

### General Description

- Trench Power AlphaSGT™ technology
- Low  $R_{DS(ON)}$
- Low Gate Charge
- Optimized fast-switching applications

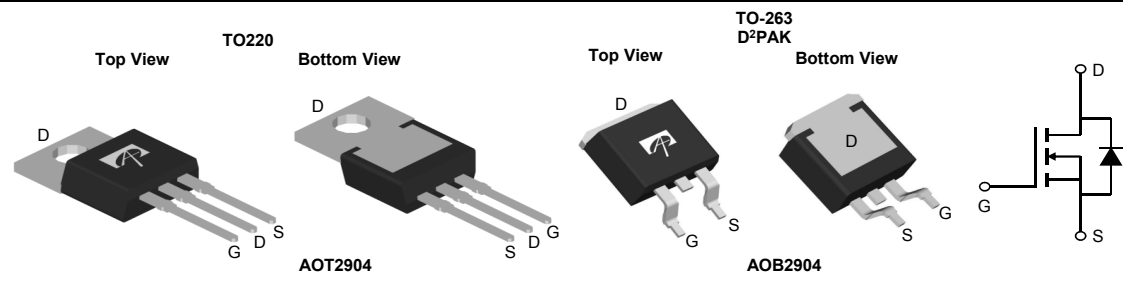
### Applications

- Industrial
- BMS battery protection
- Synchronous Rectifiers in DC/DC and AC/DC Converters

### Product Summary

|                                 |                                   |
|---------------------------------|-----------------------------------|
| $V_{DS}$                        | 100V                              |
| $I_D$ (at $V_{GS}=10V$ )        | 120A                              |
| $R_{DS(ON)}$ (at $V_{GS}=10V$ ) | < 4.4m $\Omega$ < 4.2m $\Omega^*$ |
| $R_{DS(ON)}$ (at $V_{GS}=6V$ )  | < 5.5m $\Omega$ < 5.2m $\Omega^*$ |

100% UIS Tested  
100% Rg Tested



| Orderable Part Number | Package Type | Form        | Minimum Order Quantity |
|-----------------------|--------------|-------------|------------------------|
| AOT2904               | TO-220       | Tube        | 1000                   |
| AOB2904               | TO-263       | Tape & Reel | 800                    |

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

| Parameter                              | Symbol         | Maximum                 | Units            |
|--|----------------|-------------------------|------------------|
| Drain-Source Voltage                   | $V_{DS}$       | 100                     | V                |
| Gate-Source Voltage                    | $V_{GS}$       | $\pm 20$                | V                |
| Continuous Drain Current <sup>G</sup>  | $I_D$          | $T_C=25^\circ\text{C}$  | A                |
|  |                | $T_C=100^\circ\text{C}$ |                  |
| Pulsed Drain Current <sup>C</sup>      | $I_{DM}$       | 425                     |                  |
| Continuous Drain Current               | $I_{DSM}$      | $T_A=25^\circ\text{C}$  | A                |
|  |                | $T_A=70^\circ\text{C}$  |                  |
| Avalanche Current <sup>C</sup>         | $I_{AS}$       | 77                      | A                |
| Avalanche energy L=0.1mH <sup>C</sup>  | $E_{AS}$       | 296                     | mJ               |
| $V_{DS}$ Spike <sup>I</sup>            | $V_{SPIKE}$    | 120                     | V                |
| Power Dissipation <sup>B</sup>         | $P_D$          | $T_C=25^\circ\text{C}$  | W                |
|  |                | $T_C=100^\circ\text{C}$ |                  |
| Power Dissipation <sup>A</sup>         | $P_{DSM}$      | $T_A=25^\circ\text{C}$  | W                |
|  |                | $T_A=70^\circ\text{C}$  |                  |
| 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> $t \leq 10s$   | $R_{\theta JA}$ | 12   | 15   | $^\circ\text{C/W}$ |
| Maximum Junction-to-Ambient <sup>A,D</sup> Steady-State |                 | 50   | 60   | $^\circ\text{C/W}$ |
| Maximum Junction-to-Case Steady-State                   | $R_{\theta JC}$ | 0.36 | 0.46 | $^\circ\text{C/W}$ |

