

Product Summary

- Continuous Drain Source Voltage: 60V
- On-State Resistance: 500mΩ
- Nominal Load Current ($V_{IN} = 5V$): 1.3A
- Clamping Energy: 90mJ

Description

The ZXMS6004FFQ is a self-protected low side IntelliFET™ MOSFET with logic level input. It integrates overtemperature, overcurrent, overvoltage (active clamp) and ESD protected logic level functionality. The ZXMS6004FFQ is ideal as a general purpose switch driven from 3.3V or 5V microcontrollers in harsh environments where standard MOSFETs are not rugged enough.

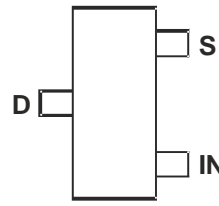
Applications

- Especially Suited for Loads with a High In-Rush Current such as Lamps and Motors
- All Types of Resistive, Inductive and Capacitive Loads in Switching Applications
- μ C Compatible Power Switch for 12V and 24V DC Applications
- Automotive Rated
- Replaces Electromechanical Relays and Discrete Circuits
- Linear Mode Capability – the current-limiting protection circuitry is designed to de-activate at low V_{DS} to minimize on state power dissipation. The maximum DC operating current is therefore determined by the thermal capability of the package/board combination, rather than by the protection circuitry. This does not compromise the product's ability to self-protect at low V_{DS} .

SOT23F



Top View



Top view
Pin Out

Features and Benefits

- Compact High Power Dissipation Package
- Low Input Current
- Logic Level Input (3.3V and 5V)
- Short Circuit Protection with Auto Restart
- Overvoltage Protection (Active Clamp)
- Thermal Shutdown with Auto Restart
- Overcurrent Protection
- Input Protection (ESD)
- High Continuous Current Rating
- **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

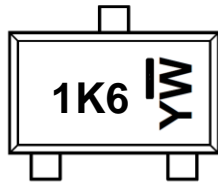
- Case: SOT23F
- Case Material: Molded Plastic, "Green" Molding Compound. UL Flammability Classification Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020
- Terminals: Matte Tin Finish Ⓜ
- Weight: 0.012 grams (Approximate)

Ordering Information (Note 5)

| Product | Marking | Reel Size (inches) | Tape Width (mm) | Quantity per Reel |
|---------------|---------|--------------------|-----------------|-------------------|
| ZXMS6004FFQTA | 1K6 | 7 | 12 | 3,000 |

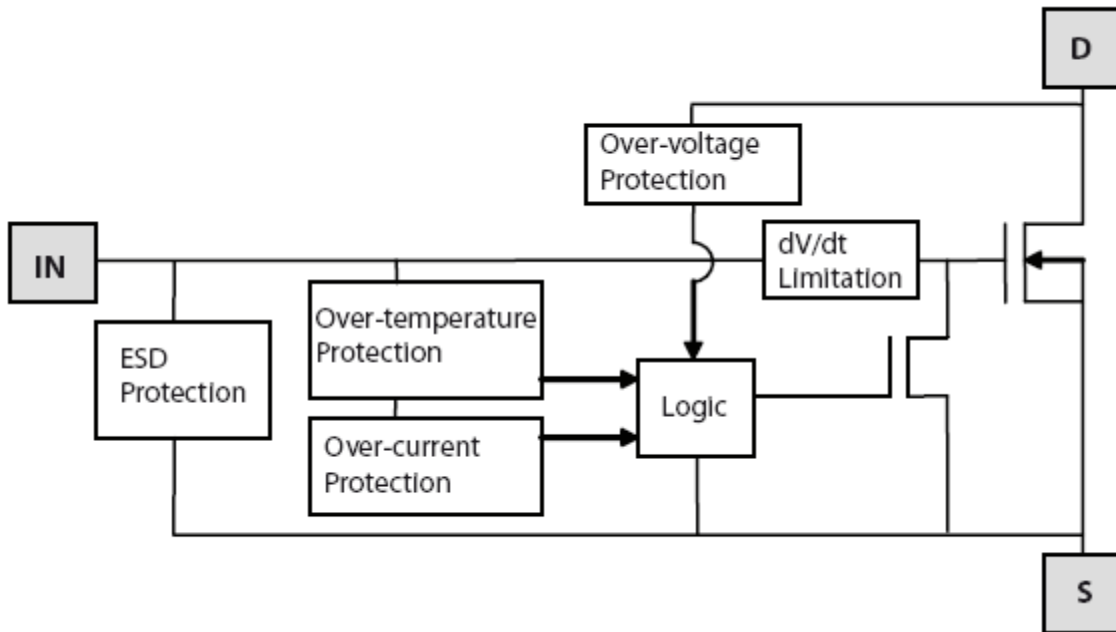
- Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS) & 2011/65/EU (RoHS 2) compliant.
 2. See http://www.diodes.com/quality/lead_free.html for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
 3. Halogen- and Antimony-free "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-Q10x 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



