

TLP2345

1. Applications

- Intelligent Power Module Signal Isolation
- Programmable Logic Controllers (PLCs)
- High-Speed Digital Interfacing for Instrumentation and Control Devices

2. General

The Toshiba TLP2345 consists of high-output GaAs light-emitting diode coupled with a high-gain, high-speed photo detector. It is housed in the SO6 package.

This product can operate in power supply voltage 4.5 V to 30 V with the maximum operative temperature of 110 °C.

Since TLP2345 has guaranteed 3 mA low supply current (I_{CCL}/I_{CCH}), and 1.6 mA low threshold input current (I_{FLH}), it contributes to energy saving of devices. It can drive directly from a microcomputer for a low input current. The detector has a totem-pole output stage with current sourcing and sinking capabilities. The TLP2345 has an internal Faraday shield that provides a guaranteed common-mode transient immunity of ± 30 kV/ μ s.

The TLP2345 has a buffer output. An inverter output version, the TLP2348, is also available.

3. Features

- (1) Buffer logic type (Totem pole output)
- (2) Package: SO6
- (3) Operating temperature: -40 to 110 °C
- (4) Supply voltage: 4.5 to 30 V
- (5) Threshold input current: 1.6 mA (max)
- (6) Supply current: 3 mA (max)
- (7) Propagation delay time: $t_{pHL}/t_{pLH} = 120$ ns (max)
- (8) Pulse width distortion: $|t_{pHL} - t_{pLH}| = 40$ ns (max)
- (9) Common-mode transient immunity: ± 30 kV/ μ s (min)
- (10) Isolation voltage: 3750 Vrms (min)
- (11) Safety standards

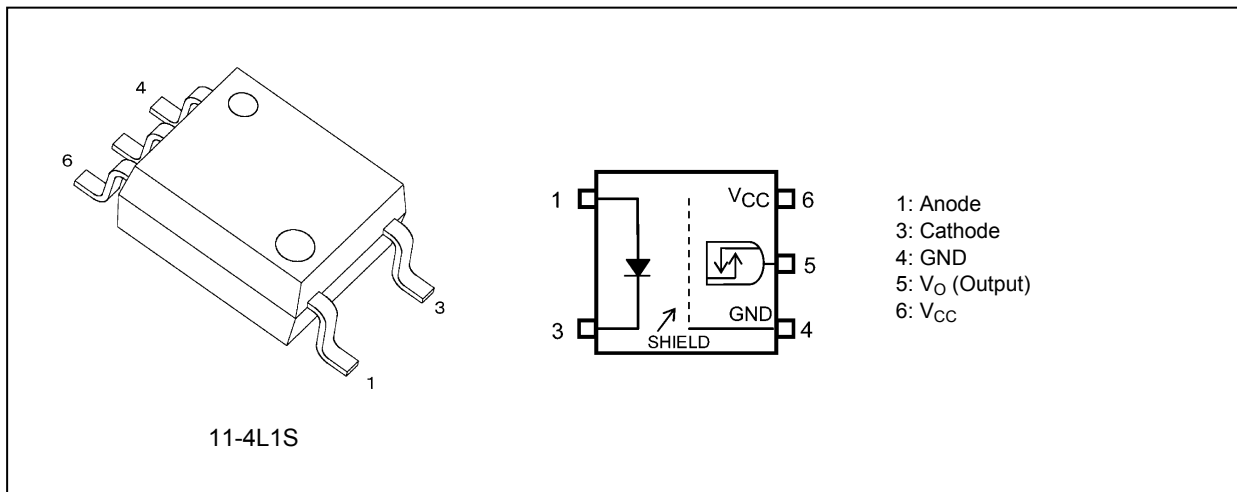
UL-under application: UL1577 File No.E67349

cUL-under application: CSA Component Acceptance Service No.5A, File No.E67349

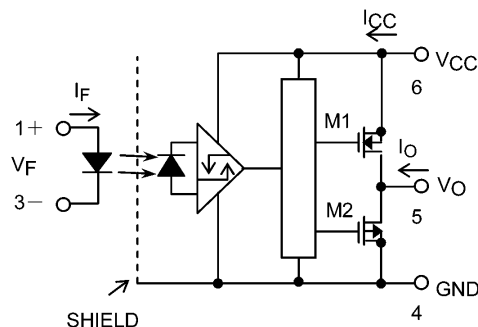
VDE-under application: Option (V4) EN60747-5-5 (**Note**)

Note: When an EN60747-5-5 approved type is needed, please designate the **Option (V4)**.

4. Packaging and Pin Configuration



5. Internal Circuit (Note)



Note: A 0.1- μ F bypass capacitor must be connected between pin 6 and pin 4.

6. Principle of Operation

6.1. Truth Table

Input	LED	Output
H	ON	H
L	OFF	L

6.2. Mechanical Parameters

Characteristics	Min	Unit
Creepage distances	5.0	mm
Clearance distances	5.0	
Internal isolation thickness	0.4	

7. 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		15	mA
	Peak transient input forward current	I_{FPT}	(Note 1)	1	A
	Input power dissipation	P_D		40	mW
	Input reverse voltage	V_R		5	V
Detector	Output current	I_O		50 / -50	mA
	Output voltage	V_O		-0.5 to 30	V
	Supply voltage	V_{CC}		-0.5 to 30	V
	Output power dissipation	P_O		100	mW
	Output power dissipation derating ($T_a \geq 75\text{ }^\circ\text{C}$)	$\Delta P_O / \Delta T_a$		-2	mW/ $^\circ\text{C}$
Common	Operating temperature	T_{opr}		-40 to 110	$^\circ\text{C}$
	Storage temperature	T_{stg}		-55 to 125	$^\circ\text{C}$
	Lead soldering temperature (10 s)	T_{sol}		260	$^\circ\text{C}$
	Isolation voltage AC, 1 min., R.H. $\leq 60\%$	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) $\leq 1\text{ }\mu\text{s}$, 300 pps

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

8. Recommended Operating Conditions (Note)

Characteristics	Symbol	Note	Min	Typ.	Max	Unit
Input on-state current	$I_{F(ON)}$	(Note 1)	2	—	10	mA
Input off-state voltage	$V_{F(OFF)}$		0	—	0.8	V
Supply voltage	V_{CC}	(Note 2)	4.5	—	30	
Operating temperature	T_{opr}	(Note 2)	-40	—	110	°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.

