TOSHIBA Photocoupler GaAs IRED & Photo−Transistor

TLP785,TLP785F

Office Equipment

Household Appliances

Solid State Relays

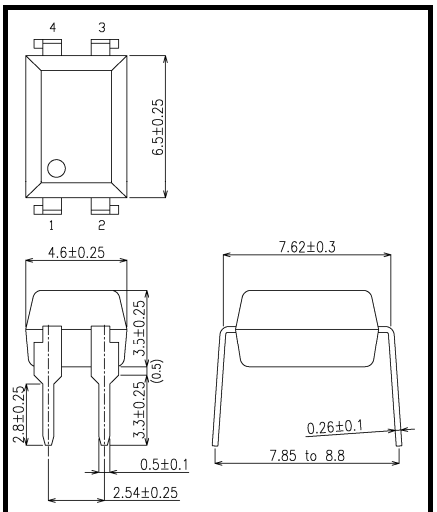
Switching Power Supplies

Various Controllers

Signal Transmission Between Different Voltage Circuits

The TOSHIBA TLP785 consists of a silicone phototransistor optically coupled to a gallium arsenide (GaAs) infrared emitting diode in a four lead plastic DIP (DIP4) with having high isolation voltage (AC: 5kV$_{RMS}$ (min)).
TLP785F is a lead forming type for the long creepage surface mounting of TLP785.

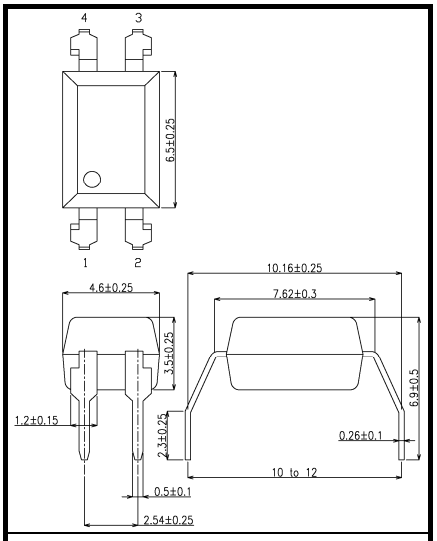
TLP785 Unit: mm



TOSHIBA 11-5L1

Weight: 0.32 g (typ.)

TLP785F Unit: mm



TOSHIBA 11-5L102

Weight: 0.32g (typ.)

- TLP785: 7.62mm pitch type DIP4
- TLP785F: 10.16mm pitch type DIP4
- Collector-emitter voltage: 80V (min.)
- Current transfer ratio: 50% (min.)
  Rank GB: 100% (min.)
- Isolation voltage: 5000V$_{rms}$ (min.)
- UL approved: UL1577, file No. E67349
- BSI under application: BS EN60065:2002
  BS EN60950-1:2006
- SEMKO under application:EN60065:2002
  EN60950-1:2001, EN60335-1:2002
- Option(D4)type
  VDE approved: DIN EN60747-5-2
  (Note): When an EN60747-5-2 approved type is needed,
  Please designate “Option (D4)”

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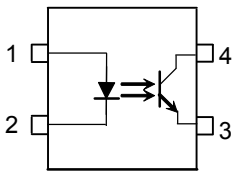
- Construction mechanical rating

	7.62mm Pitch Standard Type	10.16mm Pitch TLPxxxF Type
Creepage distance	7.0mm(min)	8.0mm(min)
Clearance	7.0mm(min)	8.0mm(min)
Insulation thickness	0.4mm(min)	0.4mm(min)
Inner creepage distance	4.0mm(min)	4.0mm(min)

Pin Configurations (top view)



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

Current Transfer Ratio

Type	Classification (Note 1)	Current Transfer Ratio (%) (I_C / I_F) I_F = 5mA, V_{CE} = 5V, Ta = 25°C		Marking of Classification
		Min	Max	
TLP785	None	50	600	Blank
	Rank Y	50	150	YE
	Rank GR	100	300	GR
	Rank BL	200	600	BL
	Rank GB	100	600	GB
	Rank YH	75	150	Y+
	Rank GRL	100	200	G
	Rank GRH	150	300	G+
	Rank BLL	200	400	B

(Note 1): Ex. rank GB: TLP785 (GB)

(Note 2): Application type name for certification test, please use standard product type name, i. e. TLP785 (GB): TLP785

Absolute Maximum Ratings (Ta = 25°C)

Characteristic			Symbol	Rating	Unit
LED	Forward current		I_F	60	mA
	Forward current derating (Ta ≥ 39°C)		ΔI_F / °C	−0.7	mA / °C
	Pulse forward current	(Note 3)	I_{FP}	1	A
	Power dissipation		P_D	90	mW
	Power dissipation derating		ΔP_D / °C	−0.9	mW / °C
	Reverse voltage		V_R	5	V
	Junction temperature		T_j	125	°C
Detector	Collector−emitter voltage		V_{CEO}	80	V
	Emitter−collector voltage		V_{ECO}	7	V
	Collector current		I_C	50	mA
	Power dissipation (single circuit)		P_C	150	mW
	Power dissipation derating (Ta ≥ 25°C)		ΔP_C / °C	−1.5	mW / °C
	Junction temperature		T_j	125	°C
Operating temperature range			T_{opr}	−55 to 110	°C
Storage temperature range			T_{stg}	−55 to 125	°C
Lead soldering temperature (10s)			T_{sol}	260	°C
Total package power dissipation			P_T	240	mW
Total package power dissipation derating (Ta ≥ 25°C)			ΔP_T / °C	−2.4	mW / °C
Isolation voltage		(Note 4)	BV_S	5000	V_{rms}

(Note): Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings.
Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook (“Handling Precautions”/“Derating Concept and Methods”) and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

(Note 3): 100 μs pulse, 100 Hz frequency

(Note 4): AC, 1 min., R.H.≤ 60%. Apply voltage to LED pin and detector pin together.

