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APPROVED BY: <i>Y.Y. Nov. 11, 1999</i>	DATE:	ELECTRONIC COMPONENTS GROUP SHARP CORPORATION SPECIFICATION	REPRESENTATIVE DIVISION OPTO-ELECTRONIC DEVICES DIV.

.DEVICE SPECIFICATION FOR
 VOLTAGE REGULATOR
 MODEL No.
PQ07RX11

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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 • Rescue and security equipment
 • Other safety 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.

CUSTOMER'S APPROVAL

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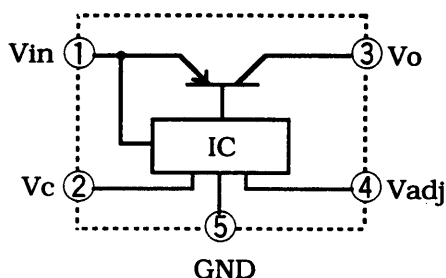
1. Application

This specification applies to the outline and characteristics of series regulator (linear type), Model No. PQ07RX11.

Usage

PQ07RX11 is the device for stabilization of positive output voltage with built-in ON/OFF function, the over current protection function and the overheat protection function, adjustable DC output voltage by using external resistance and low consumption current at OFF-state (stand-by). This device is possible to use in power supply circuit up to current capacity 1A.

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
4. Reliability : Refer to the attached sheet, Page 8, 9.
5. Incoming inspection : Refer to the attached sheet, Page 9.

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6. Supplement : Refer to the attached sheet, Page 10 to 11.

6.1 Example of application

6.2 Over current protection characteristics (Typical value)

6.3 Output voltage adjustment characteristics (Typical value)

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 : CFC_s, Halon, Carbon tetrachloride,
1.1.1-Trichloroethane (Methylchloroform)

6.5 Brominated flame retardants

Specific brominated flame retardants such as the PBBO_s and PBB_s 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 12 to 14.

