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SHARP

OPTO-ELECTRONIC DEVICES DIVISION
ELECTRONIC COMPONENTS GROUP
SHARP CORPORATION

SPECIFICATION

DEVICE SPECIFICATION FOR

VOLTAGE REGULATOR

MODEL No.

PQ1LAX95MSPQ

Specified for

Enclosed please find copies of the Specifications which consists of 15 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

DATE

BY

PRESENTED

DATE June 11, 2007

BY

H. Imanaka

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Engineering Dept., II
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ELECOM Group
SHARP CORPORATION

Product name : VOLTAGE REGULATOR

Model No. : PQ1LAX95MSPQ

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2. When using this product, please observe the absolute maximum ratings and the instructions for use outlined in these specification sheets, as well as the precautions mentioned below. Sharp assumes no responsibility for any damage resulting from use of the product which does not comply with the absolute maximum ratings and the instructions included in these specification sheets, and the precautions mentioned below.

(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.

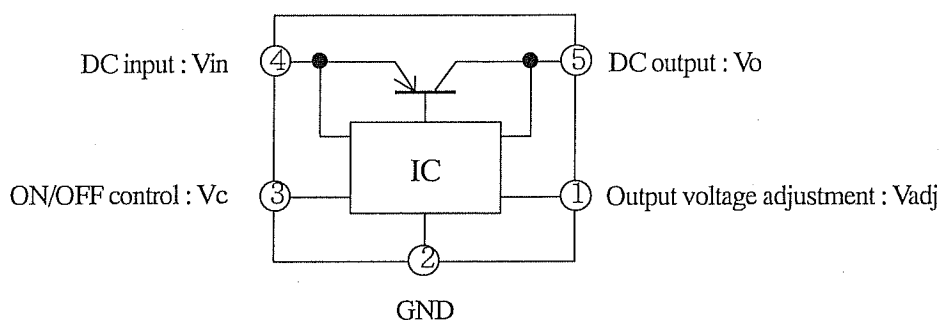
1. Application

This specification applies to the outline and characteristics of surface mount type series regulator (linear type), Model No. PQ1LAX95MSPQ.

Features

This product is low power-loss voltage regulator with built-in output voltage ON/OFF function, over current protection function, the over heat protection function and adjustable DC output voltage.

Block diagram



2. Outline : Refer to the attached sheet, Page 4.

3. Ratings and characteristics : Refer to the attached sheet, Page 5 to 7.

3.1 Absolute maximum ratings

3.2 Electrical characteristics

3.3 Electrical characteristics measuring circuit

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 12.

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 Compliance with each regulation

6.5.1 The RoHS directive(2002/95/EC)

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

Object substances: mercury, lead, cadmium, hexavalent chromium, polybrominated biphenyls (PBB) and polybrominated diphenyl ethers (PBDE)

6.5.2 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 .

6.6 Specified brominated flame retardants

Specified brominated flame retardants (PBB and PBDE) 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 13, 14.

