

TLP3905

1. Applications

- Measuring Instruments
- MOSFET Gate Drivers

2. General

The TLP3905 is a photocoupler in the SO6 package that consists of an infrared light emitting diode optically coupled to a photodiode array. The photodiodes are connected in series, making the TLP3905 suitable for MOS gate drive applications.

3. Features

- (1) Open voltage: 7 V (min)
- (2) Short current: 12 μ A (min)
- (3) Isolation voltage: 3750 Vrms (min)
- (4) Safety standards

UL-approved: UL1577, File No.E67349

cUL-approved: CSA Component Acceptance Service No.5A File No.E67349

VDE-approved: EN60747-5-5, EN60065 or EN60950-1 (**Note 1**)

Note 1: When a VDE approved type is needed, please designate the **Option (V4)**.

Table Short-Circuit Current (Note) (Unless otherwise specified, $T_a = 25^\circ\text{C}$)

Rank	I_{SC} Rank Marking	Test Condition	Short-Circuit Current I_{SC} (min)	Unit
C20	C	$I_F = 10\text{ mA}$	20	μA
None	C, Blank	$I_F = 10\text{ mA}$	12	

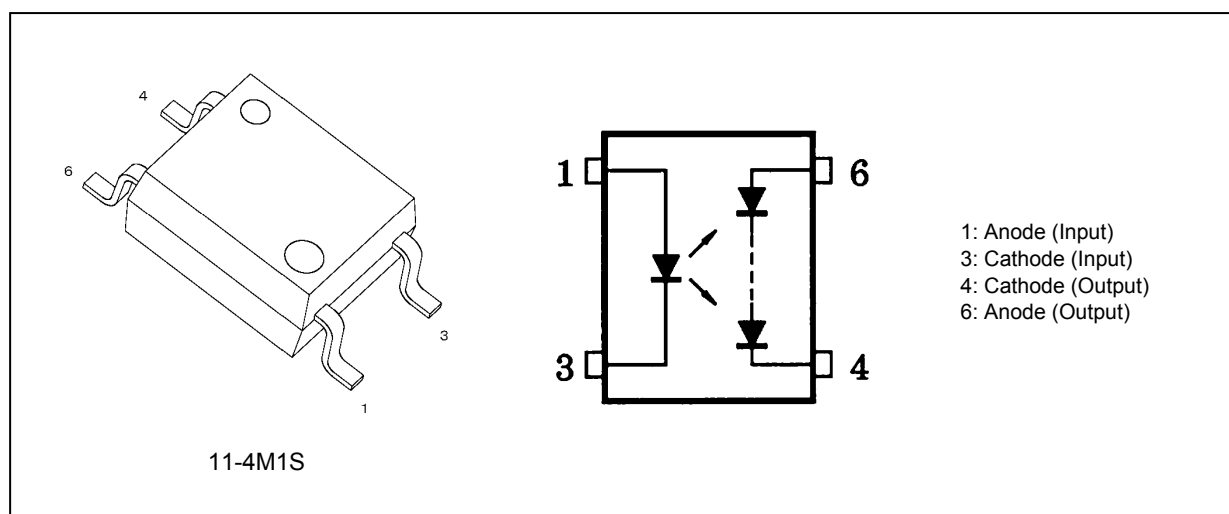
Note: Specify both the part number and a rank in this format when ordering.

Example: TLP3905(C20)

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

Example: TLP3905(C20,E(O \rightarrow TLP3905)

4. Packaging and Pin Assignment



Start of commercial production

2014-02

5. Mechanical Parameters

Characteristics	Min	Unit
Creepage distances	5.0	mm
Clearance	5.0	
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		30	mA
	Input forward current ($T_a = 125\text{ }^{\circ}\text{C}$)	I_F		10	
	Input forward current derating ($T_a \geq 100\text{ }^{\circ}\text{C}$)	$\Delta I_F / \Delta T_a$		-0.8	$\text{mA}/^{\circ}\text{C}$
	Input power dissipation	P_D		50	mW
	Input power dissipation derating ($T_a \geq 100\text{ }^{\circ}\text{C}$)	$\Delta P_D / \Delta T_a$		-1.3	$\text{mW}/^{\circ}\text{C}$
	Input reverse voltage	V_R		3	V
Detector	Output forward current	I_{FD}		50	μA
	Output reverse voltage	V_{RD}		10	V
	Output power dissipation ($-40 \leq T_a \leq 125\text{ }^{\circ}\text{C}$)	P_O		0.5	mW
Common	Operating temperature	T_{opr}		-40 to 125	$^{\circ}\text{C}$
	Storage temperature	T_{stg}		-55 to 125	$^{\circ}\text{C}$
	Lead soldering temperature (10 s)	T_{sol}		260	$^{\circ}\text{C}$
	Isolation voltage AC, 60 s, R.H. $\leq 60\%$	BV_S	(Note 1)	3750	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: 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. Recommended Operating Conditions (Note)

