Photocouplers Photorelay

TLP172GM

1. Applications

- Battery Management System (BMS)
- Factory Automation (FA)
- Security Systems
- Measuring Instruments
- Smart Meters
- Mechanical relay replacements

2. General

The Toshiba TLP172GM consists of an aluminum gallium arsenide infrared emitting diode optically coupled to a photo-MOSFET in a 4-pin SO6 package, which is suitable for surface mount assembly.

The TLP172GM is suitable for the battery management systems which require space savings.

3. Features

(1) Halogen-free

(2) Operating temperature range: 110℃(max)

(3) Normally opened (1-Form-A)

(4) OFF-state output terminal voltage: 350 V (min)

(5) Trigger LED current: 3 mA (max)

(6) ON-state current: 110 mA (max)

(7) ON-state resistance: 35 Ω (max, t<1s)

(8) ON-state resistance: 50 Ω (max, continuous)

(9) Isolation voltage: 3750 Vrms (min)

(10) Safety standards

UL-approved: UL1577, File No.E67349

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

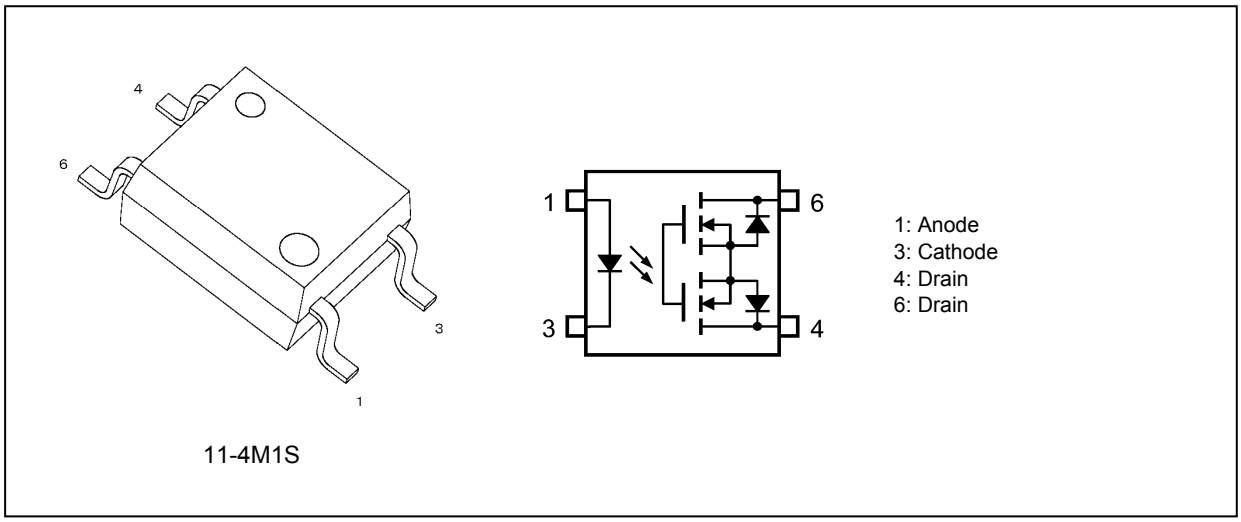
Table 3.1 Mechanical Parameters

Characteristics	TLP172GM	Unit
Creepage distances	5.0 (min)	mm
Clearance distances	5.0 (min)	
Internal isolation thickness	0.2 (min)	

