

## Description

The ZXTR2105FQ 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.

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

## Applications

Supply voltage regulation for:

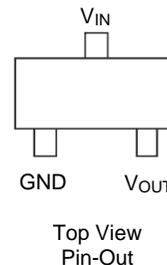
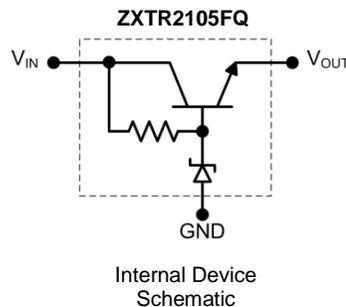
- 12V to 5V Rails
- 24V to 5V Rails
- Other Customized Input Rails

## Features

- Series Linear Regulator Using Emitter-Follower Stage
- Input Voltage = 7V 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)**

## 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
- Weight: 0.008 grams (Approximate)



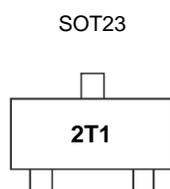
| Pin Name         | Pin Function   |
|------------------|----------------|
| V <sub>IN</sub>  | Input Supply   |
| GND              | Power Ground   |
| V <sub>OUT</sub> | Voltage Output |

## Ordering Information (Note 5)

| Product      | Compliance | Marking | Reel Size (inches) | Tape Width (mm) | Quantity per Reel |
|--------------|------------|---------|--------------------|-----------------|-------------------|
| 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. Refer to [http://www.diodes.com/product\\_compliance\\_definitions.html](http://www.diodes.com/product_compliance_definitions.html).
  5. For packaging details, go to our website at <https://www.diodes.com/design/support/packaging/diodes-packaging/>.

## Marking Information



2T1 = Product Type Marking Code

**Absolute Maximum Ratings** (Voltage relative to GND, @T<sub>A</sub> = +25°C, unless otherwise specified.)

| Characteristic                              | Symbol                             | Value                                 | Unit |
|---|------------------------------------|---------------------------------------|------|
| Input Voltage                               | V <sub>IN</sub>                    | -0.3 to 60                            | V    |
| Continuous Input and Output Current         | I <sub>IN</sub> , I <sub>OUT</sub> | 320                                   | mA   |
| Peak Pulsed Input and Output Current        | I <sub>IM</sub> , I <sub>OM</sub>  | 2                                     | A    |
| Maximum Voltage Applied to V <sub>OUT</sub> | V <sub>OUT(MAX)</sub>              | Smaller of V <sub>IN</sub> +5V or 10V | V    |

**Maximum Current at V<sub>IN</sub> = 12V** (@T<sub>A</sub> = +25°C, unless otherwise specified.)

| Characteristic            | Symbol           | Value | Unit |
|---------------------------|------------------|-------|------|
| Continuous Output Current | I <sub>OUT</sub> | 89    | mA   |
| Pulsed Output Current     | I <sub>OM</sub>  | 2,000 | mA   |
|                           |                  | 890   |      |

**Thermal Characteristics**

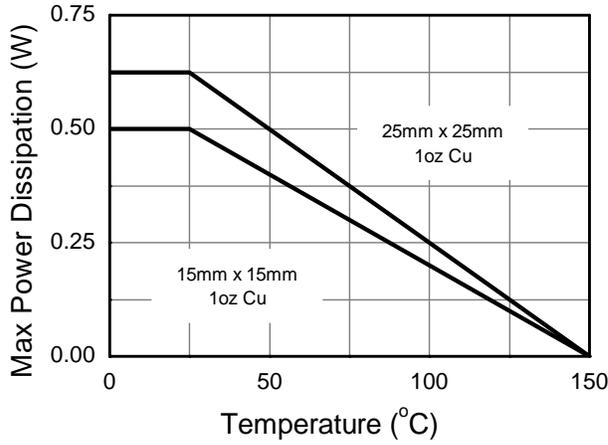
| Characteristic   | Symbol                            | Value       | Unit |
|--|-----------------------------------|-------------|------|
| Power Dissipation  | P <sub>D</sub>                    | 625         | mW   |
|  |                                   | 500         |      |
| Thermal Resistance, Junction to Ambient                  | R <sub>θJA</sub>                  | 200         | °C/W |
|  |                                   | 250         |      |
| Thermal Resistance, Junction to Lead                     | R <sub>θJL</sub>                  | 197         |      |
| Thermal Resistance, Junction to Case                     | R <sub>θJC</sub>                  | 17          |      |
| Maximum Operating Junction and Storage Temperature Range | T <sub>J</sub> , T <sub>STG</sub> | -65 to +150 | °C   |

