

TLP3548, TLP3548F

1. Applications

- Mechanical relay replacements
- Factory Automation (FA)
- Programmable Logic Controllers (PLCs)
- Measuring Instruments
- ATE (Automatic Test Equipment)

2. General

The TLP3548 and TLP3548F photorelay consist of a photo MOSFET optically coupled to an infrared light emitting diode. It is housed in a 8-pin DIP package. The low ON-state resistance and the high permissible ON-state current of the TLP3548 and TLP3548F make it suitable for power line control applications.

3. Features

- (1) Normally opened (1-Form-A)
- (2) OFF-state output terminal voltage: 400 V (min)
- (3) Trigger LED current: 1 mA (max)
- (4) ON-state current: 0.4 A (max) (A connection)
- (5) ON-state resistance: 5 Ω (max) (A connection)
- (6) Isolation voltage: 2500 Vrms (min)
- (7) Safety standards

UL-recognized: UL 1577, File No.E67349

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

UL-recognized: UL 508, File No.E499232 (**Note 1**)

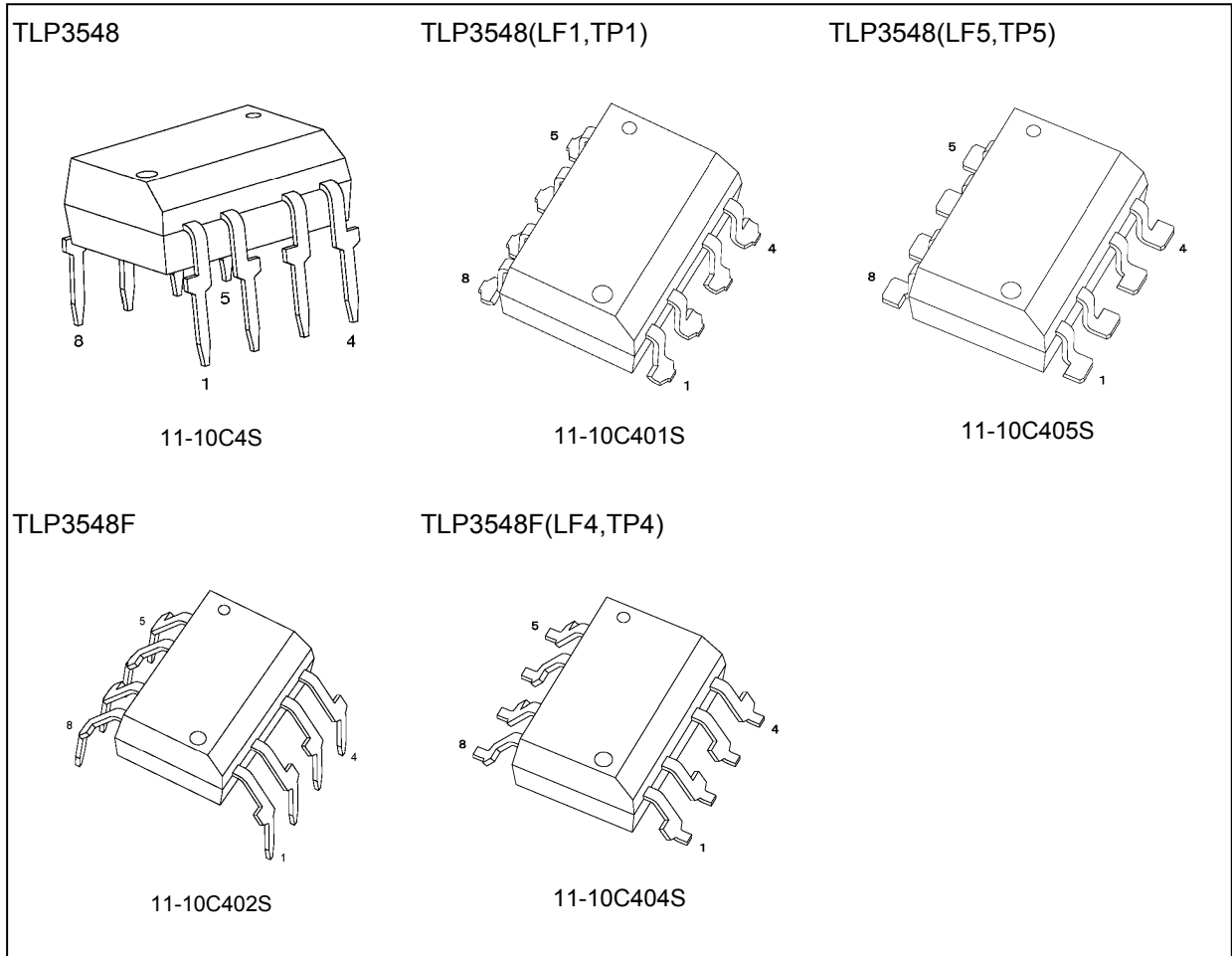
Note 1: Please refer Absolute Maximum Ratings (UL-recognized UL 508) for UL 508 products.

