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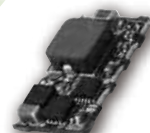
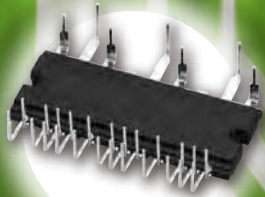
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# SEMICONDUCTORS GENERAL CATALOG

ICs  
Transistors  
Thyristors  
Diodes  
DC/DC Power Modules



**SANKEN ELECTRIC CO., LTD.**

<http://www.sanken-ele.co.jp/en/>

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# SANKEN SEMICONDUCTORS

## CONTENTS

### 1 ICs

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 .....	9
1-1-4	Linear Regulator ICs .....	70
1-2	Motor Driver ICs .....	92
1-2-1	2-Phase Stepper Motor Unipolar Driver ICs .....	96
1-2-2	5-Phase Stepper Motor Driver ICs .....	110
1-2-3	Brush DC Motor Driver ICs .....	112
1-2-4	Low Voltage 3-Phase Brushless Motor Driver ICs .....	114
1-2-5	High Voltage 3-Phase Brushless Motor Driver ICs .....	120
1-3	LED Lighting ICs .....	134

### 2 Transistors

2-1	Transistors .....	157
2-2	MOS FETs .....	167
2-3	IGBT .....	171
2-4	Transistors and MOS FET Arrays .....	174

### 3 Thyristors

3-1	Thyristors .....	194
3-2	Triacs .....	196

### 4 Diodes

4-1	Rectifier Diodes .....	207
4-2	Fast Recovery Diodes .....	208
4-3	Ultrafast Recovery Diodes .....	210
4-4	Schottky Barrier Diodes .....	213
4-5	Power Zener Diodes .....	216
4-6	Silicon Varistors .....	217

### 5 DC/DC Power Modules

5	DC/DC Power Modules .....	221
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Part Number Index .....	236
-------------------------	-----

# ICs

# 1

<b>Ordering Information &amp; Standard Packing Quantities .....</b>	<b>4</b>
<b>1-1 Power Management ICs .....</b>	<b>6</b>
1-1-1 Power Factor Correction (PFC) ICs .....	6
1-1-2 AC/DC Converter ICs .....	6
1-1-3 DC/DC Converter ICs .....	9
Selection Guide .....	9
Application Note .....	11
1-1-4 Linear Regulator ICs .....	70
Selection Guide .....	70
Application Note .....	71
<b>1-2 Motor Driver ICs .....</b>	<b>92</b>
Selection Guide .....	92
Application Note .....	95
1-2-1 2-Phase Stepper Motor Unipolar Driver ICs .....	96
1-2-2 5-Phase Stepper Motor Driver ICs .....	110
1-2-3 Brush DC Motor Driver ICs .....	112
1-2-4 Low Voltage 3-Phase Brushless Motor Driver ICs ..	114
1-2-5 High Voltage 3-Phase Brushless Motor Driver ICs..	120
<b>1-3 LED Lighting ICs .....</b>	<b>134</b>

# Ordering Information

All products listed must be ordered in standard packing increments.

Series Name/ Product Name	Package	Standard Packing Quantities	
		Bulk	Taping
LC52xxD	DIP8	2500	–
LC52xxS	SOP8(Surface-mount)	–	1000
LC55xxD/LD	DIP8	2500	–
LC55xxF/LF	TO220F-7	1800	–
LC57xxS	HSOP8(Surface-mount)	–	1000
NR110K	HSOP8(Surface-mount)	–	1000
NR111E	eSOIC8(Surface-mount)	–	2500
NR117K	HSOP8(Surface-mount)	–	1000
NR119E	eSOIC8(Surface-mount)	–	2500
NR301E	eSOIC8(Surface-mount)	–	2500
NR885E	eSOIC8(Surface-mount)	–	2500
NR885K	HSOP8(Surface-mount)	–	1000
NR887D	DIP8	2500	–
SAI	PS4(Surface-mount)	–	2000
SCM1240M	DIP33Pin	LF.No.2551/2552: 250	–
SI-3000KD	TO263-5(Surface-mount)	–	800
SI-3000KF	TO220F-5	2000	–
SI-3000KS	SOP8(Surface-mount)	–	1000
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-6633C	QFN36(Surface-mount)	–	2500
SI-6633M	QFN36(Surface-mount)	–	2500
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	–

Series Name/ Product Name	Package	Standard Packing Quantities	
		Bulk	Taping
SI-8205NHD	HSOP8(Surface-mount)	–	1000
SI-8205NHG	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(Surface-mount)	–	2800
SIM6800M	DIP40Pin	LF.No.2971: 1080	–
SLA686xMZ	SIP24 with Fin (SLA24Pin)	LF.No.2171: 648, LF.No.2175: 540	–
SLA7022MU/ 7029M	ZIP15 with Fin (SLA15Pin)	1080	–
SLA7024M/ 7026M/7027MU	ZIP18 with Fin (SLA18Pin)	1080	–
SLA707xMR/MPR /MPRT	ZIP23 with Fin (SLA23Pin)	1080	–
SLA708xMPR	ZIP23 with Fin (SLA23Pin)	1080	–
SMA682xMH/ 686xMZ	SIP24 (SMA24Pin)	LF.No.2451: 1080, LF.No.2452: 1008	–
SMA7022MU/ 7029M	ZIP15 (SMA15Pin)	1440	–
SPI-6631M	HSOP16(Surface-mount)	–	1400
SPI-8000A	HSOP16(Surface-mount)	–	1400
SPI-8000TW	HSOP16(Surface-mount)	–	1400
SSC2000	SOP8(Surface-mount)	–	1000
SSC2100	SOP8(Surface-mount)	–	1000
SSC9512	DIP16	1250	–
SSC9522S	SOP18(Surface-mount)	–	2000
STA6940M	ZIP18(STA18Pin)	LF.No.434: 1785	–
STA713xMPR	ZIP18(STA18Pin)	LF.No.434: 1785	–
STA801M	ZIP10(STA10Pin)	100	–
STR2W100	TO220F-6	1800	–
STR3A100	DIP8	2500	–
STR-A6000	DIP8	2500	–
STR-A6100	DIP8	2500	–
STR-L400	SIP10(STA10Pin)	3300	–
STR-L6400	SIP10(STA10Pin)	3300	–
STR-V100	SIP8(STA8Pin)	4050	–
STR-V600	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	–

Series Name/ Product Name	Package	Standard Packing Quantities	
		Bulk	Taping
SX68000MH	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 $\mu$ s	SOP8
	SSC2102S	20.7 $\mu$ s	SOP8

### 1-1-2 AC/DC Converter ICs

#### ●PWM type

<STR-3A100 Series>

- For small power applications
- Low noise, low standby power (Input power  $P_{IN}$  < 15mW at no load)

Part Number	Oscillation Frequency	MOSFET		Overvoltage and Thermal Protection Operation	Package
		V <sub>DSS</sub> (MIN)	R <sub>DS(ON)</sub> (MAX)		
STR3A151	67kHz	650V	4.0 $\Omega$	Latch	DIP8
STR3A152			3.0 $\Omega$		
STR3A153			1.9 $\Omega$		
STR3A154			1.4 $\Omega$		
STR3A155			1.1 $\Omega$		
STR3A151D	67kHz	650V	4.0 $\Omega$	Auto restart	
STR3A152D			3.0 $\Omega$		
STR3A153D			1.9 $\Omega$		
STR3A154D			1.4 $\Omega$		
STR3A155D			1.1 $\Omega$		
STR3A161HD	100kHz	700V	4.2 $\Omega$	Auto restart	
STR3A162HD			3.2 $\Omega$		
STR3A163HD			2.2 $\Omega$		

<STR-A6000 Series>

- For small power applications
- Low noise, low standby power (Input power  $P_{IN}$  < 25mW at no load)
- Brown-in and brown-out functions

Part Number	Oscillation Frequency	MOSFET		Package
		V <sub>DSS</sub> (MIN)	R <sub>DS(ON)</sub> (MAX)	
STR-A6051M	67kHz	650V	3.95 $\Omega$	DIP8
STR-A6052M			2.8 $\Omega$	
STR-A6053M			1.9 $\Omega$	
STR-A6079M			800V	
STR-A6059H	100kHz	700V	6 $\Omega$	
STR-A6061H			3.95 $\Omega$	
STR-A6062H			2.8 $\Omega$	
STR-A6069H			6 $\Omega$	
STR-A6061HD*	100kHz	700V	3.95 $\Omega$	
STR-A6062HD*			2.8 $\Omega$	
STR-A6063HD*			2.3 $\Omega$	
STR-A6069HD*			6 $\Omega$	

- In addition to normal overcurrent protection, overcurrent protection that operates in the case of a short circuit at the output coil has been added. This overcurrent protection operates during the leading edge blanking period.