7.1 External connection

7.2 Output voltage adjustment

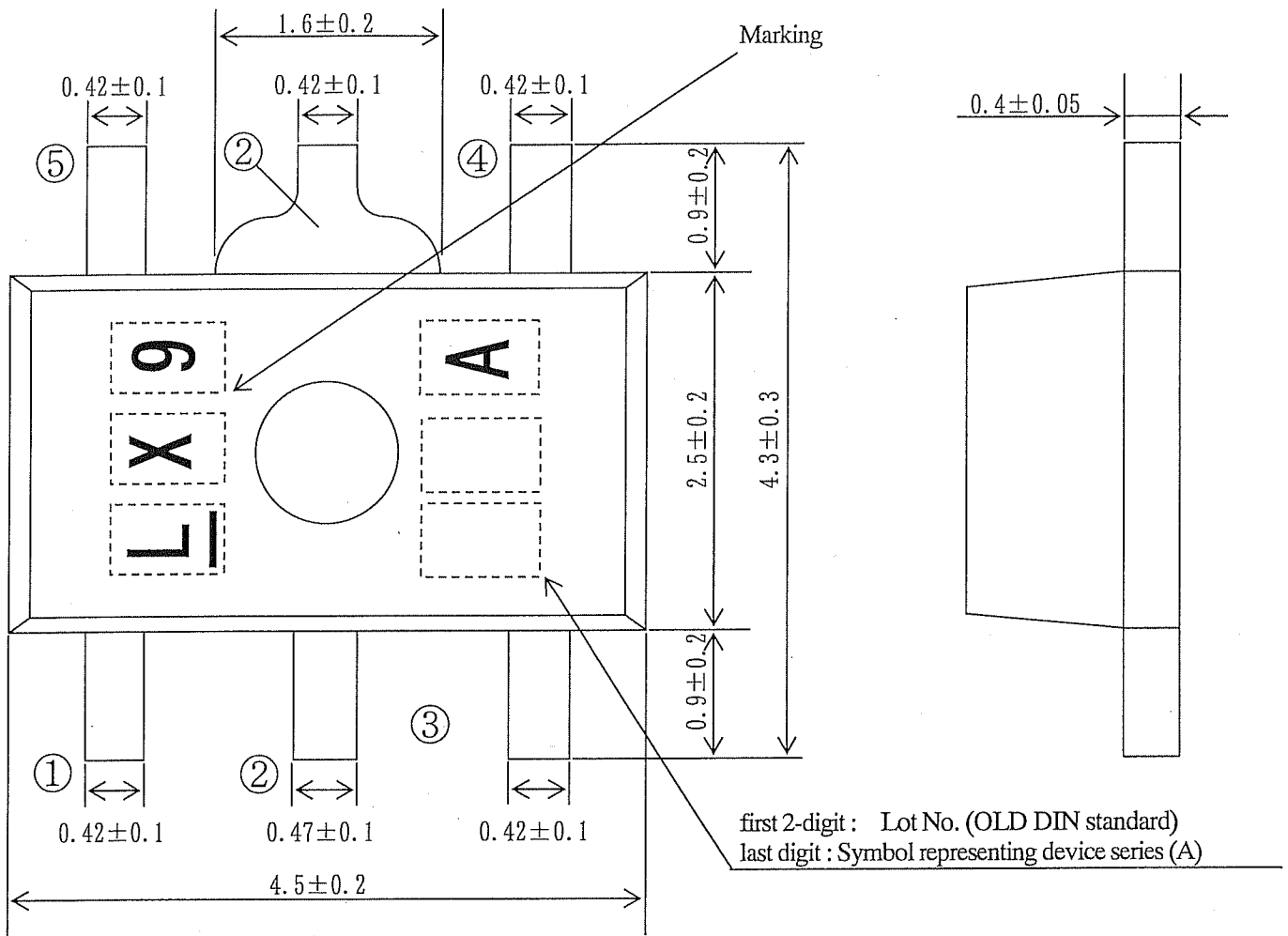
7.3 Thermal protection design

7.4 Static electricity

7.5 Soldering

7.6 Cleaning

2. Outline

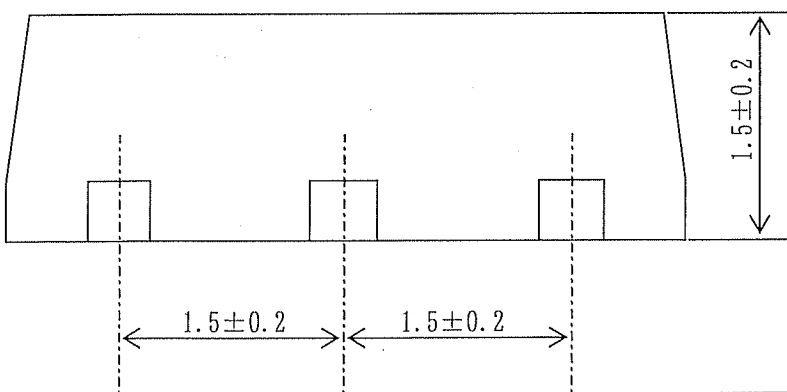


Unit : mm

Lead finish : Lead-free solder plating
(Composition: SnBi)

Lead material : Cu

Product mass : (0.055g)



Pin No.	Pin name	Symbol
①	Output voltage adjustment	V _{adj}
②	GND	GND
③	ON/OFF control	V _c
④	DC input	V _{in}
⑤	DC output	V _o

