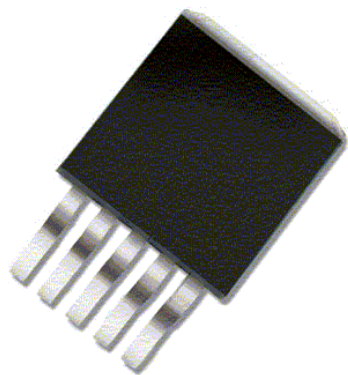
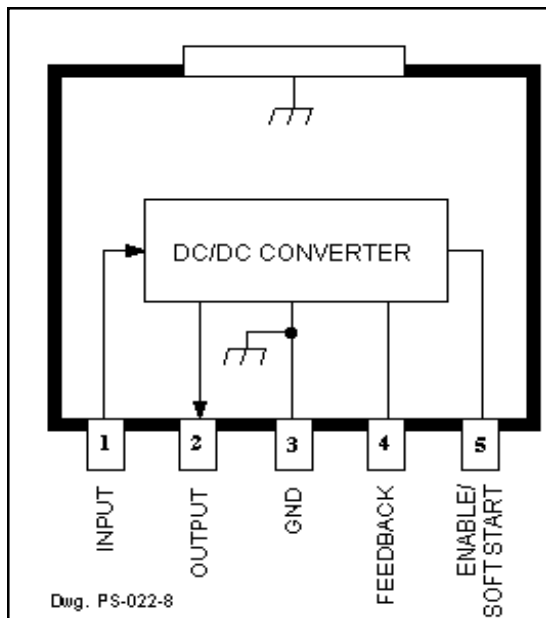


## Step-Down to 9.0 V, 1.5 A, DC/DC Converter



### ABSOLUTE MAXIMUM RATINGS

Input Voltage, $V_I$ .....	43 V
Output Current, $I_O$ .....	1.5 A*
Enable Input Voltage, $V_{OE}$ .....	6 V
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 or telecommunications equipment, the SI-8090JD dc/dc step-down (buck) converter offers a constant 125 kHz switching frequency essential for low EMI noise. The npn switch is included on the die along with the oscillator, control, and logic circuitry requiring only four external components for a regulated 9.0 V output at up to 1.5 A. .

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

This device is supplied in a 5-lead surface-mount plastic package (TO-263) with ground tab to provide a low-resistance path for maximum heat dissipation. A similar device in a flange-mounted (TO-220-style) high-power package is the SI-8090JF.

### FEATURES

- 11 V to 40 V Input Range
- 1.5 A Output Current at 9.0 V
- 2% Output Voltage Tolerance
- Foldback Current Limiting
- Constant 125 kHz Switching Frequency
- 200  $\mu$ A Maximum Standby Current
- Soft Start Prevents Supply Voltage Dip
- Remote Voltage Sensing
- Exposed Pad for Superior Heat Dissipation
- Thermal Protection

### APPLICATIONS

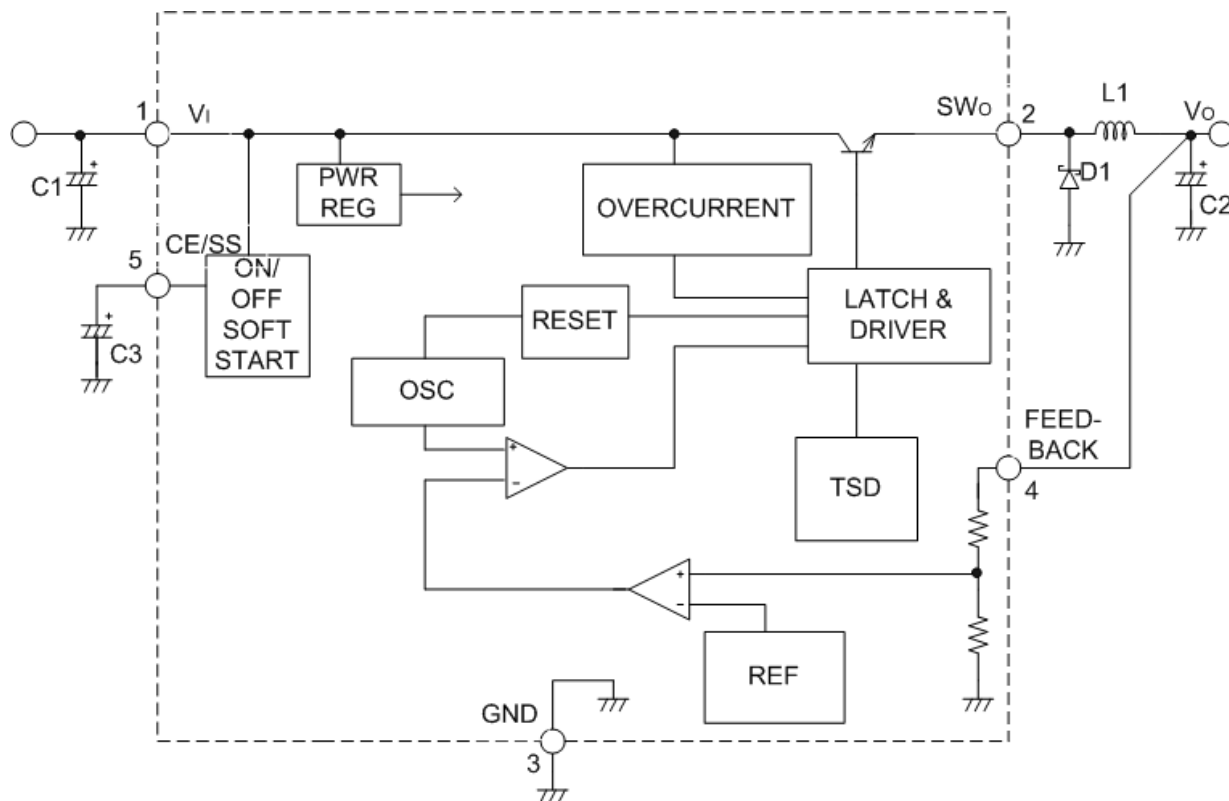
- TVs, VCRs, Electronic Games
- Embedded Core, Memory, or Logic Supplies
- Printers and Other Office Equipment
- Industrial Machinery
- Telecommunications Equipment

