Photocouplers Photorelay

TLP3475

1. Applications

- Measuring Instruments
- High-Speed Logic IC Testers
- High-Speed Memory Testers
- ATE (Automatic Test Equipment)

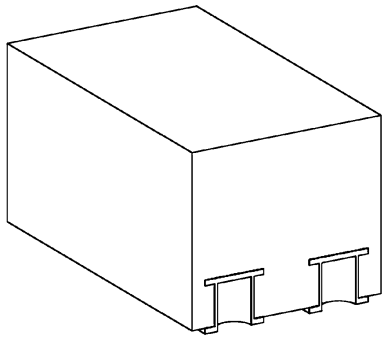
2. General

The TLP3475 photorelay consists of a photo MOSFET optically coupled to an infrared light emitting diode. It is housed in a VSON4 package. The TLP3475 features a low CR product and extremely low on-state resistance, and thus delivers high on-state current. Additionally, the TLP3475 offers low insertion loss of a high-frequency signal and thus prevents the degradation of a rapidly rising signal. The TLP3475 also features low off-state current and low output pin capacitance, making it suitable for high-frequency measuring instrument applications.

3. Features

(1) Normally opened (1-Form-A)
(2) OFF-state output terminal voltage: 50 V (min)
(3) Trigger LED current: 3 mA (max)
(4) ON-state current: 300 mA (max)
(5) ON-state resistance: 1.0 Ω (typ.), 1.5 Ω (max)
(6) Output capacitance: 12 pF(typ.), 20 pF(max)
(7) Isolation voltage: 500 Vrms (min)
(8) ERT (Equivalent Rise Time): 40 ps(typ.), 90 ps(max)

4. Packaging and Pin Assignment



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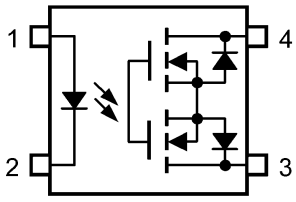
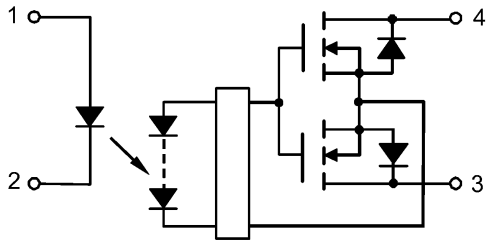


1: Anode
2: Cathode
3: Drain
4: Drain

Start of commercial production
2014-05

5. 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 reverse voltage		V_R		5	V
	Junction temperature		T_j		125	°C
Detector	OFF-state output terminal voltage		V_{OFF}		50	V
	ON-state current		I_{ON}		300	mA
	ON-state current derating	($T_a \geq$ 25 °C)	$\Delta I_{ON}/\Delta T_a$		-3.0	mA/°C
	ON-state current (pulsed)	(t = 100 ms, Duty = 1/10)	I_{ONP}		900	mA
	Junction temperature		T_j		125	°C
Common	Storage temperature		T_{stg}		-40 to 125	°C
	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)	500	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 2 are shorted together, and pins 3 and 4 are shorted together.

Note: This device is sensitive to electrostatic discharge (ESD). Extreme ESD conditions should be guarded against by using proper antistatic precautions for the worktable, operator, solder iron, soldering equipment and so on.

7. Recommended Operating Conditions (Note)

Characteristics	Symbol	Note	Min	Typ.	Max	Unit
Supply voltage	V_{DD}		—	—	40	V
Input forward current	I_F		5	7.5	20	mA
ON-state current	I_{ON}		—	—	300	mA
Operating temperature	T_{opr}		-20	—	85	°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} = 50 V	—	—	1	nA
	Output capacitance	C_{OFF}		V = 0 V, f = 100 MHz, t < 1 s	—	12	20	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} = 100 mA	—	—	3	mA
Return LED current	I_{FC}		I_{OFF} = 10 μA	0.1	—	—	
ON-state resistance	R_{ON}		I_{ON} = 300 mA, I_F = 5 mA, t < 1 s	—	1.0	1.5	Ω

