ZXMS6001N3

60V N-CHANNEL SELF PROTECTED ENHANCEMENT MODE IntelliFET MOSFET

Product Summary

- Continuous Drain Source Voltage: $V_{DS} = 60V$
- On-State Resistance: 675mΩ
- Max Nominal Load Current ($V_{IN} = 5V$): 1.1A
- Min Nominal Load Current ($V_{IN} = 5V$): 0.7A
- Clamping Energy: 550mJ

Description

The ZXMS6001N3 is a low input current, self-protected, low-side IntelliFET™ MOSFET intended for $V_{IN} = 5V$ applications. It features monolithic overtemperature, overcurrent, overvoltage (active clamp) and ESD-protected logic-level functionality. It is intended as a general purpose switch.

Features and Benefits

- Low Input Current
- Short-Circuit Protection with Auto Restart
- Overvoltage Protection (Active Clamp)
- Thermal Shutdown with Auto Restart
- Overcurrent Protection
- Input Protection (ESD)
- Load-Dump Protection (Actively Protects Load)
- **Lead-Free Finish; RoHS Compliant (Note 1 & 2)**
- **Halogen and Antimony Free. “Green” Device (Note 3)**

Applications

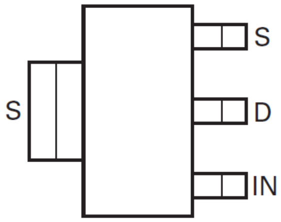
- Especially Suited for Loads with a High Inrush Current, Such as Lamps and Motors
- All Types of Resistive, Inductive, and Capacitive Loads in Switching Applications
- µC Compatible Power Switch for 12V and 24V DC Applications
- Automotive Rated
- Replaces Electromechanical Relays and Discrete Circuits
- Linear Mode Capability: Current-Limiting Protection Circuitry is Designed to Deactivate at Low V_{DS} to Minimize On-State Power Dissipation. Maximum DC Operating Current is Determined by Thermal Capability of Package/Board Combination Rather Than by Protection Circuitry, Which Does Not Compromise The Product’s Ability to Self-Protect at Low V_{DS}.

Mechanical Data

- Case: SOT223 (Type DN)
- Case Material: Molded Plastic, “Green” Molding Compound. UL Flammability Classification Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020
- Terminals: Matte Tin Finish e3
- Weight: 0.112 grams (Approximate)

SOT223 (Type DN)

Top View



Top View
Pin Out

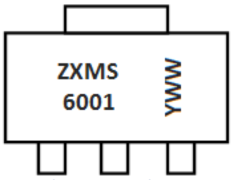
(Note 5)

Ordering Information (Note 4)

Part Number	Marking	Reel Size (inches)	Tape Width (mm)	Quantity per Reel
ZXMS6001N3TA	ZXMS6001	7	12	1000 Units

