

## SAI Series

# Surface-Mount, Separate Excitation Switching Type

### Features

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

### Applications

- Power supplies for telecommunication equipment
- Onboard local power supplies



### Lineup

| Part Number        | SAI01 | SAI02 | SAI03 | SAI04 | SAI06 |
|--------------------|-------|-------|-------|-------|-------|
| V <sub>o</sub> (V) | 5.0   | 3.3   | 12.0  | 15.0  | 9.0   |
| 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   |
| SW Terminal Applied Reverse Voltage  | V <sub>sw</sub>      | −1          | V    |
| Thermal Resistance(junction to case) | R <sub>th(j-c)</sub> | 20          | °C/W |

### Recommended Operating Conditions

| Parameter                            | Symbol           | Ratings     |           |          |          |          | Unit |
|--------------------------------------|------------------|-------------|-----------|----------|----------|----------|------|
|                                      |                  | SAI01       | SAI02     | SAI03    | SAI04    | SAI06    |      |
| DC Input Voltage Range               | V <sub>IN</sub>  | 7 to 33     | 5.3 to 28 | 15 to 33 | 18 to 33 | 12 to 33 | V    |
| Output Current Range                 | I <sub>o</sub>   | 0 to 0.5    |           | 0 to 0.4 |          |          | A    |
| Operating Junction Temperature Range | T <sub>jop</sub> | −30 to +125 |           |          |          |          | °C   |

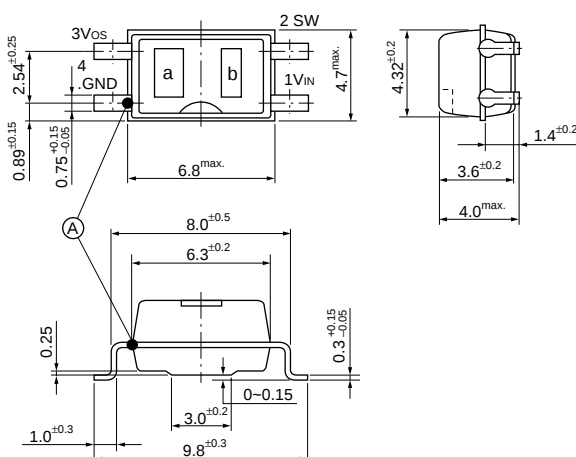
## Electrical Characteristics

(T<sub>a</sub>=25°C)

| Parameter                                 | Symbol     | Ratings                 |      |      |                         |      |      |                         |       |       |                         |       |       |                         |      |      | Unit  |
|-------------------------------------------|------------|-------------------------|------|------|-------------------------|------|------|-------------------------|-------|-------|-------------------------|-------|-------|-------------------------|------|------|-------|
|                                           |            | SAI01                   |      |      | SAI02                   |      |      | SAI03                   |       |       | SAI04                   |       |       | SAI06                   |      |      |       |
|                                           |            | min.                    | typ. | max. | min.                    | typ. | max. | min.                    | typ.  | max.  | min.                    | typ.  | max.  | min.                    | typ. | max. |       |
| Output Voltage                            | Vo         | 4.80                    | 5.00 | 5.20 | 3.17                    | 3.30 | 3.43 | 11.40                   | 12.00 | 12.60 | 14.25                   | 15.00 | 15.75 | 8.55                    | 9.00 | 9.45 | V     |
|                                           | Conditions | VIN=20V, IO=0.3A        |      |      | VIN=15V, IO=0.3A        |      |      | VIN=24V, IO=0.3A        |       |       | VIN=27V, IO=0.3A        |       |       | VIN=21V, IO=0.3A        |      |      |       |
| Efficiency                                | η          |                         | 80   |      |                         | 75   |      |                         | 88    |       |                         | 89    |       |                         | 86   |      | %     |
|                                           | Conditions | VIN=20V, IO=0.3A        |      |      | VIN=15V, IO=0.3A        |      |      | VIN=24V, IO=0.3A        |       |       | VIN=27V, IO=0.3A        |       |       | VIN=21V, IO=0.3A        |      |      |       |
| Switching Frequency                       | f          |                         | 60   |      |                         | 60   |      |                         | 60    |       |                         | 60    |       |                         | 60   |      | kHz   |
|                                           | Conditions | VIN=20V, IO=0.3A        |      |      | VIN=15V, IO=0.3A        |      |      | VIN=24V, IO=0.3A        |       |       | VIN=27V, IO=0.3A        |       |       | VIN=21V, IO=0.3A        |      |      |       |
| Line Regulation                           | ΔVOLUME    |                         | 80   | 100  |                         | 60   | 80   |                         | 100   | 130   |                         | 100   | 130   |                         | 90   | 110  | mV    |
|                                           | Conditions | VIN=10 to 30V, IO=0.3A  |      |      | VIN=8 to 28V, IO=0.3A   |      |      | VIN=18 to 30V, IO=0.3A  |       |       | VIN=21 to 30V, IO=0.3A  |       |       | VIN=15 to 30V, IO=0.3A  |      |      |       |
| Load Regulation                           | ΔVLOAD     |                         | 30   | 40   |                         | 20   | 30   |                         | 70    | 95    |                         | 90    | 120   |                         | 50   | 80   | mV    |
|                                           | Conditions | VIN=20V, IO=0.1 to 0.4A |      |      | VIN=15V, IO=0.1 to 0.4A |      |      | VIN=24V, IO=0.1 to 0.4A |       |       | VIN=27V, IO=0.1 to 0.4A |       |       | VIN=21V, IO=0.1 to 0.4A |      |      |       |
| Temperature Coefficient of Output Voltage | ΔVo/ΔTa    |                         | ±0.5 |      |                         | ±0.5 |      |                         | ±1.5  |       |                         | ±1.5  |       |                         | ±1.0 |      | mV/°C |
| Ripple Rejection                          | RREJ       |                         | 45   |      |                         | 45   |      |                         | 45    |       |                         | 45    |       |                         | 45   |      | dB    |
|                                           | Conditions | f=100 to 120Hz          |      |      | f=100 to 120Hz          |      |      | f=100 to 120Hz          |       |       | f=100 to 120Hz          |       |       | f=100 to 120Hz          |      |      |       |
| Overcurrent Protection Starting Current   | IS1        | 0.55                    |      |      | 0.55                    |      |      | 0.45                    |       |       | 0.45                    |       |       | 0.45                    |      |      | A     |
|                                           | Conditions | VIN=10V                 |      |      | VIN=8V                  |      |      | VIN=18V                 |       |       | VIN=21V                 |       |       | VIN=15V                 |      |      |       |