Recommended Operating Conditions (Note)

Characteristic	Symbol	Min	Typ.	Max	Unit
Supply voltage	V_{CC}	—	5	24	V
Forward current	I_F	—	16	25	mA
Collector current	I_C	—	1	10	mA
Operating temperature	T_{opr}	−25	—	85	°C

(Note): Recommended operating conditions are given as a design guideline to obtain expected performance of the device.
Additionally, each item is an independent guideline respectively.
In developing designs using this product, please confirm specified characteristics shown in this document.

Individual Electrical Characteristics (Ta = 25°C)

	Characteristic	Symbol	Test Condition	Min	Typ.	Max	Unit
LED	Forward voltage	V_F	I_F = 10 mA	1.0	1.15	1.3	V
	Reverse current	I_R	V_R = 5 V	—	—	10	μA
	Capacitance	C_T	V = 0V, f = 1 MHz	—	30	—	pF
Detector	Collector−emitter breakdown voltage	$V_{(BR)\ CEO}$	I_C = 0.5 mA	80	—	—	V
	Emitter−collector breakdown voltage	$V_{(BR)\ ECO}$	I_E = 0.1 mA	7	—	—	V
	Collector dark current	$I_D(I_{CEO})$	V_{CE} = 24 V	—	0.01	0.1	μA
			V_{CE} = 24 V ,Ta = 85°C	—	0.6	50	μA
	Capacitance (collector to emitter)	C_{CE}	V = 0V, f = 1 MHz	—	6	—	pF

Coupled Electrical Characteristics (Ta = 25°C)

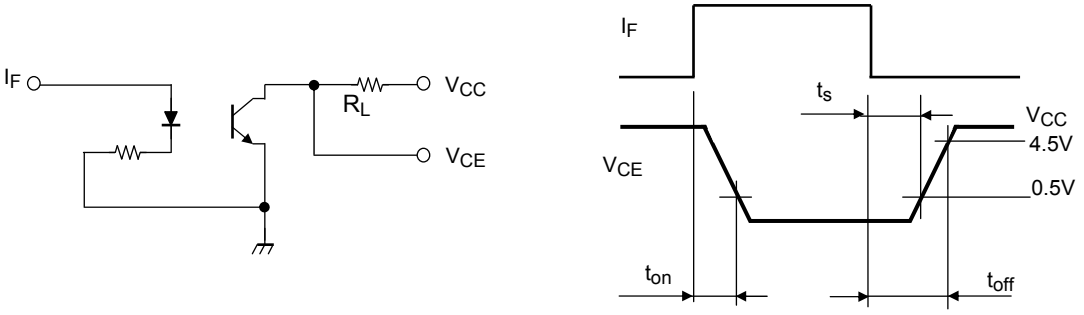
Characteristic	Symbol	Test Condition		Min	Typ.	Max	Unit
Current transfer ratio	I_C / I_F	I_F = 5 mA, V_{CE} = 5 V		50	—	600	%
			Rank GB	100	—	600	
Saturated CTR	I_C / $I_{F\ (sat)}$	IF = 1 mA, V_{CE} = 0.4 V		—	60	—	%
			Rank GB	30	—	—	
Collector−emitter saturation voltage	$V_{CE\ (sat)}$	I_C = 2.4 mA, I_F = 8 mA		—	—	0.4	V
		I_C = 0.2 mA, I_F = 1 mA		—	0.2	—	
			Rank GB	—	—	0.4	

Isolation Characteristics (Ta = 25°C)

Characteristic	Symbol	Test Condition	Min	Typ.	Max	Unit
Capacitance (input to output)	C_S	V_S = 0V, f = 1 MHz	—	0.8	—	pF
Isolation resistance	R_S	V_S = 500 V	1×10^{12}	10^{14}	—	Ω
Isolation voltage	BV_S	AC, 1 minute	5000	—	—	V_{rms}
		AC, 1 second, in oil	—	10000	—	
		DC, 1 minute, in oil	—	10000	—	Vdc

Switching Characteristics (Ta = 25°C)

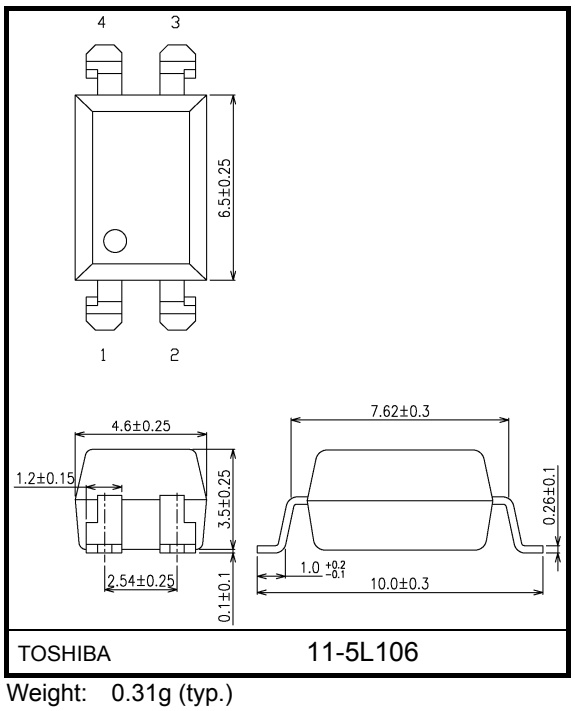
Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Rise time	t_r	V_{CC} = 10 V, I_C = 2 mA R_L = 100Ω	—	2	—	μs
Fall time	t_f		—	3	—	
Turn−on time	t_{on}		—	3	—	
Turn−off time	t_{off}		—	3	—	
Turn−on time	t_{on}	R_L = 1.9 kΩ (fig. 1) V_{CC} = 5 V, I_F = 16 mA	—	1.5	—	μs
Storage time	t_s		—	25	—	
Turn−off time	t_{off}		—	50	—	



