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

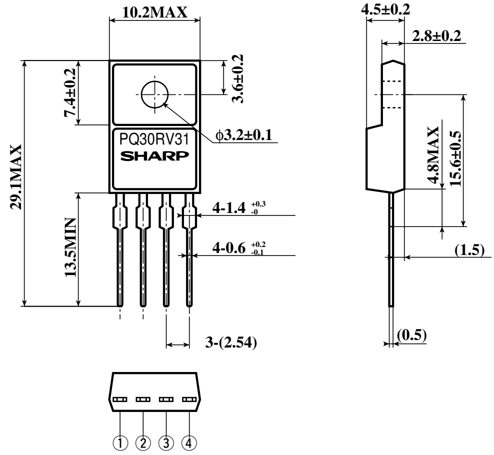
- Power supply for print concentration control of electronic typewriters with display
- Series power supply for motor drives
- Series power supply for VCRs and TVs

■ Model Line-ups

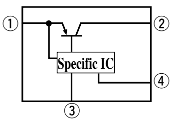
Output voltage	1A output	2A output
Reference voltage precision : ±4%	PQ30RV1	PQ30RV2
Reference voltage precision : ±2%	PQ30RV11	PQ30RV21

■ Outline Dimensions

(Unit : mm)

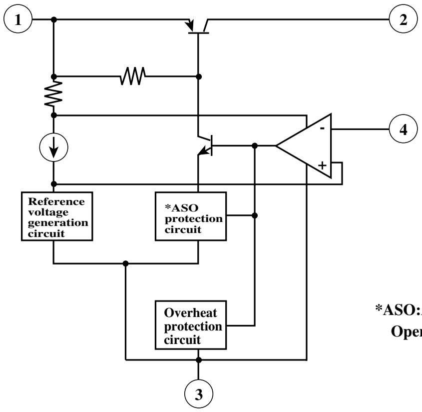


Internal connection diagram



① DC input (V_{IN})
② DC output (V_O)
③ GND
④ Output voltage minute adjustment terminal (V_{ADJ})

■ Equivalent Circuit Diagram



*ASO:Area of Safety Operation

· 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}	-20to+80	˚C
Storage temperature		T_{stg}	-40to+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_1=390Ω (PQ30RV1/PQ30RV11)

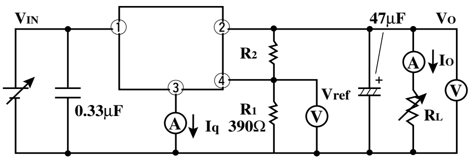
V_{IN}=15V, V_O=10V, I_O=1.0A, R_1=390Ω (PQ30RV2/PQ30RV21)

(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_2=94Ω to 8.5kΩ		1.5	-	30	V
	PQ30RV11/PQ30RV21		R_2=84Ω to 8.7kΩ					
Load regulation	PQ30RV1/PQ30RV11	RegL	I_O=5mA to 1A		-	0.3	1.0	%
	PQ30RV2/PQ30RV21		I_O=5mA to 2A		-	0.5	1.0	
Line regulation		RegI	V_{IN}=11 to 28V		-	0.5	2.5	%
Ripple rejection		RR	C_{ref}=0	Fefer to Fig. 2	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_cV_{ref}	T_j=0 to 125˚C		-	±1.0	-	%
Dropout voltage	PQ30RV1/PQ30RV11	V_{i-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.

