

## P-Channel 200V (D-S) MOSFET

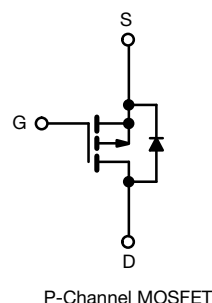
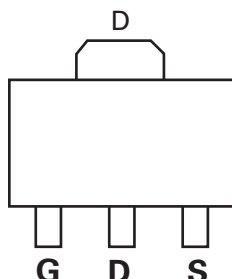
| PRODUCT SUMMARY           |                         |     |
|---------------------------|-------------------------|-----|
| $V_{DS}$ (V)              | -200                    |     |
| $R_{DS(on)}$ ( $\Omega$ ) | $V_{GS} = -10\text{ V}$ | 2.0 |
| $Q_g$ max. (nC)           | 29                      |     |
| $Q_{gs}$ (nC)             | 5.4                     |     |
| $Q_{gd}$ (nC)             | 15                      |     |
| Configuration             | Single                  |     |

### FEATURES

- Surface mount
- Available in tape and reel
- Dynamic dV/dt rating
- Repetitive avalanche rated
- P-channel
- Fast switching
- Ease of paralleling



**RoHS\***  
Available  
**HALOGEN**  
**FREE**  
Available



| ABSOLUTE MAXIMUM RATINGS (T <sub>C</sub> = 25 °C, unless otherwise noted) |                          |                         |                                   |             |      |
|---------------------------------------------------------------------------|--------------------------|-------------------------|-----------------------------------|-------------|------|
| PARAMETER                                                                 |                          |                         | SYMBOL                            | LIMIT       | UNIT |
| Drain-Source Voltage                                                      |                          |                         | V <sub>DS</sub>                   | -200        | V    |
| Gate-Source Voltage                                                       |                          |                         | V <sub>GS</sub>                   | ± 20        |      |
| Continuous Drain Current                                                  | V <sub>GS</sub> at -10 V | T <sub>C</sub> = 25 °C  | I <sub>D</sub>                    | -2.5        | A    |
|                                                                           |                          | T <sub>C</sub> = 100 °C |                                   | -1.8        |      |
| Pulsed Drain Current <sup>a</sup>                                         |                          |                         | I <sub>DM</sub>                   | -7          | W/°C |
| Linear Derating Factor                                                    |                          |                         |                                   | 0.59        |      |
| Linear Derating Factor (PCB mount) <sup>e</sup>                           |                          |                         |                                   | 0.025       |      |
| Single Pulse Avalanche Energy <sup>b</sup>                                |                          |                         | E <sub>AS</sub>                   | 300         | mJ   |
| Avalanche Current <sup>a</sup>                                            |                          |                         | I <sub>AR</sub>                   | -3.4        | A    |
| Repetitive Avalanche Energy <sup>a</sup>                                  |                          |                         | E <sub>AR</sub>                   | 5.4         | mJ   |
| Maximum Power Dissipation                                                 | T <sub>C</sub> = 25 °C   |                         | P <sub>D</sub>                    | 64          | W    |
| Maximum Power Dissipation (PCB mount) <sup>e</sup>                        | T <sub>A</sub> = 25 °C   |                         |                                   | 2.7         |      |
| Peak Diode Recovery dV/dt <sup>c</sup>                                    |                          |                         | dV/dt                             | -5.0        | V/ns |
| Operating Junction and Storage Temperature Range                          |                          |                         | T <sub>J</sub> , T <sub>stg</sub> | -55 to +150 | °C   |
| Soldering Recommendations (Peak temperature) <sup>d</sup>                 | for 10 s                 |                         |                                   | 300         |      |

### Notes

- a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).  
 b.  $V_{DD} = -50\text{ V}$ , starting  $T_J = 25\text{ }^{\circ}\text{C}$ ,  $L = 17\text{ mH}$ ,  $R_g = 25\text{ }\Omega$ ,  $I_{AS} = -6.5\text{ A}$  (see fig. 12).  
 c.  $I_{SD} \leq -6.5\text{ A}$ ,  $dI/dt \leq 120\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq V_{DS}$ ,  $T_J \leq 150\text{ }^{\circ}\text{C}$ .  
 d. 1.6 mm from case.  
 e. When mounted on 1" square PCB (FR-4 or G-10 material).

