

**60V N-CHANNEL ENHANCEMENT MODE MOSFET IN SOT89 PACKAGE**

**Product Summary**

| $V_{(BR)DSS}$ | $R_{DS(on)}$ Max                | $I_D$ max<br>$T_A = 25^\circ C$<br>(Note 5) |
|---------------|---------------------------------|---|
| 60V           | 120m $\Omega$ @ $V_{GS} = 10V$  | 3.6A  |
|               | 180m $\Omega$ @ $V_{GS} = 4.5V$ | 2.9A  |

**Features and Benefits**

- Low On-Resistance
- Low Threshold
- Fast Switching Speed
- Low Gate Drive
- **Lead Free/RoHS Compliant (Note 1)**
- **"Green" Device (Note 2)**
- **Qualified to AEC-Q101 Standards for High Reliability**

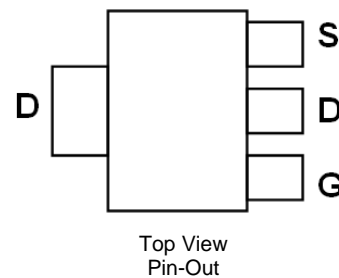
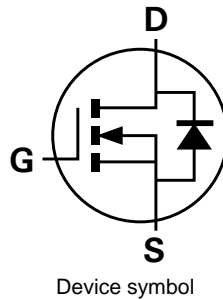
**Description and Applications**

This MOSFET has been designed to minimize the on-state resistance ( $R_{DS(on)}$ ) and yet maintain superior switching performance, making it ideal for high efficiency power management applications.

- DC-DC Converters
- Power Management functions
- Motor control
- Disconnect switches

**Mechanical Data**

- Case: SOT89
- 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
- Weight: 0.052 grams (approximate)

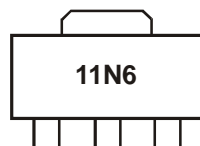


**Ordering Information** (Note 3)

| Product     | Marking | Reel size (inches) | Tape width (mm) | Quantity per reel |
|-------------|---------|--------------------|-----------------|-------------------|
| ZXMN6A11ZTA | 11N6    | 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**



11N6 = Product type Marking Code

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

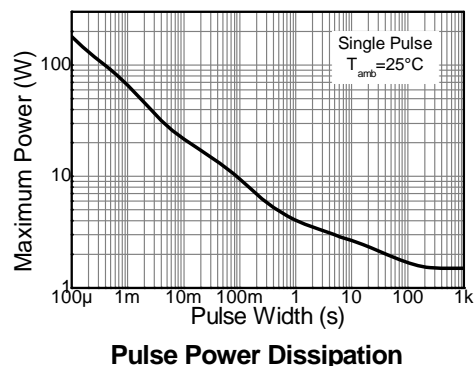
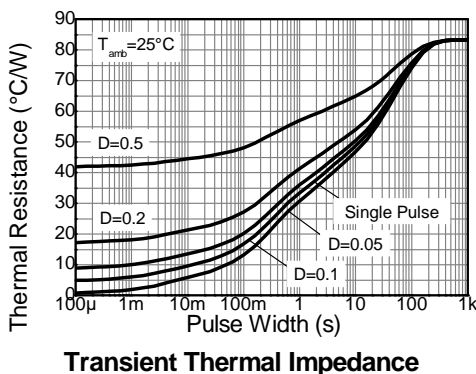
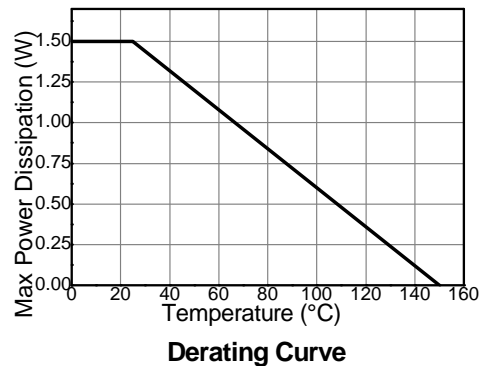
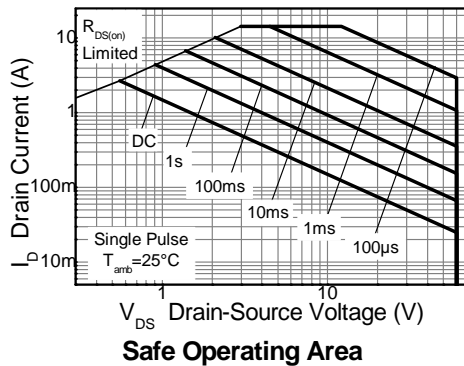
| Characteristic                                  |              | Symbol   | Value | Unit |
|---|--------------|--|-------|------|
| Drain-Source Voltage                            |              | V <sub>DS</sub>  | 60    | V    |
| Gate-Source Voltage                             |              | V <sub>GSS</sub>   | ±20   | V    |
| Continuous Drain Current                        | Steady State | @ V <sub>GS</sub> = 10V ; T <sub>A</sub> = 25°C (Note 5) | 3.6   | A    |
|   |              | @ V <sub>GS</sub> = 10V ; T <sub>A</sub> = 75°C (Note 5) | 2.9   |      |
|   |              | @ V <sub>GS</sub> = 10V ; T <sub>A</sub> = 25°C (Note 4) | 2.7   |      |
| Pulsed Drain Current (Note 6)                   |              | I <sub>DM</sub>  | 14.5  | A    |
| Continuous Source Current (Body Diode) (Note 5) |              | I <sub>S</sub>   | 3.7   | A    |
| Pulsed Source Current (Body Diode) (Note 6)     |              | I <sub>SM</sub>  | 14.5  | A    |

