ZXMS6001N3Q

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

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

Applications

- 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}.

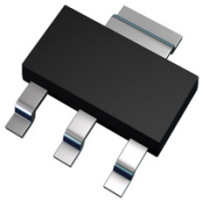
Features and Benefits

- Low Input Current
- 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)
- **Qualified to AEC-Q101 Standards for High Reliability**
- **PPAP Capable**
- **Lead-Free Finish; RoHS compliant (Note 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**

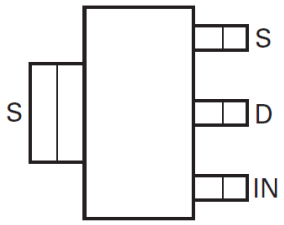
Mechanical Data

- Case: SOT-223
- 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
- Weight: 0.112 grams (approximate)

SOT-223



Top View



Top view
Pin Out

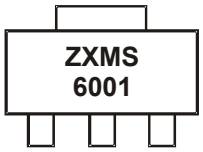
Note: The tab is connected to the source pin and must be electrically isolated from the drain pin. Connection of significant copper to the drain pin is recommended for best thermal performance.

Ordering Information

Product	Marking	Reel size (inches)	Tape width (mm)	Quantity per reel
ZXMS6001N3QTA	ZXMS6001	7	12	1,000 units

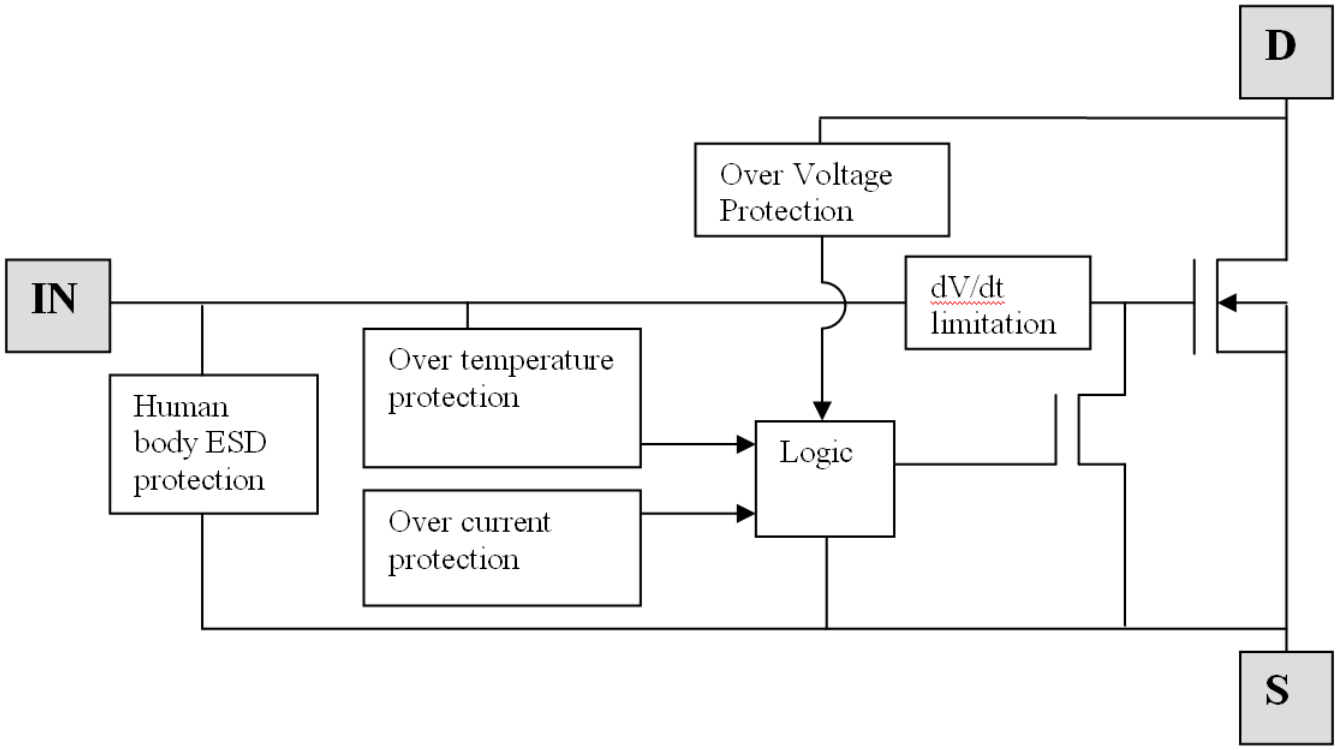
Notes:
1. EU Directive 2002/95/EC (RoHS) & 2011/65/EU (RoHS 2) compliant. All applicable RoHS exemptions applied.
2. See http://www.diodes.com/quality/lead_free.html for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.
4. Automotive products are AEC-Q101 qualified and are PPAP capable. Automotive, AEC-Q101 and standard products are electrically and thermally the same, except where specified. For more information, please refer to http://www.diodes.com/quality/product_compliance_definitions/.
5. For packaging details, go to our website at http://www.diodes.com/products/packages.html.

