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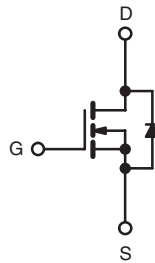
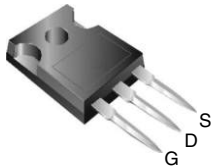
Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China



## Power MOSFET

| PRODUCT SUMMARY           |                              |
|---------------------------|------------------------------|
| $V_{DS}$ (V)              | 600                          |
| $R_{DS(on)}$ ( $\Omega$ ) | $V_{GS} = 10\text{ V}$ 0.385 |
| $Q_g$ (Max.) (nC)         | 100                          |
| $Q_{gs}$ (nC)             | 30                           |
| $Q_{gd}$ (nC)             | 46                           |
| Configuration             | Single                       |

TO-247



N-Channel MOSFET

### FEATURES

- Superfast Body Diode Eliminates the Need for External Diodes in ZVS Applications
- Lower Gate Charge Results in Simple Drive Requirements
- Enhanced  $dV/dt$  Capabilities Offer Improved Ruggedness
- Higher Gate Voltage Threshold Offers Improved Noise Immunity
- Lead (Pb)-free Available



RoHS\*  
COMPLIANT

### APPLICATIONS

- Zero Voltage Switching SMPS
- Telecom and Server Power Supplies
- Uninterruptible Power Supplies
- Motor Control Applications

| ORDERING INFORMATION |                |
|----------------------|----------------|
| Package              | TO-247         |
| Lead (Pb)-free       | IRFP15N60LPbF  |
|                      | SiHFP15N60L-E3 |
| SnPb                 | IRFP15N60L     |
|                      | SiHFP15N60L    |

| ABSOLUTE MAXIMUM RATINGS $T_C = 25\text{ }^\circ\text{C}$ , unless otherwise noted |                                  |                                   |                     |          |
|--|----------------------------------|-----------------------------------|---------------------|----------|
| PARAMETER  | SYMBOL                           | LIMIT                             | UNIT                |          |
| Drain-Source Voltage   | $V_{DS}$                         | 600                               | V                   |          |
| Gate-Source Voltage  | $V_{GS}$                         | $\pm 30$                          |                     |          |
| Continuous Drain Current   | $V_{GS}$ at 10 V                 | $T_C = 25\text{ }^\circ\text{C}$  | 15                  | A        |
|  |                                  | $T_C = 100\text{ }^\circ\text{C}$ | 9.7                 |          |
| Pulsed Drain Current <sup>a</sup>  | $I_{DM}$                         | 60                                |                     |          |
| Linear Derating Factor   |                                  | 2.3                               | W/ $^\circ\text{C}$ |          |
| Single Pulse Avalanche Energy <sup>b</sup>   | $E_{AS}$                         | 320                               | mJ                  |          |
| Repetitive Avalanche Current <sup>a</sup>  | $I_{AR}$                         | 15                                | A                   |          |
| Repetitive Avalanche Energy <sup>a</sup>   | $E_{AR}$                         | 28                                | mJ                  |          |
| Maximum Power Dissipation  | $T_C = 25\text{ }^\circ\text{C}$ | $P_D$                             | 280                 | W        |
| Peak Diode Recovery $dV/dt^c$  | $dV/dt$                          | 10                                | V/ns                |          |
| Operating Junction and Storage Temperature Range                                   | $T_J, T_{stg}$                   | - 55 to + 150                     | $^\circ\text{C}$    |          |
| 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).
- Starting  $T_J = 25\text{ }^\circ\text{C}$ ,  $L = 2.9\text{ mH}$ ,  $R_G = 25\text{ }\Omega$ ,  $I_{AS} = 15\text{ A}$ ,  $dV/dt = 10\text{ V/ns}$  (see fig. 12a).
- $I_{SD} \leq 15\text{ A}$ ,  $dI/dt \leq 340\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq V_{DS}$ ,  $T_J \leq 150\text{ }^\circ\text{C}$ .
- 1.6 mm from case.

