

# PQ05RF2/21/2V Series

2A Output, Low Power-Loss Voltage Regulators

## ■ Features

- Low power-loss (Dropout voltage : MAX. 0.5V)
- Compact resin full-mold package.
- Built-in ON/OFF control terminal (PQ05RF2/PQ05RF21 series)
- Built-in output voltage minute adjustment terminal (ripple rejection is improved) (PQ05RF2V series)

## ■ Model Line-ups

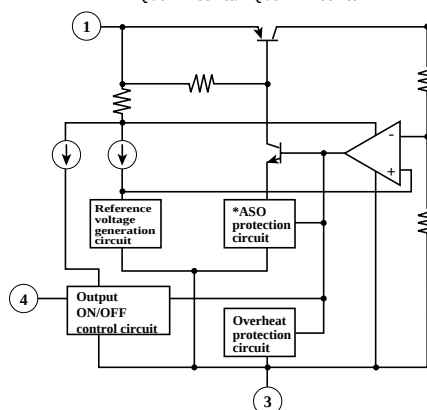
| Output voltage                                                   | 5V Output | 9V Output | 12V Output | 15V Output |
|------------------------------------------------------------------|-----------|-----------|------------|------------|
| Output voltage precision: $\pm 5\%$                              | PQ05RF2   | PQ09RF2   | PQ12RF2    | PQ15RF2    |
| Output voltage precision: $\pm 2.5\%$                            | PQ05RF21  | PQ09RF21  | PQ12RF21   | PQ15RF21   |
| Minute adjustment (Output voltage adjustment range: $\pm 10\%$ ) | PQ05RF2V  | PQ09RF2V  | PQ12RF2V   | PQ15RF2V   |

## ■ Applications

- Series power supply for various electronic equipment such as VCRs, electronic music instruments

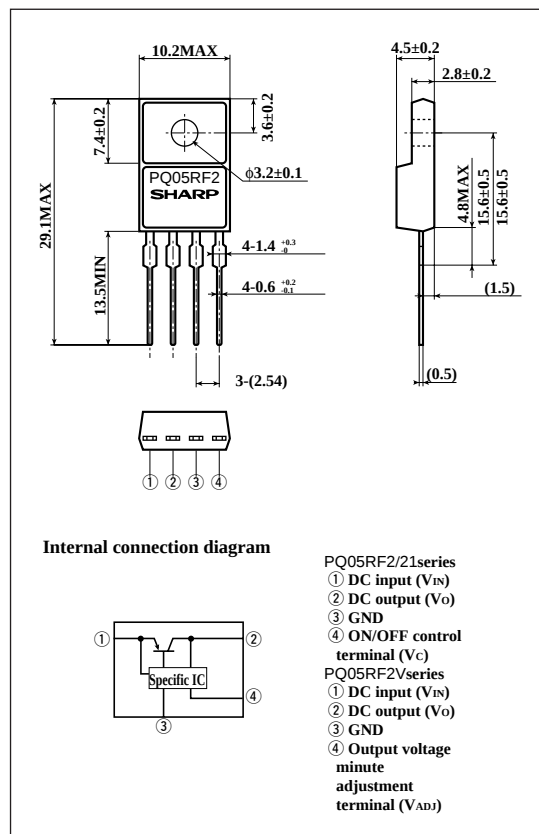
## ■ Equivalent Circuit Diagram

PQ05RF2series/PQ05RF21series



## ■ Outline Dimensions

(Unit : mm)



Internal connection diagram

PQ05RF2/21series  
 ① DC input ( $V_{in}$ )  
 ② DC output ( $V_o$ )  
 ③ GND  
 ④ ON/OFF control terminal ( $V_c$ )  
 PQ05RF2Vseries  
 ① DC input ( $V_{in}$ )  
 ② DC output ( $V_o$ )  
 ③ GND  
 ④ Output voltage minute adjustment terminal ( $V_{Adj}$ )