Marking Information



ZXMS6001 = Product type Marking Code

Functional Block Diagram



Absolute Maximum Ratings (@T_{amb} = +25°C, unless otherwise stated.)

Characteristic	Symbol	Value	Units
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 ≤ V_{IN} ≤ 10V V_{IN} < -0.2V or V_{IN} > 10V	I_{IN}	No limit $\lvert I_{IN} \rvert$ ≤2	mA
Operating Temperature Range	T_J	-40 to +150	°C
Storage Temperature Range	T_{stg}	-55 to +150	°C
Power Dissipation at T_{amb} = +25°C (Note 6)	P_D	1.5	W
Power Dissipation at T_{amb} = +25°C (Note 8)	P_D	0.6	W
Continuous Drain Current @ V_{IN} = 5V; T_{amb} = +25°C (Note 6)	I_D	1.1	A
Continuous Drain Current @ V_{IN} = 5V; T_{amb} = +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	Units
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 ZXMS6001Q 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

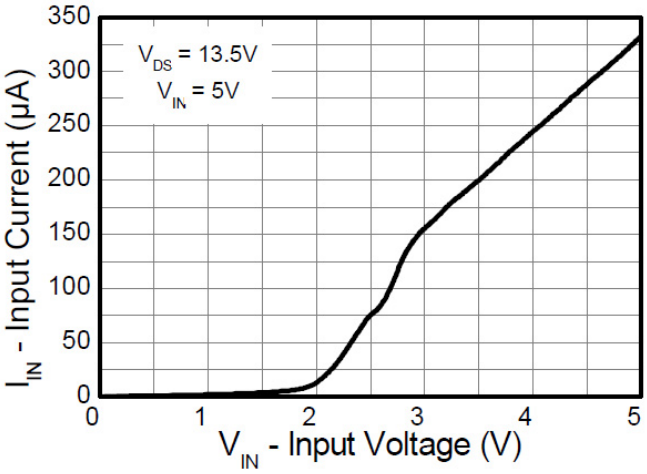
Notes:
6. For a device surface mounted on 25mm x 25mm x 1.6mm FR4 board with a high coverage of single sided 2oz weight copper. Allocation of 6cm2 copper 33% to source tab and 66% to drain pin with source tab and drain pin electrically isolated.
7. For a device surface mounted on FR4 board as (a) and measured at t<=10s.
8. For a device surface mounted on FR4 board with the minimum copper required for electrical connections.
9. Recommended input voltage range over which protection circuits function as specified.

Electrical Characteristics (@T_{amb} = +25°C, unless otherwise stated.)

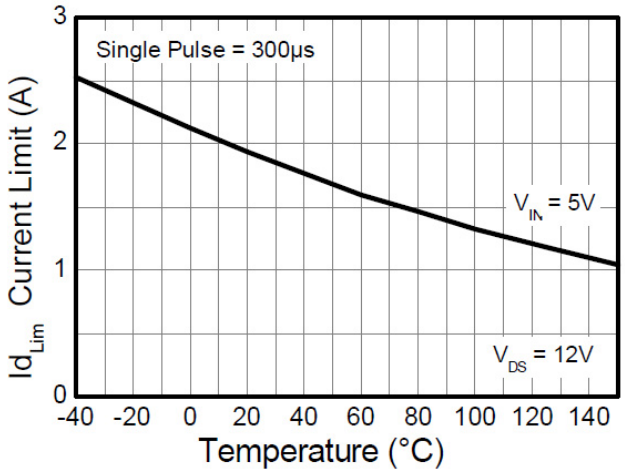
Characteristic	Symbol	Min	Typ	Max	Unit	Conditions
Static Characteristics						
Drain-Source Clamp Voltage	$V_{DS(AZ)}$	60	70	75	V	I_D = 10mA
Off state Drain Current	I_{DSS}	—	0.1	3	µA	V_{DS} = 12V, V_{IN} = 0V
Off state Drain Current	I_{DSS}	—	3	15	µA	V_{DS} = 32V, V_{IN} = 0V
Input Threshold Voltage (Note 9)	$V_{IN(th)}$	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 10)	$I_{D(LIM)}$	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 = 22ohm, V_{IN} = 0 to 5V, V_{DD} = 12V
Turn-Off Time (V_{IN} to 90% I_D)	t_{off}	—	26	40	µs	R_L = 22ohm, 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= 22ohm, 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 = 22ohm, V_{IN} = 5V to 0V, V_{DD} = 12V
Protection Functions (Note 11)						
Maximum 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

