DC/DC Step-Down Converter IC

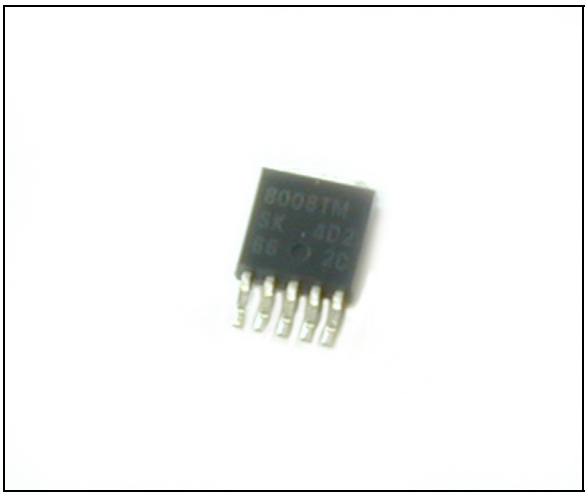
SI-8000TM Series

September 2005

■General Descriptions

SI-8000TM series has 300kHz oscillation frequency, so it contributes miniaturization of a chalk coil.
Therefore, it realizes a compact and high efficient power supply together with TO 252-5 package (compatible:SC-63) .
SI-8000TM series has the function required for switching regulators and protection circuits such as over-current, and overheating.
With only four discrete components, it realizes a high efficient switching regulator without adjustment.
1.5A output current by compact power surface mount package.

■Package---TO252-5



■Applications

- DVD Recorder、FPD TV
- OA equipment, such as a printer
- On-board local power supply

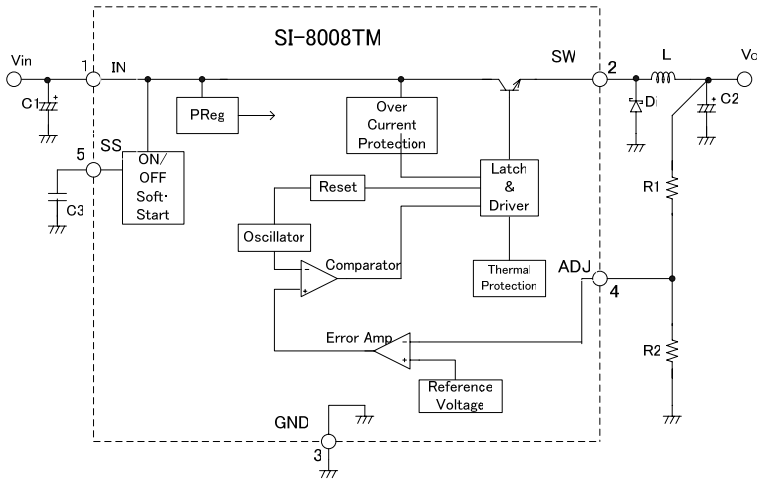
■Features

- 1.5A output current by compact power surface mount package.
- High Efficiency 81% (at VIN=15V, Io=0.5A,Vo=5V)
- Requires only four discrete components. (C3: required for soft start.)
- Built-in Oscillation circuit (oscillation frequency : 300kHz (TYP))
- Constant current type overcurrent protection and overheating protection.
- Soft start function. (ON/OFF function available. Output OFF at Low level.)
- Low consumption current at Output OFF.

■Key Specifications

	SI-8008TM (ADJ Type)	SI-8033TM	SI-8050TM	SI-8120TM
Input Voltage	43V			
Output Current	0 to 1.5A			
Output Voltage	0.8V (REF Voltage)	3.3V	5.0V	12.0V
Efficiency (TYP)	81% (5V Set-up)	76%	81%	87%

Typical Connection



C1 : 220 μ F
C2 : 470 μ F
C3 : 1 μ F
(At the time of soft start functional use)
L1 : 47 μ H
Di : SFPB66(Sanken)

SI-8000TM Series

September 2005

1. Scope

The present specifications shall apply to a DC-DC buck converter SI-8008TM.

2. Outline

Classification	Semiconductor IC (monolithic IC)
Structure	Plastic package (transfer mold)
Applications	・DC voltage regulator ・Power supplies for telecommunication equipment , office equipment etc ,ON-board local regulator ・Output voltage regulator at secondary stage of switch mode power supply

3. Absolute maximum ratings

3-1 Absolute maximum ratings

Characteristic	Symbol	Ratings	Units	Remarks
DC input voltage	VIN	43	V	
Power dissipation 1	Pd1	1 .06	W	Glass - epoxy board mounting in 900square ㎜, copper area 4.3% Tjmax=125℃
Power dissipation 2	Pd2	1.65	W	Glass - epoxy board mounting in 900square ㎜, copper area 50% Tjmax=125℃
Junction temperature	Tj	-40~150	℃	Thermal protection circuit is built-in in this product and when junction temperature rises to 130℃ or higher, it may be caused to operate Recommended max. junction temperature at operation is 125℃.
Storage temperature	Tstg	-40～150	℃	
Thermal resistance (junction-case)	θj-c	6	℃/W	
Thermal resistance (junction-ambient air)	θj-a	95	℃/W	Glass - epoxy board mounting in 900square ㎜, copper area 4.3%

3-2 Recommended operating conditions

Characteristic	Symbol	Ratings		Units	Remarks
		MIN	MAX		
DC input voltage range	VIN	*1 Vo+3	40	V	Io=0～1.5A
DC output voltage range	Vo	0.8～24		V	
DC output current range	Io	0～1.5		A	*2 VIN≧Vo+3V
Operating junction temperature range	Tjop	-40～125		℃	
Operating temperature range	Top	-40～125		℃	*2

*1 The minimum value of DC input voltage range is 8V when output is less than 5V, Vo+3,when the output is more than 5V.In the case of VIN=Vo+2～Vo+3V , it is set to Io=1A MAX.