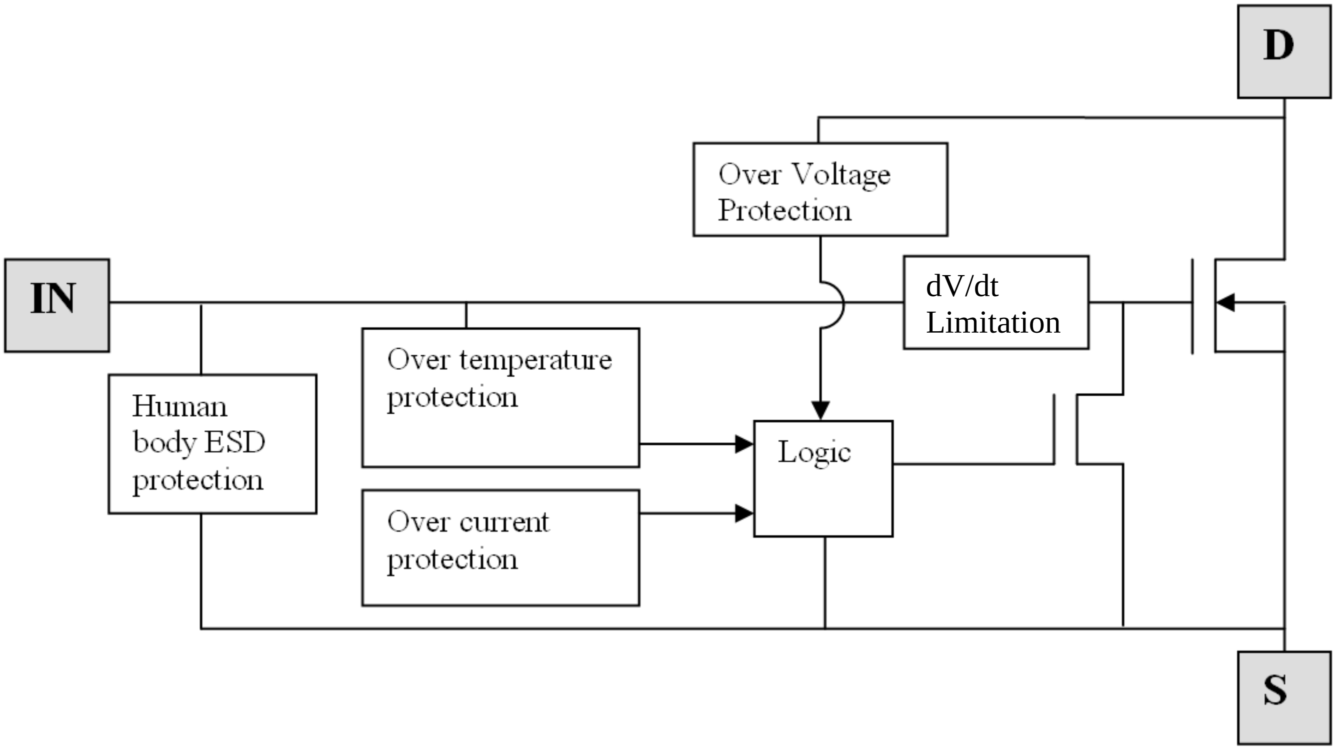
Notes:
1. EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant. All applicable RoHS exemptions applied.
2. See https://www.diodes.com/quality/lead-free/ for more information about Diodes Incorporated’s definitions of Halogen- and Antimony-free, "Green" and Lead-free.
3. Halogen- and Antimony-free "Green” products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.
4. For packaging details, see https://www.diodes.com/design/support/packaging/diodes-packaging/.
5. 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.

Marking Information



ZXMS6001 = Product Type Marking Code
YWW = Date Code Marking
Y or $\overline{Y}$ = Last Digit of Year (ex: 8 = 2018)
WW or $\overline{WW}$ = Week Code (01 to 53)

Functional Block Diagram



Absolute Maximum Ratings (@T_A = +25°C, unless otherwise stated.)

Characteristic	Symbol	Value	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 to +10	V
Peak Input Voltage	V_{IN}	-0.2 to +20	V
Continuous Input Current $-0.2V \le V_{IN} \le 10V$ $V_{IN} < -0.2V$ or $V_{IN} > 10V$	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 (Note 6)	P_D	1.5	W
Power Dissipation at T_A = +25°C (Note 8)	P_D	0.6	W
Continuous Drain Current @ V_{IN} = 5V; T_A = +25°C (Note 6)	I_D	1.1	A
Continuous Drain Current @ V_{IN} = 5V; T_A = +25°C (Note 8)	I_D	0.7	A
Continuous Source Current (Body Diode) (Note 6)	I_S	2.0	A
Pulsed Source Current (Body Diode) (Note 7)	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

Characteristic	Symbol	Value	Unit
Junction to Ambient (Note 6)	$R_{\theta JA}$	83	°C/W
Junction to Ambient (Note 7)	$R_{\theta JA}$	45	°C/W
Junction to Ambient (Note 8)	$R_{\theta JA}$	208	°C/W

