60V N-CHANNEL SELF PROTECTED ENHANCEMENT MODE *INTELLIFET*® MOSFET

Product Summary

- Continuous Drain Source Voltage V_{DS} = 60V
- On-State Resistance 500mΩ
- Nominal Load Current (V_{IN} = 5V) 1.2A
- Clamping Energy 210mJ

Description

The ZXMS6004DT8Q is a dual 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 ZXMS6004DT8Q is ideal as a general purpose switch driven from 3.3V or 5V microcontrollers in harsh environments where standard MOSFETs are not rugged enough.

Applications

- Two completely isolated independent channels
- 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}.

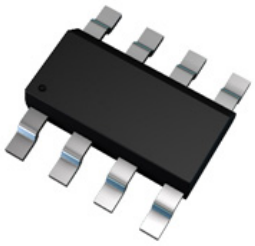
Features and Benefits

- Compact Dual 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
- **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)**

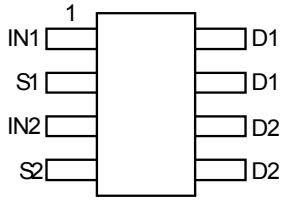
Mechanical Data

- Case: SM-8
- 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: 0.117 grams (approximate)

SM-8



Top View



Top view
Pin-Out

Ordering Information

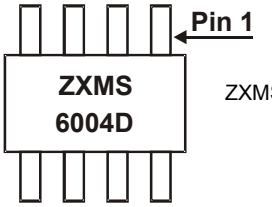
Product	Marking	Reel size (inches)	Tape width (mm)	Quantity per reel
ZXMS6004DT8QTA	ZXMS6004D	7	12	1,000 units

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.

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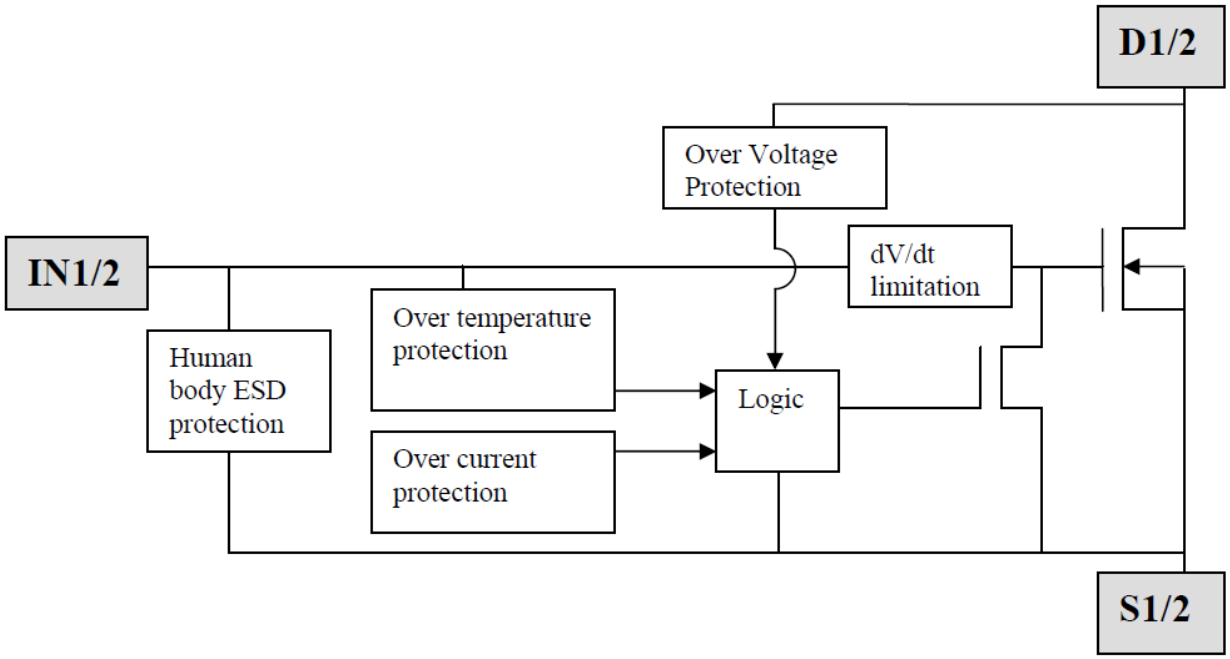
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Marking Information



