

# 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

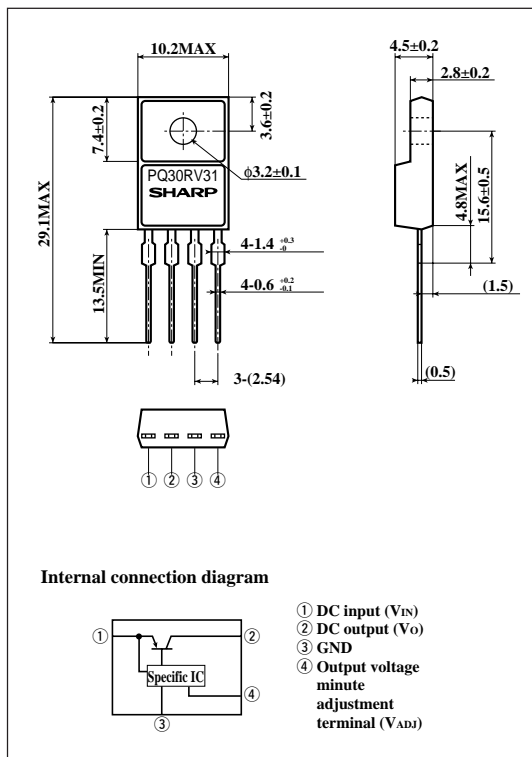
- Power supply for print concentration control of electronic typewriters with display
- Series power supply for motor drives
- Series power supply for VCRs and TVs

## ■ Model Line-ups

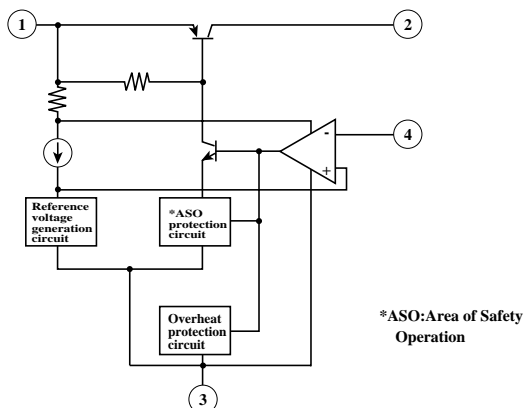
Output voltage	1A output	2A output
Reference voltage precision : $\pm 4\%$	PQ30RV1	PQ30RV2
Reference voltage precision : $\pm 2\%$	PQ30RV11	PQ30RV21

## ■ Outline Dimensions

(Unit : mm)



## ■ Equivalent Circuit Diagram



· Please refer to the chapter " Handling Precautions ".

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■ Absolute Maximum Ratings

(T<sub>a</sub>=25°C)

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

\*1 All are open except GND and applicable terminals.

\*2 Overheat protection may operate at T<sub>j</sub>>=125°C.

■ Electrical Characteristics

Unless otherwise specified, condition shall be

V<sub>IN</sub>=15V, V<sub>o</sub>=10V, I<sub>o</sub>=0.5A, R<sub>i</sub>=390Ω (PQ30RV1/PQ30RV11)

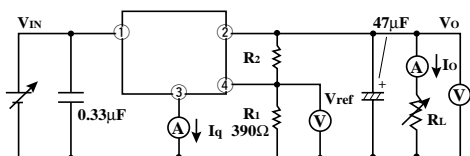
V<sub>IN</sub>=15V, V<sub>o</sub>=10V, I<sub>o</sub>=1.0A, R<sub>i</sub>=390Ω (PQ30RV2/PQ30RV21)

(T<sub>a</sub>=25°C)

