

# TLP385

## 1. Applications

- Programmable Logic Controllers (PLCs)
- AC Adapters
- I/O Interface Boards

## 2. General

TLP385 is a photocoupler of high isolation type that consists of phototransistor optically coupled to an infrared LED in a 4-pin SO6L package.

TLP385 is guaranteed high isolation voltage (5000 Vrms).

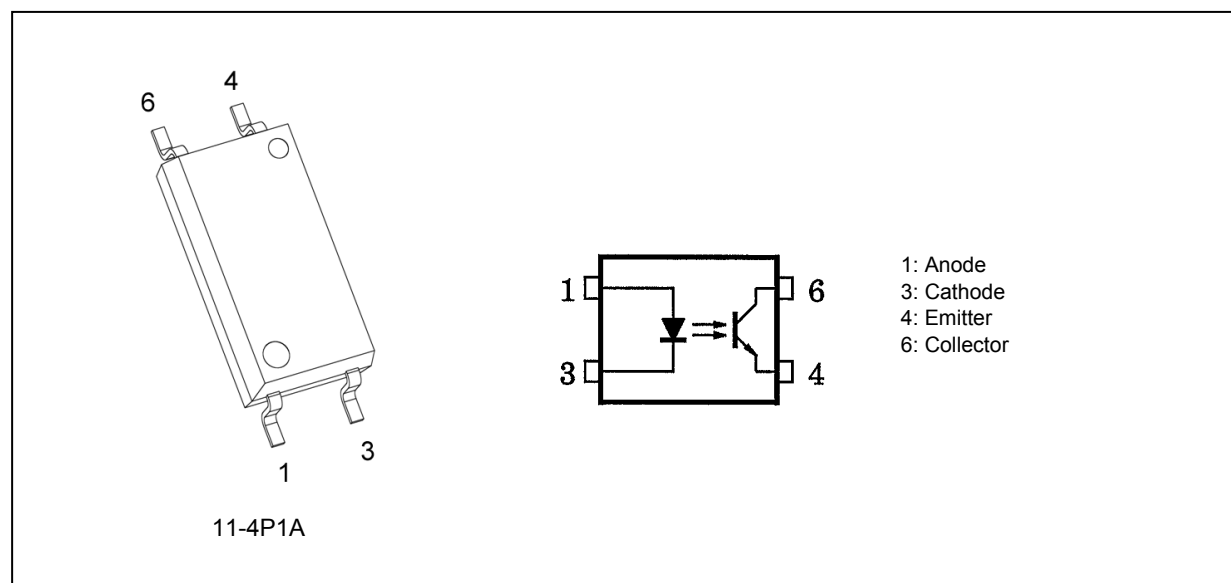
Since TLP385 has a small and thin package compared with a standard DIP package, is it is suitable for high-density surface mounting applications such as programmable controllers.

## 3. Features

- (1) Collector-emitter voltage: 80 V (min)
- (2) Current transfer ratio: 50 % (min)  
GB Rank: 100 % (min)
- (3) Isolation voltage: 5000 Vrms (min)
- (4) Operating temperature: -55 to 110 °C
- (5) Safety standards  
UL-recognized: UL 1577, File No.E67349  
cUL-recognized: CSA Component Acceptance Service No.5A File No.E67349  
VDE-approved: EN 60747-5-5, EN 62368-1 (**Note 1**)  
CQC-approved: GB4943.1, GB8898 Japan and Thailand Factory

Note 1: When a VDE approved type is needed, please designate the **Option (D4)**.

## 4. Packaging and Pin Assignment



Start of commercial production  
2014-08

## 5. Principle of Operation

### 5.1. Mechanical Parameters

Characteristics	Min	Unit
Creepage distances	8.0	mm
Clearance	8.0	
Internal isolation thickness	0.4	

## 6. Absolute Maximum Ratings (Note) (Unless otherwise specified, $T_a = 25\text{ }^{\circ}\text{C}$ )

	Characteristics	Symbol	Note	Rating	Unit
LED	Input forward current	$I_F$		50	mA
	Input forward current derating ( $T_a \geq 90\text{ }^{\circ}\text{C}$ )	$\Delta I_F / \Delta T_a$		-1.43	mA/ $^{\circ}\text{C}$
	Input forward current (pulsed)	$I_{FP}$	(Note 1)	1	A
	Input power dissipation	$P_D$		100	mW
	Input power dissipation derating ( $T_a \geq 90\text{ }^{\circ}\text{C}$ )	$\Delta P_D / \Delta T_a$		-2.86	mW/ $^{\circ}\text{C}$
	Input reverse voltage	$V_R$		5	V
	Junction temperature	$T_j$		125	$^{\circ}\text{C}$
Detector	Collector-emitter voltage	$V_{CEO}$		80	V
	Emitter-collector voltage	$V_{ECO}$		7	
	Collector current	$I_C$		50	mA
	Collector power dissipation	$P_C$		150	mW
	Collector power dissipation derating ( $T_a \geq 25\text{ }^{\circ}\text{C}$ )	$\Delta P_C / \Delta T_a$		-1.5	mW/ $^{\circ}\text{C}$
	Junction temperature	$T_j$		125	$^{\circ}\text{C}$
Common	Operating temperature	$T_{opr}$		-55 to 110	
	Storage temperature	$T_{stg}$		-55 to 125	
	Lead soldering temperature (10 s)	$T_{sol}$		260	
	Total power dissipation	$P_T$		200	mW
	Total power dissipation derating ( $T_a \geq 25\text{ }^{\circ}\text{C}$ )	$\Delta P_T / \Delta T_a$		-2.0	mW/ $^{\circ}\text{C}$
	Isolation voltage (AC, 60 s, R.H. $\leq 60\%$ )	$BV_S$	(Note 2)	5000	Vrms