<STR-V600 Series>

- Low height, at least 4 mm of creepage isolation between high and low terminal tips
- Low noise, low standby power (Input power  $P_{IN}$  < 25mW at no load)
- SIP8 package version of STR-A6000

Part Number	Oscillation Frequency	MOSFET		Package
		V <sub>DSS</sub> (MIN)	R <sub>DS(ON)</sub> (MAX)	
STR-V653	67kHz	650V	1.9 $\Omega$	SIP8

<STR2W100D Series>

- Low noise, low standby power (Input power  $P_{IN}$  < 25mW at no load)

Part Number	Oscillation Frequency	MOSFET		Package
		V <sub>DSS</sub> (MIN)	R <sub>DS(ON)</sub> (MAX)	
STR2W152D	67kHz	650V	3.0 $\Omega$	TO220F-6
STR2W153D			1.9 $\Omega$	



## &lt;STR-W6000S Series&gt;

- Low noise, low standby power (Input power  $P_{IN}<30\text{mW}$  at no load)
- Brown-in and brown-out functions

Part Number	Oscillation Frequency	MOSFET		Package
		$V_{DSS}$ (MIN)	$R_{DS(ON)}$ (MAX)	
STR-W6051S	67kHz	650V	3.95 $\Omega$	TO220F-6
STR-W6052S			2.8 $\Omega$	
STR-W6053S			1.9 $\Omega$	

## &lt;STR-W6200D Series&gt;

- Low noise, low standby power (Input power  $P_{IN}<40\text{mW}$  at no load)
- External latch protection (ELP) function

Part Number	Oscillation Frequency	MOSFET		Package
		$V_{DSS}$ (MIN)	$R_{DS(ON)}$ (MAX)	
STR-W6251D	67kHz	650V	3.95 $\Omega$	TO220F-6
STR-W6252D			2.8 $\Omega$	
STR-W6253D			1.9 $\Omega$	

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

## &lt;STR-A6100 Series&gt;

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

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

## &lt;STR-V100 Series&gt;

- 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		Package
		$V_{DSS}$ (MIN)	$R_{DS(ON)}$ (MAX)	
STR-V152	8 $\mu\text{s}$	650V	2.8 $\Omega$	SIP8
STR-V153	11.5 $\mu\text{s}$		2 $\Omega$	

### ●Quasi-resonant type

## &lt;STR-Y6700 Series&gt;

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

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

## &lt;STR-Y6400 Series&gt;

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

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

## 1-1-2 AC/DC Converter ICs

### <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		Package
	V <sub>DSS</sub> (MIN)	R <sub>DS(ON)</sub> (MAX)	
STR-L6472	850V	6.5Ω	SIP10

### <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		Package
	V <sub>DSS</sub> (MIN)	R <sub>DS(ON)</sub> (MAX)	
STR-L451	650V	3.95Ω	SIP10
STR-L472	900V	7.7Ω	

### <STR-W6700 Series>

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

Part Number	MOSFET		Auto burst operation	Bottom-skip QR operation	Package
	V <sub>DSS</sub> (MIN)	R <sub>DS(ON)</sub> (MAX)			
STR-W6734	500V	1.0Ω	Yes	Yes	TO220F-6
STR-W6735		0.57Ω			
STR-W6753		1.7Ω			
STR-W6754	650V	0.96Ω	Yes	No	
STR-W6756		0.73Ω			
STR-W6765	800V	1.8Ω	Yes	No	
STR-W6750F	650V	0.73Ω	No	Yes	
STR-W6723N	450V	1.4Ω			
STR-W6735N	500V	0.57Ω			
STR-W6756N	650V	0.73Ω			
STR-W6765N	800V	1.8Ω			

### <STR-X6700 Series>

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

Part Number	MOSFET		Auto burst operation	Bottom-skip QR operation	Package
	V <sub>DSS</sub> (MIN)	R <sub>DS(ON)</sub> (MAX)			
STR-X6737	500V	0.36Ω	Yes	Yes	TO3PF-7
STR-X6756	650V	0.73Ω			
STR-X6757		0.62Ω			
STR-X6769		800V			
STR-X6750B	650V	0.62Ω	No	No	
STR-X6759B		0.385Ω			
STR-X6769B	800V	0.66Ω	Yes	No	
STR-X6750F	650V	0.62Ω			
STR-X6759F		0.385Ω			
STR-X6729	450V	0.189Ω	No	Yes	
STR-X6737M	500V	0.36Ω			
STR-X6757N	650V	0.62Ω			
STR-X6759N		0.385Ω			
STR-X6768N		800V			1.0Ω

### ● Current resonance type

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

Part Number	Package
SSC9512	DIP16
SSC9522S	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
NR117K	1.5						○		35	30	HSOP8	Current mode control	20
NR119E	2.0						○		35	364	eSOIC8	Current mode control	20
NR885E	3.0						○		20	350	eSOIC8	Current mode control, synchronous rectifier	22
NR885K	3.0						○		20	350	HSOP8	Current mode control, synchronous rectifier	22
SI-8205NHD	3.0						○		46	200 to 1000	HSOP8	Current mode control, synchronous rectifier	24
SI-8205NHG	3.0						○		46	300 to 1000	HSOP8	Current mode control, external synchronization	24
SI-8000SD	3.0	○	○						43*1	60	TO263-5		26
SPI-8000A	3.0							○	53	250	HSOP16		28
SI-8000Q	3.5						○		30	500	HSOP8	Current mode control	32
SI-8000FDE	3.5						○		43	300	TO263-5		34
SI-8000FDL	3.5						○		43	300	TO263-5	Active: low	34
NR110K	4.0						○		35	350	HSOP8	Current mode control	20
NR111E	4.0						○		35	350	eSOIC8	Current mode control	20
SI-8000HD	5.5						○		43	150	TO263-5		36

\*1: 35V for SI-8033SD

### 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	60
SI-8000E	0.6		○								43	60	TO220F-5		38
SI-8500L	1.0		○								35	60	Non-package type	With coil and built-in diode	60
SI-8000JF	1.5	○	○		○				○		43	125	TO220F-5		40
SI-8000TFE	1.5		○					○			43	300	TO220F-5		42
SI-8000GL	1.5								○		53	250	DIP8		44
NR887D	2.0							○			20	500	DIP8	Current mode control, synchronous rectifier	46
SI-8000S	3.0	○	○	○	○	○					43*2	60	TO220F-5		48
SI-8100QL	3.5						○				30	350	DIP8	Current mode control	50
SI-8000FFE	3.5							○			43	300	TO220F-5		52
NR111D	4.0							○			35	350	DIP8	Current mode control	54
SI-8000HFE	5.5		○					○			43	150	TO220F-5		56
SI-8000Y	8.0		○						○		45	130	TO220F-7	Current mode control	58

\*2: 35V for SI-8033S

**<Multi Output>**

Part Number		Output Current	Output Voltage	Maximum Input Voltage	Oscillation Frequency	Package	Remarks	Page
		(A)	(V)	(V)	(kHz)			
STA801M	ch1	0.5	5	43	125	ZIP10	Built-in flywheel diode	62
	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		64
	ch2	1.5	Variable (1.0 to 16 V)					
SPI-8002TW	ch1	1.5	Variable (1.0 to 24 V)	40	250	HSOP16		64
	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	64
	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)	68

# 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	
SI-8000W	
SI-8000JD	
SI-8000TM	
NR117K	
NR119E	
NR885E	
NR885K	SJPM-H4 (Surface-Mount Stand-Alone Type, $V_{RM}=400V, I_O=2.0A$ )
SI-8205NHD	
SI-8205NHG	
SI-8000SD	
SPI-8000A	
SI-8005Q	
SI-8001FDE	
SI-8001FDL	
SI-8008HD	
SI-8000HFE	FMM-22S,R (Center-tap Type, $V_{RM}=200V, I_O=10A$ )
SI-8000Y	
SI-8400L	
SI-8000E	
SI-8500L	AM01Z (Axial Type, $V_{RM}=200V, I_O=1.0A$ )
SI-8000JF	
SI-8000TFE	
SI-8000GL	
NR887D	RM10Z (Axial Type, $V_{RM}=200V, I_O=1.5A$ )
SI-8000S	
NR110K	
NR111E	RM4Z (Axial Type, $V_{RM}=200V, I_O=3.0A$ )
SI-8100QL	
SI-8000FFE	
STA801M	AM01Z (Axial Type, $V_{RM}=200V, I_O=1.0A$ )
SPI-8000TW	SJPM-H4 (Surface-Mount Stand-Alone Type, $V_{RM}=400V, I_O=2.0A$ )

# 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 compensation and output voltage
- Built-in reference oscillator (60kHz)
- Built-in overcurrent and thermal protection circuits

## ■Lineup

Part Number	SAI01	SAI02	SAI03
V <sub>o</sub> (V)	5.0	3.3	12.0
I <sub>o</sub> (A)	0.5		0.4

## ■Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit
DC Input Voltage	V <sub>IN</sub>	35	V
Power Dissipation	P <sub>D</sub>	0.75	W
Junction Temperature	T <sub>J</sub>	+125	°C
Storage Temperature	T <sub>stg</sub>	-40 to +125	°C
Thermal Resistance(junction to case)	θ <sub>J-C</sub>	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 <sub>IN</sub>	7 to 33	5.3 to 28	15 to 33	V
Output Current Range	I <sub>o</sub>	0 to 0.5			A
Operating Junction Temperature Range	T <sub>top</sub>	-30 to +125			°C

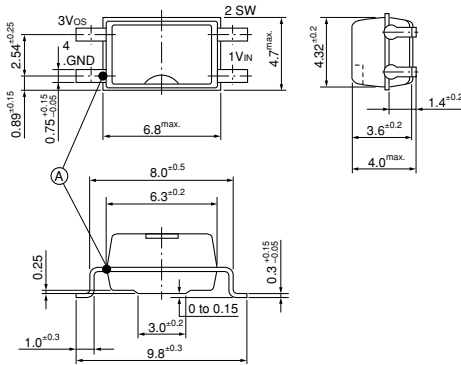
## ■Electrical Characteristics

(T<sub>a</sub>=25°C)

