ZXMS6004DG
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	490mJ

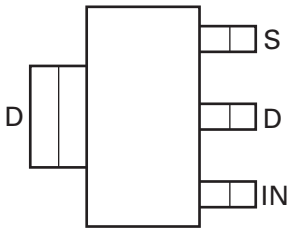

SOT223

Description

The ZXMS6004DG 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 ZXMS6004DG 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

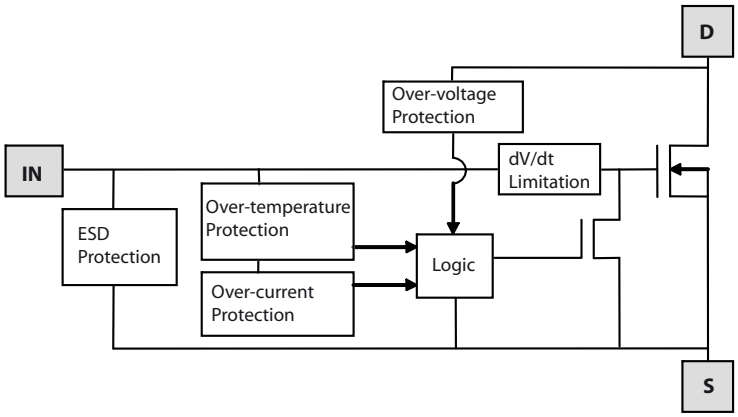


Top view

Ordering information

Device	Part mark	Reel size (inches)	Tape width (mm)	Quantity per reel
ZXMS66004DGTA	ZXMS 6004D	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 $-0.2V \le V_{IN} \le 6V$ $V_{IN}<-0.2V$ or $V_{IN}>6V$	I_{IN}	 No limit $\lvert I_{IN} \rvert \le 2$	mA
Operating temperature range	T_j,	-40 to +150	°C
Storage temperature range	T_{stg}	-55 to +150	°C
Power dissipation at T_A =25°C (a) Linear derating factor	P_D	1.3 10.4	W mW/°C
Power dissipation at T_A =25°C (b) Linear derating factor	P_D	3.0 24	W mW/°C
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) (a)	I_S	1	A
Pulsed dource current (Body Diode)	I_{SM}	5	A
Unclamped single pulse inductive energy, Tj=25°C, I_D=0.5A, V_{DD}=24V	E_{AS}	490	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)	$R_{\theta JA}$	96	°C/W
Junction to ambient (b)	$R_{\theta JA}$	42	°C/W
Junction to case (c)	$R_{\theta JC}$	12	°C/W

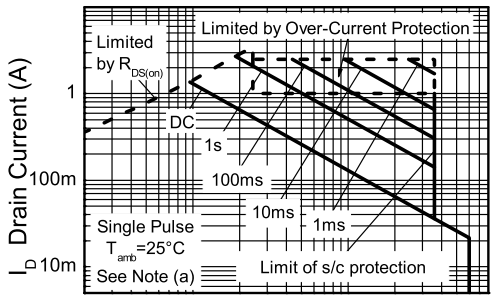
NOTES
(a) For a device surface mounted on a 15mm x 15mm single sided 1oz weight copper on 1.6mm FR4 board, in still air conditions.
(b) For a device surface mounted on 50mm x 50mm single sided 2oz weight copper on 1.6mm FR4 board in still air conditions.
(c) Thermal resistance from junction to the mounting surface of the drain pin.

Recommended operating conditions

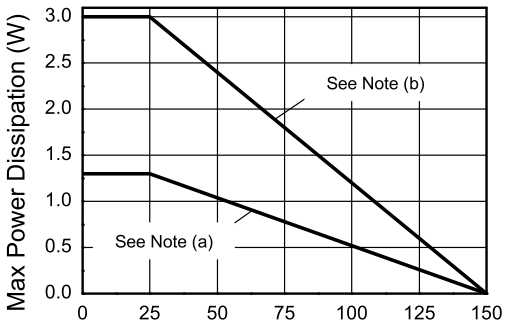
The ZXMS6004DG is optimised for use with µC operating from 3.3V and 5V supplies.