PQ05RF2Vseries

\*ASO:Area of Safety Operation

SHARP

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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                                          | ON/OFF control terminal voltage | V <sub>C</sub>   | 35            | V    |
|                                             | PQ05RF2 series                  |                  |               |      |
|                                             | PQ05RF21 series                 |                  |               |      |
| Output current                              |                                 | I <sub>O</sub>   | 2             | A    |
| Power dissipation (No heat sink)            |                                 | P <sub>D1</sub>  | 1.5           | W    |
| Power dissipation (With infinite heat sink) |                                 | P <sub>D2</sub>  | 18            | W    |
| *2                                          | Junction temperature            | T <sub>j</sub>   | 150           | °C   |
| Operating temperature                       |                                 | T <sub>opr</sub> | -20 to +80    | °C   |
| Storage temperature                         |                                 | T <sub>stg</sub> | -40 to +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 125<=T<sub>j</sub><=150°C.

## ■ Electrical Characteristics

(Unless otherwise specified, condition shall be I<sub>O</sub>=1A, T<sub>a</sub>=25°C, \*3)

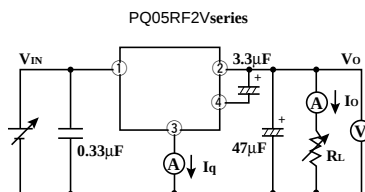
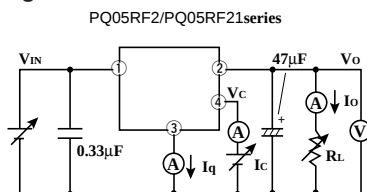
| Parameter                                 |                        | Symbol                      | Conditions                          | MIN.  | TYP.  | MAX.  | Unit |
|-------------------------------------------|------------------------|-----------------------------|-------------------------------------|-------|-------|-------|------|
| Output voltage                            | PQ05RF2/PQ05RF2V       | V <sub>O</sub>              | -                                   | 4.75  | 5.0   | 5.25  | V    |
|                                           | PQ09RF2/PQ09RF2V       |                             |                                     | 8.55  | 9.0   | 9.45  |      |
|                                           | PQ12RF2/PQ12RF2V       |                             |                                     | 11.4  | 12.0  | 12.6  |      |
|                                           | PQ15RF2/PQ15RF2V       |                             |                                     | 14.25 | 15.0  | 15.75 |      |
|                                           | PQ05RF21               |                             |                                     | 4.88  | 5.0   | 5.12  |      |
|                                           | PQ09RF21               |                             |                                     | 8.78  | 9.0   | 9.22  |      |
|                                           | PQ12RF21               |                             |                                     | 11.7  | 12.0  | 12.3  |      |
|                                           | PQ15RF21               |                             |                                     | 14.63 | 15.0  | 15.37 |      |
| Load regulation                           |                        | R <sub>egL</sub>            | I <sub>O</sub> =5mA to 2A           | -     | 0.5   | 2.0   | %    |
| Line regulation                           |                        | R <sub>egI</sub>            | *4                                  | -     | 0.5   | 2.5   | %    |
| Temperature coefficient of output voltage |                        | T <sub>cV<sub>O</sub></sub> | T <sub>j</sub> =0 to 125°C          | -     | ±0.02 | -     | %/°C |
| Ripple rejection                          | PQ05RF2/PQ05RF21Series | RR                          | I <sub>O</sub> =0.5A Refer to Fig.2 | 45    | 55    | -     | dB   |
|                                           | PQ05RF2VSeries         |                             |                                     | 55    | -     | -     |      |
| Dropout voltage                           |                        | V <sub>i-o</sub>            | *5, I <sub>O</sub> =2A              | -     | -     | 0.5   | V    |
| ON-state voltage for control              | PQ05RF2/PQ05RF21Series | V <sub>C(ON)</sub>          | -                                   | 2.0   | *6    | -     | V    |
| ON-state current for current              | PQ05RF2/PQ05RF21Series | I <sub>C(ON)</sub>          | V <sub>C</sub> =2.7V                | -     | -     | 20    | μA   |
| OFF-state voltage for control             | PQ05RF2/PQ05RF21Series | V <sub>C(OFF)</sub>         | -                                   | -     | -     | 0.8   | V    |
| OFF-state current for control             | PQ05RF2/PQ05RF21Series | I <sub>C(OFF)</sub>         | V <sub>C</sub> =0.4V                | -     | -     | -0.4  | mA   |
| Quiescent current                         |                        | I <sub>q</sub>              | I <sub>O</sub> =0                   | -     | -     | 10    | mA   |
| Output voltage minute adjustment range    | PQ05RF2V               | V <sub>O(ADJ)</sub>         | -                                   | 4.5   | 5.0   | 5.5   | V    |
|                                           | PQ09RF2V               |                             |                                     | 8.1   | 9.0   | 9.9   |      |
|                                           | PQ12RF2V               |                             |                                     | 10.8  | 12.0  | 13.2  |      |
|                                           | PQ15RF2V               |                             |                                     | 13.5  | 15.0  | 16.5  |      |

