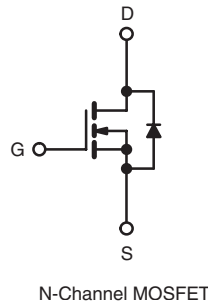
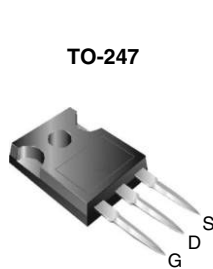


## Power MOSFET

| PRODUCT SUMMARY                  |                 |      |
|----------------------------------|-----------------|------|
| $V_{DS}$ (V)                     | 500             |      |
| $R_{DS(on)}$ (Max.) ( $\Omega$ ) | $V_{GS} = 10$ V | 0.37 |
| $Q_g$ (Max.) (nC)                | 77              |      |
| $Q_{gs}$ (nC)                    | 26              |      |
| $Q_{gd}$ (nC)                    | 34              |      |
| Configuration                    | Single          |      |



### FEATURES

- Low Gate Charge  $Q_g$  Results in Simple Drive Requirement
- Improved Gate, Avalanche and Dynamic  $dV/dt$  Ruggedness
- Fully Characterized Capacitance and Avalanche Voltage and Current
- Effective  $C_{OSS}$  Specified
- Lead (Pb)-free



### APPLICATIONS

- Switch Mode Power Supply (SMPS)
- Uninterruptible Power Supply
- High Speed Power Switching

### TYPICAL SMPS TOPOLOGIES

- Two Transistor Forward
- Half Bridge and Full Bridge
- PFC Boost


| ORDERING INFORMATION |              |
|----------------------|--------------|
| Package              | TO-247       |
| Lead (Pb)-free       | IRFP450NPbF  |
|                      | SiHFP450N-E3 |
| SnPb                 | IRFP450N     |
|                      | SiHFP450N    |

| ABSOLUTE MAXIMUM RATINGS $T_C = 25$ °C, unless otherwise noted |                  |                  |       |          |
|--|------------------|------------------|-------|----------|
| PARAMETER  | SYMBOL           | LIMIT            | UNIT  |          |
| Drain-Source Voltage   | $V_{DS}$         | 500              | V     |          |
| Gate-Source Voltage  | $V_{GS}$         | $\pm 30$         |       |          |
| Continuous Drain Current                                       | $V_{GS}$ at 10 V | $T_C = 25$ °C    | A     |          |
|  |                  | $T_C = 100$ °C   |       |          |
| Pulsed Drain Current <sup>a</sup>                              | $I_{DM}$         | 56               |       |          |
| Linear Derating Factor   |                  | 1.6              | W/°C  |          |
| Single Pulse Avalanche Energy <sup>b</sup>                     | $E_{AS}$         | 170              | mJ    |          |
| Repetitive Avalanche Current <sup>a</sup>                      | $I_{AR}$         | 14               | A     |          |
| Repetitive Avalanche Energy <sup>a</sup>                       | $E_{AR}$         | 20               | mJ    |          |
| Maximum Power Dissipation                                      | $T_C = 25$ °C    | $P_D$            | 200   | W        |
| Peak Diode Recovery $dV/dt^c$                                  | $dV/dt$          | 5.0              | V/ns  |          |
| Operating Junction and Storage Temperature Range               | $T_J, T_{stg}$   | - 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).
- Starting  $T_J = 25$  °C,  $L = 1.7$  mH,  $R_G = 25$   $\Omega$ ,  $I_{AS} = 14$  A (see fig. 12).
- $I_{SD} \leq 14$  A,  $dI/dt \leq 510$  A/ $\mu$ s,  $V_{DD} \leq V_{DS}$ ,  $T_J \leq 150$  °C.
- 1.6 mm from case.

