

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

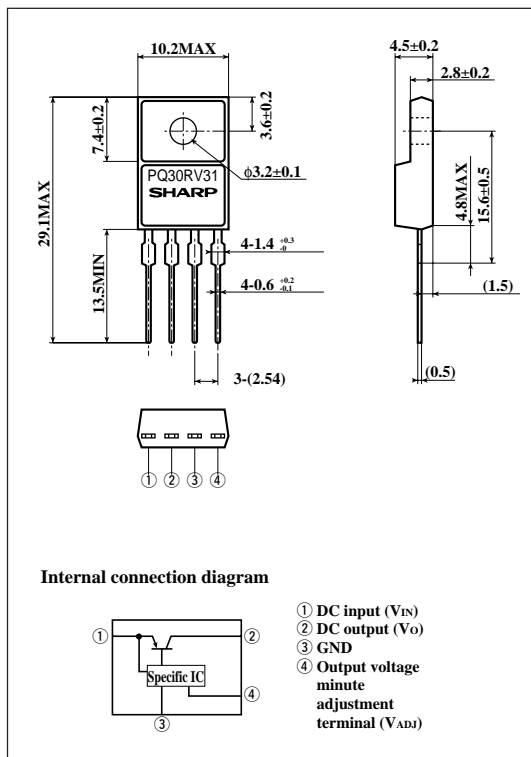
- Power supply for print concentration control of electronic typewriters with display
- Series power supply for motor drives
- Series power supply for VCRs and TVs

■ Model Line-ups

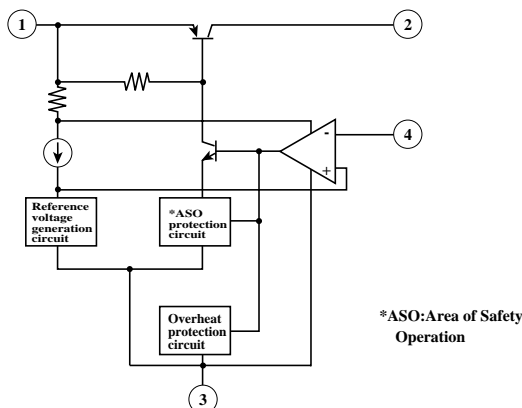
Output voltage	1A output	2A output
Reference voltage precision : $\pm 4\%$	PQ30RV1	PQ30RV2
Reference voltage precision : $\pm 2\%$	PQ30RV11	PQ30RV21

■ Outline Dimensions

(Unit : mm)



■ Equivalent Circuit Diagram



· Please refer to the chapter "Handling Precautions".

SHARP

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■ Absolute Maximum Ratings

(Ta=25°C)

Parameter		Symbol	Rating	Unit
*1	Input voltage	VIN	35	V
*1	Output voltage adjustment voltage	VADJ	7	V
	Output current	Io	1	A
	PQ30RV1/PQ30RV11 PQ30RV2/PQ30RV21		2	
Power dissipation (No heat sink)		Pd1	1.5	W
Power dissipation (With infinite heat sink)	PQ30RV1/PQ30RV11	Pd2	15	W
	PQ30RV2/PQ30RV21		18	
*2 Junction temperature		Tj	150	°C
Operating temperature		Topr	-20to+80	°C
Storage temperature		Tstg	-40to+150	°C
Soldering temperature		Tsol	260 (For 10s)	°C

*1 All are open except GND and applicable terminals.

*2 Overheat protection may operate at Tj>=125°C.

■ Electrical Characteristics

Unless otherwise specified, condition shall be

VIN=15V, Vo=10V, Io=0.5A, Ri=390Ω (PQ30RV1/PQ30RV11)

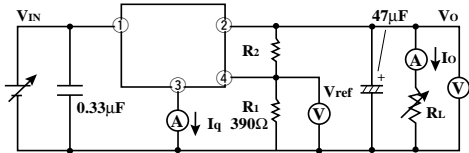
VIN=15V, Vo=10V, Io=1.0A, Ri=390Ω (PQ30RV2/PQ30RV21)

(Ta=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	R _{eg} L	I _O =5mA to 1A	-	0.3	1.0	%	
	PQ30RV2/PQ30RV21		I _O =5mA to 2A	-	0.5	1.0		
Line regulation		R _{eg} I	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 _c V _{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.

