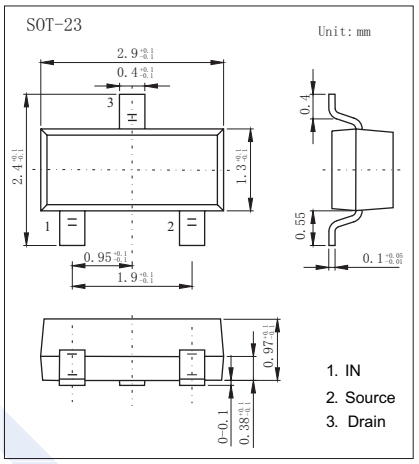
# N-Channel Self Protected Enhancement Mode MOSFET
# ZXMS6004FF(KXMS6004FF)

## ■ 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




## ■ Absolute Maximum Ratings Ta = 25℃

| Parameter | Symbol | Rating | Unit |
|---|---|---|---|
| Drain-Source Voltage | $V_{DS}$ | 60 | V |
| Drain-Source voltage for short circuit protection | $V_{DS(SC)}$ | 36 | |
| Continuous input Voltage | $V_{IN}$ | -0.5 … +6 | |
| Continuous input Current<br>-0.2V≤$V_{IN}$≤6V<br>$V_{IN}$<-0.2V or $V_{IN}$>6V | $I_{IN}$ | No limit<br>$\|I_{IN}\|$≤2 | mA |
| Pulsed Drain Current @ $V_{IN}$=3.3V | $I_{DM}$ | 2 | A |
| Pulsed Drain Current @ $V_{IN}$=5V | | 2.5 | |
| Power Dissipation at TA = 25℃ (a) | $P_D$ | 0.83 | W |
| Linear derating factor | | 6.66 | mW/℃ |
| Power Dissipation at TA = 25℃ (b) | $P_D$ | 1.5 | W |
| Linear derating factor | | 12 | mW/℃ |
| Continuous source current (Body Diode) (a) | $I_S$ | 1 | A |
| Pulsed dource current (Body Diode) | $I_{SM}$ | 5 | |
| Unclamped single pulse inductive energy,<br>$T_j$=25℃, $I_D$=0.5A, $V_{DD}$=24V | $E_{AS}$ | 90 | mJ |
| Electrostatic discharge (Human body model) | $V_{ESD}$ | 4000 | V |
| Charged device model | $V_{CDM}$ | 1000 | |
| Thermal Resistance.Junction- to-Ambient (a) | $R_{thJA}$ | 150 | ℃/W |
| Thermal Resistance.Junction- to-Ambient (b) | $R_{thJA}$ | 83 | |
| Thermal Resistance.Junction- to-Case (c) | $R_{thJC}$ | 44 | |
| Junction Temperature | $T_J$ | 150 | ℃ |
| Storage Temperature Range | $T_{stg}$ | -55 to 150 | |

Note:
(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.

# N-Channel Self Protected Enhancement Mode MOSFET
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## ■ Electrical Characteristics Ta = 25℃

