

## Description

The ZXTR2105FF 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 SOT23F package, minimizing PCB area and reducing the number of components when compared with a multi-chip discrete solution.

## Applications

Supply Voltage Regulation for:

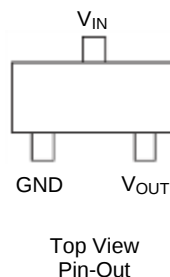
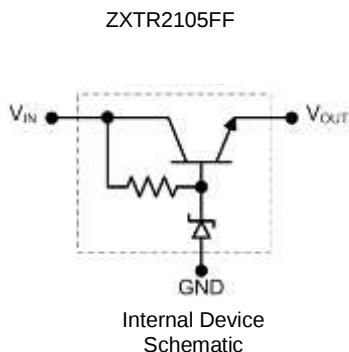
- 12V to 5V Rails
- 24V to 5V Rails
- Other Customized Input Rails

## Features

- Series Linear Regulator Using Emitter-Follower Stage
- Input Voltage = 7 to 60V (For Regulated Output Voltage)
- Output Voltage = 5V  $\pm$  5%
- Fully Integrated into a SOT23F Package
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**

## Mechanical Data

- Case: SOT23F
- 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)



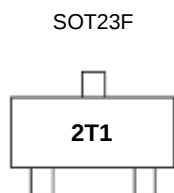
| Pin Name         | Pin Function   |
|------------------|----------------|
| V <sub>IN</sub>  | Input Supply   |
| GND              | Power Ground   |
| V <sub>OUT</sub> | Voltage Output |

## Ordering Information (Note 4)

| Product      | Compliance | Marking | Reel Size (inches) | Tape Width (mm) | Quantity per Reel |
|--------------|------------|---------|--------------------|-----------------|-------------------|
| ZXTR2105FF-7 | AEC-Q101   | 2T1     | 7                  | 8               | 3,000             |

- Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.
  2. See <https://www.diodes.com/quality/lead-free/> 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. 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<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   | mA   |

**Thermal Characteristics**

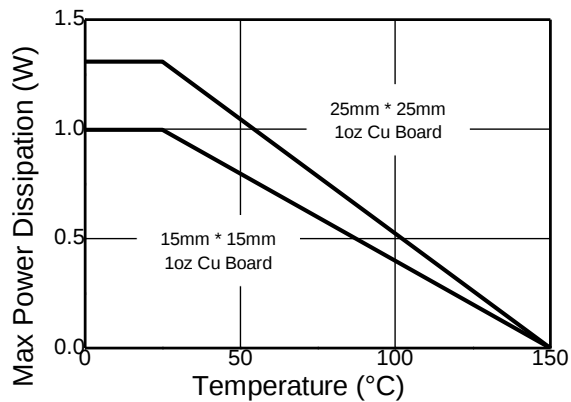
| Characteristic                                           | Symbol                            | Value       | Unit |
|----------------------------------------------------------|-----------------------------------|-------------|------|
| Power Dissipation                                        | P <sub>D</sub>                    | 1.3         | W    |
|                                                          |                                   | 1           | W    |
| Thermal Resistance, Junction to Ambient                  | R <sub>θJA</sub>                  | 95          | °C/W |
|                                                          |                                   | 126         | °C/W |
| Thermal Resistance, Junction to Lead                     | R <sub>θJL</sub>                  | 59          | °C/W |
| Thermal Resistance, Junction to Case                     | R <sub>θJC</sub>                  | 38          | °C/W |
| Maximum Operating Junction and Storage Temperature Range | T <sub>J</sub> , T <sub>STG</sub> | -65 to +150 | °C   |

