

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

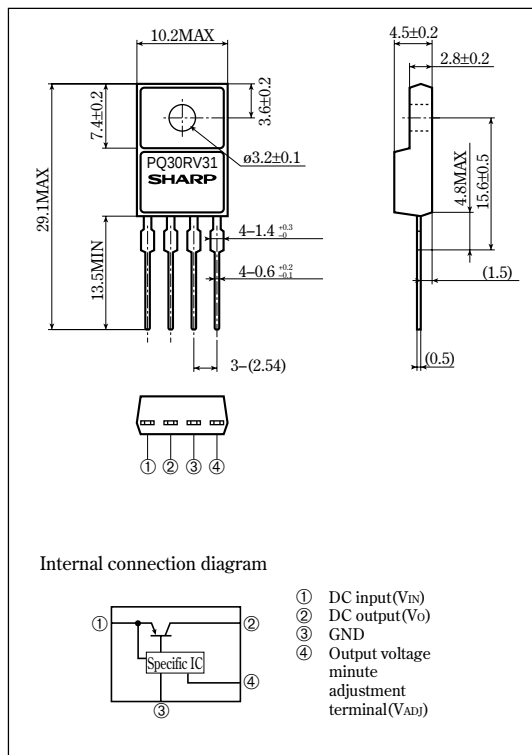
- Power supply for print concentration control of electronic typewriters with display
- Series power supply for motor drives
- Series power supply for VCRs and TVs

Model Line-ups

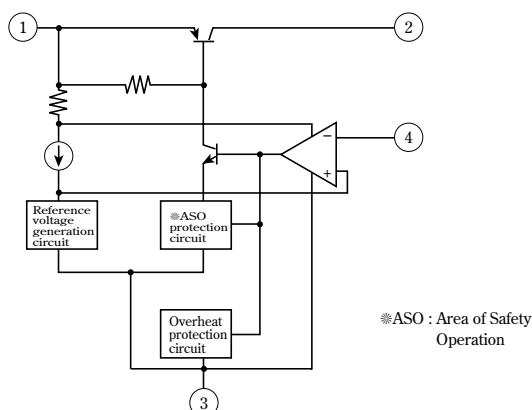
Output voltage	1A output	2A output
Reference voltage precision:±4%	PQ30RV1	PQ30RV2
Reference voltage precision:±2%	PQ30RV11	PQ30RV21

Outline Dimensions

(Unit : mm)



Equivalent Circuit Diagram



•Please refer to the chapter " Handling Precautions ".

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■ Absolute Maximum Ratings

 $(T_a=25^\circ\text{C})$

Parameter		Symbol	Rating	Unit
①	Input voltage	V _{IN}	35	V
①	Output voltage adjustment voltage	V _{ADJ}	7	V
	Output current	I _O	1	A
	PQ30RV1/PQ30RV11 PQ30RV2/PQ30RV21		2	
Power dissipation(No heat sink)		P _{D1}	1.5	W
	Power dissipation (With infinite heat sink)	P _{D2}	15	W
	PQ30RV1/PQ30RV11 PQ30RV2/PQ30RV21		18	
②	Junction temperature	T _j	150	°C
Operating temperature		T _{opr}	-20 to +80	°C
Storage temperature		T _{stg}	-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 $T_j \geq 125^\circ\text{C}$.

■ Electrical Characteristics

Unless otherwise specified, condition shall be

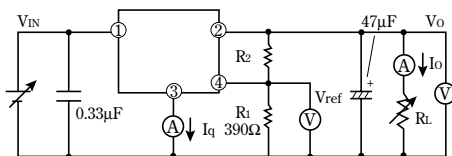
$$V_{IN}=15V, V_O=10V, I_O=0.5A, R_I=390\Omega(PQ30RV1/PQ30RV11)$$
$$V_{IN}=15V, V_O=10V, I_O=1.0A, R_I=390\Omega(PQ30RV2/PQ30RV21)$$

(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	Reg _L	I _O =5mA to 1A	—	0.3	1.0	%	
	PQ30RV2/PQ30RV21		I _O =5mA to 2A	—	0.5	1.0		
Line regulation		Reg _I	V _{IN} =11 to 28V	—	0.5	2.5	%	
Ripple rejection		RR	C _{ref} =0	Refer 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.