Start of commercial production

2016-06

4. Packaging and Pin Assignment



5. Internal Circuit

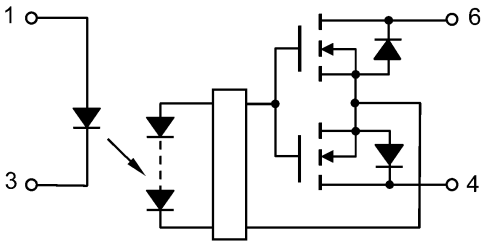


Fig. 5.1 Internal Circuit

6. Absolute Maximum Ratings (Note) (Unless otherwise specified, T_a = 25°C)

	Characteristics		Symbol	Note	Rating	Unit
LED	Input forward current		I_F		30	mA
	Input forward current derating	($T_a \geq 25$ °C)	$\Delta I_F/\Delta T_a$		-0.3	mA/°C
	Input forward current (pulsed)	(100 μs pulse, 100 pps)	I_{FP}		1	A
	Input reverse voltage		V_R		6	V
	Input power dissipation		P_D		50	mW
	Junction temperature		T_j		125	°C
Detector	OFF-state output terminal voltage		V_{OFF}		350	V
	ON-state current		I_{ON}		110	mA
	ON-state current derating	($T_a \geq 25$ °C)	$\Delta I_{ON}/\Delta T_a$		-1.1	mA/°C
	ON-state current (pulsed)	(t = 100 ms, Duty = 1/10)	I_{ONP}		0.33	A
	Output power dissipation		P_O		300	mW
	Junction temperature		T_j		125	°C
Common	Storage temperature		T_{stg}		-55 to 125	
	Operating temperature		T_{opr}		-40 to 110	
	Lead soldering temperature	(10 s)	T_{sol}		260	
	Isolation voltage	AC, 60 s, R.H. ≤ 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
Supply voltage	V_{DD}		—	—	280	V
Input forward current	I_F		5	7.5	25	mA
ON-state current	I_{ON}		—	—	110	
Operating temperature	T_{opr}		-20	—	100	°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°C)

	Characteristics	Symbol	Note	Test Condition	Min	Typ.	Max	Unit
LED	Input forward voltage	V_F		I_F = 10 mA	1.1	1.27	1.4	V
	Input reverse current	I_R		V_R = 5 V	—	—	10	μA
	Input capacitance	C_t		V = 0 V, f = 1 MHz	—	30	—	pF
Detector	OFF-state current	I_{OFF}		V_{OFF} = 350 V	—	0.001	1	μA
	Output capacitance	C_{OFF}		V = 0 V, f = 1 MHz	—	60	—	pF

9. Coupled Electrical Characteristics (Unless otherwise specified, T_a = 25°C)

Characteristics	Symbol	Note	Test Condition	Min	Typ.	Max	Unit
Trigger LED current	I_{FT}		I_{ON} = 110 mA	—	0.8	3	mA
Return LED current	I_{FC}		I_{OFF} = 100 μA	0.1	0.4	—	mA
ON-state resistance	R_{ON}		I_{ON} = 110 mA, I_F = 5 mA, t < 1 s	—	22	35	Ω
			I_{ON} = 110 mA, I_F = 5 mA	—	35	50	

10. Isolation Characteristics (Unless otherwise specified, T_a = 25°C)

Characteristics	Symbol	Note	Test Condition	Min	Typ.	Max	Unit
Total capacitance (input to output)	C_S	(Note 1)	V_S = 0 V, f = 1 MHz	—	0.8	—	pF
Isolation resistance	R_S	(Note 1)	V_S = 500 V, R.H. ≤ 60 %	5×10^{10}	10^{14}	—	Ω
Isolation voltage	BV_S	(Note 1)	AC, 60 s	3750	—	—	Vrms
			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°C)

Characteristics	Symbol	Note	Test Condition	Min	Typ.	Max	Unit
Turn-on time	t_{ON}		See Fig. 11.1 R_L = 200 Ω, V_{DD} = 20 V, I_F = 5 mA	—	0.5	1	ms
Turn-off time	t_{OFF}			—	0.1	0.5	

