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

■Features

- Compact full-mold package (equivalent to TO220)
- Output current: 1.5A
- Low dropout voltage: $V_{DIF} \leq 1V$ (at I_O=1.5A)
- Variable output voltage (rise only)

  Available 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 (SI-3033C: Drooping type overcurrent), input-overvoltage and thermal protection circuits

■Applications

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

■Absolute Maximum Ratings

(T_a=25°C)

Parameter	Symbol	Ratings				Unit
		SI-3033C	SI-3050C/3090C	SI-3120C/3150C	SI-3240C	
DC Input Voltage	V_{IN}	20	35	35	45	V
Output Control Terminal Voltage	V_C	V_{IN}				V
DC Output Current	I_O	1.5*2				A
Power Dissipation	P_{D1}	18(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)	$\theta_{j\text{-}c}$	5.5				°C/W
Thermal Resistance (junction to ambient air)	$\theta_{j\text{-}a}$	66.7(Without heatsink, stand-alone operation)				°C/W

■Electrical Characteristics

(T_a=25°C unless otherwise specified)

Parameter		Symbol	Ratings									Unit
			SI-3033C			SI-3050C			SI-3090C			
			min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	
Input Voltage		V_{IN}	*3		15*2	6*3		30*2	10*3		30*2	V
Output Voltage	SI-3000C *1	V_O	3.168	3.300	3.432	4.80	5.00	5.20	8.64	9.00	9.36	V
	SI-3000CA		3.234	3.300	3.366	4.90	5.00	5.10	8.82	9.00	9.18	
		Conditions	V_{IN}=5V, I_O=1.0A			V_{IN}=8V, I_O=1.0A			V_{IN}=12V, I_O=1.0A			
Dropout Voltage		V_{DIF}			0.5			0.5			0.5	V
		Conditions	$I_O \leq 1.0A$									
					1.0			1.0			1.0	
		Conditions	$I_O \leq 1.5A$									
Line Regulation		ΔV_{OLINE}		10	30		10	30		18	48	mV
		Conditions	V_{IN}=4.5 to 12V, I_O=1.0A			V_{IN}=6 to 15V, I_O=1.0A			V_{IN}=10 to 20V, I_O=1.0A			
Load Regulation		ΔV_{OLOAD}		40	100		40	100		70	180	mV
		Conditions	V_{IN}=5V, I_O=0 to 1.5A			V_{IN}=8V, I_O=0 to 1.5A			V_{IN}=12V, I_O=0 to 1.5A			
Temperature Coefficient of Output Voltage		$\Delta V_O/\Delta T_a$		±0.5			±0.5			±1.0		mV/°C
		Conditions	V_{IN}=5V, I_O=5mA, T_j=0 to 100°C			V_{IN}=8V, I_O=5mA, T_j=0 to 100°C			V_{IN}=12V, I_O=5mA, T_j=0 to 100°C			
Ripple Rejection		R_{REJ}		54			54			54		dB
		Conditions	V_{IN}=5V, f=100 to 120Hz			V_{IN}=8V, f=100 to 120Hz			V_{IN}=12V, f=100 to 120Hz			
Quiescent Circuit Current		I_q		3	10		5	10		5	10	mA
		Conditions	V_{IN}=5V, I_O=0A			V_{IN}=8V, I_O=0A			V_{IN}=12V, I_O=0A			
Overcurrent Protection Starting Current*4,6		I_{S1}	1.6			1.6			1.6			A
		Conditions	V_{IN}=5V			V_{IN}=8V			V_{IN}=12V			
V_C Terminal*5	Control Voltage (Output ON)	$V_{C.IH}$	2.0			2.0			2.0			V
	Control Voltage (Output OFF)	$V_{C.IL}$			0.8			0.8			0.8	
	Control Current (Output ON)	$I_{C.IH}$			20			20			20	μA
		Conditions	V_C=2.7V									
	Control Current (Output OFF)	$I_{C.IL}$			–0.3			–0.3			–0.3	mA
		Conditions	V_C=0.4V									

