

## Power MOSFET

### PRODUCT SUMMARY

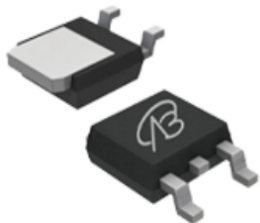
|                           |                        |   |
|---------------------------|------------------------|---|
| $V_{DS}$ (V)              | 1000                   |   |
| $R_{DS(on)}$ ( $\Omega$ ) | $V_{GS} = 10\text{ V}$ | 6 |
| $Q_g$ (Max.) (nC)         | 130                    |   |
| $Q_{gs}$ (nC)             | 24                     |   |
| $Q_{gd}$ (nC)             | 100                    |   |
| Configuration             | Single                 |   |

### FEATURES

- Dynamic  $dV/dt$  Rating
- Repetitive Avalanche Rated
- Isolated Central Mounting Hole
- Fast Switching
- Ease of Paralleling
- Simple Drive Requirements
- Compliant to RoHS Directive 2002/95/EC


 Available  
**RoHS\***  
 COMPLIANT

TO-252



Top View



N-Channel MOSFET

### ABSOLUTE MAXIMUM RATINGS ( $T_C = 25\text{ }^\circ\text{C}$ , unless otherwise noted)

| PARAMETER                                        |                         |                         | SYMBOL                            | LIMIT            | UNIT     |
|--------------------------------------------------|-------------------------|-------------------------|-----------------------------------|------------------|----------|
| Drain-Source Voltage                             |                         |                         | V <sub>DS</sub>                   | 1000             | V        |
| Gate-Source Voltage                              |                         |                         | V <sub>GS</sub>                   | ± 30             |          |
| Continuous Drain Current                         | V <sub>GS</sub> at 10 V | T <sub>C</sub> = 25 °C  | I <sub>D</sub>                    | 2                | A        |
|                                                  |                         | T <sub>C</sub> = 100 °C |                                   | 1.6              |          |
| Pulsed Drain Current <sup>a</sup>                |                         |                         | I <sub>DM</sub>                   | 6                |          |
| Linear Derating Factor                           |                         |                         |                                   | 1.5              | W/°C     |
| Single Pulse Avalanche Energy <sup>b</sup>       |                         |                         | E <sub>AS</sub>                   | 600              | mJ       |
| Repetitive Avalanche Current <sup>a</sup>        |                         |                         | I <sub>AR</sub>                   | 6.0              | A        |
| Repetitive Avalanche Energy <sup>a</sup>         |                         |                         | E <sub>AR</sub>                   | 16               | mJ       |
| Maximum Power Dissipation                        | T <sub>C</sub> = 25 °C  |                         | P <sub>D</sub>                    | 170              | W        |
| Peak Diode Recovery dV/dt <sup>c</sup>           |                         |                         | dV/dt                             | 1.0              | V/ns     |
| Operating Junction and Storage Temperature Range |                         |                         | T <sub>J</sub> , T <sub>stg</sub> | - 55 to + 150    | °C       |
| Soldering Recommendations (Peak Temperature)     | for 10 s                |                         |                                   | 300 <sup>d</sup> |          |
| Mounting Torque                                  | 6-32 or M3 screw        |                         |                                   | 10               | lbf · in |
|                                                  |                         |                         |                                   | 1.1              | N · m    |

#### Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- $V_{DD} = 50\text{ V}$ , starting  $T_J = 25\text{ }^\circ\text{C}$ ,  $L = 40\text{ mH}$ ,  $R_g = 25\text{ }\Omega$ ,  $I_{AS} = 6.1\text{ A}$  (see fig. 12).
- $I_{SD} \leq 6.1\text{ A}$ ,  $dI/dt \leq 120\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq 600$ ,  $T_J \leq 150\text{ }^\circ\text{C}$ .
- 1.6 mm from case.

