

**60V N-CHANNEL SELF PROTECTED ENHANCEMENT MODE  
INTELLIFET® MOSFET**
**Product Summary**

|                                          |       |
|------------------------------------------|-------|
| • Continuous drain source voltage        | 60V   |
| • On-state resistance                    | 100mΩ |
| • Nominal load current ( $V_{IN} = 5V$ ) | 2.8A  |
| • Clamping Energy                        | 490mJ |

**Description and Applications**

The ZXMS6006DG is a self protected low side MOSFET with logic level input. It integrates over-temperature, over-current, over-voltage (active clamp) and ESD protected logic level functionality. The ZXMS6006DG is ideal as a general purpose switch driven from 3.3V or 5V microcontrollers in harsh environments where standard MOSFETs are not rugged enough.

- Lamp Driver
- Motor Driver
- Relay Driver
- Solenoid Driver

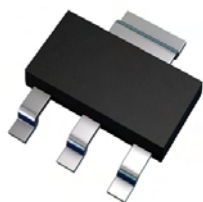
**Features and Benefits**

- Compact high power dissipation package
- Low input current
- Logic Level Input (3.3V and 5V)
- Short circuit protection with auto restart
- Over voltage protection (active clamp)
- Thermal shutdown with auto restart
- Over-current protection
- Input Protection (ESD)
- High continuous current rating
- **Green, RoHS Compliant (Note 1)**
- **Halogen and Antimony Free. (Note 2)**
- **Qualified to AEC-Q101 Standards for High Reliability**

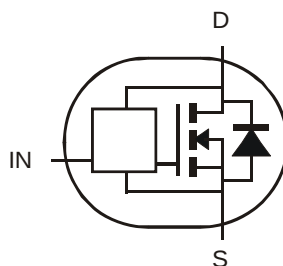
**Mechanical Data**

- Case: SOT-223
- 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: 0.112 grams (approximate)

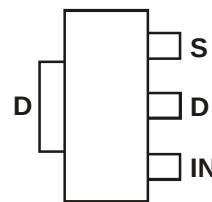
SOT-223



Top View



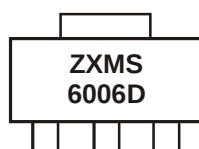
Device symbol


Top view  
Pin Out

**Ordering Information** (Note 3)

| Product      | Marking   | Reel size (inches) | Tape width (mm) | Quantity per reel |
|--------------|-----------|--------------------|-----------------|-------------------|
| ZXMS6006DGTA | ZXMS6006D | 7                  | 12              | 1,000             |

