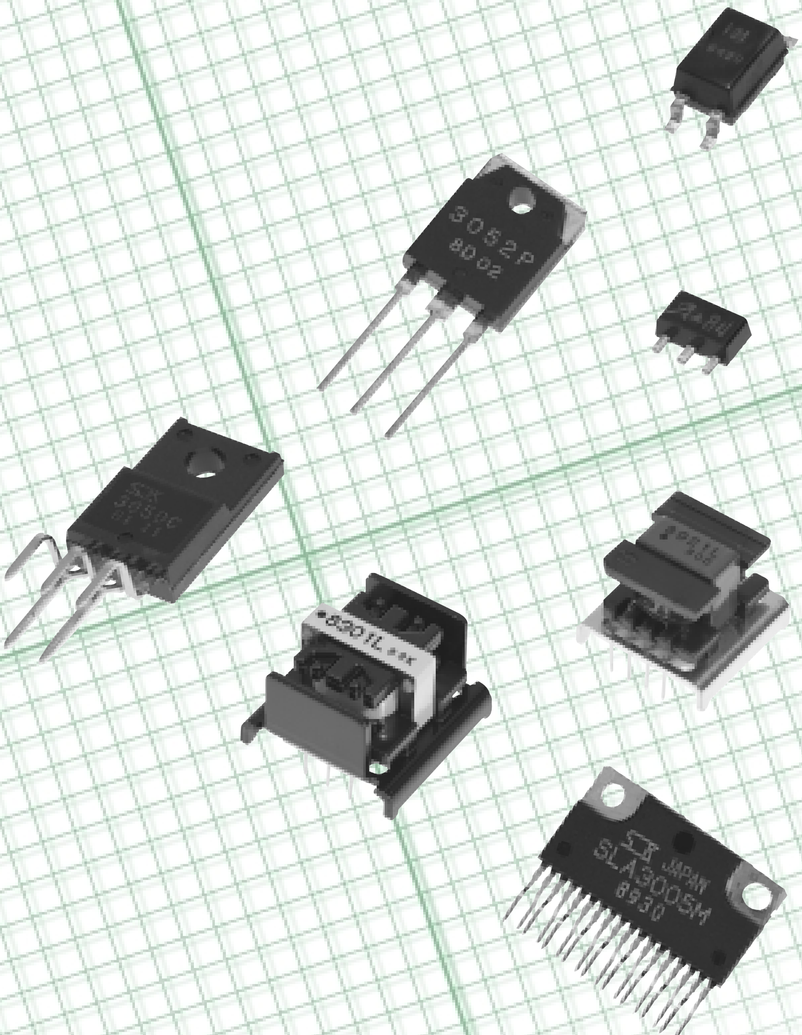
Bulletin No
I01 EDO
(Sep,2000)



IC REGULATORS

Dropper Type
Switching Type
Multi-Output Type

SANKEN ELECTRIC CO.,LTD.

⚠ CAUTION / WARNING

- The information in this publication has been carefully checked and is believed to be accurate; however, no responsibility is assumed for inaccuracies.
- Sanken reserves the right to make changes without further notice to any products herein in the interest of improvements in the performance, reliability, or manufacturability of its products. Before placing an order, Sanken advises its customers to obtain the latest version of the relevant information to verify that the information being relied upon is current.
- Application and operation examples described in this catalog are quoted for the sole purpose of reference for the use of the products herein and Sanken can assume no responsibility for any infringement of industrial property rights, intellectual property rights or any other rights of Sanken or any third party which may result from its use.
- When using the products herein, the applicability and suitability of such products for the intended purpose or object shall be reviewed at the users' responsibility.
- Although Sanken undertakes to enhance the quality and reliability of its products, the occurrence of failure and defect of semiconductor products at a certain rate is inevitable. Users of Sanken products are requested to take, at their own risk, preventative measures including safety design of the equipment or systems against any possible injury, death, fires or damages to the society due to device failure or malfunction.
- Sanken products listed in this catalog are designed and intended for the use as components in general purpose electronic equipment or apparatus (home appliances, office equipment, telecommunication equipment, measuring equipment, etc.). Before placing an order, the user's written consent to the specifications is requested.
  When considering the use of Sanken products in the applications where higher reliability is required (transportation equipment and its control systems, traffic signal control systems or equipment, fire/crime alarm systems, various safety devices, etc.), please contact your nearest Sanken sales representative to discuss and obtain written confirmation of your specifications.
  The use of Sanken products without the written consent of Sanken in the applications where extremely high reliability is required (aerospace equipment, nuclear power control systems, life support systems, etc.) is strictly prohibited.
- Anti radioactive ray design is not considered for the products listed herein.
-

Contents

Selection Guide

1. Dropper Type

Type	Series name	I_O(A)	V_O(V) 3.3	5	9	12	15	15.7	24	Variable output voltage (3 to 24)	Functions	Page
5-Terminal, Multi-Function, Low Dropout Voltage Type	SI-3000B	0.27						SI-3157B		SI-3025B	Variable output voltage (rise only) (excluding SI-3025B, SI-3025F, SI-3050R), Output ON/OFF control (excluding SI-3050R), Overcurrent/overvoltage/thermal protection, Reset (SI-3050R only)	24
	SI-3000F	1.0		SI-3050F	SI-3090F	SI-3120F	SI-3150F	SI-3157F	SI-3240F	SI-3025F		29
	SI-3000C	1.5	SI-3033C	SI-3050C	SI-3090C	SI-3120C	SI-3150C		SI-3240C			35
	SI-3000R	1.5		SI-3050R								48
	SI-3000J	2.0		SI-3050J	SI-3090J	SI-3120J	SI-3150J					42
3-Terminal, Low Dropout Voltage Type	SI-3000N	1.0		SI-3050N	SI-3090N	SI-3120N	SI-3150N				Overcurrent/ overvoltage/thermal protection	8
	SI-3003N	1.0		SI-3053N		SI-3123N	SI-3153N					12
	SI-3001N	1.5		SI-3051N	SI-3091N	SI-3121N	SI-3151N		SI-3241N			16
	SI-3002N	2.0		SI-3052N	SI-3092N	SI-3122N	SI-3152N					20
	SI-3000V	2.0		SI-3052V		SI-3122V	SI-3152V				Overcurrent protection	58
3-Terminal Type	SI-3000P	2.0		SI-3052P		SI-3122P	SI-3152P		SI-3242P		Overcurrent protection	54

2. Switching Type

Type	Series name	I_O(A)	V_O(V) 3.3	5	9	12	15	±5	Functions	Page
Surface-Mount, Separate Excitation Type	SAI	0.4			SAI06	SAI03	SAI04		Overcurrent/Thermal protection, Variable output voltage (rise)	64
		0.5	SAI02	SAI01						
Separate Excitation Type	SI-8000E	0.6		SI-8050E	SI-8090E	SI-8120E			Overcurrent/Thermal protection, Variable output voltage (rise)	68
	SI-8000S	3.0	SI-8033S	SI-8050S	SI-8090S	SI-8120S	SI-8150S		Overcurrent/Thermal protection, Soft start, Output ON/OFF control, Variable output voltage (rise)	72
Self Oscillating Type with Coil	SI-8200L	0.28				SI-8213L				78
		0.3		SI-8211L						
		0.35				SI-8203L				
		0.4		SI-8201L						
	SI-8300L	1.0		SI-8301L						
Separate Excitation Type with Coil	SI-8400L	0.4				SI-8402L	SI-8405L		Overcurrent/ Thermal protection	82
		0.5	SI-8403L	SI-8401L						
	SI-8500L	1.0	SI-8503L	SI-8501L	SI-8504L	SI-8502L	SI-8505L		Overcurrent/Thermal protection Soft start, Output ON/OFF control	
Separate Excitation Type with Transformer	SI-8800L	0.45/0.05						SI-8811L	Overcurrent protection (+5V)	88
	SI-8910L	0.3/0.1						SI-8911L	Overcurrent protection (+5V)	
	SI-8920L	0.6		SI-8921L					Overcurrent protection	
				SI-8922L						

3. Multi-Output Type

Type	Part Number		V_O(V)	I_O(A)	Regulator type	Functions	Page
2-Output	STA801M	ch 1	5	0.5	Switching	Overcurrent/ Thermal protection, Output ON/OFF control, Soft start	94
		ch 2	Select one from 9, 11.5, 12.1, 15.5	0.5	Switching		
	STA802M	ch 1	9	0.5	Switching		
		ch 2	Select one from 9.1, 11.7, 12.1, 15.7	0.5	Switching		
	SDI02	ch 1	5	0.5	Dropper	Output ON/OFF control, Overcurrent protection (Vo shutdown after operation) Thermal protection Flag output function	100
		ch 2	5	0.5	Dropper		
3-Output	SLA3001M	Regulator 1	12	1.5	Dropper	Variable output voltage (rise), Output ON/OFF control, Overcurrent/Overvoltage/Thermal protection	104
		Regulator 2	5	1.5	Dropper		
		Regulator 3	9	1.5	Dropper		
	SLA3002M	Regulator 1	5	0.5	Switching	Overcurrent/Thermal protection	
		Regulator 2	15.7	1	Dropper	Variable output voltage (rise) , Output ON/OFF control, Overcurrent/ Overvoltage/Thermal protection	
		Regulator 3	9	0.4	Switching	Overcurrent/Thermal protection	
	SLA3004M	Regulator 1	5	0.5	Switching	Overcurrent/Thermal protection	
		Regulator 2	9	0.4	Switching		
		Regulator 3	9	0.4	Switching		
4-Output	SLA3005M	ch 1	5	0.5	Dropper	Output ON/OFF control, Overcurrent protection (Vo shutdown after operation) Thermal protection Flag output function	110
		ch 2	5	0.5	Dropper		
		ch 3	5	0.5	Dropper		
		ch 4	5	0.5	Dropper		
	SLA3006M	ch 1	5	0.5	Dropper	Output ON/OFF control Overcurrent protection Thermal protection Flag output function	
		ch 2	5	0.5	Dropper		
		ch 3	5	0.5	Dropper		
		ch 4	5	0.5	Dropper		
	SLA3007M	ch 1	5	0.5	Dropper	Output ON/OFF control, Overcurrent protection (Vo shutdown after operation) Thermal protection Flag output function (except ch 4)	
		ch 2	5	0.5	Dropper		
		ch 3	5	0.5	Dropper		
		ch 4	3.3	0.5	Dropper		

Product Index by Part Number

Part Number	V_O(V)	I_O(A)	Regulator type	Package	Remarks	Page
SAI01	5.0	0.5	Switching	Surface-Mount		64
SAI02	3.3	0.5	Switching	Surface-Mount		64
SAI03	12.0	0.4	Switching	Surface-Mount		64
SAI04	15.0	0.4	Switching	Surface-Mount		64
SAI06	9.0	0.4	Switching	Surface-Mount		64
SDI02	5.0/5.0	0.5/Each output	Dropper	Surface-Mount	2-Output	100
SI-3025B	Variable Output Voltage	0.27	Dropper	5-Terminal Full-Mold	Low Dropout Voltage	24
SI-3025F	Variable Output Voltage	1.0	Dropper	5-Terminal Full-Mold	Low Dropout Voltage	29
SI-3033C	3.3	1.5	Dropper	5-Terminal Full-Mold	Low Dropout Voltage	35
SI-3050C	5.0	1.5	Dropper	5-Terminal Full-Mold	Low Dropout Voltage	35
SI-3050F	5.0	1.0	Dropper	5-Terminal Full-Mold	Low Dropout Voltage	29
SI-3050J	5.0	2.0	Dropper	5-Terminal Full-Mold	Low Dropout Voltage	42
SI-3050N	5.0	1.0	Dropper	3-Terminal Full-Mold	Low Dropout Voltage	8
SI-3050R	5.0	1.5	Dropper	5-Terminal Full-Mold	Built-in Reset Function, Low dropout Voltage	48
SI-3051N	5.0	1.5	Dropper	3-Terminal Full-Mold	Low Dropout Voltage	16
SI-3052N	5.0	2.0	Dropper	3-Terminal Full-Mold	Low Dropout Voltage	20
SI-3052P	5.0	2.0	Dropper	3-Terminal		55
SI-3052V	5.0	2.0	Dropper	3-Terminal	Low Dropout Voltage	59
SI-3053N	5.0	1.0	Dropper	3-Terminal Full-Mold	Low Dropout Voltage	12
SI-3090C	9.0	1.5	Dropper	5-Terminal Full-Mold	Low Dropout Voltage	35
SI-3090F	9.0	1.0	Dropper	5-Terminal Full-Mold	Low Dropout Voltage	29
SI-3090J	9.0	2.0	Dropper	5-Terminal Full-Mold	Low Dropout Voltage	42
SI-3090N	9.0	1.0	Dropper	3-Terminal Full-Mold	Low Dropout Voltage	8
SI-3091N	9.0	1.5	Dropper	3-Terminal Full-Mold	Low Dropout Voltage	16
SI-3092N	9.0	2.0	Dropper	3-Terminal Full-Mold	Low Dropout Voltage	20
SI-3120C	12.0	1.5	Dropper	5-Terminal Full-Mold	Low Dropout Voltage	35
SI-3120F	12.0	1.0	Dropper	5-Terminal Full-Mold	Low Dropout Voltage	29
SI-3120J	12.0	2.0	Dropper	5-Terminal Full-Mold	Low Dropout Voltage	42
SI-3120N	12.0	1.0	Dropper	3-Terminal Full-Mold	Low Dropout Voltage	8
SI-3121N	12.0	1.5	Dropper	3-Terminal Full-Mold	Low Dropout Voltage	16
SI-3122N	12.0	2.0	Dropper	3-Terminal Full-Mold	Low Dropout Voltage	20
SI-3122P	12.0	2.0	Dropper	3-Terminal		55
SI-3122V	12.0	2.0	Dropper	3-Terminal	Low Dropout Voltage	59
SI-3123N	12.0	1.0	Dropper	3-Terminal Full-Mold	Low Dropout Voltage	12
SI-3150C	15.0	1.5	Dropper	5-Terminal Full-Mold	Low Dropout Voltage	35
SI-3150F	15.0	1.0	Dropper	5-Terminal Full-Mold	Low Dropout Voltage	29
SI-3150J	15.0	2.0	Dropper	5-Terminal Full-Mold	Low Dropout Voltage	42
SI-3150N	15.0	1.0	Dropper	3-Terminal Full-Mold	Low Dropout Voltage	8
SI-3151N	15.0	1.5	Dropper	3-Terminal Full-Mold	Low Dropout Voltage	16
SI-3152N	15.0	2.0	Dropper	3-Terminal Full-Mold	Low Dropout Voltage	20
SI-3152P	15.0	2.0	Dropper	3-Terminal		55
SI-3152V	15.0	2.0	Dropper	3-Terminal	Low Dropout Voltage	59
SI-3153N	15.0	1.0	Dropper	3-Terminal Full-Mold	Low Dropout Voltage	12
SI-3157B	15.7	0.27	Dropper	5-Terminal Full-Mold	Low Dropout Voltage	24
SI-3157F	15.7	1.0	Dropper	5-Terminal Full-Mold	Low Dropout Voltage	29
SI-3240C	24.0	1.5	Dropper	5-Terminal Full-Mold	Low Dropout Voltage	35
SI-3241N	24.0	1.5	Dropper	3-Terminal Full-Mold	Low Dropout Voltage	16
SI-3242P	24.0	2.0	Dropper	3-Terminal		55

Part Number	V_O(V)	I_O(A)	Regulator type	Package	Remarks	Page
SI-8033S	3.3	3.0	Switching	5-Terminal Full-Mold		72
SI-8050E	5.0	0.6	Switching	5-Terminal Full-Mold		68
SI-8050S	5.0	3.0	Switching	5-Terminal Full-Mold		72
SI-8090E	9.0	0.6	Switching	5-Terminal Full-Mold		68
SI-8090S	9.0	3.0	Switching	5-Terminal Full-Mold		72
SI-8120E	12.0	0.6	Switchin	5-Terminal Full-Mold		68
SI-8120S	12.0	3.0	Switching	5-Terminal Full-Mold		72
SI-8150S	15.0	3.0	Switching	5-Terminal Full-Mold		72
SI-8201L	5.0	0.4	Switching		With Coil	78
SI-8203L	12.0	0.35	Switching		With Coil	78
SI-8211L	5.0	0.3	Switching		With Coil	78
SI-8213L	12.0	0.28	Switching		With Coi	78
SI-8301L	5.0	1.0	Switching		With Coil	78
SI-8401L	5.0	0.5	Switching		With Coil	82
SI-8402L	12.0	0.4	Switching		With Coil	82
SI-8403L	3.3	0.5	Switching		With Coil	82
SI-8405L	15.0	0.4	Switching		With Coil	82
SI-8501L	5.0	1.0	Switching		With Coil	82
SI-8502L	12.0	1.0	Switching		With Coil	82
SI-8503L	3.3	1.0	Switching		With Coil	82
SI-8504L	9.0	1.0	Switching		With Coil	82
SI-8505L	15.0	1.0	Switching		With Coil	82
SI-8811L	±5	0.45/0.05	Switching		With Transformer	88
SI-8911L	±5	0.3/0.1	Switching		With Transformer	88
SI-8921L	5.0	0.6	Switching		With Transformer	88
SI-8922L	5.0	0.6	Switching		With Transformer	88
SLA3001M	12/5/9	1.5/1.5/1.5	DR/DR/DR		3-Output	104
SLA3002M	5/15.7/9	0.5/1/0.4	SW/DR/SW		3-Output	104
SLA3004M	5/9/9	0.5/0.4/0.4	SW/SW/SW		3-Output	104
SLA3005M	5	0.5/Each Output	Dropper		4-Output	110
SLA3006M	5	0.5/Each Output	Dropper		4-Output	110
SLA3007M	5/5/5/3.3	0.5/Each Output	Dropper		4-Output	110
STA801M	ch1:5/ch2:select one from 9, 11.5, 12.1, 15.5	0.5/Each Output	Switching		2-Output	94
STA802M	ch1:9/ch2:select one from 9.1, 11.7, 12.1, 15.7	0.5/Each Output	Switching		2-Output	94

Ordering

Please specify a multiple of the standard minimum number of packages when ordering.

Series	Standard minimum number of packages
SI-3000N	100 pcs.
SI-3001N	
SI-3002N	
SI-3003N	
SI-3000B	
SI-3000F	
SI-3000C	
SI-3000J	
SI-3000R	
SI-3000P	
SI-3000V	
SI-8000E	
SI-8000S	
SI-8200L/8300L	
SI-8400L/8500L	
SI-8800L/9800L	
STA800M	
SLA3000M	
SAI	2,000 pcs. (reel)
SDI	1,200 pcs. (reel)

Dropper Type - Application Note

■Temperature and Reliability

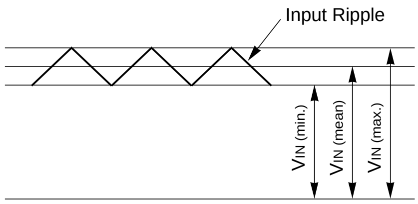
The reliability of an IC is highly dependent on its operating temperature. Design should pay particular attention to ensuring ample space for radiating heat.
Be sure to apply silicon grease to the IC before attaching a heatsink, and to secure it firmly to the heatsink.
Other important items to be considered regarding heat radiation include air convection during operation.

■Calculating Internal Power Dissipation (P_D)

P_D is given by the following formula:
$P_D = I_O \bullet [V_{IN(mean)} - V_O]$
Determine the size of the heatsink according to the relationship between allowable power dissipation and ambient temperature.

■Setting DC Input Voltage

The waveform of a DC input voltage is shown below.



When setting the DC input voltage, pay attention to the following:

- ● $V_{IN(min)}$ must be no less than the sum of output voltage and dropout voltage.
- ● $V_{IN(max)}$ must be no more than the maximum rated DC input voltage.

■Heatsink Design

The maximum junction temperature $T_{j(max)}$ given in the absolute maximum ratings is specific to each product type and must be strictly observed. Thus, thermal design must consider the conditions of use which affect the maximum power dissipation $P_{D(max)}$ and the maximum ambient temperature $T_{a(max)}$.
To simplify thermal design, the relationship between these two parameters has been presented in a graph, the T_a-P_D characteristic graph. Thermal design should include these steps:

1. Obtain the maximum ambient temperature $T_{a(max)}$.
2. Obtain the maximum power dissipation $P_{D(max)}$.
3. Look for the intersection point on the T_a-P_D characteristic graph and determine the size of the heatsink.

The size of the heatsink has now been obtained. However, in actual applications, a 10 to 20% derating factor is introduced. Moreover, the heat dissipation capacity of a heatsink highly depends on how it is mounted. Thus, it is recommended to measure the heatsink and case temperature in the actual operating environment.
The T_a-P_D characteristics for each product type are provided for reference purposes.

Fastening Torque

SI-3000N SI-3001N SI-3002N SI-3003N SI-3000B SI-3000F SI-3000C SI-3000J SI-3000R	0.588 to 0.686[N•m] (6.0 to 7.0[kgf•cm])
SI-3000P SI-3000V	0.686 to 0.882[N•m] (7.0 to 9.0[kgf•cm])

■Recommended Silicone Grease

- Shin-Etsu Chemical Co., Ltd.: G746
- GE Toshiba Silicone Co., Ltd.: YG-6260
- Dow Corning Toray Silicone Co., Ltd.: SC102

Please be careful when selecting silicone grease since the oil in some grease may penetrate the product, which will result in an extremely short product life.

■Others

- Devices can not be operated in parallel to increase current.
- An isolation type diode is provided from input to ground and also from output to ground. These may be destroyed if the device is reverse biased. In this case, use a diode with low VF to protect them.

■Rectifier Diodes for Power Supplies

To rectify the AC input using rectifier diodes in power supplies, use any of the SANKEN rectifier diodes shown in the following list. (Use axial type diodes in a center-tap or bridge configuration.)

Regulator Type	Diodes
SI-3000N Series SI-3001N Series SI-3002N Series SI-3003N Series	RM2Z(Axial Type, V_{RM}:200V, I_O:1.2A) RBV-402(Bridge Type, V_{RM}:200V, I_O:4.0A)
SI-3000B Series	AM01Z(Axial Type, V_{RM}:200V, I_O:1.0A)
SI-3000F Series SI-3000C Series SI-3000J Series SI-3000R Series SI-3000P Series SI-3000V Series	RM2Z(Axial Type, V_{RM}:200V, I_O:1.2A) RBV-402(Bridge Type, V_{RM}:200V, I_O:4.0A)

SI-3000N Series

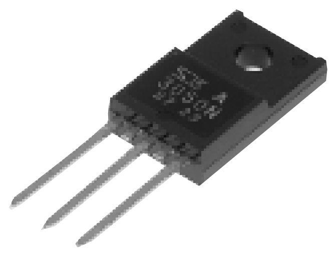
3-Terminal, Full-Mold, Low Dropout Voltage Dropper Type

■Features

- Compact full-mold package (equivalent to TO220)
- Output current: 1.0A
- Low dropout voltage: $V_{DIF} \leq 1V$ (at I_O=1.0A)
- 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°C)

Parameter	Symbol	Ratings			Unit
		SI-3050N	SI-3090N/3120N	SI-3150N	
DC Input Voltage	V_{IN}	25	30	35	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
Ambient Operating Temperature	T_{op}	–30 to +100			°C
Storage Temperature	T_{stg}	–40 to +125			°C
Thermal Resistance (junction to case)	$R_{th(j-c)}$	7.0			°C/W
Thermal Resistance (junction to ambient air)	$R_{th(j-a)}$	66.7(Without heatsink, stand-alone operation)			°C/W

■Electrical Characteristics

(T_a=25°C unless otherwise specified)

Parameter	Symbol	Ratings												Unit
		SI-3050N			SI-3090N			SI-3120N			SI-3150N			
		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*3		27*2	V
Output Voltage SI-3000N *1	V_O	4.80	5.00	5.20	8.64	9.00	9.36	11.52	12.00	12.48	14.40	15.00	15.60	V
Output Voltage SI-3000NA	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=0.5A			V_{IN}=12V, I_O=0.5A			V_{IN}=15V, I_O=0.5A			V_{IN}=18V, I_O=0.5A			
Dropout Voltage	V_{DIF}			0.5			0.5			0.5			0.5	V
	Conditions	I_O≤0.5A												
				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	mV
	Conditions	V_{IN}=6 to 15V, I_O=0.5A			V_{IN}=10 to 20V, I_O=0.5A			V_{IN}=13 to 25V, I_O=0.5A			V_{IN}=16 to 27V, I_O=0.5A			
Load Regulation	ΔV_{OLOAD}		40	100		70	180		93	240		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}=18V, 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		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			
Overcurrent Protection Starting Current*4,5	I_{S1}	1.2			1.2			1.2			1.2			A
	Conditions	V_{IN}=8V			V_{IN}=12V			V_{IN}=15V			V_{IN}=18V			

*1: "A" may be indicated to the right of the Sanken logo.

*2: $V_{IN(max)}$ and $I_{O(max)}$ are restricted by the relation $P_{D(max)}=(V_{IN}-V_O)\bullet I_O$=14(W).

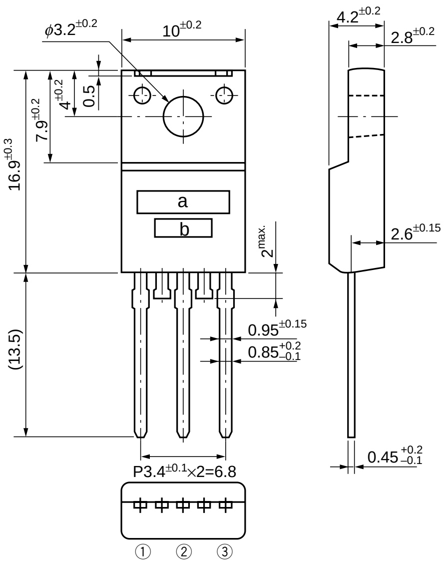
*3: Refer to the dropout voltage.(Refer to Setting DC Input Voltage on page 7.)

*4: I_{S1} is specified at –5(%) drop point of output voltage V_O on the condition that $V_{IN}=V_O$+3V, I_O=0.5A.

*5: A foldback type overcurrent protection circuit is built into the IC 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_O adjustment by raising ground voltage

■External Dimensions

(unit: mm)

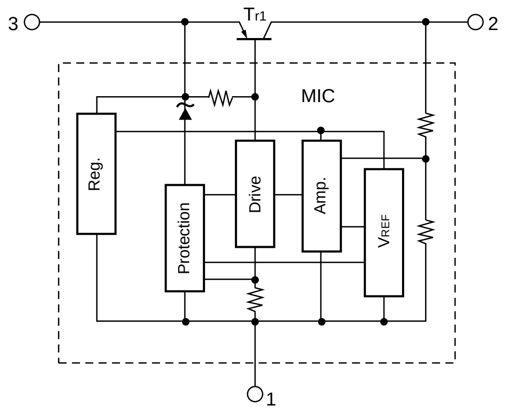


a. Part Number
b. Lot Number

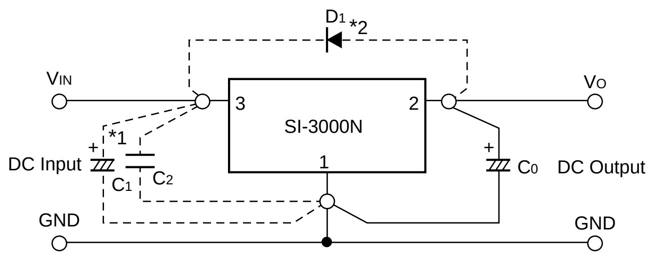
Pin Arrangement
① GND
② V_O
③ V_{IN}

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

■Block Diagram

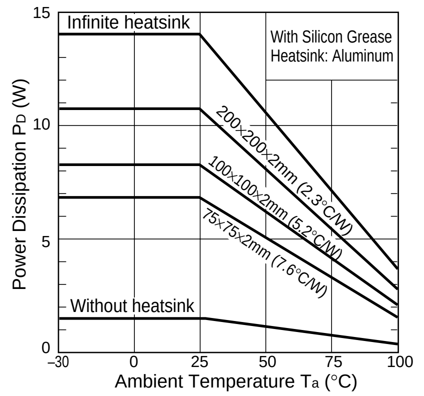


■Standard External Circuit



	C_0	: Output capacitor (47 to 100µF)
*1	C_1, C_2	: Oscillation prevention capacitor (C1: Approx. 47µF, C2: 0.33µF) These capacitors are required if the input line is inductive and in the case of long wiring. Tantalum capacitors are recommended for C1 and C0, particularly at low temperatures.
*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

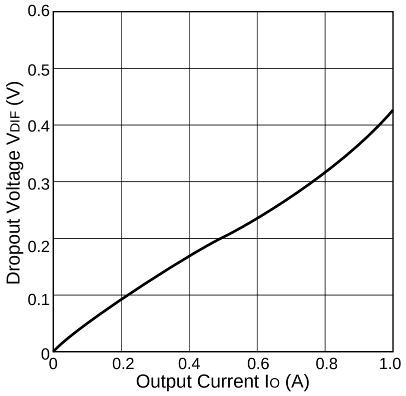


$P_D = I_O \cdot [V_{IN}(\text{mean}) - V_O]$

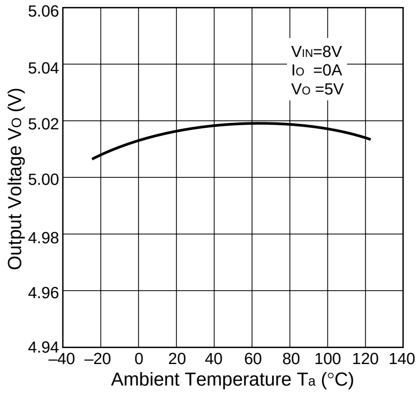
■Typical Characteristics

(Ta=25°C)

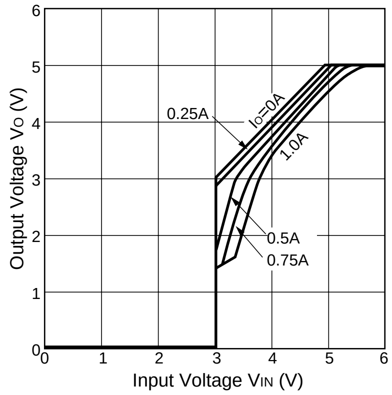
Io vs. VDIF Characteristics



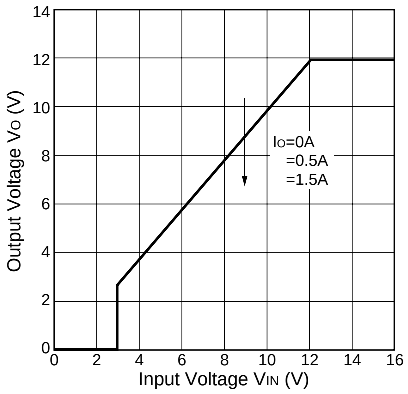
Temperature Coefficient of Output Voltage(SI-3050N)



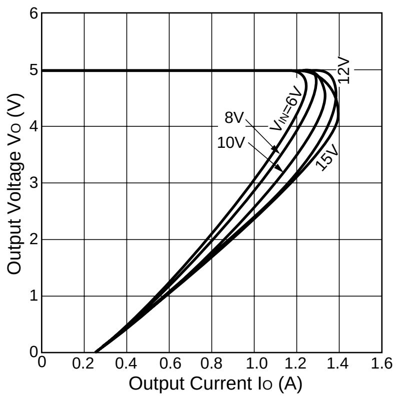
Output Voltage(SI-3050N)



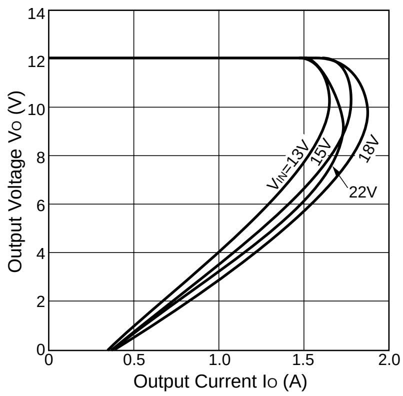
Output Voltage(SI-3120N)



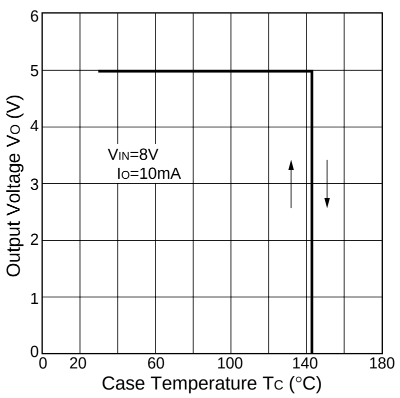
Overcurrent Protection Characteristics(SI-3050N)



Overcurrent Protection Characteristics(SI-3120N)



Thermal Protection Characteristics(SI-3050N)



Note on Thermal Protection:

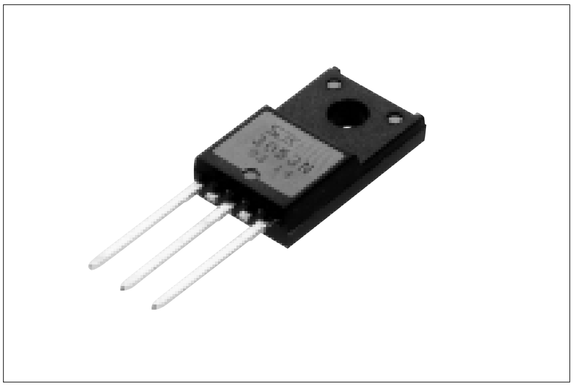
The thermal protection circuit is intended for protection against heat during instantaneous short-circuiting. Its operation is not guaranteed for continuous heating condition such as short-circuiting over extended periods of time.

SI-3003N Series

3-Terminal, Full-Mold, Low Dropout Voltage Dropper Type

■Features

- Compact full-mold package (equivalent to TO220)
- Output current: 1.0A
- Low dropout voltage: $V_{DIF} \leq 0.5V$ (at I_O=1.0A)
- Built-in dropping overcurrent, overvoltage, thermal protection circuits
- Supports constant current load and plus/minus power supplies.



■Applications

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

■Absolute Maximum Ratings

(T_a=25°C)

Parameter	Symbol	Ratings			Unit
		SI-3053N	SI-3123N	SI-3153N	
DC Input Voltage	V_{IN}	25	30	30	V
DC Output Current	I_O	1.0*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
Ambient Operating Temperature	T_{op}	–30 to +100			°C
Storage Temperature	T_{stg}	–40 to +125			°C
Thermal Resistance (junction to case)	$R_{th(j-c)}$	5.0			°C/W
Thermal Resistance (junction to ambient air)	$R_{th(j-a)}$	66.7(Without heatsink, stand-alone operation)			°C/W

■Electrical Characteristics

(T_a=25°C unless otherwise specified)

Parameter	Symbol	Ratings									Unit
		SI-3053N			SI-3123N			SI-3153N			
		min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	
Input Voltage	V_{IN}	6*2		15*1	13*2		22*1	16*2		25*1	V
Output Voltage	V_O	4.90	5.00	5.10	11.76	12.00	12.24	14.70	15.00	15.30	V
	Conditions	V_{IN}=8V, 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	V
	Conditions	I_O≤1.0A									
Line Regulation	ΔV_{OLINE}		10	30		24	64		30	90	mV
	Conditions	V_{IN}=6V to 15V, I_O=1.0A			V_{IN}=13V to 22V, I_O=1.0A			V_{IN}=16V to 25V, I_O=1.0A			
Load Regulation	ΔV_{OLOAD}		20	50		40	120		50	150	mV
	Conditions	V_{IN}=8V, I_O=0 to 1.0A			V_{IN}=15V, I_O=0 to 1.0A			V_{IN}=18V, I_O=0 to 1.0A			
Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T_a$		±0.5			±1.5			±1.5		mV/°C
	Conditions	V_{IN}=8V, 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		dB
	Conditions	V_{IN}=8V, 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	mA
	Conditions	V_{IN}=8V, I_O=0A			V_{IN}=15V, I_O=0A			V_{IN}=18V, I_O=0A			
Overcurrent Protection Starting Current*4,5	I_{S1}	1.2			1.2			1.2			A
	Conditions	V_{IN}=8V			V_{IN}=15V			V_{IN}=18V			
Limited Current at Overcurrent Protection	I_{S2}	1.2			1.2			1.2			A
	Conditions	V_{IN}=8V, V_O=0A			V_{IN}=15V, V_O=0A			V_{IN}=18V, V_O=0A			

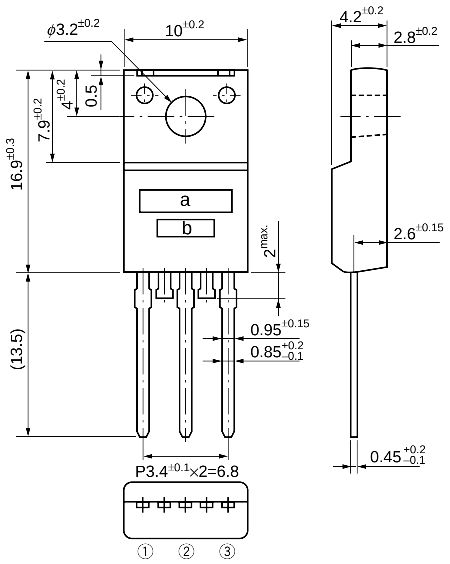
*1: $V_{IN(max)}$ and $I_{O(max)}$ are restricted by the relation $P_{D(max)}=(V_{IN}-V_O)\bullet I_O$=20(W).

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

*3: $I_{S}1$ is specified at –5(%) drop point of output voltage V_O on the condition that $V_{IN}=V_O$+3V, I_O=1A.

■External Dimensions

(unit:mm)

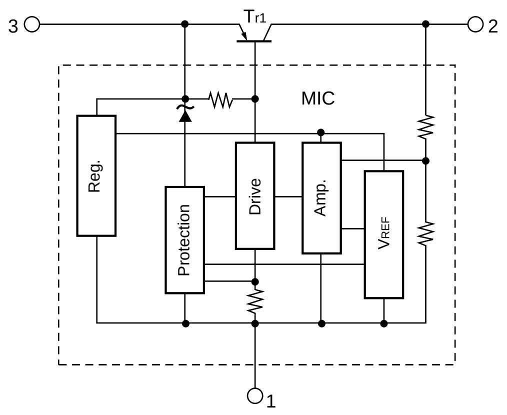


a. Part Number
b. Lot Number

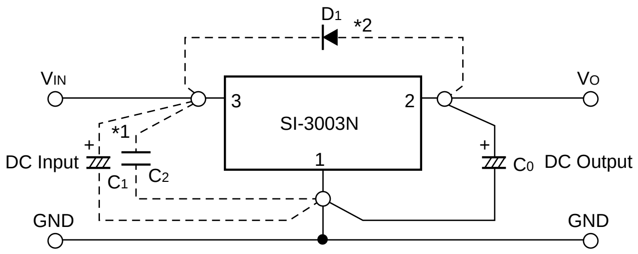
Pin Arrangement
① GND
② V_O
③ V_{IN}

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

■Block Diagram



■Standard External Circuit

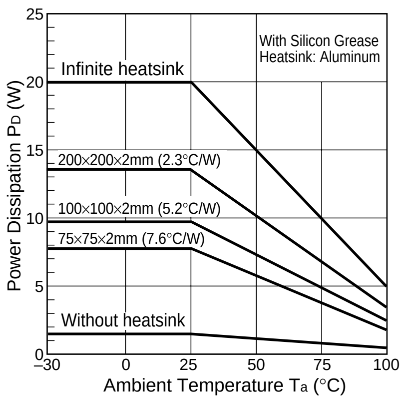


C_0 : Output capacitor (47 to 100µF)

*1 C_1, C_2 : Oscillation prevention capacitor (C_1: Approx. 47µF, C_2: 0.33µF)
These capacitors are required if the input line is inductive and in the case of long wiring. Tantalum capacitors are recommended for C_1 and C_0, particularly at low temperatures.

*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

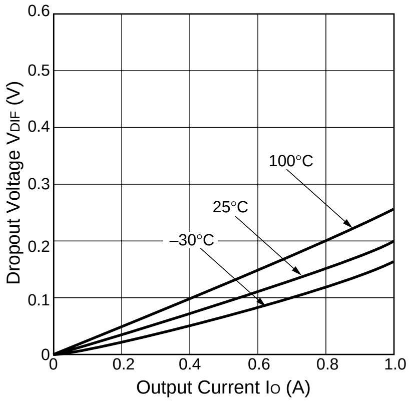


$P_D = I_O \cdot [V_{IN}(\text{mean}) - V_O]$

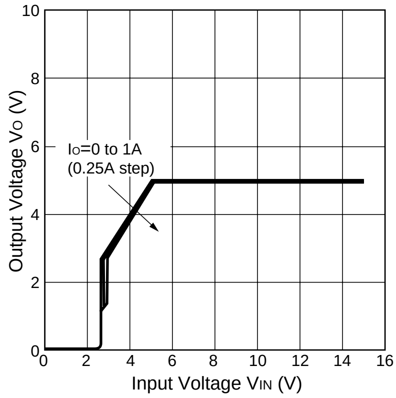
■Typical Characteristics

(Ta=25°C)

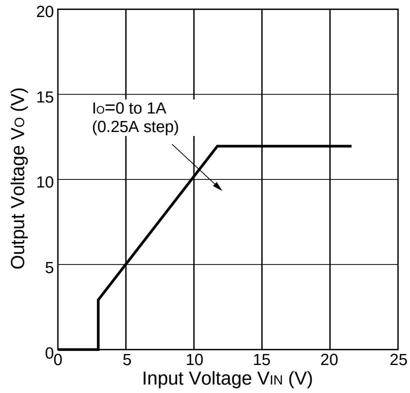
Io vs. VDIF Characteristics



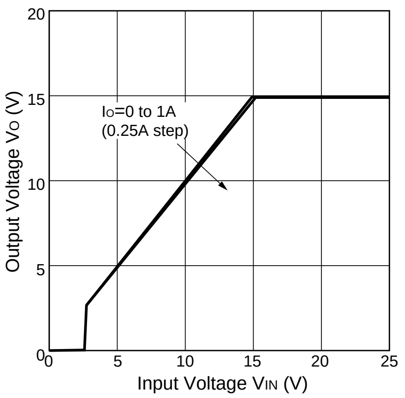
Output Voltage(SI-3053N)



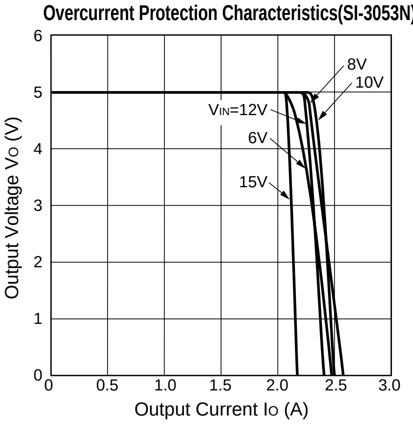
Output Voltage(SI-3123N)



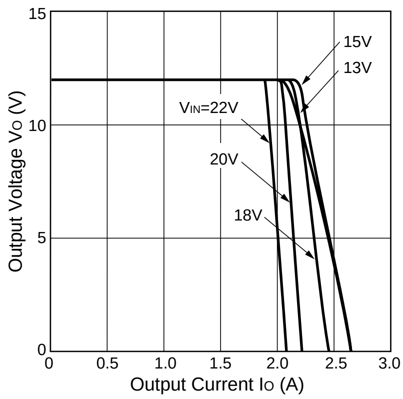
Output Voltage(SI-3153N)



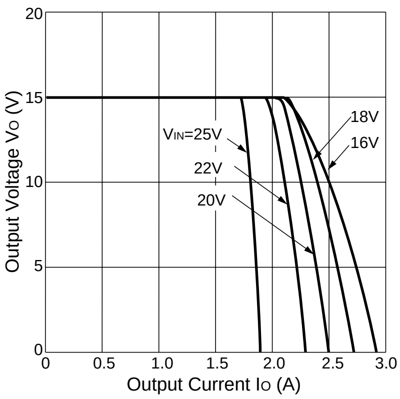
Overcurrent Protection Characteristics(SI-3053N)



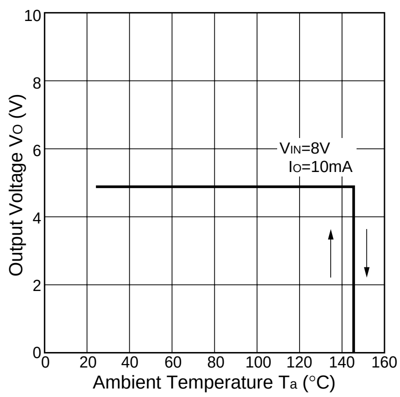
Overcurrent Protection Characteristics(SI-3123N)



Overcurrent Protection Characteristics(SI-3153N)



Thermal Protection Characteristics(SI-3053N)



Note on Thermal Protection:

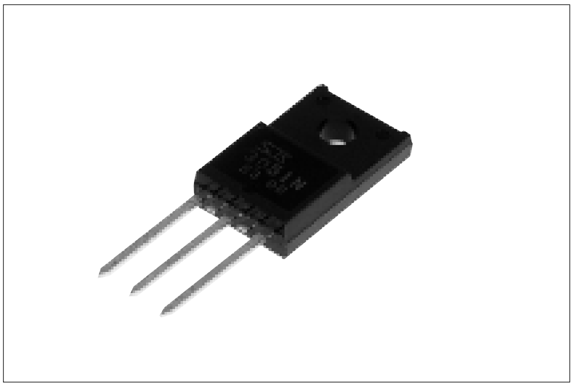
The thermal protection circuit is intended for protection against heat during instantaneous short-circuiting. Its operation is not guaranteed for continuous heating condition such as short-circuiting over extended periods of time.

