

60V P-CHANNEL ENHANCEMENT MODE MOSFET

Product Summary

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

Description and Applications

This MOSFET has been 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

Features and Benefits

- Fast switching speed
- Low gate drive
- Low input capacitance
- **Qualified to AEC-Q101 Standards for High Reliability**

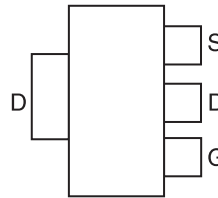
Mechanical Data

- Case: SOT223
- Case Material: Molded Plastic, UL Flammability Classification Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020
- Terminals: Finish - Matte Tin annealed over Copper lead frame. Solderable per MIL-STD-202, Method 208
- Weight: 0.112 grams (approximate)

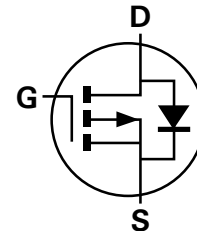
SOT223



Top View



Pin Out - Top View

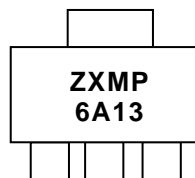


Equivalent Circuit

Ordering Information

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

Marking Information



ZXMP = Product Type Marking Code, Line 1
6A13 = Product Type Marking Code, Line 2

Maximum Ratings @ $T_A = 25^\circ\text{C}$ unless otherwise specified

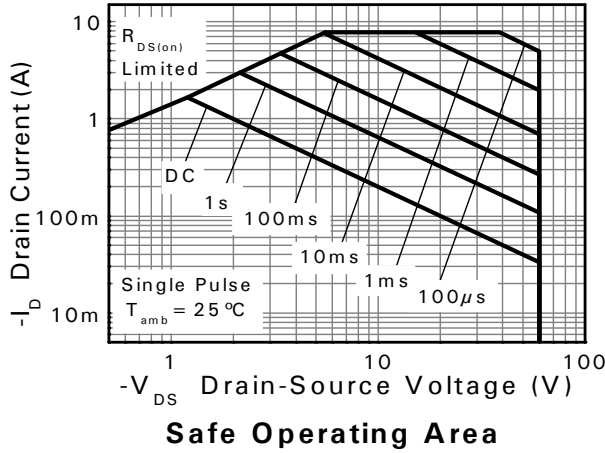
Characteristic			Symbol	Value	Unit	
Drain-Source voltage			V_{DSS}	-60	V	
Gate-Source voltage			V_{GS}	± 20	V	
Continuous Drain current	$V_{GS} = 10\text{V}$	(Note 2)	I_D	-2.3	A	
		$T_A = 70^\circ\text{C}$ (Note 2)		-1.9		
		(Note 1)		-1.7		
Pulsed Drain current	$V_{GS} = 10\text{V}$	(Note 3)	I_{DM}	-7.8	A	
Continuous Source current (Body diode)			(Note 2)	I_S	-4.1	A
Pulsed Source current (Body diode)			(Note 3)	I_{SM}	-7.8	A

Thermal Characteristics @ $T_A = 25^\circ\text{C}$ unless otherwise specified

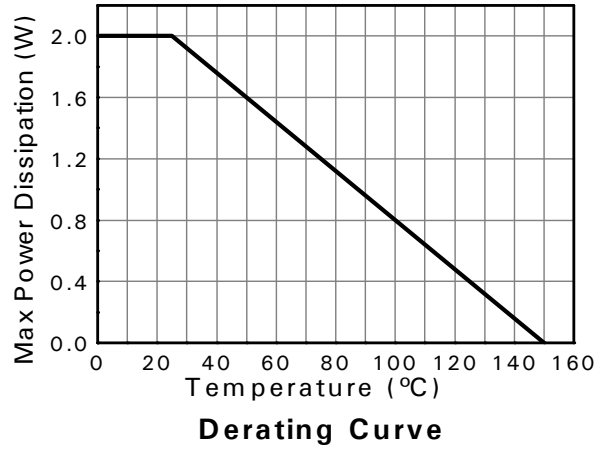
Characteristic		Symbol	Value	Unit
Power dissipation	(Note 1)	P_D	2.0	W
	Linear derating factor		16	
(Note 2)			3.9	
			31	
Thermal Resistance, Junction to Ambient	(Note 1)	$R_{\theta JA}$	62.5	$^\circ\text{C/W}$
	(Note 2)		32.0	
Thermal Resistance, Junction to Lead	(Note 4)	$R_{\theta JL}$	9.8	
Operating and storage temperature range		T_J, T_{STG}	-55 to 150	

- Notes:
1. 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.
 2. Same as note (1), except the device is measured at $t \leq 10$ sec.
 3. Same as note (1), except the device is pulsed with $D = 0.02$ and pulse width 300 μs . The pulse current is limited by the maximum junction temperature.
 4. Thermal resistance from junction to solder-point (at the end of the drain lead).