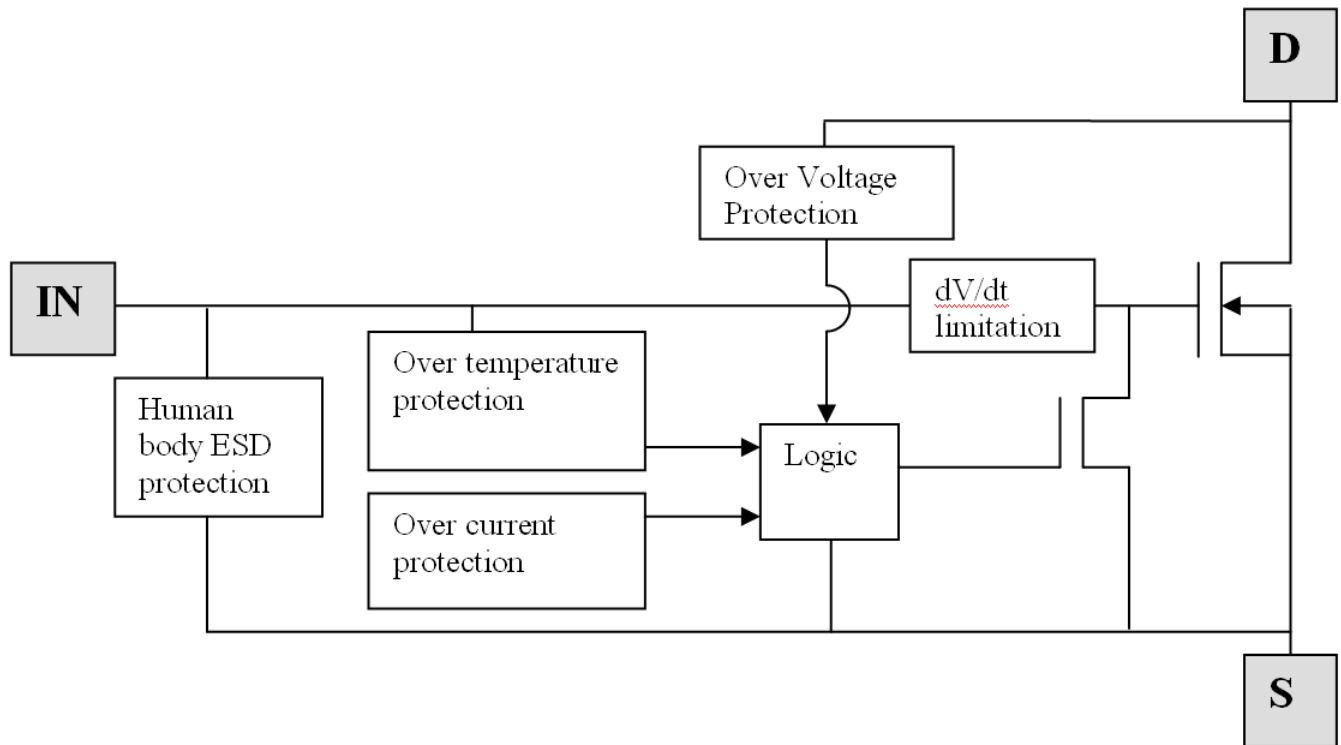
- Notes:
1. Contain <900ppm bromine, chlorine (<1500ppm total) and <1000ppm antimony compounds.
  2. Diodes Inc's "Green" Policy can be found on our website at <http://www.diodes.com>
  3. For packaging details, go to our website at <http://www.diodes.com>

**Marking Information**


ZXMS6006D = Product type Marking Code

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## Functional Block Diagram



**Maximum Ratings** @T<sub>A</sub> = 25°C unless otherwise specified

| Characteristic                                                                                                  | Symbol              | Value                 | Units |
|-----------------------------------------------------------------------------------------------------------------|---------------------|-----------------------|-------|
| Continuous Drain-Source Voltage                                                                                 | V <sub>DS</sub>     | 60                    | V     |
| Drain-Source Voltage for Short Circuit Protection                                                               | V <sub>DS(SC)</sub> | 16                    | V     |
| Continuous Input Voltage                                                                                        | V <sub>IN</sub>     | -0.5 ... +6           | V     |
| Continuous Input Current @ -0.2V ≤ V <sub>IN</sub> ≤ 6V                                                         | I <sub>IN</sub>     | No limit              | mA    |
| Continuous Input Current @ V <sub>IN</sub> < -0.2V or V <sub>IN</sub> > 6V                                      | I <sub>IN</sub>     | I <sub>IN</sub>   ≤ 2 | mA    |
| Pulsed Drain Current @ V <sub>IN</sub> = 3.3V                                                                   | I <sub>DM</sub>     | 11                    | A     |
| Pulsed Drain Current @ V <sub>IN</sub> = 5V                                                                     | I <sub>DM</sub>     | 13                    | A     |
| Continuous Source Current (Body Diode) (Note 4)                                                                 | I <sub>S</sub>      | 2                     | A     |
| Pulsed Source Current (Body Diode)                                                                              | I <sub>SM</sub>     | 12                    | 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>     | 490                   | mJ    |
| Electrostatic Discharge (Human Body Model)                                                                      | V <sub>ESD</sub>    | 4000                  | V     |
| Charged Device Model                                                                                            | V <sub>CDM</sub>    | 1000                  | V     |

