

# TLP240D, TLP240DF

## 1. Applications

- Mechanical relay replacements
- Security Systems
- Measuring Instruments
- Factory Automation (FA)
- Amusement Equipment
- Smart Meters
- Electricity Meters

## 2. General

The TLP240D and TLP240DF photorelay consist of a photo MOSFET optically coupled to an infrared light emitting diode. They are housed in a 4-pin DIP package. They provide an isolation voltage of 5000 Vrms, making them suitable for applications that require reinforced insulation.

## 3. Features

- (1) Normally opened (1-Form-A)
- (2) OFF-state output terminal voltage: 200 V (min)
- (3) Trigger LED current: 3 mA (max)
- (4) ON-state current: 250 mA (max)
- (5) ON-state resistance: 8 Ω (max)
- (6) Isolation voltage: 5000 Vrms (min)
- (7) Safety standards

UL-approved UL1577 File No. E67349

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

VDE-approved: Option (D4) EN60747-5-5 (**Note**)

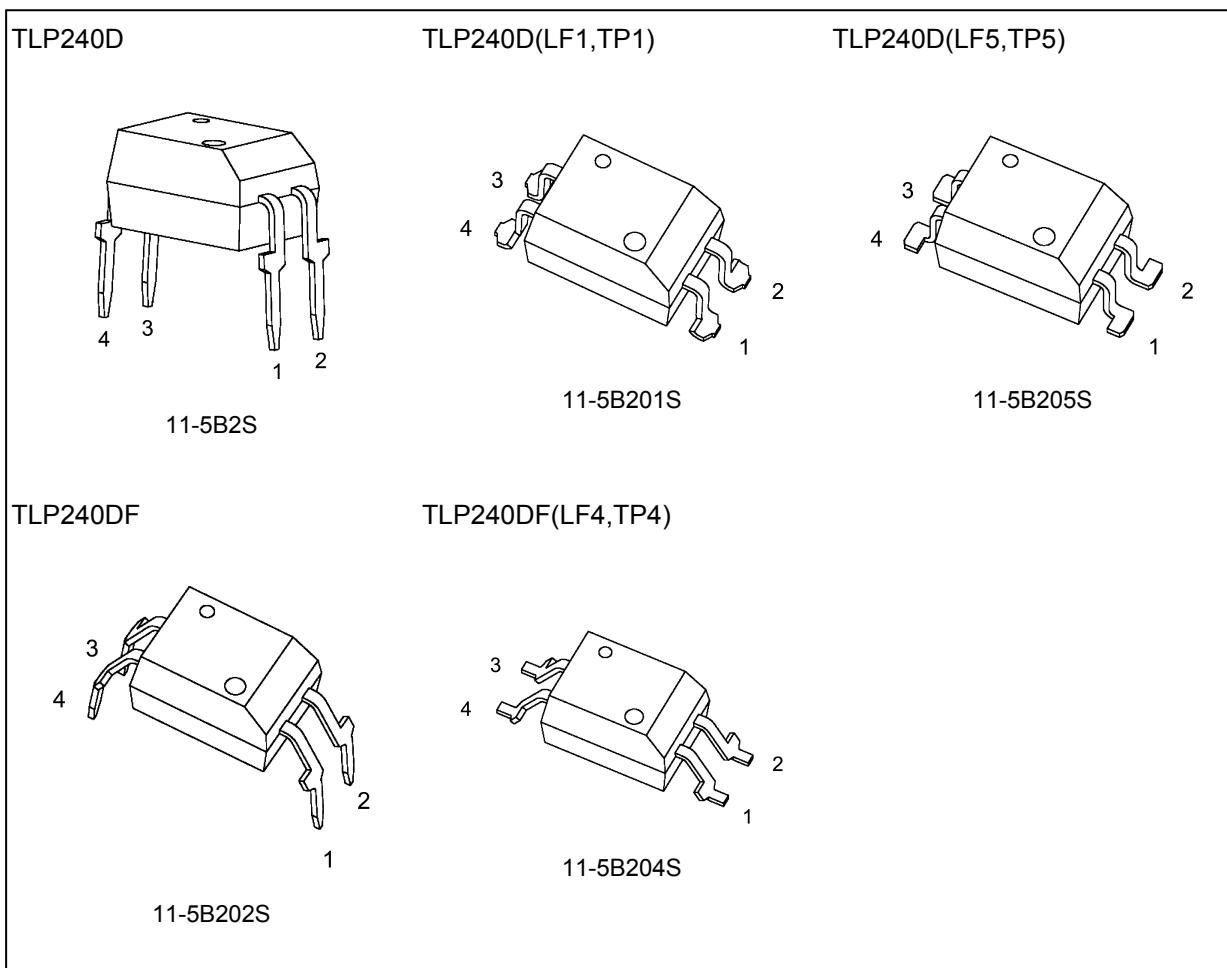
Note: When an EN60747-5-5 approved type is needed, please designate the **Option (D4)**.

## 4. Mechanical Parameters

Characteristics	7.62-mm Pitch TLP240D	10.16-mm Pitch TLP240DF	Unit
Creepage distances	7.0 (min)	8.0 (min)	mm
Clearance distances	7.0 (min)	8.0 (min)	
Internal isolation thickness	0.4 (min)	0.4 (min)	

Start of commercial production  
2013-03

## 5. Packaging (Note)

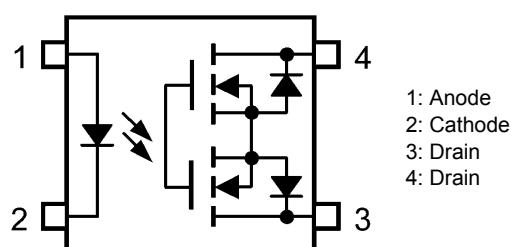


Note: Through hole type: TLP240D, TLP240DF

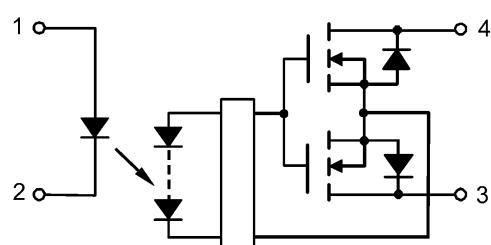
Lead forming option: (LF1), (LF4), (LF5)