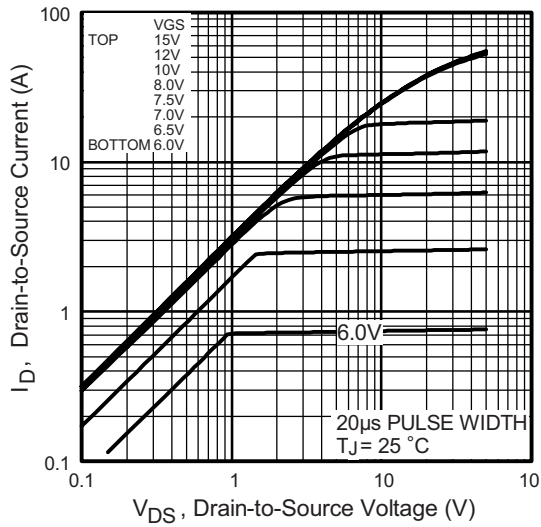
| THERMAL RESISTANCE RATINGS          |            |      |      |      |
|-------------------------------------|------------|------|------|------|
| PARAMETER                           | SYMBOL     | TYP. | MAX. | UNIT |
| Maximum Junction-to-Ambient         | $R_{thJA}$ | -    | 40   | °C/W |
| Case-to-Sink, Flat, Greased Surface | $R_{thCS}$ | 0.24 | -    |      |
| Maximum Junction-to-Case (Drain)    | $R_{thJC}$ | -    | 0.64 |      |

| 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   | $V_{DS}$              | $V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$  | 500   | -    | -         | V             |
| $V_{DS}$ Temperature Coefficient   | $\Delta V_{DS}/T_J$   | Reference to $25\text{ }^\circ\text{C}$ , $I_D = 1\text{ mA}$  | -   | 0.59 | -         | 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  | $I_{DSS}$             | $V_{DS} = 500\text{ V}, V_{GS} = 0\text{ V}$   | -   | -    | 25        | $\mu\text{A}$ |
|  |                       | $V_{DS} = 400\text{ V}, V_{GS} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$  | -   | -    | 250       |               |
| Drain-Source On-State Resistance   | $R_{DS(on)}$          | $V_{GS} = 10\text{ V}, I_D = 8.4\text{ A}^b$   | -   | -    | 0.37      | $\Omega$      |
| Forward Transconductance   | $g_{fs}$              | $V_{DS} = 50\text{ V}, I_D = 8.4\text{ A}$   | 7.9   | -    | -         | 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   | -   | 2260 | -         | pF            |
| Output Capacitance   | $C_{oss}$             |  | -   | 210  | -         |               |
| Reverse Transfer Capacitance   | $C_{rss}$             |  | -   | 14   | -         |               |
| Output Capacitance   | $C_{oss}$             | $V_{GS} = 0\text{ V}$  | $V_{DS} = 1.0\text{ V}, f = 1.0\text{ MHz}$ | -    | 2410      | -             |
|  |                       |  | $V_{DS} = 400\text{ V}, f = 1.0\text{ MHz}$ | -    | 59        | -             |
| Effective Output Capacitance   | $C_{oss\text{ eff.}}$ | $V_{DS} = 0\text{ V to } 400\text{ V}^c$   | -   | 110  | -         |               |
| Total Gate Charge  | $Q_g$                 | $V_{GS} = 10\text{ V}, I_D = 14\text{ A}, V_{DS} = 400\text{ V}$ , see fig. 6 and 13 <sup>b</sup>  | -   | -    | 77        | nC            |
| Gate-Source Charge   | $Q_{gs}$              |  | -   | -    | 26        |               |
| Gate-Drain Charge  | $Q_{gd}$              |  | -   | -    | 34        |               |
| Turn-On Delay Time   | $t_{d(on)}$           | $V_{DD} = 250\text{ V}, I_D = 14\text{ A}, R_G = 6.2\text{ }\Omega, V_{GS} = 10\text{ V}$ , see fig. 10 <sup>b</sup>                                 | -   | 20   | -         | ns            |
| Rise Time  | $t_r$                 |  | -   | 63   | -         |               |
| Turn-Off Delay Time  | $t_{d(off)}$          |  | -   | 29   | -         |               |
| Fall Time  | $t_f$                 |  | -   | 25   | -         |               |
| <b>Drain-Source Body Diode Characteristics</b>                           |                       |  |   |      |           |               |
| Continuous Source-Drain Diode Current                                    | $I_S$                 | MOSFET symbol showing the integral reverse p - n junction diode  | -   | -    | 14        | A             |
| Pulsed Diode Forward Current <sup>a</sup>                                | $I_{SM}$              |  | -   | -    | 56        |               |
| Body Diode Voltage   | $V_{SD}$              | $T_J = 25\text{ }^\circ\text{C}, I_S = 14\text{ A}, V_{GS} = 0\text{ V}^b$   | -   | -    | 1.4       | V             |
| Body Diode Reverse Recovery Time   | $t_{rr}$              | $T_J = 25\text{ }^\circ\text{C}, I_F = 14\text{ A}, di/dt = 100\text{ A}/\mu\text{s}^b$  | -   | 430  | 650       | ns            |
| Body Diode Reverse Recovery Charge                                       | $Q_{rr}$              |  | -   | 3.7  | 5.6       | $\mu\text{C}$ |
| Forward Turn-On Time   | $t_{on}$              | Intrinsic turn-on time is negligible (turn-on is dominated by $L_S$ and $L_D$ )  |   |      |           |               |