**Thermal Characteristics** @T<sub>A</sub> = 25°C unless otherwise specified

| Characteristic                                      | Symbol           | Value       | Units |
|-----------------------------------------------------|------------------|-------------|-------|
| Power Dissipation at T <sub>A</sub> = 25°C (Note 4) | P <sub>D</sub>   | 1.3         | W     |
| Linear Derating Factor                              | P <sub>D</sub>   | 10.4        | mW/°C |
| Power Dissipation at T <sub>A</sub> = 25°C (Note 5) | P <sub>D</sub>   | 3.0         | W     |
| Linear Derating Factor                              | P <sub>D</sub>   | 24          | mW/°C |
| Thermal Resistance, Junction to Ambient (Note 4)    | R <sub>θJA</sub> | 96          | °C/W  |
| Thermal Resistance, Junction to Ambient (Note 5)    | R <sub>θJA</sub> | 42          | °C/W  |
| Thermal Resistance, Junction to Case (Note 6)       | R <sub>θJC</sub> | 12          | °C/W  |
| Operating Temperature Range                         | T <sub>J</sub>   | -40 to +150 | °C    |
| Storage Temperature Range                           | T <sub>STG</sub> | -55 to +150 | °C    |

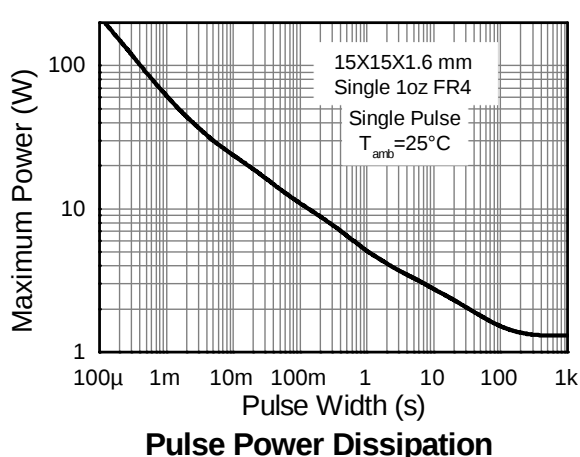
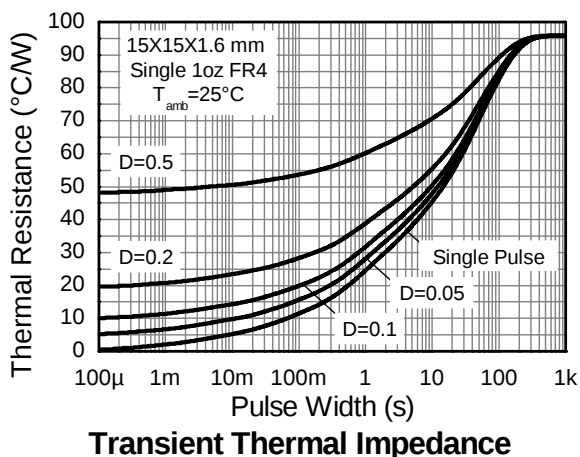
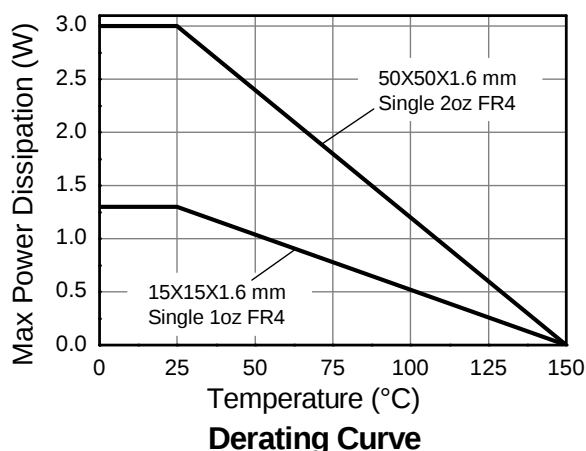
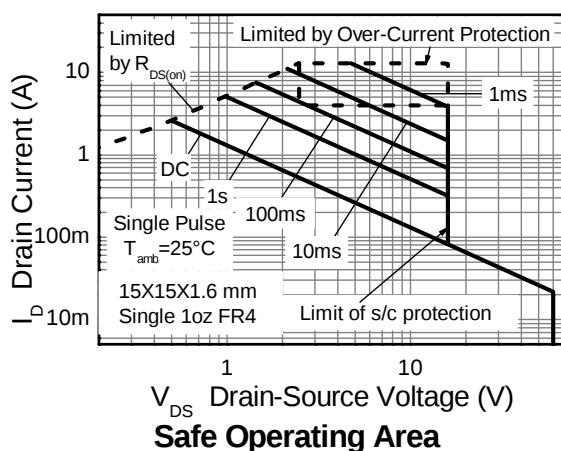
- Notes:
4. For a device surface mounted on 15mm x 15mm single sided 1oz weight copper on 1.6mm FR4 board, in still air conditions.
  5. For a device surface mounted on 50mm x 50mm single sided 2oz weight copper on 1.6mm FR4 board, in still air conditions.
  6. Thermal resistance between junction and the mounting surfaces of drain and source pins.

