

Description

The ZXTR2112FQ monolithically integrates a transistor, zener diode and resistor to function as a linear regulator. The device regulates with a 12V 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 number of components when compared with a multi-chip discrete solution.

This linear regulator is designed to meet the stringent requirements of automotive applications.

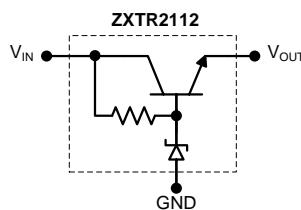
Applications

Supply voltage regulation for:

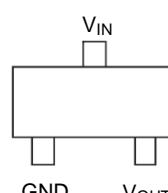
- 24V to 12V Rails
- Other Customized Input Rails



Top View



Internal Device Schematic



Top View
Pin-Out

| Pin Name | Pin Function |
|------------------|----------------|
| V _{IN} | Input Supply |
| GND | Power Ground |
| V _{OUT} | Voltage Output |

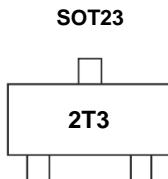
Ordering Information (Notes 4 & 5)

| Product | Compliance | Marking | Reel Size (inches) | Tape Width (mm) | Quantity per Reel |
|--------------|------------|---------|--------------------|-----------------|-------------------|
| ZXTR2112FQ-7 | Automotive | 2T3 | 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 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. Refer to 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



2T3 = 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 & Output Current | I_{IN}, I_{OUT} | 320 | mA |
| Peak Pulsed Input & Output Current | I_{IM}, I_{OM} | 2 | A |
| Maximum Voltage applied to V_{OUT} | $V_{OUT(max)}$ | Smaller of $V_{IN}+5\text{V}$ or 17V | V |

Maximum Current (@ $V_{IN} = 24\text{V}$) (@ $T_A = +25^\circ\text{C}$, unless otherwise specified.)

| Characteristic | Symbol | Value | Unit |
|---------------------------|-----------|-------|------|
| Continuous Output Current | I_{OUT} | 50 | mA |
| Pulsed Output Current | I_{OM} | 2,000 | mA |
| | | 500 | |

