Photocouplers GaAℓAs Infrared LED & Photo IC

TLP2301

1. Applications

- Industrial Inverters
- Communications Equipment
- Home Electric Appliances

2. General

The Toshiba TLP2301 consists of a high-speed detector based on the photo-transistor optically coupled to GaAℓAs infrared emitting diodes. It is housed in the SO6 package. The TLP2301 has realized the early switching characteristics by several kΩ resistance. The TLP2301 correspond to the transmission rate of 20 kbps, and has become a product which fills between a general-purpose transistor coupler and IC couplers corresponding to 1 Mbps.

3. Features

(1) Collector-emitter voltage: 40 V (min)

(2) Current transfer ratio: 50% (min) (@I_F = 1 mA, V_{CE} = 5 V)
Rank GB: 100% (min) (@I_F = 1 mA, V_{CE} = 5 V)

(3) Isolation voltage: 3750 Vrms (min)

(4) Propagation delay time: t_{pHL} = 30 μs (max), t_{pLH} = 30 μs (max) @ I_F = 1 mA, R_L = 10 kΩ, T_a = 25 ℃

(5) Operating temperature: -55 to 125 ℃

(6) Safety standards

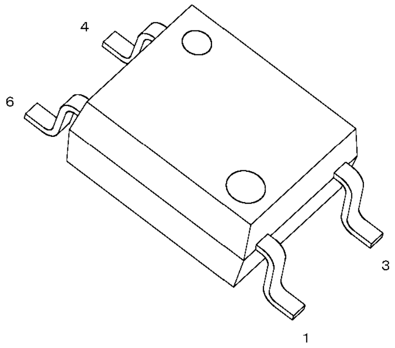
UL-approved: UL1577, File No.E67349
cUL-approved: CSA Component Acceptance Service No.5A File No.E67349
VDE-approved: EN60747-5-5, EN60065 or EN60950-1 **(Note 1)**
: EN62368-1 (Pending) **(Note 1)**
CQC-approved: GB4943.1, GB8898 Japan and Thailand Factory

仅适用于海拔 2000m 以下地区安全使用

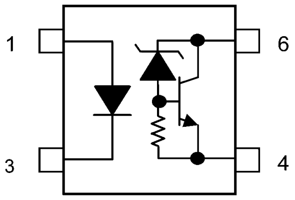
Note 1: When a VDE approved type is needed, please designate the **Option (V4)**.

Start of commercial production
2013-03

4. Packaging and Pin Assignment



11-4M1S



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)	$\Delta I_F/\Delta T_a$		-1.11	mA/°C
	Input forward current (pulsed)		I_{FP}	(Note 1)	1	A
	Input reverse voltage		V_R		5	V
	Input power dissipation		P_D		100	mW
	Input power dissipation derating	($T_a \geq$ 90 °C)	$\Delta P_D/\Delta T_a$		-2.8	mW/°C
	Junction temperature		T_j		135	°C
Detector	Collector-emitter voltage		V_{CEO}		40	V
	Emitter-collector voltage		V_{ECO}		7	V
	Collector current		I_C		50	mA
	Collector power dissipation		P_C		150	mW
	Collector power dissipation derating	($T_a \geq$ 25 °C)	$\Delta P_C/\Delta T_a$		-1.35	mW/°C
	Junction temperature		T_j		135	°C
Common	Operating temperature		T_{opr}		-55 to 125	
	Storage temperature		T_{stg}		-55 to 125	
	Lead soldering temperature	(10 s)	T_{sol}		260	°C
	Total power dissipation		P_T		200	mW
Common	Isolation voltage	AC, 60 s, 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) ≤ 0.1 ms, 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	40	—	—	V
	Emitter-collector breakdown voltage	$V_{(BR)ECO}$		I_E = 0.1 mA	7	—	—	
	Dark Current	I_{DARK}		V_{CE} = 40 V	—	0.01	0.08	μA
				V_{CE} = 40 V, T_a = 85 °C	—	2	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	(Note1)	I_F = 1 mA, V_{CE} = 5 V	50	—	600	%
			I_F = 1 mA, V_{CE} = 5 V, Rank GB	100	—	600	
Saturated current transfer ratio	$I_C/I_{F(sat)}$		I_F = 1 mA, V_{CE} = 0.3 V	—	100	—	
			I_F = 1 mA, V_{CE} = 0.3 V, Rank GB	50	—	—	
Collector-emitter saturation voltage	$V_{CE(sat)}$		I_C = 2.4 mA, I_F = 8 mA	—	—	0.3	V
			I_C = 0.2 mA, I_F = 1 mA	—	0.2	—	
			I_C = 0.2 mA, I_F = 1 mA, Rank GB	—	—	0.3	
OFF-state collector current	$I_{C(off)}$		V_F = 0.7 V, V_{CE} = 40 V	—	1	10	μA

