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REFERENCE

OPTO-ELECTRONIC DEVICES DIVISION
ELECTRONIC COMPONENTS GROUP
SHARP CORPORATION

SPECIFICATION

DEVICE SPECIFICATION FOR

VOLTAGE REGULATOR

MODEL No.

PQ30RV21J00H

Specified for

Enclosed please find copies of the Specifications which consists of 13 pages including cover.
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 Apr. 13, 2004

BY H. Imanaka

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SHARP CORPORATION

Product name : VOLTAGE REGULATOR

Model No. : PQ30RV21J00H

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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.

1. Application

This specification applies to the outline and characteristics of output variable type low power loss regulator (linear type),
Model No. PQ30RV21J00H.

Applied Model name

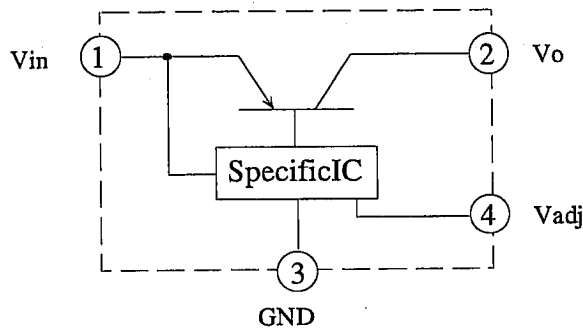
PQ30RV21J00H

Usage

PQ30RV21J00H is the device for stabilization of positive output voltage with built-in the over current protection function, the overheat protection function, adjustable DC output voltage by using external resistance.

This device is possible to be used in power supply circuit up to current capacity 2A.

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, 9.

6.1 Example of application

6.2 Over current protection characteristics (Typical value)

6.3 Output voltage adjustment characteristics

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 10 to 12.

