

Dual output voltage regulator with power saving

BA41W12ST

The BA41W12ST is a general-purpose power supply with two outputs : 8V, 1A and 5V, 500mA. The IC is available in a compact TO220FP-5 package. The outputs can be turned off during the power saving state with a built-in switch. Also built in the IC are an overcurrent protection circuit, an overvoltage protection circuit, and a thermal shutdown circuit.

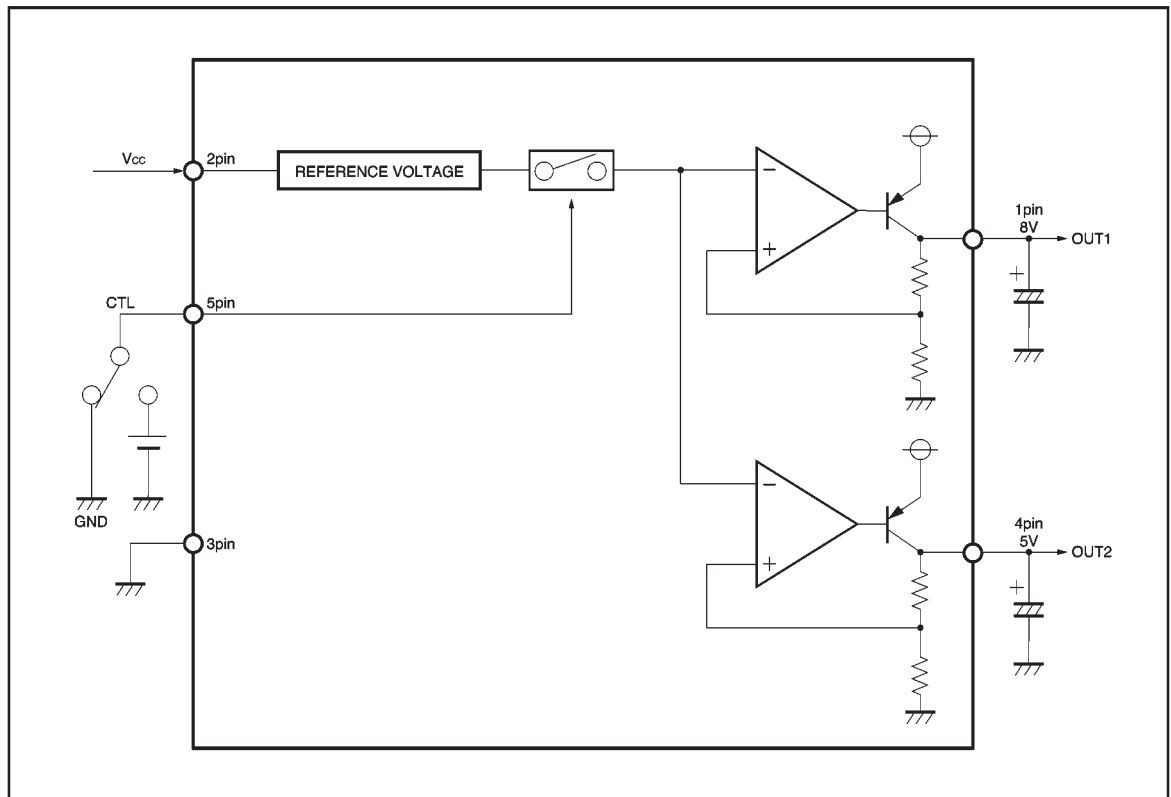
●Applications

Car audio systems, VCRs, facsimiles, air conditioners, and other household and industrial equipment

●Features

- 1) Minimum I / O voltage differential is 0.5V or less.
- 2) Built-in protection circuits against overcurrent, over-voltage, and overheat.
- 3) Available in a compact TO220FP-5 package (pins are bendable).
- 4) Zero power saving current. (Typ.)