Always order by complete part number, e.g., **SI-8090JD-TL**, where "-TL" indicates tape and reel.

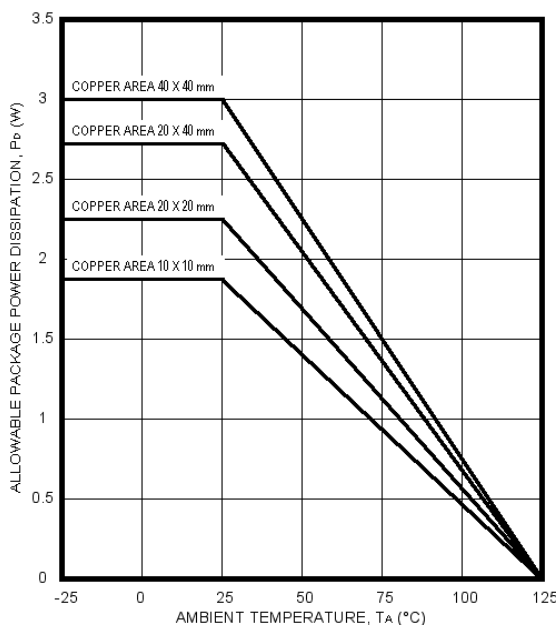
**SI-8090JD**  
**Step-Down**  
**to 9.0 V, 1.5 A,**  
**DC/DC Converter**

*Switching  
Regulators*

**FUNCTIONAL BLOCK DIAGRAM**



**Allowable Package Power Dissipation**



Dwg. 6K-003-7A

**Recommended Operating Conditions**

	Min	Max	Units
DC Input Voltage ( $I_o \leq 1 \text{ A}$ )	11	12	V
( $I_o \leq 1.5 \text{ A}$ )	12	40	V
DC Output Current ( $V_i \geq 6.3 \text{ V}$ )	0	1.5	A
Operating Junction Temp.	-30	+125	°C

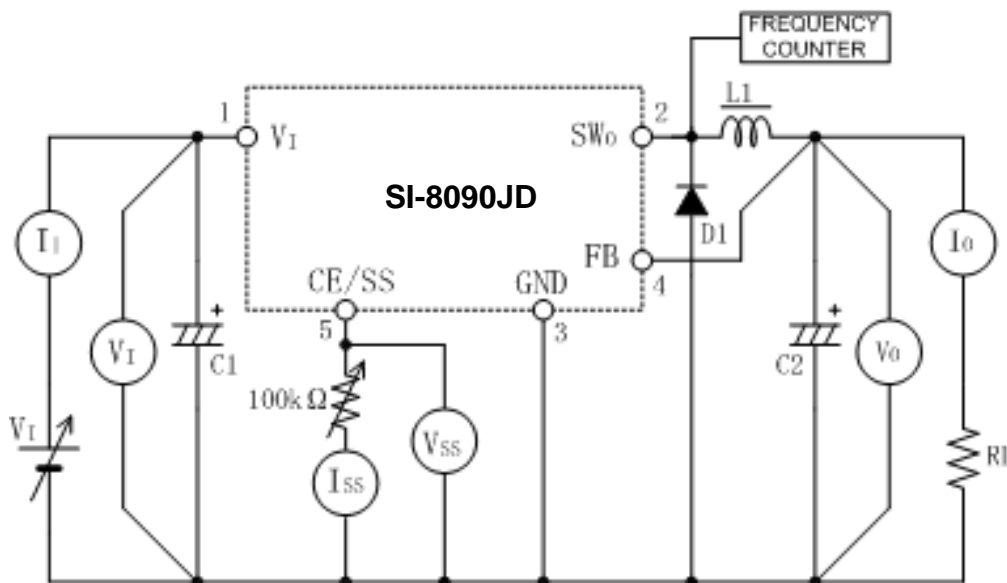
This data sheet is based on Sanken data sheet SSJ-01774

**ELECTRICAL CHARACTERISTICS** at  $T_A = +25^\circ\text{C}$ ,  $V_I = 21\text{ V}$ ,  $I_O = 0.5\text{ A}$  (unless otherwise noted).

