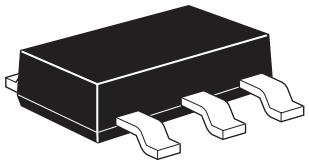
ZXMS6001N3
60V N-channel self protected enhancement mode *INTELLIFET*™ MOSFET

Summary



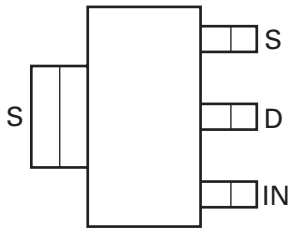
Continuous drain source voltage	**V_{DS} = 60V**
On-state resistance	**675mΩ**
Max nominal load current (a)	**1.1A (V_{IN} = 5V)**
Min nominal load current (c)	**0.7A (V_{IN} = 5V)**
Clamping Energy	**550mJ**

Description

Low input current self protected low side MOSFET intended for Vin=5V applications. Monolithic over temperature, over current, over voltage (active clamp) and ESD protected logic level functionality. Intended as a general purpose switch.

Note:

The tab is connected to the source pin and must be electrically isolated from the drain pin. Connection of significant copper to the drain pin is recommended for best thermal performance.



SOT223

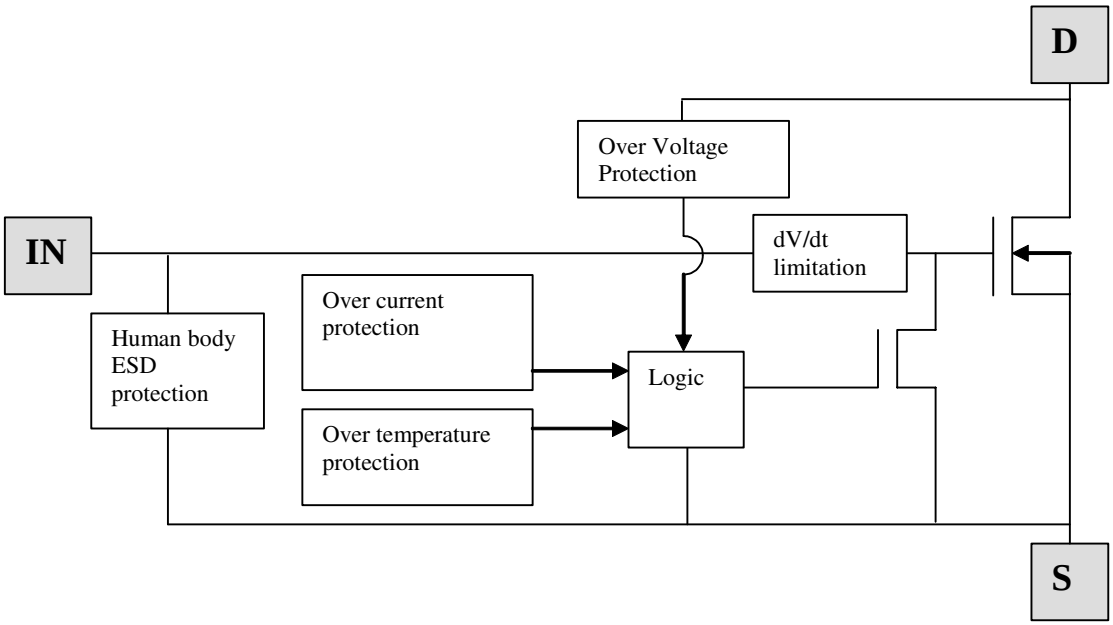
Features

- Short circuit protection with auto restart
- Over voltage protection (active clamp)
- Thermal shutdown with auto restart
- Over-current protection
- Input protection (ESD)
- Load dump protection (actively protects load)
- Low input current

Ordering information

Device	Package	Part mark	Reel size (inches)	Tape width (mm)	Quantity per reel
ZXMS6001N3TA	SOT223	ZXMS6001	7	12 embossed	1,000