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

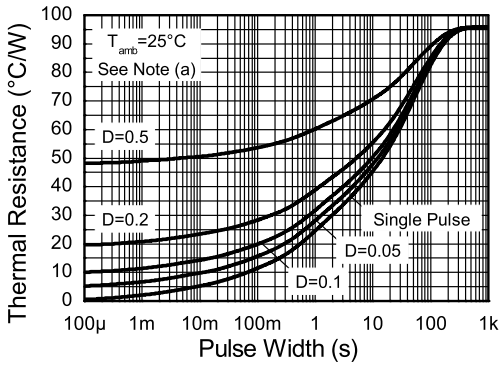
Characteristics



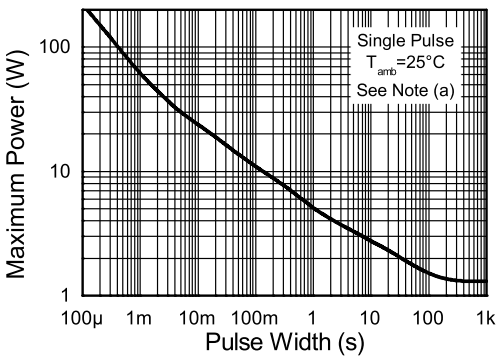
Safe Operating Area



Derating Curve



Transient Thermal Impedance



Pulse Power Dissipation

Electrical characteristics (at T_{amb} = 25°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=10mA
Off-state drain Ccrrent	I_{DSS}			500	nA	V_{DS}=12V, V_{IN}=0V
Off-state drain current	I_{DSS}			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
Input current	I_{IN}		120	200	μA	V_{IN}=+5V
Input current while over temperature active				400	μA	V_{IN}=+5V
Static Drain-Source on-state resistance	$R_{DS(on)}$		400	600	mΩ	V_{IN}=+3V, I_D=0.5A
Static Drain-Source on-state resistance	$R_{DS(on)}$		350	500	mΩ	V_{IN}=+5V, I_D=0.5A
Continuous drain current(a)	I_D	0.9			A	V_{IN}=3V; T_A=25°C
Continuous drain cCurrent (a)	I_D	1.0			A	V_{IN}=5V; T_A=25°C
Continuous drain current (b)	I_D	1.2			A	V_{IN}=3V; T_A=25°C
Continuous drain current (b)	I_D	1.3			A	V_{IN}=5V; T_A=25°C
Current limit	$I_{D(LIM)}$	0.7	1.7		A	V_{IN}=+3V,
Current limit (c)	$I_{D(LIM)}$	1	2.2		A	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		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.

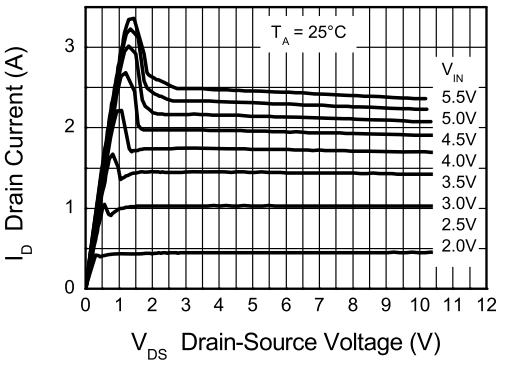
Electrical characteristics - continued

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

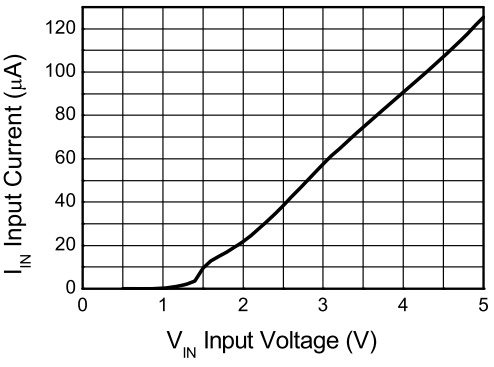
Note:

(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..