Note: A ceramic capacitor (0.1 μ F) should be connected between pin 6 and pin 4 to stabilize the operation of a high-gain linear amplifier. Otherwise, this photocoupler may not switch properly. The bypass capacitor should be placed within 1 cm of each pin.

Note 1: The rise and fall times of the input on-current should be less than 0.5 μ s.

Note 2: Denotes the operating range, not the recommended operating condition.

9. Electrical Characteristics (Note)
(Unless otherwise specified, $T_a = -40$ to 110 °C, $V_{CC} = 4.5$ to 30 V)

Characteristics	Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Input forward voltage	V_F	—	$I_F = 3$ mA, $T_a = 25$ °C	1.35	1.55	1.65	V
Input forward voltage temperature coefficient	$\Delta V_F / \Delta T_a$	—	$I_F = 3$ mA	—	-2.0	—	mV/°C
Input reverse current	I_R	—	$V_R = 5$ V, $T_a = 25$ °C	—	—	10	μ A
Input capacitance	C_t	—	$V = 0$ V, $f = 1$ MHz, $T_a = 25$ °C	—	20	—	pF
Low-level output voltage	V_{OL}	Fig. 12.1.1	$V_F = 0.8$ V, $I_O = 3.5$ mA	—	0.026	0.2	V
			$V_F = 0.8$ V, $I_O = 6.5$ mA	—	0.047	0.4	
High-level output voltage	V_{OH}	Fig. 12.1.2	$I_F = 3$ mA, $I_O = -3.5$ mA	$V_{CC} - 0.2$	$V_{CC} - 0.03$	—	
			$I_F = 3$ mA, $I_O = -6.5$ mA	$V_{CC} - 0.4$	$V_{CC} - 0.05$	—	
Low-level supply current	I_{CCL}	Fig. 12.1.3	$V_{CC} = 5.5$ V	—	2.1	3	mA
			$V_{CC} = 30$ V	—	2.4	3	
High-level supply current	I_{CCH}	Fig. 12.1.4	$I_F = 3$ mA, $V_{CC} = 5.5$ V	—	2.1	3	
			$I_F = 3$ mA, $V_{CC} = 30$ V	—	2.4	3	
Low-level short-circuit output current	I_{OSL}	Fig. 12.1.5	$V_{CC} = V_O = 5.5$ V	150	270	—	
			$V_{CC} = V_O = 20$ V	160	300	—	
High-level short-circuit output current	I_{OSH}	Fig. 12.1.6	$I_F = 3$ mA, $V_{CC} = 5.5$ V, $V_O = GND$	—	-330	-150	
			$I_F = 3$ mA, $V_{CC} = 20$ V, $V_O = GND$	—	-350	-160	
Threshold input current (L/H)	I_{FLH}	—	$I_O = -3.5$ mA, $V_O > 4.8$ V, $V_{CC} = 5$ V	—	0.35	1.6	
Input current hysteresis	I_{HYS}	—	$I_O = -3.5$ mA	—	0.1	—	
Threshold input voltage (H/L)	V_{FHL}		$I_O = 6.5$ mA, $V_O < 0.4$ V	0.8	—	—	V

Note: All typical values are at $V_{CC} = 5$ V, $T_a = 25$ °C, unless otherwise noted.

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

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

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

11. Switching Characteristics (Note)
(Unless otherwise specified, $T_a = -40\text{ to }110\text{ }^\circ\text{C}$, $V_{CC} = 4.5\text{ to }30\text{ V}$)

Characteristics	Symbol	Note	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Propagation delay time (H/L)	t_{pHL}	(Note 1)	Fig. 12.1.7, Fig. 12.1.8	$I_F = 3 \rightarrow 0\text{ mA}$	35	61	120	ns
Propagation delay time (L/H)	t_{pLH}			$I_F = 0 \rightarrow 3\text{ mA}$	35	65	120	
Pulse width distortion	$ t_{pHL} - t_{pLH} $			$I_F = 3\text{ mA}$	—	4	40	
Propagation delay skew (device to device)	t_{psk}	(Note 1), (Note 2)		$I_F = 3\text{ mA}$	-70	—	70	
Fall time	t_f	(Note 1)		$I_F = 3 \rightarrow 0\text{ mA}$	—	3	30	
Rise time	t_r			$I_F = 0 \rightarrow 3\text{ mA}$	—	3	30	
Common-mode transient immunity at output high	CM_H		Fig. 12.1.9	$I_F = 3\text{ mA}$, $V_{CC} = 30\text{ V}$, $V_{CM} = 1500\text{ V}_{p-p}$, $T_a = 25\text{ }^\circ\text{C}$	± 30	± 50	—	kV/ μs
Common-mode transient immunity at output low	CM_L			$I_F = 0\text{ mA}$, $V_{CC} = 30\text{ V}$, $V_{CM} = 1500\text{ V}_{p-p}$, $T_a = 25\text{ }^\circ\text{C}$	± 30	± 50	—	

Note: All typical values are at $V_{CC} = 5\text{ V}$, $T_a = 25\text{ }^\circ\text{C}$, unless otherwise noted.

