Package Power Dissipation Derating	ΔP_T/°C	2.6*	mW/°C

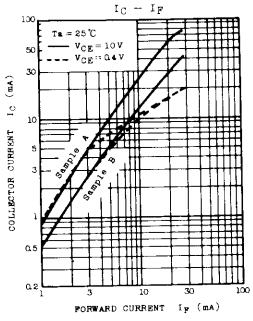
Note : Pulse width 1μs, 300 pps.
* Above 25°C ambient.

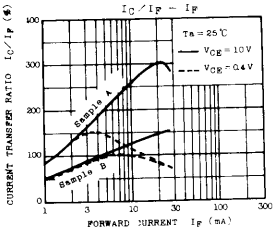
ELECTRICAL CHARACTERISTICS (Ta =25°C)

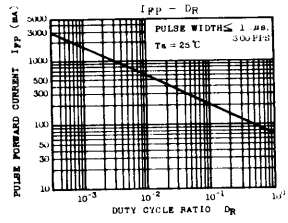
	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=3V	-	-	100	μA
	Capacitance	C_D	V=0, f=1MHz	-	30	-	pF
PHOTO-TRANSISTOR	DC Forward Current Gain	h_{FE}	V_{CE}=5, I_C=500μA	100	200	-	
	Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C=1mA, I_F=0	35	-	-	V
	Collector-Base Breakdown Voltage	$V_{(BR)CBO}$	I_C=100μA, I_F=0	70	-	-	V
	Emitter-Collector Breakdown Voltage	$V_{(BR)ECO}$	I_E=100μA, I_F=0	7	-	-	V
	Collector Dark Current	I_{CEO}	V_{CE}=10V, I_F=0	-	1	50	nA
	Collector Dark Current	I_{CBO}	V_{CB}=10V, I_F=0	-	0.1	20	nA
	Collector-Emitter Capacitance	C_{CE}	V=0, f=1MHz	-	10	-	pF
COUPLED	Current Transfer Ratio	I_C/I_F GR	I_F=10mA, V_{CE}=10V	50	-	-	%
		I_C/I_F BL		100			
				200			
	Saturation Voltage	$V_{CE(SAT)}$	I_F=10mA, I_C=2mA	-	0.1	0.3	V
	Capacitance Input to Output	C_S	V=0, f=1MHz	-	0.8	-	pF
	Isolation Resistance	R_S	V=500V	-	10^{11}	-	Ω
	AC Isolation Voltage	BV_S	AC 1 minute	2500	-	-	V_{RMS}
	Peak Isolation Voltage	BV_S	Peak	3550	-	-	V
	Rise Fall Time	t_r/t_f	V_{CE}=10V, I_C=2mA, R_L=100Ω	-	5	-	μs
	Rise/Fall Time Photo Diode	t_r/t_f	V_{CB}=10V, I_{CB}=50μA, R_L=100Ω	-	200	-	ns
	Turn-on Time	t_{on}	V_{CC}=5V, R_L=1.9kΩ, I_F=16mA	-	2	-	μs
	Storage Time	t_s		-	12	-	
	Turn-off Time	t_{off}	R_{BE}=220kΩ	-	20	-	

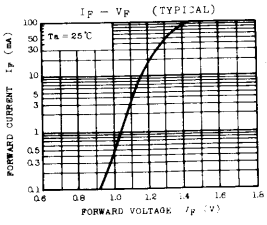

I_F – Ta
ALLOWABLE FORWARD CURRENT I_F (mA)
AMBIENT TEMPERATURE Ta (°C)

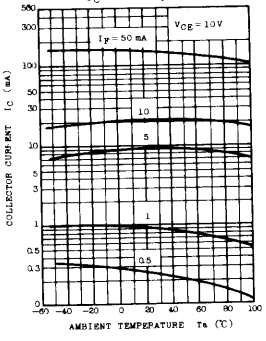

P_C – Ta
ALLOWABLE COLLECTOR POWER DISSIPATION P_C (mW)
AMBIENT TEMPERATURE Ta (°C)

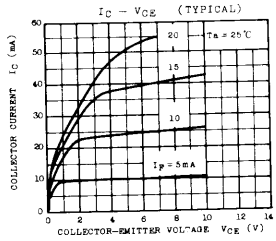

I_C – I_F
Ta = 25°C
V_{CE} = 10V
V_{CE} = 0.4V
Sample A
Sample B
COLLECTOR CURRENT I_C (mA)
FORWARD CURRENT I_F (mA)

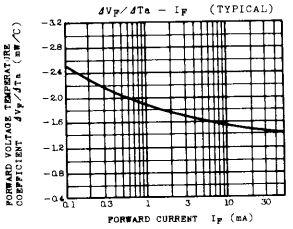

I_C / I_F – I_F
Ta = 25°C
V_{CE} = 10V
V_{CE} = 0.4V
Sample A
Sample B
CURRENT TRANSFER RATIO I_C/I_F (%)
FORWARD CURRENT I_F (mA)

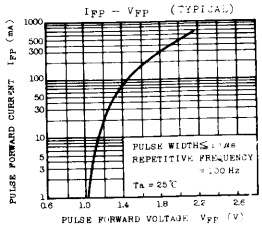

I_{FP} – D_R
PULSE WIDTHS ≦ 1 μs, 300PPS
Ta = 25°C
PULSE FORWARD CURRENT I_{FP} (mA)
DUTY CYCLE RATIO D_R

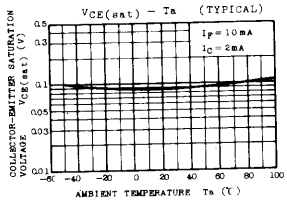

I_F – V_F (TYPICAL)
Ta = 25°C
FORWARD CURRENT I_F (mA)
FORWARD VOLTAGE V_F (V)

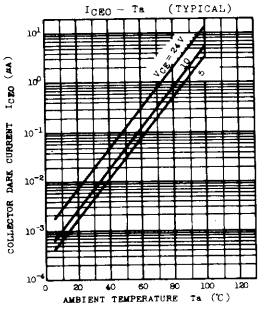

I_C – Ta (TYPICAL)
V_{CE} = 10V
I_F = 50 mA
10
5
1
0.5
COLLECTOR CURRENT I_C (mA)
AMBIENT TEMPERATURE Ta (°C)

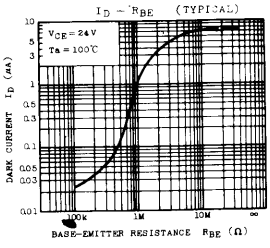

I_C – V_{CE} (TYPICAL)
Ta = 25°C
20
15
10
I_F = 5mA
COLLECTOR CURRENT I_C (mA)
COLLECTOR-EMITTER VOLTAGE V_{CE} (V)

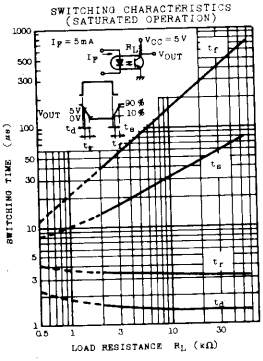

$\delta V_F / \delta Ta$ – I_F (TYPICAL)
FORWARD VOLTAGE TEMPERATURE COEFFICIENT $\delta V_F / \delta Ta$ (mV/°C)
FORWARD CURRENT I_F (mA)

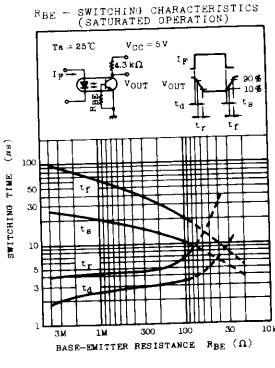

I_{FP} – V_{FP} (TYPICAL)
PULSE WIDTHS ≦ 1 μs
REPETITIVE FREQUENCY = 100 Hz
Ta = 25°C
PULSE FORWARD CURRENT I_{FP} (mA)
PULSE FORWARD VOLTAGE V_{FP} (V)


$V_{CE(sat)}$ – Ta (TYPICAL)
I_F = 10 mA
I_C = 2mA
COLLECTOR-EMITTER SATURATION VOLTAGE $V_{CE(sat)}$ (V)
AMBIENT TEMPERATURE Ta (°C)


I_{CEO} – Ta (TYPICAL)
V_{CE} = 24V
12V
COLLECTOR DARK CURRENT I_{CEO} (A)
AMBIENT TEMPERATURE Ta (°C)


I_D – R_{BE} (TYPICAL)
V_{CE} = 24V
Ta = 100°C
DARK CURRENT I_D (A)
BASE-EMITTER RESISTANCE R_{BE} (Ω)


SWITCHING CHARACTERISTICS (SATURATED OPERATION)
I_F = 5mA
V_{CC} = 5V
V_{OUT}
t_r
t_s
t_d
SWITCHING TIME (μs)
LOAD RESISTANCE R_L (kΩ)


R_{BE} – SWITCHING CHARACTERISTICS (SATURATED OPERATION)
Ta = 25°C
V_{CC} = 5V
4.3kΩ
R_{BE}
I_F
V_{OUT}
90%
10%
t_d
t_s
t_r
t_f
SWITCHING TIME (μs)
BASE-EMITTER RESISTANCE R_{BE} (Ω)

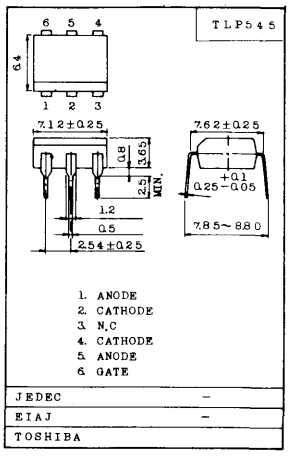
TLP543H, 543J, 545H, 545J

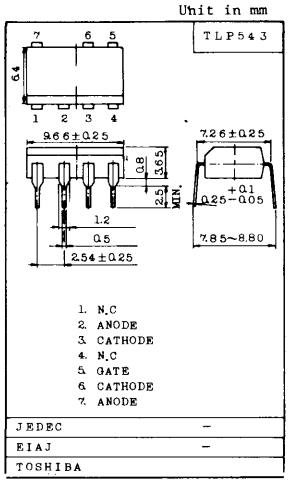
INFRARED LED + PHOTO THYRISTOR

TLP543H,J and TLP545H,J consist of a photo sensitive SCR coupled to a gallium arsenide infrared emitting diode in a DIP package.

- Trigger LED Current : I_{FT}=10mA(Max.)
- On-State Current : $I_{T(RMS)}$=150mA
- Peak Blocking Voltage
  : TLP543H, TLP545H, V_{DRM}=V_{RRM}=500V
  TLP543J, TLP545J, V_{DRM}=V_{RRM}=600V
- Isolation Voltage : BV_S=2500V AC/1 minute
- UL Recognized : File No. E67349
  Type designations P543H,J and P545H,J are identical to TLP543H,J and TLP545H,J respectively.

Unit in mm





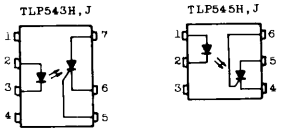
MAXIMUM RATINGS (Ta = 25°C)

	CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	DC Forward Current		I_F	70	mA
	DC Forward Current Reduction Rate (Ta≥25°C)		ΔI_F/°C	0.7	mA/°C
	Pulse Forward Current (Note)		I_{FP}	1	A
	DC Reverse Voltage		V_R	5	V
	Junction Temperature		Tj	100	°C
DETECTOR	Peak Forward Blocking Voltage and Peak Reverse Voltage (R_{GK}=27kΩ)	TLP543H TLP545H	V_{DRM} and V_{RRM}	500	V
		TLP543J TLP545J		600	
	On-State Current		$I_{T(RMS)}$	150	mA
	On-State Current Derating (Ta≥25°C)		ΔI_T/°C	-2	mA/°C
	Peak One Cycle Surge Current		I_{TSM}	1	A
	Peak Reverse Gate Voltage		V_{GM}	-5	V
	Junction Temperature		Tj	100	°C
Operating Temperature			T_{opr}	-30 ~ 100	°C
Storage Temperature			T_{stg}	-55 ~ 125	°C

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

Soldering Temp. 260°C (10 sec.)

PIN CONFIGURATIONS

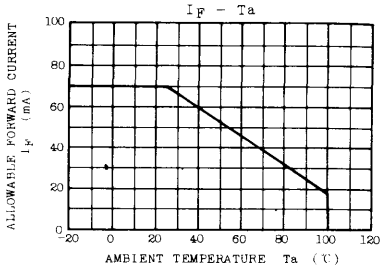


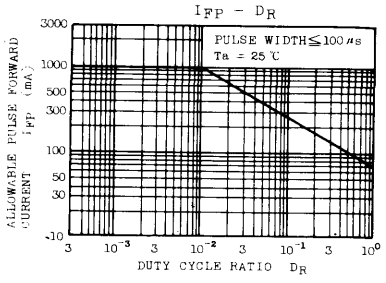
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

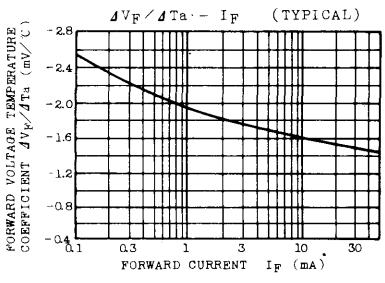
	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	Peak Forward Leakage Current and Peak Reverse Current	I_{DRM} and I_{RRM}	V_{DRM}=Rating, R_{GK}=27kΩ	-	-	5	μA
	On-State Voltage	V_{TM}	I_{TM}=100mA	-	-	1.3	V
	Holding Current	I_H	R_{GK}=27kΩ	-	0.2	-	mA
	Critical Rate of Rise of Off-State Voltage	dv/dt	V_{DRM}=Rating, R_{GK}=27kΩ	-	10	-	V/μs
COUPLED	Trigger LED Current	I_{FT}	V_D=6V, R_{GK}=27kΩ	-	-	10	mA
	Turn-on Time	t_{on}	I_F=50mA, R_{GK}=27kΩ	-	10	-	μs
	Input to Output Capacitance	C_S	V=0, f=1MHz	-	0.8	-	pF
	Isolation Resistance	R_S	R.H.=40 ~ 60%, V=1kV	-	10^{11}	-	Ω
	Isolation Voltage	BV_S	AC/1 minute, R.H.=40 ~ 60%	2500	-	-	V

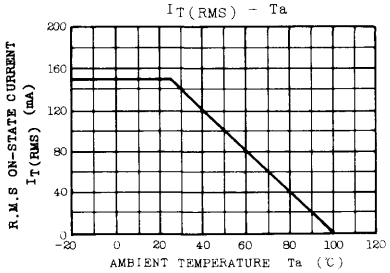
RECOMMENDED OPERATING CONDITIONS

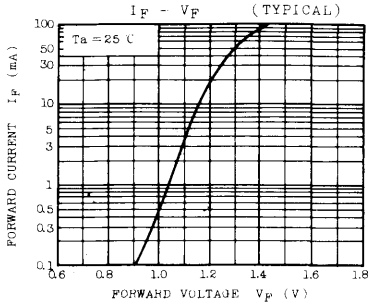
CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{AC}	-	-	250	V_{AC}
Forward Current	I_F	15	20	25	mA
Operating Temperature	T_{opr}	-30	-	85	°C
Gate to Cathode Resistance	R_{GK}	-	10	27	kΩ
Gate to Cathode Capacity	C_{GK}	-	0.01	0.1	μF

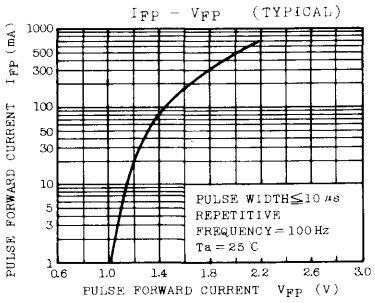


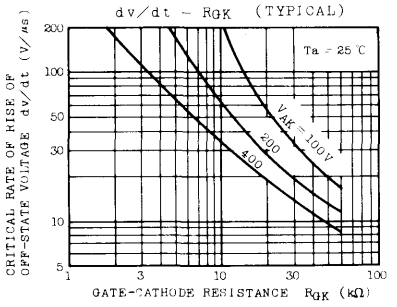


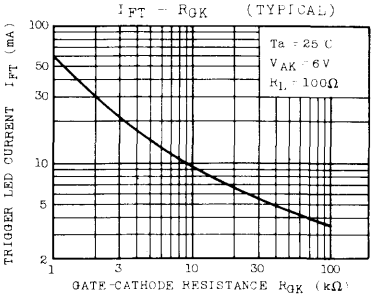


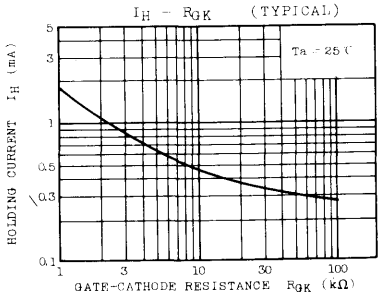

$I_{T(RMS)}$ – Ta
R.M.S ON-STATE CURRENT $I_{T(RMS)}$ (mA)
AMBIENT TEMPERATURE Ta (°C)

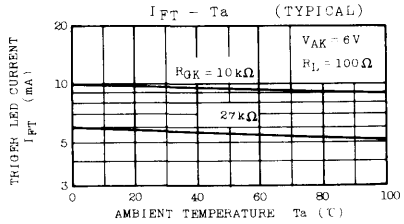

I_F – V_F (TYPICAL)
Ta = 25°C
FORWARD CURRENT I_F (mA)
FORWARD VOLTAGE V_F (V)

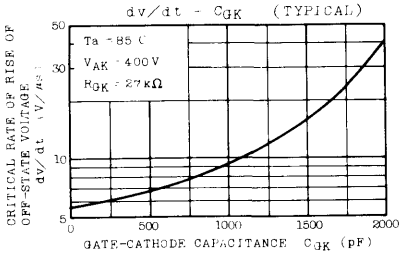

I_{FP} – V_{FP} (TYPICAL)
PULSE WIDTH ≦ 10 μs
REPETITIVE
FREQUENCY = 100 Hz
Ta = 25°C
PULSE FORWARD CURRENT I_{FP} (mA)
PULSE FORWARD CURRENT V_{FP} (V)

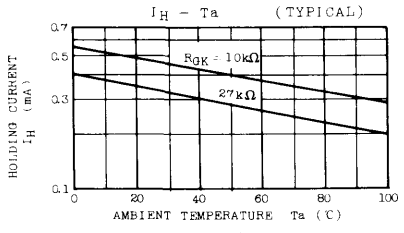

dv/dt – R_{GK} (TYPICAL)
Ta = 25°C
V_{AK} = 100V
200
400
CRITICAL RATE OF RISE OF OFF-STATE VOLTAGE dv/dt (V/μs)
GATE-CATHODE RESISTANCE R_{GK} (kΩ)

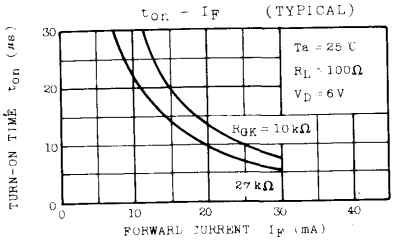

I_{FT} – R_{GK} (TYPICAL)
Ta = 25°C
V_{AK} = 6V
R_L = 100Ω
TRIGGER LED CURRENT I_{FT} (mA)
GATE-CATHODE RESISTANCE R_{GK} (kΩ)


I_H – R_{GK} (TYPICAL)
Ta = 25°C
HOLDING CURRENT I_H (mA)
GATE-CATHODE RESISTANCE R_{GK} (kΩ)


I_{FT} – Ta (TYPICAL)
V_{AK} = 6V
R_L = 100Ω
R_{GK} = 10kΩ
27kΩ
TRIGGER LED CURRENT I_{FT} (mA)
AMBIENT TEMPERATURE Ta (°C)


dv/dt – C_{GK} (TYPICAL)
Ta = 85°C
V_{AK} = 400V
R_{GK} = 27kΩ
CRITICAL RATE OF RISE OF OFF-STATE VOLTAGE dv/dt (V/μs)
GATE-CATHODE CAPACITANCE C_{GK} (pF)


I_H – Ta (TYPICAL)
R_{GK} = 10kΩ
27kΩ
HOLDING CURRENT I_H (mA)
AMBIENT TEMPERATURE Ta (°C)


t_{on} – I_F (TYPICAL)
Ta = 25°C
R_L = 100Ω
V_D = 6V
R_{GK} = 10kΩ
27kΩ
TURN-ON TIME t_{on} (μs)
FORWARD CURRENT I_F (mA)

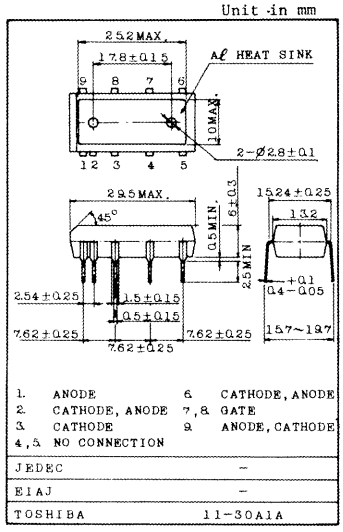
TLP546G

INFRARED LED + PHOTO THYRISTOR

CONTROL 1A(RMS) OF 120VAC LINE.
MOTOR CONTROLS.
CONTROLLER.
COPIER.
HOME ELECTRIC MACHINE.

- Trigger LED Current : I_{FT}=12mA(Max.) (R_{GK}=15kΩ)
- R.M.S On-State Current
  : $I_{T(RMS)}$=1A (Single Phase Full Wave, No Heat Sink, Ta=40°C)
- Repetitive Peak On-State Voltage : V_{DRM}=400V
- High Isolation Voltage : BV_S=2500V AC/1 min.
- Type Name : P546G
- 9-Lead DIP Package
- UL Recognized : File No. E67349
  (Note) Type designation P546G is identical to TLP546C.

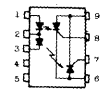
Unit in mm



1. ANODE
2. CATHODE, ANODE
3. CATHODE
4,5 NO CONNECTION
6. CATHODE, ANODE
7,8 GATE
9. ANODE, CATHODE

JEDEC	—
EIAJ	—
TOSHIBA	11-30A1A

PIN CONFIGURATIONS



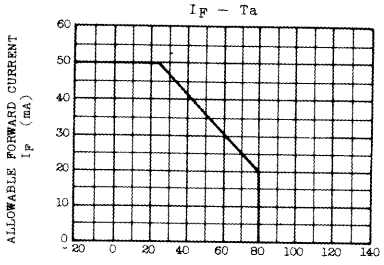
MAXIMUM RATINGS (Ta = 25°C)

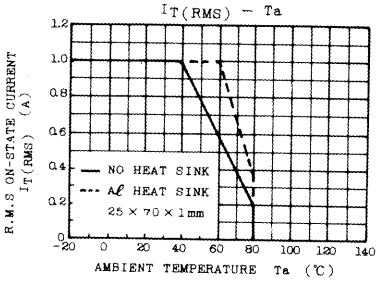
	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	50	mA
	Forward Current Derating (Ta > 25°C)	$\Delta I_F/°C$	-0.55	A/°C
	Reverse Voltage	V_R	5	V
DETECTOR	Repetitive Peak Off-State Voltage and Repetitive Peak Reverse Voltage	V_{DRM} and V_{RRM}	400	V
	R.M.S On-State Current (Single Phase Full Wave Ta=40°C)	$I_{T(RMS)}$	1 (No Heat Sink)	A
	On-State Current Derating (Single Phase Full Wave Ta=40°C)	$\Delta I_T/°C$	-0.04	A/°C
	Peak One Cycle Surge On-State Current	I_{TSM}	20	A
Operating Temperature Range		T_{opr}	-30 ~ 80	°C
Storage Temperature Range		T_{stg}	-55 ~ 125	°C
Isolation Voltage (Note)		BV_S	2500	V

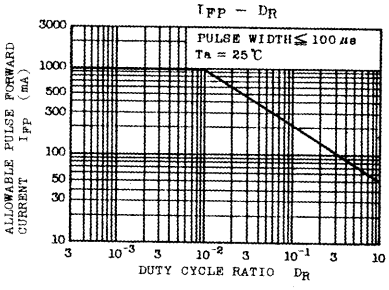
Note : AC/1 min. R.H.=40 ~ 60%

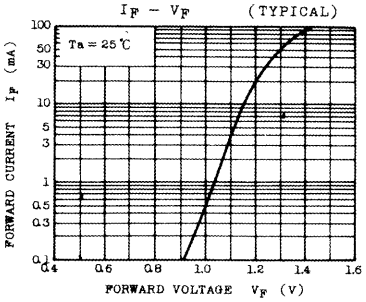
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

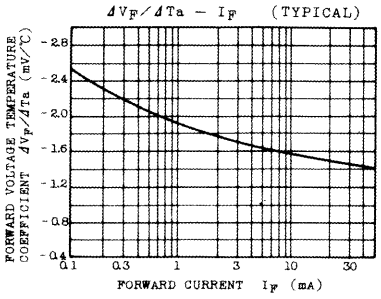
	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=30mA (1 LED)	1.10	1.24	1.40	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
DETECTOR	Repetitive Peak Off-State Voltage and Repetitive Peak Reverse Voltage	I_{DRM} and I_{RRM}	V_{DRM}=Rated, T2=80°C R_{GK}=15kΩ	-	-	100	μA
	Peak On-State Voltage	V_{TM}	I_{TM}=2A, I_F=15mA	-	-	1.6	V
	Holding Current	I_H	R_L=100Ω, R_{GK}=15kΩ	-	0.5	-	mA
	Critical Rate of Rise of Off-State Voltage	dv/dt	V_{DRM}=2/3 Rated R_{GK}=15kΩ	5	-	-	V/μs
COUPLED	Trigger LED Current	I_{FT}	V_D=6V, R_L=100Ω R_{GK}=15kΩ	-	6	10	mA
	Isolation Resistance	R_S	R.H.=40 ~ 60%, V=1kV	-	10^{11}	-	Ω

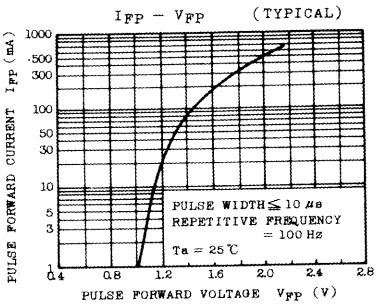


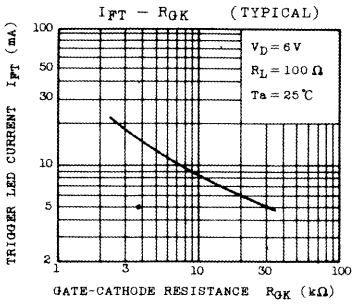


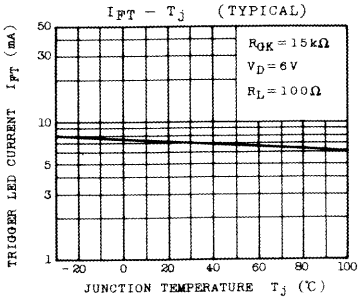


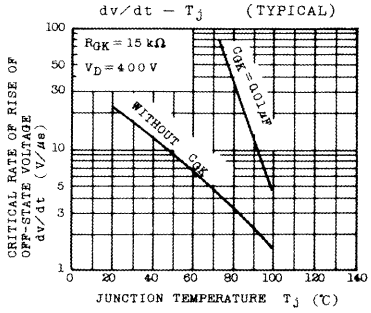

$I_F - V_F$ (TYPICAL)
Ta = 25℃
FORWARD CURRENT I_F (mA)
FORWARD VOLTAGE V_F (V)

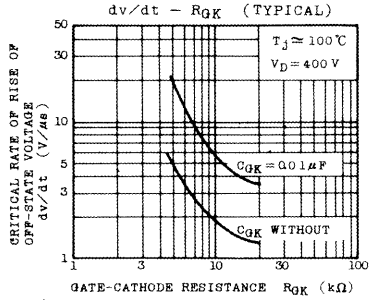

$\Delta V_F / \Delta Ta - I_F$ (TYPICAL)
FORWARD VOLTAGE TEMPERATURE COEFFICIENT $\Delta V_F / \Delta Ta$ (mV/℃)
FORWARD CURRENT I_F (mA)


$I_{FP} - V_{FP}$ (TYPICAL)
PULSE WIDTH ≦ 10 μs
REPETITIVE FREQUENCY = 100 Hz
Ta = 25℃
PULSE FORWARD CURRENT I_{FP} (mA)
PULSE FORWARD VOLTAGE V_{FP} (V)


$I_{FT} - R_{GK}$ (TYPICAL)
V_D = 6V
R_L = 100Ω
Ta = 25℃
TRIGGER LED CURRENT I_{FT} (mA)
GATE-CATHODE RESISTANCE R_{GK} (kΩ)


$I_{FT} - T_j$ (TYPICAL)
R_{GK} = 15kΩ
V_D = 6V
R_L = 100Ω
TRIGGER LED CURRENT I_{FT} (mA)
JUNCTION TEMPERATURE T_j (℃)


dv/dt - T_j (TYPICAL)
R_{GK} = 15 kΩ
V_D = 400 V
C_{GK} = 0.1 μF
WITHOUT C_{GK}
CRITICAL RATE OF RISE OF OFF-STATE VOLTAGE dv/dt (V/μs)
JUNCTION TEMPERATURE T_j (℃)


dv/dt - R_{GK} (TYPICAL)
T_j ≅ 100℃
V_D = 400 V
C_{GK} = 0.1 μF
C_{GK} WITHOUT
CRITICAL RATE OF RISE OF OFF-STATE VOLTAGE dv/dt (V/μs)
GATE-CATHODE RESISTANCE R_{GK} (kΩ)

TLP550, 551

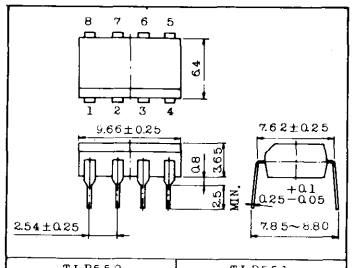
INFRARED LED + PHOTO IC

DEGITAL LOGIC ISOLATION.
LINE RECEIVER FEEDBACK CONTROL.
POWER SUPPLY CONTROL.
SWITCHING POWER SUPPLY.
TRANSISTOR INVERTOR.

TLP550 and TLP551 construct a high emitting diode and a one chip photo diode-transistor.
Each unit is 8-lead DIP package.

- High Isolation Voltage
- High Speed : t_{pHL}, t_{pLH}=0.5μs(Typ.) (R_L=1.9kΩ)
- TTL Compatible
- Base Pin of TLP551 should be used for analog application or enable operation.
  If base pin is open, output signal will be noisy by environmental condition. For this case, TLP550 is suitable.
- UL Recognized: File No. E67349

(Note) Type designation P550, P551 are identical to TLP550, TLP551 respectively.

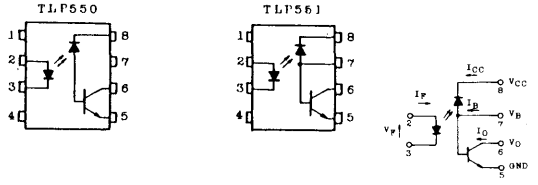


TLP550	TLP551
1. N.C 2. ANODE 3. CATHODE 4. N.C 5. EMITTER 6. COLLECTOR 7. N.C 8. CATHODE	1. N.C 2. ANODE 3. CATHODE 4. N.C 5. EMITTER 6. COLLECTOR 7. BASE, ANODE 8. CATHODE
JEDEC —	JEDEC —
EIAJ —	EIAJ —
TOSHIBA 11-10C1E	TOSHIBA 11-10C1F

MAXIMUM RATINGS (Ta = 25°C)

	CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	Forward Current	(Note 1)	I_F	25	mA
	Pulse Forward Current	(Note 2)	I_{FP}	50	mA
	Total Pulse Forward Current	(Note 3)	I_{FPT}	1	A
	Reverse Voltage		V_R	5	V
	Diode Power Dissipation	(Note 4)	P_D	45	mW
DETECTOR	Output Current		I_O	8	mA
	Peak Output Current		I_{OP}	16	mA
	Emitter-Base Reverse Voltage (TLP551)		V_{EB}	5	V
	Supply Voltage		V_{CC}	-0.5 ~ 15	V
	Output Voltage		V_O	-0.5 ~ 15	V
	Base Current (TLP551)		I_B	5	mA
	Output Power Dissipation	(Note 5)	P_O	100	mW
Operating Temperature Range			T_{opr}	-55 ~ 100	°C
Storage Temperature Range			T_{stg}	-55 ~ 125	°C
Isolation Voltage		(Note 6)	BV_S	2500	V_{rms}

PIN CONFIGURATIONS (TOP VIEW)



ELECTRICAL CHARACTERISTICS (Ta = 25°C)

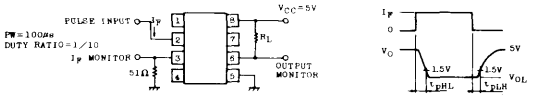
	CHARACTERISTIC	SYMBOL	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=16mA		1.45	1.65	1.85	V
	Forward Voltage Temperature Coefficient	$\Delta V_F/\Delta Ta$	I_F=16mA		-	-2	-	mV/°C
	Reverse Current	I_R	V_R=5V		-	-	10	μA
	Terminal Between Capacitance	C_T	V_F=0, f=1MHz		-	60	-	pF
DETECTOR	High Level Output Current	$I_{OH(1)}$	I_F=0mA, V_{CC}=V_O=5.5V		-	3	500	nA
		$I_{OH(2)}$	I_F=0mA, V_{CC}=V_O=15V		-	-	5	μA
		I_{OH}	I_F=0mA, V_{CC}=V_O=15V, Ta=70°C		-	-	250	μA
	High Level Supply Voltage	I_{CCH}	I_F=0mA, V_{CC}=15V		-	0.01	1	μA
COUPLED	Current Transfer Ratio	I_O/I_F	I_F=16mA, V_{CC}=4.5V, V_O=0.4V	Ta=25°C	10	30	-	%
				Ta=25°C, rank:0	19	30	-	
				Ta=0 ~ 70°C	5	-	-	
				Ta=0 ~ 70°C, rank:0	15	-	-	
	Low Level Output Voltage	V_{OL}	I_F=16mA, V_{CC}=4.5V, I_O=1.1mA (rank 0: I_O=2.4mA)		-	-	0.4	V
	Isolation Resistance	R_S	R.H.=40 ~ 60%, V=1kV DC (Note 3)		-	10^{12}	-	Ω
	Input/Output Between Stray Capacitance	C_S	V=0, f=1MHz		-	0.8	-	pF
	Propagation Delay Time (H→L)	t_{pHL}	I_F=0→16mA, V_{CC}=5V, R_L=4.1kΩ		-	0.3	0.8	μs
			(Note 4)	rank 0: R_L=1.9kΩ	-	0.5	0.8	
	Propagation Delay Time (L→H)	t_{pLH}	I_F=16→0mA, V_{CC}=5V, R_L=4.1kΩ		-	1.0	2.0	μs
			(Note 4)	rank 0: R_L=1.9kΩ	-	0.6	1.2	

TLP550 and TLP551 construct a high emitting diode and a one chip photo diode-transistor.
Each unit is 8-lead DIP package.

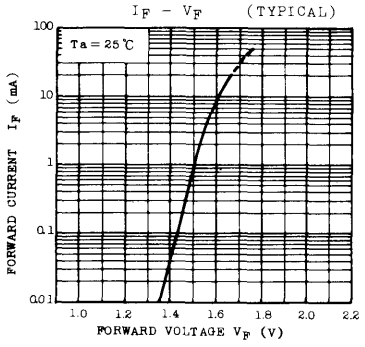
- High Isolation Voltage
- High Speed : t_{pHL}, t_{pLH}=0.5μs(Typ.) (R_L=1.9kΩ)
- TTL Compatible
- Type Name : P550 or P551
- Base Pin of TLP551 should be used for analog application or enable operation.
  If base pin is open, output signal will be noisy by environmental condition. For this case, TLP550 is suitable.
- UL Recognized : File No. E67349

(Note) Type designation P550, P551 are identical to TLP550, TLP551 respectively.

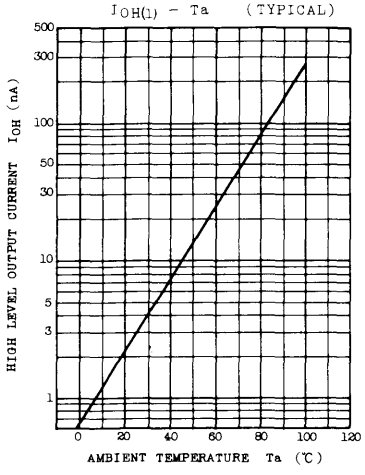
PRECAUTION
Please be careful of the followings.
1. Soldering temperature: 260°C MAX. Soldering time: 10 sec MAX.
   (Soldering portion of lead: up to 2mm from the body of the device)
2. Avoid using the Solvents except for the follows, when washing off flux and wiping off stain on the device.
   Washing time: 30 sec MAX. Solvents temperature: 45°C MAX.
   o Freon TE or TF o Dai-Fron Solvents S3 or S3-E
3. Device considered a two-terminal device : Pins 1,2,3 and 4 shorted together and Pin 5,6,7 and 8 shorted together.
4. Switching test circuit.



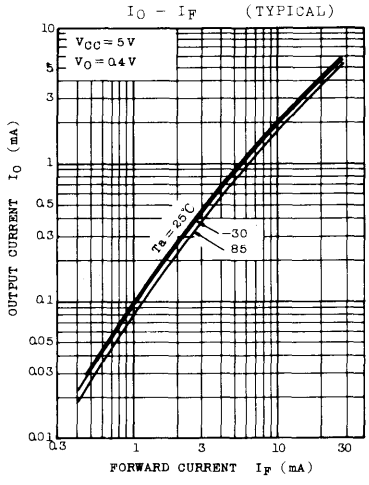
$I_F - V_F$ (TYPICAL)



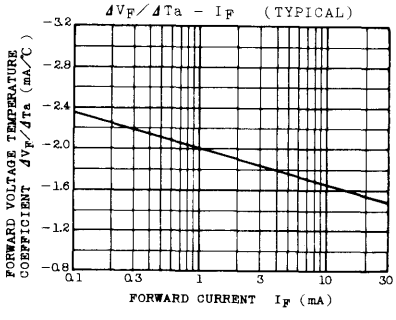
$I_{OH(1)} - Ta$ (TYPICAL)



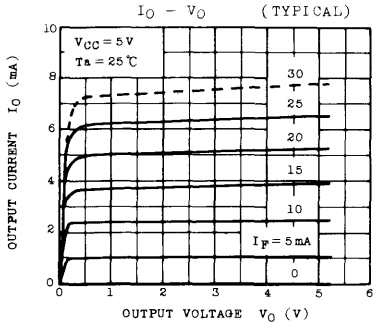
$I_O - I_F$ (TYPICAL)



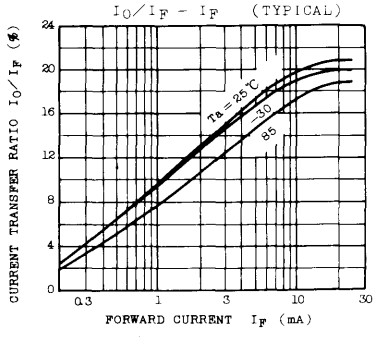
$\Delta V_F / \Delta Ta - I_F$ (TYPICAL)



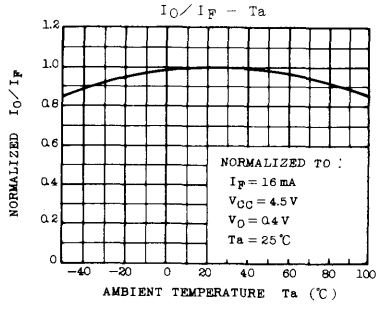
$I_O - V_O$ (TYPICAL)



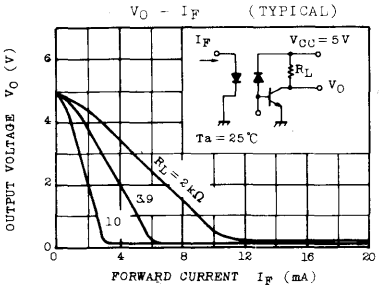
$I_O / I_F - I_F$ (TYPICAL)



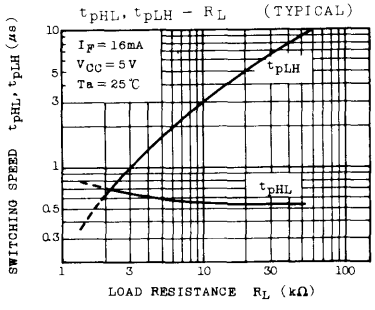
$I_O / I_F - Ta$



$V_O - I_F$ (TYPICAL)



$t_{pHL}, t_{pLH} - R_L$ (TYPICAL)



TLP552

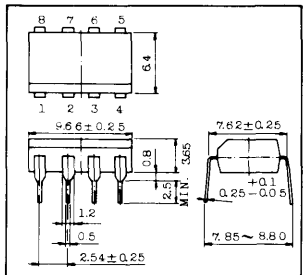
INFRARED LED + PHOTO IC

DEGITAL LOGIC ISOLATION.
TELE-COMMUNICATION.
ANALOG DATA EQUIPMENT CONTROL.

The TOSHIBA TLP552 Consists of a high emitting dinde and a one chip photo IC. This unit is 8-lead DIP package.

- LSTTL/TTL Compatible : 5V Supply
- Ultra High Speed
- Guaranteed Performance Over Temperature
- High Isolation Voltage : 2500V_{rms}
- UL Recognized : File No. E67349

Unit in mm

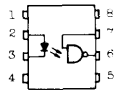


1. NO CONNECTION
2. LED ANODE
3. LED CATHODE
4. NO CONNECTION
5. GND
6. OUTPUT (OPEN COLLECTOR)
7. ENABLE
8. V_{CC}

JEDC	—
EIAJ	—
TOSHIBA	11-10C1G

PIN CONFIGURATIONS

(TOP VIEW)



RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	MAX.	UNIT
Input Current, Low Level Each Channel	I_{FL}	0	250	μA
Input Current, High Level Each Channel	I_{FH}	7	20	mA
High Level Enable Voltage	V_{EH}	2.0	V_{CC}	V
Low Level Enable Voltage (Output High)	V_{EL}	0	0.8	V
Fan Out (TTL LOAD)	N	-	8	
Operating Temperature	Ta	0	70	°C

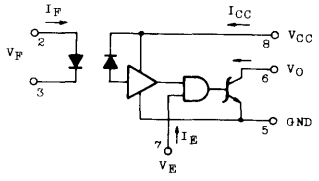
MAXIMUM RATINGS

	CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	Forward Current	(Note 1)	I_F	20	mA
	Pulse Forward Current	(Note 2)	I_{FP}	40	mA
	Reverse Voltage		V_R	5	V
DETECTOR	Output Current		I_O	50	mA
	Output Voltage		V_O	7	V
	Supply Voltage (1 minute Maximum)		V_{CC}	7	V
	Enable Input Voltage (Not to exceed V_{CC} by more than 500mV)		V_{EH}	5.5	V
	Output Collector Power Dissipation		P_O	85	mW
Operating Temperature Range			T_{opr}	0 ~ 70	°C
Storage Temperature Range			T_{stg}	-55 ~ 125	°C
Isolation Voltage		(Note 2)	BV_S	2500	V_{rms}

Note 1 : 50% duty cycle, 1ms pulse width
2 : R.H.=40 ~ 60%, AC/1 min.
Device considered a two-terminal device
: Pins 1,2,3 and 4 shorted together and Pin 5,6,7 and 8 shorted together.

TRUTH TABLE

INPUT	ENABLE	OUTPUT
H	H	L
L	H	H
H	L	H
L	L	H



ELECTRICAL CHARACTERISTICS

OVER RECOMMENDED TEMPERATURE (Ta=0°C ~ 70°C Unless otherwise noted)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	**TYP.	MAX.	UNIT
High Level Output Current	I_{OH}	V_{CC}=5.5V, V_O=5.5V, I_F=250μA, V_E=2.0V	-	1	250	μA
Low Level Output Voltage	V_{OL}	V_{CC}=5.5V, I_F=5mA, V_{EH}=2.0V, I_{OL}(Sinking)=13mA	-	0.4	0.6	V
High Level Enable Current	I_{EH}	V_{CC}=5.5V, V_E=2.0V	-	-0.1	-	mA
Low Level Enable Current	I_{EL}	V_{CC}=5.5V, V_E=0.5V	-	-1.6	-2.0	mA
High Level Supply Current	I_{CCH}	V_{CC}=5.5V, I_F=0, V_E=0.5V	-	7	15	mA
Low Level Supply	I_{CCL}	V_{CC}=5.5V, I_F=10mA, V_E=0.5V	-	12	18	mA
Resistance (Input-Output)	R_{I-O}	V_{I-O}=500V, Ta=25°C	-	10^{12}	-	Ω
Capacitance (Input-Output)	C_{I-O}	f=1MHz, Ta=25°C	-	0.6	-	pF
Input Forward Voltage	V_F	I_F=10mA, Ta=25°C	-	1.65	1.9	V
Input Reverse Breakdown Voltage	BV_R	I_R=10μA, Ta=25°C	5	-	-	V
Input Capacitance	C_{IN}	V_F=0, f=1MHz	-	45	-	pF
Current Transfer Ratio	CTR	I_F=5.0mA, R_L=100Ω	-	1000	-	%

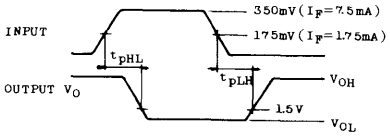
** All typical values are at V_{CC}=5V, Ta=25°C.

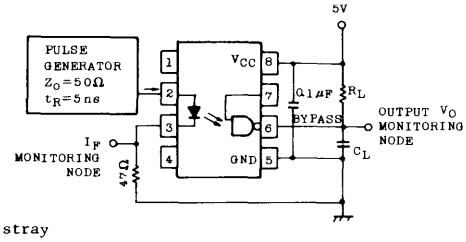
SWITCHING CHARACTERISTICS (Ta=25°C, V_{CC}=5V)

CHARACTERISTIC	SYMBOL	TEST CIRCUIT	TEST CONDTION	MIN.	TYP.	MAX.	UNIT
Propagation Delay Time to High Output Level	t_{pLH}	1	R_L=350Ω, C_L=15pF, I_F=7.5mA	-	60	120	ns
Propagation Delay Time to Low Output Level	t_{pHL}	1	R_L=350Ω, C_L=15pF, I_F=7.5mA	-	60	120	ns
Output Rise-Fall Time (10-90%)	t_r, t_f	-	R_L=350Ω, C_L=15pF, I_F=7.5mA	-	30	-	ns
Propagation Delay Time of Enable from V_{EH} to V_{EL}	t_{ELH}	2	R_L=350Ω, C_L=15pF, I_F=7.5mA, V_{EH}=3.0V, V_{EL}=0.5V	-	25	-	ns
Propagation Delay Time of Enable from V_{EL} to V_{EH}	t_{EHL}	2	R_L=350Ω, C_L=15pF, I_F=7.5mA, V_{EH}=3.0V, V_{EL}=0.5V	-	25	-	ns
Common Mode Transient Immunity at Logic High Output Level	CM_H	3	V_{CM}=200V, R_L=350Ω, $V_{O(min.)}$=2V, I_F=0mA	-	200	-	V/ns
Common Mode Transient Immunity at Logic Low Output Level	CM_L	3	V_{CM}=200V, R_L=350Ω, $V_{O(max.)}$=0.8V, I_F=5mA	-	-500	-	V/ns

TEST CIRCUIT 1.

t_{pHL} and t_{pLH}

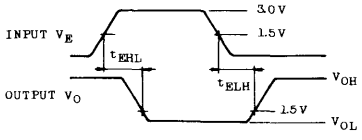


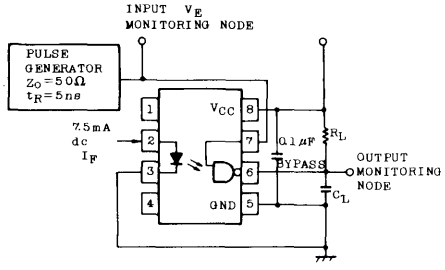


. C_L is approximately 15pF which includes probe and stray wiring capacitance.

TEST CIRCUIT 2.

t_{ELH} and t_{EHL}

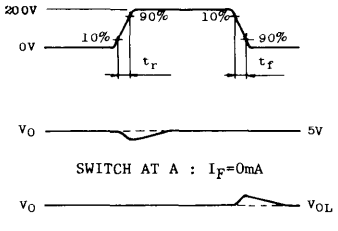


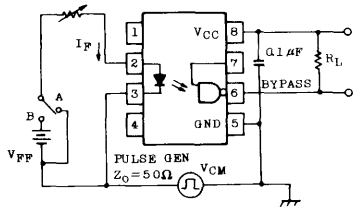


. C_L is approximately 15pF which includes probe and stray wiring capacitance.

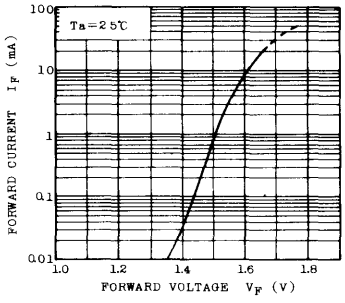
TEST CIRCUIT 3.

Transient Immunity and Typical Waveforms.

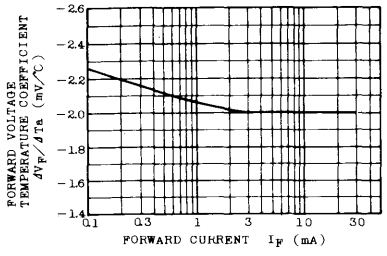




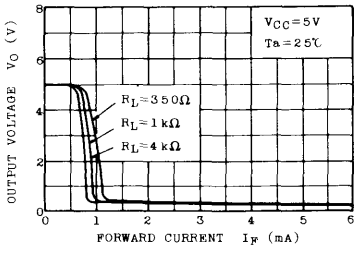
I_F – V_F (TYPICAL)



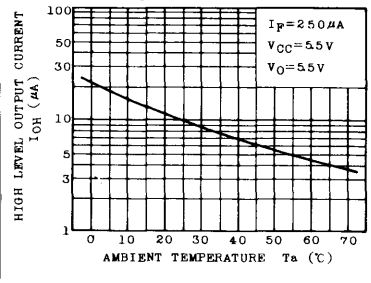
$\Delta V_F/\Delta Ta$ – I_F (TYPICAL)



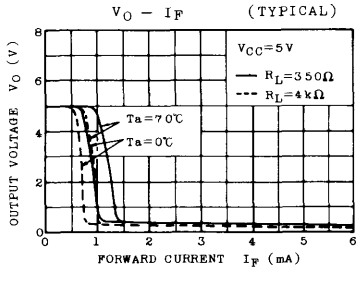
V_O – I_F (TYPICAL)



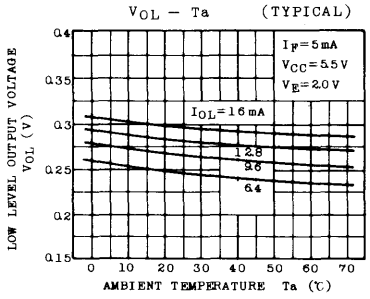
I_{OH} – Ta (TYPICAL)



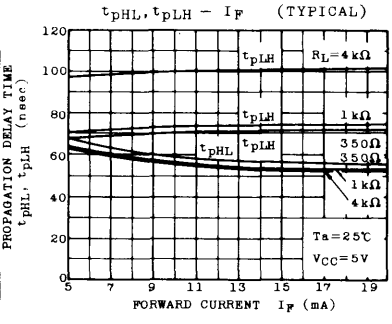
V_O – I_F (TYPICAL)



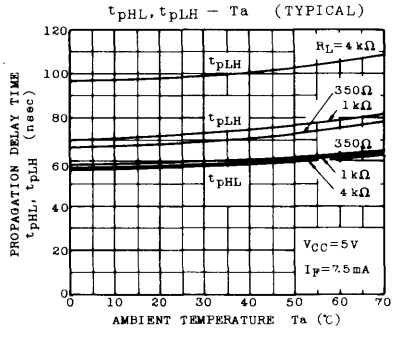
V_{OL} – Ta (TYPICAL)



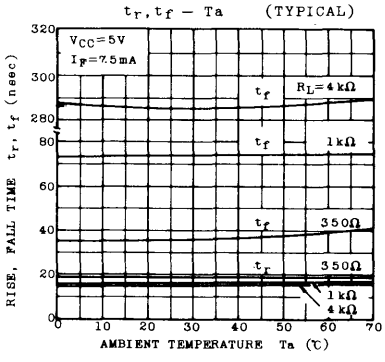
t_{pHL}, t_{pLH} – I_F (TYPICAL)



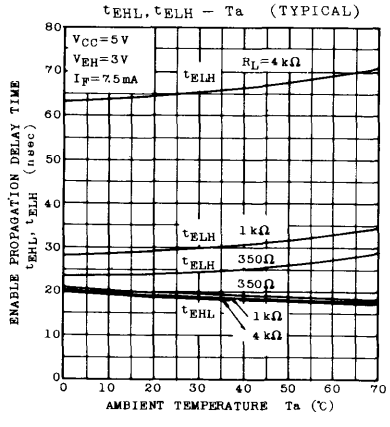
t_{pHL}, t_{pLH} – Ta (TYPICAL)



t_r, t_f – Ta (TYPICAL)



t_{EHL}, t_{ELH} – Ta (TYPICAL)



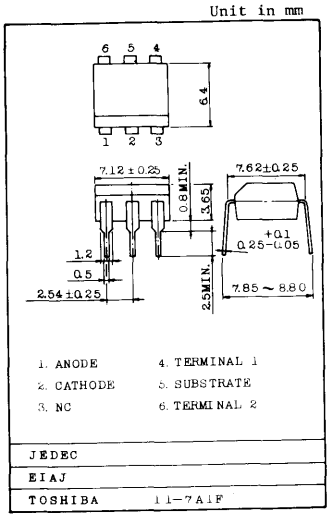
TLP560E/F/G

INFRARED LED + PHOTO TRIAC

GaAs INFRARED EMITTING DIODE & LIGHT ACTIVATED TRIAC DRIVER.

TLP560 series consists of a gallium arsenide infrared emitting diode coupled with a light activated silicon bilateral switch, which functions like a triac, in a dual in-line package.

Unit in mm



1. ANODE
2. CATHODE
3. NC
4. TERMINAL 1
5. SUBSTRATE
6. TERMINAL 2

JEDEC	
EIAJ	
TOSHIBA	11-7A1F

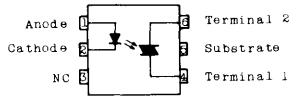
MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC		SYMBOL	RATING			UNIT
			TLP560E	TLP560F	TLP560G	
LED	Forward Current	I_F	50			mA
	Pulse Forward Current (Note 1)	I_{FP}	1			A
	Reverse Voltage	V_R	6			V
DETECTOR	Off-State Output Terminal Voltage	V_{DRM}	250	300	400	V
	R.M.S. On-State Current (Note 2)	$I_{T(RMS)}$	100			mA
	Peak Nonrepetitive Surge Current (PW=10ms, DC=10%)	I_{TSM}	1.2			A
Operating Temperature Range		T_{OPR}	-30 ~ 100			°C
Storage Temperature Range		T_{STG}	-40 ~ 125			°C
Lead Soldering Time (at 260°C)		t_{sol}	10			sec
Isolation Voltage (AC /1 min.)		BV_S	2500			V_{rms}

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

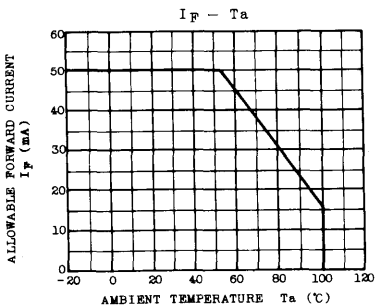
2 : Full cycle sine wave, 50 ~ 60Hz

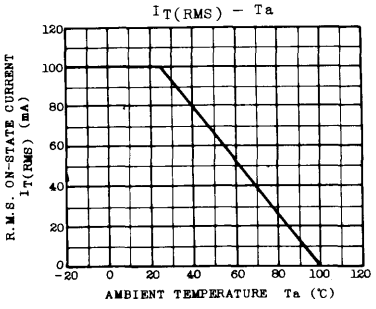
PIN CONFIGURATIONS (TOP VIEW)

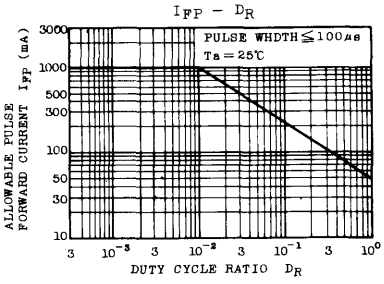


ELECTRICAL CHARACTERISTICS (Ta=25°C)

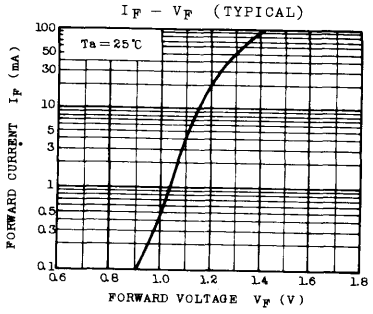
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=3V	-	-	10	μA
	Terminal Between Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	Peak Off-State Current	I_{DRM}	V_{DRM}=Rated	-	-	1	μA
	Peak On-State Voltage	V_{TM}	I_{TM}=100mA	-	1.3	3	V
	Critical Rate of Rise of Off-State Voltage	dv/dt	V_{DRM}=Rated	200	1000	-	V/μs
COUPLED	IRED Trigger Current, Current Required to Latch Output	I_{FT}	V_{AK}=6V, R_L=100Ω	-	-	10	mA
	Holding Current, Either Direction	I_H		-	200	-	mA
	Isolation Resistance	R_S		-	10^{11}	-	Ω



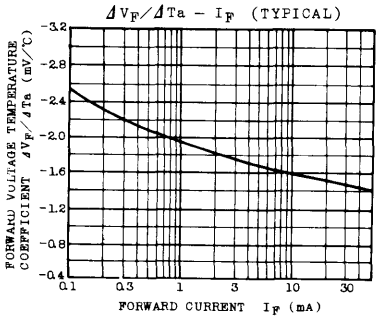




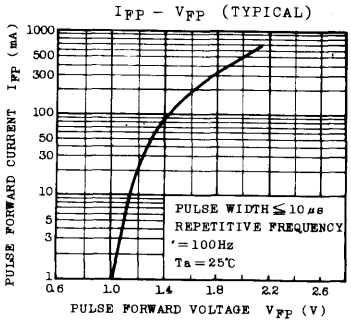
$I_F - V_F$ (TYPICAL)



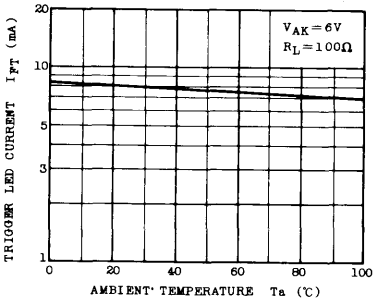
$\Delta V_F / \Delta Ta - I_F$ (TYPICAL)



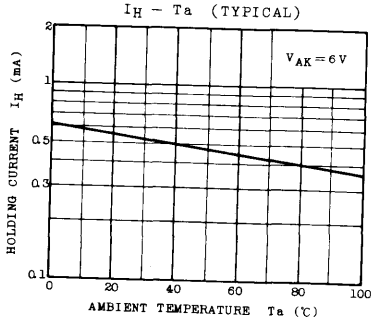
$I_{FP} - V_{FP}$ (TYPICAL)



$I_{FT} - Ta$ (TYPICAL)



$I_H - Ta$ (TYPICAL)



TLP570

INFRARED LED + PHOTO DARLINGTON TRANSISTOR

VERY HIGH CURRENT TRANSFER RATIOS.

SOLID STATE RELAY.

COPY MACHINE.

CONTROLLER.

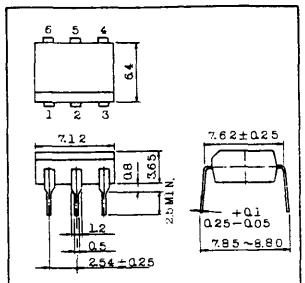
LINE RECEIVER.

HIGH VOLTAGE INDUSTRIAL CONTROL.

- C-MOS Compatible : I_F=1mA
- Current Transfer Ratio : I_C/I_F=1000% (Min.)
- High Isolation Voltage : BV_S=2500V AC/1 min.
- High Collector Current : I_C=150mA (Max.)
- Speed : t_{OFF}=100μs (Typ.)
- UL Recognized : File No. E67349

Type designation P570 is identical to TLP570.

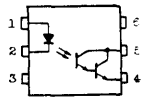
Unit in mm



1. ANODE
2. CATHODE
3, 6. NC
4. EMITTER
5. COLLECTOR

JEDEC	—
EIAJ	—
TOSHIBA	11-7A1D

PIN CONFIGURATIONS



MAXIMUM RATINGS (Ta = 25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	70	mA
	Forward Current Derating (Ta≥25°C)	ΔI_F/°C	0.7	mA/°C
	Pulse Forward Current (Note)	I_{FP}	1	A
	Reverse Voltage	V_R	5	V
DETECTOR	Collector-Emitter Voltage	V_{CEO}	35	V
	Emitter-Collector Voltage	V_{ECO}	5	V
	Collector Current	I_C	150	mA
	Collector Power Dissipation	P_C	150	mW
	Collector Power Dissipation Derating	ΔP_C/°C	-1.5	mW/°C
Operating Temperature Range		T_{opr}	-30~85	°C
Storage Temperature Range		T_{stg}	-55~125	°C
Isolation Voltage (AC 1 min.)		BV_S	2500	V_{rms}
Total Power Dissipation		P_T	200	mW
Total Power Dissipation Derating		ΔP_T/°C	-2.6	mW/°C

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

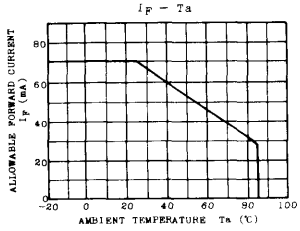
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Terminal Between Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	Collector-Emitter Between Voltage	$V_{(BR)CEO}$	I_C=0.5mA	35	-	-	V
	Emitter-Collector Breakdown Voltage	$V_{(BR)ECO}$	I_E=0.1mA	5	-	-	V
	Dark Current	$I_{D(ICEO)}$	I_F=0, V_{CE}=24V	-	10	200	nA
			I_F=0, V_{CE}=24V, Ta=85°C	-	-	300	μA
	Terminal Between Capacitance	C_T	V_{CE}=0, f=1MHz	-	10	-	pF
COUPLED	Current Transfer Ratio	I_C/I_F	I_F=1mA, V_{CE}=1.2V	1000	2000	-	%
	Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	I_C=100mA, I_F=10mA	0.3	-	1.2	V
	Input/Output Between Stray Capacitance	C_S	V=0, f=1MHz	-	0.8	-	pF
	Isolation Voltage	R_S	R.H.=40~60%, V=1kV	-	10^{11}	-	Ω
	Turn-On Time	t_{ON}	V_{CC}=5V, R_L=180Ω, I_F=10mA	-	3	-	μs
	Turn-Off Time	t_{OFF}	V_{CC}=5V, R_L=180Ω, I_F=10mA	-	100	-	μs

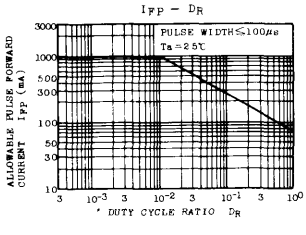
RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}	-	12	24	V
Forward Current	I_F	-	-	25	mA
Collector Current	I_C	-	-	40	mA
Operating Temperature	T_{opr}	-30	-	85	°C

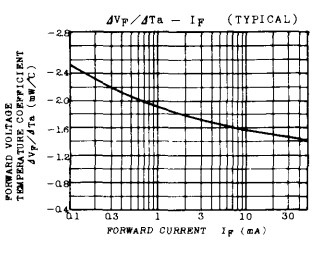
I_F – Ta

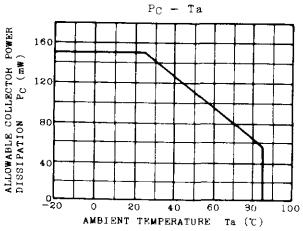


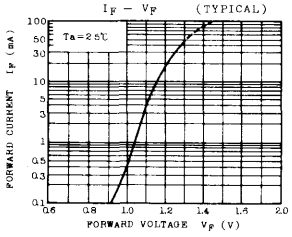
I_{FP} – D_R

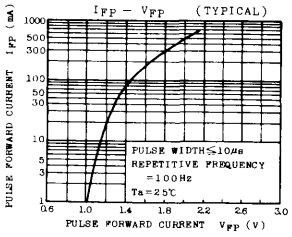


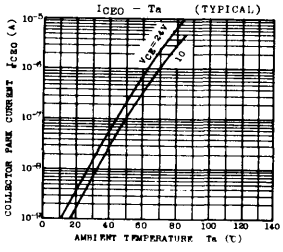
$\Delta V_F/\Delta Ta$ – I_F (TYPICAL)

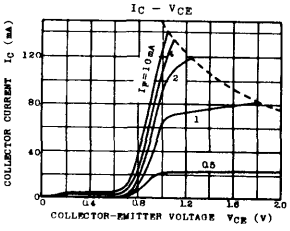


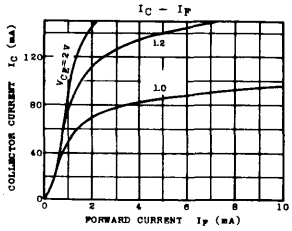

P_C – Ta
ALLOWABLE COLLECTOR POWER DISSIPATION P_C (mW)
160
120
80
40
0
−20
0
20
40
60
90
100
AMBIENT TEMPERATURE Ta (°C)

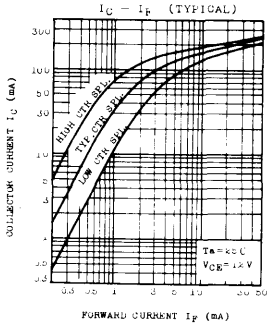

I_F – V_F (TYPICAL)
FORWARD CURRENT I_F (mA)
Ta=25°C
100
50
30
10
5
3
1
0.5
0.3
0.1
0.6
0.8
1.0
1.2
1.4
1.6
2.0
FORWARD VOLTAGE V_F (V)

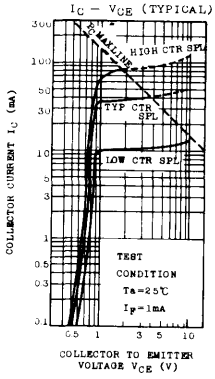

I_{FP} – V_{FP} (TYPICAL)
PULSE FORWARD CURRENT I_{FP} (mA)
1000
500
300
100
50
30
10
5
3
1
0.6
1.0
1.4
1.8
2.2
2.6
3.0
PULSE WIDTH≦10μs
REPETITIVE FREQUENCY
=100Hz
Ta=25°C
PULSE FORWARD CURRENT V_{FP} (V)

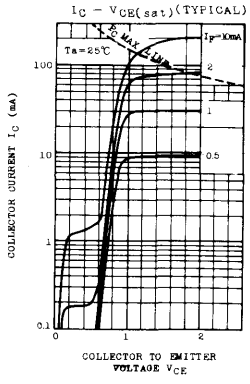

I_{CEO} – Ta (TYPICAL)
COLLECTOR DARK CURRENT I_{CEO} (A)
10^{-5}
10^{-6}
10^{-7}
10^{-8}
10^{-9}
V_{CE}=24V
10
0
20
40
60
80
100
120
140
AMBIENT TEMPERATURE Ta (°C)

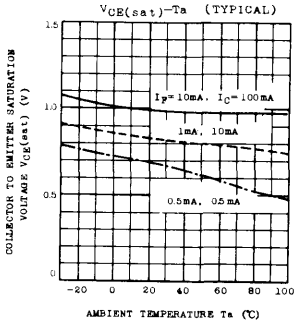

I_C – V_{CE}
COLLECTOR CURRENT I_C (mA)
120
80
40
0
I_F=10mA
2
1
0.5
0
0.4
0.8
1.2
1.6
2.0
COLLECTOR-EMITTER VOLTAGE V_{CE} (V)

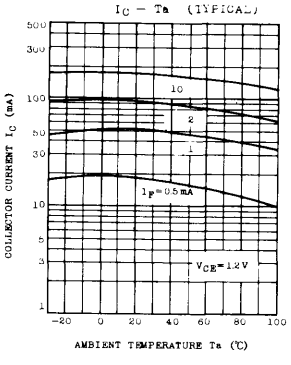

I_C – I_F
COLLECTOR CURRENT I_C (mA)
120
80
40
0
V_{CE}=2V
1.2
1.0
0
2
4
6
8
10
FORWARD CURRENT I_F (mA)

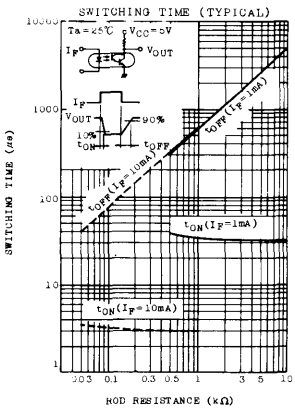

I_C – I_F (TYPICAL)
COLLECTOR CURRENT I_C (mA)
300
100
50
30
10
3
1
0.5
HIGH CTR SPL
TYP CTR SPL
LOW CTR SPL
Ta=25°C
V_{CE}=12V
0.5
1
3
5
10
30
50
FORWARD CURRENT I_F (mA)

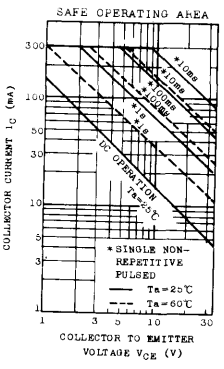

I_C – V_{CE} (TYPICAL)
COLLECTOR CURRENT I_C (mA)
300
100
50
30
10
3
1
0.5
0.3
0.1
I_F=5mA MAX.
HIGH CTR SPL
TYP CTR SPL
LOW CTR SPL
TEST
CONDITION
Ta=25°C
I_F=1mA
0.5
1
3
5
10
COLLECTOR TO EMITTER
VOLTAGE V_{CE} (V)


I_C – $V_{CE(sat)}$ (TYPICAL)
COLLECTOR CURRENT I_C (mA)
100
10
1
0.1
Ta=25°C
I_C MAX. (PULSED)
I_F=10mA
2
1
0.5
0
1
2
COLLECTOR TO EMITTER
VOLTAGE V_{CE}


$V_{CE(sat)}$–Ta (TYPICAL)
COLLECTOR TO EMITTER SATURATION VOLTAGE $V_{CE(sat)}$ (V)
1.5
1.0
0.5
0
I_F=10mA, I_C=100mA
1mA, 10mA
0.5mA, 0.5mA
−20
0
20
40
60
80
100
AMBIENT TEMPERATURE Ta (°C)


I_C – Ta (TYPICAL)
COLLECTOR CURRENT I_C (mA)
500
300
100
50
30
10
5
3
1
10
2
1
I_F=0.5mA
V_{CE}=12V
−20
0
20
40
60
80
100
AMBIENT TEMPERATURE Ta (°C)


SWITCHING TIME (TYPICAL)
SWITCHING TIME (μs)
10000
1000
100
10
1
Ta=25°C
V_{CC}=5V
I_F
V_{OUT}
I_F
V_{OUT}
90%
10%
t_{ON}
t_{OFF}
t_{OFF} (I_F=1mA)
t_{OFF} (I_F=10mA)
t_{ON} (I_F=1mA)
t_{ON} (I_F=10mA)
0.03
0.1
0.3
0.5
1
3
5
10
ROD RESISTANCE (kΩ)


SAFE OPERATING AREA
COLLECTOR CURRENT I_C (mA)
300
100
50
30
10
5
3
1
*10ms
*100ms
*1s
DC OPERATION
Ta=25°C
*SINGLE NON-
REPETITIVE
PULSED
Ta=25°C
Ta=60°C
1
3
5
10
30
COLLECTOR TO EMITTER
VOLTAGE V_{CE} (V)

TLP571

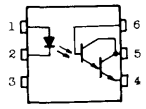
GaAs infrared Emitting Diode & NPN Silicon
Photo-darlington

AC LINE/DIGITAL LOGIC ISOLATOR.
DIGITAL LOGIC/DIGITAL LOGIC ISOLATOR.
TELEPHONE LINE RECEIVER.
TWISTED PAIR LINE RECEIVER.
RELAY CONTACT MONITOR.

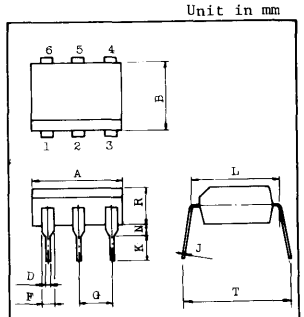
The TOSHIBA TLP571 consist of a gallium arsenide infrared emitting diode coupled with a silicon photo darington in a dual in-line package.

- Small Package Size and Low Cost
- Fast Switching Speeds : 100μs
- High DC Current Transfer Ratio : 1000%
- High Isolation Resistance : $10^{11}\Omega$
- High Isolation Voltage : 2500 V_{RMS}
- UL Recognized : File No. E67349
- Type Designation P571 is Identical to TLP571.

PIN CONFIGUTATIONS (TOP VIEW)



Unit in mm



1. ANODE 4. EMITTER
2. CATHODE 5. COLLECTOR
3. NC 6. BASE

JEDEC	—
EIAJ	—
TOSHIBA	11-7A1A

SYMBOL	INCH	MM.
A	0.280±0.010	7.12±0.25
B	0.252	6.4
D	0.020	0.50
F	0.047	1.20
G	0.1(TYP)	2.54(TYP)
J	0.010	0.25
K	0.100(MIN)	2.50(MIN)
L	0.300	7.62
N	0.031	0.80
R	0.144	3.65
T	0.309~3.465	7.85~8.80

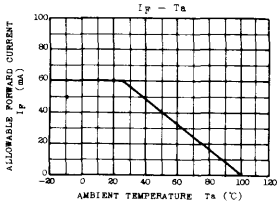
ABSOLUTE MAXIMUM RATINGS (Ta =25°C)

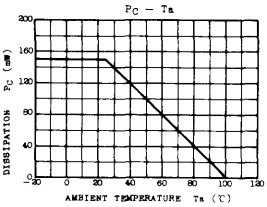
	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	60	mA
	Forward Current Derating	ΔI_F/°C	0.8*	mA/°C
	Peak Forward Current (Note)	I_{FP}	3	A
	Power Dissipation	P_D	100	mW
	Power Dissipation Derating	ΔP_D/°C	1.33*	mW/°C
	Reverse Voltage	V_R	3	V
PHOTO DARLINGTON	Collector-Emitter Voltage	BV_{CEO}	35	V
	Collector-Base Voltage	BV_{CBO}	35	V
	Emitter-Collector Voltage	BV_{ECO}	7	V
	Collector Current	I_C	100	mA
	Power Dissipation	P_C	150	mW
	Power Dissipation Derating	ΔP_C/°C	2.0*	mW/°C
COUPLED	Storage Temperature	Tstg	-55~150	°C
	Operating Temperature	Topr	-55~100	°C
	Lead Soldering Temperature (at 10 sec.)	Tsold	260	°C
	Total Package Power Dissipation	P_T	200	mW
	Total Package Power Dissipation Derating	ΔP_T/°C	2.6*	mW/°C

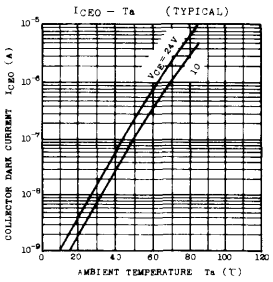
Note : Pulse width L≤s, 300 pps.
* Above 25°C ambient.

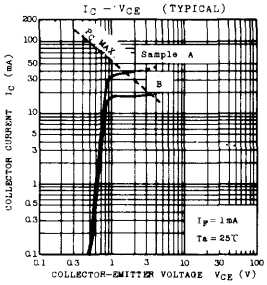
ELECTRICAL CHARACTERISTICS (Ta =25°C)

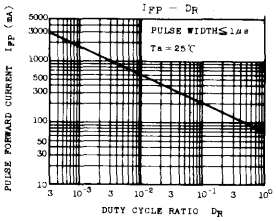
	CHARACTERISTIC	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=3V	-	-	10	μA
	Capacitance	C_D	V=0, f=1MHz	-	30	-	pF
PHOTO-DARLINGTON	DC Forward Current Gain	h_{FE}	V_{CE}=5, I_C=10mA	-	50K	-	
	Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C=1mA, I_F=0	35	-	-	V
	Collector-Base Breakdown Voltage	$V_{(BR)CBO}$	I_C=100μA, I_F=0	35	-	-	V
	Emitter-Collector Breakdown Voltage	$V_{(BR)ECO}$	I_E=100μA, I_F=0	5	-	-	V
	Collector Dark Current	I_{CEO}	V_{CE}=24V, I_F=0	-	1.0	150	nA
COUPLED	Current Transfer Ratio	I_C/I_F	I_F=1mA, V_{CE}=1V	1000	2000	-	%
	Saturation Voltage	$V_{CE(sat)}$	I_F=10mA, I_C=50mA	-	-	1.0	V
	Turn-On Time	t_{on}	I_F=10mA, V_{CC}=10V, R_L=180Ω	-	3	-	μs
	Turn-Off Time	t_{off}		-	100	-	μs
	Capacitance Input to Output	C_S	V=0, f=1MHz	-	0.8	-	pF
	Isolation Resistance	R_S	V=500V	-	10^{11}	-	Ω
	AC Isolation Voltage	BV_S	AC 1 minute	2500	-	-	V_{RMS}
	Peak Isolation Voltage	BV_S	Peak	3550	-	-	V

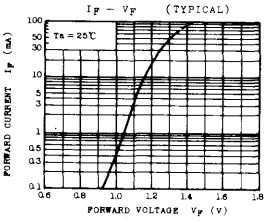

I_F – Ta
ALLOWABLE FORWARD CURRENT I_F (mA)
AMBIENT TEMPERATURE Ta (°C)

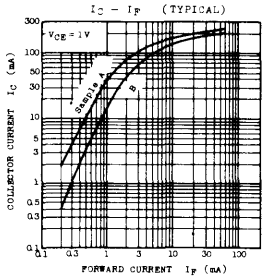

P_C – Ta
ALLOWABLE COLLECTOR POWER DISSIPATION P_C (mW)
AMBIENT TEMPERATURE Ta (°C)

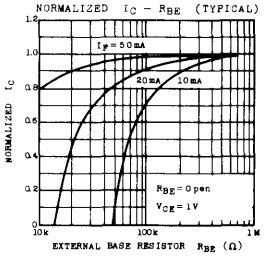

I_{CEO} – Ta (TYPICAL)
COLLECTOR DARK CURRENT I_{CEO} (A)
V_{CE} = 24V
10
AMBIENT TEMPERATURE Ta (°C)

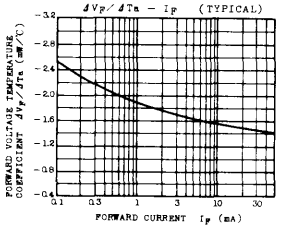

I_C – V_{CE} (TYPICAL)
COLLECTOR CURRENT I_C (mA)
DC MAX.
Sample A
A
B
I_F = 1mA
Ta = 25°C
COLLECTOR-EMITTER VOLTAGE V_{CE} (V)

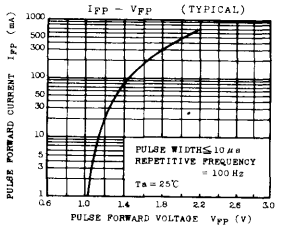

I_{FP} – D_R
PULSE FORWARD CURRENT I_{FP} (mA)
PULSE WIDTH≦1μs
Ta = 25°C
DUTY CYCLE RATIO D_R

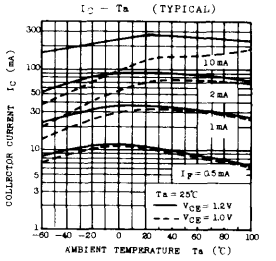

I_F – V_F (TYPICAL)
FORWARD CURRENT I_F (mA)
Ta = 25°C
FORWARD VOLTAGE V_F (V)

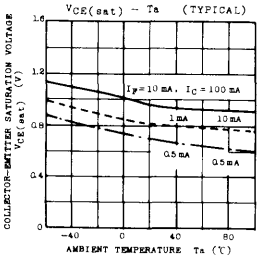

I_C – I_F (TYPICAL)
COLLECTOR CURRENT I_C (mA)
V_{CE} = 1V
Sample A
A
B
FORWARD CURRENT I_F (mA)

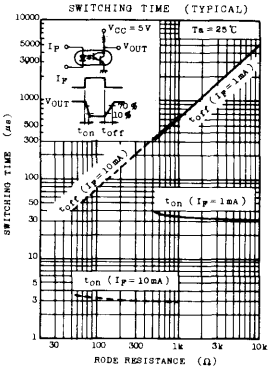

NORMALIZED I_C – R_{BE} (TYPICAL)
NORMALIZED I_C
I_F = 50mA
20mA
10mA
R_{BE} = Open
V_{CE} = 1V
EXTERNAL BASE RESISTOR R_{BE} (Ω)

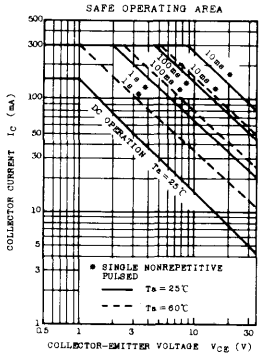

dV_F/dTa – I_F (TYPICAL)
FORWARD VOLTAGE TEMPERATURE COEFFICIENT dV_F/dTa (mV/°C)
FORWARD CURRENT I_F (mA)


I_{FP} – V_{FP} (TYPICAL)
PULSE FORWARD CURRENT I_{FP} (mA)
PULSE WIDTH≦10μs
REPETITIVE FREQUENCY = 100Hz
Ta = 25°C
PULSE FORWARD VOLTAGE V_{FP} (V)


I_C – Ta (TYPICAL)
COLLECTOR CURRENT I_C (mA)
10mA
2mA
1mA
I_F = 0.5mA
Ta = 25°C
V_{CE} = 1.2V
V_{CE} = 1.0V
AMBIENT TEMPERATURE Ta (°C)


$V_{CE(sat)}$ – Ta (TYPICAL)
COLLECTOR-EMITTER SATURATION VOLTAGE $V_{CE(sat)}$ (V)
I_F = 10mA, I_C = 100mA
1mA
10mA
0.5mA
0.5mA
AMBIENT TEMPERATURE Ta (°C)


SWITCHING TIME (TYPICAL)
SWITCHING TIME (μs)
V_{CC} = 5V
Ta = 25°C
I_P
V_{OUT}
I_F
V_{OUT}
90%
10%
t_{on} t_{off}
t_{off} (I_F = 1mA)
t_{off} (I_F = 10mA)
t_{on} (I_F = 1mA)
t_{on} (I_F = 10mA)
RODE RESISTANCE (Ω)


SAFE OPERATING AREA
COLLECTOR CURRENT I_C (mA)
10ms
100ms
1s
DC OPERATION
Ta = 25°C
● SINGLE NONREPETITIVE PULSED
Ta = 25°C
Ta = 60°C
COLLECTOR-EMITTER VOLTAGE V_{CE} (V)

TLP572

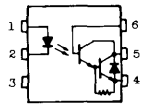
GaAs infrared Emitting Diode & NPN Silicon
Photo-darlington

AC LINE/DIGITAL LOGIC ISOLATOR.
DIGITAL LOGIC/DIGITAL LOGIC ISOLATOR.
TELEPHONE LINE RECEIVER.
TWISTED PAIR LINE RECEIVER.
RELAY CONTACT MONITOR.

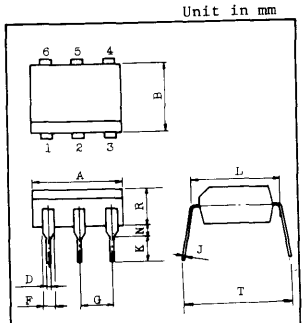
The TOSHIBA TLP572 consists of a gallium aresenide, infrared emitting diode coupled with a silicon, darlington connected, photo transistor which has an integral base-emitter resistor to optimize switching speed and elevated temperature characteristics.

- Small Package Size and Low Cost
- Fast Switching Speeds : 100μs
- High DC Current Transfer Ratio : 1000%
- High Isolation Resistance : $10^{11}\Omega$
- High Isolation Voltage : 2500 V_{RMS}
- UL Recognized : File No. E67349
- Type Designation P572 is Is Identical to TLP572

PIN CONFIGURATIONS (TOP VIEW)



Unit in mm



1. ANODE 4. EMITTER
2. CATHODE 5. COLLECTOR
3. NC 6. BASE

JEDEC	—
EIAJ	—
TOSHIBA	11-7A1F

SYMBOL	INCH	MM.
A	0.280±0.10	7.12±0.25
B	0.252	6.40
D	0.020	0.50
F	0.047	1.20
G	0.1(TYP)	2.54(TYP)
J	0.010	0.25
K	0.100(MIN)	2.50(MIN)
L	0.300	7.62
N	0.031	0.80
R	0.144	3.65
T	0.309~3.465	7.85~8.80

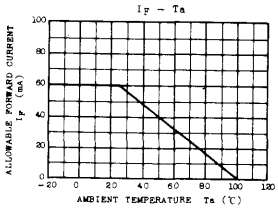
ABSOLUTE MAXIMUM RATINGS (Ta = 25°C)

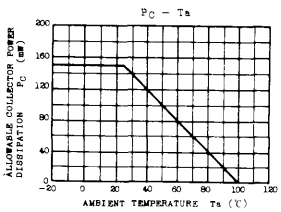
	CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	Forward Current		I_F	60	mA
	Forward Current Derating		ΔI_F/°C	0.8*	mA/°C
	Peak Forward Current (Note)		I_{FP}	1	A
	Power Dissipation		P_D	100	mW
	Power Dissipation Derating		ΔP_D/°C	1.33**	mW/°C
	Reverse Voltage		V_R	6	V
PHOTO-DARLINGTON	Collector-Emitter Voltage		BV_{CEO}	35	V
	Collector-Base Voltage		BV_{CBO}	35	V
	Emitter-Base Voltage		BV_{EBO}	-	V
	Collector Current	Forward	I_C	150	mA
		Reverse		-10	
	Power Dissipation		P_C	150	mW
	Power Dissipation Derating		ΔP_C/°C	2.0**	mW/°C
COUPLED	Storage Temperature		T_{stg}	-55 ~ 150	°C
	Operating Temperature		T_{opr}	-55 ~ 100	°C
	Lead Soldering Temperature (at 10 sec.)		T_{sold}	260	°C
	Total Package Power Dissipation		P_T	200	mW
	Total Package Power Dissipation Derating		ΔP_T/°C	2.6**	mW/°C

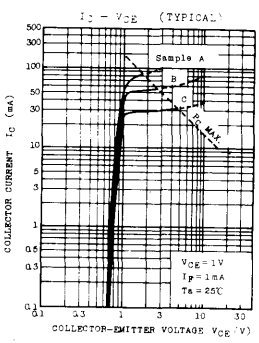
Note : Pulse width 100μs, f=100Hz
* Above 35°C ambient
** Above 25°C ambient

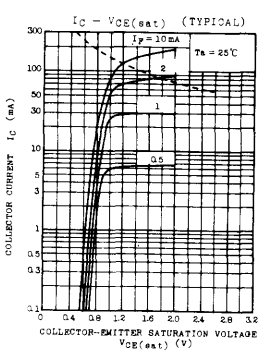
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

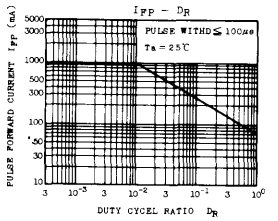
	CHARACTERISTIC	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=3V	-	-	10	μA
	Capacitance	C_D	V=0, f=1MHz	-	30	-	pF
PHOTO-DARLINGTON	DC Forward Current Gain	h_{FE}	V_{CE}=5V, I_C=0.5mA	-	50K	-	
	Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C=100μA, I_F=0	35	-	-	V
	Collector-Base Breakdown Voltage	$V_{(BR)CBO}$	I_C=100μA, I_F=0	35	-	-	V
	Emitter-Collector Breakdown Voltage	$V_{(BR)ECO}$	I_F=100μA, I_P=0	5	-	-	V
	Collector Dark Current	I_{CEO}	V_{CE}=10V, I_F=0	-	1.0	100	nA
COUPLED	Current Transfer Ratio	I_C/I_F	I_F=1mA, V_{CE}=1V	1000	2000	-	%
	Saturation Voltage	$V_{CE(sat)}$	I_F=10mA, I_C=50mA	-	-	1.0	V
	Turn-On Time	t_{on}	I_F=10mA, V_{CC}=10V, R_L=180Ω	-	3	-	μs
	Turn-Off Time	t_{off}		-	100	-	μs
	Capacitance Input to Output	C_S	V=0, f=1MHz	-	0.8	-	pF
	Isolation Resistance	R_S	V=500V	-	10^{11}	-	Ω
	AC Isolation Voltage	BV_S	AC 1 minute	2500	-	-	V_{RMS}
	Peak Isolation Voltage	BV_S	Peak	3550	-	-	V

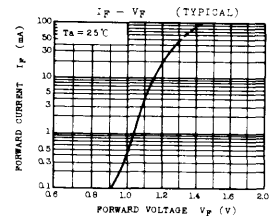

I_F – Ta
ALLOWABLE FORWARD CURRENT I_F (mA)
AMBIENT TEMPERATURE Ta (°C)

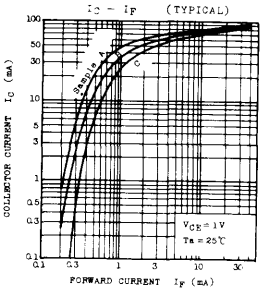

P_C – Ta
ALLOWABLE COLLECTOR POWER DISSIPATION P_C (mW)
AMBIENT TEMPERATURE Ta (°C)

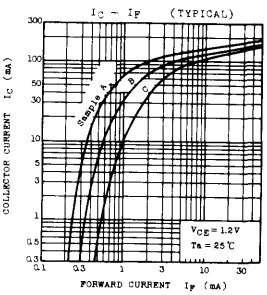

I_C – V_{CE} (TYPICAL)
Sample A
B
C
P_C MAX.
V_{CE} = 1V
I_F = 1mA
Ta = 25°C
COLLECTOR CURRENT I_C (mA)
COLLECTOR-EMITTER VOLTAGE V_{CE} (V)

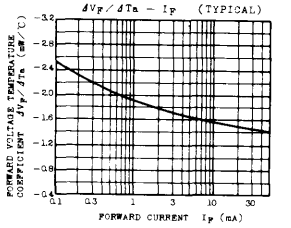

I_C – $V_{CE(sat)}$ (TYPICAL)
I_F = 10mA
Ta = 25°C
2
1
0.5
COLLECTOR CURRENT I_C (mA)
COLLECTOR-EMITTER SATURATION VOLTAGE $V_{CE(sat)}$ (V)

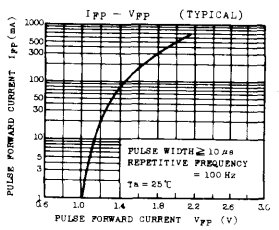

I_{FP} – D_R
PULSE WITHD≦ 100μs
Ta = 25°C
PULSE FORWARD CURRENT I_{FP} (mA)
DUTY CYCEL RATIO D_R

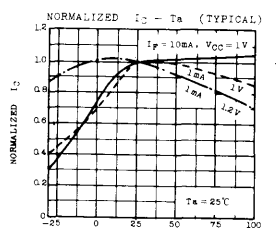

I_F – V_F (TYPICAL)
Ta = 25°C
FORWARD CURRENT I_F (mA)
FORWARD VOLTAGE V_F (V)

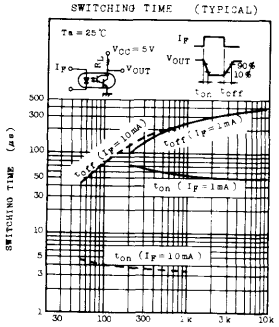

I_C – I_F (TYPICAL)
Sample A
B
C
V_{CE} = 1V
Ta = 25°C
COLLECTOR CURRENT I_C (mA)
FORWARD CURRENT I_F (mA)

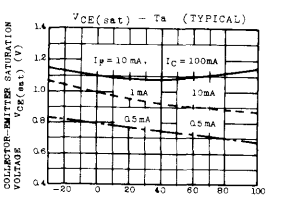

I_C – I_F (TYPICAL)
Sample A
B
C
V_{CE} = 1.2V
Ta = 25°C
COLLECTOR CURRENT I_C (mA)
FORWARD CURRENT I_F (mA)

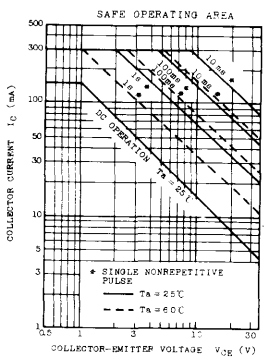

$\Delta V_F / \Delta Ta$ – I_F (TYPICAL)
FORWARD VOLTAGE TEMPERATURE COEFFICIENT $\Delta V_F / \Delta Ta$ (mV/°C)
FORWARD CURRENT I_F (mA)

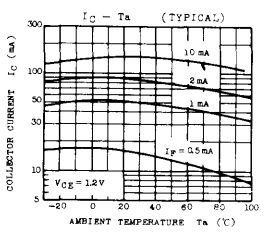

I_{FP} – V_{FP} (TYPICAL)
PULSE WIDTH≧ 10 μs
REPETITIVE FREQUENCY = 100 Hz
Ta = 25°C
PULSE FORWARD CURRENT I_{FP} (mA)
PULSE FORWARD CURRENT V_{FP} (V)


NORMALIZED I_C – Ta (TYPICAL)
I_F = 10mA, V_{CC} = 1V
Ta = 25°C
NORMALIZED I_C
AMBIENT TEMPERATURE Ta (°C)


SWITCHING TIME (TYPICAL)
Ta = 25°C
V_{CC} = 5V
I_F
V_{OUT}
10%
90%
t_{on} t_{off}
t_{off} (I_F = 10mA)
t_{off} (I_F = 1mA)
t_{on} (I_F = 1mA)
t_{on} (I_F = 10mA)
SWITCHING TIME (μs)
LOAD RESISTANCE R_L (Ω)


$V_{CE(sat)}$ – Ta (TYPICAL)
I_F = 10 mA, I_C = 100mA
1mA
10mA
0.5mA
0.5mA
COLLECTOR-EMITTER SATURATION VOLTAGE $V_{CE(sat)}$ (V)
AMBIENT TEMPERATURE Ta (°C)


SAFE OPERATING AREA
1s
100ms
10ms
1ms
DC OPERATION Ta = 25°C
* SINGLE NONREPETITIVE PULSE
Ta = 25°C
Ta = 60°C
COLLECTOR CURRENT I_C (mA)
COLLECTOR-EMITTER VOLTAGE V_{CE} (V)


I_C – Ta (TYPICAL)
10 mA
2mA
1mA
I_F = 0.5mA
V_{CE} = 1.2V
COLLECTOR CURRENT I_C (mA)
AMBIENT TEMPERATURE Ta (°C)

TLP573

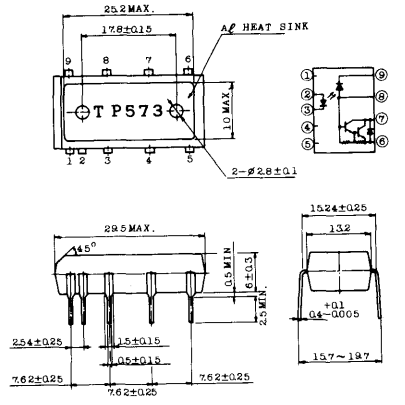
INFRARED LED + PHOTO DIODE + DARLINGTON

TLP573 CAN CONTROL DC 1A, THIS UNIT IS A 9-LEAD DIP PACKAGE.

- MOTOR CONTROL
- CONTROLLER
- COPIER
- NC MACHINE
- PULSE MOTOR DRIVE
- POWER TRANSISTOR DRIVE

. High Output Current : I_O=1A, @ I_F=12mA, V_O=1.5V, V_{CC}=5V
: $I_O \leqq$1mA, @ V_O=5V, I_F=1.5mA
. High Output Voltage : V_O(V_{CEO})=60V, V_{CC} (photo-diode)=60V
. High Isolation Voltage : BV_S=2500V AC/1min.
. Type Name : P573 or TLP573
. UL Recognized : File No. E67349
(Note) Please use Type No. P573 to the application for UL.

Unit : mm



1. NO CONNECTION
2. LED ANODE
3. LED CATHODE
4. NO CONNECTION
5. NO CONNECTION
6. DARINGTON Tr. EMITTER
7. DRAINGTON Tr. COLLECTOR
8. DARINGTON Tr. BASE, PHOTO DIODE ANODE
9. PHOTO DIODE CATHODE

JEDEC	—
EIAJ	—
TOSHIBA	11-30A1B

MAXIMUM RATINGS (Ta = 25°C)

	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	60	mA
	Forward Current Derating (Ta≧50°C)	ΔI_F/°C	-1.2	mA/°C
	Pulse Forward Current (Note 1)	I_{FP}	1	A
	Reverse Voltage	V_R	5	V
	Junction Temperature	T_j	100	°C
DETECTOR	Supply Voltage	V_{CC}	-0.5~60	V
	Output Voltage	V_O	-0.5~60	V
	Output Current	I_O	1	A
	Emitter-Base Reverse Voltage	V_{EBO}	5	V
	Base Current	I_B	0.2	A
	Output Power Dissipation	P_o	1.3	W
	Output Power Dissipation Derating (Ta≧25°C)	ΔP_O/°C	18	mW/°C
	Junction Temperature	T_j	100	°C
Isolation Voltage (Note 2)		BV_S	2500	V_{rms}
Operationg Temperature Range		Topr	-30~80	°C
Storage Temperature Range		Tstg	-55~125	°C
Lead Temperature . Time		T_{sol}	260°C, 3 sec	

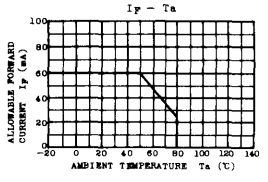
Note 1 : Pulse width≦100μs, Repetitive frequency=100Hz
2 : AC /1min.; R.H=40~60%
Soldering Temp. 260°C (10 sec.)

