60V N-CHANNEL SELF PROTECTED ENHANCEMENT MODE INTELLIFET MOSFET WITH STATUS INDICATION

Product Summary

- Continuous Drain Source Voltage V_{DS} = 60V
- On-State Resistance: 500mΩ
- Nominal Load Current (V_{IN} = 5V): 1.4A
- Clamping Energy: 550mJ

Description

The ZXMS6002GQ is a self-protected low-side IntelliFET™ MOSFET. It features monolithic overtemperature, overcurrent, overvoltage (active clamp) and ESD-protected logic level functionality.

It is intended as a general purpose switch, with status indication and programmable current limit.

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}, 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.
- Status pin voltage reflects the gate drive being applied internally to the power MOSFET
- With V_{IN} = 5V:
  - Status Voltage: 5V indicates normal operation
  - Status Voltage: 2V to 3V indicates that the device is in current-limiting mode
  - Status Voltage: <1V indicates that the device is in thermal shutdown

Features and Benefits

- Status Pin (Analog Status Indication)
- Logic Level Input
- 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)
- High Continuous Current Rating
- **Lead-Free Finish; RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**
- **Qualified to AEC-Q101 Standards for High Reliability**
- **PPAP Capable (Note 4)**

Mechanical Data

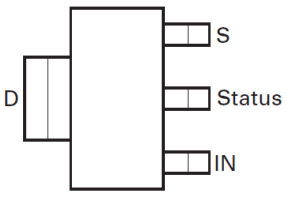
- Case: SOT223 (Type ZN)
- Case Material: Molded Plastic, "Green" Molding Compound
- UL Flammability Classification Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020
- Terminals: Matte Tin Finish e3
- Weight: 0.112 grams (Approximate)

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

SOT223 (Type ZN)



Top View



Top View
Pin Out

Ordering Information (Note 5)

Part Number	Marking	Reel Size (inches)	Tape Width (mm)	Quantity per Reel
ZXMS6002GQTA	ZXMS6002	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.
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5. For packaging details, go to our website at https://www.diodes.com/design/support/packaging/diodes-packaging/.

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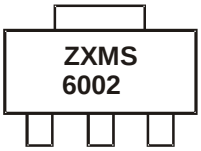
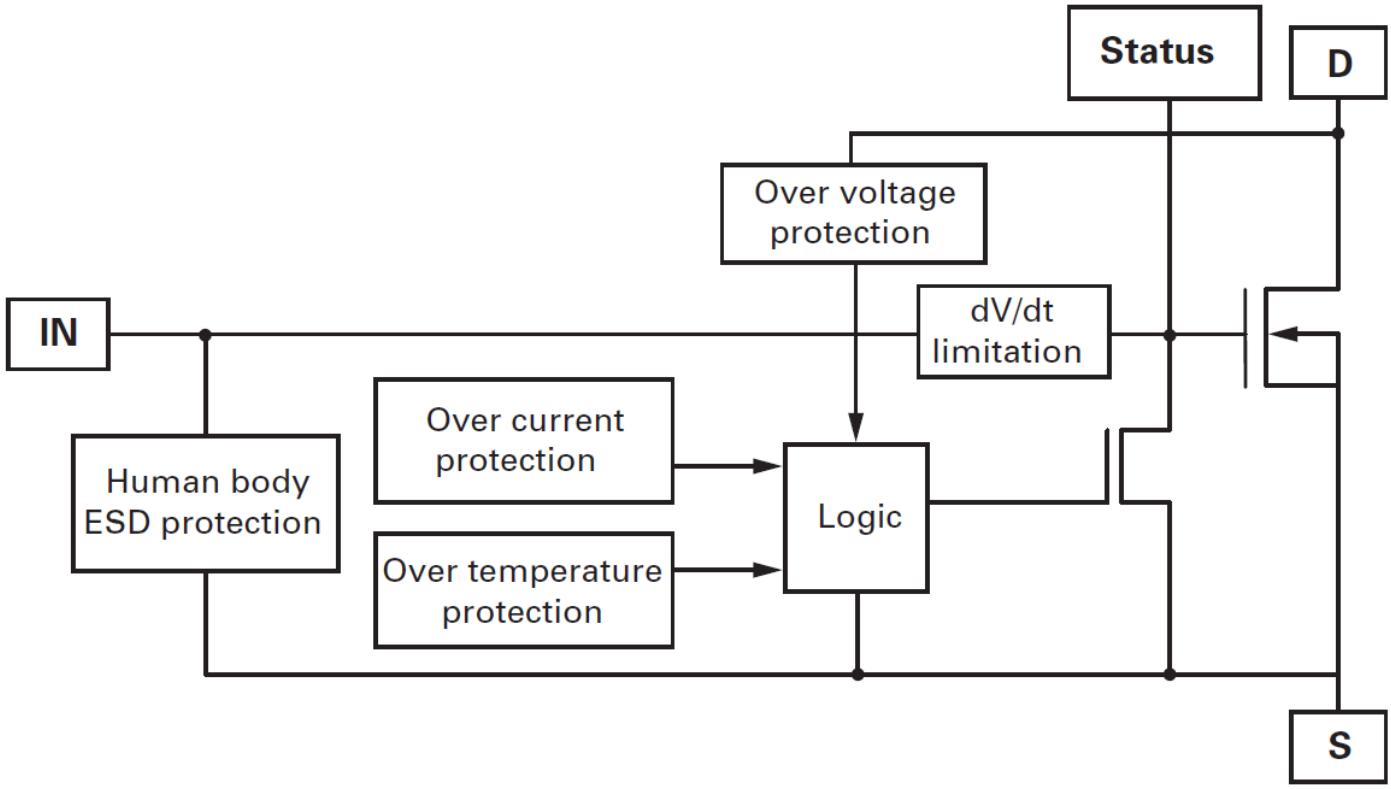
Marking Information



