

REFERENCE

SHARP

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OPTO-ANALOG DEVICES DIVISION
ELECTRONIC COMPONENTS GROUP
SHARP CORPORATION

SPECIFICATION

DEVICE SPECIFICATION FOR

VOLTAGE REGULATOR

MODEL No.

PQ***ENB1ZPH

Applied Model No.

PQ012ENB1ZPH
PQ015ENB1ZPH
PQ018ENB1ZPH
PQ025ENB1ZPH
PQ033ENB1ZPH

Specified for

Enclosed please find copies of the Specifications which consists of 17 pages including cover.
This specification sheets and attached sheets shall be both side copy.

After confirmation of the contents, please be sure to send back copies of the Specifications
with approving signature on each.

CUSTOMER'S APPROVAL

PRESENTED

DATE

DATE

June 12, 2007

BY

BY

H. Imanaka

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Department General Manager of
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ELECOM Group
SHARP CORPORATION

Product name : VOLTAGE REGULATOR

Model No. : PQ***ENB1ZPH

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(Precautions)

- (1) This product is designed for use in the following application areas ;

· OA equipment	· Audio visual equipment	· Home appliances
· Telecommunication equipment (Terminal)	· Measuring equipment	
· Tooling machines	· Computers	

If the use of the product in the above application areas is for equipment listed in paragraphs (2) or (3), please be sure to observe the precautions given in those respective paragraphs.

- (2) Appropriate measures, such as fail-safe design and redundant design considering the safety design of the overall system and equipment, should be taken to ensure reliability and safety when this product is used for equipment which demands high reliability and safety in function and precision, such as ;

· Transportation control and safety equipment (aircraft, train, automobile etc.)	
· Traffic signals	· Gas leakage sensor breakers
· Other safety equipment	· Rescue and security equipment

- (3) Please do not use this product for equipment which require extremely high reliability and safety in function and precision, such as ;

· Space equipment	· Telecommunication equipment (for trunk lines)
· Nuclear power control equipment	· Medical equipment

- (4) Please contact and consult with a Sharp sales representative if there are any questions regarding interpretation of the above three paragraphs.

3. Please contact and consult with a Sharp sales representative for any questions about this product.

1. Application

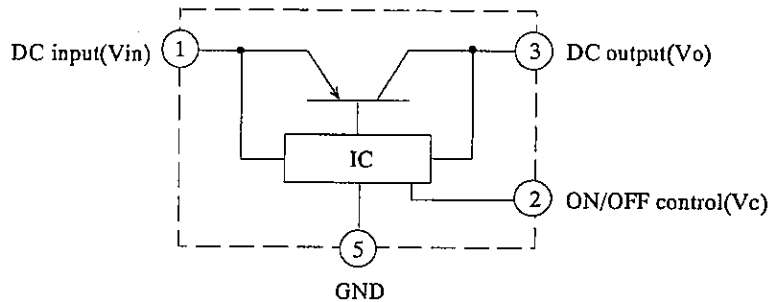
This specification applies to the outline and characteristics of series regulator (linear type), Model No. PQ***ENB1ZPH.

Usage

PQ***ENB1ZPH are the devices for stabilization of positive output voltage with the built-in ON/OFF function, the over current protection function, the overheat protection function and adjustable DC output voltage by using external resistance, and is low consumption current at OFF-state (stand-by).

These devices are possible to use in power supply circuit up to current capacity 1.0A.

Block diagram



2. Outline : Refer to the attached sheet, page 3.

3. Ratings and characteristics : Refer to the attached sheet, page 4 to 7

- 3.1 Absolute maximum ratings
- 3.2 Electrical characteristics
- 3.3 Electrical characteristics measuring circuit
- 3.4 Pd-Ta rating (Typical value)

4. Reliability : Refer to the attached sheet, Page 8.

5. Outgoing inspection : Refer to the attached sheet, Page 9.

6. Supplement : Refer to the attached sheet, Page 9 to 13

- 6.1 Example of application
- 6.2 Taping and reel packaging
- 6.3 ODS materials

1) This product shall not contain the following materials.

2) Also, the following materials shall not be used in the production process for this product.

Materials for ODS : CFCs, Halon, Carbon tetrachloride, 1.1.1-Trichloroethane (Methyl chloroform)

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6.4 Compliance with each regulation

6.4.1 The RoHS directive(2002/95/EC)

This product complies with the RoHS directive(2002/95/EC) .

Object substances: mercury, lead (except for lead in high melting temperature type solders^{*1}), cadmium, hexavalent chromium, polybrominated biphenyls (PBB) and polybrominated diphenyl ethers (PBDE)

*1 : i.e. tin-lead solder alloys containing more than 85% lead

6.4.2 Content of six substances specified in Management Methods for Control of Pollution Caused by Electronic formation Products Regulation (Chinese : 电子信息产品污染控制管理办法).

Category	Toxic and hazardous substances					
	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent chromium (Cr ⁶⁺)	Polybrominated biphenyls (PBB)	Polybrominated diphenyl ethers (PBDE)
Voltage regulator	*	✓	✓	✓	✓	✓

✓ : indicates that the content of the toxic and hazardous substance in all the homogeneous materials of the part is below the concentration limit requirement as described in SJ/T 11363-2006 standard .

* : indicates that the content of the toxic and hazardous substance in at least one homogeneous material of the part exceeds the concentration limit requirement as described in SJ/T 11363-2006 standard.

Lead in high melting temperature type solders (i.e. tin-lead solder alloys containing more than 85% lead) (designated by “*” in the above table) are exempt from the RoHS directive (2002/95/EC) , because there is no effective way to eliminate or substitute them by present scientific technology.

6.5 Specified brominated flame retardants

Specified brominated flame retardants (PBB and PBDE) are not used in this device at all.