**ESD Ratings** (Note 11)

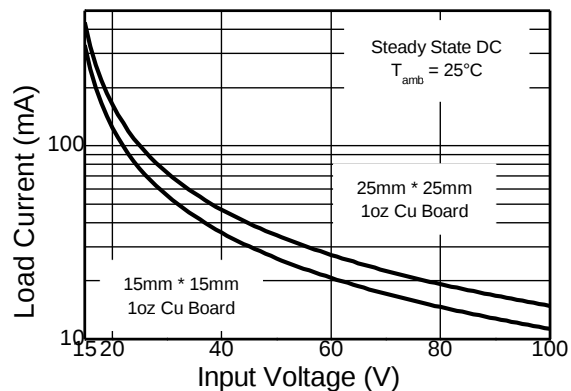
| Characteristics                            | Symbols | Value | Unit | JEDEC Class |
|--------------------------------------------|---------|-------|------|-------------|
| Electrostatic Discharge – Human Body Model | ESD HBM | 4,000 | V    | 3A          |
| Electrostatic Discharge – Machine Model 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

- Notes:
- For a device mounted with the VIN 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.
  - Same as Note 5, except mounted on 15mm x 15mm 1oz copper.
  - Same as Note 5, whilst operating at VIN=12V. Refer to Safe Operating Area for other Input Voltages.
  - Same as Note 5, except measured with a single pulse width = 100μs and VIN=12V.
  - Same as Note 5, except measured with a single pulse width = 10ms and VIN=12V.
  - R<sub>θJL</sub> = Thermal resistance from junction to solder-point (at the end of the VIN lead). R<sub>θJC</sub> = Thermal resistance from junction to the top of case.
  - Refer to JEDEC specification JESD22-A114 and JESD22-A115.

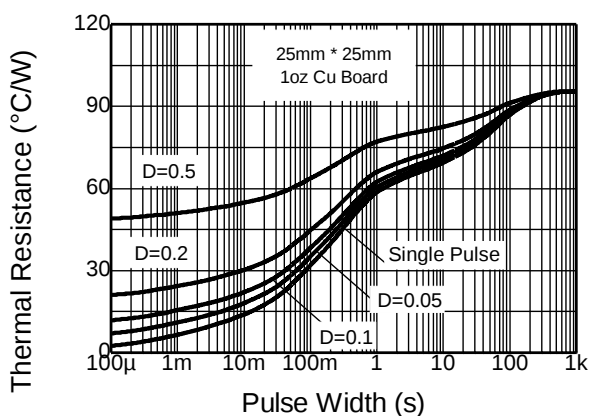
## Thermal Characteristics and Derating Information