7.1 External connection

7.2 Mounting

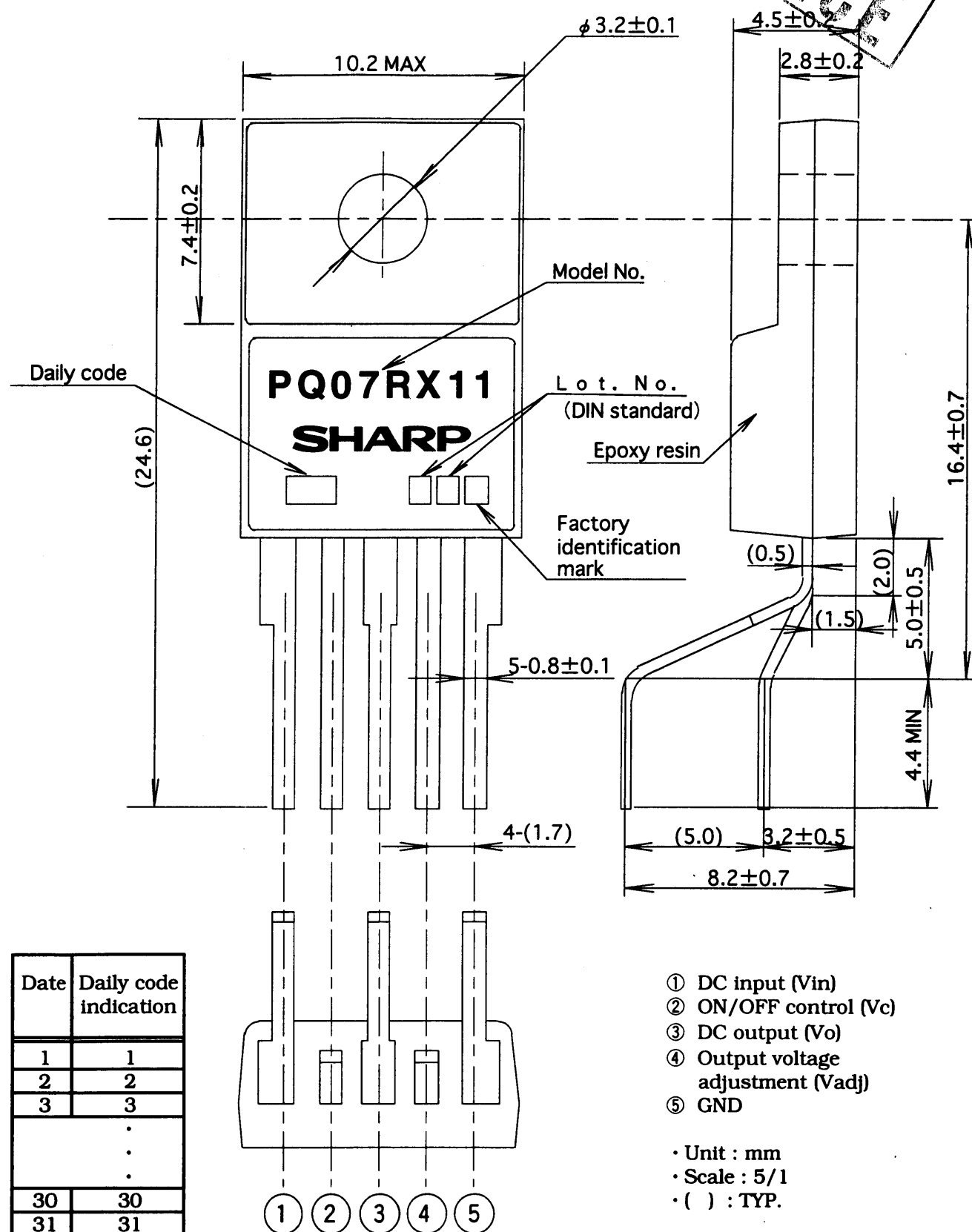
7.3 Thermal protection design

7.4 Static electricity,

7.5 For cleaning

7.6 Output voltage fine tuning

2. Outline



3. Ratings and characteristics

3.1 Absolute maximum ratings

Ta=25°C

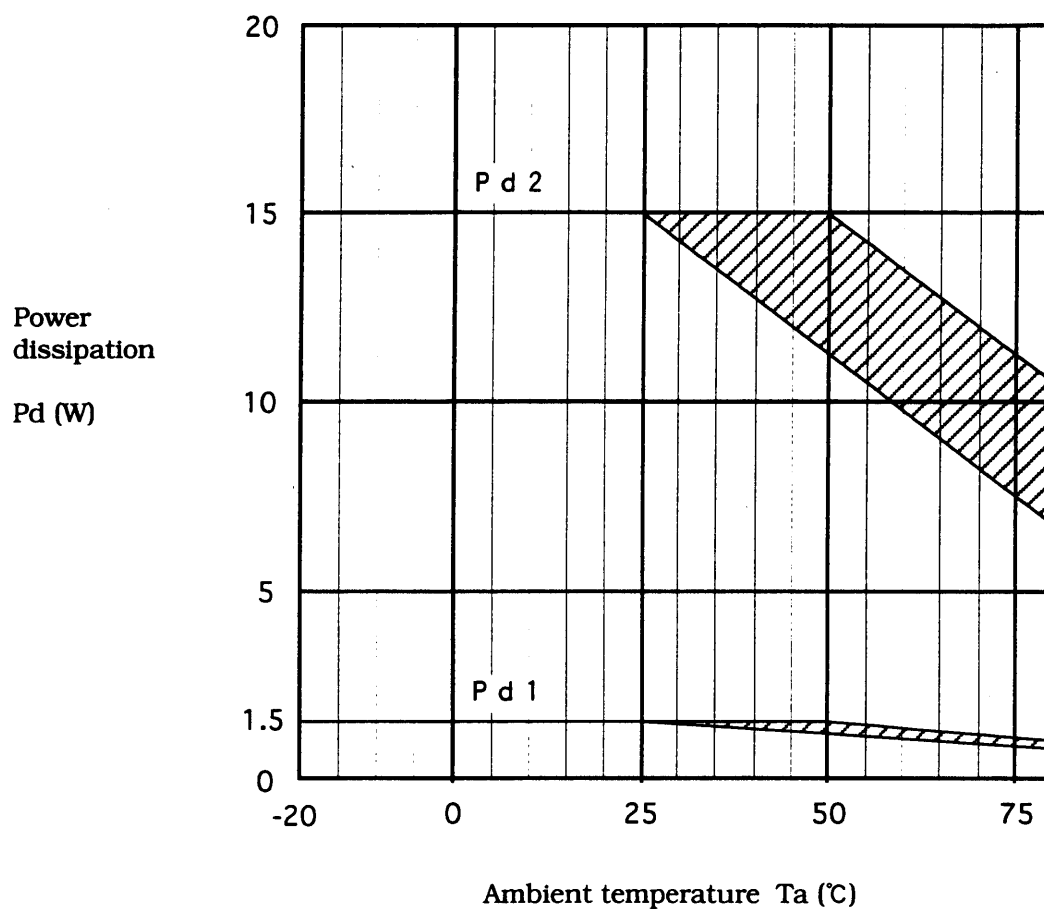
Parameter	Symbol	Rating	Unit	Conditions
Input voltage (*1)	V _{in}	10	V	
Input-output voltage	V _{i-o}	5	V	
ON/OFF control voltage (*1)	V _c	10	V	
Output adjustment pin voltage (*1)	V _{adj}	5	V	
Output current	I _o	1.0	A	
Power dissipation (*2)	Pd1	1.5	W	Refer to Fig. 1
	Pd2	15	W	
Junction temperature (*3)	T _j	150	°C	
Operating temperature	T _{opr}	-20 to +80	°C	
Storage temperature	T _{stg}	-40 to +150	°C	
Soldering temperature	T _{sol}	260	°C	For 10 s