ZXMS6004D = Product Type Marking Code

Functional Block Diagram



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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	$V_{DS(SC)}$	36	V
Continuous Input Voltage	V_{IN}	-0.5 ... +6	V
Continuous Input Current @ -0.2V ≤ V_{IN} ≤ 6V Continuous Input Current @V_{IN} < -0.2V or V_{IN} > 6V	I_{IN}	No limit | I_{IN} | ≤2	mA
Pulsed Drain Current @V_{IN} = 3.3V (Note 8)	I_{DM}	2	A
Pulsed Drain Current @V_{IN} = 5V (Note 8)	I_{DM}	2.5	A
Continuous Source Current (Body Diode) (Note 6)	I_S	1	A
Pulsed Source Current (Body Diode) (Note 8)	I_{SM}	5	A
Unclamped Single Pulse Inductive Energy, T_J = +25°C, I_D = 0.5A, V_{DD} = 24V	E_{AS}	210	mJ
Electrostatic Discharge (Human Body Model)	V_{ESD}	4000	V
Charged Device Model	V_{CDM}	1000	V

Thermal Resistance

Characteristic	Symbol	Value	Units
Power Dissipation at T_{amb} = +25°C (Notes 6 & 9) Linear Derating Factor	P_D	1.16 9.28	W mW/°C
Power Dissipation at T_{amb} = +25°C (Notes 6 & 10) Linear Derating Factor	P_D	1.67 13.3	W mW/°C
Power Dissipation at T_{amb} = +25°C (Notes 7 & 9) Linear Derating Factor	P_D	2.13 17	W mW/°C
Thermal Resistance, Junction to Ambient (Notes 6 & 9)	$R_{\theta JA}$	108	°C/W
Thermal Resistance, Junction to Ambient (Notes 6 & 10)	$R_{\theta JA}$	75	°C/W
Thermal Resistance, Junction to Case (Notes 7 & 9)	$R_{\theta JC}$	58.7	°C/W
Thermal Resistance, Junction to Case (Note 11)	$R_{\theta JC}$	26.5	°C/W
Operating Temperature Range	T_J	-40 to +150	°C
Storage Temperature Range	T_{STG}	-55 to +150	°C

Notes:
6. For a dual device surface mounted on a 25mm x 25mm FR4 PCB single sided 1oz weight copper split down the middle on 1.6mm FR4 board, in still air conditions
7. For a dual device surface mounted on FR4 PCB measured at t ≤ 10sec
8. Repetitive rating 25mm x 25mm FR4 PCB, D = 0.02 pulse width = 300µs – pulse width limited by junction temperature. Refer to transient Thermal Impedance Graph
9. For a dual device with one active die
10. For dual device with 2 active die running at equal power
11. Thermal resistance from junction to solder-point (at the end of the drain lead)

Recommended Operating Conditions

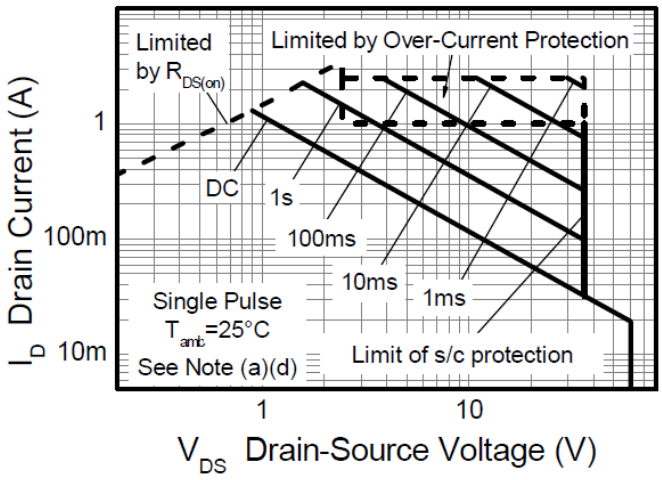
The ZXMS6004DT8Q is optimized for use with µC operating from 3.3V and 5V supplies.

