

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

Product Summary

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

Description

The ZXMS6002G 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

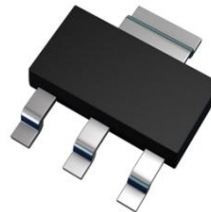
Features and Benefits

- 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)**
- **An Automotive-Compliant Part is Available Under Separate Datasheet ([ZXMS6002GQ](#))**

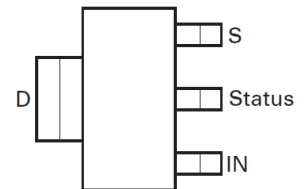
Mechanical Data

- 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(③)
- Weight: 0.112 grams (Approximate)

SOT223 (Type DN)



Top View



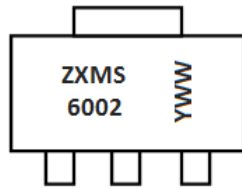
Top View
Pin Out

Ordering Information (Note 4)

Part Number	Marking	Reel Size (inches)	Tape Width (mm)	Quantity per Reel
ZXMS6002GTA	ZXMS6002	7	12	1,000 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, go to our website at <https://www.diodes.com/design/support/packaging/diodes-packaging/>.

Marking Information



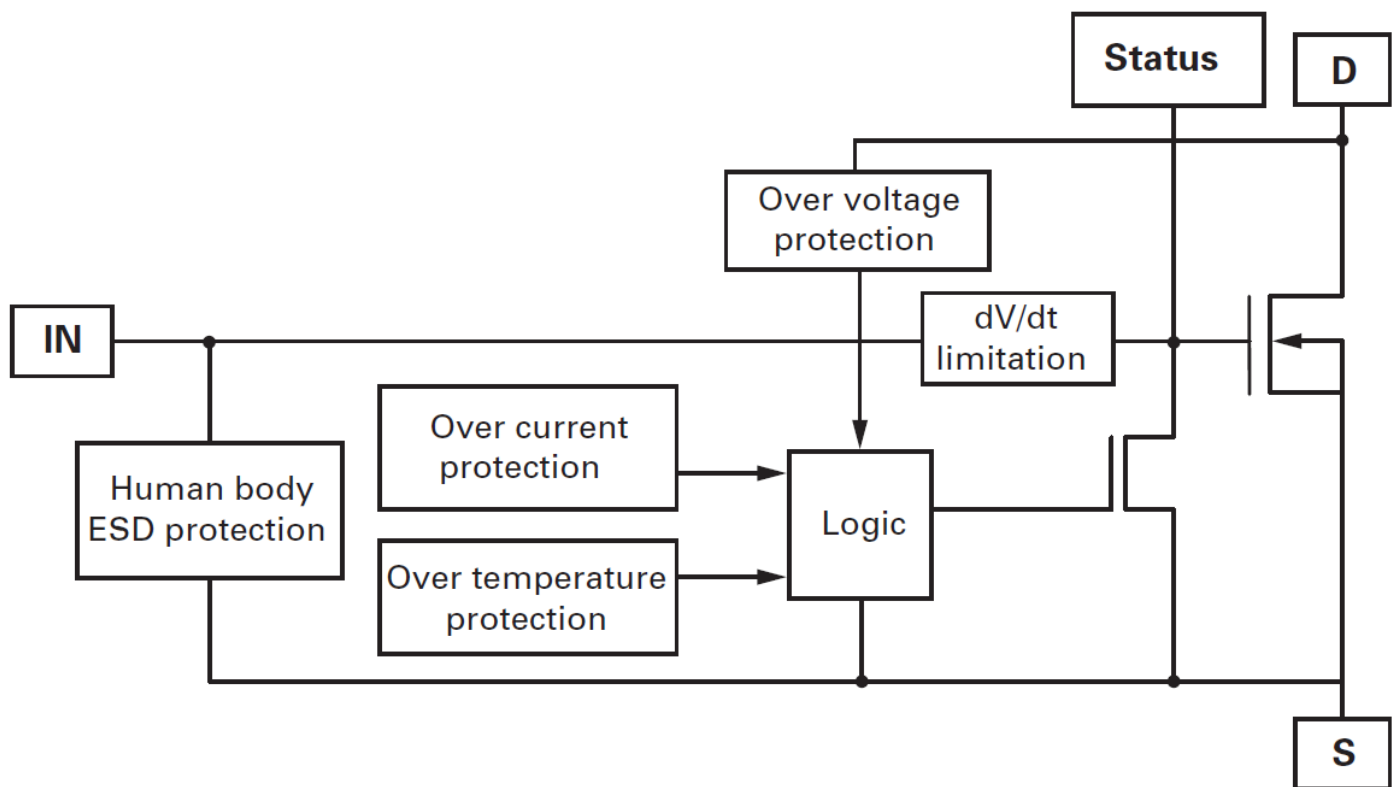
ZXMS6002 = Product Type Marking Code

