
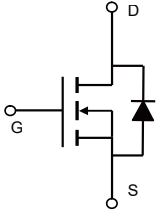


|   |   |           |      |       |    |                  |              |             |         |
|---|---|-----------|------|-------|----|------------------|--------------|-------------|---------|
| <p><b>Description</b></p> <p>The Power MOSFET is fabricated using the advanced planer <b>VDMOS</b> technology. The resulting device has low conduction resistance, superior switching performance and high avalanche energy.</p> <p><b>Features</b></p> <ul style="list-style-type: none"> <li>◆ Low <math>R_{DS(on)}</math></li> <li>◆ Low gate charge (typ. <math>Q_g = 22.5</math> nC)</li> <li>◆ 100% UIS tested</li> <li>◆ RoHS compliant</li> </ul> <p><b>Applications</b></p> <ul style="list-style-type: none"> <li>◆ Power factor correction.</li> <li>◆ Switched mode power supplies.</li> <li>◆ LED driver.</li> </ul> | <p><b>Product Summary</b></p> <table> <tr> <td><math>V_{DSS}</math></td><td>500V</td></tr> <tr> <td><math>I_D</math></td><td>9A</td></tr> <tr> <td><math>R_{DS(on),max}</math></td><td>0.8<math>\Omega</math></td></tr> <tr> <td><math>Q_{g,typ}</math></td><td>22.5 nC</td></tr> </table> <p><b>Pin Configuration</b></p> <div style="display: flex; justify-content: space-around; align-items: center;">   </div> <div style="display: flex; justify-content: space-around; align-items: center;"> <p>TO-220F</p> <p>Schematic</p> </div> | $V_{DSS}$ | 500V | $I_D$ | 9A | $R_{DS(on),max}$ | 0.8 $\Omega$ | $Q_{g,typ}$ | 22.5 nC |
| $V_{DSS}$   | 500V  |           |      |       |    |                  |              |             |         |
| $I_D$   | 9A  |           |      |       |    |                  |              |             |         |
| $R_{DS(on),max}$  | 0.8 $\Omega$  |           |      |       |    |                  |              |             |         |
| $Q_{g,typ}$   | 22.5 nC   |           |      |       |    |                  |              |             |         |

## Absolute Maximum Ratings

| Parameter   | Symbol         | Value       | Unit             |
|---|----------------|-------------|------------------|
| Drain-Source Voltage  | $V_{DSS}$      | 500         | V                |
| Continuous drain current<br>( $T_C = 25^\circ\text{C}$ )<br>( $T_C = 100^\circ\text{C}$ ) | $I_D$          | 9           | A                |
|   |                | 5.2         | A                |
| Pulsed drain current <sup>1)</sup>  | $I_{DM}$       | 36          | A                |
| Gate-Source voltage   | $V_{GSS}$      | $\pm 30$    | V                |
| Avalanche energy, single pulse <sup>2)</sup>  | $E_{AS}$       | 405         | mJ               |
| Power Dissipation<br>( $T_C = 25^\circ\text{C}$ )   | $P_D$          | 30          | W                |
| Operating junction and storage temperature range  | $T_J, T_{STG}$ | -55 to +150 | $^\circ\text{C}$ |
| Continuous diode forward current  | $I_S$          | 9           | A                |
| Diode pulse current   | $I_{S,pulse}$  | 36          | A                |

## Thermal Characteristics

| Parameter   | Symbol          | Value | Unit               |
|---|-----------------|-------|--------------------|
| Thermal resistance, Junction-to-case                  | $R_{\theta JC}$ | 4.1   | $^\circ\text{C/W}$ |
| Thermal resistance, Junction-to-ambient <sup>3)</sup> | $R_{\theta JA}$ | 65    | $^\circ\text{C/W}$ |

## Package Marking and Ordering Information

| Device     | Device Package | Marking    | Units/Tube |
|------------|----------------|------------|------------|
| VSM9N50-TF | TO-220F        | VSM9N50-TF | 50         |