*2 To be used within the allowable package power dissipation characteristics (refer to P6).

4. Electrical characteristics

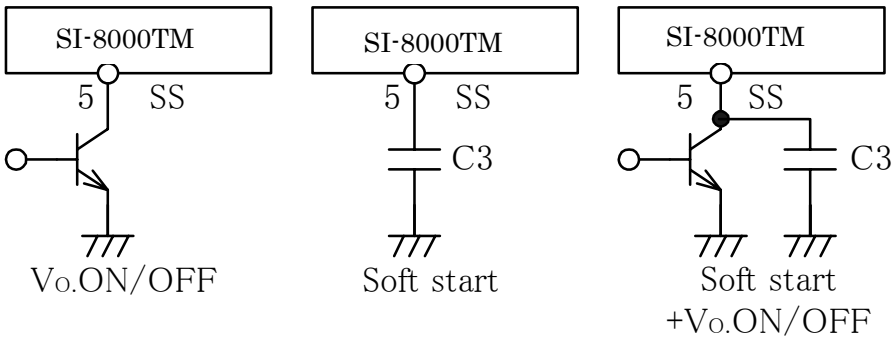
4-1 Electrical characteristics (Ta=25℃、Vo=5V adjusted R1=4.2kΩ,R2=0.8kΩ)

Characteristic		Symbol	Limits			Units	Test conditions
			MIN	TYP	MAX		
Reference voltage		V_{ADJ}	0.784	0.800	0.816	V	V_{IN}=15V, I_O=0.1A
Reference voltage temperature coefficient		$\triangle V_{REF}/\triangle T$		±0.1		mV/℃	V_{IN}=15V , I_O=0.1A,Tc=0~100℃
Efficiency *3		η		81		%	V_{IN}=15V,I_O=0.5A
Operating frequency		fo		300		kHz	V_{IN}=15V, I_O=0.5A
Line regulation		VLine		60	80	mV	V_{IN}=10～30V, I_O=0.5A
Load regulation		VLoad		10	40	mV	V_{IN}=15V, I_O=0.2～1.5A
Over current protection starting current		I_S	1.6			A	V_{IN}=15V
ON/OFF terminal *4	Low level voltage	V_{SSL}			0.5	V	
	Flow-out current at low level voltage	I_{SSL}		10	40	μA	V_{SSL}=0V
Quiescent current 1		Iq		6		mA	V_{IN}=15V, I_O=0A
Quiescent current 2		Iq(off)		200	400	μA	V_{IN}=15V V_{SS}=0V

*3 Efficiency is calculated by the following equation.

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

*4 No.5 terminal is a SS terminal to enable soft start by connecting a capacitor. The output can be turned on and off by using a SS terminal. The output is stopped by decreasing the SS terminal voltage below V_{SSL} and in order to perform ON/OFF operation of Vout, it is required to connect NPN transistor or the output of open collector type TTL between No.5 terminal and GND.
In case that both soft and Vout ON/OFF are used, a protection measure such as limitation of current is required, as the discharge current of C3 flows across a transistor for ON/OFF operation, if the capacitance of C3 large. As a pull-up type resistor is provided inside the IC, no external voltage can be applied. In case of no use of ON/OFF, please keep it open.

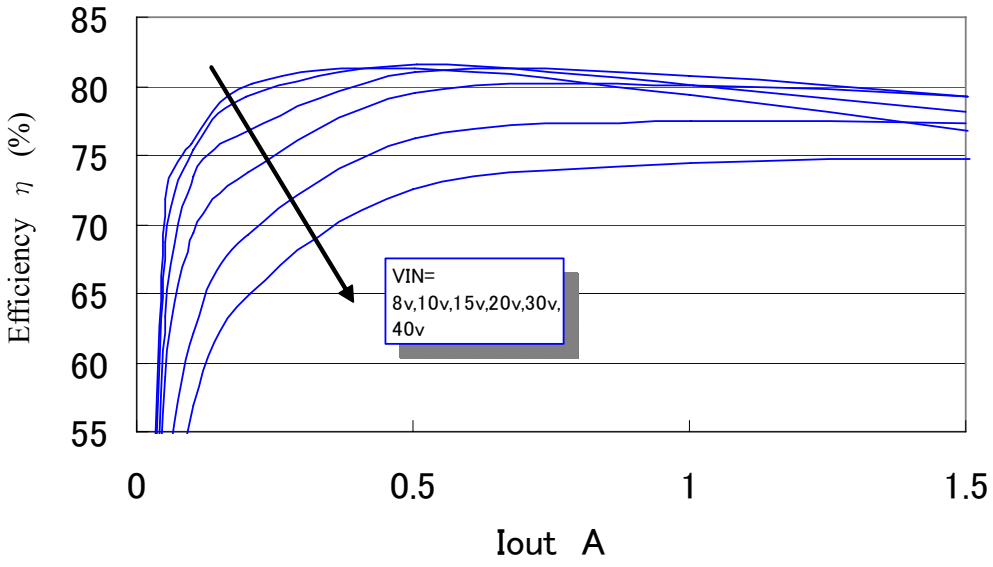


4-2 Typical characteristics (Ta=25℃)