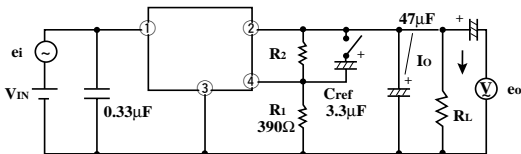
Fig.1 Test Circuit



$$Vo = Vref \times \left(1 + \frac{R_2}{R_1} \right) \approx 1.25 \times \left(1 + \frac{R_2}{R_1} \right)$$

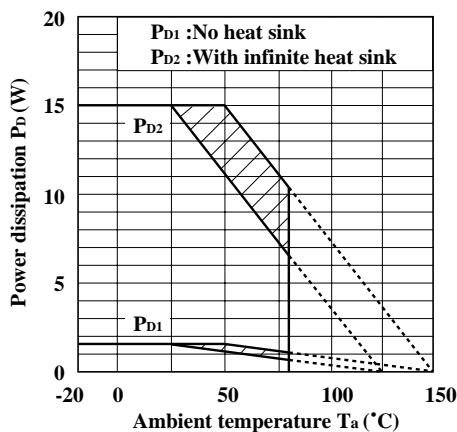
$$[R_1 = 390\Omega, Vref \approx 1.25V]$$

Fig.2 Test Circuit of Ripple Rejection



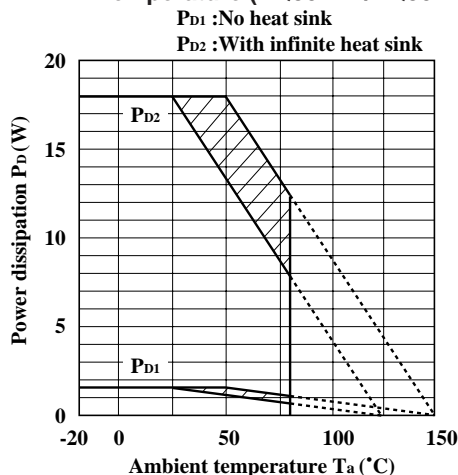
Io=0.5A
f=120Hz (sine wave)
ei=0.5Vrms
RR=20 log (ei/eo)

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)

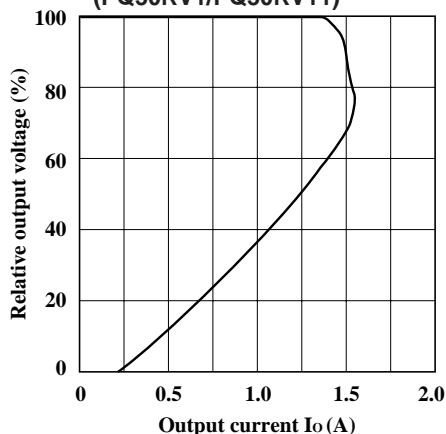


Fig.6 Overcurrent Protection Characteristics (PQ30RV2/PQ30RV21)

