

## Power MOSFET

### PRODUCT SUMMARY

|                           |                        |     |
|---------------------------|------------------------|-----|
| $V_{DS}$ (V)              | 500                    |     |
| $R_{DS(on)}$ ( $\Omega$ ) | $V_{GS} = 10\text{ V}$ | 3.0 |
| $Q_g$ (Max.) (nC)         | 24                     |     |
| $Q_{gs}$ (nC)             | 3.3                    |     |
| $Q_{gd}$ (nC)             | 13                     |     |
| Configuration             | Single                 |     |

### FEATURES

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

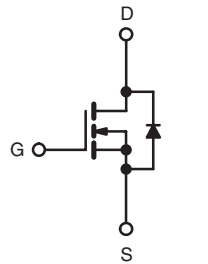
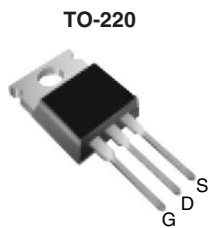


Available  
**RoHS\***  
COMPLIANT

### 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-220 package is universally preferred for commercial-industrial applications at power dissipation levels to approximately 50 W. The low thermal resistance and low package cost of the TO-220 contribute to its wide acceptance throughout the industry.



N-Channel MOSFET

### ORDERING INFORMATION

|                |                         |
|----------------|-------------------------|
| Package        | TO-220                  |
| Lead (Pb)-free | IRF820PbF<br>SiHF820-E3 |
| SnPb           | IRF820<br>SiHF820       |

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

| PARAMETER                                        |                         |                         | SYMBOL                            | LIMIT            | UNIT     |
|--------------------------------------------------|-------------------------|-------------------------|-----------------------------------|------------------|----------|
| Drain-Source Voltage                             |                         |                         | V <sub>DS</sub>                   | 500              | 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 |                                   | 1.6              |          |
| Pulsed Drain Current <sup>a</sup>                |                         |                         | I <sub>DM</sub>                   | 8.0              |          |
| Linear Derating Factor                           |                         |                         |                                   | 0.40             | W/°C     |
| Single Pulse Avalanche Energy <sup>b</sup>       |                         |                         | E <sub>AS</sub>                   | 210              | mJ       |
| Repetitive Avalanche Current <sup>a</sup>        |                         |                         | I <sub>AR</sub>                   | 2.5              | A        |
| Repetitive Avalanche Energy <sup>a</sup>         |                         |                         | E <sub>AR</sub>                   | 5.0              | mJ       |
| Maximum Power Dissipation                        | T <sub>C</sub> = 25 °C  |                         | P <sub>D</sub>                    | 50               | W        |
| Peak Diode Recovery dV/dt <sup>c</sup>           |                         |                         | dV/dt                             | 3.5              | 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

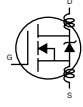
- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- $V_{DD} = 50\text{ V}$ , starting  $T_J = 25\text{ }^{\circ}\text{C}$ ,  $L = 60\text{ mH}$ ,  $R_G = 25\text{ }\Omega$ ,  $I_{AS} = 2.5\text{ A}$  (see fig. 12).
- $I_{SD} \leq 2.5\text{ A}$ ,  $dI/dt \leq 50\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq V_{DS}$ ,  $T_J \leq 150\text{ }^{\circ}\text{C}$ .
- 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         | $R_{thJA}$ | -    | 62   | °C/W |
| Case-to-Sink, Flat, Greased Surface | $R_{thCS}$ | 0.50 | -    |      |
| Maximum Junction-to-Case (Drain)    | $R_{thJC}$ | -    | 2.5  |      |