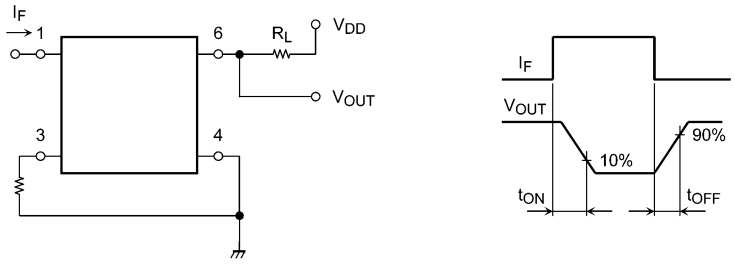


Fig. 11.1 Switching Time Test Circuit

12. Characteristics Curves and Circuit Connections

12.1. Characteristics Curves (Note)

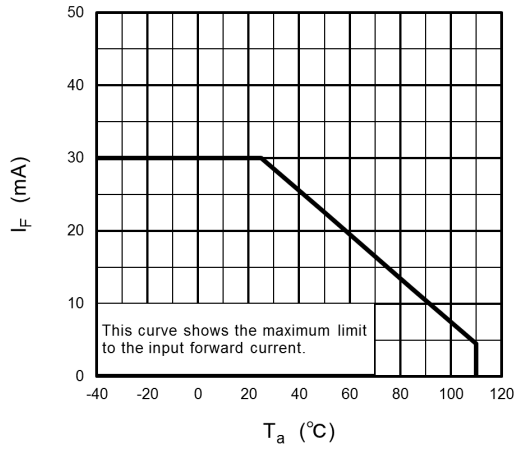


Fig. 12.1.1 I_F - T_a

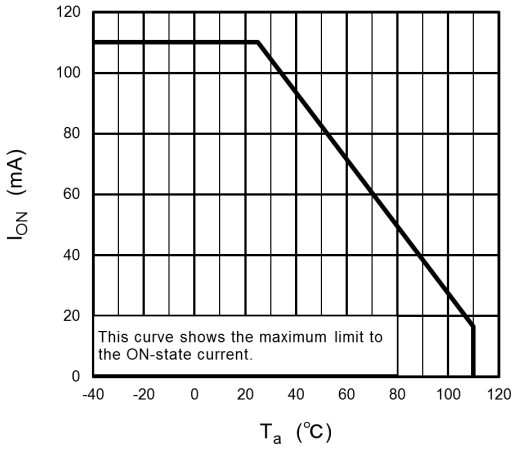


Fig. 12.1.2 I_{ON} - T_a

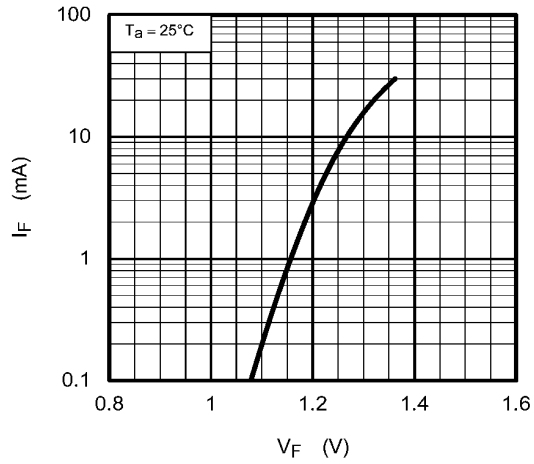


Fig. 12.1.3 I_F - V_F

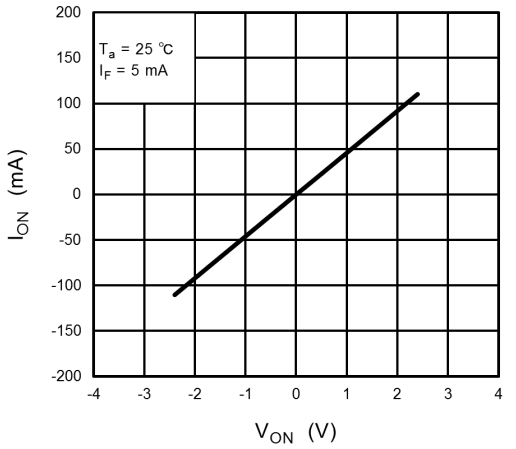


Fig. 12.1.4 I_{ON} - V_{ON}

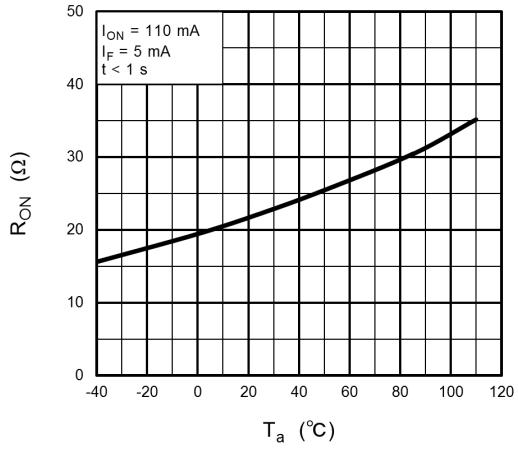


Fig. 12.1.5 R_{ON} - T_a

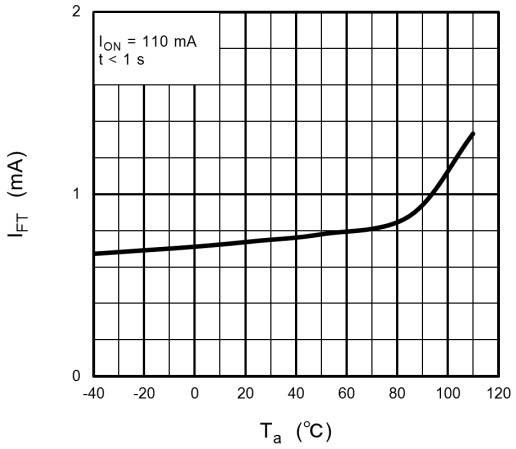


Fig. 12.1.6 I_{FT} - T_a

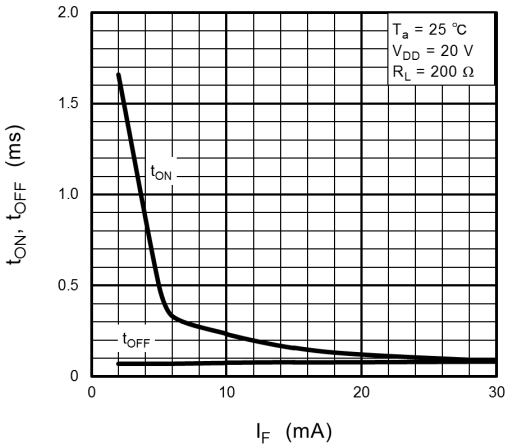


Fig. 12.1.7 t_{ON}, t_{OFF} - I_F

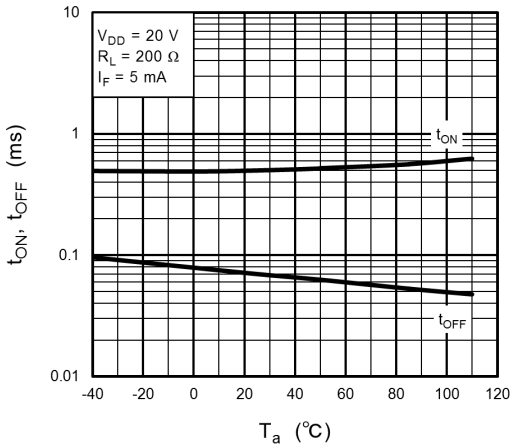


Fig. 12.1.8 t_{ON}, t_{OFF} - T_a