YWW = Date Code Marking

Y or $\bar{Y}$ = Last Digit of Year (ex: 8 = 2018)

WW or $\bar{WW}$ = Week Code (01 to 53)

Functional Block Diagram



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

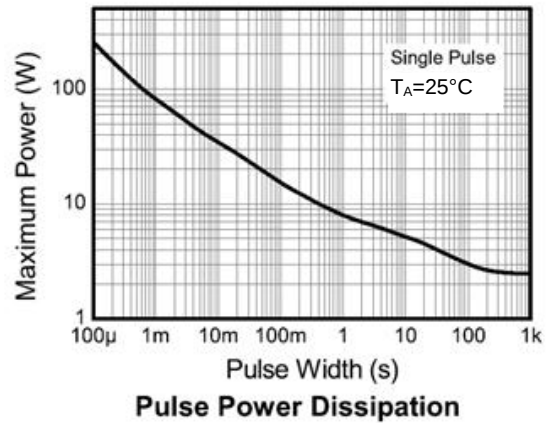
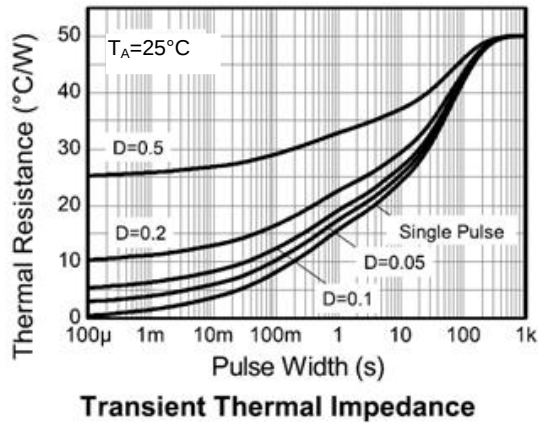
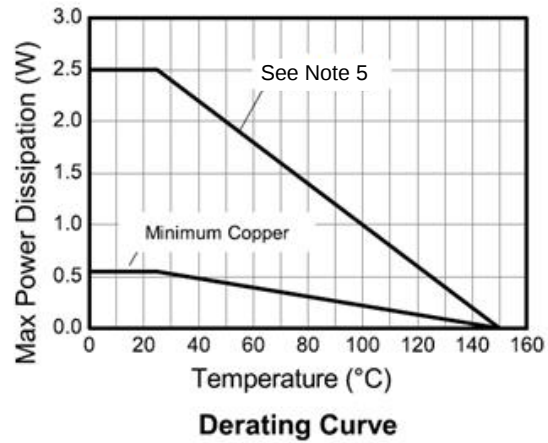
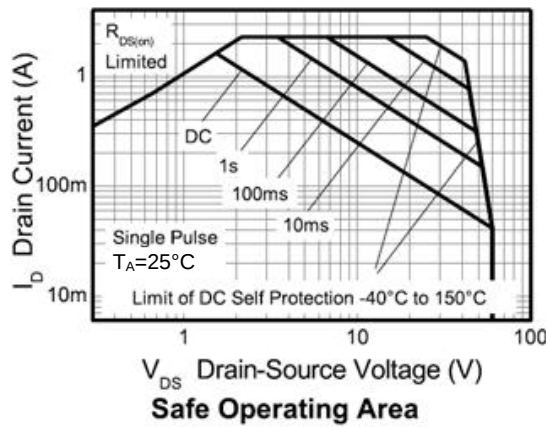
Parameter	Symbol	Limit	Unit
Continuous Drain-Source Voltage	V _{DS}	60	V
Drain-Source Voltage for Short Circuit Protection V _{IN} = 5V	V _{DS(SC)}	36	V
Drain-Source Voltage for Short Circuit Protection V _{IN} = 10V	V _{DS(SC)}	20	V
Continuous Input Voltage	V _{IN}	-0.2 to +10	V
Peak Input Voltage	V _{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 _A = +25°C (Note 5)	P _D	2.5	W
Continuous Drain Current @ V _{IN} = 10V; T _A = +25°C (Note 5)	I _D	1.6	A
Continuous Drain Current @ V _{IN} = 5V; T _A = +25°C (Note 5)	I _D	1.4	A
Continuous Source Current (Body Diode) (Note 5)	I _S	3	A
Pulsed Source Current (Body Diode) (Note 6)	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	—