4. Mechanical Parameters

Characteristics	7.62-mm Pitch TLP3548	10.16-mm Pitch TLP3548F	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)	

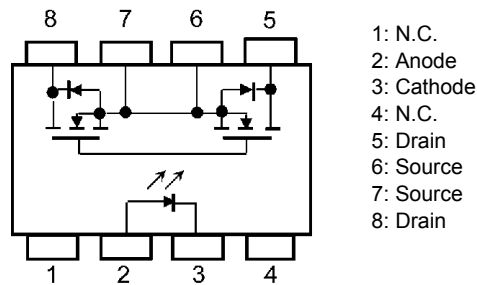
Start of commercial production
2016-05

5. Packaging (Note)

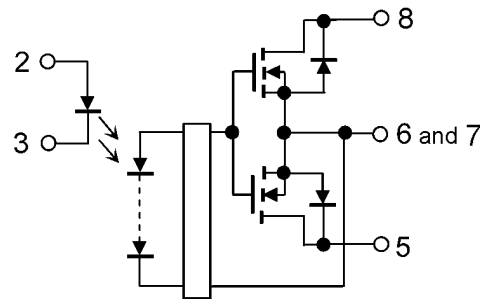


Note: Through-hole type: TLP3548, TLP3548F
 Lead forming option: (LF1), (LF4), (LF5)
 Taping option: (TP1), (TP4), (TP5)

6. Pin Assignment



7. Internal Circuit



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

	Characteristics	Symbol	Note	Rating	Unit
LED	Input forward current	I_F		30	mA
	Input forward current derating ($T_a \geq 25\text{ }^\circ\text{C}$)	$\Delta I_F / \Delta T_a$		-0.3	mA/ $^\circ\text{C}$
	Input forward current (pulsed) (100 μs pulse, 100 pps)	I_{FP}		1	A
	Input reverse voltage	V_R		5	V
	Input power dissipation	P_D		50	mW
	Input power dissipation derating ($T_a \geq 25\text{ }^\circ\text{C}$)	$\Delta P_D / \Delta T_a$		-0.5	mW/ $^\circ\text{C}$
	Junction temperature	T_j		125	$^\circ\text{C}$
Detector	OFF-state output terminal voltage	V_{OFF}		400	V
	ON-state current (A connection)	I_{ON}	(Note 1)	0.4	A
	ON-state current (B connection)			0.4	
	ON-state current (C connection)			0.8	
	ON-state current derating (A connection) ($T_a \geq 25\text{ }^\circ\text{C}$)	$\Delta I_{ON} / \Delta T_a$	(Note 1)	-4.0	mA/ $^\circ\text{C}$
	ON-state current derating (B connection) ($T_a \geq 25\text{ }^\circ\text{C}$)			-4.0	
	ON-state current derating (C connection) ($T_a \geq 25\text{ }^\circ\text{C}$)			-8.0	
	ON-state current (pulsed) ($t = 100\text{ ms}$, duty = 1/10)	I_{ONP}		1.2	A
	Output power dissipation	P_O		750	mW
	Output power dissipation derating ($T_a \geq 25\text{ }^\circ\text{C}$)	$\Delta P_O / \Delta T_a$		-7.5	mW/ $^\circ\text{C}$
	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	
	Lead soldering temperature (10 s)	T_{sol}		260	
	Isolation voltage AC, 60 s, R.H. $\leq 60\%$	BV_S	(Note 2)	2500	

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: For an application circuit example, see Chapter 16.2.

Note 2: This device is considered as a two-terminal device: Pins 1, 2, 3 and 4 are shorted together, and pins 5, 6, 7 and 8 are shorted together.

9. Recommended Operating Conditions (Note)

Characteristics	Symbol	Note	Min	Typ.	Max	Unit
Supply voltage	V_{DD}		—	—	320	V
Input forward current	I_F		—	2	25	mA
ON-state current (A connection)	I_{ON}		—	—	0.4	A
Operating temperature	T_{opr}		-40	—	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 data sheet should also be considered.

10. Absolute Maximum Ratings (UL-recognized: UL 508) (Note) (Unless otherwise specified, $T_a = 25\text{ °C}$)

	Characteristics	Symbol	Note	Rating	Unit
LED	Input forward current	I_F		30	mA
	Input forward current derating ($T_a \geq 25\text{ °C}$)	$\Delta I_F/\Delta T_a$		-0.3	mA/°C
	Input forward current (pulsed) (100 μ s pulse, 100 pps)	I_{FP}		1	A
	Input reverse voltage	V_R		5	V
	Input power dissipation	P_D		50	mW
	Input power dissipation derating ($T_a \geq 25\text{ °C}$)	$\Delta P_D/\Delta T_a$		-0.5	mW/°C
	Junction temperature	T_j		105	°C
Detector	OFF-state output terminal voltage	V_{OFF}		400	V
	ON-state current (A connection)	I_{ON}	(Note 1)	0.4	A
	ON-state current (B connection)			0.4	
	ON-state current (C connection)			0.8	
	ON-state current derating (A connection) ($T_a \geq 25\text{ °C}$)	$\Delta I_{ON}/\Delta T_a$	(Note 1)	-4.0	mA/°C
	ON-state current derating (B connection) ($T_a \geq 25\text{ °C}$)			-4.0	
	ON-state current derating (C connection) ($T_a \geq 25\text{ °C}$)			-8.0	
	ON-state current (pulsed) ($t = 100\text{ ms}$, duty = 1/10)	I_{ONP}		1.2	A
	Output power dissipation	P_O		750	mW
	Output power dissipation derating ($T_a \geq 25\text{ °C}$)	$\Delta P_O/\Delta T_a$		-7.5	mW/°C
Junction temperature	T_j		105	°C	
Common	Storage temperature	T_{stg}		-55 to 125	°C
	Case temperature	T_c		105	°C
	Operating temperature	T_{opr}		-40 to 85	°C
	Lead soldering temperature (10 s)	T_{sol}		260	°C
	Isolation voltage (AC, 60 s, R.H. $\leq 60\%$)	BV_S	(Note 2)	2500	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: For an application circuit example, see Chapter 16.2.

