## ■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 | | $V_{REF}$ | 0.996 | 1.006 | 1.016 | 0.996 | 1.006 | 1.016 | 0.966 | 1.006 | 1.016 | V |
| | | Conditions | $V_{IN}$=10V, $V_O$=1V, $I_O$=0.1A | | | | | | $V_{IN}$=14V, $I_O$=0.1A | | | |
| Temperature Coefficient of Reference Voltage | | $\Delta V_{REF}/\Delta T$ | | ±0.1 | | | ±0.1 | | | ±0.1 | | mV/°C |
| | | Conditions | $V_{IN}$=10V, $V_O$=1V, $I_O$=0.1A, Ta=–30 to +135°C | | | | | | $V_{IN}$=14V, $I_O$=0.1A, Ta=–30 to +125°C | | | |
| Efficiency 1[*2] | | Eff1 | | 80 | | | 78 | | | 78 | | % |
| | | Conditions | $V_{IN}$=$V_{CC}$=15V, $V_O$=5V, $I_O$=0.5A, $I_{IN}$: including $I_{CC}$ | | | | | | $V_{IN}$= $V_{CC}$=14V, $V_O$=5V, $I_O$=0.5A, $I_{IN}$ : including $I_{CC}$ | | | |
| Efficiency 2[*2] | | Eff2 | | 83 | | | 81 | | | 81 | | % |
| | | Conditions | $V_{IN}$=15V, $V_O$=5V, $I_O$=0.5A, $V_{CC}$=5V, $I_{IN}$: excluding $I_{CC}$ | | | | | | $V_{IN}$=14V, $V_{CC}$=5V, $V_O$=5V, $I_O$=0.5A, $I_{IN}$ : excluding $I_{CC}$ | | | |
| Oscillation Frequency | | $f_{osc}$ | | 250 | | 215 | 250 | 285 | 200 | | 400 | kHz |
| | | Conditions | $V_{IN}$=$V_{CC}$=15V, $V_O$=5V, $I_O$=0.5A | | | | | | $V_{IN}$=14V, $I_O$=0.1A, $C_{OSC}$=100pF | | | |
| Line Regulation | | $V_{LINE}$ | | 30 | 60 | | 30 | 60 | | 30 | 60 | mV |
| | | Conditions | $V_{IN}$=$V_{CC}$=10 to 20V, $V_O$=5V, $I_O$=1A | | | | | | $V_{IN}$=$V_{CC}$=9 to 18V, $V_O$=5V, $I_O$=1A | | | |
| Load Regulation | | $V_{LOAD}$ | | 10 | 40 | | 10 | 40 | | 10 | 40 | mV |
| | | Conditions | $V_{IN}$=$V_{CC}$=15V, $V_O$=5V, $I_O$=0.2 to 1.5A | | | | | | $V_{IN}$=$V_{CC}$=14V, $V_O$=5V, $I_O$=0.2 to 1.5A | | | |
| Overcurrent Protection Starting Current | | $I_S$ | 1.6 | | | 1.6 | | | 1.6 | | | A |
| | | Conditions | $V_{IN}$=$V_{CC}$=15V | | | | | | $V_{IN}$=$V_{CC}$=14V | | | |
| Quiescent Circuit Current 1 | | $I_{IN}$ | | 4 | | | 4 | | | 4 | | mA |
| | | Conditions | $V_{IN}$=15V, $V_{CC}$=5V, $I_O$=0V, $V_O$≤12V | | | | | | $V_{IN}$=14V, $V_{CC}$=5V, $I_O$=0A, $V_O$≤12V | | | |
| Quiescent Circuit Current 2 | | $I_{CC}$ | | 8.5 | | | 8.5 | | | 8.5 | | mA |
| | | Conditions | $V_{CC}$=15V, $I_O$=0A | | | | | | $V_{CC}$=14V, $I_O$=0A | | | |
| Quiescent Circuit Current 3 | | $I_{IN\ (off)}$ | | | 1 | | | 1 | | | 1 | μA |
| | | Conditions | $V_{IN}$=15V, $V_{C/E}$=0V or Open | | | | | | $V_{IN}$=14V, $V_{C/E}$=0V or Open | | | |
| Quiescent Circuit Current 4 | | $I_{CC\ (off)}$ | | | 1 | | | 1 | | | 1 | μA |
| | | Conditions | $V_{CC}$=15V, $V_{C/E}$=0V or Open | | | | | | $V_{IN}$=14V, $V_{C/E}$=0V or Open | | | |
| Quiescent Circuit Current 5 | | $I_{IN\ (ssov)}$ | — | | | | | | | 4 | | mA |
| | | Conditions | — | | | | | | $V_{IN}$=14V, $V_{CC}$=5V, $I_O$=0A, SS1=SS2=0V | | | |
| Quiescent Circuit Current 6 | | $I_{CC\ (ssov)}$ | — | | | | | | | 8.5 | | mA |
| | | Conditions | — | | | | | | $V_{CC}$=14V, $I_O$=0V, SS1=SS2=0V | | | |
| C/E Pin | High Level Voltage | $V_{C/EH}$ | 2 | | | 2 | | | 2 | | | V |
| | | Conditions | $V_{IN}$=$V_{CC}$=15V | | | | | | $V_{IN}$=$V_{CC}$=14V | | | |
| | Low Level Voltage | $V_{C/EL}$ | | | 0.8 | | | 0.8 | | | 0.8 | V |
| | | Conditions | $V_{IN}$=$V_{CC}$=15V | | | | | | $V_{IN}$=$V_{CC}$=14V | | | |
| | Inflow Current at High | $I_{C/EH}$ | | 95 | | | 95 | | | 95 | | μA |
| | | Conditions | $V_{C/E}$=20V | | | | | | $V_{C/E}$=20V | | | |
| SS Pin[*3] | Low Level Voltage | $V_{SSL}$ | | | 0.5 | | | 0.5 | | | 0.5 | V |
| | | Conditions | $V_{IN}$=$V_{CC}$=15V | | | | | | $V_{IN}$=$V_{CC}$=14V | | | |
| | Inflow Current at Low | $I_{SSL}$ | | 60 | 80 | | 60 | 80 | | 60 | 80 | μA |
| | | Conditions | $V_{SSL}$=0V, $V_{IN}$=$V_{CC}$=15V | | | | | | $V_{SSL}$=0V, $V_{IN}$=$V_{CC}$=14V | | | |

