

Description

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

The ZXTR2105FFQ 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:

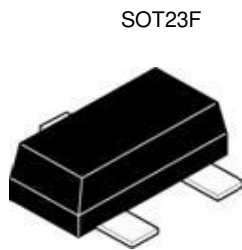
- 12V to 5V Rails
- 24V to 5V Rails
- Other Customized Input Rails

Features

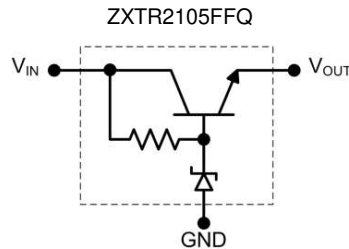
- Series Linear Regulator Using Emitter-Follower Stage
- Input Voltage = 7V to 60V (For Regulated Output Voltage)
- Output Voltage = 5V ± 5%
- Fully Integrated into a SOT23F Package
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**
- **Qualified to AEC-Q101 Standards for High Reliability**
- **PPAP Capable (Note 4)**

Mechanical Data

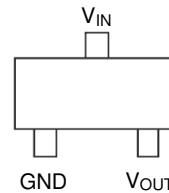
- Case: SOT23F
- Case Material: Molded Plastic "Green" Molding Compound; UL Flammability Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020
- Terminals: Finish - Matte Tin Plated Leads; Solderable per MIL-STD-202, Method 208
- Weight: 0.008 grams (Approximate)



Top View



Internal Device Schematic



Top View Pin-Out

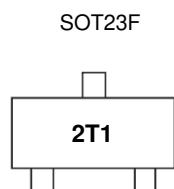
| Pin Name | Pin Function |
|------------------|----------------|
| V _{IN} | Input Supply |
| GND | Power Ground |
| V _{OUT} | Voltage Output |

Ordering Information (Note 5)

| Part Number | Compliance | Marking | Reel Size (inches) | Tape Width (mm) | Quantity per Reel |
|---------------|------------|---------|--------------------|-----------------|-------------------|
| ZXTR2105FFQ-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) & 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. Automotive products are AEC-Q101 qualified and are PPAP capable. Refer to <https://www.diodes.com/quality/>.
 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, @ $T_A = +25^\circ\text{C}$, 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

