Photocouplers GaAℓAs Infrared LED & Photo Transistor

TLP188

1. Applications

- Programmable Logic Controllers (PLCs)
- Air Conditioner Inverters

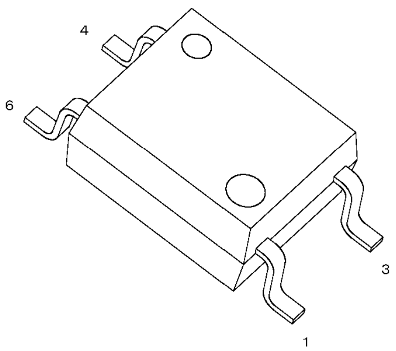
2. General

TLP188 consists of phototransistors optically coupled to GaAℓAs infrared emitting diodes. The TLP188 is housed in the very small and thin SO6(4pin) package and that guarantees high temperature operation(T_a = 110°C max). With the high brakedown voltage between the collector and emitter(V_{CEO} = 350V), TLP188 is suitable for use in programmable logiccontrollers (PLCs), and home appliances, include air conditioners.

3. Features

(1) Collector-emitter voltage: 350 V (min)
(2) Current transfer ratio: 50% (min)
Rank GB: 100% (min)
(3) Isolation voltage: 3750 Vrms (min)
(4) Operating temperature: -55 to 110°C
(5) Safety standards
UL-Under application UL1577 File No.E67349
cUL-Under application CSA Component Acceptance Service No.5A File No.E67349
BSI-Under application BS EN60065:2002, BS EN60950-1:2002
VDE-Under application EN60747-5-5 Certificate No. 40009347 (Note)
Note: When an EN60747-5-5 approved type is needed, please designate the Option (V4).

4. Packaging and Pin Configuration



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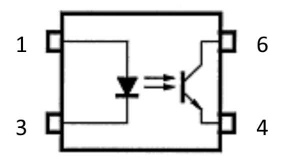


1: Anode
3: Cathode
4: Emitter
6: Collector

5. Principle of Operation

5.1. 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°C)

	Characteristics		Symbol	Note	Rating	Unit
LED	Input forward current		I_F		50	mA
	Input forward current derating	($T_a \geq$ 90°C)	$\Delta I_F/\Delta T_a$		-1.43	mA/°C
	Input forward current (pulsed)		I_{FP}	(Note 1)	1	A
	Input reverse voltage		V_R		5	V
	Junction temperature		T_j		125	°C
Detector	Collector-emitter voltage		V_{CEO}		350	V
	Emitter-collector voltage		V_{ECO}		7	
	Collector current		I_C		50	mA
	Collector power dissipation		P_C		150	mW
	Collector power dissipation derating	($T_a \geq$ 25°C)	$\Delta P_C/\Delta T_a$		-1.5	mW/°C
	Junction temperature		T_j		125	°C
Common	Operating temperature		T_{opr}		-55 to 110	
	Storage temperature		T_{stg}		-55 to 125	
	Lead soldering temperature	(10 s)	T_{sol}		260	
	Total power dissipation		P_T		200	mW
	Input power dissipation derating	($T_a \geq$ 25°C)	$\Delta P_D/\Delta T_a$		-2	mW/°C
	Isolation voltage	AC, 1min, R.H. ≤ 60%	BV_S	(Note 2)	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: Pulse width (PW) ≤ 100 μs, f = 100 Hz

Note 2: 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. 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	1.25	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	Collector-emitter breakdown voltage	$V_{(BR)CEO}$		I_C = 0.1 mA	350	—	—	V
	Emitter-collector breakdown voltage	$V_{(BR)ECO}$		I_E = 0.1 mA	7	—	—	
	Dark Current	I_{DARK}		V_{CE} = 300 V	—	0.01	0.2	μA
				V_{CE} = 300 V, T_a = 85°C	—	—	50	
	Collector-emitter capacitance	C_{CE}		V = 0 V, f = 1 MHz	—	10	—	pF