●Block diagram



● Absolute maximum ratings ($T_a = 25^\circ\text{C}$)

| Parameter | Symbol | Limits | Unit |
|-----------------------|-------------|--------------------|------------------|
| Power supply voltage | V_{CC} | 35 | V |
| Power dissipation | P_d | 2000* ¹ | mW |
| Operating temperature | T_{opr} | $-40 \sim +85$ | $^\circ\text{C}$ |
| Storage temperature | T_{stg} | $-55 \sim +150$ | $^\circ\text{C}$ |
| Peak applied voltage | V_{surge} | 50* ² | V |

*1 Reduced by 16 mW for each increase in T_a of 1°C over 25°C .

*2 Applied time is less than 200 ms ($t_r \geq 1$ ms).

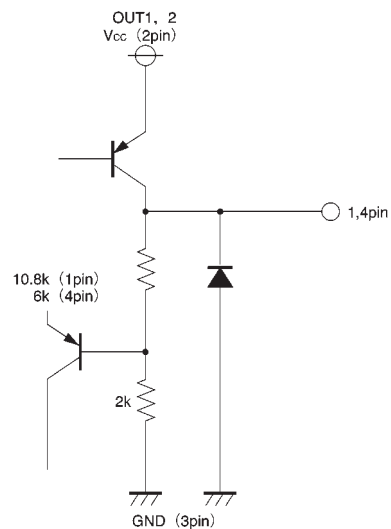
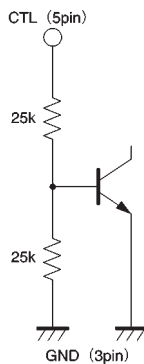
● Recommended operating conditions ($T_a = 25^\circ\text{C}$)

| Parameter | Symbol | Min. | Typ. | Max. | Unit |
|----------------------|----------|------|------|------|------|
| Power supply voltage | V_{CC} | 9.0 | 13 | 25 | V |

● Pin descriptions

| Pin No. | Pin name | Function |
|---------|----------|------------------------|
| 1 | OUT1 | Output 1 (8 V, 1 A) |
| 2 | V_{CC} | Power supply |
| 3 | GND | Ground |
| 4 | OUT2 | Output 2 (5 V, 500 mA) |
| 5 | CTL | ON/OFF switch |

● Input / output circuits



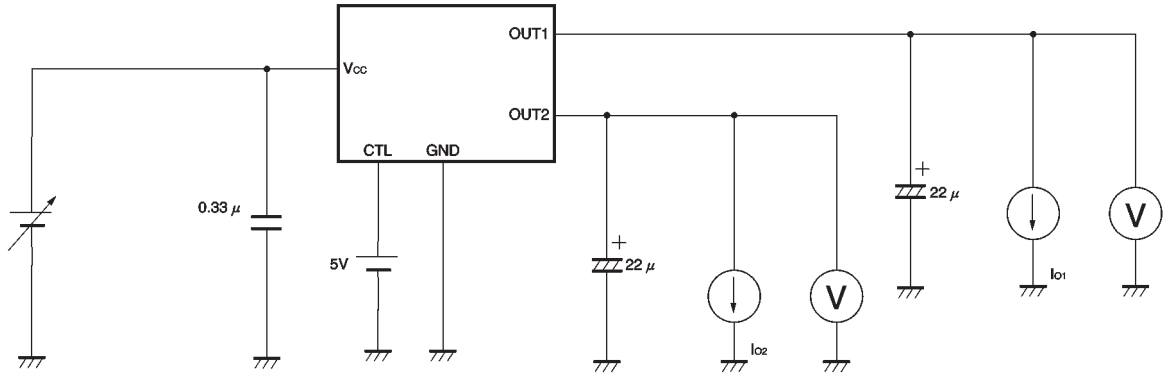
●Electrical characteristics (unless otherwise noted, $T_a = 25^\circ\text{C}$ and $V_{CC} = 13.0\text{V}$)

