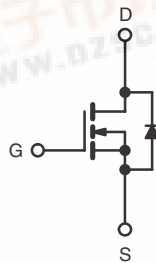


## Power MOSFET

### PRODUCT SUMMARY

|                           |                        |      |
|---------------------------|------------------------|------|
| $V_{DS}$ (V)              | 400                    |      |
| $R_{DS(on)}$ ( $\Omega$ ) | $V_{GS} = 10\text{ V}$ | 0.20 |
| $Q_g$ (Max.) (nC)         | 210                    |      |
| $Q_{gs}$ (nC)             | 30                     |      |
| $Q_{gd}$ (nC)             | 110                    |      |
| Configuration             | Single                 |      |



N-Channel MOSFET

### FEATURES

- Dynamic  $dV/dt$  Rated
- Repetitive Avalanche Rated
- Isolated Central Mounting Hole
- Fast Switching
- Ease of Paralleling
- Simple Drive Requirements
- Lead (Pb)-free Available



### DESCRIPTION

Third generation Power MOSFETs from Vishay provide the designer with the best combination of fast switching, ruggedized device design, low on-resistance and cost-effectiveness.

The TO-247 package is preferred for commercial-industrial applications where higher power levels preclude the use of TO-220 devices. The TO-247 is similar but superior to the earlier TO-218 package because of its isolated mounting hole. It also provides greater creepage distance between pins to meet the requirements of most safety specifications.

### ORDERING INFORMATION

|                |                           |
|----------------|---------------------------|
| Package        | TO-247                    |
| Lead (Pb)-free | IRFP360PbF<br>SiHFP360-E3 |
| SnPb           | IRFP360<br>SiHFP360       |

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

| PARAMETER                                        | SYMBOL           | LIMIT                             | UNIT                |
|--------------------------------------------------|------------------|-----------------------------------|---------------------|
| Drain-Source Voltage                             | $V_{DS}$         | 400                               | V                   |
| Gate-Source Voltage                              | $V_{GS}$         | $\pm 20$                          |                     |
| Continuous Drain Current                         | $I_D$            | $T_C = 25\text{ }^\circ\text{C}$  | A                   |
|                                                  |                  | $T_C = 100\text{ }^\circ\text{C}$ |                     |
| Pulsed Drain Current <sup>a</sup>                | $I_{DM}$         | 92                                |                     |
| Linear Derating Factor                           |                  | 2.2                               | W/ $^\circ\text{C}$ |
| Single Pulse Avalanche Energy <sup>b</sup>       | $E_{AS}$         | 1200                              | mJ                  |
| Repetitive Avalanche Current <sup>a</sup>        | $I_{AR}$         | 23                                | A                   |
| Repetitive Avalanche Energy <sup>a</sup>         | $E_{AR}$         | 28                                | mJ                  |
| Maximum Power Dissipation                        | $P_D$            | 280                               | W                   |
| Peak Diode Recovery $dV/dt$ <sup>c</sup>         | $dV/dt$          | 4.0                               | 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).
- $V_{DD} = 50\text{ V}$ , starting  $T_J = 25\text{ }^\circ\text{C}$ ,  $L = 4.0\text{ mH}$ ,  $R_G = 25\text{ }\Omega$ ,  $I_{AS} = 23\text{ A}$  (see fig. 12).
- $I_{SD} \leq 23\text{ A}$ ,  $dI/dt \leq 170\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq V_{DS}$ ,  $T_J \leq 150\text{ }^\circ\text{C}$ .
- 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)    | $R_{thJC}$ | -    | 0.45 |      |