Taping option: (TP1), (TP4), (TP5)

## 6. Pin Assignment



## 7. Internal Circuit



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

	Characteristics	Symbol	Note	Rating	Unit
LED	Input forward current	$I_F$		30	mA
	Input forward current derating ( $T_a \geq 25^\circ\text{C}$ )	$\Delta I_F/\Delta T_a$		-0.3	mA/ $^\circ\text{C}$
	Input forward current (pulsed) (100 $\mu\text{s}$ pulse, 100 pps)	$I_{FP}$		1	A
	Input reverse voltage	$V_R$		5	V
	Input power dissipation	$P_D$		50	mW
	Junction temperature	$T_j$		125	$^\circ\text{C}$
Detector	OFF-state output terminal voltage	$V_{OFF}$		200	V
	ON-state current	$I_{ON}$		250	mA
	ON-state current derating ( $T_a \geq 25^\circ\text{C}$ )	$\Delta I_{ON}/\Delta T_a$		-2.5	mA/ $^\circ\text{C}$
	ON-state current (pulsed) ( $t = 100 \text{ ms}$ , Duty = 1/10)	$I_{ONP}$		750	mA
	Output power dissipation	$P_O$		500	mW
	Junction temperature	$T_j$		125	$^\circ\text{C}$
Common	Storage temperature	$T_{stg}$		-55 to 125	$^\circ\text{C}$
	Operating temperature	$T_{opr}$		-40 to 85	$^\circ\text{C}$
	Lead soldering temperature (10 s)	$T_{sol}$		260	$^\circ\text{C}$
	Isolation voltage AC, 60 s, R.H. $\leq 60\%$	$BV_S$	(Note 1)	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: This device is considered as a two-terminal device: Pins 1 and 2 are shorted together, and pins 3 and 4 are shorted together.

## 9. Recommended Operating Conditions (Note)

Characteristics	Symbol	Note	Min	Typ.	Max	Unit
Supply voltage	$V_{DD}$		—	—	160	V
Input forward current	$I_F$		5	7.5	25	mA
ON-state current	$I_{ON}$		—	—	250	mA
Operating temperature	$T_{opr}$		-20	—	65	$^\circ\text{C}$

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.

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

	Characteristics	Symbol	Note	Test Condition	Min	Typ.	Max	Unit
LED	Input forward voltage	$V_F$		$I_F = 10 \text{ mA}$	1.1	1.27	1.4	V
	Input reverse current	$I_R$		$V_R = 5 \text{ V}$	—	—	10	$\mu\text{A}$
	Input capacitance	$C_t$		$V = 0 \text{ V}, f = 1 \text{ MHz}$	—	50	—	pF
Detector	OFF-state current	$I_{OFF}$		$V_{OFF} = 200 \text{ V}$	—	—	1000	nA
	Output capacitance	$C_{OFF}$		$V = 0 \text{ V}, f = 1 \text{ MHz}$	—	80	—	pF

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

Characteristics	Symbol	Note	Test Condition	Min	Typ.	Max	Unit
Trigger LED current	$I_{FT}$		$I_{ON} = 250 \text{ mA}$	—	0.6	3	mA
Return LED current	$I_{FC}$		$I_{OFF} = 10 \mu\text{A}$	0.1	—	—	—
ON-state resistance	$R_{ON}$	(Note 1)	$I_{ON} = 250 \text{ mA}, I_F = 5 \text{ mA}, \text{Continuous}$	—	5	8	$\Omega$

Note 1: Thermally saturated state.

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

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)	$V_S = 500 \text{ V}, \text{R.H.} \leq 60\%$	$1 \times 10^{12}$	$10^{14}$	—	$\Omega$
Isolation voltage	$BV_S$	(Note 1)	AC, 60 s	5000	—	—	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 2 are shorted together, and pins 3 and 4 are shorted together.

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

Characteristics	Symbol	Note	Test Condition	Min	Typ.	Max	Unit
Turn-on time	$t_{ON}$		See Fig. 13.1. $R_L = 200 \Omega, V_{DD} = 20 \text{ V}, I_F = 5 \text{ mA}$	—	1	3	ms
Turn-off time	$t_{OFF}$			—	0.1	1	