**ESD Ratings** (Note 12)

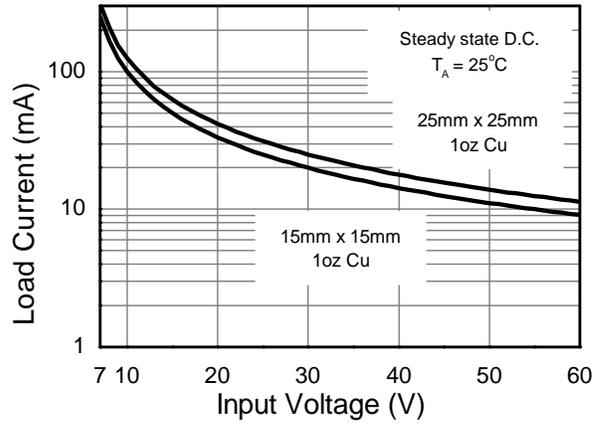
| Characteristics                            | Symbols | Value | Unit | JEDEC Class |
|--|---------|-------|------|-------------|
| Electrostatic Discharge – Human Body Model | ESD HBM | 4,000 | V    | 3A          |
| Electrostatic Discharge – Machine Model    | ESD MM  | 400   | V    | C           |

- Notes:
- For a device mounted with the V<sub>IN</sub> lead on 25mm x 25mm 1oz copper that is on a single-sided 1.6mm FR-4 PCB; device is measured under still air conditions whilst operating in steady-state.
  - Same as Note 6, except mounted on 15mm x 15mm 1oz copper.
  - Same as Note 6, whilst operating at V<sub>IN</sub>=12V. Refer to Safe Operating Area for other Input Voltages.
  - Same as Note 6, except measured with a single pulse width = 100µs and V<sub>IN</sub>=12V.
  - Same as Note 6, except measured with a single pulse width = 10ms and V<sub>IN</sub>=12V.
  - R<sub>θJL</sub> = Thermal resistance from junction to solder-point (at the end of the V<sub>IN</sub> lead). R<sub>θJC</sub> = Thermal resistance from junction to the top of case.
  - Refer to JEDEC specification JESD22-A114 and JESD22-A115.

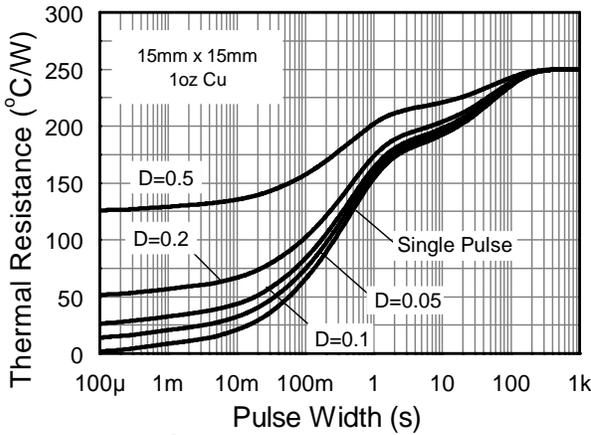
**Thermal Characteristics and Derating Information**