Note 2: This device is considered as a two-terminal device: Pins 1, 2, 3 and 4 are shorted together, and pins 5, 6, 7 and 8 are shorted together.

11. Recommended Operating Conditions (UL-recognized: UL 508) (Note)

Characteristics	Symbol	Note	Min	Typ.	Max	Unit
Supply voltage	V_{DD}		—	—	320	V
Input forward current	I_F	(Note 1)	—	2	19.5	mA
ON-state current(A connection)	I_{ON}	(Note 1)	—	—	0.26	A
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 data sheet should also be considered.

Note 1: The above recommended operating conditions are at $T_a = 60^\circ\text{C}$.

However, within the derating range of the characteristic curves of " $I_F - T_a$ ", " $I_{ON} - T_a$ ", it can be used up to 85°C .

12. 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		$I_F = 10\text{ mA}$	1.50	1.64	1.80	V
	Input reverse current	I_R		$V_R = 5\text{ V}$	—	—	10	μA
	Input capacitance	C_t		$V = 0\text{ V}, f = 1\text{ MHz}$	—	70	—	pF
Detector	OFF-state current	I_{OFF}		$V_{OFF} = 400\text{ V}$	—	0.001	1	μA
	Output capacitance	C_{OFF}		$V = 0\text{ V}, f = 1\text{ MHz}$	—	410	—	pF

13. 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}		$I_{ON} = 0.4\text{ A}$	—	0.2	1.0	mA
	Return LED current	I_{FC}		$I_{OFF} = 1\text{ }\mu\text{A}$	0.01	0.19	—	
	ON-state resistance (A connection)	R_{ON}	(Note 1)	$I_{ON} = 0.4\text{ A}, I_F = 2\text{ mA}, t < 1\text{ s}$	—	3.0	5.0	Ω
	ON-state resistance (B connection)			$I_{ON} = 0.4\text{ A}, I_F = 2\text{ mA}, t < 1\text{ s}$	—	—	2.5	
	ON-state resistance (C connection)			$I_{ON} = 0.8\text{ A}, I_F = 2\text{ mA}, t < 1\text{ s}$	—	—	1.3	

Note 1: For an application circuit example, see Chapter 16.2.

14. 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)	$V_S = 500\text{ V}, R.H. \leq 60\%$	5×10^{10}	10^{14}	—	Ω
Isolation voltage	BV_S	(Note 1)	AC, 60 s	2500	—	—	Vrms

Note 1: This device is considered as a two-terminal device: Pins 1, 2, 3 and 4 are shorted together, and pins 5, 6, 7 and 8 are shorted together.

15. 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. 15.1.	—	0.22	1.0	ms
Turn-off time	t_{OFF}		$R_L = 200\text{ }\Omega, V_{DD} = 20\text{ V}, I_F = 5\text{ mA}$	—	0.08	1.0	