Characteristics	Symbol	Note	Min	Typ.	Max	Unit
Input forward current	I_F		—	12	15	mA
Operating temperature	T_{opr}		-25	—	100	$^{\circ}\text{C}$

Note: The recommended operating conditions are given as a design guide necessary to obtain the intended performance of the device. Each parameter is an independent value. When creating a system design using this device, the electrical characteristics specified in this datasheet should also be considered.

8. 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		$I_F = 10\text{ mA}$	1.5	1.65	1.8	V
	Input reverse current	I_R		$V_R = 3\text{ V}$	—	—	10	μA
	Input capacitance	C_t		$V = 0\text{ V}$, $f = 1\text{ MHz}$	—	45	—	pF
Detector	Output forward voltage	V_{FD}		$I_F = 10\text{ }\mu\text{A}$	—	10	—	V
	Output reverse current	I_{RD}		$V_R = 10\text{ V}$	—	1	—	nA

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

Characteristics	Symbol	Note	Test Condition	Min	Typ.	Max	Unit
Open voltage	V_{OC}		$I_F = 10\text{ mA}$	7	9	—	V
			$I_F = 10\text{ mA}, T_a = 125\text{ }^{\circ}\text{C}$	—	5	—	
Short-circuit current	I_{SC}		$I_F = 10\text{ mA}$	12	30	—	μA
			$I_F = 10\text{ mA}, T_a = 125\text{ }^{\circ}\text{C}$	—	12	—	

10. 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)	$V_S = 500\text{ V}, \text{R.H.} \leq 60\%$	10^{12}	10^{14}	—	Ω
Isolation voltage	BV_S	(Note 1)	AC, 60 s	3750	—	—	V_{rms}
			AC, 1 s in oil	—	10000	—	
			DC, 60 s in oil	—	10000	—	Vdc

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.

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

Characteristics	Symbol	Note	Test Condition	Min	Typ.	Max	Unit
Turn-on time	t_{on}		$I_F = 10\text{ mA}, C_L = 1000\text{ pF}$ $R_{SH} = 510\text{ k}\Omega$, See Fig. 11.1.	—	0.3	—	ms
Turn-off time	t_{off}			—	1	—	

