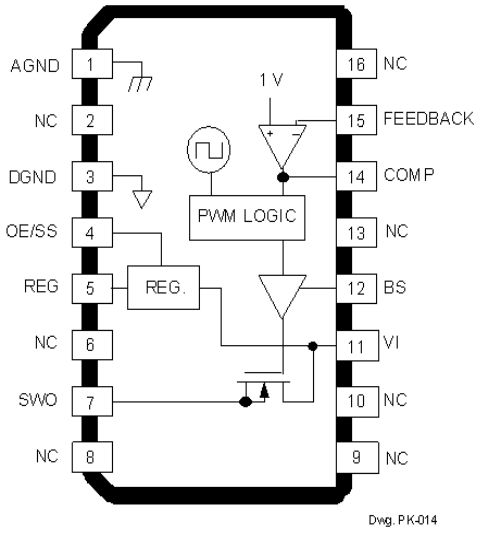
Switching Regulators

SPI-8010A

Data Sheet 27469.1†

3 A, DC/DC Step-Down Converter



ABSOLUTE MAXIMUM RATINGS

Input Voltage, V_I . . . . . **53 V**

Output Current, I_O . . . . . **3 A***

Junction Temperature, T_J . . . . **+125°C**

Storage Temperature Range, T_S . . . . . **-40°C to +125°C**

* Output current rating is limited by input voltage, duty cycle, and ambient temperature. Under any set of conditions, do not exceed a junction temperature of +125°C.

Designed to meet high-current requirements at high efficiency in industrial and consumer applications; embedded core, memory, or logic supplies; TVs, VCRs, and office equipment, the SPI-8010A dc/dc step-down (buck) converter offers a constant 250 kHz switching frequency essential for small external components. The n-channel high-current FET is included on the die along with the oscillator, control, and logic circuitry.

A wide input voltage range and integrated thermal and overcurrent protection enhance overall system reliability. Reference accuracy and excellent temperature characteristics are provided. A chip-enable input gives the designer complete control over power up, standby, or power down.

This device is supplied in a 16-lead surface-mount plastic SOIC with exposed pad to provide a low-resistance path for maximum power dissipation, low junction temperature, and improved reliability.

FEATURES

- Wide 8 V to 50 V Input Range
- Adjustable 1.2 V to 24 V Output Range
- 3% Output Voltage Tolerance
- To 3 A Output Current
- Foldback Current Limiting
- Constant 250 kHz Switching Frequency
- 400 µA Maximum Standby Current
- 1.0 V Feedback Reference Voltage
- Soft Start Avoids Supply Voltage Dip
- Remote Voltage Sensing
- Exposed Pad for Superior Heat Dissipation
- Thermal Protection

APPLICATIONS

- TVs, VCRs, Electronic Games
- Embedded Core, Memory, or Logic Supplies
- Printers and Other Office Equipment
- Industrial Machinery

Always order by complete part number, e.g., **SPI-8010A-TL** , where "-TL" indicates tape and reel.