Note 1: $f = 50\text{ kHz}$, duty = 50 %, input current $t_r = t_f = 5\text{ ns}$, C_L is approximately 15 pF which includes probe and stray wiring capacitance.

Note 2: The propagation delay skew, t_{psk} , is equal to the magnitude of the worst-case difference in t_{pHL} and/or t_{pLH} that will be seen between units at the same given conditions (supply voltage, input current, temperature, etc).

12. Test Circuits and Characteristics Curves

12.1. Test Circuits

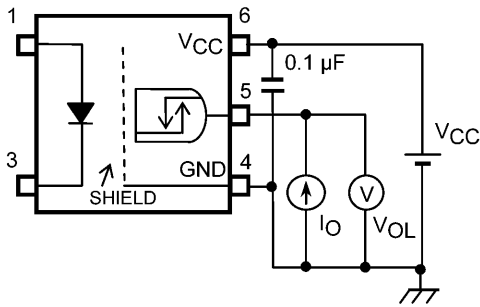


Fig. 12.1.1 VOL Test Circuit

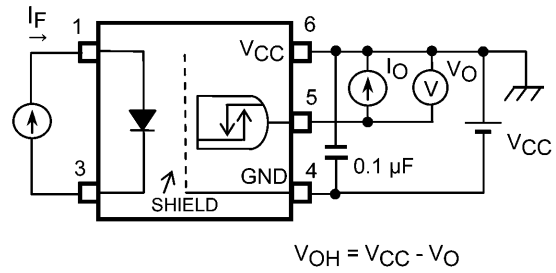


Fig. 12.1.2 VOH Test Circuit

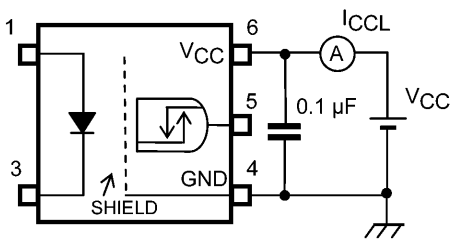


Fig. 12.1.3 ICCL Test Circuit

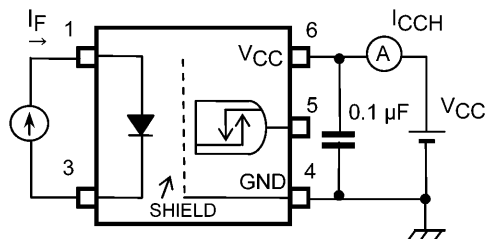


Fig. 12.1.4 ICCH Test Circuit

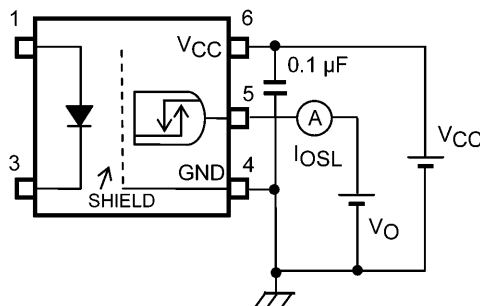


Fig. 12.1.5 IOSL Test Circuit

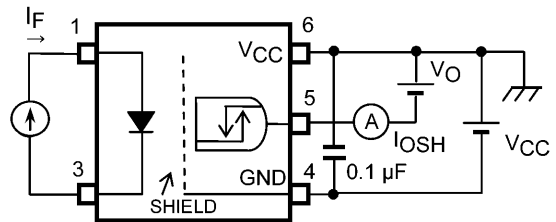
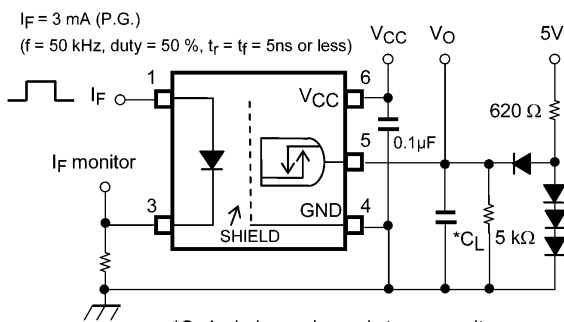