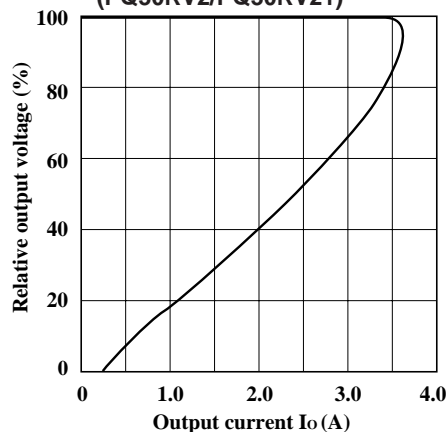


Fig.7 Output Voltage Adjustment Characteristics

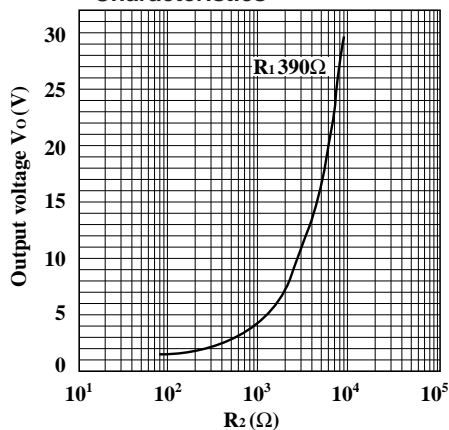


Fig.8 Reference Voltage Deviation vs. Junction Temperature

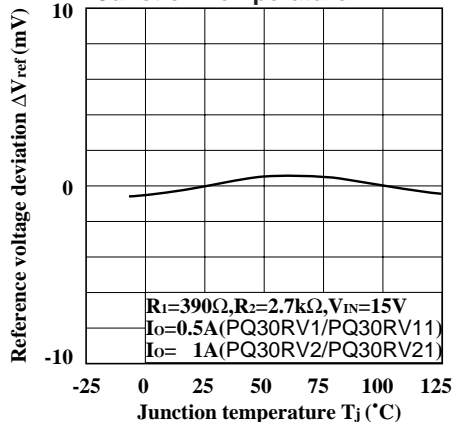


Fig.9 Output Voltage vs. Input Voltage (PQ30RV1/PQ30RV11)

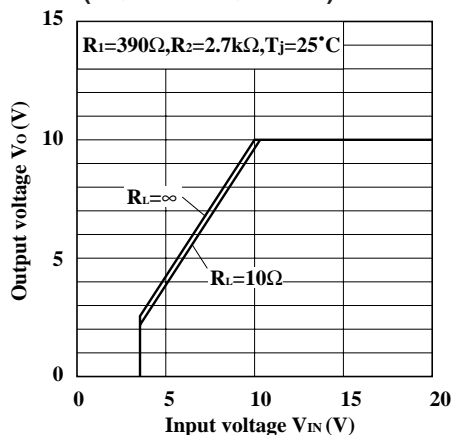


Fig.10 Output Voltage vs. Input Voltage (PQ30RV2/PQ30RV21)

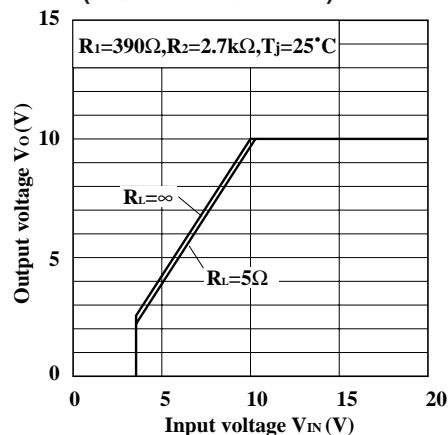


Fig.11 Dropout Voltage vs. Junction Temperature (PQ30RV1/PQ30RV11)

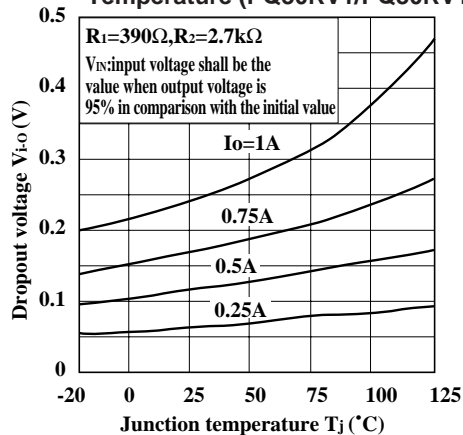


Fig.12 Dropout Voltage vs. Junction Temperature (PQ30RV2/PQ30RV21)