Y: Year: 0~9
 W: Week: A-Z : 1~26
 a-z: 27~52
 z: Represents 52 & 53 Week
 1K6 = Product Type Marking Code

Functional Block Diagram



Maximum Ratings (@T_A = +25°C, unless otherwise specified.)

| Characteristic | Symbol | Value | Units |
|--|---------------------|-----------------------|-------|
| Continuous Drain-Source Voltage | V _{DS} | 60 | V |
| Drain-Source Voltage for Short Circuit Protection | V _{DS(SC)} | 36 | V |
| Continuous Input Voltage | V _{IN} | -0.5 ... +6 | V |
| Continuous Input Current @ -0.2V ≤ V _{IN} ≤ 6V | I _{IN} | No limit | mA |
| Continuous Input Current @ V _{IN} < -0.2V or V _{IN} > 6V | | I _{IN} ≤ 2 | |
| Pulsed Drain Current @ V _{IN} = 3.3V | I _{DM} | 2 | A |
| Pulsed Drain Current @ V _{IN} = 5V | I _{DM} | 2.5 | A |
| Continuous Source Current (Body Diode) | I _S | 1 | A |
| Pulsed Source Current (Body Diode) | I _{SM} | 5 | A |
| Unclamped Single Pulse Inductive Energy, T _J = +25°C, I _D = 0.5A, V _{DD} = 24V | E _{AS} | 90 | mJ |
| Electrostatic Discharge (Human Body Model) | V _{ESD} | 4,000 | V |
| Charged Device Model | V _{CDM} | 1,000 | V |

Thermal Characteristics (@T_A = +25°C, unless otherwise specified.)

| Characteristic | Symbol | Value | Units |
|---|------------------|-------------|-------|
| Power Dissipation @ T _A = +25°C (Note 6) | P _D | 0.83 | W |
| Linear Derating Factor | | 6.66 | mW/°C |
| Power Dissipation @ T _A = +25°C (Note 7) | P _D | 1.5 | W |
| Linear Derating Factor | | 12.0 | mW/°C |
| Thermal Resistance, Junction to Ambient (Note 6) | R _{θJA} | 150 | °C/W |
| Thermal Resistance, Junction to Ambient (Note 7) | R _{θJA} | 83 | °C/W |
| Thermal Resistance, Junction to Case (Note 8) | R _{θJC} | 44 | °C/W |
| Operating Temperature Range | T _J | -40 to +150 | °C |
| Storage Temperature Range | T _{STG} | -55 to +150 | °C |

Notes: 6. For a device surface mounted on 15mm x 15mm single sided, 1oz weight copper on 1.6mm FR4 board, in still air conditions.

7. For a device surface mounted on 50mm x 50mm single sided, 2oz weight copper on 1.6mm FR4 board, in still air conditions.

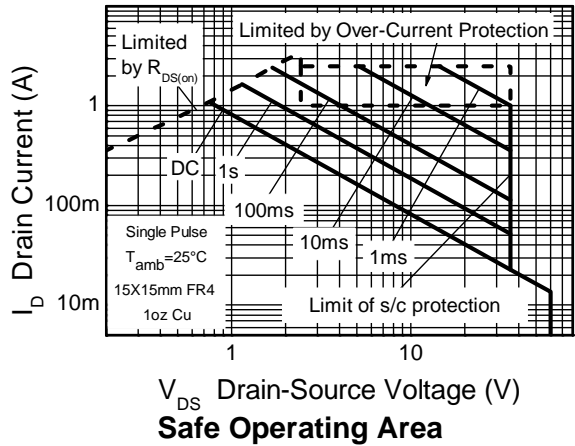
8. Thermal resistance from junction and the mounting surfaces of the drain pins.

