

ICs

1

Ordering Information & Standard Packing Quantities	4
1-1 Power Management ICs	6
1-1-1 Power Factor Correction (PFC) ICs	6
1-1-2 AC/DC Converter ICs	6
1-1-3 DC/DC Converter ICs	10
Selection Guide	10
Application Note	11
1-1-4 Linear Regulator ICs	64
Selection Guide	64
Application Note	65
1-2 Motor Driver ICs	86
Selection Guide	86
Application Note	89
1-2-1 2-Phase Stepper Motor Unipolar Driver ICs	90
1-2-2 3-Phase Stepper Motor Driver ICs	112
1-2-3 5-Phase Stepper Motor Driver ICs	114
1-2-4 Brush DC Motor Driver ICs	116
1-2-5 Low Voltage 3-Phase Brushless Motor Driver ICs ..	118
1-2-6 High Voltage 3-Phase Brushless Motor Driver ICs ...	120
1-3 Lighting ICs	142
1-3-1 LED Lighting ICs	142
1-3-2 Household HID Lamp Driver ICs	146

Ordering Information

All products listed must be ordered in standard packing increments.

Series Name/ Product Name	Package	Standard Packing Quantities	
		Bulk	Taping
LC5200D	DIP8	2500	–
LC5500D	DIP8	2500	–
LC5500F	TO220F-7	1800	–
NR885K	HSOP8(Surface-mount)	–	1000
SAI	PS4(Surface-mount)	–	2000
SCM1100M/ SCM1200M	SCM33Pin	LF.No.2551/2552/ 2554/2556:250	–
SI-3000KD	TO263-5(Surface-mount)	–	800
SI-3000KF	TO220F-5	2000	–
SI-3000KM	TO252-5(Surface-mount)	–	3000
SI-3000KS	SOP8(Surface-mount)	–	1000
SI-3000KWM	TO252-5(Surface-mount)	–	3000
SI-3000LLSL	SOP8(Surface-mount)	–	1000
SI-3000LSA	SOP8(Surface-mount)	–	1000
SI-3000LU	SOT89-5(Surface-mount)	–	1000
SI-3000ZD	TO263-5(Surface-mount)	–	800
SI-3000ZF	TO220F-5	2000	–
SI-7321M	HSOP44(Surface-mount)	–	2000
SI-7510	DIP30	680	–
SI-8000E	TO220F-5	2000	–
SI-8000FD	TO263-5(Surface-mount)	–	800
SI-8000FFE	TO220F-5	2000	–
SI-8000GL	DIP8	2500	–
SI-8000HD	TO263-5(Surface-mount)	–	800
SI-8000HFE	TO220F-5	2000	–
SI-8000JD	TO263-5(Surface-mount)	–	800
SI-8000JF	TO220F-5	2000	–
SI-8000Q	HSOP8(Surface-mount)	–	1000
SI-8000S	TO220F-5	2000	–
SI-8000SD	TO263-5(Surface-mount)	–	800
SI-8000TFE	TO220F-5	2000	–
SI-8000TM	TO252-5(Surface-mount)	–	3000
SI-8000W	SOP8(Surface-mount)	–	1000
SI-8000Y	TO220F-7	2000	–
SI-8100QL	DIP8	2500	–
SI-8205NHD	HSOP8(Surface-mount)	–	1000
SI-8400L	Non-package type (EI-12.5 core)	864	–
SI-8500L	Non-package type (EI-19 core)	320	–
SI-8511NVS	TSSOP24	–	2800
SLA2600M	SLA24Pin	LF.No.2176/2179:648	–
SLA6805MP	SLA23Pin	LF.No.2151/2152:648 LF.No.2153:540	–
SLA682xM/ 686xM/6845M	SLA24Pin	LF.No.2171/2178:648 LF.No.2175:540	–

Series Name/ Product Name	Package	Standard Packing Quantities	
		Bulk	Taping
SLA7022MU/ 7029M	ZIP15 with Fin (SLA15Pin)	1080	–
SLA7024M/ 7026M/7027MU	ZIP18 with Fin (SLA18Pin)	1080	–
SLA703xM	ZIP18 with Fin (SLA18Pin)	1080	–
SLA705xM	ZIP18 with Fin (SLA18Pin)	1080	–
SLA706xM	ZIP21 with Fin (SLA21Pin)	1080	–
SLA707xMR/MPR	ZIP23 with Fin (SLA23Pin)	1080	–
SLA708xMPR	ZIP23 with Fin (SLA23Pin)	1080	–
SLA7611M	ZIP18 with Fin (SLA18Pin)	1080	–
SMA682xMP/ 685xM/686xM	SMA24Pin	LF.No.2451/2457:1080 LF.No.2452/2453:1008	–
SMA7022MU/ 7029M	ZIP15 (SMA15Pin)	1440	–
SMA7036M	ZIP15(SMA15Pin)	1440	–
SPI-6631M	HSOP16(Surface-mount)	–	1400
SPI-8000A	HSOP16(Surface-mount)	–	1400
SPI-8000TW	HSOP16(Surface-mount)	–	1400
SSC2000S	SOP8(Surface-mount)	–	1000
SSC2100S	SOP8(Surface-mount)	–	1000
SSC9510	DIP16	1250	–
SSC9510S	SOP18(Surface-mount)	–	2000
STA6940M	ZIP18(STA18Pin)	LF.No434:1785	–
STA801M	ZIP10(STA10Pin)	100	–
STR-A6000	DIP8	2500	–
STR-A6100	DIP8	2500	–
STR-L400	SIP10(STA10Pin)	3300	–
STR-L6400	SIP10(STA10Pin)	3300	–
STR-V100	SIP8(STA8Pin)	4050	–
STR-W6000S	TO220F-6	1800	–
STR-W6200D	TO220F-6	1800	–
STR-W6700	TO220F-6	1800	–
STR-X6700	TO3PF-7	500	–
STR-Y6400	TO220F-7	1800	–
STR-Y6700	TO220F-7	1800	–
SX68000M	SOP27(Surface-mount)	–	LF1890:3000

1-1 Power Management ICs

1-1-1 Power Factor Correction (PFC) ICs

Control ICs

●Continuous Conduction Mode (CCM) PFC Control IC

For high power and high efficiency applications, with brown-in and brown-out functions

Series Name	Part Number	Oscillation Frequency	Package
SSC2000	SSC2001S	Fixed to 65kHz	SOP8

●Interleaved Discontinuous Conduction Mode (DCM) PFC Control IC

8-pin package, minimum number of discrete components, low noise, and low ripple

Series Name	Part Number	Maximum on-time	Package
SSC2100	SSC2101S	15 μ s	SOP8

1-1-2 AC/DC Converter ICs

●PWM type

<STR-A6000 Series>

- For small power applications
- Low noise, low standby power
- Brown-in and brown-out functions

Part Number	Oscillation Frequency	MOSFET V _{DSS}	R _{DS(ON)}	Package
STR-A6051M	67kHz	650V	3.95 Ω	DIP8
STR-A6052M	67kHz	650V	2.8 Ω	
STR-A6053M	67kHz	650V	1.9 Ω	
STR-A6059H	100kHz	650V	6.0 Ω	
STR-A6062H	100kHz	700V	2.8 Ω	
STR-A6069H	100kHz	700V	6.0 Ω	
STR-A6079M	67kHz	800V	19.2 Ω	

<STR-V600 Series>

- Low height, at least 4 mm of creepage isolation between high and low terminal tips
- Low noise, low standby power
- SIP8 package version of STR-A6000

Part Number	Oscillation Frequency	MOSFET V _{DSS}	R _{DS(ON)}	Package
STR-V653	67kHz	650V	1.9 Ω	SIP8

<STR-W6000S Series>

- Low noise, low standby power
- Brown-in and brown-out functions

Part Number	Oscillation Frequency	MOSFET V _{DSS}	R _{DS(ON)}	Package
STR-W6051S	67kHz	650V	3.95 Ω	TO220F-6
STR-W6052S	67kHz	650V	2.8 Ω	
STR-W6053S	67kHz	650V	1.9 Ω	

<STR-W6200D Series>

- Low noise, low standby power
- External latch protection (ELP) function

Part Number	Oscillation Frequency	MOSFET V _{DSS}	R _{DS(ON)}	Package
STR-W6251D	67kHz	650V	3.95 Ω	TO220F-6
STR-W6252D	67kHz	650V	2.8 Ω	
STR-W6253D	67kHz	650V	1.9 Ω	

●Pulse ratio control (PRC) type with off-time period fixed (originated by Sanken Electric)

<STR-A6100 Series>

- For small power applications
- Low noise, low standby power

Part Number	Fixed off-time period	MOSFET V_{DSS}	$R_{DS(ON)}$	Auto burst standby function	Package
STR-A6131	8 μ s	500V	3.95 Ω	Yes	DIP8
STR-A6132		500V	2.62 Ω	Yes	
STR-A6159		650V	6 Ω	Yes	
STR-A6151		650V	3.95 Ω	Yes	
STR-A6131M	11.5 μ s	500V	3.95 Ω	No	
STR-A6159M		650V	6 Ω	No	
STR-A6151M		650V	3.95 Ω	No	
STR-A6153E		650V	1.9 Ω	No	
STR-A6169	8 μ s	800V	19.2 Ω	Yes	

<STR-V100 Series>

- Low height, at least 4 mm of creepage isolation between high and low terminal tips
- Low noise, low standby power
- SIP8 package version of STR-A6100

Part Number	Fixed off-time period	MOSFET V_{DSS}	$R_{DS(ON)}$	Package
STR-V152	8 μ s	650V	2.8 Ω	SIP8
STR-V153	11.5 μ s	650V	2 Ω	

●Quasi resonance type

<STR-Y6700 Series>

- High efficiency in full load range
- Low noise, low standby power

Part Number	MOSFET V_{DSS}	$R_{DS(ON)}$	Package
STR-Y6735	500V	0.8 Ω	TO220F-7
STR-Y6753	650V	1.9 Ω	
STR-Y6754	650V	1.4 Ω	
STR-Y6763	800V	3.5 Ω	
STR-Y6765	800V	2.2 Ω	
STR-Y6766	800V	1.7 Ω	

<STR-Y6400 Series>

- High efficiency in full load range
- Low noise, low standby power
- Mode change delay time adjustable

Part Number	MOSFET V_{DSS}	$R_{DS(ON)}$	Package
STR-Y6453	650V	1.8 Ω	TO220F-7
STR-Y6456	650V	0.73 Ω	
STR-Y6473	850V	3.6 Ω	
STR-Y6476	850V	1.3 Ω	

<STR-L6400 Series>

- Low height, at least 6.5 mm of creepage isolation between high and low terminal tips
- High efficiency in full load range, low noise, and low standby power
- SIP10 package version of STR-Y6400

Part Number	MOSFET V_{DSS}	$R_{DS(ON)}$	Package
STR-L6472	850V	6.5 Ω	SIP10

1-1-2 AC/DC Converter ICs

<STR-L400 Series>

- Low height, at least 6.5 mm of creepage isolation between high and low terminal tips
- Low noise, high efficiency

Part Number	MOSFET V_{DSS}	$R_{DS(ON)}$	Package
STR-L451	650V	3.95 Ω	SIP10
STR-L472	900V	7.7 Ω	

<STR-W6700 Series>

- High efficiency in full load range
- Low noise, undervoltage lockout (UVLO) standby function

Part Number	MOSFET V_{DSS}	$R_{DS(ON)}$	Auto burst oscillation	Bottom-skip QR operation	Package
STR-W6723N	450V	1.4 Ω	No	Yes	TO220F-6
STR-W6734	500V	1.0 Ω	Yes	Yes	
STR-W6735	500V	0.57 Ω	Yes	Yes	
STR-W6735N	500V	0.57 Ω	No	Yes	
STR-W6753	650V	1.7 Ω	Yes	Yes	
STR-W6754	650V	0.96 Ω	Yes	Yes	
STR-W6750F	650V	0.73 Ω	Yes	No	
STR-W6756	650V	0.73 Ω	Yes	Yes	
STR-W6756N	650V	0.73 Ω	No	Yes	
STR-W6765	800V	1.8 Ω	Yes	Yes	
STR-W6765N	800V	1.8 Ω	No	Yes	

<STR-X6700 Series>

- High efficiency in full load range
- Low noise, undervoltage lockout (UVLO) standby function

Part Number	MOSFET V_{DSS}	$R_{DS(ON)}$	Auto burst oscillation	Bottom-skip QR operation	Package
STR-X6729	450V	0.189 Ω	No	Yes	TO3PF-7
STR-X6737	500V	0.36 Ω	Yes	Yes	
STR-X6737M	500V	0.36 Ω	No	Yes	
STR-X6756	650V	0.73 Ω	Yes	Yes	
STR-X6757	650V	0.62 Ω	Yes	Yes	
STR-X6757N	650V	0.62 Ω	No	Yes	
STR-X6750B	650V	0.62 Ω	No	No	
STR-X6750F	650V	0.62 Ω	Yes	No	
STR-X6759N	650V	0.385 Ω	No	Yes	
STR-X6759F	650V	0.385 Ω	Yes	No	
STR-X6759B	650V	0.385 Ω	No	No	
STR-X6768N	800V	1.0 Ω	No	Yes	
STR-X6769	800V	0.66 Ω	Yes	Yes	
STR-X6769B	800V	0.66 Ω	No	No	

●Current resonance type

<SSC9510 Series>

- Half-bridge resonance
- High efficiency, low noise
- Brown-in and brown-out functions

Part Number	Package
SSC9512	DIP16
SSC9512S	SOP18

Selection Guide

<Single Output>

Surface-Mount Type

Series Name	Output Current (A)	Output Voltage (V)				Variable (Reference Voltage) (V)			Maximum Input Voltage (V)	Oscillation Frequency (kHz)	Package	Remarks	Page
		3.3	5.0	9.0	12	0.5	0.8	1.0					
SAI	0.4				⊙				35	60	PS-4		12
	0.5	⊙	⊙										
SI-8000W	0.6	⊙	⊙						35	60	SOP8		14
SI-8000JD	1.5	⊙	⊙	⊙	⊙				43	125	TO263-5		16
SI-8000TM	1.5							⊙	43	300	TO252-5		18
NR885K	3.0							⊙	20	350	HSOP8	Current mode control, soft start	52
SI-8205NHD	3.0						⊙		46	200 to 1000	HSOP8	Current mode control, synchronous rectifier	50
SI-8000SD	3.0	⊙	⊙						43	60	TO263-5		20
SPI-8000A	3.0							⊙	53	250	HSOP16		22
SI-8000Q	3.5						⊙		30	500	HSOP8	Current mode control	26
SI-8000FDE	3.5							⊙	43	300	TO263-5		28
SI-8000FDL	3.5							⊙	43	300	TO263-5	Active: low	28
SI-8000HD	5.5							⊙	43	150	TO263-5		30

Thru-Hole Type

Series Name	Output Current (A)	Output Voltage (V)					Variable (Reference Voltage) (V)				Maximum Input Voltage (V)	Oscillation Frequency (kHz)	Package	Remarks	Page
		3.3	5.0	9.0	12	15	0.5	0.8	1.0	1.5					
SI-8400L	0.5		⊙								35	60	Non-package type	With coil and built-in diode	54
SI-8000E	0.6		⊙								43	60	TO220F-5		32
SI-8500L	1.0		⊙								35	60	Non-package type	With coil and built-in diode	54
SI-8000JF	1.5	⊙	⊙		⊙					⊙	43	125	TO220F-5		34
SI-8000TFE	1.5		⊙						⊙		43	300	TO220F-5		36
SI-8000GL	1.5								⊙		53	250	DIP8		38
SI-8000S	3.0	⊙	⊙	⊙	⊙	⊙					43 ^{*1}	60	TO220F-5		40
SI-8100QL	3.5						⊙				30	350	DIP8	Current mode control	42
SI-8000FFE	3.5								⊙		43	300	TO220F-5		44
SI-8000HFE	5.5		⊙						⊙		43	150	TO220F-5		46
SI-8000Y	8.0		⊙							⊙	45	130	TO220F-7	Current mode control	48

*1: 35V for SI-8033S

<Multi Output>

Part Number		Output Current (A)	Output Voltage (V)	Maximum Input Voltage (V)	Oscillation Frequency (kHz)	Package	Remarks	Page
	ch2	0.5	Select from 9.0, 11.5, 12.1, and 15.5.					
SPI-8001TW	ch1	1.5	Variable (1.0 to 16 V)	21	250	HSOP16		58
	ch2	1.5	Variable (1.0 to 16 V)					
SPI-8002TW	ch1	1.5	Variable (1.0 to 24 V)	40	250	HSOP16		58
	ch2	1.5	Variable (1.0 to 24 V)					
SPI-8003TW	ch1	1.5	Variable (1.0 to 24 V)	40	200 to 400	HSOP16	Frequency variable	58
	ch2	1.5	Variable (1.0 to 24 V)					

<Control ICs>

Series Name	Variable (Reference Voltage)	Maximum Input Voltage	Oscillation Frequency	Package	Remarks	Page
	(V)	(V)	(kHz)			
SI-8511NVS	1.1	25	100 to 400	TSSOP24	Synchronous rectifier, PRC (fixed to ton)	62

Application Note

Heat Dissipation and Reliability

The reliability of an IC is highly dependent on its operating temperature. Please be sure to apply silicone grease to the IC and to mount it to the heatsink with a proper mounting torque. Heatsink design should pay particular attention to ensuring sufficient heat dissipation capacity. In addition, please take into account the air convection in operation. The reliability of discrete 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. With an adequate derating for the coils, minimize heat emission as far as possible. (For discrete components, refer to the individual user manuals.)

Internal Power Dissipation

P_D can be obtained from the following formula.

- For the device with built-in flywheel diode:

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

- For the device with external flywheel diode:

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

Efficiency $\eta \chi$ depends on the input/output conditions. Please refer to the efficiency characteristics of the devices. (Posted on the Web site.)

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

Thermal 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 maximum power dissipation $P_{D(max)}$, which varies by the conditions of use, and the maximum ambient temperature $T_{a(max)}$.

To simplify thermal design, T_a - P_D characteristic graphs are provided herein. Please observe the following steps for heatsink design:

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.

Although the heatsink size is now obtained, in actual applications, 10-to-20% derating factor is generally 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.

Please refer to the T_a - P_D characteristic graphs for respective product types.

Mounting Torque

SI-8000E	0.588 to 0.686[N•m] (6.0 to 7.0[kgf•cm])
SI-8000JF	
SI-8000S	
SI-8000TFE	
SI-8000HFE	
SI-8000FFE	
SI-8000Y	

Recommended Silicone Grease

- Shin-Etsu Chemical Co., Ltd.: G746
- Momentive Performance Materials Inc.: YG-6260
- Dow Corning Toray Silicone Co., Ltd.: SC102

Please select proper silicone grease carefully since the oil in some grease products may penetrate the device and result in an extremely short device life.

Others

- Devices can not be operated in parallel connection aiming for a larger current.
- Not applicable for the current boost or voltage step-up use.

Rectifier Diodes for Power Supplies

To rectify the AC input using rectifier diodes in power supplies, please use SANKEN rectifier diodes shown in the following list. (Please use a center-tap or bridge configuration in using stand-alone type diodes.)

Series Name	Diodes
SAI Series	SJPM-H4 (Surface-Mount Stand-Alone Type, $V_{RM}=400V, I_O=2.0A$)
SI-8000W Series	
SI-8000JD Series	
SI-8000TM Series	
SI-8000SD Series	
SPI-8000A Series	
SI-8005Q Series	
SI-8001FDE Series	
SI-8001FDL Series	
SI-8008HD Series	
SI-8000E Series	AM01Z (Axial Type, $V_{RM}=200V, I_O=1.0A$)
SI-8000JF Series	
SI-8000TFE Series	
SI-8000GL Series	RM10Z (Axial Type, $V_{RM}=200V, I_O=1.5A$)
SI-8000S Series	
SI-8100QL Series	RM4Z (Axial Type, $V_{RM}=200V, I_O=3.0A$)
SI-8000FFE Series	
SI-8000HFE Series	
SI-8000Y Series	FMM-22S,R (Center-tap Type, $V_{RM}=200V, I_O=10A$)
SI-8205NHD Series	RM10Z (Axial Type, $V_{RM}=200V, I_O=1.5A$)
STA801M Series	AM01Z (Axial Type, $V_{RM}=200V, I_O=1.0A$)
SI-8400L Series	AM01Z (Axial Type, $V_{RM}=200V, I_O=1.0A$)
SI-8500L Series	

SAI Series Surface-Mount, Separate Excitation Step-down Switching Mode

■ Features

- Surface-mount power package
- Output current: 0.4 to 0.5A
- High efficiency: 75 to 88%
- Requires only 4 discrete components
- Internally-adjusted phase correction and output voltage
- Built-in reference oscillator (60kHz)
- Built-in overcurrent and thermal protection circuits

■ Line up

Part Number	SAI01	SAI02	SAI03
V _o (V)	5.0	3.3	12.0
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
Thermal Resistance(junction to case)	θ _{J-C}	20	°C/W

■ Applications

- Power supplies for telecommunication equipment
- Onboard local power supplies

■ Recommended Operating Conditions

Parameter	Symbol	Ratings			Unit
		SAI01	SAI02	SAI03	
DC Input Voltage Range	V _{IN}	7 to 33	5.3 to 28	15 to 33	V
Output Current Range	I _o	0 to 0.5			A
Operating Junction Temperature Range	T _{top}	-30 to +125			°C

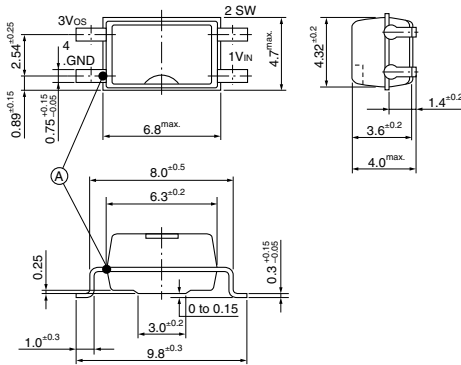
■ Electrical Characteristics

(T_a=25°C)

Parameter	Symbol	Ratings									Unit
		SAI01			SAI02			SAI03			
		min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	
Output Voltage	V _o	4.80	5.00	5.20	3.17	3.30	3.43	11.40	12.00	12.60	V
Conditions	V _{IN} =20V, I _o =0.3A			V _{IN} =15V, I _o =0.3A			V _{IN} =24V, I _o =0.3A				
Efficiency	η	80			75			88			%
Conditions	V _{IN} =20V, I _o =0.3A			V _{IN} =15V, I _o =0.3A			V _{IN} =24V, I _o =0.3A				
Oscillation Frequency	f	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				
Line Regulation	ΔV _{OLINE}	80			60			100			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				
Load Regulation	ΔV _{OLOAD}	30			20			70			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				
Temperature Coefficient of Output Voltage	ΔV _O /ΔT _a	±0.5			±0.5			±1.5			mV/°C
Conditions	45			45			45				
Ripple Rejection	R _{REJ}	f=100 to 120Hz			f=100 to 120Hz			f=100 to 120Hz			dB
Conditions	f=100 to 120Hz			f=100 to 120Hz			f=100 to 120Hz				
Overcurrent Protection Starting Current	I _{s1}	0.55			0.55			0.45			A
Conditions	V _{IN} =10V			V _{IN} =8V			V _{IN} =18V				

External Dimensions (PS4)

(unit : mm)



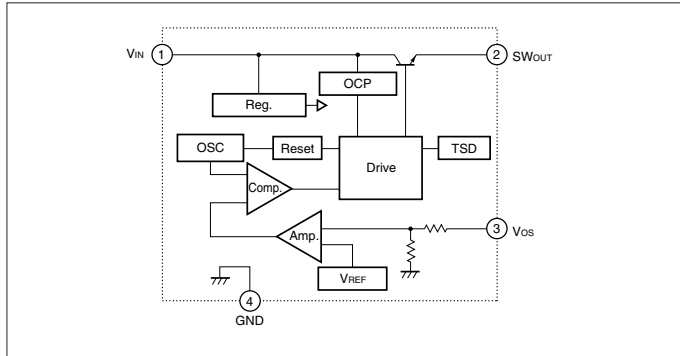
Ⓐ Case Temperature Measuring Point

Pin Assignment

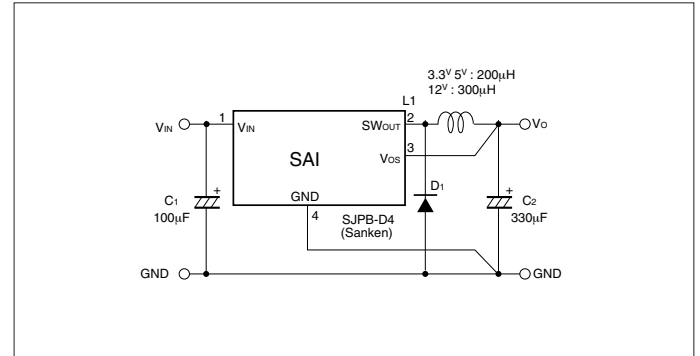
- ① VIN
- ② SWOUT
- ③ Vos
- ④ GND

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

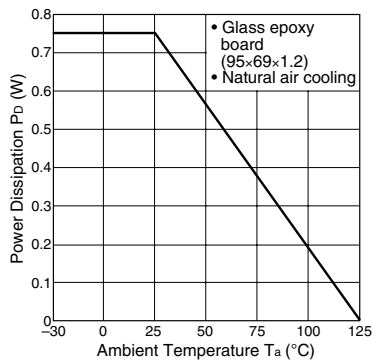
Block Diagram



Typical Connection Diagram



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. Therefore, obtain the value from the efficiency graph and substitute the percentage in the formula above.

- Vo : Output voltage
- Io : Output current
- ηχ : Efficiency (%)
- V_F : Diode D₁ forward voltage
SJPB-D4-0.3V

Thermal design for D₁ must be considered separately.

SI-8000W Series Surface-Mount, Separate Excitation Step-down Switching Mode

■Features

- Surface-mount package (SOP8)
- Output current: 0.6A
- High efficiency: 75 to 80%
- Requires only 4 discrete components
- Internally-adjusted phase correction and output voltage adjustment performed internally
- Built-in reference oscillator (60kHz)
- Built-in overcurrent and thermal protection circuits

■Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit
DC Input Voltage	V_{IN}	35	V
Power Dissipation	P_D	1	W
Junction Temperature	T_j	-30 to +125	°C
Storage Temperature	T_{stg}	-40 to +125	°C
Thermal Resistance (Junction to 7-Pin Lead)	θ_{j-L}	22	°C/W
Thermal Resistance (Junction to Ambient Air) ^{*1}	θ_{j-a}	100	°C/W

*1: Glass-epoxy board of 40 × 40mm (copper laminate area 4.3%)

■Applications

- Power supplies for telecommunication equipment
- Onboard local power supplies

■Recommended Operating Conditions

Parameter	Symbol	Ratings		Unit
		SI-8033W	SI-8050W	
DC Input Voltage Range	V_{IN}	5.3 to 28	7 to 33	V
Output Current Range	I_O	0 to 0.6		A
Operating Junction Temperature Range	T_{jop}	-30 to +125		°C

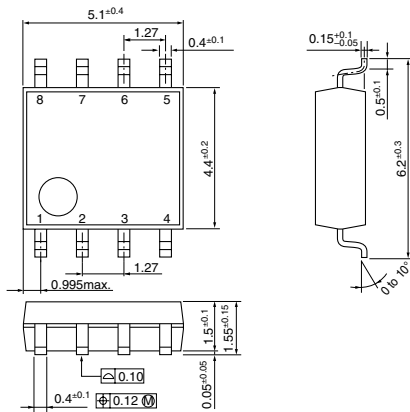
■Electrical Characteristics

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

Parameter	Symbol	Ratings						Unit
		SI-8033W			SI-8050W			
		min.	typ.	max.	min.	typ.	max.	
Output Voltage	V_O	3.17	3.30	3.43	4.80	5.00	5.20	V
	Conditions	$V_{IN}=15\text{V}, I_O=0.3\text{A}$			$V_{IN}=20\text{V}, I_O=0.3\text{A}$			
Efficiency	η	75			80			%
	Conditions	$V_{IN}=15\text{V}, I_O=0.3\text{A}$			$V_{IN}=20\text{V}, I_O=0.3\text{A}$			
Oscillation Frequency	f	60			60			kHz
	Conditions	$V_{IN}=15\text{V}, I_O=0.3\text{A}$			$V_{IN}=20\text{V}, I_O=0.3\text{A}$			
Line Regulation	ΔV_{OLINE}	60			80			mV
	Conditions	$V_{IN}=8\text{ to }28\text{V}, I_O=0.3\text{A}$			$V_{IN}=10\text{ to }30\text{V}, I_O=0.3\text{A}$			
Load Regulation	ΔV_{OLOAD}	20			30			mV
	Conditions	$V_{IN}=15\text{V}, I_O=0.1\text{ to }0.4\text{A}$			$V_{IN}=20\text{V}, I_O=0.1\text{ to }0.4\text{A}$			
Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T_a$	± 0.5			± 0.5			mV/°C
Ripple Rejection	R_{REJ}	45			45			dB
	Conditions	$f=100\text{ to }120\text{Hz}$			$f=100\text{ to }120\text{Hz}$			
Overcurrent Protection Starting Current	I_{S1}	0.61			0.61			A
	Conditions	$V_{IN}=15\text{V}$			$V_{IN}=20\text{V}$			

External Dimensions (SOP8)

(Unit : mm)

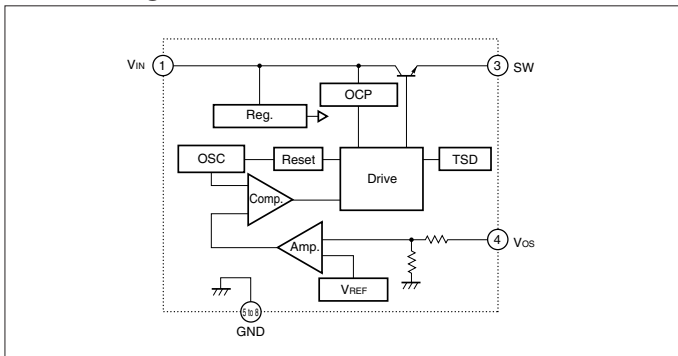


Pin Assignment

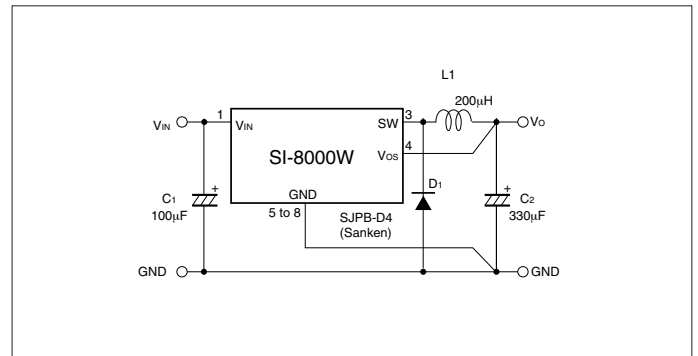
- ① VIN
- ② N.C
- ③ SW
- ④ Vos
- ⑤ GND
- ⑥ GND
- ⑦ GND
- ⑧ GND

Plastic Mold Package Type
 Flammability: UL94V-0
 Product Mass: Approx. 0.1g

Block Diagram

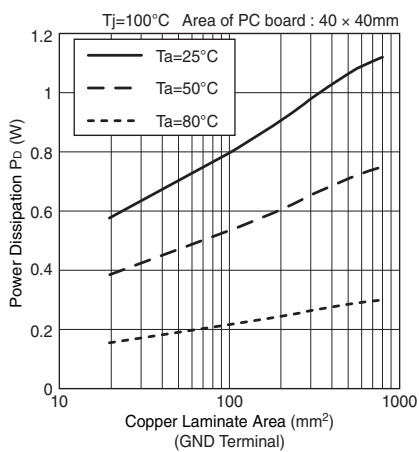


Typical Connection Diagram

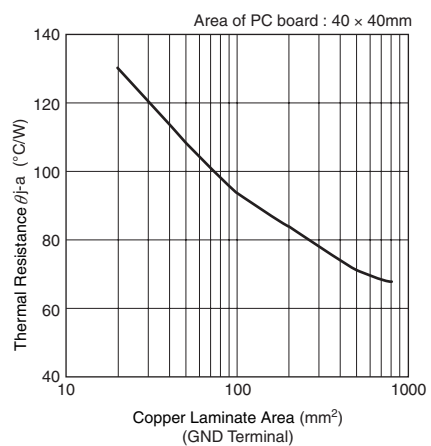


Reference Data

Copper Laminate Area vs. Power Dissipation



Copper Laminate Area vs. Thermal Resistance θ_{j-a}



SI-8000JD Series Surface-Mount, Separate Excitation Step-down Switching Mode

■Features

- Surface-mount package (TO263-5)
- Output current: 1.5A
- High efficiency: 77 to 88%
- Requires only 4 discrete components
- Internally-adjusted phase correction and output voltage
- Capable of downsizing a choke-coil due to IC's high switching frequency (125 kHz). (Compared with conventional Sanken devices)
- Built-in foldback-overcurrent and thermal protection circuits
- Output ON/OFF available (Circuit current at output OFF: 200μA max)
- Soft start available by ON/OFF pin Conditions

■Lineup

Part Number	SI-8033JD	SI-8050JD	SI-8090JD	SI-8120JD
Vo(V)	3.3	5.0	9.0	12.0
Io(A)	1.5			

■Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit	Conditions
DC Input Voltage	V _{IN}	43	V	
Output Current	I _o	1.5	A	
Power Dissipation*	P _d	3	W	When mounted on glass-epoxy board 40 × 40 mm (copper area 100%)
Junction Temperature	T _j	+125	°C	
Storage Temperature	T _{stg}	-40 to +125	°C	
Thermal Resistance (Junction to Case)	θ _{J-C}	3	°C/W	
Thermal Resistance (Junction to Ambient Air)	θ _{J-A}	33.3	°C/W	When mounted on glass-epoxy board 40 × 40 mm (copper area 100%)

*: Limited by thermal protection circuit

■Applications

- Power supplies for telecommunication equipment
- Onboard local power supplies, etc.

■Recommended Operating Conditions

Parameter	Symbol	Ratings				Unit	Conditions
		SI-8033JD	SI-8050JD	SI-8090JD	SI-8120JD		
DC Input Voltage Range	V _{IN1}	5.3 to 40	7 to 40	11 to 40	14 to 40	V	I _o =0 to 1A
	V _{IN2}	6.3 to 40	8 to 40	12 to 40	15 to 40		I _o =0 to 1.5A
DC Output Current Range*	I _o	0 to 1.5				A	V _{IN} ≥V _O +3V
Operating Junction Temperature Range	T _{TOP}	-30 to +125				°C	
Operating Temperature Range*	T _{OP}	-30 to +125				°C	

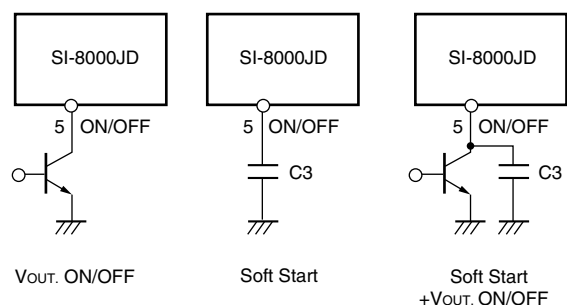
*: Limited by Ta-Pd characteristics

■Electrical Characteristics

(T_a=25°C)

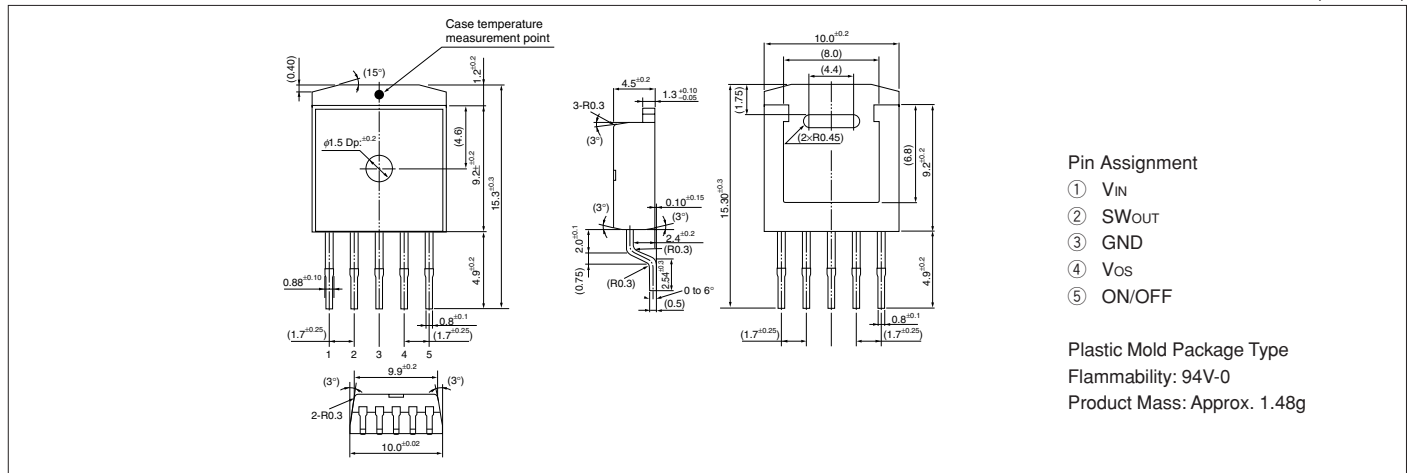
Parameter	Symbol	Ratings												Unit
		SI-8033JD			SI-8050JD			SI-8090JD			SI-8120JD			
		min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	
Output Voltage	V _o	3.234	3.30	3.366	4.90	5.00	5.10	8.82	9.00	9.18	11.76	12.00	12.24	V
	Conditions	V _{IN} =15V, I _o =0.5A			V _{IN} =20V, I _o =0.5A			V _{IN} =21V, I _o =0.5A			V _{IN} =24V, I _o =0.5A			
Efficiency	η	77			82			86			88			%
	Conditions	V _{IN} =15V, I _o =0.5A			V _{IN} =20V, I _o =0.5A			V _{IN} =21V, I _o =0.5A			V _{IN} =24V, I _o =0.5A			
Oscillation Frequency	f	125			125			125			125			kHz
	Conditions	V _{IN} =15V, I _o =0.5A			V _{IN} =20V, I _o =0.5A			V _{IN} =21V, I _o =0.5A			V _{IN} =24V, I _o =0.5A			
Line Regulation	ΔV _{OLINE}	25 80			40 100			50 120			60 130			mV
	Conditions	V _{IN} =8 to 30V, I _o =0.5A			V _{IN} =10 to 30V, I _o =0.5A			V _{IN} =15 to 30V, I _o =0.5A			V _{IN} =18 to 30V, I _o =0.5A			
Load Regulation	ΔV _{OLOAD}	10 30			10 40			10 40			10 40			mV
	Conditions	V _{IN} =15V, I _o =0.2 to 0.8A			V _{IN} =20V, I _o =0.2 to 0.8A			V _{IN} =21V, I _o =0.2 to 0.8A			V _{IN} =24V, I _o =0.2 to 0.8A			
Temperature Coefficient of Output Voltage	ΔV _O /ΔT _a	±0.5			±0.5			±1.0			±1.0			mV/°C
Overcurrent Protection Starting Current	I _{st}	1.6			1.6			1.6			1.6			A
	Conditions	V _{IN} =15V			V _{IN} =20V			V _{IN} =21V			V _{IN} =24V			
ON/OFF* Pin	Low Level Voltage	V _{SSL}			0.5			0.5			0.5			V
	Outflow Current at Low Voltage	I _{SSL}			100			100			100			
Quiescent Circuit Current	I _q	7			7			7			7			mA
		Conditions	V _{IN} =15V, I _o =0A			V _{IN} =20V, I _o =0A			V _{IN} =21V, I _o =0A			V _{IN} =24V, I _o =0A		
	I _{q(OFF)}	200			200			200			200			μA
		Conditions	V _{IN} =15V, V _{ON/OFF} =0.3V			V _{IN} =20V, V _{ON/OFF} =0.3V			V _{IN} =21V, V _{ON/OFF} =0.3V			V _{IN} =24V, V _{ON/OFF} =0.3V		

*: Pin 5 is the ON/OFF pin. Soft start at power on can be performed with a capacitor connected to this pin.
 The output can also be turned ON/OFF with this pin.
 The output is stopped by setting the voltage of this pin to V_{SSL} or lower.
 ON/OFF-pin voltage can be changed with an open-collector drive circuit of a transistor.
 When using both the soft-start and ON/OFF functions together, the discharge current from C₃ flows into the ON/OFF control transistor. Therefore, limit the current securely to protect the transistor if C₃ capacitance is large.
 The ON/OFF pin is pulled up to the power supply in the IC, so applying the external voltage is prohibited.

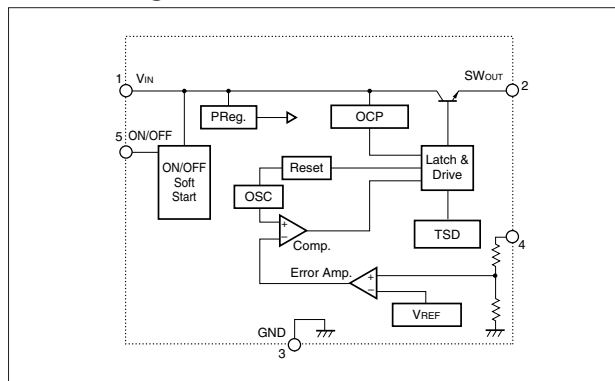


External Dimensions (TO263-5)

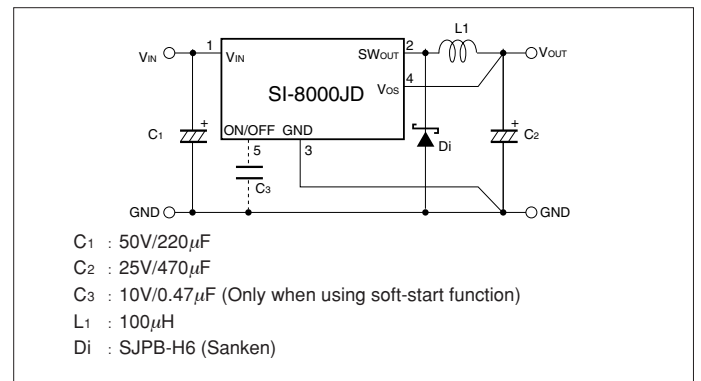
(Unit : mm)



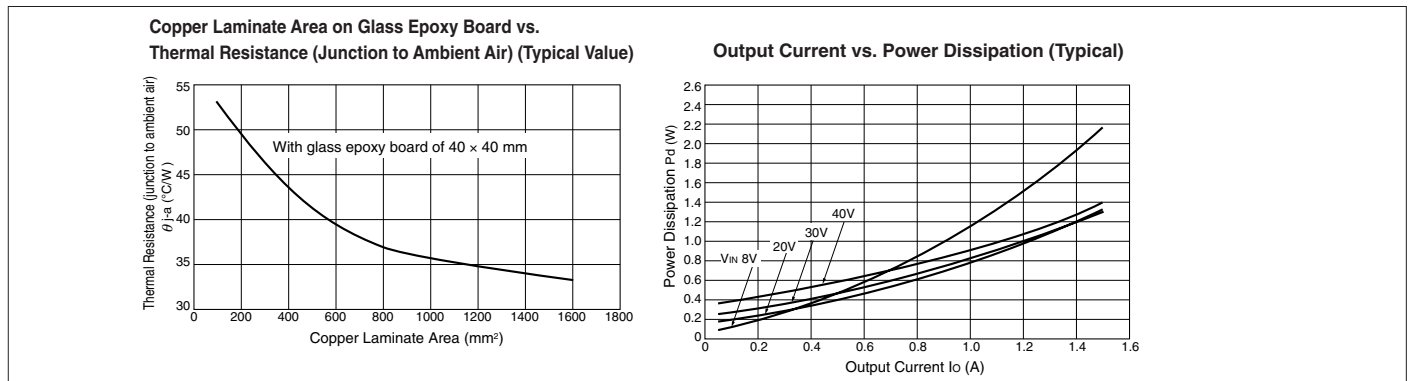
Block Diagram



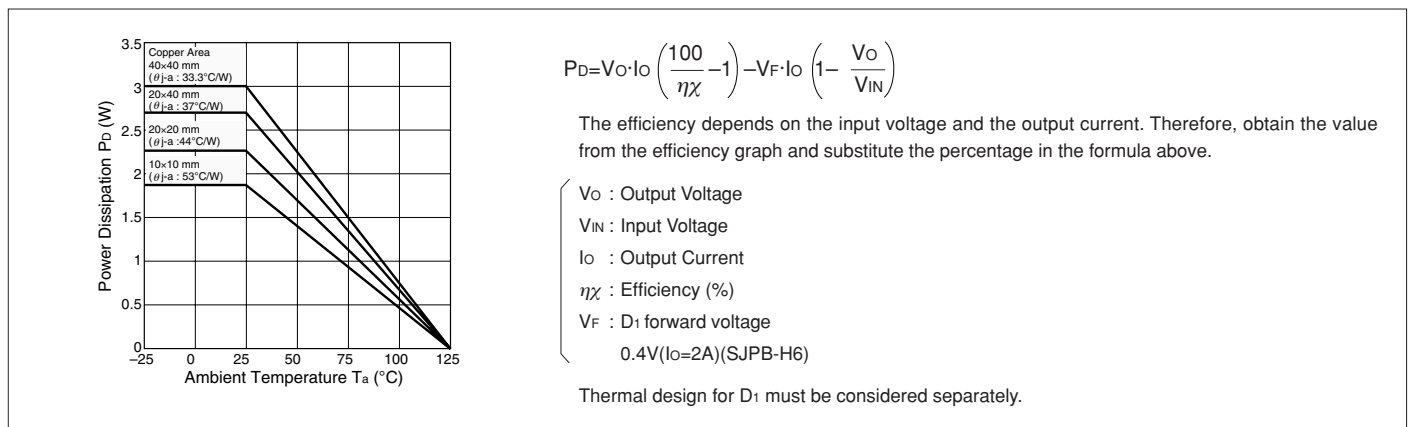
Typical Connection Diagram



Reference Data



T_a-P_D Characteristics



SI-8000TM Series Surface-Mount, Separate Excitation Step-down Switching Mode

Features

- Compact surface-mount package (TO252-5)
- Output current: 1.5 A
- High efficiency: 81% typ. (at $V_o = 5\text{ V}$)
- Requires only 4 discrete components
- Built-in reference oscillator (300 kHz)
- Built-in drooping-type-overcurrent and thermal protection circuits
- Output ON/OFF available (circuit current at output OFF: 200 μA typ.)
- Soft start available by ON/OFF pin

Applications

- Onboard local power supplies
- AV equipment
- OA equipment

Recommended Operating Conditions

Parameter	Symbol	Ratings		Unit
		SI-8008TM		
Input Voltage Range	V_{IN}	$V_o + 3^{*1}$ to 40		V
Output Voltage	V_o	0.8 to 24		V
Output Current Range	I_o	0 to 1.5		A
Operating Junction Temperature Range	T_{jop}	-20 to +100		$^{\circ}\text{C}$
Operating Temperature Range	T_{op}	-20 to +85		$^{\circ}\text{C}$

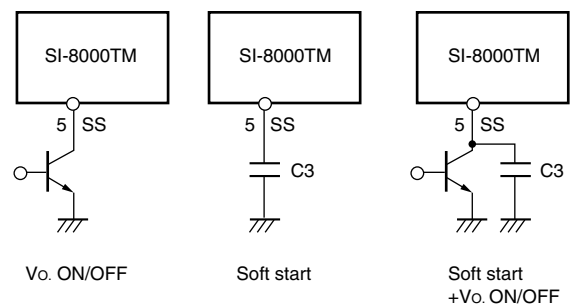
*1: The minimum value of an input voltage range is the higher of 4.5 V or $V_o + 3\text{ V}$.

