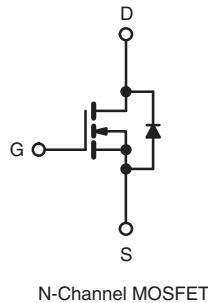
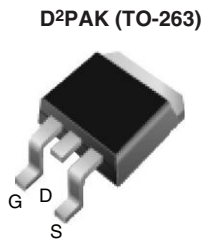


## S Series Power MOSFET

| PRODUCT SUMMARY                         |                 |       |
|---|-----------------|-------|
| $V_{DS}$ at $T_J$ max. (V)              | 650             |       |
| $R_{DS(on)}$ max. at 25 °C ( $\Omega$ ) | $V_{GS} = 10$ V | 0.190 |
| $Q_g$ max. (nC)                         | 98              |       |
| $Q_{gs}$ (nC)                           | 17              |       |
| $Q_{gd}$ (nC)                           | 25              |       |
| Configuration                           | Single          |       |



### FEATURES

- Generation One
- **Halogen-free According to IEC 61249-2-21 Definition**
- High  $E_{AR}$  Capability
- Lower Figure-of-Merit  $R_{on} \times Q_g$
- 100 % Avalanche Tested
- Ultra Low  $R_{on}$
- dV/dt Ruggedness
- Ultra Low Gate Charge ( $Q_g$ )
- Compliant to RoHS Directive 2002/95/EC

### Note

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

### APPLICATIONS

- PFC Power Supply Stages
- Hard Switching Topologies
- Solar Inverters
- UPS
- Motor Control
- Lighting
- Server Telecom



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

| ORDERING INFORMATION            |                             |
|---------------------------------|-----------------------------|
| Package                         | D <sup>2</sup> PAK (TO-263) |
| Lead (Pb)-free and Halogen-free | SiHB22N60S-GE3              |
| Lead (Pb)-free                  | SiHB22N60S-E3               |


| ABSOLUTE MAXIMUM RATINGS ( $T_C = 25$ °C, unless otherwise noted) |                  |                             |               |      |      |
|---|------------------|-----------------------------|---------------|------|------|
| PARAMETER   | SYMBOL           | LIMIT                       | UNIT          |      |      |
| Drain-Source Voltage  | $V_{DS}$         | 600                         | V             |      |      |
| Gate-Source Voltage   | $V_{GS}$         | $\pm 20$                    |               |      |      |
| Gate-Source Voltage AC ( $f > 1$ Hz)                              |                  | 30                          |               |      |      |
| Continuous Drain Current  | $V_{GS}$ at 10 V | $T_C = 25$ °C               | 22            | A    |      |
|   |                  | $T_C = 100$ °C              | 13            |      |      |
| Pulsed Drain Current <sup>a</sup>                                 |                  | $I_{DM}$                    | 65            |      |      |
| Linear Derating Factor  |                  | D <sup>2</sup> PAK (TO-263) | 2             | W/°C |      |
| Single Pulse Avalanche Energy <sup>b</sup>                        |                  | $E_{AS}$                    | 690           | mJ   |      |
| Repetitive Avalanche Energy <sup>a</sup>                          |                  | $E_{AR}$                    | 25            |      |      |
| Maximum Power Dissipation   |                  | D <sup>2</sup> PAK (TO-263) | $P_D$         | 250  | W    |
| Drain-Source Voltage Slope  | $T_J = 125$ °C   |                             | dV/dt         | 37   | V/ns |
| Reverse Diode dV/dt <sup>d</sup>                                  |                  |                             |               | 5.3  |      |
| Operating Junction and Storage Temperature Range                  |                  | $T_J, T_{stg}$              | - 55 to + 150 | °C   |      |
| Soldering Recommendations (Peak Temperature) <sup>c</sup>         | for 10 s         |                             | 300           |      |      |

### Notes

- Repetitive rating; pulse width limited by maximum junction temperature.
- $V_{DD} = 50$  V, starting  $T_J = 25$  °C,  $L = 28.2$  mH,  $R_g = 25$   $\Omega$ ,  $I_{AS} = 7$  A.
- 1.6 mm from case.
- $I_{SD} \leq I_D$ ,  $dI/dt = 100$  A/ $\mu$ s, starting  $T_J = 25$  °C.