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	—	1.0	—	pF
Isolation resistance	R_S	(Note 1)	V_S = 500 V, R.H. ≤ 60 %	—	10^{14}	—	Ω
Isolation voltage	BV_S	(Note 1)	AC, 60 s	500	—	—	Vrms
			AC, 1 s in oil	—	1000	—	
			DC, 60 s in oil	—	1000	—	Vdc

Note 1: This device is considered as a two-terminal device: Pins 1 and 2 are shorted together, and pins 3 and 4 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	—	—	500	μs
Turn-off time	t_{OFF}			—	—	400	
Turn-on time	t_{ON}		See Fig. 11.1. R_L = 200 Ω, V_{DD} = 20 V, I_F = 10 mA	—	—	250	
Turn-off time	t_{OFF}			—	—	400	
Equivalent rise time	ERT		See Fig. 11.2. I_F = 5 mA, V_{DD} = 0.25 V, $t_{r(in)}$ = 25 ps	—	40	90	ps

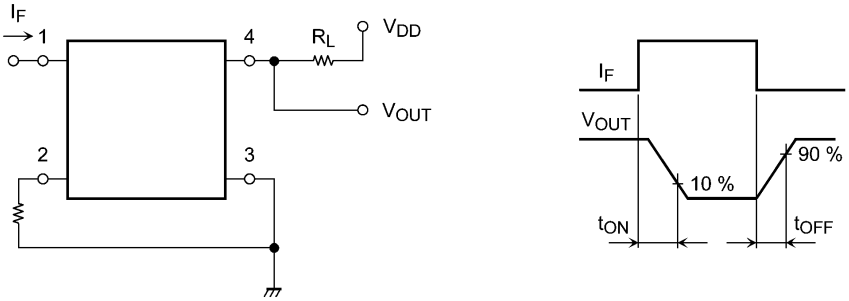


Fig. 11.1 Switching Time Test Circuit

$$ERT = \sqrt{t_{r(out)}^{\ 2} - t_{r(in)}^{\ 2}}$$

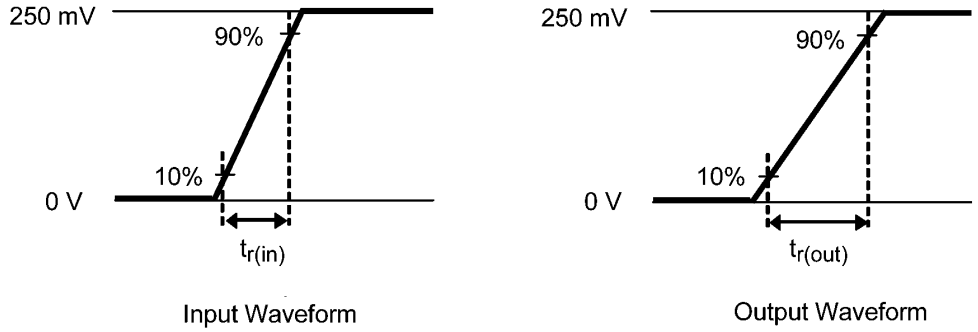


Fig. 11.2 ERT (Equivalent Rise Time)

