SI-3000J Series 5-Terminal, Full-Mold, Low Dropout Voltage Linear Regulator ICs

■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) Available for remote sensing used for remote sensing.
- Output ON/OFF control terminal is compatible with LS-TTL.
  (It can be driven directly by LS-TTL or standard CMOS logic.)
- Built-in foldback-overcurrent, input-overvoltage and thermal protection circuits

■Absolute Maximum Ratings

(T_a=25°C)

Parameter	Symbol	Ratings SI-3050J	Ratings SI-3090J	Ratings SI-3120J/3150J	Unit
DC Input Voltage	V_{IN}	25	30	35	V
Output Control Terminal Voltage	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			°C
Operating Ambient Temperature	T_{op}	–30 to +100			°C
Storage Temperature	T_{stg}	–40 to +125			°C
Thermal Resistance (junction to case)	θ_{j-c}	5.0			°C/W
Thermal Resistance (junction to ambient air)	θ_{j-a}	66.7(Without heatsink, stand-alone operation)			°C/W

■Applications

- For stabilization of the secondary-side output voltage of switching power supplies
- Electronic equipment

■Electrical Characteristics

(T_a=25°C unless otherwise specified)

Parameter	Symbol	SI-3050J min.	SI-3050J typ.	SI-3050J max.	SI-3090J min.	SI-3090J typ.	SI-3090J max.	SI-3120J min.	SI-3120J typ.	SI-3120J max.	SI-3150J min.	SI-3150J typ.	SI-3150J max.	Unit
Input Voltage	V_{IN}	6*2		15*1	10*2		25*1	13*2		27*1	16*2		27*1	V
Output Voltage	V_O	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_{IN}=8V, I_O=1.0A			V_{IN}=12V, I_O=1.0A			V_{IN}=15V, I_O=1.0A			V_{IN}=18V, I_O=1.0A			
Dropout Voltage	V_{DIF}			0.5			0.5			0.5			0.5	V
	Conditions	$I_O \leq 1.5A$												
				1.0			1.0			1.0			1.0	
	Conditions	$I_O \leq 2.0A$												
Line Regulation	ΔV_{OLINE}		10	30		18	48		24	64		30	90	mV
	Conditions	V_{IN}=6 to 15V, I_O=1.0A			V_{IN}=10 to 20V, I_O=1.0A			V_{IN}=13 to 25V, I_O=1.0A			V_{IN}=16 to 25V, I_O=1.0A			
Load Regulation	ΔV_{OLOAD}		40	100		70	180		93	240		120	300	mV
	Conditions	V_{IN}=8V, I_O=0 to 2.0A			V_{IN}=12V, I_O=0 to 2.0A			V_{IN}=15V, I_O=0 to 2.0A			V_{IN}=18V, I_O=0 to 2.0A			
Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T_a$		±0.5			±1.0			±1.5			±1.5		mV/°C
	Conditions	V_{IN}=8V, I_O=5mA, T_j=0 to 100°C			V_{IN}=12V, I_O=5mA, T_j=0 to 100°C			V_{IN}=15V, I_O=5mA, T_j=0 to 100°C			V_{IN}=18V, I_O=5mA, T_j=0 to 100°C			
Ripple Rejection	R_{REJ}		54			54			54			54		dB
	Conditions	V_{IN}=8V, f=100 to 120Hz			V_{IN}=12V, f=100 to 120Hz			V_{IN}=15V, f=100 to 120Hz			V_{IN}=18V, f=100 to 120Hz			
Quiescent Circuit Current	I_q		3	10		3	10		3	10		3	10	mA
	Conditions	V_{IN}=8V, I_O=0A			V_{IN}=12V, I_O=0A			V_{IN}=15V, I_O=0A			V_{IN}=18V, I_O=0A			
	I_q(off)		0.5	1.0		0.5	1.0		0.5	1.0		0.5	1.0	mA
	Conditions	V_{IN}=8V, I_O=0A, V_C=0.4V			V_{IN}=12V, I_O=0A, V_C=0.4V			V_{IN}=15V, I_O=0A, V_C=0.4V			V_{IN}=18V, I_O=0A, V_C=0.4V			
Overcurrent Protection Starting Current*3,5	I_{S1}	2.1			2.1			2.1			2.1			A
	Conditions	V_{IN}=8V			V_{IN}=12V			V_{IN}=15V			V_{IN}=18V			
V_C Terminal*4: Control Voltage (Output ON)	$V_{C.IH}$	2.0			2.0			2.0			2.0			V
V_C Terminal*4: Control Voltage (Output OFF)	$V_{C.IL}$			0.8			0.8			0.8			0.8	V
V_C Terminal*4: Control Current (Output ON)	$I_{C.IH}$			20			20			20			20	µA
	Conditions	V_C=2.7V												
V_C Terminal*4: Control Current (Output OFF)	$I_{C.IL}$			–0.3			–0.3			–0.3			–0.3	mA
	Conditions	V_C=0.4V												