7.1 External connection

7.2 Mounting

7.3 Thermal protection design

7.4 Static electricity

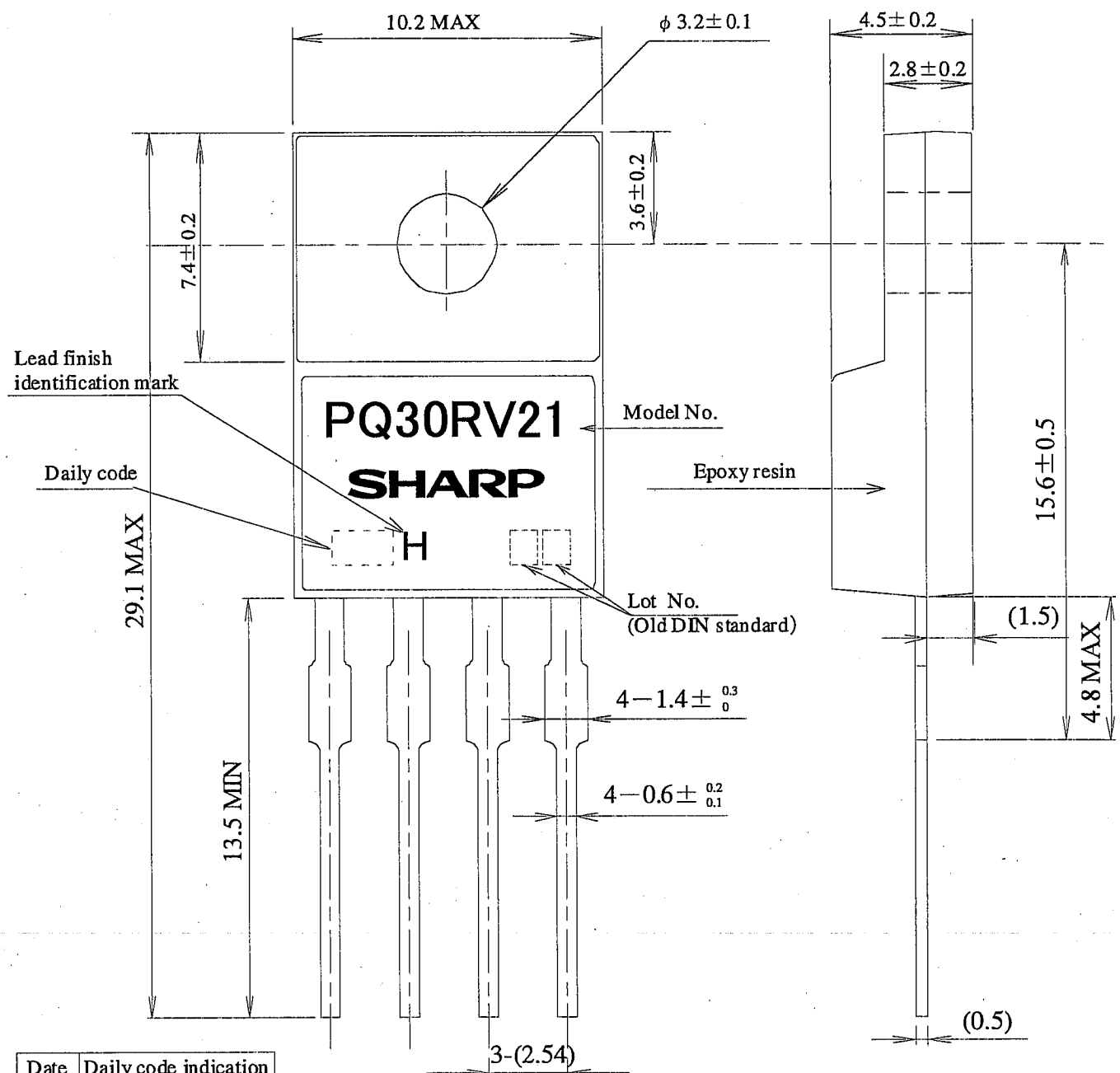
7.5 For cleaning

7.6 Storage environment

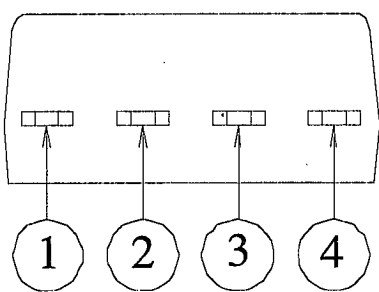
7.7 Output voltage fine tuning

7.8 ON/OFF control of output voltage

2. Outline



Date	Daily code indication
1	1
2	2
3	3
.	.
.	.
30	30
31	31



- ①DC input (V_{in})
- ②DC output (V_o)
- ③GND
- ④Output voltage adjustment (V_{adj})

• () : TYP.
 • Unit : mm
 • Scale : 5/1

Applied model No.	Marked model No.
PQ30RV21J00H	PQ30RV21

- Lead finish : Pb free Solder plating (Composition:Sn2Cu)
- Lead material : Cu
- Product mass : 1.9 ± 0.2 g

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3. Ratings and characteristics

