

## Product Summary

$V_{(BR)DSS}$	$R_{DS(on)}$	$I_D$ $T_A = +25^\circ\text{C}$
-60V	390m $\Omega$ @ $V_{GS} = -10\text{V}$	-2.3A
	595m $\Omega$ @ $V_{GS} = -4.5\text{V}$	-1.9A

## Description and Applications

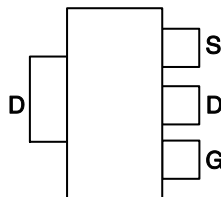
This MOSFET is designed to minimize the on-state resistance and yet maintain superior switching performance, making it ideal for high efficiency power management applications.

- Motor Control
- DC-DC Converters
- Power Management Functions
- Uninterrupted Power Supply

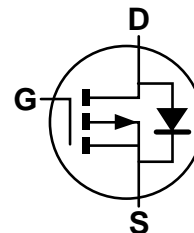
SOT223



Top View



Pin Out - Top View



Equivalent Circuit

## Features and Benefits

- Fast Switching Speed
- Low Gate Drive
- Low Input Capacitance
- **Lead-Free Finish; RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**
- **Qualified to AEC-Q101 Standards for High Reliability**

## Mechanical Data

- Case: SOT223
- Case Material: Molded Plastic, "Green" Molding Compound; UL Flammability Classification Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020
- Terminals Connections: See Diagram Below
- Terminals: Finish - Matte Tin Annealed over Copper Leadframe; Solderable per MIL-STD-202, Method 208 (E3)
- Weight: 0.112 grams (Approximate)

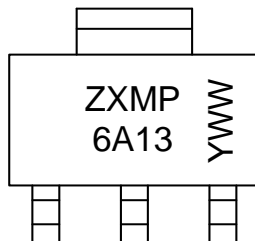
## Ordering Information (Note 4)

Product	Marking	Reel size (inches)	Tape width (mm)	Quantity per reel
ZXMP6A13GTA	ZXMP6A13	7	12	1,000

- 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](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. For packaging details, go to our website at <http://www.diodes.com/products/packages.html>.

## Marking Information

SOT223



ZXMP 6A13 = Product Type Marking Code  
 YWW = Date Code Marking  
 Y or  $\bar{Y}$  = Last Digit of Year (ex: 5= 2015)  
 WW or  $\bar{W}W$  = Week Code (01-53)

**Maximum Ratings** (@T<sub>A</sub> = +25°C unless otherwise specified.)

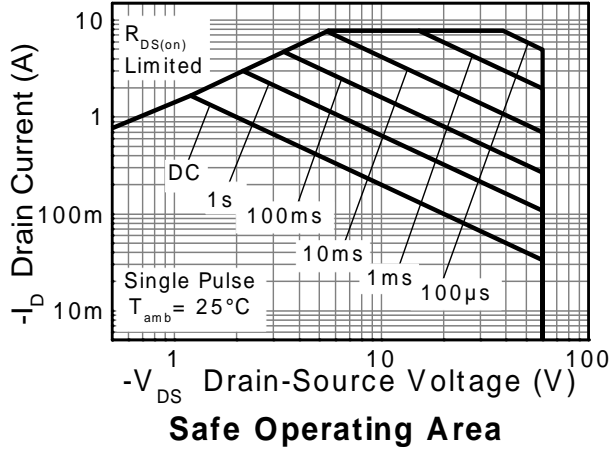
Characteristic			Symbol	Value	Unit	
Drain-Source Voltage			V <sub>DSS</sub>	-60	V	
Gate-Source Voltage			V <sub>GS</sub>	±20	V	
Continuous Drain Current	V <sub>GS</sub> = 10V	(Note 6)	I <sub>D</sub>	-2.3	A	
		T <sub>A</sub> = +70°C (Note 6)		-1.9		
		(Note 5)		-1.7		
Pulsed Drain Current	V <sub>GS</sub> = 10V	(Note 7)	I <sub>DM</sub>	-7.8	A	
Continuous Source Current (Body Diode)			(Note 6)	I <sub>S</sub>	-4.1	A
Pulsed Source Current (Body Diode)			(Note 7)	I <sub>SM</sub>	-7.8	A

