

## Product Summary

- Continuous Drain Source Voltage:  $V_{DS} = 60V$
- On-State Resistance:  $700m\Omega$
- Nominal Load Current ( $V_{IN} = 5V$ ): 1.1A
- Clamping Energy: 90mJ

## Description

The DIODES™ ZXMS6008FFQ 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 ZXMS6008FFQ 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 inrush current, such as lamps and motors
- All types of resistive, inductive and capacitive loads in switching applications
- $\mu C$  compatible power switches 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 deactivate 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  $V_{DS}$ .

## 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
- **Lead-Free Finish; RoHS Compliant (Note 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**
- **The ZXMS6008FFQ is suitable for automotive applications requiring specific change control; this part is AEC-Q101 qualified, PPAP capable, and manufactured in IATF 16949 certified facilities.**

<https://www.diodes.com/quality/product-definitions/>

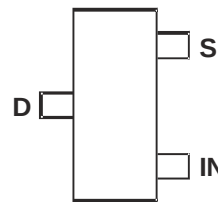
## Mechanical Data

- Package: SOT23F
- Package Material: Molded Plastic, "Green" Molding Compound. UL Flammability Classification Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020
- Terminals: Matte Tin Finish (Ⓔ3)
- Weight: 0.012 grams (Approximate)

SOT23F



Top View



Top View  
Pin Out

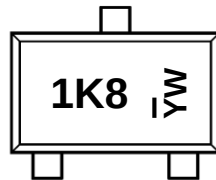
## Ordering Information (Note 4)

| Part Number   | Package | Marking | Reel Size (inches) | Tape Width (mm) | Packing |         |
|---------------|---------|---------|--------------------|-----------------|---------|---------|
|               |         |         |                    |                 | Qty.    | Carrier |
| ZXMS6008FFQ-7 | SOT23F  | 1K8     | 7                  | 8               | 3,000   | Reel    |

- Notes:
1. EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant. All applicable RoHS exemptions applied.
  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 <https://www.diodes.com/design/support/packaging/diodes-packaging/>.

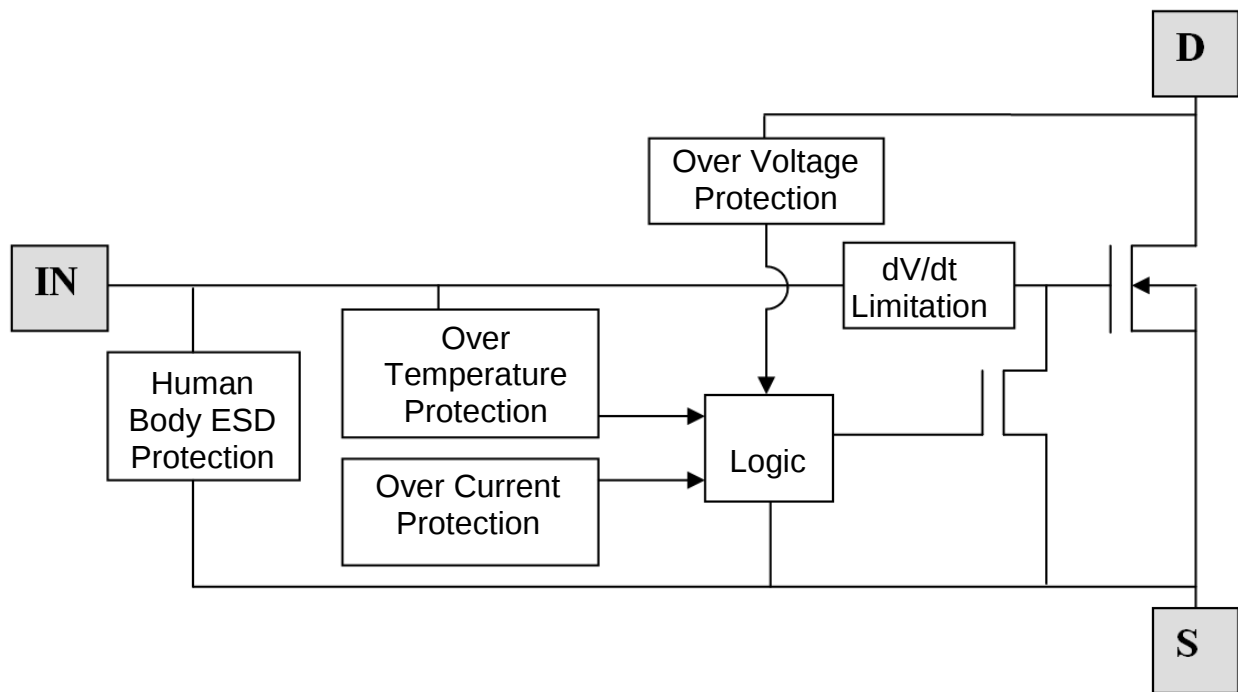
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## Marking Information