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

| Characteristic                                   |  | Symbol                            | Value       | Unit  |
|--|--|-----------------------------------|-------------|-------|
| Power Dissipation (Note 4)                       |  | P <sub>D</sub>                    | 1.5         | W     |
| Linear Derating Factor                           |  |                                   | 12          | mW/°C |
| Power Dissipation (Note 5)                       |  | P <sub>D</sub>                    | 2.6         | W     |
| Linear Derating Factor                           |  |                                   | 21          | mW/°C |
| Thermal Resistance, Junction to Ambient (Note 4) |  | R <sub>θJA</sub>                  | 83.3        | °C/W  |
| Thermal Resistance, Junction to Ambient (Note 5) |  | R <sub>θJA</sub>                  | 47.4        | °C/W  |
| Operating and Storage Temperature Range          |  | T <sub>J</sub> , T <sub>STG</sub> | -55 to +150 | °C    |

- Notes:
4. For a device surface mounted on 25mm x 25mm FR4 PCB with high coverage of single sided 1oz copper, in still air conditions.
  5. For a device surface mounted on FR4 PCB measured at t ≤ 10 sec.
  6. Repetitive rating - 25mm x 25mm FR4 PCB, D = 0.02, pulse width 300µs – pulse width limited by maximum junction temperature.