Electrical Characteristics

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

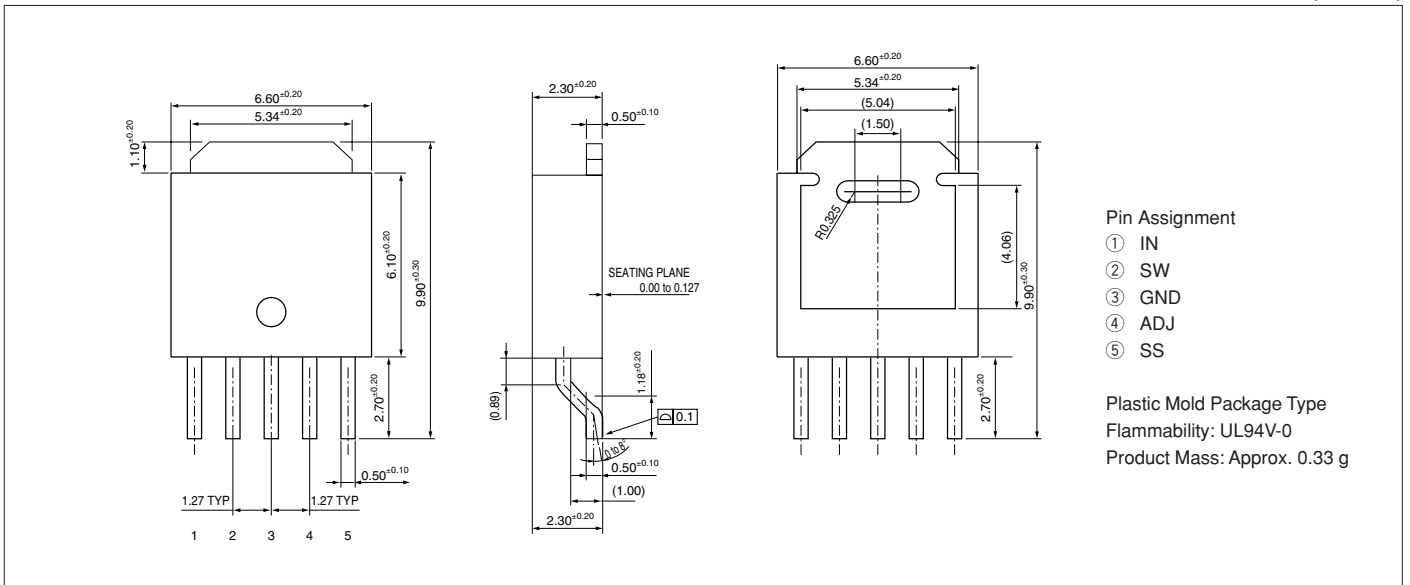
Parameter	Symbol	Rating			Unit
		SI-8008TM			
		min.	typ.	max.	
Reference Voltage	V_{ADJ}	0.784	0.800	0.816	V
	Conditions	$V_{IN} = 15\text{ V}, I_o = 0.1\text{ A}$			
Temperature Coefficient of Reference Voltage	$\Delta V_{ADJ}/\Delta T$		± 0.1		$\text{mV}/^{\circ}\text{C}$
	Conditions	$V_{IN} = 15\text{ V}, I_o = 0.1\text{ A}, T_c = 0\text{ to }100^{\circ}\text{C}$			
Efficiency	η		81		%
	Conditions	$V_{IN} = 15\text{ V}, I_o = 0.5\text{ A}$			
Oscillation Frequency	f_o		300		kHz
	Conditions	$V_{IN} = 15\text{ V}, I_o = 0.5\text{ A}$			
Line Regulation	ΔV_{OLINE}		60	80	mV
	Conditions	$V_{IN} = 10\text{ to }30\text{ V}, I_o = 0.5\text{ A}$			
Load Regulation	ΔV_{OLOAD}		10	40	mV
	Conditions	$V_{IN} = 15\text{ V}, I_o = 0.2\text{ to }1.5\text{ A}$			
Overcurrent Protection Starting Current	I_s	1.6			A
	Conditions	$V_{IN} = 15\text{ V}$			
ON/OFF Pin*	Low Level Voltage	V_{SSL}		0.5	V
	Outflow Current at Low Voltage	I_{SSL}	10	40	μA
	Conditions	$V_{SSL} = 0\text{ V}$			
Quiescent Circuit Current	I_q		6		mA
		Conditions	$V_{IN} = 15\text{ V}, I_o = 0\text{ A}$		
	$I_q(\text{OFF})$		200	400	μA
	Conditions	$V_{IN} = 15\text{ V}, V_{SS} = 0\text{ V}$			

*: Pin 5 is the SS pin. Soft start at power on can be performed with a capacitor connected to this pin. The output can also be turned ON/OFF with this pin. The output is stopped by setting the voltage of this pin to V_{SSL} or lower. SS-pin voltage can be changed with an open-collector drive circuit of a transistor. When using both the soft-start and ON/OFF functions together, the discharge current from C3 flows into the ON/OFF control transistor. Therefore, limit the current securely to protect the transistor if C3 capacitance is large. The SS pin is pulled up to the power supply in the IC, so applying the external voltage is prohibited. If the pin is not used, leave it open.

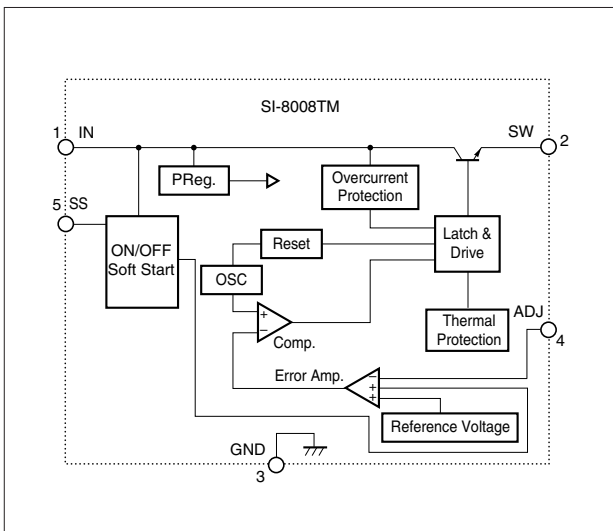


External Dimensions (TO252-5)

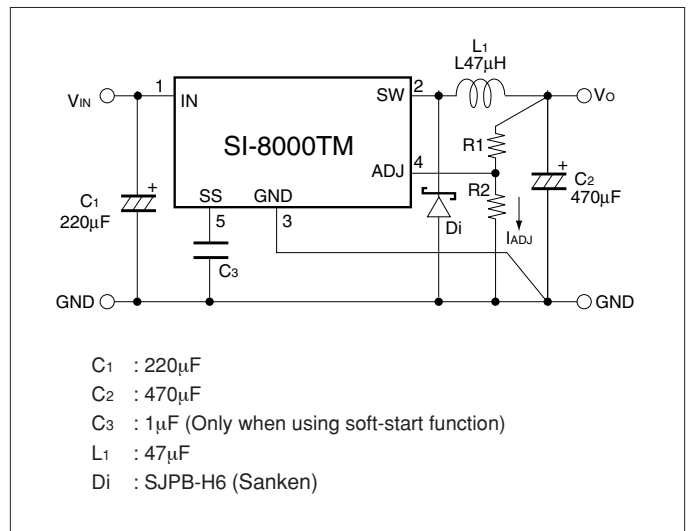
(Unit : mm)



Block Diagram



Typical Connection Diagram



SI-8000SD Series Surface Mount, Separate Excitation Step-down Switching Mode

Features

- Surface-mount package (TO263-5)
- Output current: 3.0A
- High efficiency: 79% typ. (SI-8033SD), 84% typ. (SI-8050SD)
- Requires only 4 discrete external components
- Internally-adjusted phase correction and output voltage
- Built-in reference oscillator (60kHz)
- Built-in overcurrent and thermal protection circuits
- Output ON/OFF available
- Soft start available by S.S pin

Lineup

Part Number	SI-8033SD	SI-8050SD
Vo (V)	3.3	5.0
Io (A)	3	

Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit	Conditions
DC Input Voltage	V _{IN}	43*1	V	
Power Dissipation*2	P _D	3	W	When mounted on glass-epoxy board 40 x 40 mm (copper area: 100%)
Junction Temperature	T _j	+125	°C	
Storage Temperature	T _{stg}	-40 to +125	°C	
Thermal Resistance (Junction to Case)	θ _{J-C}	3	°C/W	
Thermal Resistance (Junction to Ambient Air)	θ _{J-A}	33.3	°C/W	When mounted on glass-epoxy board 40 x 40 mm (copper area: 100%)

*1: 35V for SI-8033SD

*2: Limited by thermal protection circuit.

Applications

- Power supplies for telecommunication equipment
- Onboard local power supplies

Recommended Operating Conditions

Parameter	Symbol	Ratings		Unit
		SI-8033SD	SI-8050SD	
DC Input Voltage Range	V _{IN1}	5.5 to 28	7 to 40	V
Output Current Range*	I _O	0 to 3.0		A
Operating Junction Temperature Range	T _{jop}	-30 to +125		°C
Operating Temperature Range*	T _{op}	-30 to +125		°C

*: Limited by Ta-Pd characteristics.

Electrical Characteristics

(T_a=25°C)

Parameter	Symbol	Ratings						Unit	
		SI-8033SD			SI-8050SD				
		min.	typ.	max.	min.	typ.	max.		
Output Voltage	V _O	3.17	3.3	3.43	4.8	5.0	5.2	V	
	Conditions	V _{IN} =15V, I _O =1A			V _{IN} =20V, I _O =1A				
Efficiency	η		79			84		%	
	Conditions	V _{IN} =15V, I _O =1A			V _{IN} =20V, I _O =1A				
Oscillation Frequency	f		60			60		kHz	
	Conditions	V _{IN} =15V, I _O =1A			V _{IN} =20V, I _O =1A				
Line Regulation	ΔV _{OLINE}		25	80		40	100	mV	
	Conditions	V _{IN} =8 to 28V, I _O =1A			V _{IN} =10 to 30V, I _O =1A				
Load Regulation	ΔV _{OLOAD}		10	30		10	40	mV	
	Conditions	V _{IN} =15V, I _O =0.5 to 1.5A			V _{IN} =20V, I _O =0.5 to 1.5A				
Temperature Coefficient of Output Voltage	ΔV _O /ΔT _a		±0.5			±0.5		mV/°C	
Overcurrent Protection Starting Current	I _{S1}	3.1			3.1			A	
	Conditions	V _{IN} =15V			V _{IN} =20V				
Soft Start Pin*	Low-Level Voltage	V _{SSL}	0.2			0.2		V	
	Outflow Current at Low Voltage	I _{SSL}	20	30	40	20	30		40
		Conditions	V _{SSL} =0.2V						μA

* Pin 5 is a soft start pin. Soft start at power on can be performed with a capacitor connected to this pin.

The output can also be turned ON/OFF with this pin.

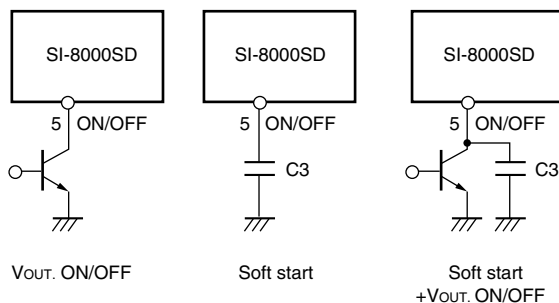
The output is stopped by setting the voltage of this pin to V_{SSL} or lower.

Soft-start pin voltage can be changed with an open-collector drive circuit of a transistor.

When using both the soft-start and ON/OFF functions together, the discharge current from C₃ flows into the ON/OFF control transistor. Therefore, limit the current securely to protect the transistor if C₃ capacitance is large.

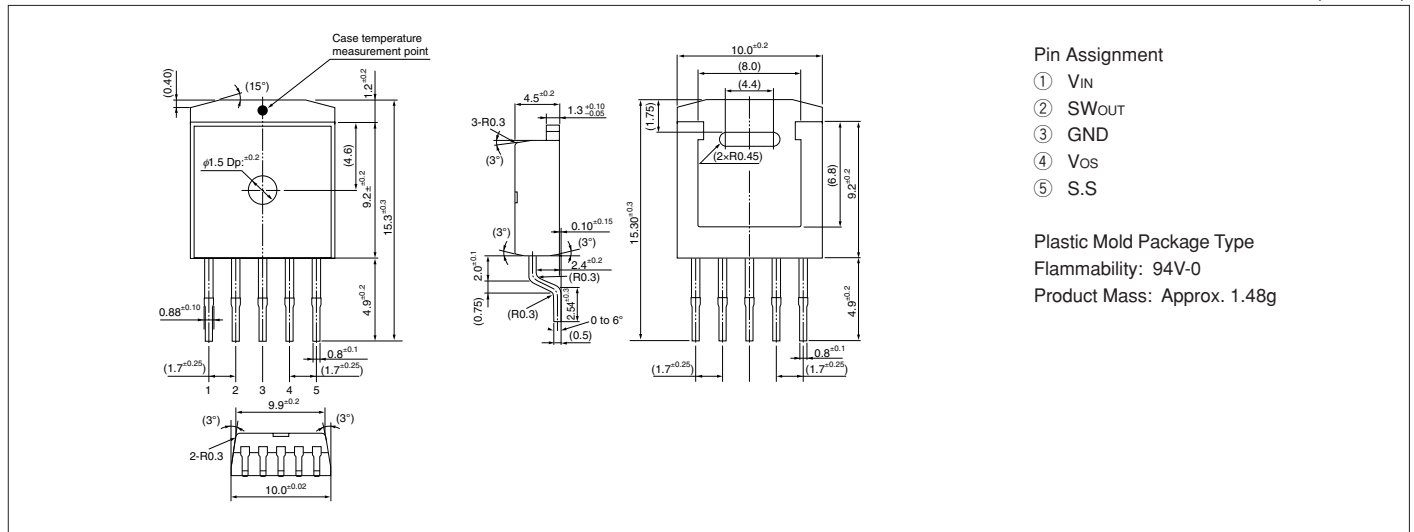
The ON/OFF pin is pulled up to the power supply in the IC, so applying the external voltage is prohibited.

If this pin is not used, leave it open.



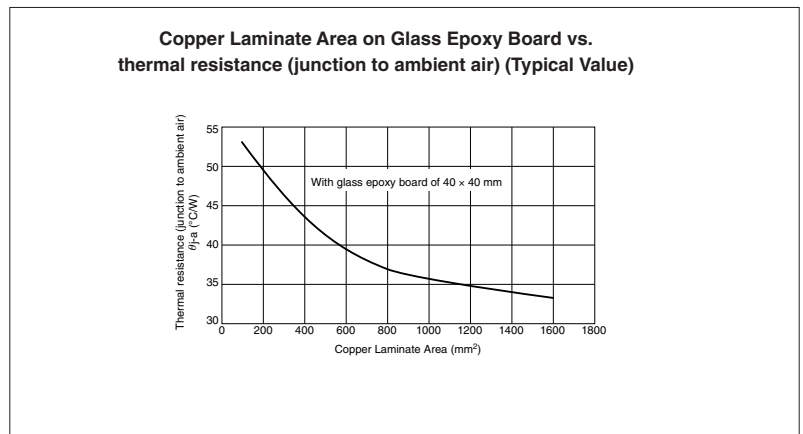
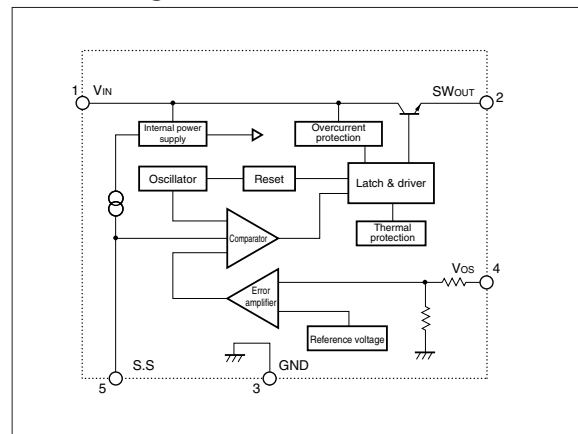
External Dimensions (TO263-5)

(Unit : mm)

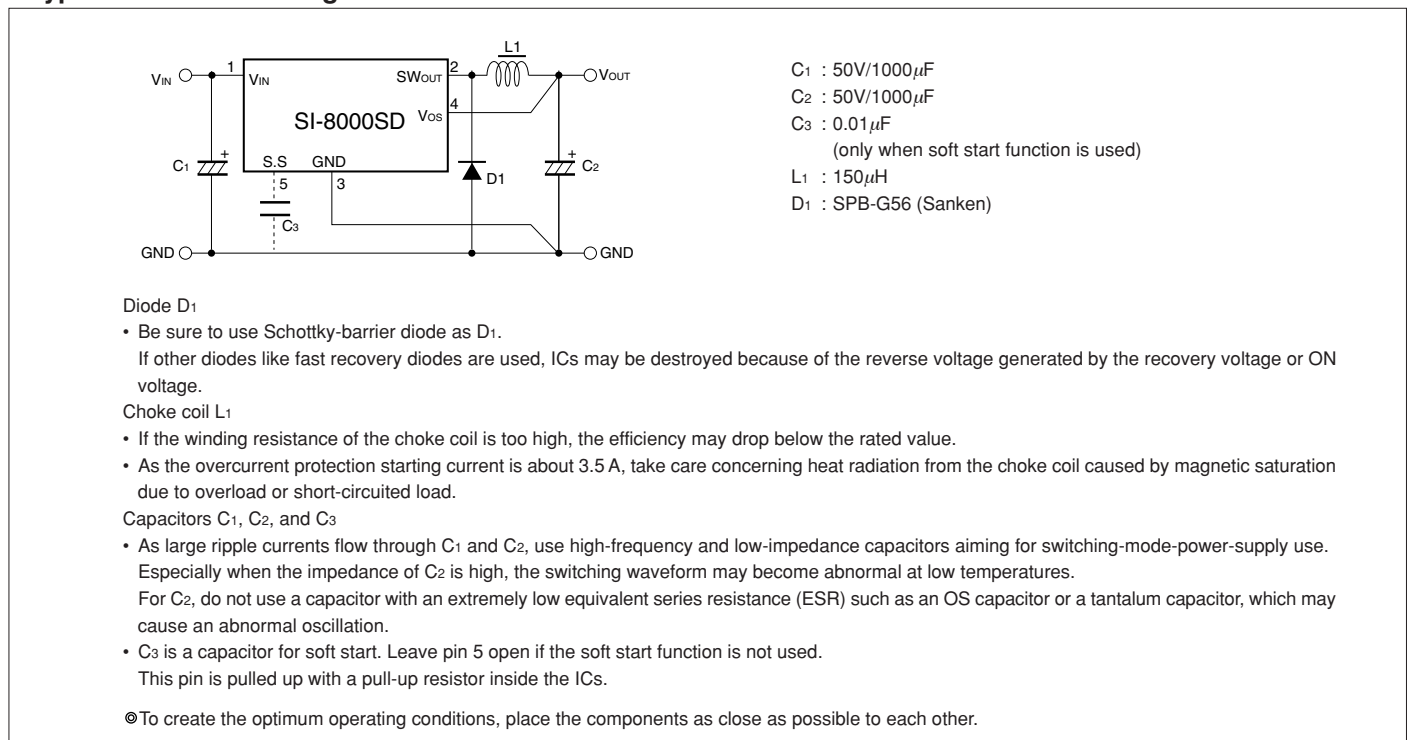


Block Diagram

Reference Data



Typical Connection Diagram



SPI-8000A Series Surface Mount, Separate Excitation Step-down Switching Mode

■Features

- Surface-mount 16 pin package
- Output current: 3.0A
- High efficiency: 91% (at $V_{IN} = 10V$, $I_O = 1A$, $V_O = 5V$)
- Capable of downsizing a choke-coil due to IC's high switching frequency (125kHz). (Compared with conventional Sanken devices)
- The output-voltage-variable type can vary its output voltage from 1V to 14V because of its low reference voltage (V_{REF}) of 1V.
- Wide Input Voltage Range (8 to 50V)
- Output ON/OFF available
- Built-in overcurrent and thermal protection circuits

■Absolute Maximum Ratings

($T_a=25^\circ C$)

Parameter	Symbol	Rated	Unit
DC Input Voltage	V_{IN}	53	V
Power Dissipation	$P_D^{*1, *2}$	2.4	W
Junction Temperature	T_j	+125	$^\circ C$
Storage Temperature	T_{stg}	-40 to +125	$^\circ C$
Thermal Resistance (junction to case)	θ_{j-c}^{*2}	18	$^\circ C/W$
Thermal Resistance (junction to ambient air)	θ_{j-a}^{*2}	50	$^\circ C/W$

*1: Limited due to thermal protection.

*2: When mounted on glass-epoxy board 700cm² (copper laminate area 30.8cm²).

■Applications

- Onboard local power supplies
- OA equipment
- For stabilization of the secondary-side output voltage of switching power supplies

■Recommended Operating Conditions

Parameter	Symbol	Ratings		Unit
		SPI-8010A		
DC Input Voltage Range	V_{IN}	(8 or V_O+3) ^{*1} to 50		V
Output Voltage Range	V_O	1 to 14		V
Output Current Range ^{*2}	I_O	0.02 to 3.0 ^{*2}		A
Operating Junction Temperature Range	T_{jop}	-30 to +125		$^\circ C$
Operating Temperature Range	T_{op}	-30 to +125		$^\circ C$

*1: The minimum value of an input voltage range is the higher of either 8V or V_O+3V .

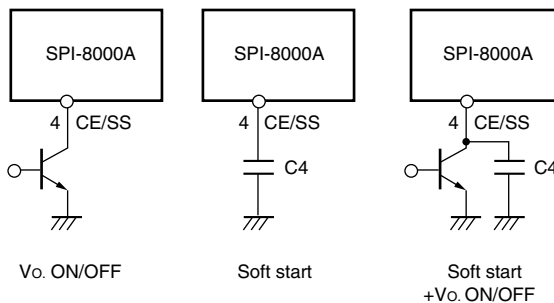
*2: Please be sure to let the output current run more than 20 mA. When using by less than 20 mA, there is a possibility that the output voltage becomes unstable.

■Electrical Characteristics

($T_a=25^\circ C$)

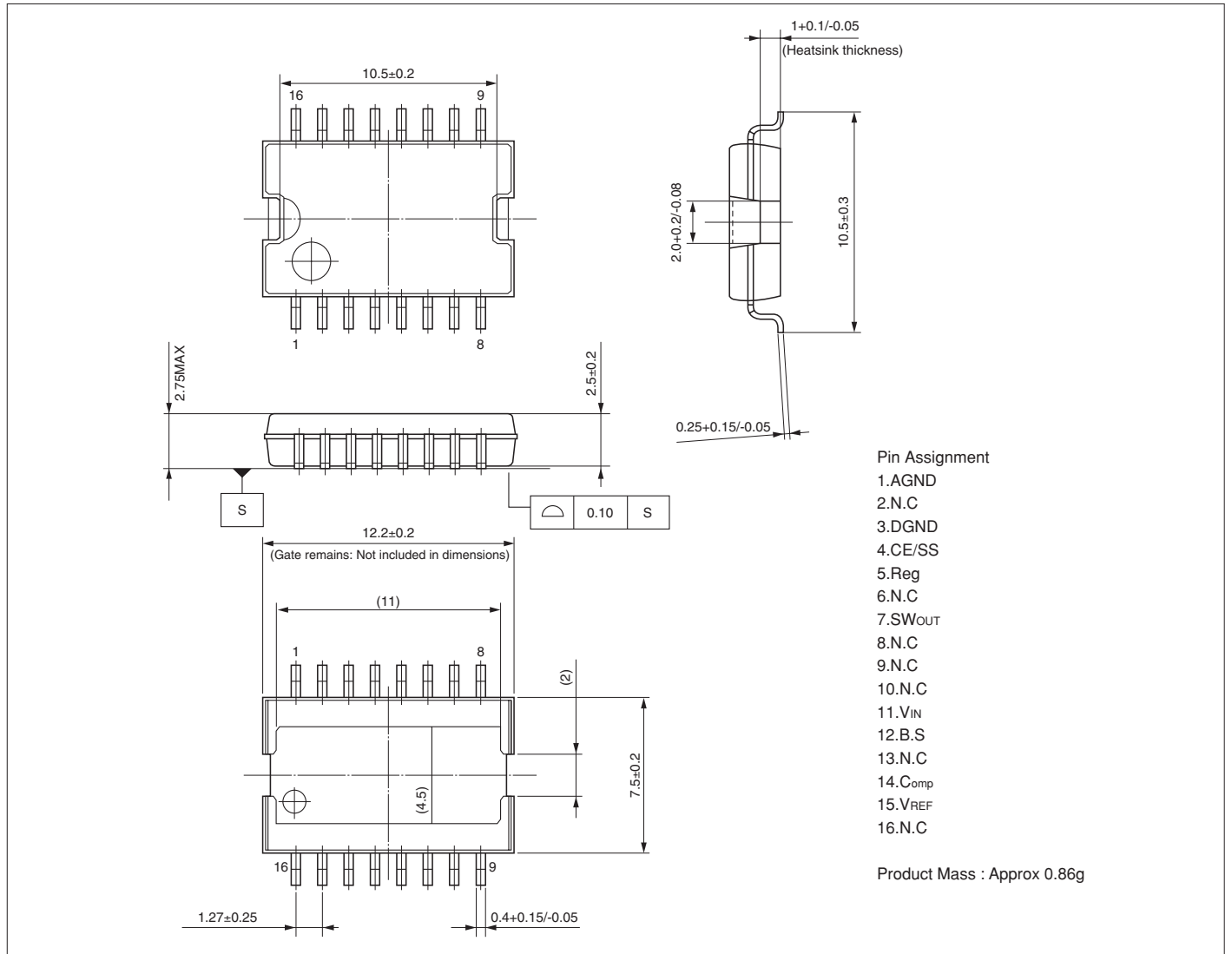
Parameter	Symbol	Rating			Unit
		SPI-8010A (Variable type)			
		min.	typ.	max.	
Reference Voltage	V_{REF}	0.97	1.00	1.03	V
	Conditions	$V_{IN}=12V, I_O=1A$			
Efficiency	Eff		86		%
	Conditions	$V_{IN}=20V, I_O=1A, V_O=5V$			
Oscillation Frequency	F_{OSC}		250		kHz
	Conditions	$V_{IN}=12V, I_O=1A$			
Line Regulation	ΔV_{OLINE}		20	40	mV
	Conditions	$V_{IN}=10$ to $30V, I_O=1A$			
Load Regulation	ΔV_{OLOAD}		10	30	mV
	Conditions	$V_{IN}=12V, I_O=0.1$ to $1.5A$			
Temperature Coefficient of Reference Voltage	$\Delta V_{REF}/\Delta T_a$		± 0.5		mV/ $^\circ C$
Overcurrent Protection Starting Current	I_S	3.1			A
	Conditions	$V_{IN}=12V$			
Quiescent Circuit Current	I_q		7		mA
	Conditions	$V_{IN}=12V, I_O=0A$			
Circuit Current at Output OFF	$I_{q(off)}$			400	μA
	Conditions	$V_{IN}=12V, V_{ON/OFF}=0.3V$			
CE/SS Terminal	Low Level Voltage	V_{SSL}		0.5	V
	Outflow Current at Low Voltage	I_{SSL}		50	μA
	Conditions	$V_{SSL}=0V$			

* Pin 4 is the CE/SS pin. Soft start at power on can be performed with a capacitor connected to this pin. The output can also be turned ON/OFF with this pin. The output is stopped by setting the voltage of this pin to V_{SSL} or lower. CE/SS-pin voltage can be changed with an open-collector drive circuit of a transistor. When using both the soft-start and ON/OFF functions together, the discharge current from C4 flows into the ON/OFF control transistor. Therefore, limit the current securely to protect the transistor if C3 capacitance is large. The CE/SS pin is pulled up to the power supply in the IC, so applying the external voltage is prohibited.

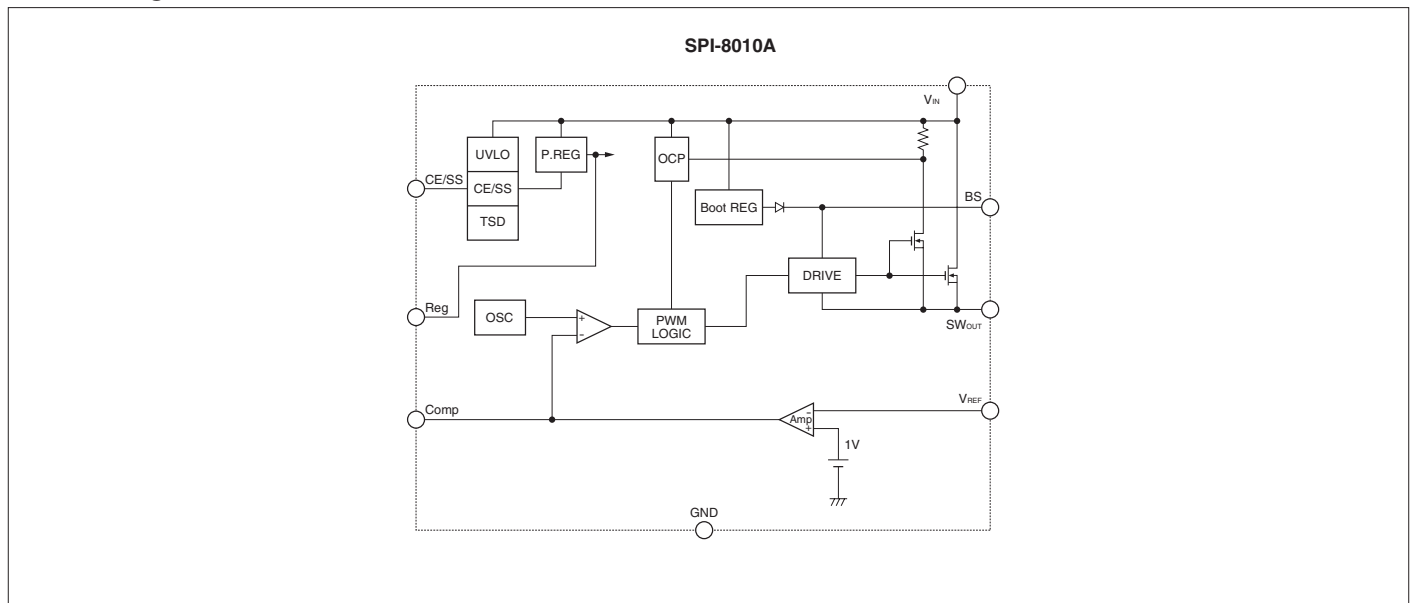


External Dimensions (HSOP16)

(Unit : mm)



Block Diagram



■ Typical Connection Diagram

C1: 220 μ F/63V
 C2: 470 μ F/25V
 C3: 0.1 μ F
 C4: 1000pF
 C5: 0.1 μ F
 C6: 0.047 μ F
 C7: 0.1 μ F
 C8: 0.1 μ F
 R1: 47 Ω
 L1: 47 μ H
 D1: SPB-G56S
 (Sanken)

Diode D1

- Be sure to use a Schottky-barrier diode for D1. If other diodes like fast recovery diodes are used, ICs may be destroyed because of the reverse voltage generated by the recovery voltage or ON voltage.

Choke coil L1

- If the winding resistance of the choke coil is too high, the efficiency may drop below the rated value.
- As the overcurrent protection starting current is about 4.5A, take care concerning heat radiation from the choke coil caused by magnetic saturation due to overload or short-circuited load.

Capacitors C1, C2

- As large ripple currents flow through C1 and C2, use high-frequency and low-impedance capacitors aiming for switching-mode-power-supply use. Especially when the impedance of C2 is high, the switching waveform may become abnormal at low temperatures. For C2, do not use a capacitor with an extremely low equivalent series resistance (ESR) such as an OS capacitor or a tantalum capacitor, which may cause an abnormal oscillation.

Resistors R2, R3

- R2 and R3 are the resistors to set the output voltage. Set their values so that IREF becomes approx. 2mA. Obtain R2 and R3 values by the following formula:

$$R2 = \frac{(V_{OUT} - V_{REF})}{I_{REF}} = \frac{(V_{OUT} - 1)}{2 \times 10^{-3}} (\Omega), R3 = \frac{V_{REF}}{I_{REF}} = \frac{1}{2 \times 10^{-3}} \approx 500(\Omega)$$

©To create the optimum operating conditions, place the components as close as possible to each other.

■ Ta-Pd Characteristics

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

Note 1: The efficiency depends on the input voltage and the output current. Therefore, obtain the value from the efficiency graph and substitute the percentage in the formula above.

Note 2: Thermal design for D1 must be considered separately.

V_O : Output voltage
 V_{IN} : Input voltage
 I_O : Output current
 η% : Efficiency (%)
 V_F : Diode D1 forward voltage
 SPB-G56S...0.4V(I_O=2A)

SI-8000Q Series Surface Mount, Current Mode Control Step-down Switching Mode

Features

- Compact surface-mount package (HSOP8)
- Introduction of current mode control method
- Output current: 3.5 A
- High efficiency: 90% ($V_o = 5\text{ V}$)
- Built-in reference oscillator (500 kHz)
- A ceramic capacitor can be used for output
- Built-in drooping-type overcurrent and thermal protection circuits
- Built-in soft start circuit
- Built-in on/off function (Active Hi)
- Low current consumption during off

Absolute Maximum Ratings

Parameter	Symbol	Rating	Unit	Conditions
Input Voltage	V_{IN}	30	V	
Power Dissipation ^{*1}	P_D	1.35	W	When mounted on glass-epoxy board, 30×30 mm (copper laminate area: 25×25 mm)
Junction Temperature ^{*2}	T_j	-30 to +150	°C	
Storage Temperature	T_{stg}	-40 to +150	°C	
Thermal Resistance(junction to case)	θ_{j-c}	40	°C/W	
Thermal Resistance(junction to ambient air)	θ_{j-a}	74	°C/W	When mounted on glass-epoxy board, 30×30 mm (copper laminate area: 25×25 mm)

*1: Limited by thermal protection circuit

*2: Note that the detection temperature for thermal protection is about 140°C.

Applications

- DVD recorder, FPD-TV
- Onboard local power supplies
- OA equipment

Recommended Operating Conditions

Parameter	Symbol	Ratings		Unit	Conditions
		SI-8005Q			
DC Input Voltage Range	V_{IN}	$V_o + 3^{*1}$ to 28		V	
Output Voltage Range	V_o	0.5 to 24		V	
Output Current Range	I_o	0 to 3.5		A	
Operating Junction Temperature Range	T_{jop}	-30 to +125		°C	
Operating Temperature Range	T_{op}	-30 to +85		°C	

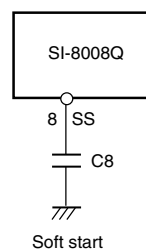
*1: The minimum value of the input voltage range is 4.75 V or $V_o + 3\text{ V}$, whichever is higher.

Electrical Characteristics

($R_1=4.2\text{ k}\Omega$, $R_2=0.8\text{ k}\Omega$ when $T_a = 25^\circ\text{C}$ and $V_o=5\text{V}$)

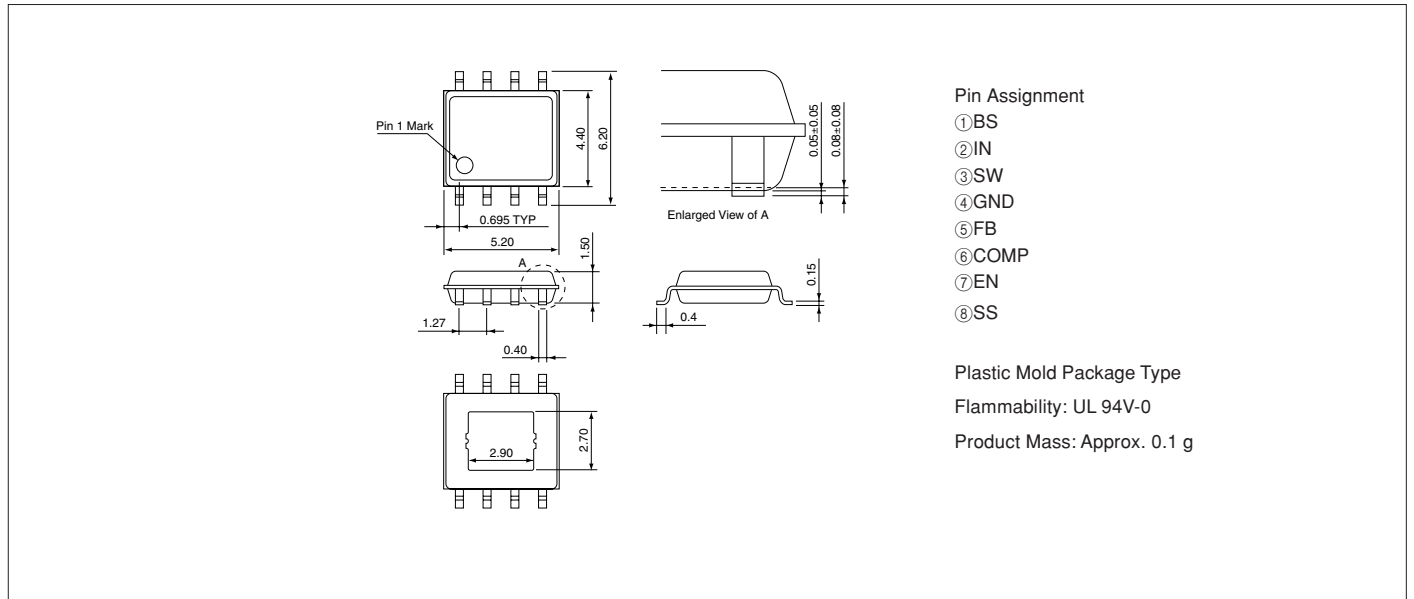
Parameter	Symbol	Rating			Unit
		SI-8005Q			
		min.	typ.	max.	
Reference Voltage	V_{ADJ}	0.485	0.500	0.515	V
	Conditions	$V_{IN}=12\text{V}$, $I_o=1\text{A}$			
Temperature Coefficient of Reference Voltage	$\Delta V_{ADJ}/\Delta T$		0.05		mV/°C
	Conditions	$V_{IN}=12\text{V}$, $I_o=1\text{A}$, $T_a=-40$ to $+85^\circ\text{C}$			
Efficiency	η		90		%
	Conditions	$V_{IN}=12\text{V}$, $I_o=1\text{A}$			
Oscillation Frequency	f_o	450	500	550	kHz
	Conditions	$V_{IN}=16\text{V}$, $I_o=1\text{A}$			
Line Regulation	ΔV_{OLINE}		30	60	mV
	Conditions	$V_{IN}=8$ to 28V , $I_o=1\text{A}$			
Load Regulation	ΔV_{OLOAD}		30	60	mV
	Conditions	$V_{IN}=12\text{V}$, $I_o=0.1$ to 3.5A			
Overcurrent Protection Starting Current	I_s	3.6		6.0	A
	Conditions	$V_{IN}=12\text{V}$			
Quiescent Circuit Current	I_q		18		mA
	Conditions	$V_{IN}=12\text{V}$, $I_o=0\text{A}$, $V_{EN}=\text{open}$			
	$I_{q(\text{OFF})}$			20	μA
SS Pin	Outflow Current at Low Voltage	I_{SSL}	5		μA
		Conditions	$V_{IN}=16\text{V}$, $V_{SSL}=0\text{V}$		
EN Pin	High Level Voltage	V_{CEN}	2.8		V
		Conditions	$V_{IN}=12\text{V}$		
	Low Level Voltage	V_{CEL}			2.2
Inflow Current at Low Voltage	I_{CIEH}		5		μA
	Conditions	$V_{EN}=0\text{V}$			
Error Amplifier Voltage Gain	AEA		1000		V/V
Error Amplifier Transformer Conductance	GEA		800		$\mu\text{A}/\text{V}$
Current Sense Amplifier Impedance	$1/GCS$		0.35		V/A
Maximum ON Duty	DMAX		92		%
Minimum ON Time	DMIN		100		nsec.

*: Pin 8 is the SS pin. Soft start at power on can be performed with a capacitor connected to this pin. The SS pin is pulled up to the power supply in the IC, so applying the external voltage is prohibited.