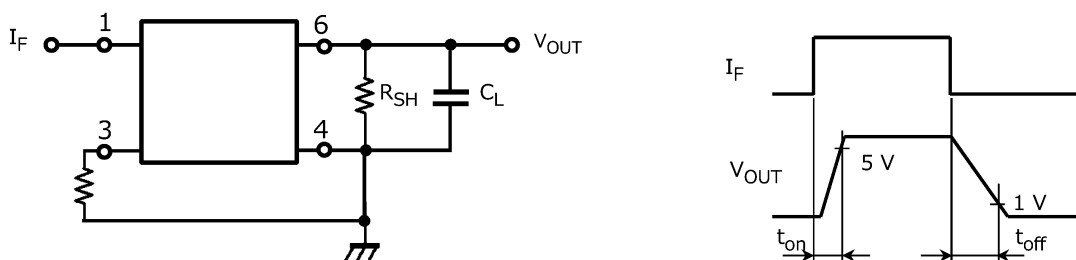


Fig. 11.1 Switching Time Test Circuit, Waveform

12. Characteristics Curves (Note)

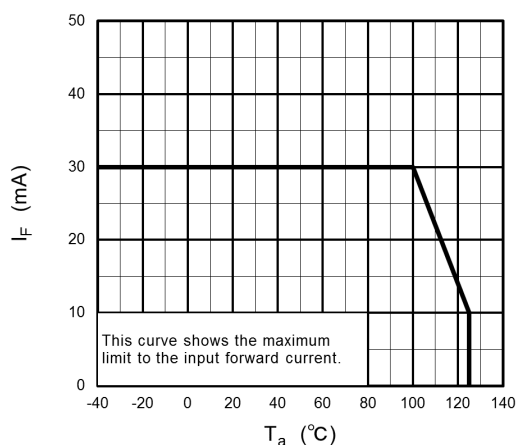


Fig. 12.1 $I_F - T_a$

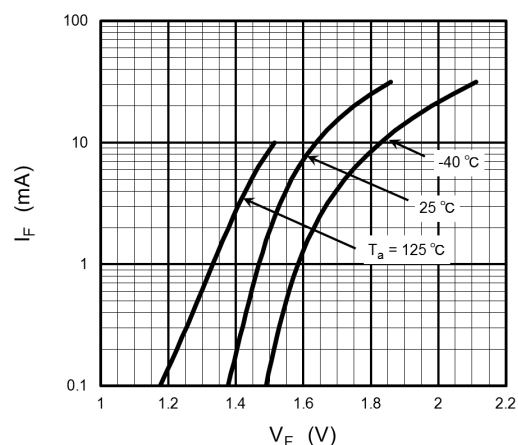


Fig. 12.2 $I_F - V_F$

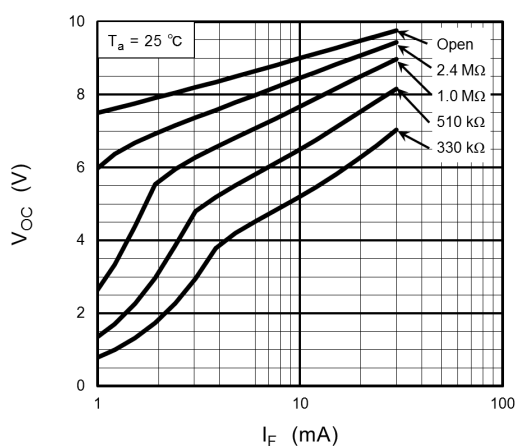


Fig. 12.3 $V_{OC} - I_F$

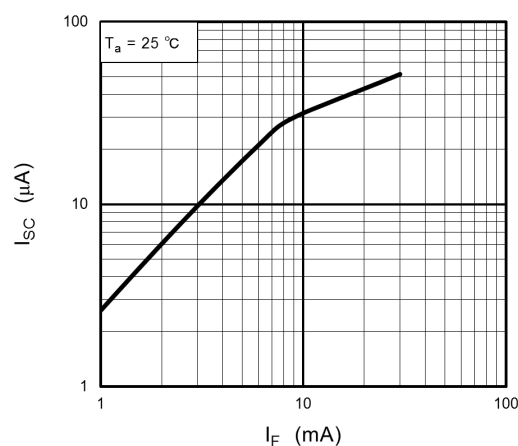


Fig. 12.4 $I_{SC} - I_F$

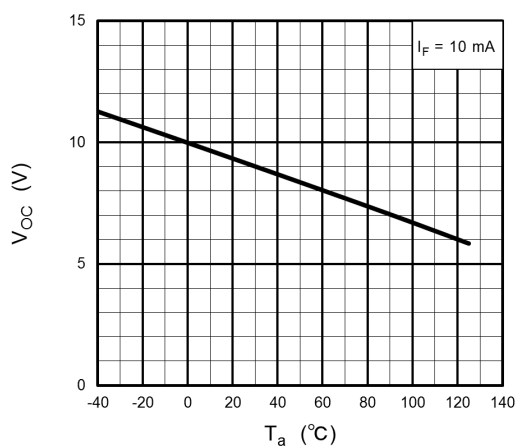


Fig. 12.5 $V_{OC} - T_a$

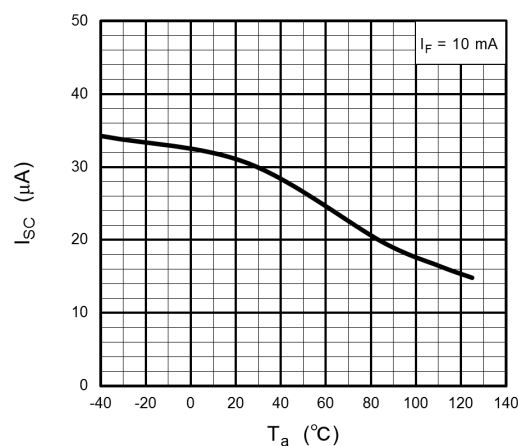


Fig. 12.6 $I_{SC} - T_a$

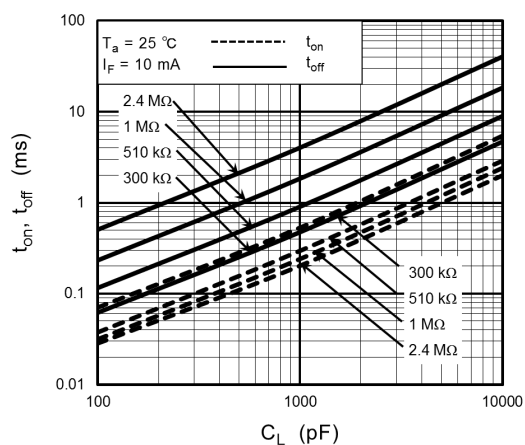


Fig. 12.7 $t_{on}, t_{off} - C_L$

