| PREPARED BY: | DATE: |
| --- | --- |
| *November 11, 1999* | |
| *K. Shirai* | |

| APPROVED BY: | DATE: |
| --- | --- |
| *Y.Y.* | *Nov. 11. '99* |

# SHARP

**SPEC. No.** ED-99226

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PAGE 14 Pages

ELECTRONIC COMPONENTS
GROUP SHARP CORPORATION

## SPECIFICATION

REPRESENTATIVE DIVISION

OPTO-ELECTRONIC DEVICES DIV.

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.DEVICE SPECIFICATION FOR

VOLTAGE REGULATOR

MODEL No.

## PQ07RX11

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CUSTOMER'S APPROVAL

DATE

BY

DATE
PRESENTED
BY *K. H*

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K. Hachimura,
Department General Manager of
Engineering Dept.,II
Opto-Electronic Devices Div.
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SHARP CORPORATION

## 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
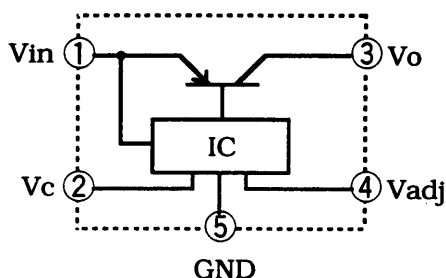


## 2. Outline : Refer to the attached sheet, page 3.

## 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.

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



φ3.2±0.1

10.2 MAX

4.5±0.2

2.8±0.2

7.4±0.2

Model No.

Daily code

PQ07RX11

SHARP

Lot. No.
(DIN standard)

Epoxy resin

Factory
identification
mark

(24.6)

16.4±0.7

(0.5)

(2.0)

5.0±0.5

(1.5)

4.4 MIN

5-0.8±0.1

4-(1.7)