ZXMS6002 = Product Type Marking Code

Functional Block Diagram



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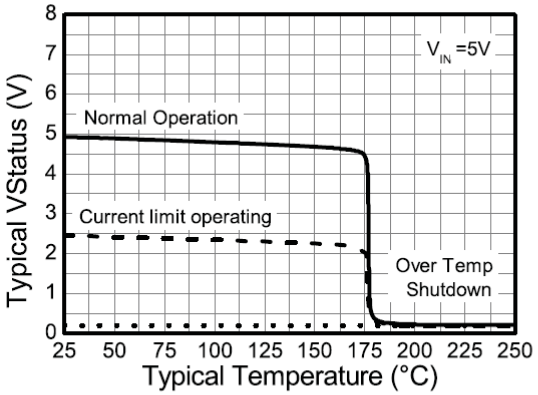
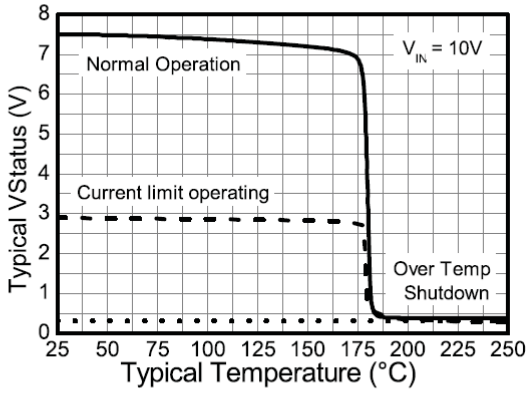
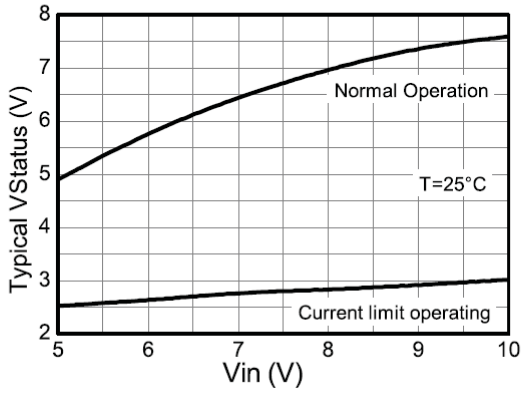
Current Limiting and Over Temp Shutdown Status Indication at Vin=5V



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





VStatus vs Vin

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

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
Drain-Source Voltage for Short Circuit Protection V_{IN} = 10V	$V_{DS(SC)}$	20	V
Continuous Input Voltage	V_{IN}	-0.2 to +10	V
Peak Input Voltage	V_{IN}	-0.2 to +20	V
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	2.5	W
Continuous Drain Current @ V_{IN} = 10V; T_{AMB} = +25°C (Note 6)	I_D	1.6	A
Continuous Drain Current @ V_{IN} = 5V; T_{AMB} = +25°C (Note 6)	I_D	1.4	A
Continuous Source Current (Body Diode) (Note 6)	I_S	3	A
Pulsed Source Current (Body Diode) (Note 7)	I_S	4.7	A
Unclamped Single Pulse Inductive Energy	E_{AS}	550	mJ
Load Dump Protection	$V_{LOADDUMP}$	80	V
Electrostatic Discharge (Human Body Model)	V_{ESD}	4,000	V
DIN Humidity Category, DIN 40 040	—	E	—
IEC Climatic Category, DIN IEC 68-1	—	40/150/56	—

