



**ALPHA & OMEGA**  
SEMICONDUCTOR



**AOL1704**

**N-Channel Enhancement Mode Field Effect Transistor**

**SRFET™**

### General Description

**SRFET™** AOL1704 uses advanced trench technology with a monolithically integrated Schottky diode to provide excellent  $R_{DS(ON)}$  and low gate charge. This device is suitable for use as a low side FET in SMPS, load switching and general purpose applications.

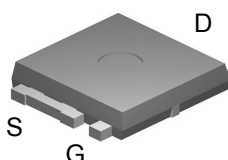
- RoHS Compliant
- Halogen and Antimony Free Green Device\*

### Features

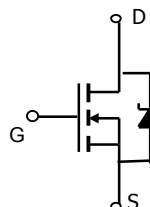
$V_{DS}$  (V) = 30V  
 $I_D$  = 50A ( $V_{GS}$  = 10V)  
 $R_{DS(ON)} < 7.8m\Omega$  ( $V_{GS}$  = 10V)  
 $R_{DS(ON)} < 9.8m\Omega$  ( $V_{GS}$  = 4.5V)

UIS Tested!  
 $R_g, C_{iss}, C_{oss}, C_{rss}$  Tested

Ultra SO-8™ Top View



Bottom tab  
connected to  
drain



**SRFET™**

Soft Recovery MOSFET:  
Integrated Schottky Diode

### Absolute Maximum Ratings $T_A=25^\circ\text{C}$ unless otherwise noted

| Parameter                                          | Symbol         | Maximum    | Units            |
|----------------------------------------------------|----------------|------------|------------------|
| Drain-Source Voltage                               | $V_{DS}$       | 30         | V                |
| Gate-Source Voltage                                | $V_{GS}$       | $\pm 12$   | V                |
| Continuous Drain Current <sup>B</sup>              | $I_D$          | 50         | A                |
| $T_C=25^\circ\text{C}^I$                           |                | 43         |                  |
| $T_C=100^\circ\text{C}$                            | $I_D$          | 43         | A                |
| Pulsed Drain Current                               | $I_{DM}$       | 120        | A                |
| Continuous Drain Current <sup>H</sup>              | $I_{DSM}$      | 12         | A                |
| $T_A=25^\circ\text{C}$                             |                | 10         |                  |
| $T_A=70^\circ\text{C}$                             | $I_{DSM}$      | 10         | A                |
| Avalanche Current <sup>C</sup>                     | $I_{AR}$       | 25         | A                |
| Repetitive avalanche energy $L=0.3mH$ <sup>C</sup> | $E_{AR}$       | 94         | mJ               |
| Power Dissipation <sup>B</sup>                     | $P_D$          | 50         | W                |
|                                                    |                | 25         |                  |
| Power Dissipation <sup>A</sup>                     | $P_{DSM}$      | 2.0        | W                |
|                                                    |                | 1.3        |                  |
| Junction and Storage Temperature Range             | $T_J, T_{STG}$ | -55 to 175 | $^\circ\text{C}$ |

### Thermal Characteristics

| Parameter                                | Symbol          | Typ | Max | Units              |
|------------------------------------------|-----------------|-----|-----|--------------------|
| Maximum Junction-to-Ambient <sup>A</sup> | $R_{\theta JA}$ | 24  | 29  | $^\circ\text{C/W}$ |
| $t \leq 10s$                             |                 | 53  | 64  | $^\circ\text{C/W}$ |
| Maximum Junction-to-Ambient <sup>A</sup> | $R_{\theta JA}$ | 53  | 64  | $^\circ\text{C/W}$ |
| Steady-State                             |                 | 2.4 | 3.0 | $^\circ\text{C/W}$ |
| Maximum Junction-to-Case <sup>C</sup>    | $R_{\theta JC}$ | 2.4 | 3.0 | $^\circ\text{C/W}$ |
| Steady-State                             | $R_{\theta JC}$ | 2.4 | 3.0 | $^\circ\text{C/W}$ |