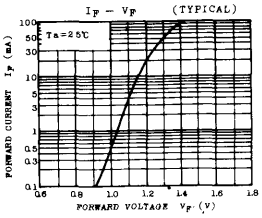
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

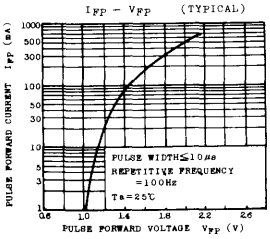
	CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage		V_F	I_F=30mA	1.10	1.24	1.40	V
	Reverse Current		I_R	V_R=5V	-	-	10	μA
	Terminal Between Capacitance		C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	High Level Output Current		I_{OH}	I_F=0mA, V_{CC}=V_O=60V	-	-	1	μA
	Photo Diode Reverse Current		I_{CCH}	I_F=0mA, V_{CC}=60V	-	-	200	nA
	DC Current Gain		h_{FE}	V_{CE}=1.5V, I_O=1A	-	5000	-	
	Emitter Cut-off Current		I_{EBO}	V_{EB}=5V, I_O=0	-	-	10	mA
COUPLED	Trigger Current 1		$I_{F1(ON)}$	V_O=1.5V, V_{CC}=5V, I_O=1A	-	6	12	mA
	Trigger Current 2		$I_{F2(ON)}$	V_O=V_{CC}=1.5V, I_O=1A	-	9	20	mA
	Non-Trigger Current		$I_{F(OFF)}$	V_O=1.5V, V_{CC}=5V, I_O=1mA	1.5	3.5	-	mA
	Current Transfer Ratio		I_O/I_F	V_O=1.5V, V_{CC}=5V, I_O=1A	8200	-	-	%
	Low Level Output Voltage 1		V_{OL1}	V_{CC}=5V, I_O=1A, I_F=15mA	-	1.3	1.5	V
	Low Level Output Voltage 2		V_{OL2}	V_{CC}=V_{OL2}, I_O=1A, I_F=20mA	-	1.3	1.5	V
	Switching Time	Delay Time	t_d	I_F=20mA, f=10kHz, DUTY CYCLE=10%, V_{CC}=24V, R_L=100Ω, V_{OUT}	-	0.6	-	μs
		Rise Time	t_r		-	0.6	-	μs
		Storage	t_s		-	4	-	μs
		Fall Time	t_f		-	2	-	μs

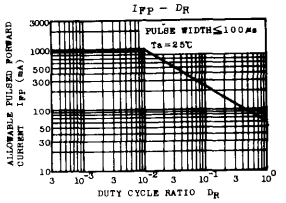
RECOMMENDED OPERATING CONDITIONS (Ta=-30 55°C)

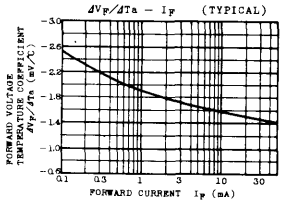
CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Trigger Current 1	$I_{F1(ON)}$	18	20	40	mA
Trigger Current 2	$I_{F2(ON)}$	25	30	40	mA
Non-Trigger Current	$I_{F(OFF)}$	0	-	1	mA
Output Low Level Current	I_{OL}	-	-	0.55	A
Supply Voltage	V_{CC}	3	24	30	V
Output High Level Voltage	V_{OH}	-	24	30	V

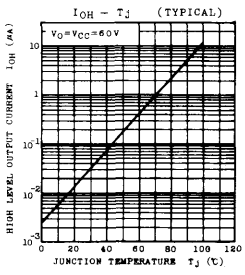


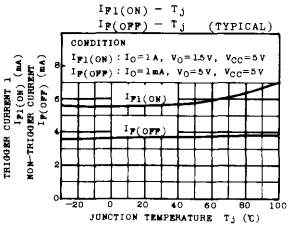


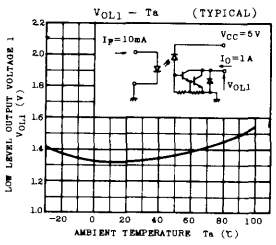


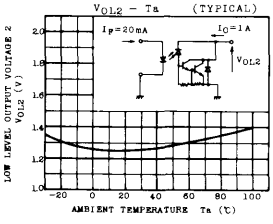


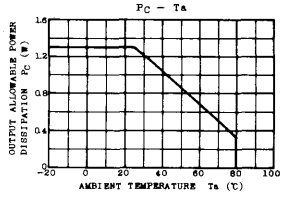

$\Delta V_F/\Delta Ta - I_F$ (TYPICAL)
FORWARD VOLTAGE TEMPERATURE COEFFICIENT $\Delta V_F/\Delta Ta$ (mV/℃)
FORWARD CURRENT I_F (mA)

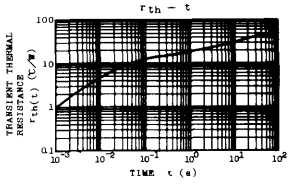

$I_{OH} - T_j$ (TYPICAL)
$V_O = V_{CC} = 60V$
HIGH LEVEL OUTPUT CURRENT I_{OH} (A)
JUNCTION TEMPERATURE T_j (℃)

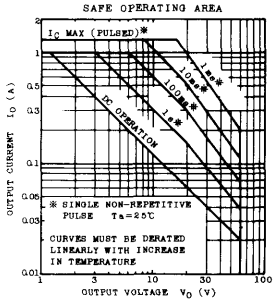

$I_{F1(ON)} - T_j$
$I_{F(OFF)} - T_j$ (TYPICAL)
CONDITION
$I_{F1(ON)}$: I_O=1A, V_O=1.5V, V_{CC}=5V
$I_{F(OFF)}$: I_O=1mA, V_O=5V, V_{CC}=5V
TRIGGER CURRENT 1 $I_{F1(ON)}$ (mA)
NON-TRIGGER CURRENT $I_{F(OFF)}$ (mA)
JUNCTION TEMPERATURE T_j (℃)

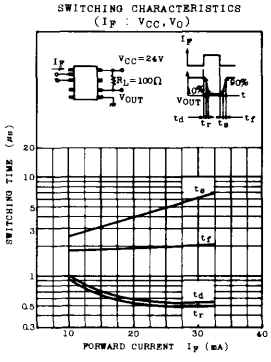

$V_{OL1} - Ta$ (TYPICAL)
I_F=10mA
V_{CC}=5V
I_O=1A
LOW LEVEL OUTPUT VOLTAGE 1 V_{OL1} (V)
AMBIENT TEMPERATURE Ta (℃)

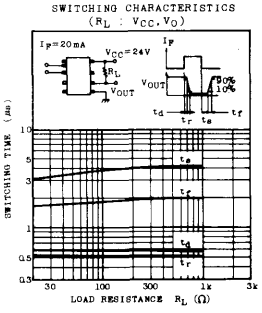

$V_{OL2} - Ta$ (TYPICAL)
I_F=20mA
I_O=1A
LOW LEVEL OUTPUT VOLTAGE 2 V_{OL2} (V)
AMBIENT TEMPERATURE Ta (℃)

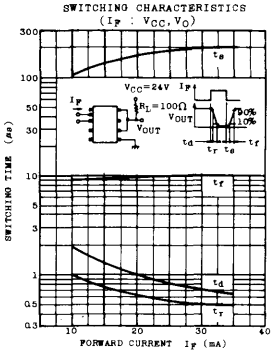

$P_C - Ta$
OUTPUT ALLOWABLE POWER DISSIPATION P_C (W)
AMBIENT TEMPERATURE Ta (℃)

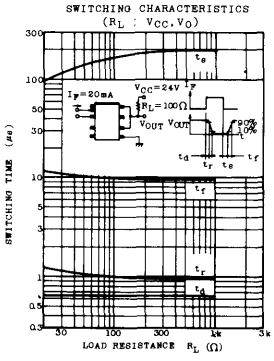

$r_{th} - t$
TRANSIENT THERMAL RESISTANCE r_{th} (℃/W)
TIME t (s)


SAFE OPERATING AREA
I_C MAX (PULSED)*
1ms*
10ms*
100ms*
DC OPERATION
* SINGLE NON-REPETITIVE PULSE Ta=25℃
CURVES MUST BE DERATED LINEARLY WITH INCREASE IN TEMPERATURE
OUTPUT CURRENT I_O (A)
OUTPUT VOLTAGE V_O (V)


SWITCHING CHARACTERISTICS
(I_F : V_{CC}, V_O)
V_{CC}=24V
R_L=100Ω
SWITCHING TIME (μs)
FORWARD CURRENT I_F (mA)


SWITCHING CHARACTERISTICS
(R_L : V_{CC}, V_O)
I_F=20mA
V_{CC}=24V
SWITCHING TIME (μs)
LOAD RESISTANCE R_L (Ω)


SWITCHING CHARACTERISTICS
(I_F : V_{CC}, V_O)
V_{CC}=24V
R_L=100Ω
SWITCHING TIME (μs)
FORWARD CURRENT I_F (mA)


SWITCHING CHARACTERISTICS
(R_L : V_{CC}, V_O)
I_F=20mA
V_{CC}=24V
SWITCHING TIME (μs)
LOAD RESISTANCE R_L (Ω)

TLP575

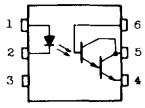
GaAs infrared Emitting Diode & NPN Silicon Photo-darlington

AC LINE/DIGITAL LOGIC ISOLATOR.
DIGITAL LOGIC/DIGITAL LOGIC ISOLATOR.
TELEPHONE LINE RECEIVER.
TWISTED PAIR LINE RECEIVER.
RELAY CONTACT MONITOR.

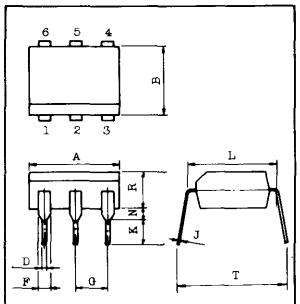
The TOSHIBA TLP575 consists of a gallium arsenide infrared emitting diode coupled with a silicon photo darlington in a dual in-line package.

- Small Package Size and Low Cost
- Fast Switching Speeds : 200μs
- High DC Current Transfer Ratio : 200%
- High Isolation Resistance : $10^{11}\Omega$
- High Isolation Voltage : 2500 V_{RMS}

PIN CONFIGURATIONS (TOP VIEW)



Unit in mm



1. ANODE 4. EMITTER
2. CATHODE 5. COLLECTOR
3. NC 6. BASE

JEDEC	—
EIAJ	—
TOSHIBA	11-7A1F

SYMBOL	INCH	MM.
A	0.280±0.010	7.12±0.25
B	0.252	6.40
D	0.020	0.50
F	0.047	1.20
G	0.1(TYP)	2.54(TYP)
J	0.010	0.25
K	0.100(MIN)	2.50(MIN)
L	0.300	7.62
N	0.031	0.80
R	0.144	3.65
T	0.309~3.465	7.85~8.80

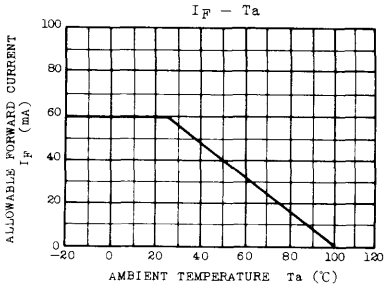
ABSOLUTE MAXIMUM RATINGS (Ta = 25°C)

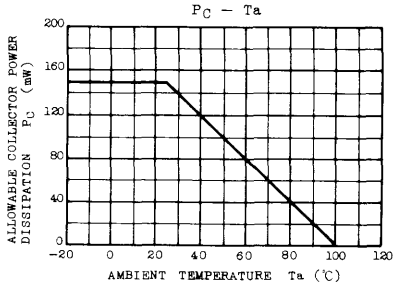
	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	60	mA
	Forward Current Derating	$\Delta I_F/°C$	0.8*	mA/°C
	Peak Forward Current (Note)	I_{FP}	3	A
	Power Dissipation	P_D	100	mW
	Power Dissipation Derating	$\Delta P_D/°C$	1.33*	mW/°C
	Reverse Voltage	V_R	3	V
PHOTO-DARLINGTON	Collector-Emitter Voltage	BV_{CEO}	35	V
	Collector-Base Voltage	BV_{CBO}	35	V
	Emitter-Collector Voltage	BV_{ECO}	7	V
	Collector Current	I_C	100	mA
	Power Dissipation	P_C	150	mW
	Power Dissipation Derating	$\Delta P_C/°C$	2.0*	mW/°C
COUPLED	Storage Temperature	T_{stg}	-55~150	°C
	Operating Temperature	T_{opr}	-55~100	°C
	Lead Soldering Temperature (at 10 sec)	T_{sold}	260	°C
	Total Package Power Dissipation	P_T	250	mW
	Total Package Power Dissipation Derating	$\Delta P_C/°C$	3.3*	mW/°C

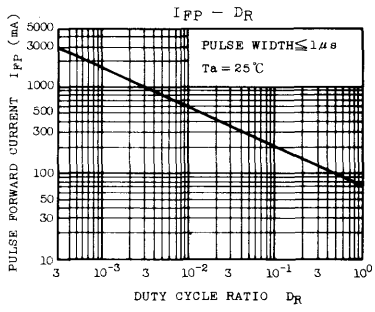
Note : Pulse width 300μs, 2% duty cycle.
* Above 25°C ambient

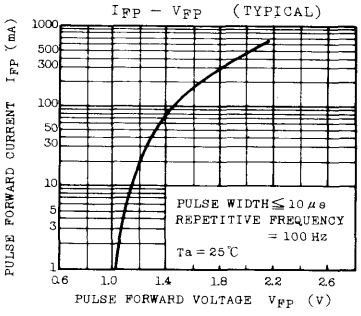
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

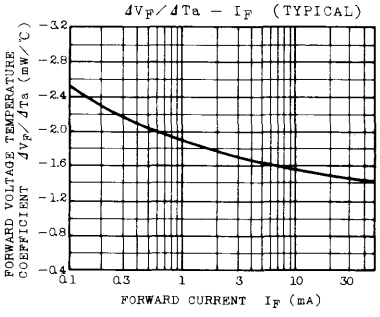
	CHARACTERISTIC	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	-	1.15	1.5	V
	Reverse Current	I_R	V_R=3V	-	-	100	μA
	Capacitance	C_D	V=0, f=1MHz	-	30	-	pF
PHOTO-DARLINGTON	DC Forward Current Gain	h_{FE}	V_{CE}=5, I_C=0.5mA	-	10K	-	
	Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C=1mA, I_F=0	35	-	-	V
	Collector-Base Breakdown Voltage	$V_{(BR)CBO}$	I_C=100μA, I_F=0	35	-	-	V
	Emitter-Collector Breakdown Voltage	$V_{(BR)ECO}$	I_E=100μA, I_F=0	7	-	-	V
	Collector Dark Current	I_{CEO}	V_{CE}=10V, I_F=0	-	1.0	100	nA
COUPLED	Current Transfer Ratio	I_C/I_F	V_{CE}=1V, I_F=1mA	200	-	-	%
	Saturation Voltage	$V_{CE(sat)}$	I_F=1mA, I_C=1mA	-	-	1.0	V
	Turn-On Time	t_{on}	I_C=10mA, V_{CE}=10V, R_L=100Ω	-	50	-	μs
	Turn-Off Time	t_{off}		-	50	-	μs
	Capacitance Input to Output	C_S	V=0, f=1MHz	-	0.8	-	pF
	Isolation Resistance	R_S	V=500V	-	10^{11}	-	Ω
	Isolation Voltage	BV_S	AC 1 minute	3535	-	-	V_{peak}
				2500	-	-	V_{RMS}

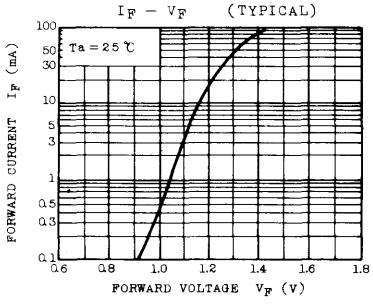

I_F – Ta
ALLOWABLE FORWARD CURRENT I_F (mA)
AMBIENT TEMPERATURE Ta (°C)

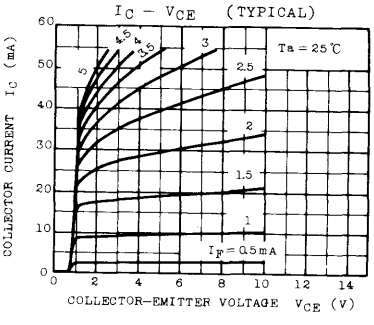

P_C – Ta
ALLOWABLE COLLECTOR POWER DISSIPATION P_C (mW)
AMBIENT TEMPERATURE Ta (°C)

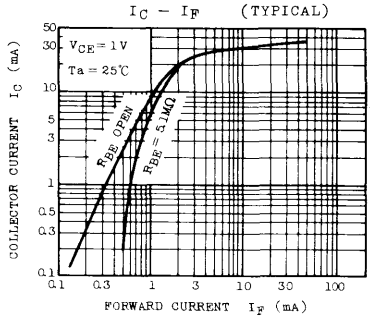

I_{FP} – D_R
PULSE WIDTH≦1μs
Ta = 25°C
PULSE FORWARD CURRENT I_{FP} (mA)
DUTY CYCLE RATIO D_R

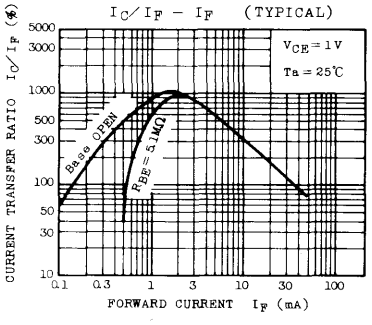

I_{FP} – V_{FP} (TYPICAL)
PULSE WIDTH≦10μs
REPETITIVE FREQUENCY = 100 Hz
Ta = 25°C
PULSE FORWARD CURRENT I_{FP} (mA)
PULSE FORWARD VOLTAGE V_{FP} (V)

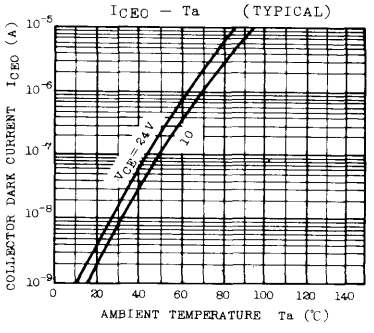

$\Delta V_F / \Delta Ta$ – I_F (TYPICAL)
FORWARD VOLTAGE TEMPERATURE COEFFICIENT $\Delta V_F / \Delta Ta$ (mV/°C)
FORWARD CURRENT I_F (mA)

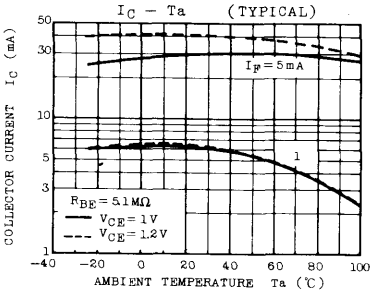

I_F – V_F (TYPICAL)
Ta = 25°C
FORWARD CURRENT I_F (mA)
FORWARD VOLTAGE V_F (V)

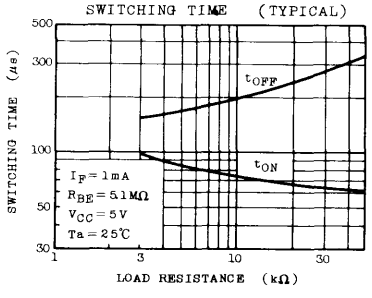

I_C – V_{CE} (TYPICAL)
Ta = 25°C
I_F = 0.5mA
COLLECTOR CURRENT I_C (mA)
COLLECTOR–EMITTER VOLTAGE V_{CE} (V)


I_C – I_F (TYPICAL)
V_{CE} = 1V
Ta = 25°C
R_{BE} OPEN
R_{BE} = 5.1MΩ
COLLECTOR CURRENT I_C (mA)
FORWARD CURRENT I_F (mA)


I_C / I_F – I_F (TYPICAL)
V_{CE} = 1V
Ta = 25°C
Base OPEN
R_{BE} = 5.1MΩ
CURRENT TRANSFER RATIO I_C / I_F (%)
FORWARD CURRENT I_F (mA)


I_{CEO} – Ta (TYPICAL)
V_{CE} = 24V
10
1
COLLECTOR DARK CURRENT I_{CEO} (A)
AMBIENT TEMPERATURE Ta (°C)


I_C – Ta (TYPICAL)
I_F = 5mA
1
R_{BE} = 5.1MΩ
V_{CE} = 1V
V_{CE} = 1.2V
COLLECTOR CURRENT I_C (mA)
AMBIENT TEMPERATURE Ta (°C)


SWITCHING TIME (TYPICAL)
t_{OFF}
t_{ON}
I_F = 1mA
R_{BE} = 5.1MΩ
V_{CC} = 5V
Ta = 25°C
SWITCHING TIME (μs)
LOAD RESISTANCE (kΩ)

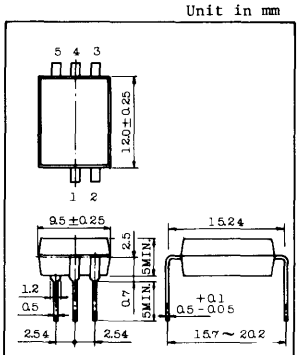
TLP581

GaAlAs Infrared Emitting Diode & NPN Silicon Photo-Transisotr

The TOSHIBA TLP581 consists of a gallium Aluminum arsenide, infrared emitting diode coupled with a silicon photo transistor in a dual in-line package.

- AC Isolation Voltage : 5kV
- Nominal Isolation Operating Voltage (Note 1)
  : 1000Vac or 1200Vdc for Isolation Group B
  750Vac or 900Vdc for Isolation Group C
- Climatic Test Class : 25/100/21 DIN40045
- Internal Isolation Thickness Between Metal Parts
  : 2mm (Min.) (Note 2)
- External Creepage Distance and Airgaps
  : 14.5mm (Min.) (Note 3)
- Housing : Epoxy Molded
- TOSHIBA Unique Double Molded Construction
- High Efficiency Low Degradation Liquid Epitaxial IRED
- Low Coupling Capacity : 0.3pF (Typ.)
- Current Transfer Ratio : 60% (Typ.)

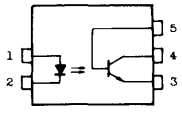
Unit in mm



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

JEDEC	—
EIAJ	—
TOSHIBA	11-10D1A

PIN CONFIGUTATION (TOP VIEW)



Note 1. According to VDE0110b/2.79
2. According to VDE0730-2P
3. Creeping current resistance : Group I (KB > 100-KC > 100)
According to VDE0110b/2.79 Table 3.

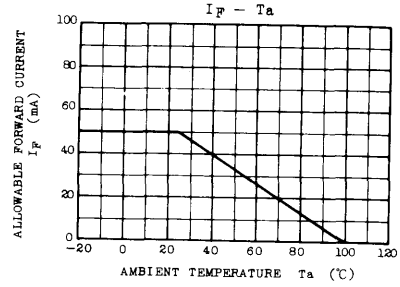
ABSOLUTE MAXIMUM RATINGS

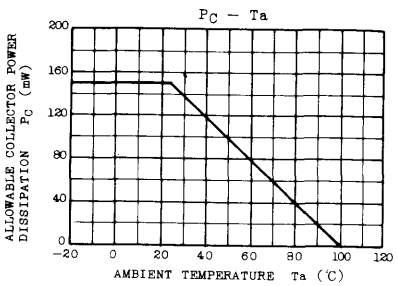
(Ta = 25°C)

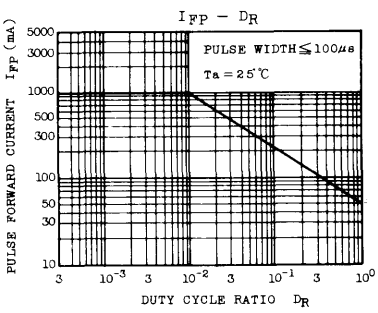
	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Reverse Voltage	V_R	5	V
	Forward Current	I_F	50	mA
	Forward Surge Current ($t_p \leq 100\mu s$)	I_{FSM}	1	A
	Power Dissipation	P_D	100	mW
	Junction Temperature	T_j	100	°C
PHOTO-TRANSISTOR	Collector-Emitter Voltage	BV_{CEO}	35	V
	Collector-Base Voltage	BV_{CBO}	50	V
	Emitter-Collector Voltage	BV_{ECO}	5	V
	Collector Current	I_C	50	mA
	Peak Collector Current ($\frac{t_p}{T} = 0.5$, $t_p \leq 10ms$)	I_{CM}	100	mA
	Power Dissipation	P_C	150	mW
	Junction Temperature	T_j	100	°C
COUPLED	AC Isolation Voltage	BV_S	5	kV
	Storage Temperature	T_{stg}	-55 ~ 125	°C
	Operating Temperature	T_{opr}	-55 ~ 100	°C
	Lead Soldering Temperature (at 10 sec.)	T_{sold}	260	°C
	Total Power Dissipation	P_T	250	mW

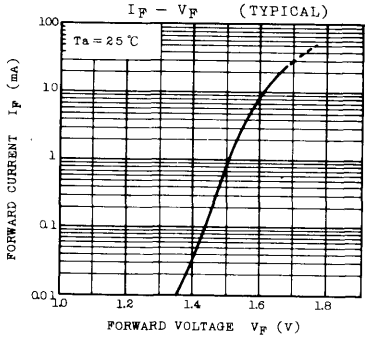
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

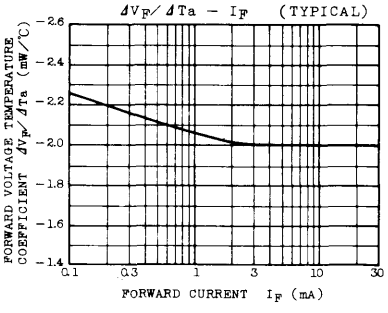
	CHARACTERISTIC	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	-	1.65	1.8	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_D	V=0, f=1MHz	-	45	-	pF
PHOTO-TRANSISTOR	Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C=0.5mA, I_F=0	35	-	-	V
	Collector-Base Breakdown Voltage	$V_{(BR)CBO}$	I_C=100μA, I_F=0	50	-	-	V
	Emitter-Collector Breakdown Voltage	$V_{(BR)ECO}$	I_E=100μA, I_F=0	5	-	-	V
	Collector Dark Current	I_{CEO}	V_{CE}=10V, I_F=0	-	1	50	nA
	Collector-Emitter Capacitance	C_{CE}	V=0, f=1MHz	-	15	-	pF
COUPLED	Current Transfer Ratio	I_C/I_F	I_F=10mA, V_{CE}=5V	25	60	-	%
	Saturation Voltage	$V_{CE(sat)}$	I_F=10mA, I_C=2.4mA	-	0.1	0.4	V
	Capacitance Input to Output	C_S	V=0, f=1MHz	-	0.3	-	pF
	Isolation Resistance	R_S	V=1000V, 50% R.H.	-	10^{12}	-	Ω
	AC Isolation Voltage	BV_S	t=1 minute	5	-	-	kV
	Turn-On Time	t_{on}	V_{CE}=10V, I_C=2mA R_L=100Ω	-	6	-	μs
	Turn-Off Time	t_{off}	V_{CE}=10V, I_C=2mA R_L=100Ω	-	6	-	μs

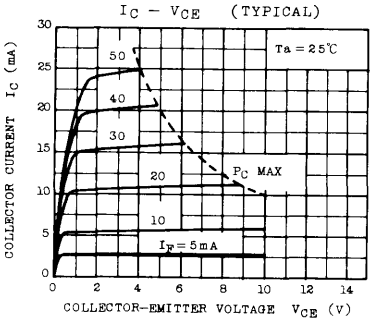

I_F – Ta
ALLOWABLE FORWARD CURRENT I_F (mA)
AMBIENT TEMPERATURE Ta (°C)

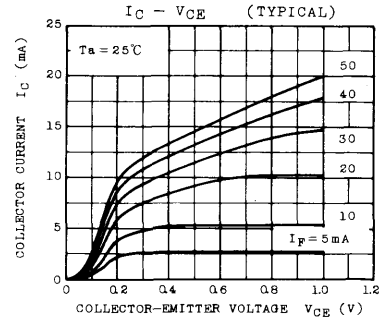

P_C – Ta
ALLOWABLE COLLECTOR POWER DISSIPATION P_C (mW)
AMBIENT TEMPERATURE Ta (°C)

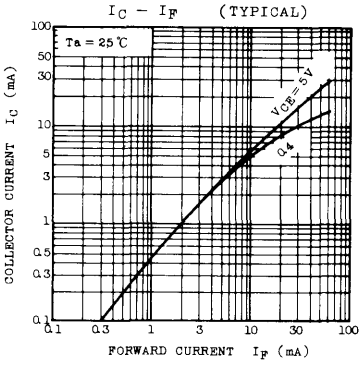

I_{FP} – D_R
PULSE WIDTH≦100μs
Ta = 25°C
PULSE FORWARD CURRENT I_{FP} (mA)
DUTY CYCLE RATIO D_R

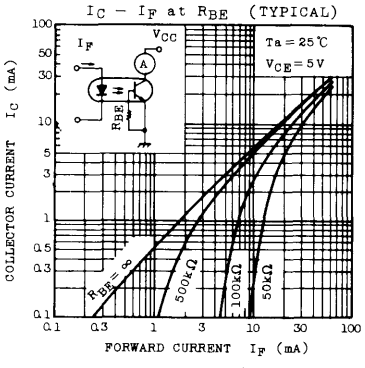

I_F – V_F (TYPICAL)
Ta = 25°C
FORWARD CURRENT I_F (mA)
FORWARD VOLTAGE V_F (V)

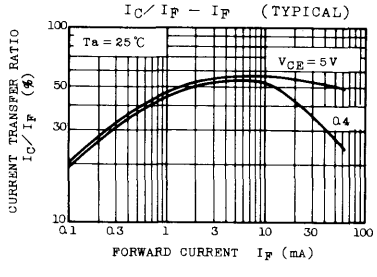

$\Delta V_F/\Delta Ta$ – I_F (TYPICAL)
FORWARD VOLTAGE TEMPERATURE COEFFICIENT $\Delta V_F/\Delta Ta$ (mV/°C)
FORWARD CURRENT I_F (mA)

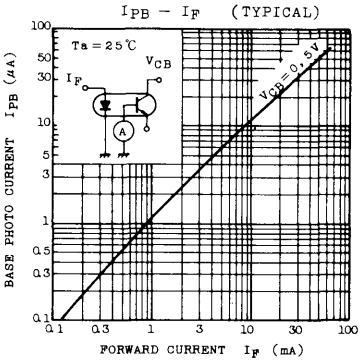

I_C – V_{CE} (TYPICAL)
Ta = 25°C
50
40
30
20
10
I_F = 5mA
P_C MAX
COLLECTOR CURRENT I_C (mA)
COLLECTOR–EMITTER VOLTAGE V_{CE} (V)

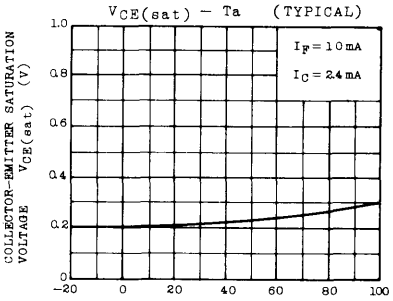

I_C – V_{CE} (TYPICAL)
Ta = 25°C
50
40
30
20
10
I_F = 5mA
COLLECTOR CURRENT I_C (mA)
COLLECTOR–EMITTER VOLTAGE V_{CE} (V)

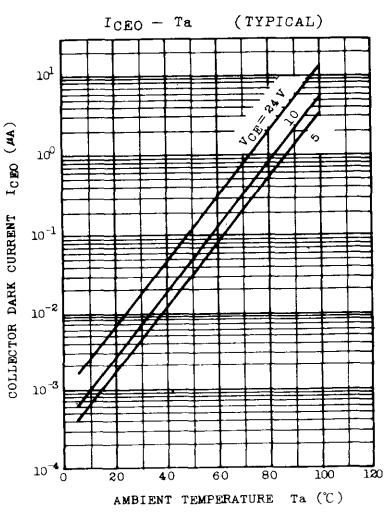

I_C – I_F (TYPICAL)
Ta = 25°C
V_{CE} = 5V
0.4
COLLECTOR CURRENT I_C (mA)
FORWARD CURRENT I_F (mA)

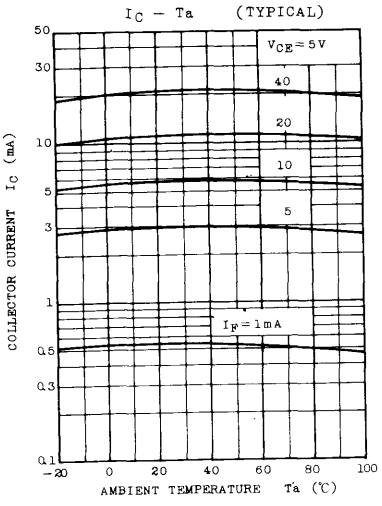

I_C – I_F at R_{BE} (TYPICAL)
Ta = 25°C
V_{CE} = 5V
I_F
V_{CC}
R_{BE}
R_{BE} = ∞
500kΩ
100kΩ
50kΩ
COLLECTOR CURRENT I_C (mA)
FORWARD CURRENT I_F (mA)

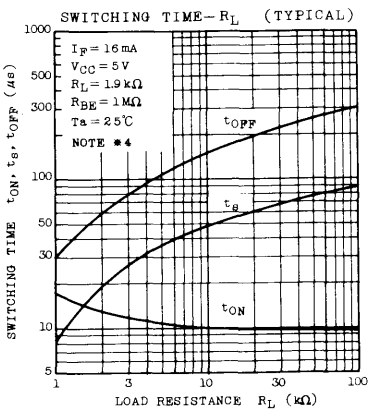

I_C/I_F – I_F (TYPICAL)
Ta = 25°C
V_{CE} = 5V
0.4
CURRENT TRANSFER RATIO I_C/I_F (%)
FORWARD CURRENT I_F (mA)

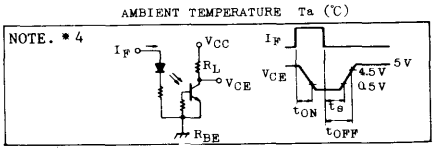

I_{PB} – I_F (TYPICAL)
Ta = 25°C
I_F
V_{CB}
V_{CB} = 0.5V
BASE PHOTO CURRENT I_{PB} (μA)
FORWARD CURRENT I_F (mA)


$V_{CE(sat)}$ – Ta (TYPICAL)
I_F = 10mA
I_C = 2.4mA
COLLECTOR–EMITTER SATURATION VOLTAGE $V_{CE(sat)}$ (V)


I_{CEO} – Ta (TYPICAL)
COLLECTOR DARK CURRENT I_{CEO} (μA)
V_{CE} = 24 V
10
5
AMBIENT TEMPERATURE Ta (°C)


I_C – Ta (TYPICAL)
COLLECTOR CURRENT I_C (mA)
V_{CE} = 5V
40
20
10
5
I_F = 1mA
AMBIENT TEMPERATURE Ta (°C)


SWITCHING TIME – R_L (TYPICAL)
I_F = 16 mA
V_{CC} = 5 V
R_L = 1.9 kΩ
R_{BE} = 1 MΩ
Ta = 25°C
NOTE ✱4
t_{OFF}
t_s
t_{ON}
SWITCHING TIME t_{ON}, t_s, t_{OFF} (μs)
LOAD RESISTANCE R_L (kΩ)


AMBIENT TEMPERATURE Ta (°C)
NOTE. ✱4
I_F
V_{CC}
R_L
V_{CE}
R_{BE}
I_F
V_{CE}
5 V
4.5 V
0.5 V
t_{ON}
t_s
t_{OFF}

TLP620, -2, -4/630

AC INPUT PHOTO COUPLER

TELECOMMUNICATION RING DETECTOR.

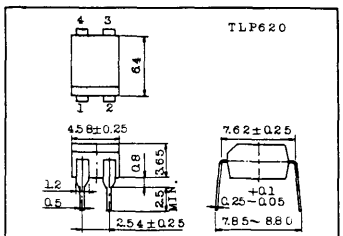
AC-INPUT MODULES.

PROGRAMMABLE CONTROLLERS.

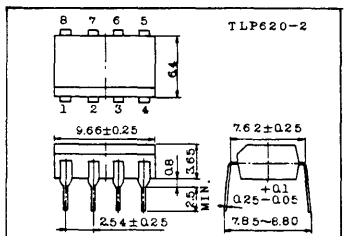
The TOSHIBA TLP620, -2, -4 and TLP630 consist of two gallium arsenide infrared emitting diodes connected in inverse parallel and coupled with a silicon photo-transistor in a dual in-line package. The TLP620-2 offers two isolated channels in a single DIP package, while the TLP620-4 provides four isolated channels per package.

- AC or Polarity Insensitive Inputs
- Built-in Reverse Polarity Input Protection
- High Isolation Voltage.....5000V_{RMS}, 1 minut.
- High DC Current Transfer Ratio..50% MIN.

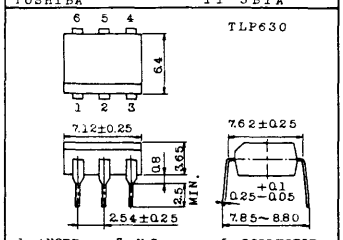
Unit in mm



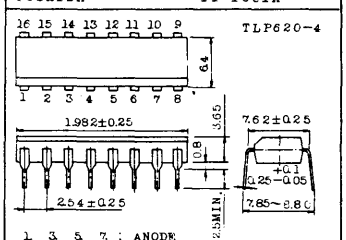
JEDEC	–
EIAJ	–
TOSHIBA	11-5B1A



JEDEC	–
EIAJ	–
TOSHIBA	11-10C1A

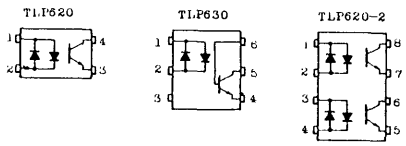


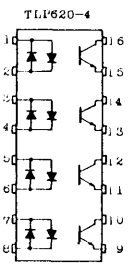
JEDEC	–
EIAJ	–
TOSHIBA	11-7A1B



JEDEC	–
EIAJ	–
TOSHIBA	11-7A1B

PIN CONFIGURATIONS (TOP VIEW)





RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}	–	–	24	V
Forward Current	I_F	–	–	20(25)	mA
Operating Temperature Range	T_{opr}	-40	–	85	°C

Note : ( ) is TLP620, TLP630

MAXIMUM RATINGS (Ta = 25°C)

	CHARACTERISTIC	SYMBOL	RATING			UNIT
			TLP630	TLP620	TLP620-3, TLP620-4	
LED	Forward Current	$I_{F(RMS)}$	60	50	50	mA
	Forward Current Derating	ΔI_F/°C	-0.7 (Ta≧39°C)	-0.7 (Ta≧53°C)	-0.5 (Ta≧25°C)	mA/°C
	Pulse Forward Current (Note 1)	I_{FP}	±1			A
DETECTOR	Collector-Base Voltage	V_{CBO}	80	–	–	V
	Emitter-Base Voltage	V_{EBO}	7			
	Collector-Emitter Voltage	V_{CEO}	55			V
	Emitter-Collector Voltage	V_{ECO}	7			V
	Collector Current	I_C	50			mA
	Collector Power Dissipation (1 Circuit)	P_C	150		100	mW
	Collector Power Dissipation Derating (1 Circuit) (Ta≧25°C)	ΔP_C/°C	-1.5		-1.0	mW/°C
Operating Temperature Range		T_{opr}	-55~+100			°C
Storage Temperature Range		T_{stg}	-55~+150			°C
Total Power Dissipation		P_T	200		150	mW
Total Power Dissipation Derating (Ta≧25°C)		ΔP_T/°C	-2.6		-2	mW/°C
Isolation Voltage (Note 2)		BV_S	5000			V_{rms}

Note 1 : Pulse width≦100μs, Repetitive frequency=100Hz
2 : AC/1 min. R.H.=40~60%

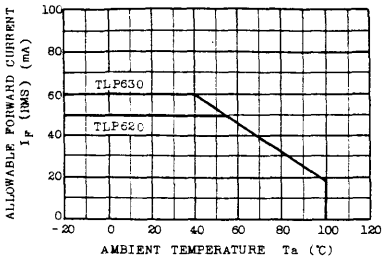
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	–	–	10	μA
	Terminal Between Capacitance	C_T	V=0, f=1MHz	–	30	–	pF
DETECTOR	Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C=0.5mA	55	–	–	V
	Emitter-Collector Breakdown Voltage	$V_{(BR)ECO}$	I_E=0.1mA	7	–	–	V
	Collector Dark Current	I_{CEO}	I_F=0, V_{CE}=24V	–	10	100	nA
			I_F=0, V_{CE}=24V, Ta=85°C	–	2	50	μA
	Terminal Between Capacitance	C_T	V_{CE}=0, f=1MHz	–	10	–	pF
COUPLED	Current Transfer Ratio	I_C/I_F (Note)	I_F=±5mA, V_{CE}=5V	50	–	600	%
	Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	I_F=5mA, I_C=1mA	–	0.1	0.4	V
	Input/Output Between Stray Capacitance	C_S	V=0, f=1MHz	–	0.8	–	pF
	Isolation Voltage	R_S	R.H.=40~60%, V=1kV DC	–	10^{11}	–	Ω
	Rise and Fall Time	t_r, t_f	V_{CE}=5V, R_L=100Ω, I_C=2mA	–	6	–	μs
	Current Transfer Ratio Symmetry	$I_{C(Ratio)}$	I_F=5mA, V_{CE}=5V (Note)	0.33	1	3	–

Note : $I_{C(Ratio)} = \frac{I_{C2}(I_F=-5mA,\ V_{CE}=5V)}{I_{C1}(I_F=+5mA,\ V_{CE}=5V)}$

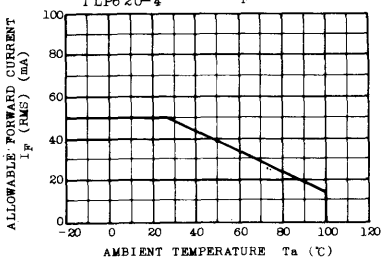
TLP620
TLP630

I_F – Ta



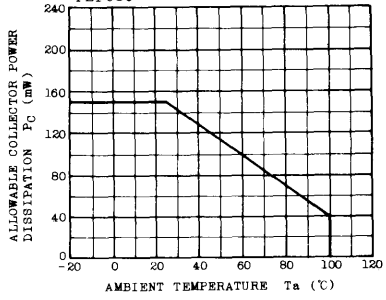
TLP620-2
TLP620-4

I_F – Ta



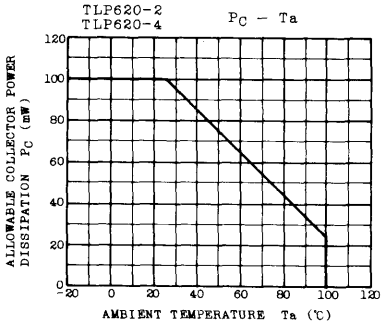
TLP620
TLP630

P_C – Ta



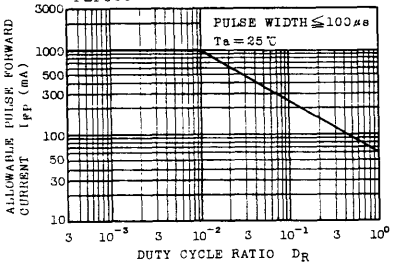
TLP620-2
TLP620-4

P_C – Ta



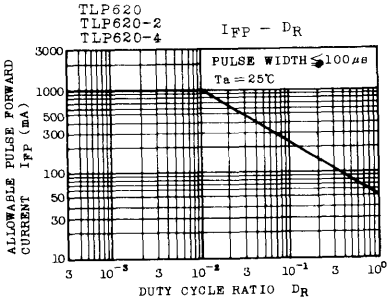
TLP630

I_{FP} – D_R

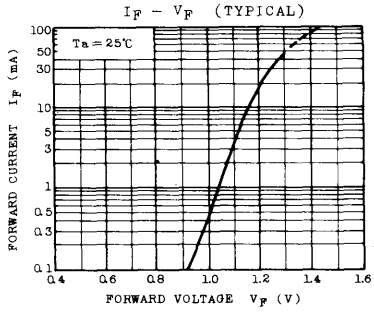


TLP620
TLP620-2
TLP620-4

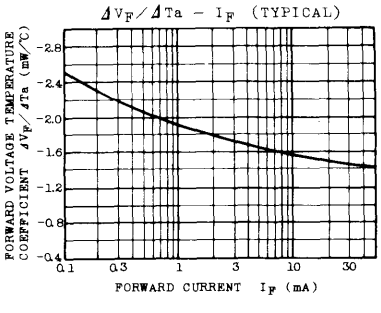
I_{FP} – D_R



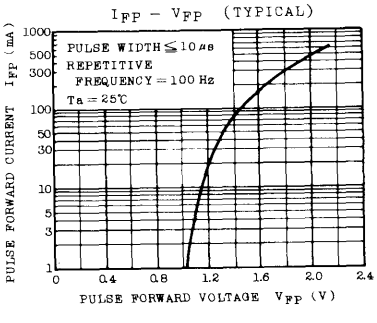
I_F – V_F (TYPICAL)



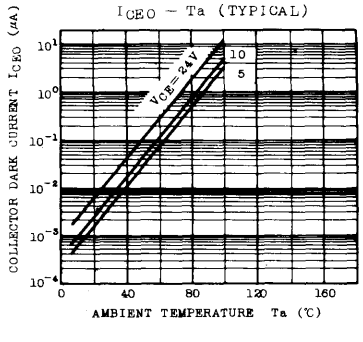
$\Delta V_F / \Delta Ta$ – I_F (TYPICAL)



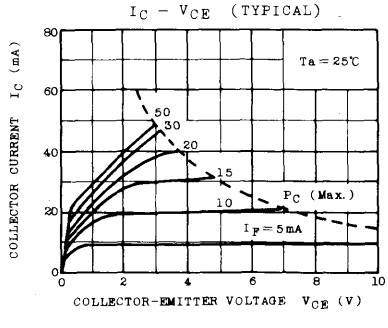
I_{FP} – V_{FP} (TYPICAL)



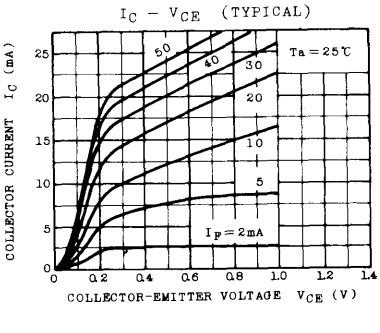
I_{CEO} – Ta (TYPICAL)



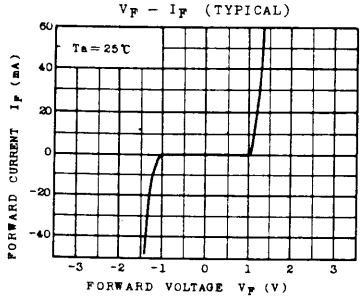
I_C – V_{CE} (TYPICAL)



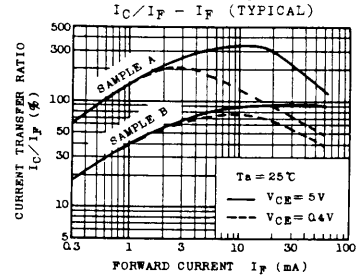
I_C – V_{CE} (TYPICAL)



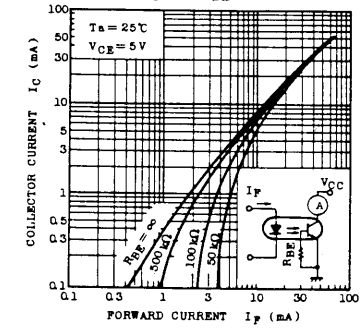
$V_F - I_F$ (TYPICAL)



$I_C / I_F - I_F$ (TYPICAL)



$I_C - I_F$ at R_{BE} (TYPICAL)



R_L - SWITCHIG TIME (TYPICAL)

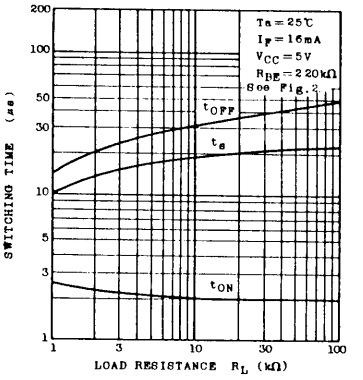
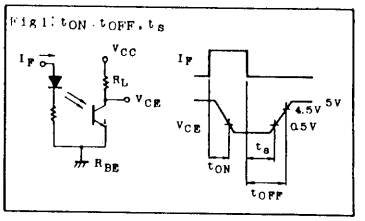
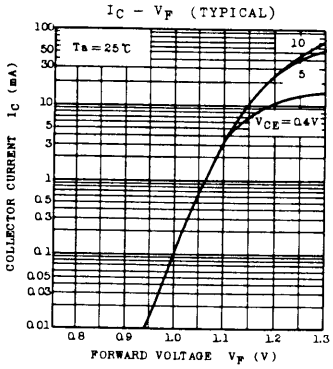


Fig.1 t_{ON}, t_{OFF}, t_s



$I_C - V_F$ (TYPICAL)



$I_C - T_a$ (TYPICAL)

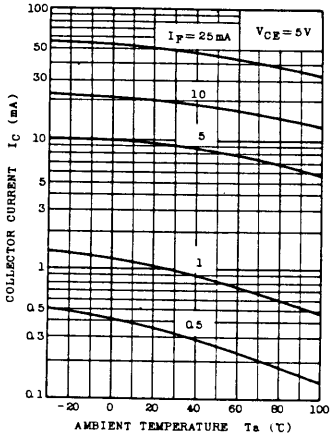
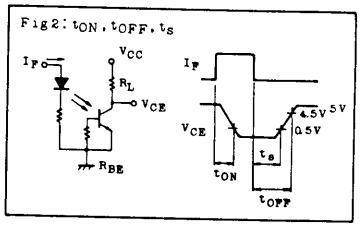
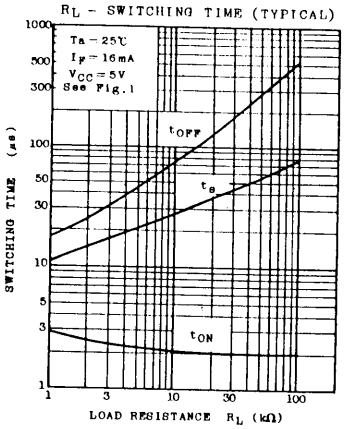


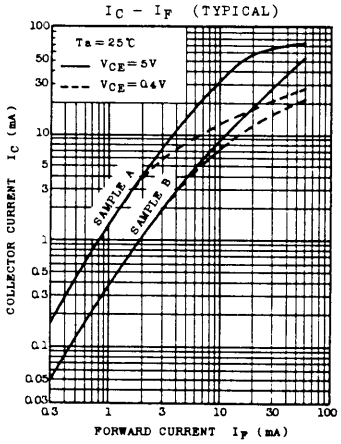
Fig.2 t_{ON}, t_{OFF}, t_s



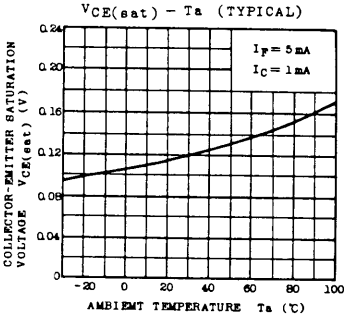
R_L - SWITCHING TIME (TYPICAL)



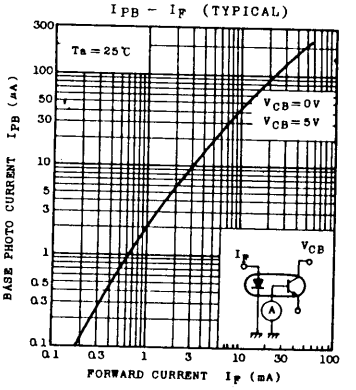
$I_C - I_F$ (TYPICAL)



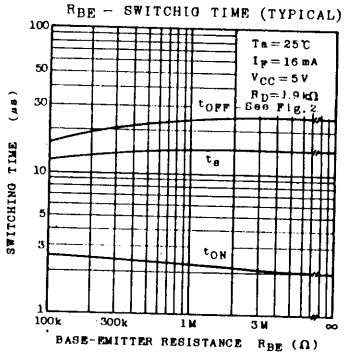
$V_{CE(sat)}$ - Ta (TYPICAL)



$I_{PB} - I_F$ (TYPICAL)



R_{BE} - SWITCHIG TIME (TYPICAL)



TLP621, -2, -4/632

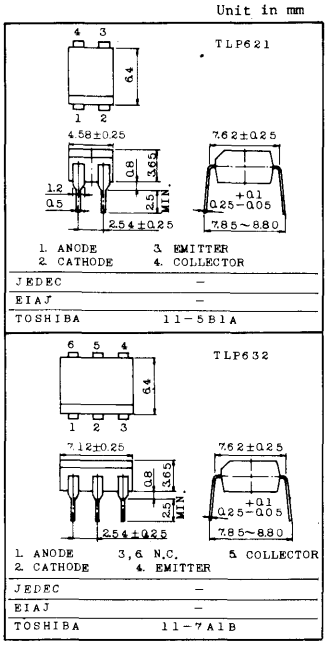
INFRARED LED + PHOTO TRANSISTOR

AC LINE/DIGITAL ISOLATOR
PROGRAMMABLE CONTROLLERS
SOLID STATE RELAY

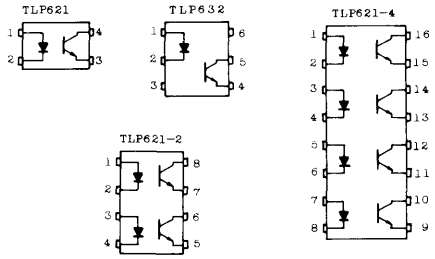
The TOSHIBA TLP621, -2, -4 and TLP632 consist of a gallium arsenide infrared emitting diode coupled with a silicon photo-transistor in a dual in-line package.
The TLP621-2 offers two isolated channels in a eight leads plastic DIP package, while the TLP621-4 provides four isolated channels per package.

- High DC Current Transfer Ratio ($\frac{\text{CTR rank}}{\text{GB}}$ .....50% MIN. (GB :100% MIN.)
- High Isolation Voltage.....5000V_{RMS}, 1 minut.
- 7400 Series TTL Compatible
- UL Recognized ..... File No.E67349
  Type designations P621, -2, -4 and P632 are identical to TLP621, -2, -4 and TLP632 respectively.

Unit in mm



PIN CONFIGURATIONS (TOP VIEW)



MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC		SYMBOL	RATING		UNIT
			TLP621, TLP632	TLP621-2, TLP621-4	
LED	Forward Current	I_F	50		mA
	Forward Current Derating	ΔI_F/°C	-0.7 (Ta≧53°C)	-0.5 (Ta≧25°C)	mA/°C
	Pulse Forward Current (Note 1)	I_{FP}	1		A
	Reverse Voltage	V_R	5		V
DETECTOR	Collector-Emitter Voltage	V_{CEO}	55		V
	Emitter-Collector Voltage	V_{ECO}	7		V
	Collector Current	I_C	50		mA
	Collector Power Dissipation (1 Circuit)	P_C	150	100	mW
	Collector Power Dissipation Derating (1 Circuit (Ta≧25°C)	ΔP_C/°C	-1.5	-1.0	mW/°C
Operating Temperature Range		Topr	-55 ~ +100		°C
Storage Temperature Range		Tstg	-55 ~ +150		°C
Total Power Dissipation		P_T	200	150	mW
Total Power Dissipation Derating (Ta≧25°C)		ΔP_T/°C	-2.6	-2	mW/°C
Isolation Voltage	(Note 2)	B_{VS}	5000		Vrms

Note 1 : Pulse width ≦100μs, Repetitive frequency=100Hz
2 : AC/1 min. R.H.=40 ~ 60%

RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}	–	–	24	V
Forward Current	I_F	–	–	20(25)	mA
Operating Temperature Range	Topr	-40	–	85	°C

Note : ( ) is TLP621, TLP632

PRECAUTION

Please be careful of the followings.
1. Soldering temperature: 260°C MAX.
   Soldering time : 10 sec MAX.
   (Soldering portion of lead: up to 2mm from the body of the device)
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.
   o Freon TE or TF o Dai-Fron Solvents S3 or S3-E

ELECTRICAL CHARACTERISTICS (Ta=25°C)

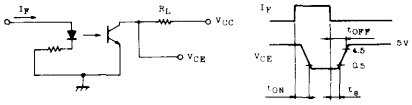
	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Terminal Between Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C=0.5mA	55	-	-	V
	Emitter-Collector Breakdown Voltage	$V_{(BR)ECO}$	I_E=0.1mA	7	-	-	V
	Collector Dark Current	I_{CEO}	I_F=0, V_{CE}=24V	-	10	100	nA
			I_F=0, V_{CE}=24V, Ta=85°C	-	2	50	μA
	Terminal Between Capacitance	C_T	V_{CE}=0, f=1MHz	-	10	-	pF
COUPLED	Current Transfer Ratio	I_C/I_F (Note)	I_F=5mA, V_{CE}=5V	50	-	600	%
	Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	I_F=5mA, I_C=1mA	-	0.1	0.4	V
	Input/Output Between Stray Capacitance	C_S	V=0, f=1MHz	-	0.8	-	pF
	Isolation Voltage	R_S	R.H.=40 ~ 60%, V=1kV DC	-	10^{11}	-	Ω

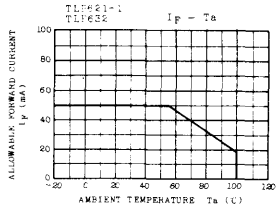
Note : CTR rank GB: I_C/I_F=100% MIN., 600% MAX.

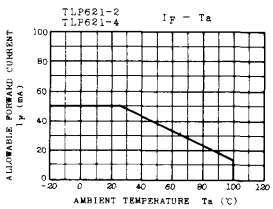
SWITCHING CHARACTERISTICS (Ta=25°C)

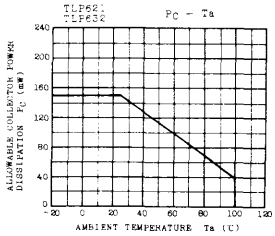
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Rise and Fall Time	t_r, t_f	V_{CC}=5V, R_L=100Ω, I_C=2mA	-	6	-	μs
Turn-on Time	t_{ON}	V_{CC}=5V, R_L=1.9kΩ	-	2	-	μs
Storage Time	t_s	I_F=16mA (Note)	-	15	-	
Turn-off Time	t_{OFF}		-	25	-	

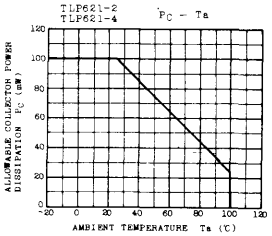
Note: SWITCHING TIME TEST CIRCUIT

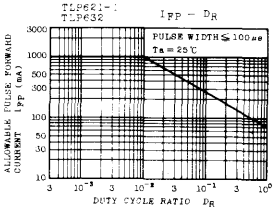


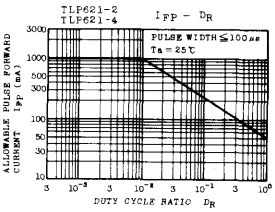


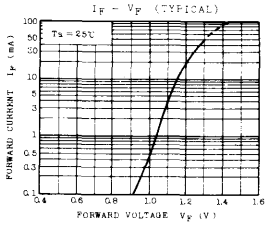


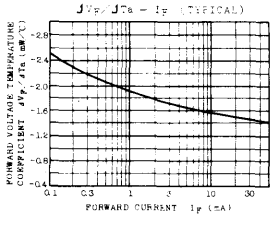


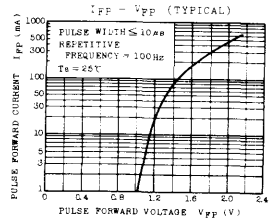


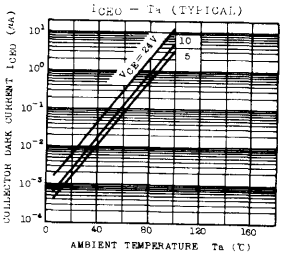


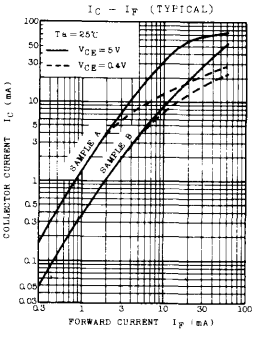


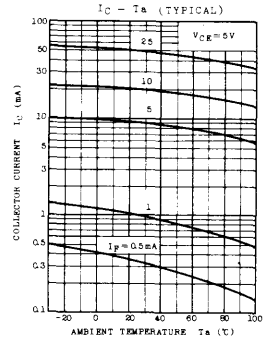


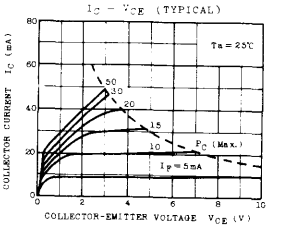


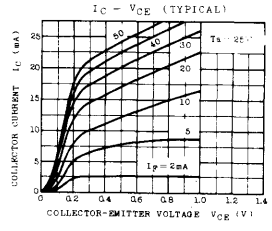


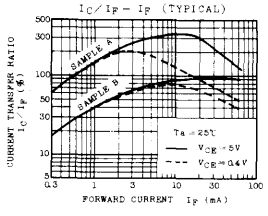


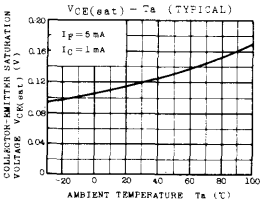


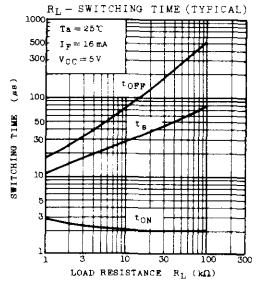












TLP631

GaAs Infrared Emitting Diode & NPN Sillicon Photo-Transistor

TENTATIVE

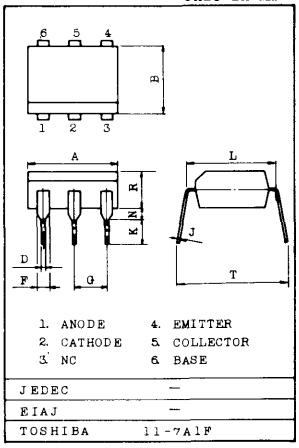
The TOSHIBA TLP631 consist of a gallium arsenide infrared emitting diode coupled with a silicon photo transistor in a dual in-line package.

- Small Package Size and Low Cost
- Fast Switching Speeds : 5μs
- High DC Current Transfer Ratio : * 50% Min.
  - * CTR Rank (@I_F=5mA, V_{CE}=5V)
    - Standard Type : 50% Min.
    - Selected Rank GB : 100% Min.
- High Isolation Resistance : $10^{11}\Omega$
- High Isolation Voltage : $5000V_{RMS}$
- UL Recognized : File No. E67349
- Type Designation P631 is identical to TLP631.

APPLICATIONS:

AC LINE/DIGITAL LOGIC ISOLATOR.
DIGITAL LOGIC/DIGITAL LOGIC ISOLATOR.
TELEPHONE LINE. RECEIVER.
TWISTED PAIR LINE RECEIVER.
HIGH FREQUENCY POWER SUPPLY FEEDBACK CONTROL.
RELAY CONTACT MONITOR.

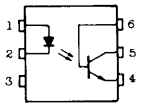
Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	11-7A1F

SYMBOL	INCH	MM.
A	0.280±0.010	7.12±0.25
B	0.252	6.40
D	0.020	0.50
F	0.047	1.20
G	0.1 (TYP)	2.54 (TYP)
J	0.010	0.25
K	0.100(MIN)	2.5 (MIN)
L	0.300	7.62
N	0.031	0.8
R	0.144	3.65
T	0.309~3.465	7.85~8.80

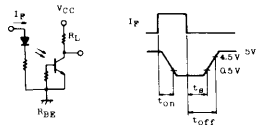
PIN CONFIGURATIONS (TOP VIEW)



ELECTRICAL CHARACTERISTICS (Ta = 25°C)

	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_D	V=0, f=1MHz	-	30	-	pF
PHOTO-TRANSISTOR	DC Forward Current Gain	h_{FE}	V_{CE}=5	-	200	-	
	Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C=0.5mA, I_F=0	55	-	-	V
	Collector-Base Breakdown Voltage	$V_{(BR)CBO}$	I_C=100μA, I_F=0	80	-	-	V
	Emitter-Collector Breakdown Voltage	$V_{(BR)ECO}$	I_E=100μA, I_F=0	7	-	-	V
	Collector Dark Current	I_{CEO}	V_{CE}=24V, I_F=0	-	10	100	nA
			V_{CE}=24V, I_F=0,Ta=85°C	-	-	50	μA
	Collector-Emitter Capacitance	C_{CE}	V=0, f=1MHz	-	10	-	pF
COUPLED	Current Transfer Ratio	I_C/I_F	I_F=5mA, V_{CE}=5V	50	-	-	%
	Rank GB			100			
	Saturation Voltage	$V_{CE(sat)}$	I_F=5mA, I_C=1mA	-	0.1	0.4	V
	Capacitance Input to Output	C_S	V=0, f=1MHz	-	0.8	-	pF
	Isolation Resistance	R_S	V=500V	-	10^{11}	-	Ω
	AC Isolation Voltage	BV_S	AC 1 minute	5000	-	-	V_{RMS}
	Peak Isolation Voltage	BV_S	Peak	7070	-	-	V
	Rise/Fall Time	t_r/t_f	V_{CE}=10V, I_C=2mA, R_L=100Ω	-	6	-	μs
	Turn-on Time	t_{on}	V_{CC}=5V (Note)	-	2	-	μs
	Storage Time	t_s	R_L=1.9kΩ, I_F=16mA	-	12	-	
	Turn-off Time	t_{off}	R_{BE}=220kΩ	-	20	-	

Note: Switching time test circuit

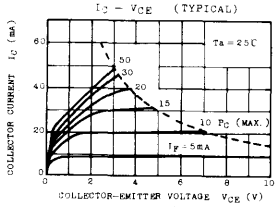


ABSOLUTE MAXIMUM RATINGS (Ta = 25°C)

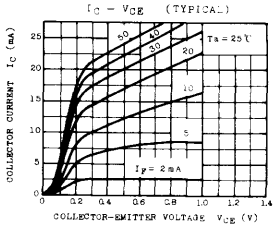
	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	50	mA
	Forward Current Derating (Ta≧53°C)	ΔI_F/°C	-0.7	mA/°C
	Peak Forward Current (Note)	I_{PF}	1	A
	Power Dissipation	P_D	100	mW
	Power Dissipation Derating	ΔP_D/°C	1.33*	mW/°C
	Reverse Voltage	V_R	5	V
PHOTO-TRANSISTOR	Collector-Emitter Voltage	BV_{CEO}	55	V
	Collector-Base Voltage	BV_{CBO}	80	V
	Emitter-Collector Voltage	BV_{ECO}	7	V
	Collector Current	I_C	50	mA
	Power Dissipation	P_C	150	mW
	Power Dissipation Derating	ΔP_C/°C	-1.5*	mW/°C
COUPLED	Storage Temperature	T_{stg}	-55 ~ 150	°C
	Operating Temperature	T_{opr}	-55 ~ 100	°C
	Lead Soldering Temperature (at 10 sec.)	T_{sold}	260	°C
	Total Package Dissipation	P_T	200	mW
	Total Package Power Dissipation Derating	ΔP_T/°C	2.6*	mW/°C

Note : Pulse width 100μs, f=100Hz
* Above 25°C ambient.

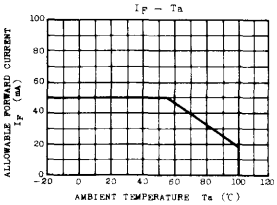
$I_C - V_{CE}$ (TYPICAL)



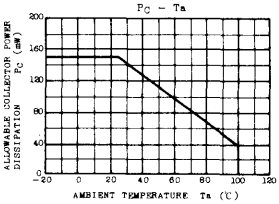
$I_C - V_{CE}$ (TYPICAL)



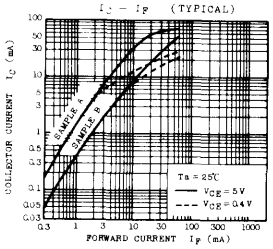
$I_F - Ta$



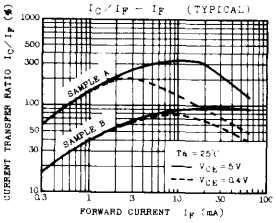
$P_C - Ta$



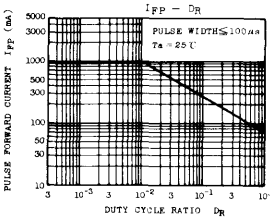
$I_C - I_F$ (TYPICAL)



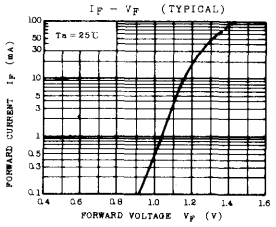
$I_C / I_F - I_F$ (TYPICAL)



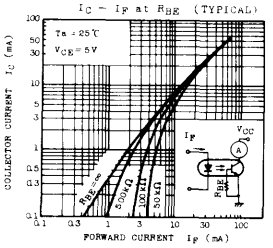
$I_{FP} - D_R$



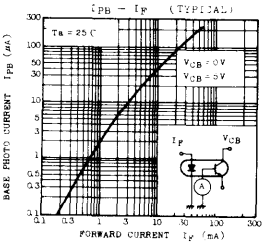
$I_F - V_F$ (TYPICAL)



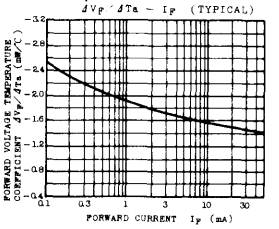
$I_C - I_F$ at R_{BE} (TYPICAL)



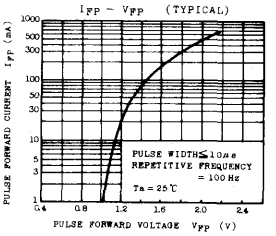
$I_{PB} - I_F$ (TYPICAL)



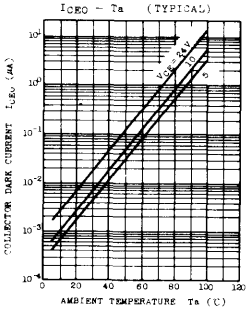
$\Delta V_F / \Delta Ta - I_F$ (TYPICAL)



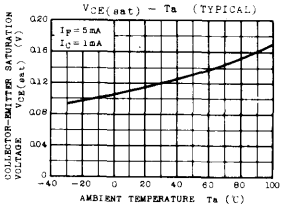
$I_{FP} - V_{FP}$ (TYPICAL)



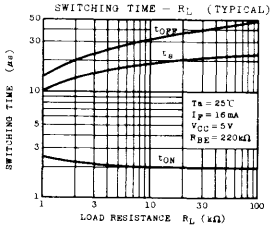
$I_{CEO} - Ta$ (TYPICAL)



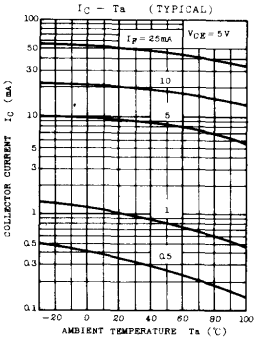
$V_{CE(sat)} - Ta$ (TYPICAL)



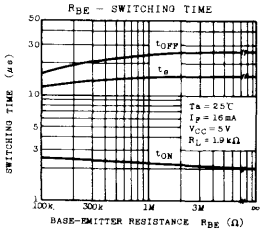
SWITCHING TIME – R_L (TYPICAL)



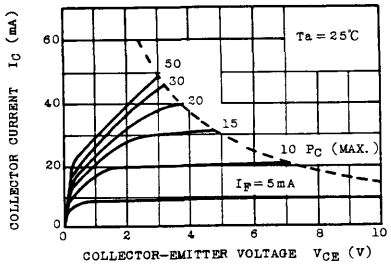
$I_C - Ta$ (TYPICAL)



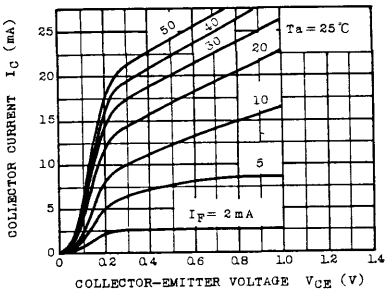
R_{BE} – SWITCHING TIME



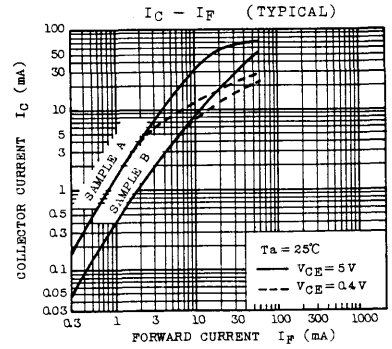
$I_C - V_{CE}$ (TYPICAL)



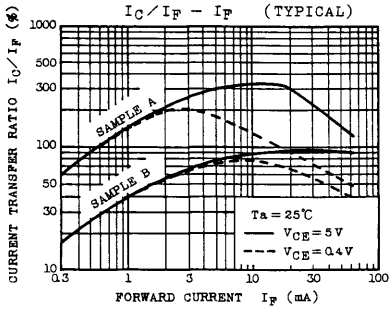
$I_C - V_{CE}$ (TYPICAL)



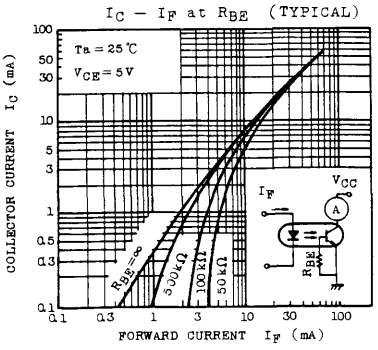
$I_C - I_F$ (TYPICAL)



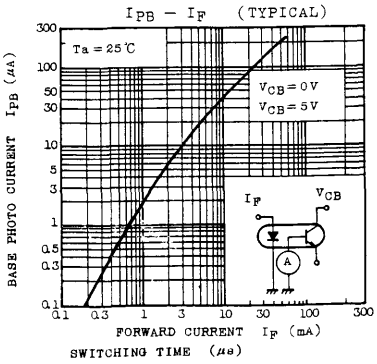
$I_C / I_F - I_F$ (TYPICAL)



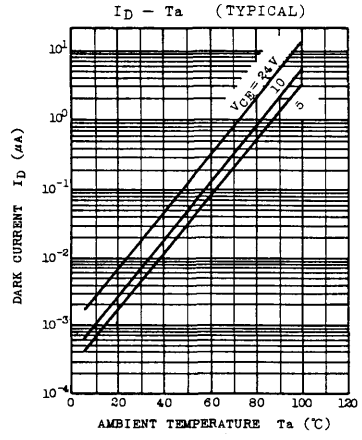
$I_C - I_F$ at R_{BE} (TYPICAL)



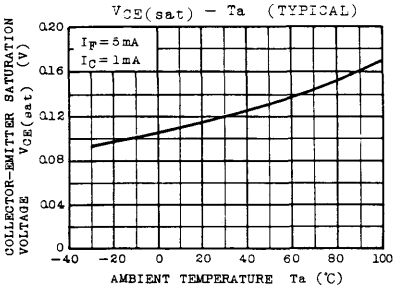
$I_{PB} - I_F$ (TYPICAL)



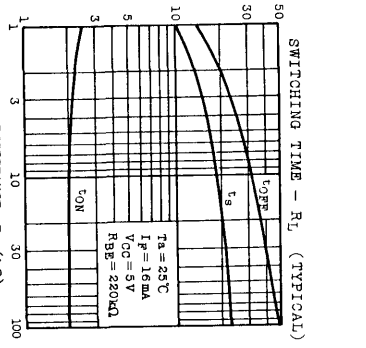
I_D — Ta (TYPICAL)



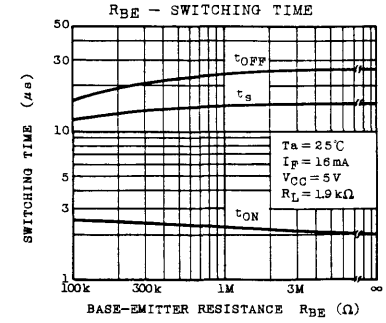
$V_{CE(sat)}$ — Ta (TYPICAL)



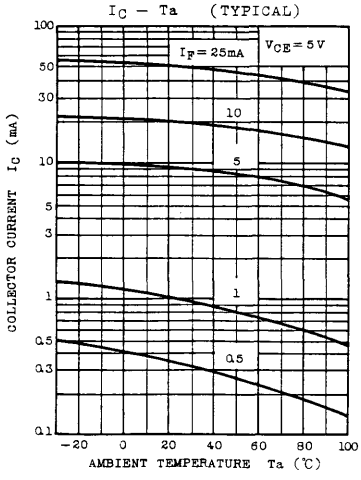
SWITCHING TIME — R_L (TYPICAL)



R_{BE} — SWITCHING TIME



I_C — Ta (TYPICAL)



TLP641G
PHOTO THYRISTOR COUPLER

PROGRAMMABLE CONTROLLERS

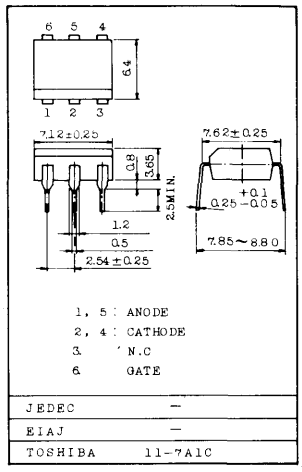
AC-OUTPUT MODULE

SOLID STATE RELAY

The TOSHIBA TLP641G, consists of a gallium arsenide infrared emitting diode optically coupled a photo sensitive silicon controlled rectifier in a plastic dual in line package.

- High Isolation Voltage : $5000V_{RMS}$/1 min.
- Small Input Current to Trigger: 7mA
- UL recognized: File No. E67349
  Type P641G is identical to TLP641G.

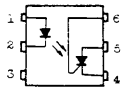
Unit in mm



1, 5 : ANODE
2, 4 : CATHODE
3 : N.C
6 : GATE

JEDEC	—
EIAJ	—
TOSHIBA	11-7A1C

PIN CONFIGURATIONS



MAXIMUM RATINGS (Ta =25°C)

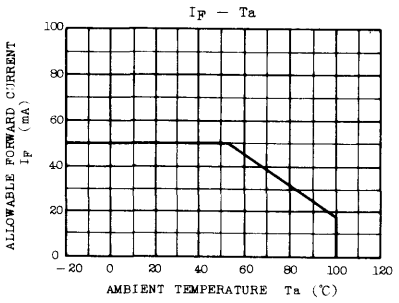
	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	50	mA
	Forward Current Derating (Ta≧53°C)	I_F/°C	-0.7	mA/°C
	Pulse Forward Current (Note 1)	I_{FP}	1	A
	Reverse Voltage	V_R	5	V
	Junction Temperature	Tj	125	°C
DETECTOR	Repetitive Peak Off-State Voltage and Repetitive Peak Reverse Voltage (R_{GK}=27kΩ)	V_{DRM} and V_{RRM}	400	V
	R.M.S On-State Current	$I_{T(RMS)}$	150	mA
	On-State Current Derating	I_T/°C	-2	mA/°C
	Peak One Cycle Surge On-State Current	I_{TSM}	2	A
	Peak Reverse Gate Voltage	V_{RGM}	-5	V
	Junction Temperature	Tj	100	°C
Operating Temperature Range		Topr	-55~+100	°C
Storage Temperature Range		Tstg	-55~+125	°C
Isolation Voltage (Note 2)		BVS	5000	Vrms

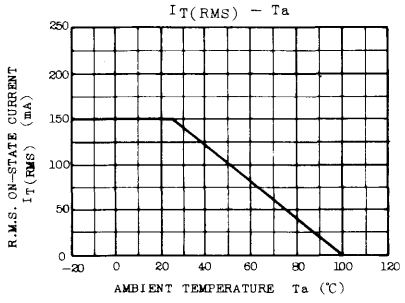
ELECTRICAL CHARACTERISTICS (Ta =25°C)

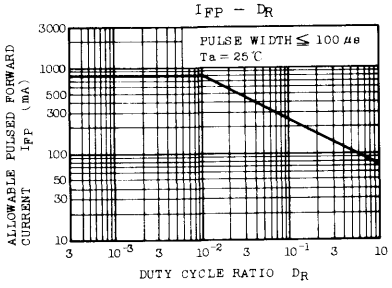
	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Terminal Between Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	Repetitive Peak Off-State Voltage and Repetitive Peak Reverse Voltage	I_{DRM} and I_{RRM}	V_{DRM}=Rated, R_{GK}=27kΩ	-	-	5	μA
			V_{DRM}=Rated, R_{GK}=27kΩ Ta=100°C	-	-	100	
	Peak On-State Voltage	V_{TM}	I_{TM}=300mA, I_F=10mA	-	0.9	1.3	V
	Holding Current	I_H	R_{GK}=27kΩ	-	0.2	1	mA
	Critical Rate of Rise of Off-State Voltage	dv/dt	V_{AK}=Rated, R_{GK}=27kΩ	5	10	-	V/μs
COUPLED	Trigger LED Current	I_{FT}	V_{AK}=6V, R_{GK}=27kΩ R_L=100Ω	1	4	7	mA
	Turn-On Time	ton	I_F=50mA, R_{GK}=27kΩ	-	10	-	μs
	Input/Output Between Stray Capacitance	C_S	V=0, f=1MHz	-	0.8	-	pF
	Isolation Resistance	R_S	R.H.=40~60%, V=1kV	-	10^{11}	-	

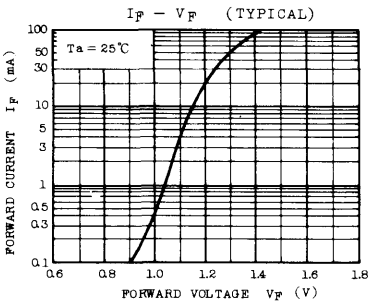
RECOMMENDED OPERATING CONDITIONS

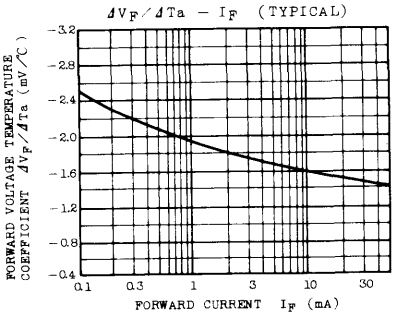
CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Working Voltage	V_{AC}	-	-	120	V_{AC}
Forward Current	I_F	16	20	30	mA
Operating Temperature Range	T_{opr}	-40	-	85	°C
Gate-Cathode Resistance	R_{GK}	-	27	33	kΩ
Gate-Cathode Capacitance	C_{GK}	-	0.01	0.1	μF

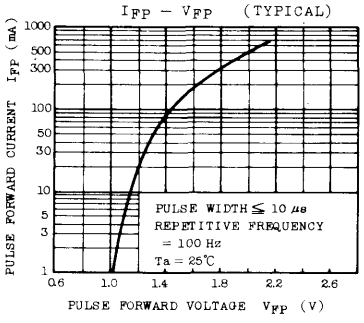


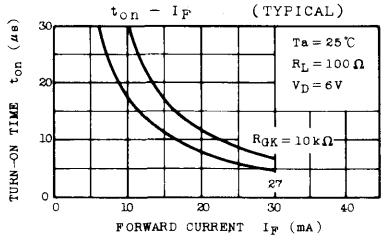


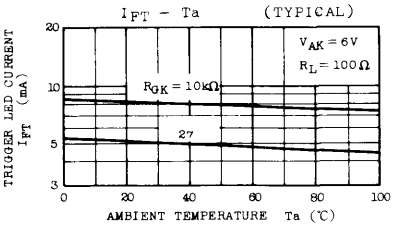


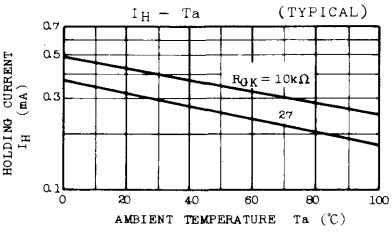




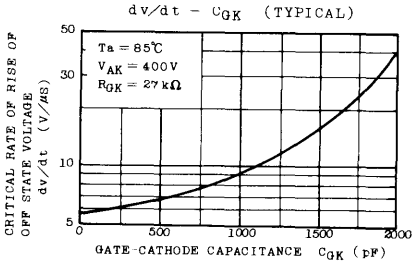




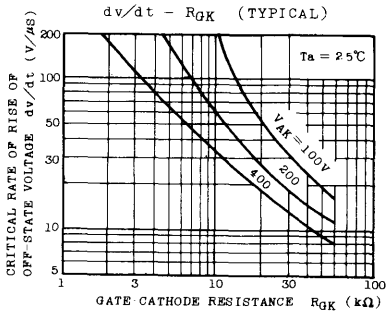




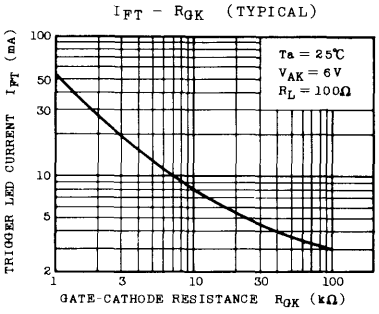
dv/dt – C_{GK} (TYPICAL)



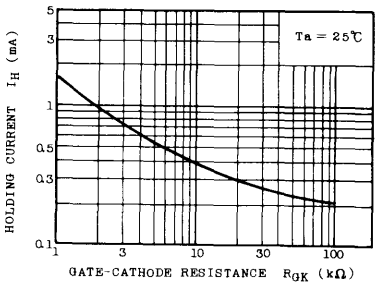
dv/dt – R_{GK} (TYPICAL)



I_{FT} – R_{GK} (TYPICAL)



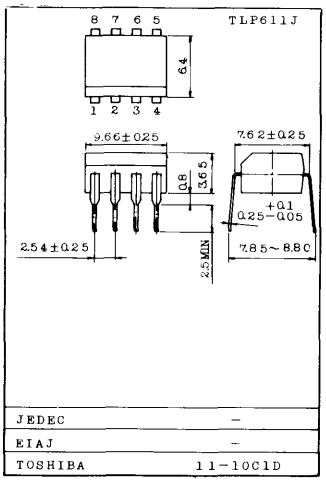
I_H – R_{GK} (TYPICAL)

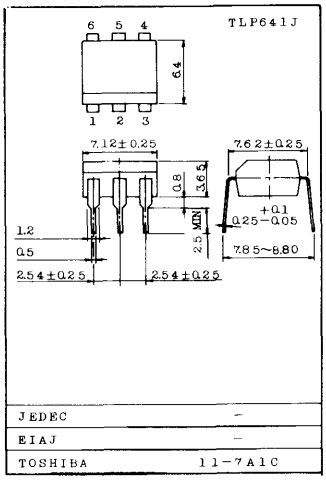


TLP641J/611J

INFRARED LED + PHOTO THYRISTOR

Unit in mm





SOLID STATE RELAY.
PROGRAMMABLE CONTROLLERS.
AC-OUTPUT MODULE.

The TLP641J consists of a photo sensitive SCR coupled to a gallium arsenide infrared emitting diode in a six pin plastic DIP package.
The TLP611J is optically-isolated solid state relay with two photo-SCR's connected Anode-to-Cathode.
(See circuit diagram)

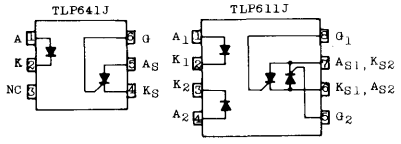
- High Blocking Voltage.....600V.
- High Isolation Voltage.....5000V_{RMS}/1 min.
- Small Input Current to Trigger.....10mA

MAXIMUM RATINGS (Ta=25°C)

	CHARACTERISTIC	SYMBOL	RATING		UNIT
			TLP641J	TLP611J	
LED	Forward Current	I_F	50		mA
	Power Dissipation	P_D	100		mW
	Pulse Forward Current (Note 1)	I_{FP}	1		A
	Reverse Voltage	V_R	5		V
	Junction Temperature	T_j	125		°C
DETECTOR	Repetitive Peak Off-State Voltage and Repetitive Peak Reverse Voltage (R_{GK}=27kΩ)	V_{DRM} and V_{RRM}	600		V
	R.M.S. On-State Current	$I_{T(RMS)}$	150	200	mA
	On-State Current Derating (Ta≥25°C)	ΔI_T/°C	-2	-2.7	mA/°C
	Peak One Cycle Surge On-State Current	I_{TSM}	2		A
	Peak Reverse Gate Voltage	V_{RGM}	-5		V
	Junction Temperature	T_j	100		°C
Operating Temperature Range		T_{opr}	-55 ~ 100		°C
Storage Temperature Range		T_{stg}	-55 ~ 150		°C
Isolation Voltage (Note 2)		BVS	5000		V_{rms}

Note 1 : Pulse width ≤100μs, Repetitive frequency=100Hz
2 : AC/1 min., R.H.=40 ~ 60%

PIN CONFIGURATIONS (TOP VIEW)



A : LED ANODE
K : LED CATHODE
A_S: SCR ANODE
K_S: SCR CATHODE
G : GATE

ELECTRICAL CHARACTERISTICS (Ta=25°C)

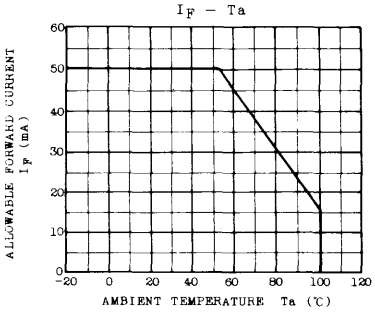
	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.0	1.15	1.3	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Terminal Between Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	Repetitive Peak Off-State Voltage and Repetitive Peak Reverse Voltage	I_{DRM} * and I_{RRM}	V_{DRM}=Rated, R_{GK}=27kΩ	-	-	5	μA
			V_{DRM}=Rated, R_{GK}=10kΩ Ta=85°C	-	-	150	μA
	Peak On-State Voltage	V_{TM}	I_{TM}=100mA, I_F=10mA	-	0.9	1.3	V
	Holding Current	I_H	R_{GK}=27kΩ	-	0.2	-	mA
	Critical Rate of Rise of Off-State Voltage	dv/dt	V_{AK}=400V, R_{GK}=27kΩ	5	10	-	V/μs
COUPLED	Trigger LED Current	I_{FT}	V_{AK}=6V, R_{GK}=27kΩ R_L=100Ω	1	4	10	mA
	Turn-on Time	t_{on}	I_F=50mA, R_{GK}=27kΩ	-	10	-	μs
	Input/Output Between Stray Capacitance	C_S	V=0, f=1MHz	-	0.8	-	pF
	Isolation Resistance	R_S	R.H.=40 ~ 60%, V=1kV DC	-	10^{11}	-	Ω

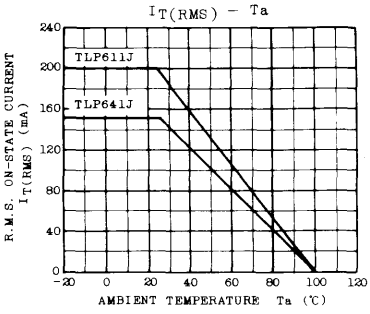
* TLP611J : I_{DRM}=300μA MAX.

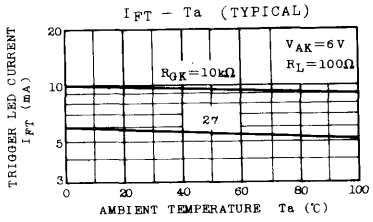
RECOMMENDED OPERATING CONDITIONS

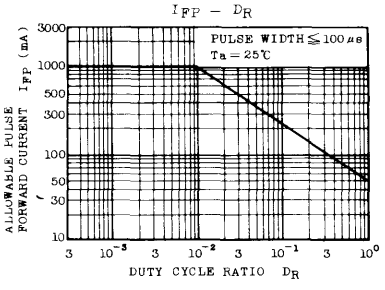
CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Working Voltage	V_{AC}	-	-	240	V
Forward Current	I_F	20	25	30	mA
Operating Temperature Range	T_{opr}	-40	-	85	°C
Gate-Cathode Resistance	R_{GK}	-	10k	27	kΩ
Gate-Cathode Capacitance	C_{GK}	-	0.01	0.1	μF

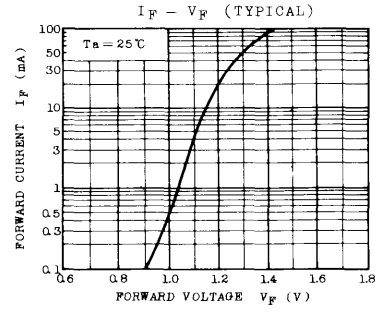
PRECAUTION

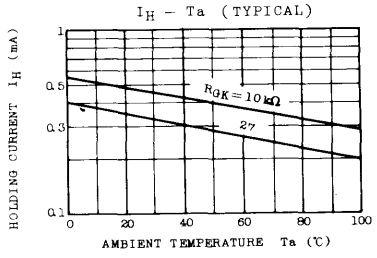

I_F – Ta
ALLOWABLE FORWARD CURRENT I_F (mA)
AMBIENT TEMPERATURE Ta (℃)

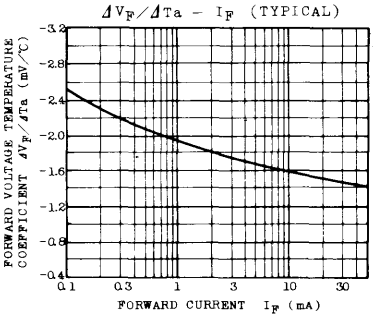

$I_{T(RMS)}$ – Ta
TLP611J
TLP641J
R.M.S. ON-STATE CURRENT $I_{T(RMS)}$ (mA)
AMBIENT TEMPERATURE Ta (℃)

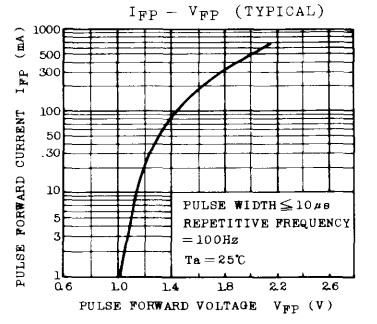

I_{FT} – Ta (TYPICAL)
V_{AK}=6V
R_L=100Ω
R_{GK}=10kΩ
27
TRIGGER LED CURRENT I_{FT} (mA)
AMBIENT TEMPERATURE Ta (℃)

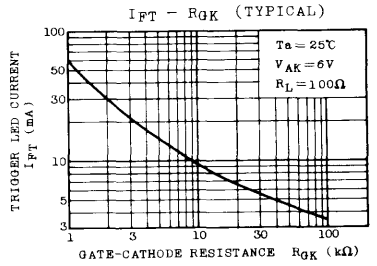

I_{FP} – D_R
PULSE WIDTH≦100μs
Ta=25℃
ALLOWABLE PULSE FORWARD CURRENT I_{FP} (mA)
DUTY CYCLE RATIO D_R

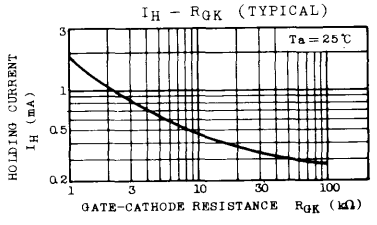

I_F – V_F (TYPICAL)
Ta=25℃
FORWARD CURRENT I_F (mA)
FORWARD VOLTAGE V_F (V)

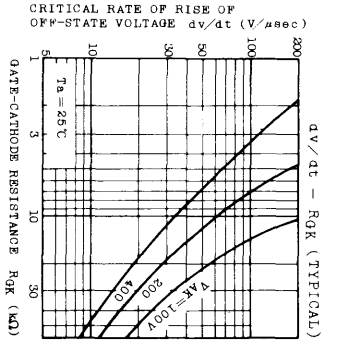

I_H – Ta (TYPICAL)
R_{GK}=10kΩ
27
HOLDING CURRENT I_H (mA)
AMBIENT TEMPERATURE Ta (℃)

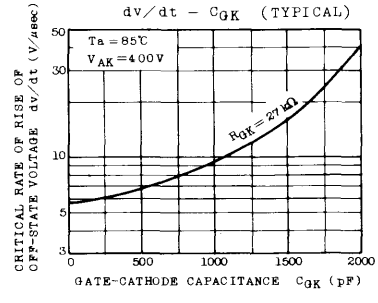

$\Delta V_F/\Delta Ta$ – I_F (TYPICAL)
FORWARD VOLTAGE TEMPERATURE COEFFICIENT $\Delta V_F/\Delta Ta$ (mV/℃)
FORWARD CURRENT I_F (mA)

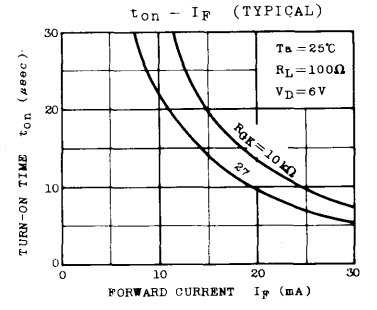

I_{FP} – V_{FP} (TYPICAL)
PULSE WIDTH≦10μs
REPETITIVE FREQUENCY
=100Hz
Ta=25℃
PULSE FORWARD CURRENT I_{FP} (mA)
PULSE FORWARD VOLTAGE V_{FP} (V)


I_{FT} – R_{GK} (TYPICAL)
Ta=25℃
V_{AK}=6V
R_L=100Ω
TRIGGER LED CURRENT I_{FT} (mA)
GATE-CATHODE RESISTANCE R_{GK} (kΩ)


I_H – R_{GK} (TYPICAL)
Ta=25℃
HOLDING CURRENT I_H (mA)
GATE-CATHODE RESISTANCE R_{GK} (kΩ)


CRITICAL RATE OF RISE OF OFF-STATE VOLTAGE dv/dt (V/μsec)
Ta=25℃
400
200
100
V_{AK}=4V
GATE-CATHODE RESISTANCE R_{GK} (kΩ)
dv/dt – R_{GK} (TYPICAL)


dv/dt – C_{GK} (TYPICAL)
Ta=85℃
V_{AK}=400V
R_{GK}=27kΩ
CRITICAL RATE OF RISE OF OFF-STATE VOLTAGE dv/dt (V/μsec)
GATE-CATHODE CAPACITANCE C_{GK} (pF)


t_{on} – I_F (TYPICAL)
Ta=25℃
R_L=100Ω
V_D=6V
R_{GK}=10kΩ
27
TURN-ON TIME t_{on} (μsec)
FORWARD CURRENT I_F (mA)

TLN101A

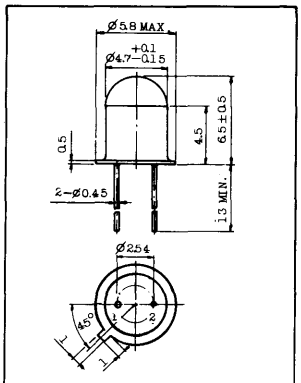
GaAs INFRARED EMITTER

INFRARED LED FOR PHOTO SENSOR.

