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**ZXTR2105F**

**60V INPUT, 5V 15mA REGULATOR TRANSISTOR**

**Description**

The ZXTR2105F monolithically integrates a transistor, zener diode and resistor to function as a linear regulator. The device regulates with a 5V nominal output at 15mA. It is designed for use in high-voltage applications where standard linear regulators cannot be used. This function is fully integrated into a SOT23 package, minimizing PCB area and reducing the number of components when compared with a multi-chip discrete solution.

**Features**

- Series Linear Regulator Using Emitter-Follower Stage
- Input Voltage = 7 to 60V (For regulated output voltage)
- Output Voltage = 5V ± 5%
- Fully integrated into a SOT23 Package
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**
- **Qualified to AEC-Q101 Standards for High Reliability**
- **PPAP Capable (Note 4)**

**Applications**

Supply voltage regulation for:

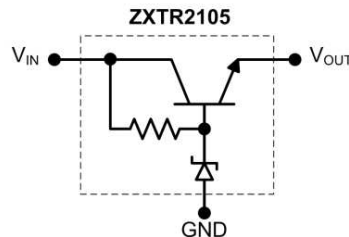
- 12V to 5V Rails
- 24V to 5V Rails
- Other Customized Input Rails

**Mechanical Data**

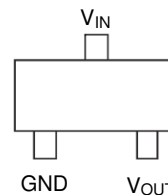
- Case: SOT23
- Case Material: Molded Plastic "Green" Molding Compound; UL Flammability Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020
- Terminals: Finish - Matte Tin Plated Leads; Solderable per MIL-STD-202, Method 208 <sup>Ⓔ</sup>
- Weight: 0.008 grams (Approximate)



Top View



Internal Device Schematic



Top View Pin-Out

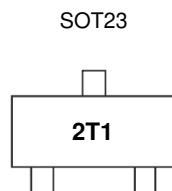
Pin Name	Pin Function
V <sub>IN</sub>	Input Supply
GND	Power Ground
V <sub>OUT</sub>	Voltage Output

**Ordering Information** (Note 5)

Product	Compliance	Marking	Reel Size (inches)	Tape Width (mm)	Quantity per Reel
ZXTR2105F-7	AEC-Q101	2T1	7	8	3,000
ZXTR2105FQ-7	Automotive	2T1	7	8	3,000

- Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS) & 2011/65/EU (RoHS 2) compliant.
  2. See [http://www.diodes.com/quality/lead\\_free.html](http://www.diodes.com/quality/lead_free.html) for more information about Diodes Incorporated's definitions of Halogen and Antimony free, "Green" and Lead-Free.
  3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.
  4. Automotive products are AEC-Q101 qualified and are PPAP capable. Automotive, AEC-Q101 and standard products are electrically and thermally the same, except where specified. For more information, please refer to [http://www.diodes.com/quality/product\\_compliance\\_definitions/](http://www.diodes.com/quality/product_compliance_definitions/).
  5. For packaging details, go to our website at <http://www.diodes.com/products/packages.html>.

**Marking Information**



2T1 = Product Type Marking Code

**Absolute Maximum Ratings** (Voltage relative to GND, @ $T_A = +25^\circ\text{C}$ , unless otherwise specified.)

Characteristic	Symbol	Value	Unit
Input Voltage	$V_{IN}$	-0.3 to 60	V
Continuous Input and Output Current	$I_{IN}, I_{OUT}$	320	mA
Peak Pulsed Input and Output Current	$I_{IM}, I_{OM}$	2	A
Maximum Voltage Applied to $V_{OUT}$	$V_{OUT(max)}$	Smaller of $V_{IN}+5V$ or 10V	V

**Maximum Current at  $V_{IN} = 12V$**  (@ $T_A = +25^\circ\text{C}$ , unless otherwise specified.)

Characteristic	Symbol	Value	Unit
Continuous Output Current	$I_{OUT}$	89	mA
Pulsed Output Current	$I_{OM}$	2,000	mA
		890	

