

ZXMS6004FF

60V N-channel self protected enhancement mode Intellifet MOSFET

Summary

| | |
|--|--------|
| Continuous drain source voltage | 60 V |
| On-state resistance | 500 mΩ |
| Nominal load current ($V_{IN} = 5V$) | 1.3 A |
| Clamping energy | 90mJ |



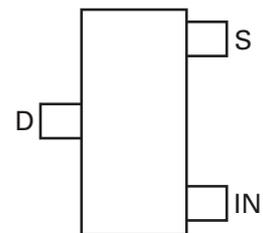
SOT23F

Description

The ZXMS6004FF 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 ZXMS6004FF is ideal as a general purpose switch driven from 3.3V or 5V microcontrollers in harsh environments where standard MOSFETs are not rugged enough.

Features

- 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

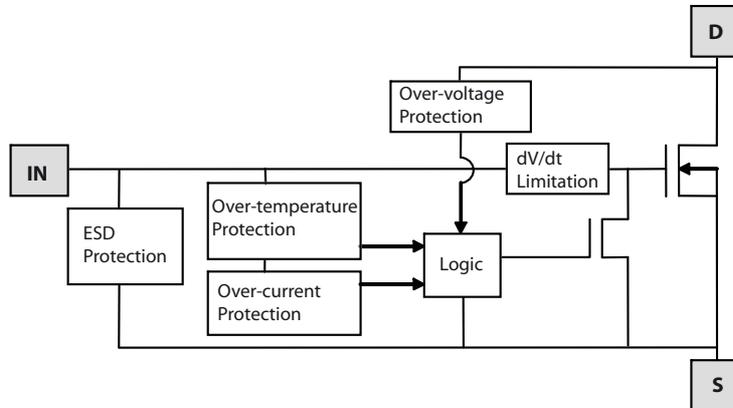


Pinout - top view

Ordering information

| Device | Part mark | Reel size (inches) | Tape width (mm) | Quantity per reel |
|---------------|-----------|--------------------|-----------------|-------------------|
| ZXMS66004FFTA | 1K6 | 7 | 12 embossed | 3,000 units |

Functional block diagram



Application information

- 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.
- μC 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 minimise 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} .

Absolute maximum ratings

| Parameter | Symbol | Limit | Unit |
|--|--------------|-------------------------------|-------|
| 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 V_{IN} < -0.2V or V_{IN} > 6V | I_{IN} | No limit $ I_{IN} \leq 2$ | mA |
| Operating temperature range | $T_{j,r}$ | -40 to +150 | °C |
| Storage temperature range | T_{stg} | -55 to +150 | °C |
| Power dissipation at $T_A = 25^\circ\text{C}$ ^(a) | P_D | 0.83 | W |
| Linear derating factor | | 6.66 | mW/°C |
| Power dissipation at $T_A = 25^\circ\text{C}$ ^(b) | P_D | 1.5 | W |
| Linear derating factor | | 12.0 | mW/°C |
| Pulsed drain current @ $V_{IN}=3.3\text{V}$ | I_{DM} | 2 | A |
| Pulsed drain current @ $V_{IN}=5\text{V}$ | I_{DM} | 2.5 | A |
| Continuous source current (Body Diode) ^(a) | I_S | 1 | A |
| Pulsed dource current (Body Diode) | I_{SM} | 5 | A |
| Unclamped single pulse inductive energy, $T_j=25^\circ\text{C}$, $I_D=0.5\text{A}$, $V_{DD}=24\text{V}$ | E_{AS} | 90 | mJ |
| Electrostatic discharge (Human body model) | V_{ESD} | 4000 | V |
| Charged device model | V_{CDM} | 1000 | V |

Thermal resistance

| Parameter | Symbo | Value | Unit |
|------------------------------------|-----------------|-------|------|
| Junction to ambient ^(a) | $R_{\theta JA}$ | 150 | °C/W |
| Junction to ambient ^(b) | $R_{\theta JA}$ | 83 | °C/W |
| Junction to case ^(c) | $R_{\theta JC}$ | 44 | °C/W |

NOTES

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

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

(c) Thermal resistance from junction to the mounting surface of the drain pin.