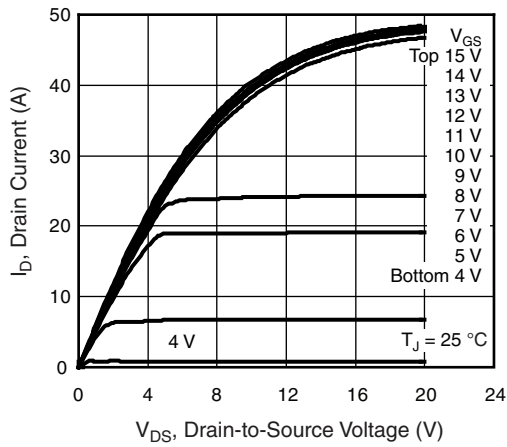
| THERMAL RESISTANCE RATINGS       |                             |                   |      |      |      |
|----------------------------------|-----------------------------|-------------------|------|------|------|
| PARAMETER                        |                             | SYMBOL            | TYP. | MAX. | UNIT |
| Maximum Junction-to-Ambient      | D <sup>2</sup> PAK (TO-263) | R <sub>thJA</sub> | -    | 62   | °C/W |
| Maximum Junction-to-Case (Drain) | D <sup>2</sup> PAK (TO-263) | R <sub>thJC</sub> | -    | 0.5  |      |

| SPECIFICATIONS (T <sub>J</sub> = 25 °C, unless otherwise noted) |  |   |  |      |       |       |      |
|---|--|---|--|------|-------|-------|------|
| PARAMETER   | SYMBOL                                 | TEST CONDITIONS   |  | MIN. | TYP.  | MAX.  | UNIT |
| <b>Static</b>   |  |   |  |      |       |       |      |
| Drain-Source Breakdown Voltage                                  | V <sub>DS</sub>                        | V <sub>GS</sub> = 0 V, I <sub>D</sub> = 1 mA  |  | 600  | -     | -     | 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   |  | -    | 0.70  | -     | V/°C |
| Gate-Source Threshold Voltage (N)                               | 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> = 600 V, V <sub>GS</sub> = 0 V  |  | -    | -     | 1     | μA   |
|   |  | V <sub>DS</sub> = 600 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 150 °C   |  | -    | -     | 100   |      |
| Drain-Source On-State Resistance                                | R <sub>DS(on)</sub>                    | V <sub>GS</sub> = 10 V  | I <sub>D</sub> = 11 A                          | -    | 0.160 | 0.190 | Ω    |
| Forward Transconductance <sup>a</sup>                           | g <sub>fs</sub>                        | V <sub>DS</sub> = 50 V, I <sub>D</sub> = 13 A   |  | -    | 9.4   | -     | S    |
| <b>Dynamic</b>  |  |   |  |      |       |       |      |
| Input Capacitance   | C <sub>iss</sub>                       | V <sub>GS</sub> = 0 V,<br>V <sub>DS</sub> = 25 V,<br>f = 1.0 MHz  |  | -    | 2810  | -     | pF   |
| Output Capacitance  | C <sub>oss</sub>                       |   |  | -    | 1480  | -     |      |
| Reverse Transfer Capacitance                                    | C <sub>rss</sub>                       |   |  | -    | 33    | -     |      |
| Effective Output Capacitance (Time Related)                     | C <sub>oss eff. (TR)<sup>a</sup></sub> | V <sub>GS</sub> = 0 V   | V <sub>DS</sub> = 0 V to 480 V                 | -    | 155   | -     |      |
| Total Gate Charge   | Q <sub>g</sub>                         | V <sub>GS</sub> = 10 V  | I <sub>D</sub> = 22 A, V <sub>DS</sub> = 480 V | -    | 75    | 110   | nC   |
| Gate-Source Charge  | Q <sub>gs</sub>                        |   |  | -    | 17    | -     |      |
| Gate-Drain Charge   | Q <sub>gd</sub>                        |   |  | -    | 25    | -     |      |
| Turn-On Delay Time  | t <sub>d(on)</sub>                     | V <sub>DD</sub> = 380 V, I <sub>D</sub> = 22 A,<br>R <sub>g</sub> = 9.1 Ω, V <sub>GS</sub> = 10 V   |  | -    | 24    | 50    | ns   |
| Rise Time   | t <sub>r</sub>                         |   |  | -    | 68    | 100   |      |
| Turn-Off Delay Time   | t <sub>d(off)</sub>                    |   |  | -    | 77    | 115   |      |
| Fall Time   | t <sub>f</sub>                         |   |  | -    | 59    | 90    |      |
| Gate Input Resistance   | R <sub>g</sub>                         | f = 1 MHz, open drain   |  | -    | 0.65  | -     | Ω    |
| <b>Drain-Source Body Diode Characteristics</b>                  |  |   |  |      |       |       |      |
| Continuous Source-Drain Diode Current                           | I <sub>S</sub>                         | MOSFET symbol showing the integral reverse p - n junction diode  |  | -    | -     | 22    | A    |
| Pulsed Diode Forward Current                                    | I <sub>SM</sub>                        |   |  | -    | -     | 88    |      |
| Diode Forward Voltage   | V <sub>SD</sub>                        | T <sub>J</sub> = 25 °C, I <sub>S</sub> = 22 A, V <sub>GS</sub> = 0 V  |  | -    | -     | 1.2   | V    |
| Reverse Recovery Time   | t <sub>rr</sub>                        | T <sub>J</sub> = 25 °C, I <sub>F</sub> = I <sub>S</sub> ,<br>di/dt = 100 A/μs, V <sub>R</sub> = 25 V  |  | -    | 462   | 690   | ns   |
| Reverse Recovery Charge   | Q <sub>rr</sub>                        |   |  | -    | 8.3   | 16    | μC   |
| Reverse Recovery Current  | I <sub>RRM</sub>                       |   |  | -    | 30    | 60    | A    |