**THERMAL RESISTANCE RATINGS**

| PARAMETER                           | SYMBOL     | TYP. | MAX. | UNIT |
|-------------------------------------|------------|------|------|------|
| Maximum Junction-to-Ambient         | $R_{thJA}$ | -    | 40   | °C/W |
| Case-to-Sink, Flat, Greased Surface | $R_{thCS}$ | 0.24 | -    |      |
| Maximum Junction-to-Case (Drain)    | $R_{thJC}$ | -    | 0.65 |      |

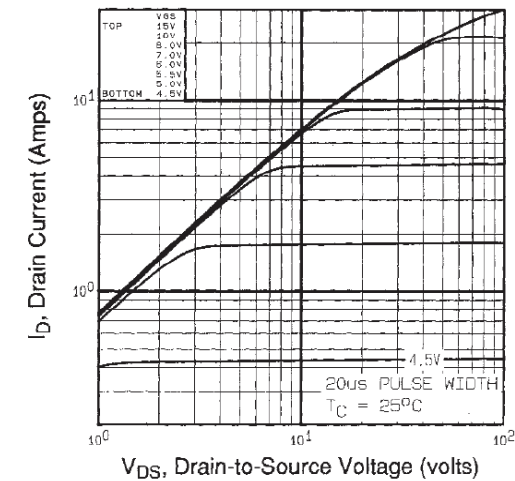
**SPECIFICATIONS** ( $T_J = 25\text{ }^{\circ}\text{C}$ , unless otherwise noted)