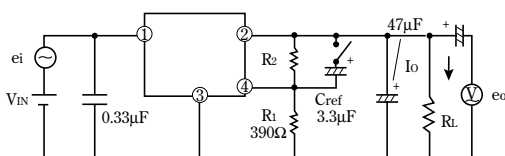
Fig. 1 Test Circuit



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

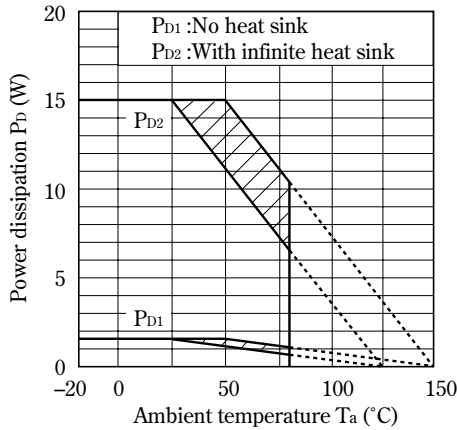
[R₁=390Ω,V_{ref} Nearly=1.25V]

Fig. 2 Test Circuit of Ripple Rejection



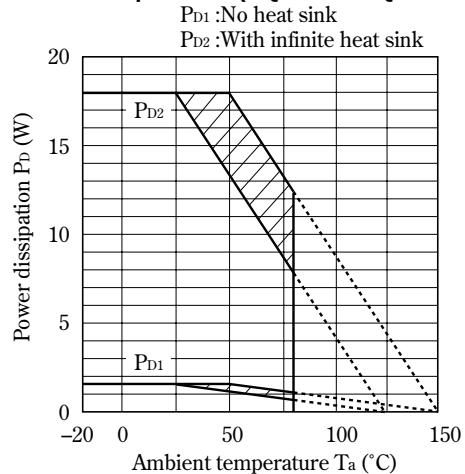
$I_o = 0.5A$
 $f = 120Hz$ (sine wave)
 $e_i(rms) = 0.5V$
 $RR = 20 \log(e_i(rms)/e_o(rms))$

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)

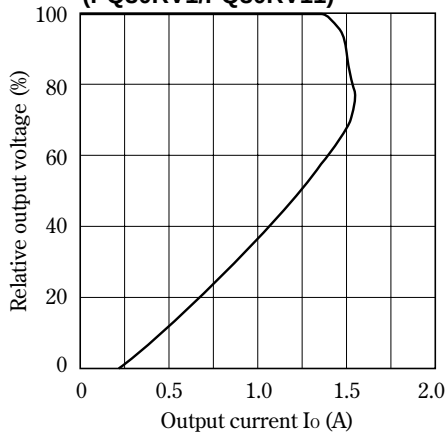


Fig. 6 Overcurrent Protection Characteristics (PQ30RV2/PQ30RV21)