**Thermal Characteristics** (@T<sub>A</sub> = +25°C unless otherwise specified.)

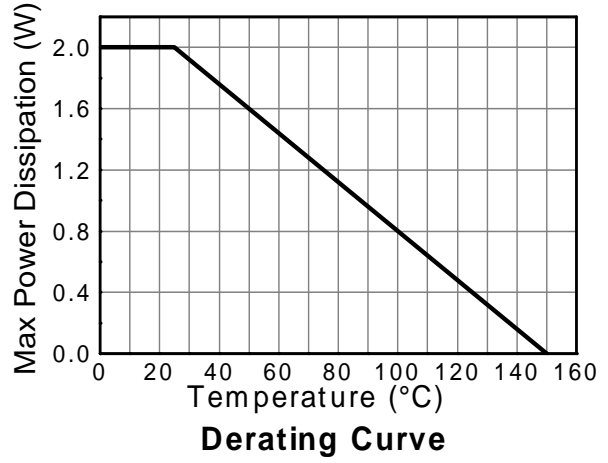
Characteristic		Symbol	Value	Unit
Power Dissipation Linear Derating Factor	(Note 5)	P <sub>D</sub>	2.0	W mW/°C
	(Note 6)		16	
Thermal Resistance, Junction to Ambient	(Note 5)	R <sub>θJA</sub>	3.9	°C/W
	(Note 6)		31	
Thermal Resistance, Junction to Lead	(Note 8)	R <sub>θJL</sub>	62.5	°C/W
Operating and Storage Temperature Range		T <sub>J</sub> , T <sub>STG</sub>	32.0	
			9.8	°C
			-55 to 150	

- Notes:
5. For a device surface mounted on 25mm x 25mm x 1.6mm FR4 PCB with high coverage of single sided 1oz copper, in still air conditions; the device is measured when operating in a steady-state condition.
  6. Same as Note 5, except the device is measured at t ≤ 10 sec.
  7. Same as Note 5, except the device is pulsed with D = 0.02 and pulse width 300μs. The pulse current is limited by the maximum junction temperature.
  8. Thermal resistance from junction to solder-point (at the end of the drain lead).