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 1: Pulse width (PW)  $\leq 0.1\text{ ms}$ ,  $f = 100\text{ Hz}$

Note 2: This device is considered as a two-terminal device: Pins 1 and 3 are shorted together, and pins 4 and 6 are shorted together.

## 7. Electrical Characteristics (Unless otherwise specified, $T_a = 25\text{ }^{\circ}\text{C}$ )

	Characteristics	Symbol	Note	Test Condition	Min	Typ.	Max	Unit
LED	Input forward voltage	$V_F$		$I_F = 10\text{ mA}$	1.1	1.25	1.4	V
	Input reverse current	$I_R$		$V_R = 5\text{ V}$	—	—	5	$\mu\text{A}$
	Input capacitance	$C_t$		$V = 0\text{ V}, f = 1\text{ MHz}$	—	30	—	pF
Detector	Collector-emitter breakdown voltage	$V_{(BR)CEO}$		$I_C = 0.5\text{ mA}$	80	—	—	V
	Emitter-collector breakdown voltage	$V_{(BR)ECO}$		$I_E = 0.1\text{ mA}$	7	—	—	V
	Dark Current	$I_{DARK}$		$V_{CE} = 48\text{ V}$	—	0.01	0.08	$\mu\text{A}$
				$V_{CE} = 48\text{ V}, T_a = 85\text{ }^{\circ}\text{C}$	—	2	50	$\mu\text{A}$
	Collector-emitter capacitance	$C_{CE}$		$V = 0\text{ V}, f = 1\text{ MHz}$	—	10	—	pF

## 8. Coupled Electrical Characteristics (Unless otherwise specified, $T_a = 25\text{ }^{\circ}\text{C}$ )

Characteristics	Symbol	Note	Test Condition	Min	Typ.	Max	Unit
Current transfer ratio	$I_C/I_F$	(Note 1)	$I_F = 5\text{ mA}, V_{CE} = 5\text{ V}$	50	—	600	%
			$I_F = 5\text{ mA}, V_{CE} = 5\text{ V}, \text{Rank GB}$	100	—	600	
Saturated current transfer ratio	$I_C/I_{F(sat)}$		$I_F = 1\text{ mA}, V_{CE} = 0.3\text{ V}$	—	60	—	V
			$I_F = 1\text{ mA}, V_{CE} = 0.3\text{ V}, \text{Rank GB}$	30	—	—	
Collector-emitter saturation voltage	$V_{CE(sat)}$		$I_F = 8\text{ mA}, I_C = 2.4\text{ mA}$	—	—	0.3	V
			$I_F = 1\text{ mA}, I_C = 0.2\text{ mA}$	—	0.13	—	
			$I_F = 1\text{ mA}, I_C = 0.2\text{ mA}, \text{Rank GB}$	—	—	0.3	
OFF-state collector current	$I_{C(off)}$		$V_F = 0.7\text{ V}, V_{CE} = 48\text{ V}$	—	—	10	$\mu\text{A}$

Note 1: See Table 8.1 for current transfer ratio.

**Table 8.1 Current Transfer Ratio (CTR) Rank (Note) (Unless otherwise specified,  $T_a = 25\text{ }^{\circ}\text{C}$ )**

Rank	Test Condition	Current transfer ratio $I_C/I_F$ Min	Current transfer ratio $I_C/I_F$ Max	Marking of classification	Unit
Blank	$I_F = 5\text{ mA}, V_{CE} = 5\text{ V}$	50	600	Blank, YE, GR, GB, Y+, G, G+, BL, B	%
Y		50	150	YE, Y+	
GR		100	300	GR, G, G+	
BL		200	600	BL, B	
GB		100	600	GB, GR, G, G+, BL, B	
YH		75	150	Y+	
GRL		100	200	G	
GRH		150	300	G+	
BLL		200	400	B	

Note: Specify both the part number and a rank in this format when ordering.

Example: TLP385(GB,E)

For safety standard certification, however, specify the part number alone.