SI-3001N Series

3-Terminal, Full-Mold, Low Dropout Voltage Dropper Type

■Features

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

Parameter	Symbol	Ratings			Unit
		SI-3051N/3091N	SI-3121N/3151N	SI-3241N	
DC Input Voltage	V_{IN}	35	35	45	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
Ambient Operating Temperature	T_{op}	–30 to +100			°C
Storage Temperature	T_{stg}	–40 to +125			°C
Thermal Resistance (junction to case)	$R_{th(j-c)}$	5.5			°C/W
Thermal Resistance (junction to ambient air)	$R_{th(j-a)}$	66.7(Without heatsink, stand-alone operation)			°C/W

■Electrical Characteristics

(T_a=25°C unless otherwise specified)

Parameter	Symbol	Ratings															Unit
		SI-3051N			SI-3091N			SI-3121N			SI-3151N			SI-3241N			
		min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	
Input Voltage	V_{IN}	6*3		30*2	10*3		30*2	13*3		30*2	16*3		30*2	25*3		40*2	V
Output Voltage SI-3001N *1	V_O	4.80	5.00	5.20	8.64	9.00	9.36	11.52	12.00	12.48	14.40	15.00	15.60	23.04	24.00	24.96	V
Output Voltage SI-3001NA	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	23.52	24.00	24.48	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			V_{IN}=27V, I_O=1.0A			
Dropout Voltage	V_{DIF}			0.5			0.5			0.5			0.5			0.5	V
	Conditions	I_O≤1.0A															
				1.0			1.0			1.0			1.0			1.0	
	Conditions	I_O≤1.5A															
Line Regulation	ΔV_{OLINE}		10	30		18	48		24	64		30	90		48	128	mV
	Conditions	V_{IN}=6V to 15V, I_O=1.0A			V_{IN}=10V to 20V, I_O=1.0A			V_{IN}=13V to 25V, I_O=1.0A			V_{IN}=16V to 27V, I_O=1.0A			V_{IN}=25V to 38V, I_O=1.0A			
Load Regulation	ΔV_{OLOAD}		40	100		70	180		93	240		120	300		120	300	mV
	Conditions	V_{IN}=8V, I_O=0 to 1.5A			V_{IN}=12V, I_O=0 to 1.5A			V_{IN}=15V, I_O=0 to 1.5A			V_{IN}=18V, I_O=0 to 1.5A			V_{IN}=27V, I_O=0 to 1.5A			
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}=18V, 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}=18V, f=100 to 120Hz			V_{IN}=27V, f=100 to 120Hz			
Quiescent Circuit Current	I_q		5	10		5	10		5	10		5	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}=18V, I_O=0A			V_{IN}=27V, I_O=0A			
Overcurrent Protection Starting Current*4,5	I_{S1}	1.6			1.6			1.6			1.6			1.6			A
	Conditions	V_{IN}=8V			V_{IN}=12V			V_{IN}=15V			V_{IN}=18V			V_{IN}=27V			

*1: "A" may be indicated to the right of the Sanken logo.

*2: $V_{IN(max)}$ and $I_{O(max)}$ are restricted by the relation $P_{D(max)}=(V_{IN}-V_O)\cdot I_O$=18(W).

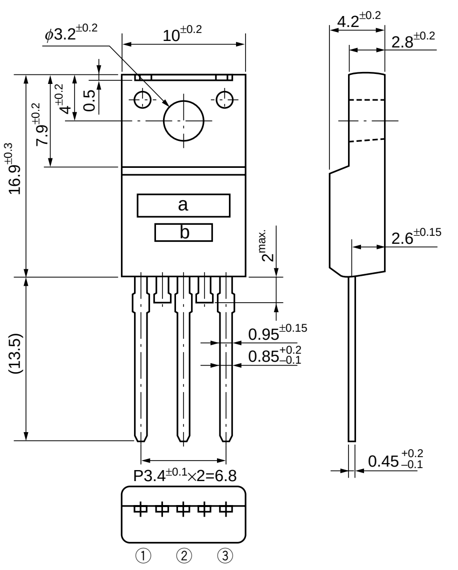
*3: Refer to the dropout voltage.(Refer to Setting DC Input Voltage on page 7.)

*4: I_{S1} is specified at –5(%) drop point of output voltage V_O on the condition that $V_{IN}=V_O$+3V, I_O=1A.

*5: A foldback type overcurrent protection circuit is built into the IC 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_O adjustment by raising ground voltage

■External Dimensions

(unit:mm)

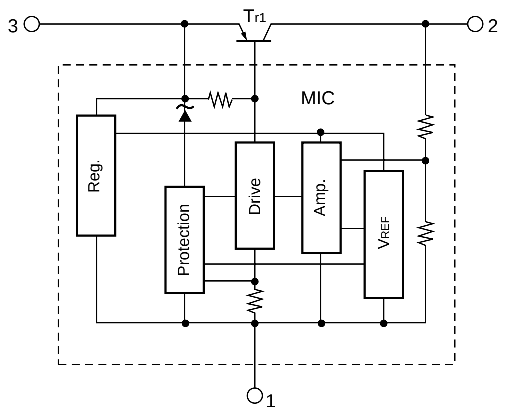


a. Part Number
b. Lot Number

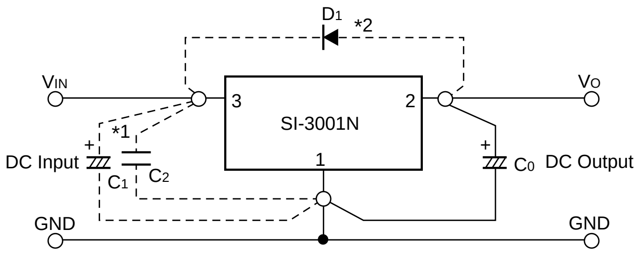
Pin Arrangement
① GND
② V_O
③ V_{IN}

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

■Block Diagram



■Standard External Circuit



C_0 : Output capacitor (47 to 100µF)

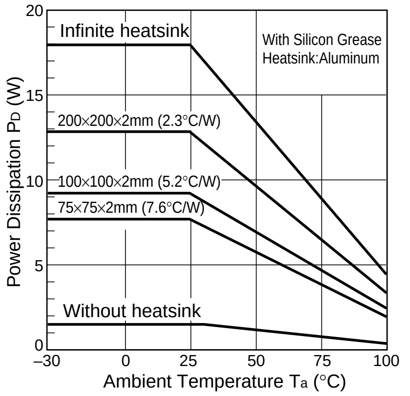
*1 C_1, C_2 : Oscillation prevention capacitor (C_1: Approx. 47µF, C_2: 0.33µF)

These capacitors are required if the input line is inductive and in the case of long wiring. Tantalum capacitors are recommended for C_1 and C_0, particularly at low temperatures.

*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

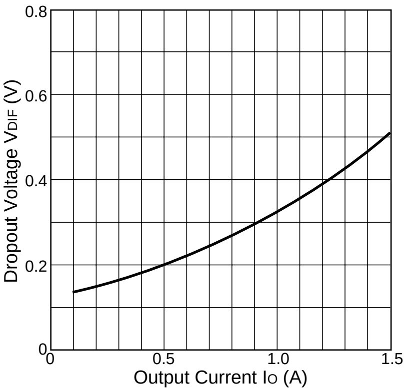


$P_D = I_O \bullet [V_{IN}(mean) - V_O]$

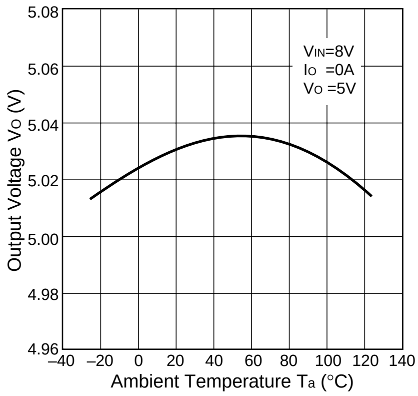
■Typical Characteristics

(T_a=25°C)

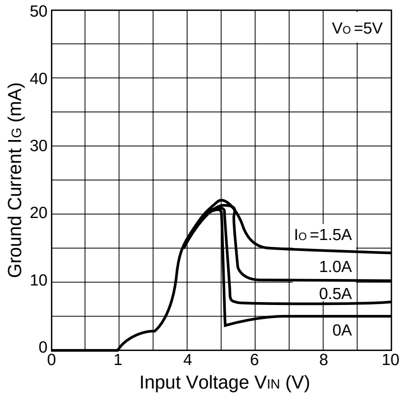
I_O vs. V_{DIF} Characteristics



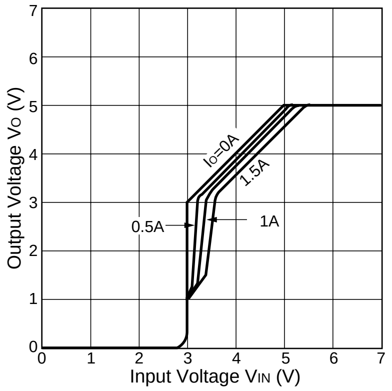
Temperature Coefficient of Output Voltage(SI-3051N)



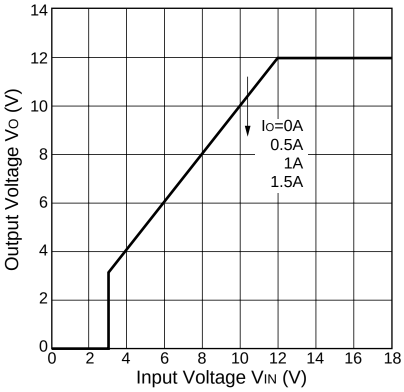
Circuit Current(SI-3051N)



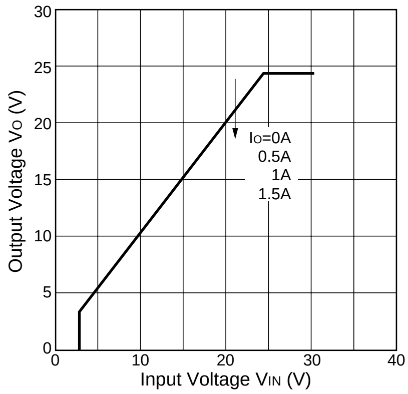
Output Voltage(SI-3051N)



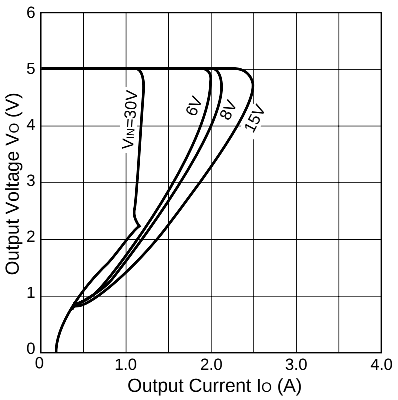
Output Voltage(SI-3121N)



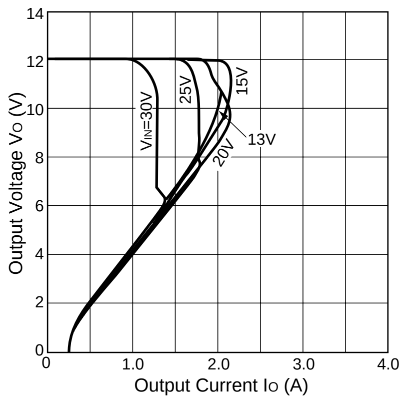
Output Voltage(SI-3241N)



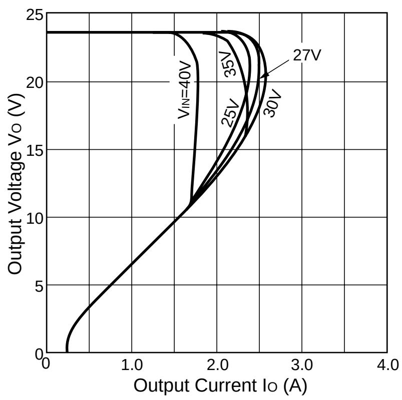
Overcurrent Protection Characteristics(SI-3051N)



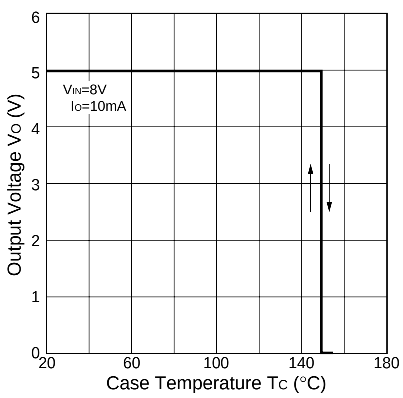
Overcurrent Protection Characteristics(SI-3121N)



Overcurrent Protection Characteristics(SI-3241N)



Thermal Protection Characteristics(SI-3051N)



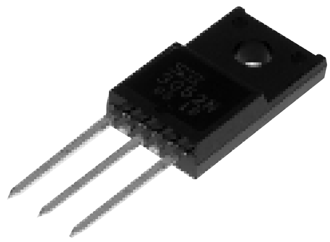
Note on Thermal Protection:

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.

SI-3002N Series

3-Terminal, Full-Mold, Low Dropout Voltage Dropper Type

■Features
- Compact full-mold package (equivalent to TO220)
- Output current: 2.0A
- Low dropout voltage: V_{DIF}≤1V (at I_O=2.0A)
- 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°C)

Parameter	Symbol	Ratings			Unit
		SI-3052N	SI-3092N	SI-3122N/3152N	
DC Input Voltage	V_{IN}	25	30	35	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
Ambient Operating Temperature	T_{op}	–30 to +100			°C
Storage Temperature	T_{stg}	–40 to +125			°C
Thermal Resistance (junction to case)	$R_{th(j-c)}$	5.0			°C/W
Thermal Resistance (junction to ambient air)	$R_{th(j-a)}$	66.7(Without heatsink, stand-alone operation)			°C/W

■Electrical Characteristics

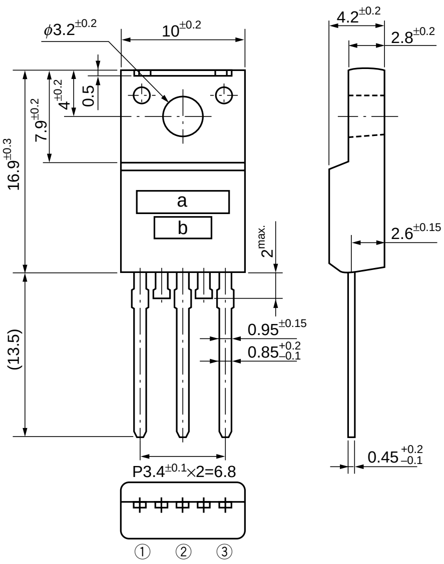
(T_a=25°C unless otherwise specified)

Parameter	Symbol	Ratings												Unit
		SI-3052N			SI-3092N			SI-3122N			SI-3152N			
		min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	
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≤1.5A												
				1.0			1.0			1.0			1.0	
	Conditions	I_O≤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			
Overcurrent Protection Starting Current[*3.4]	I_{S1}	2.1			2.1			2.1			2.1			A
	Conditions	V_{IN}=8V			V_{IN}=12V			V_{IN}=15V			V_{IN}=18V			

*1: $V_{IN(max)}$ and $I_{O(max)}$ are restricted by the relation $P_{D(max)}=(V_{IN}-V_O) \bullet I_O$=20(W).
*2: Refer to the dropout voltage.(Refer to Setting DC Input Voltage on page 7.)
*3: I_{S1} is specified at –5(%) drop point of output voltage V_O on the condition that $V_{IN}=V_O$+3V, I_O=1.0A.
*4: A foldback type overcurrent protection circuit is built into the IC 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_O adjustment by raising ground voltage

■External Dimensions

(unit:mm)

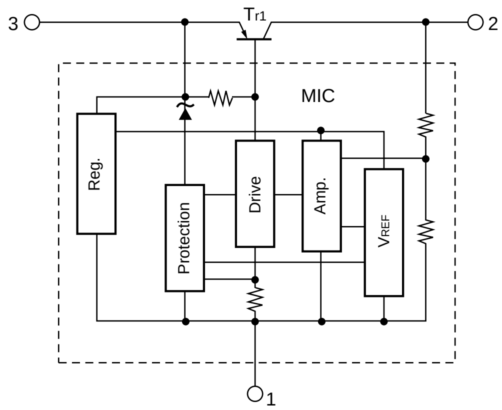


a. Part Number
b. Lot Number

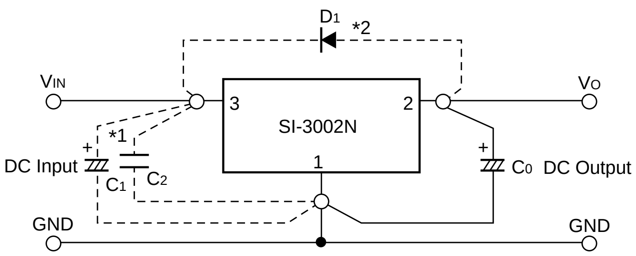
Pin Arrangement
① GND
② V_O
③ V_{IN}

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

■Block Diagram

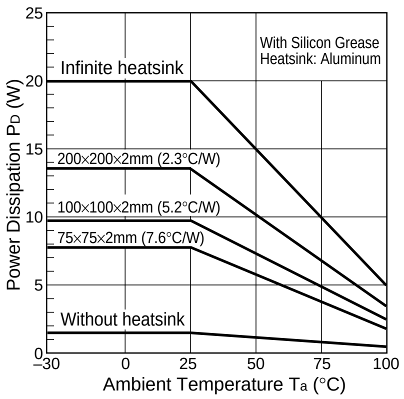


■Standard External Circuit



C_0	:	Output capacitor (47 to 100µF)
*1 C_1, C_2	:	Oscillation prevention capacitor (C1: Approx. 47µF, C2: 0.33µF) These capacitors are required if the input line is inductive and in the case of long wiring. Tantalum capacitors are recommended for C1 and C0, particularly at low temperatures.
*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

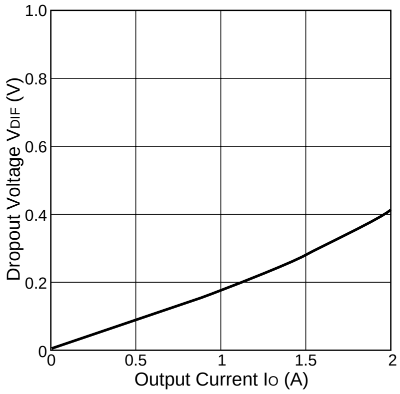


$P_D = I_O \cdot [V_{IN}(\text{mean}) - V_O]$

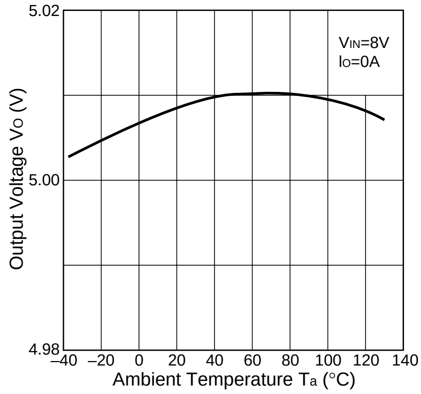
■Typical Characteristics

(Ta=25°C)

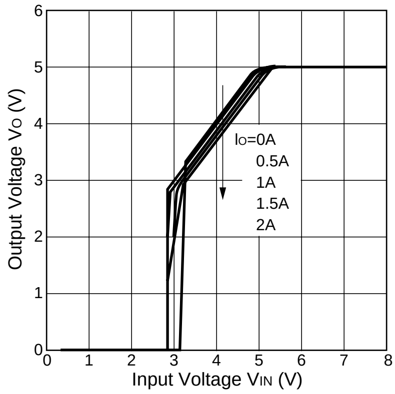
Io vs. VDIF Characteristics



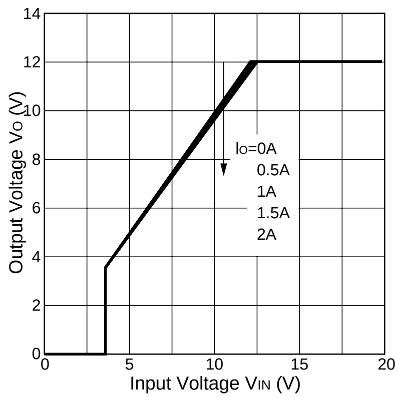
Temperature Coefficient of Output Voltage(SI-3052N)



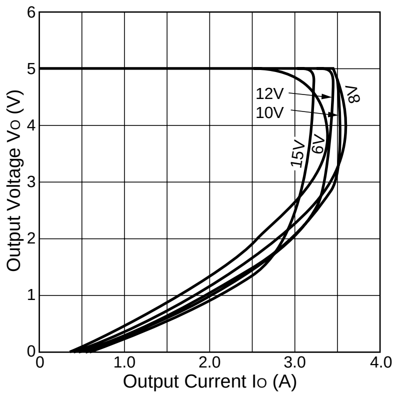
Output Voltage(SI-3052N)



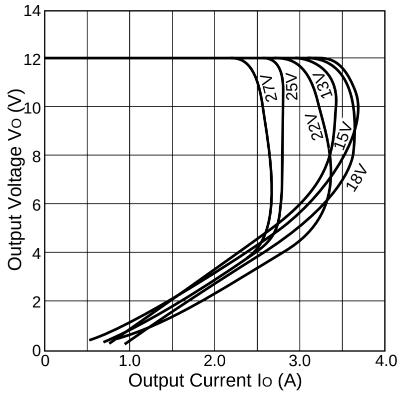
Output Voltage(SI-3122N)



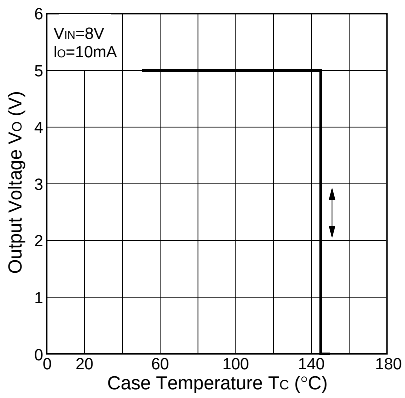
Overcurrent Protection Characteristics(SI-3052N)



Overcurrent Protection Characteristics(SI-3122N)



Thermal Protection Characteristics(SI-3052N)



Note on Thermal Protection:

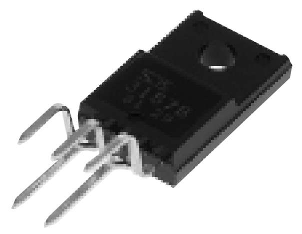
The thermal protection circuit is intended for protection against heat during instantaneous short-circuiting. Its operation is not guaranteed for continuous heating condition such as short-circuiting over extended periods of time.

SI-3000B Series

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

■Features

- Compact full-mold package (equivalent to TO220)
- Output current: 0.27A
- Low dropout voltage: $V_{DIF} \leq 0.5V$ (at I_O=0.27A)
- 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, thermal protection circuits
- Accurate overcurent protection starting current
  SI-3157B : 0.3 to 0.7A (V_{IN}=18V)
  SI-3025B : 0.3 to 0.7A (When V_{IN}=18V, at V_O=15.7V)
  0.3 to 0.75A (When V_{IN}=18V, at V_O=11.7V)
- Variable output voltage type (SI-3025B) also available



■Applications

- For BS and CS antenna power supplies
- Electronic equipment

■Absolute Maximum Ratings

(T_a=25°C)

Paarameter	Symbol	Ratings	Unit
DC Input Voltage	V_{IN}	35	V
Voltage of Output Control Terminal	V_C	V_{IN}	V
DC Output Current	I_O	0.27*1	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
Ambient Operating Temperature	T_{op}	–30 to +100	°C
Storage Temperature	T_{stg}	–40 to +125	°C
Thermal Resistance (junction to case)	$R_{th(j-c)}$	7.0	°C/W
Thermal Resistance (junction to ambient air)	$R_{th(j-a)}$	66.7(Without heatsink, stand-alone operation)	°C/W

■Electrical Characteristics

(T_a=25°C unless otherwise specified)

Parameter	Symbol	Ratings						Unit
		SI-3157B			SI-3025B			
		min.	typ.	max.	min.	typ.	max.	
Input Voltage	V_{IN}	[*2]		27[*1]	6[*2,6]		27[*1]	V
Output Voltage (SI-3025B: Reference Voltage)	V_O (V_{REF})	14.92	15.70	16.48	2.448	2.550	2.652	V
	Conditions	V_{IN}=18V, I_O=0.2A			V_{IN}=V_O+3V, I_O=0.2A			
Dropout Voltage	V_{DIF}			0.5			0.5	V
	Conditions	I_O≤0.27A			I_O≤0.27A			
Line Regulation	ΔV_{OLINE}		30	90			10	mV (3025B: mV/V)
	Conditions	V_{IN}=17 to 27V, I_O=0.2A			V_{IN}=(V_O+1) to 27V, I_O=0.27A			
Load Regulation	ΔV_{OLOAD}		120	300			10	mV (3025B: mV/V)
	Conditions	V_{IN}=18V, I_O=0 to 0.27A			V_{IN}=V_O+3V, I_O=0 to 0.27A			
Temperature Coefficient of Output Voltage (SI-3025B: Temperature Coefficient of Reference Voltage)	$\Delta V_O/\Delta T_a$ ($\Delta V_{REF}/\Delta T_a$)		±1.5			±0.5		mV/°C
	Conditions	V_{IN}=18V, I_O=5mA, T_j=0 to 100°C			V_{IN}=V_O+3V, I_O=5mA, T_j=0 to 100°C			
Ripple Rejection	R_{REJ}		54			54		dB
	Conditions	V_{IN}=18V, f=100 to 120Hz			V_{IN}=V_O+3V, f=100 to 120Hz			
Quiescent Circuit Current	I_q		3	10		3	10	mA
	Conditions	V_{IN}=18V, I_O=0A			V_{IN}=V_O+3V, I_O=0A			
Overcurrent Protection Starting Current[*3,4]	I_{S1}	0.3		0.7	0.3		0.75	A
	Conditions	V_{IN}=18V			V_{IN}=18V, at V_O=11.7V			
			———		0.3		0.7	
	Conditions				V_{IN}=18V, at V_O=15.7V			
V_C Terminal[*5]: Control Voltage (Output ON)	$V_{C.IH}$	2.0			2.0			V
V_C Terminal[*5]: Control Voltage (Output OFF)	$V_{C.IL}$			0.8			0.8	V
V_C Terminal[*5]: Control Current (Output ON)	$I_{C.IH}$			20			20	μA
	Conditions	V_C=2.7V			V_C=2.7V			
V_C Terminal[*5]: Control Current (Output OFF)	$I_{C.IL}$			–0.3			–0.3	mA
	Conditions	V_C=0.4V			V_C=0.4V			

*1: $V_{IN(max)}$ and $I_{O(max)}$ are restricted by the relation $P_{D(max)}$=(V_{IN}-V_O)•I_O=14(W).

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

*3: I_{S1} is specified at –5(%) drop point of output voltage V_O on the condition that V_{IN}=V_O+3V, I_O=0.2A.

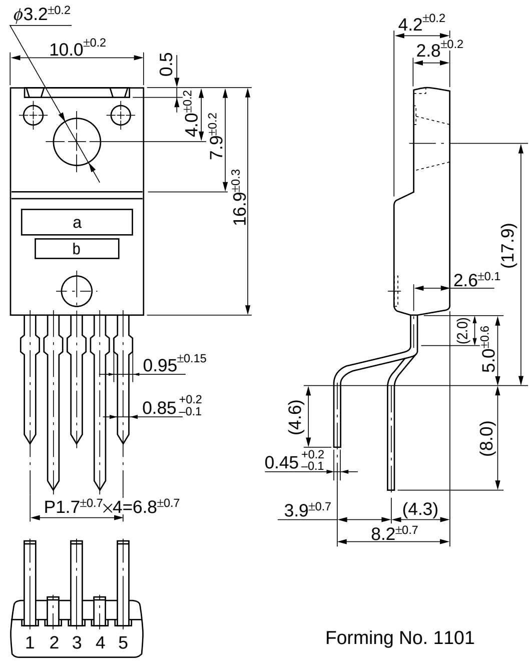
*4: A foldback type overcurrent protection circuit is built into the IC regulator. Therefore, avoid using it for the following applications as it may cause starting errors:
(1) Constant current load (2) Plus/minus power (3) Series power (4) V_O adjustment by raising ground voltage

*5: Output is ON even when output control terminal V_C is open. Each input level is equivalent to LS-TTL. Therefore, it may be directly driven by an LS-TTL circuit.

*6. When setting output voltage to 5V or less, input voltage needs to be set to 6V or over to operate stably.

■External Dimensions

(unit:mm)



a. Part Number
b. Lot Number

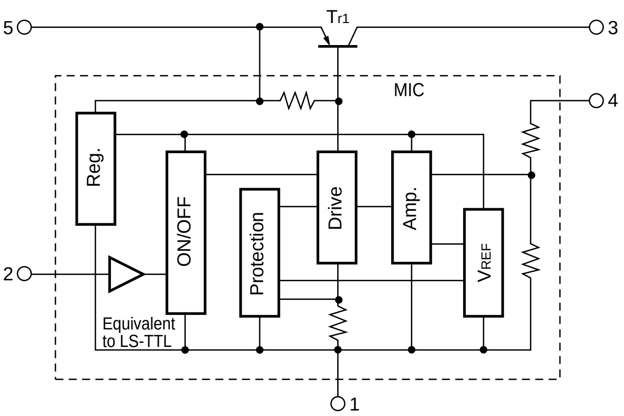
Pin Arrangement

SI-3157B	SI-3025B
① GND	① GND
② VC	② VC
③ VO	③ VO
④ VOS	④ VREF
⑤ VIN	⑤ VIN

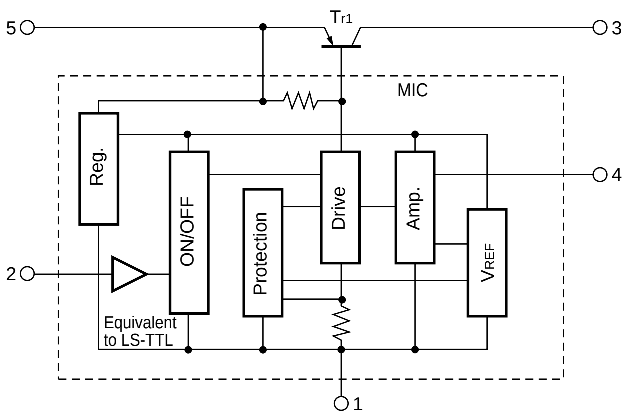
Plastic Mold Package Type
Flammability: UL94V-0
Weight: Approx. 2.3g

■Block Diagram

SI-3157B

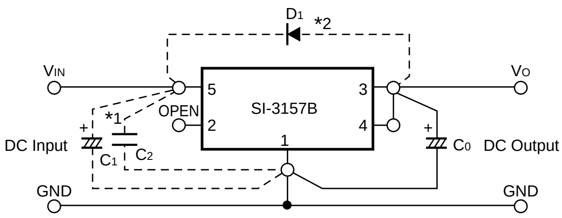


SI-3025B

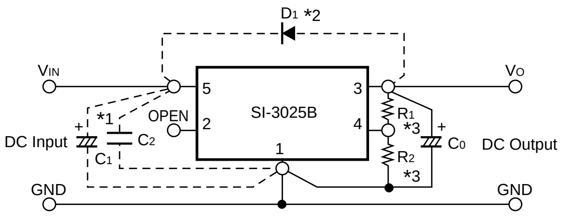


■Standard External Circuit

SI-3157B



SI-3025B



C_0 : Output capacitor (47 to 100µF)

*1 C_1, C_2 : Oscillation prevention capacitor (C1: Approx. 47µF, C2: 0.33µF)
These capacitors are required if the input line is inductive and in the case of long wiring. Tantalum capacitors are recommended for C_1 and C_0, particularly at low temperatures.

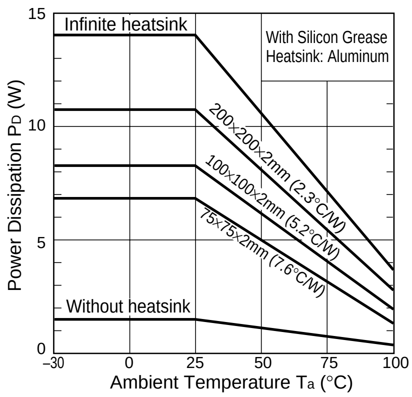
*2 D_1 : Protection diode
This diode is required for protection against reverse biasing of the input and output. Sanken EU2Z is recommended.

*3 R_1, R_2 : External resistor for setting output voltage
Relationship between output voltage V_O and external resistors R_1 and R_2 is as follows.

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

R_2 must be 2.55kΩ for stable operation.

■T_a-P_D Characteristics

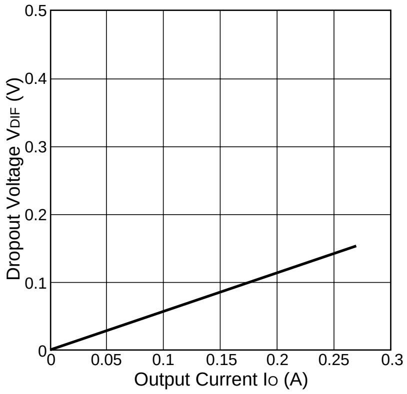


$$P_D = I_O \cdot [V_{IN}(mean) - V_O]$$

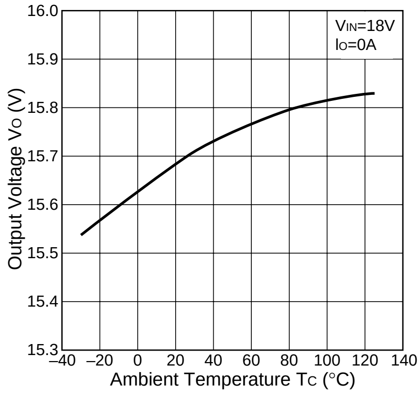
■Typical Characteristics (at V_O=15.7V for SI3025B)

(T_a=25°C)

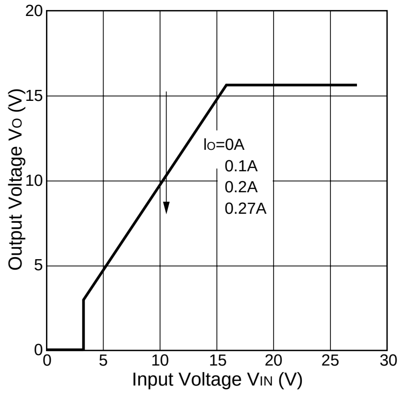
I_O vs. V_{DIF} Characteristics



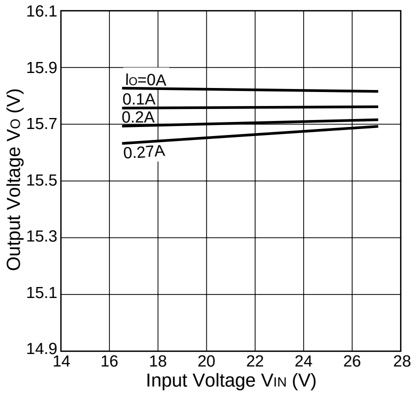
Temperature Coefficient of Output Voltage(SI-3157B)



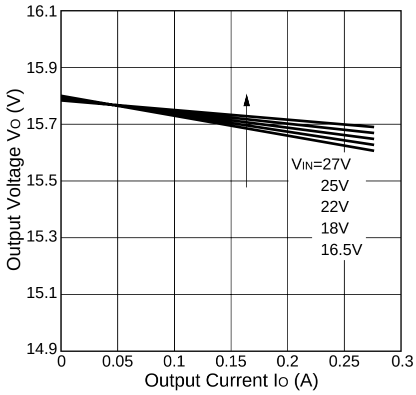
Output Voltage(SI-3157B)



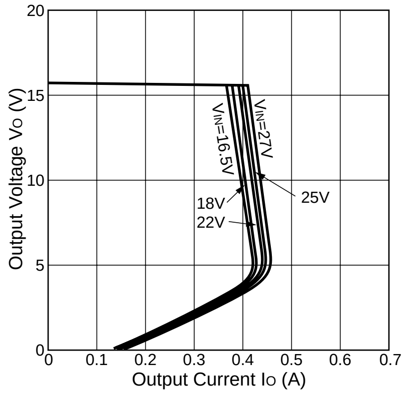
Line Regulation



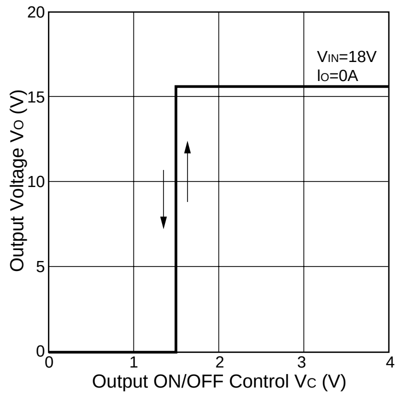
Load Regulation



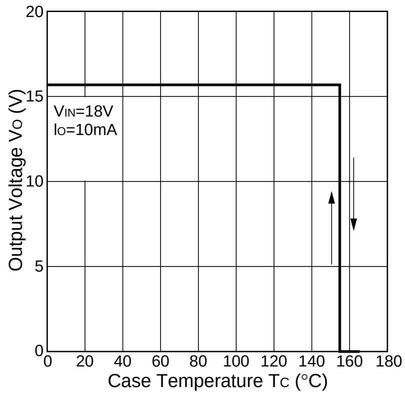
Overcurrent Protection Characteristics(SI-3157B)



Output ON/OFF Control



Thermal Protection Characteristics



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.

SI-3000F Series

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

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

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

■Absolute Maximum Ratings

(T_a=25°C)

Parameter	Symbol	Ratings					Unit
		SI-3050F	SI-3090F/3120F	SI-3150F/3157F	SI-3240F	SI-3025F	
DC Input Voltage	V_{IN}	25	30	35	45	30	V
Voltage of Output Control Terminal	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
Ambient Operating Temperature	T_{op}	–30 to +100					°C
Storage Temperature	T_{stg}	–40 to +125					°C
Thermal Resistance (junction to case)	$R_{th(j-c)}$	7.0***					°C/W
Thermal Resistance (junction to ambient air)	$R_{th(j-a)}$	66.7(Without heatsink, stand-alone operation)					°C/W

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

■Electrical Characteristics (except SI-3025F)

(T_a=25°C unless otherwise specified)

Parameter		Symbol	Ratings																		Unit
			SI-3050F			SI-3090F			SI-3120F			SI-3150F			SI-3157F			SI-3240F			
			min.	typ.	max.	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[*3]		27[*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	14.40	15.00	15.60	14.92	15.70	16.48	23.04	24.00	24.96	V
	SI-3000FA	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		—			—		
		Conditions	V_{IN}=8V, I_O=0.5A			V_{IN}=12V, I_O=0.5A			V_{IN}=15V, I_O=0.5A			V_{IN}=18V, 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			0.5	V
		Conditions	I_O≤0.5A																		
					1.0			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		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}=16V to 27V, 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		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}=18V, 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			±1.5			±2.5		mV/°C
		Conditions	V_{IN}=8V, I_O=5mA, Tj=0 to 100°C			V_{IN}=12V, I_O=5mA, Tj=0 to 100°C			V_{IN}=15V, I_O=5mA, Tj=0 to 100°C			V_{IN}=18V, I_O=5mA, Tj=0 to 100°C			V_{IN}=19V, I_O=5mA, Tj=0 to 100°C			V_{IN}=27V, I_O=5mA, Tj=0 to 100°C			
Ripple Rejection		R_{REJ}		54			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}=18V, 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		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}=18V, I_O=0A			V_{IN}=19V, I_O=0A			V_{IN}=27V, I_O=0A			
Overcurrent Protection Starting Current[*4,7]		I_{S1}	1.2			1.2			1.2			1.2			1.2			1.2			A
		Conditions	V_{IN}=8V			V_{IN}=12V			V_{IN}=15V			V_{IN}=18V			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			2.0			V
	Control Voltage (Output OFF)	$V_{C.IL}$			0.8			0.8			0.8			0.8			0.8			0.8	
	Control Current (Output ON)	$I_{C.IH}$			20			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			–0.3	mA
		Conditions	V_C=0.4V																		

*1: "A" may be indicated to the right of the Sanken logo.

*2: $V_{IN(max)}$ and $I_{O(max)}$ are restricted by the relation $P_{D(max)}=(V_{IN}-V_O)\cdot I_O$=14W(SI-3240F: 18W).

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

*4: I_{S1} is specified at –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. Therefore, it may be directly driven by an LS-TTL circuit.

*6: When setting output voltage to 5V or less, input voltage needs to be set to 6V or over to operate stably.

*7: A foldback type overcurrent protection circuit is built into the IC 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_O adjustment by raising ground voltage

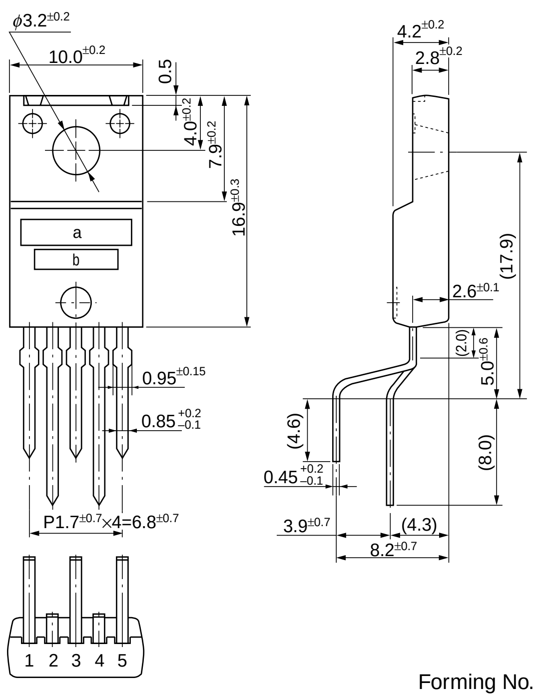
■Electrical Characteristics (SI-3025F)

(T_a=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_{DIF}			0.5	V
		Conditions		I_O≤0.5A		
					1.0	
		Conditions		I_O≤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	V
	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

(unit:mm)



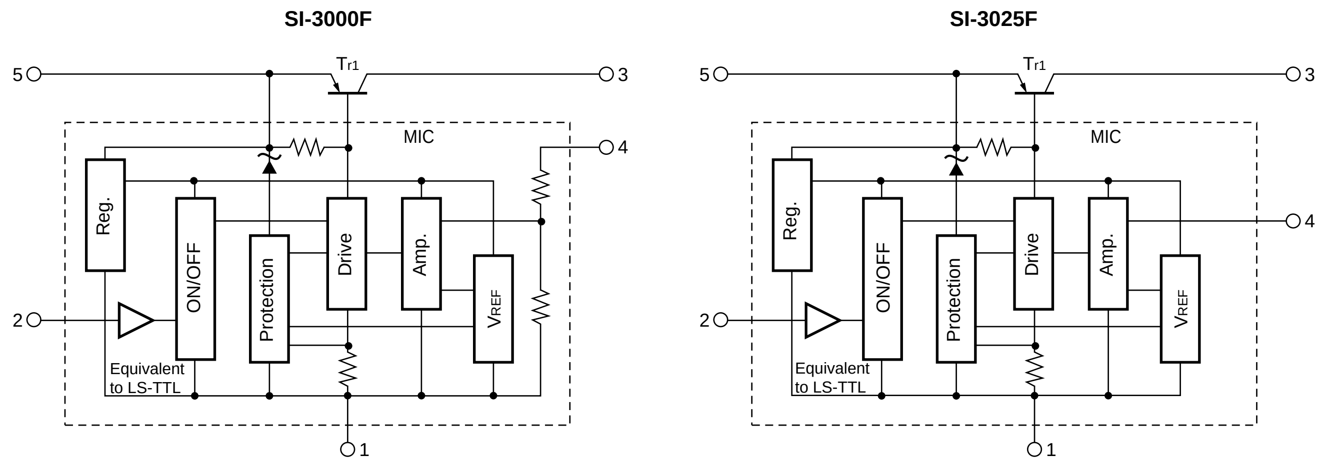
Forming No. 1101

a. Part Number
b. Lot Number

Pin Arrangement	(Only SI-3025F)
① GND	① GND
② V_C	② V_C
③ V_O	③ V_O
④ V_{OS}	④ V_{REF}
⑤ V_{IN}	⑤ V_{IN}

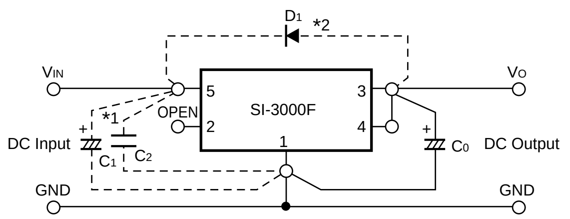
Plastic Mold Package Type
Flammability: UL94V-0
Weight: Approx. 2.3g

■Block Diagram

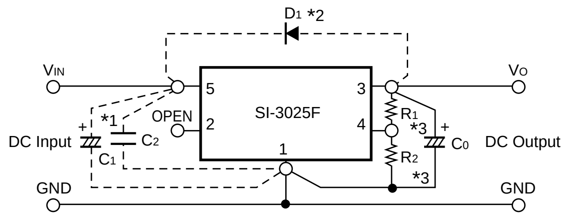


■Standard External Circuit

SI-3000F



SI-3025F



C_0 : Output capacitor (47 to 100µF)

*1 C_1, C_2 : Oscillation prevention capacitor (C_1: Approx. 47µF, C_2: 0.33µF)
These capacitors are required if the input line is inductive and in the case of long wiring. Tantalum capacitors are recommended for C_1 and C_0, particularly at low temperatures.

*2 D_1 : Protection diode
This diode is required for protection against reverse biasing of the input and output. Sanken EU2Z is recommended.

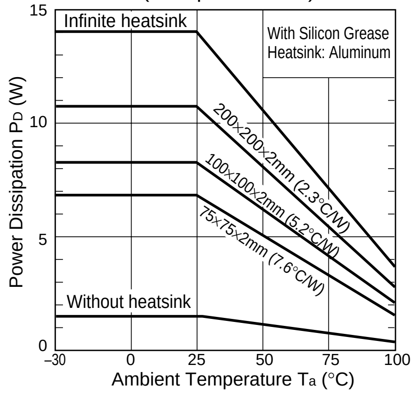
*3 R_1, R_2 : External resistor for setting output voltage
Relationship between output voltage V_O and external resistors R_1 and R_2 is as follows.

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

R_2 must be 2.55kΩ for stable operation.