(5.0)　3.2±0.5

8.2±0.7
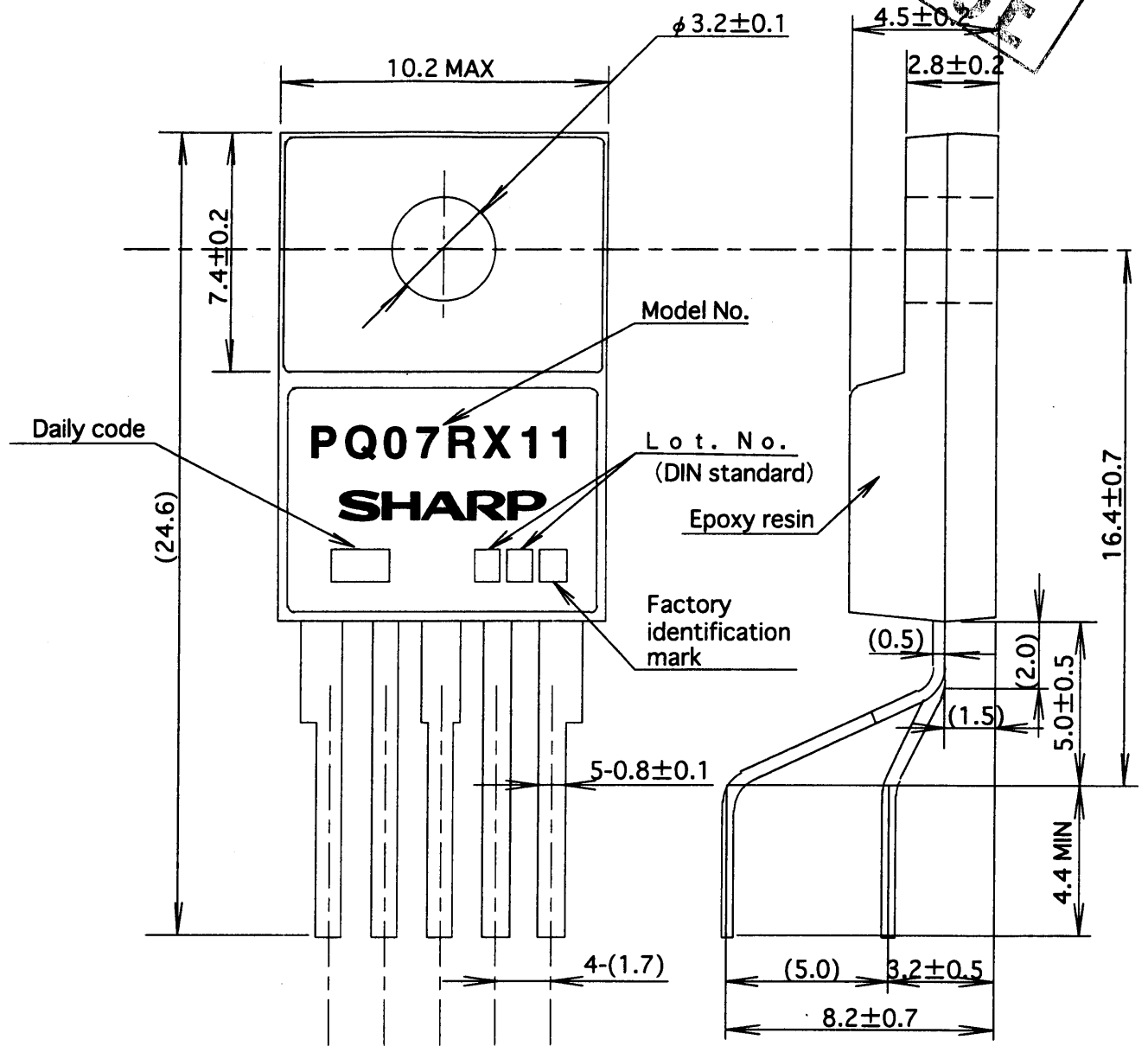
| Date | Daily code indication |
|------|------------------------|
| 1    | 1                      |
| 2    | 2                      |
| 3    | 3                      |
| .    | .                      |
| .    | .                      |
| .    | .                      |
| 30   | 30                     |
| 31   | 31                     |

① ② ③ ④ ⑤
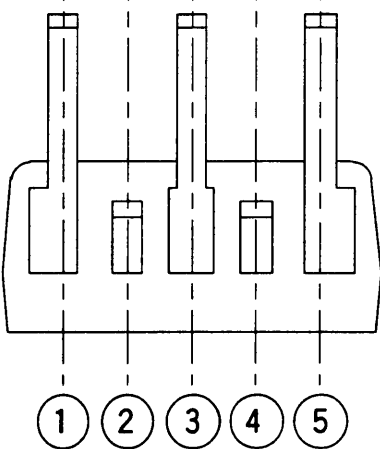
① DC input (Vin)
② ON/OFF control (Vc)
③ DC output (Vo)
④ Output voltage
　 adjustment (Vadj)
⑤ GND

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

· Lead finish : Solder plating
· Lead material : Cu
· Product mass : 2.0±0.2g

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MODEL No.
PQ07RX11

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### 3. Ratings and characteristics

#### 3.1 Absolute maximum ratings

Ta=25℃

| Parameter | Symbol | Rating | Unit | Conditions |
|---|---|---|---|---|
| Input voltage (*1) | Vin | 10 | V | |
| Input-output voltage | Vi-o | 5 | V | |
| ON/OFF control voltage (*1) | Vc | 10 | V | |
| Output adjustment pin voltage (*1) | Vadj | 5 | V | |
| Output current | Io | 1.0 | A | |
| Power dissipation (*2) | Pd1 | 1.5 | W | Refer to Fig. 1 |
| | Pd2 | 15 | W | |
| Junction temperature (*3) | Tj | 150 | ℃ | |
| Operating temperature | Topr | -20 to +80 | ℃ | |
| Storage temperature | Tstg | -40 to +150 | ℃ | |
| Soldering temperature | Tsol | 260 | ℃ | 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 Tj=125℃ to 150℃