\*3 PQ05RF2 Series:V<sub>IN</sub>=7V, PQ09RF2 Series:V<sub>IN</sub>=15V, PQ12RF2 Series:V<sub>IN</sub>=18V, PQ15RF2 Series:V<sub>IN</sub>=23V\*4 PQ05RF2/PQ05RF21/PQ05RF2V:V<sub>IN</sub>=6 to 12V PQ09RF2/PQ09RF21/PQ09RF2V:V<sub>IN</sub>=10 to 25V  
PQ12RF2/PQ12RF21/PQ12RF2V:V<sub>IN</sub>=13 to 29V PQ15RF2/PQ15RF21/PQ15RF2V:V<sub>IN</sub>=16 to 32V

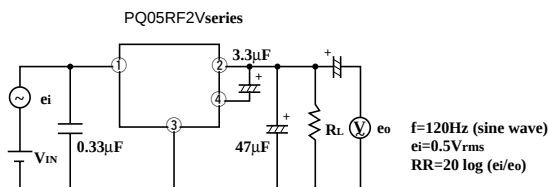
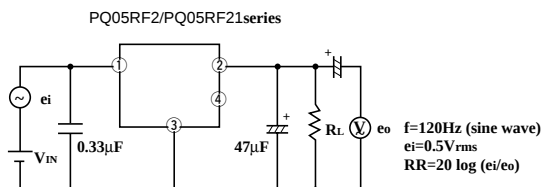
\*5 Input voltage shall be the value when output voltage is 95% in comparison with the initial value.

\*6 In case of opening control terminal ④, output voltage turns on.(PQ05RF2/PQ05RF21 Series)

