TOSHIBA PHOTOCOUPLER IRED & PHOTO-IC

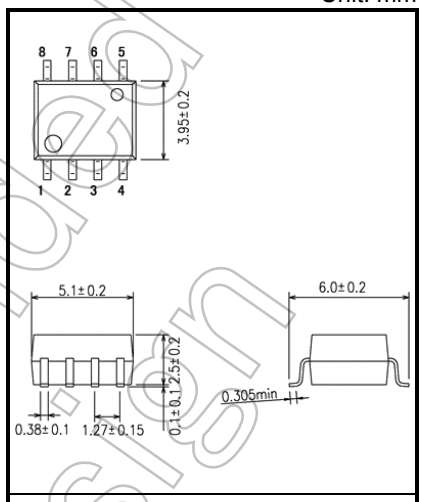
TLP2166A

Plasma Display Panels (PDPs)

High-Speed Interfaces

3.3-V Voltage Source

Unit: mm



JEDEC	—
JEITA	—
TOSHIBA	11−5K1S

Weight: 0.11 g (typ.)

The Toshiba TLP2166A consists of an infrared emitting diode and an integrated high-gain, high-speed photodetector.
The TLP2166A is housed in the 8-pin SO package.
Since the TLP2166A contains two photocouplers, it saves board space.
The TLP2166A operates with a 3.3-V supply voltage.

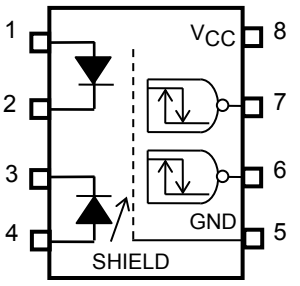
- Inverting logic output (totem-pole output)
- SO8 package
- Guaranteed performance over -40 to 100°C
- Power supply voltage: 3.0 to 3.6 V
- Input threshold current: I_{FHL} = 3 mA (max)
- Switching time (t_{pHL} / t_{pLH}): 75 ns (max)
- Switching speed: 15 MBd (typ.)(NRZ)
- Common-mode transient immunity: ±15 kV/μs
- Isolation voltage: 2500 V_{rms}
- UL-recognized: UL 1577, File No.E67349
- cUL-recognized: CSA Component Acceptance Service No.5A
  File No.E67349
- VDE-approved: EN 60747-5-5 (Note 1)

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

Truth Table

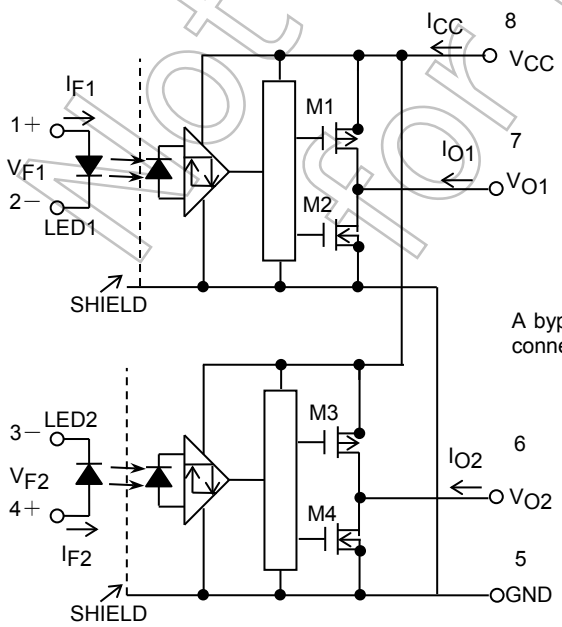
Input	LED1(2)	M1(3)	M2(4)	Output 1(2)
H	ON	OFF	ON	L
L	OFF	ON	OFF	H

Pin Configuration (Top View)



1: ANODE 1
2: CATHODE 1
3: CATHODE 2
4: ANODE 2
5: GND
6: V_{O2} (Output2)
7: V_{O1} (Output1)
8: V_{CC}

Schematic



A bypass capacitor of 0.1μF must be connected between pins 8 and 5.