| PARAMETER                                 | SYMBOL                           | TEST CONDITIONS                                                                                                           |                                                                                  | MIN. | TYP. | MAX.  | UNIT |
|-------------------------------------------|----------------------------------|---------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|------|------|-------|------|
| Static                                    |                                  |                                                                                                                           |                                                                                  |      |      |       |      |
| Drain-Source Breakdown Voltage            | V <sub>DS</sub>                  | V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA                                                                            |                                                                                  | 1000 | -    | -     | V    |
| V <sub>DS</sub> Temperature Coefficient   | ΔV <sub>DS</sub> /T <sub>J</sub> | Reference to 25 °C, I <sub>D</sub> = 1 mA                                                                                 |                                                                                  | -    | 1.2  | -     | V/°C |
| Gate-Source Threshold Voltage             | V <sub>GS(th)</sub>              | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA                                                               |                                                                                  | 3.0  | -    | 4.0   | V    |
| Gate-Source Leakage                       | I <sub>GSS</sub>                 | V <sub>GS</sub> = ± 30 V                                                                                                  |                                                                                  | -    | -    | ± 100 | nA   |
| Zero Gate Voltage Drain Current           | I <sub>DSS</sub>                 | V <sub>DS</sub> = 880 V, V <sub>GS</sub> = 0 V                                                                            |                                                                                  | -    | -    | 100   | μA   |
|                                           |                                  | V <sub>DS</sub> = 880 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 125 °C                                                   |                                                                                  | -    | -    | 500   |      |
| Drain-Source On-State Resistance          | R <sub>DS(on)</sub>              | V <sub>GS</sub> = 10 V                                                                                                    | I <sub>D</sub> = 2 A <sup>b</sup>                                                | -    | 6    | -     | Ω    |
| Forward Transconductance                  | g <sub>fs</sub>                  | V <sub>DS</sub> = 100 V, I <sub>D</sub> = 2A <sup>b</sup>                                                                 |                                                                                  | 5.4  | -    | -     | S    |
| Dynamic                                   |                                  |                                                                                                                           |                                                                                  |      |      |       |      |
| Input Capacitance                         | C <sub>iss</sub>                 | V <sub>GS</sub> = 0 V,<br>V <sub>DS</sub> = 25 V,<br>f = 1.0 MHz, see fig. 5                                              |                                                                                  | -    | 400  | -     | pF   |
| Output Capacitance                        | C <sub>oss</sub>                 |                                                                                                                           |                                                                                  | -    | 250  | -     |      |
| Reverse Transfer Capacitance              | C <sub>rss</sub>                 |                                                                                                                           |                                                                                  | -    | 84   | -     |      |
| Total Gate Charge                         | Q <sub>g</sub>                   | V <sub>GS</sub> = 10 V                                                                                                    | I <sub>D</sub> = 2 A, V <sub>DS</sub> = 400 V,<br>see fig. 6 and 13 <sup>b</sup> | -    | -    | 130   | nC   |
| Gate-Source Charge                        | Q <sub>gs</sub>                  |                                                                                                                           |                                                                                  | -    | -    | 24    |      |
| Gate-Drain Charge                         | Q <sub>gd</sub>                  |                                                                                                                           |                                                                                  | -    | -    | 100   |      |
| Turn-On Delay Time                        | t <sub>d(on)</sub>               | V <sub>DD</sub> = 500 V, I <sub>D</sub> = 2 A,<br>R <sub>g</sub> = 6.2 Ω, R <sub>D</sub> = 81 Ω, see fig. 10 <sup>b</sup> |                                                                                  | -    | 19   | -     | ns   |
| Rise Time                                 | t <sub>r</sub>                   |                                                                                                                           |                                                                                  | -    | 35   | -     |      |
| Turn-Off Delay Time                       | t <sub>d(off)</sub>              |                                                                                                                           |                                                                                  | -    | 60   | -     |      |
| Fall Time                                 | t <sub>f</sub>                   |                                                                                                                           |                                                                                  | -    | 36   | -     |      |
| Internal Drain Inductance                 | L <sub>D</sub>                   | Between lead,<br>6 mm (0.25") from<br>package and center of<br>die contact                                                |                                                                                  | -    | 5.0  | -     | nH   |
| Internal Source Inductance                | L <sub>S</sub>                   |                                                                                                                           |                                                                                  | -    | 13   | -     |      |
| Drain-Source Body Diode Characteristics   |                                  |                                                                                                                           |                                                                                  |      |      |       |      |
| Continuous Source-Drain Diode Current     | I <sub>S</sub>                   | MOSFET symbol<br>showing the<br>integral reverse<br>p - n junction diode                                                  |                                                                                  | -    | -    | 2     | A    |
| Pulsed Diode Forward Current <sup>a</sup> | I <sub>SM</sub>                  |                                                                                                                           |                                                                                  | -    | -    | 6     |      |
| Body Diode Voltage                        | V <sub>SD</sub>                  | T <sub>J</sub> = 25 °C, I <sub>S</sub> = 2 A, V <sub>GS</sub> = 0 V <sup>b</sup>                                          |                                                                                  | -    | -    | 1.8   | V    |
| Body Diode Reverse Recovery Time          | t <sub>rr</sub>                  | T <sub>J</sub> = 25 °C, I <sub>F</sub> = 2 A, dI/dt = 100 A/μs <sup>b</sup>                                               |                                                                                  | -    | 4    | -     | ns   |
| Body Diode Reverse Recovery Charge        | Q <sub>rr</sub>                  |                                                                                                                           |                                                                                  | -    | 3.5  | 5.3   | μC   |
| Forward Turn-On Time                      | t <sub>on</sub>                  | Intrinsic turn-on time is negligible (turn-on is dominated by L <sub>S</sub> and L <sub>D</sub> )                         |                                                                                  |      |      |       |      |

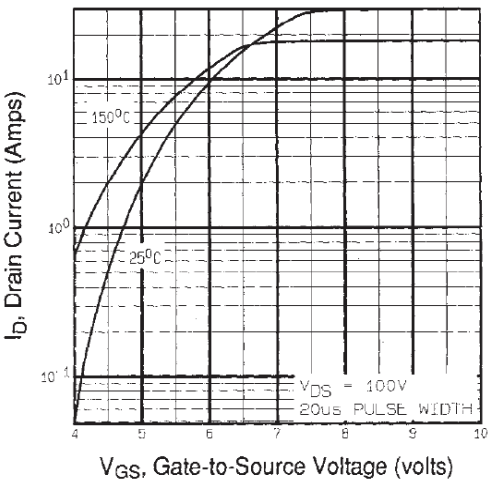
**Notes**

- a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).  
 b. Pulse width  $\leq 300\text{ }\mu\text{s}$ ; duty cycle  $\leq 2\%$ .