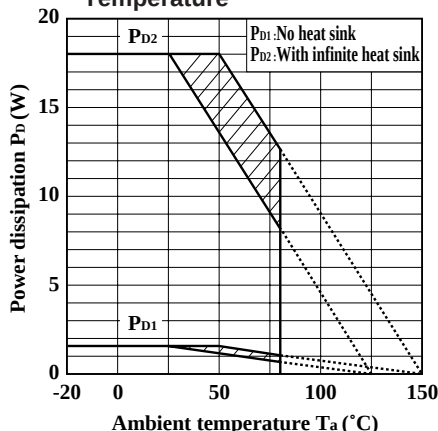
**Fig.1 Test Circuit**



**Fig.2 Test Circuit of Ripple Rejection**

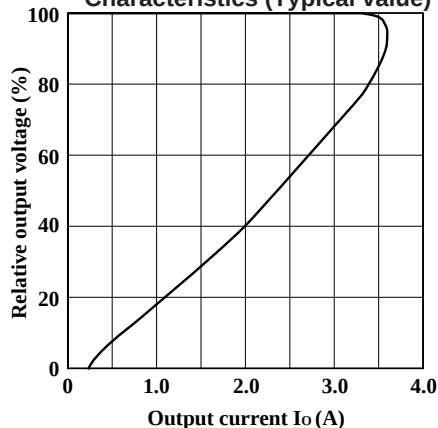


**Fig.3 Power Dissipation vs. Ambient Temperature**

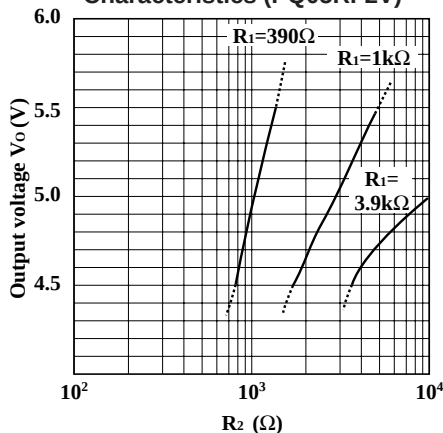


Note) Oblique line portion: Overheat protection may operate in this area.

**Fig.4 Overcurrent Protection Characteristics (Typical value)**



**Fig.5 Output Voltage Minute Adjustment Characteristics (PQ05RF2V)**



**Fig.6 Output Voltage Minute Adjustment Characteristics (PQ09RF2V)**

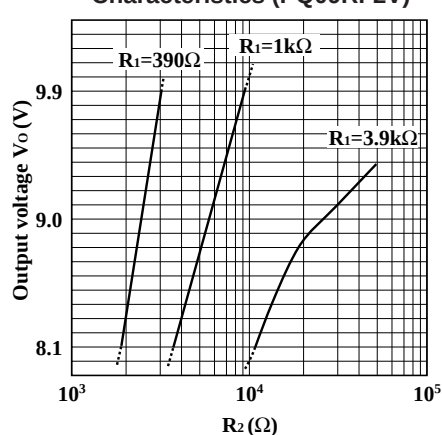


Fig.7 Output Voltage Minute Adjustment Characteristics (PQ12RF2V)

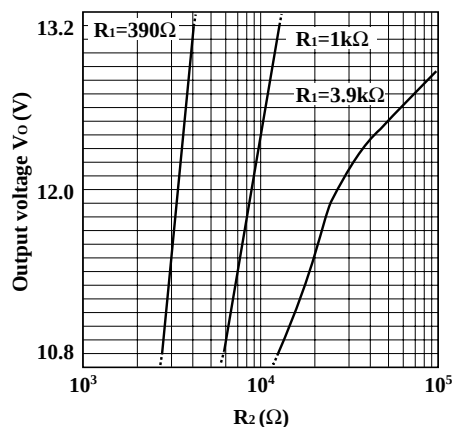


Fig.8 Output Voltage Minute Adjustment Characteristics (PQ15RF2V)

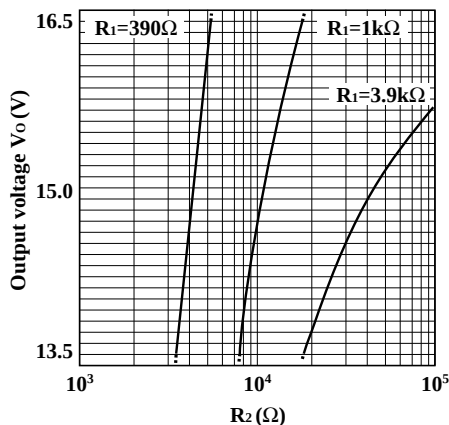


Fig.9 Output Voltage Deviation vs. Junction Temperature (PQ05RF2/PQ05RF21/PQ05RF2V)

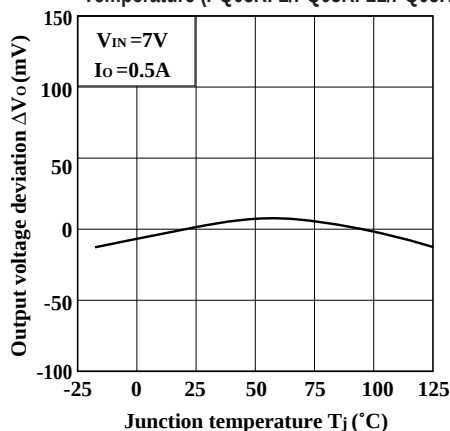


Fig.10 Output Voltage Deviation vs. Junction Temperature (PQ09RF2/PQ09RF21/PQ09RF2V)