3. Ratings and characteristics

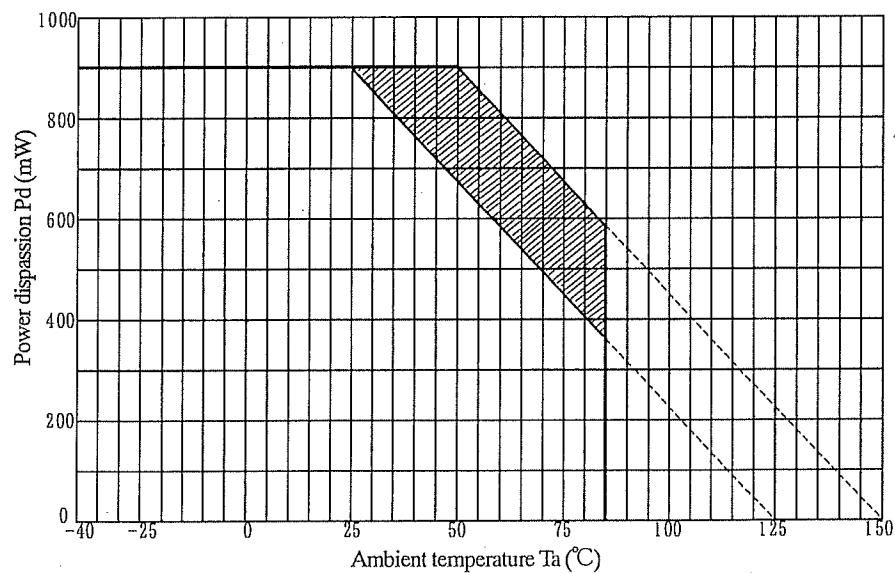
3.1 Absolute maximum ratings

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

Parameter	Symbol	Rating	Unit	Conditions
Input voltage (*1)	V_{in}	15	V	
Output control voltage (*1)	V_c	15	V	
Output adjustment pin voltage (*1)	V_{adj}	5	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

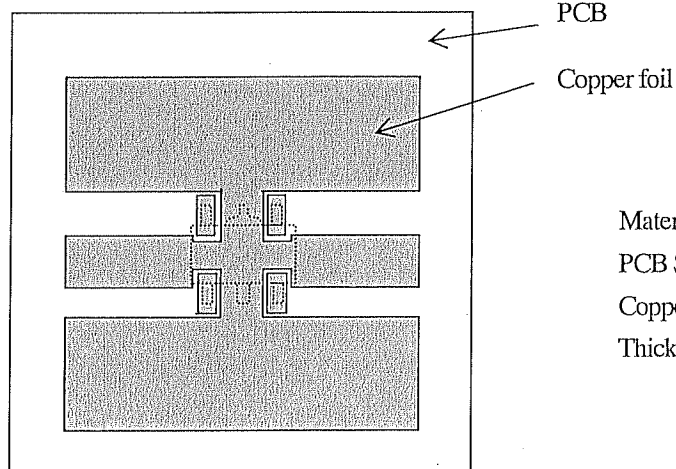
(*1) All are open except GND and applicable terminals.

(*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 portion.Fig. 1 $P_d - T_a$ rating

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

Mounting PCB



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

3.2 Electrical characteristics

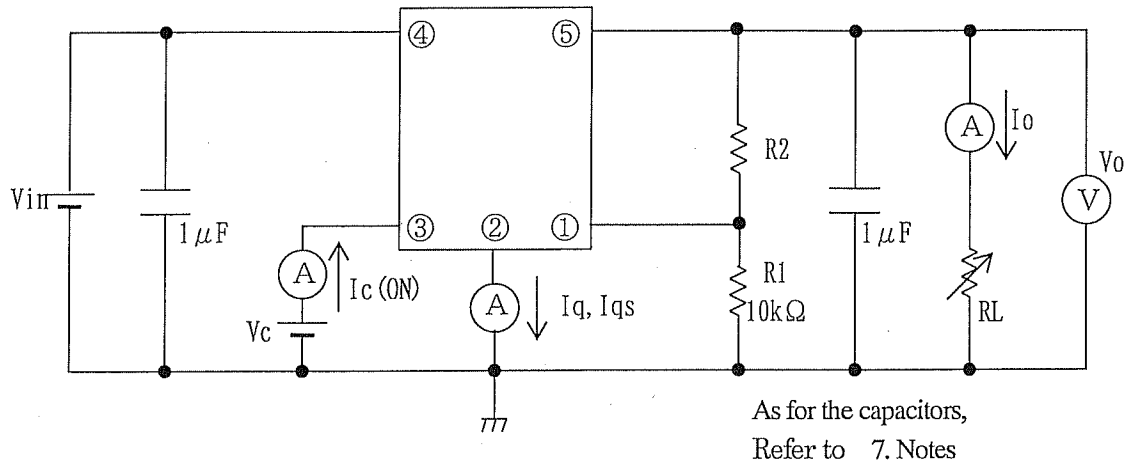
Unless otherwise specified condition shall be $V_{in}=3.5V$, $V_o=2.48V$ ($R_1=R_2=10k\Omega$), $I_o=30mA$, $V_c=1.8V$, $T_a=25^\circ C$