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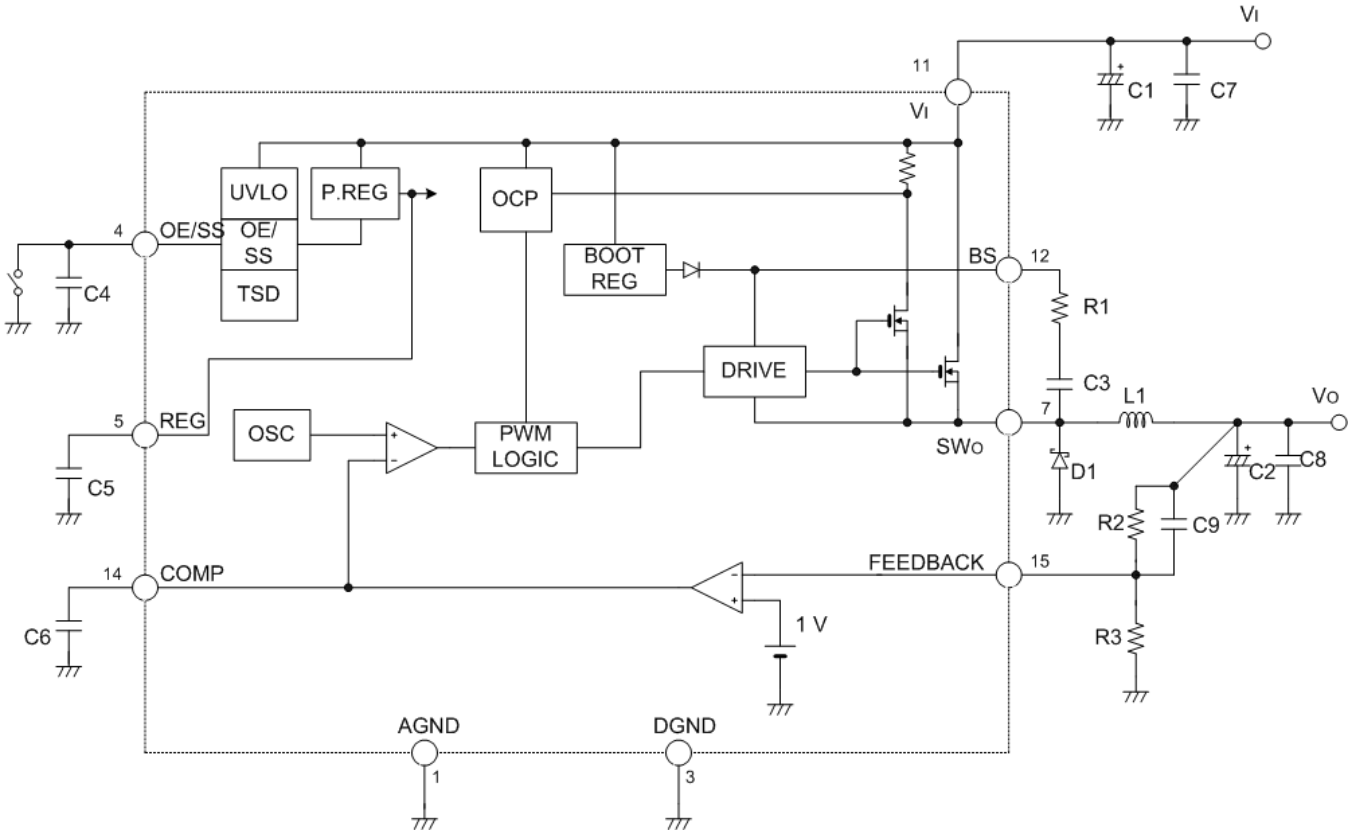
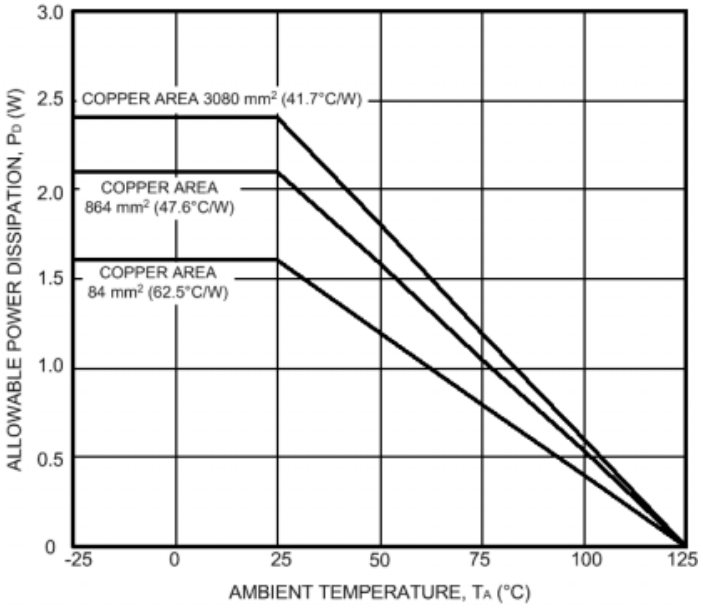
http://www.sanken-ele.co.jp/en/

FUNCTIONAL BLOCK DIAGRAM



Allowable Package Power Dissipation



Recommended Operating Conditions

	Min	Max	Units
DC Input Voltage*	8	50	V
DC Output Current	0.02	3	A
Adjustable Voltage Range	1.2	24	V
Operating Junction Temp.	-30	+125	°C†

*The minimum value of dc input voltage is 8 V when the output is less than 5 V, V_O + 3 V when the output voltage is more than 5 V. The recommended maximum value is 50 V when the output value is more than 2.5 V, derated linearly to 30 V when the output is 1 V.
†For the availability of parts meeting -40°C requirements, contact Sanken's Sales Representative.