（1）Efficiency

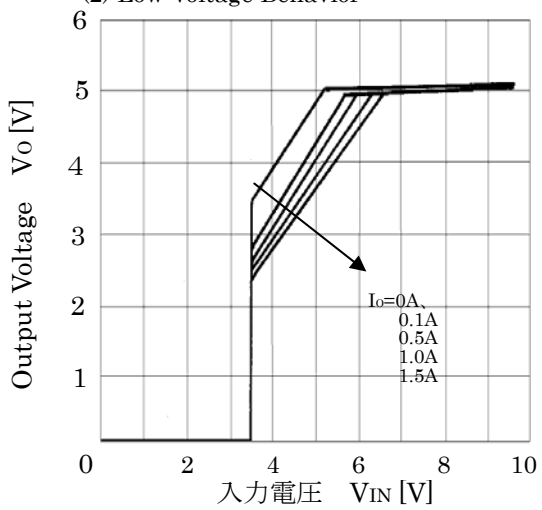
SI-8008TM Efficiency Curve

Vo=5V Adjusted : R1=4.2kOhm, R2=0.8kOhm

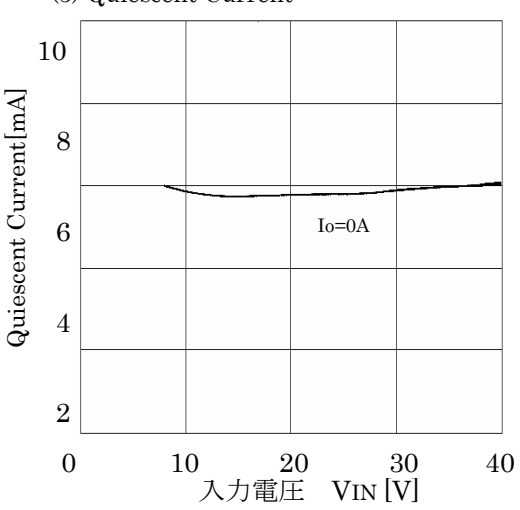


□ Output Voltage: 5V Adjusted (R2=0.8k[Ohm])

