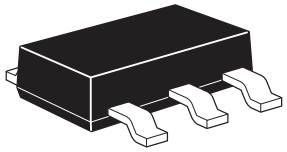
ZXMS6003G

60V N-channel self protected enhancement mode IntelliFET™ MOSFET with programmable current limit

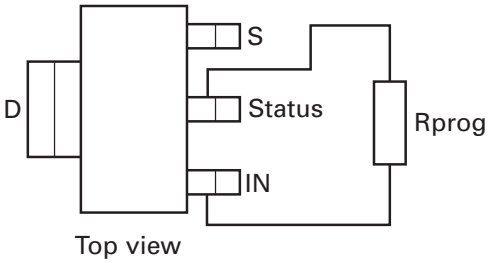
Summary



Continuous drain source voltage	**V_{DS} = 60V**
On-state resistance	**500mΩ**
Nominal load current (V_{IN} = 5V)	**1.4A**
Clamping energy	**550mJ**

Description

Self protected low side MOSFET. Monolithic over temperature, over current, over voltage (active clamp) and ESD protected logic level functionality. Intended as a general purpose switch, with status indication and programmable current limit.



Top view

Note: Rprog must be connected between the Status and IN pins

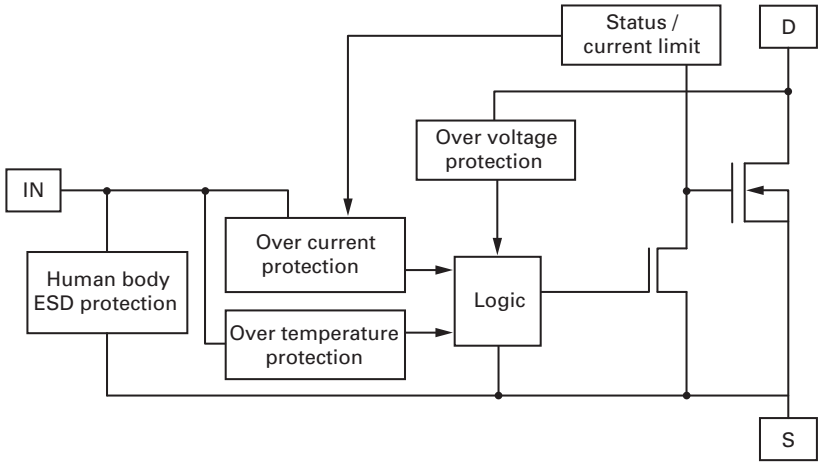
Features

- Current limit programmable via external resistor
- Status pin (analog status indication)
- 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)
- Logic Level Input
- High continuous current rating

Ordering information

Device	Part mark	Reel size (inches)	Tape width (mm)	Quantity per reel
ZXMS6003GTA	ZXMS6003	7	12	1,000

