

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)

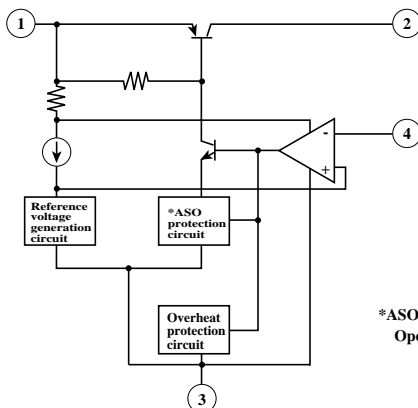
■ Applications

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

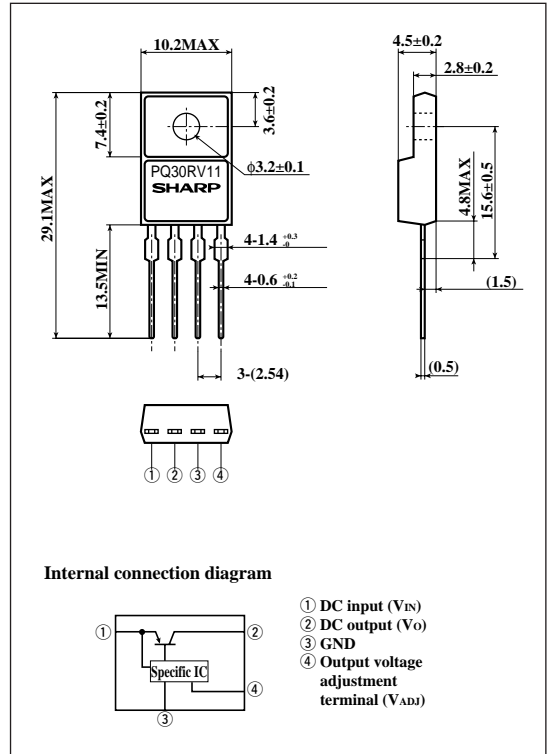
■ Equivalent Circuit Diagram



*ASO:Area of Safety Operation

■ Outline Dimensions

(Unit : mm)



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■ 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 to +80	°C
Storage temperature		T _{sig}	-40 to +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)

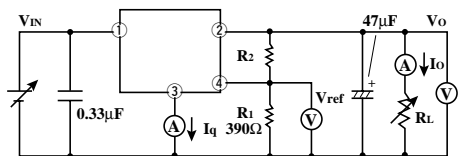
V_{IN}=15V, V_o=10V, I_o=1.0A, R_i=390Ω (PQ30RV2/PQ30RV21)

(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 ₂ =94Ω to 8.5kΩ	1.5	-	30	V		
	PQ30RV11/PQ30RV21		R ₂ =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			R _{RR}	Fefer to Fig. 2	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 _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.

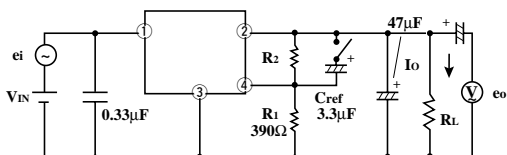
Fig.1 Test Circuit



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

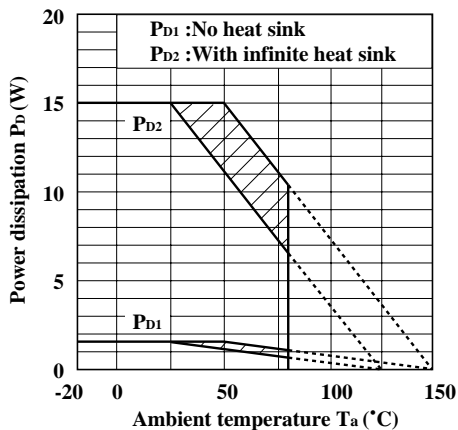
[R₁=390Ω, V_{ref}≈1.25V]