12. Characteristics Curves (Note)

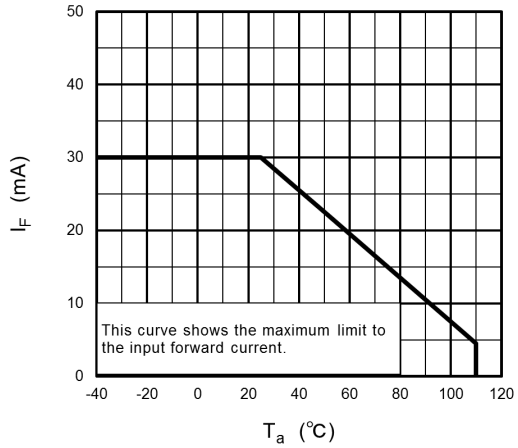


Fig. 12.1 I_F - T_a

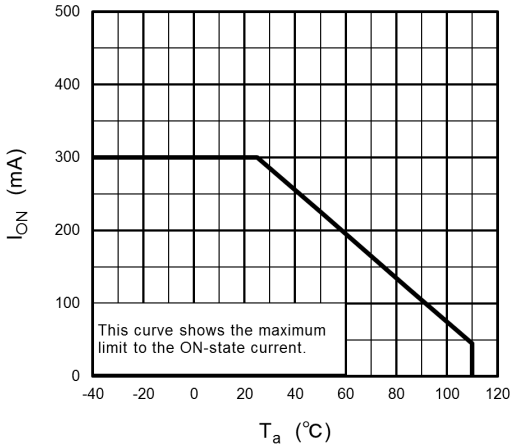


Fig. 12.2 I_{ON} - T_a

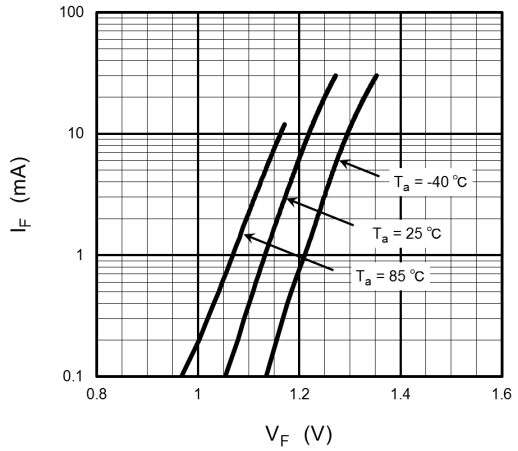


Fig. 12.3 I_F - V_F

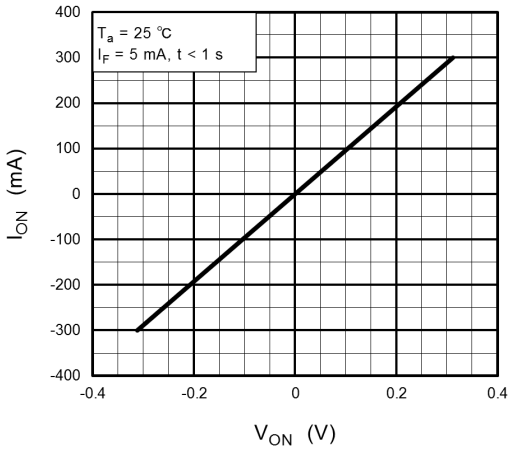


Fig. 12.4 I_{ON} - V_{ON}

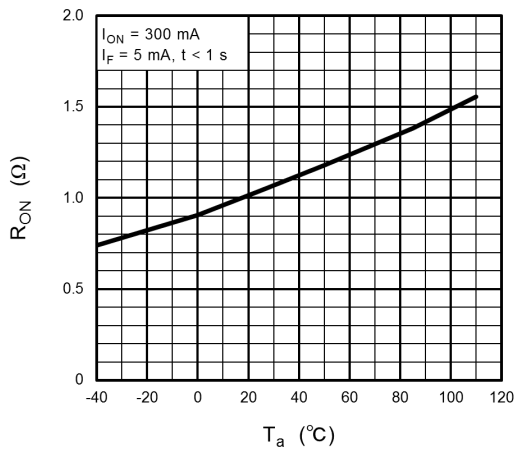


Fig. 12.5 R_{ON} - T_a

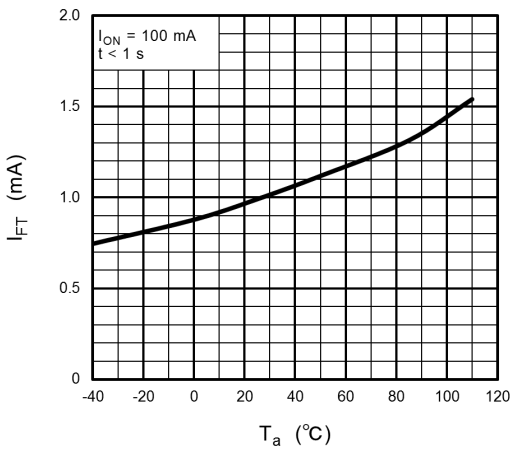


Fig. 12.6 I_{FT} - T_a

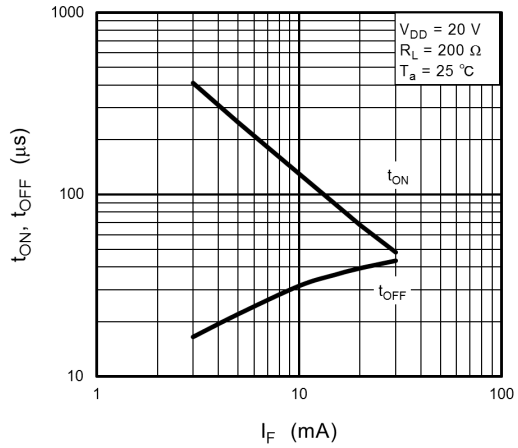


Fig. 12.7 t_{ON}, t_{OFF} - I_F

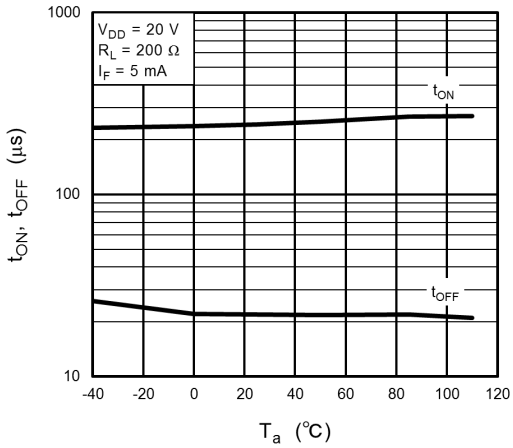


Fig. 12.8 t_{ON}, t_{OFF} - T_a