Recommended Operating Conditions

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

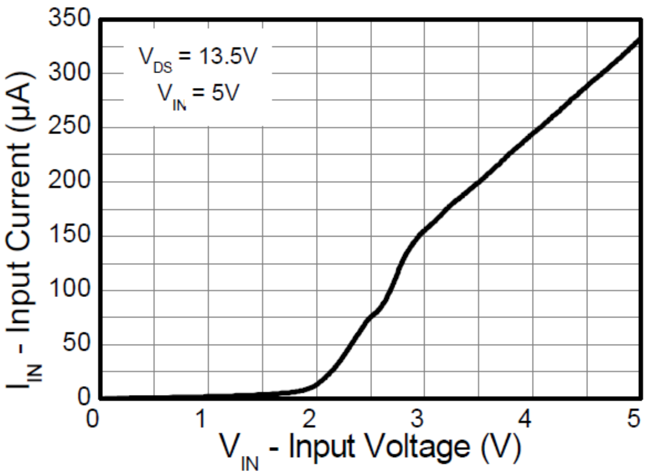
Characteristic	Symbol	Min	Max	Unit
Input Voltage Range	V_{IN}	0	6	V
Ambient Temperature Range	T_A	-40	+125	°C
High Level Input Voltage for MOSFET (Note 9)	V_{IH}	4	6	V
Peripheral Supply Voltage (Voltage to which Load is Referred)	V_P	—	60	V

Notes:
6. For a device surface mounted on 25mm × 25mm × 1.6mm FR-4 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.
7. For a device surface mounted on FR-4 board as (Note 6) and measured at t ≤10s.
8. For a device surface mounted on FR-4 board with the minimum copper required for electrical connections.
9. Recommended input voltage range over which protection circuits function as specified.

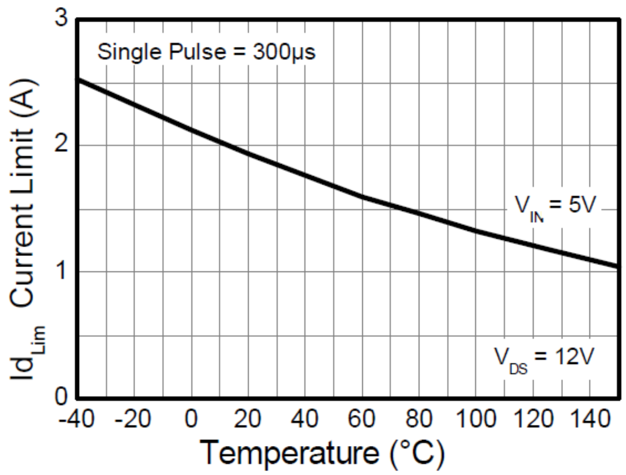
Electrical Characteristics (@T_A = +25°C, unless otherwise stated.)

Characteristic	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 (Note 10)	$V_{IN(TH)}$	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 (Note 11)	$I_{D(LIM)}$	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	—	µs	R_L = 22Ω, V_{IN} = 0 to 5V, V_{DD} = 12V
Turn-Off Time (V_{IN} to 90% I_D)	t_{OFF}	—	26	—	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	—	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	—	V/µs	R_L = 22Ω, V_{IN} = 5V to 0V, V_{DD} = 12V
Protection Functions (Note 12)						
Minimum Input Voltage for Over-Temperature Protection (Note 13)	$V_{PROT(MIN)}$	—	3.5	4	V	T_{TRIP} > +150°C
Maximum Input Voltage for Over-Temperature Protection (Note 13)	$V_{PROT(MAX)}$	6	7	—	V	T_{TRIP} > +150°C
Thermal Overload Trip Temperature	T_{JT}	+150	+175	—	°C	—
Thermal Hysteresis	—	—	+8	—	°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
Inverse Diode						
Source Drain Voltage	V_{SD}	—	—	1	V	V_{IN} = 0V, -I_D = 1.4A

Notes:
10. Recommended input voltage range over which protection circuits function as specified.
11. The drain current is limited to a reduced value when V_{DS} exceeds a safe level.
12. 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.
13. Not subject to production test, specified by design.