- . OPTICAL SWITCH . ENCODERS
- . 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

Unit in mm



1. ANODE
2. CATHODE (CASE)

JEDEC	—
EIAJ	—
TOSHIBA	4-5D1A

Weight : 0.39g

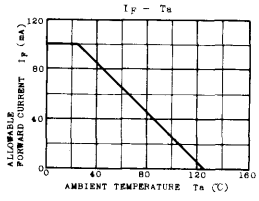
MAXIMUM RATINGS (Ta = 25°C)

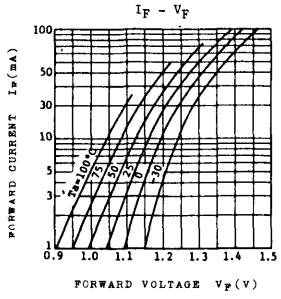
CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current	I_F	100	mA
Pulse Forward Current (Note)	I_{FP}	1	A
Reverse Voltage	V_R	5	V
Forward Current Derating	$\Delta I_F/^\circ C$	-1.0	mA/°C
Operating Temperature Range	T_{opr}	-40 ~ 125	°C
Storage Temperature Range	T_{stg}	-55 ~ 150	°C

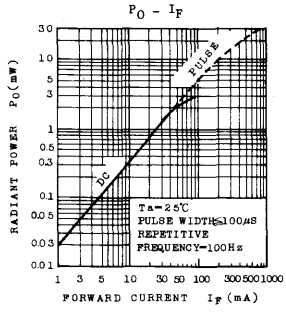
Note : Pulse width ≦ 100μs, Repetitive frequency=100Hz.

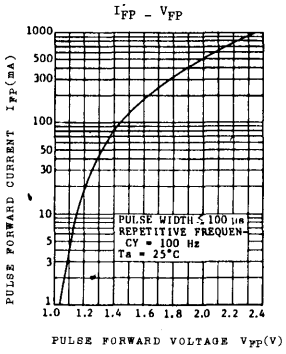
OPTO-ELECTRICAL CHARACTERISTICS (Ta = 25°C)

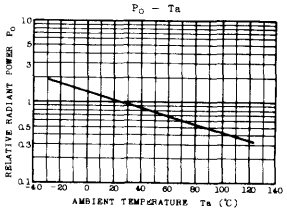
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=50mA	-	1.3	1.4	V
Reverse Current	I_R	V_R=5V	-	-	10	μA
Radiant Power	P_O	I_F=50mA	0.5	1.8	-	mW
Capacitance	C_T	V_R=0, f=1MHz	-	30	-	pF
Peak Emission Wave Length	λ_P	I_F=50mA	-	940	-	nm
Spectral Line Half Width	$\Delta\lambda$	I_F=50mA	-	50	-	nm

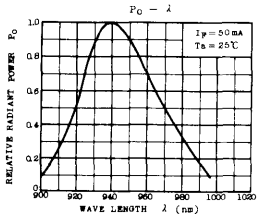


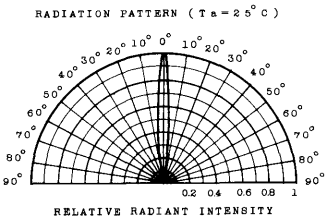












TLN103

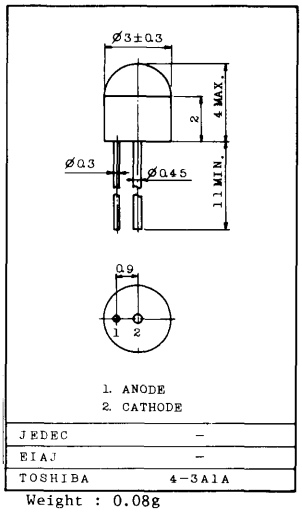
GaAs INFRARED EMITTER

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



Weight : 0.08g

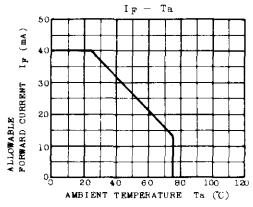
MAXIMUM RATINGS (Ta =25°C)

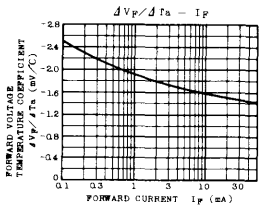
CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current	I_F	40	mA
Pulse Forward Current (Note)	I_{FP}	400	mA
Reverse Voltage	V_R	5	V
Forward Current Derating	$\Delta I_F/^\circ C$	-0.53	mA/°C
Operating Temperature Range	T_{opr}	-20~75	°C
Storage Temperature Range	T_{stg}	-30~100	°C

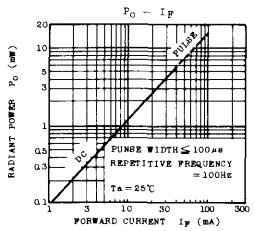
Note : Pulse width≦100μs, Repetitive frequency=100Hz

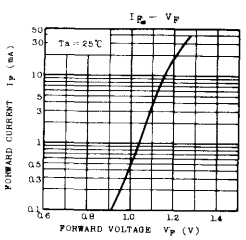
OPTO-ELECTRICAL CHARACTERISTICS (Ta =25°C)

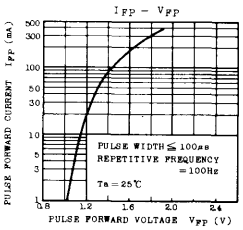
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=10mA	-	1.15	1.35	V
Reverse Current	I_R	V_R=5V	-	-	10	μA
Radiant Power	P_O	I_F=20mA	0.5	2.5	-	mW
Capacitance	C_T	V_R=0, f=1MHz	-	30	-	pF
Peak Emission Wave Length	λ_P	I_F=20mA	-	940	-	nm
Spectral Line Half Width	$\Delta\lambda$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

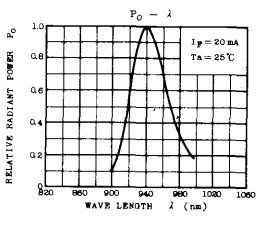


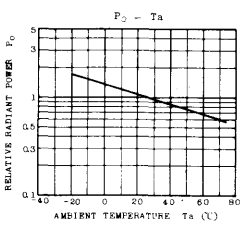


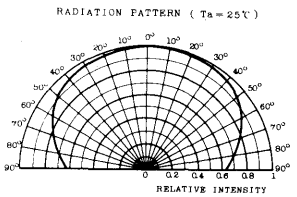












TLN104

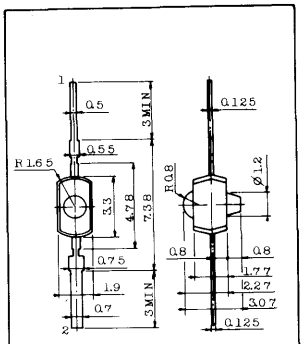
GaAs INFRARED EMITTER

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



1. ANODE
2. CATHODE

JEDEC	–
EIAJ	–
TOSHIBA	4-2A1A

Weight : 0.02g

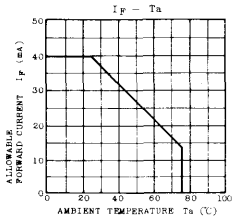
MAXIMUM RATINGS (Ta =25°C)

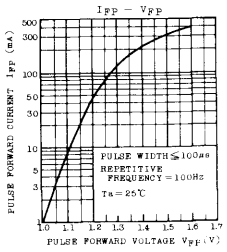
CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current	I_F	40	mA
Pulse Forward Current (Note)	I_{FP}	400	mA
Reverse Voltage	V_R	5	V
Forward Current Derating	$\Delta I_F/^\circ C$	-0.53	mA/°C
Operating Temperature Range	T_{opr}	-20 ~ 75	°C
Storage Temperature Range	T_{stg}	-30 ~ 80	°C

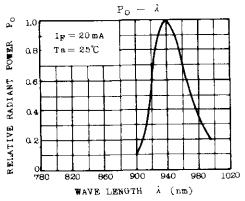
Note : Pulse width ≦100μs, Repetitive frequency=100Hz.

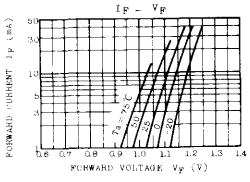
OPTO-ELECTRICAL CHARACTERISTICS (Ta =25°C)

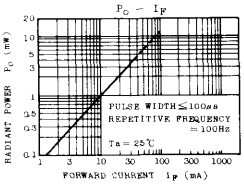
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=10mA	–	1.13	1.35	V
Reverse Current	I_R	V_R=5V	–	–	10	μA
Radiant Power	P_O	I_F=20mA	1.5	3.0	–	mW
Capacitance	C_T	V_R=0, f=1MHz	–	50	–	pF
Peak Emission Wave Length	λ_P	I_F=20mA	–	940	–	nm
Spectral Line Half Width	$\Delta\lambda$	I_F=20mA	–	50	–	nm

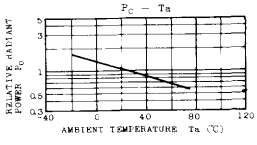


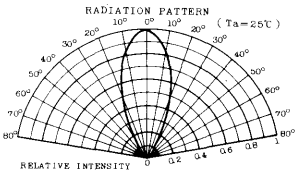












TLN105A

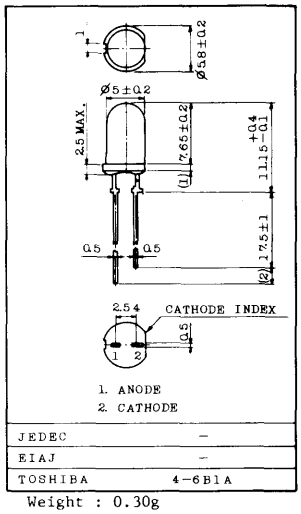
GaAs INFRARED EMITTER

INFRARED LED FOR PHOTO SENSOR.

- REMOTE CONTROL SYSTEM
- OPTICAL SWITCH

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

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	4-6B1A

Weight : 0.30g

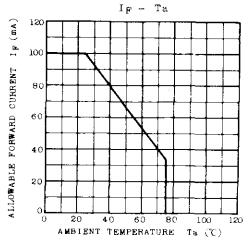
MAXIMUM RATINGS (Ta = 25°C)

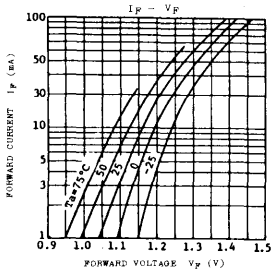
CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current	I_F	100	mA
Pulse Forward Current (Note)	I_{FP}	1	A
Reverse Voltage	V_R	5	V
Forward Current Derating	$\Delta I_F/^\circ C$	-1.34	mA/°C
Operating Temperature Range	T_{opr}	-20 ~ 75	°C
Storage Temperature Range	T_{stg}	-30 ~ 100	°C

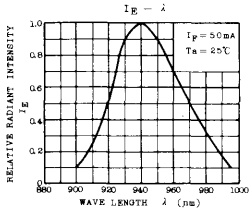
Note : Pulse width≦100μs, Repetitive frequency=100Hz.

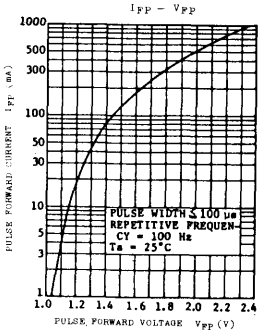
OPTO-ELECTRICAL CHARACTERISTICS (Ta = 25°C)

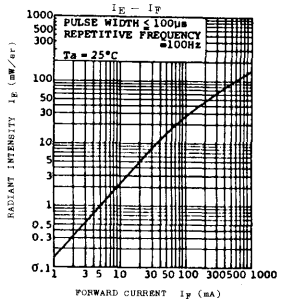
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=100mA	-	1.35	1.5	V
Reverse Current	I_R	V_R=5V	-	-	10	μA
Radiant Intensity	I_E	I_F=50mA	7	15	-	mW/sr
Radiant Power	P_O	I_F=50mA	-	9	-	mW
Capacitance	C_T	V_R=0, f=1MHz	-	20	-	pF
Peak Emission Wave Length	λ_P	I_F=50mA	-	940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

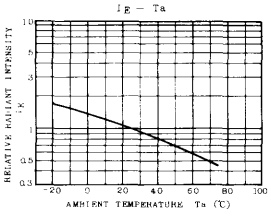


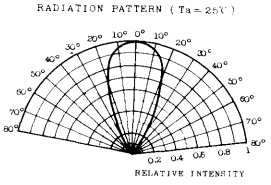












TLN107A

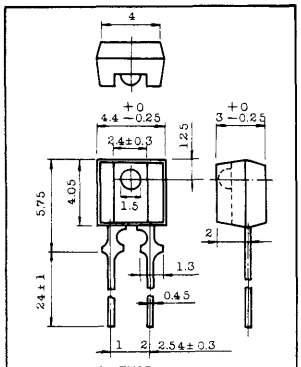
GaAs INFRARED EMITTER

INFRARED LED FOR PHOTO SENSOR.

. OPTICAL SWITCH
. TAPE, CARD READERS

. Output Spearally Compatible with Silicon Sensor TPS607A, TPS608A.
. 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

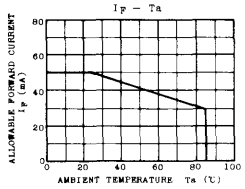
MAXIMUM RATINGS (Ta = 25°C)

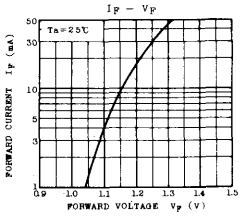
CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current	I_F	50	mA
Pulse Forward Current (Note)	I_{FP}	600	mA
Reverse Voltage	V_R	5	V
Forward Current Derating	$\Delta I_F/^\circ C$	-0.33	mA/°C
Operating Temperature Range	T_{opr}	-25 ~ 85	°C
Storage Temperature Range	T_{stg}	-40 ~ 100	°C

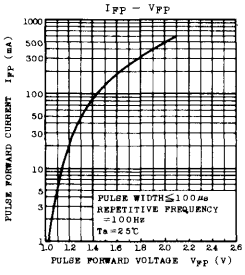
Note : Pulse Width ≦ 100μs, Repetitive frequency=100Hz.

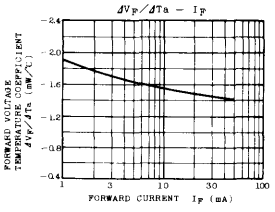
OPTO-ELECTRICAL CHARACTERISTICS (Ta = 25°C)

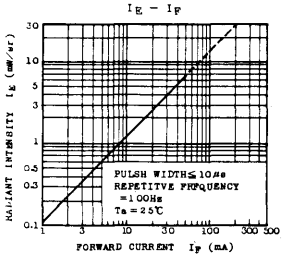
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=10mA	1.00	1.15	1.30	V
Reverse Current	I_R	V_R=5V	-	-	10	μA
Radiant Intensity	I_E	I_F=20mA	0.7	2	-	mW/sr
Radiant Power	P_O	I_F=20mA	-	2.0	-	mW
Capacitance	C_T	V_R=0, f=1MHz	-	30	-	pF
Peak Emission Wave Length	λ_P	I_F=20mA	-	940	-	nm
Spectral Line Half Width	$\Delta\lambda$	I_F=20mA	-	50	-	nm

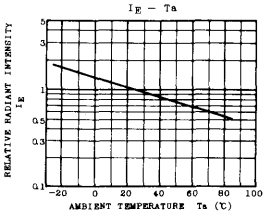


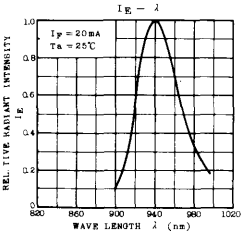


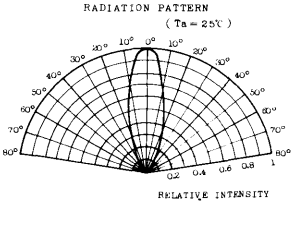












TLN108

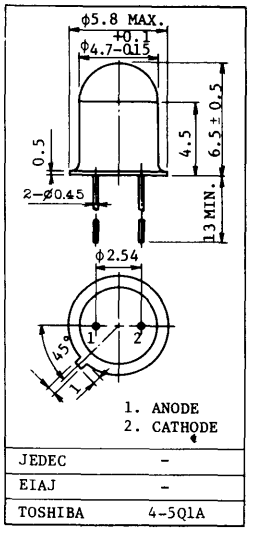
GaAs INFRARED EMITTER

INFRARED LED FOR PHOTO SENSOR.

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

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

Unit in mm



JEDEC	–
EIAJ	–
TOSHIBA	4-5Q1A

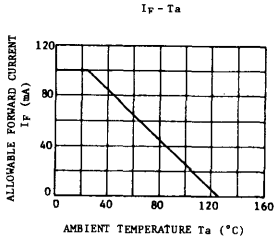
MAXIMUM RATINGS (Ta = 25°C)

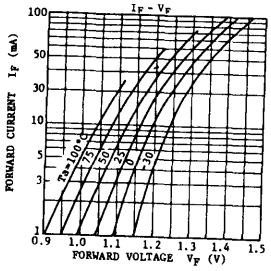
CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current	I_F	100	mA
Pulse Forward Current (Note)	I_{FP}	1	A
Reverse Voltage	V_R	5	V
Operating Temperature Range	T_{opr}	−40 ∿ 125	°C
Storage Temperature Range	T_{stg}	−55 ∿ 150	°C

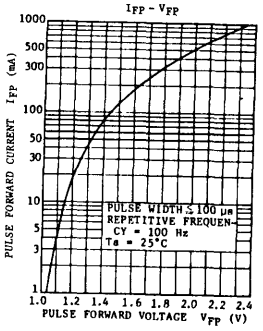
Note: Pulse width ≦ 100 μs, Repetitive frequency = 100 Hz

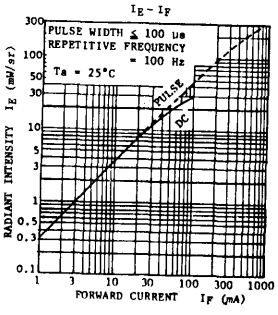
OPTO-ELECTRICAL CHARACTERISTICS (Ta = 25°C)

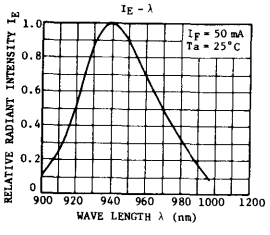
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F = 50 mA	–	1.35	1.45	V
Pulse Forward Voltage	V_{FP}	I_{FP} = 1 A	–	2.0	–	V
Reverse Current	I_R	V_R = 5 V	–	–	10	μA
Radiant Intensity	I_E	I_F = 50 mA	10	20	–	mW/sr
Radiant Power	P_O	I_F = 50 mA	–	3	–	mW
Capacitance	C_T	V_R = 0V, f = 1MHz	–	20	–	pF
Peak Emission Wave Length	λ_P	I_F = 50 mA	–	940	–	nm
Spectral Line Half Width	$\Delta\lambda$	I_F = 50 mA	–	50	–	nm

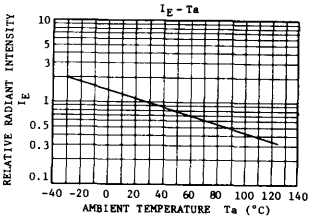


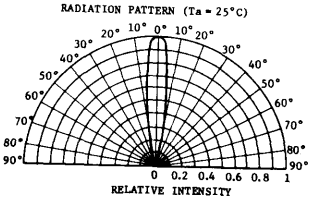












TLN109

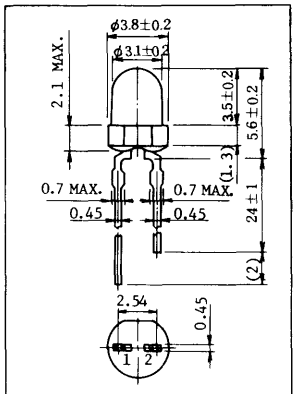
GaAs INFRARED EMITTER

INFRARED LED FOR PHOTO SENSOR.

- ○ OPTICAL SWITCH
- ○ TAPE, CARD READER
- ○ EDGE SENSOR

- · Output Spectrally Compatible with Silicon Sensor TPS603
- · High Power Output
- · High Radiant Intensity: I_E = 1.5 mW/sr (TYP.)

Unit in mm



1. ANODE, 2. CATHODE

JEDEC	-
EIAJ	-
TOSHIBA	4-4E1A

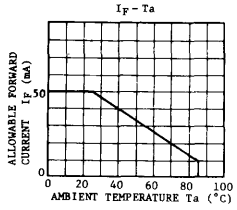
MAXIMUM RATINGS (Ta = 25°C)

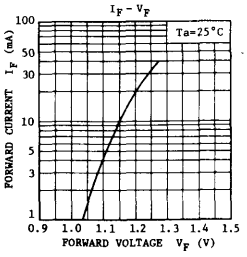
CHARACTERISTICS	SYMBOL	RATING	UNIT
Forward Current	I_F	50	mA
Pulse Forward Current (Note)	I_{FP}	500	mA
Reverse Voltage	V_R	5	V
Operating Temperature Range	T_{opr}	-20 ~ 85	°C
Storage Temperature Range	T_{stg}	-30 ~ 100	°C

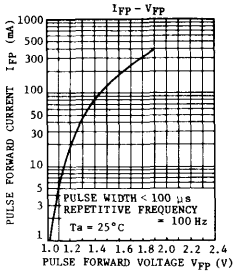
Note: Pulse width ≤ 100 μs, Repetitive frequency = 100Hz.

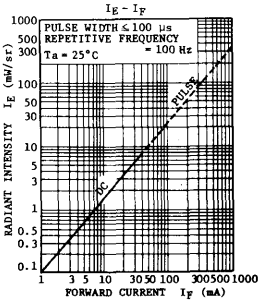
OPTO-ELECTRICAL CHARACTERISTICS (Ta = 25°C)

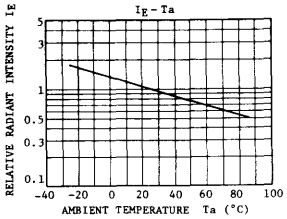
CHARACTERISTICS	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F = 10 mA	1.00	1.15	1.30	V
Reverse Current	I_R	V_R = 5 V	-	-	10	μA
Radiant Intensity	I_E	I_F = 10 mA	0.5	1.5	-	mW/sr
Radiant Power	P_O	I_F = 10 mA	-	1.3	-	mW
Capacitance	C_T	V_R = 0 V, f = 1MHz	-	20	-	pF
Peak Emission Wave Length	λ_p	I_F = 10 mA	-	940	-	nm
Spectral Line Half Width	$\Delta\lambda$	I_F = 10 mA	-	50	-	nm

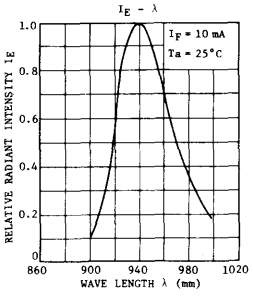


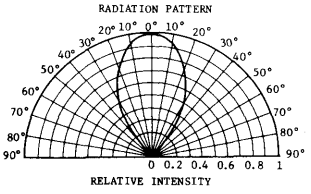












TLN110

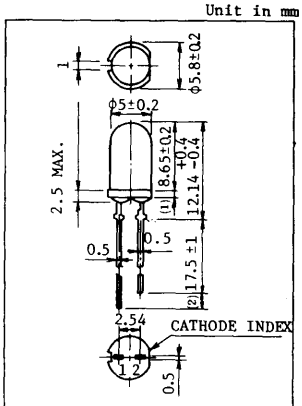
GaAs INFRARED EMITTER

INFRARED LED FOR PHOTO SENSOR.

- ◦ REMOTE CONTROL SYSTEM
- ◦ OPTICAL SWITCH

- · Output Spectrally Compatible with Silicon Sensor TPS703
- · High Radiant Power
- · High Radiant Intensity: I_E = 30 mW/sr

Unit in mm



1. ANODE
2. CATHODE

JEDEC	-
EIAJ	-
TOSHIBA	4-6CIA

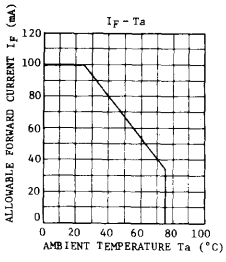
MAXIMUM RATINGS (Ta = 25°C)

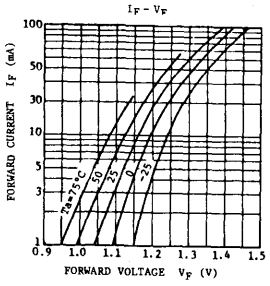
CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current	I_F	100	mA
Pulse Forward Current (Note)	I_{FP}	1	A
Reverse Voltage	V_R	5	V
Diode Power Dissipation	P_D	150	mW
Operating Temperature Range	T_{opr}	-20 ∿ 75	°C
Storage Temperature Range	T_{stg}	-30 ∿ 100	°C

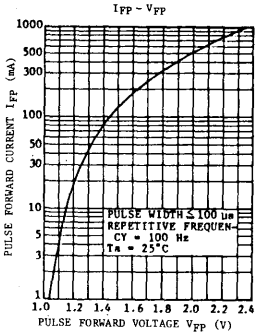
Note: Pulse width ≦ 100 μs,
Repetitive frequency = 100 Hz

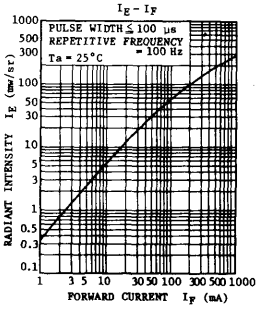
OPTO-ELECTRICAL CHARACTERISTICS (Ta = 25°C)

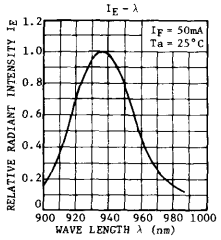
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F = 100 mA	-	1.35	1.5	V
Reverse Current	I_R	V_R = 5 V	-	-	10	μA
Radiant Intensity	I_E	I_F = 50 mA	15	30	-	mW/sr
Radiant Power	P_O	I_F = 50 mA	-	9	-	mW
Capacitance	C_T	V_R = 0, f = 1 MHz	-	20	-	pF
Peak Emission Wave Length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

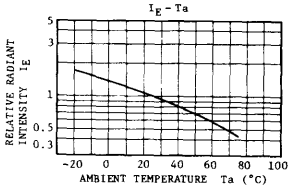


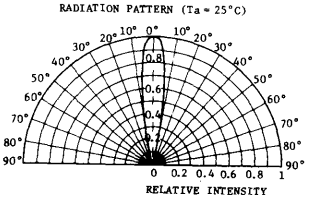












TLN113

GaAs INFRARED EMITTER

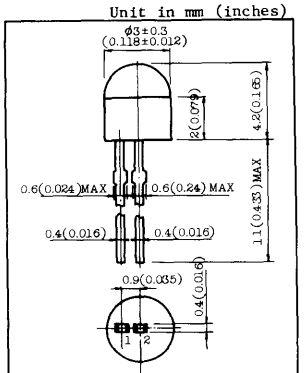
TENTATIVE

INFRARED LED FOR PHOTO SENSOR

- OPTICAL SWITCH
- ENCORDERS
- TAPE, CARD READERS

- 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	-

Weight : 0.08g

MAXIMUM RATINGS

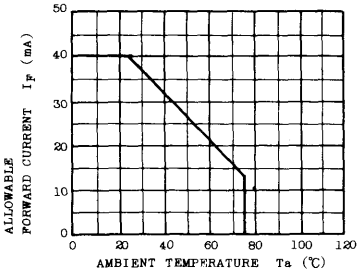
CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current	I_F	40	mA
Pulse Forward Current (Note)	I_{FP}	400	mA
Reverse Voltage	V_R	5	V
Forward Current Derating	ΔI_F/°C	-0.53	mA/°C
Operating Temperature Range	T_{opr}	-20 ∿ 75	°C
Storage Temperature Range	T_{stg}	-30 ∿ 100	°C

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

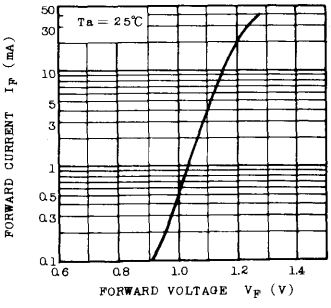
OPTO-ELECTRICAL CHARACTERISTICS

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=10mA	1.00	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	I_F=20mA	0.8	2.0	-	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

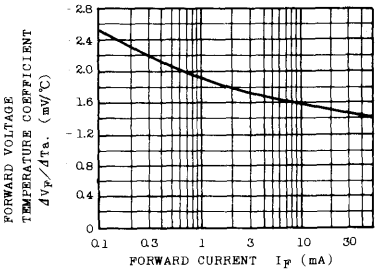
I_F - Ta



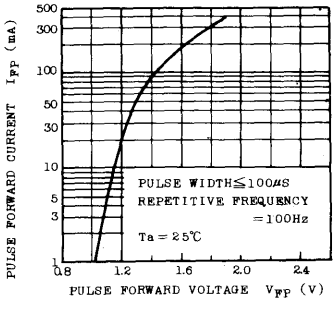
I_F - V_F



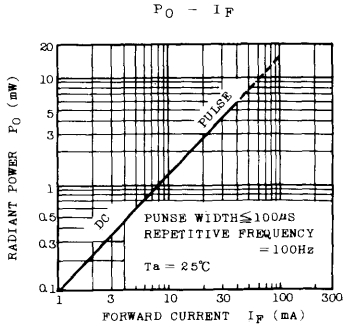
$\Delta V_F/\Delta Ta$ - I_F



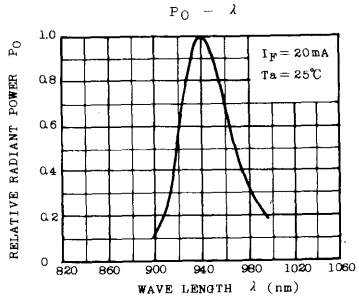
I_{FP} - V_{FP}



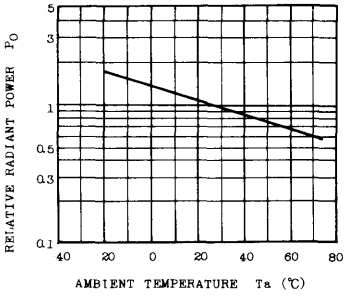
P_O - I_F



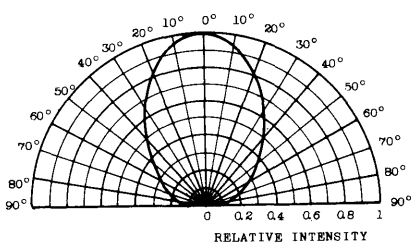
P_O - λ



P_O – Ta



RADIATION PATTERN (Ta = 25℃)



TLN201

GaAlAs INFRARED EMITTER

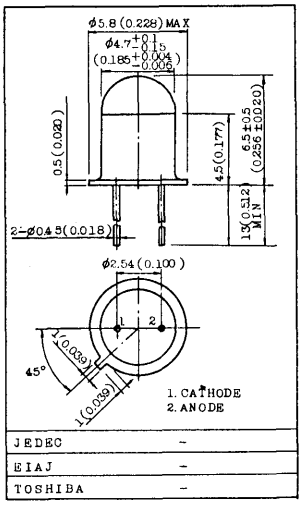
TENTATIVE

INFRARED LED FOR PHOTO SENSOR.

- 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	–

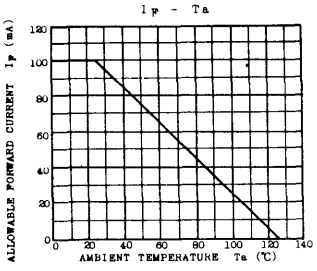
MAXIMUM RATINGS

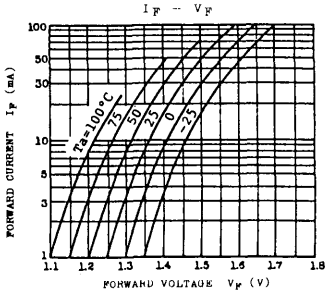
CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current	I_F	100	mA
Pulse Forward Current (Note)	I_{FP}	1	A
Reverse Voltage	V_R	5	V
Operating Temperature Range	T_{opr}	-40 ~ 125	°C
Storage Temperature Range	T_{stg}	-55 ~ 150	°C

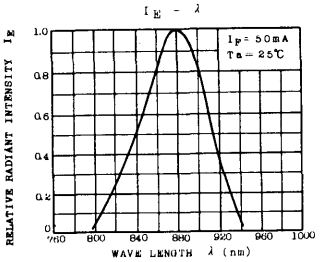
Note: Pulse Width ≦100μs, Repetitive frequency=100Hz

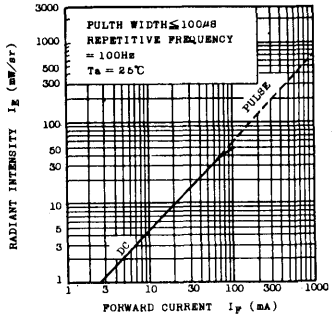
OPTO-ELECTRICAL CHARACTERISTICS

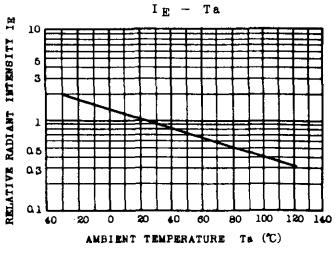
CHARACTERISTICS	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=50mA	–	1.5	1.9	V
Pulse Forward Voltage	V_{FP}	I_{FP}=1A	–	2.8	–	V
Reverse Current	I_R	V_R=5V	–	–	10	μA
Radiant Intensity	I_E	I_F=50mA	20	35	–	mW/sr
Radiant Power	P_O	I_F=50mA	–	5	–	mW
Capacitance	C_T	V_R=0, f=1MHz	–	40	–	pF
Peak Emission Wave Length	λ_P	I_F=50mA	–	880	–	nm
Spectral Line Half Width	$\Delta\lambda$	I_F=50mA	–	80	–	nm

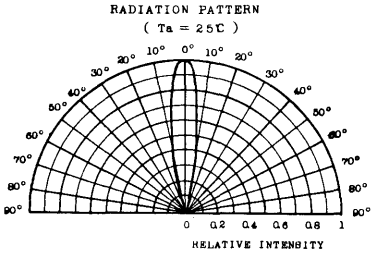












TLN205

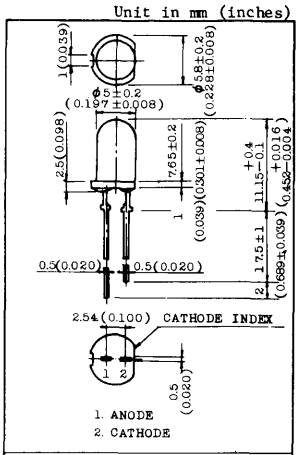
GaAlAs INFRARED EMITTER

TENTATIVE

INFRARED LED FOR PHOTO SENSOR

- OPTICAL SWITCH
- Output Spectrally Compatible with Silicon Sensor TPS610
- High Radiant Power
- High Radiant Intensity: I_E=45mW/sr (Typ.)

Unit in mm (inches)



JEDEC	—
EIAJ	—
TOSHIBA	4-6B1A

Weight: 0.30g

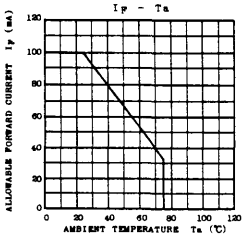
MAXIMUM RATINGS

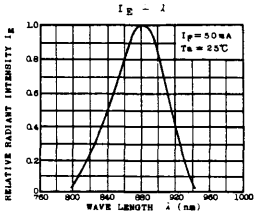
CHARACTERISTIC	SYMBOL	RATING	UNIT
Forward Current	I_F	100	mA
Pulse Forward Current (Note)	I_{FP}	1	A
Reverse Voltage	V_R	5	V
Operating Temperature Range	T_{opr}	-20 ∿ 75	°C
Storage Temperature Range	T_{stg}	-30 ∿ 100	°C

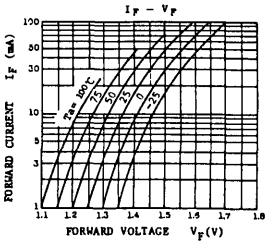
Note: Pulse Width ≦100μs, Repetitive frequency=100Hz

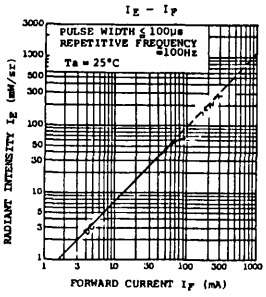
OPTO-ELECTRICAL CHARACTERISTICS

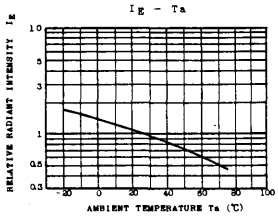
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Forward Voltage	V_F	I_F=50mA	-	1.5	1.9	V
Reverse Current	I_R	V_R=5V	-	-	10	μA
Radiant Intensity	I_E	I_F=50mA	14	40	-	mW/sr
Radiant Power	P_O	I_F=50mA	-	10	-	mW
Capacitance	C_T	V_R=0, f=1MHz	-	40	-	pF
Peak Emission Wave Length	λP	I_F=50mA	-	880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

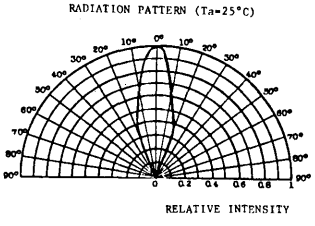












TPS601A

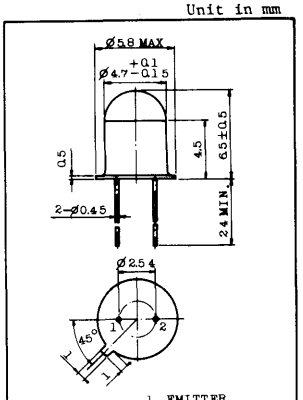
SILICON NPN EPITAXIAL PLANAR

SILICON PHOTO TRANSISTOR FOR PHOTO SENSOR

- OPTICAL SWITCH
- TAPE, CARD READERS
- VELOCITY SENSOR

- High Sensitivity : I_L=250μA
- Spectrally and Mechanically Matched with IR Emitter TLN101A
- Glass-to-Metal-Seal Header
- Saturation Level Directly Compatible with Most TTL

Unit in mm



1. EMITTER
2. COLLECTOR

JEDEC	−
EIAJ	−
TOSHIBA	0-5A2A

Weight : 0.39g

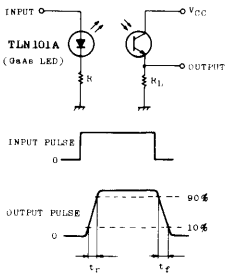
MAXIMUM RATINGS (Ta = 25°C)

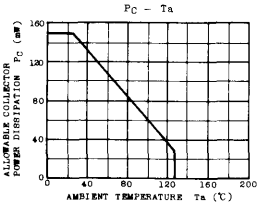
CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Emitter Voltage	V_{CEO}	40	V
Emitter-Collector Voltage	V_{ECO}	5	V
Collector Current	$I_C(I_L)$	50	mA
Collector Power Dissipation	P_C	150	mW
Collector Power Dissipation Derating	$\Delta P_C/^\circ C$	-1.2	mW/°C
Operating Temperature Range	T_{opr}	-40 ~ 125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

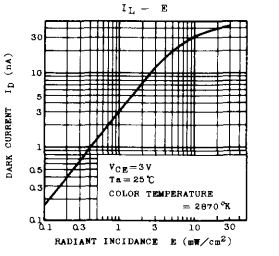
OPTO-ELECTRICAL CHARACTERISTICS (Ta = 25°C)

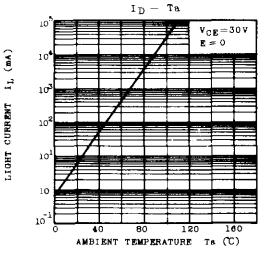
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Dark Current		$I_D(I_{CEO})$	V_{CE}=30V, E=0	-	10	200	nA
Light Current		I_L	V_{CE}=3V, E=0.1mW/cm²	60	250	-	μA
Collector-Emitter Saturation Voltage		$V_{CE(sat)}$	I_C=30μA, E=0.1mW/cm²	-	0.25	0.4	V
Switching Time	Rise Time	t_r	V_{CC}=5V, I_C=10mA, R_L=100Ω	-	2	-	μs
	Fall Time	t_f	(Fig.1)	-	2	-	μs

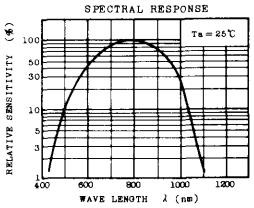
Fig. 1 SWITCHING TIME TEST CIRCUIT

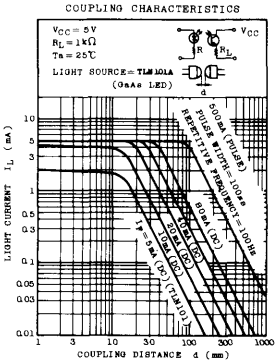


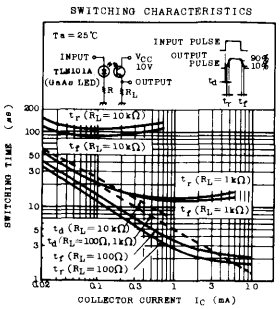


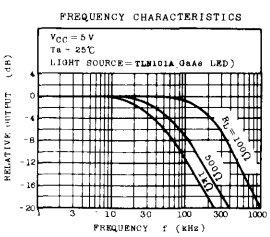


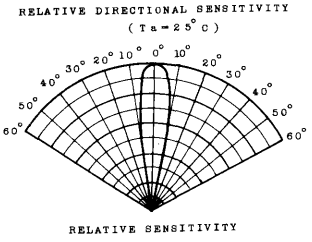












TPS603

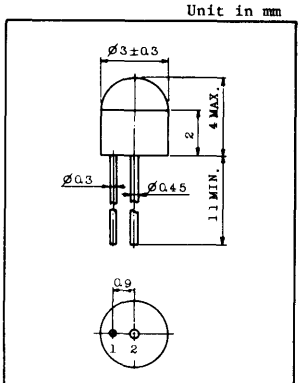
SILICON NPN EPITAXIAL PLANAR

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



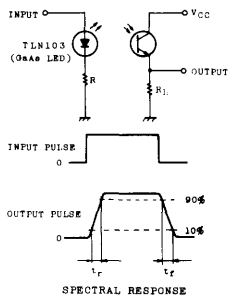
JEDEC	—
EIAJ	—
TOSHIBA	0-3A1A

Weight : 0.02g

MAXIMUM RATINGS (Ta = 25°C)

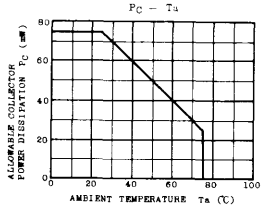
CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Emitter Voltage	V_{CEO}	20	V
Emitter-Collector Voltage	V_{ECO}	5	V
Collector Current	$I_C(I_L)$	20	mA
Collector Power Dissipation	P_C	75	mW
Collector Power Dissipation Derating	$\Delta P_C/^\circ C$	-1.0	mW/°C
Operating Temperature Range	T_{opr}	-20 ~ 75	°C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

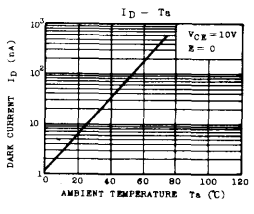
Fig. 1 SWITCHING TIME TEST CIRCUIT

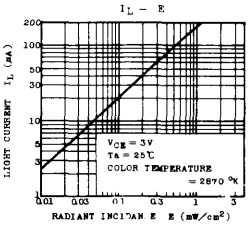


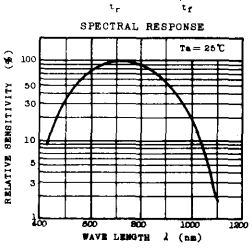
OPTO-ELECTRICAL CHARACTERISTICS (Ta = 25°C)

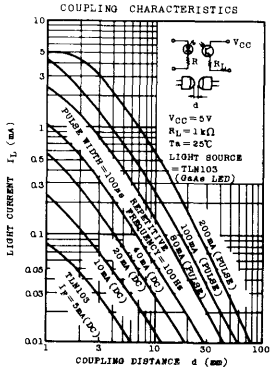
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Dark Current		$I_D(I_{CEO})$	V_{CE}=10V, E=0	-	10	100	nA
Light Current		I_L	V_{CE}=3V, E=0.1mW/cm² (Note)	1.5	10	-	μA
Collector-Emitter Saturation Voltage		$V_{CE(sat)}$	I_C=0.8μA, E=0.1mW/cm² (Note)	-	0.2	0.4	V
Switching Time	Rise Time	t_r	V_{CC}=10V,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

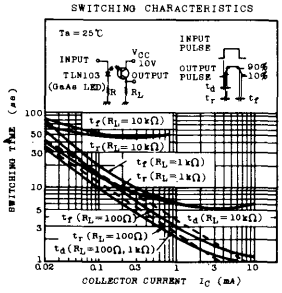


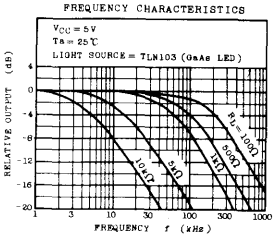


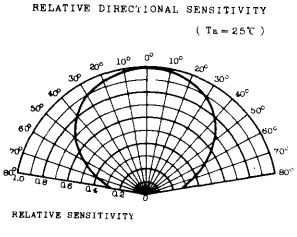












TPS604

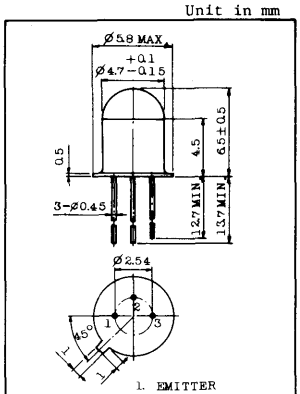
SILICON NPN EPITAXIAL PLANAR

SILICON PHOTO TRANSISTOR FOR PHOTO SENSOR

. OPTIAL SWITCH . TAPE, CARD READERS . VELOCITY SENSOR

- High Sensitivity : I_L=250μA (Typ.)
- Spectrally and Mechanically Matched with IR Emitter TLN101
- Glass-to-Metal-Seal Header
- Base Contact Externally Available
- Saturation Level Directly Compatible with Most TTL

Unit in mm



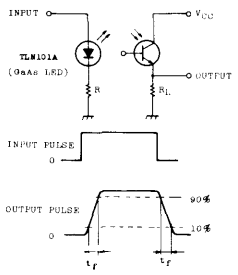
JEDEC	—
EIAJ	—
TOSHIBA	0-5B1A

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 (I_L)	50	mA
Collector Power Dissipation	P_C	150	mW
Collector Power Dissipation Derating	$\Delta P_C/^oC$	-1.2	mW/°C
Operating Temperature Range	T_{opr}	-40 ~ 125	°C
Storage Temperature Range	T_{stg}	-55 ~ 150	°C

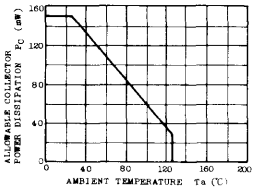
Fig. 1 SWITCHING TIME TEST CIRCUIT



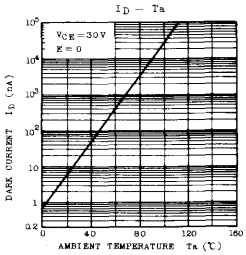
OPTO-ELECTRICAL CHARACTERISTICS (Ta = 25°C)

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	V_{CE}=3V, E=0.1mW/cm²	60	250	-	μA
Collector-Emitter Saturation Voltage		$V_{CE(sat)}$	I_C=30μA, E=0.1mW/cm²	-	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

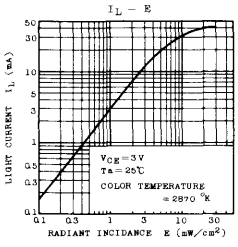
P_C – Ta



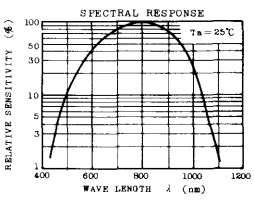
I_D – Ta



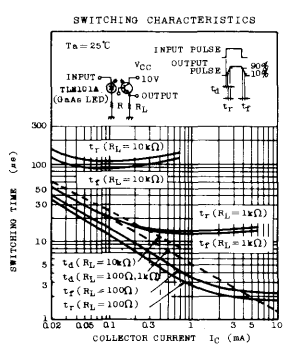
I_L – E



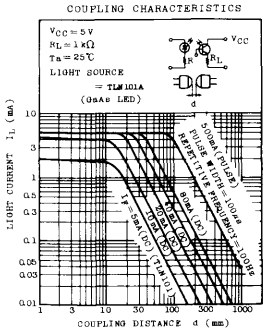
SPECTRAL RESPONSE



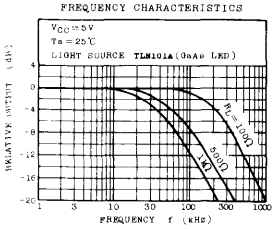
SWITCHING CHARACTERISTICS



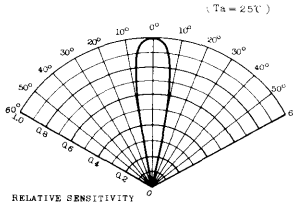
COUPLING CHARACTERISTICS



FREQUENCY CHARACTERISTICS



RELATIVE DIRECTIONAL SENSITIVITY (Ta = 25°C)



TPS605

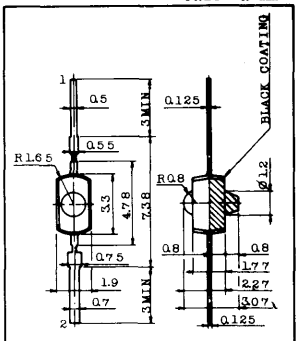
SILICON NPN EPITAXIAL PLANAR

SILICON PHOTO TRANSISTOR FOR PHOTO SENSOR

- OPTICAL SWITCH TAPE, CARD READERS
- POSITION SENSOR

- High Sensitivity : I_L=1mA (Typ.)
- Spectrally and Mechanically Matched with IR Emitter TLN104
- Small Size Package
- Saturation Level Directly Compatible with Most TTL

Unit in mm



1. EMITTER
2. COLLECTOR

JEDEC	–
EIAJ	–
TOSHIBA	0-2C1A

Weight : 0.08g

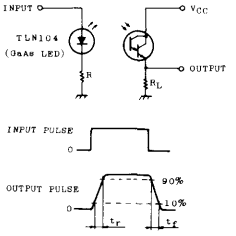
MAXIMUM RATINGS (Ta = 25°C)

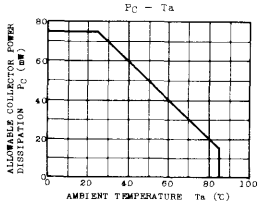
CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Emitter Voltage	V_{CEO}	30	V
Emitter-Collector Voltage	V_{ECO}	5	V
Collector Current	$I_C(I_L)$	40	mA
Collector Power Dissipation	P_C	75	mW
Collector Power Dissipation Derating	$\Delta P_C/^\circ C$	-1.0	mW/°C
Operating Temperature Range	T_{opr}	-25 ~ 85	°C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

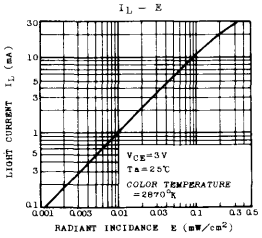
OPTO-ELECTRICAL CHARACTERISTICS (Ta = 25°C)

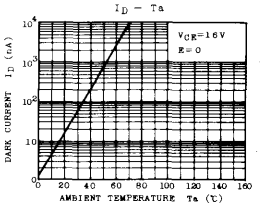
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Dark Current		$I_D(I_{CEO})$	V_{CE}=16V, E=0	–	30	250	nA
Light Current		I_L	V_{CE}=3V, E=0.01mW/cm²	0.15	1	–	mA
Collector-Emitter Saturation Voltage		$V_{CE(sat)}$	I_C=0.08mA, E=0.01mW/cm²	–	0.9	1.2	V
Switching Time	Rise Time	t_r	V_{CC}=5V, I_C=10mA, R_L=100Ω (Fig.1)	–	0.2	–	ms
	Fall Time	t_f		–	0.1	–	ms

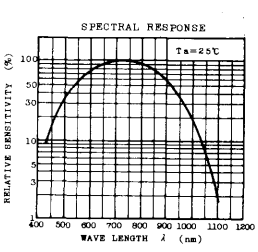
Fig. 1 SWITCHING TIME TEST CIRCUIT

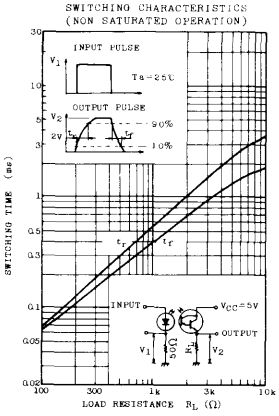


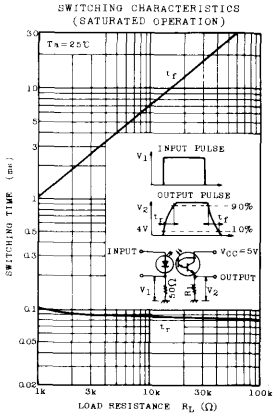


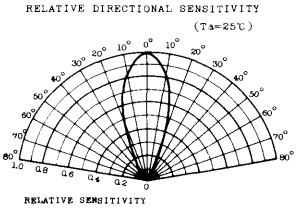












TPS606

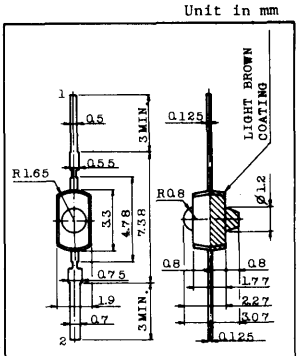
SILICON NPN EPITAXIAL PLANAR

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

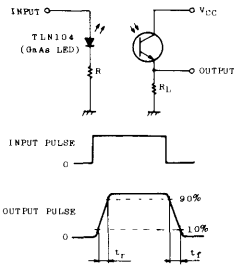
MAXIMUM RATINGS (Ta = 25°C)

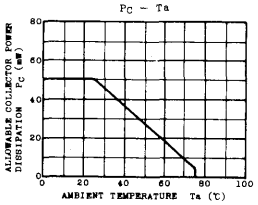
CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Emitter Voltage	V_{CEO}	20	V
Emitter-Collector Voltage	V_{ECO}	5	V
Collector Current	I_C (I_L)	20	mA
Collector Power Dissipation	P_C	50	mW
Collector Power Dissipation Derating	$\Delta P_C/°C$	-0.9	mW/°C
Operating Temperature Range	T_{opr}	-20 ~ 75	°C
Storage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

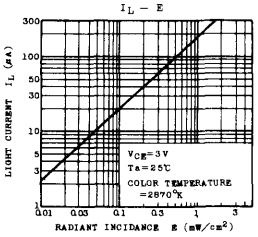
OPTO-ELECTRICAL CHARACTERISTICS (Ta = 25°C)

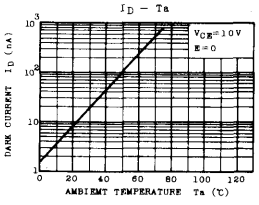
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Dark Current		I_D (I_{CEO})	V_{CE}=10V, E=0	-	10	100	nA
Light Current		I_L	V_{CE}=3V, E=0.1mW/cm²	2	20	-	μA
Collector-Emitter Saturation Voltage		$V_{CE(sat)}$	I_C=1μA, E=0.1mW/cm²	-	0.2	0.4	V
Switching Time	Rise Time	t_r	V_{CC}=10V, I_C=1mA,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

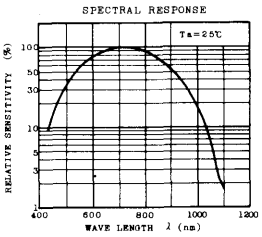
Fig. 1 SWITCHING TIME TEST CIRCUIT

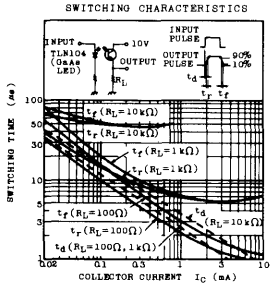


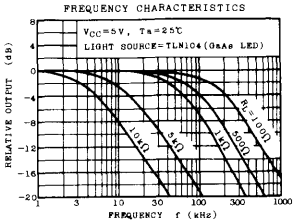


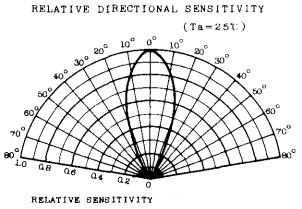












TPS607A

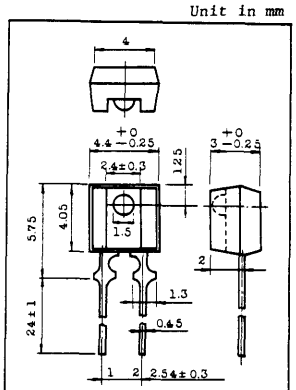
SILICON NPN EPITAXIAL PLANAR

SILICON PHOTO TRANSISTOR FOR PHOTO SENSOR

- . OPTIAL SWITCH
- . INTERRUPTER
- . TAPE CARD READERS

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

Unit in mm



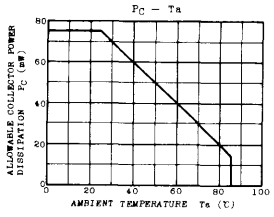
JEDEC	—
EIAJ	—
TOSHIBA	0-4B1A

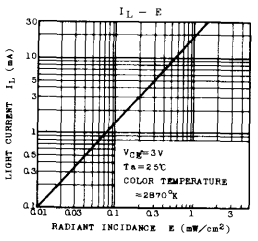
MAXIMUM RATINGS (Ta = 25°C)

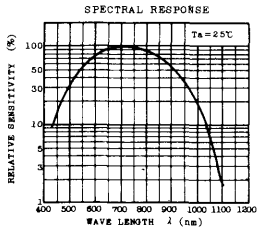
CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Emitter Voltage	V_{CEO}	30	V
Emitter-Collector Voltage	V_{ECO}	5	V
Collector Current	$I_C(I_L)$	50	mA
Collector Power Dissipation	P_C	75	mW
Collector Power Dissipation Derating	$\Delta P_C/^\circ C$	-1.0	mW/°C
Operating Temperature Range	T_{opr}	-25 ~ 85	°C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

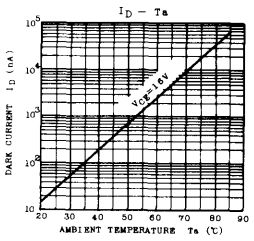
OPTO-ELECTRICAL CHARACTERISTICS (Ta = 25°C)

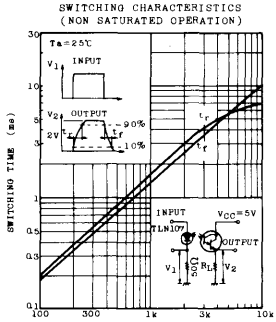
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Dark Current		$I_D(I_{CEO})$	V_{CE}=16V, E=0	-	30	250	nA
Light Current		I_L	V_{CE}=3V, E=0.1mW/cm²	0.6	2	-	mA
Collector-Emitter Saturation Voltage		$V_{CE(sat)}$	I_C=0.3mA, E=0.1mW/cm²	-	0.9	1.2	V
Switching Time	Rise Time	t_r	V_{CC}=5V, I_C=10mA, R_L=100Ω	-	200	-	μs
	Fall Time	t_f		-	100	-	μs

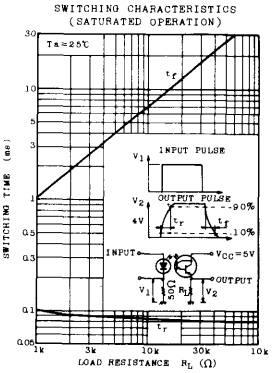


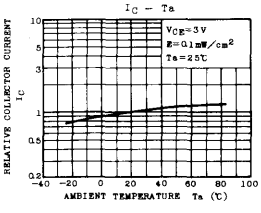


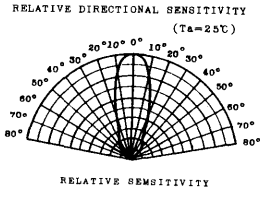












TPS608A

SILICON NPN EPITAXIAL PLANAR

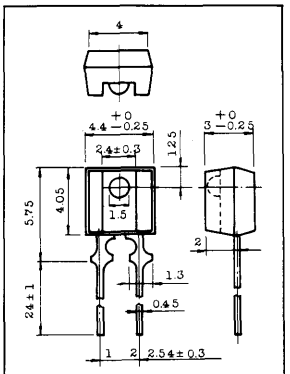
TENTATIVE

SILICON PHOTO TRANSISTOR FOR PHOTO SENSOR

- OPTICAL SWITCH
- INTERRUPTER
- TAPE CARD READERS

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

Unit in m.



JEDEC	—
EIAJ	—
TOSHIBA	0-4B1A

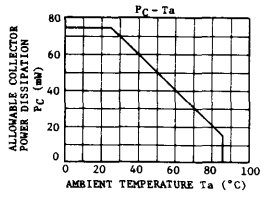
MAXIMUM RATINGS (Ta = 25°C)

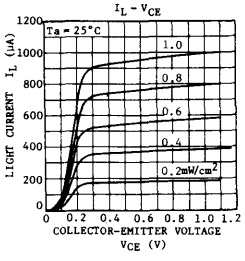
CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Emitter Voltage	V_{CEO}	30	V
Emitter-Collector Voltage	V_{ECO}	5	V
Collector Current	I_C	50	mA
Collector Power Dissipation	P_C	75	mW
Operating Temperature Range	T_{opr}	-25 ~ 85	°C
Storage Temperature Range	T_{stg}	-40 ~ 100	°C

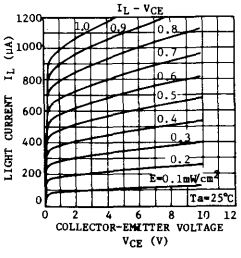
OPTO-ELECTRICAL CHARACTERISTICS (Ta = 25°C)

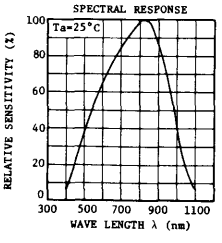
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Dark Current		I_D(ICEO)	V_{CE} = 24V, E = 0	-	5	100	nA
Light Current		I_L(I_C)	V_{CE} = 3V, E = 0.1mW/cm² (Note)	30	100	-	μA
Collector-Emitter Saturation Voltage		$V_{CE(sat)}$	I_C = 15μA, E = 0.1mW/cm²	-	0.15	0.4	V
Switching Time	Rise Time	t_r	V_{CC} = 5V, I_C = 1mA	-	6	-	μs
	Fall Time	t_f	R_L = 100Ω	-	6	-	μs

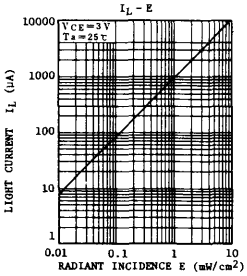
NOTE: Color temperature = 2870°K Tungsten Lamp

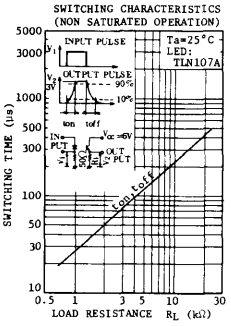


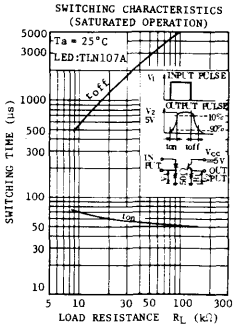


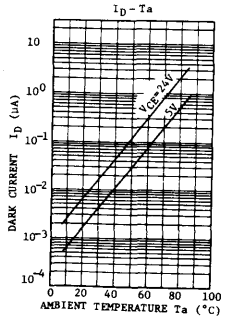


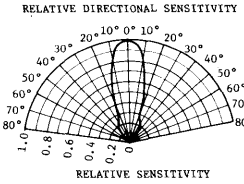












TPS610

SILICON NPN EPITAXIAL PLANAR

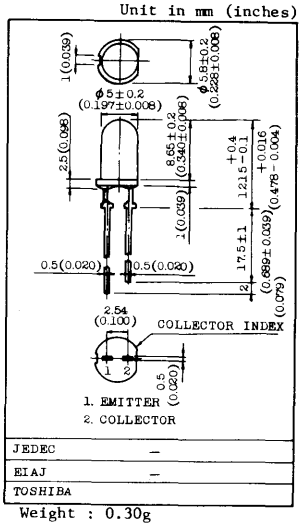
TENTATIVE

SILICON PHOTO TRANSISTOR FOR PHOTO SENSOR

- OPTICAL SWITCH
- TAPE, CARD READERS
- VELOCITY SENSOR

- High Sensitivity: I_L=100μA
- Spectrally and Mechanically Matched with IR Emitter
  TLN105A, TLN110
- Saturation Level Directly Compatible with Most TTL

Unit in mm (inches)



JEDEC	—
EIAJ	—
TOSHIBA	

Weight : 0.30g

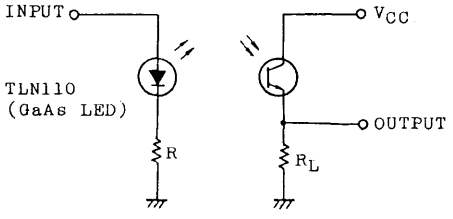
MAXIMUM RATINGS (Ta = 25°C)

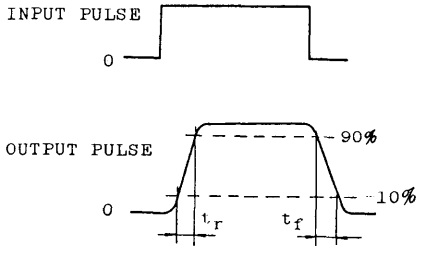
CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Emitter Voltage	V_{CEO}	30	V
Emitter-Collector Voltage	V_{ECO}	5	V
Collector Current	$I_C(I_L)$	50	mA
Collector Power Dissipation	P_C	150	mW
Collector Power Dissipation Derating	ΔP_C/°C	-2.0	mW/°C
Operating Temperature Range	T_{opr}	-20 ∿ 75	°C
Storage Temperature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

OPTO-ELECTRICAL CHARACTERISTICS

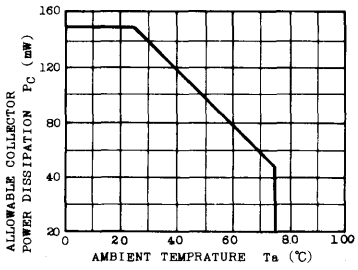
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Dark Current		$I_D(I_{CEO})$	V_{CE}=24V, E=0	-	5	100	nA
Light Current		I_L	V_{CE}=3V, E=0.1mW/cm (Note)	30	100	-	μA
Collector-Emitter Saturation Voltage		$V_{CE(sat)}$	I_C=15μA, E=0.1mW/cm	-	0.25	0.4	V
Switching Time	Rise Time	t_r	V_{CC}=5V, I_C=2mA, R_L=100Ω (Fig. 1)	-	6	-	μs
	Fall Time	t_f		-	6		

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

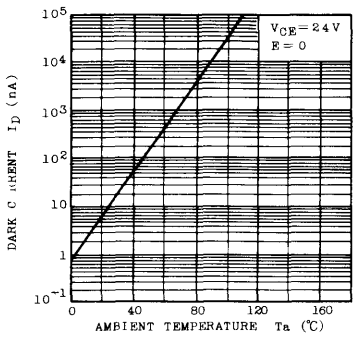




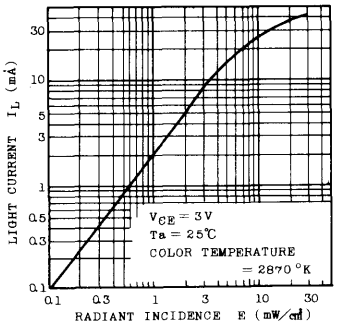
P_C – Ta



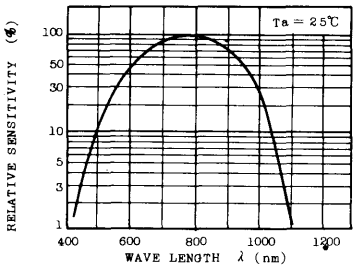
I_D – Ta



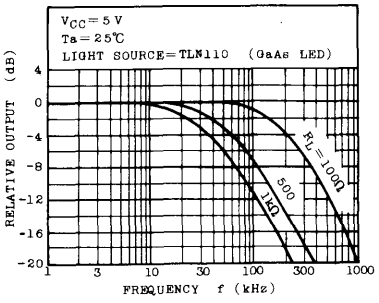
I_L – E



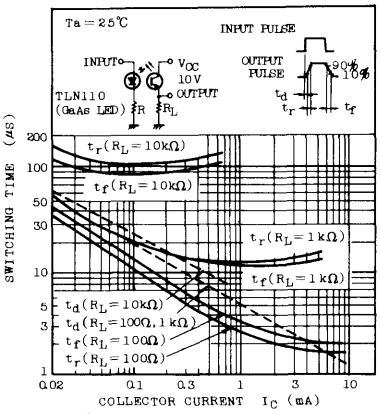
SPECTRAL RESPONSE



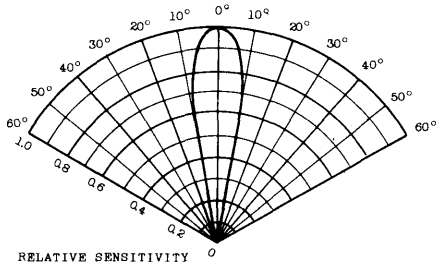
FREQUENCY CHARACTERISTICS



SWITCHING CHARACTERISTICS



RELATIVE DIRECTIONAL SENSITIVITY
(Ta = 25℃)



TPS613

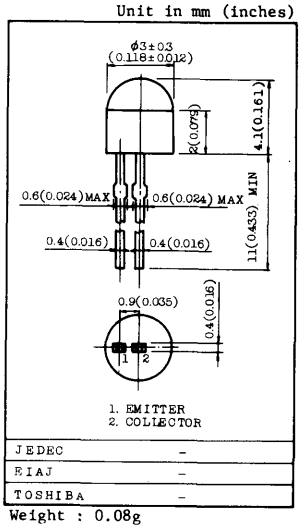
SILICON NPN EPITAXIAL PLANAR

TENTATIVE

SILICON PHOTO TRANSISTOR FOR PHOTO SENSOR

- OPTICAL SWITCH
- POSITION SENSOR
- TAPE, CARD READERS
- ENCODERS
- Spectrally and Mechanically Matched with IR Emitter TLN113
- Saturation Level Directly Compatible with Most TTL

Unit in mm (inches)



JEDEC	–
EIAJ	–
TOSHIBA	–

Weight : 0.08g

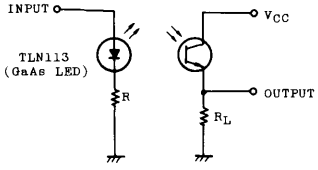
MAXIMUM RATINGS

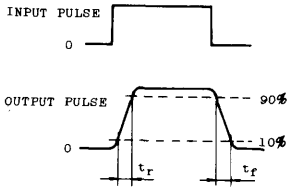
CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Emitter Voltage	V_{CEO}	20	V
Emitter-Collector Voltage	V_{ECO}	5	V
Collector Current	$I_C(I_L)$	20	mA
Collector Power Dissipation	P_C	75	mW
Collector Power Dissipation Derating	$\Delta P_C/°C$	-1.0	mW/°C
Operating Temperature Range	T_{opr}	-20 ~ 75	°C
Storage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

OPTO-ELECTRICAL CHARACTERISTICS Ta = 25°C

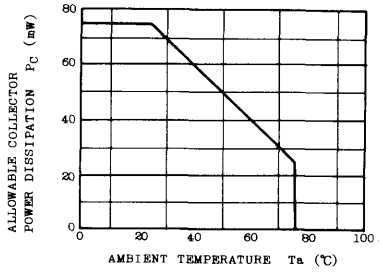
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Dark Current		$I_D(I_{CEO})$	V_{CE}=10V, E=0	-	10	100	nA
Light Current		I_L	V_{CE}=3V, E=0.1mW/cm² (Note)	20	45	-	μA
Collector-Emitter Saturation Voltage		$V_{CE(sat)}$	I_C= 10 μA, E=0.1mW/cm² (Note)	-	0.2	0.4	V
Switching Time	Rise Time	t_r	V_{CC}=10V, I_C=1mA, R_L=100Ω (Fig.1)	-	4	-	μs
	Fall Time	t_f		-	3	-	

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

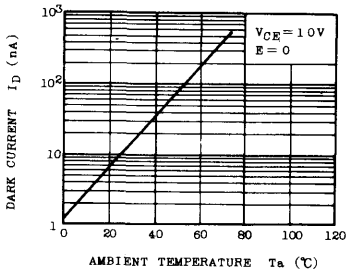




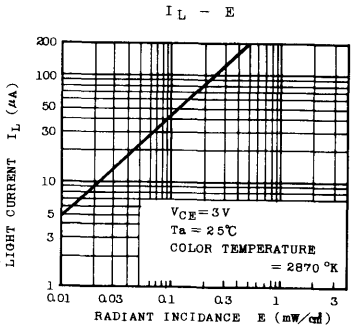
P_C – Ta



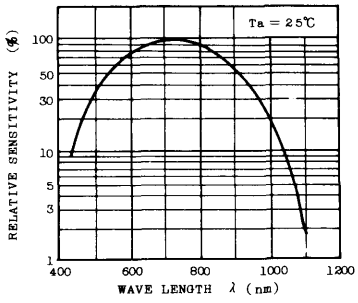
I_D – Ta



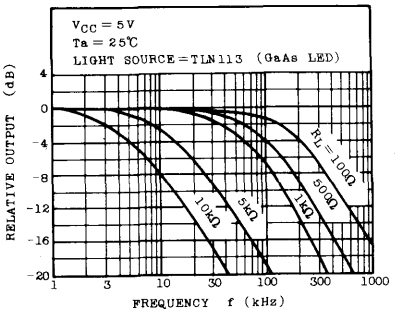
I_L – E



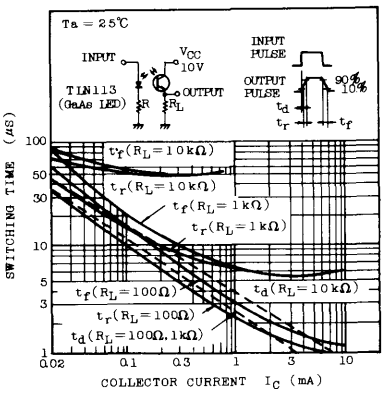
SPECTRAL RESPONSE



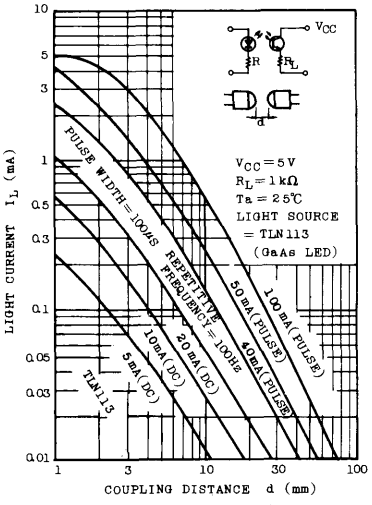
FREQUENCY CHARACTERISTICS



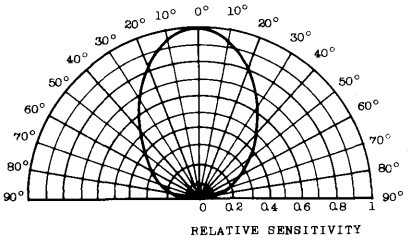
SWITCHING CHARACTERISTICS



COUPLING CHARACTERISTICS



RELATIVE DIRECTIONAL SENSITIVITY
(Ta = 25℃)



TPS614

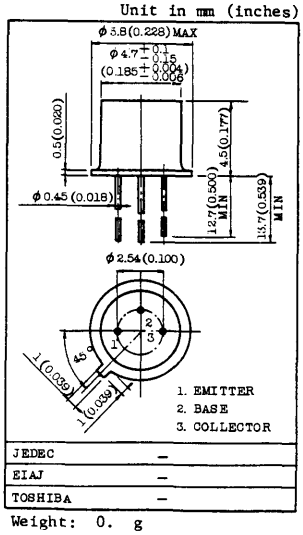
SILICON NPN EPITAXIAL PLANAR

TENTATIVE
SILICON PHOTO TRANSISTOR FOR PHOTO SENSOR

- OPTICAL SWITCH
- TAPE, CARD READERS
- VELOCITY SENSOR

- High Sensitivity: I_L=1.5mA
- 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	—

Weight: 0. g

MAXIMUM RATINGS (Ta = 25°C)

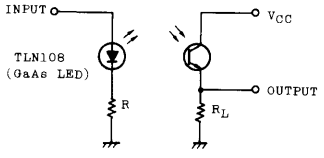
CHARACERISTIC	SYMBOL	RATING	UNIT
Collector-Emitter Voltage	V_{CEO}	40	V
Emitter-Collector Voltage	V_{ECO}	5	V
Collector Current	$I_C(I_L)$	50	mA
Collector Power Dissipation	P_C	150	mW
Collector Power Dissipation Derating	ΔP_C/°C	-1.2	mW/°C
Operating Temperature Range	T_{opr}	-40∼125	°C
Storage Temperature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

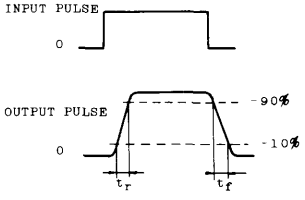
OPTO-ELECTRICAL CHARACTERISTICS

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	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 (Fig. 1)	-	2	-	μs
	Fall Time	t_f		-	2	-	

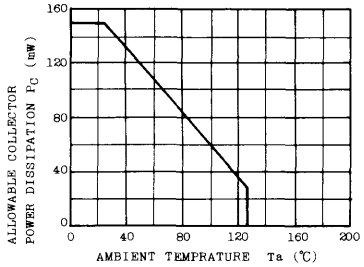
Note: Color temperature = 2870°K Standard Tungsten Lamp.

Fig.1 SWITCHING TIME TEST CIRCUIT

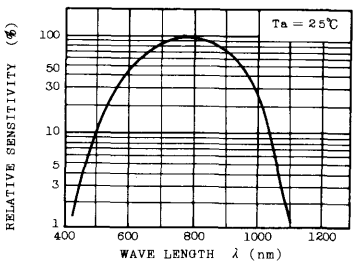




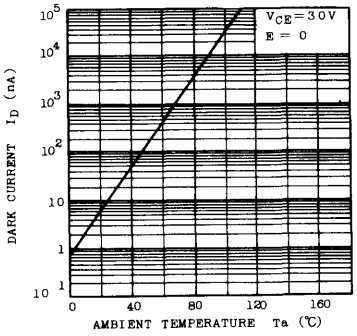
P_C – Ta



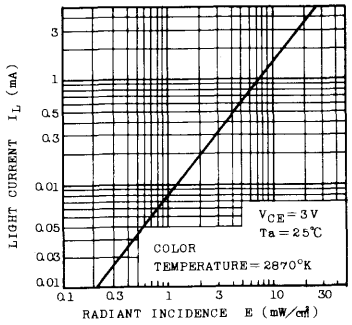
SPECTRAL RESPONSE



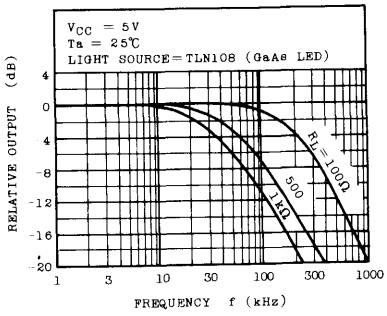
I_D – Ta



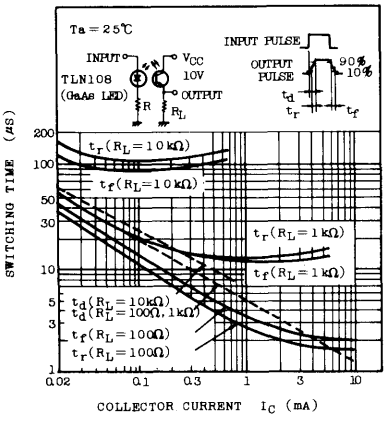
I_L – E



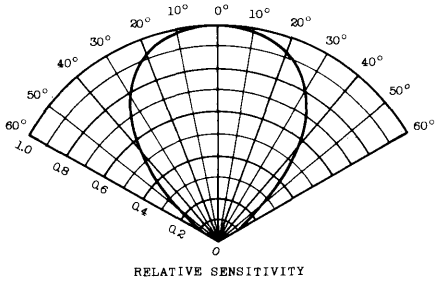
FREQUENCY CHARACTERISTICS



SWITCHING CHARACTERISTICS



RELATIVE DIRECTIONAL SENSITIVITY
(Ta = 25°C)



TPS617

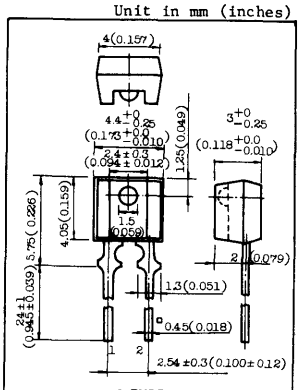
SILICON NPN EPITAXIAL PLANAR

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

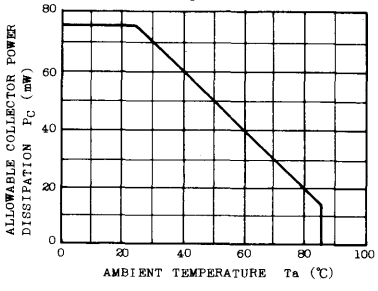
CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Emitter Voltage	V_{CEO}	30	V
Emitter-Collector Voltage	V_{ECO}	5	V
Collector Current	$I_C(I_L)$	50	mA
Collector Power Dissipation	P_C	75	mW
Collector Power Dissipation Derating	ΔP_C/°C	-1.0	mW/°C
Operating Temperature Range	T_{opr}	-25 ∿85	°C
Storage Temperature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

OPTO-ELECTRICAL CHARACTERISTICS (Ta =25°C)

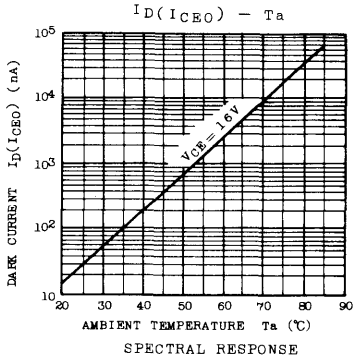
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Dark Current		$I_D(I_{CEO})$	V_{CE}=16V, E=0	-	30	250	nA
Light Current		I_L	V_{CE}=3V, E=0.1mW/cm^2 (Note)	0.4	1.4	-	mA
Collector-Emitter Saturation Voltage		$V_{CE(sat)}$	I_C=0.2mA, E=0.1mW/cm^2(Note)	-	0.9	1.2	V
Switching Time	Rise Time	t_r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

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

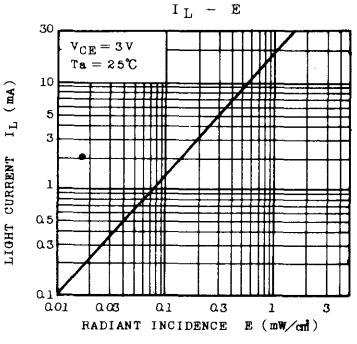
P_C – Ta



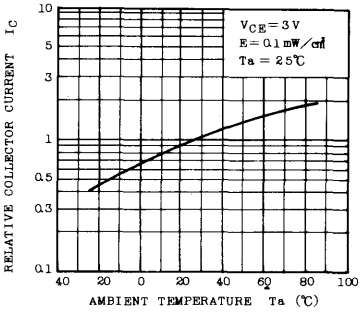
$I_D(I_{CEO})$ – Ta



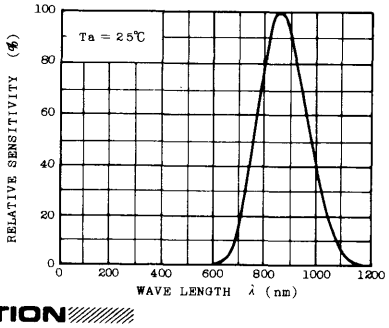
I_L – E



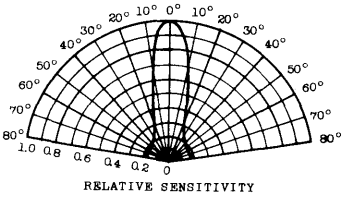
I_C – Ta



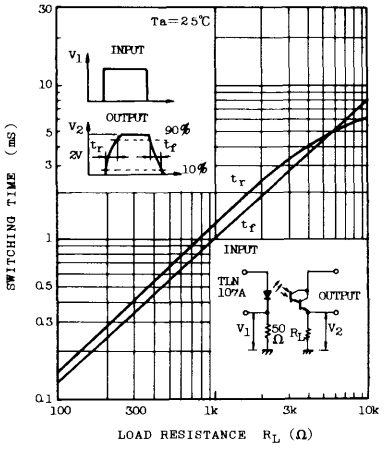
SPECTRAL RESPONSE



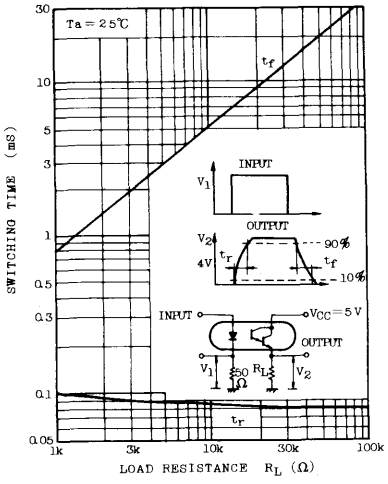
RELATIVE DIRECTIONAL SENSITIVITY
(Ta=25°C)



SWITCHING CHARACTERISTICS
(NON SATURATED OPERATION)



SWITCHING CHARACTERISTICS
(SATURATED OPERATION)



TPS618

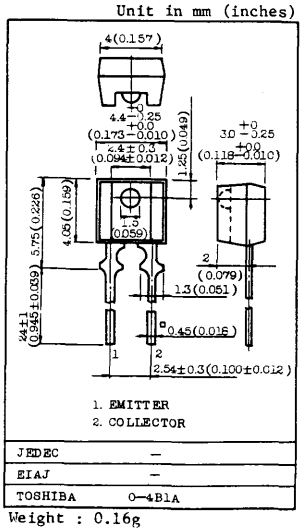
SILICON NPN EPITAXIAL PLANAR

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

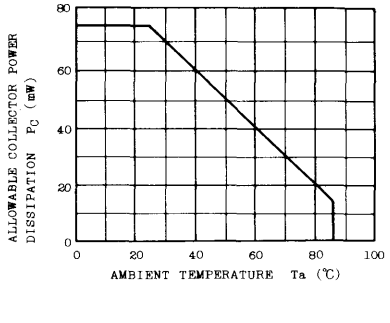
CHARACTERISTIC	SYMBOL	RATING	UNIT
Collector-Emitter Voltage	V_{CEO}	30	V
Emittter-Collector Voltage	V_{ECO}	5	V
Collector Current	$I_C(I_L)$	50	mA
Collector Power Dissipation	P_C	75	mW
Collector Power Dissipation Derating	$\Delta P_C/°C$	-1.0	mW/°C
Operating Temperature Range	T_{opr}	-25 ∿85	°C
Storage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

OPTO-ELECTRICAL CHARACTERISTICS

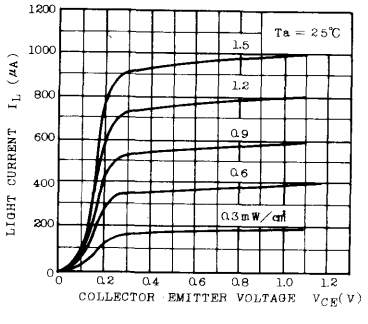
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Dark Current		$I_D(I_{CEO})$	V_{CE}=24V, E=0	-	5	100	nA
Light Current		I_L	V_{CE}=3V, E=0.1mW/cm^2 (Note)	20	70	-	μA
Collector-Emitter Saturation Voltage		$V_{CE(sat)}$	V_C=10μA, E=0.1mW/cm^2 (Note)	-	0.15	0.4	V
Switching Time	Rise Time	t_r	V_{CC}=5V, I_C=1mA, R_L=100Ω	-	6	-	μs
	Fall Time	t_f		-	6	-	

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

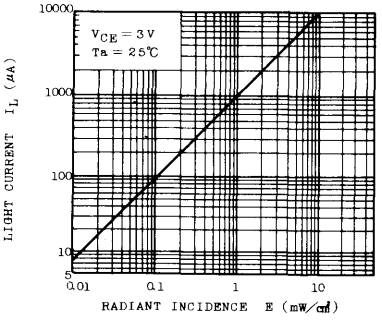
P_C – Ta



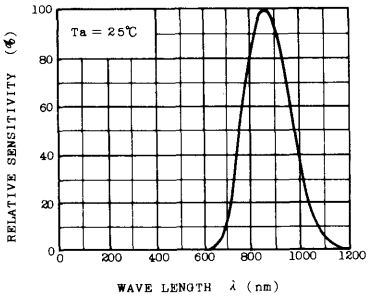
I_L – V_{CE}



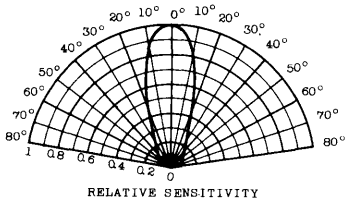
I_L – E



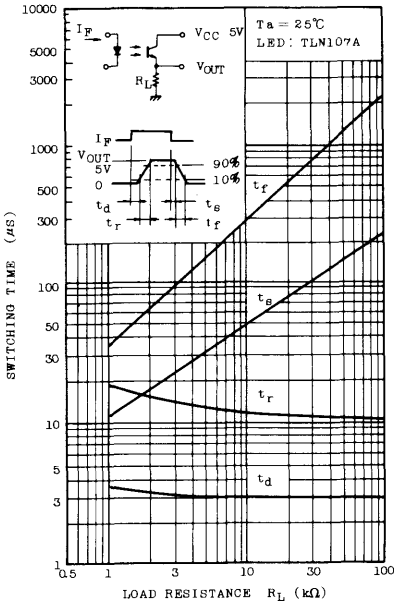
SPECTRAL RESPONSE



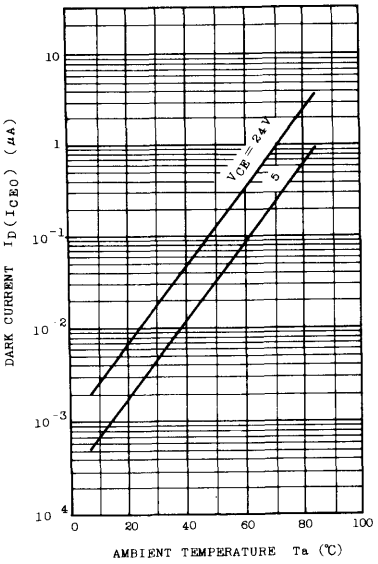
RELATIVE DIRECTIONAL SENSITIVITY
(Ta = 25℃)



SWITCHING CHARACTERISTICS



$I_D(I_{CEO})$ – Ta



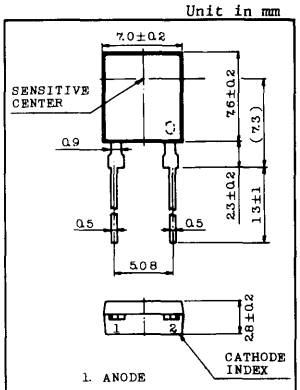
TPS703

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 TLN105A, TLN110

Unit in mm



JEDEC	–
EIAJ	–
TOSHIBA	0-7B1A

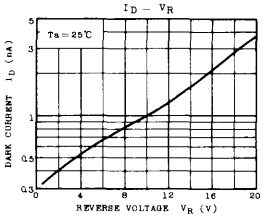
Weight : 0.31g

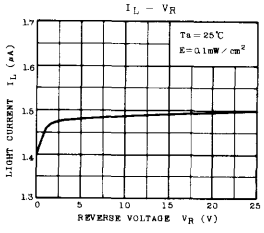
MAXIMUM RATINGS (Ta = 25°C)

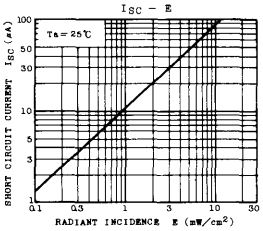
CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	20	V
Power Dissipation	P_D	150	mW
Operating Temperature Range	T_{opr}	−30 ~ 80	°C
Storage Temperature Range	T_{stg}	−40 ~ 90	°C

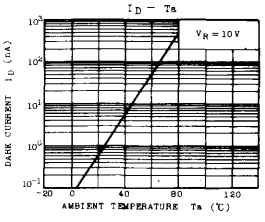
OPTO-ELECTRICAL CHARACTERISTICS (Ta = 25°C)

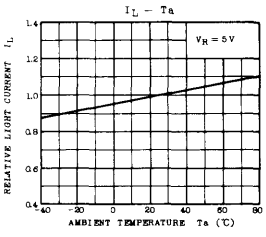
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Dark Current		I_D	V_R=10V, E=0	–	1	30	nA
Short Circuit Current		I_{SC}	E=0.1mW/cm² (Note)	0.9	1.5	–	μA
Capacitance		C_T	V_R=3V, f=1MHz	–	20	–	pF
Peak Sensitivity Wave Length		λ_P	–	–	960	–	nm
Switching Time	Rise Time	t_r	V_R=10V, R_L=1kΩ	–	100	–	ns
	Fall Time	t_f		–	100	–	ns

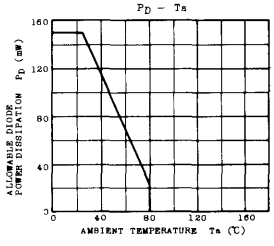


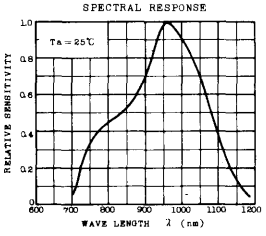


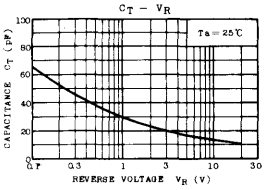


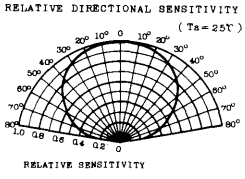












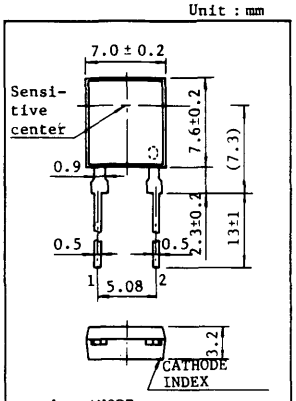
TPS703A

SILICON PIN PHOTO DIODE

TPS703A is a high sensitive and high speed photo diode with PIN structure. Employment of filtered mold resin for cuting the visible light are suitable for the detectors of infrared applications.