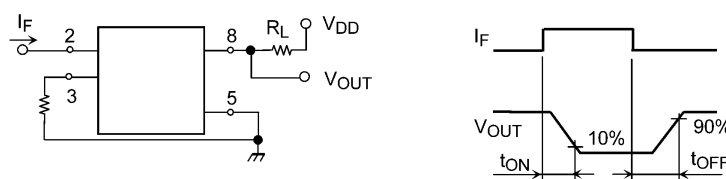


Fig. 15.1 Switching Time Test Circuit and Waveform

16. Characteristics Curves and Circuit Connections

16.1. Characteristics Curves (Note)

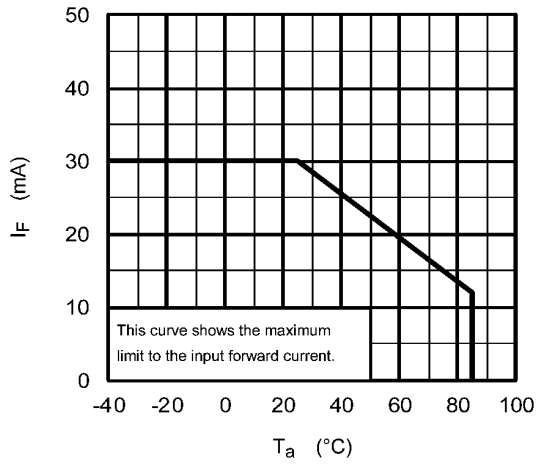


Fig. 16.1.1 $I_F - T_a$

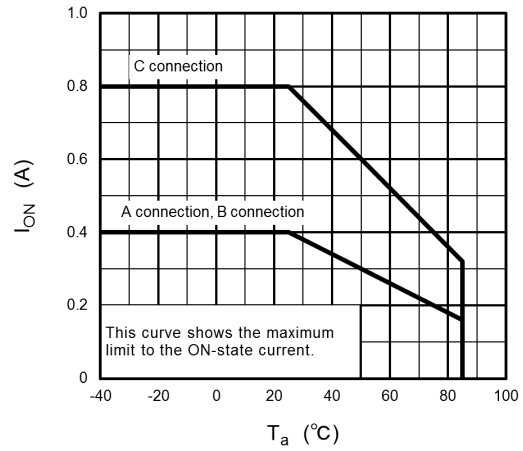


Fig. 16.1.2 $I_{ON} - T_a$

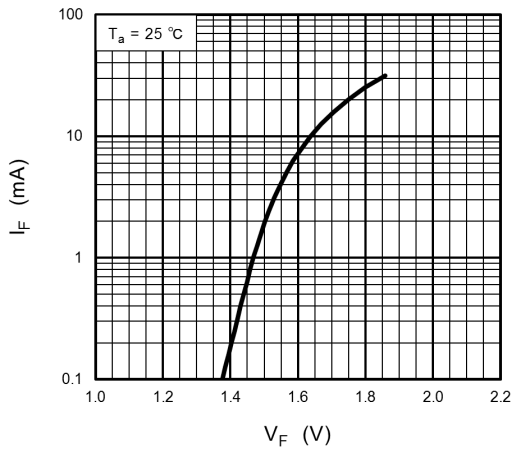


Fig. 16.1.3 $I_F - V_F$

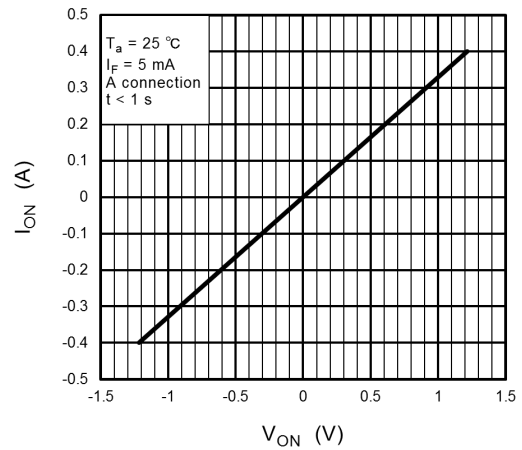


Fig. 16.1.4 $I_{ON} - V_{ON}$

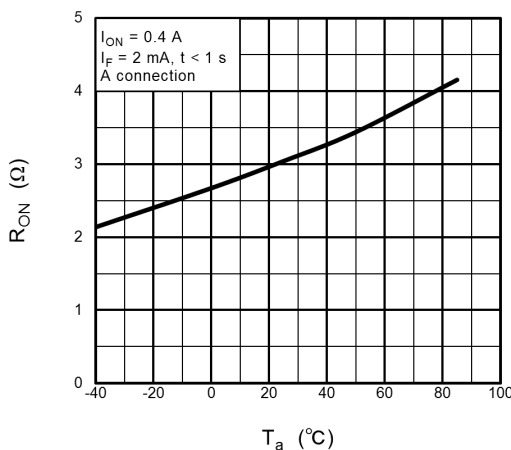


Fig. 16.1.5 $R_{ON} - T_a$

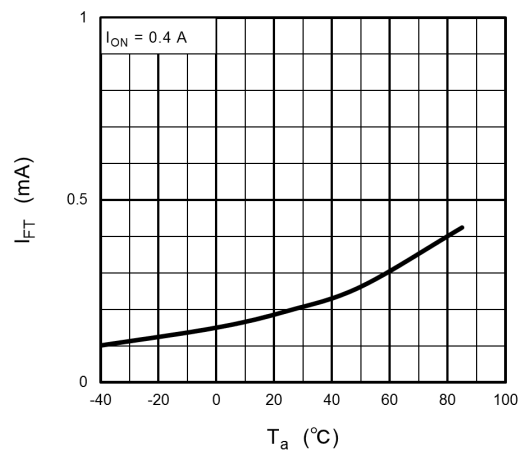


Fig. 16.1.6 $I_{FT} - T_a$

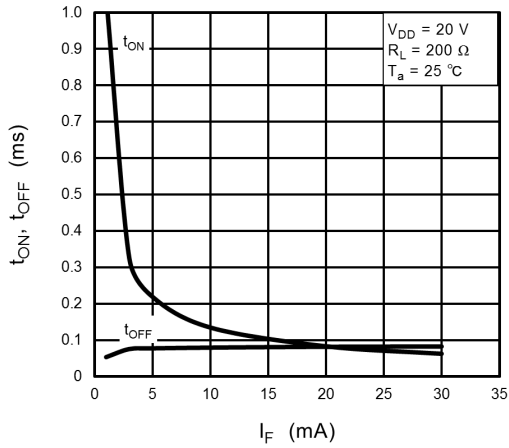


Fig. 16.1.7 $t_{ON}, t_{OFF} - I_F$

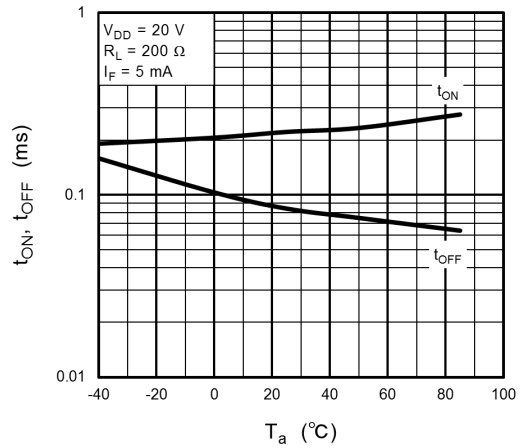


Fig. 16.1.8 $t_{ON}, t_{OFF} - T_a$

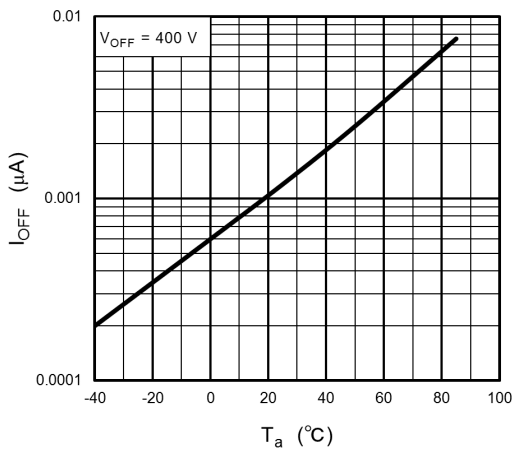


Fig. 16.1.9 $I_{OFF} - T_a$

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