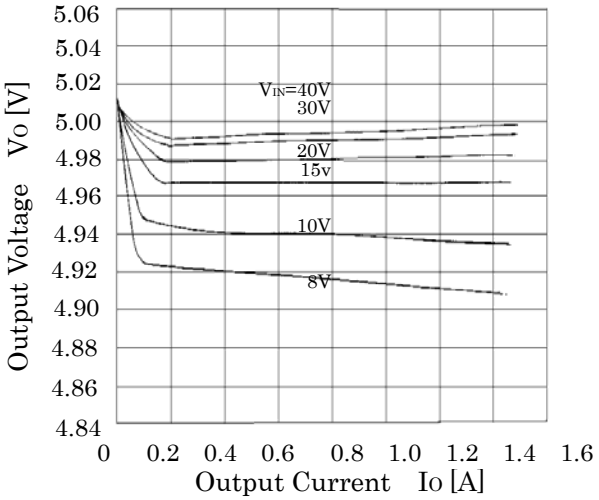
(2) Low Voltage Behavior



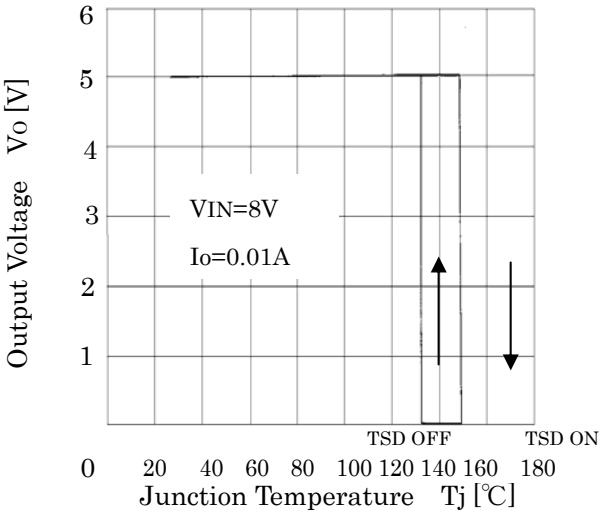
(5) Quiescent Current



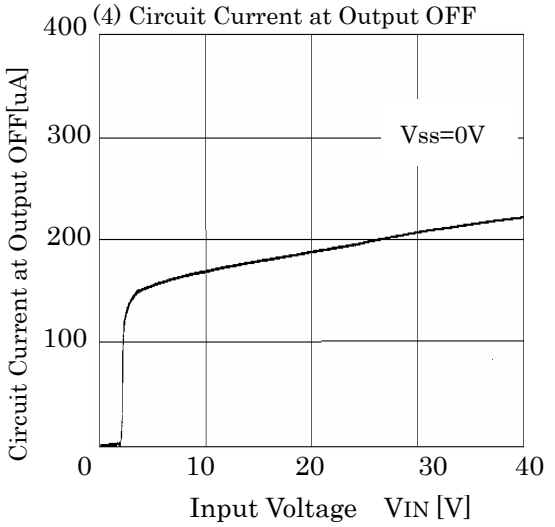
(3) Load Regulation



(6) Thermal Protection



(4) Circuit Current at Output OFF



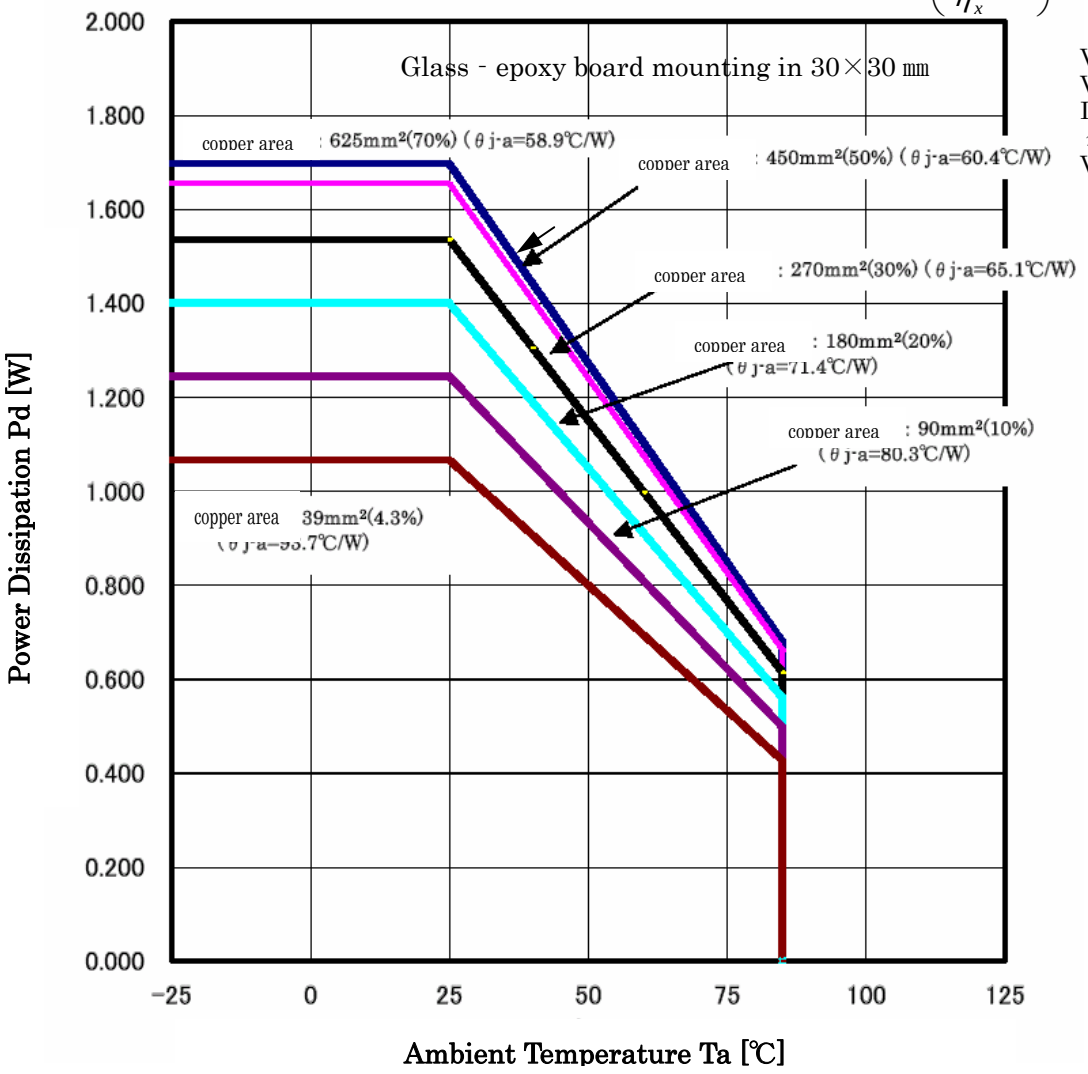
4-2 Power Dissipation

SI-8000TM Series Power Dissipation

Tjmax=125℃

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

V_O: Output voltage
V_{IN}: Input voltage
I_O: Output current
η_x: Efficiency (%)
V_F: Diode forward voltage
SFPB66‥0.5V
(I_O=1.5A)



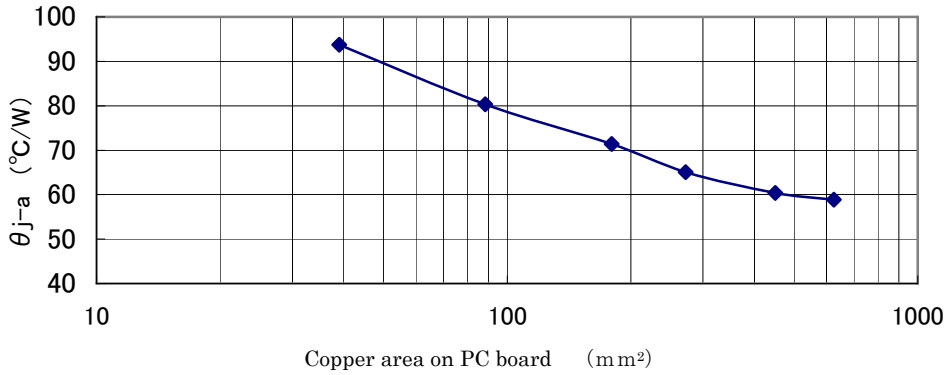
Note1 : As the efficiency varies subject to the input voltage and output current, it shall be obtained from the efficiency curve in page 4 and substituted in percent.

