

## SI-3000J Series

# 5-Terminal, Multi-Function, Full-Mold, Low Dropout Voltage Dropper Type

### ■Features

- Compact full-mold package (equivalent to TO220)
- Output current: 2.0A
- Low dropout voltage:  $V_{DIF} \leq 1V$  (at  $I_o = 2.0A$ )
- Variable output voltage (rise only) May be used for remote sensing
- Output ON/OFF control terminal is compatible with LS-TTL. (It may be directly driven by LS-TTL or standard CMOS logic.)
- Built-in foldback overcurrent, overvoltage, thermal protection circuits

### ■Applications

- For stabilization of the secondary stage of switching power supplies
- Electronic equipment



### ■Absolute Maximum Ratings

( $T_a = 25^\circ C$ )

| Parameter                                    | Symbol        | Ratings                                       |          |                | Unit         |
|----------------------------------------------|---------------|-----------------------------------------------|----------|----------------|--------------|
|                                              |               | SI-3050J                                      | SI-3090J | SI-3120J/3150J |              |
| DC Input Voltage                             | $V_{IN}$      | 25                                            | 30       | 35             | V            |
| Voltage of Output Control Terminal           | $V_c$         | $V_{IN}$                                      |          |                | V            |
| DC Output Current                            | $I_o$         | $2.0^{*1}$                                    |          |                | A            |
| Power Dissipation                            | $P_{D1}$      | 20(With infinite heatsink)                    |          |                | W            |
|                                              | $P_{D2}$      | 1.5(Without heatsink, stand-alone operation)  |          |                | W            |
| Junction Temperature                         | $T_j$         | -40 to +125                                   |          |                | $^\circ C$   |
| Ambient Operating Temperature                | $T_{op}$      | -30 to +100                                   |          |                | $^\circ C$   |
| Storage Temperature                          | $T_{stg}$     | -40 to +125                                   |          |                | $^\circ C$   |
| Thermal Resistance (junction to case)        | $R_{th(j-c)}$ | 5.0                                           |          |                | $^\circ C/W$ |
| Thermal Resistance (junction to ambient air) | $R_{th(j-a)}$ | 66.7(Without heatsink, stand-alone operation) |          |                | $^\circ C/W$ |

■Electrical Characteristics

(Ta=25°C unless otherwise specified)