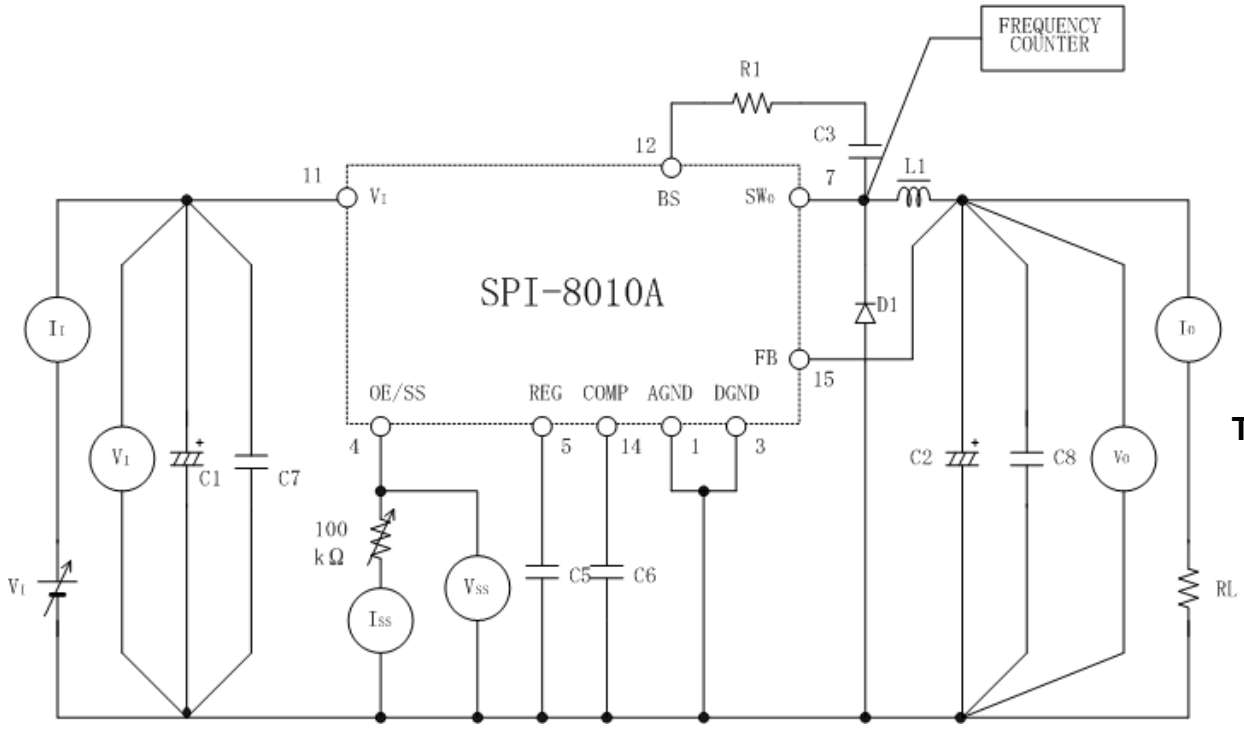
This data sheet is based on Sanken data sheet SSJ-02095

ELECTRICAL CHARACTERISTICS at T_A = +25°C, V_I = 12 V, I_O = 1 A (unless otherwise noted).

Characteristic	Symbol	Test Conditions	Limits			
			Min.	Typ.	Max.	Units
Internal Reference Voltage	V_{ref}		0.97	1.00	1.03	V
Ref. Volt. Temp. Coeff.	a_{Vref}		—	±0.5	—	mV/°C
Output Short-Circuit Current	I_{OM}	See note	3.1	—	—	A
Efficiency	η	V_I = 20 V, V_O = 5 V, I_O = 1 A	—	86	—	%
Operating Frequency	f		—	250	—	kHz
Overvoltage Protection	V_{IM}	I_O = 10 mA	33	—	—	V
Line Regulation	$\Delta V_{O(\Delta VI)}$	V_I = 10 V ~ 30 V	—	20	40	mV
Load Regulation	$\Delta V_{O(\Delta IO)}$	I_O = 0.1 A ~ 1.5 A	—	10	30	mV
Quiescent Current	I_{IQ}	I_O = 0 A	—	7.0	—	mA
		$V_{OE/SS}$ = 0.3 V	—	—	400	µA
Chip Enable Voltage	$V_{OE/SS}$	Device turn-off voltage	—	—	0.5	V
Soft-Start Current	$I_{OE/SS}$	$V_{OE/SS}$ = 0 V	—	—	-50	µA

Typical values are given for circuit design information only.