Fig.2 Test Circuit of Ripple Rejection



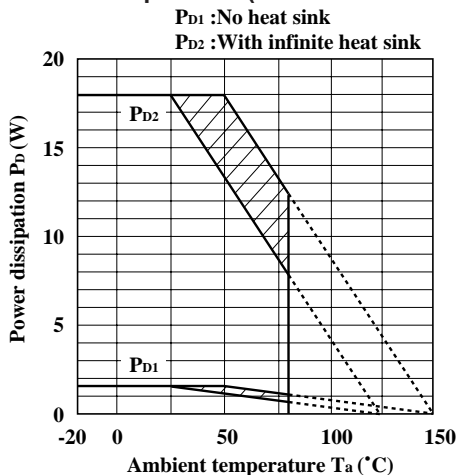
I_o=0.5A
f=120Hz (sine wave)
e_i=0.5V_{rms}
RR=20 log (e_i/e_o)

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



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

Fig.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)

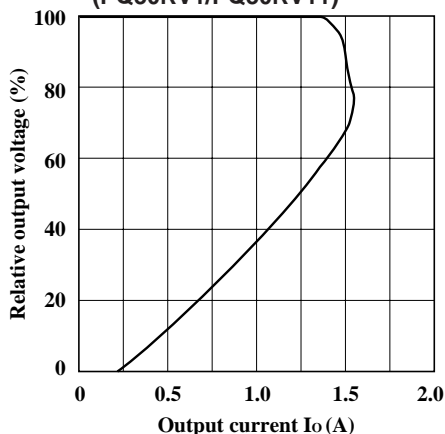


Fig.6 Overcurrent Protection Characteristics (PQ30RV2/PQ30RV21)

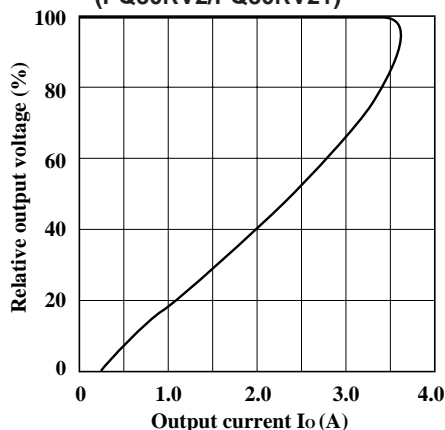


Fig.7 Output Voltage Adjustment Characteristics

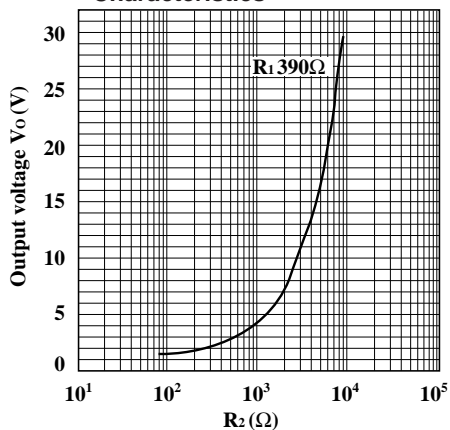


Fig.8 Reference Voltage Deviation vs. Junction Temperature

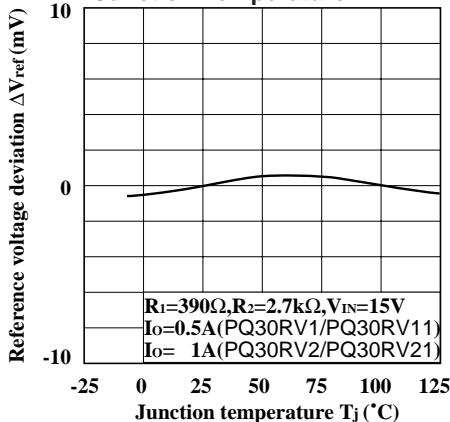


Fig.9 Output Voltage vs. Input Voltage (PQ30RV1/PQ30RV11)

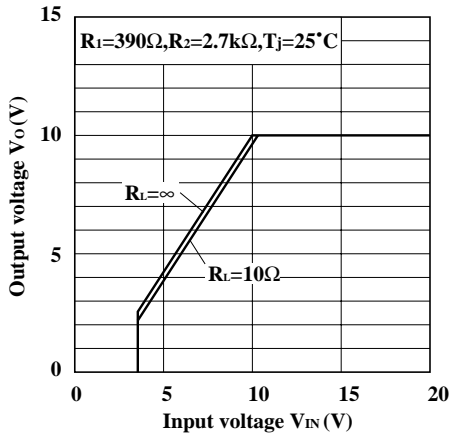


Fig.10 Output Voltage vs. Input Voltage (PQ30RV2/PQ30RV21)