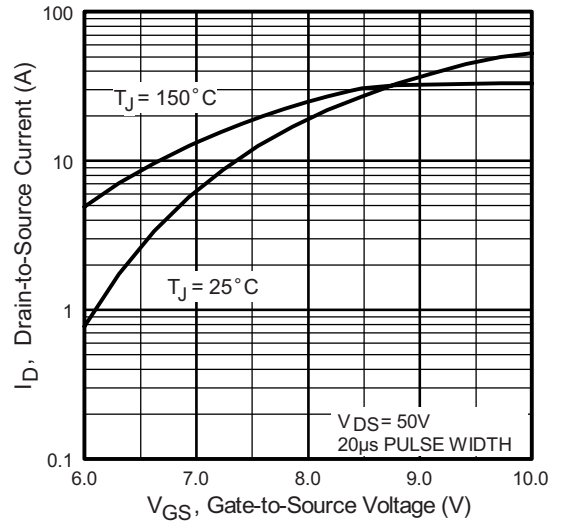
**Notes**

- a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- b. Pulse width  $\leq 400\text{ }\mu\text{s}$ ; 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 %  $V_{DS}$ .

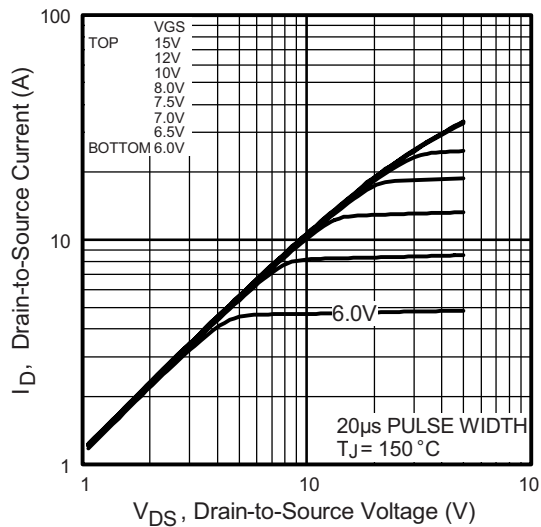
**TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



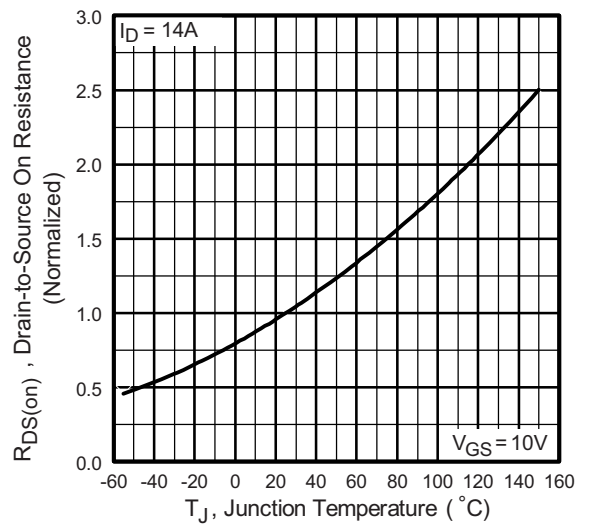
**Fig. 1 - Typical Output Characteristics**



