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The S-802 Series are three-terminal negative voltage regulators made using a CMOS process. Since the S-802 Series consume less current and need a smaller input/output voltage difference than existing three-terminal voltage regulators, battery-powered portable equipment can have a higher capacitance and a longer service life.

■ Features

- Low power consumption
- Small input/output voltage difference
- Low temperature coefficient of output voltage
- Wide operating voltage range
- Good input stability: 0.1%/V typ.
- TO-92 and SOT-89-3 mini-powermold plastic packages are available

■ Applications

- Constant voltage power supply of battery-powered equipment, communications equipment, video equipment and others

■ Selection Guide

Table 1

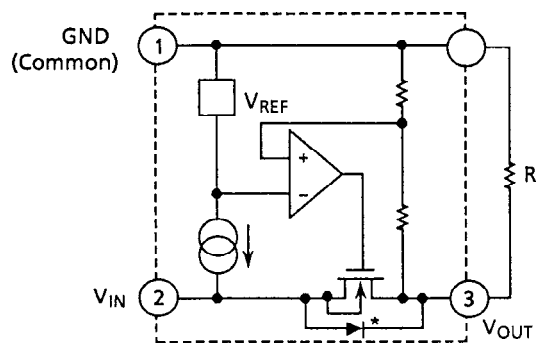
Output voltage	TO-92	SOT-89-3*
-3 V ± 5%	S-80230AG	S-80230AG-GA-X
-5 V ± 5%	S-80250AG	S-80250AG-GB-X

* The last digit of the model name changes depending upon the packing form when it is an SOT-89-3 package product.

X = S : Stick

X = T1 or T2 : Tape

■ Block Diagram



* Parasitic diode

Figure 1 (In case of TO-92)

NEGATIVE VOLTAGE REGULATOR

S-802 Series

Pin Assignment

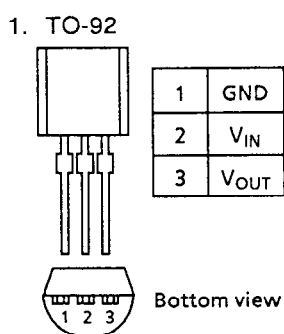


Figure 2

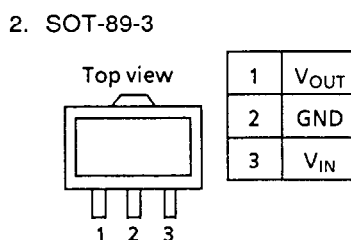


Figure 3

Absolute Maximum Ratings

Table 2
(Unless otherwise specified: $T_a = 25^\circ\text{C}$)

Parameter	Symbol	Ratings	Unit
Input voltage	V_{IN}	-12	V
Output voltage	V_{OUT}	$V_{IN} - 0.3$ to $V_{SS} + 0.3$	V
Output current	I_{OUT}	100	mA
Power dissipation	P_D	200	mW
Operating temperature	T_{opr}	-20 to +70	$^\circ\text{C}$
Storage temperature	T_{stg}	-40 to +125	$^\circ\text{C}$

Caution: Keep static electricity to a minimum.

Electrical Characteristics

1. S-80230AG, S-80230AG-GA-X (-3 V output type)

Table 3
(Unless otherwise specified: $T_a = 25^\circ\text{C}$)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit	Test cir.
Output voltage	V_{OUT}	$V_{IN} = -5\text{ V}$, $I_{OUT} = 10\text{ mA}$	-3.15	-3.00	-2.85	V	1
Output current	I_{OUT}	$V_{IN} = -5\text{ V}$	20	30	—	mA	1
Load regulation	ΔV_{OUT}	$1\text{ mA} \leq I_{OUT} \leq 20\text{ mA}$ $V_{IN} = -5\text{ V}$	—	60	100	mV	1
I/O voltage difference	V_{dif}	$I_{OUT} = 1\text{ mA}$	—	60	—	mV	—
Current consumption	I_{SS}	$V_{IN} = -5\text{ V}$, No load	—	2.5	6.0	μA	2
Line regulation	$\frac{\Delta V_{OUT}}{\Delta V_{IN} - V_{OUT}}$	$-10\text{ V} \leq V_{IN} \leq -4\text{ V}$ $I_{OUT} = 1\text{ mA}$	—	0.1	—	%/V	1
Input voltage	V_{IN}		-10	—	—	V	—
Temperature characteristic of ΔV_{OUT}	$\frac{\Delta V_{OUT}}{\Delta T_a}$	$V_{IN} = -5\text{ V}$, $I_{OUT} = 10\text{ mA}$ $-20^\circ\text{C} \leq T_a \leq 70^\circ\text{C}$	—	± 0.375	—	mV/ $^\circ\text{C}$	—