Functional block diagram



Applications and 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 Vds, in order not to compromise the load current during normal operation. The design max 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 products ability to self protect itself 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_{IN} = 5V	$V_{DS(SC)}$	36	V
Continuous Input Voltage	V_{IN}	-0.2 ... +10	V
Peak Input Voltage	V_{IN}	-0.2 ... +20	V
Continuous Input Current -0.2V=V_{IN}=10V V_{IN}<-0.2V or V_{IN}>10V	I_{IN}	No limit $\mid I_{IN} \mid \leq 2$	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]	P_D	1.5	W
Power Dissipation at T_A =25°C[c]	P_D	0.6	W
Continuous Drain Current @ V_{IN}=5V; T_A=25°C[a]	I_D	1.1	A
Continuous Drain Current @ V_{IN}=5V; T_A=25°C[c]	I_D	0.7	A
Continuous Source Current (Body Diode)[a]	I_S	2.0	A
Pulsed Source Current (Body Diode)[b]	I_S	3.3	A
Unclamped single pulse inductive energy	E_{AS}	550	mJ
Load dump protection	$V_{LoadDump}$	80	V
Electrostatic Discharge (Human Body Model)	V_{ESD}	4000	V
DIN humidity category, DIN 40 040		E	
IEC climatic category, DIN IEC 68-1		40/150/56	

Thermal resistance

Parameter	Symbol	Value	Unit
Junction to ambient[a]	$R_{\Theta JA}$	83	°C/W
Junction to ambient[b]	$R_{\Theta JA}$	45	°C/W
Junction to ambient[c]	$R_{\Theta JA}$	208	°C/W

NOTES:

(a) For a device surface mounted on 25mm x 25mm x 1.6mm FR4 board with a high coverage of single sided 2oz weight copper. Allocation of 6cm^2 copper 33% to source tab and 66% to drain pin with source tab and drain pin electrically isolated.

(b) For a device surface mounted on FR4 board as (a) and measured at t<=10s.

(c) For a device surface mounted on FR4 board with the minimum copper required for electrical connections.

Recommended operating conditions

The ZXMS6001 is optimized for use with µC operating from 5V supplies.

Symbol	Description	Min	Max	Units
V_{IN}	Input voltage range	0	6	V
T_A	Ambient temperature range	-40	125	°C
V_{IH}	High level input voltage for MOSFET(d)	4	6	V
V_P	Peripheral supply voltage (voltage to which load is referred)		60	V

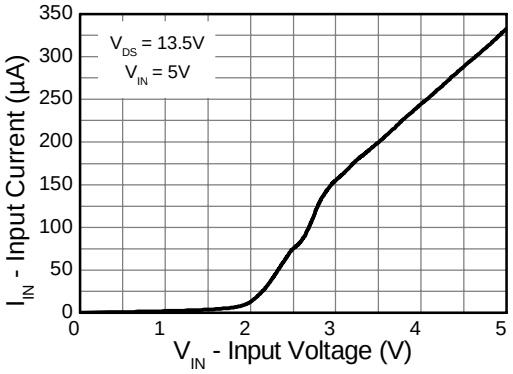
Electrical characteristics (at T_{amb} = 25°C unless otherwise stated).

Parameter	Symbol	Min	Typ	Max	Unit	Conditions
Static Characteristics						
Drain-Source Clamp Voltage	$V_{DS(AZ)}$	60	70	75	V	I_D=10mA
Off state Drain Current	I_{DSS}		0.1	3	µA	V_{DS}=12V, V_{IN}=0V
Off state Drain Current	I_{DSS}		3	15	µA	V_{DS}=32V, V_{IN}=0V
Input Threshold Voltage(d)	$V_{IN(th)}$	1	1.8	2.5	V	V_{DS}=V_{GS}, I_D=10mA
Input Current	I_{IN}		150		µA	V_{IN}=+3V
Input Current	I_{IN}		335	500	µA	V_{IN}=+5V, all circumstances
Static Drain-Source On-State Resistance	$R_{DS(on)}$		1	2	Ω	V_{IN}=3V, I_D=0.1A
Static Drain-Source On-State Resistance	$R_{DS(on)}$		520	675	mΩ	V_{IN}=5V, I_D=0.7A
Current Limit(e)	$I_{D(LIM)}$	1	1.8	3	A	V_{IN}=5V, V_{DS}>5V
Dynamic Characteristics						
Turn-On Time (V_{IN} to 90% I_D)	t_{on}		27	40	µs	R_L=22Ω, V_{IN}=0 to 5V, V_{DD}=12V
Turn-Off time (V_{IN} to 90% I_D)	t_{off}		26	40	µs	R_L=22Ω, V_{IN}=5V to 0V, V_{DD}=12V
Slew Rate On (70 to 50% V_{DD})	$-dV_{DS}/dt_{on}$		1.4	10	V/µs	R_L=22Ω, V_{IN}=0 to 5V, V_{DD}=12V
Slew Rate Off (50 to 70% V_{DD})	DV_{DS}/dt_{on}		1.2	10	V/µs	R_L=22Ω, V_{IN}=5V to 0V, V_{DD}=12V