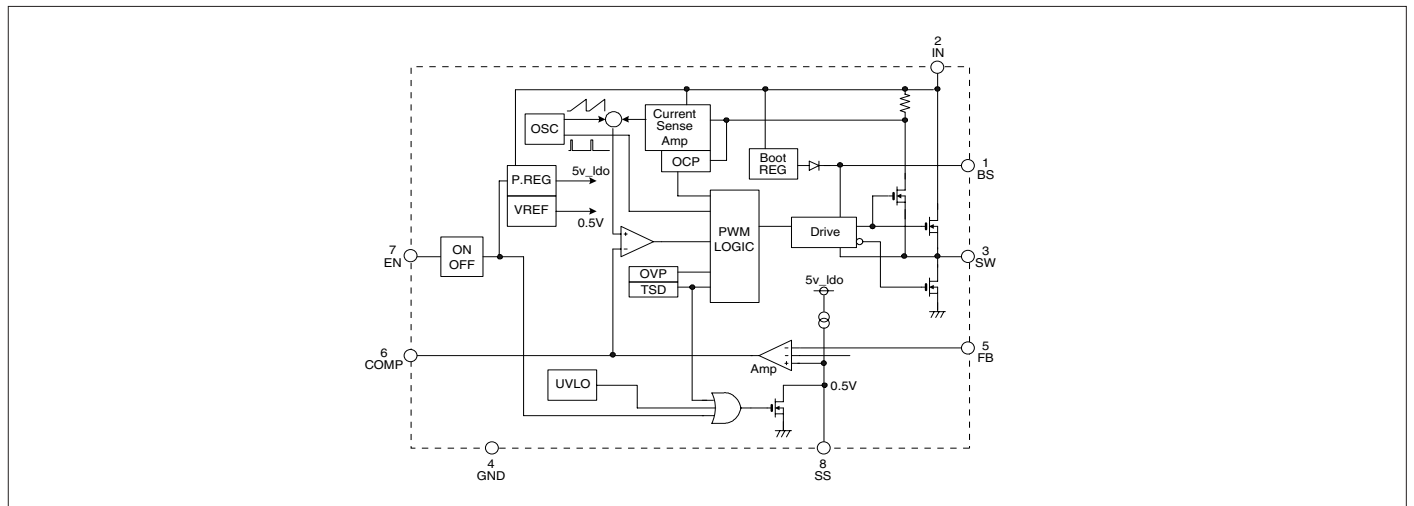


External Dimensions (HSOP8)

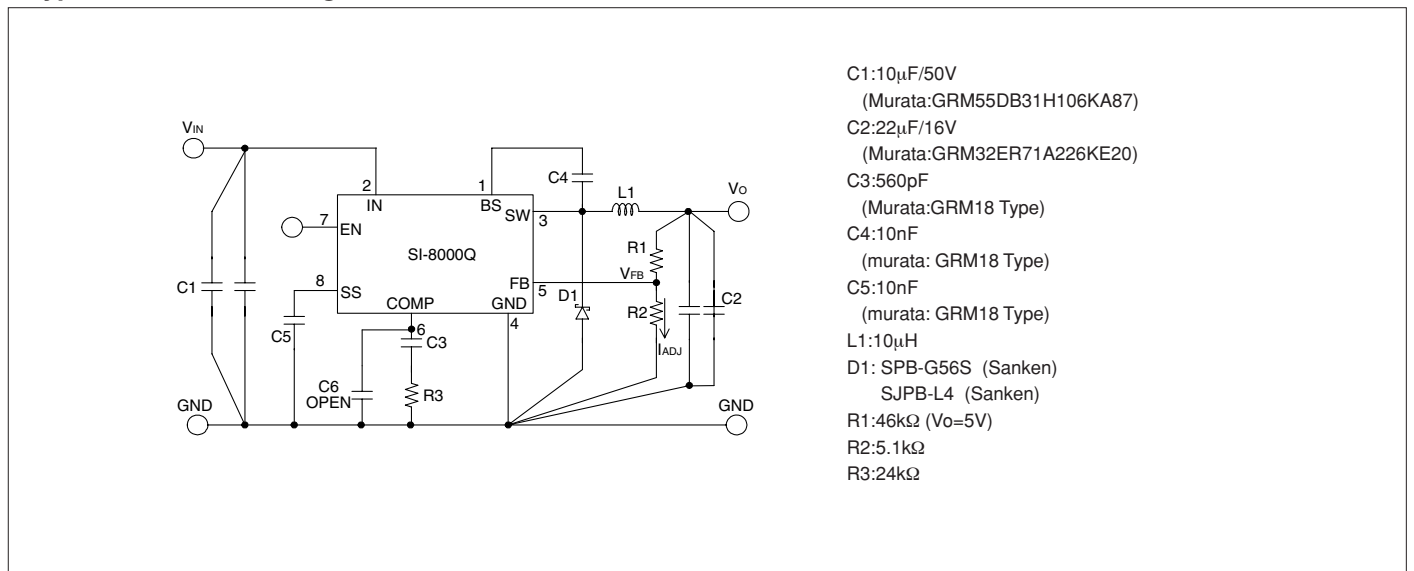
(Unit : mm)



Block Diagram



Typical Connection Diagram



SI-8000FD Series Surface Mount, Separate Excitation Step-down Switching Mode

■Features

- Surface-mount package (TO263-5)
- Output current: 3.5 A
- High efficiency: 83% ($V_o = 5\text{ V}$, $V_{IN} = 15\text{ V}$, $I_o = 2\text{ A}$)
- Requires only 6 discrete components
- Built-in reference oscillator (300 kHz)
- Built-in drooping-type overcurrent and thermal protection circuits
- Built-in soft start circuit (Output ON/OFF available)
 - SI-8001FDE
- Built-in on/off function (active Low)
 - SI-8001FDL
- Low current consumption during off
 - SI-8001FDL

■Lineup

Part Number	SI-8001FDE	SI-8001FDL
V_o (V)	Variable(0.8 to 24)	
I_o (A)	3.5	
Function	Soft start	ON/OFF

■Absolute Maximum Ratings

Parameter	Symbol	Ratings		Unit	Conditions
		SI-8001FDE	SI-8001FDL		
Input Voltage	V_{IN}	43		V	
ON/OFF Control Voltage	V_c	—	V_{IN}	V	
Power Dissipation ^{*1}	P_D	3		W	When mounted on glass-epoxy board measuring 40x40 mm (copper laminate area: 100%)
Junction Temperature ^{*2}	T_j	+150		°C	
Storage Temperature	T_{stg}	-40 to +150		°C	
Thermal Resistance (Junction to Case)	θ_{j-c}	3 ^{*1}		°C/W	When mounted on glass-epoxy board measuring 40x40 mm (copper laminate area: 100%)
Thermal Resistance (Junction to Ambient Air)	θ_{j-a}	33.3 ^{*1}		°C/W	When mounted on glass-epoxy board measuring 40x40 mm (copper laminate area: 100%)

*1 : Limited by thermal protection circuit

*2 : This product has built-in thermal protection circuits that may activate when the junction temperature exceeds 130°C. The recommended design for the junction temperature during IC operation is below 125°C.

■Applications

- DVD recorder, FPD-TV
- OA equipment, such as printers
- Onboard local power supplies

■Recommended Operating Conditions

Parameter	Symbol	Ratings		Unit
		SI-8001FDE	SI-8001FDL	
Input Voltage Range	V_{IN}	$V_o + 3^{*1}$ to 40		V
Output Voltage Range	V_o	0.8 to 24		V
Output Current Range	I_o	0 to 3.5		A
Operating Junction Temperature Range	T_{jop}	-30 to +100		°C
Operating Temperature Range	T_{op}	-30 to +85		°C

*1: The minimum value of the input voltage range is 4.5 V or $V_o + 3\text{ V}$, whichever is higher.

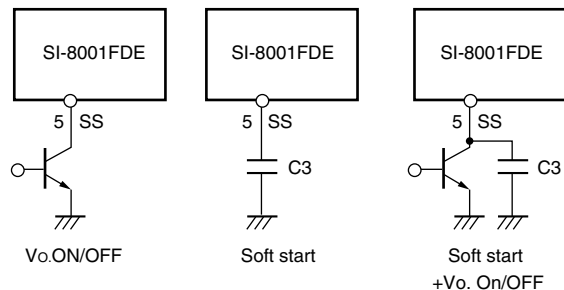
■Electrical Characteristics

($R_1 = 4.2\text{ k}\Omega$, $R_2 = 0.8\text{ k}\Omega$ when $T_a = 25^\circ\text{C}$ and $V_o = 5\text{V}$)

Parameter	Symbol	Ratings						Unit
		SI-8001FDE			SI-8001FDL			
		min.	typ.	max.	min.	typ.	max.	
Reference Voltage	V_{ADJ}	0.784	0.800	0.816	0.784	0.800	0.816	V
Temperature Coefficient of Reference Voltage	$\Delta V_{ADJ}/\Delta T$	± 0.1			± 0.1			mV/°C
	Conditions	$V_{IN} = 15\text{V}$, $I_o = 0.2\text{A}$, $T_c = 0$ to 100°C			$V_{IN} = 15\text{V}$, $I_o = 0.2\text{A}$, $T_c = 0$ to 100°C			
Efficiency	η	83			83			%
	Conditions	$V_{IN} = 15\text{V}$, $I_o = 2\text{A}$			$V_{IN} = 15\text{V}$, $I_o = 2\text{A}$			
Oscillation Frequency	f_o	270	300	330	270	300	330	kHz
	Conditions	$V_{IN} = 15\text{V}$, $I_o = 2\text{A}$			$V_{IN} = 15\text{V}$, $I_o = 2\text{A}$			
Line Regulation	ΔV_{OLINE}	80			80			mV
	Conditions	$V_{IN} = 10$ to 30V , $I_o = 2\text{A}$			$V_{IN} = 10$ to 30V , $I_o = 2\text{A}$			
Load Regulation	ΔV_{LOAD}	50			50			mV
	Conditions	$V_{IN} = 15\text{V}$, $I_o = 0.2$ to 3.5A			$V_{IN} = 15\text{V}$, $I_o = 0.2$ to 3.5A			
Overcurrent Protection Starting Current	I_s	3.6			3.6			A
	Conditions	$V_{IN} = 15\text{V}$			$V_{IN} = 15\text{V}$			
SS Pin ^{*1}	Low Level Voltage	V_{SSL}		0.5	—	—	—	V
	Outflow Current at Low Voltage	I_{SSL}	6	30	—	—	—	μA
	Conditions	$V_{IN} = 15\text{V}$, $V_{SS} = 0\text{V}$						
ON/OFF Pin ^{*2}	ON/OFF Control Voltage (Output on)	V_c, IH	—	—	—	—	0.8	V
	ON/OFF Control Voltage (Output off)	V_c, IL	—	—	2.0	—	—	V
	ON/OFF Control Current (Output on)	I_c, IH	—	—	—	6	100	μA
Conditions				$V_c = 2\text{V}$				
Quiescent Circuit Current	I_q		6			6		mA
	Conditions	$V_{IN} = 15\text{V}$, $I_o = 0\text{A}$			$V_{IN} = 15\text{V}$, $I_o = 0\text{A}$			
	$I_q(\text{OFF})$		200	600		30	200	μA
	Conditions	$V_{IN} = 15\text{V}$, $V_{SS} = 0\text{V}$			$V_{IN} = 15\text{V}$, $V_c = 2\text{V}$			

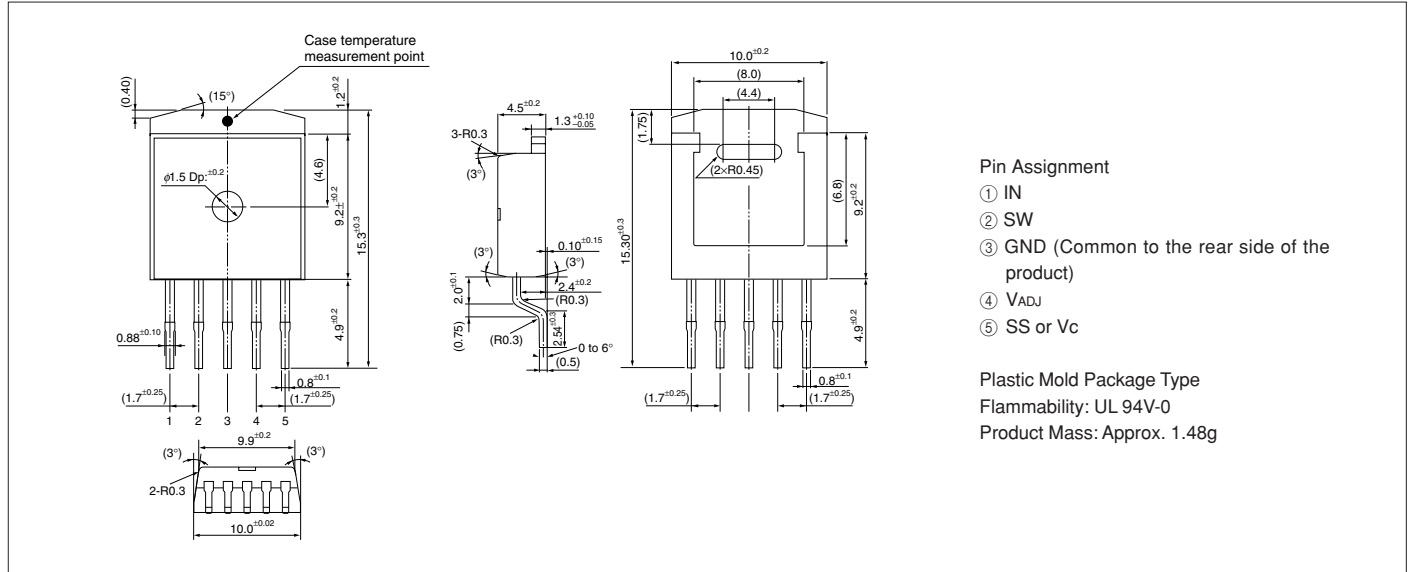
*1: Pin 5 is the SS pin. Soft start at power on can be performed with a capacitor connected to this pin. The output can also be turned ON/OFF with this pin. The output is stopped by setting the voltage of this pin to V_{SSL} or lower. SS-pin voltage can be changed with an open-collector drive circuit of a transistor. When using both the soft-start and ON/OFF functions together, the discharge current from C3 flows into the ON/OFF control transistor. Therefore, limit the current securely to protect the transistor if C3 capacitance is large. The SS pin is pulled up (3.7 V typ.) to the power supply in the IC, so applying the external voltage is prohibited. If this pin is not used, leave it open.

*2: Output is OFF when the output control terminal VC is open. Each input level is equivalent to LS-TTL. Therefore, the device can be driven directly by LS-TTLs.

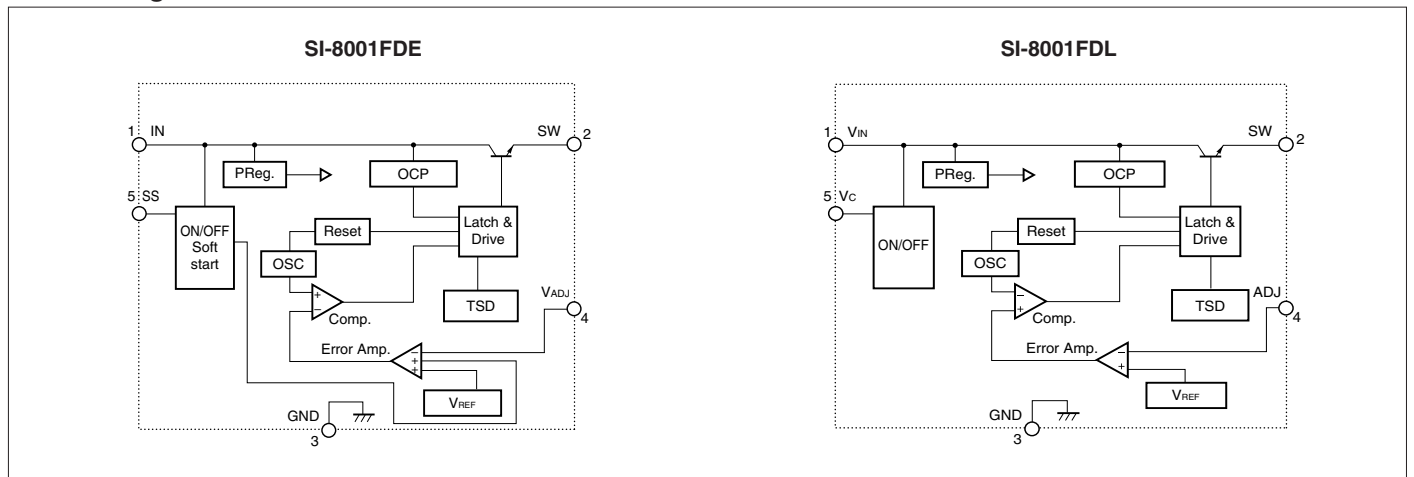


External Dimensions (TO263-5)

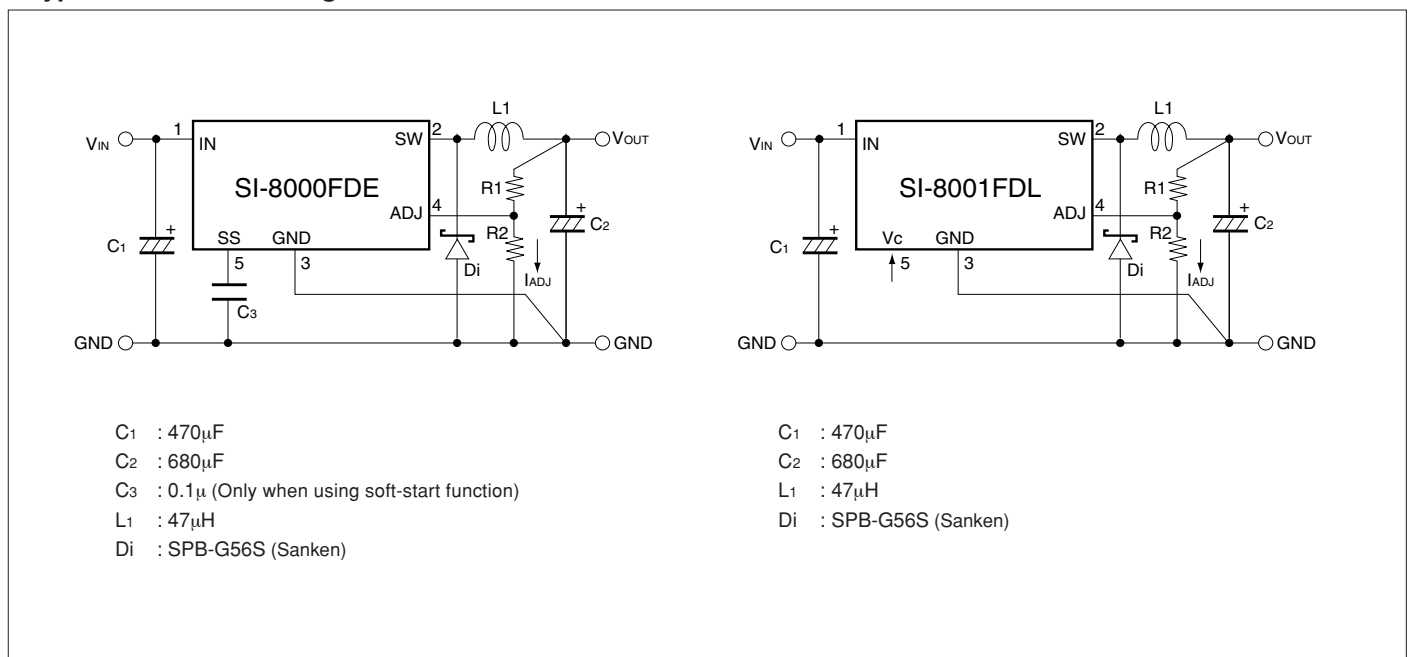
(Unit : mm)



Block Diagram



Typical Connection Diagram



SI-8000HD Series Surface-Mount, Separate Excitation Step-down Switching Mode

Features

- Surface-mount package (TO263-5)
- Output current: 5.5 A
- High efficiency: 83% (at TYP, $V_o = 5\text{ V}$)
- Requires only 5 discrete components (SI-8008HD)
- Built-in reference oscillator (150 kHz)
- Built-in drooping-type overcurrent and thermal protection circuits
- Built-in soft start circuit (Output ON/OFF available)
- Low current consumption during off

Applications

- DVD recorder, FPD-TV
- Onboard local power supplies
- OA equipment

Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit	Conditions
Input Voltage	V_{IN}	43	V	
Power Dissipation ^{*1}	P_D	3	W	When mounted on glass-epoxy board measuring 40×40 mm (copper laminate area: 100%)
Junction Temperature ^{*2}	T_J	+150	°C	
Storage Temperature	T_{stg}	-40 to +150	°C	
Thermal Resistance (Junction to Case)	θ_{j-c}	3	°C/W	When mounted on glass-epoxy board measuring 40×40 mm (copper laminate area: 100%)
Thermal Resistance (Junction to Ambient Air)	θ_{j-a}	33.3	°C/W	When mounted on glass-epoxy board measuring 40×40 mm (copper laminate area: 100%)

*1: Limited by thermal protection circuit

*2: This product has built-in thermal protection circuits that may activate when the junction temperature exceeds 130°C. The recommended design for the junction temperature during IC operation is below 125°C.

Recommended Operating Conditions

Parameter	Symbol	Ratings	Unit	Conditions
		SI-8008HD		
Input Voltage Range	V_{IN}	V_o+3 ^{*1} to 40	V	
Output Voltage Range	V_o	0.8 to 24	V	
Output Current Range	I_o	0 to 5.5	A	$V_{IN} \geq V_o+3\text{V}$
Operating Junction Temperature Range	T_{jop}	-30 to +100	°C	
Operating Temperature Range	T_{op}	-30 to +85	°C	

*1: The minimum value of the input voltage range is 4.5 V or $V_o+3\text{ V}$, whichever is higher.

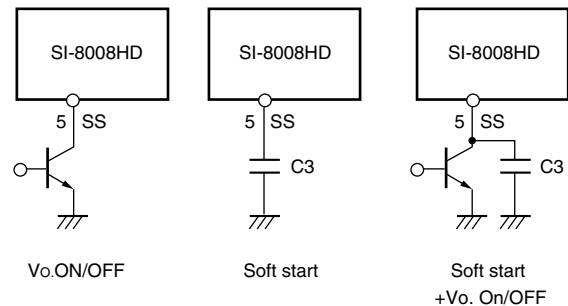
Electrical Characteristics

($R_1=4.2\text{k}\Omega$, $R_2=0.8\text{k}\Omega$ when $T_a=25^\circ\text{C}$ and $V_o=5\text{V}$)

Parameter	Symbol	Ratings			Unit
		SI-8008HD			
		min.	typ.	max.	
Reference Voltage	V_{ADJ}	0.784	0.800	0.816	V
Temperature Coefficient of Reference Voltage	$(\Delta V_{ADJ}/\Delta T)$		+0.1		mV/°C
	Conditions	$V_{IN}=15\text{V}$, $I_o=1\text{A}$, $T_c=0$ to 100°C			
Efficiency	η		83		%
	Conditions	$V_{IN}=15\text{V}$, $I_o=3\text{A}$			
Oscillation Frequency	f_o		150		kHz
	Conditions	$V_{IN}=15\text{V}$, $I_o=3\text{A}$			
Line Regulation	ΔV_{OLINE}		60	80	mV
	Conditions	$V_{IN}=10$ to 30V , $I_o=3\text{A}$			
Load Regulation	ΔV_{OLOAD}		20	50	mV
	Conditions	$V_{IN}=15\text{V}$, $I_o=0.2$ to 5.5A			
Overcurrent Protection Starting Current	I_s	5.6	6.5	7.5	A
	Conditions	$V_{IN}=15\text{V}$			
SS Pin ^{*1}	Low Level Voltage	V_{SSL}		0.5	V
	Outflow Current at Low Voltage	I_{SSL}	10	30	μA
Quiescent Circuit Current		Conditions	I_q	6	
	$V_{IN}=15\text{V}$, $I_o=0\text{A}$				
	$I_{q(OFF)}$	200	400	μA	
Conditions		$V_{IN}=15\text{V}$, $V_{SS}=0\text{V}$			

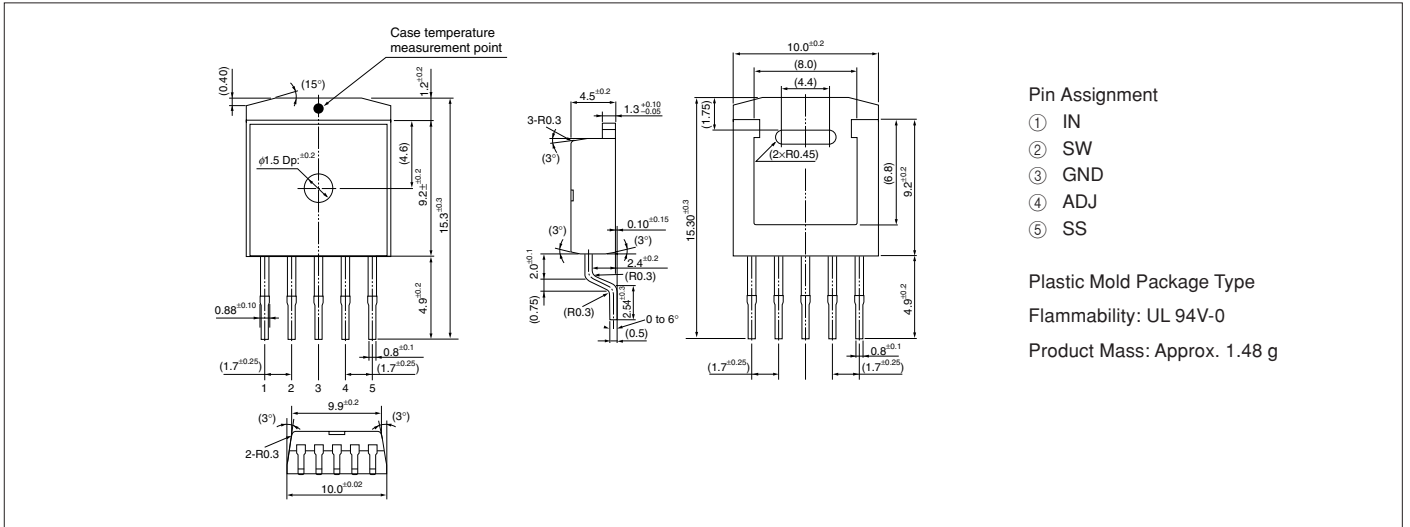
*1: Pin 5 is the SS pin. Soft start at power on can be performed with a capacitor connected to this pin. The output can also be turned ON/OFF with this pin.

The output is stopped by setting the voltage of this pin to V_{SSL} or lower. SS-pin voltage can be changed with an open-collector drive circuit of a transistor. When using both the soft-start and ON/OFF functions together, the discharge current from C3 flows into the ON/OFF control transistor. Therefore, limit the current securely to protect the transistor if C3 capacitance is large. The SS pin is pulled up (3.7 V typ.) to the power supply in the IC, so applying the external voltage is prohibited. If this pin is not used, leave it open.

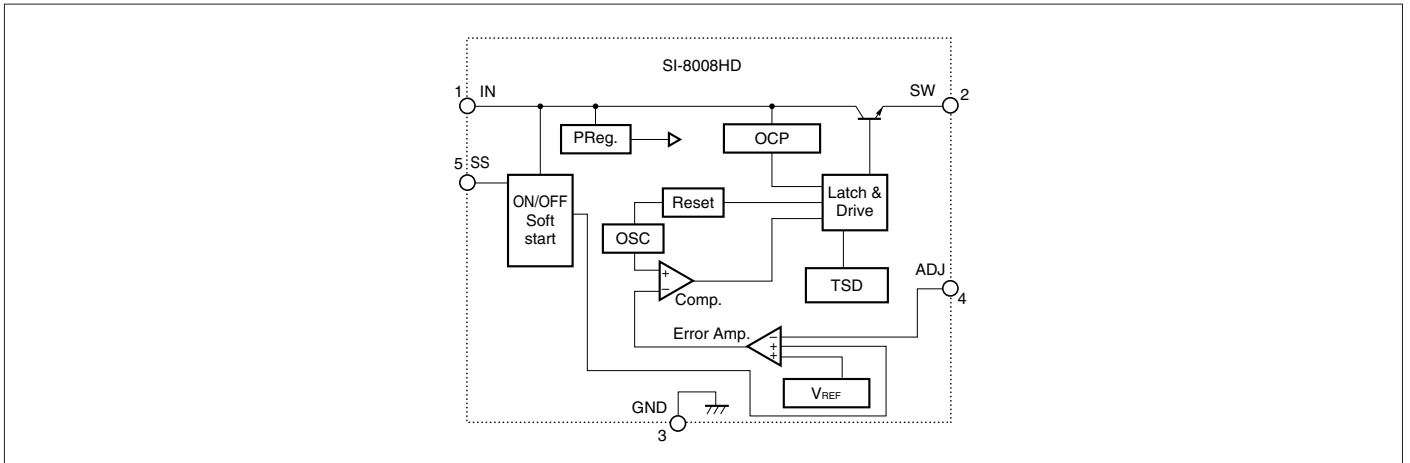


External Dimensions (TO263-5)

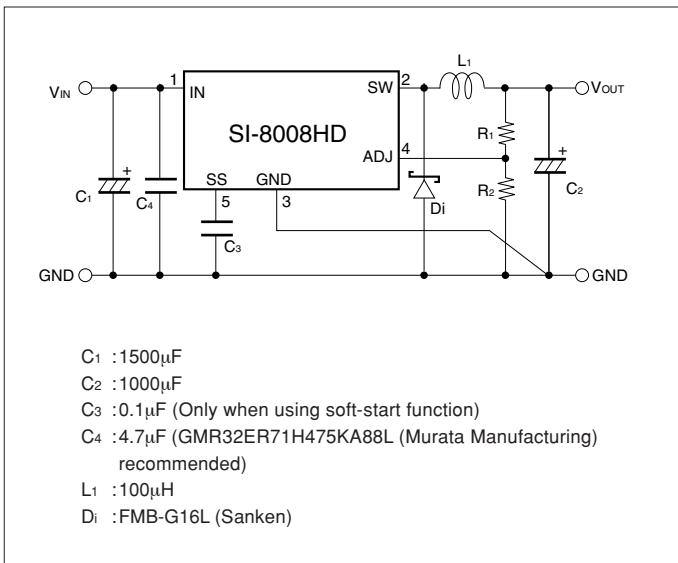
(Unit : mm)



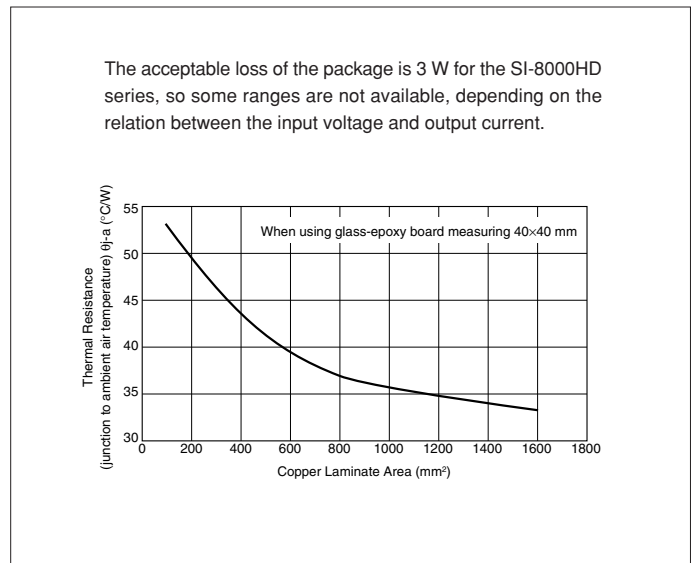
Block Diagram



Typical Connection Diagram



Reference Data



SI-8000E Series Full-Mold, Separate Excitation Step-down Switching Mode

■Features

- Compact full-mold package (equivalent to TO220)
- High efficiency: 80%
- Requires only 4 discrete components
- Internally-adjusted phase correction and output voltage
- 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
Vo(V)	5.0
Io(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)	θ _{J-c}	7.0	°C/W
Thermal Resistance(junction to ambient air)	θ _{J-a}	66.7	°C/W

■Recommended Operating Conditions

Parameter	Symbol	Ratings		Unit
		SI-8050E		
DC Input Voltage Range	V _{IN}	7 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

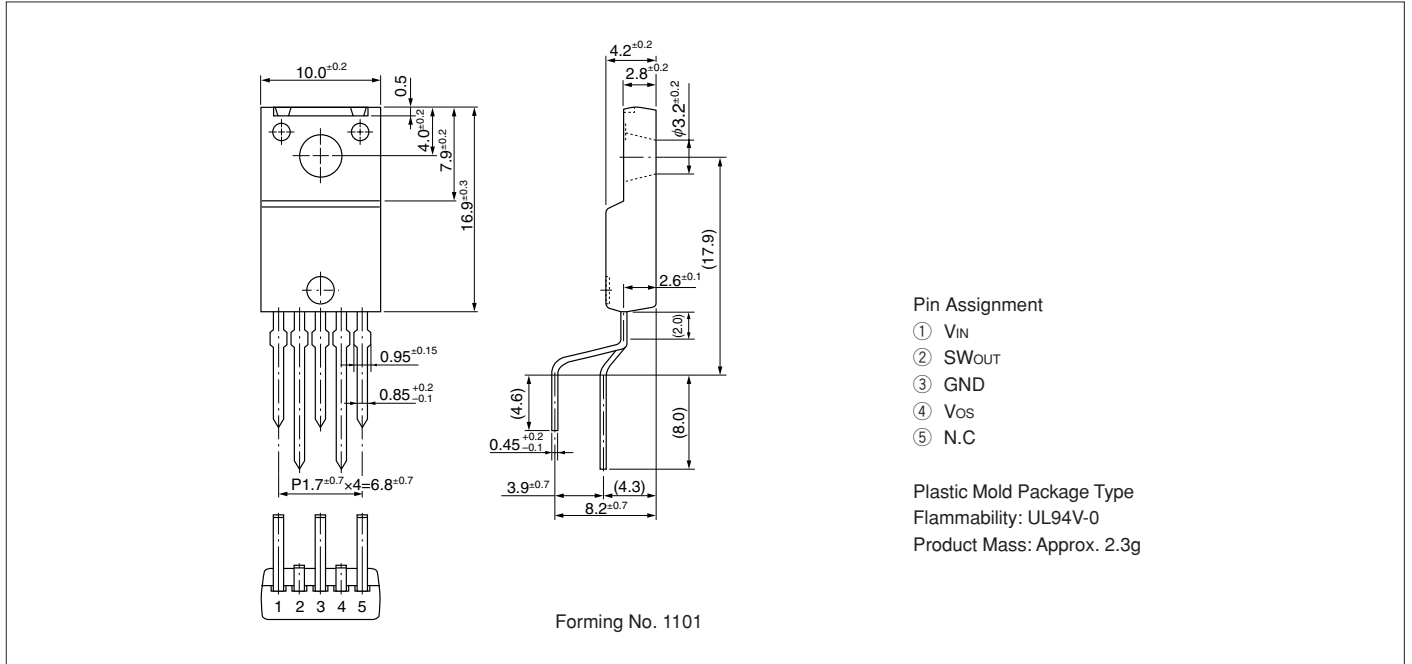
■Electrical Characteristics

(T_a=25°C)

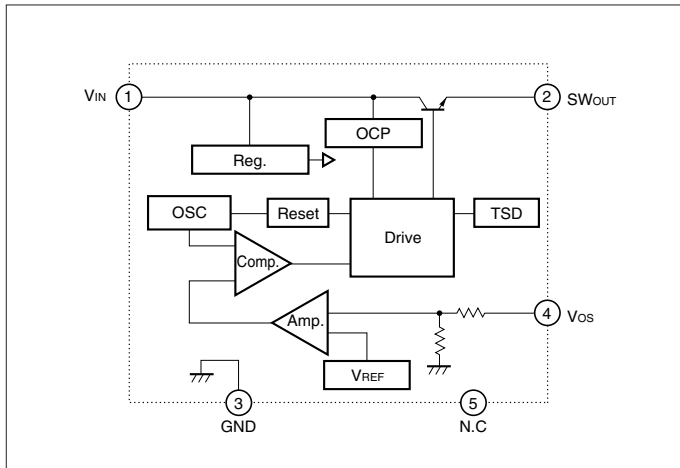
Parameter	Symbol	Ratings			Unit
		SI-8050E			
		min.	typ.	max.	
Output Voltage	V _O	4.80	5.00	5.20	V
	Conditions	V _{IN} =20V, I _O =0.3A			
Efficiency	η		80		%
	Conditions	V _{IN} =20V, I _O =0.3A			
Oscillation Frequency	f		60		kHz
	Conditions	V _{IN} =20V, I _O =0.3A			
Line Regulation	ΔV _{OLINE}		80	100	mV
	Conditions	V _{IN} =10 to 30V, I _O =0.3A			
Load Regulation	ΔV _{OLOAD}		30	40	mV
	Conditions	V _{IN} =20V, I _O =0.1 to 0.4A			
Temperature Coefficient of Output Voltage	ΔV _O /ΔT _a		±0.5		mV/°C
Overcurrent Protection Starting Current	I _{S1}	0.61			A
	Conditions	V _{IN} =10V			

External Dimensions (TO220F-5)

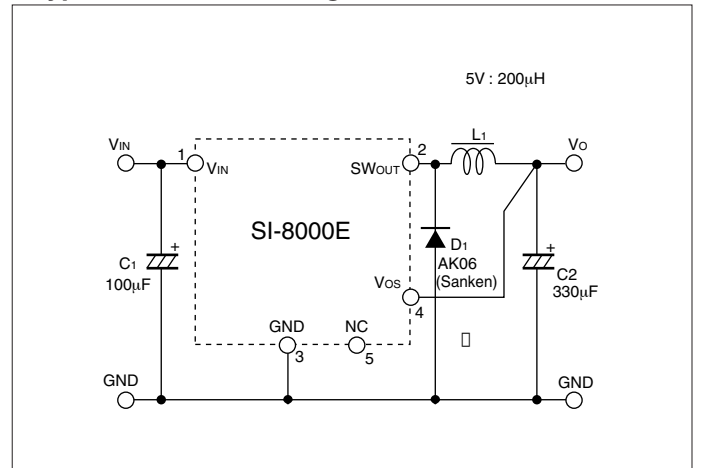
(Unit : mm)



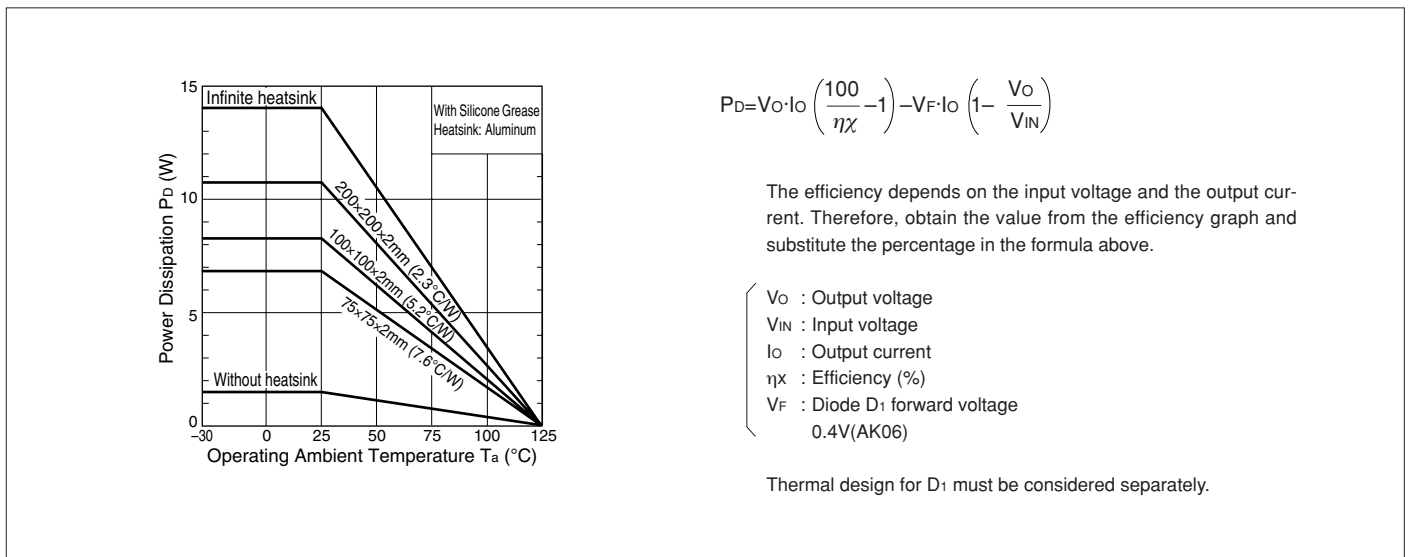
Block Diagram



Typical Connection Diagram



Ta-Pd Characteristics



SI-8000JF Series Full-Mold, Separate Excitation Step-down Switching Mode

Features

- Compact full-mold package (equivalent to TO220)
- Output current: 1.5A
- High efficiency: 67 to 88%
- Requires only 4 discrete components
- Internally-adjusted phase correction and output voltage
- Capable of downsize a choke-coil due to IC's high switching frequency (125kHz). (Compared with conventional Sanken devices)
- Built-in foldback-overcurrent and thermal protection circuits
- Output ON/OFF available (circuit current at output OFF: 200 μ A max.)
- Soft start available by ON/OFF pin

Lineup

Part Number	SI-8015JF	SI-8033JF	SI-8050JF	SI-8120JF
V _O (V)*	1.59	3.3	5.0	12.0
I _O (A)	1.5			

* V_{REF}(V) for SI-8015JF

Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit
DC Input Voltage	V _{IN}	43	V
Power Dissipation	P _{D1}	16.6 (with infinite heatsink)	W
	P _{D2}	1.5 (without heatsink, standalone operation)	W
Junction Temperature	T _j	+125	°C
Storage Temperature	T _{stg}	-40 to +125	°C
Thermal Resistance (Junction to Case)	θ_{j-c}	6.0	°C/W

Applications

- Power supplies for telecommunication equipment
- Onboard local power supplies

Recommended Operating Conditions

Parameter	Symbol	Ratings				Unit	Conditions
		SI-8015JF*	SI-8033JF	SI-8050JF	SI-8120JF		
DC Input Voltage Range	V _{IN1}	V _O +2 to 40	5.3 to 40	7 to 40	14 to 40	V	I _O =0 to 1A
	V _{IN2}	V _O +3 to 40	6.3 to 40	8 to 40	15 to 40	V	I _O =0 to 1.5A
Output Current Range	I _O	0 to 1.5				A	V _{IN} ≥V _O +3V
Operating Junction Temperature Range	T _{top}	-30 to +125				°C	

* SI-8015JF is a variable output voltage type. The variable output voltage range is from 2.5 V to 24 V.

Electrical Characteristics

(T_a=25°C)

Parameter	Symbol	Ratings												Unit
		SI-8015JF			SI-8033JF			SI-8050JF			SI-8120JF			
		min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	
Output Voltage ¹	V _O ²	1.558	1.59	1.622	3.234	3.30	3.366	4.90	5.00	5.10	11.76	12.00	12.24	V
	Conditions	V _{IN} =12V, I _O =0.5A			V _{IN} =15V, I _O =0.5A			V _{IN} =20V, I _O =0.5A			V _{IN} =24V, I _O =0.5A			
Efficiency	η	67			77			82			88			%
	Conditions	V _{IN} =12V, I _O =0.5A			V _{IN} =15V, I _O =0.5A			V _{IN} =20V, I _O =0.5A			V _{IN} =24V, I _O =0.5A			
Oscillation Frequency	f	125			125			125			125			kHz
	Conditions	V _{IN} =12V, I _O =0.5A			V _{IN} =15V, I _O =0.5A			V _{IN} =20V, I _O =0.5A			V _{IN} =24V, I _O =0.5A			
Line Regulation	ΔV_{OLINE}	25 80			25 80			40 100			60 130			mV
	Conditions	V _{IN} =8 to 30V, I _O =0.5A			V _{IN} =8 to 30V, I _O =1.0A			V _{IN} =10 to 30V, I _O =1.0A			V _{IN} =18 to 30V, I _O =1.0A			
Load Regulation	ΔV_{OLOAD}	10 30			10 30			10 40			10 40			mV
	Conditions	V _{IN} =12V, I _O =0.2 to 0.8A			V _{IN} =15V, I _O =0.5 to 1.5A			V _{IN} =20V, I _O =0.5 to 1.5A			V _{IN} =24V, I _O =0.5 to 1.5A			
Temperature Coefficient of Output Voltage ³	$\Delta V_O/\Delta T_a$ ⁴	±0.5			±0.5			±0.5			±1.0			mV/°C
Overcurrent Protection Starting Current	I _{SI}	1.6			1.6			1.6			1.6			A
ON/OFF ⁵ Terminal	Low Level Voltage	V _{SSL}			0.5			0.5			0.5			V
	Outflow Current at Low Voltage	I _{SSL}			100			100			100			μ A
Quiescent Circuit Current	I _q	7			7			7			7			mA
	Conditions	V _{IN} =12V, I _O =0A			V _{IN} =15V, I _O =0A			V _{IN} =20V, I _O =0A			V _{IN} =24V, I _O =0A			
	I _{q(OFF)}	200			200			200			200			μ A
Conditions	V _{IN} =12V, V _{ON/OFF} =0.3V			V _{IN} =15V, V _{ON/OFF} =0.3V			V _{IN} =20V, V _{ON/OFF} =0.3V			V _{IN} =24V, V _{ON/OFF} =0.3V				

*1: Reference voltage for SI-8015JF

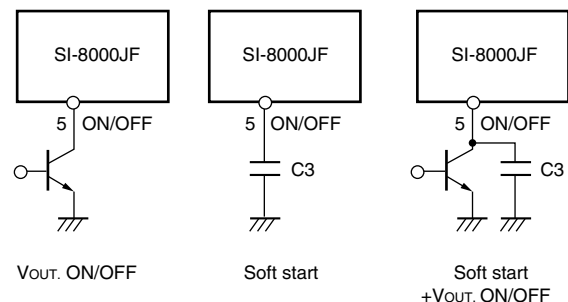
*3: Temperature Coefficient of Reference Voltage for SI-8015JF

*2: V_{REF} for SI-8015JF

*4: $\Delta V_{REF}/\Delta T_a$ for SI-8015JF

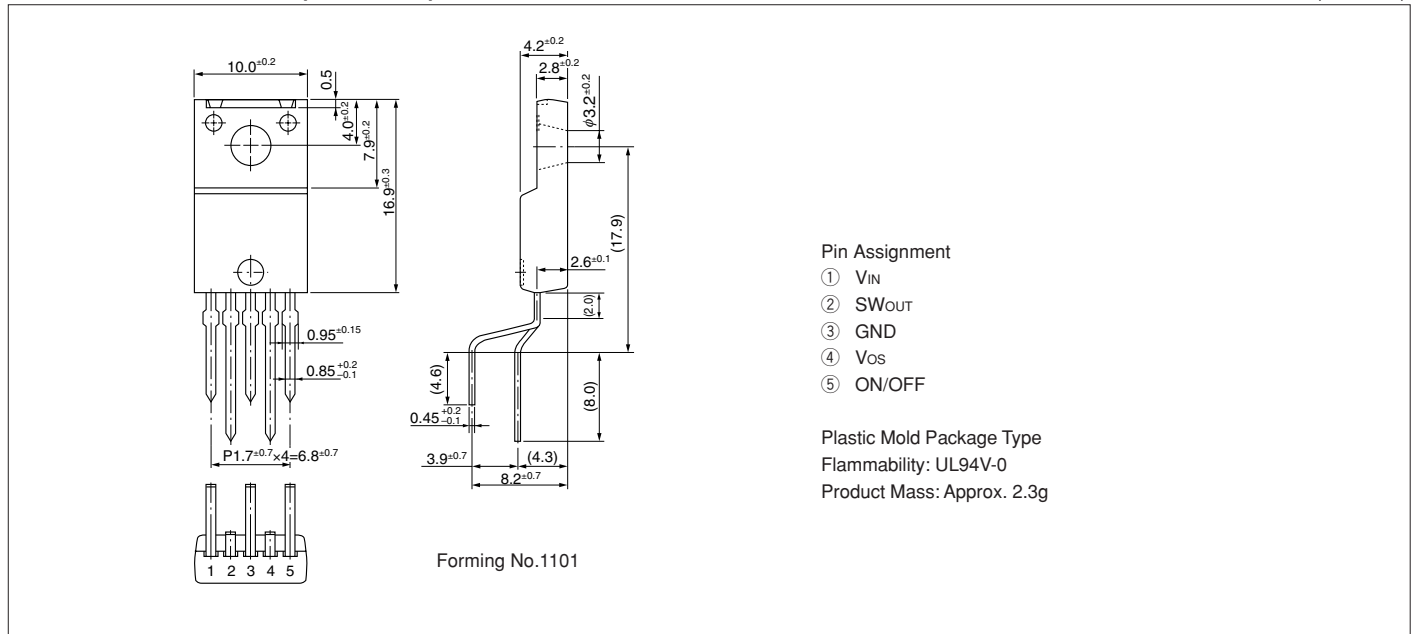
*5: Pin 5 is the ON/OFF pin. Soft start at power on can be performed with a capacitor connected to this pin.