*1: $V_{IN(max)}$ and $I_{O(max)}$ are restricted by the relation $P_{D(max)}=(V_{IN}-V_O) \cdot I_O$=20(W).
*2: Refer to the Dropout Voltage parameter. (Refer to Setting DC Input Voltage on page 9.)
*3: I_{S1} is specified at the 5% drop point of output voltage V_O on the condition that $V_{IN}=V_O$+3V, I_O=1A.
*4: Output is ON even when output control terminal V_C is open. Each input level is equivalent to LS-TTL level. Therefore, it can be driven directly by LS-TTLs.
*5: These products cannot be used in the following applications because the built-in foldback-type overcurrent protection may cause errors during start-up stage.
(1) Constant current load (2) Positive and negative power supply (3) Series-connected power supply (4) V_O adjustment by raising ground voltage

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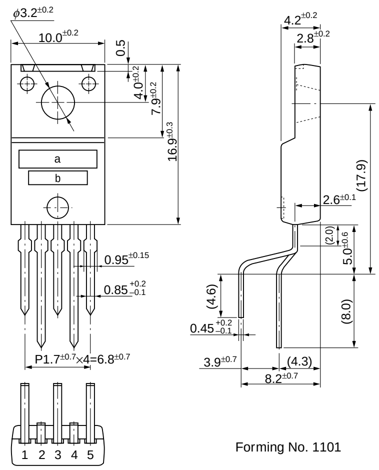
■External Dimensions (TO220F-5)

(unit : mm)

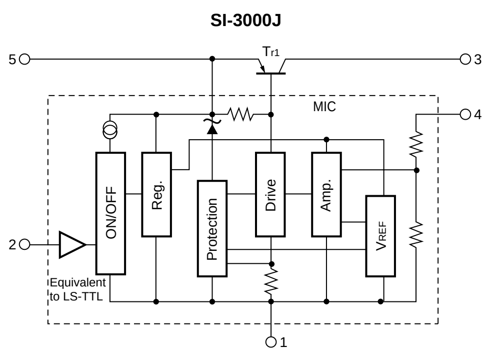


a. Part Number
b. Lot Number

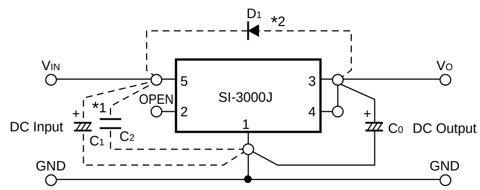
Pin Assignment
① GND
② V_C
③ V_O
④ Sense
⑤ V_{IN}

Plastic Mold Package Type
Flammability: UL94V-0
Product Mass: Approx. 2.3g

■Block Diagram

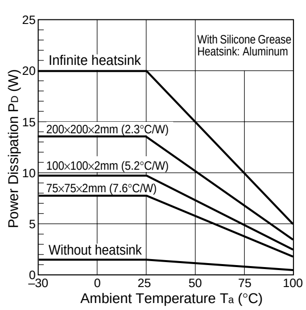


■Typical Connection Diagram



C_0 : Output capacitor (47 to 100μF)
*1 C_1, C_2 : Oscillation prevention capacitor (Approx. C_1: 47μF, C_2: 0.33μF)
These capacitors are required if the input line contains inductance or the wiring is long. Especially at low temperatures, tantalum capacitors are recommended for C_1 and C_0.
*2 D_1 : Protection diode
This diode is required for protection against reverse biasing of the input and output. Sanken EU2Z is recommended.