**Electrical Characteristics**
 $T_c = 25^{\circ}\text{C}$  unless otherwise noted

| Parameter                        | Symbol               | Test Condition   | Min.   | Typ. | Max.     | Unit |
|----------------------------------|----------------------|--|--------|------|----------|------|
| Static characteristics           |                      |  |        |      |          |      |
| Drain-source breakdown voltage   | BV <sub>DSS</sub>    | V <sub>GS</sub> =0 V, I <sub>D</sub> =0.25 mA  | 500    | -    | -        | V    |
| Gate threshold voltage           | V <sub>GS(th)</sub>  | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =0.25 mA                                       | 2      | -    | 4        | V    |
| Drain cut-off current            | I <sub>DSS</sub>     | V <sub>DS</sub> =500 V, V <sub>GS</sub> =0 V,<br>T <sub>j</sub> = 25°C<br>T <sub>j</sub> = 150°C | -<br>- | -    | 1<br>100 | μA   |
| Gate leakage current, Forward    | I <sub>GSSF</sub>    | V <sub>GS</sub> =30 V, V <sub>DS</sub> =0 V  | -      | -    | 100      | nA   |
| Gate leakage current, Reverse    | I <sub>GSSR</sub>    | V <sub>GS</sub> =-30 V, V <sub>DS</sub> =0 V   | -      | -    | -100     | nA   |
| Drain-source on-state resistance | R <sub>DS(on)</sub>  | V <sub>GS</sub> =10 V, I <sub>D</sub> =4.5A, T <sub>J</sub> =25°C                                | -      | 0.66 | 0.8      | Ω    |
| Gate resistance                  | R <sub>g</sub>       | V <sub>GS</sub> =0V, V <sub>DS</sub> =0V, f=1MHz   | -      | 2.3  | -        | Ω    |
| Dynamic characteristics          |                      |  |        |      |          |      |
| Input capacitance                | C <sub>iss</sub>     | V <sub>DS</sub> = 25 V, V <sub>GS</sub> = 0 V,<br>f = 1 MHz                                      | -      | 1063 | -        | pF   |
| Output capacitance               | C <sub>oss</sub>     |  | -      | 107  | -        |      |
| Reverse transfer capacitance     | C <sub>rss</sub>     |  | -      | 4.7  | -        |      |
| Turn-on delay time               | t <sub>d(on)</sub>   | V <sub>DD</sub> = 250 V, I <sub>D</sub> = 9A<br>R <sub>G</sub> = 10 Ω, V <sub>GS</sub> =15 V     | -      | 12.2 | -        | ns   |
| Rise time                        | t <sub>r</sub>       |  | -      | 11.7 | -        |      |
| Turn-off delay time              | t <sub>d(off)</sub>  |  | -      | 53.4 | -        |      |
| Fall time                        | t <sub>f</sub>       |  | -      | 10.2 | -        |      |
| Gate charge characteristics      |                      |  |        |      |          |      |
| Gate to source charge            | Q <sub>gs</sub>      | V <sub>DD</sub> =400 V, I <sub>D</sub> =9 A,<br>V <sub>GS</sub> =0 to 10 V                       | -      | 5    | -        | nC   |
| Gate to drain charge             | Q <sub>gd</sub>      |  | -      | 8.7  | -        |      |
| Gate charge total                | Q <sub>g</sub>       |  | -      | 22.5 | -        |      |
| Gate plateau voltage             | V <sub>plateau</sub> |  | -      | 5    | -        | V    |
| Reverse diode characteristics    |                      |  |        |      |          |      |
| Diode forward voltage            | V <sub>SD</sub>      | V <sub>GS</sub> =0 V, I <sub>F</sub> =9 A  | -      | -    | 1.5      | V    |
| Reverse recovery time            | t <sub>rr</sub>      | V <sub>R</sub> =400 V, I <sub>F</sub> =9 A,<br>dI <sub>F</sub> /dt=100 A/μs                      | -      | 294  | -        | ns   |
| Reverse recovery charge          | Q <sub>rr</sub>      |  | -      | 2.3  | -        | μC   |
| Peak reverse recovery current    | I <sub>rrm</sub>     |  | -      | 15.4 | -        | A    |

