

PQ30RV1/PQ30RV11/PQ30RV2/PQ30RV21

Variable Output Low Power-Loss Voltage Regulators

■ Features

- Compact resin full-mold package
- Low power-loss (Dropout voltage : MAX.0.5V)
- Variable output voltage (setting range : 1.5 to 30V)
- Built-in output ON/OFF control function

■ Applications

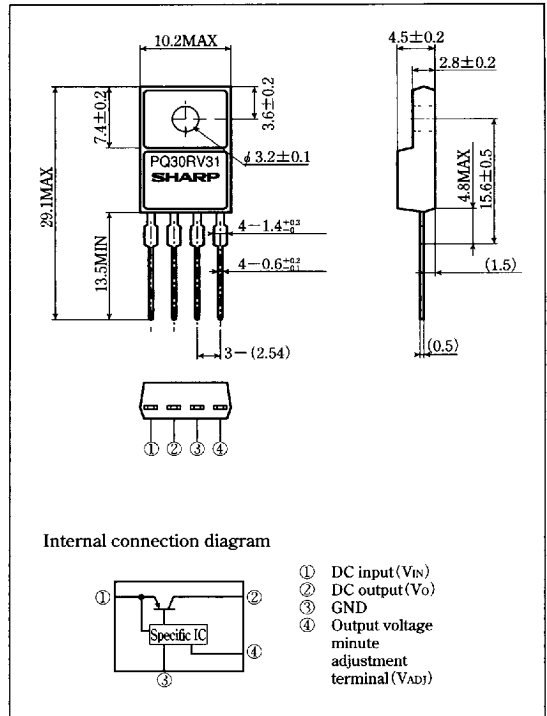
- Power supply for print concentration control of electronic typewriters with display
- Series power supply for motor drives
- Series power supply for VCRs and TVs

■ Model Line-ups

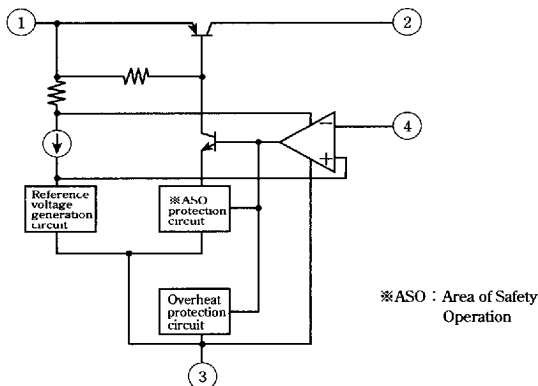
Output voltage	1A output	2A output
Reference voltage precision: $\pm 4\%$	PQ30RV1	PQ30RV2
Reference voltage precision: $\pm 2\%$	PQ30RV11	PQ30RV21

■ Outline Dimensions

(Unit : mm)



■ Equivalent Circuit Diagram



· Please refer to the chapter "Handling Precautions".

Absolute Maximum Ratings

(T_a=25°C)

Parameter		Symbol	Rating	Unit
*1 Input voltage		V _{IN}	35	V
*1 Output voltage adjustment voltage		V _{ADJ}	7	V
Output current	PQ30RV1/PQ30RV11	I _O	1	A
	PQ30RV2/PQ30RV21		2	
Power dissipation (No heat sink)		P _{D1}	1.5	W
Power dissipation (With infinite heat sink)	PQ30RV1/PQ30RV11	P _{D2}	15	W
	PQ30RV2/PQ30RV21		18	
*2 Junction temperature		T _J	150	°C
Operating temperature		T _{opr}	-20~+80	°C
Storage temperature		T _{stg}	-40~+150	°C
Soldering temperature		T _{sol}	260 (For 10s)	°C

*1 All are open except GND and applicable terminals

*2 Overheat protection may operate at T_J ≧ 125°C.