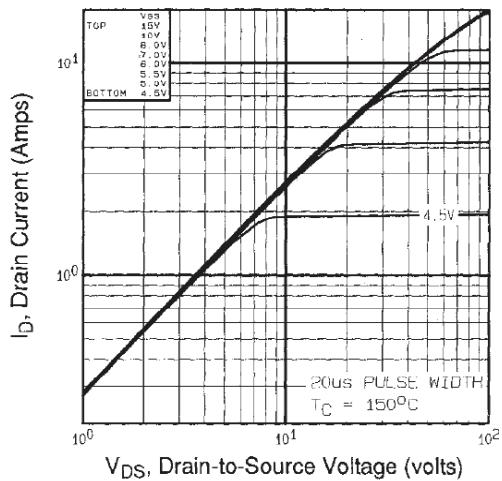
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



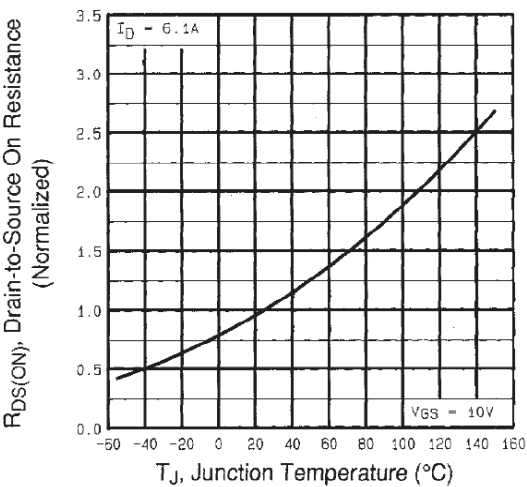
**Fig. 1 - Typical Output Characteristics,  $T_C = 25\text{ }^{\circ}\text{C}$**