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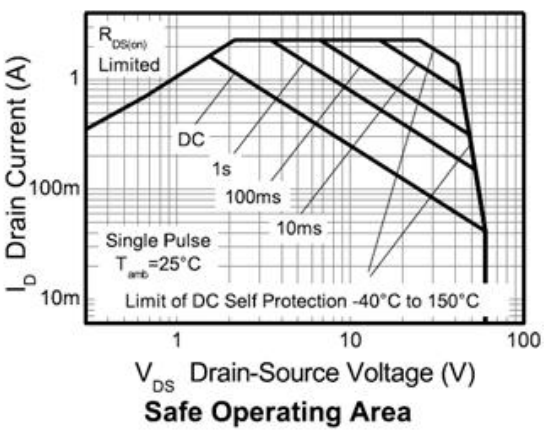
Thermal Resistance (@T_{AMB} = +25°C, unless otherwise stated.)

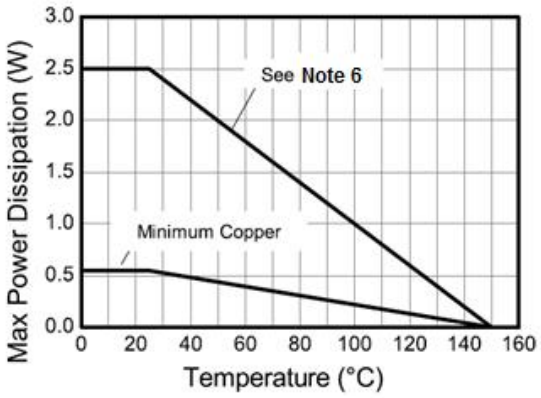
Parameter	Symbol	Value	Unit
Junction to Ambient (Note 6)	$R_{\theta JA}$	50	°C/W
Junction to Ambient (Note 7)	$R_{\theta JA}$	28	°C/W

Notes: 6. For a device surface mounted on 50mm x 50mm x 1.6mm FR-4 board with a high coverage of single sided 2oz weight copper.
7. For a device surface mounted on FR-4 board and measured at t<=10s.

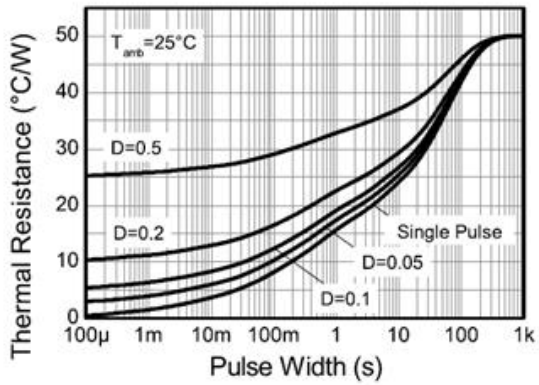
Thermal Characteristics



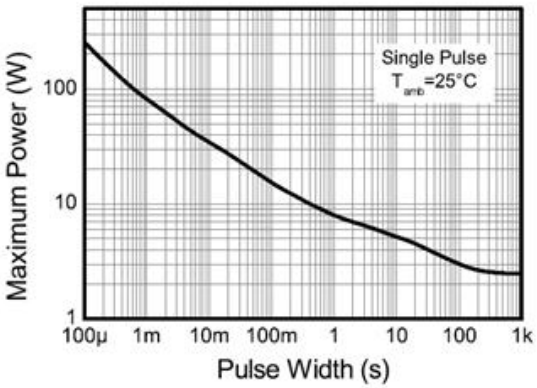
Safe Operating Area



Derating Curve



Transient Thermal Impedance



Pulse Power Dissipation

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

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 (Note 8)	$V_{IN(TH)}$	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 = 0.7A
Static Drain-Source On-State Resistance	$R_{DS(ON)}$	—	385	500	mΩ	V_{IN} = 10V, I_D = 0.7A
Current Limit (Note 9)	$I_{D(LIM)}$	0.7	1.0	1.5	A	V_{IN} = 5V, V_{DS} > 5V
Current Limit (Note 9)	$I_{D(LIM)}$	1	1.8	2.3	A	V_{IN} = 10V, V_{DS} > 5V
Dynamic Characteristics						
Turn-On Time (V_{IN} to 90% I_D)	t_{ON}	—	3	—	µs	R_L = 22Ω, V_{IN} = 0 to 10V, V_{DD} = 12V
Turn-Off Time (V_{IN} to 90% I_D)	t_{OFF}	—	13	—	µs	R_L = 22Ω, V_{IN} = 10V to 0V, V_{DD} = 12V
Slew Rate On (70 to 50% V_{DD})	dV_{DS}/dt_{ON}	—	8	—	V/µs	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	—	V/µs	R_L = 22Ω, V_{IN} = 10V to 0V, V_{DD} = 12V