Input Current v Input Voltage



Current Limit v Temperature

Application Information

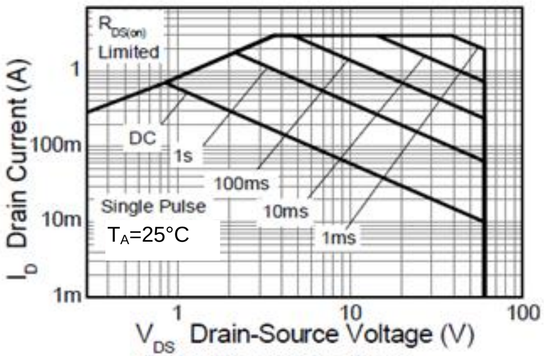
The current-limit protection circuitry is designed to deactivate at low V_{DS} to prevent the load current from unnecessarily restriction during normal operation. The design max-DC operating current is therefore determined by the thermal capability of the package/board combination, rather than by the protection circuitry (see *Typical Output Characteristic* graph). 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.

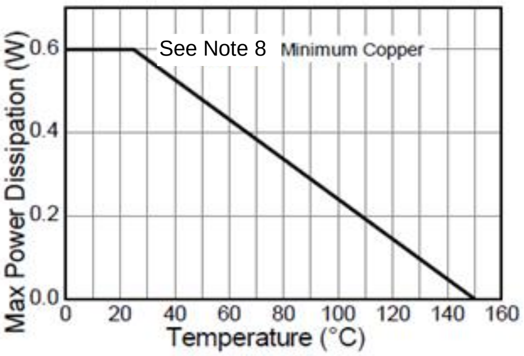
Minimum Copper Area Characteristics

For minimum copper condition as described in Note 8.

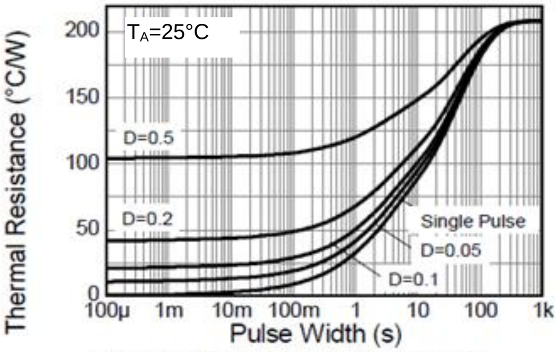
Max Ambient Temperature T_A	Maximum Continuous Current V_{IN} = 5V
+25°C at V_{IN} = 5V	720mA
+70°C at V_{IN} = 5V	575mA
+85°C at V_{IN} = 5V	520mA
+125°C at V_{IN} = 5V	320mA