6.6 This product is not designed as electromagnetic and ionized-particle radiation resistant.

7. Notes : Refer to the attached sheet, Page 14to 16

7.1 External connection

7.2 Thermal protection design

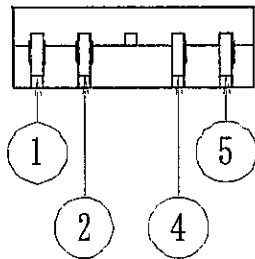
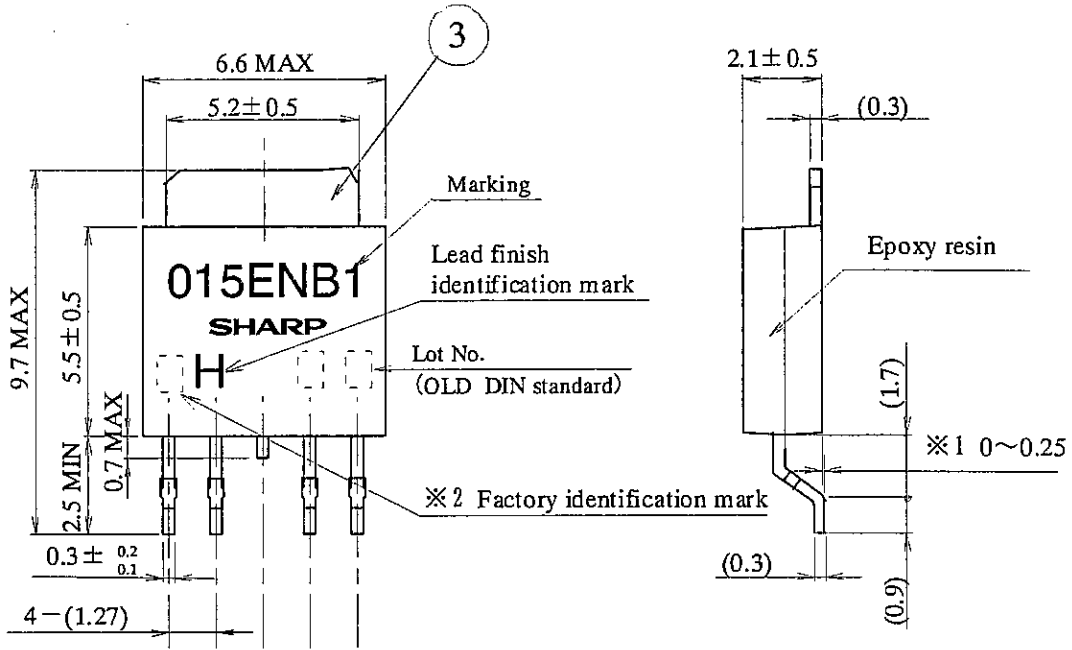
7.3 Static electricity

7.4 Soldering

7.5 Cleaning



2. Outline



- ※1 Reference value
- (): TYP.
- Unit : mm
- Scale : 5/1

- ① DC input (Vin)
- ② ON/OFF control (Vc)
- ③ DC output (Vo)
- ④ NC
- ⑤ GND

※2 Without : Fujimoto Electric Co., Ltd.
 △ : P.T.SHARP
 SEMICONDUCTOR INDONESIA
 ◇ : Fujimoto International
 Technology Corp.

Lead finish : Lead-free solder plating
 (Composition : Sn2Cu)
 Lead material : Cu
 Product mass : (0.23g)

Applied model No.	Marking
PQ012ENB1ZPH	012ENB1
PQ015ENB1ZPH	015ENB1
PQ018ENB1ZPH	018ENB1
PQ025ENB1ZPH	025ENB1
PQ033ENB1ZPH	033ENB1

Marked model No.is in accordance with the applied model.

3. Ratings and characteristics

3.1 Absolute maximum ratings

Ta=25°C

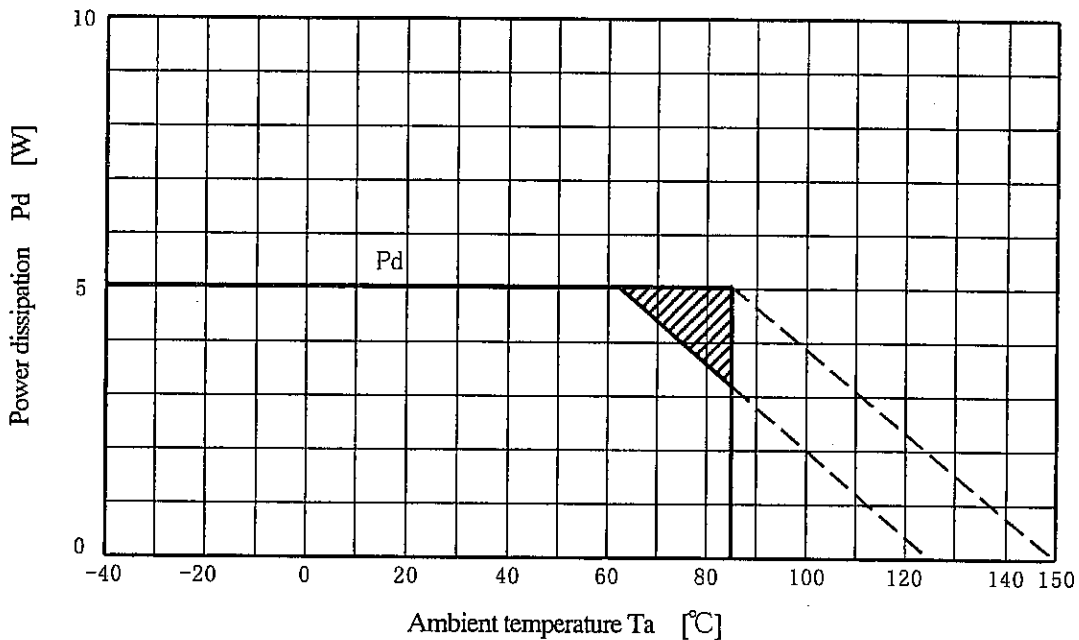
Parameter	Symbol	Rating	Unit	Conditions
Input voltage (*1)	Vin	10	V	Io<10mA
Voltage differential between input and output	Vi-o(max)	5	V	10mA≤Io≤1A
Output control voltage (*1)	Vc	10	V	
Output current	Io	1	A	
Power dissipation (*2)	Pd	5	W	Refer to Fig.1
Junction temperature (*3)	Tj	150	°C	
Operating temperature	Topr	-40 to +85	°C	
Storage temperature	Tstg	-40 to +150	°C	
Soldering temperature	Tsol	260	°C	For 10 s

(*1) All are open except GND and applicable terminals.

(*2) Pd : With infinite heat sink

(*3) There is case that over heat protection function operates at temperature Tj=125 to 150°C,so this item cannot be used in this temperature range.

Fig. 1 Inner derating curve



Pd : With infinite heat sink

(Note) There is case that over heat protection function operates at oblique line portion.

Regarding thermal design, please consider "3.4 Power dissipation vs Ambient temperature" with priority.