- O TV channel control
- O Smoke detector
- O Counters
- ∘ High Speed
- ∘ High Sensitivity: I_{SC} = 0.9 μA (TYP)
- ∘ Low Dark Current
- ∘ Visible light cut filter is employed ≦800 nm (TYP)
- ∘ Wide Radiation Pattern

Unit : mm



1. ANODE
2. CATHODE

JEDEC
EIAJ
TOSHIBA

MAXIMUM RATINGS (Ta = 25 °C)

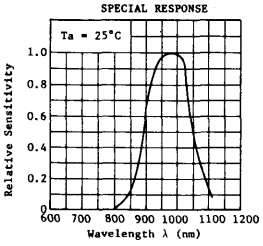
CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	20	V
Power Dissipation	P_D	150	mW
Operating Temperature	T_{opr}	-30~60	°C
Storage Temperature	T_{stg}	-40~60	°C

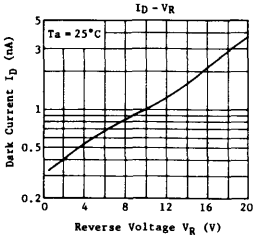
ELECTRICAL CHARACTERISTICS (Ta = 25 °C)

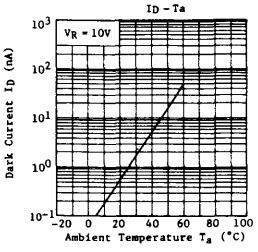
CHARACTERISTIC	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Dark Current	I_D	V_R=10V	-	1	30	nA
Short Circuit Current	I_{SC}	(Note) E=0.1 mW/cm²	0.5	0.9	-	μA
Capacitance Under Voltage	C_T	VR=3V , f=1MHz	-	20	-	pF
Peak Sensitivity Wavelength	λ_p		-	1000	-	nm
Rise Time, Fall Time	t_r , t_f	VR=10V , R_L=1KΩ	-	100	-	ns

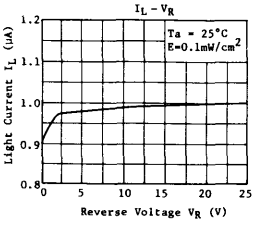
(Note): Color Temperature = 2870°K

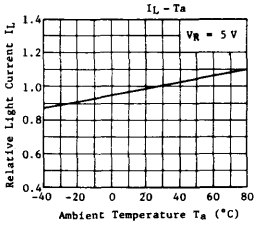
SPECIAL RESPONSE

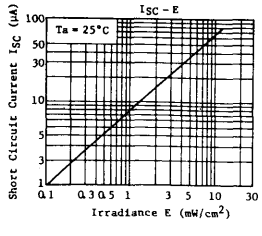


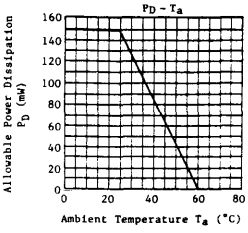


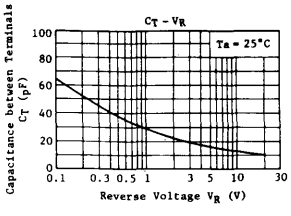


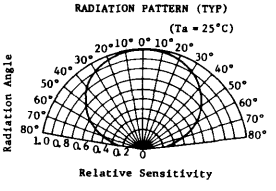












TPS708

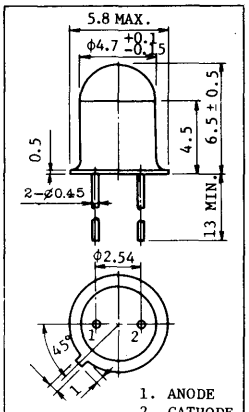
SILICON PIN PHOTO DIODE

SILICON PIN PHOTO DIODE

- OPTICAL SWITCH
- AUTOMOBILE VELOCITY SENSORS
- OPTICAL FIBER LINK

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

Unit in mm



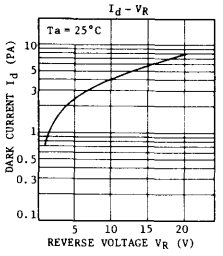
JEDEC	—
EIAJ	—
TOSHIBA	0-5A1B

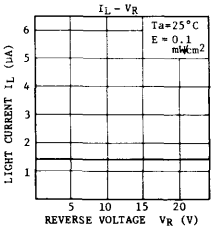
MAXIMUM RATINGS (Ta = 25°C)

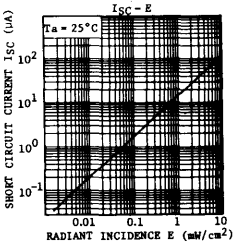
CHARACTERISTIC	SYMBOL	RATING	UNIT
Reverse Voltage	V_R	30	V
Power Dissipation	P_D	100	mW
Operating Temperature Range	T_{opr}	-40 ~ 125	°C
Storage Temperature Range	T_{stg}	-55 ~ 150	°C

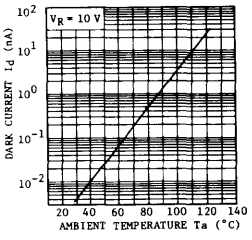
OPTO-ELECTRICAL CHARACTERISTICS (Ta = 25°C)

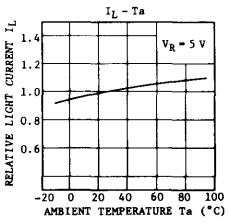
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Dark Current		I_D	V_R = 10 V, E = 0 mW/cm²	-	0.01	60	nA
Short Circuit Current		I_{SC}	E = 0.1 mW/cm² (Note)	1.0	1.5	-	μA
Capacitance		C_T	V_R = 10 V, f = 1 MHz	-	50	-	pF
Peak Sensitivity Wave Length		λ_p	-	-	850	-	nm
Switching Time	Rise Time	t_r	V_{CC} = 20 V, R_L = 50 Ω	-	2	-	ns
	Fall Time	t_f		-	2	-	ns

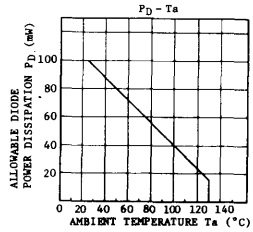


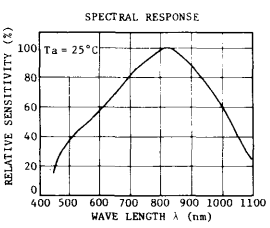


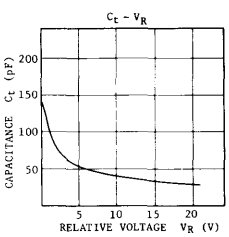


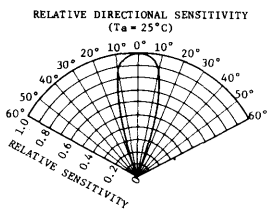












TLP507A

INFRARED LED + PHOTO DARLINGTON TRANSISTOR

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)

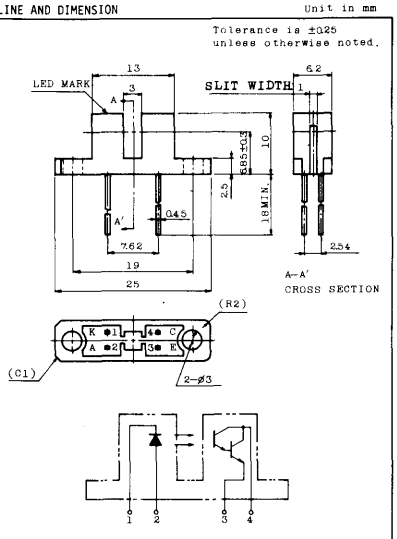
	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	50	mA
	Reverse Voltage	V_R	5	V
	Forward Current Derating	$\Delta I_F/^\circ C$	-0.33	mA/°C
DETECTOR	Collector-Emitter Voltage	V_{CEO}	30	V
	Emitter-Collector Voltage	V_{ECO}	5	V
	Collector Power Dissipation	P_C	75	mW
	Collector Power Dissipation Derating	$\Delta P_C/^\circ C$	-1.0	mW/°C
	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	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	-		%

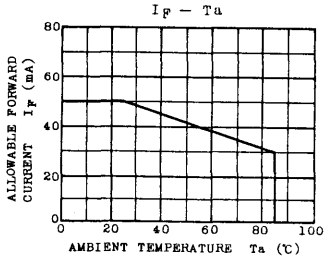
OUTLINE AND DIMENSION

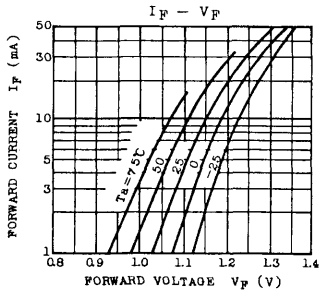
Unit in mm

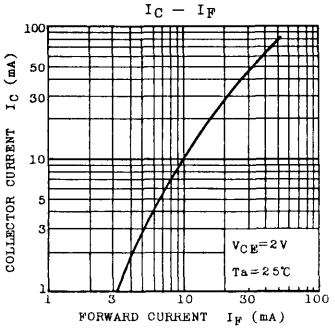


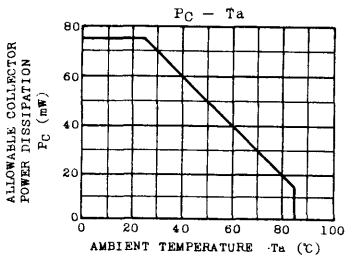
JEDEC	—
EIAJ	—
TOSHIBA	11-13B1A

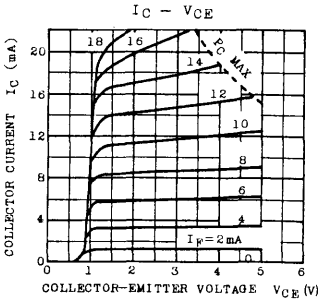
Weight : 0.84g

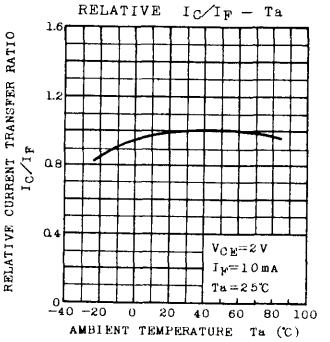




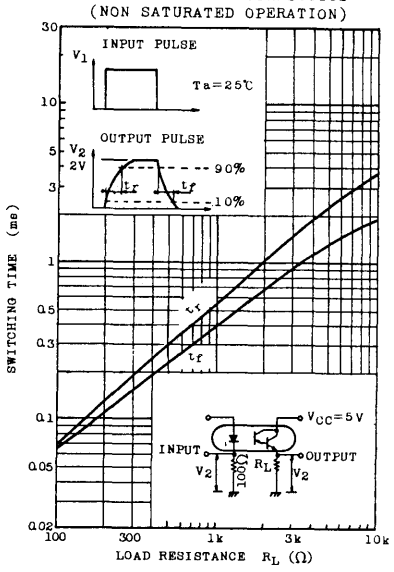




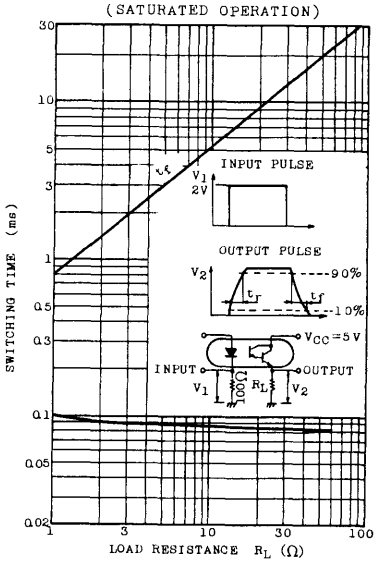




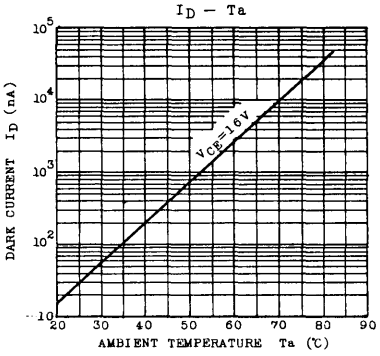
SWITCHING CHARACTERISTICS
(NON SATURATED OPERATION)



SWITCHING CHARACTERISTICS
(SATURATED OPERATION)



I_D – Ta



SENSING POSITION

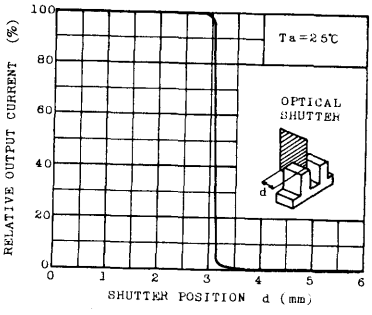


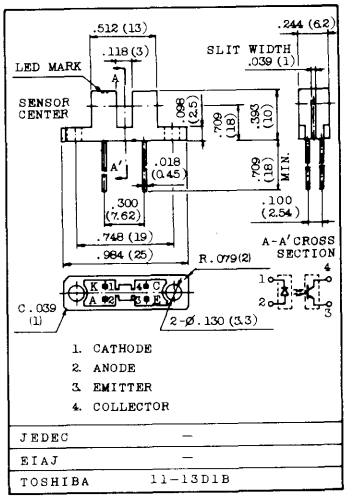
PHOTO INTERRUPTER

TLP800A

INFRARED LED + PHOTO TRANSISTOR

- 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)

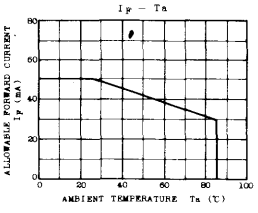


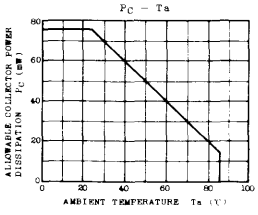
MAXIMUM RATINGS (Ta = 25°C)

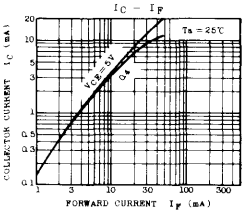
CHARACTERISTIC		SYMBOL	RATING	UNIT
LED	Forward Current	I_F	50	mA
	Reverse Voltage	V_R	5	V
DETECTOR	Collector-Emitter Voltage	V_{CEO}	30	V
	Emitter-Collector Voltage	V_{ECO}	5	V
	Collector Power Dissipation	P_C	75	mW
	Collector Current	I_C	50	mA
Operating Temperature Range		T_{opr}	-25 ~ 85	°C
Storage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

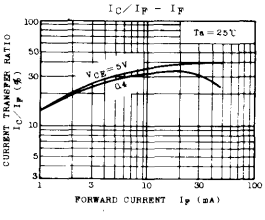
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

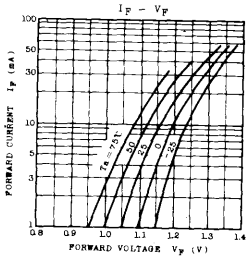
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.00	1.15	1.30	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	Dark Current	I_D (I_{CEO})	V_{CE}=24V, I_F=0	-	5	100	nA
	Capacitance	C_T	V=0, f=1MHz	-	13	-	pF
COUPLED	Current 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

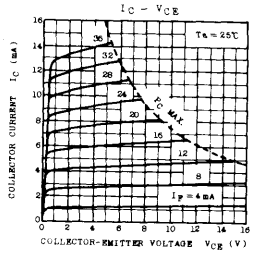


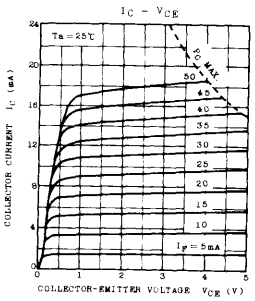


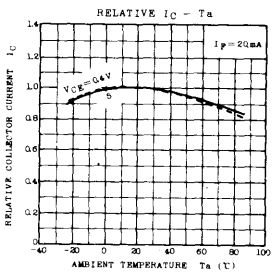


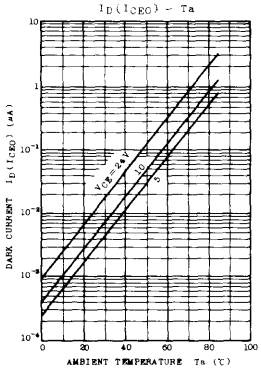


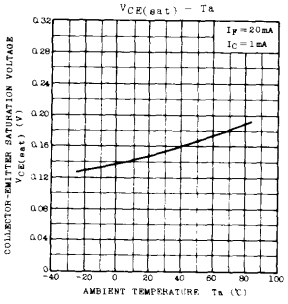


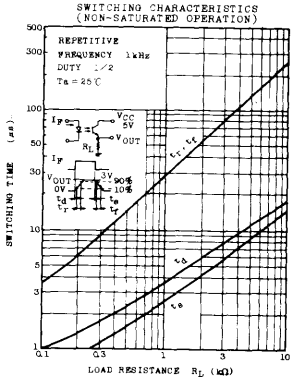


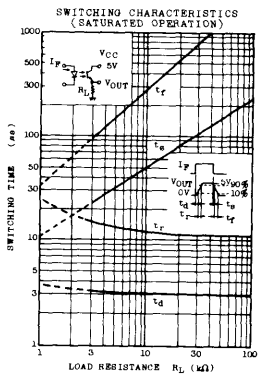


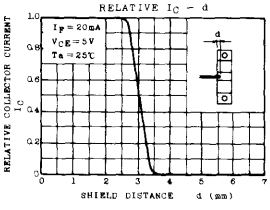


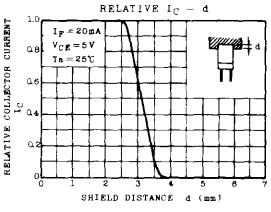


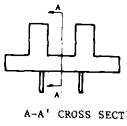






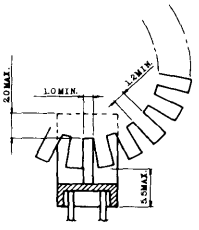


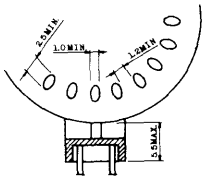


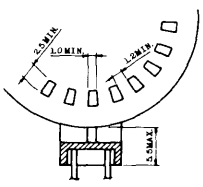


A-A' CROSS SECTION

Unit in mm







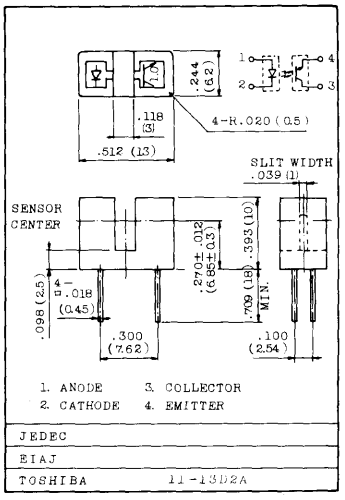
TLP801A

INFRARED LED + PHOTO TRANSISTOR

HIGH SENSITIVE OPTICAL SENSOR.

- 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

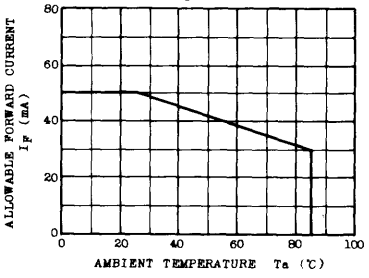
MAXIMUM RATINGS (Ta = 25°C)

	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

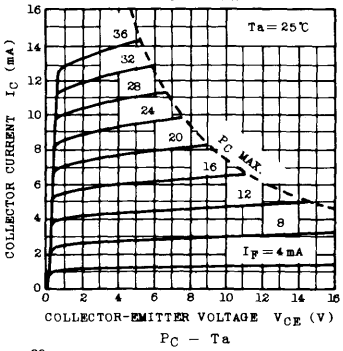
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

	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	-	6	-	μs
		t_f	R_L=100Ω	-	6	-	μs

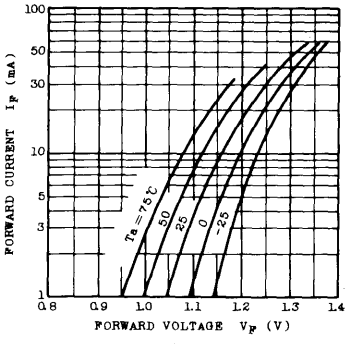
I_F – Ta



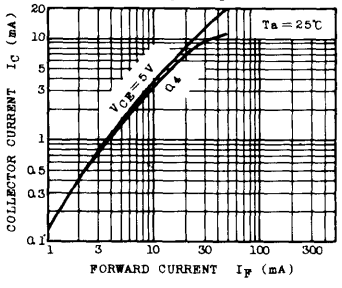
I_C – V_{CE}



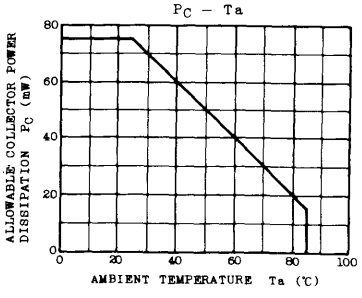
I_F – V_F



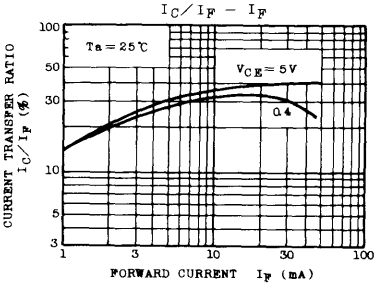
I_C – I_F

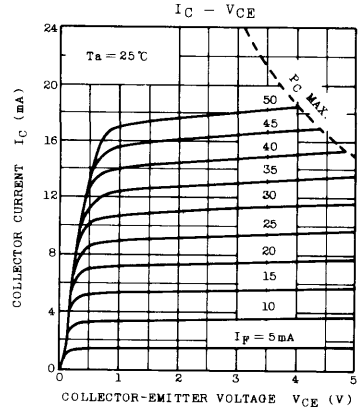


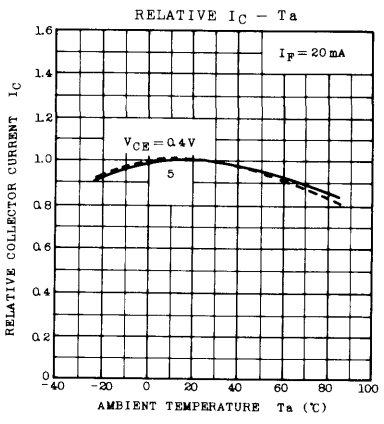
P_C – Ta

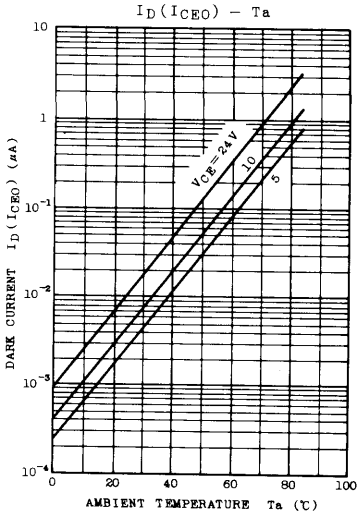


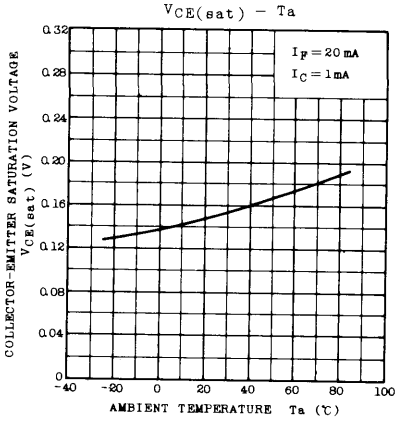
I_C/I_F – I_F

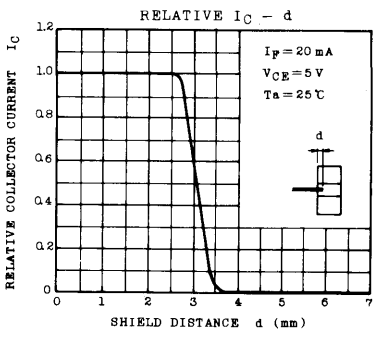


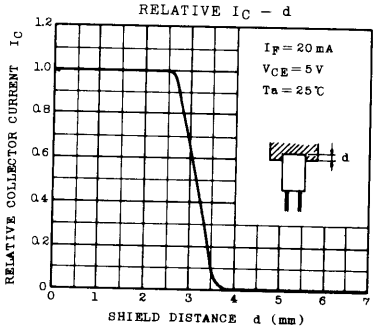

$I_C - V_{CE}$
Ta = 25℃
I_C MAX.
50
45
40
35
30
25
20
15
10
I_F = 5mA
COLLECTOR CURRENT I_C (mA)
COLLECTOR-EMITTER VOLTAGE V_{CE} (V)

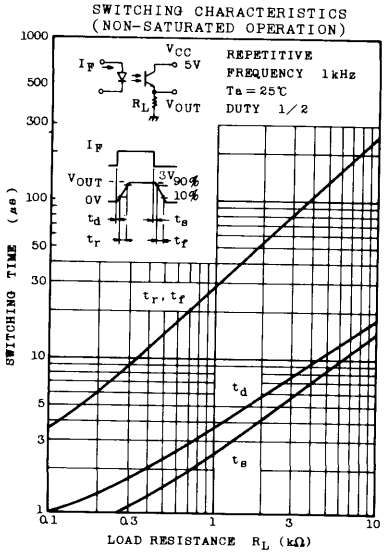

RELATIVE I_C – Ta
I_F = 20mA
V_{CE} = 0.4V
5
RELATIVE COLLECTOR CURRENT I_C
AMBIENT TEMPERATURE Ta (℃)

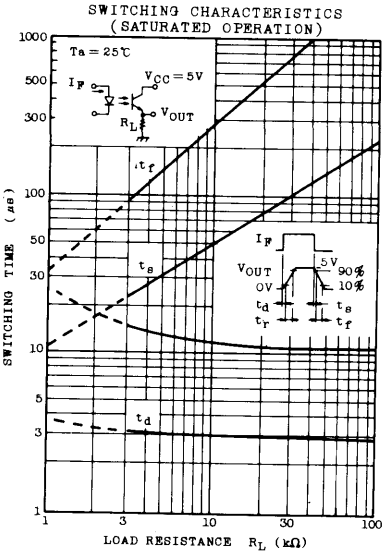

$I_D(I_{CEO})$ – Ta
V_{CE} = 24V
10
5
DARK CURRENT $I_D(I_{CEO})$ (μA)
AMBIENT TEMPERATURE Ta (℃)

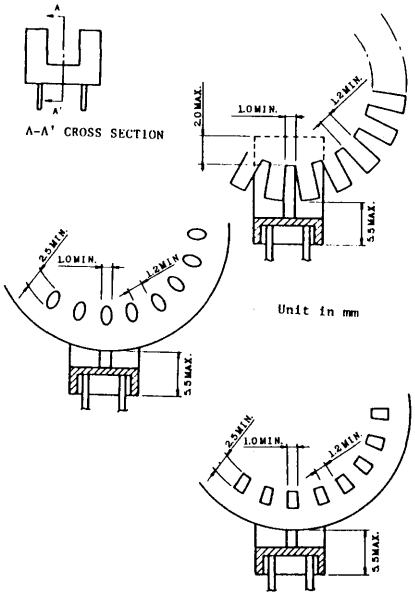

$V_{CE(sat)}$ – Ta
I_F = 20mA
I_C = 1mA
COLLECTOR-EMITTER SATURATION VOLTAGE $V_{CE(sat)}$ (V)
AMBIENT TEMPERATURE Ta (℃)


RELATIVE I_C – d
I_F = 20mA
V_{CE} = 5V
Ta = 25℃
d
RELATIVE COLLECTOR CURRENT I_C
SHIELD DISTANCE d (mm)


RELATIVE I_C – d
I_F = 20mA
V_{CE} = 5V
Ta = 25℃
d
RELATIVE COLLECTOR CURRENT I_C
SHIELD DISTANCE d (mm)


SWITCHING CHARACTERISTICS
(NON-SATURATED OPERATION)
V_{CC} 5V
R_L
V_{OUT}
REPETITIVE
FREQUENCY 1kHz
Ta = 25℃
DUTY 1/2
I_F
V_{OUT}
3V
0V
90%
10%
t_d
t_r
t_s
t_f
t_r, t_f
t_d
t_s
SWITCHING TIME (μs)
LOAD RESISTANCE R_L (kΩ)


SWITCHING CHARACTERISTICS
(SATURATED OPERATION)
Ta = 25℃
I_F
V_{CC} = 5V
V_{OUT}
R_L
t_r
t_s
t_f
t_d
I_F
V_{OUT}
5V
0V
90%
10%
SWITCHING TIME (μs)
LOAD RESISTANCE R_L (kΩ)


A
A'
A-A' CROSS SECTION
2.0MAX.
1.0MIN.
1.2MIN.
5.5MAX.
2.5MIN.
Unit in mm

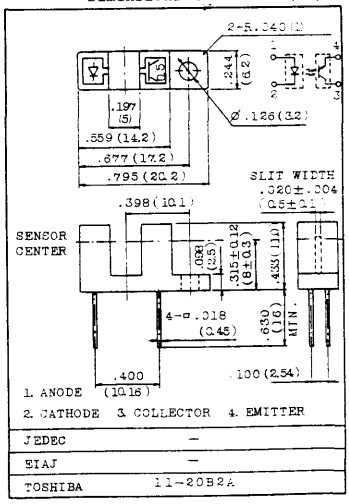
TLP802

INFRARED LED + PHOTO TRANSISTOR

HIGH SENSITIVE. OPTICAL SENSOR.

- 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)



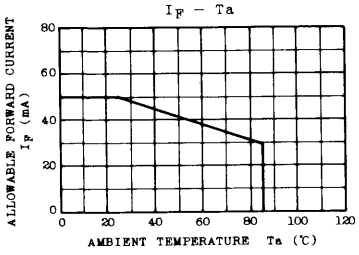
JEDEC	—
EIAJ	—
TOSHIBA	11-20B2A

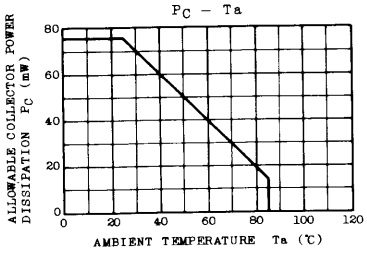
MAXIMUM RATINGS (Ta = 25°C)

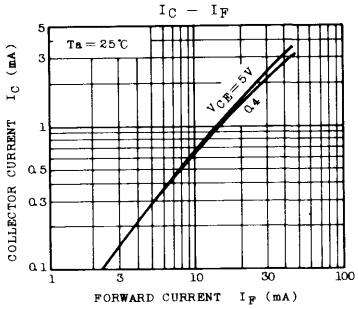
	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	50	mA
	Reverse Voltage	V_R	5	V
DETECTOR	Collector-Emitter Voltage	V_{CEO}	30	V
	Emitter-Collector Voltage	V_{ECO}	5	V
	Collector Power Dissipation	P_C	75	mW
	Collector Current	I_C	50	mA
Operating Temperature Range		T_{opr}	-25 ~ 85	°C
Storage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

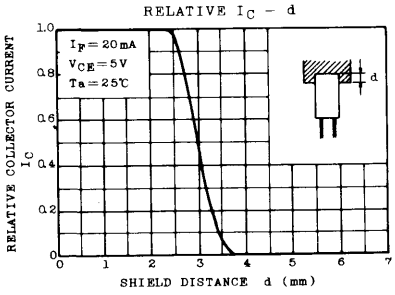
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

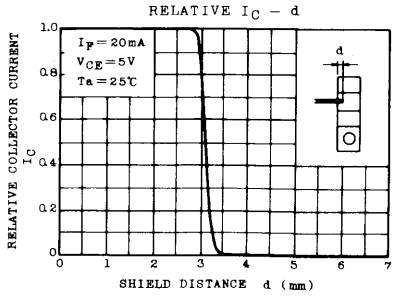
	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.00	1.15	1.30	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	Dark Current	I_D (I_{CEO})	V_{CE}=24V, I_F=0	-	5	100	nA
	Capacitance	C_T	V=0, f=1MHz	-	13	-	pF
COUPLED	Current 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



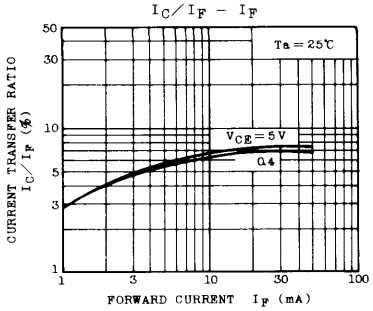




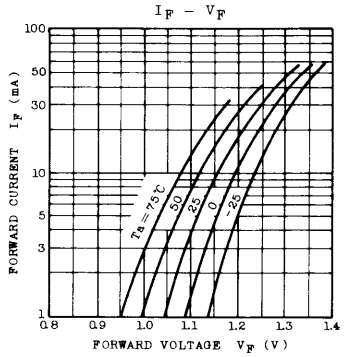




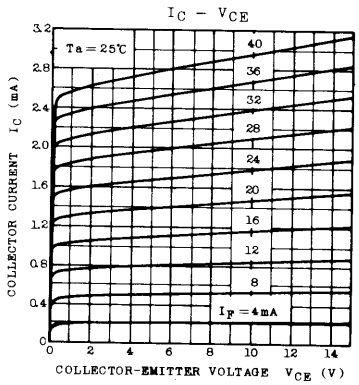
$I_C / I_F - I_F$



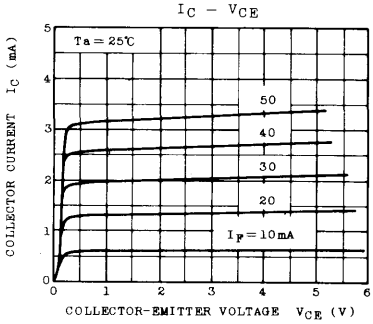
$I_F - V_F$



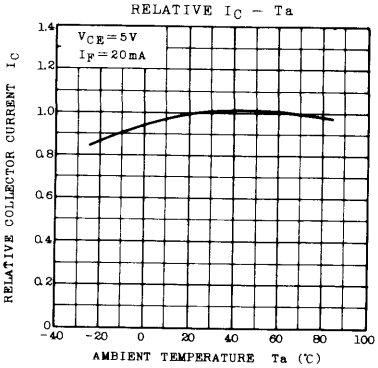
$I_C - V_{CE}$



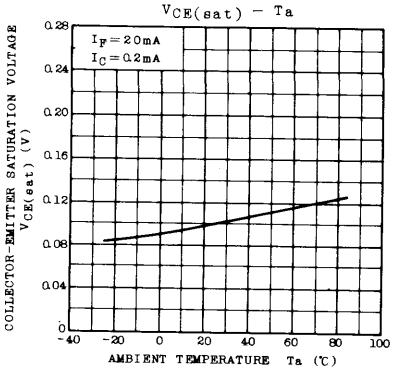
$I_C - V_{CE}$



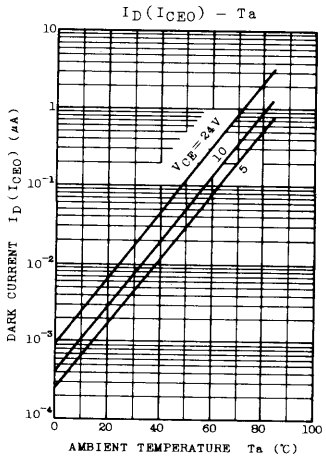
RELATIVE I_C - Ta



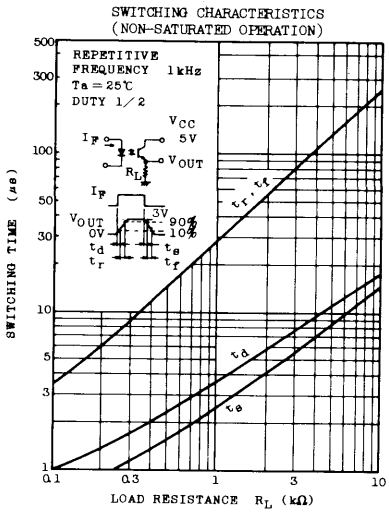
$V_{CE(sat)}$ - Ta



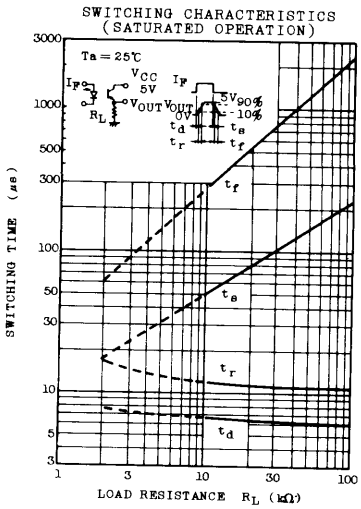
$I_D (I_{CEO})$ - Ta

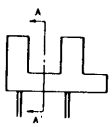


SWITCHING CHARACTERISTICS
(NON-SATURATED OPERATION)



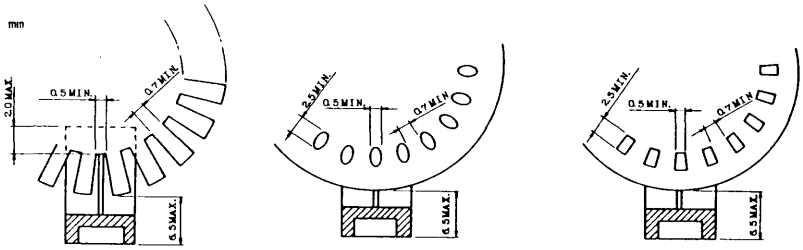
SWITCHING CHARACTERISTICS
(SATURATED OPERATION)





A-A' CROSS SECTION

Unit in mm



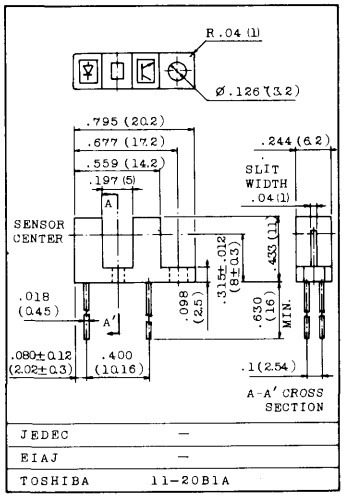
TLP850

INFRARED LED + PHOTO DARLINGTON TRANSISTOR

HIGH SENSITIVE OPTICAL SENSOR.

- 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)

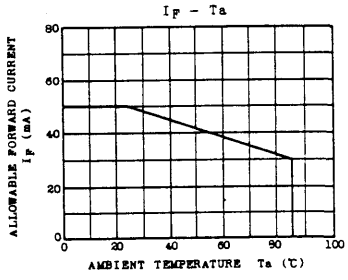


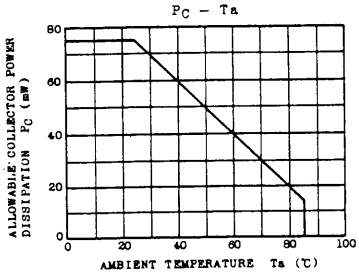
MAXIMUM RATINGS (Ta = 25°C)

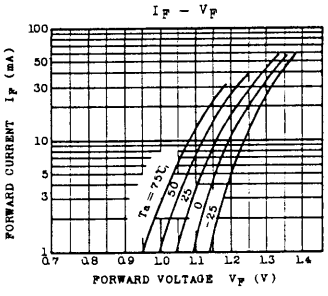
	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	50	mA
	Reverse Voltage	V_R	5	V
DETECTOR	Collector-Emitter Voltage	V_{CEO}	30	V
	Emitter-Collector Voltage	V_{ECO}	5	V
	Collector Power Dissipation	P_C	75	mW
	Collector Current	I_C	50	mA
Operating Temperature Range		T_{opr}	-25 ~ 85	°C
Storage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

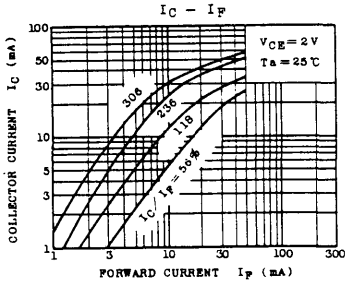
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

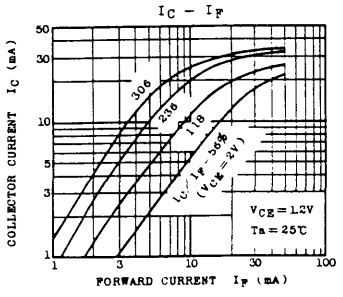
	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F=10mA	1.00	1.15	1.30	V
	Reverse Current	I_R	V_R=5V	-	-	10	μA
	Capacitance	C_T	V=0, f=1MHz	-	30	-	pF
DETECTOR	Dark Current	I_D (I_{CEO})	V_{CE}=16V, I_F=0	-	30	250	nA
	Capacitance	C_T	V=0, f=1MHz	-	7	-	pF
COUPLED	Current 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	-	200	-	μs
		t_f	R_L=100Ω	-	150	-	μs

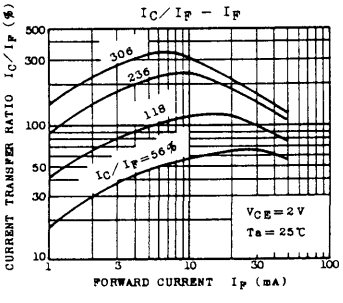


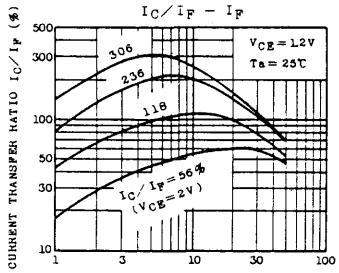


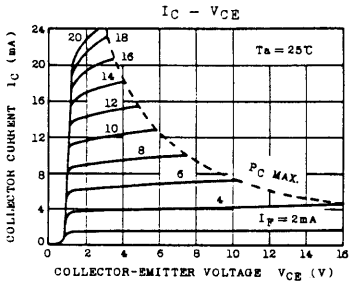


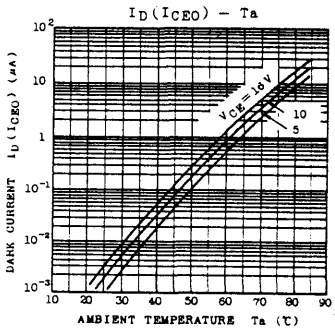


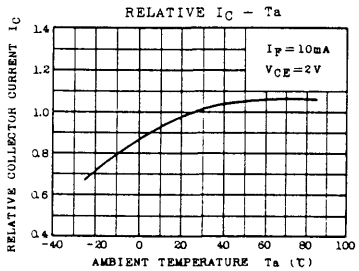


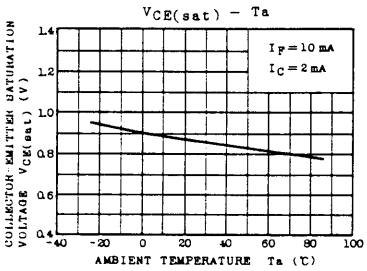


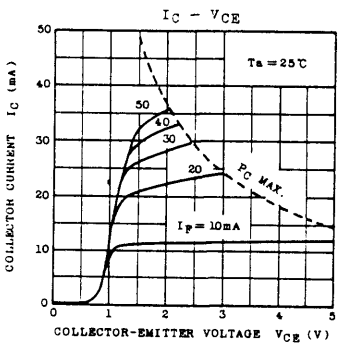


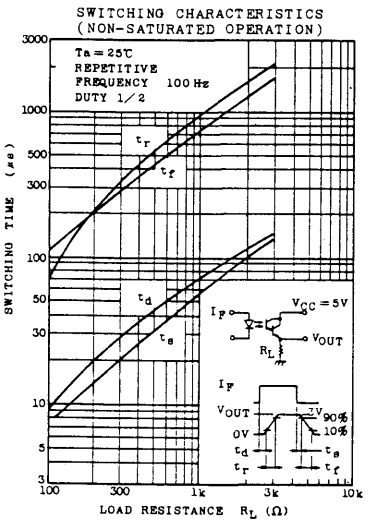


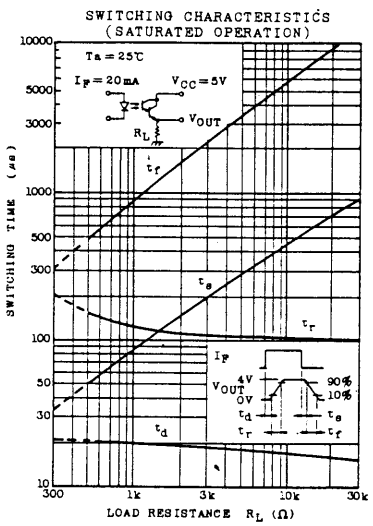


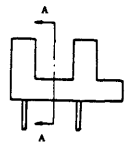




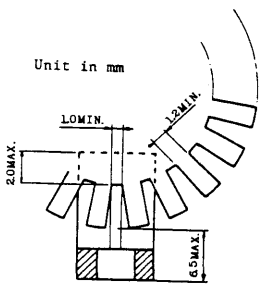


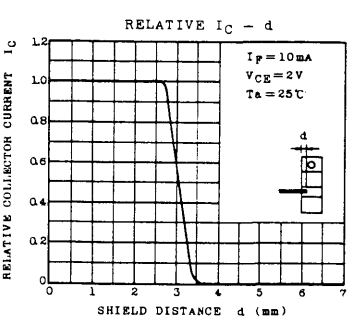


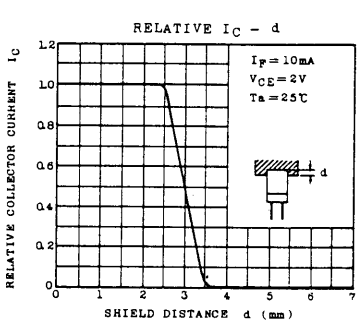


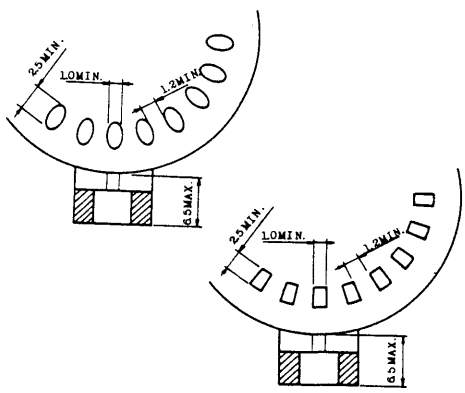


A-A' CROSS SECTION









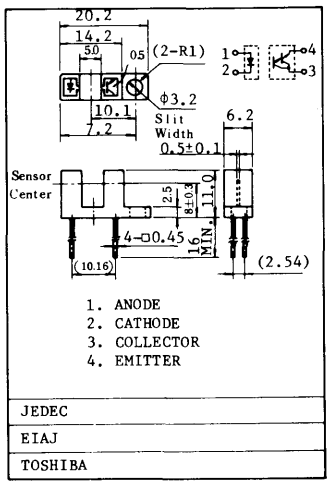
TLP851

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: mm



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

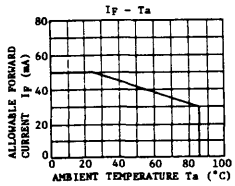
JEDEC
EIAJ
TOSHIBA

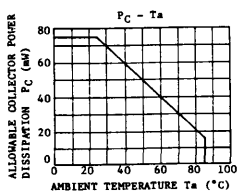
MAXIMUM RATINGS (Ta = 25°C)

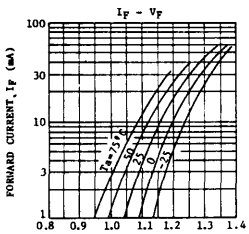
	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	50	mA
	Reverse Voltage	V_R	5	V
DETECTOR	Collector to Emitter Voltage	V_{CEO}	30	V
	Emitter to Collector Voltage	V_{ECO}	5	V
	Collector Power Dissipation	P_C	75	mW
	Collector Current	I_C	50	mA
Operating Temperature		T_{opr}	-25 ~ 85	°C
Storage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

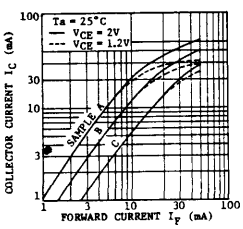
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

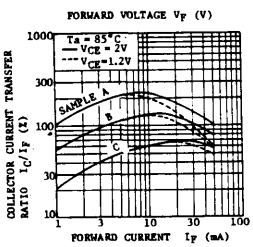
	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F = 10mA	1.00	1.15	1.30	V
	Reverse Current	I_R	V_R = 5V	-	-	10	μA
	Capacitance between Terminals	C_T	V = 0, f = 1MHz	-	30	-	pF
Detector	Dark Current	$I_D(I_{CEO})$	V_{CE} = 16V, I_F = 0	-	30	250	nA
	Capacitance between Terminals	C_T	V = 0, f = 1MHz	-	7	-	pF
Coupled	Current Transfer Ratio	I_C / I_F	V_{CE} = 2V; I_F = 10mA	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

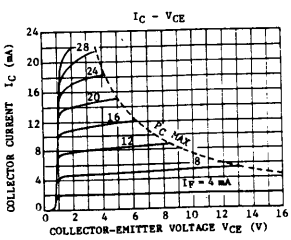


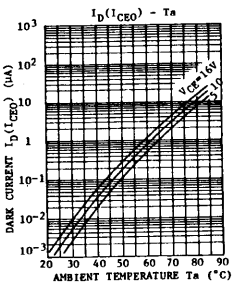


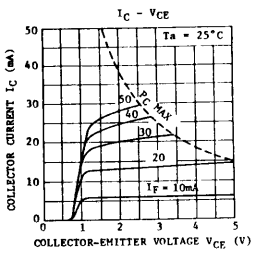




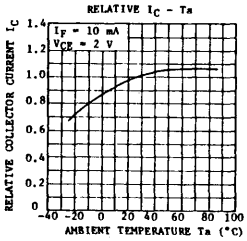




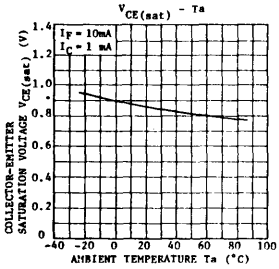




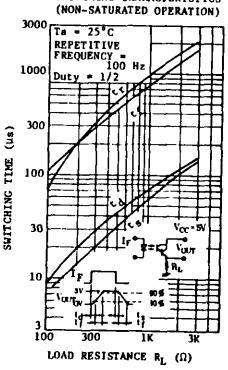
RELATIVE I_C - Ta



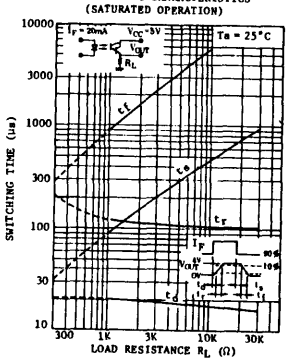
$V_{CE(sat)}$ - Ta



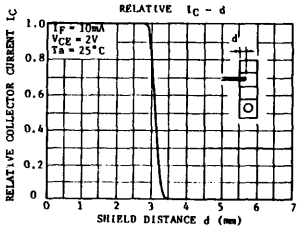
SWITCHING CHARACTERISTICS (NON-SATURATED OPERATION)



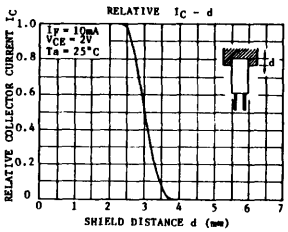
SWITCHING CHARACTERISTICS (SATURATED OPERATION)

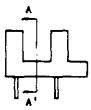


RELATIVE I_C - d



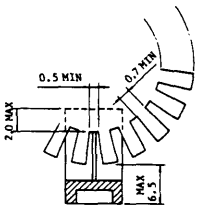
RELATIVE I_C - d

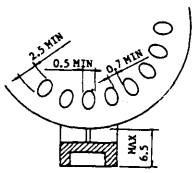


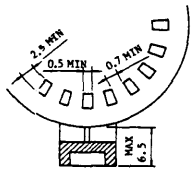


A-A' CROSS SECTION

Unit in mm





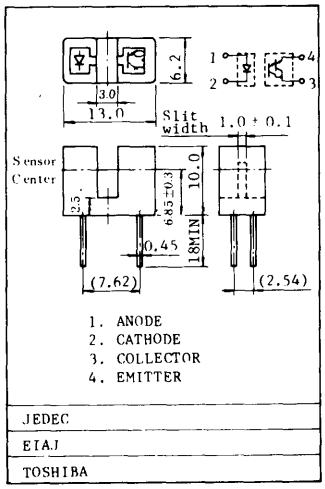


TLP852

INFRARED LED + PHOTO DARLINGTON TRANSISTOR

- 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: mm



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

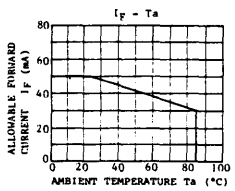
JEDEC	
EIAJ	
TOSHIBA	

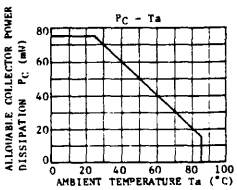
MAXIMUM RATINGS (Ta = 25°C)

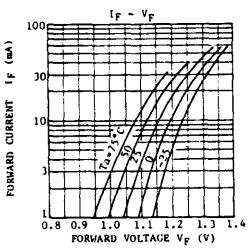
	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	50	mA
	Reverse Voltage	V_R	5	V
DETECTOR	Collector to Emitter Voltage	V_{CEO}	30	V
	Emitter to Collector Voltage	V_{ECO}	5	V
	Collector Power Dissipation	P_C	75	mW
	Collector Current	I_C	50	mA
Operating Temperature		T_{opr}	-25 ~ 85	°C
Storage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

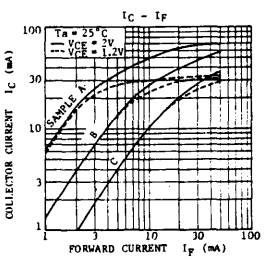
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

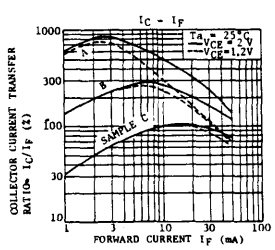
	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F = 10mA	1.00	1.15	1.30	V
	Reverse Current	I_R	V_R = 5V	-	-	10	μA
	Capacitance between Terminals	C_T	V = 0, f = 1MHz	-	30	-	pF
Detector	Dark Current	$I_D(I_{CEO})$	V_{CE} = 16V, I_F = 0	-	30	250	nA
	Capacitance between 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, R_L = 100Ω	-	200	-	μs
	Fall Time	t_f		-	150	-	μs

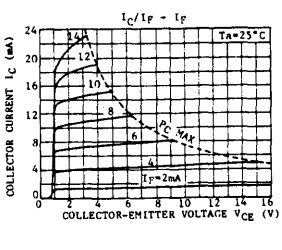


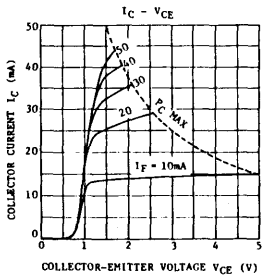


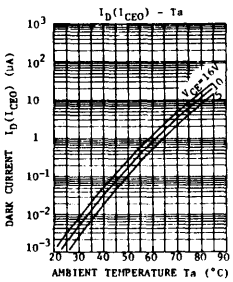


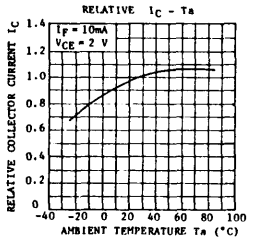


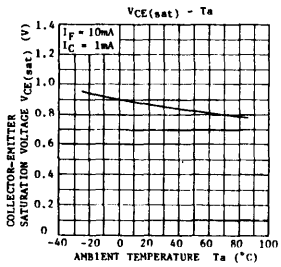


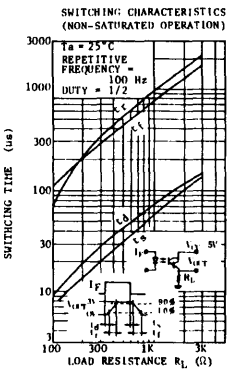


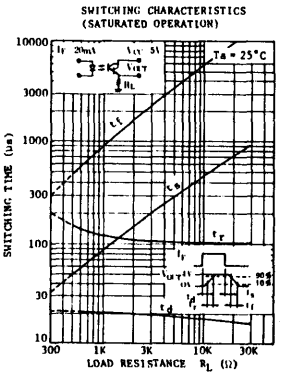


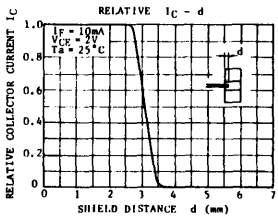


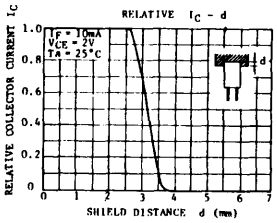


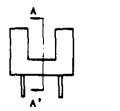




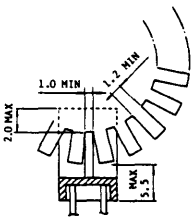




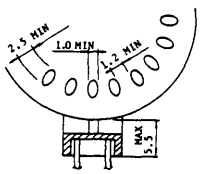


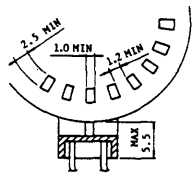


A-A' CROSS SECTION



Unit in mm





TLP903

INFRARED LED + PHOTO DARLINGTON TRANSISTOR

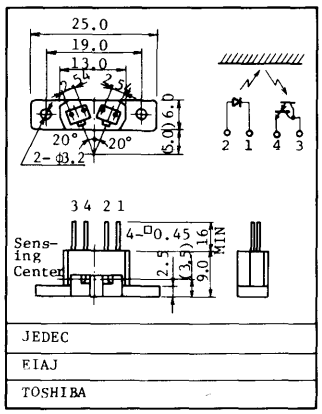
TENTATIVE

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	

MAXIMUM RATINGS (Ta = 25°C)

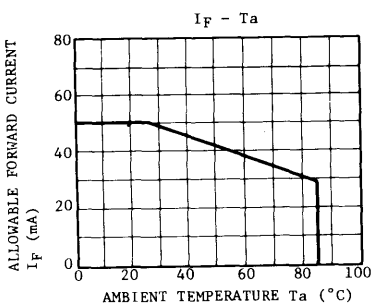
	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	50	mA
	Pulse Forward Current (Note 1)	I_{FP}	600	mA
	Reverse Voltage	V_R	5	V
DETECTOR	Collector-Emitter Voltage	V_{CEO}	30	V
	Emitter-Collector Voltage	V_{ECO}	5	V
	Collector Current	I_C	50	mA
	Collector Power Dissipation	P_C	75	mW
Operating Temperature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

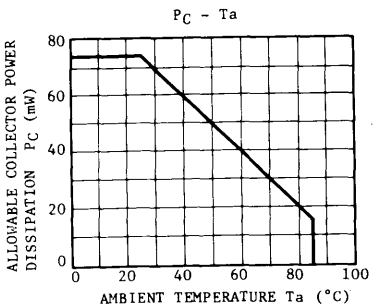
Note 1: Pulse width ≤ 100 μs, Repetitive frequency = 100 Hz

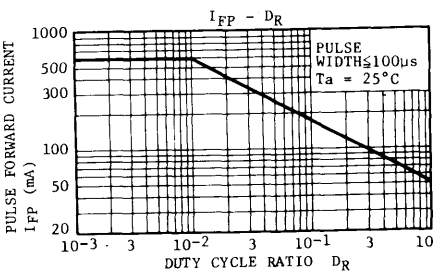
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

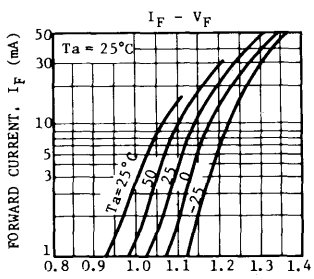
	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F = 10mA	-	1.15	1.30	V
	Reverse Current	I_R	V_R = 5V	-	-	10	μA
	Terminal Between Capacitance	C_T	V = 0, f = 1MHz	-	30	-	PF
DETECTOR	Dark Current	$I_D(I_{CEO})$	V_{CE}=16V, I_F=0	-	30	250	nA
COUPLED	Collector Current (Note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

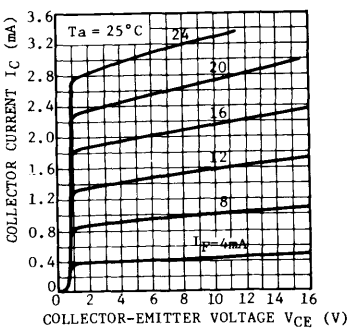
Note 2: Reflective Efficiency 90 % White Paper, Detective Distance 5 mm

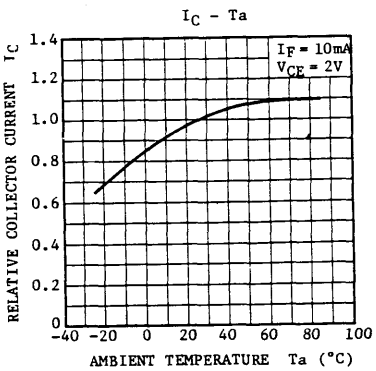




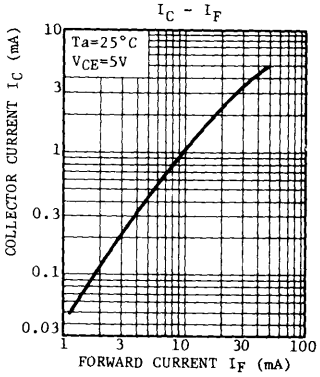




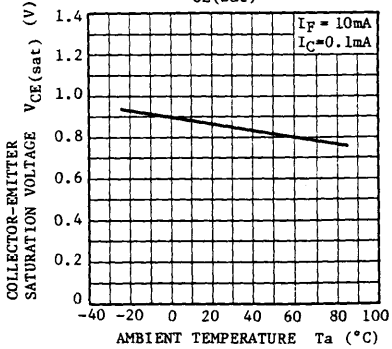




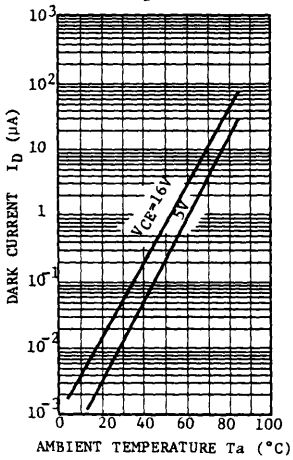
$I_C - I_F$



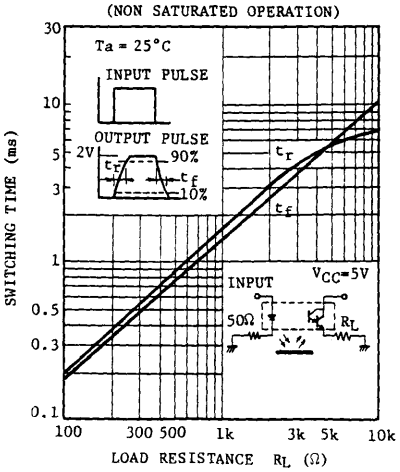
$V_{CE(sat)}$ - Ta



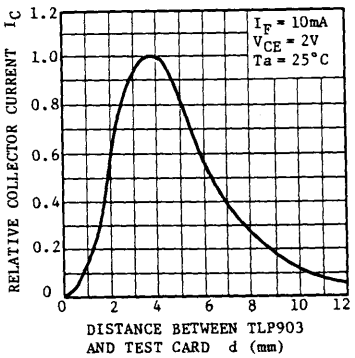
I_D - Ta



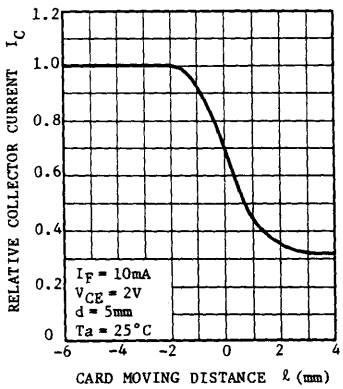
SWITCHING CHARACTERISTICS
(NON SATURATED OPERATION)



RELATIVE COLLECTOR CURRENT -
DISTANCE BETWEEN TLP903 AND CARD

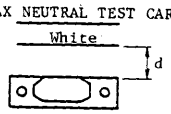


RELATIVE COLLECTOR CURRENT -
CARD MOVING DISTANCE

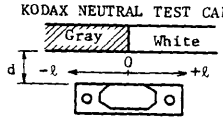


(TEST CONDITION)

KODAX NEUTRAL TEST CARD



KODAX NEUTRAL TEST CARD



White Paper: Reflective Efficiency
90 %
Gray Paper : Reflective Efficiency
18%

TLP904

INFRARED LED + PHOTO TRANSISTOR

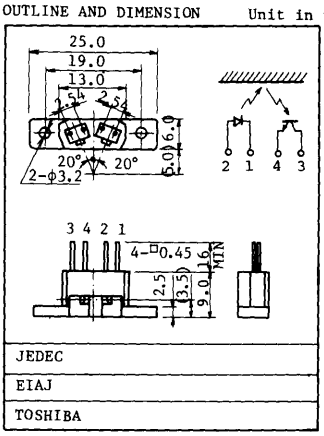
TENTATIVE

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

MAXIMUM RATINGS (Ta = 25°C)

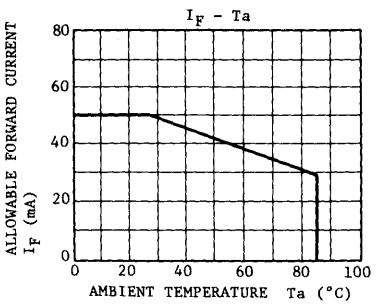
	CHARACTERISTIC	SYMBOL	RATING	UNIT
LED	Forward Current	I_F	50	mA
	Pulse Forward Current (Note 1)	I_{FP}	600	mA
	Reverse Voltage	V_R	5	V
DETECTOR	Collector-Emitter Voltage	V_{CEO}	30	V
	Emitter-Collector Voltage	V_{ECO}	5	V
	Collector Current	I_C	50	mA
	Collector Power Dissipation	P_C	75	mW
Operating Temperature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

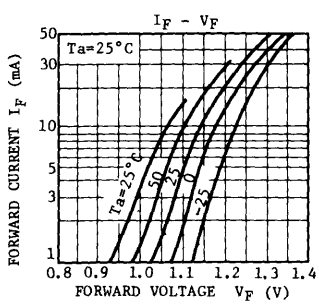
Note 1: Pulse width ≤100 μs, Repetitive frequency = 100 Hz

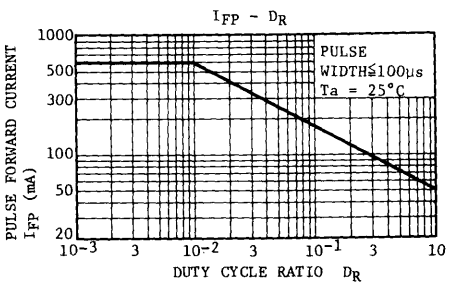
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

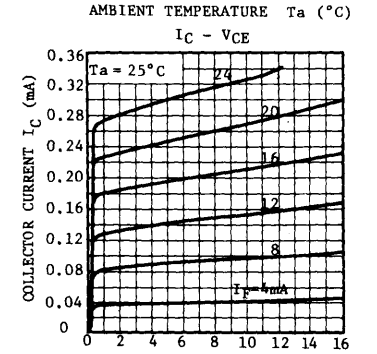
	CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage	V_F	I_F = 10mA	-	1.15	1.30	V
	Reverse Current	I_R	V_R = 5V	-	-	10	μA
	Terminal Between Capacitance	C_T	V = 0, f = 1MHz	-	30	-	pF
DETECTOR	Dark Current	$I_D(I_{CEO})$	V_{CE}=24V, I_F=0	-	5	100	nA
COUPLED	Collector Current (Note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

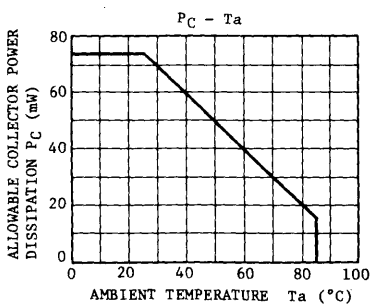
Note 2: Reflective Efficiency 90 % White Paper, Detective Distance 5 mm

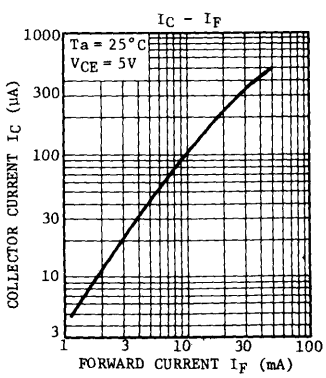




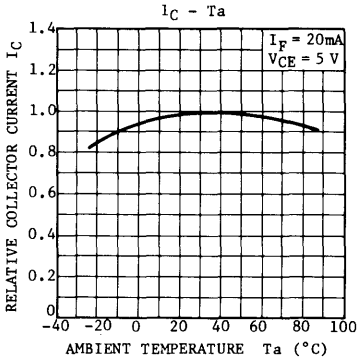




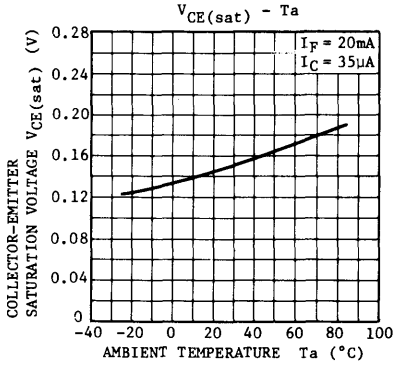




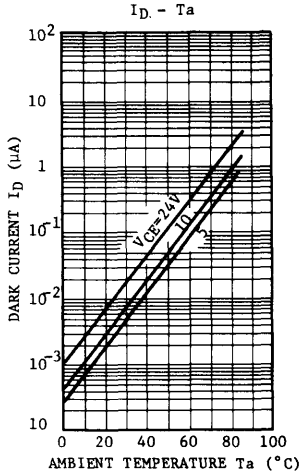
I_C - Ta



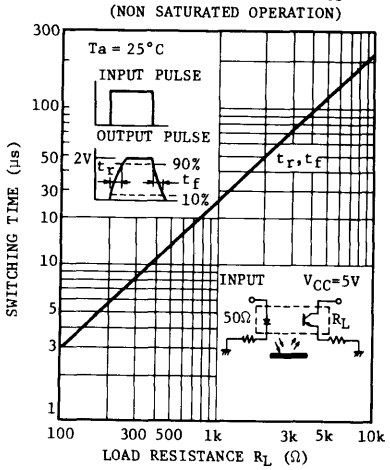
$V_{CE(sat)}$ - Ta



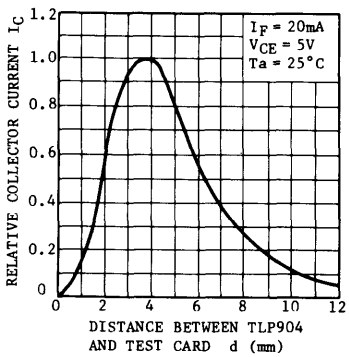
I_D - Ta



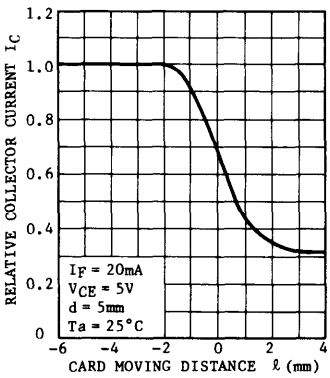
SWITCHING CHARACTERISTICS
(NON SATURATED OPERATION)

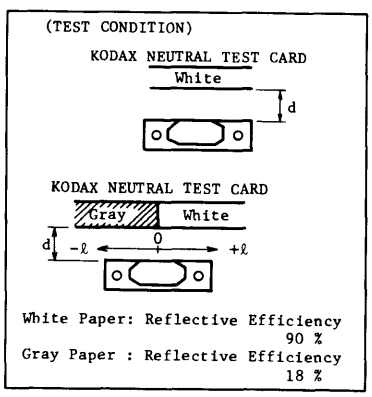


RELATIVE COLLECTOR CURRENT -
DISTANCE BETWEEN TLP904 AND CARD



RELATIVE COLLECTOR CURRENT -
CARD MOVING DISTANCE





TLP1000

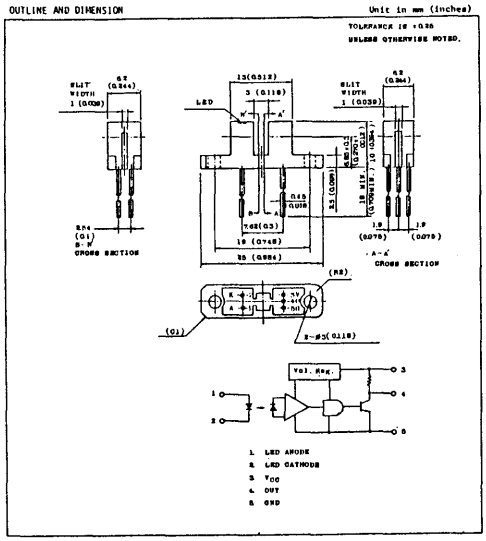
INFRARED LED + PHOTO IC

TLP1000 contains a gallium arsenide infrared emitting diode coupled to a monolithic integrated circuit, which incorporates a photodiode, a linear amplifier and a Schmitt trigger on a single silicon chip.

- OPTICAL SWITCH
- SHAFT POSITION AND VELOCITY SENSOR
- TTL, LSTTL compatible
- Wide Supply Voltage (V_{CC}=4.5 ∿16V)
- Non Sensitivity for Visible Light
- High Speed (ton3 μs, t_{off} 5μs typ.)
- Output Terminal contains a high voltage limiting diode.

OUTLINE AND DIMENSION

Unit in mm (inches)



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	-0.67	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, 3sec	

RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}	4.5	5	NOTE	V
Forward Current	I_F	11	13	15	mA
Operating Temperature	T_{opr}	0	-	70	°C

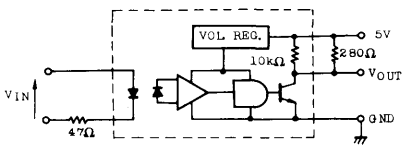
NOTE: Limited by Total output Power Dissipation.

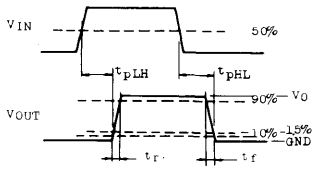
ELECTRICAL CHARACTERISTICS

(Over recommended temperature Ta=0∿ 70°C unless otherwise noted.)

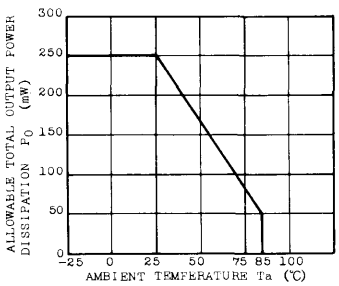
	CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage		V_F	I_F=8mA	-	1.15	1.4	V
	Reverse Current		I_R	V_R=5V, Ta=25°C	-	-	10	μA
	Capacitance		C_T	V=0, f=1MHz, Ta=25°C	-	30	-	pF
DETECTOR	Supply Voltage		V_{CC}	Ta=25°C	4.5	-	16	V
	Low Level Supply Current		I_{CCL}	V_{CC}=5V, I_F=0	-	6	15	mA
	High Level Supply Current		I_{CCH}	V_{CC}=5V, I_F=8mA	-	4	10	mA
	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}	V_{CC}=5V, I_F=8mA	4.0	-	-	V
COUPLED	'H→L' LED Threshold Current		I_{FLH}	V_{CC}=5V, Ta=25°C	-	2	5	mA
				V_{CC}=5V	-	-	8	mA
	Hysteresis Ratio		I_{FHL}/I_{FLH}	V_{CC}=5V	-	0.9	-	
	Propagation Delay (NOTE)	L→H	t_{PLH}	Ta=25°C	-	3	-	μS
		H→L	t_{PHL}	V_{CC}=5V, I_F=0↔8mA	-	5	-	
	Rise Time (NOTE)		t_r	R_L=280Ω	-	0.1	-	
	Fall Time (NOTE)		t_f	(NOTE)	-	0.05	-	

NOTE: Switching Time, Test Circuit and Voltage Waveform

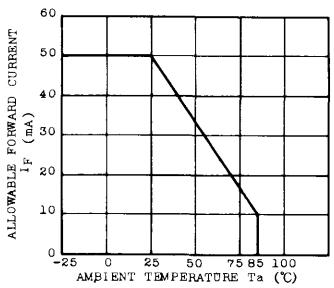




P_O – Ta



I_F – Ta



TLP1001

INFRARED LED + PHOTO IC

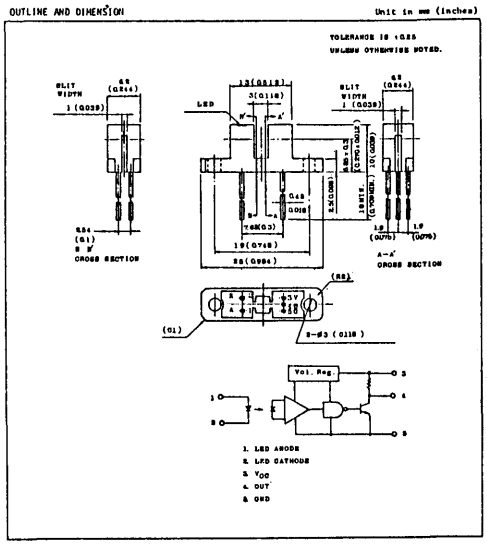
TENTATIVE

TLP1001 contains a gallium arsenide infrared emitting diode coupled to a monolithic integrated circuit, which incorporates a photodiode, a linear amplifier and a Schmitt trigger on a single silicon chip.

- OPTICAL SWITCH
- SHAFT POSITION AND VELOCITY SENSOR
- TTL, LSTTL compatible
- Wide Supply Voltage (V_{CC}=4.5 ∿16V)
- Non Sensitivity for Visible Light
- High Speed (ton 8μs, t_{off} 5μs Typ.)
- Output Terminal contains a high voltage's limiting diode.

OUTLINE AND DIMENSION

Unit in mm (inches)



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	-0.67	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		Tstg	-40 ∿ 100	°C
Soldering Temp. and Time		Tsol	260°C, 3sec	

RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}	4.5	5	NOTE	V
Forward Current	I_F	11	13	15	mA
Operating Temperature	T_{opr}	0	-	70	°C

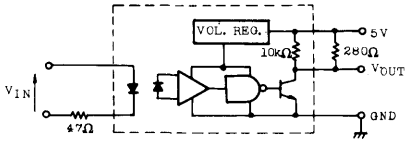
NOTE: Limited by Total Output Power Dissipation.

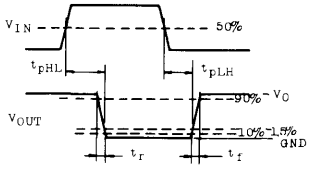
ELECTRICAL CHARACTERISTICS

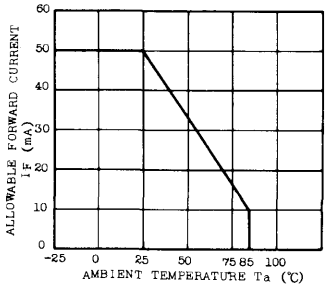
(Over recommended temperature Ta=0 ∿ 70°C unless otherwise noted.)

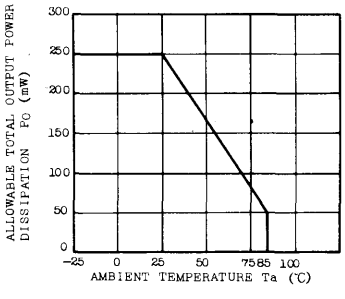
	CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LED	Forward Voltage		V_F	I_F=8mA	-	1.15	1.4	V
	Reverse Current		I_R	V_R=5V, Ta=25°C	-	-	10	μA
	Capacitance		C_T	V=0, f=1MHz, Ta=25°C	-	30	-	pF
DETECTOR	Supply Voltage		V_{CC}	Ta=25°C	4.5	-	16	V
	Low Level Supply Current		I_{CCL}	V_{CC}=5V, I_F=8mA	-	6	15	mA
	High Level Supply Current		I_{CCH}	V_{CC}=5V, I_F=0	-	7	20	mA
	Low Level Output Voltage		V_{OL}	I_{OL}=16mA, V_{CC}=5V, I_F=8mA	-	0.15	0.4	V
	High Level Output Voltage		V_{OH}	V_{CC}=5V, I_F=0	4.0	-	-	V
COUPLED	'H→L' LED Threshold Current		I_{FHL}	V_{CC}=5V, Ta=25°C	-	2	5	mA
				V_{CC}=5V	-	-	8	
	Hysteresis Ratio		I_{FLH}/I_{FHL}	V_{CC}=5V	-	0.9	-	
	Propagation Delay (NOTE)	L→H	t_{PLH}	Ta=25°C	-	8	-	μs
		H→L	t_{PHL}	V_{CC}=5V, I_F=0↔8mA	-	5	-	
	Rise Time (NOTE)		t_r	R_L=280Ω	-	0.1	-	
	Fall Time (NOTE)		t_f	(NOTE)	-	0.05	-	

NOTE: Switching Time Test circuit and Voltage Waveform.









2. APPLICATION NOTE

2-1. LED LAMPS AND LED DISPLAYS

2-2. OPTO ISOLATORS (PHOTO COUPLERS)

2-3. OPTO SENSORS

2-1-1 General

The Light Emitting Diode (LED) is basically a forward-biased P-N junction semiconductor devices exhibiting injection luminescence.

LED chip materials are combinations of elements from the III and V columns of the periodic chart. The P-N junction of the diode is formed by either epitaxially growing or by diffusing the junction. Frequently, the light producing material is different from the substrate material. Typical materials used for the most common colors of LEDs are listed in Table 2-1.

Wavelength	Light-emitting color	Material and structure of LEDs	Production method
700	red	GaP: Zn-O/Gap	LPE
660	red	$GaAl_{0.35}As/GaAs$	LPE
630	red	$GaAs_{0.35}P_{0.65}$: N/GaP	VPE + diffusion
610	orange	$GaAs_{0.25}P_{0.75}$: N/GaP	VPE + diffusion
590	yellow	$GaAs_{0.15}P_{0.85}$: N/GaP	VPE + diffusion
565	green	GaP: N/GaP	LPE
555	green	GaP/GaP	LPE

LPE: liquid-phase epitaxial growth method
VPE: vapor-phase epitaxial growth method

Table 2-1: Main materials used for LEDs

The relative eye response for various III-V materials is compared in Fig. 2-1. Green and yellow have much higher eye sensitivity than orange or red. Blue, at 400nm, has a low eye sensitivity.

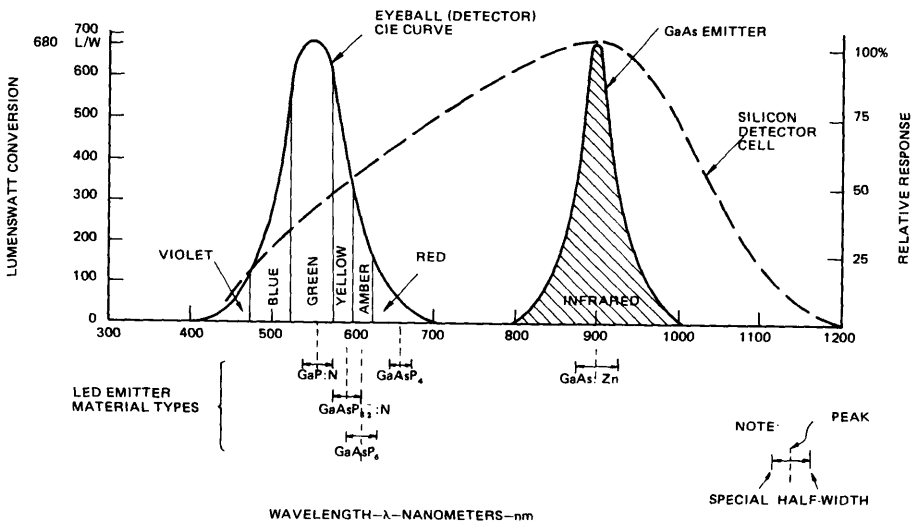


Fig. 2-1: The relative eye response for various III-V materials

(a) LED Lamps

LED lamps have obvious advantages over conventional tungsten lamps or other types the main advantages being ruggedness freedom from catastrophic failure and low-voltage operation.

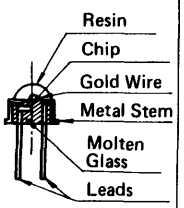
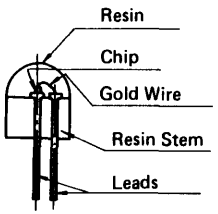
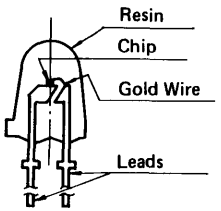
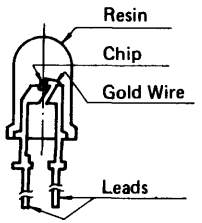
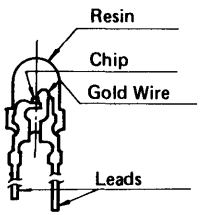
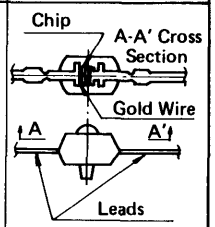
The kinds and structures of LED lamps are shown in Table 2-2 , and outline of their manufacturing process is shown in Fig. 2-2.

The lamp is manufactured by encapsulating the chip in a plastic package which is provided with a lens surface above the LED.

The purpose is reduce Fresnel loss and maximize the light output by increasing the critical angle. In order to get high output power the lens is applicable to encapsulation in undiffused plastic. The resulting luminous flux has a narrow radiation pattern.

When a very wide, off-axis viewing angle is needed, the LED emission is dispersed using a diffusant added to plastic.

Table 2 - 2 : Structure of LED Lamps

		Metal Stem Type	Resin Stem Type	All Plastic Mold Type								Molding
				Casting								
				Short Type		Long Type		MiniType				Submini Type
Structure											
Visible LED Lamp Type No.	Red	TLR101	TLR102A TLR108A TLR109A	TLR143 TLR144 TLR145 TLR146 TLR147 TLR140		TLR113A TLR114A TLR115A TLR110A TLR120A TLS153 TLS154 TLUR153 TLUR154	Special Shape Package TLR205 TLR206 TLR207 TLR208	TLR123 TLR124 TLS163 TLS163 TLS164 TLUR163 TLUR164	Special Shape Package TLR226 TLR209 TLR210 TLR211	TLR121 TLR122	
	Green		TLG102A TLG108A	TLG143 TLG144 TLG145 TLG147		TLG113A TLG114A TLG115A TLG153 TLG154 TLUG153 TLUG154	TLG205 TLG206 TLG207 TLG208	TLG123A TLG124A TLG163 TLG164 TLUG163 TLUG164	TLG226 TLG209 TLG210 TLG211	TLG121 TLG122	
	Yellow		TLY102A TLY108A	TLY143 TLY144 TLY147		TLY113A TLY114A TLY153 TLY154 TLUY153 TLUY154	TLY205 TLY206 TLY207 TLY208	TLY123 TLY124 TLY163 TLY164 TLUY163 TLUY164	TLY226 TLY209 TLY210 TLY211		
	Orange		TLO102A			TLO113A TLO114A TLO153 TLO154		TLO123 TLO124 TLO163 TLO164			
	Red/ Green		TLRG101(Tri-Lead) * Ceramic Stem								

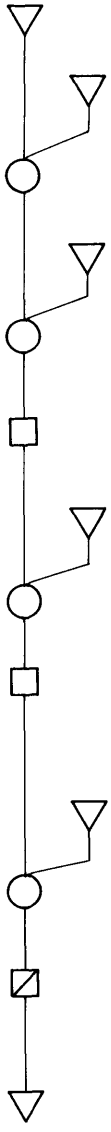
Manufacturing Process		Check Item
Flow Chart	Process	
	Chip	
	Stem	
	Mounting	
	Bonding Wire	
	Bonding	Temperature, Pressure
	Inspection of Appearance	Mounting, Bonding Strength
	Resin	
	Casting	Temperature, Time
	Inspection	Electrical Characteristics, Appearances, Optical Appearances
	Packing Material	
	Packing	
	Lot Confirmation Inspection	Electrical Characteristics, Appearances, Optical Appearances, Life Test
	Shipment	

Fig. 2-2: Manufacturing Process Flow Chart of LED Lamps

The industry standards for LED lamps are Metal stem, Resin stem and All plastic mold types. The features of each type are described as follows.

① Metal Stem Type

This LED lamp, has anode and cathode leads fixed to the metal stem with molten glass. It has a higher heat resistant temperature in soldering leads, than all the plastic mold types described later, and needs no special precaution for the soldering.
The N side electrode of a LED chip is mounted on the top of the cathode lead, while the P side electrode is connected to the anode lead by the gold wire. (Bonding)
The epoxy resin which contains dyestuff and light diffuser is put on the stem (Potting) and then the packages are formed by using the surface tension of molten resin.

② Resin Stem Type (FRS Type)

The anode and cathode leads are fixed by the rugged epoxy resin stem, so the heat resistant temperature of this type is the same as that of the metal stem type. For mounting and bonding of LED chips, the formation of packages are done in the same manner as the metal stem type.

③ All Plastic Mold Type

The packages of the above two types are formed in resin potting, while those of their type are formed by the casting method and the transfer molding method.

Casting Type

The lead frame on which the LED chip has been attached is inserted into the hard plastic case. Epoxy resin is poured into it and becomes a solid state after heating.

Transfer Molding Type

The lead frame on which the LED chip has been attached is inserted into the metal mold. The packages are formed by thermosetting resin at high temperature.

(b) LED Displays

LED displays offer more display colors and operate at higher temperatures than other display devices (example; liquid crystal, gas discharge/plasma, vacuum fluorescent, etc.) and are found in a large variety of end-use equipment.

Among the latter are watches, calculators, appliances, instruments, point-of-sale devices and channel indicators for television sets and audio equipments.
Main advantages are driving ease, moderate power requirements and low cost.
Concerning their structure, LED displays are devided into two types.
They are monolithic type and hybrid type. Monolithic LED displays are used almost exclusively for the smallest characters, from 0.1 to 0.3 inches in height, for applications such as watches, calculators and cameras. The structure of typical monolityic segmented LED is shown in Fig. 2-3.
They are constructed by diffusing several LED junctions in a single GaAsP die.

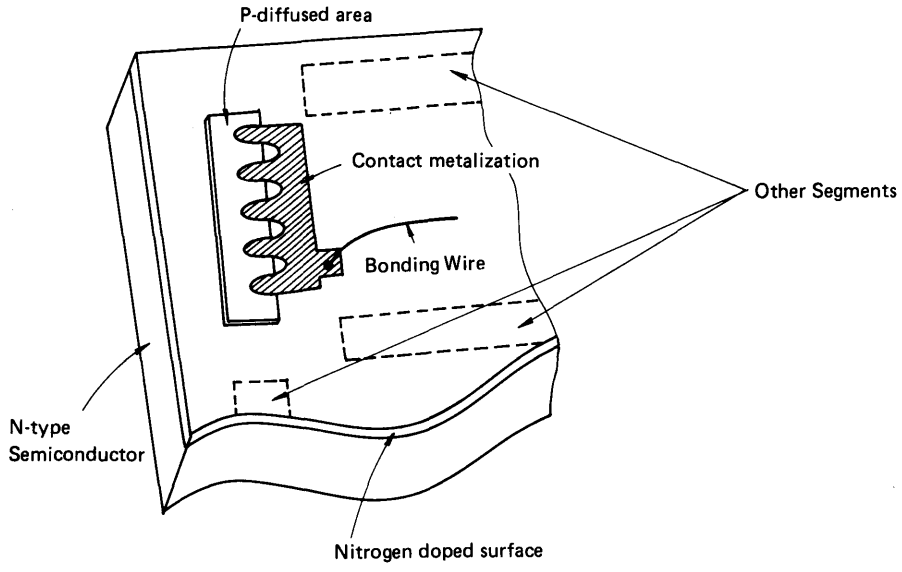


Fig. 2-3: Monolithic segmented LED

More economical to manufacture, hybrid type is becoming increasingly popular.

Our LED display has a hybrid structure. The kinds and structures of LED displays are shown in table 2-3, and the outline of the manufacturing process is illustrated in Fig. 2-4. The features of each type are described as follows.

① **Case Sealing Type**

The LED chip is attached to the stem (Mounting, Bonding). The reflector and light diffusing film are placed on it, and then it is all packed in the package (case) and sealed with resin. This package also has the role of giving contract to the display.

② **Film Type**

As illustrated in the structure diagram in Table 2-3, this type is composed of stem, reflector, and film. Under operating conditions, this type has the same optical quality as the case sealing type, because this film plays the role of case and light diffusing film.

③ **Casting Type**

Light pipe technology for segmented LEDs, as illustrated in Table 2 - 3 , is the most satisfactory type of large segmented LED display. The light pipes consist of a transparent plastic material containing diffusion particles.

Features of LED Lamps and Displays

The features of LED lamps and displays become clear by comparison with tungsten filament incandescent lamps and discharge tubes in their light emitting mechanisms and structures.
On above reason, LED has following features.

① **Long Life-time**

The light emitting phenomenon makes use of the injection light emitting to the P-N junction instead of thermal radiation, therefore, LEDs are free of waste and wear and they can be expected to have a long life time.

② **Excellent Drive Characteristic**

The LEDs response time is very high (a few hundred nano-seconds) and the forward voltage and current at the practical luminour intensity are very low ($\simeq$2V, $\simeq$10mA), which makes it simpler to design the drive circuits.
By control of only the forward current, a suitable light output for the surrounding brightness can be obtained easily.

③ **Excellent mechanical strength and wide variety for Set Design.**

The packages of LEDs are made of resin, so they have excellent mechanical strength and can withstand dropping, vibration, shock and others.
The variety of the set design can be incorporated into the LED's package design, which can produce original devices.

Precautions when using LEDs

When using LEDs, in addition to the general attention as for normal semiconductors, the LEDs need special attention to be paid to them. The former refers to the ratings and characteristics and the latter to the characteristics of resin used as the package.
The following describes the precautions to be taken when using LED lamps and displays.

① **Soldering**

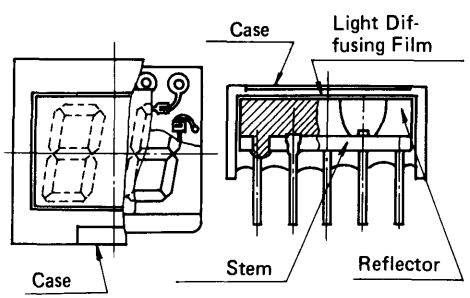
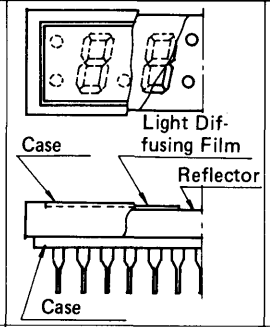
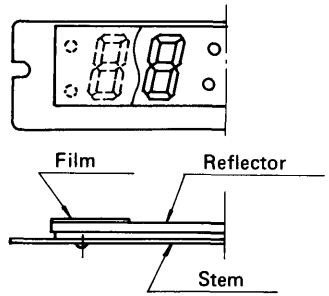
The softening temperature of the resin of which the LED's packages are made is generally low; less than about 100°C. This limits the soldering temperature and time, which are shown in Table 2-4.

② **Washing**

When the devices are washed in the chemicals for removal of flux after soldering, the use of unsuitable chemicals results in the change in quality and color, and even cracks in the packages. The recommended chemicals for washing are shown in Table 2-5.

When the devices are ultrasonic-washed in these chemicals, use the ultrasonic-washing machine that has an output power of less than 300W; do not resonate the devices attached on the board; do not let the print circuit board and the device touch on the oscillator, and wash the devices as soon as possible (less than 30 seconds).

Table 2 - 3 : Structure of LED Displays

	Case Type			Film Type	Casting Type
	Sealing Type		Non-Sealing	Non-Sealing Type	Sealing Type
Structure					
Digit No.	One Digit	Two Digit	Four Digit	Four Digit	One/Two Digit
Red Color	Character Height 8.3 mm TLR312 ~ TLR315 Character Height 15 mm (0.6") TLR306 ~ TLG309	Character Height 7.6 mm (0.3") TLR322, TLR323 Character Height 10 mm (0.4") TLR320, TLR321 Character Height 12.7 mm (0.5") TLR324 ~ TLR327	Character Height 6.3 mm (0.25") TLR2130, TLR2140 Character Height 7.6 mm (0.3") TLR2110, TLR2120 TLR4115, TLR4125	Character Height 15 mm (0.6")* TLR2177, TLR4172 TLR2207, TLR4202 Character Height 23 mm (0.9")* TLR2057A, TLR4052A TLR2087A, TLR4082A * There are many types which have only different pin connections each other in the same structure.	Character Height 0.3" TLR332 ~ TLR335 Character Height 0.43" TLR342 ~ TLR345 Character Height 0.53" TLR358, TLR359 (1D) TLR328, TLR329 (2D)
Green Color	Character Height 8.3 mm TLG312A~TLG315A Character Height 12.7 mm (0.5") TLG352, TLG353	Character Height 10 mm (0.4") TLG320, TLG321 Character Height 12.7 mm (0.5") TLG324 ~ TLG327	Character Height 6.3 mm (0.25") TLG2130, TLG2140 TLG4135, TLG4145 Character Height 7.6 mm (0.3") TLG2110, TLG2120 TLG4115, TLG4125	Character Height 15 mm (0.6")* TLG2177, TLG4172 TLG2207, TLG4202 Character Height 23 mm (0.9")* TLG2057A, TLG4052A TLG2087A, TLG4082A * There are many types which have only different pin connections each other in the same structures.	Character Height 0.3" TLG332 ~ TLG335 Character Height 0.43" TLG342 ~ TLG345 Character Height 0.53" TLG358, TLG359 (1D) TLG328, TLG329 (2D)

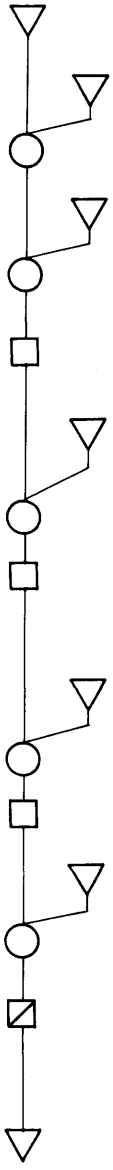
Manufacturing Process		Check Item
Flow Chart	Process	
	Chip	
	Stem	
	Mounting	
	Bonding Wire	
	Bonding	Temperature, Pressure
	Inspection of Appearances	Mounting, Bonding Strength
	Reflector, Light Diffusing Film, Case	
	Sealing	
	Inspection	Electrical Characteristics, Appearances, Optical Appearances
	Mark Ink	
	Marking	Temperature, Time
	Inspection	Appearances
	Packing Material	
	Packing	
	Lot Confirmation Inspection	Electrical Characteristics, Appearances, Optical Appearances Life Test
	Shipment	

Fig. 2 - 4 : Manufacturing Process Flow Chart of LED Displays

Table 2 - 4 : Precautions When Soldering
(Solder Temperature; 260°C, Dwell Time; less than 3 sec.)