Start of commercial production
2008-07

Absolute Maximum Ratings (Ta=25°C)

CHARACTERISTIC			SYMBOL	RATING	UNIT
LED	Forward Current	(Note 1)	I_F	15	mA
	Forward Current Derating (Ta ≥ 95°C)	(Note 1)	$\Delta I_F/\Delta Ta$	-0.5	mA/°C
	Peak Transient Forward Current	(Note 1, 2)	I_{FP}	1	A
	Reverse Voltage	(Note 1)	V_R	5	V
	Input Power Dissipation	(Note 1)	P_D	40	mW
	Input Power Dissipation Derating (Ta ≥ 95°C)	(Note 1)	ΔP_D/°C	-1.3	mW/°C
DETECTOR	Output Current	(Note 1)	I_O	10	mA
	Output Voltage	(Note 1)	V_O	6	V
	Supply Voltage		V_{CC}	6	V
	Output Power Dissipation		P_O	40	mW
	Output Power Dissipation Derating (Ta ≥ 25°C)		ΔP_O/°C	-0.4	mW/°C
Operating Temperature Range			T_{opr}	-40 to 100	°C
Storage Temperature Range			T_{stg}	-55 to 125	°C
Lead Soldering Temperature		(10 s)	T_{sol}	260	°C
Isolation Voltage	(AC, 60 s, R.H.≤ 60 %)	(Note 3)	BV_S	2500	V_{rms}

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: Each Channel.

Note 2: Pulse width ≤ 1 μs, 300 pps.

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

Recommended Operating Conditions

CHARACTERISTIC		SYMBOL	MIN	TYP.	MAX	UNIT
Input Current, ON	(Note 1)	$I_{F(ON)}$	5	—	10	mA
Input Voltage, OFF	(Note 1)	$V_{F(OFF)}$	0	—	0.8	V
Supply Voltage*	(Note 4)	V_{CC}	3.0	3.3	3.6	V
Operating Temperature		T_{opr}	-40	—	100	°C

* This item denotes operating range, not meaning of recommended operating conditions.

Note 4: The detector of this product requires a power supply voltage (V_{CC}) of 3.0 V or higher for stable operation. If the V_{CC} is lower than this value, an I_{CCH} may increase, or an output may be unstable. Be sure to use the product after checking the supply current, and the operation of a power-on/-off

Note: A ceramic capacitor (0.1 μF) should be connected from pin 8 (V_{CC}) to pin 5 (GND) to stabilize the operation of the high gain linear amplifier. Failure to provide the bypass may impair the switching property. The total lead length between capacitor and coupler should not exceed 1 cm.

Electrical Characteristics
(Unless otherwise specified, Ta = -40 to 100 °C, V_{CC} = 3.0 to 3.6 V)

Characteristic		Symbol	Test Circuit	Condition	Min	Typ.	Max	Unit
Input Forward Voltage	(Note 1)	V_F	—	I_F = 10 mA, Ta = 25 °C	1.3	1.65	1.75	V
Temperature Coefficient of Forward Voltage	(Note 1)	$\Delta V_F/\Delta Ta$	—	I_F = 10 mA	—	-2.0	—	mV/°C
Input Reverse Current	(Note 1)	I_R	—	V_R = 5 V, Ta = 25 °C	—	—	10	μA
Input Capacitance	(Note 1)	C_T	—	V = 0 V, f = 1 MHz, Ta = 25 °C	—	45	—	pF
Logic Low Output Voltage	(Note 1)	V_{OL}	1	I_{OL} =1.6 mA, I_F = 10 mA, V_{CC} = 3.3 V	—	0.3	0.6	V
Logic High Output Voltage	(Note 1)	V_{OH}	2	I_{OH} = -0.02 mA, V_F = 1.05 V V_{CC} = 3.3 V	2.0	2.6	—	V
Logic Low Supply Current		I_{CCL}	3	I_F = 10 mA	—	7.0	10.0	mA
Logic High Supply Current		I_{CCH}	4	V_F = 0 V (Note 4)	—	4.0	10.0	mA
Operating Supply Voltage		V_{CC}	—	—	3.0	—	3.6	V
Input Current Logic Low Output	(Note 1)	I_{FHL}	—	I_O = 1.6 mA, V_O < 0.6 V	—	—	3	mA
Input Voltage Logic High Output	(Note 1)	V_{FLH}	—	I_O = -0.02 mA, V_O > 2.0 V	0.8	—	—	V

*All typical values are at Ta=25°C.