**Thermal Characteristics**

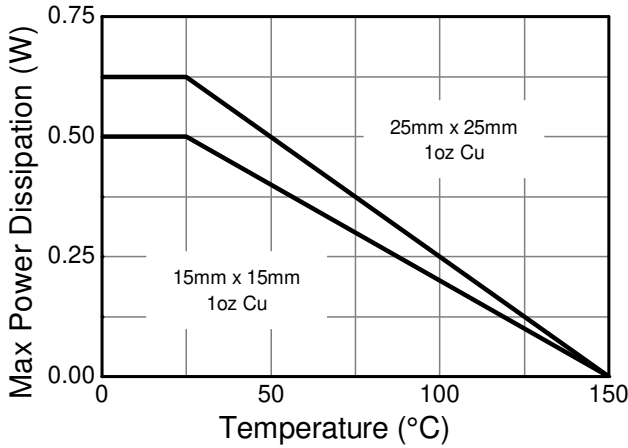
Characteristic	Symbol	Value	Unit
Power Dissipation	$P_D$	625	mW
		500	
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	200	$^\circ\text{C/W}$
		250	
Thermal Resistance, Junction to Lead	$R_{\theta JL}$	197	
Thermal Resistance, Junction to Case	$R_{\theta JC}$	17	
Maximum Operating Junction and Storage Temperature Range	$T_J, T_{STG}$	-65 to +150	$^\circ\text{C}$

**ESD Ratings** (Note 12)

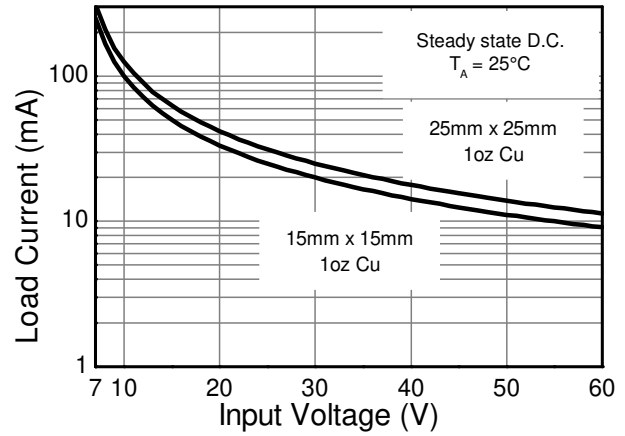
Characteristics	Symbols	Value	Unit	JEDEC Class
Electrostatic Discharge – Human Body Model	ESD HBM	4,000	V	3A
Electrostatic Discharge – Machine Model	ESD MM	400	V	C

- Notes:
6. For a device mounted with the  $V_{IN}$  lead on 25mm x 25mm 1oz copper that is on a single-sided 1.6mm FR4 PCB; device is measured under still air conditions whilst operating in steady-state.
  7. Same as Note 5, except mounted on 15mm x 15mm 1oz copper.
  8. Same as Note 5, whilst operating at  $V_{IN}=12V$ . Refer to Safe Operating Area for other Input Voltages.
  9. Same as Note 5, except measured with a single pulse width = 100 $\mu\text{s}$  and  $V_{IN}=12V$ .
  10. Same as Note 5, except measured with a single pulse width = 10ms and  $V_{IN}=12V$ .
  11.  $R_{\theta JL}$  = Thermal resistance from junction to solder-point (at the end of the  $V_{IN}$  lead).  $R_{\theta JC}$  = Thermal resistance from junction to the top of case.
  12. Refer to JEDEC specification JESD22-A114 and JESD22-A115.

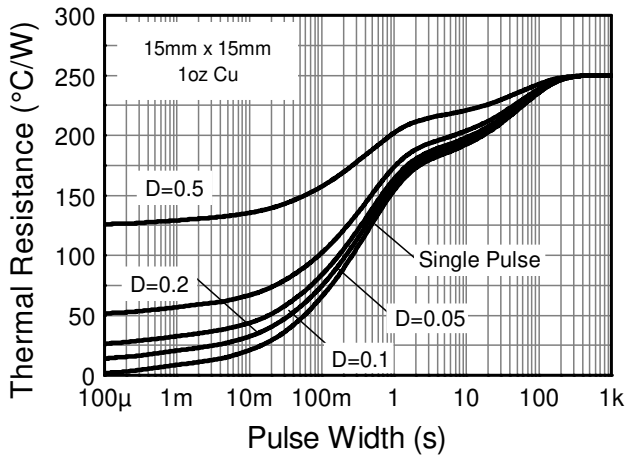
**Thermal Characteristics and Derating Information**