Thermal Characteristics

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

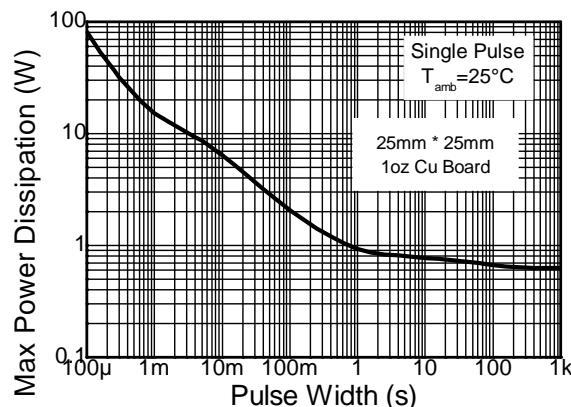
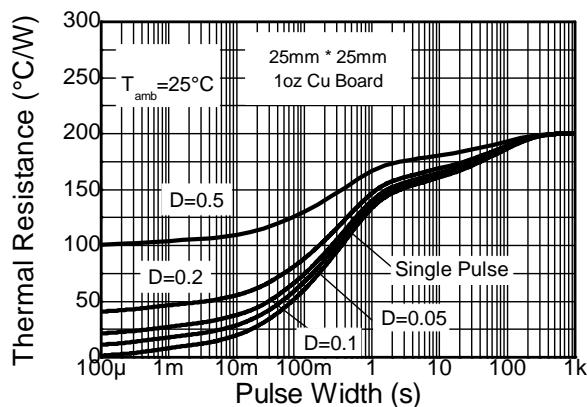
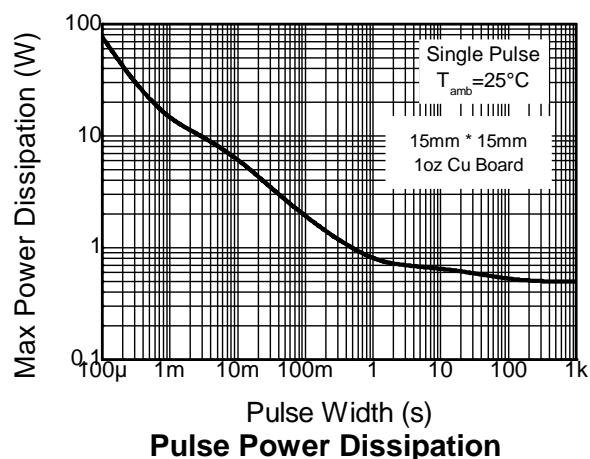
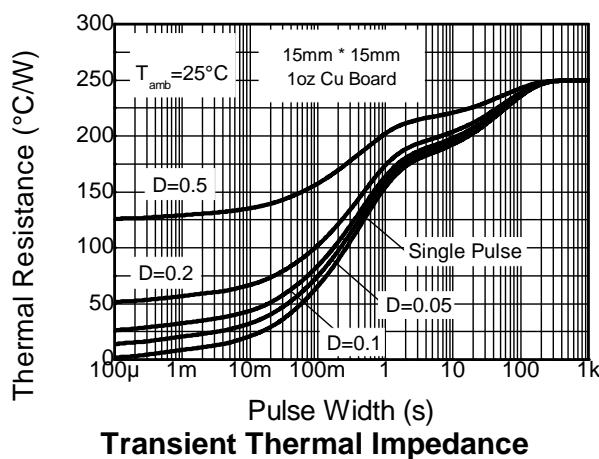
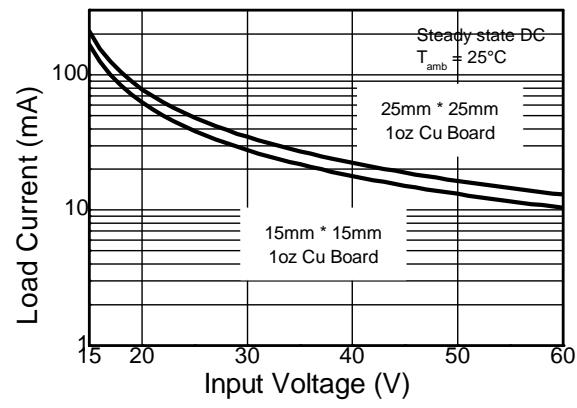
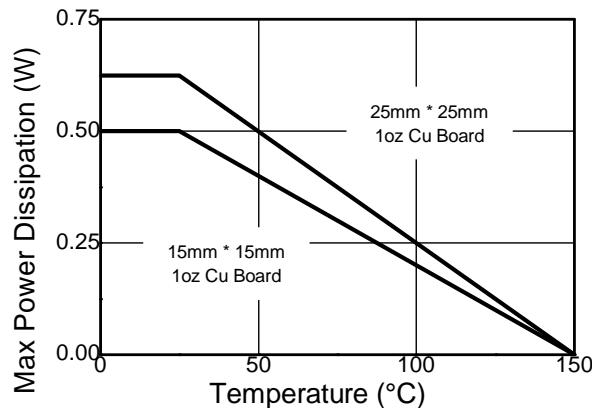
ESD Ratings (Note 12)

| 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 6, except mounted on 15mm x 15mm 1oz copper.
8. Same as Note 6, whilst operating at $V_{IN}=24\text{V}$. Refer to Safe Operating Area for other Input Voltages.
9. Same as Note 6, except measured with a single pulse width = 100μs and $V_{IN}=24\text{V}$.
10. Same as Note 6, except measured with a single pulse width = 10ms and $V_{IN}=24\text{V}$.
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