(fig. 1): Switching time test circuit

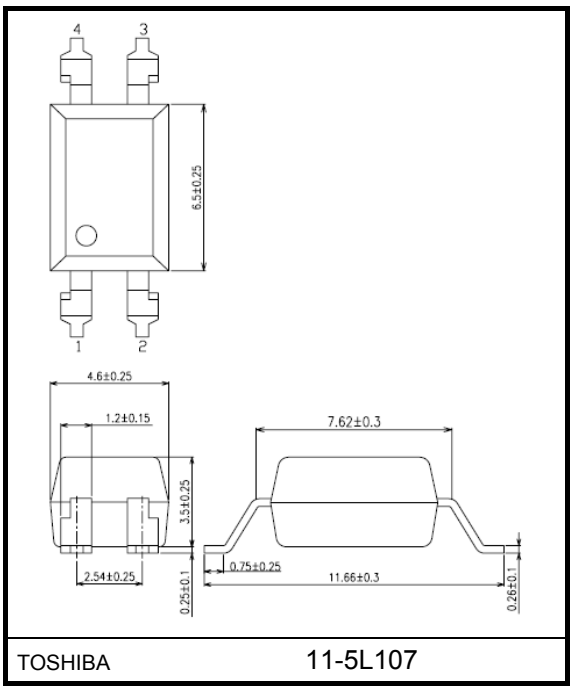
Surface-Mount Lead Form Option

TLP785(LF6) Unit: mm



Weight: 0.31g (typ.)

TLP785F(LF7) Unit: mm



Weight: 0.31g (typ.)

Option: Specifications for Embossed-Tape Packing; (TP6)/(TP7)

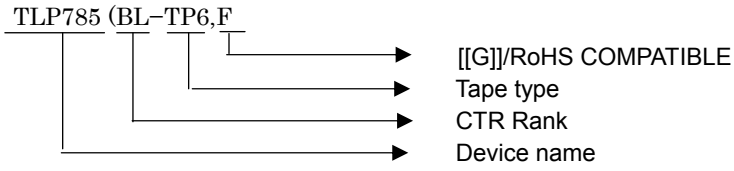
1. Applicable Package

Package Name	Product Type
DIP4LF6	TLP785
DIP4LF7	TLP785F

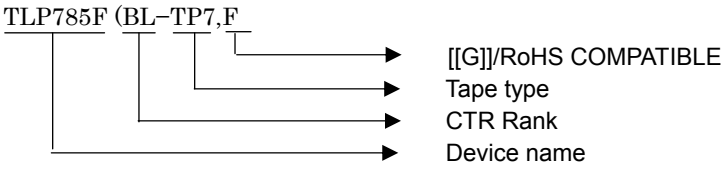
2. Product Naming System

Type of package used for shipment is denoted by a symbol suffix after a product number. The method of classification is as below.

(Example)



(Example2)



3. Tape Dimensions

3.1 Orientation of Device in Relation to Direction of Tape Movement

Device orientation in the recesses is as shown in Figure 2.

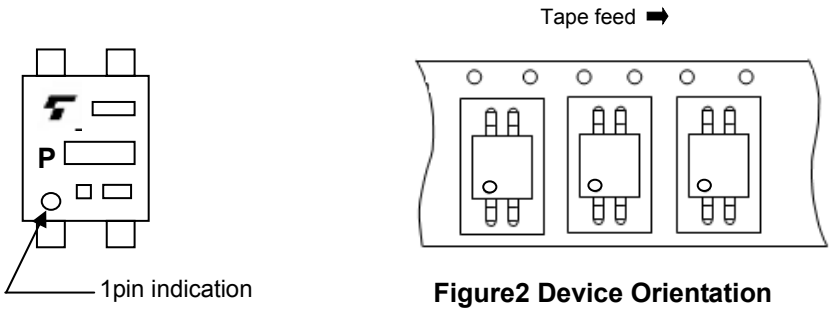


Figure2 Device Orientation

3.2 Tape Packing Quantity:2000 devices per reel

3.3 Empty Device Recesses Are as Shown in Table 1.

Table1 Empty Device Recesses

	Standard	Remarks
Occurrences of 2 or more successive empty device recesses	0	Within any given 40-mm section of tape, not including leader and trailer
Single empty device recesses	6 devices (max.) per reel	Not including leader and trailer