Example: TLP385(GB,E: TLP385

## 9. Isolation Characteristics (Unless otherwise specified, $T_a = 25\text{ }^{\circ}\text{C}$ )

Characteristics	Symbol	Note	Test Condition	Min	Typ.	Max	Unit
Total capacitance (input to output)	$C_S$	(Note 1)	$V_S = 0\text{ V}, f = 1\text{ MHz}$	—	0.8	—	pF
Isolation resistance	$R_S$	(Note 1)	$V_S = 500\text{ V}, RH \leq 60\%$	$10^{12}$	$10^{14}$	—	$\Omega$
Isolation voltage	$BV_S$	(Note 1)	AC, 60 s	5000	—	—	Vrms

Note 1: This device is considered as a two-terminal device: Pins 1 and 3 are shorted together, and pins 4 and 6 are shorted together.

10. Switching Characteristics (Unless otherwise specified,  $T_a = 25\text{ }^{\circ}\text{C}$ )

Characteristics	Symbol	Note	Test Condition	Min	Typ.	Max	Unit
Rise time	$t_r$		$V_{CC} = 10\text{ V}$ , $I_C = 2\text{ mA}$ , $R_L = 100\text{ }\Omega$	—	2	—	$\mu\text{s}$
Fall time	$t_f$			—	3	—	
Turn-on time	$t_{on}$			—	3	—	
Turn-off time	$t_{off}$			—	3	—	
Turn-on time	$t_{on}$		See Fig. 10.1. $R_L = 1.9\text{ k}\Omega$ , $V_{CC} = 5\text{ V}$ , $I_F = 16\text{ mA}$	—	0.5	—	
Storage time	$t_s$			—	25	—	
Turn-off time	$t_{off}$			—	40	—	