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

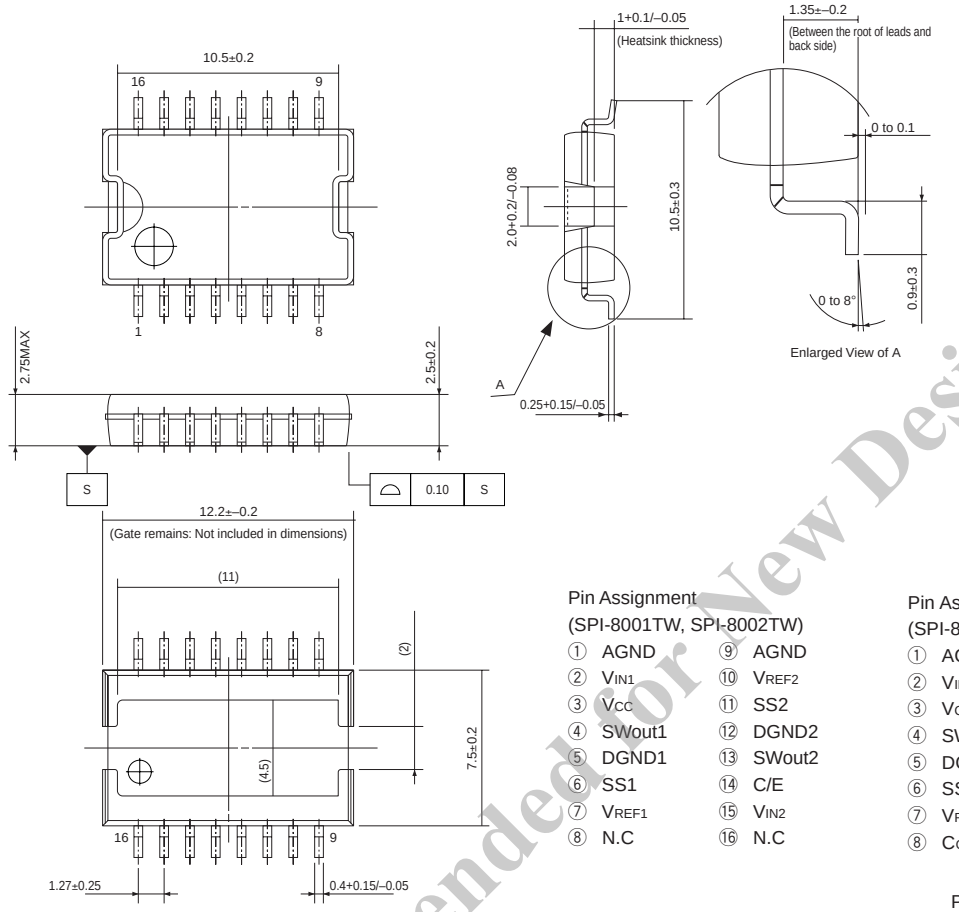
*2: Efficiency is calculated from the following formula.