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

Characteristics	Symbol	Note	Test Condition	Min	Typ.	Max	Unit
Current transfer ratio	I_C/I_F	(Note 1)	I_F = 5 mA, V_{CE} = 5 V	50	—	600	%
			I_F = 5 mA, V_{CE} = 5 V, Rank GB	100	—	600	
Saturated current transfer ratio	$I_C/I_{F(sat)}$		I_F = 1 mA, V_{CE} = 0.4 V	—	60	—	
			I_F = 1 mA, V_{CE} = 0.4 V, Rank GB	30	—	—	
Collector-emitter saturation voltage	$V_{CE(sat)}$		I_C = 2.4 mA, I_F = 8 mA	—	—	0.4	V
			I_C = 0.2 mA, I_F = 1 mA	—	0.2	—	
			I_C = 0.2 mA, I_F = 1 mA, Rank GB	—	—	0.4	
OFF-state collector current	$I_{C(off)}$		V_F = 0.7 V, V_{CE} = 350 V	—	—	200	μA

Note 1: See Table 8.1 for current transfer ratio.

Table 8.1 Current transfer ratio (CTR) Rank (Note) (Unless otherwise specified, T_a = 25°C)

Rank	Test Condition	Current transfer ratio I_C/I_F Min	Current transfer ratio I_C/I_F Max	Marking of Classification	Unit
Blank	I_F = 5 mA, V_{CE} = 5 V	50	600	Blank	%
GB		100	600	GB	

Note: Specify both the part number and a rank in this format when ordering.
Example: TLP188(GB)
For safety standard certification, however, specify the part number alone.
Example: TLP188(GB,E: TLP188

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

Characteristics	Symbol	Note	Test Conditions	Min	Typ.	Max	Unit
Total capacitance (input to output)	C_S	Note1	V_S = 0 V, f = 1 MHz	—	0.8	—	pF
Isolation resistance	R_S	Note1	V_S = 500 V, R.H. ≤ 60%	5×10^{12}	10^{14}	—	Ω
Isolation voltage	BV_S	Note1	AC, 1 min	3750	—	—	Vrms
			AC, 1s in oil	—	10000	—	
			DC, 1min in oil	—	10000	—	Vdc

Note1: This device is considered as a two-terminal device: Pins 1 and 3 are shorted together, and pins 4 and 6 are shorted together.

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

Characteristics	Symbol	Note	Test Condition	Min	Typ.	Max	Unit
Rise time	t_r		V_{CC} = 10 V, I_C = 2 mA, R_L = 100 Ω	—	2	—	μs
Fall time	t_f			—	3	—	
Turn-on time	t_{on}			—	3	—	
Turn-off time	t_{off}			—	3	—	
Turn-on time	t_{on}		See Figure 10.1 R_L = 1.9 kΩ, V_{CC} = 5 V, I_F = 16 mA	—	3	—	
Storage time	t_s			—	60	—	
Turn-off time	t_{off}			—	80	—	