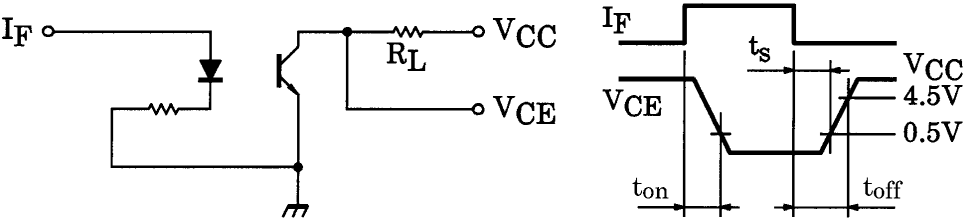


Fig. 10.1 Switching Time Test Circuit and Waveform

11. Characteristics Curves (Note)

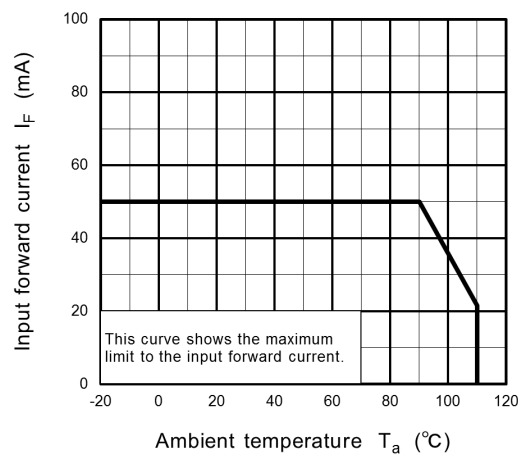


Fig. 11.1  $I_F - T_a$

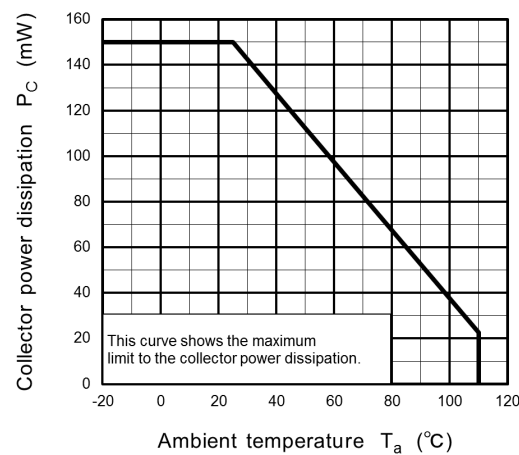


Fig. 11.2  $P_C - T_a$

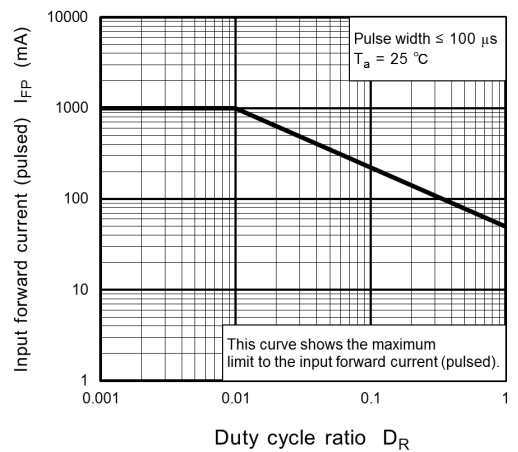


Fig. 11.3  $I_{FP} - D_R$

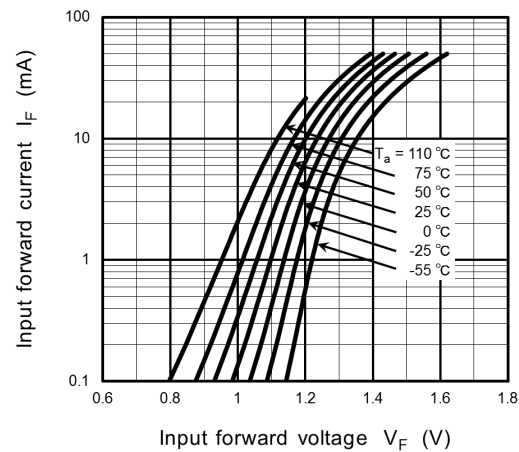


Fig. 11.4  $I_F - V_F$

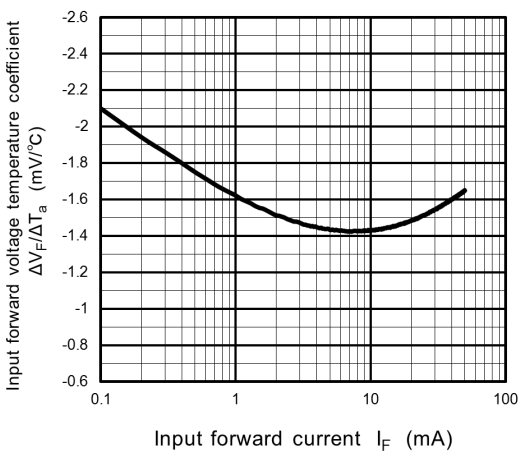


Fig. 11.5  $\Delta V_F / \Delta T_a - I_F$

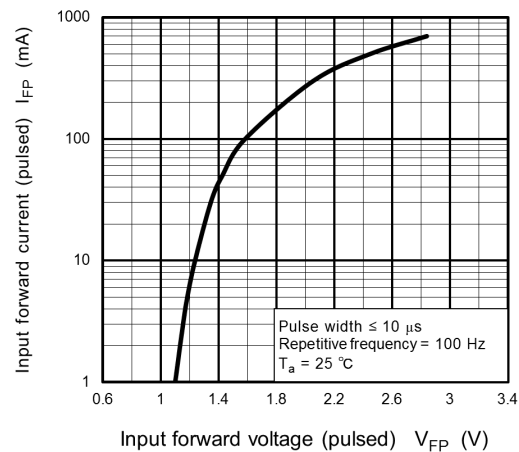


Fig. 11.6  $I_{FP} - V_{FP}$

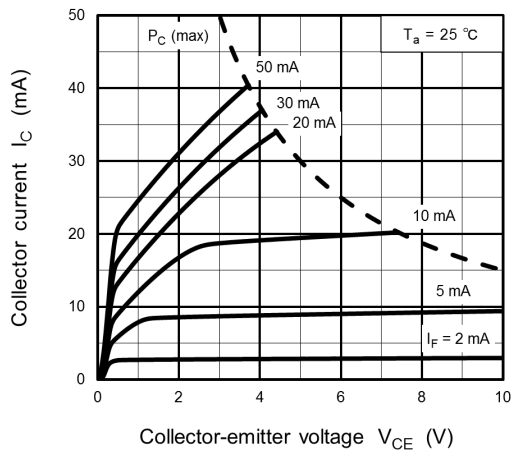


Fig. 11.7  $I_C - V_{CE}$

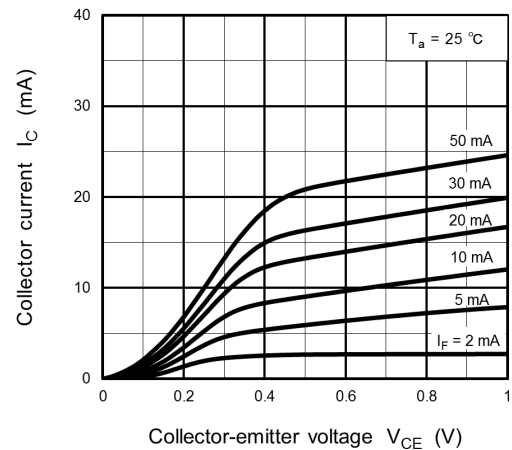


Fig. 11.8  $I_C - V_{CE}$

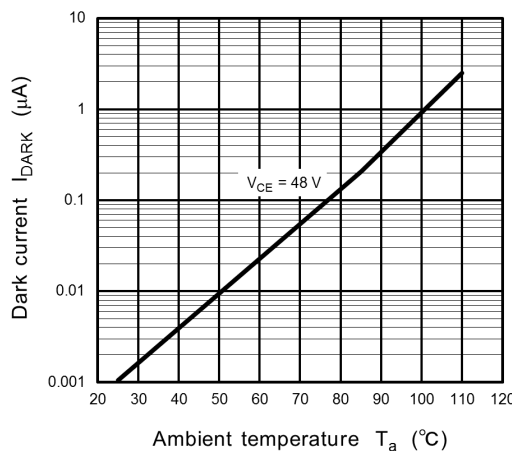


Fig. 11.9  $I_{DARK} - T_a$

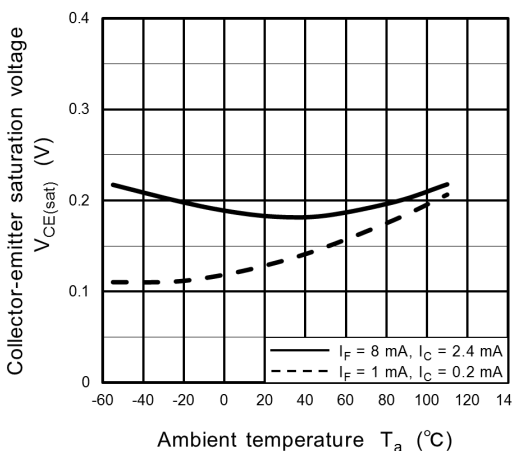


Fig. 11.10  $V_{CE(sat)} - T_a$

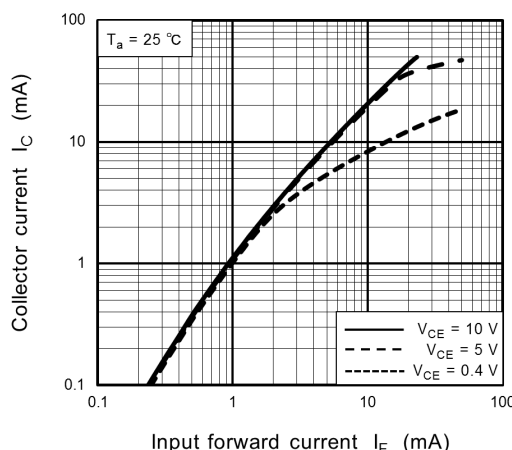


Fig. 11.11  $I_C - I_F$

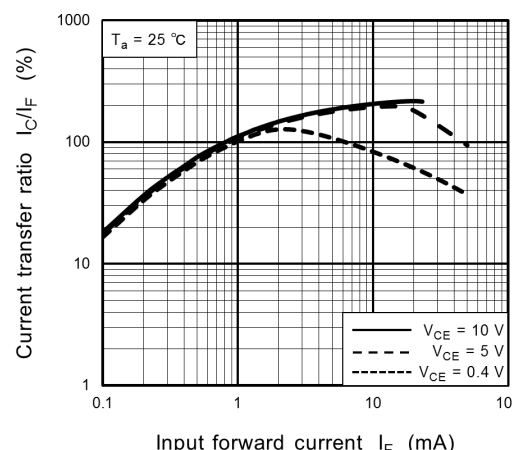


Fig. 11.12  $I_C/I_F - I_F$

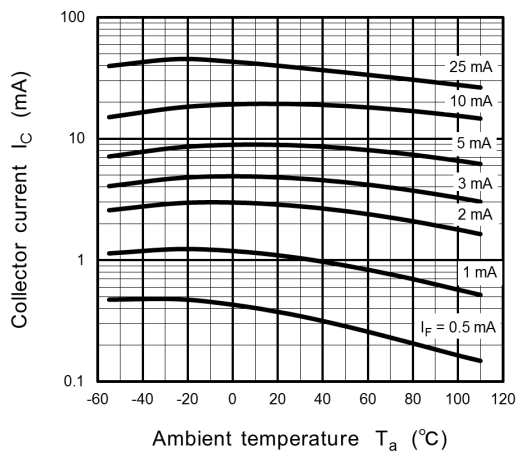


Fig. 11.13  $I_C - T_a$

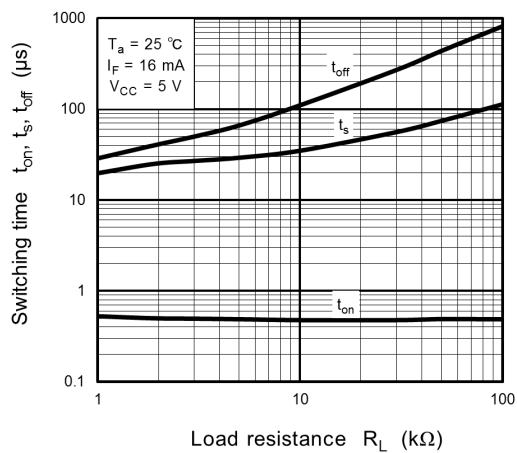


Fig. 11.14 Switching Time -  $R_L$

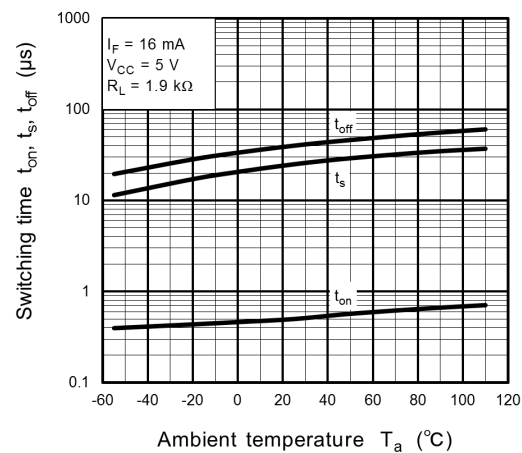


Fig. 11.15 Switching Time -  $T_a$