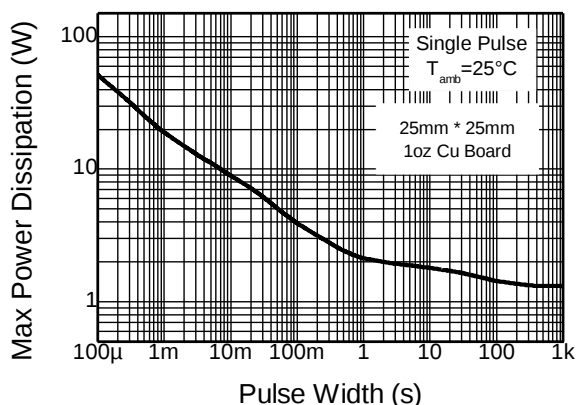
**Derating Curve**



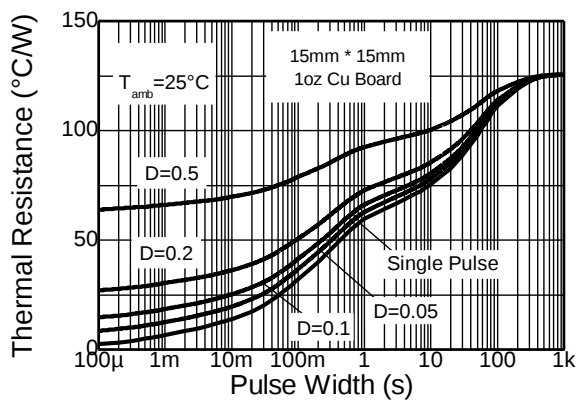
**Safe Operating Area**



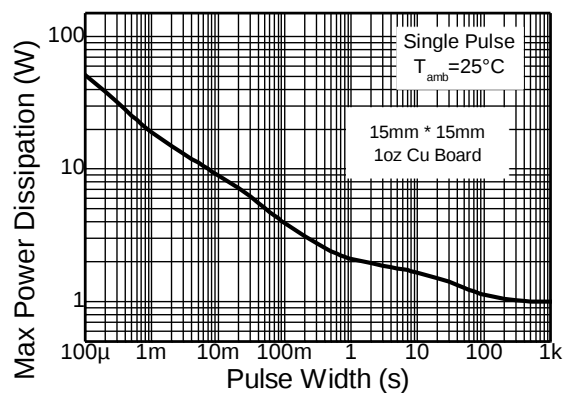
**Transient Thermal Impedance**



**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 12)                                            | V <sub>OUT</sub>                    | 4.75 | 5.0          | 5.25         | V     | V <sub>IN</sub> = 12V, I <sub>OUT</sub> = 15mA                                                                     |
| Line Regulation (Notes 12 & 13)                                     | ΔV <sub>OUT</sub>                   | —    | 33           | 220          | mV    | V <sub>IN</sub> = 10 to 15V, I <sub>OUT</sub> = 15mA                                                               |
|                                                                     |                                     | —    | 400          | 700          |       | V <sub>IN</sub> = 7 to 60V, I <sub>OUT</sub> = 15mA                                                                |
|                                                                     |                                     | —    | 145          | 400          |       | V <sub>IN</sub> = 10 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 12 & 14)                                     | ΔV <sub>OUT</sub>                   | —    | -20<br>-166  | -130<br>-300 | mV    | I <sub>OUT</sub> = 10 to 20mA, V <sub>IN</sub> = 12V<br>I <sub>OUT</sub> = 0.1 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> = 7 to 60V, f = 100Hz |

Notes: 12. Measured Under Pulsed Conditions; Pulse Width ≤ 300μs. Duty cycle ≤ 2%.

13. Line Regulation ΔV<sub>OUT</sub> = V<sub>OUT</sub>(@V<sub>IN</sub> = 15V) – V<sub>OUT</sub>(@V<sub>IN</sub> = 10V)

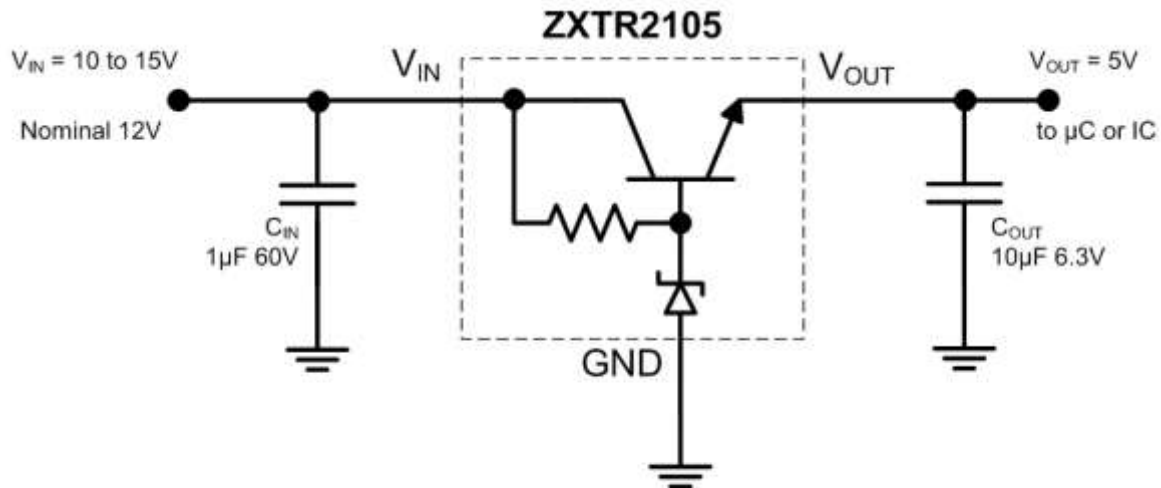
ΔV<sub>OUT</sub> = V<sub>OUT</sub>(@V<sub>IN</sub> = 60V) – V<sub>OUT</sub>(@V<sub>IN</sub> = 7V)

ΔV<sub>OUT</sub> = V<sub>OUT</sub>(@V<sub>IN</sub> = 60V) – V<sub>OUT</sub>(@V<sub>IN</sub> = 10V)