Thermal Resistance (@T_A = +25°C, unless otherwise stated.)

Parameter	Symbol	Value	Unit
Junction to Ambient (Note 5)	R _{θJA}	50	°C/W
Junction to Ambient (Note 6)	R _{θJA}	28	°C/W

Notes: 5. 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.
6. For a device surface mounted on FR-4 board and measured at t<=10s.

Thermal Characteristics



Electrical Characteristics (@T_A = +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 7)	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 8)	I _{D(LIM)}	0.7	1.0	1.5	A	V _{IN} = 5V, V _{DS} > 5V
Current Limit (Note 8)	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

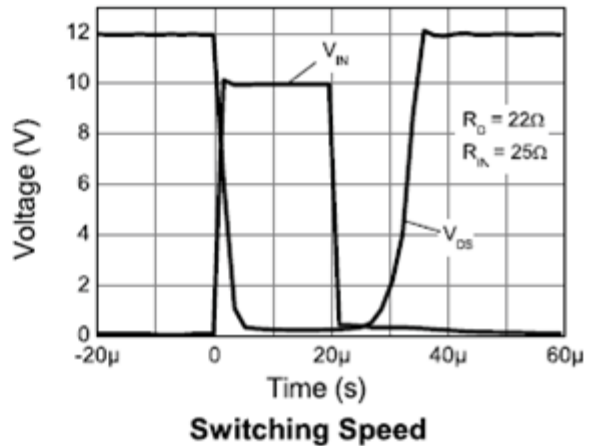
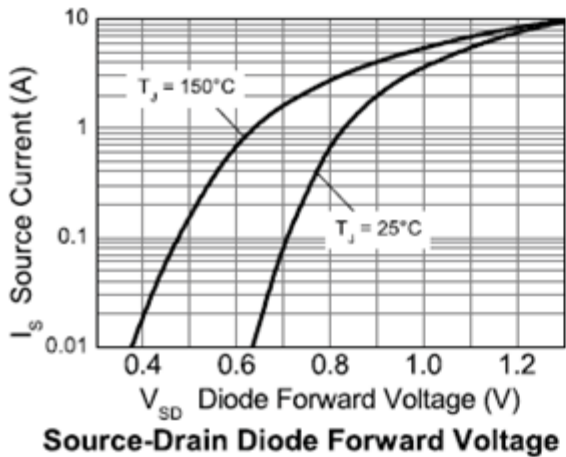
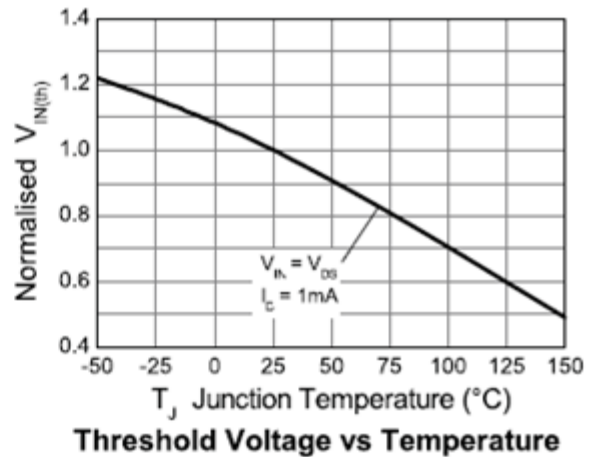
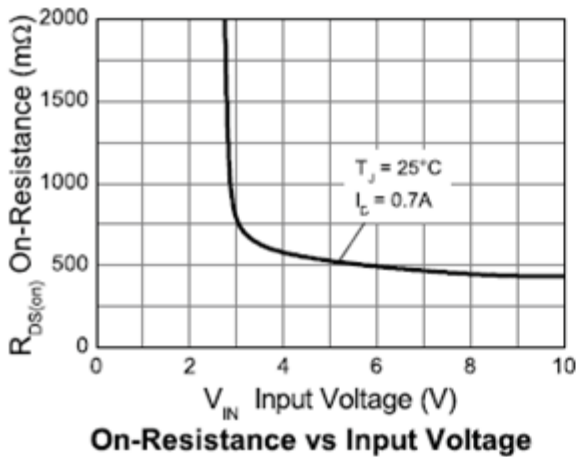
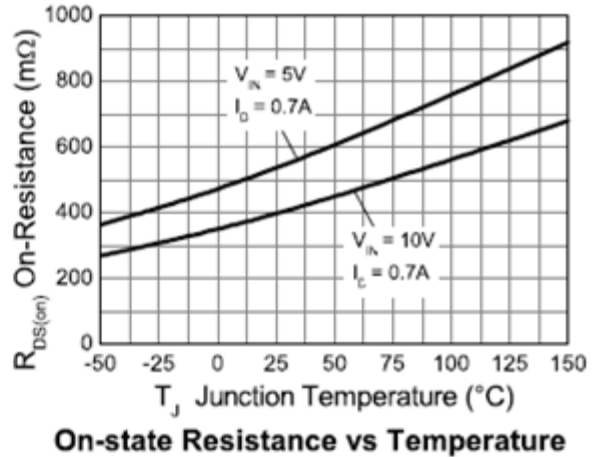
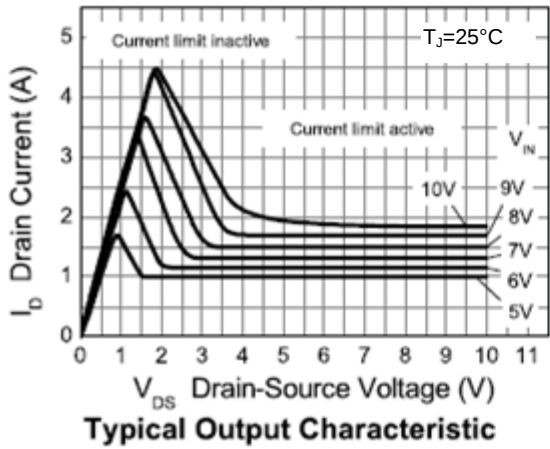
Notes: 7. Protection features may operate outside spec for V_{IN} < 4.5V.
8. The drain current is limited to a reduced value when V_{DS} exceeds a safe level.