Parameter	Symbol	Ratings									Unit
		SAI01			SAI02			SAI03			
		min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	
Output Voltage	V <sub>o</sub>	4.80	5.00	5.20	3.17	3.30	3.43	11.40	12.00	12.60	V
Conditions		V <sub>IN</sub> =20V, I <sub>o</sub> =0.3A			V <sub>IN</sub> =15V, I <sub>o</sub> =0.3A			V <sub>IN</sub> =24V, I <sub>o</sub> =0.3A			
Efficiency	η		80			75			88		%
Conditions		V <sub>IN</sub> =20V, I <sub>o</sub> =0.3A			V <sub>IN</sub> =15V, I <sub>o</sub> =0.3A			V <sub>IN</sub> =24V, I <sub>o</sub> =0.3A			
Oscillation Frequency	f		60			60			60		kHz
Conditions		V <sub>IN</sub> =20V, I <sub>o</sub> =0.3A			V <sub>IN</sub> =15V, I <sub>o</sub> =0.3A			V <sub>IN</sub> =24V, I <sub>o</sub> =0.3A			
Line Regulation	ΔV <sub>OLINE</sub>		80	100		60	80		100	130	mV
Conditions		V <sub>IN</sub> =10 to 30V, I <sub>o</sub> =0.3A			V <sub>IN</sub> =8 to 28V, I <sub>o</sub> =0.3A			V <sub>IN</sub> =18 to 30V, I <sub>o</sub> =0.3A			
Load Regulation	ΔV <sub>OLOAD</sub>		30	40		20	30		70	95	mV
Conditions		V <sub>IN</sub> =20V, I <sub>o</sub> =0.1 to 0.4A			V <sub>IN</sub> =15V, I <sub>o</sub> =0.1 to 0.4A			V <sub>IN</sub> =24V, I <sub>o</sub> =0.1 to 0.4A			
Temperature Coefficient of Output Voltage	ΔV <sub>O</sub> /ΔT <sub>a</sub>		±0.5			±0.5			±1.5		mV/°C
Conditions		45			45			45			
Ripple Rejection	R <sub>REJ</sub>										dB
Conditions		f=100 to 120Hz			f=100 to 120Hz			f=100 to 120Hz			
Overcurrent Protection Starting Current	I <sub>s1</sub>	0.55			0.55			0.45			A
Conditions		V <sub>IN</sub> =10V			V <sub>IN</sub> =8V			V <sub>IN</sub> =18V			

External Dimensions (PS4)

(Unit : mm)



Ⓐ Case Temperature Measuring Point

Pin Assignment

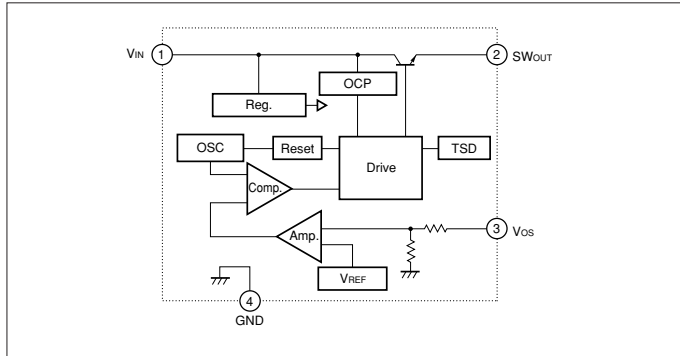
- ① VIN
- ② SWOUT
- ③ Vos
- ④ GND

Plastic Mold Package Type

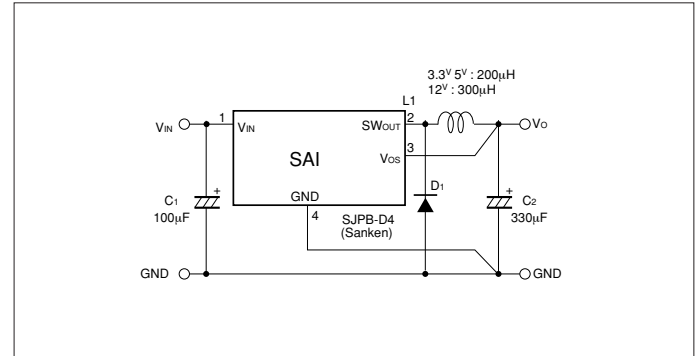
Flammability: UL94V-0

Product Mass: Approx. 0.22g

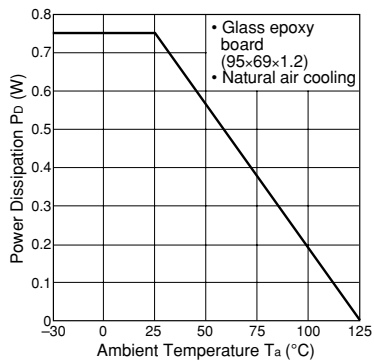
Block Diagram



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<sub>F</sub> : Diode D<sub>1</sub> forward voltage  
SJPB-D4-0.3V

Thermal design for D<sub>1</sub> 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 compensation 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)	$\theta_{j-L}$	22	°C/W
Thermal Resistance (Junction to Ambient Air) <sup>*1</sup>	$\theta_{j-a}$	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

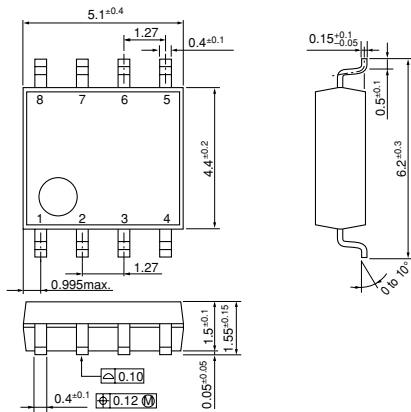
( $T_a=25^\circ\text{C}$ )

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	$\eta$	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	$\Delta V_{OLINE}$	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	$\Delta V_{OLOAD}$	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	$\Delta V_O/\Delta T_a$	$\pm 0.5$			$\pm 0.5$			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)

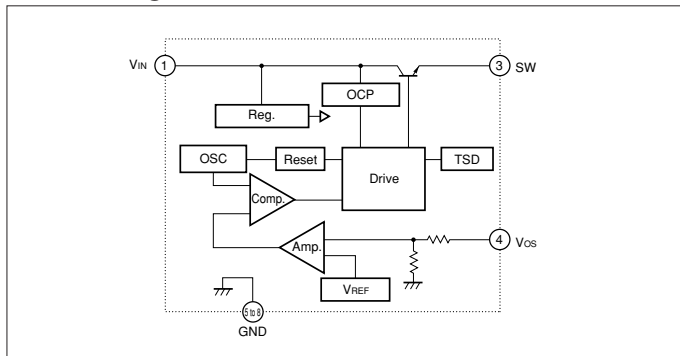


Pin Assignment

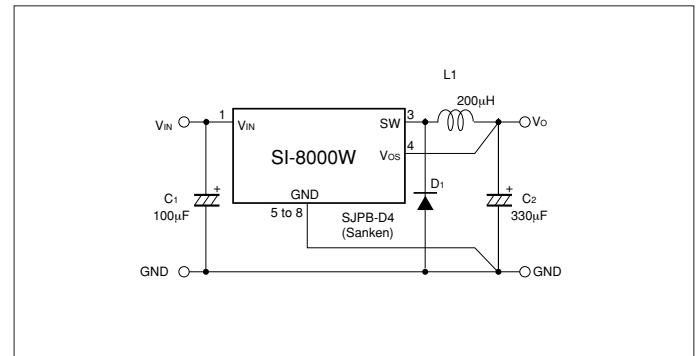
- ① VIN
- ② N.C
- ③ SW
- ④ V<sub>OS</sub>
- ⑤ GND
- ⑥ GND
- ⑦ GND
- ⑧ GND

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

Block Diagram

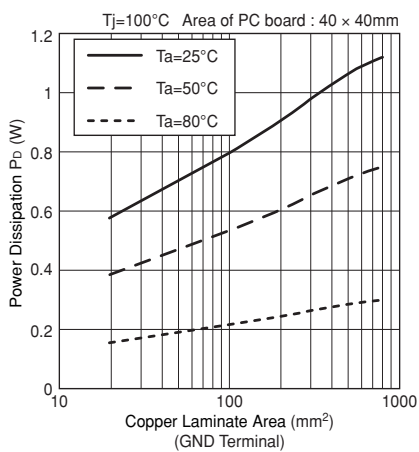


Typical Connection Diagram

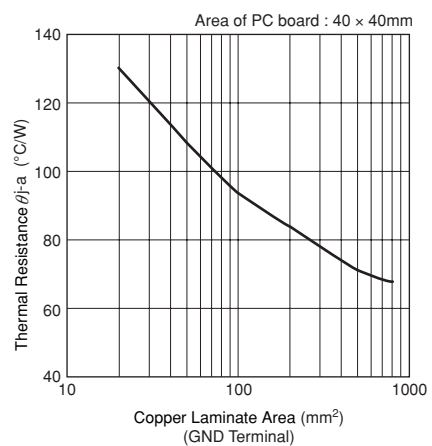


Reference Data

Copper Laminate Area vs. Power Dissipation



Copper Laminate Area vs. Thermal Resistance  $\theta_{j-a}$



# 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 compensation 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
V <sub>o</sub> (V)	3.3	5.0	9.0	12.0
I <sub>o</sub> (A)	1.5			

## ■Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit	Conditions
DC Input Voltage	V <sub>IN</sub>	43	V	
Output Current	I <sub>o</sub>	1.5	A	
Power Dissipation*	P <sub>d</sub>	3	W	When mounted on glass-epoxy board 40 × 40 mm (copper area 100%)
Junction Temperature	T <sub>j</sub>	+125	°C	
Storage Temperature	T <sub>stg</sub>	-40 to +125	°C	
Thermal Resistance (Junction to Case)	θ <sub>J-C</sub>	3	°C/W	
Thermal Resistance (Junction to Ambient Air)	θ <sub>J-A</sub>	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 <sub>IN1</sub>	5.3 to 40	7 to 40	11 to 40	14 to 40	V	I <sub>o</sub> =0 to 1A
	V <sub>IN2</sub>	6.3 to 40	8 to 40	12 to 40	15 to 40		I <sub>o</sub> =0 to 1.5A
DC Output Current Range*	I <sub>o</sub>	0 to 1.5				A	V <sub>IN</sub> ≥V <sub>o</sub> +3V
Operating Junction Temperature Range	T <sub>TOP</sub>	-30 to +125				°C	
Operating Temperature Range*	T <sub>OP</sub>	-30 to +125				°C	