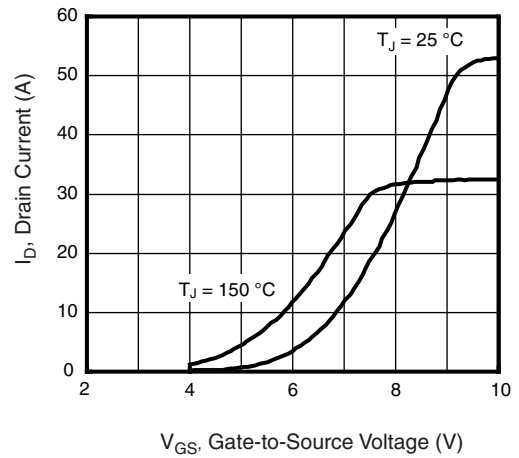
**Note**

a. C<sub>oss eff. (TR)</sub> is a fixed capacitance that gives the same charging time as C<sub>oss</sub> while V<sub>DS</sub> is rising from 0 % to 80 % V<sub>DS</sub>.

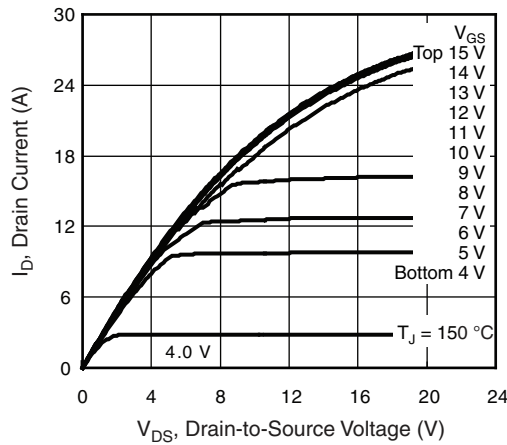
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