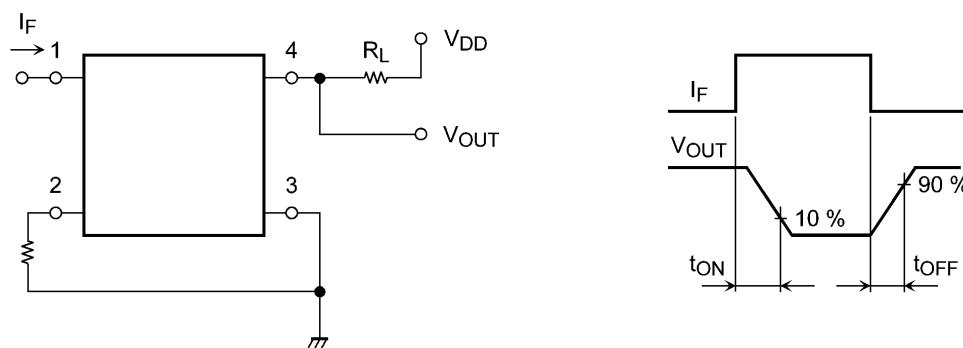
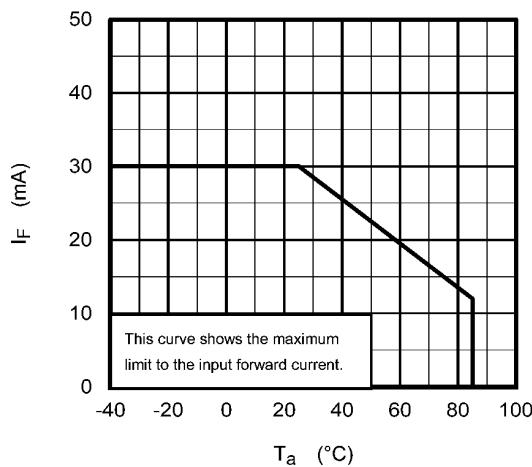
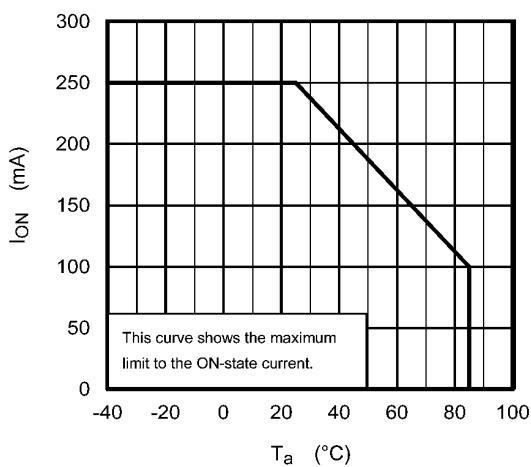
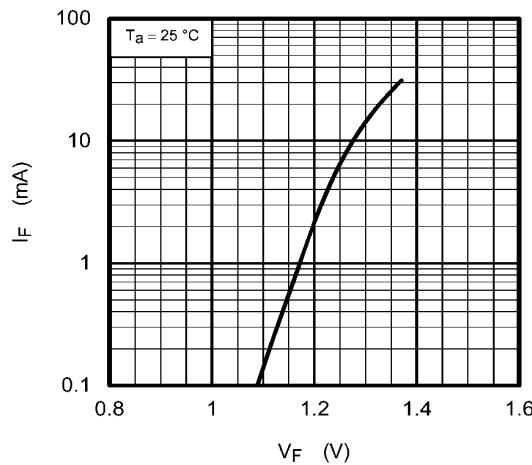
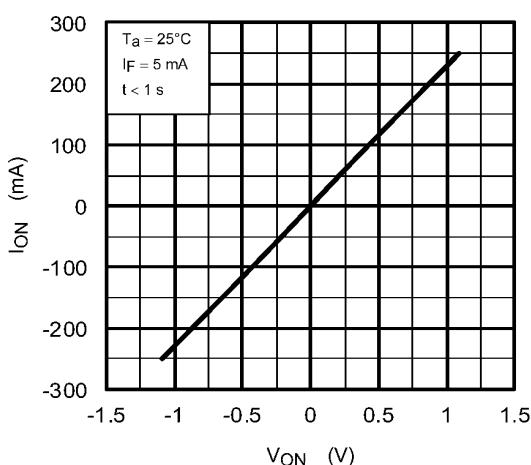
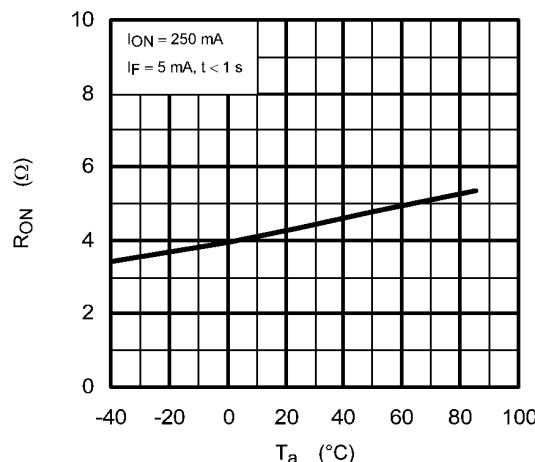
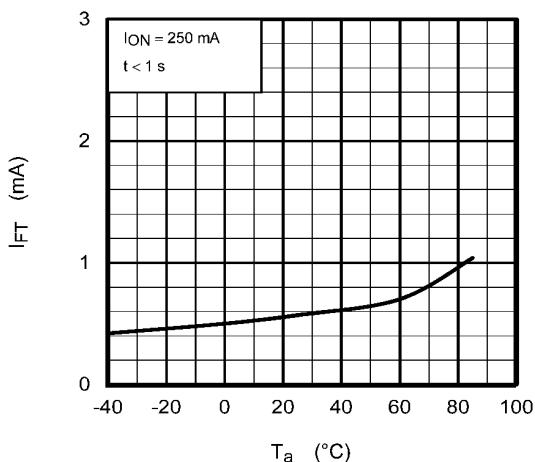
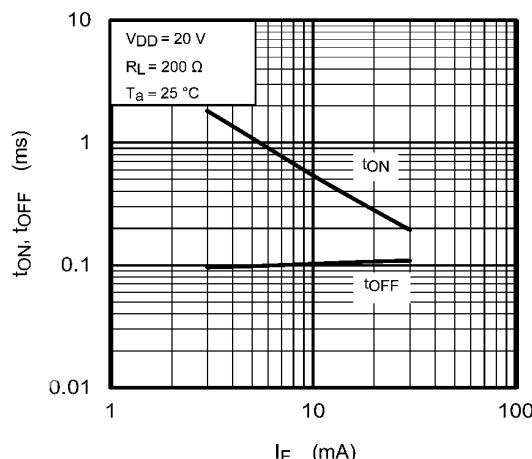
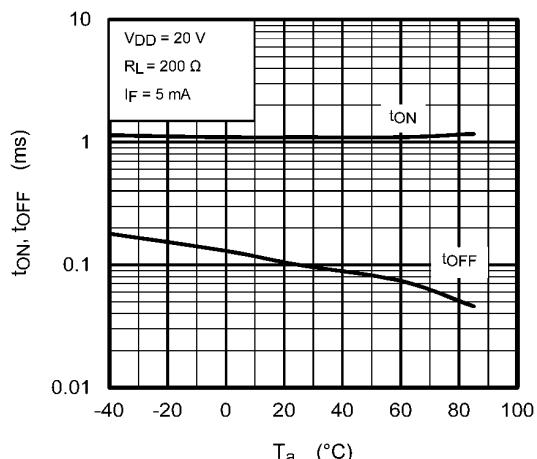
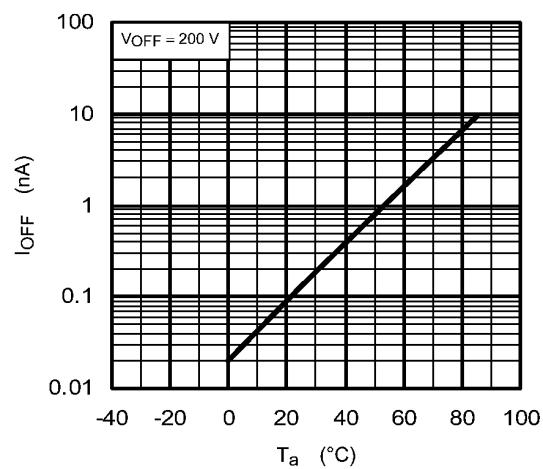