Characteristic	Symbol	Test Conditions	Limits			
			Min.	Typ.	Max.	Units
Output Voltage	$V_O$		8.82	9.00	9.18	V
Ref. Volt. Temp. Coeff.	$a_{V_{ref}}$		—	$\pm 1.0$	—	mV/°C
Output Short-Circuit Current	$I_{OM}$	See note	1.6	—	—	A
Efficiency	$\eta$		—	86	—	%
Operating Frequency	f		—	125	—	kHz
Line Regulation	$\Delta V_{O(\Delta V_I)}$	$V_I = 15\text{ V} \sim 30\text{ V}$ , $I_O = 0.5\text{ A}$	—	50	120	mV
Load Regulation	$\Delta V_{O(\Delta I_O)}$	$V_I = 21\text{ V}$ , $I_O = 0.2\text{ A} \sim 0.8\text{ A}$	—	10	40	mV
Quiescent Current	$I_{IQ}$	$I_O = 0\text{ A}$	—	7.0	—	mA
		$V_{CE} = 0.3\text{ V}$	—	—	200	$\mu\text{A}$
Chip Enable Voltage	$V_{CE}$	Converter turn-off voltage	—	—	0.5	V
Soft-Start Current	$I_{SS}$	$V_{SS} = 0\text{ V}$	—	—	-100	$\mu\text{A}$

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**

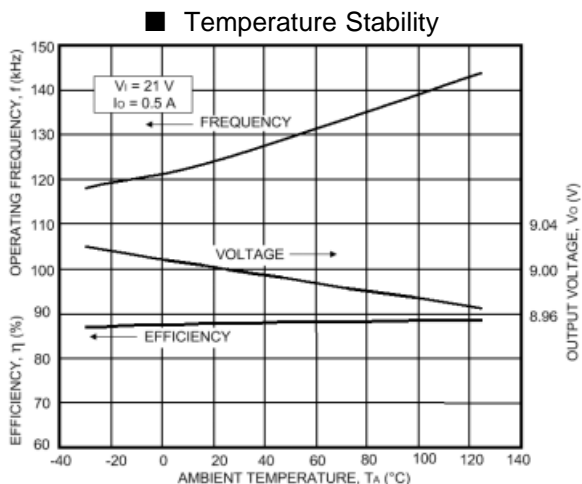
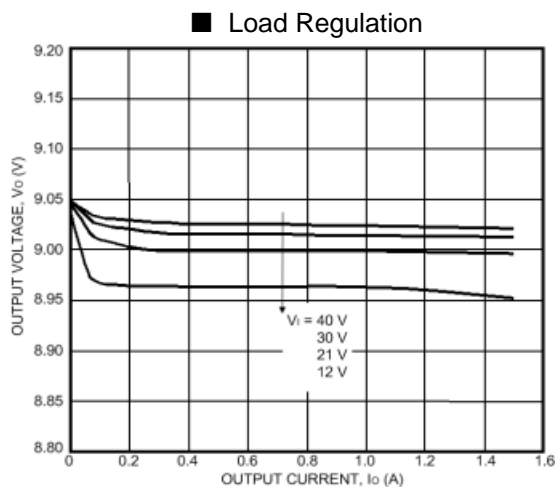
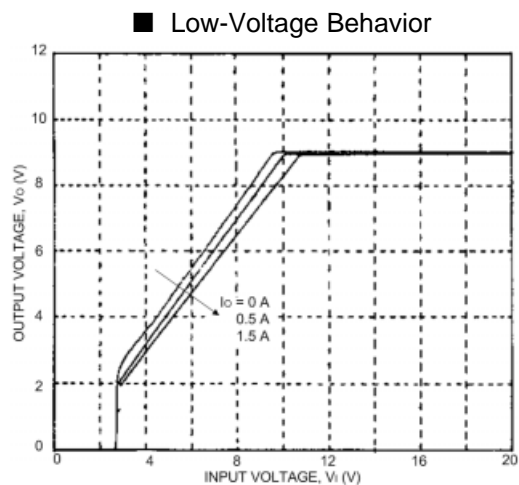
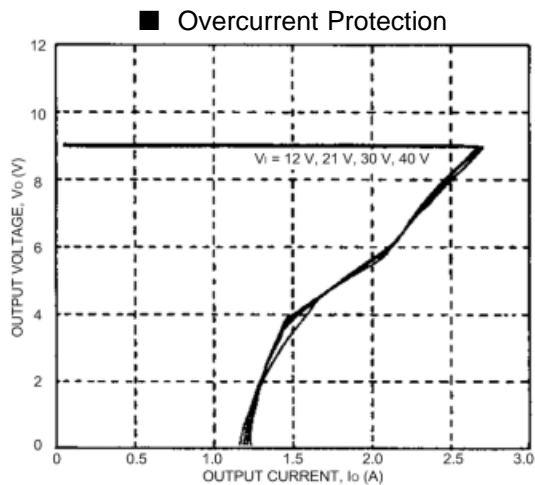
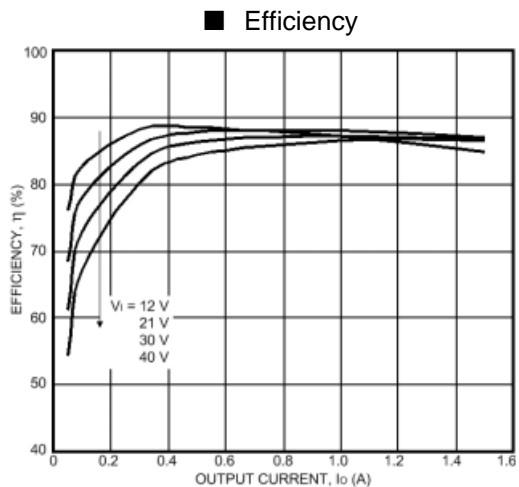
- C1 = 220  $\mu\text{F}/50\text{ V}$
- C2 = 470  $\mu\text{F}/25\text{ V}$
- C3 = 0.47  $\mu\text{F}/10\text{ V}$
- L1 = 100  $\mu\text{H}$
- D1 = Sanken SFPB-66