\* Pb containing terminations are not RoHS compliant, exemptions may apply

| 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)    | $R_{thJC}$ | -    | 0.44 |      |

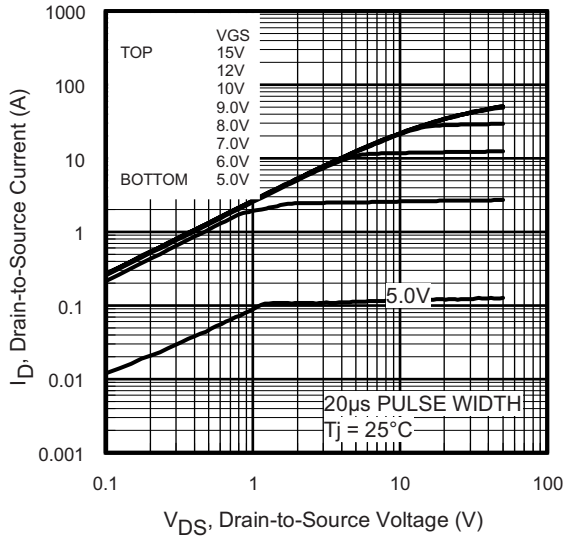
**SPECIFICATIONS**  $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted

| PARAMETER                                      | SYMBOL                     | TEST CONDITIONS  | MIN. | TYP.  | MAX.      | UNIT          |
|--|----------------------------|--|------|-------|-----------|---------------|
| <b>Static</b>                                  |                            |  |      |       |           |               |
| Drain-Source Breakdown Voltage                 | $V_{DS}$                   | $V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$  | 600  | -     | -         | V             |
| $V_{DS}$ Temperature Coefficient               | $\Delta V_{DS}/T_J$        | Reference to $25\text{ }^\circ\text{C}$ , $I_D = 1\text{ mA}$  | -    | 0.39  | -         | V/°C          |
| Gate-Source Threshold Voltage                  | $V_{GS(th)}$               | $V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$  | 3.0  | -     | 5.0       | V             |
| Gate-Source Leakage                            | $I_{GSS}$                  | $V_{GS} = \pm 30\text{ V}$   | -    | -     | $\pm 100$ | nA            |
| Zero Gate Voltage Drain Current                | $I_{DSS}$                  | $V_{DS} = 600\text{ V}, V_{GS} = 0\text{ V}$   | -    | -     | 50        | $\mu\text{A}$ |
|  |                            | $V_{DS} = 480\text{ V}, V_{GS} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$  | -    | -     | 2.0       | mA            |
| Drain-Source On-State Resistance               | $R_{DS(on)}$               | $V_{GS} = 10\text{ V}$   $I_D = 9.0\text{ A}^b$  | -    | 0.385 | 0.460     | $\Omega$      |
| Forward Transconductance                       | $g_{fs}$                   | $V_{DS} = 50\text{ V}, I_D = 9.0\text{ A}$   | 8.3  | -     | -         | S             |
| <b>Dynamic</b>                                 |                            |  |      |       |           |               |
| Input Capacitance                              | $C_{iss}$                  | $V_{GS} = 0\text{ V}, V_{DS} = 25\text{ V}, f = 1.0\text{ MHz}$ , see fig. 5   | -    | 2720  | -         | pF            |
| Output Capacitance                             | $C_{oss}$                  |  | -    | 260   | -         |               |
| Reverse Transfer Capacitance                   | $C_{rss}$                  |  | -    | 20    | -         |               |
| Effective Output Capacitance                   | $C_{oss\text{ eff.}}$      | $V_{GS} = 0\text{ V}, V_{DS} = 0\text{ V to } 480\text{ V}^c$  | -    | 120   | -         | pF            |
| Effective Output Capacitance (Energy Related)  | $C_{oss\text{ eff. (ER)}}$ |  | -    | 100   | -         |               |
| Total Gate Charge                              | $Q_g$                      | $V_{GS} = 10\text{ V}$   $I_D = 15\text{ A}, V_{DS} = 480\text{ V}$ , see fig. 7 and 15 <sup>b</sup>   | -    | -     | 100       | nC            |
| Gate-Source Charge                             | $Q_{gs}$                   |  | -    | -     | 30        |               |
| Gate-Drain Charge                              | $Q_{gd}$                   |  | -    | -     | 46        |               |
| Turn-On Delay Time                             | $t_{d(on)}$                | $V_{DD} = 300\text{ V}, I_D = 15\text{ A}, R_G = 1.8\text{ }\Omega, V_{GS} = 10\text{ V}$ , see fig. 11a and 11b <sup>b</sup>                        | -    | 20    | -         | ns            |
| Rise Time                                      | $t_r$                      |  | -    | 44    | -         |               |
| Turn-Off Delay Time                            | $t_{d(off)}$               |  | -    | 28    | -         |               |
| Fall Time                                      | $t_f$                      |  | -    | 5.5   | -         |               |
| <b>Drain-Source Body Diode Characteristics</b> |                            |  |      |       |           |               |
| Continuous Source-Drain Diode Current          | $I_S$                      | MOSFET symbol showing the integral reverse p - n junction diode  | -    | -     | 15        | A             |
| Pulsed Diode Forward Current <sup>a</sup>      | $I_{SM}$                   |  | -    | -     | 60        |               |
| Body Diode Voltage                             | $V_{SD}$                   | $T_J = 25\text{ }^\circ\text{C}, I_S = 15\text{ A}, V_{GS} = 0\text{ V}^b$   | -    | -     | 1.5       | V             |
| Body Diode Reverse Recovery Time               | $t_{rr}$                   | $T_J = 25\text{ }^\circ\text{C}, I_F = 15\text{ A}$  | -    | 130   | 200       | ns            |
|  |                            | $T_J = 125\text{ }^\circ\text{C}, di/dt = 100\text{ A}/\mu\text{s}^b$  | -    | 240   | 360       |               |
| Body Diode Reverse Recovery Charge             | $Q_{rr}$                   | $T_J = 25\text{ }^\circ\text{C}, I_F = 15\text{ A}, V_{GS} = 0\text{ V}^b$   | -    | 450   | 670       | nC            |
|  |                            | $T_J = 125\text{ }^\circ\text{C}, di/dt = 100\text{ A}/\mu\text{s}^b$  | -    | 1080  | 1620      |               |
| Reverse Recovery Time                          | $I_{RRM}$                  | $T_J = 25\text{ }^\circ\text{C}$   | -    | 5.8   | 8.7       | A             |
| Forward Turn-On Time                           | $t_{on}$                   | Intrinsic turn-on time is negligible (turn-on is dominated by $L_S$ and $L_D$ )  |      |       |           |               |