## Recommended Operating Conditions

The ZXMS6006DG is optimized for use with  $\mu\text{C}$  operating from 3.3V and 5V supplies.

| Characteristic                                                | Symbol          | Min | Max | Unit               |
|---------------------------------------------------------------|-----------------|-----|-----|--------------------|
| Input Voltage Range                                           | $V_{\text{IN}}$ | 0   | 5.5 | V                  |
| Ambient Temperature Range                                     | $T_A$           | -40 | 125 | $^{\circ}\text{C}$ |
| High Level Input Voltage for MOSFET to be on                  | $V_{\text{IH}}$ | 3   | 5.5 | V                  |
| Low level input voltage for MOSFET to be off                  | $V_{\text{IL}}$ | 0   | 0.7 | V                  |
| Peripheral Supply Voltage (voltage to which load is referred) | $V_P$           | 0   | 16  | V                  |

## Thermal Characteristics



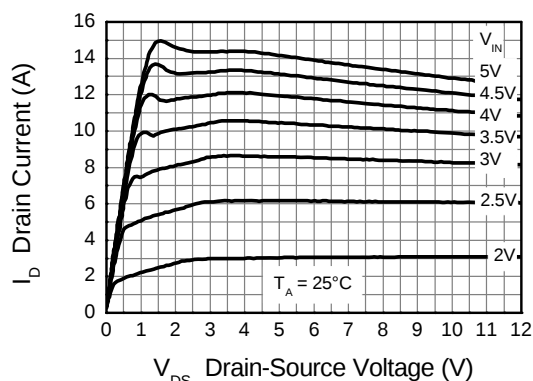
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**Electrical Characteristics** @T<sub>A</sub> = 25°C unless otherwise specified