Notes: 8. Protection features may operate outside spec for V_{IN} < 4.5V.
9. The drain current is limited to a reduced value when V_{DS} exceeds a safe level.

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Electrical Characteristics (Cont.) (@T_{AMB} = +25°C, unless otherwise specified.)

Parameter	Symbol	Min	Typ	Max	Unit	Conditions
Protection Functions (Note 10)						
Required Input Voltage for Overtemperature 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	—	V	V_{IN} = 10V
Current Limit Operation	V_{STATUS}	—	3	—	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

Note: 10. 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.

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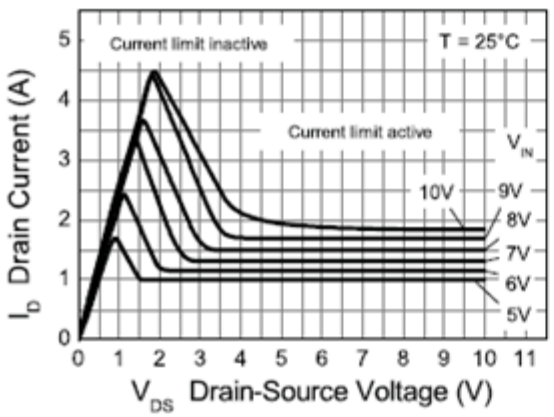
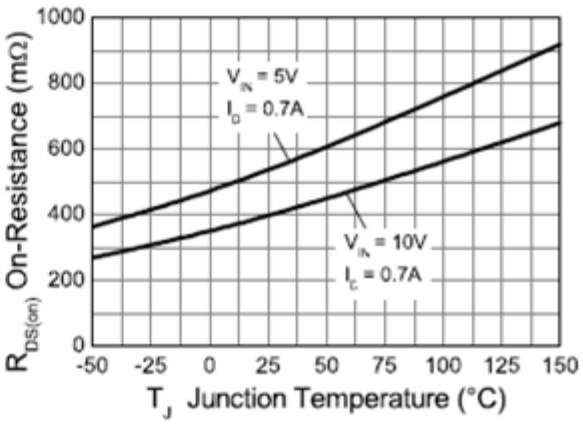
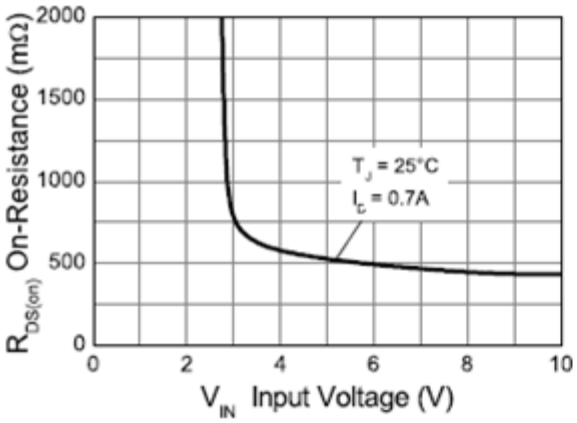
Typical Characteristics