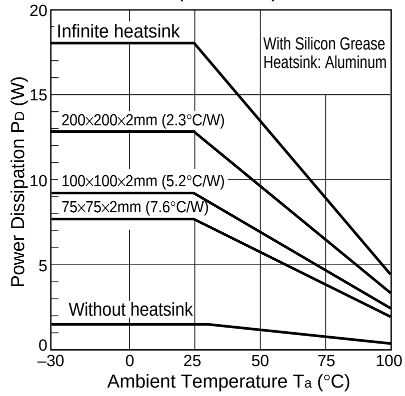
■T_a-P_D Characteristics

(Except SI-3240F)



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

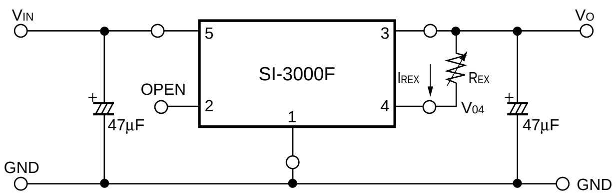
(SI-3240F)

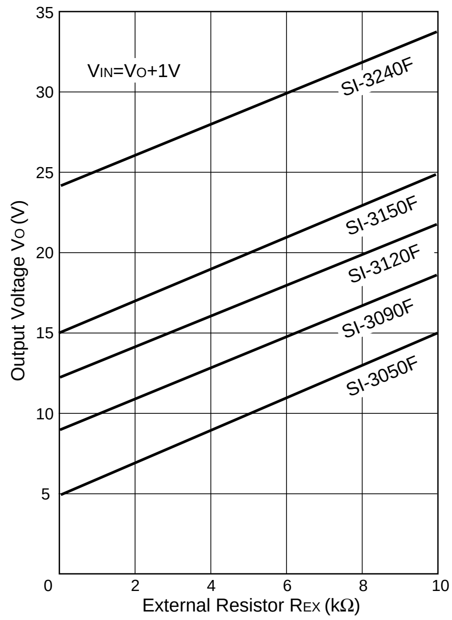


$P_D = I_O \cdot [V_{IN}(mean) - V_O]$

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

1. Variable output voltage with a single external resistor





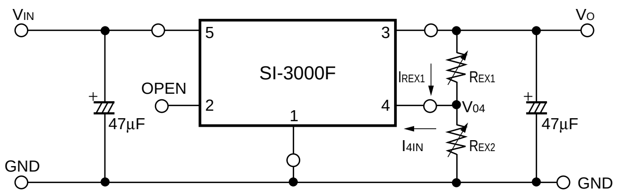
The output voltage may be increased by inserting resistor R_{EX} between terminals No.4 (sensing terminal) and No.3 (output terminal). The current I_{REX} flowing into terminal No.4 is 1mA (typ.), therefore the adjusted output voltage V_{OUT} is:

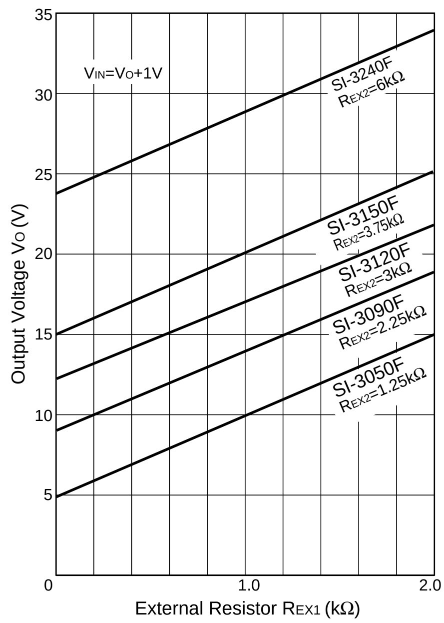
$V_O=V_{04}+I_{REX}\bullet R_{EX}$ *V_{04}: output voltage of SI-3000F series

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:

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

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-3000F series

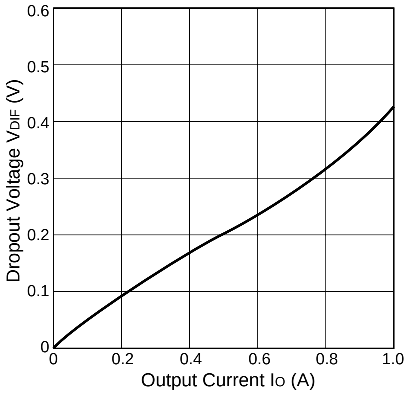
S: Stability coefficient of I_{4IN} (may be set to any value)

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.

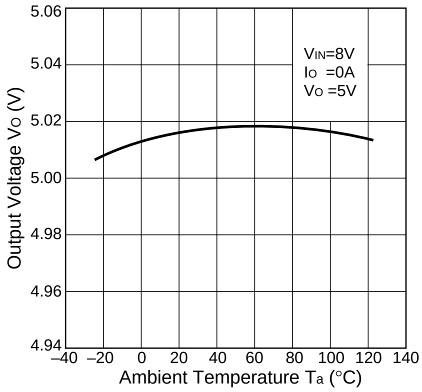
■Typical Characteristics

(T_a=25°C)

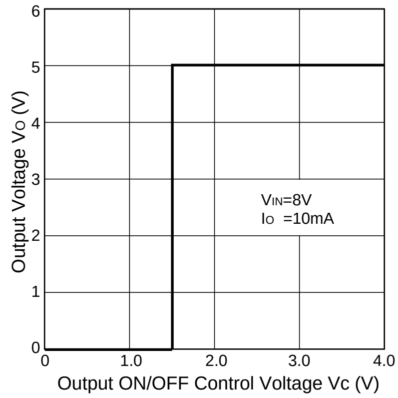
Io vs. VDIF Characteristics



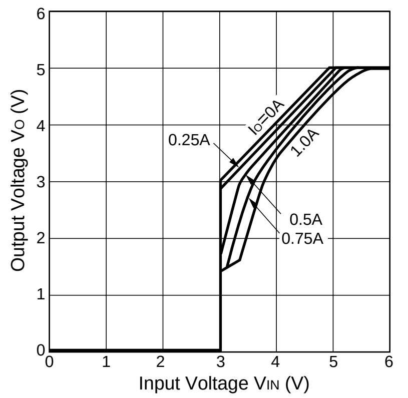
Temperature Coefficient of Output Voltage(SI-3050F)



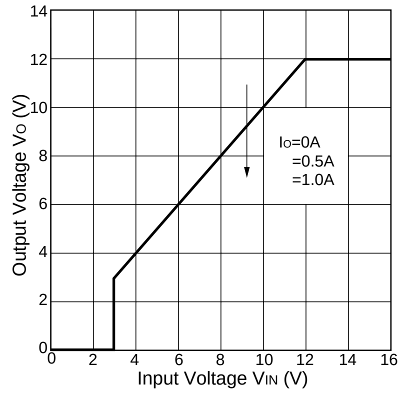
Output ON/OFF Control(SI-3050F)



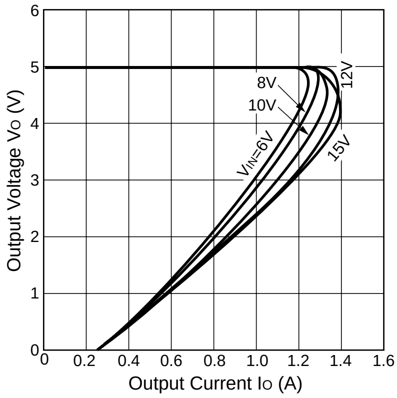
Output Voltage(SI-3050F)



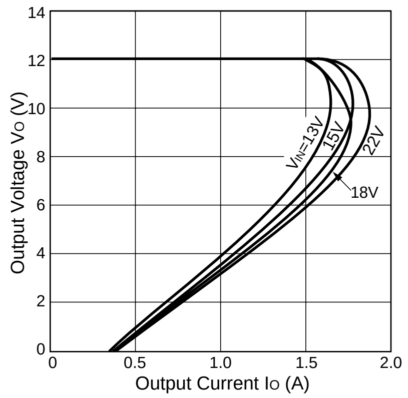
Output Voltage(SI-3120F)



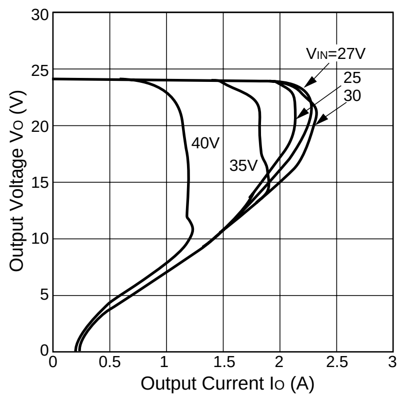
Overcurrent Protection Characteristics(SI-3050F)



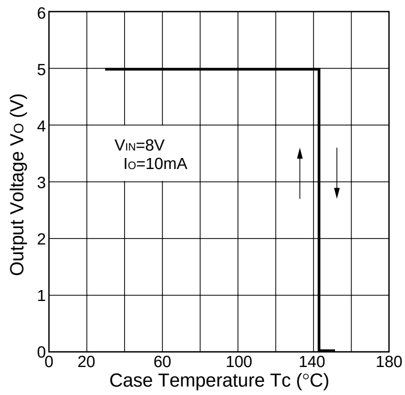
Overcurrent Protection Characteristics(SI-3120F)



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.

SI-3000C Series

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

■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)
  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 (SI-3033C: Drooping type overcurrent), overvoltage, thermal protection circuits

■Applications
- For stabilization of the secondary stage 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
Voltage of Output Control Terminal	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
Ambient Operating Temperature	T_{op}	–30 to +100				°C
Storage Temperature	T_{stg}	–40 to +125				°C
Thermal Resistance (junction to case)	$R_{th(j-c)}$	5.5				°C/W
Thermal Resistance (junction to ambient air)	$R_{th(j-a)}$	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
Output Voltage	SI-3000CA	V_O	3.234	3.300	3.366	4.90	5.00	5.10	8.82	9.00	9.18	V
		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≤1.0A									
					1.0			1.0			1.0	
		Conditions	I_O≤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	V
	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: "A" may be indicated to the right of the Sanken logo.

*2: $V_{IN(max)}$ and $I_{O(max)}$ are restricted by the relation $P_{D(max)}$=(V_{IN}-V_O)•I_O=18(W).

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

*4: I_{S1} is specified at –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. Therefore, it may be directly driven by an LS-TTL circuit.

*6: A foldback type overcurrent protection circuit is built into the IC regulator (excluding SI-3033C). 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_O adjustment by raising ground voltage

■Electrical Characteristics

(T_a=25°C unless otherwise specified)

Parameter	Symbol	SI-3120C min.	SI-3120C typ.	SI-3120C max.	SI-3150C min.	SI-3150C typ.	SI-3150C max.	SI-3240C min.	SI-3240C typ.	SI-3240C max.	Unit
Input Voltage	V_{IN}	13[*3]		30[*2]	16[*3]		30[*2]	25[*3]		40[*2]	V
Output Voltage SI-3000C[*1]	V_O	11.52	12.00	12.48	14.40	15.00	15.60	23.04	24.00	24.96	V
Output Voltage SI-3000CA	V_O	11.76	12.00	12.24	14.70	15.00	15.30	23.52	24.00	24.48	V
	Conditions	V_{IN}=15V, I_O=1.0A			V_{IN}=18V, I_O=1.0A			V_{IN}=27V, I_O=1.0A			
Dropout Voltage	V_{DIF}			0.5			0.5			0.5	V
	Conditions	I_O≤1.0A									
				1.0			1.0			1.0	V
	Conditions	I_O≤1.5A									
Line Regulation	ΔV_{OLINE}		24	64		30	90		48	128	mV
	Conditions	V_{IN}=13 to 25V, I_O=1.0A			V_{IN}=16 to 25V, I_O=1.0A			V_{IN}=25 to 38V, I_O=1.0A			
Load Regulation	ΔV_{OLOAD}		93	240		120	300		120	300	mV
	Conditions	V_{IN}=15V, I_O=0 to 1.5A			V_{IN}=18V, I_O=0 to 1.5A			V_{IN}=27V, I_O=0 to 1.5A			
Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T_a$		±1.5			±1.5			±2.5		mV/°C
	Conditions	V_{IN}=15V, I_O=5mA, T_j=0 to 100°C			V_{IN}=18V, 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		dB
	Conditions	V_{IN}=15V, f=100 to 120Hz			V_{IN}=18V, f=100 to 120Hz			V_{IN}=27V, f=100 to 120Hz			
Quiescent Circuit Current	I_q		5	10		5	10		5	10	mA
	Conditions	V_{IN}=15V, I_O=0A			V_{IN}=18V, I_O=0A			V_{IN}=27V, I_O=0A			
Overcurrent Protection Starting Current[*4,6]	I_{S1}	1.6			1.6			1.6			A
	Conditions	V_{IN}=15V			V_{IN}=18V			V_{IN}=27V			
V_C Terminal[*5] Control Voltage (Output ON)	$V_{C.IH}$	2.0			2.0			2.0			V
V_C Terminal[*5] Control Voltage (Output OFF)	$V_{C.IL}$			0.8			0.8			0.8	V
V_C Terminal[*5] Control Current (Output ON)	$I_{C.IH}$			20			20			20	µA
	Conditions	V_C=2.7V									
V_C Terminal[*5] Control Current (Output OFF)	$I_{C.IL}$			–0.3			–0.3			–0.3	mA
	Conditions	V_C=0.4V									

*1: "A" may be indicated to the right of the Sanken logo.

*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.(Refer to Setting DC Input Voltage on page 7.)

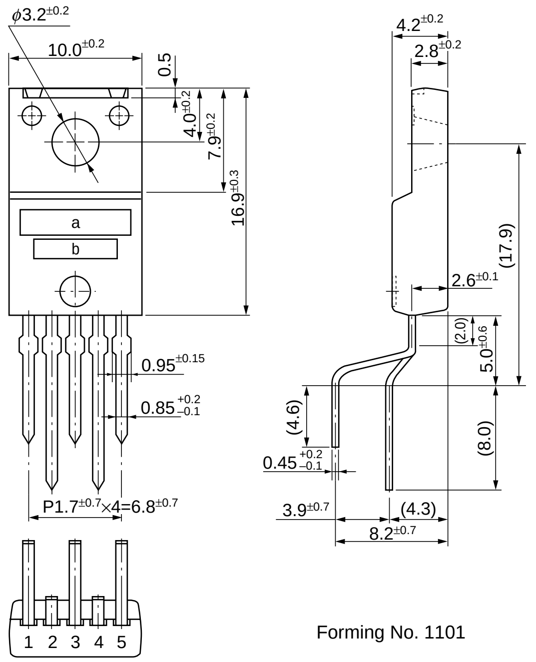
*4: I_{S1} is specified at –5(%) drop point of output voltage V_O on the condition that $V_{IN}=V_O$+3V, I_O=1A.

*5: Output is ON even when output control terminal V_C is open. Each input level is equivalent to LS-TTL. Therefore, it may be directly driven by an LS-TTL circuit.

*6: A foldback type overcurrent protection circuit is built into the I_C 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_O adjustment by raising ground voltage

■External Dimensions

(unit:mm)

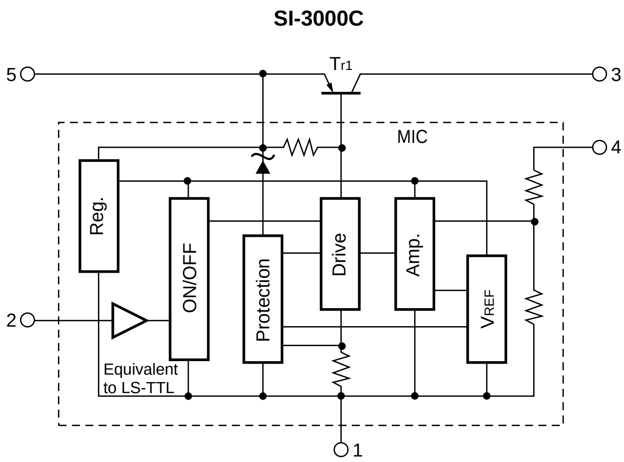


a. Part Number
b. Lot Number

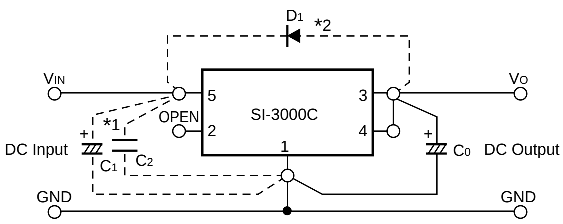
Pin Arrangement
① GND
② V_C
③ V_O
④ V_{OS}
⑤ V_{IN}

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

■Block Diagram



■Standard External Circuit

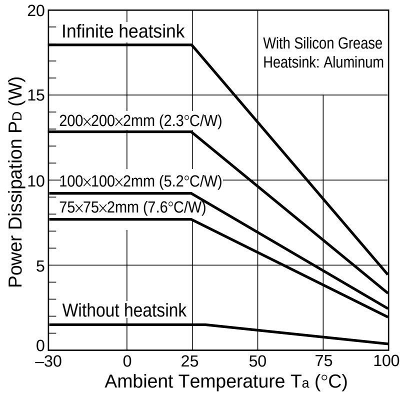


C_0 : Output capacitor (47 to 100µF)

*1 C_1, C_2 : Oscillation prevention capacitor (C_1: Approx. 47µF, C_2: 0.33µF)
These capacitors are required if the input line is inductive and in the case of long wiring. Tantalum capacitors are recommended for C_1 and C_0, particularly at low temperatures.

*2 D_1 : Protection diode
This diode is required for protection against reverse biasing of the input and output. Sanken EU2Z is recommended.

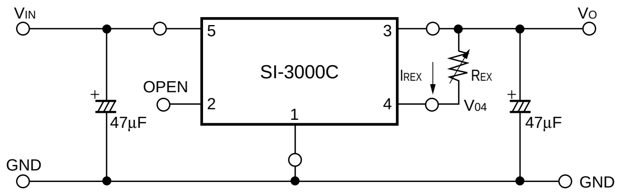
■T_a-P_D Characteristics

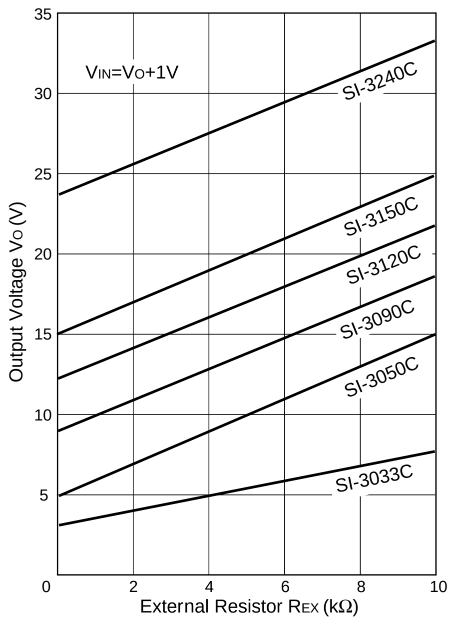


$$P_D = I_O \cdot [V_{IN}(\text{mean}) - V_O]$$

External Variable Output Voltage Circuit

1. Variable output voltage with a single external resistor





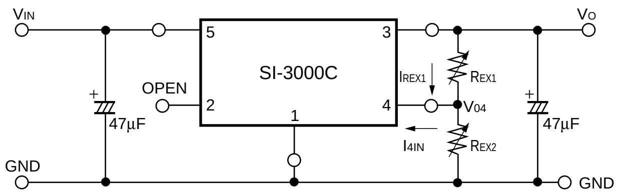
The output voltage may be increased by inserting resistor R_{EX} between terminals No.4 (sensing terminal) and No.3 (output terminal). The current I_{REX} flowing into terminal No.4 is 1mA (typ.)(SI-3033C:0.43mA (typ.)), therefore the adjusted output voltage V_{OUT} is:

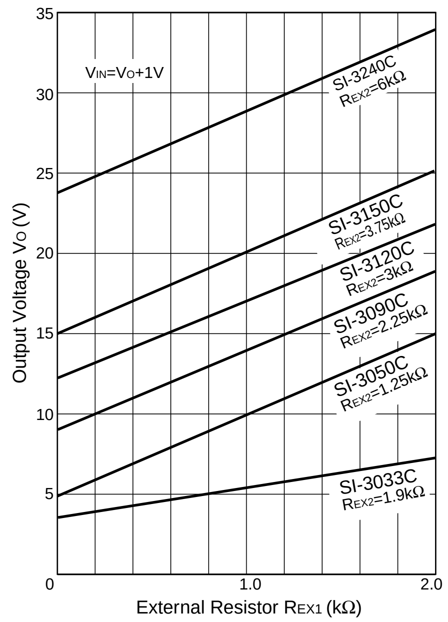
$V_O = V_{04} + I_{REX} \bullet R_{EX}$ *V_{04}: output voltage of SI-3000C series

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

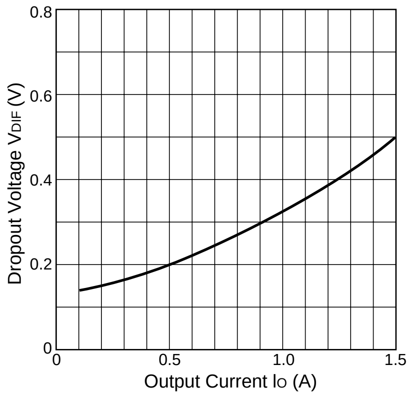
S: Stability coefficient of I_{4IN} (may be set to any value)

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.

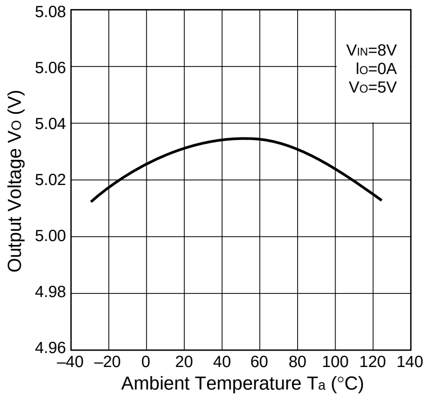
■Typical Characteristics

(T_a=25°C)

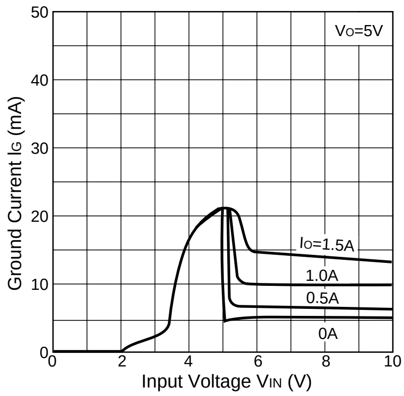
I_O vs. V_{DIF} Characteristics



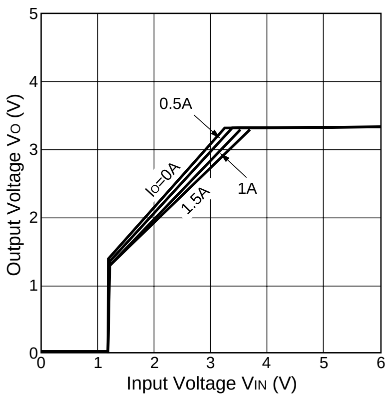
Temperature Coefficient of Output Voltage(SI-3050C)



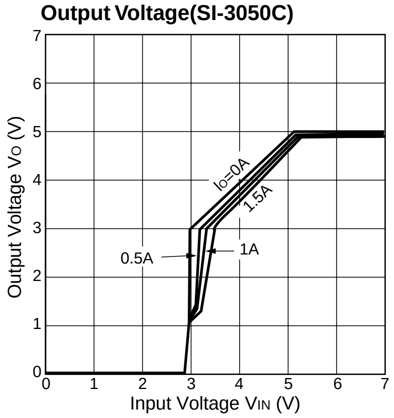
Circuit Current(SI-3050C)



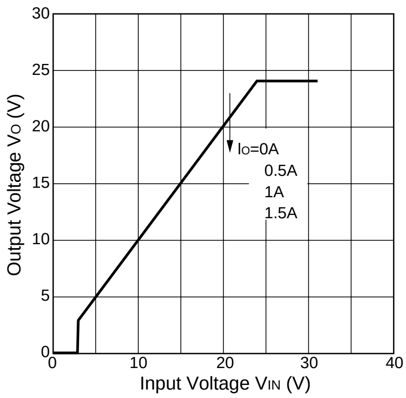
Output Voltage(SI-3033C)



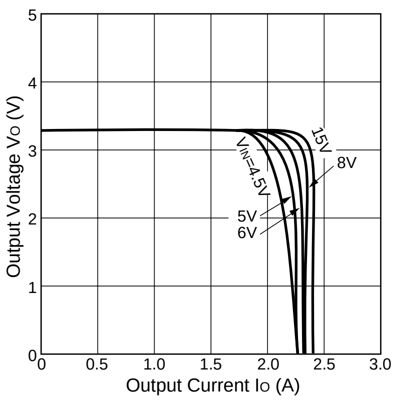
Output Voltage(SI-3050C)



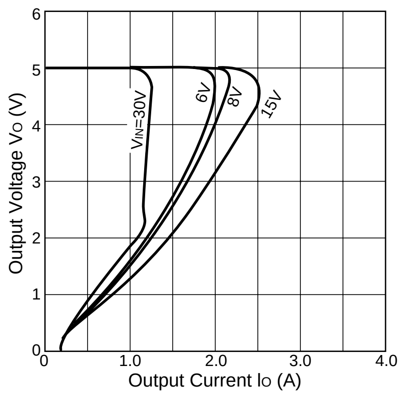
Output Voltage(SI-3240C)



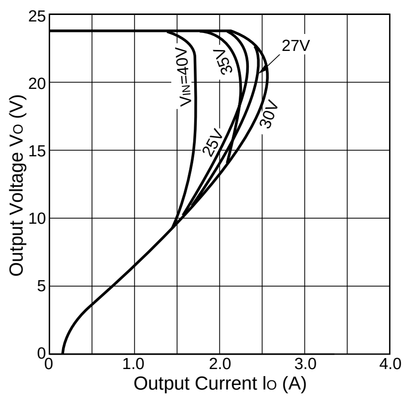
Overcurrent Protection Characteristics(SI-3033C)



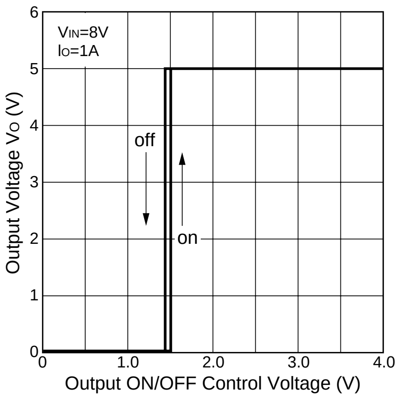
Overcurrent ProtectionCharacteristics(SI-3050C)



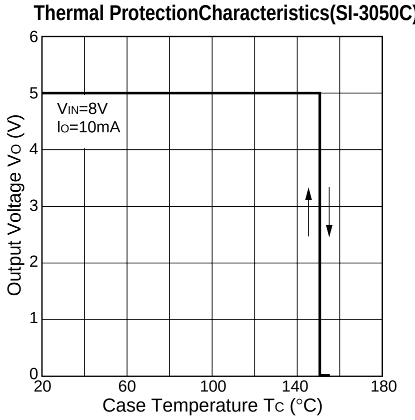
Overcurrent Protection Characteristics(SI-3240C)



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.

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°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			°C
Ambient Operating Temperature	T_{op}	–30 to +100			°C
Storage Temperature	T_{stg}	–40 to +125			°C
Thermal Resistance (junction to case)	$R_{th(j-c)}$	5.0			°C/W
Thermal Resistance (junction to ambient air)	$R_{th(j-a)}$	66.7(Without heatsink, stand-alone operation)			°C/W

■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≤1.5A												
					1.0			1.0			1.0			1.0	
		Conditions	I_O≤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
	Control Voltage (Output OFF)	$V_{C.IL}$			0.8			0.8			0.8			0.8	V
	Control Current (Output ON)	$I_{C.IH}$			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	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.(Refer to Setting DC Input Voltage on page 7.)

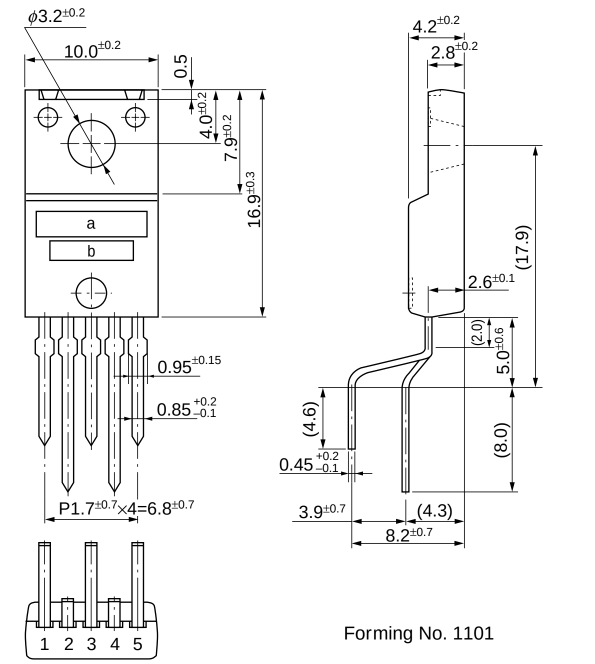
*3: I_{S1} is specified at –5(%) drop point of output voltage V_O on the condition that $V_{IN}=V_O$+3V, I_O=1A.

*4: Output is ON even when output control terminal V_C is open. Each input level is equivalent to LS-TTL. Therefore, it may be directly driven by an LS-TTL circuit.

*5: A foldback type overcurrent protection circuit is built into the IC 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_O adjustment by raising ground voltage

■External Dimensions

(unit:mm)

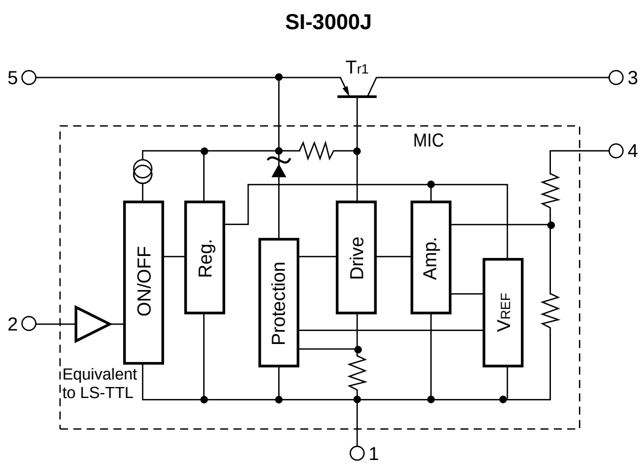


a. Part Number
b. Lot Number

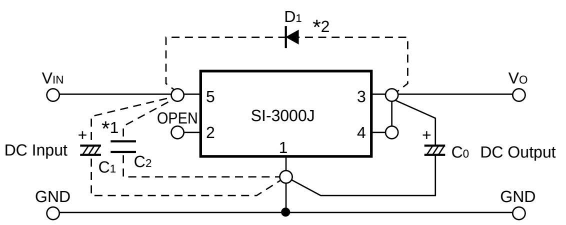
Pin Arrangement
① GND
② V_C
③ V_O
④ V_{OS}
⑤ V_{IN}

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

■Block Diagram



■Standard External Circuit

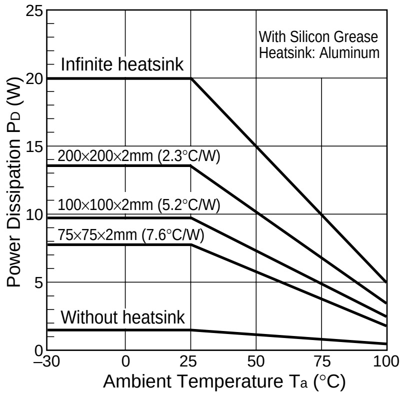


C_O : Output capacitor (47 to 100µF)

*1 C_1, C_2 : Oscillation prevention capacitor (C1: Approx. 47µF, C2: 0.33µF)
These capacitors are required if the input line is inductive and in the case of long wiring. Tantalum capacitors are recommended for C1 and Co, particularly at low temperatures.

*2 D_1 : Protection diode
This diode is required for protection against reverse biasing of the input and output. Sanken EU2Z is recommended.

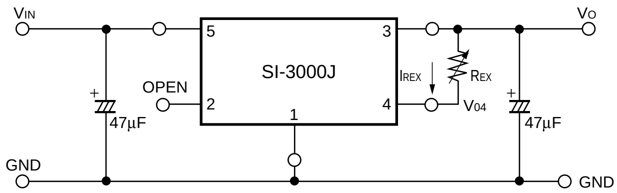
■T_a-P_D Characteristics

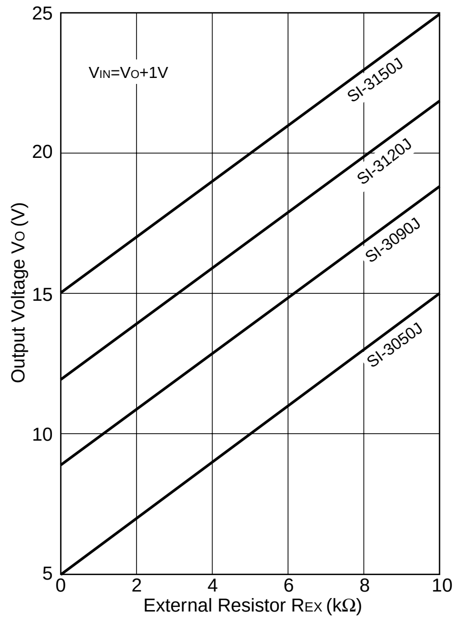


$P_D=I_O \bullet [V_{IN}(mean)-V_O]$

External Variable Output Voltage Circuit

1. Variable output voltage with a single external resistor





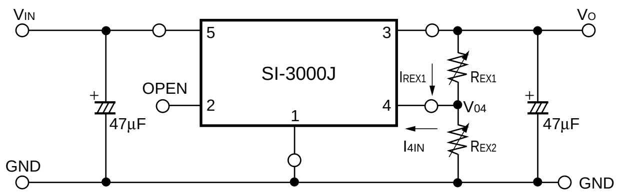
The output voltage may be increased by inserting resistor R_{EX} between terminals No.4 (sensing terminal) and No.3 (output terminal). The current I_{REX} flowing into terminal No.4 is 1mA (typ.), therefore the adjusted output voltage V_{OUT} is:

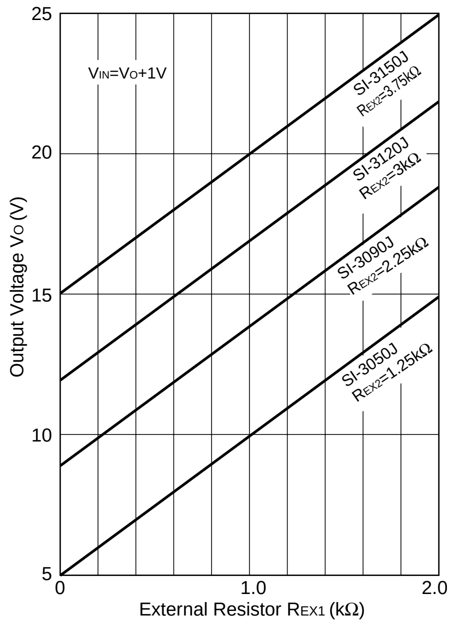
$V_O = V_{04} + I_{REX} \cdot R_{EX}$ *V_{04}: output voltage of SI-3000J series

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

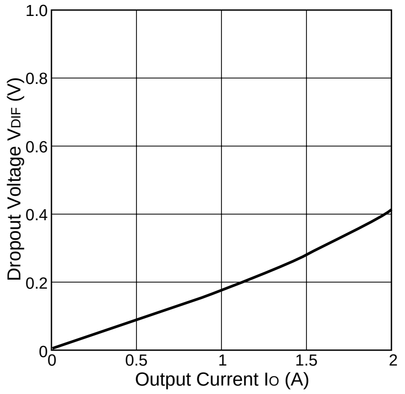
S: Stability coefficient of I_{4IN} (may be set to any value)

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.

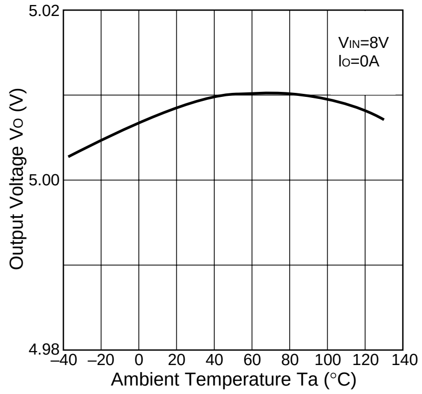
■Typical Characteristics

(T_a=25°C)

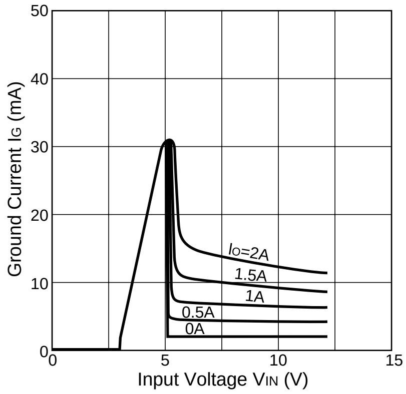
I_O vs. V_{DIF} Characteristics



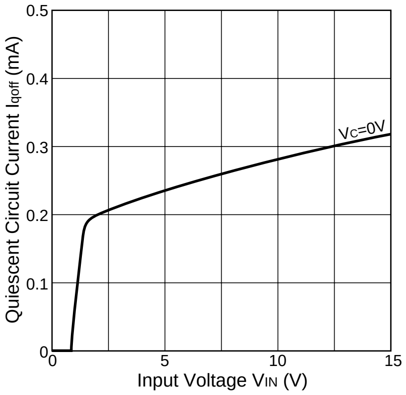
Temperature Coefficient of Output Voltage(SI-3050J)



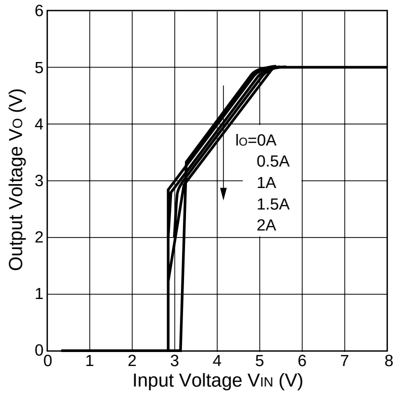
Circuit Current(SI-3050J)



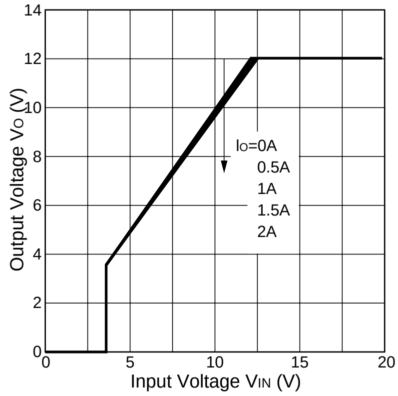
Quiescent Circuit Current(SI-3050J)



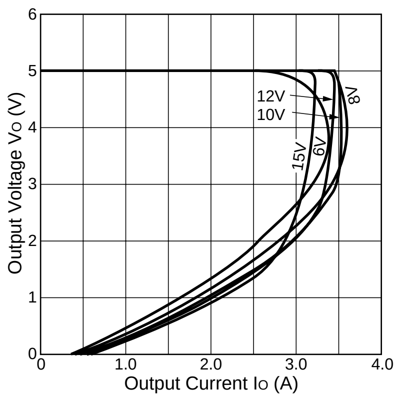
Output Voltage(SI-3050J)



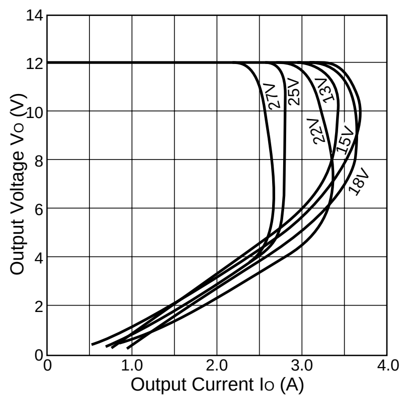
Output Voltage(SI-3120J)



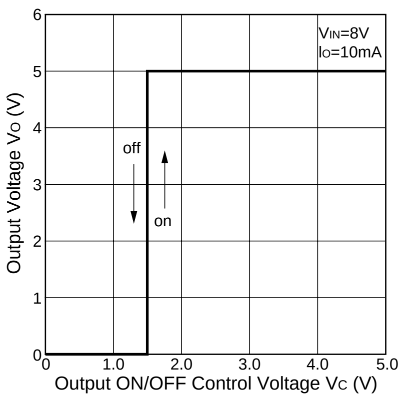
Overcurrent Protection Characteristics(SI-3050J)



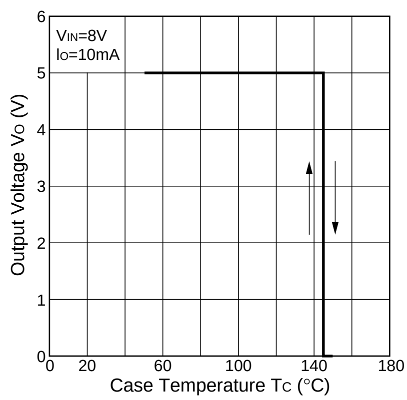
Overcurrent Protection Characteristics(SI-3120J)



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.

SI-3000R Series

5-Terminal, Full-Mold, Low Dropout Voltage Dropper Type with Reset Function

■Features

- Reset signal output (As the output rises it sends a reset signal to the micro-computer to secure normal operation of the system. As the output drops a reset signal is also sent out to protect the system.)
- Reset signal detection output voltage level Voth is 92% of output voltage in the standard specification. Models with different setting values for different needs are scheduled to be added to the series.
- Delay time for reset signal can be set freely by external capacitor.
- Compact full-mold package (equivalent to TO220)
- Output current: 1.5A
- Low dropout voltage :V_{DIF}≤1V (at I_O=1.5A)
  Applicable to battery driven equipment with built-in microcomputer.
- Built-in dropping type overcurrent, overvoltage, thermal protection circuits
- Low circuit current I_D=typ.1.5mA(I_O=0A)

■Applications

- Microcomputer-controlled equipment
- Battery-driven micro-computer-controlled equipment

■Absolute Maximum Ratings

(T_a=25°C)

Parameter	Symbol	Ratings SI-3050R	Unit
DC Input Voltage	V_{IN}	35	V
Voltage of Rest Signal Output Terminal	V_{RST}	V_{IN}	V
DC Output Current	I_O	1.5*1	A
Power Dissipation	P_{D1}	18(With infinite heatsink)	W
	P_{D2}	1.5(Without heatsink, stand-alone operation)	W
Junction Temperature	T_j	–30 to +125	°C
Ambient Operating Temperature	T_{OP}	–30 to +100	°C
Storage Temperature	T_{stg}	–30 to +125	°C
Thermal Resistance (junction to case)	$R_{th(j-c)}$	5.5	°C/W
Thermal Resistance (junction to ambient air)	$R_{th(j-a)}$	66.7(Without heatsink, stand-alone operation)	°C/W

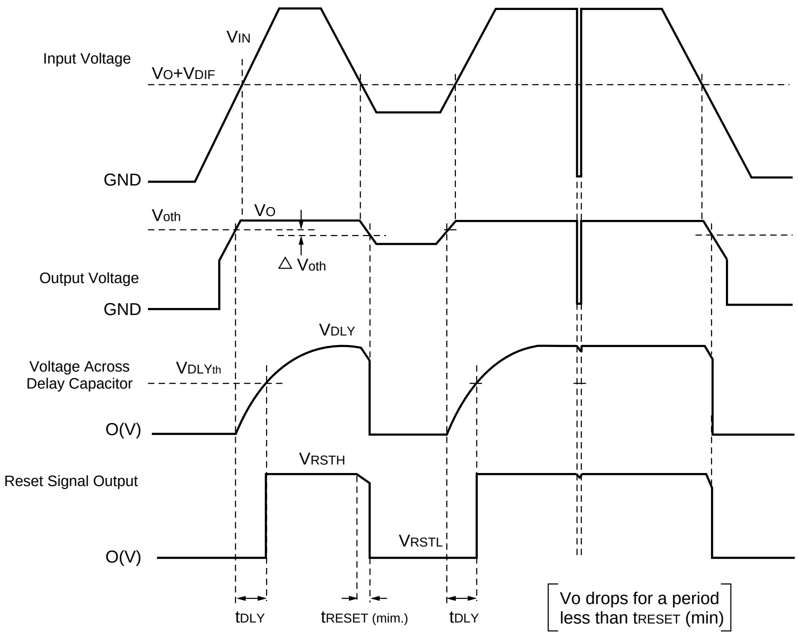
■Electrical Characteristics

(T_a=25°C unless otherwise specified)

Parameter		Symbol	Ratings SI-3050R min.	typ.	max.	Unit
Input Voltage		V_{IN}	6[*2]		30[*1]	V
Output Voltage		V_O	4.80	5.00	5.20	V
		Conditions	V_{IN}=8V, I_O=1.0A			
Dropout Voltage		V_{DIF}			0.5	V
		Conditions	I_O≤1.0A			
					1.0	
		Conditions	I_O≤1.5A			
Line Regulation		ΔV_{OLINE}			30	mV
		Conditions	V_{IN}=6 to 15V, I_O=1.0A			
Load Regulation		ΔV_{OLOAD}			100	mV
		Conditions	V_{IN}=8V, I_O=0 to 1.5A			
Ripple Rejection		R_{REJ}		54		dB
		Conditions	V_{IN}=8V, f=100 to 120Hz			
Quiescent Circuit Current		I_q		1.5	5.0	mA
		Conditions	V_{IN}=8V, I_O=0A			
Overcurrent Protection Starting Current (Dropping Type)		I_{S1}	1.6			A
		Conditions	V_{IN}=8V			
Limited Current at Overcurrent Protection Operation		I_{S2}	1.6			A
		Conditions	V_{IN}=8V			
DLY Terminal	Threshold	V_{DLyth}	2.7	2.9	3.1	V
	Source	I_{DLY}	25	35	45	µA
Reset Threshold Voltage Level (Voth: Threshold Output Voltage)		V_{oth}/V_O	90	92	94	%
Reset Threshold Voltage Hysteresis		ΔV_{oth}	50	100	150	mV
V_{RST} Terminal[*4]	H-level Output Voltage	V_{RSTH}	V_{CC}–1			V
	L-level Output Voltage	V_{RSTL}			0.8	V
	Sink Current at H level	I_{RSTH}			–20	µA
	Source Current at L level	I_{RSTL}	–16			mA

*1: $V_{IN(max)}$ and $I_{O(max)}$ are restricted by the relation $P_{D(max)}=(V_{IN}-V_O)\bullet I_O$=18(W).
*2: Refer to the dropout voltage.(Refer to Setting DC Input Voltage on page 7.)
*3: I_{S1} is specified at –5(%) drop point of output voltage V_O on the condition that V_{IN}=8V, I_O=1.0A.
*4: Reset signal output terminal V_{RST} is an open-collector output. Use a pull-up resistor when connecting it to a logic circuit.

■Reset Signal Output Timing Chart



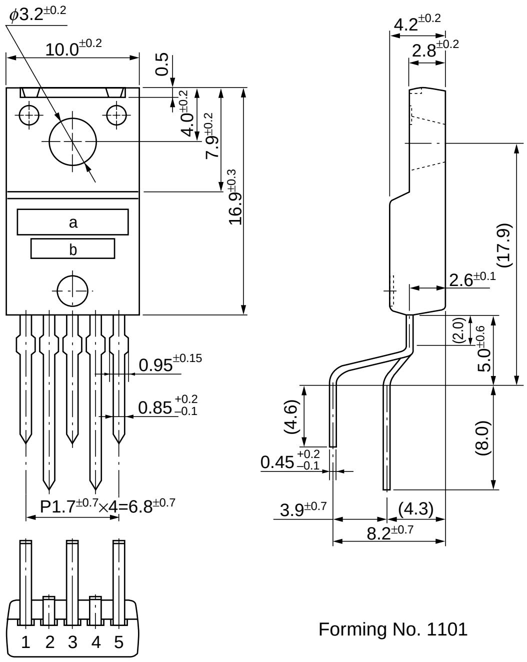
The delay time t_{DLY} of the reset signal can be calculated from the following formula:

$$t_{DLY} = \frac{V_{DLYth}}{I_{DLY}} \times C_{DLY}$$

*I_{DLY} is the current flowing from the t_{DLY} terminal shown in the standard connection circuit diagram.