3.1 Absolute maximum ratings

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

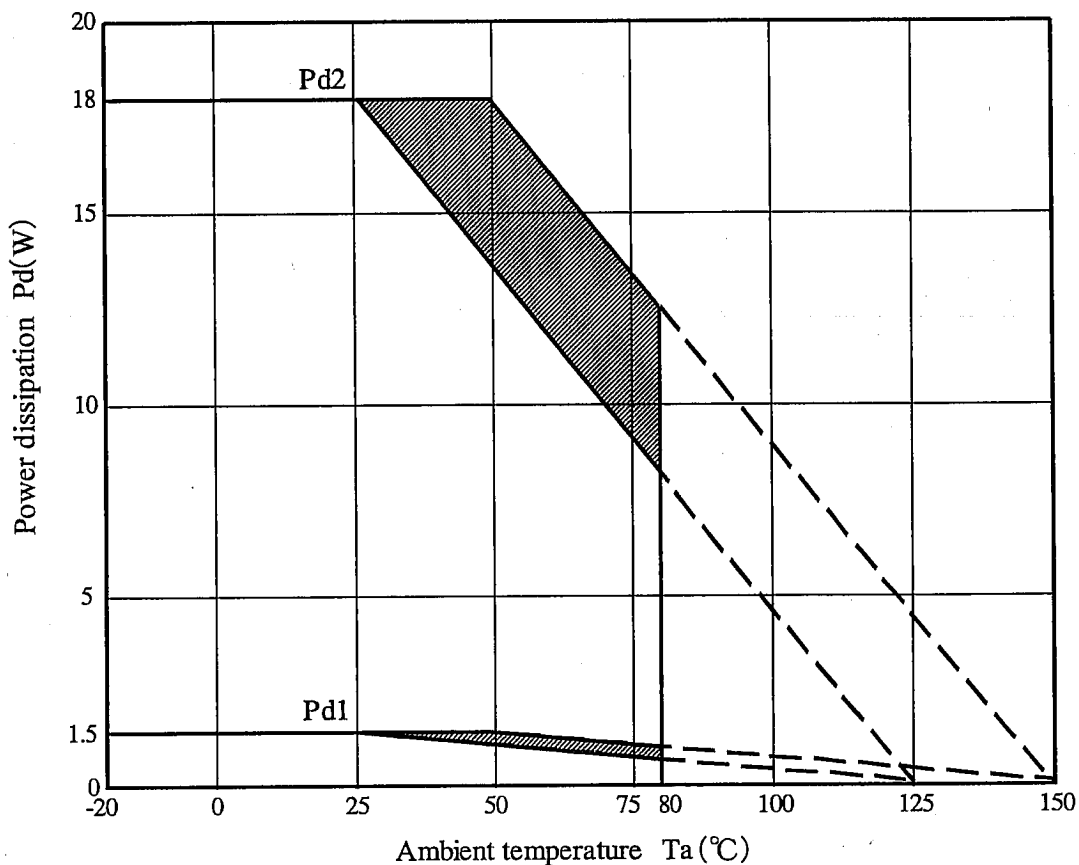
Parameter	Symbol	Rating	Unit	Conditions
Input voltage (*1)	V_{in}	35	V	
Output adjustment pin voltage (*1)	V_{adj}	7	V	
Output current	I_o	2	A	
Power dissipation (*2)	$Pd1$	1.5	W	Refer to Fig. 1
	$Pd2$	18	W	
Junction temperature (*3)	T_j	150	$^\circ\text{C}$	
Operating temperature	T_{opr}	-20 to +80	$^\circ\text{C}$	
Storage temperature	T_{stg}	-40 to +150	$^\circ\text{C}$	
Soldering temperature	T_{sol}	260	$^\circ\text{C}$	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 function operates at the temperature $T_j = 125$ to 150°C , this item cannot be used in this temperature range.

Fig. 1 $Pd - T_a$ rating



$Pd1$: No heat sink

$Pd2$: With infinite heat sink

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

3.2 Electrical characteristics

Unless otherwise specified condition shall be $V_{in}=15V$, $V_o=10V$ ($R1=390\Omega$), $I_o=1A$

$T_a=25^\circ C$

Parameter	Symbol	MIN.	TYP.	MAX.	Unit	Conditions
Input voltage	V_{in}	4.5	-	35	V	
Output voltage	V_o	1.5	-	30	V	
Load regulation	RegL	-	0.5	1.0	%	$I_o=5mA$ to 2A
Line regulation	RegI	-	0.5	2.5	%	$V_{in}=11$ to 28V $I_o=5mA$
Ripple rejection	RR	45	55	-	dB	Cref: Without
		55	65	-	dB	Cref=3.3 μF
Reference voltage	V_{ref}	1.225	1.25	1.275	V	*Refer to Fig. 3
Temperature coefficient of reference voltage	TcV_{ref}	-	± 1.0	-	%	
Dropout voltage	V_{i-o}	-	-	0.5	V	(*4) $I_o=2A$
Quiescent current	I_q	-	-	7	mA	$I_o=0A$

(*4) Input voltage shall be the value when output voltage is 95% in comparison with the initial value.