| Parameter                                               | Symbol                           | Ratings                                                              |                      |                 |                                                                       |      |                 |                                                                       |       |                 |                                                                       |       |                 | Unit  |    |
|---------------------------------------------------------|----------------------------------|----------------------------------------------------------------------|----------------------|-----------------|-----------------------------------------------------------------------|------|-----------------|-----------------------------------------------------------------------|-------|-----------------|-----------------------------------------------------------------------|-------|-----------------|-------|----|
|                                                         |                                  | SI-3050J                                                             |                      |                 | SI-3090J                                                              |      |                 | SI-3120J                                                              |       |                 | SI-3150J                                                              |       |                 |       |    |
|                                                         |                                  | min.                                                                 | typ.                 | max.            | min.                                                                  | typ. | max.            | min.                                                                  | typ.  | max.            | min.                                                                  | typ.  | max.            |       |    |
| Input Voltage                                           | V <sub>IN</sub>                  | 6 <sup>2</sup>                                                       |                      | 15 <sup>1</sup> | 10 <sup>2</sup>                                                       |      | 25 <sup>1</sup> | 13 <sup>2</sup>                                                       |       | 27 <sup>1</sup> | 16 <sup>2</sup>                                                       |       | 27 <sup>1</sup> | V     |    |
| Output Voltage                                          | V <sub>O</sub>                   | 4.90                                                                 | 5.00                 | 5.10            | 8.82                                                                  | 9.00 | 9.18            | 11.76                                                                 | 12.00 | 12.24           | 14.70                                                                 | 15.00 | 15.30           | V     |    |
|                                                         | Conditions                       | V <sub>IN</sub> =8V, I <sub>O</sub> =1.0A                            |                      |                 | V <sub>IN</sub> =12V, I <sub>O</sub> =1.0A                            |      |                 | V <sub>IN</sub> =15V, I <sub>O</sub> =1.0A                            |       |                 | V <sub>IN</sub> =18V, I <sub>O</sub> =1.0A                            |       |                 |       |    |
| Dropout Voltage                                         | V <sub>DIF</sub>                 |                                                                      |                      | 0.5             |                                                                       |      | 0.5             |                                                                       |       | 0.5             |                                                                       |       | 0.5             | V     |    |
|                                                         | Conditions                       | I <sub>O</sub> ≤1.5A                                                 |                      |                 |                                                                       |      |                 |                                                                       |       |                 |                                                                       |       |                 |       |    |
|                                                         | Conditions                       |                                                                      |                      | 1.0             |                                                                       |      | 1.0             |                                                                       |       | 1.0             |                                                                       |       | 1.0             |       |    |
| Line Regulation                                         | ΔV <sub>OLINE</sub>              |                                                                      | 10                   | 30              |                                                                       | 18   | 48              |                                                                       | 24    | 64              |                                                                       | 30    | 90              | mV    |    |
|                                                         | Conditions                       | V <sub>IN</sub> =6 to 15V, I <sub>O</sub> =1.0A                      |                      |                 | V <sub>IN</sub> =10 to 20V, I <sub>O</sub> =1.0A                      |      |                 | V <sub>IN</sub> =13 to 25V, I <sub>O</sub> =1.0A                      |       |                 | V <sub>IN</sub> =16 to 25V, I <sub>O</sub> =1.0A                      |       |                 |       |    |
| Load Regulation                                         | ΔV <sub>OLOAD</sub>              |                                                                      | 40                   | 100             |                                                                       | 70   | 180             |                                                                       | 93    | 240             |                                                                       | 120   | 300             | mV    |    |
|                                                         | Conditions                       | V <sub>IN</sub> =8V, I <sub>O</sub> =0 to 2.0A                       |                      |                 | V <sub>IN</sub> =12V, I <sub>O</sub> =0 to 2.0A                       |      |                 | V <sub>IN</sub> =15V, I <sub>O</sub> =0 to 2.0A                       |       |                 | V <sub>IN</sub> =18V, I <sub>O</sub> =0 to 2.0A                       |       |                 |       |    |
| Temperature Coefficient of Output Voltage               | ΔV <sub>O</sub> /ΔT <sub>a</sub> |                                                                      | ±0.5                 |                 |                                                                       | ±1.0 |                 |                                                                       | ±1.5  |                 |                                                                       | ±1.5  |                 | mV/°C |    |