\* Surface mount package TO263(AOB2904)

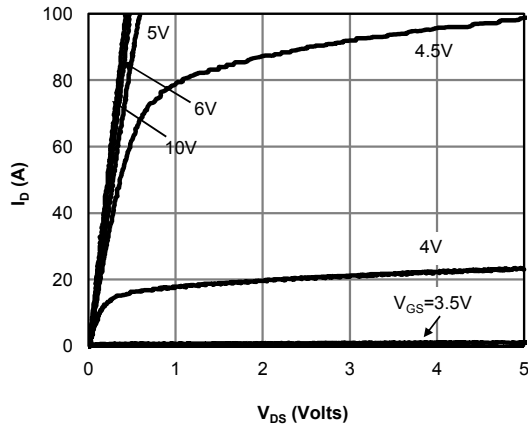
**Electrical Characteristics (T<sub>J</sub>=25°C unless otherwise noted)**

| 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  | 100 |      |        | V     |
| I <sub>DSS</sub>            | Zero Gate Voltage Drain Current                    | V <sub>DS</sub> =100V, V <sub>GS</sub> =0V<br>T <sub>J</sub> =55°C                        |     |      | 1<br>5 | μA    |
| I <sub>GSS</sub>            | Gate-Body leakage current                          | V <sub>DS</sub> =0V, V <sub>GS</sub> =±20V  |     |      | ±100   | nA    |
| V <sub>GS(th)</sub>         | Gate Threshold Voltage                             | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =250μA                                  | 2.3 | 2.75 | 3.3    | V     |
| R <sub>DS(on)</sub>         | Static Drain-Source On-Resistance                  | V <sub>GS</sub> =10V, I <sub>D</sub> =20A TO-220<br>T <sub>J</sub> =125°C                 |     | 3.6  | 4.4    | mΩ    |
|                             |  | V <sub>GS</sub> =6V, I <sub>D</sub> =20A TO-220   |     | 4.1  | 5.5    |       |
|                             |  | V <sub>GS</sub> =10V, I <sub>D</sub> =20A TO-263  |     | 3.4  | 4.2    | mΩ    |
|                             |  | V <sub>GS</sub> =6V, I <sub>D</sub> =20A TO-263   |     | 3.9  | 5.2    | mΩ    |
| g <sub>FS</sub>             | Forward Transconductance                           | V <sub>DS</sub> =5V, I <sub>D</sub> =20A  |     | 90   |        | S     |
| V <sub>SD</sub>             | Diode Forward Voltage                              | I <sub>S</sub> =1A, V <sub>GS</sub> =0V   |     | 0.68 | 1      | V     |
| I <sub>S</sub>              | Maximum Body-Diode Continuous Current <sup>G</sup> |   |     |      | 120    | A     |
| <b>DYNAMIC PARAMETERS</b>   |  |   |     |      |        |       |
| C <sub>iss</sub>            | Input Capacitance                                  | V <sub>GS</sub> =0V, V <sub>DS</sub> =50V, f=1MHz   |     | 7085 |        | pF    |
| C <sub>oss</sub>            | Output Capacitance                                 |   |     | 605  |        | pF    |
| C <sub>riss</sub>           | Reverse Transfer Capacitance                       |   |     | 32   |        | pF    |
| R <sub>g</sub>              | Gate resistance                                    | f=1MHz  | 0.7 | 1.5  | 2.3    | Ω     |
| <b>SWITCHING PARAMETERS</b> |  |   |     |      |        |       |
| Q <sub>g(10V)</sub>         | Total Gate Charge                                  | V <sub>GS</sub> =10V, V <sub>DS</sub> =50V, I <sub>D</sub> =20A                           |     | 93   | 135    | nC    |
| Q <sub>gs</sub>             | Gate Source Charge                                 |   |     | 23   |        | nC    |
| Q <sub>gd</sub>             | Gate Drain Charge                                  |   |     | 16   |        | nC    |
| t <sub>D(on)</sub>          | Turn-On DelayTime                                  | V <sub>GS</sub> =10V, V <sub>DS</sub> =50V, R <sub>L</sub> =2.5Ω,<br>R <sub>GEN</sub> =3Ω |     | 21   |        | ns    |
| t <sub>r</sub>              | Turn-On Rise Time                                  |   |     | 22   |        | ns    |
| t <sub>D(off)</sub>         | Turn-Off DelayTime                                 |   |     | 58   |        | ns    |
| t <sub>f</sub>              | Turn-Off Fall Time                                 |   |     | 20   |        | ns    |
| t <sub>rr</sub>             | Body Diode Reverse Recovery Time                   | I <sub>F</sub> =20A, di/dt=500A/μs  |     | 49   |        | ns    |
| Q <sub>rr</sub>             | Body Diode Reverse Recovery Charge                 | I <sub>F</sub> =20A, di/dt=500A/μs  |     | 460  |        | nC    |