3.3 Electrical characteristics measuring circuit

Fig. 2 Standard measuring circuit of Regulator

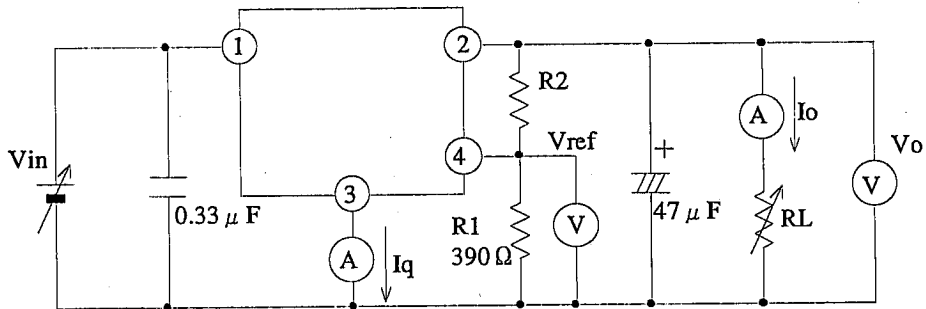
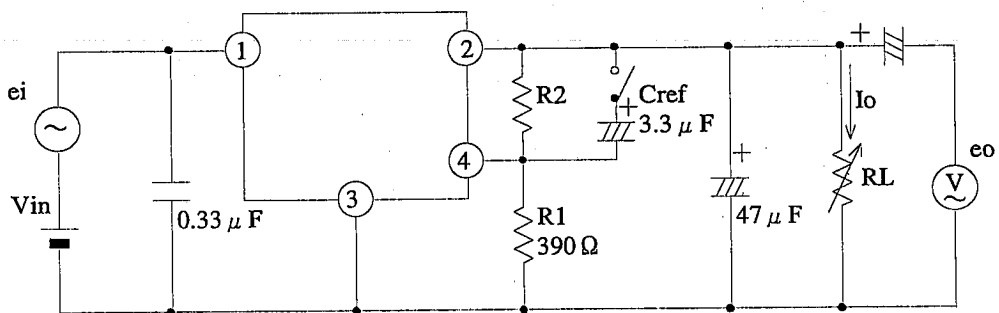


Fig. 3 Standard measuring circuit of critical rate of ripple rejection

$f=120\text{Hz}$ sine wave
 $e_i(\text{rms})=0.5\text{V}$
 $V_o=10\text{V}$
 $V_{in}=15\text{V}$
 $I_o=0.5\text{A}$
 $RR=20\log \{e_i(\text{rms})/e_o(\text{rms})\}$



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4. Reliability

The reliability of products shall satisfy items listed below.

Confidence level : 90%

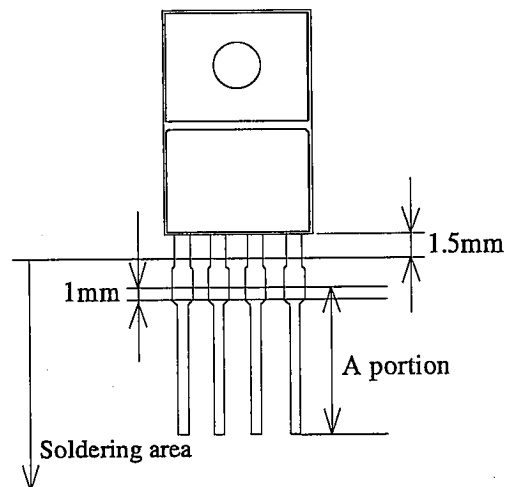
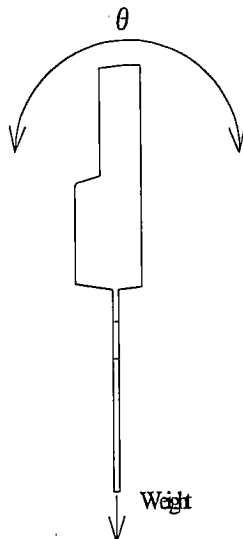
LTPD : 10 or 20