Fig. 12.1.6 IOSH Test Circuit



*CL includes probe and stray capacitance.
P.G.: Pulse generator

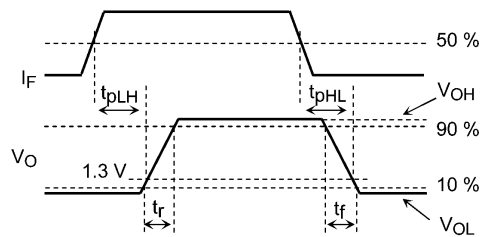


Fig. 12.1.7 Switching Time Test Circuit

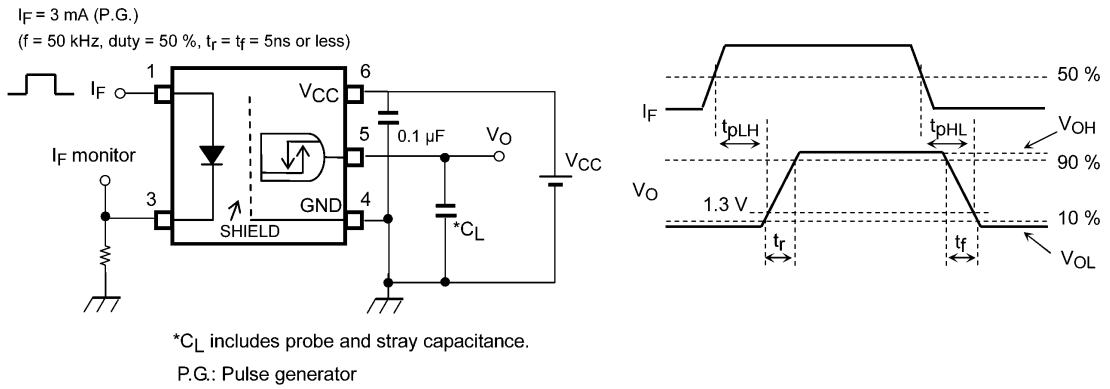


Fig. 12.1.8 Switching Time Test Circuit

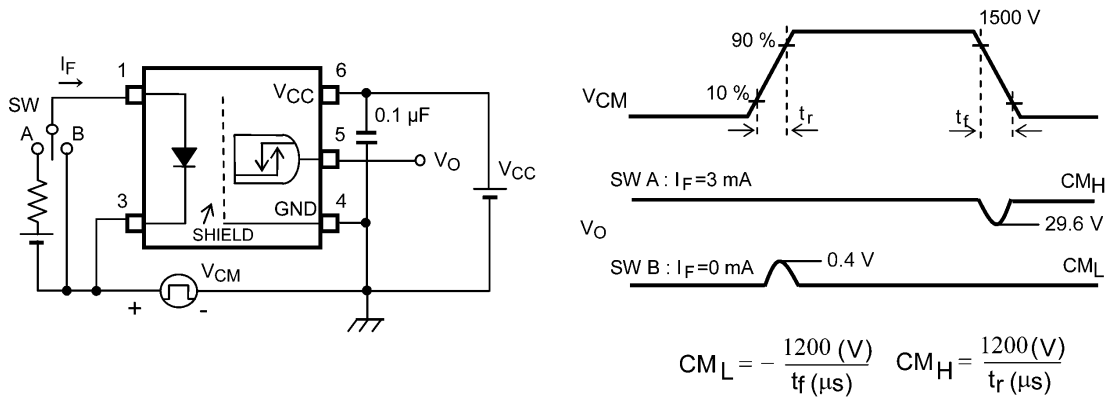


Fig. 12.1.9 Common-Mode Transient Immunity and Waveform

12.2. Characteristics Curves (Note)

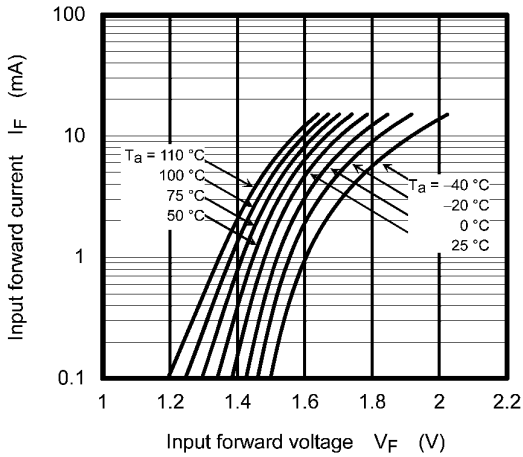


Fig. 12.2.1 $I_F - V_F$

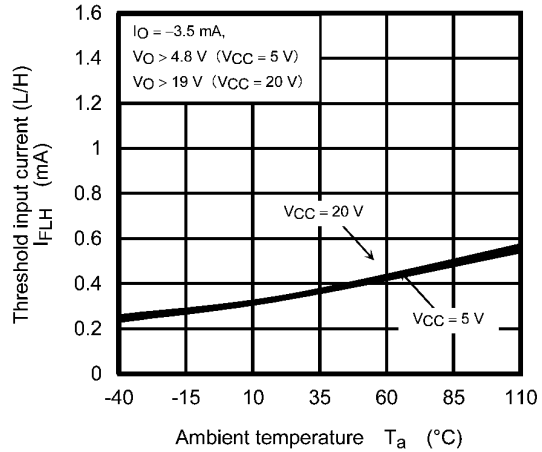


Fig. 12.2.2 $I_{FLH} - T_a$

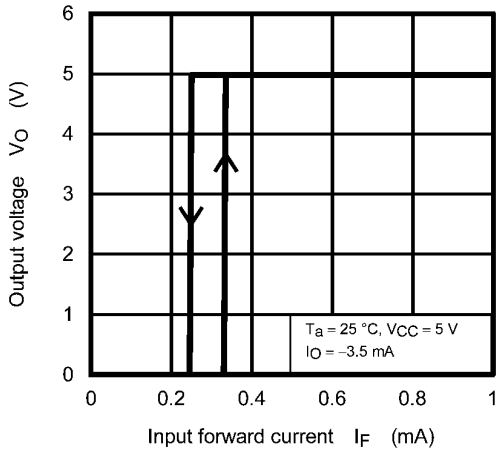


Fig. 12.2.3 $V_O - I_F(I_{HYS})$