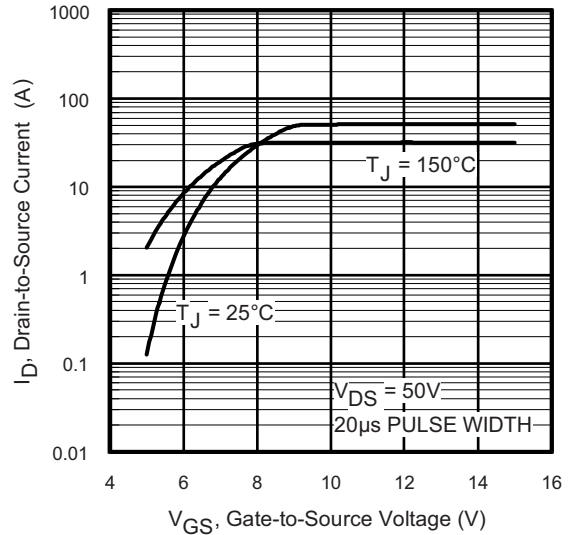
**Notes**

- a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- b. Pulse width  $\leq 300\text{ }\mu\text{s}$ ; duty cycle  $\leq 2\%$ .
- c.  $C_{oss\text{ eff.}}$  is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DS}$ .  $C_{oss\text{ eff. (ER)}}$  is a fixed capacitance that stores the same energy as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DS}$ .

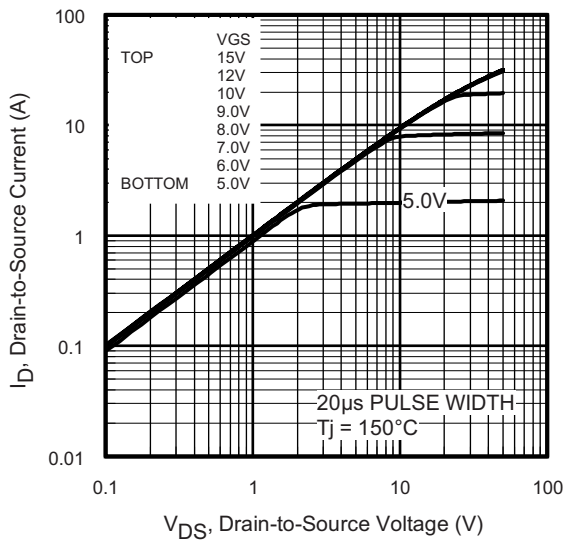
**TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