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	$V_{ref} < L \times 0.8$ $V_{ref} > U \times 1.2$ $RegL > U \times 1.2$ $RegI > U \times 1.2$ $V_{i-o} > U \times 1.2$	n=22, C=0	
Humidity (Steady State)	+60°C, 90%RH, 1000h		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		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	Ta=25°C, Pd=1.5W, Without radiator plate, 1000h		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		U: Upper specification limit L: Lower specification limit	n=11, C=0
Soldering heat	260°C, 10s, Dip up to 1.5mm from resin portion *3		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 *2		n=11, C=0	
Solderability	245±2°C, 3 s Solder : Sn/3.0Ag/0.5Cu Use EC19S(TAMURA KAKEN Corporation made flux) *3	Failure if soldershall not adhereat the area of 95% or more A portion.	n=11, C=0	

*1 Although color of terminals may change, this change of color is not included in criteria of failure judgement.

*2 Terminal bending direction is shown below.

*3 Soldering area is shown below.



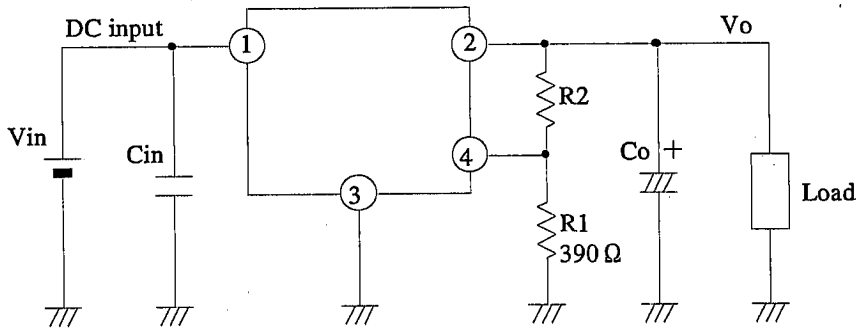
5. Outgoing inspection

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.

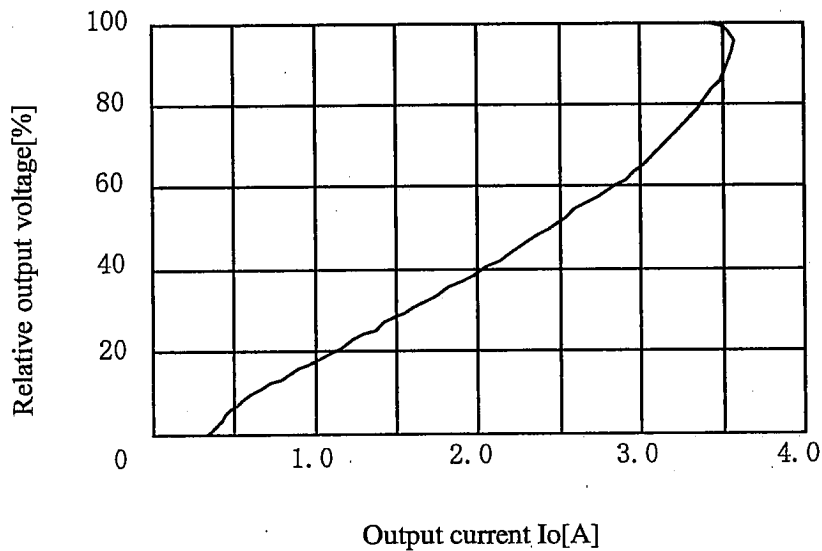
Defect	Inspection items	AQL (%)	Judgement criteria
Major defect	Electrical characteristics	0.1	It is based on the contents in the specification.
	Marking		To be recognized.
Minor defect	Dimensions	0.4	It is based on the contents in the specification.
	Appearance		There should not have resin break off and lead bending.

