

# SI-3033LSA

## LOW-VOLTAGE, HIGH-CURRENT 3.3 V LINEAR REGULATOR

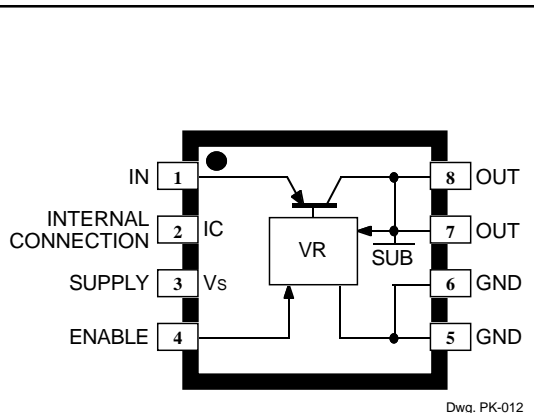
The SI-3033LSA is designed to meet the requirement for increased integration and reliability in low-voltage, high-current, linear regulator applications such as personnel computers (PCs) and set-top boxes. Each device incorporates a monolithic low-level reference and control circuit with a high-current pnp transistor in a power multi-chip module (PMCM™). Regulated output voltages of 1.8 V or 2.5 V are also available.

The high-current pass element provides a low dropout voltage with output current to 1 A. Regulator accuracy of  $\pm 2\%$  and excellent temperature characteristics are provided. The logic-compatible ENABLE input gives the designer complete control over power up, power down, and standby or sleep.

These devices are supplied in a fully molded 8-lead miniature surface-mount package (tape and reel) with enhanced power-dissipating qualities. They are rated for continuous operation between  $-30^{\circ}\text{C}$  and  $+100^{\circ}\text{C}$ .

### FEATURES

- 1 A Output Current
- Low Dropout voltage
- LSTTL/CMOS-Compatible On/Off Control
- Less Than 1  $\mu\text{A}$  "Sleep" Current
- Internal Foldback Overcurrent Limiting
- Internal Thermal Shutdown
- Surface-Mount Package



### ABSOLUTE MAXIMUM RATINGS

Input Voltage, $V_I$ .....	16 V
Supply Voltage, $V_S$ .....	16 V
Continuous Output Current, $I_O$ .....	1.0 A*
Logic Input Voltage, $V_E$ .....	$V_S$
Package Power Dissipation, $P_D$ .....	See Graph
Output Junction Temperature, $T_J$ .....	$+150^{\circ}\text{C}\dagger$
Operating Temperature Range, $T_A$ .....	$-30^{\circ}\text{C}$ to $+100^{\circ}\text{C}$
Storage Temperature Range, $T_{stg}$ .....	$-30^{\circ}\text{C}$ to $+150^{\circ}\text{C}$