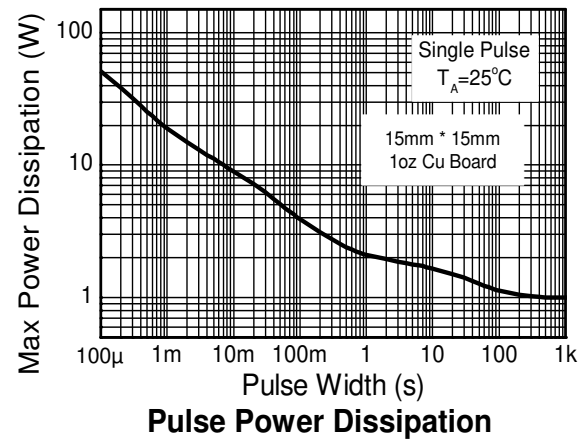
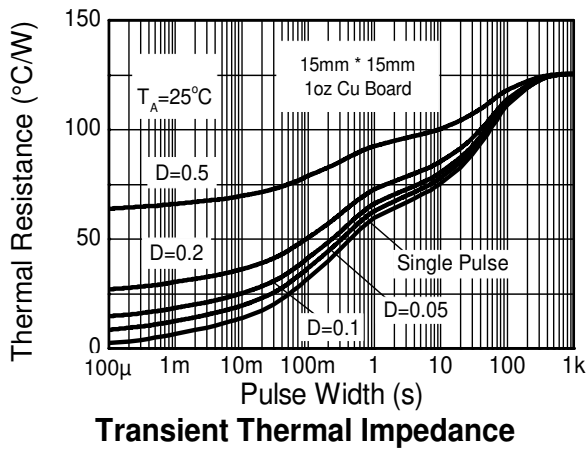
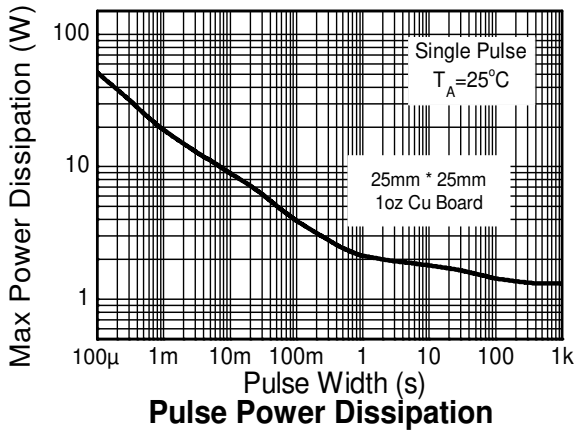
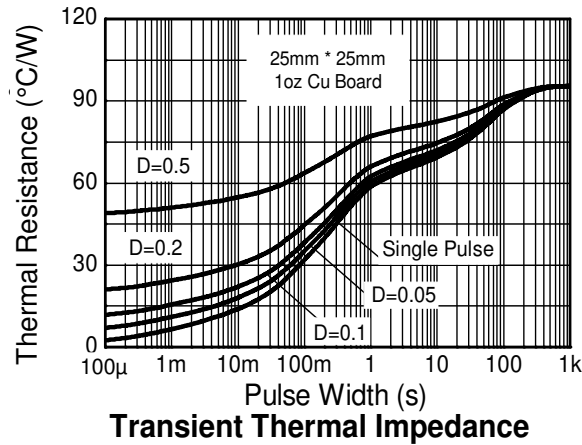
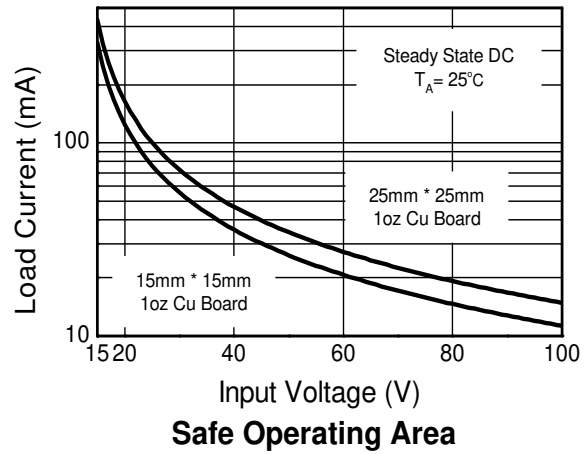
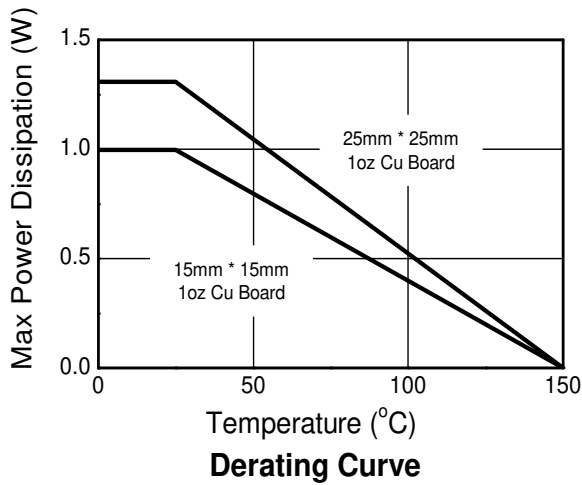
| Characteristic | Symbol | Value | Unit |
|--|-----------------|-------------|--------------------|
| Power Dissipation | P_D | 1.3 | W |
| | | 1 | |
| Thermal Resistance, Junction to Ambient | $R_{\theta JA}$ | 95 | $^\circ\text{C/W}$ |
| | | 126 | |
| Thermal Resistance, Junction to Lead | $R_{\theta JL}$ | 59 | |
| Thermal Resistance, Junction to Case | $R_{\theta JC}$ | 38 | |
| Maximum Operating Junction and Storage Temperature Range | T_J, T_{STG} | -65 to +150 | $^\circ\text{C}$ |

ESD Ratings (Note 12)

| Characteristics | Symbol | Value | Unit | JEDEC Class |
|---|---------|-------|------|-------------|
| Electrostatic Discharge – Human Body Model | ESD HBM | 4,000 | V | 3A |
| Electrostatic Discharge – Charge Device Model | ESD CDM | 1,000 | V | IV |

- 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 FR-4 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 $V_{IN}=12V$. Refer to Safe Operating Area for other Input Voltages.
 9. Same as Note 6, except measured with a single pulse width = 100 μs and $V_{IN}=12V$.
 10. Same as Note 6, 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-C101.