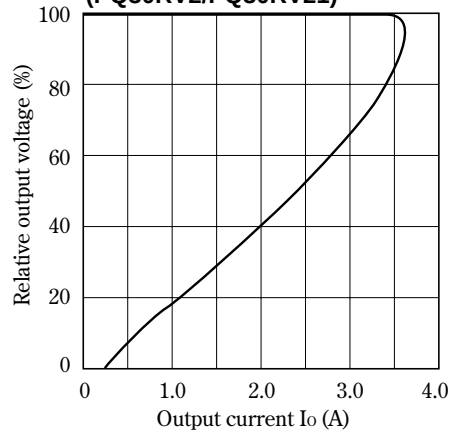


Fig. 7 Output Voltage Adjustment Characteristics

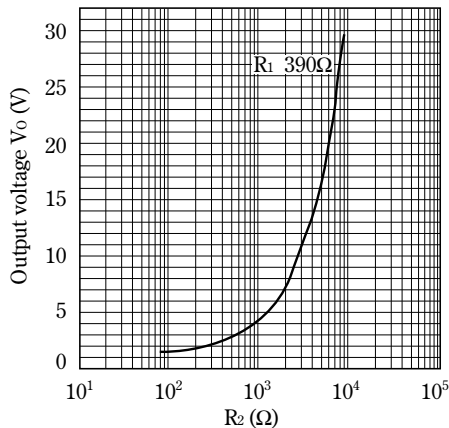


Fig. 8 Reference Voltage Deviation vs. Junction Temperature

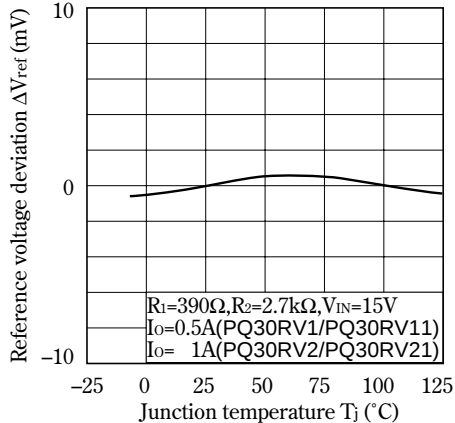


Fig. 9 Output Voltage vs. Input Voltage (PQ30RV1/PQ30RV11)

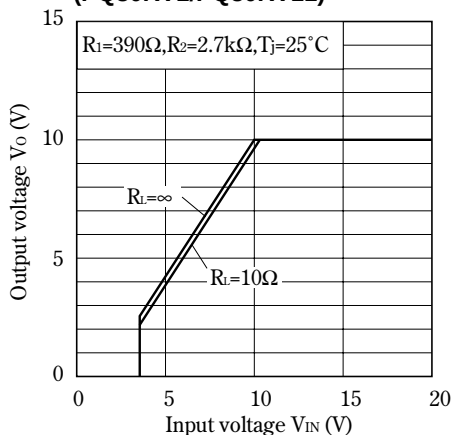


Fig.10 Output Voltage vs. Input Voltage (PQ30RV2/PQ30RV21)

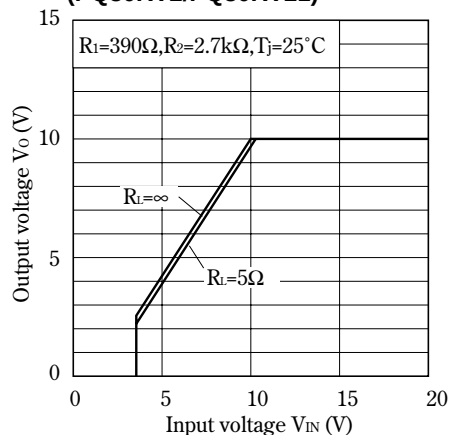


Fig.11 Dropout Voltage vs. Junction Temperature (PQ30RV1/PQ30RV11)

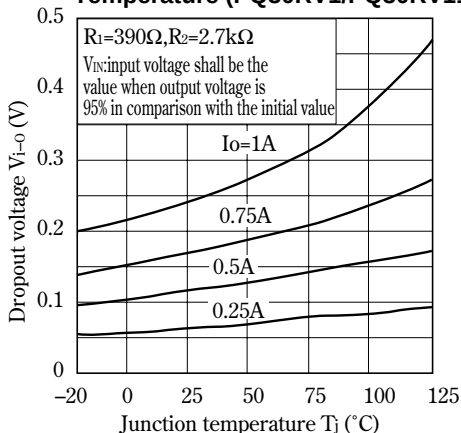


Fig.12 Dropout Voltage vs. Junction Temperature (PQ30RV2/PQ30RV21)