2. S-80250AG, S-80250AG-GB-X (-5 V output type)

Table 4
(Unless otherwise specified: $T_a = 25^\circ\text{C}$)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit	Test cir.
Output voltage	V_{OUT}	$V_{IN} = -7\text{ V}$, $I_{OUT} = 10\text{ mA}$	-5.25	-5.00	-4.75	V	1
Output current	I_{OUT}	$V_{IN} = -7\text{ V}$	40	50	—	mA	1
Load regulation	ΔV_{OUT}	$1\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$ $V_{IN} = -7\text{ V}$	—	40	80	mV	1
I/O voltage difference	V_{dif}	$I_{OUT} = 1\text{ mA}$	—	30	—	mV	—
Current consumption	I_{SS}	$V_{IN} = -7\text{ V}$, No load	—	3.0	7.0	μA	2
Line regulation	$\frac{\Delta V_{OUT}}{\Delta V_{IN} - V_{OUT}}$	$-10\text{ V} \leq V_{IN} \leq -6\text{ V}$ $I_{OUT} = 1\text{ mA}$	—	0.1	—	%/V	1
Input voltage	V_{IN}		-10	—	—	V	—
Temperature characteristic of ΔV_{OUT}	$\frac{\Delta V_{OUT}}{\Delta T_a}$	$V_{IN} = -7\text{ V}$, $I_{OUT} = 10\text{ mA}$ $-20^\circ\text{C} \leq T_a \leq 70^\circ\text{C}$	—	± 0.625	—	mV/ $^\circ\text{C}$	—

■ Test Circuits

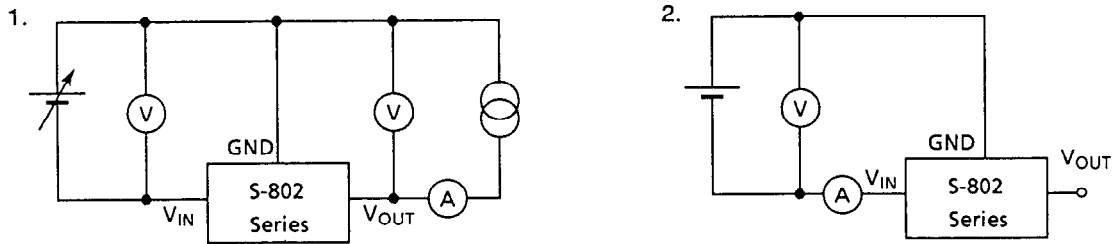
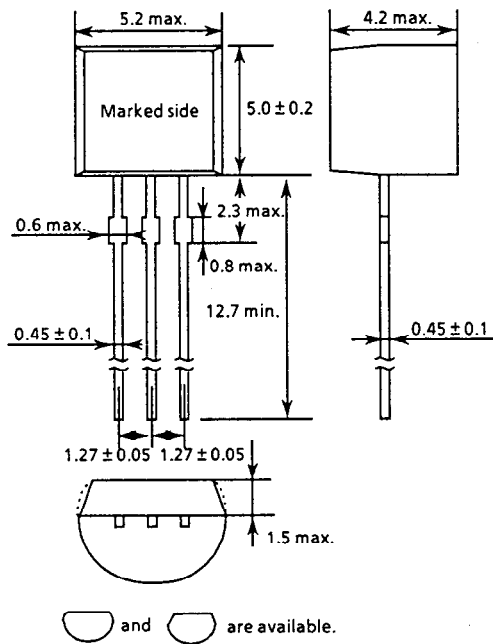