1K8 = Product Type Marking Code  
Y or  $\overline{Y}$ : Year: 0 to 9  
W or  $\overline{W}$ : Week: A-Z: 1 to 26  
a-z: 27 to 52  
z: Represents 52 & 53 Week

## Functional Block Diagram



## Absolute Maximum Ratings (@T<sub>A</sub> = +25°C, unless otherwise specified.)

| Characteristic                                                                                                   | Symbol              | Value                               | Unit |
|------------------------------------------------------------------------------------------------------------------|---------------------|-------------------------------------|------|
| Continuous Drain-Source Voltage                                                                                  | V <sub>DS</sub>     | 60                                  | V    |
| Drain-Source Voltage for Short Circuit Protection                                                                | V <sub>DS(SC)</sub> | 36                                  | V    |
| Continuous Input Voltage                                                                                         | V <sub>IN</sub>     | -0.5 to +6                          | V    |
| Continuous Input Current @ -0.2V ≤ V <sub>IN</sub> ≤ 6V                                                          | I <sub>IN</sub>     | No Limit<br>  I <sub>IN</sub>   ≤ 2 | mA   |
| Continuous Input Current @ V <sub>IN</sub> < -0.2V or V <sub>IN</sub> > 6V                                       |                     |                                     |      |
| Pulsed Drain Current @ V <sub>IN</sub> = 3.3V                                                                    | I <sub>DM</sub>     | 1.4                                 | A    |
| Pulsed Drain Current @ V <sub>IN</sub> = 5V                                                                      | I <sub>DM</sub>     | 1.8                                 | A    |
| Continuous Source Current (Body Diode) (Note 5)                                                                  | I <sub>S</sub>      | 0.7                                 | A    |
| Pulsed Source Current (Body Diode)                                                                               | I <sub>SM</sub>     | 4                                   | A    |
| Unclamped Single Pulse Inductive Energy,<br>T <sub>J</sub> = +25°C, I <sub>D</sub> = 0.5A, V <sub>DD</sub> = 24V | E <sub>AS</sub>     | 90                                  | mJ   |
| Electrostatic Discharge (Human Body Model)                                                                       | V <sub>ESD</sub>    | 4000                                | V    |
| Charged Device Model                                                                                             | V <sub>CDM</sub>    | 1000                                | V    |

## Thermal Resistance

| Characteristic                                       | Symbol           | Value       | Unit  |
|------------------------------------------------------|------------------|-------------|-------|
| Power Dissipation at T <sub>A</sub> = +25°C (Note 5) | P <sub>D</sub>   | 0.81        | W     |
| Linear Derating Factor                               |                  | 6.54        | mW/°C |
| Power Dissipation at T <sub>A</sub> = +25°C (Note 6) | P <sub>D</sub>   | 1.5         | W     |
| Linear Derating Factor                               |                  | 12          | mW/°C |
| Thermal Resistance, Junction to Ambient (Note 5)     | R <sub>θJA</sub> | 153         | °C/W  |
| Thermal Resistance, Junction to Ambient (Note 6)     | R <sub>θJA</sub> | 83          | °C/W  |
| Thermal Resistance, Junction to Lead (Note 7)        | R <sub>θJC</sub> | 65          | °C/W  |
| Operating Temperature Range                          | T <sub>J</sub>   | -40 to +150 | °C    |
| Storage Temperature Range                            | T <sub>STG</sub> | -55 to +150 | °C    |