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

13. Soldering and Storage

13.1. 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.

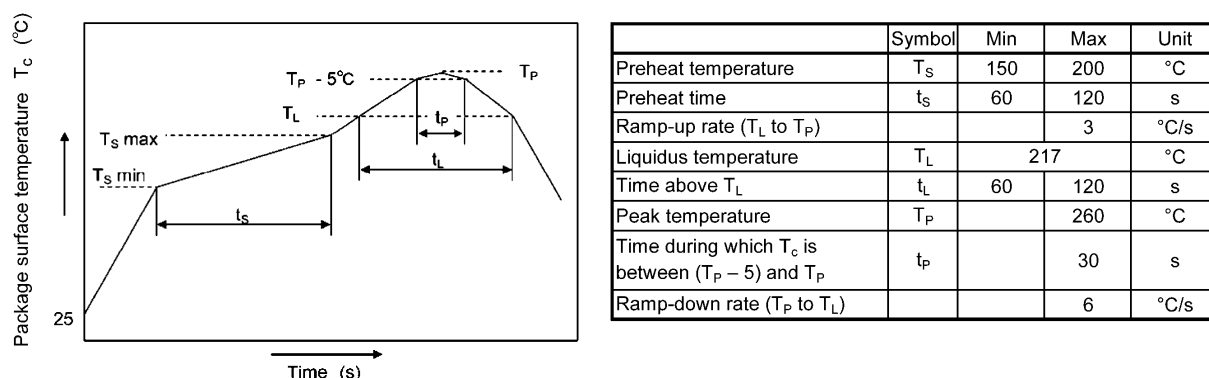


Fig. 13.1.1 An example of a temperature profile when lead(Pb)-free solder is used

- 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.

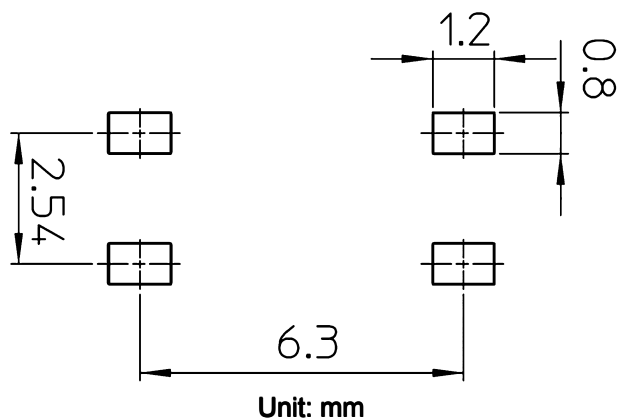
- When using soldering Iron

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.

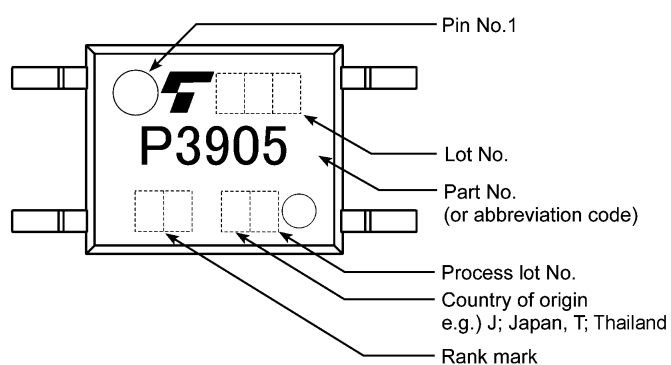
13.2. Precautions for General Storage

- 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.