**Fig. 3 - Typical Transfer Characteristics**



**Fig. 2 - Typical Output Characteristics**



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

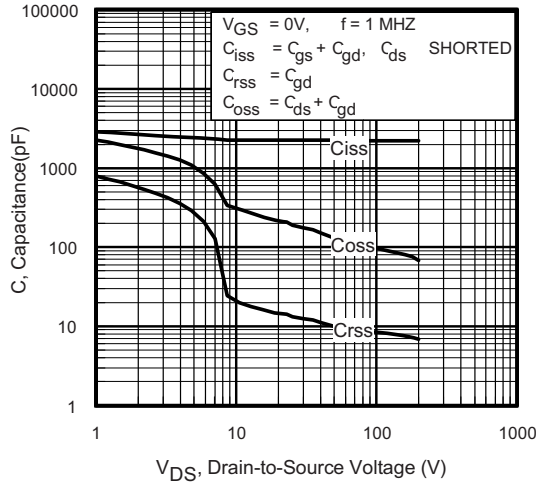


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

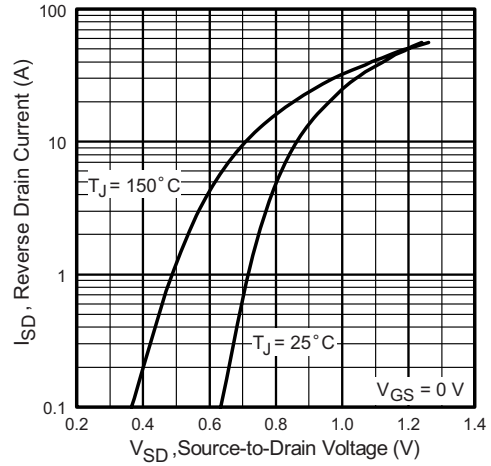


Fig. 7 - Typical Source-Drain Diode Forward Voltage

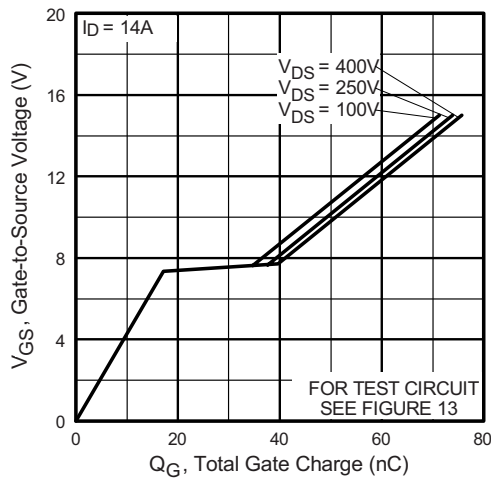


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

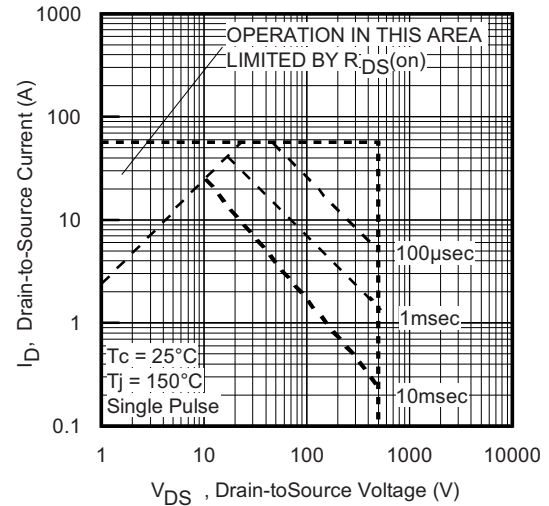
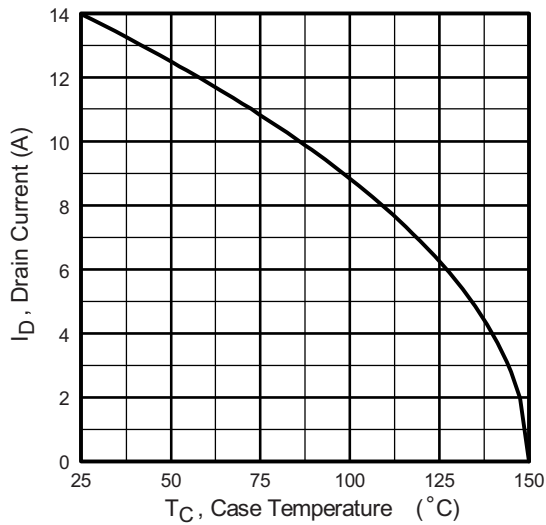
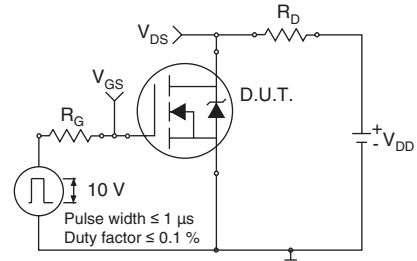