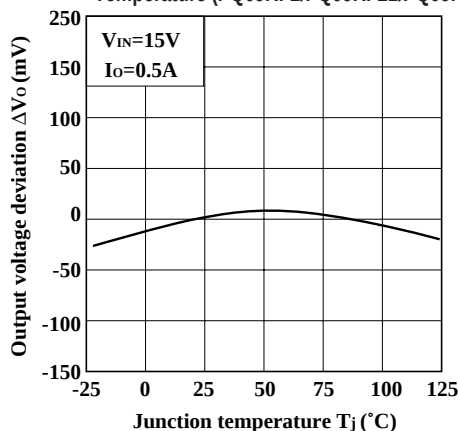


Fig.11 Output Voltage Deviation vs. Junction Temperature (PQ12RF2/PQ12RF21/PQ12RF2V)

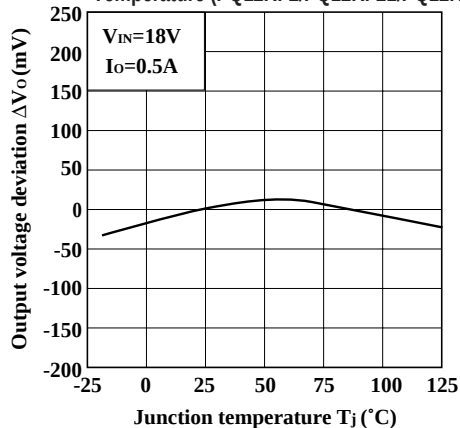


Fig.12 Output Voltage Deviation vs. Junction Temperature (PQ15RF2/PQ15RF21/PQ15RF2V)

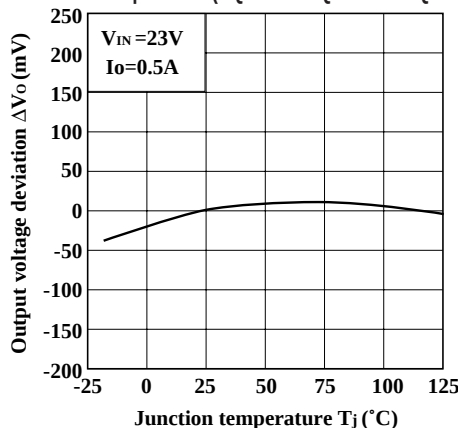


Fig.13 Output Voltage vs. Input Voltage (PQ05RF2/PQ05RF21/PQ05RF2V)

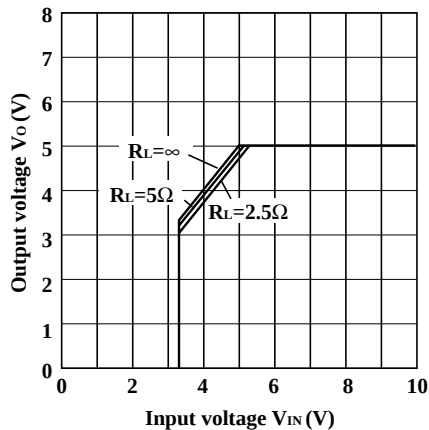


Fig.14 Output Voltage vs. Input Voltage (PQ09RF2/PQ09RF21/PQ09RF2V)

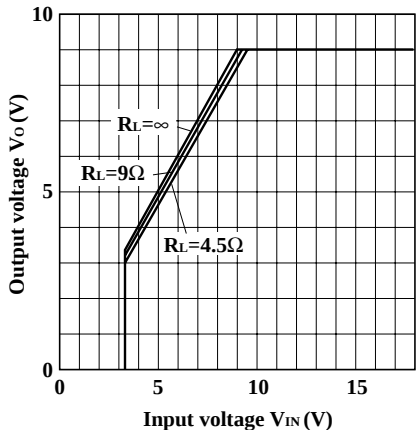


Fig.15 Output Voltage vs. Input Voltage (PQ12RF2/PQ12RF21/PQ12RF2V)