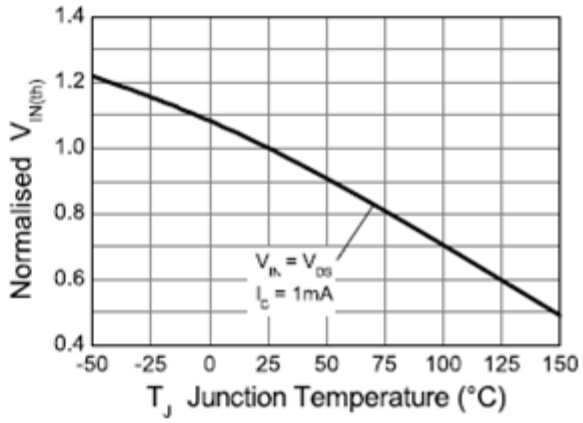
Typical Output Characteristic



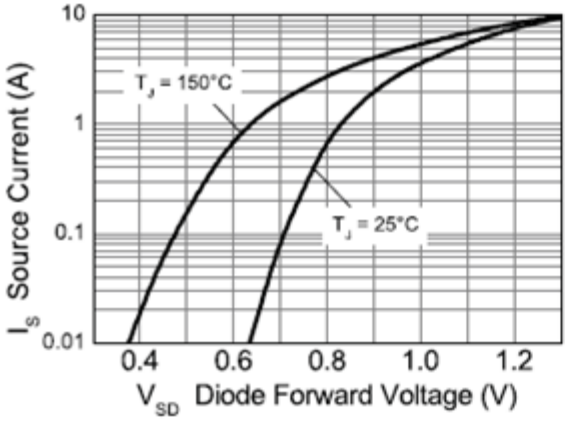
On-state Resistance vs Temperature



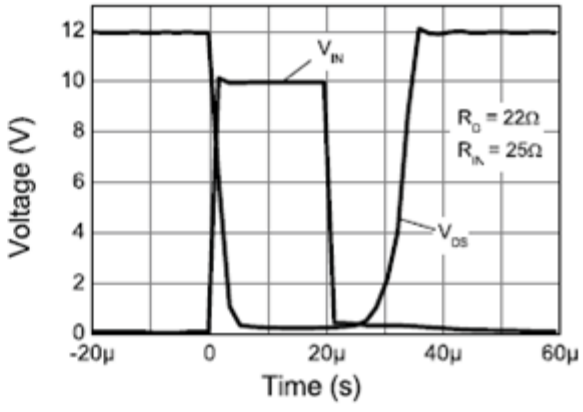
On-Resistance vs Input Voltage



Threshold Voltage vs Temperature



Source-Drain Diode Forward Voltage



Switching Speed

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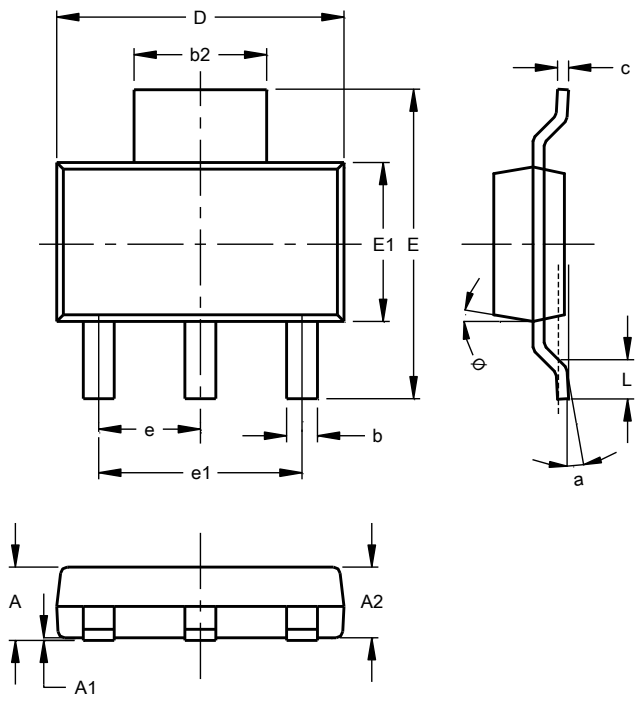
Package Outline Dimensions

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

SOT223 (Type ZN)



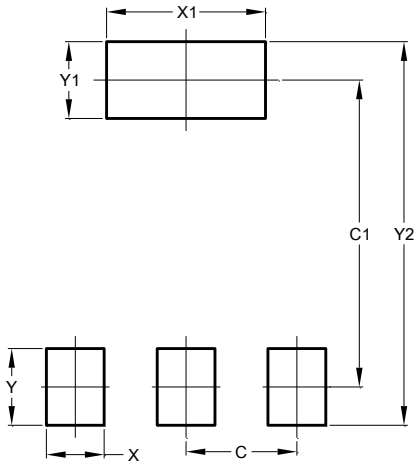
SOT223 (Type ZN)			
Dim	**Min**	**Max**	**Typ**
A	--	1.70	--
A1	0.02	0.10	--
A2	1.50	1.68	1.60
b	0.60	0.80	--
b2	2.90	3.10	--
c	0.24	0.32	--
D	6.30	6.70	--
E	6.70	7.30	--
E1	3.30	3.70	--
e	2.30 NOM		
e1	4.60 NOM		
L	0.90	--	--
a	--	--	10°
ϴ	--	15°	--
All Dimensions in mm			

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

Suggested Pad Layout

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

SOT223 (Type ZN)



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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