Electrical Characteristics

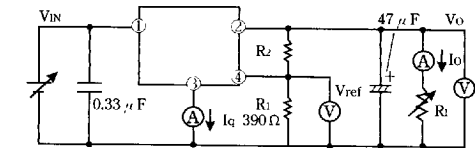
Unless otherwise specified, condition shall be
V_{IN}=15V, V_O=10V, I_O=0.5A, R_i=390Ω (PQ30RV1/PQ30RV11)
V_{IN}=15V, V_O=10V, I_O=1.0A, R_i=390Ω (PQ30RV2/PQ30RV21)

(T_a=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input voltage		V _{IN}	—	4.5	—	35	V
Output voltage	PQ30RV1/PQ30RV2	V _O	R _Z =94Ω to 8.5kΩ	1.5	—	30	V
	PQ30RV11/PQ30RV21		R _Z =84Ω to 8.7kΩ				
Load regulation	PQ30RV1/PQ30RV11	R _{egL}	I _O =5mA to 1A	—	0.3	1.0	%
	PQ30RV2/PQ30RV21		I _O =5mA to 2A	—	0.5	1.0	
Line regulation		R _{egI}	V _{IN} =11 to 28V	—	0.5	2.5	%
Ripple rejection		RR	C _{ref} =0	45	55	—	dB
			C _{ref} =3.3μF	55	65	—	
Reference voltage	PQ30RV1/PQ30RV2	V _{ref}	—	1.20	1.25	1.30	V
	PQ30RV11/PQ30RV21			1.225	1.25	1.275	
Temperature coefficient of reference voltage		T.V _{ref}	T _J =0 to 125°C	—	±1.0	—	%
Dropout voltage	PQ30RV1/PQ30RV11	V _{r-O}	*3, I _O =0.5A	—	—	0.5	V
	PQ30RV2/PQ30RV21		*3, I _O =2A				
Quiescent current		I _q	I _O =0	—	—	7	mA

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

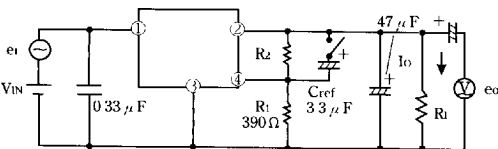
Fig. 1 Test Circuit



$$V_O = V_{ref} \times \left(1 + \frac{R_Z}{R_i}\right) \approx 1.25 \times \left(1 + \frac{R_Z}{R_i}\right)$$

[R_i=390Ω, V_{ref}≈1.25V]

Fig. 2 Test Circuit of Ripple Rejection



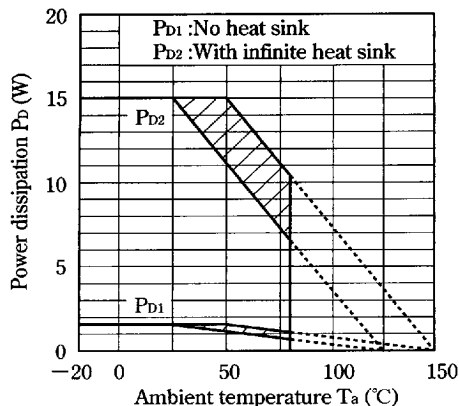
I_O=0.5A

f=120Hz (sine wave)

e_i=0.5Vrms

RR=20 log (e_i/e_o)

Fig. 3 Power Dissipation vs. Ambient Temperature (PQ30RV1/PQ30RV11)



Note) Oblique line portion : Overheat protection may operate in this area.

Fig. 5 Overcurrent Protection Characteristics (PQ30RV1/PQ30RV11)