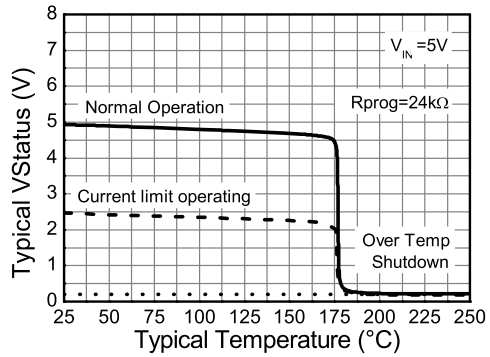
Functional block diagram



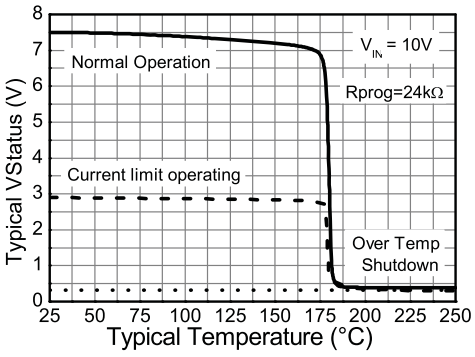
Applications and information

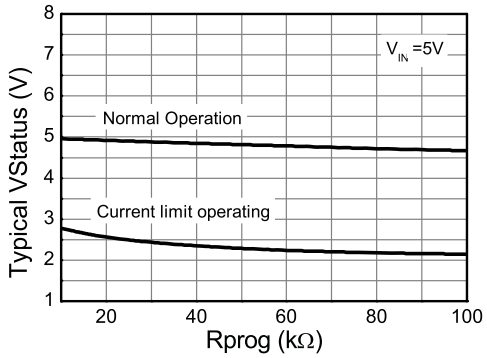
- Especially suited for loads with a high in-rush current such as lamps and motors.
- All types of resistive, inductive and capacitive loads in switching applications.
- μC compatible power switch for 12V and 24V DC applications.
- Automotive rated.
- Replaces electromechanical relays and discrete circuits.
- Linear mode capability - the current-limiting protection circuitry is designed to de-activate at low V_{DS}, 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.
  Note: This does not compromise the product's ability to self-protect during short-circuit load conditions.
- The current limit is programmable via an external resistor R_{prog} connected between Status and IN pins.
- Status pin voltage reflects the gate drive being applied internally to the power MOSFET.
  With V_{IN} = 5V and R_{prog} = 24kΩ:
  Status voltage ~ 5V indicates normal operation.
  Status voltage ~ (2-3)V indicates that the device is in current-limiting mode.
  Status voltage < 1V indicates that the device is in thermal shutdown.

Current Limiting and Over Temp Shutdown Status Indication at Vin=5V

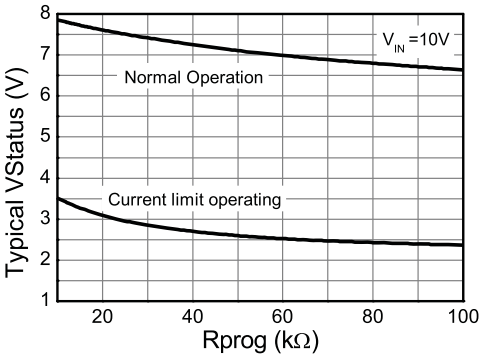


Current Limiting and Over Temp Shutdown Status Indication at Vin=10V

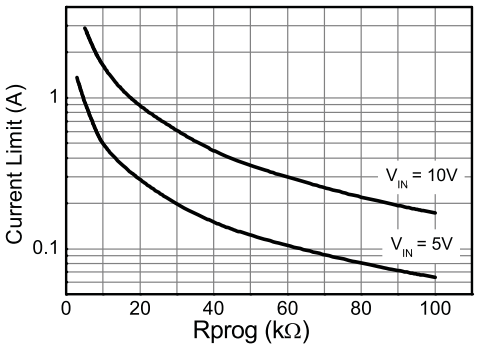




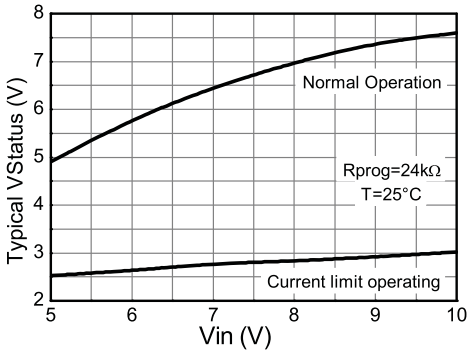
VStatus vs Rprog @ Vin=5V



VStatus vs Rprog @ Vin=10V



Current Limit vs Rprog



VStatus vs Vin

Absolute maximum ratings

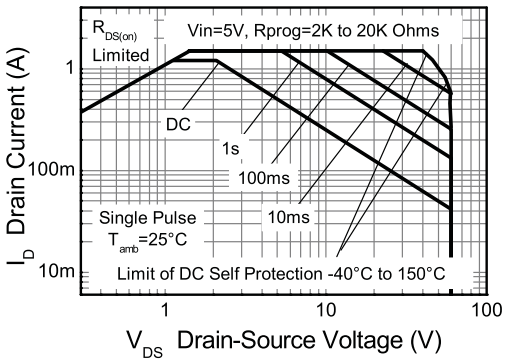
Parameter	Symbol	Limit	Unit
Continuous drain-source voltage	V_{DS}	60	V
Drain-source voltage for short circuit protection V_{IN}=5V[a]	$V_{DS(SC)}$	36	V
Drain-source voltage for short circuit protection V_{IN}=10V[a]	$V_{DS(SC)}$	20	V
Continuous input voltage	V_{IN}	-0.2 ... +10	V
Peak input voltage	V_{IN}	-0.2 ... +20	V
Operating temperature range	T_j,	-40 to +150	°C
Storage temperature range	T_{stg}	-55 to +150	°C
Power dissipation @ T_{amb} =25°C[a]	P_D	2.5	W
Continuous drain current @ V_{IN}=10V; T_{amb}=25°C[b]	I_D	1.6	A
Continuous drain current @ V_{IN}=5V; T_{amb}=25°C[b]	I_D	1.4	A
Continuous source current (body diode)[b]	I_S	3	A
Pulsed source current (body diode)[c]	I_S	8	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