6. Supplement

6.1 Example of application

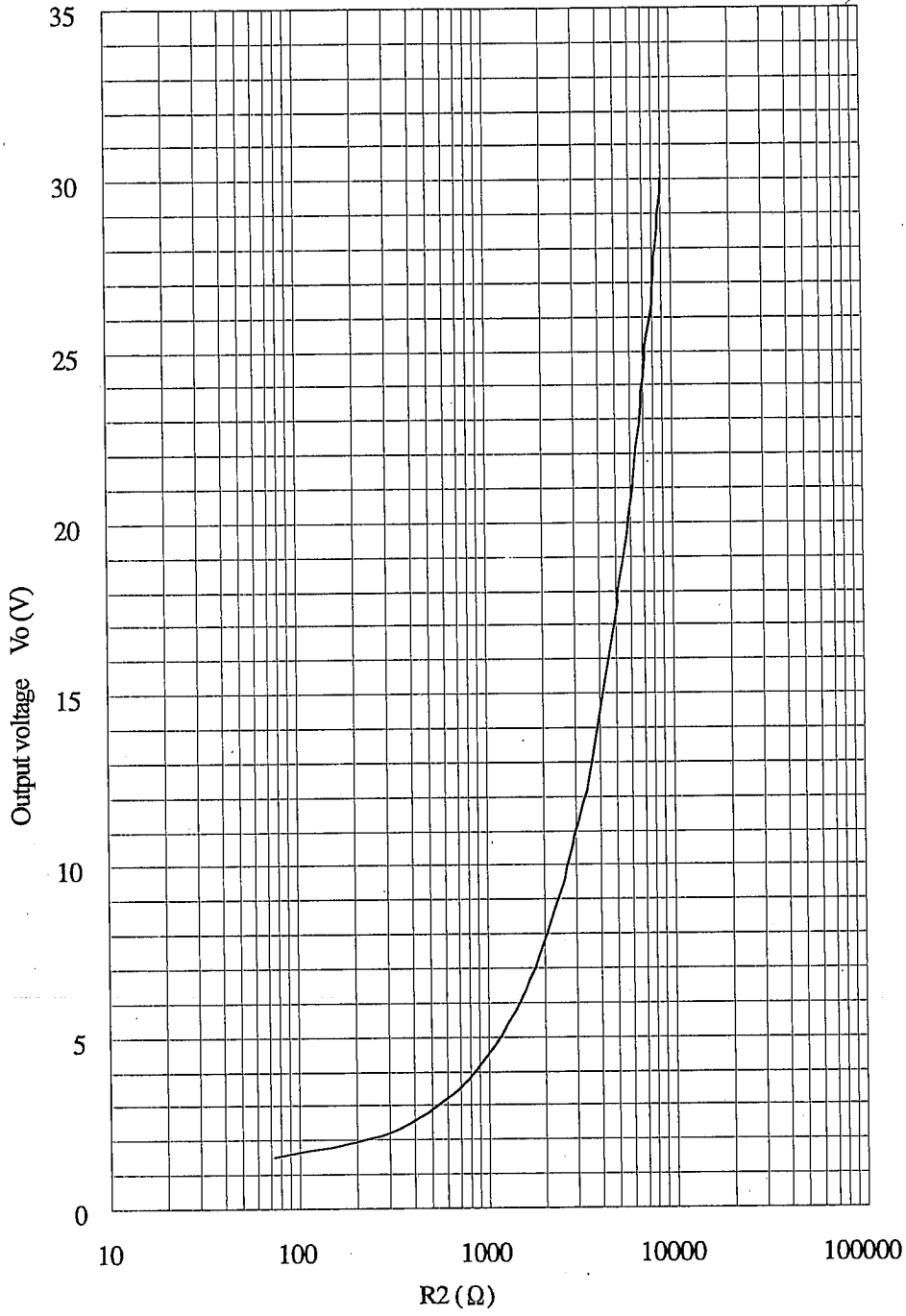


6.2 Over current protection characteristics (Typical value)



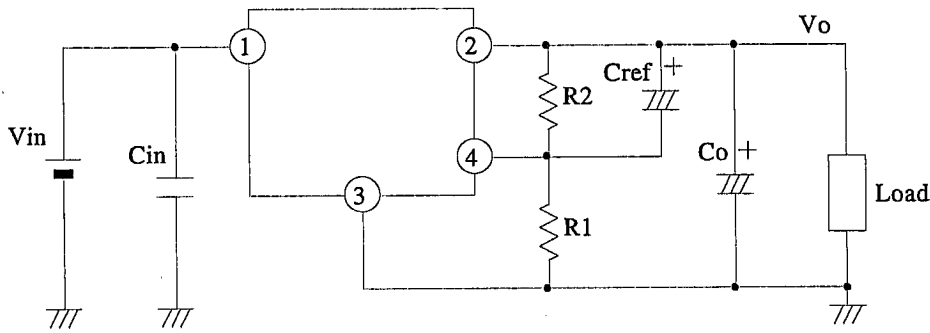
6.3 Output voltage adjustment characteristics (Typical value)