**Electrical Characteristics (T<sub>J</sub>=25°C unless otherwise noted)**

| Symbol                      | Parameter                                                           | Conditions                                                                                 | Min | Typ        | Max         | Units |
|-----------------------------|---------------------------------------------------------------------|--------------------------------------------------------------------------------------------|-----|------------|-------------|-------|
| <b>STATIC PARAMETERS</b>    |                                                                     |                                                                                            |     |            |             |       |
| BV <sub>DSS</sub>           | Drain-Source Breakdown Voltage                                      | I <sub>D</sub> =250μA, V <sub>GS</sub> =0V                                                 | 30  |            |             | V     |
| I <sub>DSS</sub>            | Zero Gate Voltage Drain Current                                     | V <sub>DS</sub> =24V, V <sub>GS</sub> =0V<br>T <sub>J</sub> =125°C                         |     | 0.04<br>5  | 0.1<br>20   | mA    |
| I <sub>GSS</sub>            | Gate-Body leakage current                                           | V <sub>DS</sub> =0V, V <sub>GS</sub> = ±12V                                                |     |            | 0.1         | μA    |
| V <sub>GS(th)</sub>         | Gate Threshold Voltage                                              | V <sub>DS</sub> =V <sub>GS</sub> I <sub>D</sub> =250μA                                     | 1.4 | 1.8        | 2.4         | V     |
| I <sub>D(ON)</sub>          | On state drain current                                              | V <sub>GS</sub> =4.5V, V <sub>DS</sub> =5V                                                 | 120 |            |             | A     |
| R <sub>DS(ON)</sub>         | Static Drain-Source On-Resistance                                   | V <sub>GS</sub> =10V, I <sub>D</sub> =20A<br>T <sub>J</sub> =125°C                         |     | 6.5<br>9.2 | 7.8<br>11.5 | mΩ    |
|                             |                                                                     | V <sub>GS</sub> =4.5V, I <sub>D</sub> =20A                                                 |     | 8          | 9.8         | mΩ    |
|                             |                                                                     |                                                                                            |     |            |             |       |
| g <sub>FS</sub>             | Forward Transconductance                                            | V <sub>DS</sub> =5V, I <sub>D</sub> =20A                                                   |     | 95         |             | S     |
| V <sub>SD</sub>             | Diode Forward Voltage                                               | I <sub>S</sub> =1A, V <sub>GS</sub> =0V                                                    |     | 0.36       | 0.5         | V     |
| I <sub>S</sub>              | Maximum Body-Diode + Schottky Diode Continuous Current <sup>†</sup> |                                                                                            |     |            | 50          | A     |
| <b>DYNAMIC PARAMETERS</b>   |                                                                     |                                                                                            |     |            |             |       |
| C <sub>iss</sub>            | Input Capacitance                                                   | V <sub>GS</sub> =0V, V <sub>DS</sub> =15V, f=1MHz                                          |     | 2800       | 3640        | pF    |
| C <sub>oss</sub>            | Output Capacitance                                                  |                                                                                            |     | 390        |             | pF    |
| C <sub>rss</sub>            | Reverse Transfer Capacitance                                        |                                                                                            |     | 145        |             | pF    |
| R <sub>g</sub>              | Gate resistance                                                     | V <sub>GS</sub> =0V, V <sub>DS</sub> =0V, f=1MHz                                           |     | 0.8        | 1.2         | Ω     |
| <b>SWITCHING PARAMETERS</b> |                                                                     |                                                                                            |     |            |             |       |
| Q <sub>g</sub> (10V)        | Total Gate Charge                                                   | V <sub>GS</sub> =10V, V <sub>DS</sub> =15V, I <sub>D</sub> =20A                            |     | 42         | 50          |       |
| Q <sub>g</sub> (4.5V)       | Total Gate Charge                                                   |                                                                                            |     | 19         | 23          | nC    |
| Q <sub>gs</sub>             | Gate Source Charge                                                  |                                                                                            |     | 7          |             | nC    |
| Q <sub>gd</sub>             | Gate Drain Charge                                                   |                                                                                            |     | 6          |             | nC    |
| t <sub>D(on)</sub>          | Turn-On DelayTime                                                   | V <sub>GS</sub> =10V, V <sub>DS</sub> =15V, R <sub>L</sub> =0.75Ω,<br>R <sub>GEN</sub> =3Ω |     | 7          |             | ns    |
| t <sub>r</sub>              | Turn-On Rise Time                                                   |                                                                                            |     | 7          |             | ns    |
| t <sub>D(off)</sub>         | Turn-Off DelayTime                                                  |                                                                                            |     | 31         |             | ns    |
| t <sub>f</sub>              | Turn-Off Fall Time                                                  |                                                                                            |     | 5          |             | ns    |
| t <sub>rr</sub>             | Body Diode Reverse Recovery Time                                    | I <sub>F</sub> =20A, dI/dt=300A/μs                                                         |     | 13         | 16          | ns    |
| Q <sub>rr</sub>             | Body Diode Reverse Recovery Charge                                  | I <sub>F</sub> =20A, dI/dt=300A/μs                                                         |     | 12         |             | nC    |

A: The value of R<sub>θJA</sub> is measured with the device in a still air environment with T<sub>A</sub>=25°C. The power dissipation P<sub>DSM</sub> and current rating I<sub>DSM</sub> are based on T<sub>J(MAX)</sub>=150°C, using t ≤ 10s junction-to-ambient thermal resistance.

