

**ZXMP6A13G**

**60V P-CHANNEL ENHANCEMENT MODE MOSFET**

**Product Summary**

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

**Features and Benefits**

- Fast switching speed
- Low gate drive
- Low input capacitance
- "Lead Free", RoHS Compliant (Note 1)
- Halogen and Antimony Free. "Green" Device (Note 2)
- Qualified to AEC-Q101 Standards for High Reliability

**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

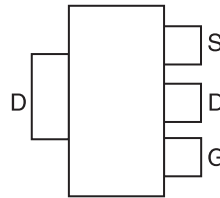
**Mechanical Data**

- 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)

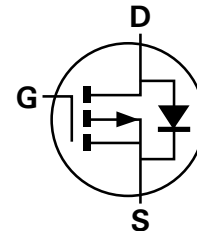
SOT223



Top View



Pin Out - Top View



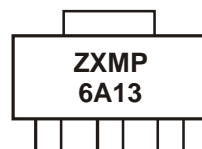
Equivalent Circuit

**Ordering Information** (Note 3)

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

- Notes:
1. No purposefully added lead
  2. Diodes Inc's "Green" policy can be found on our website at <http://www.diodes.com>.
  3. For packaging details, go to our website at <http://www.diodes.com>.

**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

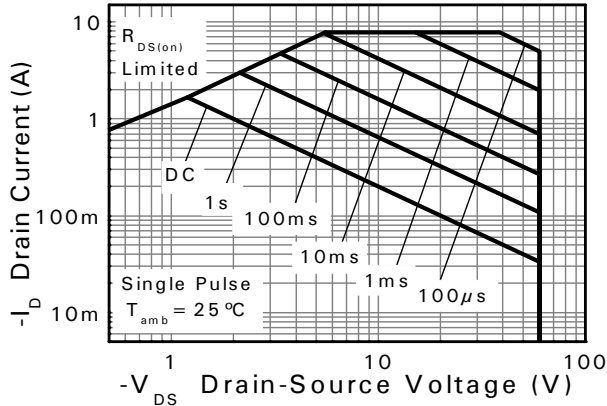
| Characteristic                         |                       |                                   | Symbol    | Value    | Unit |
|--|-----------------------|-----------------------------------|-----------|----------|------|
| Drain-Source voltage                   |                       |                                   | $V_{DSS}$ | -60      | V    |
| Gate-Source voltage                    |                       |                                   | $V_{GS}$  | $\pm 20$ | V    |
| Continuous Drain current               | $V_{GS} = 10\text{V}$ | (Note 5)                          | $I_D$     | -2.3     | A    |
|  |                       | $T_A = 70^\circ\text{C}$ (Note 5) |           | -1.9     |      |
|  |                       | (Note 4)                          |           | -1.7     |      |
| Pulsed Drain current                   | $V_{GS} = 10\text{V}$ | (Note 6)                          | $I_{DM}$  | -7.8     | A    |
| Continuous Source current (Body diode) |                       |                                   | $I_S$     | -4.1     | A    |
| Pulsed Source current (Body diode)     |                       |                                   | $I_{SM}$  | -7.8     | A    |

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

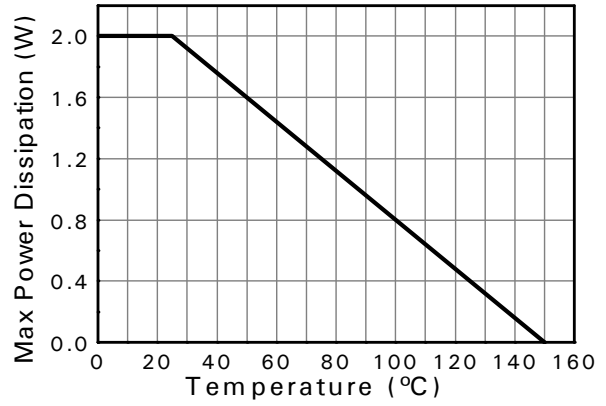
| Characteristic                              |  |          | Symbol          | Value      | Unit                      |
|---|--|----------|-----------------|------------|---------------------------|
| Power dissipation<br>Linear derating factor |  | (Note 4) | $P_D$           | 2.0        | W<br>mW/ $^\circ\text{C}$ |
|   |  |          |                 | 16         |                           |
|   |  | (Note 5) |                 | 3.9        |                           |
| Thermal Resistance, Junction to Ambient     |  | (Note 4) | $R_{\theta JA}$ | 62.5       | $^\circ\text{C/W}$        |
|   |  | (Note 5) |                 | 32.0       |                           |
| Thermal Resistance, Junction to Lead        |  | (Note 7) | $R_{\theta JL}$ | 9.8        |                           |
| Operating and storage temperature range     |  |          | $T_J, T_{STG}$  | -55 to 150 | $^\circ\text{C}$          |