Fig. 1  Pd - Ta rating
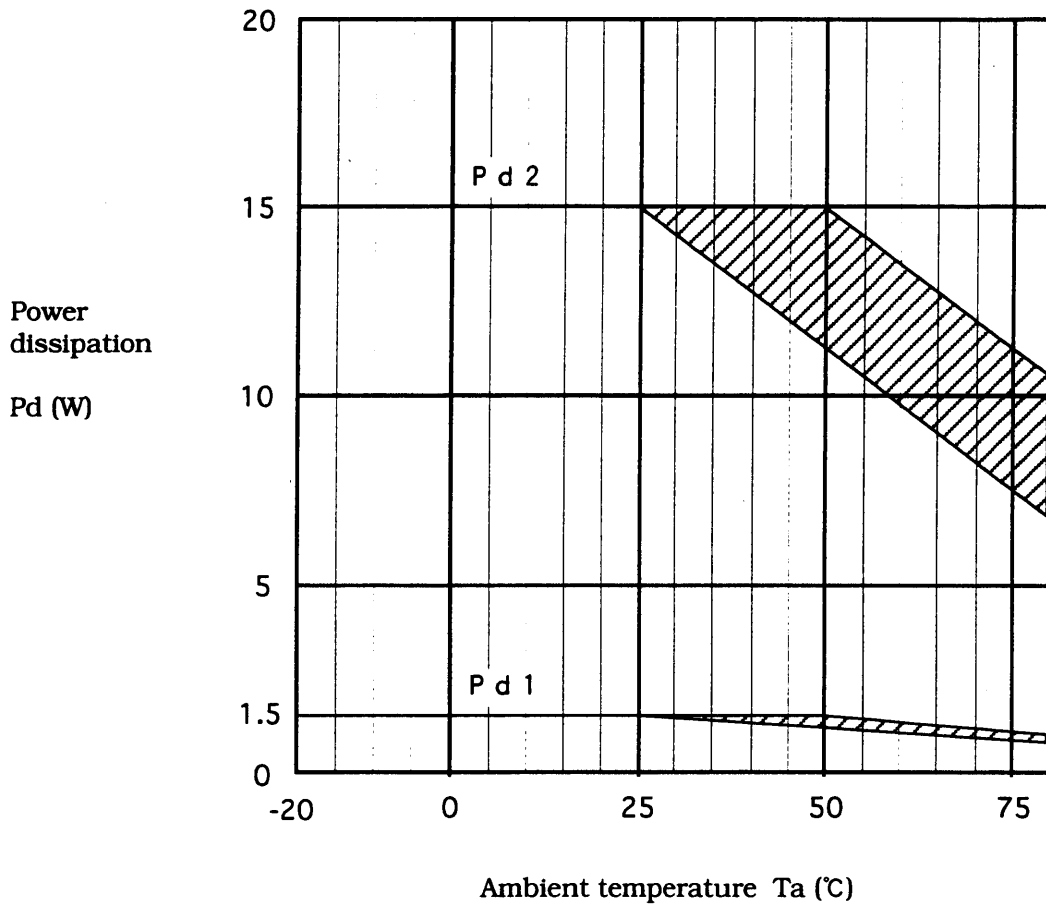


Pd 1 : No heat sink

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
Vin=5V, Vo=3V (R1=1kΩ), Io=0.5A, Vc=2.7V