Recommended Operating Conditions

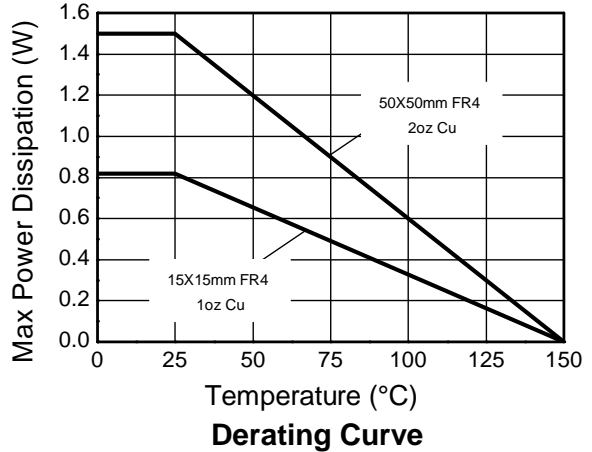
The ZXMS6004FF is optimized for use with μC operating from 3.3V and 5V supplies.

| Characteristic | Symbol | Min | Max | Unit |
|---|-----------------|-----|------|------|
| Input Voltage Range | V _{IN} | 0 | 5.5 | V |
| Ambient Temperature Range | T _A | -40 | +125 | °C |
| High Level Input Voltage for MOSFET to be On | V _{IH} | 3 | 5.5 | V |
| Low Level Input Voltage for MOSFET to be Off | V _{IL} | 0 | 0.7 | V |
| Peripheral Supply Voltage (Voltage to which Load is Referred) | V _P | 0 | 36 | V |

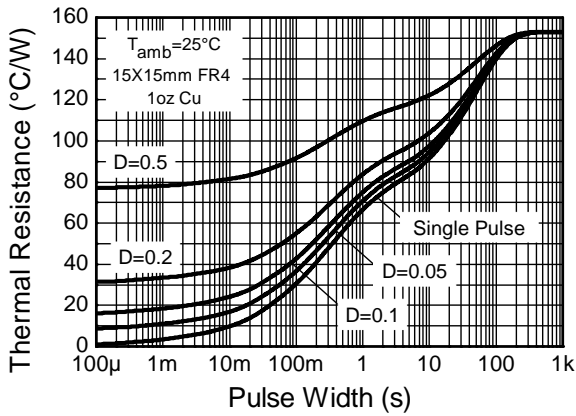
Typical Thermal Characteristics



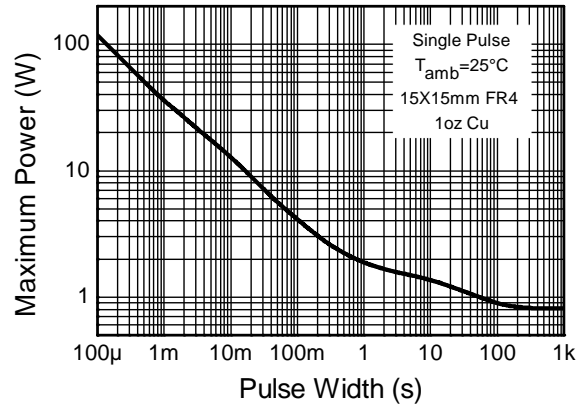
Safe Operating Area



Derating Curve



Transient Thermal Impedance



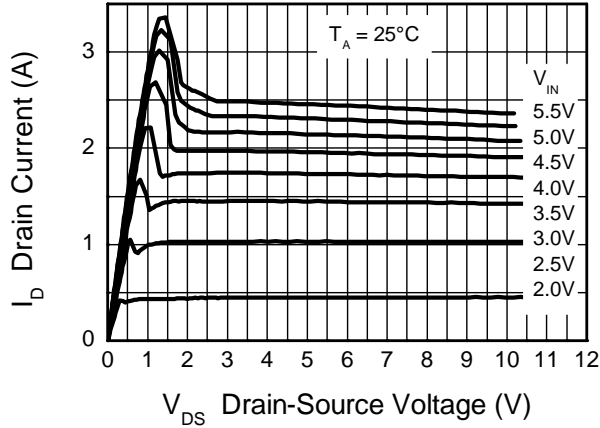
Pulse Power Dissipation

Electrical Characteristics (@T_A = +25°C, unless otherwise specified.)