14. Land Pattern Dimensions (for reference only)



15. Marking



16. EN60747-5-5 Option (V4) Specification

- Part number: TLP3905
- The following part naming conventions are used for the devices that have been qualified according to option (V4) of EN60747.
Example: TLP3905(V4-TPL,E(O)
V4: EN60747 option
TPL: Tape type
E: [[G]]/RoHS COMPATIBLE (**Note 1**)
O: Domestic ID (Country/Region of origin: Japan)

Note: Use TOSHIBA standard type number for safety standard application.
e.g., TLP3905(V4-TPL,E(O) → TLP3905

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.

Description	Symbol	Rating	Unit
Application classification			
for rated mains voltage ≤ 150 Vrms		I-IV	—
for rated mains voltage ≤ 300 Vrms		I-III	
Climatic classification		40 / 125 / 21	—
Pollution degree		2	—
Maximum operating insulation voltage	V_{IORM}	707	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}	1131	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}	1325	Vpeak
Highest permissible overvoltage (transient overvoltage, $t_{pr} = 60$ s)	V_{TR}	6000	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}	$\geq 10^{12}$ $\geq 10^{11}$ $\geq 10^9$	Ω

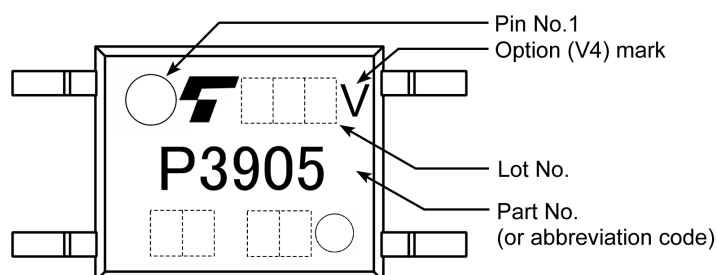
Fig. 16.1 EN60747 Insulation Characteristics

Minimum creepage distance	Cr	5.0 mm
Minimum clearance	Cl	5.0 mm
Minimum insulation thickness	ti	0.4 mm
Comparative tracking index	CTI	175

Fig. 16.2 Insulation Related Specifications (Note)

Note: 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 centers of 3.5 mm). If this is not permissible, the user shall take suitable measures.

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. 16.3 Marking on packing for EN60747

Fig. 16.4 Marking Example (Note)

Note: The above marking is applied to the photocouplers that have been qualified according to option (V4) of EN60747.

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

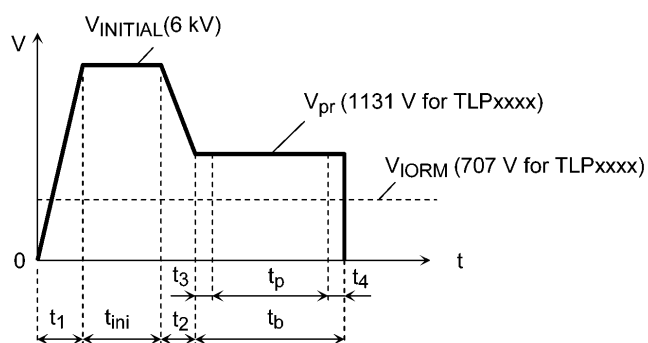


Figure 2 Partial discharge measurement procedure according to EN60747
Non-destructive test for 100 % inspection.