Ta=25°C

| Parameter | Symbol | MIN. | TYP. | MAX. | Unit | Conditions |
|---|---|---|---|---|---|---|
| Input voltage | Vin | 3.0 | - | 10.0 | V | |
| Output voltage | Vo | 1.5 | - | 7 | V | |
| Load regulation | RegL | - | 0.2 | 2.0 | % | Io=5mA to 1.0A |
| Line regulation | RegI | - | 0.2 | 2.5 | % | Vin=4 to 8V Io=5mA |
| Ripple rejection | RR | 45 | 60 | - | dB | Refer to Fig.3 |
| Dropout voltage | Vi-o | - | - | 0.5 | V | Vin=3.0V, Io=0.5A |
| Reference voltage | Vref | 1.225 | 1.25 | 1.275 | V | |
| Temperature coefficient of reference voltage | TcVref | - | ±1.0 | - | % | Tj=0 to 125°C Io=5mA |
| On-state voltage for control | Vc (on) | 2.0 | - | - | V | (*4) |
| On-state current for control | Ic (on) | - | - | 200 | μA | |
| Off-state voltage for control | Vc (off) | - | - | 0.8 | V | Io=0A |
| Off-state current for control | Ic (off) | - | - | 2 | μA | Io=0A, Vc=0.4V |
| Quiescent current | Iq | - | 4 | 7 | mA | Io=0A |
| Output off-state consumption current | Iqs | - | - | 5 | μA | Vc=0.4V |

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

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### 3.3 Electrical characteristics measuring circuit

Fig. 2 Standard measuring circuit of Regulator portion

$$Vo = Vref \times (1 + R2/R1)$$
$$\fallingdotseq 1.25 \times (1 + R2/R1)$$
$$(R1 = 1k\Omega, \ Vref \fallingdotseq 1.25V)$$
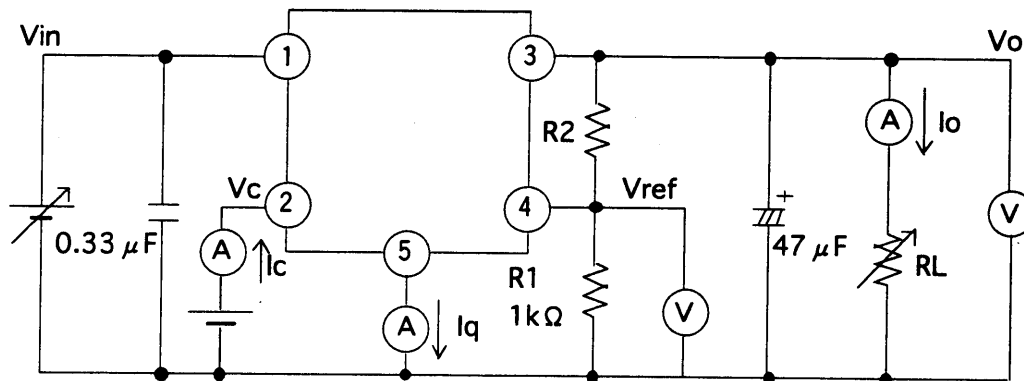


Fig. 3 Standard measuring circuit of critical rate of ripple rejection

f=120Hz sine wave
ei(rms)=0.5V
Vin=5V
Vo=3V (R1=1kΩ)
Io=0.3A
RR=20 log {ei(rms)/eo(rms)}
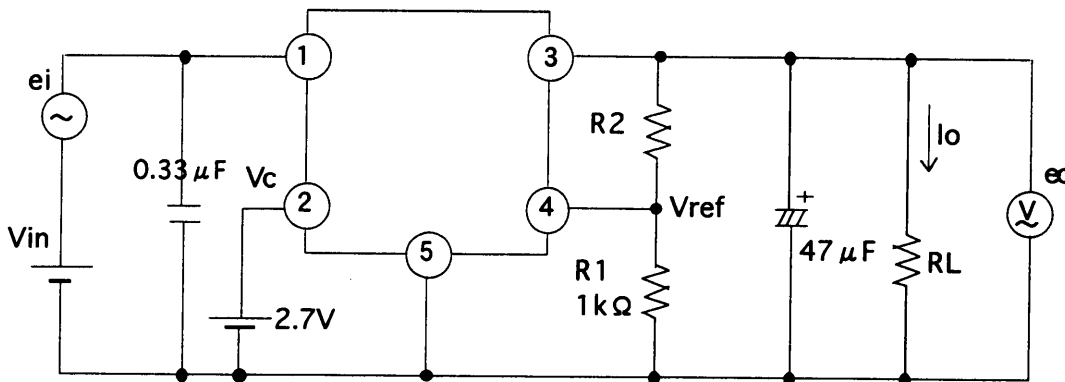
4. Reliability

The reliability of products shall satisfy items listed below.

