

SHARP

REFERENCE

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OPTO-ANALOG DEVICES DIVISION
ELECTRONIC COMPONENTS GROUP
SHARP CORPORATION

SPECIFICATION

DEVICE SPECIFICATION FOR

VOLTAGE REGULATOR

MODEL No.

PQ1LA**5MSPQ

Applied model name

Applied model name			
	PQ1LA155MSPQ		PQ1LA335MSPQ
	PQ1LA185MSPQ		PQ1LA505MSPQ
	PQ1LA255MSPQ		

Specified for

CUSTOMER'S APPROVAL

DATE

BY

PRESENTED

DATE

BY

H. Imanaka,
Department General Manager of
Engineering Dept., II
Opto-Analog Devices Div.
ELECOM Group
SHARP CORPORATION

Product name : VOLTAGE REGULATOR

Model No. PQ1LA**5MSPQ

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Applied model name	
PQ1LA155MSPQ	PQ1LA335MSPQ
PQ1LA185MSPQ	PQ1LA505MSPQ
PQ1LA255MSPQ	

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(Precautions)

- 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.

- 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

- 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

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

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

1. Application

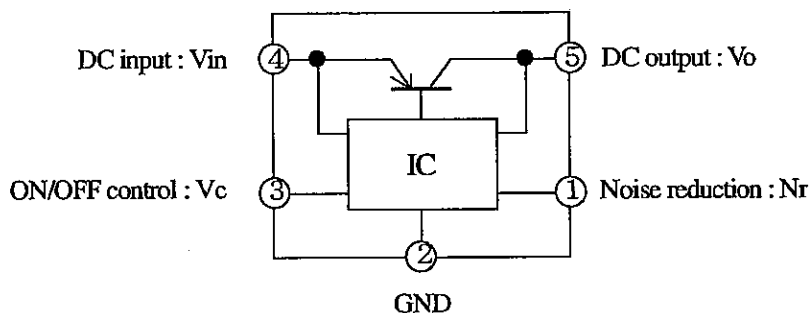
This specification applies to the outline and characteristics of surface mount type series regulator (linear type), Model No. PQ1LA**5MSPQ.

Usage

The series of this product is the device for stabilization of DC positive output voltage with built-in output voltage ON/OFF function, over current protection function and the over heat protection function.

These devices are possible to use in power supply circuit up to current capacity 0.5A.

Block diagram



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

3. Ratings and characteristics : Refer to the attached sheet, Page 4 to 6.

3.1 Absolute maximum ratings

3.2 Electrical characteristics

3.3 Electrical characteristics measuring circuit

4. Reliability : Refer to the attached sheet, Page 7.

5. Outgoing inspection : Refer to the attached sheet, Page 8.

6. Supplement : Refer to the attached sheet, Page 8 to 11.

6.1 Example of application

6.2 Over current protection characteristics (Typical value)

6.3 Package specification

6.4 ODS materials

This product shall not contain the following materials.

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 (Methylchloroform)

6.5 The directive of RoHS

This product conforms to the directive of RoHS.

Material for RoHS: mercury, lead, cadmium, hexavalent chromium,

polybrominated biphenyls and Polybrominated diphenyl ethers.

6.6 Brominated flame retardants

Specific brominated flame retardants such as the PBBOS and PBBS are not used in this device at all.