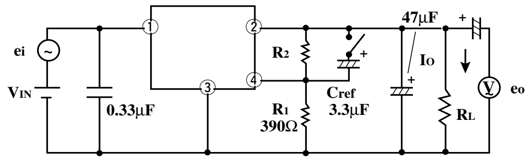
Fig.1 Test Circuit



$$V_O = V_{ref} \times \left(1+\frac{R_2}{R_1}\right) \fallingdotseq 1.25 \times \left(1+\frac{R_2}{R_1}\right)$$

[R_1=390Ω, V_{ref} ≒1.25V]

Fig.2 Test Circuit of Ripple Rejection



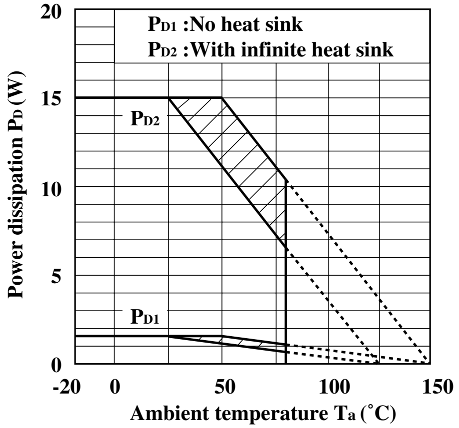
I_O=0.5A

f=120Hz (sine wave)

ei=0.5V_{rms}

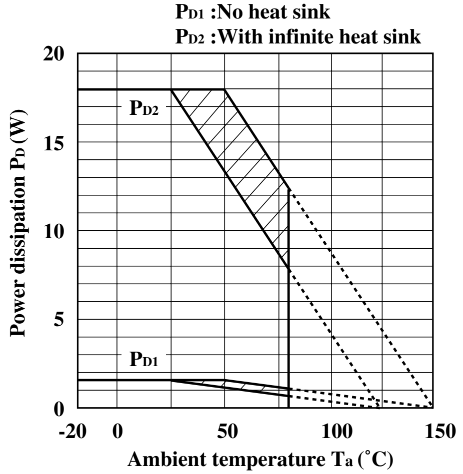
RR=20 log (ei/eo)

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



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

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



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

Fig.5 Overcurrent Protection Characteristics (PQ30RV1/PQ30RV11)

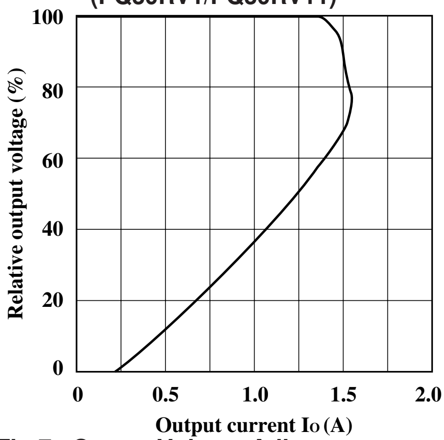


Fig.6 Overcurrent Protection Characteristics (PQ30RV2/PQ30RV21)