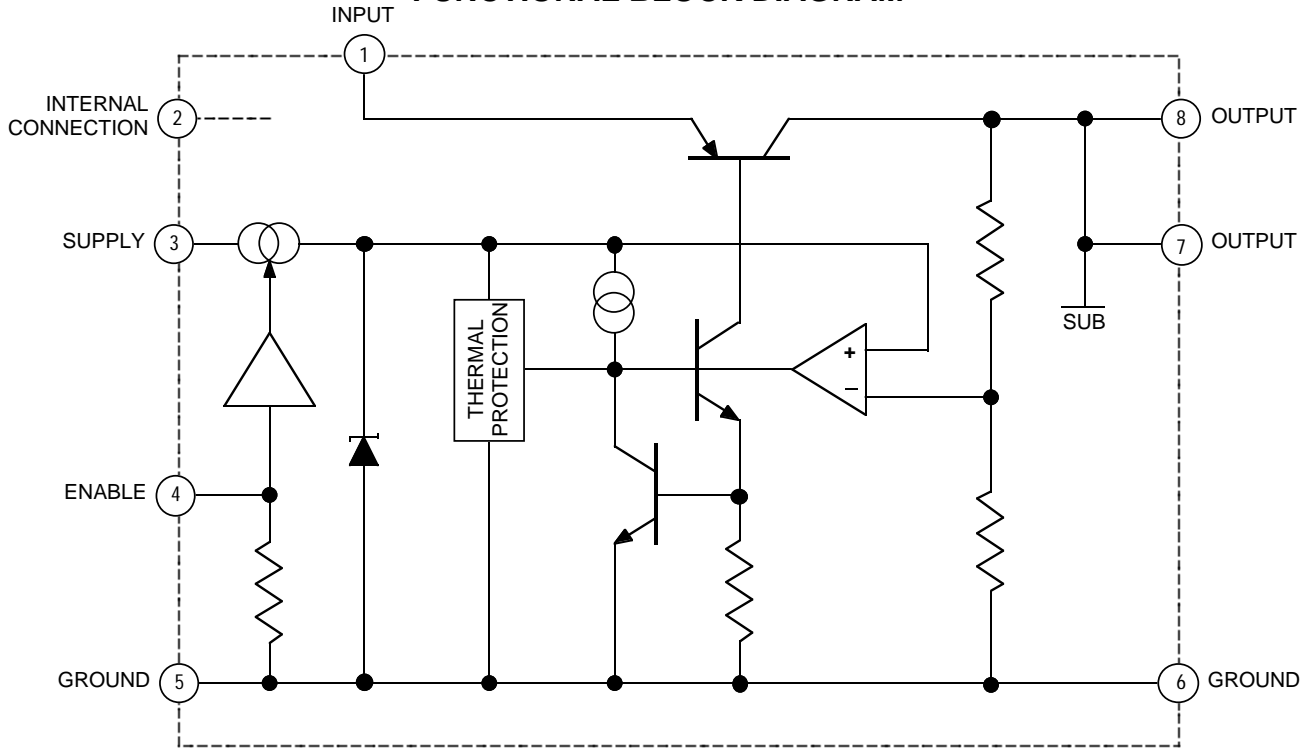
\* Output current rating may be limited by duty cycle, ambient temperature, and heat sinking. Under any set of conditions, do not exceed the specified current rating or a junction temperature of  $150^{\circ}\text{C}$ .

† Fault conditions that produce excessive junction temperature will activate the device's thermal shutdown circuitry. These conditions can be tolerated but should be avoided.

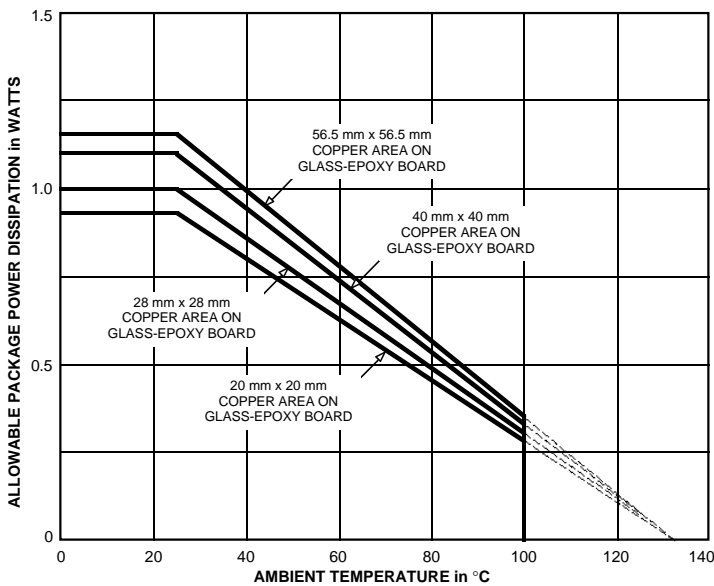
Always order by complete part number: **SI-3033LSA-TL** ,  
where "-TL" indicates tape and reel.

**SI-3033LSA**  
**LOW-VOLTAGE, HIGH-CURRENT**  
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**FUNCTIONAL BLOCK DIAGRAM**



Dwg. FK-019



Dwg. GK-010-1

Leads 7 and 8 are soldered to the copper area and provide heat sinking of the pass transistor.

**RECOMMENDED OPERATING CONDITIONS**

Max. Input Voltage,  $V_I$  ..... 5.2 V  
 Output Current,  $I_O$  ..... 0 A to 1.0 A  
 Output Junction Temperature Range,  $T_J$  -20 °C to +125°C  
 Ambient Temperature Range,  $T_A$  ..... -30°C to +85°C

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**ELECTRICAL CHARACTERISTICS** at  $T_A = +25^\circ\text{C}$ ,  $V_I = V_S = 5.0\text{ V}$ ,  $V_E = 2.0\text{ V}$  (unless otherwise noted).