3.2 Electrical characteristics

Unless otherwise specified, condition shall be $V_{in}=V_o(TYP)+1V$ PQ012ENB1ZPH $V_{in}=2.5V$,
 $I_o=0.5A$, $V_c=2.7V$, $T_a=25^\circ C$

Parameter	Symbol	MIN.	TYP.	MAX.	Unit	Conditions
Input voltage range	V_{in}	Refer to list 1			V	
Output voltage	V_o	Refer to list 2			V	
Load regulation	RegL	-	0.2	1.0	%	$I_o=5mA$ to 1.0A
Line regulation	RegI	-	0.2	1.0	%	$V_{in}=V_o(TYP)+1V(MIN\ 2.35V)$ $\sim V_o(TYP)+6V, I_o=5mA$
Output-voltage temperature coefficient	TcV_o	-	± 0.01	-	%/°C	$I_o=5mA$, $T_j=0\sim 125^\circ C$
Ripple rejection	RR	-	60	-	dB	Refer to Fig. 3
Minimum voltage differential between input and output (*4)	V_{i-o}	-	0.2	0.3	V	(*5), $I_o=0.5A$
On-state voltage for control (*6)	$V_c(on)$	2.0	-	-	V	
On-state current for control	$I_c(on)$	-	25	100	μA	
Off-state voltage for control	$V_c(off)$	-	-	0.8	V	$I_o=0A$
Off-state current for control	$I_c(off)$	-	-	5	μA	$V_c=0.4V, I_o=0A$
Quiescent current	I_q	-	1	2	mA	$I_o=0A$
Output off-state consumption current	I_{qs}	-	-	5	μA	$I_o=0A, V_c=0.4V$

(*4) Applied to PQ033ENB1ZPH.

(*5) Input voltage when output voltage falls 0.95 V_o by input voltage falling down.

(*6) In case that the control terminal (② pin) is non-connection, output voltage should be OFF state.

List 1 Input voltage range

Unless otherwise specified, condition shall be $I_o=0.5A$, $V_c=2.7V$, $T_a=25^\circ C$

Model No.	Symbol	MIN	TYP	MAX	Unit	Condition
PQ012ENB1ZPH	V_{in}	2.35	—	6.20	V	
PQ015ENB1ZPH	V_{in}	2.35	—	6.50	V	
PQ018ENB1ZPH	V_{in}	2.35	—	6.80	V	
PQ025ENB1ZPH	V_{in}	3.0	—	7.5	V	
PQ033ENB1ZPH	V_{in}	3.8	—	8.3	V	

List 2 Output voltage

Unless otherwise specified, condition shall be $V_{in}=V_o(TYP)+1V$, $I_o=0.5A$, $V_c=2.7V$, $T_a=25^\circ C$

Model No.	Symbol	MIN	TYP	MAX	Unit	Condition
PQ012ENB1ZPH	V_o	1.176	1.200	1.224	V	$V_{in}=2.5V$
PQ015ENB1ZPH	V_o	1.47	1.50	1.53	V	
PQ018ENB1ZPH	V_o	1.764	1.800	1.836	V	
PQ025ENB1ZPH	V_o	2.45	2.50	2.55	V	
PQ033ENB1ZPH	V_o	3.234	3.300	3.366	V	