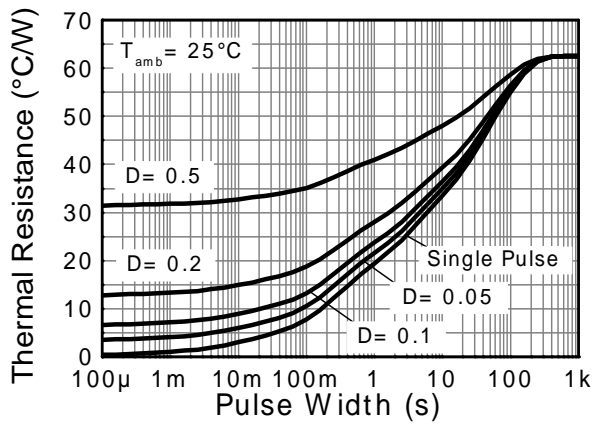
**Thermal Characteristics**



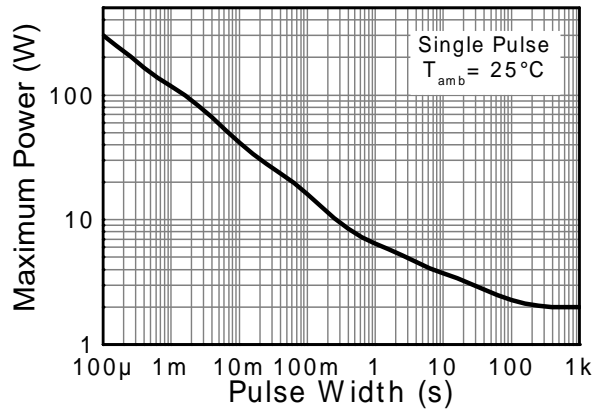
**Safe Operating Area**



**Derating Curve**



**Transient Thermal Impedance**



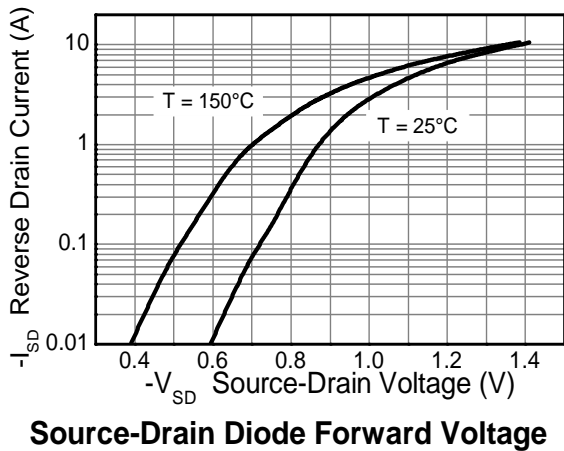