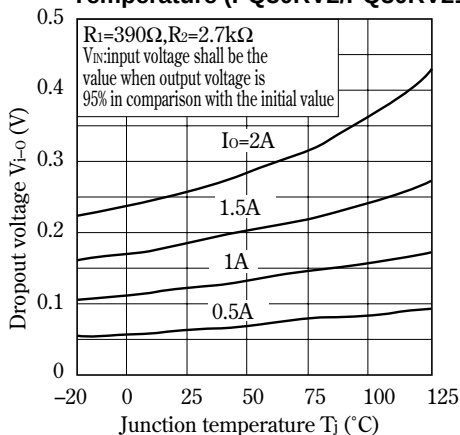


Fig.13 Quiescent Current vs. Junction Temperature

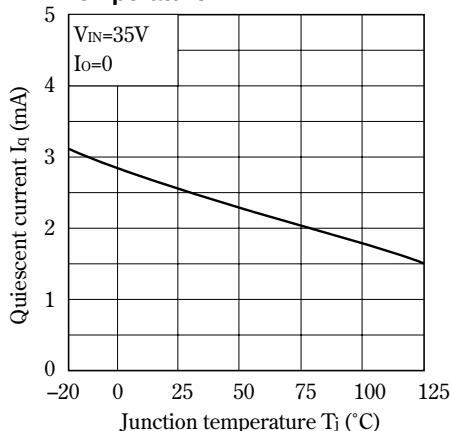


Fig.14 Ripple Rejection vs. Input Ripple Frequency (PQ30RV1/PQ30RV11)