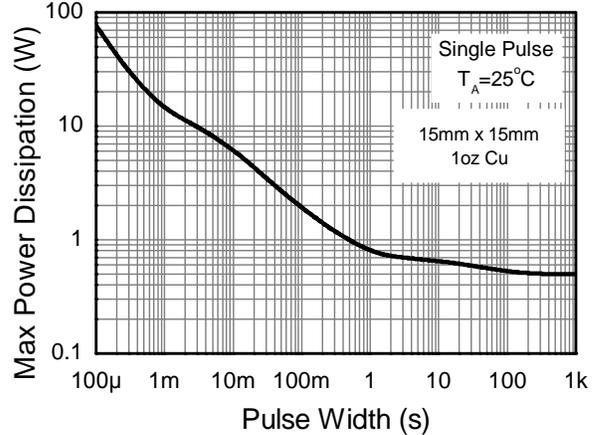
**Derating Curve**



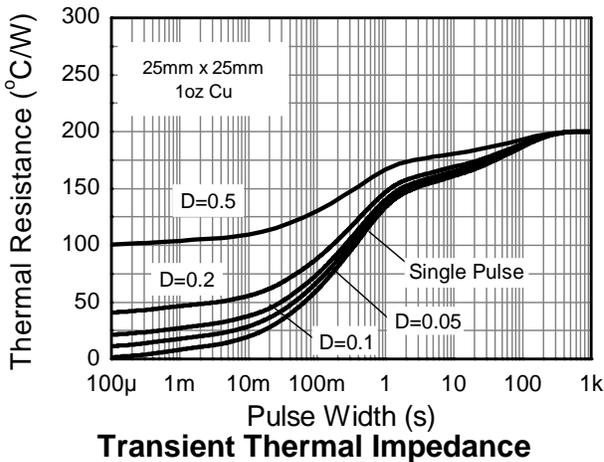
**Safe Operating Area**



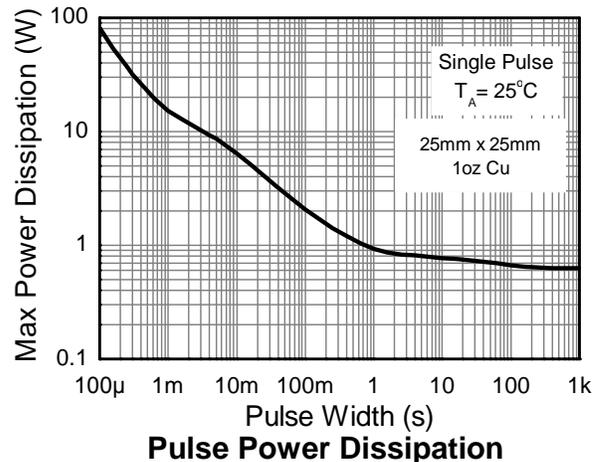
**Transient Thermal Impedance**



**Pulse Power Dissipation**



**Transient Thermal Impedance**

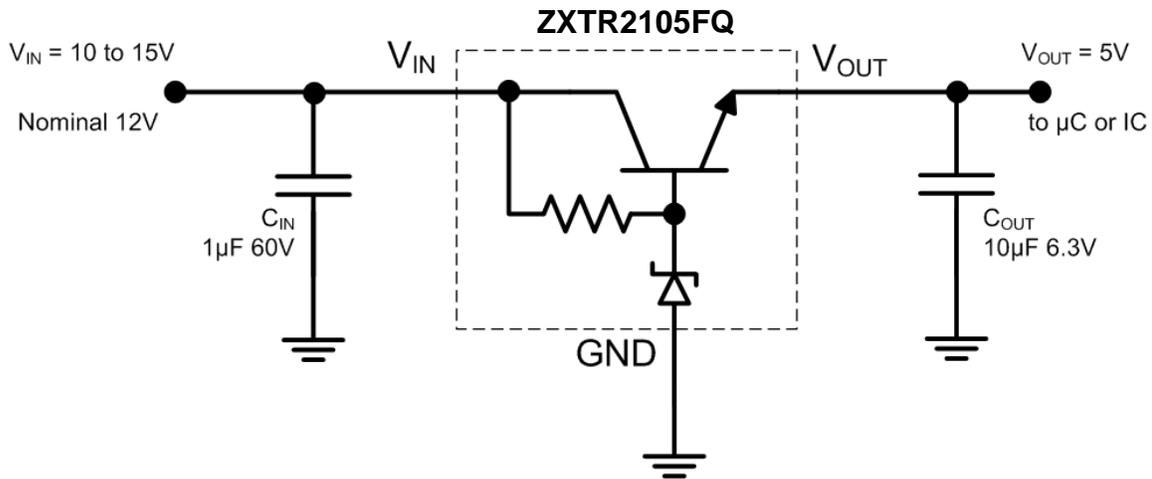


**Pulse Power Dissipation**

**Electrical Characteristics** (@T<sub>A</sub> = +25°C, unless otherwise specified.)

| Characteristic  | Symbol                              | Min  | Typ          | Max          | Unit  | Test Condition  |
|---|-------------------------------------|------|--------------|--------------|-------|---|
| Output Voltage (Note 13)  | V <sub>OUT</sub>                    | 4.75 | 5.0          | 5.25         | V     | V <sub>IN</sub> = 12V, I <sub>OUT</sub> = 15mA  |
| Line Regulation (Notes 13 & 14)                                     | ΔV <sub>OUT</sub>                   | —    | 33           | 220          | mV    | V <sub>IN</sub> = 10V to 15V, I <sub>OUT</sub> = 15mA   |
|   |                                     | —    | 400          | 700          |       | V <sub>IN</sub> = 7V to 60V, I <sub>OUT</sub> = 15mA  |