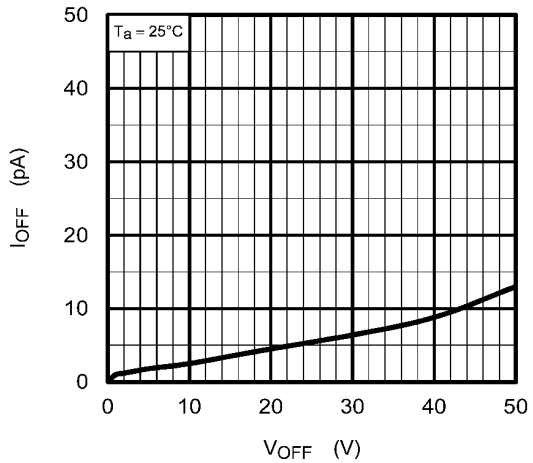


Fig. 12.9 I_{OFF} - V_{OFF}

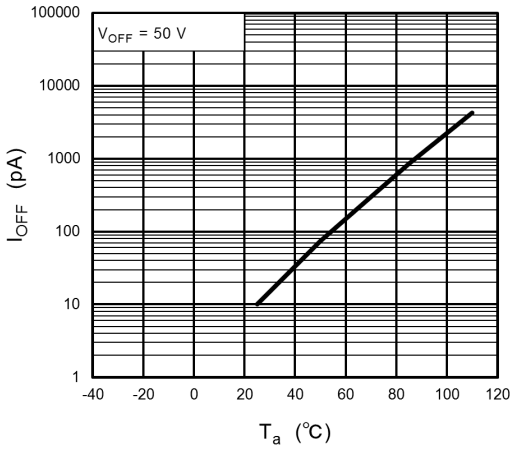


Fig. 12.10 I_{OFF} - T_a

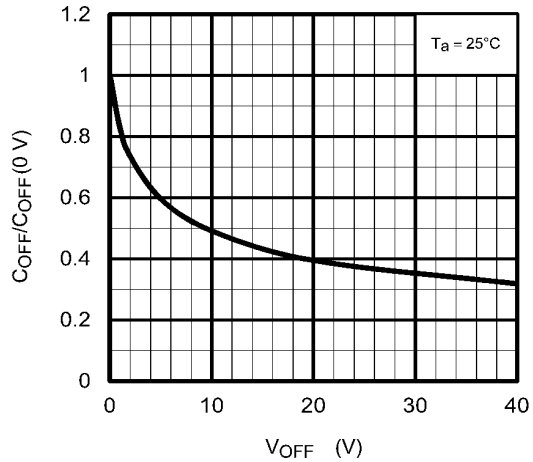


Fig. 12.11 C_{OFF}/C_{OFF}(0 V) - V_{OFF}

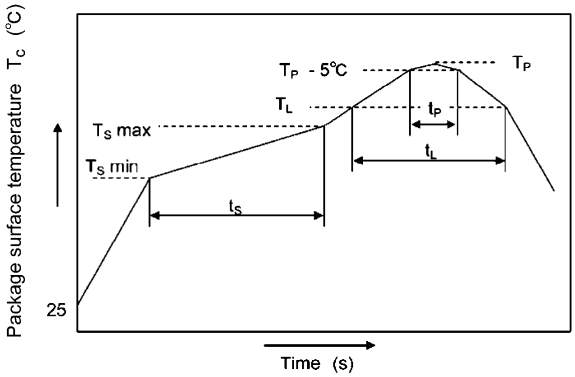
Note: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.

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
  (See the figure shown below, which is based on the package surface temperature.)
  Reflow soldering may be performed up to twice.