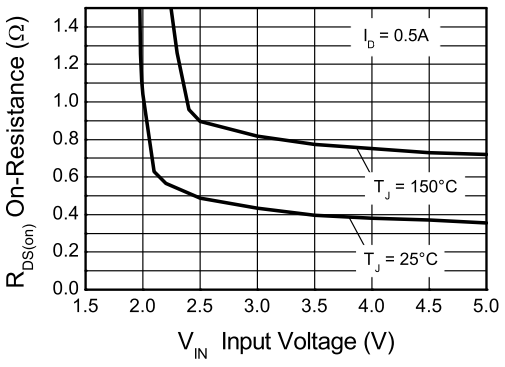
Typical characteristics



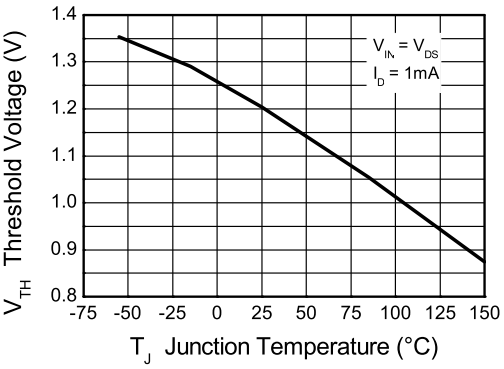
Typical Output Characteristic



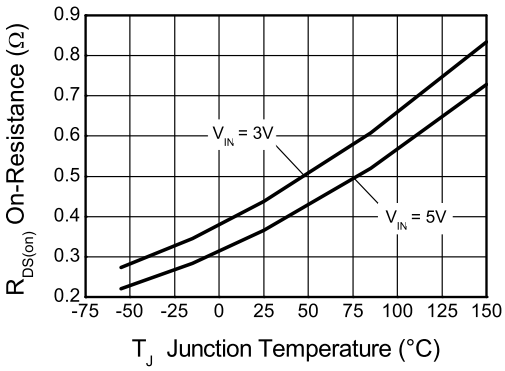
Input Current vs Input Voltage



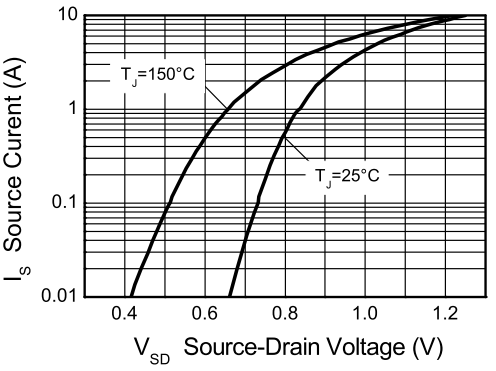
On-Resistance vs Input Voltage



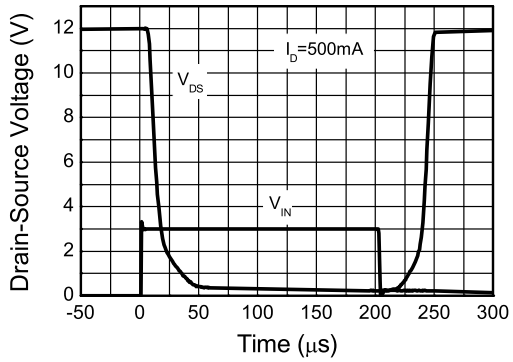
Threshold Voltage vs Temperature



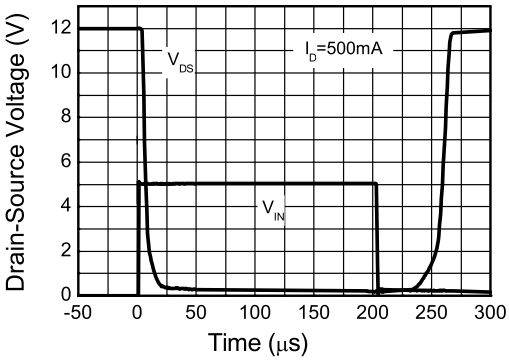
On-Resistance vs Temperature



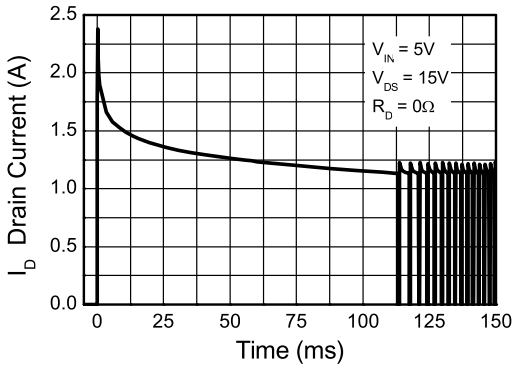
Reverse Diode Characteristic



Switching Speed

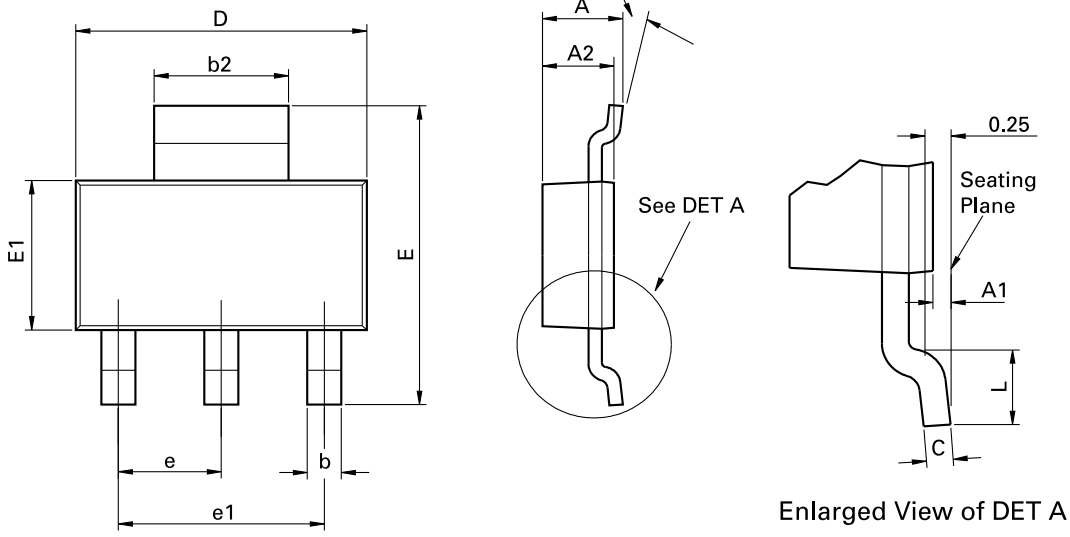


Switching Speed



Typical Short Circuit Protection

Package information - SOT223



Conforms to JEDEC TO-261 AA Issue B

Enlarged View of DET A

Dim.	Millimeters		Inches		Dim.	Millimeters		Inches	
	Min.	Max.	Min.	Max.		Min.	Max.	Min.	Max.
A	-	1.8	-	0.071	D	6.30	6.70	0.248	0.264
A1	0.02	0.1	0.0008	0.004	e	2.30 BSC		0.0905 BSC	
A2	1.55	1.65	0.0610	0.0649	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	-

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

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"Not recommended for new designs"	Device is still in production to support existing designs and production
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Datasheet status key:

"Draft version"	This term denotes a very early datasheet version and contains highly provisional information, which may change in any manner without notice.
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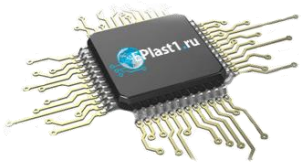

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