Isolation Characteristics (Ta = 25°C)

Characteristic	Symbol	Test Condition	Min	Typ.	Max	Unit
Capacitance input to output	C_S	V_S = 0 V, f = 1 MHz (Note 3)	—	0.8	—	pF
Isolation resistance	R_S	R.H. ≤ 60 %, V_S = 500 V (Note 3)	1×10^{12}	10^{14}	—	Ω
Isolation voltage	BV_S	AC, 60 s (Note 3)	2500	—	—	V_{rms}

Switching Characteristics

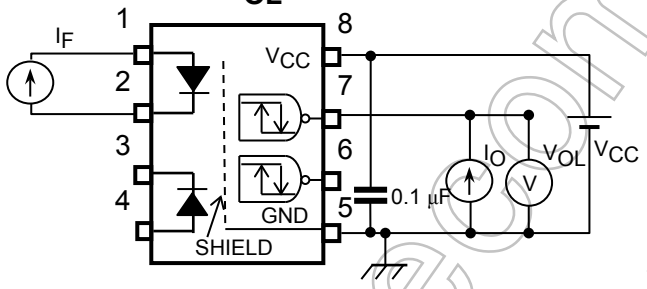
(Unless otherwise specified, Ta=-40 to 100°C、V_{CC}=3.0 to 3.6 V)(Each Channel)

Characteristic	Symbol	Test Circuit	Condition		Min	Typ.	Max	Unit
Propagation Delay Time to Logic Low output	t_{pHL}	5	I_F = 0→7.5 mA	R_{IN} = 100 Ω, C_L = 15 pF (Note 6)	—	—	75	ns
Propagation Delay Time to Logic High output	t_{pLH}		I_F = 7.5→0 mA		—	—	75	ns
Switching Time Dispersion between ON and OFF	$\|t_{pHL}-t_{pLH}\|$		I_F = 7.5 mA, R_{IN} = 100 Ω, C_L = 15 pF (Note 6)		—	—	45	ns
Fall Time (90 – 10 %)	t_f		I_F = 0→7.5 mA	R_{IN} = 100 Ω, C_L = 15 pF (Note 6)	—	5	—	ns
Rise Time (10 – 90 %)	t_r		I_F = 7.5→0 mA		—	5	—	ns
Common Mode transient Immunity at High Level Output	CM_H	6	V_{CM} = 1000 V_{p-p}, I_F = 0 mA, V_O(min) = 2 V, Ta = 25 °C		15000	—	—	V/μs
Common Mode transient Immunity at Low Level Output	CM_L		V_{CM} = 1000 V_{p-p}, I_F = 7.5 mA, V_O(max) = 0.6 V, Ta = 25 °C		-15000	—	—	V/μs

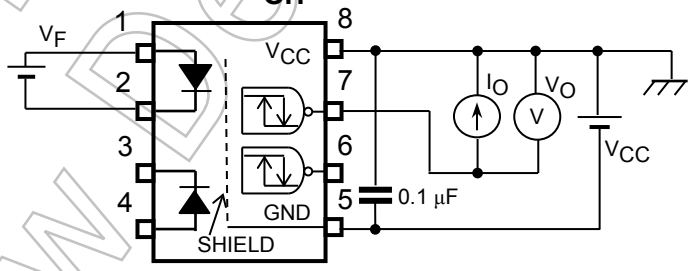
*All typical values are at Ta = 25 °C, V_{CC} = 3.3 V.

Note 6: C_L is approximately 15 pF which includes probe and jig/stray wiring capacitance.