Note1: See Table 9.1 for current transfer ratio.

Table 9.1 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	Unit
None	I_F = 1 mA, V_{CE} = 5 V	50	600	%
GB		100	600	

Note: Specify both the part number and a rank in this format when ordering.
Example: TLP2301(GB)
For safety standard certification, however, specify the part number alone.
Example: TLP2301(GB,E: TLP2301

9. 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%	1×10^{12}	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: 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
Propagation delay time (H/L)	t_{pHL}		See figure 10.1 V_{CC} = 5 V, I_F = 1 mA, R_L = 10 kΩ	—	15	30	μs
Propagation delay time (L/H)	t_{pLH}		See figure 10.1 V_{CC} = 5 V, I_F = 1 mA, R_L = 10 kΩ	—	8	30	μs

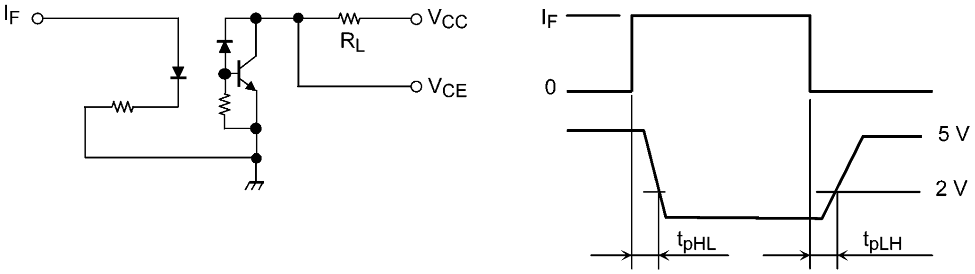


Fig. 10.1 Propagation delay Time Test Circuit and Waveform

11. Characteristics Curves (Note)

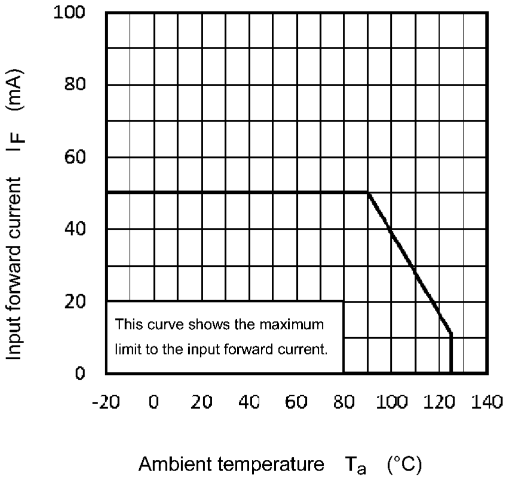


Fig. 11.1 I_F - T_a

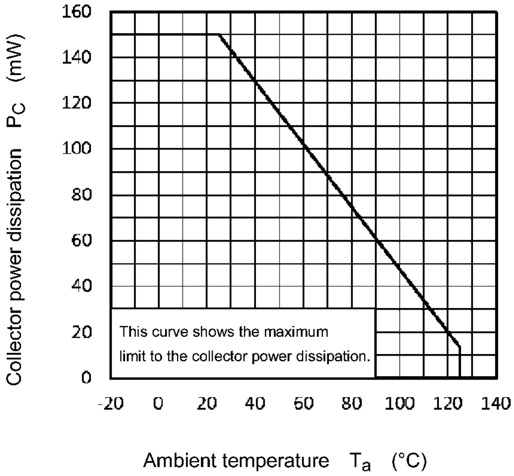


Fig. 11.2 P_C - T_a

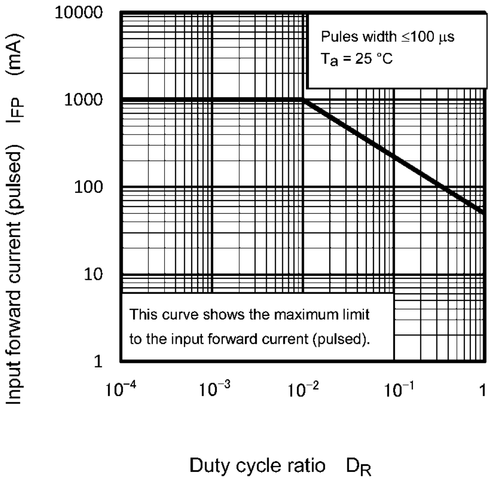


Fig. 11.3 I_{FP} - D_R

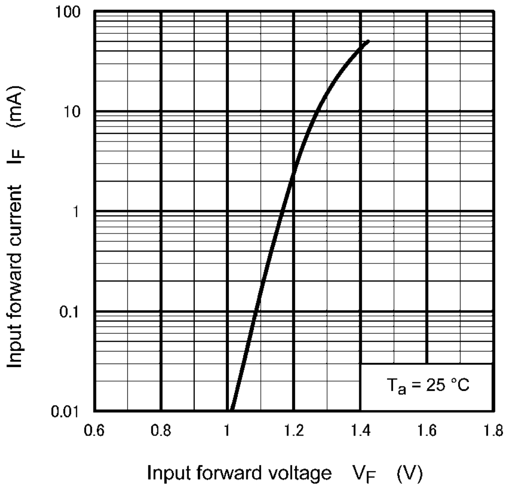


Fig. 11.4 I_F - V_F

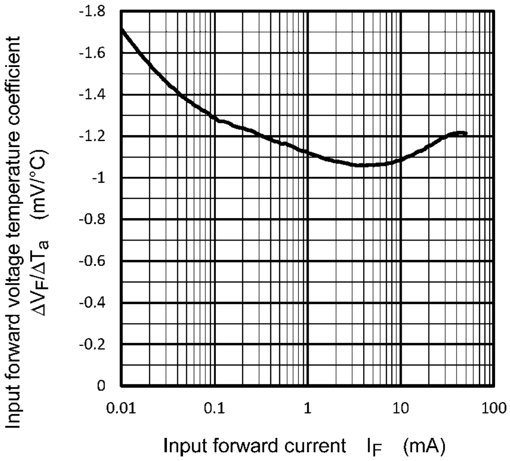


Fig. 11.5 $\Delta V_F/\Delta T_a$ - I_F

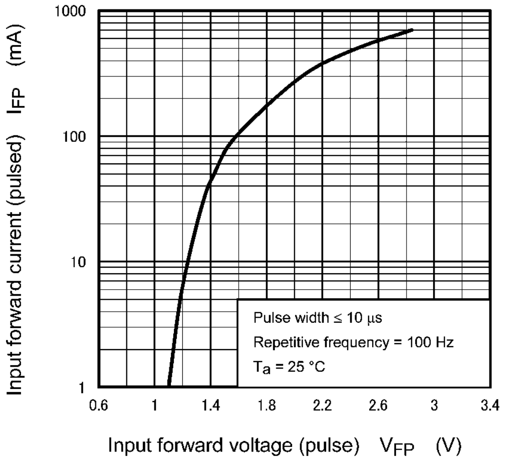