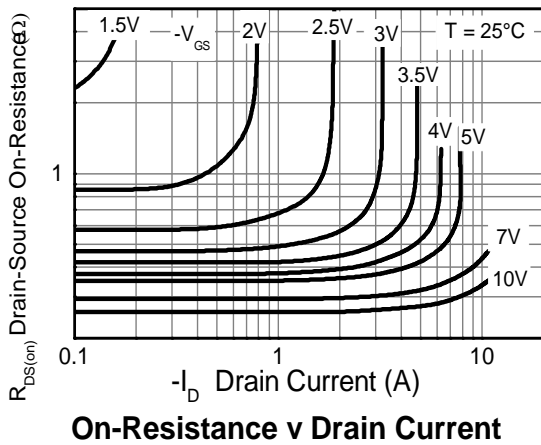
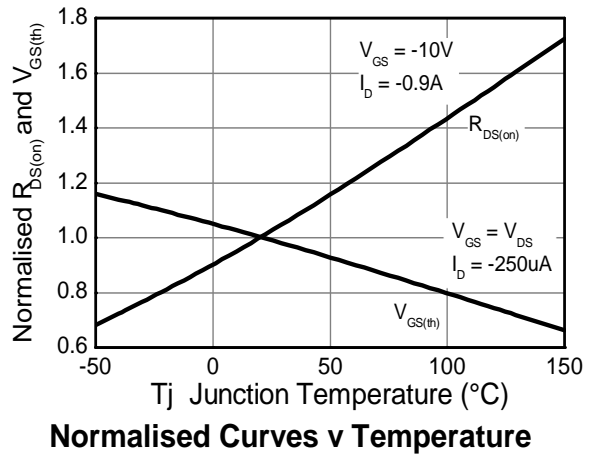
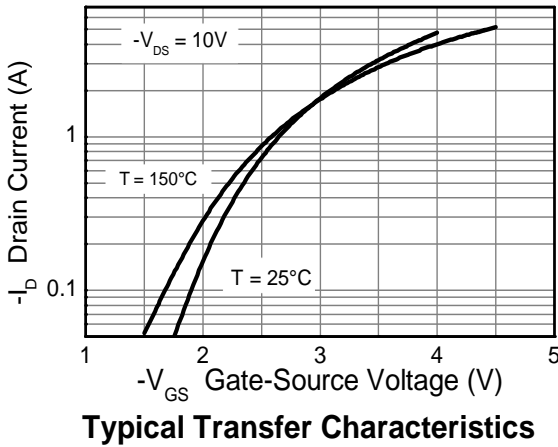
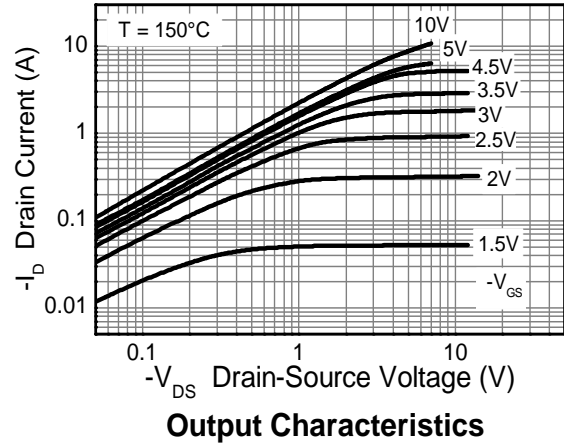
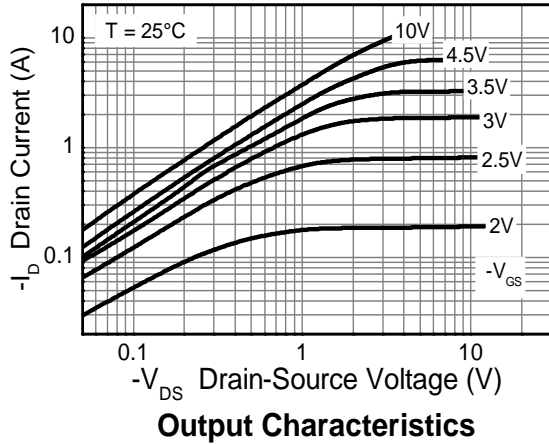
**Pulse Power Dissipation**