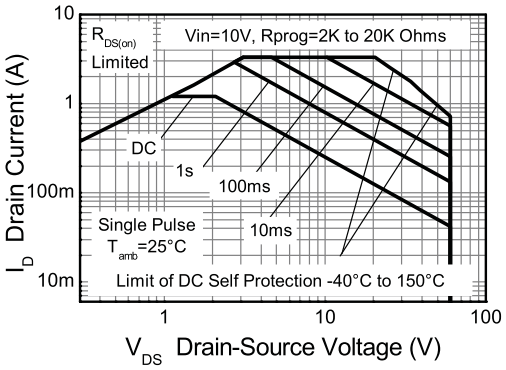
Parameter	Symbol	Limit	Unit
Junction to ambient	$R_{\Theta JA}$	50	°C/W
Junction to ambient	$R_{\Theta JA}$	28	°C/W

NOTES:
(a) For $I_{D(LIM)}$ < 1.2A (see safe operating area curve).
(b) For a device surface mounted on 50mm x 50mm x 1.6mm FR4 board with a high coverage of single sided 2oz weight copper.
(c) For a device surface mounted on FR4 board and measured at t<=10s.

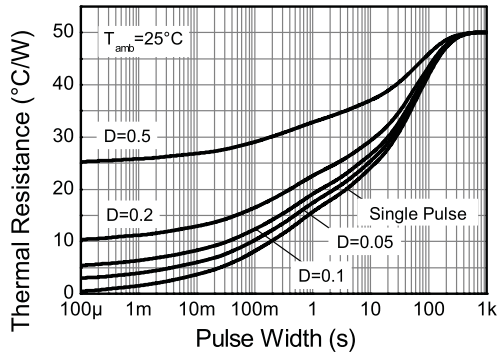
Characteristics



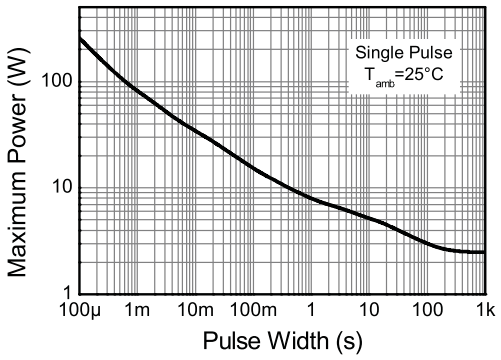
Safe Operating Area



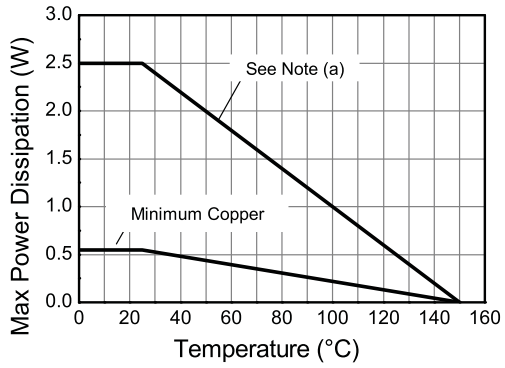
Safe Operating Area



Transient Thermal Impedance



Pulse Power Dissipation



Derating Curve

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 (*)	$V_{IN(th)}$	1	2.1		V	V_{DS}=V_{GS}, I_D=1mA
Input current	I_{IN}		0.7	1.2	mA	V_{IN}=+5V
Input current	I_{IN}		1.5	2.7	mA	V_{IN}=+7V
Input current	I_{IN}		4	7	mA	V_{IN}=+10V
Static drain-source on-state resistance	$R_{DS(on)}$		520	675	mΩ	V_{IN}=5V, I_D=0.2A
Static drain-source on-state resistance	$R_{DS(on)}$		385	500	mΩ	V_{IN}=10V, I_D=0.5A
Current limit (†)	$I_{D(LIM)}$	0.2	0.3	0.4	A	V_{IN}=5V, Vds=10V Rprog=20k
Current limit(†)	$I_{D(LIM)}$	0.7	0.9	1.2	A	V_{IN}=10V, Vds=10V, Rprog=20k
Dynamic characteristics						
Turn-on time (V_{IN} to 90% I_D)	t_{on}		3.0	10	μs	Rprog=20k, R_L=22Ω, V_{IN}=0 to 10V, V_{DD}=12V
Turn-off time (V_{IN} to 90% I_D)	t_{off}		13	20	μs	Rprog=20k, R_L=22Ω, V_{IN}=10V to 0V, V_{DD}=12V