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

*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 $V_{SSL}$ 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 $C_4$ and $C_5$ flow into the ON/OFF control transistors respectively. Therefore, limit the currents securely to protect the transistors if $C_4$ and $C_5$ 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)




Pin Assignment
(SPI-8001TW, SPI-8002TW)

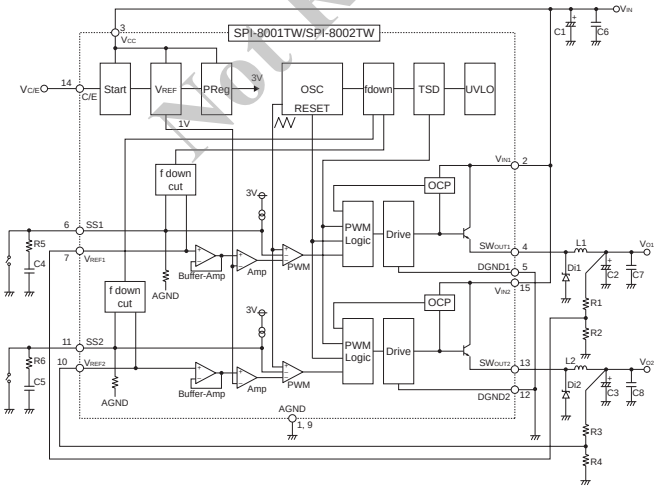
| | | | |
|---|---|---|---|
| ① | AGND | ⑨ | AGND |
| ② | $V_{IN1}$ | ⑩ | $V_{REF2}$ |
| ③ | $V_{CC}$ | ⑪ | SS2 |
| ④ | SWout1 | ⑫ | DGND2 |
| ⑤ | DGND1 | ⑬ | SWout2 |
| ⑥ | SS1 | ⑭ | C/E |
| ⑦ | $V_{REF1}$ | ⑮ | $V_{IN2}$ |
| ⑧ | N.C | ⑯ | N.C |

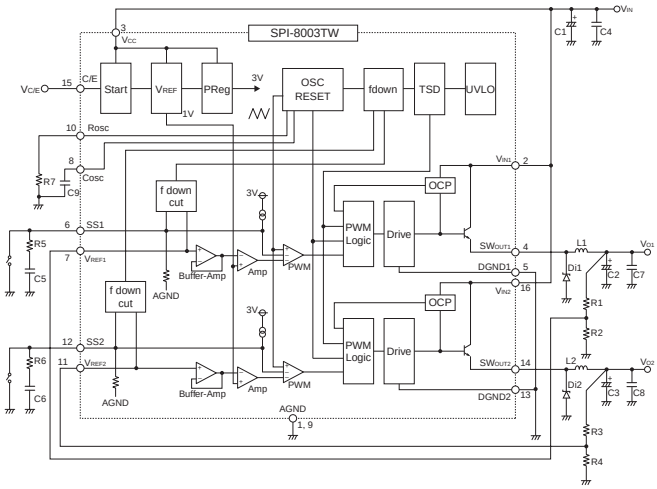
Pin Assignment
(SPI-8003TW)

| | | | |
|---|---|---|---|
| ① | AGND | ⑨ | AGND |
| ② | $V_{IN1}$ | ⑩ | Rosc |
| ③ | $V_{CC}$ | ⑪ | $V_{REF2}$ |
| ④ | SWout1 | ⑫ | SS2 |
| ⑤ | DGND1 | ⑬ | DGND2 |
| ⑥ | SS1 | ⑭ | SWout2 |
| ⑦ | $V_{REF1}$ | ⑮ | C/E |
| ⑧ | Cosc | ⑯ | $V_{IN2}$ |