*1: In some cases, "A" may be printed on the right of the marking.
*2: $V_{IN(max)}$ and $I_{O(max)}$ are restricted by the relation $P_{D(max)}=(V_{IN}-V_O)\bullet I_O$=18(W).
*3: Refer to the Dropout Voltage parameter. (Refer to Setting DC Input Voltage on page 9.)
*4: 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.
*5: Output is ON even when output control terminal V_C is open. Each input level is equivalent to LS-TTL level. Therefore, the device can be driven directly by LS-TTLs.
*6: These products (except for SI-3033C) 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

■Electrical Characteristics

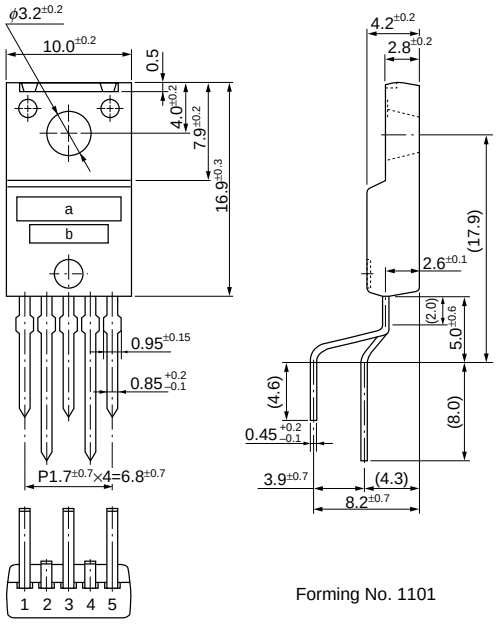
(Ta=25°C unless otherwise specified)

Parameter		Symbol	Ratings									Unit
			SI-3120C			SI-3150C			SI-3240C			
			min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	
Input Voltage		VIN	13*3		30*2	16*3		30*2	25*3		40*2	V
Output Voltage	SI-3000C *1	VO	11.52	12.00	12.48	14.40	15.00	15.60	23.04	24.00	24.96	V
	SI-3000CA		11.76	12.00	12.24	14.70	15.00	15.30	23.52	24.00	24.48	
		Conditions	VIN=15V, IO=1.0A			VIN=18V, IO=1.0A			VIN=27V, IO=1.0A			
Dropout Voltage		VDIF			0.5			0.5			0.5	V
		Conditions	IO≤1.0A									
					1.0			1.0			1.0	
		Conditions	IO≤1.5A									
Line Regulation		ΔVOLINE		24	64		30	90		48	128	mV
		Conditions	VIN=13 to 25V, IO=1.0A			VIN=16 to 25V, IO=1.0A			VIN=25 to 38V, IO=1.0A			
Load Regulation		ΔVOLOAD		93	240		120	300		120	300	mV
		Conditions	VIN=15V, IO=0 to 1.5A			VIN=18V, IO=0 to 1.5A			VIN=27V, IO=0 to 1.5A			
Temperature Coefficient of Output Voltage		ΔVO/ΔTa		±1.5			±1.5			±2.5		mV/°C
		Conditions	VIN=15V, IO=5mA, Tj=0 to 100°C			VIN=18V, IO=5mA, Tj=0 to 100°C			VIN=27V, IO=5mA, Tj=0 to 100°C			
Ripple Rejection		RREJ		54			54			54		dB
		Conditions	VIN=15V, f=100 to 120Hz			VIN=18V, f=100 to 120Hz			VIN=27V, f=100 to 120Hz			
Quiescent Circuit Current		Iq		5	10		5	10		5	10	mA
		Conditions	VIN=15V, IO=0A			VIN=18V, IO=0A			VIN=27V, IO=0A			
Overcurrent Protection Starting Current*4,6		IS1	1.6			1.6			1.6			A
		Conditions	VIN=15V			VIN=18V			VIN=27V			
VC Terminal*5	Control Voltage (Output ON)	VC. IH	2.0			2.0			2.0			V
	Control Voltage (Output OFF)	VC. IL			0.8			0.8			0.8	
	Control Current (Output ON)	IC. IH			20			20			20	μA
		Conditions	VC=2.7V									
	Control Current (Output OFF)	IC. IL			–0.3			–0.3			–0.3	mA
		Conditions	VC=0.4V									