**SI-8090JD**  
**Step-Down**  
**to 9.0 V, 1.5 A,**  
**DC/DC Converter**

Switching  
Regulators

**TYPICAL CHARACTERISTICS**

( $T_A = 25^\circ\text{C}$ )



**APPLICATIONS INFORMATION**

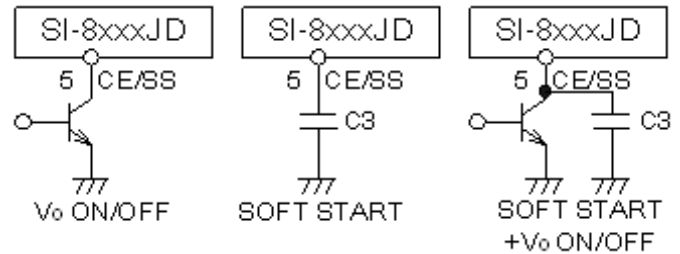
**Input Capacitor (C1).** Capacitors with low impedance for high-frequency ripple current must be used.

**Output Capacitor (C2).** 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 capacitor 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 2.5 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.

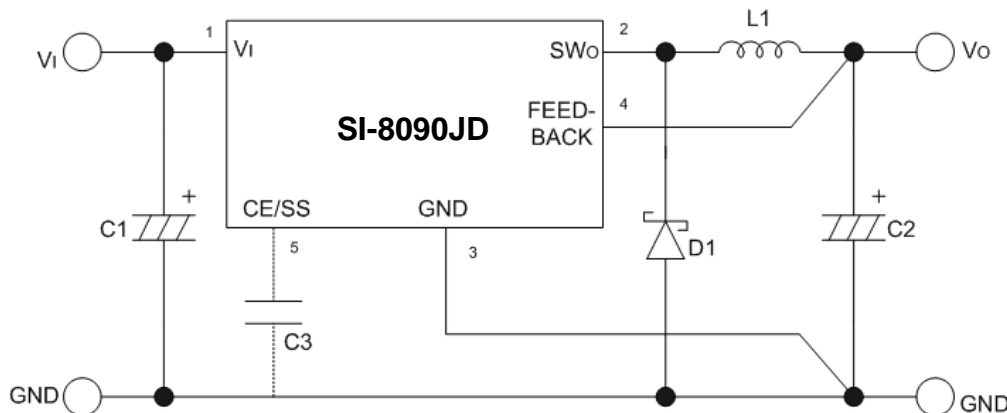
**Soft-Start Capacitor (C3).** Soft start for the converter is enabled by connecting a capacitor between terminal 5 and ground. The converter may be turned off by decreasing the terminal 5 voltage below 0.5 V with either an npn small-signal transistor or the output of open-collector TTL. If both a large soft-start capacitor and on/off control are desired, collector current limiting must be used to prevent transistor damage. No external voltage can be applied to terminal 5.



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

**Overcurrent Protection.** The SI-8000JD 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.



**Typical Application**

**SI-8090JD**  
**Step-Down**  
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**APPLICATIONS INFORMATION (cont.)**

**Thermal Protection.** Circuitry turns off the switching transistor when the junction temperature rises above 150°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.