B: The power dissipation P<sub>D</sub> is based on T<sub>J(MAX)</sub>=175°C, using junction-to-case thermal resistance, and is more useful in setting the upper dissipation limit for cases where additional heatsinking is used.

C: Repetitive rating, pulse width limited by junction temperature T<sub>J(MAX)</sub>=175°C.

D: The R<sub>θJA</sub> is the sum of the thermal impedance from junction to case R<sub>θJC</sub> and case to ambient.

E: The static characteristics in Figures 1 to 6 are obtained using <300 us pulses, duty cycle 0.5% max.

F: These curves are based on the junction-to-case thermal impedance which is measured with the device mounted to a large heatsink, assuming a maximum junction temperature of T<sub>J(MAX)</sub>=175°C.

G: These tests are performed with the device mounted on 1 in 2 FR-4 board with 2oz. Copper, in a still air environment with T<sub>A</sub>=25°C. The SOA curve provides a single pulse rating.

H: Surface mounted on a 1 in 2 FR-4 board with 2oz. Copper.

I: The maximum current rating is limited by bond-wires.

\* This device is guaranteed green after date code 8P11 (June 1<sup>ST</sup> 2008)

Rev2: July. 2008

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## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

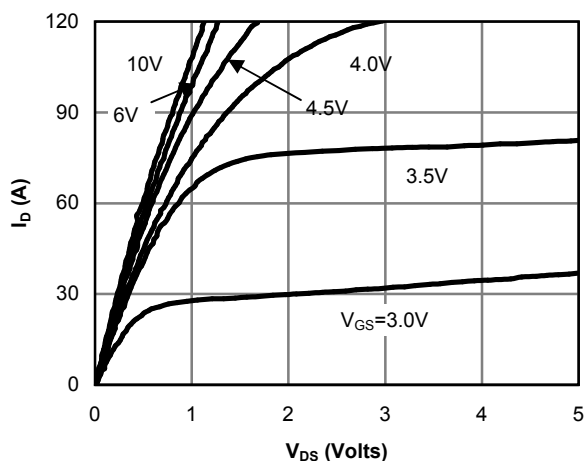


Figure 1: On-Region Characteristics

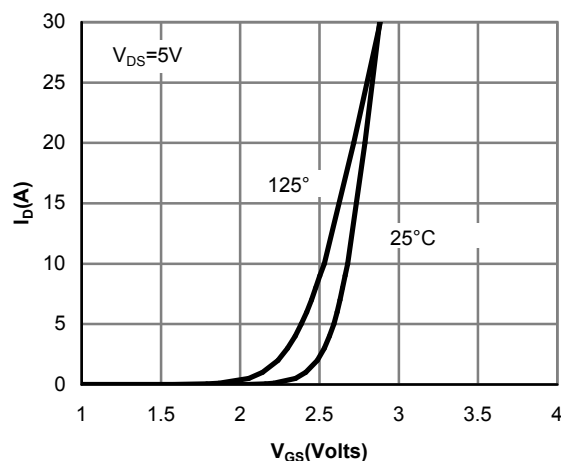


Figure 2: Transfer Characteristics

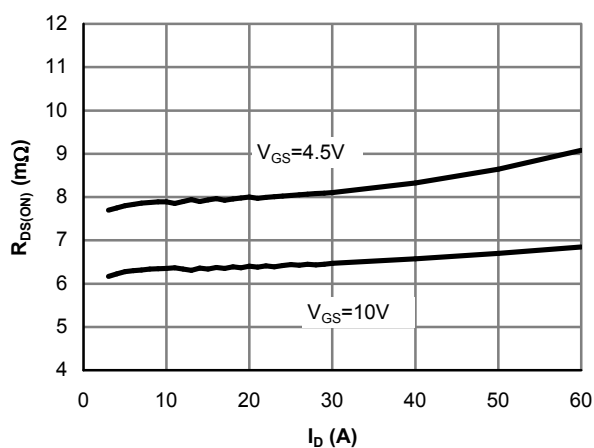


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

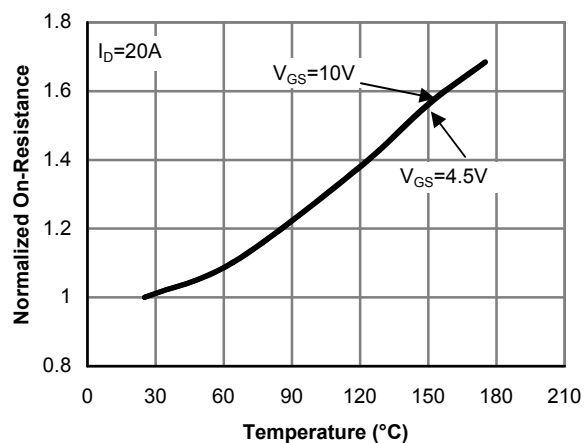