**Fig. 3 - Typical Transfer Characteristics**



**Fig. 2 - Typical Output Characteristics,  $T_C = 150\text{ }^{\circ}\text{C}$**



**Fig. 4 - Normalized On-Resistance vs. Temperature**

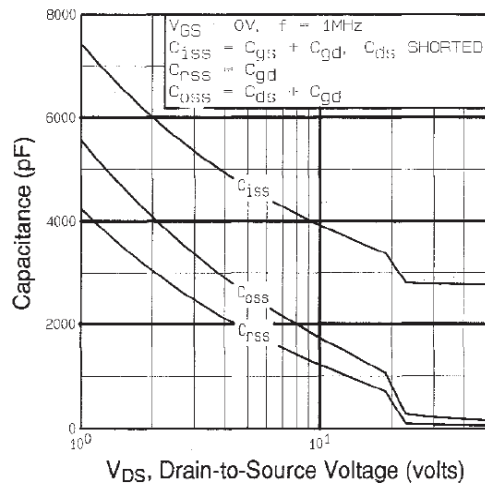


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

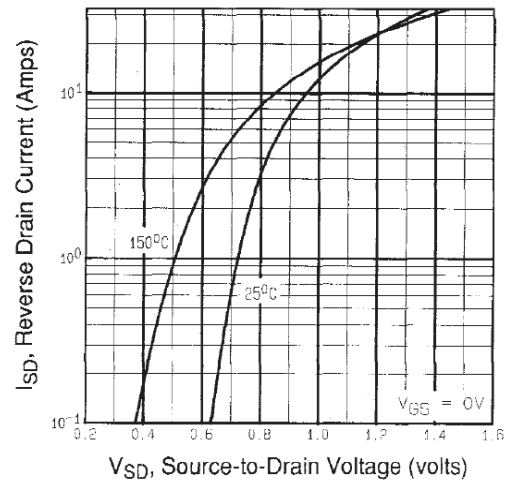


Fig. 7 - Typical Source-Drain Diode Forward Voltage

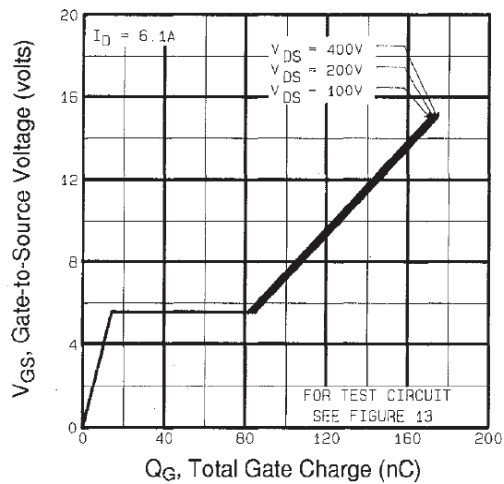


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

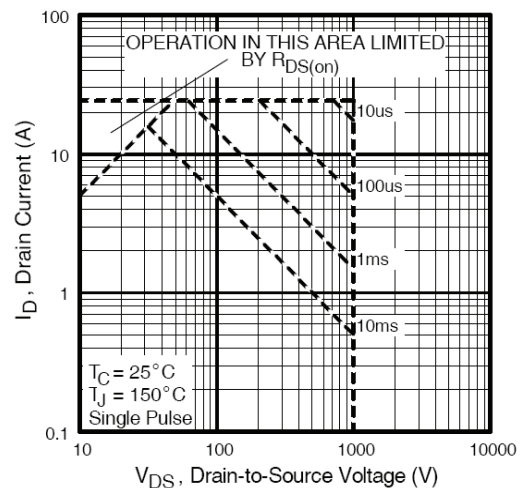


Fig. 8 - Maximum Safe Operating Area

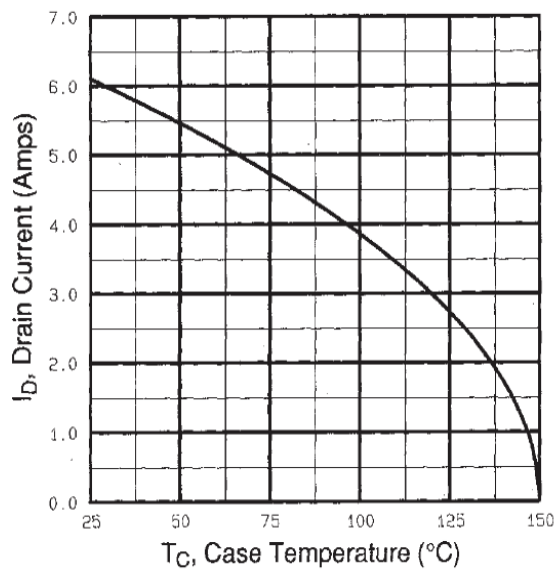