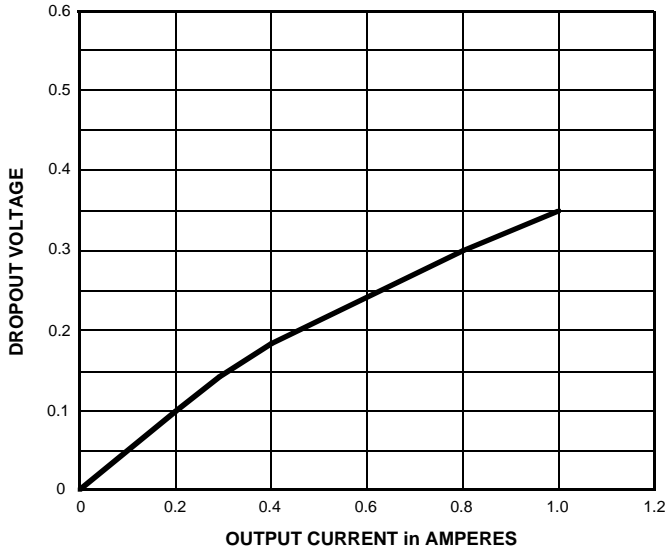
Characteristic	Symbol	Test Conditions	Limits			
			Min.	Typ.	Max.	Units
Output Voltage	$V_O$	$I_O = 500\text{ mA}$	3.234	3.300	3.366	V
	$V_{OQ}$	$V_E = 0\text{ V}$ , Output Off			0.5	V
Output Volt. Temp. Coeff.	$a_{VO}$	$I_O = 5\text{ mA}$ , $0^\circ\text{C} \leq T_J \leq 100^\circ\text{C}$		$\pm 0.3$		mV/°C
Overcurrent Limit	$I_{OM}$	$V_O = 95\%$ of $V_O$ at $I_O = 500\text{ mA}$	1.2	1.5		A
Line Regulation	$\Delta V_{O(\Delta V_I)}$	$4.5\text{ V} \leq V_I = V_S \leq 5.5\text{ V}$ , $I_O = 300\text{ mA}$		3.0	10	mV
Load Regulation	$\Delta V_{O(\Delta I_O)}$	$0 \leq I_O \leq 1\text{ A}$		10	20	mV
Dropout Voltage	$V_{I\text{min}} - V_O$	$I_O \leq 0.5\text{ A}$		220	400	mV
		$I_O \leq 1\text{ A}$		350	800	mV
Ground Terminal Current	$I_{GND}$	$I_O = 0\text{ mA}$		1.7	2.5	mA
	$I_Q$	$V_E = 0\text{ V}$ , $I_O = 0\text{ mA}$			1.0	$\mu\text{A}$
Rejection Ratio	PSRR	$100\text{ Hz} \leq f \leq 120\text{ Hz}$		55		dB
ENABLE Input Voltage	$V_{EH}$	Output On	2.0			V
	$V_{EL}$	Output Off			0.8	V
ENABLE Input Current	$I_{EH}$	$V_E = 2\text{ V}$ , Output On		30	80	$\mu\text{A}$
	$I_{EL}$	$V_E = 0\text{ V}$ , Output Off		0	-5.0	$\mu\text{A}$
Thermal Shutdown Temp.	$T_J$		135	150		°C
Thermal Resistance	$R_{\theta JL}$	To terminals 7 and 8		36		°C/W

Typical values are at  $T_A = +25^\circ\text{C}$  and are given for circuit design information only.

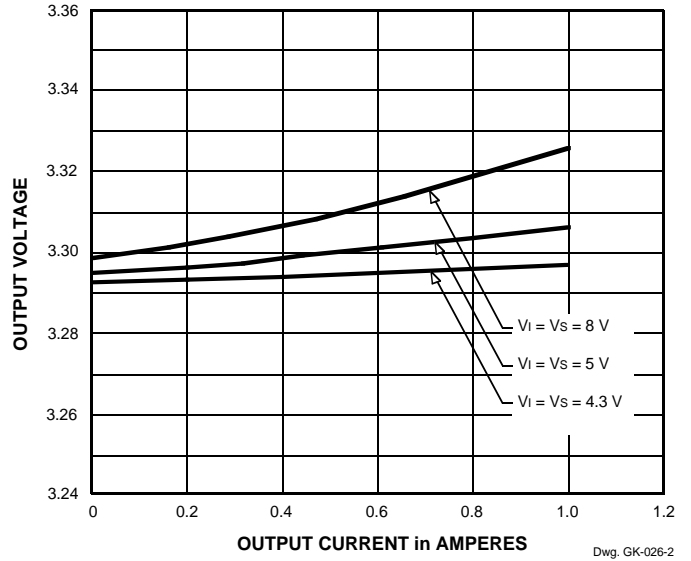
**SI-3033LSA**  
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**TYPICAL CHARACTERISTICS at  $T_A = 25^\circ\text{C}$**