The output can also be turned ON/OFF with this pin. The output is stopped by setting the voltage of this pin to V_{SSL} or lower. ON/OFF-pin voltage can be changed with an open-collector drive circuit of a transistor. When using both the soft-start and ON/OFF functions together, the discharge current from C₃ flows into the ON/OFF control transistor. Therefore, limit the current securely to protect the transistor if C₃ capacitance is large. The ON/OFF pin is pulled up to the power supply in the IC, so applying the external voltage is prohibited. If this pin is not used, leave it open.

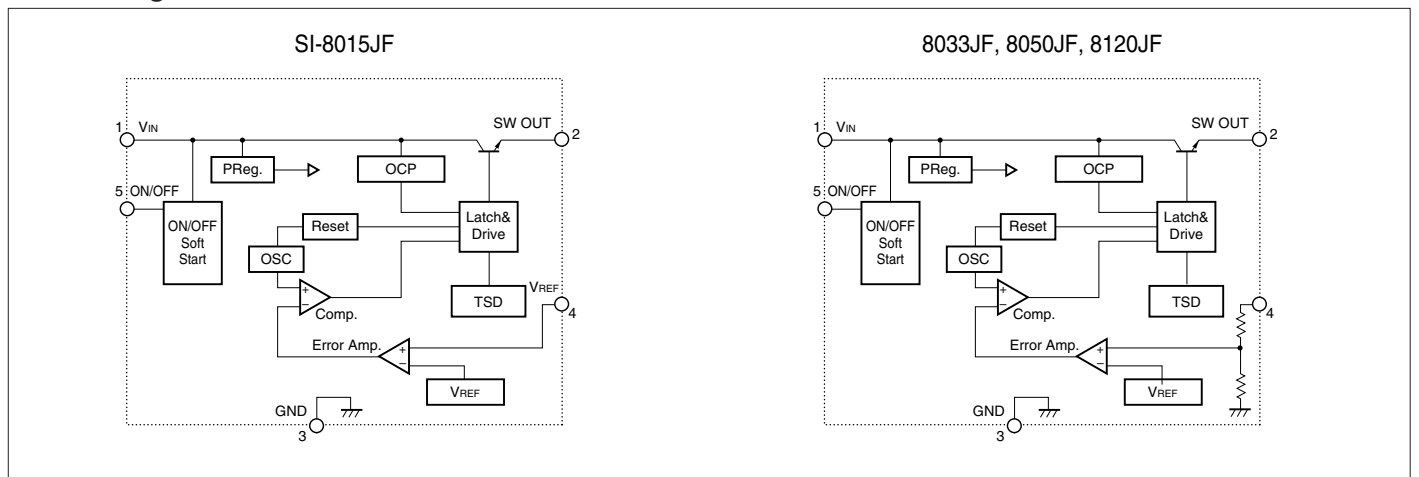


External Dimensions (TO220F-5)

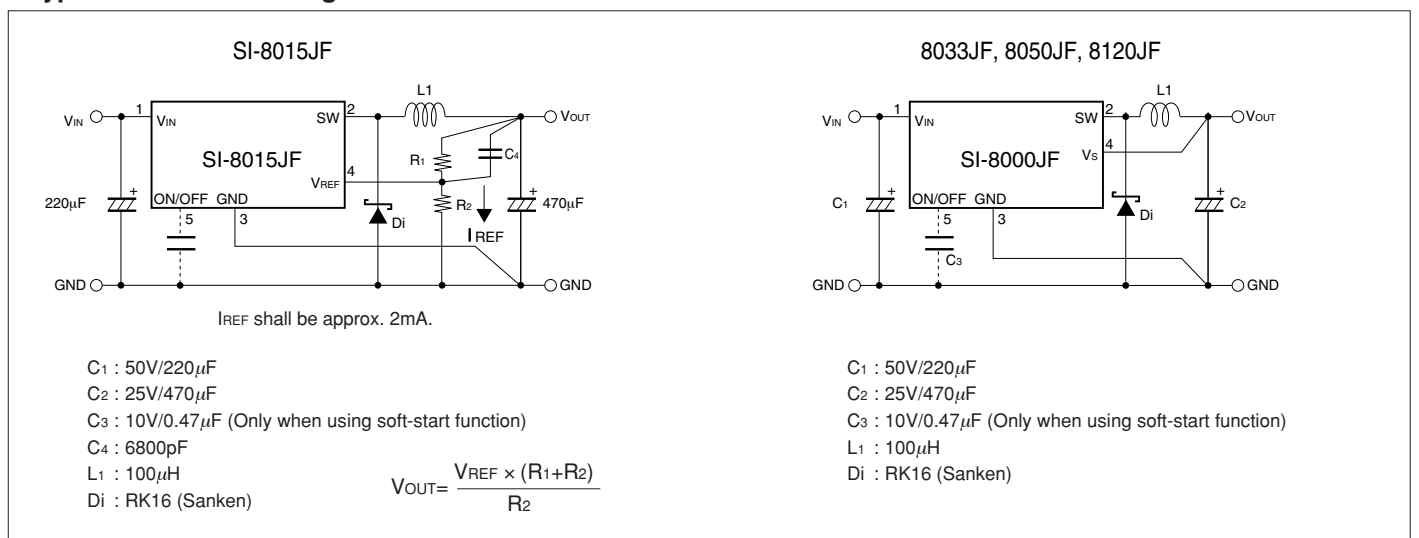
(Unit : mm)



Block Diagram



Typical Connection Diagram



SI-8000TFE Series Full-Mold, Separate Excitation Step-down Switching Mode

Features

- Compact full-mold package (equivalent to TO220)
- Output current: 1.5 A
- High efficiency: 81% typ. (at $V_o = 5\text{ V}$)
- Requires only 4 discrete components
- Built-in reference oscillator (300 kHz)
- Built-in dropping-type-overcurrent and thermal protection circuits
- Output ON/OFF available (circuit current at output OFF: $200\mu\text{A}$ typ.)
- Soft start available by ON/OFF pin

Applications

- Onboard local power supplies
- AV equipment
- OA equipment

Lineup

Part Number	SI-8008TFE	SI-8050TFE
V_o (V)	Variable (0.8 to 24)	5
I_o (A)		1.5

Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit	Conditions
DC Input Voltage	V_{IN}	43	V	
Power Dissipation	P_{D1-1}	17.8 (with infinite heatsink)	W	Limited by thermal protection, $T_{jmax}=150^\circ\text{C}$
	P_{D1-2}	14.2 (with infinite heatsink)		$T_{jmax}=125^\circ\text{C}$
	P_{D2-1}	2.15 (without heat sink, standalone operation)		Limited by thermal protection, $T_{jmax}=150^\circ\text{C}$
	P_{D2-2}	1.72 (without heatsink, standalone operation)		$T_{jmax}=125^\circ\text{C}$
Junction Temperature*	T_j	-30 to +150	$^\circ\text{C}$	
Storage Temperature	T_{stg}	-40 to +150	$^\circ\text{C}$	
Thermal Resistance (Junction to Case)	θ_{j-c}	7	$^\circ\text{C}/\text{W}$	
Thermal Resistance (Junction to Ambient Air)	θ_{j-a}	58	$^\circ\text{C}/\text{W}$	

*: This product has built-in thermal protection circuits that may operate when the junction temperature rises above 130°C . The recommended design for the junction temperature during operation is below 125°C .

Recommended Operating Conditions

Parameter	Symbol	Ratings		Unit
		SI-8008TFE	SI-8050TFE	
Input Voltage Range	V_{IN}	V_o+3^1 to 40	8 to 40	V
Output Voltage Range	V_o	0.8 to 24	5.0	V
Output Current Range	I_o		0 to 1.5	A
Operating Junction Temperature Range	T_{jop}		-20 to +125	$^\circ\text{C}$
Operating Temperature Range	T_{op}		-20 to +85	$^\circ\text{C}$

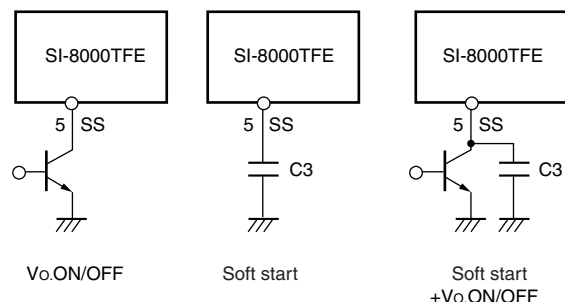
*1: The minimum value of an input voltage range is the higher of 4.5 V or $V_o + 3\text{ V}$.

Electrical Characteristics

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

Parameter	Symbol	Ratings			Ratings			Unit	
		SI-8008TFE			SI-8050TFE				
		min.	typ.	max.	min.	typ.	max.		
Output Voltage (Reference Voltage)	V_o (V_{ADJ})	0.784	0.800	0.816	4.90	5.00	5.10	V	
	Conditions	$V_{IN}=15\text{V}, I_o=0.1\text{A}$			$V_{IN}=15\text{V}, I_o=0.1\text{A}$				
Temperature Coefficient of Output Voltage (Temperature Coefficient of Reference Voltage)	$\Delta V_o/\Delta T$ ($\Delta V_{REF}/\Delta T$)		± 0.1			± 0.5		$\text{mV}/^\circ\text{C}$	
	Conditions	$V_{IN}=15\text{V}, I_o=0.1\text{A}, T_c=0$ to 100°C			$V_{IN}=15\text{V}, I_o=0.1\text{A}, T_c=0$ to 100°C				
Efficiency	η		81			81		%	
	Conditions	$V_{IN}=15\text{V}, I_o=0.5\text{A}$			$V_{IN}=15\text{V}, I_o=0.5\text{A}$				
Oscillation Frequency	f_o		300			300		kHz	
	Conditions	$V_{IN}=15\text{V}, I_o=0.5\text{A}$			$V_{IN}=15\text{V}, I_o=0.5\text{A}$				
Line Regulation	ΔV_{OLINE}		60	80		60	80	mV	
	Conditions	$V_{IN}=10$ to $30\text{V}, I_o=0.5\text{A}$			$V_{IN}=10$ to $30\text{V}, I_o=0.5\text{A}$				
Load Regulation	ΔV_{OLOAD}		10	40		10	40	mV	
	Conditions	$V_{IN}=15\text{V}, I_o=0.2$ to 1.5A			$V_{IN}=15\text{V}, I_o=0.2$ to 1.5A				
Overcurrent Protection Starting Current	I_s	1.6			1.6			A	
	Conditions	$V_{IN}=15\text{V}$			$V_{IN}=15\text{V}$				
ON/OFF Pin*	Low Level Voltage	V_{SSL}		0.5			0.5	V	
	Outflow Current at Low Voltage	I_{SSL}		10	40		10		μA
Quiescent Circuit Current	I_q	Conditions	6			6			mA
		Conditions	$V_{IN}=15\text{V}, I_o=0\text{A}$			$V_{IN}=15\text{V}, I_o=0\text{A}$			
	$I_{q(OFF)}$	Conditions	200			200			μA
		Conditions	$V_{IN}=15\text{V}, V_{SS}=0\text{V}$			$V_{IN}=15\text{V}, V_{SS}=0\text{V}$			

*: Pin 5 is the SS pin. Soft start at power on can be performed with a capacitor connected to this pin. The output can also be turned ON/OFF with this pin. The output is stopped by setting the voltage of this pin to V_{SSL} or lower. SS-pin voltage can be changed with an open-collector drive circuit of a transistor. When using both the soft-start and ON/OFF functions together, the discharge current from C3 flows into the ON/OFF control transistor. Therefore, limit the current securely to protect the transistor if C3 capacitance is large. The SS pin is pulled up to the power supply in the IC, so applying the external voltage is prohibited. If the pin is not used, leave it open.



SI-8000GL Series Compact, Separate Excitation Step-down Switching Mode

■Features

- DIP 8 pin package
- Output current: 1.5A
- High efficiency: 86% (at $V_{IN} = 20V$, $I_o = 1A$, $V_o = 5V$)
- Capable of downsize a choke-coil due to IC's high switching frequency (250kHz). (Compared with conventional Sanken devices)
- The output-voltage-variable type can vary its output voltage from 1V to 14V because of its low reference voltage (V_{ref}) of 1V.
- Wide Input Voltage Range (8 to 50V)
- Output ON/OFF available
- Built-in overcurrent protection and thermal protection circuits

■Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit
DC Input Voltage	V_{IN}	53	V
Power Dissipation	P_D^{*1}	1	W
Junction Temperature	T_j	+125	°C
Storage Temperature	T_{stg}	-40 to +125	°C
Thermal Resistance (junction to case)	θ_{j-c}	28	°C/W
Thermal Resistance (junction to ambient air)	θ_{j-a}	100	°C/W

*1: Limited by thermal protection.

■Applications

- Onboard local power supplies
- OA equipment
- For stabilization of the secondary-side output voltage of switching power supplies

■Recommended Operating Conditions

Parameter	Symbol	Ratings		Unit
		SI-8010GL		
DC Input Voltage Range	V_{IN}	(8 or V_o+3) ^{*1} to 50		V
Output Voltage Range	V_o	1 to 14		V
Output Current Range ^{*2}	I_o	0.02 to 1.5 ^{*2}		A
Operating Junction Temperature Range	T_{jop}	-30 to +125		°C
Operating Temperature Range	T_{op}	-30 to +125		°C

*1: The minimum value of an input voltage range is the higher of either 8V or V_o+3V .

*2: Please be sure to let the output current run more than 20 mA. When using by less than 20 mA, there is a possibility that the output voltage becomes unstable.

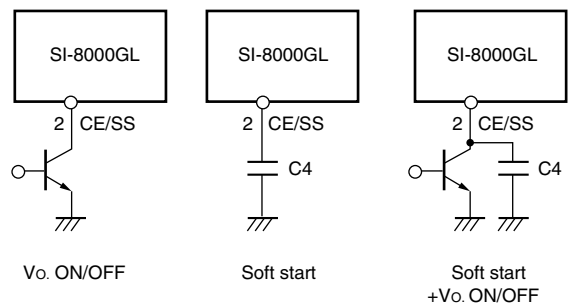
■Electrical Characteristics

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

Parameter	Symbol	Ratings			Unit
		SI-8010GL (Variable type)			
		min.	typ.	max.	
Reference Voltage	V_{REF}	0.97	1.00	1.03	V
	Conditions	$V_{IN}=12V, I_o=1A$			
Efficiency	Eff	86			%
	Conditions	$V_{IN}=20V, I_o=1A, V_o=5V$			
Oscillation Frequency	F_{osc}	250			kHz
	Conditions	$V_{IN}=12V, I_o=1A$			
Line Regulation	ΔV_{OLINE}	20			mV
	Conditions	$V_{IN}=10$ to $30V, I_o=1A$			
Load Regulation	ΔV_{OLOAD}	10			mV
	Conditions	$V_{IN}=12V, I_o=0.1$ to $1.5A$			
Temperature Coefficient of Reference Voltage	$\Delta V_{REF}/\Delta T_a$	± 0.5			mV/°C
Overcurrent Protection Starting Current	I_s	1.6			A
	Conditions	$V_{IN}=12V$			
Quiescent Circuit Current	I_q	7			mA
	Conditions	$V_{IN}=12V, I_o=0A$			
Circuit Current at Output OFF	$I_{q(OFF)}$	400			μA
	Conditions	$V_{IN}=12V, V_{ON/OFF}=0.3V$			
CE/SS* Terminal	Low Level Voltage	V_{SSL}	0.5		V
	Terminal Outflow Current at Low Voltage	I_{SSL}	50		μA
		Conditions	$V_{SSL}=0V$		

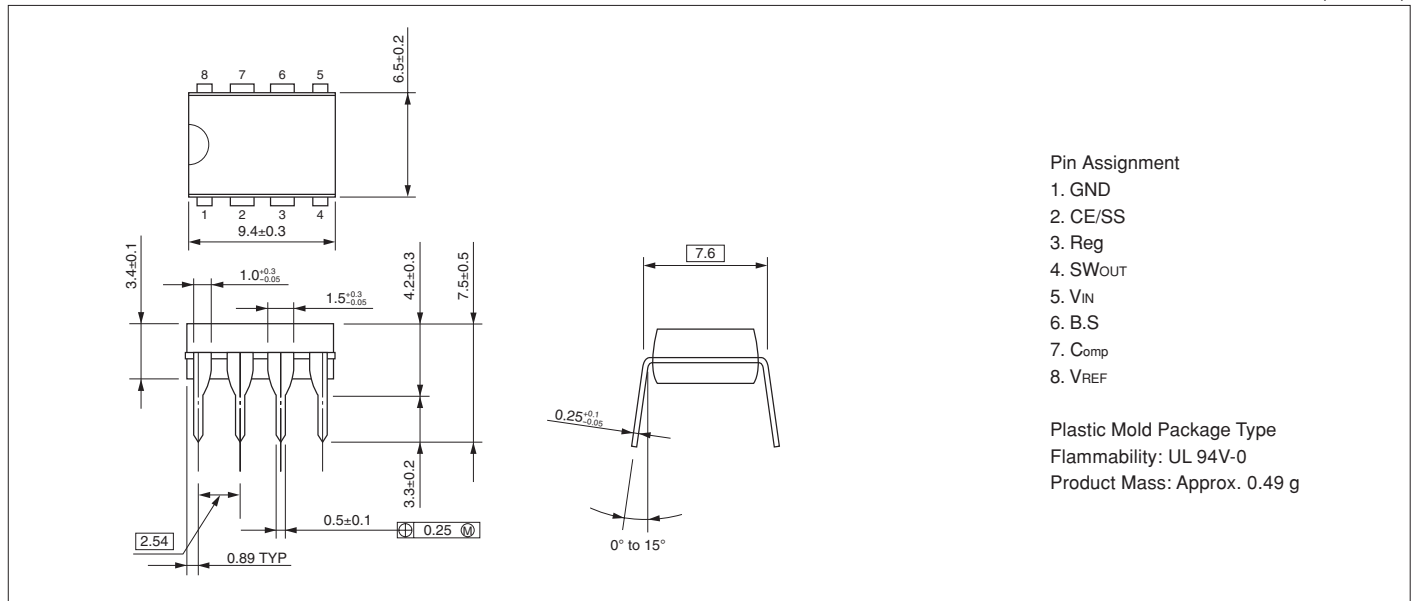
*: Pin 2 is the CE/SS pin. Soft start at power on can be performed with a capacitor connected to this pin. The output can also be turned ON/OFF with this pin. The output is stopped by setting the voltage of this pin to V_{SSL} or lower. CE/SS-pin voltage can be changed with an open-collector drive circuit of a transistor.

When using both the soft-start and ON/OFF functions together, the discharge current from C_4 flows into the ON/OFF control transistor. Therefore, limit the current securely to protect the transistor if C_3 capacitance is large. The CE/SS pin is pulled up to the power supply in the IC, so applying the external voltage is prohibited.

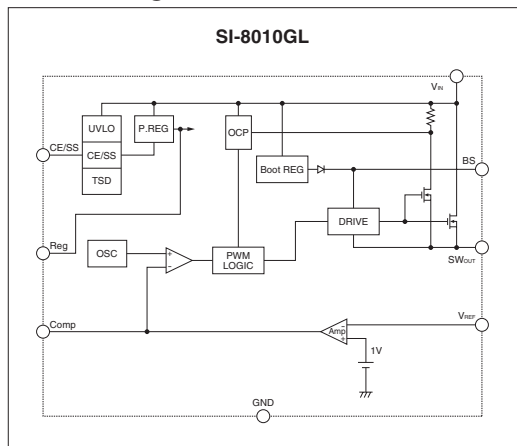


External Dimensions (DIP8)

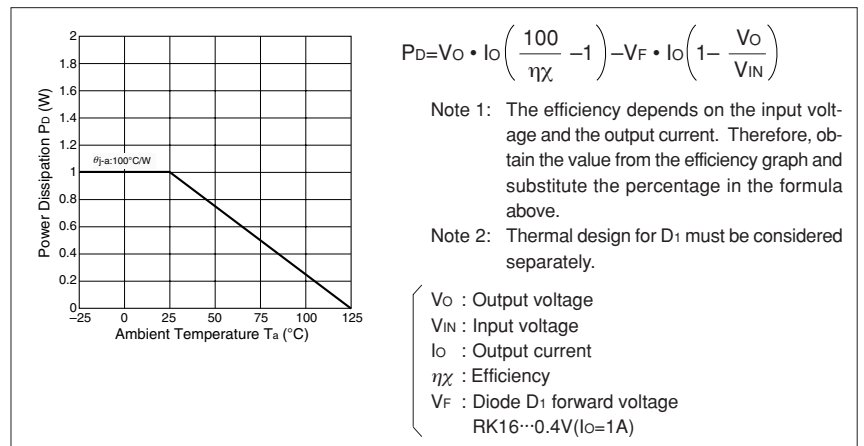
(Unit: mm)



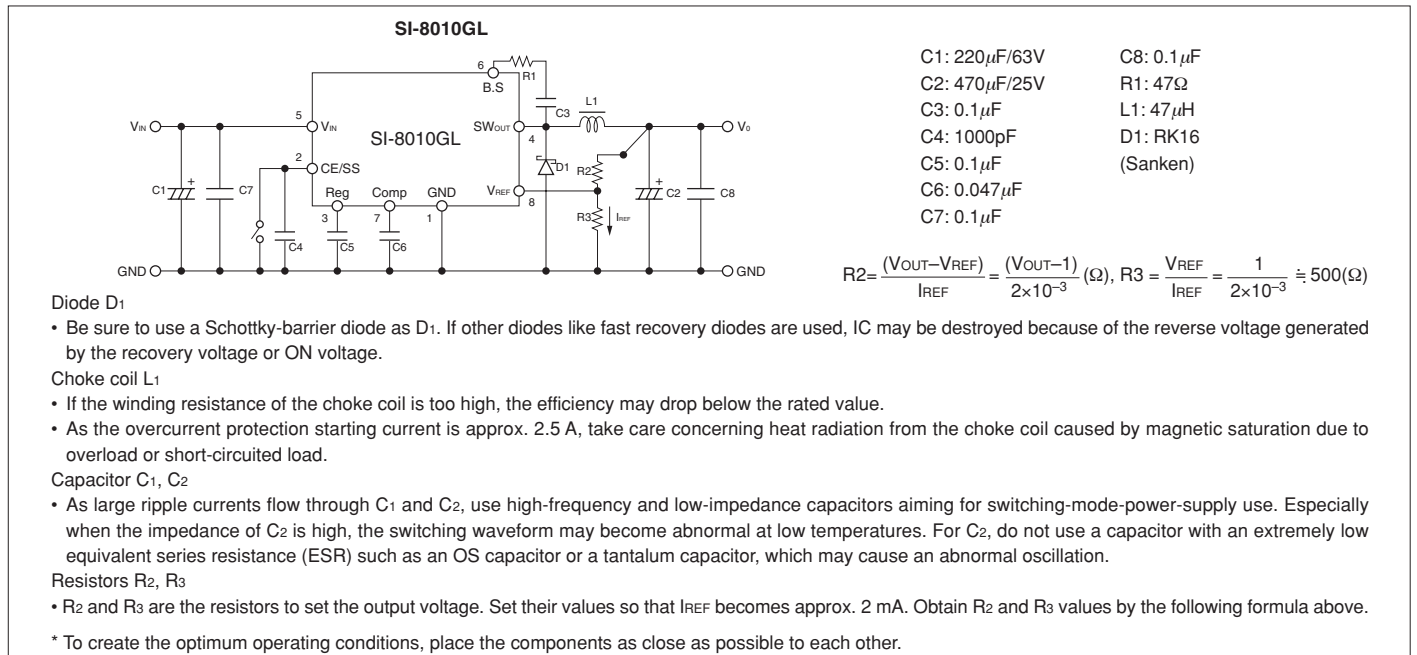
Block Diagram



Ta-Pd Characteristics



Typical Connection Diagram



SI-8000S Series Full-Mold, Separate Excitation Step-down Switching Mode

Features

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

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)	θ _{J-C}	5.5	°C/W

*35V for SI-8033S

Applications

- Power supplies for telecommunication equipment
- Onboard local power supplies

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 _{OP}	-30 to +125					°C

Electrical Characteristics

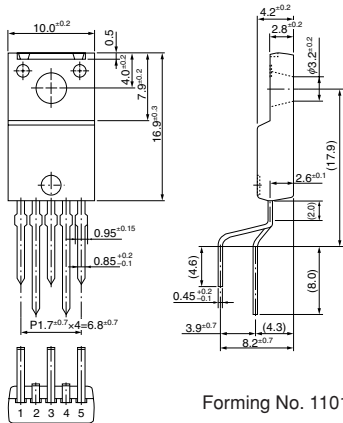
(T_a=25°C)

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	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										
	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			
Oscillation 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	ΔV _o /ΔT _a	±0.5			±0.5			±1.0			±1.0			±1.0			mV/°C
Overcurrent Protection Starting Current	I _{St}	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 printed to the right of the marking (except SI-8090S, SI-8120S, SI-8150S).

External Dimensions (TO220F-5)

(Unit : mm)

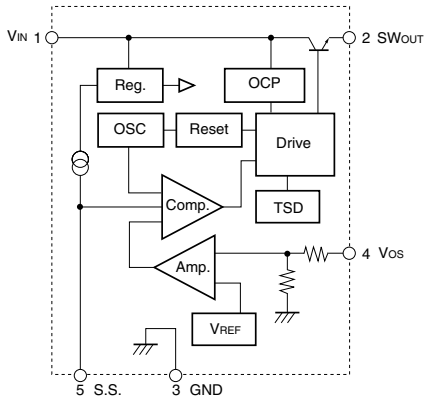


Pin Assignment

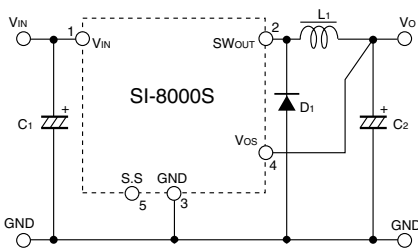
- ① VIN
- ② SWout
- ③ GND
- ④ Vos
- ⑤ S.S

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

Block Diagram

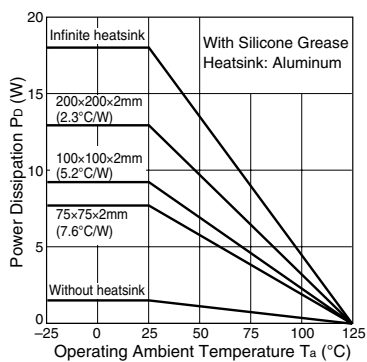


Typical Connection Diagram



- C_{1,2} : 1000μF
- L₁ : 150μH
- D₁ : 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. Therefore, obtain the value from the efficiency graph and substitute the percentage in the formula above.

- V_o : Output voltage
- V_{IN} : Input voltage
- I_o : Output current
- ηχ : Efficiency (%)
- V_F : Diode D₁ forward voltage
0.5V(RK46)

Thermal design for D₁ must be considered separately.

SI-8100QL Series Current Mode Control Step-down Switching Mode

■ Features

- DIP8 package
- Introduction of current mode control method
- Output current: 3.5A
- High efficiency: 90% (Vo=5V)
- Built-in reference oscillator (350kHz)
- Built-in drooping-type overcurrent and thermal protection circuits
- Built-in soft start circuit
- Built-in on/off function (Active Hi)
- Low current consumption during off

■ Applications

- DVD recorder, FPD-TV
- Onboard local power supplies
- OA equipment

■ Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit	Conditions
Input Voltage	V _{IN}	30	V	
Power Dissipation ^{*1}	P _D	1.56	W	When mounted on glass-epoxy board measuring 70×60 mm (copper laminate area: 1310 mm ²)
Junction Temperature ^{*2}	T _j	-30 to +150	°C	
Storage Temperature	T _{stg}	-40 to +150	°C	
Thermal Resistance (Junction to Case)	θ _{j-c}	25	°C/W	
Thermal Resistance (Junction to Ambient Air)	θ _{j-a}	64	°C/W	When mounted on glass-epoxy board measuring 70×60 mm (copper laminate area: 1310 mm ²)

*1: Limited by thermal protection circuit

*2: Note that the detect temperature for thermal protection is about 140°C.

■ Recommended Operating Conditions

Parameter	Symbol	Ratings		Unit	Conditions
		SI-8105QL			
Input Voltage Range	V _{IN}	Vo+3 ^{*1} to 28		V	
Output Voltage Range	Vo	0.5 to 24		V	
Output Current Range	Io	0 to 3.5		A	
Operating Junction Temperature Range	T _{jop}	-30 to +125		°C	
Operating Temperature Range	Top	-30 to +85		°C	

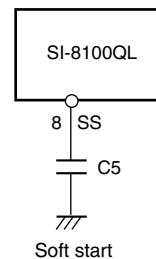
*1: The minimum value of the input voltage range is 4.75 V or Vo +3 V, whichever is higher.

■ Electrical Characteristics

(When Ta=25°C and Vo=5V)

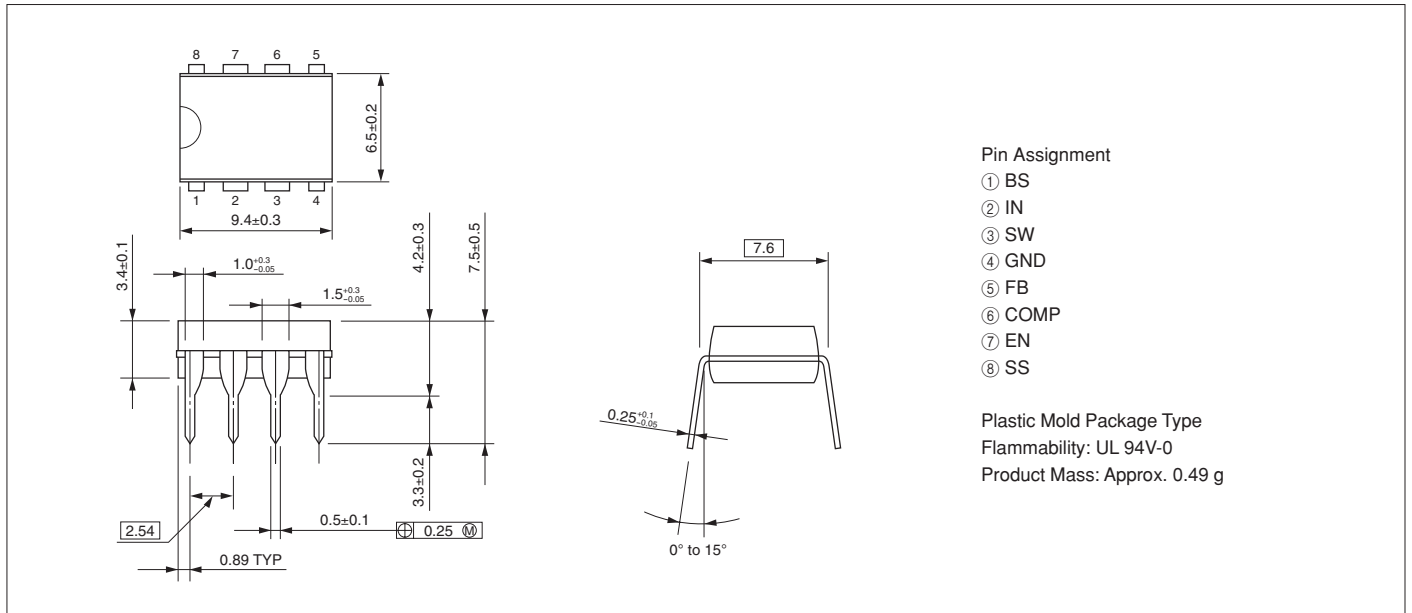
Parameter	Symbol	Ratings			Unit
		SI-8105QL			
		min.	typ.	max.	
Reference Voltage	V _{ADJ}	0.485	0.500	0.515	V
	Conditions	V _{IN} =12V, I _o =1A			
Temperature Coefficient of Reference Voltage	(ΔV _{ADJ} /ΔT)		0.05		mV/°C
	Conditions	V _{IN} =12V, I _o =1A, Ta=-40 to +85°C			
Efficiency	η		90		%
	Conditions	V _{IN} =12V, I _o =1A			
Oscillation Frequency	f _o	315	350	385	kHz
	Conditions	V _{IN} =16V, I _o =1A			
Line Regulation	ΔV _{LINE}		30	60	mV
	Conditions	V _{IN} =8 to 28V, I _o =1A			
Load Regulation	ΔV _{LOAD}		30	60	mV
	Conditions	V _{IN} =12V, I _o =0.1 to 3.5A			
Overcurrent Protection Starting Current	I _s	3.6		6.0	A
	Conditions	V _{IN} =12V			
Quiescent Circuit Current	I _q		18		mA
	Conditions	V _{IN} =12V, I _o =0A, V _{EN} =open			
	I _{q(OFF)}			20	μA
Conditions	V _{IN} =12V, I _o =0A, V _{EN} =0V				
SS Pin	Outflow Current at Low Voltage	I _{SSL}	5		μA
		Conditions	V _{IN} =12V, V _{SSL} =0V		
EN Pin	High Level Voltage	V _{C/EH}	2.8		V
		Conditions	V _{IN} =12V		
	Low Level Voltage	V _{C/EL}		2.2	V
Inflow Current at Low Voltage	I _{C/EH}		5		μA
		Conditions	V _{EN} =0V		
Error Amplifier Voltage Gain	AEA		1000		V/V
Error Amplifier Transformer Conductance	GEA		800		μA/V
Current Sense Amplifier Impedance	1/GCS		0.35		V/A
Maximum ON Duty	D _{MAX}		92		%
Minimum ON Time	D _{MIN}		100		nsec.

*: Pin 8 is the SS pin. Soft start at power on can be performed with a capacitor connected to this pin. The SS pin is pulled up to the power supply in the IC, so applying the external voltage is prohibited.

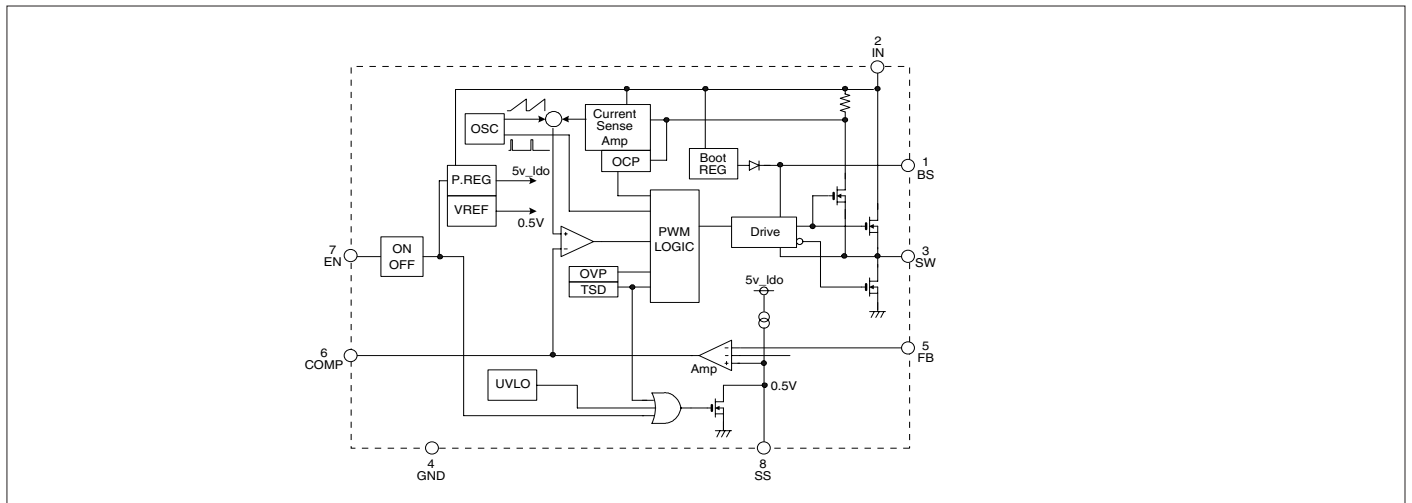


External Dimensions (DIP8)

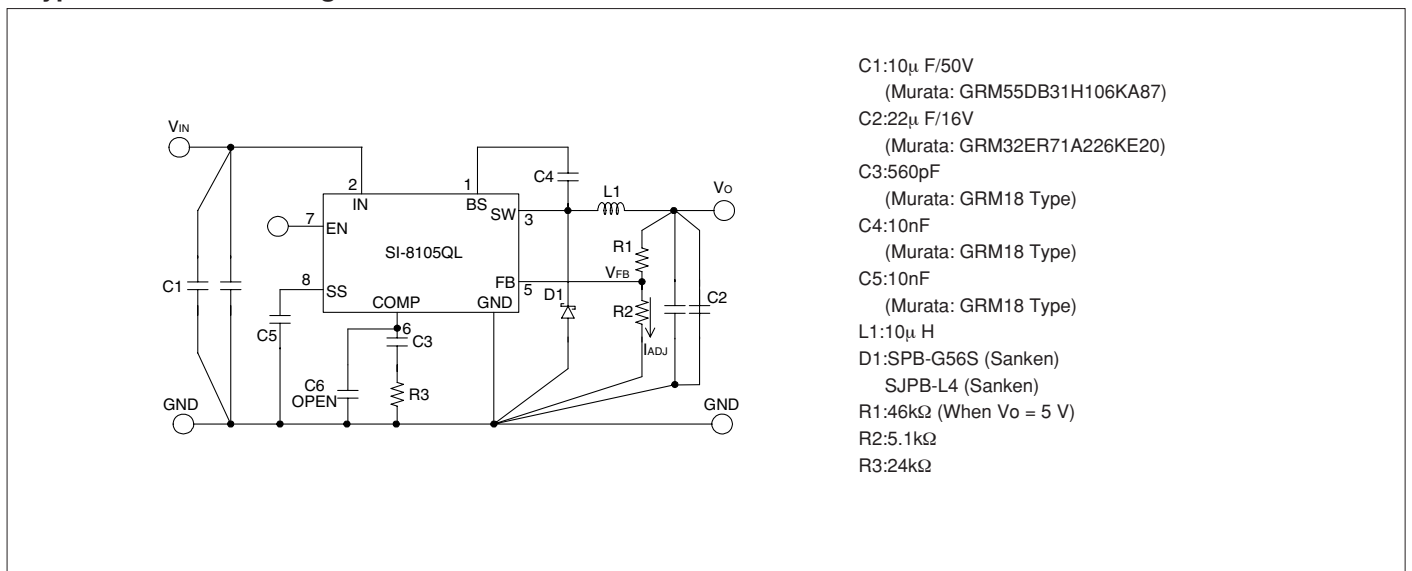
(Unit : mm)



Block Diagram



Typical Connection Diagram



SI-8000FFE Series Full-Mold, Separate Excitation Step-down Switching Mode

Features

- Compact full-mold package (equivalent to TO220)
- Output current: 3.5 A
- High efficiency: 83% ($V_o = 5\text{ V}$, $V_{IN} = 15\text{ V}$, $I_o = 2\text{ A}$)
- Requires only 6 discrete components
- Built-in reference oscillator (300 kHz)
- Built-in drooping-type overcurrent and thermal protection circuits
- Built-in soft start circuit (Output ON/OFF available)

Applications

- DVD recorder, FPD-TV
- OA equipment, such as printers
- Onboard local power supplies

Lineup

Part Number	SI-8001FFE
V_o (V)	Variable (0.8 to 24)
I_o (A)	3.5
Function	Soft start

Absolute Maximum Ratings

Parameter	Symbol	Ratings		Unit	Conditions
		SI-8001FFE			
Input Voltage	V_{IN}	43		V	
Power Dissipation (With infinite heatsink)	P_{D1-1}	22.7		W	Limited by thermal protection circuit, $T_j=150^\circ\text{C}$ $T_j=125^\circ\text{C}$
	P_{D1-2}	18.2			
Power Dissipation (Without heatsink)	P_{D2-1}	2.15		W	Limited by thermal protection circuit, $T_{jmax}=150^\circ\text{C}$ $T_j=125^\circ\text{C}$
	P_{D2-2}	1.72			
Junction Temperature ¹⁾	T_j	+150		$^\circ\text{C}$	
Storage Temperature	T_{stg}	-40 to +150		$^\circ\text{C}$	
Thermal Resistance (Junction to Case)	θ_{j-c}	5.5		$^\circ\text{C}/\text{W}$	
Thermal Resistance (Junction to Ambient Air)	θ_{j-a}	58		$^\circ\text{C}/\text{W}$	

*: This product has built-in thermal protection circuits that may activate when the junction temperature exceeds 130°C . The recommended design for the junction temperature during IC operation is below 125°C .

Recommended Operating Conditions

Parameter	Symbol	Ratings		Unit
		SI-8001FFE		
Input Voltage Range	V_{IN}	V_o+3^{*1} to 40		V
Output Voltage Range	V_o	0.8 to 24		V
Output Current Range	I_o	0 to 3.5		A
Operating Junction Temperature Range	T_{jop}	-30 to +125		$^\circ\text{C}$
Operating Temperature Range	T_{op}	-30 to +85		$^\circ\text{C}$

*: The minimum value of the input voltage range is 4.5 V or $V_o + 3\text{ V}$, whichever is higher.

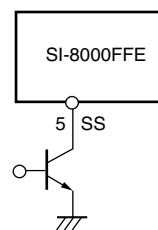
Electrical Characteristics

($R_1=4.2\text{k}\Omega$, $R_2=0.8\text{k}\Omega$ when $T_a=25^\circ\text{C}$ and $V_o=5\text{V}$)

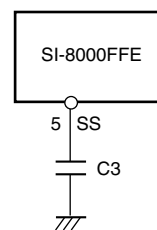
Parameter	Symbol	Ratings			Unit
		SI-8001FFE			
		min.	typ.	max.	
Reference Voltage	V_{ADJ}	0.784	0.800	0.816	V
	Conditions	$V_{IN}=15\text{V}$, $I_o=0.2\text{A}$			
Temperature Coefficient of Reference Voltage	$\Delta V_{ADJ}/\Delta T$		± 0.1		$\text{mV}/^\circ\text{C}$
	Conditions	$V_{IN}=15\text{V}$, $I_o=0.2\text{A}$, $T_c=0$ to 100°C			
Efficiency	η		83		%
	Conditions	$V_{IN}=15\text{V}$, $I_o=2\text{A}$			
Oscillation Frequency	f_o	270	300	330	kHz
	Conditions	$V_{IN}=15\text{V}$, $I_o=2\text{A}$			
Line Regulation	ΔV_{OLINE}		55	80	mV
	Conditions	$V_{IN}=10$ to 30V , $I_o=2\text{A}$			
Load Regulation	ΔV_{OLOAD}		15	50	mV
	Conditions	$V_{IN}=15\text{V}$, $I_o=0.2$ to 3.5A			
Overcurrent Protection Starting Current	I_s	3.6			A
	Conditions	$V_{IN}=15\text{V}$			
SS Pin	Low Level Voltage	V_{SSL}		0.5	V
	Outflow Current at Low Voltage	I_{SSL}		6	μA
Quiescent Circuit Current	I_q	Conditions	6		mA
		Conditions	$V_{IN}=15\text{V}$, $I_o=0\text{A}$		
	$I_{q(OFF)}$	Conditions	200		μA
		Conditions	$V_{IN}=15\text{V}$, $V_{SS}=0\text{V}$		

*: Pin 5 is the SS pin. Soft start at power on can be performed with a capacitor connected to this pin. The output can also be turned ON/OFF with this pin.