Fig. 9 - Maximum Drain Current vs. Case Temperature

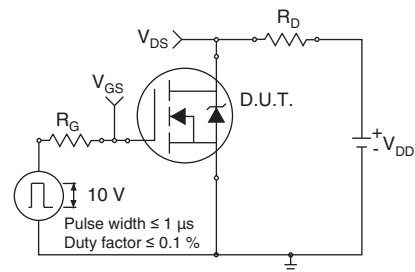


Fig. 10a - Switching Time Test Circuit

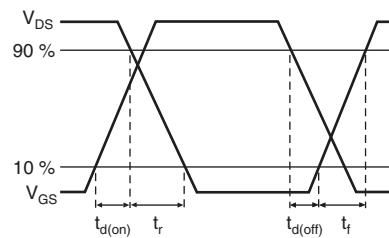


Fig. 10b - Switching Time Waveforms

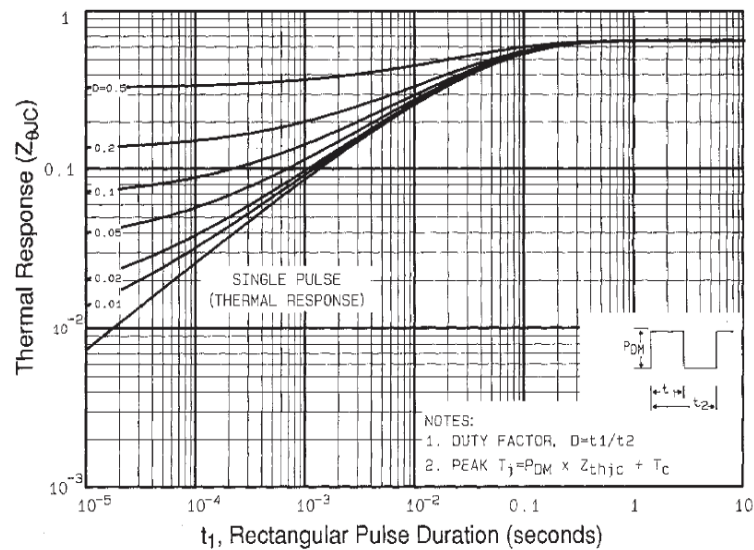
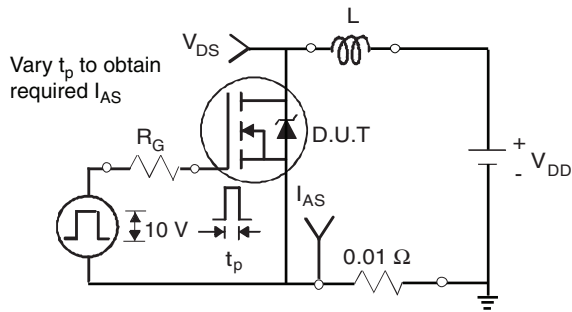
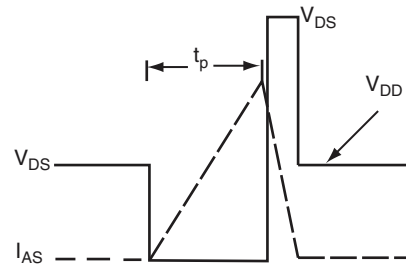


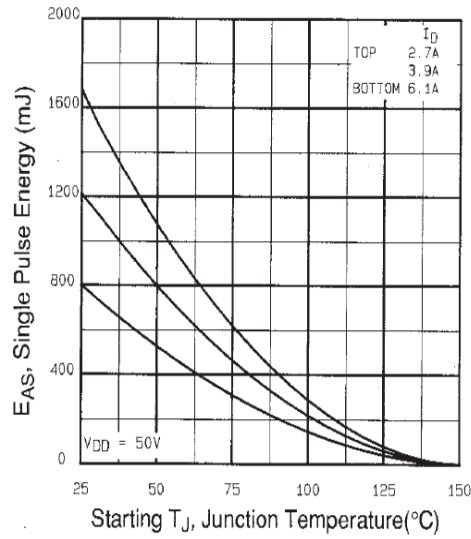
Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case



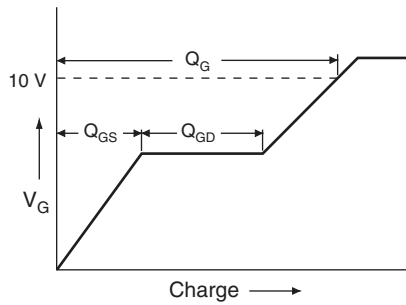
**Fig. 12a - Unclamped Inductive Test Circuit**



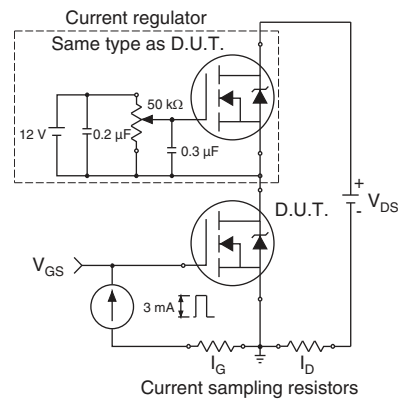
**Fig. 12b - Unclamped Inductive Waveforms**