Notes: 10. The drain current is limited to a reduced value when V_{DS} exceeds a safe level.

11. 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

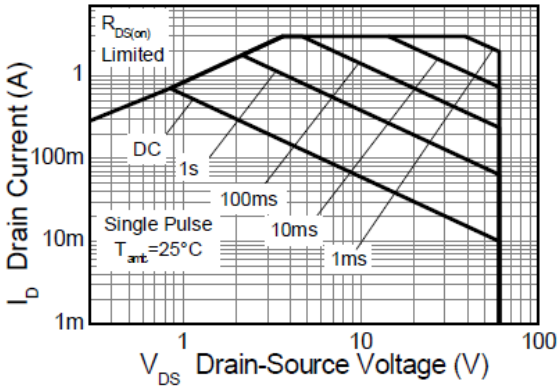
The current-limit protection circuitry is designed to de-activate at low V_{DS} to prevent the load current from being unnecessarily restricted during normal operation. The design max DC operating current is therefore determined by the thermal capability of the package/board combination, rather than by the protection circuitry (see graph '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.

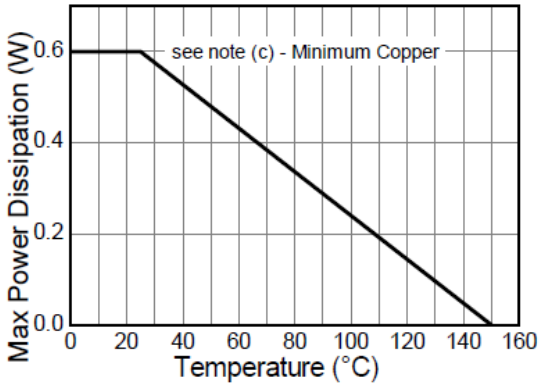
Minimum Copper Area Characteristics

For minimum copper condition as described in Note 8

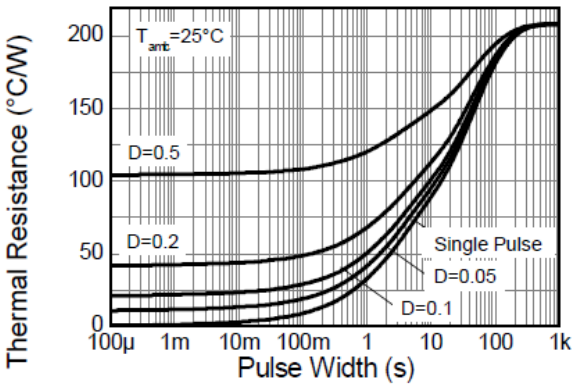
Max Ambient Temperature T_A	Maximum Continuous Current V_{IN} = 5V
25°C at V_{IN} =5V	720
70°C at V_{IN} =5V	575
85°C at V_{IN} =5V	520
125°C at V_{IN} =5V	320