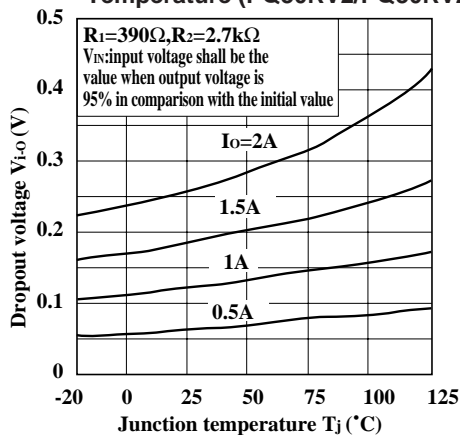


Fig.13 Quiescent Current vs. Junction Temperature

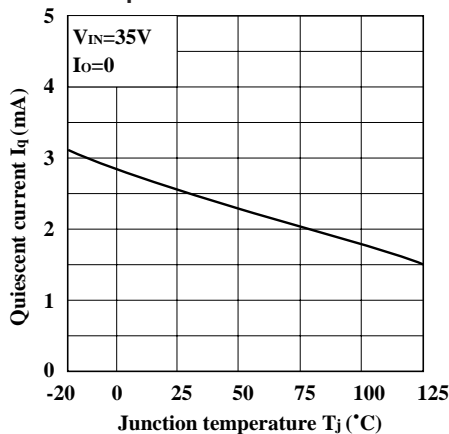


Fig.14 Ripple Rejection vs. Input Ripple Frequency (PQ30RV1/PQ30RV11)

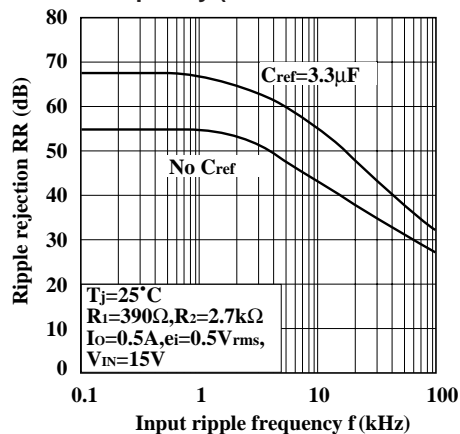


Fig.15 Ripple Rejection vs. Input Ripple Frequency (PQ30RV2/PQ30RV21)

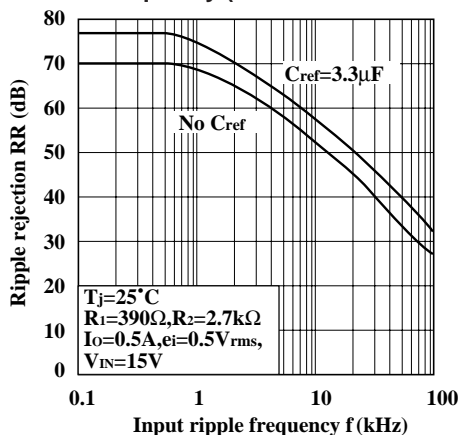


Fig.16 Ripple Rejection vs. Output Current (PQ30RV1/PQ30RV11)

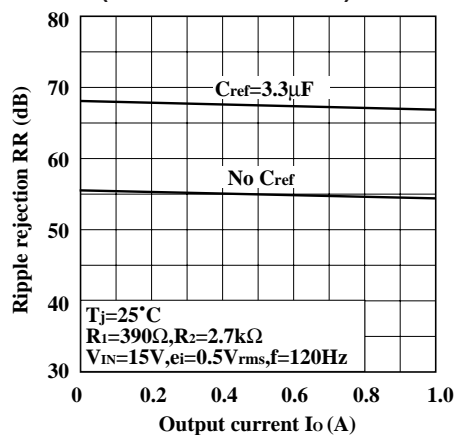


Fig.17 Ripple Rejection vs. Output Current (PQ30RV2/PQ30RV21)