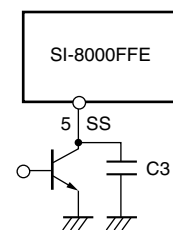
The output is stopped by setting the voltage of this pin to V_{SSL} or lower. SS-pin voltage can be changed with an open-collector drive circuit of a transistor. When using both the soft-start and ON/OFF functions together, the discharge current from C3 flows into the ON/OFF control transistor. Therefore, limit the current securely to protect the transistor if C3 capacitance is large. The SS pin is pulled up (3.7 V typ.) to the power supply in the IC, so applying the external voltage is prohibited. If this pin is not used, leave it open.



Vo.ON/OFF



Soft start



Soft start +Vo.ON/OFF

SI-8000HFE Series Full-Mold, Separate Excitation Step-down Switching Mode

Features

- Compact full-mold package (equivalent to TO220)
- Output current: 5.5 A
- High efficiency: 83% typ. (at $V_o = 5\text{ V}$)
- Requires only 4 discrete components
- Built-in reference oscillator (150 kHz)
- Built-in drooping-type-overcurrent and thermal protection circuits
- Built-in soft start circuit (Output ON/OFF available)

Applications

- Onboard local power supplies
- OA equipment

Lineup

Part Number	SI-8008HFE	SI-8050HFE
V_o (V)	Variable (0.8 to 15)	5
I_o (A)		5.5

Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit	Conditions
DC Input Voltage	V_{IN}	43	V	
Power Dissipation	P_{D1-1}	25 (with infinite heatsink)	W	Limited by thermal protection, $T_{jmax}=150^\circ\text{C}$
	P_{D1-2}	20 (with infinite heatsink)		$T_{jmax}=125^\circ\text{C}$
	P_{D2-1}	2.15 (without heat sink, standalone operation)		Limited by thermal protection, $T_{jmax}=150^\circ\text{C}$
	P_{D2-2}	1.72 (without heatsink, standalone operation)		$T_{jmax}=125^\circ\text{C}$
Junction Temperature*	T_j	+150	$^\circ\text{C}$	
Storage Temperature	T_{stg}	-40 to +150	$^\circ\text{C}$	
Thermal Resistance (Junction to Case)	θ_{j-c}	5	$^\circ\text{C/W}$	
Thermal Resistance (Junction to Ambient Air)	θ_{j-a}	58	$^\circ\text{C/W}$	

*: This product has built-in thermal protection circuits that may operate when the junction temperature rises above 130°C . The recommended design for the junction temperature during operation is below 125°C .

Recommended Operating Conditions

Parameter	Symbol	Ratings		Unit
		SI-8008HFE	SI-8050HFE	
Input Voltage Range	V_{IN}	V_o+3^1 to 40	8 to 40	V
Output Voltage Range	V_o	0.8 to 24	5.0	V
Output Current Range	I_o		0 to 5.5	A
Operating Junction Temperature Range	T_{jop}		-30 to +125	$^\circ\text{C}$
Operating Temperature Range	T_{op}		-30 to +85	$^\circ\text{C}$

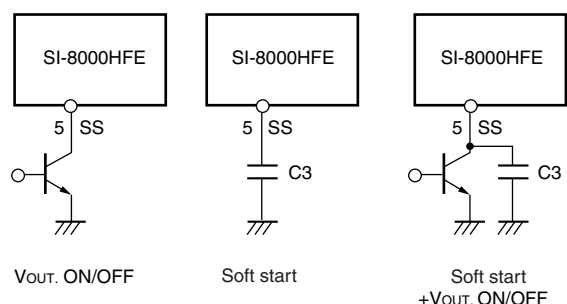
*1: The minimum value of an input voltage range is the higher of 4.5 V or $V_o + 3\text{ V}$.

Electrical Characteristics

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

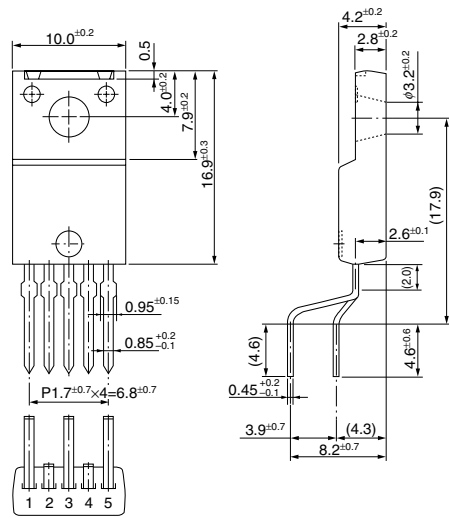
Parameter	Symbol	Ratings			Ratings			Unit
		SI-8008HFE (at $V_o = 5\text{ V}$)			SI-8050HFE			
		min.	typ.	max.	min.	typ.	max.	
Output Voltage (Reference Voltage)	V_o (V_{ADJ})	0.784	0.800	0.816	4.90	5.00	5.10	V
	Conditions	$V_{IN}=15\text{V}, I_o=1\text{A}$			$V_{IN}=15\text{V}, I_o=1\text{A}$			
Temperature Coefficient of Output Voltage (Temperature Coefficient of Reference Voltage)	$\Delta V_o/\Delta T$ ($\Delta V_{ADJ}/\Delta T$)		± 0.1			± 0.5		$\text{mV}/^\circ\text{C}$
	Conditions	$V_{IN}=15\text{V}, I_o=1\text{A}, T_c=0$ to 100°C			$V_{IN}=15\text{V}, I_o=1\text{A}, T_c=0$ to 100°C			
Efficiency	η		83			83		%
	Conditions	$V_{IN}=15\text{V}, I_o=3\text{A}$			$V_{IN}=15\text{V}, I_o=3\text{A}$			
Oscillation Frequency	f_o		150			150		kHz
	Conditions	$V_{IN}=15\text{V}, I_o=3\text{A}$			$V_{IN}=15\text{V}, I_o=3\text{A}$			
Line Regulation	ΔV_{OLINE}		60	80		60	80	mV
	Conditions	$V_{IN}=10$ to $30\text{V}, I_o=3\text{A}$			$V_{IN}=10$ to $30\text{V}, I_o=3\text{A}$			
Load Regulation	ΔV_{LOAD}		20	50		20	50	mV
	Conditions	$V_{IN}=15\text{V}, I_o=0.2$ to 5.5A			$V_{IN}=15\text{V}, I_o=0.2$ to 5.5A			
Overcurrent Protection Starting Current	I_s	5.6			5.6			A
	Conditions	$V_{IN}=15\text{V}$			$V_{IN}=15\text{V}$			
ON/OFF Pin*	Low Level Voltage	V_{SSL}		0.5			0.5	V
	Outflow Current at Low Voltage	I_{SSL}		10		10	30	
		Conditions	$V_{SSL}=0\text{V}$			$V_{SSL}=0\text{V}$		
Quiescent Circuit Current	I_q		6			6		mA
		Conditions	$V_{IN}=15\text{V}, I_o=0\text{A}$			$V_{IN}=15\text{V}, I_o=0\text{A}$		
	$I_{q(OFF)}$		200	400		200	400	μA
	Conditions	$V_{IN}=15\text{V}, V_{SS}=0\text{V}$			$V_{IN}=15\text{V}, V_{SS}=0\text{V}$			

*: Pin 5 is the SS pin. Soft start at power on can be performed with a capacitor connected to this pin. The output can also be turned ON/OFF with this pin. The output is stopped by setting the voltage of this pin to V_{SSL} or lower. SS-pin voltage can be changed with an open-collector drive circuit of a transistor. When using both the soft-start and ON/OFF functions together, the discharge current from C3 flows into the ON/OFF control transistor. Therefore, limit the current securely to protect the transistor if C3 capacitance is large. The SS pin is pulled up to the power supply in the IC, so applying the external voltage is prohibited. If the pin is not used, leave it open.



External Dimensions (TO220F-5)

(Unit : mm)

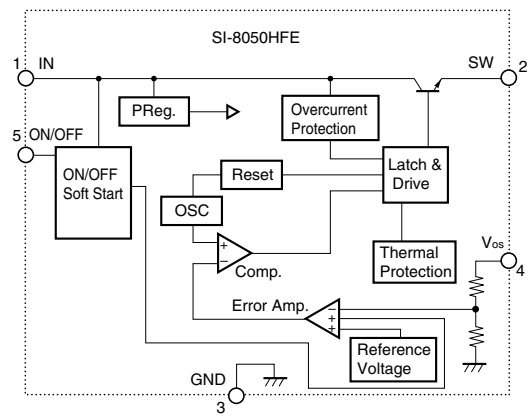
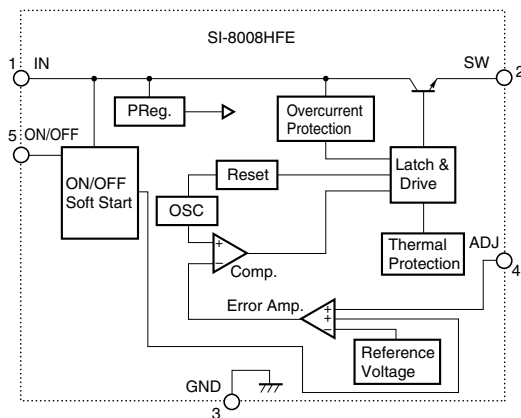


Pin Assignment

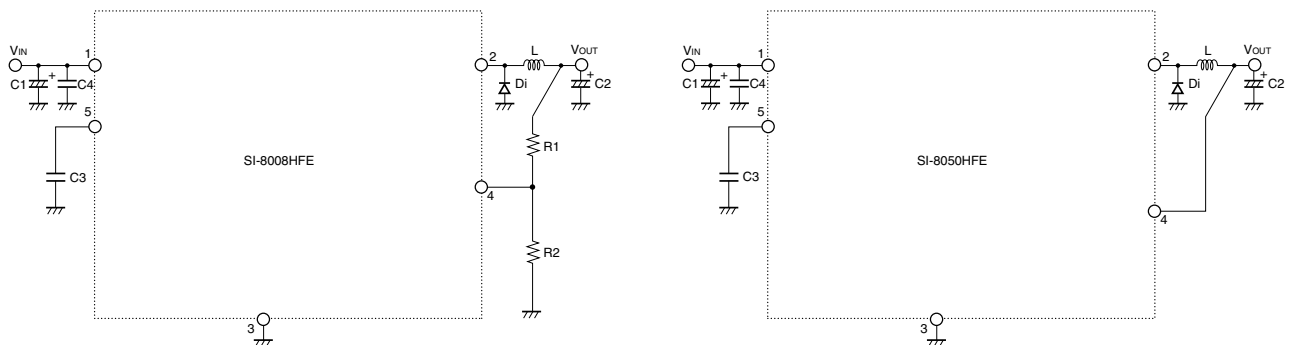
- ① VIN
- ② SW
- ③ GND
- ④ ADJ (Vos for SI-8050HFE)
- ⑤ SS

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

Block Diagram



Typical Connection Diagram



- C1 : 1500 μ F
- C2 : 1000 μ F
- C3 : 1 μ F (Only when using soft-start function)
- C4 : 4.7 μ F (RPER11H475K5 (Murata Manufacturing) recommended)
- L1 : 100 μ H
- Di : FMB-G16L (Sanken)

SI-8000Y Series Current Mode Control Step-down Switching Mode

Features

- Compact (equivalent to TO220) full-mold package
- Output current: 8.0 A
- High efficiency: 86%
- Built-in reference oscillator (130 kHz)
- Built-in drooping-type-overcurrent protection and thermal protection circuits
- Built-in soft start circuit (Output ON/OFF available)
- Low current consumption during off

Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit
Input Voltage	V_{IN}	45	V
Power Dissipation	P_{D1}	20.8(With infinite heatsink)	W
	P_{D2}	1.8(Without heatsink, stand-alone operation)	W
Junction Temperature	T_j	-30 to +150	°C
Storage Temperature	T_{stg}	-40 to +150	°C
Thermal Resistance (Junction to Case)	θ_{j-c}	6	°C/W
Thermal Resistance (Junction to Ambient Air)	θ_{j-a}	66.7	°C/W

Applications

- AV equipment
- OA equipment
- Gaming equipment
- Onboard local power supplies

Recommended Operating Conditions

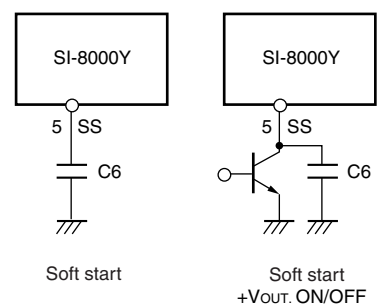
Parameter	Symbol	Ratings		Unit
		SI-8010Y	SI-8050Y	
Input Voltage Range	V_{IN}	8 or V_o+3^* to 43	8 to 43	V
Output Voltage Range	V_o	1 to 15	5	V
Output Current Range	I_o	0 to 8.0		A
Operating Junction Temperature Range	T_{jop}	-30 to +135		°C
Operating Temperature Range	T_{op}	-30 to +85		°C

*: The minimum value of the input voltage range is 8 V or $V_o + 3V$, whichever is higher.

Electrical Characteristics

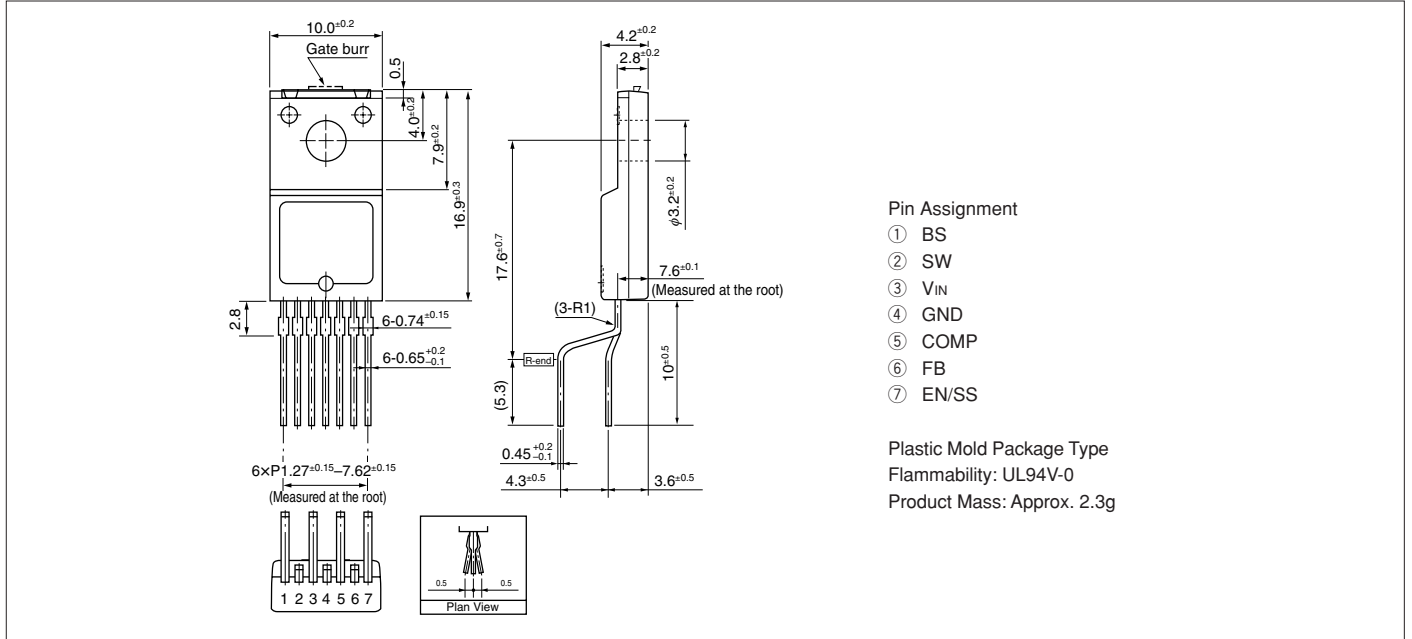
Parameter	Symbol	Ratings						Unit
		SI-8010Y*			SI-8050Y			
		min.	typ.	max.	min.	typ.	max.	
Output Voltage (Reference voltage for SI-8010Y)	$V_o(V_{REF})$	0.98	1.00	1.02	4.90	5.00	5.10	V
Temperature Coefficient of Output Voltage (Reference voltage temperature coefficient for SI-8010Y)	$\Delta V_o/\Delta T(\Delta V_{REF}/\Delta T)$	± 0.1			± 0.5			mV/°C
	Conditions	$V_{IN}=30V, I_o=0.1A, T_a=0 \text{ to } 100^\circ C$			$V_{IN}=30V, I_o=0.1A, T_a=0 \text{ to } 100^\circ C$			
Efficiency	η	86			86			%
	Conditions	$V_{IN}=30V, I_o=3A$			$V_{IN}=30V, I_o=3A$			
Oscillation Frequency	f_o	130			130			kHz
	Conditions	$V_{IN}=30V, I_o=3A$			$V_{IN}=30V, I_o=3A$			
Line Regulation	ΔV_{OLINE}	30			30			mV
	Conditions	$V_{IN}=10 \text{ to } 43V, I_o=3A$			$V_{IN}=10 \text{ to } 43V, I_o=3A$			
Load Regulation	ΔV_{OLOAD}	30			30			mV
	Conditions	$V_{IN}=30V, I_o=0.1 \text{ to } 8A$			$V_{IN}=30V, I_o=0.1 \text{ to } 8A$			
Overcurrent Protection Starting Current	I_s	8.1			8.1			A
	Conditions	$V_{IN}=20V$			$V_{IN}=20V$			
Quiescent Circuit Current	I_q	8			8			mA
	Conditions	$V_{IN}=30V, I_o=0A, EN/SS=open$			$V_{IN}=30V, I_o=0A, EN/SS=open$			
	$I_{q(OFF)}$	200			200			μA
Conditions	$V_{IN}=30V, EN/SS=0V$			$V_{IN}=30V, EN/SS=0V$				
EN/SS Pin*	Outflow Current at Low Voltage	I_{SSL}	10		10		30	μA
		Conditions	$V_{IN}=30V, EN/SS=0V$		$V_{IN}=30V, EN/SS=0V$			
	Low Level Voltage	V_{SSL}	0.5		0.5		V	
Conditions	$V_{IN}=30V$		$V_{IN}=30V$					
Error Amplifier Voltage Gain	AEA	300			300			V/V
Error Amplifier Transformer Conductance	GEA	800			800			$\mu A/V$
Current Sense Amplifier Impedance	1/GCS	0.16			0.16			V/A
Maximum ON Duty	DMAX	92			92			%
Minimum ON Time	DMIN	200			200			nsec

*: $R1=8k\Omega, R2=2k\Omega$ when $T_a=25^\circ C$ and $V_o=5V$

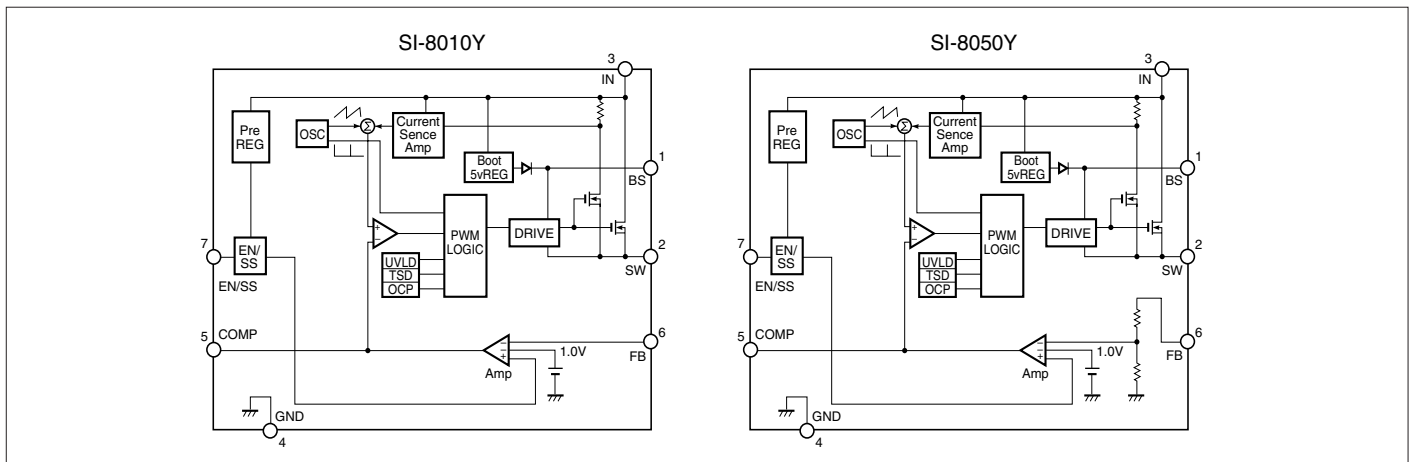


External Dimensions (TO220F-7)

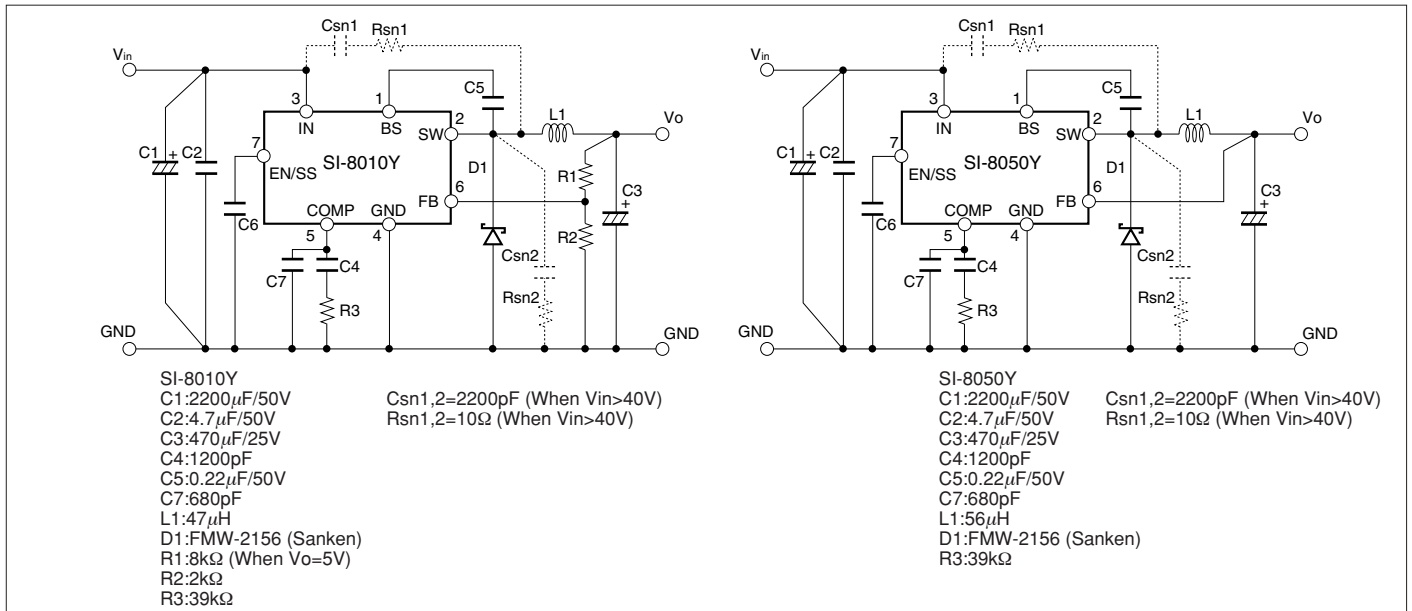
(Unit : mm)



Block Diagram



Typical Connection Diagram



SI-8205NHD Surface-Mount, Current Mode Control, Synchronous Rectifier Step-down Switching Mode

■ Features

- Compact surface-mount (HSOP8) package
- Wide input voltage range (V_{IN}): $V_o + 3$ to 43 V
- Synchronous rectifier mode
- Output current: 3 A
- Reference voltage and accuracy of 0.5 V $\pm 1\%$
- Oscillation frequency: 200 kHz to 1 MHz
- A ceramic capacitor can be used for output
- Output can be disabled
- Undervoltage Lock Out
- Soft start function

■ Applications

- Power supply for LCD module
- Power supply for notebook PC
- Onboard local power supplies
- Power supply for LBP/PPC

■ Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit	Conditions
Input Voltage (V_{IN} Pin)	V_{IN}	46	V	
Power Dissipation	P_D	1.35	W	When mounted on a 30 × 30 mm glass-epoxy board (with a 25 × 25 mm copper area)
Junction Temperature	T_J	-40 to +150	°C	
Storage Temperature	T_{stg}	-40 to +150	°C	
Thermal Resistance (Junction to Lead <1 pin>)	θ_{j-c}	40	°C/W	
Thermal Resistance (Junction to Ambient Air)	θ_{j-a}	74	°C/W	When mounted on a 30 × 30 mm glass-epoxy board (with a 25 × 25 mm copper area)

■ Recommended Operating Conditions

Parameter	Symbol	Ratings	Unit
Input Voltage Range	V_{IN}	8 or $V_o + 3$ to 43	V
Output Current Range	I_o	0 to 3.0	A
Output Voltage Range	V_o	0.5 to 24	V
Operating Junction Temperature Range	T_{jop}	-40 to +125	°C
Operating Temperature Range	T_{op}	-40 to +85	°C

*: The minimum value of the input voltage range is 8 V or $V_o + 3$ V, whichever is higher.

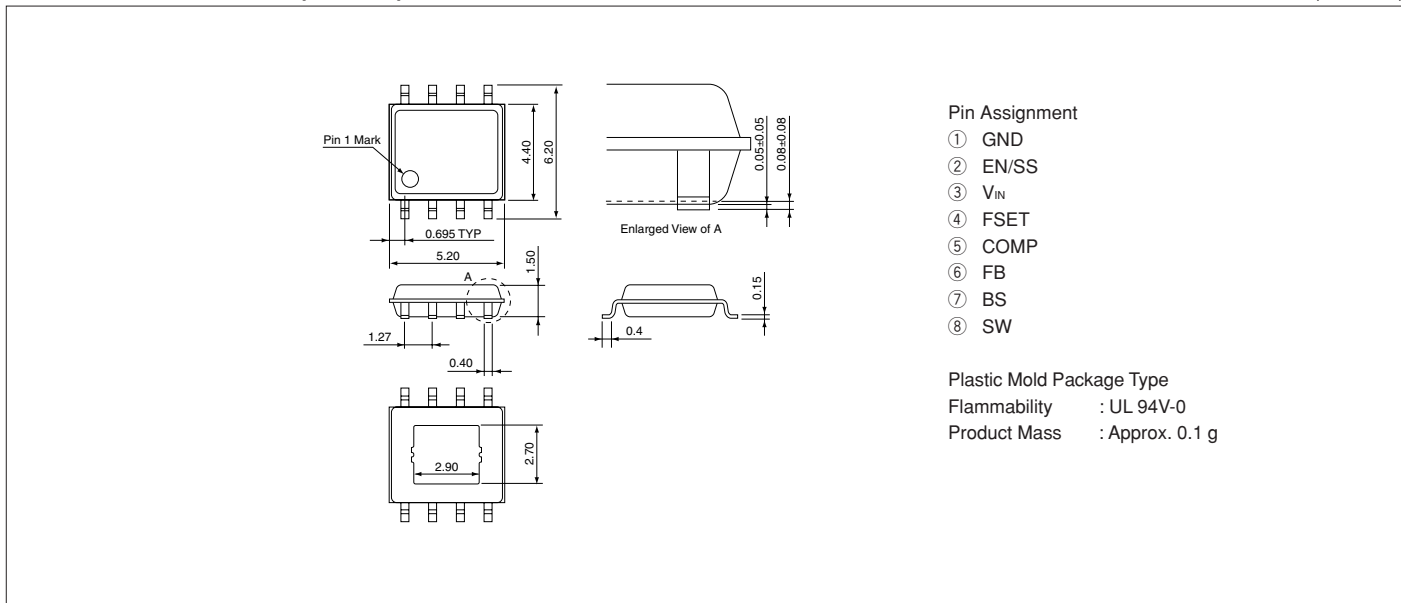
■ Electrical Characteristics

($T_a = 25^\circ\text{C}$ and $f_o = 500\text{kHz}$, unless otherwise specified)

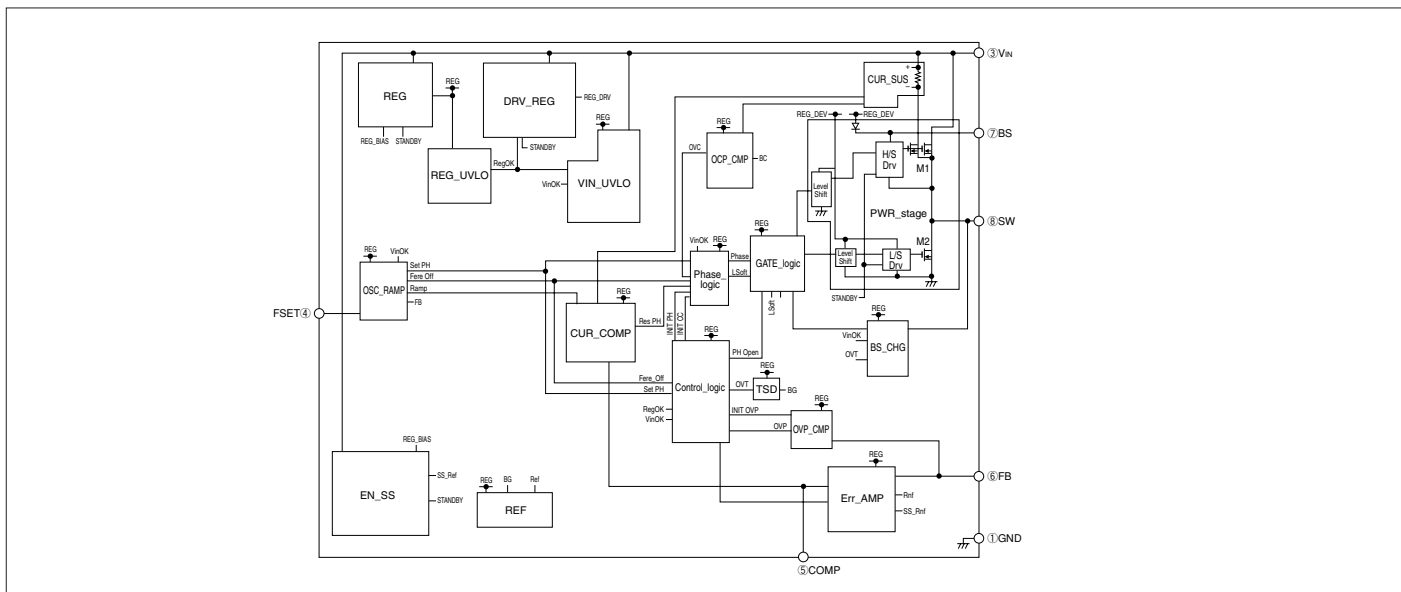
Parameter	Symbol	Ratings			Unit	Conditions	
		min.	typ.	max.			
Reference Voltage	V_{ref}	0.495	0.500	0.505	V	$V_{IN}=12\text{V}$, $I_o=1.0\text{A}$	
Temperature Coefficient of Reference Voltage	$\Delta V_{REF}/\Delta T$		± 0.05		mV/°C	$V_{IN}=12\text{V}$, $I_o=1.0\text{A}$, $T_a=-40$ to $+85^\circ\text{C}$	
Efficiency	η		90		%	$V_{IN}=12\text{V}$, $V_o=5\text{V}$, $I_o=1.0\text{A}$	
Oscillation Frequency 1	f_{o1}		200		kHz	$V_{IN}=12\text{V}$, $V_o=5\text{V}$, $I_o=1\text{A}$, $R_{fset}=375\text{k}\Omega$	
Oscillation Frequency 2	f_{o2}		1		MHz	$V_{IN}=12\text{V}$, $V_o=5\text{V}$, $I_o=1\text{A}$, $R_{fset}=75\text{k}\Omega$	
Line Regulation	ΔV_{OLINE}		50		mV	$V_{IN}=8$ to 43V , V_o to 5V , $I_o=1\text{A}$	
Load Regulation	ΔV_{OLOAD}		50		mV	$V_{IN}=12\text{V}$, $V_o=5\text{V}$, $I_o=0.1$ to 3.0A	
Overcurrent Protection Starting Current	I_s	3.1		6.0	A	$V_{IN}=12\text{V}$, $V_o=5\text{V}$	
Quiescent Circuit Current	I_{IN}		8		mA	$V_{IN}=12\text{V}$, $V_{comp}=0\text{V}$	
	$I_{IN(OFF)}$			40	μA	$V_{IN}=12\text{V}$, $V_{EN/SS}=0\text{V}$	
EN/SS Pin	Outflow Current at Low Voltage	$I_{EN/SS}$	5		μA	$V_{EN/SS}=0\text{V}$, $V_{IN}=12\text{V}$	
	Open Voltage	V_{SSH}	3.0	4.5	6.0	V	$V_{IN}=12\text{V}$
	On Threshold Voltage	$V_{C/IEH}$	0.6	1.3	2.0	V	$V_{IN}=12\text{V}$
OVP Start Voltage	V_{ovp}	0.57	0.60	0.63	V		
Thermal Protection Start Temperature	T_J	151	160		°C		
Error Amplifier Voltage Gain	AEA		800		V/V		
Error Amplifier Transformer Conductance	GEA		800		$\mu\text{A}/\text{V}$		
Current Sense Amplifier Impedance	GCS		3.33		A/V		
Maximum ON Duty	DMAX	80	90		%	$V_{IN}=12\text{V}$	
Minimum ON Time	DMIN		150		nsec	$V_{IN}=12\text{V}$	

External Dimensions (HSOP8)

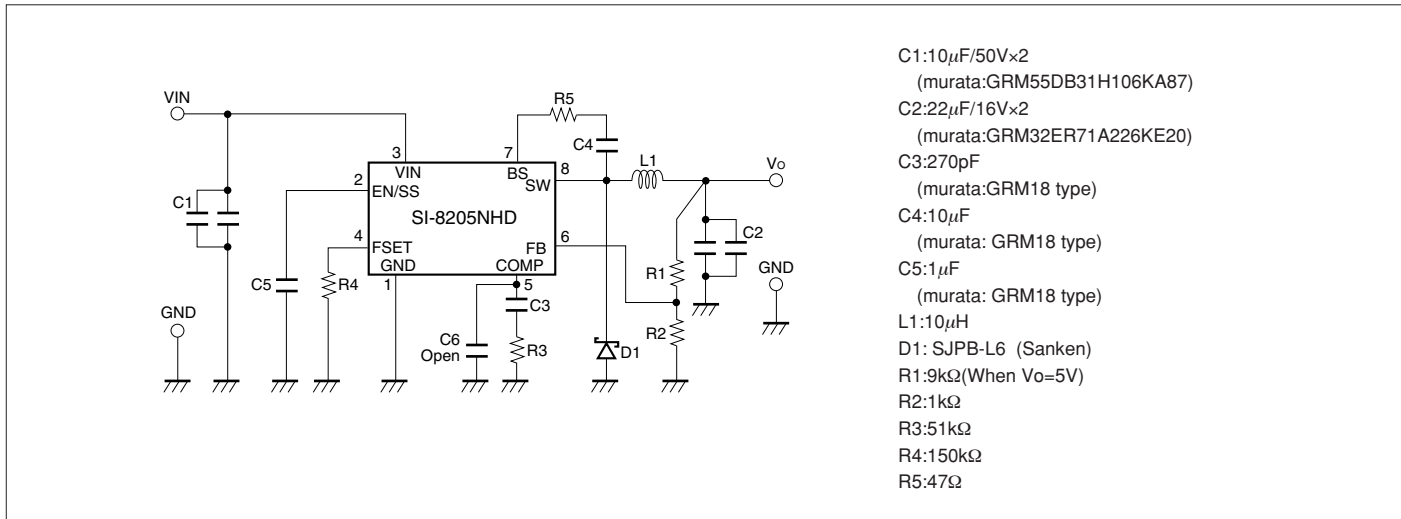
(Unit : mm)



Block Diagram



Typical Connection Diagram



NR885K Surface-Mount, Current Mode Control, Synchronous Rectifier Step-down Switching Mode

■ Features

- Compact surface-mount package (HSOP8)
- Input voltage range (V_{IN}): $V_O + 3$ to 18 V
- Synchronous rectifier mode
- High efficiency of at least 94%
- Introduction of current mode control method
- A ceramic capacitor can be used for output
- Built-in phase correction component
- Output current: 3 A
- Reference voltage and accuracy of $0.8\text{ V} \pm 2\%$
- Oscillation frequency: 350 kHz
- Output ON/OFF available
- Undervoltage lockout
- Soft start function

■ Applications

- Power supply for LCDTV and PDP
- Power supply for DVD, BD, and STB
- On-board local power supply
- Power supply for LBP and PPC

■ Electrical Characteristics

($T_a=25^\circ\text{C}$, $V_{IN}=12\text{V}$, and $V_O=3.3\text{V}$, unless otherwise specified)

Parameter	Symbol	Ratings			Unit	Conditions
		min.	typ.	max.		
Reference Voltage	V_{REF}	0.784	0.800	0.816	V	$V_{IN}=12\text{V}$, $I_O=1.0\text{A}$
Temperature Coefficient of Reference Voltage	$\Delta V_{REF}/\Delta T$		± 0.05		mV/C	$V_{IN}=12\text{V}$, $I_O=1.0\text{A}$ $T_a=-40^\circ\text{C}$ to $+85^\circ\text{C}$
Efficiency	η		90		%	$V_{IN}=12\text{V}$, $V_O=3.3\text{V}$, $I_O=1\text{A}$
Oscillation Frequency	f_o	280	350	420	kHz	$V_{IN}=12\text{V}$, $V_O=3.3\text{V}$, $I_O=1\text{A}$
Line Regulation	V_{LINE}		50		mV	$V_{IN}=12\text{V}$, $V_O=3.3\text{V}$, $I_O=1\text{A}$
Load Regulation	V_{Load}		50		mV	$V_{IN}=6.3\text{V}$ to 18V , $V_O=3.3\text{V}$, $I_O=1\text{A}$
Overcurrent Protection Starting Current	I_S	3.1		6.0	A	$V_{IN}=12\text{V}$, $V_O=3.3\text{V}$
Quiescent Circuit Current 1	I_{IN}		6		mA	$V_{IN}=12\text{V}$, $V_{EN}=3\text{V}$
Quiescent Circuit Current 2	$I_{IN(off)}$	0		10	μA	$V_{IN}=12\text{V}$, $I_O=0\text{A}$, $V_{EN}=0\text{V}$
SS Pin	Outflow Current at Low Voltage	6	10	14	μA	$V_{SS}=0\text{V}$, $V_{IN}=12\text{V}$
	Open Voltage		3.0		V	$V_{IN}=12\text{V}$
EN Pin	Inflow Current		50	100	μA	$V_{EN}=10\text{V}$
	On Threshold Voltage	0.7	1.4	2.1	V	$V_{IN}=12\text{V}$
Maximum ON Duty	$DMAX$		90		%	
Minimum ON Time	$DMIN$		150		nsec	
Thermal Protection Start Temperature	TSD	151	165		$^\circ\text{C}$	
Thermal Protection Return Hysteresis	TSD_hys		20		$^\circ\text{C}$	

- *: Pin 8 is the SS pin. Soft start at power on can be performed with a capacitor connected to this pin. The SS pin is pulled up to the power supply in the IC, so applying the external voltage is prohibited.

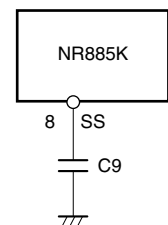
■ Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit	Conditions
Input Voltage	V_{IN}	20	V	
Power Dissipation	P_D	1.69	W	When mounted on 30 x 30 mm glass-epoxy board (with a 25 x 25 mm copper area)
Junction Temperature	T_J	-40 to +150	$^\circ\text{C}$	
Storage Temperature	T_{stg}	-40 to +150	$^\circ\text{C}$	
Thermal Resistance (Junction to Lead (4 pins))	θ_{j-c}	40	$^\circ\text{C}/\text{W}$	
Thermal Resistance (Junction to Ambient Air)	θ_{j-a}	74	$^\circ\text{C}/\text{W}$	When mounted on a 30 x 30 mm glass-epoxy board (with a 25 x 25 mm copper area)

■ Recommended Operating Conditions

Parameter	Symbol	Ratings	Unit
Input Voltage Range	V_{IN}	4.5 or $V_O + 3^*$ to 18	V
Output Current Range	I_O	0 to 3.0	A
Output Voltage Range	V_O	0.8 to 14	V
Operating Temperature Range	T_{op}	-40 to +85	$^\circ\text{C}$

*: The minimum value of the input voltage range is 4.5 V or $V_O + 3\text{ V}$, whichever is higher.