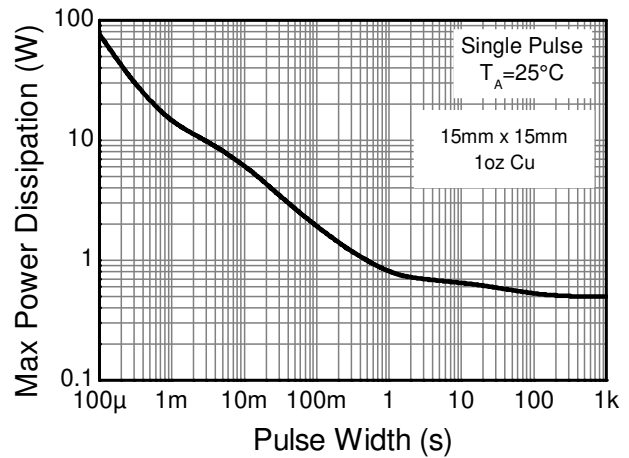
**Derating Curve**



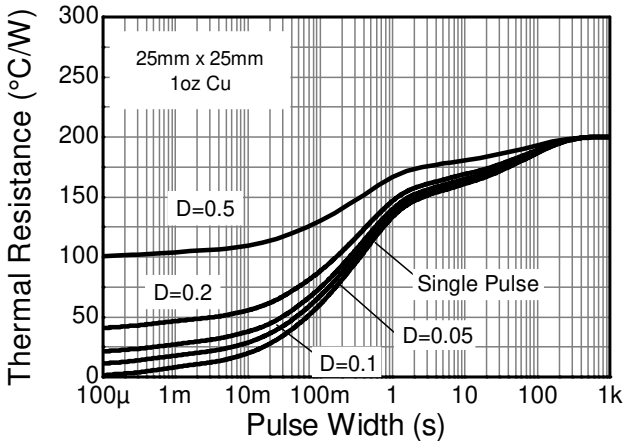
**Safe Operating Area**



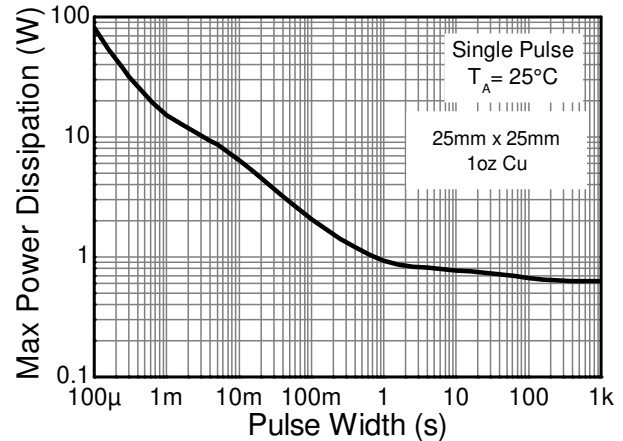
**Transient Thermal Impedance**



**Pulse Power Dissipation**



**Transient Thermal Impedance**



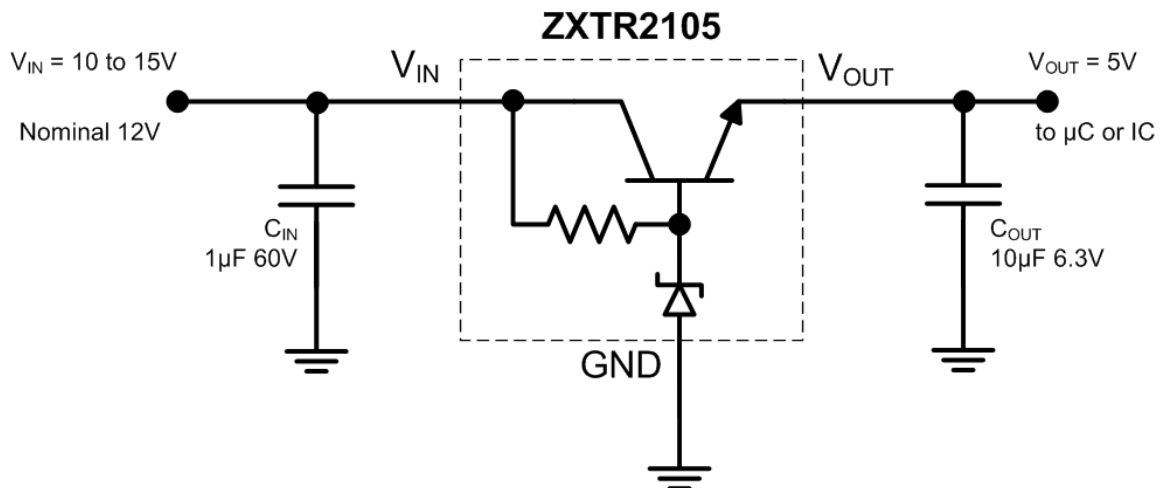
**Pulse Power Dissipation**

**Electrical Characteristics** (@ $T_A = +25^\circ\text{C}$ , unless otherwise specified.)

Characteristic	Symbol	Min	Typ	Max	Unit	Test Condition
Output Voltage (Note 13)	$V_{OUT}$	4.75	5.0	5.25	V	$V_{IN} = 12\text{V}$ , $I_{OUT} = 15\text{mA}$
Line Regulation (Notes 13 & 14)	$\Delta V_{OUT}$	—	33	220	mV	$V_{IN} = 10$ to $15\text{V}$ , $I_{OUT} = 15\text{mA}$
		—	400	700		$V_{IN} = 7$ to $60\text{V}$ , $I_{OUT} = 15\text{mA}$
		—	145	400		$V_{IN} = 10$ to $60\text{V}$ , $I_{OUT} = 15\text{mA}$
Temperature Coefficient	$\Delta V_{OUT}/\Delta T$	—	3.52	—	mV/ $^\circ\text{C}$	$T_J = -40^\circ\text{C}$ to $+150^\circ\text{C}$ $V_{IN} = 12\text{V}$ , $I_{OUT} = 15\text{mA}$
Load Regulation (Notes 13 & 15)	$\Delta V_{OUT}$	—	-20 -166	-130 -300	mV	$I_{OUT} = 10$ to $20\text{mA}$ , $V_{IN} = 12\text{V}$ $I_{OUT} = 0.1$ to $50\text{mA}$ , $V_{IN} = 12\text{V}$