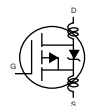
**THERMAL RESISTANCE RATINGS**

| PARAMETER                                            | SYMBOL     | TYP. | MAX. | UNIT |
|------------------------------------------------------|------------|------|------|------|
| Maximum Junction-to-Ambient                          | $R_{thJA}$ | -    | 62   | °C/W |
| Maximum Junction-to-Ambient (PCB mount) <sup>a</sup> | $R_{thJA}$ | -    | 40   |      |
| Maximum Junction-to-Case (Drain)                     | $R_{thJC}$ | -    | 1.7  |      |

**Note**

a. When mounted on 1" square PCB (FR-4 or G-10 material).

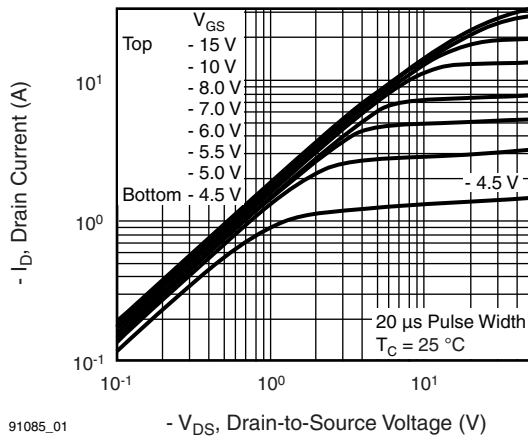
**SPECIFICATIONS** ( $T_J = 25\text{ °C}$ , unless otherwise noted)