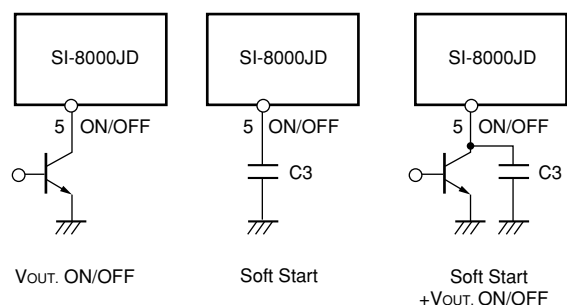
\*: Limited by Ta-Pd characteristics

## ■Electrical Characteristics

(T<sub>a</sub>=25°C)

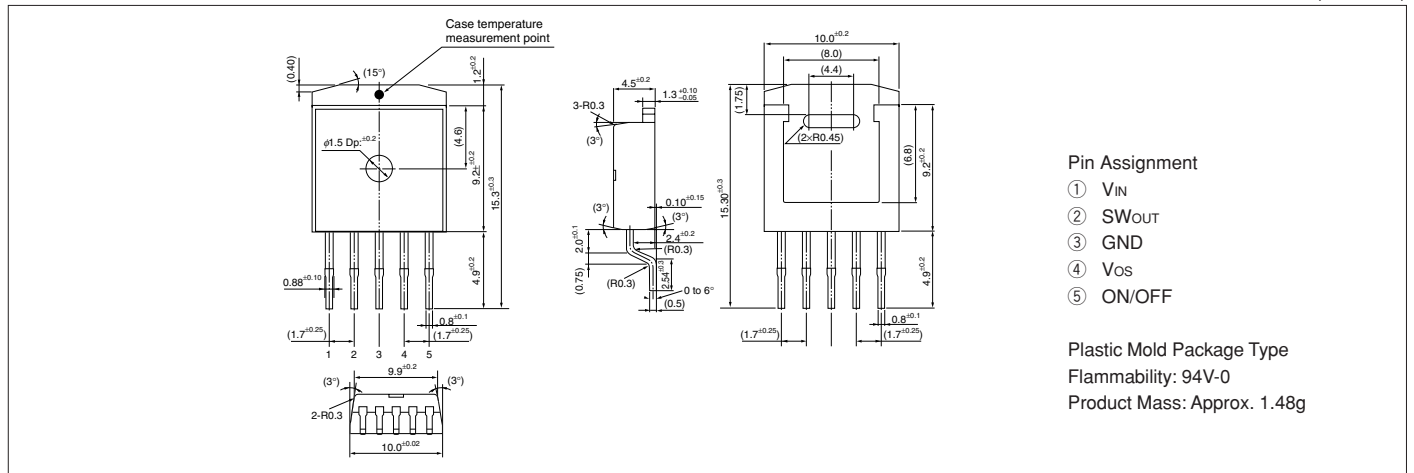
Parameter	Symbol	Ratings												Unit	
		SI-8033JD			SI-8050JD			SI-8090JD			SI-8120JD				
		min.	typ.	max.	min.	typ.	max.	min.	typ.	max.	min.	typ.	max.		
Output Voltage	V <sub>o</sub>	3.234	3.30	3.366	4.90	5.00	5.10	8.82	9.00	9.18	11.76	12.00	12.24	V	
	Conditions	V <sub>IN</sub> =15V, I <sub>o</sub> =0.5A			V <sub>IN</sub> =20V, I <sub>o</sub> =0.5A			V <sub>IN</sub> =21V, I <sub>o</sub> =0.5A			V <sub>IN</sub> =24V, I <sub>o</sub> =0.5A				
Efficiency	η	77			82			86			88			%	
	Conditions	V <sub>IN</sub> =15V, I <sub>o</sub> =0.5A			V <sub>IN</sub> =20V, I <sub>o</sub> =0.5A			V <sub>IN</sub> =21V, I <sub>o</sub> =0.5A			V <sub>IN</sub> =24V, I <sub>o</sub> =0.5A				
Oscillation Frequency	f	125			125			125			125			kHz	
	Conditions	V <sub>IN</sub> =15V, I <sub>o</sub> =0.5A			V <sub>IN</sub> =20V, I <sub>o</sub> =0.5A			V <sub>IN</sub> =21V, I <sub>o</sub> =0.5A			V <sub>IN</sub> =24V, I <sub>o</sub> =0.5A				
Line Regulation	ΔV <sub>OLINE</sub>	25 80			40 100			50 120			60 130			mV	
	Conditions	V <sub>IN</sub> =8 to 30V, I <sub>o</sub> =0.5A			V <sub>IN</sub> =10 to 30V, I <sub>o</sub> =0.5A			V <sub>IN</sub> =15 to 30V, I <sub>o</sub> =0.5A			V <sub>IN</sub> =18 to 30V, I <sub>o</sub> =0.5A				
Load Regulation	ΔV <sub>LOAD</sub>	10 30			10 40			10 40			10 40			mV	
	Conditions	V <sub>IN</sub> =15V, I <sub>o</sub> =0.2 to 0.8A			V <sub>IN</sub> =20V, I <sub>o</sub> =0.2 to 0.8A			V <sub>IN</sub> =21V, I <sub>o</sub> =0.2 to 0.8A			V <sub>IN</sub> =24V, I <sub>o</sub> =0.2 to 0.8A				
Temperature Coefficient of Output Voltage	ΔV <sub>o</sub> /ΔT <sub>a</sub>	±0.5			±0.5			±1.0			±1.0			mV/°C	
Overcurrent Protection Starting Current	I <sub>st</sub>	1.6			1.6			1.6			1.6			A	
	Conditions	V <sub>IN</sub> =15V			V <sub>IN</sub> =20V			V <sub>IN</sub> =21V			V <sub>IN</sub> =24V				
ON/OFF* Pin	Low Level Voltage	V <sub>SSL</sub>			0.5			0.5			0.5			V	
	Outflow Current at Low Voltage	I <sub>SSL</sub>			100			100			100				
Quiescent Circuit Current	I <sub>q</sub>	7			7			7			7			mA	
		Conditions			V <sub>IN</sub> =15V, I <sub>o</sub> =0A			V <sub>IN</sub> =20V, I <sub>o</sub> =0A			V <sub>IN</sub> =21V, I <sub>o</sub> =0A				V <sub>IN</sub> =24V, I <sub>o</sub> =0A
	I <sub>q(OFF)</sub>	200			200			200			200			μA	
		Conditions			V <sub>IN</sub> =15V, V <sub>ON/OFF</sub> =0.3V			V <sub>IN</sub> =20V, V <sub>ON/OFF</sub> =0.3V			V <sub>IN</sub> =21V, V <sub>ON/OFF</sub> =0.3V				V <sub>IN</sub> =24V, V <sub>ON/OFF</sub> =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<sub>SSL</sub> 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 C<sub>3</sub> flows into the ON/OFF control transistor. Therefore, limit the current securely to protect the transistor if C<sub>3</sub> capacitance is large.  
 The ON/OFF pin is pulled up to the power supply in the IC, so applying the external voltage is prohibited.

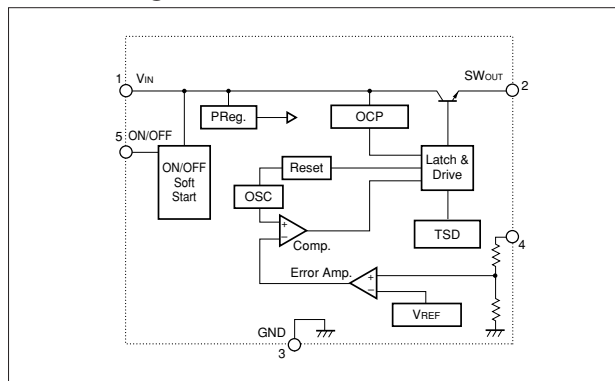


External Dimensions (TO263-5)

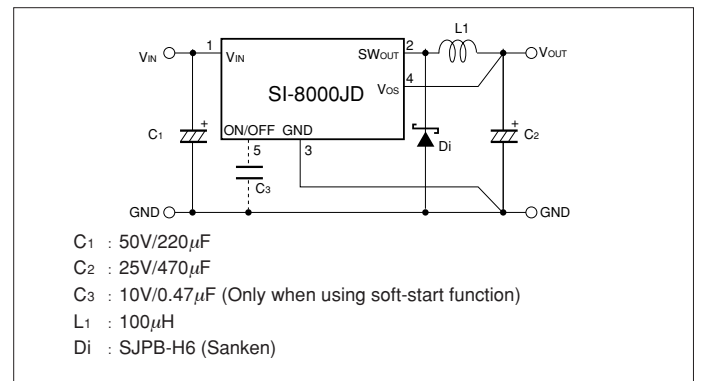
(Unit : mm)