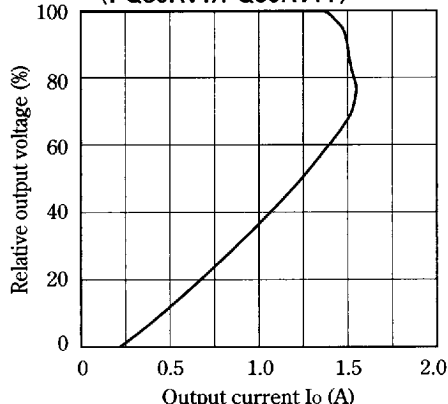


Fig. 7 Output Voltage Adjustment Characteristics

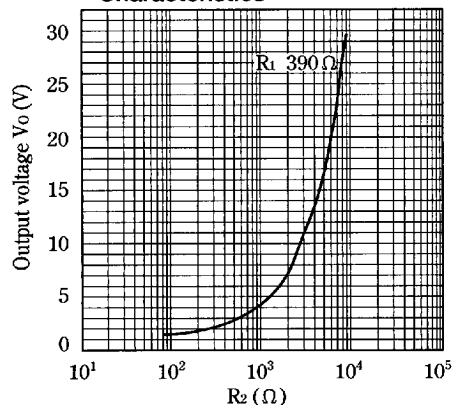
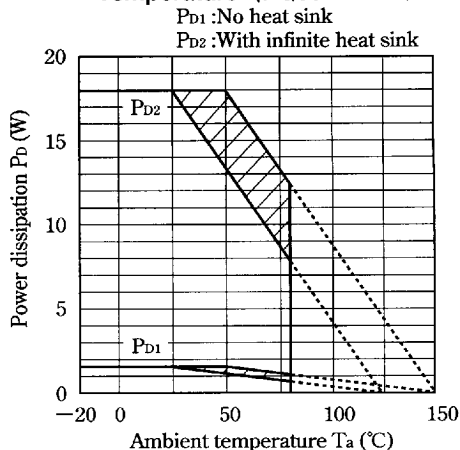


Fig. 4 Power Dissipation vs. Ambient Temperature (PQ30RV2/PQ30RV21)



Note) Oblique line portion : Overheat protection may operate in this area.

Fig. 6 Overcurrent Protection Characteristics (PQ30RV2/PQ30RV21)