Fig. 13.1 Switching Time Test Circuit

## 14. Characteristics Curves (Note)

Fig. 14.1 I<sub>F</sub> - T<sub>a</sub>Fig. 14.2 I<sub>ON</sub> - T<sub>a</sub>Fig. 14.3 I<sub>F</sub> - V<sub>F</sub>Fig. 14.4 I<sub>ON</sub> - V<sub>ON</sub>Fig. 14.5 R<sub>ON</sub> - T<sub>a</sub>Fig. 14.6 I<sub>FT</sub> - T<sub>a</sub>

Fig. 14.7  $t_{ON}$ ,  $t_{OFF}$  -  $I_F$ Fig. 14.8  $t_{ON}$ ,  $t_{OFF}$  -  $T_a$ Fig. 14.9  $I_{OFF}$  -  $T_a$ 

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

## 15. Soldering and Storage

### 15.1. 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.

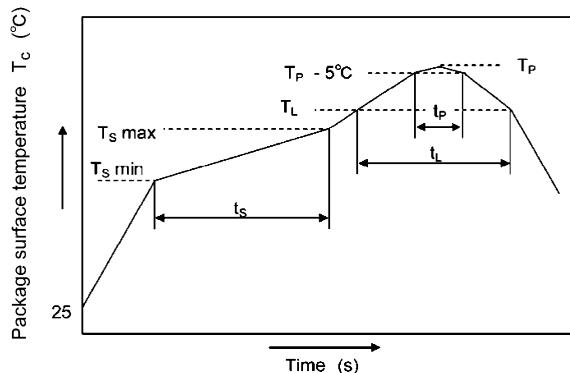
- When using soldering reflow.

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. 15.1.1 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.

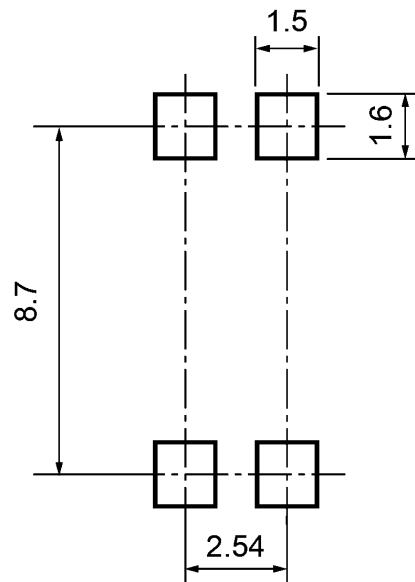
### 15.2. Precautions for General Storage

- 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.

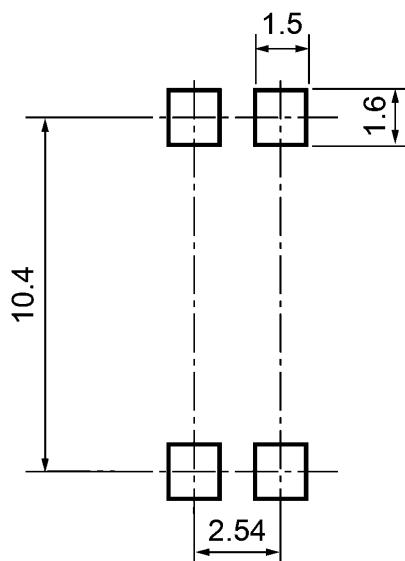
**16. Land Pattern Dimensions (for reference only)**

Unit: mm

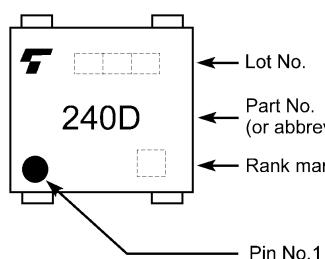
TLP240D

**Fig. 16.1 Lead forming and taping option  
(LF1), (TP1), (LF5), (TP5)**

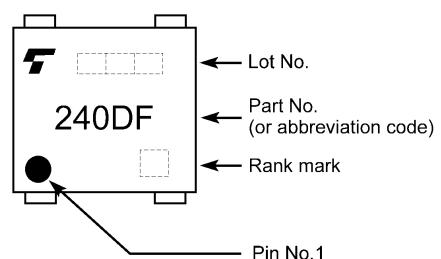
TLP240DF

**Fig. 16.2 Lead forming and taping option  
(LF4), (TP4)****17. Marking (Note)**

TLP240D



TLP240DF



Note: A different marking is used for photodiodes that have been qualified according to option (D4) of EN60747.  
See Fig.18.3 and Fig.18.4.

## 18. EN60747-5-5 Option (D4) Specification

- Part number: TLP240D (**Note**)
- The following part naming conventions are used for the devices that have been qualified according to option (D4) of EN60747.

Example: TLP240D(D4-TP1,F(O

D4: EN60747 option

TP1: Tape type

F: [[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., TLP240D(D4-TP1,F(O → TLP240D

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.