| PARAMETER                                      | SYMBOL              | TEST CONDITIONS                                                                                                                                                  | MIN. | TYP.  | MAX.     | UNIT          |
|------------------------------------------------|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------|----------|---------------|
| <b>Static</b>                                  |                     |                                                                                                                                                                  |      |       |          |               |
| Drain-Source Breakdown Voltage                 | $V_{DS}$            | $V_{GS} = 0$ , $I_D = -250\text{ }\mu\text{A}$                                                                                                                   | -200 | -     | -        | V             |
| $V_{DS}$ Temperature Coefficient               | $\Delta V_{DS}/T_J$ | Reference to $25\text{ °C}$ , $I_D = -1\text{ mA}$                                                                                                               | -    | -0.24 | -        | V/°C          |
| Gate-Source Threshold Voltage                  | $V_{GS(th)}$        | $V_{DS} = V_{GS}$ , $I_D = -250\text{ }\mu\text{A}$                                                                                                              | -1.5 | -     | -4.0     | V             |
| Gate-Source Leakage                            | $I_{GSS}$           | $V_{GS} = \pm 20\text{ V}$                                                                                                                                       | -    | -     | $\pm 10$ | $\mu\text{A}$ |
| Zero Gate Voltage Drain Current                | $I_{DSS}$           | $V_{DS} = -200\text{ V}$ , $V_{GS} = 0\text{ V}$                                                                                                                 | -    | -     | -100     | $\mu\text{A}$ |
|                                                |                     | $V_{DS} = -160\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_J = 125\text{ °C}$                                                                                         | -    | -     | -500     |               |
| Drain-Source On-State Resistance               | $R_{DS(on)}$        | $V_{GS} = -10\text{ V}$ , $I_D = -1.0\text{ A}$ <sup>b</sup>                                                                                                     | -    | 2.00  | -        | $\Omega$      |
| Forward Transconductance                       | $g_{fs}$            | $V_{DS} = -50\text{ V}$ , $I_D = -1.0\text{ A}$ <sup>b</sup>                                                                                                     | 2.8  | -     | -        | S             |
| <b>Dynamic</b>                                 |                     |                                                                                                                                                                  |      |       |          |               |
| Input Capacitance                              | $C_{iss}$           | $V_{GS} = 0\text{ V}$ ,<br>$V_{DS} = -25\text{ V}$ ,<br>$f = 1.0\text{ MHz}$ , see fig. 5                                                                        | -    | 700   | -        | pF            |
| Output Capacitance                             | $C_{oss}$           |                                                                                                                                                                  | -    | 200   | -        |               |
| Reverse Transfer Capacitance                   | $C_{rss}$           |                                                                                                                                                                  | -    | 40    | -        |               |
| Total Gate Charge                              | $Q_g$               | $V_{GS} = -10\text{ V}$ ,<br>$I_D = -1.5\text{ A}$ , $V_{DS} = -160\text{ V}$ ,<br>see fig. 6 and 13 <sup>b</sup>                                                | -    | -     | 29       | nC            |
| Gate-Source Charge                             | $Q_{gs}$            |                                                                                                                                                                  | -    | -     | 5.4      |               |
| Gate-Drain Charge                              | $Q_{gd}$            |                                                                                                                                                                  | -    | -     | 15       |               |
| Turn-On Delay Time                             | $t_{d(on)}$         | $V_{DD} = -100\text{ V}$ , $I_D = -1.5\text{ A}$ ,<br>$R_g = 12\text{ }\Omega$ , $R_D = 15\text{ }\Omega$ , see fig. 10 <sup>b</sup>                             | -    | 12    | -        | ns            |
| Rise Time                                      | $t_r$               |                                                                                                                                                                  | -    | 27    | -        |               |
| Turn-Off Delay Time                            | $t_{d(off)}$        |                                                                                                                                                                  | -    | 28    | -        |               |
| Fall Time                                      | $t_f$               |                                                                                                                                                                  | -    | 24    | -        |               |
| Internal Drain Inductance                      | $L_D$               | Between lead,<br>6 mm (0.25") from<br>package and center of<br>die contact  | -    | 4.5   | -        | nH            |
| Internal Source Inductance                     | $L_S$               |                                                                                                                                                                  | -    | 7.5   | -        |               |
| Gate Input Resistance                          | $R_g$               | $f = 1\text{ MHz}$ , open drain                                                                                                                                  | 0.6  | -     | 3.7      | $\Omega$      |
| <b>Drain-Source Body Diode Characteristics</b> |                     |                                                                                                                                                                  |      |       |          |               |
| Continuous Source-Drain Diode Current          | $I_S$               | MOSFET symbol<br>showing the<br>integral reverse<br>p - n junction diode    | -    | -     | -2       | A             |
| Pulsed Diode Forward Current <sup>a</sup>      | $I_{SM}$            |                                                                                                                                                                  | -    | -     | -4       |               |
| Body Diode Voltage                             | $V_{SD}$            | $T_J = 25\text{ °C}$ , $I_S = -1.5\text{ A}$ , $V_{GS} = 0\text{ V}$ <sup>b</sup>                                                                                | -    | -     | -6.5     | V             |
| Body Diode Reverse Recovery Time               | $t_{rr}$            | $T_J = 25\text{ °C}$ , $I_F = -3.5\text{ A}$ , $dI/dt = 100\text{ A}/\mu\text{s}$ <sup>b</sup>                                                                   | -    | 200   | 300      | ns            |
| Body Diode Reverse Recovery Charge             | $Q_{rr}$            |                                                                                                                                                                  | -    | 1.9   | 2.9      | $\mu\text{C}$ |
| Forward Turn-On Time                           | $t_{on}$            | Intrinsic turn-on time is negligible (turn-on is dominated by $L_S$ and $L_D$ )                                                                                  |      |       |          |               |

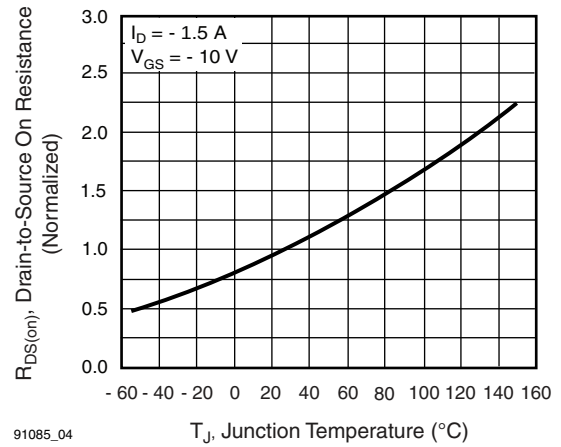
**Notes**

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

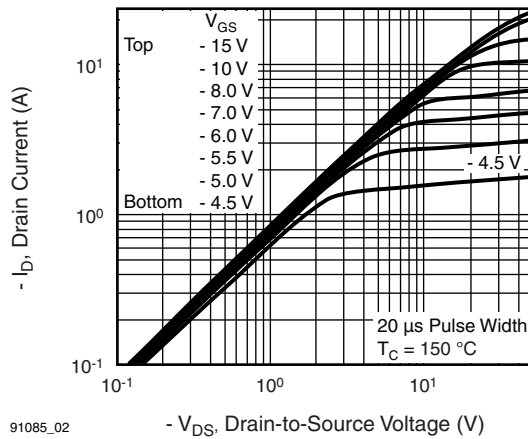
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