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

7. Notes : Refer to the attached sheet, Page 12, 13.

7.1 External connection

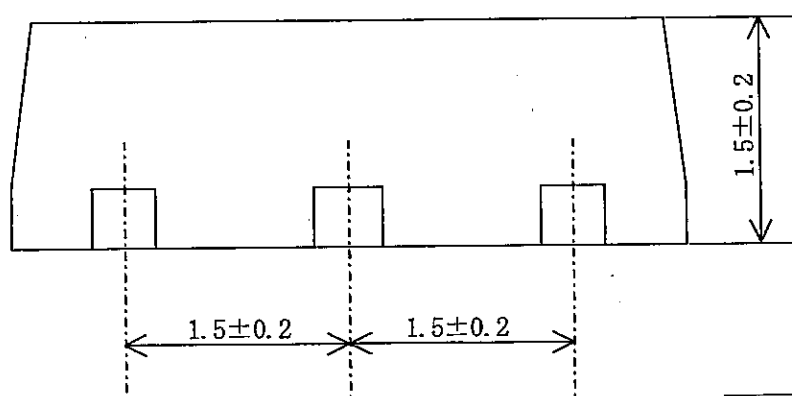
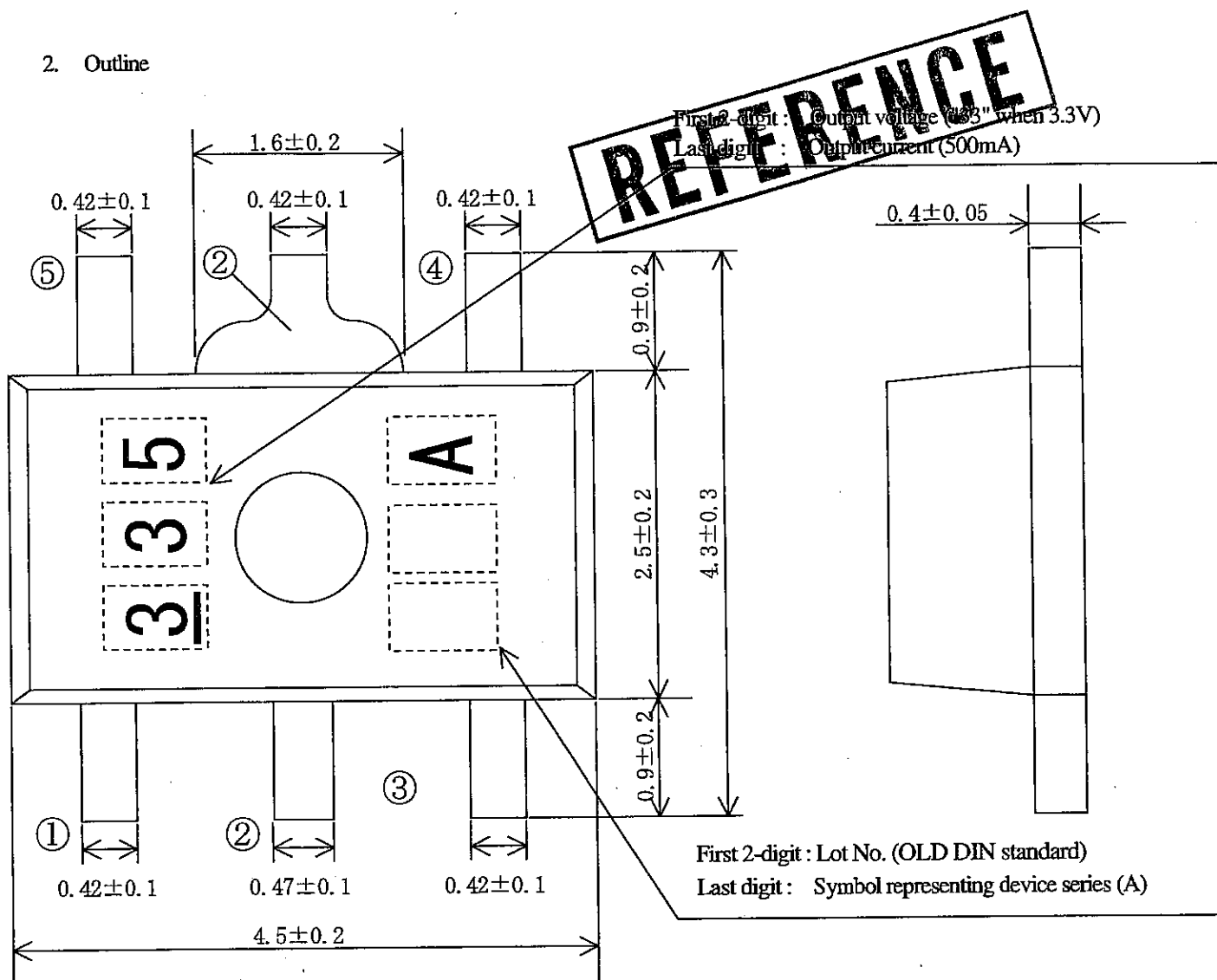
7.2 Thermal protection design

7.3 Static electricity

7.4 Soldering

7.5 For cleaning

2. Outline



Unit: mm

Lead finish : Lead-free solder plating
(Composition:Sn-2Bi)

Lead material : Cu

Product mass : 0.055g

Pin No.	Pin name	Symbol
①	Noise reduction (Nr)	Nr
②	GND	GND
③	ON/OFF control	Vc
④	DC input	Vin
⑤	DC output	Vo

3. Ratings and characteristics

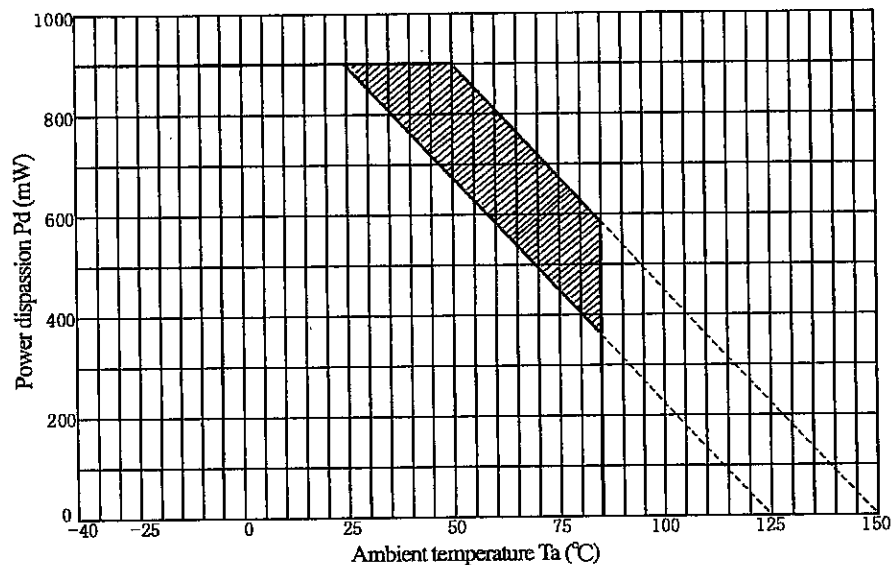
3.1 Absolute maximum ratings

 $T_a = 25^\circ\text{C}$

Parameter	Symbol	Rating	Unit	Conditions
Input voltage (*1)	V_{in}	15	V	
Output control voltage (*1)	V_c	15	V	
Output current	I_o	500	mA	
Power dissipation (*2)	P_d	900	mW	Refer to Fig.1
Junction temperature (*3)	T_j	150	$^\circ\text{C}$	
Operating temperature	T_{opr}	-40 to +85	$^\circ\text{C}$	
Storage temperature	T_{stg}	-55 to +150	$^\circ\text{C}$	
Soldering temperature	T_{sol}	270	$^\circ\text{C}$	For 10s