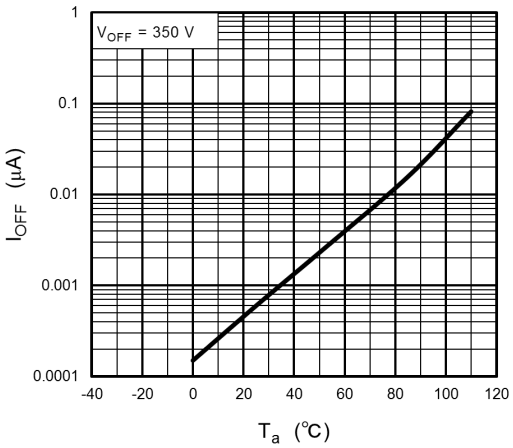


Fig. 12.1.9 I_{OFF} - T_a

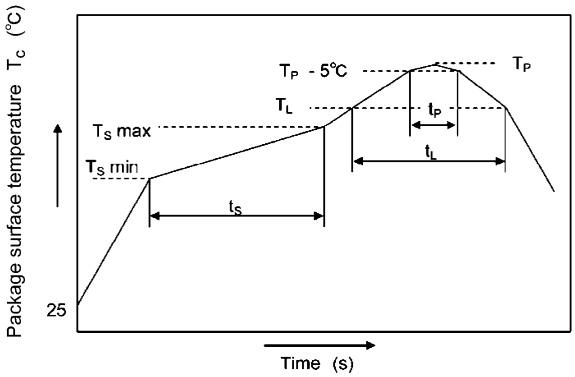
Note: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.

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.



	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

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

14.1. Applicable Package

Package Name	Product Type
4-pin SO6	Photorelay

14.2. 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) TLP172GM(TPL,E(O

Part number: TLP172GM
Tape type: TPL
[[G]]/RoHS COMPATIBLE: E **(Note 1)**
Domestic ID (Country/Region of origin: Japan): O

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 electronics equipment.