Figure 4: On-Resistance vs. Junction Temperature

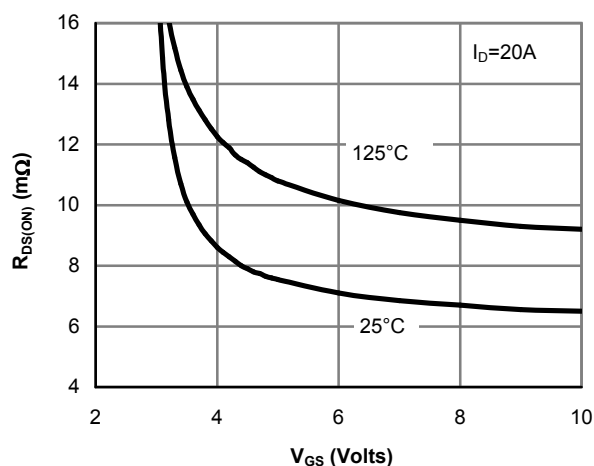


Figure 5: On-Resistance vs. Gate-Source Voltage

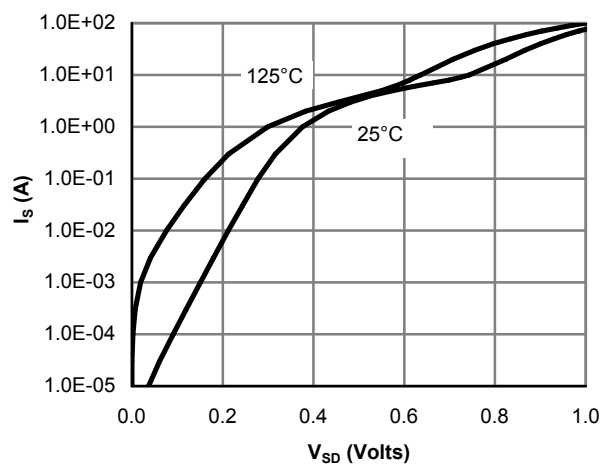


Figure 6: Body-Diode Characteristics

## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

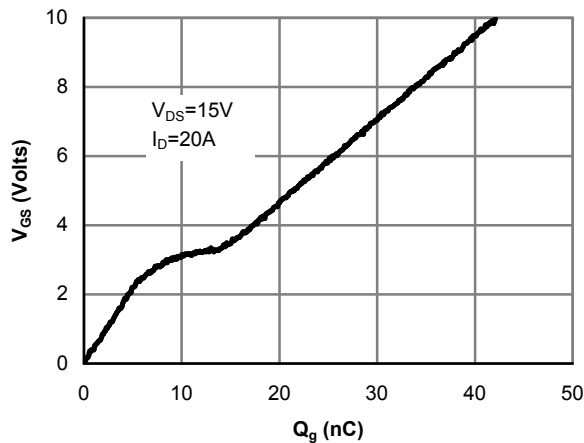


Figure 7: Gate-Charge Characteristics

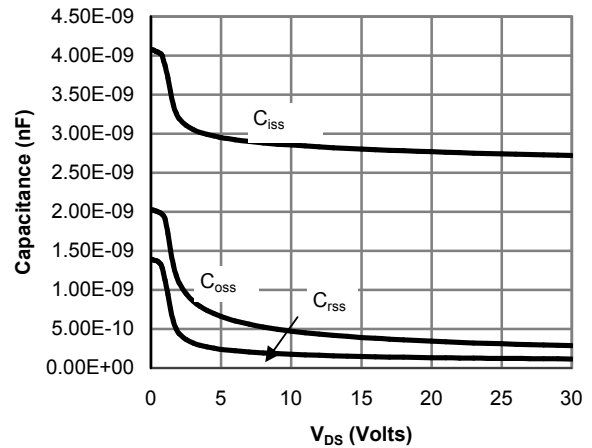


Figure 8: Capacitance Characteristics

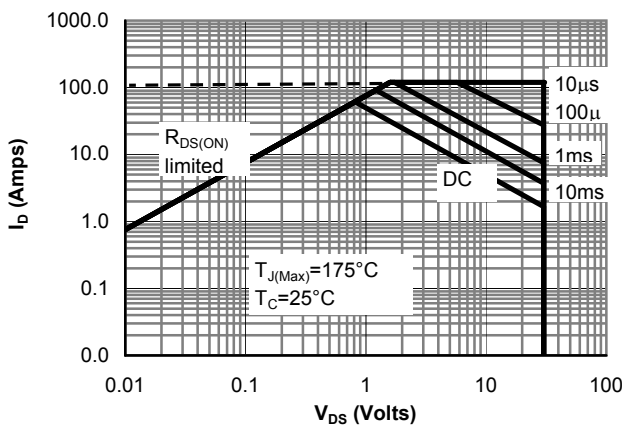


Figure 9: Maximum Forward Biased Safe Operating Area (Note F)

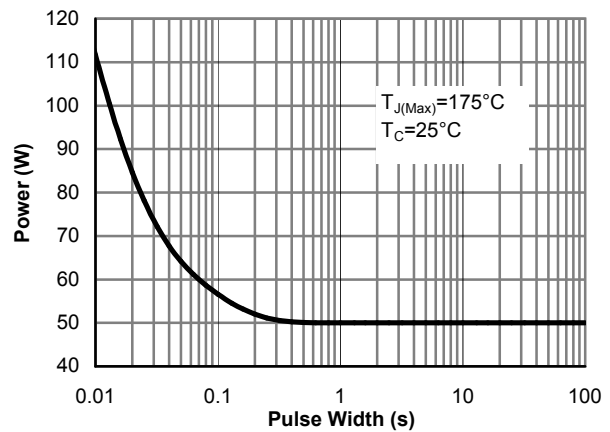


Figure 10: Single Pulse Power Rating Junction-to-Case (Note F)

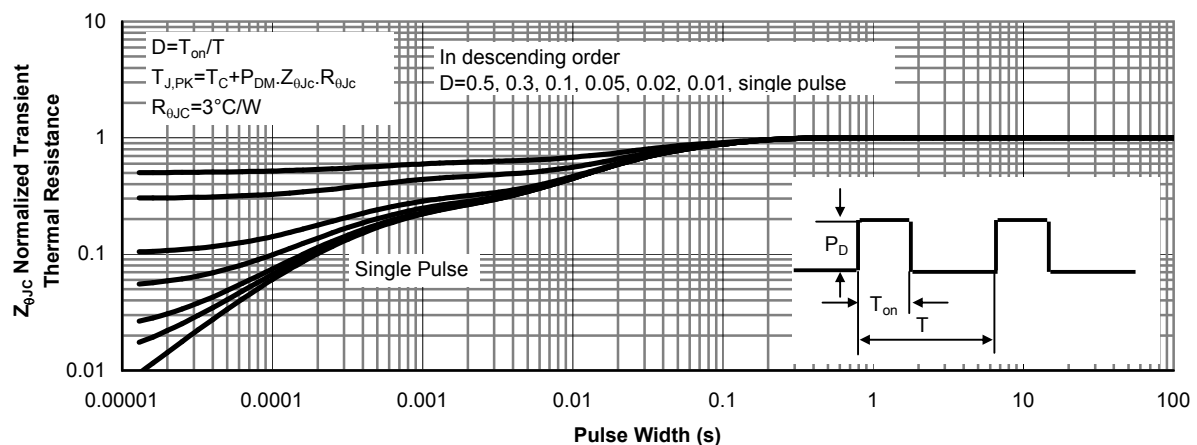


Figure 11: Normalized Maximum Transient Thermal Impedance (Note F)

## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

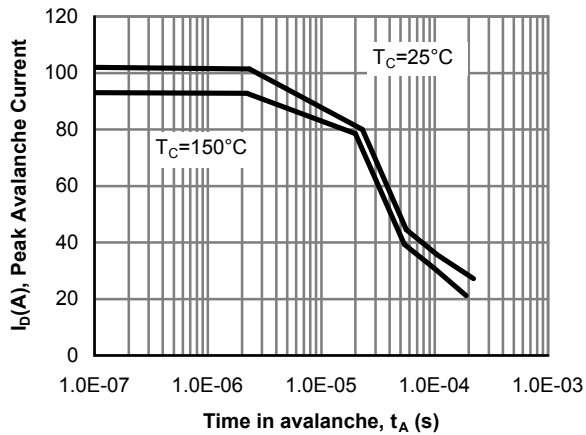


Figure 12: Single Pulse Avalanche capability

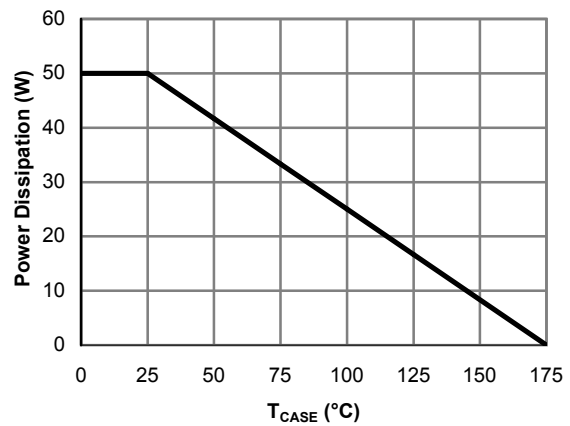


Figure 13: Power De-rating (Note B)

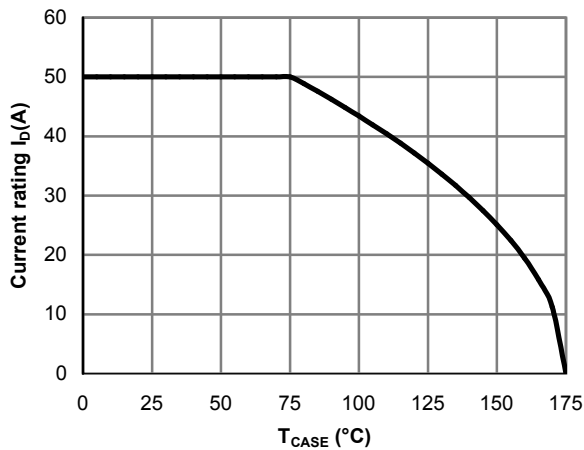


Figure 14: Current De-rating (Note B)

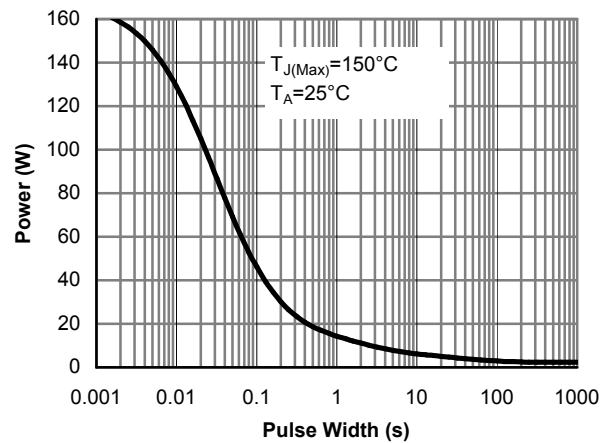


Figure 15: Single Pulse Power Rating Junction-to-Ambient (Note G)

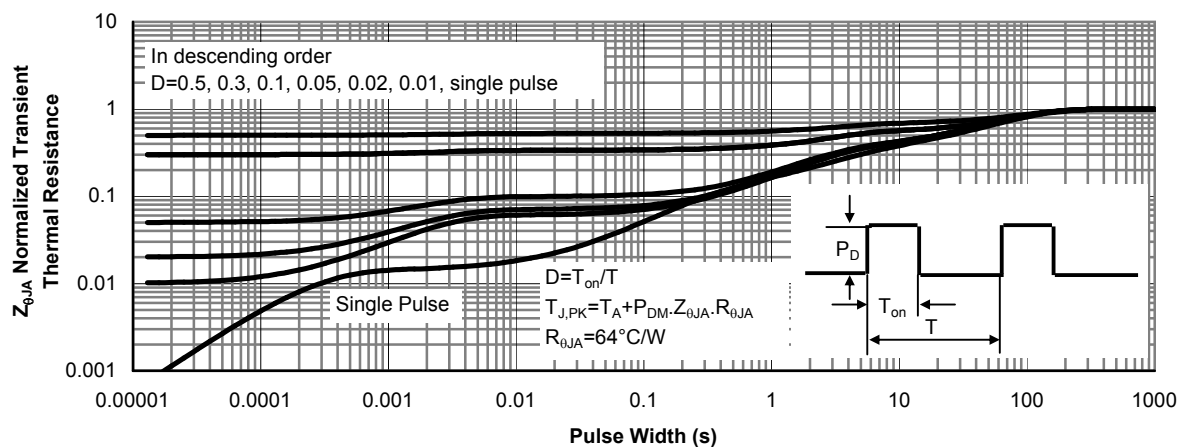


Figure 16: Normalized Maximum Transient Thermal Impedance (Note G)

## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

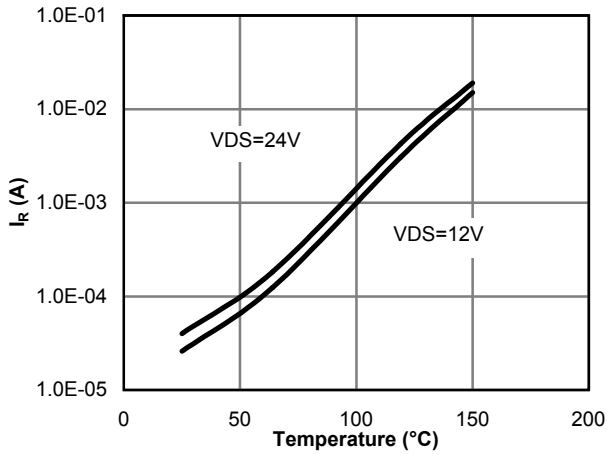


Figure 17: Diode Reverse Leakage Current vs. Junction Temperature

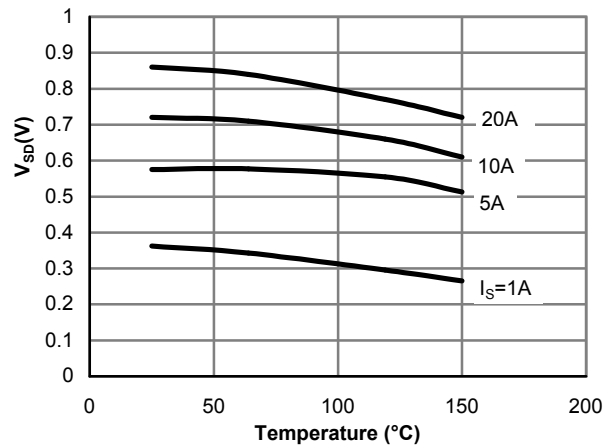


Figure 18: Diode Forward voltage vs. Junction Temperature

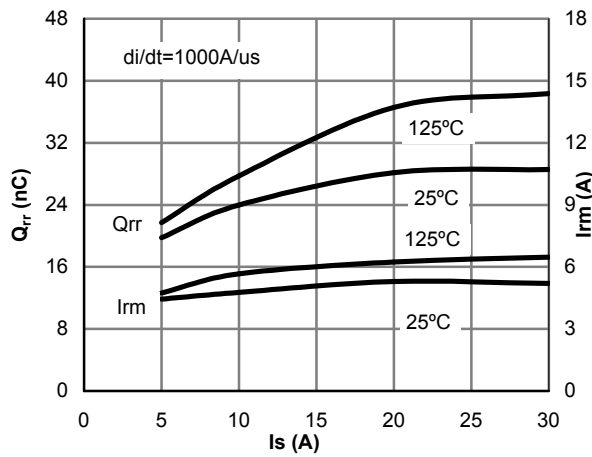


Figure 19: Diode Reverse Recovery Charge and Peak Current vs. Conduction Current

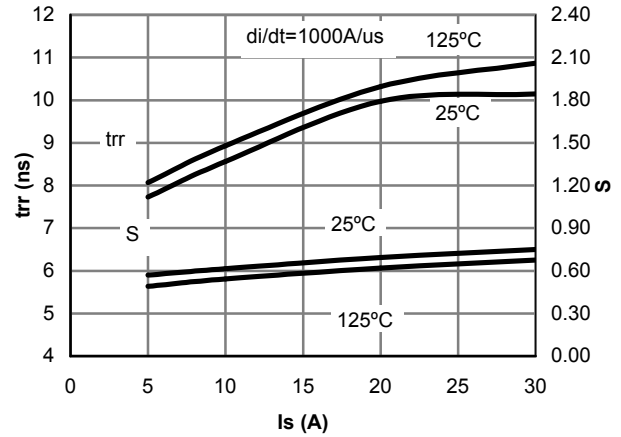


Figure 20: Diode Reverse Recovery Time and Soft Coefficient vs. Conduction Current