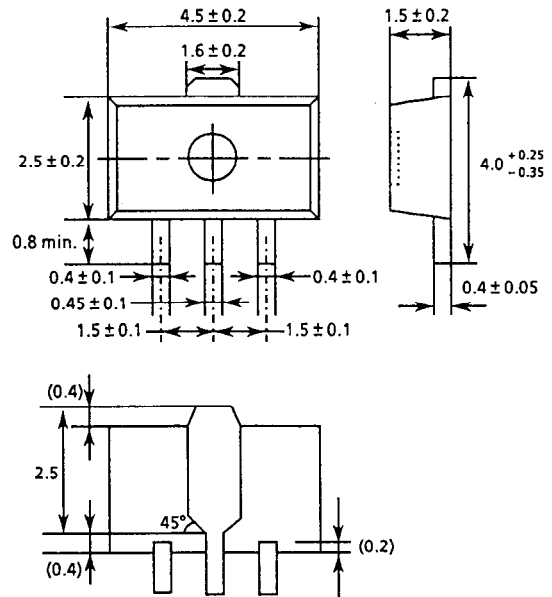
Figure 4

■ Dimensions

1. TO-92



2. SOT-89-3



Unit: mm

Figure 5

NEGATIVE VOLTAGE REGULATOR

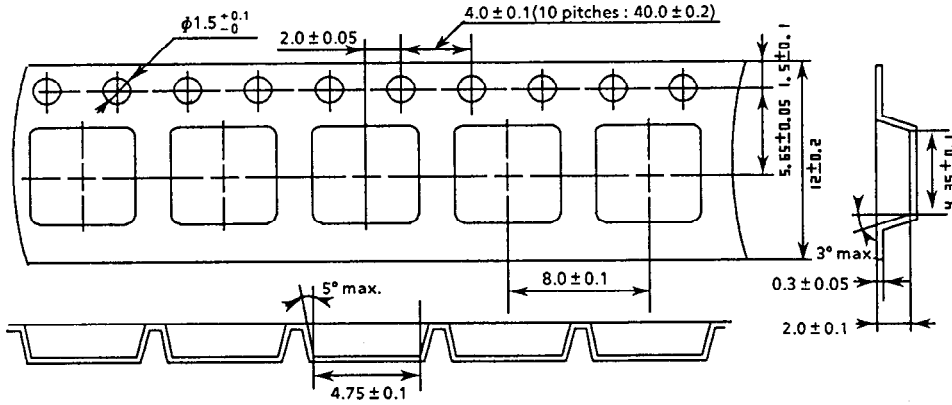
S-802 Series

■ Taping Dimensions

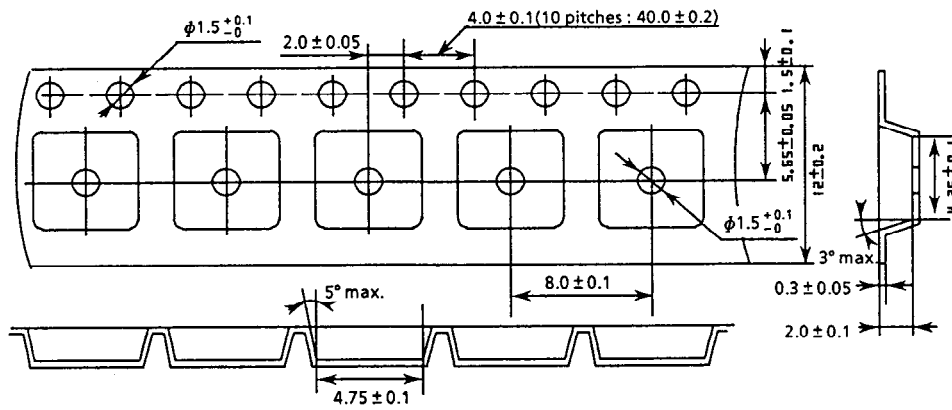
1. Tape specifications

T1 and T2 types are available depending upon the direction of ICs on the tape.