■T_a-P_D Characteristics



$P_D = I_O \cdot [V_{IN}(mean) - V_O]$

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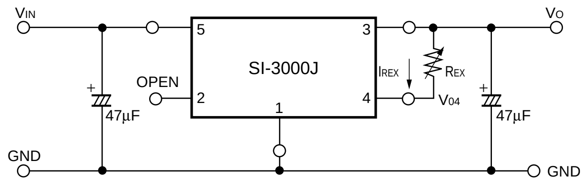
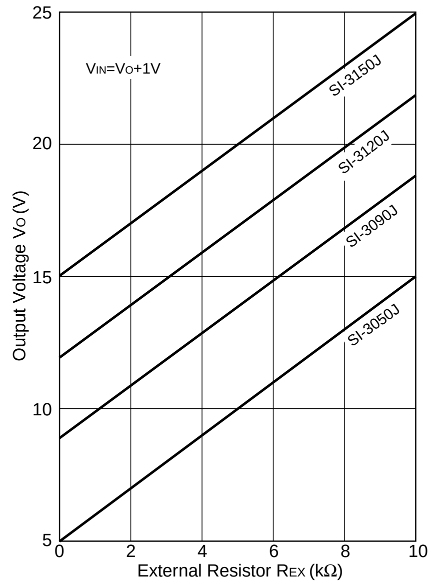
External Variable Output Voltage Circuit

1. Variable output voltage with a single external resistor





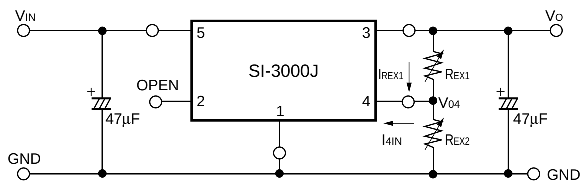
The output voltage may be increased by inserting resistor R_{EX} between terminals No.4 (sensing terminal) and No.3 (output terminal). The current I_{REX} flowing into terminal No.4 is 1mA (typ.), therefore the adjusted output voltage V_{OUT} is:

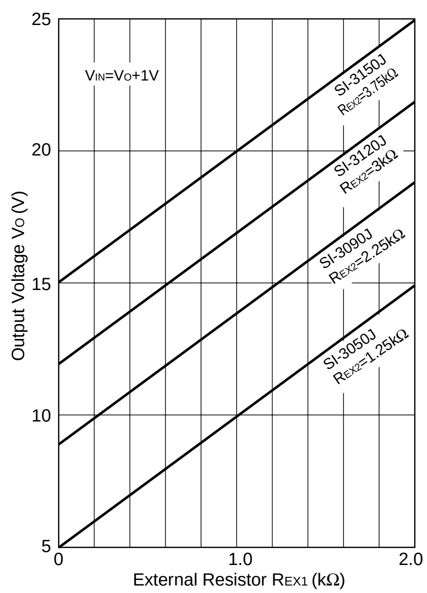
$V_O=V_{04}+I_{REX} \cdot R_{EX}$ *V_{04}: output voltage of SI-3000J series

However, the internal 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.

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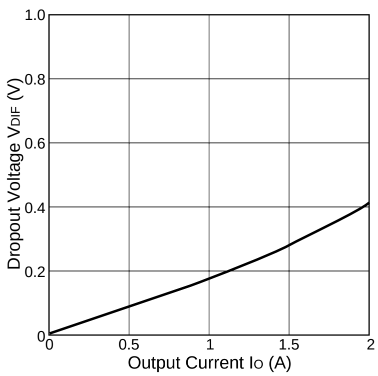
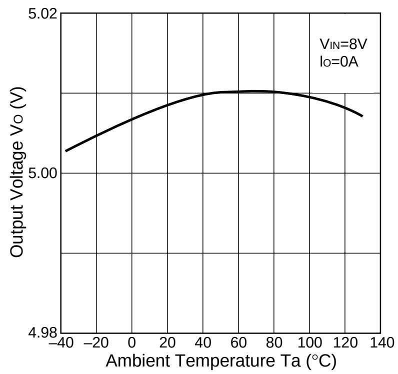
■Typical Characteristics

(T_a=25°C)