**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                                                                                                                     |                                                                                    | 500  | -    | -     | 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                                                                                                                          |                                                                                    | -    | 0.59 | -     | 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> = 500 V, V <sub>GS</sub> = 0 V                                                                                                                     |                                                                                    | -    | -    | 25    | μA   |
|                                           |                                  | V <sub>DS</sub> = 400 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> = 1.5 A <sup>b</sup>                                                | -    | -    | 3.0   | Ω    |
| Forward Transconductance                  | g <sub>fs</sub>                  | V <sub>DS</sub> = 50 V, I <sub>D</sub> = 1.5 A                                                                                                                     |                                                                                    | 1.5  | -    | -     | 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                                                                                       |                                                                                    | -    | 360  | -     | pF   |
| Output Capacitance                        | C <sub>oss</sub>                 |                                                                                                                                                                    |                                                                                    | -    | 92   | -     |      |
| Reverse Transfer Capacitance              | C <sub>rss</sub>                 |                                                                                                                                                                    |                                                                                    | -    | 37   | -     |      |
| Total Gate Charge                         | Q <sub>g</sub>                   | V <sub>GS</sub> = 10 V                                                                                                                                             | I <sub>D</sub> = 2.1 A, V <sub>DS</sub> = 400 V,<br>see fig. 6 and 13 <sup>b</sup> | -    | -    | 24    | nC   |
| Gate-Source Charge                        | Q <sub>gs</sub>                  |                                                                                                                                                                    |                                                                                    | -    | -    | 3.3   |      |
| Gate-Drain Charge                         | Q <sub>gd</sub>                  |                                                                                                                                                                    |                                                                                    | -    | -    | 13    |      |
| Turn-On Delay Time                        | t <sub>d(on)</sub>               | V <sub>DD</sub> = 250 V, I <sub>D</sub> = 2.1 A,<br>R <sub>G</sub> = 18 Ω, R <sub>D</sub> = 100 Ω, see fig. 10 <sup>b</sup>                                        |                                                                                    | -    | 8.0  | -     | ns   |
| Rise Time                                 | t <sub>r</sub>                   |                                                                                                                                                                    |                                                                                    | -    | 8.6  | -     |      |
| Turn-Off Delay Time                       | t <sub>d(off)</sub>              |                                                                                                                                                                    |                                                                                    | -    | 33   | -     |      |
| Fall Time                                 | t <sub>f</sub>                   |                                                                                                                                                                    |                                                                                    | -    | 16   | -     |      |
| Internal Drain Inductance                 | L <sub>D</sub>                   | Between lead,<br>6 mm (0.25") from<br>package and center of<br>die contact<br> |                                                                                    | -    | 4.5  | -     | nH   |
| Internal Source Inductance                | L <sub>S</sub>                   |                                                                                                                                                                    |                                                                                    | -    | 7.5  | -     |      |
| 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<br>   |                                                                                    | -    | -    | 2.5   | A    |
| Pulsed Diode Forward Current <sup>a</sup> | I <sub>SM</sub>                  |                                                                                                                                                                    |                                                                                    | -    | -    | 8.0   |      |
| Body Diode Voltage                        | V <sub>SD</sub>                  | T <sub>J</sub> = 25 °C, I <sub>S</sub> = 2.5 A, V <sub>GS</sub> = 0 V <sup>b</sup>                                                                                 |                                                                                    | -    | -    | 1.6   | V    |
| Body Diode Reverse Recovery Time          | t <sub>rr</sub>                  | T <sub>J</sub> = 25 °C, I <sub>F</sub> = 2.1 A, dI/dt = 100 A/μs                                                                                                   |                                                                                    | -    | 260  | 520   | ns   |
| Body Diode Reverse Recovery Charge        | Q <sub>rr</sub>                  |                                                                                                                                                                    |                                                                                    | -    | 0.7  | 1.4   | nC   |
| 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