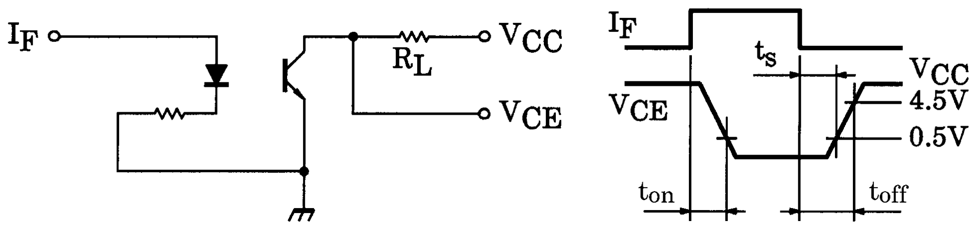


Fig. 10.1 Switching Time Test Circuit

11. Characteristics Curves (Note)

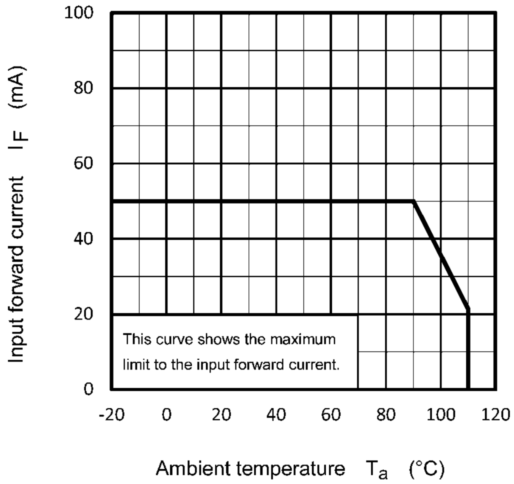


Fig. 11.1 I_F - T_a

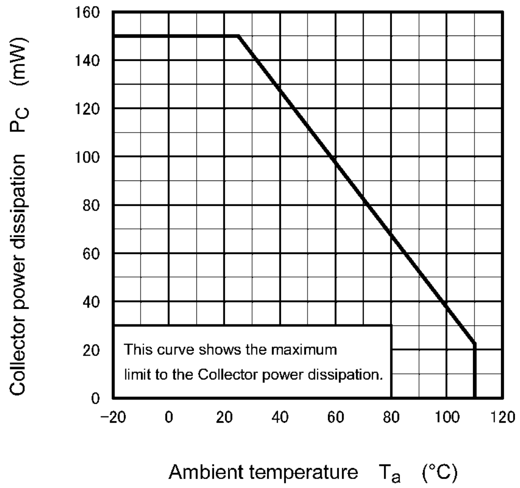


Fig. 11.2 P_C - T_a

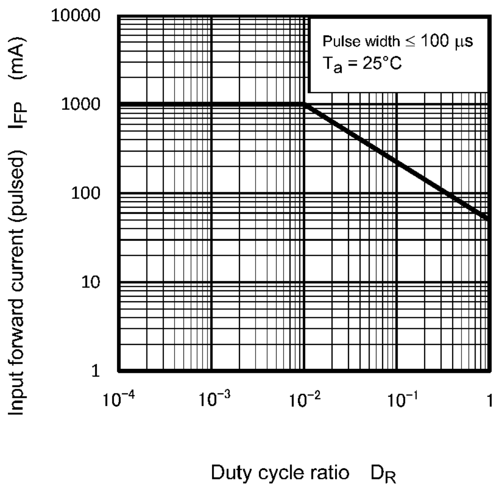


Fig. 11.3 I_{FP} - D_R

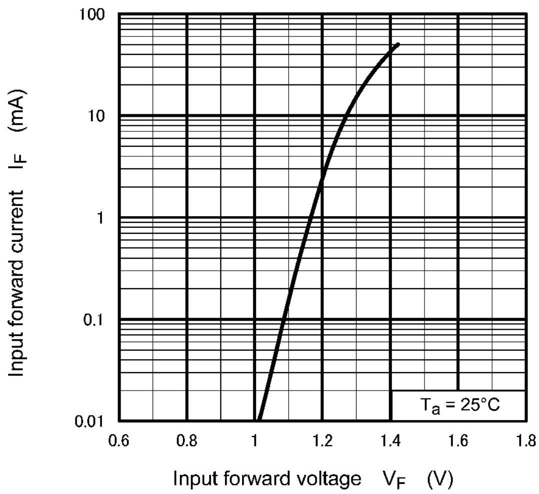


Fig. 11.4 I_F - V_F

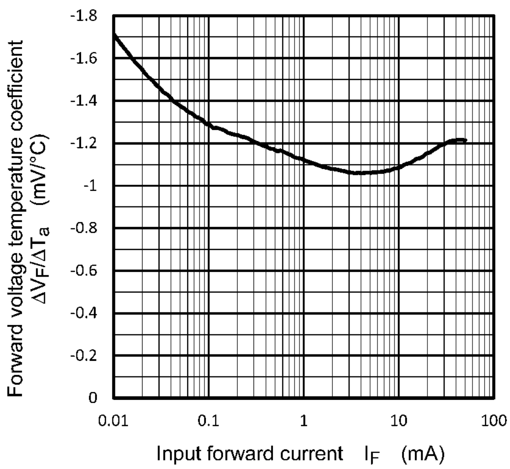