  The first reflow soldering should be performed within 168 hours after opening the moisture-proof packaging.
  The second reflow soldering must be performed within 168 hours of the first reflow.



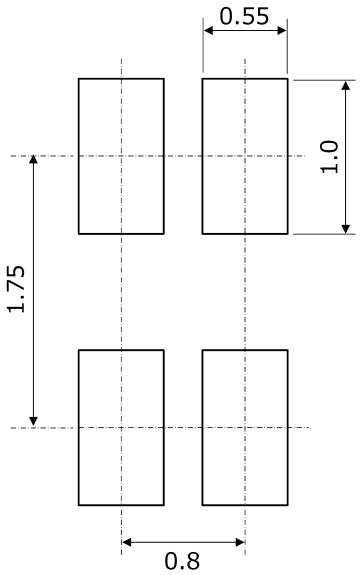
	Symbol	Min	Max	Unit
Preheat temperature	T_S	150	200	°C
Preheat time	t_S	60	120	s
Ramp-up rate (T_L to T_P)			3	°C/s
Liquidus temperature	T_L	217		°C
Time above T_L	t_L	60	150	s
Peak temperature	T_P		260	°C
Time during which T_c is between (T_P – 5) and T_P	t_P		30	s
Ramp-down rate (T_P to T_L)			6	°C/s

Fig. 13.1.1 An Example of a Temperature Profile When Lead(Pb)-free Solder Is Used