**Notes:**

- Pulse width limited by maximum junction temperature.
- $V_{DD}=60\text{ V}, L=10\text{ mH}, I_{AS} = 9\text{ A}$ , Starting  $T_j=25^{\circ}\text{C}$ .
- The value of  $R_{thJA}$  is measured by placing the device in a still air box which is one cubic foot.

## Electrical Characteristics Diagrams

Figure 1. Typical Output Characteristics

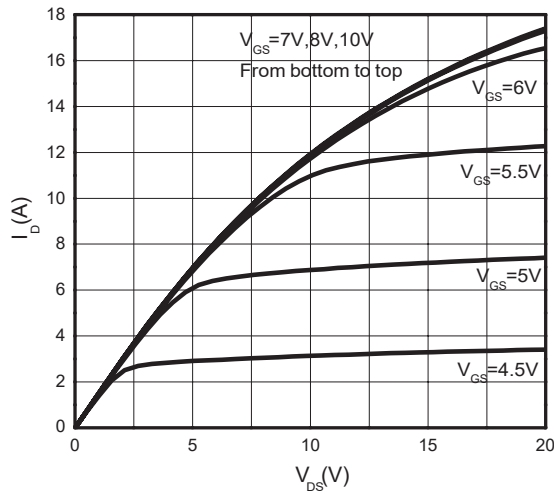


Figure 2. Transfer Characteristics