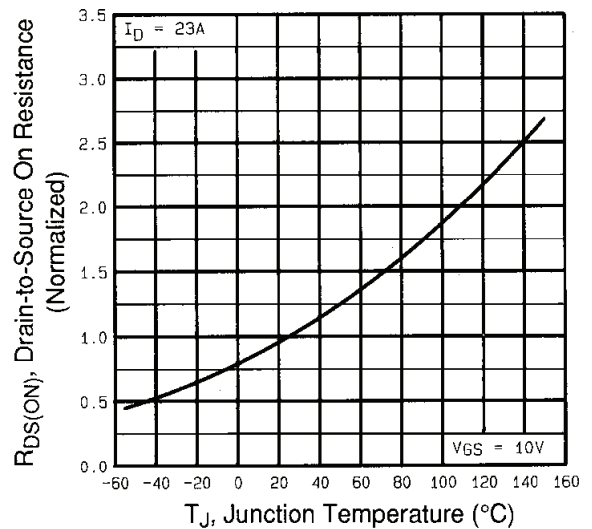
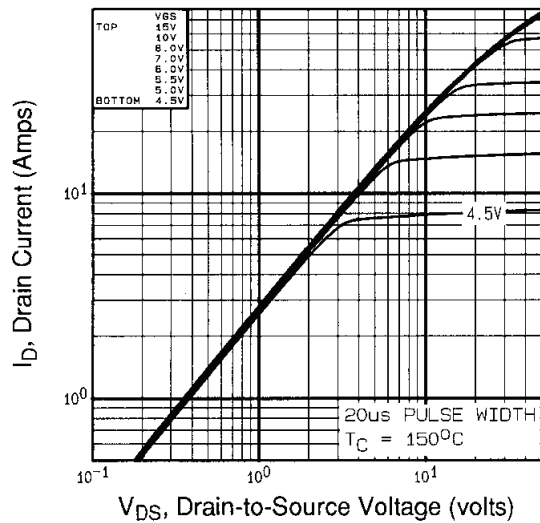
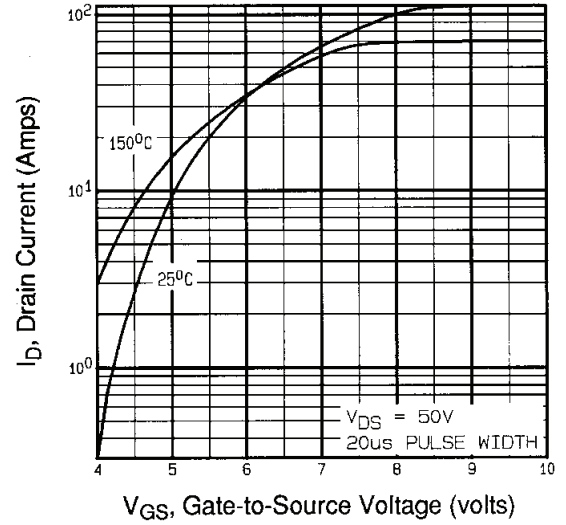
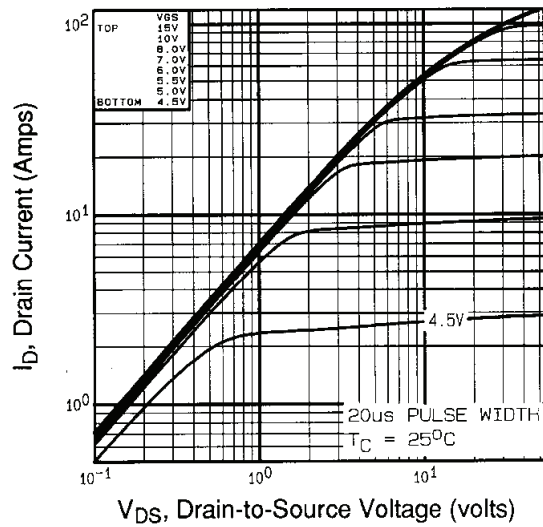
**SPECIFICATIONS**  $T_J = 25\text{ }^{\circ}\text{C}$ , unless otherwise noted