Minimum Value of Input Voltage Required to Maintain Line Regulation	$V_{IN(MIN)}$	7	—	—	V	—
Quiescent Current	$I_Q$	—	450	800	$\mu\text{A}$	$V_{IN} = 12\text{V}$ , $I_{OUT} = 10\mu\text{A}$
		—	4,000	6,700		$V_{IN} = 60\text{V}$ , $I_{OUT} = 10\mu\text{A}$
Power Supply Rejection Ratio	$\Delta V_{IN}/\Delta V_{out}$	—	46	—	dB	$C_{OUT} = 100\text{nF}$ , $I_{OUT} = 15\text{mA}$ , $V_{OUT} = 5\text{V}$ , $V_{IN} = 7$ to $60\text{V}$ , $f = 100\text{Hz}$

- Notes:
- 13. Measured Under Pulsed Conditions; Pulse Width  $\leq 300\mu\text{s}$ . Duty cycle  $\leq 2\%$ .
  - 14. Line Regulation  $\Delta V_{OUT} = V_{OUT}(@V_{IN} = 15\text{V}) - V_{OUT}(@V_{IN} = 10\text{V})$   
 $\Delta V_{OUT} = V_{OUT}(@V_{IN} = 60\text{V}) - V_{OUT}(@V_{IN} = 7\text{V})$   
 $\Delta V_{OUT} = V_{OUT}(@V_{IN} = 60\text{V}) - V_{OUT}(@V_{IN} = 10\text{V})$
  - 15. Load Regulation  $\Delta V_{OUT} = V_{OUT}(@I_{OUT} = 20\text{mA}) - V_{OUT}(@I_{OUT} = 10\text{mA})$   
 $\Delta V_{OUT} = V_{OUT}(@I_{OUT} = 50\text{mA}) - V_{OUT}(@I_{OUT} = 0.1\text{mA})$

**Typical Application Circuit**

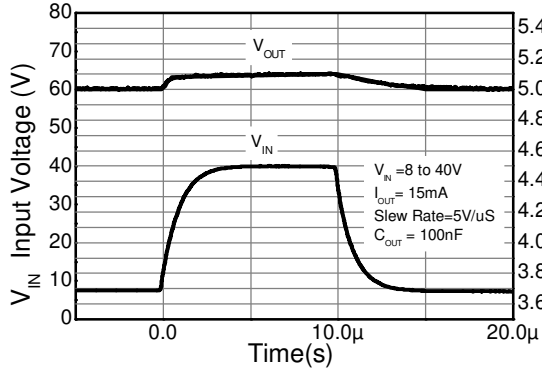


Example of a 5V regulated supply from a nominal 12V for powering a Controller IC.