Parameter		Symbol	Conditions	MIN.	TYP.	MAX.	Unit	
Input voltage		V <sub>IN</sub>	-	4.5	-	35	V	
Output voltage	PQ30RV1/PQ30RV2	V <sub>o</sub>	R <sub>2</sub> =94Ω to 8.5kΩ	1.5	-	30	V	
	PQ30RV11/PQ30RV21		R <sub>2</sub> =84Ω to 8.7kΩ					
Load regulation	PQ30RV1/PQ30RV11	R <sub>regL</sub>	I <sub>o</sub> =5mA to 1A	-	0.3	1.0	%	
	PQ30RV2/PQ30RV21		I <sub>o</sub> =5mA to 2A	-	0.5	1.0		
Line regulation		R <sub>regI</sub>	V <sub>IN</sub> =11 to 28V	-	0.5	2.5	%	
Ripple rejection	RR		C <sub>ref</sub> =0	Fefer to Fig. 2	45	55	-	dB
			C <sub>ref</sub> =3.3μF		55	65	-	
Reference voltage	PQ30RV1/PQ30RV2	V <sub>ref</sub>	-		1.20	1.25	1.30	V
	PQ30RV11/PQ30RV21				1.225	1.25	1.275	
Temperature coefficient of reference voltage		T <sub>c</sub> V <sub>ref</sub>	T <sub>j</sub> =0 to 125°C	-	±1.0	-	%	
Dropout voltage	PQ30RV1/PQ30RV11	V <sub>i-o</sub>	*3, I <sub>o</sub> =0.5A	-	-	0.5	V	
	PQ30RV2/PQ30RV21		*3, I <sub>o</sub> =2A					
Quiescent current		I <sub>q</sub>	I <sub>o</sub> =0	-	-	7	mA	

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

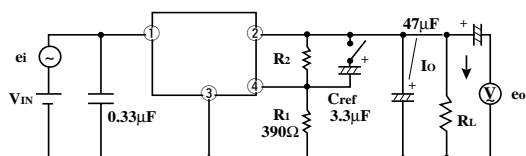
Fig.1 Test Circuit



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

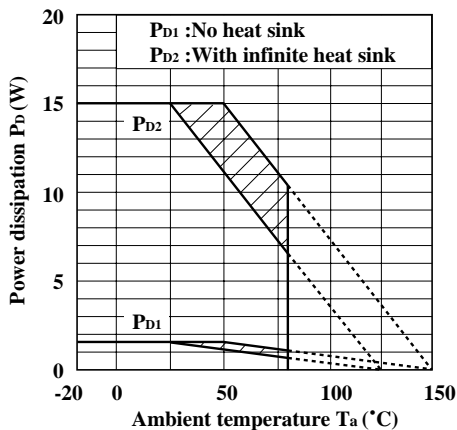
[R<sub>1</sub>=390Ω, V<sub>ref</sub>≈1.25V]

Fig.2 Test Circuit of Ripple Rejection



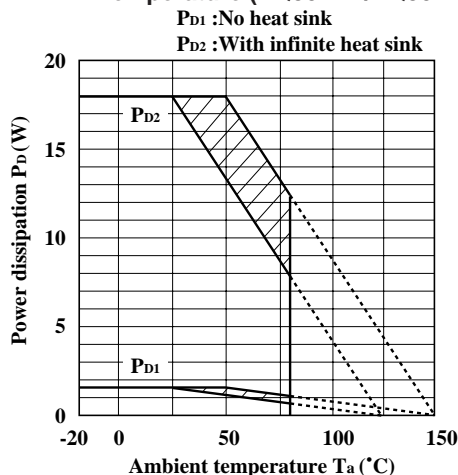
I<sub>o</sub>=0.5A  
f=120Hz (sine wave)  
e<sub>i</sub>=0.5V<sub>rms</sub>  
RR=20 log (e<sub>i</sub>/e<sub>o</sub>)

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)

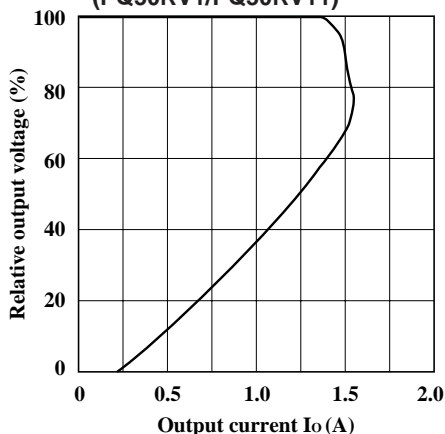


Fig.6 Overcurrent Protection Characteristics (PQ30RV2/PQ30RV21)