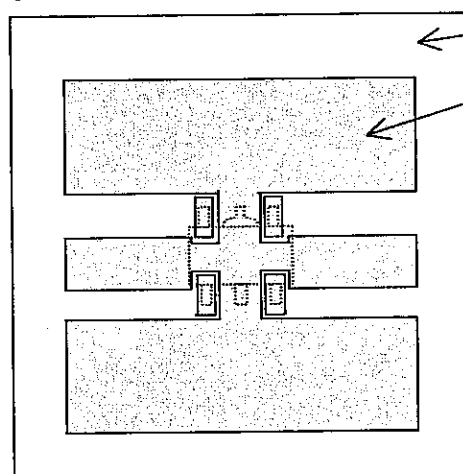
(*1) All are open except GND and applicable terminals.

(*2) At mounting PCB shown in Fig.1

(*3) There is case that over heat protection function operates at the temperature $T_j = 125^\circ\text{C}$ to 150°C .
So, don't use at the oblique line portionFig. 1 $P_d - T_a$ rating

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

Mounting PCB



PCB

Copper foil

Material : Glass-cloth epoxy resin
 PCB Size : $20 \times 20 \times 1.0$ mm
 Copper foil area : 180 mm^2
 Thickness of copper : $35 \mu\text{m}$

3.2 Electrical characteristics

Unless otherwise specified condition shall be $V_{in}=V_o(TYP)+1.0V$, $I_o=30mA$, $V_c=1.8V$, $T_a=25^{\circ}C$

Parameter	Symbol	MIN.	TYP	MAX.	Unit	Conditions
Input voltage	V_{in}	2.5	—	15	V	
Output voltage	V_o	Refer to list 1			V	
Load regulation	$RegL$	—	15	90	mV	$V_o < 3V$, $I_o = 5$ to $500mA$
		—	0.5	3	%	$V_o \geq 3V$, $I_o = 5$ to $500mA$
Line regulation	$RegI$	—	6	15	mV	$V_o < 3V$, $V_{in} = V_o(TYP) + 1V$ to $V_o(TYP) + 6V$
		—	0.2	0.5	%	$V_o \geq 3V$, $V_{in} = V_o(TYP) + 1V$ to $V_o(TYP) + 6V$
Temperature coefficient of output voltage	TcV_o	—	± 0.5	—	%	$I_o = 10mA$, $T_j = 0$ to $100^{\circ}C$
Ripple rejection (*4)	RR	—	55	—	dB	Refer to Fig.3
Output noise voltage (*4)	$V_{no(rms)}$	—	50	—	μV	$10Hz < f < 100kHz$ $C_n = 0.1 \mu F$, $I_o = 30mA$
Dropout voltage(*6)	V_{i-o}	—	0.4	0.7	V	$I_o = 300mA$, (*5)
On-state voltage for control (*7)	$V_{c(on)}$	1.8	—	—	V	
On-state current for control	$I_{c(on)}$	—	5	30	μA	$V_c = 1.8V$
Off- voltage for control	$V_{c(off)}$	—	—	0.4	V	
Quiescent current	I_q	—	500	800	μA	$I_o = 0mA$
Output off-state consumption current	I_{qs}	—	—	1	μA	$V_c = 0.2V$

(*4) Typical value of 3.3V output model.

(*5) Input voltage when output voltage falls 0.1V from that at $V_{in} = V_o(TYP) + 1.0V$.

(*6) This specification does not apply for PQ1LA155MSPQ and PQ1LA185MSPQ.

(*7) In case that the control terminal (③ pin) is non-connection, output voltage should be OFF state.

List 1 Output voltage

$V_{in} = V_o(TYP) + 1.0V$, $I_o = 30mA$, $V_c = 1.8V$, $T_a = 25^{\circ}C$

Model No.	Symbol	MIN	TYP	MAX	Unit	Condition
PQ1LA155MSPQ	V_o	1.470	1.5	1.530	V	
PQ1LA185MSPQ	V_o	1.764	1.8	1.836	V	
PQ1LA255MSPQ	V_o	2.450	2.5	2.550	V	
PQ1LA335MSPQ	V_o	3.234	3.3	3.366	V	
PQ1LA505MSPQ	V_o	4.900	5.0	5.100	V	