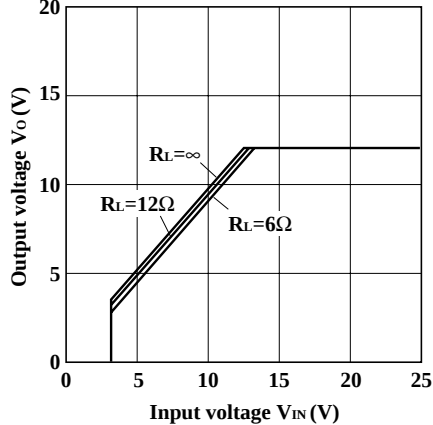


Fig.16 Output Voltage vs. Input Voltage (PQ15RF2/PQ15RF21/PQ15RF2V)

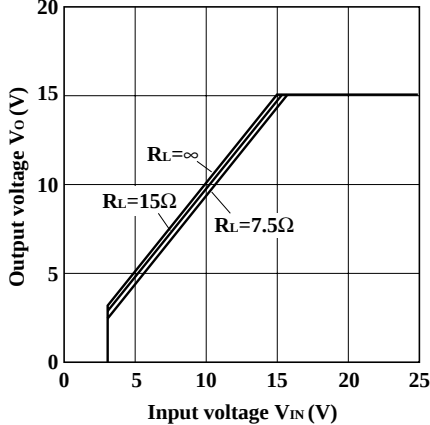


Fig.17 Circuit Operating Current vs. Input Voltage (PQ05RF2/PQ05RF21/PQ05RF2V)

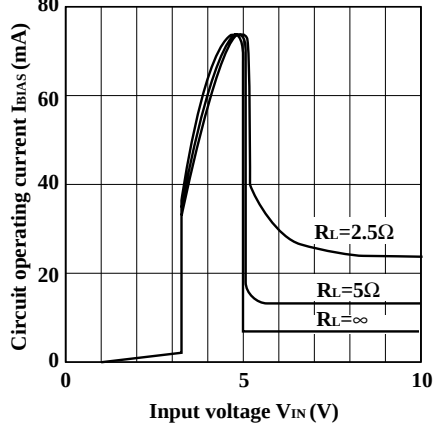


Fig.18 Circuit Operating Current vs. Input Voltage (PQ09RF2/PQ09RF21/PQ09RF2V)

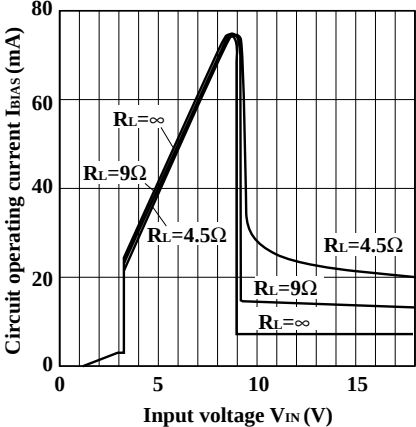


Fig.19 Circuit Operating Current vs. Input Voltage (PQ12RF2/PQ12RF21/PQ12RF2V)

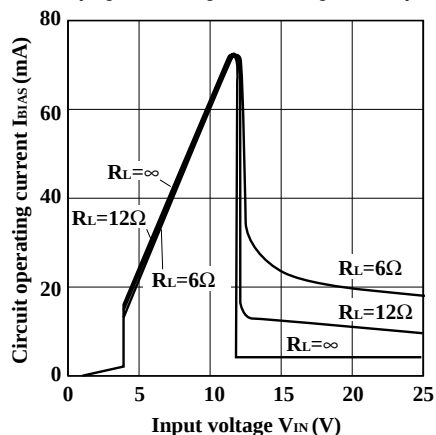


Fig.20 Circuit Operating Current vs. Input Voltage (PQ15RF2/PQ15RF21/PQ15RF2V)