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

(*2) Pd1 : No heat sink, Pd2 : With infinite heat sink

(*3) There is case that over heat protection operates at the condition T_j=125°C to 150°C

Fig. 1 Pd - Ta rating



Pd 1 : No heat sink

Pd 2 : With infinite heat sink

(Note) There is case that thermal shut down function operates at oblique line portion.

3.2 Electrical characteristics

Unless otherwise specified condition shall be
 $V_{in}=5V$, $V_o=3V$ ($R_L=1k\Omega$), $I_o=0.5A$, $V_c=2.7V$

$T_a=25^\circ C$

Parameter	Symbol	MIN.	TYP.	MAX.	Unit	Conditions
Input voltage	V_{in}	3.0	-	10.0	V	
Output voltage	V_o	1.5	-	7	V	
Load regulation	Reg_L	-	0.2	2.0	%	$I_o=5mA$ to 1.0A
Line regulation	Reg_I	-	0.2	2.5	%	$V_{in}=4$ to 8V $I_o=5mA$
Ripple rejection	RR	45	60	-	dB	Refer to Fig.3
Dropout voltage	V_{i-o}	-	-	0.5	V	$V_{in}=3.0V$, $I_o=0.5A$
Reference voltage	V_{ref}	1.225	1.25	1.275	V	
Temperature coefficient of reference voltage	TcV_{ref}	-	± 1.0	-	%	$T_j=0$ to $125^\circ C$ $I_o=5mA$
On-state voltage for control	$V_c (on)$	2.0	-	-	V	(*4)
On-state current for control	$I_c (on)$	-	-	200	μA	
Off-state voltage for control	$V_c (off)$	-	-	0.8	V	$I_o=0A$
Off-state current for control	$I_c (off)$	-	-	2	μA	$I_o=0A$, $V_c=0.4V$
Quiescent current	I_q	-	4	7	mA	$I_o=0A$
Output off-state consumption current	I_{qs}	-	-	5	μA	$V_c=0.4V$

(*4) In case of opening control terminal (2th pin), output voltage turns OFF.