3.3 Electrical characteristics measuring circuits

Fig. 2 Standard measuring circuit of Regulator portion

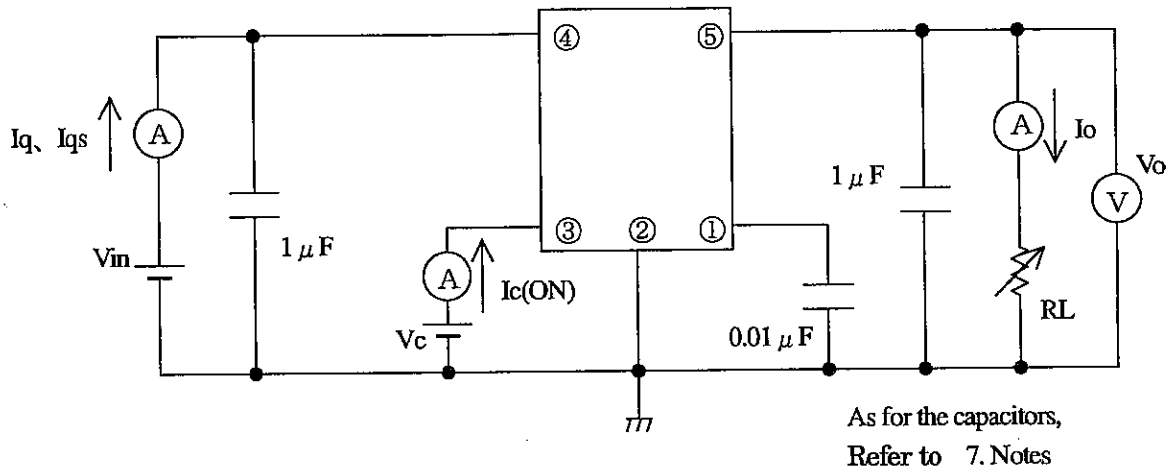
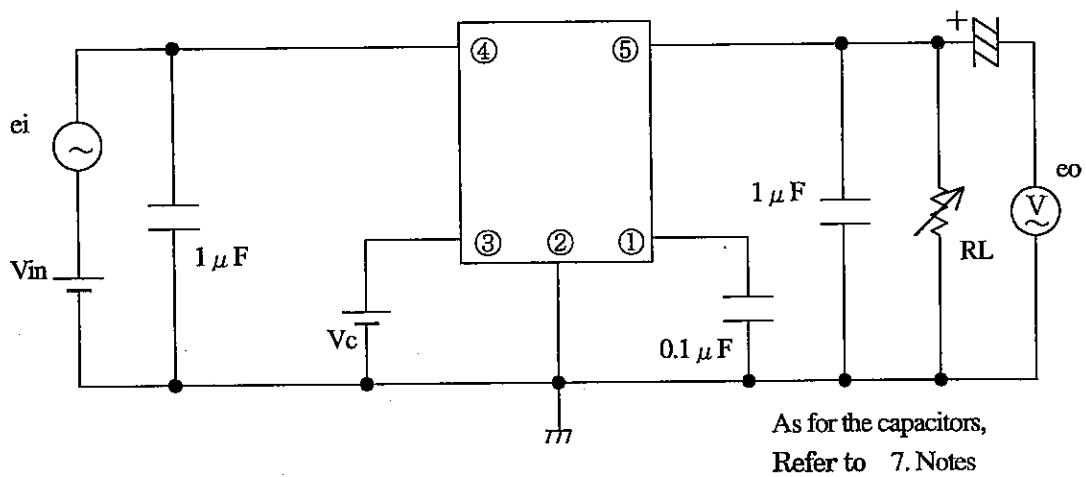
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Fig. 3 Standard measuring circuit of critical rate of ripple rejection

f=400Hz Sine wave

 $e_i(\text{rms})=100\text{mV}$ $V_{in}=V_o(\text{TYP})+1.0\text{V}$ $V_c=1.8\text{V}$ $I_o=30\text{mA}$

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



4. Reliability

The reliability of products shall satisfy items listed below.

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Confidence level : 90%

LTPD : 10 or 20

Test Items	Test Conditions	Failure Judgment Criteria	Samples (n)
			Defective(C)
Temperature cycling	1 cycle -55°C to +150°C (30min) (30min) 20 cycles test	$V_o < L \times 0.8$ $V_o > U \times 1.2$ $RegL > U \times 1.2$ $RegI > U \times 1.2$ $Vi-o > U \times 1.2$ U: Upper specification limit L: Lower specification limit	n=22, C=0
Temperature humidity bias	+85°C, 85%RH, $V_{in}=15V$, $V_c=15V$, $I_o=0A$, 1000h		n=22, C=0
Damp Heat cyclic	1 cycle : -20°C(2h) to 70°C(2h) Transfer time between high and low temp. is 1h. 40 cycles test, 90%RH		n=22, C=0
High temp. storage	+150°C, 1000h		n=22, C=0
Low temp. storage	-55°C, 1000h		n=22, C=0
Operation life	$T_a=25^\circ C$, $P_d=0.9W$, 1000h *5		n=22, C=0
Mechanical shock	15km/s ² , 0.5ms 3 times/ $\pm X$, $\pm Y$, $\pm Z$		n=11, C=0
Vibration (Variable frequency)	200m/s ² , 100 to 2000 to 100Hz/4 min 4 times/ X, Y, Z direction		n=11, C=0
Soldering heat	270°C, 10 s *3		n=11, C=0
Reflow soldering heat resistance	2 times with the reflow soldering profile shown in clause 7-4.		n=11, C=0
Electrostatic discharge	$\pm 100V$, 200pF, 0 Ω Between GND and each terminal/ 3 times		n=11, C=0
Robustness of Termination (Tensile test)	Weight: 2.5N 10 s/ each terminal *1	Failure if it has breakdown and loosened pin *2	n=11, C=0
Solderability	240 \pm 2°C, 3s Solder : Sn/3.0Ag/0.5Cu EC19S TAMURA KENCORPORATION made flux use *3	Failure if soldering area is not soldered 95% or more. *4	n=11, C=0