3.3 Electrical characteristics measuring circuit

Fig. 2 Standard measuring circuit of Regulator portion

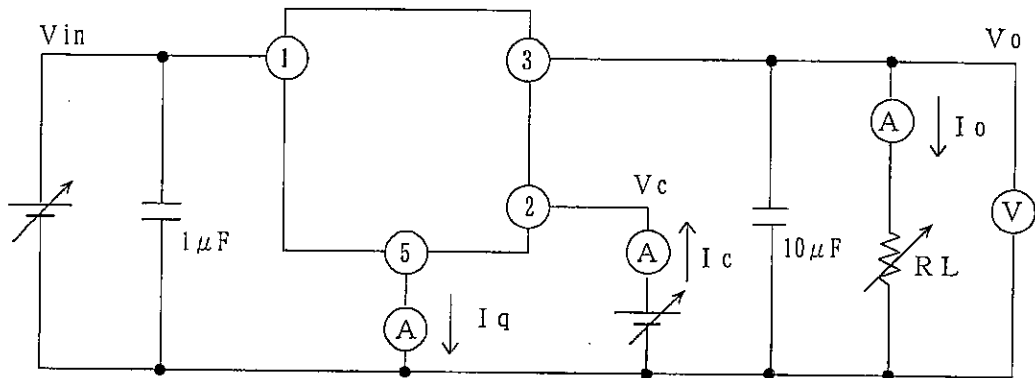


Fig. 3 Standard measuring circuit of critical rate of ripple rejection

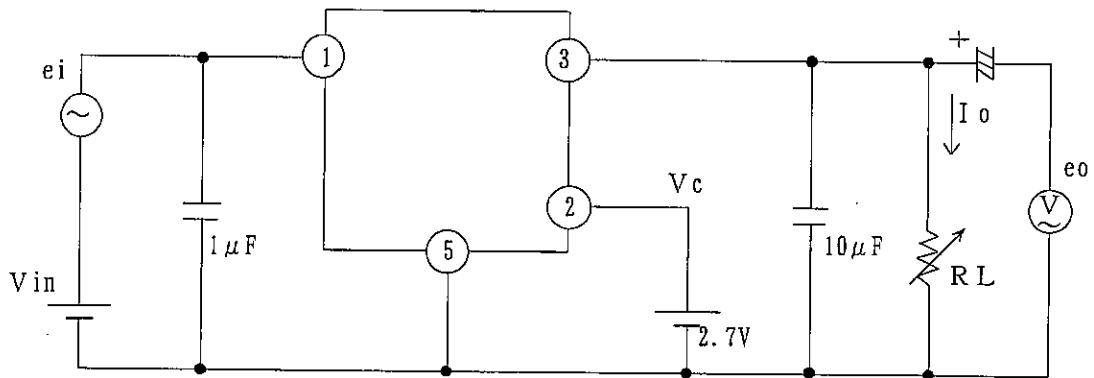
$f=120\text{Hz}$ sine wave

$e_i(\text{rms})=0.5\text{V}$

$V_{in}=V_o(\text{TYP})+2\text{V}$

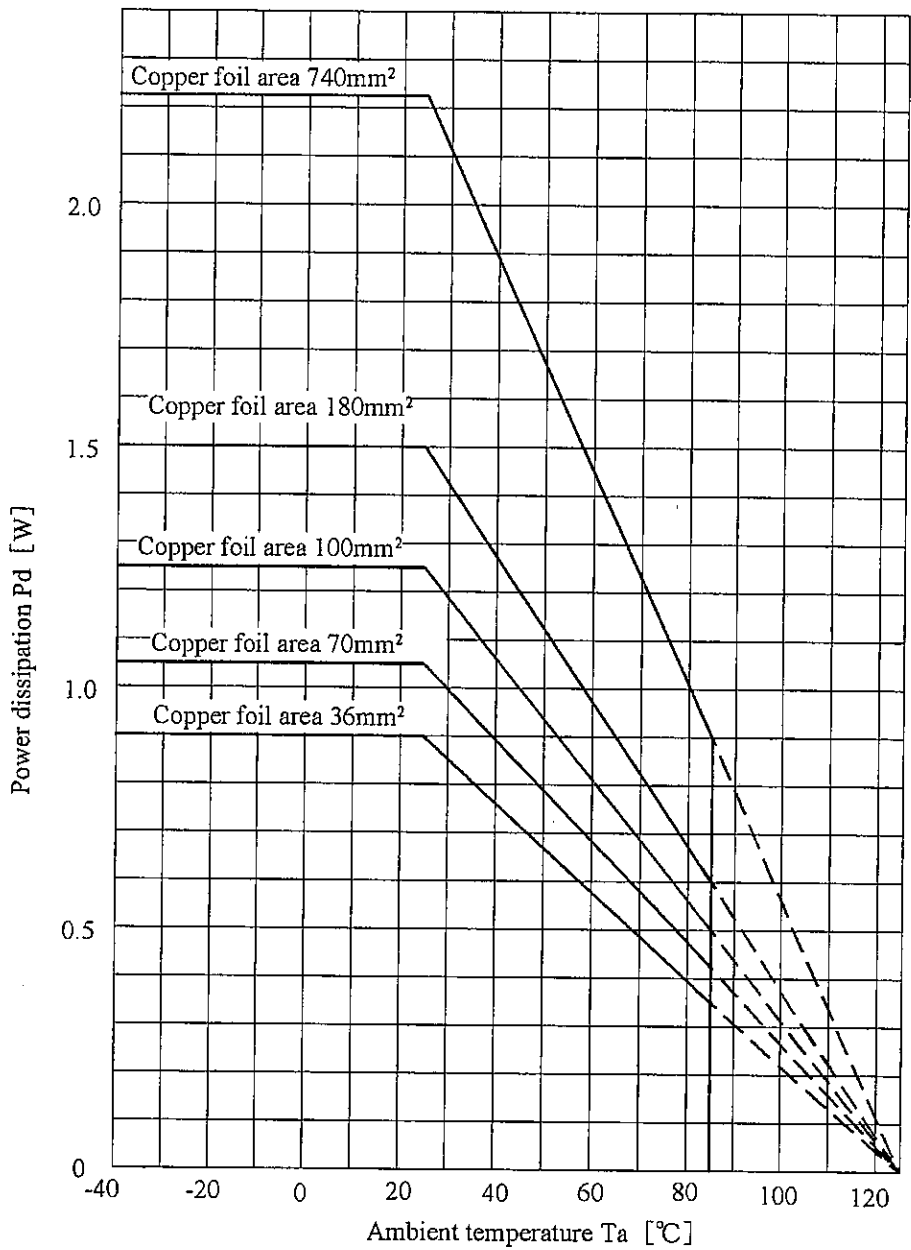
$I_o=0.3\text{A}$

$RR=20\log\{e_i(\text{rms})/e_o(\text{rms})\}$





3.4 Power dissipation vs Ambient temperature (Typical value)

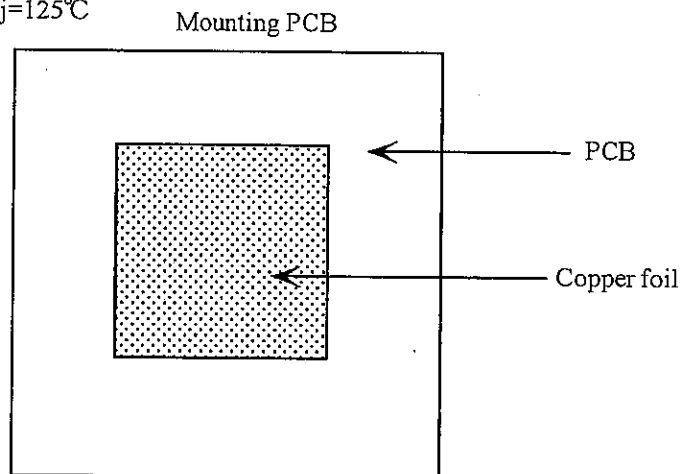


※The graph (power dissipation vs. Ambient temperature) indicates $T_j=125^\circ\text{C}$

Thermal design shall be considered in the safety operating area in the graph above. Even though in the safety operating area, please consider thermal design well.

In case of insufficient thermal design or using by exceeding the safety operating area, there is possibility that this device does not operate well or the reliability may have bad affection.

In case of using by exceeding the safety operating area, this device will not work because overheat protection function will operate.



Material: Glass-cloth epoxy resin

Size: $50 \times 50 \times 1.6\text{mm}$

Thickness of copper foil: $35 \mu\text{m}$

4. Reliability

The reliability of products shall be satisfied with items listed below.

Confidence level : 90%

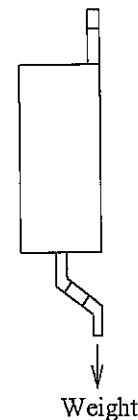
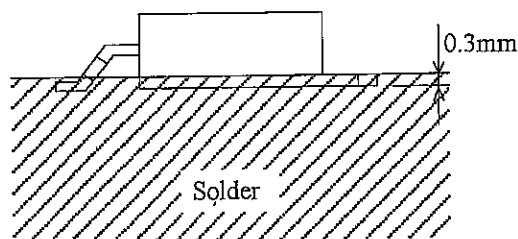
LTPD : 10 or 20

Test Items	Test Conditions	Failure Judgment Criteria	Samples (n) Defective (c)	
Temperature cycling	1 cycle; -40°C(30min) to +150°C (30min) 20 cycles test	$V_o < L \times 0.8$ $V_o > U \times 1.2$ $RegI > U \times 1.2$ $RegI > U \times 1.2$ $V_i - o > U \times 1.2$ *4 U: Upper specification limit L: Lower specification limit	n=22, c=0	
Temperature humidity bias	+85°C, 85%RH, $V_{in}=V_c=10V$, $I_o=0A, 1000h$		n=22, c=0	
Damp Heat cycling	1 cycle; -20°C (2h) to +70°C (2h), 90%RH Transfer time between high and low temp. is 1h. 40 cycles test		n=22, c=0	
High temp. storage	+150°C, 1000h		n=22, c=0	
Low temp. storage	-40°C, 1000h		n=22, c=0	
Operation life	$T_a=25^\circ C$, $P_d=0.9W$, 1000h Mount on PCB copper foil area 36 mm^2 in Para.3-4.		n=22, c=0	
Mechanical shock	15 km/s^2 , 0.5ms, each 3 times /±X, ±Y, ±Z		n=11, c=0	
Vibration (Variable frequency)	200 m/s^2 , 100 to 2000 to 100Hz/4min each 4 times/X, Y, Z direction		n=11, c=0	
Soldering heat	260°C, 10s, Dip in solder up to the position of 0.3mm from resin portion *2		n=11, c=0	
Reflow Soldering heat	Temperature profile as shown in the item 7-6, twice.		n=11, c=0	
Electrostatic discharge	±250V, 200pF, 0Ω Between GND and each terminal/ each 3 times		n=11, c=0	
Robustness of Termination (Tensile test)	Weight: 5N, 10s/each terminal *3		Failure if it has breakdown and loosened pin. *5	n=11, c=0
Solderability	245±2°C, 3s Solder : Sn/3.0Ag/0.5Cu EC19S TAMURA KAKEN CORPORATION made flux use *2		Failure if A portion area is not soldered 95% or more. *6	n=11, c=0