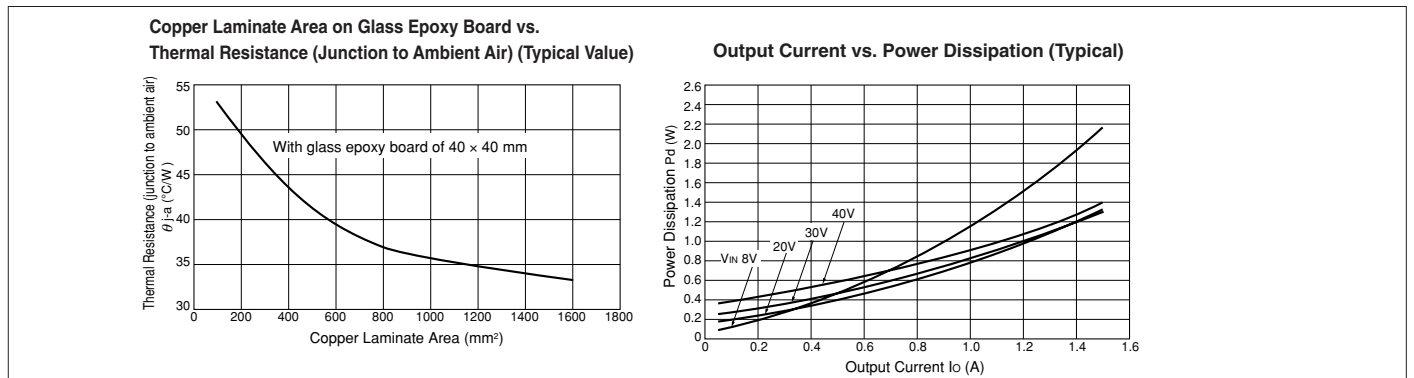
Block Diagram



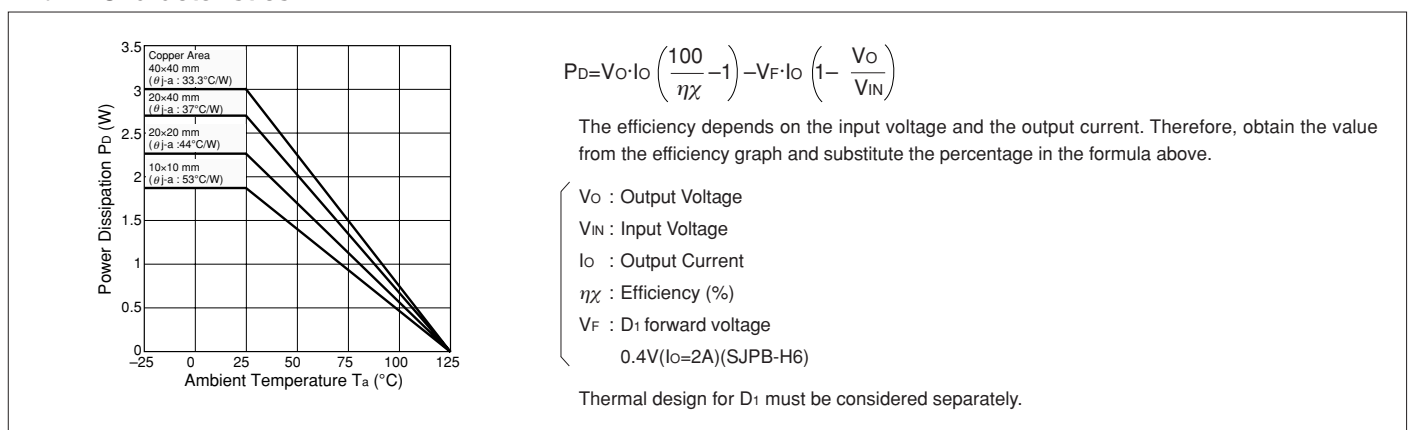
Typical Connection Diagram



Reference Data



T<sub>a</sub>-P<sub>D</sub> 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  $\mu\text{A}$  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		$^{\circ}\text{C}$

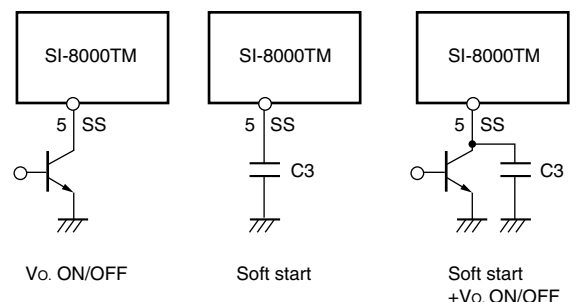
\*1: The minimum value of an input voltage range is the higher of 4.5 V or  $V_o + 3\text{ V}$ .

## 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	$\Delta V_{ADJ}/\Delta T$		$\pm 0.1$		$\text{mV}/^{\circ}\text{C}$
	Conditions	$V_{IN} = 15\text{ V}, I_o = 0.1\text{ A}, T_c = 0\text{ to }100^{\circ}\text{C}$			
Efficiency	$\eta$		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	$\Delta V_{OLINE}$		60	80	mV
	Conditions	$V_{IN} = 10\text{ to }30\text{ V}, I_o = 0.5\text{ A}$			
Load Regulation	$\Delta V_{OLOAD}$		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	$\mu\text{A}$
	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	$\mu\text{A}$
	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.



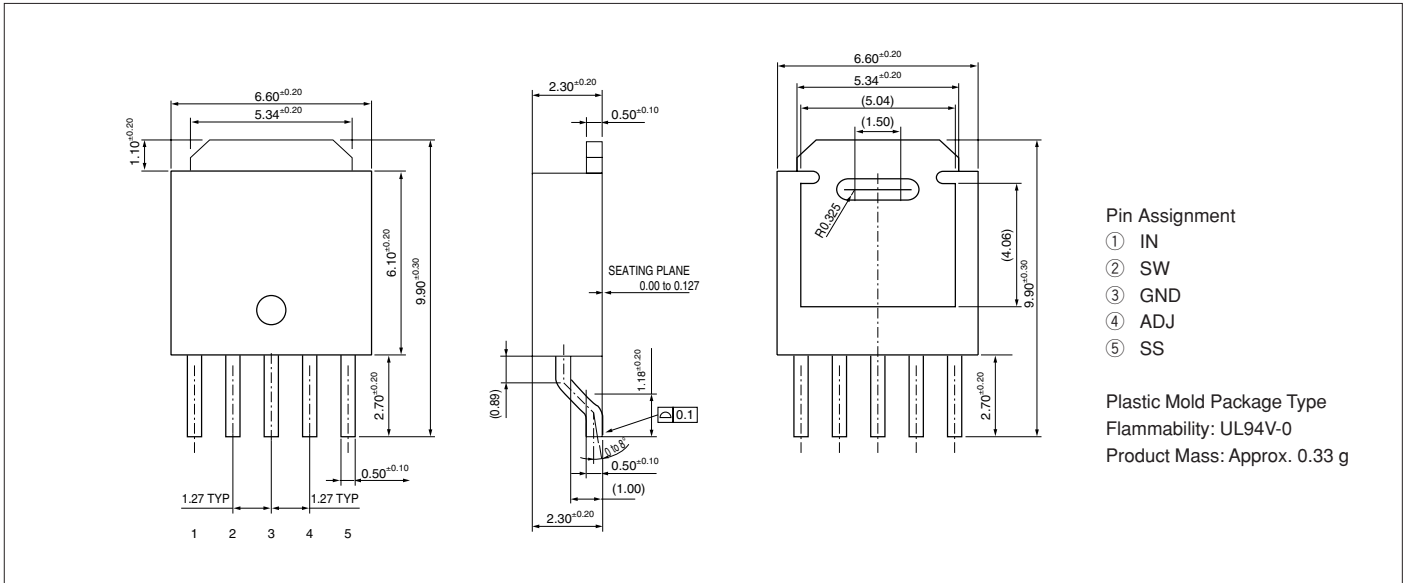
Vo. ON/OFF

Soft start

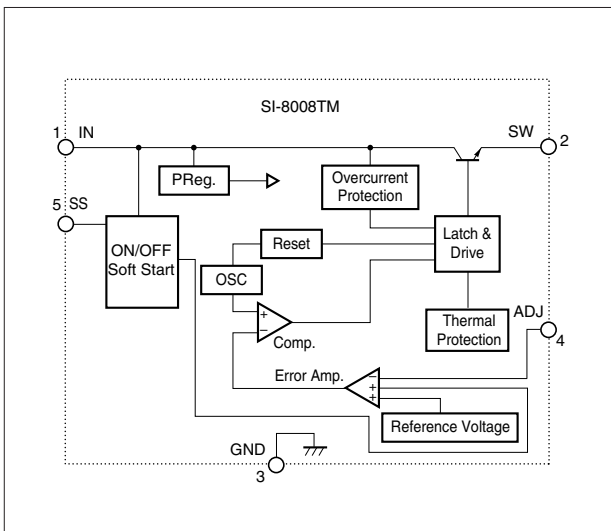
Soft start +Vo. ON/OFF

External Dimensions (TO252-5)

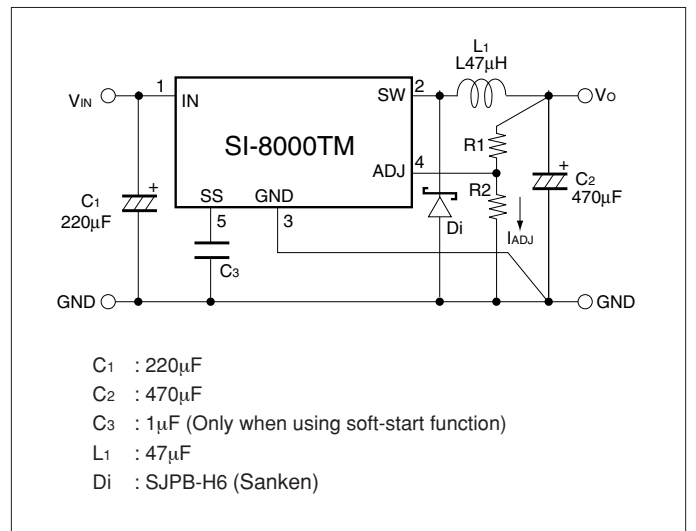
(Unit : mm)



Block Diagram



Typical Connection Diagram



# NR110E/K Surface-Mount, Current Mode Control Step-down Switching Mode

## Features

- Compact surface-mount package
- Input voltage range ( $V_{IN}$ ):  $V_O + 3$  to 31 V
- Oscillation frequency: 30 kHz, 350 kHz, 364 kHz
- High efficiency under light load
- High efficiency: 94% or higher
- Current mode control
- Stable with low-ESR ceramic output capacitors
- Built-in phase compensation component
- Output current: 1.5 A, 2 A, 4 A
- Reference voltage and accuracy of  $0.8 \text{ V} \pm 2\%$
- Overcurrent protection function that can be adjusted externally
- Output ON/OFF available
- Undervoltage lockout
- Soft start function

## Applications

- Power supply for LCDTV, STB and Blu-Ray
- Power supplies for domestic appliances
- On-board local power supply
- Switching power supplies