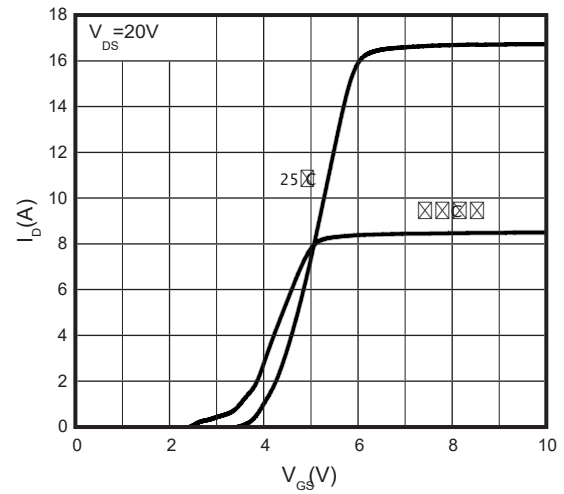


Figure 3. On-Resistance vs. Drain Current

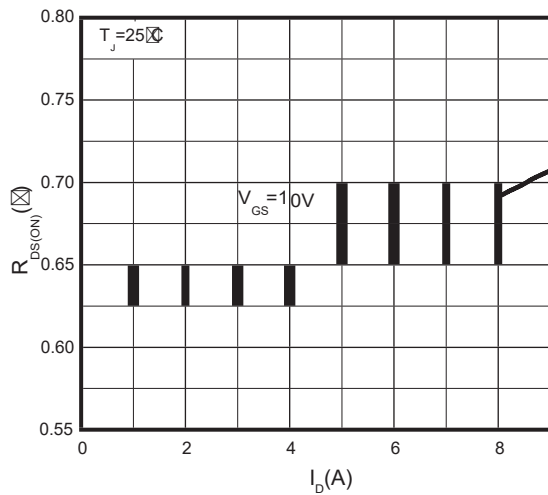


Figure 4. On-Resistance vs. Temperature

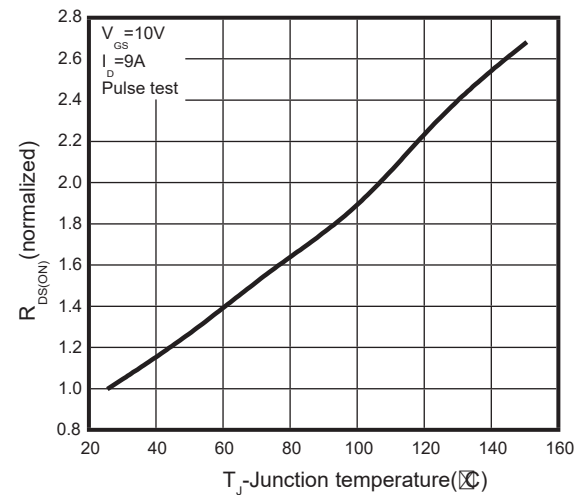


Figure 5. Breakdown Voltage vs. Temperature

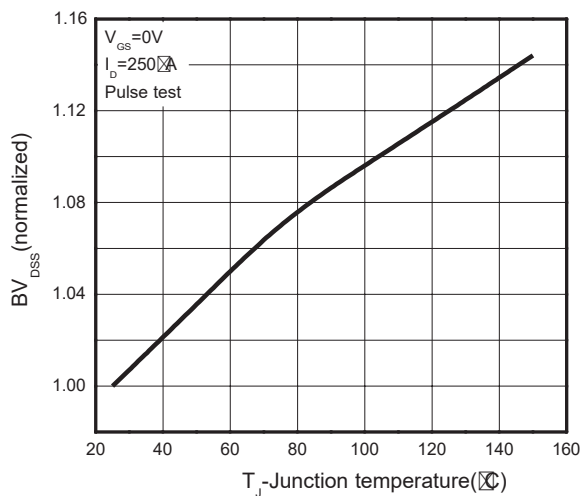


Figure 6. Threshold Voltage vs. Temperature

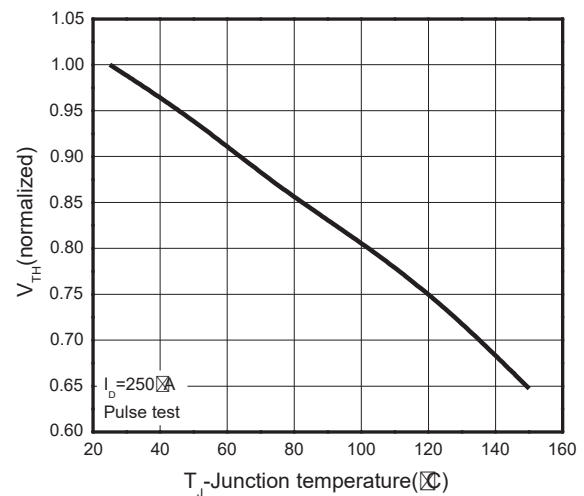


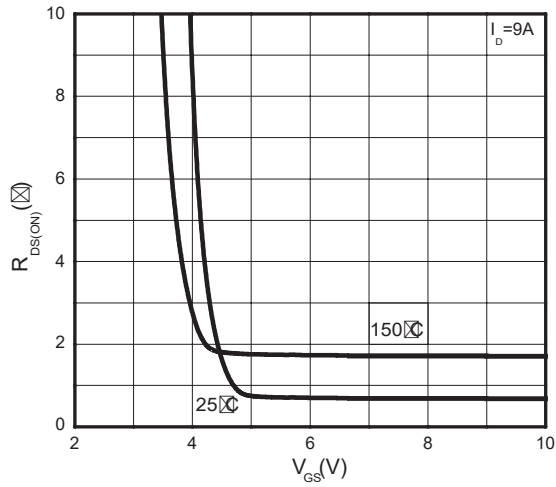
Figure 7.  $R_{DS(on)}$  vs. Gate Voltage