*1 There is cases that heat sink and terminals will have color change of the surface.
The color change should be excluded from the failure judgment criteria.

*2 Soldering area is shown below.

*3 Terminal tensile direction is shown below.



*4 $V_i - o$ is applied only to PQ033ENB1ZPH.

*5 Except for the bending of terminal.

*6 Except for the portion within 0.3mm from the interface between the heat sink and the resin portion, the side and top surface of heat sink, and leads tiber cut portion.



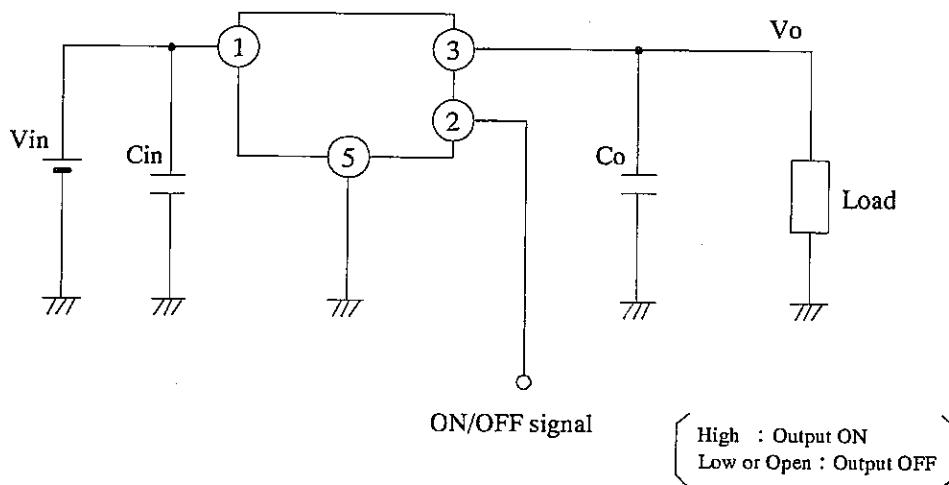
5. Outgoing inspection

A single sampling plan, normal inspection level II based on ISO 2859 is applied.
 The AQL according to the inspection items are shown below.

Defect	Inspection items	AQL (%)	Judgment criteria
Major defect	Electrical characteristics	0.1	It is based on the contents in the specification.
	Marking		To be recognized.
Minor defect	Dimensions	0.4	It is based on the contents in the specification.
	Appearance		Having no resin break off and lead bending.

6. Supplement

6.1 Example of application



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6.2 Packing specifications

6.2.1 Packing form

(1) Tape structure and Dimensions (Refer to Fig. A)

The carrier tape shall have a structure in which a cover tape is sealed heat-pressed on the carrier tape of polystyrene emboss protect against static electricity.

Dimensions are shown in Fig. A.

(2) Reel structure and Dimensions (Refer to Fig. B)

The reel shall be made of polystyrene. Dimensions are shown in Fig. B.

(3) Direction of product insertion (Refer to Fig. C)

Product direction in carrier tape shall direct to the radiate fin of product at the hole side on the tape.

6.2.2 Tape characteristics

(1) Adhesiveness of cover tape

The peel-back force between carrier tape and cover tape shall be 0.1N to 0.8N for the angle 160 to 180°. (Tape speed : 5mm/s)

(2) Bending strength

Sealed tape : Bended tape radius shall be 30mm or more.

If bended tape radius is 30mm or less, there is case that cover tape come off carrier tape.

(3) Carrier tape : Bended tape radius shall be 15mm or more.

6.2.3 Rolling method and quantity

(1) Rolling method

Wind the tape back on the reel so that the cover tape will be outside the tape.

Attach 20 pitches or more of empty cavities to the trailer and attach

10 or more pitches of empty cavities to the leader of the tape and fix the both ends with adhesive tape.

(2) Quantity

Basically, one package shall contain 3000pcs.

6.2.4 Indication

(1) Reel

The label shall be pasted on the reel to indicate following contents.

* Model No.	* Quantity	* Packing date
-------------	------------	----------------

(2) Package case

The label with below contents shall be pasted on the outer packaging case.

* Model No.	* Quantity	* Packing date
-------------	------------	----------------

6.2.5 Storage environment

Taped products shall be stored at the temperature 5 to 30°C and the humidity 70%RH or less avoiding direct sunlight. If taped products aren't used for 10days, Please rewind the tape pulled out and storage.

Regarding the devices stored for long time, there is possibility that deterioration of lead pin color and solderability may be caused. Please use the devices after checking the solderability in advance.

6.2.6 Others

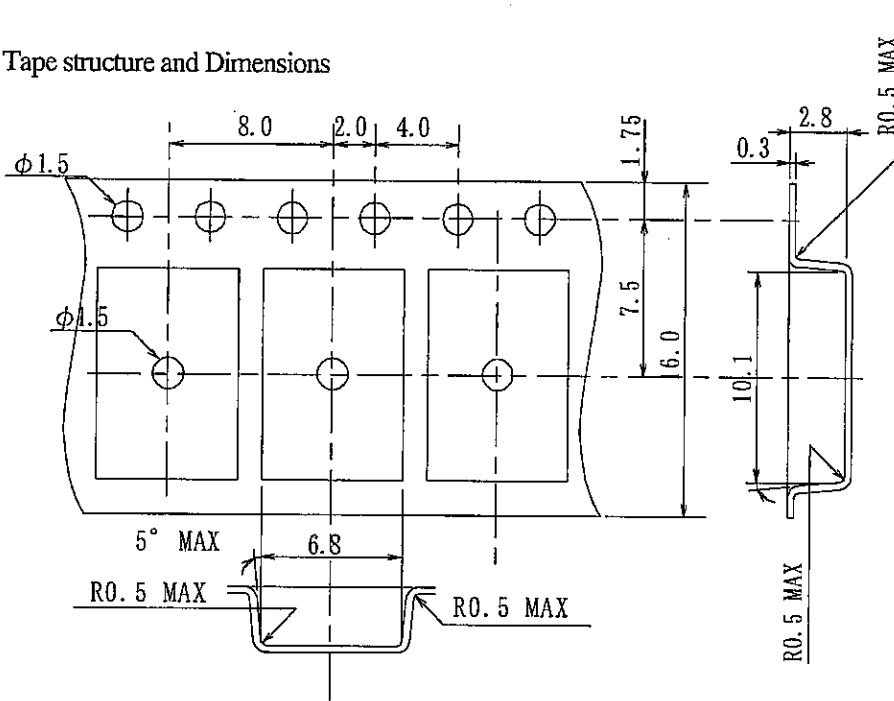
(1) Joint of tape

The cover tape and carrier tape in one reel shall be jointless.