Note: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.

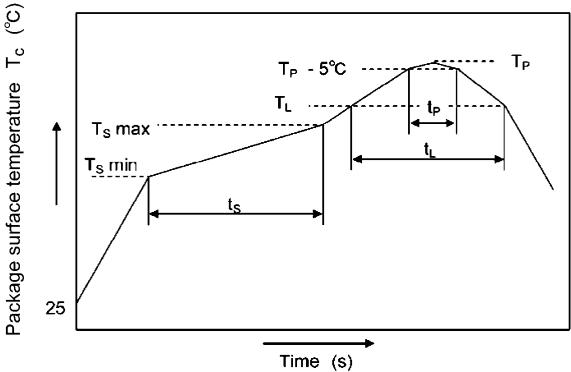
12. Soldering and Storage

12.1. Precautions for Soldering

The soldering temperature should be controlled as closely as possible to the conditions shown below, irrespective of whether a soldering iron or a reflow soldering method is used.

- When using soldering reflow.

The soldering temperature profile is based on the package surface temperature.  
(See the figure shown below, which is based on the package surface temperature.)  
Reflow soldering must be performed once or twice.  
The mounting should be completed with the interval from the first to the last mountings being 2 weeks.



	Symbol	Min	Max	Unit
Preheat temperature	$T_S$	150	200	°C
Preheat time	$t_S$	60	120	s
Ramp-up rate ( $T_L$ to $T_P$ )			3	°C/s
Liquidus temperature	$T_L$	217		°C
Time above $T_L$	$t_L$	60	150	s
Peak temperature	$T_P$		260	°C
Time during which $T_c$ is between ( $T_P - 5$ ) and $T_P$	$t_P$		30	s
Ramp-down rate ( $T_P$ to $T_L$ )			6	°C/s

An Example of a Temperature Profile When Lead(Pb)-Free Solder Is Used

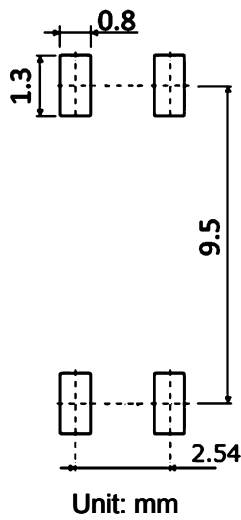
- When using soldering flow  