Description	Symbol	Rating	Unit
Application classification  for rated mains voltage $\leq 300$ Vrms for rated mains voltage $\leq 600$ Vrms		I-IV I-III	—
Climatic classification		40 / 085 / 21	—
Pollution degree		2	—
Maximum operating insulation voltage	TLPxxxx type	890	Vpeak
	TLPxxxxF type	1130	
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	TLPxxxx type	1424	Vpeak
	TLPxxxxF type	1808	
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	TLPxxxx type	1670	Vpeak
	TLPxxxxF type	2120	
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 $I_F$ , $P_{so} = 0$ ) power (output or total power dissipation) temperature	$I_{si}$ $P_{so}$ $T_s$	400 700 150	mA mW °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. 18.1 EN60747 Insulation Characteristics

Table 18.1 Insulation Related Specifications (Note)

Insulation Related Parameters	Symbol	TLP240D	TLP240DF
Minimum creepage distance	Cr	7.0 mm	8.0 mm
Minimum clearance	Cl	7.0 mm	8.0 mm
Minimum insulation thickness	ti	0.4 mm	0.4 mm
Comparative tracking index	CTI	175	175

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 7.5 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. 18.2 Marking on Packing for EN60747

TLP240D

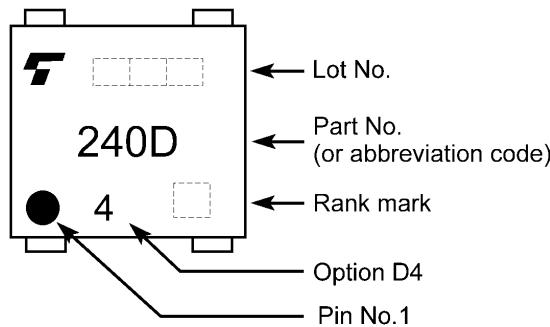


Fig. 18.3 Marking Example (Note)

TLP240DF

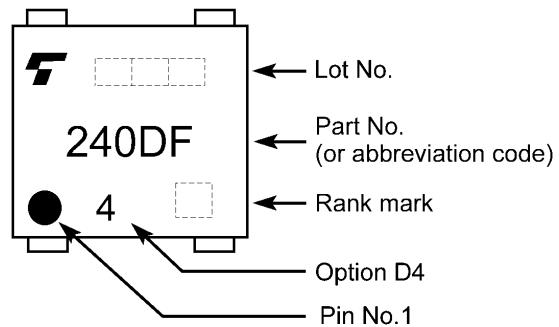


Fig. 18.4 Marking Example (Note)

Note: The above marking is applied to the photocouplers that have been qualified according to option (D4) of EN60747.