Package \ Soldering conditions / Type No.		Soldering Part of Lead	Lead Forming Position
Metal Stem	TLR101	More than 2 mm from the body of the device.	Form the lead at the point more than 2 mm from the body of the device.
Epoxy Resin Stem	TLR102A, 108A, 109A TLG102A, 108A TLY102A, 108A TLO102A, *TLRG101 (*Ceramic Stem)		
All Plastic Mold	TLR143 ~ 147, 140 TLG143 ~ 145, 147 TLY143, 144, 147 TLS153, 154 TLUR153, 154 TLG153, 154 TLUG153, 154 TLY153, 154 TLUY153, 154 TLφ153, 154		
	TLR113A ~ 116A, 120A TLG113A, 114A, 115A TLY113A, 114A TLO113A, 114A	More than 2.5 mm from the body of the device.	Form the lead at the point more than 2.5 mm from the body of the device.
	TLR205 ~ 208 TLG205 ~ 208 TLY205 ~ 208		
	TLS163, 164 TLUR163, 164 TLG163, 164 TLUG163, 164 TLY163, 164 TLUY163, 164 TLP163, 164 TLR123, 124 TLG123A, 124A TLY123, 124 TLO123, 124	More than 2 mm from the body of the device.	Form the lead at the point more than 5 mm from the body of the device.
	TLR209, 210 TLR211, 226 TLG209, 210 TLG211, 226 TLY209, 210 TLY211, 226		
	TLR121, 122 TLG121, 122		Form the lead at the point more than 0.8 mm from the body of the device.

Table 2 - 5 : Recommended Chemicals When Washing

(1) Visible LED Lamps

Type	Chemical
LED Lamps with Holder (TLR102KB. kW Types) Holder (MH5A, MA6A)	Freon TP Dai-Fron Solvent S3
All visible LED lamps except for the above	Chrlorothene, Freon TE or TF Dai-Fron Solvent S3 or S3-E

(2) LED Displays

Type	Chemical
All Sealing Case Type	Dai-Fron Solvent S3 or S3-E. Freon TE or TF Methyl Alcohol
Non-Sealing Case Type, Film Types and Casting Type	Avoid washing the display. Only the following chemicals can be used to wipe off the stain on the display. Dai-Fron Solvent S3 or S3-E. Freon TE or TF Methyl Alcohol

2-1-2 LED lamp application

In this paragraph, the basic drive methods of LED lamp are described. We hope that they will be helpful to your correct user of LED lamp.

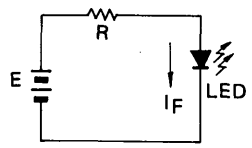
(a) Current limiting by resistors

At using LED lamps, the precaution that the LED elements do not have current control function should be paied. Therefore, the utilization of constant-voltage power supply requires limiting elements. (resistors)

In other words, LED is current-dependent device since it is basically diode. Then, basic drive methods are introduced as following.

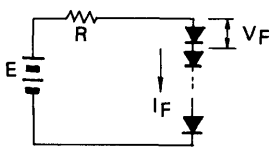
DC Drive Techniques

Fig. 2-5(a) to (c) show basic circuit examples for the DC drive.



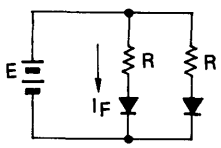
$$I_F = \frac{E - V_F}{R}$$

(a) DC basic circuit



$$I_F = \frac{E - n\,V_F}{R}$$

(b) n pcs LED's series connection



$$I_F = \frac{E - V_F}{R}$$

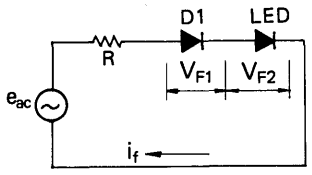
(c) LED's parallel connection

Fig. 2-5: Examples of DC drive circuit

Where, E is a supply DC voltage, V_F and I_F are the LED forward characteristics, and R is a current limiting resistor.

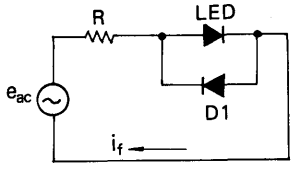
AC Drive Techniques

The precaution for the AC operation is that a reverse bias protective circuit is necessary for LED lamps. Because normally LEDs should be operated in the forward direction. Since the maximum reverse voltage of LED is about 3 to 5V, a protective diode circuit as shown in Fig. 2-6 (a) and (b) is usually used.



$$i_f = \frac{e_{ac} - (V_{F1} + V_{F2})}{R}$$

(a) Protective diode series connection



$$i_f = \frac{e_{ac} - V_{F2}}{R}$$

(b) Protective diode placed "back-to-back" connection

Fig. 2-6: AC drive circuit

Where e_{ac} ; AC supply voltage

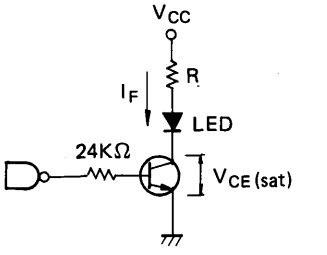
D1 ; protective diode

V_{F1} ; forward voltage of D1

V_{F2} ; forward voltage of LED

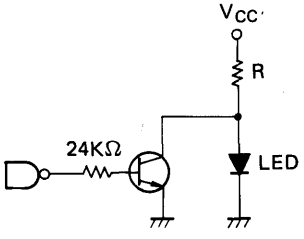
Drive method by IC

Fig. 2-7 gives LED drive method by C-MOS IC.



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

(a) Lamp lights on "H" level



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

(b) Lamp lights on "L" level

Fig. 2-7: Driving method by C-MOS IC

Where V_{CC} and V_{CE} (sat) represent a supply voltage and saturation voltage of LED driver respectively.
The low forward voltage of the LED makes the displays inherently IC compatible. If the large currents are required, TTL buffer will be effective as shown in Fig. 2-7.

(b) In this section the maximum ratings of LED lamp and pulse drive method are discussed. The absolute maximum ratings of LED have been determined theoretically and by extensive reliability test. Forward current, power dissipation, thermal resistance and LED junction temperature are all interrelated in establishing absolute maximum rating. Particularly at the maximum operation temperature the optimistic derating method should be taken.

The maximum forward current of LED is decided on the following conditions.

(1) The level of current density within LED junction that produces no more than acceptable amount of light output degredation.
(2) The amount of power dissipation generated by the forward current that maintains LED junction at an acceptable temperature level below the glass transition temperature, TG, of the encapsulating epoxy.

Therefore, the forward current should be derated so as to meet item (1) and (2) with a change of ambient temperature.

Forward current for pulsed drive

The pulsed drive is often used as a LED lamp drive method.
In this case, the maximum tolerable limits should not exceed the LED junction temperature above what would be obtained by operating the lamp at the maximum DC current.
This interreiationship is most easily obtained by establishing combinations of peak current and pulse with for various refresh rated, maintaining the maximum junction temperature at that value obtained by operating at the maximum DC current.
These data are plotted on a log-log scale to form the family of curves shown in Fig. 2-8.

The raising rate of junction temperature slightly depends on a transient thermal resistance, but usually the maximum peak current can be determined by using Fig. 2-8.

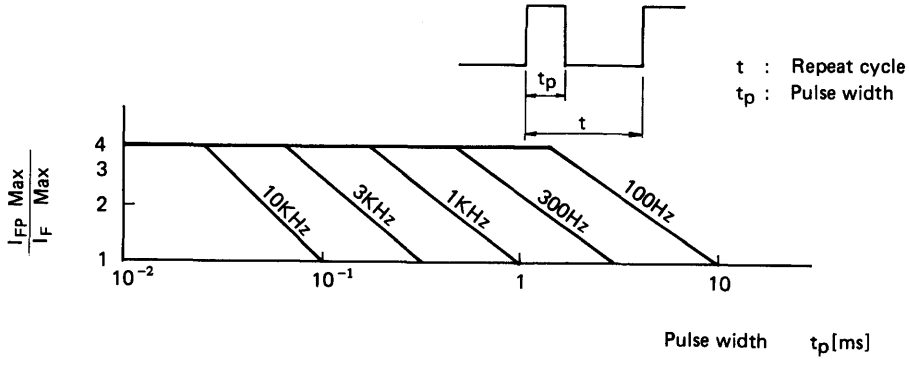
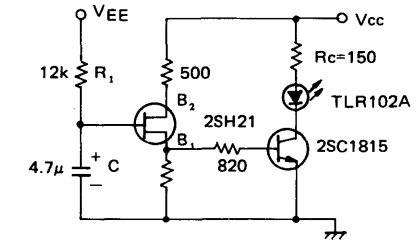


Fig. 2-8: Allowable ratio of I_{FP} Max to I_F Max

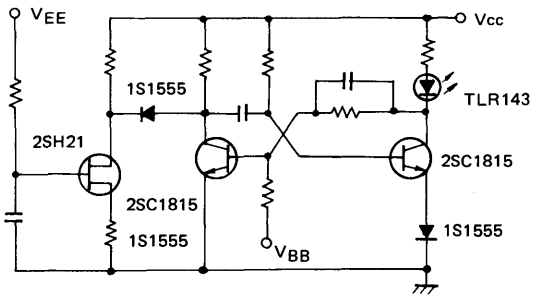
(c) Examples of LED lamp application

Application for alarm circuits



		NUMBER OF FLASHING	VOLTAGE	
			VEE(V)	Vcc(V)
Constant	Increase	Decrease	8	3 – 8
Increase	Constant	Increase	6 – 15	6

(a) Simple circuit



(b) Monostable multi-circuit

Fig. 2-9: Alarm circuits (The number of flashing varies with the voltage.)

Fig. 2-9 gives examples of alarm circuits in which the voltage level change expresses an alarm degree in terms of a gradual increase or decrease in number of LED flashing.

In circuit of Fig. 2-9(a), the relation between V_{EE} and V_{CC} permits variations in number of flashing with an increase in voltage. A monostable multi-drive circuit is used in order to increase the light output. This circuit is shown in Fig. 2-9(b).

Application for battery charging circuits

A charging circuit of Ni-Cd cell is shown in Fig. 2-10. The red LED TLR144 turns on during charging, while the green LED TLG144 turns on upon completion of charging.

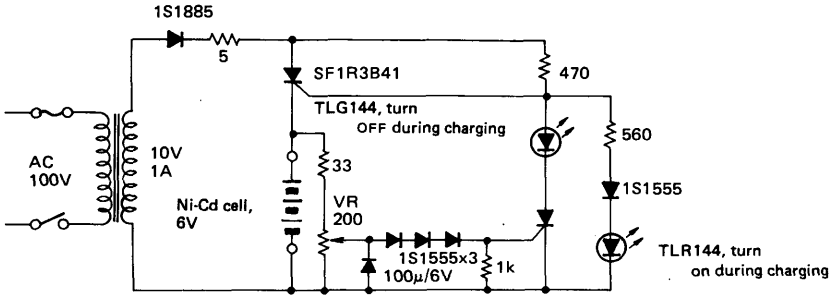


Fig. 2-10: Battery charging circuit

2-1-3 LED display application

(a) Applications of one digit and two digits LED displays

LED displays have various display functions such as not only 7-segments numerical display but also 16-segments alphabet/numerical display and bar point display which is an analog display with segments placed in a row.

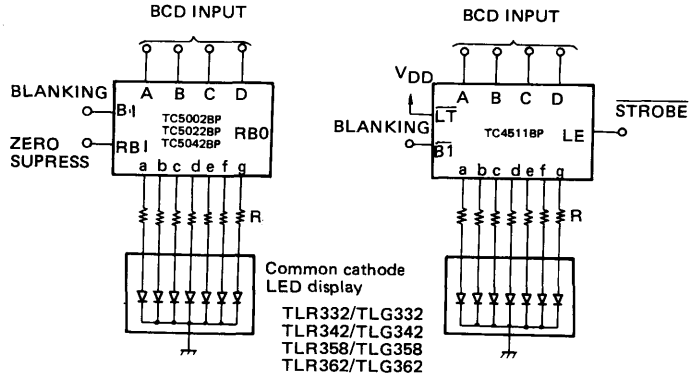
The LED display drive methods are divided into two types, static drive (DC drive and dynamic drive (pulse drive), and any number of decoders or drives are commercially produced for each connection of a common anode and cathode.

Static drive method

A static drive method for one digit numerical LED display is shown in Fig. 2-11. The figure (a) shows an example using TC5002BP (TC5022BP/T5042BP), which has a zero-suppress input for erasing a zero display. If zeros display is need, the zero-suppress input should be set on "L" level.

The figure (b) shows an example using TC4511BP. If the STROBE (latch-enable) is set on "L" level, TC4511BP will operate as decoder driver, while if set on "H" level, the BCD input is held in the internal latch and the display remains unaltered regardless of the change of BCD input.

For N-digits driving, N each of the circuit shown in Fig. 2-11 should be basically used, and TC5002BP (TC5022BP/TC5042BP) permits reading zero suppress with RB1 and RB0. The circuit example is shown in Fig. 2-12.



a) With zero supress function b) With latch

Fig. 2-11 Static drive circuit with a one-digit numerical display

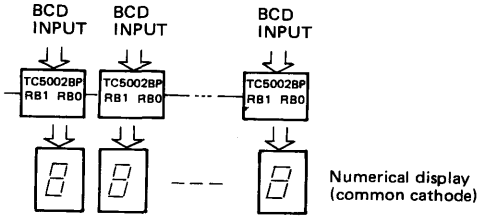


Fig. 2-12 Static drive circuit with N-digits numerical display (The N-digits reading zero suppress is driven with TC5002BP.)

Current limit resistor R, when a LED display is driven with TC5002BP or TC4511BP should be determined by the diagrams given in Fig. 2-13. The luminous intensity varies with a change in resistor R between the LED and driver IC.

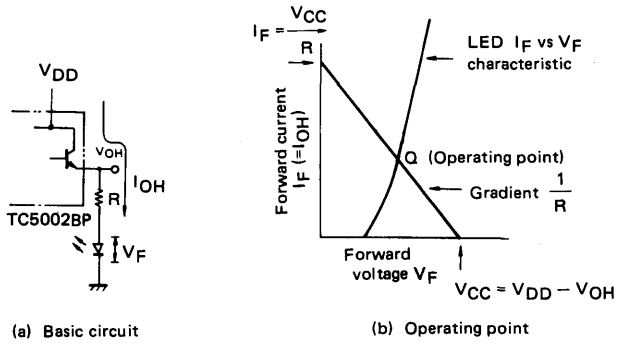


Fig. 2-13 Operating point of static drive circuit

The drive current should be controlled below the maximum current of IC and the maximum forward current of LED display. The R can be usually determined from the following equation:

$$R = \frac{V_{DD} - V_{OH} - V_F}{I_F \ (= I_{OH})}$$

To be easy to read, no-lighting segments should be invisible and only lighting segments should be clearly visible. This ratio is a contrast, and to get good ON/OFF contrast, an optical filter, mathing to its wavelength, should be placed before a LED display. However, a Toshiba's LED display has been provided with a case, which serves as a filter. And this case provides good ON/OFF contrast.

Toshiba's LED displays are classfied by their luminous intensity, for the multi-digit use. Therefore, the use of products in the same class of luminous intensity, will provide the better lighting appearance.

Multiplex drive method (pulse drive)

A multiplex drive method is used for timeshared of the decoder driver for the multi-digit LED driving. Fig. 2-14 shows a four-digit multiplex drive method with TC5002BP.

The diagram is made up of multiplexer enable signals DS1 to DS4 and the base input of digit driver TD62003P (Darlington transistor array) which correspond each other, one to one, multiplexing the four-digit BCD input using latch TC4508BP with the 3-STATE output.

In practical use, if, the code input is statically input as shown in the diagram, the multiplexer and driver decrease the multiplex drive merit. If the LSI output has multiplicity output or timeshared data are transferred to the bus line, it will provide a very effective drive method.

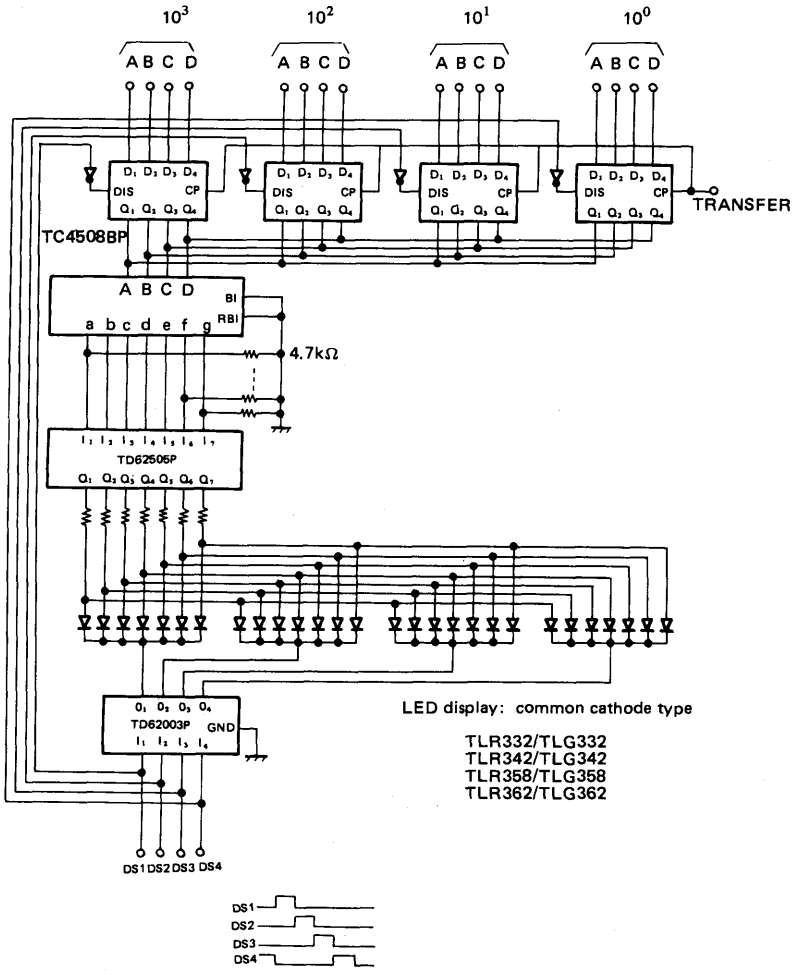


Fig. 2-14 Four-digit multiplex drive method

Fig. 2-15 shows a basic multiplex drive circuit.

Current I_{FP}/seg which flows through each LED segment may be determined by the following relation.

$$I_{FP/seg} = \frac{V_{CC} - V_{CE(sat)}1 - V_F - V_{CE(sat)}2}{R}$$

where V_{CC} : Supply voltage

$V_{CE(sat)}1$: Saturation voltage between collector and emitter of segment driver

V_F : Forward voltage of LED

$V_{CE(sat)}2$: Saturation voltage between collector and emitters of digit driver

R : Current limit resistor

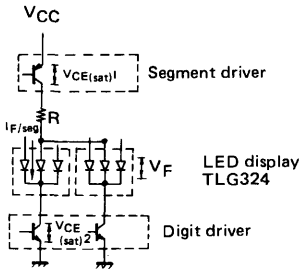


Fig. 2-15 Basic multiplex drive circuit

The $I_{FP/seg}$ should not exceed the maximum ratings of LED and driver.

Fig. 2-16 shows the luminous intensity characteristics under pulse drive. (TLG324)

For multiplex driving, peak forward current $I_{FP/seg}$ should increase with an increase in the number of digits in order to get the same luminance intensity. If the scanning speed is slow, the display will flicker and becomes worse lighting appearance.

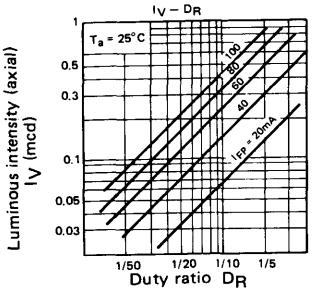


Fig. 2-16 Luminous intensity vs. pulse forward current characteristics of two-digit LED display (TLG324)

Example of a decimal counter application circuit by multiplex drive.

Fig. 2-17 shows a four-digits decimal counter circuit. The TC5001P is a four-digits decimal counter with a latch and a multi-plexer circuit and the LED displays are driven in multiplex method. The counter can express the maximum figures of 9999 and is provided with three separate carry terminals which can carry depending upon the purpose of use and also with blanking input (zero suppress operation) and transfer input (latch operation) terminals.

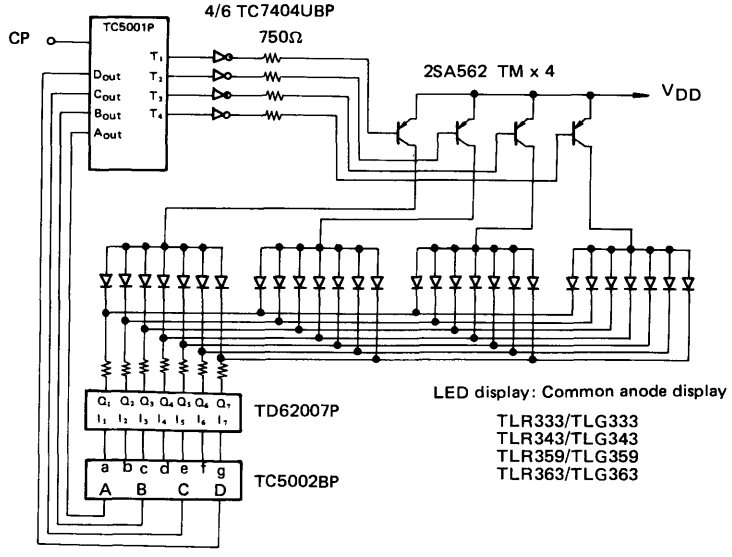


Fig. 2-17 Four-digits decimal counter application circuit

Example of universal counter application circuit by multiplex drive.

Fig. 2-18 shows a six-digits universal counter application circuit. The TC5070P is a six-digits universal counter which has a built-in six-digit memory register with the up-down counter, data preset, zero suppress, and latch functions.

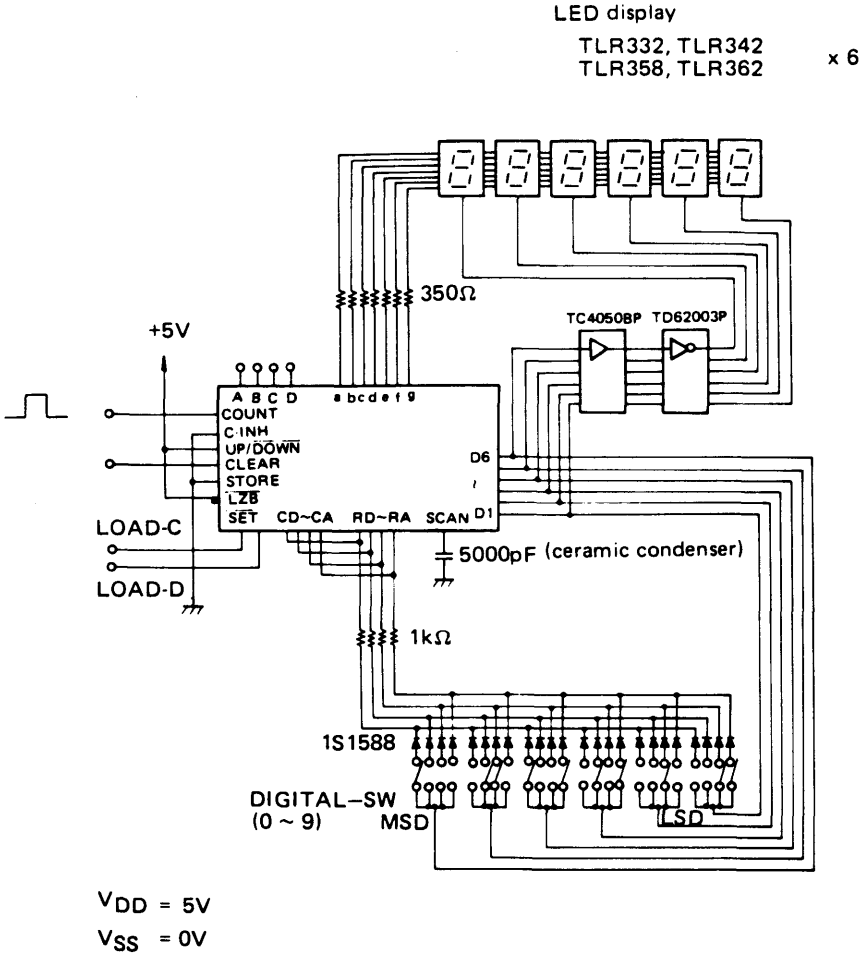


Fig. 2-18 Six-digits universal counter application circuit

Example of digital multimeter application circuit by multiplex drive

Fig. 2-19 shows a 3-1/2-digit digital VOLT/MULTIMETER application circuit. The TC5055P is a dual slop type A/D converter and the circuit is designed in consideration of the digital multimeter. Therefore, it has multifunctions such as an A/D converter control circuit, a built-in range counter which will permit an auto-range operation, a manual up/down range change operation under the remote control, and direct range settings.

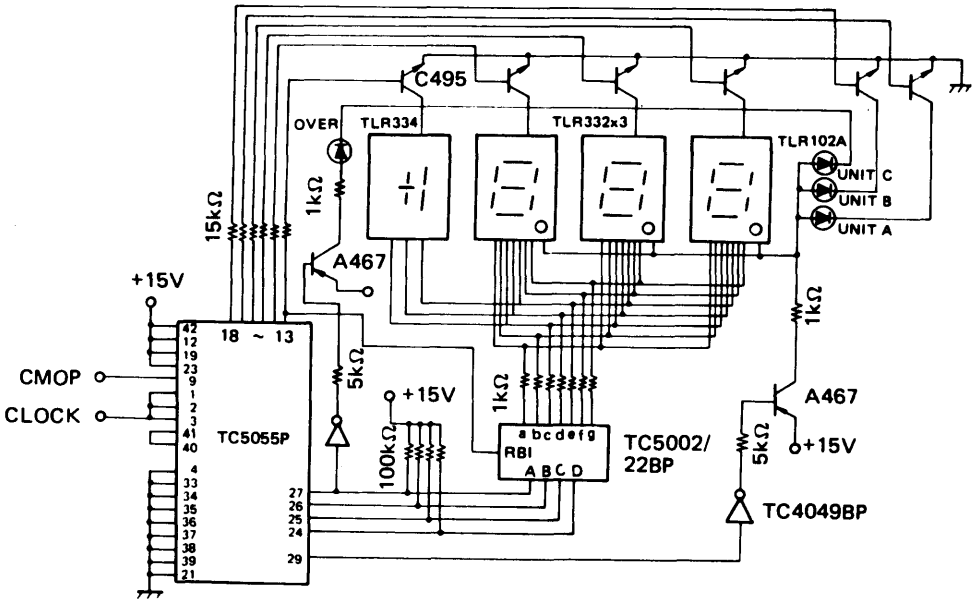


Fig. 2-19 3½-digit digital VOLT/MULTIMETER application

Application of alphanumeric LED

Two PROMs are used for code-conversion from six-bits ASCII code to sixteen-segments format. Fig. 2-20 shows a decoder block diagram. Characters from A of the alphabet to simbol ヲ are decoded. (Table 2-7)

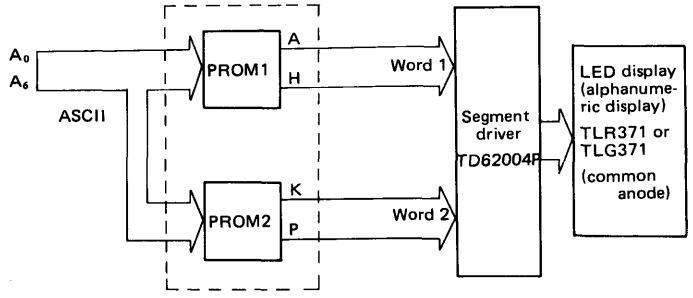


Fig. 2-20 Decoder block diagram

The PROM output is used for driving segment driver TD62004P. PROM1 is used for decording from segment A to segment H and PROM2 from segment K to segment P. The segment turns on when the PROM output become High true, that is high ("1").

Each character or symbol coding is expressed in terms of a hexadecimal format in Table 2-6 for easy PROM programming. The condition in which the ON segment represents character P is given, in Table 2-6. The table shows that the byte of data representing segment H from segment A is C7 in hexadecimal number and the byte of data representing segment P from segment K is CO. Fig. 2-21 shows a connection diagram of the decoders and segment drivers. In this case, a resistor of 180Ω is used for limiting collector current of the segment driver.

Table 2-6 Decorder detailed list of Alphabetic Characters "P" and "D"

Character	Data Format	ASCII Code		High True Segment Assignment											
				Word 2								Word 1			
A B H C G U P	Segment			P	U	T	S	R	N	M	K	H	G	F	E	D	C	B	A
	Bit	A_6 A_5 A_4	A_3 A_2 A_1 A_0	D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0	D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0
	Hexadecimal	5	0	C				0				C				7			
	Binary	1 0 1	0 0 0 0	1	1	0	0	0	0	0	0	1	1	0	0	0	1	1	1
A B M C S D K E	Segment			P	U	T	S	R	N	M	K	H	G	F	E	D	C	B	A
	Bit	A_6 A_5 A_4	A_3 A_2 A_1 A_0	D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0	D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0
	Hexadecimal	4	4	1				2				3				F			
	Bit	1 0 0	0 1 0 0	0	0	0	1	0	0	1	0	0	0	1	1	1	1	1	1

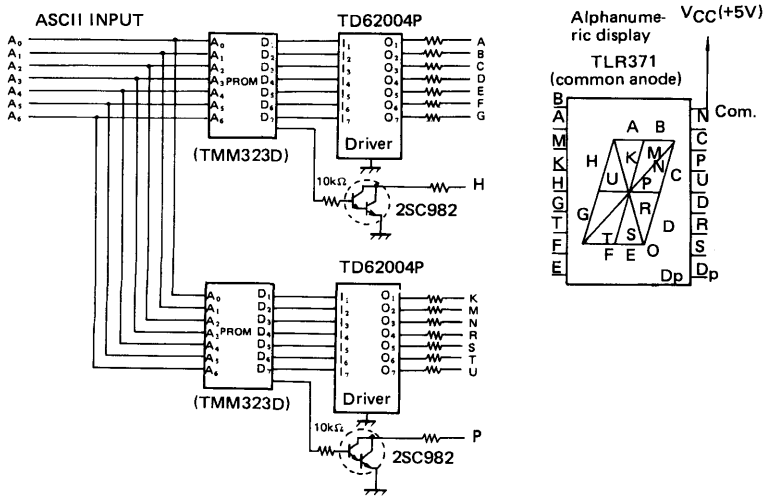


Fig. 2-21 Decoder and segment driver connection diagram

Table 2-7 Code conversion from ASCII to sixteen-segments

Character	ASCII code decimal notation	Decoded segment data hexadecimal notation	
		Word 2	Word 1
A	41	A0	CF
B	42	92	3F
C	43	00	F3
D	44	12	3F
E	45	40	F3
F	46	40	C3
G	47	80	FB
H	48	C0	CC
I	49	12	33
J	4A	12	63
K	4B	4C	C0
L	4C	00	F0
M	4D	05	CC
N	4E	09	CC
O	4F	00	FF
P	50	C0	C7
Q	51	08	FF
R	52	C8	C7
S	53	C0	BB
T	54	12	03
U	55	00	FC
V	56	24	C0
W	57	28	CC
X	58	2D	00
Y	59	15	00
Z	5A	24	33
0	30	12	1E
1	31	00	0C
2	32	90	16
3	33	80	1E

Character	ASCII code hexadecimal notation	Decoded segment data hexadecimal notation	
		Word 2	Word 1
4	34	82	0C
5	35	82	1A
6	36	92	1A
7	37	00	0E
8	38	92	1E
9	39	82	0E
[	5B	00	E1
\	5C	09	00
]	5D	00	1E
↑	5E	24	06
←	5F	8C	00
"	22	02	04
#	23	D2	33
$	24	D2	BB
%	25	F6	99
'	26	02	00
(	28	0C	00
)	29	21	00
*	2A	FF	00
+	2B	D2	00
,	2C	04	00
-	2D	C0	00
/	2F	24	00
<	3C	24	30
=	3D	C0	30
>	3E	09	30
?	3F	90	07

(b) Applications of four-digits LED display

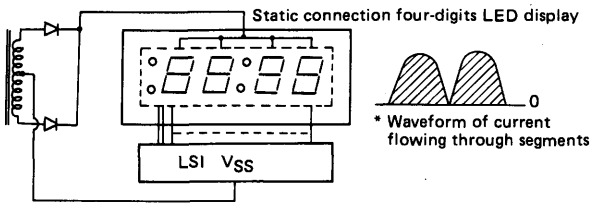
The four-digits LED displays have been mainly used for clock radios, clocks, and timers. Recently they are used in various equipments such as household electrical appliances like TVs, VTRs, and stereos, and automobile because of widespreading LSIs and microcomputers.

A wide range of character heights varying from 6.3 mm (0.25 inch) to 45 mm (1.8 inch) allow the designer to choose the correct size display for the desired viewing range.

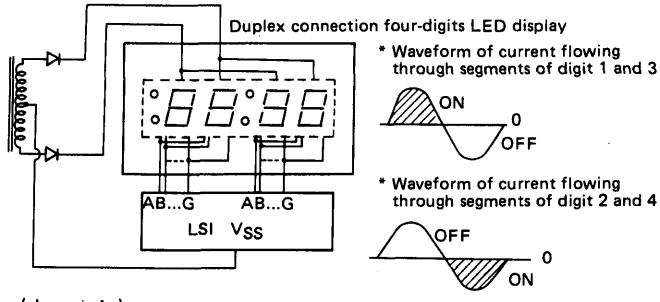
The static connection, duplex connection, and multiplex (dynamic) connection are available, though depending upon the character size, in correspondence to the difference in driving method, and they can be selected in accordance with used LSIs.

Examples of drive methods

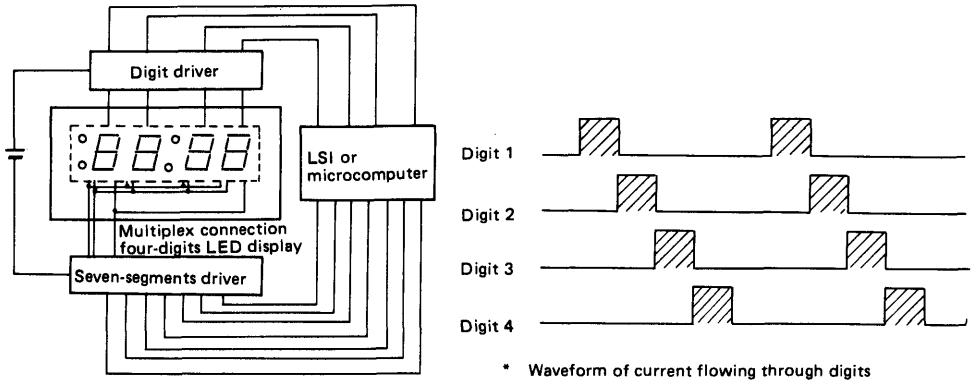
1 Static drive



2 Duplex drive



3 Multiplex drive (dynamic)



Applications for digital electronic clocks

1 Application circuit with static connection four-digits LED display.

The above LED display is devided into two types, anode-common and common cathode, and a N-channel LSI is suitable for an common anode type and a P-channel LSI for a cathode-common type. An application circuit with an anode-common type is shown in Fig. 2-22 and an application circuit with a common cathode type in Fig. 2-23.

They are suitable for display, in timers, clocks, and clock radios.

Even space four-digits LED displays are available for clock display, and frequency counter.

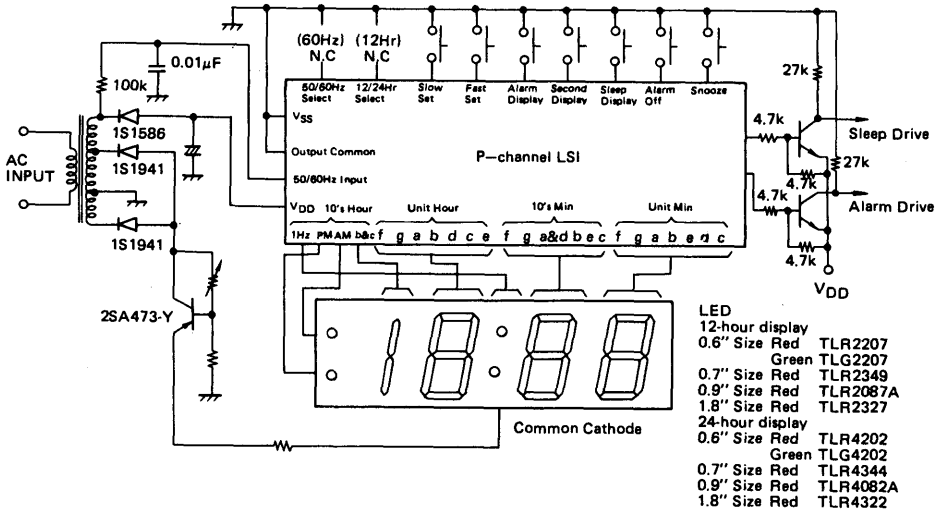


Fig. 2-22 Digital electronic clock with common cathode four-digits LED display and P—channel LSI

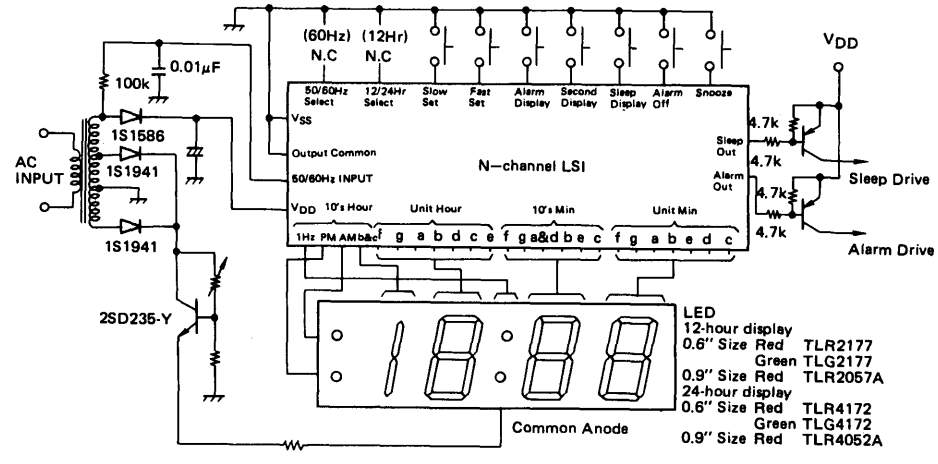


Fig. 2-23 Digital electronic clock with common anode four-digits LED display and N—channel LSI

2 Application circuit with duplex connection four-digits LED display.

An application circuit with the common anode type of LED display is shown in Fig. 2-24 and an application circuit with the common cathode type in Fig. 2-25.

They are suitable, as with the static connection type, for VTR timers or clocks and clock radios.

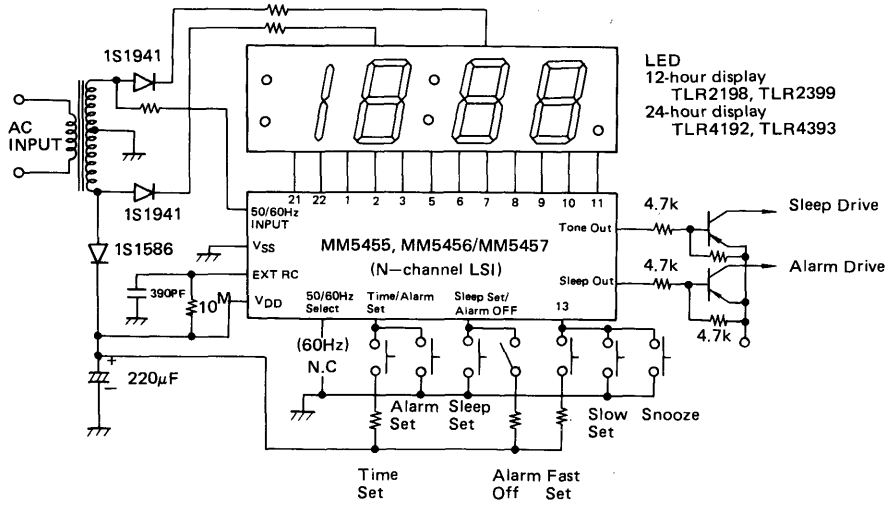


Fig. 2-24 Digital electronic clock with common anode four-digits LED display (TLR2198 Series) and N-channel LSI

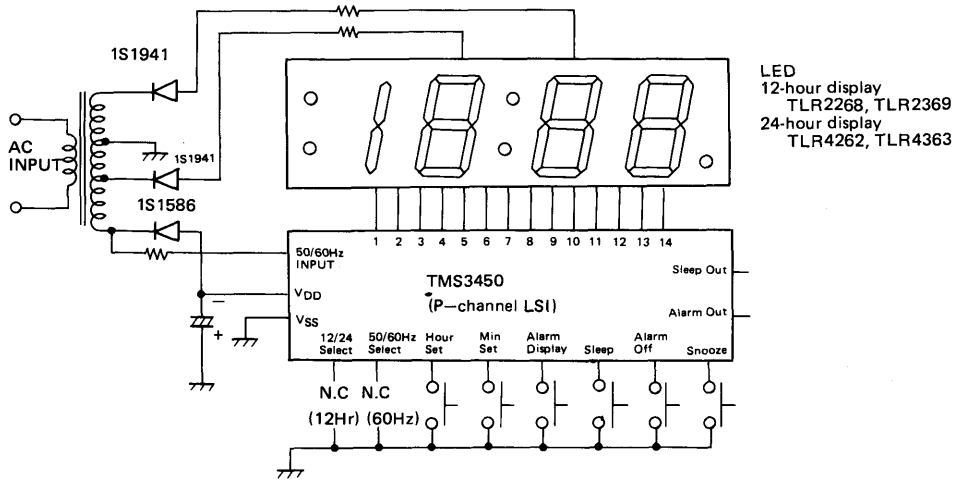


Fig. 2-25 Digital electronic clock with common cathode four-digits LED display (TLR2268 Series) and P-channel LSI

3 Application circuit examples with four-digits LED display with weekly display

Application examples with the above LED display are shown in Figs. 2-26 and 2-27. The function of a clock LSI with weekly display in Fig. 2-26 is a simple one, in which weekly display function is added to the general clock function. The clock LSI with weekly display in Fig. 2-27 has multi-functions, such as weekly display and month/day changeover display, with alarm and battery back-up circuits.

They are best suited to clocks and clock radios, and also audio-timers and VTRs.

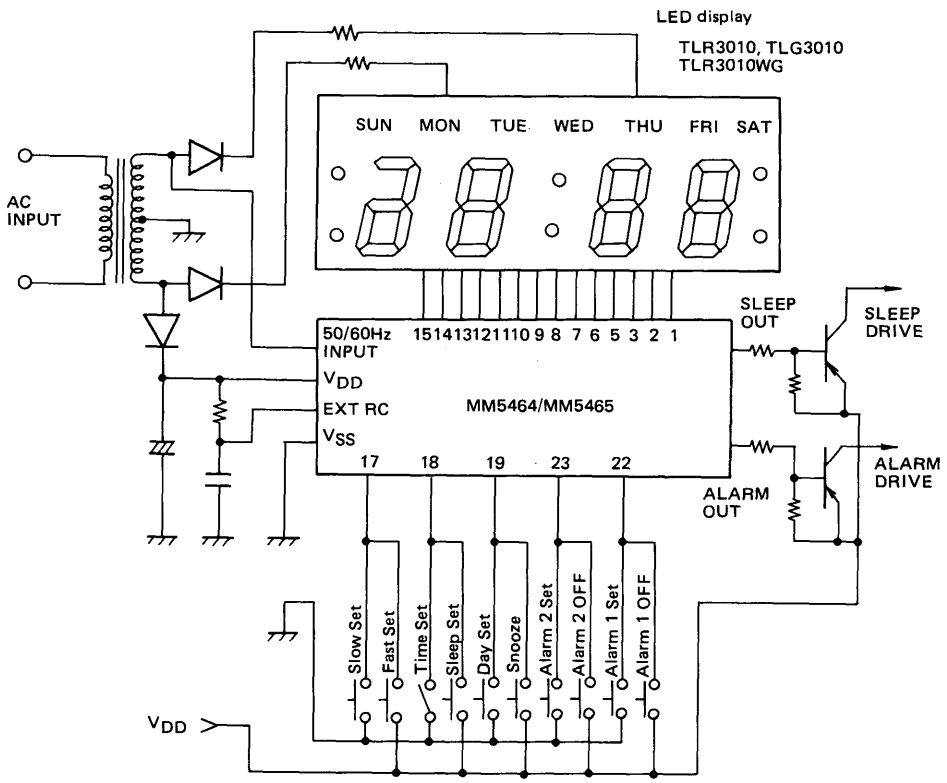


Fig. 2-26 Digital electronic clock with weekly display

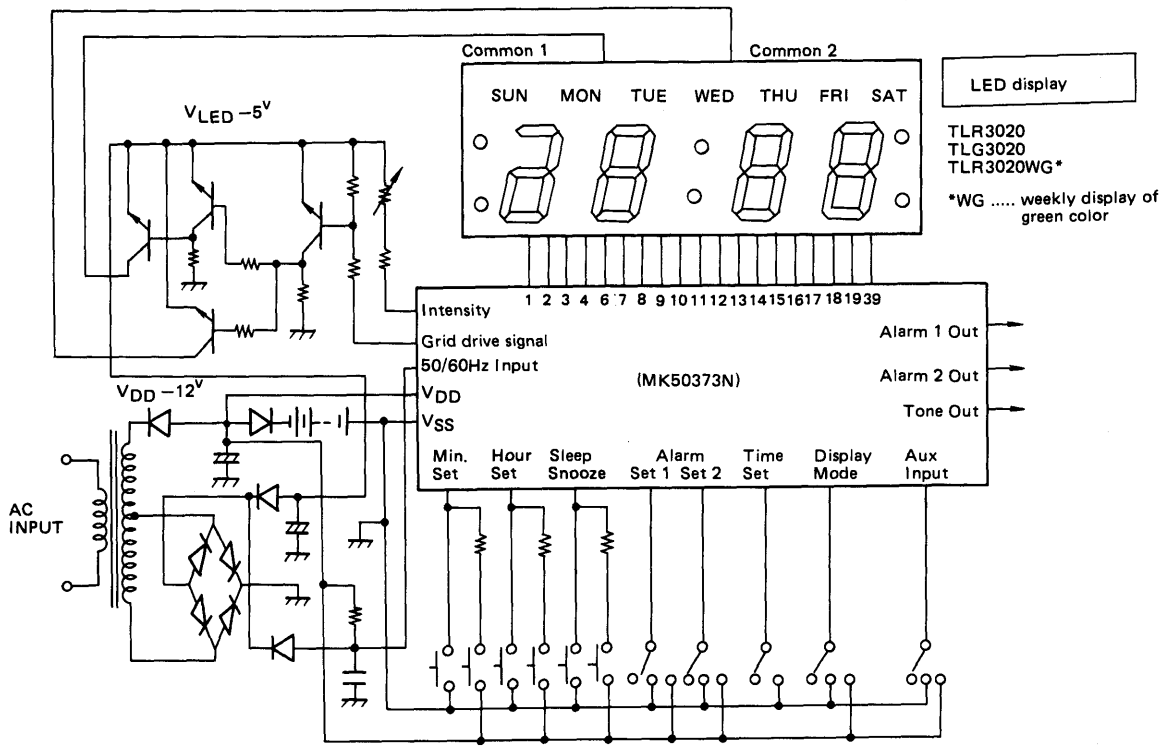


Fig. 2-27 Digital electronic clock with week day display

4 Application circuit with multiplex connection (dynamic) of four-digits LED display

The above LED display have been developed for digital displays of equipments using microcomputers. Using microcomputers they are applied in clock display, timer display, temperature display, and channel display.

An application circuit is shown in Fig. 2-28.

They are suitable for displays of TVs, VTRs, household electrical appliances, and audio instruments.

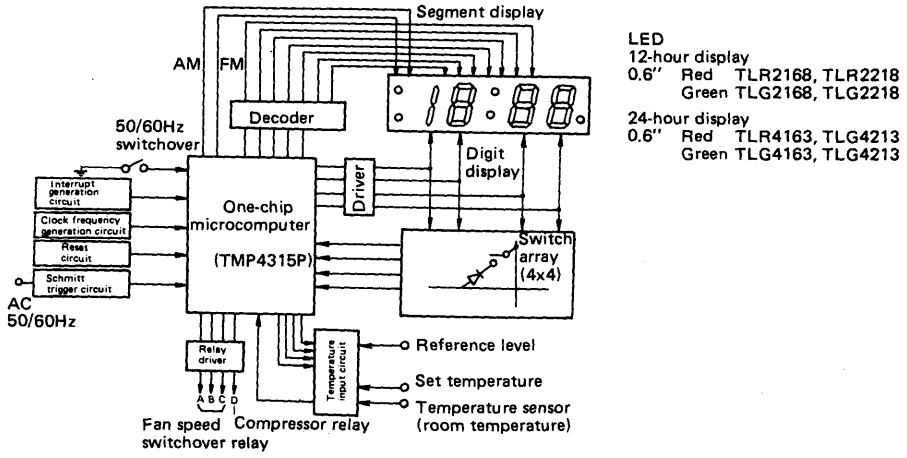


Fig. 2-28 Air conditioning control system circuit configuration with four-digits LED display and one-chip microcomputer

Applications for car-radio of stereo tuner frequency display

Fig. 2-29 shows an example in which four-digits LED display, TLG4115 or TLG4135, is multiplex, driven with LSI T1400. The T1400 can provide the display, of the receive frequency of a FM/AM receiver. If the frequency display is not needed, it permits the operation of an electronic quartz clock. The TLG4115 and TLG4135 are a common anode type display, the pin terminals are connected inside for multiplex drive, and the segment terminal arrangement corresponds with that of the LSI.

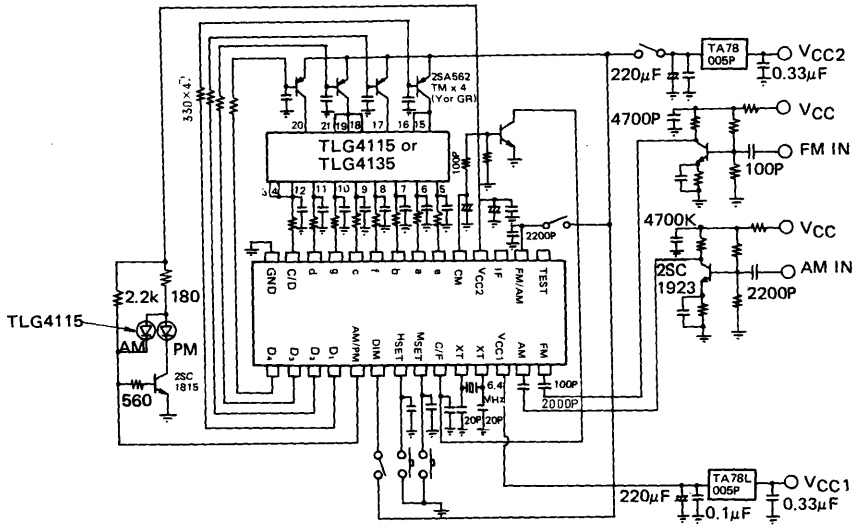


Fig. 2-29 Stereo-tuner frequency display and clock display circuit for car-radio

(c) Applications of digital tuning system with LED display

Application of static connection 4.5-digits LED display

Fig. 2-30 shows an example of a static digital tuning system application circuit with TLR5002/TLG5002 of 10 mm character size.

The TC9147P is a system LSI which provides one-chip PLL circuit and control circuit for the synthesizer digital tuning system. The TD6301AP is static driver with a receive frequency digital display function.

The circuit in Fig. 2-30 is designed for the European zone, but the TLR5001 and TLG5001 which can express a FM or AM display for the American and Japanese zones are available.

The TLR2259 and TLG2259 of 15 mm character height four-digits LED display, are also available though different in size. However, the dot display is applicable for FM or AM display.

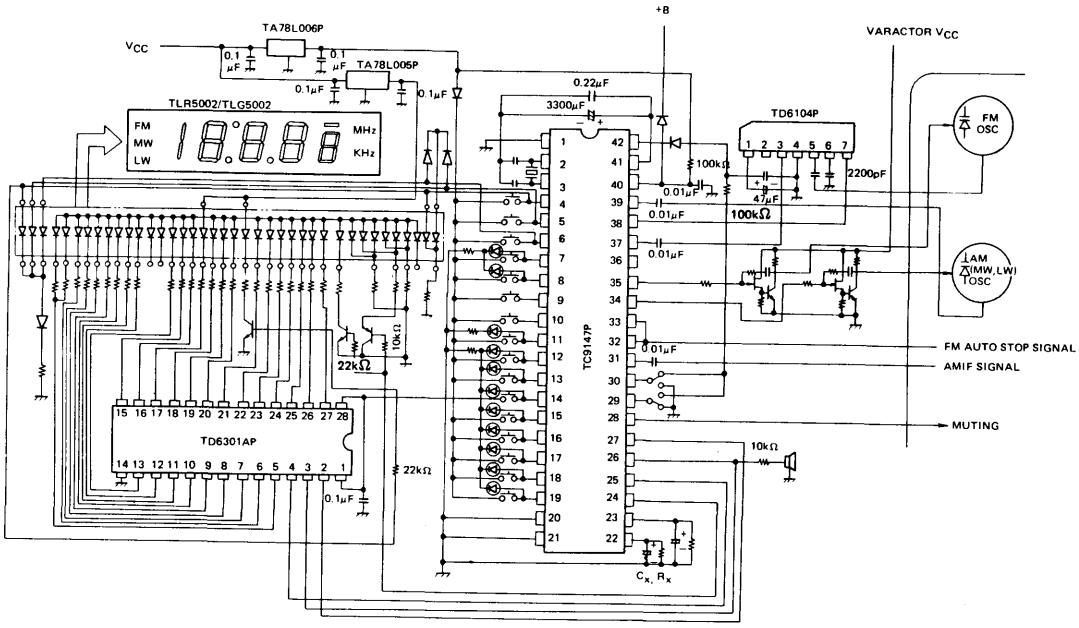


Fig. 2-30 Digital tuning system application circuit with 4.5-digits LED display

Application example with multiplex connection of four-digits LED display

Fig. 2-31 shows a multiplex circuit for digital tuning system with TLR4286/TLG4286 of 15 mm character size.

The TC9137P is LSI for PLL synthesizer digital tuning system which has one chip control circuit.

The TC9159P is a multiplex driver for receive frequency digital display.

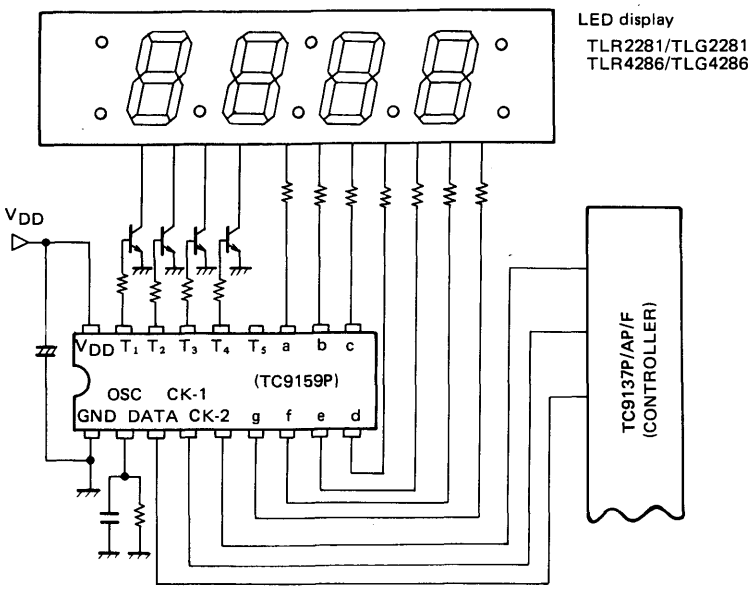


Fig. 2-31 Digital tuning system application circuit with four-digits LED display

(d) Applications of bar point display

The needle meters are normally used in various equipments for indication of physical quantities such as voltage, current, temperature, and humidity and of audio instrument input/output levels. A LED bar point display takes the place of conventional needle meters. It has the following features in addition to originally characteristics of LED.

1 High resolution.
2 Provides an indication by color for each displacement range.
3 High speed response and provides an indication of transient displacement.
4 Free of waste and wear because of no moving parts.
5 An improved space efficiency.

The application circuits of LED bar point display are shown as following.

Fig. 2-32 shows the application circuit of a 5-point 1-channel bar point display. The logarithmic scale indication is available for an IC of TA7654P, while the linear scale indication for TA7655P.

Fig. 2-33 shows the application circuit of a 5-point 2-channel bar point display. In this case the logarithmic scale indication is available.

Fig. 2-34 shows the application circuit of a 10-point 1-channel bar point display. In this case the linear scale indication is available.

Fig. 2-35 shows the application circuit of a 10-point 2-channel bar point display. In this case the logarithmic scale indication is available.

Fig. 2-36 shows the application circuit of a 20-point 2-channel bar point display.

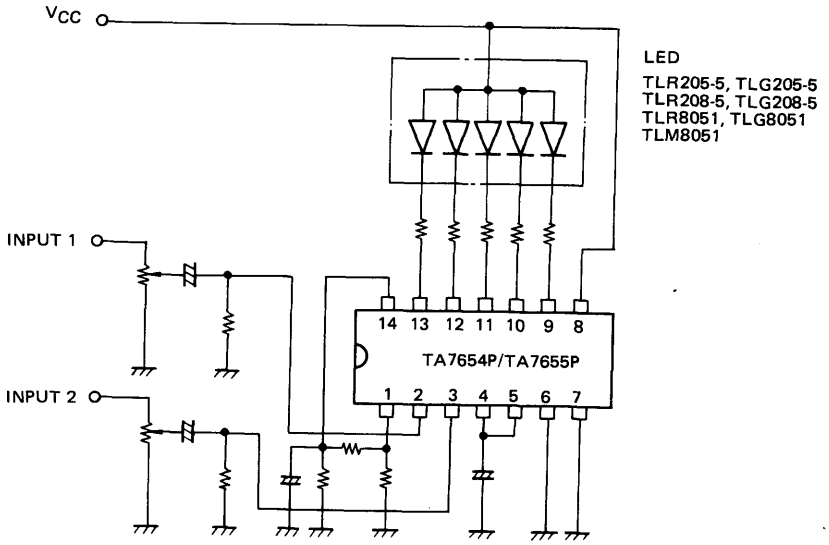


Fig. 2-32 5-point bar point display drive circuit

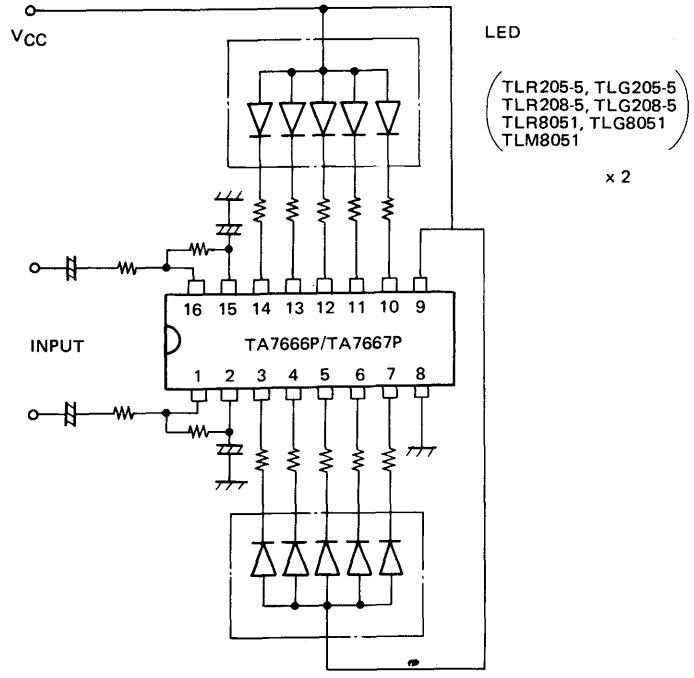


Fig. 2-33 5-point 2-channel bar point display drive circuit

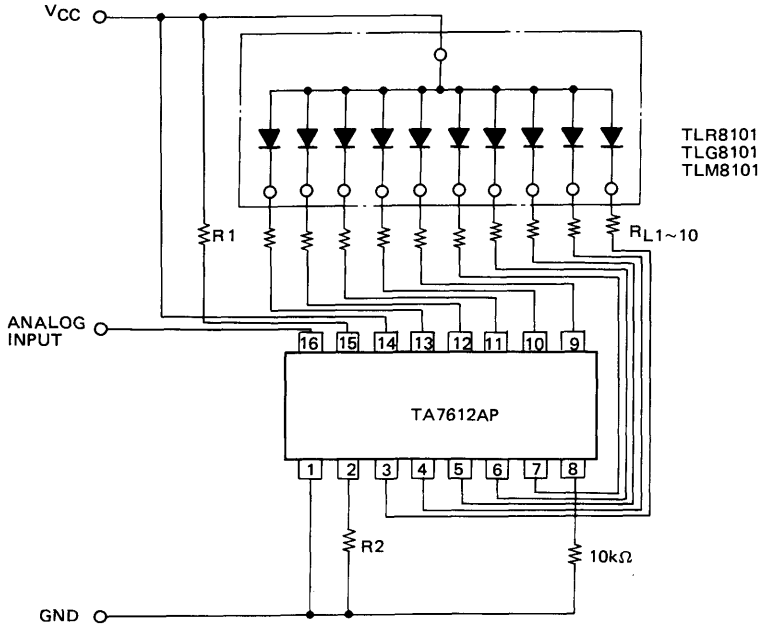


Fig. 2-34 10-point bar point display drive circuit

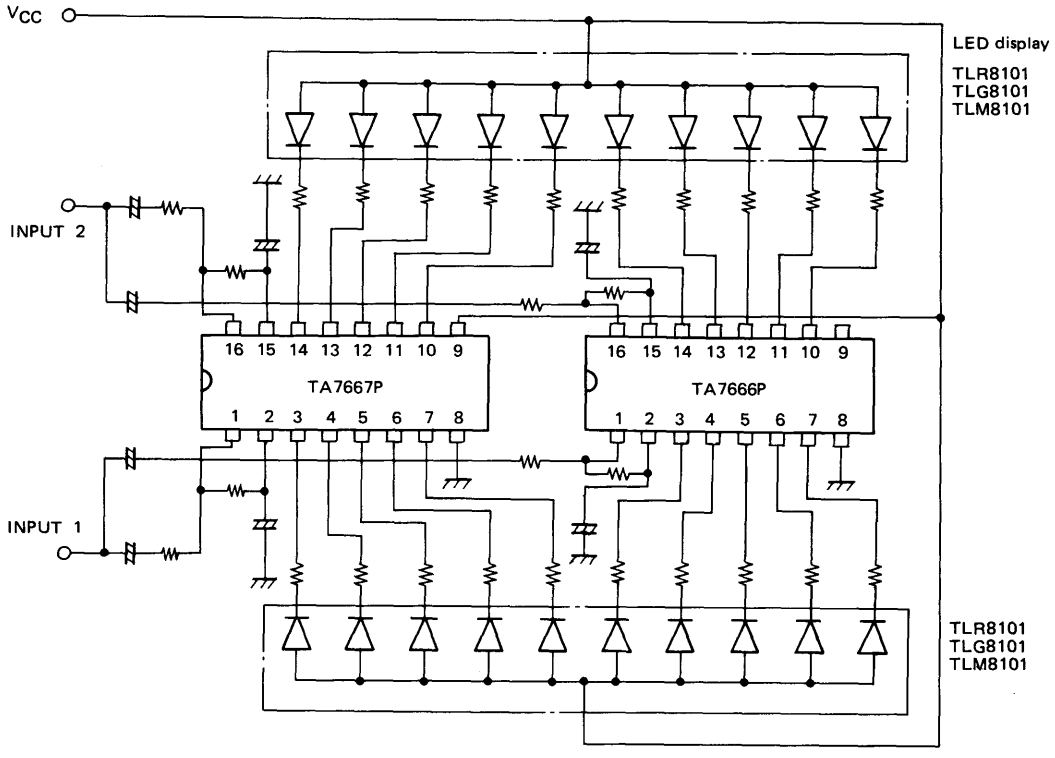


Fig. 2-35 10-point 2-channel bar point display drive circuit

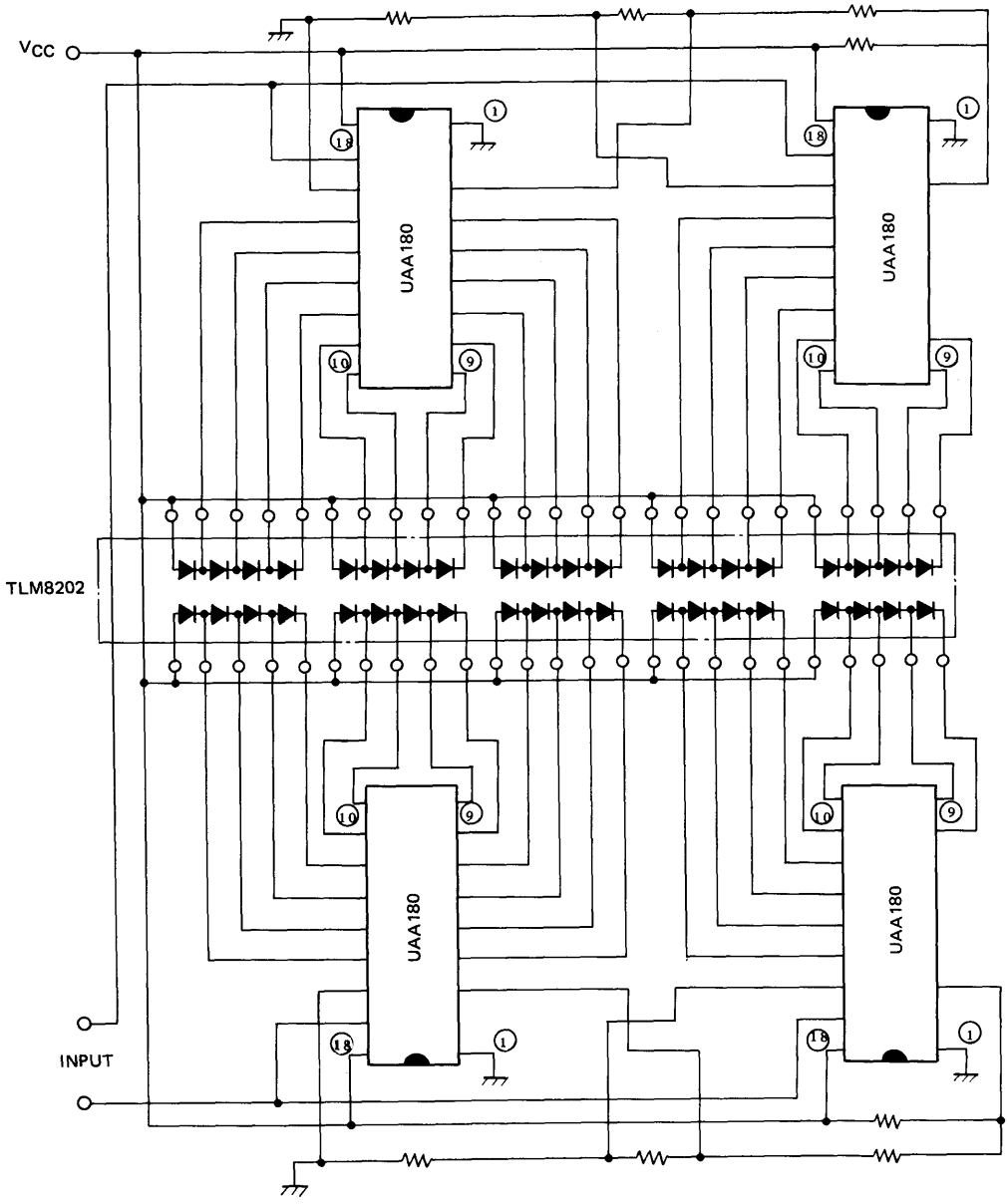


Fig. 2-36 20-point 2-channel bar point display drive circuit

2-2-1 Description of Photocouplers for General Purposes

Structure and basic characteristics for photocouplers

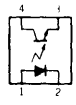
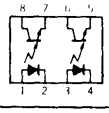
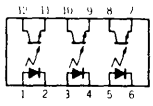
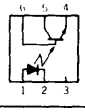
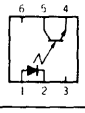
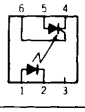
Demand for photocouplers entered a real growth period around 1977. The background for this is the expansion of application in signal transmission between CPU and peripheral devices caused by the popularization of microprocessors and in isolation interface between logic circuits and power line load circuits.

Traditionally, for these applications, relays and isolation transformers have been used. Photocouplers not only replace these devices, but also have merits such as elimination of impedance mismatching, improvement in insulation capability between outputs and ease of noise cutoff. Moreover, while circuit configurations employ more LSIs and microcomputers, additional merits of reduction in the printed circuit board occupying area and maintenance-free operation based on reliability improvement help increase the demand rapidly.

With this as a background, metal-sealed tubular photocoupler TLP501 was developed in 1972. Since then, TLP503 (DIP, 6-pin) and TLP504 (DIP, 8-pin, 2ch), which are easy to mount on a printed circuit board, and photo-thristor couplers TLP505G and TLP506G were commercialized. Recently, however, as represented by sequence controllers, with the advance in large-scale control due to the popularization of microcomputers, the number of photocouplers used for I/O interface has increased markedly. Accordingly, to increase the number of units mountable per printed circuit board, multichannel units, which can be mounted with high density, high transformation efficiency photo-transistor couplers, which can be used at low input power, and high sensitivity photo-thyristor couplers are in heavy demand. To fulfill the market demands, six kinds of white molded coupler with white external epoxy resin have been commercialized.

In this paragraph, the structure and basic characteristics for these units will be described.

Table 2-8 Photocoupler Lineup by New Assembly Process

	Type	Photo	Pin connections
Photo-Transistor coupler	TLP521-1		
	TLP521-2		
	TLP521-3		
	TLP531		
	TLP532		
Photo-Thyristor coupler	TLP541G		

Lineup of Photocouplers by New Assembly Process

The new photocouplers include 5 kinds with photo-transistor output and 1 photo-thyristor, as shown in Table 2-8. The TLP521-1 has the simplest structure and is most suited as an insulation component for hybrid devices, such as SSR (solid-state relay). TLP521-2, TLP521-3 were developed for multichannel interface by sequence controllers etc. and can be mounted at a high density of 1.5 times, compared with the traditional units.

Structure

Figure 2-37 shows TLP521-1 as a structure example of new photocouplers. As shown in the cross-sectional structure in Fig. 2-38, an infrared light emitting diode chip and a photo-transistor chip are individually die bonded to separate lead frames with conductive paste. Then, each electrode is thermal compressive wire bonded with 25 μ diameter Au wire, so that the light-emitting and the light-receiving lead frames face each other with their optical centers coinciding. Further, transparent silicone resin is applied between the chips facing each other to obtain optical coupling and electrical isolation. At the same time, white epoxy resin is used for transfer molding in order to form a double structure with two kinds of resin.

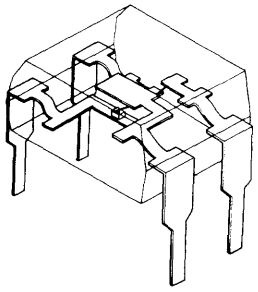


Fig. 2-37 TLP521-1 structure

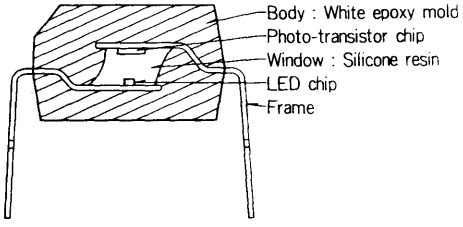


Fig. 2-38 Section of TLP521-1

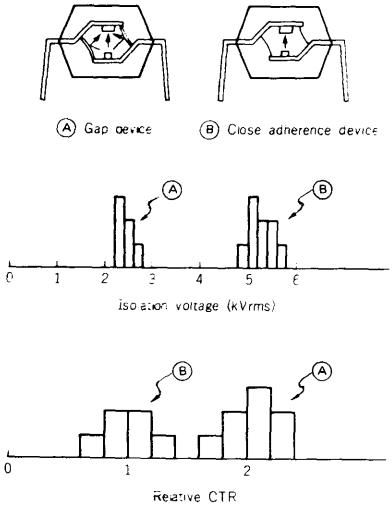


Fig. 2-39 Isolation voltage vs. CTR

The infrared light-emitting diode is an Si-doped liquid phase epitaxial GaAs diode and is mounted with its P-side up. The light-receiving chip is an Si NPN epitaxial planner photo-transistor. (For TLP541G, PNPN epitaxial planner photo-thyristor is used.)

Basic Characteristics

○ Isolation Voltage

If the isolation distance between the input and the output is designed wide, the isolation voltage becomes high. On the other hand, as the quantity of light reaching the light receiving end decreases exponentially, the current-transfer-ratio goes down. Also, even if isolation distance widening is permissible, the package size becomes large, which is contrary to the market needs for small DIP form. As a solution to this contradicting problem, transparent silicone resin for optical guide is used between the input and output to maintain the required isolation voltage. The isolation voltage of transparent silicone resin as a light guide is about 17 kV/mm, regardless of the kinds used. To guarantee 2.5 kVrms minimum isolation voltage for the photocouplers and, accordingly, to maintain the center of breakdown voltage disbribution at 6 kVrms, the shortest distance between the input and output conductors is designed at about 0.3 mm. Also, to increases the creepage spark voltage at the interface between the transparent silicone and molding resin, materials with strong mutual adhesion are used so that no air gap is formed at the interface with the transparent silicone after transfer molding.

However, as Model B in Fig. 2-39 shows, good adhesion lowers light reflectivity at the resin interface, reducing the quantity of light reaching the light receiving end, and resulting in an undesired effect of lowering the current-transfer-ratio. Consequently, selection of resin used as an optical guide is important from the viewpoint of product design, as it greatly influences the isolation voltage and current-transfer-ratio, which are basic characteristics of a photocoupler, and is related to reliability, as will be described later.

The isolation voltage distribution of new photocouplers has a high average of about 6 kVrms as shown in Fig. 2-40, achieving the initial goal. Figure 2-41 shows the impulsed isolation voltage distribution, which is considered important in connection with lightning surge in electric systems.

○ Current Transfer Ratio (CTR)

To meet the market needs for high isolation voltage of 2.5 kVrms minimum, transparent silicone resin with strong interface adhesion is used for an optical guide. Accordingly, CTR is reduced considerably. However, the improvement in interface reflectivity brought about by white epoxy molding has made CTR two to three times higher, as compared with the traditional black-molded device (TLP503), and maintains CTR of typically 200% (minimum 50%).

Significant Points in Applications

When using photocouplers, it is necessary to pay attention to the following:

① When used for a long time, reduction in CTR due to LED light emitting efficiency lowering is as small as about −10%, compared with the initial value. It is recommended, however, to have a design margin by considering this as about −30 to −50%.

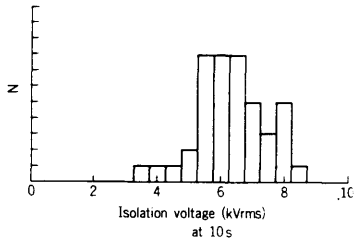


Fig. 2-40 Isolation voltage distribution

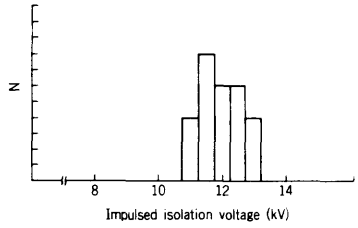


Fig. 2-41 Impulsed isolation voltage distribution

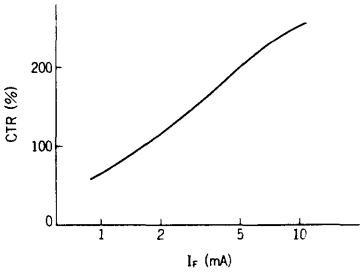


Fig. 2-42 I_F vs. CTR

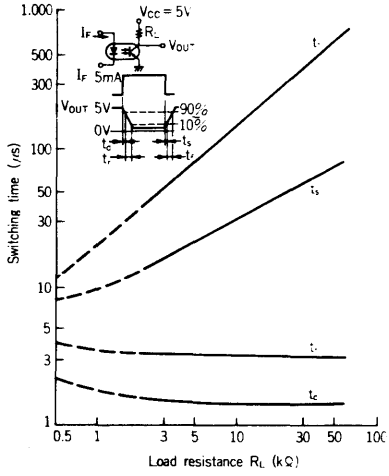


Fig. 2-43 Switching time vs. R_L

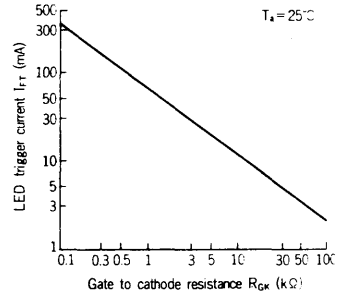


Fig. 2-44 I_{FT} vs. R_{GK}

② CTR input current dependency: When used with low input current, CTR drops, as shown in Fig. 2-42. In designing circuit, this effect should be considered.

③ CTR ambient temperature dependency: At high temperatures, the decrease in light emission efficiency is more dominant than the increase in hFE, resulting in reducing CTR. Attention should be paid to this effect.

④ Response time. When the light-receiving photo-transistor is used in a saturated switching mode, the response time must be considered. Of photo-transistor's response characteristics, turn-off (tf) is the slowest and is represented approximately by $t_f \sim 2.2\ C_{ob} \cdot h_{FE} \cdot R_L$. Here, C_{ob} is the collector-to-base capacitance, h_{FE} is the grounded emitter current amplification factor and R_L is the load resistance. Switching time is shown in Fig. 2-43.

Photo-thyristor Coupler I_{FT} Characteristic

The photo-thristor itself is highly sensitive to light. However, as gate-to-cathode resistance (R_{GK}) is connected to bypass the charging current i = C·dV/dt due to -dV/dt in order to increase permissible dV/dt, photo current Iλ due to incident light partly flows through R_{GK} and reduces the trigger sensitivity (I_{FT}) by LED. Figure 2-46 shows the R_{GK} dependency for I_{FT}.

Also, for I_{FT} ambient temperature dependency, at low temperatures the decrease in the photo-thyristor gate sensitivity is more dominant than the increase in light emission efficiency, I_{FT} sensitivity becomes poor at low temperatures. Typical effect of R_{GK} on dV/dt and temperature effect on I_{FT} are illustrated in Fig. 2 − 45, Fig. 2 − 46.

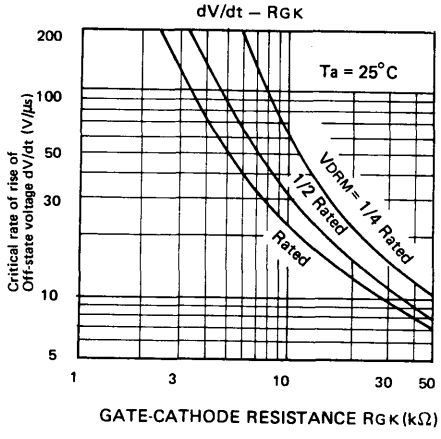


Fig. 2-45 Typical effect R_{GK} on dt/df

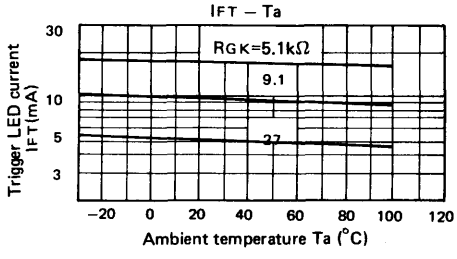
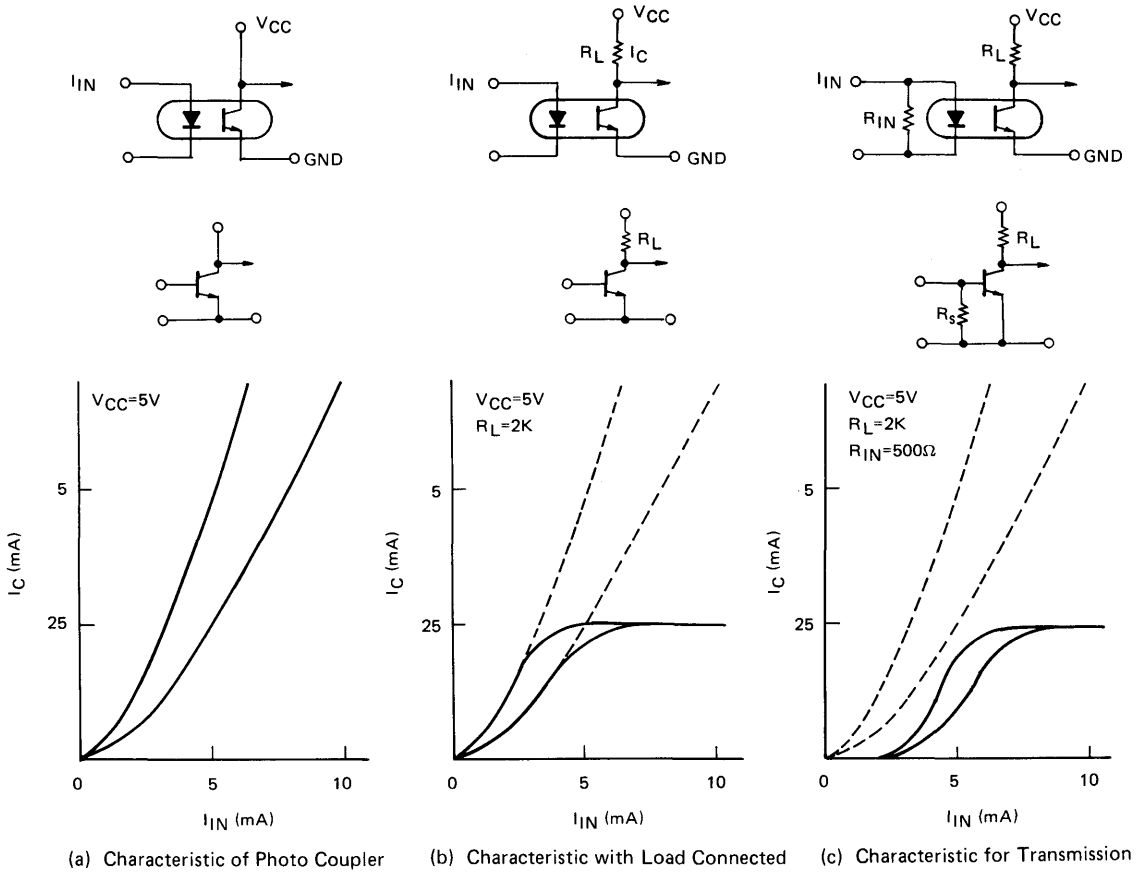


Fig. 2-46 Typical effect temperature on I_{FT}

Examples of Application to Signal Transmission

Products which have high sensitivity and high conversion efficiency are effective as an interface for signal transmission. Generally, transmission lines may subject to all kinds of noises and it is therefore necessary to take countermeasures against these noises at receiving side. Photo transistor couplers are normally in such design as shown by (b) of Fig. 2-47 in many cases. Photo couplers in this design, however, are actually unfavorable for signal transmission. This is because no measure has been taken against differential noises although there is no proble for same phase noises because of insulation property of photo couplers. (c) in Fig. 2-47 is a basic example of the circuit for erasing differential noises. This circuit is the same as that of general transistors with a resistor inserted between the base and the emitter. It can be seen from the characteristic graph shown below that a high conversion efficiency product is able to bring the breaking area and saturation area more close each other than by a low convergency efficiency product and it is possible to design threshold level with a sufficient margin and therefore, this usage is recommended.



(a) Characteristic of Photo Coupler (b) Characteristic with Load Connected (c) Characteristic for Transmission

Fig. 2-47 Load Characteristics of Photo Transistor Coupler

2-2-2 High-Power Photo Thyristor Coupler

Photo couplers are being used for transmitting signals between circuits in different ground potential or for discriminating noise fractions in a data transmission line. A photo thyristor coupler, amont other things, is capable of directly opening or closing an AC line by input side LED ON-OFF behavior, while electrically separating input side LED from output side photo thyristor.

Recently, the photo thyristor coupler is rapidly expanding its demands as a gate trigger switch to open or close an alternative load for a main triac due to increasing solid-state utilization, not only in industrial use control equipment but also for home electrical appliances (electronic cooker, air-conditioner, automatic washing machine etc.) as well as duplicator, automatic vending machine etc., all resulting from microcomputer's widespread use and prevalence. Accompanying this expansion in demands, such requirements on the markets as for open or closed capacity increase, trigger sensitivity improvement, isolation voltage increase etc., are becoming intense for photo thyristor couplers. In response to these requirements, Toshiba has commercialized a high-power photo thyristor coupler, Model TLP546G, aiming at DIP-type lead relay (switching capacity is nearly 1 A rms) solid-state formation. Its construction, electrical characteristics and applications will be discussed.

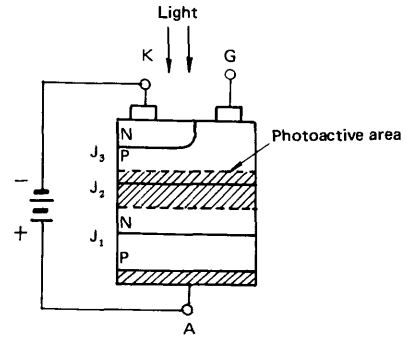


Fig. 2-48 Photo thyristor structure

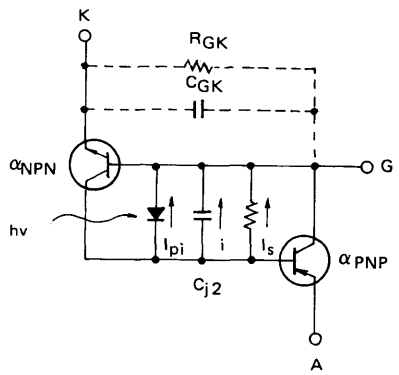


Fig. 2-49 Photo thyristor equivalent circuit

(a) Photo Thyristor

A photo thyristor, having a PNPN construction similar to ordinary thyristors, is made up of two different transistor types (PNP and NPN) with central junction J_2 commonly used for a collector. This construction is outlined in Fig. 2-48. A simplified equivalent circuit is shown in Fig. 2-49.

When a photo thyristor is operated with a forward bias voltage between its anode and cathode, central junction J_2 functions as a reverse biased photo diode. This bias enables gate current flow. Photo thyristor's anode current I_A in the equivalent circuit shown in Fig. 2-49 is expressed by Eq. (1).

$$I_A = \frac{I_S + I_{P\lambda}}{1 - (\alpha_{PNP} + \alpha_{NPN})} \quad (1)$$

where, α_{PNP}: Positive hole current ratio that reaches a collector over these injected by an emitter in the PNP section.

α_{NPN}: Electron current ratio that reaches a collector over these injected by an emitter in the NPN section.

I_S: Saturated leakage current at a reverse biased J_2 junction.

$I_{P\lambda}$: Photo current appearing at a J_2 junction due to an incidental light.

Transistor's α_{PNP} and α_{NPN} increase as its emitter current increases. When a current flows upon light incidence, anode current $I_{P\lambda}$ increases due to gain factor in a regeneration feedback loop consisting of two different types of transistors (PNP and NPN). With the increase in I_A current, α_{PNP} and α_{NPN} further increase until α_{PNP} plus α_{NPN} reaches a value equal to 1 when I_A becomes infinite, firing the photo thyristor.

(b) Element Structure

Internal Structure

The TLP546G, consisting of two photo thyristors connected in a reverse parallel connection, has a structure wherein each infrared light emission diode, opposing a respective photo thyristor, is buried up inside a resin master board with a heat emission aluminum plate. An outline of this internal structure and pin connection is shown in Fig. 2-50.

Transparent silicone is packed into the clearance between infrared light emission diode and photo thyristor, as a light guide. The surrounding areas are further molded closely with adhesive white epoxy resin having high-light reflection factor, all making a twofold structure. Moreover, respective individual clearances between aluminum plate and individual input and output leads are completely separated from one another with resin filler, thus preserving high-voltage insulation, 2.5 kVrms (for one minute duration).

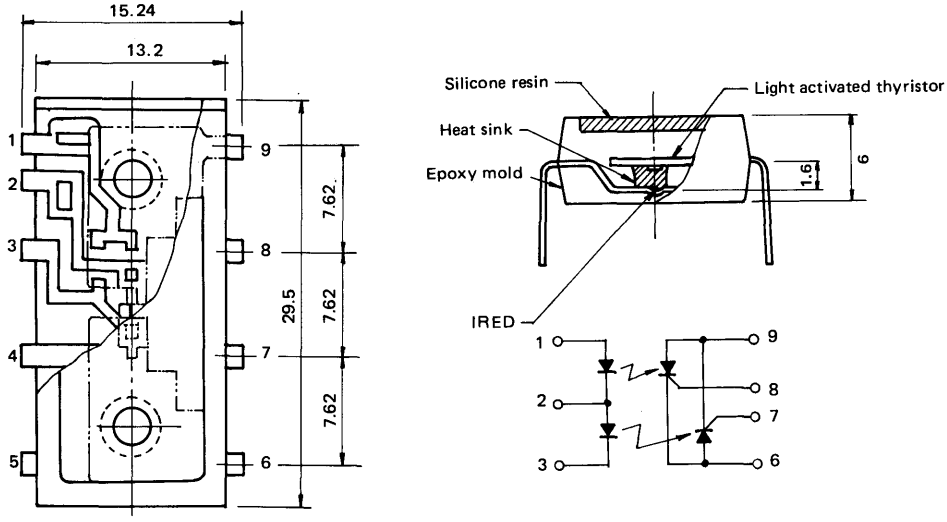


Fig. 2-50 TLP546G structure

When the TLP546G is operated at 40°C environment temperature with rated parameters, photo thyristor chip temperature increases to nearly 100°C. In order to efficiently emit this heat energy into the ambient environment, the maximum allowable surface area dictated by package dimensions is provided for its output side frame and the minimum distance within voltage resistance maintaining limits is selected for a clearance with the aluminum plate. Furthermore, small convex and concave unevennesses, or dimples, are made on the heat emission aluminum plate so as to increase contact area with the atmosphere for heat emission effect improvement.

Product External View

In order to ease mounting on a printed master board, DIP-type 0.1 inch pin pitch was selected, as shown in Fig. 2-50. On the photo thyristor side, as the pin pitch was selected to be 7.62 mm, the inter conductor separation on the printed master board, which is desired for OFF voltage preservation during load release, can be designed larger.

(c) Maximum Ratings and Electrical Characteristics

Maximum Ratings

When the maximum rating is exceeded, even a few times during element operation, not only are element electrical characteristics and reliabilities lost but also the element breaks down in the worst case. Therefore, adequately careful design is necessary for applicational use. Table 2-9 shows the TLP546G ratings. If these ratings are exceeded or in case there is no adequate derating operation, sudden trigger sensitivity (trigger LED current, I_{FT}) will be degraded, or repetitive peak off-state voltage will be decreased.

Table 2-9 Maximum Ratings (Ta = 25°C)

	Characteristics	Symbol	Rating	Unit
LED	Forward current*	I_F	50	mA
	Reverse voltage	V_R	5	V
Detector	Repetitive peak off-state voltage (R_K = 15kΩ)	V_{RRM} and V_{DRM}	400	V
	On-state current (rms)**	I_T (rms)	1 (non-heatsink)	A
	On-state one cycle surge current (50 Hz)	I_{TBM}	10	A
Operating Temperature		$T_{opr.}$	−30~ 80	°C
Storage Temperature		$T_{stg.}$	−30~125	°C

Note:

* Derate linearly above 25°C free-air temperature at a rate of 0.55 mA/°C.

** Derate linearly above 40°C free-air temperature at a rate of 20 mA (rms)/°C.

Table 2-10 Electrical Characteristics (T_a = 25°C)

	Item	Symbol	Conditions	Min.	Typ.	Max.	Unit
LED	Forward voltage	V_F	I_F = 30 mA	–	–	1.45	V
	Reverse current	I_R	V_R = 5V	–	–	10	μA
Detector	Repetitive peak off-state current	I_{DRM}	V_{DRM} = rated, T_a = 80°C	–	–	100	μA
	On-state voltage	V_{TM}	I_{TM} = 2A	–	–	2	V
	Holding current	I_H	R_L = 100Ω, R_{GK} = 15 kΩ	–	0.5	–	mA
	Critical rise rate of off-state voltage	dV/dt	V_{DRM} = 2/3 rated, R_{GK} = 15 kΩ	5	–	–	V/μs
Coupler	LED trigger current	I_{FT}	V_D = 6V, R_L = 100Ω, R_{GK} = 15kΩ	–	7	10	mA
	Isolation resistance	R_S	R. H. = 40~60%, V=1,000V DC	–	10^{11}	–	Ω
	Isolation voltage	BV_S	AC 1 minute, R.H. 40~60%	2,500	–	–	V

Electrical Characteristics

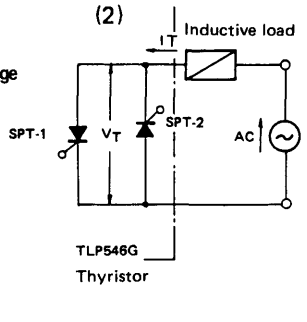
The TLP546G electrical characteristics are shown in Table 2-10. As important electrical characteristics when applying the TLP546G, dV/dt (critical rise rate of off-state voltage) and I_{FT} are discussed.

○ **dV/dt resistance value**

When a steep forward bias voltage increase is applied to photo thyristor's inter anode and cathode point, there is a case where the photo thyristor turns on, even though this voltage is within its breakover voltage and despite the fact that the trigger LED current is disabled. This is due to the fact that, when the element is in a forward biased state, a central junction J_2 shown in Fig. 2-48 is reverse biased, forming a depletion layer capacitor C_{J2} wherein displacement current, *i*, flows in as forward biased voltage applied varies. This displacement current, *i*, is expressed by the following approximation equation (2).

$$J = Cj_2 V^{\frac{1}{k}} \cdot \frac{dV}{dT} \quad (2)$$

V; Applied Voltage
K; 2~3



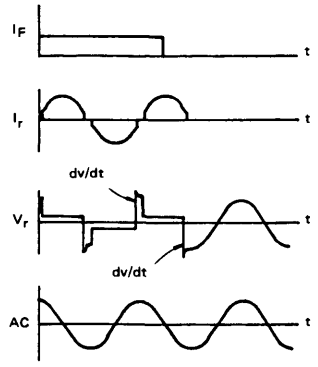


Fig. 2-51 Inductive lead connection and various waveforms

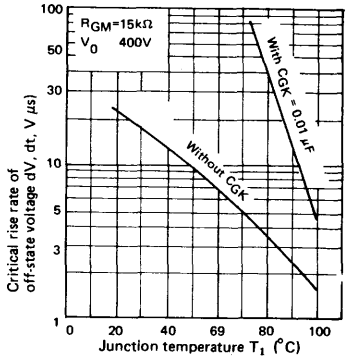


Fig. 2-52 dV/dt vs. T_J

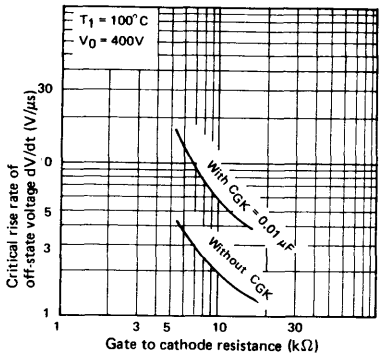


Fig. 2-53 dV/dt vs. R_{GK}

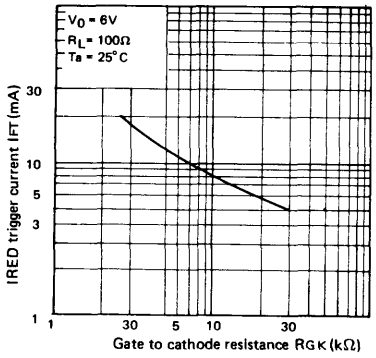


Fig. 2-54 I_{FT} vs R_{GK}

Table 2-11 Object to Interface for Control Circuits

Application	Examples
Motor Control	Sequence controller, automatic vending machine, ECR, sewing machine, air-conditioner, automatic door, automatic
Light Control	Fluorescent lamp dimmer, stage lighting advertisement lighting, traffic signal, game machine
Temperature control	Duplicator, panel heater, electronic cooker
To Prevent Disasters	Fire alarm, gas alarm, circuit breaker, various indicators

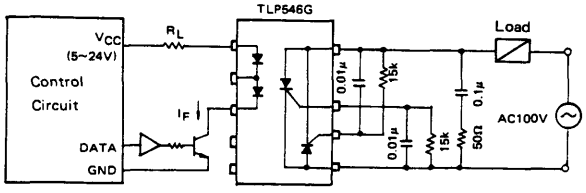


Fig. 2-55 TLP546G application

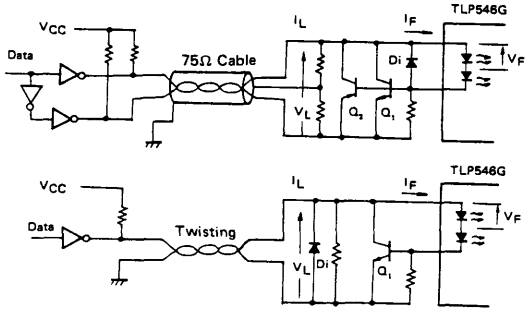


Fig. 2-56 Logic systems interface application

When switching an inductive load in this regard, it must be noted that load current flows with $\pi/2$ phase lag in reference to the power source. Also, with the fact that two photo thyristors are connected in a reverse parallel connection in the TLP546G, as shown in Fig. 2-51, when photo thyristor 1 turns off, the maximum power source voltage is suddenly applied to photo thyristor 2 in a forward bias direction. Displacement current, i, caused by this steep voltage increase, functions with an effect similar to that by photo current $I_{P\lambda}$ and fires photo thyristor 2 when a condition of $\alpha PNP+\alpha NPN \geqq 1$ is met.

The dV/dt value is meant to be a limitation wherein the photo thyristor never fires due to this voltage increase. Moreover, as this dV/dt value decreases with junction section temperature T_j, increase, it must be taken into adequate consideration. Figure 2-52 shows the TLP546G's dV/dt vs. T_j, characteristics.