(1) White label (without a hole in the center of embossed area)



(2) Blue label (with a hole in the center of embossed area)



Unit: mm

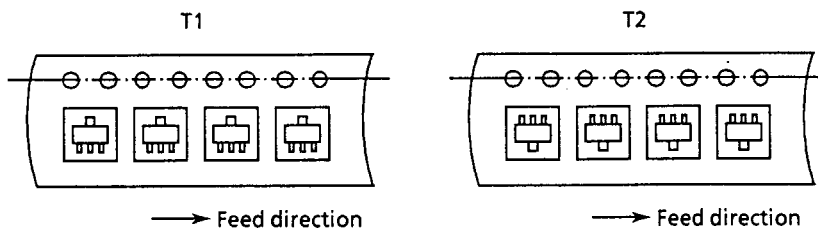


Figure 6

2. Reel specifications
1 reel has 1000 regulators.

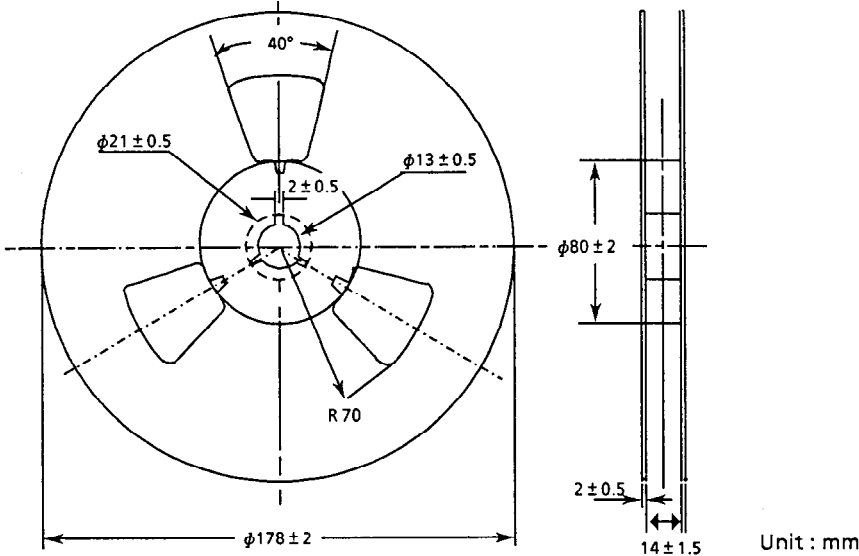


Figure 7

■ Magazine Dimensions
1 stick has 25 regulators.