16.2. Circuit Connections

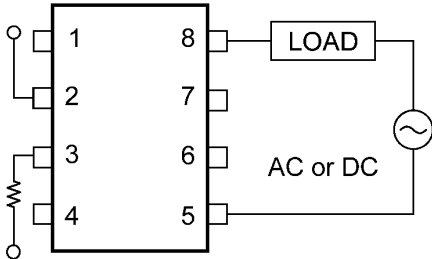


Fig. 16.2.1 A Connection

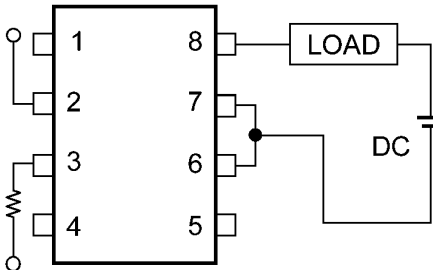


Fig. 16.2.2 B Connection

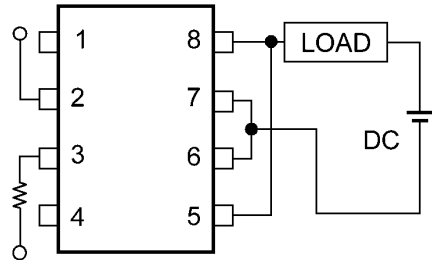


Fig. 16.2.3 C Connection

17. Soldering and Storage

17.1. 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.

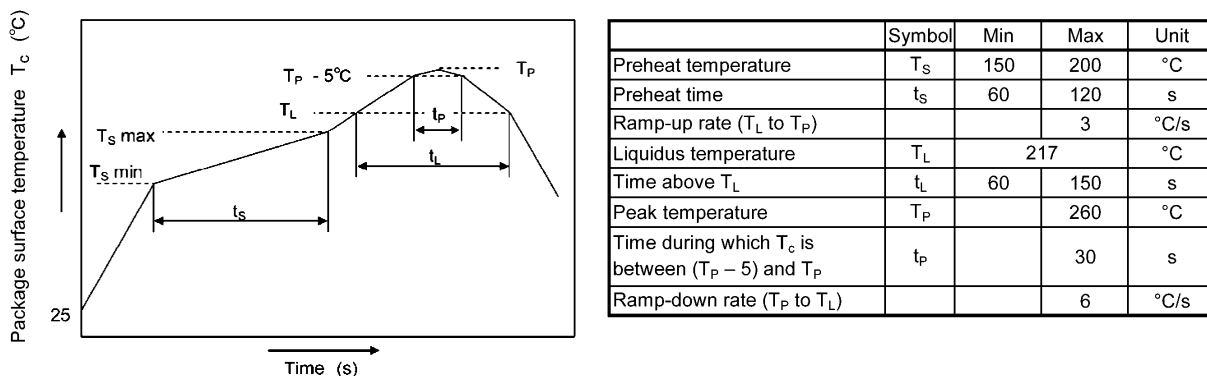


Fig. 17.1.1 An Example of a Temperature Profile When Lead(Pb)-Free Solder Is Used

- 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.

17.2. 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.

18. Land Pattern Dimensions (for reference only)

(Unit: mm)

TLP3548

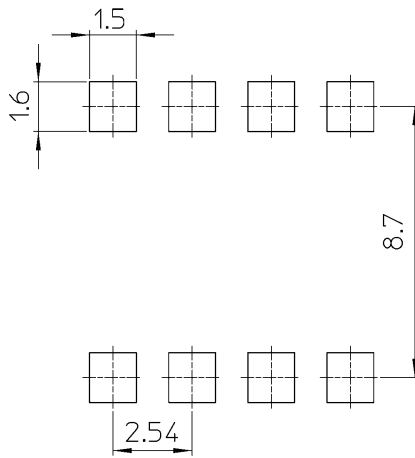


Fig. 18.1 Lead forming and taping option
(LF1), (TP1), (LF5), (TP5)

TLP3548F

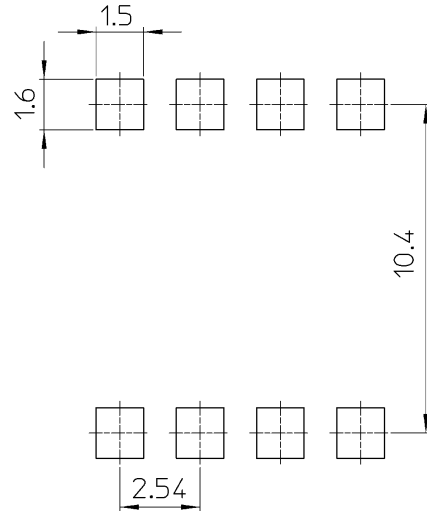
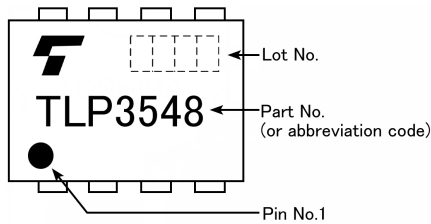