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

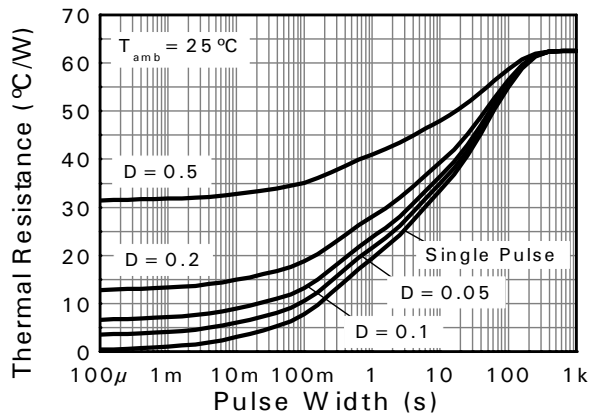
**Thermal Characteristics**



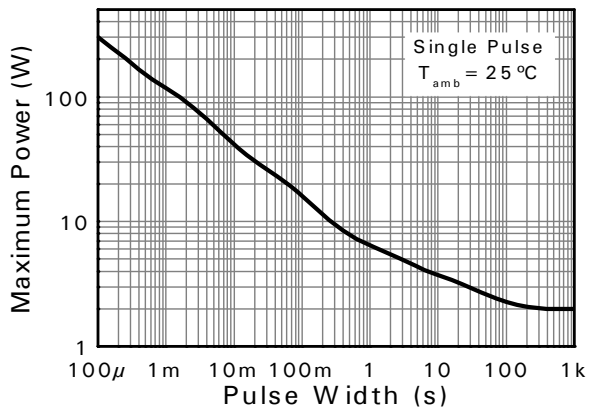
**Safe Operating Area**



**Derating Curve**



**Transient Thermal Impedance**



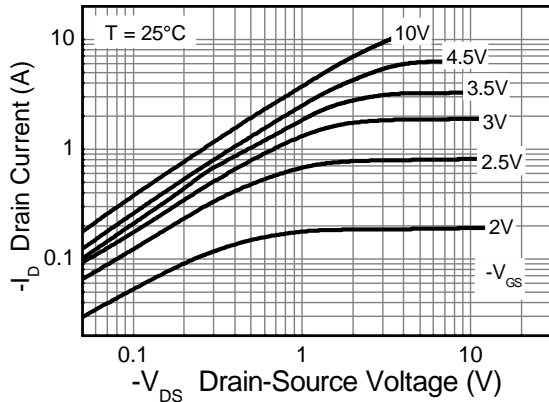
**Pulse Power Dissipation**

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

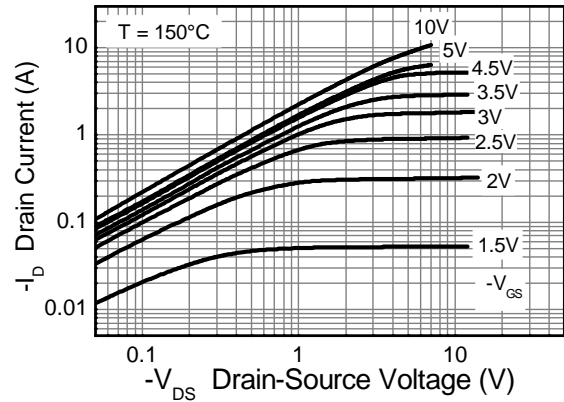
| Characteristic                             | Symbol       | Min  | Typ   | Max       | Unit          | Test Condition   |
|--|--------------|------|-------|-----------|---------------|--|
| <b>OFF CHARACTERISTICS</b>                 |              |      |       |           |               |  |
| Drain-Source 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      | $\mu\text{A}$ | $V_{DS} = -60\text{V}, V_{GS} = 0\text{V}$   |
| Gate-Source Leakage                        | $I_{GSS}$    | —    | —     | $\pm 100$ | nA            | $V_{GS} = \pm 20\text{V}, V_{DS} = 0\text{V}$  |
| <b>ON CHARACTERISTICS</b>                  |              |      |       |           |               |  |
| Gate Threshold Voltage                     | $V_{GS(th)}$ | -1.0 | —     | -3.0      | V             | $I_D = -250\mu\text{A}, V_{DS} = V_{GS}$   |
| Static Drain-Source On-Resistance (Note 8) | $R_{DS(on)}$ | —    | —     | 0.390     | $\Omega$      | $V_{GS} = -10\text{V}, I_D = -0.9\text{A}$   |
|  |              |      |       | 0.595     |               | $V_{GS} = -4.5\text{V}, I_D = -0.8\text{A}$  |
| Forward Transconductance (Notes 8 & 9)     | $g_{fs}$     | —    | 1.8   | —         | S             | $V_{DS} = -15\text{V}, I_D = -0.9\text{A}$   |