Fig. 11.5 $\Delta V_F/\Delta T_a$ - I_F

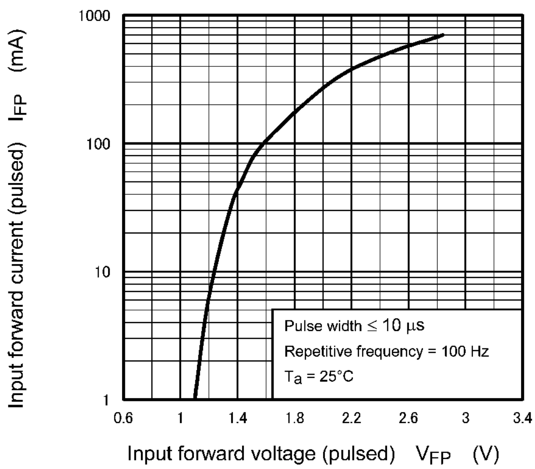


Fig. 11.6 I_{FP} - V_{FP}

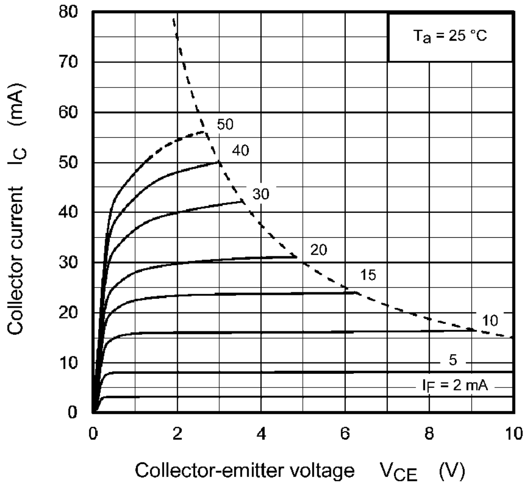


Fig. 11.7 I_C - V_{CE}

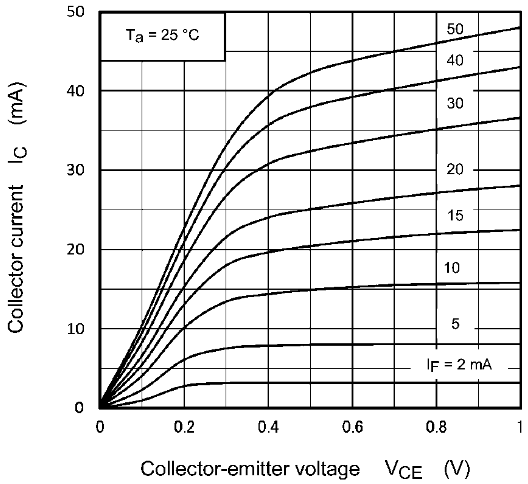


Fig. 11.8 I_C - V_{CE}

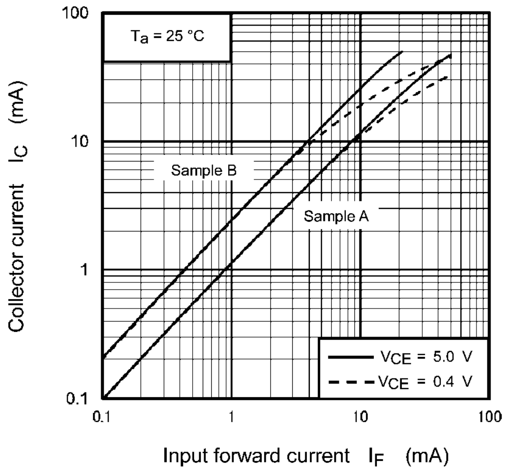


Fig. 11.9 I_C - I_F

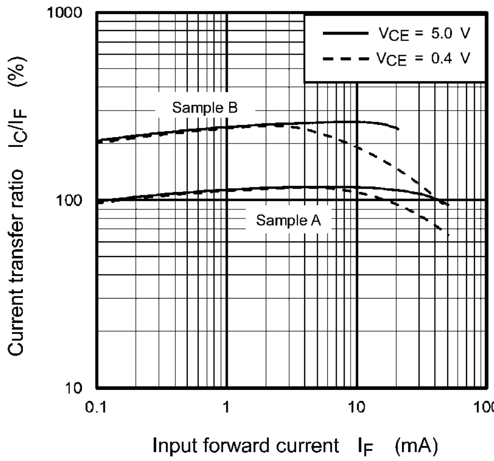


Fig. 11.10 I_C/I_F - I_F

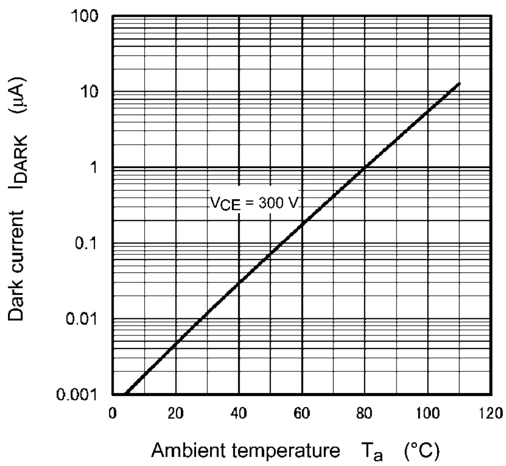


Fig. 11.11 I_{DARK} - T_a