13.2. Precautions for General Storage

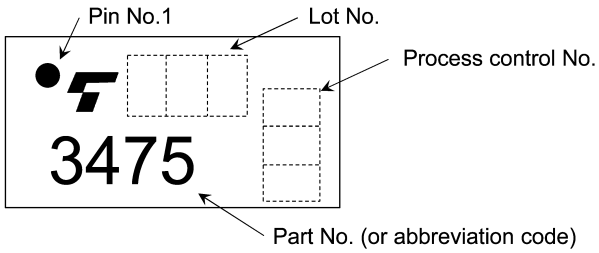
- Avoid storage locations where devices may be exposed to moisture or direct sunlight.
- Do not store the products in locations with poisonous gases (especially corrosive gases) or in dusty conditions.
- Store the products in locations with minimal temperature fluctuations. Rapid temperature changes 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.
- Follow the precautions printed on the packing label of the device for transportation and storage.
- Thermal stress may cause a crack in surface-mount products during surface-mount assembly if they have absorbed atmospheric moisture. To prevent a crack, please observe the following precautions.
  1. Moisture-proof bags may be stored unopened for up to 12 months under the following conditions.
     Temperature: 5 °C to 30 °C
     Humidity: 90 % (max)
  2. After opening the moisture-proof bag, the devices should be assembled within 168 hours in an environment of 5 °C to 30 °C/70 %RH or below.
  3. If, upon opening, the moisture indicator card shows a humidity of 30 % or above (i.e., has turned pink) or the expiration date has passed, the devices should be baked in tape and reel.
     After baking, use the baked devices within 72 hours, but perform baking only once.
     Baking conditions: 60±5 °C, for 64 to 72 hours.
     Expiration date: 12 months from the sealing date, which is imprinted on the label affixed.
  4. Repeated baking can affect the peeling strength of taping and cause a trouble during mounting. Furthermore, protect the devices against static electricity for baking.
  5. If the laminated packing material is broken, its hermeticity deteriorates. Therefore, do not throw or drop the packed devices.

14. Land Pattern Dimensions (for reference only)



Unit: mm

15. Marking



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

16.1. Applicable Package

Package Name	Product Type
VSON4	Photorelay

16.2. 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) TLP3475(TP,F(O

Part number: TLP3475
Tape type: TP
[[G]]/RoHS COMPATIBLE: F **(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 electronic equipment.

16.3. Tape Dimensions Specification

Tape Type	Division	Packing Amount (A unit per reel)
TP	—	3000

16.3.1. Orientation of Device in Relation to Direction of Feed

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

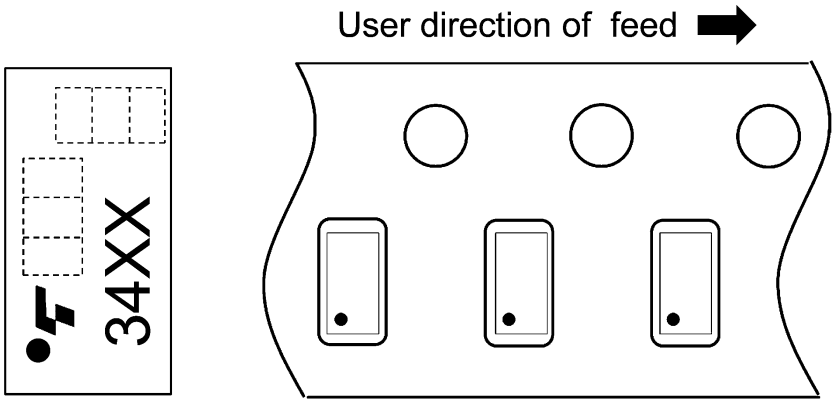


Fig. 16.3.1.1 Device Orientation

16.3.2. 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

16.3.3. Tape Leader and Trailer

The start end of the tape has 40 or more empty cavities. The hub end of the tape has 40 or more empty cavities and one-third empty turn only for a cover tape.

16.3.4. Tape Dimensions

Tape material: Plastic (for protection against static electricity)

Unit: mm

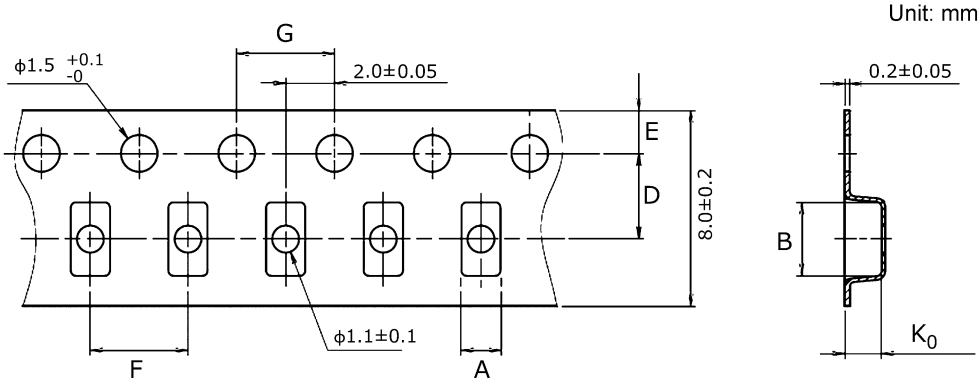


Table Tape Dimensions (unit: mm, tolerance: ±0.1)