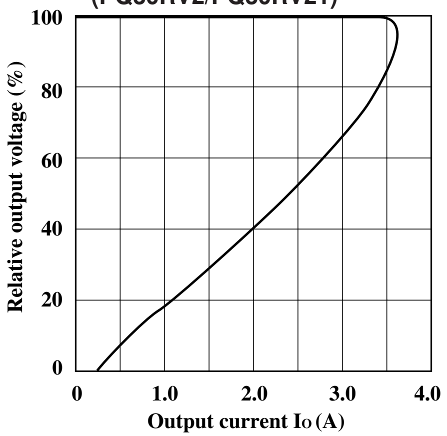


Fig.7 Output Voltage Adjustment Characteristics

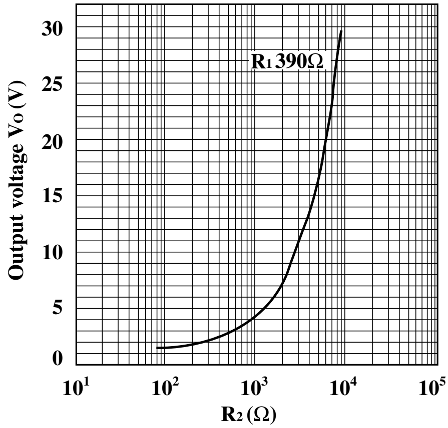


Fig.8 Reference Voltage Deviation vs. Junction Temperature

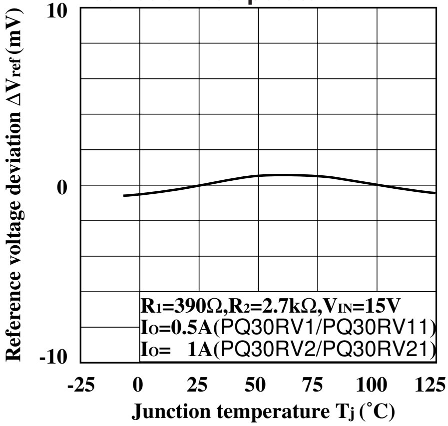


Fig.9 Output Voltage vs. Input Voltage (PQ30RV1/PQ30RV11)

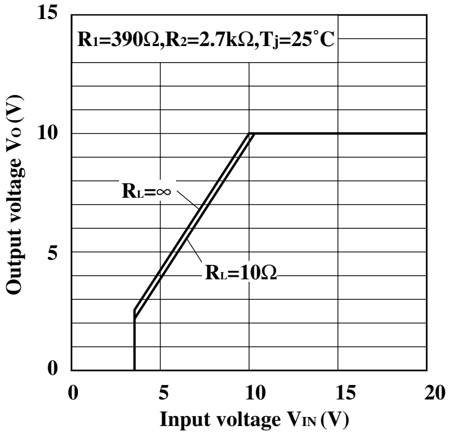


Fig.10 Output Voltage vs. Input Voltage (PQ30RV2/PQ30RV21)

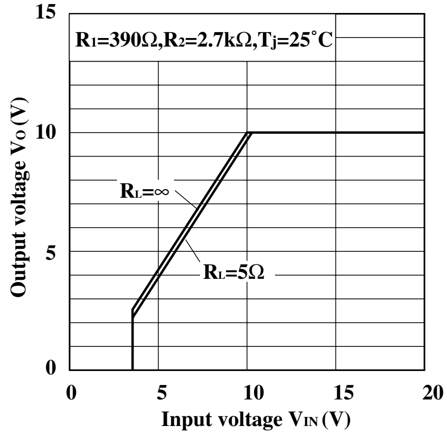


Fig.11 Dropout Voltage vs. Junction Temperature (PQ30RV1/PQ30RV11)

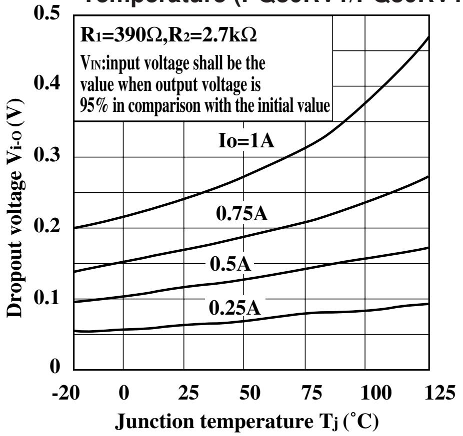


Fig.12 Dropout Voltage vs. Junction Temperature (PQ30RV2/PQ30RV21)