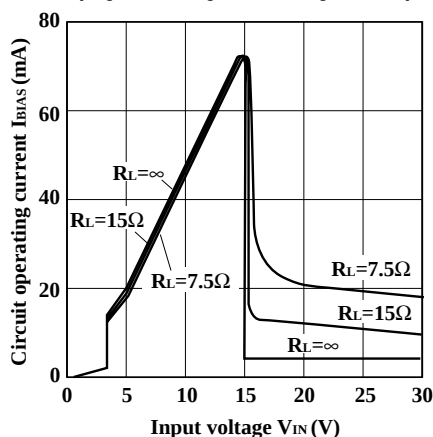


Fig.21 Dropout Voltage vs. Junction Temperature

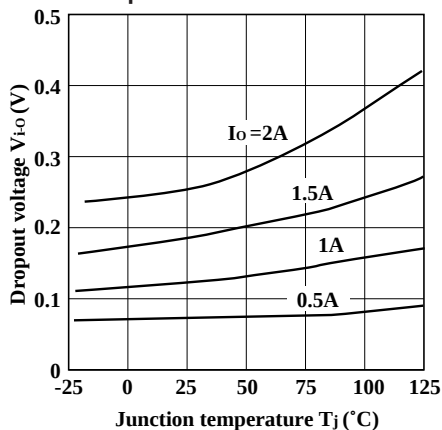


Fig.22 Quiescent Current vs. Junction Temperature

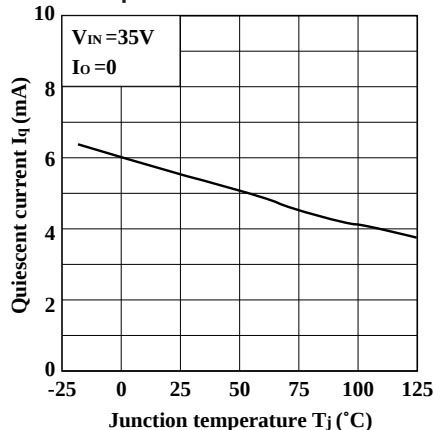


Fig.23 Ripple Rejection vs. Input Ripple Frequency (PQ05RF2/PQ05RF21/PQ09RF2/PQ09RF21/PQ12RF2/PQ12RF21/PQ15RF2/PQ15RF21)

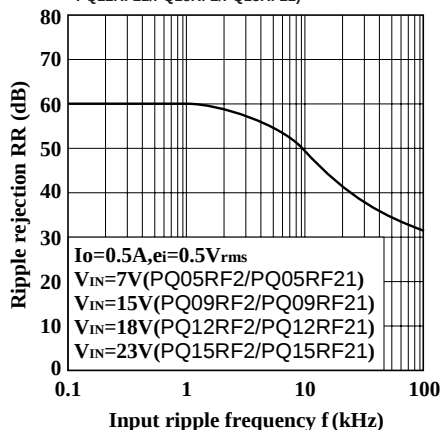


Fig.24 Ripple Rejection vs. Input Ripple Frequency (PQ05RF2V/PQ09RF2V/PQ12RF2V/PQ15RF2V)