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Conditions | Measurement circuit |
|------------------------------------|-----------------|------|------|------|---------------|---|---------------------|
| Power save supply current | I_{ST} | — | 0 | 10 | μA | OFF mode | Fig.4 |
| Bias current | I_b | — | 3.0 | 5.0 | mA | ON mode | Fig.4 |
| 〈8V output section〉 | | | | | | | |
| Output voltage 1 | V_{O1} | 7.6 | 8.0 | 8.4 | V | $I_{O1}=500\text{mA}$ | Fig.1 |
| Minimum I/O voltage differential 1 | ΔV_{O1} | — | 0.3 | 0.5 | V | $I_{O1}=500\text{mA}$ $V_{CC}=0.95V_{O1}$ | Fig.3 |
| Output current capacity 1 | I_{O1} | 1.0 | — | — | A | | Fig.1 |
| Ripple rejection ratio 1 | R.R1 | — | 55 | — | dB | $I_{O1}=500\text{mA}$, $f=120\text{Hz}$ $e_{IN}=1V_{rms}$ | Fig.2 |
| Input stability 1 | Reg.I1 | — | 50 | 100 | mV | $V_{CC}=9\rightarrow 25\text{V}$, $I_O=500\text{mA}$ | Fig.1 |
| Load regulation 1 | Reg.L1 | — | 100 | 150 | mV | $I_O=5\text{mA}\rightarrow 1\text{A}$ | Fig.1 |
| Output short-circuit current 1 | I_{OS1} | — | 150 | — | mA | $V_{CC}=25\text{V}$ | Fig.5 |
| 〈5V output section〉 | | | | | | | |
| Output voltage 2 | V_{O2} | 4.75 | 5.0 | 5.25 | V | $I_{O2}=350\text{mA}$ | Fig.1 |
| Minimum I/O voltage differential 2 | ΔV_{O2} | — | 0.3 | 0.5 | V | $I_{O2}=350\text{mA}$ $V_{CC}=0.95V_{O2}$ | Fig.3 |
| Output current capacity 2 | I_{O2} | 500 | — | — | mA | | Fig.1 |
| Ripple rejection ratio 2 | R.R2 | — | 60 | — | dB | $I_{O2}=350\text{mA}$, $f=120\text{Hz}$ $e_{IN}=1V_{rms}$ | Fig.2 |
| Input stability 2 | Reg.I2 | — | 50 | 100 | mV | $V_{CC}=6\rightarrow 25\text{V}$, $I_O=350\text{mA}$ | Fig.1 |
| Load regulation 2 | Reg.L2 | — | 50 | 100 | mV | $I_O=5\text{mA}\rightarrow 500\text{mA}$ | Fig.1 |
| Output short-circuit current 2 | I_{OS2} | — | 100 | — | mA | $V_{CC}=25\text{V}$ | Fig.5 |
| 〈Switch section〉 | | | | | | | |
| ON mode voltage | V_{TH1} | 2.0 | — | — | V | Output ACTIVE mode | Fig.6 |
| OFF mode voltage | V_{TH2} | — | — | 0.8 | V | Output OFF mode | Fig.6 |
| Input high level current | I_{IN} | — | 150 | — | μA | $V_{TH}=5\text{V}$ | Fig.7 |

Note: All the characteristic values are measured with a $0.33\mu\text{F}$ F-capacitor connected to the input pin and $22\mu\text{F}$ F-capacitor connected to the output pin.