| Parameter | Symbol | Test Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Static Characteristics | | | | | | |
| Drain-Source Clamp Voltage | $V_{DS(AZ)}$ | $I_D$=10 mA, $V_{GS}$=0V | 60 | | 70 | V |
| Off-state drain Current | $I_{DSS}$ | $V_{DS}$=12V, $V_{IN}$=0V | | | 500 | nA |
| | | $V_{DS}$=36V, $V_{IN}$=0V | | | 1 | μA |
| Input threshold voltage | $V_{IN(th)}$ | $V_{DS}$=$V_{GS}$ , $I_D$=1mA | 0.7 | | 1.5 | V |
| Input Current | $I_{IN}$ | $V_{IN}$=+3V | | | 100 | μA |
| Input Current | $I_{IN}$ | $V_{IN}$=+5V | | | 200 | |
| Input current while over temperature active | | $V_{IN}$=+5V | | | 220 | |
| Static Drain-Source On-Resistance | $R_{DS(on)}$ | $V_{IN}$=+3V, $I_D$=0.5A | | | 600 | mΩ |
| | | $V_{IN}$=+5V, $I_D$=0.5A | | | 500 | |
| Continuous drain current [a] | $I_D$ | $V_{IN}$=3V, $T_A$=25℃ | 0.9 | | | A |
| Continuous drain current [a] | $I_D$ | $V_{IN}$=5V, $T_A$=25℃ | 1 | | | A |
| Continuous drain current [b] | $I_D$ | $V_{IN}$=3V, $T_A$=25℃ | 1.2 | | | A |
| Continuous drain current [b] | $I_D$ | $V_{IN}$=5V, $T_A$=25℃ | 1.3 | | | A |
| Current limit | $I_{D(LIM)}$ | $V_{IN}$=+3V | 0.7 | | | A |
| Current limit [d] | $I_{D(LIM)}$ | $V_{IN}$=+5V | 1 | | | A |
| Dynamic characteristics | | | | | | |
| Turn-On DelayTime | $t_{d(on)}$ | $V_{GS}$=5V, $V_{DS}$=12V, $I_D$=0.5A | | 5 | | μs |
| Rise Time | $t_r$ | | | 10 | | |
| Turn-Off DelayTime | $t_{d(off)}$ | | | 45 | | |
| Fall Time | $t_f$ | | | 15 | | |
| Over-temperature protection | | | | | | |
| Thermal overload trip temperature [e] | TJT | | 150 | 175 | | ℃ |
| Thermal hysteresis [e] | | | | 10 | | ℃ |

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.

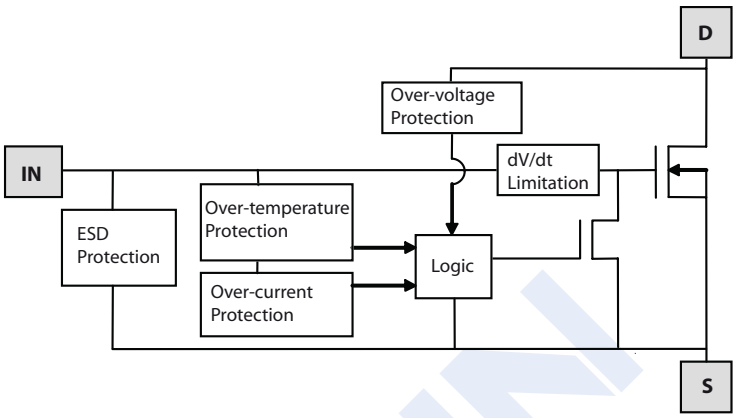
(e) Over-temperature protection is designed to prevent device destruction under fault conditions. Fault conditions are considered as "outside" normal operating range, so this part is not designed to withstand over-temperature for extended periods.