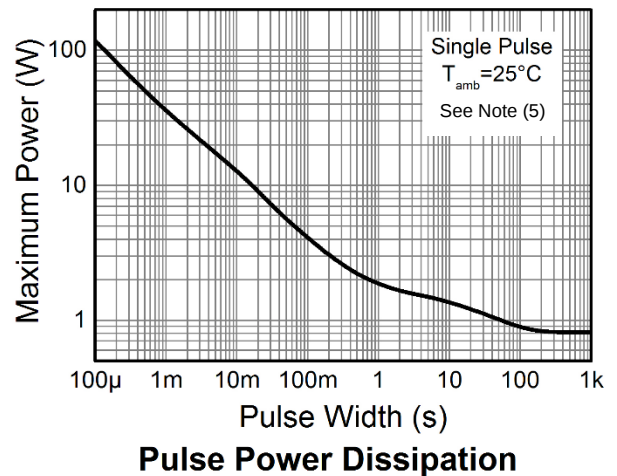
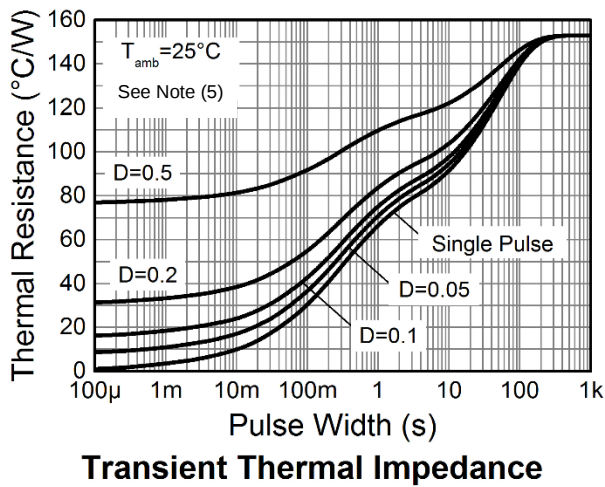
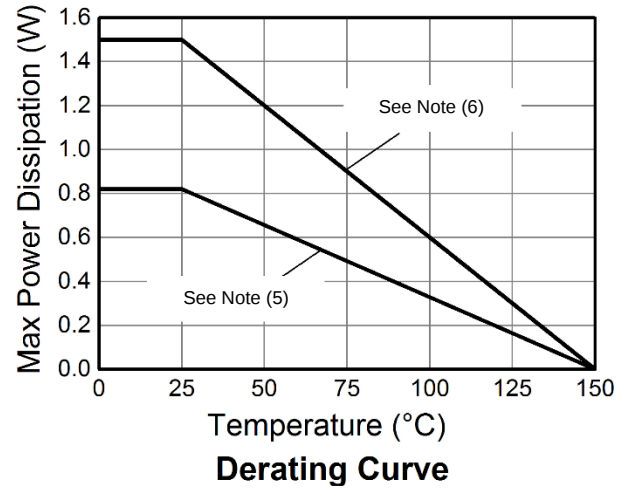
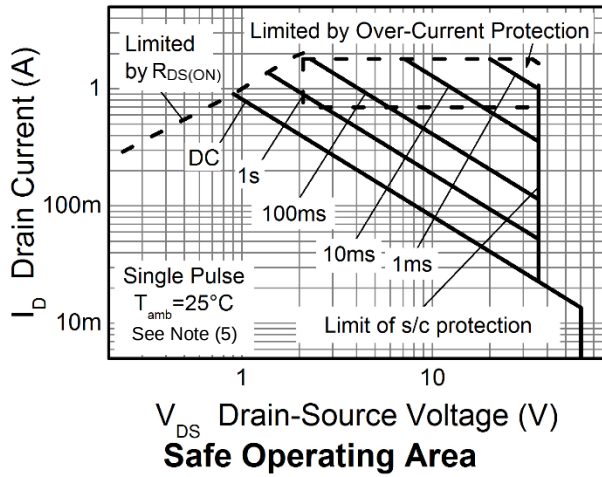
Notes: 5. For a device surface mounted on 15mm x 15mm single sided 1oz weight copper on 1.6mm FR-4 board, in still air conditions.  
6. For a device surface mounted on 50mm x 50mm single sided 2oz weight copper on 1.6mm FR-4 board, in still air conditions.  
7. Thermal resistance between junction and the mounting surfaces of drain and source pins.