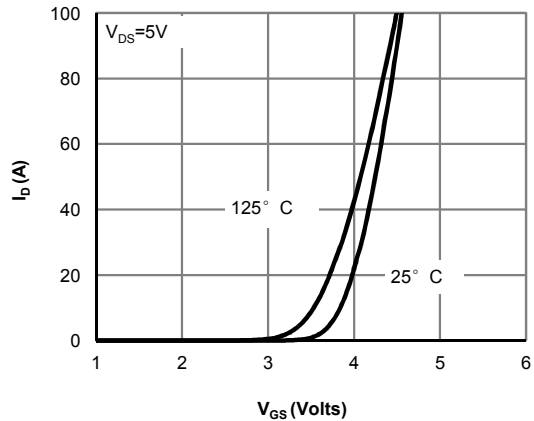
- A. The value of R<sub>θJA</sub> is measured with the device mounted on 1in<sup>2</sup> FR-4 board with 2oz. Copper, in a still air environment with T<sub>A</sub>=25° C. The Power dissipation P<sub>DSM</sub> is based on R<sub>θJA</sub> t<sub>s</sub> ≤ 10s and the maximum allowed junction temperature of 150° C. The value in any given application depends on the user's specific board design, and the maximum temperature of 175° C may be used if the PCB allows it.
- 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. Single 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 <300μs 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. The SOA curve provides a single pulse rating.
- G. The maximum current rating is package limited.
- H. These tests are performed with the device mounted on 1 in<sup>2</sup> FR-4 board with 2oz. Copper, in a still air environment with T<sub>A</sub>=25° C.
- I. The spike duty cycle 5% max, limited by junction temperature T<sub>J(MAX)</sub>=125° C.

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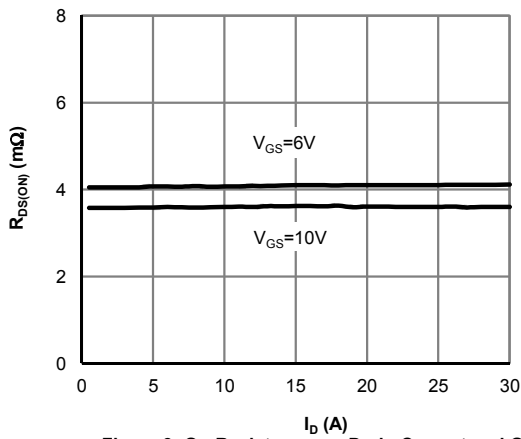
**TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS**



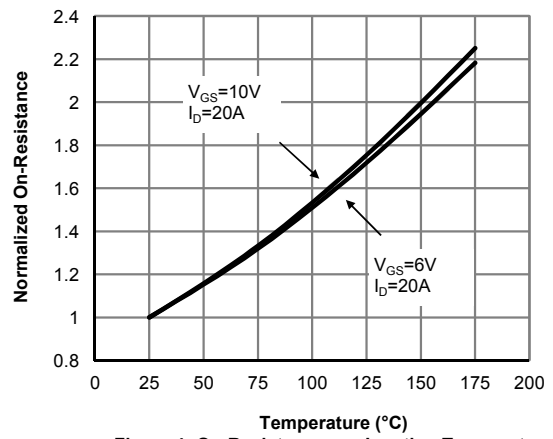
**Figure 1: On-Region Characteristics (Note E)**