Preheat the device at a temperature of 150 °C (package surface temperature) for 60 to 120 seconds.  
Mounting condition of 260 °C within 10 seconds is recommended.  
Flow soldering must be performed once.
- When using soldering Iron  
Complete soldering within 10 seconds for lead temperature not exceeding 260 °C or within 3 seconds not exceeding 350 °C  
Heating by soldering iron must be done only once per lead.

12.2. Precautions for General Storage

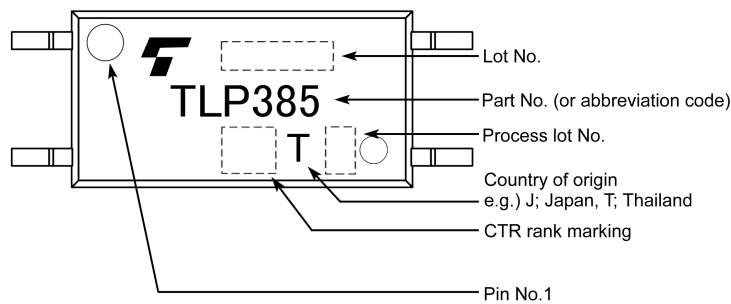
- Avoid storage locations where devices may be exposed to moisture or direct sunlight.
- Follow the precautions printed on the packing label of the device for transportation and storage.
- Keep the storage location temperature and humidity within a range of 5 °C to 35 °C and 45 % to 75 %, respectively.
- Do not store the products in locations with poisonous gases (especially corrosive gases) or in dusty conditions.
- 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.
- When restoring devices after removal from their packing, use anti-static containers.
- Do not allow loads to be applied directly to devices while they are in storage.
- 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.