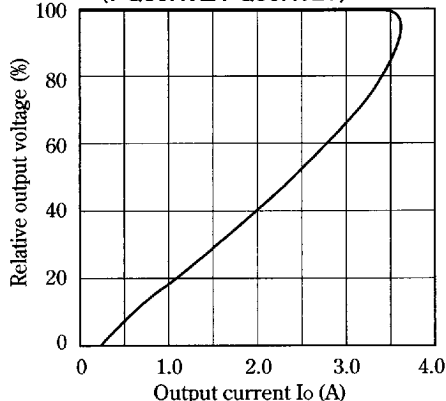


Fig. 8 Reference Voltage Deviation vs. Junction Temperature

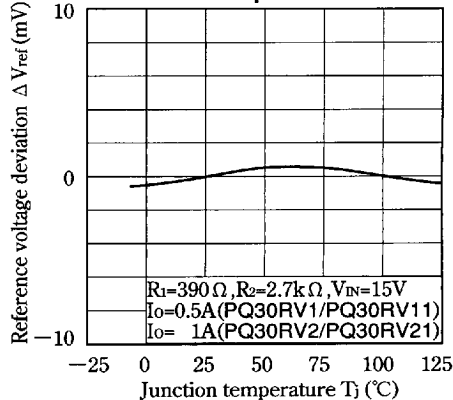
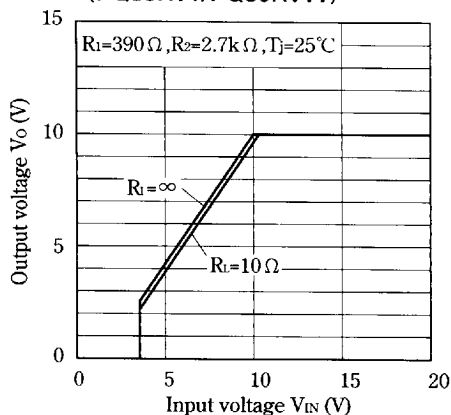
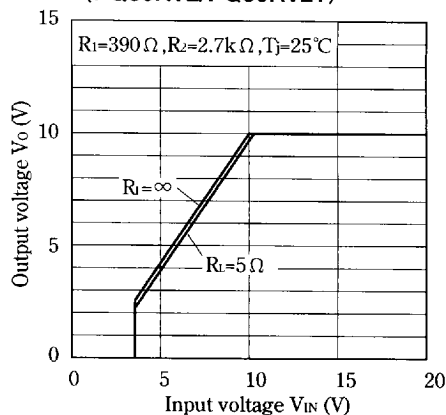
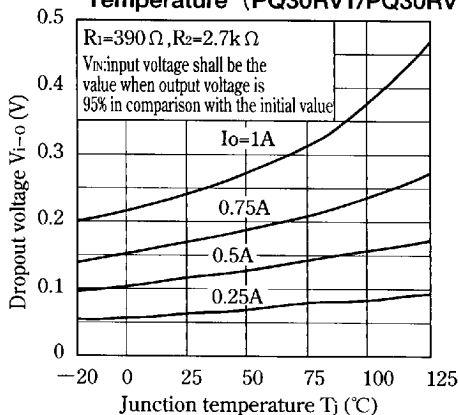
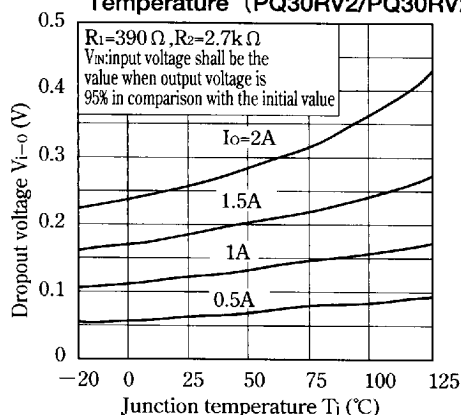
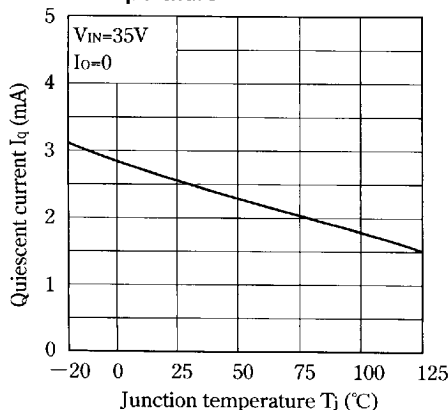
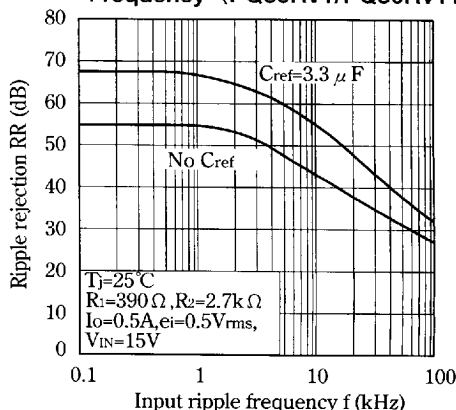


Fig. 9 Output Voltage vs. Input Voltage (PQ30RV1/PQ30RV11)**Fig.10 Output Voltage vs. Input Voltage (PQ30RV2/PQ30RV21)****Fig.11 Dropout Voltage vs. Junction Temperature (PQ30RV1/PQ30RV11)****Fig.12 Dropout Voltage vs. Junction Temperature (PQ30RV2/PQ30RV21)****Fig.13 Quiescent Current vs. Junction Temperature****Fig.14 Ripple Rejection vs. Input Ripple Frequency (PQ30RV1/PQ30RV11)**