Soft start

SI-8400L/8500L Series Separate Excitation Switching Mode with Coil

■Features

- Switching ICs/Coil combined type
- Requires only 2 discrete components
- Low switching noise
- No heatsink required
- Built-in overcurrent and thermal protection circuits
- Built-in soft start circuit (Output ON/OFF available)...SI-8500L Series

■Applications

- Telephone power supplies
- Onboard local power supplies

■Lineup

Part Number	SI-8401L	SI-8501L
V _o (V)	5.0	5.0
I _o (A)	0.5	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		
DC Input Voltage Range	V _{IN}	7 to 33		V
Output Current Range	I _o	0 to 0.5		A
Operating Temperature Range	T _{op}	-20 to +85		°C

Parameter	Symbol	Ratings		Unit
		SI-8501L		
DC Input Voltage Range	V _{IN}	7 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)

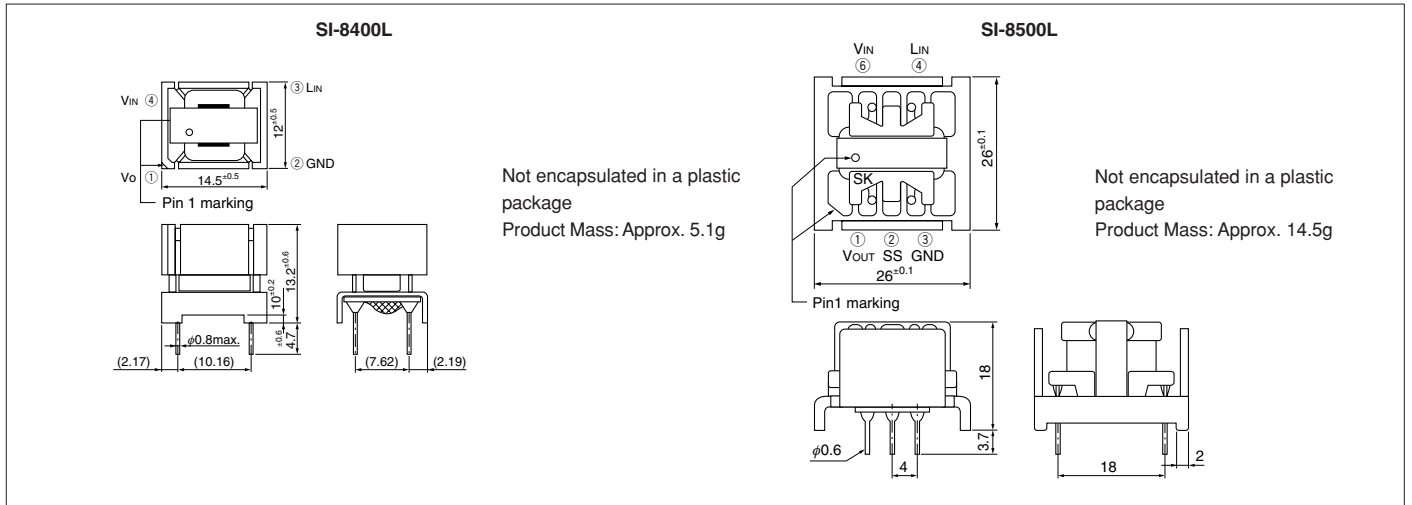
Parameter	Symbol	Ratings			Unit
		SI-8401L			
		min.	typ.	max.	
Output Voltage	V _o	4.80	5.00	5.20	V
	Conditions	V _{IN} =20V, I _o =0.3A			
Efficiency	η	80			%
	Conditions	V _{IN} =20V, I _o =0.3A			
Oscillation Frequency	f	60			kHz
	Conditions	V _{IN} =20V, I _o =0.3A			
Line Regulation	ΔV _{OLINE}	80			mV
	Conditions	V _{IN} =10 to 30V, I _o =0.3A			
Load Regulation	ΔV _{OLOAD}	30			mV
	Conditions	V _{IN} =20V, I _o =0.1 to 0.4A			
Temperature Coefficient of Output Voltage	ΔV _o /ΔT _a	±0.5			mV/°C
Switching Ripple Voltage (C ₂ =470μF)	ΔV _r	20			mV _{p-p}
	Conditions	V _{IN} =20V, I _o =0.3A			
Overcurrent Protection Starting Current	I _{s1}	0.55			A
	Conditions	V _{IN} =10V			

(T_a=25°C)

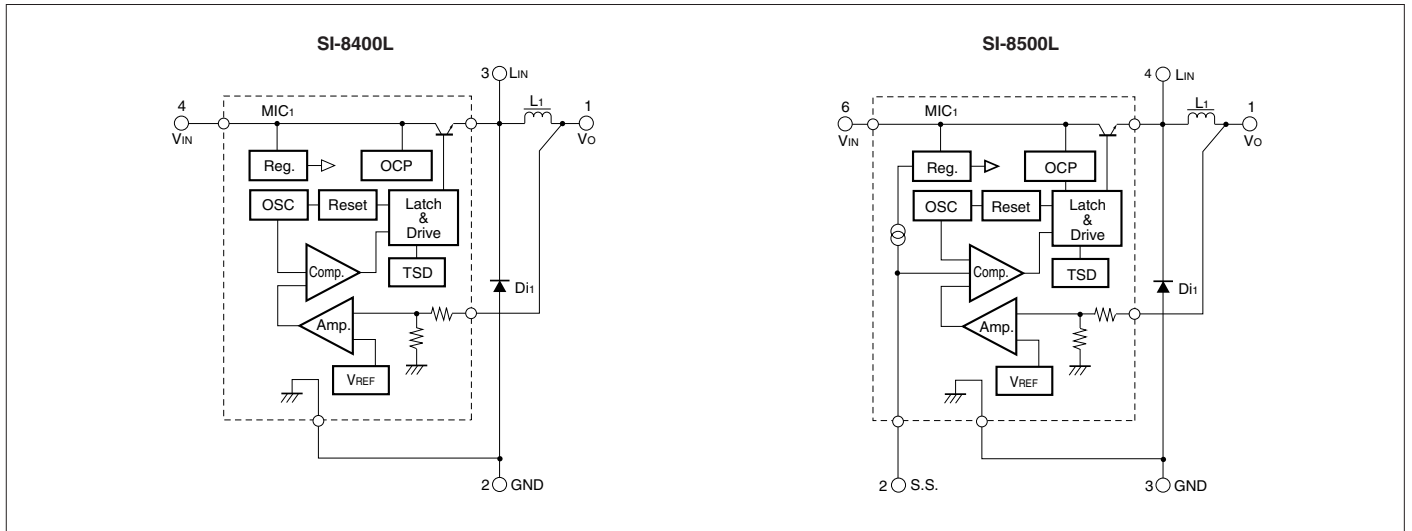
Parameter	Symbol	Ratings			Unit
		SI-8501L			
		min.	typ.	max.	
Output Voltage	V _o	4.80	5.00	5.20	V
	Conditions	V _{IN} =20V, I _o =0.5A			
Efficiency	η	83			%
	Conditions	V _{IN} =20V, I _o =0.5A			
Oscillation Frequency	f	60			kHz
	Conditions	V _{IN} =20V, I _o =0.5A			
Line Regulation	ΔV _{OLINE}	70			mV
	Conditions	V _{IN} =10 to 30V, I _o =0.5A			
Load Regulation	ΔV _{OLOAD}	30			mV
	Conditions	V _{IN} =20V, I _o =0.2 to 0.8A			
Temperature Coefficient of Output Voltage	ΔV _o /ΔT _a	±0.5			mV/°C
Switching Ripple Voltage (C ₂ =470μF)	ΔV _r	45			mV _{p-p}
	Conditions	V _{IN} =20V, I _o =0.5A			
Overcurrent Protection Starting Current	I _{s1}	1.1			A
	Conditions	V _{IN} =18V			

External Dimensions (Non-package type [EI-12.5 core/EI-19 core])

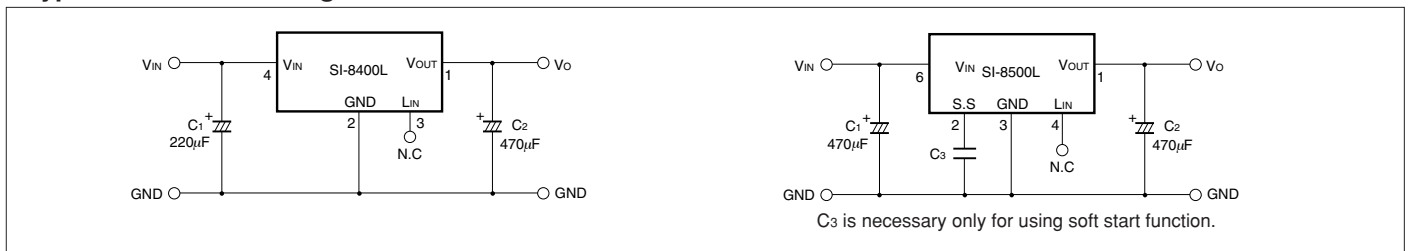
(Unit : mm)



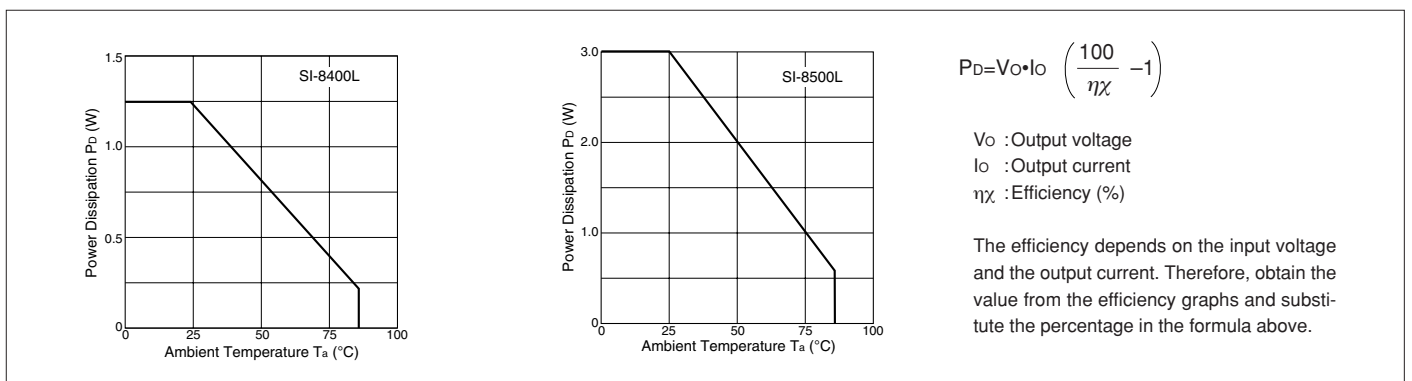
Block Diagram



Typical Connection Diagram



Ta-Pd Characteristics



STA801M 2-Output Separate Excitation Switching Mode

Features

- 2 regulators combined in 1 package
- Compact inline package
- Output current (0.5A × 2 outputs)
- Output voltage of Ch2 selectable from 4 levels
- Built-in flywheel diode (Schottky barrier diode)
- Requires only 7 discrete components (2 outputs)
- Internally-adjusted phase corrections and output voltages
- Built-in reference oscillator (125kHz) - Enables to downsize a choke-coil due to IC's high oscillating frequency. (Compared with conventional Sanken devices)
- Built-in overcurrent and thermal protection circuits
- Built-in soft start circuits (Output ON/OFF available)

Lineup

Part Number	Output Voltage (V)	
	Ch1	Ch2(Select one output)
STA801M	5	9.0 / 11.5 / 12.1 / 15.5

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

Applications

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

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 _{top}	-20	+125	°C

Electrical Characteristics

(T_a=25°C)

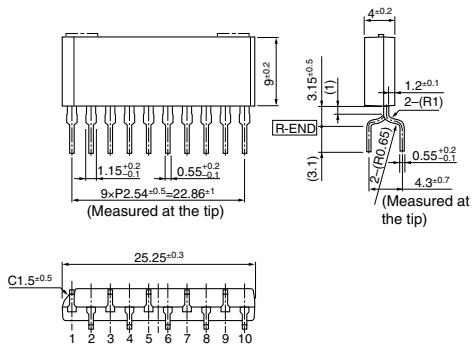
	Parameter	Symbol	Ratings			Unit	
			STA801M				
			min.	typ.	max.		
Ch1	Output voltage 1	V _{O1}	4.80	5.00	5.20	V	
		Conditions	V _{IN} =20V, I _o =0.3A				
	Efficiency *	η ₁		80		%	
		Conditions	V _{IN} =20V, I _o =0.3A				
	Temperature Coefficient of Output Voltage	ΔV _O /ΔT _{a1}		±0.5		mV/°C	
	Line Regulation	ΔV _{OLINE1}		30	90	mV	
Conditions		V _{IN} =10 to 30V, I _o =0.3A					
Load Regulation	ΔV _{LOAD1}		10	40	mV		
	Conditions	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	V	
		Conditions	V _{IN} =20V, I _o =0.3A				
	Output voltage 2-2	V _{O2-2}	11.04	11.50	11.96	V	
		Conditions	V _{IN} =20V, I _o =0.3A				
	Output voltage 2-3	V _{O2-3}	11.62	12.10	12.58	V	
		Conditions	V _{IN} =20V, I _o =0.3A				
	Output voltage 2-4	V _{O2-4}	14.88	15.50	16.12	V	
		Conditions	V _{IN} =20V, I _o =0.3A				
	Vo2-4	Efficiency*	η		89	%	
			Conditions	V _{IN} =20V, I _o =0.3A			
		Temperature Coefficient of Output Voltage	ΔV _O /ΔT _a		±2.0		mV/°C
		Line Regulation	ΔV _{OLINE}		40	130	mV
Conditions	V _{IN} =20 to 30V, I _o =0.3A						
Load Regulation	ΔV _{LOAD}		30	120	mV		
	Conditions	V _{IN} =20V, I _o =0.1 to 0.4A					
Common	No-load Circuit Current	I _{cc}		15	mA		
	Oscillation Frequency	f		125	kHz		
	Overcurrent Protection Starting Current	I _{s1}	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 $\frac{I_{cc}}{2}$ at unused output.

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

External Dimensions (SIP10 [STA 10Pin])

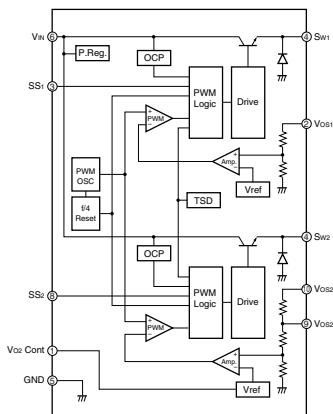
(Unit : mm)



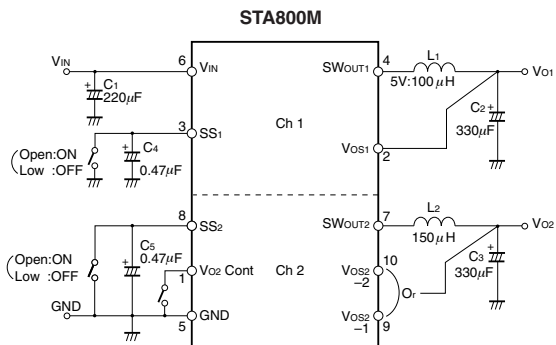
Pin Assignment

- ① Vo2 Cont
 - ② Vos1
 - ③ SS1
 - ④ SWOUT1
 - ⑤ GND
 - ⑥ VIN
 - ⑦ SWOUT2
 - ⑧ SS2
 - ⑨ Vos2-2
 - ⑩ Vos2-1
- Plastic Mold Package Type
 Flammability: UL94V-0
 Product Mass: Approx. 2.5g

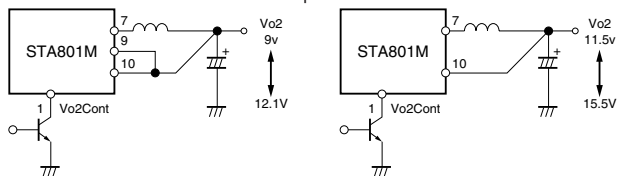
Block Diagram



Typical Connection Diagram

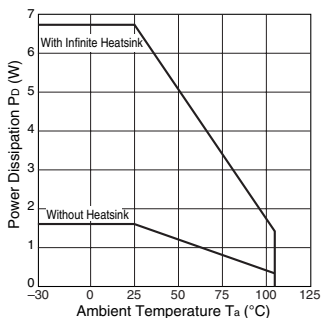


Selection of connection method and output for Vos2-1 and Vos2-2 of Channel 2



Vo2 Sensing Pin \ Vo2Cont Pin	Open	Low
Pin 9	9V	12.1V
Pin 10	11.5V	15.5V

Ta-Pd Characteristics



SPI-8001TW/SPI-8002TW/SPI-8003TW 2-Output, Step-down Switching Mode

■ Features

- 2 regulators combined in one package
- Output current: 1.5A × 2 (HSOP 16 Pin Surface mount package)
- High efficiency: TYP80% (SPI-8001TW), TYP78% (SPI-8002TW)
- Variable output voltage: 1.0 to 16V (SPI-8001TW), 1.0 to 24V (SPI-8002TW)
- Built-in reference oscillator (250kHz): Enables to downsize a choke-coil
- Low circuit current consumption: $\leq 1\mu\text{A}$ (at output OFF)
- High accuracy reference voltage: $\pm 1\%$
- Built-in foldback-overcurrent and thermal protection circuits
- Built-in ON/OFF circuit (soft start available) – per output

■ Applications

- Onboard local power supplies
- OA equipment
- For stabilization of the secondary-side output voltage of switching power supplies

■ Absolute Maximum Ratings*1

Parameter	Symbol	Ratings			Unit
		SPI-8001TW	SPI-8002TW	SPI-8003TW	
Input Voltage	V_{IN}	21	40	40	V
	V_{CC}	21	40	40	V
	$V_{C/E}$	21	40	40	V
Power Dissipation*2, *3	P_D	3.0			W
Junction Temperature	T_J	+135		+150	°C
Storage Temperature	T_{stg}	-40 to +135		-40 to +150	°C
Thermal Resistance (junction to case)*2	θ_{j-c}	9.0			°C/W
Thermal Resistance (junction to ambient air)*2	θ_{j-a}	35.8			°C/W

*1: Absolute maximum ratings show the destructive limit. No parameter should exceed the ratings in transient or normal operations.

*2: When mounted on glass-epoxy board 70cm² (copper laminate area 30.8cm²).

*3: Limited by thermal protection.

■ Recommended Operating Conditions*1

Parameter	Symbol	Ratings						Unit
		SPI-8001TW		SPI-8002TW		SPI-8003TW		
		min.	max.	min.	max.	min.	max.	
Input Voltage Range	V_{IN}	V_{O+3}	20	V_{O+3}	38	V_{O+3}	38	V
	V_{CC}	4.5	20	4.5	38	4.5	38	V
	$V_{C/E}$		20		38		38	V
Output Voltage Range	V_O	1	16	1	24	1	24	V
Output Current Range	I_O		1.5		1.5		1.5	A
Operating Junction Temperature Range	T_{jop}	-30	+135	-30	+135	-30	+125	°C
Operating Temperature Range	T_{op}	-30	+135	-30	+135	-30	+85	°C

*1: Recommended operating conditions show the operating conditions required for the normal circuit function described in the electrical characteristics. These conditions must be followed in actual use.

■Electrical Characteristics*1

(Ta=25°C)

Parameter	Symbol	Ratings									Unit	
		SPI-8001TW			SPI-8002TW			SPI-8003TW				
		min.	typ.	max.	min.	typ.	max.	min.	typ.	max.		
Reference Voltage	VREF	0.996	1.006	1.016	0.996	1.006	1.016	0.966	1.006	1.016	V	
	Conditions	VIN=10V, VO=1V, IO=0.1A						VIN=14V, IO=0.1A				
Temperature Coefficient of Reference Voltage	ΔVREF/ΔT		±0.1			±0.1			±0.1		mV/°C	
	Conditions	VIN=10V, VO=1V, IO=0.1A, Ta=-30 to +135°C						VIN=14V, IO=0.1A, Ta=-30 to +125°C				
Efficiency 1 ²	Eff1		80			78			78		%	
	Conditions	VIN=VCC=15V, VO=5V, IO=0.5A, IIN: including Icc						VIN=VCC=14V, VO=5V, IO=0.5A, IIN: including Icc				
Efficiency 2 ²	Eff2		83			81			81		%	
	Conditions	VIN=15V, VO=5V, IO=0.5A, VCC=5V, IIN: excluding Icc						VIN=14V, VCC=5V, VO=5V, IO=0.5A, IIN: excluding Icc				
Oscillation Frequency	fosc		250		215	250	285	200		400	kHz	
	Conditions	VIN=VCC=15V, VO=5V, IO=0.5A						VIN=14V, IO=0.1A, COsc=100pF				
Line Regulation	VLINE		30	60		30	60		30	60	mV	
	Conditions	VIN=VCC=10 to 20V, VO=5V, IO=1A						VIN=VCC=9 to 18V, VO=5V, IO=1A				
Load Regulation	VLOAD		10	40		10	40		10	40	mV	
	Conditions	VIN=VCC=15V, VO=5V, IO=0.2 to 1.5A						VIN=VCC=14V, VO=5V, IO=0.2 to 1.5A				
Overcurrent Protection Starting Current	IS	1.6			1.6			1.6			A	
	Conditions	VIN=VCC=15V						VIN=VCC=14V				
Quiescent Circuit Current 1	IIN		4			4			4		mA	
	Conditions	VIN=15V, VCC=5V, IO=0V, VO≤12V						VIN=14V, VCC=5V, IO=0A, VO≤12V				
Quiescent Circuit Current 2	Icc		8.5			8.5			8.5		mA	
	Conditions	VCC=15V, IO=0A						VCC=14V, IO=0A				
Quiescent Circuit Current 3	IIN (off)			1			1			1	μA	
	Conditions	VIN=15V, VC/E=0V or Open						VIN=14V, VC/E=0V or Open				
Quiescent Circuit Current 4	Icc (off)			1			1			1	μA	
	Conditions	VCC=15V, VC/E=0V or Open						VIN=14V, VC/E=0V or Open				
Quiescent Circuit Current 5	IIN (ssov)								4		mA	
	Conditions	—						VIN=14V, VCC=5V, IO=0A, SS1=SS2=0V				
Quiescent Circuit Current 6	Icc (ssov)								8.5		mA	
	Conditions	—						VCC=14V, IO=0V, SS1=SS2=0V				
C/E Pin	High Level Voltage	VC/EH	2			2			2		V	
		Conditions	VIN=VCC=15V						VIN=VCC=14V			
	Low Level Voltage	VC/EL			0.8			0.8			0.8	V
		Conditions	VIN=VCC=15V						VIN=VCC=14V			
Inflow Current at High	IC/EH		95			95			95		μA	
	Conditions	VC/E=20V						VC/E=20V				
SS Pin ³	Low Level Voltage	VSSL			0.5		0.5			0.5	V	
		Conditions	VIN=VCC=15V						VIN=VCC=14V			
	Inflow Current at Low	ISSL		60	80		60	80		60	80	μA
		Conditions	VSSL=0V, VIN=VCC=15V						VSSL=0V, VIN=VCC=14V			

*1: Electrical characteristics show the characteristic ratings guaranteed when operating the ICs under the measurement conditions described in the above table.

*2: Efficiency is calculated from the following formula.

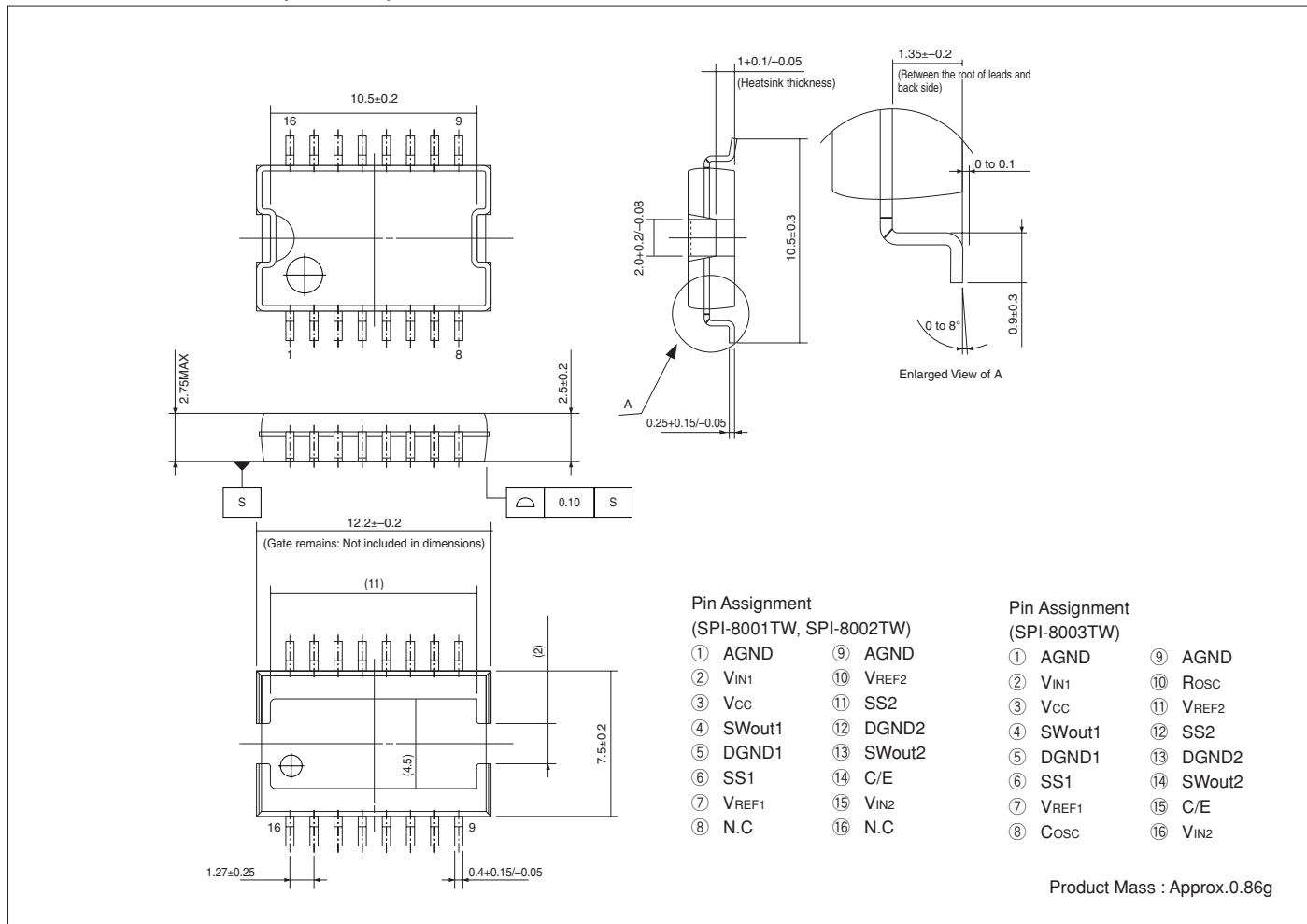
$$\eta (\%) = \frac{V_O \cdot I_O}{V_{IN} \cdot I_{IN}} \times 100$$

*3: Pin 6 and pin 11 are the SS pins. Soft start at power on can be performed with capacitors connected to these pins. The outputs can also be turned ON/OFF with these pins. The outputs are stopped by setting the voltages of these pins to VSSL or lower. SS-pin voltages can be changed with open-collector drive circuits of transistors.

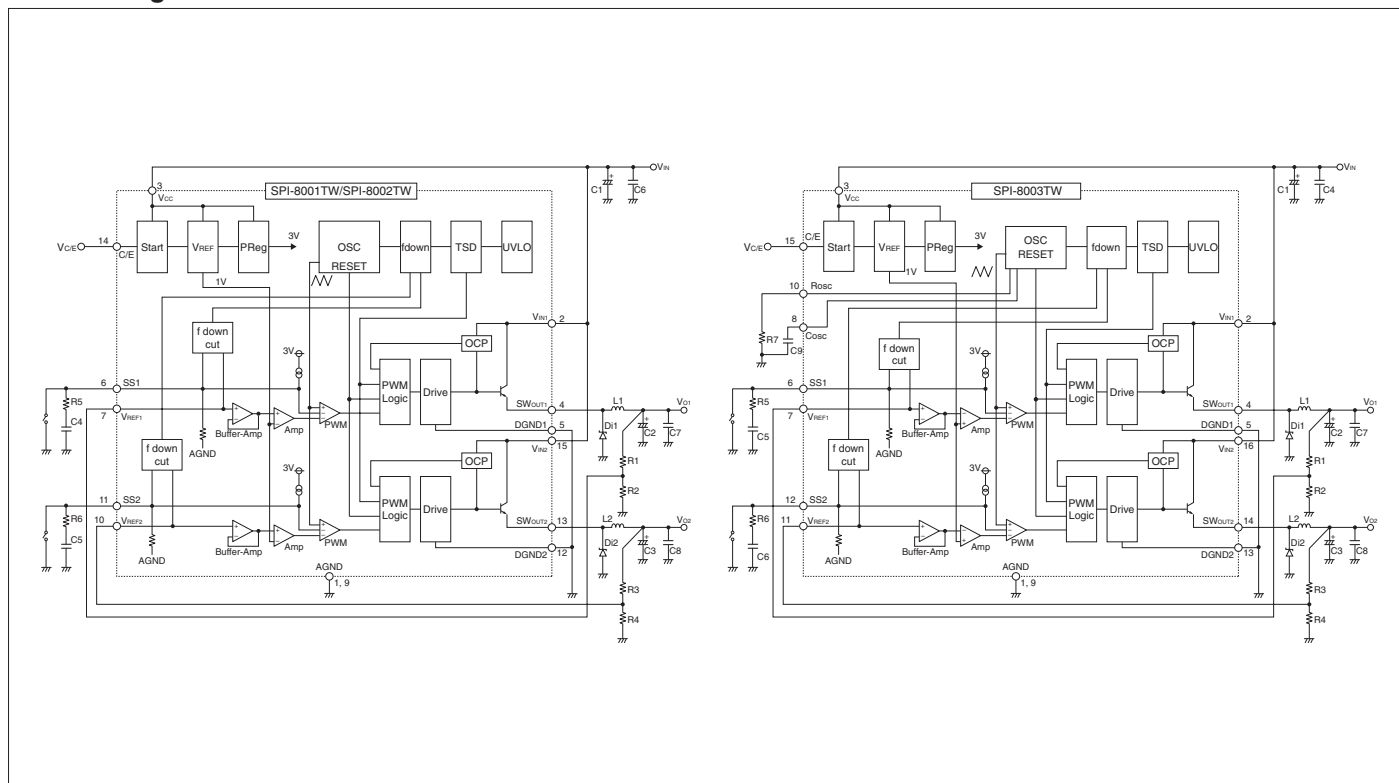
When using both the soft-start and ON/OFF functions together, the discharge currents from C4 and C5 flow into the ON/OFF control transistors respectively. Therefore, limit the currents securely to protect the transistors if C4 and C5 capacitances are large. The SS pins are pulled up to the power supply in the ICs, so applying the external voltages are prohibited.

External Dimensions (HSOP16)

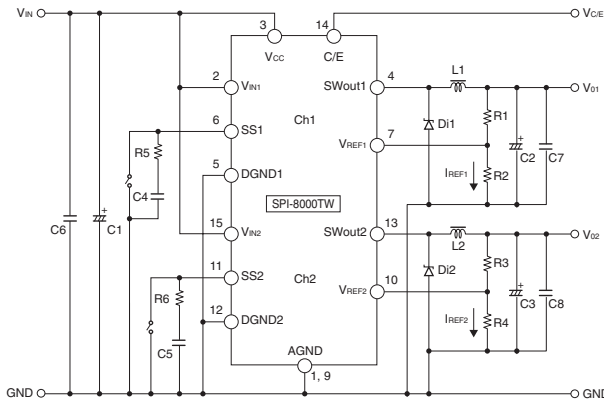
(Unit : mm)



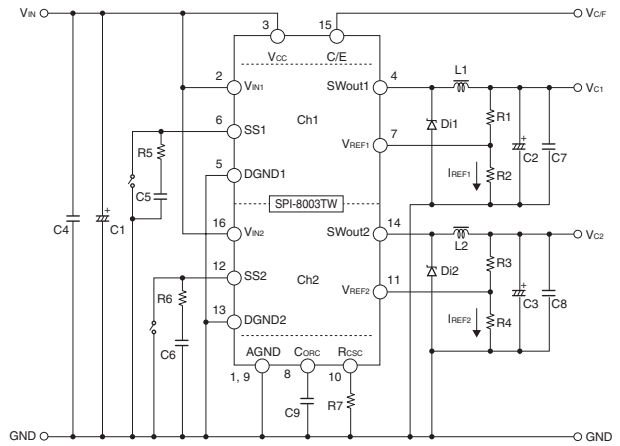
Block Diagram



Typical Connection Diagram



- C1 : 220 μF/50V
- C2, C3 : 470 μF/25V
- C4, C5 : 1 μF
- C6, C7, C8 : 0.1 μF
- R5, R6 : 1kΩ
- L1, L2 : 47 μH
- Di1, Di2 : SJPB-H6 (Sanken)



- C1 : 220 μF/50V
- C2, C3 : 470 μF/25V
- C4 : 1 μF/50V
- C5, C6 : 1 μF/10V
- C7, C8 : 0.1 μF/50V
- C9 : 100pF/10V
- L1, L2 : 47 μH
- R2, R4 : 1kΩ
- R5, R6 : 1kΩ
- Di1, Di2 : SJPB-H6 (Sanken)

Diodes Di1, Di2

- Be sure to use Schottky-barrier diodes for Di1 and Di2.
- If other diodes like fast recovery diodes are used, IC may be destroyed because of the reverse voltage generated by the recovery voltage or ON voltage.

Choke coils L1, L2

- If the winding resistance of the choke coil is too high, the efficiency may drop below the rated value.
- As the overcurrent protection starting current is about 2.0A, take care concerning heat radiation from the choke coil caused by magnetic saturation due to overload or short-circuited load.
- Use a closed-magnetic-path coil to prevent interference between the channels SWout1 and SWout2.

Capacitors C1, C2, C3

- As large ripple currents flow through C1, C2 and C3, use high-frequency and low-impedance capacitors suitable for switching mode power supplies. Especially when the impedance of C2 and C3 are high, the switching waveforms may become abnormal at low temperatures. For C2 and C3, do not use capacitors with extremely low equivalent series resistance (ESR) such as OS capacitors or tantalum capacitors, which may cause abnormal oscillation.

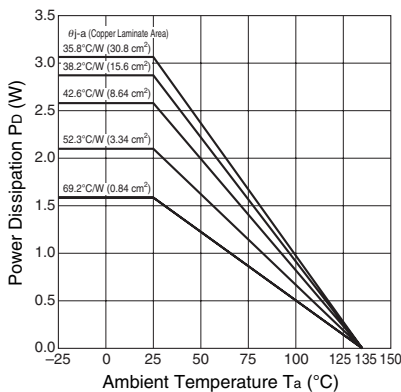
Resistors R1, R2, R3, R4

- R1, R2, R3 and R4 are resistors for setting output voltages. Set the resistors so that IREF is approx. 1 mA. For example, R1 and R2 can be calculated as shown below.

$$R1 = \frac{(V_{O1} - V_{REF1})}{I_{REF1}} = \frac{(V_{O1} - V)}{1 \times 10^{-3}} (\Omega), R2 = \frac{V_{REF1}}{I_{REF1}} = \frac{1}{1 \times 10^{-3}} \approx 1(K\Omega)$$

© To create the optimum operating conditions, place the components as close as possible to each other.

Ta-Pd Characteristics



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

- VO : Output Voltage
- VIN : Input Voltage
- IO : Output Current
- η% : Efficiency (%)
- VF : D1 Forward Voltage
SJPB-H6...0.45V (IO=1A)

Note 1: The efficiency depends on the input voltage and the output current. Therefore, obtain the value from the efficiency graph and substitute the percentage in the formula above.

Note 2: Thermal design for D1 must be considered separately.

SI-8511NVS Surface-Mount, Synchronous Rectifier Step-down Switching Mode Control ICs

■ Features

- Surface-mount package (TSSOP24)
- High efficiency due to synchronous rectification: 92% (at $V_{IN} = 5V$, $I_o = 1A$, $V_o = 2.5V$)
- Capable of downsize a choke-coil due to IC's high switching frequency (400kHz typ, On Time Control). (Compared with conventional Sanken devices)
- Low reference voltage (V_{ref}) of 1.1V. The output voltage is variable from 1.1V to 6V.
- High-speed response to a load
- Compatible with low ESR capacitors
- Soft start and output ON/OFF available
- Built-in overcurrent and output-overvoltage protection circuits
- PWRGD function to indicate the output voltage status
- High precision reference voltage: $1.1V \pm 1.2\%$

■ Absolute Maximum Ratings

(Ta=25°C)

Parameter	Symbol	Ratings	Unit
Control-System DC Input Voltage	V_{CC}	7	V
DC Input Voltage	V_{IN}	25	V
Boost Block Input Voltage	V_H	30	V
EN Terminal Input Voltage	V_{EN}	V_{CC}	V
PWRGD Terminal Applied Voltage	V_{PWRGD}	7	V
Junction Temperature	T_j	+150	°C
Storage Temperature	T_{sig}	-40 to +150	°C

■ Applications

- Power supplies for notebook PCs and mobile devices
- Onboard local power supplies
- OA equipment
- For stabilization of the secondary-side output voltage of switching power supplies

■ Recommended Operating Conditions

Parameter	Symbol	Ratings	Unit
Control System Input Voltage Range	V_{CC}	4.5 to 5.5	V
Input Voltage Range	V_{IN}	3 to 18	V
Output Voltage Range	V_o	1.1 to 6	V
Operating Temperature Range	T_{op}	-20 to +85	°C

■ Electrical Characteristics

(Ta=25°C unless otherwise specified)

Parameter	Symbol	Ratings			Unit	Conditions	
		min.	typ.	max.			
Dynamic Characteristics	Output Voltage	V_o	-1.2%	1.1	+1.2%	V	$V_{IN}=5V$, $V_{CC}=5V$, $VSNS$ connected to VO , $I_o=0A$
	Temperature Coefficient of Output Voltage	$\Delta V_o/\Delta T$		± 0.03		mV/°C	$V_{IN}=5V$, $V_{CC}=5V$, $VSNS$ connected to VO , $I_o=0A$, $T_a=0$ to $85^\circ C$
Circuit Current	Circuit Current (V_{CC} Terminal)	I_{op}			6	mA	$V_{CC}=5V$, $EN=H$, $FADJ=open$
	Circuit Current (V_{IN} Terminal)	I_{op}			1	mA	$V_{IN}=5V$, $EN=H$
	Standby Current 1 (V_{CC} Terminal)	I_{std1}			100	μA	$V_{CC}=5V$, $EN=L$
	Standby Current 2 (V_{IN} Terminal)	I_{std2}			50	μA	$V_{IN}=5V$, $EN=L$
Undervoltage Lockout	UVLO Operating Voltage 1 (V_{CC} Terminal)	V_{uvlo1}	3.7		4.45	V	$V_{IN}=5V$
	UVLO Operating Voltage 2 (V_{IN} Terminal)	V_{uvlo2}	2.5		2.9	V	$V_{CC}=5V$
On Time Control	On Time	T_{on}		1.27		μS	$V_{CC}=5V$, $V_{IN}=5V$, $V_o=2.5V$
	Minimum Off Time	T_{off}		0.7		μS	$V_{CC}=5V$
	REF Terminal Voltage	V_{ref}	1.1	1.2	1.3	V	$V_{CC}=5V$
	REF Terminal Source Current	I_{ref}			100	μA	$V_{CC}=5V$
High Side Drive	On Resistance (high side)	R_{onHH}		5.5		Ω	$V_H-V_{LIN}=5V$
	On Resistance (low side)	R_{onHL}		5.5		Ω	$V_H-V_{LIN}=5V$
Low Side Drive	On Resistance (high side)	R_{onLH}		5.5		Ω	$V_{CC}=5V$
	On Resistance (low side)	R_{onLL}		5.5		Ω	$V_{CC}=5V$
Bootstrap	Bootstrap Voltage	V_H-V_{LIN}	4.5	5	5.5	V	
Protection System	Current for Current Limit Detection	I_{lim}	90	100	110	μA	$V_{CC}=5V$, $V_{IN}=5V$
	Soft Start Terminal Current	I_{ss}		± 20		μA	$V_{CC}=5V$
	EN Low Level Voltage	V_{celo}	0		0.8	V	$V_{CC}=5V$
	EN High Level Voltage	V_{cehi}	2.4		V_{CC}	V	$V_{CC}=5V$
	EN Bias Level Current	ICE			5	μA	$V_{CC}=5V$, $EN=5V$
	PWRGD Good Voltage (high side)	V_{sens}		1.32		V	$V_{CC}=5V$
	PWRGD Good Voltage (low side)	V_{sens}		0.88		V	$V_{CC}=5V$
	PWRGD Low Output Voltage	V_{pwrgrd}			0.4	V	$V_{CC}=5V$, $I_{pwrgrd}=120\mu A$
	PWRGD Terminal Current	I_{pwrgrd}			120	μA	$V_{CC}=5V$, $V_{pwrgrd}=0.4V$
	PWRGD Leakage Current	I_{pwrgrd}			5	μA	$V_{pwrgrd}=5V$

Selection Guide

Linear Regulator ICs (low dropout voltage, built-in overcurrent protection and thermal shutdown circuits)

<Single Output>

Surface-Mount Type

Series Name	Output Current (A)	Output Voltage (V)						Variable (Reference Voltage) (V)				Dropout Voltage (V)	Maximum Input Voltage (V)	Package	Can Use Low ESR Capacitor	Page
		1.8	2.5	3.3	5.0	9.0	12	1.0	1.1	1.25	1.28					
SI-3000LU	0.25									⊙		0.5	18	SOT89-5	○	66
SI-3000LSA	1.0	⊙	⊙	⊙	⊙							1.2	16	SOP8	–	68
SI-3000KS	1.0		⊙	⊙							⊙	0.6	17	SOP8	○	70
SI-3000KD	1.0			⊙	⊙			⊙			⊙	0.6	35 ^{*1}	TO263-5	○ ^{*2}	72
SI-3000LLSL	1.5							⊙				0.3	10	SOP8	○	76
SI-3000ZD	3.0			⊙					⊙			0.6	10	TO263-5	–	78

*1: For the SI-3012KD and 3033KD: 17 V

*2: The SI-3010KD and 3050KD cannot use a low ESR capacitor.

Thru-Hole Type

Series Name	Output Current (A)	Variable (Reference Voltage) (V)		Dropout Voltage (V)	Maximum Input Voltage (V)	Package	Can Use Low ESR Capacitor	Page
		1.0	1.1					
SI-3000KF	1.0	⊙		0.5	35	TO220F-5	–	80
SI-3000ZF	3.0		⊙	0.7	10	TO220F-5	–	82

<Multi Output>

Part Number		Output Voltage	Output Current	Dropout Voltage (V)	Maximum Input Voltage (V)	Package	Can Use Low ESR Capacitor	Page
		(V)	(A)					
SI-3002KWM	ch1	3.3	1.0	0.6	18.0	TO252-5	–	84
	ch2	2.5	1.0					

Application Note

Heat dissipation and Reliability

The reliability of an IC is highly dependent on its operating temperature. Please be sure to apply silicone grease to the IC and to mount it to the heatsink with a proper mounting torque.

Heatsink design should pay particular attention to ensuring sufficient heat dissipation capacity.

In addition, please take into account the air convection in operation.

Calculating Internal Power Dissipation(P_D)

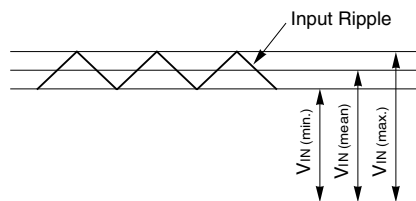
P_D is given by the following formula:

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

Determine the size of the heatsink according to the relationship between allowable power dissipation and ambient temperature.

Setting DC Input Voltage

The following is the waveform of a DC input voltage.



When setting the DC input voltage, please follow the instructions below:

- Make $V_{IN(\text{min})} \geq [(\text{Output voltage}) + (\text{Minimum dropout voltage})]$
- Make $V_{IN(\text{max})} \leq$ DC input voltage shown in the "Absolute Maximum Ratings"

Thermal Design

The maximum junction temperature $T_{J(\text{max})}$ given in the absolute maximum ratings is specific to each product type and must be strictly observed. Thus, thermal design must consider the maximum power dissipation $P_{D(\text{max})}$, which varies by the conditions of use, and the maximum ambient temperature $T_{a(\text{max})}$.

To simplify thermal design, T_a - P_D characteristic graphs are provided herein.

Please observe the following steps for heatsink design:

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

Although the heatsink size is now obtained, in actual applications, 10-to-20% derating factor is generally 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.

Please refer to the T_a - P_D characteristic graphs for respective product types.

Mounting Torque

SI-3000KF	} 0.588 to 0.686 [N•m] (6.0 to 7.0 [kgf•cm])
SI-3000ZF	

Recommended Silicone Grease

- Shin-Etsu Chemical Co., Ltd.: G746
- Momentive Performance Materials Inc.: YG-6260
- Dow Corning Toray Silicones Co., Ltd.: SC102

Please select proper silicone grease carefully since the oil in some grease products may penetrate the device and result in an extremely short device life.

Others

- Devices can not be operated in parallel connection aiming for a larger current.
- Diodes for isolation purpose are provided in between input and ground, and also in between output and ground. They may be broken down if the device is reverse biased. In this case, please clamp the device with low V_F diodes to protect them.

Rectifier Diodes for Power Supplies

To rectify the AC input voltage using rectifier diodes for power supplies, please use SANKEN rectifier diodes shown in the following list. (Please use a center-tap or bridge configuration in using stand-alone type diodes.)

Series Name	Diodes
SI-3000LU Series	SJPM-H4(Surface-Mount Stand-Alone Type, V_{RM} :400V, I_O :2.0A)
SI-3000LSA Series	
SI-3000KS Series	
SI-3000KD Series	
SI-3000LLSL Series	
SI-3000ZD Series	AM01Z(Axial Type, V_{RM} :200V, I_O :1.0A)
SI-3000KF Series	
SI-3000ZF Series	

SI-3000LU Series Surface-Mount, Low Current Consumption, Low Dropout Voltage

■ Features

- Compact surface-mount package (SOT89-5)
- Output current: 250 mA
- Low current consumption I_q (OFF) $\leq 1\mu\text{A}$ ($V_c = 0\text{ V}$)
- Low dropout voltage: $V_{\text{DIF}} \leq 0.5\text{ V}$ (at $I_o = 250\text{ mA}$)
- Output voltage range (1.5V to 15V)
- Built-in drooping-type-overcurrent and thermal protection circuits

■ Absolute Maximum Ratings

(T_a=25°C)

Parameter	Symbol	Rated	Unit
DC Input Voltage	V _{IN}	18	V
Output control terminal voltage	V _c	V _{IN}	V
DC Output Current	I _o	250	mA
Power Dissipation	P _D ^{*1}	0.75	W
Junction Temperature	T _j ^{*2}	-40 to +135	°C
Storage Temperature	T _{stg} ^{*2}	-40 to +125	°C
Thermal Resistance (Junction to Ambient Air)	θ _{ja} ^{*1}	146	°C/W

*1: When mounted on glass-epoxy board 40 × 40 mm (copper laminate area 2%).

*2: Thermal protection circuits may operate if the junction temperature exceeds 135°C.

■ Applications

- Auxiliary power supplies for PC
- Battery-driven electronic equipment

■ Recommended Operating Conditions

Parameter	Symbol	Rated		Unit
		min.	max.	
Input Voltage	V _{IN}	*2, *3	V _O +2 ^{*1}	V
DC Output Current	I _o	0	250	mA
Operating Ambient Temperature	T _{op}	-20	85	°C

*1: V_{IN} (max) and I_o (max) are restricted by the relation P_D = (V_{IN} - V_O) × I_o.

Calculate these values referring to the reference data on page 67.

*2: Refer to the Dropout Voltage parameter.

*3: For the SI-3012LU, set the input voltage to V_{in} ≥ 2.4 V, and secure the minimum voltage as explained in "Setting DC Input Voltage" section in Linear Regulator Application Note.

■ Electrical Characteristics

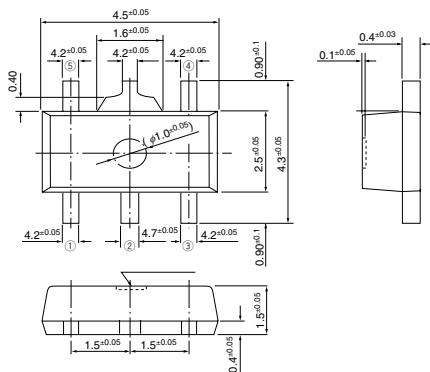
(T_a=25°C, V_c=2V, unless otherwise specified)

Parameter	Symbol	Rated			Unit	
		SI-3012LU(Variable)				
		min.	typ.	max.		
Reference Voltage	V _{ADJ} Conditions	1.210	1.250	1.290	V	
Dropout Voltage	V _{DIF} Conditions		V _{IN} =V _O +1V, I _o =10mA	0.3	V	
	Conditions		I _o =100mA(V _O =3.3V)	0.5		
	Conditions		I _o =250mA(V _O =3.3V)	0.5		
Line Regulation	ΔV _{LINE} Conditions		V _{IN} =V _O +1 to V _O +5V, I _o =10mA(V _O =3.3V)	10	mV	
Load Regulation	ΔV _{LOAD} Conditions		V _{IN} =V _O +1V, I _o =1 to 250mA(V _O =3.3V)	20	mV	
Temperature Coefficient of Reference Voltage	ΔV _O /ΔT _a Conditions		±0.3 T _j =0 to 100°C		mV/°C	
Ripple Rejection	R _{REJ} Conditions		V _{IN} =V _O +1V, f=100 to 120Hz(V _O =3.3V)		dB	
Quiescent Circuit Current	I _q Conditions		V _{IN} =V _O +1V, I _o =0mA V _c =2V, R ₂ =100kΩ	150	μA	
Circuit Current at Output OFF	I _q (OFF) Conditions		V _{IN} =V _O +1V, V _c =0V	1	μA	
Overcurrent Protection Starting Current ^{*1}	I _{S1} Conditions	260	V _{IN} =V _O +1V		mA	
V _c Terminal	Control Voltage (Output ON) ^{*2}	V _c , I _H	2.0		V	
	Control Voltage (Output OFF) ^{*2}	V _c , I _L		0.8		
	Control Current (Output ON)	I _c , I _H Conditions		V _c =2V	40	μA
	Control Current (Output OFF)	I _c , I _L Conditions		0 V _c =0V	-5	

*1: I_{S1} is specified at the 5% drop point of output voltage V_O on the condition that V_{IN} = 3.3 V, and I_o = 10 mA.*2: Output is OFF when the output control terminal (V_c terminal) is open. Each input level is equivalent to LS-TTL level. Therefore, the device can be driven directly by LS-TTLs.