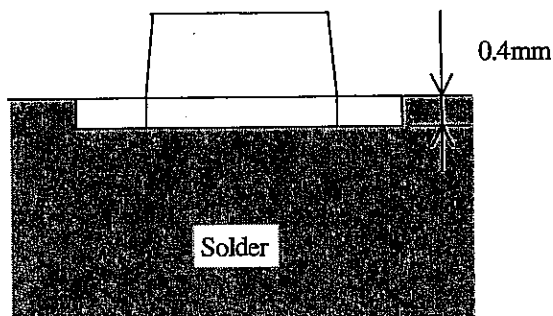
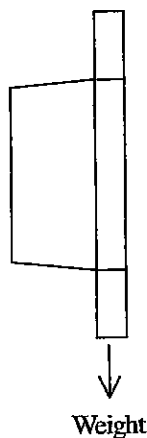
*1 Terminal bending direction is shown below.

*2 Except for the bending of terminal.

*3 Soldering area is shown below.

*4 Excluding side face of lead edge.

*5 At mounting PCB shown in Fig.1



5. Outgoing inspection

TABLE II-A single sampling plans for normal inspection based on ISO 2859 as applied

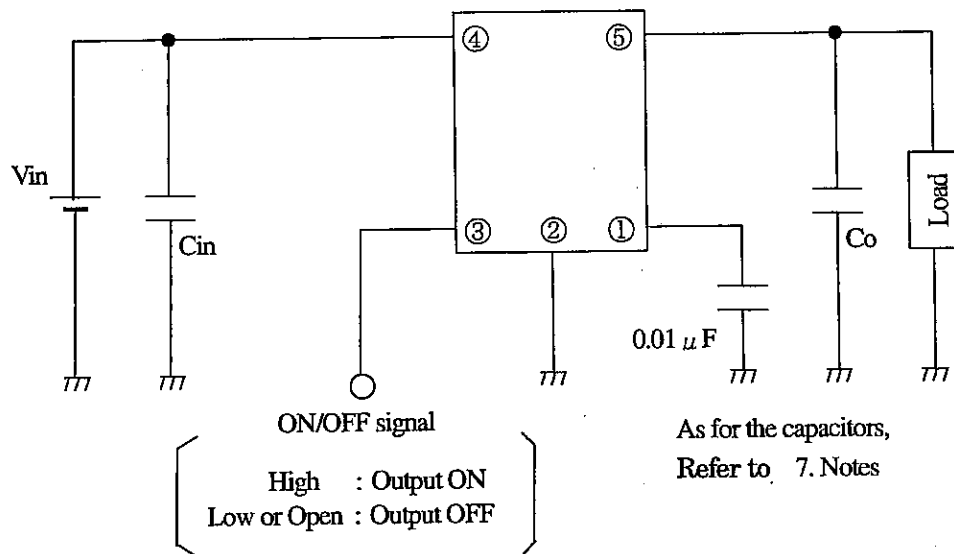
The AQL according to the inspection items are shown below.

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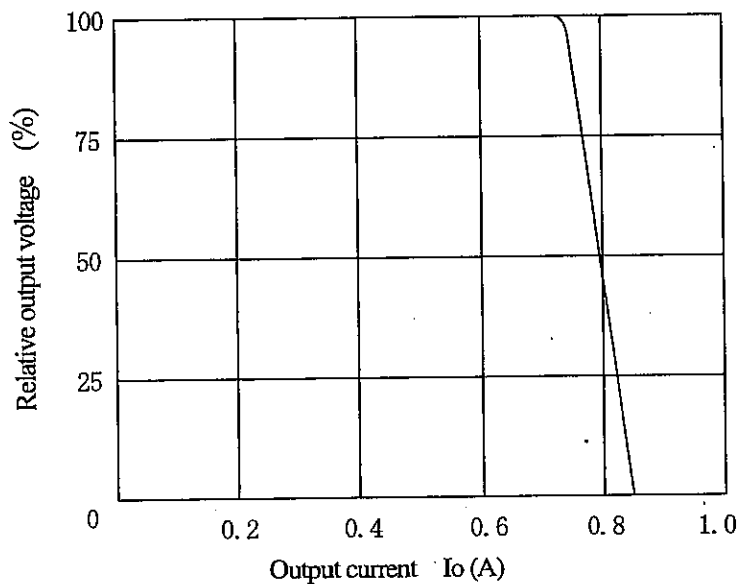
Defect	Inspection items	AQL (%)	Judgment criteria
Major defect	Electrical characteristics	0.1	Depend on the specification
	Unreadable marking		Readability
Minor defect	Dimensions	0.4	Depend on the specification
	Appearance		No chipped resin and no bent lead

6. Supplement

6.1 Example of application



6.2 Over current protection characteristics (Typical value)



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6.3 Package specification

6.3.1 Taping package conditions

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

The tape is made of the carrier tape (material : PS) and the cover tape (material : PET and PE), which are combined together by heating. Each dimension is shown in Fig. A.

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

Each dimension of the reel (material : PS) is shown in Fig. B.

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

Product direction in carrier tape are shown in Fig. C.

(4) Joint of tape

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

(5) The way to repair taped failure devices

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

6.3.2 Tape characteristics

(1) Adhesiveness of cover tape

The peel-back force between carrier tape and cover tape shall be 0.1N to 1N 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.

6.3.3 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 more than 10 pitch of empty cavities to the trailer and attach more than 20 pitch of empty cavities to the leader of the tape and fix the both ends with adhesive tape.