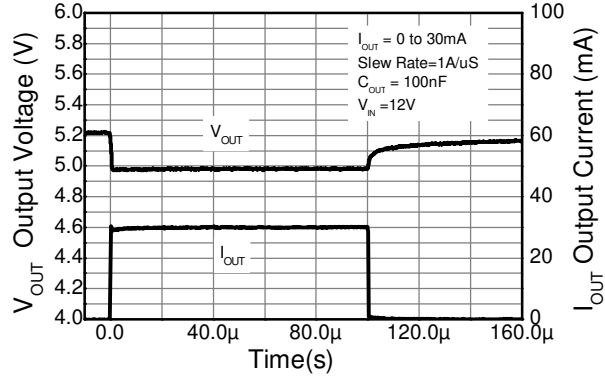
**Pin Functions**

Pin Name	Pin Function	Notes
$V_{IN}$	Input Supply	Input voltage can vary from $-0.3\text{V}$ to $60\text{V}$ with respect to GND; for $V_{OUT}$ regulated then $7\text{V} \leq V_{IN} \leq 60\text{V}$ . It is recommended to connect a $1\mu\text{F}$ capacitor to GND.
GND	Power Ground	This pin should be tied to the system ground.
$V_{OUT}$	Voltage Output	Outputs a regulated $5\text{V}$ when $7\text{V} \leq V_{IN} \leq 60\text{V}$ . When $V_{IN} < 7\text{V}$ , then $V_{OUT}$ maximum = $V_{IN} - 1\text{V}$ . The pin can be pulled high to a maximum of $+10\text{V}$ with respect to GND, or $+5\text{V}$ with respect to $V_{IN}$ , whichever is lower. It is recommended to connect a $10\mu\text{F}$ capacitor to GND and a minimum of $10\mu\text{A}$ to be drawn from $V_{OUT}$ to maintain regulation.

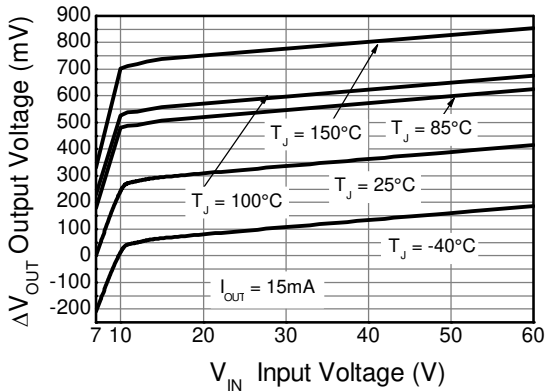
**Typical Electrical Characteristics** (@ $T_A = +25^\circ\text{C}$ , unless otherwise specified.)