3.4 Start and End of Tape

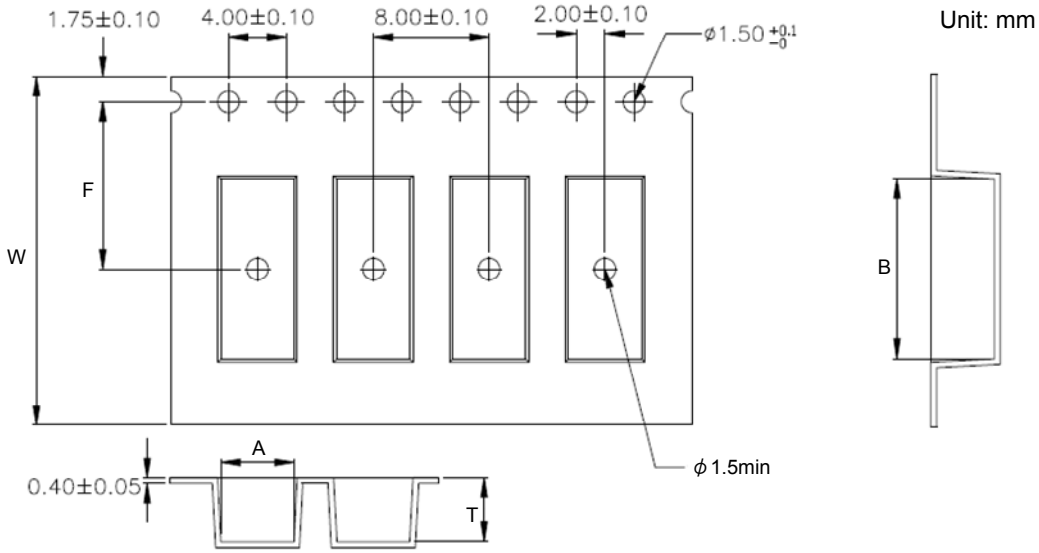
The start of the tape has 30 or more empty holes. The end of the tape has 50 or more empty holes.

3.5 Tape Specification

[1] TLP785(TP6) / TLP785F(TP7)

(1)Tape material: Plastic

(2)Dimensions: The tape dimensions are as shown in Figure 3.



	TP6 Type	TP7Type
A	5.1±0.1	5.05±0.1
B	10.6±0.1	12.35±0.1
W	16.0±0.3	24.0±0.3
F	7.5±0.1	11.5±0.1
T	4.2±0.15	4.4±0.1

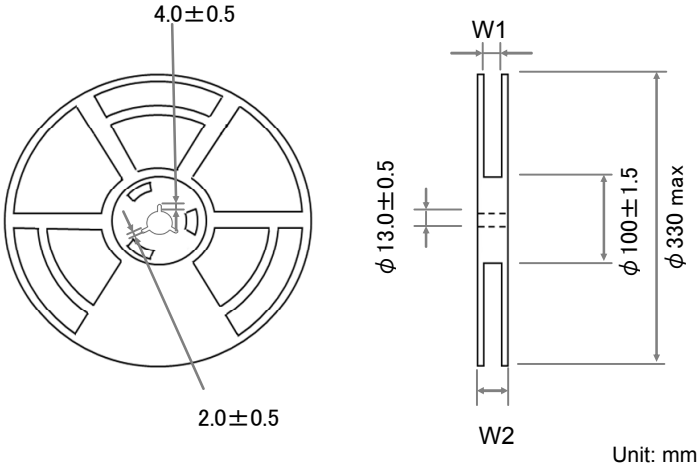
Figure 3 Tape Forms

3.6 Reel Specification

[1] TLP785(TP6) / TLP785F(TP7)

(1)Material: Plastic

(2)Dimensions: The reel dimensions are as shown in Figure 4.



	TP6 Type	TP7 Type
W1	16.5typ	24.4typ
W2	23max	30.4max

Unit: mm

Figure 4 Reel Forms

4. Packing

Two reels of photocouplers are packed in a shipping carton.

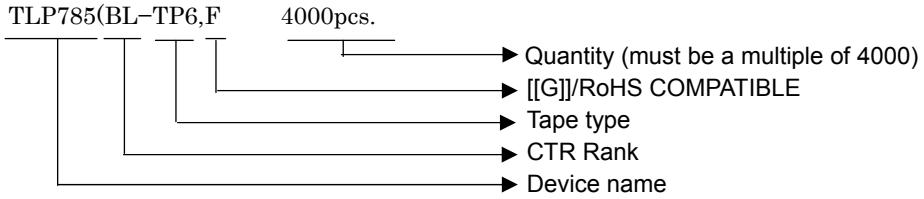
5. Label Indication

The carton bears a label indicating the product number, the symbol representing classification of standard, the quantity, the lot number and the Toshiba company name.

6. Ordering Information

When placing an order, please specify the product number, the CTR rank, the tape type and the quantity as shown in the following example.

(Example)



(Note): The order code may be suffixed with a letter or a digit.
Please contact your nearest Toshiba sales representative for more details.

Soldering and Storage

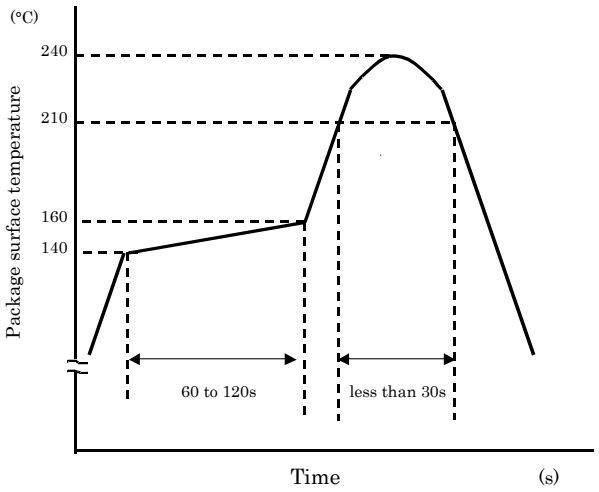
1. Soldering

1.1 Soldering

When using a soldering iron or medium infrared ray/hot air reflow, avoid a rise in device temperature as much as possible by observing the following conditions.