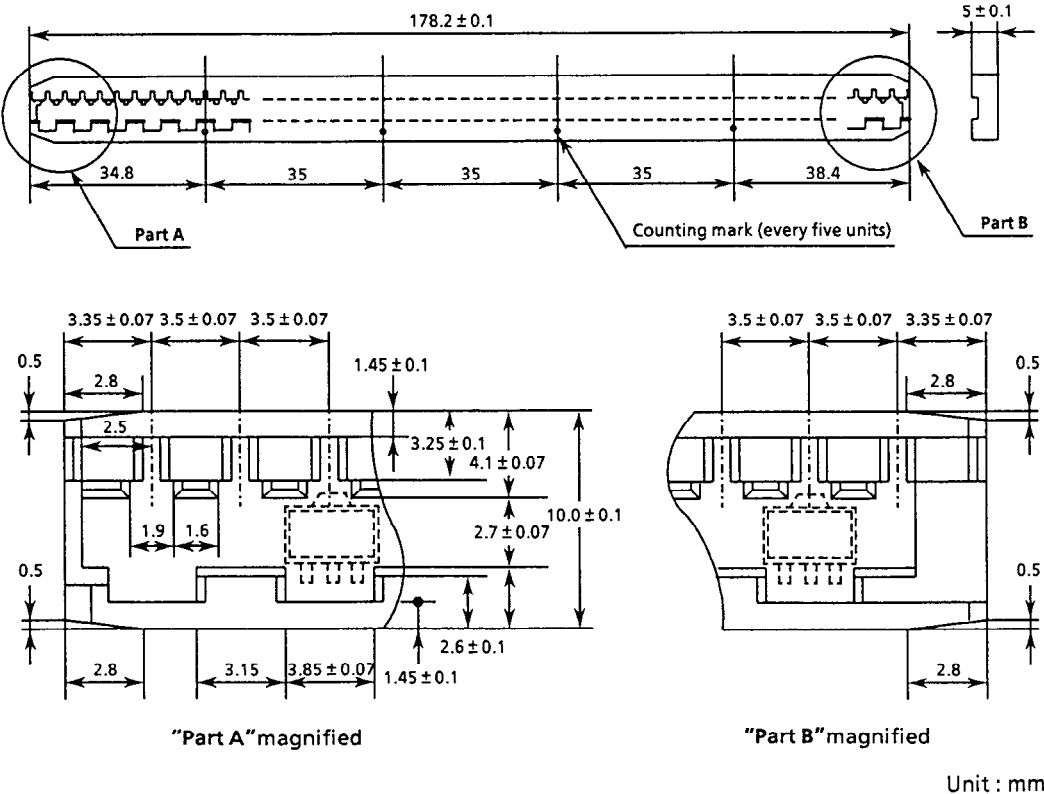
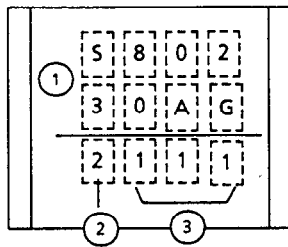


Figure 8

NEGATIVE VOLTAGE REGULATOR S-802 Series

■ Markings

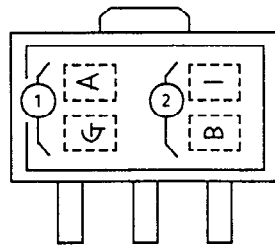
1. TO-92



- ① Product No.
- ② Last digit of the year
- ③ Lot No.

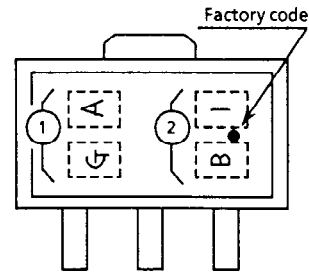
2. SOT-89-3

(1) White label



- ① Product No. (abbreviation)
- ② Lot No.

(2) Blue label



- ① Product No. (abbreviation)
- ② Lot No.

Figure 9 Marking examples

■ Technical Terms

1. Output voltage (V_{OUT})

Output voltage V_{OUT} is that voltage guaranteed by the voltage regulator (accuracy $\pm 5\%$) under given input voltage, output current, and temperature conditions. Changes in these conditions will result in an output voltage that may exceed specification limits. For details, please refer to electrical characteristics and characteristics data.

2. Line regulation ($\Delta V_{OUT}/\Delta V_{IN} \times V_{OUT}$)

This value represents the degree of dependence of the output voltage on the input voltage. It shows the change in output voltage for a given change in input voltage, with output current fixed.

3. Load regulation (ΔV_{OUT})

This value represents the degree of dependence of the output voltage on the output current. It quantifies the change in output voltage for a given change in output current, with input voltage fixed.

4. Input/output voltage difference (V_{dif})

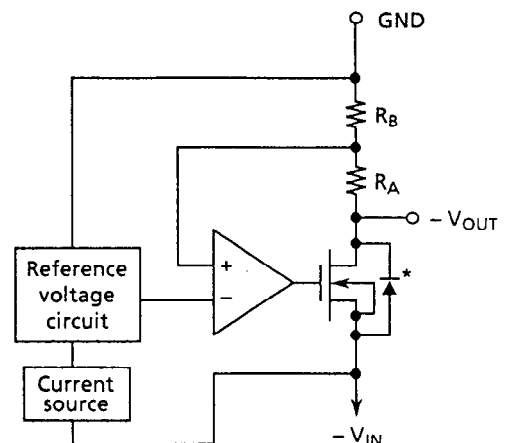
Inputting a product's output voltage (V_{OUT}) + input/output voltage difference (V_{dif}) to V_{IN} causes output of $V_{OUT} \times 95\%$. A low V_{dif} value suggests that a regulator is (1) capable of delivering constant output voltages even with marginal (low) input voltages, and (2) capable of outputting substantial current. For these reasons, a low V_{dif} value is desirable.