|                                                         | Conditions                       | V <sub>IN</sub> =8V, I <sub>O</sub> =5mA, T <sub>J</sub> =0 to 100°C |                      |                 | V <sub>IN</sub> =12V, I <sub>O</sub> =5mA, T <sub>J</sub> =0 to 100°C |      |                 | V <sub>IN</sub> =15V, I <sub>O</sub> =5mA, T <sub>J</sub> =0 to 100°C |       |                 | V <sub>IN</sub> =18V, I <sub>O</sub> =5mA, T <sub>J</sub> =0 to 100°C |       |                 |       |    |
| Ripple Rejection                                        | R <sub>REJ</sub>                 |                                                                      | 54                   |                 |                                                                       | 54   |                 |                                                                       | 54    |                 |                                                                       | 54    |                 | dB    |    |
|                                                         | Conditions                       | V <sub>IN</sub> =8V, f=100 to 120Hz                                  |                      |                 | V <sub>IN</sub> =12V, f=100 to 120Hz                                  |      |                 | V <sub>IN</sub> =15V, f=100 to 120Hz                                  |       |                 | V <sub>IN</sub> =18V, f=100 to 120Hz                                  |       |                 |       |    |
| Quiescent Circuit Current                               | I <sub>q</sub>                   |                                                                      | 3                    | 10              |                                                                       | 3    | 10              |                                                                       | 3     | 10              |                                                                       | 3     | 10              | mA    |    |
|                                                         | Conditions                       | V <sub>IN</sub> =8V, I <sub>O</sub> =0A                              |                      |                 | V <sub>IN</sub> =12V, I <sub>O</sub> =0A                              |      |                 | V <sub>IN</sub> =15V, I <sub>O</sub> =0A                              |       |                 | V <sub>IN</sub> =18V, I <sub>O</sub> =0A                              |       |                 |       |    |
|                                                         | I <sub>q</sub> (off)             |                                                                      | 0.5                  | 1.0             |                                                                       | 0.5  | 1.0             |                                                                       | 0.5   | 1.0             |                                                                       | 0.5   | 1.0             | mA    |    |
| Overcurrent Protection Starting Current <sup>*3,5</sup> | I <sub>s1</sub>                  | 2.1                                                                  |                      |                 | 2.1                                                                   |      |                 | 2.1                                                                   |       |                 | 2.1                                                                   |       |                 | A     |    |
|                                                         | Conditions                       | V <sub>IN</sub> =8V                                                  |                      |                 | V <sub>IN</sub> =12V                                                  |      |                 | V <sub>IN</sub> =15V                                                  |       |                 | V <sub>IN</sub> =18V                                                  |       |                 |       |    |
| V <sub>C</sub> Terminal <sup>*4</sup>                   | Control Voltage (Output ON)      | V <sub>C</sub> IH                                                    | 2.0                  |                 |                                                                       | 2.0  |                 |                                                                       | 2.0   |                 |                                                                       | 2.0   |                 | V     |    |
|                                                         | Control Voltage (Output OFF)     | V <sub>C</sub> IL                                                    |                      |                 | 0.8                                                                   |      |                 | 0.8                                                                   |       |                 | 0.8                                                                   |       | 0.8             |       |    |
|                                                         | Control Current (Output ON)      | I <sub>C</sub> IH                                                    |                      |                 | 20                                                                    |      |                 | 20                                                                    |       |                 | 20                                                                    |       |                 | 20    | μA |
|                                                         |                                  | Conditions                                                           | V <sub>C</sub> =2.7V |                 |                                                                       |      |                 |                                                                       |       |                 |                                                                       |       |                 |       |    |
|                                                         | Control Current (Output OFF)     | I <sub>C</sub> IL                                                    |                      |                 | -0.3                                                                  |      |                 | -0.3                                                                  |       |                 | -0.3                                                                  |       |                 | -0.3  | mA |
| Conditions                                              |                                  | V <sub>C</sub> =0.4V                                                 |                      |                 |                                                                       |      |                 |                                                                       |       |                 |                                                                       |       |                 |       |    |