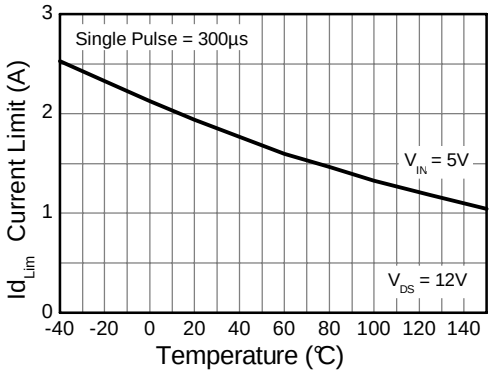
NOTES:
(d) Recommended input voltage range over which protection circuits function as specified.
(e) The drain current is limited to a reduced value when Vds exceeds a safe level

Parameter	Symbol	Min	Typ	Max	Unit	Conditions
Protection Functions (f)						
Minimum input voltage for over temperature protection	V_{PROT}	4	3.5		V	Ttrip>150°C
Maximum input voltage for over temperature protection	V_{PROT}		7	6	V	Ttrip>150°C
Thermal Overload Trip Temperature	T_{JT}	150	175		°C	
Thermal hysteresis			8		°C	
Unclamped single pulse inductive energy Tj=25°C	E_{AS}	550			mJ	$I_{D(ISO)}$=0.7A, V_{DD}=32V
Unclamped single pulse inductive energy Tj=150°C	E_{AS}	200			mJ	$I_{D(ISO)}$=0.7A, V_{DD}=32V
Inverse Diode						
Source drain voltage	V_{SD}			1	V	V_{IN}=0V, -I_D=1.4A

f Integrated protection functions are designed to prevent IC destruction under fault conditions described in the datasheet. Fault conditions are considered as "outside" normal operating range. Protection functions are not designed for continuous, repetitive operation.



Input Current v Input Voltage



Current Limit v Temperature

Application information

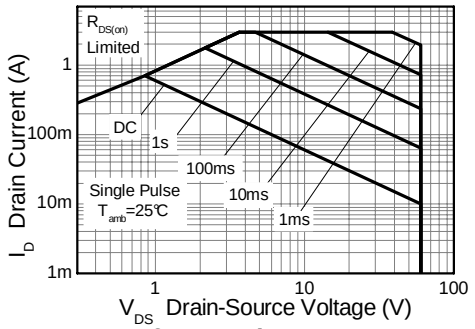
The current-limit protection circuitry is designed to de-activate at low Vds to prevent the load current from being unnecessarily restricted during normal operation. The design max DC operating current is therefore determined by the thermal capability of the package/board combination, rather than by the protection circuitry (see graph page 8 'typical output characteristic'). This does not compromise the products ability to self protect at low V_{DS}.

The overtemperature protection circuit trips at a minimum of 150°C. So the available package dissipation reduces as the maximum required ambient temperature increases. This leads to the following maximum recommended continuous operating currents.

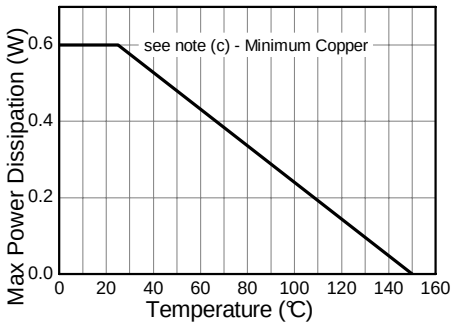
Minimum copper area characteristics

For minimum copper condition as described in note (c)

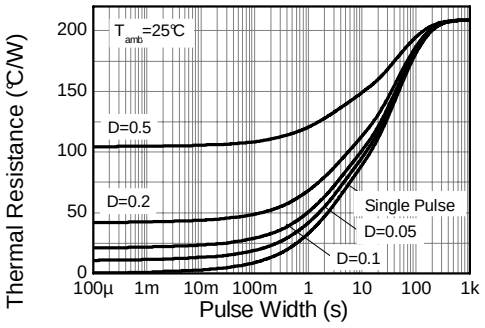
Max Ambient Temperature T_A	Maximum continuous current V_{IN}=5V
25°C at Vin=5V	720
70°C at Vin=5V	575
85°C at Vin=5V	520
125°C at Vin=5V	320