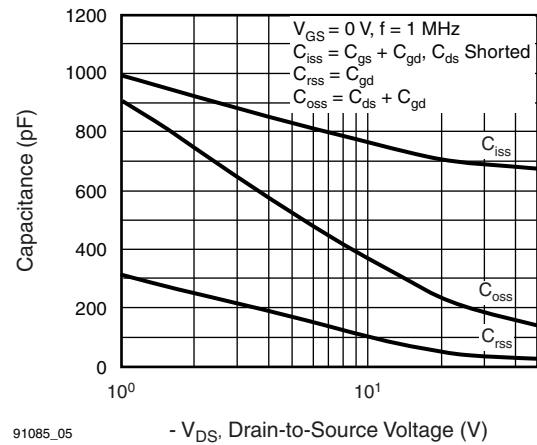
**Fig. 1 - Typical Output Characteristics,  $T_C = 25^\circ\text{C}$**



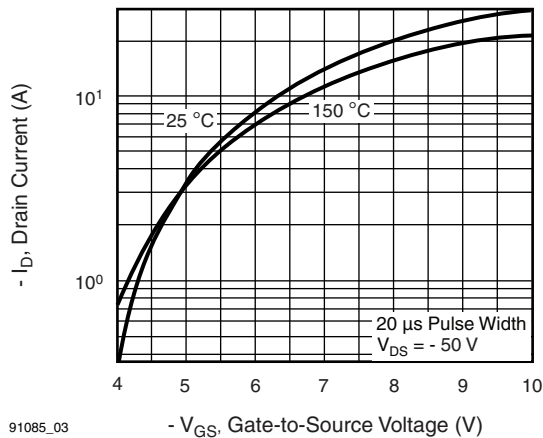
**Fig. 4 - Normalized On-Resistance vs. Temperature**



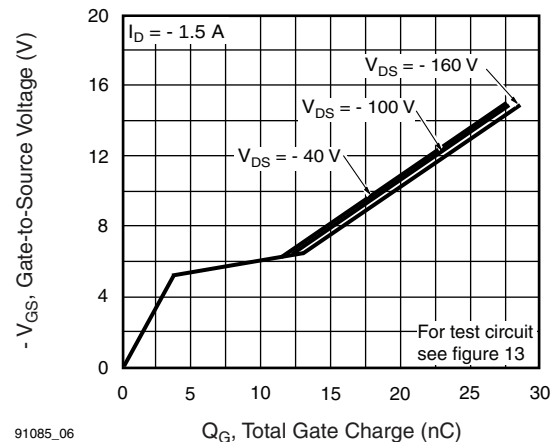
**Fig. 2 - Typical Output Characteristics,  $T_C = 150^\circ\text{C}$**



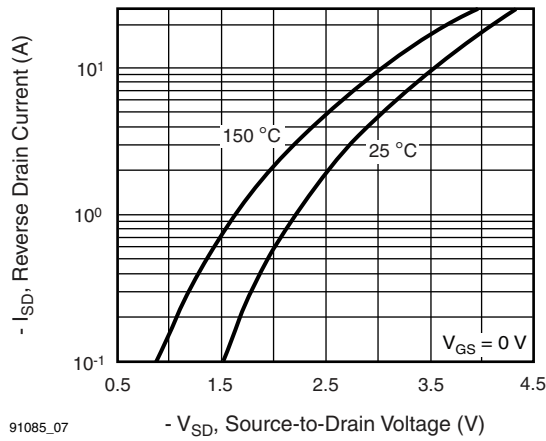
**Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage**



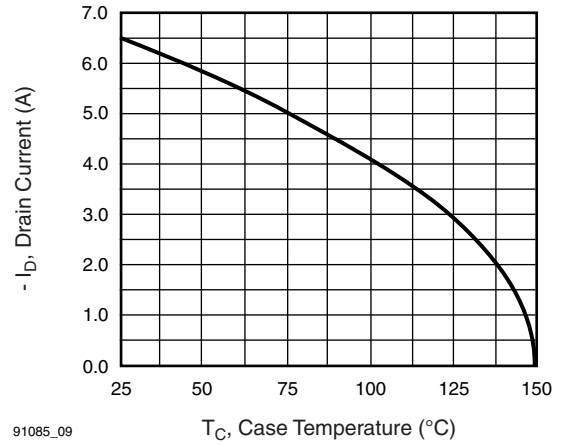
**Fig. 3 - Typical Transfer Characteristics**