\*1: V<sub>IN(max)</sub> and I<sub>O(max)</sub> are restricted by the relation P<sub>D(max)</sub>=(V<sub>IN</sub>-V<sub>O</sub>)•I<sub>O</sub>=20(W).

\*2: Refer to the dropout voltage.(Refer to Setting DC Input Voltage on page 7.)

\*3: I<sub>s1</sub> is specified at -5(%) drop point of output voltage V<sub>O</sub> on the condition that V<sub>IN</sub>=V<sub>O</sub>+3V, I<sub>O</sub>=0.5A.

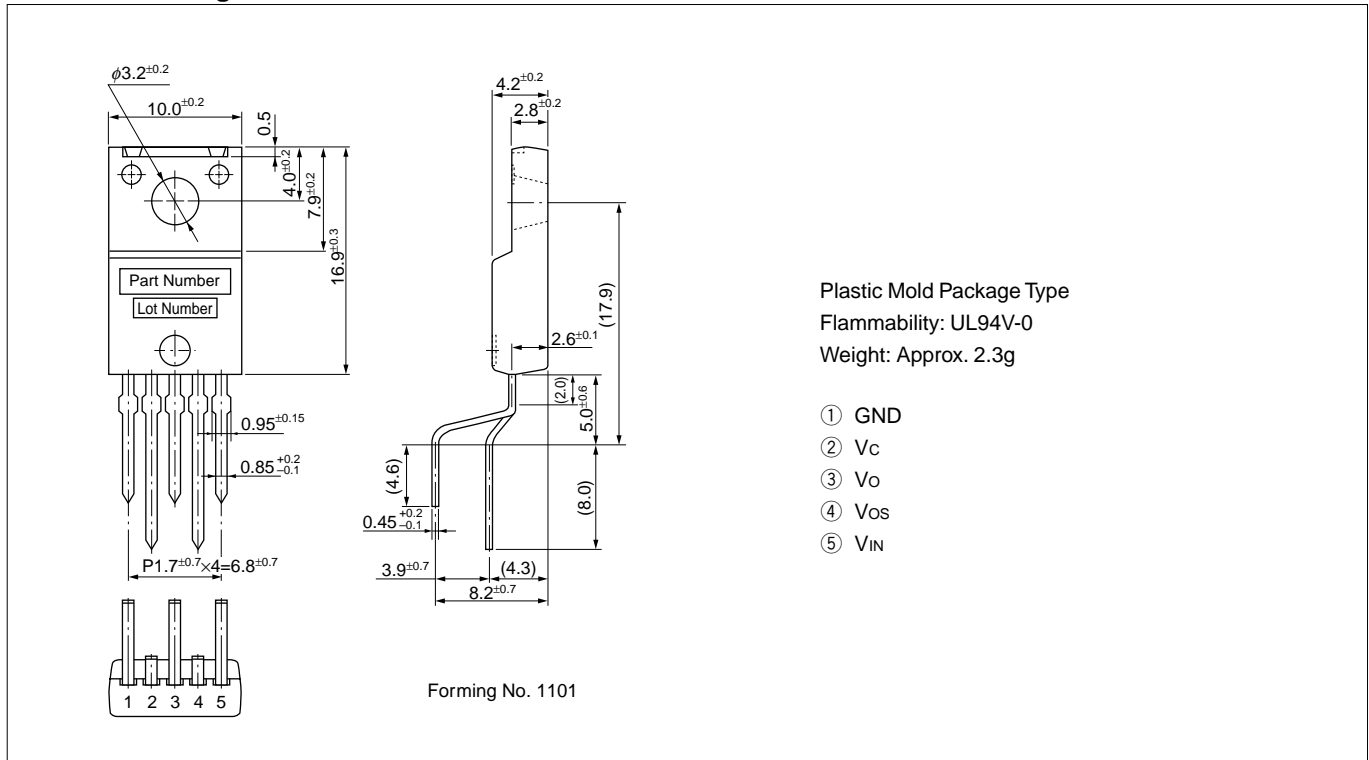
\*4: Output is ON even when output control terminal V<sub>C</sub> is open. Each input level is equivalent to LS-TTL. Therefore, it may be directly driven by an LS-TTL circuit.

\*5: A foldback type overcurrent protection circuit is built into the I<sub>C</sub> regulator. Therefore, avoid using it for the following applications as it may cause starting errors:

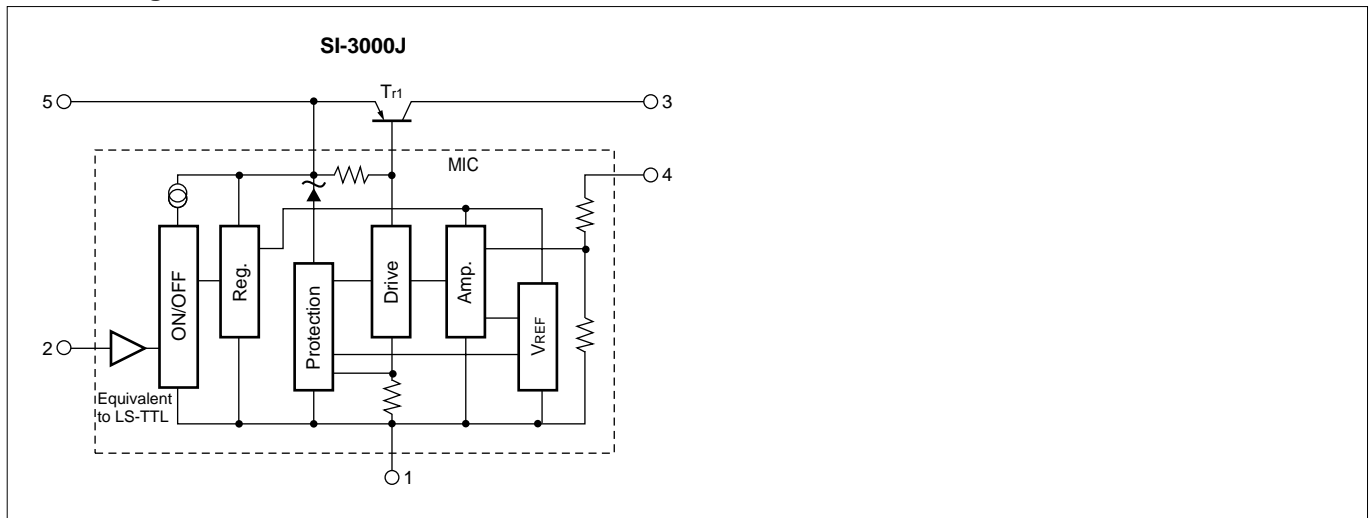
- (1) Constant current load (2) Plus/minus power (3) Series power (4) V<sub>O</sub> adjustment by raising ground voltage

■Outline Drawing

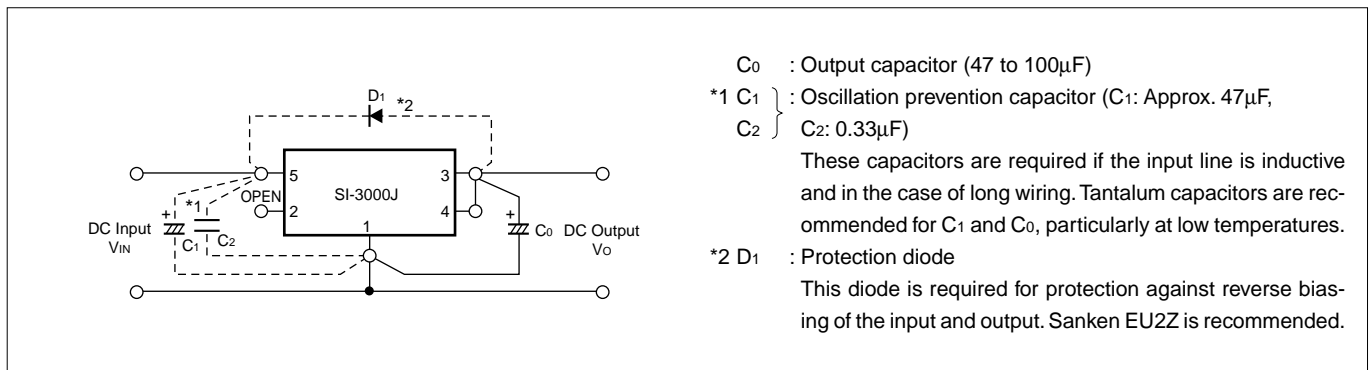
(unit:mm)