|   |                                     | —    | 145          | 400          |       | V <sub>IN</sub> = 10V to 60V, I <sub>OUT</sub> = 15mA   |
| Temperature Coefficient   | ΔV <sub>OUT</sub> /ΔT               | —    | 3.52         | —            | mV/°C | T <sub>J</sub> = -40°C to +150°C<br>V <sub>IN</sub> = 12V, I <sub>OUT</sub> = 15mA                                  |
| Load Regulation (Notes 13 & 15)                                     | ΔV <sub>OUT</sub>                   | —    | -20<br>-166  | -130<br>-300 | mV    | I <sub>OUT</sub> = 10mA to 20mA, V <sub>IN</sub> = 12V<br>I <sub>OUT</sub> = 0.1mA to 50mA, V <sub>IN</sub> = 12V   |
| Minimum Value of Input Voltage Required to Maintain Line Regulation | V <sub>IN(MIN)</sub>                | 7    | —            | —            | V     | —   |
| Quiescent Current   | I <sub>Q</sub>                      | —    | 450<br>4,000 | 800<br>6,700 | μA    | V <sub>IN</sub> = 12V, I <sub>OUT</sub> = 10μA<br>V <sub>IN</sub> = 60V, I <sub>OUT</sub> = 10μA                    |
| Power Supply Rejection Ratio  | ΔV <sub>IN</sub> /ΔV <sub>OUT</sub> | —    | 46           | —            | dB    | C <sub>OUT</sub> = 100nF, I <sub>OUT</sub> = 15mA,<br>V <sub>OUT</sub> = 5V, V <sub>IN</sub> = 7V to 60V, f = 100Hz |