■External Dimensions

(unit:mm)



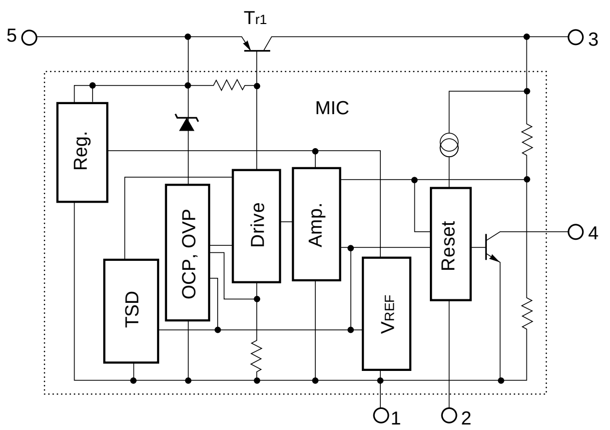
Forming No. 1101

a. Part Number
b. Lot Number

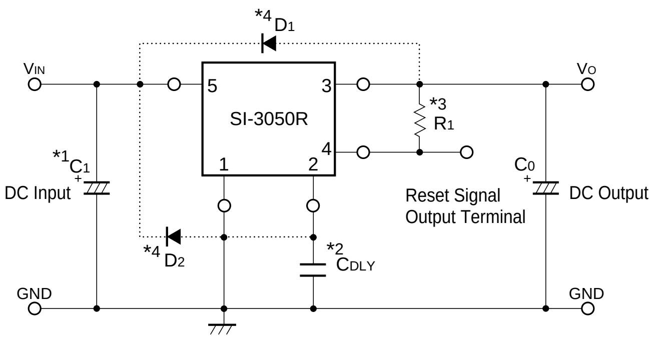
Pin Arrangement
① GND
② DELAY
③ V_O
④ Rest Signal output
⑤ V_{IN}

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

■Block Diagram

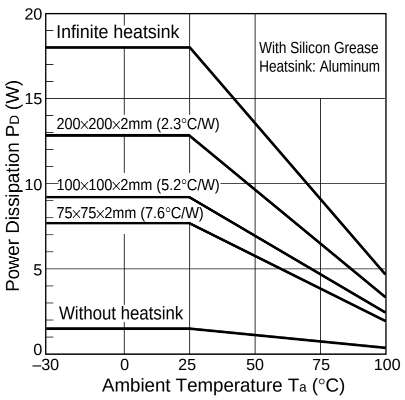


■Standard External Circuit



C_0	: Output capacitor (Approx. 200μF)
*1 C_1	: Oscillation prevention capacitor (C_1: Approx. 47μF) The distance between terminals No.5 (V_{IN}) and No.1 (GND) must be made as short as possible. If the input line is inductive or in the case of long wiring, a capacitor of approximately 0.33μF with superior high frequency characteristics must be connected in parallel. Tantalum capacitors are recommended for C_1 and C_0, particularly at low temperatures.
*2 C_{DLY}	: Delay capacitor (reset output)
*3 R_1	: Pull-up resistor (300Ω or above)
*4 D_1, D_2	: Protection diodes These diodes are required for protection against reverse biasing of the input and output. Sanken EU2Z is recommended.

■T_a-P_D Characteristics

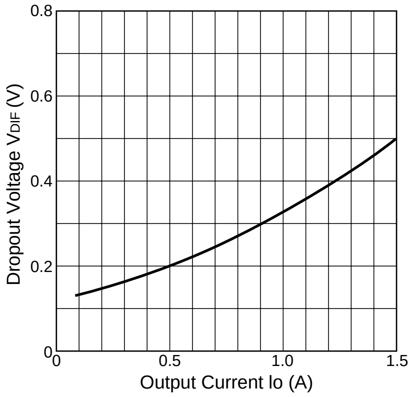


$P_D = I_O \bullet [V_{IN}(\text{mean}) - V_O]$

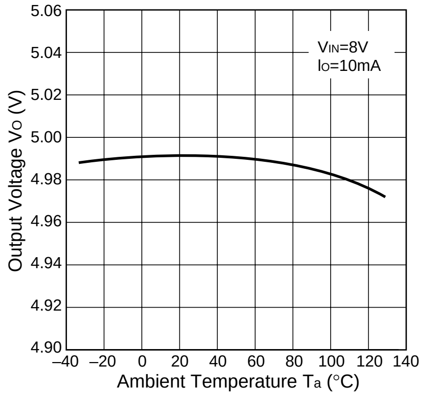
■Typical Characteristics

(T_a=25°C)

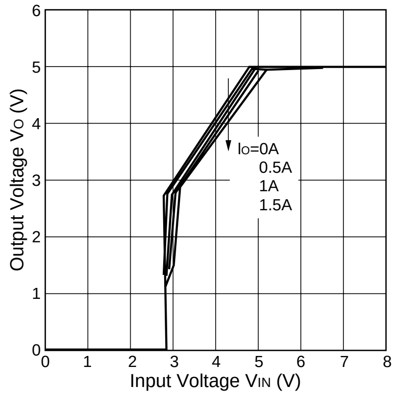
I_O vs. V_{DIF} Characteristics



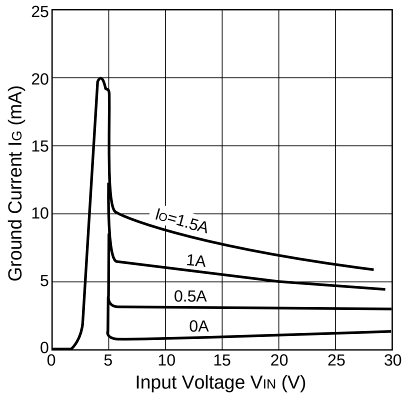
Temperature Coefficient of Output Voltage



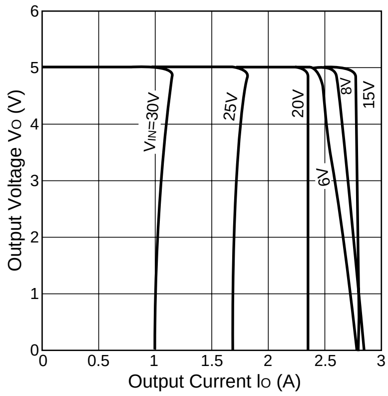
Output Voltage



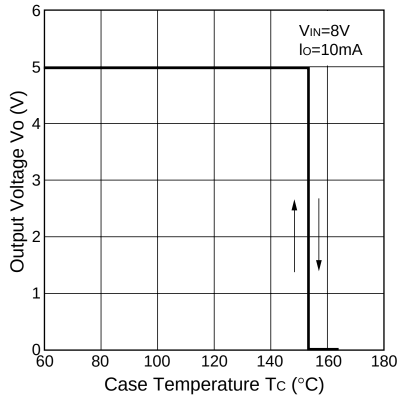
Circuit Current



Overcurrent Protection Characteristics



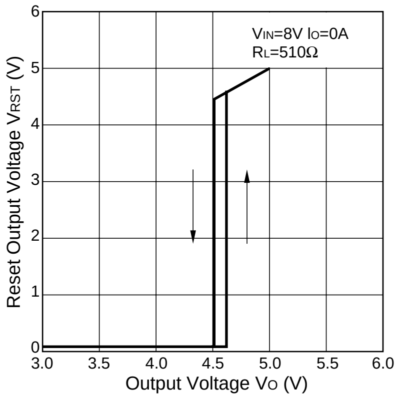
Thermal Protection Characteristics



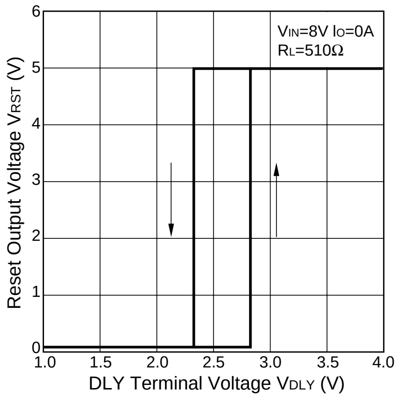
Note on Thermal Protection:

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.

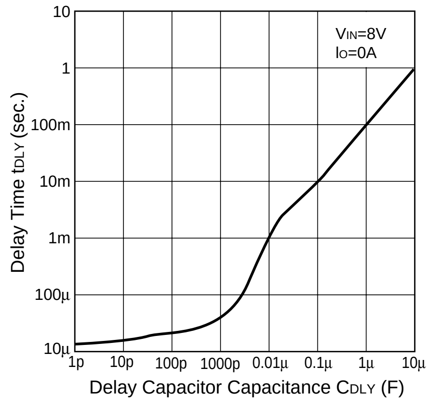
Reset Output vs. V_O Characteristics



Reset Output vs. DLY Terminal Voltage Characteristics



Reset Signal Delay Time t_{DLY}(sec)

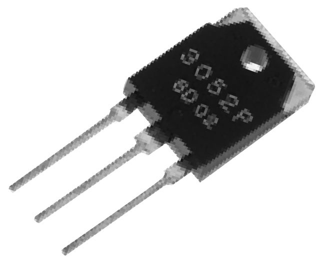


SI-3000P Series

3-Terminal, Dropper Type

■Features
- TO-3P package 3-terminal regulator
- Output current: 2.0A
- Wide range of DC input voltage
- Built-in foldback overcurrent protection circuit

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



■Absolute Maximum Ratings

(T_a=25°C)

Parameter	Symbol	Ratings	Unit
DC Input Voltage	V_{IN}	45	V
DC Output Current	I_O	2.0	A
Power Dissipation	P_{D1}	50(T_C=25°C)	W
	P_{D2}	2.0(Without heatsink, stand-alone operation)	W
Junction Temperature	T_j	–30 to +125	°C
Ambient Operating Temperature	T_{op}	–20 to +80	°C
Storage Temperature	T_{stg}	–30 to +125	°C
Thermal Resistance (junction to case)	$R_{th(j-c)}$	2.0	°C/W

■Electrical Characteristics

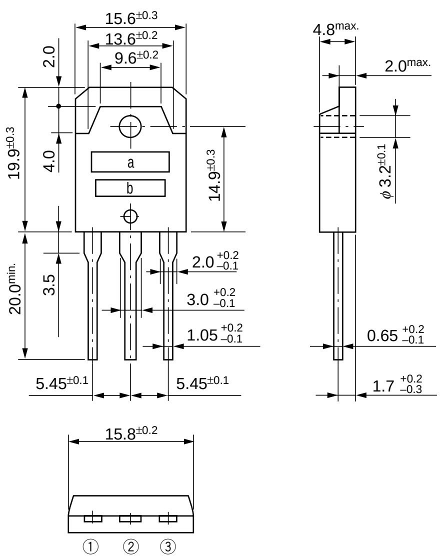
(T_a=25°C)

Parameter	Symbol	Ratings												unit
		SI-3052P			SI-3122P			SI-3152P			SI-3242P			
		min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	
Input Voltage	V_{IN}	8		30	15		35	18		40	27		40	V
Output Voltage	V_O	4.9	5.0	5.1	11.8	12.0	12.2	14.8	15.0	15.2	23.8	24.0	24.2	V
	Conditions	V_{IN}=10V, I_O=0.5A			V_{IN}=19V, I_O=0.5A			V_{IN}=23V, I_O=0.5A			V_{IN}=33V, I_O=0.5A			
Dropout Voltage	V_{DIF}			3			3			3			3	V
	Conditions	I_O=2.0A												
Line Regulation	ΔV_{OLINE}		2	10		10	30		10	30		25	50	mV
	Conditions	V_{IN}=8.5 to 11.5V, I_O=0.5A			V_{IN}=16 to 22V, I_O=0.5A			V_{IN}=19.5 to 26.5V, I_O=0.5A			V_{IN}=28 to 38V, I_O=0.5A			
Load Regulation	ΔV_{OLOAD}		40	100		80	200		80	200		120	300	mV
	Conditions	V_{IN}=10V, I_O=0 to 2.0A			V_{IN}=19V, I_O=0 to 2.0A			V_{IN}=23V, I_O=0 to 2.0A			V_{IN}=33V, I_O=0 to 2.0A			
Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T_a$		±0.5			±1.5			±1.5			±2.5		mV/°C
Ripple Rejection	R_{REJ}	60			60			60			60			dB
	Conditions	f=100 to 120Hz												
Overcurrent Protection Starting Current	I_{S1}	2.4			2.4			2.4			2.4			A
	Conditions	V_{IN}=10V			V_{IN}=19V			V_{IN}=23V			V_{IN}=33V			
Limited Current at Overcurrent Protection	I_{S2}			0.6			0.6			0.6			0.6	A
	Conditions	V_{IN}=10V			V_{IN}=19V			V_{IN}=23V			V_{IN}=33V			

A foldback type overcurrent protection circuit is built into the IC 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_O adjustment by raising ground voltage

■External Dimensions

(unit:mm)

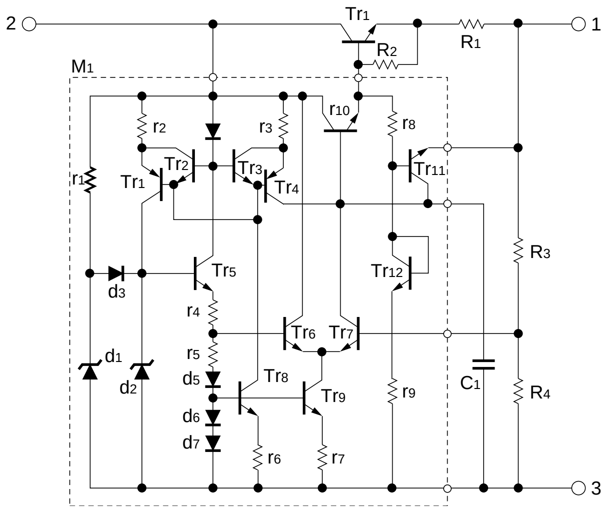


a. Part Number
b. Lot Number

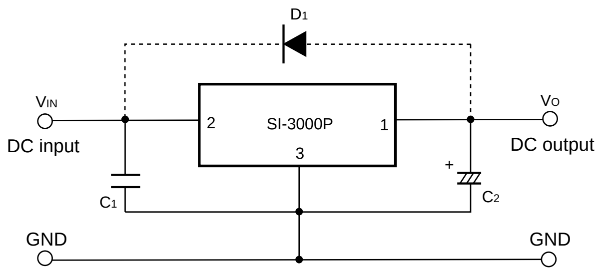
Pin Arrangement
① V_O
② V_{IN} (backside of case)
③ GND

Plastic Mold Package Type (TO-3P)
Flammability: UL94V-0
Weight: Approx. 6g

■Block Diagram



■Standard External Circuit



C1: Oscillation prevention capacitor (approx. 0.33µF)
Connection to terminal No.2 must be made as short as possible.

C2: Output capacitor (47 to 100µF)
Connection to terminal No.1 must be made as short as possible.

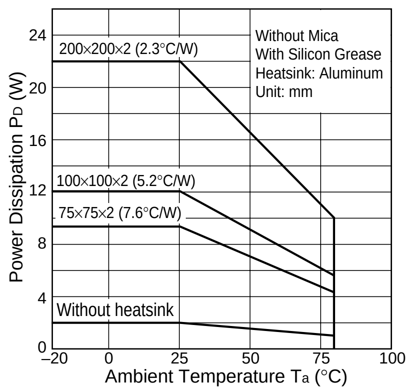
D1: Protection diode (RM1Z)
Required for protection against reverse biasing of input and output.

Note 1: Connect a 47µF to 100µF capacitor to both sides of the load if the wiring between the output terminal and the load is long.

Note 2: An isolation type diode is provided from input to ground and also from output to ground. These may be destroyed if the device is reverse biased. In this case, use a diode with low VF to protect them.

Note 3: The output voltage may not be adjusted by raising the ground voltage (using a diode or resistor).

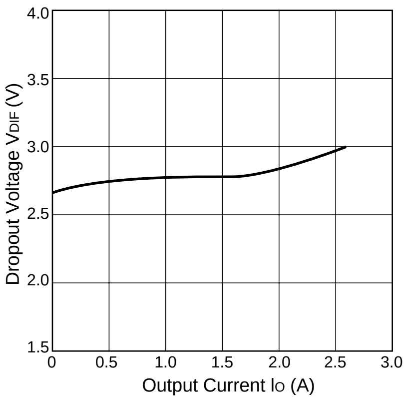
■Ta-PD Characteristics



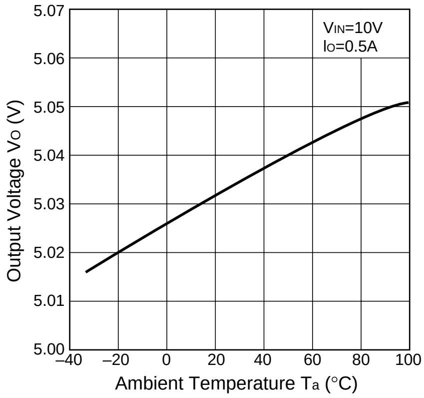
■Typical Characteristics

(T_a=25°C)

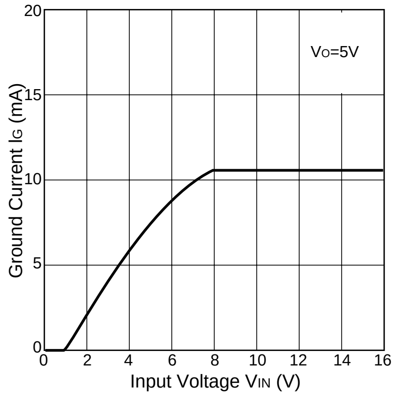
I_O vs. V_{DIF} Characteristics



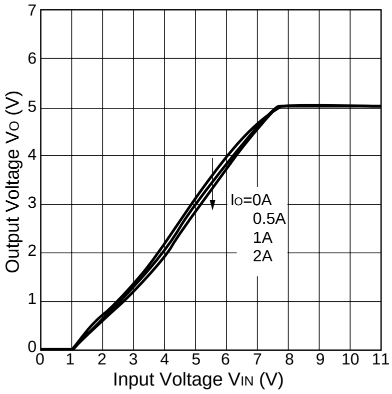
Temperature Coefficient of Output Voltage(SI-3052P)



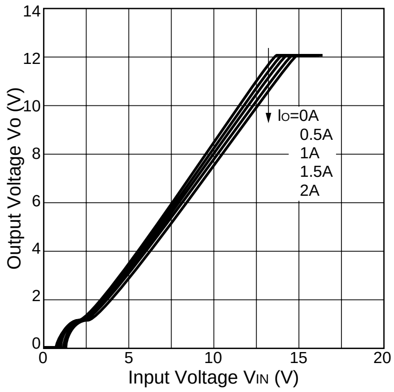
Circuit Current(SI-3052P)



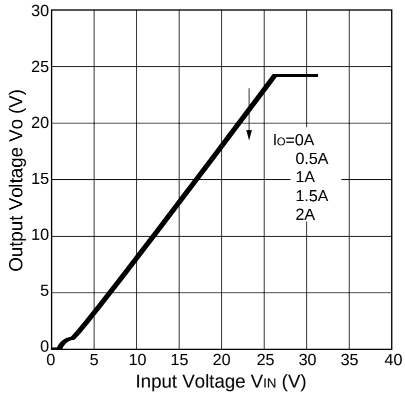
Output Voltage(SI-3052P)



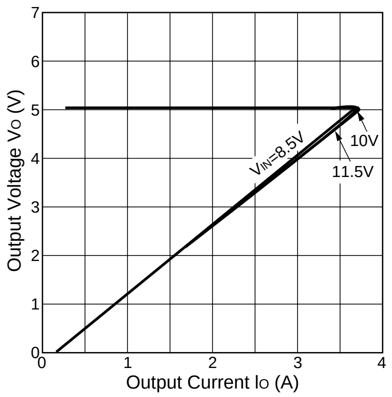
Output Voltage(SI-3122P)



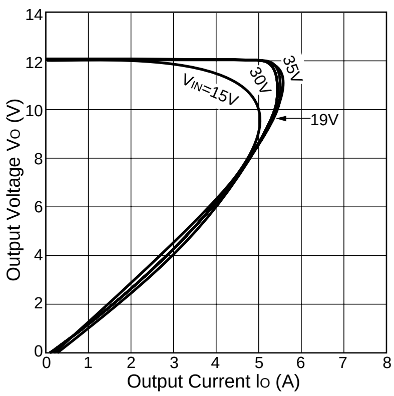
Output Voltage(SI-3242P)



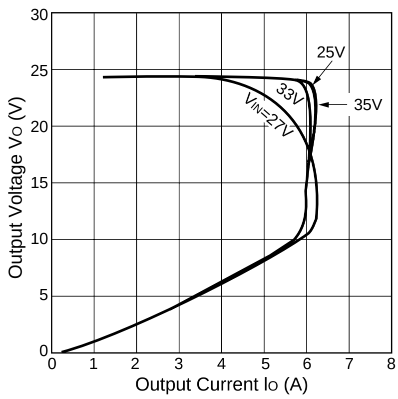
Overcurrent Protection Characteristics(SI-3052P)



Overcurrent Protection Characteristics(SI-3122P)



Overcurrent Protection Characteristics(SI-3242P)

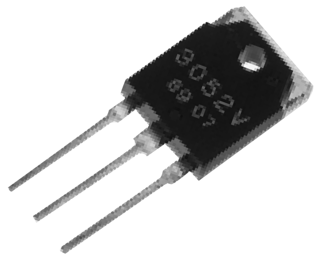


SI-3000V Series

3-Terminal, Low Dropout Voltage Dropper Type

■Features
- TO-3P package 3-terminal regulator
- Output current: 2.0A
- Low dropout voltage: $V_{DIF} \leq 1V$ (at I_O=2.0A)
- Built-in foldback overcurrent protection circuit

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



■Absolute Maximum Ratings

(T_a=25°C)

Parameter	Symbol	Ratings		Unit
		SI-3052V	SI-3122V/3152V	
DC Input Voltage	V_{IN}	25	30	V
DC Output Current	I_O	2.0		A
Power Dissipation	P_{D1}	50(T_C=25°C)		W
	P_{D2}	1.6(Without heatsink, stand-alone operation)		W
Junction Temperature	T_j	–30 to +125		°C
Ambient Operating Temperature	T_{op}	–20 to +100		°C
Storage Temperature	T_{stg}	–30 to +125		°C
Thermal Resistance (junction to case)	$R_{th(j-c)}$	2.0		°C/W

■Electrical Characteristics

(T_a=25°C)

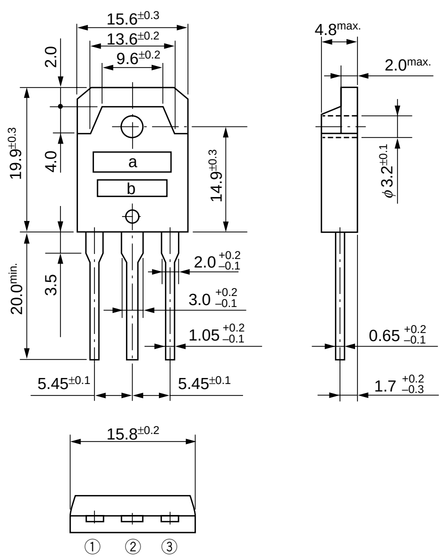
Parameter	Symbol	SI-3052V min.	SI-3052V typ.	SI-3052V max.	SI-3122V min.	SI-3122V typ.	SI-3122V max.	SI-3152V min.	SI-3152V typ.	SI-3152V max.	unit
Input Voltage	V_{IN}	6		15	13		25	16		25	V
Output Voltage	V_O	4.9	5.0	5.1	11.8	12.0	12.2	14.8	15.0	15.2	V
	Conditions	V_{IN}=8V, I_O=1.0A			V_{IN}=16V, I_O=1.0A			V_{IN}=20V, I_O=1.0A			
Dropout Voltage	V_{DIF}			0.5			0.5			0.5	V
	Conditions	I_O=1.0A									
				1.0			1.0			1.0	
	Conditions	I_O=2.0A									
Line Regulation	ΔV_{OLINE}		10	30		20	60		20	60	mV
	Conditions	V_{IN}=6 to 15V, 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		80	200		80	200	mV
	Conditions	V_{IN}=8V, I_O=0 to 2.0A			V_{IN}=16V, I_O=0 to 2.0A			V_{IN}=20V, I_O=0 to 2.0A			
Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T_a$		±0.5			+1.5			±1.5		mV/°C
Ripple Rejection	R_{REJ}		54			54			54		dB
	Conditions	f=100 to 120Hz									
Overcurrent Protection Starting Current	I_{S1}	2.4			2.4			2.4			A
	Conditions	V_{IN}=8V			V_{IN}=16V			V_{IN}=20V			

The following are also available: SI-3522V(5.2V), SI-3062V(6V), SI-3082V(8V), SI-3922V(9.2V), SI-3102V(10V), SI-3132V(13.1V), SI-3182V(18V), SI-3202V(20V).

*: A foldback type overcurrent protection circuit is built into the IC 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_O adjustment by raising ground voltage

■External Dimensions

(unit:mm)

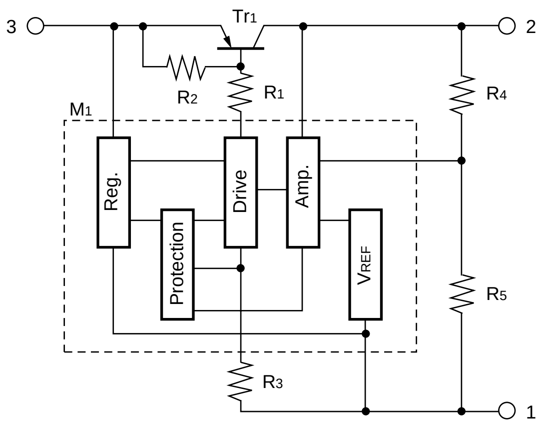


a. Part Number
b. Lot Number

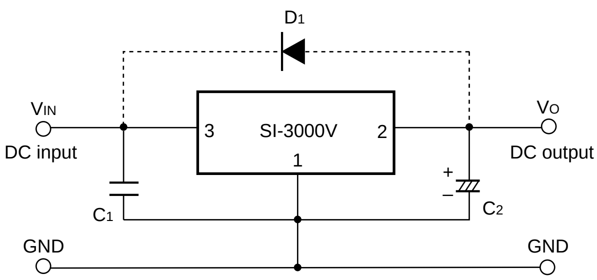
Pin Arrangement
① GND
② V_O (backside of case)
③ V_{IN}

Plastic Mold Package Type (TO-3P)
Flammability: UL94V-0
Weight: Approx. 6g

■Block Diagram



■Standard External Circuit



C_1: Oscillation prevention capacitor (approx. 0.33µF)
Connection to terminal No.3 must be made as short as possible.

C_2: Output capacitor (47 to 100µF)
Connection to terminal No.2 must be made as short as possible.

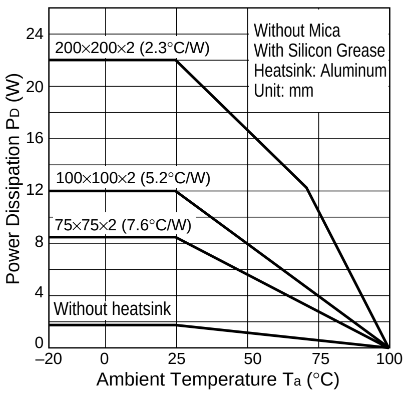
D_1: Protection diode (RM1Z)
Required for protection against reverse biasing of input and output.

Note 1: Prevention of oscillation at low temperatures
At low temperatures, oscillation may occur unless an output capacitor with good tanδ is used. Be sure to connect a tantalum capacitor (approx. 10µF) in parallel with output capacitor C_2.

Note 2: An isolation type diode is provided from input to ground and also from output to ground. These may be destroyed if the device is reverse biased. In this case, use a diode with low V_F to protect them.

Note 3: The output voltage may not be adjusted by raising the ground voltage (using a diode or resistor).

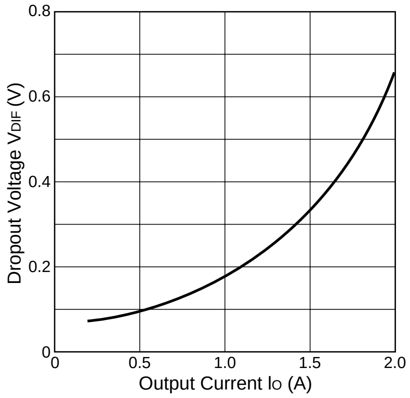
■T_a-P_D Characteristics



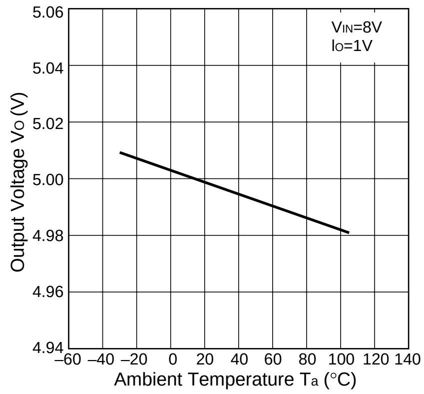
■Typical Characteristics

(T_a=25°C)

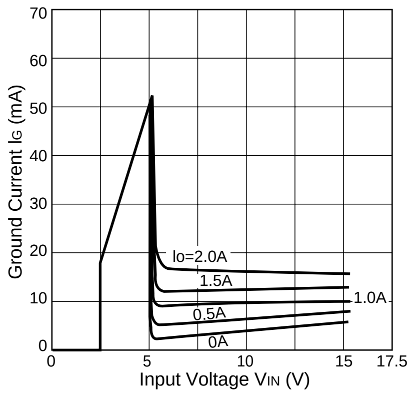
I_O vs. V_{DIF} Characteristics



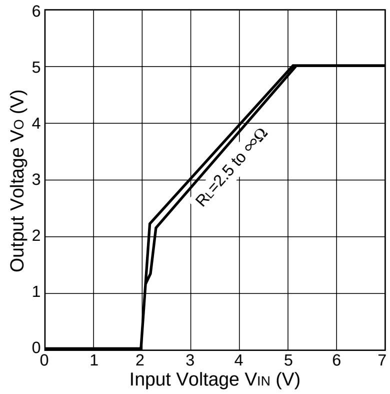
Temperature Coefficient of Output Voltage(SI-3052V)



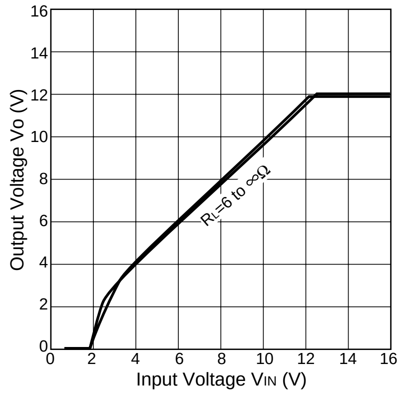
Circuit Current(SI-3052V)



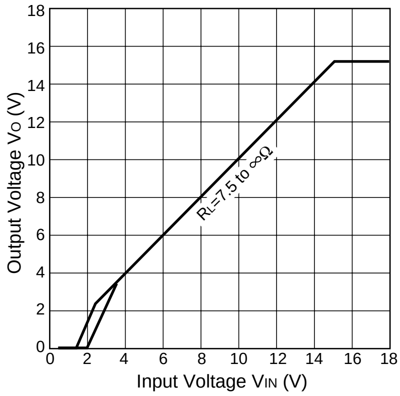
Output Voltage(SI-3052V)



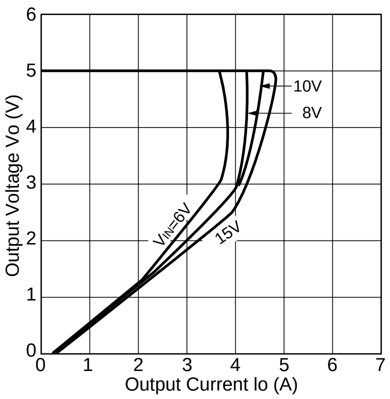
Output Voltage(SI-3122V)



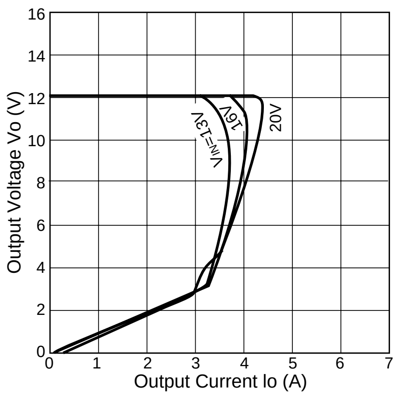
Output Voltage(SI-3152V)



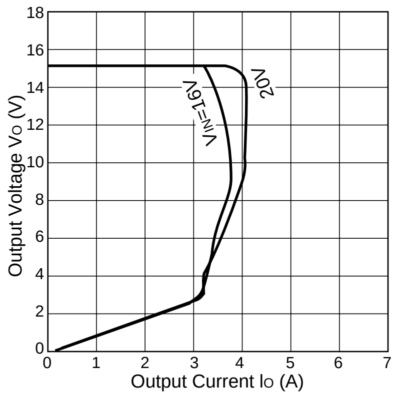
Overcurrent Protection Characteristics(SI-3052V)



Overcurrent Protection Characteristics(SI-3122V)



Overcurrent Protection Characteristics(SI-3152V)



Switching Type - Application Note

■Temperature and Reliability

The reliability of an IC is highly dependent on its operating temperature. Design should pay particular attention to ensuring ample space for radiating heat.
Be sure to apply silicon grease to the IC before attaching a heatsink, and to secure it firmly to the heatsink. Allow sufficient margine which designing the heatsink.
Other important items to be considered regarding heat radiation include air convection during operation.
The reliability of peripheral components such as capacitors and coils is closely related to temperature. A high operating temperature may reduce the service life. Exceeding the allowable temperature may burn the coils or damage capacitors. It is important to make sure that the temperature of output smoothing coils and input/output capacitors do not exceed their allowable levels during operation. Allow for variation in the ratings of the coils and minimize heat emission as far as possible. (For peripheral components, refer to the user manuals.)

■Internal Power Dissipation

P_D can be obtained from the following formula.

- With built-in flywheel diode:
  (SI-8000L series)
  $$P_D=V_O \bullet I_O \left(\frac{100}{\eta x}-1\right)$$
- With external flywheel diode:
  (SAI series, SI-8000E series, SI-8000S series)
  $$P_D=V_O \bullet I_O\left(\frac{100}{\eta x}-1\right)-V_F \bullet I_O\left(1-\frac{V_O}{V_{IN}}\right)$$

Efficiency ηx depends on the input/output conditions. The efficiency characteristics of each product type are provided for reference purposes.

V_O : Output voltage
V_{IN} : Input voltage
I_O : Output current
ηx : Efficiency(%)
V_F : Diode forward voltage

■Heatsink Design

The maximum junction temperature $T_{j(max)}$ given in the absolute maximum ratings is specific to each product type and must be strictly observed. Thus, thermal design must consider the conditions of use which affect the maximum power dissipation $P_{D(max)}$ and the maximum ambient temperature $T_{a(max)}$.
To simplify thermal design, the relationship between these two parameters has been presented in a graph, the T_a-P_D characteristic graph. Thermal design should include these steps:

1. Obtain the maximum ambient temperature $T_{a(max)}$.
2. Obtain the maximum power dissipation $P_{D(max)}$.
3. Look for the intersection point on the T_a-P_D characteristic graph and determine the size of the heatsink.

The size of the heatsink has now been obtained. However, in actual applications, a 10 to 20% derating factor is introduced. Moreover, the heat dissipation capacity of a heatsink highly depends on how it is mounted. Thus, it is recommended to measure the heatsink and case temperature in the actual operating environment.
The T_a-P_D characteristics for each product type are provided for reference purposes.

■Fastening Torque

SI-8000E, SI-8000S: 0.588 to 0.686[N•m] (6.0 to 7.0[kgf•cm])

■Recommended Silicon Grease

- Shin-Etsu Chemical Co., Ltd.: G746
- GE Toshiba Silicone Co., Ltd.: YG-6260
- Dow Corning Toray Silicone Co., Ltd.: SC102

Please be careful when selecting silicone grease since the oil in some grease may penetrate the product, which will result in an extremely short product life.

■Others

- Parallel operation can not be performed for increasing current.
- This type IC regulators can not be used for boosting current and raising voltage.

■Rectifier Diodes for Power Supplies

To rectify the AC input using rectifier diodes in power supplies, use any of the SANKEN rectifier diodes shown in the following list. (Use axial type diodes in a center-tap or bridge configuration.)

Regulator Type	Diodes
SAI Series	SFPM-62(Surface-Mount Type, V_{RM}:200V, I_O:1.0A)
SI-8000E Series SI-8200L Series SI-8400L Series	AM01Z(Axial Type, V_{RM}:200V, I_O:1.0A)
SI-8000S Series	RM 4Z(Axial Type,V_{RM}:200V, I_O:3.0A) RBV-402(Bridge Type, V_{RM}:200V, I_O:4.0A)
SI-8300L Series SI-8500L Series,	RM10Z(Axial Type, V_{RM}:F200V, I_O:1.5A)
SI-8800L Series SI-8900L Series	AM01Z(Axial Type, V_{RM}:200V, I_O:1.0A)

SAI Series

Surface-Mount, Separate Excitation Switching Type

■Features
- Surface-mount package
- Output current: 0.4 to 0.5A
- High efficiency: 75 to 89%
- Requires only 4 external components
- Phase correction and output voltage adjustment performed internally
- Built-in reference oscillator (60kHz)
- Built-in overcurrent and thermal protection circuits

■Applications
- Power supplies for telecommunication equipment
- Onboard local power supplies

■Lineup

Part Number	SAI01	SAI02	SAI03	SAI04	SAI06
V_O(V)	5.0	3.3	12.0	15.0	9.0
I_O(A)	0.5		0.4		

■Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit
DC Input Voltage	V_{IN}	35	V
Power Dissipation	P_D	0.75	W
Junction Temperature	T_j	+125	°C
Storage Temperature	T_{stg}	–40 to +125	°C
SW Terminal Applied Reverse Voltage	V_{SW}	–1	V
Thermal Resistance(junction to case)	$R_{th(j-c)}$	20	°C/W

■Recommended Operating Conditions

Parameter	Symbol	Ratings					Unit
		SAI01	SAI02	SAI03	SAI04	SAI06	
DC Input Voltage Range	V_{IN}	7 to 33	5.3 to 28	15 to 33	18 to 33	12 to 33	V
Output Current Range	I_O	0 to 0.5		0 to 0.4			A
Operating Junction Temperature Range	T_{jop}	–30 to +125					°C

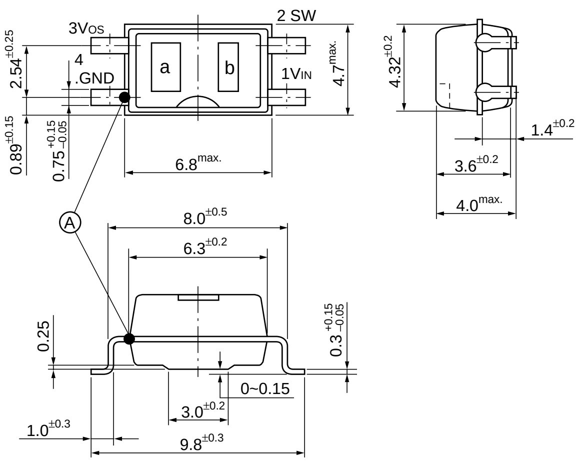
■Electrical Characteristics

(Ta=25°C)

Parameter	Symbol	SAI01 min.	SAI01 typ.	SAI01 max.	SAI02 min.	SAI02 typ.	SAI02 max.	SAI03 min.	SAI03 typ.	SAI03 max.	SAI04 min.	SAI04 typ.	SAI04 max.	SAI06 min.	SAI06 typ.	SAI06 max.	Unit
Output Voltage	V_O	4.80	5.00	5.20	3.17	3.30	3.43	11.40	12.00	12.60	14.25	15.00	15.75	8.55	9.00	9.45	V
	Conditions	V_{IN}=20V, I_O=0.3A			V_{IN}=15V, I_O=0.3A			V_{IN}=24V, I_O=0.3A			V_{IN}=27V, I_O=0.3A			V_{IN}=21V, I_O=0.3A			
Efficiency	η		80			75			88			89			86		%
	Conditions	V_{IN}=20V, I_O=0.3A			V_{IN}=15V, I_O=0.3A			V_{IN}=24V, I_O=0.3A			V_{IN}=27V, I_O=0.3A			V_{IN}=21V, I_O=0.3A			
Switching Frequency	f		60			60			60			60			60		kHz
	Conditions	V_{IN}=20V, I_O=0.3A			V_{IN}=15V, I_O=0.3A			V_{IN}=24V, I_O=0.3A			V_{IN}=27V, I_O=0.3A			V_{IN}=21V, I_O=0.3A			
Line Regulation	ΔV_{OLINE}		80	100		60	80		100	130		100	130		90	110	mV
	Conditions	V_{IN}=10 to 30V, I_O=0.3A			V_{IN}=8 to 28V, I_O=0.3A			V_{IN}=18 to 30V, I_O=0.3A			V_{IN}=21 to 30V, I_O=0.3A			V_{IN}=15 to 30V, I_O=0.3A			
Load Regulation	ΔV_{OLOAD}		30	40		20	30		70	95		90	120		50	80	mV
	Conditions	V_{IN}=20V, I_O=0.1 to 0.4A			V_{IN}=15V, I_O=0.1 to 0.4A			V_{IN}=24V, I_O=0.1 to 0.4A			V_{IN}=27V, I_O=0.1 to 0.4A			V_{IN}=21V, I_O=0.1 to 0.4A			
Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T_a$		±0.5			±0.5			±1.5			±1.5			±1.0		mV/°C
Ripple Rejection	R_{REJ}		45			45			45			45			45		dB
	Conditions	f=100 to 120Hz			f=100 to 120Hz			f=100 to 120Hz			f=100 to 120Hz			f=100 to 120Hz			
Overcurrent Protection Starting Current	I_{S1}	0.55			0.55			0.45			0.45			0.45			A
	Conditions	V_{IN}=10V			V_{IN}=8V			V_{IN}=18V			V_{IN}=21V			V_{IN}=15V			

■External Dimensions

(unit: mm)

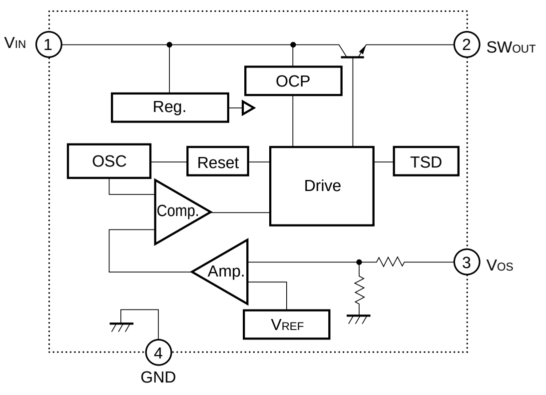


a. Part Number
b. Lot Number
Ⓐ Case temperature measuring point

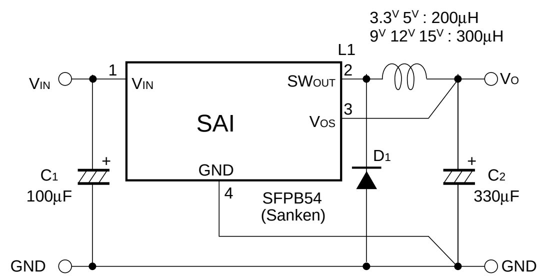
Pin Arrangement
① V_{IN}
② SW_{OUT}
③ V_{OS}
④ GND

Plastic Mold Package Type
Flammability: UL94V-0
Weight: Approx. 0.22g

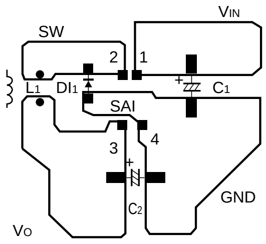
■Block Diagram



■Standard External Circuit



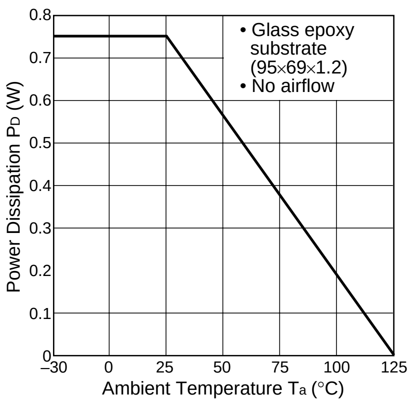
■Example of Printed Circuit Board



a) For optimum operation, there must be only one GND line originating from terminal 4 and each component must be connected with the shortest possible wiring.

b) To prevent heating of the IC, it is best to make the GND pattern as large as possible since the internal frame and terminal 4 (GND) are connected to each other.

■T_a-P_D Characteristics



$$P_D = V_O \cdot I_O \left(\frac{100}{\eta\chi} - 1 \right) - V_F \cdot I_O \left(1 - \frac{V_O}{V_{IN}} \right)$$

The efficiency depends on the input voltage and the output current. Thus, obtain the value from the efficiency graph on page 67 and substitute the percentage in the formula above.

V_O : Output voltage
I_O : Output current
$\eta\chi$: Efficiency (%)
V_F : Diode forward voltage
SFPB54-0.3V

Thermal design for D_1 must be considered separately.

■Selecting External Components

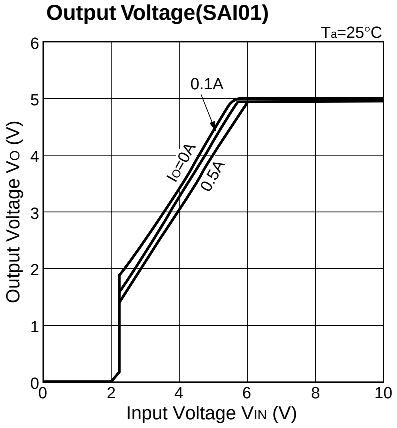
1. Inductor L_1
   1) It must be suited for switching regulators.
      Do not use inductors such as noise filters, because they generate excessive heat.
   2) It must have the appropriate inductance value.
      If the inductance is too small (150µH or lower), abnormal oscillation may occur causing operation problems in the overcurrent protection circuit within the rated current range.
   3) The rated current must be satisfied.
      If the rated current is exceeded, magnetic saturation leads to overcurrent.
2. Capacitors C_1 and C_2
   1) They must satisfy the breakdown voltage and allowable ripple current.
      Exceeding the ratings of these capacitors or using them without derating shortens their service lives and may also cause abnormal oscillation of the IC.
   2) C_2 should be a low-impedance type capacitor.
      A low-impedance type capacitor is recommended for C_2 to ensure reduced ripple voltage and stable switching operation.
3. Diode D_1
   The Sanken SFPB54 diode is recommended for D_1. If you intended to use an equivalent diode, be sure to use a Schottky Barrier diode and make sure that the reverse voltage applied to terminal 2 of the IC does not exceed the value (–1V) given in the absolute maximum ratings. If you use a fast recovery diode or any other diode, supplying a reverse voltage generated from the recovery or ON voltage of the diode may damage the IC.