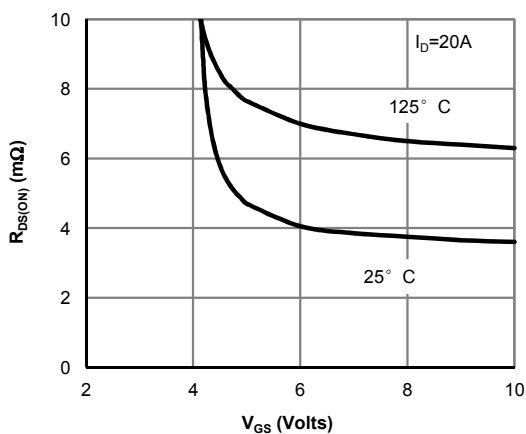
**Figure 2: Transfer Characteristics (Note E)**



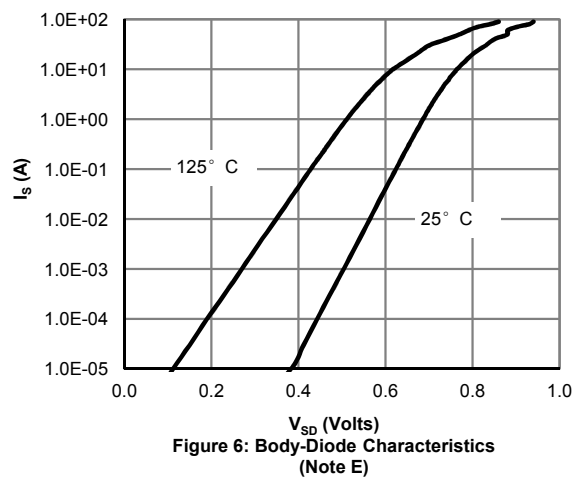
**Figure 3: On-Resistance vs. Drain Current and Gate Voltage (Note E)**