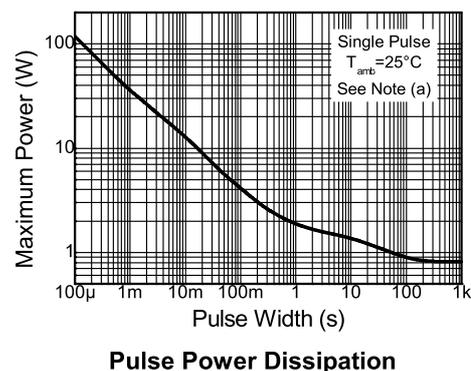
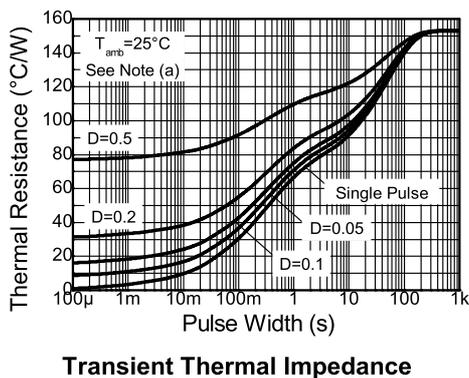
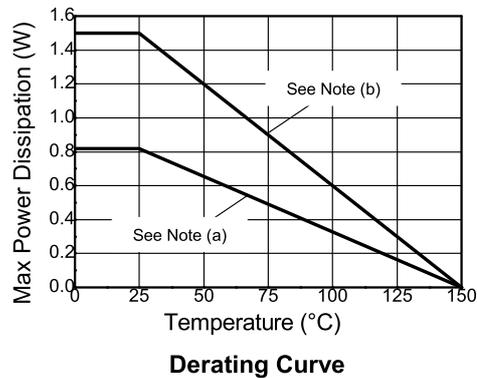
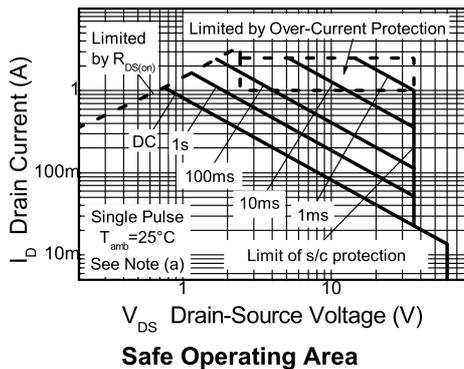
ZXMS6004FF

Recommended operating conditions

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

| Symbol | Description | Min | Max | Units |
|-----------------|---|-----|-----|--------------------|
| V_{IN} | Input voltage range | 0 | 5.5 | V |
| T_{A} | Ambient temperature range | -40 | 125 | $^{\circ}\text{C}$ |
| V_{IH} | High level input voltage for MOSFET to be on | 3 | 5.5 | V |
| V_{IL} | Low level input voltage for MOSFET to be off | 0 | 0.7 | V |
| V_{P} | Peripheral supply voltage (voltage to which load is referred) | 0 | 36 | V |

Characteristics



ZXMS6004FF

Electrical characteristics (at $T_{amb} = 25^{\circ}\text{C}$ unless otherwise stated).