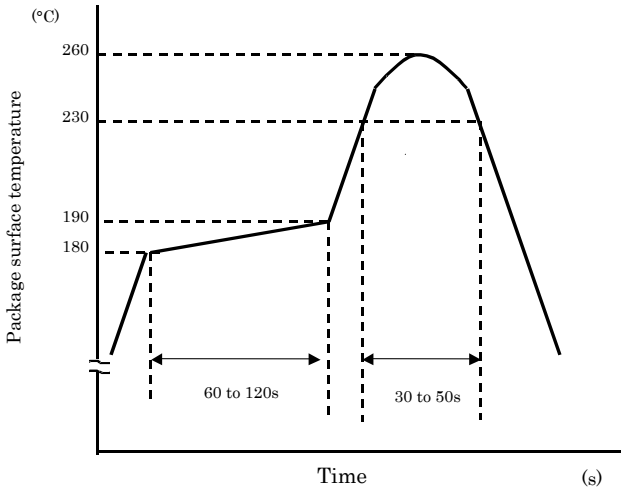
1) Using solder reflow

·Temperature profile example of lead (Pb) solders



This profile is based on the devices maximum heat resistance guaranteed value. Set the preheat temperature/heating temperature to the optimum temperature corresponding to the solder paste type used by the customer within the described profile.

·Temperature profile example of using lead (Pb)-free solders



This profile is based on the devices maximum heat resistance guaranteed value. Set the preheat temperature/heating temperature to the optimum temperature corresponding to the solder paste type used by the customer within the described profile.

2) Using solder flow (for lead (Pb) solder, or lead (Pb)-free solder)

Please preheat it at 150°C between 60 and 120 seconds.

Complete soldering within 10 seconds below 260°C. Each pin may be heated at most once.

3) Using a soldering iron

Complete soldering within 10 seconds below 260°C, or within 3 seconds at 350°C. Each pin may be heated at most once.

2. Storage

1) Avoid storage locations where devices may be exposed to moisture or direct sunlight.
2) Follow the precautions printed on the packing label of the device for transportation and storage.
3) Keep the storage location temperature and humidity within a range of 5°C to 35°C and 45% to 75%, respectively.
4) Do not store the products in locations with poisonous gases (especially corrosive gases) or in dusty conditions.
5) Store the products in locations with minimal temperature fluctuations. Rapid temperature changes during storage can cause condensation, resulting in lead oxidation or corrosion, which will deteriorate the solderability of the leads.
6) When restoring devices after removal from their packing, use anti-static containers.
7) Do not allow loads to be applied directly to devices while they are in storage.
8) If devices have been stored for more than two years under normal storage conditions, it is recommended that you check the leads for ease of soldering prior to use.

EN60747-5-2 'Option: (D4)'

Attachment: Specification for EN60747-5-2 option: (D4)

Types: TLP785, TLP785F

Type designations for 'option: (D4) ', which are tested under EN60747 requirements.

Ex.: TLP785(D4-GR-LF6,F D4: EN60747 option
GR: CTR rank name
LF6: standard lead bend name
F: [[G]]/RoHS COMPATIBLE

Note: Use TOSHIBA standard type number for safety standard application.
Ex. TLP785(D4-GR-LF6,F → TLP785

EN60747 Isolation Characteristics

Description		Symbol	Rating	Unit
Application classification for rated mains voltage ≤ 300 V_{rms} for rated mains voltage ≤ 600 V_{rms}			 I–IV I–III	—
Climatic classification			55 / 115 / 21	—
Pollution degree			2	—
Maximum operating insulation voltage	TLP785	V_{IORM}	890	Vpk
	TLP785F		1140	
Input to output test voltage, Vpr = 1.5×V_{IORM}, type and sample test t_p = 10s, partial discharge < 5pC	TLP785	V_{pr}	1335	Vpk
	TLP785F		1710	
Input to output test voltage, Vpr = 1.875×V_{IORM}, 100% production test t_p = 1s, partial discharge < 5pC	TLP785	V_{pr}	1670	Vpk
	TLP785F		2140	
Highest permissible overvoltage (transient overvoltage, t_{pr} = 60s)		V_{TR}	8000	Vpk
Safety limiting values (max. permissible ratings in case of fault) current (input current) P_{si} = 0mW power (output or total power dissipation) temperature		 I_{si} P_{si} T_{si}	 400 700 175	 mA mW °C
Insulation resistance, V_{IO} = 500V,Ta=25°C		Rsi	$\geq 10^{12}$	Ω

Insulation Related Specifications

		 7.62mm pitch TLPxxx type	 10.16mm pitch TLPxxxF type
Minimum creepage distance	Cr	7.0mm	8.0mm
Minimum clearance	Cl	7.0mm	8.0mm
Minimum insulation thickness	ti	0.4 mm	
Comparative tracking index	CTI	175	

(1) If a printed circuit is incorporated, the creepage distance and clearance may be reduced below this value. (e.g.at a standard distance between soldering eye centres of 7.5mm). If this is not permissible, the user shall take suitable measures.

(2) This photocoupler is suitable for 'safe electrical isolation' only within the safety limit data. Maintenance of the safety data shall be ensured by means of protective circuits.

VDE test sign: Marking on product for EN60747 4

Marking on packing for EN60747 

Marking Example: TLP785, TLP785F

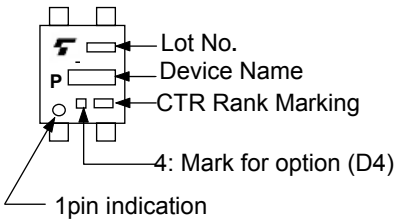


Figure 1 Partial discharge measurement procedure according to EN60747
Destructive test for qualification and sampling tests.