## External Dimensions

(unit: mm)



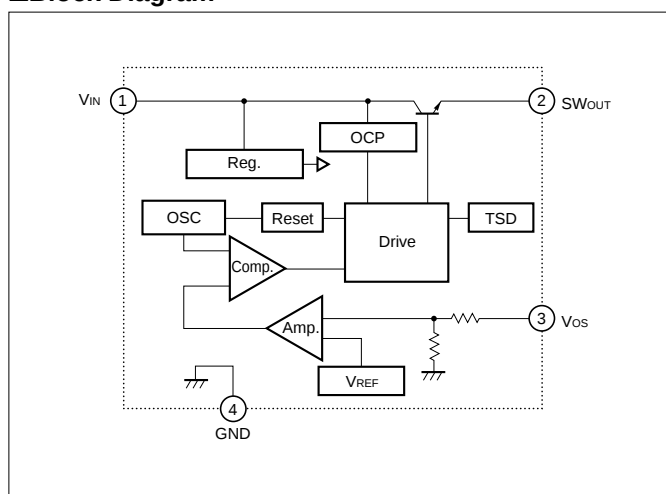
- a. Part Number
- b. Lot Number
- Ⓐ Case temperature measuring point

### Pin Arrangement

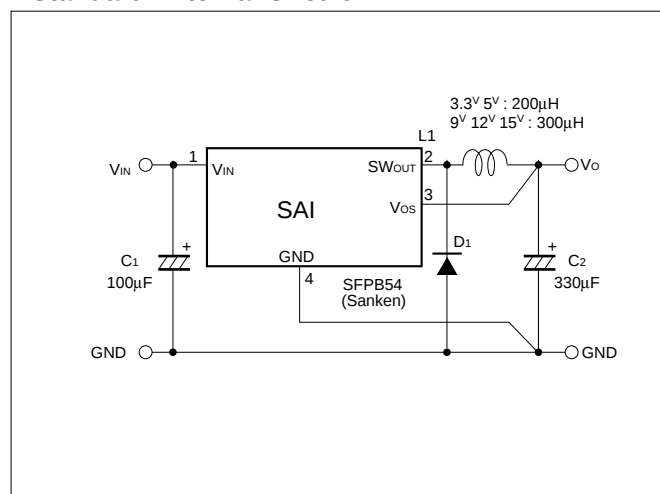
- ① V<sub>IN</sub>
- ② SW<sub>OUT</sub>
- ③ V<sub>OS</sub>
- ④ GND

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

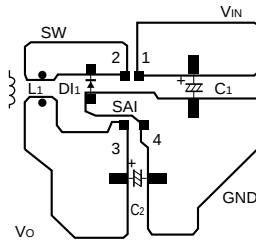
## Block Diagram



## Standard External Circuit

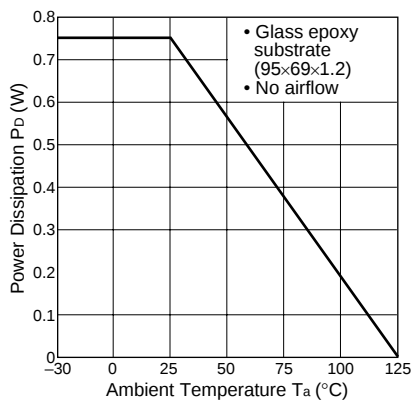


## ■Example of Printed Circuit Board



- For optimum operation, there must be only one GND line originating from terminal 4 and each component must be connected with the shortest possible wiring.
- To prevent heating of the IC, it is best to make the GND pattern as large as possible since the internal frame and terminal 4 (GND) are connected to each other.