For preventing applied circuits from being affected by this dV/dt effect, there is a countermeasure that a resistance R_{GK} and a condenser C_{GK} are connected in parallel between photo thyristor's gate and cathode. This measure is to bypass the displacement current, i, shown in Fig. 2-49, into a cathode for suppressing α increase. The effects resulted from connecting R_{GK} and C_{GK} for the TLP546G are shown in Fig. 2-52 and 2-53.

○ **Trigger LED current**

A photo current $I_{P\lambda}$ caused by a forward current I_P fires a thyristor following the previously mentioned turn-on process. This minimum required forward current is defined as trigger LED current I_{FT} in this regard. The I_{FT} increases with R_{GK} connection. This is because a fraction of $I_{P\lambda}$ leaks into the photo thyristor's cathode. The TLP546G's I_{FT} vs. R_{GK} characteristics are shown in Fig. 2-54.

(d) TLP546G Application Examples

The TLP546G can be applied to wide spectrum applications, ranging from control circuits made up on various ICs, such as microcomputers, to a case where a small motor operating at 100 V AC, heater solenoid, relay, lamp etc., are driven directly. Table 2-11 shows control circuit examples that become an object of thyristor interface. Also, Fig. 2-54 shows a representative circuit example.

Although trigger LED current I_{FT} in case R_{GK} is equal to 15 kΩ, is less than 10 mA, an I_F nearly equal to 20 mA is recommended, considering the element's yearly deterioration, environment temperature and turn-on lead time, together with assuming overdrives approximately two times as large. Also, in case cable or twisted pair wire is used for remotely operated AC control, erroneous behavior or input LED breakdown is sometimes caused by large line current variation due to external noises. For this prevention, a protection circuit for input LED for suppressing drive current becomes necessary. This example is shown in Fig. 2-55. A characteristic chart for input LED's bias condition is shown in Fig. 2-56 for a case where a current I_L from a line driver shown in Fig. 2-55, varies both positively and negatively. This chart is divided into the following four operational regions.

① Non-triggered region: No forward bias current leads before I_L reaches a constant value.
② Triggered region: Forward bias current necessary for firing leads.
③ Forward bias current protection region: Excessive I_L is absorbed by a transistor Q_1 and I_F is preserved within rating values.
④ Reverse bias voltage protection region: Reverse bias voltage is absorbed by diode D_1 and transistor Q_2 and LED's reverse bias is preserved within rating values.

* * *

The TLP546G, with no contact point construction functionally replacing DIP-type lead relays with respect to product external shape and load switching capacity, is assumed to be the simplest solid-state relay (SSR) from structural viewpoints with additional benefits of high-reliability factors.

The authors expect that the high-power thyristor coupler will continue to expand its application range together with microcomputer prevalence, covering not only industrial use equipment but also home electrical appliances.

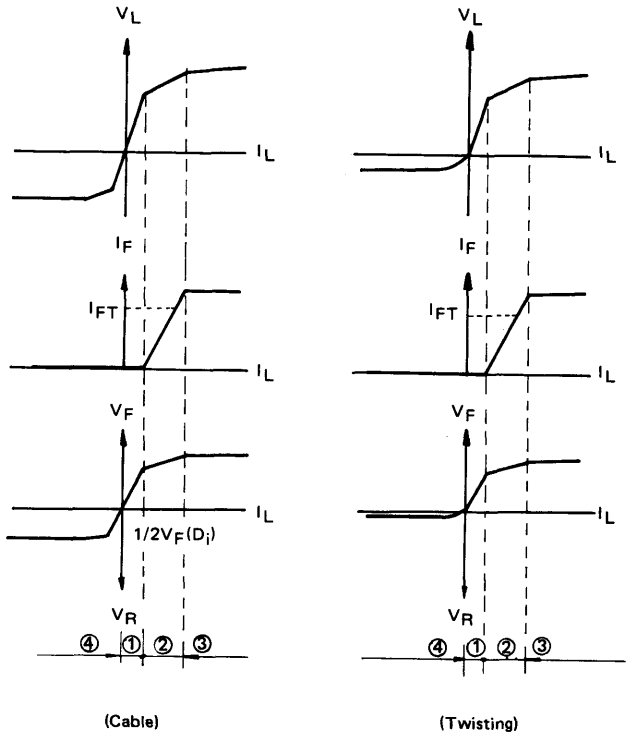


Fig. 2-57 Figure circuit rough characteristics

2-2-3 High-Speed Photo Coupler (TLP552)

Recently, with the advancement of office automation, various applied products using CPU for office and industrial uses are produced and high speed processings through digital control are increasingly demanded. With such a background necessity for high-speed response which cannot be realized by conventional photo transistor couplers has been increased for interfaces among various systems.

In designing the high-speed photo coupler TLP552, which has been newly developed by Toshiba, materials for high-speed response light emitting element have been carefully selected and photo-electric IC that can be connected to TTL has been designed with extreme care so that this photo coupler has same construction as that of our conventional photo couplers. As a result isolation performance of this newly developed photo coupler can be guaranteed at 2.5 kV rms which is the same level as that of Toshiba's white mold coupler and high response speed of approx. 70 ns has been obtained. Extensive use of this photo coupler is expected as a popular product of high-speed photo coupler in the future.

Preface

In recent years, degree of integration of microprocessors, memories, etc. has been greatly improved and also, logic analyzers for supporting digital circuit designing which is becoming highly precise have become extensively used. As a result, products for industrial and office use have been rapidly progressed. In particular, computers which are the intensive systems of semiconductor products, coupled with arrival of the office automation age, are expected to grow at an annual rate of 30%. Further, industrial electronic equipment have become highly efficient, multi-functioned and large scaled as a result of active use of microprocessors, memories, etc.

With the improvement of individual systems to higher level of efficiency, interfaces which are capable of accurately exchange data at high speed have become demanded. However, the system design is troubled by various problems existing on transmission lines. For instance, if offset voltage due to ground loop is generated, loop current may flow between systems and finally damage equipment. To solve these problems use of optical fibers for long distances and photo couplers for short distances is effective.

Photo couplers which are generally used for digital data transmission at present are photo transistor output type. Response frequency of these photo couplers, if they are reasonably designed, will be DC ~ several tens kbit/S. However, as reduction of data transmission waiting time between systems is desired and when loop process between circuits is performed at high speed, adjustment of timing resulted from propagation delay of a photo coupler becomes necessary.

Thus, it has become not possible to ignore propagation time of data or command between systems or circuits. When a photo transistor coupler is operated at marginal high speed and connected to a logic IC at the rear stage, it also becomes necessary to design a discrete circuit which match with the rear stage. Further, a careful design with conditions under adverse environment considered is demanded for automation systems which are used in production line. (process controller, NC equipment, robot, etc.).

Existing photo couplers which is capable of high speed processing are in most simple construction of GaAs LED and photo diode. However, as output photo current is as low as several tens μA, it is necessary to design a high gain and high speed amplifier. It is considered that a wide application of this type of photo couplers in high speed signal circuits had been delayed for this reason.

In order to respond the above market needs, Toshiba has newly developed the high-speed photo coupler TLP552 which connected a light emitting element of high speed response and a logic output type light detective IC. Selection of the element, its structure, basic characteristics and application of this high-speed photo coupler TLP552 are described here.

I/O Component Elements and its Internal Structure

In designing the construction of a photo coupler, it is necessary to examine response characteristics of light emitting element and light detective element individually.

Light emitting elements have different characteristics according to external quantum efficiency attributable to their materials and pulse response characteristics as shown in Table 2-12. The material of emitting element which is generally used is a Si doped GaAs. LED by the liquid phase grown method with wavelength λ = 9,400 Å. It has an extremely large light emitting output and external quantum efficiency of about 5 ~ 10%. However, this GaAs LED has a defect of low pulse response speed of about 500 ns and it cannot be used for the high-speed photo coupler.

Table 2-12: Response Characteristics of LED

Material	I_F = 7.5mA Response Time (ns)	External Quantum Efficiency (%)
GaAs	500	8
GaAsP	40	0.2
GaAlAs	50	3
GaP	300	3

According to this reason, an element that has response characteristics suited to the high-speed photo coupler is used a GaAsP LED but its external quantum efficiency is lower than GaAs LED by about 1 ~ 2 digits. Therefore, it is necessary to design a distance to be short between light emission and defective elements so that transmission efficiency between light emission and defective is improved. However, such construction remarkably reduces isolation voltage between input and output, which is the most important item of the photo coupler. As this counterplan, the following methods are adopted. One method is to insert an insulation film such as teflon which is sufficiently transparent to emitting wavelength of LED between input and output as shown in Fig. 2-58. Another method is to close fit LED and a defective element with a thin spacer which has high dielectric strength (a glass sheet, etc.) inserted between them as shown in Fig. 2-59. By these counterplan, the internal creeping distance between conductors including input/output leads which are discharging routes is extended.

However,these manufacturing methods are more complicated than that of conventional photo couplers and require a new assembly technique. Furthermore, there is some danger that because of a short distance between the light emitting and detective elements, the variance of coupling characteristics will increase. In view of above, Toshiba has concluded that

a GaAlAs LED which has high external quantum efficiency is optimum for the high-speed photo coupler. Because its response characteristics are somewhat worse than GaAsP LED.

As GaAlAs LED has larger photo output than that of GaAsP LED, sufficient coupling efficiency is obtained between the emitting and detective elements and it is possible to design a photo coupler with a wider distance between the emitting and detective elements. For this reason, we have become to consider only high sensitivity. Then, the high speed photo coupler TLP552 has been designed in the same structure as in conventional photo couplers.

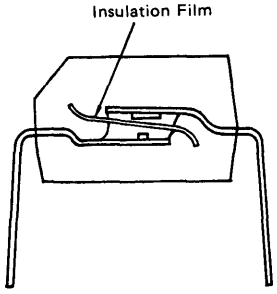


Fig. 2-58 Isolation method with insulation film

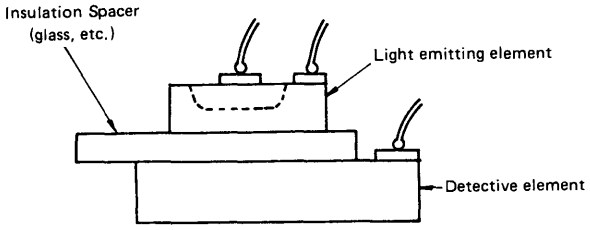


Fig 2-59 Isolation method with galss sheet

When a PIN photo diode is assembled using a GaAlAs LED as a light emitting element, output current in such a structure as shown in Fig. 2-60 is no more than several tens μA. As output current of currently available photo transistor is also about several mA, sufficient output cannot be obtained. For response characteristics between the input and output elements, it is necessary for the photo transistor coupler to enlarge the joining surface between the collector and base, which is its light receiving section in order to increase light detective sensitivity. For this reason, its junction capacity is amplified and made large due to mirror effect. Therefore, response speed becomes inevitably slow and even when an applicable load circuit is designed, maximum response speed will become about 100 kbit/s.

There is also a method to separate a photo diode and a transistor for amplyfication but sufficient high-speed cannot be expected because of capacity between the collector and base of a transistor for amplification. So, the light detective element of the TLP552 has been made of monolithic IC type which consists of a PIN photo diode with a high gain high-speed linear amplification circuit and a Schottky transistor to its final stage for open collector output.

The cross section of the TLP552 using the above-stated emitting and detective elements is shown in Fig. 2-60 and its pin arrangement in Fig. 2-61. A GaAlAs LED and Si light detective element have been die bonded and wire bonded to independent lead frames, respectively. And the lead frames of the LED and light detective elements are placed to face each other and the optical centers of the elements agree each other, with transparent silicon resin filled between the facing elements and white epoxy resin transfer molded. Thus, it is possible not only to make the structure simple but also to improve positioning accuracy of the light emitting and detective elements as well as to minimize breakup of coupling characteristics.

Basic Characteristics of High-Speed Photo Coupler (TLP552)

- **Isolation characteristics**

The TLP552 has employed a structure similar to that of Toshiba's conventional photo coupler TLP521 Series. And materials which have excellent mutual adhesiveness as white mold resin for external coating and clear silicon resin for internal coating have been selected. Consequently the isolation voltage between input and output of the TLP552, which is the basic characteristics of photo coupler, can be guaranteed at 2.5 kVrms (peak 3.550V).

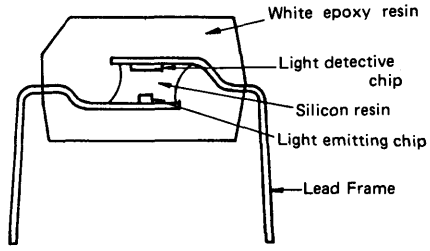


Fig. 2-60 Cross Section of TLP 552

Further, on an output IC photo coupler, as the amplifier gain after transfering photo signal to electric signal has been designed at high level, it is necessary to pay attention to common mode noise applied between input and output. As the TLP552 has been designed with the wider internal distance between input and output, it acts advantageous against noise as shown in Fig. 2-62 and Fig. 2-63.

The upper state in Fig. 2-63 is output waveform of a photo coupler with a distance shortened by method of a film inserted the middle stage is output waveform of the TLP552 and the lower stage is waveform of common mode noise. If noise of about 10V/25ns (≈400V/us) is applied between input and output when the input LED is OFF, the output terminal cannot be kept at OFF state and is instantaneously at ON state. On the TLP552, noise can be reduced at about 1/3.

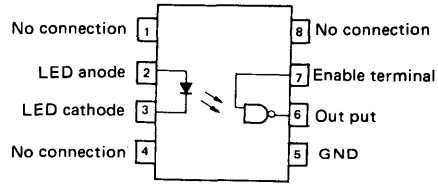


Fig. 2-61 Pin Arrangement of TLP552

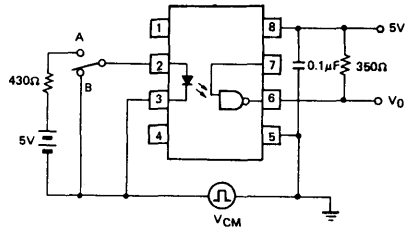
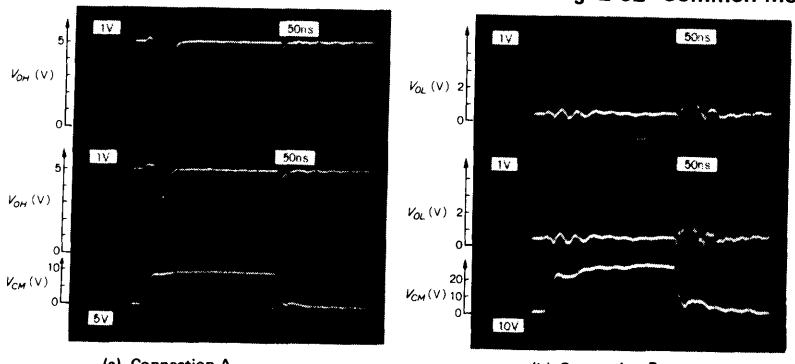


Fig. 2-62 Common Mode Noise Measuring



Upper Stage:
Output noise waveform of film type system
Middle Stage:
Output noise waveform of TLP552
Lower Stage:
Common mode noise

(a) Connection A
(CMH: High Output Level)

(b) Connection B
(CML: Low Output Level)

Fig. 2-63 Common Mode Noise

Then, when the output IC is placed in ON state by applying power to the input LED, the output begins momentarily to OFF. There are also some differences as shown in Fig. 2-64.

- **Response characteristics**

A GaAlAs has been selected as a light emitting element. As shown in Fig. 2-64, t_{PHL} ~ 75 ns and t_{PLH} ~ 65 ns have been obtained, which are nearly satisfactory values for the originally aimed coupling response characteristics with CMOS and TTL. The measuring circuit is shown in Fig. 2-65. Further, the TLP552 has been designed to suppress temperature Change speed of the amplifiers speed. And almost flat temperature dependence characteristics of response has been obtained as shown in Fig. 2-66. This is one of the excellent characteristics of the TLP552.

Further, this response time changes depending upon input current I_F and load resistance R_L but not much change is observed because of effect of the output Schottky transistor.

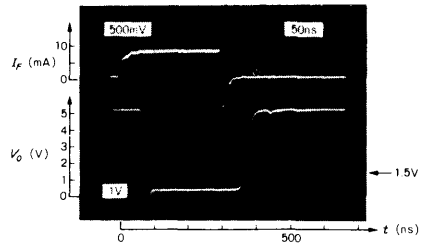


Fig. 2-64 Switching Operation Waveform

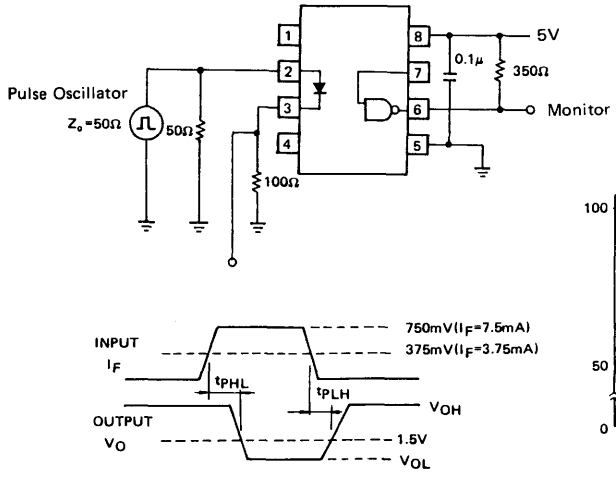


Fig. 2-65 t PHL,tp LH Measuring Circuit

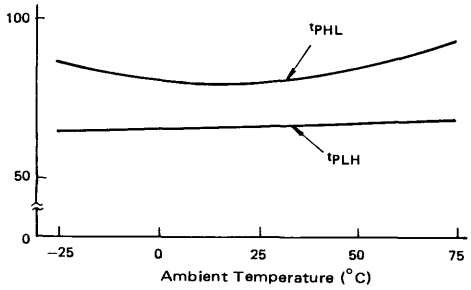


Fig. 2-66 Temperature Dependency of Switching Speed

- **Input driving current**

As gain is obtained by the linear amplifier, it is possible to take low level output current I_{OL} by more than 13 mA at LED driving current I_F = 5 mA, which is the same level of the general use TLP521 Series. This has ability to connect about 8 standard TTLs. LED can be directly driven by TTL and its output can drive TTL. The important characteristics of the TLP552 are described as following.

(1) Output low level voltage:
$V_{OL} \leqq 0.6V$ (I_F = 5 mA, I_{OL} = 16 mA, V_{CC} = 5.5V, Ta = 0 ~ 70°C, C = 0.1 μF)

(2) Output high level current:
$I_{OH} \leqq 250\ \mu A$ (I_F = 250 μA, $V_{CC} = V_O$ = 5.5V, Ta = 0 ~ 70°C, C = 0.1 μF)

C = 0.1 μF in the above conditional items is required for stabilizing power supply Vcc. If frequency impedance of the power supply is high, the linear amplifier which is contained in TLP552 may become unstable and low level voltage of above-stated output may not act properly. Low impedance bypass capacitance (ceramic capacitance) is desirable for a condenser of 0.1 μF.

Effect of load resistance is shown in Fig. 2-67. When load resistance is increased, input LED current can be somewhat reduced but there is almost no difference. From the output low level voltage standard of the above (1) including temperature dependence characteristics, I_F = 7 ~ 15 mA is set as the recommended value. Further, if switching speed is considered to be important, load resistance should be set at R_L = 350Ω.

- **Enable Terminal**

Pin 7 in Fig. 2-62 is the enable terminal. When voltage of 0.8V or less is applied to this terminal, output voltage is kept at high level and becomes independent of input LED signal.

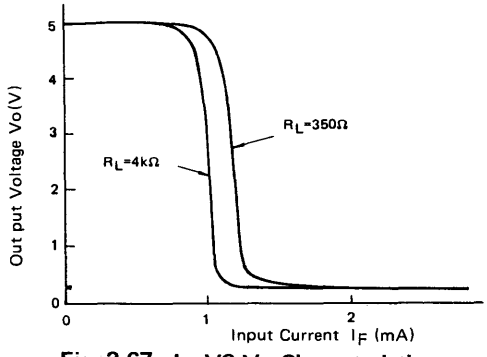


Fig. 2-67 I_F VS Vo Characteristics

Application of High-Speed Photo Coupler (TLP552)

In transmitting digital signals, there is the possibility of generating ground loop or ground shift. When a photo coupler is used, ground loop current can be sharply reduced and even when some large noises are applied, internal damages can be prevented by the photo coupler. As an example of application, the basic circuit when the TLP552 is used as a line receiver is described here.

In terminating a transmission line, the following 3 items become important:

(1) Setting of LED forward current I_F that can be properly ON/OFF.
(2) Adjustment of delay time difference t_{PLH} and t_{PHL} between sending signal and receiving signal.
(3) Load matching to reduce reflection on a low loss and high-speed use.

Here, a design example of line termination that completely satisfies (1) and nearly satisfies (3) of the above design items is performed on a circuit shown in Fig. 2-68.

The design conditions are as follows:

(1) Characteristic impedance: $Z_O = 75\ \Omega$
(2) Photo coupler's forward current: $V_F = 1.7V$ at $I_F = 10$ mA
(3) Input current for output ON: $I_{FT} = 10$ mA
(4) Matching with characteristic impedance at $I_F = I_{FT}$
(5) Set a sum of line resistance and impedance at line driver side at 25Ω.
(6) Release voltage of a source line
Application voltage E_0 assumed to be 3 V.

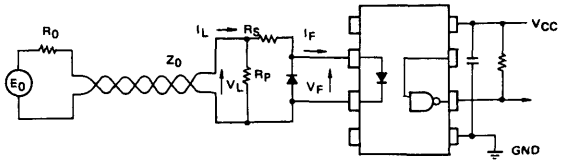


Fig. 2-68 Application to Line Termination

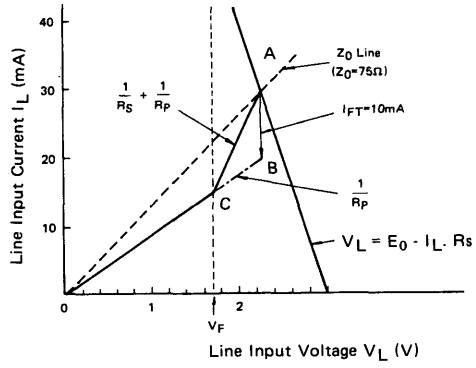


Fig. 2-69 Line Termination Design Graph

With the above conditions, obtain resistance values R_P and R_S which have been set for the line termination. Perform the design in order of numbers in circles in Fig. 2-69.

(1) Draw a characteristic curve at line input ON state:
$V_L = E_O - I_L \cdot R_S$
(2) Draw Z_O line.
(3) Removing $I_{FT} = 10$ mA from the intersecting point A of the termination ON line and the Z_O line, obtain Point B.
(4) Connect Point B and the original point. As this slope indicates current flowing to R_P,

$$R_P = \frac{2.5\ (A)}{20\ (mA)} = 125\ (\Omega)$$

(5) Connect Point C and Point A. As this slope indicates current flowing to R_P and R_S,

$$\frac{1}{R_S} + \frac{1}{R_P} = \frac{19.5\ (mA)}{2.15 - 1.7\ (V)} \quad \therefore R_S = 28\Omega$$

From standard resistance values, $R_P = 120\ \Omega$ and $R_S = 27\ \Omega$.

Reflection coefficient according to this calculation method is positive before input LED is ON. Therefore, when a photo coupler is OFF, a reflection accompanying vibration may be caused on a transmission line, however, this vibration is normally at low level and it is possible to design the most simple termination.

2-2-4 Application of Photocoupler

(a) General matters

A photocoupler is a composite device for transferring signals between the electrically isolated input and output optically.

The signal transfer process is, "input electrical signal" → "light signal" → "output electrical signal" and it is almost one way process without any reverse transfer.

As light sources of a photocoupler are mostly used GaAs infrared emitting diodes (IRED) grown by liquid phase epitaxy. This is because their luminous intensity is high, and their emission spectrum is efficiently coupled to silicon detectors.

The Toshiba-photocoupler has usually liquid expitaxial grown GaAs infrared emitting diodes with high emission efficacy of 7 ~ 10% and peak emission wave of length of 940nm.

Utilization of photocouplers

The characteristics of photocouplers such as an electrical isolation between input and output and one way transfer of the signal, provide the following utilization.

(1) Substitution of the mechanical relay and the pulse transformer.
(2) Noise elimination between circuits.
(3) Interface between circuits of different potential.
(4) Interface between circuits of different impedances.

Usefulness of the 4 pin type photocoupler

Although the 6PIN DIP photocoupler is used in general, the 4PIN type TLP521 series is useful in case the high-density mounting is required on a printing board. That is the case of an assembly of a sequence controller and SSR. Mounting density of this series is 1.5 times higher than that of the 6 pin type.

(b) LED Controle Circuit

Direct-current voltage drive

An example of controlling IRED drive current by switching on and off the power supply, is shown in Fig. 2-70.

In this case, resister R is

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

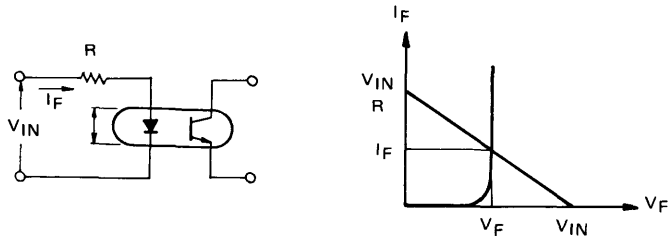


Fig. 2-70 Simple drive circuit for an LED

For example, when I_F = 10 mA, $V_{F(MAX)}$ = 1.35V, and V_{IN} = 5V

$$R = \frac{5 - 1.35}{10\,mA} = 365\Omega$$

Therefore, it should be at R = 360Ω. Assuming that V_F = 0.9V due to its fluctuation, the value of I_F is 11.4 mA.

IRED Protection from inverse voltage

When an inverse surge voltage is applied on a light emitting diode, a Si diode (for example, 1S1588) should be connected in reverse parallel with the light emitting diode so that the inverse surge voltage bypasses the LED.

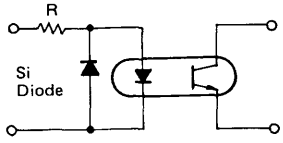


Fig. 2-71 Protection from inverse voltage by Sidiode

Threshold voltage

When the input voltage is not absolutely zero or some uncontrolable steady current flow is in a data transmission line, the threshold voltage of IRED should be raised up to a certain level by connecting a resistor in parallel with the light emitting diode. (Fig. 2-72)

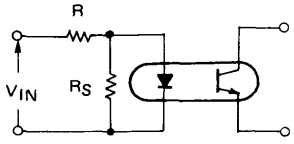


Fig. 2-72 Obtaining the threshold voltage of IRED which is in the zero emission

If the forward voltage of IRED which is in the zero-emission V_T, the off-level input voltage $V_{IN(OFF)}$, and the off-level input current $I_{IN(OFF)}$ are given by

$$V_{IN\ (off)} = V_T + R\frac{V_T}{R_S}$$

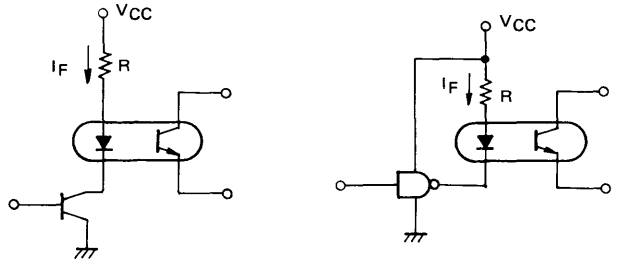
$$= \left(1 + \frac{R}{R_S}\right) V_T$$

$$I_{IN(off)} = \frac{V_T}{R_S}$$

In the case of the Toshiba-IRED, the value of V_T is 0.5V.

Driving by transistor or IC

In Fig. 2-73 are shown examples of IRED driving circuits by using transistor or IC.



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

Fig. 2-73 Driving by transistor or IC

Driving by alternating voltage

In this case, a rectifying bridge is used as shown in Fig. 2-74.

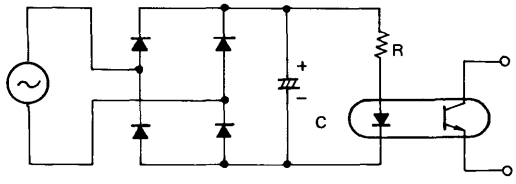


Fig. 2-74 Driving by alternating voltage

(c) How to use photocouplers

Phototransistor coupler

(1) Use of base terminal

The transistor action of a output photo transistor, is achieved by receiving a light signal from LRED. Then the base terminal of the transistor is not necessary in general so that elements are used without the base terminal. However, the base-terminal is used in the case of forward current threshold action, and improvement of the dark current, inearity, and switching speed of photocouplers.

○ **Improvement of dark current**

The dark current of an output phototransistor increases exponentially with respect to temperature. When we use the circuit in Fig. 2-75 and the output voltage level is decreased by this effect, certainly it is possible to transfer wrong signals to the next stage. Adding a resistor between the base and emitter terminal to pass the leakage current at the collector-base junction(I_{CBO}) to R_{BE} makes it possible to decrease both the dark current and the wrong effect to the next stage. In Fig. 2-76 is shown an example of I_D-R_{BE} characteristics. (See the respective data in detail)

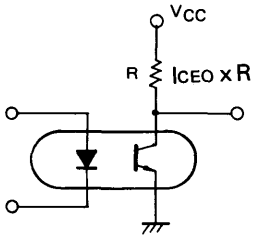


Fig. 2-75 Basic circuit

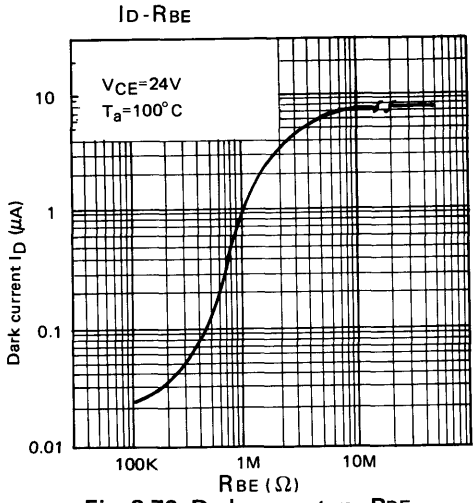


Fig. 2-76 Dark current vs. R_{BE}

- **Forward current threshold action**

Fig. 2-77 shows the relationship between the forward current IF of LED and the collector current I_C of phototransistor. If the resistor R_{BE} is added between base and emitter, the photocurrent I_{PB} is bypassed through R_{BE} and the collector current cannot flow until the $V_{BE\ (on)}$ voltage appears, as shown in Fig. 2-78. For example, when R_{BE} = 0.2 MΩ, collector current I_C < 0.1 mA and I_F = 1mA, the collector current decreases to one tenth of its value in case of R_{BE} = ∞. This shows that the forward current threshold action is possible by adding a suitable value of R_{BE}. This is effective in preventing spurious noise signals appearing at the input side.

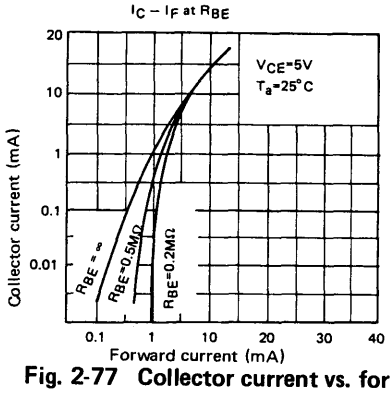


Fig. 2-77 Collector current vs. forward current

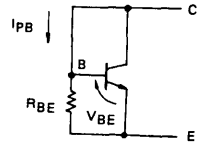


Fig. 2-78

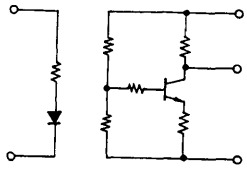


Fig. 2-79 Bleeder Method

- **Improvement of linearity**

The collector current of an phototransistor is large because the photo-electric current I_{PB} is amplified by h_{FE} of a transistor. However, the collector current is unstable due to the fluctuation of h_{FE} depend on I_{PB}, V_{CE}, and temperature. Generally, for linear application, the collector voltage is set at about half of the supply voltage, however, the transistor action point is shifted for the above reason.

In order to stabilize the collector voltage, it is better to use DC biasing by the bleeder method as shown in Fig. 2-79.

(2) Common noise at the base terminal

When a photocoupler with a base terminal is used, the base terminal acts like an antenna in the open state and picks up a noise. In particular, when a high pulse voltage is applied between the input and output, the induction noise from the base lead terminal and the noise from the capacitance between the input and output are added together to act as an input signal. In this case, adding a capacitance (C_{BE}) between the base and emitter is able to absorb the transitional noise from the base terminal and prevents the error action. However, care must be taken regarding the slowering of response time(examples is shown in Fig. 2-80)

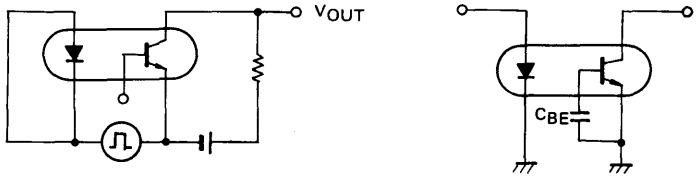


Fig. 2-80 Common noise absorption by C_{BE}

(d) Designings of a circuit using phototransistor coupler

A typical application of the phototransistor coupler is for transmission of digital signals. For longterm stable operation, the following parameters should be considered for circuit designing, data speed, logic families of interface, fluctuation of the power supply and parts used, rated value of elements,

(e) Basic Circuit Design

Design of Interface Circuit between TTLs using Photo Coupler

A circuit using a DIP 4 pin photo coupler as an interface between TTLs is shown in Fig. 2-81. In order to assure positive ON/OFF operation of TTL, LED current I_F should be set to satisfy I_{OL} which is decided by R_C and I_{IL}.

Example of Design Specifications

Operating temperature:	0 ∿ 70°C
Data speed:	5 k bits/sec
Supply voltage:	V_{CC} = 5V ± 5%
Operating life:	20 years (170,000 hours)
System working ratio:	50%

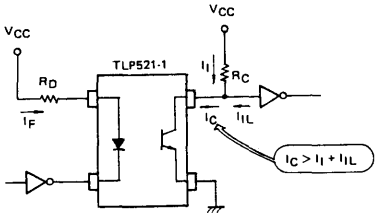


Fig. 2-81 Interface Circuit between TTLS using 4 pin photo coupler

Specifications for products required for designing are shown in Table 2-13.

Table 2-13: Principal Characteristics of Photo Coupler

Item	Symbol	Measurement condition (Ta=25℃)		min	typ	max	Unit
Voltage	V_F	I_F=10 mA		1.0	1.15	1.3	V
Voltage between collector and emitter	$V_{(BR)CEO}$	I_C=0.5 mA		35			V
Voltage between emitter and collector	$V_{(BR)ECO}$	I_E=0.1 mA		5			V
Dark current	I_{CEO}	I_F=0, V_{CE}=24V		—	10	100	μA
		I_F=0, V_{CE}=24V, Ta=85℃		—	2	50	μA
Conversion efficiency	CTR (I_C/I_F)	I_F=5 mA, V_{CE}=5 V	A rank	50	—	600	
			GB rank	100	—	600	
			GR rank	100	—	300	
			BL rank	200	—	600	
Collector saturated voltage	$V_{CE(sat)}$	I_F=5 mA, I_C=1 mA		—	0.1	0.4	V

▼ **Setting of R_C (max)**

Set $R_{C\ (max)}$ by both or either one of switching time and dark current $I_{CEO\ (max)}$ at max. operating temperature of the photo coupler.

The relation between switching time and R_L (load resistance), R_C is shown as following.

As switching speed is 5 kbits/sec in data sheet, total switching time is obtained

$T=tr+td+tf+ts \leqq 200\ \mu s$

Load resistance R_L is obtained from the switching time (saturation operation) characteristic in Fig. 2-82 so that $T = 100\ \mu s$ is obtained taking variation of elements into consideration in order to secure $T \leqq 200\ \mu s$. From this graph, $R_L = 4.7\ k\Omega$ is obtained. Here, R_L can be expressed by parallel resistance of the standard TTL input resistance P_{IN} and R_C. (Fig. 2-83)

$R_L = R_C // P_{IN}$

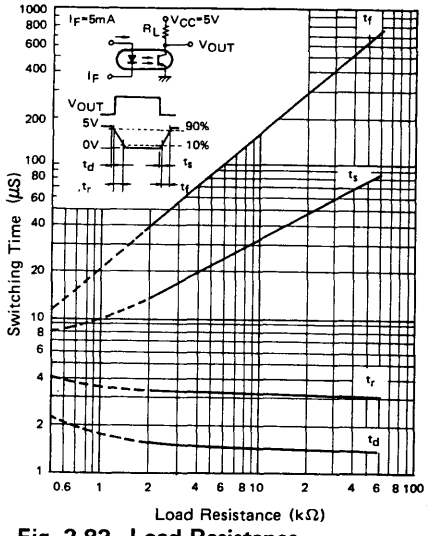


Fig. 2-82 Load Resistance VS. Switching Time

As $R_L = 4.7\ k\Omega > R_{IN} = 4\ k\Omega$, R_C may be indefinite ($R_C = \infty$) but $R_{C\ (max)}$ corresponding to dark current $I_{CEO\ (max)}$ is limited.

The relation between $I_{CEO\ (max)}$ and $R_{C\ (max)}$ is shown below.

$$R_{C(max)} = \frac{V_{CC(max)} - V_{IH}}{I_{CEO(max)} + I_{IH}}$$

Then, $I_{CEO\ (max)}$ at Ta = 70°C is estimated. Temperature dependency of $I_{CEO\ (typ)}$ with a parameter of V_{CE} = 5V/10V/24V is shown in Fig. 2-84.

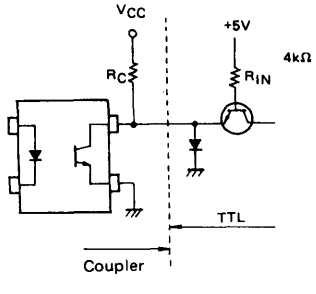


Fig. 2-83 R_L can be expressed by R_{IN} and R_C

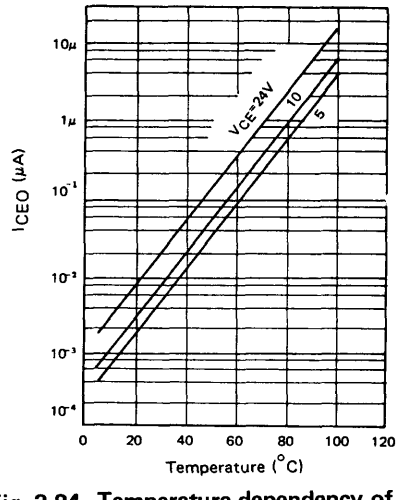


Fig. 2-84 Temperature dependency of I_{CEO}

In the case of the TLP521-1, $I_{CEO\ (max)}$ = 50 μA at Ta = 85°C and V_{CE} = 24V and therefore, taking V_{CE} dependency and Ta dependency into consideration from Fig. 2-84, $I_{CEO\ (max)}$ at Ta = 70°C and V_E = 5V is estimated.

V_{CE} dependency: $I_{CEO(typ)}$ is 1/4 times at V_{CE} = 24V to 5V

Ta dependency: $I_{CEO(typ)}$ is 1/4 times at Ta = 85°C to 70°C

Therefore, $I_{CEO(max)}$ at Ta = 70°C and V_{CE} = 5V is estimated to be,

$$I_{CEO} = 50\,\mu A \times \frac{1}{4} \times \frac{1}{4} = 3.1\,\mu A$$

Accordingly, $R_{C\ (max)}$ will be obrained as following

$$R_{C(max)} = \frac{4.75V - 2V}{3.1\,\mu A + 40\,\mu A} = 64\ k\Omega$$

▼ Setting of Forward Current I_F

Maximum forward current I_F is I_F = 16 mA from $I_F = I_{OL}$ and maximum tolerable value of I_F is I_F = 50 mA from Fig. 2-85. However, it should be kept at minimum required as secular change of conversion efficiency CTR increases with the increase of forward current. Fig. 2-86 shows secular change of CTR. In order to expect the continuous operating life of approx. 100,000 hours, forward current should be set at I_F = 10 mA ± 50%.

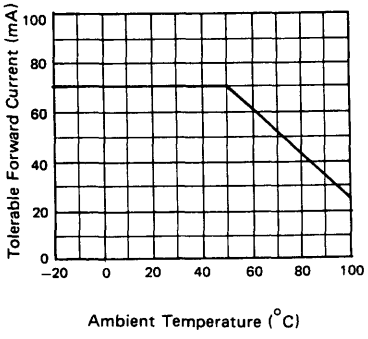


Fig. 2-85 Ambient Temperature vs. Tolerable Forward Current (TLP521-1)

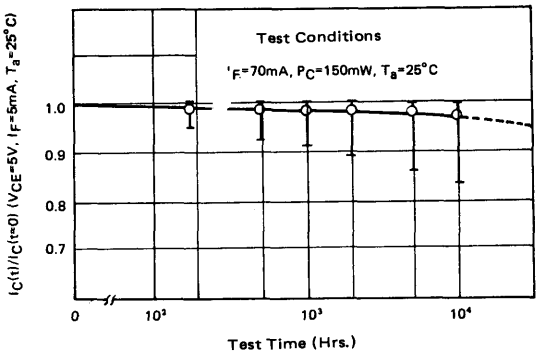


Fig. 2-86 Life Test Data

▼ Setting of I_F Limiting Resistance R_D

Forward Current (typ.) is expressed by the following equation:

$$I_F = \frac{V_{CC} - V_{F(typ)} - V_{OL}}{R_{D(typ)}}$$

where $V_{F(typ)}$ is obtained from a technical data.
then, $V_{F(typ)}$ = 1.15V (at I_F = 10 mA)

Therefore, R_D is given as following.

$$R_D = \frac{5V - 1.15V - 0.4V}{10\,mA}$$

$$= 345\Omega$$

Therefore, R_D = 330Ω ± 5% will be optimum.

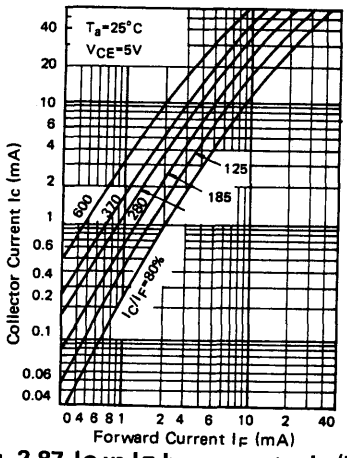


Fig. 2-87 I_C vs I_F by parameter I_C/I_F

When $I_{F(min)}$ and $I_{F(max)}$ should be checked to make sure,

$$I_{F(min)} = \frac{V_{CC(min)} - V_{F\ (max)} - V_{OL}}{R_{D(max)}}$$

$$= \frac{4.75V - 1.3V - 0.4V}{314\Omega}$$

$$= 9.7\ mA$$

$$I_{F(max)} = \frac{V_{CC(max)} - V_{F(min)} - V_{OL}}{R_{D(min)}}$$

$$= \frac{5.25V - 1.0V - 0.4V}{347}$$

$$= 11.1\ mA$$

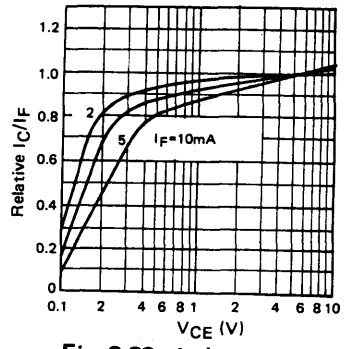


Fig. 2-88 I_C/I_F vs. V_{CE}

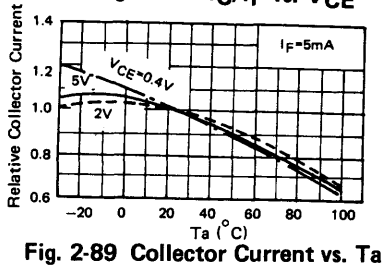


Fig. 2-89 Collector Current vs. Ta

▼' Setting of Pull-Up Resistance R_C

When a value of collector current I_C in the worst case is assumed to be min I_C, it can be expressed by the following relation:

$$R_C = \frac{V_{CC(max)} - V_{OL}}{\min I_C - I_{IL}}$$

$$\min I_C = I_{C(min)} \times D_t \times D_{IF} \times D_{VCE} \times D_{Ta}$$

where,

D_t : I_C deterioration rate after certain time has passed.

D_{IF} : I_C change rate at I_F setting for catalog conditions.

D_{VCE} : I_C drop rate under $V_{CE(sat)}$ condition.

D_{Ta} : I_C fluctuation rate within operating temperature T_{OPR}.

These values are obtained from technical data.

In the case of the TLP521-1:

From Fig. 2-86, D_t = 0.5 ($t = 17 \times 10^{-5}$, H_R x 50% working ratio)

From Fig. 2-87, D_{IF} = 1.37 (I_F = 10 mA)

From Fig. 2-88, D_{VCE} = 0.86 (V_{CE} = 0.4V)

From Fig. 2-89, D_{Ta} = 0.75 (Ta = 70°C)

On the other hand, as $I_{C(min)}$ = 2.5 mA,

min I_C = 2.5 mA x 0.5 x 1.37 x 0.86 x 0.75 = 1.47 mA

However, if based on these data, the following equation can not be formed

$$\min I_C - I_{IL} > \frac{V_{CC(max)} - V_{OL}}{R_{C(max)}}$$

Therefore, a photo coupler with higher CTR should be selected. In the case of the TLP521-GB, as $I_{C(min)}$ is guaranteed to be 5 mA, min I_C will become 2.95 mA. Accordingly, $R_{C(min)}$ can be obtained as following:

$$R_{C(min)} = \frac{5.24 - 0.4}{2.95 - 1.6} = 3.6\ k\Omega$$

In other words, R_C can be set from 3.6 kΩ to 64 kΩ but it is also need to consider the switching speed, required by a system and the certainty of logical ON/OFF. If the switching speed is attached to be important, R_C should be set to be near to $R_{C(min)}$. On the other hand, if the certainty of ON/OFF operation (this may be taken as the operating life) is considered as important, a value close to $R_{C(max)}$ should be selected. In this case, since Dt is assumed to be 0.5, the switching speed should be considered to be important. So, Rc is obtained as 4.7 kΩ.

Design of TRIAC drive circuit using photo coupler

Such electronic equipment as electronic oven, duplicating machine, auto-door, etc. have become controlled by microcomputer recently and interface between power circuit and microcomputer logic becomes more and more important. In this paragraph, as a power circuit a TRIAC drive circuit which has especially wide applications is explained.

(1) Drive by Photo Darlington Coupler

Gate trigger current I_{GT} of 3 ~ 16A class TRIAC is necessary 20 ~ 50 mA. Accordingly, I_G = 40 ~ 50 mA is necessary as gate current and therefore, a photo Darlington coupler with high CTR is used. An example of this circuit is shown in Fig. 2-90.

Example of Design Specifications

Operating temperature:	−30 ~ 85°C
Switching capacity:	100V, $3A_{RMS}$
Supply voltage:	V_{CC} = 5V ±5%
Operating life:	20 years (170,000 hours)
System working ratio:	50%

First, the TLP570 is used in this example.

Design Procedures

▼ Setting of Forward Current I_F

In the same manner as in the above mentioned TTL interface, I_F is set to be 10 mA and therefore, R_D = 330Ω and $I_{F(min)}$ = 9.7 mA ≒ 10 mA are obtained.

▼ Setting of R_C

The minI_C (the minimum value) of the TLP570 is 42 mA when $I_{C(min)}$ is 100 mA (I_F = 10 mA, V_{CE} = 1.2V) and variable coefficients are assumed as following:

D_t = 0.6

D_{IF} = 1

D_{Ta} = 0.7

Therefore, R_C is calculated as following:

$$R_C = \frac{V_Z - V_{CE(sat)}}{\min I_C} = \frac{6.8\ V - 1.2\ V}{42\ mA} = 133\ \Omega$$

Therefore, R_C = 130 Ω (1/4W) is optimum.

▼ Setting of Other Constants

R_Z is given by the following equation:

$$R_Z = \frac{V_{AC} - V_Z - V_{F(D_1)}}{I_Z}$$

By substituting I_Z = 20 mA and V_F = 1V into this equation, R_Z = 4.6 kΩ is obtained. Power consumption of R_Z is $I_Z^2 R$ = 1.8W. Therefore, R_Z = 4.7 kΩ (3W) is optimum.

(2) 400V/8A TRIAC Drive Circuit

In the case of a 8A class TRIAC, gate trigger current I_G is as high as 50 mA and therefore, I_G = 100 mA is required. So, the circuit shown in Fig. 2-91 is effective.

The design procedures are briefly described below.

- As I_F = 10 mA, R_D = 330Ω
- As I_G = 100 mA, R_E = 33Ω
- As I_C = 10 mA, R_C = 470Ω

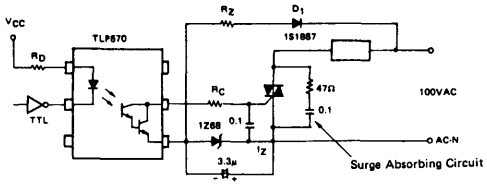


Fig. 2-90 3A TRIAC Drive Circuit

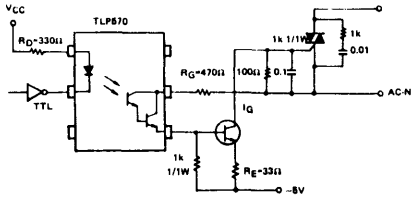


Fig. 2-91 8A TRIAC Drive Circuit

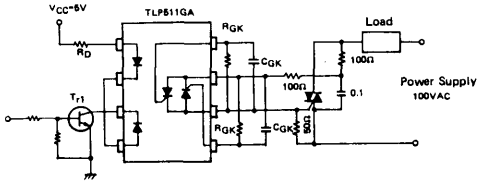


Fig. 2-92 Thyristor Coupler TRIAC Drive Circuit

(3) Reverse Parallel Thyristor Coupler Drive

The TRIAC driving through a unidirectional conducting thyristor coupler with a bridge rectifier circuit has been principally described until this paragraph. When reverse parallel thyristor couplers are used, following merits can be derived:

① A bridge rectifier circuit can be eliminated, thus reducing number of components and simplifying circuits are acceptable.

② As independent photo thyristors are reverse parallelly connected and either one is always non-conductive for half cycle, dv/dt of photo couplers does not exist intrinsically.

For these features, this type of driving is considered to be employed principally in the future. An example of the circuit using reverse parallel thyristor couplers is shown in Fig. 2-92.

Example of Design Specifications

Operating temperature:	−30 ~ 85°C
dv/dt capacity:	above 10V/μs
Operating life:	20 years (170,000 hours)
System working ratio:	50%

In this example, the TLP511GA Photo Coupler is used.

Design Procedures

▼ Setting of R_{GK}, C_{GK}

As trigger energy of photo-electric trigger is extremely less than that of current trigger, R_{GK} is set at relatively high level as 10 k ~ 33 kΩ and therefore, gate sensitivity increases and dv/dt capacity decreases. In this case, even when no trigger gate input is applied, if voltage between anode and cathode rises to exceed a certain critical value (dv/dt capacity), the circuit is turned on. This dv/dt capacity is in reverse strongly depends proportional to gate sensitivity. And it depends on R_{GK}, C_{GK} and Ta strongly as shown by (a), (b) and (c) in Fig. 2-93. From Fig. 2-93, R_{GK} and C_{GK} which satisfy dv/dt ≧ 10V/us of the design specifications are set as follows:

R_{GK} = 27 kΩ , C_{GK} = 0.01 μF

▼ Setting of Forward Current I_F

Minimum LED current $I_{F(min)}$ required for trigger is given by

$$I_{F(min)} = I_{FT(max)} \times D_{Ta} \times D_{RGK} \times D_t \times D_{toy}$$

where,

$I_{FT(max)}$: I_F value required for turn-on and 7 mA from technical data

D_{Ta} : 1.2 from temperature characteristics of I_{FT}.

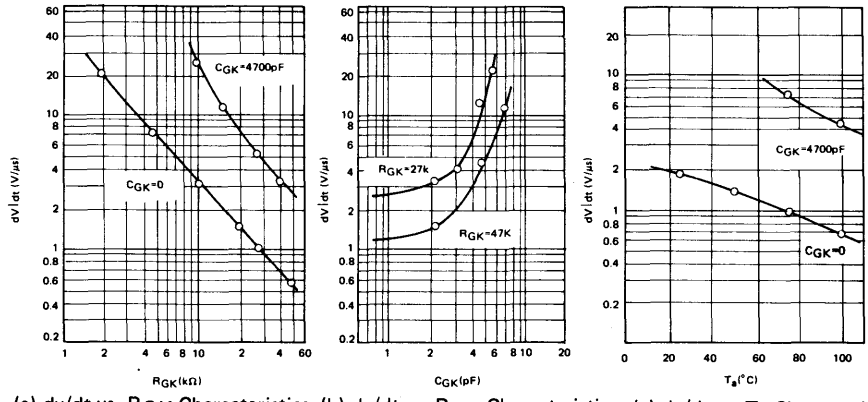
D_{RGK} : Ratio 1 which is obtained from R_{GK} dependence characteristics of I_{FT}

D_t : 1.3, Secular change of I_{FT}

D_{ON} : 2, Overdrive factor

Therefore, $I_{F(min)}$ = 20 mA is obtained. But the direct driving by TTL is impossible, so Tr_1 is used as a LED driver.

From $R_D = \dfrac{V_{CC} - 2V_F - V_{CE(sat)}}{I_{F(min)}}$, R_D = 120 Ω ± 5% is optimum.



(a) dv/dt vs. R_{GK} Characteristics (Ta=100°C) (b) dv/dt vs. R_{GK} Characteristics (Ta=100°C) (c) dv/dt vs. Ta Characteristics (R_{GK}=27kΩ)

Fig. 2-93 Thyristor Coupler Characteristics

(f) Application of Photo Thyristor Coupler

In transmitting electric signals between circuits having different grounds potential, isolation transformers (pulse transformers), lead relays have been widely used until now. However, for such problems as service life, reliability, space factor, easiness for mounting to circuit board and mounting density, photo couplers have become generally employed.

In the field of industrial control equipment, with the advancement of equipment automation and realization of central control, application of photo couplers has been further expanded. In this field, as a result of wide use of microcomputer, photo couplers are used in interfaces between CPU and I/O cards as presented by sequence controllers, and in interface between microcomputer and power device in such household electric equipment as electric oven, air conditioner and in such office machines as recording machine.

Especially, a photo thrystor coupler, when used as a power TRIAC gate trigger element, has more merits than a pule transformer and small lead relay which have been used until now.

For instance, when a pulse transformer is used, sufficient trigger pulse width enough to ignite a power TRIAC or a trigger circuit for generating trigger pulses continuously for more than 1 ms is necessary and this makes the circuit to be more expensive.

From this viewpoint, when a photo thyristor coupler is used as an ON/OFF switch of a gate circuit, power can be simply controlled only by driving input side LEDs by TTL gate. Furthermore, in the mechanical contact switching of a lead relay, phase control is not possible as response speed is slow and when operating frequency is high, its service life can be adversely affected. In this point, a photo thyristor coupler is superior to conventional pulse transformers and lead relays.

With this background, recently a photo thyristor coupler has been made available in many kinds and its range of application is more and more expanding. The fundamental characteristics, precautions in use and application circuits of these photo thyristor couplers are described here.

Turn-On Mechanism of Photo Thyristor

There are several important turn-on mechanisms of photo thyristors. The first one is the mechanism by gate current I_G which is normally applied to ordinary thyristors.

The second one is the mechanism to ignite a photo thyristor by a light from a light emitting diode, which is applied to a photo thyristor coupler.

The third one is the turn-ON/OFF mechanism through increase of leakage current I_{CO}. ICO increases by about 2 times per 8°C at high ambient temperature and a photo thyristor is turned ON/OFF in αPNP + αPNP→1. Further, if voltage between the anode and cathode rushes into the avalanche break down state by exceeding break over voltage V_{BO} of an element, a photo thyristor is turned ON by this avalanche current, which is however undesirable.

The final one is the turn-on by dv/dt. If a rapid forward voltage rise (dv/dt) is applied between the anode and cathode of a photo thyristor, the thyristor may be ignited even when that voltage applied is less than break over voltage V_{BO} of the photo thyristor and furthermore, LED current is shut off.

When an element is in forward voltage rejecting state, the center junction J_2 shown in Fig. 2-48 is reverse biased and the junction capacity C_{j2} in Fig. 2-94 is generated. If forward voltage changes rapidly, charging current i_{j2} flows to C_{j2}. because of this charging current i_{j2}, electron is injected through J_1 and J_2, respectively, thus igniting a photo thyristor as in the turn-on mechanism by the above-stated $I_{P\lambda}$ (I_F). This injected current is expressed by the following equation:

$$i_{j2} = C_{j2} \times V^{1/K} \times dv/dt$$

$K = 2 \sim 3$

V : Applied voltage

Further a critical value of dv/dt immediately before a photo thyristor is turned off is called dv/dt capacity or build-up rate of critical off voltage and expressed in V/us. As current gains of two transistors increase as a result of rise of the junction temperature T_j, dv/dt capacity is reduced as shown in the graph of Fig. 2-95. This may further increase transient voltage when the power switch is turned on and malfunction at time of commutation of inductive load and therefore, it is necessary to take measure described later.

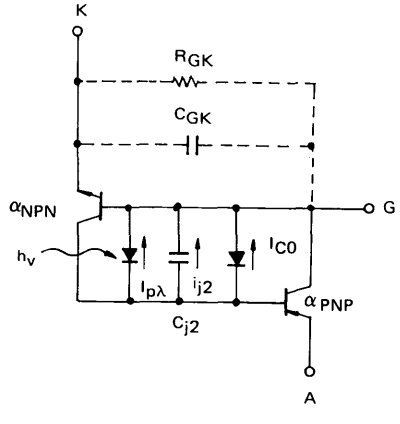


Fig. 2-94 Equivalent Circuit of Photo Thyristor

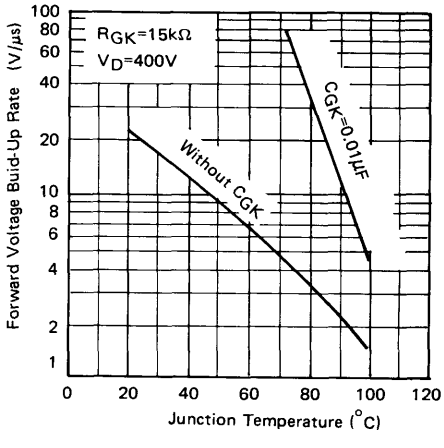


Fig. 2-95 Characteristics of Drop in dv/dt Capacity due to Junction Temperature

Basic Circuit and Erroneous Ignition Preventive Measure

Generation of dv/dt closely relates to transient voltage when the switch is turned on or off. Mechanisms for generating transient voltage applied to the photo thyristor circuit are shown in Fig. 2-96 and 2-97.

When ON/OFF of an AC circuit by a photo thyristor, the thyristor is positively turned off at an interval of 1/2 cycle. In case of resistance load, when current becomes zero, voltage also becomes zero and voltage build-up immediately after commutation shows a gentle sine wave of supply voltage.

However, in such a photo thyristor circuit of reverse parallel connection with a inductive load as shown in Fig. 2-98, immediately after current of SPT-1 drops below holding current and SPT-1 is turned off, a peak value of supply voltage is rapidly applied in the forward direction of SPT-2. If this forward voltage build-up rate dv/dt is too large, V_{BO} drops due to charging current by the junction capacity C_{j2} of the photo thyristor, and finally erroneous ignition and malfunction of the circuit and system will be caused.

So, in order to positively turn off SPT-2 (not to allow turn-off by dv/dt), it is considered as counterplan to capacitance C_1 insert to erase overshoot by load inductance (L) and insert R_1 as a resistor for limiting surge (di/dt) from a capacitor when the photo thyristor is ignited. Generally, when $R_1 = 100\ \Omega$ and $C_1 = 0.1\ \mu F$ are used in an actual inductive circuit, it is possible to suppress dv/dt at time of commutation to about $1 \sim 1.5 V/\mu s$. The waveform of dv/dt at this example is shown in Fig. 2-100.

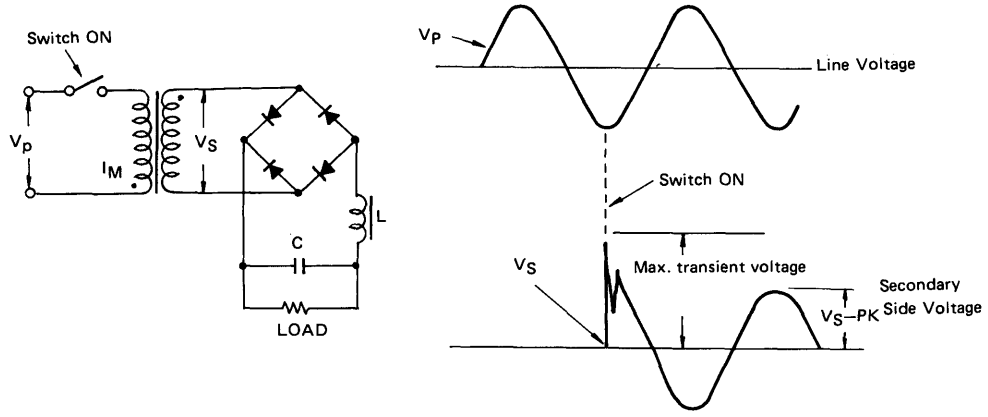


Fig. 2-96 Generation of Transient Voltage When Power Switch of Transformer Primary Side is ON

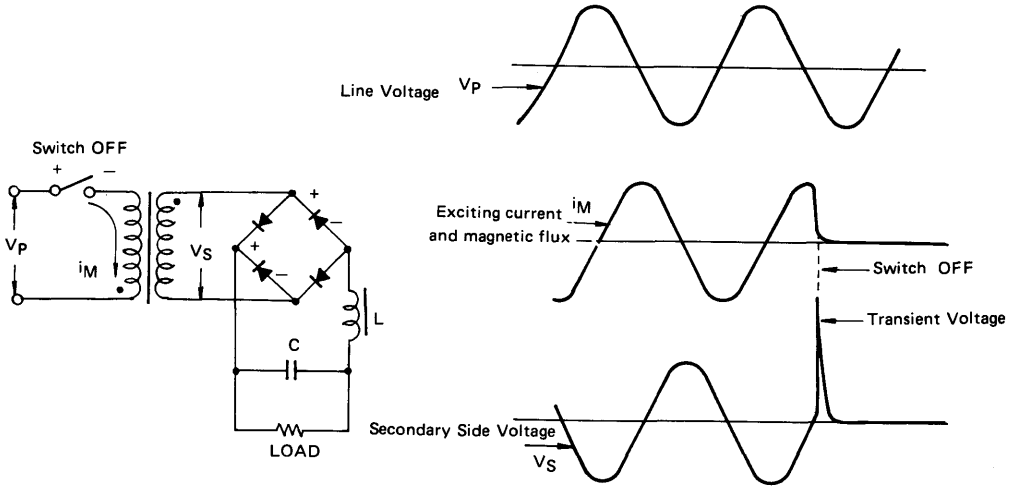


Fig. 2-97 Generation of Transient Voltage when Power Switch of Transformer Primary Side is OFF

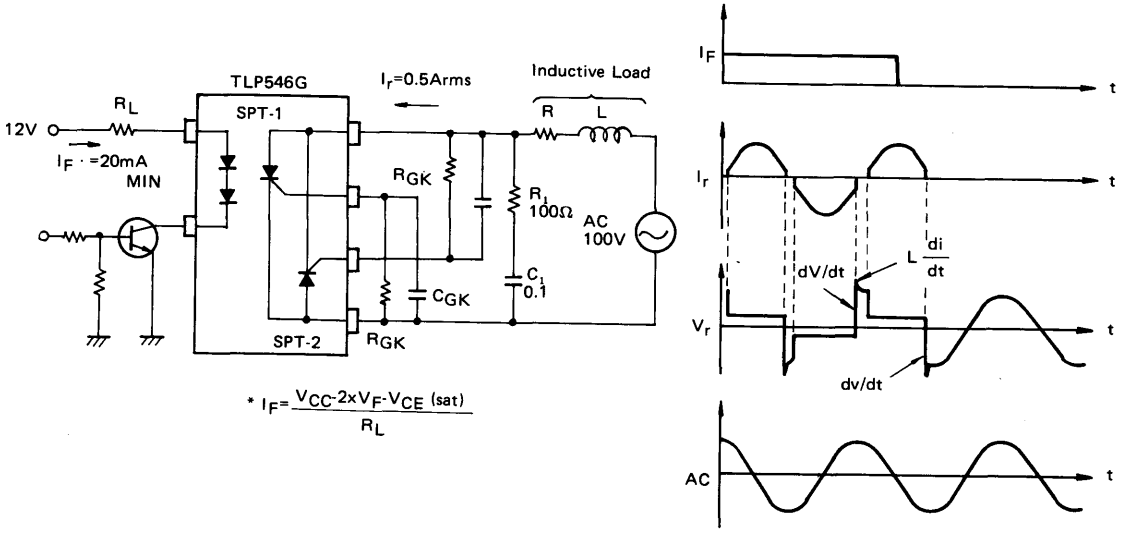


Fig. 2-98 Control of Inductive Load by Photo Thyristor of Parallel Connection

It is necessary to keep dv/dt capacity of a photo thyristor at about 2 V/μs when operated at high ambient temperature Ta = 100°C. From the characteristic curve shown in Fig. 2-95, C_{GK} = 0.01 μF and R_{GK} = 15kΩ are optimum. As dv/dt vs T_j characteristic differs depending upon used elements it is necessary to refer to the technical data of manufacturers.

Fig. 2-99 shows an example of a circuit using reverse parallely connected small capacity (I_T = 0.1 ~ 0.2 Arms). In this case photo thyristor couplers as the main TRIAC photo trigger elements when several Ampere ~ several tens Ampere load current is turned ON/OFF.

C_{GK} shown in Fig. 2-99 increases dv/dt capacity while maintaining high gate sensitivity for DC and low frequency trigger signals. By bypassing changed current of C_{j2} due to dv/dt to the cathode by C_{GK} in the equivalent circuit in Fig. 2-94, the regeneration feedback gain of the photo thyristor can be suppressed, and it will prevent erroneus ignition.

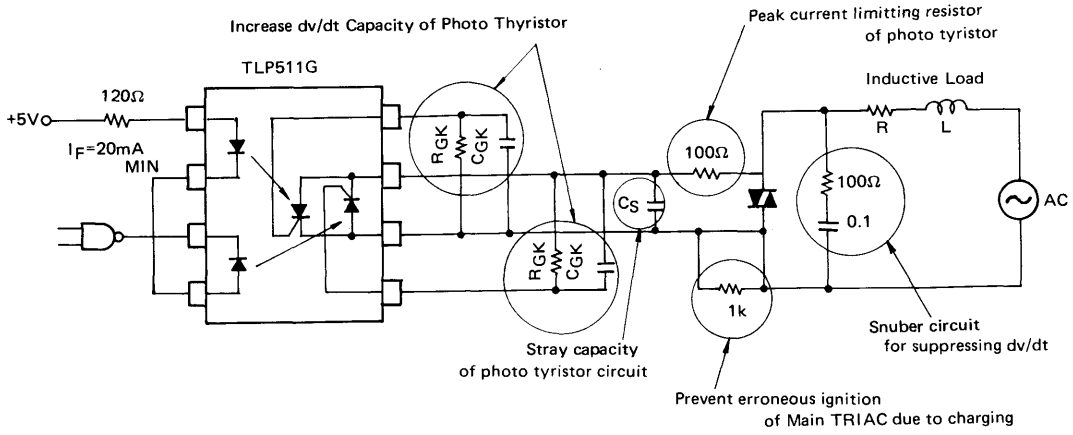


Fig. 2-99 Use of Photo Thyristor of Parallel Connection as TRIAC trigger element

An representative example of characteristics of the relation between C_{GK} and dv/dt capacity is shown in Fig. 2-101. In case of photo thyristor couplers available in the market, C_{GK} = 0.001 ~ 0.1 μF is used. Further, as a matter of course, if C_{GK} is set up, the turn-on time t_{ON} becomes longer. Normally, $t_{ON} \cong$ 20 ~ 30 μs at C_{GK} = 0.01 μF and over drive factor I_F/I_{FT} = 1.5.

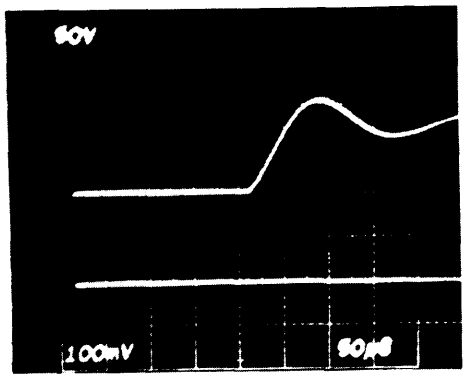


Fig. 2-100 dv/dt Suppression Effect by Snuber Circuit of R=100Ω, C=0.1μF at Time of Comutation

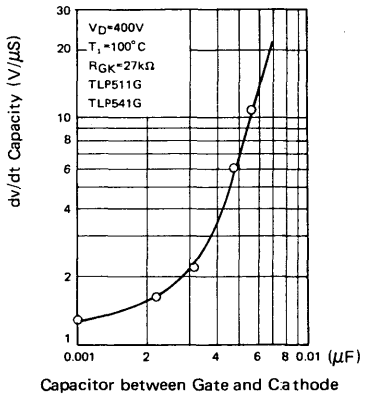


Fig. 2-101 C_{GK} Dependency of dv/dt Capacity

The gate sensitivity of a photo thyristor has been designed high (I_{GT} = 5 ~ 30 μF) so that it is turned ON by fine photo current I_P and therefore, the thyristor is apt to be erroneously ignited by leakage current I_{CO} generated at high temperature operation. So, to assure stable operation, R_{GK} is inserted to bypass I_{CO} to cathode as shown in Fig. 2-99.

Further, as R_{GK} also bypasses gate current i_{j2} by dv/dt, dv/dt capacity also increases.

However, as $I_{P\lambda}$ obtained by light energy from LED is bypassed to the cathode, contribution rate as gate current drops and I_{FT} (minimum current of LED required for igniting a photo thyristor) is increased. And if R_{GK} is too small, LED cannot be triggered. Representative characteristics of this I_{FT} vs R_{GK} are shown in Fig. 2-102.

When full-wave rectification is performed by a diode bridge and its switching is made by photo thyristors, one set of photo thyristor couplers is sufficient enough and it will be expected to be economical. In Fig. 2-103, a simple solid relay which is constructed by combining photo thyristor couplers with a main TRIAC is shown as an example of the basic application of photo thyristor couplers.

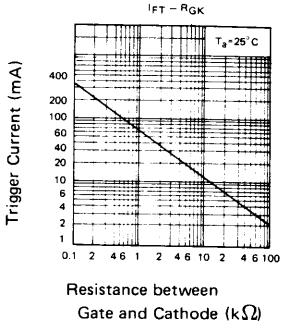


Fig. 2-102 R_{GK} Dependency of I_{FT}

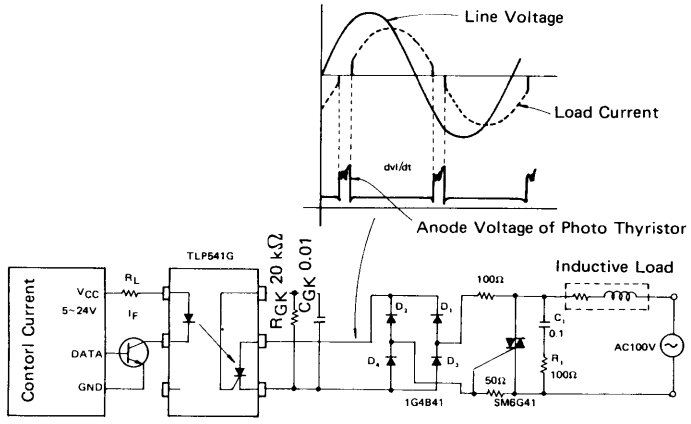


Fig. 2-103 Application of Photo Thyristor Coupler

This circuit is generally used for motor control and various load switching. As anode current of a photo thyristor drops below holding current (I_F = 0.2 mA) and is turned off when the main TRIAC is ignited, the photo thyristor itself does not almost need the power.

Design of AC Switching Circuit

In this paragraph, as the basic circuit of a solid state relay (SSR), Fig. 2-103 is shown. in this circuit, the methods for selecting R_{GK} and C_{GK} and deciding control current (forward current I_F) are described as following.

Example of Design Specifications

Operating temperature:	T_{opr}	= 0 to 70°C
Supply voltage:	V_{CC}	= 5V ± 5%
Resistance variation:	±5%	
Operating life:	170,000 hours (about 20 years)	
System working ratio:	50%	

▼ Selection of Components

In the circuit shown in Fig. 2-103, the TLP541G is used as the photo thyristor coupler. However, as the TLP541G is of unidirectional conduction type, the 1G41B is used as a rectifying bridge.

In order to turn ON/OFF 100V, 2A load, the SM6G14 is used as a main TRIAC. Further a circuit with R = 100Ω and C = 0.1 μF is adequate for a snubber circuit. R = 50Ω which is set up between G and T_2 of the TRIAC is for bypassing charging current by component of capacitance of a diode bridge or photo thyristor.

▼ Setting of R_{GK}, C_{GK}

As load is inductive, dv/dt capacity should be designed to be large as a measure against the above-stated problems. When the SM6G14 is turned on, as no power flows through the TLP541G, power loss is less and T_j rise due to self-power dissipation is not so much. Therefore, the maximum junction temperature of the photo thyristor is considered to be maximum ambient temperature added to the heat spread from LED side. LED forward current I_F is limited to be $I_F \leqq 30$ mA from the relation of a longer service life as described later and even when this heat generation is added, the junction temperature of thyristor coupler, $T_{j(SCR)}$ will be below about 80°C.

With effect of the snubber circuit taken into consideration, dv/dt = 2 ~ 3V/μs is kept at $T_{j(SCR)}$ = 80°C and V_{DRM} = 280V which is twice of maximum supply voltage.

To give a margin to dv/dt, R_{GK} = 27 kΩ, C_{GK} = 0.01 μF are considered to be adequate from the characteristic curve in Fig. 2-101. C_{GK} can be increased to a level where no trouble due to length of turn-on time of the thyristor coupler is generated.

▼ Setting of Forward Current

Minimum forward current I_F for turning on a photo thyristor is defined to be trigger LED current. I_F which is required here is obtained from the following equation:

$$I_F = I_{FT(max)} \times D_{Ta} \times D_{RGK} \times D_t \times D_{ton}$$

where,

$I_{FT(max)}$: I_{FT} which is initially guaranteed in technical data

D_{Ta} : A relative value of temperature dependency of I_{FT} within a range of 1.1~1.2 times

D_{RGK} : A relative value of R_{GK} dependency of I_{FT}.
No correction is necessary as R_{GK} = 27 kΩ which is the same as measuring condition of manufacturer.

D_t : Correction factor of secular change of I_{FT}. It is necessary to confirm with manufacturer. Fig. 2-104 is referred to here.

D_{ton} : Overdrive factor to shorten turn-on time. In this case, estimated at $D_{ton} = 1.2$

Numerical examples are defined as follows:

$I_{FT(max)}$ = 7mA at Ta = 25°C, R_{GK} = 27 kΩ

D_{RGK} = 1 at R_{GK} = 27 kΩ

D_t = 1.3 at 8.5 x 10^4 Hrs (working ratio 50%)

D_{ton} = 1.5

Therefore, minimum required value of I_F is given as following.

$I_{F(min)} \cong 16$ (mA)

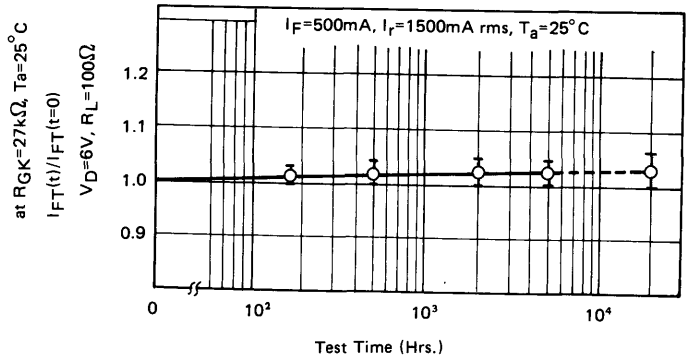


Fig. 2-104 Life Test Results of LED Trigger Sensitivity I_{FT}(TLP541G)

Zero-Cross Switch Circuit

When a switch is turned on, current suddenly changes and by resulted rush current transient voltage, the radio frequency interference (RFI) is generated.

To minimize RFI there is a method to make a switching around the zero cross point of AC voltage. This is called the zero voltage switching or zero-cross switching.

Fig. 2-105 shows an example of the zero-cross switch constructed using the photo thyristor coupler TLP541. In this circuit, the photo thyristor is turned ON only when voltage between T_1 and T_2 of TRIAC is around zero voltage and TRIAC is triggered.

This zero-cross system divided voltage between $T_1 \sim T_2$ by resistors R_1 and R_2 and transistor T_{rl} is saturated by this divided voltage. That is, as photo current I_P of the photo thyristor flows from the gate through T_{rl} and shorted to the cathode when voltage is other than zero, the photo thyristor is not turned ON even when V_{IN} is applied.

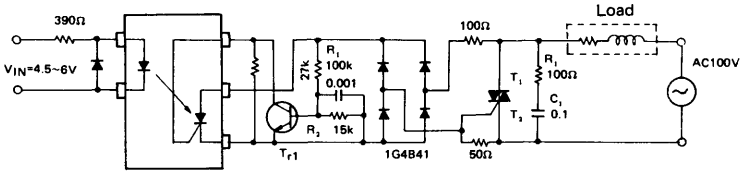


Fig. 2-105 Zero Cross SSR Circuit

Power Control of Magnetron for Electronic Oven

Fig. 2-106 shows an example of power control circuit of an electronic oven. This circuit consist of a phase shift circuit using Uni Junction Transistor 2SH21. The LED trigger phase of the TLP511G is delayed from line voltage by about 90°. Thus, delay in current generated by inductive load of main thyristor SM16G14 is reduced and oscillation of magnetron is stabilized.

The trigger circuit operates at duty ratio set in the timer circuit and power of the electronic oven is controlled by interrupting oscillation of the magnetron intermittently.

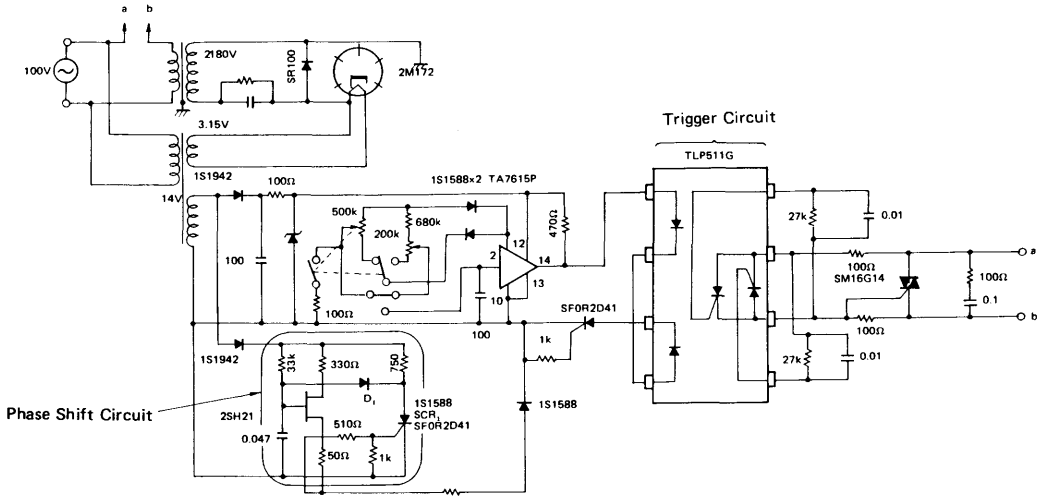


Fig. 2-106 Power Control Circuit of Electronic Oven

Driving of Motor in Normal and Reverse Directions

Fig. 2-107 shows the driving circuit of a reversible motor in the normal/reverse direction with high output photo thyristor couplers applied. Recently, photo thyristors are available in the market, of which power capacity itself is increased for directly turning ON/OFF load current of about 1 Arms. In this circuit, the TLP546G drives a motor of 4W output. The TLP546G has an aluminium radiating plate of 2 ~ 3 cm^2 embeded in DIP mold and is able to turn ON/OFF 1 Arms at ambient temperature Ta = 40°C.

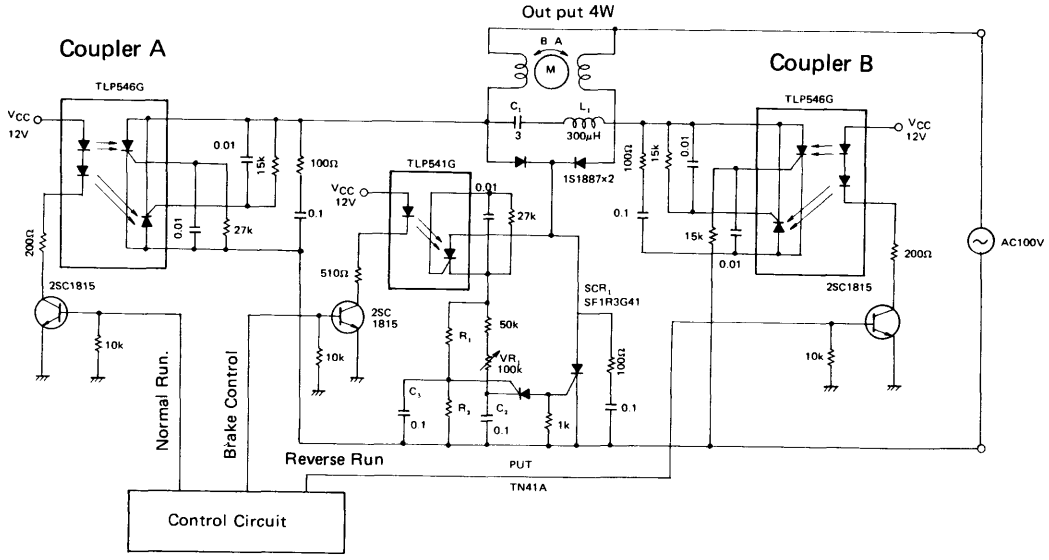


Fig. 2-107 Reversible Motor Normal/Reverse Drive Circuit

Inductive L_1 shown in Fig. 2-107 is necessary for suppressing surge current from C_1 and should be set at 200 ~ 500 μH.

Control signal for switching driving of the photo couplers from direction A to direction B or vice versa requires a pause time more than 1/2 cycle. In other words, if Coupler B is turned ON when Coupler A has not been turned OFF, excessive discharge current suddenly flows from C_1 to both Couplers A and B and elements are completely destructed. Fig. 2-108 shows discharge current from C_1 when a 5Ω resistor is inserted for L_1 and its peak value has reached 45A.

For braking, the TLP541G is operated. When the TLP514G is turned ON, PUT is operated to turn OFF SCR_1 at a certain phase difference. When DC component is applied, the reversible motor is braked. As discharge surge current is also generated from C_1 at this time, it is indispensable to insert L_1.

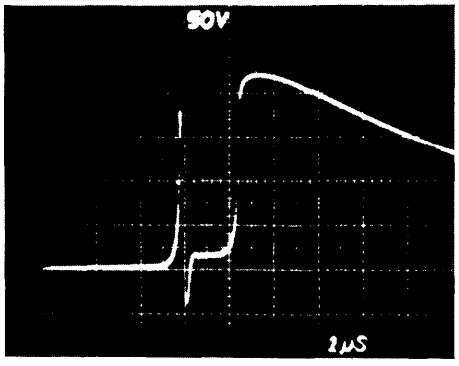
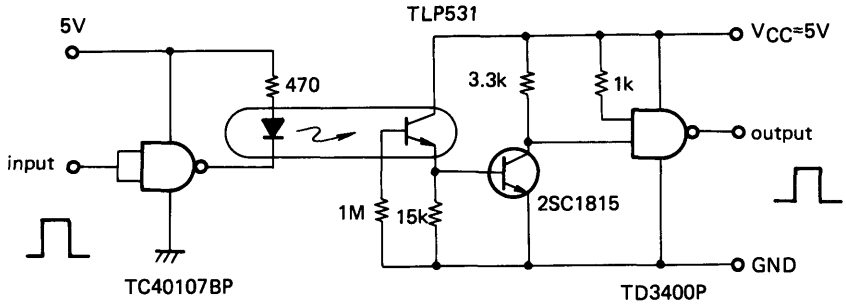


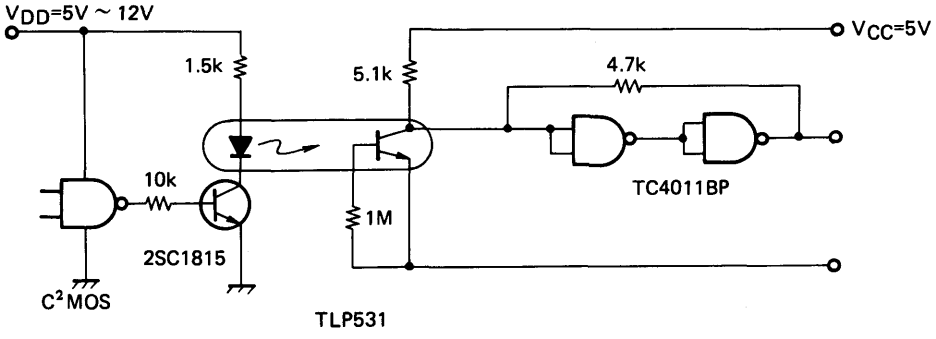
Fig. 2-108 Discharge Surge Current from Condenser C_1 (Voltage Drop of 5Ω Resistor)

(g) Examples of application circuit

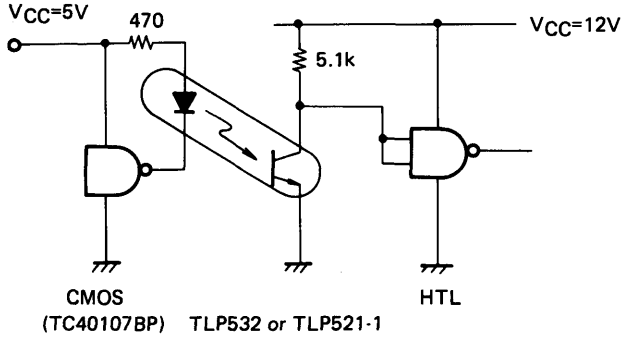
(1) Interface between systems



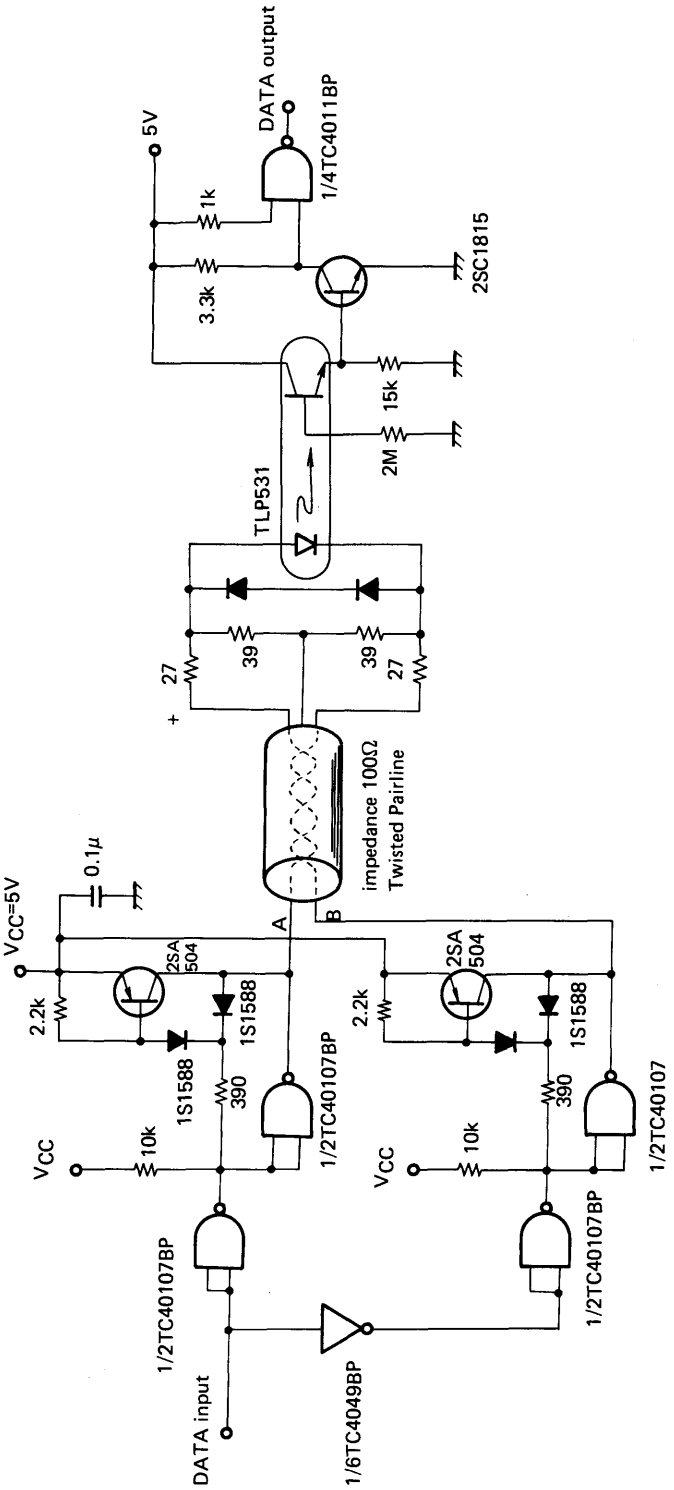
(2) Interface between systems having schmitt circuit



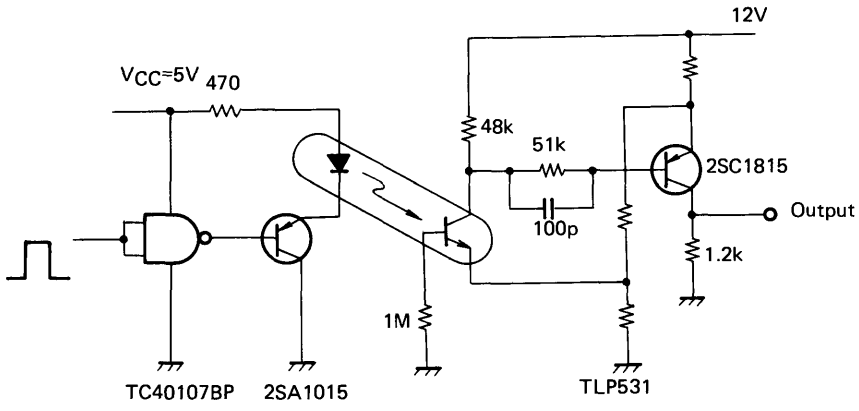
(3) Interface between TTL, HTL



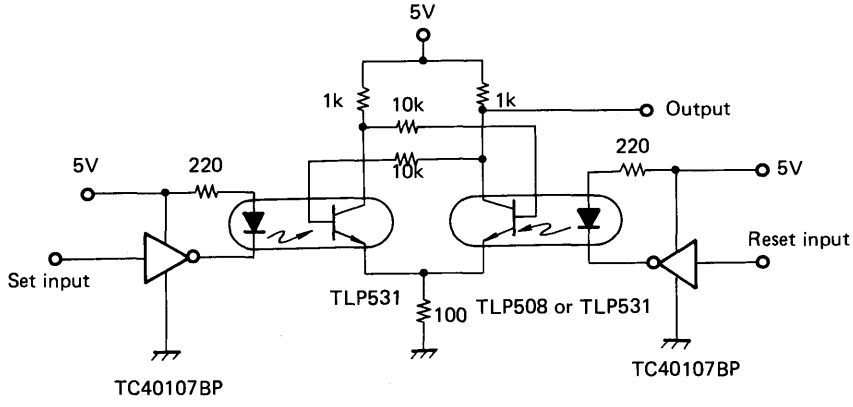
(4) Line driver and line receiver system



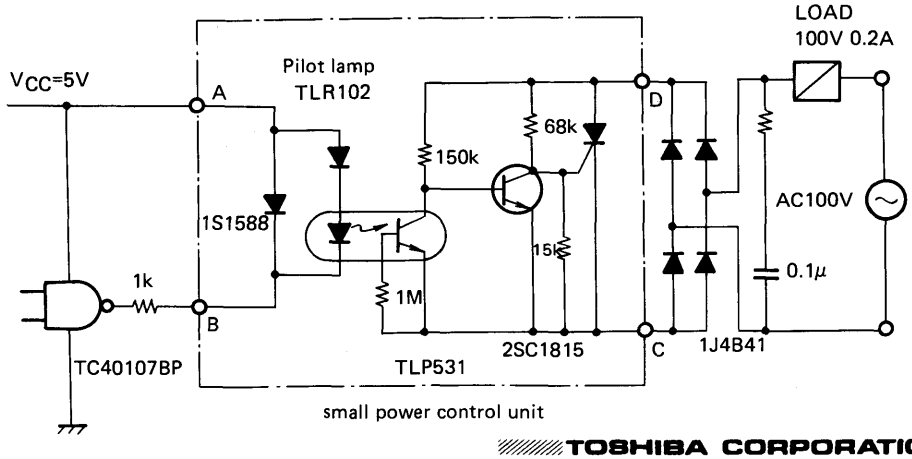
(5) Optical coupling schmitt trigger



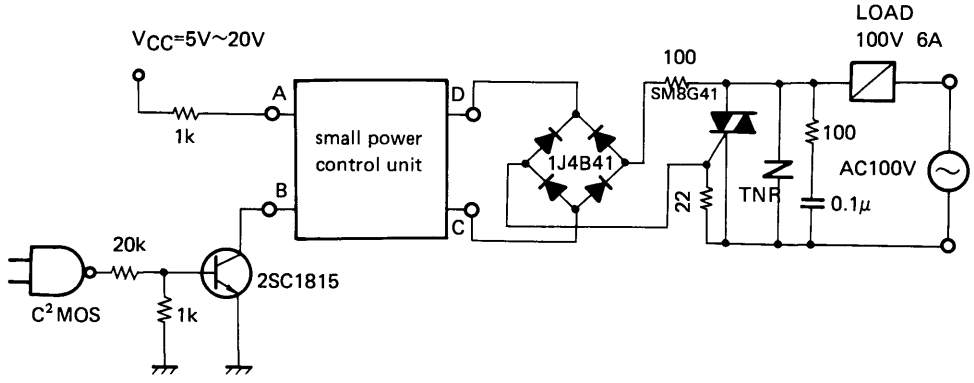
(6) Optical coupling R-S flipflop



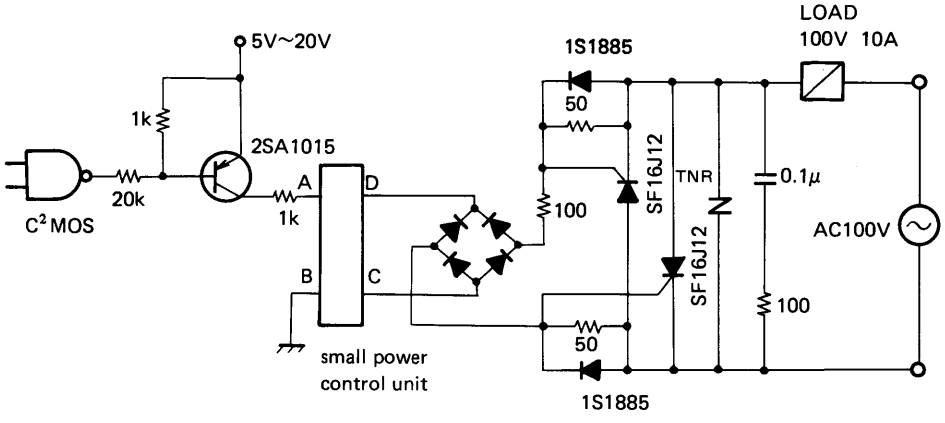
(7) Power control circuit
AC Solid state relay
(a) Small power control (by C^2 MOS)



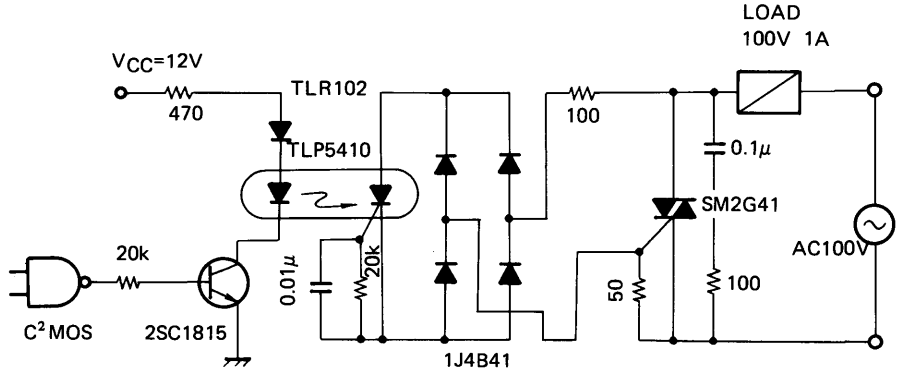
(b) Medium power control (by C^2MOS)



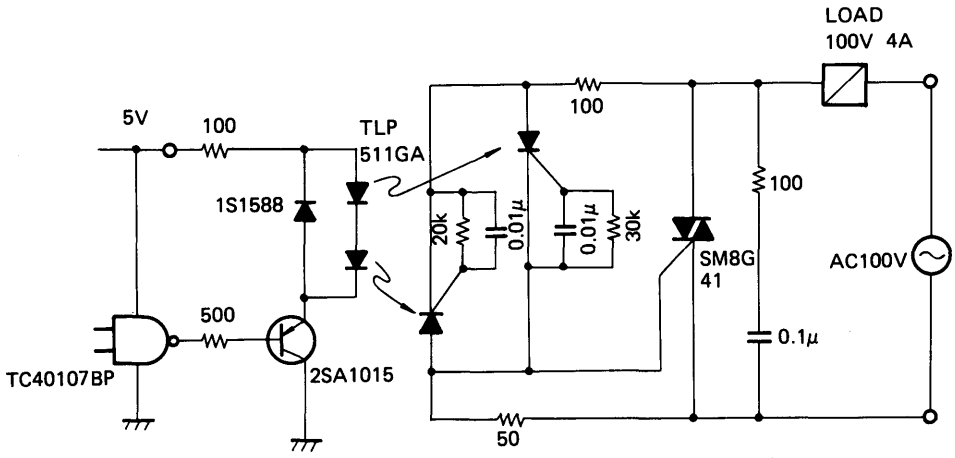
(c) Medium power control



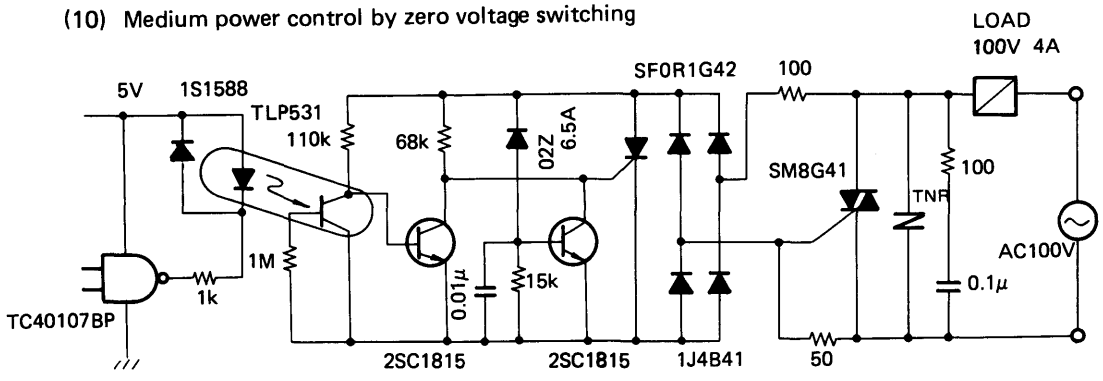
(8) Small power control by photo thyristor coupler



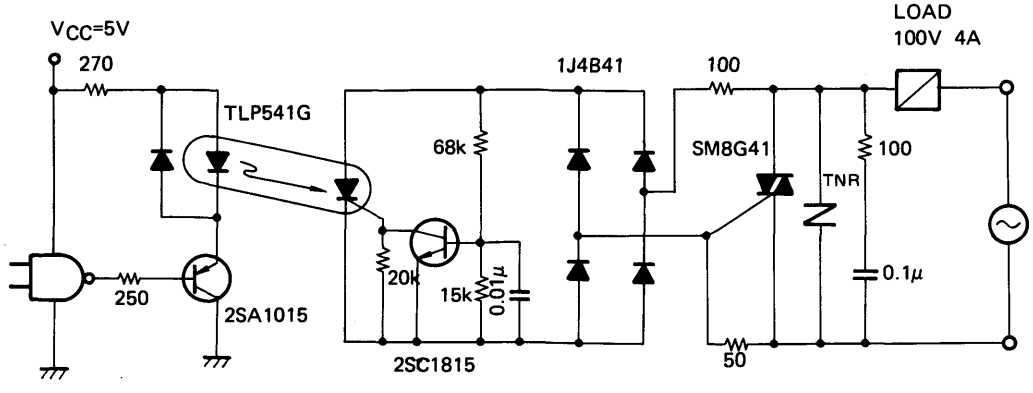
(9) Medium power control by photo triac coupler



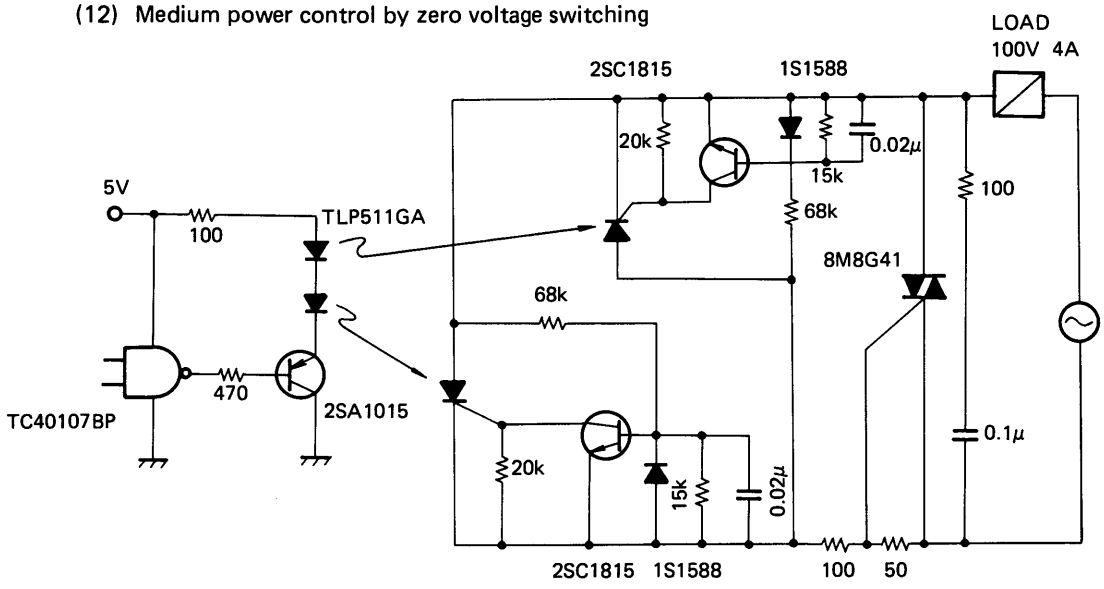
(10) Medium power control by zero voltage switching



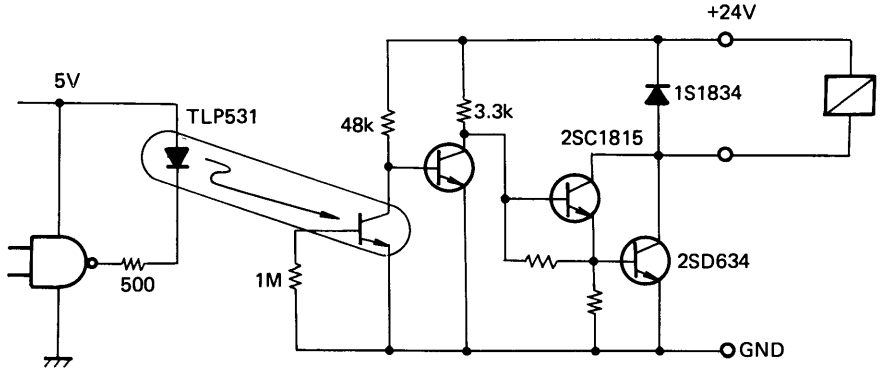
(11) Medium power control by zero voltage switching



(12) Medium power control by zero voltage switching



(13) DC. solid state relay



2-3-1 Introduction

The rapid grouth of digital processing being used in commercial, industrial, and consumer products, has created the needs for new sensors that convert physical parameters into electrical signals which may be directly interfaced to a digital system.