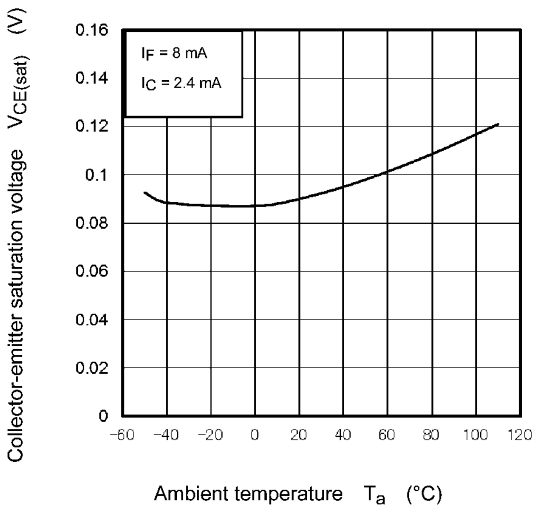


Fig. 11.12 $V_{CE(sat)}$ - T_a

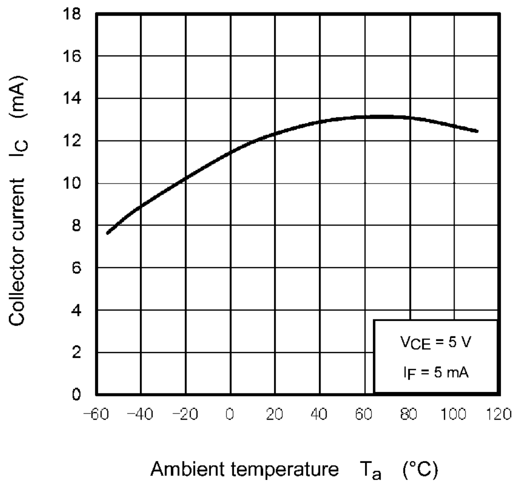


Fig. 11.13 I_C - T_a

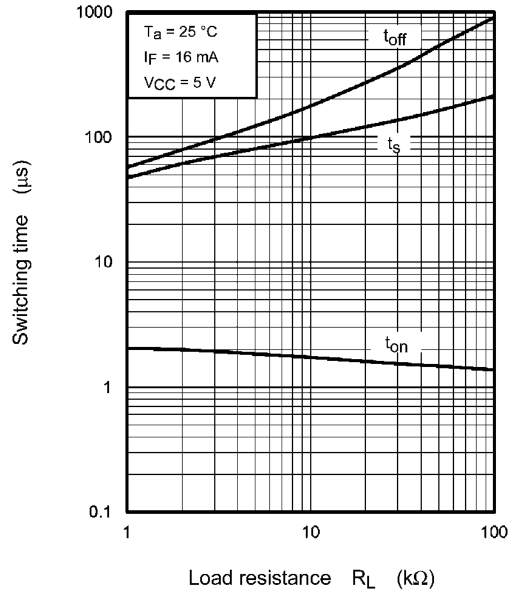


Fig. 11.14 Switching Time - R_L

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

12. Soldering and Storage

12.1. 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 Fig. 12.1.1 and 12.1.2)
  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.

