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

■Features

- Compact full-mold package (equivalent to TO220)
- Output current: 1.0A
- Low dropout voltage: $V_{DIF} \leq 1V$ (at I_O=1.0A)
- Variable output voltage (rise only) Available for remote sensing (excluding SI-3025F)
- 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
- Variable output voltage type (SI-3025F) also available

■Absolute Maximum Ratings

(T_a=25°C)

Parameter	Symbol	Ratings					Unit
		SI-3050F	SI-3090F/3120F	SI-3057F	SI-3240F	SI-3025F	
DC Input Voltage	V_{IN}	25	30	35	45	30	V
Output Control Terminal Voltage	V_C	V_{IN}					V
DC Output Current	I_O	1.0*2					A
Power Dissipation	P_{D1}	14**(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)	$\theta_{j\text{-}c}$	7.0***					°C/W
Thermal Resistance (junction to ambient air)	$\theta_{j\text{-}a}$	66.7(Without heatsink, stand-alone operation)					°C/W

** SI-3240F: 18
*** SI-3240F: 5.5

■Applications

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

■Electrical Characteristics (except SI-3025F)

(T_a=25°C unless otherwise specified)

Parameter		Symbol	Ratings															Unit
			SI-3050F			SI-3090F			SI-3120F			SI-3157F			SI-3240F			
			min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	
Input Voltage		V_{IN}	6*3		15*2	10*3		20*2	13*3		25*2	16.7*3		27*2	25*3		40*2	V
Output Voltage	SI-3000F *1	V_O	4.80	5.00	5.20	8.64	9.00	9.36	11.52	12.00	12.48	14.92	15.70	16.48	23.04	24.00	24.96	V
	SI-3000FA		4.90	5.00	5.10	8.82	9.00	9.18	———			———			———			
		Conditions	V_{IN}=8V, I_O=0.5A			V_{IN}=12V, I_O=0.5A			V_{IN}=15V, I_O=0.5A			V_{IN}=19V, I_O=0.5A			V_{IN}=27V, I_O=0.5A			
Dropout Voltage		V_{DIF}			0.5			0.5			0.5			0.5			0.5	V
		Conditions	I_O≤0.5A															
					1.0			1.0			1.0			1.0			1.0	
		Conditions	I_O≤1.0A															
Line Regulation		ΔV_{OLINE}		10	30		18	48		24	64		30	90		48	128	mV
		Conditions	V_{IN}=6V to 15V, I_O=0.5A			V_{IN}=10V to 20V, I_O=0.5A			V_{IN}=13V to 25V, I_O=0.5A			V_{IN}=17V to 27V, I_O=0.5A			V_{IN}=25V to 38V, I_O=0.5A			
Load Regulation		ΔV_{OLOAD}		40	100		70	180		93	240		120	300		120	300	mV
		Conditions	V_{IN}=8V, I_O=0 to 1.0A			V_{IN}=12V, I_O=0 to 1.0A			V_{IN}=15V, I_O=0 to 1.0A			V_{IN}=19V, I_O=0 to 1.0A			V_{IN}=27V, I_O=0 to 1.0A			
Temperature Coefficient of Output Voltage		$\Delta V_O/\Delta T_a$		±0.5			±1.0			±1.5			±1.5			±2.5		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}=19V, I_O=5mA, T_j=0 to 100°C			V_{IN}=27V, I_O=5mA, T_j=0 to 100°C			
Ripple Rejection		R_{REJ}		54			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}=19V, f=100 to 120Hz			V_{IN}=27V, f=100 to 120Hz			
Quiescent Circuit Current		I_q		3	10		3	10		3	10		3	10		5	10	mA
		Conditions	V_{IN}=8V, I_O=0A			V_{IN}=12V, I_O=0A			V_{IN}=15V, I_O=0A			V_{IN}=19V, I_O=0A			V_{IN}=27V $_O$=0A			
Overcurrent Protection Starting Current*4,7		I_{S1}	1.2			1.2			1.2			1.2			1.2			A
		Conditions	V_{IN}=8V			V_{IN}=12V			V_{IN}=15V			V_{IN}=19V			V_{IN}=27V			
V_C Terminal*5	Control Voltage (Output ON)	$V_{C.IH}$	2.0			2.0			2.0			2.0			2.0			V
	Control Voltage (Output OFF)	$V_{C.IL}$			0.8			0.8			0.8			0.8			0.8	
	Control Current (Output ON)	$I_{C.IH}$			20			20			20			20			20	μA
		Conditions	V_C=2.7V															
	Control Current (Output OFF)	$I_{C.IL}$			–0.3			–0.3			–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 $P_{D(max)}=(V_{IN}-V_O)\bullet I_O$=14W(SI-3240F: 18W).
*3: Refer to the Dropout Voltage parameter. (Refer to Setting DC Input Voltage on page 7.)
*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=0.5A.
*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: When setting output voltage to 5V or lower, input voltage needs to be set to 6V or higher to operate stably.
*7: 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