**Figure 4: On-Resistance vs. Junction Temperature (Note E)**

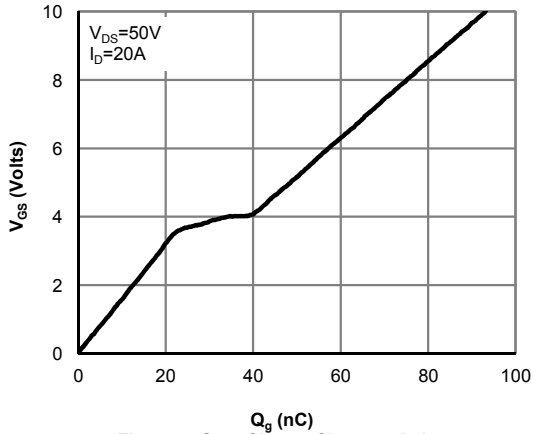


**Figure 5: On-Resistance vs. Gate-Source Voltage (Note E)**

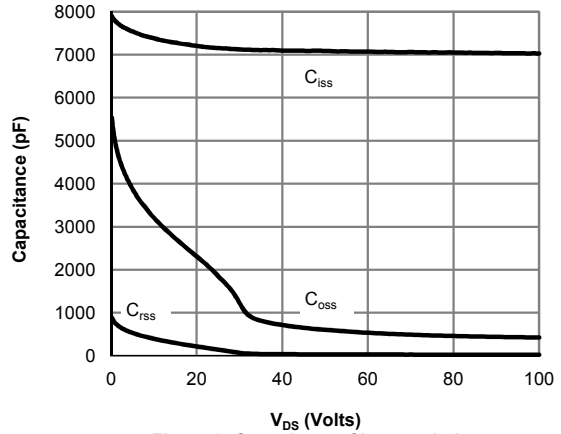


**Figure 6: Body-Diode Characteristics (Note E)**

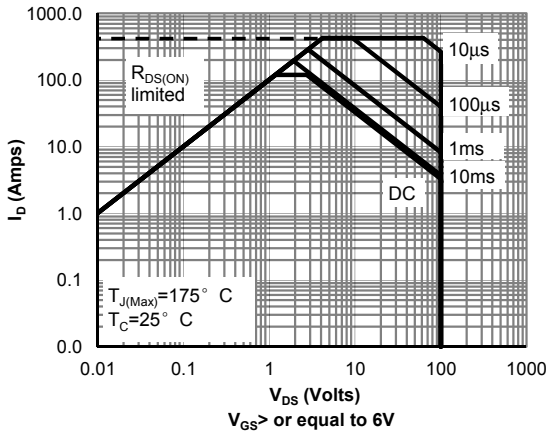
**TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS**



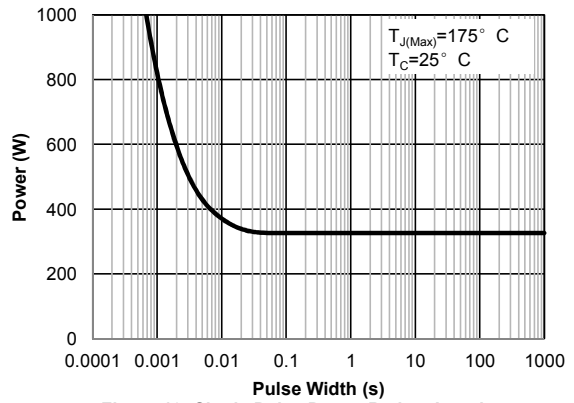
**Figure 7: Gate-Charge Characteristics**



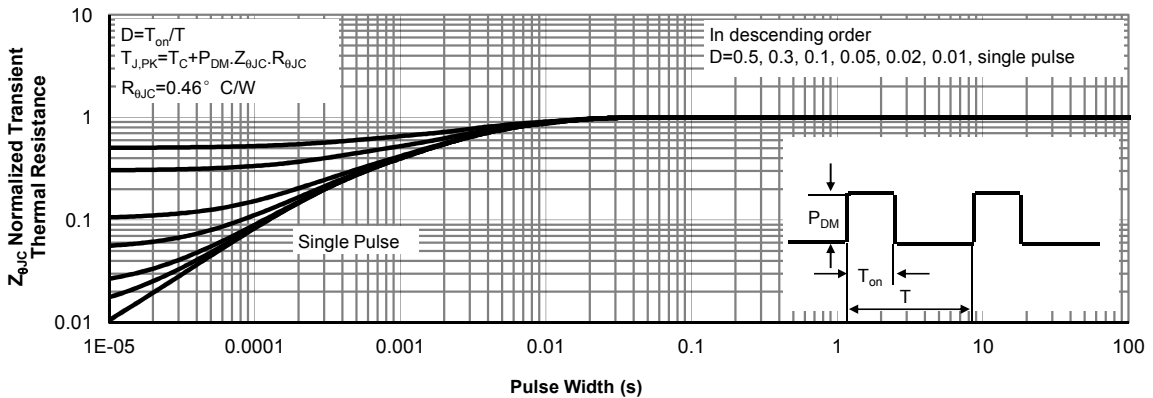
**Figure 8: Capacitance Characteristics**



**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**

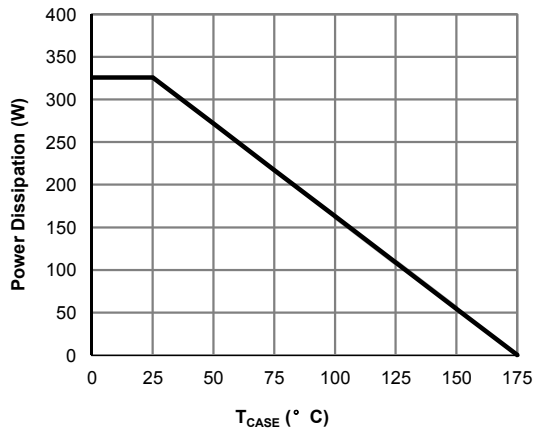


Figure 12: Power De-rating (Note F)