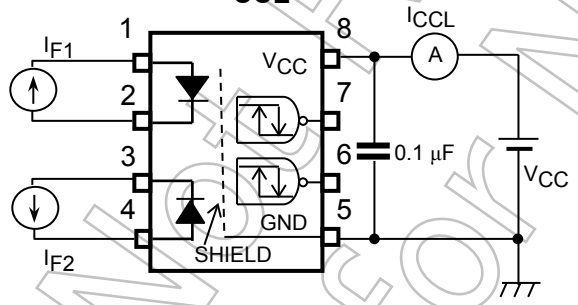
TEST CIRCUIT 1: V_{OL} Test Circuit



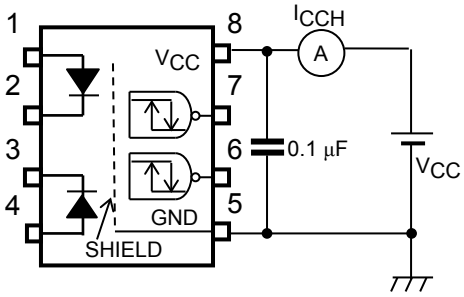
TEST CIRCUIT 2: V_{OH} Test Circuit



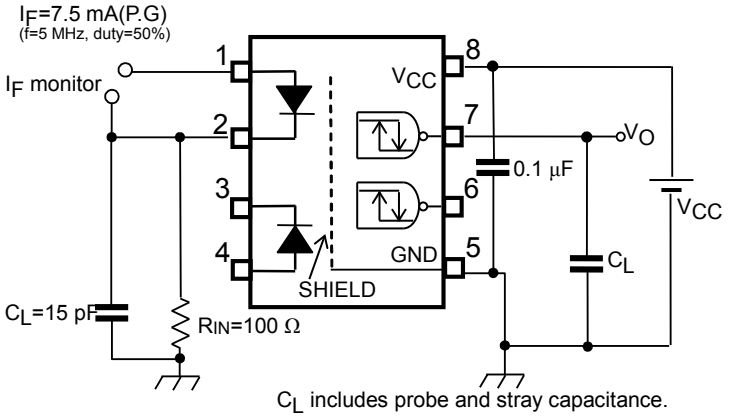
TEST CIRCUIT 3: I_{CCL} Test Circuit

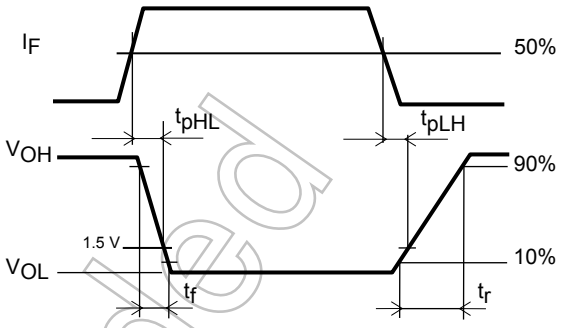


TEST CIRCUIT 4: I_{CCH} Test Circuit



TEST CIRCUIT 5: Switching Time Test Circuit

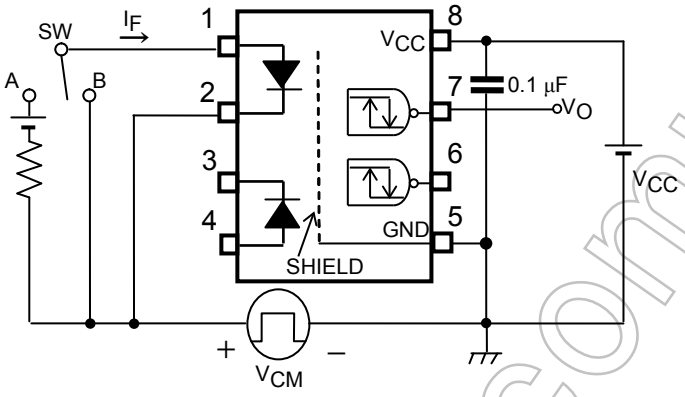


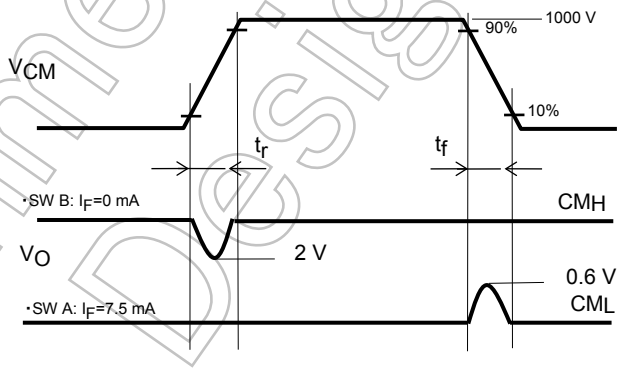


CL includes probe and stray capacitance.

P.G.: Pulse generator

TEST CIRCUIT 6: Common-Mode Transient Immunity Test Circuit





$$CM_H = \frac{800(V)}{tr(\mu s)} \quad CM_L = \frac{800(V)}{tf(\mu s)}$$

Specification for Embossed–Tape Packing (TP) for SO8 Coupler

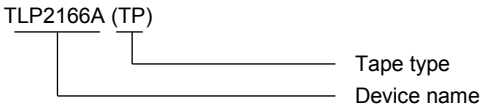
1. Applicable Package

Package	Product Type
SO8	Photocoupler

2. Product Naming System

Type of package used for shipment is denoted by a symbol suffix after a product number. The method of classification is as below.

(Example)



3. Tape Dimensions

3.1 Orientation of Device in Relation to Direction of Tape Movement

Device orientation in the recesses is as shown in Figure 1.