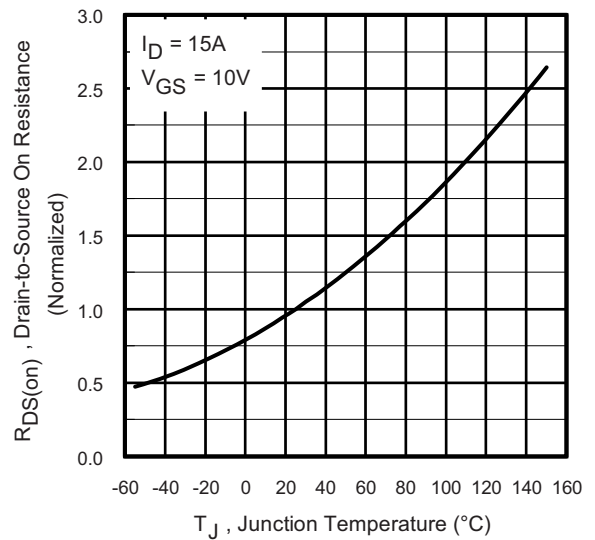
**Fig. 1 - Typical Output Characteristics**



**Fig. 3 - Typical Transfer Characteristics**



**Fig. 2 - Typical Output Characteristics**



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

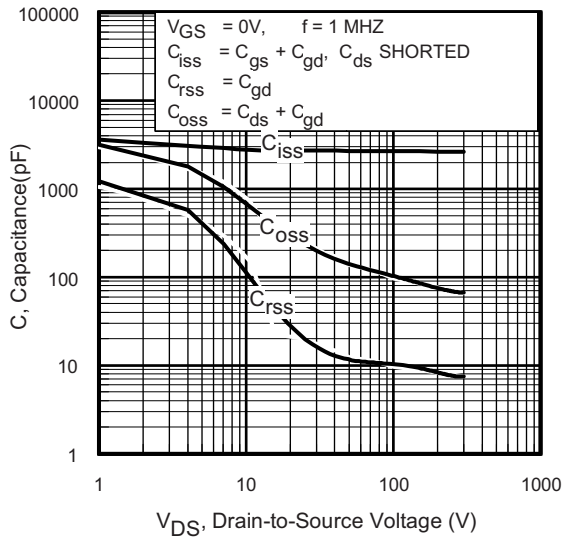


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

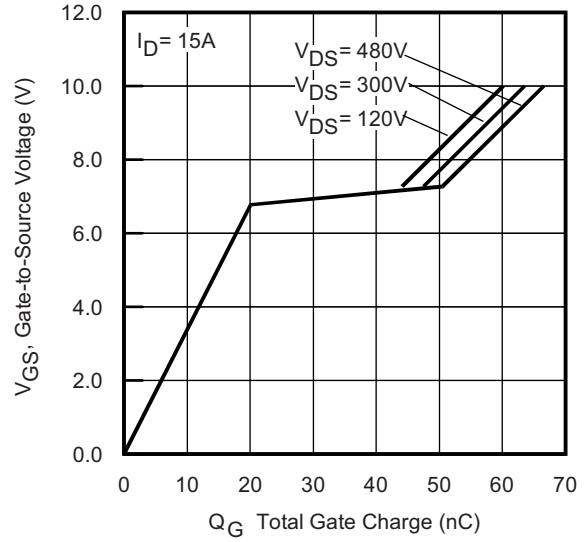