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

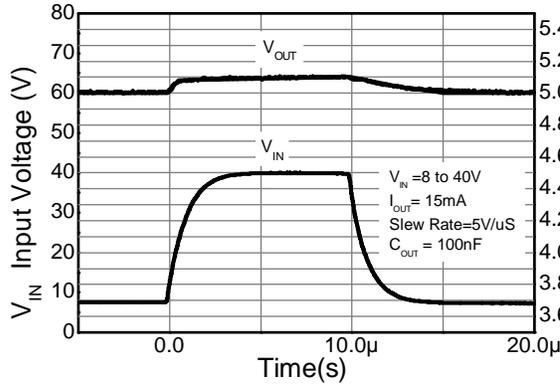
**Typical Application Circuit**


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

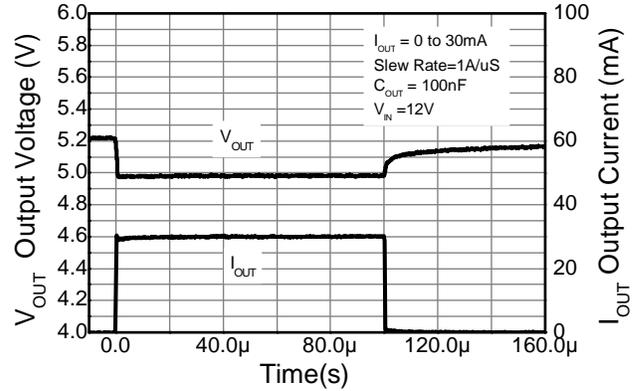
**Pin Functions**

| Pin Name         | Pin Function   | Notes   |
|------------------|----------------|---|
| V <sub>IN</sub>  | Input Supply   | Input voltage can vary from -0.3V to 60V with respect to GND; for V <sub>OUT</sub> regulated then 7V ≤ V <sub>IN</sub> ≤ 60V. It is recommended to connect a 1μF capacitor to GND.  |
| GND              | Power Ground   | This pin should be tied to the system ground.   |
| V <sub>OUT</sub> | Voltage Output | Outputs a regulated 5V when 7V ≤ V <sub>IN</sub> ≤ 60V. When V <sub>IN</sub> < 7V, then V <sub>OUT</sub> maximum = V <sub>IN</sub> - 1V. The pin can be pulled high to a maximum of +10V with respect to GND, or +5V with respect to V <sub>IN</sub> , whichever is lower. It is recommended to connect a 10μF capacitor to GND and a minimum of 10μA to be drawn from V <sub>OUT</sub> to maintain regulation. |

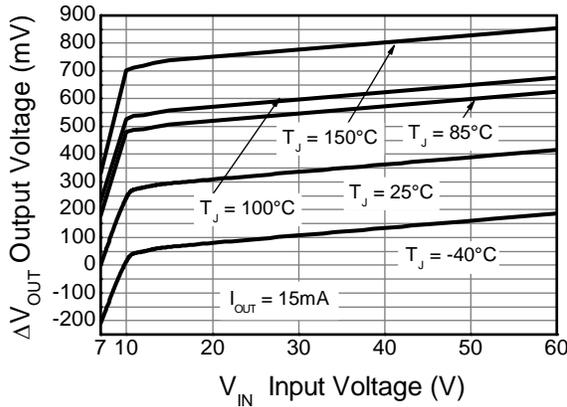
**Typical Electrical Characteristics** (@T<sub>A</sub> = +25°C, unless otherwise specified.)