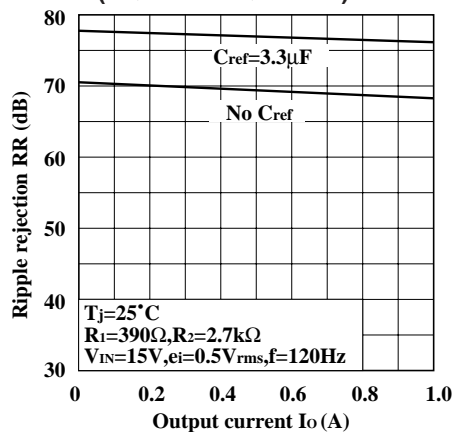


Fig.18 Output Peak Current vs. Dropout Voltage (PQ30RV1/PQ30RV11)

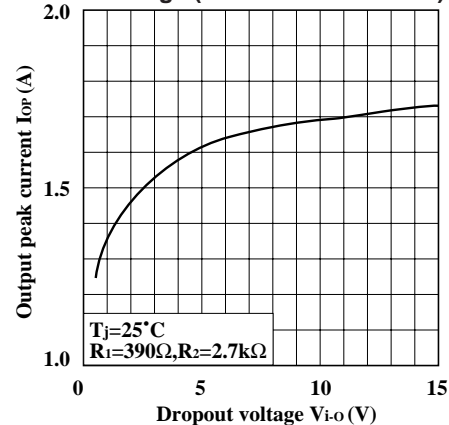


Fig.19 Output Peak Current vs. Dropout Voltage (PQ30RV2/PQ30RV21)

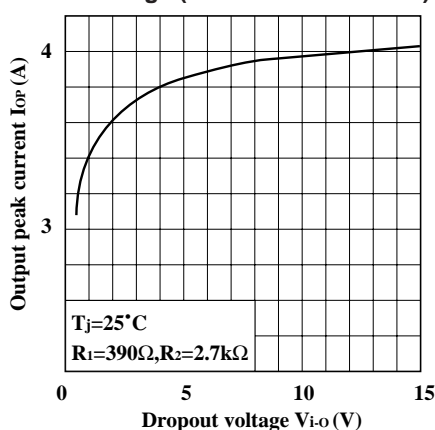


Fig.20 Output Peak Current vs. Junction Temperature (PQ30RV1/PQ30RV11)

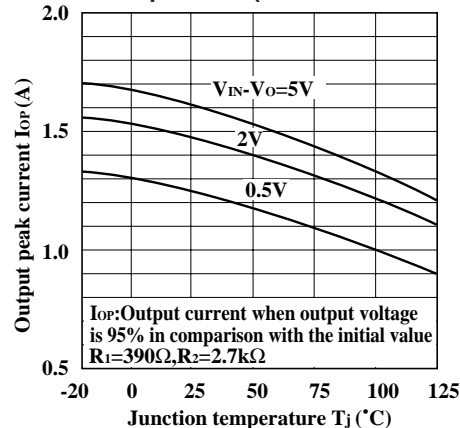
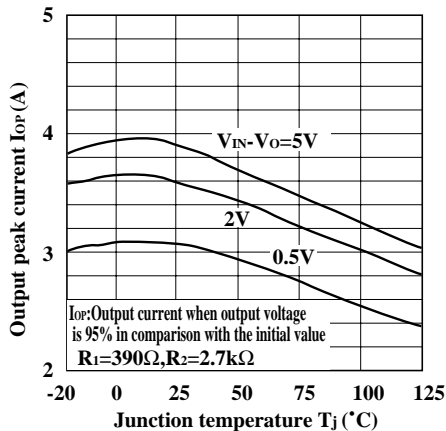
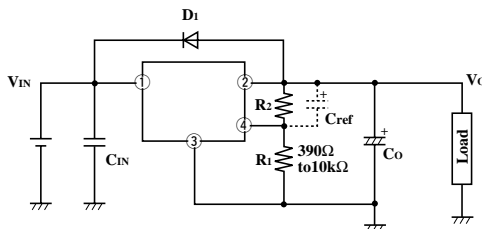


Fig.21 Output Peak Current vs. Junction Temperature (PQ30RV2/PQ30RV21)



■ 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 $0.33\mu F$ and $47\mu F$, respectively. However, adjust them as necessary after checking.