Parameter	Symbol	MIN.	TYP.	MAX.	Unit	Conditions
Operating input voltage	V_{in}	2.5	—	15.0	V	
Output voltage	V_o	V_{ref}	—	9.0	V	
Reference voltage	V_{ref}	1.215	1.24	1.265	V	
Load regulation	Reg_L	—	35	100	mV	$I_o=5$ to $500mA$
Line regulation	Reg_I	—	6	20	mV	$V_{in}=3.5V$ to $8.5V$
Temperature coefficient of Reference voltage	TcV_{ref}	—	± 1.0	—	%	$I_o=10mA$, $T_j=-0$ to $100^\circ C$
Ripple rejection	RR	—	50	—	dB	Refer to Fig.3
Output noise voltage	$V_{no(rms)}$	—	180	—	μV	$10Hz < f < 100kHz$
Dropout voltage	V_{i-o}	—	—	0.7	V	$V_{in}=3V, I_o=300mA$
On-state voltage for control (*4)	$V_{c(on)}$	1.8	—	—	V	
On-state current for control	$I_{c(on)}$	—	5	30	μA	$V_c=1.8V$
Off-state voltage for control	$V_{c(off)}$	—	—	0.4	V	
Quiescent current	I_q	—	400	700	μA	$I_o=0mA$
Output off-state consumption current	I_{qs}	—	—	1	μA	$V_c=0.2V$

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

3.3 Electrical characteristics measuring circuits

Fig. 2 Standard measuring circuit of Regulator portion



Adjusting R1 between Vadj and GND, R2 between Vadj and Vo to below condition,
allows the output voltage to be fine tuned.

$$V_o = V_{ref} \times (1 + R_2/R_1) \quad (R_1 = 10k\Omega, V_{ref} = 1.24V)$$

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

$f = 400\text{Hz}$ Sine wave

$e_i(\text{rms}) = 100\text{mV}$

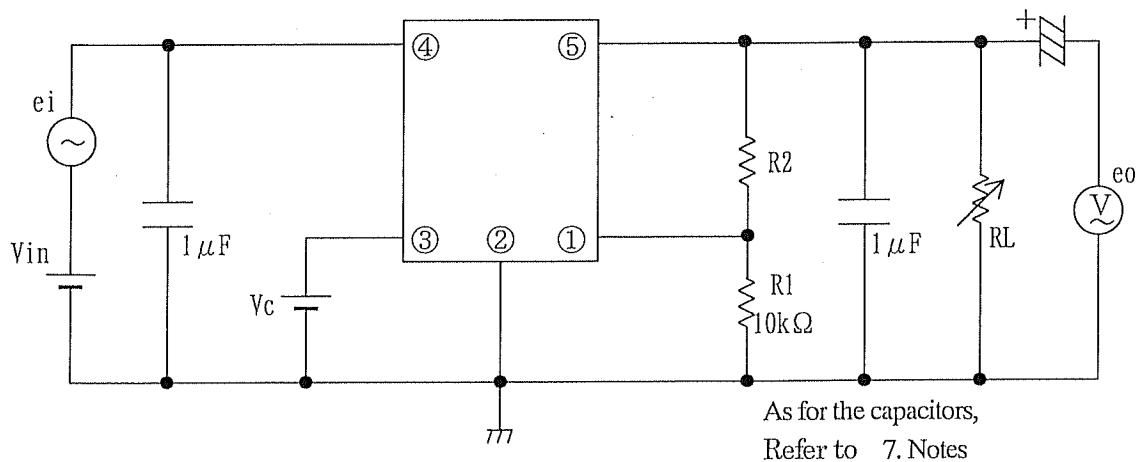
$V_{in} = 3.5\text{V}$

$V_c = 1.8\text{V}$

$V_o = 2.48\text{V} (R_1 = 10k\Omega)$

$I_o = 30\text{mA}$

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



4. Reliability

The reliability of products shall satisfy items listed below.

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	$V_{ref} < L \times 0.8$ $V_{ref} > U \times 1.2$ $RegL > U \times 1.2$ $RegI > U \times 1.2$ $Vi-o > U \times 1.2$ U: Upper specification limit L: Lower specification limit	n=22, C=0
Humidity (Steady State)	+60°C, 90%RH, 1000h		n=22, C=0
Damp Heat cycling	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	Ta=25°C, Pd=0.9W, 1000h *5		n=22, C=0
Mechanical shock	15km/s ² , 0.5ms 3 times/ ±X, ±Y, ±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
Solder reflow thermal resistance	Item 7-5, Reflow profile × 2 times		n=11, C=0
Electrostatic discharge	±100V, 200pF, 0Ω 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±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

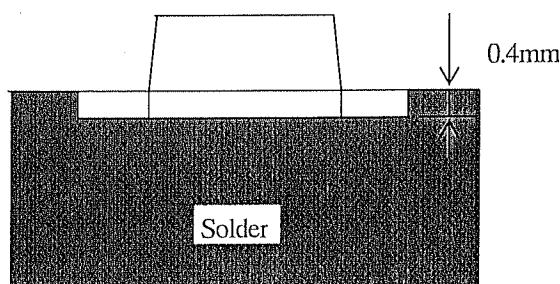
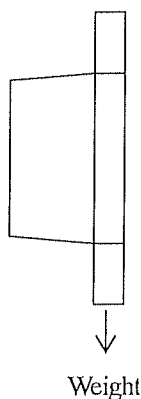
*1 Terminal bending direction is shown below.