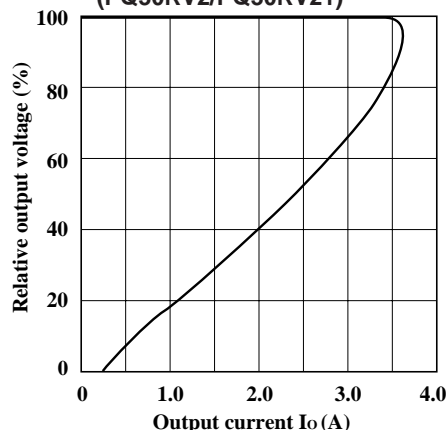


Fig.7 Output Voltage Adjustment Characteristics

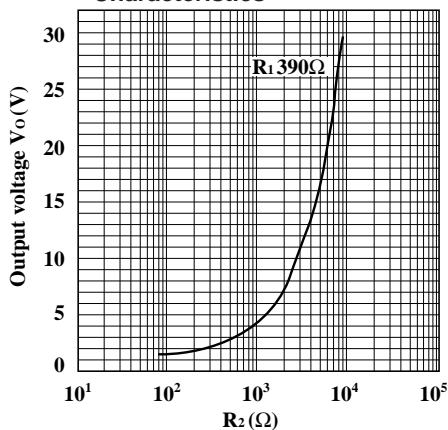


Fig.8 Reference Voltage Deviation vs. Junction Temperature

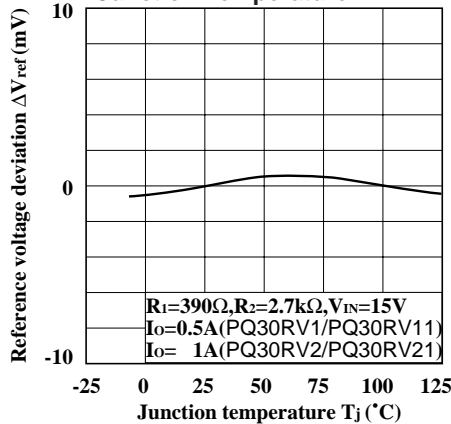


Fig.9 Output Voltage vs. Input Voltage (PQ30RV1/PQ30RV11)

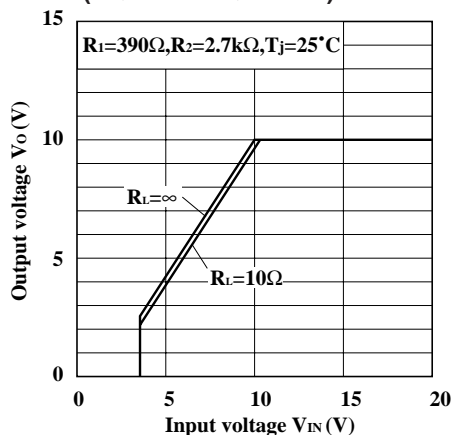


Fig.10 Output Voltage vs. Input Voltage (PQ30RV2/PQ30RV21)

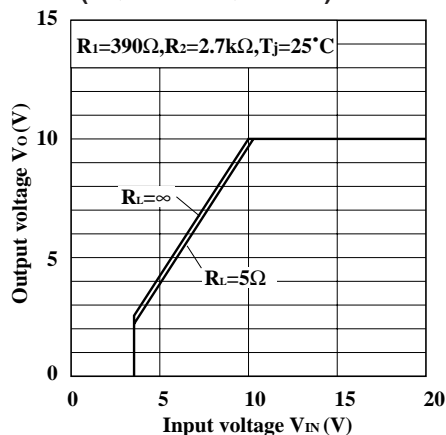


Fig.11 Dropout Voltage vs. Junction Temperature (PQ30RV1/PQ30RV11)