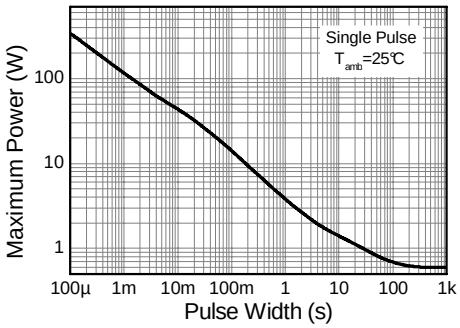
Safe Operating Area



Derating Curve



Transient Thermal Impedance

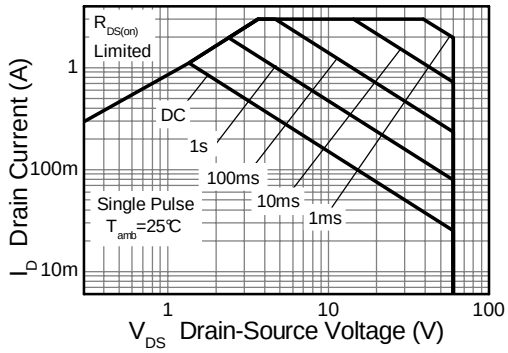


Pulse Power Dissipation

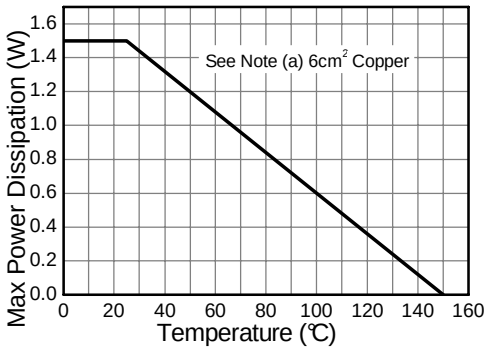
Large copper area characteristics

For large copper area as described in note (a)

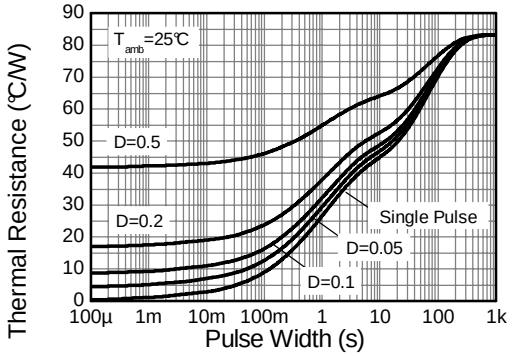
Max Ambient Temperature T_A	Maximum continuous current V_{IN}=5V
25°C at Vin=5V	1140
70°C at Vin=5V	915
85°C at Vin=5V	825
125°C at Vin=5V	510