*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

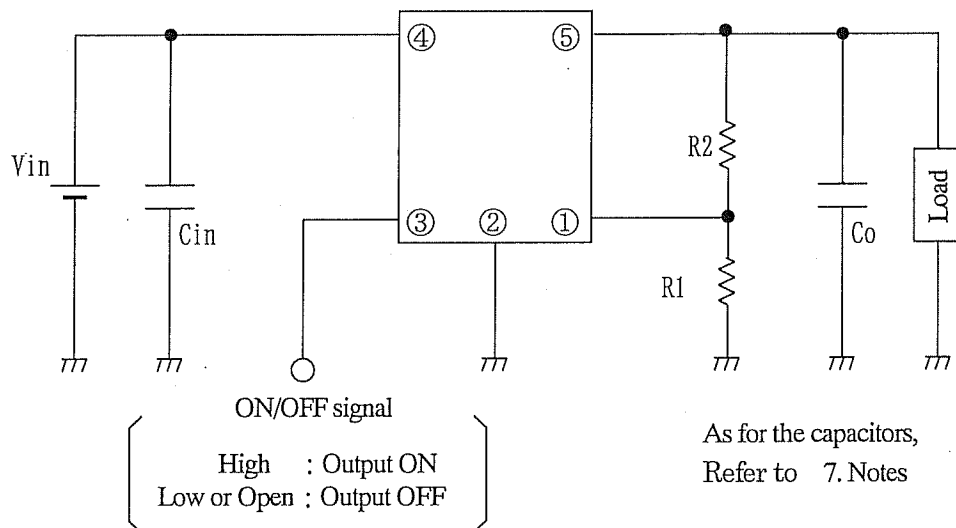
A single sampling plan, normal inspection level II based on ISO 2859 is applied.

The AQL according to the inspection items are shown below.

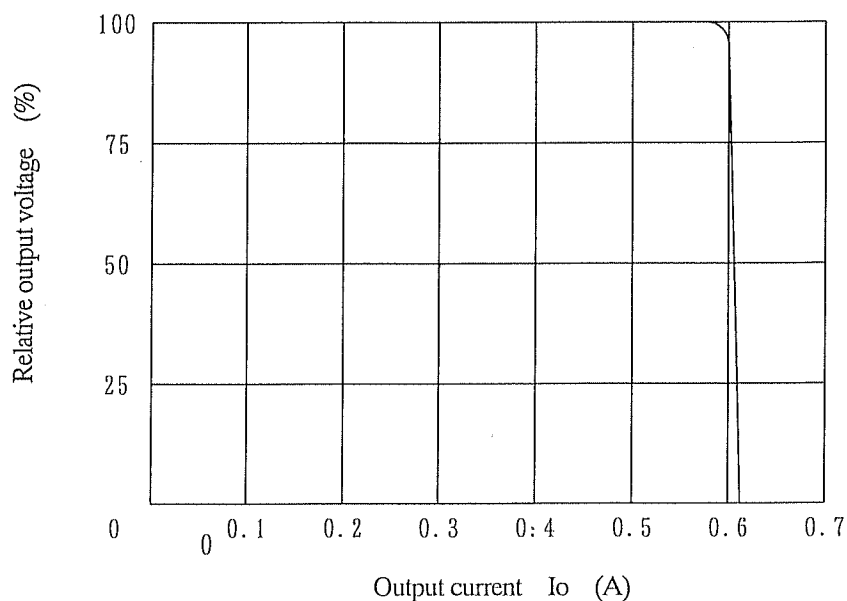
Defect	Inspection items	AQL(%)	Judgement criteria
Major defect	Electrical characteristics	0.1	Depend on the specification
	Unreadable marking		Readability
Minor defect	Dimensions	0.4	Depend on the specification
	Appearance		No chipped resin and no bent lead

6. Supplement

6.1 Example of application



6.2 Over current protection characteristics (Typical value)



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 less than 30mm, 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 pitches of empty cavities to the trailer and attach more than 20 pitches 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 below contents shall be pasted on the reel.