Note: Output short-circuit current is at point where output voltage has decreased 5% below $V_{O(nom)}$.

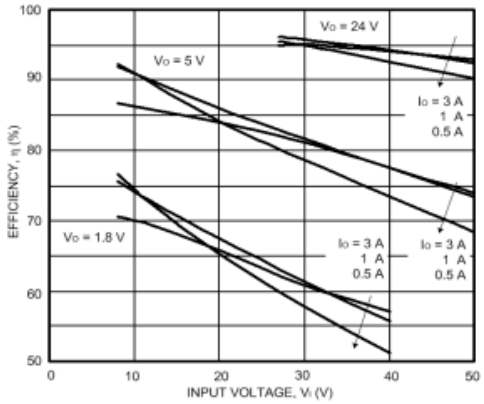


Test Circuit

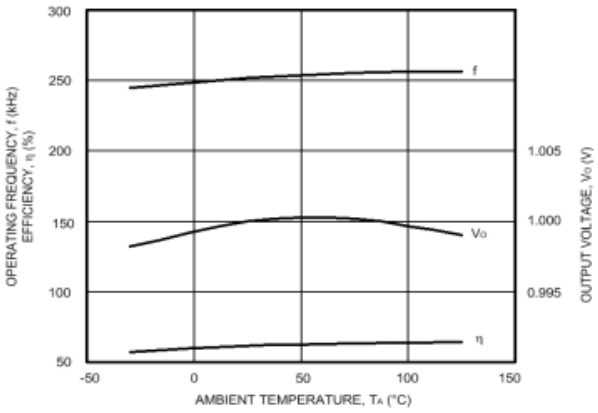
TYPICAL CHARACTERISTICS

(V_I = 12 V, T_A = 25°C)