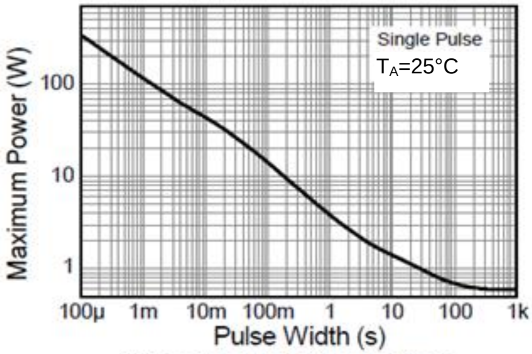
Safe Operating Area



Derating Curve



Transient Thermal Impedance

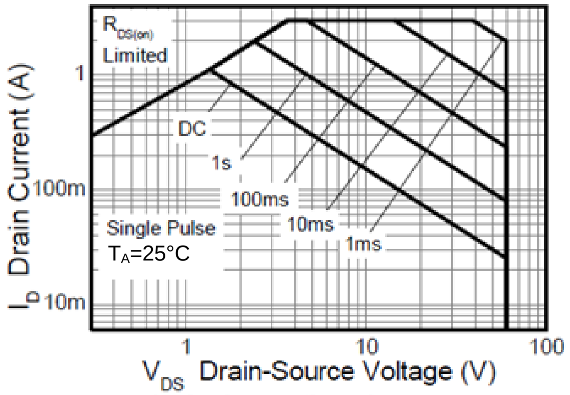


Pulse Power Dissipation

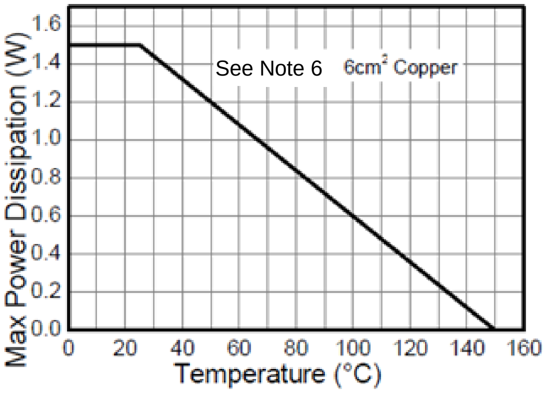
Large Copper Area Characteristics

For large copper area as described in Note 6.

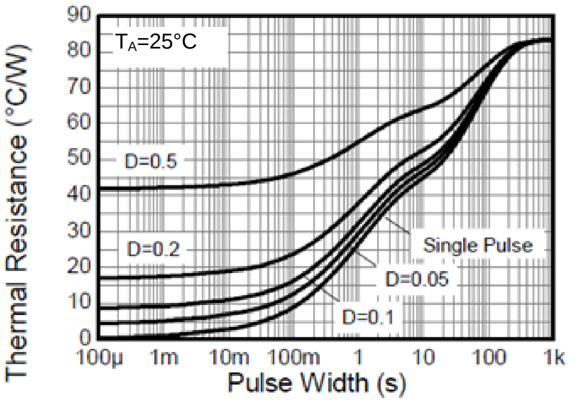
Max Ambient Temperature T_A	Maximum Continuous Current V_{IN} = 5V
+25°C at V_{IN} = 5V	1140mA
+70°C at V_{IN} = 5V	915mA
+85°C at V_{IN} = 5V	825mA
+125°C at V_{IN} = 5V	510mA