Note2 : Thermal design for Di shall be made separately.

Reference data

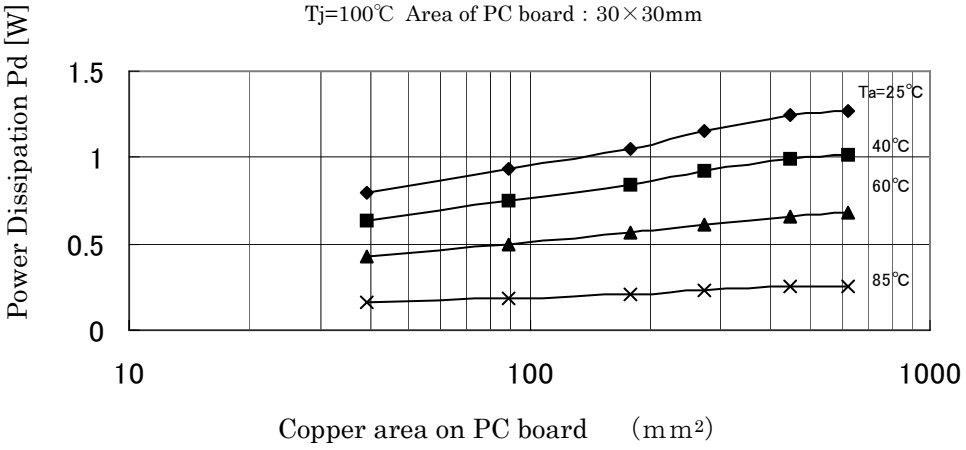
SI-8000TM　Copper area on PC board vs. thermal resistance.

Area of PC board：30×30mm



Copper area on PC board vs. Power dissipation

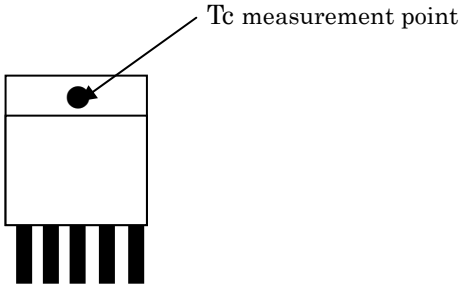
Tj=100℃ Area of PC board：30×30mm



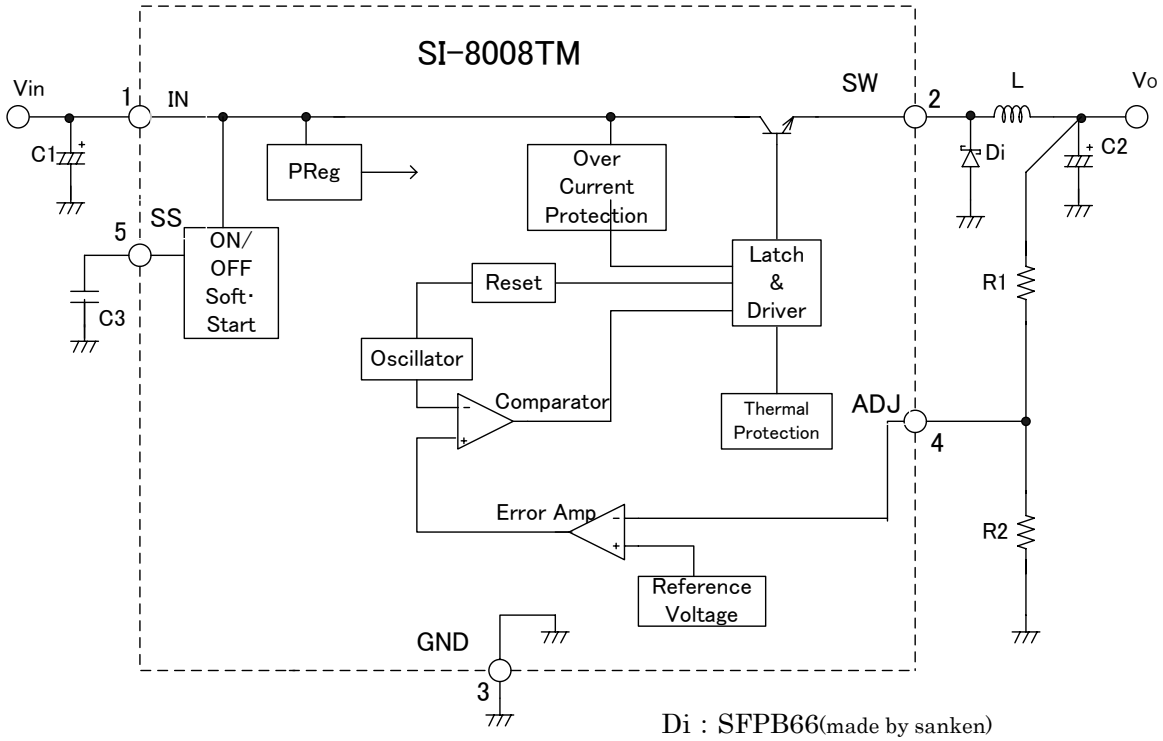
・Calculation of junction temperature

The junction temperature can be obtained from the following equation using the Tc that is measured by thermocouple.