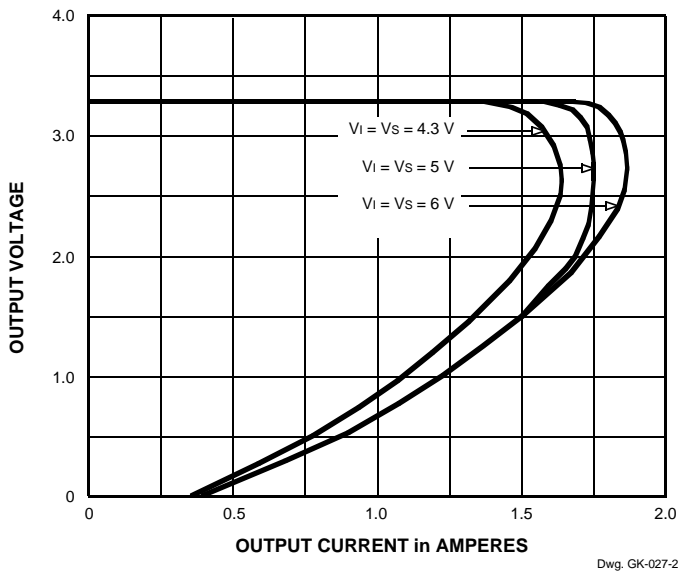
**Dropout voltage**



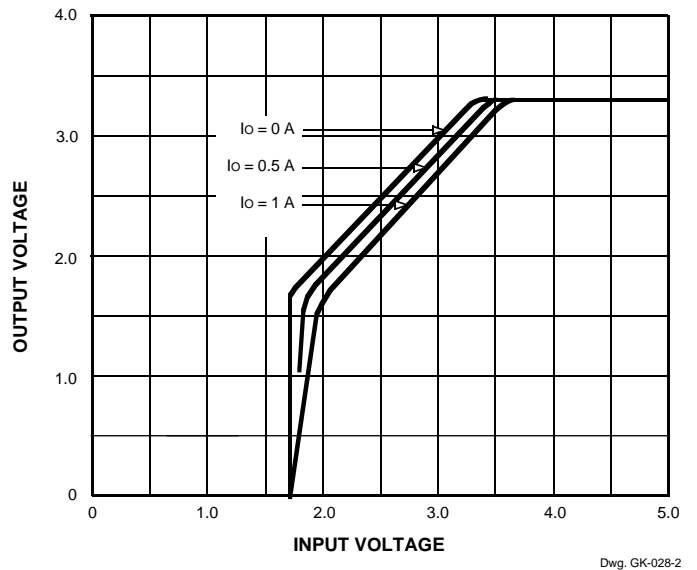
**Load regulation**



**Overcurrent protection**



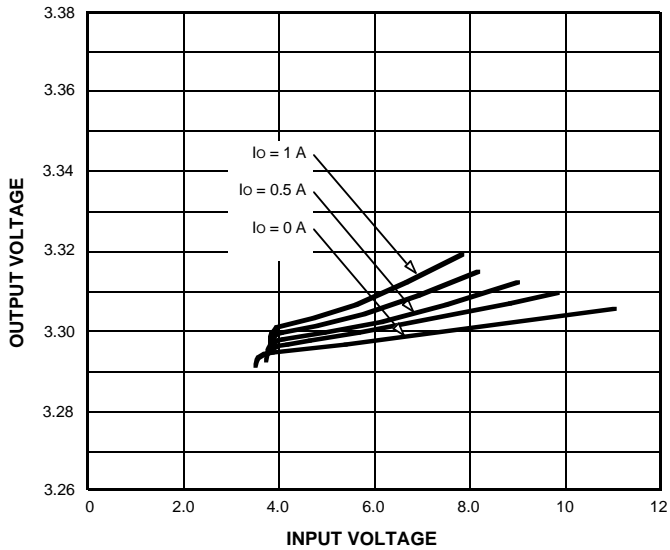
**$V_{OUT}$  vs  $V_{IN}$**



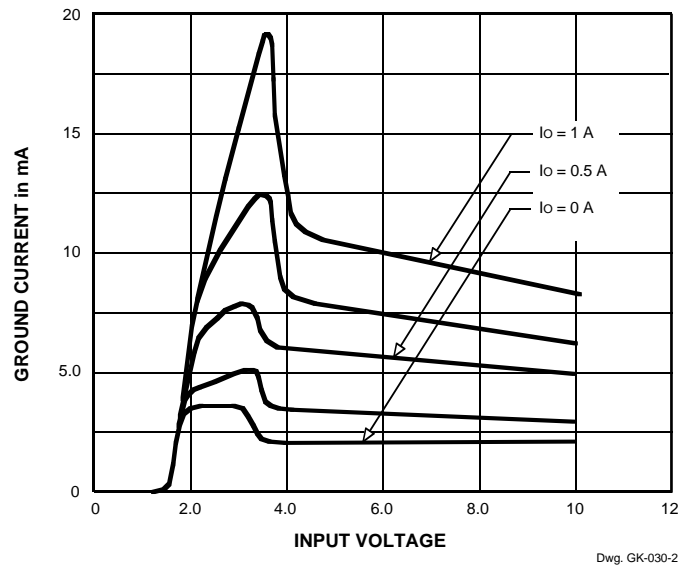
# SI-3033LSA LOW-VOLTAGE, HIGH-CURRENT 3.3 V LINEAR REGULATOR

## TYPICAL CHARACTERISTICS at $T_A = 25^\circ\text{C}$ (cont'd)

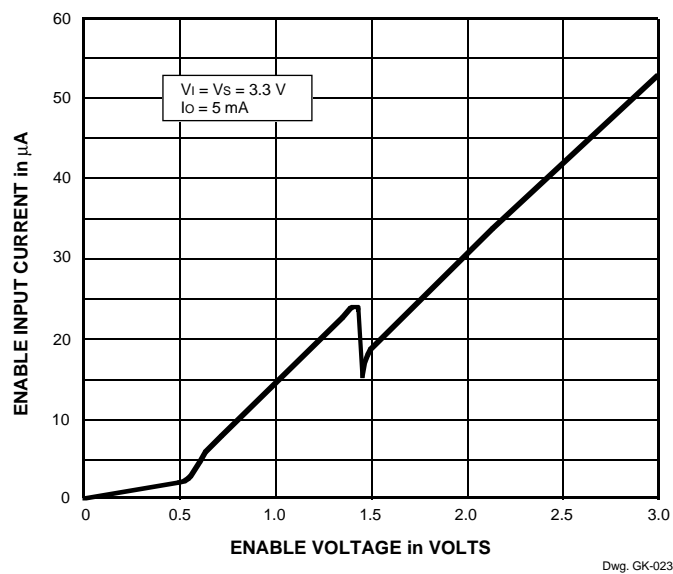
**Line regulation**



**GND current**



**ENABLE input current**



# SI-3033LSA

## LOW-VOLTAGE, HIGH-CURRENT

### 3.3 V LINEAR REGULATOR

## APPLICATIONS INFORMATION

**Thermal shutdown and heat sinking.** Thermal protection circuitry turns off the device should the junction temperature rise above 135°C. This is intended only to protect the device from failures due to excessive junction temperatures and should not imply that high-temperature operation is permitted. Ambient temperature is affected by air circulation and proximity to other heat-producing components. Normal operation is resumed when the junction temperature is reduced. Output terminals 7 and 8 are the lead frame and substrate of the pass transistor and provide a low thermal-resistance path for heat sinking.