(2) The way to repair taped failure devices

Cutting a bottom of carrier tape with a cutter, and after replacing to good devices, the cutting portion shall be sealed with adhesive tape.

Fig. A Tape structure and Dimensions



Dimensions : TYP. value

Unit : mm

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Fig.B. Reel structure Dimensions

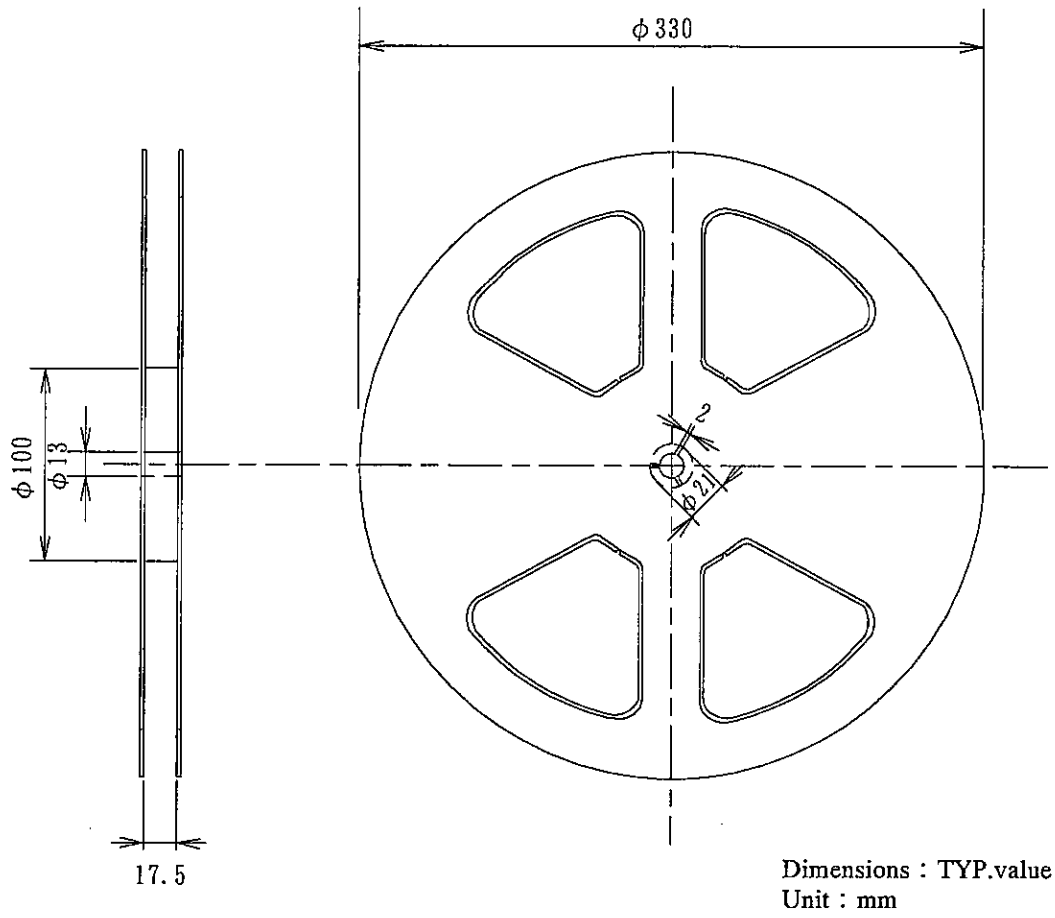
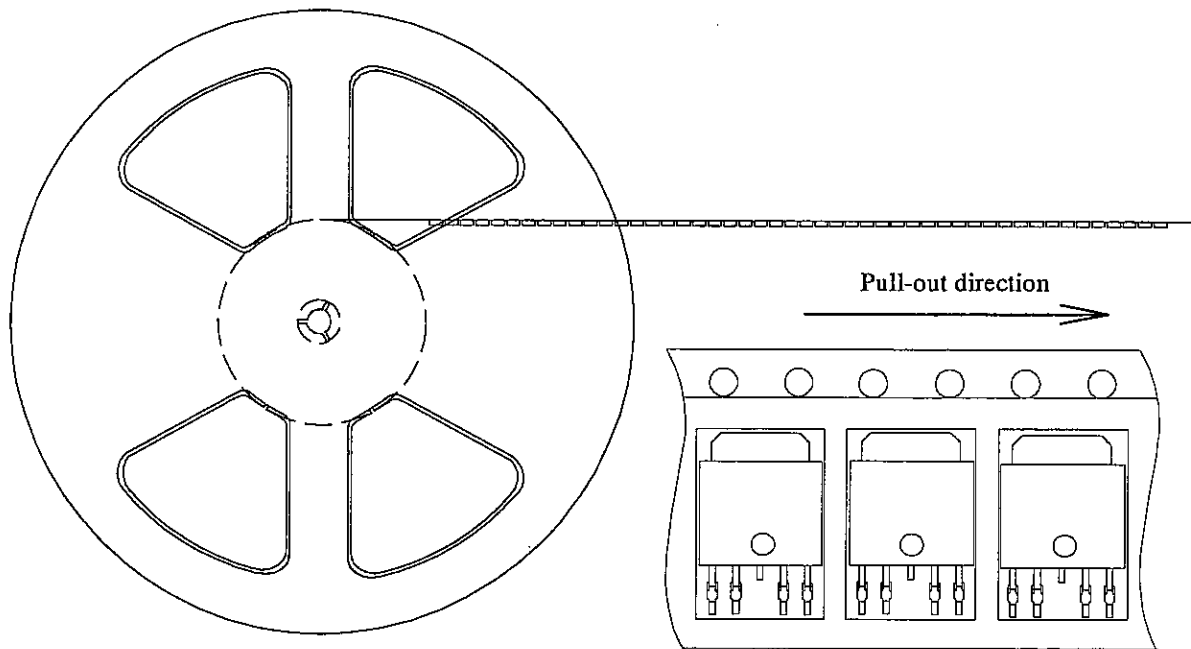
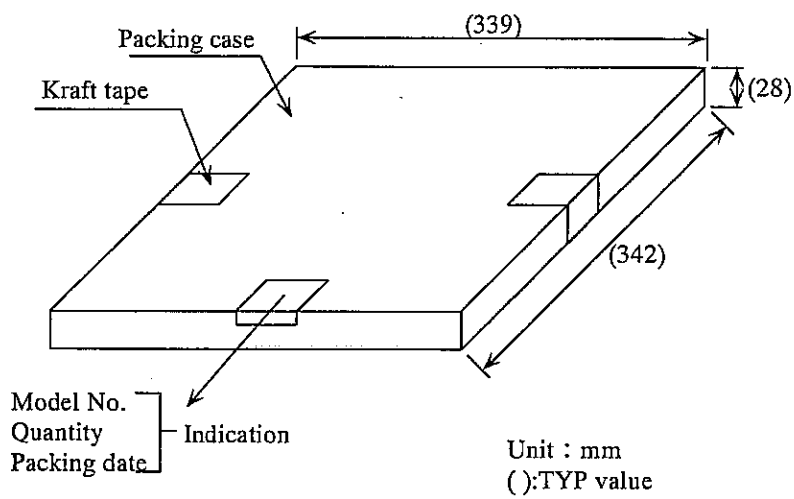
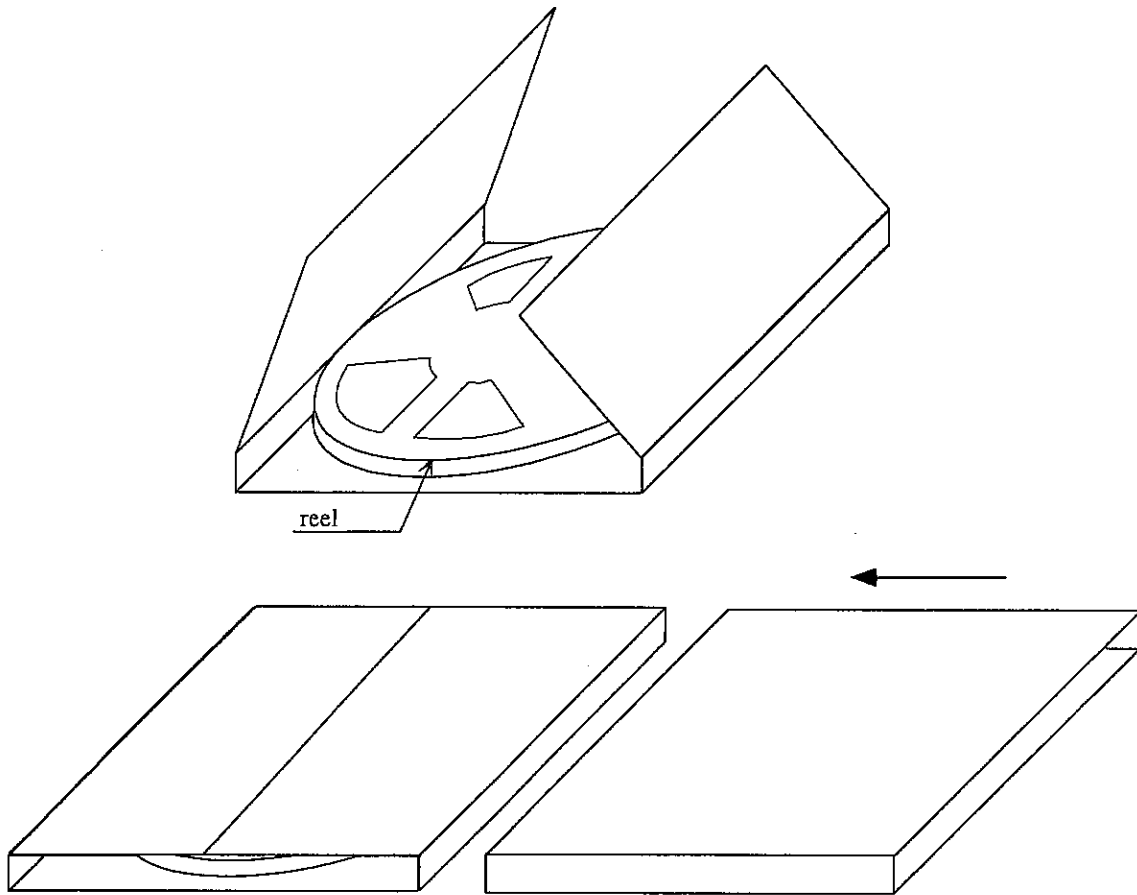