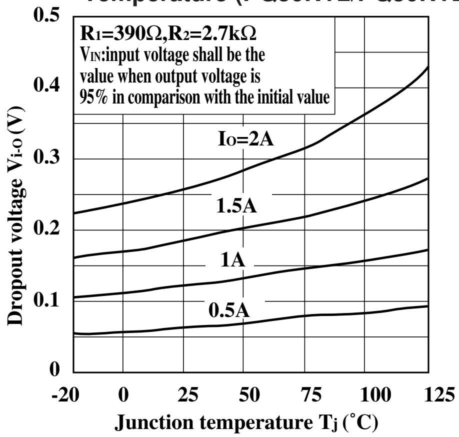


Fig.13 Quiescent Current vs. Junction Temperature

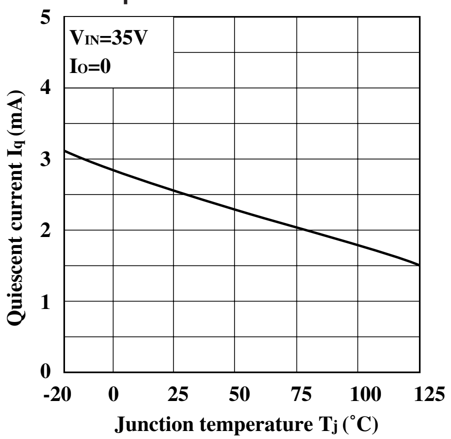


Fig.14 Ripple Rejection vs. Input Ripple Frequency (PQ30RV1/PQ30RV11)

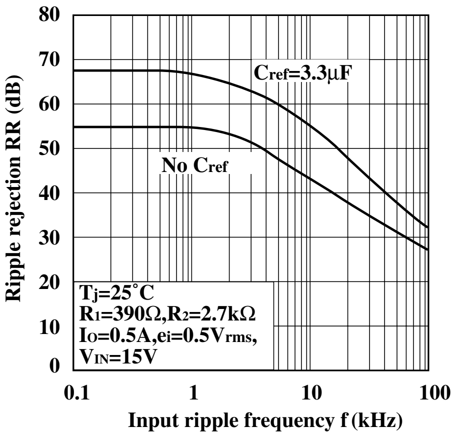


Fig.15 Ripple Rejection vs. Input Ripple Frequency (PQ30RV2/PQ30RV21)

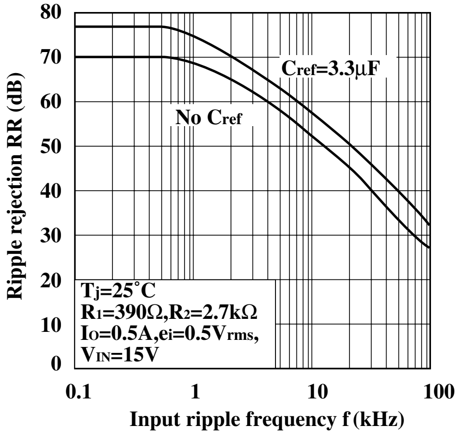


Fig.16 Ripple Rejection vs. Output Current (PQ30RV1/PQ30RV11)

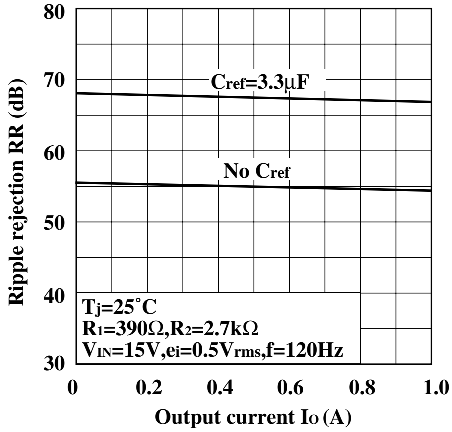


Fig.17 Ripple Rejection vs. Output Current (PQ30RV2/PQ30RV21)

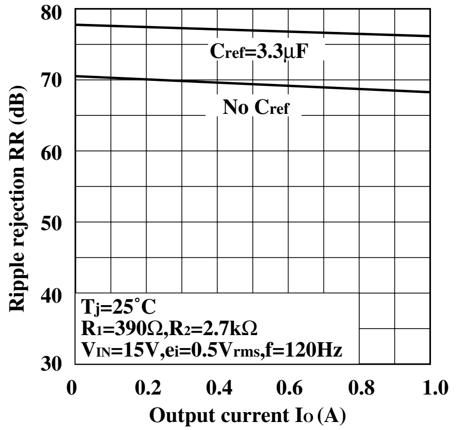


Fig.18 Output Peak Current vs. Dropout Voltage (PQ30RV1/PQ30RV11)