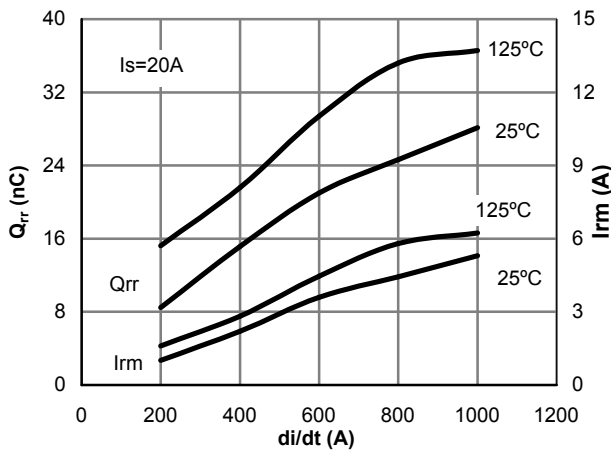


Figure 21: Diode Reverse Recovery Charge and Peak Current vs. di/dt

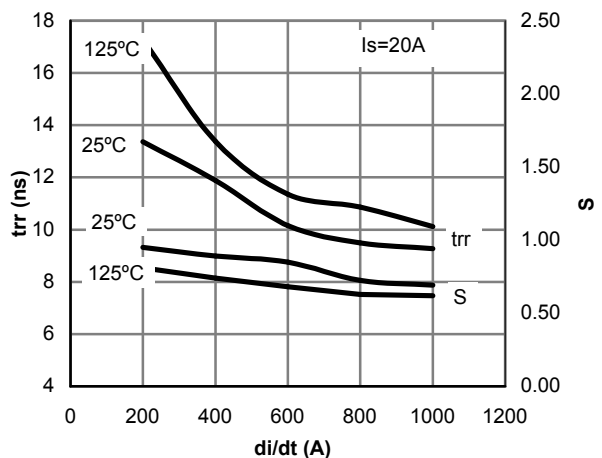
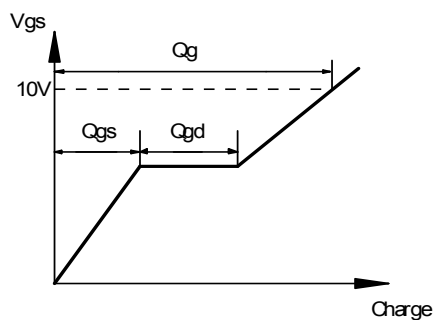
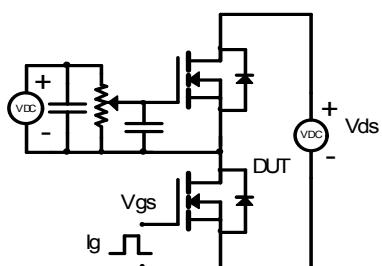
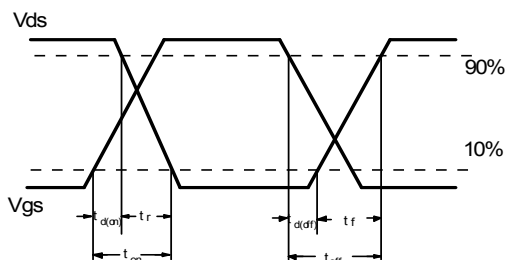
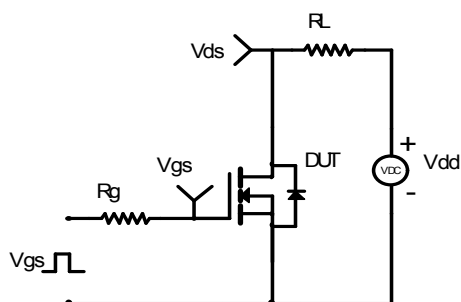


Figure 22: Diode Reverse Recovery Time and Soft Coefficient vs. di/dt

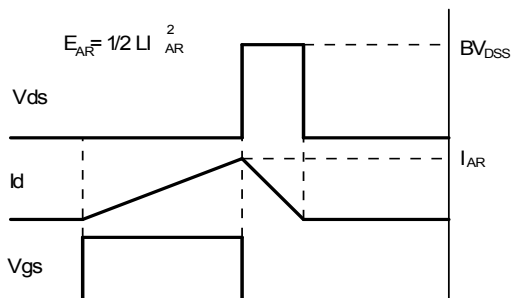
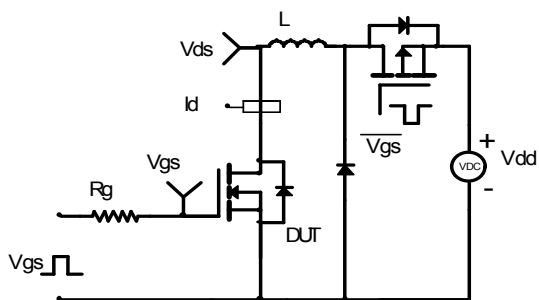
Gate Charge Test Circuit &amp; Waveform



Resistive Switching Test Circuit &amp; Waveforms



Unclamped Inductive Switching (UIS) Test Circuit &amp; Waveforms



Diode Recovery Test Circuit &amp; Waveforms