**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 GND terminal (pin 3). Therefore, it is very effective for heat radiation to enlarge the copper area that is connected to the GND terminal. The graph illustrates the effect of the copper area on the junction-to-ambient thermal resistance ( $R_{\theta JA}$ ).

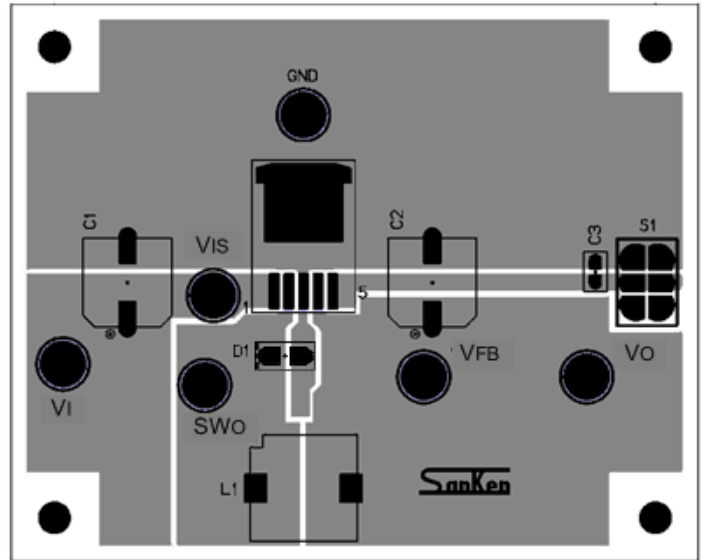
The junction temperature ( $T_J$ ) can be determined from either of the following equations:

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

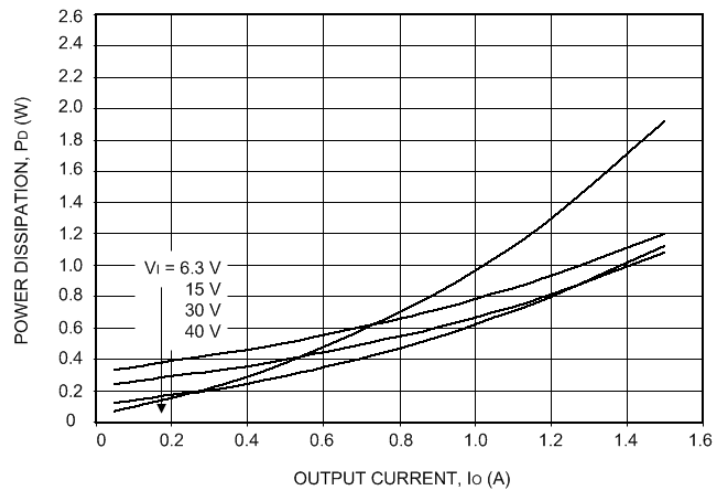
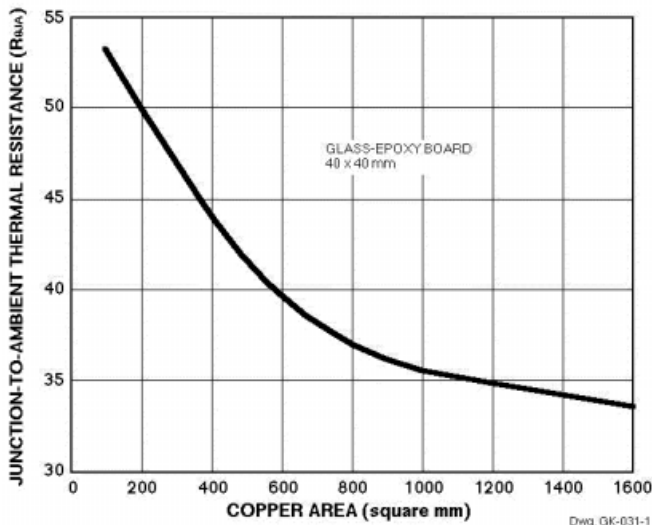
or