Figure 8. Body-Diode Characteristics

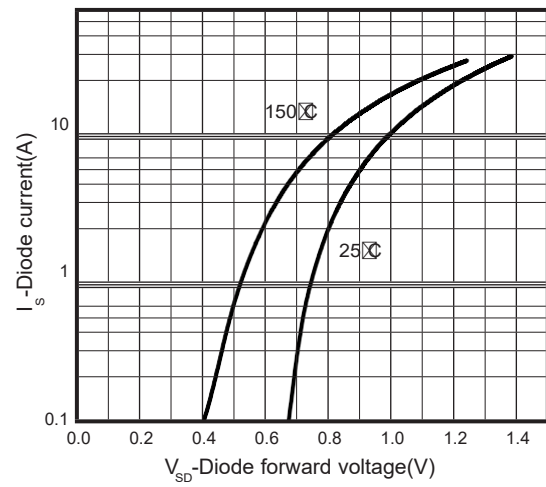


Figure 9. Capacitance Characteristics

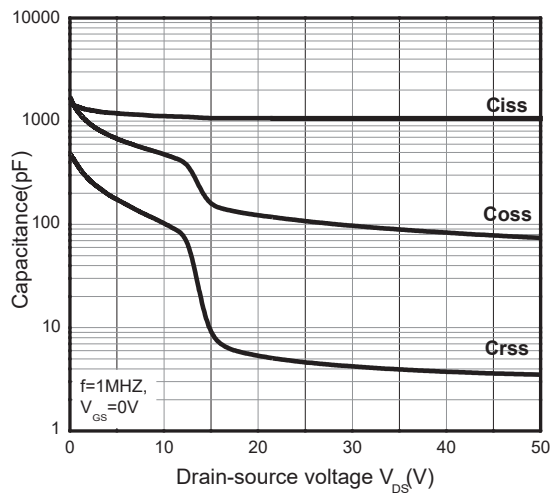


Figure 10. Gate Charge Characteristics

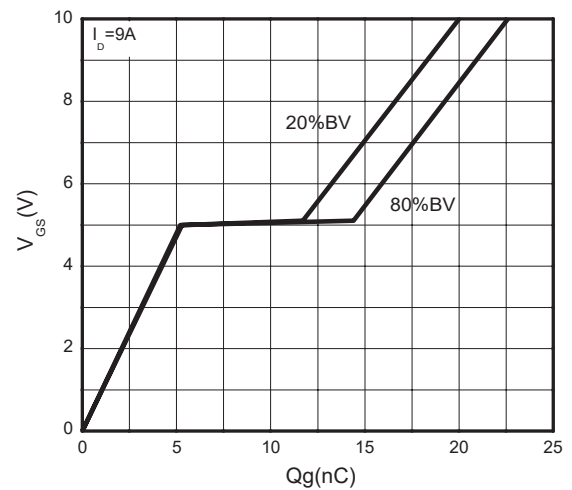