14. Load Regulation ΔV<sub>OUT</sub> = V<sub>OUT</sub>(@I<sub>OUT</sub> = 20mA) – V<sub>OUT</sub>(@I<sub>OUT</sub> = 10mA)

ΔV<sub>OUT</sub> = V<sub>OUT</sub>(@I<sub>OUT</sub> = 50mA) – V<sub>OUT</sub>(@I<sub>OUT</sub> = 0.1mA)

## Typical Application Circuit

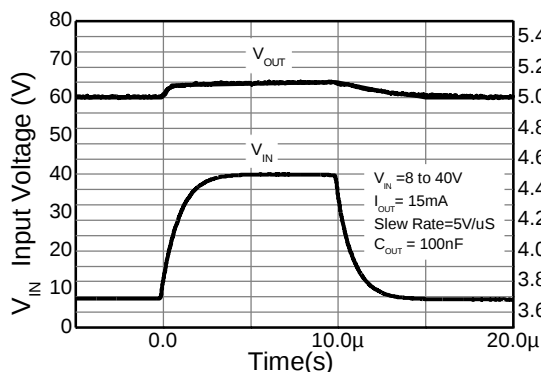


Example of a 5V regulated supply from a nominal 12V for powering a Controller IC.

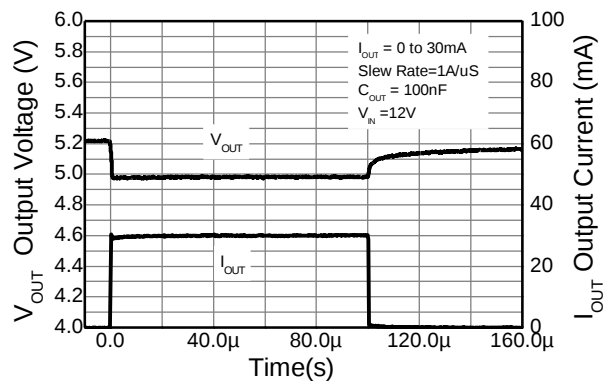
## Pin Functions

| 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. |

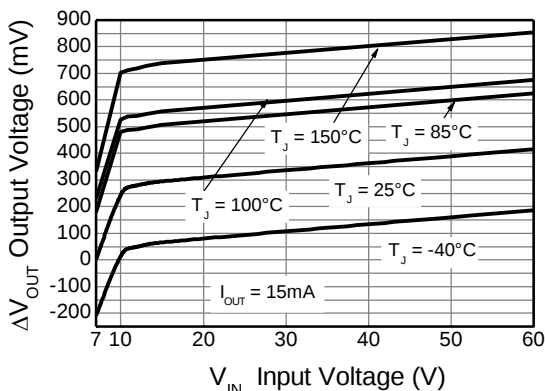
**Typical Electrical Characteristics** (@ $T_A = +25^\circ\text{C}$ , unless otherwise specified.)