Fig. 7 - Typical Gate Charge vs. Gate-to-Source Voltage

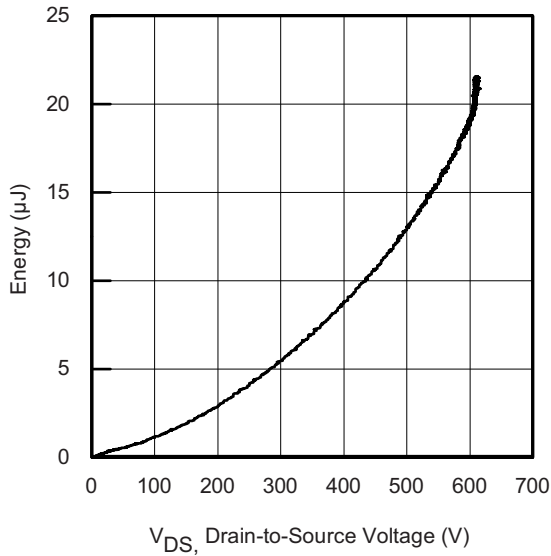


Fig. 6 - Typical Output Capacitance Stored Energy vs.  $V_{DS}$

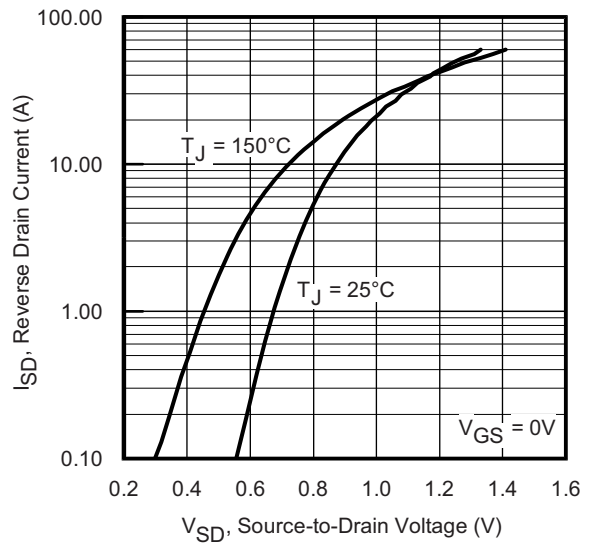
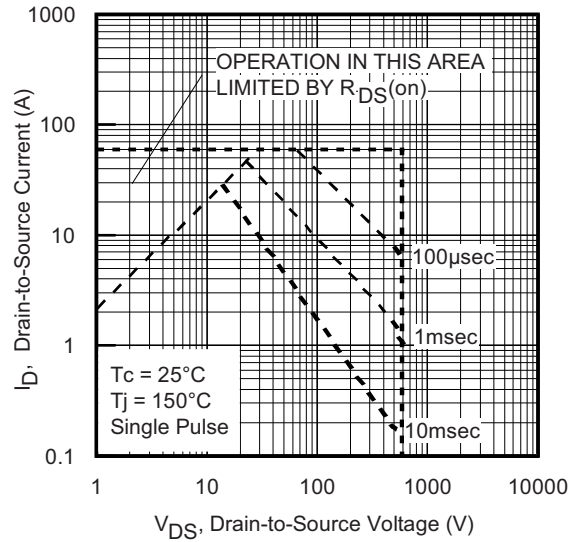
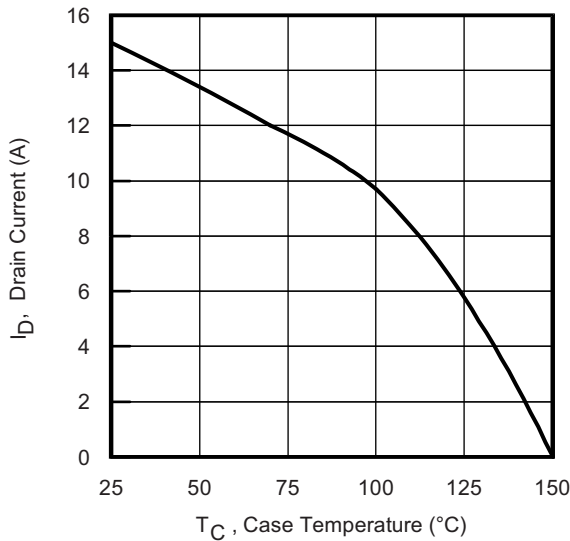


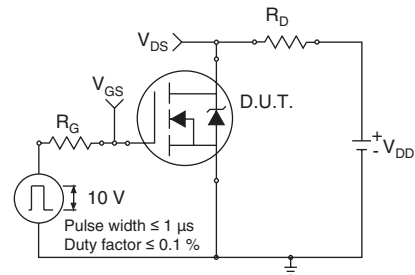
Fig. 8 - Typical Source-Drain Diode Forward Voltage