Fig. 11.6 I_{FP} - V_{FP}

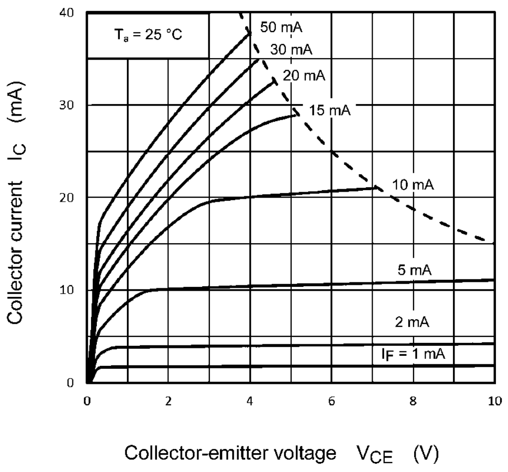


Fig. 11.7 I_C - V_{CE}

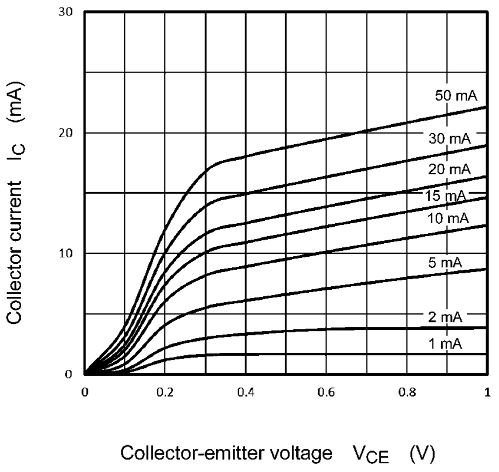


Fig. 11.8 I_C - V_{CE}

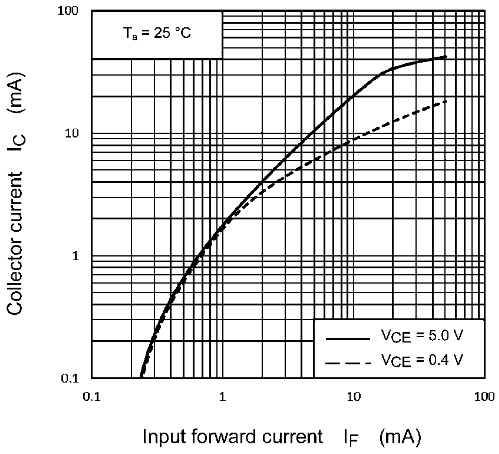


Fig. 11.9 I_C - I_F

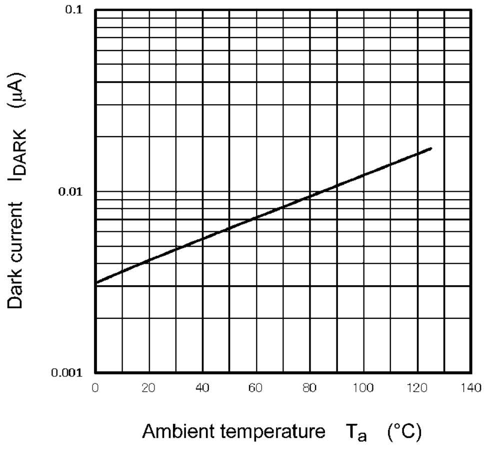


Fig. 11.10 I_{DARK} - T_a

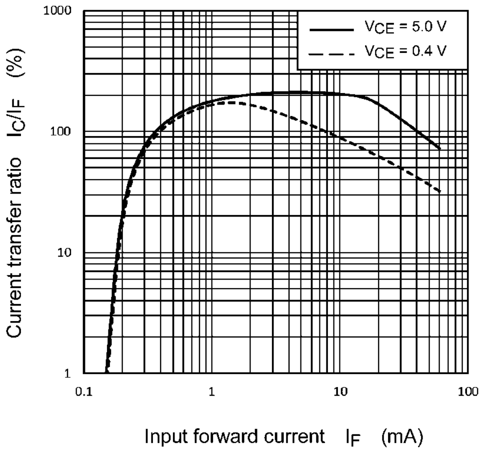


Fig. 11.11 I_C/I_F - I_F

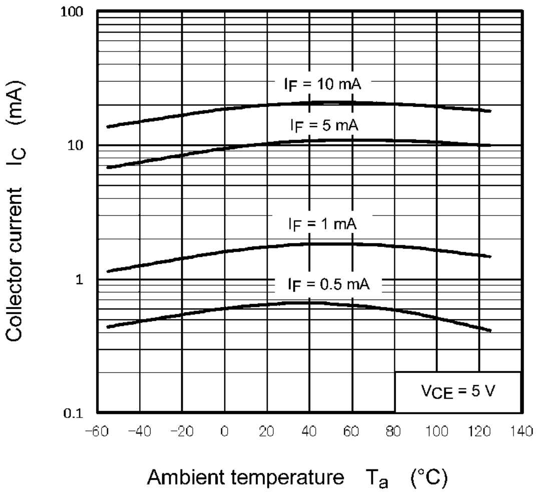


Fig. 11.12 I_C - T_a

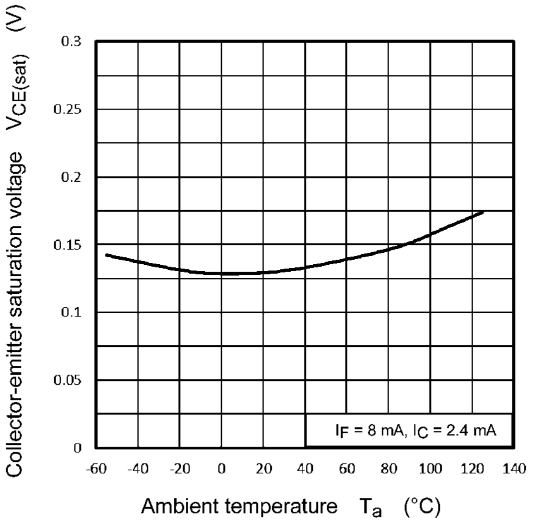


Fig. 11.13 $V_{CE(sat)}$ - T_a

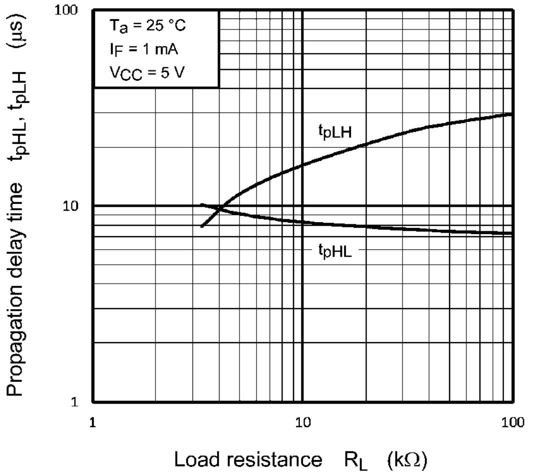


Fig. 11.14 t_{pHL},t_{pLH} - R_L

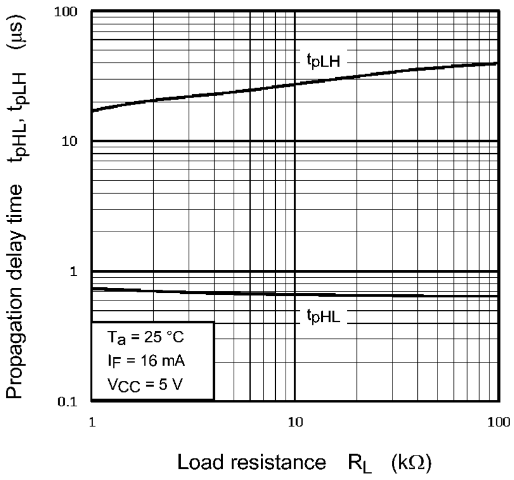