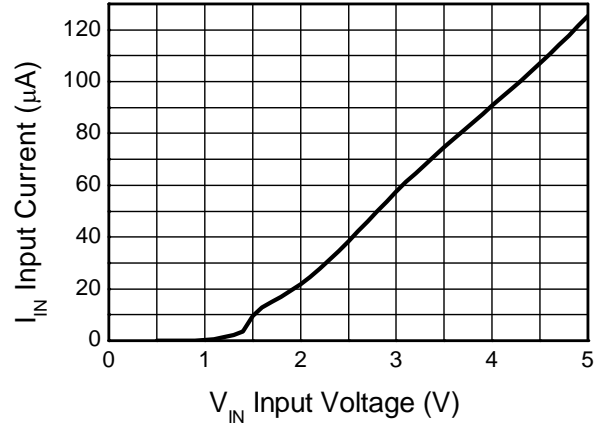
| Characteristic | Symbol | Min | Typ | Max | Unit | Test Condition |
|---|---------------------|------|------|-----|------|--|
| Static Characteristics | | | | | | |
| Drain-Source Clamp Voltage | V _{DS(AZ)} | 60 | 65 | 70 | V | I _D = 10mA |
| Off-State Drain Current | I _{DSS} | — | — | 500 | nA | V _{DS} = 12V, V _{IN} = 0V |
| | | — | — | 1 | μA | V _{DS} = 36V, V _{IN} = 0V |
| Input Threshold Voltage | V _{IN(TH)} | 0.7 | 1 | 1.5 | V | V _{DS} = V _{GS} , I _D = 1mA |
| Input Current | I _{IN} | — | 60 | 100 | μA | V _{IN} = +3V |
| | | — | 120 | 200 | | V _{IN} = +5V |
| Input Current while Overtemperature Active | — | — | — | 220 | μA | V _{IN} = +5V |
| Static Drain-Source On-State Resistance | R _{DS(ON)} | — | 400 | 600 | mΩ | V _{IN} = +3V, I _D = 0.5A |
| | | — | 350 | 500 | | V _{IN} = +5V, I _D = 0.5A |
| Continuous Drain Current (Note 6) | I _D | 0.9 | — | — | A | V _{IN} = 3V; T _A = +25°C |
| | | 1.0 | — | — | | V _{IN} = 5V; T _A = +25°C |
| Continuous Drain Current (Note 7) | | 1.2 | — | — | | V _{IN} = 3V; T _A = +25°C |
| | | 1.3 | — | — | | V _{IN} = 5V; T _A = +25°C |
| Current Limit (Note 9) | I _{D(LIM)} | 0.7 | 1.7 | — | A | V _{IN} = +3V |
| | | 1 | 2.2 | — | | V _{IN} = +5V |
| Dynamic Characteristics | | | | | | |
| Turn-On Delay Time | t _{D(ON)} | — | 5 | — | μs | V _{DD} = 12V, I _D = 0.5A, V _{GS} = 5V |
| Rise Time | t _R | — | 10 | — | | |
| Turn-Off Delay Time | t _{D(OFF)} | — | 45 | — | | |
| Fall Time | t _F | — | 15 | — | | |
| Overtemperature Protection | | | | | | |
| Thermal Overload Trip Temperature (Note 10) | T _{JT} | +150 | +175 | — | °C | — |
| Thermal Hysteresis (Note 10) | f _F | — | +10 | — | °C | — |

- Notes:
- The drain current is restricted only when the device is in saturation (see graph 'Typical Output Characteristic'). This allows the device to be used in the fully on-state without interference from the current limit. The device is fully protected at all drain currents, as the low power dissipation generated outside saturation makes current limit unnecessary.
 - Overtemperature protection is designed to prevent device destruction under fault conditions. Fault conditions are considered as "outside" normal operating range, so this part is not designed to withstand over-temperature for extended periods.