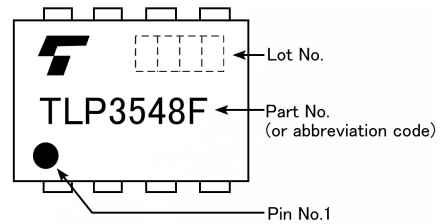
Fig. 18.2 Lead forming and taping option
(LF4), (TP4)

19. Marking

TLP3548



TLP3548F



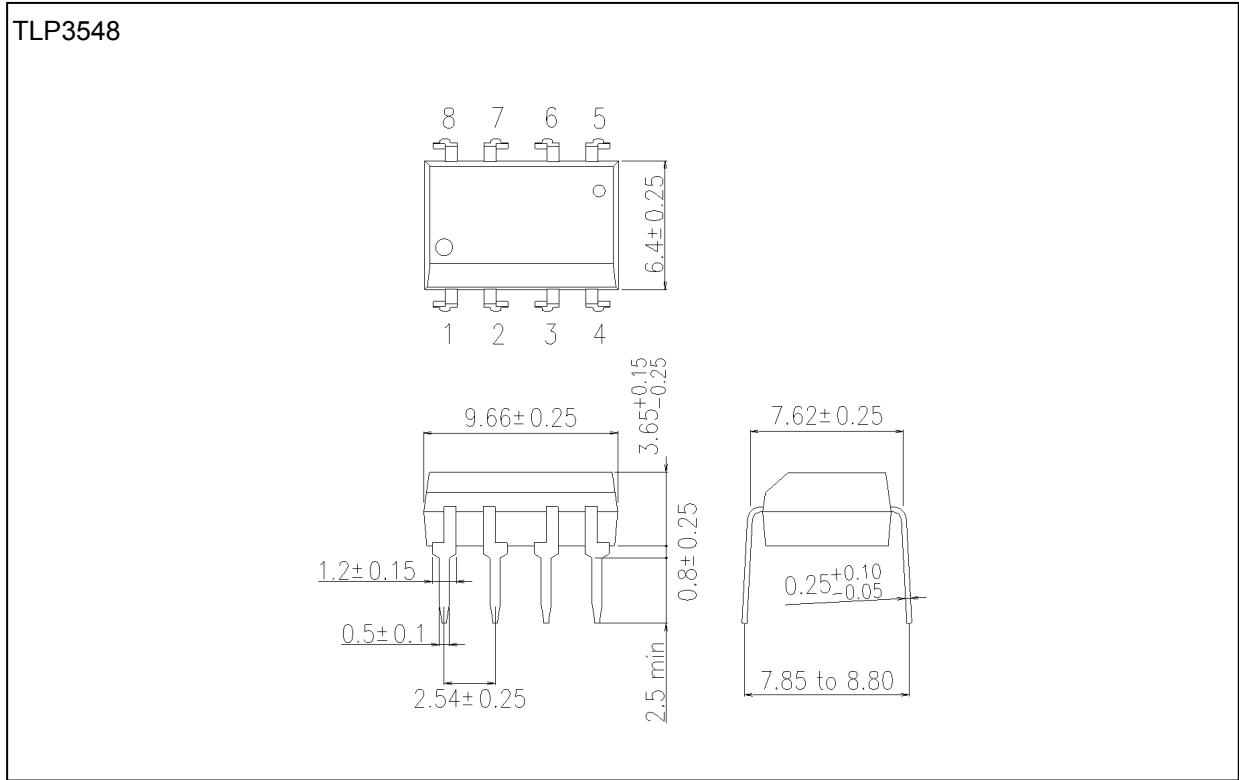
20. Ordering Information (Example of Item Name)

Item Name	Packaging (Note 1)	Packing (MOQ)
TLP3548(F)	TH	Magazine (50 pcs)
TLP3548(LF1,F)	LF1	Magazine (50 pcs)
TLP3548(LF5,F)	LF5	Magazine (50 pcs)
TLP3548(TP1,F)	LF1	Tape and reel (1500 pcs)
TLP3548(TP5,F)	LF5	Tape and reel (1500 pcs)
TLP3548F(F)	TH, Wide forming	Magazine (50 pcs)
TLP3548F(LF4,F)	LF4, Wide forming	Magazine (50 pcs)
TLP3548F(TP4,F)	LF4, Wide forming	Tape and reel (1000 pcs)

Note 1: TH: Through-hole, LF/TP: Lead forming for surface mount

Package Dimensions

Unit: mm



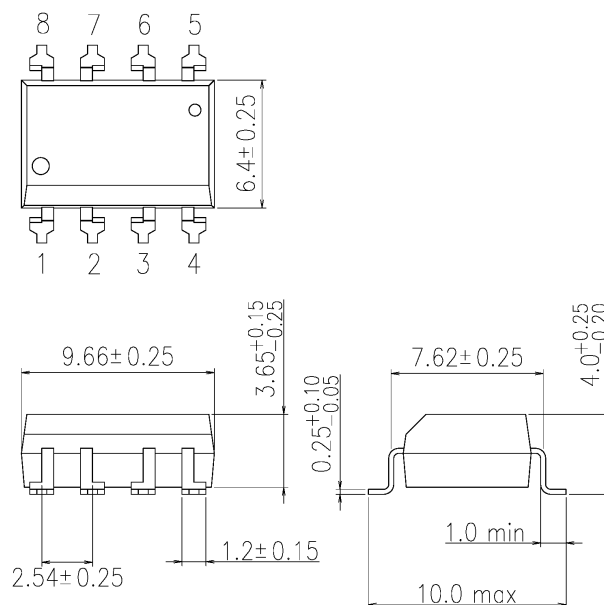
Weight: 0.54 g (typ.)