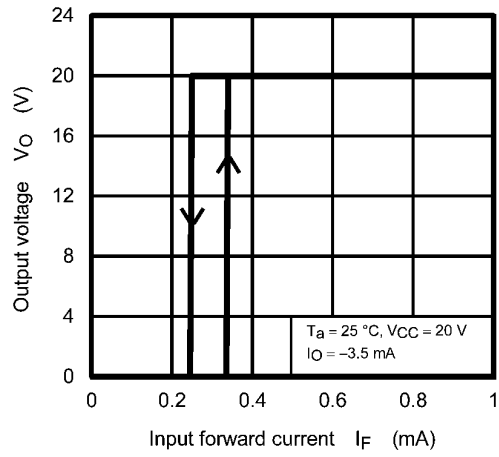


Fig. 12.2.4 $V_O - I_F(I_{HYS})$

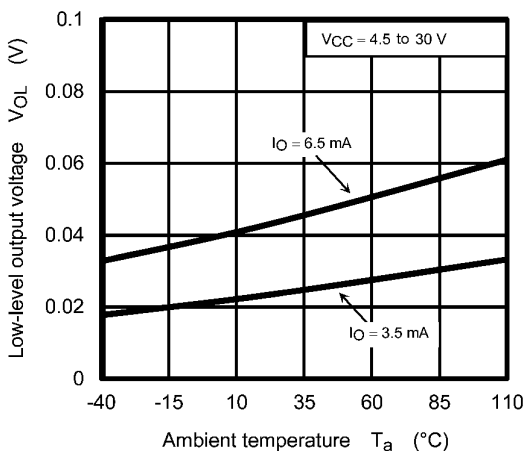


Fig. 12.2.5 $V_{OL} - T_a$

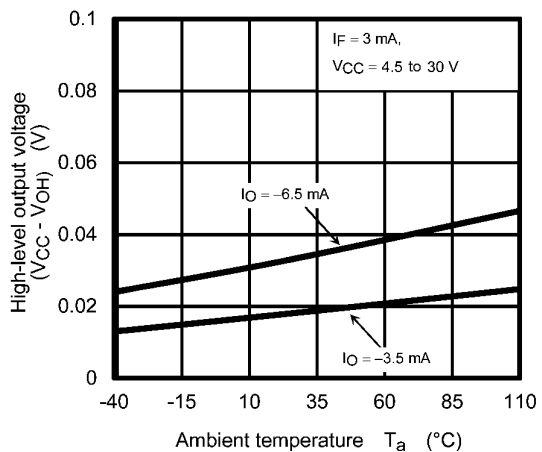


Fig. 12.2.6 $(V_{CC} - V_{OH}) - T_a$

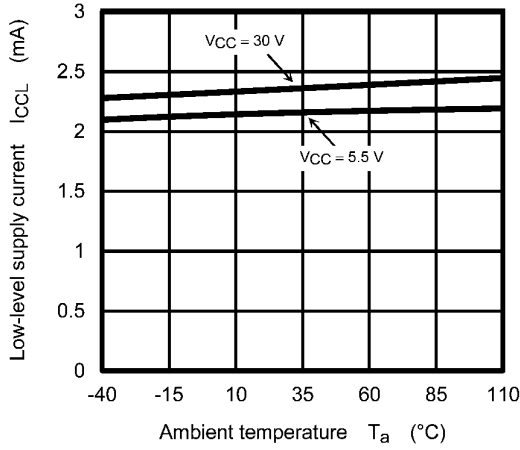


Fig. 12.2.7 $I_{cCL} - T_a$

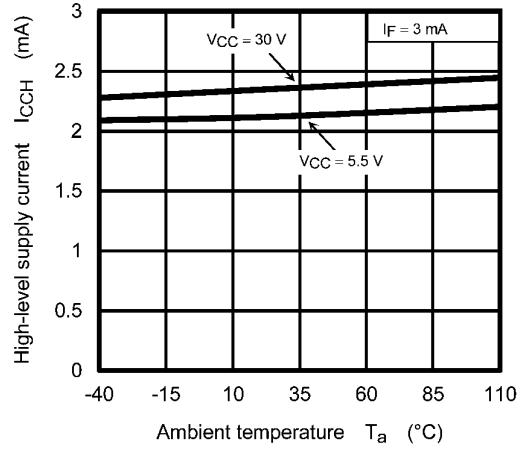


Fig. 12.2.8 $I_{cCH} - T_a$

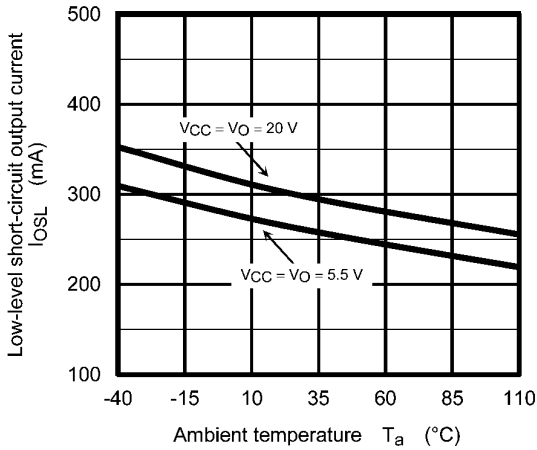


Fig. 12.2.9 $I_{osL} - T_a$

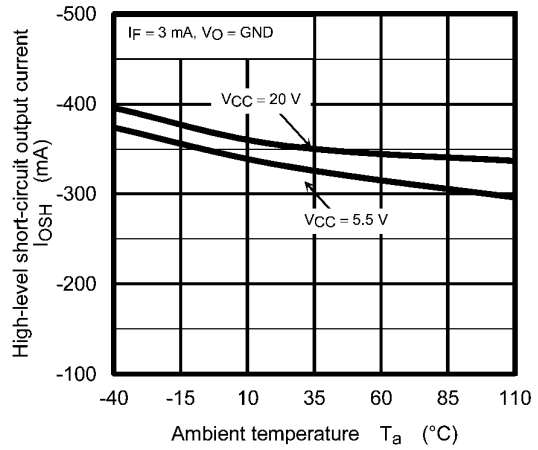


Fig. 12.2.10 $I_{osH} - T_a$

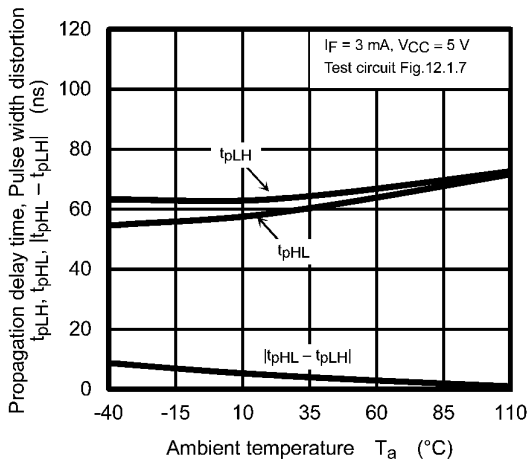


Fig. 12.2.11 $t_{pLH}, t_{pHL}, |t_{pHL} - t_{pLH}| - T_a$
(Test Circuit Fig. 12.1.7)