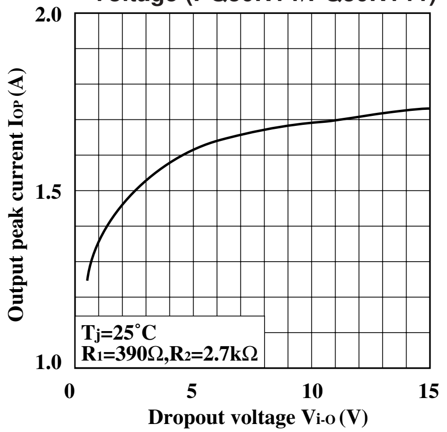


Fig.19 Output Peak Current vs. Dropout Voltage (PQ30RV2/PQ30RV21)

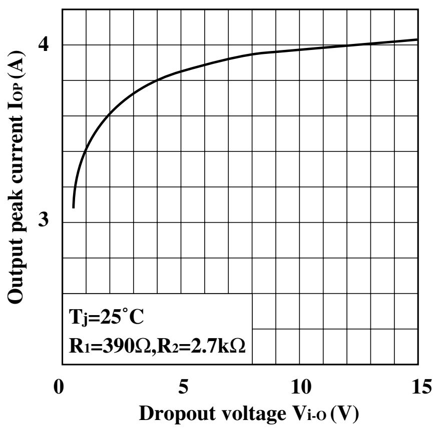


Fig.20 Output Peak Current vs. Junction Temperature (PQ30RV1/PQ30RV11)

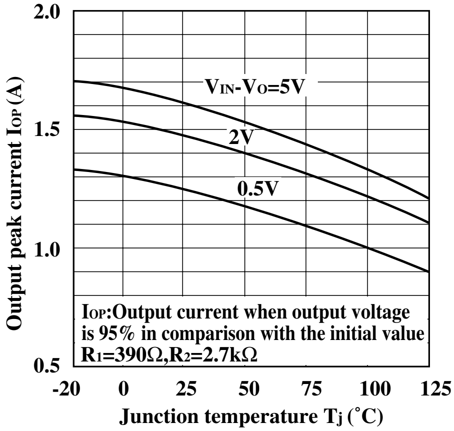
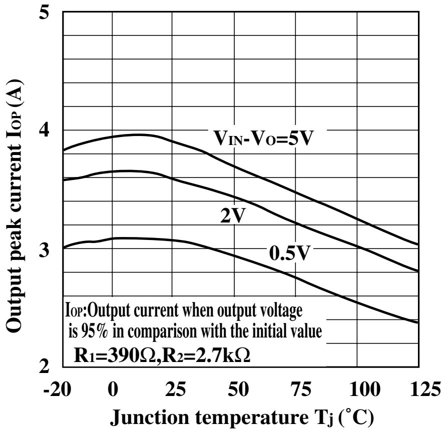
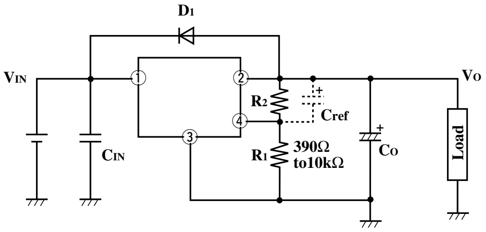


Fig.21 Output Peak Current vs. Junction Temperature (PQ30RV2/PQ30RV21)



■ Standard Connection



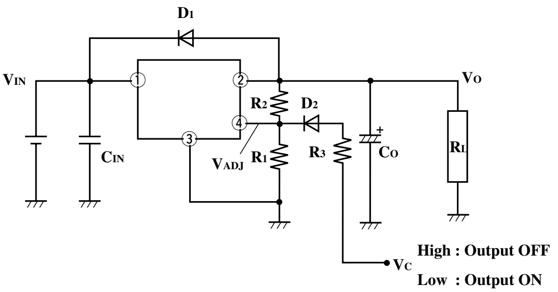
D_1 : This device is necessary to protect the element from damage when reverse voltage may be applied to the regulator in case of input short-circuiting.