External Dimensions (SOT89-5)

(Unit : mm)

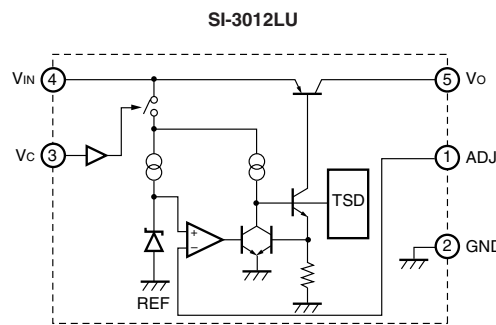


Pin Assignment

- ① ADJ
- ② GND
- ③ Vc
- ④ VIN
- ⑤ Vo

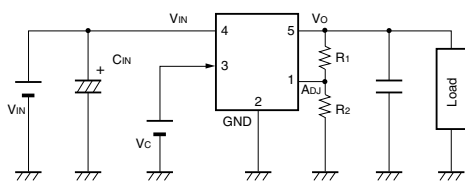
Plastic Mold Package Type
 Flammability: UL94V-0
 Product Mass: Approx. 0.05g

Block Diagram



Typical Connection Diagram

SI-3012LU



Co: Output capacitor (10 μF or larger)

For SI-3000LU series, Co has to be a low ESR capacitor such as a ceramic capacitor.

CIN: Input capacitor (10 μF approx.)

● Setting of SI-3012LU output voltage (recommended voltage: 1.5 V to 15 V)

R1 and R2: Resistors for output setting

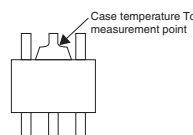
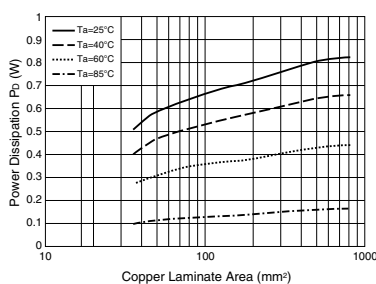
The output voltage can be set by connecting R1 and R2 as shown in the diagram on the left.

R2: 100 kΩ is recommended

$$R1 = (V_O - V_{ADJ}) / (V_{ADJ} / R2)$$

Reference Data

Copper Laminate Area vs Power Dissipation
 Tj=100°C PCB size 40x40



- A monolithic ICs mounts an inner frame stage that is connected to the GND pin (pin 2). Therefore, enlarging the copper laminate area connected to the GND pin improves heat radiation effect.

- Obtaining the junction temperature
 Measure the temperature Tc at the lead part of the GND pin (pin 2) with a thermocouple, etc. Then, substitute this value in the following formula to obtain the junction temperature.

$$T_j = P_D \times \theta_j - c + T_c \quad (\theta_j - c = 5^\circ\text{C/W})$$

SI-3000LSA Series Surface-Mount, Low Current Consumption, Low Dropout Voltage

Features

- Compact surface-mount package (SOP8)
- Output current: 1 A
- Low circuit current at output OFF: $I_{q(OFF)} \leq 1 \mu A$ ($V_C = 0 V$)
- Low dropout voltage: $V_{DIF} \leq 0.8 V$ (at $I_O = 1 A$)
 $V_{DIF} \leq 1.2 V$ ($I_O = 1 A$) for SI-3018LSA
- 4 types of output voltages (1.8 V, 2.5 V, 3.3 V, 5.0 V) available
- Output ON/OFF control terminal voltage compatible with LS-TTL
- Built-in foldback-type-overcurrent and thermal protection circuits

Absolute Maximum Ratings

($T_a = 25^\circ C$)

Parameter	Symbol	Ratings	Unit
DC Input Voltage	V_{IN}	16	V
Output control terminal voltage	V_C	V_{IN}	V
DC Output Current	I_O	1	A
Power Dissipation	P_{D1}^{*1}	1.16	W
	P_{D2}^{*2}	1.1	W
Junction Temperature	T_J^{*3}	-30 to +150	$^\circ C$
Operating Ambient Temperature	T_{OP}	-30 to +150	$^\circ C$
Storage Temperature	T_{STG}	-30 to +150	$^\circ C$
Thermal Resistance (Junction to Lead (pin 8))	θ_{J-L}	36	$^\circ C/W$
Thermal Resistance (Junction to Ambient Air)	θ_{J-a}^{*2}	100	$^\circ C/W$

*1: When mounted on glass-epoxy board 56.5 × 56.5 mm (copper laminate area 100%).

*2: When mounted on glass-epoxy board 40 × 40 mm (copper laminate area 100%).

*3: Thermal protection circuits may be activated if the junction temperature exceeds 135 $^\circ C$.

Applications

- Auxiliary power supplies for PC
- Battery-driven electronic equipment

Recommended Operating Conditions

Parameter	Symbol	Ratings				Unit
		SI-3018LSA	SI-3025LSA	SI-3033LSA	SI-3050LSA	
DC Input Voltage Range	V_{IN}	3.1 to 3.5 ^{*1}	^{*2} to 3.5 ^{*1}	^{*2} to 5.2 ^{*1}	^{*2} to 8.0	V
DC Output Current Range	I_O	0 to 1				A
Operating Junction Temperature	T_{JP}	-20 to +125				$^\circ C$
Operating Ambient Temperature	T_{AP}	-30 to +85				$^\circ C$

*1: V_{IN} (max) and I_O (max) are restricted by the relation $P_D = (V_{IN} - V_O) \times I_O$.

Please calculate these values referring to the reference data on page 69.

*2: Refer to the Dropout Voltage parameter.

Electrical Characteristics

($T_a = 25^\circ C$, $V_C = 2V$, unless otherwise specified)

Parameter	Symbol	Ratings										Unit		
		SI-3018LSA			SI-3025LSA			SI-3033LSA			SI-3050LSA			
		min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	min.		typ.	max.
Output Voltage	V_O	1.764	1.800	1.836	2.450	2.500	2.550	3.234	3.300	3.366	4.90	5.00	5.10	V
	Conditions	$V_{IN} = 3.3V, I_O = 0.5A$			$V_{IN} = 3.3V, I_O = 0.5A$			$V_{IN} = 5V, I_O = 0.5A$			$V_{IN} = 6V, I_O = 0.5A$			
Dropout Voltage	V_{DIF}	-			0.4			0.4			0.4			V
	Conditions	-			$I_O \leq 0.5A$			$I_O \leq 0.5A$			$I_O \leq 0.5A$			
	Conditions	0.6	1.2				0.8			0.8			0.8	
Line Regulation	ΔV_{LINE}	2			2			3			3			mV
	Conditions	$V_{IN} = 3.1$ to 3.5V, $I_O = 0.3A$			$V_{IN} = 3.1$ to 3.5V, $I_O = 0.3A$			$V_{IN} = 4.5$ to 5.5V, $I_O = 0.3A$			$V_{IN} = 6$ to 7V, $I_O = 0.3A$			
Load Regulation	ΔV_{LOAD}	10			10			10			10			mV
	Conditions	$V_{IN} = 3.3V, I_O = 0$ to 1A			$V_{IN} = 3.3V, I_O = 0$ to 1A			$V_{IN} = 5V, I_O = 0$ to 1A			$V_{IN} = 6V, I_O = 0$ to 1A			
Temperature Coefficient of Output Voltage	$\Delta V_O / \Delta T_a$	± 0.3			± 0.3			± 0.3			± 0.5			mV/ $^\circ C$
	Conditions	$V_{IN} = 3.3V, I_O = 5mA, T_J = 0$ to 100 $^\circ C$			$V_{IN} = 3.3V, I_O = 5mA, T_J = 0$ to 100 $^\circ C$			$V_{IN} = 5V, I_O = 5mA, T_J = 0$ to 100 $^\circ C$			$V_{IN} = 6V, I_O = 5mA, T_J = 0$ to 100 $^\circ C$			
Ripple Rejection	R_{REJ}	60			57			55			55			dB
	Conditions	$V_{IN} = 3.3V, f = 100$ to 120Hz			$V_{IN} = 3.3V, f = 100$ to 120Hz			$V_{IN} = 5V, f = 100$ to 120Hz			$V_{IN} = 6V, f = 100$ to 120Hz			
Quiescent Circuit Current	I_q	1.7			1.7			1.7			1.7			mA
	Conditions	$V_{IN} = 3.3V, I_O = 0A$			$V_{IN} = 3.3V, I_O = 0A$			$V_{IN} = 5V, I_O = 0A$			$V_{IN} = 6V, I_O = 0A$			
Circuit Current at Output OFF	$I_{q(OFF)}$	1			1			1			1			μA
	Conditions	$V_{IN} = 3.3V, I_O = 0A, V_C = 0V$			$V_{IN} = 3.3V, I_O = 0A, V_C = 0V$			$V_{IN} = 5V, I_O = 0A, V_C = 0V$			$V_{IN} = 6V, I_O = 0A, V_C = 0V$			
Overcurrent Protection Starting Current ^{*1,3}	I_{S1}	1.2			1.2			1.2			1.2			A
	Conditions	$V_{IN} = 3.3V$			$V_{IN} = 3.3V$			$V_{IN} = 5V$			$V_{IN} = 6V$			
V_C Terminal	Control Voltage (Output ON) ^{*2}	V_C, IH	2.0		2.0		2.0		2.0		2.0		V	
	Control Voltage (Output OFF) ^{*2}	V_C, IL	0.8		0.8		0.8		0.8		0.8			
	Control Current (Output ON)	I_C, IH	40		40		40		40		40			μA
	Conditions	$V_C = 2V$												
	Control Current (Output OFF)	I_C, IL	0		0		0		0		0			
Conditions	$V_C = 0V$													

*1: I_{S1} is specified at the 5% drop point of output voltage V_O on the condition that $V_{IN} = 3.3 V$ (5 V for SI-3033LSA), and $I_O = 0.5 A$.

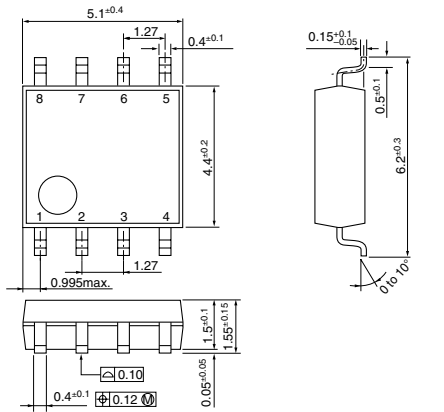
*2: Output is OFF when the output control terminal V_C is open. Each input level is equivalent to LS-TTL level. Therefore, the device can be driven directly by LS-TTLs.

*3: These products cannot be used in the following applications. Because these applications require a certain current at start-up and so the built-in foldback-type overcurrent protection may cause errors during start-up stage.

(1) Constant current load (2) Positive and negative power supply (3) Series-connected power supply (4) V_O adjustment by raising ground voltage

External Dimensions (SOP8)

(Unit : mm)

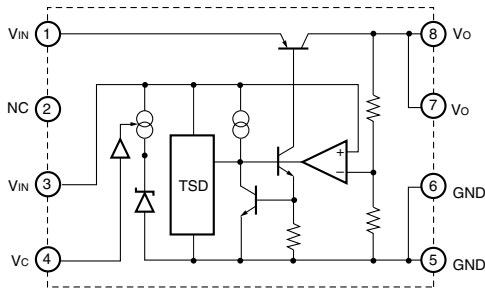


Pin Assignment

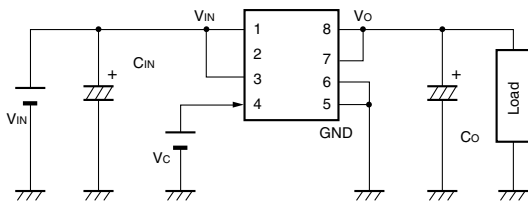
- ① VIN
- ② NC (Leave open)
- ③ VIN
- ④ Vc
- ⑤ GND
- ⑥ GND
- ⑦ Vo
- ⑧ Vo

Plastic Mold Package Type
 Flammability: UL94V-0
 Product Mass: Approx. 0.1g

Block Diagram



Typical Connection Diagram



C_O: Output capacitor (22 μ F or larger)

C_{IN}: Input capacitor (10 μ F)

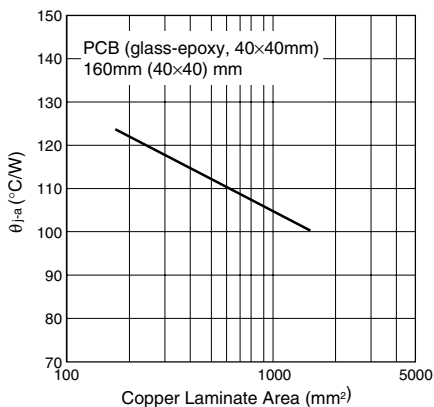
This capacitor is required in the case of an inductive input line or long wiring.

Tantalum capacitors are recommended for C_{IN} and C_O, particularly at low temperatures.

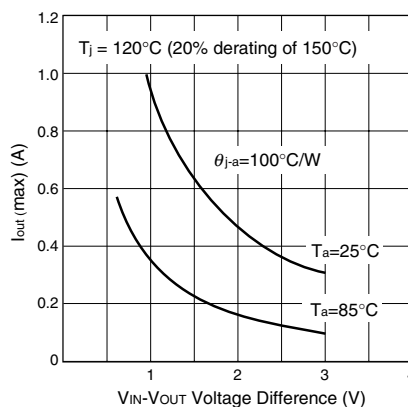
* Leave pin 2 open.

Reference Data

PCB Copper Laminate Area vs. Junction to Ambient Air Thermal Resistance



Allowable Output Current (vs. VIN-VOUT Voltage Difference)
 VIN-Io max



The inner frame stage, on which the PTR is mounted, is directly connected to the V_{out} pin.

Therefore, enlarging the copper laminate area around the V_{out} pin is really effective for a heat radiation.

SI-3000KS Series Surface-Mount, Low Current Consumption, Low Dropout Voltage

Features

- Compact surface-mount package (SOP8)
- Output current: 1.0 A
- Compatible with low ESR capacitor
- Low circuit current at output OFF $I_q \leq 350 \mu\text{A}$ ($I_o = 0 \text{ A}$, $V_c = 2 \text{ V}$)
- Low current consumption $I_q (\text{OFF}) \leq 1 \mu\text{A}$ ($V_c = 0 \text{ V}$)
- Low dropout voltage $V_{\text{DIF}} \leq 0.6 \text{ V}$ ($I_o = 1 \text{ A}$)
- 3 types of output voltages (2.5 V, 3.3 V, and variable type) available
- Output ON/OFF control terminal voltage compatible with LS-TTL
- Built-in drooping-type-overcurrent and thermal protection circuits

Absolute Maximum Ratings

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

Parameter	Symbol	Ratings	Unit
DC Input Voltage	V_{IN}^{*1}	17	V
Output Control Terminal Voltage	V_c	V_{IN}	V
DC Output Current	I_o^{*1}	1.0	A
Power Dissipation	$P_D^{*1, *2}$	0.76	W
Junction Temperature	T_j	-40 to +125	$^\circ\text{C}$
Storage Temperature	T_{stg}	-40 to +125	$^\circ\text{C}$
Thermal Resistance (Junction to Ambient Air)	θ_{j-a}	130	$^\circ\text{C/W}$
Thermal resistance (Junction to Lead (pin 7))	θ_{j-L}	22	$^\circ\text{C/W}$

*1: V_{IN} (max) and I_o (max) are restricted by the relation $P_D = (V_{\text{IN}} - V_o) \times I_o$. Please calculate these values referring to the Copper laminate area vs. Power dissipation data as shown hereinafter.

*2: When mounted on a glass epoxy board of 1600 mm² (copper laminate area 2%).

Applications

- Local power supplies
- Battery-driven electronic equipment

Electrical Characteristics

($T_a=25^\circ\text{C}$, $V_c=2 \text{ V}$, unless otherwise specified)

Parameter	Symbol	Ratings									Unit
		SI-3012KS (variable type)			SI-3025KS			SI-3033KS			
		min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	
Input Voltage	V_{IN}	2.4			*1			*1			V
Output Voltage (Reference voltage V_{ADJ} for SI-3012KS)	$V_o (V_{\text{ADJ}})$	1.24	1.28	1.32	2.45	2.50	2.55	3.234	3.300	3.366	V
Dropout Voltage	V_{DIF}			0.3			0.4			0.4	V
	Conditions	$V_{\text{IN}}=3.3\text{V}$, $I_o=10\text{mA}$			$V_{\text{IN}}=3.3\text{V}$, $I_o=10\text{mA}$			$V_{\text{IN}}=5\text{V}$, $I_o=10\text{mA}$			
	Conditions	$I_o=0.5\text{A}$ ($V_c=2.5\text{V}$)			$I_o=0.5\text{A}$			$I_o=0.5\text{A}$			
Line Regulation	ΔV_{OLINE}			10			10			15	mV
	Conditions	$V_{\text{IN}}=3.3$ to 8V , $I_o=10\text{mA}$ ($V_c=2.5\text{V}$)			$V_{\text{IN}}=3.3$ to 8V , $I_o=10\text{mA}$			$V_{\text{IN}}=5$ to 10V , $I_o=10\text{mA}$			
Load Regulation	ΔV_{LOAD}			40			40			50	mV
	Conditions	$V_{\text{IN}}=3.3\text{V}$, $I_o=0$ to 1A ($V_c=2.5\text{V}$)			$V_{\text{IN}}=3.3\text{V}$, $I_o=0$ to 1A			$V_{\text{IN}}=5\text{V}$, $I_o=0$ to 1A			
Quiescent Circuit Current	I_q			350			350			350	μA
	Conditions	$V_{\text{IN}}=3.3\text{V}$, $I_o=0\text{A}$, $V_c=2\text{V}$, $R_2=24\text{k}\Omega$			$V_{\text{IN}}=3.3\text{V}$, $I_o=0\text{A}$, $V_c=2\text{V}$			$V_{\text{IN}}=5\text{V}$, $I_o=0\text{A}$, $V_c=2\text{V}$			
Circuit Current at Output OFF	$I_q (\text{OFF})$			1			1			1	μA
	Conditions	$V_{\text{IN}}=3.3\text{V}$, $V_c=0\text{V}$			$V_{\text{IN}}=3.3\text{V}$, $V_c=0\text{V}$			$V_{\text{IN}}=5\text{V}$, $V_c=0\text{V}$			
Temperature Coefficient of Output Voltage	$\Delta V_o/\Delta T_a$		± 0.3			± 0.3			± 0.3		mV/ $^\circ\text{C}$
	Conditions	$T_j=0$ to 100°C ($V_o=2.5\text{V}$)			$T_j=0$ to 100°C			$T_j=0$ to 100°C			
Ripple Rejection	R_{REJ}		55			55			55		dB
	Conditions	$V_{\text{IN}}=3.3\text{V}$, $f=100$ to 120Hz ($V_c=2.5\text{V}$)			$V_{\text{IN}}=3.3\text{V}$, $f=100$ to 120Hz			$V_{\text{IN}}=5\text{V}$, $f=100$ to 120Hz			
Overcurrent Protection Starting Current ²	I_{S1}	1.2			1.2			1.2			A
	Conditions	$V_{\text{IN}}=3.3\text{V}$ ($V_c=2.5\text{V}$)			$V_{\text{IN}}=3.3\text{V}$			$V_{\text{IN}}=5\text{V}$			
V_c Terminal	Control Voltage (Output ON) ³	V_c, IH	2.0		2.0			2.0			V
	Control Voltage (Output OFF)	V_c, IL			0.8		0.8			0.8	
	Control Current (Output ON)	I_c, IH			40		40			40	μA
	Conditions	$V_c=2\text{V}$									
	Control Current (Output OFF)	I_c, IL	-5	0		-5	0		-5	0	
Conditions	$V_c=0\text{V}$										

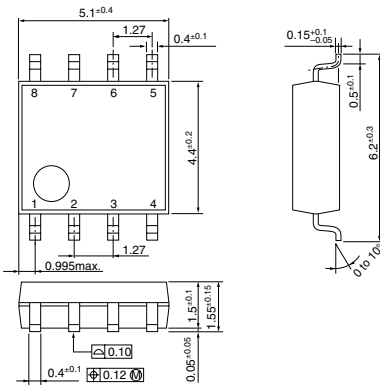
*1: Refer to the Dropout Voltage parameter.

*2: The I_{S1} is specified at the 5% drop point of output voltage V_o on the condition that $V_{\text{IN}} = V_o + 1 \text{ V}$, and $I_o = 10 \text{ mA}$.

*3: Output is OFF when the output control terminal V_c is open. Each input level is equivalent to LS-TTL level. Therefore, the device can be driven directly by LS-TTLs.

External Dimensions (SOP8)

(Unit : mm)



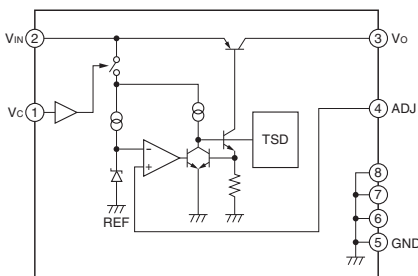
Pin Assignment

- ① V_c
- ② V_{IN}
- ③ V_o
- ④ Sense (ADJ for SI-3012KS)
- ⑤ GND
- ⑥ GND
- ⑦ GND
- ⑧ GND

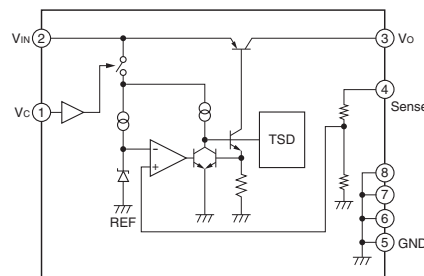
Plastic Mold Package Type
 Flammability: UL 94V-0
 Product Mass: Approx. 0.1 g

Block Diagram

SI-3012KS

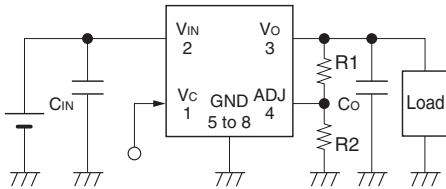


SI-3025KS, SI-3033KS



Typical Connection Diagram

SI-3012KS

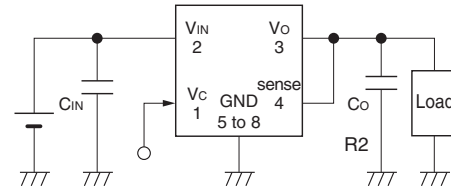


R₁, R₂: Output voltage setting resistors
 The output voltage can be set by connecting R₁ and R₂ as shown above.

The recommended value of R₂ is 24 kΩ.

$$R_1 = (V_o - V_{ADJ}) \cdot (V_{ADJ} / R_2)$$

SI-3025KS, SI-3033KS



C_{IN}: Input capacitor (22 μF or larger)

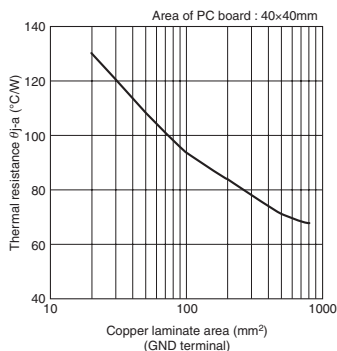
C_o: Output capacitor (22 μF or larger)

For SI-3000KS series, C_o has to be a low ESR capacitor.

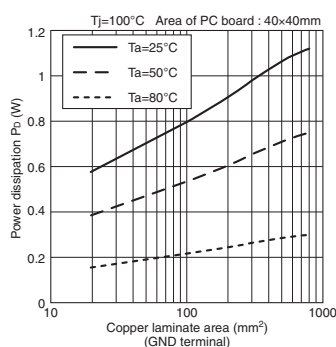
When using the electrolytic capacitor, the SI-3000KS series may oscillate at a low temperature.

Reference Data

Copper Laminate Area vs. Thermal Resistance



Copper Laminate Area vs. Power Dissipation



- Obtaining the junction temperature
 Measure the temperature T_L at the lead part of the GND pin (pin 7) with a thermocouple, etc. Then, substitute this value in the following formula to obtain the junction temperature.

$$T_J = P_D \times \theta_{J-L} + T_L \quad (\theta_{J-L} = 22^\circ \text{C/W})$$

SI-3000KD Series Surface-Mount, Low Current Consumption, Low Dropout Voltage

■Features

- Compact surface-mount package (TO263-5)
- Output current: 1.0A
- Low dropout voltage: $V_{DIF} \leq 0.6V$ (at $I_o = 1.0A$)
- Low circuit current consumption: $I_q \leq 350 \mu A$ (600 μA for SI-3010KD, SI-3050KD)
- Low circuit current at output OFF: $I_q (OFF) \leq 1 \mu A$
- Built-in overcurrent, thermal protection circuits
- Compatible with low ESR capacitors (SI-3012KD and SI-3033KD)

■Absolute Maximum Ratings

($T_a=25^\circ C$)

Parameter	Symbol	Ratings		Unit
		SI-3012KD/3033KD	SI-3010KD/3050KD	
DC Input Voltage	V_{IN}	17	35 ^{*1}	V
DC Output Current	I_o	1.0		A
Power Dissipation	P_D^{*2}	3		W
Junction Temperature	T_j	-30 to +125		$^\circ C$
Storage Temperature	T_{stg}	-30 to +125		$^\circ C$
Thermal Resistance (Junction to Ambient Air)	θ_{j-a}	33.3		$^\circ C/W$
Thermal Resistance (Junction to Case)	θ_{j-c}	3		$^\circ C/W$

*1: A built-in input-overvoltage-protection circuit shuts down the output voltage at the Input Overvoltage Shutdown Voltage of the electrical characteristics.

*2: When mounted on glass-epoxy board of 1600mm² (copper laminate area 100%).

■Applications

- Secondary stabilized power supply (local power supply)

■Electrical Characteristics 1 (Low Input Voltage type compatible with low ESR output capacitor)

($T_a=25^\circ C$, $V_C=2V$, unless otherwise specified)

Parameter	Symbol	Ratings						Unit
		SI-3012KD (Variable type)			SI-3033KD			
		min.	typ.	max.	min.	typ.	max.	
Input Voltage	V_{IN}	2.4 ^{*3}		*4	*3		*4	V
Output Voltage (Reference Voltage for SI-3012KD)	$V_O (V_{ADJ})$	1.24	1.28	1.32	3.234	3.300	3.366	V
Line Regulation	ΔV_{OLINE}	$V_{IN}=3.3V, I_o=10mA$			$V_{IN}=5V, I_o=10mA$			mV
	Conditions	$V_{IN}=3.3 \text{ to } 8V, I_o=10mA (V_O=2.5V)$			$V_{IN}=5 \text{ to } 10V, I_o=10mA$			
Load Regulation	ΔV_{OLOAD}				40			mV
	Conditions	$V_{IN}=3.3V, I_o=0 \text{ to } 1A (V_O=2.5V)$			$V_{IN}=5V, I_o=0 \text{ to } 1A$			
Dropout Voltage	V_{DIF}				0.4			V
	Conditions	$I_o=0.5A (V_O=2.5V)$			$I_o=0.5A$			
	Conditions	$I_o=1A (V_O=2.5V)$			$I_o=1A$			
Quiescent Circuit Current	I_q				350			μA
	Conditions	$V_{IN}=3.3V, I_o=0A, V_C=2V, R_2=2.4k\Omega$			$V_{IN}=5V, I_o=0A, V_C=2V$			
Circuit Current at Output OFF	$I_q (OFF)$				1			μA
	Conditions	$V_{IN}=3.3V, V_C=0V$			$V_{IN}=5V, V_C=0V$			
Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T_a$	± 0.3			± 0.3			mV/ $^\circ C$
	Conditions	$T_j=0 \text{ to } 100^\circ C (V_O=2.5V)$			$T_j=0 \text{ to } 100^\circ C$			
Ripple Rejection	R_{REJ}	55			55			dB
	Conditions	$V_{IN}=3.3V, f=100 \text{ to } 120Hz, I_o=0.1A (V_O=2.5V)$			$V_{IN}=5V, f=100 \text{ to } 120Hz, I_o=0.1A$			
Overcurrent Protection Starting Current ^{*1}	I_{S1}	1.1			1.1			A
	Conditions	$V_{IN}=3.3V$			$V_{IN}=5V$			
V _C Terminal	Control Voltage (Output ON) ^{*2}	2			2			V
	Control Voltage (Output OFF)				0.8			
	Control Current (Output ON)				40			μA
	Conditions	$V_C=2V$			$V_C=2V$			
	Control Current (Output OFF)	-5			-5			μA
Conditions	$V_C=0V$			$V_C=0V$				

*1: I_{S1} is specified at the 5% drop point of output voltage V_O under the condition of Output Voltage parameter.

*2: Output is OFF when the output control terminal (V_C terminal) is open. Each input level is equivalent to LS-TTL level. Therefore, the device can be driven directly by LS-TTLs.

*3: Refer to the Dropout Voltage parameter.

*4: V_{IN} (max) and I_o (max) are restricted by the relation $P_D = (V_{IN} - V_O) \times I_o$. Please calculate these values referring to the Copper laminate area vs. Power dissipation data.

■Electrical Characteristics 2 (High Input Voltage Type)

Parameter	Symbol	Ratings						Unit
		SI-3010KD (Variable type)			SI-3050KD			
		min.	typ.	max.	min.	typ.	max.	
Input Voltage	V_{IN}	2.4 ^{*1}		27 ^{*5}	^{*1}			V
Output Voltage (Reference Voltage V_{ADJ} for SI-3010KD)	V_O (V_{ADJ})	0.98	1.00	1.02	4.90	5.00	5.10	V
	Conditions	$V_{IN}=7V, I_O=10mA$			$V_{IN}=7V, I_O=10mA$			
Line Regulation	ΔV_{OLINE}			30			30	mV
	Conditions	$V_{IN}=6$ to 11V, $I_O=10mA$ ($V_O=5V$)			$V_{IN}=6$ to 11V, $I_O=10mA$			
Load Regulation	ΔV_{OLOAD}			75			75	mV
	Conditions	$V_{IN}=7V,$ $I_O=0$ to 1A ($V_O=5V$)			$V_{IN}=7V, I_O=0$ to 1A			
Dropout Voltage	V_{DIF}			0.3			0.3	V
	Conditions	$I_O=0.5A$ ($V_O=5V$)			$I_O=0.5A$			
	Conditions	$I_O=1A$ ($V_O=5V$)			$I_O=1A$			
Quiescent Circuit Current	I_q			600			600	μA
	Conditions	$V_{IN}=7V, I_O=0A, V_C=2V$ $R_2=10k\Omega$			$V_{IN}=7V, I_O=0A,$ $V_C=2V$			
Circuit Current at Output OFF	I_q (OFF)			1			1	μA
	Conditions	$V_{IN}=7V, V_C=0V$			$V_{IN}=7V, V_C=0V$			
Temperature Coefficient of Output Voltage	$\Delta V_O/\Delta T_a$		± 0.5			± 0.5		mV/ $^{\circ}C$
	Conditions	$T_j=0$ to 100 $^{\circ}C$ ($V_O=5V$)			$T_j=0$ to 100 $^{\circ}C$			
Ripple Rejection	RREJ		75			75		dB
	Conditions	$V_{IN}=7V,$ $f=100$ to 120Hz, $I_O=0.1A$ ($V_O=5V$)			$V_{IN}=7V,$ $f=100$ to 120Hz, $I_O=0.1A$			
Overcurrent Protection Starting Current ^{*2}	I_{S1}	1.1			1.1			A
	Conditions	$V_{IN}=7V$			$V_{IN}=7V$			
Vc Terminal	Control Voltage (Output ON) ^{*3}	V_C, I_H	2.0		2.0			V
	Control Voltage (Output OFF) ^{*3}	V_C, I_L					0.8	
	Control Current (Output ON)	I_C, I_H			40		40	μA
	Control Current (Output OFF)	I_C, I_L	-5	0		-5	0	μA
		Conditions	$V_C=0V$			$V_C=0V$		
Input Overvoltage Shutdown Voltage	V_{OVP}	33			26			V
	Conditions	$I_O=10mA$			$I_O=10mA$			

*1: Refer to the Dropout Voltage parameter.

*2: I_{S1} is specified at the 5% drop point of output voltage V_O under the condition of Output Voltage parameter.

*3: Output is OFF when the output control terminal (Vc terminal) is open. Each input level is equivalent to LS-TTL level. Therefore, the device can be driven directly by LS-TTLs.

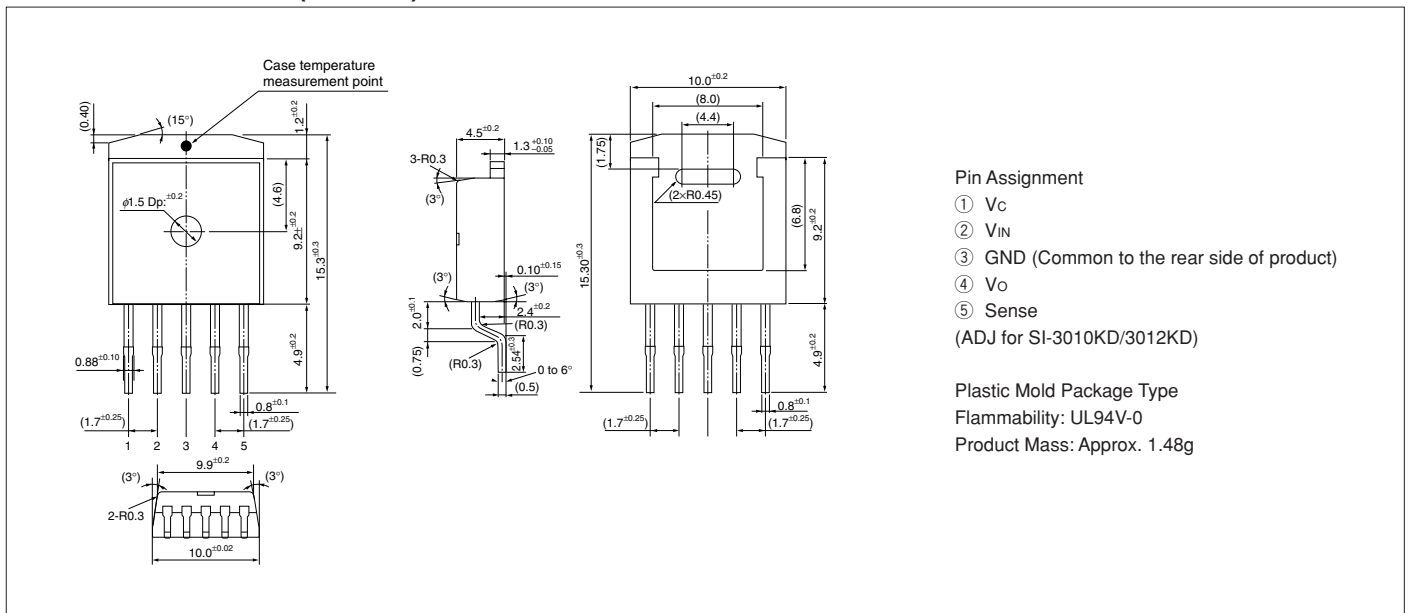
*4: SI-3010KD, SI-3050KD, cannot be used in the following applications because the built-in foldback-type overcurrent protection may cause errors during start-up stage.

(1) Constant current load (2) Positive and negative power supply (3) Series-connected power supply (4) V_O adjustment by raising ground voltage

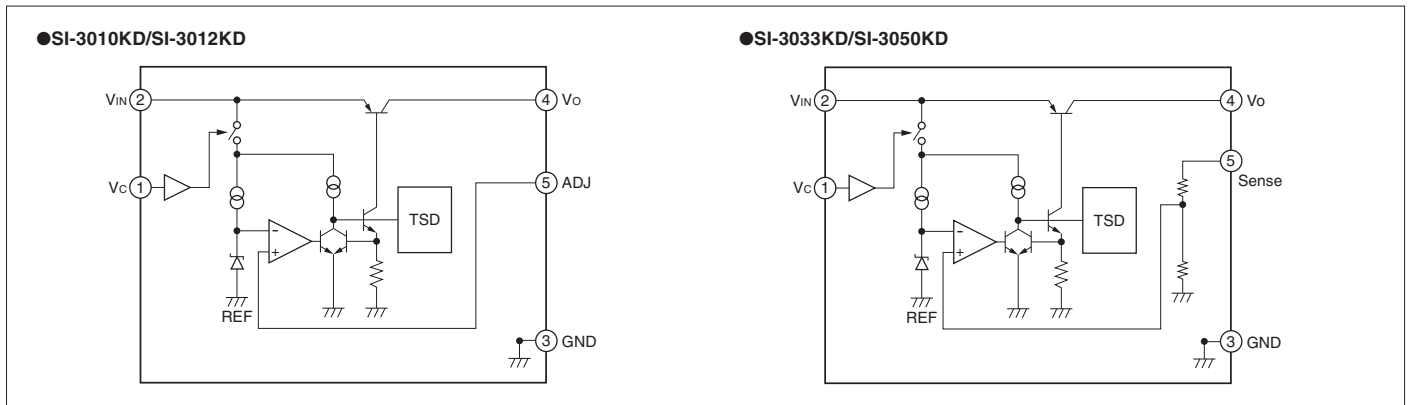
*5: V_{IN} (max) and I_O (max) are restricted by the relation $P_D = (V_{IN} - V_O) \times I_O$. Please calculate these values referring to the Copper laminate area vs. Power dissipation data as shown hereinafter.

■External Dimensions (TO263-5)

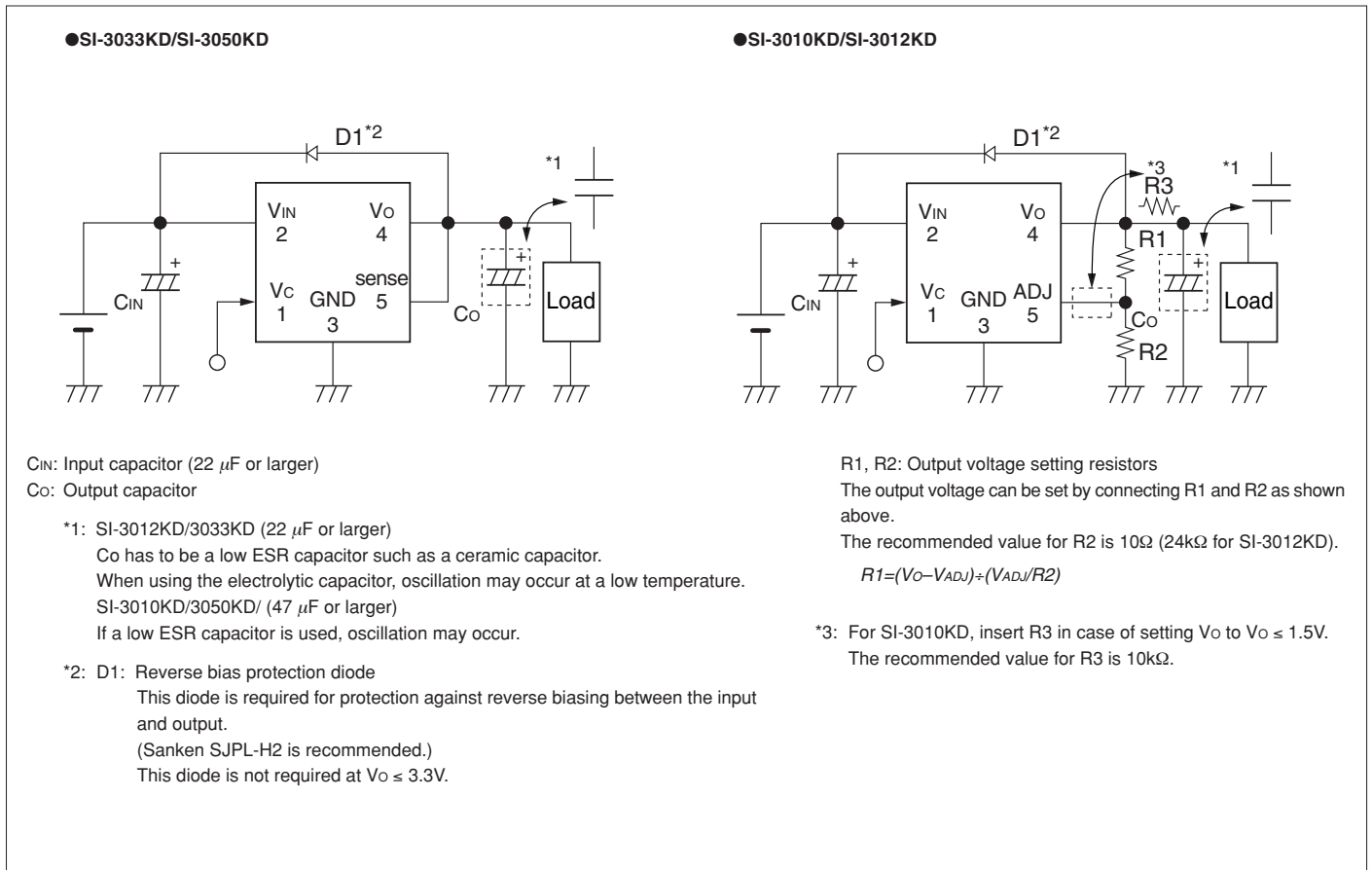
(unit : mm)



■Block Diagram

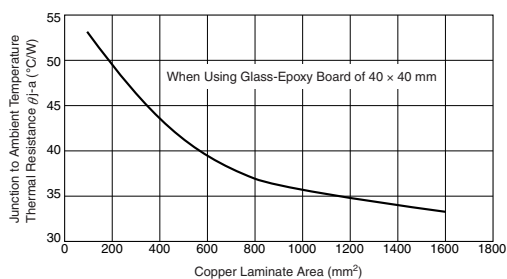


■Typical Connection Diagram



■Reference Data

Copper Laminate Area (on Glass-Epoxy Board) vs. Thermal Resistance (from Junction to Ambient Temperature) (Typical Value)



- A higher heat radiation effect can be achieved by enlarging the copper laminate area connected to the inner frame to which a monolithic ICs is mounted.
- Obtaining the junction temperature
 Measure the case temperature Tc with a thermocouple, etc. Then, substitute this value in the following formula to obtain the junction temperature.

$$T_j = P_D \times \theta_{j-c} + T_c \quad (\theta_{j-c} = 3^\circ\text{C/W}) \quad P_D = (V_{IN} - V_O) \cdot I_{OUT}$$

SI-3000LLSL Series Surface-Mount, Low Current Consumption, Low Dropout Voltage

■ Features

- Low input voltage (1.3V) and low output voltage (1.0V)
- Compact surface-mount package (SOP8)
- Low dropout voltage: $V_{DIF} \leq 0.3V$ (at $I_o = 1.5A$)
- Built-in overcurrent, input-overvoltage and thermal protection circuits
- Built-in ON/OFF function (OFF state circuit current: $1\mu A$ max.)
- Compatible with low ESR capacitors

■ Absolute Maximum Ratings

(T_a=25°C)

Parameter	Symbol	Rated	Unit
DC Input Voltage	V _{IN}	10	V
DC Bias Voltage	V _B	10	V
Output Control Terminal Voltage	V _C	V _{IN}	V
DC Output Current	I _O	1.5	A
Power Dissipation	P _D ^{*1}	1.1	W
Junction Temperature	T _J	-30 to +125	°C
Operating Ambient Temperature	T _{OP}	-30 to +100	°C
Storage Temperature	T _{STG}	-30 to +125	°C
Thermal Resistance (Junction to Lead (Pin 8))	θ _(j-l)	36	°C/W
Thermal Resistance (Junction to Ambient Air)	θ _(j-a) ^{*1}	100	°C/W

*1: When mounted on glass-epoxy board of 40 × 40mm (copper laminate area 100%).

■ Applications

- On-board local power supply
- For stabilization of the secondary-side output voltage of switching power supplies

■ Recommended Operating Conditions

Parameter	Symbol	Ratings		Unit
		SI-3010LLSL		
Input Voltage	V _{IN}	1.4 to 3.6 ^{*1}		V
Bias Voltage	V _B	3.3 to 5.5		V
Output Current	I _O	0 to 1.5 ^{*1}		A
Operating Ambient Temperature	T _{OP}	-20 to +85 ^{*1}		°C

*1: V_{IN} (max) and I_O (max) are restricted by the relation P_D = (V_{IN} - V_O) × I_O.