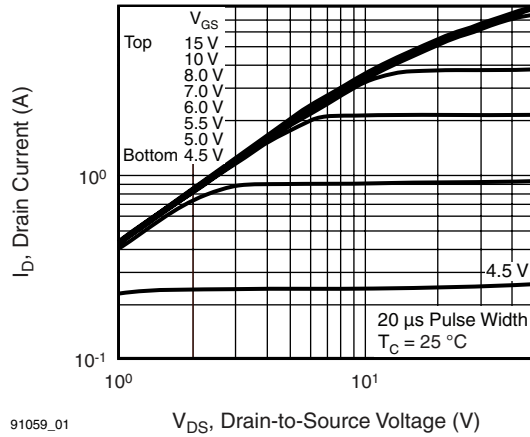


Fig. 1 - Typical Output Characteristics,  $T_C = 25^\circ\text{C}$

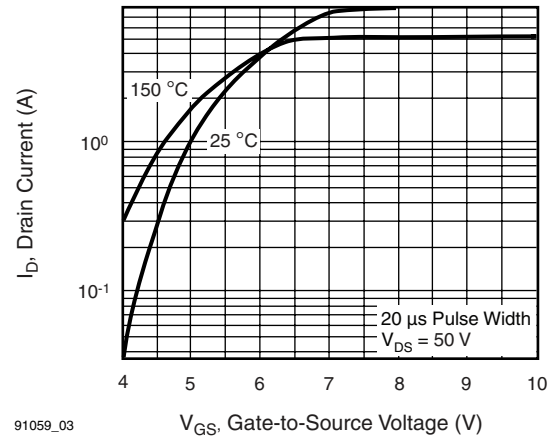


Fig. 3 - Typical Transfer Characteristics

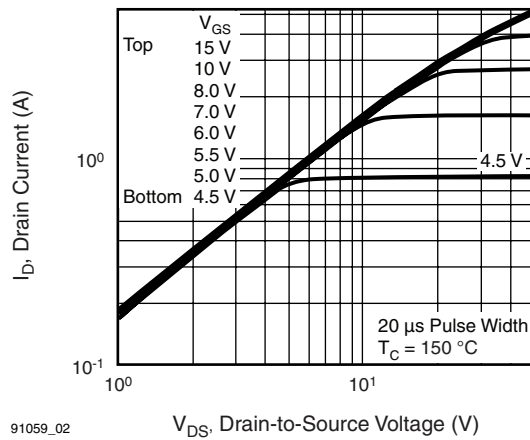


Fig. 2 - Typical Output Characteristics,  $T_C = 150^\circ\text{C}$

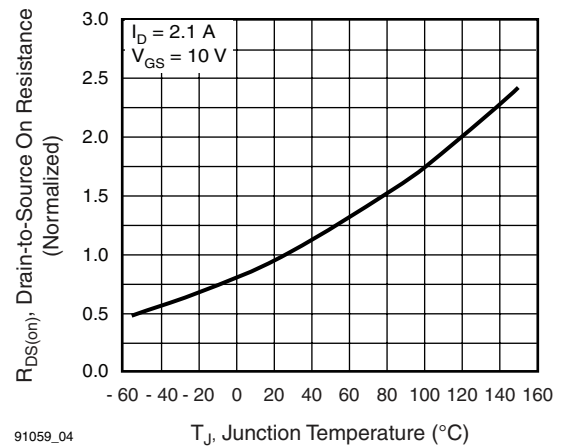


Fig. 4 - Normalized On-Resistance vs. Temperature