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

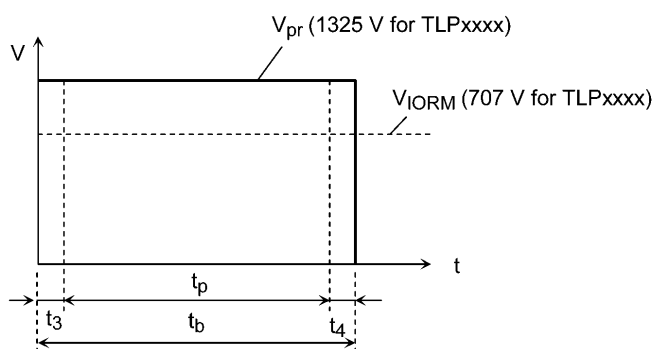


Figure 3 Dependency of maximum safety ratings on ambient temperature

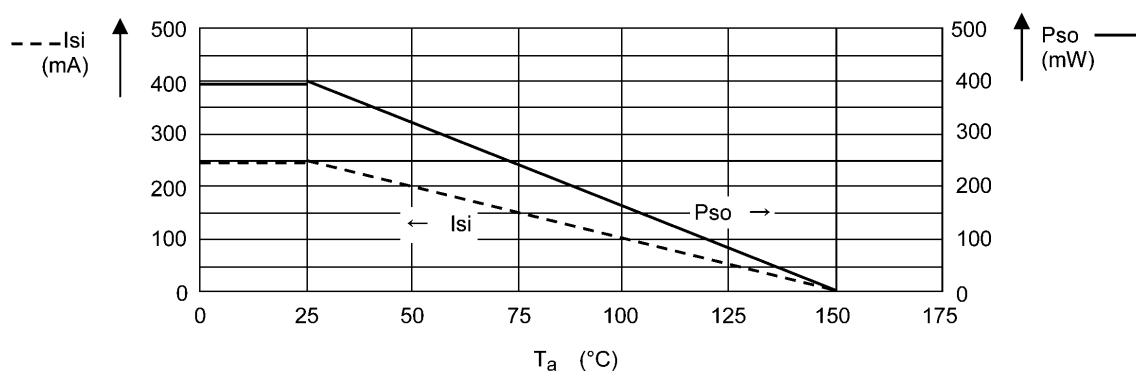


Fig. 16.5 Measurement Procedure

17. Embossed-Tape Packing (TP) Specification for Mini-Flat Photocouplers

17.1. Applicable Package

Package Name	Product Type
SO6	Mini flat coupler

17.2. Product Naming Conventions

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

Example) TLP3905(TPL,E(O

Part number: TLP3905

Tape type: TPL

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

Domestic ID (Country / Region of origin: Japan): (O

Note: 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.

17.3. Tape Dimensions Specification

Tape Type	Division	Packing Amount (A unit per reel)
TPL, TL	L direction	3000
TPR, TR	R direction	3000

17.3.1. Orientation of Device in Relation to Direction of Feed

Device orientation in the carrier cavities as shown in the following figure.

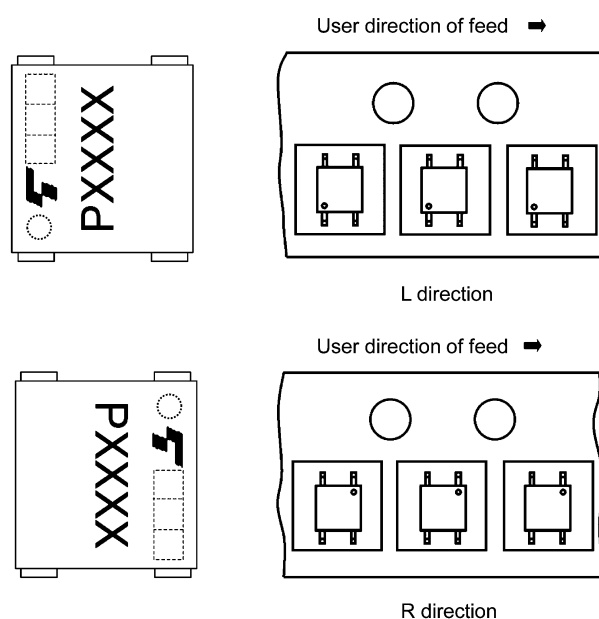


Fig. 17.3.1.1 Device Orientation

17.3.2. Empty Cavities

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

17.3.3. Tape Leader and Trailer

The start end of the tape has 50 or more empty cavities. The hub end of the tape has 50 or more empty cavities and two empty turns only for a cover tape.

17.3.4. Tape Dimensions

Tape material: Plastic (for protection against static electricity)

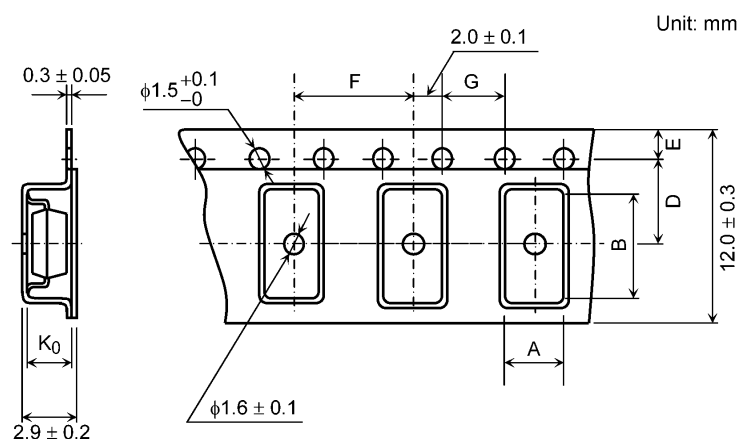


Table Tape Dimensions (unit: mm, tolerance: ± 0.1)