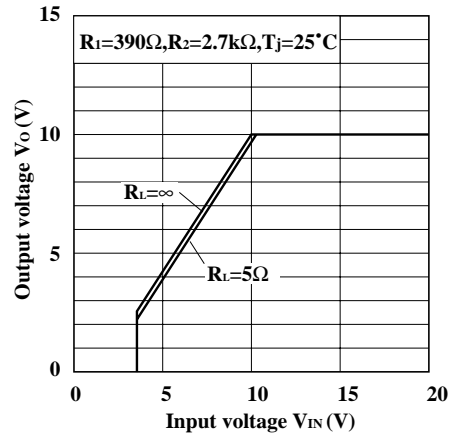


Fig.11 Dropout Voltage vs. Junction Temperature (PQ30RV1/PQ30RV11)

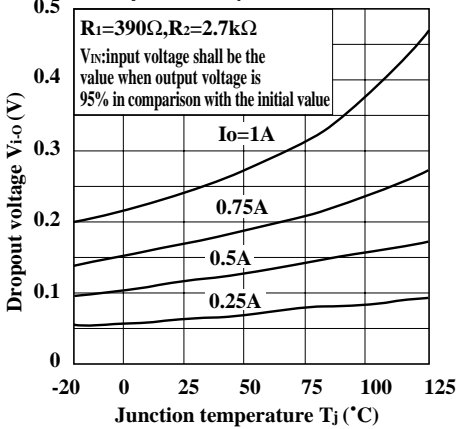


Fig.12 Dropout Voltage vs. Junction Temperature (PQ30RV2/PQ30RV21)

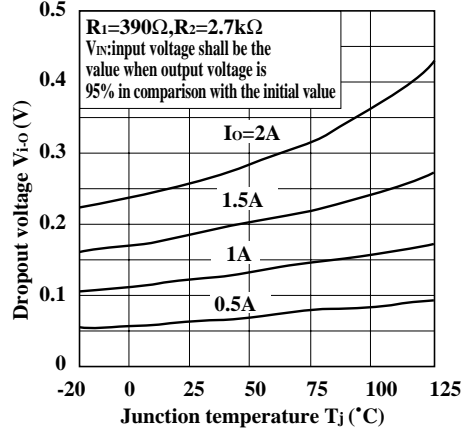


Fig.13 Quiescent Current vs. Junction Temperature

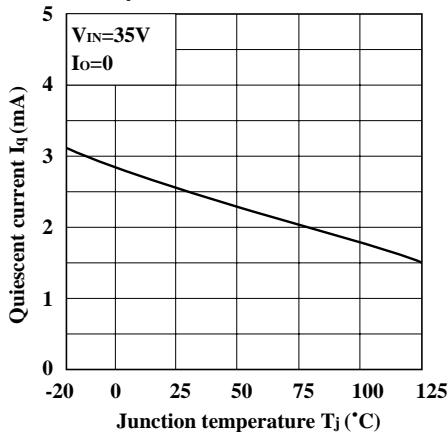


Fig.14 Ripple Rejection vs. Input Ripple Frequency (PQ30RV1/PQ30RV11)

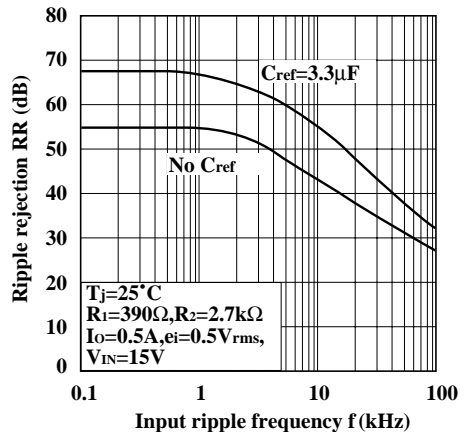


Fig.15 Ripple Rejection vs. Input Ripple Frequency (PQ30RV2/PQ30RV21)

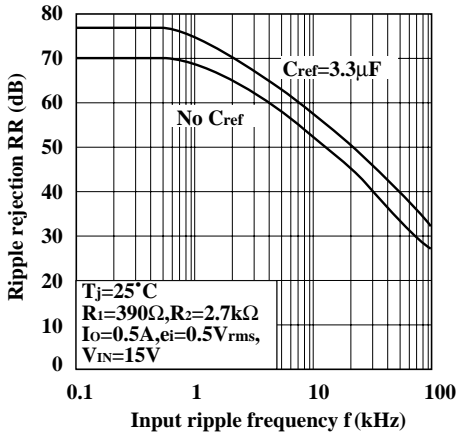


Fig.16 Ripple Rejection vs. Output Current (PQ30RV1/PQ30RV11)