14.3. Tape Dimensions Specification

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

14.3.1. Orientation of Device in Relation to Direction of Feed

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

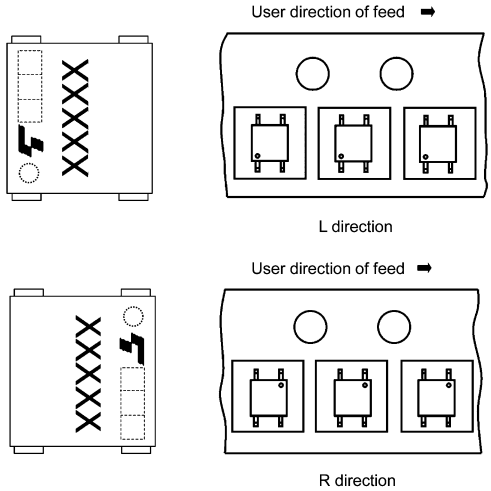


Fig. 14.3.1.1 Device Orientation

14.3.2. Empty Cavities

Characteristics	Criterion	Remarks
Occurrences of 2 or more successive empty cavities	0 device	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

14.3.3. Tape Leader and Trailer

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

14.3.4. Tape Dimensions

Tape material: Plastic (for protection against static electricity)

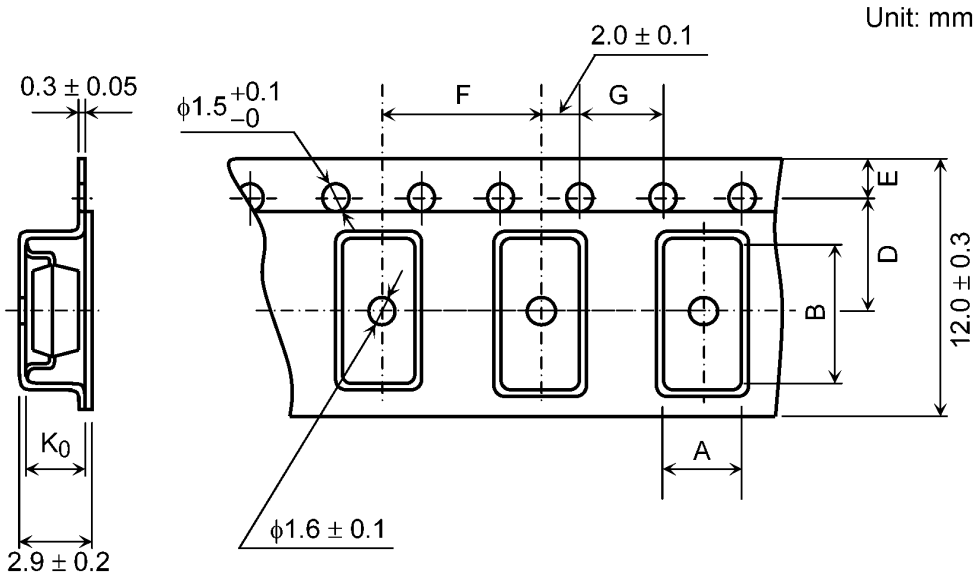


Table Tape Dimensions (unit: mm, tolerance: ±0.1)