Slew rate on (70 to 50% V_{DD})	$-dV_{DS}/dt_{on}$		8	20	V/μs	Rprog=20k, R_L=22Ω, V_{IN}=0 to 10V, V_{DD}=12V
Slew rate off (50 to 70% V_{DD})	DV_{DS}/dt_{on}		3.2	10	V/μs	Rprog=20k, R_L=22Ω, V_{IN}=10V to 0V, V_{DD}=12V

NOTES:
(*) Protection features may operate outside spec for V_{IN}<4.5V
(†) The drain current is limited to a reduced value when Vds exceeds a safe level.

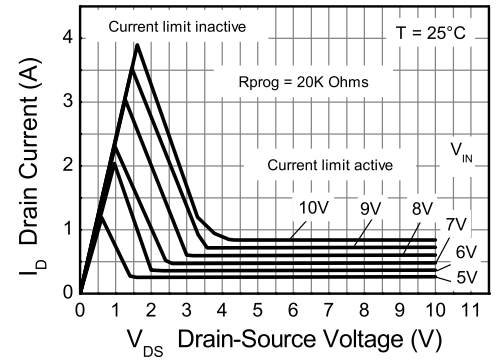
Electrical characteristics (at T_{amb} = 25°C unless otherwise stated) (cont.)

Parameter	Symbol	Min	Typ	Max	Unit	Conditions
Protection functions(‡)						
Required input voltage for over temperature protection	V_{PROT}	4.5			V	
Thermal overload trip temperature	T_{JT}	150	175		°C	
Thermal hysteresis			1		°C	
Unclamped single pulse inductive energy T_j=25°C	E_{AS}	550			mJ	$I_{D(ISO)}$=0.7A, V_{DD}=32V
Unclamped single pulse inductive energy T_j=150°C	E_{AS}	200			mJ	$I_{D(ISO)}$=0.7A, V_{DD}=32V
Status flag						
Normal operation	V_{STATUS}		4.95		V	V_{IN} = 5V
Current limit operating	V_{STATUS}		2.5		V	V_{IN} = 5V
Thermal shutdown activated	V_{STATUS}		0.2	1	V	V_{IN} = 5V
Normal operation	V_{STATUS}		8.0		V	V_{IN} = 10V
Current limit operation	V_{STATUS}		3.0		V	V_{IN} = 10V
Thermal shutdown activated	V_{STATUS}		0.35	1	V	V_{IN} = 10V
Inverse diode						
Source drain voltage	V_{SD}			1	V	V_{IN}=0V, $-I_D$=1.4A

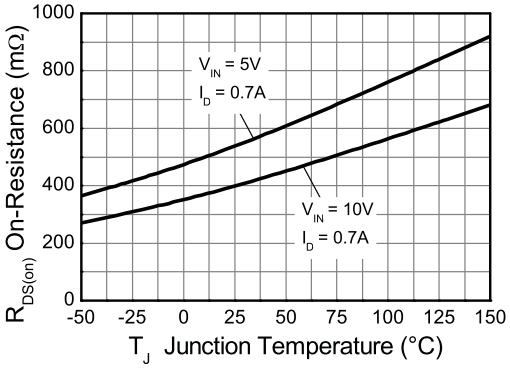
NOTES:

(‡) 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.