| Diode Forward Voltage (Note 8)             | $V_{SD}$     | —    | -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 9)             | $t_{rr}$     | —    | 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 9)           | $Q_{rr}$     | —    | 19.3  | —         | nC            | $T_J = 25^\circ\text{C}$   |
| <b>DYNAMIC CHARACTERISTICS (Note 9)</b>    |              |      |       |           |               |  |
| Input Capacitance                          | $C_{iss}$    | —    | 219   | —         | pF            | $V_{DS} = -30\text{V}, V_{GS} = 0\text{V}$<br>$f = 1\text{MHz}$                          |
| Output Capacitance                         | $C_{oss}$    | —    | 25.7  | —         | pF            |  |
| Reverse Transfer Capacitance               | $C_{rss}$    | —    | 20.5  | —         | pF            |  |
| Total Gate Charge (Note 10)                | $Q_g$        | —    | 2.9   | —         | nC            | $V_{GS} = -4.5\text{V}$  |
| Total Gate Charge (Note 10)                | $Q_g$        | —    | 5.9   | —         | nC            | $V_{GS} = -10\text{V}$<br>$V_{DS} = -30\text{V}$<br>$I_D = -0.9\text{A}$                 |
| Gate-Source Charge (Note 10)               | $Q_{gs}$     | —    | 0.74  | —         | nC            |  |
| Gate-Drain Charge (Note 10)                | $Q_{gd}$     | —    | 1.5   | —         | nC            |  |
| Turn-On Delay Time (Note 10)               | $t_{D(on)}$  | —    | 1.6   | —         | ns            | $V_{DD} = -30\text{V}, V_{GS} = -10\text{V}$<br>$I_D = -1\text{A}, R_G \equiv 6.0\Omega$ |
| Turn-On Rise Time (Note 10)                | $t_r$        | —    | 2.2   | —         | ns            |  |
| Turn-Off Delay Time (Note 10)              | $t_{D(off)}$ | —    | 11.2  | —         | ns            |  |
| Turn-Off Fall Time (Note 10)               | $t_f$        | —    | 5.7   | —         | ns            |  |