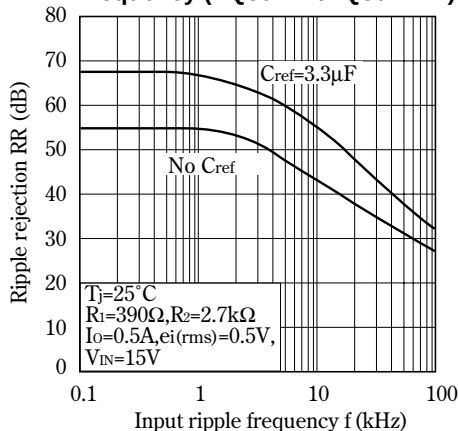


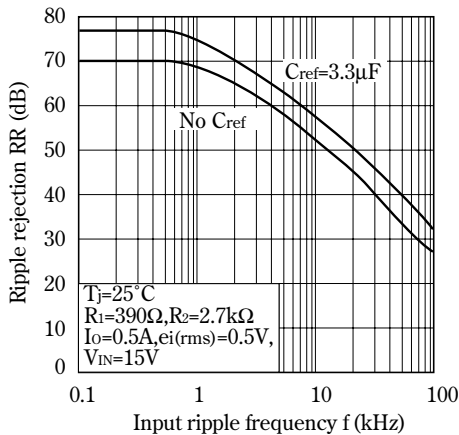
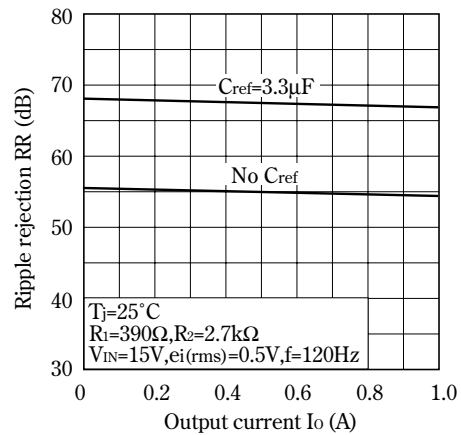
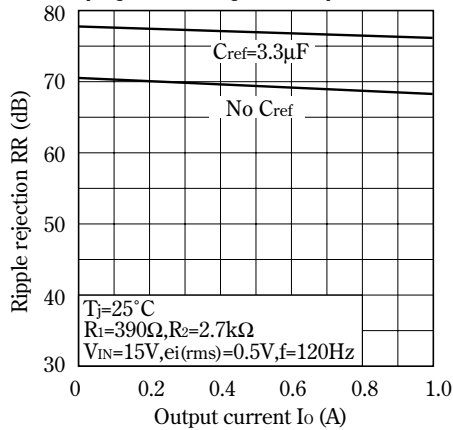
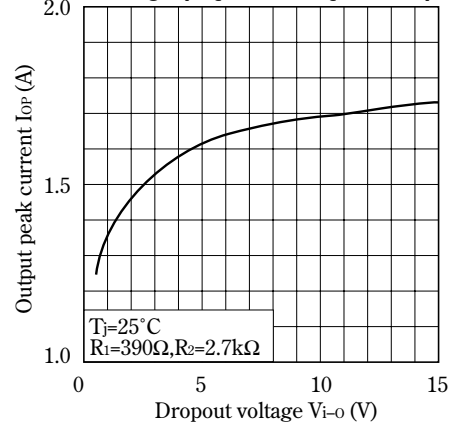
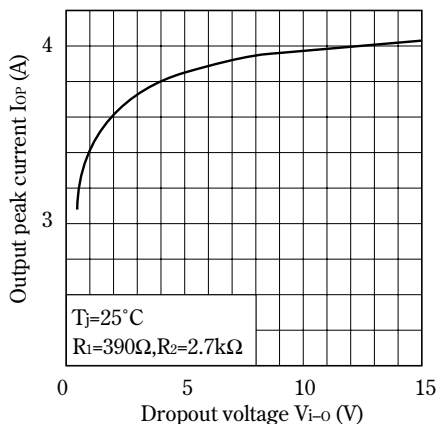
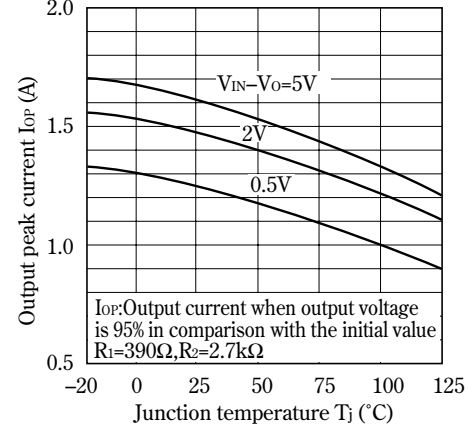
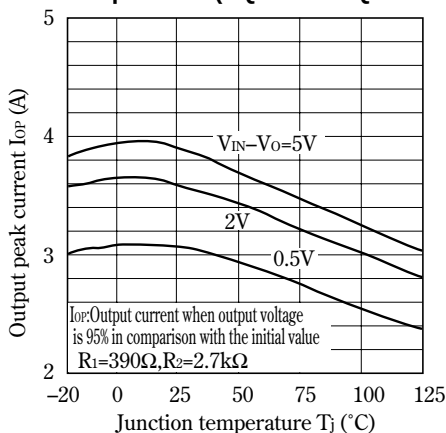
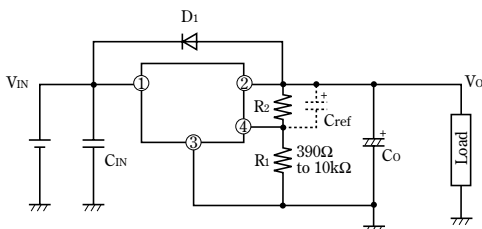
Fig.15 Ripple Rejection vs. Input Ripple Frequency (PQ30RV2/PQ30RV21)**Fig.16 Ripple Rejection vs. Output Current (PQ30RV1/PQ30RV11)****Fig.17 Ripple Rejection vs. Output Current (PQ30RV2/PQ30RV21)****Fig.18 Output Peak Current vs. Dropout Voltage (PQ30RV1/PQ30RV11)****Fig.19 Output Peak Current vs.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