R1=390Ω

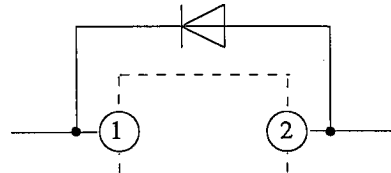


7. Notes

7.1 External connection

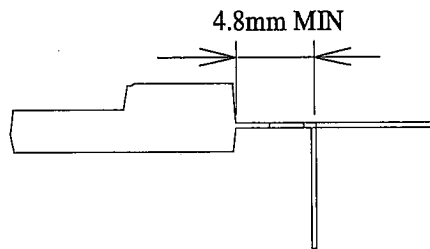


- (1) Please perform shortest wiring for connection between Co, Cref and the individual terminal.
There is case that oscillation occurs easily by kinds of capacitor, capacity and how to wire.
Before you use this device, you should confirm output voltage in your actual using conditions.
- (2) As voltage 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.
- (3) In applying greater voltage to the output terminal (2) 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 (Co) flows into the input side.
This may cause breakdown of the device. In such case, please connect a silicon diode as shown below in the schematic.



7.2 Mounting

- (1) In case the lead forming is applied, please secure the minimum size as follows and 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 loaded to the terminal and mold resin.
It is recommended to use flat washer for tightening a screw.
Strictly observe the following items to effectively radiate the heat generated in the device.
 - (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 derating curve in Fig. 1.

Insufficient radiation or in case of using exceeding the limitation of the internal 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.

7.4 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 10M Ω 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
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.

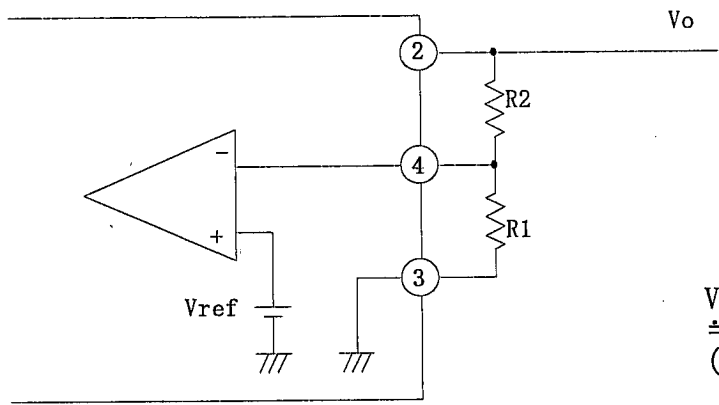
7.6 Storage environment

The products shall be stored at the temperature 5 to 30°C and the humidity lower than 70%RH.

Regarding the devices stored for 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.

7.7 Output voltage fine tuning

Connecting external resistors R1 and R2 to terminals ②, ③, ④ allows the output voltage to be fine tuned from 1.5V to 30V. Refer to the figure below and "Paragraph 6.3 Output voltage adjustment characteristics" when connecting external resistors for fine tuning output voltage.



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

$$\approx 1.25 \times (1 + R_2/390)$$

(R1=390 Ω, Vref ≈ 1.25V)

7.8 ON/OFF control of output voltage

As to ON/OFF control of output voltage, it is possible to become to OFF-state output voltage at the condition that ON/OFF control signal stays to "High" in the below circuit and the 4th terminal Vadj allows the range of $V_{ref} < V_{adj} \leq 7.0V$. And the output voltage becomes to On-state by ON/OFF control signal "Low". Since lead current comes output through R2 at OFF-state, R1 should be as much as possible within 10kΩ and the voltage at Vadj terminal should be as low as possible.