Opto Sensors have utility in each of these areas, in that they provide a quick non-contact response to the parameter sought as a data source. Commercial applications include bar code reading, paper edge sensing, end of tape sensing, position and magnetic tape loop stabilizing. Industrial uses may consist of optical tachometry, assembly line monitoring, and safety interlocks, while the consumer uses of optical sensors may be found in audio products, entertaiment products, and video games. Each of these applications include an optical emitter, a transmission path, and a detector to perform the sensing function.

The sensing may occur by having the object obstruct the transmission path, or complete it by reflecting the emitter beam to the detector. In either the transmissive or reflective sensing configuration, electrical and mechanical consideration there must be addressed in order to insure optimum performance of the emitter-detector system.

System Elements

Every opto sensor system includes a source of optical flux, a transmission path, and receiving detector. In most sensor system analysis, the available flux and the responsivity of the reciever are considered to be constant and consequently the dynamic incidence change found at the receiver results from modifications of the transmission path.

Fig. 2-109 shows a paper tape reader and densitometer examples of transmissive sensor systems. The presence or absence of the paper hole results in a binary ON-OFF transmission path attenuation. The densitometer functions by causing an analog modulation of the transmission path. Bar code scanning and paper edge sensing are applications of reflective sensor techniques shown in Fig. 2-109.

The bar code provides a reflective contrast between the background and the bars. In paper edge sensing applications, the paper edge creates a digital responding transmission. When the paper edge is not present in the reflecting field of the sensor, the flux transmission will be zero, and the transmittance will increase when the edge is in the field.

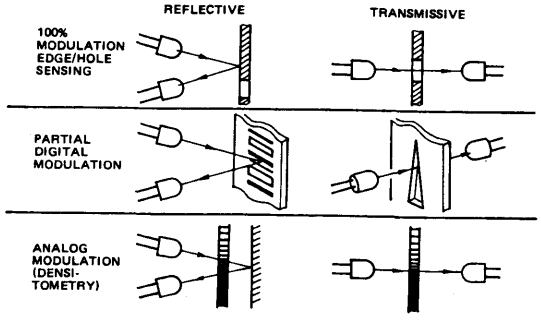


Fig. 2-109 Different Techniques of Flux Path Modulation.

2-3-2 Process and Construction

IRED (Infrared Emitting Diode)

The gallium-arsenide IRED used by Toshiba is produced using Liquid Phase Epitaxial (LPE) processing and provides high light output and long life time performance.

The kinds and structures of IRED lamps are shown Table 2-14 and the outline of their manufacturing process is shown in Table 2-15.

Phototransistor & Photodiode

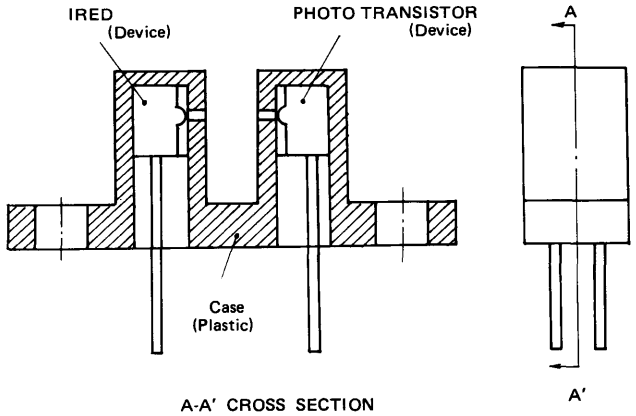
Silicon phototransistors and PIN photodiodes respond to the entire visible radiation range as well as to the near infrared radiation range. They show the same basic radiation frequency response which peaks in the near infrared range. Therefore, the sensitivity range of Toshiba silicon sensors is ideally suited to Toshiba IRED.

The kinds and structures of them are shown Table 2-16 and the outline of their manufacturing process is shown in Table 2-17.

Photointerrupter

Photointerrupters are a kind of limit switch which transmits light from a GaAs IRED to a silicon phototransistor. Both devices face each other across some airgap. Photointerrupter senses an object the interrupts the beam.

The fundamental structure of photointerrupter is shown in Fig. 2-110 and the outline of their manufacturing process is shown in Table 2-18.



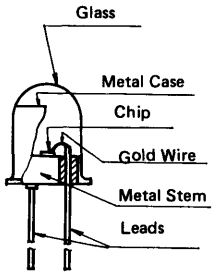
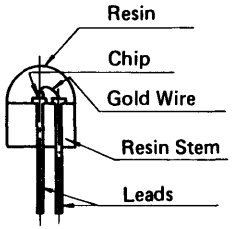
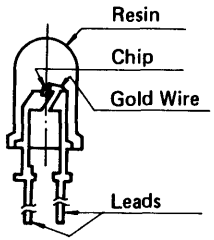
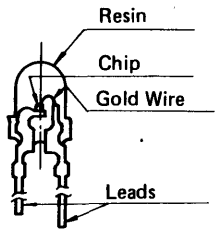
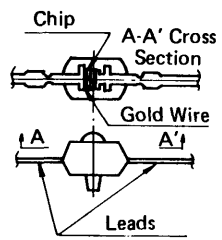
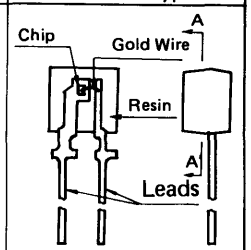
A-A' CROSS SECTION

TYPE NO. TLP507A
TLP800

Fig. 2-110 Structure of Photointerrupter

Table 2-14 Structure of Opto Sensor

IRED

	Metal Type (Note 1)	Resin Stem Type (Note 2)	All Plastic Mold Type			
			Casting		Molding	
			Long Type	Mini Type	Submini Type	Side View Type
Structure						 A–A' Cross Section
IRED TYPE No.	TLN101 TLN108	TLN103	TLN 105A TLN 110	TLN 109	TLN 104	TLN 107

Note 1) Glass-to-Metal-Seal Header

2) Ceramic Stem

Table 2-15 Manufacturing process flow chart of infrared LED (Plastic package); TLN107

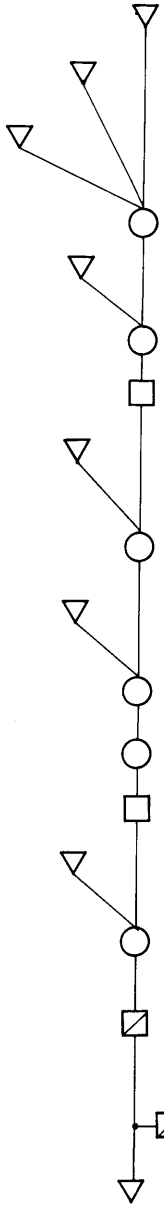
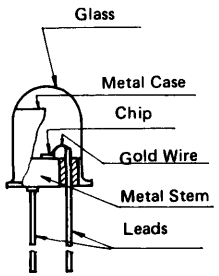
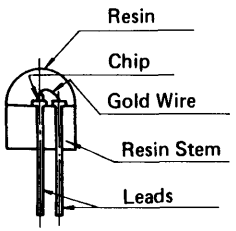
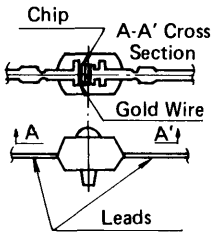
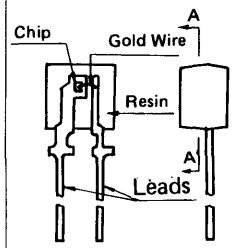
PROCESS FLOW CHART	NOTE
	
Chip	
Frame	
Mount Material	
Die Mount	Strength of die attachment, and visual inspection
Bonding Wire	
Bonding	Temperature, Bond Strength
Inspection of Appearances	Mount & Bond Appearance
Encap. Material (Siricone)	
Encap.	
Mold Material (Epoxy resin)	
Mold	Temperature
Lead Cut	
Inspection	Electrical & Optical Characteristics, Appearances
Packing Material	
Packing	
Lot Quality Assurance Test	Electrical & Optical Characteristics, Appearance
Reliability-Test	Life Test, Mechanical Test
Ship	

Table 2-16 Structure of Phototransistor and Photodiodes

Photo transistor & Photo Diode

	Metal Type (Note 1)	Resin Stem Type (Note 2)	All Plastic Mold Type	
			Submini Type	Side View Type
Structure				 A–A' Cross Section
Phototransistor & Photodiode	TPS601 TPS604 TPS708 (Note 3)	TPS603	TPS605 TPS606	TPS607 TPS608 TPS703 (Note 3)

Note 1) Glass-to-Metal-Seal Header

2) Ceramic Stem

3) PIN Photo diode

Table 2-17 Manufacturing process flow chart of Phototransistor (Plastic Package); TPS607

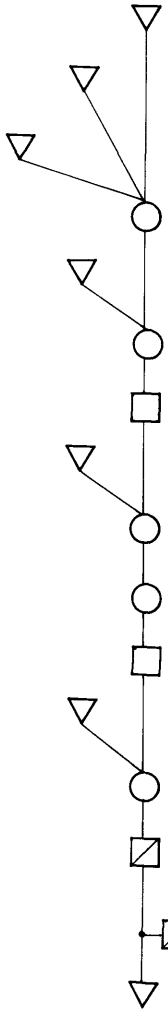
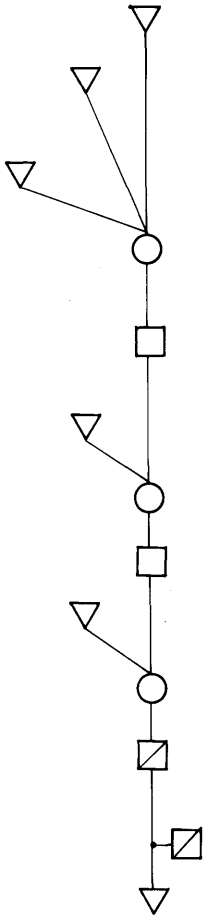
PROCESS FLOW CHART	NOTE
	
Chip	
Frame	
Mount Material	
Die Mount	Strength of die attachment, and visual inspection
Bonding Wire	
Bonding	Temperature, Bond Strength
Inspection of Appearancer	Mount & Bond Appearance
Mold Material (Epoxy resin)	
Mold	Temperature
Lead Cut	
Inspection	Electrical & Optical Characteristics Appearancer
Packing Material	
Packing	
Lot Quality Assurance Test	Electrical & Optical Characteristics Appearance
Reliability Test	Life Test, Mechanical Test
Ship	

Table 2-18 Manufacturing process flow chart of photointerrupter (Plastic package); TLP800

PROCESS FLOW CHART	NOTE
	
Emitters (IRED Lamp)	
Detector (Phototransistor)	
Adhesive Material	
Coupling	Temperature
Inspection	Electrical Characteristics
Marking Material	
Marking	
Final Electrical Test	Electrical Characteristics
Packing Material	
Packing	
Lot Quality Assurance Test	Electrical Characteristics Appearance
Reliability Test	Life Test, Mechanical Test
Ship	

2-3-3 Circuit design procedure and precaution for photo sensor

(a) Main characterisitics of emitter and detector and device selection guide

Characteristics of light emitting diode (LED)

LEDs have many superior features of small size, long life, high speed response, and high luminous efficiency. At present, GaAs Infrared LEDs are usually available in photo sensor application because their light emission wave length fits the light receive spectral sensitivity of photo diodes and photo transistors. Fig. 2-111 shows the light emission spectrum of GaAs infrared LED TLN108 and the spectral sensitivity characteristics of Si photo diode TPS708.

Photo transistors, are generally sensitive to wavelengths of 500 to 1000 nm. So the signal output of photo transistor can be obtained even by using other visible light LEDs (GaP, GaAsP, etc.), but their output power are rather smaller than Infrared LED's.

Fig. 2-112 shows the relation between radiant Intensity I_E of TLN108 and driving forward current I_F. It shows that the output power increases in proportion to the forward current. Radiant intensity I_E means the light output, on the optical axial and its value is closer to the practical conditions than the total radiant output P_O.

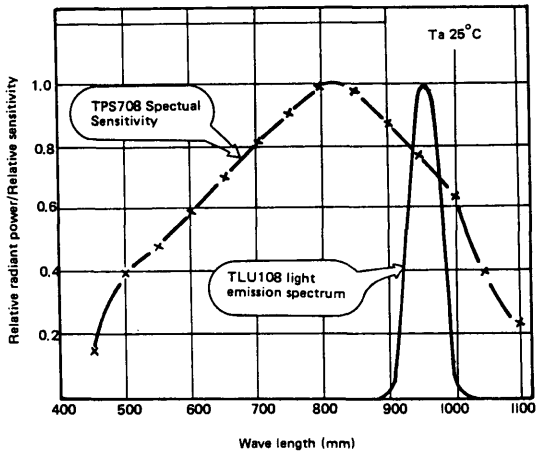


Fig. 2-111 Light emission spectrum of TLN108 and spectual sensitivity of TPS708

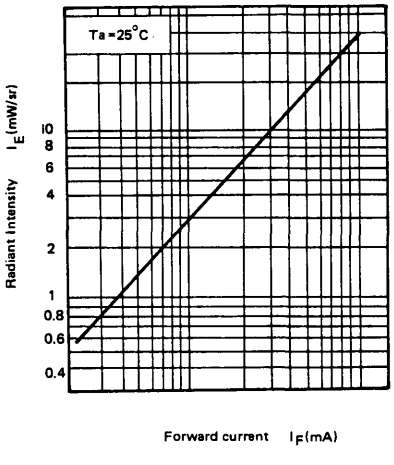


Fig. 2-112 I_E-I_F characteristic of TLN108

Fig. 2-113 shows the radiation pattern of TLN108 and TLN103.

In the LED with narrow radiation angle, such as TLN108, has large radiant intensity in the axial direction and the signal output of detector is also larger than there of TLN103 with wide radiation angle. However, the signal output may decrease by 70% when LED with narrow radiation angle is tilted at about 10 degrees. So be careful in the axial deviation when mounting it.

On the other hand, in the LED with wide radiation angle, such as TLN103, which smaller than that of TLN108 when their radiant power Po are the same; the former's signal unaltered even if the LED is slightly tilted. Radiant intensity I_E of TLN103, however, is smaller than that of TLN108 when their light output P_O is the same. So the former's signal output is also smaller the latter's. So be careful in this regard.

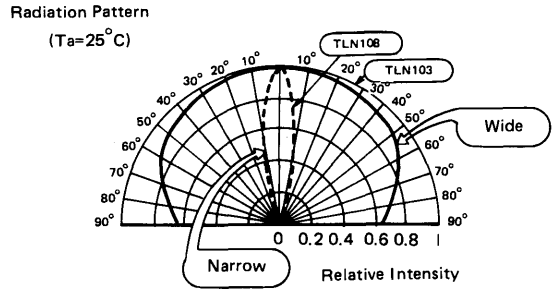


Fig. 2-113 Radiation pattern of TLN103, TLN108

Characteristics of photo transistors (photo diodes)

Photo transistors are considered to be equivalent to complex of a photo diode and transistor and are classified in two types; single or darlington.

Photo diodes need an amplifier cirucit because of the very low light sensitivity, so before designing a circuit, their characteristics should be understood sufficiently.

Fig. 2-114 shows the relation between light current I_L (collector current I_C) and radiant incidence E, where I_L increases with increasing E (growing input light). In case of darlington type TPS605, I_L is greatly larger than that of single type TPS606. (They have the same package).

Even in the dark condition (non-input light) a very small current I_d (a dark current) flows through a photo transistor, and Fig. 2-115 shows its temperature characteristics where I_d increases logarithmically with rise in temperature.

The TPS605 permits a larger dark current because of its higher light sensitivity, so when designing a high temperature operation the light current I_L should be larger sufficiently than the dark current.

The light directional sensitivity of a photo transistor is similar to that shown in Fig. 2-113. [In the normal application] The light current of TPS601 (the same package as TLN 108) with the narrow sensitivity angle is larger than that in TPS603 (the same package as TLN103) with the wide sensitivity angle, but the former might be smaller than that of the lather when TPS601 is slightly tilted. Therefore, devices should be selected in accordance with applications and operating conditions.

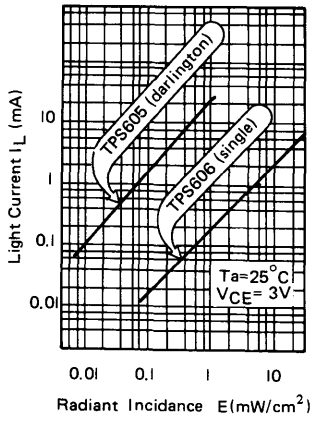


Fig. 2-114 I_L-E of photo transistor

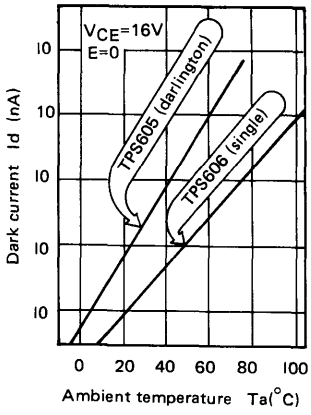


Fig. 2-115 Id-Ta of photo transistor

Coupling characteristics of emitter and detector

Current Transfer Ratio CTR (I_C/I_F) is the most important characteristic when these devices are used and corresponds to the h_{FE} of a transistor. A Darlington type naturally has a higher CTR because of its phototransistor's higher light sensitivity. Fig. 2-116 shows the temperature characteristics and Fig. 2-117 shows the variation of CTR in the operation test. Since light output of LED has a negative tendency against temperature and light-current of photo transistor has positive one, the coupling CTR decreases at higher and lower temperatures as shown in Fig. 2-116. Fig. 2-117 shows the result of long term stress testing. The CTR may decrease slightly after long operation, which contributes mainly to a slow reduction of LED light output.

Under the same load condition, as seen from Fig. 2-118, response time of Darlington type interrupter (TLP850) is very slower than that of a single type (TLP800).

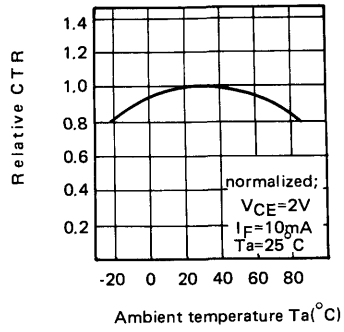


Fig. 2-116 CTR-Ta of TLP 850

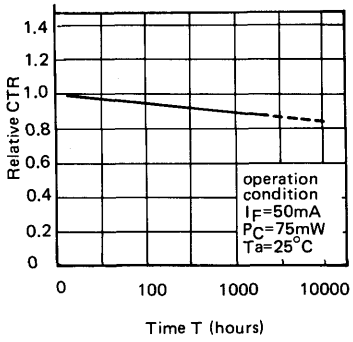


Fig. 2-117 Results of Long Term Stress Test (TLP850)

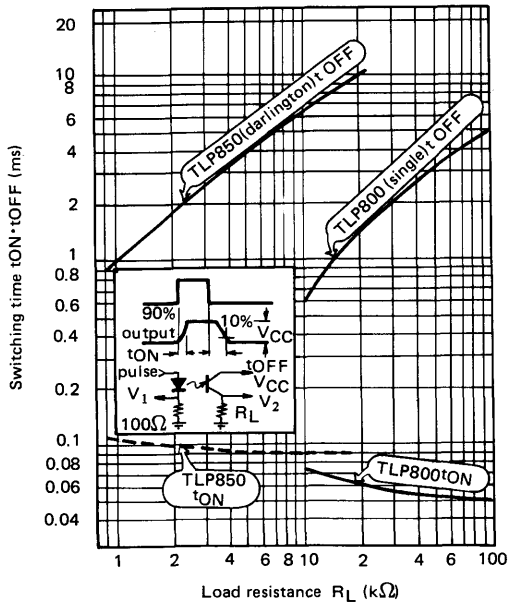


Fig. 2-118 Switching time-load resistance of photointerrupter (Sat. operation)

(b) Basical operation of Photo Sensor

The fundamental circuit of photo sensor is shown in Fig. 2-119 (a). The LED anode is connected through resistor R_E to supply line V_{CC} and the cathode is grounded. Forward current I_F flows through the LED, and a GaAs LED emits infrared light which are not visible. The photo transistor collector is connected through resistor R_L to supply line V_{CC} and the emitter is grounded. The collector is also connected to the input terminals of the next stage comparator or IC.

LED and phototransistor are stationed as shown in Fig. 2-119. When the light cut plate passes through the airgap between LED and phototransistor, the collector potential V_{out} rises as shown in Fig. 2-119 (c), while, when the light cut plate comes out from the airgap, the potential V_{out} falls. In other words, photosensors detect the presence of an object without contact and change it to an electric signal. Usually this signal is transmitted to the control circuit and then will control arious peripheral functions.

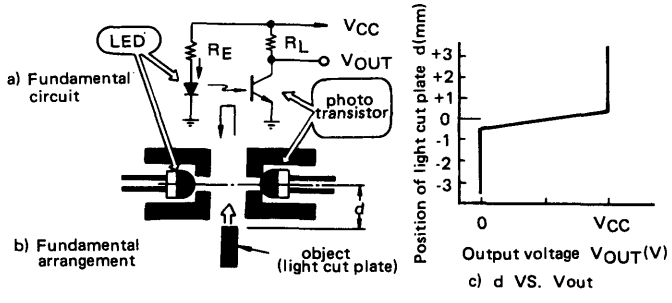


Fig. 2-119 Basical operation of photo sensor

(c) Design procedure for photo sensor circuit

▼ Determination of R_E and R_L values.

Optimistic value of R_E

In Fig. 2-119 (a), the LED forward current I_F is written as following.

$$I_F = \frac{V_{CC} - V_F}{R_E} \qquad (1)$$

where V_F is the forward voltage of LED.

Then I_F should be satisfied with following condition.

$$I_F \leqq I_{F(max)} \text{ at } Ta = T_{opr(max)} \qquad (2)$$

In consequence R_E is obtained by the following equation.

$$R_E \geqq \frac{V_{CC} - V_F}{I_{F(max)}} \qquad (3)$$

As seen from Fig. 2-120, the I_E increases in proportion to the forward current. So, $I_{F(min)}$ should be confirmed after the determination of R_E in consideration of V_F and R_E and its power dissipation.

Adquate value of load resistance

Determination the maximum value of R_L

When the light cut plate pauser through the airgap in Fig. 2-119, the light current of phototransistor by LED can not flow through the photo transistor. Only a disturbance photocurrent I_L' and an dark current I_d flow. In this case, collector potential V_{OH} is given by

$$V_{OH} = V_{CC} - R_L X(I_d + I_L')$$

Where the input current to the next stage is assumed to be very small. Since I_d, as shown in Fig. 2-113, rapidly increases with ambient temperature.
The collector voltage V_{OH} should satisfy the following formula

$$V_{OH} > V_{IN} \text{ at } Ta = T_{opr.max.}$$

(assuming V_{IN} as a next stage high level input voltage)

Then R_L can be calculated from

$$R_{LMAX} = \frac{V_{CC} - V_{IH}}{I_d + I_L}$$

▼ **Determination the maximum value of R_L**

When the light cut plate is out from the airgap, the LED light is received by the photo transistor, and lightcurrent I_L and $Id + I_L'$ flow. In order to get the normal operation that photosensor can do sensing whether the light cut plate is in the airgap or not, the light current I_L should be sufficiently larger than I_d and I_L'.

$$I_L \geqq I_d + I_L'$$

In this case, the collector potential V_{OL} is given by

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

the collector voltage V_{OL} should be satisfied with following formula

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

where V_{IL} is low level input voltage of the next stage. E_q. (4) and (5) should be satisfied even for the minimum value of I_L.

The minimum value of I_L, $I_{L(min)}$ is given by

$$I_{L(min)} = CTR_{(min)} \times D_t \times D_{Ta} \times D_n$$

where CTR(min): $I_C/I_{F(min)}$ at initial (as Data Sheet).
D_t : CTR variation factor in the operation test (Fig. 2-115)
D_{Ta}: CTR temperature factor (Fig. 2-114)
D_n : CTR variation by dirt and dust etc.

From E_q. (4) and (5), $R_{L\,MIN}$ is given by

$$R_{L\,MIN} = \frac{V_{CC} - V_{IL}}{I_{L(min)} + I_d + I_L'}$$

When the fast switching time is required, R_L should be as smaller possible.

(d) How to determine coupling characteristics of Emitter (LED) and Detector (Photo Transistor)

The dispersion of CTR (IC/IF) should be obtained by practical assembling of both devices. The minimum CTR, which is most important in the circuit design, should be estimated from the its dispersion. Or by the assembling of a minimum light output sample and a minimum light sensitivity sample and by the simulation of the following data-attached samples, when a minimum output LED and a minimum sensitivity phototranistor can't be obtained.

The minimum CTR simulation precedure by the above two samples can be discribed the following:. Assume that a LED has the characteristic of radiant intensity I_E — foward current I_F as shown in Fig. 2-120 and its I_E (light output) is measured under the Toshiba standard measuring conditions (I_F = 10 mA in this example), and the standard specification is

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

The data-attached sample No. 1 emits light at 12 mW/sr under the Toshiba standard measuring conditions (I_F = 10 mA). Assuming that a photo transistor has the characteristics light current I_L VS radiant incidence E (light input) as shown in Fig. 2-121 and its I_L is measured under the Toshiba standard measuring conditions (E = 0.1 mW/cm² and V_{CE} = 3V in this example), and the standard specification is

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

The data-attached sample No. 2 receives light at I_L = 1.3 mA under the standard measuring conditions. (E = 0.1 mW/cm², V_{CE} = 3V)

When LED drive current I_F is designated as 8 mA, the minimum light output sample can emitt only I_E = 4 mW/sr from Fig.2-120 and this light output of 4 mW/sr is similar the light output of sample No. 1 at I_F = 3.1 mA.

Measure the lightcurrent I_L of a photo transistor in the state that the forward current of sample No. 1 is 3.1 mA, which is equal to the state that the minimum light output LED emitt the light at I_F = 8 mA.

When the light current of sample No. 2 becomes 1 mA after actual assembling the radiant incedence of sample No. 2 can be found to be E = 0.076 mW/cm² from Fig. 2-121; the light of E = 0.076 mW/cm² would be irradiated to the photo transistor. Accordingly the light current of the minimum light sensitivity photo transistor can be estimated to be 0.36 mA from Fig. 2-121.

Therefore, when a minimum light output LED and a minimum light sensitivity photo transistor are assembled in their situation, the minimum CTR value is estimated as

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

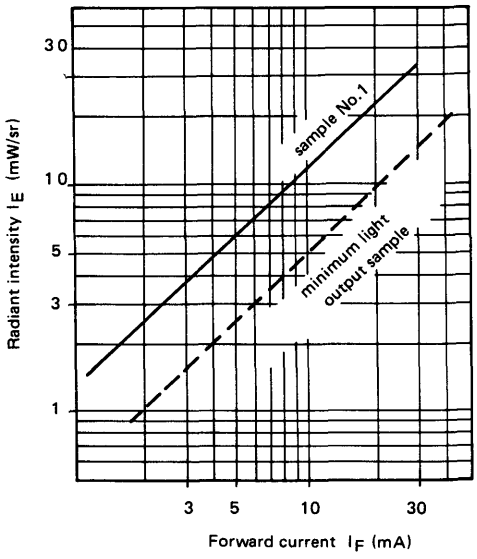


Fig. 2-120 I_E-I_F of LED

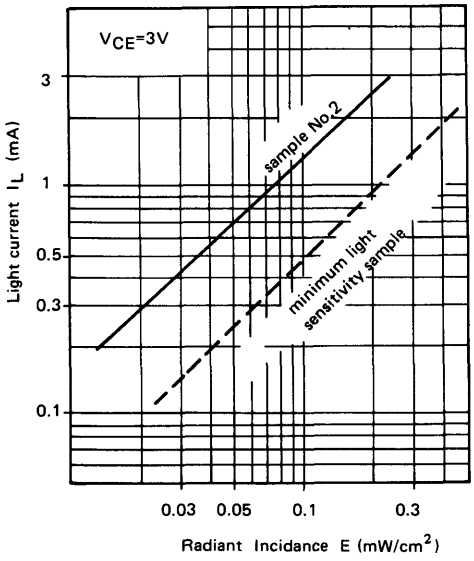


Fig. 2-121 I_L-E of Phototransistor

2-3-4 Application of Opto Sensor

(a) IRED Control Circuit

Direct-Current Drive

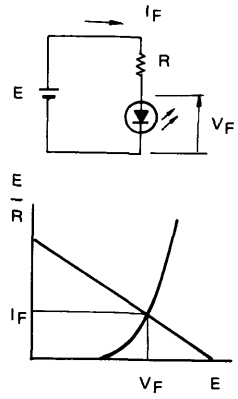


Fig. 2-122 Basic Circuit

Fig. 2-122 shows a basic drive circuit with a direct-current (DC) power supply.

In this case, I_F is expressed by the following equation:

$$I_F = \frac{E - V_F}{R}$$

E: Supply voltage
V_F: Forward voltage of LED
I_F: Forward current of LED

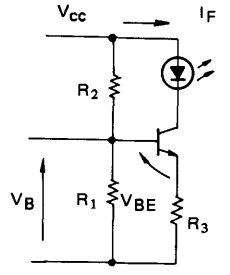


Fig. 2-123 V_F Scattering compensation circuit.

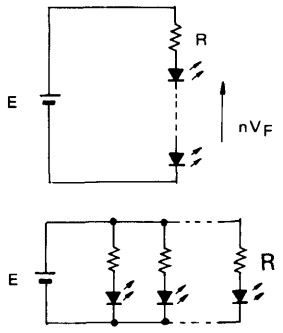
Fig. 2-123 shows the circuit where the scattering of the voltage V_F is compensated by transistor.

In this case, I_F is expressed by the following equation:

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

V_B: Base voltage
V_{BE}: Voltage between base and emitter
R_3: Emitter resistance

The dependency of luminous output power on temperature can be reduced by setting suitable values of V_{BE} and V_B in this circuit.



The small light emitting output can be improved by the series connection or parallel connection shown in Fig. 2-124.

$$I_F = \frac{E - n.V_F}{R} \quad \text{(series connection)}$$

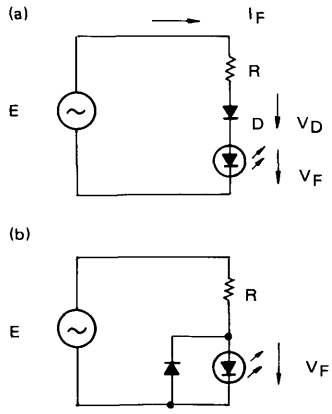
$$I_F = \frac{E - V_F}{R} \quad \text{(parallel connection)}$$

Fig. 2-124 Multi LED Drive Circuits.

Alternating-Current Drive

Fig. 2-125 shows a basic circuit where almost halfwave alternating current is used for driving. Protective diodes are added in the two driving circuits (a) and (b) so that the over reverse voltage is not applied to the LED.

These protective diodes require the reverse breakdown voltage more than the supply voltage E in (a), and the reverse breakdown voltage which is about twice higher than the forward voltage V_F of the LED in (b).



$$I_F = \frac{E - V_F - V_D}{R}$$

$$I_F = \frac{E - V_F}{R}$$

Fig. 2-125 AC Current Drive Circuits.

The resistance R is so determined that the forward current I_F of the light emitting diode is within the rated value at the maximum supply voltage E.

Pulse Drive

The advantages of the pulse modulated light transmission are as follows.

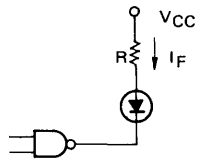
① Reduction of the duty ratio of a pulse modulated light signal enables instantaneous increase of luminous output of a light emitting diode, so the difference between the light signal and the surrounding light disturbance (S/N ratio) is improved to ensure the complete operation.

② When batteries are used as the power source, the power consumption of the device is reduced.

③ By the capacitance coupling to the next stage, the system becomes free of the dark current influence and the surrounding light disturbance.

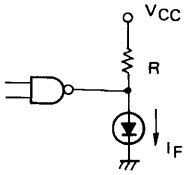
Basic drive circuit

This pulse drive system is designed as the combination of TTL or C-MOS and transistor etc.



(Turn on at Low Level)

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



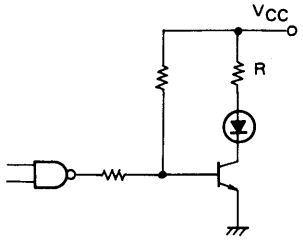
urn on at High Level)

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

Fig. 2-126 Fundamental Pulse Drive Circuits.

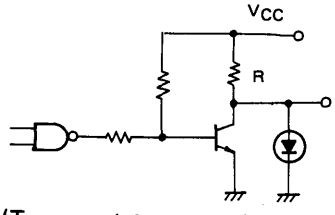
In Fig. 2-126 the electrical characteristic of TTL and C-MOS should be considered; $I_F < I_{OL}$.

The high current driving requires a buffer IC or transistor as shown in Fig. 2-127.



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

(Turn on at High Level)



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

(Turn on at Low Level)

Fig. 2-127 Pulse Drive Circuits by Buffer ICs.

I_{OL} and V_{OL} characteristics of the standard TTL, C-MOS, and Buffer IC are shown in Table 2-19.

Table 2-19: I_{OL} and V_{OL} of Buffer ICs.

Classification	V_{OL}	I_{OL}	Type
TTL	0.4V	16 mA	SN74XX Series
C-MOS	0.4V	3.2 mA V_{DD}=5V, Ta=25°C	TC4009BP, TC4010BP TC4049BP, TC4050BP
Buffer IC	1.3V Ta = 25°C	200 mA	TD62002P, TD62003P, TD62004P

Other Drive Circuit

Various pulse generating circuits for the pulse drive are easily formed by using multivibrators or UJT (Uni Junction Transistor).

Fig. 2-128 (a) gives a 400 mA pulse current with 40 μs pulse width and 0.33% duty ratio. Fig. 2-128 (b) gives a 80 ~ 800 mA pulse current with 140 μs pulse width and 1 ~ 10% duty ratio. Fig. 2-128 (c) ~ (e) shows other pulse drive circuit.

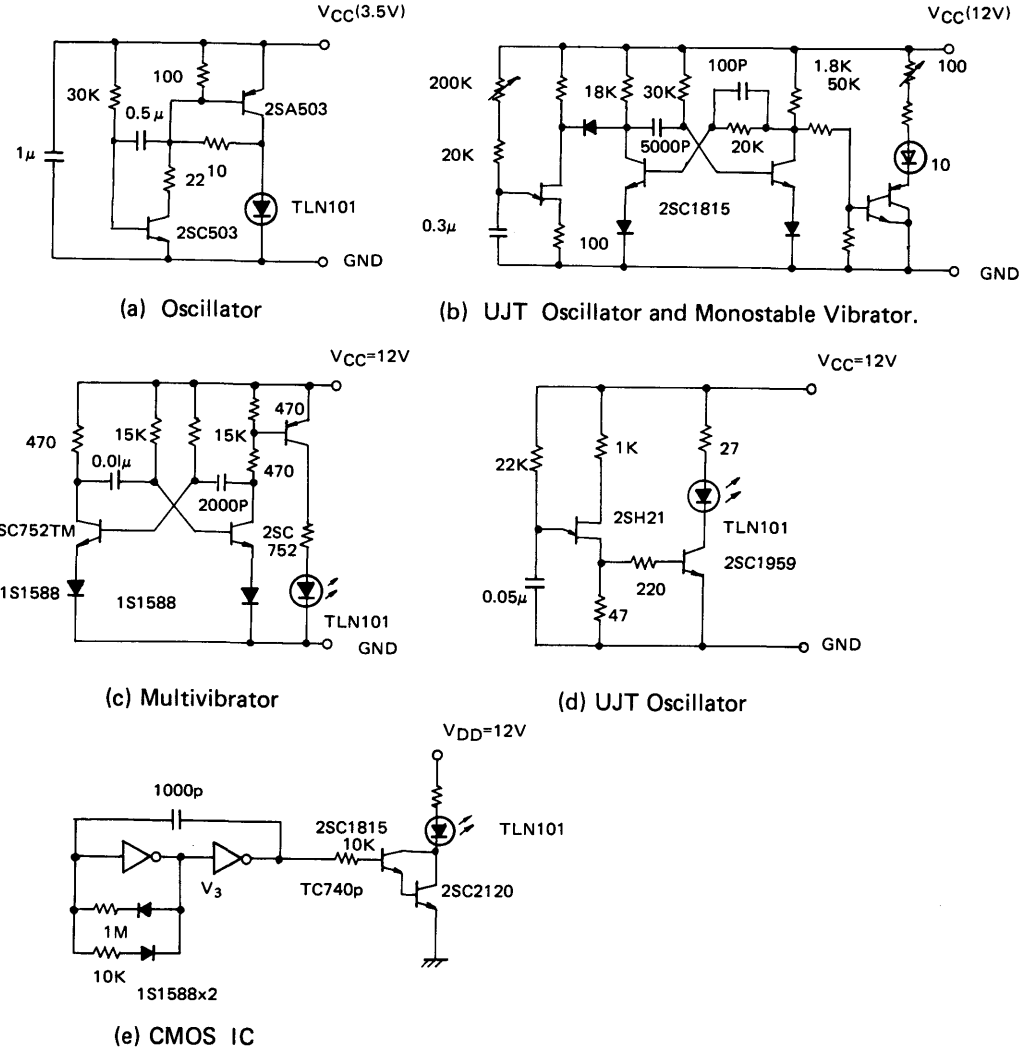


Fig. 2-128 Pulse Drive Circuits.

(b) Application of Photo Detector

The photo detector generates the light current by applied light. The silicon photo detector applications and precautions are described as following. Fig. 2-129 shows the kinds of photo detectors; a photodiode photo-Tr. (without base), photo-Tr. (with base), photo-darlington transistor and photothyristor.

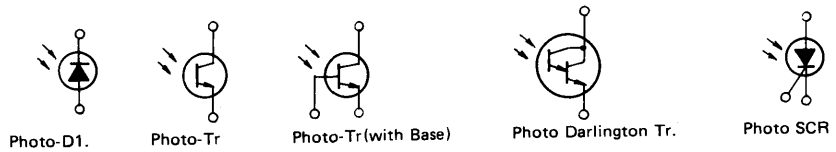


Fig. 2-129 Kinds of Photo Detectors

Photo sensitivities of these devices generally are Di < Tr < Darlington Tr., while response speeds are Di > Tr > Darlington Tr.
Before using these photo detectors, the characteristics of the response speed, photo sensitivity, directional sensitivity and sensitive wave length range should be made sure.

Photodiode Application

The photodiode is used in two ways. One is the digital use such as optical switch combined with IRED and the other is analog use like light linear detector.

- Digital Use

The photodiode has the high speed response but low sensitivity, so it requires FET amplifier with high input impedance, or a high gain amplifier as show in Fig. 2-130. When an OP-Amp is available, its signal response should be high speed.

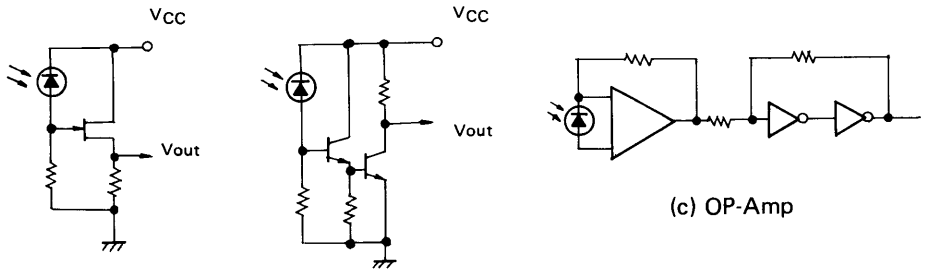


Fig. 2-130 Photodiode Amplifier Circuits.

- Analog use

The photodiode is suitable for analog use because light current is almost linearly proportional to radiant incidence (input light). This is used as linear amplification or logarithmic amplification which is especially used for camera.

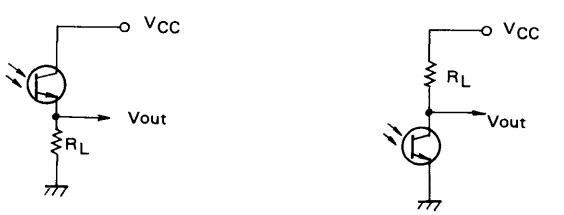
(a) Linear amplification (b) Logarithmic amplification

Fig. 2-131 Analog uses.

Photo-transistor Application

- Basic Circuit

Fig. 2-132 shows a basic circuit of a phototransistor. The load resistor R_L should be determined not only by the sensitivity but also by the dark current and surrounding light disturbance. Especially the increase of dark current at high temperature should be considered. For example, in the TPS601 operation at Ta = 100°C the dark current becomes about 100 μA. When V_{CC} = 5V, R_L = 50 kΩ, this circuit becomes "on" condition in spite of no light due to the increase of the dark current at high temperature.



(a) Collector grounded (b) Emitter grounded

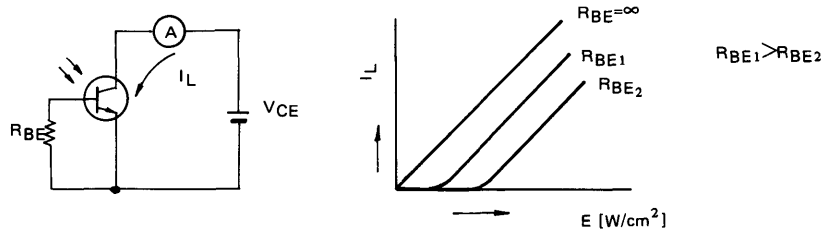
Fig. 2-132 Phototransistor Basic Circuits.

Bias circuits of the phototransistor with a base terminal.

In Fig. 2-133 the effect of the resistor R_{BE} connected between base and emitter on the dark current and photoelectric current is shown. Usually the dark current of a phototransistor is very small; several nA ~ tens of nA at room temperature. Moreover this value of the dark current can be reduced by placing R_{BE} which can bypass the leak current of collector base junction to emitter. In case of exessive low R_{BE}, the apparent h_{FE} of the phototransistor reduces and then enough photo current to operate the circuit cannot be obtained. Thus R_{BE} should be more than 1 MΩ.

Base terminal is also available for mixing photo signal and electric signal Fig. 2-134 shows the relation between light current and radiant incidence (input light) when the constant current source is connected to the base terminal, where the linearity of the photo current and radiant incidence characteristic is considerably improved in comparison with the case of zero base bias current.

(a) $R_{BE} - I_D$



(b) $R_{BE} - I_L$

Fig. 2-133 Relation between R_{BE} and I_d, I_L.

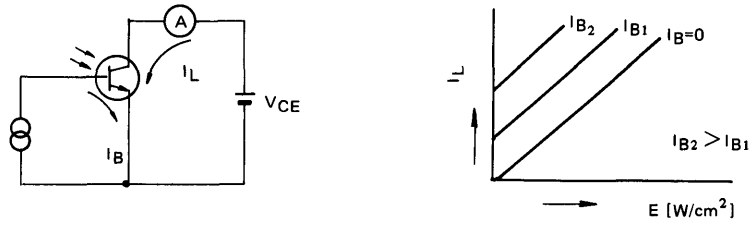


Fig. 2-134 Mixing of Photo Signal and Electrical Signal.

Phototransistor with base terminal can be biased in breeder method as well as the other normal transistor as shown in Fig. 2-135. One different point from normal transistor circuit is to require high resistance R_B at base terminal which rises up base input impedance and then makes the most of the photocurrent I_λ of the collector-base junction photodiode to flow into the base-emitter of the phototransistor. This resistor R_B should be determined $2 \sim 10\ M\Omega$.

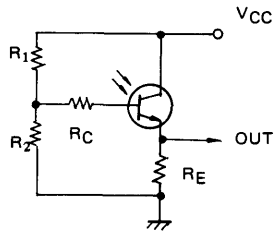
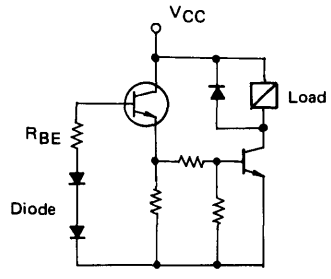


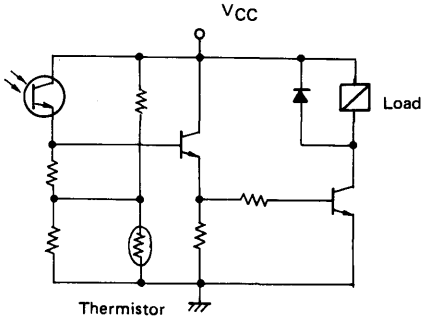
Fig. 2-135 Breeder Bias Circuit

Temperature Compensating Circuit

The photo current I_L and dark current of a phototransistor have positive temperature coefficient and especially the dark current increase exponentially as shown in the each data. To get the normal operation even at the high room temperature $50 \sim 60°C$, the temperature compensating circuit is used as shown in Fig. 2-136. Fig. 2-136 (a) shows the temperature compensating circuit which utilizes the negative temperature coefficient of forward voltage V_F of a diode. When using a phototransistor without base terminal, thermister is used to compensate output voltage by decreasing load resistance of phototransistor at high temperature as shown in Fig. 2-136 (b).



(a) Diode use

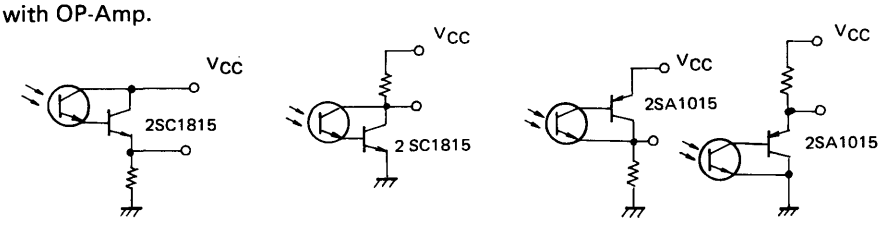


(b) Thermistor use

Fig. 2-136 Temperature Compensating Circuit.

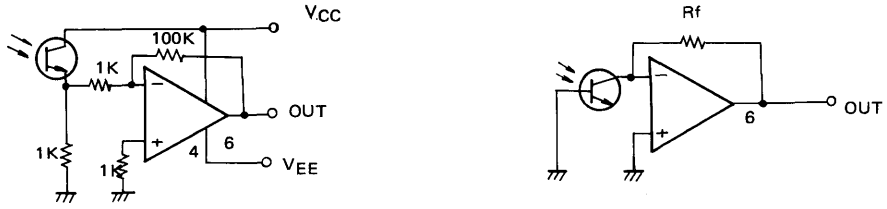
Basic Amplifier Circuit

Fig. 2-137 (a) shows the darlington connection by NPN transistor and Fig. 2-137 (b) shows the darlington connection by PNP transistor. In both case $I_C = h_{FE} \cdot I_L$ where I_C is the output current and I_L is the photo current. Fig. 2-137 shows photo amplifier circuits with OP-Amp.



(a) NPN (b) PNP

Fig. 2-137 Basic Amplifier Circuit



(1) Phototransistor amplifier circuit

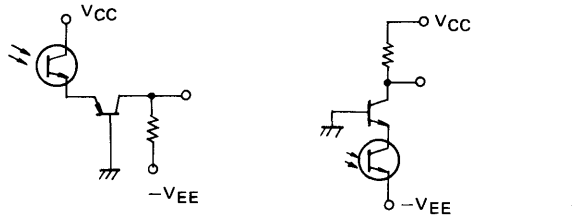
(2) Photodiode amplifier circuit

Fig. 2-138 Amplifier Circuits with OP-Amp.

Improvement of Switching Speed

When phototransistor can't get high output current, it requires high load impedance to operate the circuit. But in this case, it should be considered that the switching speed becomes low.

Fig. 2-139 shows the improvement circuit. High switching speed can be obtained by the impedance convert of PNP base grounded or NPN cascade connect circuit as shown in Fig. 2-139.



(a) Base ground (b) Cascade connection

Fig. 2-139 Higher Switching Speed Circuits.

Detecting Circuit for Constant Light

Fig. 2-140 shows the detecting circuit for constant light as optical switch. The amplifier and R-S filp flop circuit are connected with the TPS601 to get the stable output.

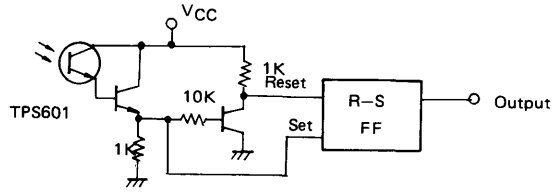


Fig. 2-140 Detecting Circuit for Constant Light.

Detecting Circuit for Pulse Modulated Light

The advantages of pulse modulated light transmission have already been described in the preceding. Fig. 2-141 shows those detecting circuits for pulse modulated light. In Fig. 2-141 (a), when pulse modulated light enters into the phototransistor, it can be transmitted to the T_{rl} through the condenser C_1. Even though pulse modulated light contains the constant surrounding disturbance light and dark current, they are cut by the condenser C_1.

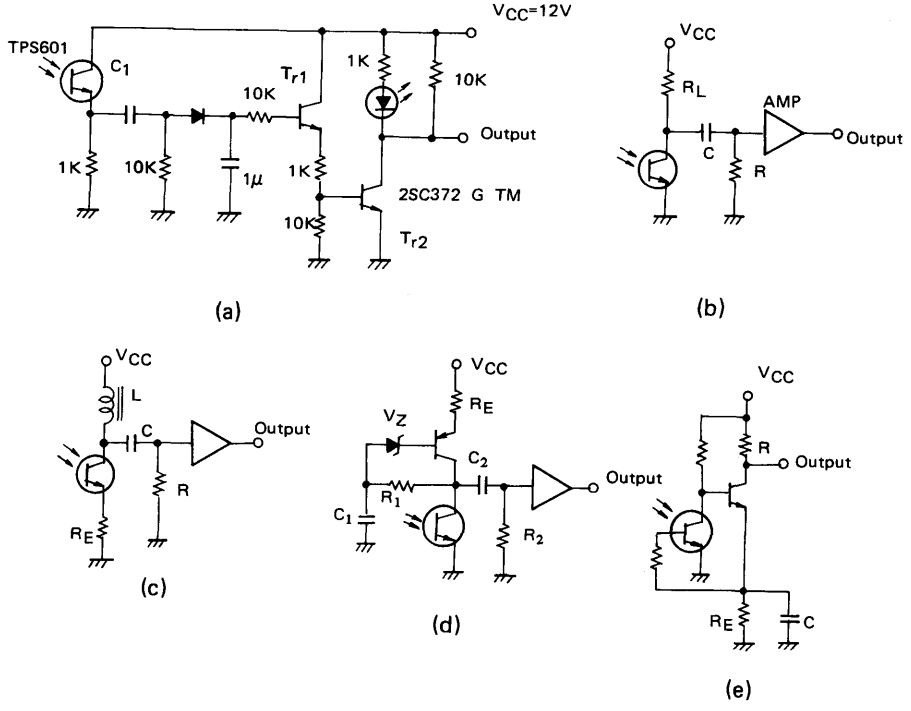


Fig. 2-141 Detecting Circuits for Pulse Modulated Light.

Connect to Digital IC

When a digital IC (TTL, HTL, and C^2-MOS etc.) is driven by a phototransistor, the load resistance R_L of the phototransistor and the light current I_L should be determined in consideration of the type of IC.

In the emitter load as shown Fig. 2-142 (a), the load resistance R_L and light current I_L should satisfy the following formula:

ON condition; $R_L \times (I_L - I_{IH}) > V_{IH}$

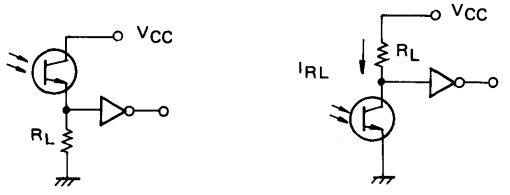
OFF condition; $R_L \times (I_d + I_{IL}) < V_{IL}$

R_L:	Load resistance
I_L:	Light current
I_D:	Dark current
I_{IH}:	High level input current
I_{IL}:	Low level input current
V_{IH}:	High level input voltage
V_{IL}:	Low level input voltage

In the collector load as shown Fig. 2-142 (b), the load resistance R_L and light current I_L should satisfy the following formula, where output becomes high level when phototransistor detect the light.

ON condition: $V_{CC} - R_L \times (I_L - I_{IL}) < V_{IL}$

OFF condition: $V_{CC} - R_L \times (I_d + I_{IH}) > V_{IH}$

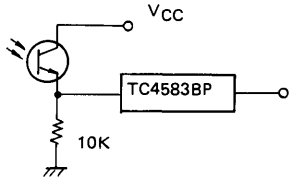


(a) Emitter Load (b) Collector Load

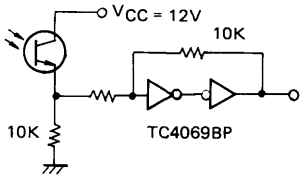
Fig. 2-142 Connects to Digital IC

Schmitt Trigger Circuit

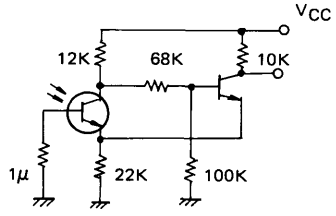
In the flip-flop and counter circuit, the schmitt trigger circuit should be entered between phototransistor and digital IC to be free of miss-operation. Fig. 2-143 shows the schmitt trigger cirucits.



(a) Schmitt Trigger IC



(b) Constructed by Gate IC



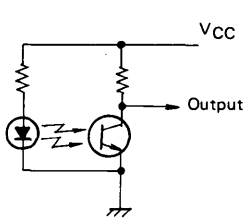
(c) Constructed by transistor

Fig. 2-143 Schmitt Trigger Circuit.

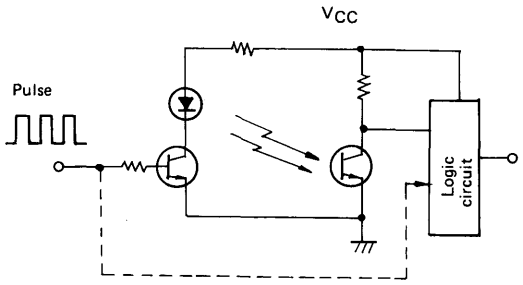
(c) Optical Switch

Basic Circuit for Optical Switch

Fig. 2-144 shows the two basic circuits for optical switches, which are (a) DC light transmission and (b) pulse modulated light transmission. The former is the simple circuit but can't get the long transmittable distance, while the latter is the little complicated but can get the long transmittable distance.



(a) DC Light



(b) Pulse Modulated Light

Fig. 2-144 Basic Circuits for Optical Switch.

Radiant incidence to the detector by the output of LED is inversely proportional to the square of distance(r) from LED. When radiant incidence (input light) is E(d) at the point of r = d, the radiant incidence at the point of r = 2d decreases 1/4E(d) as shown in Fig. 2-145.

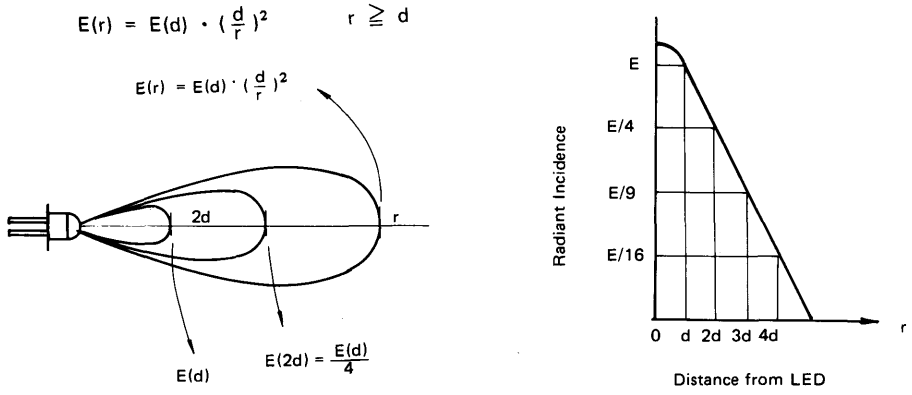


Fig. 2-145 Radiant Incidence from LED Emitter.

To get the longer transmitable distance, optical lens is sometimes placed in front of LED as shown in Fig. 2-146. When LED is placed at the focal point, the radiant incidence E(r) at the point r ≧ d is nearly equal to that at the point r = d as shown in Fig. 2-146. Therefore it will be able to get the long transmittable distance.

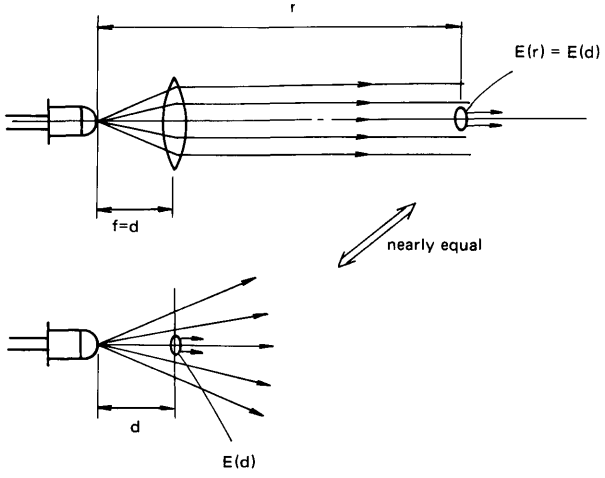


Fig. 2-146 Optical Lens Effect

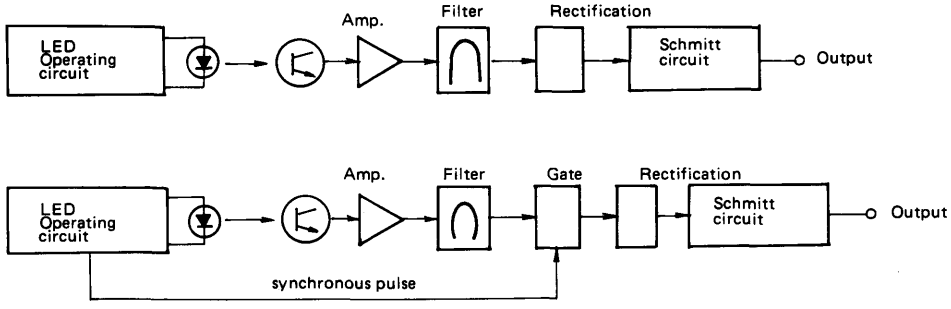


Fig. 2-147 Block Diagrams of Optical Switch in Pulse Modulation

By using pulse modulated drive, the transmittable distance becomes still longer. Fig. 2-147 shows this block diagrams.

(d) Design Procedure

Distance between emitter and detector

Transmittable distance of optical switch depends on the kinds of device and the surrounding circuit designes, but it is roughly 30 ~ 100 mm in DC. driving, 8 ~ 30 m in pulse during as shown in Table 2-20.

Table 2-20: Transmittable Distance

Emitter	Detector	Distance between Emitter and Detector	
		DC drive	Pulse drive
TLN108	TPS601	60 mm	20 m
TLN108	TPS708	40 mm	20 m
TLN103	TPS603	30 mm	8 m
TLN104	TPS605	40 mm	10 m
TLN105A	TPS703	60 mm	20 m
TLN107	TPS607	40 mm	10 m
TLN110	TPS703	100 m	30 m

Counterplan for Surrounding Light Disturbance

The light source of optical switch is mostly IRED whose light emitting wave length is within the range of 900 ~ 1000 nm, while the spectral response (wave length) of the detector (phototransistor and photodiode) is within 400 ~ 1100 nm which contains even the visible light (400 ~ 700 nm) as shown in Fig. 2-148.

Since the surrounding light have influence on the S/N ratio of optical switch, the counterplans to improve S/N ratio are described as follows;

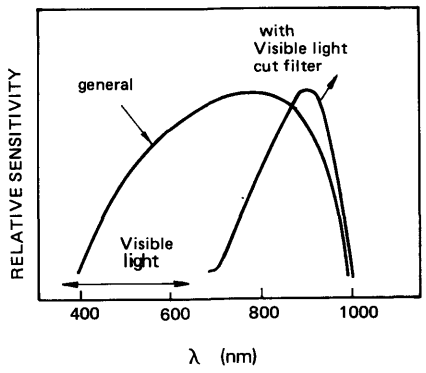
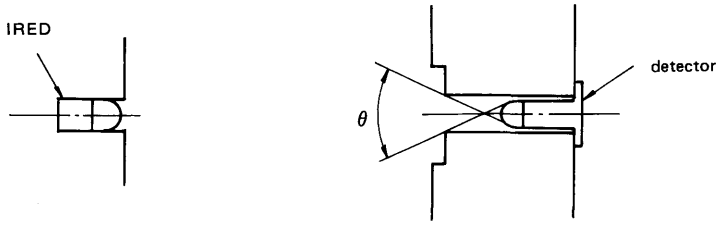
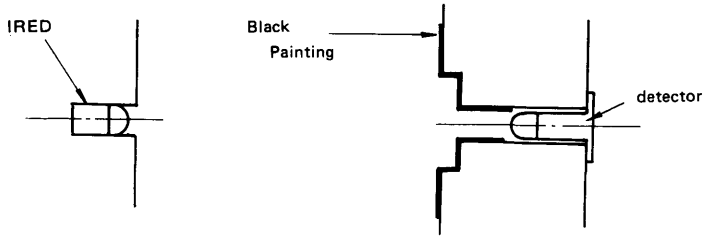


Fig. 2-148 Spectral Response of Detectors

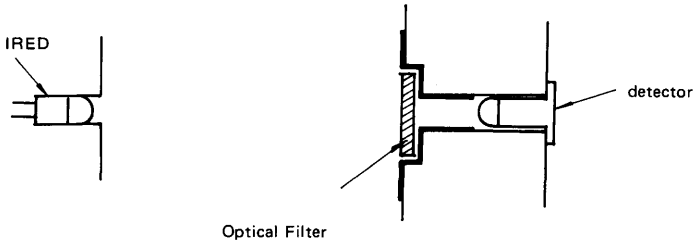
ⓐ Decrease "θ" the angle of incidence to the detector.



ⓑ Paint black the housing around the detectors or use the molding resin which cuts out visible light (scattering and reflection of light).



ⓒ Use the filter to cut out the surrounding visible light.
(Fuji filter 1R84 etc.)



Dust along the Optical Path

Existence of dust along the optical path between the emitter and detector causes less transmittable distance, so operational life of the equipment will become shorter.

Design of Electric Circuits

Fig. 2-149 shows the basic circuit by DC light transmission and the design procedure to determine the value of R_1, R_2.

For example operational temperture range of the equipment;

$$T_{opr} = 0 \sim 70°C \quad \cdots\cdots\cdots\cdots ①$$

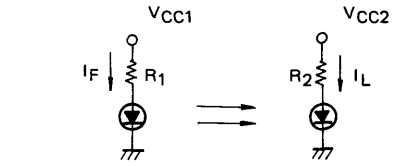
From the maximum ratings of LED, the tolerable forward current I_F MAX. at the ambient temperature 70°C becomes

$$30\ mA \quad \cdots\cdots\cdots\cdots\cdots\cdots ②$$

The load resistance R_1 is gotten by the following equation:

$$R_1 = \frac{V_{CC1} - V_F}{I_F} \quad \cdots\cdots ③$$

where $V_F \sim 1.0$ V at. $I_F = 30$ mA



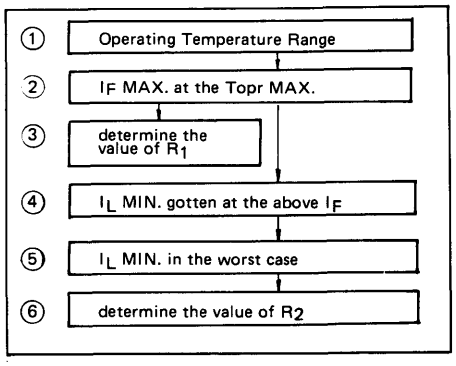


Fig. 2-149 Circuit Design Procedure

The scattering of the light current of a detector depends on the scattering of the distance between the emitter and detector, the radiant power of a emitter and photosensitivity of a detector. Even though the circuit can operate in the experiment only by using several pairs of emitter and detector, it is very doubtful whether the circuit design is completely suitable for the mass production. The circuit design should be confirmed by using the limit samples; LED with minimum Radiant Power and Detector with minimum Photosensitivity. If these limit samples can't be gotten, another way to confirm the circuit design is described as follows;

Prepare LED ① with radiant intensity data and Detector ① with light current data. Set those device into the equipment and estimate MIN. Light Current I_L MIN. as shown in Fig. 2-150 and Fig. 2-151.

Radiant intensity $I_{E(1)}$ of LED ① at $I_F = 30$ mA is

$$I_{E(1)} = 38\ mW/sr$$

In the case of the limit LED, $I_E = I_{E(2)}$ at $I_F = 30$ mA is

$$I_{E(2)} = 11\ mW/sr$$

Decrease I_F until I_E of LED ① becomes 11 mW/sr.
Therefore I_E of the limit LED at $I_F = 30$ mA corresponds with I_E of LED ① at $I_F = 9$ mA from the simulation of Fig. 2-148.

When LED ① and Detector ① are set in the equipment and light current $I_{L(1)}$ at I_F = 9 mA, V_{CE} = 3V is

$$I_{L(1)} = 2 \text{ mA}$$

Radiant incidence E(1) to the detector ① is 0.22 mW/cm^2.
In the case of the limit detector, light current $I_{L(1)}$ gotten at E = 0.22 mW/cm^2, V_{CE} = 3V is

$$I_{L(1)} = 0.6 \text{ mA} \quad ④$$

Accordingly, $I_{IL\ MIN.}$ becomes 0.6 mA, when the limit LED and the limit detector are coupled in the equipment.

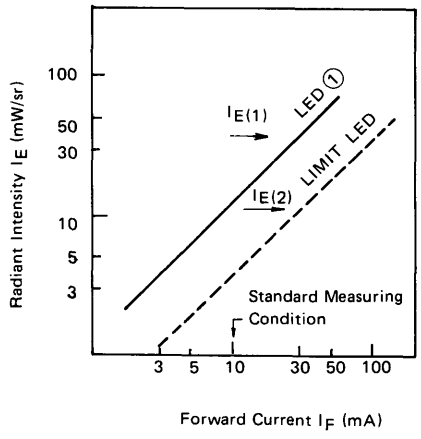


Fig. 2-150 I_E VS I_F Characteristic of LED.

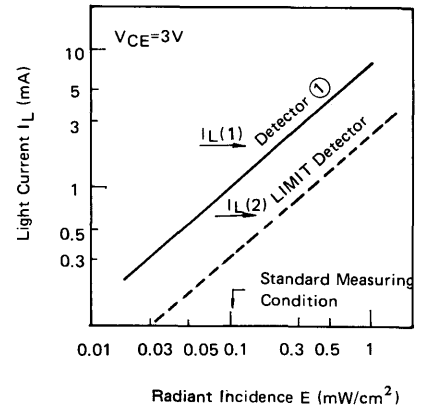


Fig. 2-151 I_L VS E Characteristic of Phototransistor

The factors which may reduce the coupling output current of LED and detector are as follows:

- Dust along the light path ..... −50%
- Temperature characteristics (T_{opr} = 0 70°C) ..... −10%
- Operating Life ..... −30%

The minimum value of light current in the worst case from the above consideration becomes

$$I'_{L\,MIN} = I_{L\,MIN} \underbrace{\times\ 0.5}_{\text{dust}} \underbrace{\times\ 0.9}_{\text{Temperature}} \underbrace{\times\ 0.70}_{\text{Life}}$$

$$= 0.19\ \text{mA} \qquad (5)$$

load resistance R_2 is expressed by

$$R_2 = \frac{V_{CC2} - V_{CE(sat)}}{I'_{L\,MIN}} \qquad (6)$$

Finally an example of circuits which can drive TTL is shown in Fig. 2-152.

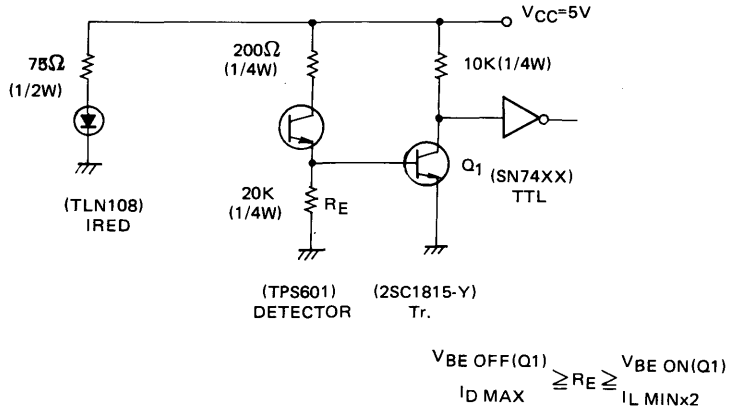


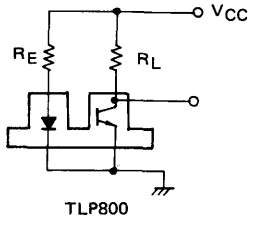
Fig. 2-152 Example of Circuit Design.

(e) Application of Photointerruper

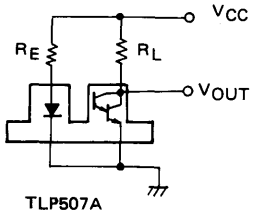
Photointerrupter is an optical switch where LED and phototransistor are assemblied in the housing so as to face each other with air gap. Photointerrupters available for position sensor, rotator sensor in a vending machine, copier and audio record player etc.

Basic Circuit

Fig. 2-153 shows the basic circuit of photointerrupter, which are the same as optical switch as described in basic circuit for optical switch. The transistor output type is suitable for sensing a high speed rotating disc and the darlington-transistor output is suitable for controlling a heavy load.



(a) Transistor output



(b) Darlington Transistor output

Fig. 2-153 Basic Circuits of Photointerrupter.

Other Circuit of Photointerrupter

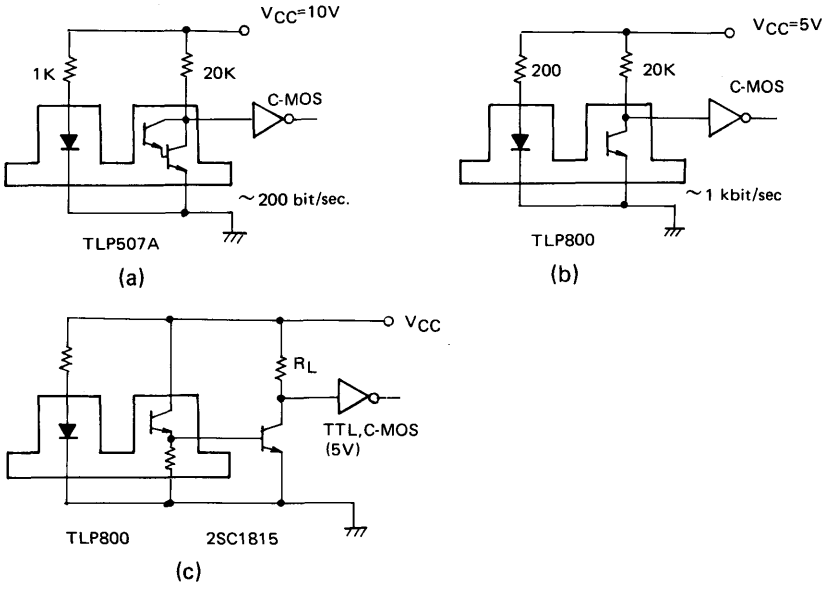


Fig. 2-154 Other Circuits of Photointerrupter.

When digital IC (TTL, HTL, C^2-MOS etc.) are driven by the photointerruper, available IC depends on $V_{CE(sat)}$ (Saturation voltage between collector and emitter).

In the photo-darlington transistor $V_{CE(sat)}$ = 1.0 V, so direct driving of the TTL may be impossible because of V_{OL} = 0.8 V of the TTL.

Fig. 2-154 (a) shows a design example with a sensing speed of 200 bit/sec. Fig. 2-154 (b) and Fig. 2-154 (c) show examples of sensing speeds of 1 Kbit/sec. and 10 Kbit/sec.

Heavy load can be also controlled by using the photointerruper.

Fig. 2-155 shows circuits for driving power transistors and thyristors with heavy load.

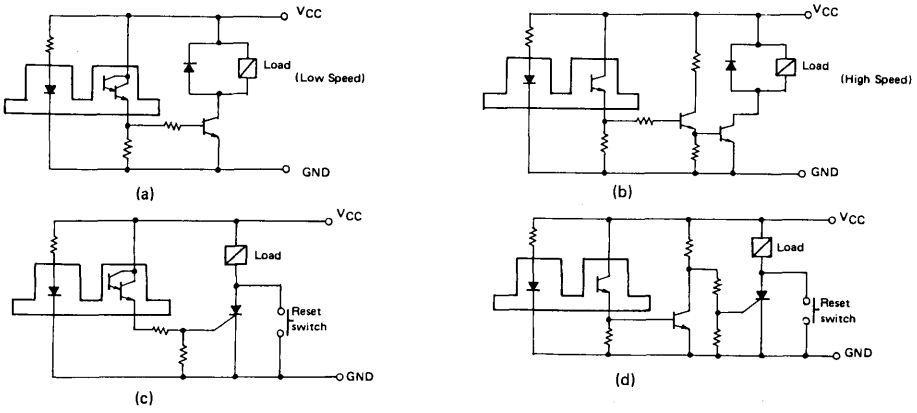


Fig. 2-155 Heavy Load Control Circuit.

Design of Light Cutting Disk

When a photointerrupter is used for sensing the rotation speed, it needs the light cutting disk synchronous moving with rotator in order to cut the light path between LED and phototransistor. The sensing area has relation to the switching accuracy, that is, the switching time from "open" (ON) to "closed" (OFF).

Fig. 2-156 shows the relation between the sensing area and the switching accuracy.

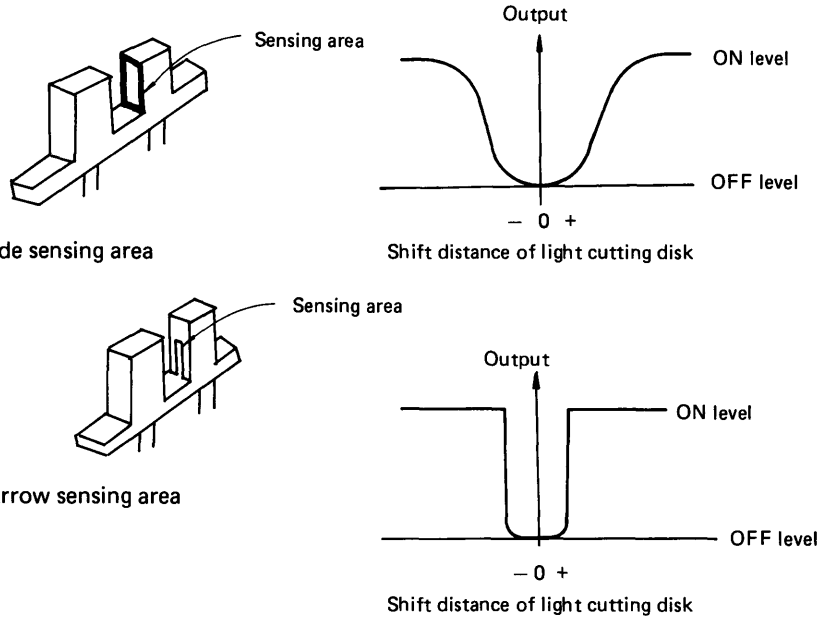
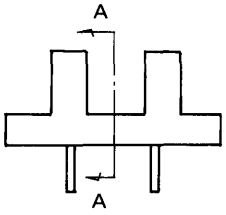


Fig. 2-156 *Sensing area and switching accuracy*

In the motor speed control, the larger the number of switching per a rotation becomes, the easier the speed control becomes. Sensing area should be narrow to increase the number of switching per a rotation, while output current becomes small.

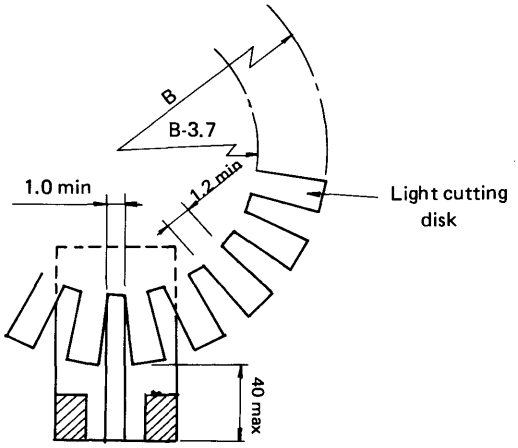
Fig. 2-157 shows the recommendable light cutting disk for TOSHIBA photointerrupter TLP800 and TLP507A.

The width disk hole is designed in consideration of the open and close time of the rotating disk and frequency response of the interrupter.



A-A' Sectional view

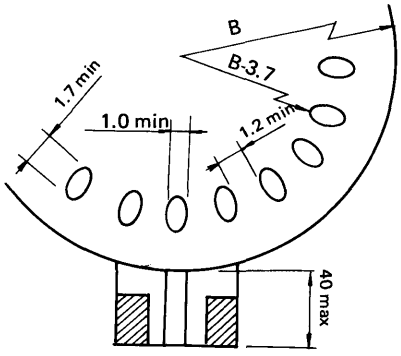
Interrupter type: TLP507A
TLP800



TLP800

Unit in mm

B: a radius of light cutting disk



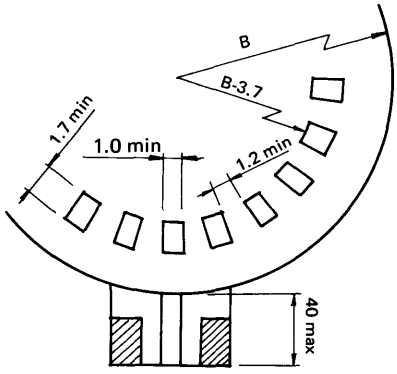


Fig. 2-157 Light cutting disk

Application circuit of photo reflective sensor

Fig. 2-158 shows the basic circuit of a photo reflective sensor. The reflected light with focus type (TLP903/904), which have their own applications according to their features of characteristic. The sensing position characteristic near the black-white boundary line is sharper in a focus type than that in a non-focus type as shown Fig. 2-159(a), Fig. 2-160(a) so the former is excellent in the bar code detective applications. A small, compact reflective sensor is suitable for the object-approach detection.

Sensor outputs of sensing operation should be digital output so it needs usualy the comparator circuit or shown Fig. 2-158.

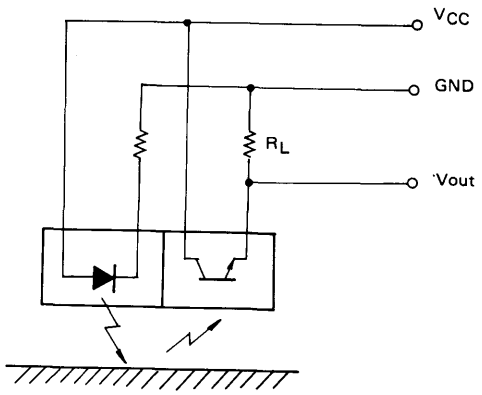


Fig. 2-158 Fundamental Circuit of Photo Reflective Sensor

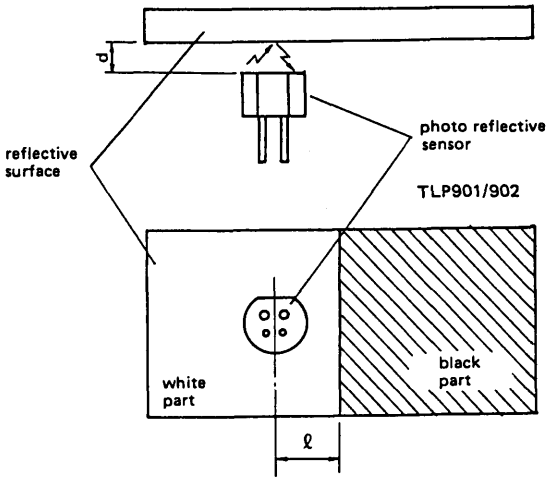
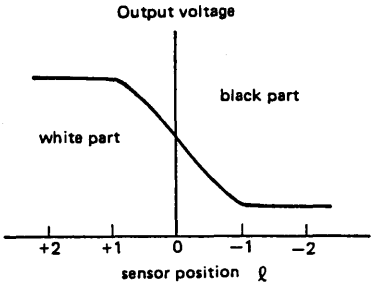
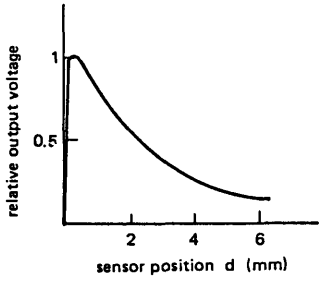


Fig. 2-159 Sensing position characteristics (non focus type)



(a) horizontal shift



(b) approach

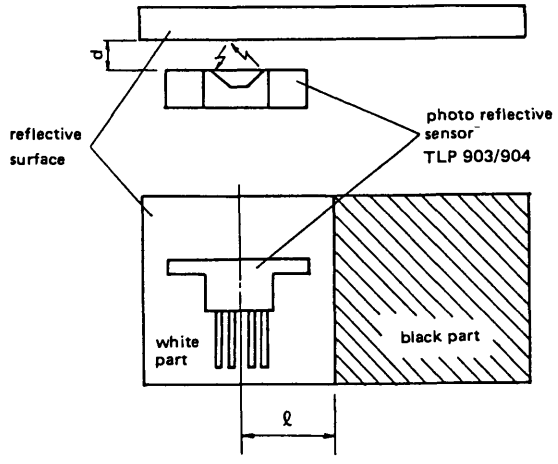
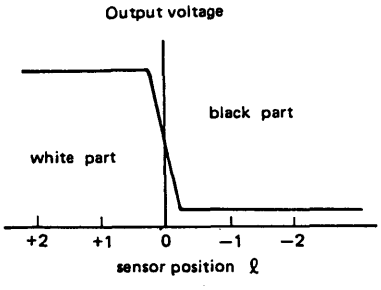
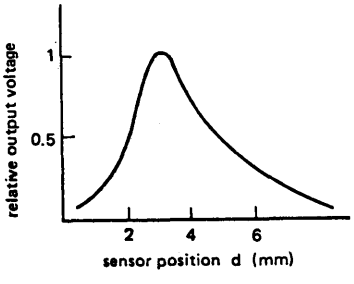


Fig. 2-160 Sensing position characteristics of TLP903 (with focus type)



(a) horizontal shift



(b) approach

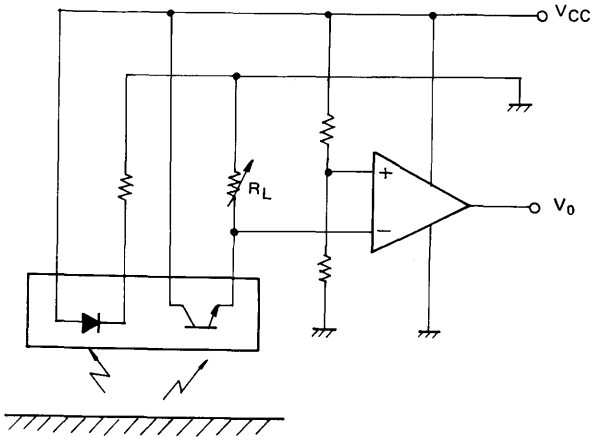


Fig. 2-161 Photo Reflective Sensor Circuit to Conparator Circuit.

3. RELIABILITY

It is the purpose of this chapter to introduce the periodic reliability reports issued by Toshiba on our optoelectronic products.

As new products, processes and test procedures evolve, the applicability of past data to reliability prediction changes.

Thus, data presented here represents a "snapshot in time" of data believed applicable to the product made now and in the immediately anticipated future.

These test methods and their results are divided into three categories, LED lamps/ displays, opto-isolaters and opto sensors.

3-1 LED lamps and LED displays

3-1-1 Reliability Tests

Reliability Tests are conducted to confirm the design margin and limit levels of devices, or to maintain and confirm the quality assurance levels of the mass produced devices.

Though the test methods and test conditions depend on the purpose usually, the electrical stress, thermal stress and mechanical stress during the use of the devices are assumed and their withstand levels are estimated.

Table 3-1 shows the reliability tests method of the LED lamps and displays.

Reliability Test Methods

Life Test

- Operating Life Test

To confirm the stability during usual operation, the maximum rating forward current at room temperature is applied to the LED.

- Storage Life Test

To confirm the stability in storage, the high and low temperature storage life tests are conducted under the conditions of the maximum and minimum storage temperature. Since the devices may be used or in storage at high temperature and high humidity, therefore the high temperature and high humidity storage life test is conducted.

- Environmental Test

Since the estimation of thermal stress and mechanical stress applies to the rating, the attaching and using of the devices, the soldering heat, temperature cycles, thermal shock, vibration and lead strength etc. are examined.

Table 3-1 Reliability Test methods of LED lamps and LED displays

	Test	Test Conditions	MIL-STD-750 Reference
Life Test	Operating Life	T_a = 25°C I_F = Max. Rating	1026.3
	High Temperature Storage	T_a = T_{stg}, Max.	1031.4
	Low Temperature Storage	T_a = T_{stg}, Min.	–
	High Temperature and High Humidity Storage	T_a = 60°C or 40°C, R. H. = 90%	–
Environmental Tests	Soldering Heat	Immersed for 10 sec. at 260°C up to 2 mm from the body.	2031.1
	Temperature Cycling	T_{stg}. Min. ~ 25°C ~ T_{stg}. Max. ~ 25°C (30 min.) (5 min.) (30 min.) (5 min.) ← 1 cycle →	1051.1
	Thermal Shock (except for non-sealing type.)	100°C or T_{stg}. Max. ~ 0°C (15 sec) (5 sec.) ← 1 cycle → 3 sec. transfer in water	1056.1
	Moisture Resistance	65°C, 90 ~ 98% R.H., 25°C, 10 Cycles, −10°C ← 24h (1 cycle) →	1021.1
	Vibration Variable Frequency	100~2000~100 Hz 4 cycles each X, Y Z at 20G ← 4 min. →	2056
	Shock	3 blows, 1500G, 0.5 ms (Lamps) 3 blows, 500G, 1 ms (Displays)	2016.2
	Constant Acceleration	1 minute each X,Y,Z at 20,000G (Lamps) 1 minute each X,Y,Z at 5000G (Displays)	2006
	Lead Bending Stress	Weight 250 g, 0° ~ 90° ~ 0° bend, 3 times	2036.3
	Solderability	Immersed for 5 sec. at 230°C flux: 75% isopropyl alcohol, 25% WW resin	2026.2

3-1-2 Reliability Test Data

The above test data obtained from the main devices of the LED lamps and displays is shown later.

The measuring terms and failure criteria are as follows;

Measuring Terms	Failure Criteria
Luminous Intensity (I_V)	Lower Standard Limit x 0.5
Forward Voltage Drop (V_F)	Upper Standard Limit x 1.2
Reverse Leakage Current (I_R)	Upper Standard Limit x 2.0

Test Data

The test data of LED lamps are shown in tables 3-2 and 3-3, and that of LED displays are shown in table 3-4 and 3-5. The relative luminous intensity vs. stress time, in the operating life tests of each main device is shown in Figure 3-1.

The failure modes in the operating life test are the variations of the forward voltage drop and reverse leakage current, and the degradation of the luminous intensity. The failure mode in the environmental tests is the open failure in the temperature cycling test.

Prediction of Failure Rate

From the view point of our LED using achievements in the field and our extensive test data, the failure modes when using LEDs are dominated by accidental failure (open, short, etc.) rather than the degradation of the luminous intensity. These accidental failures are considered to result from, carelessness in the manufacturing process; fatigue due to the thermal stress and mechanical stress etc; breakdown due to over voltage (current). Accordingly, if we take into account these accidential failures, the failure rate can be predicted.

From our LED using achievements in the field and our extensive test data, this accidental failure rate can be estimated to be about 10 to 50 Fit.

Regarding the luminous intensity (I_V) which is the main characteristic of LEDs, the half life-time (time when the luminous intensity has been reduced to 50% of the initial value) obtained from the accelerated operating lifetest, is estimated as shown in Figure 3-2.

Table 3-2 Life test data sheet of LED lamps

Test	Device No.	Test Condition	Stress Time	Failed Number (n=20)	Failure Rate (Note)	Failed Content
Operating Life	TLR102A Series	T_a = 25°C I_F = 25 mA	27.5×10^5	1	0.07	I_V
	TLR143 Series	I_F = 25 mA	14.4×10^5	0	0.06	
	TLR121 Series	I_V = 15 mA	3.0×10^5	0	0.31	
	TLG113A Series	I_F = 25 mA	8.2×10^5	0	0.11	
	TLY123 Series	I_F = 25 mA	2.0×10^5	0	0.46	
High Temperature Storage	TLR102A Series	T_a = 100°C 1000H	7.0×10^5	0		
	TLR143 Series	T_a = 100°C 1000H	8.0×10^5	0		
	TLR121 Series	T_a = 80°C 1000H	1.3×10^5	0		
	TLG113A Series	T_a = 100°C 1000H	3.5×10^5	0		
	TLY123 Series	T_a = 100°C 1000H	0.5×10^5	0		
High Temperature and High Humidity Storage	TLR102A Series	T_a = 60°C R.H. = 90%	6.7×10^5	0		
	TLR143 Series		5.0×10^5	0		
	TLR121 Series		1.2×10^5	0		
	TLG113A Series		3.0×10^5	0		
	TLY123 Series		0.5×10^5	0		

Note: 60% confidence level % / 1000 Hrs.

Table 3-3 Environment test data sheet of LED lamps

Test and Conditions \ Device No.		TLR102A Series		TLY123 Series		TLO163 Series		TLY143 Series		TLG113A Series		TLUR153 Series		TLR121 Series		Note
		n	r	n	r	n	r	n	r	n	r	n	r	n	r	
Soldering Heat 260°C, 10 sec.		120	0	100	0	150	0	150	0	120	0	150	0	150	0	
Temperature Cycling −30°C~100°C* (30′ min.) (30′min.)	10 cycle	300	0	200	0	300	0	300	0	540	0	300	0	150	0	
	100 cycle	300	0	200	0	300	0	300	0	540	0	300	0	150	1**	*TLR121 Series 80°C **open
Thermal Shock 5 cycles 100°C* (15 sec.) ~ 0°C (5 sec.)		40	0	30	0	40	0	40	0	60	0	40	0	40	0	* same as the above
Vibration Variable Frequency		40	0	60	0	40	0	40	0	60	0	40	0	40	0	
Shock		40	0	60	0	40	0	40	0	60	0	40	0	40	0	
Constant Acceleration		40	0	60	0	40	0	40	0	60	0	40	0	40	0	
Lead Bending Stress		60	0	60	0	60	0	60	0	60	0	60	0	60	0	

n: units tested, r: units failed

Table 3-4 Life test data sheet of LED displays

Test	Device No.	Test Condition	Stress Time	Failed Number (n=30)	Failure Rate (Note)	Failed Content
Operating Life	TLR312 Series	T_a=25°C, I_F=15 mA/seg.	17.0×10^5	1	0.12	IR
	TLR324 Series	T_a=25°C, I_F=20 mA/seg.	13.3×10^5	0	0.07	
	TLR4135 Series	T_a=25°C, I_{FP}=60 mA/seg. D·R =1/5	3.0×10^5	0	0.31	
	Series	T_a=40°C, I_F=15 mA/seg.	15.5×10^5	0	0.06	
	TLG324 Series	T_a=25°C, I_F=20 mA/seg.	6.2×10^5	0	0.15	
	TLG4115 Series	T_a=25°C, I_{FP}=60 mA/seg. D·R=1/5	2.0×10^5	0	0.46	
High Temperature Storage	TLR312 Series	T_a=80°C	5.0×10^5	0		
	TLR324 Series	T_a=90°C	5.0×10^5	0		
	TLR4102 Series	T_a=75°C	3.0×10^5	0		
	TLG324 Series	T_a=90°C	3.0×10^5	0		
High Temperature and High Humidity Storage	TLR312 Series	T_a=60°C R.H.=90%	6.0×10^3	0		
	TLR324 Series		5.0×10^5	0		
	TLR4115 Series		4.0×10^5	0		
	TLR4202 Series	T_a=40°C R.H.=90%	5.0×10^5	0		
	TLG324 Series	T_a=60°C R.H.=90%	3.0×10^5	0		

Note: 60% confidence level %/1000 Hrs.