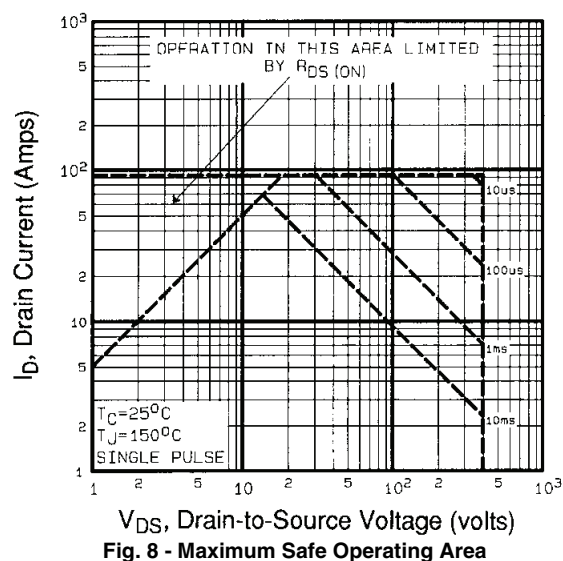
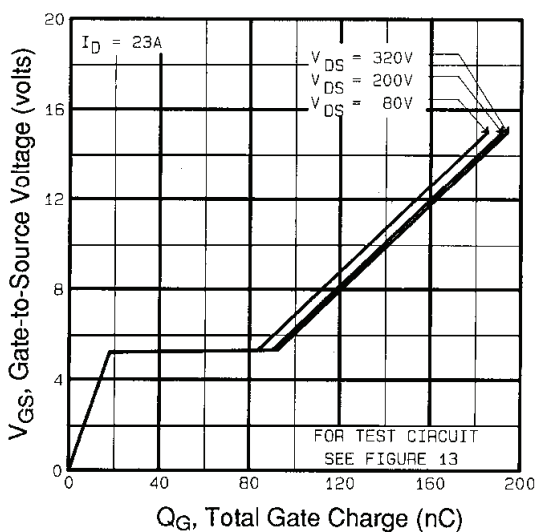
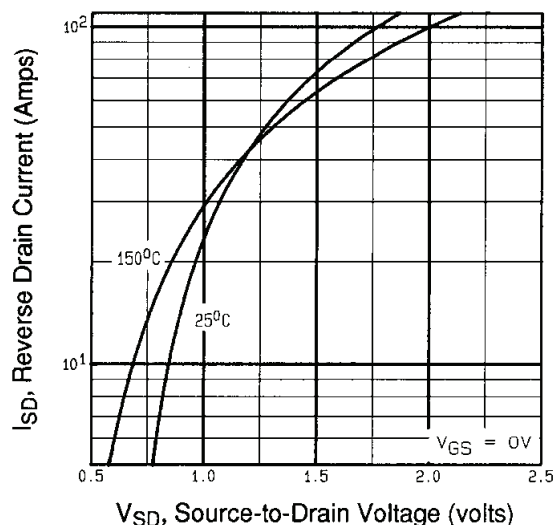
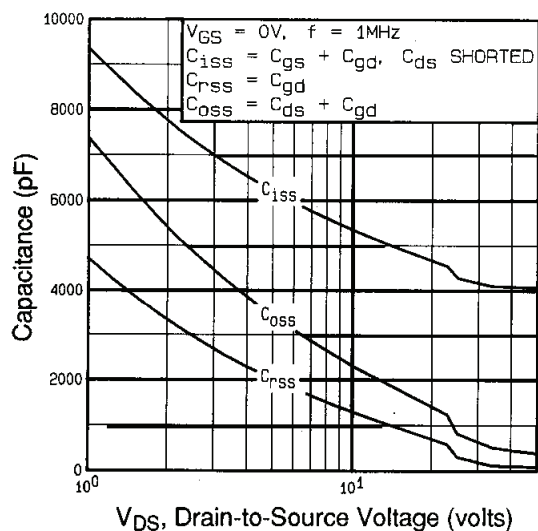
| PARAMETER                                 | SYMBOL                           | TEST CONDITIONS                                                                                                              |                                                                                   | MIN. | TYP. | MAX.  | UNIT |
|-------------------------------------------|----------------------------------|------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------|------|-------|------|
| Static                                    |                                  |                                                                                                                              |                                                                                   |      |      |       |      |
| Drain-Source Breakdown Voltage            | V <sub>DS</sub>                  | V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA                                                                               |                                                                                   | 400  | -    | -     | 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                                                                                    |                                                                                   | -    | 0.56 | -     | 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                                                                  |                                                                                   | 2.0  | -    | 4.0   | V    |
| Gate-Source Leakage                       | I <sub>GSS</sub>                 | V <sub>GS</sub> = ± 20 V                                                                                                     |                                                                                   | -    | -    | ± 100 | nA   |
| Zero Gate Voltage Drain Current           | I <sub>DSS</sub>                 | V <sub>DS</sub> = 400 V, V <sub>GS</sub> = 0 V                                                                               |                                                                                   | -    | -    | 25    | μA   |
|                                           |                                  | V <sub>DS</sub> = 320 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 125 °C                                                      |                                                                                   | -    | -    | 250   |      |
| Drain-Source On-State Resistance          | R <sub>DS(on)</sub>              | V <sub>GS</sub> = 10 V                                                                                                       | I <sub>D</sub> = 14 A <sup>b</sup>                                                | -    | -    | 0.20  | Ω    |
| Forward Transconductance                  | g <sub>fs</sub>                  | V <sub>DS</sub> = 50 V, I <sub>D</sub> = 14 A <sup>b</sup>                                                                   |                                                                                   | 14   | -    | -     | 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                                                 |                                                                                   | -    | 4500 | -     | pF   |
| Output Capacitance                        | C <sub>oss</sub>                 |                                                                                                                              |                                                                                   | -    | 1100 | -     |      |