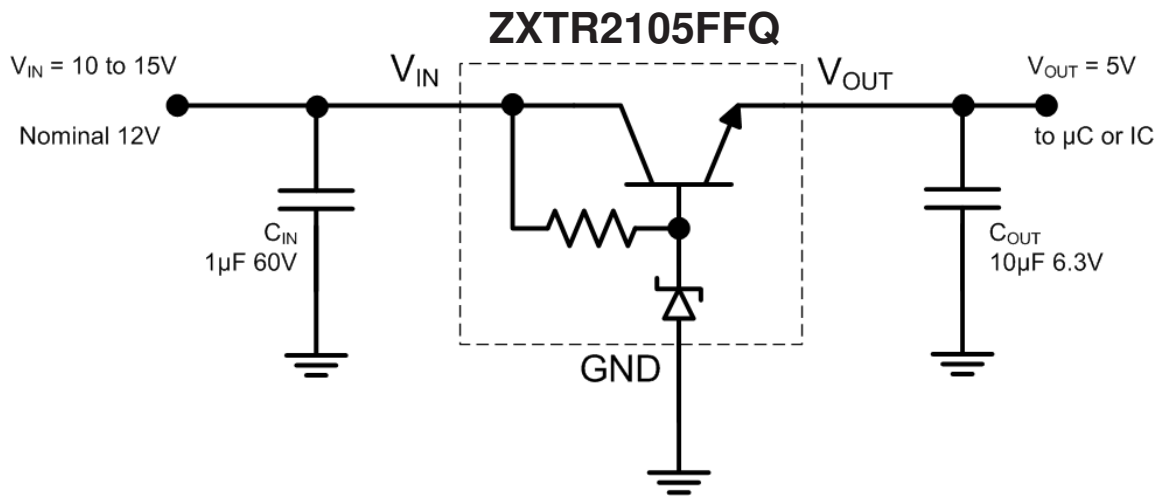
Thermal Characteristics and Derating Information



Electrical Characteristics (@T_A = +25°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} = 12V, I _{OUT} = 15mA |
| Line Regulation (Notes 13 & 14) | ΔV _{OUT} | — | 33 | 220 | mV | V _{IN} = 10V to 15V, I _{OUT} = 15mA |
| | | — | 400 | 700 | | V _{IN} = 7V to 60V, I _{OUT} = 15mA |
| | | — | 145 | 400 | | V _{IN} = 10V to 60V, I _{OUT} = 15mA |
| Temperature Coefficient | ΔV _{OUT} /ΔT | — | 3.52 | — | mV/°C | T _J = -40°C to +150°C V _{IN} = 12V, I _{OUT} = 15mA |
| Load Regulation (Notes 13 & 15) | ΔV _{OUT} | — | -20 -166 | -130 -300 | mV | I _{OUT} = 10mA to 20mA, V _{IN} = 12V I _{OUT} = 0.1mA to 50mA, V _{IN} = 12V |
| Minimum Value of Input Voltage Required to Maintain Line Regulation | V _{IN(MIN)} | 7 | — | — | V | — |
| Quiescent Current | I _Q | — | 450 | 800 | μA | V _{IN} = 12V, I _{OUT} = 10μA |
| | | — | 4,000 | 6,700 | | V _{IN} = 60V, I _{OUT} = 10μA |
| Power Supply Rejection Ratio | ΔV _{IN} /ΔV _{OUT} | — | 46 | — | dB | C _{OUT} = 100nF, I _{OUT} = 15mA, V _{OUT} = 5V, V _{IN} = 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
 $\Delta V_{OUT} = V_{OUT}@I_{OUT} = 20mA - V_{OUT}@I_{OUT} = 10mA$
 $\Delta V_{OUT} = V_{OUT}@I_{OUT} = 50mA - V_{OUT}@I_{OUT} = 0.1mA$