SHARP

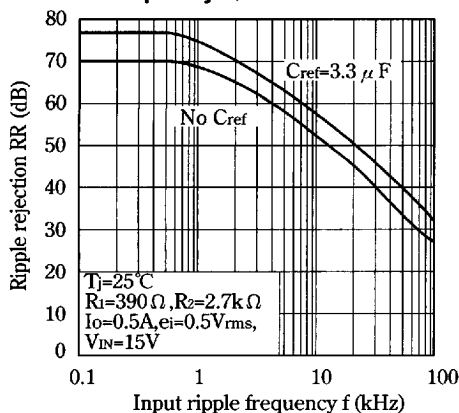
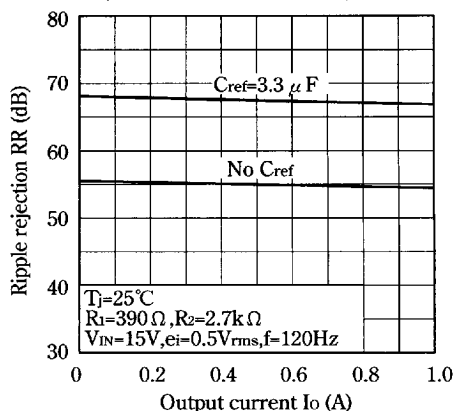
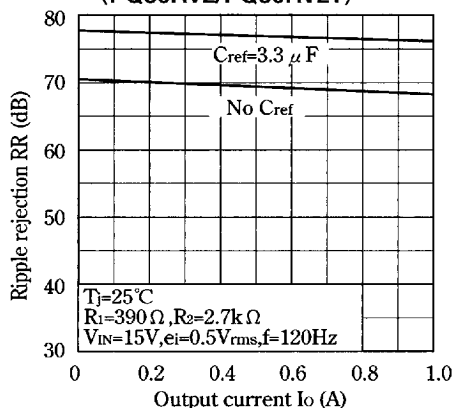
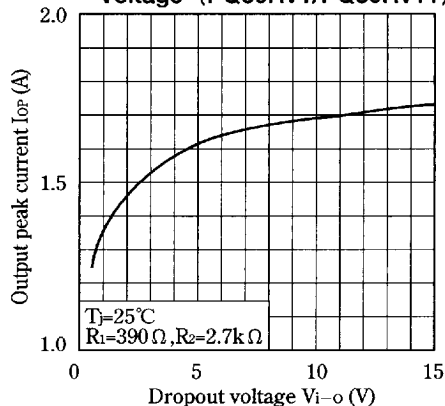
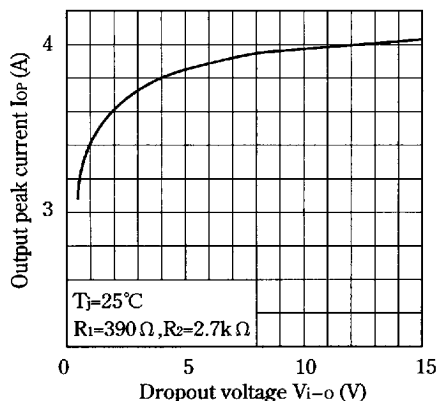
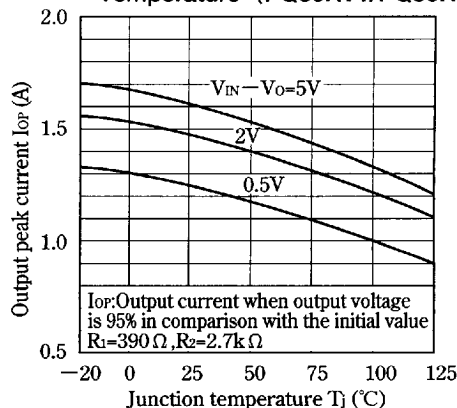
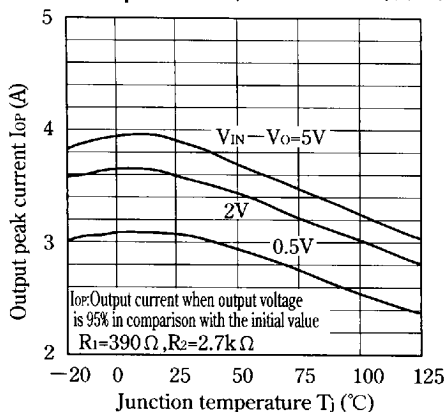
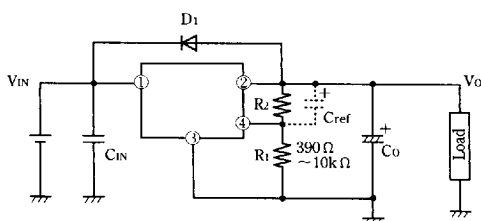
Fig.15 Ripple Rejection vs. Input Ripple Frequency (PQ30RV2/PQ30RV21)**Fig.16** Ripple Rejection vs. Output Current (PQ30RV1/PQ30RV11)**Fig.17** Ripple Rejection vs. Output Current (PQ30RV2/PQ30RV21)**Fig.18** Output Peak Current vs. Dropout Voltage (PQ30RV1/PQ30RV11)**Fig.19** Output Peak Current vs. Dropout Voltage (PQ30RV2/PQ30RV21)**Fig.20** Output Peak Current vs. Junction Temperature (PQ30RV1/PQ30RV11)

Fig.21 Output Peak Current vs. Junction Temperature (PQ30RV2/PQ30RV21)



Standard Connection



D1 : This device is necessary to protect the element from damage when reverse voltage may be applied to the regulator in case of input short-circuiting.