3.3 Electrical characteristics measuring circuit

Fig. 2 Standard measuring circuit of Regulator portion

$$V_o = V_{ref} \times (1 + R_2/R_1)$$

$$\approx 1.25 \times (1 + R_2/R_1)$$

$$(R_1 = 1k\Omega, V_{ref} \approx 1.25V)$$

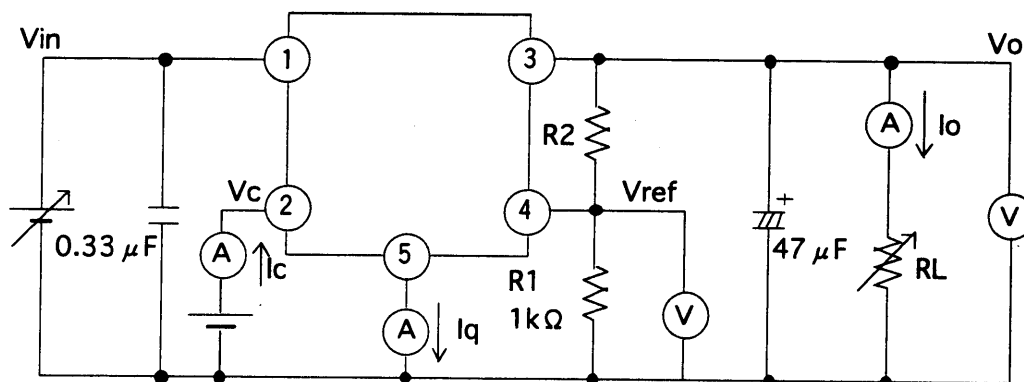


Fig. 3 Standard measuring circuit of critical rate of ripple rejection

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

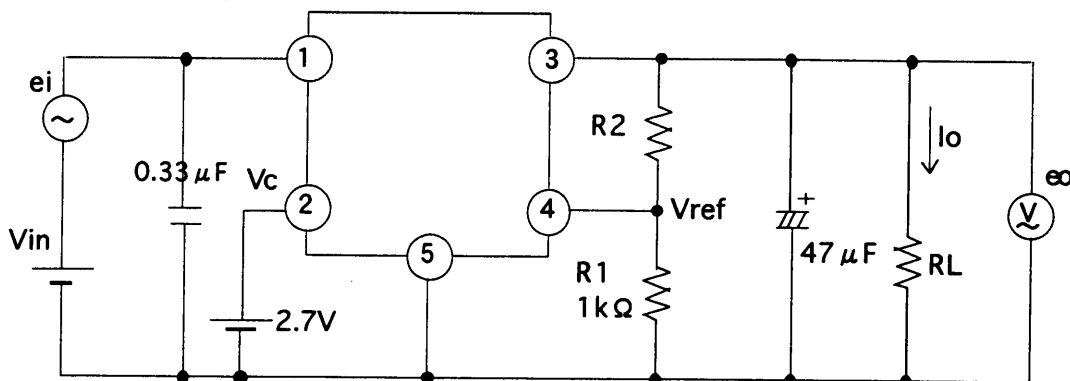
$$e_i(\text{rms}) = 0.5V$$

$$V_{in} = 5V$$

$$V_o = 3V (R_1 = 1k\Omega)$$

$$I_o = 0.3A$$

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



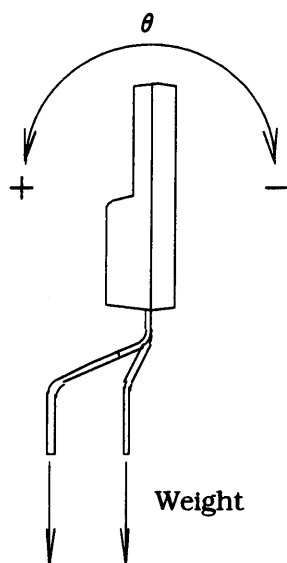
4. Reliability

The reliability of products shall satisfy items listed below.