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

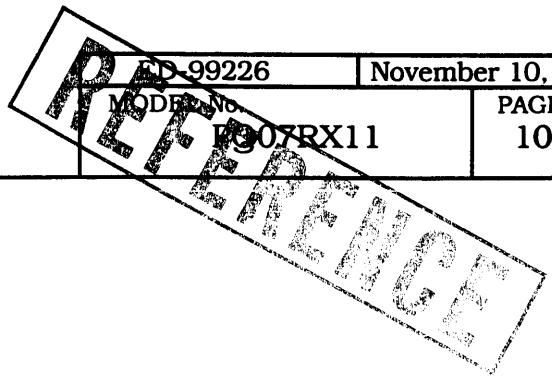| Test Items | Test Conditions | Failure Judgement Criteria | Samples (n) / Defective(C) |
|---|---|---|---|
| Temperature cycling | 1 cycle  -40℃ to +150℃<br>　　　(30min)　(30min)<br>20 cycles test | $Vref<L\times0.8$ | n=22, C=0 |
| Humidity (Steady State) | +60℃,90%RH, 1000h | $Vref>U\times1.2$ | n=22, C=0 |
| Damp Heat cyclic | 1 cycle : -20℃ to 70℃<br>　　　(2h)　　(2h)<br>Transfer time between high and low temp. is 1h<br>40 cycles test, 90%RH | $RegL>U\times1.2$<br><br>$RegI>U\times1.2$ | n=22, C=0 |
| High temp. storage | +150℃, 1000h | $RR<L\times0.8$ | n=22, C=0 |
| Low temp. storage | -40℃, 1000h | $Vi\text{-}o>U\times1.2$ | n=22, C=0 |
| Operation life | Ta=25℃, Pd=1.5W, 1000h | | n=22, C=0 |
| Mechanical shock | 15000m/s$^2$, 0.5ms<br>3 times/ ±X, ±Y, ±Z | | n=11, C=0 |
| Vibration (Variable frequency) | 200m/s$^2$,<br>100 to 2000 to 100Hz/4 min<br>4 times/ X, Y, Z direction | U: Upper specification limit | n=11, C=0 |
| Soldering heat | 260℃, 10 s, Dip up to 1.5mm from resin portion *2 | L: Lower specification limit | n=11, C=0 |
| Electrostatic discharge | ±250V, 200pF, 0Ω<br>Between GND and each terminal/ 3 times | | n=11, C=0 |
| Robustness of Termination (Tensile test) | Weight: 10N<br>30 s/ each terminal | Failure if it has breakdown and loosened pin. | n=11, C=0 |
| Robustness of Termination (Bending test) | Weight: 2.5N<br>0° ~90° ~0° ~-90° ~0°<br>each terminal *1 | | n=11, C=0 |
| Solderability | 230±5℃, 5±0.5 s<br>Use rogin 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.
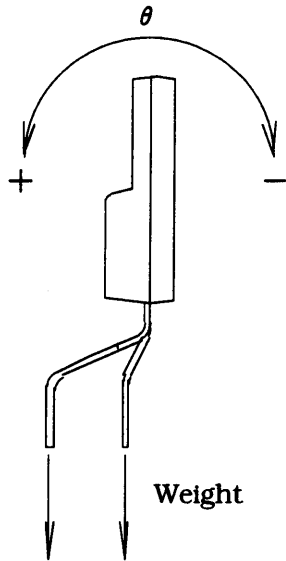
*2 Soldering area is shown below.