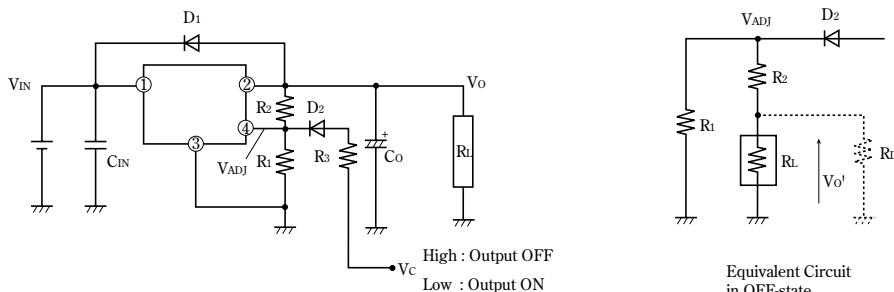


- D_1 : This device is necessary to protect the element from damage when reverse voltage may be applied to the regulator in case of input short-circuiting.
- C_{ref} : This device is necessary when it is required to enhance the ripple rejection or to delay the output start-up time(※1).
 (※1) Otherwise, 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 $0.33\mu\text{F}$ and $47\mu\text{F}$, 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:

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

$$(V_{ref} \text{ is } 1.25\text{V TYP})$$
 The standard value of R_1 is 390Ω . But value up to $10\text{k}\Omega$ 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_1 up to $10k\Omega$ is allowed. Select as high value of R_1 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

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

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

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

Output should be set as follows.

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

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 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, ignoring R_L (52Ω):

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

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

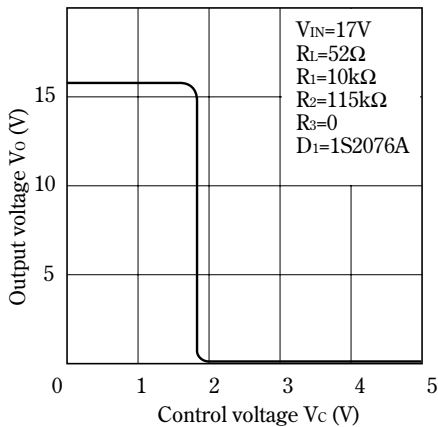
Hence, $I_{OH} < 0.2mA$. Therefore $V_{OH(min)}$ is ensured.

Next, assuming that $V_F(min) = 0.5V$ for 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 $R_1 = 10k\Omega$, $R_2 = 115k\Omega$, $R_3 = 0\Omega$, $V_{IN} = 17V$, $R_L = 52\Omega$, and $D_1 = 1S2076A$ (Hitachi).

Output Voltage vs. Control Voltage(PQ30RV1)

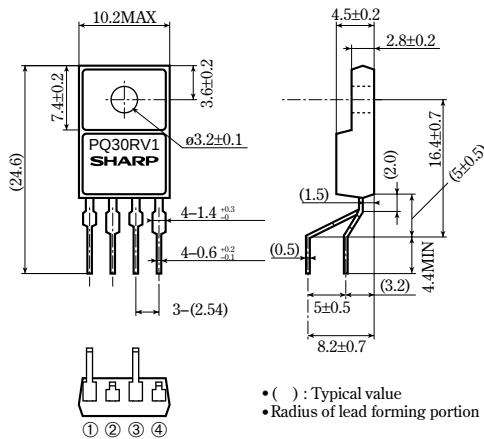


Model Line-ups for Lead Forming Type

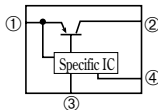
Output current	1A output	2A output
Output voltage precision:±2.5%	PQ30RV1B	PQ30RV2B

Outline Dimensions(PQ30RV1B/PQ30RV2B)

(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})

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

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