## Recommended Operating Conditions

The ZXMS6008FFQ is optimized for use with  $\mu$ C operating from 3.3V and 5V supplies.

| Characteristic                                                | Symbol          | Min | Max  | Unit |
|---------------------------------------------------------------|-----------------|-----|------|------|
| Input Voltage Range                                           | V <sub>IN</sub> | 0   | 5.5  | V    |
| Ambient Temperature Range                                     | T <sub>A</sub>  | -40 | +125 | °C   |
| High Level Input Voltage for MOSFET to be On                  | V <sub>IH</sub> | 3   | 5.5  | V    |
| Low Level Input Voltage for MOSFET to be Off                  | V <sub>IL</sub> | 0   | 0.7  | V    |
| Peripheral Supply Voltage (Voltage to Which Load is Referred) | V <sub>P</sub>  | 0   | 36   | V    |

## Thermal Characteristics



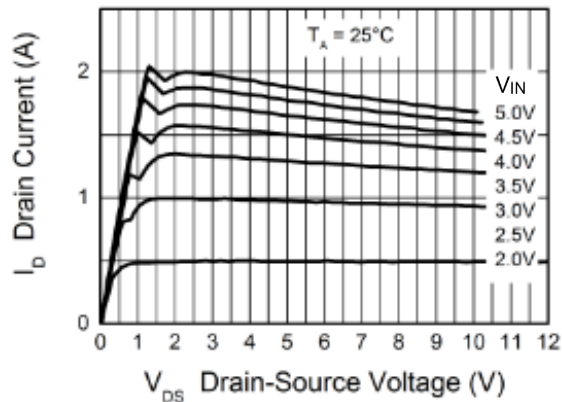
- Notes:
5. For a device surface mounted on 15mm x 15mm single sided 1oz weight copper on 1.6mm FR-4 board, in still air conditions.
  6. For a device surface mounted on 50mm x 50mm single sided 2oz weight copper on 1.6mm FR-4 board, in still air conditions.