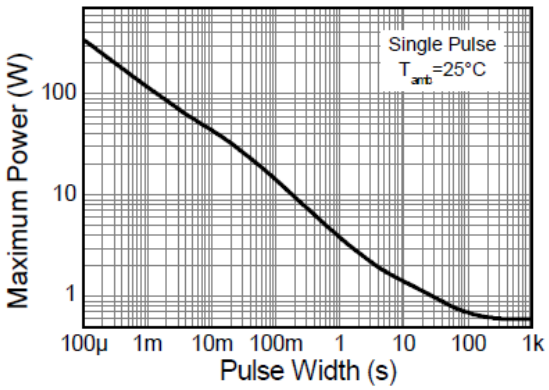
Safe Operating Area



Derating Curve



Transient Thermal Impedance

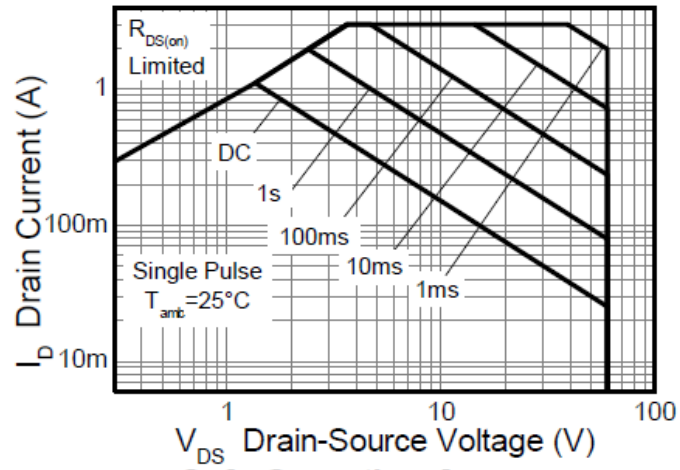


Pulse Power Dissipation

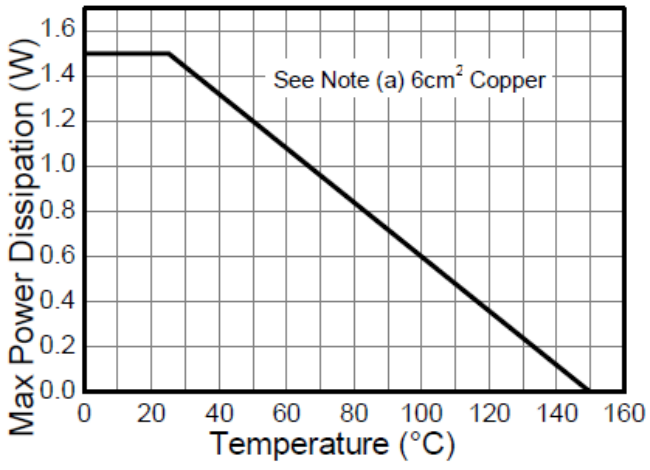
Large copper area characteristics

For large copper area as described in Note 6

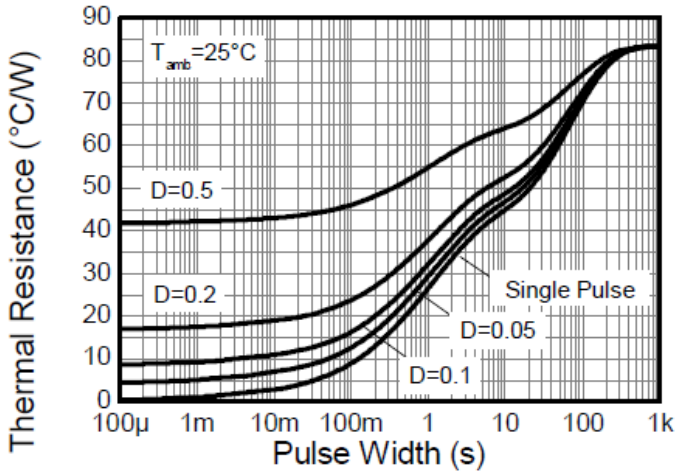
Max Ambient Temperature T_A	Maximum Continuous Current V_{IN} = 5V
25°C at V_{IN} = 5V	1140
70°C at V_{IN} = 5V	915
85°C at V_{IN} = 5V	825
125°C at V_{IN} = 5V	510