**Electrical Characteristics** (@T<sub>A</sub> = +25°C unless otherwise specified.)

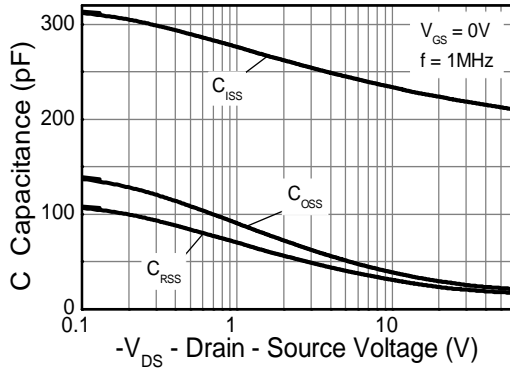
Characteristic	Symbol	Min	Typ	Max	Unit	Test Condition	
<b>OFF CHARACTERISTICS</b>							
Drain-Source Breakdown Voltage	BV <sub>DSS</sub>	-60	—	—	V	I <sub>D</sub> = -250μA, V <sub>GS</sub> = 0V	
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	—	—	-0.5	μA	V <sub>DS</sub> = -60V, V <sub>GS</sub> = 0V	
Gate-Source Leakage	I <sub>GSS</sub>	—	—	±100	nA	V <sub>GS</sub> = ±20V, V <sub>DS</sub> = 0V	
<b>ON CHARACTERISTICS</b>							
Gate Threshold Voltage	V <sub>GS(th)</sub>	-1.0	—	-3.0	V	I <sub>D</sub> = -250μA, V <sub>DS</sub> = V <sub>GS</sub>	
Static Drain-Source On-Resistance (Note 9)	R <sub>DS(on)</sub>	—	—	0.390	Ω	V <sub>GS</sub> = -10V, I <sub>D</sub> = -0.9A	
				0.595		V <sub>GS</sub> = -4.5V, I <sub>D</sub> = -0.8A	
Forward Transconductance (Notes 9 & 10)	g <sub>fs</sub>	—	1.8	—	S	V <sub>DS</sub> = -15V, I <sub>D</sub> = -0.9A	
Diode Forward Voltage (Note 9)	V <sub>SD</sub>	—	-0.85	-0.95	V	I <sub>S</sub> = -0.8A, V <sub>GS</sub> = 0V, T <sub>J</sub> = +25°C	
Reverse Recovery Time (Note 10)	t <sub>rr</sub>	—	21.1	—	ns	I <sub>S</sub> = -0.9A, di/dt = 100A/μs,	
Reverse Recovery Charge (Note 10)	Q <sub>rr</sub>	—	19.3	—	nC	T <sub>J</sub> = +25°C	
<b>DYNAMIC CHARACTERISTICS (Note 10)</b>							
Input Capacitance	C <sub>iSS</sub>	—	219	—	pF	V <sub>DS</sub> = -30V, V <sub>GS</sub> = 0V f = 1MHz	
Output Capacitance	C <sub>oss</sub>	—	25.7	—	pF		
Reverse Transfer Capacitance	C <sub>rSS</sub>	—	20.5	—	pF		
Total Gate Charge (Note 11)	Q <sub>g</sub>	—	2.9	—	nC	V <sub>GS</sub> = -4.5V	V <sub>DS</sub> = -30V I <sub>D</sub> = -0.9A
Total Gate Charge (Note 11)	Q <sub>g</sub>	—	5.9	—	nC	V <sub>GS</sub> = -10V	
Gate-Source Charge (Note 11)	Q <sub>gs</sub>	—	0.74	—	nC		
Gate-Drain Charge (Note 11)	Q <sub>gd</sub>	—	1.5	—	nC		
Turn-On Delay Time (Note 11)	t <sub>D(on)</sub>	—	1.6	—	ns	V <sub>DD</sub> = -30V, V <sub>GS</sub> = -10V I <sub>D</sub> = -1A, R <sub>G</sub> ≅ 6.0Ω	
Turn-On Rise Time (Note 11)	t <sub>r</sub>	—	2.2	—	ns		
Turn-Off Delay Time (Note 11)	t <sub>D(off)</sub>	—	11.2	—	ns		
Turn-Off Fall Time (Note 11)	t <sub>f</sub>	—	5.7	—	ns		