Fig.C. Direction of product insertion



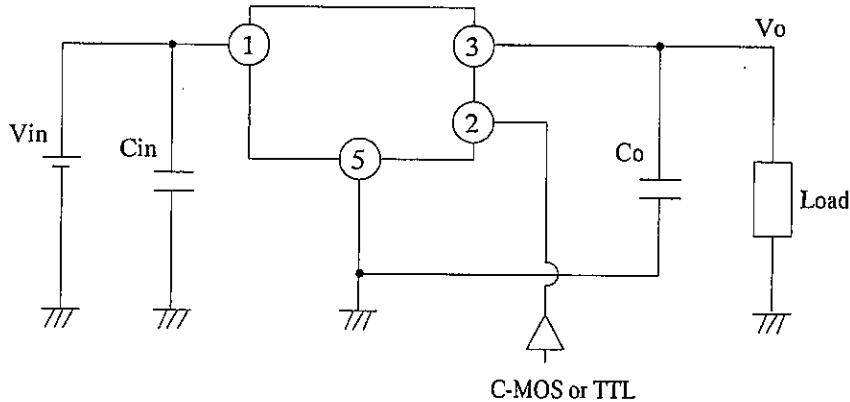
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Fig.D. Packing case

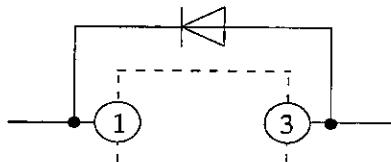


7. Notes

7.1 External connection



- (1) Please use C_{in} and C_o for sure to use this device.
For C_o , the ceramic capacitor of $10\mu F$ or more with B characteristics is recommend.
Please design the shortest wiring for the connection between C_{in} , C_o and the relevant terminal.
There is a case that the oscillation easily occurs by kinds and value of the capacity.
Before use, this device, please confirm the output voltage in your real application circuit.
- (2) The input terminal for ON/OFF output control ; ② is compatible with LS-TTL, and direct driving by TTL or C-MOS standard logic (RCA 4000 series) is also available.
In case that ON/OFF terminal is not used, we recommend to connect the ON/OFF terminal directly to the input terminal ; ① input voltage.
- (3) Voltage application under conditions that the device pin is inserted divergently or reversely, may occur the degradation of characteristics or breakdown of the device, please avoid it absolutely.
- (4) In applying greater voltage to the output terminal ③ than the voltage of the DC input terminal ①, breakdown of the device may occur. Especially in the case that the DC input terminal ① is short-circuited with GND, under the normal condition, the charge that is being charged into the output capacitor (C_o) flows into the input side. This may cause breakdown of the device. To prevent such a breakdown, please connect a silicon diode as shown below in the schematic.