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} | 10.8 | 12 | 13.2 | V | $V_{\text{IN}} = 24\text{V}$, $I_{\text{OUT}} = 15\text{mA}$ |
| Line Regulation (Notes 13 & 14) | ΔV_{OUT} | — | 20 | 50 | mV | $V_{\text{IN}} = 18$ to 24V , $I_{\text{OUT}} = 15\text{mA}$ |
| | | — | 130 | — | | $V_{\text{IN}} = 18$ to 60V , $I_{\text{OUT}} = 15\text{mA}$ |
| | | — | 150 | — | | $V_{\text{IN}} = 15$ to 60V , $I_{\text{OUT}} = 15\text{mA}$ |
| | | — | 10.4 | — | mV/ $^\circ\text{C}$ | $T_J = -40^\circ\text{C}$ to $+125^\circ\text{C}$ $V_{\text{IN}} = 24\text{V}$, $I_{\text{OUT}} = 15\text{mA}$ |
| Temperature Coefficient | $\Delta V_{\text{OUT}}/\Delta T$ | — | — | — | mV/ $^\circ\text{C}$ | |
| Load Regulation (Notes 13 & 15) | ΔV_{OUT} | — | -30 -190 | -100 -300 | mV | $I_{\text{OUT}} = 10$ to 20mA , $V_{\text{IN}} = 24\text{V}$ $I_{\text{OUT}} = 0.1$ to 50mA , $V_{\text{IN}} = 24\text{V}$ |
| Minimum Value of Input Voltage Required to Maintain Line Regulation | $V_{\text{IN(MIN)}}$ | 15 | — | — | V | — |
| Quiescent Current | I_Q | — | 160 3,500 | 360 6,000 | μA | $V_{\text{IN}} = 15\text{V}$, $I_{\text{OUT}} = 10\mu\text{A}$ $V_{\text{IN}} = 60\text{V}$, $I_{\text{OUT}} = 10\mu\text{A}$ |
| Power Supply Rejection Ratio | $\Delta V_{\text{IN}}/\Delta V_{\text{OUT}}$ | — | 50 | — | dB | $C_{\text{OUT}} = 100\text{nF}$, $I_{\text{OUT}} = 15\text{mA}$, $V_{\text{OUT}} = 12\text{V}$, $V_{\text{IN}} = 15$ to 60V , $f = 100\text{Hz}$ |

Notes:

- 13. Measured under pulsed conditions. Pulse width $\leq 300\mu\text{s}$. Duty cycle $\leq 2\%$.

14. Line regulation: $\Delta V_{\text{OUT}} = V_{\text{OUT}}(@V_{\text{IN}}=24\text{V}) - V_{\text{OUT}}(@V_{\text{IN}} = 18\text{V})$

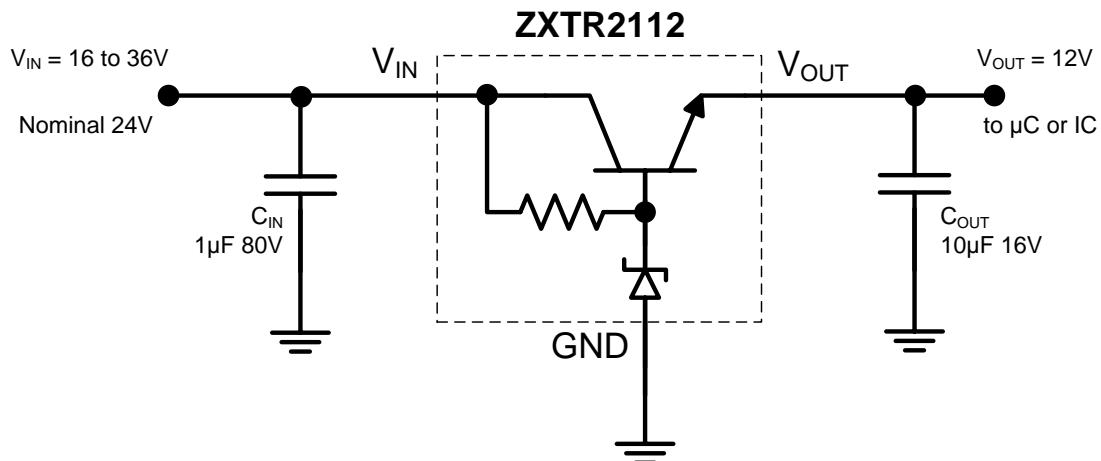
$\Delta V_{\text{OUT}} = V_{\text{OUT}}(@V_{\text{IN}}=60\text{V}) - V_{\text{OUT}}(@V_{\text{IN}} = 15\text{V})$

$\Delta V_{\text{OUT}} = V_{\text{OUT}}(@V_{\text{IN}}=60\text{V}) - V_{\text{OUT}}(@V_{\text{IN}} = 18\text{V})$

15. Load regulation: $\Delta V_{\text{OUT}} = V_{\text{OUT}}(@I_{\text{OUT}} = 20\text{mA}) - V_{\text{OUT}}(@I_{\text{OUT}} = 10\text{mA})$

$\Delta V_{\text{OUT}} = V_{\text{OUT}}(@I_{\text{OUT}} = 50\text{mA}) - V_{\text{OUT}}(@I_{\text{OUT}} = 0.1\text{mA})$

Typical Application Circuit

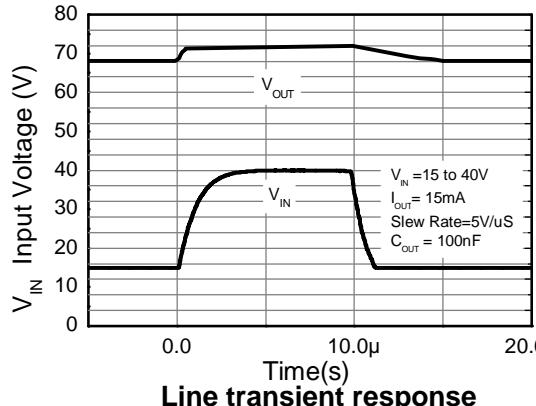


Example of a 12V regulated supply from a nominal 24V for powering a Controller IC.