Application

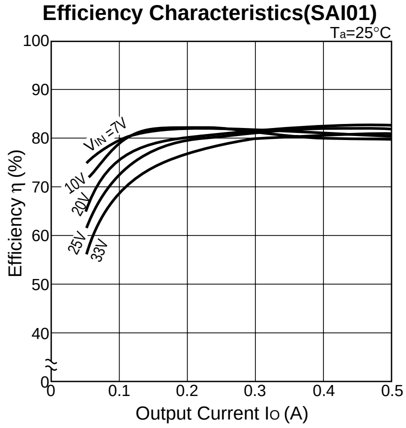
Variable output voltage
Output voltage can be adjusted in the same way as SI-8000S in page 77.

■Typical Characteristics

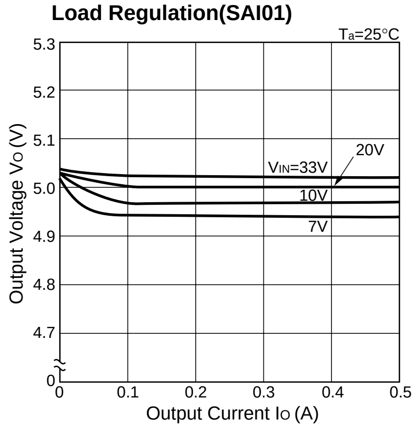
Output Voltage(SAI01)



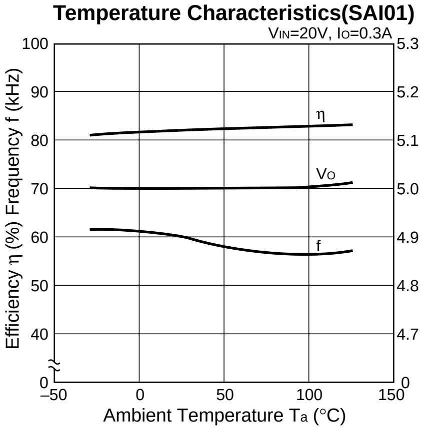
Efficiency Characteristics(SAI01)



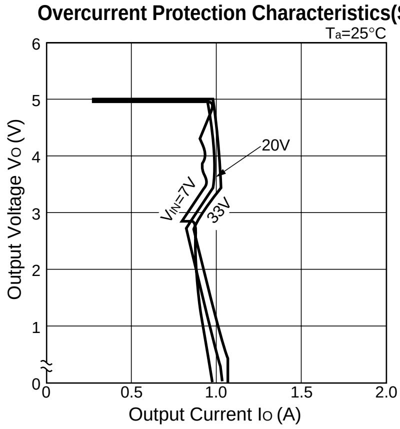
Load Regulation(SAI01)



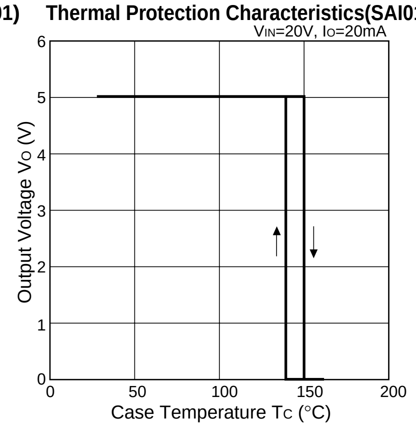
Temperature Characteristics(SAI01)



Overcurrent Protection Characteristics(SAI01)



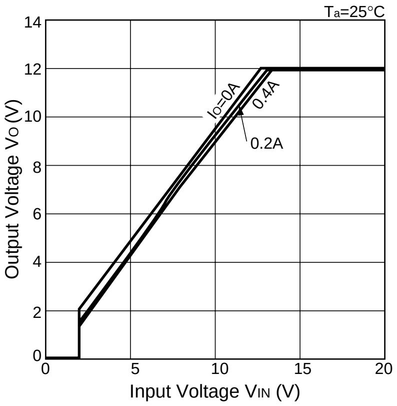
Thermal Protection Characteristics(SAI01)



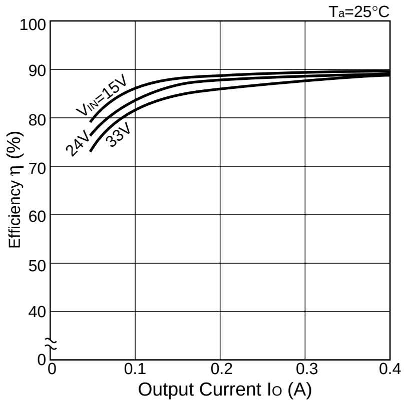
Note on Thermal Protection:

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.

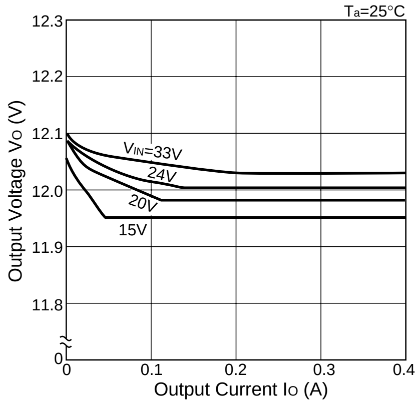
Output Voltage(SAI03)



Efficiency Characteristics(SAI03)



Load Regulation(SAI03)



SI-8000E Series

Full-Mold, Separate Excitation Switching Type

■Features
- Compact full-mold package (equivalent to TO220)
- High efficiency: 80 to 88%
- Requires only 4 external components
- Phase correction and output voltage adjustment performed internally
- Built-in reference oscillator (60kHz)
- Built-in overcurrent and thermal protection circuits

■Applications
- Power supplies for telecommunication equipment
- Onboard local power supplies

■Lineup

Part Number	SI-8050E	SI-8090E	SI-8120E
V_O(V)	5.0	9.0	12.0
I_O(A)		0.6	

■Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit
DC Input Voltage	V_{IN}	43	V
Power Dissipation	P_{D1}	14(With infinite heatsink)	W
	P_{D2}	1.5(Without heatsink, stand-alone operation)	W
Junction Temperature	T_j	+125	°C
Storage Temperature	T_{stg}	–40 to +125	°C
Thermal Resistance(junction to case)	$R_{th(j-c)}$	7.0	°C/W
Thermal Resistance(junction to ambient air)	$R_{th(j-a)}$	66.7	°C/W

■Recommended Operating Conditions

Parameter	Symbol	Ratings			Unit
		SI-8050E	SI-8090E	SI-8120E	
DC Input Voltage Range	V_{IN}	7 to 40	11 to 40	14 to 40	V
Output Current Range	I_O		0 to 0.6		A
Operating Junction Temperature Range	T_{jop}		–30 to +125		°C
Operating Temperature Range	T_{op}		–30 to +125		°C

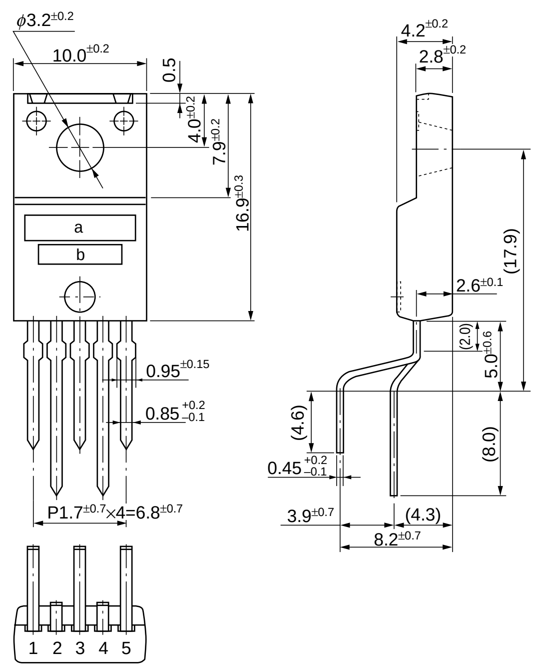
■Electrical Characteristics

(T_a=25°C)

Parameter	Symbol	SI-8050E min.	SI-8050E typ.	SI-8050E max.	SI-8090E min.	SI-8090E typ.	SI-8090E max.	SI-8120E min.	SI-8120E typ.	SI-8120E max.	Unit
Output Voltage	V_O	4.80	5.00	5.20	8.64	9.00	9.36	11.52	12.00	12.48	V
	Conditions	V_{IN}=20V, I_O=0.3A			V_{IN}=21V, I_O=0.3A			V_{IN}=24V, I_O=0.3A			
Efficiency	η		80			86			88		%
	Conditions	V_{IN}=20V, I_O=0.3A			V_{IN}=21V, I_O=0.3A			V_{IN}=24V, I_O=0.3A			
Switching Frequency	f		60			60			60		kHz
	Conditions	V_{IN}=20V, I_O=0.3A			V_{IN}=21V, I_O=0.3A			V_{IN}=24V, I_O=0.3A			
Line Regulation	ΔV_{OLINE}		80	100		90	120		100	130	mV
	Conditions	V_{IN}=10 to 30V, I_O=0.3A			V_{IN}=14 to 30V, I_O=0.3A			V_{IN}=17 to 30V, I_O=0.3A			
Load Regulation	ΔV_{OLOAD}		30	40		50	80		70	95	mV
	Conditions	V_{IN}=20V, I_O=0.1 to 0.4A			V_{IN}=21V, I_O=0.1 to 0.4A			V_{IN}=24V, I_O=0.1 to 0.4A			
Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T_a$		±0.5			±1.0			±1.5		mV/°C
Ripple Rejection	R_{REJ}		45			45			45		dB
	Conditions	f=100 to 120Hz			f=100 to 120Hz			f=100 to 120Hz			
Overcurrent Protection Starting Current	I_{S1}	0.61			0.61			0.61			A
	Conditions	V_{IN}=10V			V_{IN}=14V			V_{IN}=17V			

■External Dimensions

(unit: mm)



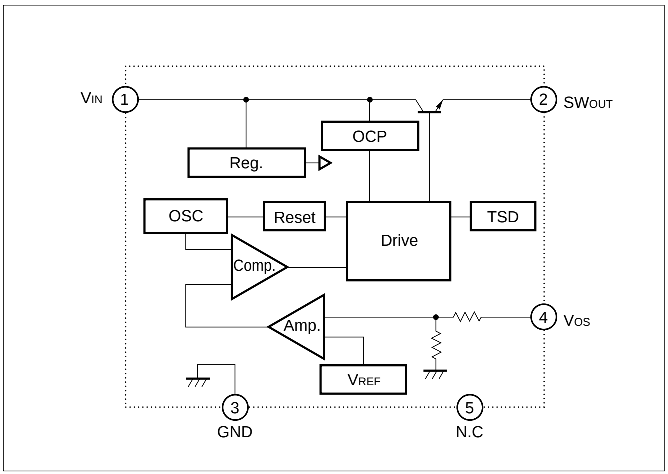
Forming No. 1101

a. Part Number
b. Lot Number

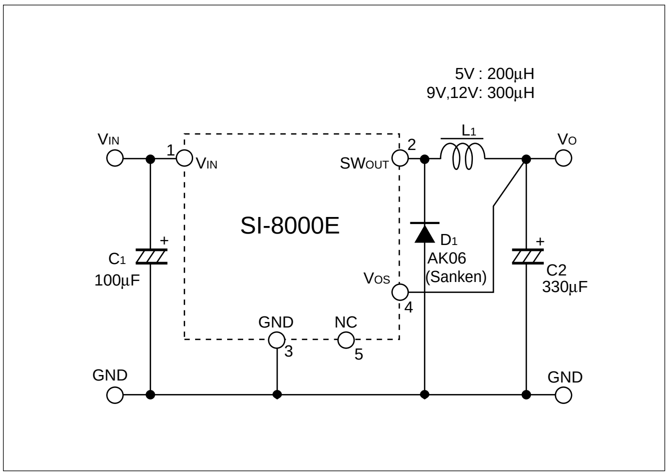
Pin Arrangement
① V_{IN}
② SW_{OUT}
③ GND
④ V_{OS}
⑤ N.C

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

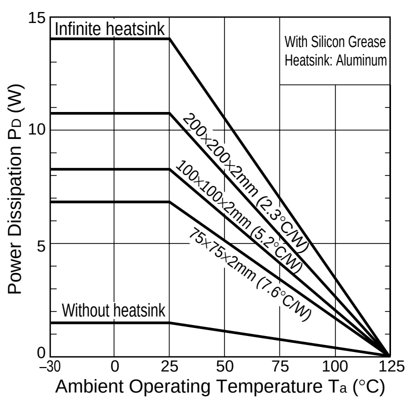
■Block Diagram



■Standard External Circuit



■Ta-PD Characteristics



$$P_D = V_O \cdot I_O \left(\frac{100}{\eta\chi} - 1 \right) - V_F \cdot I_O \left(1 - \frac{V_O}{V_{IN}} \right)$$

The efficiency depends on the input voltage and the output current. Thus, obtain the value from the efficiency graph on page 71 and substitute the percentage in the formula above.

V_O : Output voltage
V_{IN} : Input voltage
I_O : Output current
$\eta\chi$: Efficiency (%)
V_F : Diode forward voltage
0.4V(AK06)

Thermal design for D_1 must be considered separately.

■Selecting External Components

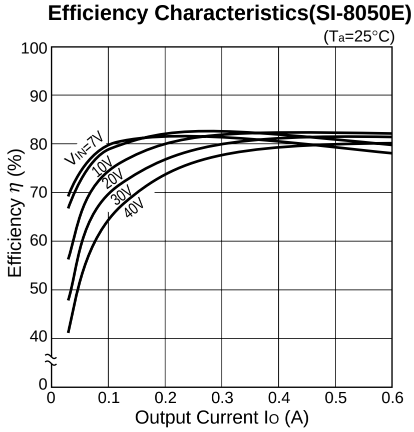
1. Inductor L_1
   1) It must be suited for switching regulators.
      Do not use inductors such as noise filters, because they generate excessive heat.
   2) It must have the appropriate inductance value.
      If the inductance is too small (150µH or lower), abnormal oscillation may occur causing operation problems in the overcurrent protection circuit within the rated current range.
   3) The rated current must be satisfied.
      If the rated current is exceeded, magnetic saturation leads to overcurrent.
2. Capacitors C_1 and C_2
   1) They must satisfy the breakdown voltage and allowable ripple current.
      Exceeding the ratings of these capacitors or using them without derating shortens their service lives and may also cause abnormal oscillation of the IC.
   2) C_2 should a low-impedance type capacitor.
      A low-impedance type capacitor is recommended for C_2 to ensure reduced ripple voltage and stable switching operation.
3. Diode D_1
   The Sanken AK06 diode is recommended for D_1. If you intended to use an equivalent diode, be sure to use a Schottky Barrier diode and make sure that the reverse voltage applied to terminal 2 of the IC does not exceed the value (–1V) given in the absolute maximum ratings. If you use a fast recovery diode or any other diode, supplying a reverse voltage generated from the recovery or ON voltage of the diode may damage the IC.

Application

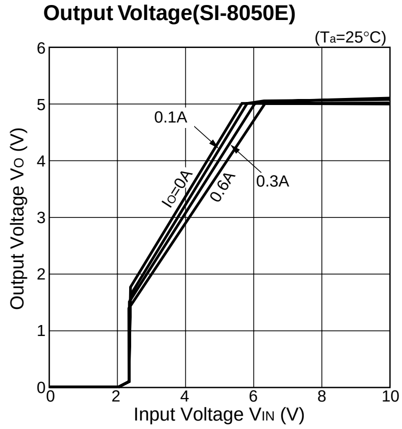
Variable output voltage
Output voltage can be adjusted in the same way as SI-8000S in page 77.

■Typical Characteristics

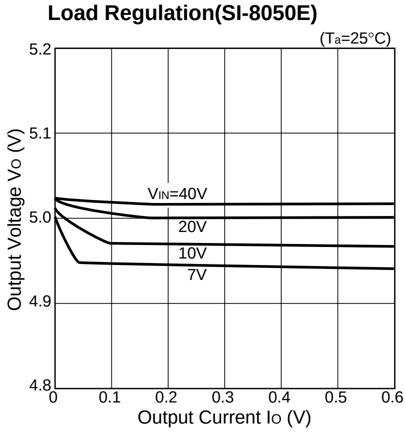
Efficiency Characteristics(SI-8050E)



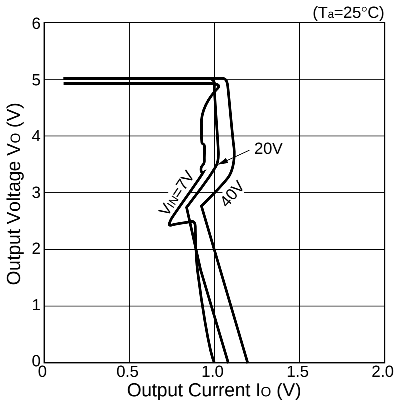
Output Voltage(SI-8050E)



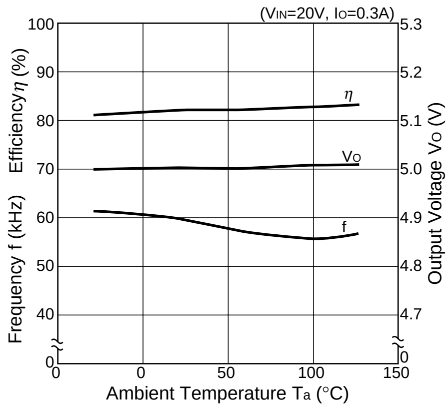
Load Regulation(SI-8050E)



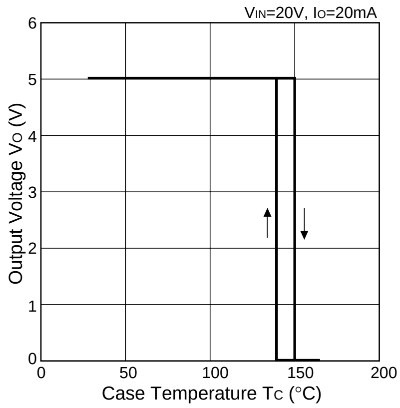
Overcurrent Protection Characteristics(SI-8050E)



Temperature Characteristics(SI-8050E)



Thermal Protection Characteristics(SI-8050E)



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.

SI-8000S Series

Full-Mold, Separate Excitation Switching Type

■Features

- Compact full-mold package (equivalent to TO220)
- Output current: 3.0A
- High efficiency: 79 to 91%
- Requires only 4 external components
- Phase correction and output voltage adjustment performed internally
- Built-in reference oscillator (60kHz)
- Built-in overcurrent and thermal protection circuits
- Built-in soft start circuit (output ON/OFF control)

■Applications

- Power supplies for telecommunication equipment
- Onboard local power supplies

■Lineup

Part Number	SI-8033S	SI-8050S	SI-8090S	SI-8120S	SI-8150S
V_O(V)	3.3	5.0	9.0	12.0	15.0
I_O(A)	3.0				

■Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit
DC Input Voltage	V_{IN}	43*	V
Power Dissipation	P_{D1}	18(With infinite heatsink)	W
	P_{D2}	1.5(Without heatsink, stand-alone operation)	W
Junction Temperature	T_j	+125	°C
Storage Temperature	T_{stg}	–40 to +125	°C
SW Terminal Applied Reverse Voltage	V_{SW}	–1	V
Thermal Resistance(junction to case)	$R_{th(j-c)}$	5.5	°C/W

*SI-8033S: 35V

■Recommended Operating Conditions

Parameter	Symbol	Ratings					Unit
		SI-8033S	SI-8050S	SI-8090S	SI-8120S	SI-8150S	
DC Input Voltage Range	V_{IN}	5.5 to 28	7 to 40	12 to 40	15 to 40	18 to 40	V
Output Current Range	I_O	0 to 3.0					A
Operating Junction Temperature Range	T_{jop}	–30 to +125					°C

■Electrical Characteristics

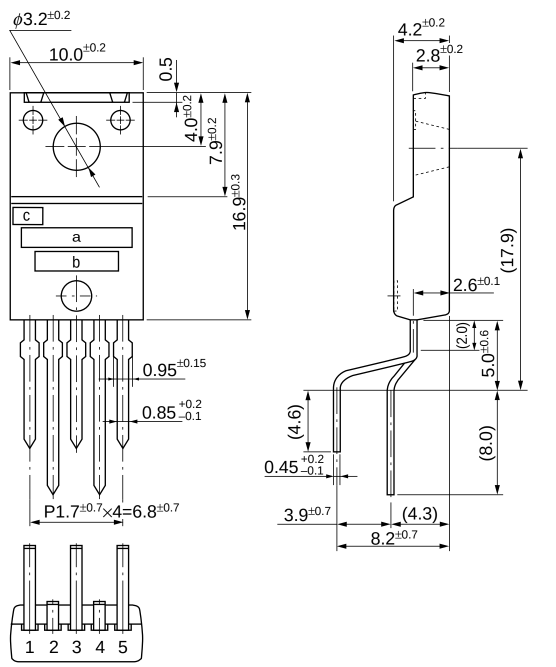
(T_a=25°C)

Parameter		Symbol	Ratings															Unit
			SI-8033S			SI-8050S			SI-8090S			SI-8120S			SI-8150S			
			min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	
Output Voltage	SI-8000S*1	V_O	3.17	3.30	3.43	4.80	5.00	5.20	8.55	9.00	9.45	11.50	12.00	12.50	14.25	15.00	15.75	V
	SI-8000SS		3.234	3.30	3.366	4.90	5.00	5.10	8.73	9.00	9.27	—			—			
		Conditions	V_{IN}=15V, I_O=1.0A			V_{IN}=20V, I_O=1.0A			V_{IN}=21V, I_O=1.0A			V_{IN}=24V, I_O=1.0A			V_{IN}=25V, I_O=1.0A			
Efficiency		η		79			84			88			90			91		%
		Conditions	V_{IN}=15V, I_O=1.0A			V_{IN}=20V, I_O=1.0A			V_{IN}=21V, I_O=1.0A			V_{IN}=24V, I_O=1.0A			V_{IN}=25V, I_O=1.0A			
Switching Frequency		f		60			60			60			60			60		kHz
		Conditions	V_{IN}=15V, I_O=1.0A			V_{IN}=20V, I_O=1.0A			V_{IN}=21V, I_O=1.0A			V_{IN}=24V, I_O=1.0A			V_{IN}=25V, I_O=1.0A			
Line Regulation		ΔV_{OLINE}		25	80		40	100		50	120		60	130		60	130	mV
		Conditions	V_{IN}=8 to 28V, I_O=1.0A			V_{IN}=10 to 30V, I_O=1.0A			V_{IN}=15 to 30V, I_O=1.0A			V_{IN}=18 to 30V, I_O=1.0A			V_{IN}=21 to 30V, I_O=1.0A			
Load Regulation		ΔV_{OLOAD}		10	30		10	40		10	40		10	40		10	40	mV
		Conditions	V_{IN}=15V, I_O=0.5 to 1.5A			V_{IN}=20V, I_O=0.5 to 1.5A			V_{IN}=21V, I_O=0.5 to 1.5A			V_{IN}=24V, I_O=0.5 to 1.5A			V_{IN}=25V, I_O=0.5 to 1.5A			
Temperature Coefficient of Output Voltage		$\Delta V_O/\Delta T_a$		±0.5			±0.5			±1.0			±1.0			±1.0		mV/°C
Ripple Rejection		R_{REJ}		45			45			45			45			45		dB
		Conditions	f=100 to 120Hz			f=100 to 120Hz			f=100 to 120Hz			f=100 to 120Hz			f=100 to 120Hz			
Overcurrent Protection Starting Current		I_{S1}	3.1			3.1			3.1			3.1			3.1			A
		Conditions	V_{IN}=15V			V_{IN}=20V			V_{IN}=21V			V_{IN}=24V			V_{IN}=25V			

*1: "S" may be indicated to the right of the Sanken logo (except SI-8120S, SI-8150S)

■External Dimensions

(unit: mm)



Forming No. 1101

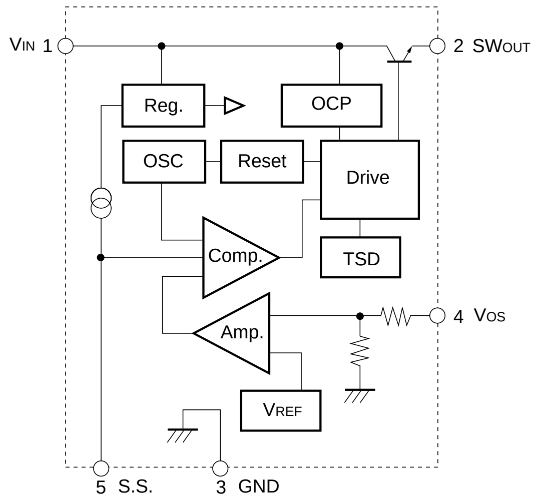
a. Part Number
b. Lot Number
c. Logo Mark

Pin Arrangement

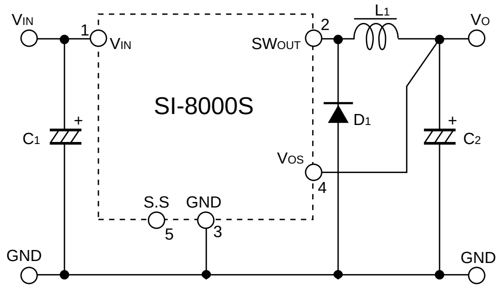
① V_{IN}
② SW_{OUT}
③ GND
④ V_{OS}
⑤ S.S

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

■Block Diagram

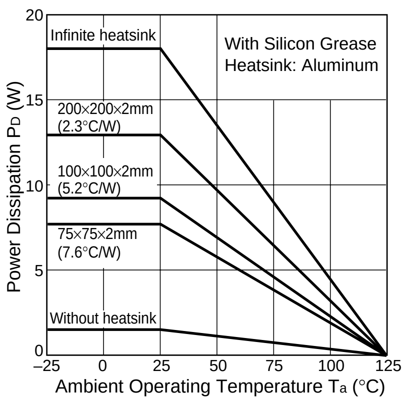


■Standard External Circuit



$C_{1,2}$: 1000µF
L_1 : 150µH
D_1 : RK46(Sanken)

■T_a-P_D Characteristics



$$P_D = V_O \cdot I_O \left(\frac{100}{\eta\chi} - 1 \right) - V_F \cdot I_O \left(1 - \frac{V_O}{V_{IN}} \right)$$

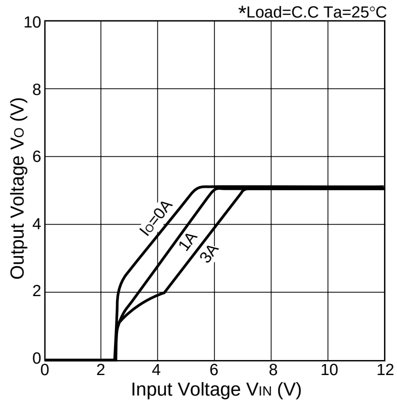
The efficiency depends on the input voltage and the output current. Thus, obtain the value from the efficiency graph on page 75 and substitute the percentage in the formula above.

V_O : Output voltage
V_{IN} : Input voltage
I_O : Output current
$\eta\chi$: Efficiency (%)
V_F : Diode forward voltage
0.5V(RK46)

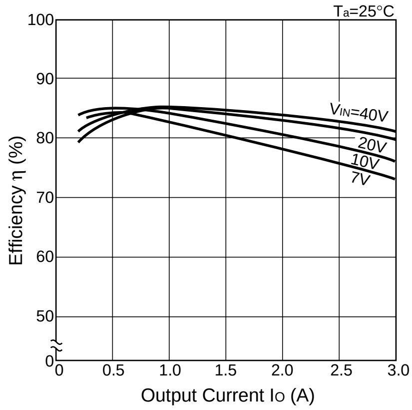
Thermal design for D_1 must be considered separately.

■Typical Characteristics

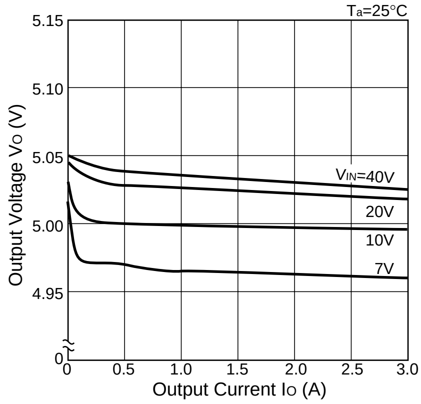
Output Voltage(SI-8050S)



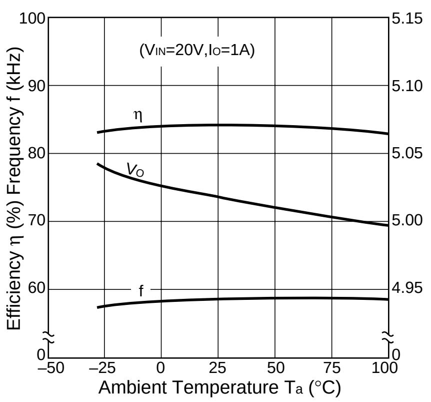
Efficiency Characteristics(SI-8050S)



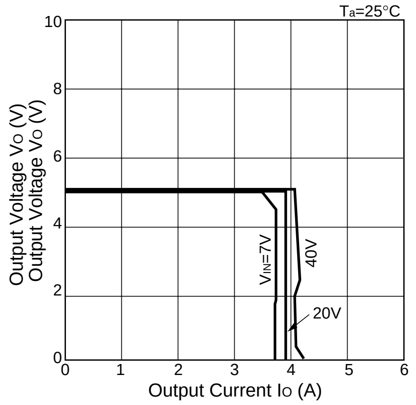
Load Regulation(SI-8050S)



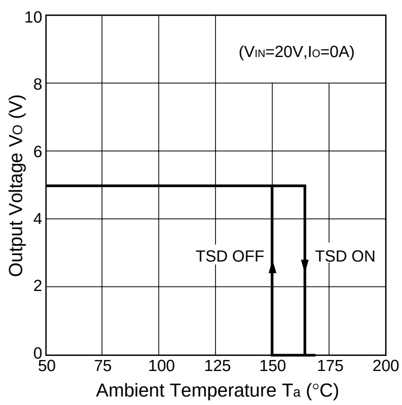
Temperature Characteristics(SI-8050S)



Overcurrent Protection Characteristics(SI-8050S)



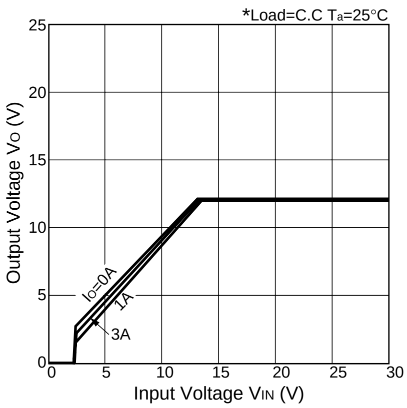
Thermal Protection Characteristics(SI-8050S)



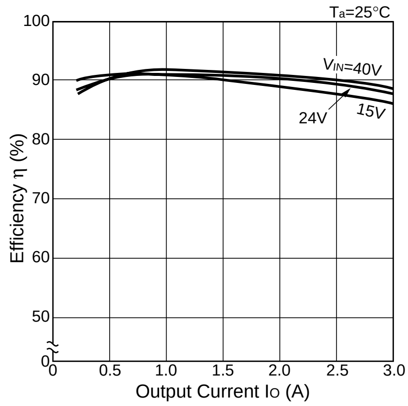
Note on Thermal Protection:

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.

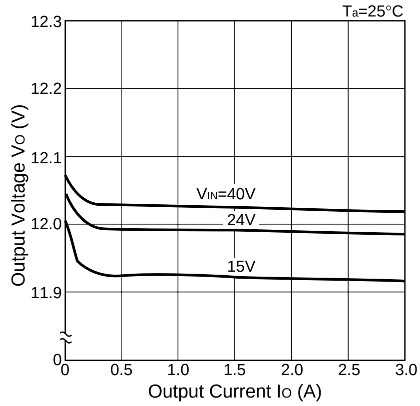
Output Voltage(SI-8120S)



Efficiency Characteristics(SI-8120S)



Load Regulation(SI-8120S)



Application Notes

1. Selecting External Components

(1) Choke coil L_1

To maintain the stable operation of the regulator, choke coil L_1 should be selected appropriately.

When selecting choke coil L_1, consider the following:

a) Suitable for a switching regulator
Do not use a coil as a noise filter because it generates excess heat.

b) Appropriate inductance
The greater the inductance of the choke coil, the smaller the output ripple voltage. However, the size of the coil increases large as the inductance increases. If the inductance is low, a greater peak current flows to the IC and loss increases. This is not favorable for stable operation.
The standard external circuit shows reference inductance values suitable for stable operation. However, the appropriate inductance may also be calculated as follows:

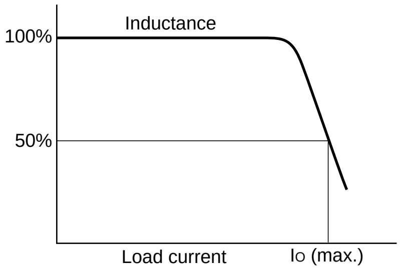
$$L = \frac{(V_{IN} - V_O) \cdot V_O}{\Delta IL \cdot V_{IN} \cdot f}$$

Where, ΔIL indicates the ripple current of the choke coil that is roughly set as follows:

- If the output current is close to the maximum rating (3 A) of SI-8000S
  Ripple current = output current × 0.2 to 0.3
- If the output current is about 1.0A or less
  Ripple current = output current × 0.3 to 0.4

c) Satisfying the rated current
The rated current of a choke coil must be greater than the maximum load current. Note that the inductance decreases drastically and an excess current flows if the load current exceeds the rated current of the coil.

d) Good DC current superposition characteristics
The current flowing through a choke coil is a triangular waveform current superimposed on a DC current equal to the load current. The coil inductance decreases as the load current increases. In general, the coil can be used until the inductance drops to 50% of the rated value. Use this as the reference value for selection.



e) Less noise
A drum-type open magnetic core coil can affect peripheral circuits with noise because the flux passes outside the coil. To avoid this problem, use a toroidal, EI, or EE type closed magnetic core coil.

(2) Input capacitor C_1

Input capacitor C_1 operates as a bypass capacitor in the input circuit.
When selecting input capacitor C_1, consider the following:

a) The breakdown voltage is higher than the maximum input voltage.

b) Satisfies the allowable ripple current
Exceeding the ratings of this capacitor or using it without derating may reduce its service life and also cause the regulator to malfunction. Therefore, an input capacitor with a sufficient margin should be selected. With the SI-8000S Series, the effective ripple current Irms flowing to the input capacitor can be calculated approximately as follows:

$$I_{rms} \fallingdotseq 1.2 \times \frac{V_O}{V_{IN}} \times I_O$$

(3) Output capacitor C_2

Output capacitor C_2 operates as a smoothing capacitor for switching output. The output ripple voltage from the regulator is determined by the product of the pulsating current part ΔIL (=C_2 charge-discharge current) of the choke coil current and the equivalent series resistance ESR of the output capacitor C_2.

$$V_{rip} = \Delta IL \cdot C2ESR$$

Therefore, a capacitor of low equivalent series resistance ESR should be selected to reduce the output ripple voltage. It is recommended to select a low-impedance capacitor intended for use with switching regulators as C_2.

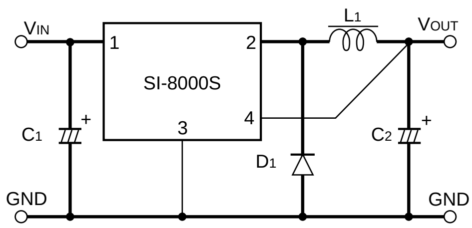
(4) Diode D_1

Use a Schottky barrier diode for D_1. If you use a general rectifier diode or fast recovery diode, the IC may be damaged. (Sanken RK46 recommended)

2. Cautions on Pattern Design

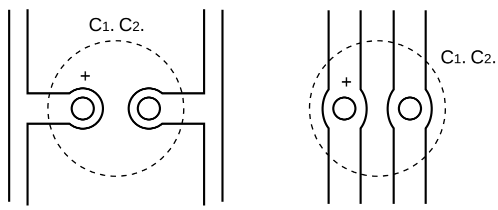
(1) Large current line

Since a large current flows through the bold lines in the standard external circuit make the pattern as wide and as short as possible.



(2) Input capacitor

Place the input capacitor C_1 and output capacitor C_2 as close to the IC as possible. Since a large current flows through the lead wires of the input and output capacitors to charge and discharge them quickly, minimize the lead wire length. The pattern around the capacitors should also be minimized.

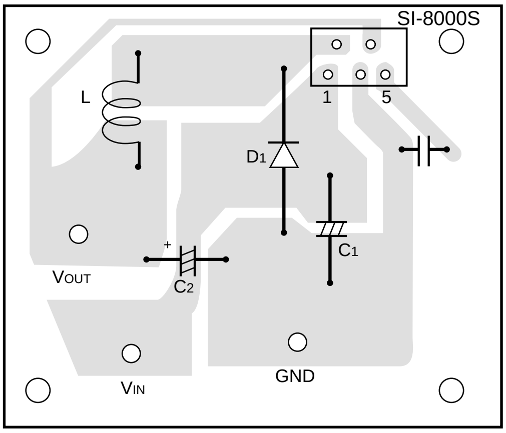


Example of bad pattern　　Example of good pattern

(3) Sensing terminal

Output voltage sensing terminal V_{OS} should be connected as close to output capacitor C_2 as possible. If the terminal is far from the capacitor, the decreasing regulation and increasing switching ripple may result in abnormal oscillation.

Example of basic pattern



Top view (with part names)

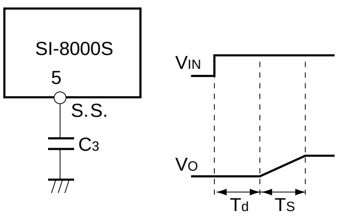
Applications

1. Soft Start

Connecting a capacitor to terminal no. 5 permits a soft start at power-on. Delay time T_d and rise time T_s can roughly be calculated as shown below. (However, the values may slightly vary in an actual application.) If the capacitance of C_3 is increased, it takes longer to discharge C_3 after V_{IN} is turned off. Therefore, it is recommended to set the value to 10µF or less. When not using the soft start function, keep terminal no. 5 open.

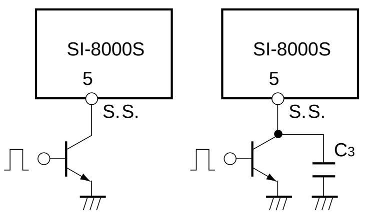
$$T_d=\frac{0.7\times C_3}{20\times10^{-6}}\ \text{(sec)}$$

$$T_s=\frac{4.845\times C_3}{V_{IN}\times20\times10^{-6}}\ \text{(sec)}$$



2. Output ON/OFF control

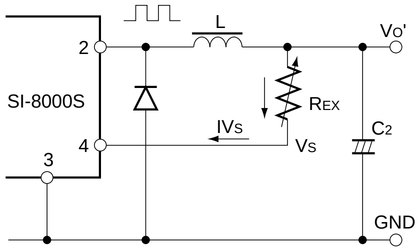
Output can be turned on and off by using the soft start terminals. Set the soft start terminal voltage to V_{SSL} (0.2V typ.) or less to stop output. To switch the potential at the soft start terminals, drive the open collector of the transistor. Since the discharge current from C_3 flows to the ON/OFF control transistor, limit the current for protection. The SS terminal is pulled up to the power supply in the IC and no external voltage can be applied.



3. Variable Output Voltage

The output voltage can be increased by connecting a resistor to V_{OS} terminal No. 4. (There is no way of decreasing the voltage)

(1) Variable output voltage with single external resistor



The output voltage adjustment resistance R_{EX} is calculated as follows:

$$R_{EX}=\frac{V_O'-V_S}{I_{VS}}$$

V_S : Output voltage of product

V_O' : Adjusted output voltage

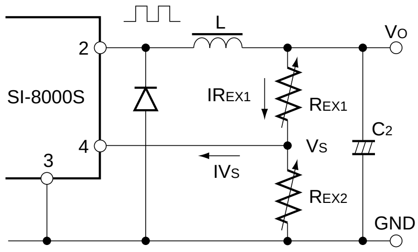
I_{VS} : Inflow current to Vs terminal

* The temperature characteristics of output voltage worsen because the value R_{EX} is not compensated for temperature. The Vs value fluctuates by up to ±20% depending on the IC product. Since the output voltage fluctuates more, a semi-fixed resistor is necessary for accurate output voltage adjustment. If Vs and R_{EX} are constant, the range of output voltage fluctuation can be expressed as follows:

$$\Delta V_O'(\%)=\pm20\bullet\frac{V_O'-V_S}{V_O'}$$

$\Delta V_O'$: Adjusted output voltage

(2) Variable output voltage with two external resistors



The output voltage adjustment resistances R_{EX1} and R_{EX2} are calculated as follows:

$$R_{EX}1=\frac{V_O'-V_S}{S\bullet I_{VS}}$$

$$R_{EX}2=\frac{V_S}{(S-1)\bullet I_{VS}}$$

S:Stability factor

Bypassing the current to R_{EX2} improves the temperature characteristics and voltage fluctuation ranges more than the method of (1). Stability factor S indicates the ratio of R_{EX1} to Vs terminal inflow current. Increasing the S value improves the fluctuations of the temperature characteristics and output voltage. (Usually 5 to 10)

If the Vs and R_{EX} values are constant, the output voltage fluctuation range can be calculated as follows:

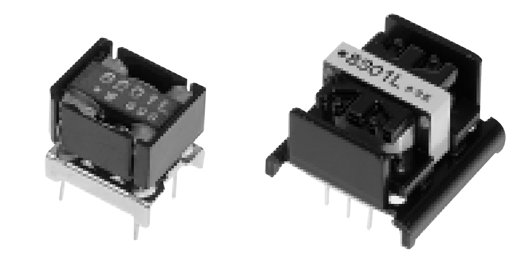
$$\Delta V_O'(\%)=\frac{\pm20}{S}\bullet\frac{V_O'-V_S}{V_O'}$$

SI-8200L/8300L Series

Self Oscillating Switching Type with Coil

■Features
- Integrated switching IC and coil construction
- Requires 2 external components only
- Low switching noise
- Heatsink not required

■Applications
- Telephone power supplies
- Onboard local power supplies



■Lineup

Part Number	SI-8201L	SI-8203L	SI-8211L	SI-8213L	SI-8301L
V_O(V)	5	12	5	12	5
I_O(A)	0.4	0.35	0.3	0.28	1.0

■Absolute Maximum Ratings

Parameter	Symbol	Ratings			Unit
		SI-8201L/8203L	SI-8211L/8213L	SI-8301L	
DC Input Voltage	V_{IN}	45	60	45	V
Power Dissipation	P_D	1.5	1.17	3.0	W
Junction Temperature	T_j	+100			°C
Storage Temperature	T_{stg}	–25 to +85			°C

■Recommended Operating Conditions

Parameter	Symbol	Ratings					Unit
		SI-8201L	SI-8203L	SI-8211L	SI-8213L	SI-8301L	
DC Input Voltage Range	V_{IN}	10 to 40	16 to 40	15 to 55	22 to 55	8 to 40	V
Output Current Range	I_O	0 to 0.4	0 to 0.35	0 to 0.3	0 to 0.28	0 to 1.0	A
Operating Temperature Range	T_{op}	–10 to +65				–10 to +85	°C

■Electrical Characteristics

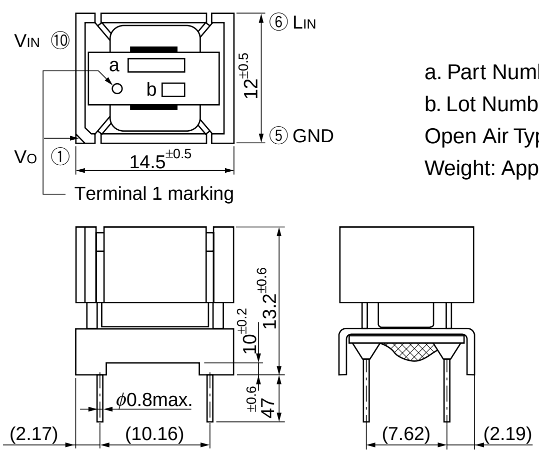
(Ta=25°C)

Parameter	Symbol	Ratings															Unit
		SI-8201L			SI-8203L			SI-8211L			SI-8213L			SI-8301L			
		min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	
Output Voltage	V_O	4.9	5.0	5.1	11.8	12.0	12.2	4.9	5.0	5.1	11.8	12.0	12.2	5.0	5.1	5.2	V
	Conditions	V_{IN}=15V, I_O=0.2A			V_{IN}=25V, I_O=0.2A			V_{IN}=35V, I_O=0.2A			V_{IN}=38V, I_O=0.2A			V_{IN}=15V, I_O=0.5A			
Efficiency	η		73			79			63			78			73		%
	Conditions	V_{IN}=15V, I_O=0.2A			V_{IN}=25V, I_O=0.2A			V_{IN}=35V, I_O=0.2A			V_{IN}=38V, I_O=0.2A			V_{IN}=15V, I_O=0.5A			
Switching Frequency	f	25			25			25			25				25		kHz
Line Regulation	ΔV_{OLINE}		15	60		15	60			60			60			50	mV
	Conditions	V_{IN}=10 to 20V, I_O=0.2A			V_{IN}=16 to 34V, I_O=0.2A			V_{IN}=20 to 50V, I_O=0.2A			V_{IN}=22 to 50V, I_O=0.2A			V_{IN}=10 to 20V, I_O=0.5A			
Load Regulation	ΔV_{OLOAD}		15	60		60	100			60			60			80	mV
	Conditions	V_{IN}=15V, I_O=0.02 to 0.25A			V_{IN}=25V, I_O=0.02 to 0.3A			V_{IN}=35V, I_O=0.02 to 0.3A			V_{IN}=38V, I_O=0.02 to 0.28A			V_{IN}=15V, I_O=0.3 to 0.7A			
Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T_a$			±1.5			±1.5			±1.5			±1.5			±1.5	mV/°C
Switching Ripple Voltage (C_2=470µF)	ΔV_r		30	60		60	100		30	60		50	100		45		mV_{p-p}
	Conditions	V_{IN}=25V, I_O=0.3A			V_{IN}=40V, I_O=0.35A			V_{IN}=48V, I_O=0.3A			V_{IN}=48V, I_O=0.28A			V_{IN}=15V, I_O=0.5A			

■External Dimensions

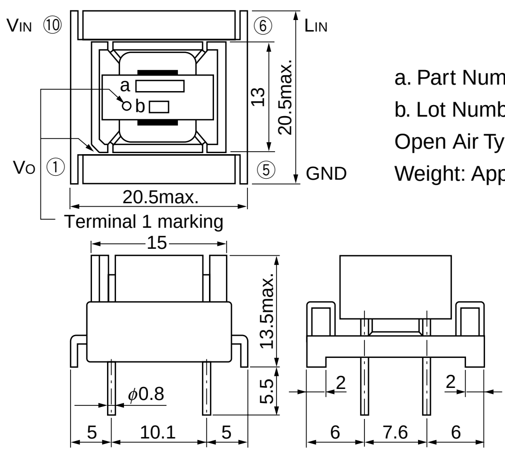
(unit: mm)

SI-8201L•8203L



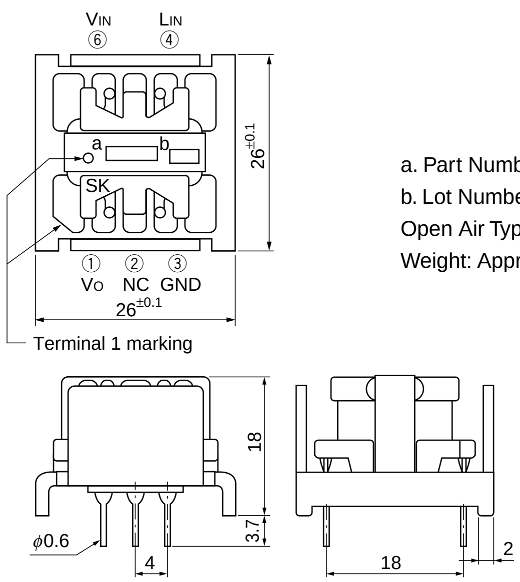
a. Part Number
b. Lot Number
Open Air Type
Weight: Approx. 5.1g

SI-8211L•8213L



a. Part Number
b. Lot Number
Open Air Type
Weight: Approx. 5.9g

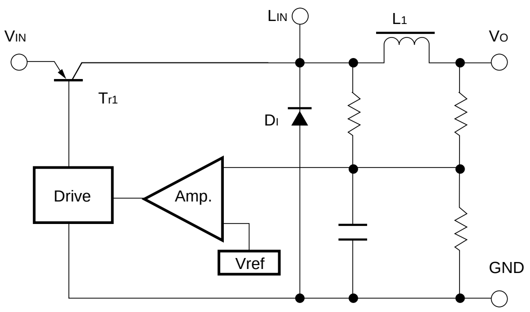
SI-8301L



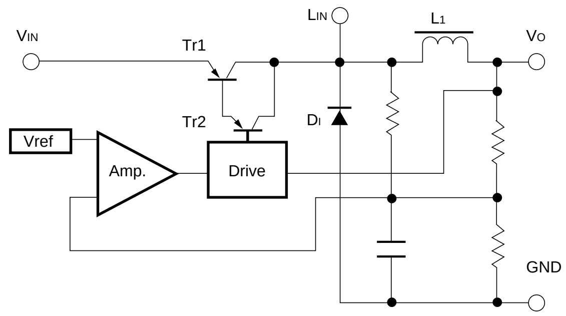
a. Part Number
b. Lot Number
Open Air Type
Weight: Approx. 14.5g

■Block Diagram

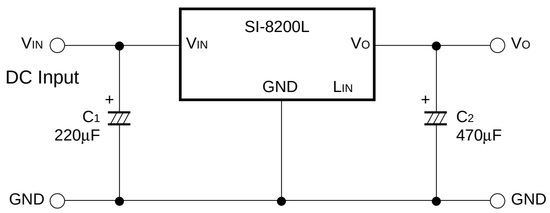
SI-8201L•8203L/SI-8301L

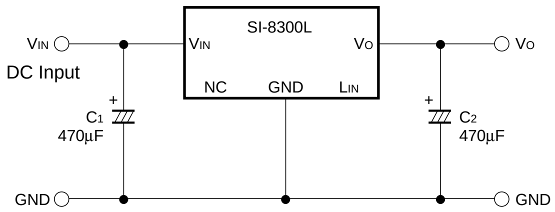


SI-8211L•8213L

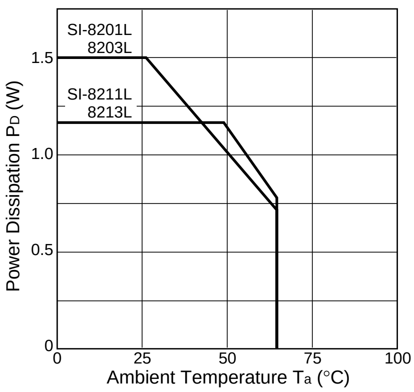


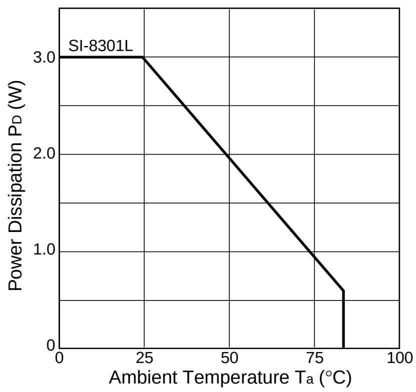
■Standard External Circuit





■T_a-P_D Characteristics





$$P_D = V_O \cdot I_O \left(\frac{100}{\eta\chi} - 1 \right)$$

V_O : Output voltage
I_O : Output current
$\eta\chi$: Efficiency (%)

The efficiency depends on the input voltage and the output current. Thus, obtain the value from the efficiency graphs on p.81 and substitute the percentage in the formula above.