| Parameter | Symbol | Min | Typ | Max | Unit | Conditions |
|---|--------------|-----|-----|-----|------------------|---|
| Static Characteristics | | | | | | |
| Drain-Source clamp voltage | $V_{DS(AZ)}$ | 60 | 65 | 70 | V | $I_D=10\text{mA}$ |
| Off-state drain Ccurrent | I_{DSS} | | | 500 | nA | $V_{DS}=12\text{V}, V_{IN}=0\text{V}$ |
| Off-state drain current | I_{DSS} | | | 1 | μA | $V_{DS}=36\text{V}, V_{IN}=0\text{V}$ |
| Input threshold voltage | $V_{IN(th)}$ | 0.7 | 1 | 1.5 | V | $V_{DS}=V_{GS}, I_D=1\text{mA}$ |
| Input current | I_{IN} | | 60 | 100 | μA | $V_{IN}=+3\text{V}$ |
| Input current | I_{IN} | | 120 | 200 | μA | $V_{IN}=+5\text{V}$ |
| Input current while over temperature active | | | | 220 | μA | $V_{IN}=+5\text{V}$ |
| Static Drain-Source on-state resistance | $R_{DS(on)}$ | | 400 | 600 | $\text{m}\Omega$ | $V_{IN}=+3\text{V}, I_D=0.5\text{A}$ |
| Static Drain-Source on-state resistance | $R_{DS(on)}$ | | 350 | 500 | $\text{m}\Omega$ | $V_{IN}=+5\text{V}, I_D=0.5\text{A}$ |
| Continuous drain current ^(a) | I_D | 0.9 | | | A | $V_{IN}=3\text{V}; T_A=25^{\circ}\text{C}$ |
| Continuous drain cCurrent (a) | I_D | 1.0 | | | A | $V_{IN}=5\text{V}; T_A=25^{\circ}\text{C}$ |
| Continuous drain current ^(b) | I_D | 1.2 | | | A | $V_{IN}=3\text{V}; T_A=25^{\circ}\text{C}$ |
| Continuous drain current ^(b) | I_D | 1.3 | | | A | $V_{IN}=5\text{V}; T_A=25^{\circ}\text{C}$ |
| Current limit | $I_{D(LIM)}$ | 0.7 | 1.7 | | A | $V_{IN}=+3\text{V},$ |
| Current limit ^(c) | $I_{D(LIM)}$ | 1 | 2.2 | | A | $V_{IN}=+5\text{V}$ |
| Dynamic characteristics | | | | | | |
| Turn-on delay time | $t_{d(on)}$ | | 5 | | μs | $V_{DD}=12\text{V}, I_D=0.5\text{A},$ $V_{GS}=5\text{V}$ |
| Rise time | t_r | | 10 | | μs | |
| Turn-off delay time | $t_{d(off)}$ | | 45 | | μs | |
| Fall time | f_f | | 15 | | μs | |

Notes:

(d) 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.

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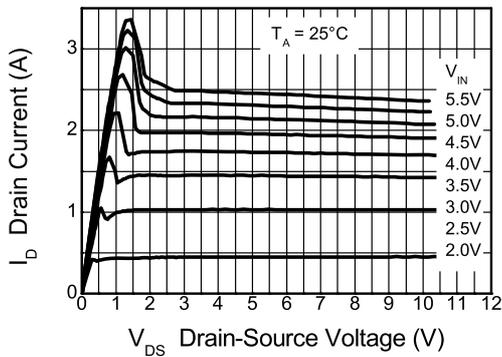
Electrical characteristics - continued

| Parameter | Symbol | Min | Typ | Max | Unit | Conditions |
|--|--------|-----|-----|-----|------|------------|
| Over-temperature protection | | | | | | |
| Thermal overload trip temperature ^(a) | TJT | 150 | 175 | | °C | |
| Thermal hysteresis ^(a) | | | 10 | | °C | |

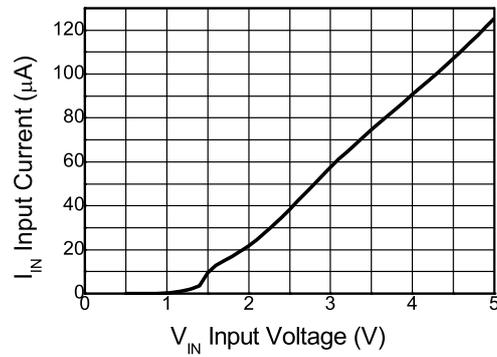
Note:

(a) 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..