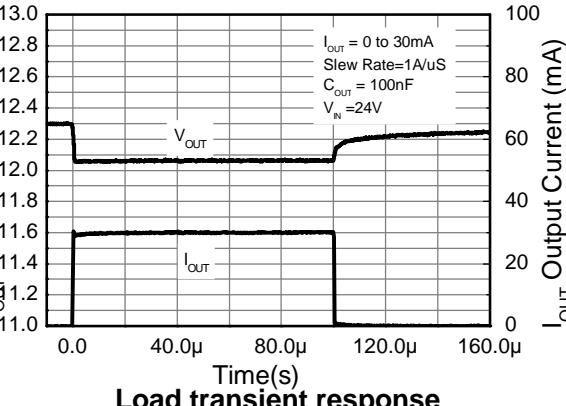
Pin Functions

| Pin Name | Pin Function | Notes |
|------------------|----------------|---|
| V_{IN} | Input Supply | Input voltage can vary from -0.3V to 60V with respect to GND; for V_{OUT} regulated then $15\text{V} \leq V_{\text{IN}} \leq 60\text{V}$. 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 12V when $15\text{V} \leq V_{\text{IN}} \leq 60\text{V}$. When $V_{\text{IN}} < 15\text{V}$, then V_{OUT} maximum = $V_{\text{IN}} - 1\text{V}$. The pin can be pulled high to a maximum of $+17\text{V}$ 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. |

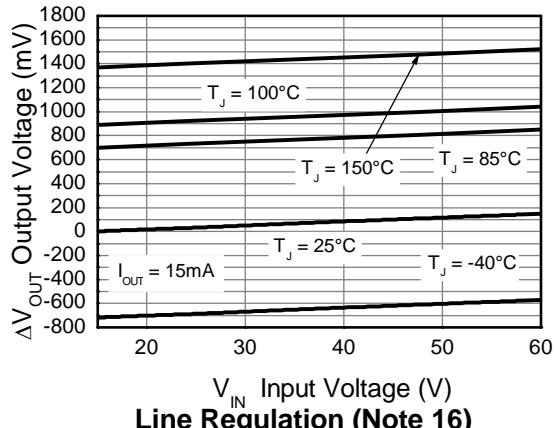
Typical Electrical Characteristics (@ $T_A = +25^\circ\text{C}$, unless otherwise specified.)