**Thermal Characteristics**

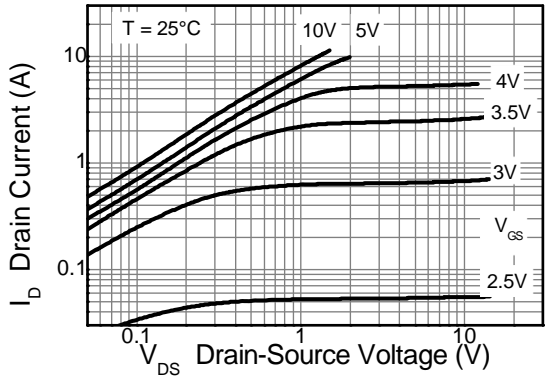


**Electrical Characteristics** @T<sub>A</sub> = 25°C unless otherwise specified

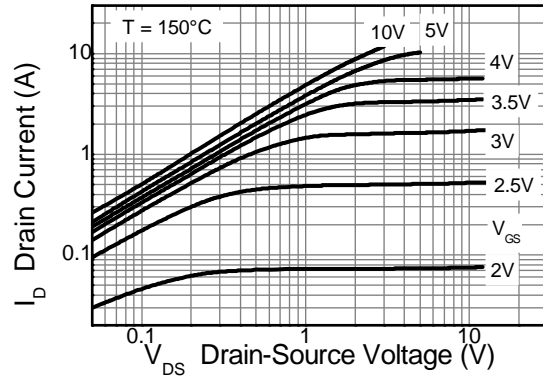
| Characteristic  | Symbol              | Min | Typ  | Max  | Unit | Test Condition  |
|---|---------------------|-----|------|------|------|---|
| <b>OFF CHARACTERISTICS</b>                            |                     |     |      |      |      |   |
| Drain-Source Breakdown Voltage                        | BV <sub>DSS</sub>   | 60  | -    | -    | V    | V <sub>GS</sub> = 0V, I <sub>D</sub> = 250μA  |
| Zero Gate Voltage Drain Current T <sub>J</sub> = 25°C | I <sub>DSS</sub>    | -   | -    | 1.0  | 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   | -    | 2.2  | V    | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250μA                                  |
| Static Drain-Source On-Resistance (Note 7)            | R <sub>DS(on)</sub> | -   | -    | 120  | mΩ   | V <sub>GS</sub> = 10V, I <sub>D</sub> = 2.5A  |
|   |                     |     | -    | 180  |      | V <sub>GS</sub> = 4.5V, I <sub>D</sub> = 2A   |
| Forward Transconductance (Note 7 & 9)                 | g <sub>FS</sub>     | -   | 4.9  | -    | S    | V <sub>DS</sub> = 15V, I <sub>D</sub> = 2.5A  |
| Diodes Forward Voltage (Note 7)                       | V <sub>SD</sub>     | -   | 0.85 | 0.95 | V    | T <sub>J</sub> = 25°C, I <sub>S</sub> = 2.8A, V <sub>GS</sub> = 10V                         |
| <b>DYNAMIC CHARACTERISTICS</b>                        |                     |     |      |      |      |   |
| Input Capacitance (Note 8 & 9)                        | C <sub>iss</sub>    | -   | 330  | -    | pF   | V <sub>DS</sub> = 40V, V <sub>GS</sub> = 0V,<br>f = 1.0MHz                                  |
| Output Capacitance (Note 8 & 9)                       | C <sub>oss</sub>    | -   | 35.2 | -    | pF   |   |
| Reverse Transfer Capacitance (Note 8 & 9)             | C <sub>rss</sub>    | -   | 17.1 | -    | pF   |   |
| Gate Charge (Note 8 & 9)                              | Q <sub>g</sub>      | -   | 3    | -    | nC   | V <sub>GS</sub> = 5V, V <sub>DS</sub> = 15V, I <sub>D</sub> = 2.5A                          |
| Total Gate Charge (Note 8 & 9)                        | Q <sub>g</sub>      | -   | 5.7  | -    | nC   | V <sub>GS</sub> = 10V, V <sub>DS</sub> = 15V,<br>I <sub>D</sub> = 2.5A                      |
| Gate-Source Charge (Note 8 & 9)                       | Q <sub>gs</sub>     | -   | 1.25 | -    | nC   |   |
| Gate-Drain Charge (Note 8 & 9)                        | Q <sub>gd</sub>     | -   | 0.86 | -    | nC   |   |
| Reverse Recovery Time (Note 9)                        | t <sub>rr</sub>     |     | 21.5 |      | ns   | T <sub>J</sub> = 25°C, I <sub>S</sub> = 2.5A,   |
| Reverse Recovery Charge (Note 9)                      | Q <sub>rr</sub>     |     | 20.5 |      | nC   | di/dt = 100A/μs   |
| Turn-On Delay Time (Note 8 & 9)                       | t <sub>D(on)</sub>  | -   | 1.95 | -    | ns   | V <sub>GS</sub> = 10V, V <sub>DD</sub> = 30V,<br>R <sub>G</sub> = 6Ω, I <sub>D</sub> = 2.5A |
| Turn-On Rise Time (Note 8 & 9)                        | t <sub>r</sub>      | -   | 3.5  | -    | ns   |   |
| Turn-Off Delay Time (Note 8 & 9)                      | t <sub>D(off)</sub> | -   | 8.2  | -    | ns   |   |
| Turn-Off Fall Time (Note 8 & 9)                       | t <sub>f</sub>      | -   | 4.6  | -    | ns   |   |