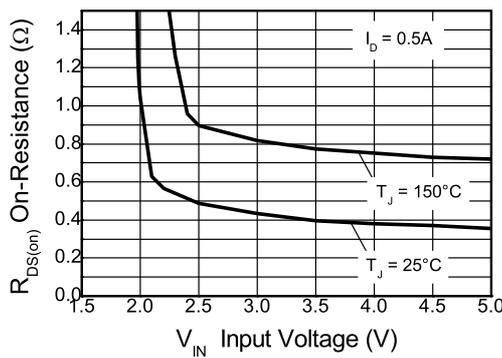
Typical characteristics



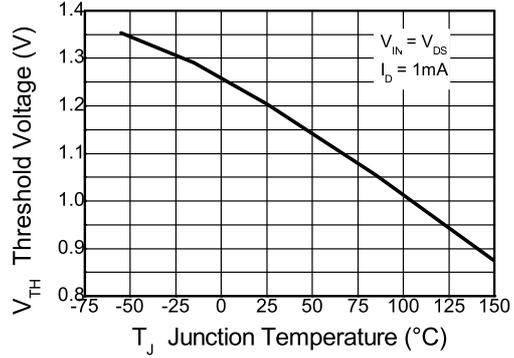
Typical Output Characteristic



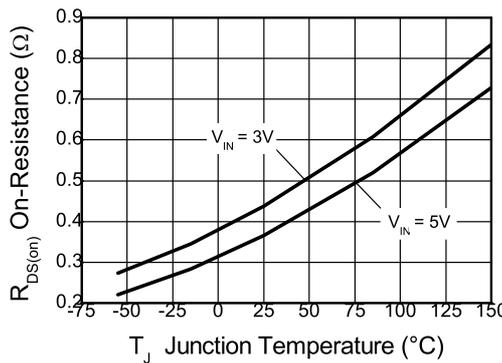
Input Current vs Input Voltage



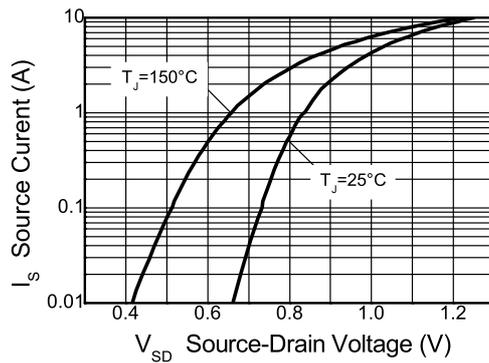
On-Resistance vs Input Voltage



Threshold Voltage vs Temperature

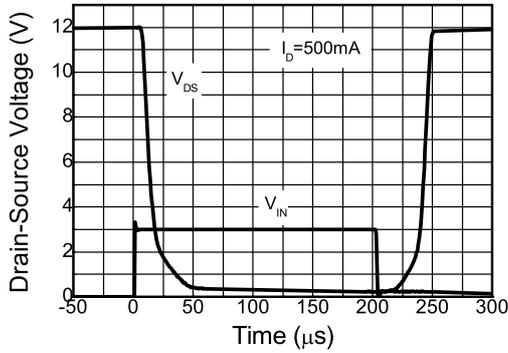


On-Resistance vs Temperature

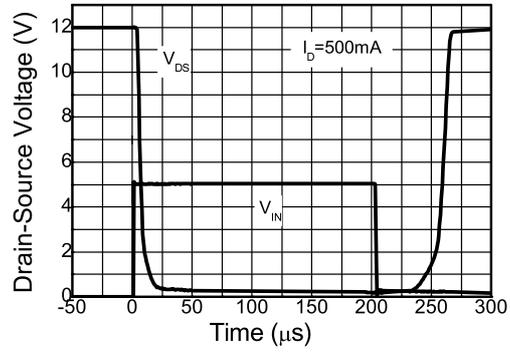


Reverse Diode Characteristic

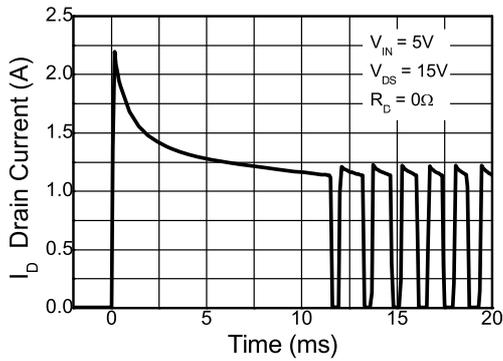
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Switching Speed