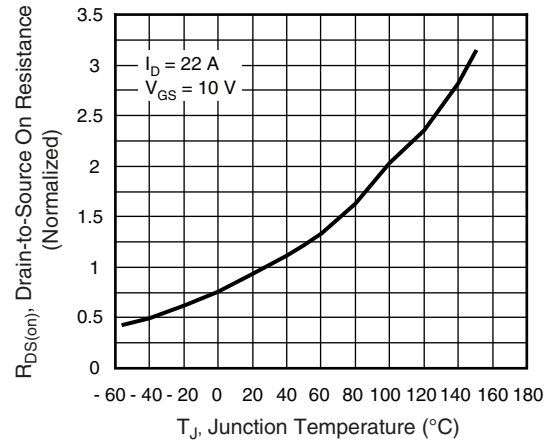
**Fig. 1 - Typical Output Characteristics,  $T_J = 25\text{ }^\circ\text{C}$**



**Fig. 3 - Typical Transfer Characteristics**



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



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

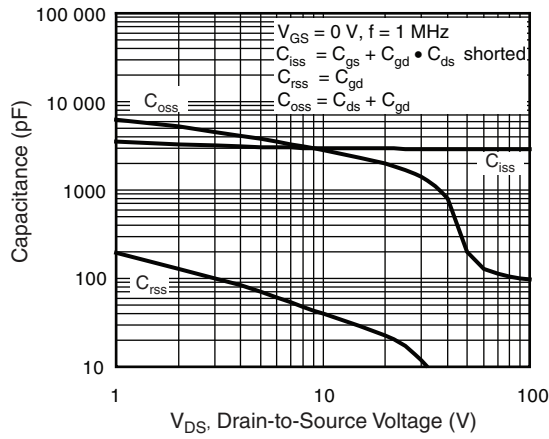


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

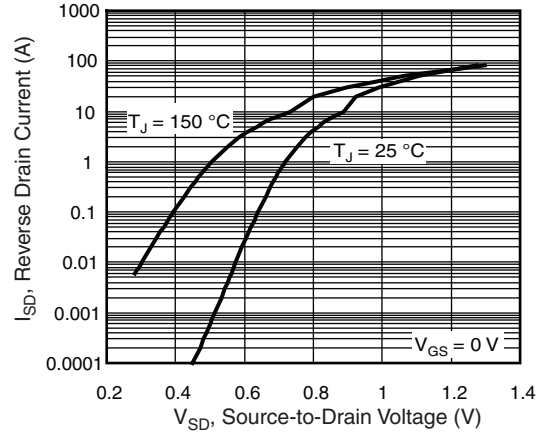


Fig. 7 - Typical Source-Drain Diode Forward Voltage