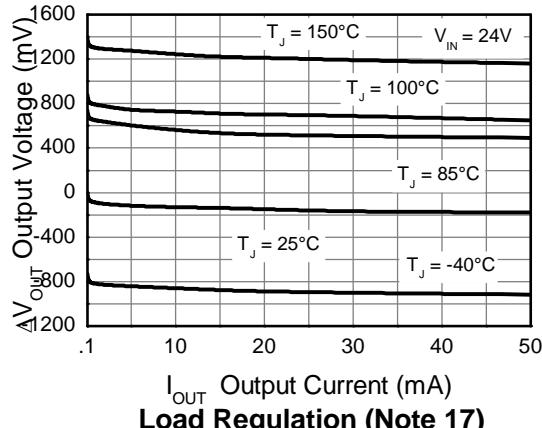
Line transient response



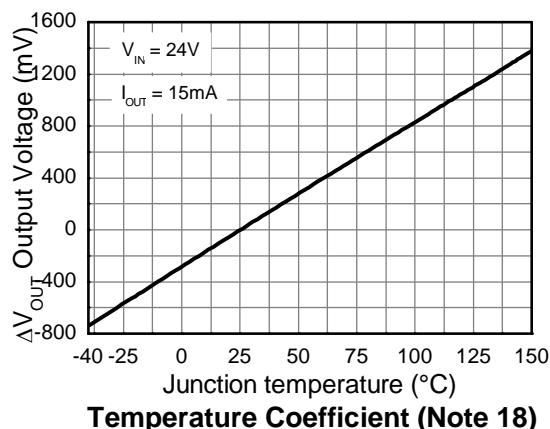
Load transient response



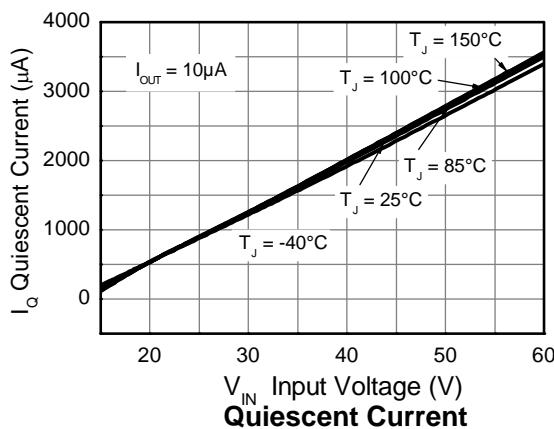
Line Regulation (Note 16)



Load Regulation (Note 17)



Temperature Coefficient (Note 18)



Quiescent Current

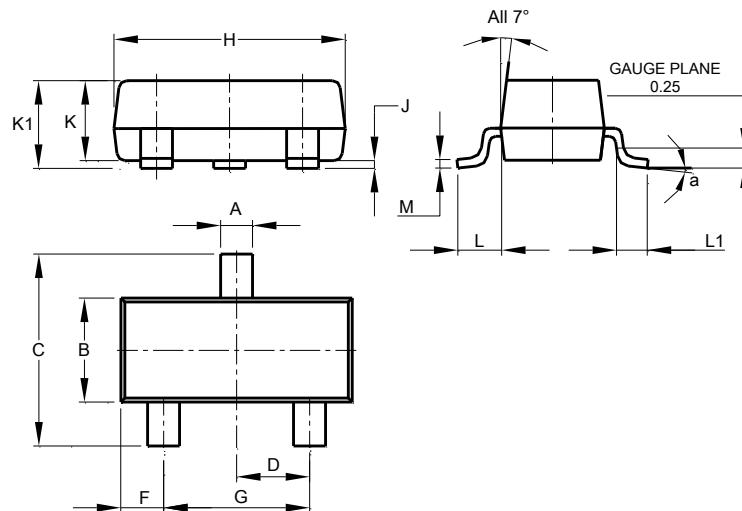
Notes:

16. Line Regulation $\Delta V_{\text{OUT}} = V_{\text{OUT}} - V_{\text{OUT}}(@ V_{\text{IN}} = 15\text{V}, I_{\text{OUT}} = 15\text{mA}, T_J = +25^\circ\text{C})$.
17. Load Regulation $\Delta V_{\text{OUT}} = V_{\text{OUT}} - V_{\text{OUT}}(@ V_{\text{IN}} = 24\text{V}, I_{\text{OUT}} = 0.1\text{mA}, T_J = +25^\circ\text{C})$.
18. Temperature Coefficient $\Delta V_{\text{OUT}} = V_{\text{OUT}} - V_{\text{OUT}}(@ V_{\text{IN}} = 24\text{V}, I_{\text{OUT}} = 15\text{mA}, T_J = +25^\circ\text{C})$.

Package Outline Dimensions

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

SOT23

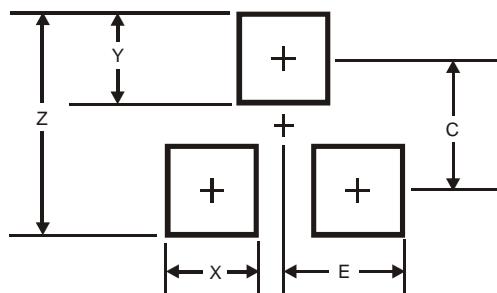


| SOT23 | | | |
|----------------------|-------|-------|-------|
| Dim | Min | Max | Typ |
| A | 0.37 | 0.51 | 0.40 |
| B | 1.20 | 1.40 | 1.30 |
| C | 2.30 | 2.50 | 2.40 |
| D | 0.89 | 1.03 | 0.915 |
| F | 0.45 | 0.60 | 0.535 |
| G | 1.78 | 2.05 | 1.83 |
| H | 2.80 | 3.00 | 2.90 |
| J | 0.013 | 0.10 | 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.

SOT23



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

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