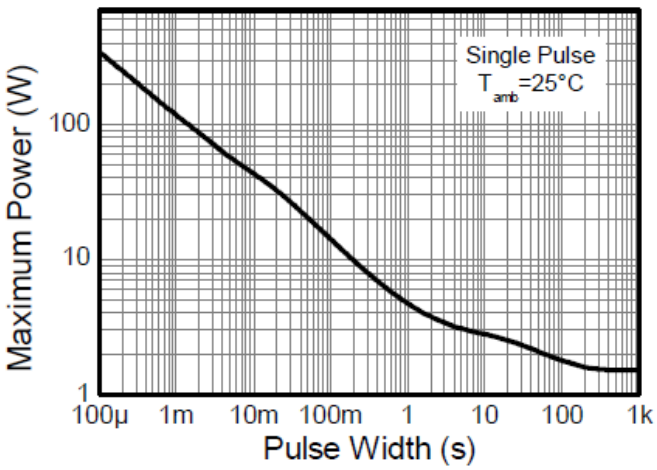
Safe Operating Area



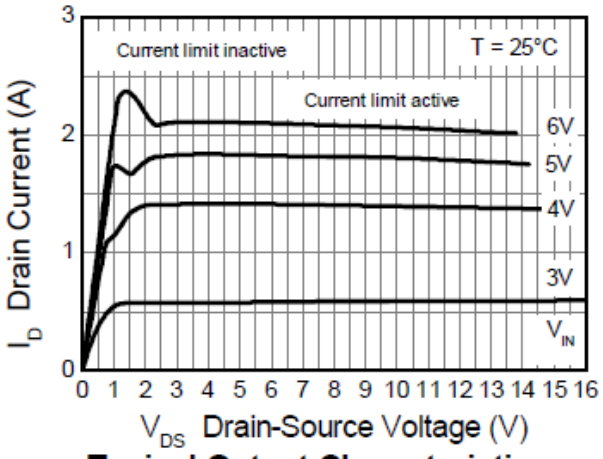
Derating Curve



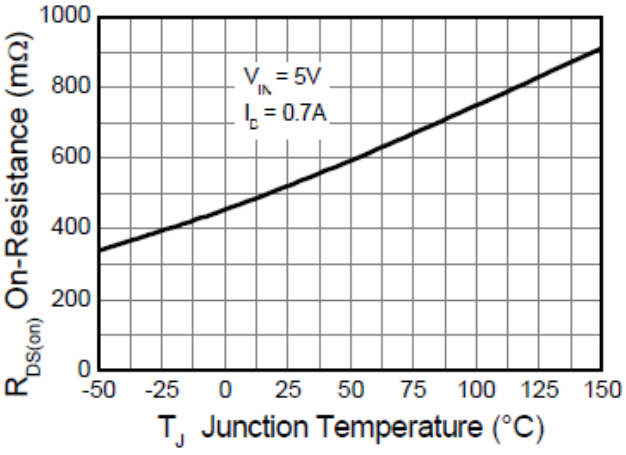
Transient Thermal Impedance



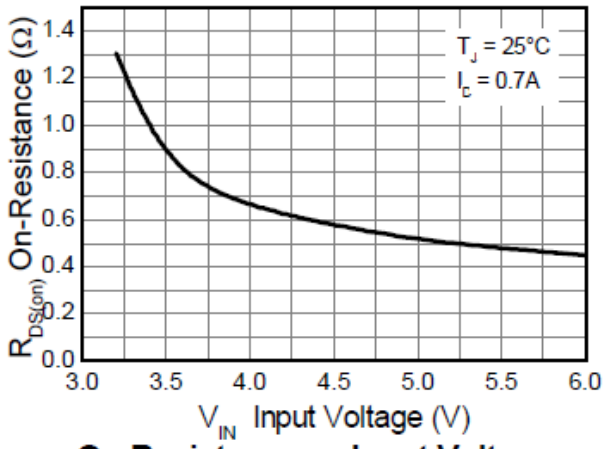
Pulse Power Dissipation



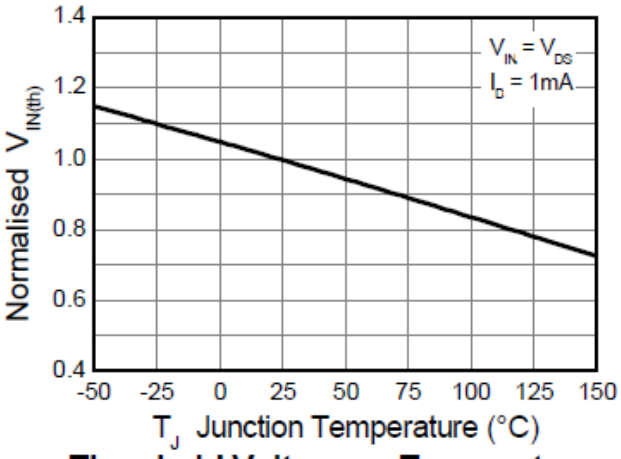
Typical Output Characteristic



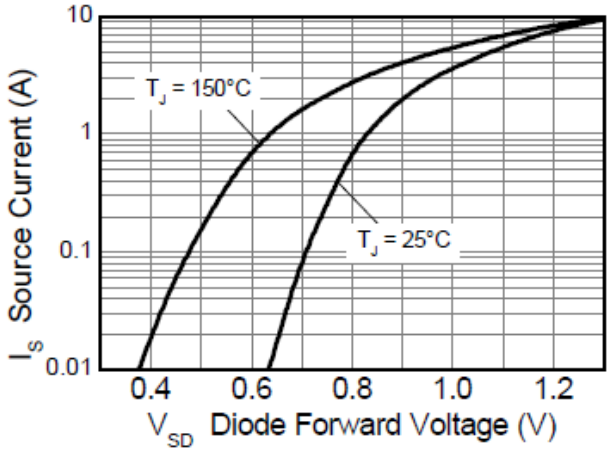
On-state Resistance vs Temperature



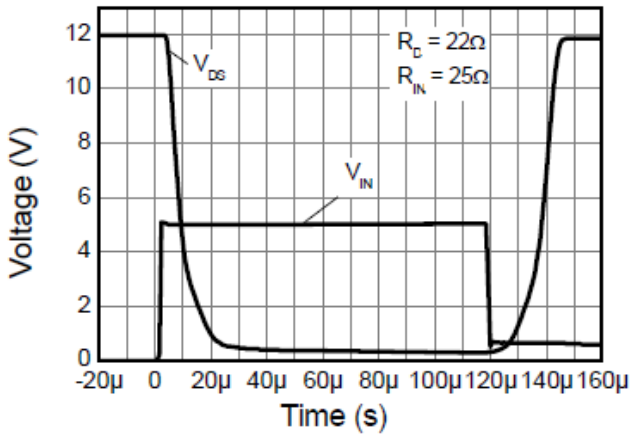
On-Resistance vs Input Voltage



Threshold Voltage vs Temperature



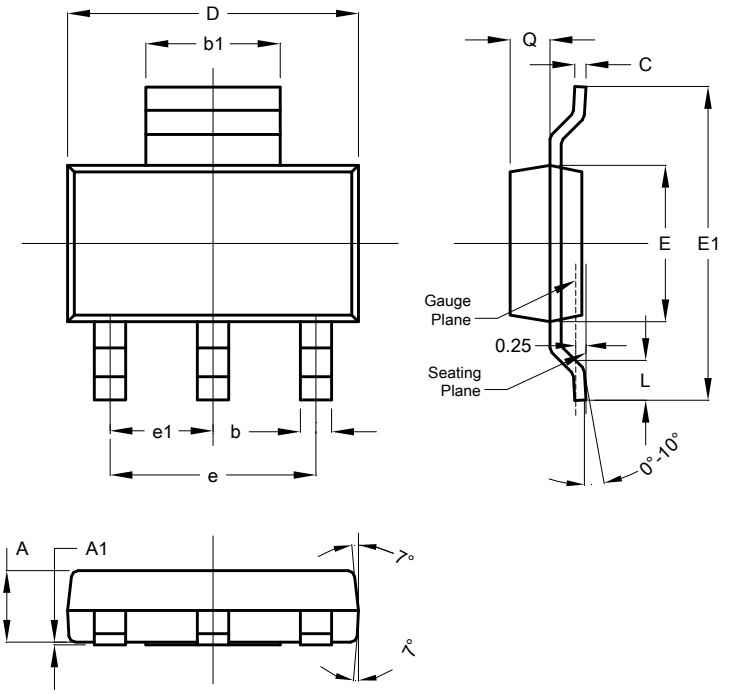
Source-Drain Diode Forward Voltage



Switching Speed

Package Outline Dimensions

Please see AP02002 at http://www.diodes.com/datasheets/ap02002.pdf for latest version.

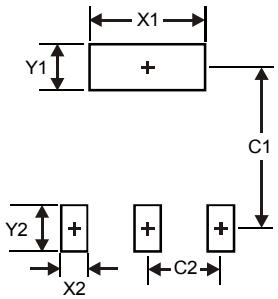


SOT223			
Dim	**Min**	**Max**	**Typ**
A	1.55	1.65	1.60
A1	0.010	0.15	0.05
b	0.60	0.80	0.70
b1	2.90	3.10	3.00
C	0.20	0.30	0.25
D	6.45	6.55	6.50
E	3.45	3.55	3.50
E1	6.90	7.10	7.00
e	-	-	4.60
e1	-	-	2.30
L	0.85	1.05	0.95
Q	0.84	0.94	0.89
All Dimensions in mm			

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

Suggested Pad Layout

Please see AP02001 at http://www.diodes.com/datasheets/ap02001.pdf for the latest version.



Dimensions	Value (in mm)
X1	3.3
X2	1.2
Y1	1.6
Y2	1.6
C1	6.4
C2	2.3

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