## Absolute Maximum Ratings

Parameter	Symbol	Ratings				Unit	Conditions
		NR110K	NR111E	NR117K	NR119E		
Input Voltage	$V_{IN}$	35	35	35	35	V	
BS Pin Voltage	$V_{BS}$	44	44	44	44	V	
Pin Voltage between BS and SW	$V_{BS-SW}$	8	8	8	8	V	
SW Pin Voltage	$V_{SW}$	35	35	35	35	V	
FB Pin Voltage	$V_{FB}$	5.5	5.5	5.5	5.5	V	
EN Pin Voltage	$V_{EN}$	35	35	35	35	V	
SS Pin Voltage	$V_{SS}$	5.5	5.5	5.5	5.5	V	
Power Dissipation	$P_D$	1.69	1.76	1.69	1.76	W	When mounted on 30 × 30 mm glass-epoxy board (with a 25 × 25 mm copper area)
Junction Temperature	$T_J$	-40 to 150	-40 to 150	-40 to 150	-40 to 150	°C	
Storage Temperature	$T_{stg}$	-40 to 150	-40 to 150	-40 to 150	-40 to 150	°C	
Thermal Resistance (Junction to Lead (4 pins))	$\theta_{J-C}$	40	26	40	26	°C/W	
Thermal Resistance (Junction to Ambient Air)	$\theta_{J-A}$	74	71	74	71	°C/W	When mounted on 30 × 30 mm glass-epoxy board (with a 25 × 25 mm copper area)

## Recommended Operating Conditions

Parameter	Symbol	Ratings				Unit
		NR110K	NR111E	NR117K	NR119E	
Input Voltage Range	$V_{IN}$	8.0 or $V_O + 3^*$ to 31	6.5 or $V_O + 3^*$ to 31	8.0 or $V_O + 3^*$ to 31	6.5 or $V_O + 3^*$ to 31	V
Output Current Range	$I_{OUT}$	0 to 4.0**	0 to 4.0**	0 to 1.5**	0 to 2.0**	A
Output Voltage Range	$V_O$	0.8 to 24	0.8 to 24	0.8 to 24	0.8 to 24	V
Operating Temperature Range	$T_{op}$	-40 to 85**	-40 to 85**	-40 to 85**	-40 to 85**	°C

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

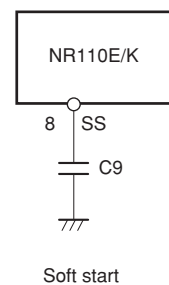
\*\* : The device must be used within the range indicated by the  $T_a$ - $P_D$  characteristics.

## Electrical Characteristics

( $T_a = 25^\circ\text{C}$ ,  $V_{IN} = 12\text{V}$ ,  $V_O = 5.0\text{V}$ , and  $I_O = 1\text{A}$ , unless otherwise specified)

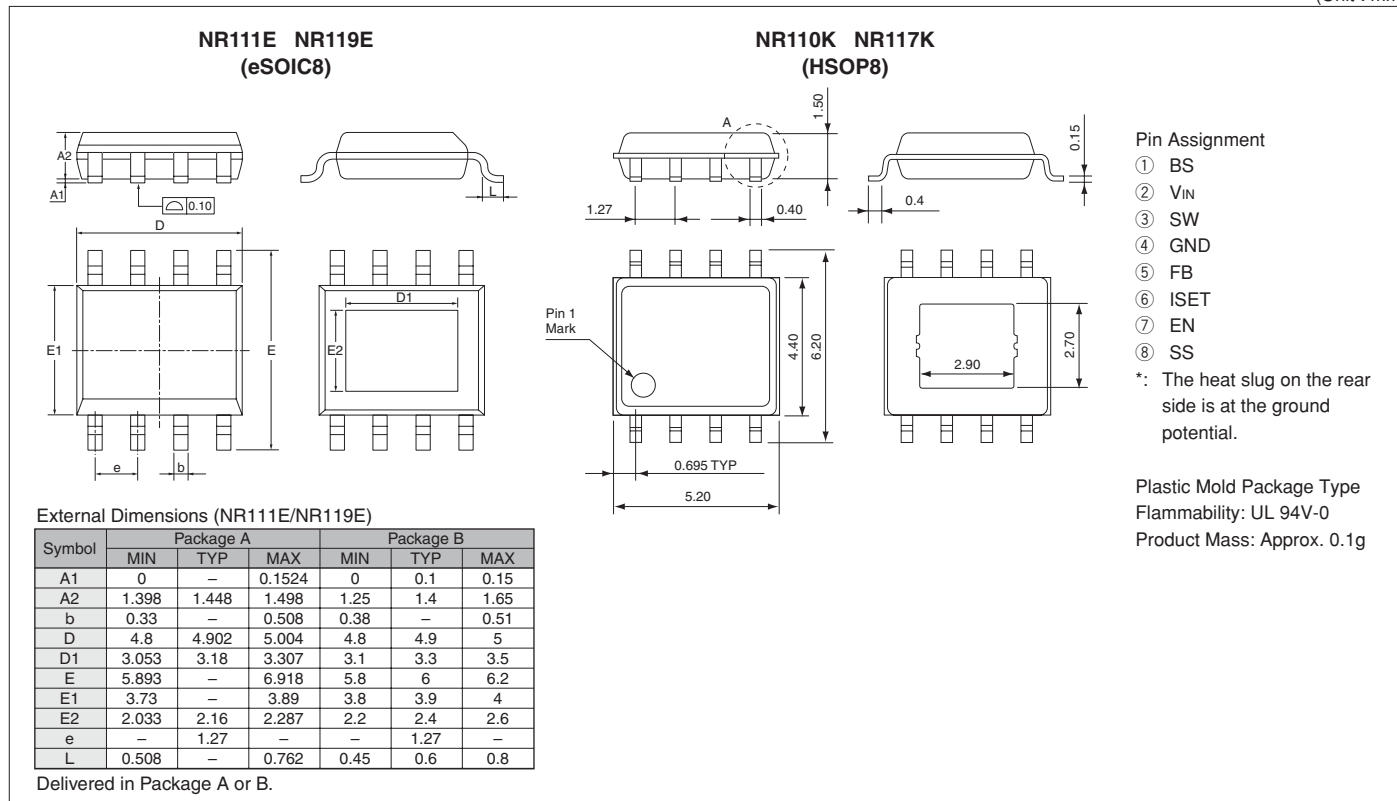
Parameter	Symbol	Ratings									Unit	Conditions	
		NR110K/NR111E			NR119E			NR117K					
		min.	typ.	max.	min.	typ.	max.	min.	typ.	max.			
Reference Voltage	$V_{REF}$	0.784	0.8000	0.816	0.784	0.8000	0.816	0.784	0.8000	0.816	V		
Temperature Coefficient of Reference Voltage	$\Delta V_{REF}/\Delta T$		$\pm 0.05$			$\pm 0.05$			$\pm 0.05$		mV/°C	$T_a = -40^\circ\text{C}$ to $+85^\circ\text{C}$	
Oscillation Frequency	$f_{sw}$		350			364			30		kHz		
Line Regulation	$V_{LINE}$		50			50			50		mV	$V_{IN} = V_{INmin}$ to 30V	
Load Regulation	$V_{Load}$		50			50			50		mV	$V_{IN} = 12\text{V}$ , $V_O = 5.0\text{V}$ , $I_O = 0.1$ to $I_{Omax}$	
Overcurrent Protection	$I_{s1}$		1.5			0.9			0.3		A	ISET=OPEN	
Starting Current	$I_{s2}$		5.5			2.8			2.1		A	ISET=SHORT	
No-load Circuit Current	$I_{IN}$		1			1			1		mA	$V_{EN} = 10\text{k}\Omega$ pull up to $V_{IN}$	
Quiescent Circuit Current	$I_{IN(off)}$		1			1			1		$\mu\text{A}$	$I_O = 0\text{A}$ , $V_{EN} = 0\text{V}$	
SS Pin	Outflow Current at Low Voltage	$I_{EN/SS}$	6	10	14	6	10	14	6	10	14	$\mu\text{A}$	$V_{SS} = 0\text{V}$
EN Pin	Inflow Current	$I_{EN}$		20	50		20	50		20	50	$\mu\text{A}$	$V_{EN} = 10\text{V}$
	On Threshold Voltage	$V_{C/EH}$	0.7	1.4	2.1	0.7	1.4	2.1	0.7	1.4	2.1	V	
ISET Pin	Open Voltage	$V_{ISET}$		1.5			1.5			1.5		V	
Maximum ON Duty	$D_{MAX}$		90			90			90		%		
Minimum ON Time	$T_{ON(MIN)}$			150			150			150		nsec	
Thermal Protection Start Temperature	TSD		151	165			151	165			151	165	°C
Thermal Protection Return Hysteresis	TSD_hys			20				20			20		°C
SW MOSFET ON Resistance	$R_{onH}$			85						150		m $\Omega$	

\*: 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.