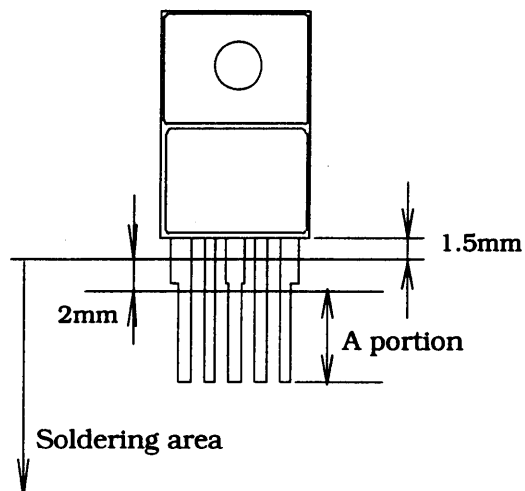
Confidence level : 90%
LTPD : 10%/20%

Test Items	Test Conditions	Failure Judgement Criteria	Samples (n) Defective(C)
Temperature cycling	1 cycle -40°C to +150°C (30min) (30min) 20 cycles test	$V_{ref} < L \times 0.8$	n=22, C=0
Humidity (Steady State)	+60°C, 90%RH, 1000h	$V_{ref} > U \times 1.2$	n=22, C=0
Damp Heat cyclic	1 cycle : -20°C to 70°C (2h) (2h) Transfer time between high and low temp. is 1h 40 cycles test, 90%RH	$RegL > U \times 1.2$ $RegI > U \times 1.2$	n=22, C=0
High temp. storage	+150°C, 1000h	$RR < L \times 0.8$	n=22, C=0
Low temp. storage	-40°C, 1000h	$Vi-o > U \times 1.2$	n=22, C=0
Operation life	Ta=25°C, Pd=1.5W, 1000h		n=22, C=0
Mechanical shock	15000m/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	U: Upper specification limit	n=11, C=0
Soldering heat	260°C, 10 s, Dip up to 1.5mm from resin portion *2	L: Lower specification limit	n=11, C=0
Electrostatic discharge	±250V, 200pF, 0Ω Between GND and each terminal/ 3 times		n=11, C=0
Robustness of Termination (Tensile test)	Weight: 10N 30 s/ each terminal	Failure if it has breakdown and loosened pin.	n=11, C=0
Robustness of Termination (Bending test)	Weight: 2.5N 0° ~90° ~0° ~-90° ~0° each terminal *1		n=11, C=0
Solderability	230±5°C, 5±0.5 s Use rosin flux *2	Failure if solder shall not be adhere at the area of 95% or more A portion.	n=11, C=0

*1 Terminal bending direction is shown below.



*2 Soldering area is shown below.



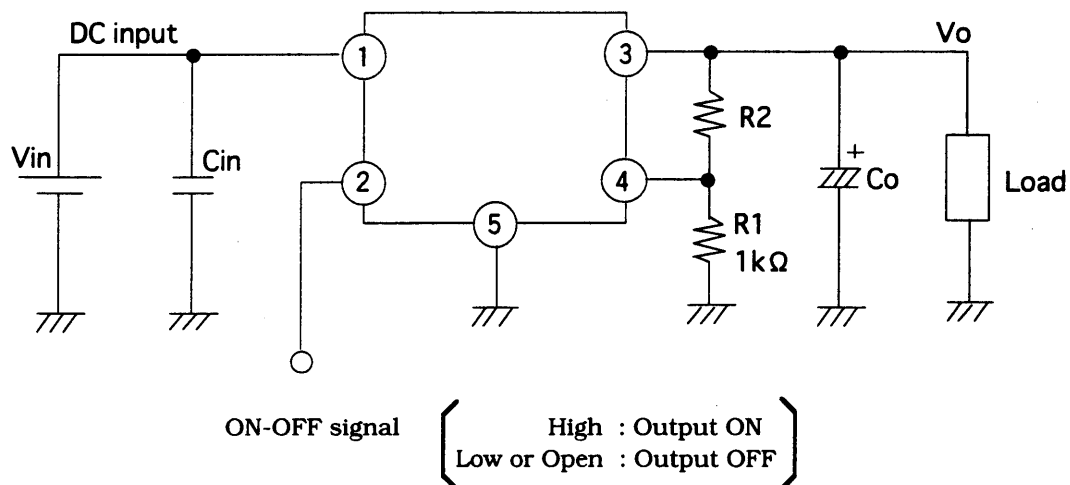
5. Incoming inspection

TABLE II-A single sampling plans for normal inspection based on ISO 2859 is applied. The AQL according to the inspection items are shown below.

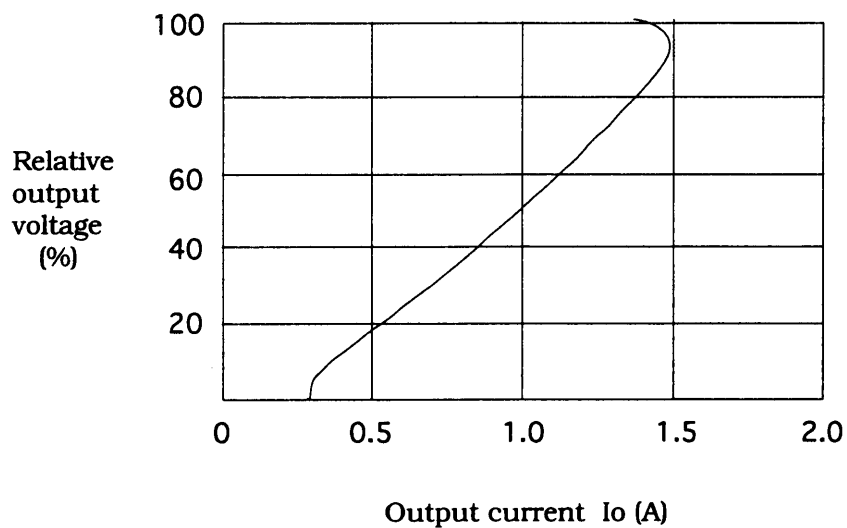
Defect	Inspection items	AQL (%)	Judgement criteria
Major defect	Electrical characteristics Unreadable marking	0.1	Depend on the specification
Minor defect	Appearance Dimensions	0.4	