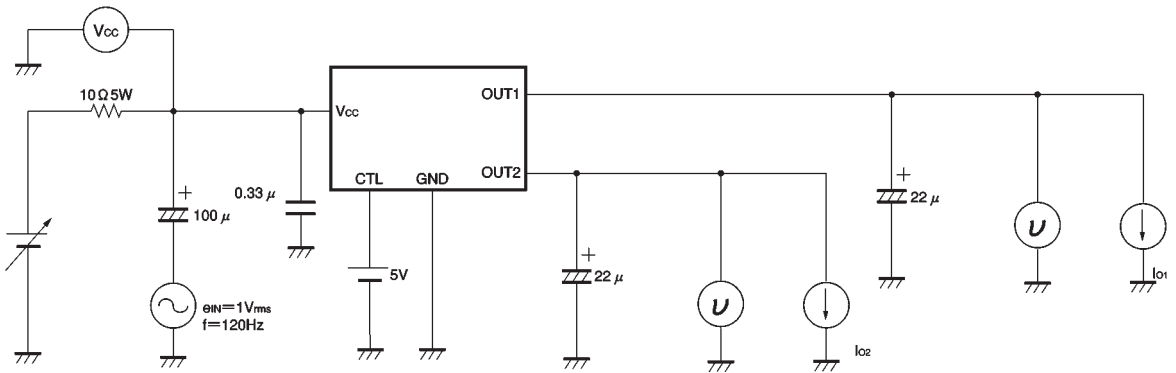
Measurements are made by using a pulse ($t_w \leq 10\text{ms}$, duty cycle $\leq 5\%$) in all cases but noise voltage and the ripple rejection ratio.

● Measurement circuits



- V_{cc} = 13 V, I_{o1} = 500 mA when measuring output voltage 1
- V_{cc} = 13 V, I_{o2} = 350 mA when measuring output voltage 2
- V_{cc} = 9→25 V, I_{o1} = 500 mA when measuring input stability 1
- V_{cc} = 6→25 V, I_{o2} = 350 mA when measuring input stability 2
- V_{cc} = 13 V, I_{o1} = 5mA→1 A when measuring load regulation 1
- V_{cc} = 13 V, I_{o2} = 5mA→500 mA when measuring load regulation 2
- V_{cc} = 13 V when measuring output current capacity 1
- V_{cc} = 13 V when measuring output current capacity 2

Fig.1 Circuit for measuring output voltage, input stability, load regulation, and output current capacity



- V_{cc} = 13 V, I_{o1} = 500 mA when measuring the ripple rejection ratio 1
- V_{cc} = 13 V, I_{o2} = 350 mA when measuring the ripple rejection ratio 2

Fig.2 Circuit for measuring ripple rejection ratio

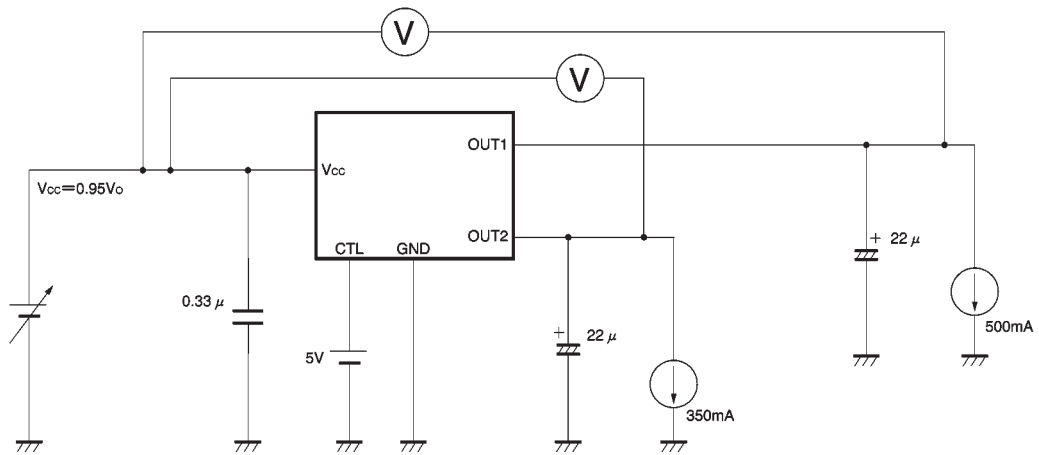
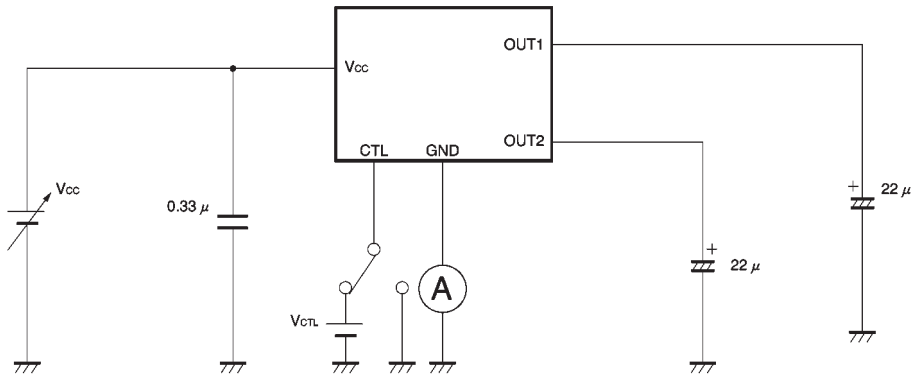