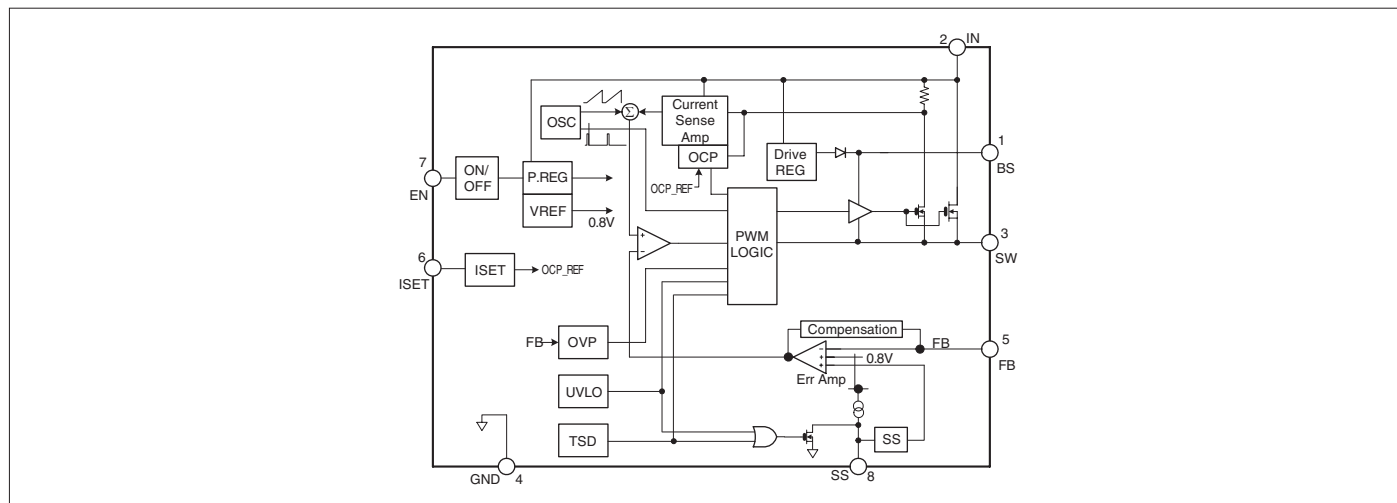


## External Dimensions

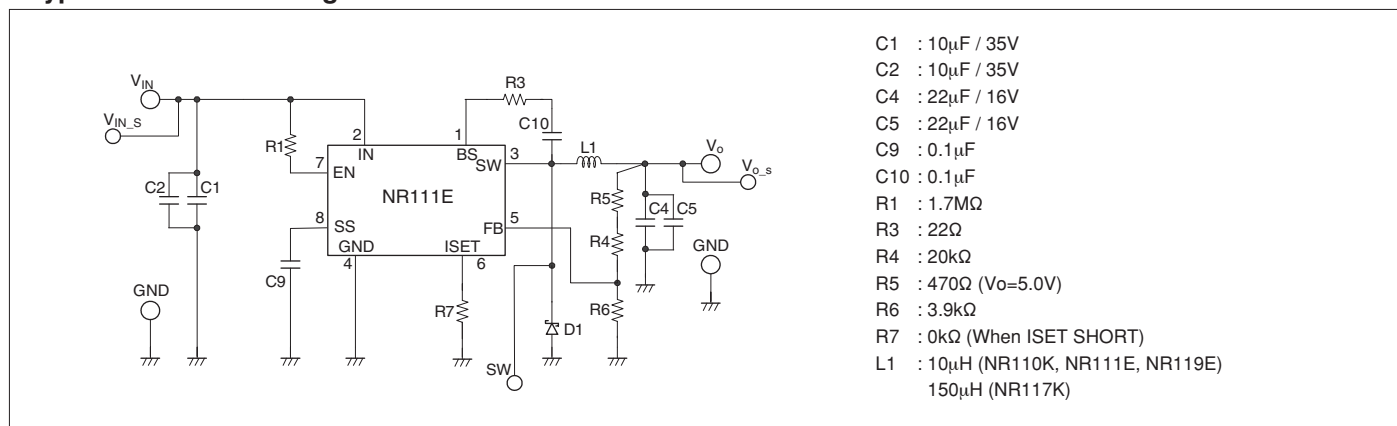
(Unit : mm)



## Block Diagram



## Typical Connection Diagram



# NR885K/NR885E Surface-Mount, Current Mode Control, Synchronous Rectifier Step-down Switching Mode

## Features

- Compact surface-mount package
- Input voltage range ( $V_{IN}$ ):  $V_O + 3$  to 18 V
- Synchronous rectifier mode
- High efficiency: 90%
- Current mode control
- Stable with low-ESR ceramic output capacitors
- Built-in phase compensation 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
- Switching power supplies

## Absolute Maximum Ratings

Parameter	Symbol	Ratings		Unit	Conditions
		NR885K	NR885E		
Input Voltage	$V_{IN}$	20	20	V	
Power Dissipation	$P_D$	1.69	1.50	W	When mounted on $70 \times 60$ mm glass-epoxy board (with a $1310\text{ mm}^2$ copper area)
Junction Temperature	$T_J$	-40 to +150	-40 to +150	$^{\circ}\text{C}$	
Storage Temperature	$T_{stg}$	-40 to +150	-40 to +150	$^{\circ}\text{C}$	
Thermal Resistance (Junction to Lead (4 pins))	$\theta_{j-c}$	40	26	$^{\circ}\text{C}/\text{W}$	
Thermal Resistance (Junction to Ambient Air)	$\theta_{j-a}$	74	71	$^{\circ}\text{C}/\text{W}$	When mounted on $70 \times 60$ mm glass-epoxy board (with a $1310\text{ mm}^2$ 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	$^{\circ}\text{C}$

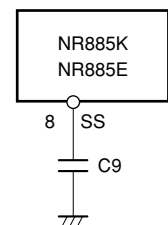
\*: The minimum value of the input voltage range is 4.5 V or  $V_O + 3$  V, whichever is higher.

## Electrical Characteristics

( $T_a=25^{\circ}\text{C}$ ,  $V_{IN}=12\text{V}$ ,  $V_O=3.3\text{V}$ , and  $I_O=1\text{A}$ , unless otherwise specified)

Parameter	Symbol	Ratings			Unit	Conditions
		min.	typ.	max.		
Reference Voltage	$V_{REF}$	0.784	0.800	0.816	V	
Temperature Coefficient of Reference Voltage	$\Delta V_{REF}/\Delta T$		$\pm 0.05$		mV/ $^{\circ}\text{C}$	$T_a=-40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$
Efficiency	$\eta$		90		%	
Oscillation Frequency	$f_o$	280	350	420	kHz	
Line Regulation	$V_{LINE}$		50		mV	$V_{IN}=6.3\text{V}$ to $18\text{V}$
Load Regulation	$V_{Load}$		50		mV	$I_O=0.1\text{A}$ to $3\text{A}$
Overcurrent Protection Starting Current	$I_S$	3.1		6.0	A	
Quiescent Circuit Current 1	$I_{IN}$		6		mA	$V_{EN}=10\text{k}\Omega$ pull up to $V_{IN}$
Quiescent Circuit Current 2	$I_{IN(off)}$	0		10	$\mu\text{A}$	$I_O=0\text{A}$ , $V_{EN}=0\text{V}$
SS Pin	Outflow Current at Low Voltage	6	10	14	$\mu\text{A}$	$V_{SS}=0\text{V}$
	Open Voltage		3.0		V	
EN Pin	Inflow Current		50	100	$\mu\text{A}$	$V_{EN}=10\text{V}$
	On Threshold Voltage	0.7	1.4	2.1	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.