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

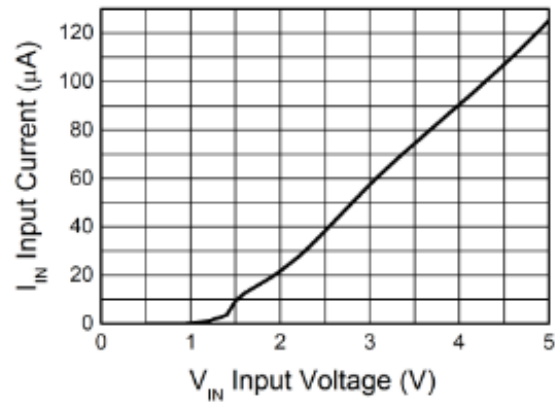
| Characteristic                              | Symbol              | Min  | Typ  | Max | Unit | Test Condition                                                        |
|---------------------------------------------|---------------------|------|------|-----|------|-----------------------------------------------------------------------|
| Static Characteristics                      |                     |      |      |     |      |                                                                       |
| Drain-Source Clamp Voltage                  | V <sub>DS(AZ)</sub> | 60   | 65   | 70  | V    | I <sub>D</sub> = 10mA                                                 |
| Off State Drain Current                     | I <sub>DSS</sub>    | —    | —    | 0.5 | μA   | V <sub>DS</sub> = 12V, V <sub>IN</sub> = 0V                           |
|                                             |                     | —    | —    | 1   |      | V <sub>DS</sub> = 36V, V <sub>IN</sub> = 0V                           |
| Input Threshold Voltage                     | V <sub>IN(TH)</sub> | 0.7  | 1.2  | 1.5 | V    | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 1mA              |
| Input Current                               | I <sub>IN</sub>     | —    | 60   | 100 | μA   | V <sub>IN</sub> = 3V                                                  |
|                                             |                     | —    | 120  | 200 |      | V <sub>IN</sub> = 5V                                                  |
| Input Current While Over Temperature Active | —                   | —    | —    | 350 | μA   | V <sub>IN</sub> = 5V                                                  |
| Static Drain-Source On-State Resistance     | R <sub>DS(ON)</sub> | —    | 550  | 800 | mΩ   | V <sub>IN</sub> = 3V, I <sub>D</sub> = 0.5A                           |
|                                             |                     | —    | 500  | 700 |      | V <sub>IN</sub> = 5V, I <sub>D</sub> = 0.5A                           |
| Continuous Drain Current (Note 5)           | I <sub>D</sub>      | 0.6  | —    | —   | A    | V <sub>IN</sub> = 3V, T <sub>A</sub> = +25°C                          |
|                                             |                     | 0.7  | —    | —   |      | V <sub>IN</sub> = 5V, T <sub>A</sub> = +25°C                          |
| Continuous Drain Current (Note 6)           |                     | 0.8  | —    | —   |      | V <sub>IN</sub> = 3V, T <sub>A</sub> = +25°C                          |
|                                             |                     | 0.9  | —    | —   |      | V <sub>IN</sub> = 5V, T <sub>A</sub> = +25°C                          |
| Current Limit (Note 8)                      | I <sub>D(LIM)</sub> | 0.5  | 1.2  | —   | A    | V <sub>IN</sub> = 3V                                                  |
|                                             |                     | 0.7  | 1.6  | —   |      | V <sub>IN</sub> = 5V                                                  |
| Dynamic Characteristics                     |                     |      |      |     |      |                                                                       |
| Turn-On Delay Time                          | t <sub>D(ON)</sub>  | —    | 5    | —   | μs   | V <sub>DD</sub> = 12V, I <sub>D</sub> = 0.5A,<br>V <sub>GS</sub> = 5V |
| Rise Time                                   | t <sub>R</sub>      | —    | 10   | —   |      |                                                                       |
| Turn-Off Delay Time                         | t <sub>D(OFF)</sub> | —    | 45   | —   |      |                                                                       |
| Fall Time                                   | t <sub>F</sub>      | —    | 15   | —   |      |                                                                       |
| Overtemperature Protection                  |                     |      |      |     |      |                                                                       |
| Thermal Overload Trip Temperature (Note 9)  | T <sub>JT</sub>     | +150 | +175 | —   | °C   | —                                                                     |
| Thermal Hysteresis (Note 9)                 | —                   | —    | +10  | —   | °C   | —                                                                     |

- Notes:
5. For a device surface mounted on 15mm x 15mm single sided 1oz weight copper on 1.6mm FR-4 board, in still air conditions.
  6. For a device surface mounted on 50mm x 50mm single sided 2oz weight copper on 1.6mm FR-4 board, in still air conditions.
  8. 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.
  9. 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 overtemperature for extended periods.