Fig.3 Circuit for measuring minimum I/O voltage differential



$V_{cc} = 13\text{ V}$, $I_o = 0\text{ mA}$, $V_{CTL} = 5\text{ V}$ when measuring bias current
 $V_{cc} = 13\text{ V}$, $I_o = 0\text{ mA}$, V_{CTL} when measuring power save supply current

Fig.4 Circuit for measuring bias current and power save supply current

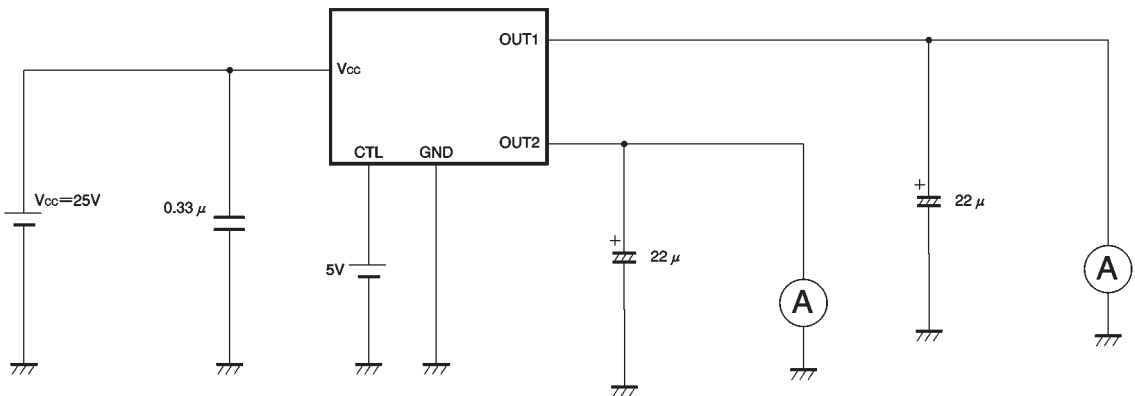


Fig.5 Circuit for measuring output short-circuit current

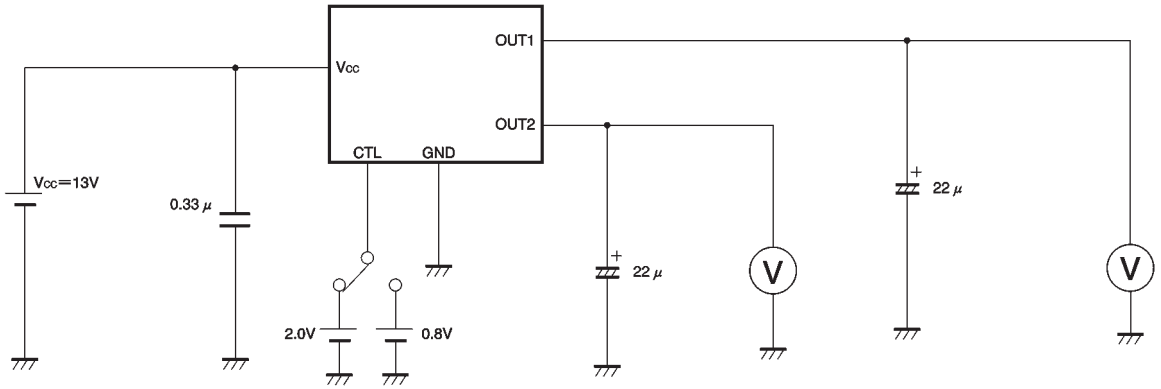


Fig.6 Circuit for measuring mode switching voltage

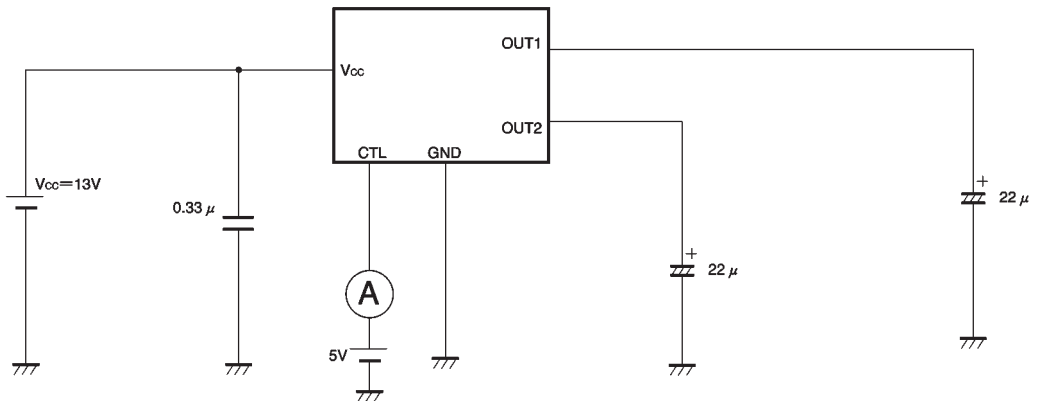


Fig.7 Circuit for measuring input high level current

●Application circuit

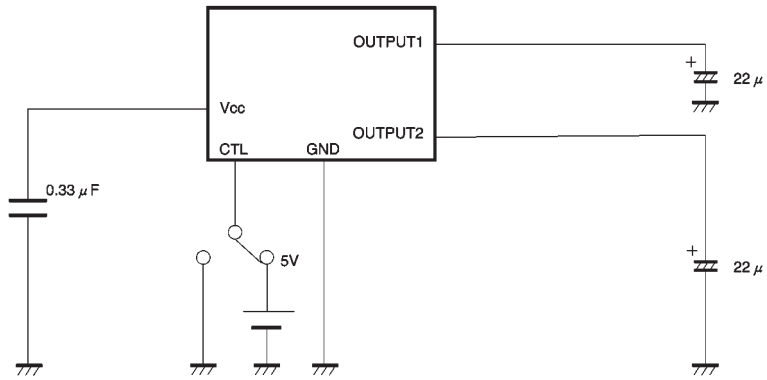


Fig.8

●Operation notes

(1) Although the circuit examples included in this handbook are highly recommendable for general use, you should be thoroughly familiar with circuit characteristics as they relate to your own use conditions. If you intend to change the number of external circuits, leave an ample margin, taking into account discrepancies in both static and dynamic characteristics of external parts and Rohm ICs. In addition, please be advised that Rohm cannot provide complete assurance regarding patent rights.

(2) Operating power supply voltage

When operating within the proper ranges of power supply voltage and ambient temperature, most circuit functions are guaranteed. Although the rated values of electrical characteristics cannot be absolutely guaranteed, characteristic values do not change drastically within the proper ranges.