Symbol	Dimension	Remark
A	1.6	—
B	3.0	—
D	3.5	Center line of embossed cavity and sprocket hole
E	1.75	Distance between tape edge and sprocket hole center
F	4.0	Cumulative error +0.2/-0.2 (max) per 10 empty cavities holes
G	4.0	Cumulative error +0.2/-0.2 (max) per 10 sprocket holes
K_0	1.5	Internal space

16.3.5. Reel Specification

Material: Plastic (for protection against static electricity)

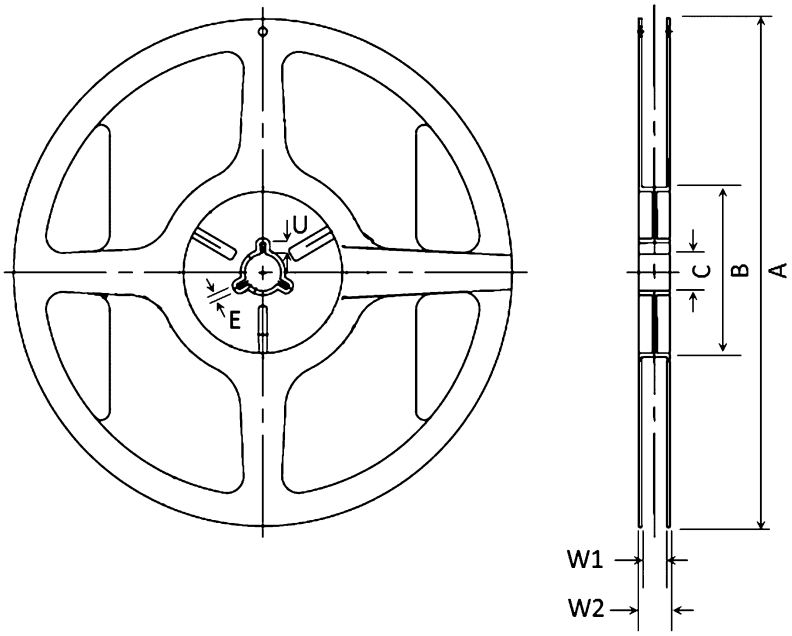


Table Reel Dimensions (unit: mm)

Symbol	Dimension
A	ϕ180 ± 3
B	ϕ60 ± 1
C	ϕ13 ± 0.5
E	2.0 ± 0.5
U	4.0 ± 0.5
W1	9.0 ± 0.3
W2	11.4 ± 1.0

16.4. Packing (Note)

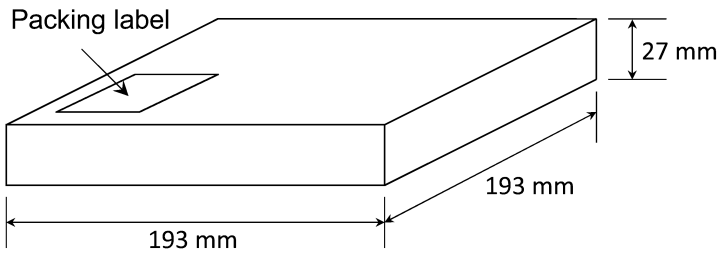


Fig. 16.4.1 1 reel/carton (unit: mm)

Note: Taping reel diameter: ϕ180 mm

16.5. 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.