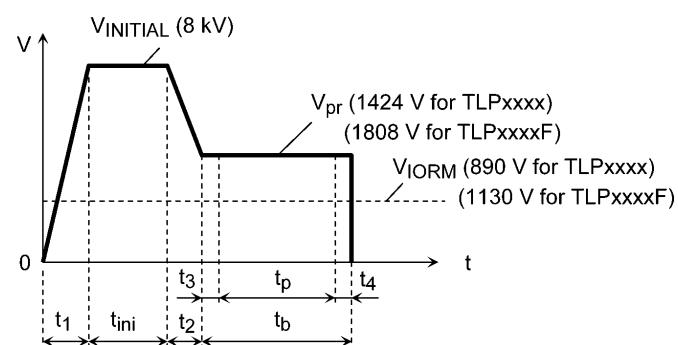
Figure

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



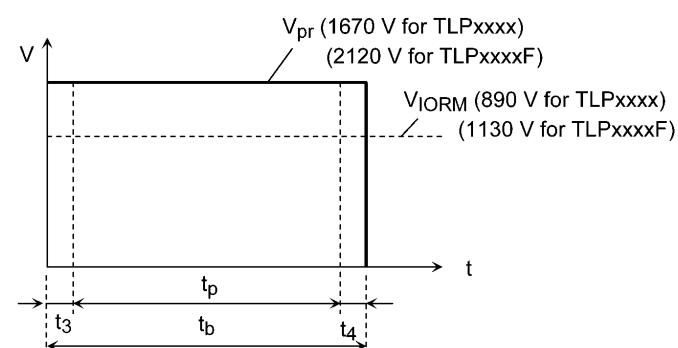
Figure

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

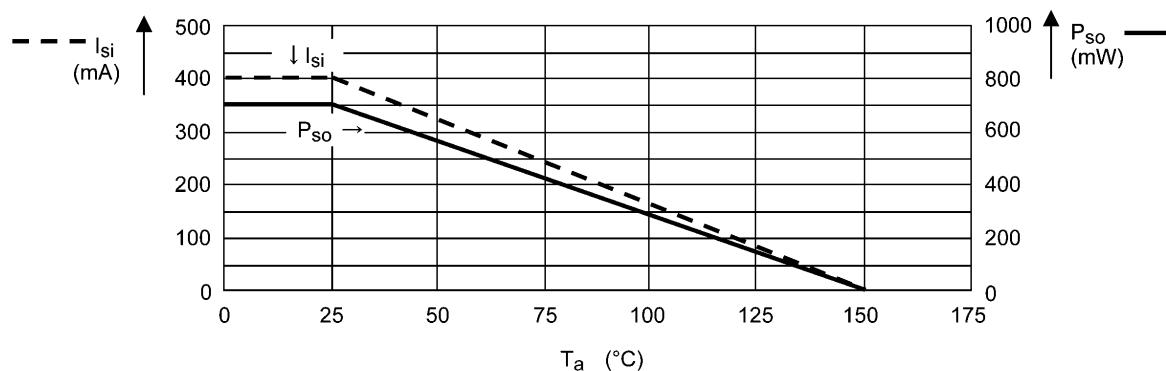
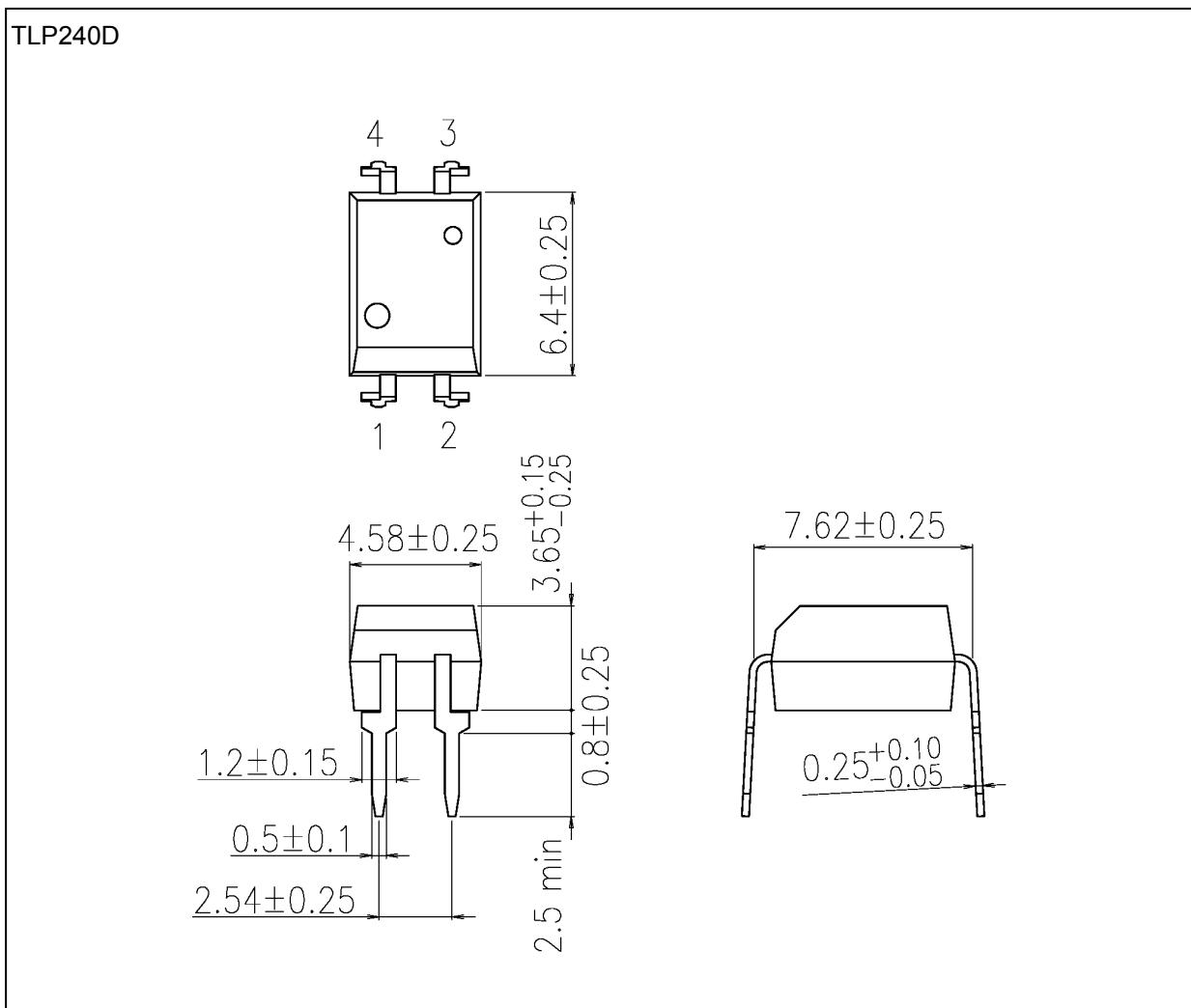