Characteristic	Symbol	Min	Max	Unit
Input Voltage Range	V_{IN}	0	5.5	V
Ambient Temperature Range	T_A	-40	125	°C
High Level Input Voltage for MOSFET to be on	V_{IH}	3	5.5	V
Low Level Input Voltage for MOSFET to be off	V_{IL}	0	0.7	V
Peripheral Supply Voltage (Voltage to Which Load is Referred)	V_P	0	36	V

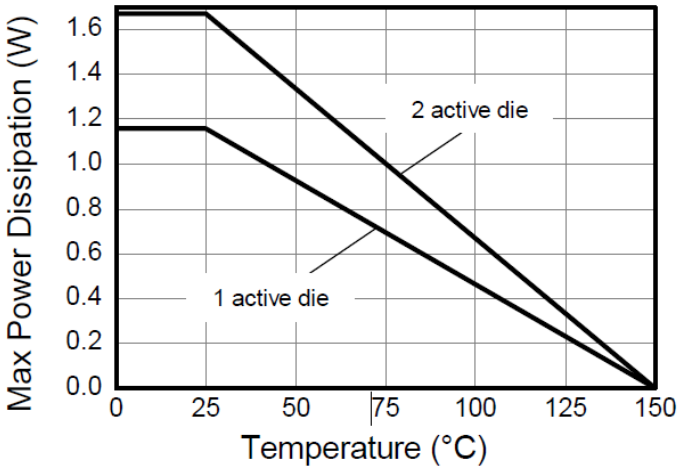
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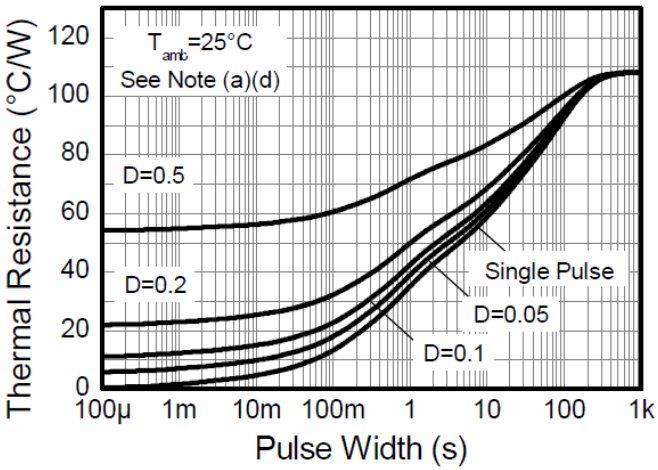
Thermal Characteristics