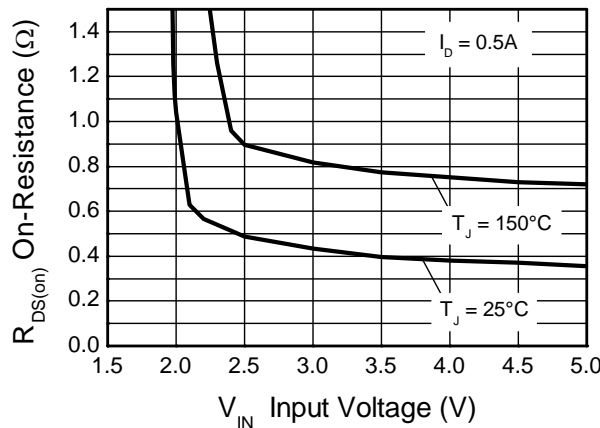
Typical Performance Characteristics



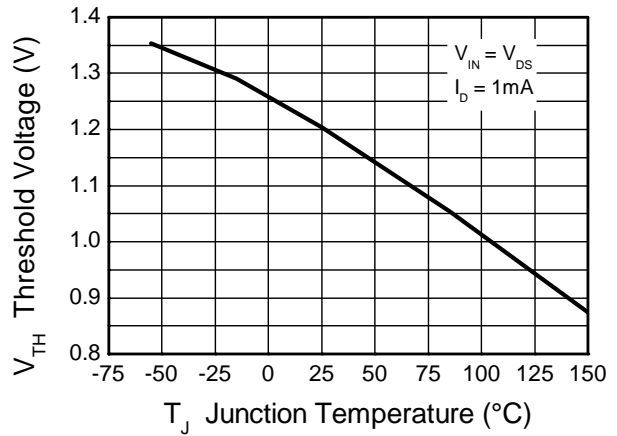
Typical Output Characteristic



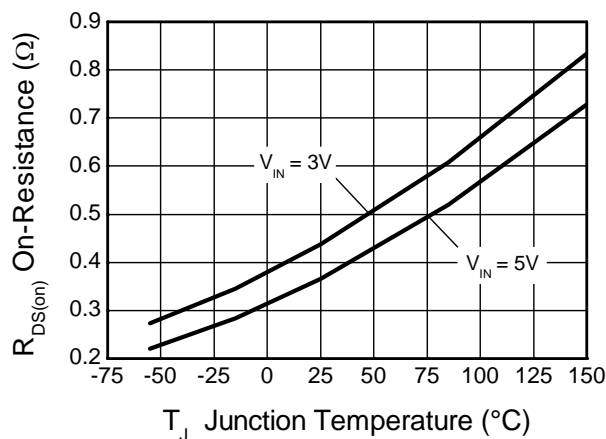
Input Current vs Input Voltage



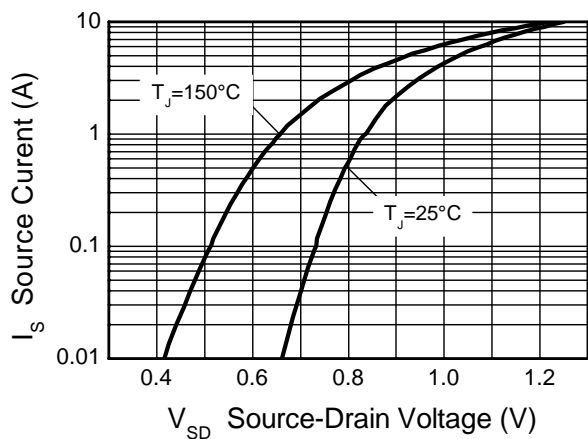
On-Resistance vs Input Voltage



Threshold Voltage vs Temperature

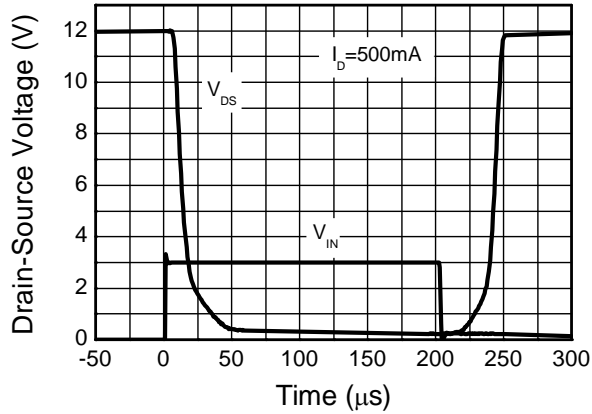


On-Resistance vs Temperature

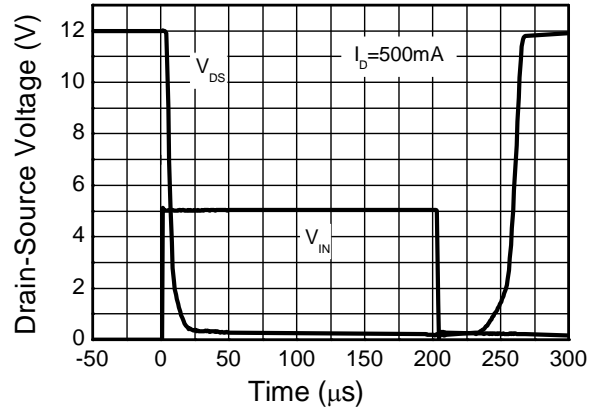


Reverse Diode Characteristic

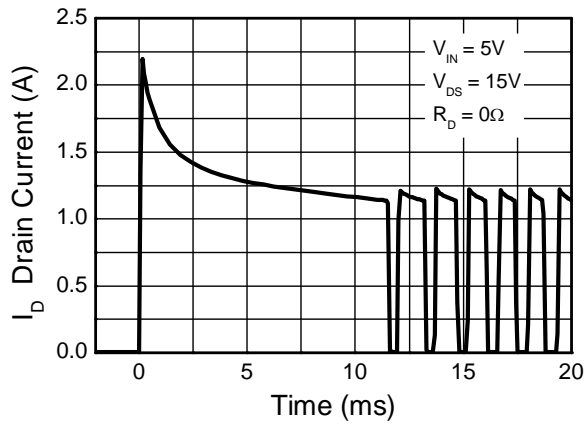
Typical Performance Characteristics (continued)



Switching Speed



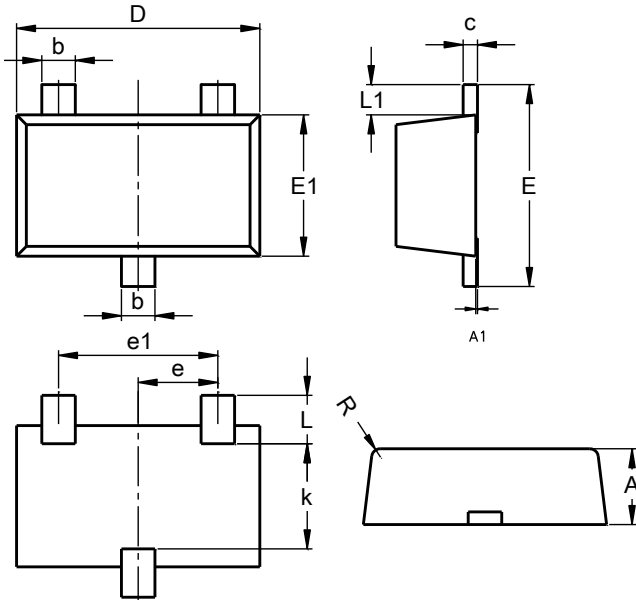
Switching Speed



Typical Short Circuit Protection

Package Outline Dimensions

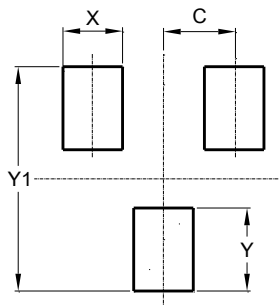
Please see AP02001 at http://www.diodes.com/_files/datasheets/ap02001.pdf for the latest version.



| SOT23F | | | |
|----------------------|-----------|------|------|
| Dim | Min | Max | Typ |
| A | 0.80 | 1.00 | 0.90 |
| 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 | 0.190 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 AP02001 at http://www.diodes.com/_files/datasheets/ap02001.pdf for the latest version.



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

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