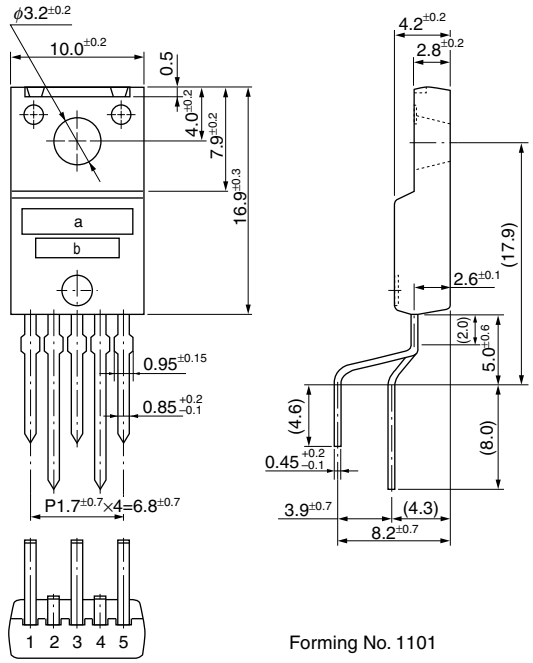
■Electrical Characteristics (SI-3025F)

(Ta=25°C unless otherwise specified)

Parameter		Symbol	Ratings SI-3025F min.	typ.	max.	Unit
Input Voltage		V_{IN}	6[*6]		25[*2]	V
Output Voltage		V_O	3		24	V
Reference Voltage		V_{REF}	2.45	2.55	2.65	V
Dropout Voltage		V_{ADJ}			0.5	V
		Conditions	$I_O \leq 0.5A$			
					1.0	
		Conditions	$I_O \leq 1.0A$			
Line Regulation		ΔV_{OLINE}			10	mV/V
		Conditions	$V_{IN}=V_O+1$ to 25V, $I_O=0.5A$			
Load Regulation		ΔV_{OLOAD}			20	mV/V
		Conditions	$V_{IN}=V_O+3V$, $I_O=0$ to 1.0A			
Temperature Coefficient of Reference Voltage		$\Delta V_{REF}/\Delta T_a$		±0.5		mV/°C
		Conditions	$V_{IN}=V_O+3V$, $I_O=5mA$, $T_j=0$ to 100°C			
Ripple Rejection		R_{REJ}		54		dB
		Conditions	$V_{IN}=V_O+3V$, f=100 to 120Hz			
Quiescent Circuit Current		I_q		3	10	mA
		Conditions	$V_{IN}=V_O+3V$, $I_O=0A$			
Overcurrent Protection Starting Current[*4,7]		I_{S1}	1.2			A
		Conditions	$V_{IN}=V_O+3V$			
V_C Terminal[*5]	Control Voltage (Output ON)	$V_{C.IH}$	2.0			V
	Control Voltage (Output OFF)	$V_{C.IL}$			0.8	
	Control Current (Output ON)	$I_{C.IH}$			20	μA
		Conditions	$V_C=2.7V$			
	Control Current (Output OFF)	$I_{C.IL}$			−0.3	mA
		Conditions	$V_C=0.4V$			

■External Dimensions (TO220F-5)

(Unit : mm)



