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

■Features

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

■Absolute Maximum Ratings

(T_a=25°C)

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

*1: Limited due to thermal protection.
*2: When mounted on glass-epoxy board 700cm^2 (copper laminate area 30.8cm^2).

■Applications

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

■Recommended Operating Conditions

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

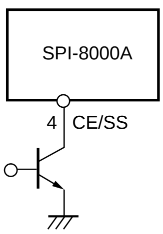
*1: The minimum value of an input voltage range is the higher of either 8V or V_O+3V.

■Electrical Characteristics

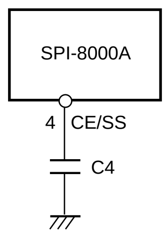
(T_a=25°C)

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

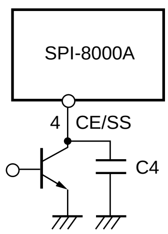
* Pin 4 is the CE/SS pin. Soft start at power on can be performed with a capacitor connected to this pin. The output can also be turned ON/OFF with this pin. The output is stopped by setting the voltage of this pin to V_{SSL} or lower. CE/SS-pin voltage can be changed with an open-collector drive circuit of a transistor. When using both the soft-start and ON/OFF functions together, the discharge current from C_4 flows into the ON/OFF control transistor. Therefore, limit the current securely to protect the transistor if C_3 capacitance is large.
The CE/SS pin is pulled up to the power supply in the IC, so applying the external voltage is prohibited.



V_O. ON/OFF



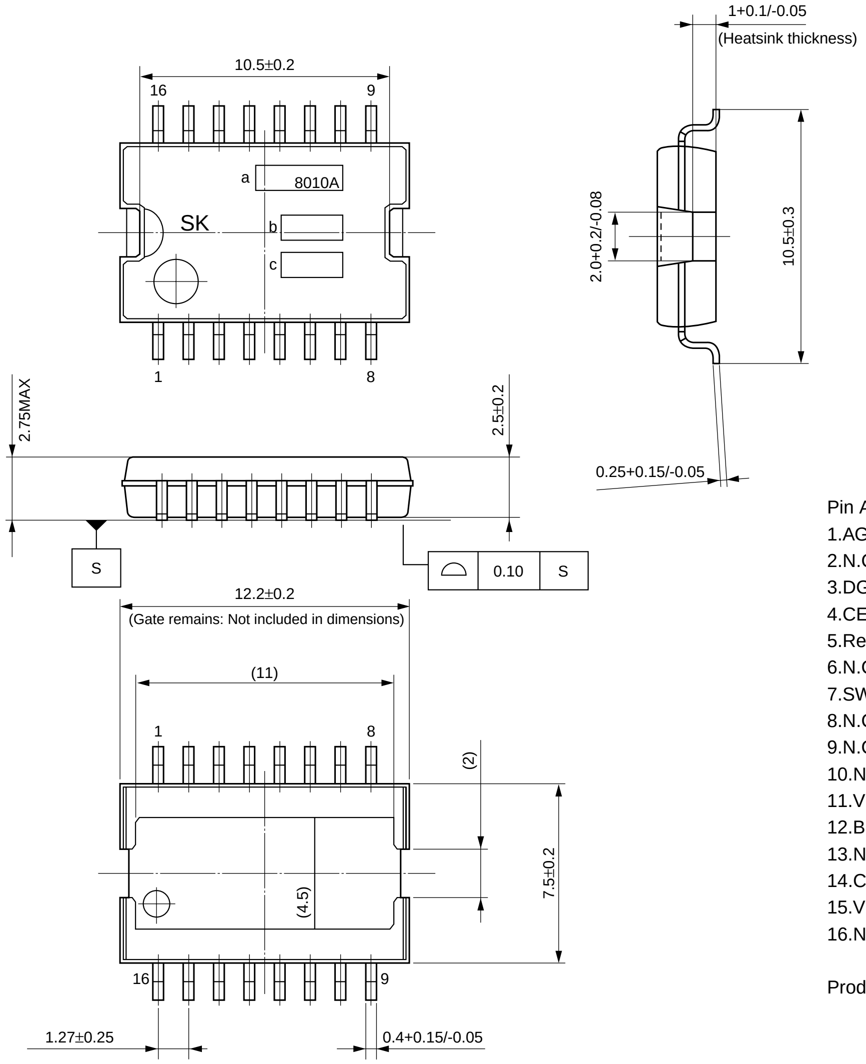
Soft start



Soft start
+V_O. ON/OFF

■External Dimensions (HSOP16)

(Unit : mm)