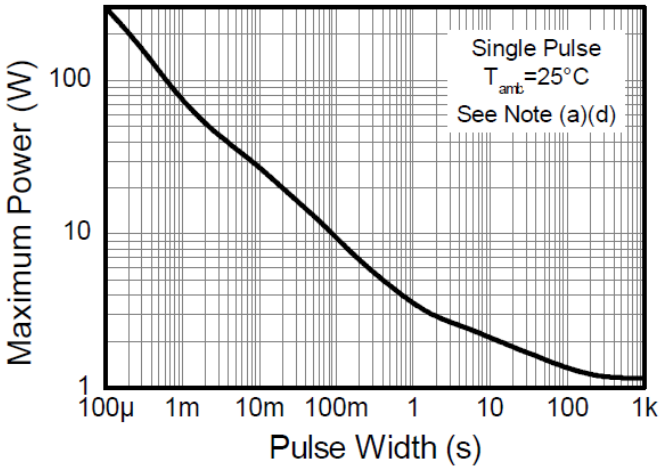
Safe Operating Area



Derating Curve



Transient Thermal Impedance



Pulse Power Dissipation

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

Characteristic	Symbol	Min	Typ	Max	Unit	Test Condition
Static Characteristics						
Drain-Source Clamp Voltage	$V_{DS(AZ)}$	60	65	70	V	I_D = 10mA
Off State Drain Current	I_{DSS}	—	—	0.5	μA	V_{DS} = 12V, V_{IN} = 0V
		—	—	1		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
		—	120	200		V_{IN} = +5V
Input Current while Over Temperature Active	—	—	—	220	μA	V_{IN} = +5V
Static Drain-Source On-State Resistance	$R_{DS(on)}$	—	400	600	mΩ	V_{IN} = +3V, I_D = 1A
		—	350	500		V_{IN} = +5V, I_D = 1A
Continuous Drain Current (Notes 6 & 10)	I_D	0.9	—	—	A	V_{IN} = 3V; T_A = +25°C
		1	—	—		V_{IN} = 5V; T_A = +25°C
Continuous Drain Current (Notes 6 & 9)		1.1	—	—		V_{IN} = 3V; T_A = +25°C
		1.2	—	—		V_{IN} = 5V; T_A = +25°C
Current Limit (Note 12)	$I_{D(LIM)}$	0.7	1.7	—	A	V_{IN} = +3V
		1	2.2	—		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	
Over-Temperature Protection						
Thermal Overload Trip Temperature (Note 13)	T_{JT}	150	175	—	°C	—
Thermal Hysteresis (Note 13)	—	—	10	—	°C	—

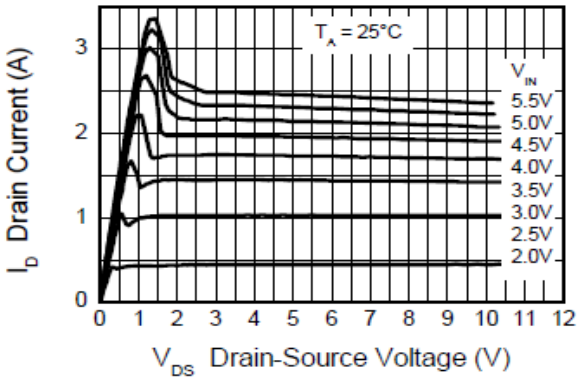
Notes: 12. The drain current is restricted only when the device is in saturation (see graph "Typical Output Characteristic"). This allows the device to be used in the fully on state without interference from the current limit. The device is fully protected at all drain currents, as the low power dissipation generated outside saturation makes current limit unnecessary.

13. 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.

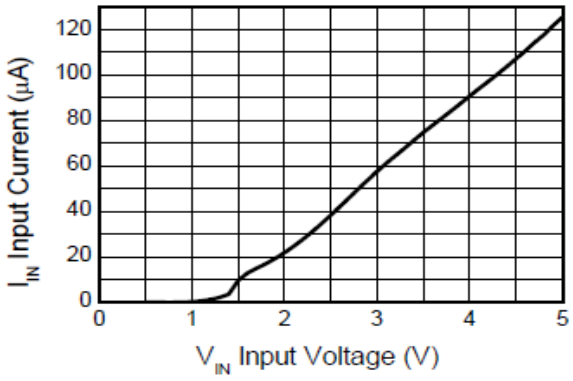
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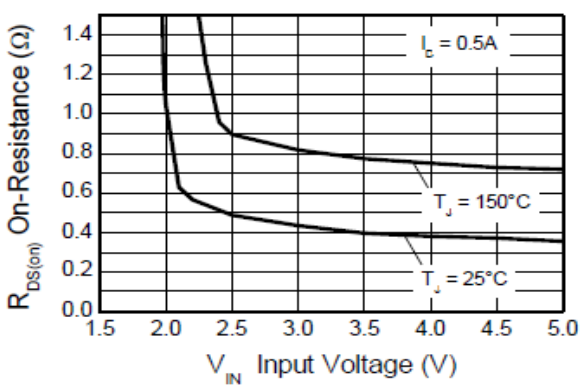
Typical Characteristics