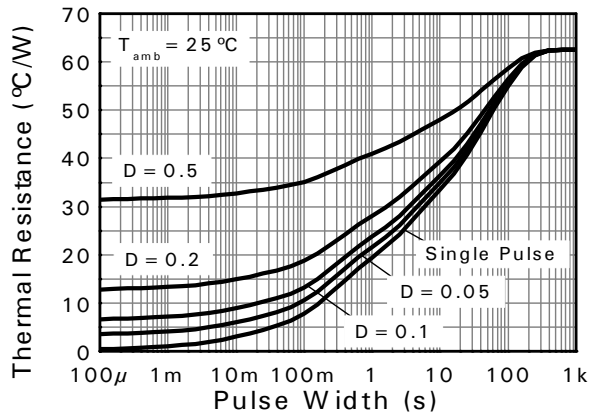
Thermal Characteristics



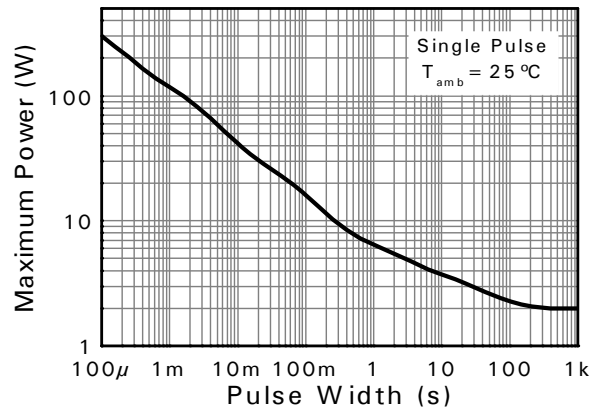
Safe Operating Area



Derating Curve



Transient Thermal Impedance



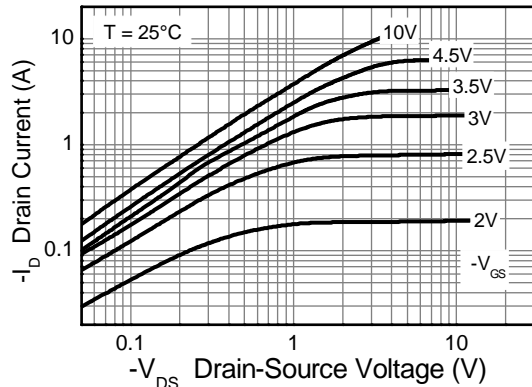
Pulse Power Dissipation

Electrical Characteristics @ $T_A = 25^\circ\text{C}$ unless otherwise specified

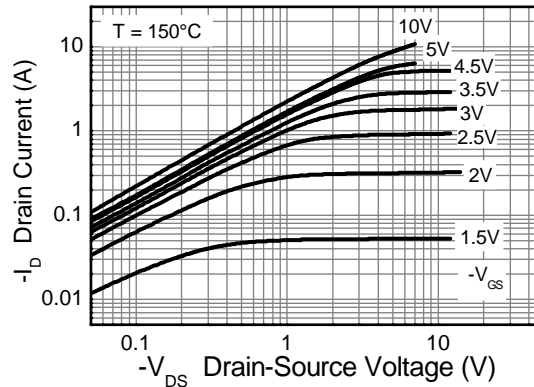
Characteristic	Symbol	Min	Typ	Max	Unit	Test Condition
OFF CHARACTERISTICS						
Drain-Source Breakdown Voltage	BV_{DSS}	-60	—	—	V	$I_D = -250\mu\text{A}$, $V_{GS} = 0\text{V}$
Zero Gate Voltage Drain Current	I_{DSS}	—	—	-0.5	μA	$V_{DS} = -60\text{V}$, $V_{GS} = 0\text{V}$
Gate-Source Leakage	I_{GSS}	—	—	± 100	nA	$V_{GS} = \pm 20\text{V}$, $V_{DS} = 0\text{V}$
ON CHARACTERISTICS						
Gate Threshold Voltage	$V_{GS(th)}$	-1.0	—	—	V	$I_D = -250\mu\text{A}$, $V_{DS} = V_{GS}$
Static Drain-Source On-Resistance (Note 5)	$R_{DS(on)}$	—	—	0.390	Ω	$V_{GS} = -10\text{V}$, $I_D = -0.9\text{A}$
				0.595		$V_{GS} = -4.5\text{V}$, $I_D = -0.8\text{A}$
Forward Transconductance (Notes 5 & 6)	g_{fs}	—	1.8	—	S	$V_{DS} = -15\text{V}$, $I_D = -0.9\text{A}$
Diode Forward Voltage (Note 5)	V_{SD}	—	-0.85	-0.95	V	$I_S = -0.8\text{A}$, $V_{GS} = 0\text{V}$, $T_J = 25^\circ\text{C}$