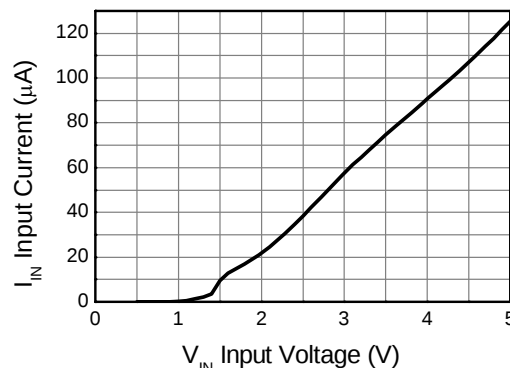
| Characteristic                              | Symbol              | Min | Typ | Max | Unit | Test Condition                                                   |
|---------------------------------------------|---------------------|-----|-----|-----|------|------------------------------------------------------------------|
| 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>    | -   | -   | 1   | μA   | V <sub>DS</sub> = 12V, V <sub>IN</sub> = 0V                      |
|                                             |                     | -   | -   | 2   |      | V <sub>DS</sub> = 36V, V <sub>IN</sub> = 0V                      |
| Input Threshold Voltage                     | V <sub>IN(th)</sub> | 0.7 | 1   | 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 | -                   | -   | -   | 400 | μA   | V <sub>IN</sub> = +5V                                            |
| Static Drain-Source On-State Resistance     | R <sub>DS(on)</sub> | -   | 85  | 125 | mΩ   | V <sub>IN</sub> = +3V, I <sub>D</sub> = 1A                       |
|                                             |                     | -   | 75  | 100 |      | V <sub>IN</sub> = +5V, I <sub>D</sub> = 1A                       |
| Continuous Drain Current (Note 4)           | I <sub>D</sub>      | 2.0 | -   | -   | A    | V <sub>IN</sub> = 3V; T <sub>A</sub> = 25°C                      |
|                                             |                     | 2.2 | -   | -   |      | V <sub>IN</sub> = 5V; T <sub>A</sub> = 25°C                      |
| Continuous Drain Current (Note 5)           |                     | 2.6 | -   | -   |      | V <sub>IN</sub> = 3V; T <sub>A</sub> = 25°C                      |
|                                             |                     | 2.8 | -   | -   |      | V <sub>IN</sub> = 5V; T <sub>A</sub> = 25°C                      |
| Current Limit (Note 7)                      | I <sub>D(LIM)</sub> | 4   | 8   | -   | A    | V <sub>IN</sub> = +3V                                            |
|                                             |                     | 6   | 13  | -   |      | V <sub>IN</sub> = +5V                                            |
| Dynamic Characteristics                     |                     |     |     |     |      |                                                                  |
| Turn On Delay Time                          | t <sub>d(on)</sub>  | -   | 8.6 | -   | μs   | V <sub>DD</sub> = 12V, I <sub>D</sub> = 1A, V <sub>GS</sub> = 5V |
| Rise Time                                   | t <sub>r</sub>      | -   | 18  | -   |      |                                                                  |
| Turn Off Delay Time                         | t <sub>d(off)</sub> | -   | 34  | -   |      |                                                                  |
| Fall Time                                   | t <sub>f</sub>      | -   | 15  | -   |      |                                                                  |
| Over-Temperature Protection                 |                     |     |     |     |      |                                                                  |
| Thermal Overload Trip Temperature (Note 8)  | T <sub>JT</sub>     | 150 | 175 | -   | °C   | -                                                                |
| Thermal Hysteresis (Note 8)                 | f <sub>f</sub>      | -   | 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.
  - Over-temperature 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..