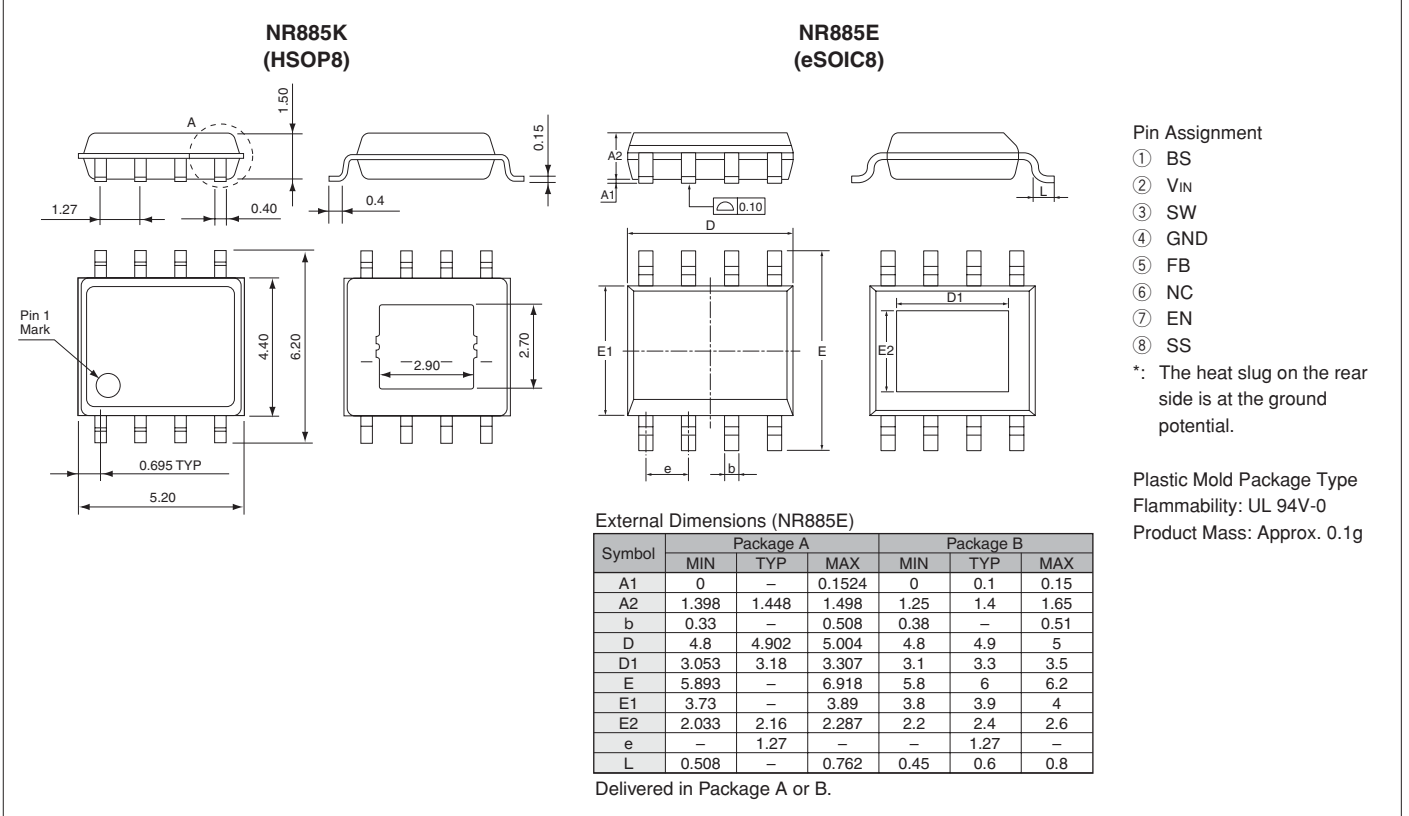


Soft start

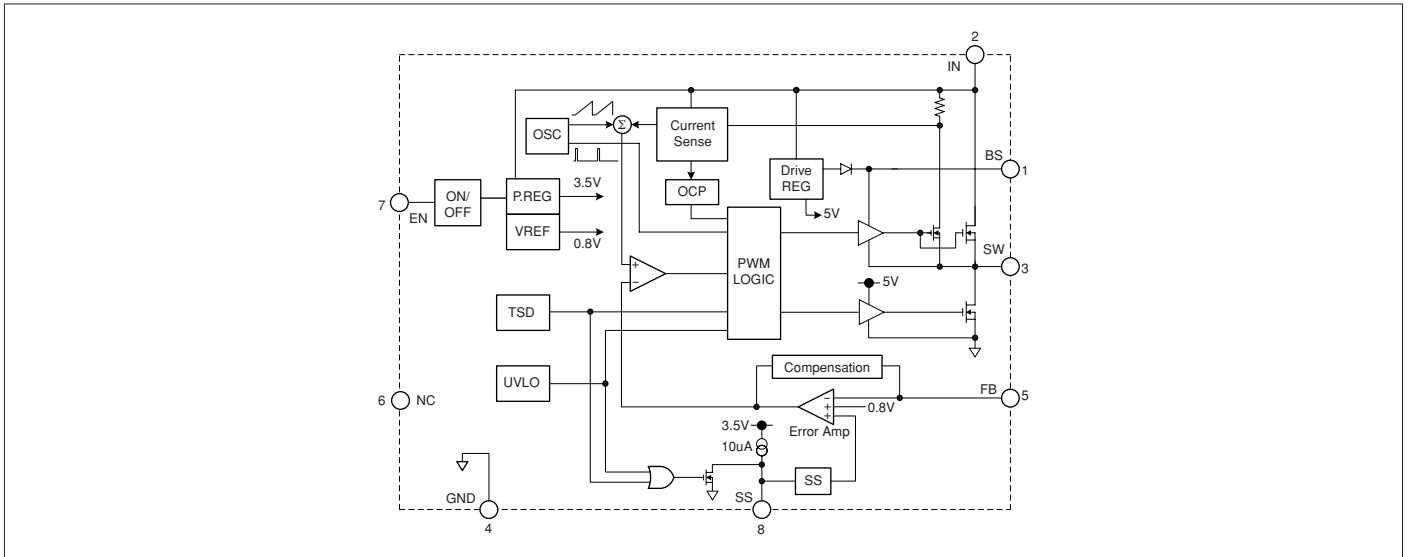


## External Dimensions

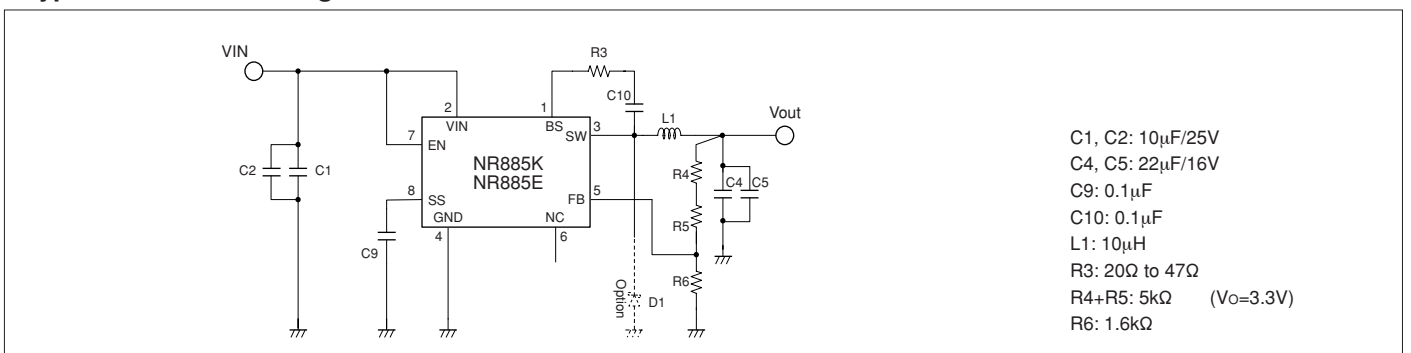
(Unit : mm)



## Block Diagram



## Typical Connection Diagram



## SI-8205NHD/SI-8205NHG

## 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  $0.5\text{ V} \pm 1\%$
- Oscillation frequency  
SI-8205NHD  
Externally adjusted frequency type: 200 kHz to 1 MHz  
SI-8205NHG  
Externally synchronized frequency type: 300 kHz to 1 MHz
- Stable with low-ESR ceramic output capacitors
- Output can be disabled
- Undervoltage lockout
- 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
		SI-8205NHD	SI-8205NHG		
Input Voltage ( $V_{IN}$ Pin)	$V_{IN}$	46	46	V	
SYNC Pin Voltage	$V_{SYNC}$	–	5.5	V	
Power Dissipation	$P_D$	1.35	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	–40 to +150	°C	
Storage Temperature	$T_{stg}$	–40 to +150	–40 to +150	°C	
Thermal Resistance (Junction to Lead <1 pin>)	$\theta_{j-c}$	40	40	°C/W	
Thermal Resistance (Junction to Ambient Air)	$\theta_{j-a}$	74	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
		SI-8205NHD	SI-8205NHG	
Input Voltage Range	$V_{IN}$	8 or $V_o + 3^*$ to 43	7 or $V_o + 3^*$ to 43	V
SYNC Pin Voltage Range	$V_{SYNC}$	–	0 to 5	V
Output Current Range	$I_{OUT}$	0 to 3.0	0 to 3.0	A
Output Voltage Range	$V_o$	0.5 to 24	0.5 to 24	V
Externally Synchronized Frequency Range	$f_{SYNC}$	–	300 to 1000	kHz
Operating Temperature Range	$T_{op}$	–40 to +85	–40 to +85	°C

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

## ■ Electrical Characteristics

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

Parameter	Symbol	Ratings						Unit	
		SI-8205NHD			SI-8205NHG				
		min.	typ.	max.	min.	typ.	max.		
Reference Voltage	$V_{REF}$	0.495	0.5000	0.505	0.495	0.5000	0.505	V	
	Conditions	$V_{IN}=12V, I_o=1.0A$			$V_{IN}=14V, I_o=1.0A$				
Temperature Coefficient of Reference Voltage	$\Delta V_{REF}/\Delta T$		$\pm 0.05$			$\pm 0.05$		mV/°C	
	Conditions	$V_{IN}=12V, I_o=1.0A, T_a=-40$ to $+85^\circ\text{C}$			$V_{IN}=14V, I_o=1.0A, T_a=-40$ to $+85^\circ\text{C}$				
Efficiency	$\eta$		90			90		%	
	Conditions	$V_{IN}=12V, V_o=5V, I_o=1.0A$			$V_{IN}=14V, V_o=5V, I_o=1.0A$				
Oscillation Frequency 1	$f_{o1}$		200			–		kHz	
	Conditions	$V_{IN}=12V, V_o=5V, I_o=1A, Rfset=375k\Omega$							
Oscillation Frequency 2	$f_{o2}$		1			–		MHz	
	Conditions	$V_{IN}=12V, V_o=5V, I_o=1A, Rfset=75k\Omega$							
Internal Oscillation Frequency	$f_o$		–			250		kHz	
	Conditions	$V_{IN}=14V, V_o=5V, I_o=1.0A, SYNC=GND$							
Line Regulation	$\Delta V_{oLINE}$		50			50		mV	
	Conditions	$V_{IN}=8$ to $43V, V_o=5V, I_o=1A$							
Load Regulation	$\Delta V_{oLoad}$		50			50		mV	
	Conditions	$V_{IN}=12V, V_o=5V, I_o=0.1$ to $3.0A$							
Overcurrent Protection Starting Current	$I_s$	3.1		6	3.1		6	A	
	Conditions	$V_{IN}=12V, V_o=5V$							
Quiescent Circuit Current 1	$I_{IN}$		8			12		mA	
	Conditions	$V_{IN}=12V, V_{comp}=0V$							
Quiescent Circuit Current 2	$I_{IN(off)}$			40			35	$\mu\text{A}$	
	Conditions	$V_{IN}=12V, V_{EN/SS}=0V$							
EN/SS Pin	Outflow Current at Low Voltage	$I_{EN/SS}$	5			5		$\mu\text{A}$	
		Conditions	$V_{EN/SS}=0V, V_{IN}=12V$						
	Open Voltage	$V_{SSH}$	3	4.5	6	3	4.5	6	V
		Conditions	$V_{IN}=12V$						
On Threshold Voltage	$V_{C/EH}$	0.6	1.3	2.0	0.6	1.3	2.0	V	
	Conditions	$V_{IN}=12V$							
SYNC Pin	Synchronization Threshold Voltage	$V_{SYNC}$		–		1.85		V	
		Conditions	$V_{IN}=14V, V_o=5V, I_o=1.0A$						
Synchronization Frequency	$f_{SYNC}$		–		300		1000.0	kHz	
	Conditions	$V_{IN}=14V, V_o=5V, I_o=1.0A$							
OVP Start Voltage	$V_{OVP}$	0.57	0.60	0.63		–		V	
Thermal Protection Start Temperature	$T_j$	151	160		151	160		°C	
Error Amplifier Voltage Gain	AEA		800			800		V/V	
Error Amplifier Transformer Conductance	GEA		800			800		$\mu\text{A}/V$	
Current Sense Amplifier Impedance	GCS		3.33			3.33		A/V	
Maximum ON Duty	DMAX	80	90			90		%	
	Conditions	$V_{IN}=12V$							
Minimum ON Time	DMIN		150			250		nsec	
	Conditions	$V_{IN}=12V$							