$$Tj = P_D \times \theta_{j-C} + T_C \qquad (\theta j\text{-}c = 6℃/W)$$

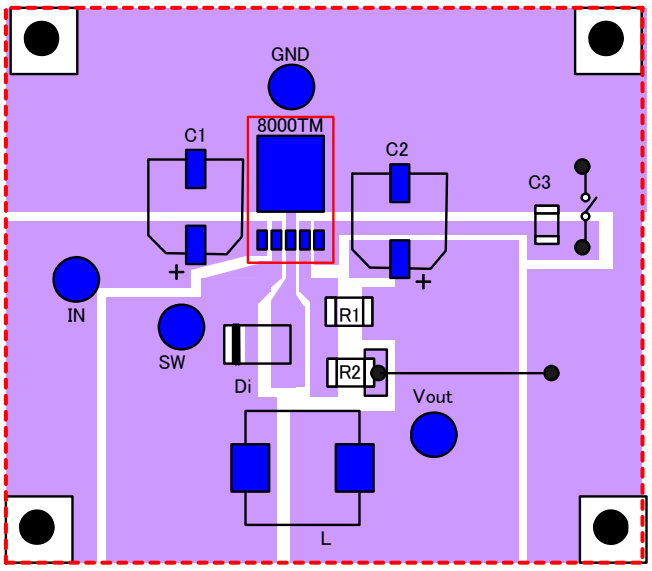


5. Block diagram (Connection diagram)

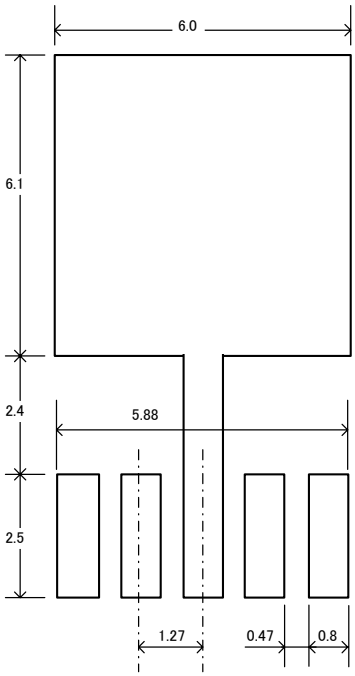


Di : SFPB66(made by sanken)

Recommended pattern



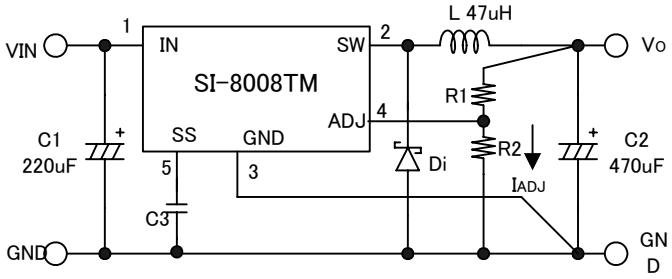
The example of the solder pattern.



*The circuit board layout is recommended as follows:
①Other components are connected as close as possible to the SI-8008TM.
②Each ground of all components is connected at one point area.

6. Example application circuit

6-1 Standard circuit diagram



C1 : 220 μ F

C2 : 470 μ F

C3 : 1 μ F

(If soft start function is used)

L1 : 47 μ H

Di : SFPB66

(Made by Sanken)

Diode Di

・The shottky-barrier diode must be used for Di. If other diodes like fast recovery diodes are used, IC may be destroyed because of the reverse voltage applied by the recovery voltage or ON voltage.

Choke coil L1

・If the winding resistance of the choke coil is too high, the efficiency may go down to the extent that it is out of the rating.

・As the overcurrent protection start current is approx. 2.5A, attention must be paid to the heating of the choke coil by the magnetic saturation due to overload or short-circulated load.

Capacitor C1, C2, C3

・As large ripple currents flow across C1 and C2, capacitors with high frequency and low impedance for SMPS must be used. Especially when the impedance of C2 is high, the switching waveform may not be normal at low temperature. Please use neither OS capacitor nor tantalum capacitor which causes an abnormal oscillation for the C2.

・C3 is a capacitor for soft start. In case soft start function is not used, please keep No.5 terminal open. A pull-up resistor is provided inside the IC.

Resister R1, R2

・R1, R2 is resistor to the Output Voltage. I_{ADJ} set to become 1mA. Moreover, R1, R2 is calculated by the following expression.

$$R1 = \frac{(V_{OUT} - V_{ADJ})}{I_{ADJ}} = \frac{(V_{OUT} - 0.8)}{1 \times 10^{-3}} (\Omega), \quad R2 = \frac{V_{ADJ}}{I_{ADJ}} = \frac{0.8}{1 \times 10^{-3}} \fallingdotseq 0.8k(\Omega)$$