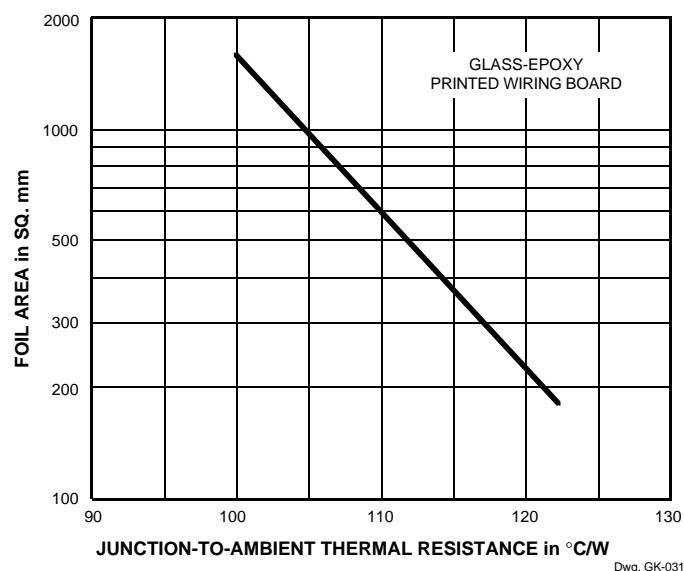
In general, the maximum ambient temperature has the most effect on determining the heat sinking that is needed to maintain a safe normal operating junction temperature. The maximum heat sinking thermal resistance ( $R_{\theta JA}$ ) can be calculated as

$$R_{\theta JA} = (135 - T_A) / I_O (V_I - 3.3)$$

where  $T_A$  is the maximum ambient temperature in °C,  $I_O$  is the maximum output (load) current in amperes, and  $V_I$  is the maximum input voltage in volts.

The following graph gives the required copper foil area (soldered to leads 7 and 8) to provide the required thermal resistance. Note that more is always better and both sides of the printed wiring board can be used.

**ENABLE input.** The ENABLE input includes an internal pull-



down resistor. If this terminal is not connected (open-circuit fault), the device output is turned off.

**Overcurrent protection.** The SI-3033LSA includes an overcurrent protection circuit, which limits the output current at start up. It thus cannot be used with

- 1) a constant-current load,
- 2) a power supply with positive and negative to a common load (center-tap type power supply),
- 3) a series power supply, or
- 4) a diode or resistor in series with the device ground to raise the output voltage.

**Input voltage.** Including ripple voltage and transients, the minimum input voltage should be greater than the sum of the output voltage and the maximum rated dropout voltage; the maximum input voltage must be less than the absolute maximum rated input voltage (16 V).

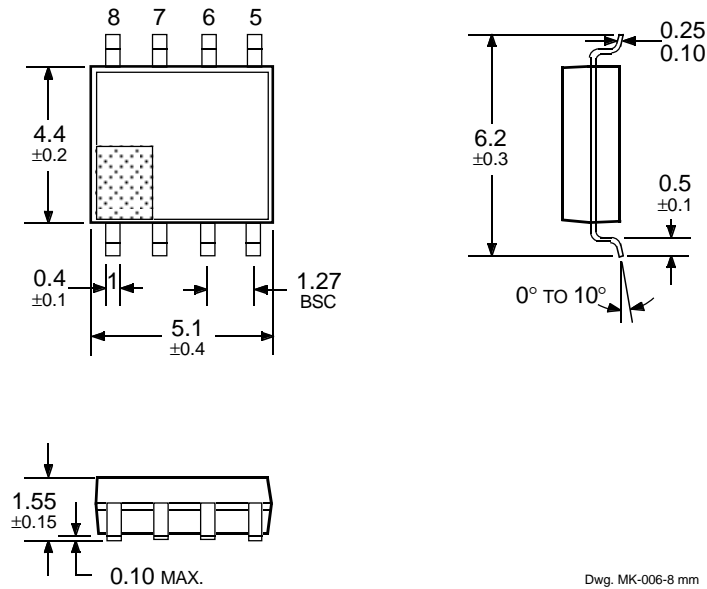
In most applications, the input voltage (terminal 1,  $V_I$ ) and the supply voltage (terminal 3,  $V_S$ ) are connected together.

**Output capacitor.** A 22  $\mu$ F tantalum electrolytic capacitor is recommended between the output and ground. Very-low ESR capacitors should not be used.

**Input capacitor.** A 0.1  $\mu$ F to 10  $\mu$ F tantalum capacitor is recommended between the input and ground to prevent oscillation.