Package Name(s)
TOSHIBA: 11-10C4S

Package Dimensions

Unit: mm

TLP3548(LF1, TP1)

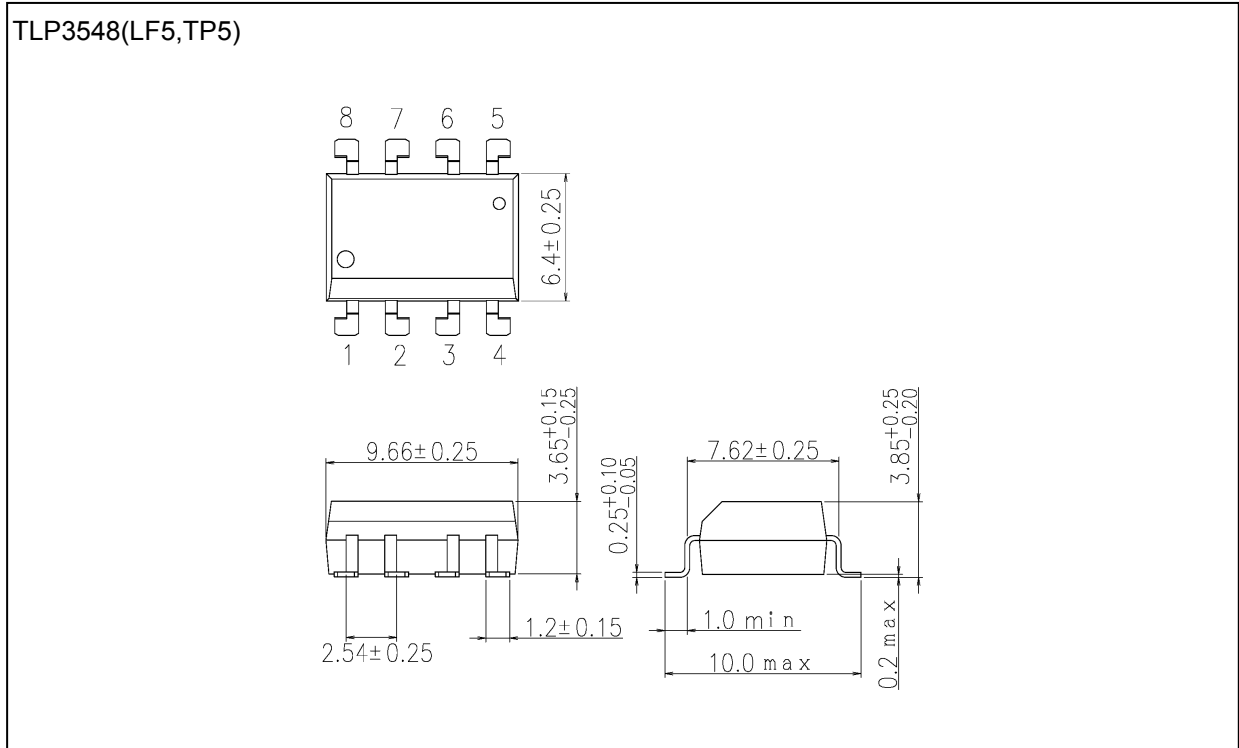


Weight: 0.53 g (typ.)