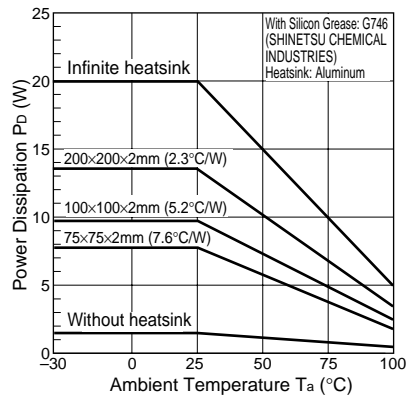


■Block Diagram



■Standard External Circuit

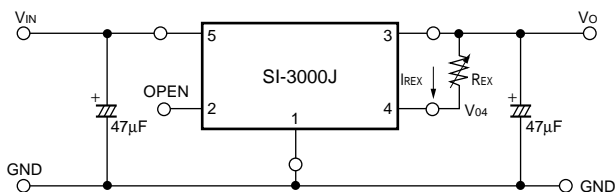


■ $T_a$ - $P_D$  Characteristics

$$P_D = I_o \cdot [V_{IN(\text{mean})} - V_o]$$

## External Variable Output Voltage Circuit

### 1. Variable output voltage with a single external resistor

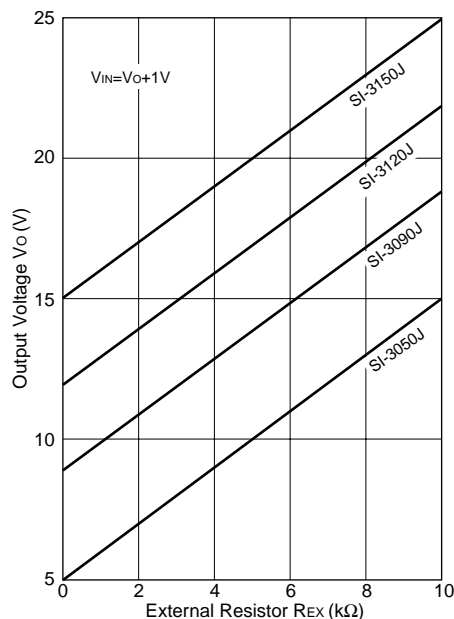


The output voltage may be increased by inserting resistor  $R_{EX}$  between terminals No.4 (sensing terminal) and No.3 (output terminal). The current  $I_{REX}$  flowing into terminal No.4 is 1mA (typ.), therefore the adjusted output voltage  $V_{OUT}$  is:

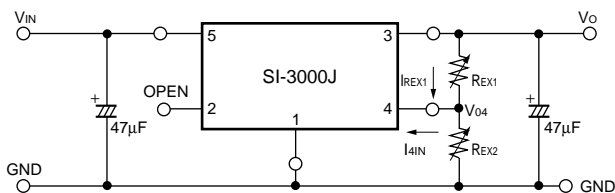
$$V_O = V_{04} + I_{REX} \cdot R_{EX} \quad *V_{04}: \text{output voltage of SI-3000J series}$$

However, the built-in resistor (between terminals No. 4 and No.1) is a semiconductor resistor, which has approximately thermal characteristics of +0.2%/°C.

It is important to keep the thermal characteristics in mind when adjusting the output voltage.



### 2. Variable output voltage with two external resistors



The output voltage may be increased by inserting resistors  $R_{EX1}$  between terminals No.4 (sensing terminal) and No.3 (output terminal) and  $R_{EX2}$  between terminals No.4 and No.1 (ground terminal).

The current  $I_{4IN}$  flowing into terminal No.4 is 1mA (typ.) so the thermal characteristics may be improved compared to the method shown in 1 by setting the external current  $I_{REX1}$  at approximately 5 times the value of  $I_{4IN}$  (stability coefficient  $S=5$ ).