Fig. 11.15 t_{pHL},t_{pLH} - R_L

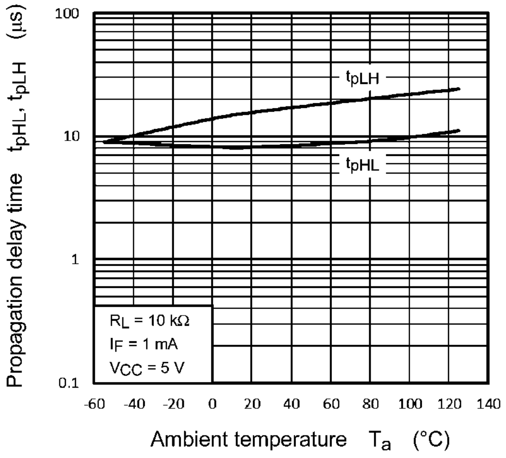


Fig. 11.16 t_{pHL},t_{pLH} - T_a

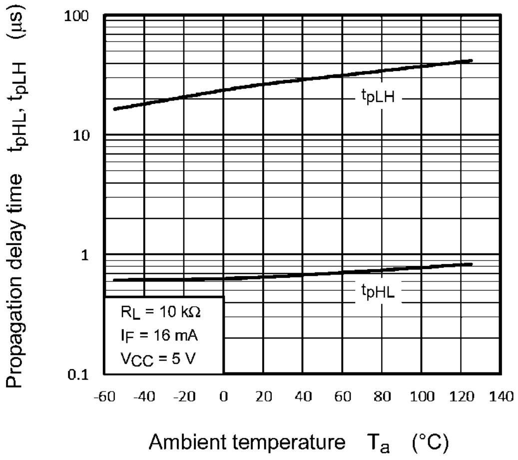


Fig. 11.17 t_{pHL},t_{pLH} - T_a

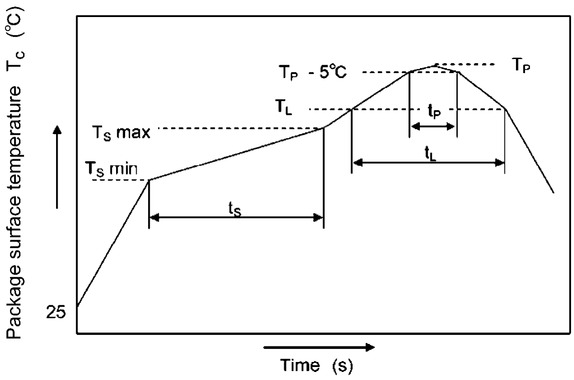
Note: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.

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.
  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

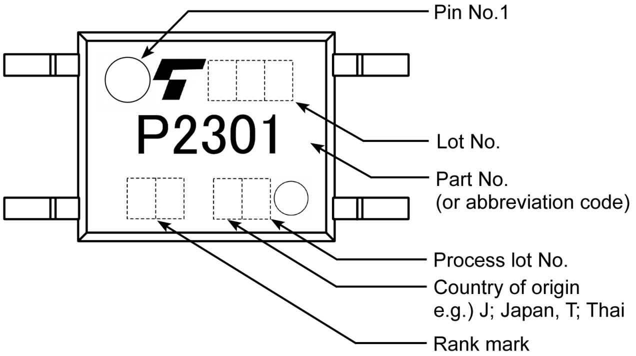
An Example of a Temperature Profile
When Lead(Pb)-Free Solder Is Used

- 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.

12.2. Precautions for General Storage

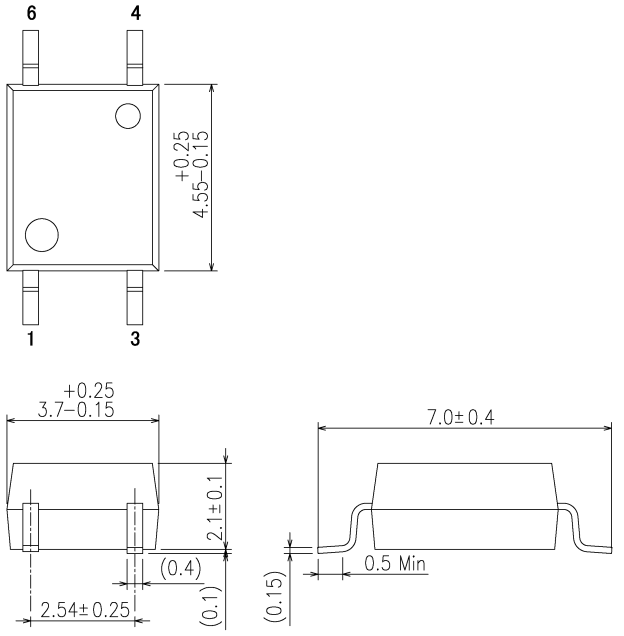
- Avoid storage locations where devices may be exposed to moisture or direct sunlight.
- Follow the precautions printed on the packing label of the device for transportation and storage.
- Keep the storage location temperature and humidity within a range of 5 °C to 35 °C and 45 % to 75 %, respectively.
- 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.

13. Marking


P2301
Pin No.1
Lot No.
Part No.
(or abbreviation code)
Process lot No.
Country of origin
e.g.) J; Japan, T; Thai
Rank mark

Package Dimensions

Unit: mm



Weight: 0.08 g (typ.)

Package Name(s)
TOSHIBA: 11-4M1S

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