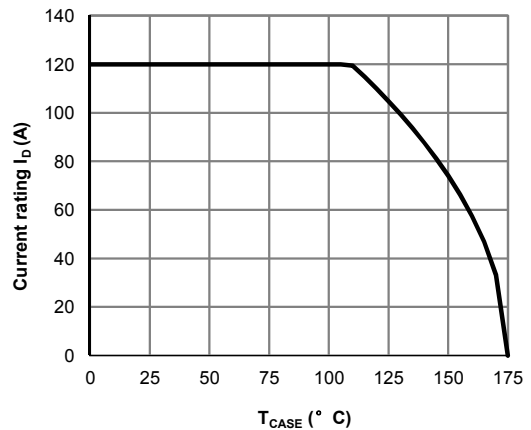


Figure 13: Current De-rating (Note F)

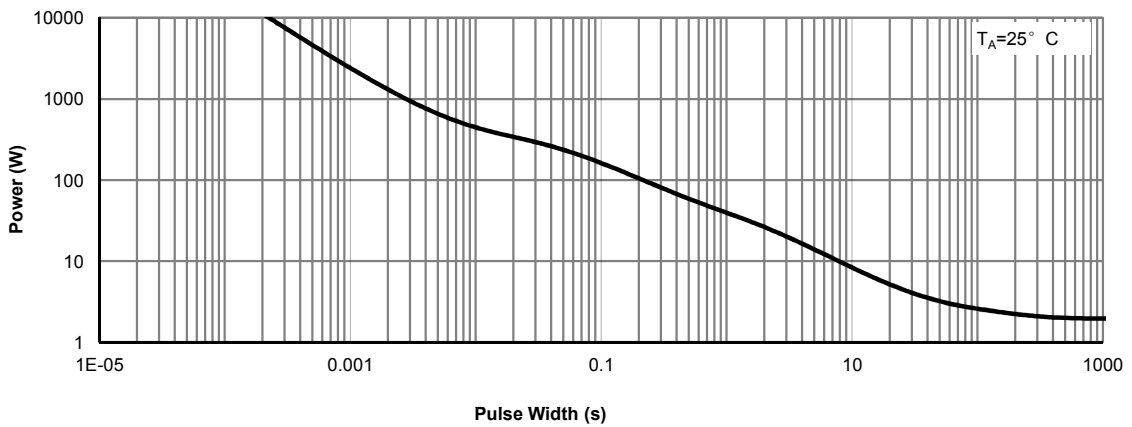


Figure 14: Single Pulse Power Rating Junction-to-Ambient (Note H)

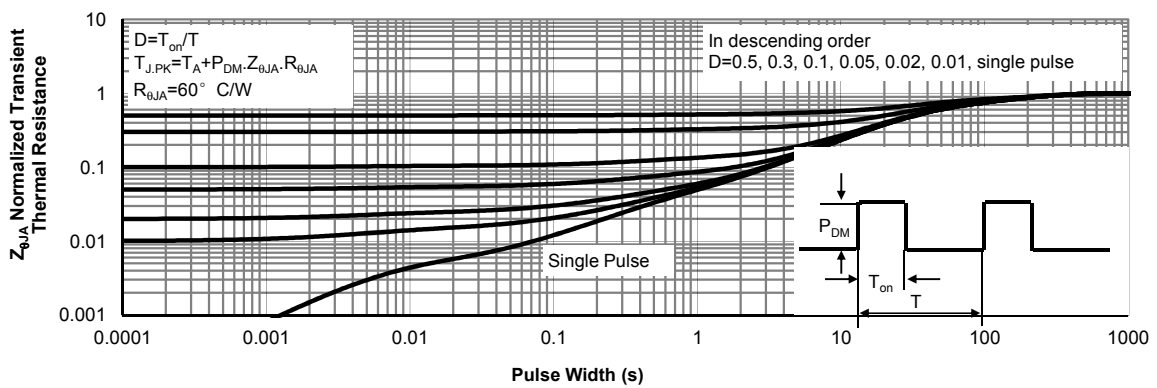


Figure 15: Normalized Maximum Transient Thermal Impedance (Note H)