The adjusted output voltage  $V_{OUT}$  in this case is:

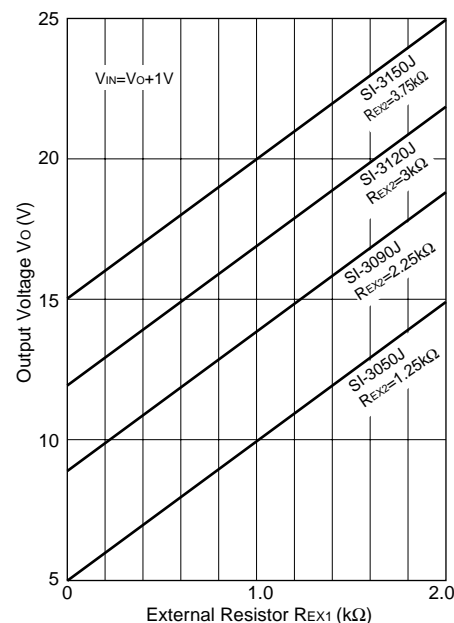
$$\begin{cases} V_O = V_{04} + R_{EX1} \cdot I_{REX1} \\ I_{REX1} = S \cdot I_{4IN} \end{cases}$$

The value of the external resistors may be obtained as follows:

$$R_{EX1} = \frac{V_O - V_{04}}{S \cdot I_{4IN}}, \quad R_{EX2} = \frac{V_{04}}{(S-1) \cdot I_{4IN}}$$

\* $V_{04}$ : Output voltage of SI-3000J series

S: Stability coefficient of  $I_{4IN}$  (may be set to any value)

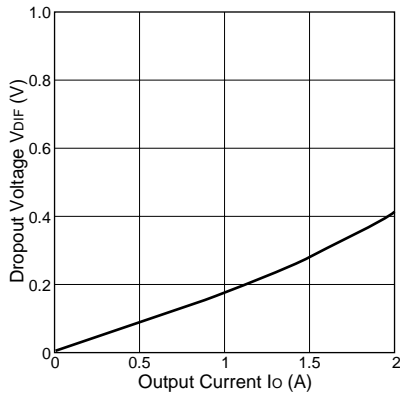


Note: In the SI-3000J series, the output voltage increase can be adjusted as mentioned above. However, when the rise is set to approximately 10V compared to output voltage  $V_{04}$ , the necessary output current may not be obtained due to the S.O.A. protection circuit in the SI-3000J series.

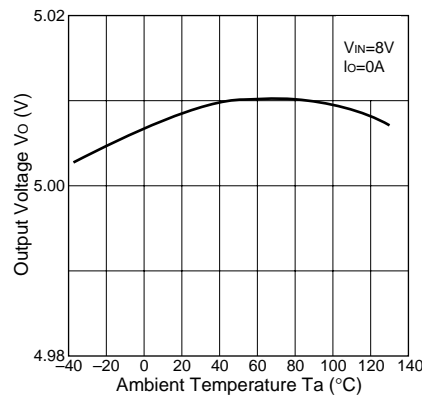
■Typical Characteristics

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

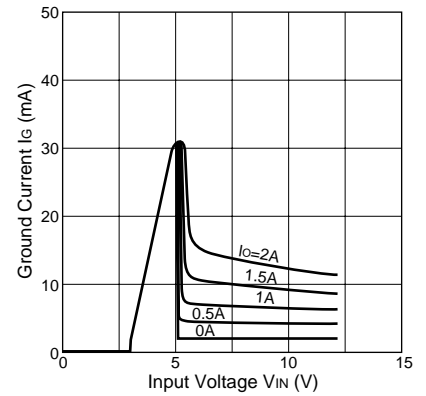
Io vs. VdIF Characteristics



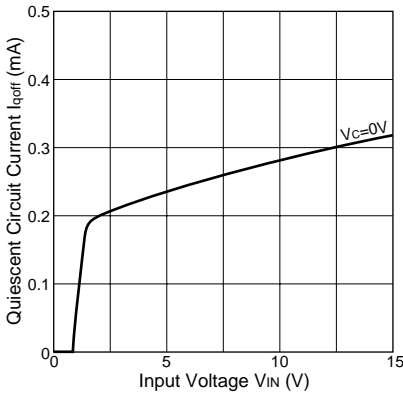
Temperature Coefficient of Output Voltage(SI-3050J)