■ Electrical Characteristics

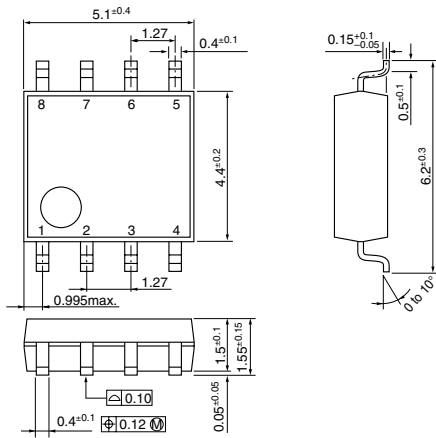
(T_a=25°C, V_C=2V, V_{IN}=1.8V, V_B=3.3V, V_O=1.5V, unless otherwise specified)

Parameter	Symbol	Ratings			Unit	
		SI-3010LLSL				
		min.	typ.	max.		
Reference Voltage	V _{ADJ}	0.980	1.000	1.020	V	
	Conditions	I _O =10mA				
Line Regulation	ΔV _{OLINE}			10	mV	
	Conditions	V _{IN} =1.7 to 2.5V, I _O =10mA				
Load Regulation	ΔV _{OLOAD}			30	mV	
	Conditions	V _{IN} =1.8V, I _O =0 to 1.5A				
Dropout Voltage	V _{DIF}			0.3	V	
	Conditions	I _O =1.0A				
Quiescent Circuit Current	I _q		500	800	μA	
	Conditions	I _O =0A, R ₂ =10kΩ				
Circuit Current at Output OFF	I _q (OFF)			1	μA	
	Conditions	V _C =0V				
Temperature Coefficient of Output Voltage	ΔV _O /ΔT _a		±0.2		mV/°C	
	Conditions	T _J =0 to 100°C				
Overcurrent Protection Starting Current ^{*1}	I _{S1}	1.6			A	
	Conditions	V _{IN} =1.8V, V _B =3.3V				
V _C Terminal	Control Voltage (Output ON) ^{*2}	V _C , IH	2		V	
	Control Voltage (Output OFF)	V _C , IL		0.8	V	
	Control Current (Output ON)	I _C , IH			50	μA
		Conditions	V _C =2.7V			
	Control Current (Output OFF)	I _C , IL			10	μA
		Conditions	V _C =0.4V			

*1: I_{S1} is specified at the 5% drop point of output voltage V_O on the condition that V_{IN} = overcurrent protection starting current, I_O = 10 mA.*2: Output is OFF when the output control terminal (V_C terminal) is open. Each input level is equivalent to LS-TTL level. Therefore, the device can be driven directly by LS-TTLs.

External Dimensions (SOP8)

(unit : mm)

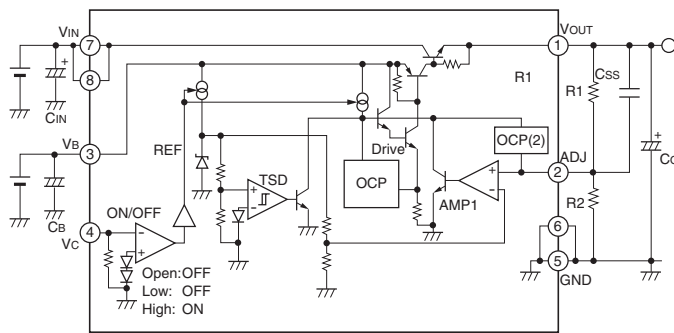


Pin Assignment

- ① Vo
- ② ADJ
- ③ Vb
- ④ Vc
- ⑤ GND
- ⑥ GND
- ⑦ Vin
- ⑧ Vin

Plastic Mold Package Type
 Flammability: UL94V-0
 Product Mass: Approx. 0.1g

Typical Connection Diagram/Block Diagram



C_{IN}, C_B: Input and bias capacitors (Approx. 0.1 to 10μF)

Required when the input line contains inductance or when the wiring is long.

C_O: Output capacitor (47μF or larger)

SI-3010LLSL is designed to use a low ESR capacitor (such as a ceramic capacitor) for the output capacitor. The recommended ESR value for an output capacitor is 500mΩ or less (at room temperature).

R₁, R₂: Output voltage setting resistors

The output voltage can be set by connecting R₁ and R₂ as shown at left.

The recommended value for R₂ is 10kΩ.

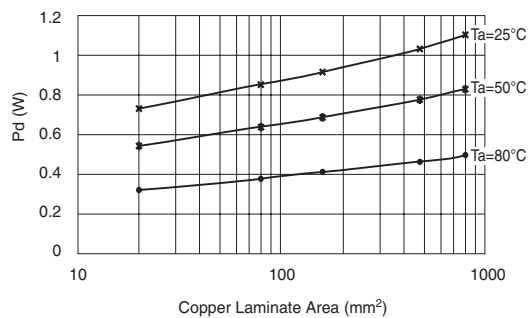
$$R1 = (Vo - V_{ADJ}) / (V_{ADJ} / R2)$$

C_{SS}: Soft start capacitor

The rising time of the output voltage can be set by connecting C_{SS} between V_{OUT} and ADJ.

Reference Data

Copper Laminate Area - Power Dissipation



SI-3000ZD Series Surface-Mount, Low Dropout Voltage

■Features

- Compact surface-mount package (TO263-5)
- Output current: 3.0A
- Low dropout voltage: $V_{DIF} \leq 0.6V$ (at $I_o = 3.0A$)
- Low circuit current at output OFF: $I_q (OFF) \leq 1\mu A$
- Built-in overcurrent and thermal protection circuits

■Applications

- Secondary stabilized power supply (local power supply)

■Absolute Maximum Ratings

($T_a=25^\circ C$)

Parameter	Symbol	Rated	Unit
DC Input Voltage	V_{IN}^{*1}	10	V
Output Control Terminal Voltage	V_c	6	V
DC Output Current	I_o^{*1}	3.0	A
Power Dissipation	P_D^{*3}	3	W
Junction Temperature	T_j	-30 to +125	$^\circ C$
Operating Ambient Temperature	T_{op}	-30 to +85	$^\circ C$
Storage Temperature	T_{stg}	-40 to +125	$^\circ C$
Thermal Resistance (Junction to Ambient Air)	θ_{ja}	33.3	$^\circ C/W$
Thermal Resistance (Junction to Case)	θ_{jc}	3	$^\circ C/W$

■Recommended Operating Conditions

Parameter	Symbol	Rated	Unit	Remarks
Input Voltage	V_{IN}	*2 to 6^{*1}	V	
Output Current	I_o	0 to 3	A	
Operating Ambient Temperature	$T_{op(a)}$	-20 to +85	$^\circ C$	
Operating Junction Temperature	$T_{op(j)}$	-20 to +100	$^\circ C$	
Output Voltage Variable Range	V_{OAdj}	1.2 to 5	V	Only for SI-3011ZD. Refer to the block diagram.

*1: V_{IN} (max) and I_o (max) are restricted by the relation $P_D = (V_{IN} - V_o) \times I_o$.

*2: Set the input voltage to 2.4V or higher when setting the output voltage to 2.0V or lower (SI-3011ZD).

*3: When mounted on glass-epoxy board of 40 x 40mm (copper laminate area 100%).

■Electrical Characteristics

($T_a=25^\circ C, V_c=2V$, unless otherwise specified)

Parameter	Symbol	Rated						Unit
		SI-3011ZD (Variable type)			SI-3033ZD			
		min.	typ.	max.	min.	typ.	max.	
Output Voltage (Reference Voltage V_{ADJ} for SI-3011ZD)	$V_o (V_{ADJ})$	1.078	1.100	1.122	3.234	3.300	3.366	V
	Conditions	$V_{IN}=V_o+1V, I_o=10mA$			$V_{IN}=5V, I_o=10mA$			
Line Regulation	ΔV_{OLINE}			10			10	mV
	Conditions	$V_{IN}=3.3$ to $5V, I_o=10mA (V_o=2.5V)$			$V_{IN}=4.5$ to $5.5V, I_o=10mA$			
Load Regulation	ΔV_{OLOAD}			40			40	mV
	Conditions	$V_{IN}=3.3V, I_o=0$ to $3A (V_o=2.5V)$			$V_{IN}=5V, I_o=0$ to $3A$			
Dropout Voltage	V_{DIF}			0.6			0.6	V
	Conditions	$I_o=3A (V_o=2.5V)$			$I_o=3A$			
Quiescent Circuit Current	I_q		1	1.5		1	1.5	mA
	Conditions	$V_{IN}=V_o+1V, I_o=0A, V_c=2V$			$V_{IN}=5V, I_o=0A, V_c=2V$			
Circuit Current at Output OFF	$I_q (OFF)$			1			1	μA
	Conditions	$V_{IN}=V_o+1V, V_c=0V$			$V_{IN}=5V, V_c=0V$			
Temperature Coefficient of Output Voltage	$\Delta V_o/\Delta T_a$		± 0.3			± 0.3		mV/ $^\circ C$
	Conditions	$T_j=0$ to $100^\circ C$			$T_j=0$ to $100^\circ C$			
Ripple Rejection	R_{REJ}		60			60		dB
	Conditions	$V_{IN}=V_o+1V, f=100$ to $120Hz, I_o=0.1A$			$V_{IN}=5V, f=100$ to $120Hz, I_o=0.1A$			
Overcurrent Protection Starting Current ^{*2}	I_{S1}	3.2			3.2			A
	Conditions	$V_{IN}=V_o+1V$			$V_{IN}=5V$			
V_c Terminal	Control Voltage (Output ON) ^{*3}	V_c, IH	2		2			V
	Control Voltage (Output OFF) ^{*3}	V_c, IL		0.8			0.8	
	Control Current (Output ON)	I_c, IH		100			100	μA
	Control Current (Output OFF)	I_c, IL	-5	0		-5	0	μA
	Conditions	$V_c=2.7V$			$V_c=2.7V$			
	Conditions	$V_c=0V$			$V_c=0V$			

*1: Set the input voltage to 2.4V or higher when setting the output voltage to 2.0V or lower.

*2: I_{S1} is specified at the -5% drop point of output voltage V_o under the condition of Output Voltage parameter.

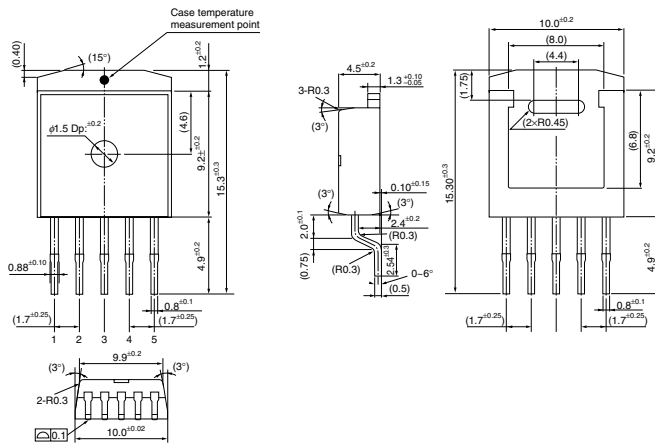
*3: Output is OFF when the output control terminal (V_c terminal) is open. Each input level is equivalent to LS-TTL level. Therefore, the device can be driven directly by LS-TTLs.

*4: These products cannot be used for the following applications because the built-in foldback-type overcurrent protection may cause errors during start-up stage.

- (1) Constant current load (2) Positive and negative power supply (3) Series-connected power supply (4) V_o adjustment by raising ground voltage

External Dimensions (TO263-5)

(Unit : mm)



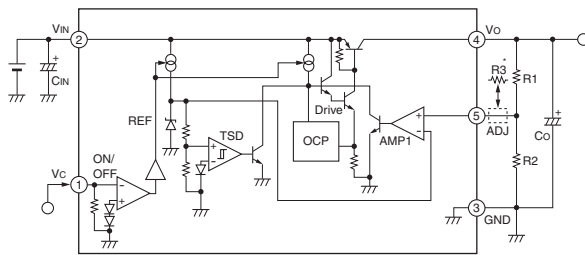
Pin Assignment

- ① V_c
- ② V_{IN}
- ③ GND (Common to the rear side of product)
- ④ V_O
- ⑤ Sense (ADJ for SI-3011ZD)

Plastic Mold Package Type
 Flammability: UL94V-0
 Product Mass: Approx. 1.48g

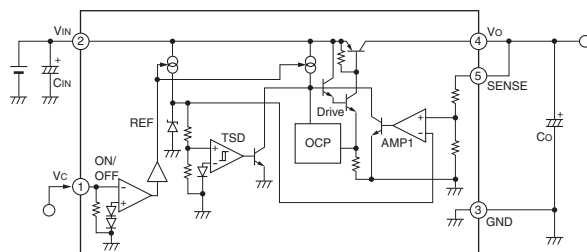
Block Diagram

SI-3011ZD



C_{IN}: Input capacitor (Approx. 10μF)
 C_O: Output capacitor (47μF or larger)
 The output voltage may oscillate if a low ESR type capacitor (such as a ceramic capacitor) is used for the output capacitor in the SI-3000ZD Series.

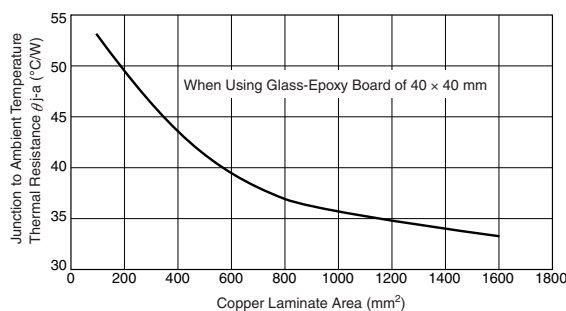
SI-3033ZD



R₁, R₂: Output voltage setting resistors
 The output voltage can be set by connecting R₁ and R₂ as shown at left.
 The recommended value for R₂ is 10kΩ or 11kΩ.
 $R1 = (V_O - V_{ADJ}) / (V_{ADJ} / R2)$
 *: Insert R₃ in case of setting V_O to V_O ≤ 1.8V. The recommended value for R₃ is 10kΩ.

Reference Data

Copper Laminate Area (on Glass-Epoxy Board) vs. Thermal Resistance (from Junction to Ambient Temperature) (Typical Value)



- A higher heat radiation effect can be achieved by enlarging the copper laminate area connected to the inner frame to which a monolithic IC is mounted.
- Obtaining the junction temperature
 Measure GND terminal temperature T_c with a thermocouple, etc. Then substitute this value in the following formula to obtain the junction temperature.

$$T_j = P_D \times \theta_{j-a} + T_c \quad P_D = (V_{IN} - V_O) \cdot I_{OUT}$$

SI-3000KF Series Low Current Consumption, Low Dropout Voltage

Features

- Compact full-mold package (equivalent to TO220)
- Output current: 1.0A
- Low dropout voltage: $V_{DIF} \leq 0.5V$ (at $I_o = 1.0A$)
- High ripple rejection: 75dB
- Low circuit current at output OFF: I_q (OFF) $\leq 1\mu A$
- Built-in overcurrent and thermal protection circuits

Applications

- Secondary stabilized power supply (local power supply)

Recommended Operating Conditions

Parameter	Symbol	Ratings		Unit
		SI-3010KF		
Input Voltage Range	V_{IN}	2.4 ² to 27 ¹		V
Output Current Range	I_o	0 to 1.0 ¹		A
Output Voltage Variable Range	$V_{O}ADJ$	1.1 to 16		V
Operating Ambient Temperature	T_{op}	-30 to +85		°C
Operating Junction Temperature	T_j	-20 to +100		°C

*1: V_{IN} (max) and I_o (max) are restricted by the relationship P_D (max) = $(V_{IN} - V_o) \times I_o = 16.6W$.

*2: Refer to the Dropout Voltage parameter.

Electrical Characteristics

Parameter	Symbol	Ratings			Unit	
		SI-3010KF				
		min.	typ.	max.		
Reference Voltage	V_{ADJ}	0.98	1.00	1.02	V	
	Conditions	$V_{IN}=7V, I_o=0.01A, V_C=2V, V_o=5A$				
Line Regulation	ΔV_{OLINE}			30	mV	
	Conditions	$V_{IN}=6$ to $15V, I_o=0.01A, V_C=2V, V_o=5A$				
Load Regulation	ΔV_{OLOAD}			75	mV	
	Conditions	$V_{IN}=7V, I_o=0$ to $1A, V_C=2V, V_o=5A$				
Dropout Voltage	V_{DIF}			0.3	V	
	Conditions	$I_o=0.5A, V_C=2V, V_o=5V$				
	Conditions	$I_o=1.0A, V_C=2V, V_o=5V$				
Quiescent Circuit Current	I_q			600	μA	
	Conditions	$V_{IN}=7V, I_o=0A, V_C=2V$				
Circuit Current at Output OFF	I_q (OFF)			1	μA	
	Conditions	$V_{IN}=7V, V_C=0V$				
Temperature Coefficient of Output Voltage	$\Delta V_o/\Delta T_a$		± 0.5		mV/°C	
	Conditions	$V_{IN}=7V, I_o=0.01A, V_C=2V, T_j=0$ to $100^\circ C, V_o=2.5V$				
Ripple Rejection	R_{REJ}		75		dB	
	Conditions	$V_{IN}=7V, I_o=0.1A, V_C=2V, f=100$ to $120Hz, V_o=5V$				
Overcurrent Protection Starting Current ³	I_{S1}	1.1			A	
	Conditions	$V_{IN}=7V, V_C=2V$				
V _C Terminal	Control Voltage (Output ON) ⁴	V_C, I_H	2		V	
		Conditions	$V_{IN}=7V$			
	Control Voltage (Output OFF)	V_C, I_L			0.8	V
		Conditions	$V_{IN}=7V$			
	Control Current (Output ON)	I_C, I_H			40	μA
		Conditions	$V_{IN}=7V, V_C=2V$			
Control Current (Output OFF)	I_C, I_L	-5	0		μA	
	Conditions	$V_{IN}=7V, V_C=0V$				
Input Overvoltage Shutdown Voltage	V_{OVP}	33			V	
	Conditions	$I_o=0.01A$				

*3: I_{S1} is specified at the 5% drop point of output voltage V_o on the condition that V_{IN} = overcurrent protection starting current, $I_o = 10$ mA.

*4: Output is OFF when the output control terminal V_C is open. Each input level is equivalent to LS-TTL level. Therefore, the device can be driven directly by LS-TTLs.

*5: SI-3000KFE cannot be used in the following applications because the built-in foldback-type overcurrent protection may cause errors during start-up stage.

(1) Constant current load (2) Positive and negative power supply (3) Series-connected power supply (4) V_o adjustment by raising ground voltage

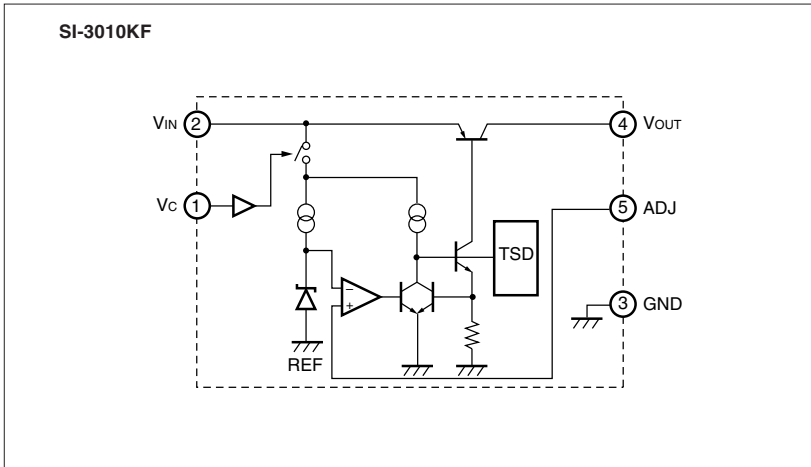
Absolute Maximum Ratings

($T_a=25^\circ C$)

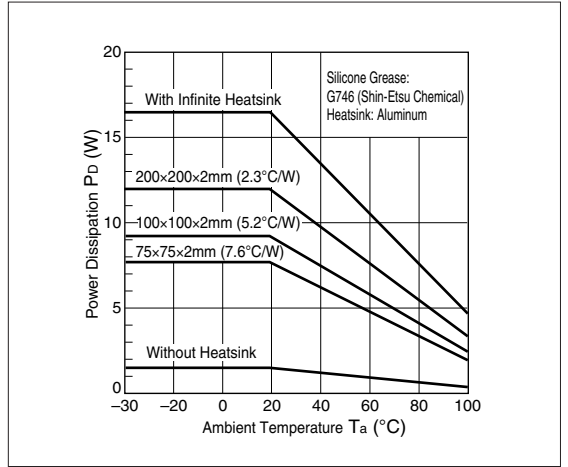
Parameter	Symbol	Ratings		Unit	Remarks
		SI-3010KF			
DC Input Voltage	V_{IN}	35 ¹		V	
Output Control Terminal Voltage	V_C	V_{IN}		V	
DC Output Current	I_o	1.0		A	
Power Dissipation	P_{D1}	16.6		W	With infinite heatsink
	P_{D2}	1.72		W	Without heatsink, stand-alone operation
Junction Temperature	T_j	-40 to +125		°C	
Storage Temperature	T_{stg}	-40 to +125		°C	
Operating Ambient Temperature	T_{op}	-40 to +100		°C	
Thermal Resistance (Junction to Case)	θ_{j-c}	6.0		°C/W	
Thermal Resistance (Junction to Ambient Air)	θ_{j-a}	58		°C/W	Without heatsink, stand-alone operation

*1: A built-in input-overvoltage-protection circuit shuts down the output voltage at the Input Overvoltage Shutdown Voltage of the electrical characteristics.

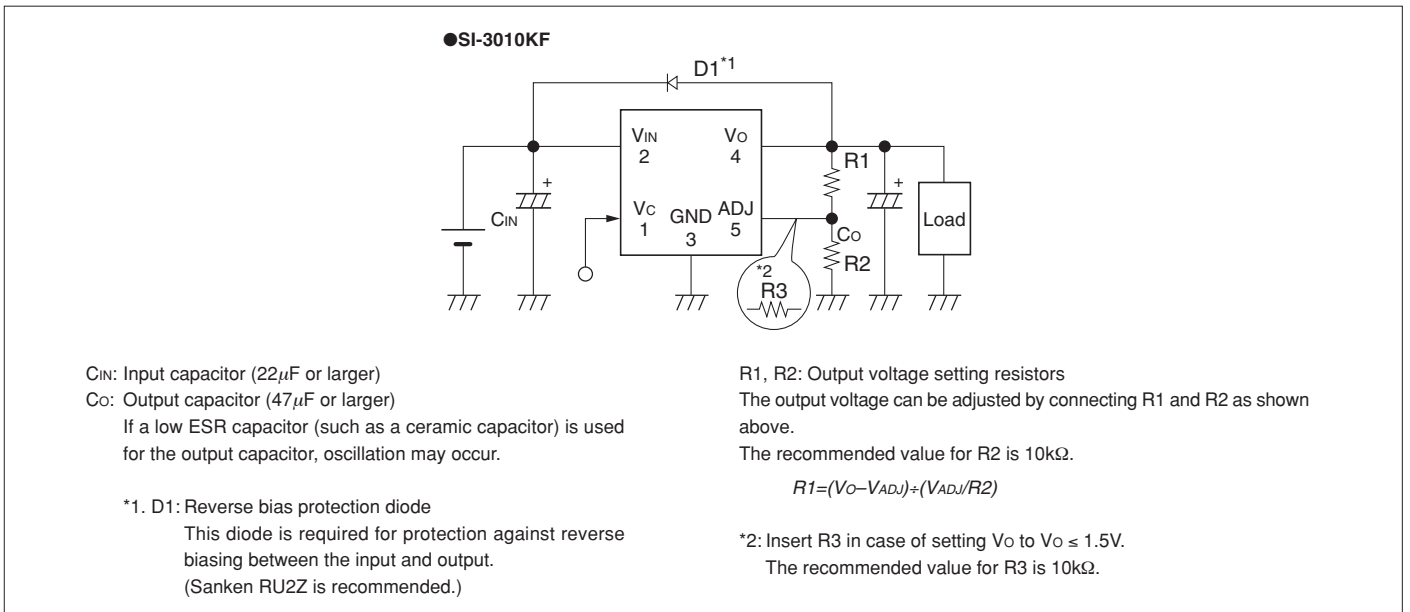
■Block Diagram



■Ta-Pd Characteristics

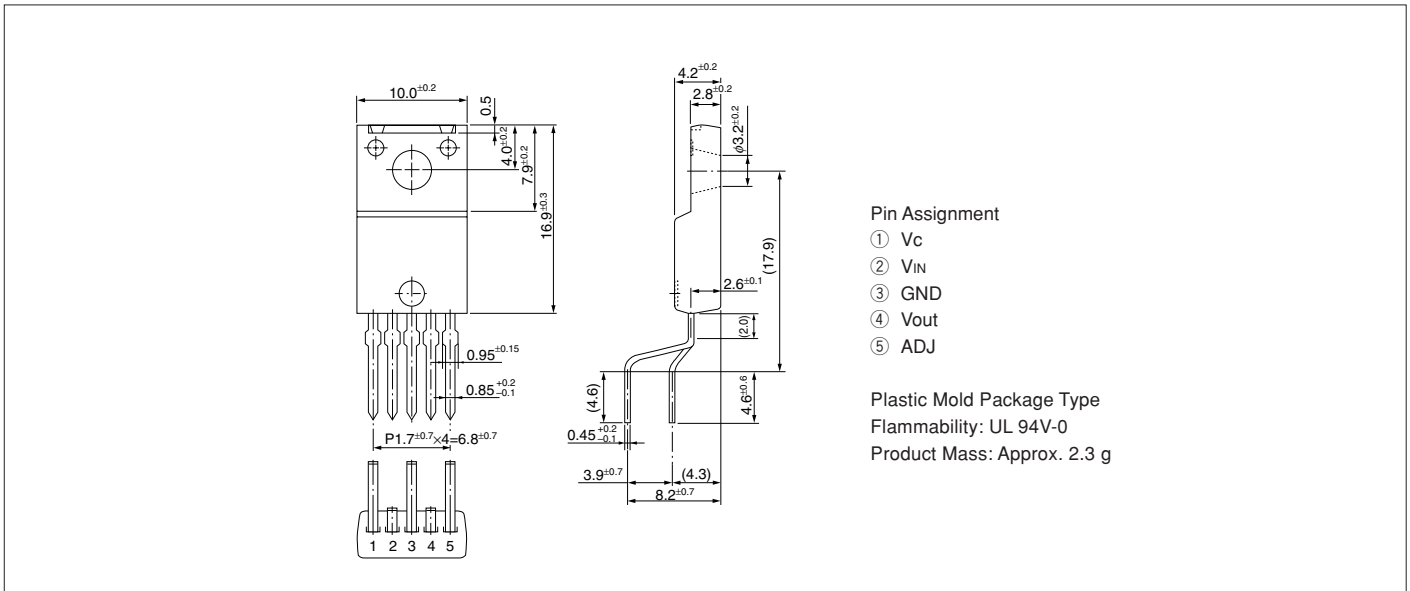


■Typical Connection Diagram



■External Dimensions (TO220F-5)

(Unit : mm)



SI-3000ZF Series 5-Terminal, Low Dropout Voltage

Features

- Compact full-mold package (equivalent to TO220)
- Output current: 3.0A
- Low dropout voltage: $V_{DIF} \leq 0.7V$ (at $I_o = 3.0A$)
- Low circuit current at output OFF: $I_q (OFF) \leq 1\mu A$
- Built-in overcurrent and thermal protection circuits

Applications

- Secondary stabilized power supply (local power supply)

Absolute Maximum Ratings

(T_a = 25°C)

Parameter	Symbol	Ratings	Unit
DC Input Voltage	V _{IN} ¹	10	V
Output Control Terminal Voltage	V _C	6	V
DC Output Current	I _O ¹	3.0	A
Power Dissipation	P _{D1}	20 (With infinite heatsink)	W
		1.5 (Without heatsink, stand-alone operation)	W
Junction Temperature	T _J	-30 to +125	°C
Operating Ambient Temperature	T _{OP}	-30 to +100	°C
Storage Temperature	T _{STG}	-30 to +125	°C
Thermal Resistance (Junction to Case)	θ _{J-C}	5.0	°C/W
Thermal Resistance (Junction to Ambient Air)	θ _{J-A}	66.7 (Without heatsink, stand-alone operation)	°C/W

Recommended Operating Conditions

Parameter	Symbol	Ratings	Unit
Input Voltage	V _{IN}	² to 6 ¹	V
Output Current	I _O	0 to 3	A
Operating Ambient Temperature	T _{OP (a)}	-20 to +85	°C
Operating Junction Temperature	T _{OP (j)}	-20 to +100	°C
Output Voltage Variable Range	V _{OADJ}	1.2 to 5	V

*1: V_{IN} (max) and I_O (max) are restricted by the relationship P_D = (V_{IN} - V_O) × I_O.

*2: Set the input voltage to 2.4V or higher when setting the output voltage to 2.0V or lower.

Electrical Characteristics

(T_a = 25°C, V_C = 2V, unless otherwise specified)

Parameter	Symbol	SI-3011ZF			Unit
		min.	typ.	max.	
Reference Voltage	V _{ADJ}	1.078	1.100	1.122	V
	Conditions	V _{IN} =V _O +1V, I _O =10mA			
Line Regulation	ΔV _{OLINE}			10	mV
	Conditions	V _{IN} =3.3 to 5V, I _O =10mA (V _O =2.5V)			
Load Regulation	ΔV _{OLOAD}			40	mV
	Conditions	V _{IN} =3.3V, I _O =0 to 3A (V _O =2.5V)			
Dropout Voltage	V _{DIF}			0.7	V
	Conditions	I _O =3A (V _O =2.5V)			
Quiescent Circuit Current	I _q		1	1.5	mA
	Conditions	V _{IN} =V _O +1V, I _O =0A, V _C =2V			
Circuit Current at Output OFF	I _q (OFF)			1	μA
	Conditions	V _{IN} =V _O +1V, V _C =0V			
Temperature Coefficient of Output Voltage	ΔV _O /ΔT _a		±0.3		mV/°C
	Conditions	T _J =0 to 100°C			
Ripple Rejection	R _{REJ}		60		dB
	Conditions	V _{IN} =V _O +1V, f=100 to 120Hz, I _O =0.1A			
Overcurrent Protection Starting Current ^{*2}	I _{S1}	3.2			A
	Conditions	V _{IN} =V _O +1V			
V _C Terminal	Control Voltage (Output ON) ^{*3}	2			V
	Control Voltage (Output OFF) ^{*3}			0.8	
	Control Current (Output ON)			100	μA
	Conditions	V _C =2.7V			
Control Current (Output OFF)		-5	0	μA	
Conditions	V _C =0V				

*1: Set the input voltage to 2.4V or higher when setting the output voltage to 2.0V or lower.

*2: I_{S1} is specified at the 5% drop point of output voltage V_O under the Output Voltage parameter conditions.

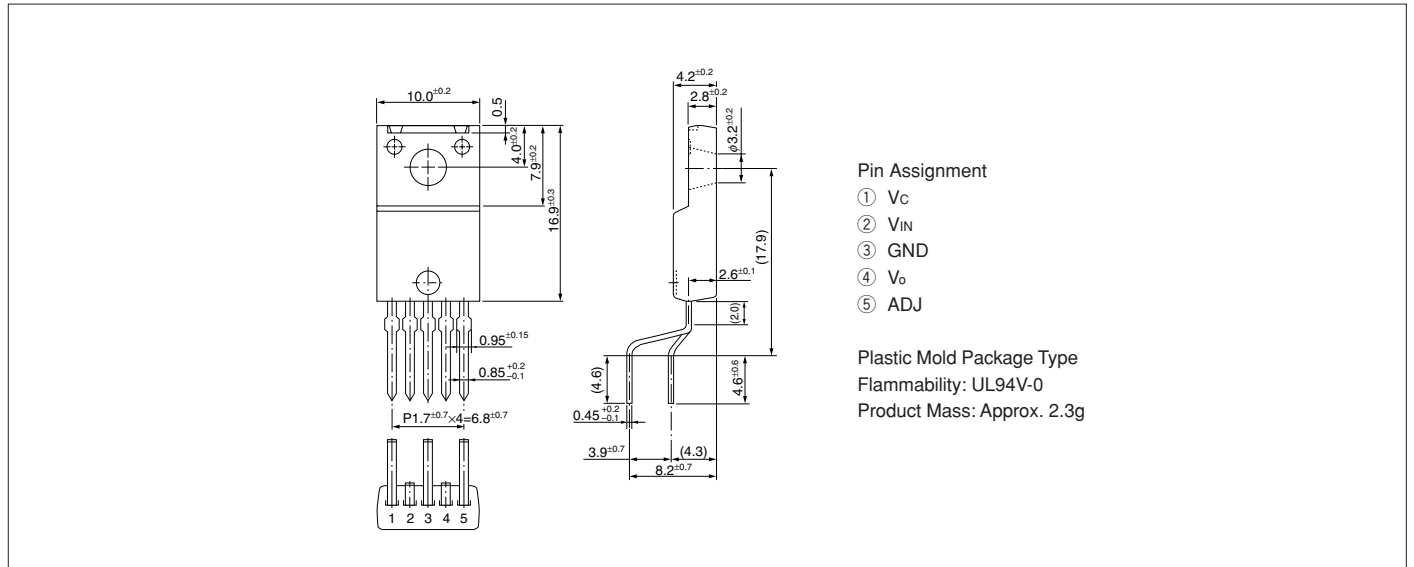
*3: Output is OFF when the output control terminal V_C is open. Each input level is equivalent to LS-TTL level. Therefore, the device can be driven directly by LS-TTLs.

*4: These products cannot be used in the following applications because the built-in foldback-type overcurrent protection may cause errors during start-up stage.

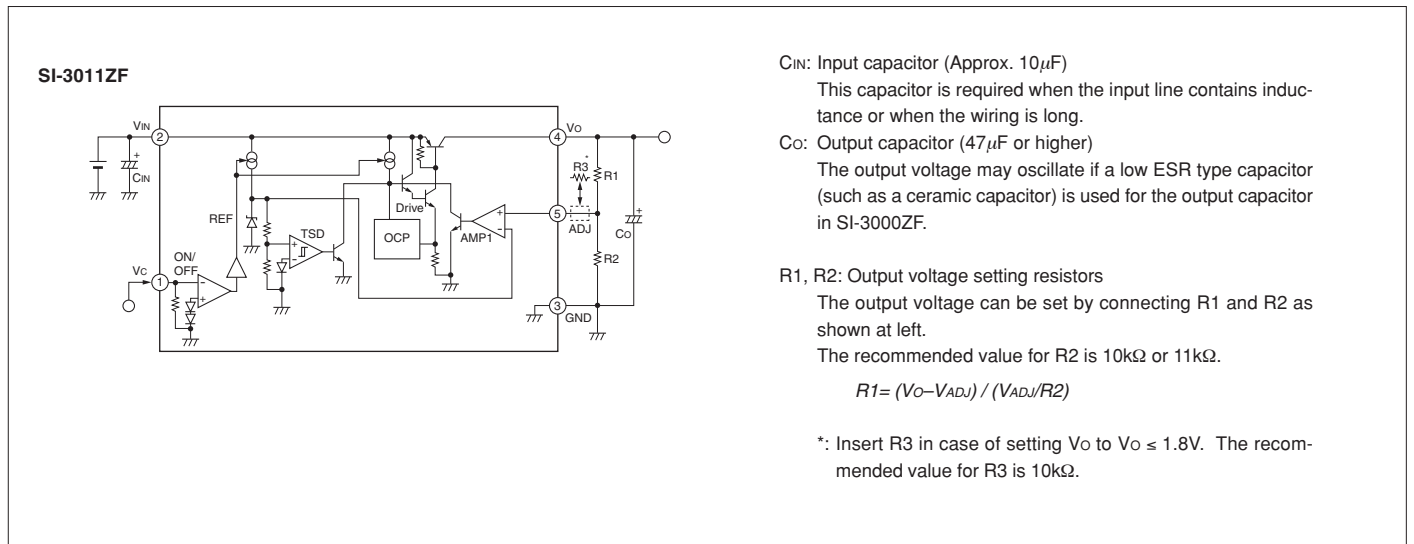
(1) Constant current load (2) Positive and negative power supply (3) Series-connected power supply (4) V_O adjustment by raising ground voltage

External Dimensions (TO220F-5)

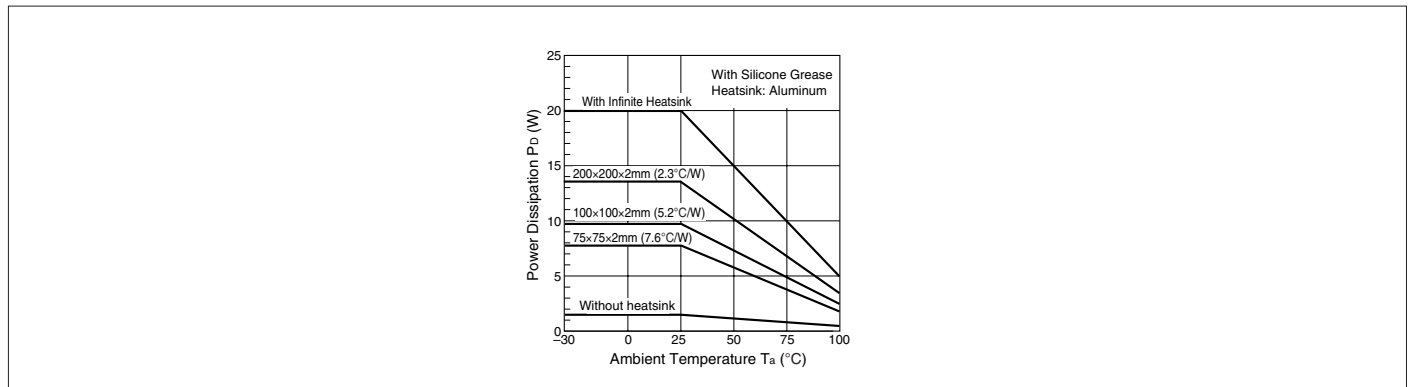
(unit : mm)



Typical Connection Diagram/Block Diagram



T_a-P_d Characteristics



SI-3000KWM Series 2-Output, Surface-Mount, Low Dropout Voltage

■ Features

- Compact surface-mount package (TO252-5)
- Output current: 1.0A × 2
- Low dropout voltage: $V_{DIF} \leq 0.6V$ (at $I_O = 1A$)
- Built-in overcurrent and thermal protection circuits

■ Applications

- Secondary stabilized power supply (local power supply)

■ Absolute Maximum Ratings

(T_a=25°C)

Parameter	Symbol	Ratings		Unit
		SI-3002KWM		
DC Input Voltage	V _{IN} ^{*1}	18		V
Output Control Terminal Voltage	V _c	6		V
Output Current ^{*1}	I _{O1}	1.0		A
	I _{O2}	1.0		
Power Dissipation (with two outputs ON)	P _D ^{*2}	1		W
Junction Temperature	T _j	-30 to +125		°C
Operating Ambient Temperature	T _{op}	-30 to +85		°C
Storage Temperature	T _{stg}	-40 to +125		°C
Thermal Resistance (Junction to Ambient Air)	θ _{ja}	95		°C/W
Thermal Resistance (Junction to Lead)	θ _{jc}	6		°C/W

*1: V_{IN} (max), I_{O1} (max) and I_{O2} (max) are restricted by the relation $P_D = (V_{IN} - V_{O1}) \times I_{O1} + (V_{IN} - V_{O2}) \times I_{O2}$.

*2: When mounted on glass-epoxy board of 30 × 30mm² (copper laminate area 4.3%)

Thermal protection may operate when the junction temperature exceeds 135°C.

■ Electrical Characteristics

Parameter	Symbol	Ratings			Unit
		SI-3002KWM			
		min.	typ.	max.	
Output Voltage	V _{O1}	3.234	3.300	3.366	V
	Conditions	V _{IN} =5V, I _O =10mA			
	V _{O2}	2.450	2.500	2.550	V
	Conditions	V _{IN} =5V, I _O =10mA			
Line Regulation	ΔV _{OLINE1}			20	mV
	Conditions	V _{IN} =4.5 to 10V, I _O =10mA			
	ΔV _{OLINE2}			20	
	Conditions	V _{IN} =4.5 to 10V, I _O =10mA			
	ΔV _{OLOAD1}			30	mV
	Conditions	V _{IN} =5V, I _O =0 to 1A			
ΔV _{OLOAD2}			30		
	Conditions	V _{IN} =5V, I _O =0 to 1A			
	V _{DIF1}			0.6	V
	Conditions	I _O =1A			
Temperature Coefficient of Output Voltage	ΔV _{O1} /ΔT _a		±0.3		mV/°C
	Conditions	T _j =0 to 100°C			
	ΔV _{O2} /ΔT _a		±0.3		
	Conditions	T _j =0 to 100°C			
	R _{REJ1}		60		dB
	Conditions	V _{IN} =5V, f=100 to 120Hz			
R _{REJ2}		60			
	Conditions	V _{IN} =5V, f=100 to 120Hz			
	I _{S1 1}	1.2			A
	Conditions	V _{IN} =5V			
I _{S1 2}	1.2				
	Conditions	V _{IN} =5V			
	I _q		1	1.5	mA
Conditions	V _{IN} =5V, I _O =0A, V _c =2V				
Circuit Current at Output OFF	I _q (OFF)			0.5	mA
	Conditions	V _{IN} =5V, V _c =0V			
V _c Terminal	Control Voltage (Output ON) ^{*2}	V _c , IH	2		V
	Control Voltage (Output OFF)	V _c , IL		0.8	V
	Control Current (Output ON)	I _c , IH		5	μA
	Conditions	V _c =2.7V			
	Control Current (Output OFF)	I _c , IL	-100		μA
Conditions	V _c =0.4V				
Output OFF Voltage	V _O (OFF)			0.5	V

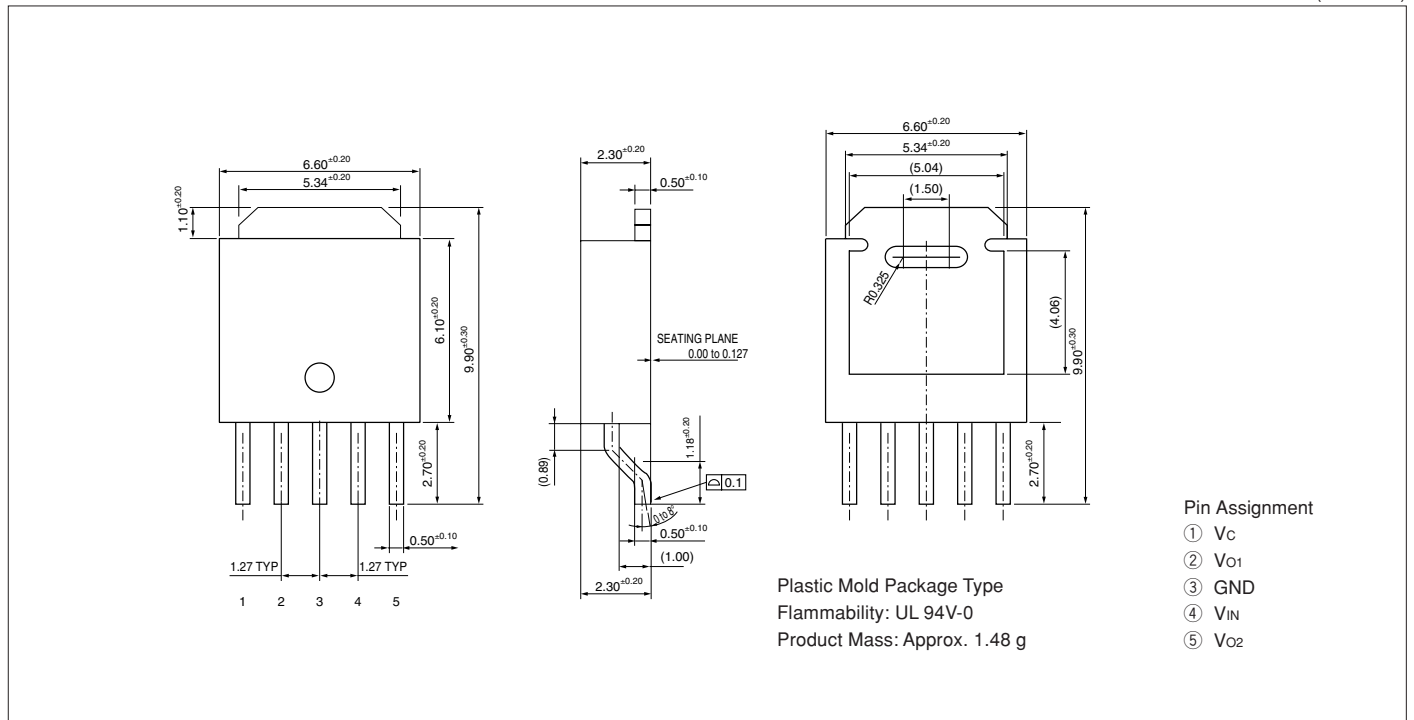
*1: I_{S1 1} and I_{S1 2} are specified at the 5% drop points of output voltages V_{O1} and V_{O2} on the condition that V_{IN} = the condition of protection starting current, I_O = 10 mA.

*2: Output is ON when the output control terminal V_c is open. Each input level is equivalent to LS-TTL. Therefore, the devices can be driven directly by LS-TTLs.

Channels 1 and 2 are turned on or off at the same time.

External Dimensions (TO252-5)

(Unit : mm)



Block Diagram