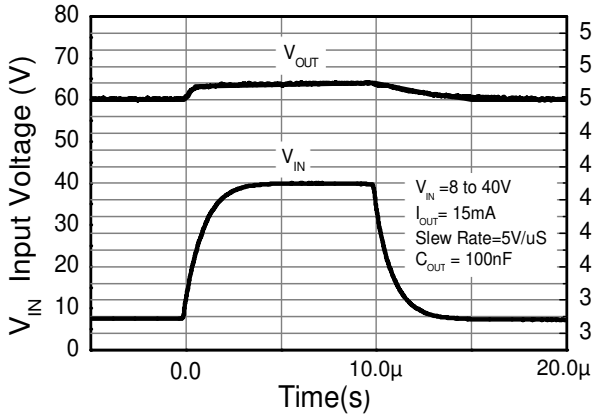
Typical Application Circuit


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

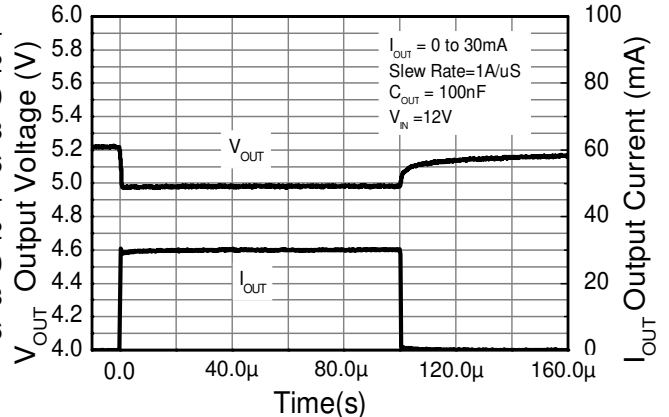
Pin Functions

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

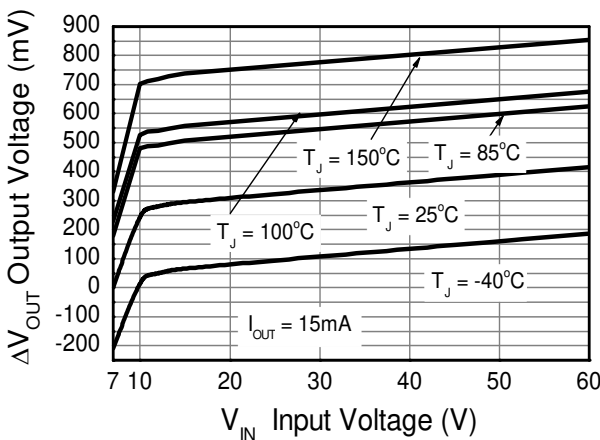
Typical Electrical Characteristics (@ $T_A = +25^\circ\text{C}$, unless otherwise specified.)