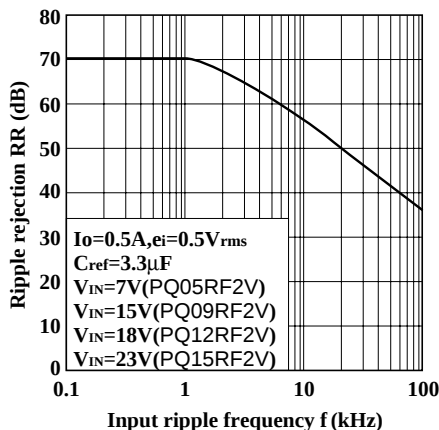
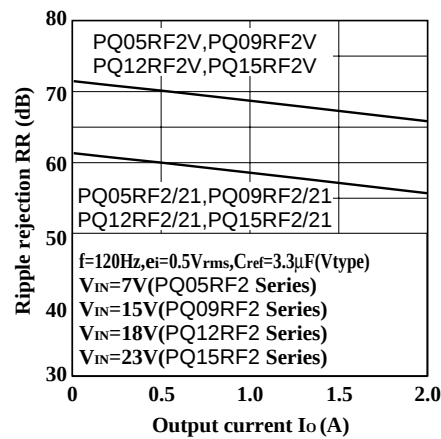
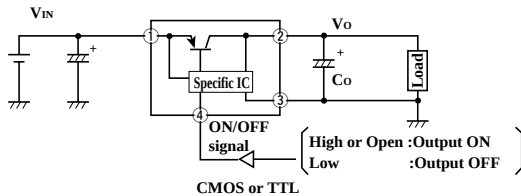


Fig.25 Ripple Rejection vs. Output Current

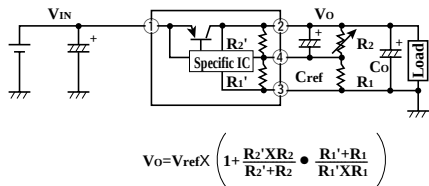


■ Typical Application

PQ05RF2/PQ05RF21 Series



PQ05RF2V Series



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

$V_{ref} \approx 1.26V, R_1' \approx 390\Omega$   
PQ05RF2V :  $R_2' \approx 1.16k\Omega$   
PQ09RF2V :  $R_2' \approx 2.40k\Omega$   
PQ12RF2V :  $R_2' \approx 3.32k\Omega$   
PQ15RF2V :  $R_2' \approx 4.45k\Omega$

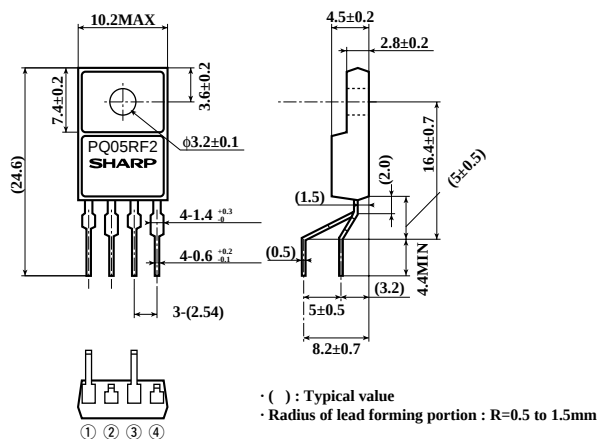
(Note)  $R_1'$  and  $R_2'$  are built in a specific IC.

■ Model Line-ups for Lead Forming Type

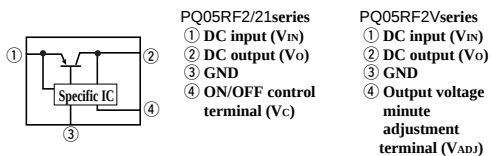
| Output voltage                 | 5V Output | 9V Output | 12V Output | 15V Output |
|--------------------------------|-----------|-----------|------------|------------|
| Output voltage precision:±5%   | PQ05RF2A  | PQ09RF2A  | PQ12RF2A   | PQ15RF2A   |
| Output voltage precision:±2.5% | PQ05RF2B  | PQ09RF2B  | PQ12RF2B   | PQ15RF2B   |

## ■ Outline Dimensions (PQ05RF2A/PQ05RF2B Series)

(Unit : mm)



Internal connection diagram



Note) The value of absolute maximum ratings and electrical characteristics is same as ones of PQ05RF2/21series.

## ■ Precautions for Use

### (1) Minute adjustment of output voltage (PQ05RF2V series)

If the external resistor is attached to the terminals ②, ③ and ④, minute adjustment of output voltage is possible.  
 (Refer to the example of basic circuit (PQ05RF2V series) and Fig.5 to 8.)

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