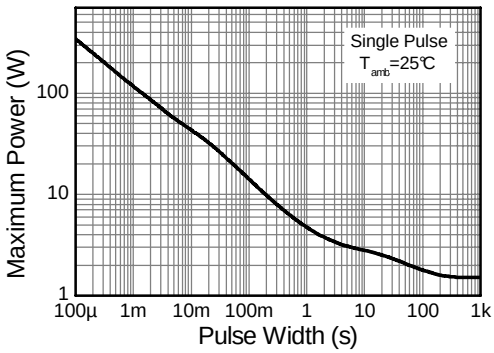
Safe Operating Area



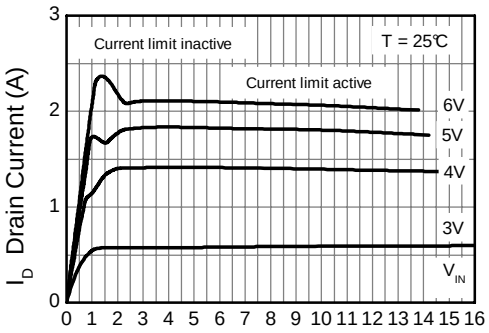
Derating Curve



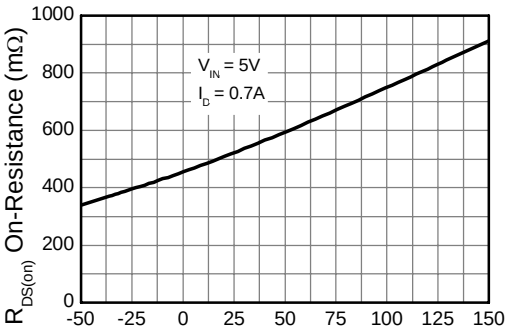
Transient Thermal Impedance



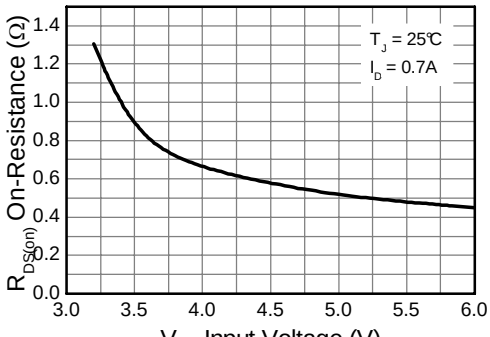
Pulse Power Dissipation



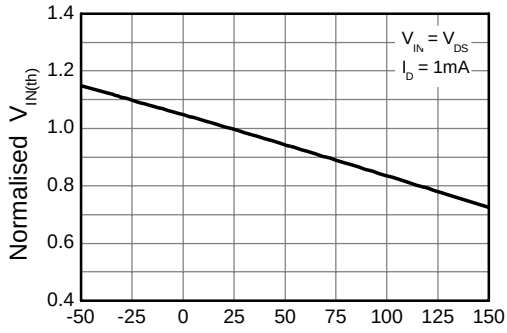
Typical Output Characteristic



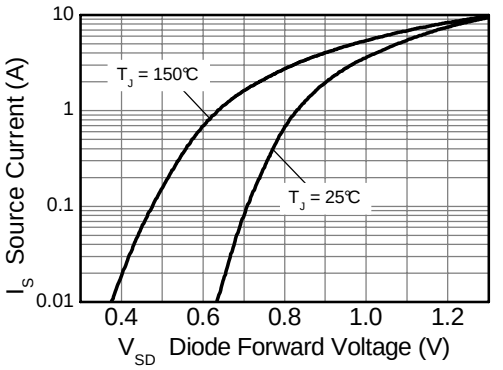
On-state Resistance vs Temperature



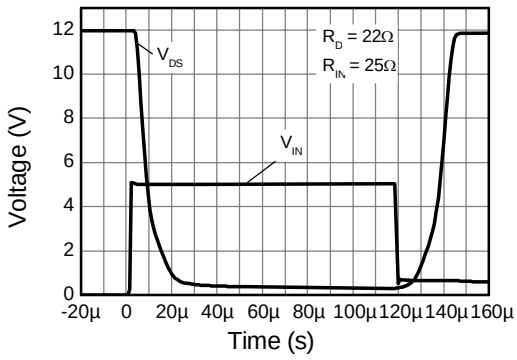
On-Resistance vs Input Voltage



Threshold Voltage vs Temperature

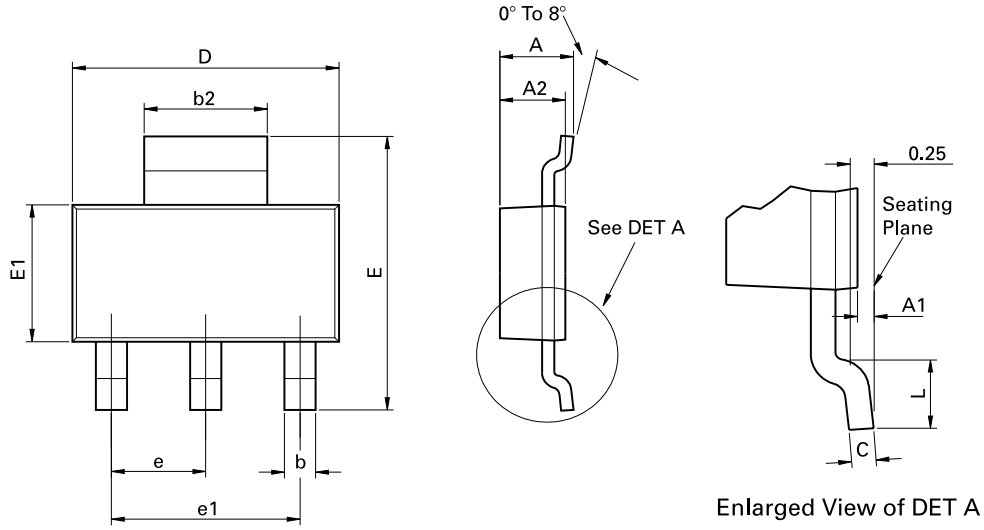


Source-Drain Diode Forward Voltage



Switching Speed

Package outline - SOT223



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	D	6.30	6.70	0.248	0.264
A1	0.02	0.10	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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"Preview"	Future device intended for production at some point. Samples may be available
"Active"	Product status recommended for new designs
"Last time buy (LTB)"	Device will be discontinued and last time buy period and delivery is in effect
"Not recommended for new designs"	Device is still in production to support existing designs and production
"Obsolete"	Production has been discontinued

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"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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