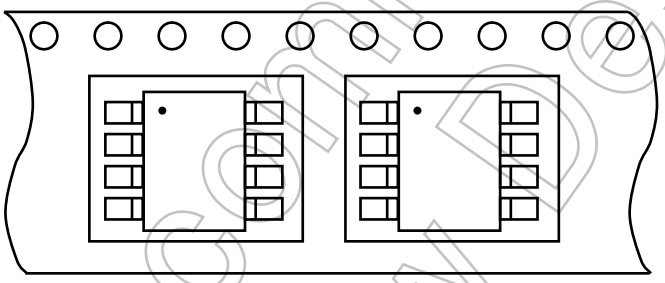


Figure 1 Device Orientation

3.2 Tape Packing Quantity:2500 devices per reel

3.3 Empty Device Recesses Are as Shown in Table 1.

Table 1 Empty Device Recesses

	Standard	Remarks
Occurrences of 2 or more successive empty device recesses	0 device	Within any given 40-mm section of tape, not including leader and trailer
Single empty device recesses	6 devices (max) per reel	Not including leader and trailer

3.4 Start and End of Tape

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

3.5 Tape Specification

(1) Tape material: Plastic (protection against electrostatics)
(2) Dimensions: The tape dimensions are as shown in Figure 2 and table 2.

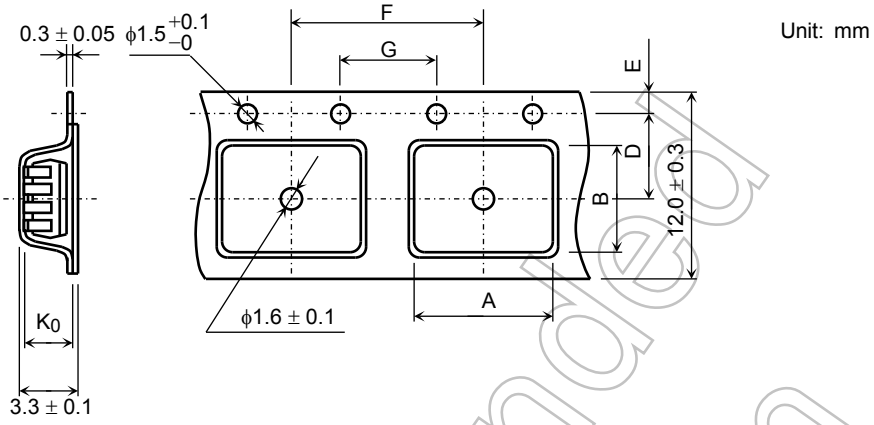


Figure 2 Tape Forms

Table 2 Tape Dimensions

Unit: mm
Unless otherwise specified: ±0.1

Symbol	Dimension	Remark
A	6.5	—
B	5.6	—
D	5.5	Center line of indented square hole and sprocket hole
E	1.75	Distance between tape edge and hole center
F	8.0	Cumulative error $^{+0.1}_{-0.3}$ (max) per 10 feed holes
G	4.0	Cumulative error $^{+0.1}_{-0.3}$ (max) per 10 feed holes
K_0	3.1	Internal space

3.6 Reel

(1) Material: Plastic (protection against electrostatics)
(2) Dimensions: The reel dimensions are as shown in Figure 3 and Table 3.