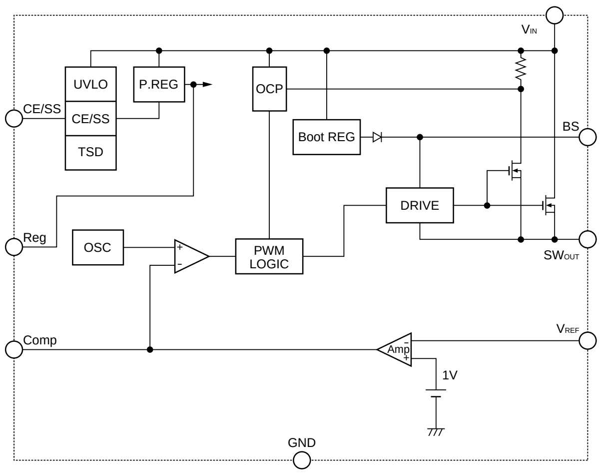


Pin Assignment
1.AGND
2.N.C
3.DGND
4.CE/SS
5.Reg
6.N.C
7.SWOUT
8.N.C
9.N.C
10.N.C
11.VIN
12.B.S
13.N.C
14.Comp
15.VREF
16.N.C

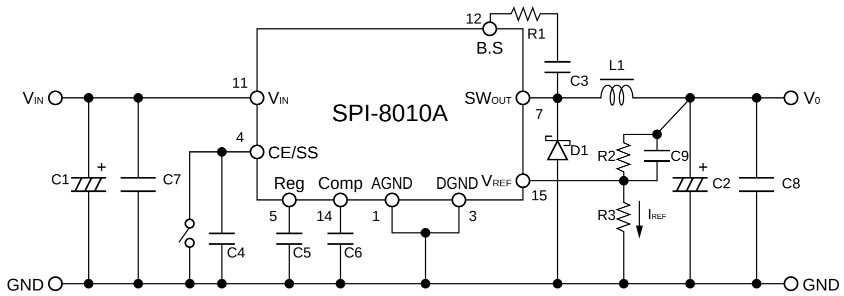
Product Mass : Approx 0.86g

■Block Diagram

SPI-8010A



■Typical Connection Diagram



C1: 220µF/63V
C2: 470µF/25V
C3: 0.1µF
C4: 1000pF
C5: 0.1µF
C6: 0.047µF
C7: 0.1µF
C8: 0.1µF
C9: 6800pF
R1: 47Ω
L1: 47µH
D1: SPB-G56S (Sanken)

Diode D_1
- Be sure to use a Schottky-barrier diode for D_1. If other diodes like fast recovery diodes are used, ICs may be destroyed because of the reverse voltage generated by the recovery voltage or ON voltage.

Choke coil L_1
- If the winding resistance of the choke coil is too high, the efficiency may drop below the rated value.
- As the overcurrent protection starting current is about 4.5A, take care concerning heat radiation from the choke coil caused by magnetic saturation due to overload or short-circuited load.

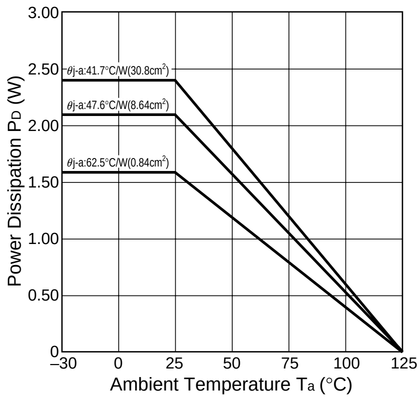
Capacitors C_1, C_2
- As large ripple currents flow through C_1 and C_2, use high-frequency and low-impedance capacitors aiming for switching-mode-power-supply use. Especially when the impedance of C_2 is high, the switching waveform may become abnormal at low temperatures. For C_2, do not use a capacitor with an extremely low equivalent series resistance (ESR) such as an OS capacitor or a tantalum capacitor, which may cause an abnormal oscillation.

Resistors R_2, R_3
- R_2 and R_3 are the resistors to set the output voltage. Set their values so that I_{REF} becomes approx. 2mA. Obtain R_2 and R_3 values by the following formula:

$$R2=\frac{(V_{OUT}-V_{REF})}{I_{REF}}=\frac{(V_{OUT}-1)}{2\times10^{-3}}(\Omega),\ R3=\frac{V_{REF}}{I_{REF}}=\frac{1}{2\times10^{-3}}\fallingdotseq 500(\Omega)$$

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

■T_a-P_D Characteristics



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

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.

V_O : Output voltage
V_{IN} : Input voltage
I_O : Output current
$\eta\chi$: Efficiency (%)
V_F : Diode D_1 forward voltage
SPB-G56S···0.4V(I_O=2A)