13. Land Pattern Dimensions (for reference only)



14. Marking



## 15. EN 60747-5-5 Option (D4) Specification

- Part number: TLP385 (Note 1)
- The following part naming conventions are used for the devices that have been qualified according to option (D4) of EN 60747.

Example: TLP385(D4GR-TL,E

D4: EN 60747 option

GR: CTR rank

TL: Tape type

E: [[G]]/RoHS COMPATIBLE (Note 2)

Note 1: Use TOSHIBA standard type number for safety standard application.

e.g., TLP385(D4GR-TL,E → TLP385

Note 2: Please contact your Toshiba sales representative for details on environmental information such as the product's RoHS compatibility.

RoHS is the Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

Description	Symbol	Rating	Unit
Application classification			
for rated mains voltage $\leq 600$ Vrms		I-IV	—
for rated mains voltage $\leq 1000$ Vrms		I-III	
Climatic classification		55 / 125 / 21	—
Pollution degree		2	—
Maximum operating insulation voltage	$V_{IORM}$	1230	Vpeak
Input to output test voltage, Method A $V_{pr} = 1.6 \times V_{IORM}$ , type and sample test $t_p = 10$ s, partial discharge $< 5$ pC	$V_{pr}$	1970	Vpeak
Input to output test voltage, Method B $V_{pr} = 1.875 \times V_{IORM}$ , 100 % production test $t_p = 1$ s, partial discharge $< 5$ pC	$V_{pr}$	2310	Vpeak
Highest permissible overvoltage (transient overvoltage, $t_{pr} = 60$ s)	$V_{TR}$	8000	Vpeak
Safety limiting values (max. permissible ratings in case of fault, also refer to thermal derating curve)			
current (input current $I_F$ , $P_{SO} = 0$ )	$I_{Si}$	250	mA
power (output or total power dissipation)	$P_{SO}$	400	mW
temperature	$T_s$	150	°C
Insulation resistance $V_{IO} = 500$ V, $T_a = 25$ °C $V_{IO} = 500$ V, $T_a = 100$ °C $V_{IO} = 500$ V, $T_a = T_s$	$R_{Si}$	$\geq 10^{12}$ $\geq 10^{11}$ $\geq 10^9$	$\Omega$

Fig. 15.1 EN 60747 Insulation Characteristics

Minimum creepage distance	Cr	8.0 mm
Minimum clearance	Cl	8.0 mm
Minimum insulation thickness	ti	0.4 mm
Comparative tracking index	CTI	175

Fig. 15.2 Insulation Related Specifications (Note)

Note: 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.



Fig. 15.3 Marking on Packing

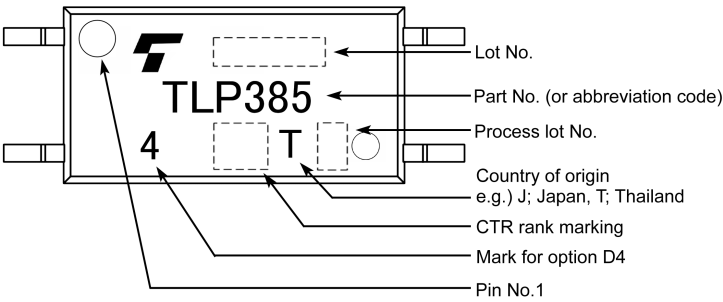
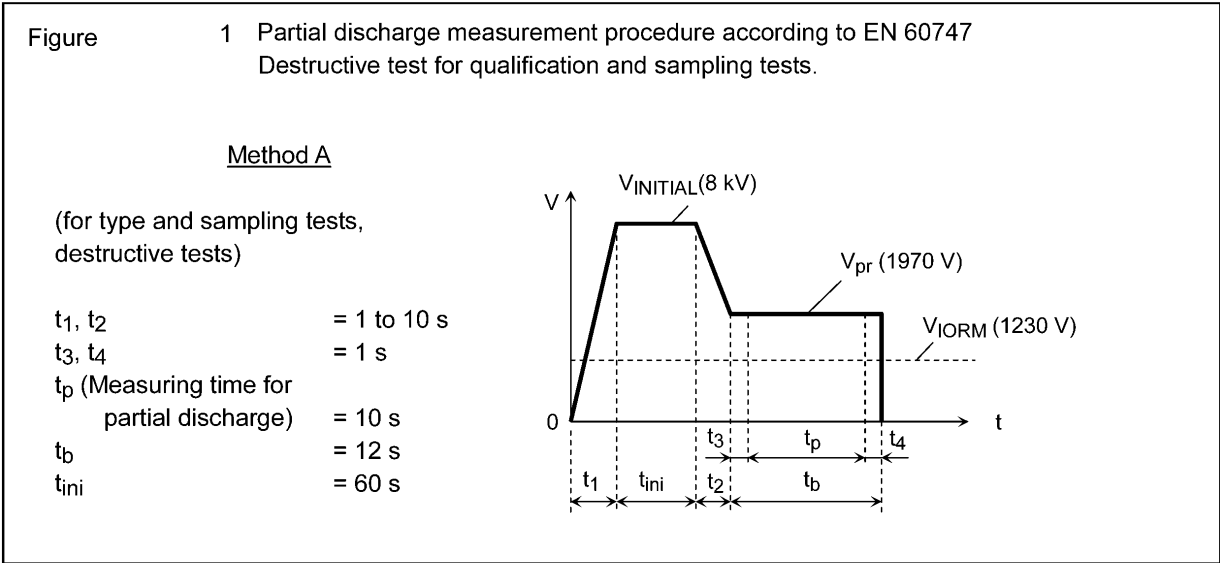