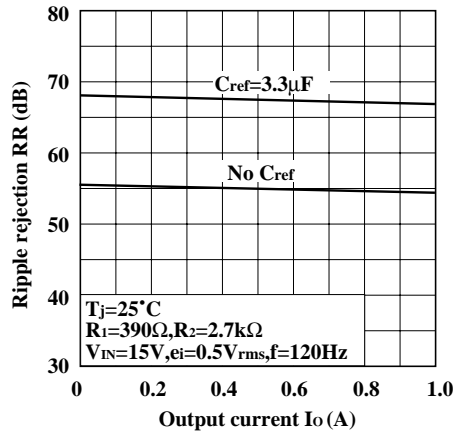


Fig.17 Ripple Rejection vs. Output Current (PQ30RV2/PQ30RV21)

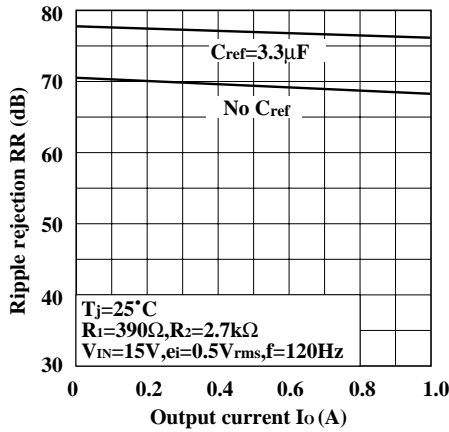


Fig.18 Output Peak Current vs. Input-output differential voltage (PQ30RV1/PQ30RV11)

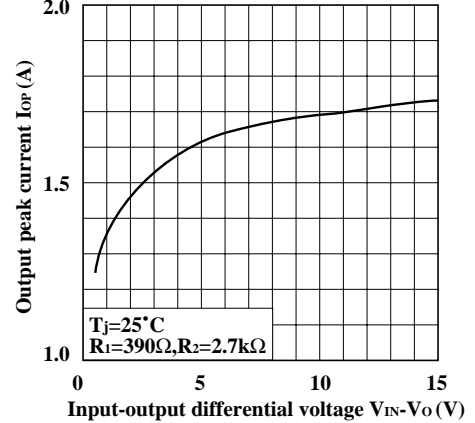


Fig.19 Output Peak Current vs. Input-output differential voltage (PQ30RV2/PQ30RV21)

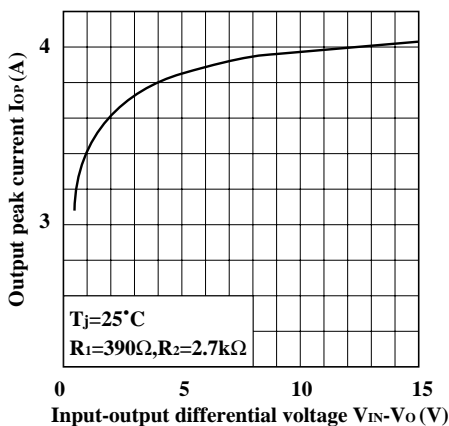


Fig.20 Output Peak Current vs. Junction Temperature (PQ30RV1/PQ30RV11)