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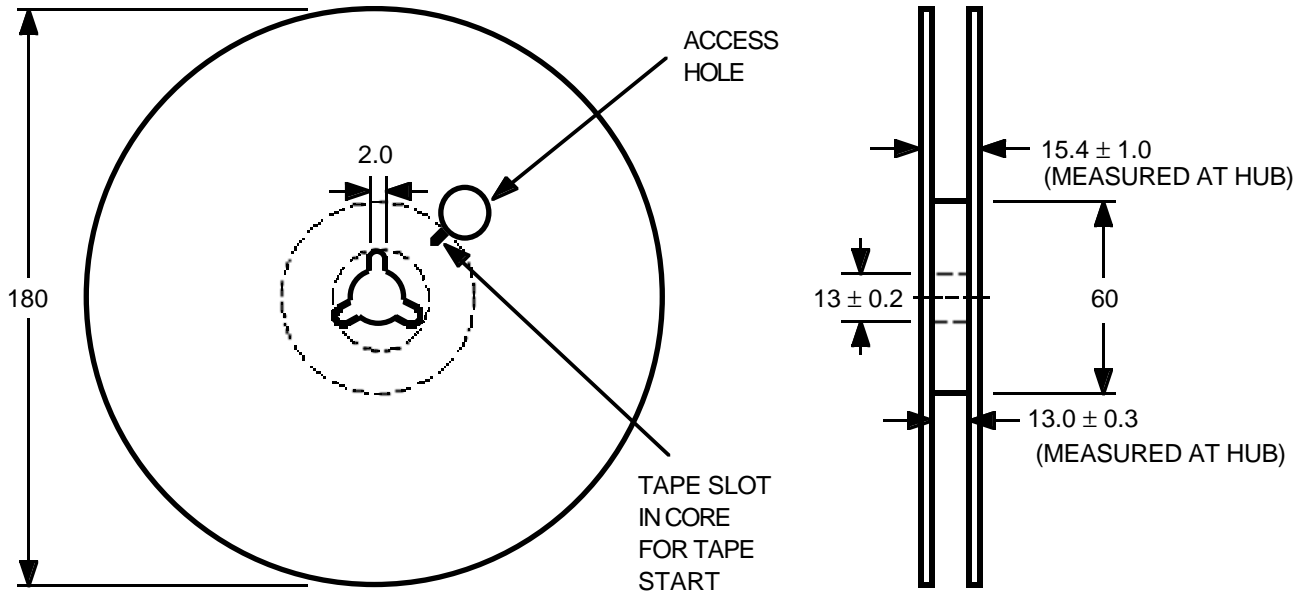
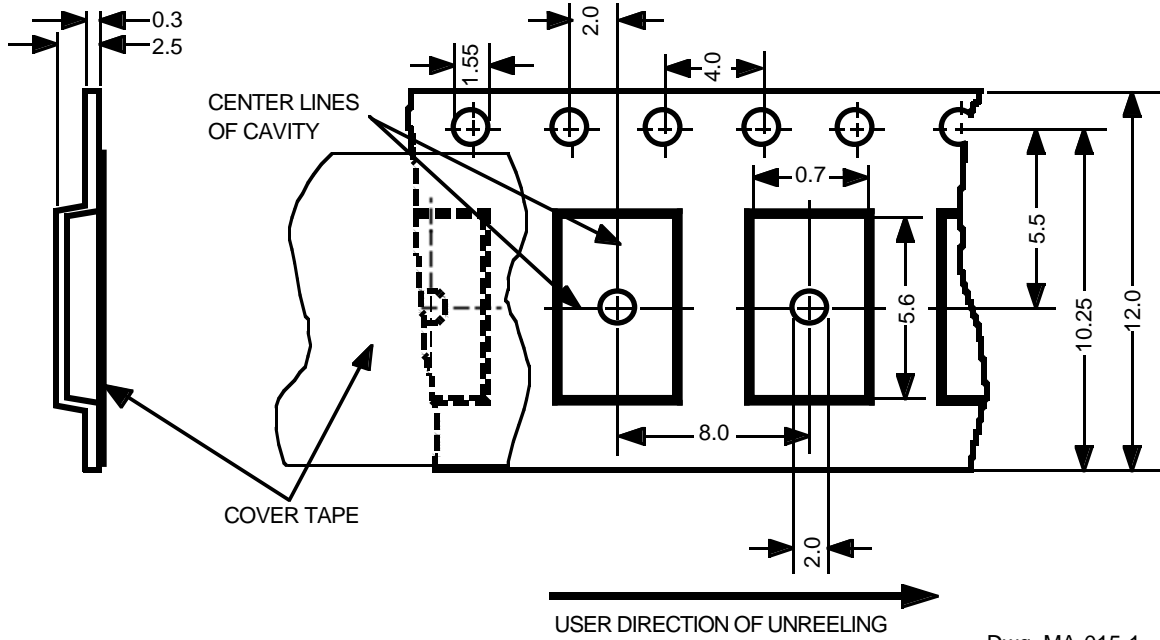
**Dimensions in Millimeters**  
**(controlling dimensions)**