Fig. 8 - Maximum Safe Operating Area



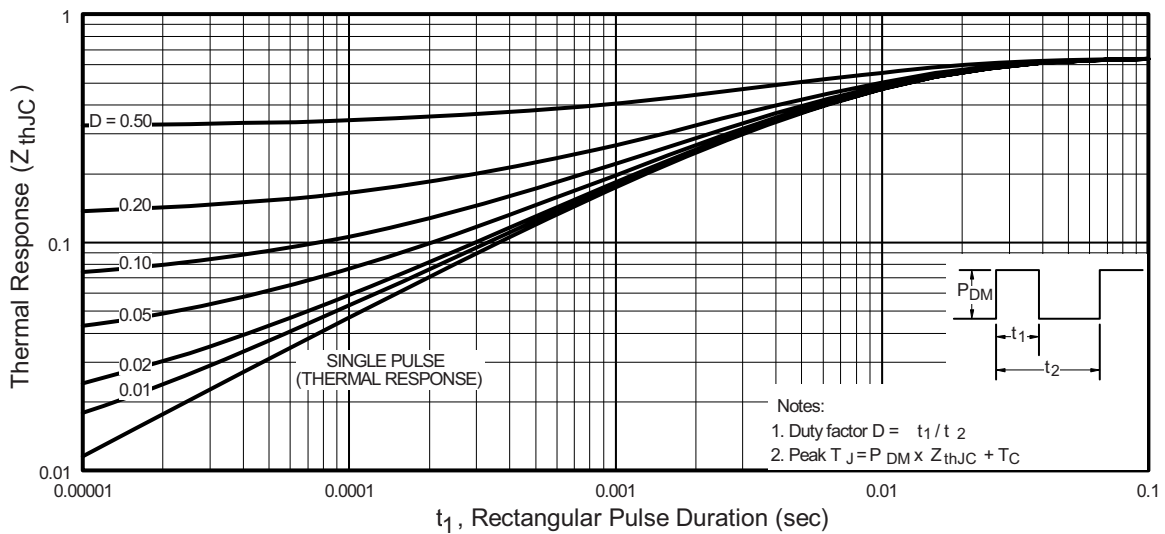
**Fig. 9 - Maximum Drain Current vs. Case Temperature**