*1: In some cases, "A" may be printed on the right of the marking.
*2: VIN(max) and IO(max) are restricted by the relation PD(max)=(VIN-VO)•IO=18(W).
*3: Refer to the Dropout Voltage parameter. (Refer to Setting DC Input Voltage on page 9.)
*4: IS1 is specified at the 5% drop point of output voltage VO on the condition that VIN=VO+3V, IO=1A.
*5: Output is ON even when output control terminal VC is open. Each input level is equivalent to LS-TTL level. Therefore, the device can be driven directly by LS-TTLs.
*6: 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) VO adjustment by raising ground voltage

■External Dimensions (TO220F-5)

(unit : mm)



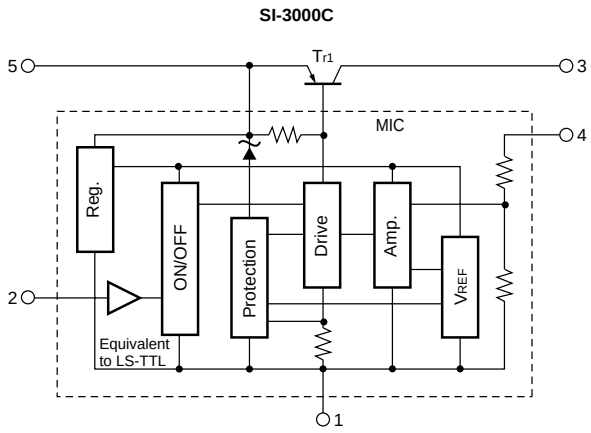
Forming No. 1101

a. Part Number
b. Lot Number

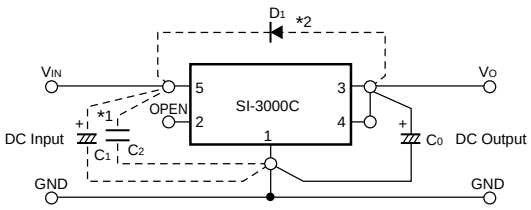
Pin Assignment
① GND
② V_C
③ V_O
④ V_{OS}
⑤ V_{IN}

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

■Block Diagram



■Typical Connection Diagram

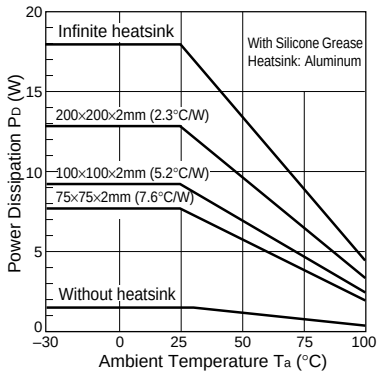


C0 : Output capacitor (47 to 100μF)

*1 C1, C2 : Oscillation prevention capacitors (Approx. C1: 47μF, C2: 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 C1 and C0.

*2 D1 : Protection diode
This diode is required for protection against reverse biasing of the input and output. Sanken EU2Z is recommended.

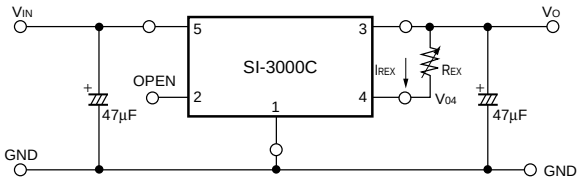
■Ta-PD Characteristics



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

External Variable Output Voltage Circuit

1. Variable output voltage with a single external resistor

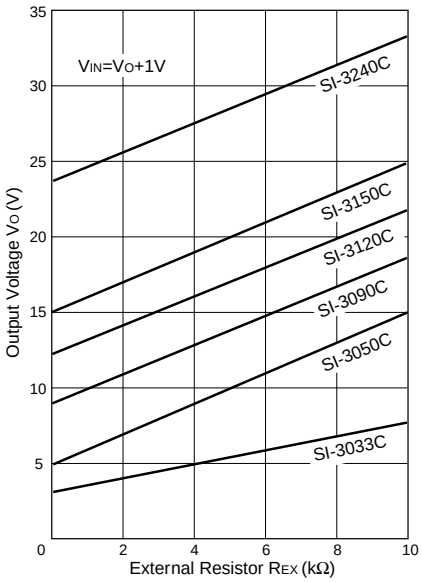


The output voltage may be increased by inserting resistor R_{EX} between terminals No.4 (sensing terminal) and No.3 (output terminal). The current I_{REX} flowing into terminal No.4 is 1mA (typ.)(SI-3033C:0.43mA (typ.)), therefore the adjusted output voltage V_{OUT} is:

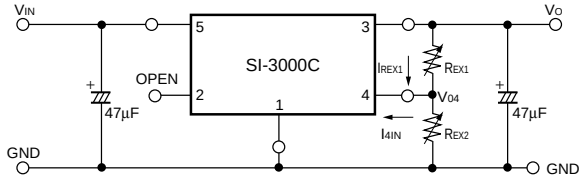
$$V_O=V_{04}+I_{REX}\bullet R_{EX}$$ *V_{04}: output voltage of SI-3000C series

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.)(SI-3033C: 0.43mA (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:

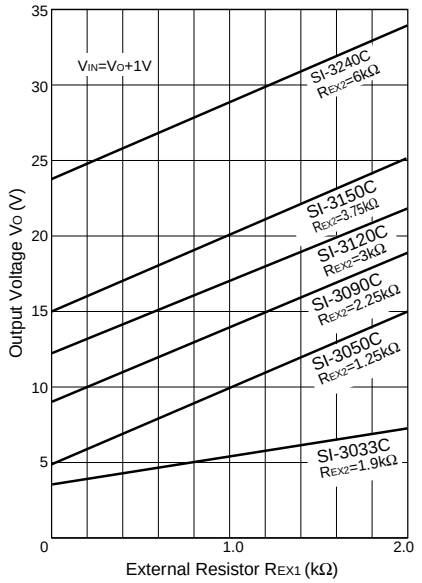
$$\begin{cases} V_O=V_{04}+R_{EX1}\bullet I_{REX1} \\ I_{REX1}=S\bullet I_{4IN} \end{cases}$$

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

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

*V_{04}: Output voltage of SI-3000C series

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

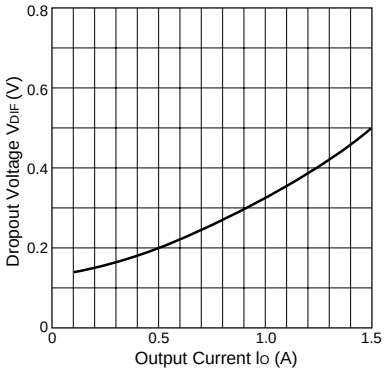


Note: In the SI-3000C series, the output voltage increase can be adjusted as mentioned above. However, when the rise is set to approximately 10V compared to output voltage V_{04}, the necessary output current may not be obtained due to the S.O.A. protection circuit in the SI-3000C series.

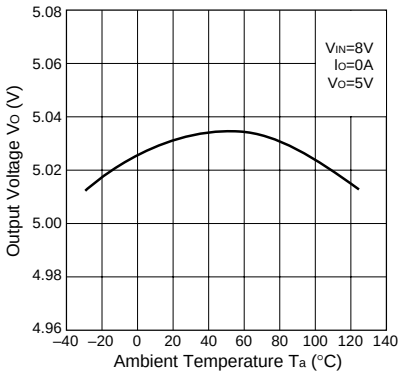
■Typical Characteristics

(T_a=25°C)

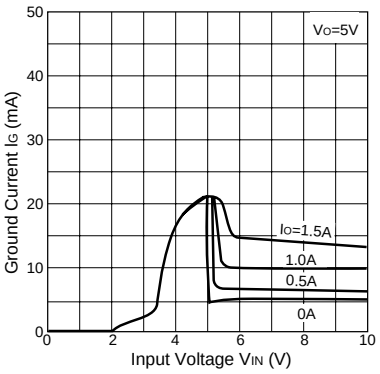
Io vs. VDIF Characteristics



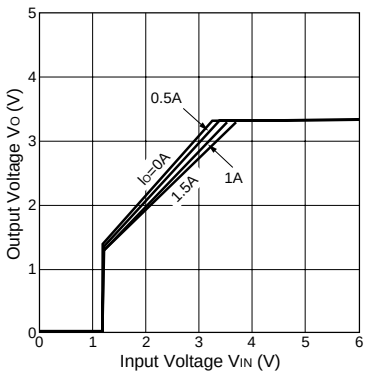
Temperature Coefficient of Output Voltage(SI-3050C)