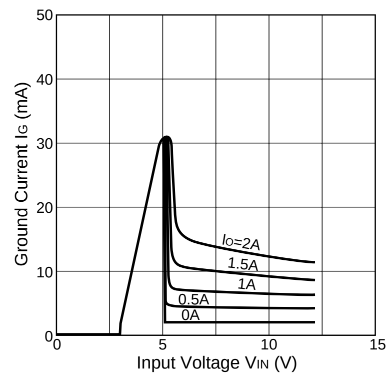
I_O vs. V_{DIF} Characteristics



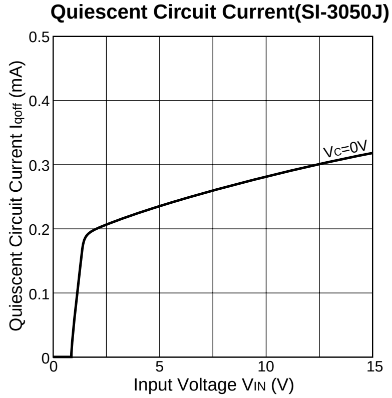
Temperature Coefficient of Output Voltage(SI-3050J)



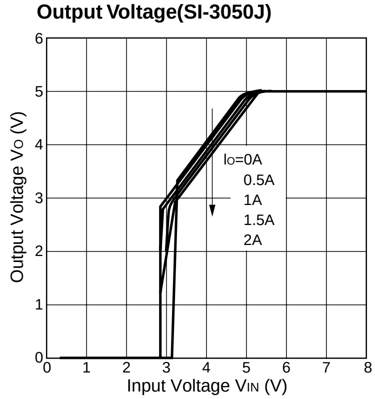
Circuit Current(SI-3050J)



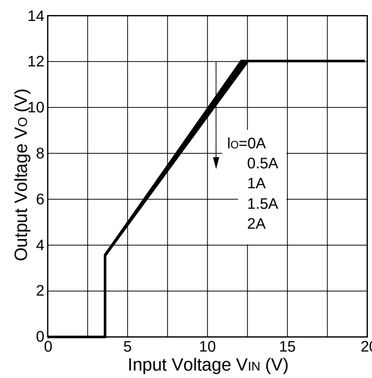
Quiescent Circuit Current(SI-3050J)



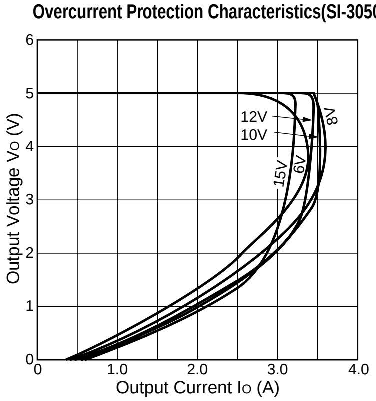
Output Voltage(SI-3050J)



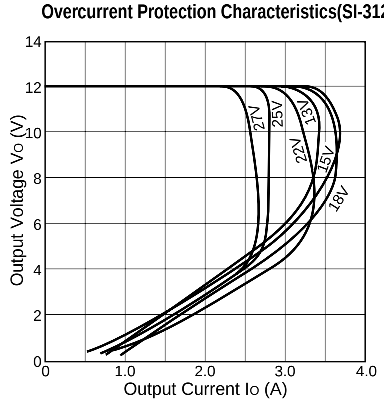
Output Voltage(SI-3120J)



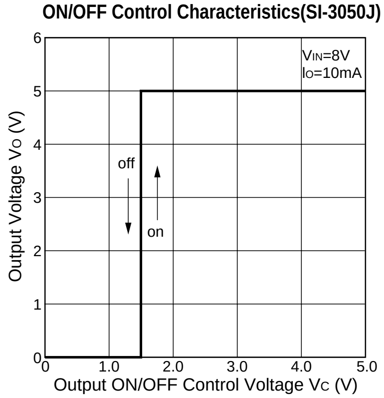
Overcurrent Protection Characteristics(SI-3050J)



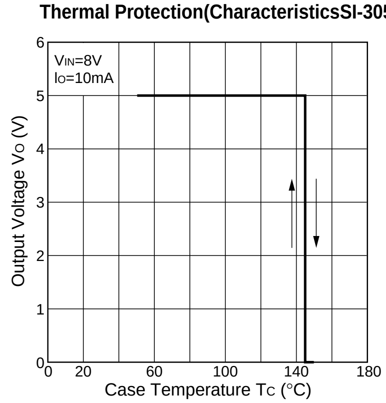
Overcurrent Protection Characteristics(SI-3120J)



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 continuous heating condition such as short-circuiting over extended periods of time.

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