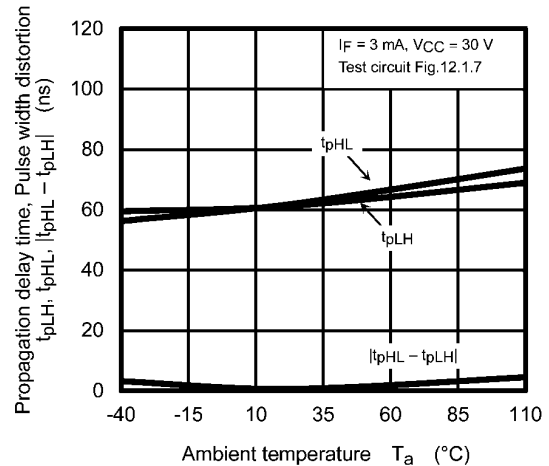


Fig. 12.2.12 $t_{pLH}, t_{pHL}, |t_{pHL} - t_{pLH}| - T_a$
(Test Circuit Fig. 12.1.7)

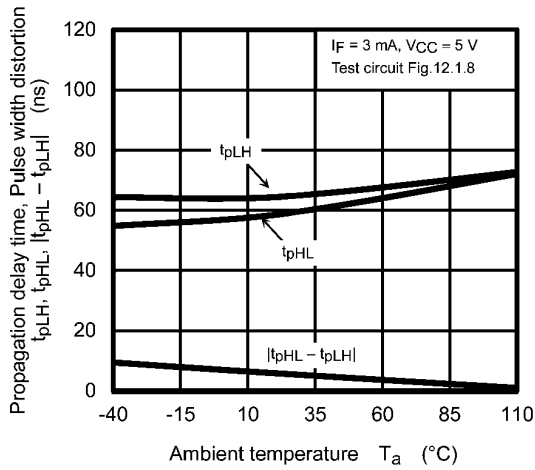


Fig. 12.2.13 t_{pLH} , t_{pHL} , $|t_{pHL}-t_{pLH}| - T_a$
(Test Circuit Fig. 12.1.8)

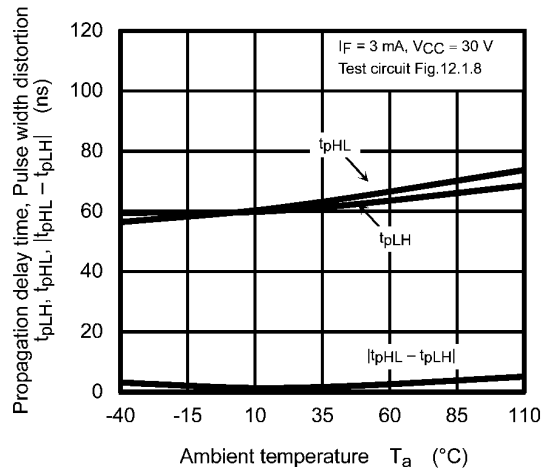


Fig. 12.2.14 t_{pLH} , t_{pHL} , $|t_{pHL}-t_{pLH}| - T_a$
(Test Circuit Fig. 12.1.8)

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 Fig. 13.1.1 and 13.1.2)

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.

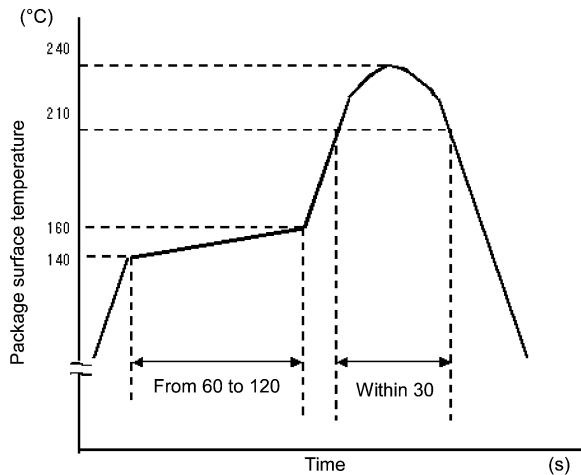


Fig. 13.1.1 An Example of a Temperature Profile When Sn-Pb Eutectic Solder Is Used

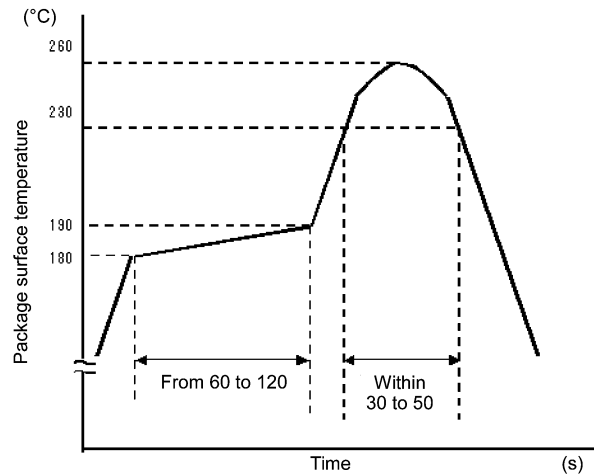
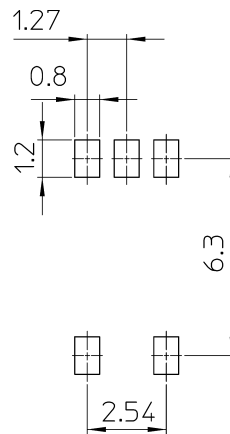