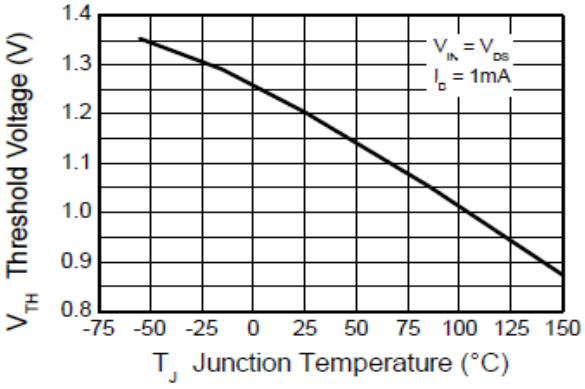
Typical Output Characteristic



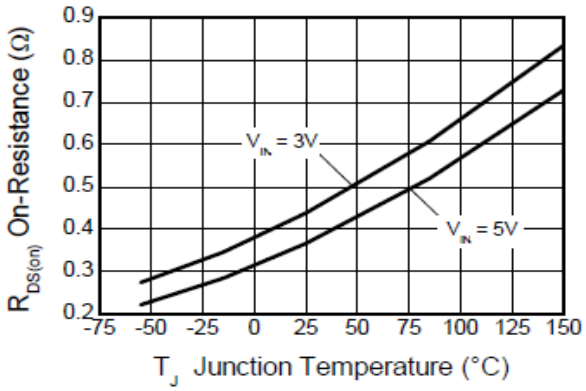
Input Current vs Input Voltage



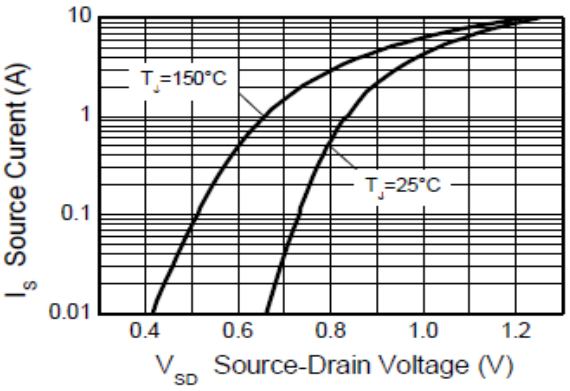
On-Resistance vs Input Voltage



Threshold Voltage vs Temperature



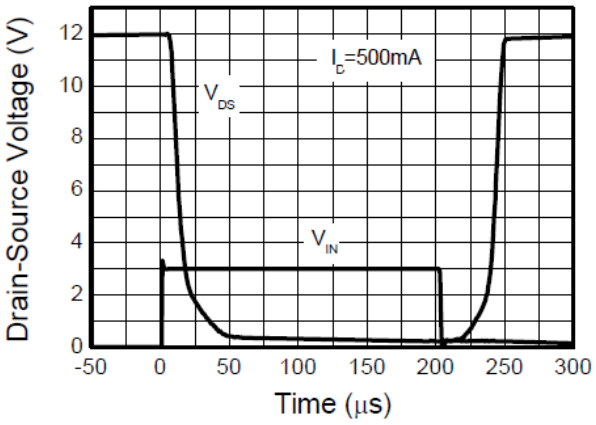
On-Resistance vs Temperature



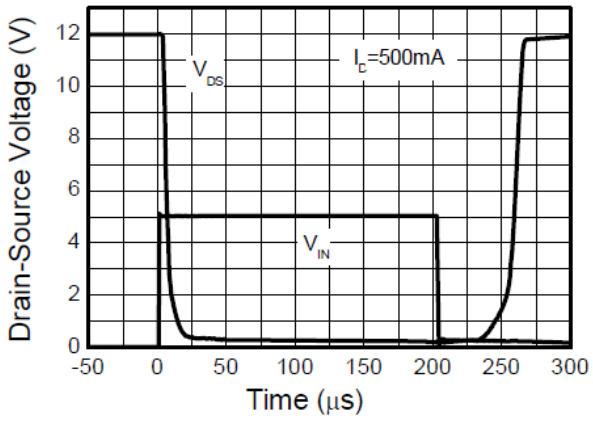
Reverse Diode Characteristic

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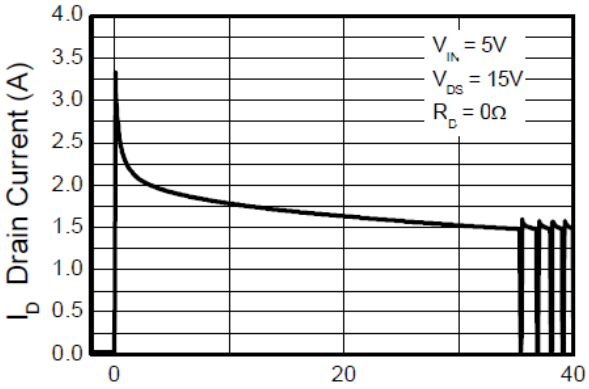
Typical Characteristics – (cont.)



Switching Speed



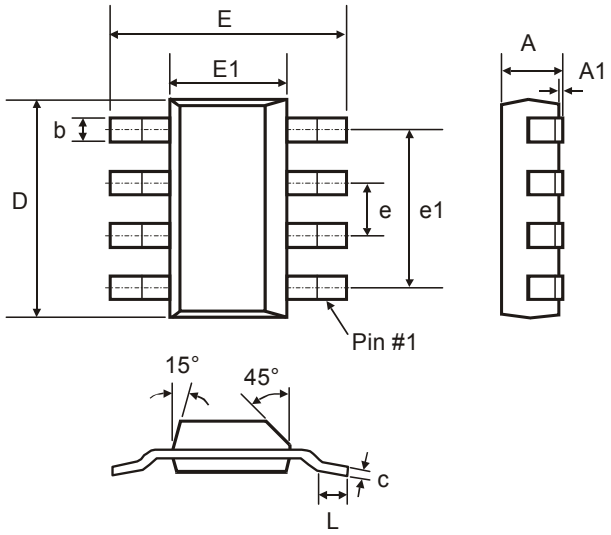
Switching Speed



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Package Outline Dimensions

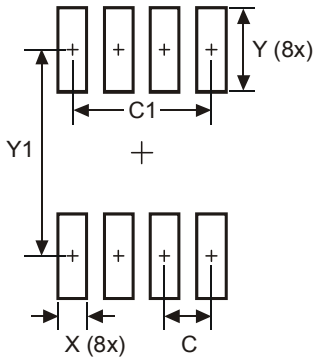
Please see AP02002 at http://www.diodes.com/datasheets/ap02002.pdf for latest version.



SM-8			
Dim	**Min**	**Max**	**Typ**
A	–	1.7	–
A1	0.02	0.1	–
b	–	0.7	–
c	0.24	0.32	–
D	6.3	6.7	–
e	–	–	1.53
e1	–	–	4.59
E	6.7	7.3	–
E1	3.3	3.7	–
L	0.9	–	–
All Dimensions in mm			

Suggested Pad Layout

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



Dimensions	Value (in mm)
C	1.52
C1	4.6
X	0.95
Y	2.80
Y1	6.80

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