- Notes:
9. Measured under pulsed conditions. Pulse width ≤ 300μs; duty cycle ≤ 2%
  10. For design aid only, not subject to production testing.
  11. Switching characteristics are independent of operating junction temperatures.

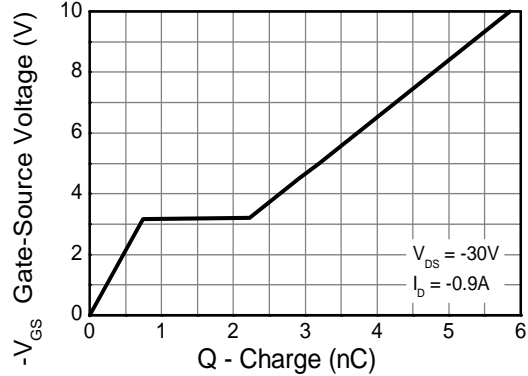
**Typical Characteristics**



**Typical Characteristics (cont.)**

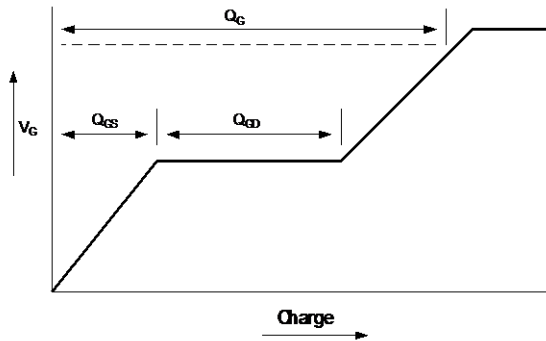


**Capacitance v Drain-Source Voltage**

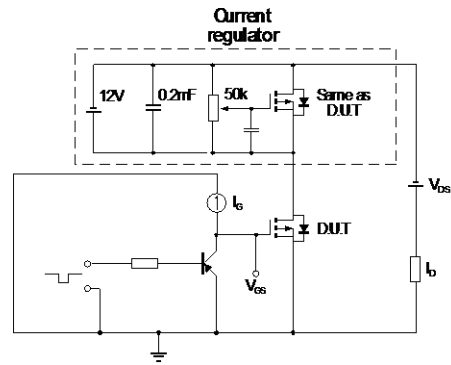


**Gate-Source Voltage v Gate Charge**

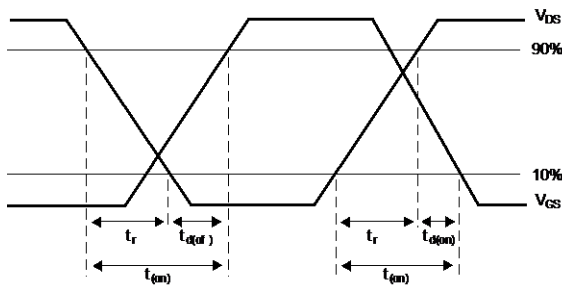
**Test Circuits**



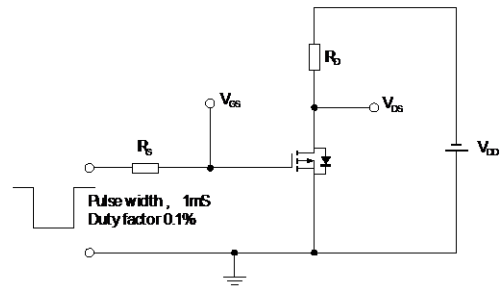
**Basic gate charge waveform**



**Gate charge test circuit**



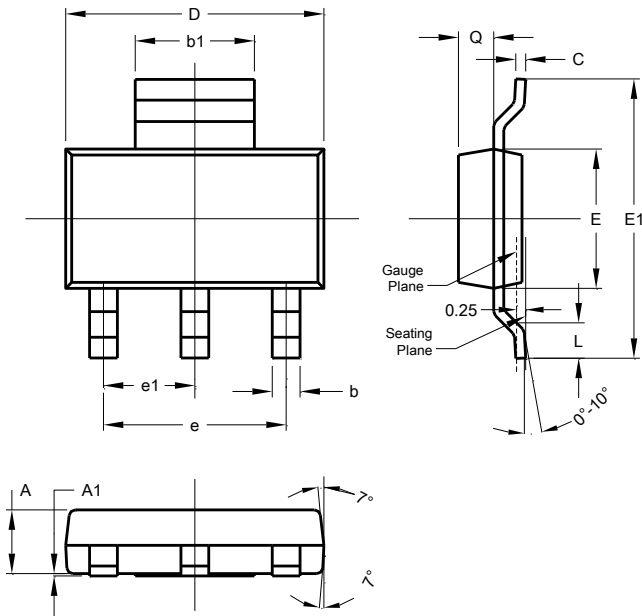
**Switching time waveforms**



**Switching time test circuit**

**Package Outline Dimensions**

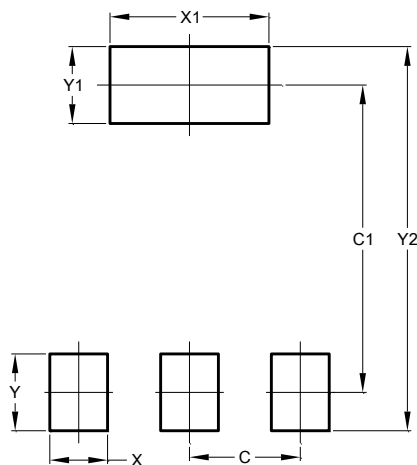
Please see AP02002 at <http://www.diodes.com/datasheets/ap02002.pdf> for the latest version.



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			

**Suggested Pad Layout**

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



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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