(3) Power dissipation (Pd)

Refer to the power dissipation characteristics in Fig. 10. If power dissipation exceeds the allowable limit, the functionality of the IC will be degraded (such as reduction of current capacity by increased chip temperature). Make sure to use the IC within the allowable range of power dissipation with a sufficient margin.

(4) Preventing oscillation at each output and bypass capacitor

To stop output oscillation, make sure to connect a capacitor between GND and each output pin (capacitance of at least 10 μ F over the whole operating temperature is recommended). Oscillation can occur if capacitance is susceptible to temperature. We recommend using a tantalum electrolytic capacitor with minimal changes in capacitance. Also, output can be further stabilized by connecting a bypass capacitor of about 0.33 μ F between V_{CC} and GND.

(5) Overcurrent protection circuit

An overcurrent protection circuit is installed in each output system, based on the respective output current. This prevents IC destruction due to overcurrent, by limiting the current with a curve shape of "7" in the voltage-current graph. The IC is designed with margins so that current flow will be restricted and latching will be prevented even if a large current suddenly flows through a large capacitor. Note that these protection circuits are only good for preventing damage from sudden accidents. Make sure your design does not cause the protection circuit to operate continuously under transitional conditions (for instance, if output is clamped at 1V_F or higher, short mode circuit operates at 1V_F or lower). Note that the capacitance is negatively correlated with temperature.

(6) Thermal protection circuit

A built-in thermal protection circuit prevents thermal damage to the IC. All outputs are turned off when the circuit operates, and revert to the original state when the temperature drops to a certain level.

(7) We recommend installing a bypass line in your application if there is a mode where potential difference between each output and input (V_{CC}) or GND is reversed from the normal state. A reversed mode may cause damage to the IC.

(8) Although the quality of this IC is rigorously controlled, the IC may be destroyed when the applied voltage or the operating temperature exceeds their absolute maximum ratings. Because short mode or open mode cannot be specified when the IC is destroyed, be sure to take physical safety measures, such as fusing, if any of the absolute maximum ratings might be exceeded.

(9) When used within a strong magnetic field, be aware that there is a slight possibility of malfunction.

●Electrical characteristic curves

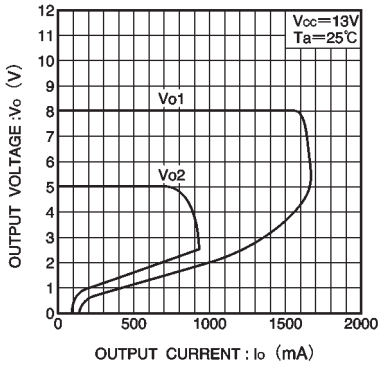


Fig.9 Output current capacity characteristics (Typ.)

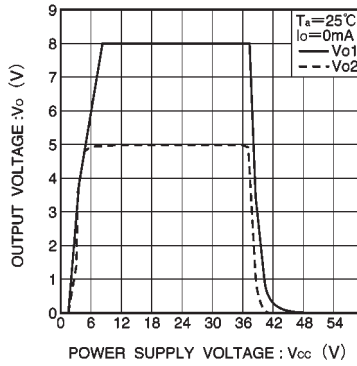


Fig.10 Output voltage characteristics (Typ.)

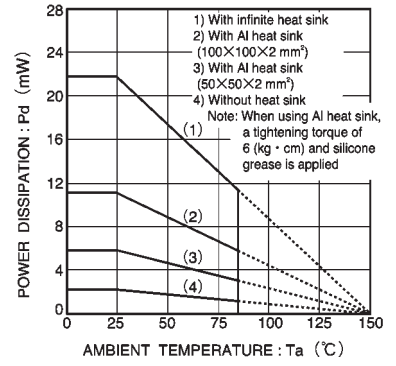


Fig.11 Thermal derating characteristics

●External dimensions (Units: mm)