(2) Quantity

One reel shall contain 1000 pcs.

Minimum order and delivery unit shall be 1000pcs. (One reel)

6.3.4 Indication

(1) Reel

The label with following information shall be pasted on the reel.

* Model No. * Number of pieces contained * Lot No.

(2) Package case

The outer packaging case shall be printed with following information.

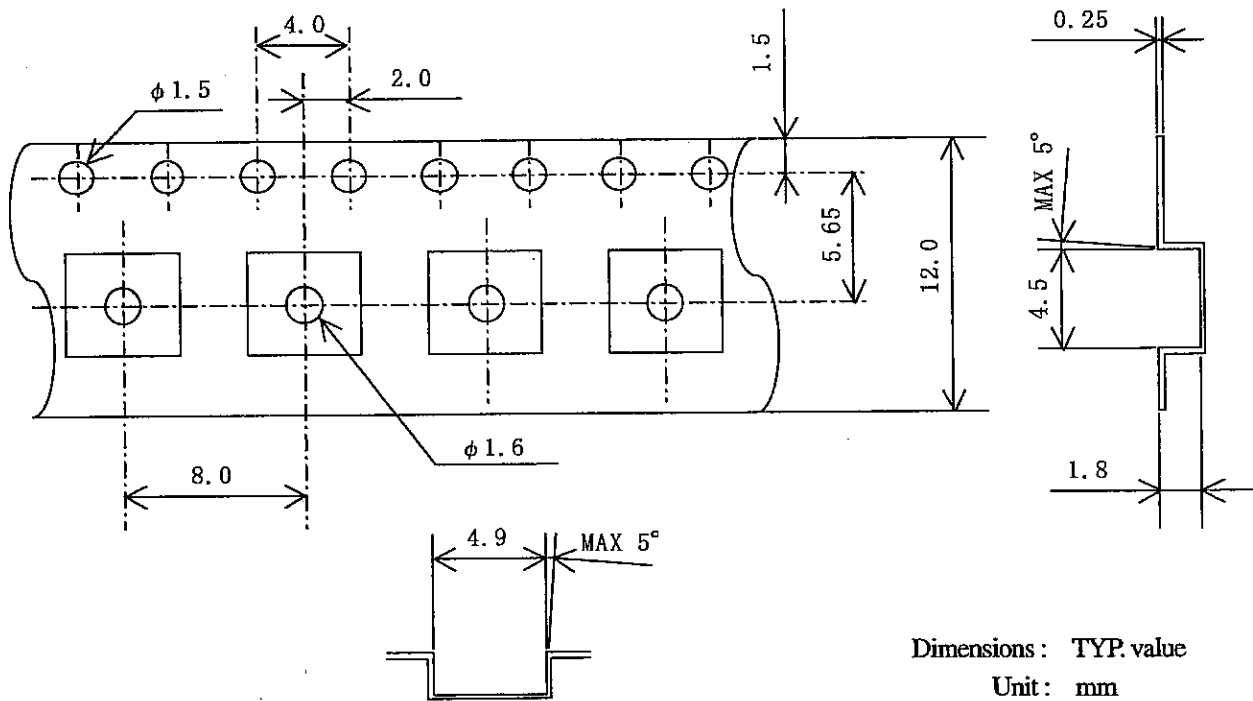
* Model No. * Number of pieces contained * Production date

6.3.5 Storage environment

Taped products shall be stored under the state keeping away from direct sunlight and at the temperature 5 to 30°C and the relative humidity 70%RH or less.

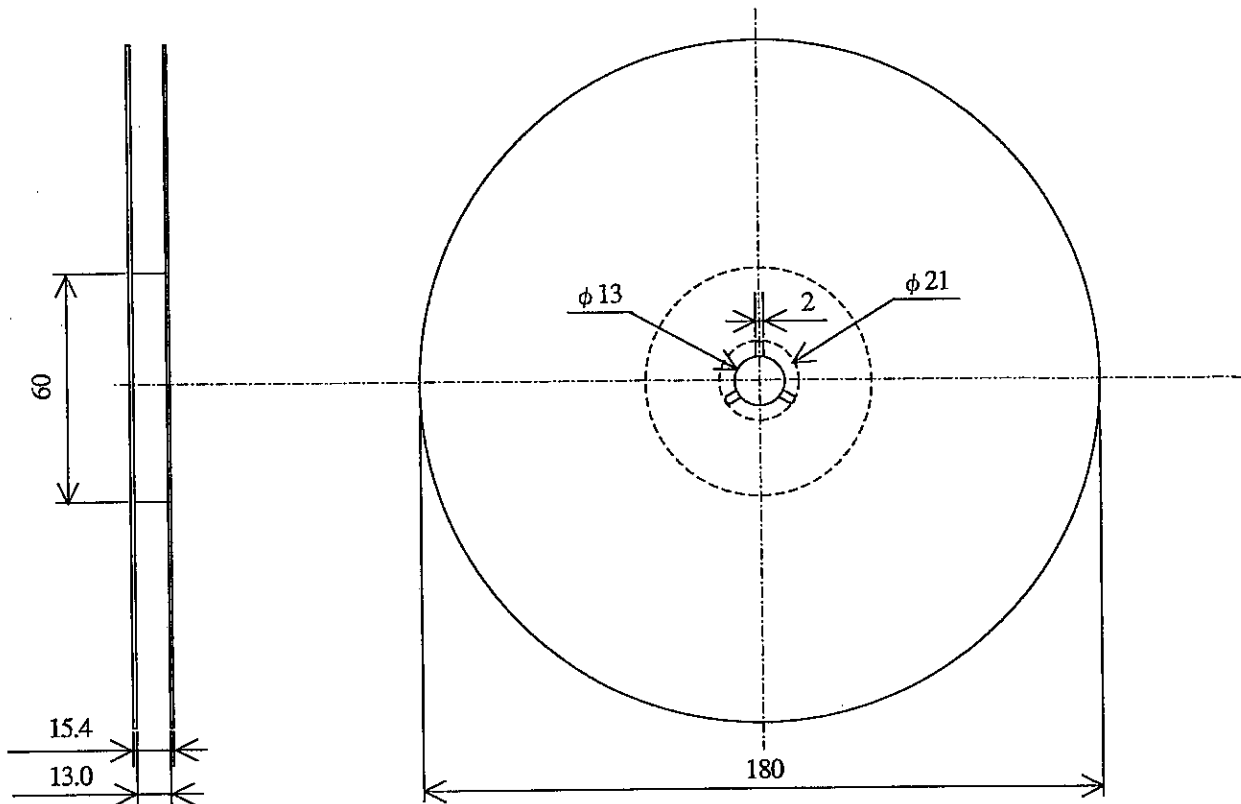
Regarding the devices stored for a long time, there is possibility that deterioration of lead pin color and solderability may occur. Please use the devices after checking the solderability in advance.