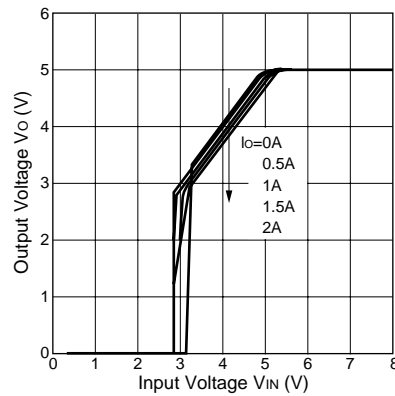
Circuit Current(SI-3050J)



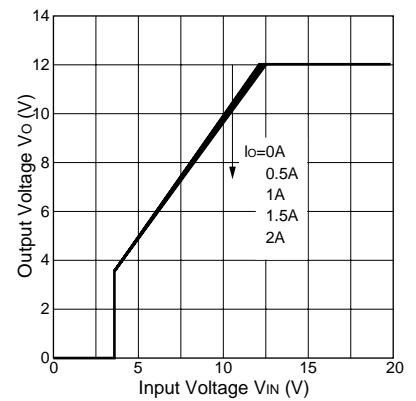
Quiescent Circuit Current(SI-3050J)



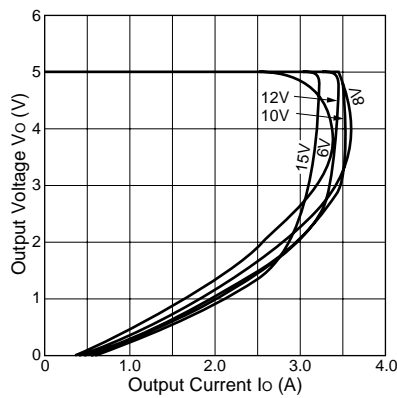
Rise Characteristics(SI-3050J)



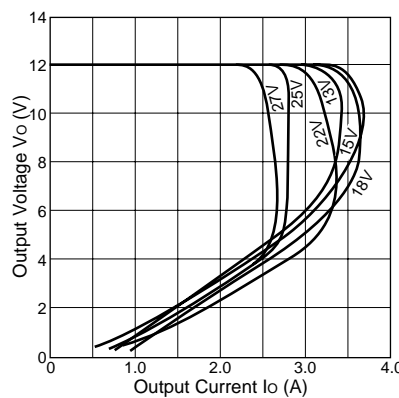
Rise Characteristics(SI-3120J)



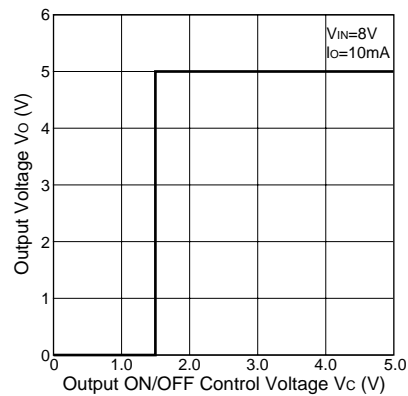
Overcurrent Protection Characteristics(SI-3050J)



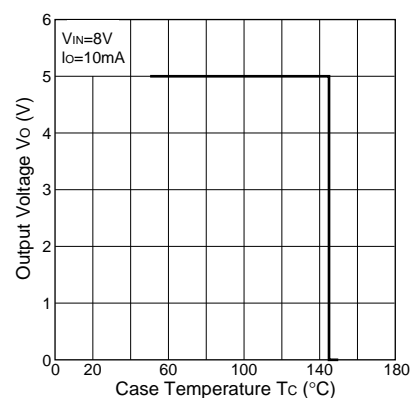
Overcurrent Protection Characteristics(SI-3120J)



ON/OFF Control Characteristics(SI-3050J)



Thermal Protection(CharacteristicsSI-3050J)



**Note on Thermal Protection:**

The thermal protection circuit is intended for protection against heat during instantaneous short-circuiting. Its operation is not guaranteed for short-circuiting over extended periods of time.