Method A

(for type and sampling tests, destructive tests)

t_1, t_2	= 1 to 10 s
t_3, t_4	= 1 s
t_p(Measuring time for partial discharge)	= 10 s
t_b	= 12 s
t_{ini}	= 60 s

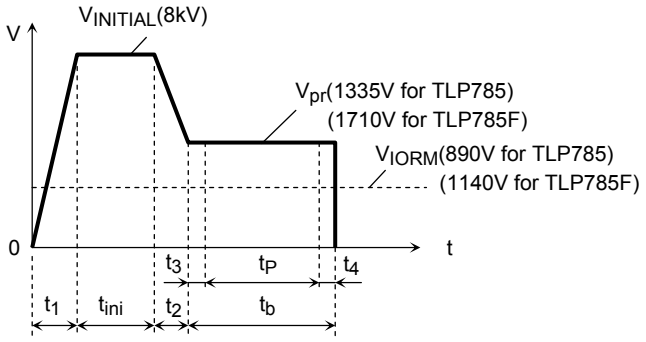


Figure 2 Partial discharge measurement procedure according to EN60747
Non-destructive test for100% inspection.

Method B

(for sample test,non-destructive test)

t_3, t_4	= 0.1 s
t_p(Measuring time for partial discharge)	= 1 s
t_b	= 1.2 s

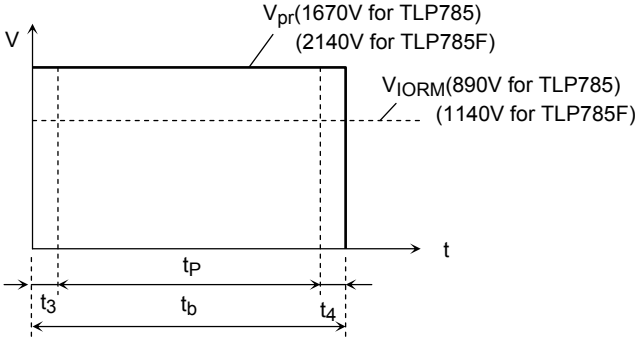
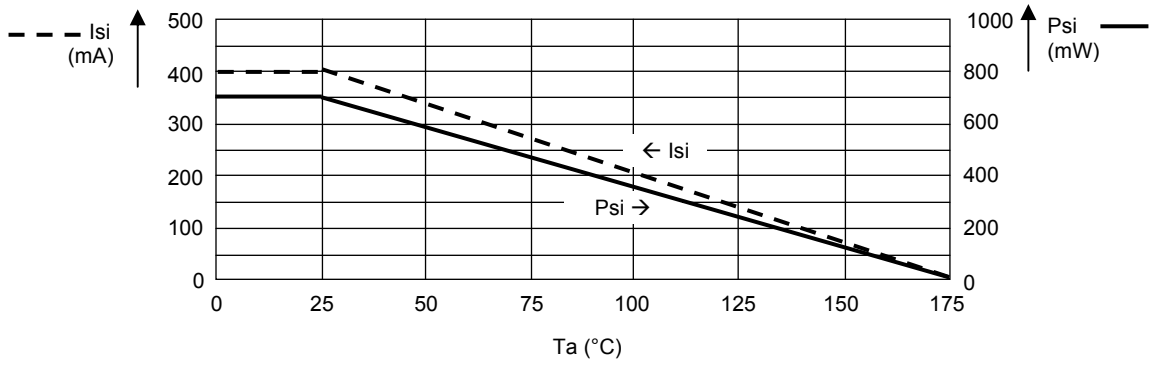
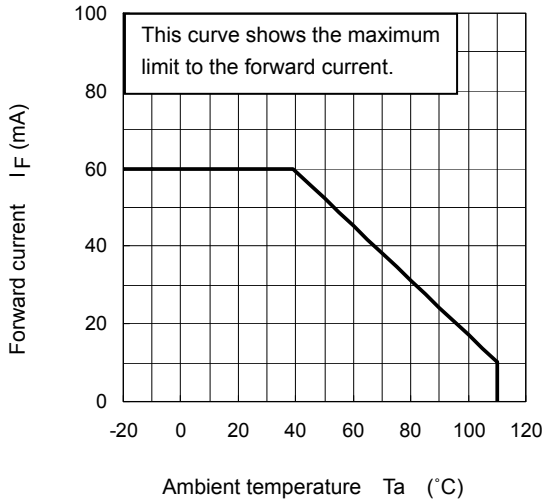


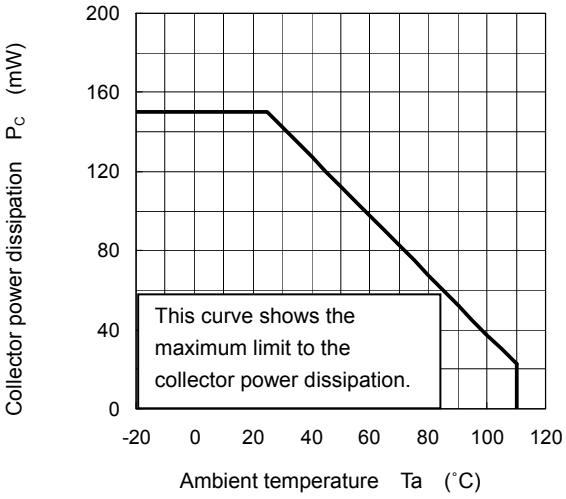
Figure 3 Dependency of maximum safety ratings on ambient temperature