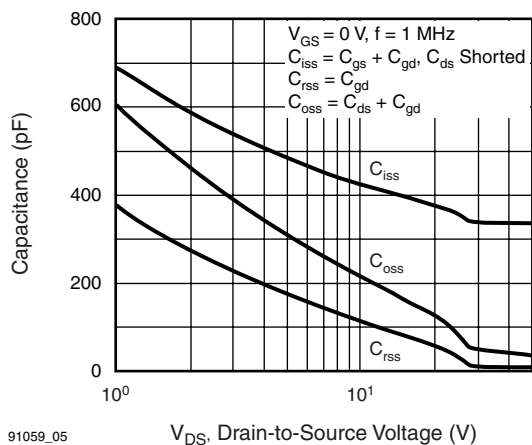


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

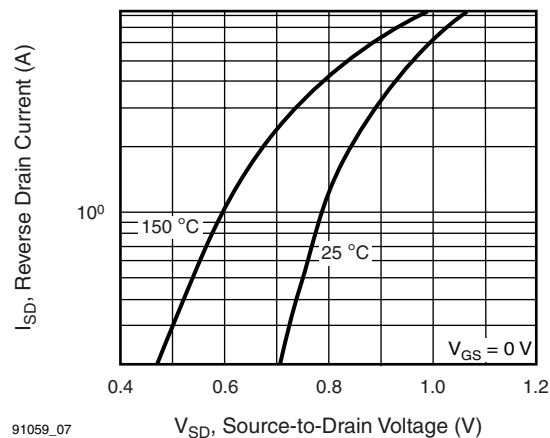


Fig. 7 - Typical Source-Drain Diode Forward Voltage

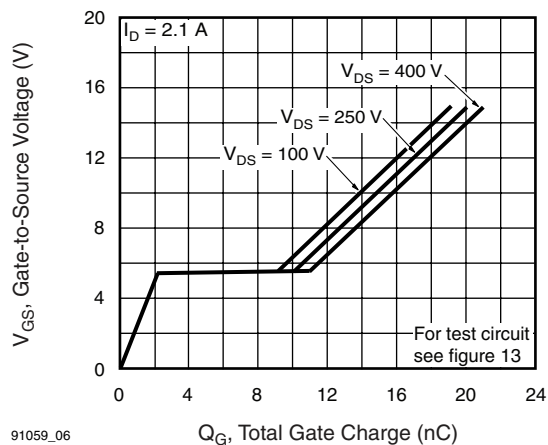


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

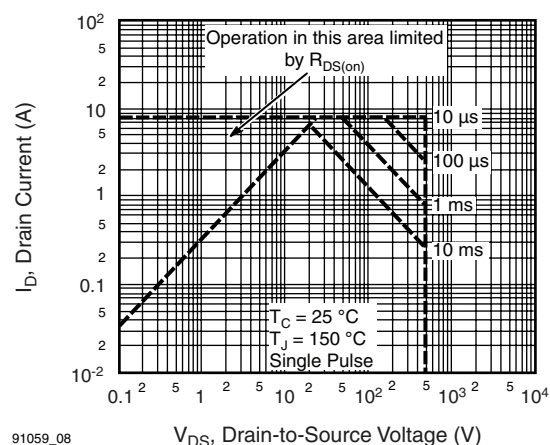
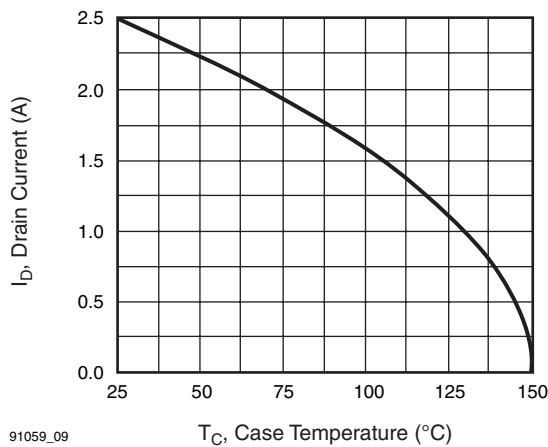
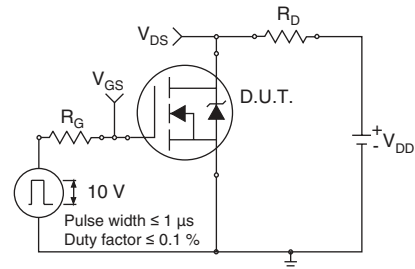