7.2 Thermal protection design

Internal power dissipation (P_d) of device is obtained by the following equation.

$$P_d = I_o \times (V_{in} - V_o) + V_{in} \times I_q$$

If the maximum operating temperature and P_d when the device is operating are determined, use such a heat sink as allows the device to operate within the safety operation area specified by the derating curve in para. 3.4.

Insufficient radiation or using over the limitation of the inner power dissipation curve gives an unfavorable influence to the normal operation and reliability of the device.

In the case of no passage within the safety operational territory illustrated by the derating curve, the overheat protection circuit operates to let output fall down, please avoid keeping such condition for a long time.

7.3 Static electricity

Good caution must be exercised against static electricity since this device consists of a bipolar IC.

Following are some examples of preventive measures against excessive voltages such as caused by static electricity.

- (a) Human body must be grounded to discharge the static electricity from the body or cloth.
- (b) Anything that is in contact with the device such as workbench, inserter, or measuring instrument must be grounded.
- (c) Use a solder dip basin with a minimum leak current (isolation resistance $10M\Omega$ or more) from the commercial power supply. Also the solder dip basin must be grounded.

7.4 Soldering

(1) Reflow soldering

It is recommended that within two times soldering be done at the temperature and the time within the temperature profile as shown in the figure.

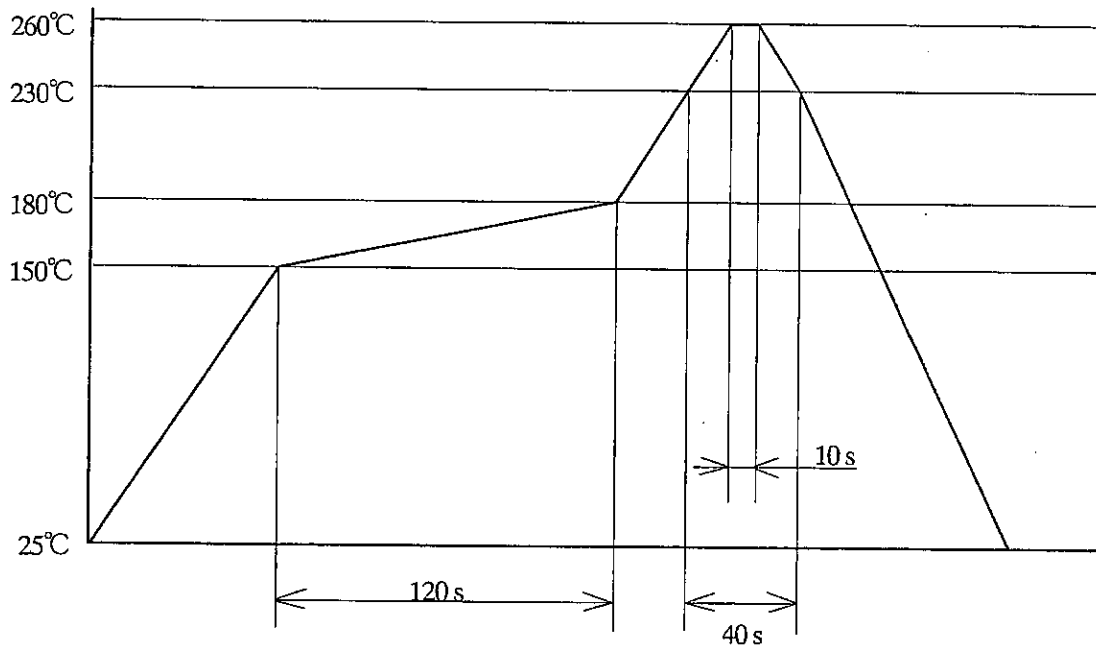
(The temperature shown in the figure is fin portion temperature of the device.)

It is recommended that the second reflow become at the device which is the room temperature.

(a) An infrared lamp used for soldering may cause a localized temperature rise in the resin.

The temperature of resin portion should be with in the temperature profile below.

(b) The temperature sloping when soldering-reflow is 4°C/s or less.



(2) Dip soldering

We recommend that solder dip should be 260°C (Solder temp.) 10s or less and 1 time only.

Please obey the note items below concerning solder reflow.

(a) After solder dip, please do cooling naturally.

(b) Please shall not give the mechanical force or the impact force to the device.

In advance, please confirm fully the dip soldering conditions etc. in the actual application in order to avoid any soldering bridge.

(3) Hand soldering

This device is basically designed for the soldering such as reflow soldering or dip soldering.

In case when hand soldering is reluctantly needed for modification etc. it is recommended that only one hand soldering should be done at 350°C or less of soldering iron edge temperature, for 3s or less.

Please be careful not to touch soldering iron edge to leads directly etc. in order not to give any force to the leads.

Please be careful, especially, when heat sink is heated up by soldering iron, there is possibility that internal device may have over heat and the reliability of the internal device may have bad affection.

Even if the above conditions regarding solder reflow, solder dip or hand soldering there is the possibility that the force given to the terminals by the deformation of PCB may cause the electric properties change and wire breaking in the device package. In advance, please confirm fully at the actual application.

(1) Solvent cleaning: Solvent temperature 45°C or less

Immersion for 3 min or less

(2) Ultrasonic cleaning: The effect to device by ultrasonic cleaning differs by cleaning bath size, ultrasonic power output, cleaning time, PCB size or device mounting condition etc.

Please test it in actual using condition and confirm that doesn't occur any defect before starting the ultrasonic cleaning.

(3) Applicable solvent: Ethyl alcohol, Methyl alcohol, Isopropyl alcohol

When the other solvent is used, there are cases that the packaging resin is eroded.

Please use the other solvent after thorough confirmation is performed in actual using condition.