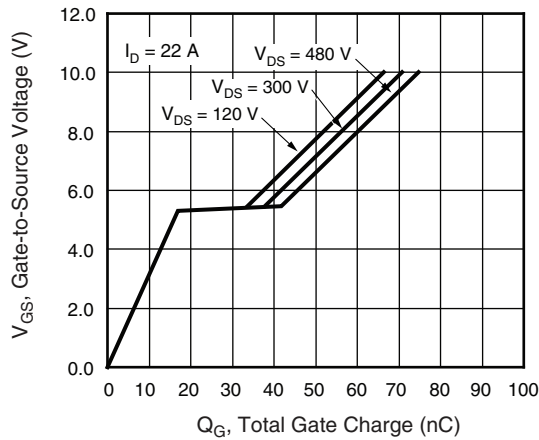


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

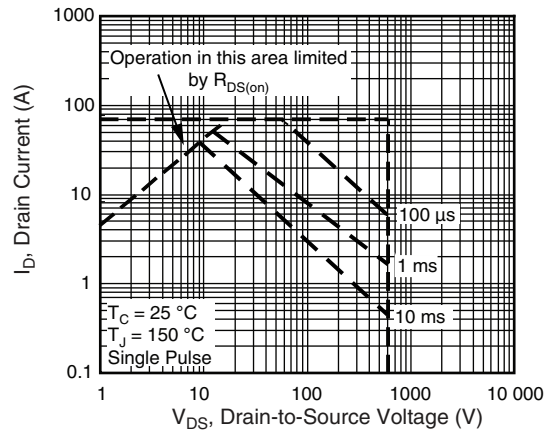
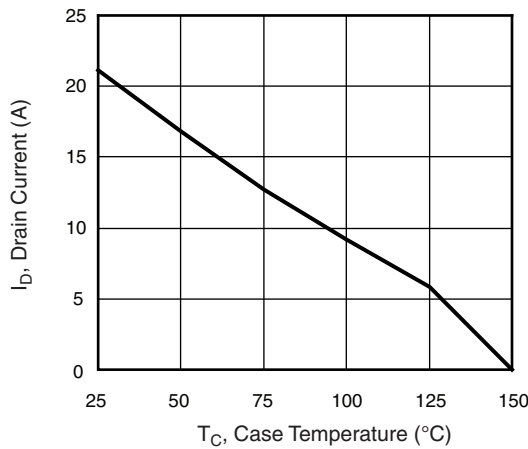
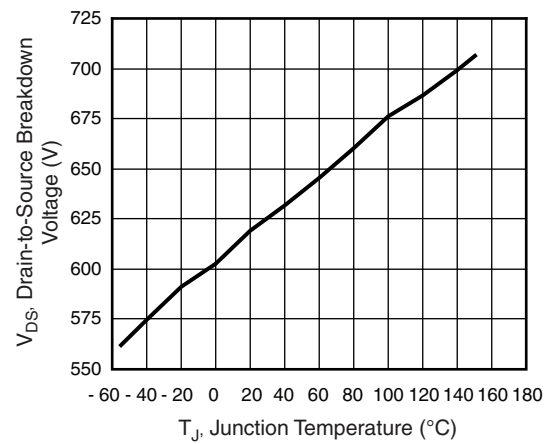


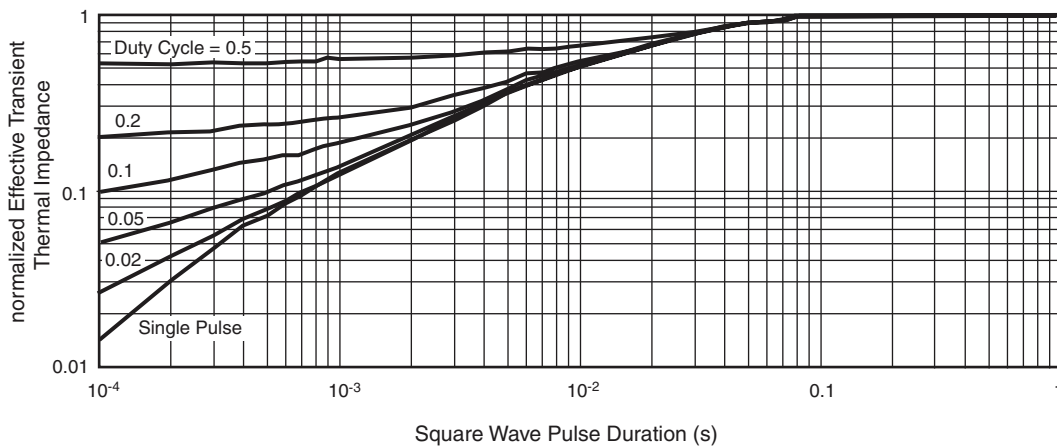
Fig. 8 - Maximum Safe Operating Area



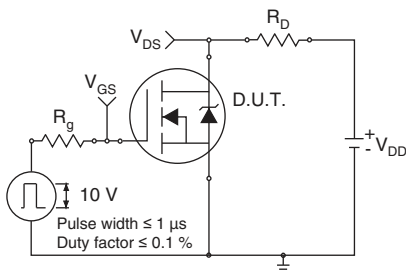
**Fig. 9 - Maximum Drain Current vs. Case Temperature**



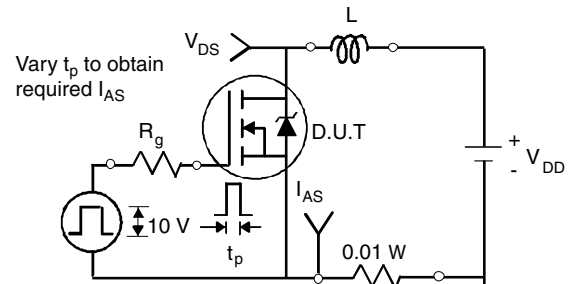
**Fig. 10 - Drain-to-Source Breakdown Voltage**