16.6. Ordering Information

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

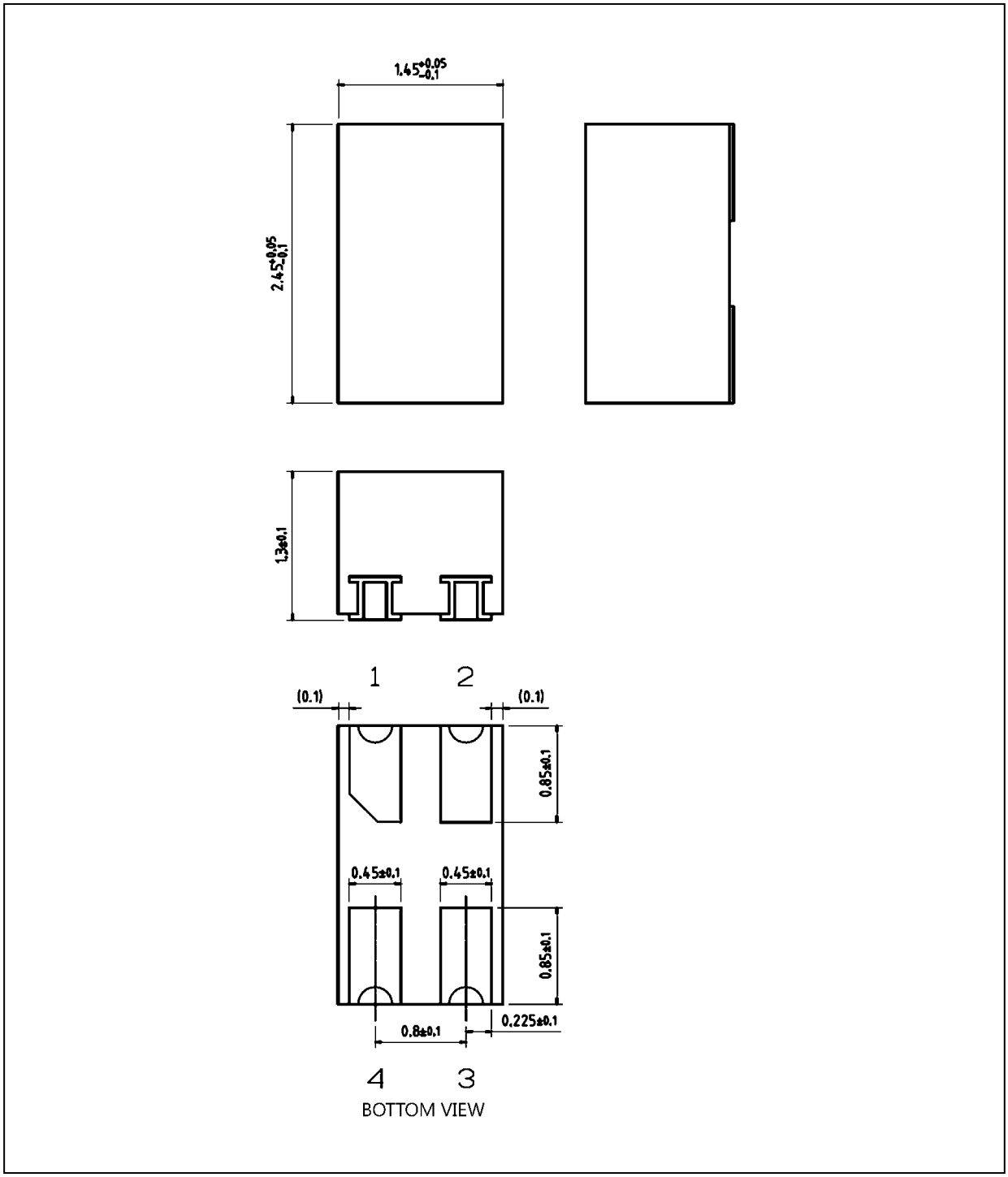
Example) TLP3475(TP,F(O 3000 pcs

Part number: TLP3475
Tape type: TP
[[G]]/RoHS COMPATIBLE: F **(Note 1)**
Quantity (must be a multiple of 3000): 3000 pcs
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 electronic equipment.

Package Dimensions

Unit: mm



Weight: 10 mg (typ.)

Package Name(s)
TOSHIBA: 11-2D1A

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