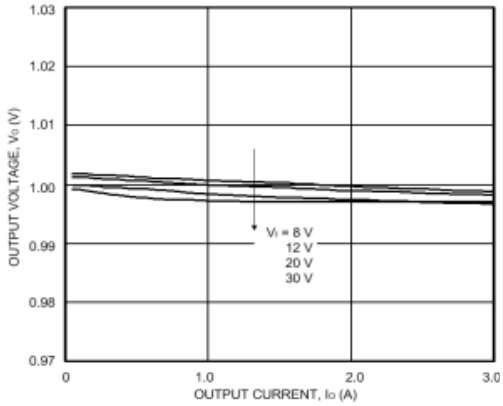
■ Efficiency



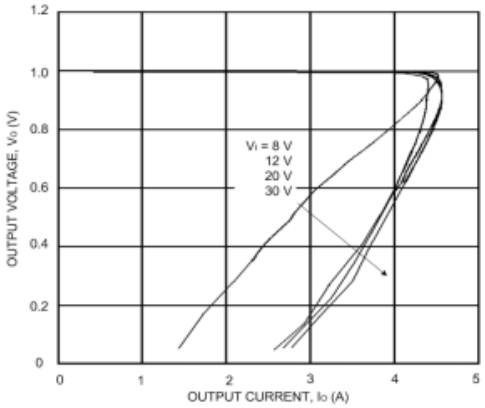
■ Temperature Characteristics



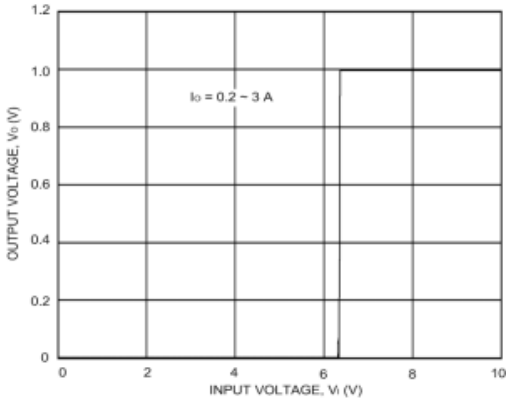
■ Load Regulation



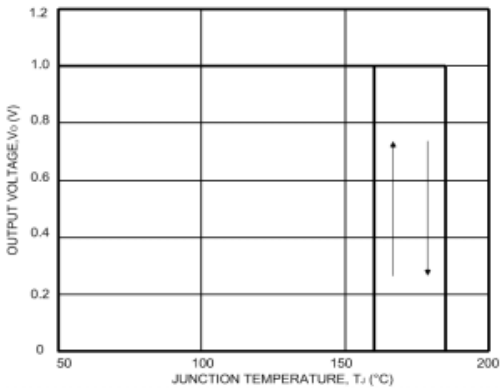
■ Overcurrent Protection



■ Rise Characteristic



■ Thermal Protection



APPLICATIONS INFORMATION

Input Capacitor (C1 and C7). Capacitors with low impedance for high-frequency ripple current must be used.

Output Capacitor (C2 and C8). Capacitors with low impedance for high-frequency ripple current must be used. Especially when the C2 impedance is high, the switching waveform may not be normal at low temperatures. Film or tantalum capacitors for C2 may cause abnormal oscillations.

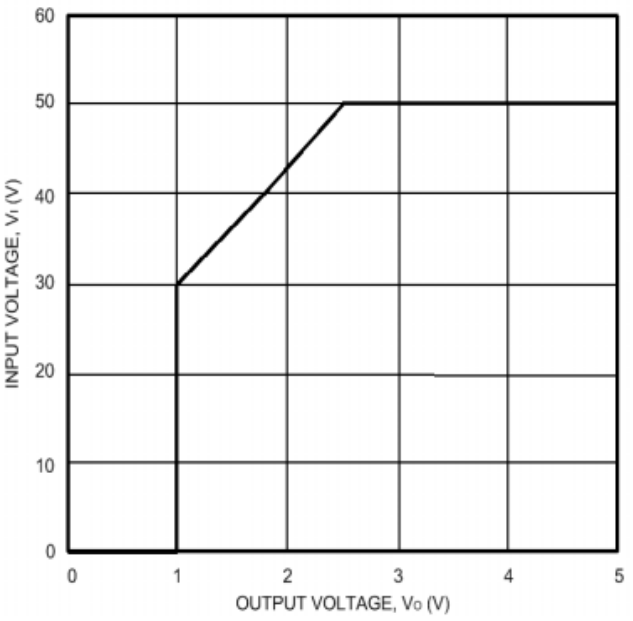
Catch Diode (D1). Diode D1 must be a Schottky diode. Other diode types will result in increased forward voltage spikes, reverse current flow, increased IC power dissipation during the off period, and possible destruction of the IC.

Choke Coil (L1). If the winding resistance of the choke coil is too high, the circuit efficiency will decrease. As the overcurrent protection start current is approximately 4.5 A, attention must be paid to the heating of the coil by magnetic saturation due to overload. To reduce the output ripple, the inductor may be increased at the expense of excessive board area and cost.

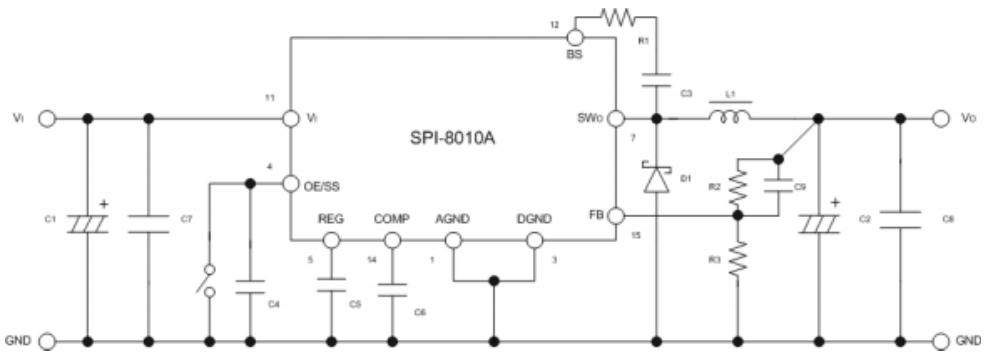
Output Voltage Adjustable Resistors (R2 and R3). The output voltage is adjusted by R2 and R3. 500 Ω for R3 is recommended.

$$R2 = (V_O - V_{ref})/(V_{ref}/R3)$$

Determination of DC Input Voltage. The minimum value of dc input voltage is 8 V when the output is less than 5 V, V_O + 3 V when the output voltage is more than 5 V. The recommended maximum value is 50 V when the output value is more than 2.5 V, derated linearly to 30 V when the output is 1 V.