* Model No. * Quantity * Packing date

(2) Package case

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

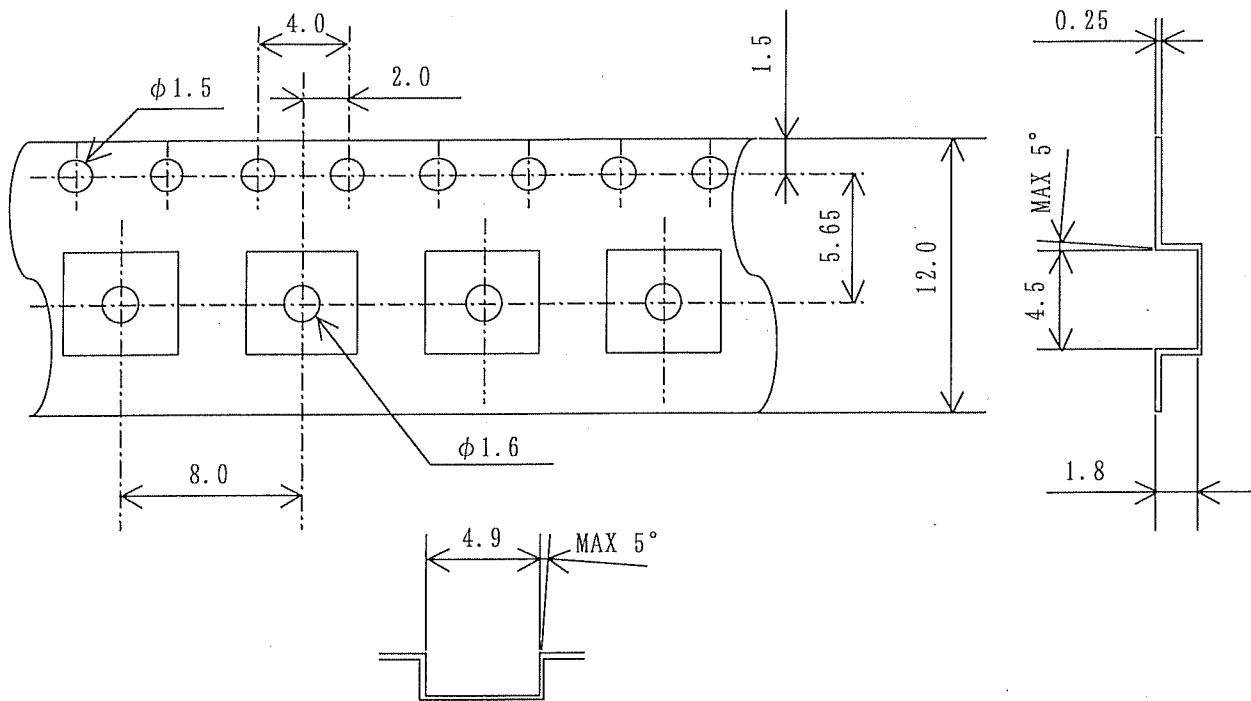
* Model No. * Quantity * Packing date

6.3.5 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 be caused. Please use the devices after checking the solderability in advance.