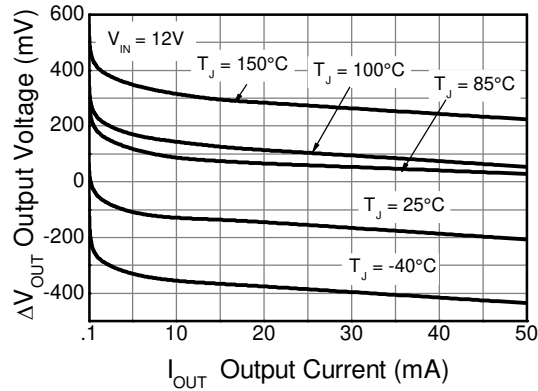
**Line transient response**



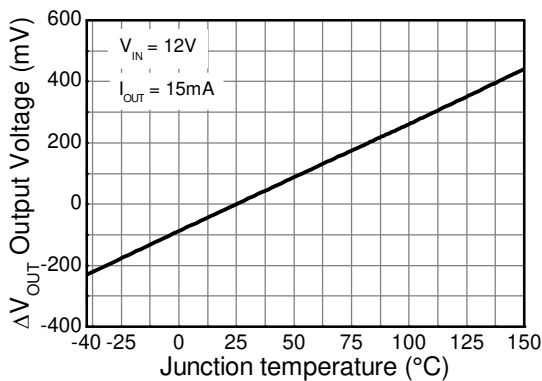
**Load transient response**



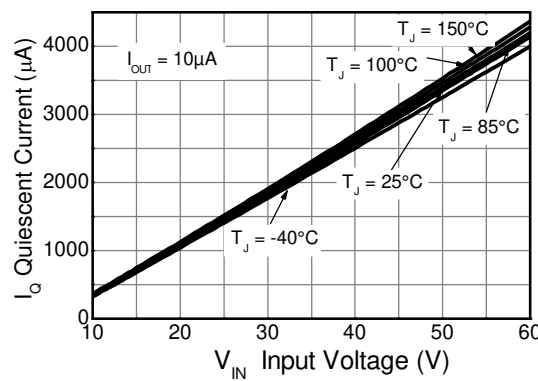
**Line Regulation (Note 16)**



**Load Regulation (Note 17)**



**Temperature Coefficient (Note 18)**

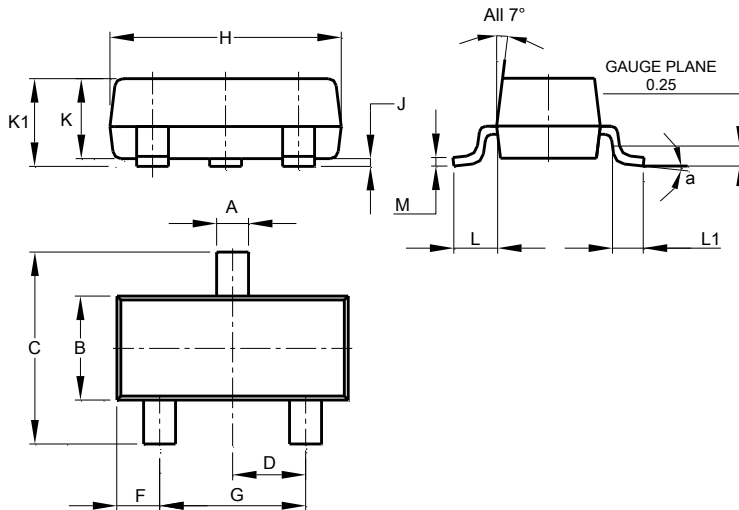


**Quiescent Current**

- Notes:
- 16. Line Regulation  $\Delta V_{OUT} = V_{OUT} - V_{OUT}(@ V_{IN} = 7V, I_{OUT} = 15mA, T_J = +25^\circ\text{C})$ .
  - 17. Load Regulation  $\Delta V_{OUT} = V_{OUT} - V_{OUT}(@ V_{IN} = 12V, I_{OUT} = 0.1mA, T_J = +25^\circ\text{C})$ .
  - 18. Temperature Coefficient  $\Delta V_{OUT} = V_{OUT} - V_{OUT}(@ V_{IN} = 12V, I_{OUT} = 15mA, T_J = +25^\circ\text{C})$ .

## Package Outline Dimensions

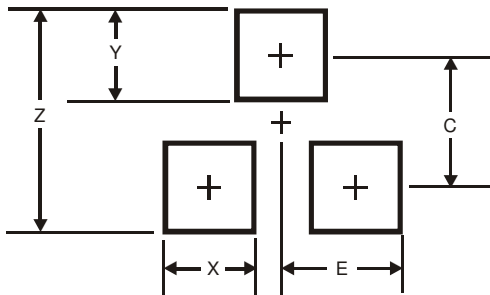
Please see AP02002 at <http://www.diodes.com/datasheets/ap02002.pdf> for the latest version.



SOT23			
Dim	Min	Max	Typ
A	0.37	0.51	0.40
B	1.20	1.40	1.30
C	2.30	2.50	2.40
D	0.89	1.03	0.915
F	0.45	0.60	0.535
G	1.78	2.05	1.83
H	2.80	3.00	2.90
J	0.013	0.10	0.05
K	0.890	1.00	0.975
K1	0.903	1.10	1.025
L	0.45	0.61	0.55
L1	0.25	0.55	0.40
M	0.085	0.150	0.110
a	8°		
All Dimensions in mm			

## Suggested Pad Layout

Please see AP02001 at <http://www.diodes.com/datasheets/ap02001.pdf> for the latest version.



Dimensions	Value (in mm)
Z	2.9
X	0.8
Y	0.9
C	2.0
E	1.35

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