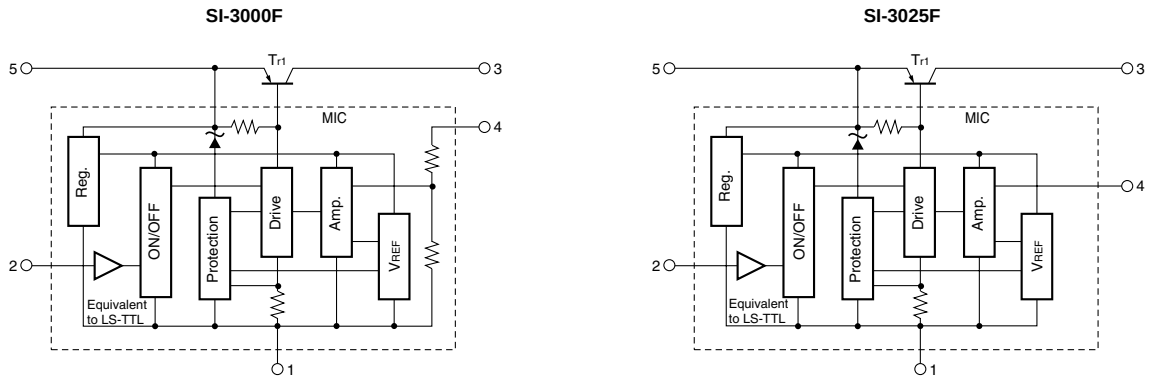
Forming No. 1101

a. Part Number
b. Lot Number

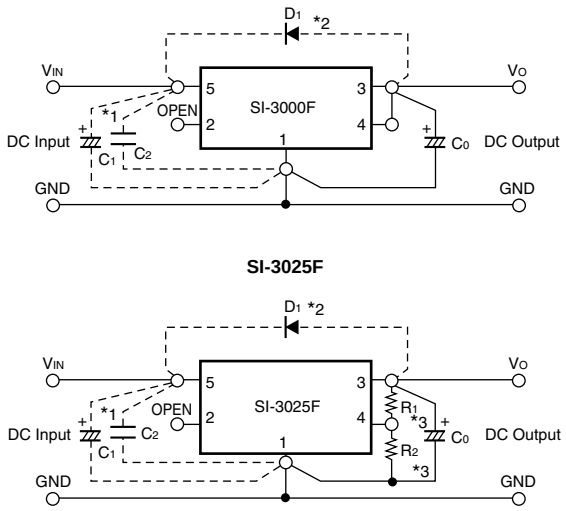
Pin Assignment	(Only for SI-3025F)
① GND	① GND
② V_C	② V_C
③ V_O	③ V_O
④ Sense	④ ADJ
⑤ V_{IN}	⑤ V_{IN}

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 capacitor
(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.

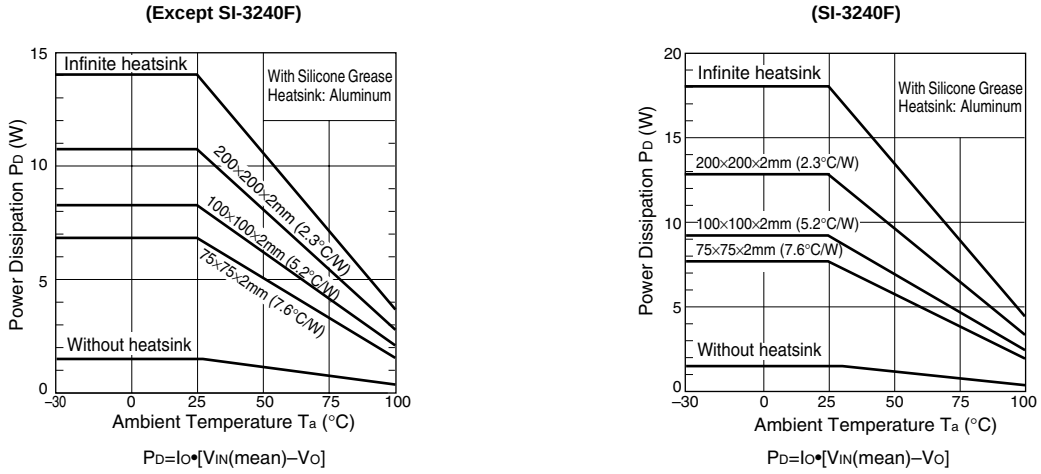
*2 D1 : Protection diode
This diode is required for protection against reverse biasing of the input and output. Sanken EU2Z is recommended.

*3 R1, R2 : External resistor for setting output voltage
Relationship between output voltage VO and external resistors R1 and R2 is as follows.

$$V_O = V_{ADJ} \bullet \left(1 + \frac{R_1}{R_2}\right) \quad (V_{ADJ}=2.55V(typ.))$$

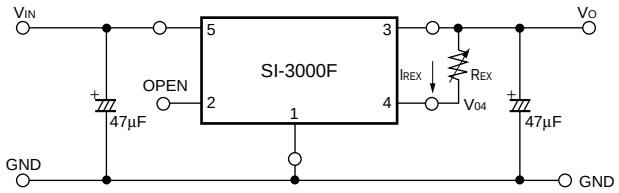
R2 must be 2.55kΩ for stable operation.