Reverse recovery time (Note 6)	t_{rr}	—	21.1	—	ns	$I_S = -0.9\text{A}$, $di/dt = 100\text{A}/\mu\text{s}$, $T_J = 25^\circ\text{C}$
Reverse recovery charge (Note 6)	Q_{rr}	—	19.3	—	nC	$T_J = 25^\circ\text{C}$
DYNAMIC CHARACTERISTICS (Note 6)						
Input Capacitance	C_{iss}	—	219	—	pF	$V_{DS} = -30\text{V}$, $V_{GS} = 0\text{V}$ $f = 1\text{MHz}$
Output Capacitance	C_{oss}	—	25.7	—	pF	
Reverse Transfer Capacitance	C_{rss}	—	20.5	—	pF	
Total Gate Charge (Note 7)	Q_g	—	2.9	—	nC	$V_{GS} = -4.5\text{V}$
Total Gate Charge (Note 7)	Q_g	—	5.9	—	nC	$V_{GS} = -10\text{V}$ $V_{DS} = -30\text{V}$ $I_D = -0.9\text{A}$
Gate-Source Charge (Note 7)	Q_{gs}	—	0.74	—	nC	
Gate-Drain Charge (Note 7)	Q_{gd}	—	1.5	—	nC	
Turn-On Delay Time (Note 7)	$t_{D(on)}$	—	1.6	—	ns	$V_{DD} = -30\text{V}$, $V_{GS} = -10\text{V}$ $I_D = -1\text{A}$, $R_G \equiv 6.0\Omega$
Turn-On Rise Time (Note 7)	t_r	—	2.2	—	ns	
Turn-Off Delay Time (Note 7)	$t_{D(off)}$	—	11.2	—	ns	
Turn-Off Fall Time (Note 7)	t_f	—	5.7	—	ns	

- Notes:
5. Measured under pulsed conditions. Pulse width $\leq 300\mu\text{s}$; duty cycle $\leq 2\%$
 6. For design aid only, not subject to production testing.
 7. Switching characteristics are independent of operating junction temperatures.