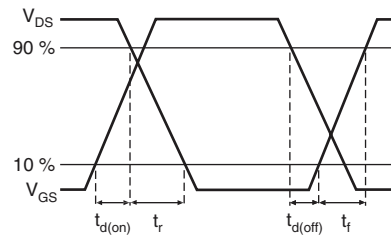
**Fig. 9 - Maximum Safe Operating Area**



**Fig. 10 - Maximum Drain Current vs. Case Temperature**



**Fig. 11a - Switching Time Test Circuit**



**Fig. 11b - Switching Time Waveforms**

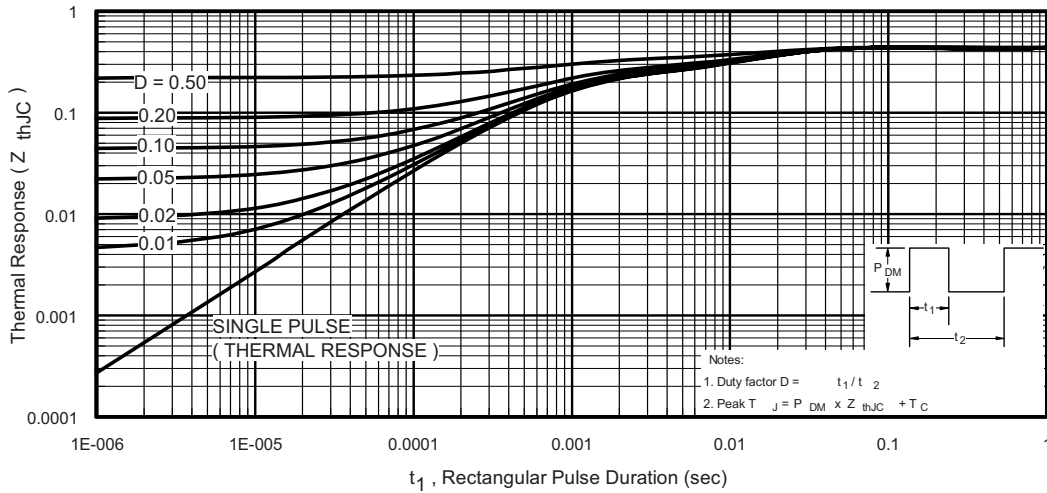


Fig. 12 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

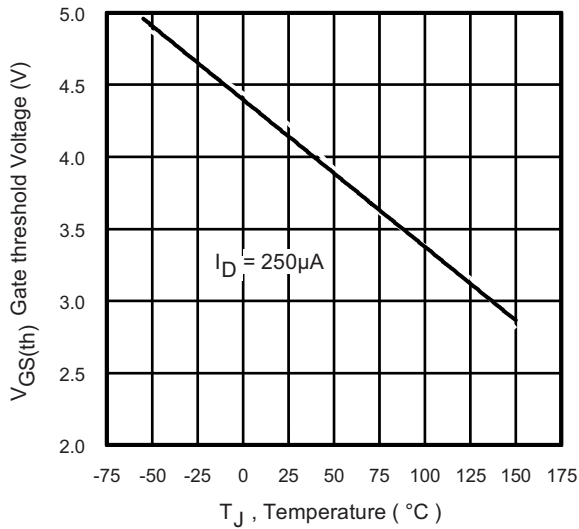


Fig. 13 - Threshold Voltage vs. Temperature

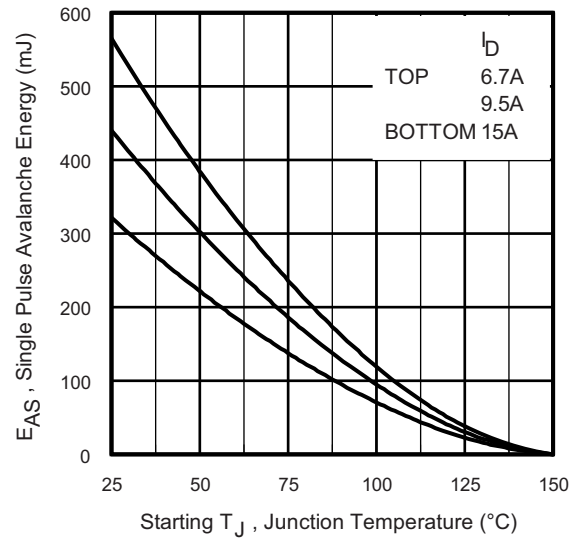


Fig. 14a - Maximum Avalanche Energy vs. Drain Current