Fig. A Tape structure and Dimensions



Dimensions : TYP. value

Unit : mm

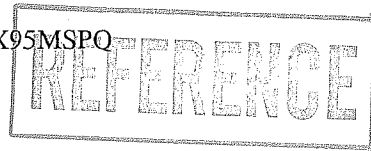
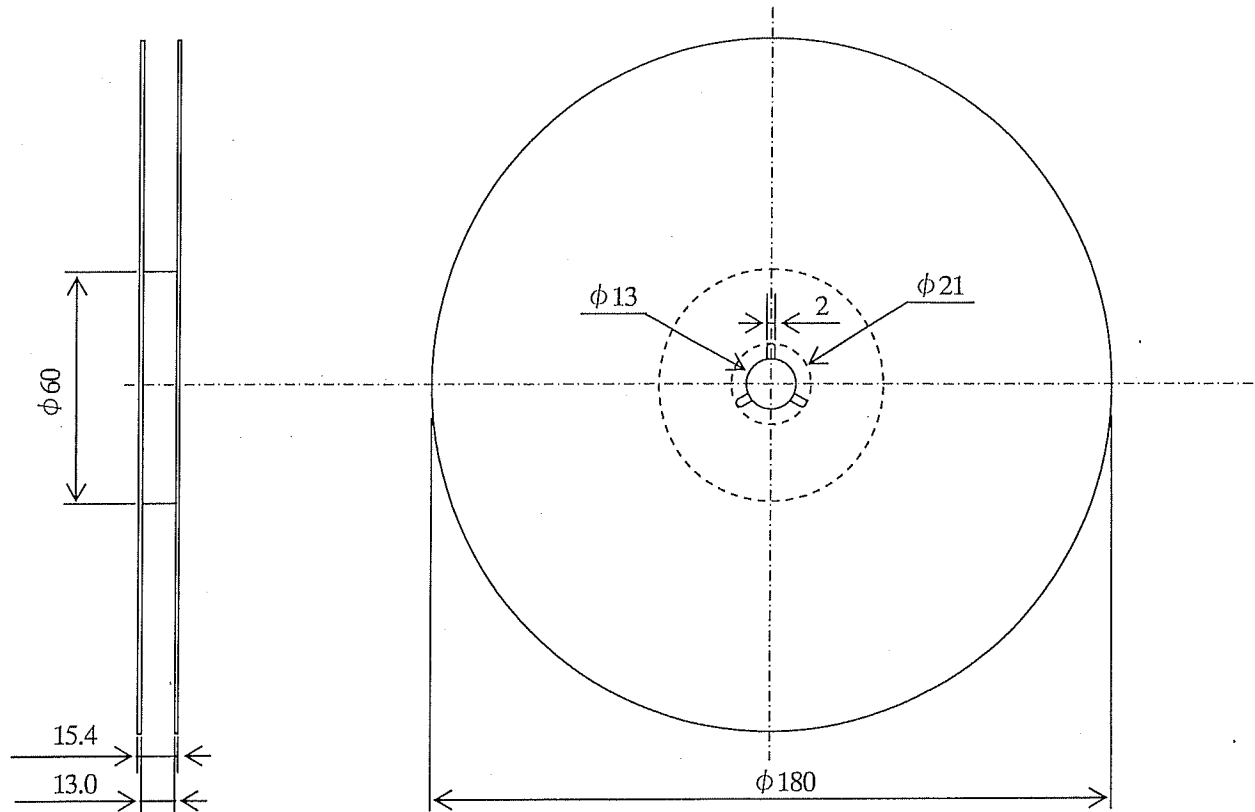
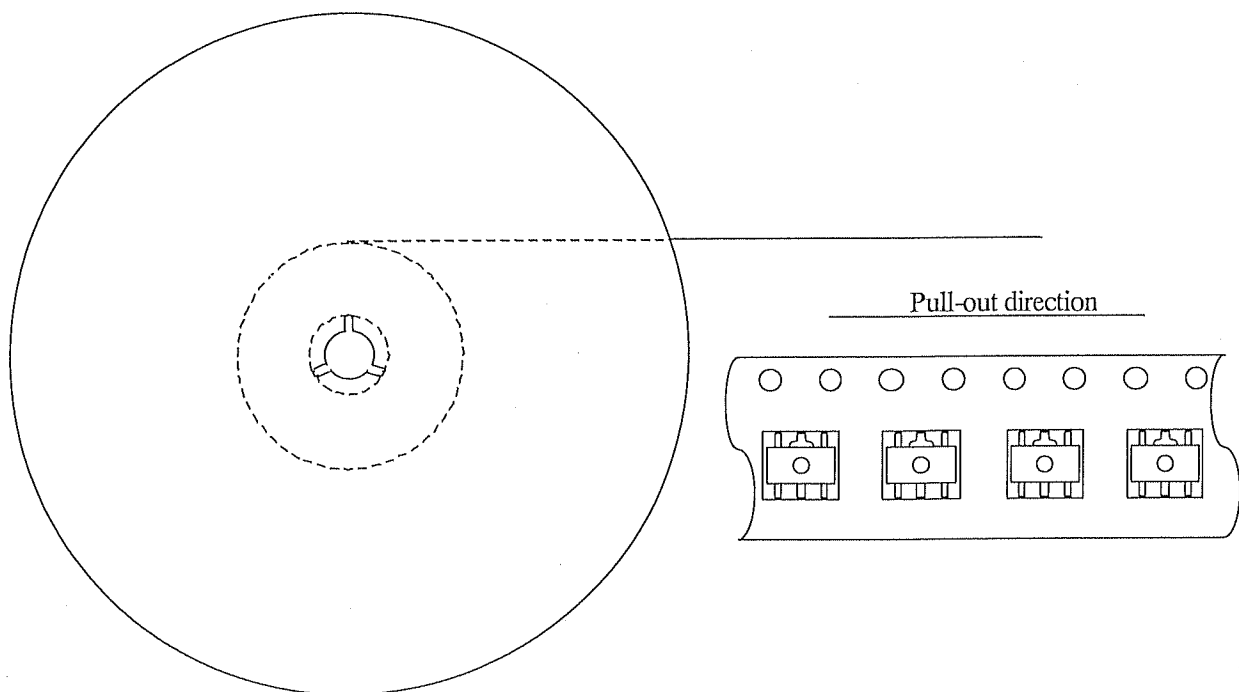