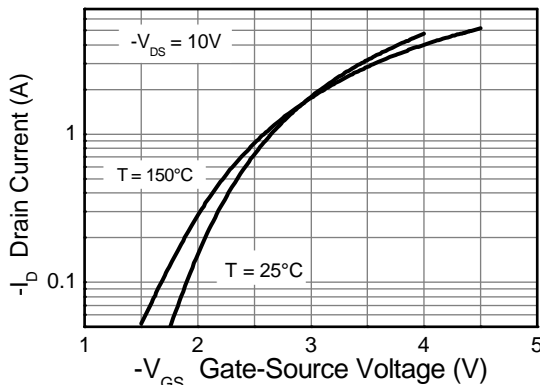
Typical Characteristics



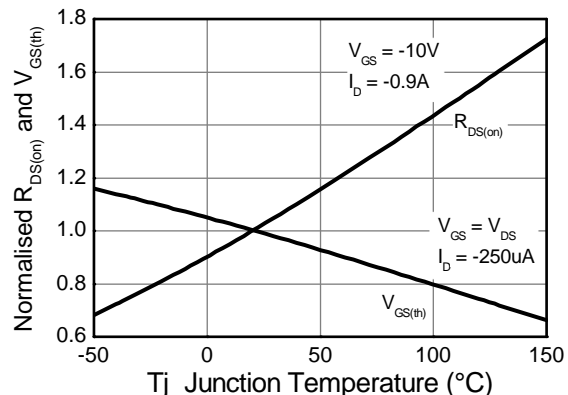
Output Characteristics



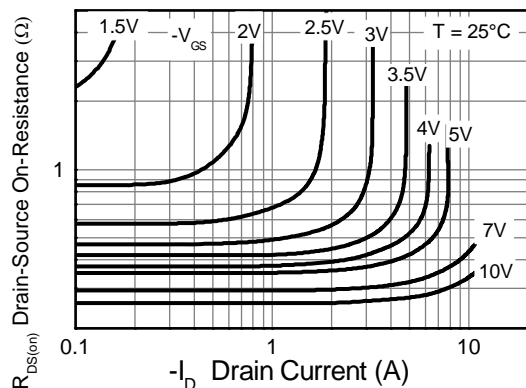
Output Characteristics



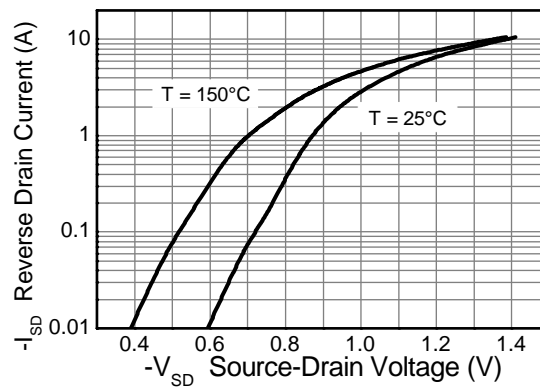
Typical Transfer Characteristics



Normalised Curves v Temperature

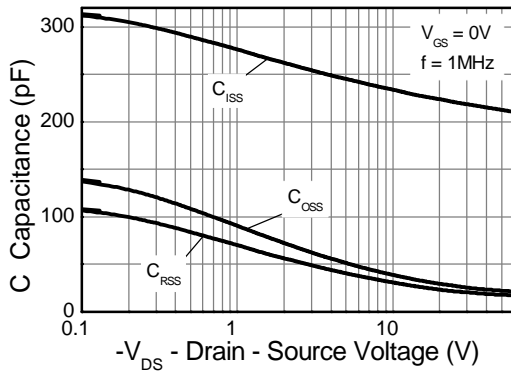


On-Resistance v Drain Current

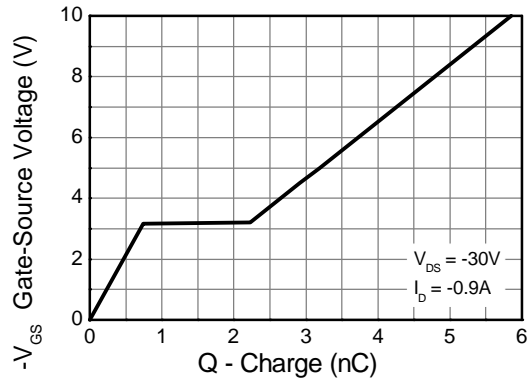


Source-Drain Diode Forward Voltage

Typical Characteristics - continued

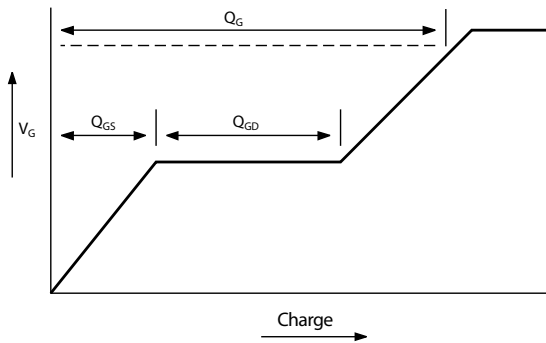


Capacitance v Drain-Source Voltage

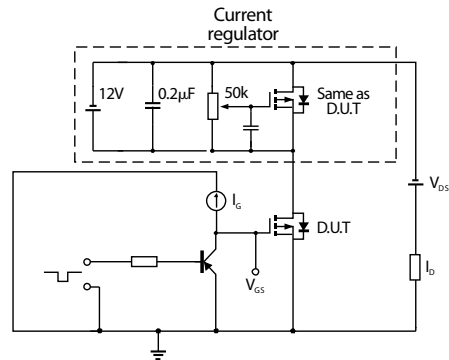


Gate-Source Voltage v Gate Charge

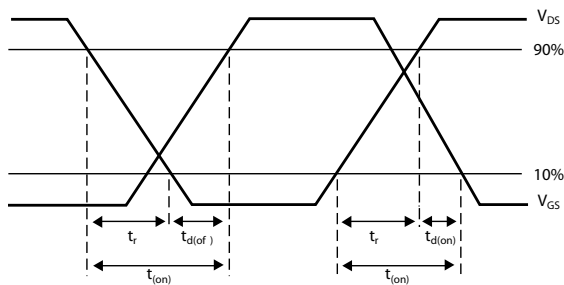
Test Circuits