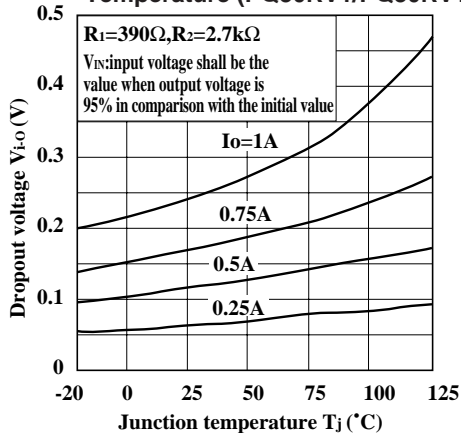


Fig.12 Dropout Voltage vs. Junction Temperature (PQ30RV2/PQ30RV21)

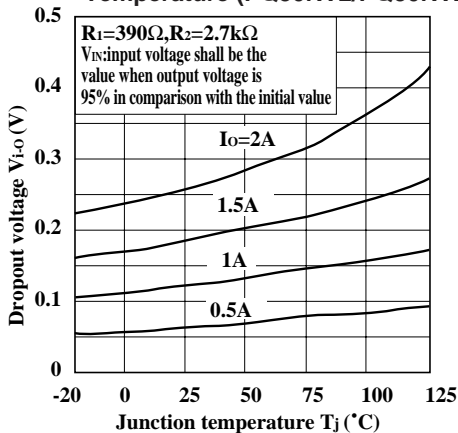


Fig.13 Quiescent Current vs. Junction Temperature

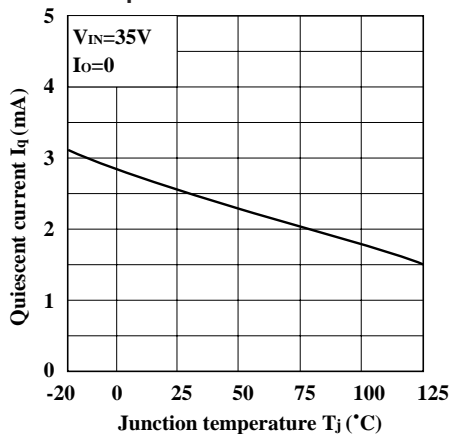


Fig.14 Ripple Rejection vs. Input Ripple Frequency (PQ30RV1/PQ30RV11)

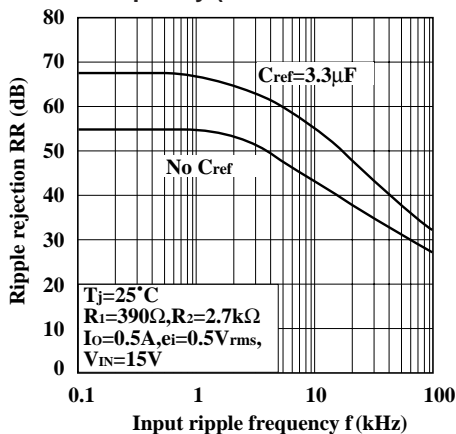


Fig.15 Ripple Rejection vs. Input Ripple Frequency (PQ30RV2/PQ30RV21)

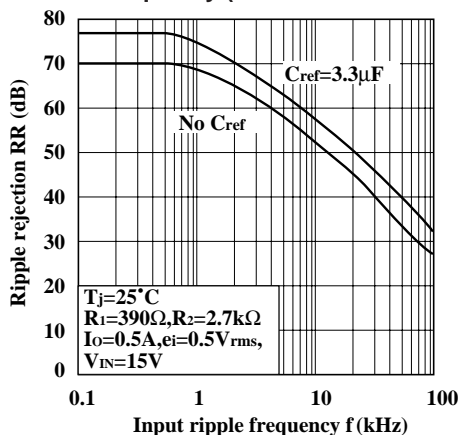


Fig.16 Ripple Rejection vs. Output Current (PQ30RV1/PQ30RV11)