Cref : This device is necessary when it is required to enhance the ripple rejection or to delay the output start-up time(*1).
 (*1) Otherwise, it is not necessary.

(Care must be taken since C_{ref} may raise the gain, facilitating oscillation.)

(*1) The output start-up time is proportional to $C_{ref} \times R_2$.

CIN, CO : Be sure to mount the devices C_{IN} and C_O as close to the device terminal as possible so as to prevent oscillation.

The standard specification of C_{IN} and C_O is $0.33\ \mu F$ and $47\ \mu F$, respectively. However, adjust them as necessary after checking.

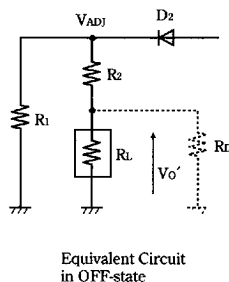
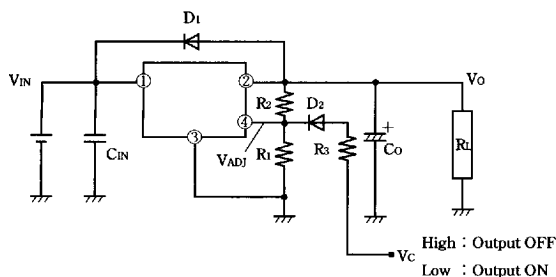
R1, R2 : These devices are necessary to set the output voltage. The output voltage V_O is given by the following formula :

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

(V_{ref} is 1.25V TYP)

The standard value of R_1 is $390\ \Omega$. But value up to $10k\ \Omega$ does not cause any trouble.

ON/OFF Operation



- ON/OFF operation is available by mounting externally D_2 and R_3 .
- When V_{ADJ} is forcibly raised above V_{ref} (1.25V TYP) by applying the external signal, the output is turned off (pass transistor of regulator is turned off). When the output is OFF, V_{ADJ} must be higher than V_{ref} MAX., and at the same time must be lower than maximum rating 7V.

In OFF-state, the load current flows to R_L from V_{ADJ} through R_2 . Therefore the value of R_2 must be as high as possible.

- $V_o' = V_{ADJ} \times R_L / (R_L + R_2)$

occurs at the load. OFF-state equivalent circuit R_L up to $10k\Omega$ is allowed. Select as high value of R_L and R_2 as possible in this range. In some case, as output voltage is getting lower ($V_o < 1V$), impedance of load resistance rises. In such condition, it is sometime impossible to obtain the minimum value of V_o' . So add the dummy resistance indicated by R_D in the figure to the circuit parallel to the load.

An Example of ON/OFF Circuit Using the 1-chip Microcomputer Output Port (PQ30RV1)

<Specification>

Output port of microcomputer

$$V_{OH}(\max) = 0.5V$$

$$V_{OH}(\min) = 2.4V \quad (I_{OH} = 0.2mA)$$

MAX. rating of $I_{OH} = 0.5mA$

Output should be set as follows.

$$15.6V \quad R_L = 52\Omega \quad (I_o = 0.3A)$$

From $V_o = 1.25V (1 + R_2/R_1)$ we get $V_o = 15.6V$.

$$R_2/R_1 = 11.48$$

Assuming that $V_F(\max) = 0.8V$ for D_2 in case of $V_{OH}(\min) = 2.4V$, we get $V_{ADJ} = V_{OH}(\min) - V_F(\max) = 2.4V - 0.8V = 1.6V$. From $V_{ref}(\max) = 1.3V$ we get $R_3 = 0\Omega$

If $R_1 = 10k\Omega$, we get $R_2 = 11.48 \times R_1 = 114.8k\Omega$ and I_{OH} as follows, ingnoring R_L (52 Ω) :

$$I_{OH} = 1.6V \times (R_1 + R_2) / R_1 \times R_2 \\ = 1.6V \times (10k\Omega + 114.8k\Omega) / 10k\Omega \times 114.8k\Omega = 0.17mA$$