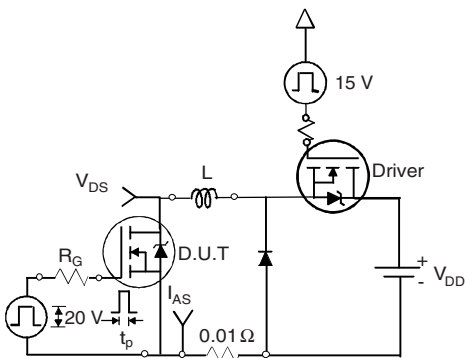


Fig. 14b - Unclamped Inductive Test Circuit

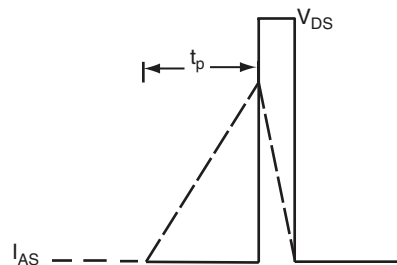


Fig. 14c - Unclamped Inductive Waveforms

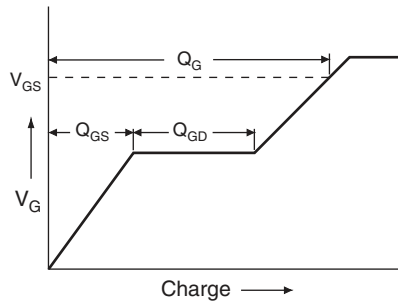


Fig. 15a - Basic Gate Charge Waveform

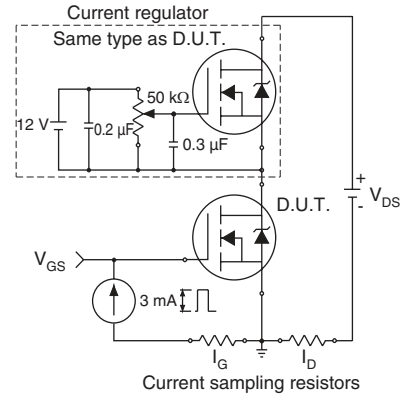


Fig. 15b - Gate Charge Test Circuit

### Peak Diode Recovery dV/dt Test Circuit

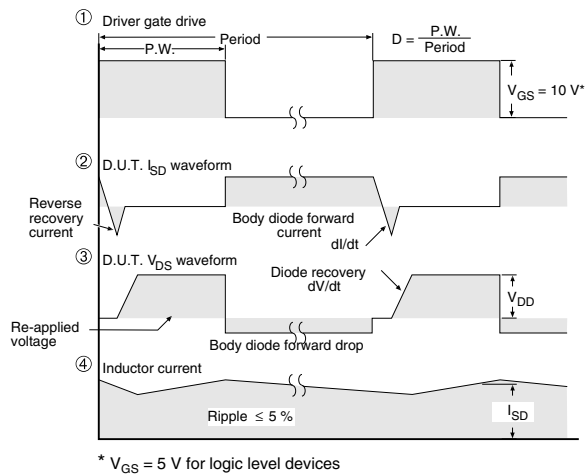
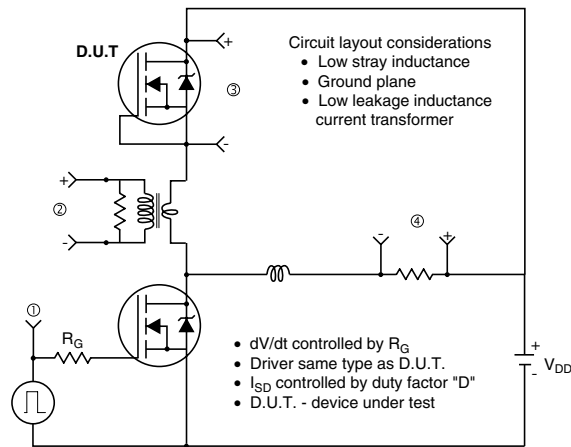


Fig. 16 - For N-Channel

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