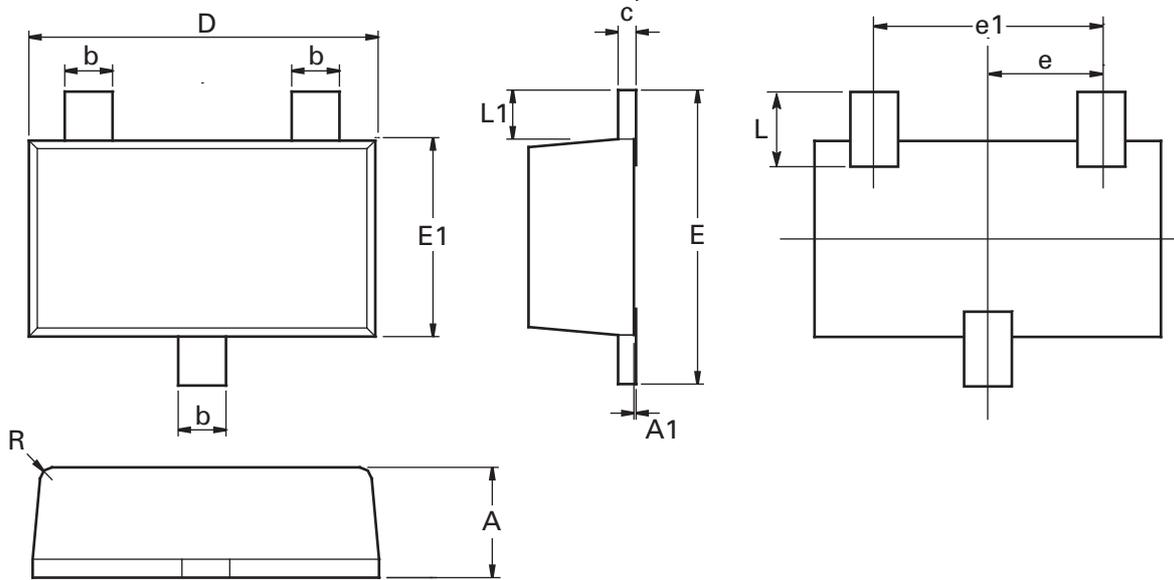
Switching Speed



Typical Short Circuit Protection

ZXMS6004FF

Package information - SOT23F



| Dim. | Millimeters | | Inches | | Dim. | Millimeters | | Inches | |
|------|-------------|------|------------|--------|------|-------------|------|--------|--------|
| | Min. | Max. | Min. | Max. | | Min. | Max. | Min. | Max. |
| A | 0.80 | 1.00 | 0.0315 | 0.0394 | E | 2.30 | 2.50 | 0.0906 | 0.0984 |
| A1 | 0.00 | 0.10 | 0.00 | 0.0043 | E1 | 1.50 | 1.70 | 0.0590 | 0.0669 |
| b | 0.35 | 0.45 | 0.0153 | 0.0161 | L | 0.48 | 0.68 | 0.0189 | 0.0268 |
| c | 0.10 | 0.20 | 0.0043 | 0.0079 | L1 | 0.30 | 0.50 | 0.0153 | 0.0161 |
| D | 2.80 | 3.00 | 0.1102 | 0.1181 | R | 0.05 | 0.15 | 0.0019 | 0.0059 |
| e | 0.95 ref | | 0.0374 ref | | O | 0° | 12° | 0° | 12° |
| e1 | 1.80 | 2.00 | 0.0709 | 0.0787 | - | - | - | - | - |

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

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| | |
|-----------------------------------|--|
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