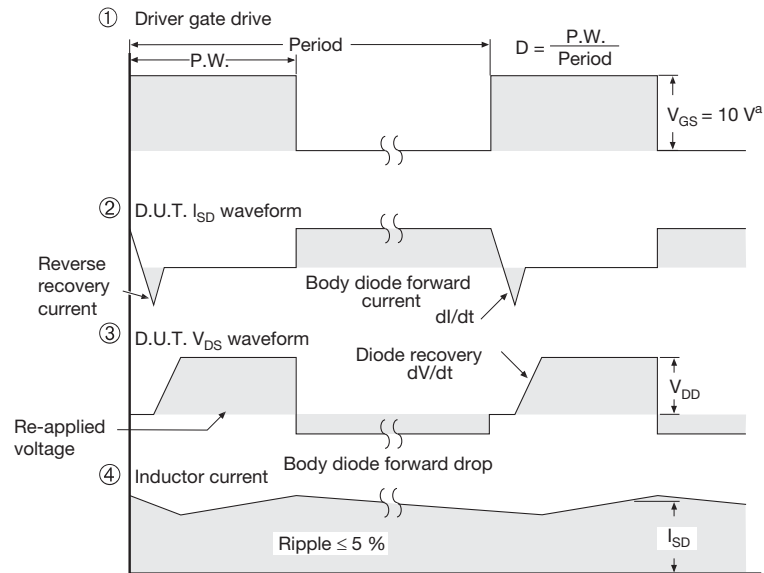
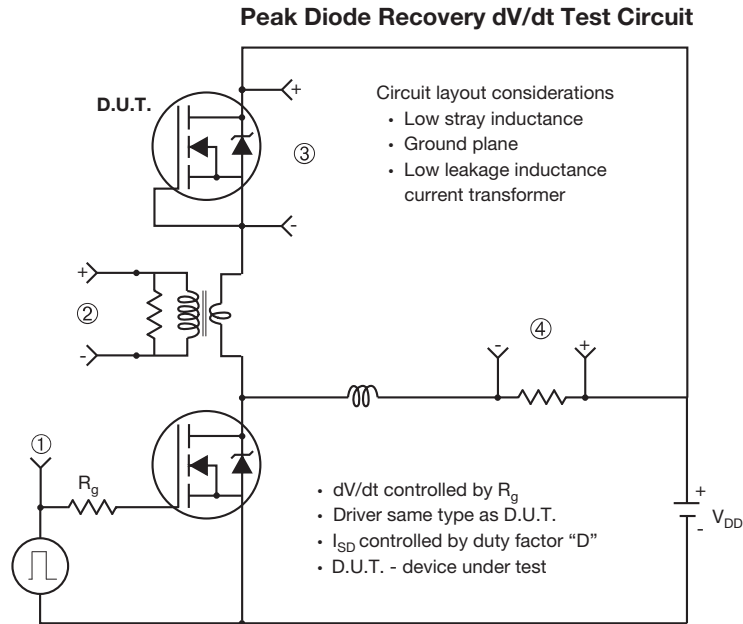
**Fig. 12c - Maximum Avalanche Energy vs. Drain Current**