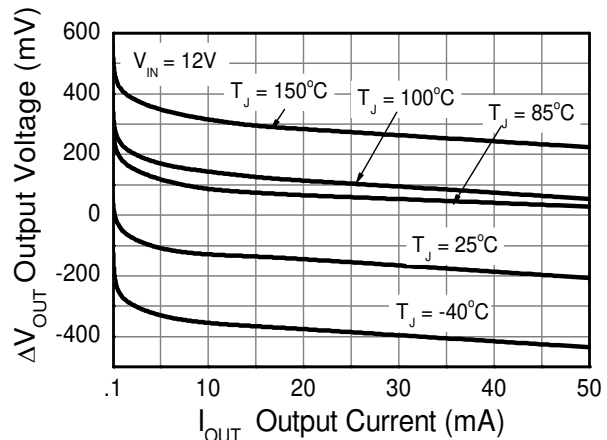
Line Transient Response



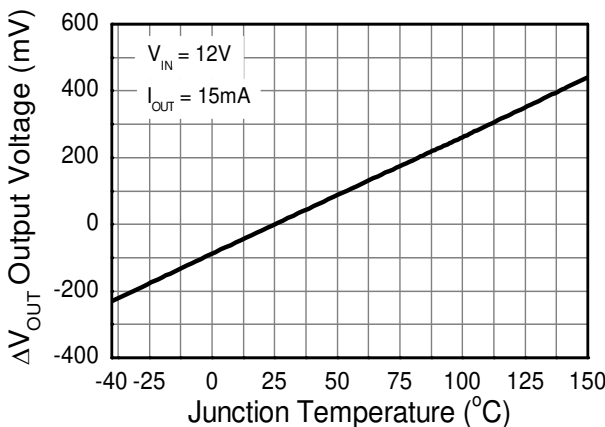
Load Transient Response



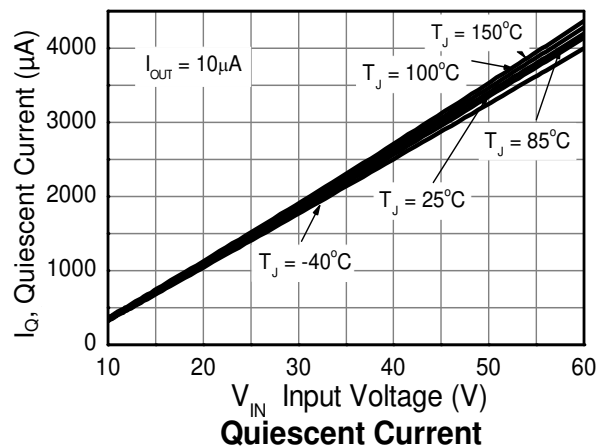
Line Regulation (Note 16)



Load Regulation (Note 17)



Temperature Coefficient (Note 18)



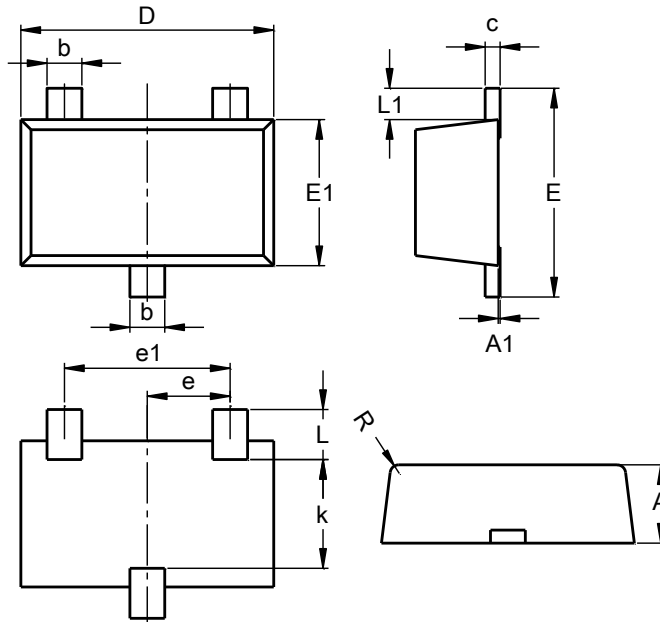
Quiescent Current

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

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

SOT23F

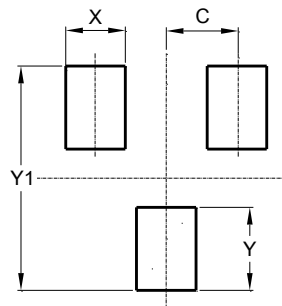


| SOT23F | | | |
|----------------------|----------|------|------|
| Dim | Min | Max | Typ |
| A | 0.80 | 1.00 | 0.90 |
| A1 | 0.00 | 0.10 | 0.01 |
| b | 0.35 | 0.50 | 0.44 |
| c | 0.10 | 0.20 | 0.16 |
| D | 2.80 | 3.00 | 2.90 |
| e | 0.95 REF | | |
| e1 | 1.90 REF | | |
| E | 2.30 | 2.50 | 2.40 |
| 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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