Fig. 18.5 Measurement Procedure

**Package Dimensions**

Unit: mm

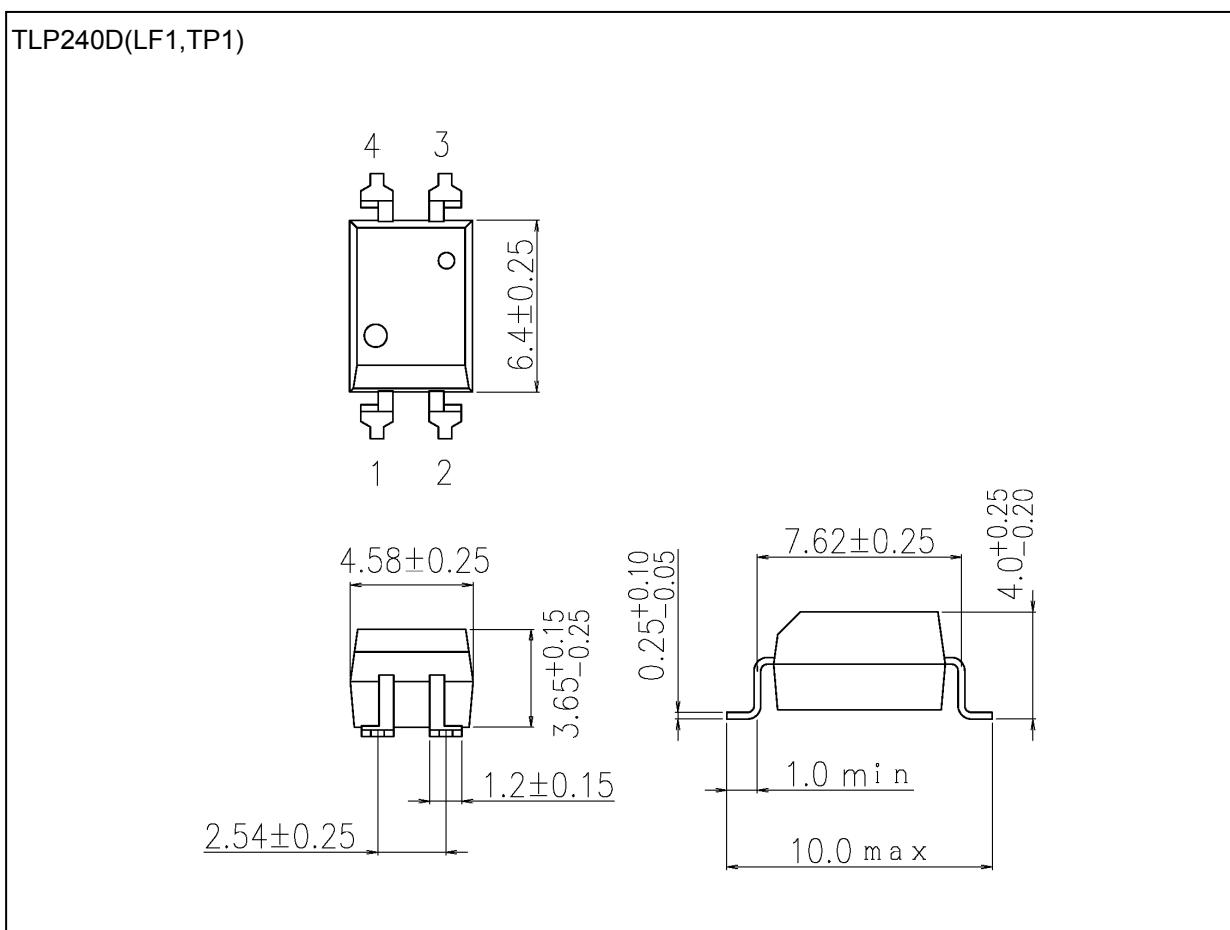


Weight: 0.26 g (typ.)

Package Name(s)
TOSHIBA: 11-5B2S

**Package Dimensions**

Unit: mm

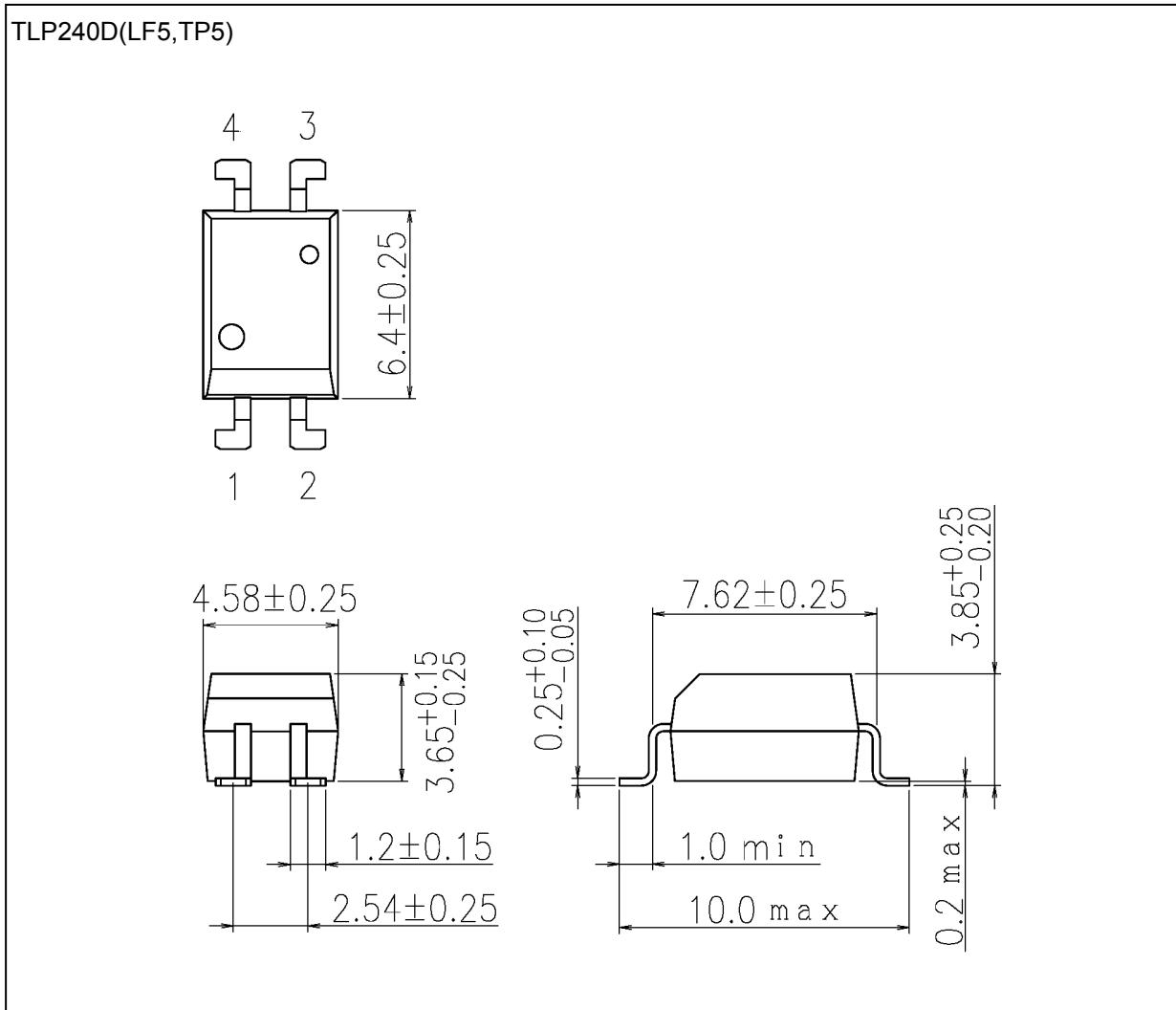


Weight: 0.25 g (typ.)