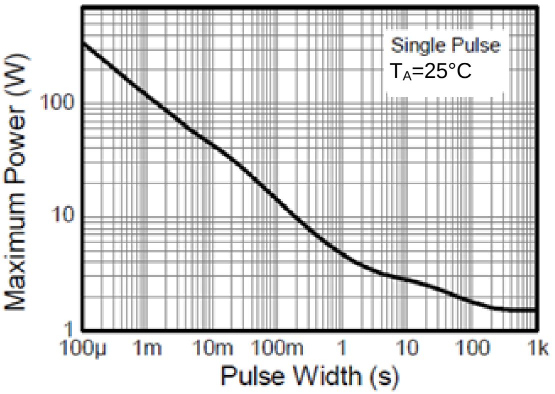
Safe Operating Area



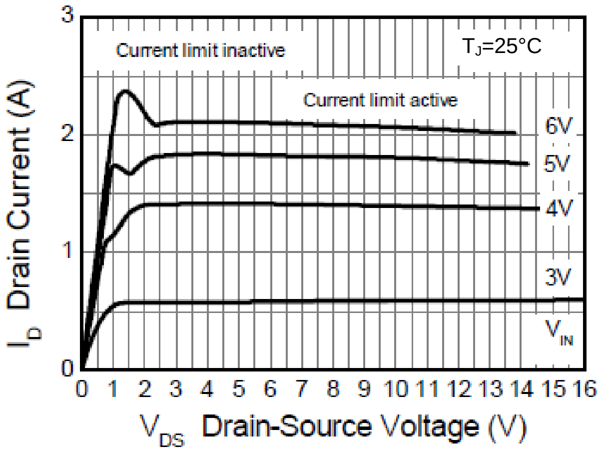
Derating Curve



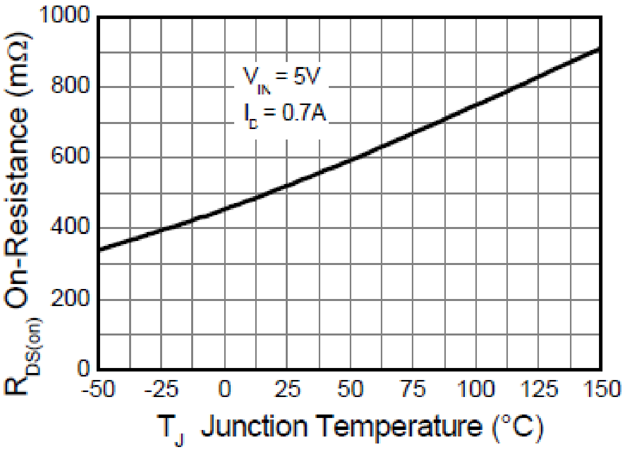
Transient Thermal Impedance



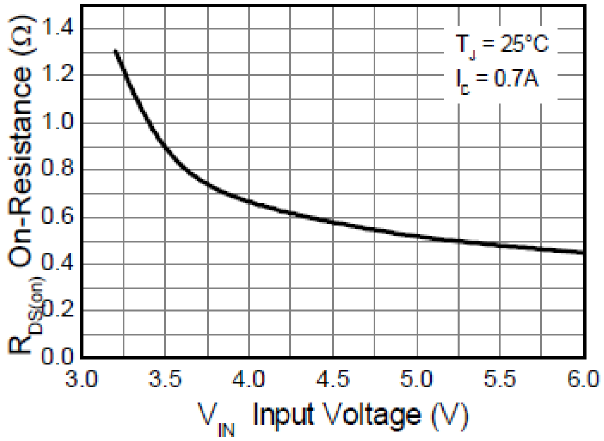
Pulse Power Dissipation



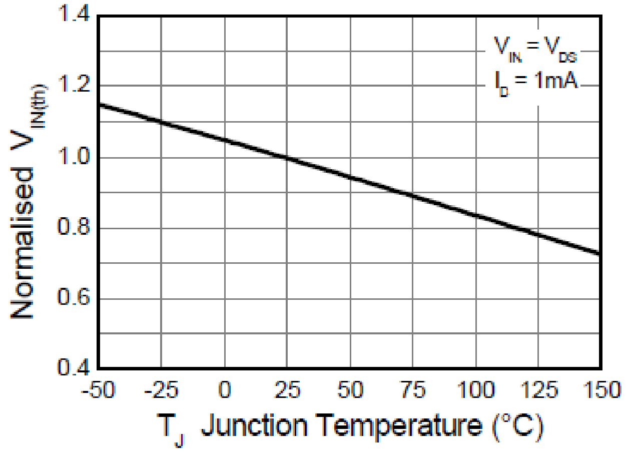
Typical Output Characteristic



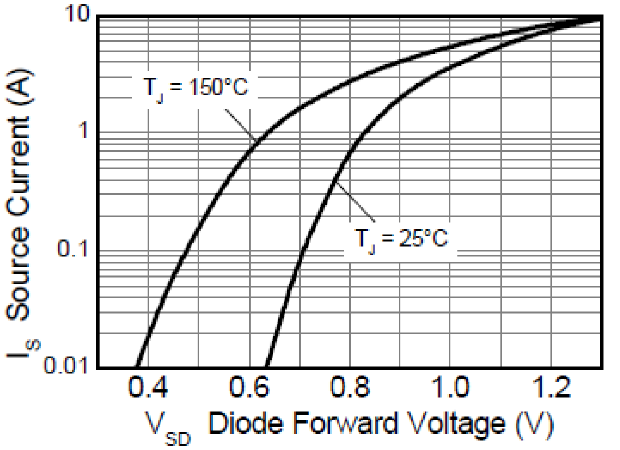
On-state Resistance vs Temperature



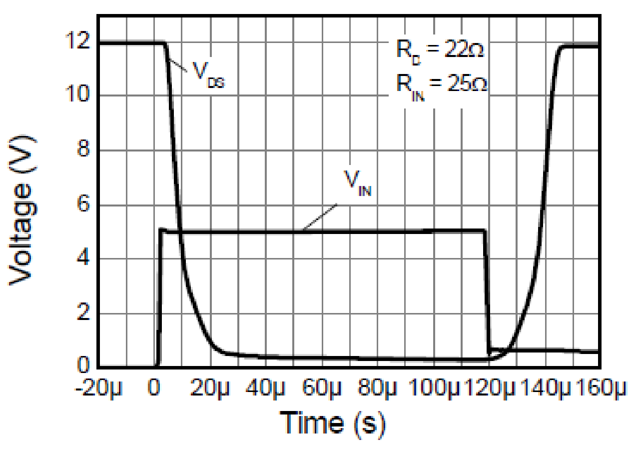
On-Resistance vs Input Voltage



Threshold Voltage vs Temperature



Source-Drain Diode Forward Voltage

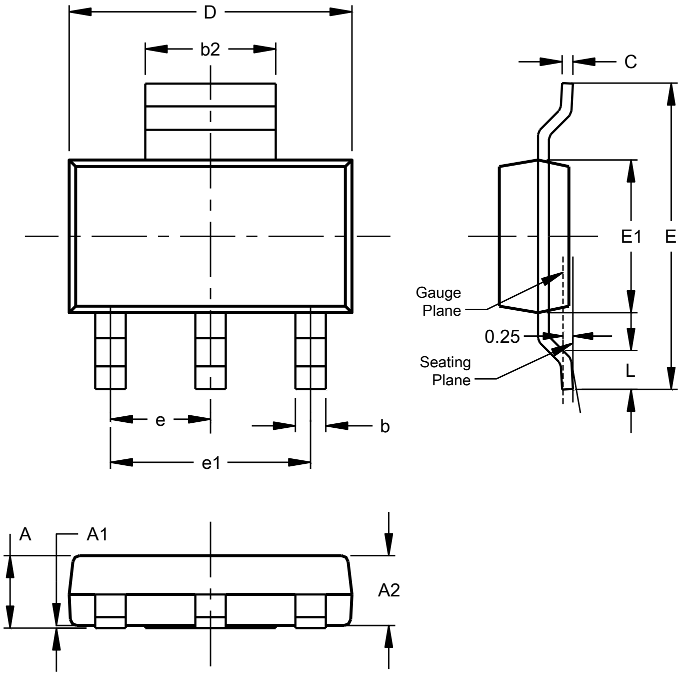


Switching Speed

Package Outline Dimensions