Note : V_{dif} is highly dependent on I_{OUT} .

■ Operation

1 Basic operation

Figure 10 shows the block diagram of the S-802 Series. The error amplifier compares a reference voltage V_{REF} with a part of the output voltage fed back by the feedback resistors R_A and R_B . It supplies the control transistor with the base current, necessary to keep a stable output voltage range not influenced by input voltage or temperature fluctuation.



* Parasitic diode

Figure 10 Reference block diagram

2 Temperature characteristic of output voltage

The temperature characteristic of the output voltage is expressed by the following formula in the range of -20°C to 70°C.

$$\frac{V_{OUT}}{V_{REF}} \times (\pm 0.1) \text{ mV/}^\circ\text{C typ.}$$

* V_{REF} is 0.7 V min., 0.8 V typ., 0.9 V max.

■ **Standard Circuits**

The basic circuits using the S-802 Series are shown in Figure 11.

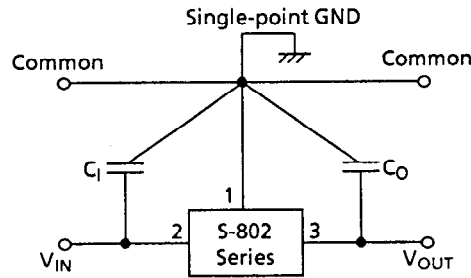


Figure 11 Basic circuits with a by-pass capacitor

■ **Notes on Design**

- Voltage regulators may oscillate if small or zero capacity is connected to IC input when the impedance of the power source is high and a large capacity is connected to IC output.
- In TO-92 products, since there are projections and resin burrs on roots of lead terminals formed at Tiebar-cut, do not solder on them.
- Because S-802 Series voltage regulators do not contain short circuit protection circuit, short-circuiting which occurs during mounting or other operations may cause damage to the component.
- Do not apply a ripple voltage of the conditions below to V_{IN} terminal.

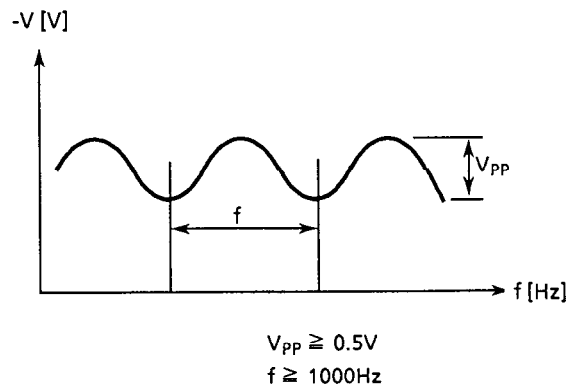


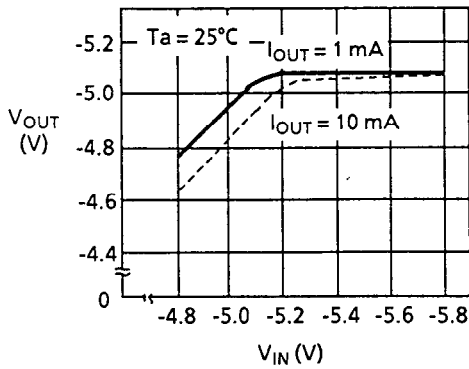
Figure 12

- When designing for mass production using an application circuit described here, take into account the deviation of components and temperature characteristics.