## ■ Marking

| Marking | 1K6 |
|---|---|

# N-Channel Self Protected Enhancement Mode MOSFET
# ZXMS6004FF(KXMS6004FF)

■ Functional block diagram



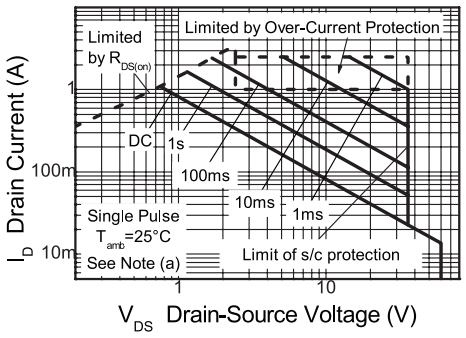

■ Recommended operating conditions

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

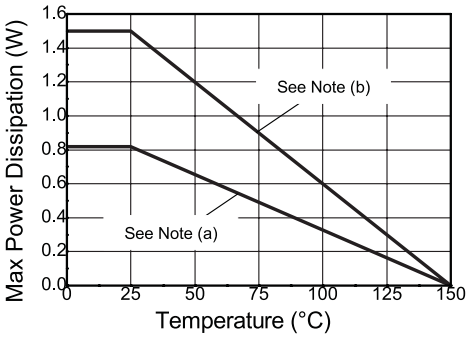
| Symbol | Description | Min | Max | Units |
|---|---|---|---|---|
| $V_{IN}$ | Input voltage range | 0 | 5.5 | V |
| $T_A$ | Ambient temperature range | -40 | 125 | °C |
| $V_{IH}$ | High level input voltage for MOSFET to be on | 3 | 5.5 | V |
| $V_{IL}$ | Low level input voltage for MOSFET to be off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