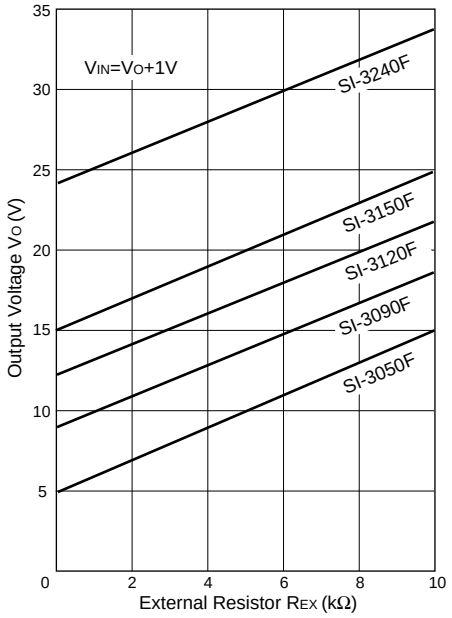
■Ta-PD Characteristics



External Variable Output Voltage Circuit (Except SI-3025F)

1. Variable output voltage with a single external resistor





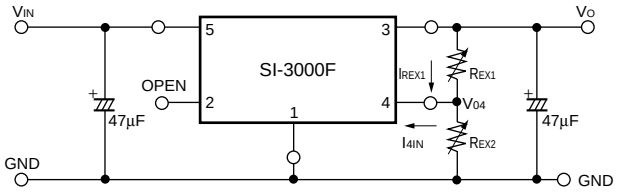
The output voltage may be increased by inserting resistor R_{EX} between terminals No.4 (sensing terminal) and No.3 (output terminal). The current I_{REX} flowing into terminal No.4 is 1mA (typ.), therefore the adjusted output voltage V_{OUT} is:

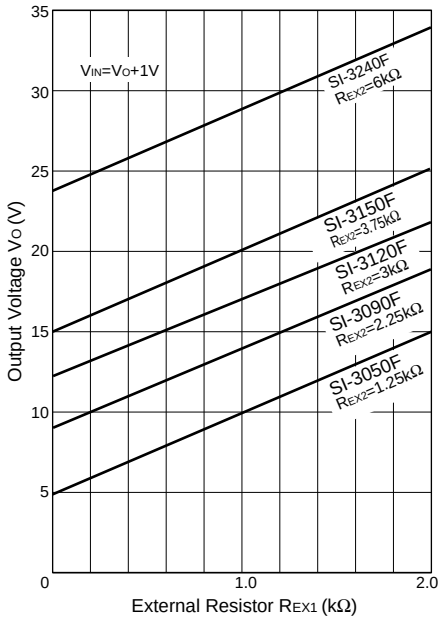
$$V_O = V_{04} + I_{REX} \cdot R_{EX}$$ *V_{04}: output voltage of SI-3000F series

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-3000F series

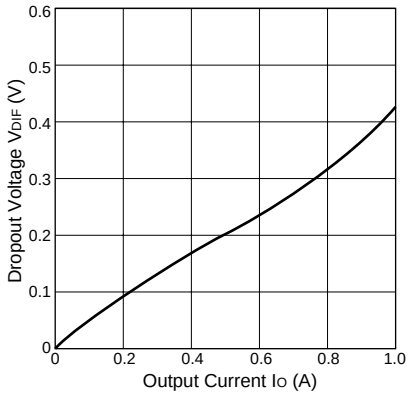
S: Stability coefficient of I_{4IN} (may be set to any value)

Note: In the SI-3000F 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-3000F series.