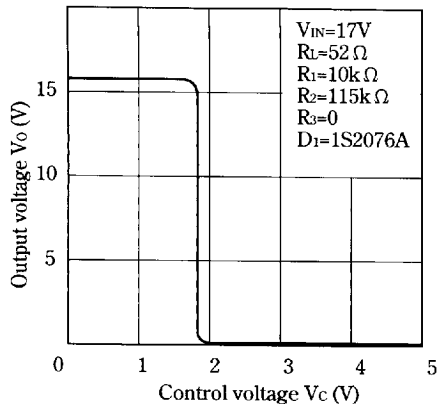
Hence, $I_{OH} < 0.2mA$. Therefore $V_{OH}(\min)$ is ensured.

Next, assuming that $V_F(\min) = 0.5V$ for D_2 in case of $V_{OH}(\max)$, we get :

$$I_{OH} = (5V - 0.5V) (R_1 + R_2) / R_1 \times R_2 = 0.49mA \text{ which is less than the rating.}$$

Figure 1 shows the $V_o - V_c$ characteristics when $R_1 = 10k\Omega$, $R_2 = 115k\Omega$, $R_3 = 0\Omega$, $V_{IN} = 17V$, $R_L = 52\Omega$, and $D_1 = 1S2076A$ (Hitachi).

Output Voltage vs. Control Voltage (PQ30RV1)

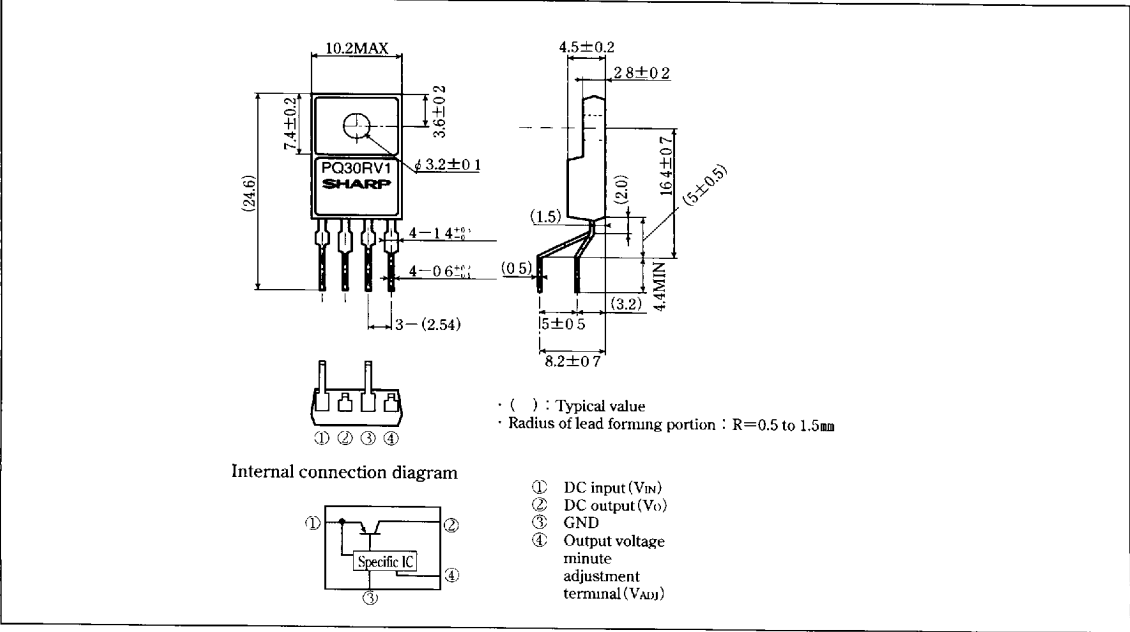


Model Line-ups for Lead Forming Type

Output voltage	5V output	2A output
Output voltage precision: $\pm 2.5\%$	PQ30RV1B	PQ30RV2B

Outline Dimensions (PQ30RV1B/PQ30RV2B)

(Unit : mm)



Note) The value of absolute maximum ratings and electrical characteristics is same as ones of PQ30RV1/2 series.