# N-Channel Self Protected Enhancement Mode MOSFET
# FZXMS6004FF(KXMS6004FF)

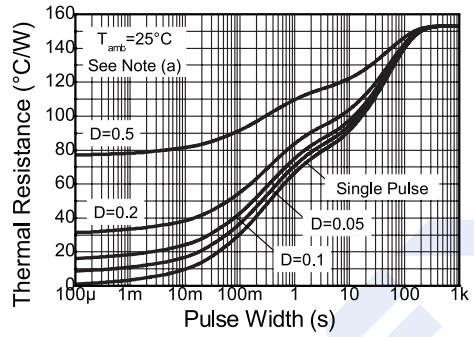
■ Typical Characterisitics



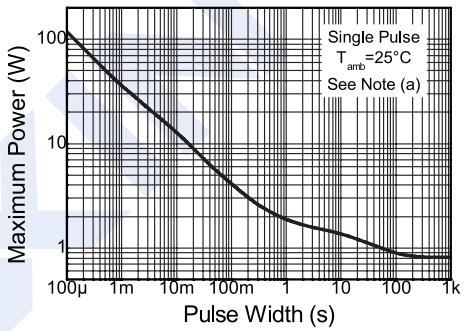

**Safe Operating Area**



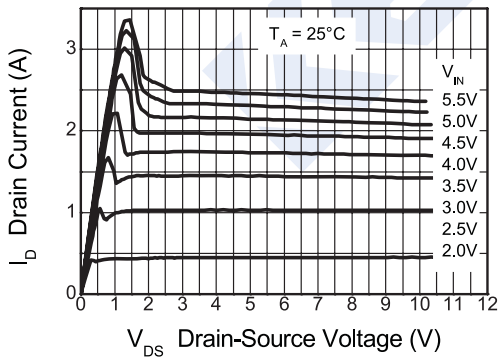

**Derating Curve**



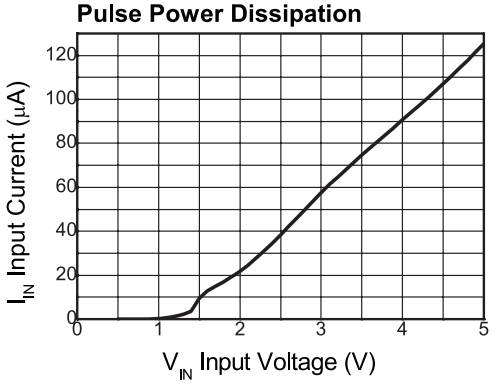

**Transient Thermal Impedance**



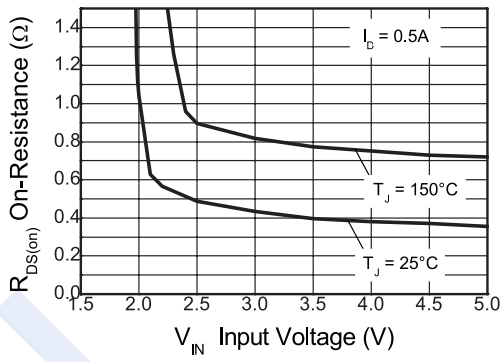

**Pulse Power Dissipation**



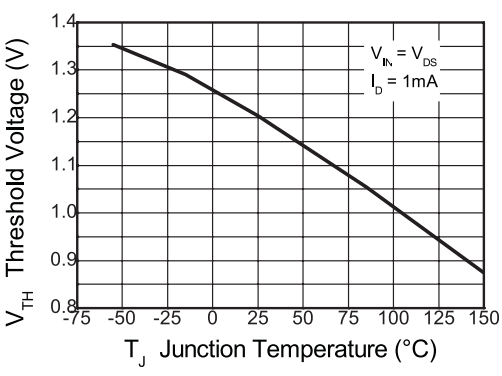

**Typical Output Characteristic**




**Input Current vs Input Voltage**



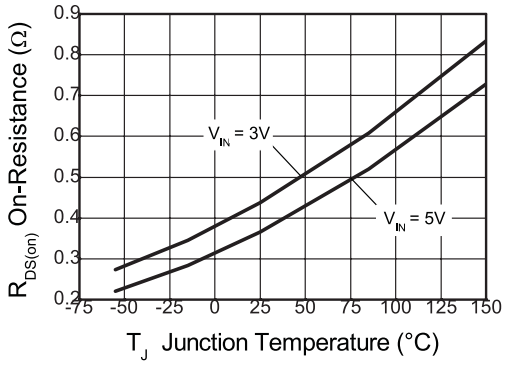

**On-Resistance vs Input Voltage**



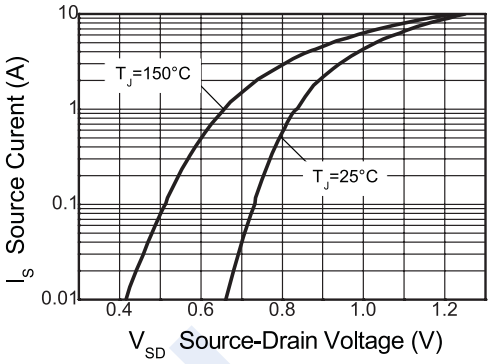

**Threshold Voltage vs Temperature**

# N-Channel Self Protected Enhancement Mode MOSFET
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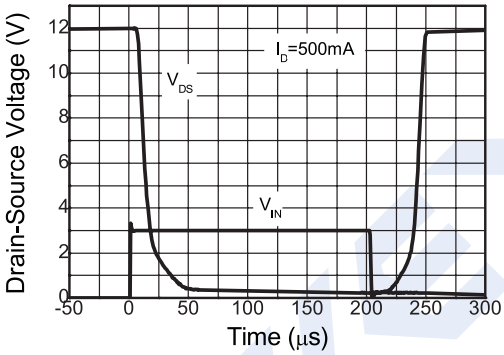
■ Typical Characterisitics



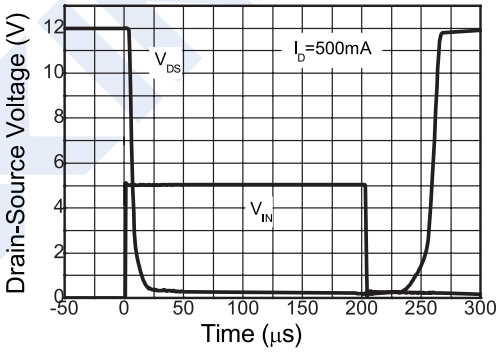

**On-Resistance vs Temperature**



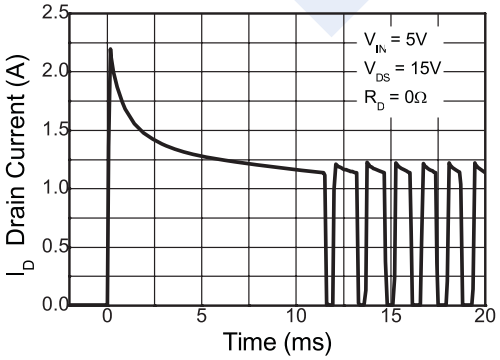

**Reverse Diode Characteristic**




**Switching Speed**




**Switching Speed**




**Typical Short Circuit Protection**