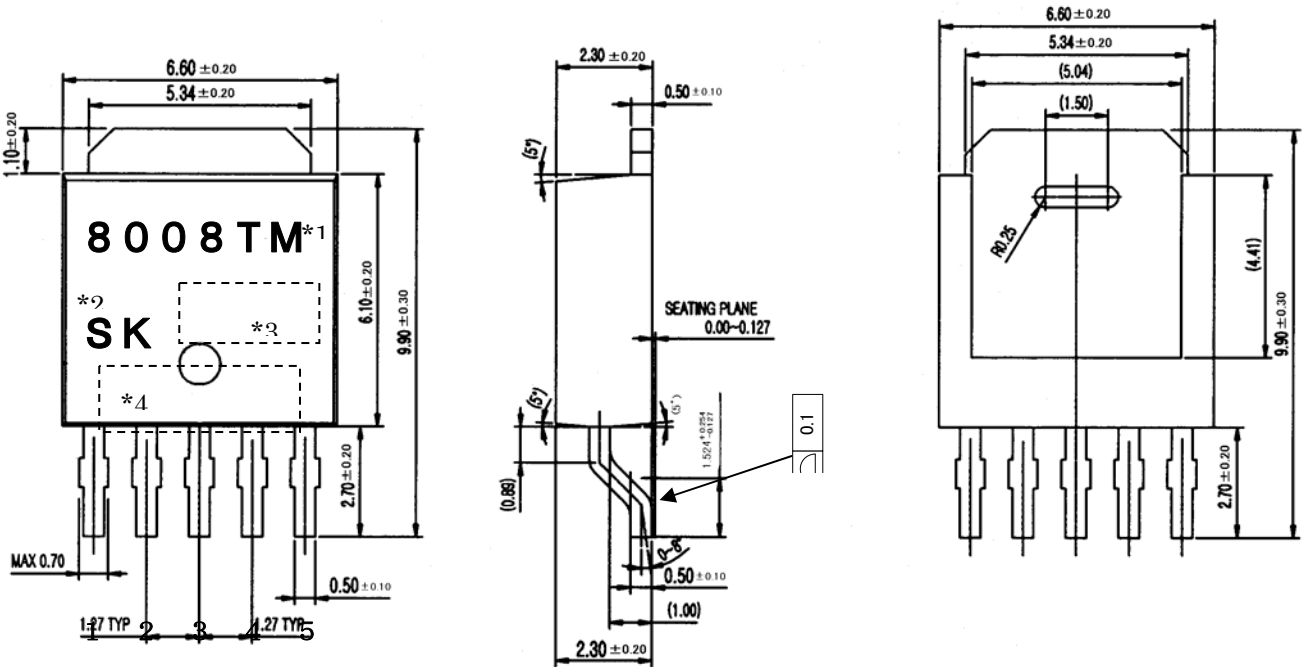
◎In order to have optimum operating condition, each component must be laid out with the minimum distance.

SI-8000TM Series

September 2005

7 Package information

7-1 Package type and dimensions



Pin assignment

1 : IN

2 : SW

3 : GND

4 : ADJ

5 : SS

Products Weight : Approx.0.33g

*1 Type No

*2 Logo mark

*3 Lot Number

1st letter : The last digit of year

2nd letter : Month

1 to 9 for Jan. to Sept.

O for Oct. N for Nov. D for Dec.

3rd letter : week(Arabic Numerical)

*4 Administer number (four digit)

7-2 Appearance

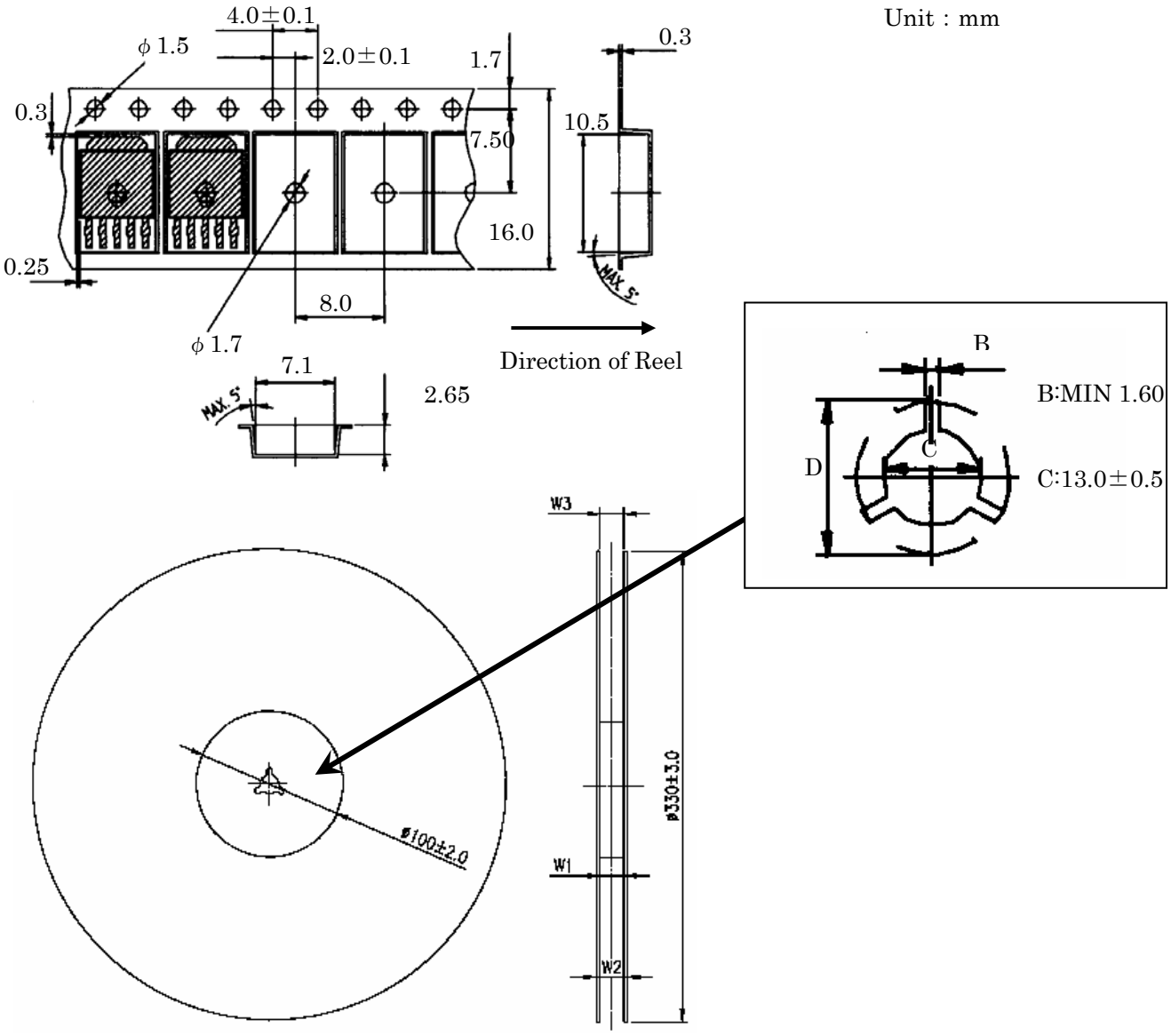
The body shall be clean and shall not bear any stain, rust or flaw.