6. Supplement

6.1 Example of application

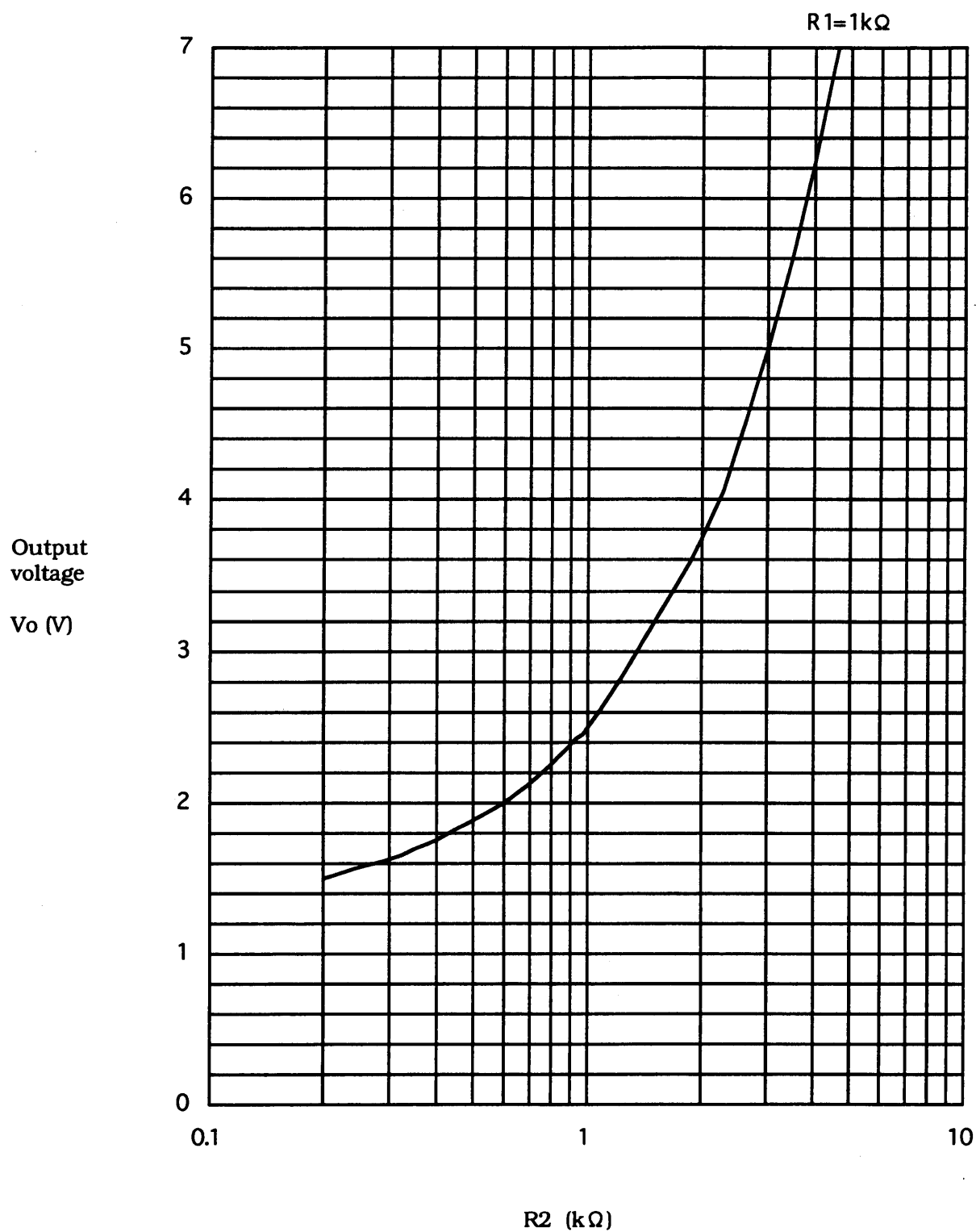


6.2 Over current protection characteristics (Typical value)



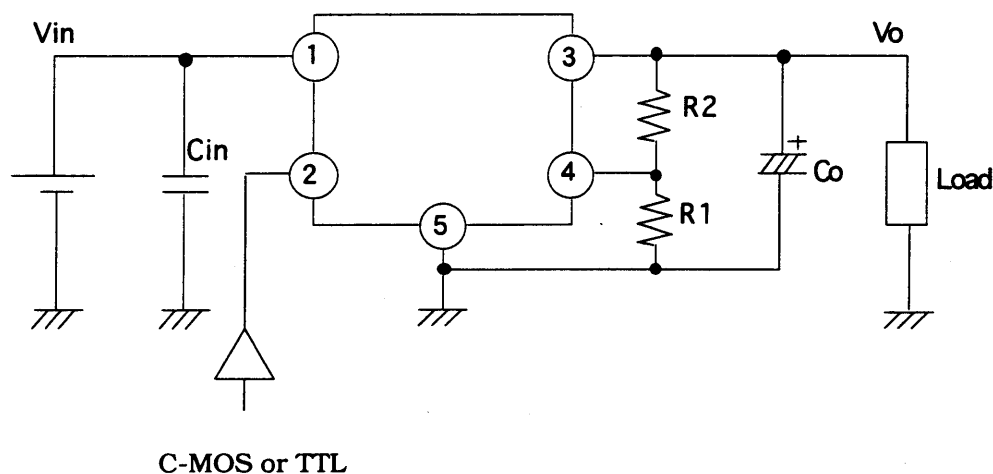
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6.3 Output voltage adjustment characteristics



7. Notes

7.1 External connection



- (1) Please perform shortest wiring for connection between C_{in} , C_o and the individual terminal or pin. 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.
- (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) 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.

7.2 Mounting

- (1) Please perform processing so that mechanical stress shall not be applied to the surface of the terminal and mold resin.
- (2) Please fix the device on the heat sink with tightening torque of 0.4 to 0.5N · m by using M3 biss.
At that time, please perform processing so that mechanical stress shall not be applied to the terminal and mold resin.
Recommended to use flat washer for tightening a screw.
Strictly observe the following items to effectively radiate the heat generated in the device inside.
 - (a) Warp and unevenness shall not occur on the contact surface of the heat sink and device.
 - (b) Metal dust and burr shall not be attached to the contact surface of the heat sink and device.
 - (c) Uniformly apply silicon grease on the contact surface of the heat sink and device. Please select the grease having no secular alteration in the operating temperature range.
And, grease to be used