## ■Ta-Pd Characteristics



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

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

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

Thermal design for D1 must be considered separately.

## ■Selecting External Components

### 1. Inductor L1

- It must be suited for switching regulators.

Do not use inductors such as noise filters, because they generate excessive heat.

- It must have the appropriate inductance value.

If the inductance is too small (150μH or lower), abnormal oscillation may occur causing operation problems in the overcurrent protection circuit within the rated current range.

- The rated current must be satisfied.

If the rated current is exceeded, magnetic saturation leads to overcurrent.

### 2. Capacitors C1 and C2

- They must satisfy the breakdown voltage and allowable ripple current.

Exceeding the ratings of these capacitors or using them without derating shortens their service lives and may also cause abnormal oscillation of the IC.

- C2 should be a low-impedance type capacitor.

A low-impedance type capacitor is recommended for C2 to ensure reduced ripple voltage and stable switching operation.

### 3. Diode D1

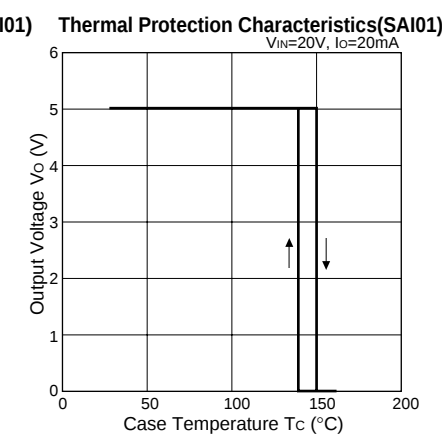
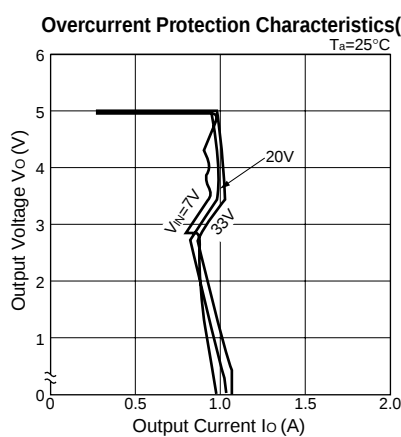
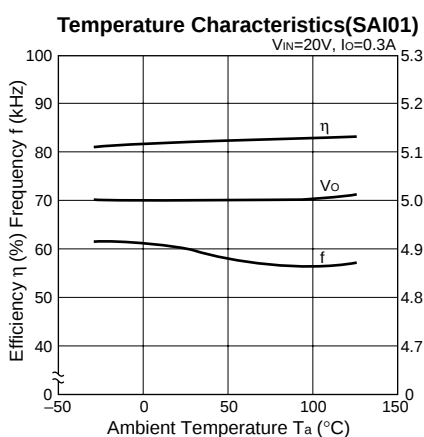
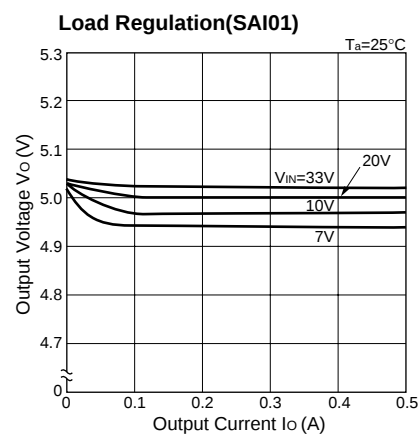
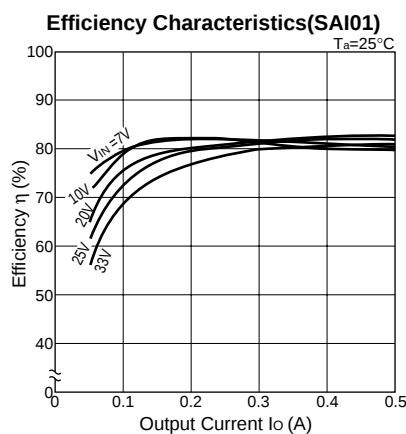
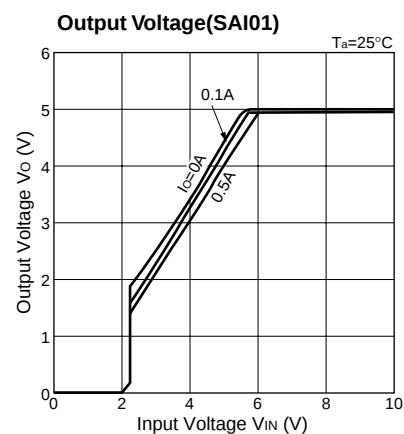
The Sanken SFPB54 diode is recommended for D1. If you intended to use an equivalent diode, be sure to use a Schottky Barrier diode and make sure that the reverse voltage applied to terminal 2 of the IC does not exceed the value (–1V) given in the absolute maximum ratings. If you use a fast recovery diode or any other diode, supplying a reverse voltage generated from the recovery or ON voltage of the diode may damage the IC.

## Application

Variable output voltage

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

## Typical Characteristics



### Note on Thermal Protection:

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