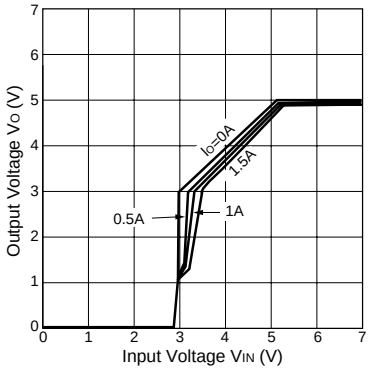
Circuit Current(SI-3050C)



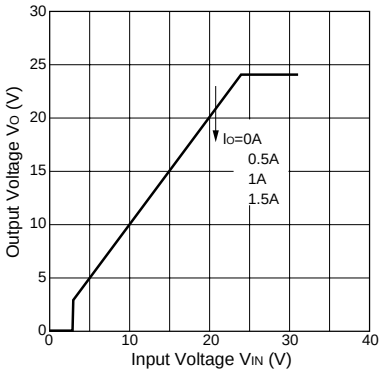
Output Voltage(SI-3033C)



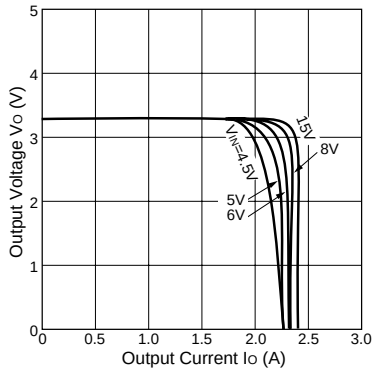
Output Voltage(SI-3050C)



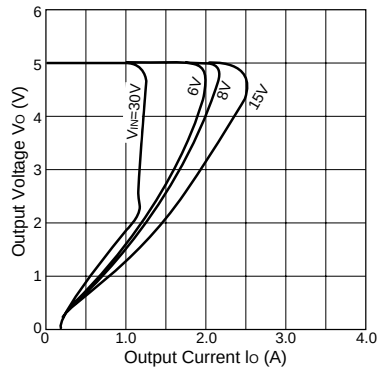
Output Voltage(SI-3240C)



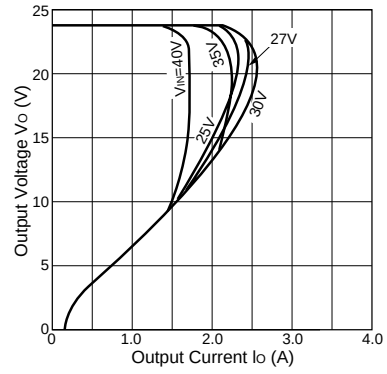
Overcurrent Protection Characteristics(SI-3033C)



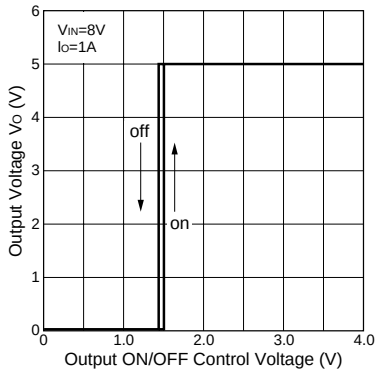
Overcurrent ProtectionCharacteristics(SI-3050C)



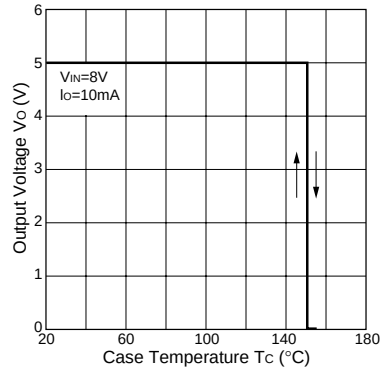
Overcurrent Protection Characteristics(SI-3240C)



ON/OFF Control Characteristics(SI-3050C)



Thermal ProtectionCharacteristics(SI-3050C)



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.