θ

+    −

Weight

1.5mm

2mm

A portion

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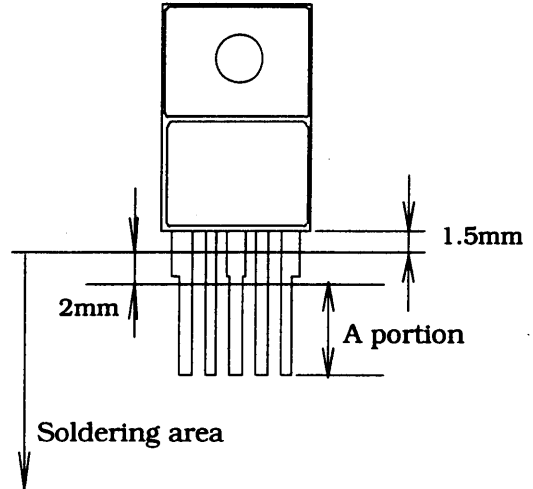
5. Incoming inspeciton
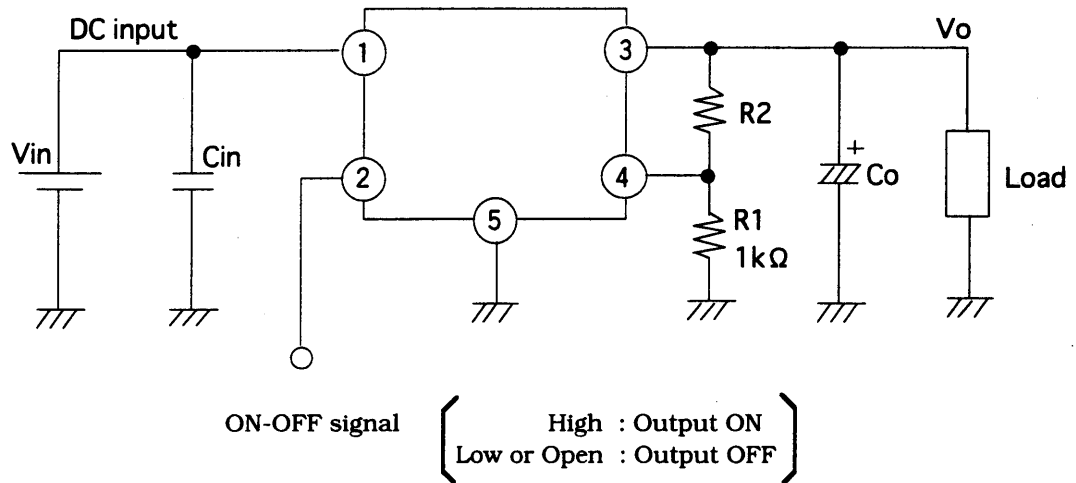
TABLE II-A single sampling plans for normal inspection based on ISO 2859 is applied. The AQL according to the inspection items are shown below.

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

## 6. Supplement

### 6.1 Example of application



ON-OFF signal

$$\left\{ \begin{array}{l} \text{High} \quad : \text{Output ON} \\ \text{Low or Open} \ : \text{Output OFF} \end{array} \right\}$$

### 6.2 Over current protection characteristics (Typical value)



Relative output voltage (%)

Output current Io (A)

REFERENCE

6.3 Output voltage adjustment characteristics

R1=1kΩ

Output
voltage

Vo (V)