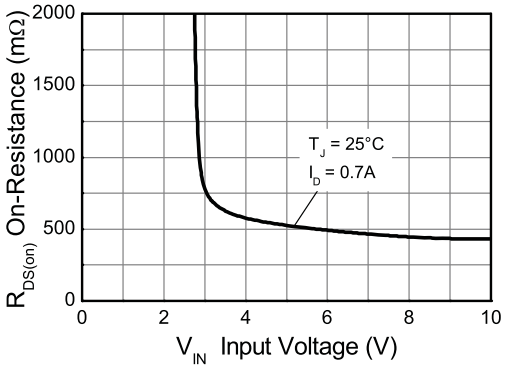
Typical characteristics



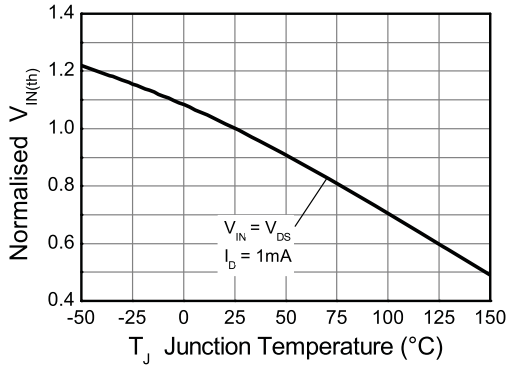
Typical Output Characteristic



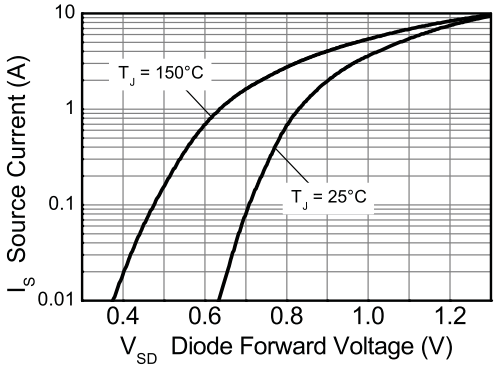
On-state Resistance vs Temperature



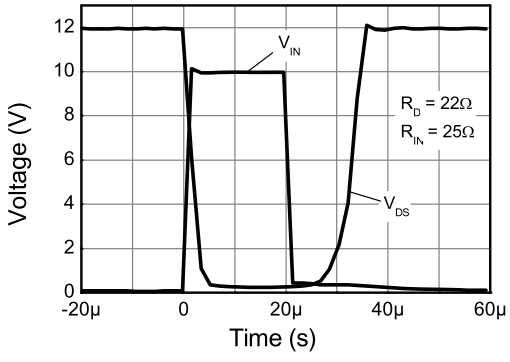
On-Resistance vs Input Voltage



Threshold Voltage vs Temperature

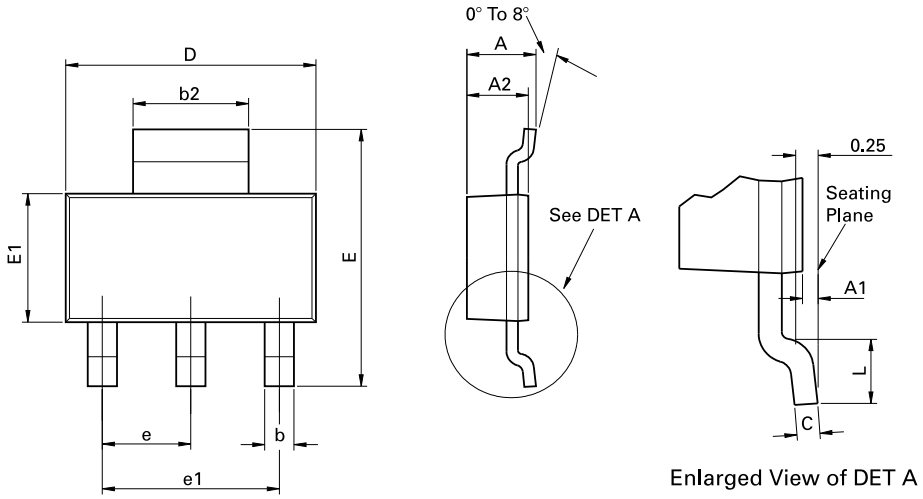


Source-Drain Diode Forward Voltage



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	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

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"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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