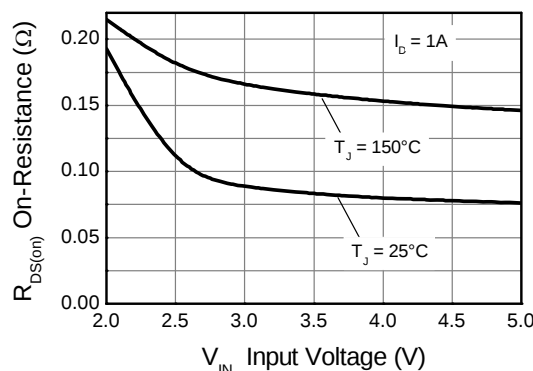
## Typical Characteristics



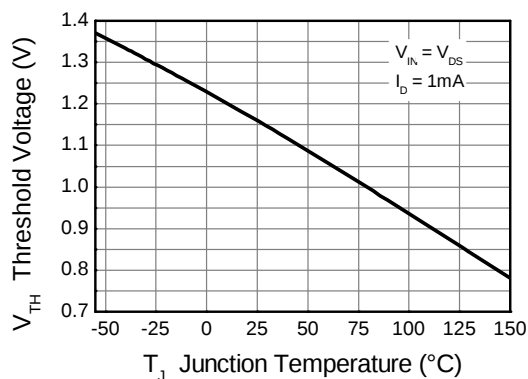
**Typical Output Characteristic**



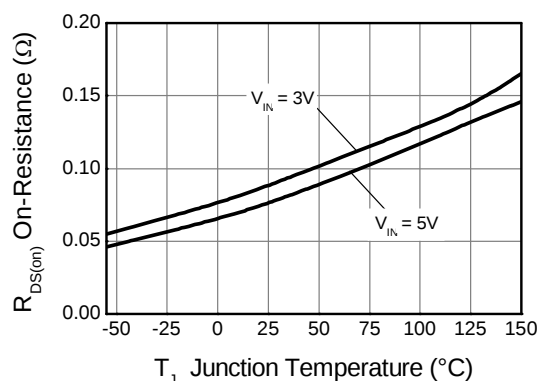
**Input Current vs Input Voltage**



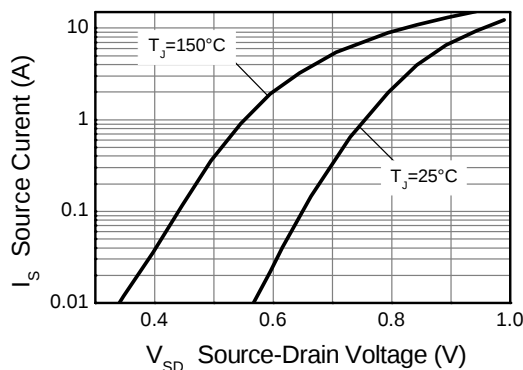
**On-Resistance vs Input Voltage**



**Threshold Voltage vs Temperature**

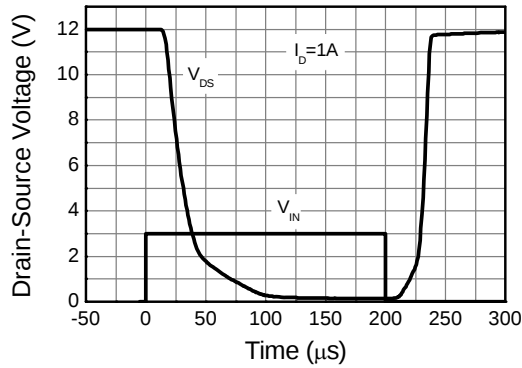


**On-Resistance vs Temperature**

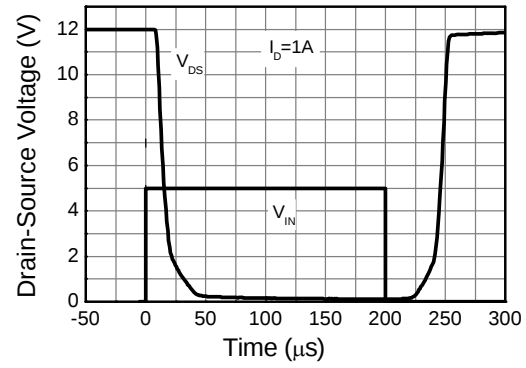


**Reverse Diode Characteristic**

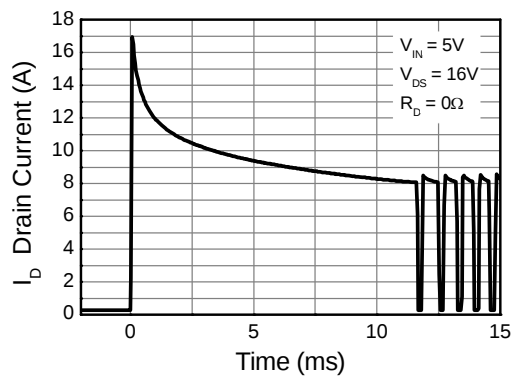
## Typical Characteristics - Continued



**Switching Speed**

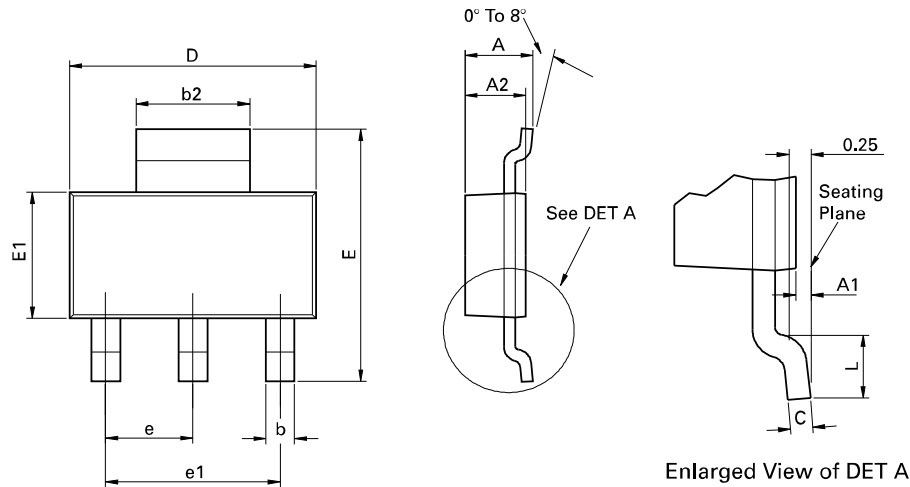


**Switching Speed**



**Typical Short Circuit Protection**

## Package Outline Dimensions

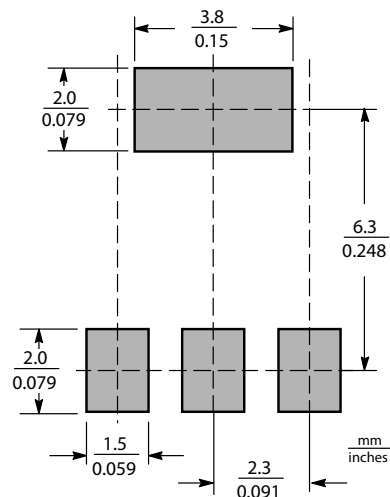


Conforms to JEDEC TO-261 AA Issue B

| DIM | Millimeters |      | Inches |       | DIM | Millimeters |      | Inches     |       |
|-----|-------------|------|--------|-------|-----|-------------|------|------------|-------|
|     | Min         | Max  | Min    | Max   |     | Min         | Max  | Min        | Max   |
| A   | -           | 1.80 | -      | 0.071 | e   | 2.30 BSC    |      | 0.0905 BSC |       |
| A1  | 0.02        | 0.10 | 0.0008 | 0.004 | e1  | 4.60 BSC    |      | 0.181 BSC  |       |
| b   | 0.66        | 0.84 | 0.026  | 0.033 | E   | 6.70        | 7.30 | 0.264      | 0.287 |
| b2  | 2.90        | 3.10 | 0.114  | 0.122 | E1  | 3.30        | 3.70 | 0.130      | 0.146 |
| C   | 0.23        | 0.33 | 0.009  | 0.013 | L   | 0.90        | -    | 0.355      | -     |
| D   | 6.30        | 6.70 | 0.248  | 0.264 | -   | -           | -    | -          | -     |

Note: Controlling dimensions are in millimeters. Approximate dimensions are provided in inches.

## Suggested Pad Layout



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