- NOTES: 1. Exact body and lead configuration at vendor's option within limits shown.  
2. Lead spacing tolerance is non-cumulative.  
3. Leads 7 and 8 are internally connected together and provide heat sinking of the pass transistor.

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**Tape and Reel Dimensions in Millimeters**  
**(controlling dimensions)**





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**LINEAR REGULATORS**

IN ORDER OF 1) OUTPUT VOLTAGE AND 2) OUTPUT CURRENT

V <sub>O</sub>	Max I <sub>O</sub>	Max DC In	Max. Dropout Voltage	Part Number	Package
1.8 V	1.0 A	16 V	1.2 V @ 1.0 A	SI-3018LSA	8-Lead SOIC
2.5 V	1.0 A	16 V	800 mV @ 1.0 A	SI-3025LSA	8-Lead SOIC
3.3 V	1.0 A	16 V	800 mV @ 1.0 A	SI-3033LSA	8-Lead SOIC
3.3 V	1.5 A	20 V	500 mV @ 1.0 A	SI-3033C	5-Lead TO-220
5.0 V	1.0 A	25 V	500 mV @ 0.5 A	SI-3050N	TO-220
5.0 V *	1.5 A	35 V	1.0 V @ 1.5 A	SLA3001M	Power-Tab SIP
5.0 V	1.5 A	35 V	500 mV @ 1.0 A	SI-3050C	5-Lead TO-220
5.0 V	1.5 A	35 V	500 mV @ 1.0 A	SI-3051N	TO-220
5.0 V	2.0 A	25 V	500 mV @ 1.0 A	SI-3052V	TO-3P
7.7 V	15 mA	30 V	—	A8178LLT	SOT-89
9.0 V	1.0 A	30 V	500 mV @ 0.5 A	SI-3090N	TO-220
9.0 V *	1.5 A	35 V	1.0 V @ 1.5 A	SLA3001M	Power-Tab SIP
9.0 V	1.5 A	35 V	500 mV @ 1.0 A	SI-3090C	5-Lead TO-220
9.0 V	1.5 A	35 V	500 mV @ 1.0 A	SI-3091N	TO-220
12 V	1.0 A	30 V	500 mV @ 0.5 A	SI-3120N	TO-220
12 V *	1.5 A	35 V	1.0 V @ 1.5 A	SLA3001M	Power-Tab SIP
12 V	1.5 A	35 V	500 mV @ 1.0 A	SI-3120C	5-Lead TO-220
12 V	1.5 A	35 V	500 mV @ 1.0 A	SI-3121N	TO-220
12 V	2.0 A	30 V	500 mV @ 1.0 A	SI-3122V	TO-3P
15 V	1.0 A	35 V	500 mV @ 0.5 A	SI-3150N	TO-220
15 V	1.5 A	35 V	500 mV @ 1.0 A	SI-3150C	5-Lead TO-220
15 V	1.5 A	35 V	500 mV @ 1.0 A	SI-3151N	TO-220
15 V	2.0 A	30 V	500 mV @ 1.0 A	SI-3152V	TO-3P
15.7 V	1.0 A	35 V	1.0 V @ 1.0 A	SLA3002M	Power-Tab SIP
24 V	1.5 A	45 V	500 mV @ 1.0 A	SI-3240C	5-Lead TO-220
24 V	1.5 A	45 V	500 mV @ 1.0 A	SI-3241N	TO-220

\* Three outputs, one each at 5 V, 9 V, and 12 V.

† Also includes two switching regulator outputs for 5 V at 500 mA and 9 V at 400 mA.

Also, see 83145 and 84145 Latched, Universal Input-Voltage Switches.