■Caution

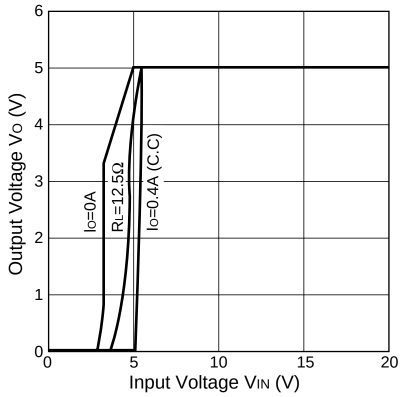
1. A low-impedance capacitor suitable for switching applications must be used for the external capacitor and must be connected as close to the IC as possible in order to assure low ripple voltage and stable switching operation.
2. The SI-8200L and 8300L series do not have a built-in overcurrent protection circuit. Thus, avoid short-circuit conditions that may cause an overcurrent.
3. The SI-8300L series may not start up if the input voltage rises too rapidly.
   Do not use the SI-8300L series in applications where the input terminal, pin6, is opened and closed directly in a state where the input voltage is already applied.
4. Terminals L_{IN} and NC in the connection diagram must be left unconnected to other circuits.
5. The IC's metalic heatsink is electrically floating. Do not connect it to GND or any other circuit.
6. Since the SI-8200L and 8300L series have an open-package construction, they can only be used in specific environments. Verify the operating environment and use the IC within the conditions indicated in the reliability data.

■Typical Characteristics

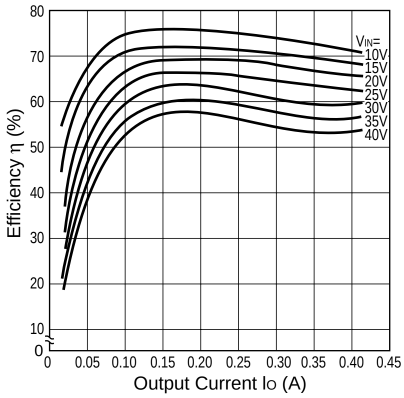
(T_a=25°C)

SI-8201L

Output Voltage

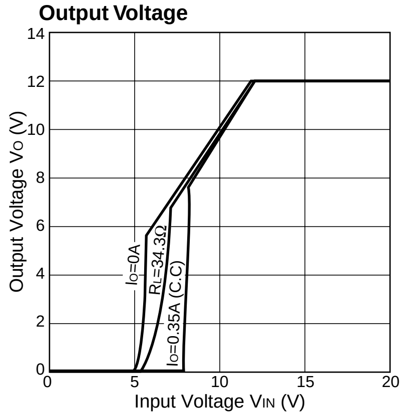


Efficiency Characteristics

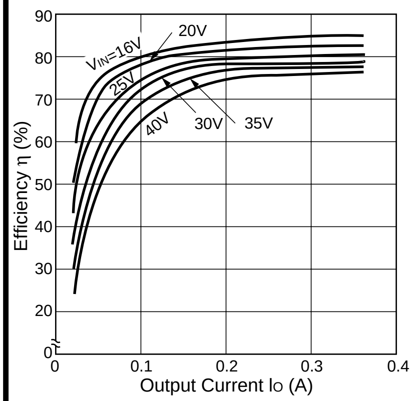


SI-8203L

Output Voltage

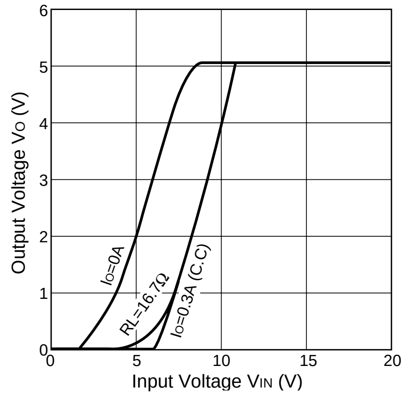


Efficiency Characteristics

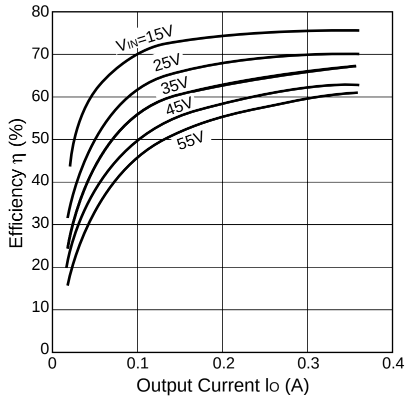


SI-8211L

Output Voltage

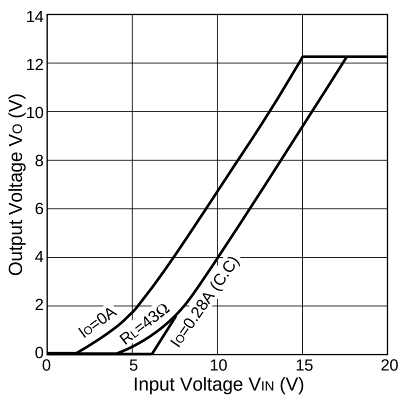


Efficiency Characteristics

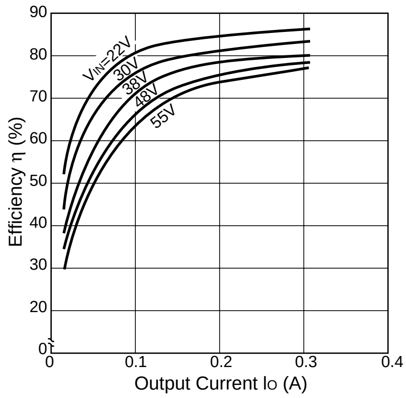


SI-8213L

Output Voltage

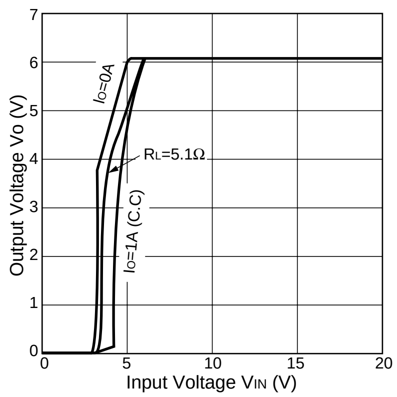


Efficiency Characteristics

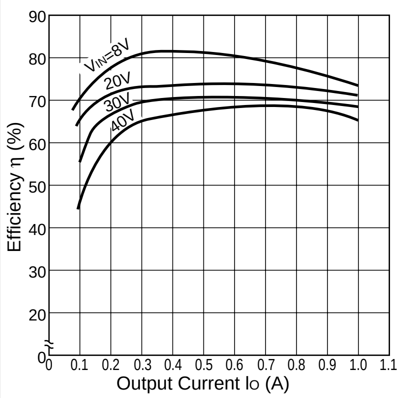


SI-8301L

Output Voltage



Efficiency Characteristics

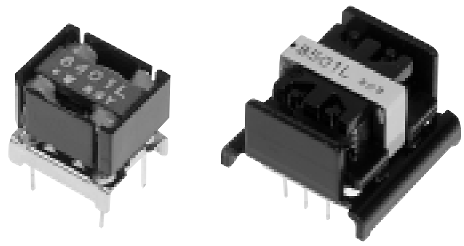


SI-8400L/8500L Series

Separate Excitation Switching Type with Coil

■Features

- Integrated switching IC and coil construction
- Requires 2 external components only
- Low switching noise
- Heatsink not required
- Built-in overcurrent and thermal protection circuits
- Built-in soft start circuit (Output ON/OFF control)...SI-8500L Series



■Applications

- Telephone power supplies
- Onboard local power supplies

■Lineup

Part Number	SI-8401L	SI-8402L	SI-8403L	SI-8405L	SI-8501L	SI-8502L	SI-8503L	SI-8504L	SI-8505L
V_O(V)	5.0	12.0	3.3	15.0	5.0	12.0	3.3	9.0	15.0
I_O(A)	0.5	0.4	0.5	0.4	1.0				

■Absolute Maximum Ratings

Parameter	Symbol	Ratings		Unit
		SI-8400L	SI-8500L	
DC Input Voltage	V_{IN}	35		V
Power Dissipation	P_D	1.25	3	W
Junction Temperature	T_j	+100		°C
Storage Temperature	T_{stg}	–25 to +85		°C

■Recommended Operating Conditions

Parameter	Symbol	Ratings				Unit
		SI-8401L	SI-8402L	SI-8403L	SI-8405L	
DC Input Voltage Range	V_{IN}	7 to 33	15 to 33	5.3 to 33	18 to 33	V
Output Current Range	I_O	0 to 0.5	0 to 0.4	0 to 0.5	0 to 0.4	A
Operating Temperature Range	T_{op}	–20 to +85				°C

Parameter	Symbol	Ratings					Unit
		SI-8501L	SI-8502L	SI-8503L	SI-8504L	SI-8505L	
DC Input Voltage Range	V_{IN}	7 to 33	15 to 33	5.3 to 33	12 to 33	18 to 33	V
Output Current Range	I_O	0 to 1.0					A
Operating Temperature Range	T_{op}	–20 to +85					°C

■Electrical Characteristics

(T_a=25°C)

Parameter	Symbol	Ratings												Unit
		SI-8401L			SI-8402L			SI-8403L			SI-8405L			
		min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	
Output Voltage	V_O	4.80	5.00	5.20	11.40	12.00	12.60	3.17	3.30	3.43	14.25	15.00	15.75	V
	Conditions	V_{IN}=20V, I_O=0.3A			V_{IN}=24V, I_O=0.3A			V_{IN}=15V, I_O=0.3A			V_{IN}=27V, I_O=0.3A			
Efficiency	η		80			88			75			89		%
	Conditions	V_{IN}=20V, I_O=0.3A			V_{IN}=24V, I_O=0.3A			V_{IN}=15V, I_O=0.3A			V_{IN}=27V, I_O=0.3A			
Switching Frequency	f		60			60			60			60		kHz
	Conditions	V_{IN}=20V, I_O=0.3A			V_{IN}=24V, I_O=0.3A			V_{IN}=15V, I_O=0.3A			V_{IN}=27V, I_O=0.3A			
Line Regulation	ΔV_{OLINE}		80	100		100	130		60	80		100	130	mV
	Conditions	V_{IN}=10 to 30V, I_O=0.3A			V_{IN}=18 to 30V, I_O=0.3A			V_{IN}=8 to 30V, I_O=0.3A			V_{IN}=21 to 30V, I_O=0.3A			
Load Regulation	ΔV_{OLOAD}		30	40		70	95		20	30		90	120	mV
	Conditions	V_{IN}=20V, I_O=0.1 to 0.4A			V_{IN}=24V, I_O=0.1 to 0.4A			V_{IN}=15V, I_O=0.1 to 0.4A			V_{IN}=27V, I_O=0.1 to 0.4A			
Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T_a$		±0.5			±1.5			±0.5			±1.5		mV/°C
Switching Ripple Voltage (C_2=470µF)	ΔV_r		20	40		35	70		15	30		40	80	mV_{p-p}
	Conditions	V_{IN}=20V, I_O=0.3A			V_{IN}=24V, I_O=0.3A			V_{IN}=15V, I_O=0.3A			V_{IN}=27V, I_O=0.3A			
Overcurrent Protection Starting Current	I_{S1}	0.55			0.45			0.55			0.45			A
	Conditions	V_{IN}=10V			V_{IN}=18V			V_{IN}=8V			V_{IN}=21V			

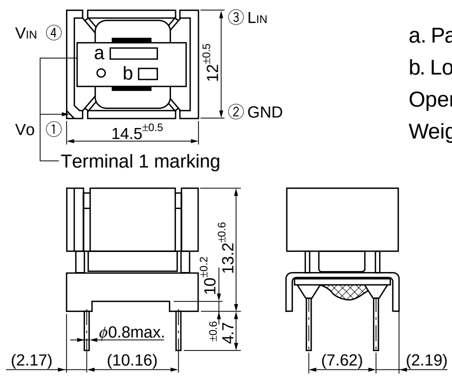
(T_a=25°C)

Parameter	Symbol	Ratings															Unit
		SI-8501L			SI-8502L			SI-8503L			SI-8504L			SI-8505L			
		min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	
Output Voltage	V_O	4.80	5.00	5.20	11.40	12.00	12.60	3.17	3.30	3.43	8.55	9.00	9.45	14.25	15.00	15.75	V
	Conditions	V_{IN}=20V, I_O=0.5A			V_{IN}=24V, I_O=0.5A			V_{IN}=15V, I_O=0.5A			V_{IN}=21V, I_O=0.5A			V_{IN}=25V, I_O=0.5A			
Efficiency	η		83			89			79			87			90		%
	Conditions	V_{IN}=20V, I_O=0.5A			V_{IN}=24V, I_O=0.5A			V_{IN}=15V, I_O=0.5A			V_{IN}=21V, I_O=0.5A			V_{IN}=25V, I_O=0.5A			
Switching Frequency	f		60			60			60			60			60		kHz
	Conditions	V_{IN}=20V, I_O=0.5A			V_{IN}=24V, I_O=0.5A			V_{IN}=15V, I_O=0.5A			V_{IN}=21V, I_O=0.5A			V_{IN}=25V, I_O=0.5A			
Line Regulation	ΔV_{OLINE}		70	130		70	130		50	80		70	130		70	130	mV
	Conditions	V_{IN}=10 to 30V, I_O=0.5A			V_{IN}=18 to 30V, I_O=0.5A			V_{IN}=8 to 30V, I_O=0.5A			V_{IN}=15 to 30V, I_O=0.5A			V_{IN}=21 to 30V, I_O=0.5A			
Load Regulation	ΔV_{OLOAD}		30	55		30	55		20	45		30	55		30	55	mV
	Conditions	V_{IN}=20V, I_O=0.2 to 0.8A			V_{IN}=24V, I_O=0.2 to 0.8A			V_{IN}=15V, I_O=0.2 to 0.8A			V_{IN}=21V, I_O=0.2 to 0.8A			V_{IN}=25V, I_O=0.2 to 0.8A			
Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T_a$		±0.5			±1.5			±0.5			±1.0			±1.5		mV/°C
Switching Ripple Voltage (C_2=470µF)	ΔV_r		45			30			15			25			30		mV_{p-p}
	Conditions	V_{IN}=20V, I_O=0.5A			V_{IN}=24V, I_O=0.5A			V_{IN}=15V, I_O=0.5A			V_{IN}=21V, I_O=0.5A			V_{IN}=25V, I_O=0.5A			
Overcurrent Protection Starting Current	I_{S1}	1.1			1.1			1.1			1.1			1.1			A
	Conditions	V_{IN}=18V			V_{IN}=24V			V_{IN}=12V			V_{IN}=21V			V_{IN}=25V			

■External Dimensions

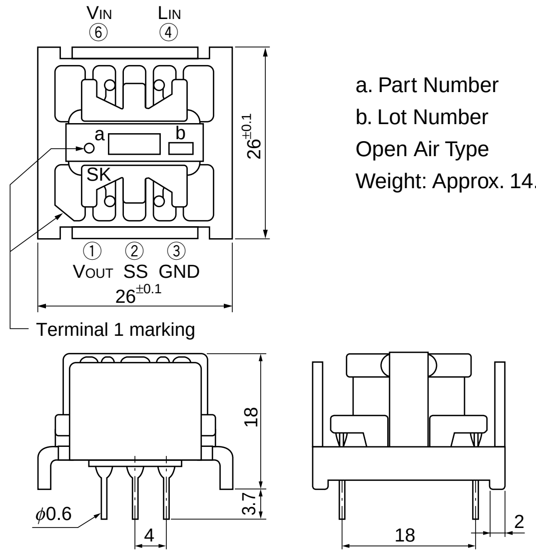
(unit:mm)

SI-8400L



a. Part Number
b. Lot Number
Open Air Type
Weight: Approx. 5.1g

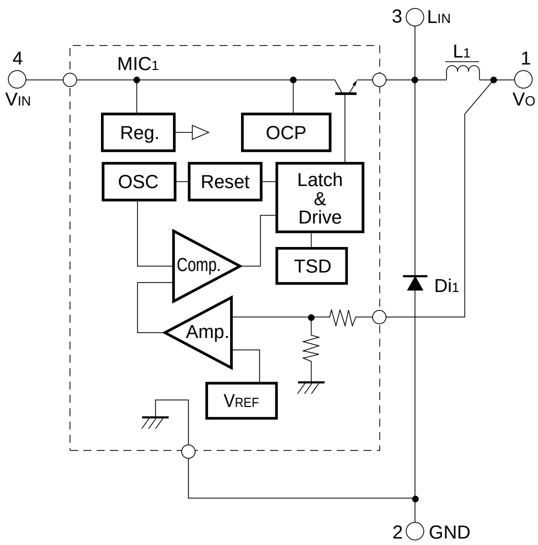
SI-8500L



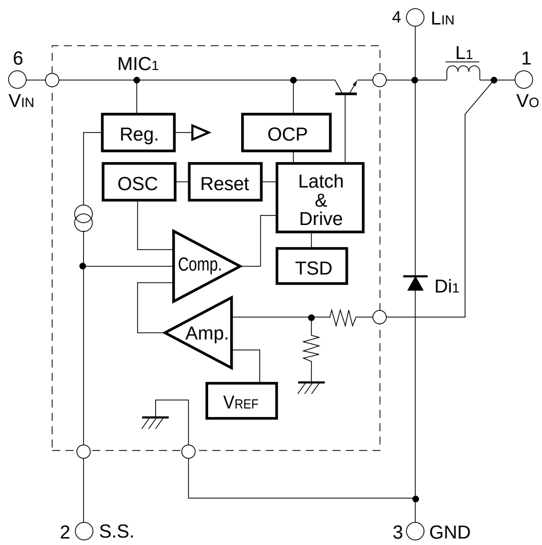
a. Part Number
b. Lot Number
Open Air Type
Weight: Approx. 14.5g

■Block Diagram

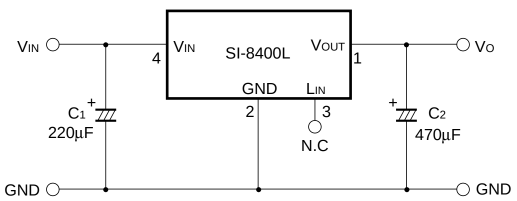
SI-8400L

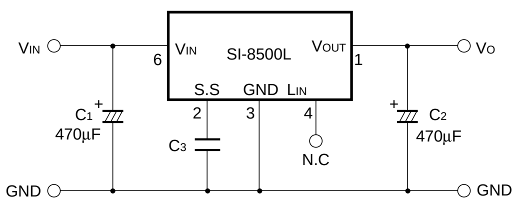


SI-8500L



■Standard External Circuit

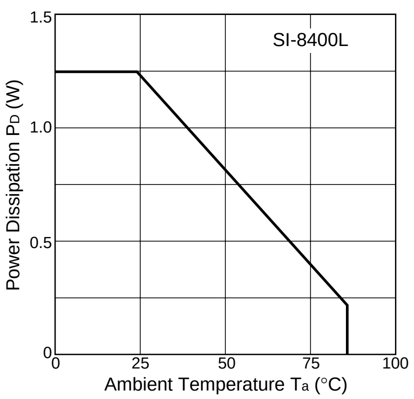


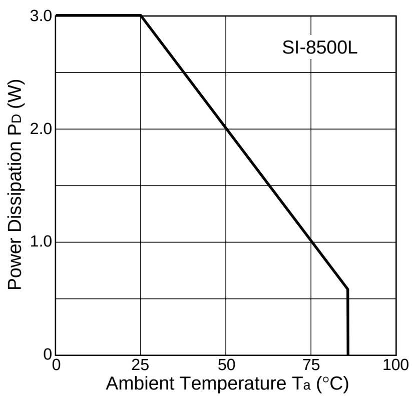


Pin compatible with SI-8200L

C3 is necessary only for using soft start function.
Pin compatible with SI-8300L

■T_a-P_D Characteristics





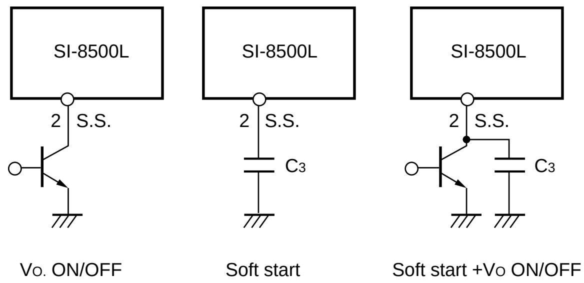
$$P_D = V_O \cdot I_O \left(\frac{100}{\eta\chi} - 1 \right)$$

V_O : Output voltage
I_O : Output current
$\eta\chi$: Efficiency (%)

The efficiency depends on the input voltage and the output current. Thus, obtain the value from the efficiency graphs on p.86, 87 and substitute the percentage in the formula above.

■SI-8500L application circuit

Terminal no.2 is for soft start. Connecting a capacitor to the terminal enables the soft start function. See page 77 for the formulas to calculate delay time and rise time. Output can be turned on and off by using the soft start terminal. To stop output, set the soft start terminal voltage to V_{SSL} (0.2V typ.) or less. To switch the potential of the soft start terminal, drive the open collector of the transistor. Since the discharge current from C_3 flows to the ON/OFF control transistor, limit the current for protection. The SS terminal is pulled up to the power supply in the IC and no external voltage can be applied.

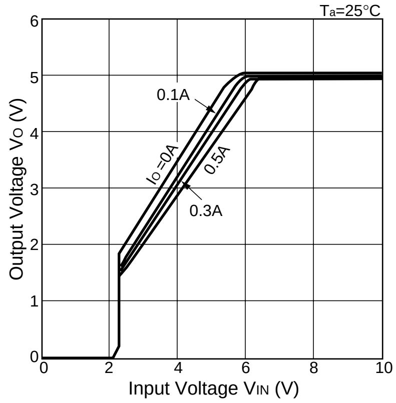


■Caution

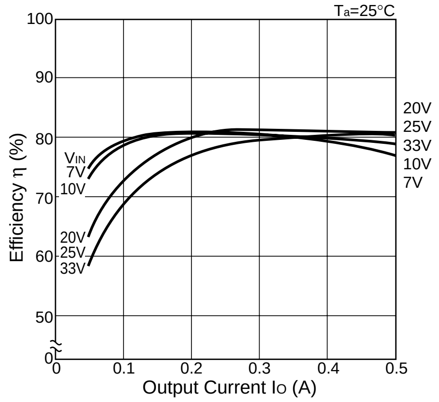
1. Allocation of Components
   For the best operating environment, the ground should be a single ground line at the GND terminal (terminal 2 on the SI-8400L, terminal 3 on the SI-8500L), and the wiring from C_1 and C_2 to ground should be as short as possible.
2. Capacitors C_1 and C_2
   1) They must satisfy the breakdown voltage and allowable ripple current.
      Exceeding the ratings of these capacitors or using them without derating shortens their service lives and may also cause abnormal oscillation of the IC.
   2) C_2 must be a low-impedance type capacitor to ensure minimum ripple voltage and stable switching operation.
   3) C_3 (SI-8500L only) is a capacitor for soft start. When not using soft start, leave terminal 2 open. It is pulled up inside the IC.
3. Terminals L_{IN} and NC in the connection diagram must be left unconnected to other circuits.
4. The IC's metalic heatsink is electrically floating. Do not connect it to GND or any other circuit.
5. Since the SI-8400L and 8500L series have an open-package construction, they can only be operated in specific environments. Verify the operating environment and use the conditions indicated in the reliability data.

■Typical Characteristics (SI-8400L Series)

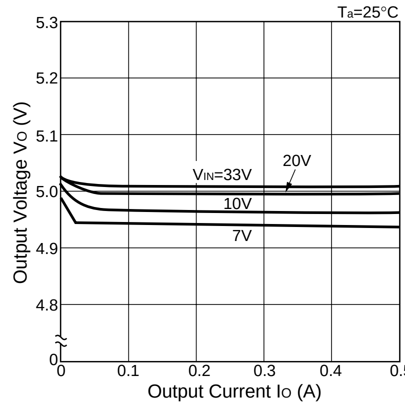
Output Voltage(SI-8401L)



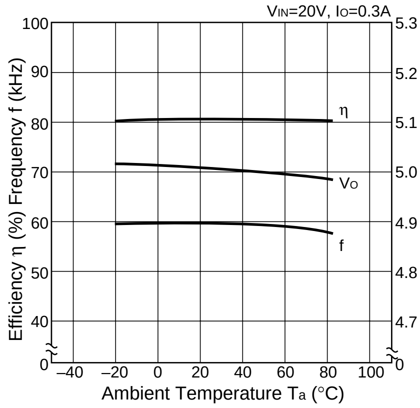
Efficiency Characteristics(SI-8401L)



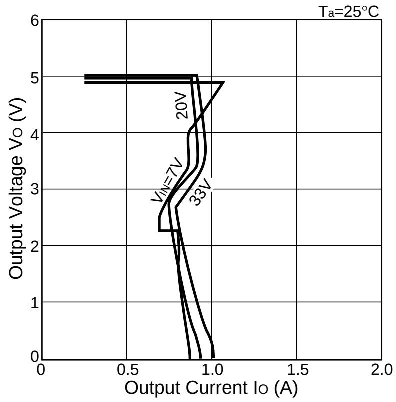
Load Regulation(SI-8401L)



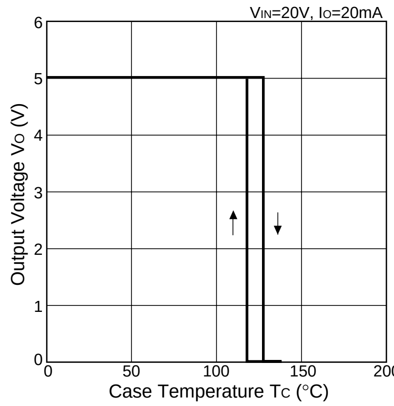
Temperature Characteristics(SI-8401L)



Overcurrent Protection Characteristics(SI-8401L)



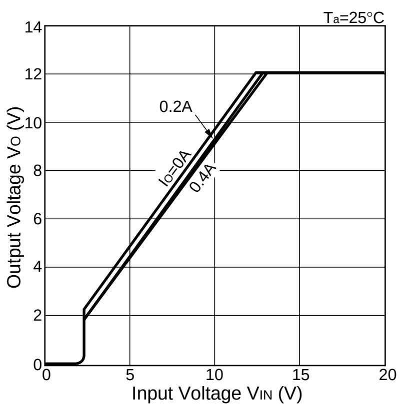
Thermal Protection Characteristics(SI-8401L)



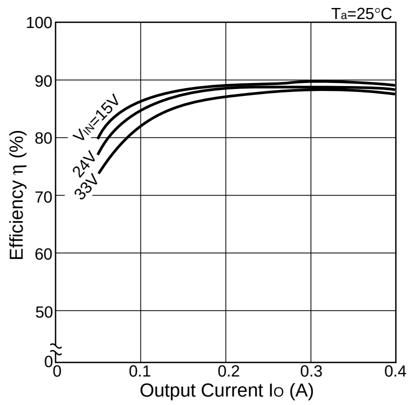
Note on Thermal Protection:

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.

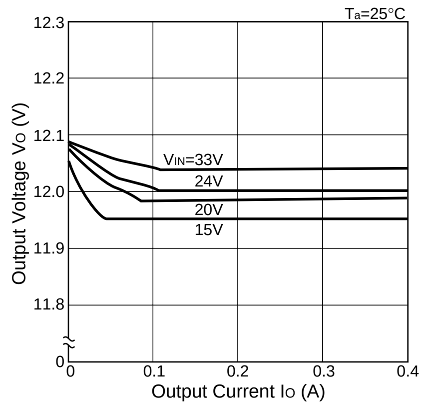
Output Voltage(SI-8402L)



Efficiency Characteristics(SI-8402L)

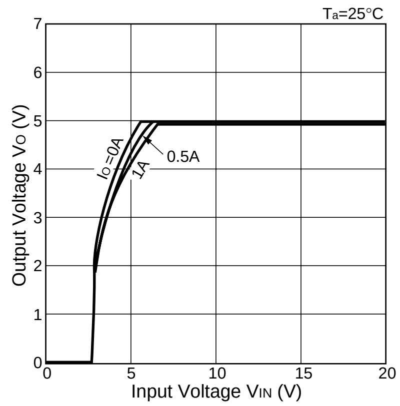


Load Regulation(SI-8402L)

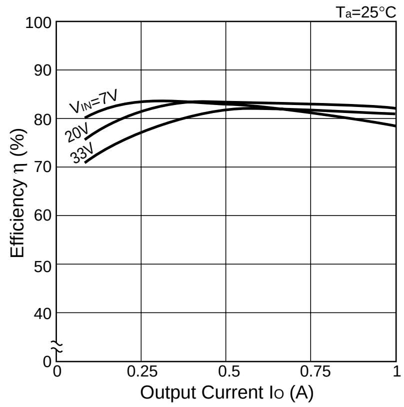


■Typical Characteristics (SI-8500L Series)

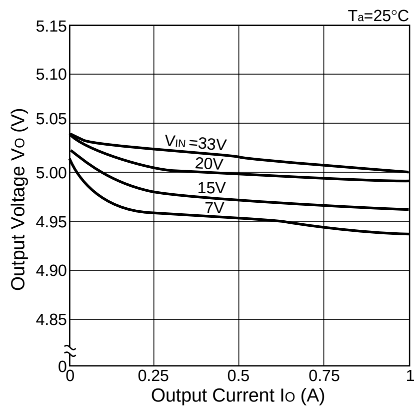
Output Voltage(SI-8501L)



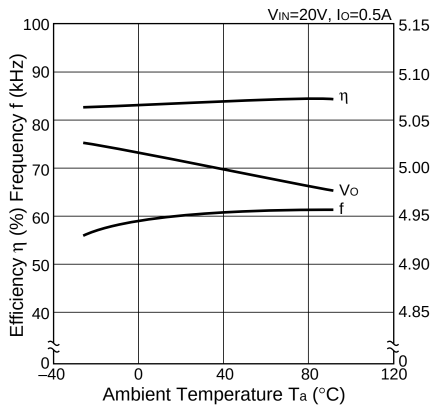
Efficiency Characteristics(SI-8501L)



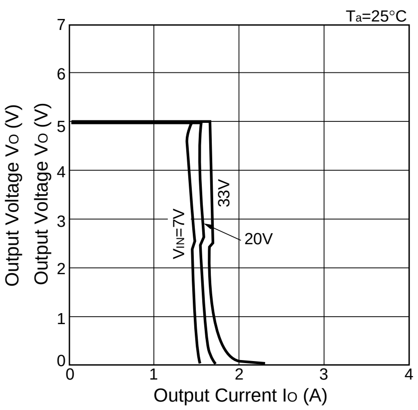
Load Regulation(SI-8501L)



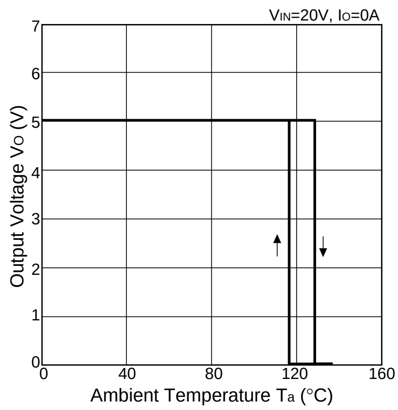
Temperature Characteristics(SI-8401L)



Overcurrent Protection Characteristics(SI-8401L)



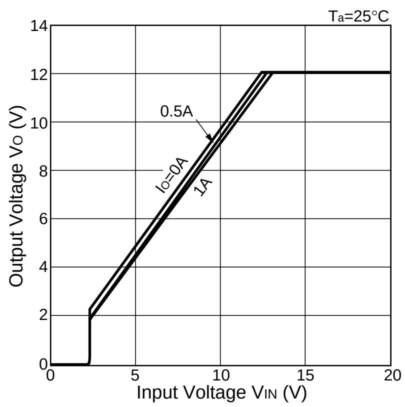
Thermal Protection Characteristics(SI-8401L)



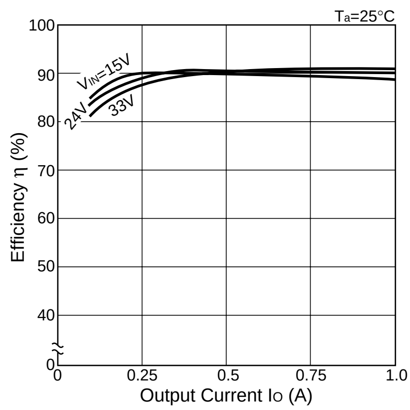
Note on Thermal Protection:

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.

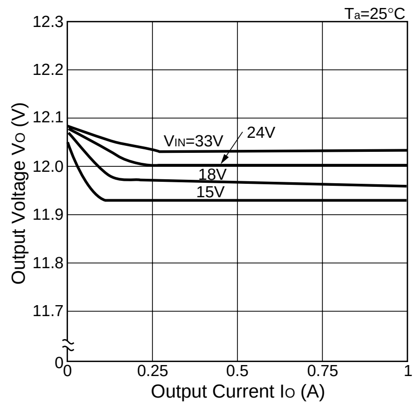
Output Voltage(SI-8502L)



Efficiency Characteristics(SI-8502L)



Load Regulation(SI-8502L)

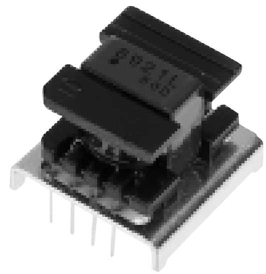


SI-8800L/8900L Series

Separate Excitation Switching Type with Transformer

■Features

- Integrated switching IC and transformer construction
- Requires only input/output and soft start capacitors as external components
- Low switching noise
- Heatsink not required
- Built-in overcurrent protection circuit (+5V)
- Both plus and minus output models available (SI-8811L, SI-8911L)



■Applications

- Telephone power supplies
- Onboard local power supplies

■Lineup

Part Number	Ch1		Ch2	
	V_O(V)	I_O(A)	V_O(V)	I_O(A)
SI-8811L	+5	0.45	–5	0.05
SI-8911L	+5	0.3	–5	0.1
SI-8921L/8922L	+5	0.6	—	

■Absolute Maximum Rating

Parameter	Symbol	Ratings				Unit
		SI-8811L	SI-8911L	SI-8921L	SI-8922L	
DC Input Voltage	V_{IN}	35	60			V
Power Dissipation	P_D	1.15	1.3	1.67	1.67	W
Junction Temperature	T_j	+100				°C
Storage Temperature	T_{stg}	–25 to +85				°C

■Recommended Operating Conditions

Parameter	Symbol	Ratings												Unit
		SI-8811L			SI-8911L			SI-8921L			SI-8922L			
		min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	
DC Input Voltage Range	V_{IN}	12	20	30	24	40	55	24	40	55	20	40	55	V
Output Current Range 1	I_{O1}	50	250	450	20	150	300*2	0	300	600	0	300	600	mA
Output Current Range 2	I_{O2}	0	–20	–50*1	0	–50	–100		—			—		mA
Operating Temperature Range	T_{op}	–10		+70	–10		+60	–10		+65	–10		+65	°C

*1: Output current 2 depends on the input/output conditions

*2: If I_{O2}=50mA or more, the condition I_{O1}>0.5×I_{O2} is recommended.

■Electrical Characteristics

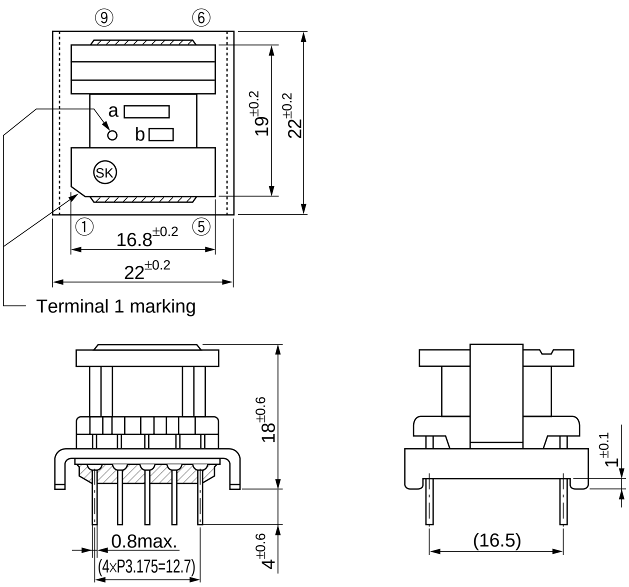
(Ta=25°C)

Parameter	Symbol	Ratings												Unit
		SI-8811L			SI-8911L			SI-8921L			SI-8922L			
		min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	
Output Voltage 1	V_{O1}	4.75	5.00	5.25	4.75	5.00	5.25	4.95	5.10	5.20	4.95	5.10	5.20	V
	Conditions	Recommended operating conditions												
Output Voltage 2	V_{O2}	–4.75	–5.00	–5.25	–4.75	–5.00	–5.25	———			———			V
	Conditions	Recommended operating conditions						———			———			
Efficiency	η		72			65			72			72		%
	Conditions	Recommended operating conditions (typ.)												
Switching Frequency	f		50			68		60	68	80	60	68	80	kHz
Switching Ripple Voltage 1	ΔV_{r1}		50			50			50	80		50	80	mV_{p-p}
	Conditions	Recommended operating conditions (typ.)												
Switching Ripple Voltage 2	ΔV_{r2}		50			50		———			———			mV_{p-p}
	Conditions	Recommended operating conditions (typ.)						———			———			
Operation Starting Voltage	V_{St}	———			22		24	22		24	17		20	V
	Conditions	———			Recommended operating conditions (typ.)									

■External Dimensions

(unit: mm)

SI-8811L, 8911L, 8921L, 8922L

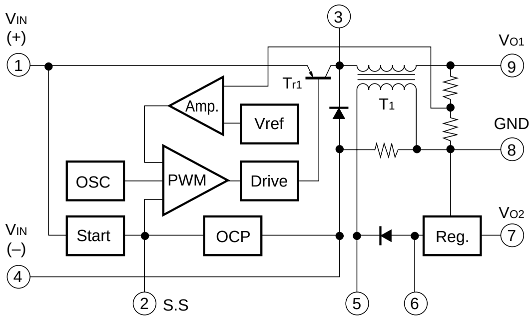


a. Part Number
b. Lot Number

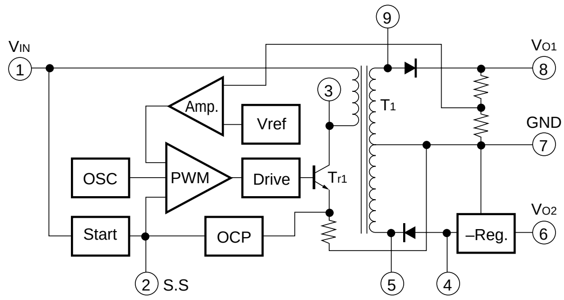
Open Air Type
Weight: Approx. 9.3g

■Block Diagram

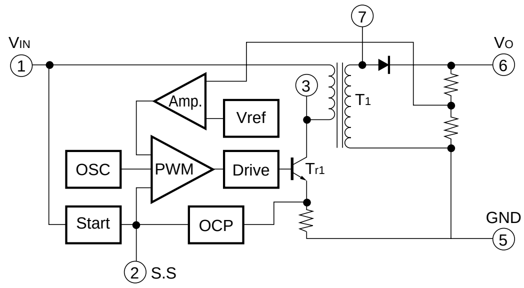
SI-8811L



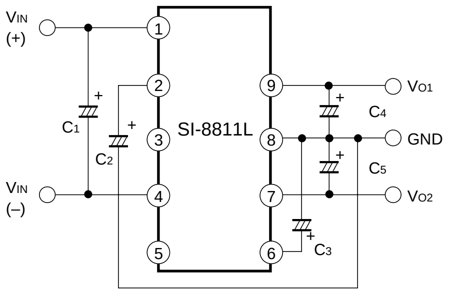
SI-8911L



SI-8921L/8922L

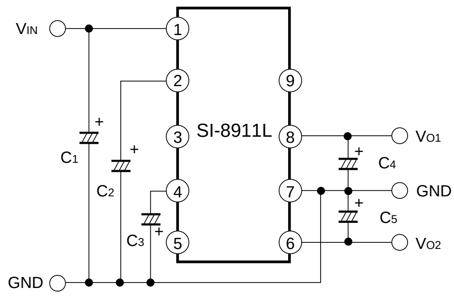


■Standard External Circuit



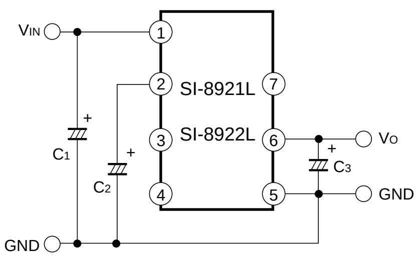
C_1(for smoothing V_{IN})	: 35V/470µF
C_2(for soft start)	: 16V/10µF
C_3(for smoothing V_{O2}Reg input)	: 10V/220µF
C_4(for smoothing V_{O1})	: 16V/1200µF
C_5(for smoothing V_{O2})	: 10V/47µF

$C_{1,2,3,5}$: Nippon Chemi-con SME Series or equivalent
C_4 : Nippon Chemi-con SXE Series or equivalent



C_1(for smoothing V_{IN})	: 63V/220µF
C_2(for soft start)	: 10V/33µF
C_3(for smoothing V_{O2}Reg input)	: 10V/220µF
C_4(for smoothing V_{O1})	: 16V/1200µF
C_5(for smoothing V_{O2})	: 10V/100µF

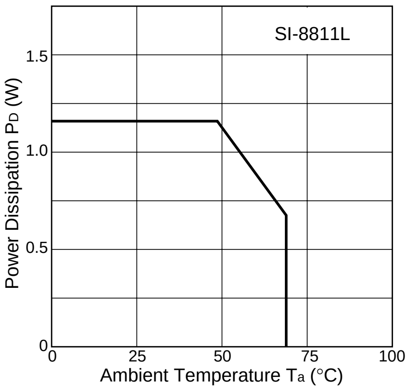
$C_{1,2,3,5}$: Nippon Chemi-con SME Series or equivalent
C_4 : Nippon Chemi-con SXE Series or equivalent

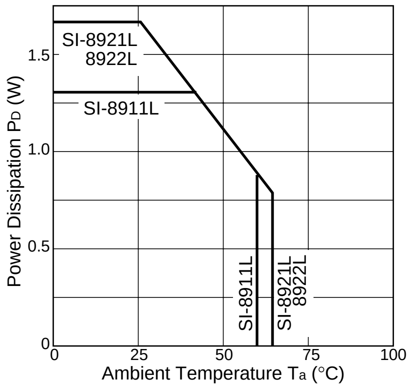


C_1(for smoothing V_{IN})	: 63V/180µF
C_2(for soft start)	: 10V/22µF
C_3(for smoothing V_O)	: 10V/1200µF

$C_{1,2}$: Nippon Chemi-con SME Series or equivalent
C_3 : Nippon Chemi-con SXE Series or equivalent

■T_a-P_D Characteristics





$$P_D = V_O \bullet I_O \left(\frac{100}{\eta\chi} - 1 \right)$$

V_O : Output voltage
I_O : Output current
$\eta\chi$: Efficiency (%)

The efficiency depends on the input voltage and the output current. Thus, obtain the value from the efficiency graphs on p.92 and substitute the percentage in the formula above.