$$T_J = (P_D R_{\theta JC}) + T_C$$

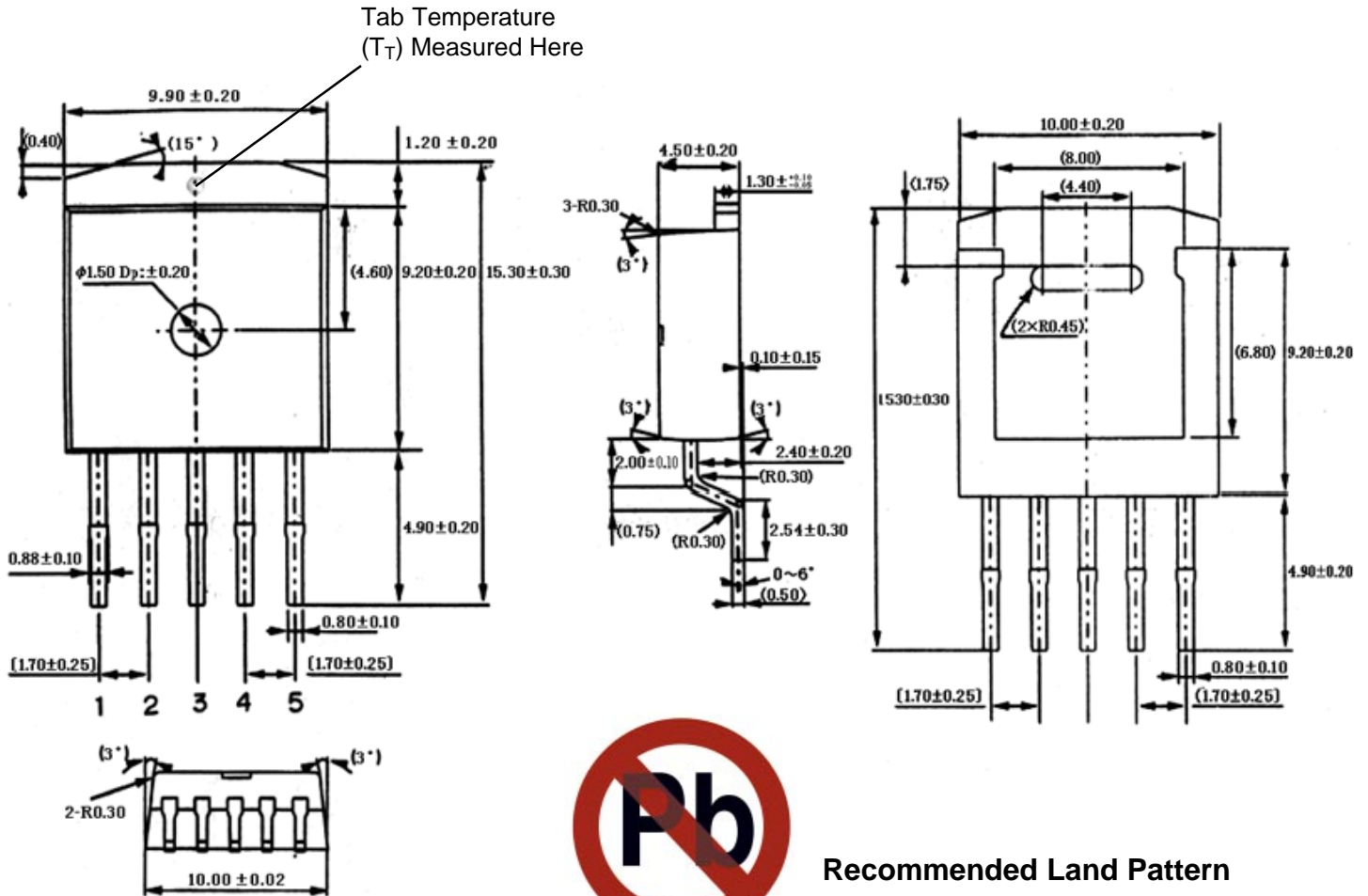
where  $P_D = V_I I_I - V_O I_O - V_F I_O (1 - [V_O/V_I])$   
 or the adjacent graph,  
 $V_F$  = the Schottky diode forward voltage, and  
 $R_{\theta JC} = 3^\circ\text{C/W}$ .



**Layout Guideline**



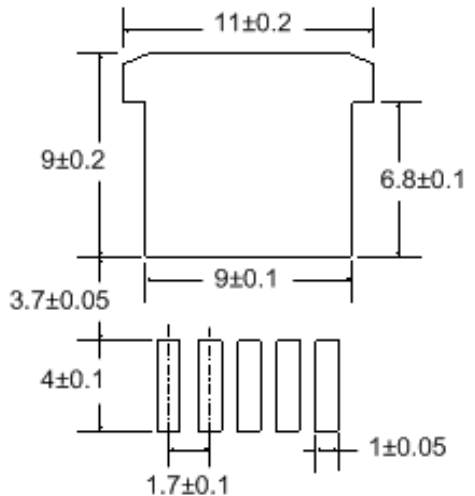
Dimensions in Millimeters



Recommended Land Pattern

Notes:

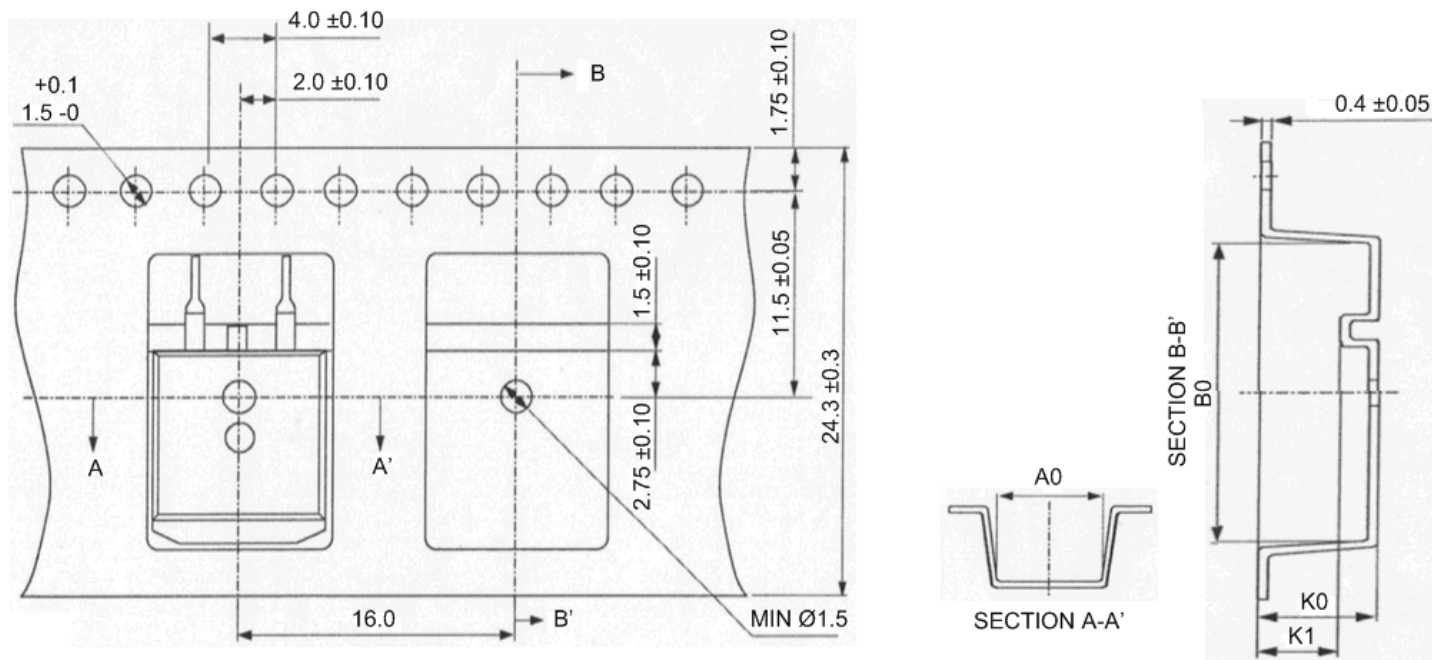
1. Dimensions do not include mold protrusions.
2. ( ) Is reference.
3. [ ] Is assembly out quality.
4. Heat sink side flash: 0.8 mm max.
5. Terminal finish: pure Sn (category e3)
6. Product weight: approximately 1.48 g



**SI-8090JD**  
**Step-Down**  
**to 9.0 V, 1.5 A,**  
**DC/DC Converter**

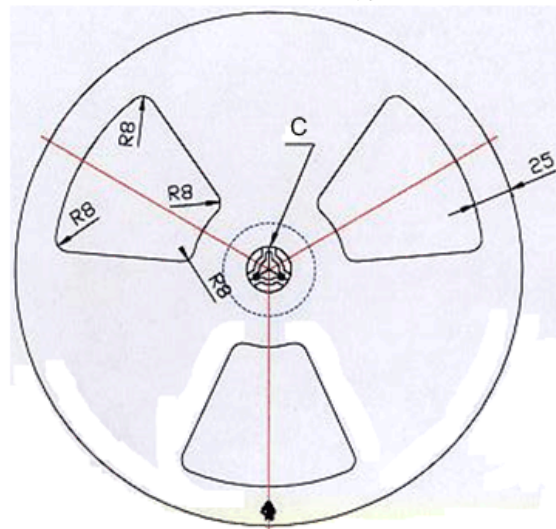
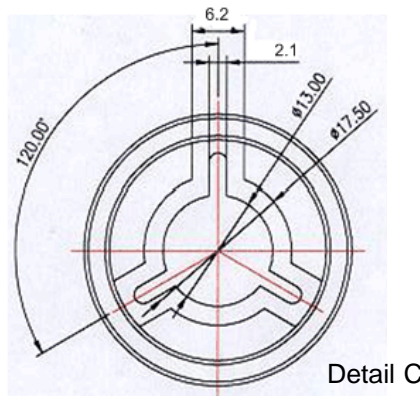
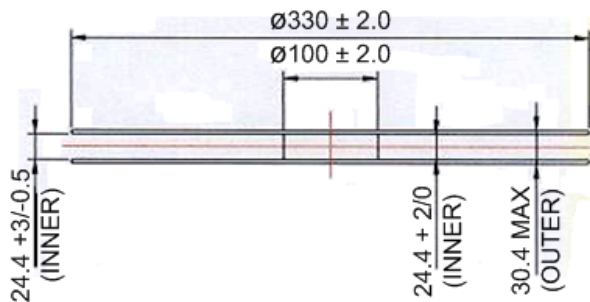
*Switching  
Regulators*