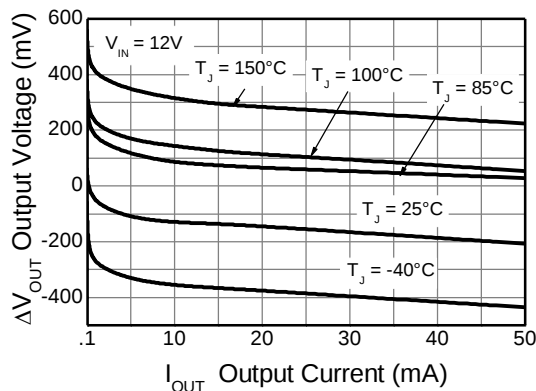
**Line transient response**



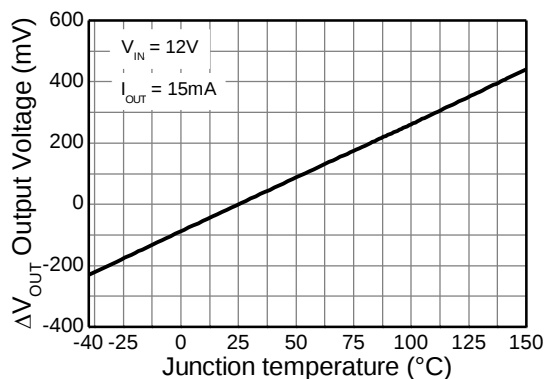
**Load transient response**



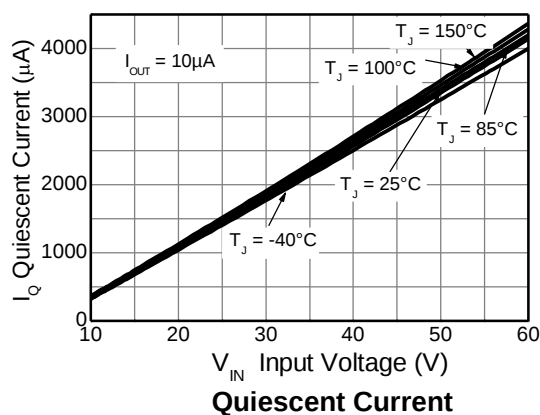
**Line Regulation (Note 15)**



**Load Regulation (Note 16)**



**Temperature Coefficient (Note 17)**



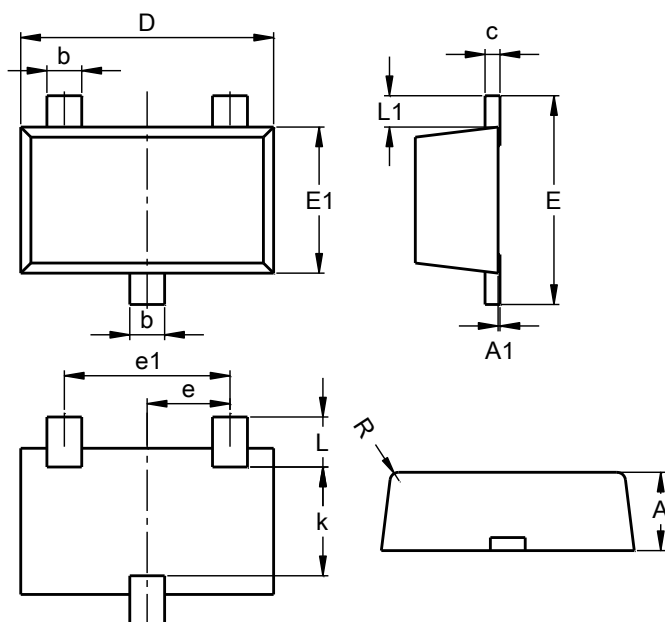
**Quiescent Current**

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

## Package Outline

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

**SOT23F**

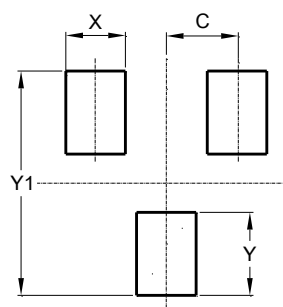


| SOT23F               |          |      |      |
|----------------------|----------|------|------|
| Dim                  | Min      | Max  | Typ  |
| A                    | 0.80     | 1.00 | 0.90 |
| A1                   | 0.00     | 0.10 | 0.01 |
| b                    | 0.35     | 0.50 | 0.44 |
| c                    | 0.10     | 0.20 | 0.16 |
| D                    | 2.80     | 3.00 | 2.90 |
| e                    | 0.95 REF |      |      |
| e1                   | 1.90 REF |      |      |
| E                    | 2.30     | 2.50 | 2.40 |
| E1                   | 1.50     | 1.70 | 1.65 |
| k                    | 1.20     | -    | -    |
| L                    | 0.30     | 0.65 | 0.50 |
| L1                   | 0.30     | 0.50 | 0.40 |
| R                    | 0.05     | 0.15 | -    |
| All Dimensions in mm |          |      |      |

## Suggested Pad Layout

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

**SOT23F**



| Dimensions | Value (in mm) |
|------------|---------------|
| C          | 0.95          |
| X          | 0.80          |
| Y          | 1.110         |
| Y1         | 3.000         |

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