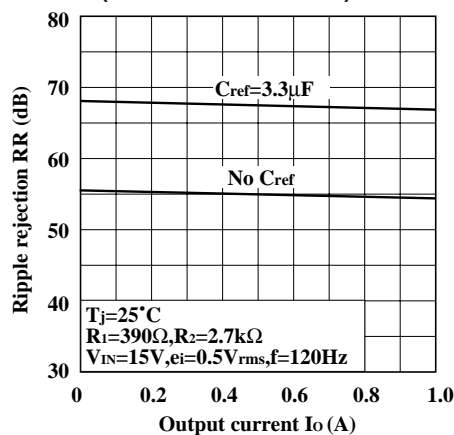


Fig.17 Ripple Rejection vs. Output Current (PQ30RV2/PQ30RV21)

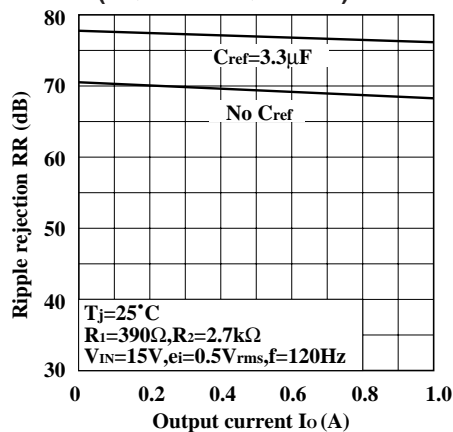


Fig.18 Output Peak Current vs. Dropout Voltage (PQ30RV1/PQ30RV11)

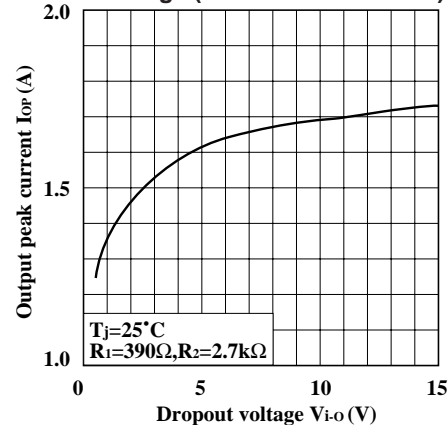


Fig.19 Output Peak Current vs. Dropout Voltage (PQ30RV2/PQ30RV21)

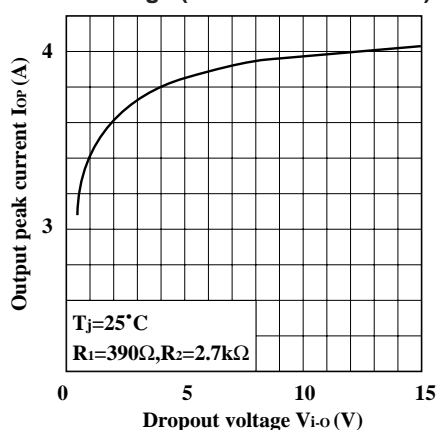


Fig.20 Output Peak Current vs. Junction Temperature (PQ30RV1/PQ30RV11)