Fig. A Tape structure and Dimensions

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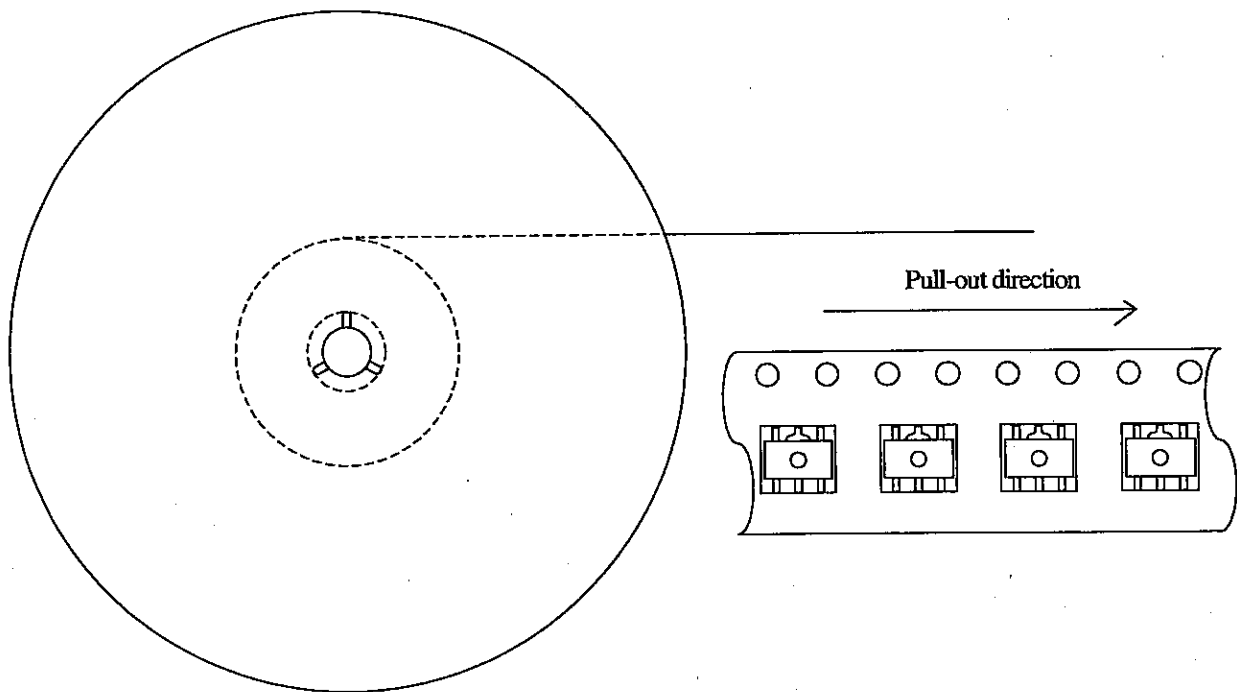
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Fig. B Reel structure and Dimensions



Dimensions : TYP. value
Unit : mm

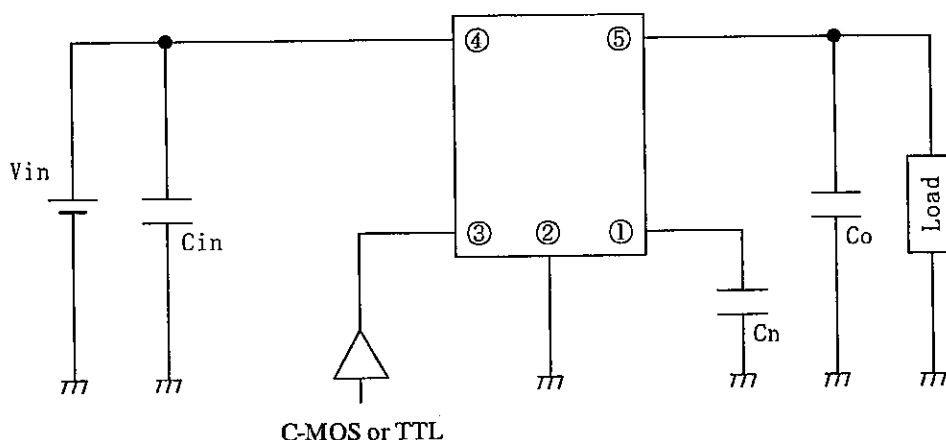
Fig. C Direction of product insertion



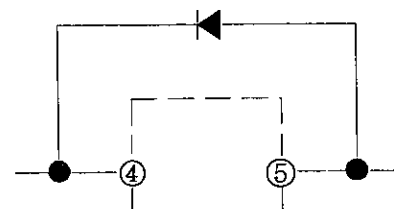
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7. Notes