Symbol	Dimension	Remark
A	4.0	—
B	7.6	—
D	5.5	Center line of embossed cavity and sprocket hole
E	1.75	Distance between tape edge and sprocket hole center
F	8.0	Cumulative error +0.1/-0.3 (max) per 10 empty cavities holes
G	4.0	Cumulative error +0.1/-0.3 (max) per 10 sprocket holes
K ₀	2.6	Internal space

17.3.5. Reel Specification

Material: Plastic

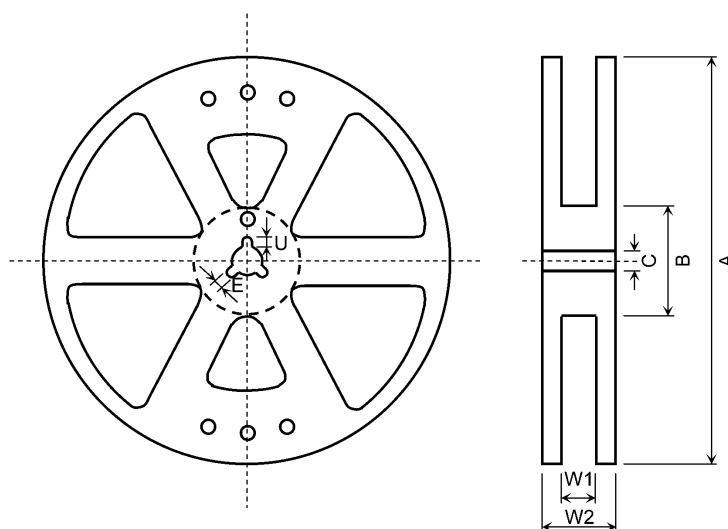


Table Reel Dimensions (unit: mm)

Symbol	Dimension
A	$\phi 330 \pm 2$
B	$\phi 80 \pm 1$ or $\phi 100 \pm 1$
C	$\phi 13 \pm 0.5$
E	2.0 ± 0.5
U	4.0 ± 0.5
W1	13.5 ± 0.5
W2	17.5 ± 1.0

17.4. Packing (Note)

One reel of photocouplers is packed in a shipping carton.