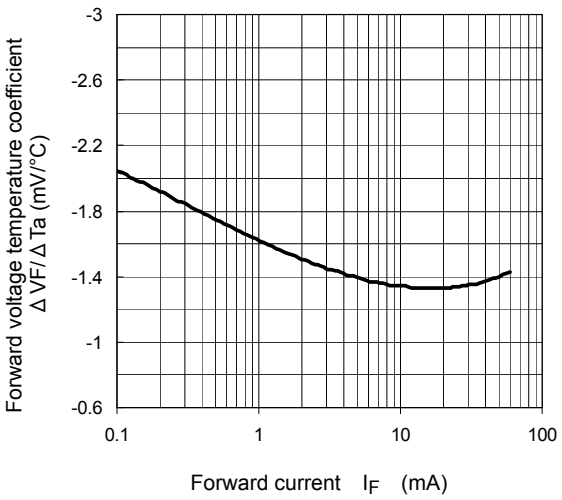
I_F - Ta



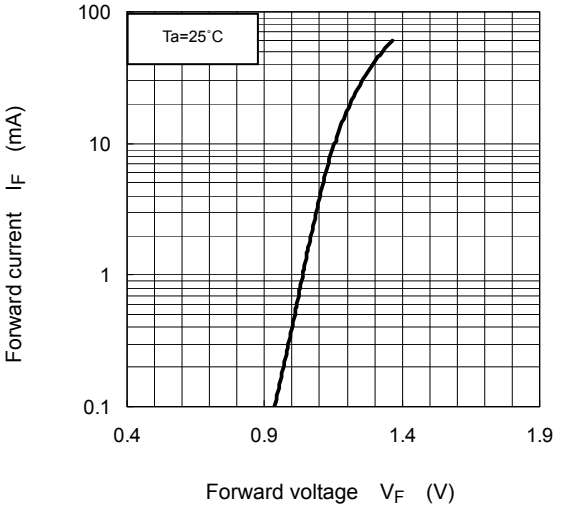
P_C - Ta



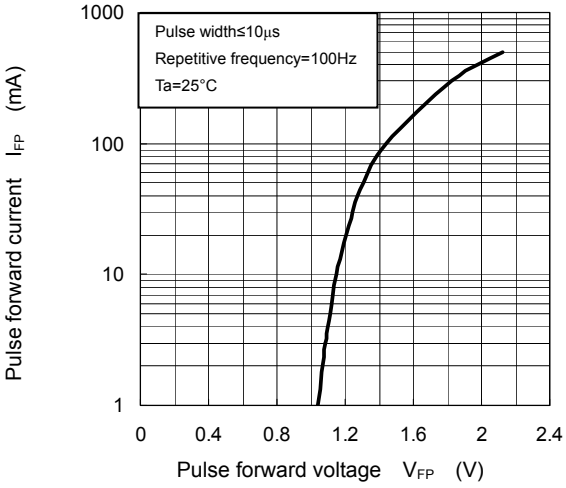
$\Delta V_F / \Delta Ta$ - I_F



I_F - V_F

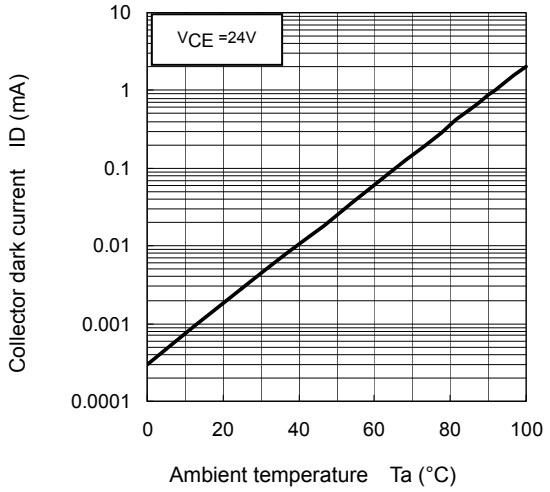


I_{FP} – V_{FP}

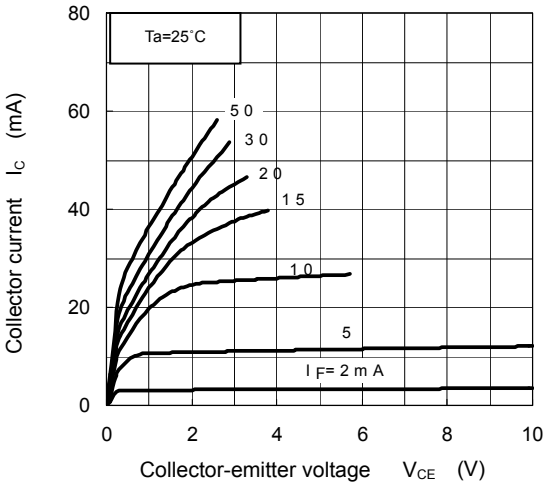


*The above graphs show typical characteristic.