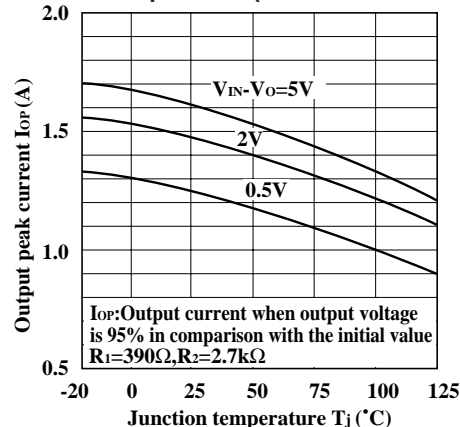
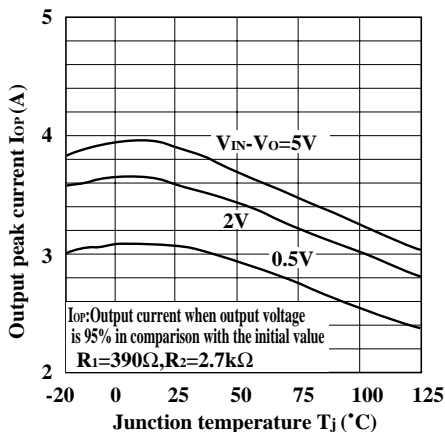
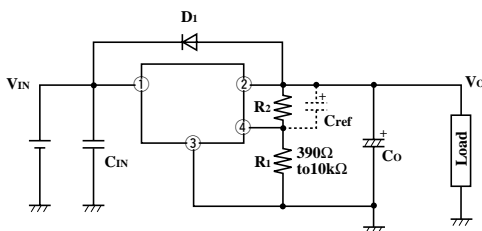


Fig.21 Output Peak Current vs. Junction Temperature (PQ30RV2/PQ30RV21)



■ 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.

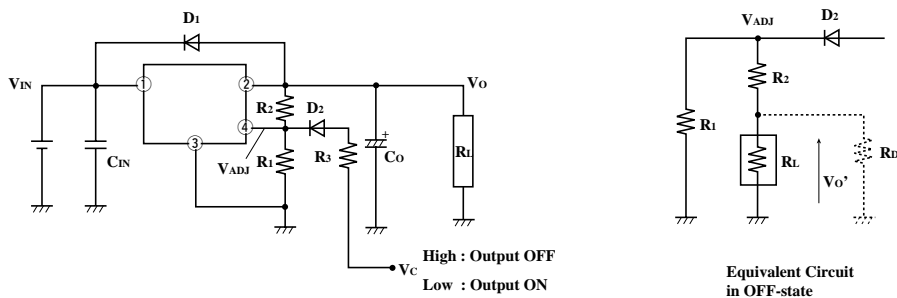
$R_1$ ,  $R_2$  : These devices are necessary to set the output voltage. The output voltage  $V_O$  is given by the following formula:

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

( $V_{ref}$  is 1.25V TYP)

The standard value of  $R_1$  is  $390\Omega$ . 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<sub>ADJ</sub> is forcibly raised above V<sub>ref</sub> (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<sub>ADJ</sub> must be higher than V<sub>ref</sub> MAX., and at the same time must be lower than maximum rating 7V.  
In OFF-state, the load current flows to R<sub>L</sub> from V<sub>ADJ</sub> through R<sub>2</sub>. Therefore the value of R<sub>2</sub> 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<sub>1</sub> up to 10Ω is allowed. Select as high value of R<sub>L</sub> and R<sub>2</sub> as possible in this range. In some case, as output voltage is getting lower (V<sub>o</sub> < 1V), impedance of load resistance rises. In such condition, it is sometime impossible to obtain the minimum value of V<sub>o'</sub>. So add the dummy resistance indicated by R<sub>D</sub> 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<sub>OH</sub>(max) = 0.5 V  
 V<sub>OH</sub>(min) = 2.4 V (I<sub>OH</sub> = 0.2mA)  
 MAX. rating of I<sub>OH</sub> = 0.5mA  
 Output should be set as follows.  
 15.6V R<sub>L</sub> = 52Ω (I<sub>o</sub> = 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<sub>F</sub>(max) = 0.8V for D<sub>2</sub> in case of V<sub>OH</sub>(min) = 2.4V, we get  $V_{ADJ} = V_{OH}(min) - V_F(max) = 2.4V - 0.8V = 1.6V$ . From V<sub>ref</sub>(max) = 1.3V we get R<sub>3</sub> = 0Ω

If R<sub>1</sub> = 10kΩ, we get  $R_2 = 11.48 \times R_1 = 114.8k\Omega$  and I<sub>OH</sub> as follows, ignoring R<sub>L</sub> (52Ω) :