■Caution

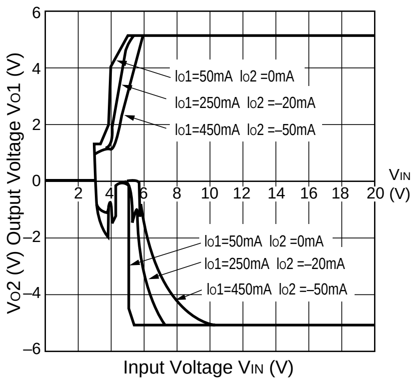
1. A low-impedance capacitor suitable for switching applications must be used for the external capacitor and must be connected as close to the IC as possible in order to assure low ripple voltage and stable switching operation.
2. The SI-881L/8911L series does not have a built-in overcurrent protection circuit on V_{O2}(–5V). Thus, avoid short-circuit conditions that may cause an overcurrent.
3. Do not connect V_{IN}(–) of SI-8811L to GND. The overcurrent protection circuit may not work if they are connected.
4. Terminals left unconnected in the connection diagram must not be connected to other circuits.
5. The IC's metallic heatsink is electrically floating. Do not connect it to GND or any other circuit.
6. Since the SI-8800L and 8900L series have an open-package construction, they can be operated in specific environments. Verify the operating environment and use the IC within the conditions indicated in the reliability data.

■Typical Characteristics

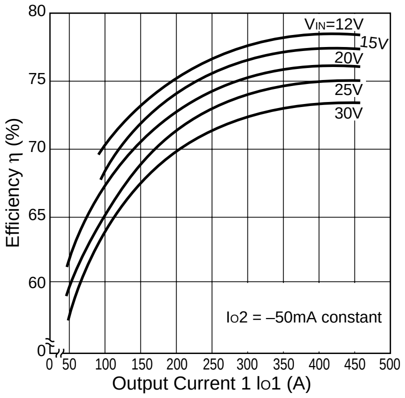
(Ta=25°C)

SI-8811L

Output Voltage

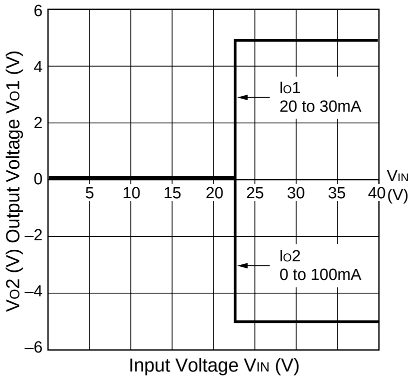


Efficiency Characteristics

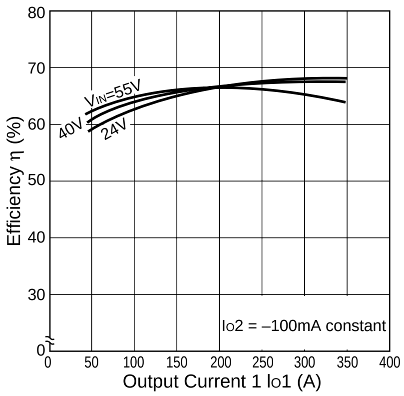


SI-8911L

Output Voltage

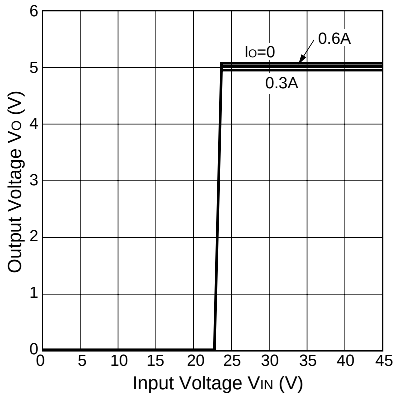


Efficiency Characteristics

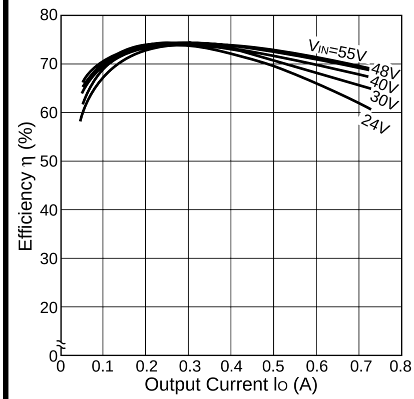


SI-8921L

Output Voltage

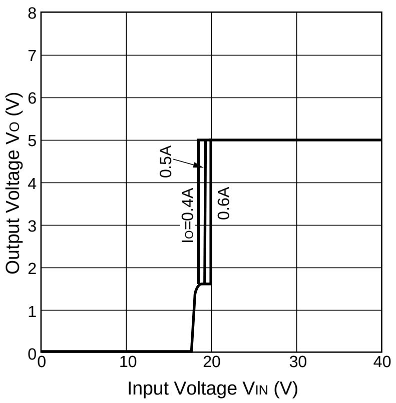


Efficiency Characteristics

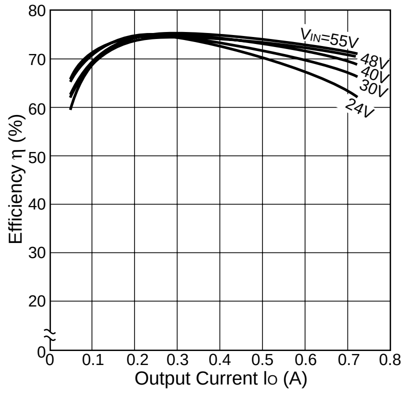


SI-8922L

Output Voltage



Efficiency Characteristics



Multi-Output Type - Application Note

■Heat Radiation and Reliability

The reliability of an IC is highly dependent on its operating temperature. Design should pay particular attention to ensuring ample space for radiating heat.
Be sure to apply silicon grease to the IC before attaching a heatsink, and to secure it firmly to the heatsink.
Other important items to be considered regarding heat radiation include air convection during operation.
The reliability of peripheral components such as capacitors and coils is closely related to temperature. A high operating temperature may reduce the service life. Exceeding the allowable temperature may burn the coils or damage capacitors. It is important to make sure that the temperature of output smoothing coils and input/output capacitors do not exceed their allowable levels during operation. Allow for variation in the ratings of the coils and minimize heat emission as far as possible. (For peripheral components, refer to the user manuals.)

■Heatsink Design

The maximum junction temperature $T_{j(max)}$ given in the absolute maximum ratings is specific to each product type and must be strictly observed. Thus, thermal design must consider the conditions of use which affect the maximum power dissipation $P_{D(max)}$ and the maximum ambient temperature $T_{a(max)}$.
To simplify thermal design, the relationship between these two parameters has been presented in a graph, the T_a-P_D characteristic graph. Thermal design should include these steps:

1. Obtain the maximum ambient temperature $T_{a(max)}$.
2. Obtain the maximum power dissipation $P_{D(max)}$.
3. Look for the intersection point on the T_a-P_D characteristic graph and determine the size of the heatsink.

The size of the heatsink has now been obtained. However, in actual applications, a 10 to 20% derating factor is introduced. Moreover, the heat dissipation capacity of a heatsink highly depends on how it is mounted. Thus, it is recommended to measure the heatsink and case temperature in the actual operating environment.
The T_a-P_D characteristics for each product type are provided for reference purposes.

■Fastening Torque

STA800M Series (when using a spring)
0.588 to 0.784 [N•m](6.0 to 8.0[kgf•cm]
SLA3000M Series
0.588 to 0.784 [N•m](6.0 to 8.0[kgf•cm]

■Recommended Silicon Grease

- Shin-Etsu Chemical Co., Ltd.: G746
- GE Toshiba Silicone Co., Ltd.: YG-6260
- Dow Corning Toray Silicone Co., Ltd.: SC102

Please be careful when selecting silicone grease since the oil in some grease may penetrate the product, which will result in an extremely short product life.

STA801M/802M

2-Output Separate Excitation Switching Type

■Features
- 2 regulators combined 1 package
- Compact inline package
- Output current (0.5A × 2 output)
- Output voltage of Ch2 selectable from 4 levels.
- Built-in flywheel diode (Schottky barrier diode)
- Requires only 7 external components (2 outputs)
- Phase correction and output voltage adjustment performed internally
- Built-in reference oscillator (125kHz) - Compact choke coil can be used due to high frequency (compared to existing Sanken product)
- Built-in overcurrent and thermal protection circuits
- Built-in soft start circuit (Output ON/OFF control)

■Applications
- For BS and CS antenna power supplies
- For stabilization of the secondary stage of switching power supplies
- Electronic equipment

■Lineup

Part Number	Output Voltage (V)	
	Ch1	Ch2(Select one output)
STA801M	5	9.0 / 11.5 / 12.1 / 15.5
STA802M	9	9.1 / 11.7 / 12.1 / 15.7

■Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit
DC Input Voltage	V_{IN}	43	V
Power Dissipation	P_{D1}	6.7(With infinite heatsink)	W
	P_{D2}	1.6(Without heatsink, stand-alone operation)	W
Junction Temperature	T_j	+125	°C
Storage Temperature	T_{stg}	–40 to +125	°C

■Recommended Operating Conditions

Parameter	Symbol	Ratings		Unit
		min.	max.	
DC Input Voltage Range	V_{IN}	Ch2 $V_{Omax.}$+2	40	V
Output Current Range per Channel	I_O	0	0.5	A
Operating Temperature Range	T_{jop}	–20	+125	°C

■Electrical Characteristics

(T_a=25°C)

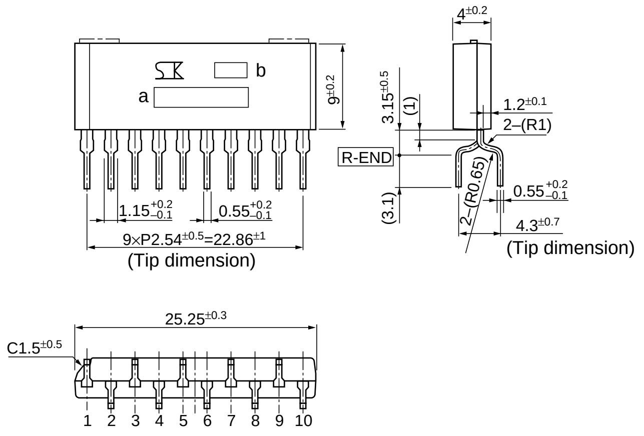
		Parameter	Symbol	Ratings						Unit
				STA801M			STA802M			
				min.	typ.	max.	min.	typ.	max.	
Ch1		Output voltage 1	V_O1	4.80	5.00	5.20	8.64	9.00	9.36	V
			Conditions	V_{IN}=20V, I_O=0.3A			V_{IN}=20V, I_O=0.3A			
		Efficiency *	η1		80			86		%
			Conditions	V_{IN}=20V, I_O=0.3A			V_{IN}=20V, I_O=0.3A			
		Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T_{a1}$		±0.5			±1.0		mV/°C
		Line Regulation	ΔV_{OLINE1}		30	90		35	110	mV
			Conditions	V_{IN}=10 to 30V, I_O=0.3A			V_{IN}=14 to 30V, I_O=0.3A			
		Load Regulation	ΔV_{OLOAD1}		10	40		20	80	mV
			Conditions	V_{IN}=20V, I_O=0.1 to 0.4A			V_{IN}=20V, I_O=0.1 to 0.4A			
Ch2 (Select one output)		Output voltage 2-1	V_O2-1	8.64	9.00	9.36	8.74	9.10	9.46	V
			Conditions	V_{IN}=20V, I_O=0.3A			V_{IN}=20V, I_O=0.3A			
		Output voltage 2-2	V_O2-2	11.04	11.50	11.96	11.24	11.70	12.16	V
			Conditions	V_{IN}=20V, I_O=0.3A			V_{IN}=20V, I_O=0.3A			
		Output voltage 2-3	V_O2-3	11.62	12.10	12.58	11.62	12.10	12.58	V
			Conditions	V_{IN}=20V, I_O=0.3A			V_{IN}=20V, I_O=0.3A			
		Output voltage 2-4	V_O2-4	14.88	15.50	16.12	15.08	15.70	16.32	V
			Conditions	V_{IN}=20V, I_O=0.3A			V_{IN}=20V, I_O=0.3A			
	V_O2-4	Efficiency*	η		89			89		%
			Conditions	V_{IN}=20V, I_O=0.3A			V_{IN}=20V, I_O=0.3A			
		Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T_a$		±2.0			±2.0		mV/°C
		Line Regulation	ΔV_{OLINE}		40	130		40	130	mV
			Conditions	V_{IN}=20 to 30V, I_O=0.3A			V_{IN}=20 to 30V, I_O=0.3A			
		Load Regulation	ΔV_{OLOAD}		30	120		30	120	mV
			Conditions	V_{IN}=20V, I_O=0.1 to 0.4A			V_{IN}=20V, I_O=0.1 to 0.4A			
Common		No-load Circuit Current	I_{CC}		15			15		mA
		Switching Frequency	f		125			125		kHz
		Overcurrent Protection Starting Current	I_{S1}	0.51	0.7		0.51	0.7		A

*Efficiency indicates the value when only one channel is active. The value can be calculated as shown below. 7.5mA is deducted for the no-load circuit current of $\frac{Icc}{2}$ at unused output.

$$\eta = \frac{V_O \bullet I_O}{V_{IN} \bullet (I_{IN} - 0.0075)} \times 100(\%)$$

■External Dimensions

(unit:mm)



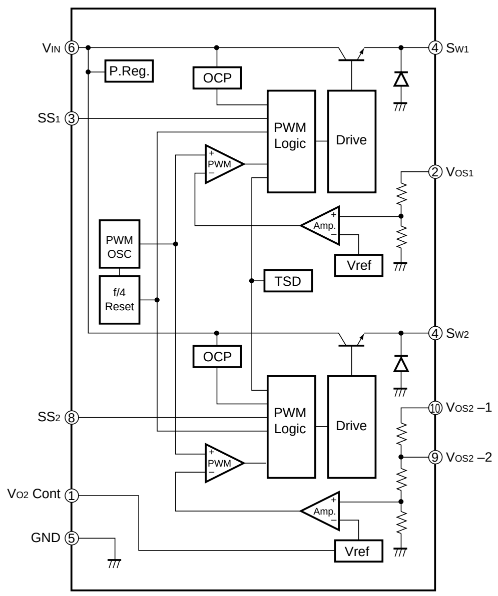
a. Part Number
b. Lot Number

Pin Arrangement

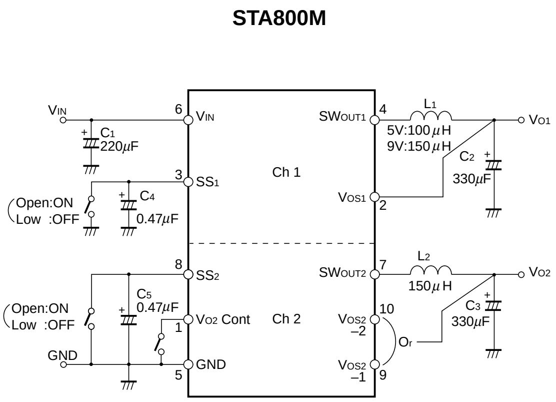
① VO2 Cont	⑥ VIN
② VOS1	⑦ SWOUT2
③ SS1	⑧ SS2
④ SWOUT1	⑨ VOS2–2
⑤ GND	⑩ VOS2–1

Plastic Mold Package Type
Flammability: UL94V-0
Weight: Approx. 2.5g

■Block Diagram

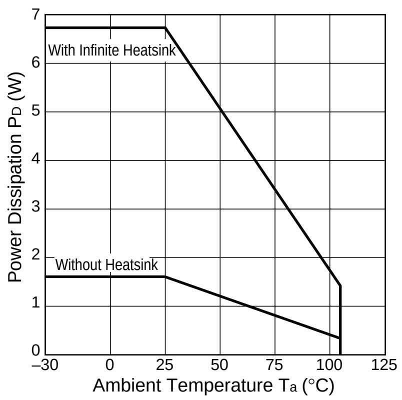


■Standard External Circuit



See P.98 "Output selection method" for details about connecting VOS2-1 and VOS2-2 of Channel 2.

■Ta-PD Characteristics



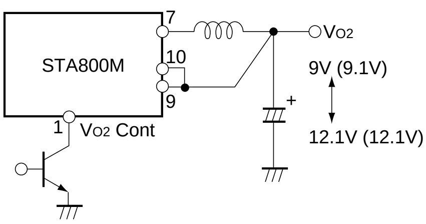
■Selecting External Components

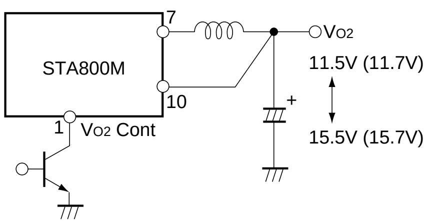
1. Inductors L_1 and L_2
   (1) Suitable for switching regulators
   Do not use a coil as a noise filter because it generates excess heat.
   (2) Appropriate inductance
   A low inductance may cause abnormal oscillation, or cause the overcurrent protection circuit to malfunction in the rated current range.
   (3) Satisfying the rated current
   Exceeding the rated current may generate an extremely high current to flow due to magnetic saturation.
2. Capacitors C_1, C_2, and C_3
   (1) Satisfy the breakdown voltage and allowable ripple current
   Exceeding the ratings of these capacitors or using them without derating may shorten their service lives and also cause abnormal oscillation.
   (2) Low impedance (C_2, and C_3)
   A low-impedance model is recommended for C_2 and C_3 to reduce the ripple voltage and stabilize switching. For stable operation throughout the input voltage range, however, the DC equivalent series resistance (ESR) of C_2 and C_3 should be 0.1 Ω or less.
3. Capacitors C_4 and C_5
   (1) C_4 and C_5 are soft-start capacitors.

■Selecting Ch2 Output Voltage

When the $V_{O2}C_{ont}$ terminal voltage is set to 0.5V or less, the output voltage changes to the values shown below. To switch the potential at the $V_{O2}C_{ont}$ terminal, drive the open collector of the transistor. No external voltage can be applied to the terminal. Leave the terminal open when not in use because the terminal is already pulled up in the IC. When using terminal no. 9, short it to terminal no. 10.

( ): STA802M





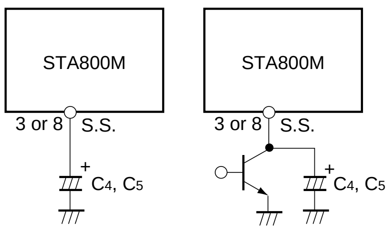
V_{O2} output voltage

V_{O2}Cont terminal (1 pin) / V_{O2} sensing terminal	STA801M		STA802M	
	OPEN	Low	OPEN	Low
9pin	9V	12.1V	9.1V	12.1V
10pin	11.5V	15.5V	11.7V	15.7V

Low : 0.5V or less

■Soft Start ON/OFF Circuit

Terminal nos. 3 and 8 are soft start terminals. Connect a capacitor to the terminal to permit a soft start. Output can be turned on and off by using the soft start terminals. Set the soft start terminal voltage to V_{SSL} (0.15V) or less to stop the output. To switch the potential at the soft start terminals, drive the open collector of the transistor. Since the discharge currents from C_4 and C_5 flow to the ON/OFF control transistor, limit the current for protection. The SS terminal is pulled up to the power supply in the IC and no external voltage can be applied to the terminal.



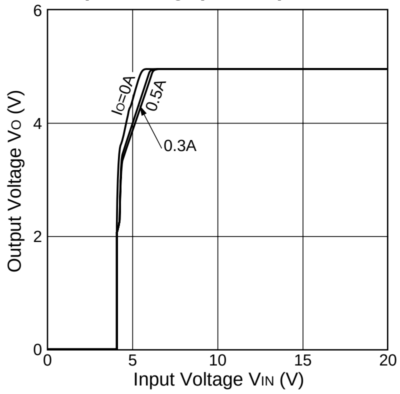
Soft start　　Soft start +V_O ON/OFF

■Typical Characteristics

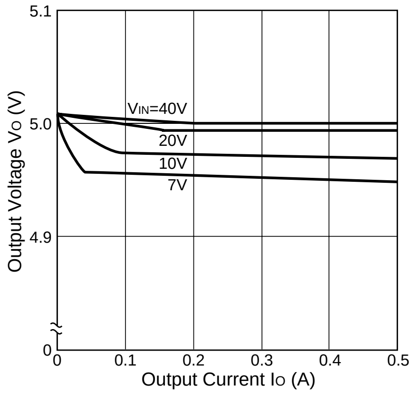
(T_a=25°C)

STA801M

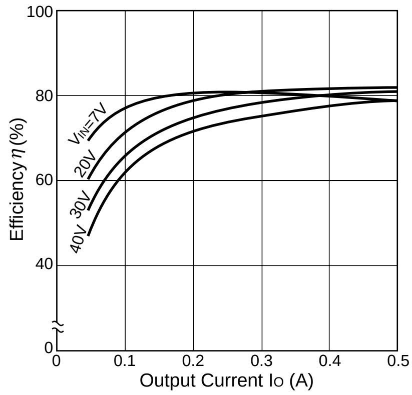
Output Voltage(Ch1:5V)



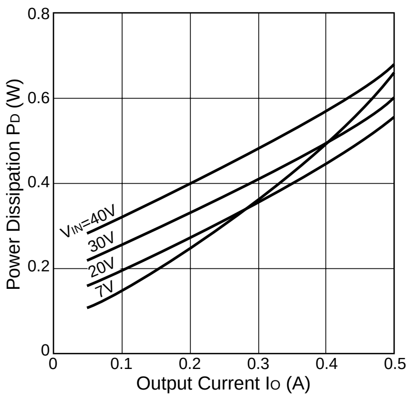
Load Regulation(Ch1:5V)



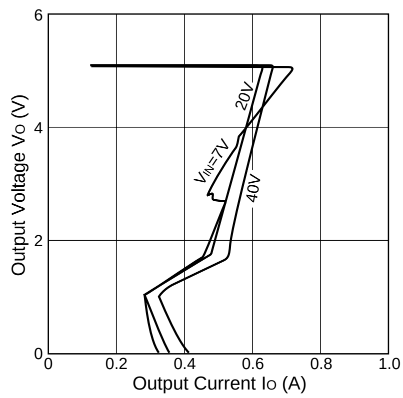
Efficiency Characteristics(Ch1:5V)



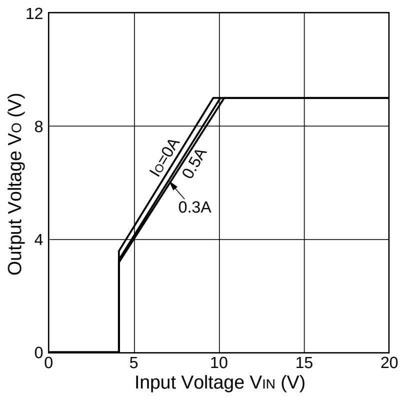
PD Characteristics(Ch1:5V)



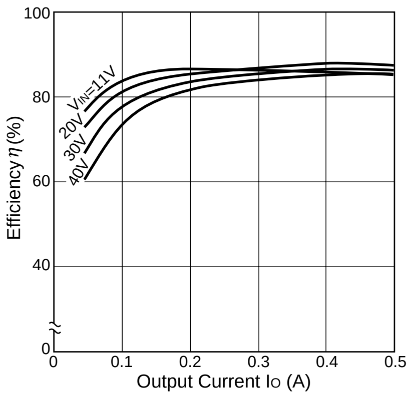
Overcurrent Protection Characteristics(Ch1:5V)



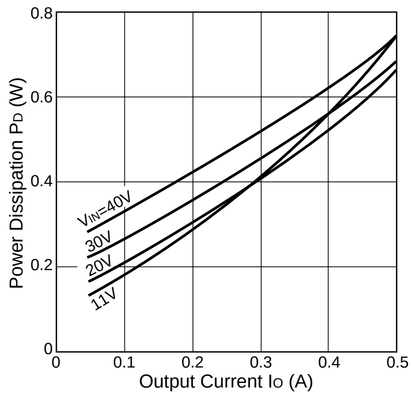
Output Voltage(Ch2:9V)



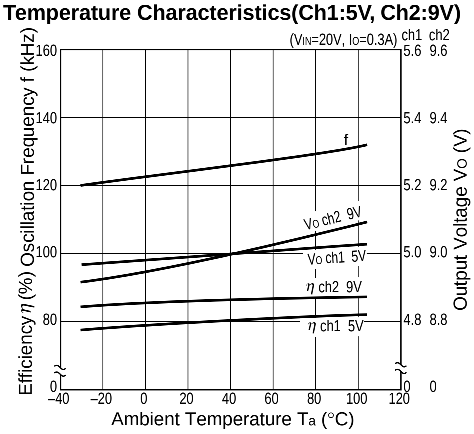
Efficiency Characteristics(Ch2:9V)



PD Characteristics(Ch2:9V)

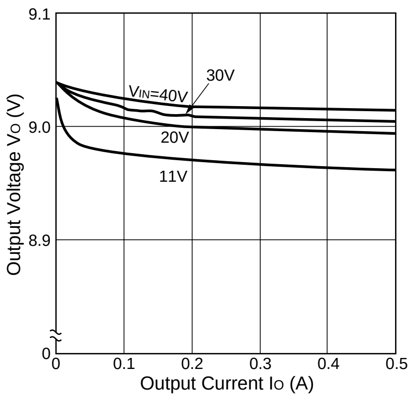


Temperature Characteristics(Ch1:5V, Ch2:9V)

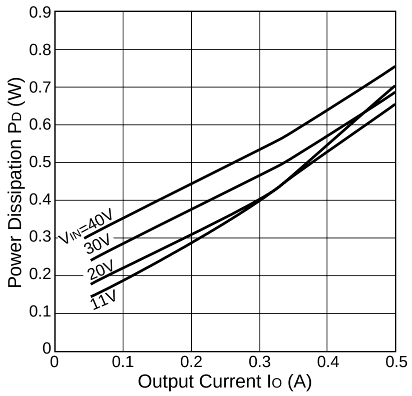


STA802M

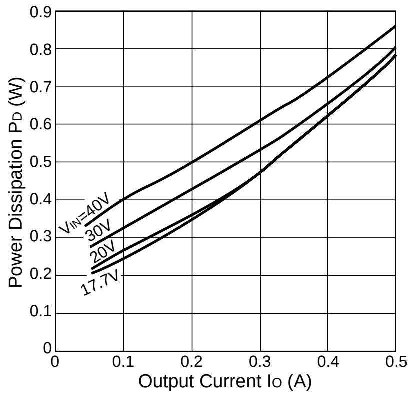
Load Regulation(Ch1:9V)



PD Characteristics(Ch1:9V)

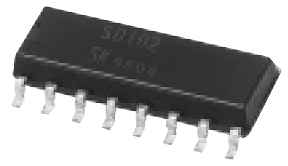


PD Characteristics(Ch2:15.7V)



SDI02

2-Output, Low Dropout Voltage Dropper Type for USB



■Features

- Two 5V/0.5A output regulators in one package
- Surface-mount 16 pin package
- Low dropout voltage: $V_{DIF} \leq 0.5V$ (at $I_O = 0.5A$)
- Output-independent ON/OFF control terminal compatible with LS-TTL (Active High)
- Built in output-independent overcurrent and thermal protection circuits
- Open collector flag-output terminals built in to output OCP operation to each output terminal (Active Low)
- Buitl-in anti-malfunction delay circuit whose time can be set with an external capacitor

■Applications

- USB power supplies
- Electronic equipment

■Absolute Maximum Ratings

(T_a=25°C)

Parameter	Symbol	Ratings	Unit
DC Input Voltage	V_{IN}	18	V
Voltage of Output Control Terminal	V_C	V_{IN}	V
DC Output Current	I_O	0.5	A
Power Dissipation	P_D	3.1*1	W
Junction Temperature	T_j	–30 to +125	°C
Ambient Operating Temperature	T_{OP}	–30 to +100	°C
Storage Temperature	T_{stg}	–30 to +125	°C
Thermal Junction (junction-to-ambient air)	$R_{th(j-a)\,1}$	42*2	°C/W
	$R_{th(j-a)\,2}$	32*1	°C/W
Thermal Junction (junction-to-lead)	$R_{th(j-l)\,1}$	11*3	°C/W
	$R_{th(j-l)\,1}$	14*4	°C/W

*1: With simultaneous operation of both two channels when mounted on glass-epoxy board 56.5mm x 56.5mm (copper foil area 50%).
*2: With operation of one channel when mounted on glass-epoxy board 56.5mm x 56.5mm (copper foil area 50%).
*3: Junction - to - pin 14 (CH1)
*4: Junction - to - pin 10 (CH2)

■Recommended Operating Control

(T_a=25°C)

Parameter	Symbol	Ratings	Unit
DC Input Voltage Range	V_{IN}	5.5*1 to 8.0	V
Output Current Range	I_O	0 to +0.5	A
Ambient Operating Temperature	T_{aop}	–10 to +85	°C
Junction Operating Temperature	T_{jop}	–10 to +100	°C

*1: $V_{IN(min)}$ must be no less than the sum of output voltage and dropout voltage.

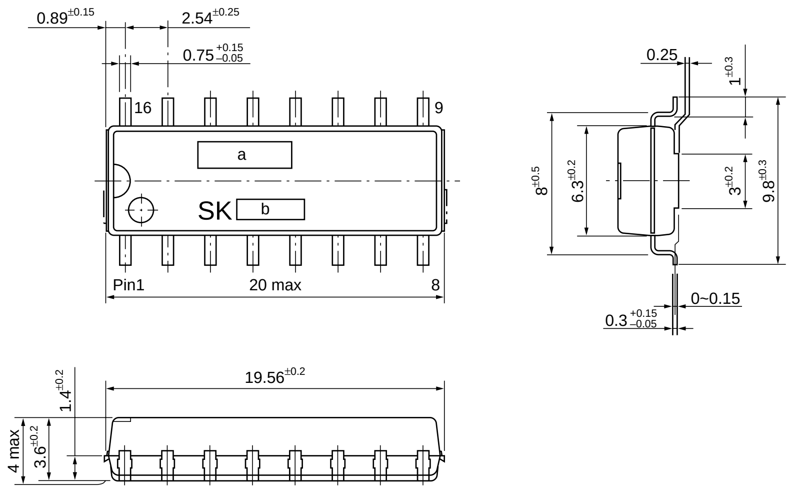
■Electrical Characteristics

(T_a=25°C unless otherwise specified)

Parameter		Symbol	Ratings			Unit
			min.	typ.	max.	
Output Voltage		V_O	4.85	5.00	5.15	V
		Conditions	V_{IN}=7V, I_O=0.1A			
Dropout Voltage		V_{DIF}			0.5	V
		Conditions	I_O≤0.5A			
Line Regulation		ΔV_{OLINE}			30	mV
		Conditions	V_{IN}=6 to 15V, I_O=0.1A			
Load Regulation		ΔV_{OLOAD}			50	mV
		Conditions	V_{IN}=7V, I_O=0 to 0.5A			
Temperature Coefficient of Output Voltage		$\Delta V_O/\Delta T_a$		±0.5		mV/°C
		Conditions	V_{IN}=7V, I_O=5mA, T_j=–10 to 100°C			
Quiescent Circuit Current		I_q			12*1	mA
		Conditions	V_{IN}=7V, I_O=0A			
Quiescent Circuit Current (Output OFF)		$I_{q\ (off)}$			0.25 *1	mA
		Conditions	V_{IN}=7V, V_C1 and 2=0V			
Overcurrent Protection Starting Current*1		I_{S1}	0.75		0.96	A
		Conditions	V_{IN}=7V			
V_C Terminal*3	Control Voltage (Output ON)	$V_{C,\ IH}$	2.0			V
	Control Voltage (Output OFF)	$V_{C,\ IL}$			0.7	
	Control Current (Output ON)	$I_{C,\ IH}$			50	μA
		Conditions	V_C=2.7V			
	Control Current (Output OFF)	$I_{C,\ IL}$			–100	μA
		Conditions	V_C=0V			
OCP Detection		V_{oth}	3.7	4.0	4.3	V
Delay Threshold Voltage		V_{DLYth}	2.1	2.3	2.5	V
Delay Terminal Output Curret		I_{DLY}	35	50	65	μA
Flag Output Terminal	Before OCP Detection	V_{FLGh}	V_{IN}–0.4			V
		Conditions	R_{FLG} connected between FLG and V_{IN}			
	After OCP Detection	V_{FLGl}			0.5	V
		Conditions	I_{FLG}=1mA			
FLG Reset Time *4		t_{Reset}		1.2		μS

*1: Total of two circuits
*2: I_{S1} is specified at –5 (%) drop point of output voltage V_O on the condition that V_{IN}=7V, I_O=0.1A.
*3: Output is ON even when output control terminal V_C is open. Each input level is equivalent to LS-TTL.
Therefore, it may be directly driven by an LS-TTL circuit.
*4: Refer to timing chart on p.103

■External Dimensions



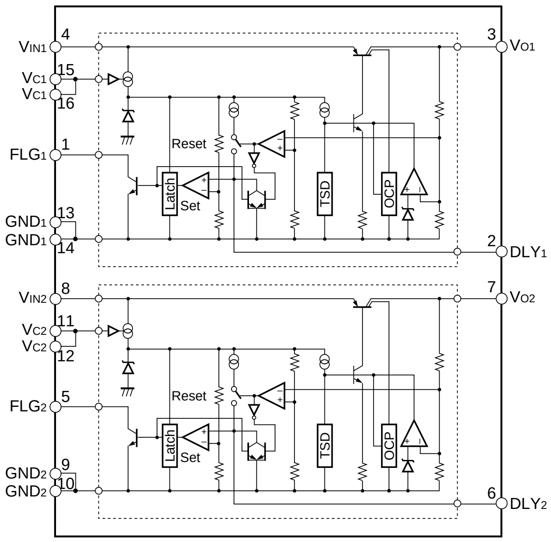
a. Part Number
b. Lot Number

Pin Arrangement

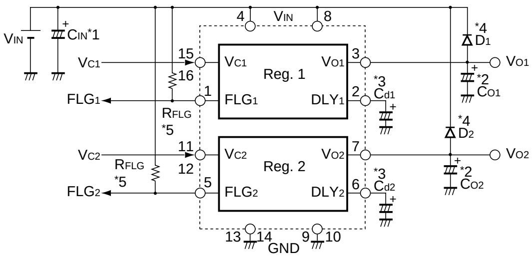
①	FLG1	⑨	GND2
②	DLY1	⑩	GND2
③	VO1	⑪	VC2
④	VIN1	⑫	VC2
⑤	FLG2	⑬	GND1
⑥	DLY2	⑭	GND1
⑦	VO2	⑮	VC1
⑧	VIN2	⑯	VC1

Plastic Mold Package Type
Flammability: UL94V-0
Weight: Approx. 1.05g

■Block Diagram



■Standard External Circuit

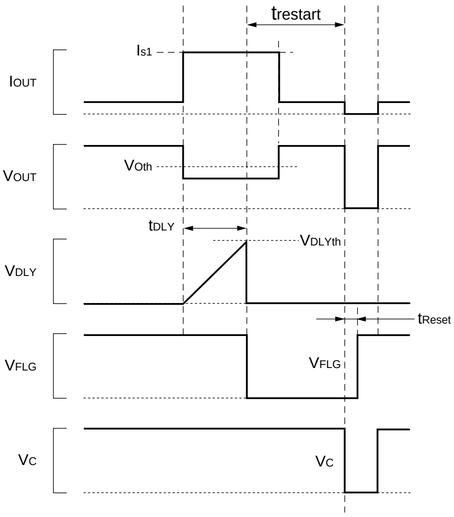


*1 C_{IN} : Input capacitor (Approx. 47µF)
This capacitor is required if the input line is inductive and in the case of long wiring.

*2 C_O : Output capacitor (47 to 220µF)
When used at low temperature (–10° or less), set to 100µF or more or use tantalum capacitor.

*3 C_d : Delay time setting capacitor (0.1µF or more)
Use C_d to set the delay time (t_{DLY}) from when a low V_O level due to OCP operation is detected until a flag signal is output.
This prevents a rush current from causing malfunction at start.
Approximate calculation: $t_{DLY} \fallingdotseq (C_d \times V_{DLYth})/I_{DLY}$[sec]
When using soft start on V_{IN} or if C_{IN} has a large capacitance, set t_{DLY} long enough for the output voltage to rise sufficiently.
Be sure to connect C_d and do not use it for other applications, such as short circuiting C_d.

Timing chart



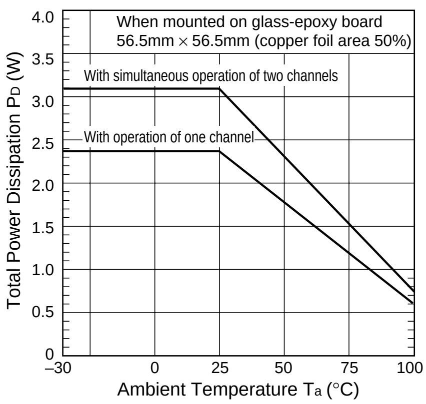
R_{FLG} connected between FLG and V_{IN}

FLG output operates after the time tDLY has elapsed (the time set by DLY) after OCP is detected, and is latched. The latch can be reset by making V_C or V_{IN} low. Allow a time lag of C_d x 600 [sec] or more between setting and restarting.

*4 D1, 2 : Reverse biasing protection diode.
This diode is required for protection against reverse biasing of the input and output.

*5 R_{FLG} : Set this to limit the inflow current into the FLG terminal to 1mA or less.

■T_a-P_D Characteristics

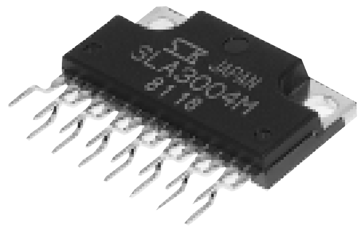


SLA3001M/3002M/3004M

3-Output Dropper/Switching Type

■Features

- 3 regulator ICs combined in 1 package
- Insulated single inline package
- Can be used with dropper type and switching type
- 3 independent circuits for input and output respectively. Internal dissipation can be reduced since different input voltages can be applied.
- Dropper type regulator IC is low-dropout voltage type with input/output voltage difference of 1V. Output ON/OFF control, variable output voltage (rise only) function
- Switching type: built-in separate excitation (60kHz), high efficiency of 80% or over
- Each regulator has overcurrent protection and thermal protection circuit.



■Applications

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

■Lineup

Part Number	SLA3001M			SLA3002M			SLA3004M		
	Type	V_O(V)	I_O(A)	Type	V_O (V)	I_O(A)	Type	V_O (V)	I_O (A)
Regulator 1	Dropper	12	1.5	Switching	5	0.5	Switching	5	0.5
Regulator 2	Dropper	5	1.5	Dropper	15.7	1.0	Switching	9	0.4
Regulator 3	Dropper	9	1.5	Switching	9	0.4	Switching	9	0.4

■Absolute Maximum Ratings

Parameter	Symbol	Ratings									Unit
		SLA3001M			SLA3002M			SLA3004M			
		Reg1	Reg2	Reg3	Reg1	Reg2	Reg3	Reg1	Reg2	Reg3	
DC Input Voltage	V_{IN}	35			35			35			V
Voltage of Output Control Terminal	V_C	V_{IN}			—	V_{IN}	—	—			V
SW Terminal Applied Reverse Voltage	V_{SW}	—			–1	—	–1	–1			V
Power Dissipation	P_D	40(T_C=25°C)			37.5(T_C=25°C)			37.5(T_C=25°C)			W
Junction Temperature	T_j	+125			+150			+150			°C
Storage Temperature	T_{stg}	–40 to +125			–40 to +150			–40 to +150			°C
Ambient Operating Temperature	T_{op}	–30 to +85			–30 to +85			–30 to +85			°C
Thermal Resistance(junction-to-case)	$R_{th(j-c)}$	7			10			10			°C/W

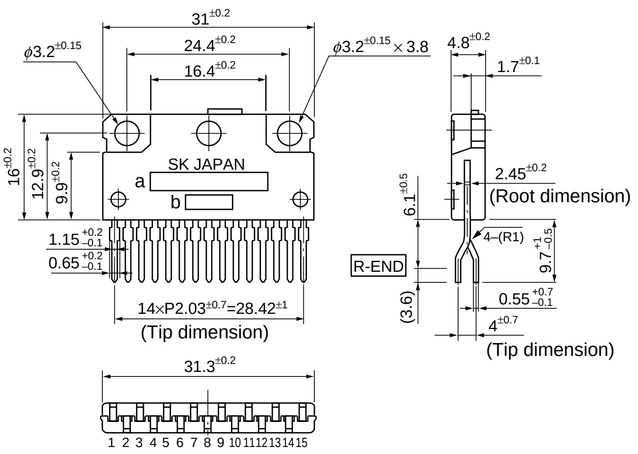
■Electrical Characteristics

(T_a=25°C unless otherwise specified)

	Parameter	Symbol	Ratings									Unit
			SLA3001M			SLA3002M			SLA3004M			
			min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	
Regulator 1	Recommended DC Input Voltage	$V_{IN}1$	13		25	7		33	7		33	V
	Output Voltage	V_O1	11.52	12.00	12.48	4.75	5.00	5.25	4.75	5.00	5.25	V
		Conditions	V_{IN}=15V, I_O=1.0A			V_{IN}=20V, I_O=0.3A			V_{IN}=20V, I_O=0.3A			
	Dropout Voltage	$V_{DIF}1$			1.0		—			—		V
		Conditions	I_O=1.5A				—			—		
	Efficiency	$\eta 1$		—			80			80		%
		Conditions		—		V_{IN}=20V, I_O=0.3A			V_{IN}=20V, I_O=0.3A			
	Line Regulation	ΔV_{OLINE1}		24	64		80	100		80	110	mV
		Conditions	V_{IN}=13 to 25V, I_O=1.0A			V_{IN}=10 to 30V, I_O=0.3A			V_{IN}=10 to 30V, I_O=0.3A			
	Load Regulation	ΔV_{OLOAD1}		93	240		30	40		30	40	mV
		Conditions	V_{IN}=15V, I_O=0 to 1.5A			V_{IN}=20V, I_O=0.1 to 0.4A			V_{IN}=20V, I_O=0.1 to 0.4A			
	Switching Frequency	f1		—			60			60		kHz
		Conditions		—		V_{IN}=20V, I_O=0.3A			V_{IN}=20V, I_O=0.3A			
	Overcurrent Protection Starting Current*1	I_{S1}, 1	1.6			0.55			0.55			A
		Conditions	V_{IN}=15V			V_{IN}=10V			V_{IN}=10V			
	V_C Terminal*2 Control Voltage (Output ON)	V_{CIH}, 1	2.0				—			—		V
	V_C Terminal*2 Control Voltage (Output OFF)	V_{CIL}, 1			0.8		—			—		V
Regulator 2	Recommended DC Input Voltage	$V_{IN}2$	6		15	17		30	12		33	V
	Output Voltage	V_O2	4.85	5.00	5.15	14.92	15.70	16.48	8.55	9.00	9.45	V
		Conditions	V_{IN}=8V, I_O=1.0A			V_{IN}=19V, I_O=0.5A			V_{IN}=21V, I_O=0.3A			
	Dropout Voltage	$V_{DIF}2$			1.0			1.0		—		V
		Conditions	I_O=1.5A			I_O=1.0A				—		
	Efficiency	$\eta 2$		—			—			85		%
		Conditions		—			—		V_{IN}=21V, I_O=0.3A			
	Line Regulation	ΔV_{OLINE2}		10	30		30	90		90	110	mV
		Conditions	V_{IN}=6 to 15V, I_O=1.0A			V_{IN}=17 to 25V, I_O=0.5A			V_{IN}=14 to 30V, I_O=0.3A			
	Load Regulation	ΔV_{OLOAD2}		40	100		120	300		50	80	mV
		Conditions	V_{IN}=8V, I_O=0 to 1.5A			V_{IN}=19V, I_O=0 to 0.1A			V_{IN}=21V, I_O=0.1 to 0.4A			
	Switching Frequency	f2		—			—			60		kHz
		Conditions		—			—		V_{IN}=21V, I_O=0.3A			
	Overcurrent Protection Starting Current*1	I_{S1}, 2	1.6			1.2			0.45			A
		Conditions	V_{IN}=8V			V_{IN}=19V			V_{IN}=14V			
	V_C Terminal*2 Control Voltage (Output ON)	V_{CIH}, 2	2.0			2.0				—		V
	V_C Terminal*2 Control Voltage (Output OFF)	V_{CIL}, 2			0.8			0.8		—		V
Regulator 3	Recommended DC Input Voltage	$V_{IN}3$	10		20	12		33	12		33	V
	Output Voltage	V_O3	8.64	9.00	9.36	8.55	9.00	9.45	8.64	9.00	9.36	V
		Conditions	V_{IN}=12V, I_O=1.0A			V_{IN}=21V, I_O=0.3A			V_{IN}=21V, I_O=0.3A			
	Dropout Voltage	$V_{DIF}3$			1.0		—			—		V
		Conditions	I_O=1.5A				—			—		
	Efficiency	$\eta 3$		—			85			85		%
		Conditions		—		V_{IN}=21V, I_O=0.3A			V_{IN}=21V, I_O=0.3A			
	Line Regulation	ΔV_{OLINE3}		18	48		90	110		90	110	mV
		Conditions	V_{IN}=10 to 20V, I_O=1.0A			V_{IN}=14 to 30V, I_O=0.3A			V_{IN}=14 to 30V, I_O=0.3A			
	Load Regulation	ΔV_{OLOAD3}		70	180		50	80		50	80	mV
		Conditions	V_{IN}=15V, I_O=0 to 1.5A			V_{IN}=21V, I_O=0.1 to 0.4A			V_{IN}=21V, I_O=0.1 to 0.4A			
	Switching Frequency	f3		—			60			60		kHz
		Conditions		—		V_{IN}=21V, I_O=0.3A			V_{IN}=21V, I_O=0.3A			
	Overcurrent Protection Starting Current*1	I_{S1}, 3	1.6			0.45			0.45			A
		Conditions	V_{IN}=12V			V_{IN}=14V			V_{IN}=14V			
	V_C Terminal*2 Control Voltage (Output ON)	V_{CIH}, 3	2.0				—			—		V
	V_C Terminal*2 Control Voltage (Output OFF)	V_{CIL}, 3			0.8		—			—		V

*1: I_{S1} of Dropper Type is specified at –5(%) drop point of output voltage V_O. I_{S1} of Switching Type is specified at –10(%) drop point of output voltage V_O.
*2: Output is ON when V_C terminal is open.