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



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



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

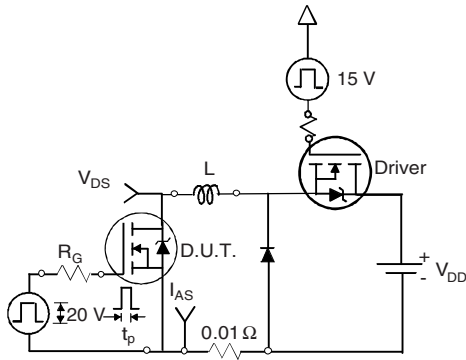


Fig. 12a - Unclamped Inductive Test Circuit

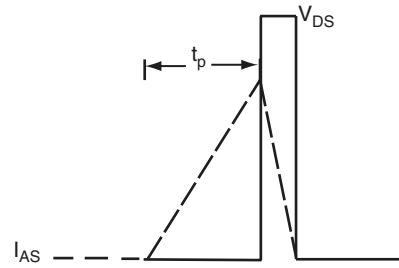


Fig. 12b - Unclamped Inductive Waveforms

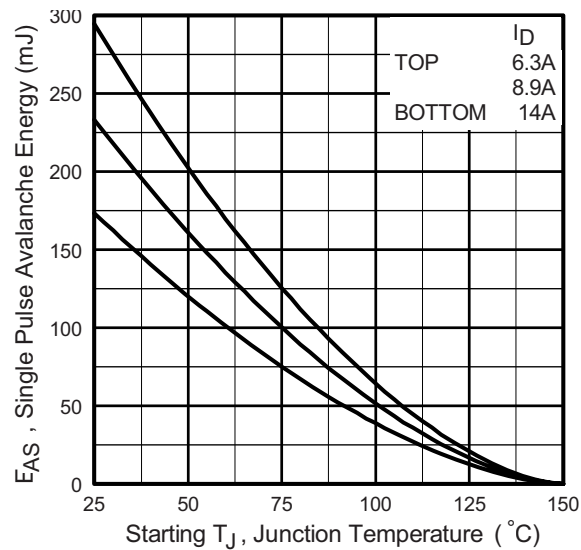


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

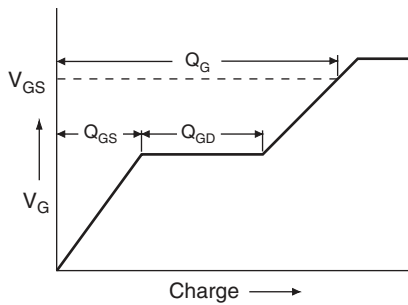


Fig. 13a - Basic Gate Charge Waveform

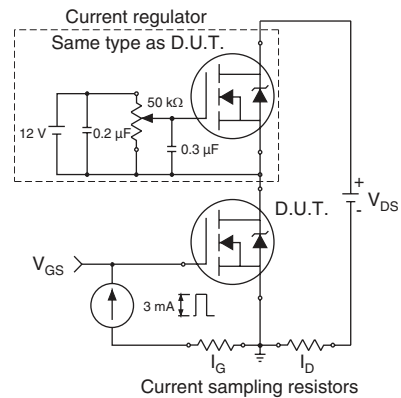


Fig. 13b - Gate Charge Test Circuit

## Peak Diode Recovery $dV/dt$ Test Circuit

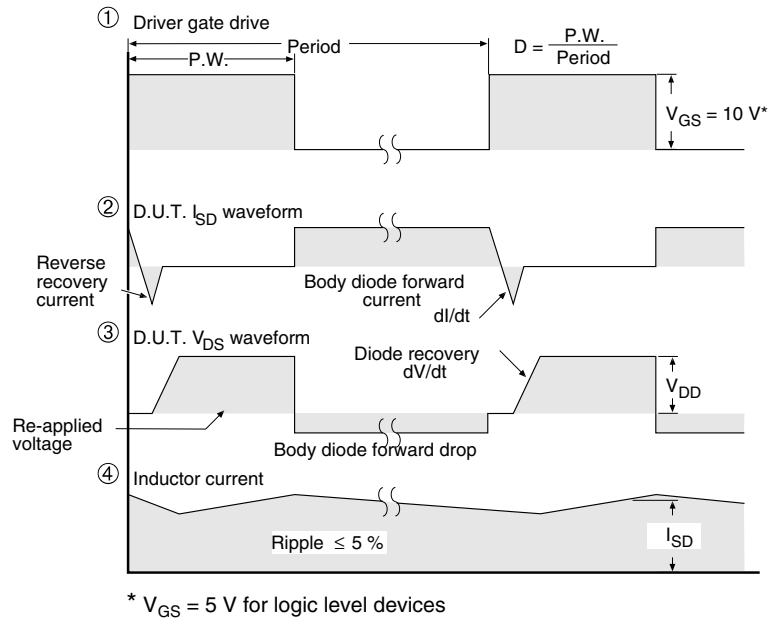
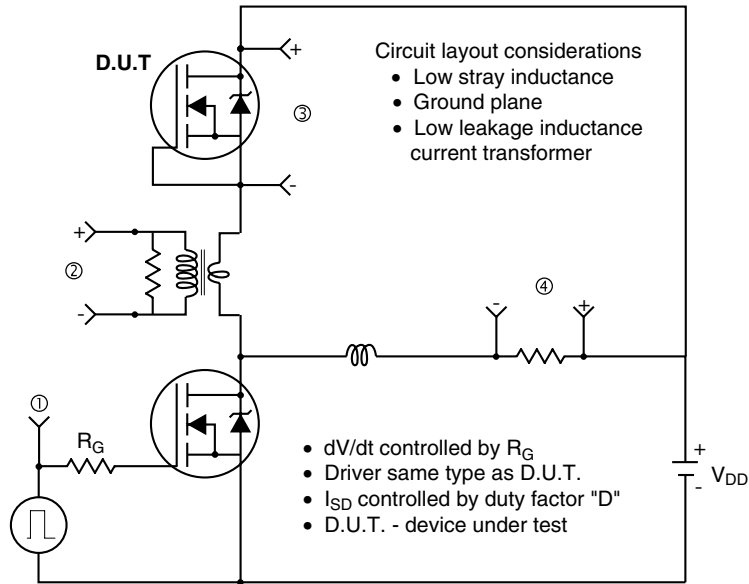


Fig. 14 - For N-Channel

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