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

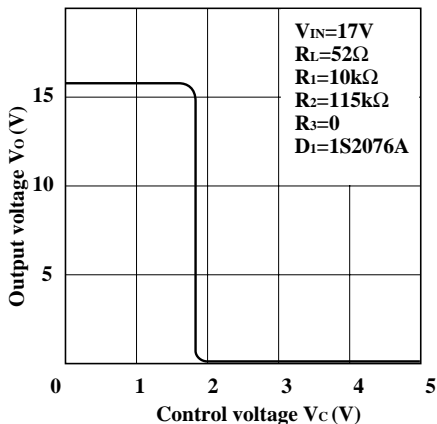
Hence, I<sub>OH</sub> < 0.2mA. Therefore V<sub>OH</sub>(min) is ensured.

Next, assuming that V<sub>F</sub>(min) = 0.5V for D<sub>2</sub> in case of V<sub>OH</sub>(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<sub>o</sub>-V<sub>c</sub> characteristics when R<sub>1</sub> = 10kΩ, R<sub>2</sub> = 115kΩ, R<sub>3</sub> = 0Ω, V<sub>IN</sub> = 17V, R<sub>L</sub> = 52Ω, and D<sub>1</sub> = 1S2076A (Hitachi).

Output Voltage vs. Control Voltage (PQ30RV1)

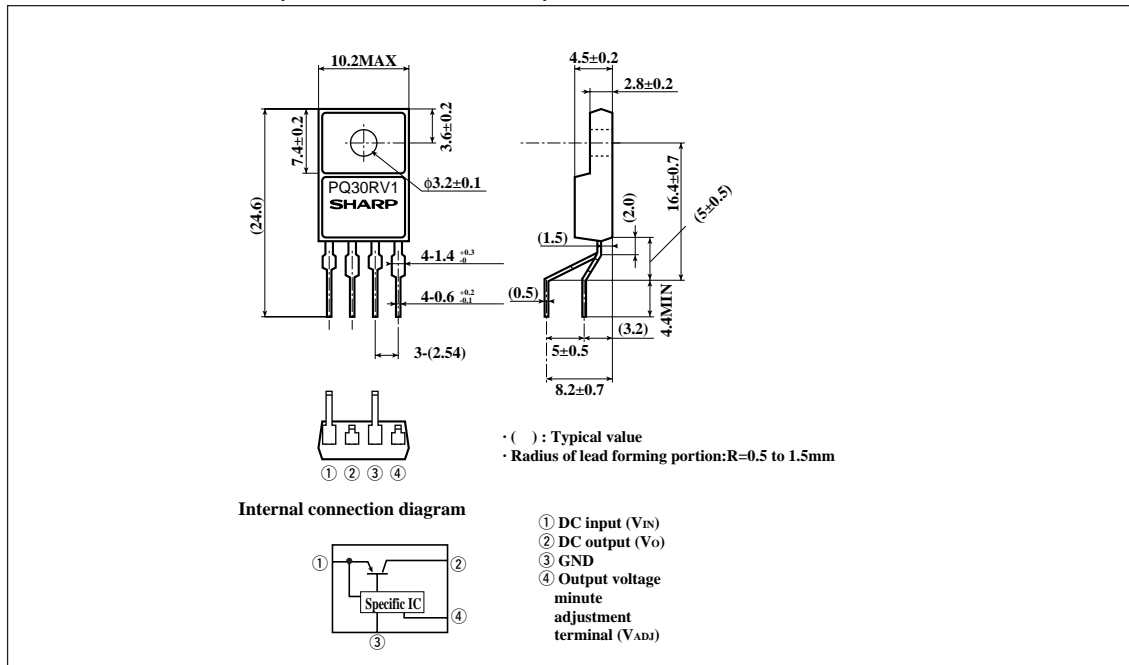


Model Line-ups for Lead Forming Type

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.