Figure 11. Continuous Drain Current vs. Temperature

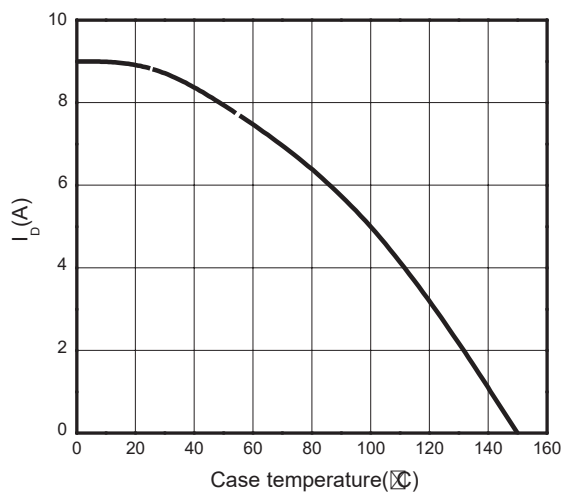
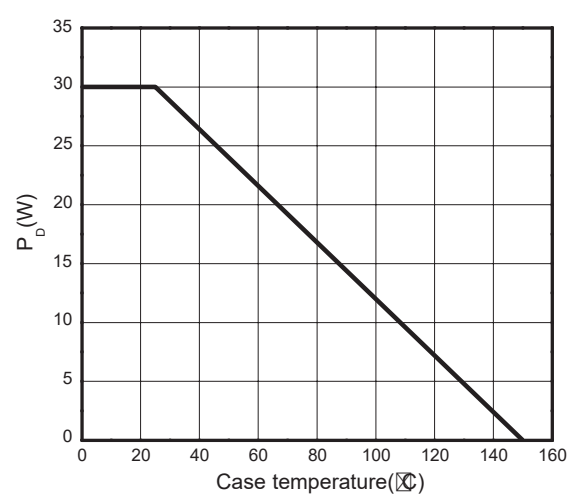
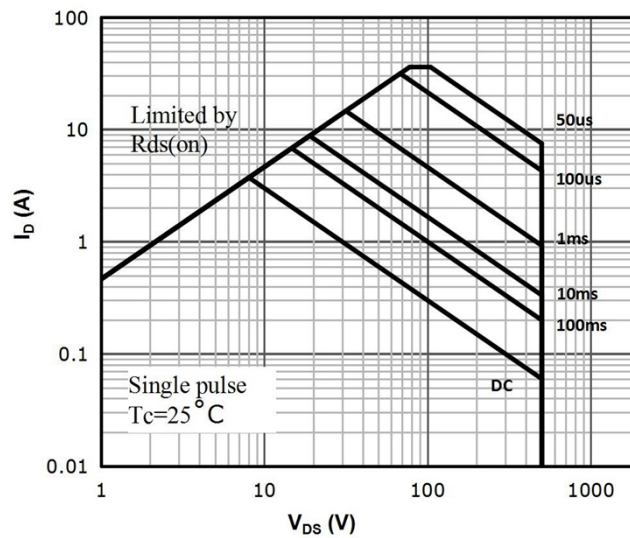
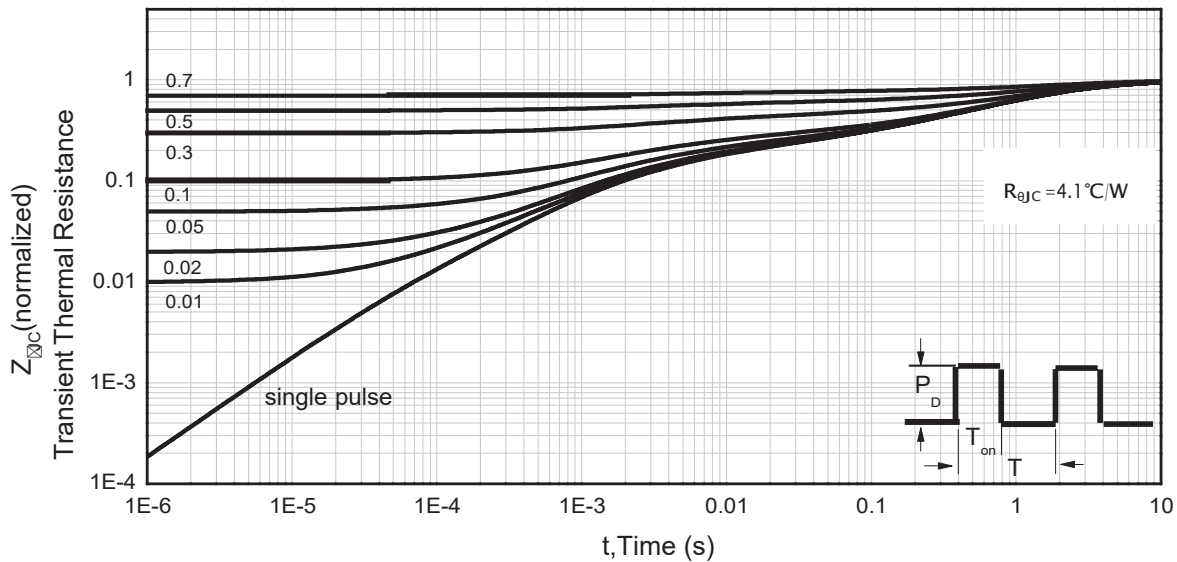