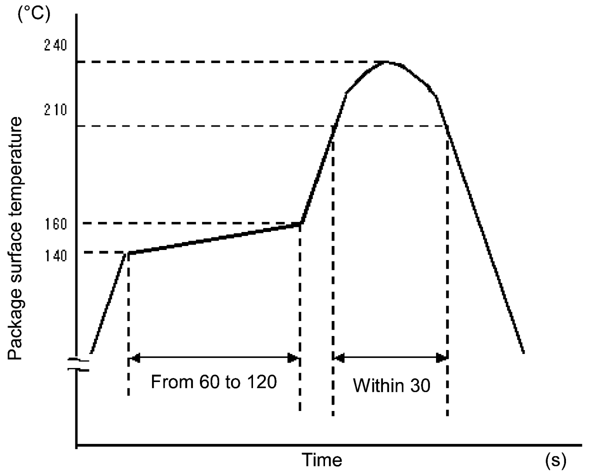


Fig. 12.1.1 An Example of a Temperature Profile When Sn-Pb Eutectic Solder is Used

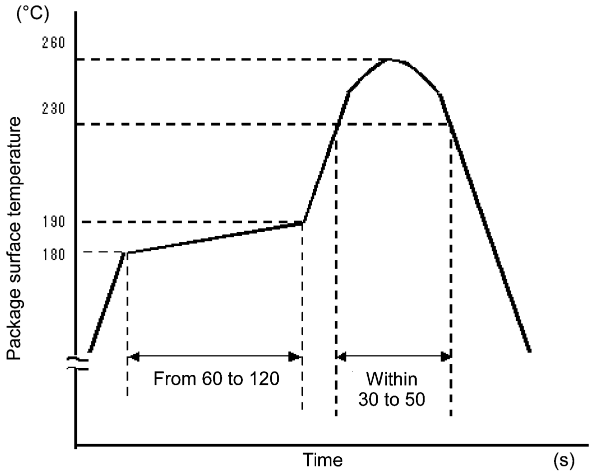


Fig. 12.1.2 An Example of a Temperature Profile When Lead(Pb)-Free Solder is Used

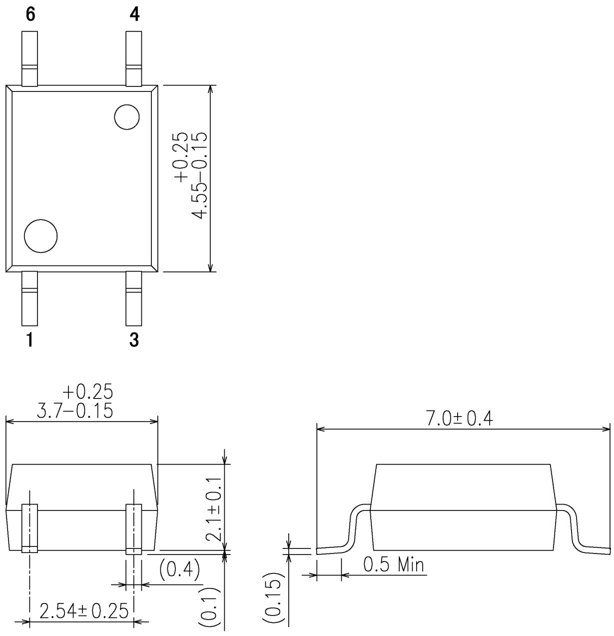
- When using soldering flow (Applicable to both eutectic solder and Lead(Pb)-Free solder)
  Apply preheating of 150°C for 60 to 120 seconds.
  Mounting condition of 260°C within 10 seconds is recommended.
  Flow soldering must be performed once.
- When using soldering Iron
  Complete soldering within 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.

12.2. 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.

Package Dimensions

Unit: mm



Weight: 0.08 g (typ.)

Package Name(s)
TOSHIBA: 11-4M1S

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