 - ① No secular variation in operating temperature range.
 - ② Base oil does not separate and it does not stay in the device.
 - ③ If base oil stay in the device, operation and life time are not given bad affection. For example, we recommend G-746; Shin-Etsu Chemical Co., Ltd. and SC-102; Toray Dow Corning Silicone Co., Ltd.

7.3 Thermal protection design

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

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

If the maximum operating temperature and Pd when the element is operating are determined, use such a heat sink as allows the element to operate within the safety operation area specified by the degrading 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.

- (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 10MΩ or more) from the commercial power supply. Also the solder dip basin must be grounded.

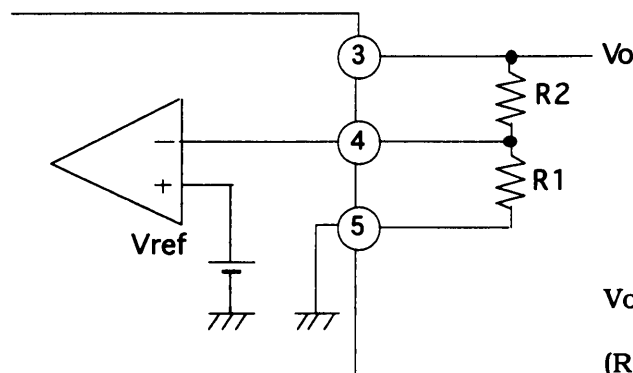
7.5 For cleaning

- (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

In case 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.

7.6 Output voltage fine tuning

Connecting external resistors R1 and R2 to terminals ③, ④, ⑤ allows the output voltage to be fine tuned from 1.5V to 7V. Refer to the figure below and "Paragraph 6.3 Output voltage adjustment characteristics" when connecting external resistors for fine tuning output voltage.



$$\begin{aligned}
 V_o &= V_{ref} \times (1 + R_2/R_1) \\
 &\approx 1.25 \times (1 + R_2/2000) \\
 (R_1 &= 1k\Omega, V_{ref} \approx 1.25V)
 \end{aligned}$$