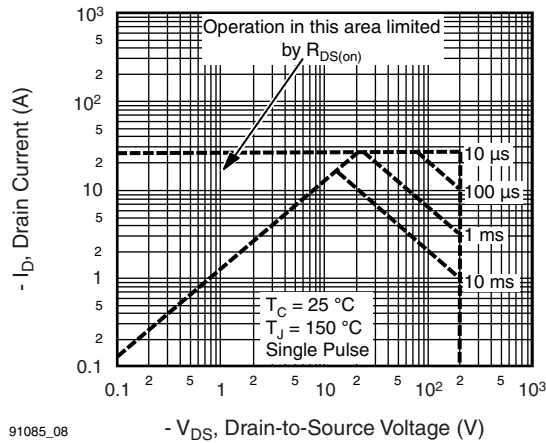
**Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage**



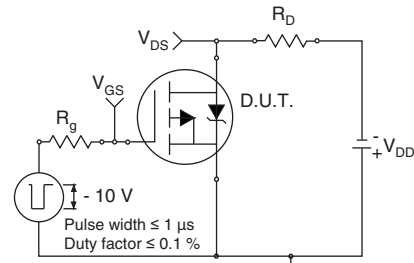
**Fig. 7 - Typical Source-Drain Diode Forward Voltage**



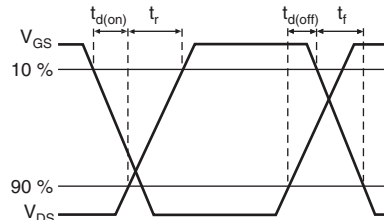
**Fig. 9 - Maximum Drain Current vs. Case Temperature**



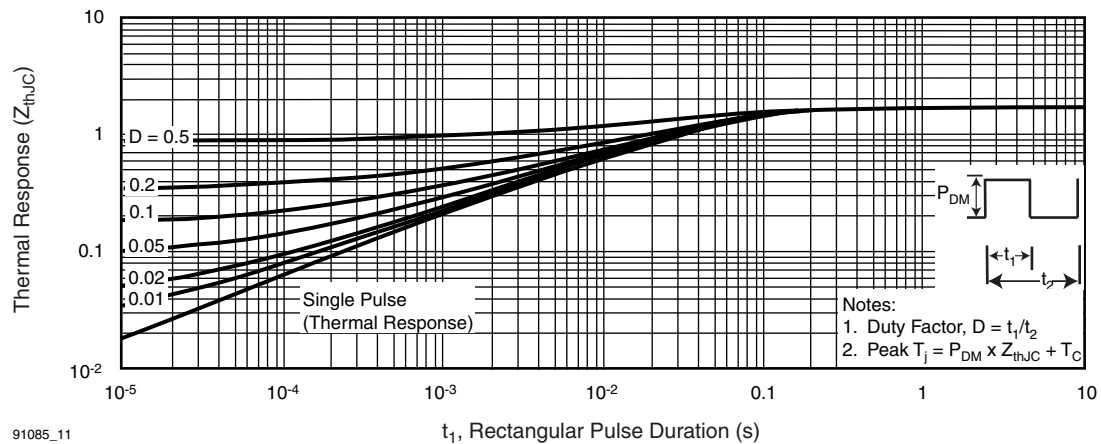
**Fig. 8 - Maximum Safe Operating Area**