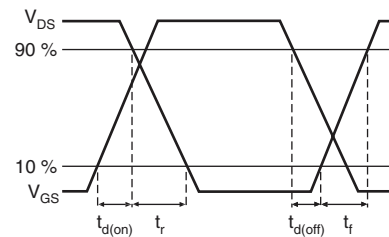
Fig. 8 - Maximum Safe Operating Area



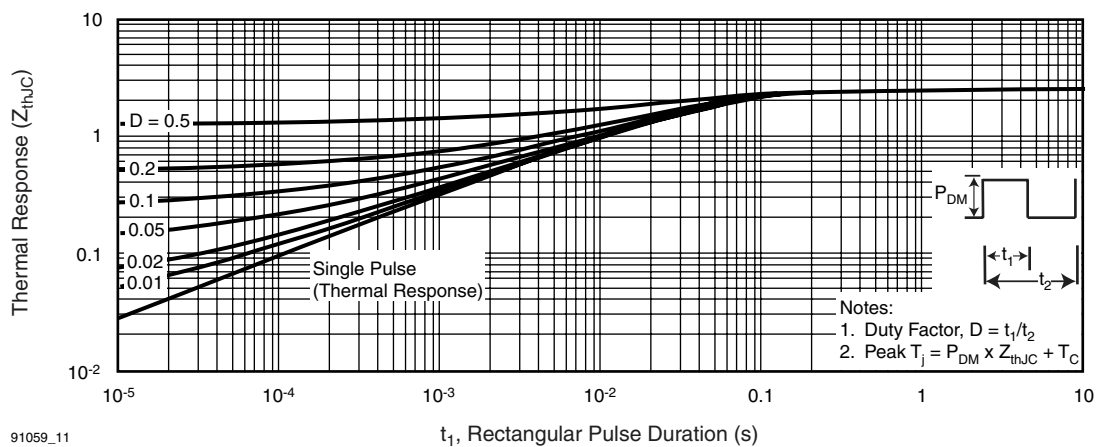
**Fig. 9 - Maximum Drain Current vs. Case Temperature**



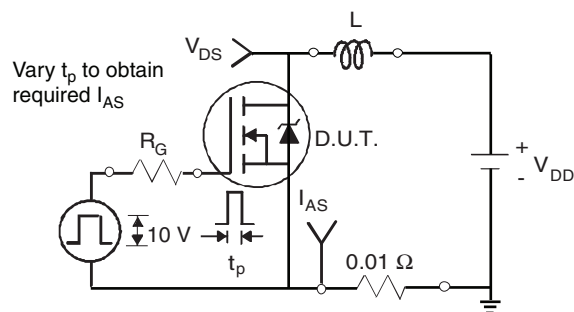
**Fig. 10a - Switching Time Test Circuit**