R2 (kΩ)
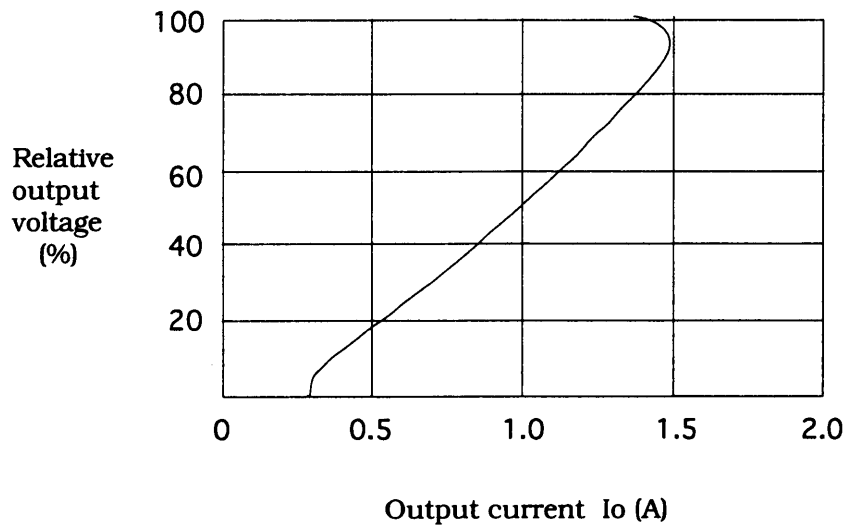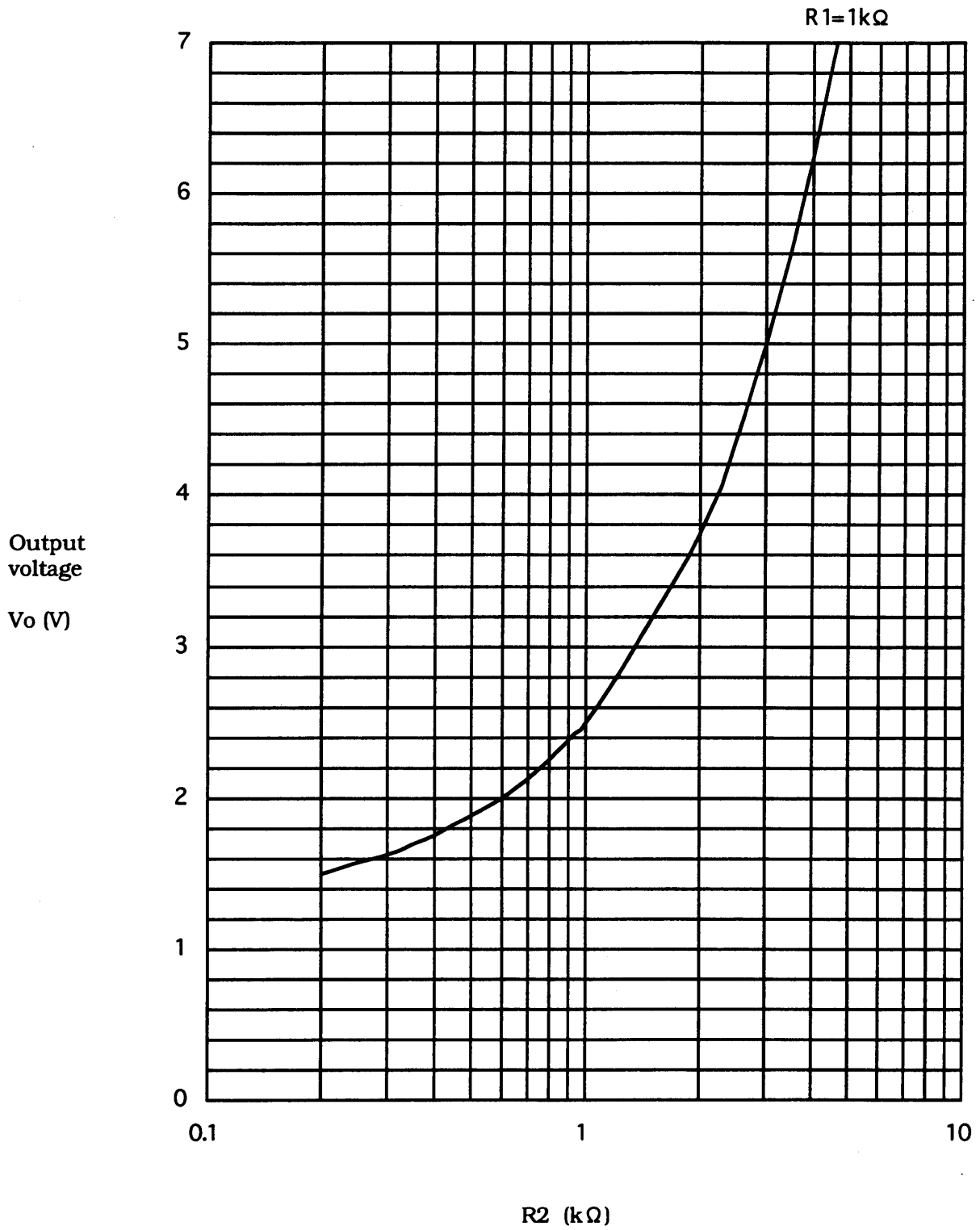
7.  Notes