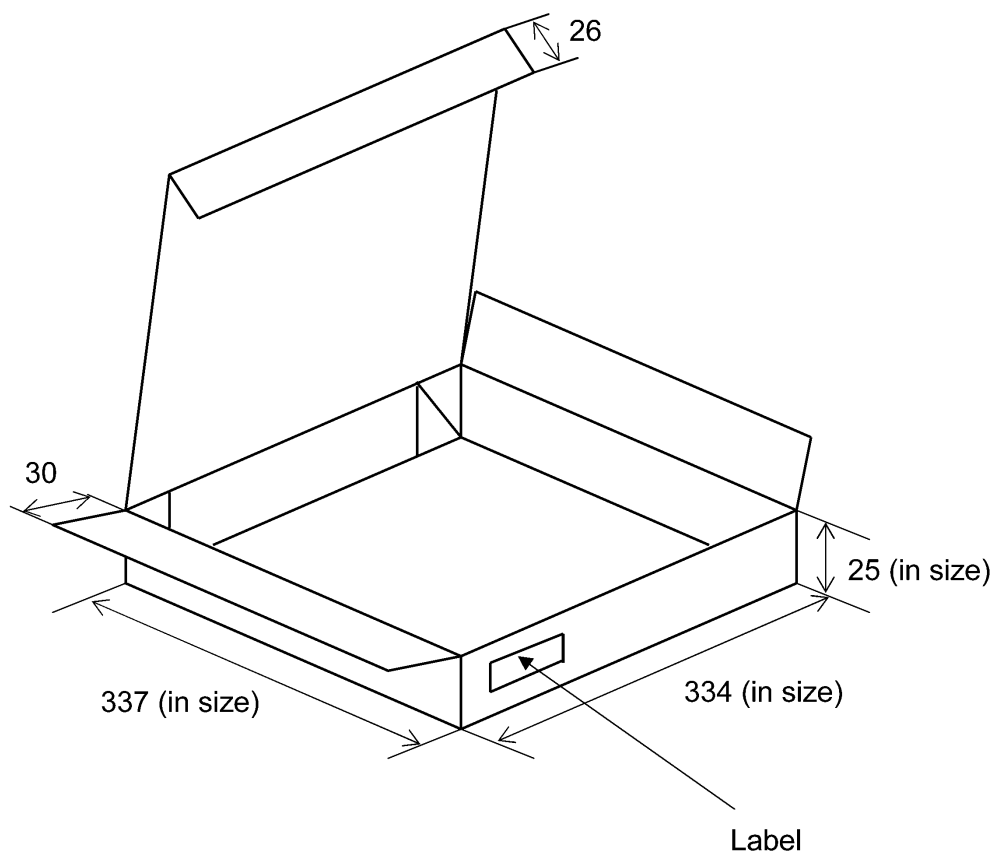


Fig. 17.4.1 1 reel/carton (unit: mm)

Note: Taping reel diameter: $\phi 330$ mm

17.5. Label Format

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.

17.6. Ordering Information

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

Example) TLP3905(TPL,E(O 3000 pcs

Part number: TLP3905

Tape type: TPL

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

Domestic ID (Country / Region of origin: Japan): (O

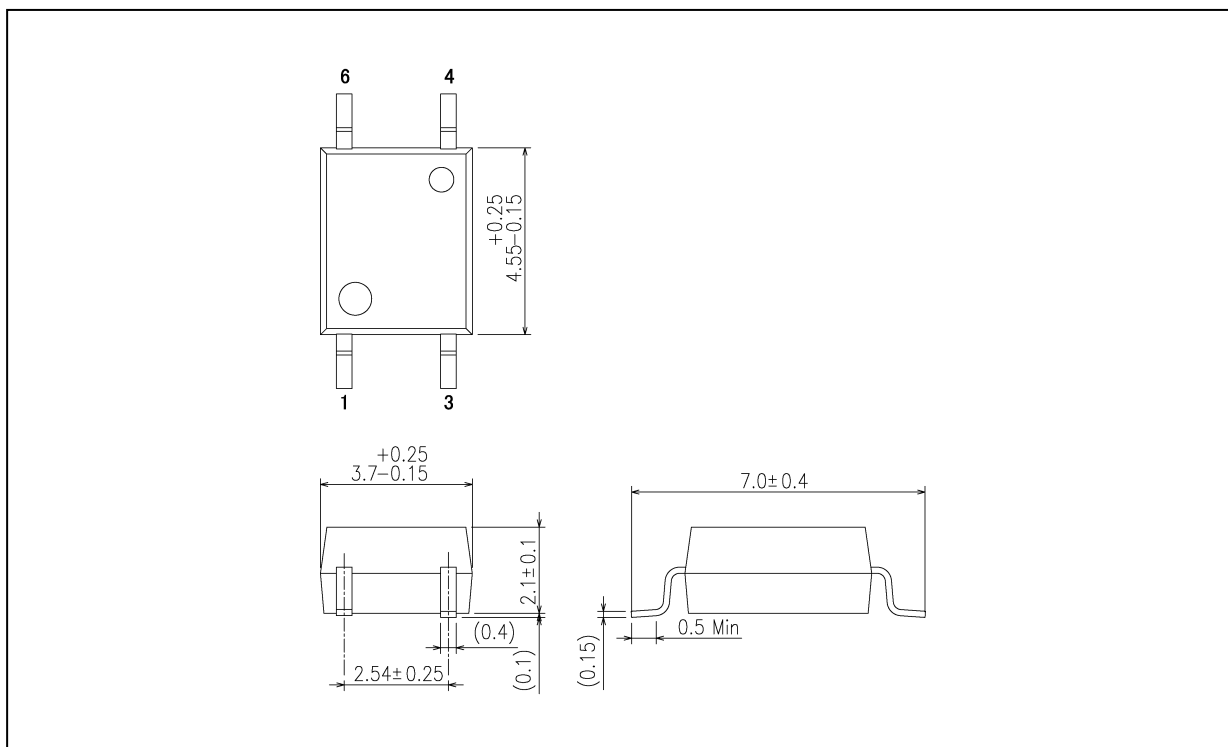
Quantity (must be a multiple of 3000): 3000 pcs

Note : 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: 0.08 g (typ.)

Package Name(s)
TOSHIBA: 11-4M1S

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