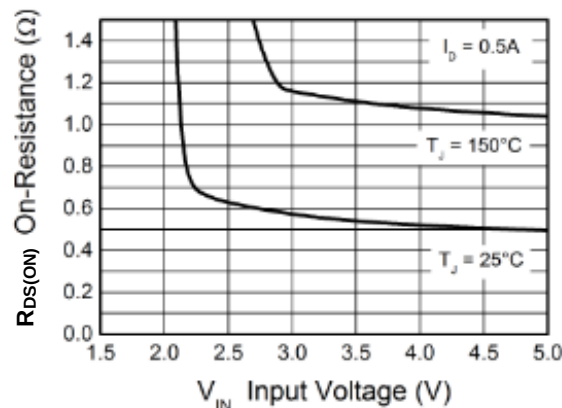
## Typical Characteristics



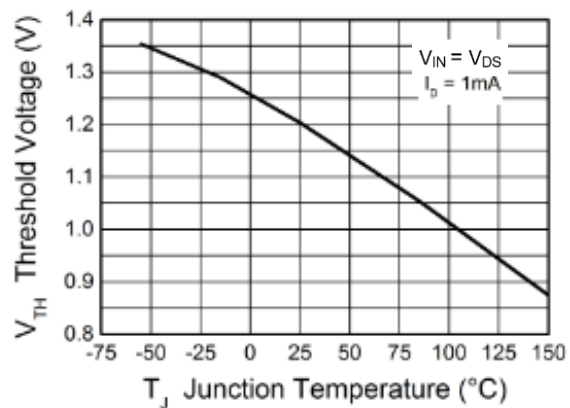
**Typical Output Characteristic**



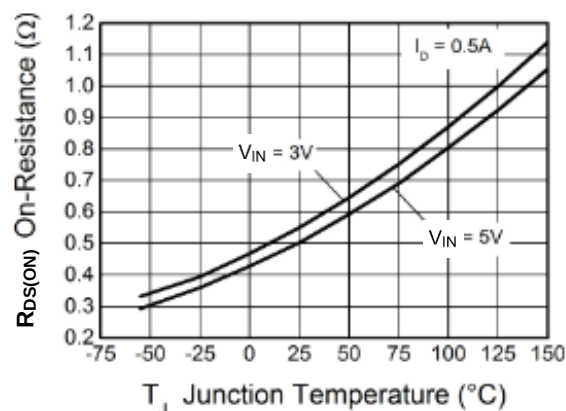
**Input Current vs Input Voltage**



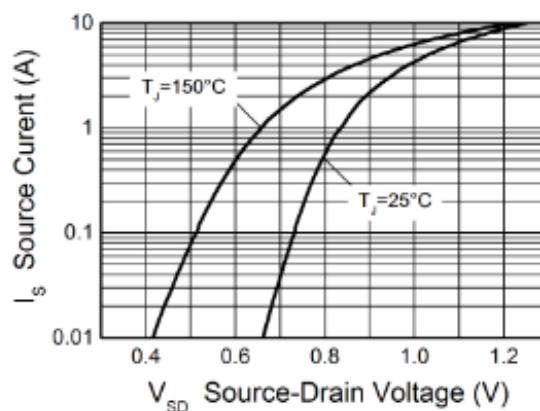
**On-Resistance vs Input Voltage**



**Threshold Voltage vs Temperature**

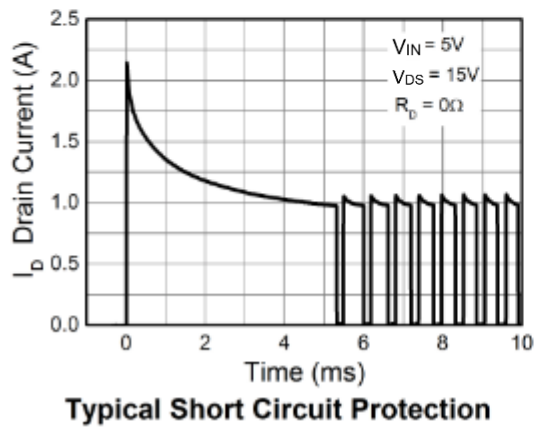
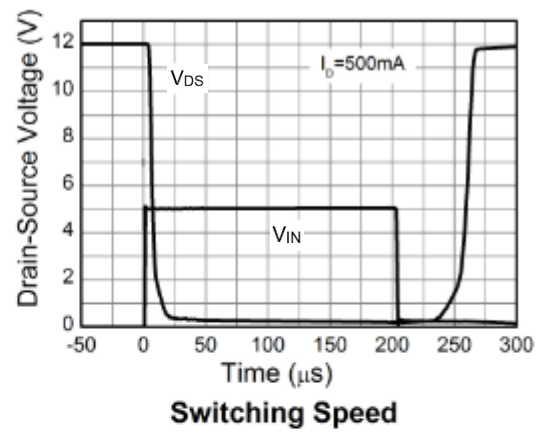
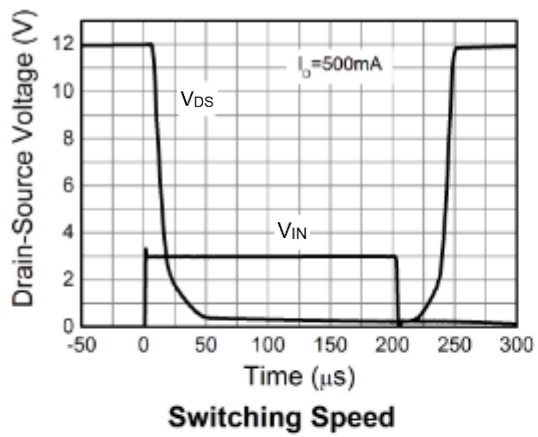


**On-Resistance vs Temperature**



**Reverse Diode Characteristic**

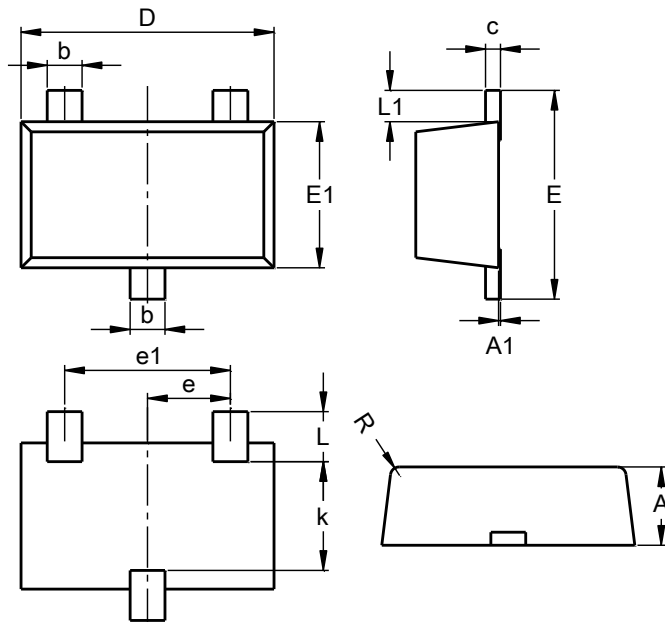
## Typical Characteristics (continued)



## Package Outline Dimensions

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

**SOT23F**

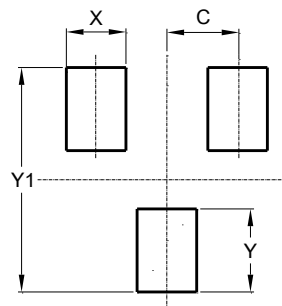


| SOT23F               |          |      |      |
|----------------------|----------|------|------|
| Dim                  | Min      | Max  | Typ  |
| A                    | 0.80     | 1.00 | 0.90 |
| A1                   | 0.00     | 0.10 | 0.01 |
| b                    | 0.35     | 0.50 | 0.44 |
| 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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