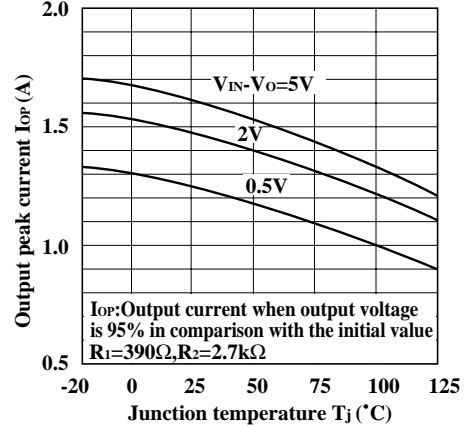
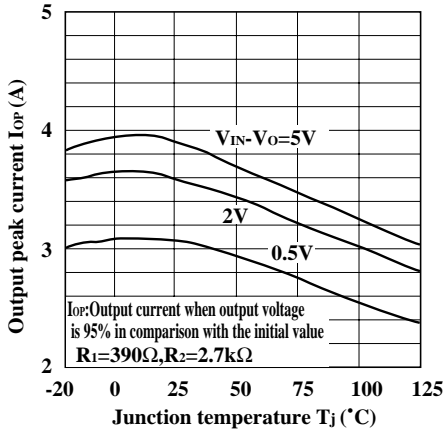
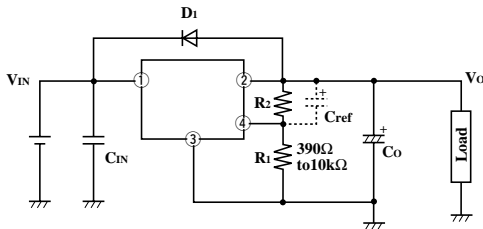


Fig.21 Output Peak Current vs. Junction Temperature (PQ30RV2/PQ30RV21)



■ 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.

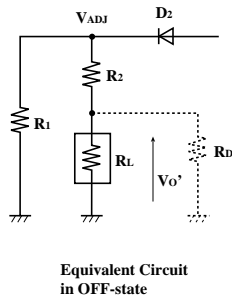
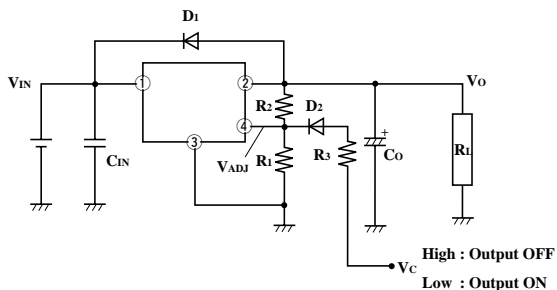
R_1, R_2 : These devices are necessary to set the output voltage. The output voltage V_O is given by the following formula:

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

(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) = 0.5 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 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 (52 Ω) :

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

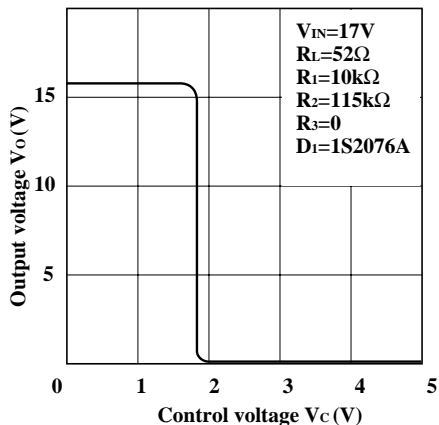
Hence, I_{OH} < 0.2mA. Therefore V_{OH}(min) is ensured.

Next, assuming that V_F(min) = 0.5V for D₂ in case of V_{OH}(max), we get:

$I_{OH} = (5V - 0.5V) / (R_1 + R_2) / R_1 \times R_2 = 0.49mA$ 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)

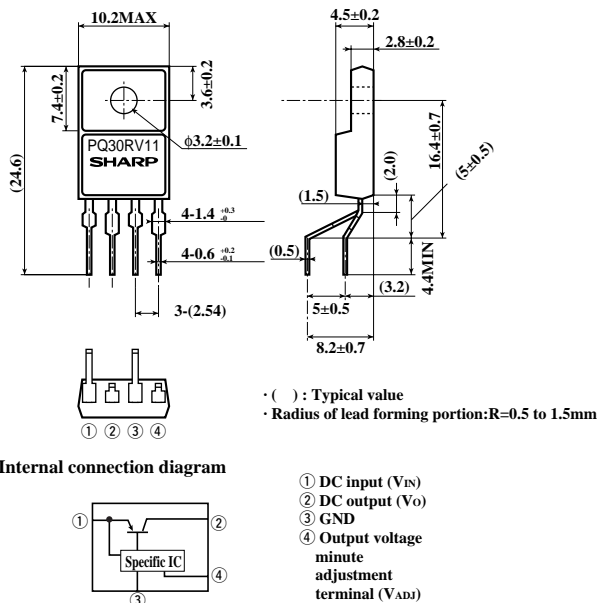


Model Line-ups for Lead Forming Type

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 PQ30RV11/21 series.

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