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 empty cavities holes
K_0	2.6	Internal space

14.3.5. Reel Specification

Material: Plastic

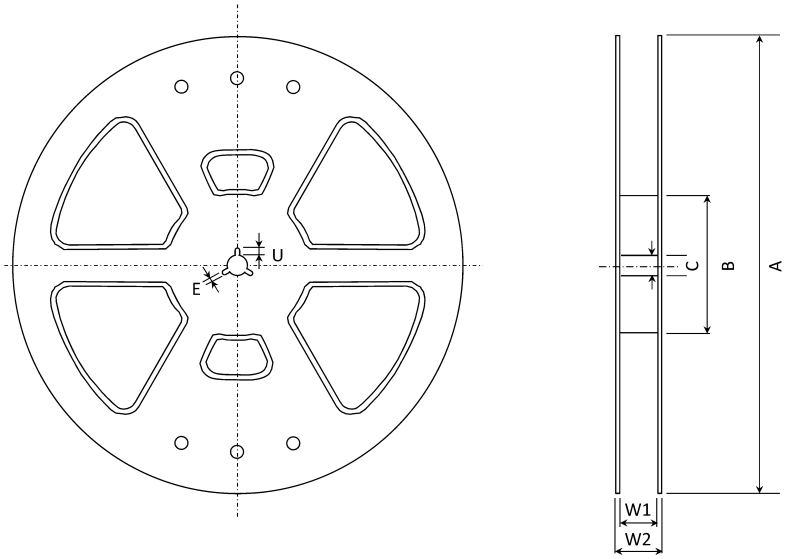
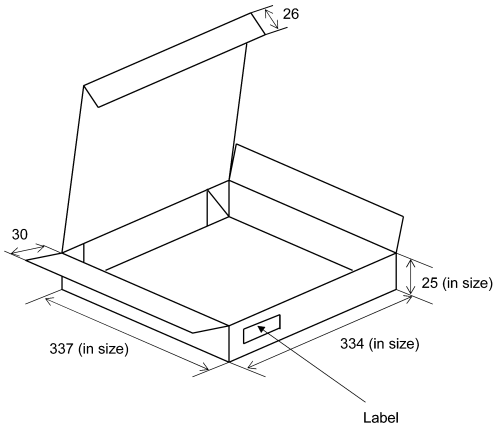


Table Reel Dimensions (unit: mm)

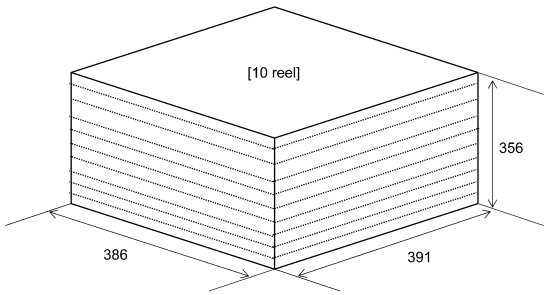
Symbol	Dimension
A	ϕ330 ± 2.0
B	ϕ80 ± 1.0
C	ϕ13 ± 0.5
E	2.0 ± 0.5
U	4.0 ± 0.5
W1	13.5 ± 0.5
W2	17.5 ± 1.0

14.4. Packing (Note)

Either one reel or ten reels of photocouplers are packed in a shipping carton.



1 reel/carton (unit: mm)



10 reel/carton (unit: mm)

Note: Taping reel diameter: ϕ330 ± 2.0 mm

14.5. Label Format

(1) Carton: The label provides the part number, quantity, lot number, the Toshiba logo, etc.