Fig. 15.4 Marking Example (Note)

Note: The above marking is applied to the photocouplers that have been qualified according to option (D4) of EN 60747.



## 16. Ordering Information

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

Example) TLP385(GR-TPL,E 3000 pcs

Part number: TLP385

CTR rank: GR

Tape type: TPL (L direction)

[[G]]/RoHS COMPATIBLE: E (**Note 1**)

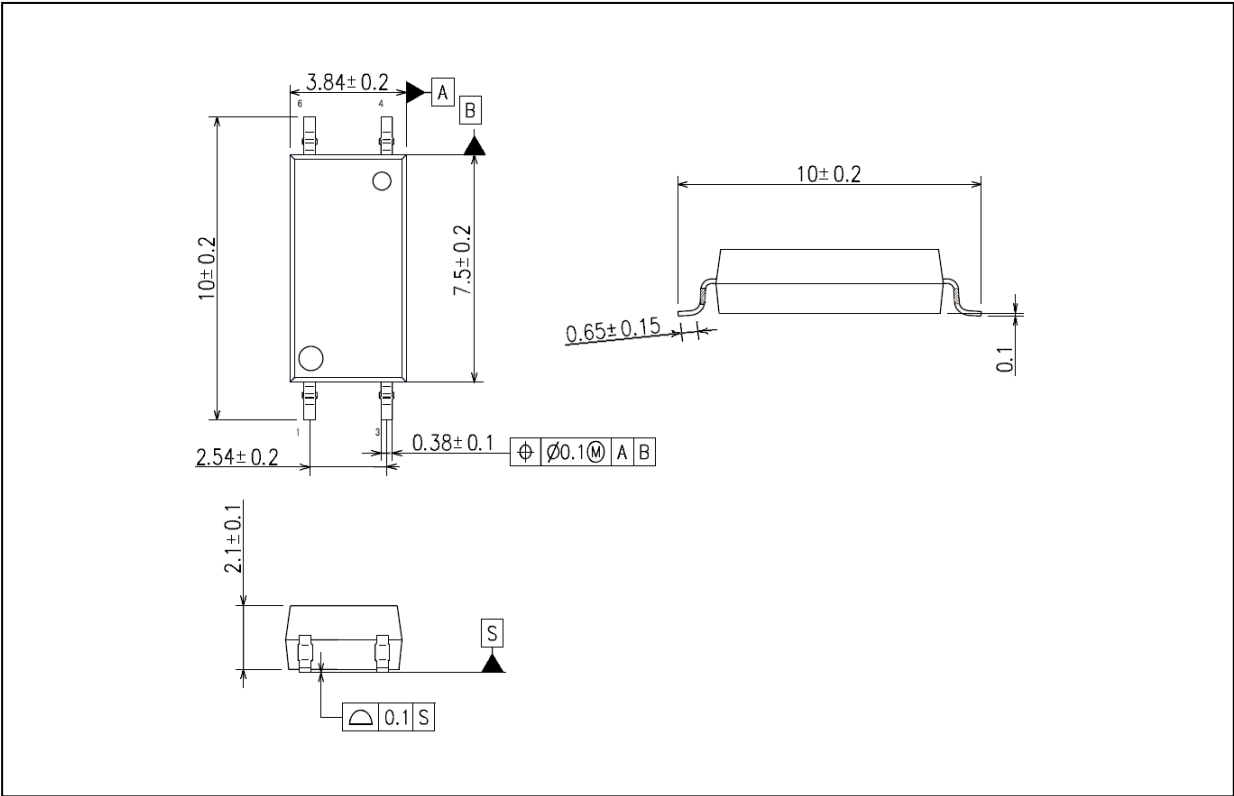
Quantity (must be a multiple of 3000 pcs): 3000 pcs

Note 1: Please contact your Toshiba sales representative for details on environmental information such as the product's RoHS compatibility.

RoHS is the Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

Package Dimensions

Unit: mm



Weight: 0.128 g (typ.)

Package Name(s)
TOSHIBA: 11-4P1A

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