**Fig. 10a - Switching Time Test Circuit**



**Fig. 10b - Switching Time Waveforms**



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

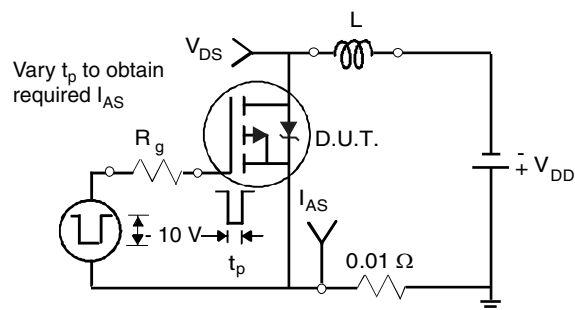


Fig. 12a - Unclamped Inductive Test Circuit

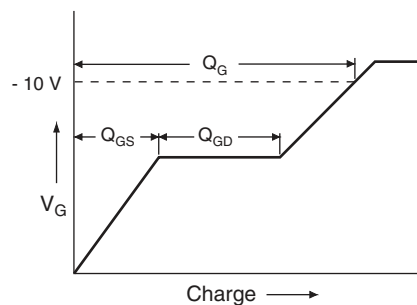


Fig. 13a - Basic Gate Charge Waveform

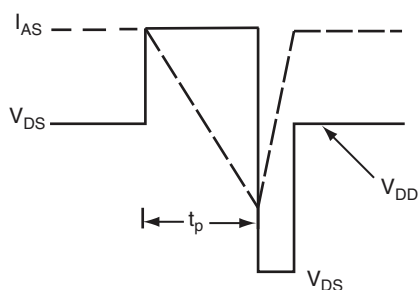


Fig. 12b - Unclamped Inductive Waveforms

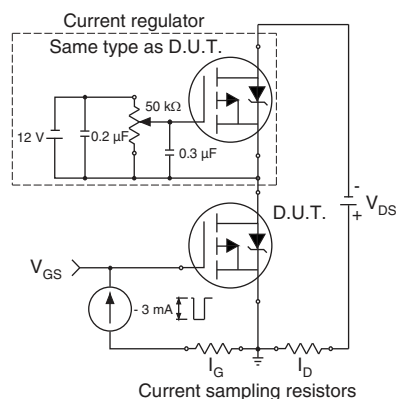


Fig. 13b - Gate Charge Test Circuit

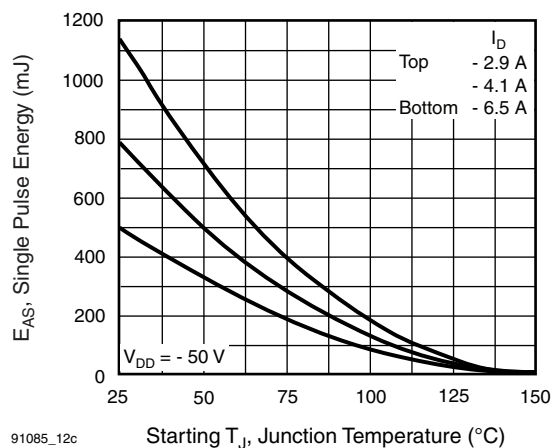
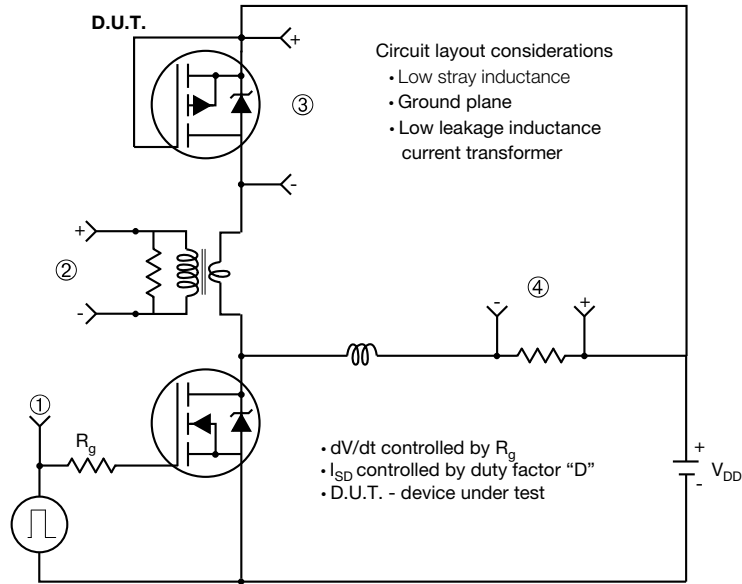