**Fig. 13a - Basic Gate Charge Waveform**



**Fig. 13b - Gate Charge Test Circuit**

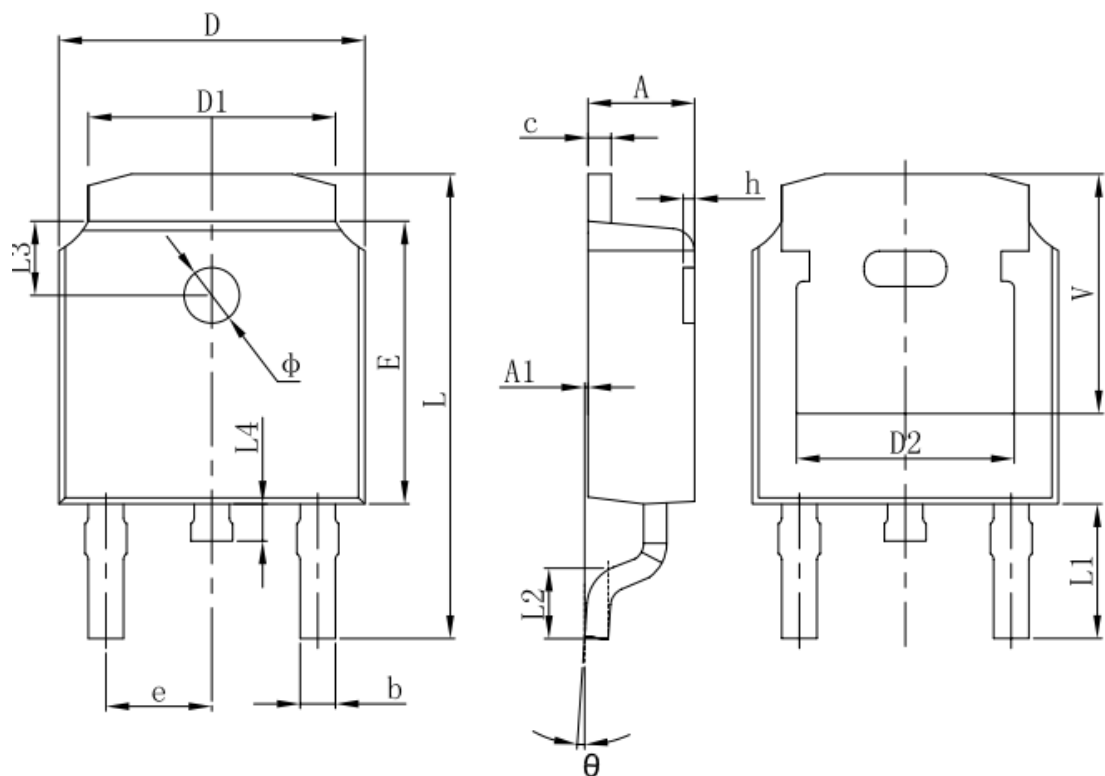


**Note**

a.  $V_{GS} = 5 V$  for logic level devices

**Fig. 14 - For N-Channel**

TO252 Package Information



| Symbol   | Dimensions In Millimeters |        | Dimensions In Inches |       |
|----------|---------------------------|--------|----------------------|-------|
|          | Min.                      | Max.   | Min.                 | Max.  |
| A        | 2.200                     | 2.400  | 0.087                | 0.094 |
| A1       | 0.000                     | 0.127  | 0.000                | 0.005 |
| b        | 0.635                     | 0.770  | 0.025                | 0.030 |
| c        | 0.460                     | 0.580  | 0.018                | 0.023 |
| D        | 6.500                     | 6.700  | 0.256                | 0.264 |
| D1       | 5.100                     | 5.460  | 0.201                | 0.215 |
| D2       | 4.830 REF.                |        | 0.190 REF.           |       |
| E        | 6.000                     | 6.200  | 0.236                | 0.244 |
| e        | 2.186                     | 2.386  | 0.086                | 0.094 |
| L        | 9.712                     | 10.312 | 0.382                | 0.406 |
| L1       | 2.900 REF.                |        | 0.114 REF.           |       |
| L2       | 1.400                     | 1.700  | 0.055                | 0.067 |
| L3       | 1.600 REF.                |        | 0.063 REF.           |       |
| L4       | 0.600                     | 1.000  | 0.024                | 0.039 |
| $\phi$   | 1.100                     | 1.300  | 0.043                | 0.051 |
| $\theta$ | 0°                        | 8°     | 0°                   | 8°    |
| h        | 0.000                     | 0.300  | 0.000                | 0.012 |
| V        | 5.250 REF.                |        | 0.207 REF.           |       |

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