Package Name(s)
TOSHIBA: 11-5B201S

**Package Dimensions**

Unit: mm



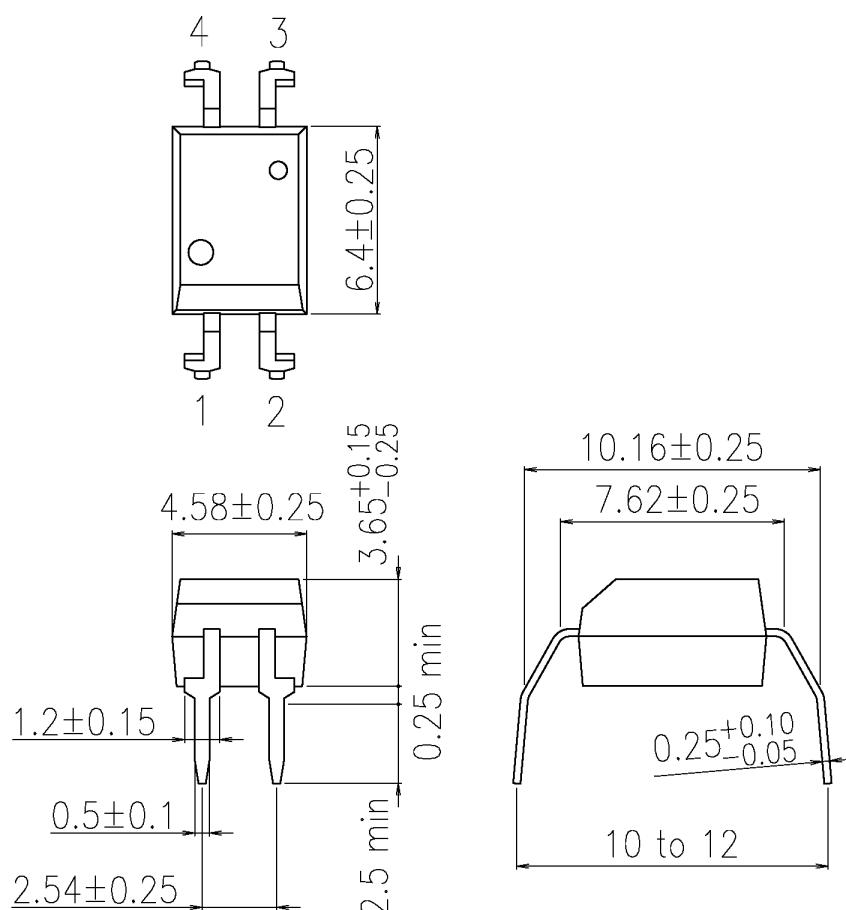
Weight: 0.25 g (typ.)

Package Name(s)
TOSHIBA: 11-5B205S

**Package Dimensions**

Unit: mm

TLP240DF

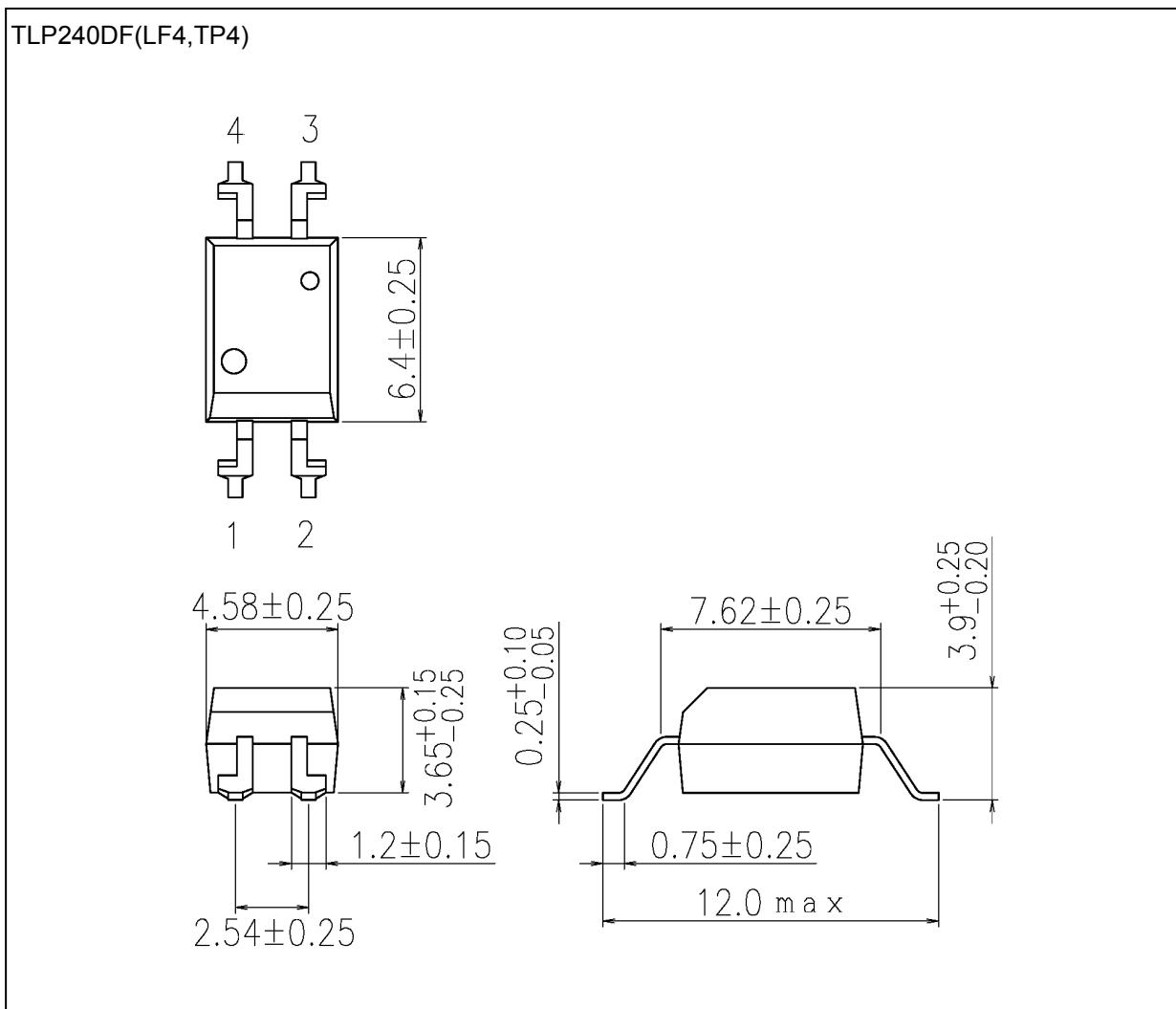


Weight: 0.26 g (typ.)

Package Name(s)
TOSHIBA: 11-5B202S

**Package Dimensions**

Unit: mm



Weight: 0.25 g (typ.)

Package Name(s)
TOSHIBA: 11-5B204S

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