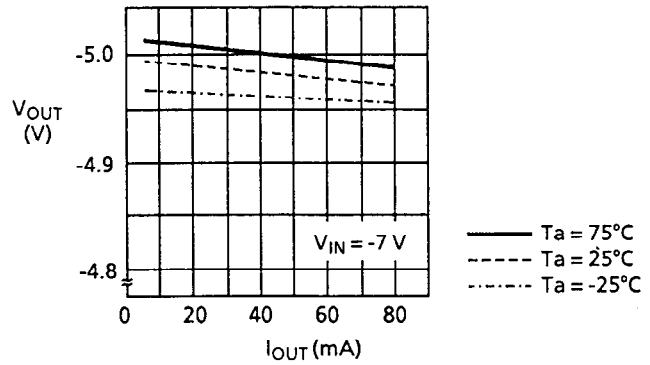
NEGATIVE VOLTAGE REGULATOR S-802 Series

■ Characteristics

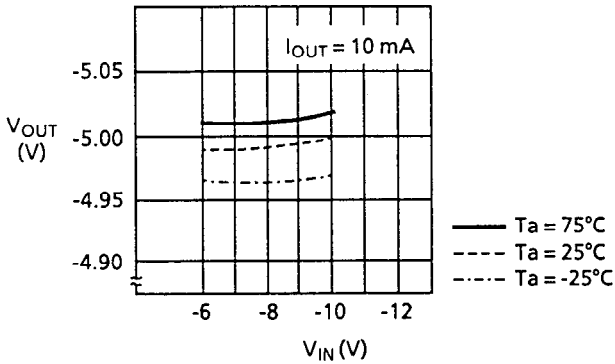
1. Input voltage - output voltage
S-80250AG, S-80250AG-GB-X



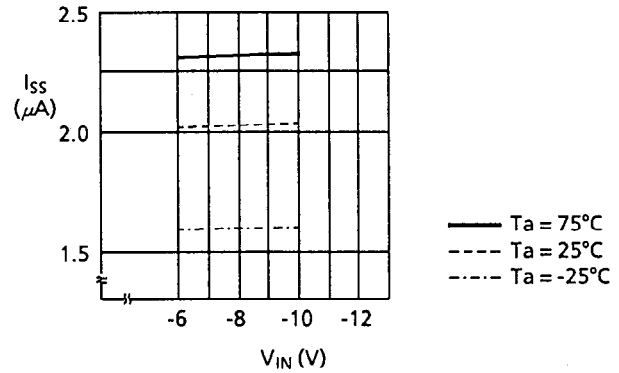
2. Output current - output voltage
S-80250AG, S-80250AG-GB-X



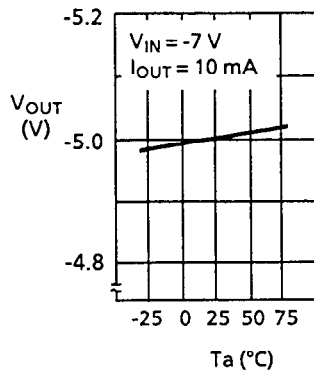
3. Input voltage - output voltage
S-80250AG, S-80250AG-GB-X



4. Current consumption characteristics
S-80250AG, S-80250AG-GB-X

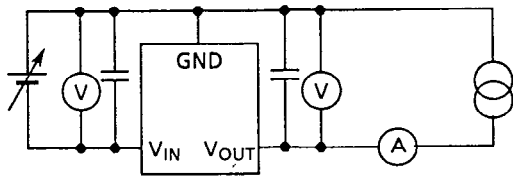


5. Temperature characteristic of output voltages
S-80250AG, S-80250AG-GB-X

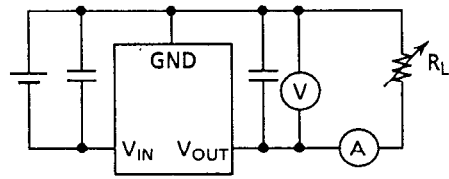


■ Measuring Circuits

1. Input voltage - output voltage



2. Output current - output voltage



3. Current consumption

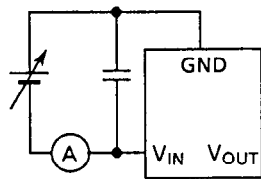


Figure 13