Table 3-5 Environmental test data sheet of LED displays

Test and Conditions \ Device No.		TLR312 Series		TLR324 Series		TLR4115 Series		TLR4102 Series		Note
		n	r	n	r	n		n	r	
Soldering Heat 260°C 10 sec.		180	0	120	0	90	0	100	0	
Temperature Cycling T_{stg}(Min) ~ T_{stg}(Max) (30 min.) (30 min.)	10 cycles	120	0	80	0	80	0	110	0	T_{stg}.: Storage Temperature of each device
	100 cycles	120	0	80	0	80	0	110	0	
Thermal Shock 5 cycles T_{stg}. Max. (15 sec.) ~0°C (5 sec.)		60	0	75	0	30	0	–	–	Same as the above
Vibration Variable Frequency 100 ~ 2000 Hz 20 G		70	0	60	0	40	0	40	0	
Shock 500 G, 1 ms, 3 blows each X, Y, Z		70	0	60	0	40	0	40	0	
Constant Acceleration 5000 G, 1 minute each X, Y, Z		70	0	60	0	40	0	40	0	

n: Units tested, r: Units failed

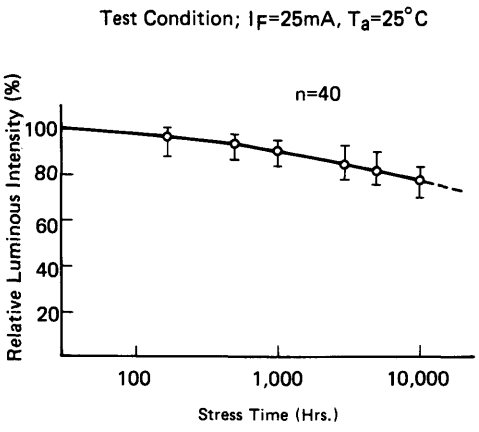


Fig. 3-1-1 TLR102A (FRS Type, Red)

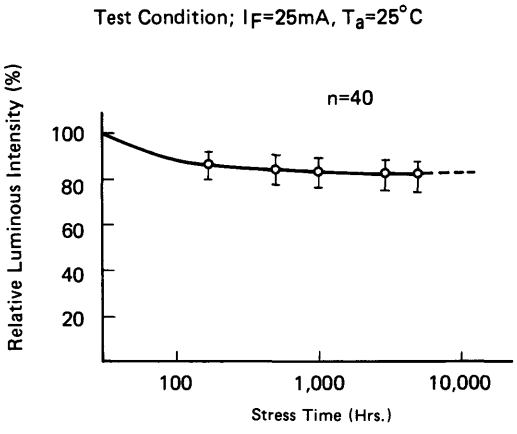


Fig. 3-1-2 TLG163 (All Plastic Mold, Mini Type)

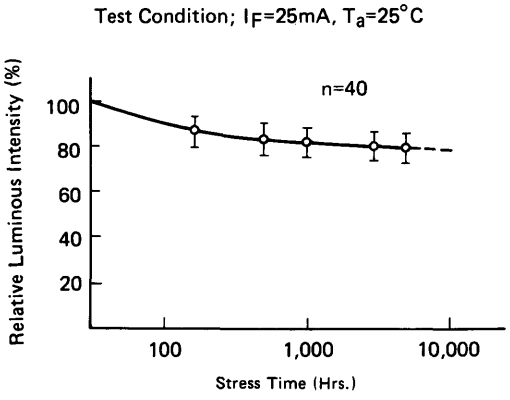


Fig. 3-1-3 TLY143 (All Plastic Mold, Short Type, Yellow)

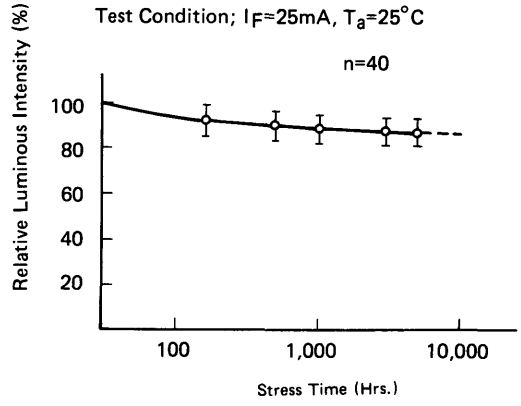


Fig. 3-1-4 TLUR153 (All Plastic Mold, Long Type, Ultra Red)

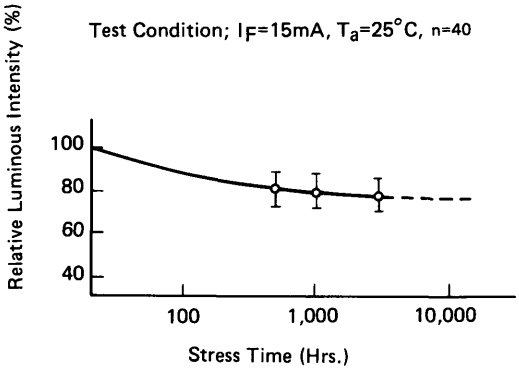


Fig. 3-1-5 TLR121 (All Plastic Mold, Submini Type, Red)

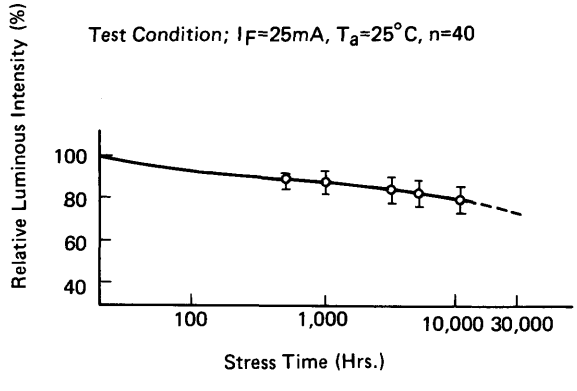


Fig. 3-1-6 TLG113A (All Plastic Mold, Long Type, Green)

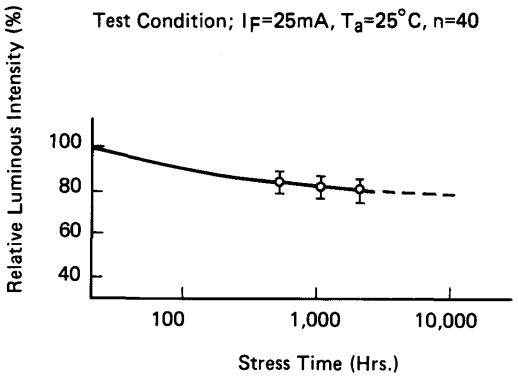


Fig. 3-1-7 TLY123 (All Plastic Mold, Mini Type, Yellow)

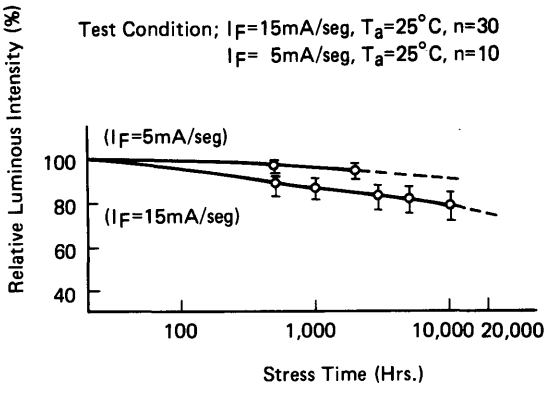


Fig. 3-1-8 TLR312 (Case Type, One Digit, Red)

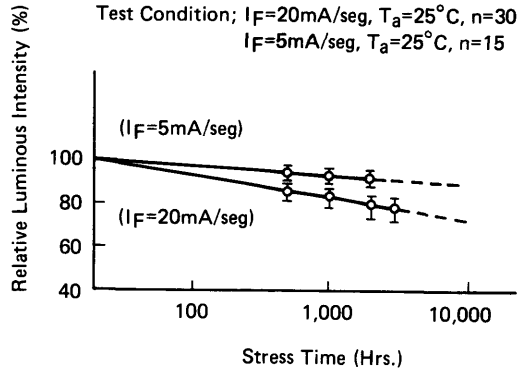


Fig. 3-1-9 TLR324 (Case Type, Two Digit, Red)

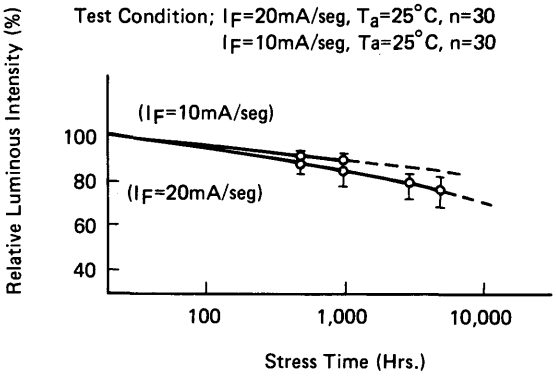


Fig. 3-1-10 TLG324 (Case Type, Two Digit, Green)

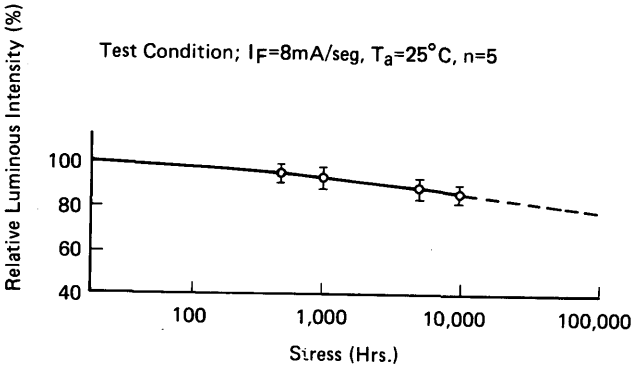


Fig. 3-1-11 TLR4202 (Film Type, Four Digit, Red)

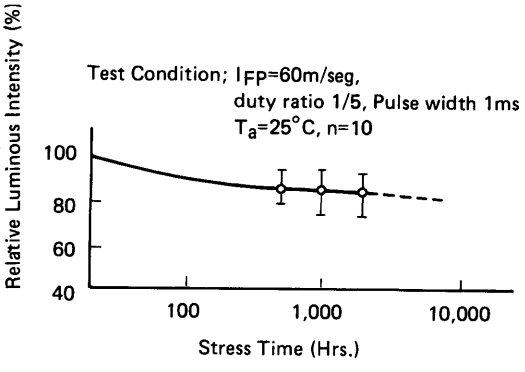


Fig. 3-1-12 TLG4115 (Case Type, Four Digit, Green)

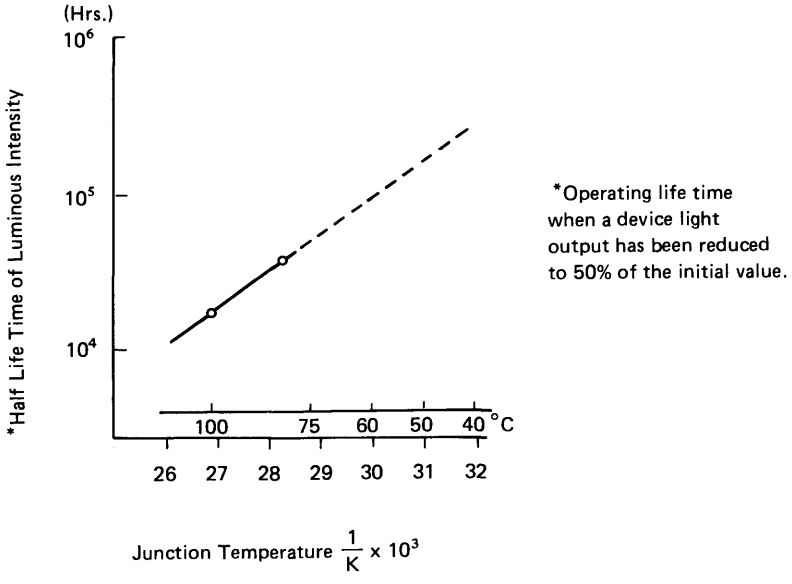


Fig. 3-2 Junction Temperature vs. Half Life Time

3-2-1 General

In recent years, as the application fields for photo couplers expand, more discussions are being made on reliability.

For reliability improvement, it is insufficient to perform strinct process management and to have reliability tests such as life test and environmental tests. It is necessary to perform a failure mechanisms for conventional transistors and diodes, tent to suffer from the following failure modes.

(a) Defective bonding between GaAs LED chip and light-detective chip.

Because of the double structure consisting of transparent silicone resin and molding resin, the difference in thermal expansion and contraction between these materials exerts a periodic force on bonding wire, causing wire breakage.

(b) CTR variation

CTR variation caused by the peeling off of the interface between GaAs LED chip and encapsulation (transparent silicone for optical guide) and of the molding resin interface.

(c) I_{CEO}, I_{DRM} increase

Water invades through the interface between the lead frame and molding resin, and cause an increase in dark current. Most of above factors are parastic causes due to the double-structured package comprising the light-emitting and light-receiving elements, and important points in designing a photo-couplers.

Our photocouplers developed, have received, based on these factors, sufficient investigation with respect to proper materials, structure and assembling method.

Accordingly, temperature resistance and moisture resistance characteristics have been especially improved.

The evaluation results for reliability tests are shown as follows.

3-2-2 Quality control of production process and quality assurance

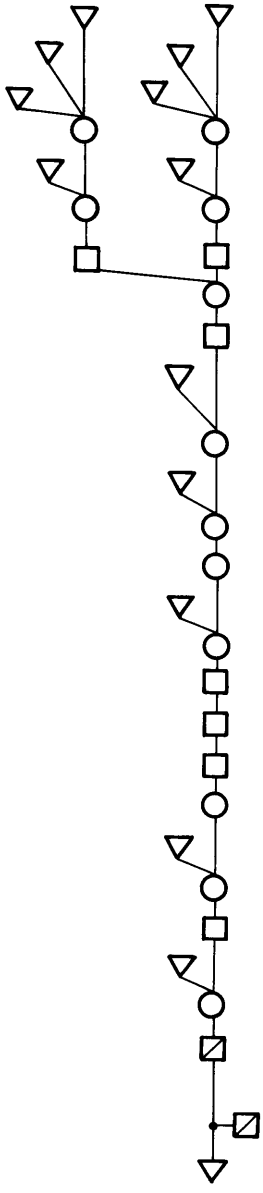
Quality control flow chart is shown in Table 3-7.

Quality assurance of shipping products are performed based on the lot quality assurance level shown in Table 3-6.

Table 3-6 Lot Quality Assurance Level of Photocoupter

Items		LTPD	Notes
Electrical characteristics	Catastrophic	1.5%	
	Major	5%	
	Minor	10%	
Lot life inspection		20%/168 HRS	

Table 3-7 Manufacturing process flow chart of photocoupler

PROCESS FLOW CHART		NOTE
[LED] [Detector]		
	Chips	Oxide thickness, breakdown voltage, etc. are inspected to confirm lot quality.
	Frame	
	Mount Material	
	Die Mount	Strength of die attachment, and visual inspection
	Bonding wire	
	Bonding	Temperature, Bond Strength
	Visual Pre-Coupling	Mount & Bond Appearance
	Coupling	Strength of bonding, shape, wire touch etc. are inspected
	Visual Pre-Mold	
	Encap. Material (Silicone)	
	Encap.	
	Mold Material (Epoxy resin)	
	Mold	Temperature
	Lead Cut, Bending	
	Plating Material	
	Plating	
	Test	Electrical Test
	Stabilization Bake	
	Temperature cycling	
	Dicing	
	Marking Material	
	Marking	
	Final Electrical Test	
	Packing Material	
	Packing	
	Lot Quality Assurance	Appearance
	Test	Life Test Electrical Test
	Reliability Test	Life Test Mechanical Test
	Ship	

3-2-3 Reliability Tests

Reliability Test Procedures

Typical test procedures published as standard test procedures are listed in Table 3-8. Toshiba has selected the procedures listed in Table 3-9, as its standard in conformance with EIAJ (Electronic Industries Association of Japan), JIS (Japanese Industrial Standard), and MIL Standards.

Furthermore, dependent on the construction and usage of the device, an accelerated life test, compounded stress test, step stress test, etc. are conducted periodically time and again. This serves to upgrade reliability level, and helps in the making of a contributes towards formulating a reliability assessment.

Table 3-8 Reliability Test Specifications and Standards

JISC5003	General Test Procedure of Failure Rate for Electronic Components
JISC5020	General Rules for Environmental Testing Method for Electronic Components
JISC5700	General Rules for Reliability Assured Electronic Components
JISC7021	Environmental Testing Methods and Endurance Testing Methods for Discrete Semiconductor Devices
EIAJ-SD-121	Environmental and Mechanical Test Methods for Discrete Semiconductor Devices
EIAJ-IC-121	Test Methods for Reliability of Integrated Circuits
MIL-STD-202	Test Methods for Electronic and Electrical Component parts
MIL-STD-750	Test Methods for Semiconductor Devices
MIL-STD-883	Test Methods and Procedures for Microelectronics
MIL-S-19500	Semiconductor Devices. General specification for
MIL-M-38510	Microcircuit General specification for
IEC Publication 147	Essential ratings and characteristics of semiconductor devices and general principles of measuring methods Part-4, Part-5

Table 3-9 Reliability Tests

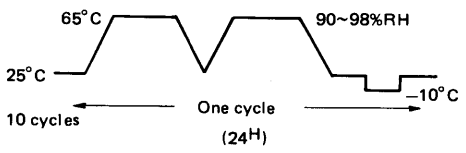
	Item	Description and Test Conditions	Standard
Life Test	Steady state operation	Electrical (voltage and current) and thermal stresses are applied continuously for a long period of time, and the durability of the product is determined. Normal testing temp is: For discrete semi conductor devices. T_a=25°C For integrated circuit. T_a=Topr. Max.	MIL-STD-750: 1026 MIL-STD-883: 1005 JIS C7021: B-1 EIAJ IC-121: B-1
	High temperature storage	When stored for a long time at a high temperature, durability against the heat is determined. Normal testing temp. is hled the same as the maximum storage temperature (Tstg. Max).	MIL-STD-750: 1031 MIL-STD-883: 1008 JIS C7021: B-10 EIAJ IC-121: B-3
	High temp. high humidity storage	When stored for a long time at a high temperature and high humidity, durability is determined. Normal testing conditions are T_a=60°C, RH=90%	MIL-STD-202E: 1038 JIS C7021: B-11 EIAJ IC-121: B-5
	Low temperature storage	When stored for a long time at a low temperature, durability is determined. Normal testing temp. is the same as minimum storage temperature (Tstg. Min)	JIS C7021: B-12 EIAJ IC-121: B-4
Environmental Test	Soldering heat	Durability of the device against heat received during soldering is determined. Normal testing conditions: To be dipped 10 secs. at 260°C.	MIL-STD-750: 2031 JIS C7021: A-1 EIAJ IC-121: A-11
	Temperature cycling	Durability when exposed to hot and cold conditions is determined. Tstg. Min — 25°C — Tstg. Max — 25°C (30 mins) (5 mins) (30 mins) (5 mins) One cycle 5 cycles	MIL-STD-750: 1051 MIL-STD-883: 1010 JIS C7021: A-4 EIAJ IC-121: A-4
	Thermal shock	Durability is assessed when the device is suddenly exposed to severe changes. 100°C — 0°C is regarded as "one" cycle, and five cycles are required when testing. Also if Tstg. Max. is below 100°C, testing is done at this temperature.	MIL-STD-750: 1056 MIL-STD-883: 1011 JIS C7021: A-3 EIAJ IC-121: A-5
	Moisture resistance	Durability is assessed when device is exposed to high temp. and high humidity conditions. 	MIL-STD-202: 106 MIL-STD-883: 1004 JIS C7021: A-5 EIAJ IC-121: A-2

Table 3-9 Reliability Tests (Cont'd)

	Item	Description and Test Conditions	Standard
Mechanical Test	Vibration	Durability is determined againt vibrations received during transportation or usage of the device. The test is performed with a variable frequency of vibration, or that with a fixed frequency. Normally a varying frequency vibration (from 100 to 2000 Hz) is used.	MIL-STD-750: 2046 2056 MIL-STD-883: 2005 2007 JIS C7021: A-10 EIAJ IC-121: A-13
	Shock	Durability resulting from structural and mechanical reasons is determined. Testing conditions will differ with construction. For molded plastic type devices, a shock of 1500G acceleration, and 0.5 ms duration is applied.	MIL-STD-750: 2016 MIL-STD-883: 2002 JIS C7021: A-7 EIAJ IC-121: A-9
	Constant acceleration	Durability against constant acceleration stresses is determined. Test conditions will differ with construction. For molded plastic type devices normally a constant acceleration of 20000G is applied.	MIL-STD-750: 2006 MIL-STD-883: 2001 JIS C7021: A-9 EIAJ IC-121: A-8
	Drop	Determine structural and mechanical durability of the device. Testing conditions: Drop from a height of 75 cm on an oak board. (Not applicable to devices encased in ceramic.)	JIS C7021: A-8 EIAJ IC-121: A-15
	Terminal strength	Determine whether the strength of the terminal area is sufficient to withstand stresses from is mounted circuit board or during usage of the device. Testing conditions: This will differ according to shape and type of terminal arrangement, and cross section of the pins. Normal test conditions call for suspending a 250 gr, weight, bending to a 90° bend, and straightening.	MIL-STD-750: 2036 MIL-STD-883: 2004 JIS C7021: A-11 EIAJ IC-121: A-12
	Solderability	Determine whether terminal area permits easy application of solder. Normal testing conditions: With the solder heated to 230°C, solder within 5 seconds.	MIL-STD-750: 2026 MIL-STD-883: 2003 JIS C7021: A-2 EIAJ IC-121: A-10
	Seal	Determine-air-tightness of the encapsulation. Use a tracer gas for detecting fine leaks. And bubbles to detect large leaks. This test applies to devices with encapsulated in a metal or a ceramic case.	MIL-STD-750: 1071 MIL-STD-883: 1014 JIS C7021: A-6 EIAJ IC-121: A-6
	Salt atmosphere	Determine corrosion resisting properties against a salt containing atmosphere. Normal testing conditions: At a room temp. of 35°C spray with a 5% salt solution for 24 hours.	MIL-STD-750: 1041 MIL-STD-883: 1009 JIS C7021: A-12 EIAJ IC-121: A-3

Failure Criteria

Table 3-10 shows Failure Criteria for Main Characteristics of Photocouplers

Table 3-10 Failure Criteria of Photocouplers

Test Item	Symbol	Limits
Isolation Voltage	BVs	2500 V_{RMS}, 1 minute
LED Forward Voltage	V_F	USL x 1.1
LED Reverse Current	I_R	USL x 2
Collector Breakdown Voltage	V_{CEO}	LSL x 0.9
Collector Dark Current	I_{CEO}	USL x 2
DC Current Transfer Ratio	CTR	Initial Data x 0.8
Saturation Voltage Collector to Emitter	VCE(SAT)	USL x 1.1
SCR Off-State Voltage	V_{DRM} V_{RRM}	LSL x 0.9
SCR Off-State Current	I_{DRM} I_{RRM}	USL x 2
SCR Input Current to Trigger	I_{FT}	Initial Data x 0.8
SCR On-State Voltage	V_{TM}	USL x 1.1

LSL; Lower Specification Limit

USL; Upper Specification Limit

Test Results

(a) Life and environmental tests

Test Results of Photocouplers are summarized from Table 3-12 to Table 3-19, which are separated to Photo Transistor family, Photo Darlington family, Photo Thyristor family, Double Molding family and Power output family.

Type name of each family are shown in Table 3-11.

Table 3-12 shows evaluation results for temperature cycling test (TCT), thermal shock test (TST) and pressure cooker test (PCT). From these, the following comments can be made.

(1) In both TCT and TST for temperature resistance, no defective units were detected up to 1000 cycles.

(2) In the test concerning moisture resistance, PCT; 24 hrs, 85°C/85% R.H; 1000 hrs. produced absolutely no defective unit and good results were obtained. In these tests, the main evaluation itemsin each step are CTR (or I_{FT}), isolation voltage, dark current, LED's reverse current.

(b) **Electrical endurance tests**

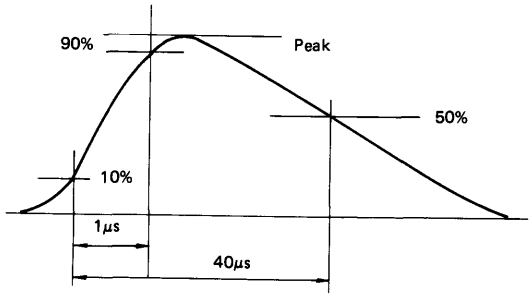
Impulse Surge Isolation Voltage

Definition:

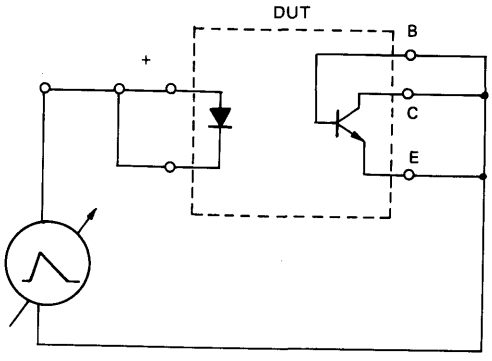
This rating is used to protect one-time transient over-voltage generated from thundering.

Test Condition

Impulse surge waveform is shown as follows.



Impulse Surge Isolation voltage is measured as illustrated below.



Test Results

Impulse Surge Isolation Breakdown Voltage (Peak value) test results are shown in Fig. 3-3.

Fig. 3-3 Impulse surge isolation test results

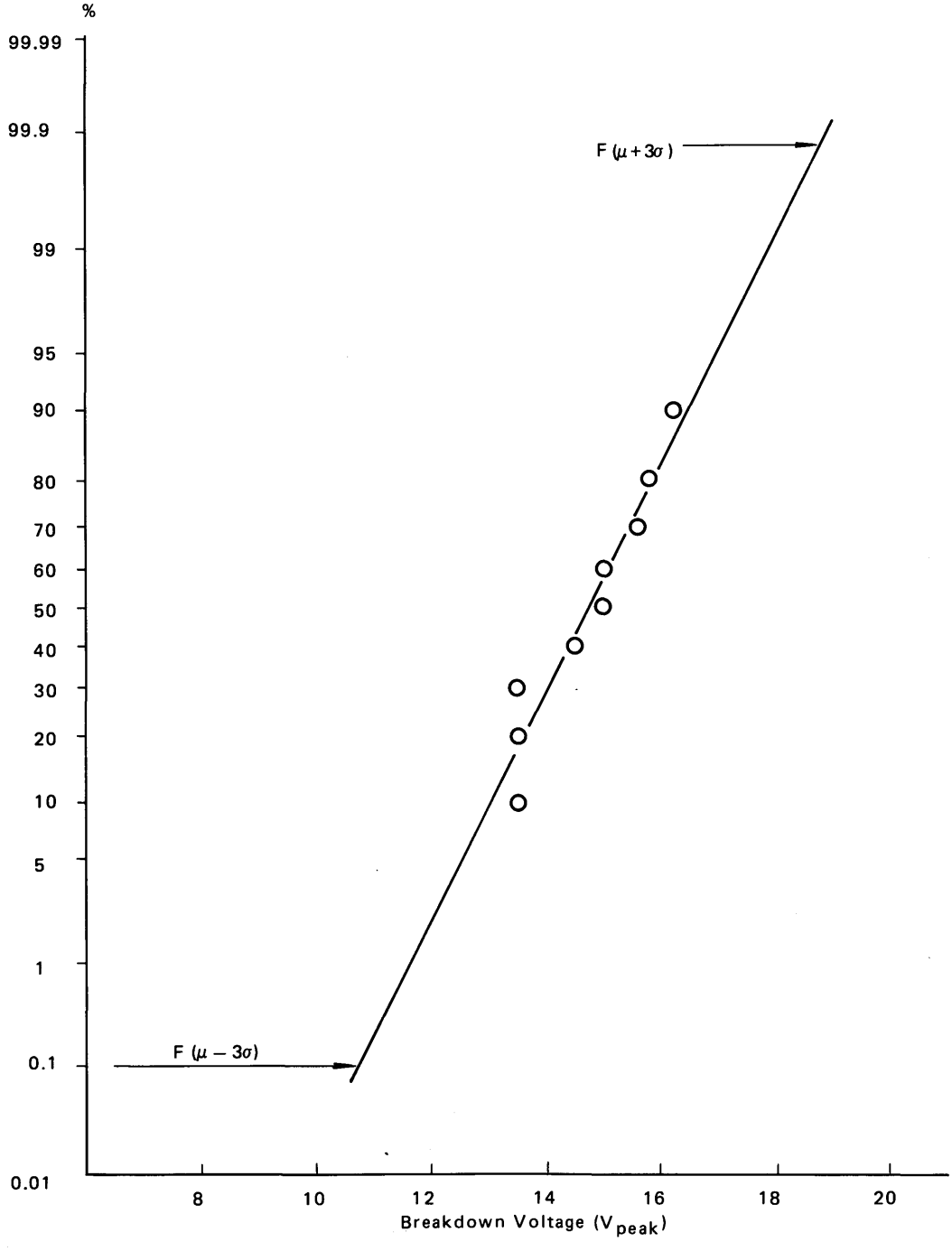


Table 3-11 Type name of each family

Family	Type name
Photo transistor Output	TLP521-1, -2, -3, -4 TLP531, 532 TLP535 4N25, 25A 4N35
Photo darlington Output	TLP570 TLP571 TLP572
Photo thyristor Output	TLP541G TLP542G TLP543H, J TLP545H, J TLP547G
Double molding Photo-transistor Output	TLP533, 534
Double molding Photo Darlington Output	TLP547G
DC Power Output	TLP573
AC Power Output	TLP546G

Table 3-12 Reliability Test Data for Photocouplers

Test		OLD TYPE Photo Transistor Family (TLP508)		Photo Transistor Family		Photo Thyristor Family	
		Sample size	Failures	Sample size	Failures	Sample size	Failure
TCT	Cycles						
	100	320	0	500	0	320	0
	300	320	0	500	0	320	0
	500	317	* 3	500	0	320	0
	1000	311	* 6	500	0	320	0
TST	Cycles						
	20	100	0	100	0	100	0
	50	100	0	100	0	100	0
	100	100	0	100	0	100	0
PCT	Hours						
	24	100	0	250	0	250	0
	48	100	** 1	250	0	250	0
	96	100	** 7	250	0	250	0
	144	100	**32	250	** 9	250	**11

* Wire Break IN mid span

** I_D or I_{DRM} Over limit

Conditions; TCT (Temperature Cycling Test)
−55°C to 125°C, 30 minutes per temperature and 5 minutes transfer time.

TST (Thermal Shock Test)
100°C to 0°C in required at 5 minutes per temperature and 5 second transfer time.

PCT (Pressure Cooker Test)
Ta = 121°C, R.H. = 100% (2 atm)

Table 3-13 Test Results of Photo Transistor Output Family

Test Items	Test Conditions	Sample Size	Test Duration	Total Component Hours	Failures
Steady State Operation	Ta = 25°C I_F = 70 mA P_C = 150 mW	300	1000 Hrs.	300,000	0
High Temp. Operation	Ta = 85°C I_F = 40 mA P_C = 60 mW	90	1000 Hrs.	90,000	0
High Temp. Storage	Ta = 125°C	300	1000 Hrs.	300,000	0
High Temp. Reverse bias	Ta = 100°C V_{CE} = 24V	300	1000 Hrs.	300,000	0
High Temp. High Humidity Storage	Ta = 85°C R.H = 85%	300	1000 Hrs.	300,000	0
High Temp. High Humidity Operation	Ta = 85°C R.H.=85% I_F = 40 mA P_C = 60 mW	90	1000 Hrs.	90,000	0
Soldering Heat	TSOL = 300°C	500	10 Sec.	–	0
Soldering Heat Stress (300°C/10 sec.) +Temp. Cycling	MIL-STD-883B T MIN = –55°C T MAX = 125°C	500	1000 Cycles	–	0
Thermal Shock	MIL-STD-883B	100	100 Cycles	–	0
Moisture Resistance	MIL-STD-883B	100	10 Cycles	–	0
Solderbility	TSOL = 230°C	100	1 sec. 1 time	–	0
Pressure Cooker	Ta = 121°C R.H = 100% (2 atm)	250	96 H	–	0

Table 3-14 Test Results of Photo Darlington Output Family

Test Items	Test Conditions	Sample Size	Test Duration	Total Component Hours	Failures
Steady State Operation	Ta = 25°C I_F = 70 mA P_C = 150 mW	120	1000 Hrs.	120,000	0
High Temp. Operation	Ta = 85°C I_F = 40 mA P_C = 60 mW	–	–	–	–
High Temp. Storage	Ta = 125°C	120	1000 Hrs.	120,000	0
High Temp. Reverse bias	Ta = 100°C V_{CE} = 24V	120	1000 Hrs.	120,000	0
High Temp. High Humidity Storage	Ta = 85°C R.H = 85%	120	1000 Hrs.	120,000	0
High Temp. High Humidity Operation	Ta = 85°C R.H=85% I_F = 40 mA P_C = 60 mW	–	–	–	–
Soldering Heat	TSOL = 300°C	300	10 Sec.	–	–
Soldering Heat Stress (300°C/10 sec.) + Temp. Cycling	MIL-STD-883B T MIN = –55°C T MAX = 125°C	300	500 Cycles	–	0
Thermal Shock	MIL-STD-883B	60	100 Cycles	–	0
Moisture Resistance	MIL-STD-883B	60	10 Cycles	–	0
Solderbility	TSOL = 230°C	60	1 sec. 1 time	–	0
Pressure Cooker	Ta = 121°C R.H = 100% (2 atm)	100	96H	–	0

Table 3-15 Test Results of Photo Thyristor Output Family

Test Items	Test Conditions	Sample Size	Test Duration	Total Component Hours	Failure
Steady State Operation	Ta = 25°C I_F = 70 mA I_T = 150 mA RMS	300	1000 Hrs.	300,000	0
High Temp. Operation	Ta = 85°C I_F = 25 mA I_T = 30 mA RMS	90	1000 Hrs.	90,000	0
High Temp. Storage	Ta = 125°C	300	1000 Hrs.	300,000	0
High Temp. Blocking	Ta = 100°C V_{DM} = 400V	300	1000 Hrs.	300,000	0
High Temp. High Humidity Storage	Ta = 85°C R.H = 85%	300	1000 Hrs.	300,000	0
High Temp. High Humidity Operation	–	–	–	–	–
Soldering Heat	TSOL = 300°C	320	10 Sec.	–	0
Soldering Heat Stress (300°C/10 sec.) + Temp. Cycling	MIL-STD-883B T MIN = –55°C T MAX = 125°C	320	1000 Cycles	–	0
Thermal Shock	MIL-STD-883B	100	100 Cycles	–	0
Moisture Resistance	MIL-STD-883B	100	10 Cycles	–	0
Solderbility	TSOL = 230°C	100	1 sec. 1 time	–	0
Pressure Cooker	Ta = 121°C R.H = 100% (2 atm)	250	96 H	–	0

Table 3-16 Test Results of Double Molding Photocouplers (Photo Transistor Family)

Test Items	Test Conditions	Sample Size	Test Duration	Total Component Hours	Failures
Steady State Operation	Ta = 25°C I_F = 70 mA P_C = 150 mW	60	1000 Hrs.	60,000	0
High Temp. Operation	Ta = 85°C I_F = 40 mA P_C = 60 mW	–	–	–	–
High Temp. Storage	Ta = 125°C	60	1000 Hrs.	60,000	0
High Temp. Reverse bias	Ta = 100°C V_{CE} = 24V	300	1000 Hrs.	60,000	0
High Temp. High Humidity Storage	Ta = 85°C R.H = 85%	300	1000 Hrs.	60,000	0
High Temp. High Humidity Operation	–	–	–	–	–
Soldering Heat	TSOL = 300°C	200	10 sec.	–	0
Soldering Heat Stress (300°C/10 sec.) + Temp. Cycling	MIL-STD-883B T MIN = –55°C T MAX = 125°C	200	200 Cycles	–	0
Thermal Shock	MIL-STD-883B	60	100 Cycles	–	0
Moisture Resistance	MIL-STD-883B	60	10 Cycles	–	0
Solderbility	TSOL = 230°C	60	1 sec. 1 time	–	0
Pressure Cooker	Ta = 121°C R.H = 100% (2 atm)	100	96H	–	0

Table 3-17 Test Results of Double Molding Photocoupler (Photo-Thyristor Output Family)

Test Items	Test Conditions	Sample Size	Test Duration	Total Component Hours	Failures
Steady State Operation	Ta = 25°C I_F = 70 mA I_T = 150 mA RMS	60	1000 Hrs.	60,000	0
High Temp. Operation	Ta = 85°C I_F = 25 mA I_T = 30 mA RMS	–	–	–	–
High Temp. Storage	Ta = 125°C	60	1000 Hrs.	60,000	0
High Temp. Reverse bias	Ta = 100°C V_{DM} = 400V	60	1000 Hrs.	60,000	0
High Temp. High Humidity Storage	Ta = 85°C R.H = 85%	60	1000 Hrs.	60,000	0
High Temp. High Humidity Operation	–	–	–	–	–
Soldering Heat	TSOL = 300°C	200	10 sec.	–	0
Soldering Heat Stress (300°C/10 sec.) + Temp. Cycling	MIL-STD-883B Ta MIN = –55°C Ta MAX = 125°C	200	200 Cycles	–	0
Thermal Shock	MIL-STD-883B	60	100 Cycles	–	0
Moisture Resistance	MIL-STD-883B	60	10 Cycles	–	0
Solderbility	TSOL = 230°C	60	1 sec. 1 time	–	0
Pressure Cooker	Ta = 121°C R.H = 100% (2 atm)	100	96 H	–	0

Table 3-18 Test Results of V_{DC}–Power Output Family

Test Items	Test Conditions	Sample Size	Test Duration	Total Component Hours	Failures
Steady State Operation	Ta = 25°C I_F = 60 mA P_C = 1.3W	60	1000 Hrs.	60,000	0
High Temp. Operation	Ta = 80°C I_F = 25mA P_C = 0.3W	60	1000 Hrs.	60,000	0
High Temp. Storage	Ta = 125°C	60	1000 Hrs.	60,000	0
High Temp. Reverse bias	Ta = 100°C V_{CE} = 48V	60	1000 Hrs.	60,000	0
High Temp. High Humidity Storage	Ta = 85°C R.H = 85%	60	1000 Hrs.	60,000	0
High Temp. High Humidity Operation	–	–	–	–	–
Soldering Heat	TSOL = 300°C	200	10 sec.	–	0
Soldering Heat Stress (300°C/10 sec. + Temp. Cycling	MIL-STD-883B Ta MIN = –55°C Ta MAX = 125°C	200	200 Cycles	–	0
Thermal Shock	MIL-STD-883B	60	100 Cycles	–	0
Moisture Resistance	MIL-STD-883B	60	10 Cycles	–	0
Solderbility	TSOL = 230°C	60	1 sec. 1 time	–	0
Pressure Cooker	Ta = 121°C R.H = 100% (2 atm)	100	96 H	–	0

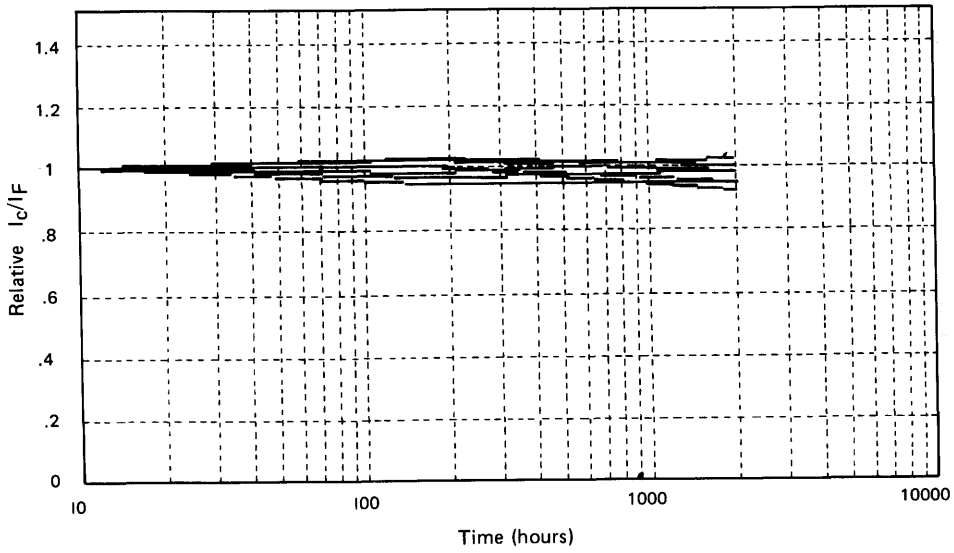
Fig. 3-19 Test Results of AC-Power Output Family

Test Items	Test Conditions	Sample Size	Test Duration	Total Component Hours	Failures
Steady State Operation	Ta = 25°C I_F = 50 mA I_T = 1A RMS	60	1000 Hrs.	60,000	0
High Temp. Operation	Ta = 80°C I_F = 20mA P_I = 0.2A RMS	60	1000 Hrs.	60,000	0
High Temp. Storage	Ta = 125°C	60	1000 Hrs.	60,000	0
High Temp. Reverse bias	Ta = 100°C V_{DU} = 400V	60	1000 Hrs.	60,000	0
High Temp. High Humidity Storage	Ta = 85°C R.H = 85%	60	1000 Hrs.	60,000	0
High Temp. High Humidity Operation	–	–	–	–	0
Soldering Heat	TSOL = 300°C	200	10 sec.	–	0
Soldering Heat Stress (300°C/10 sec.) + Temp. Cycling	MIL-STD-883B Ta MIN = –55°C Ta MAX = 125°C	200	200 Cycles	–	0
Thermal Shock	MIL-STD-883B	60	100 Cycles	–	0
Moisture Resistance	MIL-STD-883B	60	10 Cycles	–	0
Solderbility	TSOL = 230°C	60	1 sec. 1 time	–	0
Pressure Cooker	Ta = 121°C R.H = 100% (2 atm)	250	96 H	–	0

Appendix

Life Test Results of TLP531
Steady State Operation Ta=25°C; I_F=70mA, Pc=150mW
TLP531 PLOTTING SAMPLES = 10 pcs.
POWER OPERATION

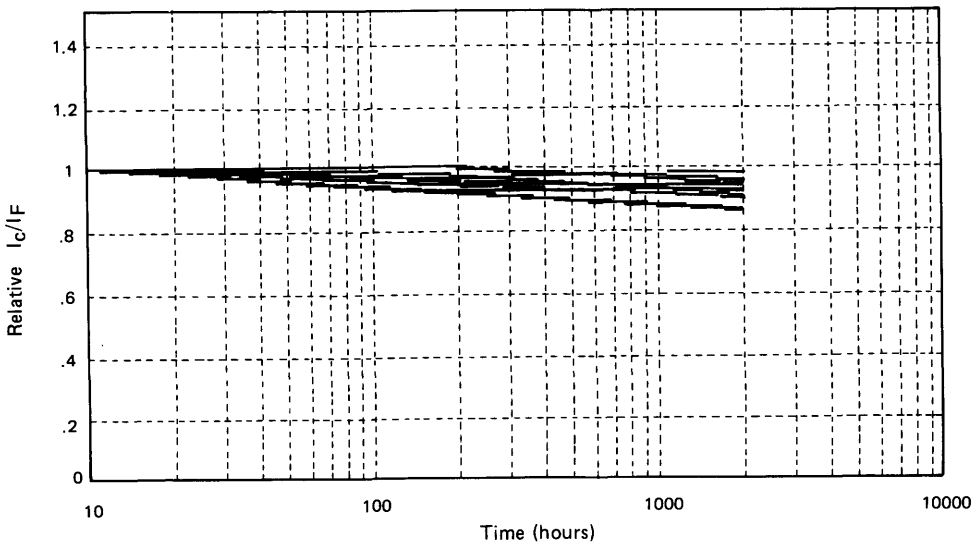
Date ; 1982-5-30



Appendix

Life Test Results of TLP531
Steady State Operation Ta=85°C, R.H.=85% I_F=40mA, Pc=60mW
TLP531 PLOTTING SAMPLES = 10 pcs.
HIGH TEMPERATURE & HIGH HUMIDITY OPERATION

Date ; 1982-5-30



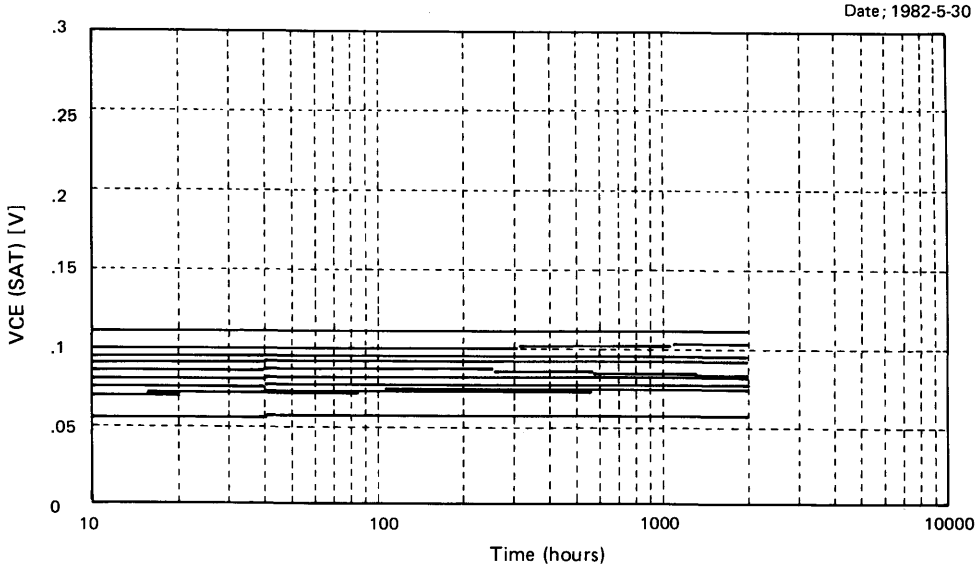
Appendix

Life Test Results of TLP531

Steady State Operation Ta=25°C, I_F=70mA, Pc=150mW

TLP531 PLOTTING SAMPLES = 10 pcs.

POWER OPERATION



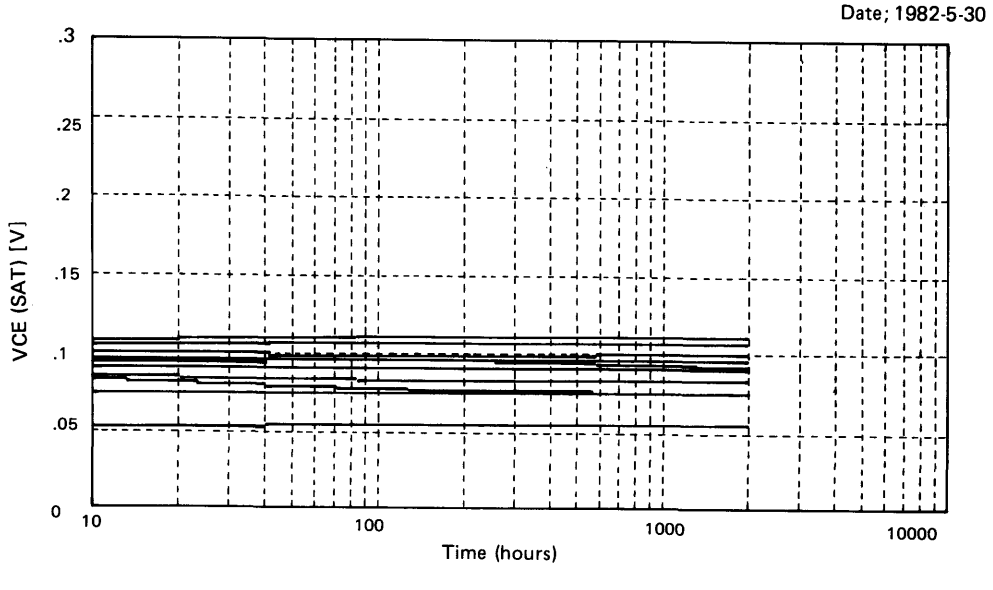
Appendix

Life Test Results of TLP531

Steady State Operation Ta=85°C, R.H.=85% I_F=40mA, Pc=60mW

TLP531 PLOTTING SAMPLES = 10 pcs.

HIGH TEMPERATURE & HIGH HUMIDITY OPERATION



Appendix

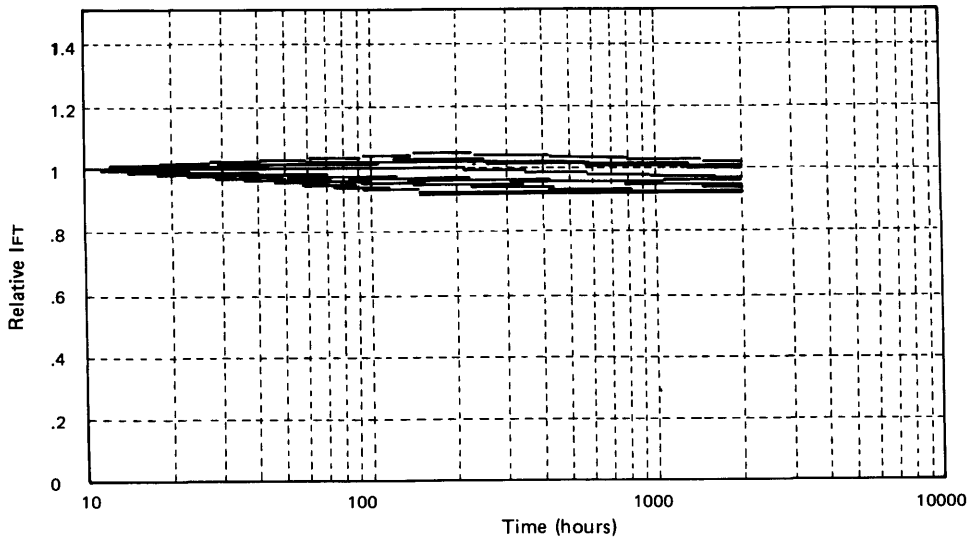
Life Test Results of TLP541G

Steady State Operation Ta=25°C, I_F=70mA, I_T=150mA

TLP PLOTTING SAMPLES = 10 pcs.

POWER OPERATION

Date; 1982-5-30



Appendix

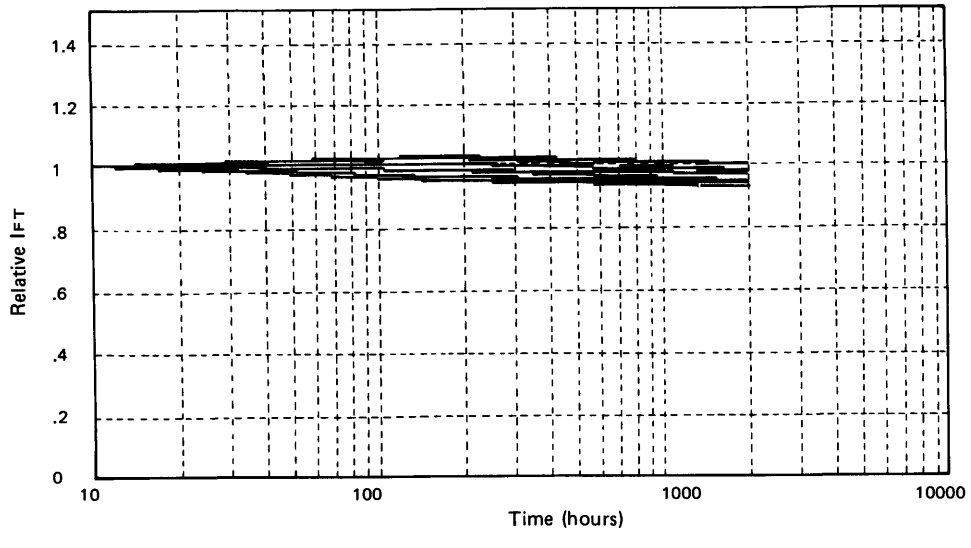
Life Test Results of TLP541G

Steady State Operation Ta=85°C, I_F=25mA, I_T=30mA

TLP PLOTTING SAMPLES = 10 pcs.

HIGH TEMPERATURE

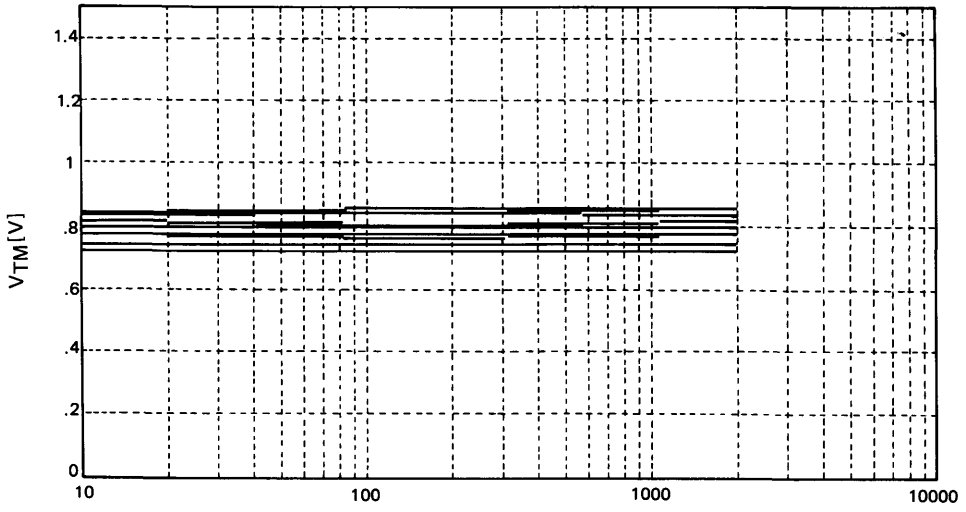
Date; 1982-5-30



Appendix

Life Test Results of TLP541G
Steady State Operation Ta=25°C, I_F=70mA, I_T=150mA
TLP541G PLOTTING SAMPLES = 10 pcs.
POWER OPERATION

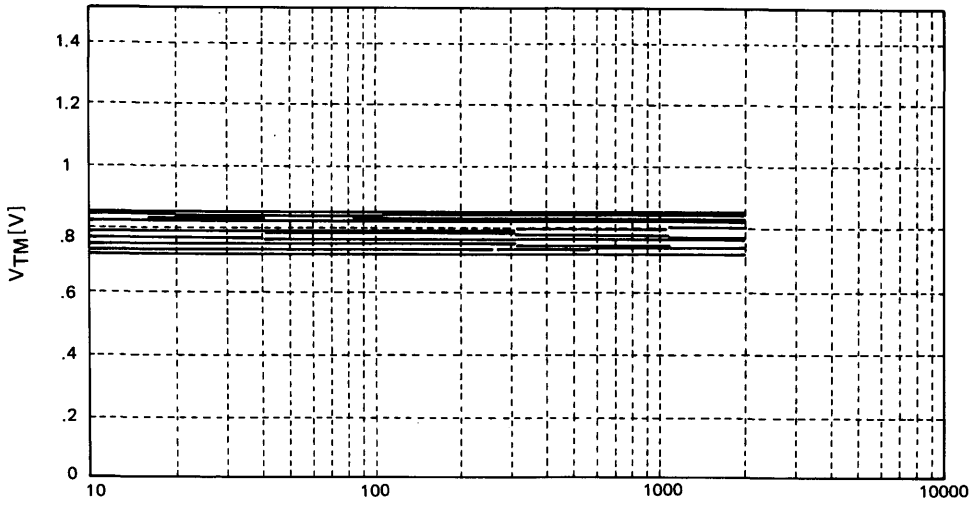
Date ; 1982-5-30



Appendix

Life Test Results of TLP541G
Steady State Operation Ta=85°C, I_F=25mA, I_T=30mA
TLP541G PLOTTING SAMPLES = 10 pcs.
HIGH TEMPERATURE OPERATION

Date ; 1982-5-30



As the applications of optosensors continue to expand, the interest in their quality and reliability performance also increases. This report discusses factors on optosensor's reliability, and presents the results of operating life and environmental tests.

Failure Criteria

Table 3-20 shown Failure Criteria for Main Characteristics of IRED, Phototransistor and Photointerrupter.

Table 3-20 (a) IRED

Test Item	Symbol	Limits
Forward Voltage	V_F	USL x 1.2
Reverse Current	I_R	USL x 2
Radiant Intensity or Radiant Power	I_E or Po	LSL x 0.7

Table 3-20 (b) Photo transistor and Photo diode

Test Item	Symbol	Limits
Collector Dark Current	I_D	USL x 2
Photo Current (Collector Current)	$I_{L(IC)}$	LSL x 0.7
Saturation Voltage Collector to Emitter	$V_{CE(SAT)}$*	USL x 1.2

* only in phototransistor

Table 3-20 (c) Photo interrupter

Test Item	Symbol	Limits
Forward Voltage	V_F	USL x 1.2
Reverse Current	I_R	USL x 2
Collector Dark Current	I_D	USL x 2
Current Transfer Ratio	I_C/I_F	LSL x 0.7

NOTE 1) LSL: Lower Specification Limit

2) USL: Upper Specification Limit

Reliability Tests Results

LIFE TEST DATA (IRED)

	Device No.	Test Conditions	Sample size	Test duration	Failures
Steady state operation	TLN101/TLN108	Ta = 25°C, I_F = 100 mA	60/60 pcs	1000 Hrs	0
	TLN103	Ta = 25°C, I_F = 40 mA	90	1000 Hrs	0
	TLN104	Ta = 25°C, IF = 40 mA	60	1000 Hrs	0
	TLN105A/TLN110	Ta = 25°C, IF = 100 mA	60	1000 Hrs	0
	TLN107	Ta = 25°C, I_F = 50 mA	60	1000 Hrs	0
	TLN109	Ta = 25°C, I_F = 40 mA	60	—	—
High temperature storage	TLN101/TLN108	Ta = 125°C/Ta = 150°C	60/60 pcs	1000 Hrs	0/0
	TLN103	Ta = 100°C	90	1000 Hrs	0
	TLN104	Ta = 80°C	60	1000 Hrs	0
	TLN105A/TLN110	Ta = 100°C	60	1000 Hrs	0
	TLN107	Ta = 100°C	60	1000 Hrs	0
	TLN109	Ta = 100°C	60	—	—
High temp. high humidity storage	TLN101/TLN108	Ta = 60°C, R.H. = 90%	60/60 pcs	1000 Hrs	0
	TLN103		90	1000 Hrs	0
	TLN104		60	1000 Hrs	0
	TLN105A/TLN110		60	1000 Hrs	0
	TLN107		60	1000 Hrs	0
	TLN109		60	—	—
Low temperature storage	TLN101/TLN108	Ta = −55°C	60/60 pcs	1000 Hrs	0
	TLN103	Ta = −30°C	90	1000 Hrs	0
	TLN104	Ta = −30°C	60	1000 Hrs	0
	TLN105A/TLN110	Ta = −30°C	60	1000 Hrs	0
	TLN107	Ta = −30°C	60	1000 Hrs	0
	TLN109	Ta = −30°C	60	—	—

ENVIRONMENT TEST DATA (IRED)

Test and Condition \ Device No.		TLN101/ TLN108		TLN103		TLN104		TLN105A /TLN110		TLN107	
		n	r	n	r	n	r	n	r	n	r
Soldering Heat 260°C, 10 sec.		60	0	80	0	20	0	300	0	60	0
Temperature cycling	10 cycles	300	0	100	0	100	0	300	0	60	0
	100 cycles	300	0	—	—	100	0	300	0	60	0
Thermal Shock		150	0	—	—	30	0	50	0	60	0
Vibration		90	0	60	0	30	0	20	0	60	0
Shock		30	0	60	0	30	0	20	0	60	0
Constant Acceleration		30	0	60	0	30	0	20	0	60	0
Terminal Strength		20	0	40	0	20	0	20	0	60	0

n; Sample Size r; Failure

LIFE TEST DATA (Phototransistor and Photodiode)

	Device No.	Test Conditions	Sample size	Test duration	Failures
Steady state operation	TPS601/TPS604	Pc = 150 mW, Ta = 25°C	60 pcs	1000 Hrs	0
	TPS708				
	TPS603	Pc = 75 mW, Ta = 25°C	90 pcs	1000 Hrs	0
	TPS605/TPS606	Pc = 50 mW, Ta = 25°C	60 pcs	1000 Hrs	0
	TPS607/TPS608	Pc = 75 mW, Ta = 25°C	60 pcs	1000 Hrs	0
	TPS703				
High temperature storage	TPS601/TPS604	Ta = 150°C	60 pcs	1000 Hrs	0
	TPS708				0
	TPS603	Ta = 100°C	90 pcs	1000 Hrs	0
	TPS605/TPS606	Ta = 100°C	60 pcs	1000 Hrs	0
	TPS607/TPS608	Ta = 100°C	60 pcs	1000 Hrs	0
	TPS703				
High temp. High humidity storage	TPS601/TPS604	Ta = 60°C, R.H. = 90%	60 pcs	1000 Hrs	0
	TPS708				
	TPS603		50 pcs	1000 Hrs	0
	TPS605/606		60 pcs	1000 Hrs	0
	TPS607/TPS608		60 pcs	1000 Hrs	0
	TPS703				
Low temperature storage	TPS601/TPS604	Ta = −55°C	60 pcs	1000 Hrs	0
	TPS708				
	TPS603	Ta = −30°C	60 pcs	1000 Hrs	0
	TPS605/TPS606	Ta = −30°C	60 pcs	1000 Hrs	0
	TPS607/TPS608	Ta = −30°C	60 pcs	1000 Hrs	0
	TPS703				

ENVIRONMENT TEST DATA (Phototransistor and Photodiode)

Test and Condition \ Device No.		TPS601/ TPS604 TPS708		TPS603		TPS605/ TPS606		TPS607/ TPS608 TPS703			
		n	r	n	r	n	r	n	r		
Soldering Heat 260°C, 10 sec		30	0	80	0	40	0	60	0		
Temperature cycling	10 cycles	40	0	100	0	300	0	60	0		
	100 cycles	40	0	—	—	300	0	60	0		
Thermal Shock		30	0	—	—	100	0	60	0		
Vibration		20	0	60	0	30	0	60	0		
Shock		40	0	60	0	30	0	60	0		
Constant Acceleration		20	0	60	0	30	0	60	0		
Terminal Strength		10	0	40	0	30	0	60	0		

n; Sample Size r; Failure

LIFE TEST DATA (Photointerrupter)

	Device No.	Test Conditions	Sample size	Test duration	Failures
Steady state operation	TLP507A	I_F = 50 mA Pc = 75 mW Ta = 25°C	60 pcs	1000 Hrs	0
	TLP800		60 pcs	1000 Hrs	0
	TLP850		60 pcs	1000 Hrs	0
High temperature storage	TLP507A	Ta = 100°C	60 pcs	1000 Hrs	0
	TLP800		60 pcs	1000 Hrs	0
	TLP850		60 pcs	1000 Hrs	0
High temp. High humidity storage	TLP507A	Ta = 60°C R.H. = 90%	60 pcs	1000 Hrs	0
	TLP800		60 pcs	1000 Hrs	0
	TLP850		60 pcs	1000 Hrs	0
Low temperature storage	TLP507A	Ta = −30°C	60 pcs	1000 Hrs	0
	TLP800		60 pcs	1000 Hrs	0
	TLP850		60 pcs	1000 Hrs	0

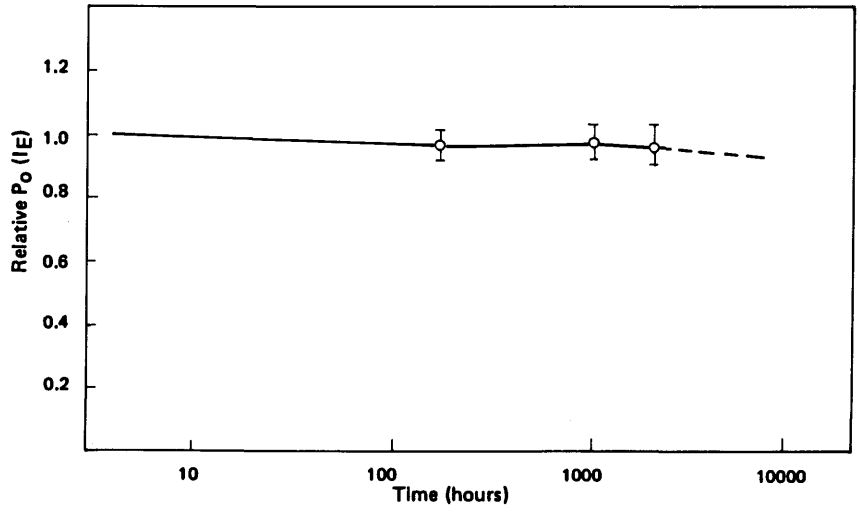
ENVIRONMENT TEST DATA (Photointerrupter)

Test and Condition \ Device No.		TLP507A		TLP800		TLP850	
		n	r	n	r	n	r
Soldering Heat 260°C, 10 sec		30	0	30	0	30	0
Temperature cycling	10 cycles	30	0	30	0	30	0
	100 cycles	30	0	30	0	30	0
Thermal Shock		30	0	30	0	30	0
Vibration		15	0	15	0	15	0
Shock		15	0	15	0	15	0
Constant Acceleration		10	0	10	0	10	0
Terminal Strength		10	0	10	0	10	0

n; Sample Size r; Failure

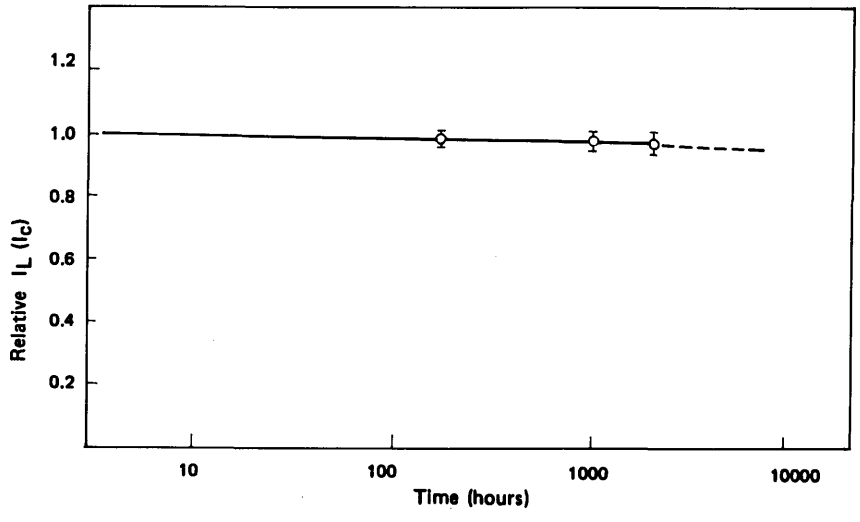
Life Test Results of TLN101

Steady State Operation Ta = 25°C, I_F = 100 mA



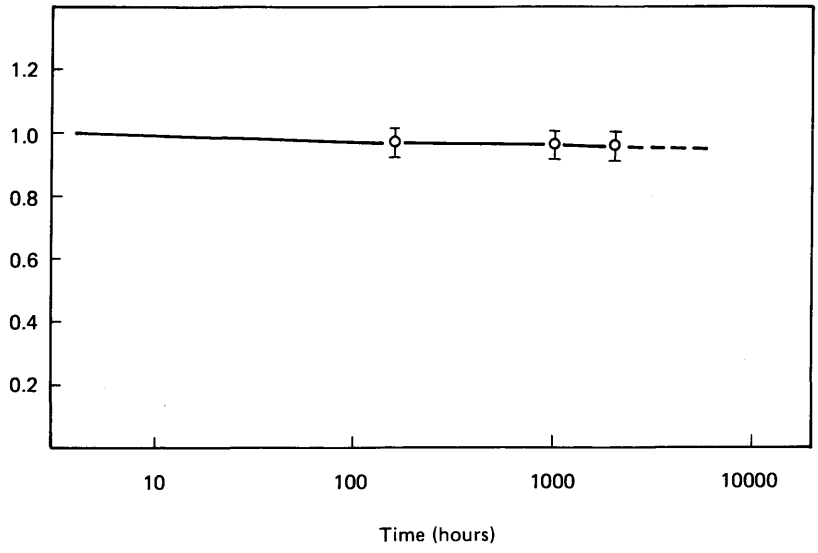
Life Test Results of TPS601

Steady State Operation Ta = 25°C, P_C = 150 mW



Life Test Results of TLP800

Steady State Operation T_a=25°C, I_F=50mA P_C=75mW



4. CROSS REFERENE

Other Mfg's P/N	Mfg.	Toshiba P/N
5082-4550	HP	TLY114A
5082-4555	HP	TLY114A
5082-4557	HP	TLY113A
5082-4558	HP	TLY113A
5082-4650	HP	TLS154
5082-4655	HP	TLS154
5082-4657	HP	TLS153
5082-4658	HP	TLS153
5082-4950	HP	TLG114A
5082-4955	HP	TLG114A
5082-4957	HP	TLG113A
5082-4958	HP	TLG113A
5082-4590	HP	TLY144
5082-4592	HP	TLY144
5082-4595	HP	TLY143
5082-4597	HP	TLY143
5082-4690	HP	TLS144
5082-4693	HP	TLS144
5082-4694	HP	TLS143
5082-4695	HP	TLS143
5082-4990	HP	TLG144
5082-4992	HP	TLG144
5082-4995	HP	TLG143
5082-4997	HP	TLG143
HLMP-1300	HP	TLS164
HLMP-1301	HP	TLS164
HLMP-1302	HP	TLS164
HLMP-1400	HP	TLY124
HLMP-1401	HP	TLY124
HLMP-1402	HP	TLY124
HLMP-1500	HP	TLG124
HLMP-1501	HP	TLG124
HLMP-1502	HP	TLG124

Other Mfg's P/N	Mfg.	Toshiba P/N
TIL220	TI	TLS114A
TIL221	TI	TLS113A
TIL222	TI	TLG114A
TIL209A	GI	TLS124
TIL212-1	GI	TLY124
TIL212-2	GI	TLY124
TIL216-1	GI	TLS124
TIL216-2	GI	TLS124
TLI220	GI	TLS114A
TIL221	GI	TLS113A
TIL224-1	GI	TLY114A
TIL224-2	GI	TLY114A
TIL227-1	GI	TLY113A
TIL227-1	GI	TLY113A
TIL228-1	GI	TLS114A
TIL228-2	GI	TLS114A
TIL231-1	GI	TLS113A
TIL231-2	GI	TLS113A
TIL232-1	GI	TLG124
TIL232-2	GI	TLG124
TIL234-1	GI	TLG114A
TIL234-2	GI	TLG114A
TIL236-1	GI	TLG113A
TIL236-2	GI	TLG113A
FLV100	Fairchild	TLS113A
FLV250	Fairchild	TLS114A
FLV251	Fairchild	TLS113A
FLV252	Fairchild	TLS113A
FLV341	Fairchild	TLG103
FLV351	Fairchild	TLG113A
FLV352	Fairchild	TLG113A
FLV356	Fairchild	TLG113A
FLV365	Fairchild	TLG114A
FLV460	Fairchild	TLPY154
FLV465	Fairchild	TLPY154
FLV160	Fairchild	TLS154

* Minor mechanical or electrical/optical differences

Other Mfg's P/N	Mfg.	Toshiba P/N	Other Mfg's P/N	Mfg.	Toshiba P/N
FLV161	Fairchild	TLS153	LD57A	Siemens	TLG114A
FLV162	Fairchild	TLS153	LD57 I	Siemens	TLG114A
			LD57 II	Siemens	TLG114A
CQY40	Telefunken	TLS114A	LD30A	Siemens	TLS124
V168P	Telefunken	TLS114A	LD30 I	Siemens	TLS124
CQX35	Telefunken	TLS113A	LD30 II	Siemens	TLS124
CQX25N	Telefunken	TLS123	LD30 III	Siemens	TLS124
CQY85N	Telefunken	TLS124	LD35A	Siemens	TLPY164
V310P	Telefunken	TLS153	LD35 I	Siemens	TLPY164
CQY72	Telefunken	TLG114A	LD35 II	Siemens	TLPY164
V169P	Telefunken	TLG114A	LD37A	Siemens	TLG124
CQX36	Telefunken	TLG113A	LD37 I	Siemens	TLG124
CQX96	Telefunken	TLG153	LD37 II	Siemens	TLG124
CQX97	Telefunken	TLG113A			
CQY26N	Telefunken	TLG123A	521-9189	Dialco	TLS124
CQY86N	Telefunken	TLG124A	521-9217	Dialco	TLS114A
V312P	Telefunken	TLG153			
CQY74	Telefunken	TLY114A	EBR3402S	Stanley	TLUR163
V170P	Telefunken	TLY114A	BR3402S	Stanley	TLUR163
CQX37	Telefunken	TLY113A	EBG3402S	Stanley	TLPG163
CQX27N	Telefunken	TLY123	EAY3402S	Stanley	TLUY163
CQY87N	Telefunken	TLY124	EAA3402S	Stanley	TLO163
V313P	Telefunken	TLY153	EBR3432S	Stanley	TLUR164
CQX38	Telefunken	TLO114A	BR3432S	Stanley	TLUR164
CQX39	Telefunken	TLO113A	EBG3432S	Stanley	TLPG164
CQX41N	Telefunken	TLO124	EPY3432S	Stanley	TLPY164
CQX42N	Telefunken	TLO123	EAY3432S	Stanley	TLUY164
			EAA3432S	Stanley	TLO164
LD57C	Siemens	TLG113A	PR3432S	Stanley	TLR124
LD57CA	Siemens	TLG113A	BG3432S	Stanley	TLPG164
LD50 I	Siemens	TLS114A	PG3432SY	Stanley	TLG164
LD50 II	Siemens	TLS114A	PY3432S	Stanley	TLPY164
LD41A	Siemens	TLS114A	AY3432S	Stanley	TLY164
LD41 I	Siemens	TLS114A	AA3432S	Stanley	TLO164
LD41 II	Siemens	TLS114A	EBR5504S	Stanley	TLUR153
LD55A	Siemens	TLPY154	BR5504S	Stanley	TLUR153
LD55 I	Siemens	TLPY154	EBG5504S	Stanley	TLPG153
LD55 II	Siemens	TLPY154	EAY5504S	Stanley	TLUY153

* Minor mechanical or electrical/optical differences

Other Mfg's P/N	Mfg.	Toshiba P/N	Other Mfg's P/N	Mfg.	Toshiba P/N
EAA5504S	Stanley	TLO153	PR2202S	Stanley	TLR121
EBR5534S	Stanley	TLUR154	BG2202S	Stanley	TLG121
BR5534S	Stanley	TLUR154	PR2222S	Stanley	TLR122
EBG5534S	Stanley	TLPG154	BG2222S	Stanley	TLG122
EPY5534S	Stanley	TLPY154	PR2434D	Stanley	TLR226
EAY5534S	Stanley	TLUY154	AY2434S	Stanley	TLY226
EAA5534S	Stanley	TLO154	PR2533D	Stanley	TLR206
PR5534S	Stanley	TLR114A	AY2533D	Stanley	TLY206
BG5534S	Stanley	TLPG154	SG2-04B	Stanley	TLR102A
PG5534SY	Stanley	TLG154	SG2-05B	Stanley	TLG102A
PY5534S	Stanley	TLPY154	SG2-06B	Stanley	TLY102A
AY5534S	Stanley	TLY154	SG2-07D	Stanley	TLRG101
AA5534S	Stanley	TLO154	BU1170-1BR	Stanley	TLR250
EBR5608S	Stanley	TLUR143	BU1170-1BG	Stanley	TLG250
BR5608S	Stanley	TLUR143	BU1170-1PY	Stanley	TLY250
EBG5608S	Stanley	TLPG143	BU1170-1AA	Stanley	TLO250
EAY5608S	Stanley	TLUY143			
EAA5608S	Stanley	TLO143			
EBR5638S	Stanley	TLUR144			
BR5638S	Stanley	TLUR144			
EBG5638S	Stanley	TLPG144			
EPY5638S	Stanley	TLPY144			
EAY5638S	Stanley	TLUY144			
EAA5638S	Stanley	TLO144			
PR5638S	Stanley	TLR144			
BG5638S	Stanley	TLPG144			
PG5638SY	Stanley	TLG114			
PY5638S	Stanley	TLPY144			
AY5638S	Stanley	TLY144			
AA5638S	Stanley	TLO144			
PR5531K	Stanley	TLR208			
PG5531KY	Stanley	TLG208			
AY5531K	Stanley	TLY208			
AA5531K	Stanley	TLO208			
PR5532K	Stanley	TLR205			
PG5532KY	Stanley	TLG205			
AY5532K	Stanley	TLY205			
AA5532K	Stanley	TLO205			

* Minor mechanical or electrical/optical differences

Other Mfg's P/N	Mfg.	Toshiba P/N	Other Mfg's P/N	Mfg.	Toshiba P/N
5082-7613	HP	TLR332	(HD1134R)	Siemens	TLR364
5082-7611	HP	TLR333	(HD1132R)	Siemens	TLR365
5082-7616	HP	TLR334	HD1133G	Siemens	TLG362
5082-7610	HP	TLR335	HD1131G	Siemens	TLG363
5082-7633	HP	TLG332	(HD1134G)	Siemens	TLG364
5082-7631	HP	TLG333	(HD1132G)	Siemens	TLG365
5082-7636	HP	TLG334			
5082-7630	HP	TLG335	(MAN74A)	GI	TLR332
5082-7653	HP	TLR342	MAN71A	GI	TLR333
5082-7651	HP	TLR343	(MAN73A)	GI	TLR334
5082-7656	HP	TLR344	MAN72A	GI	TLR335
5082-7650	HP	TLR345	(MAN54A)	GI	TLG332
5082-7673	HP	TLG342	MAN51A	GI	TLG333
5082-7671	HP	TLG343	(MAN53A)	GI	TLG334
5082-7676	HP	TLG344	MAN52A	GI	TLG335
5082-7670	HP	TLG345	(MAN4740)	GI	TLG342
HDSP5503	HP	TLR362	MAN4710	GI	TLG343
HDSP5501	HP	TLR363	(MAN4705)	GI	TLR344
HDSP5508	HP	TLR364	(MAN4540)	GI	TLG342
HDSP5507	HP	TLR365	MAN4510	GI	TLG343
HDSP5803	HP	TLG362	(MAN4505)	GI	TLG344
HDSP5801	HP	TLG363	MAN6780	GI	TLR362
HDSP5808	HP	TLG364	MAN6760	GI	TLR363
HDSP5807	HP	TLG365	MAN6940	GI	TLR366
			MAN6910	GI	TLR367
(HA10831r)	Siemens	TLR332			
(HA10821r)	Siemens	TLR334	DLO-7613	Litronix	TLR332
HA10811r	Siemens	TLR335	DLO-7611	Litronix	TLR333
(HA11031r)	Siemens	TLR342	DLO-7616	Litronix	TLR334
HA11011r	Siemens	TLR343	DLO-7610	Litronix	TLR335
(HA11021r)	Siemens	TLR344	DLO-7653S	Litronix	TLR342
HA1143r	Siemens	TLR358	DLO-7651S	Litronix	TLR343
HA1141r	Siemens	TLR359	DLO-7656S	Litronix	TLR344
HA1143g	Siemens	TLG358	DLO-7650S	Litronix	TLR345
HA1141g	Siemens	TLG359	DLO-7673S	Litronix	TLG342
HD8142g	Siemens	TLG329	DLO-7671S	Litronix	TLG343
HD1133R	Siemens	TLR362	DLO-7676S	Litronix	TLG344
HD1131R	Siemens	TLR363	DLO-7670S	Litronix	TLG345

( ) — Incompatible Pinconnection

Other Mfg's P/N	Mfg.	Toshiba P/N	Other Mfg's P/N	Mfg.	Toshiba P/N
HD1133R	Litronix	TLR368			
HD1131R	Litronix	TLR369			
(HD1134R)	Litronix	TLR364			
(HD1132R)	Litronix	TLR365			
DL-728	Litronix	TLR366			
DL-727	Litronix	TLR367			
HD1133G	Litronix	TLG368			
HD1131G	Litronix	TLG369			
(HD1134G)	Litronix	TLG364			
(HD1132G)	Litronix	TLG365			
(TIL313)	TI	TLR332			
TIL312	TI	TLR333			
(TIL327)	TI	TLR334			
TIL312	TI	TLR335			
TIL322A	TI	TLR362			
TIL321A	TI	TLR363			
FND500	Fairchild	TLR362			
FND507	Fairchild	TLR363			
FND530	Fairchild	TLG362			
FND537	Fairchild	TLG363			

Code Definitions

A : Direct Replacement
B : Minor Electrical Difference
C : Minor Mechanical Difference
D : Major Electrical Difference
E : Major Mechanical Difference
F : Call TOSHIBA *
G : No Equivalent

* Devices that can be second sourced if volume and pricing warrant.

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GENERAL ELECTRIC	515
Hewlett-Packard	516

Types	TOSHIBA Types	Code
SIEMENS-Litronix		
4N25	4N25	A
4N26	4N25	A
4N27	4N25	A
4N28	4N25	A
4N32	4N32	A
4N33	4N32	A
4N35	4N35	A
4N36	4N35	A
4N37	4N35	A
CNY17-1	TLP535	F
CNY17-2	CNY17-2	A
CNY17-3	CNY17-3	A
CNY17-4	CNY17-4	A
CNY18	–	G
H11AA1	TLP630	A
IL-1B	TLP535	A
ILD-1	TLP504A	A
ILQ-1	–	F
IL-5B	TLP535	A
IL-12B	TLP535	A
IL-74B	TLP535	A
ILD-74A	TLP504A	A
ILQ-75A	–	F
IL-100	TLP552	B
IL-101	TLP552	B
IL-201	TLP631	F
IL-202	TLP631 (GR)	F
IL-203	TLP631 (GR)	F
IL-250	TLP630	A
ILA-30B	TLP571	A
ILA-55	TLP571	F
ILAC2-30B	TLP571	A
ILCA2-55B	TLP571	F
IL-CT6A	TLP504A	A
ILD-506	TLP504A	F
SFH600-0	TLP631	F
SFH600-1	TLP631	F
SFH600-2	TLP631	F
SFH600-3	TLP631	F
SFH601-1	TLP631	F
SFH601-2	TLP631	F
SFH601-3	TLP631	F
SFH601-4	TLP631	F
AEG-TELEFUNKEN		
CNY18	–	G
CNY21	TLP581	E
CNY64	TLP581	E
CNY65	TLP581	E
CNY66	–	G
CNY75A	TLP631	F
CNY75B	TLP631 (GB)	F
CNY75C	TLP631 (GB)	F
CQY80N	TLP631	A
4N25	4N25	A
4N26	4N25	A
4N27	4N25	A
4N35	4N35	A
4N36	4N35	A
4N37	4N35	A

NOTE: (GB)s and (GR)s are Rank Name of CTR.

Types	TOSHIBA Types	Code
PHILIPS		
CNX21	TLP581	E
CNX35	TLP631	B
CNX36	TLP631 (GB)	A
CNX38	TLP631	B
CNY48	TLP535	A
CNY50	–	G
CNY52	TLP581	E
CNY53	TLP581	E
CNY57	TLP631	B
CNY57A	TLP631	A
CNY62	TLP581	E
CNY63	TLP581	E
VALVO		
CNX21	TLP581	E
CNX35	TLP631	B
CNX36	TLP631 (GB)	A
CNY50	–	G
CNY52	TLP581	E
CNY53	TLP581	E
CNY57	TLP631	B
CNY57A	TLP631	A
CNY62	TLP581	B
CNY63	TLP581	B

Types	TOSHIBA Types	Code
TRW-OPTRON		
CNY17/I	TLP535	F
CNY17/II	CNY17-2	A
CNY17/III	CNY17-3	A
CNY17/IV	CNY17-4	A
OPI102	–	G
OPI103	–	G
OPI110	TLP581	E
OPI113	–	G
OPI120	TLP581	E
OPI123	–	G
OPI125	–	G
OPI126	–	G
OPI127	–	G
OPI128	–	G
OPI1264A	TLP581	E
OPI1264B	TLP581	E
OPI1264C	TLP581	E
OPI130	–	G
OPI140	–	G
OPI150	–	G
OPI153	–	G
OPI2100	TLP631 (GB)	A
OPI2150	TLP535	A
OPI2250	TLP535	A
OPI2151	TLP535	A

NOTE: (GB)s and (GR)s are Rank Name of CTR.

Types	TOSHIBA Types	Code	Types	TOSHIBA Types	Code
TRW-OPTRON (Continued)			OPI8013	–	G
			OPI8014	–	G
OPI2251	TLP535	A	OPI8015	–	G
OPI2152	TLP535	A	3N243	–	G
OPI2252	TLP535	A	3N244	–	G
OPI2153	TLP535	A	3N245	–	G
OPI2253	TLP535	A	3N243R	–	G
OPI2154	TLP535 (GR)	A	3N244R	–	G
OPI2155	TLP535 (GR)	A	3N245R	–	G
OPI2156	TLP535 (GR)	A	4N22A	–	G
OPI2254	TLP535 (GR)	A	4N23A	–	G
OPI2255	TLP535 (GR)	A	4N24A	–	G
OPI2500	TLP630	A	4N25	4N25	A
OPI3009	TLP560E	A	4N26	4N25	A
OPI3010	TLP560E	A	4N27	4N25	A
OPI3011	TLP560E	A	4N28	4N25	A
OPI3012	TLP560E	F	4N29	4N29	A
OPI3020	TLP560G	A	4N30	4N29	A
OPI3021	TLP560G	A	4N31	4N29	A
OPI3022	TLP560G	A	4N32	4N32	A
OPI3023	TLP560G	F	4N33	4N32	A
OPI3150	TLP571	A	4N35	4N35	A
OPI3250	TLP571	A	4N36	4N35	A
OPI3151	TLP571	A	4N37	4N35	A
OPI3251	TLP571	A	4N38	TLP535	F
OPI3152	TLP571	F	4N38A	TLP535	F
OPI3252	TLP571	F			
OPI3153	TLP571	A			
OPI6000	–	G			
OPI6100	–	G			
OPI7002	TLP581	E			
OPI7010	TLP581	E			
OPI7320	–	G			
OPI7340	–	G			
OPI8012	–	G			

NOTE: (GB)s and (GR)s are Rank Name of CTR.

Types	TOSHIBA Types	Code
TEXAS INSTRUMENTS		
3N261	–	G
3N262	–	G
3N263	–	G
4N22	–	G
4N23	–	G
4N24	–	G
4N25	4N25	A
4N26	4N25	A
4N27	4N25	A
4N28	4N25	A
4N35	4N35	A
4N36	4N35	A
4N37	4N35	A
4N47	–	G
4N48	–	G
4N49	–	G
MCT2	TLP535	A
MCT2E	TLP535	A
TIL102	–	G
TIL103	–	G
TIL111	TLP535	A
TIL112	TLP535	A
TIL113	TLP571	A
TIL114	RLP535	A
TIL115	TLP535	A
TIL116	TLP535	A
TIL117	TLP535	A
TIL118	TLP535	A
TIL119	TLP570	A
TIL119A	TLP570	A

Types	TOSHIBA Types	Code
TIL120	–	G
TIL121	–	G
TIL124	TLP631	A
TIL125	TLP631	A
TIL126	TLP631	A
TIL127	TLP571	F
TIL128	TLP570	F
TIL128A	TLP570	F
TIL153	TLP535	A
TIL154	TLP535	A
TIL155	TLP535	A
TIL156	TLP571	A
TIL157	TLP570	A
TIL157A	TLP570	A
MOTOROLA		
4N25	4N25	A
4N25A	4N25A	A
4N26	4N25	A
4N27	4N25	A
4N28	4N25	A
4N29	4N29	A
4N29A	4N29A	A
4N30	4N29	A
4N31	4N29	A
4N32	4N32	A
4N32A	4N32A	A
4N33	4N32	A
4N35	4N35	A
4N36	4N35	A
4N37	4N35	A

NOTE: (GB)s and (GR)s are Rank Name of CTR.

Types	TOSHIBA Types	Code	Types	TOSHIBA Types	Code
MOTOROLA (Continued)			MOC3003	TLP641G	A
			MOC3007	TLP641G	A
4N38	TLP535	F	MOC3009	TLP560E	A
4N38A	TLP535	F	MOC3010	TLP560E	A
H11AA1	TLP630	A	MOC3011	TLP560E	A
H11AA2	TLP630	A	MOC3012	TLP560E	F
H11C1	TLP541G	A	MOC3020	TLP560G	A
H11C2	TLP541G	A	MOC3021	TLP560G	A
H11C3	TLP541G	A	MOC3022	TLP560G	A
H11D1	–	G	MOC3023	TLP560G	F
H11D2	–	G	MOC3030	–	G
H11D3	–	G	MOC3031	–	G
H11D4	–	G	MOC3032	–	G
H11G1	TLP572	F	MOC3040	–	G
H11G2	TLP572	F	MOC3041	–	G
H11G3	TLP572	F	MOC5007	–	G
H11L1	–	G	MOC5008	–	G
H11L2	–	G	MOC5009	–	G
MOC119	TLP570	A	MOC5010	–	G
MOC601A	TLP631	B	MOC8020	TLP570	B
MOC602A	TLP631	B	MOC8021	TLP570	B
MOC603A	TLP631	B	MOC8030	TLP570	B
MOC604A	TLP631	B	MOC8050	TLP570	B
MOC622A	TLP571	B	MOC8100	TLP631 (GB)	A
MOC623A	TLP571	B	MOC8111	TLP631	A
MOC624A	TLP571	B	MOC8112	TLP631	A
MOC625A	TLP571	B	MOC8113	TLP631 (GB)	A
MOC633A	TLP560G	B	MOC8204	–	G
MOC634A	TLP560G	B	MOC8205	–	G
MOC635A	TLP560G	B	MOC8206	–	G
MOC640A	–	G			
MOC641A	–	G			
MOC1005	TLP631	A			
MOC1006	TLP631	A			
MOC3002	TLP641G	A			

NOTE: (GB)s and (GR)s are Rank Name of CTR.

Types	TOSHIBA Types	Code	Types	TOSHIBA Types	Code
			MCP3010	TLP560E	A
			MCP3011	TLP560E	A
GENERAL INSTRUMENT			MCP3020	TLP560G	A
			MCP3021	TLP560G	A
			MCP3022	TLP560G	A
4N25	4N25	A	MCS2	TLP541G	A
4N26	4N25	A	MCS2400	TLP541G	A
4N27	4N25	A	MCS21	TLP641G	A
4N28	4N25	A	MCS2401	TLP641G	A
4N29	4N29	A	MCT2	TLP535	A
4N30	4N29	A	MCT2E	TLP535	A
4N31	4N29	A	MCT210	TLP535	F
4N32	4N32	A	MCT2200	TLP631	A
4N33	4N32	A	MCT2201	TLP631 (GB)	A
4N35	4N35	A	MCT2202	TLP631	F
4N36	4N35	A	MCT26	TLP535	A
4N37	4N35	A	MCT270	TLP535	A
6N137	6N137	A	MCT271	TLP535	F
6N138	–	G	MCT272	TLP535	F
6N139	–	G	MCT273	TLP535 (GR)	F
CNY17A	TLP535	F	MCT274	TLP535 (GR)	F
CNY17B	CNY17-2	A	MCT275	TLP535	F
CNY17C	CNY17-3	A	MCT276	TLP535	F
CNY17D	CNY17-4	A	MCT277	TLP535 (GR)	A
CNY65	TLP581	E	MCT4	–	G
CNY75A	TLP631	B	MCT4R	–	G
CNY75B	TLP631 (GB)	B	MCT6	TLP504A	A
CNY75C	TLP631 (GB)	B	MCT66	TLP504A	A
MCA11G1	TLP572	F	MID400	–	G
MCA11G2	TLP572	F			
MCA230	TLP571	A			
MCA255	TLP571	F			
MCA231	TLP571	A			
MCL2601	–	G			
MCP3009	TLP560E	A			

NOTE: (GB)s and (GR)s are Rank Name of CTR.

Types	TOSHIBA Types	Code	Types	TOSHIBA Types	Code
			H11AA2	TLP630	A
			H11AV1	TLP581	E
GENERAL ELECTRIC			H11AV2	TLP581	E
			H11AV3	TLP581	E
			H11B1	TLP571	A
4N25	4N25	A	H11B2	TLP571	A
4N25A	4N25A	A	H11B3	TLP571	A
4N26	4N25	A	H11B255	TLP571	F
4N27	4N25	A	H11BX522	TLP571	A
4N28	4N25	A	H11C1	TLP541G	A
4N29	4N29	A	H11C2	TLP541G	A
4N29A	4N29A	A	H11C3	TLP541G	A
4N30	4N29	A	H11C4	TLP541G	A
4N31	4N29	A	H11C5	TLP541G	A
4N32	4N32	A	H11C6	TLP541G	A
4N32A	4N32A	A	H74C1	TLP541G	A
4N33	4N32	A	H74C2	TLP541G	A
4N35	4N35	A	H11D1	–	G
4N36	4N35	A	H11D2	–	G
4N37	4N35	A	H11D3	–	G
4N38	TLP535	F	H11D4	–	G
4N38A	TLP535	F	H11F1	–	G
4N39	TLP541G	A	H11F2	–	G
4N40	TLP541G	A	H11F3	–	G
H11A1	TLP535	A	H11G1	TLP572	F
H11A2	TLP535	A	H11G2	TLP572	F
H11A3	TLP535	A	H11G3	TLP572	F
H11A4	TLP535	A	H11J1	TLP560E	F
H11A5	TLP535	A	H11J2	TLP560E	F
H11A10	TLP535	A	H11J3	TLP560E	A
H11A520	TLP631	A	H11J4	TLP560E	A
H11550	TLP631	A	H11J5	TLP560E	A
H11A5100	TLP631 (GB)	A	H11L1	–	G
H74A1	TLP535	A	H11L2	–	G
H11AA1	TLP630	A	CQY80	TLP631	A

NOTE: (GB)s and (GR)s are Rank Name of CTR.

Types	TOSHIBA Types	Code	Types	TOSHIBA Types	Code
GENERAL ELECTRIC (Continued)					
CNY17-I	TLP535	F			
CNY17-II	CNY17-2	A			
CN 17-III	CNY17-3	A			
CNY17-IV	CNY17-4	A			
CNY30	TLP541G	A			
CNY31	—	G			
CNY32	TLP581	E			
CNY33	—	G			
CNY34	TLP541G	A			
CNY35	TLP630	A			
CNY47	TLP535	F			
CNY47A	TLP535	A			
CNY48	TLP571	A			
CNY51	TLP631	F			
GFH600-I	TLP631	F			
GFH600-II	TLP631	F			
GFH600-III	TLP631	F			
HEWLETT-PACKARD					
6N135	6N135	A			
6N136	6N136	A			
HCPL-2502	TLP551	F			
HCPL-2503	TLP551	F			
SL5505	TLP551	F			
6N137	6N137	A			

NOTE: (GB)s and (GR)s are Rank Name of CTR.

Other Mfg's P/N	Mfg.	Toshiba P/N
LED55B	GE	TLN101
LED55C	GE	TLN108
H23A1	GE	TLN107
L14G1	GE	TPS604
H23B1	GE	TPS607
H23A1	GE	TPS608
H21B	GE	TLP507A
H21A	GE	TLP800
ME61	GI	TLN104
ME7024	GI	TLN110
MT2	GI	TPS604
MCA8	GI	TLP507A
MCT8	GI	TLP800
MCA7	GI	TLP901
SFH401-1	Siemens	TLN101
SFH401-3	Siemens	TLN108
LD261	Siemens	TLN104
LD271	Siemens	TLN105
LD272	Siemens	TLN107
BDY62	Siemens	TPS604
BPX65	Siemens	TPS708
BPX81	Siemens	TPS605
SFH206	Siemens	TPS703
TIL31	TI	TLN101
TIL34	TI	TLN108
TIL32	TI	TLN109
TIL41	TI	TLN104
TIL81	TI	TPS604
TIL621	TI	TPS621
TIL145	TI	TLP507A
TIL143	TI	TLP800
TIL149	TI	TLP901
SE5453-1	SPECTRONICS	TLN101
SE5453-4	SPECTRONICS	TLN108
SEP8505	SPECTRONICS	TLN109
SEP8507	SPECTRONICS	TLN104
SEP8503	SPECTRONICS	TLN105
SEP8506-1	SPECTRONICS	TLN107
SD5443	SPECTRONICS	TPS604
SD5421-2	SPECTRONICS	TPS708
SDP8107-1	SPECTRONICS	TPS605
SDP8407-1	SPECTRONICS	TPS606
SDP8106-1	SPECTRONICS	TPS607
SD8406-1	SPECTRONICS	TPS608
SPX1878	SPECTRONICS	TLP507A
SPX1879	SPECTRONICS	TLP800
SPX1397	SPECTRONICS	TLP901
IN6264	OPTRON	TLN101
OP160	OPTRON	TLN109
OP140	OPTRON	TLN107
OP815	OPTRON	TPS604
OP913	OPTRON	TPS708
OP560	OPTRON	TPS607
OP550	OPTRON	TPS608
OP915F	OPTRON	TPS703
OPB816	OPTRON	TLP800
OPB820	OPTRON	TLP850
OPB730	OPTRON	TLP901

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