Fig. 13.1.2 An Example of a Temperature Profile When Lead(Pb)-free Solder Is Used

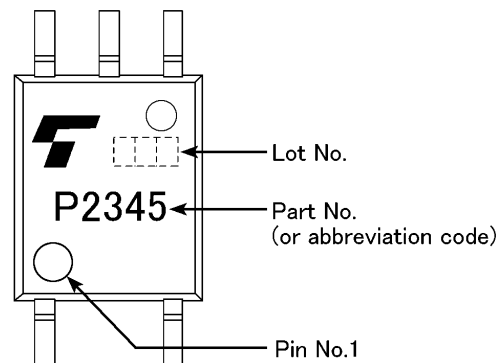
- When using soldering flow (Applicable to both eutectic solder and Lead(Pb)-Free solder)
Apply preheating of 150 °C for 60 to 120 seconds.
Mounting condition of 260 °C within 10 seconds is recommended.
Flow soldering must be performed once.
- When using soldering Iron (Applicable to both eutectic solder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

13.2. 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.

14. Land Pattern Dimensions (for reference only)

(unit: mm)

15. Marking

16. Specifications for Embossed-Tape Packing (TPL) (TPR) for SO6 Coupler

16.1. Applicable Package

Package Name	Product Type
SO6	Photocoupler

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) TLP2345 (TPL,E(O)

Part number: TLP2345

Tape type: TPL

[[G]]/RoHS COMPATIBLE: E (**Note**)

Domestic ID (Country / Region of origin: Japan): (O)

Note: 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.

16.3. Tape Dimensions Specification

Table 16.3.1 Tape Specifications

Specification	Division	Packing Amount (A unit per reel)
TPL	L direction	3000
TPR	R direction	3000

16.3.1. Orientation of Device in Relation to Direction of Feed

Device orientation in the carrier cavities as shown in Fig. 16.3.1.1

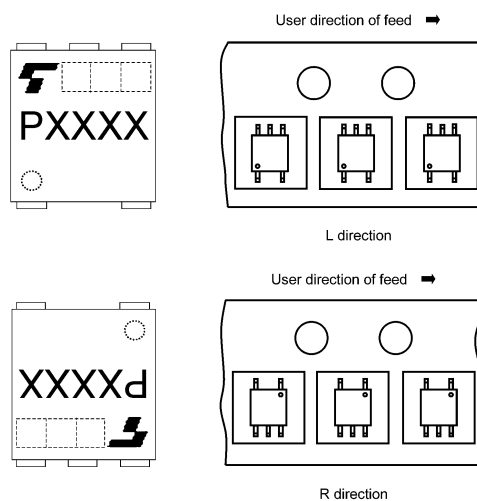


Fig. 16.3.1.1 Orientation of Device in Relation to Direction of Tape Movement

16.3.2. Packing Quantity

Reel: 3000 pcs per reel

16.3.3. Empty Device Recesses

Table 16.3.3.1 Empty Device Recesses

Characteristics	Standard	Remarks
Occurrences of 2 or more successive empty cavities	0	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

16.3.4. Tape Leader and Trailer

The start end of the tape has 50 or more empty cavities. The hub end of the tape has 50 or more empty cavities and two empty turns only for a cover tape.

16.3.5. Tape Dimensions

- (1) Tape material: Plastic (for protection against static electricity)
- (2) Dimensions: The tape dimensions area as shown in Table 16.3.5.1

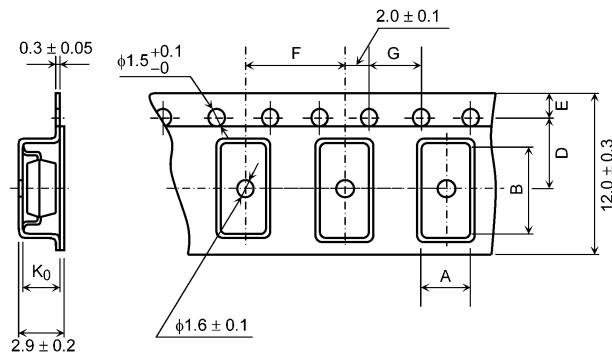


Fig. 16.3.5.1 Tape Forms

Table 16.3.5.1 Tape Dimensions (unit: mm, tolerance: ± 0.1)

Symbol	Dimension	Remark
A	4.0	—
B	7.6	—
D	5.5	Center line of embossed cavity and sprocket hole
E	1.75	Distance between tape edge and sprocket hole center
F	8.0	Cumulative error $+0.1/-0.3$ (max) per 10 empty cavities holes
G	4.0	Cumulative error $+0.1/-0.3$ (max) per 10 empty cavities holes
K ₀	2.6	Internal space

16.3.6. Reel Specification

- (1) Material: Plastic
- (2) Dimensions: The reel dimensions are as shown in Table 16.3.6.1

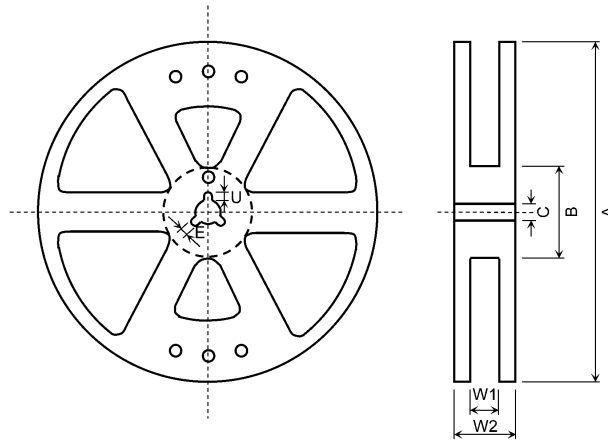


Fig. 16.3.6.1 Reel Forms

Table 16.3.6.1 Reel Dimensions (unit: mm)

Symbol	Dimension
A	$\phi 330 \pm 2$
B	$\phi 80 \pm 1$
C	$\phi 13 \pm 0.5$
E	2.0 ± 0.5
U	4.0 ± 0.5
W1	13.5 ± 0.5
W2	17.5 ± 1.0

16.4. Packing (Note)

Either one reel or ten reels of photocouplers are packed in a shipping carton.