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

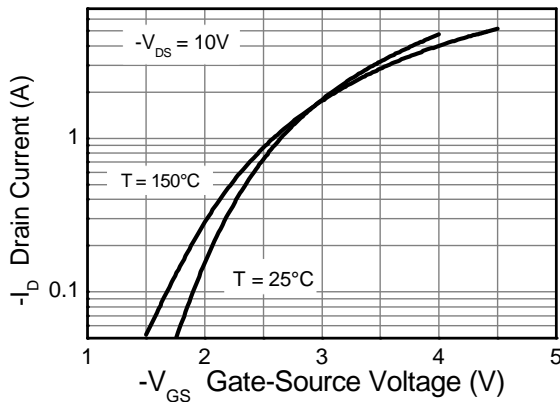
**Typical Characteristics**



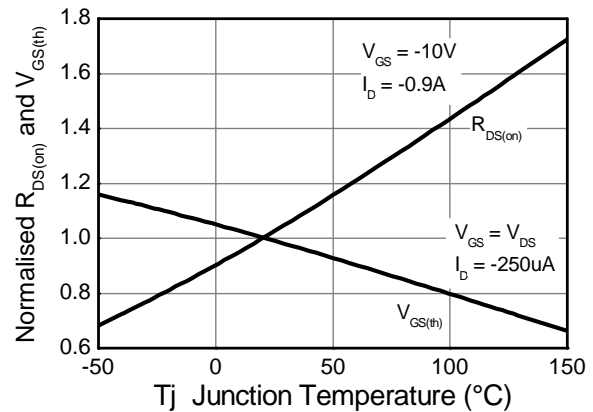
**Output Characteristics**



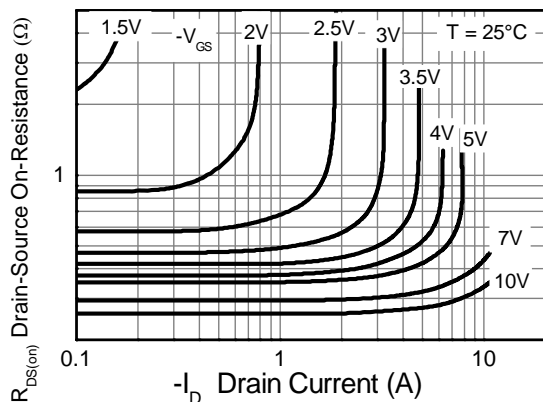
**Output Characteristics**



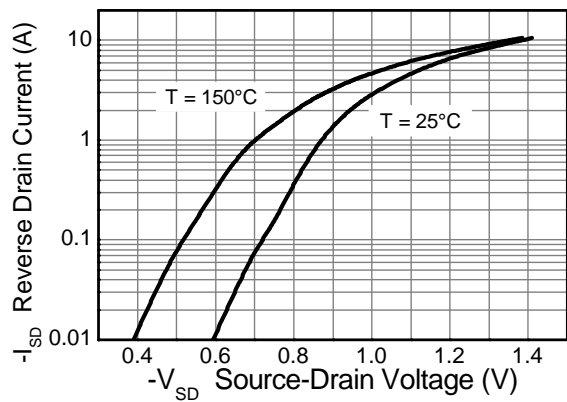
**Typical Transfer Characteristics**



**Normalised Curves v Temperature**

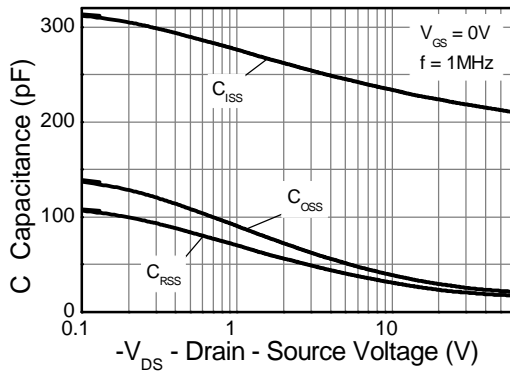


**On-Resistance v Drain Current**

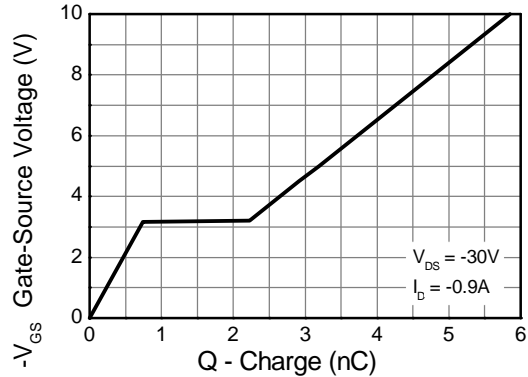


**Source-Drain Diode Forward Voltage**

**Typical Characteristics - continued**

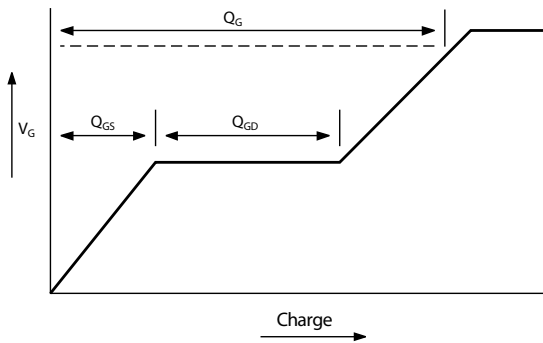


**Capacitance v Drain-Source Voltage**

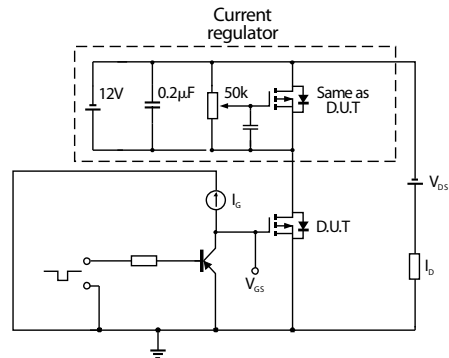


**Gate-Source Voltage v Gate Charge**

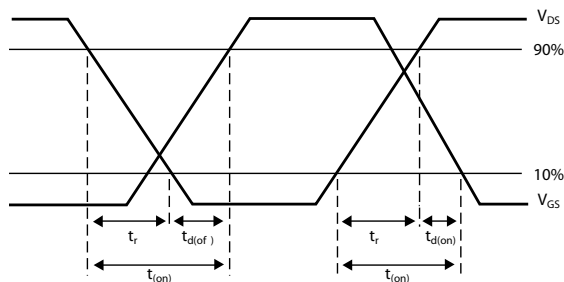
**Test Circuits**



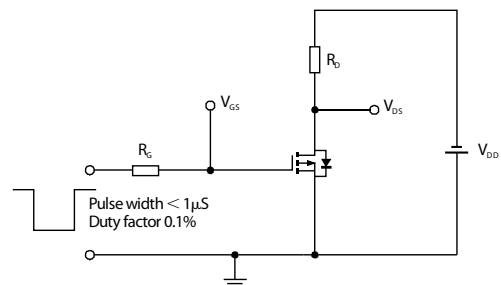