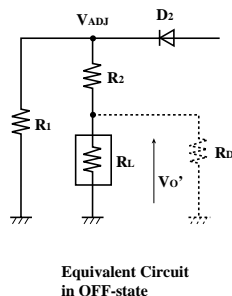
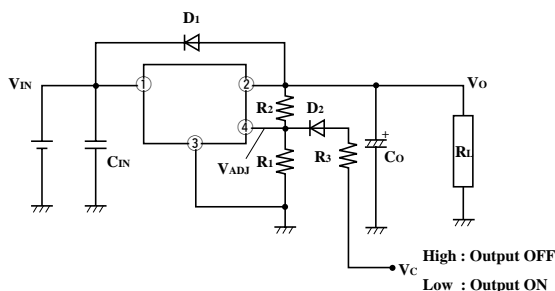
R_1, R_2 : These devices are necessary to set the output voltage. The output voltage V_O is given by the following formula:

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

(V_{ref} is 1.25V TYP)

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

■ ON/OFF Operation



- ON/OFF operation is available by mounting externally D₂ and R₃.
- 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 R₂. Therefore the value of R₂ 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 R₁ up to 10Ω is allowed. Select as high value of R_L and R₂ 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

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

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

MAX. rating of I_{OH} = 0.5mA

Output should be set as follows.

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

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 D₂ 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 R₃ = 0Ω

If R₁ = 10kΩ, we get $R_2 = 11.48 \times R_1 = 114.8k\Omega$ and I_{OH} as follows, ignoring R_L (52Ω):

$$I_{OH} = 1.6V \times (R_1 + R_2) / R_1 \times R_2$$

$$= 1.6V \times (10k\Omega + 114.8k\Omega) / 10k\Omega \times 114.8k\Omega = 0.17mA$$

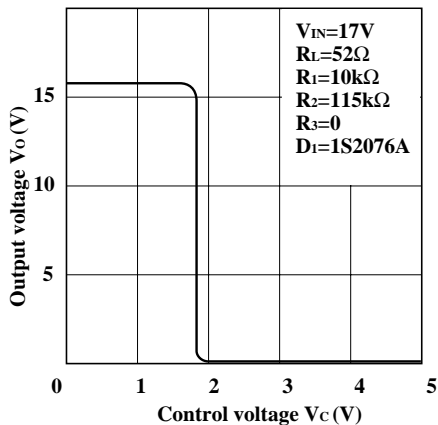
Hence, I_{OH} < 0.2mA. Therefore V_{OH}(min) is ensured.

Next, assuming that V_F(min) = 0.5V for D₂ 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 R₁ = 10kΩ, R₂ = 115kΩ, R₃ = 0Ω, V_{IN} = 17V, R_L = 52Ω, and D₁ = 1S2076A (Hitachi).

Output Voltage vs. Control Voltage (PQ30RV1)

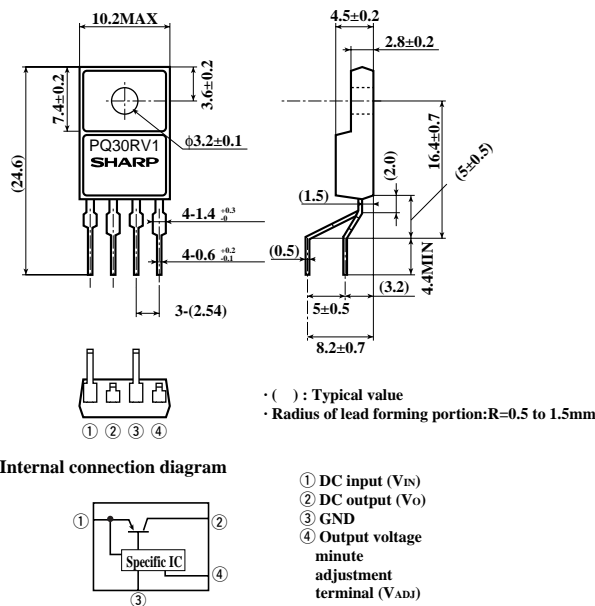


Model Line-ups for Lead Forming Type

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.