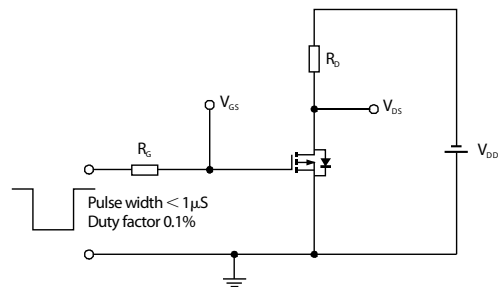
Basic gate charge waveform



Gate charge test circuit

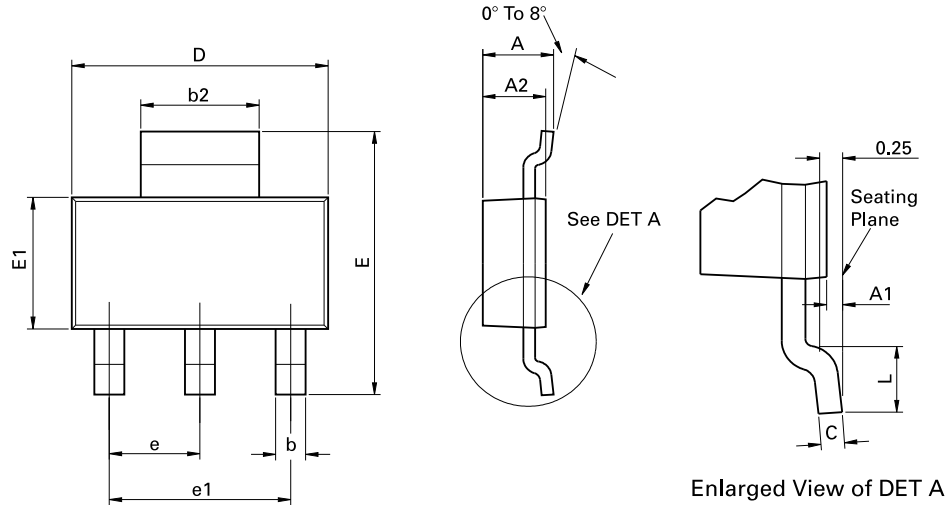


Switching time waveforms



Switching time test circuit

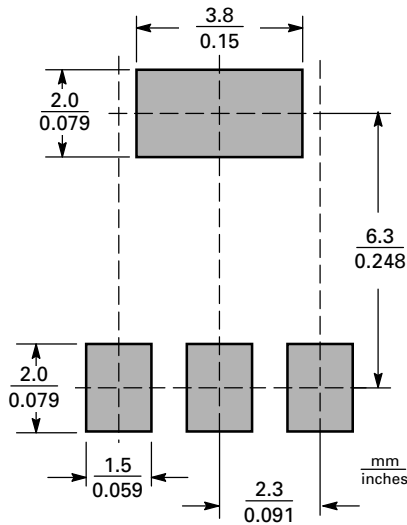
Package Outline Dimensions



Conforms to JEDEC TO-261 AA Issue B

DIM	Millimeters		Inches		DIM	Millimeters		Inches	
	Min	Max	Min	Max		Min	Max	Min	Max
A	-	1.80	-	0.071	D	6.30	6.70	0.248	0.264
A1	0.02	0.10	0.0008	0.004	e	2.30 BSC		0.0905 BSC	
A2	1.55	1.65	0.0610	0.0649	e1	4.60 BSC		0.181 BSC	
b	0.66	0.84	0.026	0.033	E	6.70	7.30	0.264	0.287
b2	2.90	3.10	0.114	0.122	E1	3.30	3.70	0.130	0.146
C	0.23	0.33	0.009	0.013	L	0.90	-	0.355	-

Suggested Pad Layout



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