   7.1  External connection



C-MOS or TTL
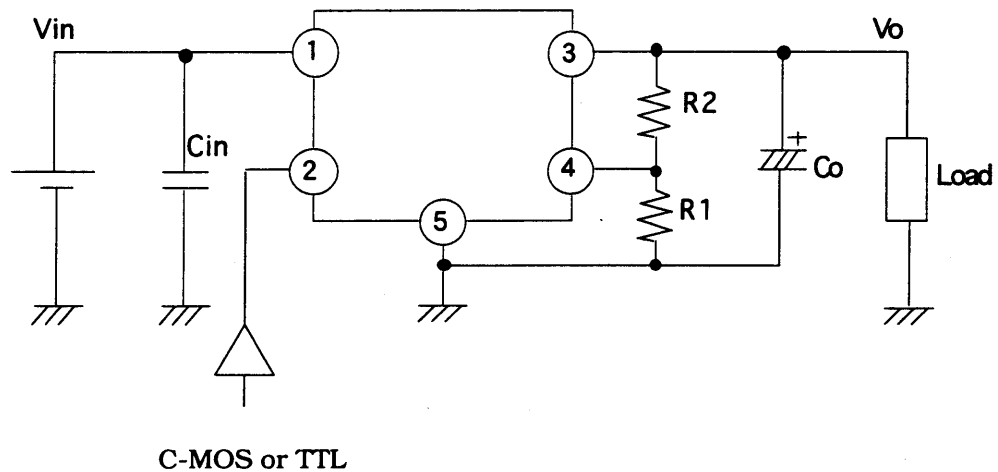
(1)  Please perform shortest wiring for connection between Cin, Co and the
    individual terminal or fin.  There is case that oscillation occurs easily by kinds
    of capacitor and capacity.  Before you use this device, you should confirm
    output voltage on your use mounting state.

(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.

$$Pd = Io \times (Vin - Vo) + Vin \times Iq$$

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℃ 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.
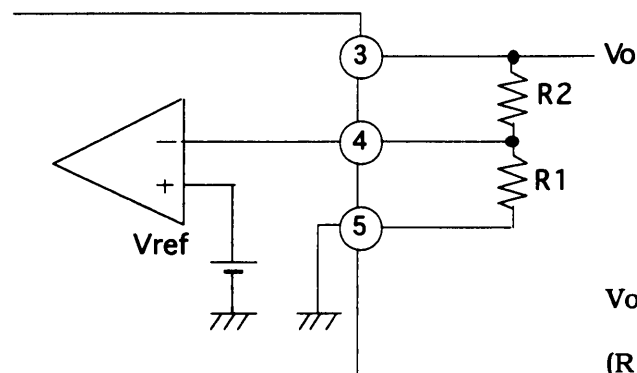


$$Vo = Vref \times (1 + R2/R1)$$
$$\fallingdotseq 1.25 \times (1 + R2/2000)$$
$$(R1 = 1k\Omega, Vref \fallingdotseq 1.25V)$$