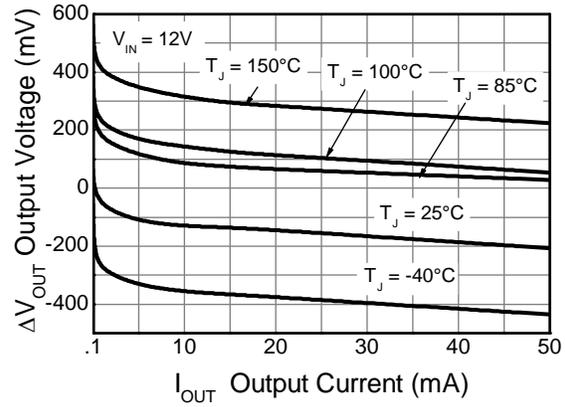
**Line transient response**



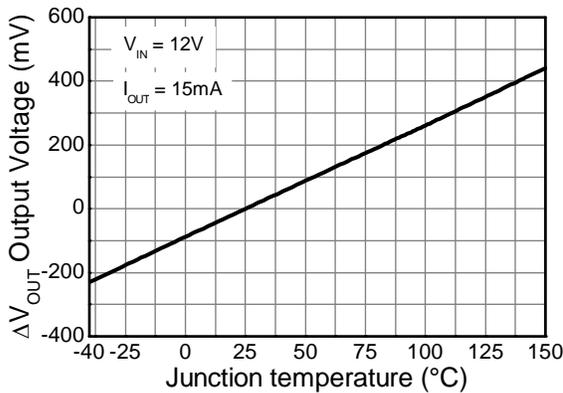
**Load transient response**



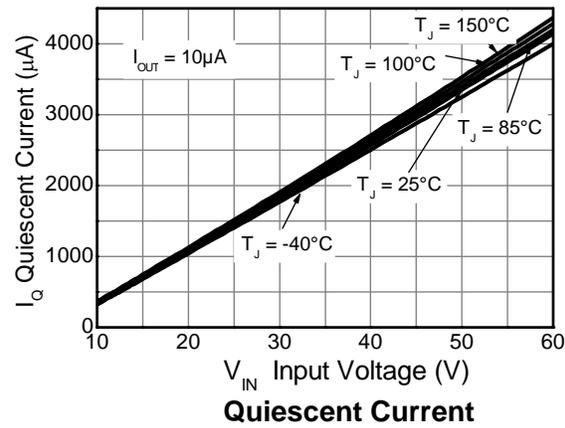
**Line Regulation (Note 16)**



**Load Regulation (Note 17)**



**Temperature Coefficient (Note 18)**



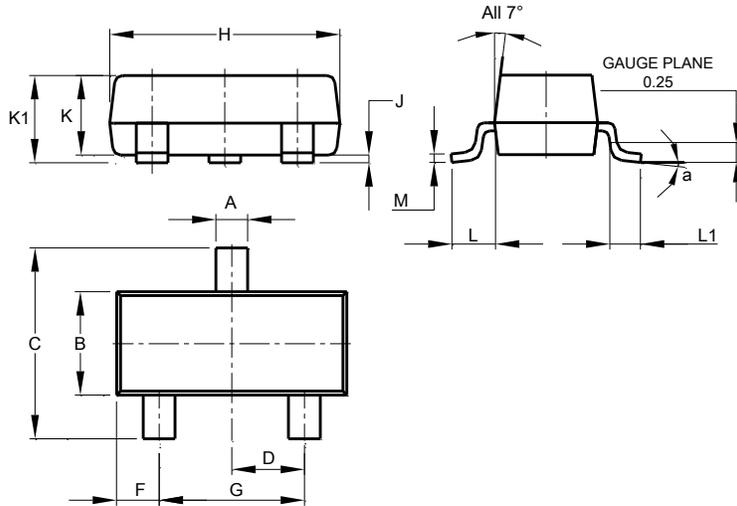
**Quiescent Current**

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

**Package Outline Dimensions**

Please see <http://www.diodes.com/package-outlines.html> for the latest version.

**SOT23**

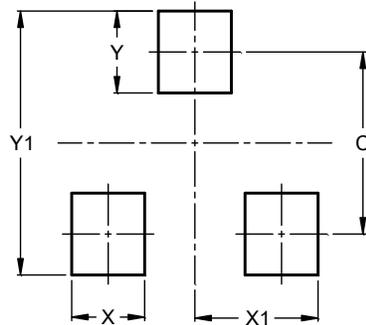


| SOT23                |       |       |       |
|----------------------|-------|-------|-------|
| Dim                  | Min   | Max   | Typ   |
| A                    | 0.37  | 0.51  | 0.40  |
| B                    | 1.20  | 1.40  | 1.30  |
| C                    | 2.30  | 2.50  | 2.40  |
| D                    | 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                    | 0°    | 8°    | --    |
| All Dimensions in mm |       |       |       |

**Suggested Pad Layout**

Please see <http://www.diodes.com/package-outlines.html> for the latest version.

**SOT23**



| Dimensions | Value (in mm) |
|------------|---------------|
| C          | 2.0           |
| X          | 0.8           |
| X1         | 1.35          |
| Y          | 0.9           |
| Y1         | 2.9           |

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