**Basic gate charge waveform**



**Gate charge test circuit**

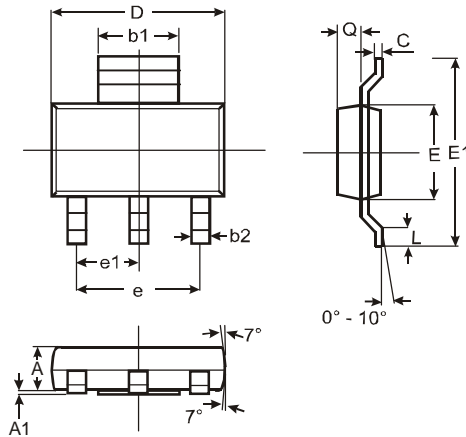


**Switching time waveforms**



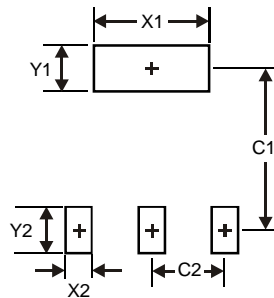
**Switching time test circuit**

**Package Outline Dimensions**



| SOT223               |       |      |      |
|----------------------|-------|------|------|
| Dim                  | Min   | Max  | Typ  |
| A                    | 1.55  | 1.65 | 1.60 |
| A1                   | 0.010 | 0.15 | 0.05 |
| b1                   | 2.90  | 3.10 | 3.00 |
| b2                   | 0.60  | 0.80 | 0.70 |
| 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**



| Dimensions | Value (in mm) |
|------------|---------------|
| X1         | 3.3           |
| X2         | 1.2           |
| Y1         | 1.6           |
| Y2         | 1.6           |
| C1         | 6.4           |
| C2         | 2.3           |

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