7-3 Marking

The type number and lot number shall be clearly stamped by laser on the body so that they cannot be erased easily.

8. Packing specifications

Unit : mm



+2 W1 -0	W2 MAX	+3 W1 -0.5
16.4 ㎜	22.4 ㎜	16.4 ㎜

Quantity : 3000pcs／reel

9. Cautions and warnings

9-1 Parallel operation

The parallel operation to increase the current is not available.

9-2 Thermal protection

The SI-8000TM series has a thermal protection circuit. This circuit keeps the IC from the fever by the over load. But this circuit cannot guarantee the long-term reliability against the continuously over load status.

<Worldwide Contacts>

Asia Pacific

China

Sanken Electric Hong Kong Co., Ltd.
Suite 1026 Ocean Centre, Canton Road, Tsimshatsui, Kowloon, Hong Kong
Tel: 852-2735-5262
Fax: 852-2735-5494

Sanken Electric (Shanghai) Co., Ltd.
Room3202, Maxdo Centre, Xingyi Road 8, Changning district, Shanghai, China
Tel: 86-21-5208-1177
Fax: 86-21-5208-1757

India

Saket Devices Pvt. Ltd.
Office No.25, 2nd Floor, Bandal - Dhankude Plaza, Near PMT Depot, Paud Road, Kothrud, Pune - 411 038, India
Tel: 91-20-5621-2340
Fax: 91-20-2528-5459

Japan

Sanken Electric Co., Ltd. Overseas Sales Headquaters
Metropolitan Plaza Bldg. 1-11-1 Nishi-Ikebukuro, Toshima-ku, Tokyo 171-0021, Japan
Tel: 81-3-3986-6164
Fax: 81-3-3986-8637

Korea

Sanken Electric Korea Co., Ltd.
Mirae Asset Life Bldg. 6F, 168 Kongduk-dong, Mapo-ku, Seoul, 121-705, Korea
Tel: 82-2-714-3700
Fax: 82-2-3272-2145

Singapore

Sanken Electric Singapore Pte. Ltd.
150 Beach Road, #14-03 The Gateway West, Singapore 189720
Tel: 65-6291-4755
Fax: 65-6297-1744

Taiwan

Taiwan Sanken Electric Co., Ltd.
Room 1801, 18th Floor, 88 Jung Shiau East Road, Sec. 2, Taipei 100, Taiwan R.O.C.
Tel: 886-2-2356-8161
Fax: 886-2-2356-8261

Europe

France

Allegro MicroSystems Europe
Les Pleiades, Park Nord Annecy, 74370 Metz-Tessy, France
Tel: 33-450512359
Fax: 33-450512083

United Kingdom

Allegro MicroSystems Europe Limited
Balfour House, Churchfield Road, Walton-on-Thames, Surrey KT12 2TD, U.K.
Tel: 44-1932-253355
Fax: 44-1932-246622

North America

United States

Allegro MicroSystems, Inc.
115 Northeast Cutoff, Worcester, Massachusetts 01606, U.S.A.
Tel: 1-508-853-5000
Fax: 1-508-853-3353

Allegro MicroSystems, Inc. (Southern California)
14 Hughes Street, Suite B105, Irvine, CA 92618
Tel: 1-949-460-2003
Fax: 1-949-460-7837

CAUTION / WARNING

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

- This is notification that you, as purchaser of the products/technology, are not allowed to perform any of the following:

1. Resell or retransfer these products/technology to any party intending to disturb international peace and security.
2. Use these products/technology yourself for activities disturbing international peace and security.
3. Allow any other party to use these products/technology for activities disturbing international peace and security.

Also, as purchaser of these products/technology, you agree to follow the procedures for the export or transfer of these products/technology, under the Foreign Exchange and Foreign Trade Law, when you export or transfer the products/technology abroad.