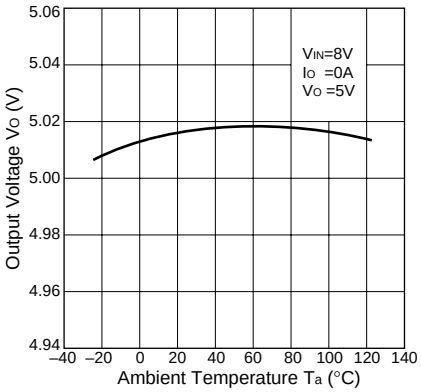
■Typical Characteristics

(T_a=25°C)

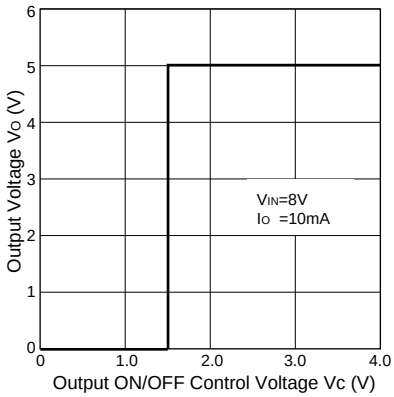
I_O vs. V_{DIF} Characteristics



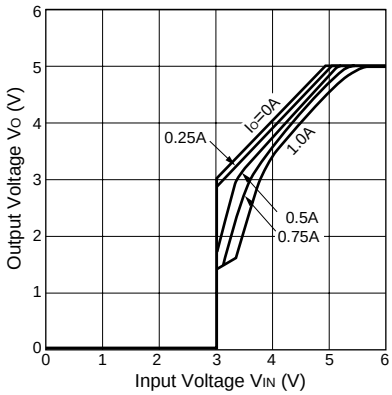
Temperature Coefficient of Output Voltage(SI-3050F)



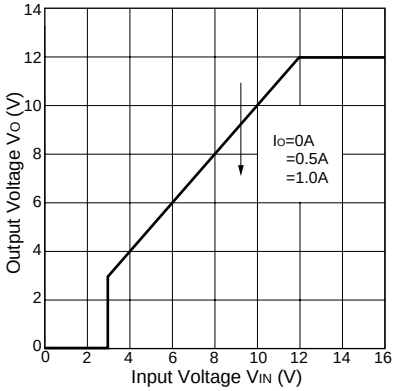
Output ON/OFF Control(SI-3050F)



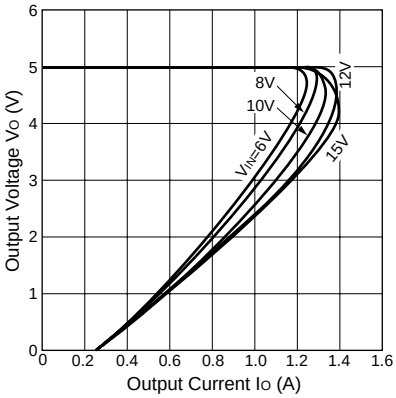
Output Voltage(SI-3050F)



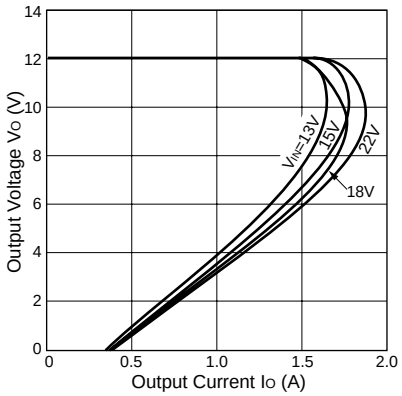
Output Voltage(SI-3120F)



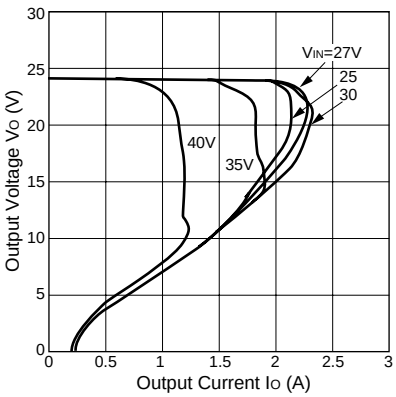
Overcurrent Protection Characteristics(SI-3050F)



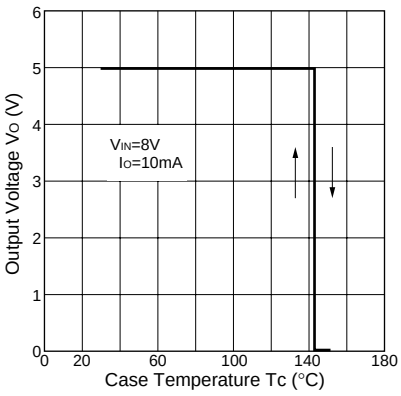
Overcurrent Protection Characteristics(SI-3120F)



Overcurrent Protection Characteristics(SI-3240F)



Thermal Protection Characteristics(SI-3050F)



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.