| Reverse Transfer Capacitance              | C <sub>rss</sub>                 |                                                                                                                              |                                                                                   | -    | 490  | -     |      |
| Total Gate Charge                         | Q <sub>g</sub>                   | V <sub>GS</sub> = 10 V                                                                                                       | I <sub>D</sub> = 23 A, V <sub>DS</sub> = 320 V,<br>see fig. 6 and 13 <sup>b</sup> | -    | -    | 210   | nC   |
| Gate-Source Charge                        | Q <sub>gs</sub>                  |                                                                                                                              |                                                                                   | -    | -    | 30    |      |
| Gate-Drain Charge                         | Q <sub>gd</sub>                  |                                                                                                                              |                                                                                   | -    | -    | 110   |      |
| Turn-On Delay Time                        | t <sub>d(on)</sub>               | V <sub>DD</sub> = 200 V, I <sub>D</sub> = 23 A ,<br>R <sub>G</sub> = 4.3 Ω, R <sub>D</sub> = 8.3 Ω, see fig. 10 <sup>b</sup> |                                                                                   | -    | 18   | -     | ns   |
| Rise Time                                 | t <sub>r</sub>                   |                                                                                                                              |                                                                                   | -    | 79   | -     |      |
| Turn-Off Delay Time                       | t <sub>d(off)</sub>              |                                                                                                                              |                                                                                   | -    | 100  | -     |      |
| Fall Time                                 | t <sub>f</sub>                   |                                                                                                                              |                                                                                   | -    | 67   | -     |      |
| 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                                                     |                                                                                   | -    | -    | 23    | A    |
| Pulsed Diode Forward Current <sup>a</sup> | I <sub>SM</sub>                  |                                                                                                                              |                                                                                   | -    | -    | 92    |      |
| Body Diode Voltage                        | V <sub>SD</sub>                  | T <sub>J</sub> = 25 °C, I <sub>S</sub> = 23 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> = 23 A, dI/dt = 100 A/μs <sup>b</sup>                                                 |                                                                                   | -    | 420  | 630   | ns   |
| Body Diode Reverse Recovery Charge        | Q <sub>rr</sub>                  |                                                                                                                              |                                                                                   | -    | 5.6  | 8.4   | 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