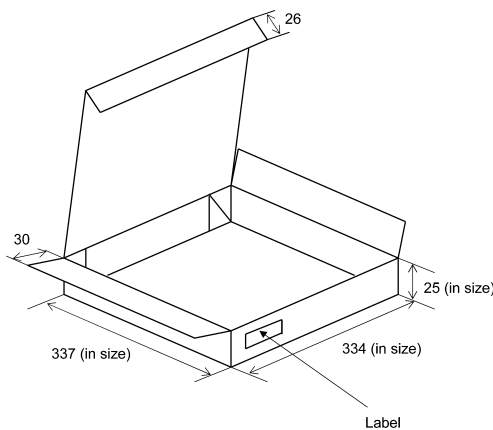


Fig. 16.4.1 1 reel/carton (unit: mm)

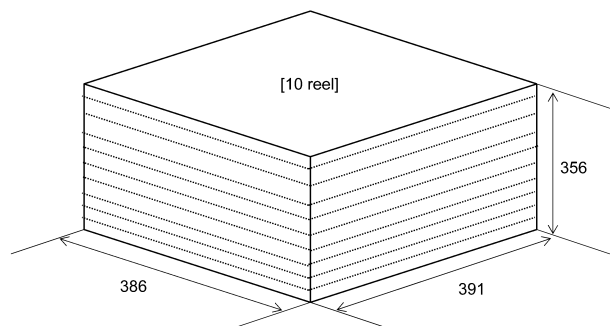


Fig. 16.4.2 10 reel/carton (unit: mm)

Note: Taping reel diameter: $\phi 330$ mm

16.5. Label Format

- (1) Carton: The label provides the part number, quantity, lot number, the Toshiba logo, etc.
- (2) Reel: The label provides the part number, the taping name (TPL), quantity, lot number, etc.

16.6. Ordering Information

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

Example) TLP2345 (TPL,E(O 3000 pcs

Part number: TLP2345

Tape type: TPL

[[G]]/RoHS COMPATIBLE: E (**Note**)

Domestic ID (Country / Region of origin: Japan): (O

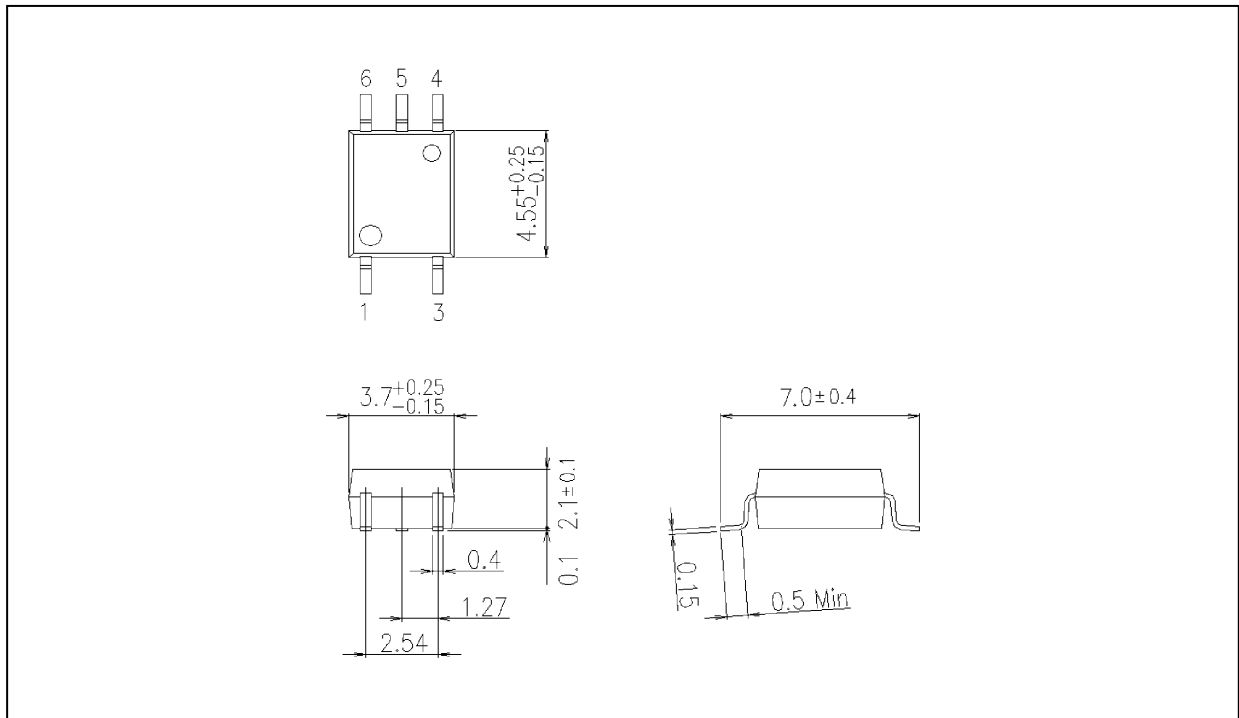
Quantity (must be a multiple of 3000): 3000 pcs

Note: 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.

Package Dimensions

Unit: mm



Weight: 0.08 g (typ.)

Package Name(s)
TOSHIBA: 11-4L1S

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