Please see http://www.diodes.com/package-outlines.html for the latest version.

SOT223 (Type DN)

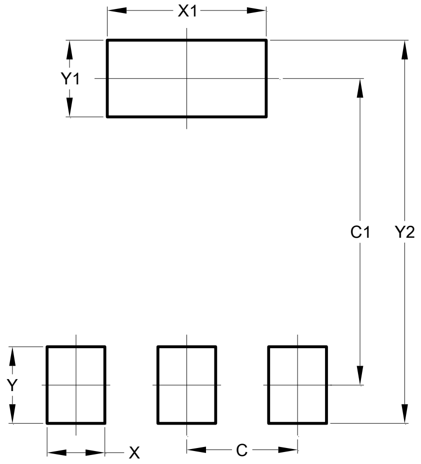


SOT223 (Type DN)			
Dim	**Min**	**Max**	**Typ**
A	--	1.70	--
A1	0.01	0.15	--
A2	1.50	1.68	1.60
b	0.60	0.80	0.70
b2	2.90	3.10	--
c	0.20	0.32	--
D	6.30	6.70	--
E	6.70	7.30	--
E1	3.30	3.70	--
e	--	--	2.30
e1	--	--	4.60
L	0.85	--	--
All Dimensions in mm			

Suggested Pad Layout

Please see http://www.diodes.com/package-outlines.html for the latest version.

SOT223 (Type DN)



Dimensions	Value (in mm)
C	2.30
C1	6.40
X	1.20
X1	3.30
Y	1.60
Y1	1.60
Y2	8.00

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