Fig. B Reel structure and Dimensions



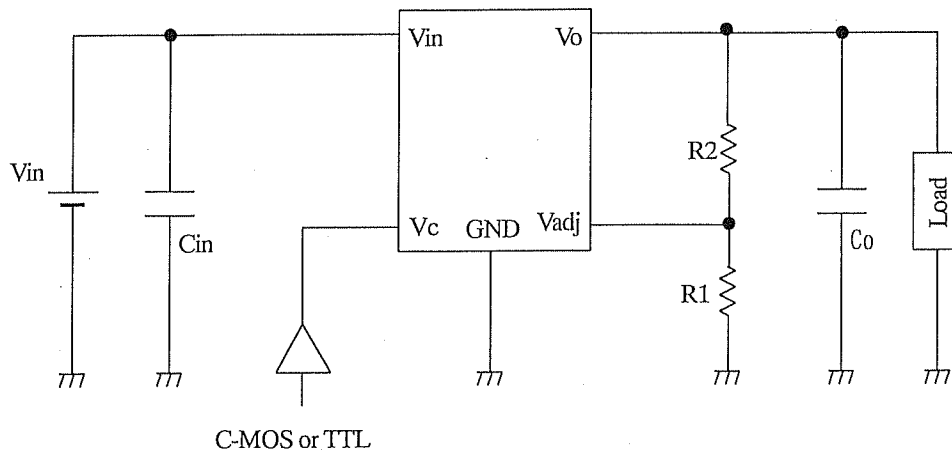
Dimensions : TYP. value
Unit : mm

Fig. C Direction of product insertion

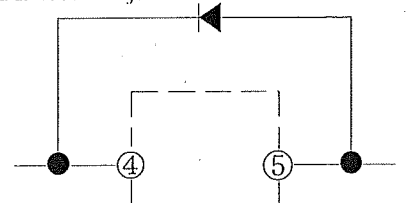


7. Notes

7.1 External connection



- (1) Please be sure to place C_o and C_{in} for this product. Also, For the C_o capacitor,
 - in case of ceramic capacitor, the capacity of over $1\mu\text{F}$ and B-type(X5R) or R-type(X7R)
 - in case of electrolytic capacitor, the capacity of over $10\mu\text{F}$ and the ESR of under 1Ω over the entire temperature range.
 Also, please perform shortest wiring for connection between C_o or C_{in} and the individual terminal. There is case that oscillation occurs easily by kinds of capacitor and capacity. Before you use this device, you should confirm output voltage on your use mounting state. 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) 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 Output voltage adjustment

Adjusting R_1 between V_{adj} and GND, R_2 between V_{adj} and V_o to below condition, allows the output voltage to be fine tuned.

$$V_o = V_{ref} \times (1 + R_2/R_1) \quad (R_1 = 10\text{k}\Omega, V_{ref} = 1.24\text{V})$$

It is recommended that R_1 between V_{adj} and GND is $10\text{k}\Omega$. In the case R_1 is not $10\text{k}\Omega$, please confirm fully at the actual application in advance.

7.3 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.

7.4 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.

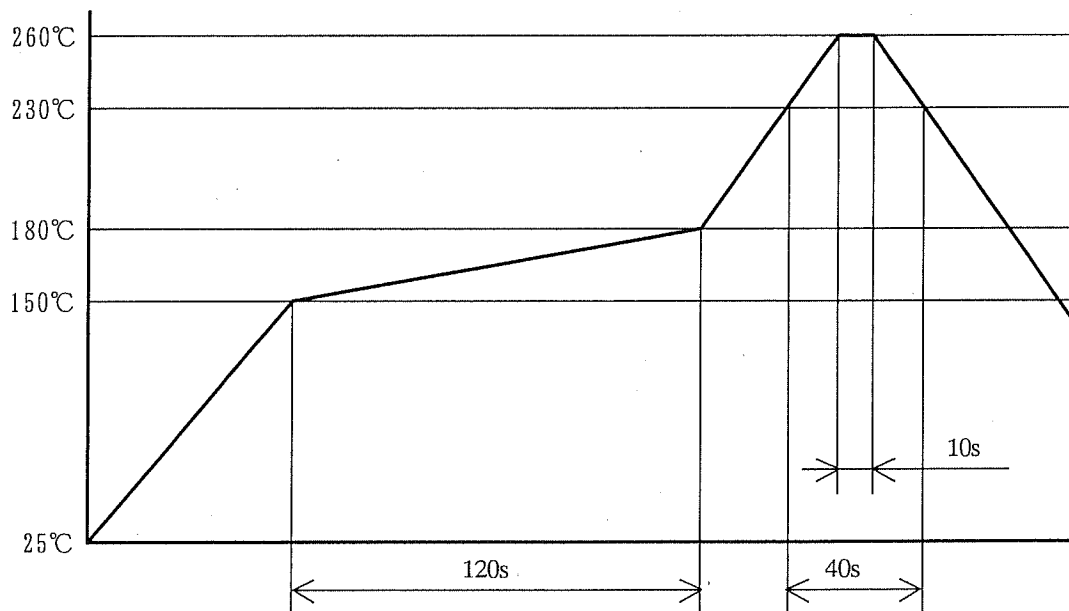
- ① Human body must be grounded to discharge the static electricity from the body or cloth.
- ② Anything that is in contact with the device such as workbench, inserter, or measuring instrument must be grounded.

7.5 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.



Even within the above conditions regarding solder reflow, there is the possibility that the external 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.

7.6 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

In case 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.