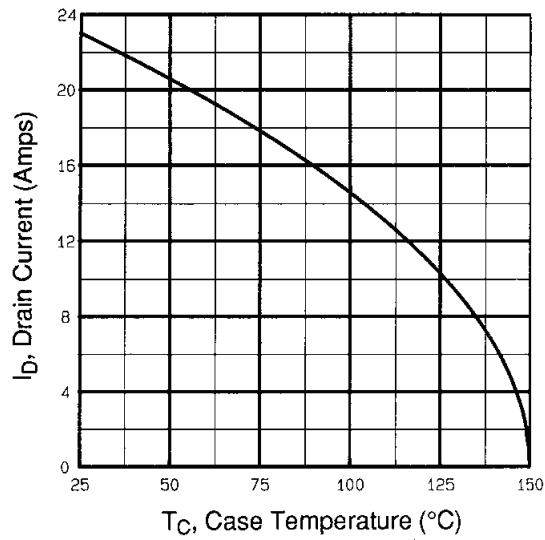


Fig. 9 - Maximum Drain Current vs. Case Temperature

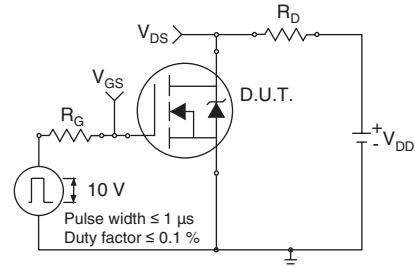


Fig. 10a - Switching Time Test Circuit

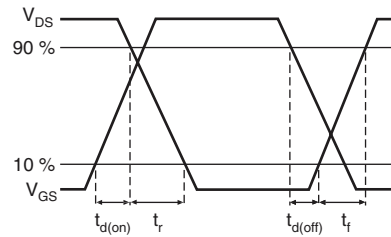


Fig. 10b - Switching Time Waveforms

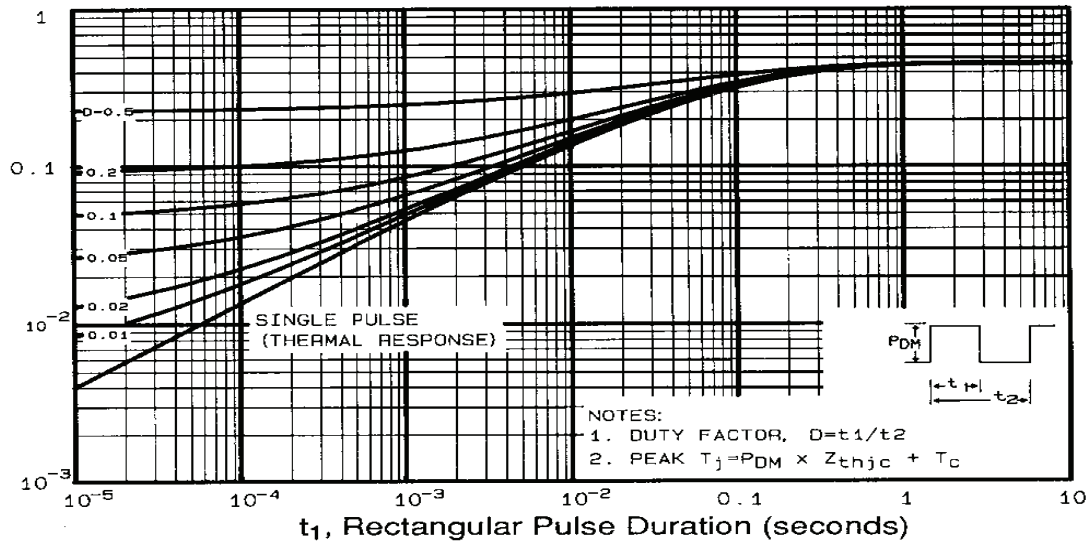


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

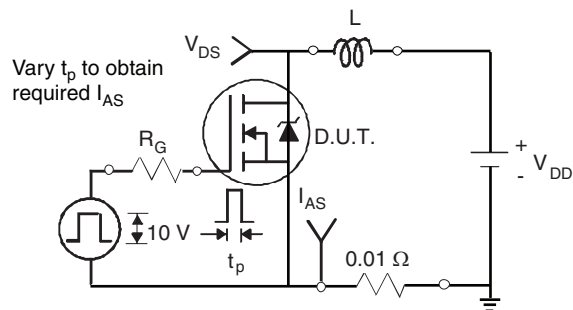


Fig. 12a - Unclamped Inductive Test Circuit

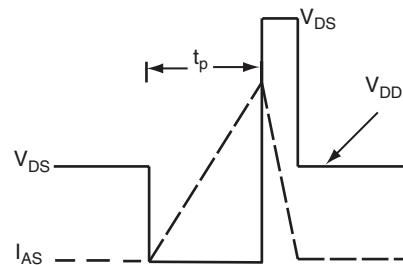


Fig. 12b - Unclamped Inductive Waveforms