(2) Reel: The label provides the part number, the taping name, quantity, lot number, etc.

14.6. Ordering Information

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

Example) TLP172GM(TPL,E(O 3000 pcs

Part number: TLP172GM
Tape type: TPL
[[G]]/RoHS COMPATIBLE: E **(Note 1)**
Domestic ID (Country/Region of origin: Japan): O
Quantity (must be a multiple of 3000): 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 electronics equipment.

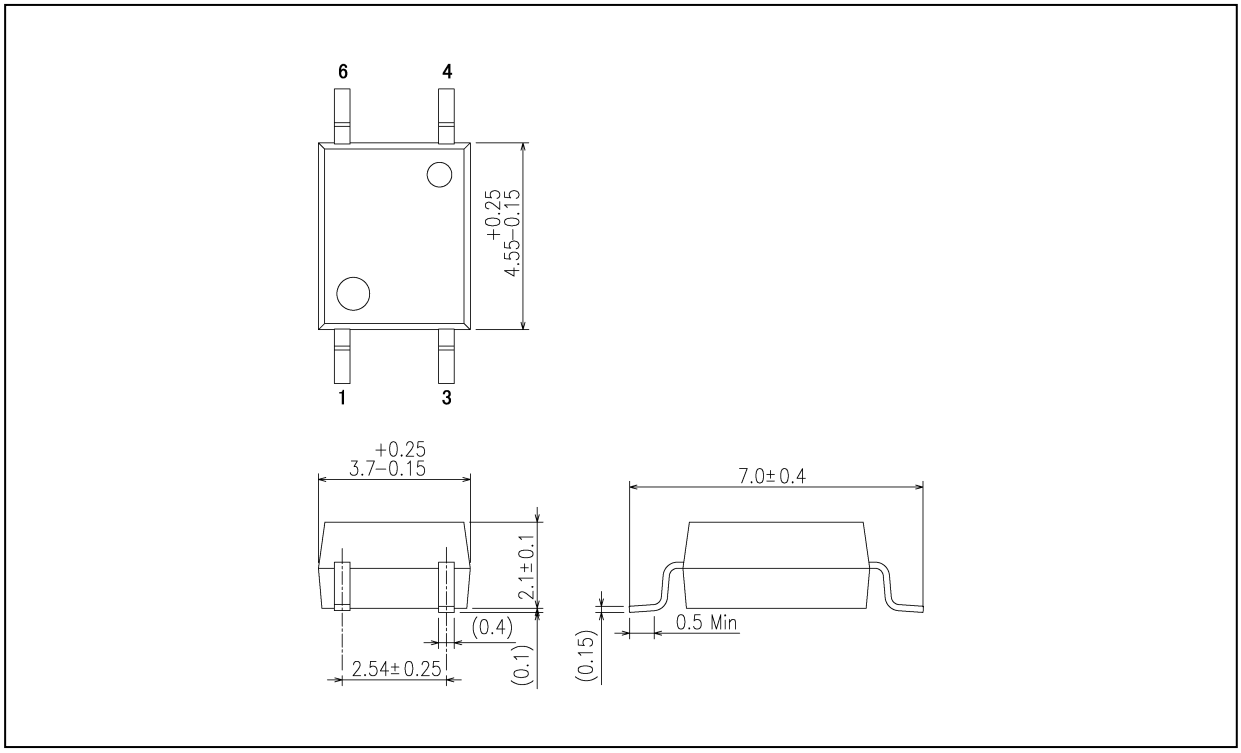
15. Ordering Information (Example of Item Name)

Item Name	Packaging (Note 1)	Packing (MOQ)
TLP172GM(E(O	SMD	Magazine (125 pcs)
TLP172GM(TPL,E(O	SMD	Tape and reel (3000 pcs)
TLP172GM(TPR,E(O	SMD	Tape and reel (3000 pcs)

Note 1: SMD: Surface Mount Device

Package Dimensions

Unit: mm



Weight: 0.1 g (typ.)

Package Name(s)
TOSHIBA: 11-4M1S

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