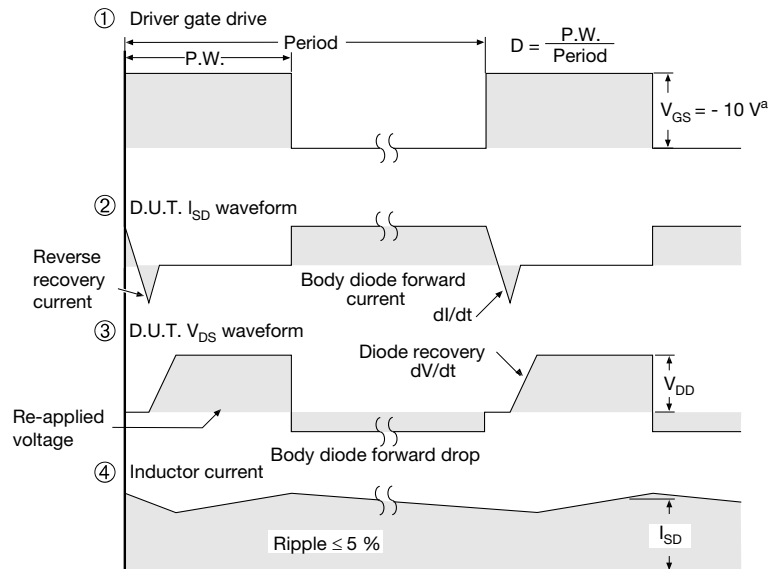
Fig. 12c - Maximum Avalanche Energy vs. Drain Current

### Peak Diode Recovery dV/dt Test Circuit



**Note**

- Complement N-Channel of D.U.T. for driver

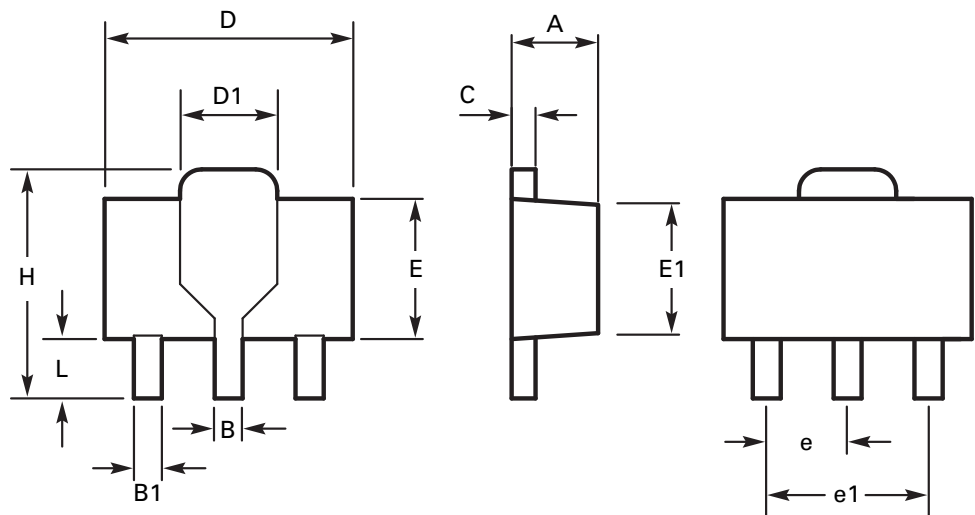


**Note**

a.  $V_{GS} = -5\text{ V}$  for logic level and  $-3\text{ V}$  drive devices

**Fig. 14 - For P-Channel**

# Package outline - SOT89



| DIM | Millimeters |      | Inches |       | DIM | Millimeters |      | Inches    |       |
|-----|-------------|------|--------|-------|-----|-------------|------|-----------|-------|
|     | Min         | Max  | Min    | Max   |     | Min         | Max  | Min       | Max   |
| A   | 1.40        | 1.60 | 0.550  | 0.630 | E   | 2.29        | 2.60 | 0.090     | 0.102 |
| B   | 0.44        | 0.56 | 0.017  | 0.022 | E1  | 2.13        | 2.29 | 0.084     | 0.090 |
| B1  | 0.36        | 0.48 | 0.014  | 0.019 | e   | 1.50 BSC    |      | 0.059 BSC |       |
| C   | 0.35        | 0.44 | 0.014  | 0.017 | e1  | 3.00 BSC    |      | 0.118 BSC |       |
| D   | 4.40        | 4.60 | 0.173  | 0.181 | H   | 3.94        | 4.25 | 0.155     | 0.167 |
| D1  | 1.62        | 1.83 | 0.064  | 0.072 | L   | 0.89        | 1.20 | 0.035     | 0.047 |

**Note:** Controlling dimensions are in millimeters. Approximate dimensions are provided in inches

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