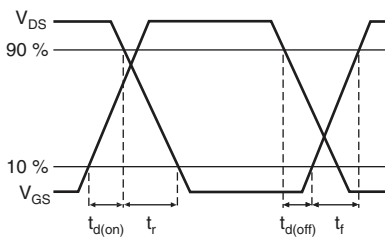
**Fig. 11 - Normalized Thermal Transient Impedance, Junction-to-Case**



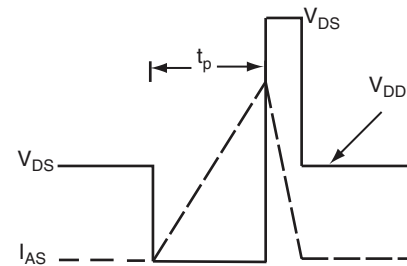
**Fig. 11a - Switching Time Test Circuit**



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



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



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

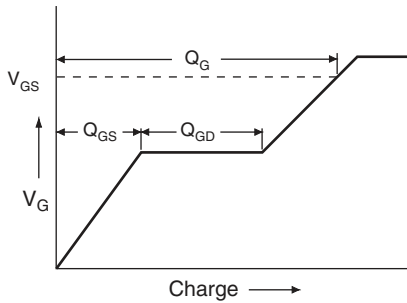


Fig. 13a - Basic Gate Charge Waveform

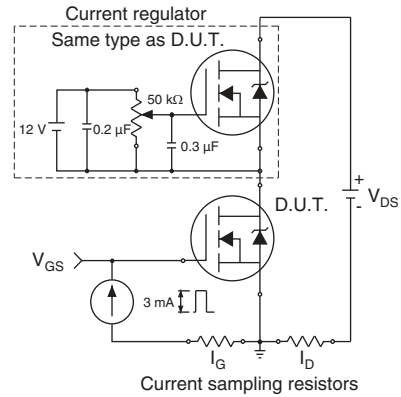


Fig. 13b - Gate Charge Test Circuit

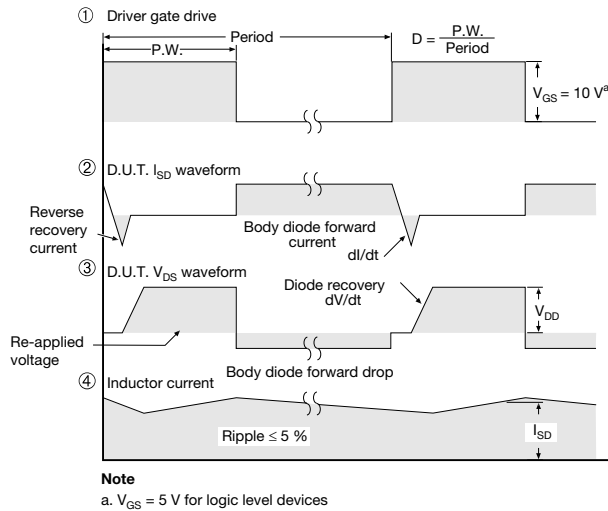
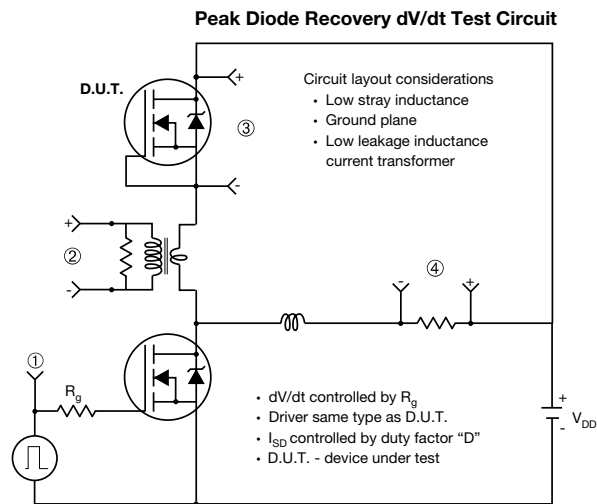


Fig. 14 - For N-Channel

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