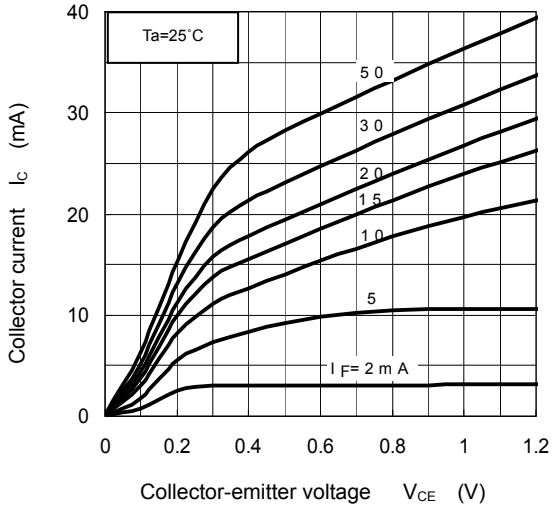
ICEO-Ta



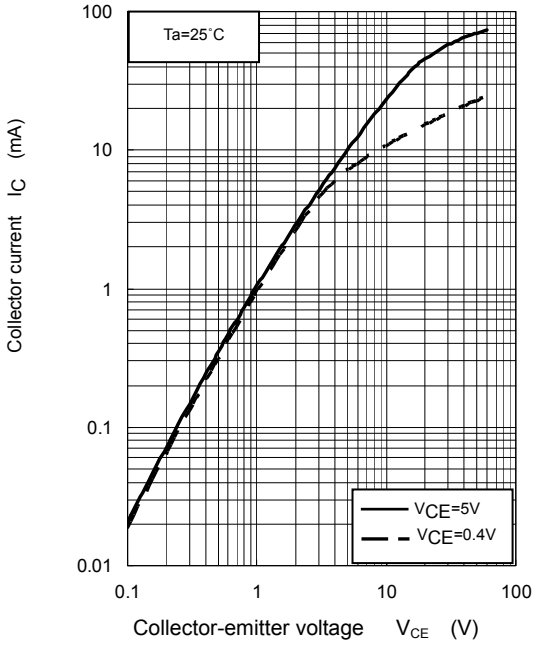
I_C-V_{CE}



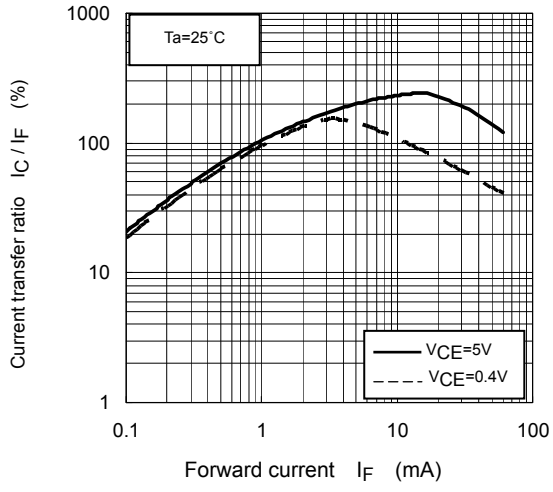
I_C-V_{CE}



I_C-I_F

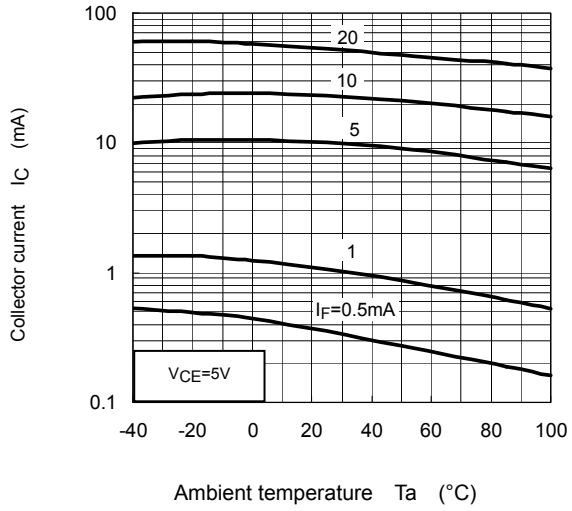


I_C / I_F - I_F

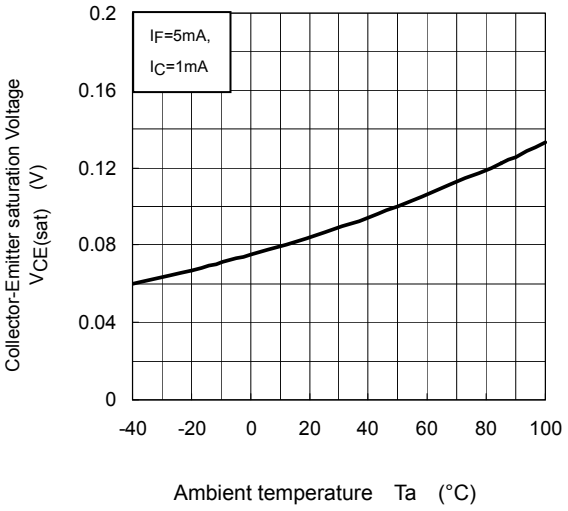


*The above graphs show typical characteristic.

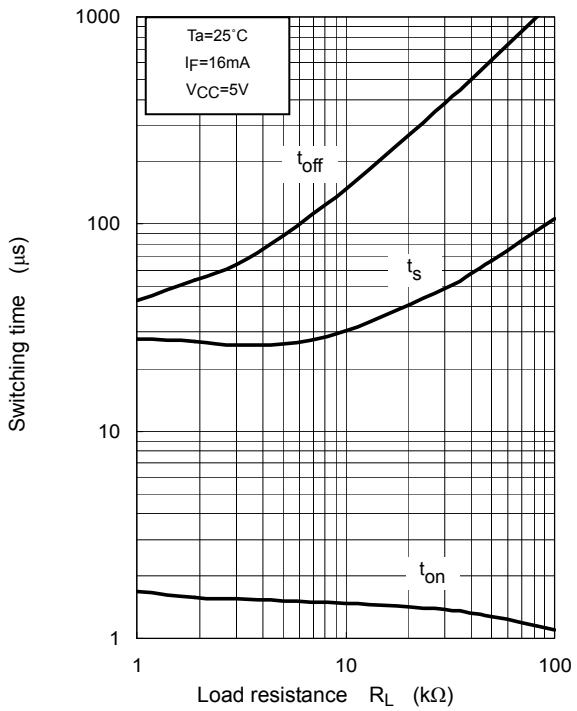
I_C - Ta



$V_{CE(sat)}$ - Ta



Switching time - R_L



*The above graphs show typical characteristic.

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