Package Name(s)
TOSHIBA: 11-10C401S

Package Dimensions

Unit: mm

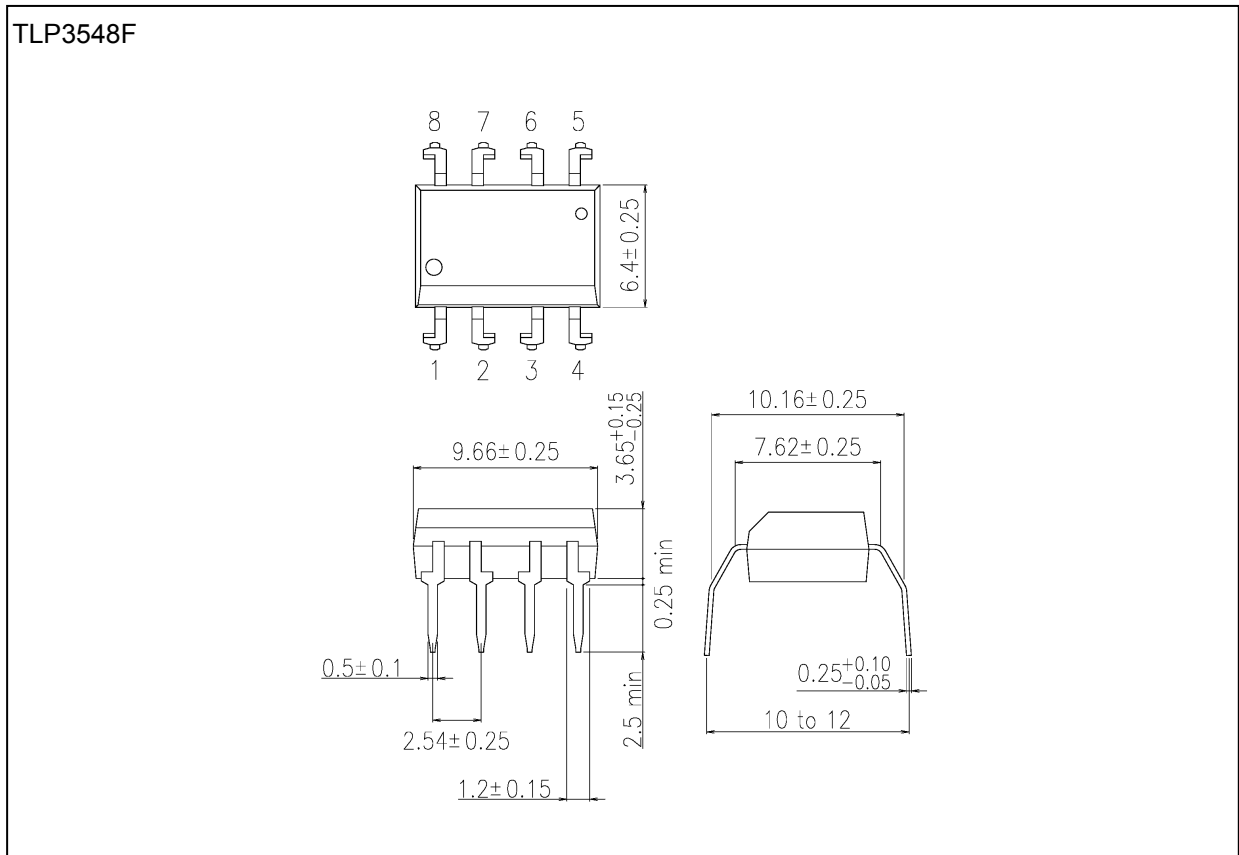


Weight: 0.53 g (typ.)

Package Name(s)
TOSHIBA: 11-10C405S

Package Dimensions

Unit: mm

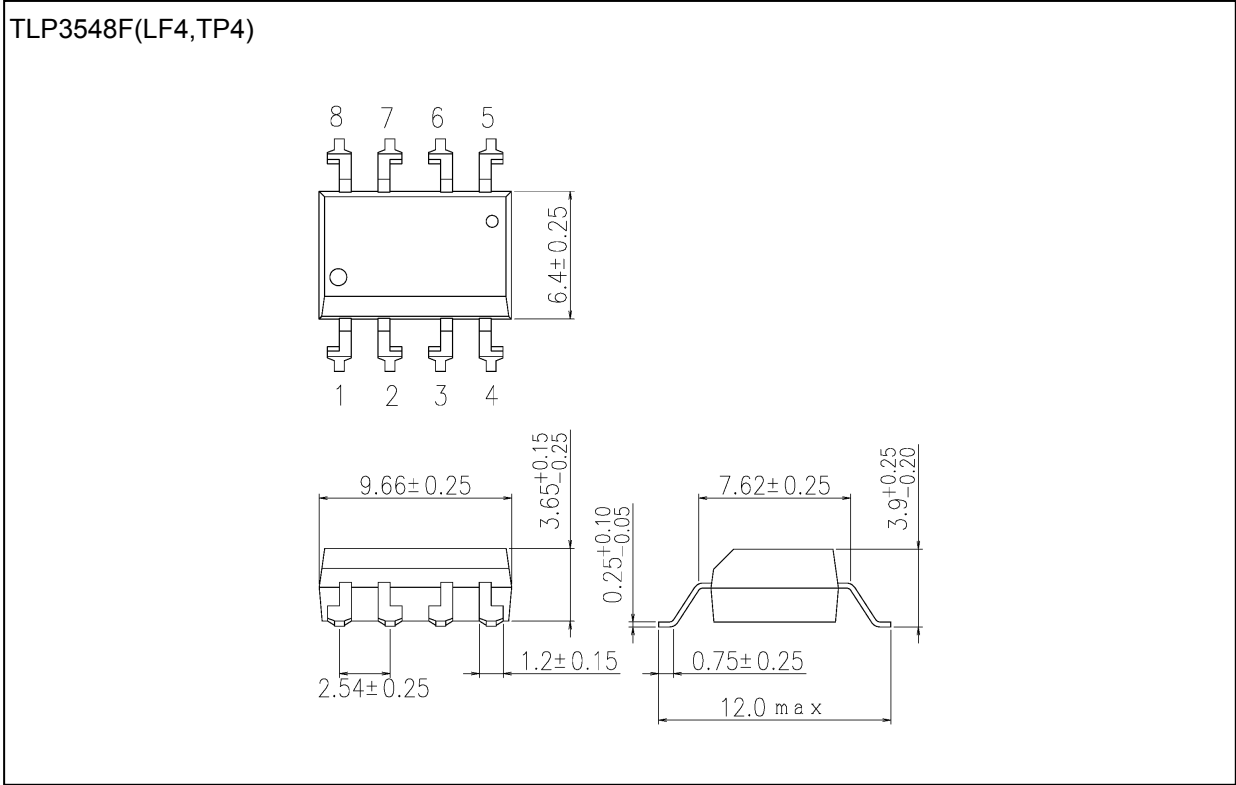


Weight: 0.54 g (typ.)

Package Name(s)
TOSHIBA: 11-10C402S

Package Dimensions

Unit: mm



Weight: 0.53 g (typ.)

Package Name(s)
TOSHIBA: 11-10C404S

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