**Tape and Reel Dimensions in Millimeters**



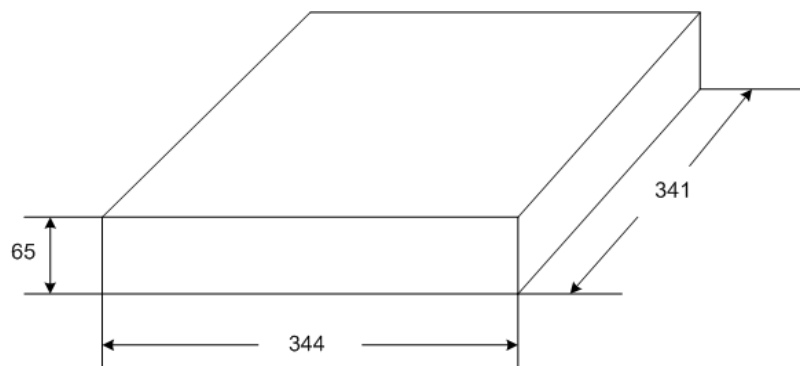
**Tape Specifications**

1. Material: conductive polystyrene.
2. Allowable camber: 1 mm/100 mm maximum.
3. A0 (10.6 mm) and B0 (15.7 mm) measured on a plane 0.3 mm above the bottom of the pocket.
4. K0 (4.9 mm) is measured from a plane on the inside bottom of the pocket to the surface of the carrier.
5. Ten pitches cumulative tolerance on tape  $\pm 0.2$  mm.
6. The space between parts and cavity must not exceed  $\pm 0.3$  mm from its normal position in any direction.
7. Surface resistivity of embossment:  $10^7$  ohm/cm<sup>2</sup> max.
8. K1 = 3.9 mm.

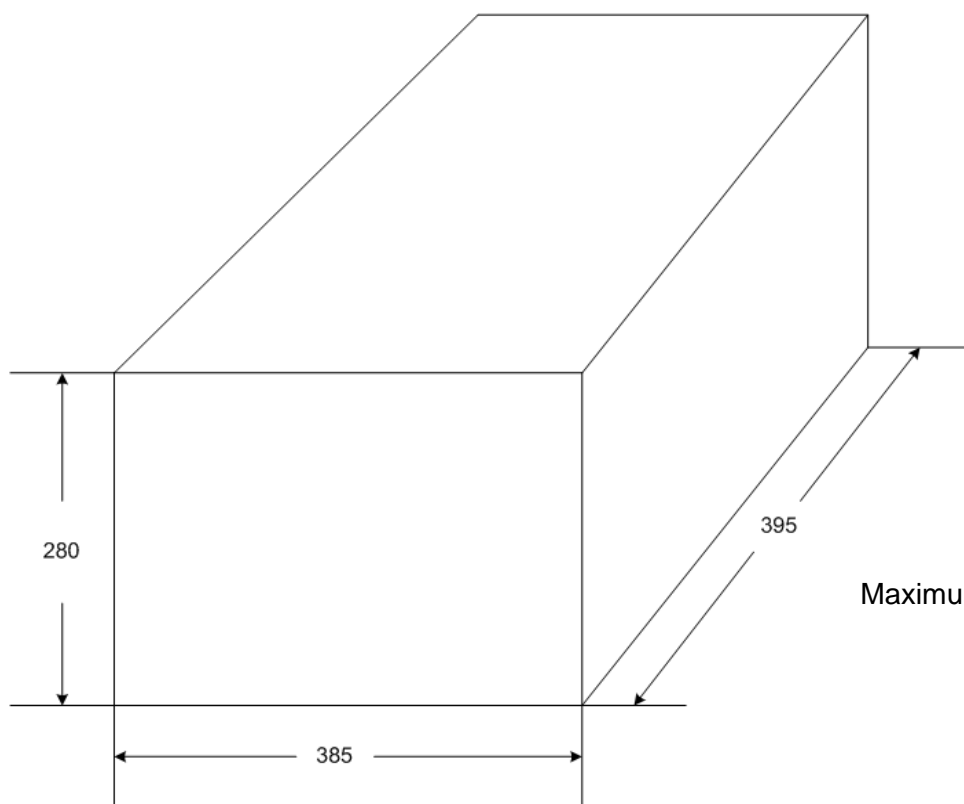




**Shipping Container Dimensions in Millimeters**



**Inner Box**  
2 reels per box, 800 pieces per reel



**Outer Box**  
Maximum 3 inner boxes per outer box

**SI-8090JD**  
**Step-Down**  
**to 9.0 V, 1.5 A,**  
**DC/DC Converter**

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Regulators**

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