7.1 External connection



- (1) Please be sure to place C_o , C_{in} and C_n for this product.
For the C_n capacitor, please place ceramic capacitor, the capacity of over $0.01\mu F$, and B-type(X5R) or R-type(X7R).
For the C_o capacitor,
 - in case of ceramic capacitor, the capacity of over $1\mu F$ and B-type(X5R) or R-type(X7R)
 - in case of electrolytic capacitor, the capacity of over $10\mu F$ and the ESR of under 1Ω over the entire temperature range.
 Also, please perform shortest wiring for connection between C_o , C_{in} or C_n and the individual terminal.
 There is case that oscillation occurs easily by kinds of capacitor and capacity.
 Please before you use this device, you should confirm output voltage on your use mounting state.
- (2) The input terminal for ON/OFF output control ; ③ is compatible with LS-TTL, and direct driving by TTL or C-MOS standard logic (RCA 4000 series) is also available.
- (3) As 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 ⑤ than the voltage of the DC input terminal ④, breakdown of the device may occur. Especially in the case that the DC input terminal ④ 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.
 In consideration of such case, please connect a silicon diode as shown in the right schematic drawing.



7.2 Thermal protection design

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

$$P_d = V_{in} \times I_{in} - V_o \times I_o \quad (I_{in} : \text{Input current})$$

Before you use this device, you should confirm that the operating temperature and P_d are within the derating curve in Fig.1.

Insufficient radiation 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.

- ① Human body must be grounded to discharge the static electricity from the body or cloth.
- ② Anything that is in contact with the device such as workbench, inserter, or measuring instrument must be grounded.
- ③ 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.

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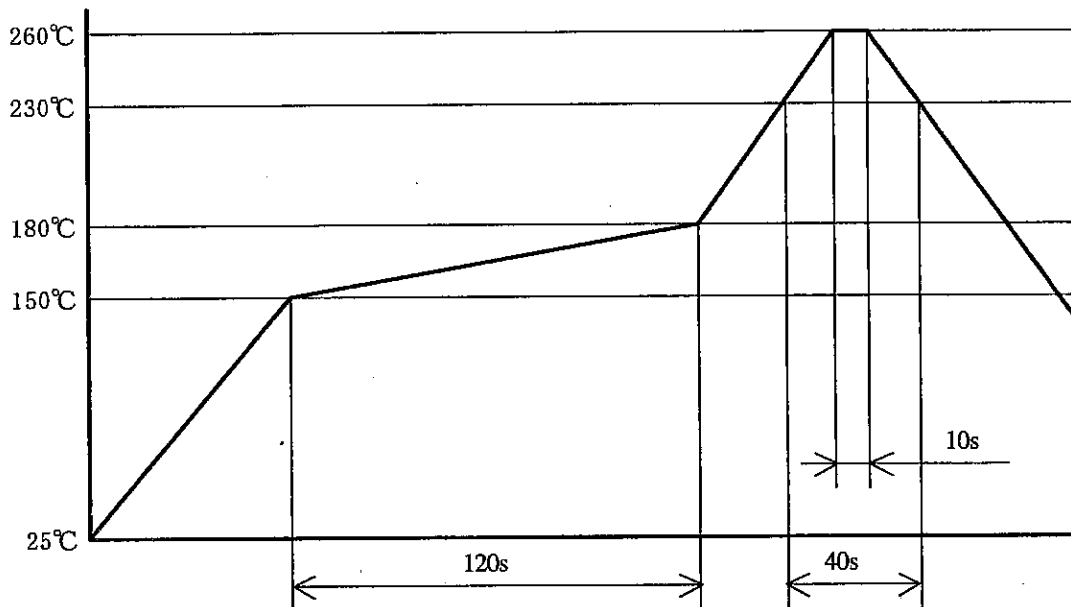
7.4 Soldering

(1) Reflow soldering :Reflow soldering should be proceeded twice as maximum within the bounds of below mentioned temperature profile.

Also, secondary reflow soldering is recommended to be proceeded after the temperature of the device cools completely down to the room temperature..

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

- ① Please avoid mounting to ceramic PCB.
- ② An infrared lamp used to heat up for soldering may cause a localized temperature rise in the resin.
The temperature of resin portion should be with in the temperature profile below.
- ③ The temperature sloping when soldering-reflow is 4°C/s or less.



(2) Hand soldering: This product 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 stress to the leads.

Please be carefully, 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 within the above conditions regarding solder reflow, there is the possibility that the stress given to the terminals by the deformation of PCB makes the wire in the device package cut. In advance, please confirm fully at the actual application.

7.5 For cleaning

- (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.