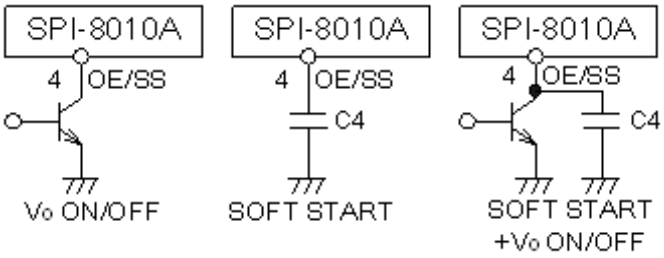
Typical Application



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

APPLICATIONS INFORMATION (cont.)

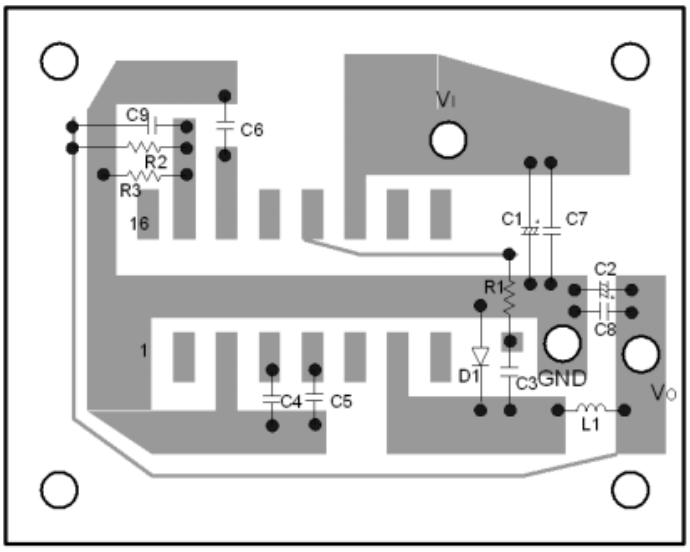
Soft-Start Capcitor (C4). Soft start is enabled by connecting a capacitor between terminal 4 and ground. The device may be turned off (chip enable) by decreasing the terminal 4 voltage below 0.5 V with either an npn small-signal transistor or the output of open-collector TTL. If both a large soft-start capacitor and chip on/off control are desired, collector current limiting must be used to prevent transistor damage. No external voltage can be applied to terminal 4.



Overcurrent Protection. The SPI-8000A series has a built-in fold-back type overcurrent protection circuit, which limits the output current at a start-up mode. It thus cannot be used in applications that require current at the start-up mode such as:
(1) constant-current load,
(2) power supply with positive and negative outputs to common load (a center-tap type power supply), or
(3) raising the output voltage by putting a diode or a resistor between the device ground and system ground.

Parallel Operation. Parallel operation to increase load current is not permitted.

Thermal Protection. Circuitry turns off the device when the junction temperature rises above 170°C. It is intended only to protect the device from failures due to excessive junction temperatures and should not imply that output short circuits or continuous overloads are permitted.



Layout Guideline

Heat Radiation and Reliability. The reliability of the IC is directly related to the junction temperature (T_J) in its operation. Accordingly, careful consideration should be given to heat dissipation.

The inner frame on which the integrated circuit is mounted is connected to the exposed pad. Therefore, it is very effective for heat radiation to enlarge the copper area that is connected to the pad. The graph on page 2 illustrates the effect of the copper area on the junction-to-ambient thermal resistance ($R_{\theta JA}$).

The junction temperature (T_J) can be determined from either of the following equations:

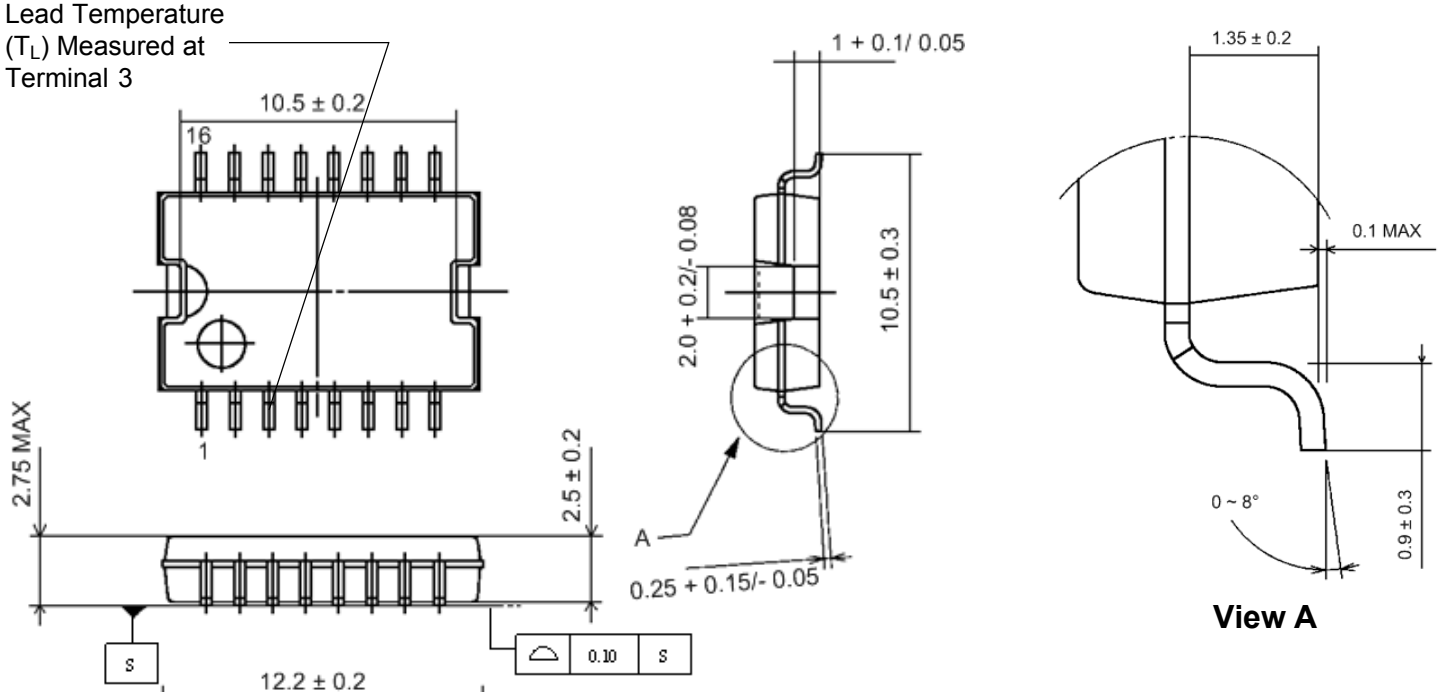
$$T_J = (P_D R_{\theta JA}) + T_A$$

or

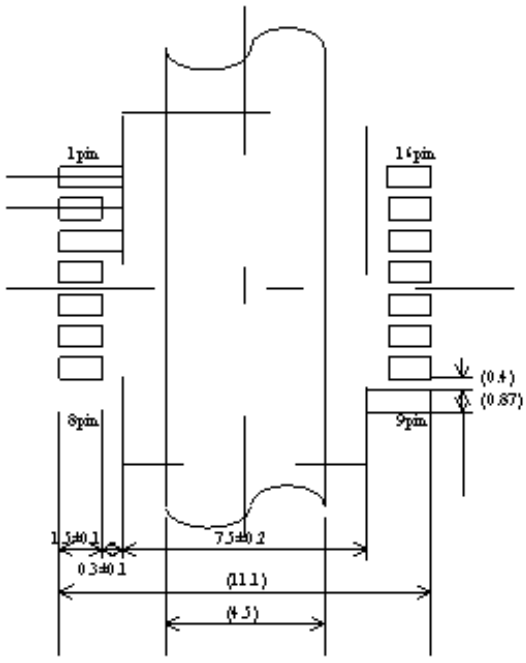
$$T_J = (P_D R_{\theta JL}) + T_L$$

where $P_D = V_I I_I - V_O I_O - V_F I_O (1 - [V_O/V_I])$,
V_F = the Schottky diode forward voltage, and
$R_{\theta JL}$ = 18°C/W.

Dimensions in Millimeters



Recommended Land Pattern



Product Weight: Approx. 0.859 g

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  In addition, it should be noted that since power devices or IC's including power devices have large self-heating value, the degree of derating of junction temperature affects the reliability significantly.
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