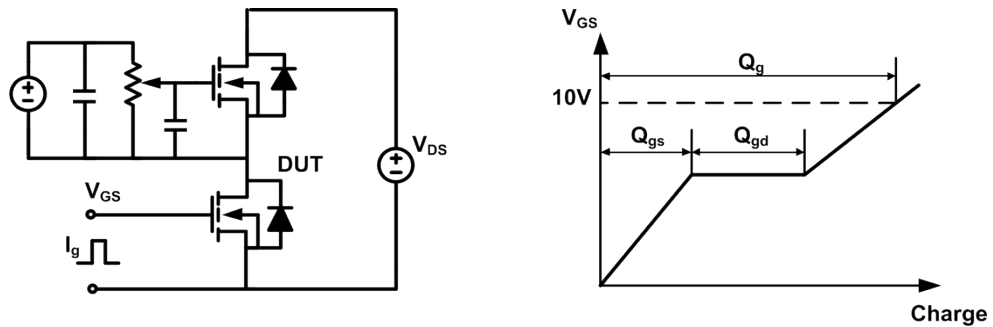
Figure 12. Power Dissipation vs. Temperature



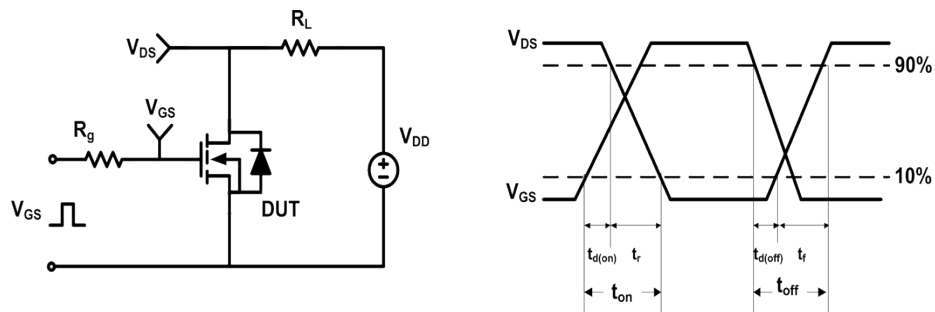
**Figure 13: Safe Operating Area**

**Figure 14. Transient Thermal Impedance, Junction to Case**


## Test Circuit & Waveforms

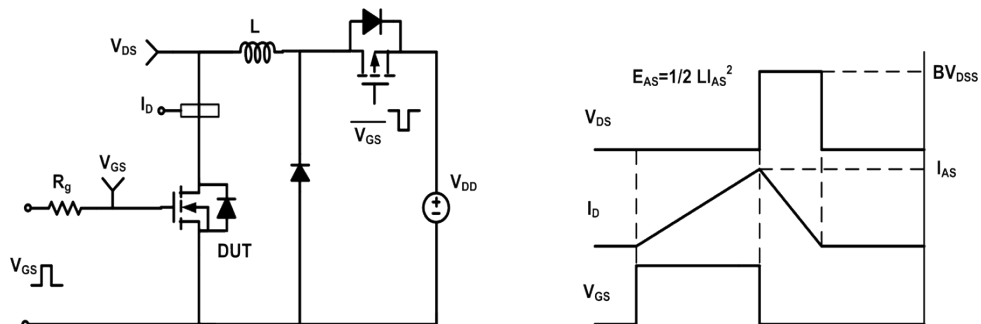
### Gate Charge Test Circuit & Waveform



### Resistive Switching Test Circuit & Waveform



### Unclamped Inductive Switching (UIS) Test Circuit & Waveform



### Diode Recovery Test Circuit & Waveform