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

Parameter	Symbol	Min	Typ	Max	Unit	Conditions
Protection Functions (Note 9)						
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

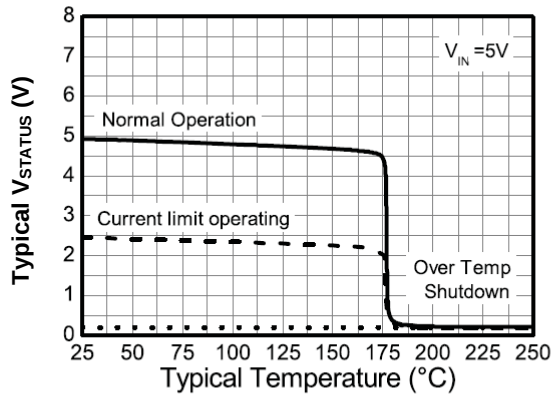
Note: 9. Integrated protection functions are designed to prevent IC destruction under fault conditions described in the datasheet. Fault conditions are considered as "outside" normal operating range. Protection functions are not designed for continuous, repetitive operation.

Typical Characteristics

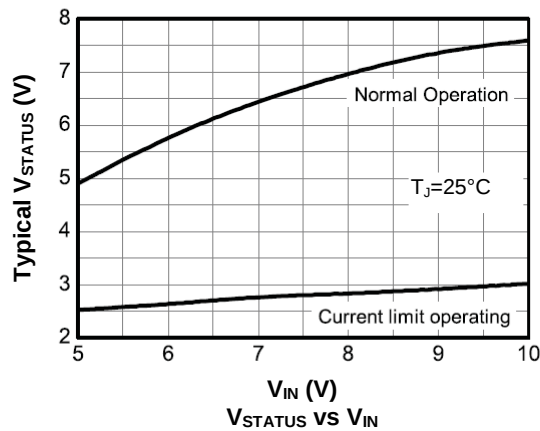
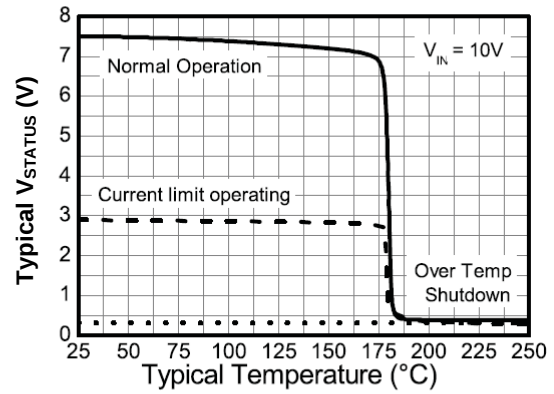


Typical Characteristics (Cont.)

**Current Limiting and Over Temp Shutdown
Status Indication at $V_{IN} = 5V$**



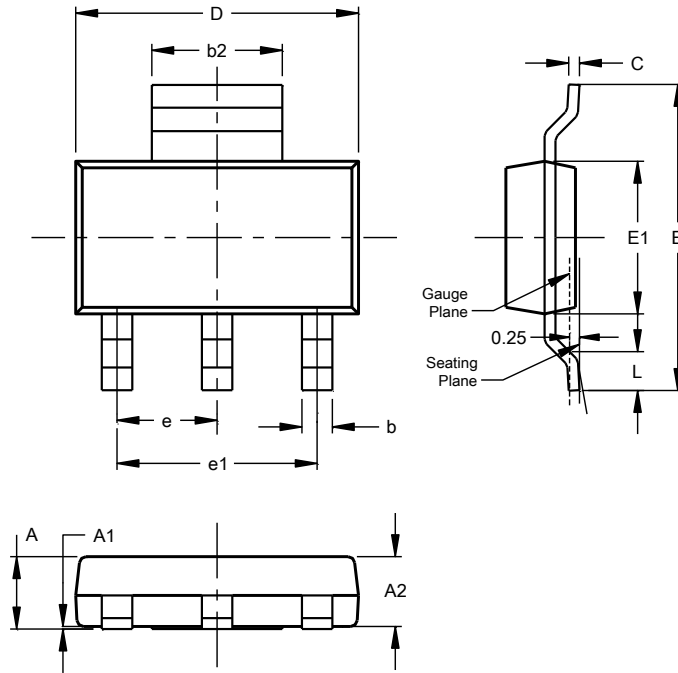
**Current Limiting and Over Temp Shutdown
Status Indication at $V_{IN} = 10V$**



Package Outline Dimensions

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

SOT223 (Type DN)

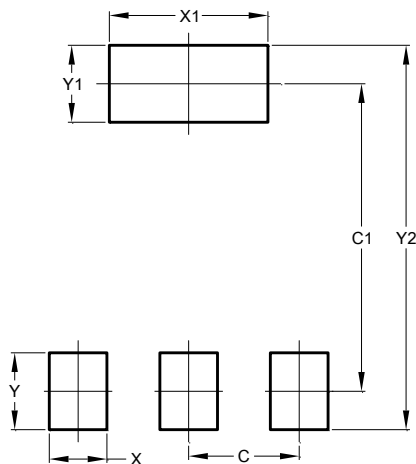


SOT223 (Type DN)			
Dim	Min	Max	Typ
A	--	1.70	--
A1	0.01	0.15	--
A2	1.50	1.68	1.60
b	0.60	0.80	0.70
b2	2.90	3.10	--
c	0.20	0.32	--
D	6.30	6.70	--
E	6.70	7.30	--
E1	3.30	3.70	--
e	--	--	2.30
e1	--	--	4.60
L	0.85	--	--
All Dimensions in mm			

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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