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

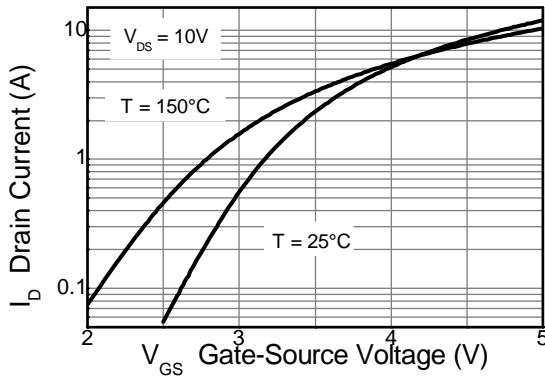
**Typical Characteristics**



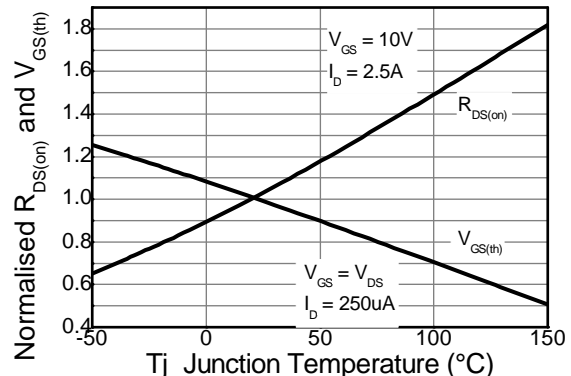
**Output Characteristics**



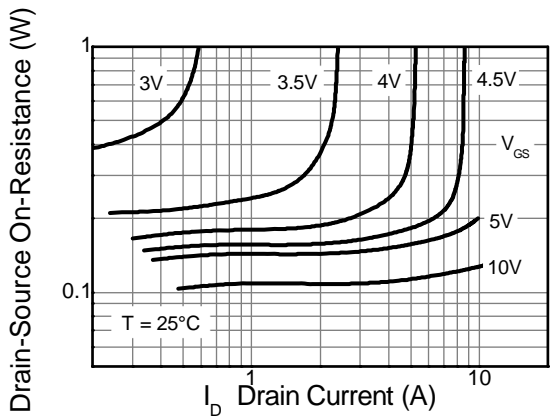
**Output Characteristics**



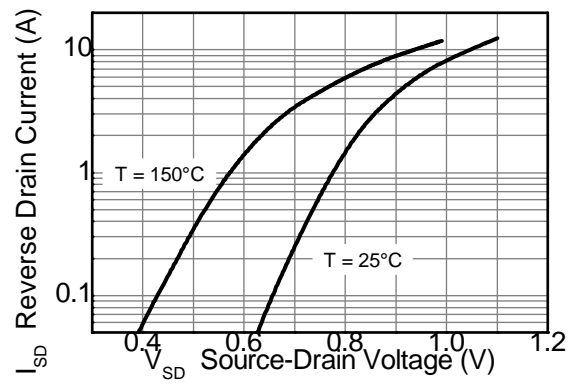
**Typical Transfer Characteristics**



**Normalised Curves v Temperature**

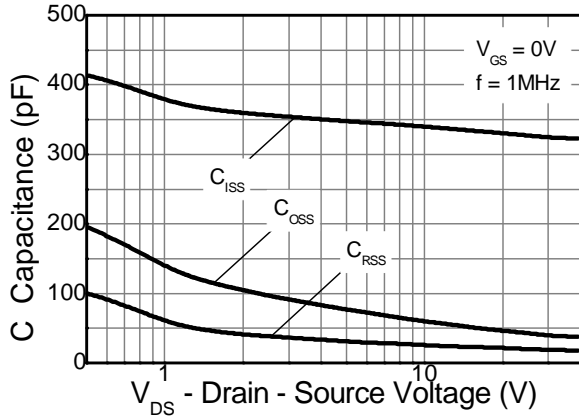


**On-Resistance v Drain Current**

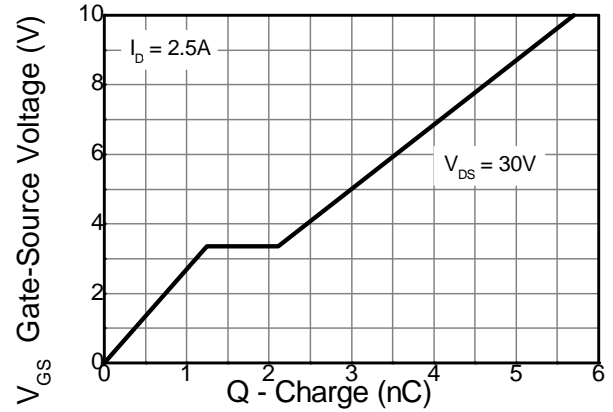


**Source-Drain Diode Forward Voltage**

**Typical Characteristics - Continued**

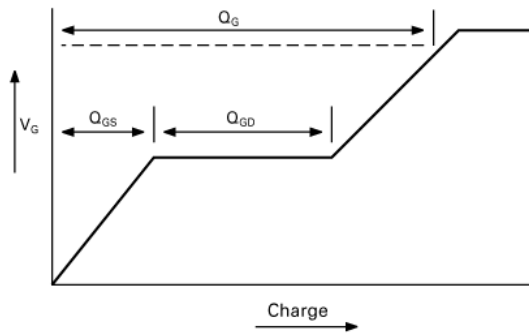


**Capacitance v Drain-Source Voltage**

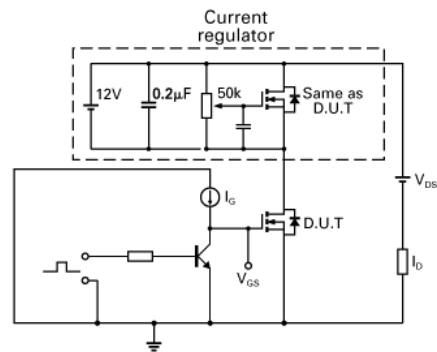


**Gate-Source Voltage v Gate Charge**

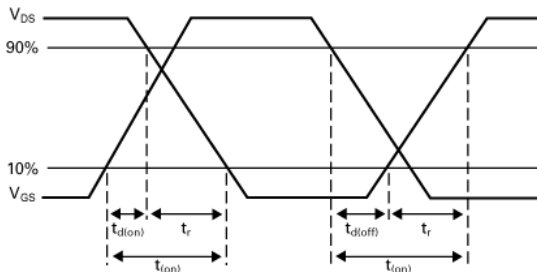
**Test Circuits**



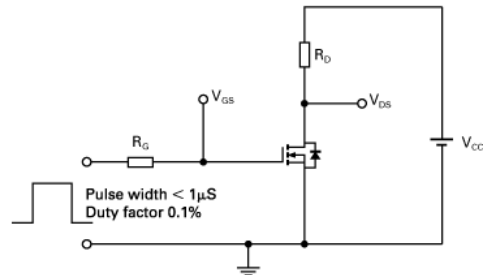
**Basic gate charge waveform**



**Gate charge test circuit**

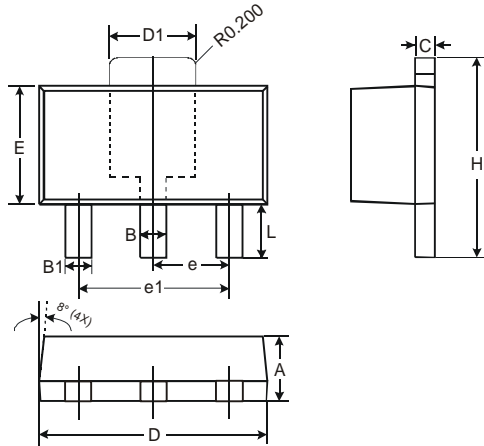


**Switching time waveforms**



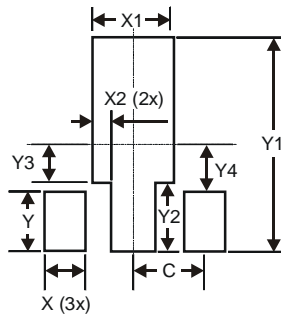
**Switching time test circuit**

**Package Outline Dimensions**



| SOT89                |          |      |
|----------------------|----------|------|
| Dim                  | Min      | Max  |
| A                    | 1.40     | 1.60 |
| B                    | 0.44     | 0.62 |
| B1                   | 0.35     | 0.54 |
| C                    | 0.35     | 0.43 |
| D                    | 4.40     | 4.60 |
| D1                   | 1.52     | 1.83 |
| E                    | 2.29     | 2.60 |
| e                    | 1.50 Typ |      |
| e1                   | 3.00 Typ |      |
| H                    | 3.94     | 4.25 |
| L                    | 0.89     | 1.20 |
| All Dimensions in mm |          |      |

**Suggested Pad Layout**



| Dimensions | Value (in mm) |
|------------|---------------|
| X          | 0.900         |
| X1         | 1.733         |
| X2         | 0.416         |
| Y          | 1.300         |
| Y1         | 4.600         |
| Y2         | 1.475         |
| Y3         | 0.950         |
| Y4         | 1.125         |
| C          | 1.500         |

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