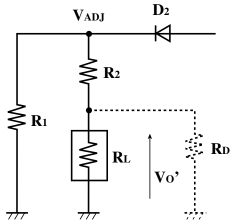
C_{ref} : This device is necessary when it is required to enhance the ripple rejection or to delay the output start-up time(*1).
(*1)Otherwise, it is not necessary.
(Care must be taken since C_{ref} may raise the gain, facilitating oscillation.)
(*1)The output start-up time is proportional to $C_{ref} \times R_2$.

C_{IN}, C_O : 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 0.33µF and 47µF, respectively. However, ajust them as necessary after checking.

R_1, R_2 : 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 390Ω.But value up 10kΩdoes not cause any trouble.

■ ON/OFF Operation





Equivalent Circuit
in OFF-state

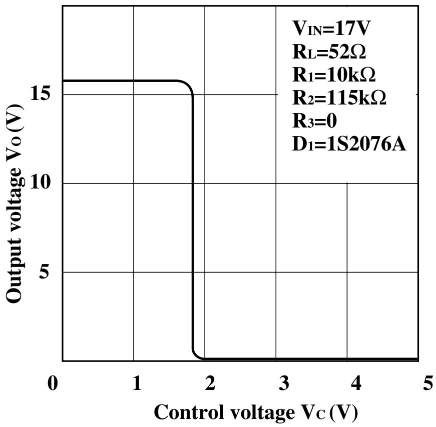
- ON/OFF operation is available by mounting externally D_2 and R_3.
- When V_{ADJ} is forcibly raised above V_{ref} (1.25V TYP) by applying the external signal, the output is turned off (pass transistor of regulator is turned off). When the output is OFF, V_{ADJ} must be higher then V_{ref} MAX., and 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_1 up to 10Ω 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) =0.5 V
V_{OH} (min) =2.4 V (I_{OH}=0.2mA)
MAX. rating of I_{OH}=0.5mA
Output should be set as follows.
15.6V R_L=52Ω (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 Ω
If R_1=10kΩ, we get $R_2=11.48 \times R_1$=114.8kΩ 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 which is less than the rating.
Figure 1 shows the V_O-V_C characteristics when R_1=10kΩ, R_2=115kΩ, R_3=0Ω, V_{IN}=17V, R_L=52Ω, and D_1=1S2076A (Hitachi).

Output Voltage vs. Control Voltage (PQ30RV1)

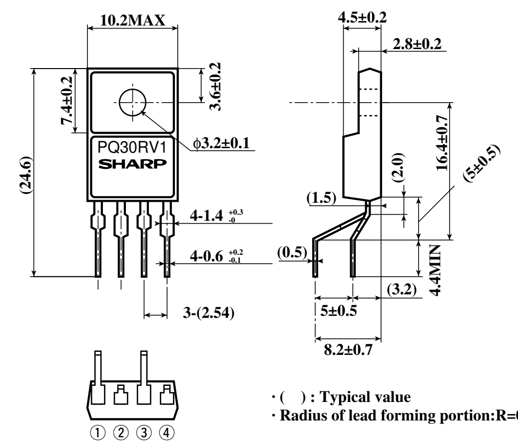


■ Model Line-ups for Lead Forming Type

Output voltage	5V output	2A output
Output voltage precision:±2.5%	PQ30RV1B	PQ30RV2B

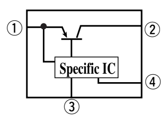
■ Outline Dimensions (PQ30RV1B/PQ30RV2B)

(Unit : mm)



· (   ) : Typical value
· Radius of lead forming portion:R=0.5 to 1.5mm

Internal connection diagram



① DC input (V_{IN})
② DC output (V_O)
③ GND
④ Output voltage minute adjustment terminal (V_{ADJ})

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