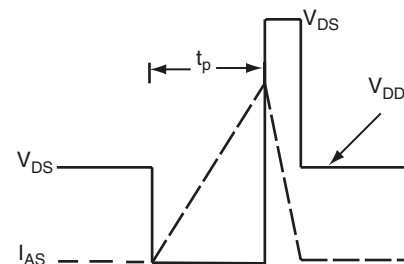
**Fig. 10b - Switching Time Waveforms**



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



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



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

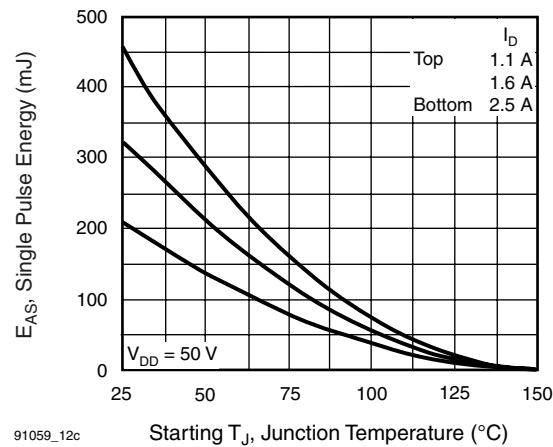


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

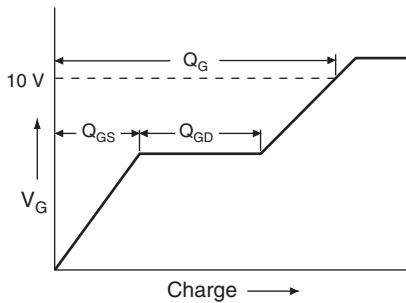


Fig. 13a - Basic Gate Charge Waveform

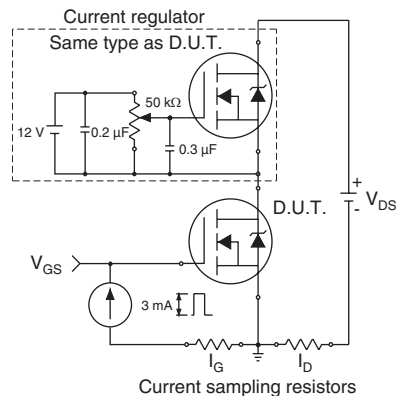
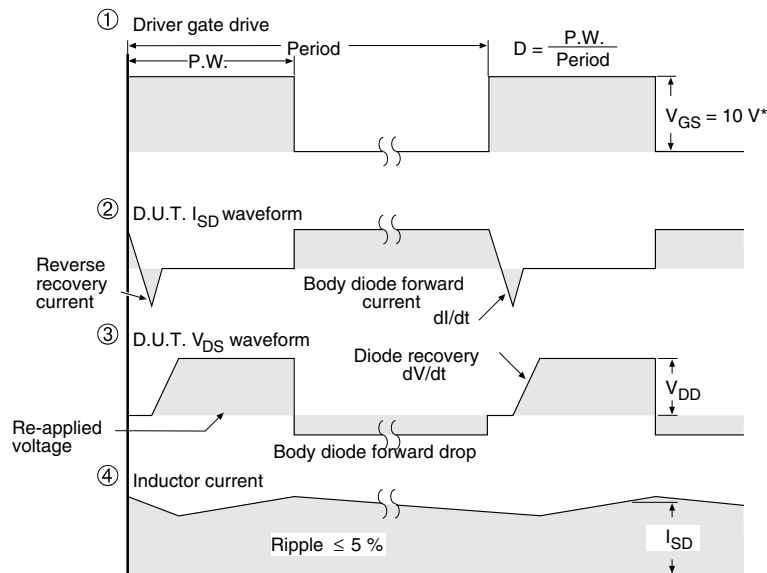
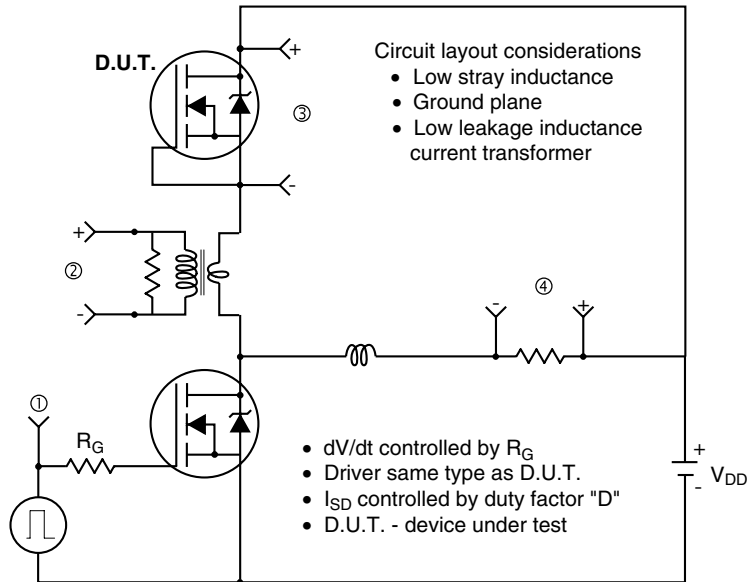


Fig. 13b - Gate Charge Test

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



\*  $V_{GS} = 5 V$  for logic level devices

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

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