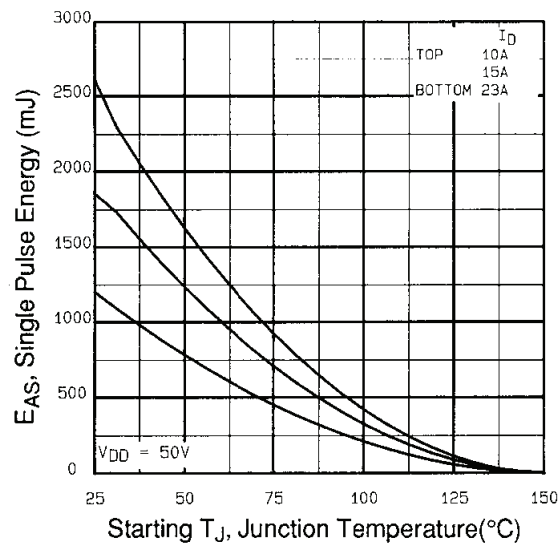


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

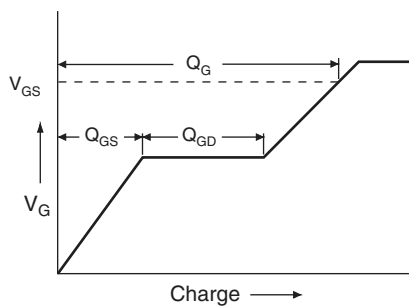


Fig. 13a - Basic Gate Charge Waveform

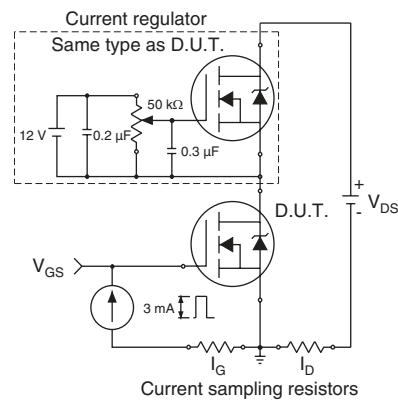
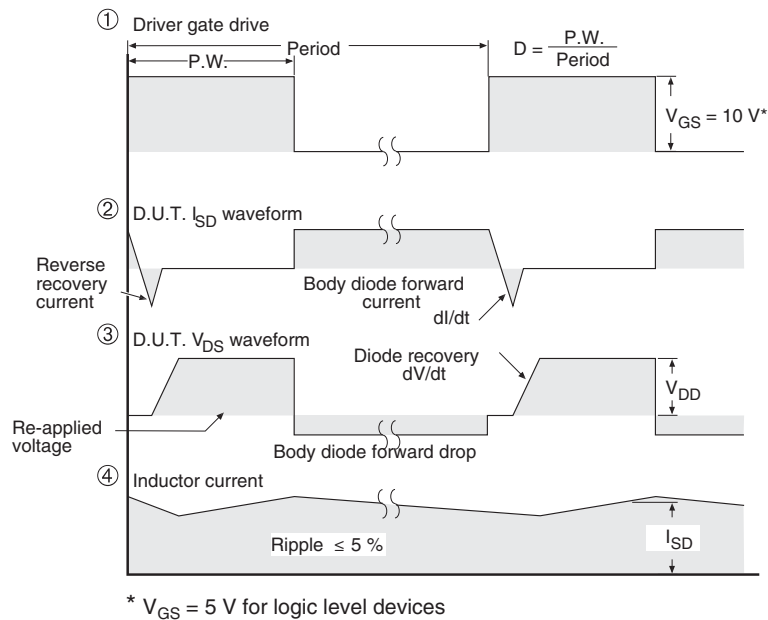
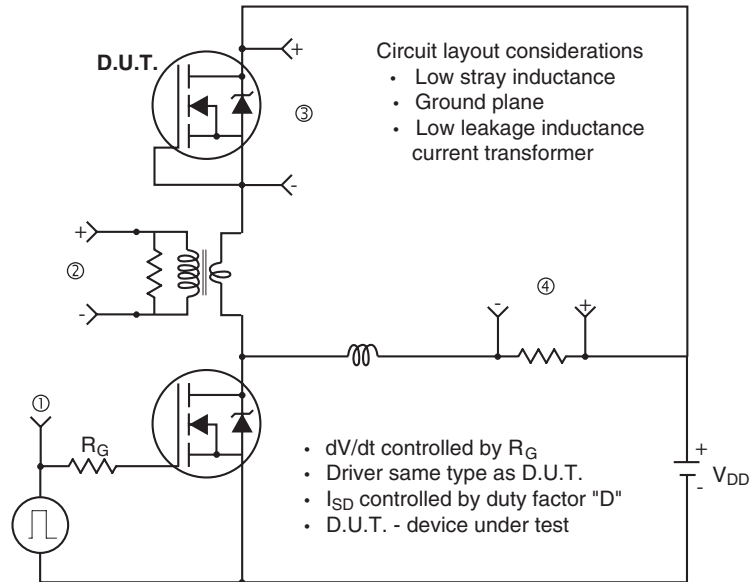


Fig. 13b - Gate Charge Test Circuit

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



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

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