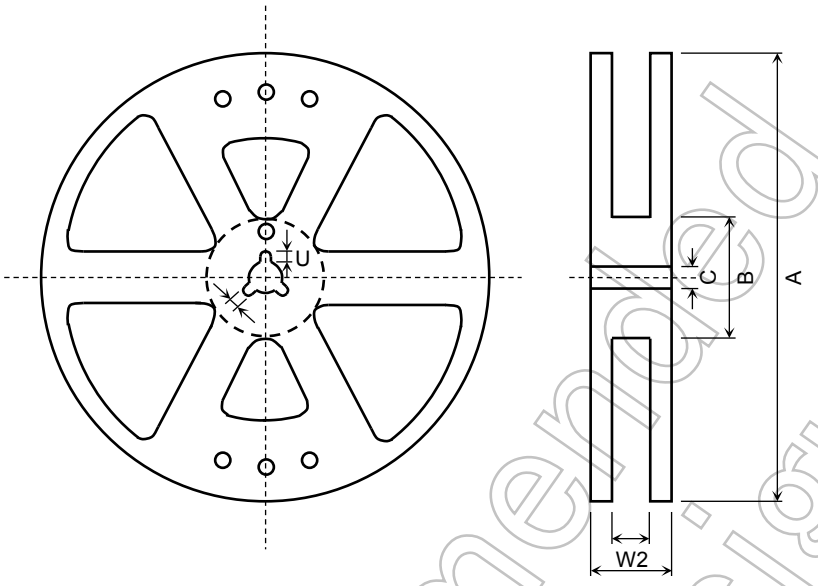


Figure 3 Reel Form

Table 3 Reel Dimensions

Unit: mm

Symbol	Dimension
A	Φ330 ±2
B	Φ80 ±1
C	Φ13 ±0.5
E	2.0 ±0.5
U	4.0 ±0.5
W1	13.5 ±0.5
W2	17.5 ±1.0

4. Packing

Packed in a shipping carton.

5. Label Indication

The carton bears a label indicating the product number, the symbol representing classification of standard, the quantity, the lot number and the Toshiba company name.

6. Ordering Method

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

(Example)

TLP2166A (TP) 2500 pcs

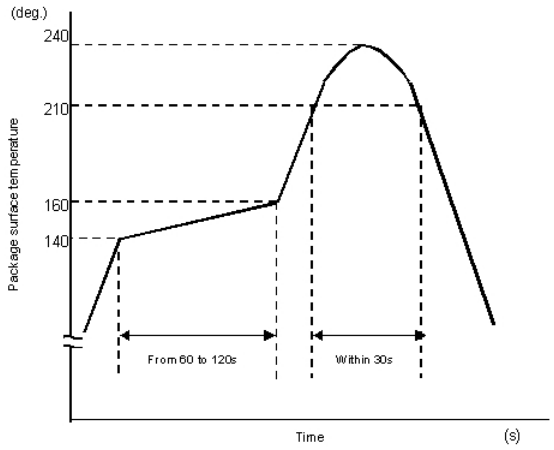
- Quantity (must be a multiple of 2500)
- Tape type
- Device name

Precautions of Surface Mounting Type Photocoupler Soldering & General Storage

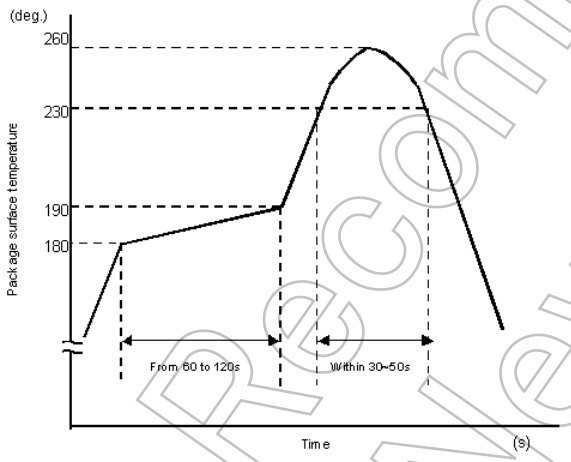
(1) Precautions for Soldering

1) When Using Soldering Reflow

- An example of a temperature profile when Sn-Pb eutectic solder is used:



- An example of a temperature profile when lead(Pb)-free solder is used:



- 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.

2) 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 or less within 10 seconds is recommended.
- Flow soldering must be performed once

3) When using soldering Iron (Applicable to both eutectic solder and Lead(Pb)-Free solder)

- Complete soldering within 10 seconds for lead temperature not exceeding °C or within 3 seconds not exceeding 350 °C.
- Heating by soldering iron must be only once per 1 lead

(2) Precautions for General Storage

1) Do not store devices at any place where they will be exposed to moisture or direct sunlight.

2) When transportation or storage of devices, follow the cautions indicated on the carton box.

3) The storage area temperature should be kept within a temperature range of 5 °C to 35 °C, and relative humidity should be maintained at between 45% and 75%.

4) Do not store devices in the presence of harmful (especially corrosive) gases, or in dusty conditions.

5) Use storage areas where there is minimal temperature fluctuation. Because rapid temperature changes can cause condensation to occur on stored devices, resulting in lead oxidation or corrosion, as a result, the solderability of the leads will be degraded.

6) When repacking devices, use anti-static containers.

7) Do not apply any external force or load directly to devices while they are in storage.

8) If devices have been stored for more than two years, even though the above conditions have been followed, it is recommended that solderability of them should be tested before they are used.

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