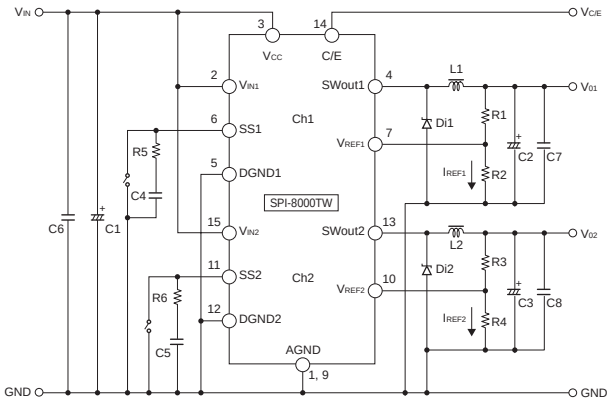
Product Mass : Approx.0.86g

## ■Block Diagram

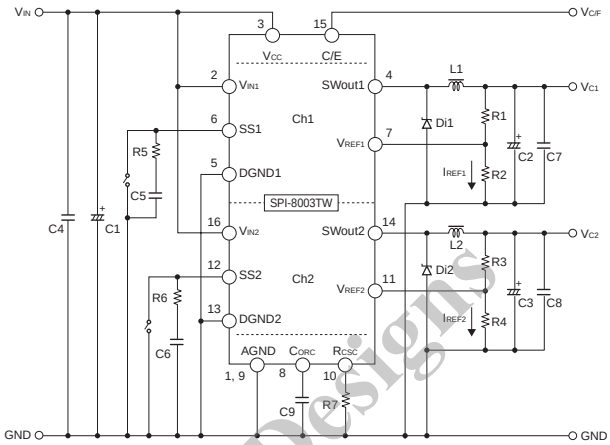


## ■Typical Connection Diagram




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




| | | | |
|---|---|---|---|
| C1 | : 220 μF/50V | C9 | : 100pF/10V |
| C2, C3 | : 470 μF/25V | L1, L2 | : 47 μH |
| C4 | : 1 μF/50V | R2, R4 | : 1kΩ |
| C5, C6 | : 1 μF/10V | R5, R6 | : 1kΩ |
| C7, C8 | : 0.1 μF/50V | 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 $SW_{out}1$ and $SW_{out}2$.

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.

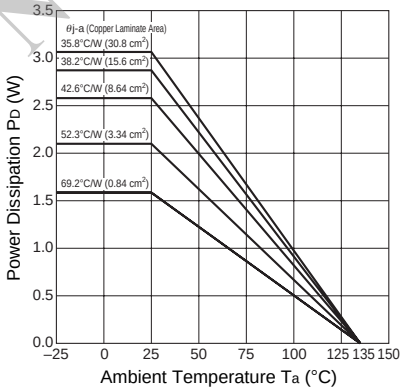
Resistors R1, R2, R3, R4

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

$$R1 = \frac{(V_{O1} - V_{REF1})}{I_{REF1}} = \frac{(V_{O1} - V)}{1\times10^{-3}}\ (\Omega),\ R2 = \frac{V_{REF1}}{I_{REF1}} = \frac{1}{1\times10^{-3}} \fallingdotseq 1\ (K\Omega)$$

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

## ■Ta-PD Characteristics




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

$V_O$ : Output Voltage
$V_{IN}$ : Input Voltage
$I_O$ : Output Current
$\eta\chi$ : Efficiency (%)
$V_F$ : $D_1$ Forward Voltage
SJPB-H6···0.45V (b=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 $D_1$ must be considered separately.