■External Dimensions



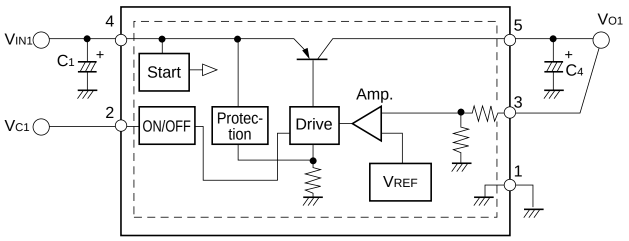
a. Part Number
b. Lot Number

Plastic Mold Package
Flammability: UL94V-0
Weight: Approx. 6g

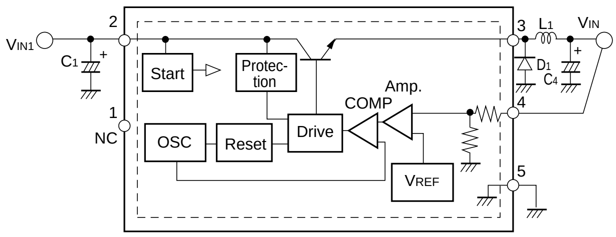
Forming No. LF861

■Block Diagram

One Dropper Type Circuit



One Switching Type Circuit

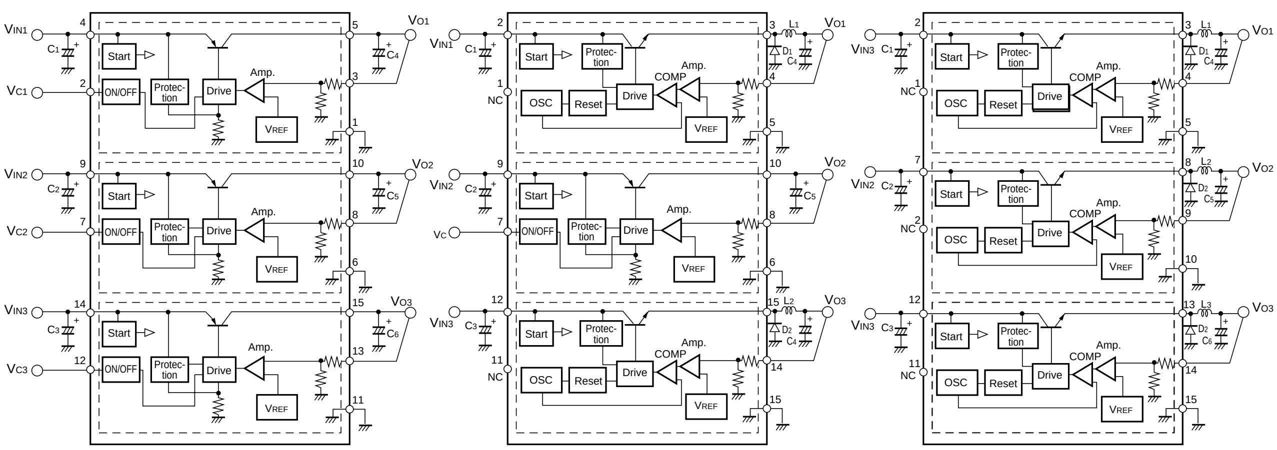


■Standard External Circuit

SLA3001M

SLA3002M

SLA3004M



■Selecting External components for dropper type regulator

Input capacitor (Approx. 47µF)

Output capacitor (Approx. 47 to 100µF)

●Low ESR capacitors are recommended for input and output when using them in low temperature conditions (0°C or less)

■Selecting External components for switching type regulator

Input capacitor (Approx. 100µF)

Output smoothing capacitor (Approx. 330µF)

●Input capacitor and output capacitor must satisfy allowable ripple current.

●Low ESR capacitors are recommended for reducing output ripple voltage.

●Low ESR capacitors are recommended for input and output when using them in low temperature conditions (0°C or less)

Choke coil (200µH when V_O is 3.3V or 5V, 300µH when V_O is other)

●When its winding resistance is high, its efficiency may decrease and the rated value may not be achieved.

●Pay attention to heat from the choke coil due to magnetic saturation caused by overload, short circuit of load, etc. because the overcurrent protection starting current is approx. 1A.

Flywheel diode (Sanken AK04 recommended)

●Use a Schottky barrier diode for D_1, D_2 and D_3 and make sure that the reverse voltage applied to SW output terminal does not exceed the value (–1V) given in the maximum ratings.

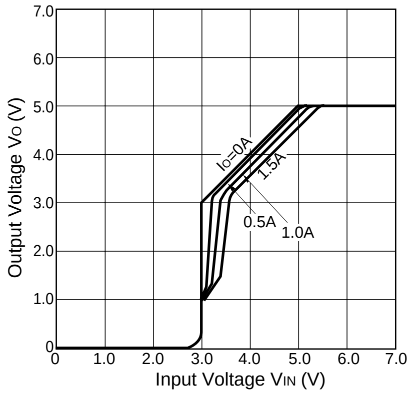
●If you use a fast recovery diode or any other diode, application of a reverse voltage generated from the recovery or ON voltage of the diode may damage the IC.

■Typical Characteristics

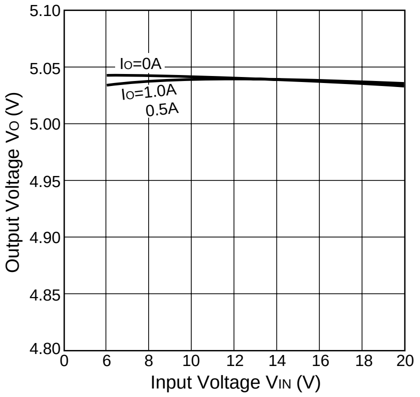
(T_a=25°C)

SLA3001M (Regulator 2, V_O=5V)

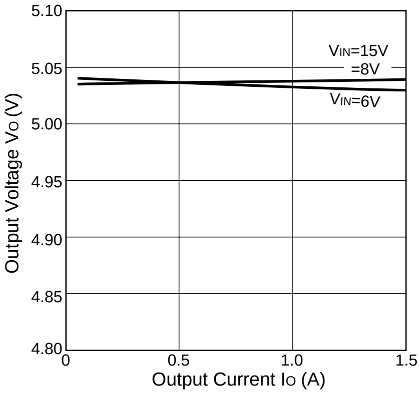
Output Voltage



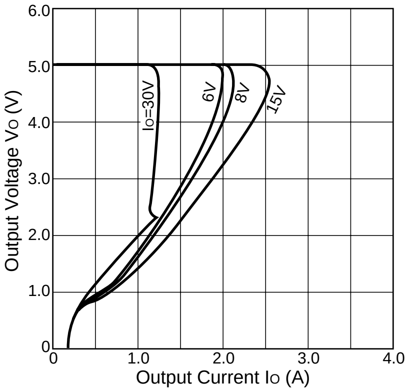
Line Regulation



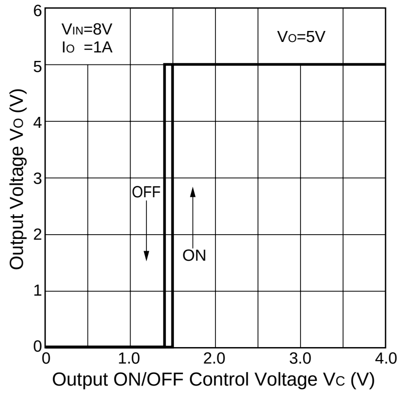
Load Regulation



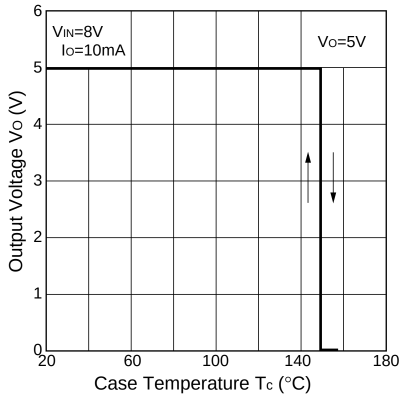
Overcurrent Protection Characteristics



ON/OFF Control Characteristics



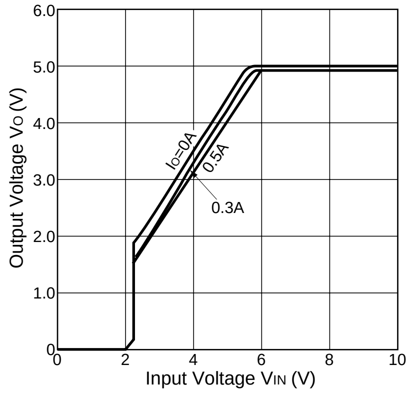
Thermal Protection Characteristics



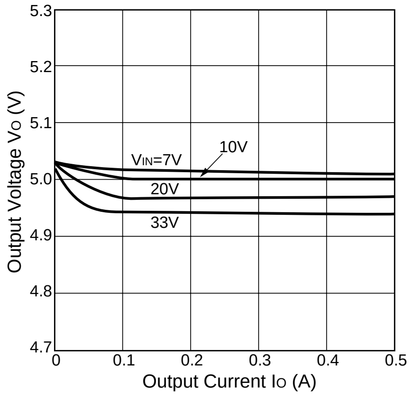
Note on Thermal Protection:
The thermal protection circuit is intended for protection against heat during instantaneous short-circuiting. Its operation is not guaranteed for continuous heating condition such as short-circuiting over extended periods of time.

SLA3002M/SLA3004M(Regulator 1, V_O=5V)

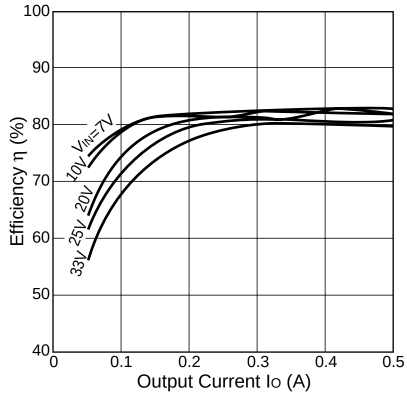
Output Voltage



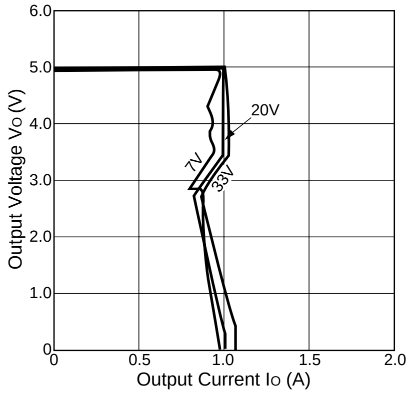
Load Regulation



Efficiency Characteristics



Overcurrent Protection Characteristics

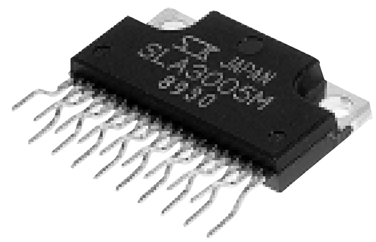


SLA3005M/3006M/3007M

4-Output, Low Dropout Voltage Dropper Type for USB Hub

■Features

- 4 regulators combined in one package
- Insulated single inline package
- SLA 3005M/3006M have four 5V/0.5A outputs. SLA3007M has three 5V/0.5A outputs and ch4 is a 3.3V/0.5A otuput for USB-IC
- Low dropout voltage: V_{DIF}≤0.5V (at I_O=0.5A)
- Output-independent ON/OFF control terminal compatible with LS-TTL (Active High)
- Output-independent overcurrent and thermal protection circuits built in
- Open collector flag-output terminals built in to output OCP operation to each output terminal (Active Low) ···· excluding SLA3007Mch4
- SLA3005M/3007M (excluding ch4) for V_O shutdown after OCP operation and SLA3006M for continuous OCP operation
- Built-in anti-malfunction delay circuit whose time can be set with an external capacitor



■Applications

- USB hub power supplies
- Electronic equipment

■Absolute Maximum Ratings

(T_a=25°C)

Parameter	Symbol	Ratings		Unit
		SLA3005M/3006M	SLA3007M	
DC Input Voltage	V_{IN}	20	18	V
Voltage of Output Control Terminal	V_C	V_{IN}		V
DC Output Current	I_O	0.5		A
Power Dissipation	P_{D1}	30(With infinite heatsink)		W
	P_{D2}	3.36(Without heatsink, stand-alone operation)		W
Junction Temperature	T_j	–30 to +125		°C
Ambient Operating Temperature	T_{OP}	–30 to +100		°C
Storage Temperature	T_{stg}	–30 to +125		°C
Thermal Resistance (junction-to-case)	$R_{t(j-c)}$	9.0		°C/W
Thermal Resistance (junction-to-ambient air)	$R_{th(j-a)}$	29.8(Without heatsink, stand-alone operation)		°C/W

■Recommended Operating Conditions

Parameter	Symbol	Ratings	Unit
DC Input Voltage Range	V_{IN}	5.5 to 10	V
Output Current Range	I_O	0 to 0.5	A
Operating Junction Temperature Range	T_{jop}	–20 to +100	°C
Ambient Operating Temperature Range	T_{aop}	–20 to +85	°C

■Electrical Characteristics

(T_a=25°C unless otherwise specified)

Parameter		SYmbol	SLA3005M min.	SLA3005M typ.	SLA3005M max.	SLA3006M min.	SLA3006M typ.	SLA3006M max.	SLA3007M ch1, 2, 3 min.	SLA3007M ch1, 2, 3 typ.	SLA3007M ch1, 2, 3 max.	SLA3007M ch4 min.	SLA3007M ch4 typ.	SLA3007M ch4 max.	Unit
Output Voltage		V_O	4.85	5.00	5.15	4.85	5.00	5.15	4.85	5.00	5.15	3.234	3.300	3.366	V
		Conditions	V_{IN}=7V, I_O=0.1A			V_{IN}=7V, I_O=0.1A			V_{IN}=7V, I_O=0.1A			V_{IN}=7V, I_O=0.1A			
Dropout Voltage		V_{DIF}			0.5			0.5			0.5			2.0	V
		Conditions	I_O≤0.5A			I_O≤0.5A			I_O≤0.5A			I_O≤0.5A			
Line Regulation		ΔV_{OLINE}			30			30			30			30	mV
		Conditions	V_{IN}=6 to 15V, I_O=0.1A			V_{IN}=6 to 15V, I_O=0.1A			V_{IN}=6 to 15V, I_O=0.1A			V_{IN}=6 to 15V, I_O=0.1A			
Load Regulation		ΔV_{OLOAD}			50			50			50			30	mV
		Conditions	V_{IN}=7V, I_O=0 to 0.5A			V_{IN}=7V, I_O=0 to 0.5A			V_{IN}=7V, I_O=0 to 0.5A			V_{IN}=7V, I_O=0 to 0.2A			
Temperature Coefficient of Output Voltage		$\Delta V_O/\Delta T_a$		±0.5			±0.5			±0.5			±0.3		mV/°C
		Conditions	V_{IN}=7V, I_O=5mA, T_j=–10 to 100°C			V_{IN}=7V, I_O=5mA, T_j=–10 to 100°C			V_{IN}=7V, I_O=5mA, T_j=–10 to 100°C			V_{IN}=7V, I_O=5mA, T_j=–10 to 100°C			
Quiescent Circuit Current*3		I_q			20			20			20	–			mA
		Conditions	V_{IN}=7V, I_O=0A			V_{IN}=7V, I_O=0A			V_{IN}=7V, I_O=0A						
Quiescent Circuit Current (Output OFF)*3		$I_{q(off)}$			0.5			0.5			0.5	–			mA
		Conditions	V_{IN}=7V, V_C1 to 4=0V			V_{IN}=7V, V_C1 to 4=0V			V_{IN}=7V, V_C1 to 4=0V						
Overcurrent Protection Starting Current*1		I_{S1}	0.55		0.65	0.75		0.96	0.55		0.65	0.55		0.65	A
		Conditions	V_{IN}=7V			V_{IN}=7V			V_{IN}=7V			V_{IN}=7V			
V_C Terminal*2	Control Voltage (Output ON)	$V_{C.IH}$	2.0			2.0			2.0			2.0			V
	Control Voltage (Output OFF)	$V_{C.IL}$			0.7			0.7			0.7			0.7	V
	Control Current (Output ON)	$I_{C.IH}$			50			50			50			50	µA
		Conditions	V_C=2.7V			V_C=2.7V			V_C=2.7V			V_C=2.7V			
	Control Current (Output OFF)	$I_{C.IL}$			–100			–100			–100			–100	µA
		Conditions	V_C=0V			V_C=0V			V_C=0V			V_C=0V			
OCP Detection Voltage Level		V_{oth}	3.7	4.0	4.3	3.7	4.0	4.3	3.7	4.0	4.3	–			V
Delay Threshold Voltage		V_{DLYth}	2.1	2.3	2.5	2.1	2.3	2.5	2.1	2.3	2.5	–			V
Delay Terminal Output Current		I_{DLY}	35	50	65	35	50	65	35	50	65	–			µA
Flag Output Terminal	Before OCP Detection	V_{FLGh}	V_{IN}–0.4			V_{IN}–0.4			V_{IN}–0.4			–			V
		Conditions	R_{FLG} connected between FLG and V_{IN}			R_{FLG} connected between FLG and V_{IN}			R_{FLG} connected between FLG and V_{IN}						
	After OCP Detection	V_{FLGl}			0.5			0.5			0.5	–			V
		Conditions	I_{FLG}=1mA			I_{FLG}=1mA			I_{FLG}=1mA						

*1 I_{S1} is specified at –5(%) drop point of output voltage V_O on the condition that V_{IN} = 7V, I_O = 0.1A.

*2 Output is ON even when output control terminal V_C is open. Each input level is equivalent to LS-TTL. Therefore, it may be directly driven by an LS-TTL circuit.

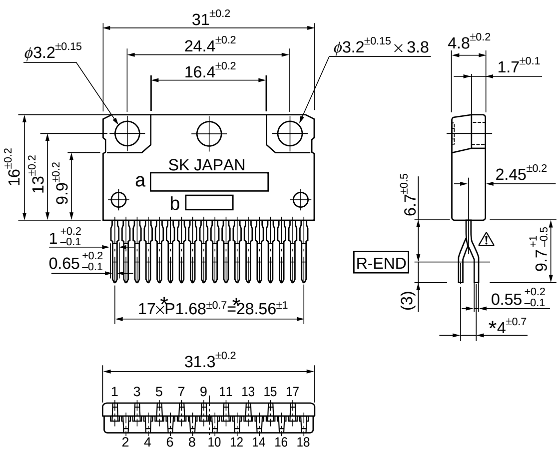
*3 Total of four circuits

* The FLG output latched by delay DLY after OCP detection. (SLA3005M/SLA3007M (ch1 to 3) shuts down the output voltage simultaneously at latching.) Set the V_{IN} or V_C to low to reset latching. Leave a time lag of $C_d \times$ 600s or more before restart.

** SLA3007Mch4 does not have the FLG output function.

■External Dimensions

(unit:mm)



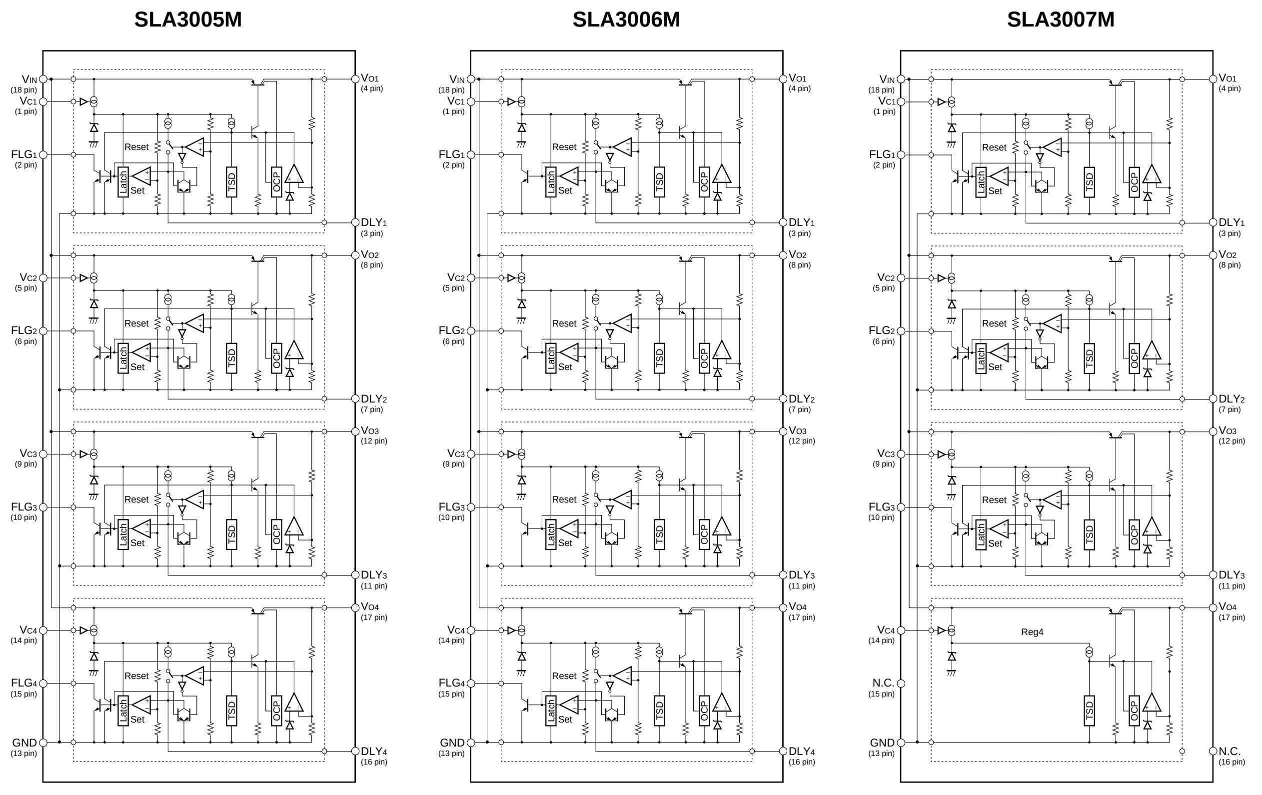
a. Part Number
b. Lot Number

Pin Arrangement

① V_{C1}	⑩ FLG3
② FLG1	⑪ DLY3
③ DLY1	⑫ V_{O3}
④ V_{O1}	⑬ GND
⑤ V_{C2}	⑭ V_{C4}
⑥ FLG2	⑮ FLG4 (SLA3007M: NC)
⑦ DLY2	⑯ DLY4 (SLA3007M: NC)
⑧ V_{O2}	⑰ V_{O4}
⑨ V_{C3}	⑱ V_{IN}

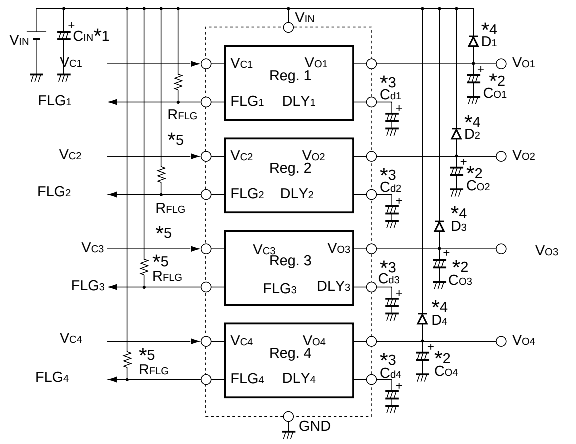
Plastic Mold Package Type
Flammability: UL94V-0
Weight: Approx. 6g

■Block Diagram

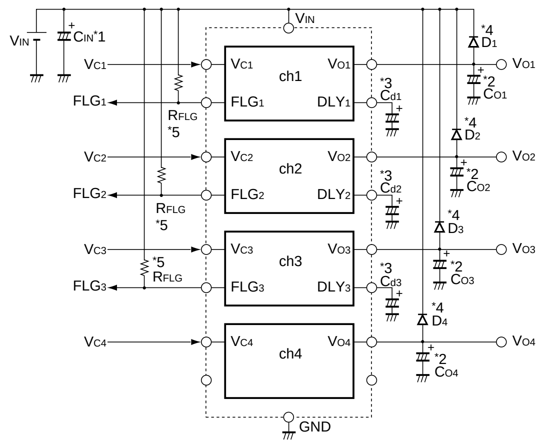


■Standard External Circuit

SLA3005M/3006M



SLA3007M



*1 C_{IN} : Input capacitor (Approx. 47µF)
This capacitor is required if the input line is inductive and in the case of long wiring.

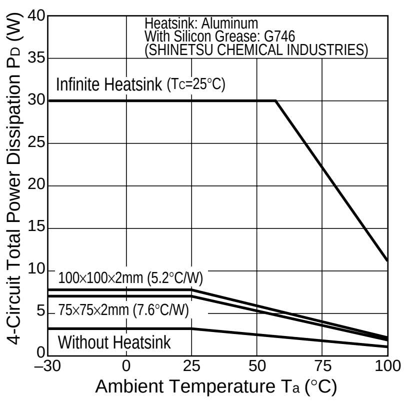
*2 C_O : Output capacitor (47 to 220µF)

*3 C_d : Delay time setting capacitor (0.1µF or more)
Use C_d to set the delay time (t_{DLY}) from when a low V_O level due to OCP operation is detected until a flag signal is output.
This prevents a rush current from causing malfunction at start.
Approximate calculation: $t_{DLY} \fallingdotseq (C_d \times V_{DLYth})/I_{DLY}$[sec]
When using soft start on V_{IN} or if C_{IN} has a large capacitance, set t_{DLY} long enough for the output voltage to rise sufficiently
Be sure to connect Cd and do not use it for other applications, such as short circuiting Cd.

*4 D_1 to D_4 : Reverse biasing protection diode
This diode is required for protection against reverse biasing of the input and output.

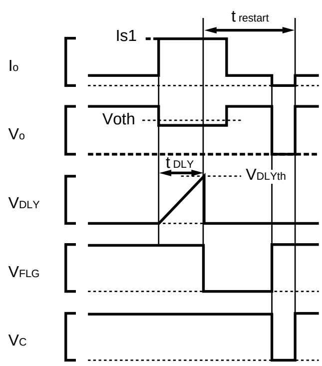
*5 R_{FLG} : Set this to limit the inflow current into the FLG terminal to 1mA or less.

■T_a-P_D Characteristics

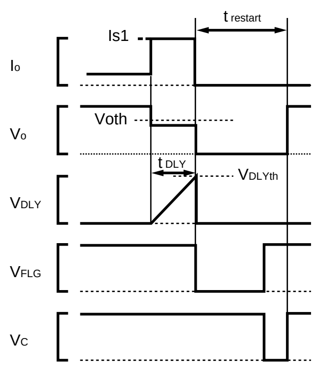


■Timing Chart

SLA3006M



SLA3005M/SLA3007M (excluding ch4)



■Calculating the Internal Dissipation

P_D is calculated as follows:

$P_D=[I_{O1}\bullet(V_{IN}-V_{O1})]+[I_{O2}\bullet(V_{IN}-V_{O2})]+[I_{O3}\bullet(V_{IN}-V_{O3})]+[I_{O4}\bullet(V_{IN}-V_{O4})]+V_{IN}\bullet IG$

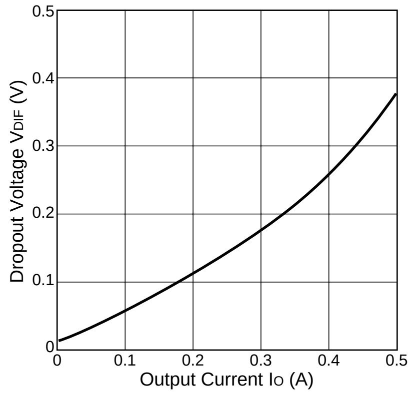
■Estimating Tj by Temperature Measurement

1. Measuring position: At the root of pin 13
2. Add the thermal resistance "θj-L" between the junction and pin 13 and the Pd product of each channel to the measured temperature.
   θj-L is as follows : θj-L1:8°C/W, θj-L2:7°C/W, θj-L3:5°C/W, θj-L4:8°C/W
   The calculation formula is as follows :Tj=θj-L1•Pd1+θj-L2•Pd2+θj-L3•Pd3+θj-L4•Pd4+T13pin

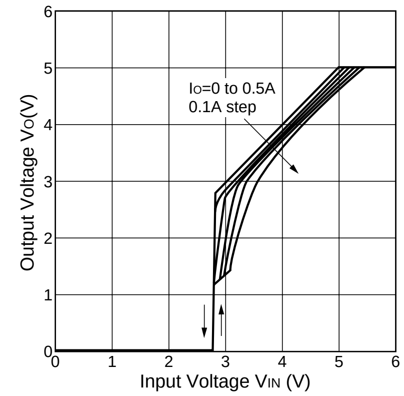
■Typical Characteristics SLA3005M

(T_a=25°C)

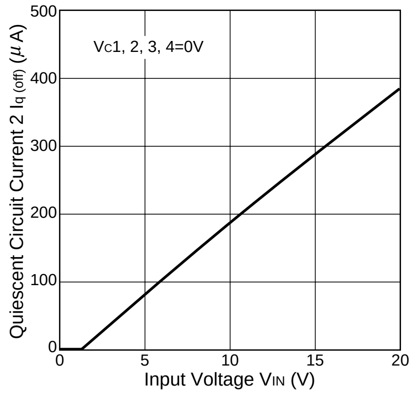
Io vs. VDIF Characteristics



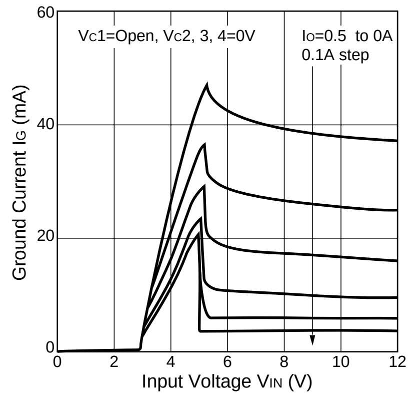
Output Voltage



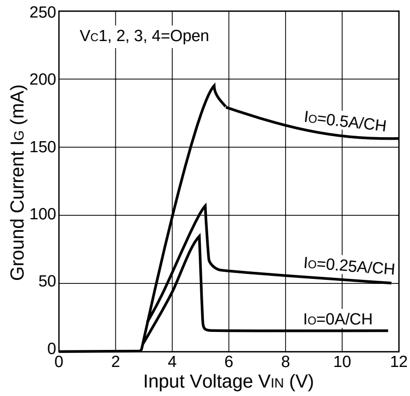
Quiescent Circuit Current



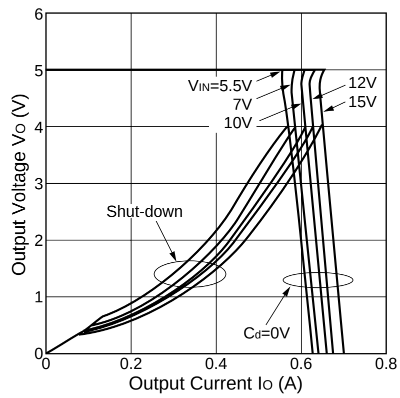
Circuit Current 1-Circuit



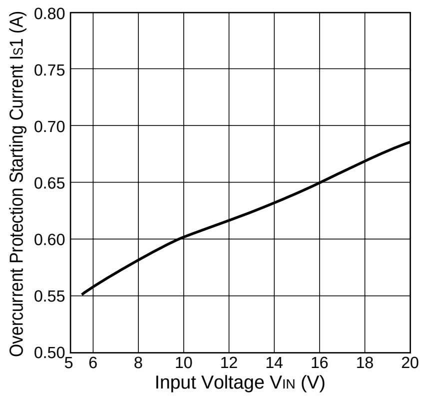
Circuit Current 4-Circuits



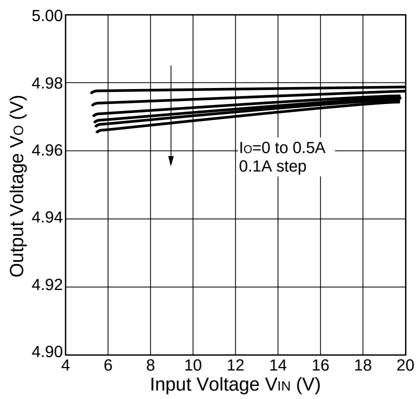
Overcurrent Protection Characteristics



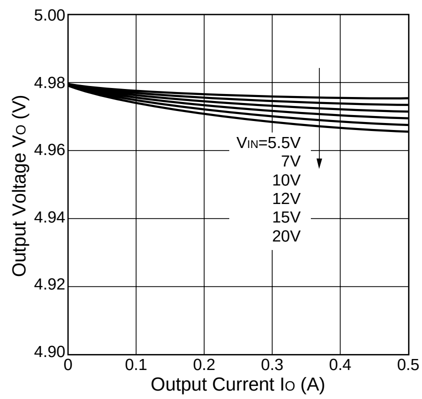
VIN vs. Is1 Characteristics



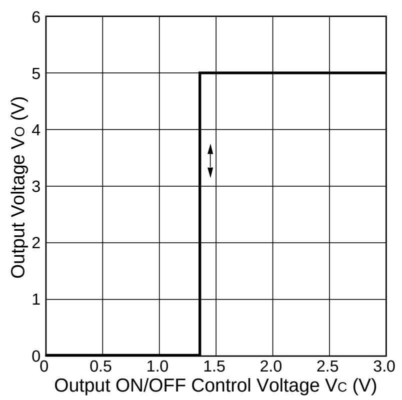
Line Regulation



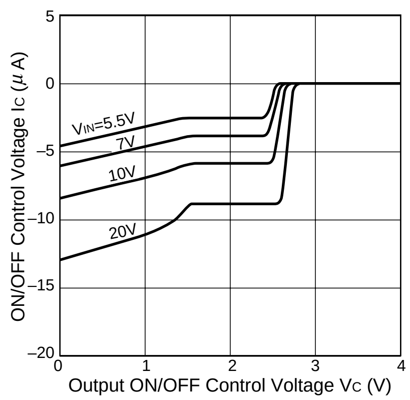
Load Regulation



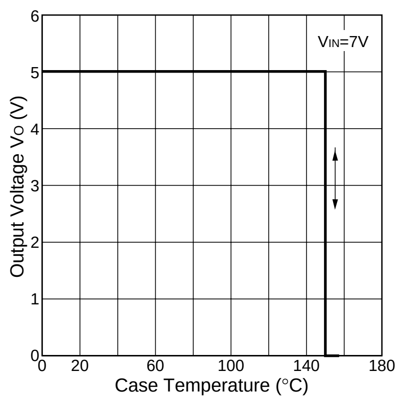
ON/OFF Control Characteristics



Vc Terminal Characteristics



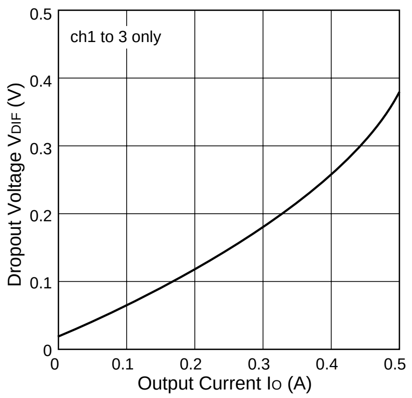
Thermal Protection Characteristics



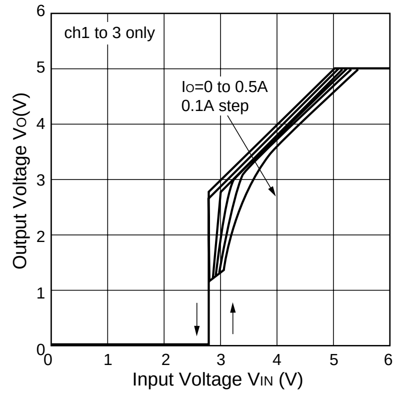
■Typical Characteristics SLA3007M

(T_a=25°C)

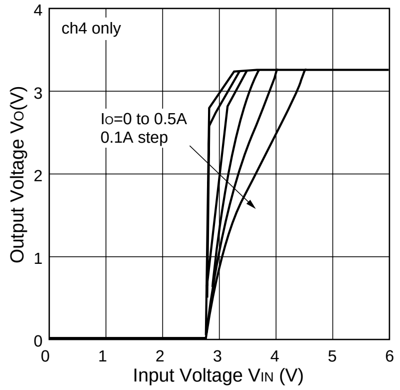
I_O vs. V_{DIF} Characteristics



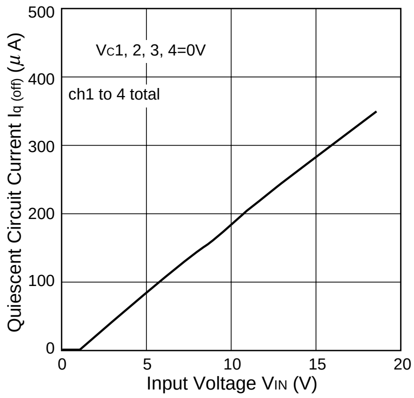
Output Voltage



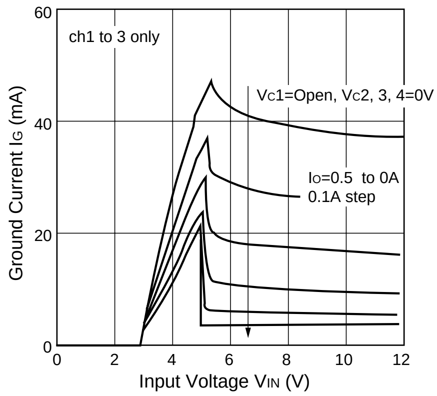
Output Voltage



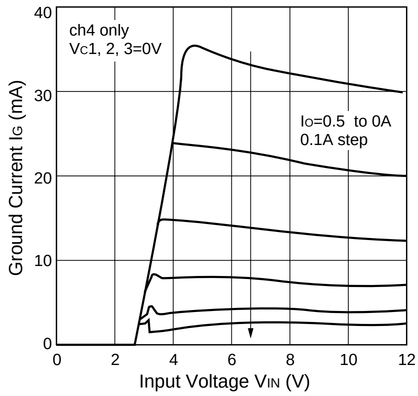
Quiescent Circuit Current



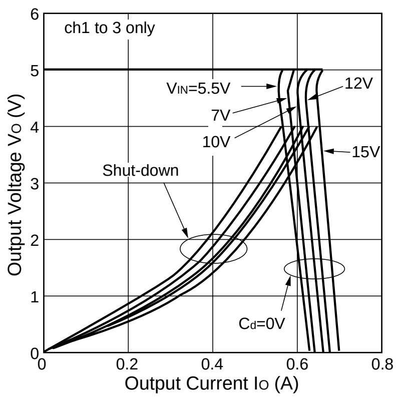
Circuit Current 1-Circuit (ch1 to 3)



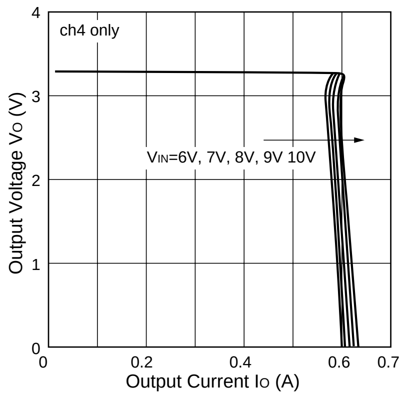
Circuit Current (ch4)



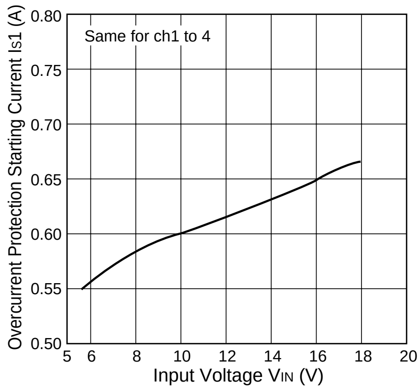
Overcurrent Protection Characteristics



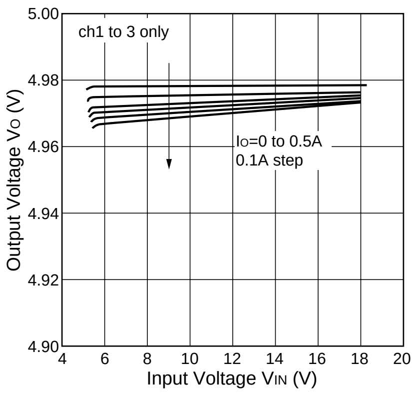
Overcurrent Protection Characteristics



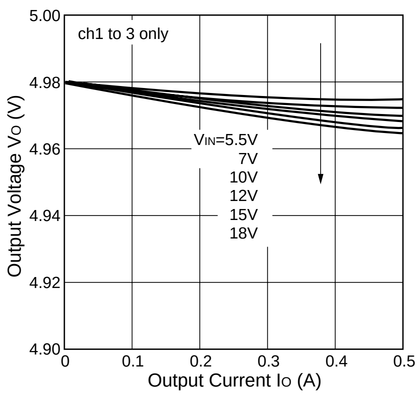
V_{IN} vs. I_{S1} Characteristics



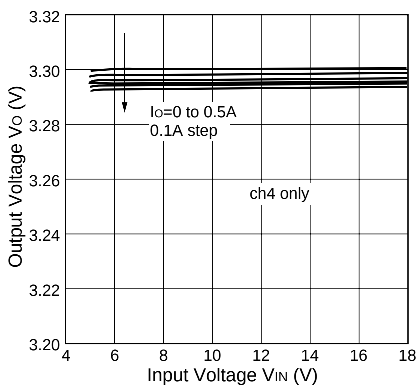
Line Regulation



Load Regulation



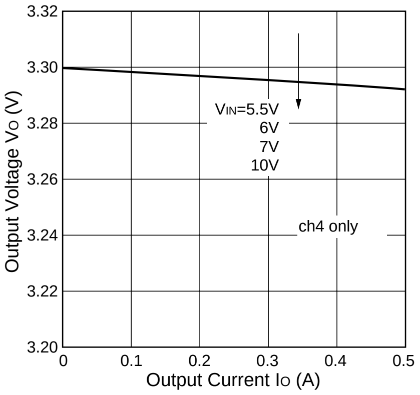
Line Regulation



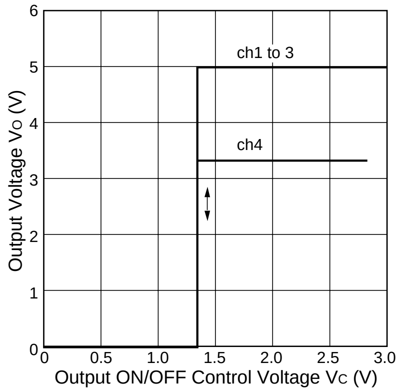
■Typical Characteristics SLA3007M

(T_a=25°C)

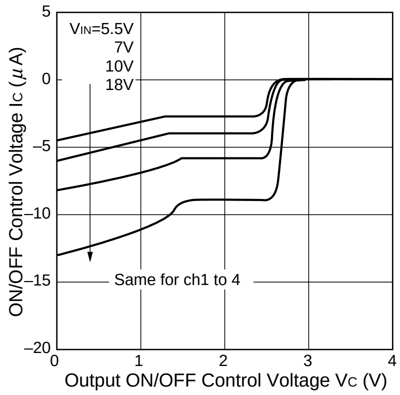
Load Regulation



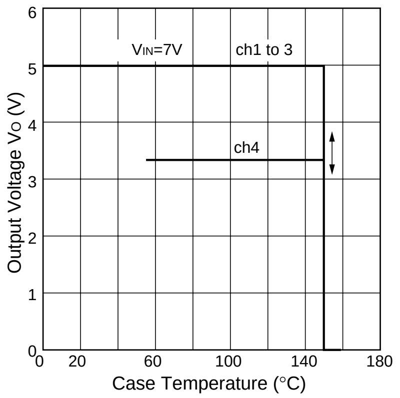
ON/OFF Control Characteristics



VC Terminal Characteristics



Thermal Protection Characteristics



Sanken Electric Co.,Ltd.
1-11-1 Nishi -Ikebukuro,Toshima-ku, Tokyo
PHONE: 03-3986-6164
FAX: 03-3986-8637
TELEX: 0272-2323(SANKEN J)

Overseas Sales Offices

●Asia

Sanken Electric Singapore Pte.Ltd.
150 Beach Road,#14-03 The Gateway West,
Singapore 0718
PHONE: 291-4755
FAX: 297-1744

Sanken Electric Hong Kong Co.,Ltd.
1018 Ocean Centre, Canton Road,
Kowloon, Hong Kong
PHONE: 2735-5262
FAX: 2735-5494
TELEX: 45498 (SANKEN HX)

Sanken Electric Korea Co.,Ltd.
SK Life B/D 6F,
168 Kongduk-dong, Mapo-ku, Seoul, 121-705, Korea
PHONE: 82-2-714-3700
FAX: 82-2-3272-2145

●North America

Allegro MicroSystems,Inc.
115 Northeast Cutoff, Box 15036
Worcester, Massachusetts 01615, U.S.A.
PHONE: (508)853-5000
FAX: (508)853-7861

●Europe

Allegro MicroSystems Europe Limited.
Balfour House, Churchfield Road,
Walton-on-Thames, Surrey KT12 2TD, U.K.
PHONE: 01932-253355
FAX: 01932-246622

PRINTED in JAPAN H1-I01ED0-0009025ND