Figure A: Gate Charge Test Circuit & Waveforms

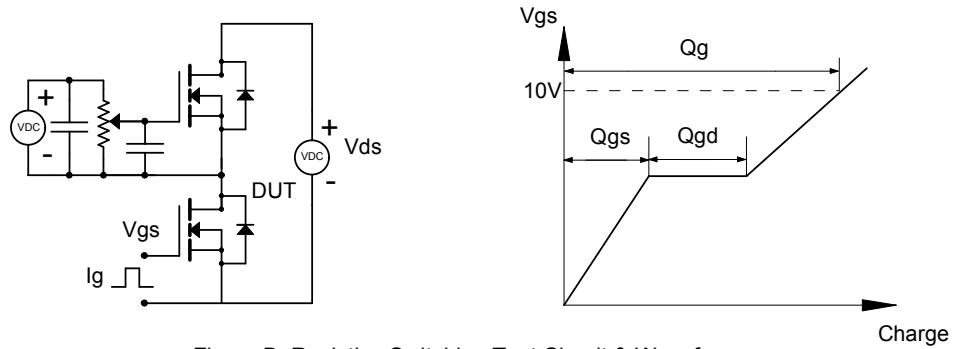


Figure B: Resistive Switching Test Circuit & Waveforms

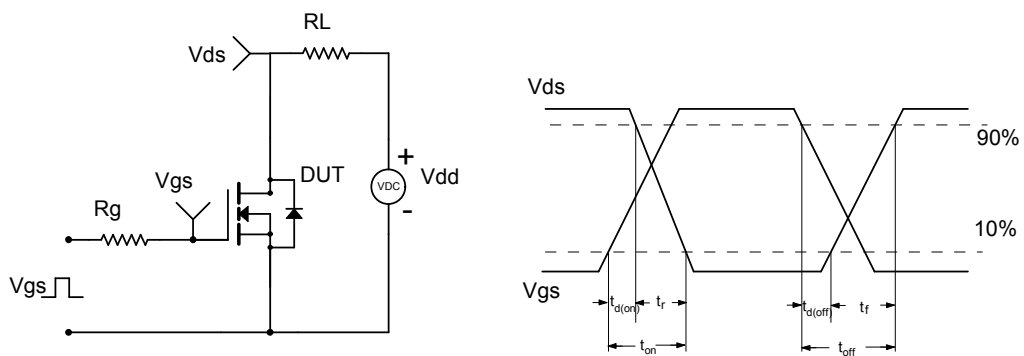


Figure C: Unclamped Inductive Switching (UIS) Test Circuit & Waveforms

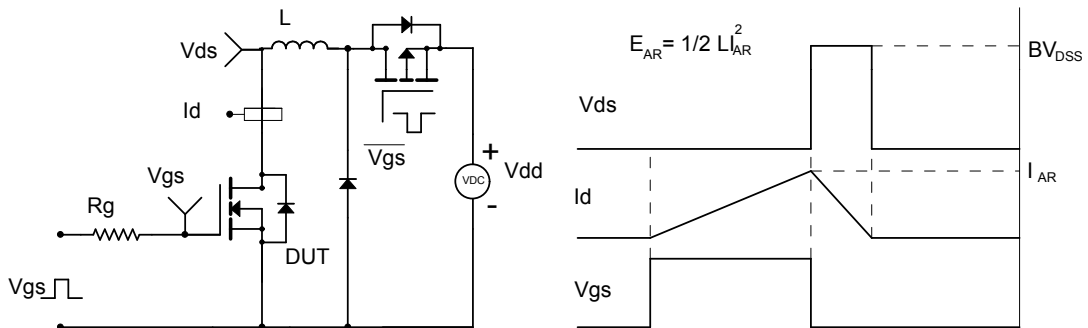
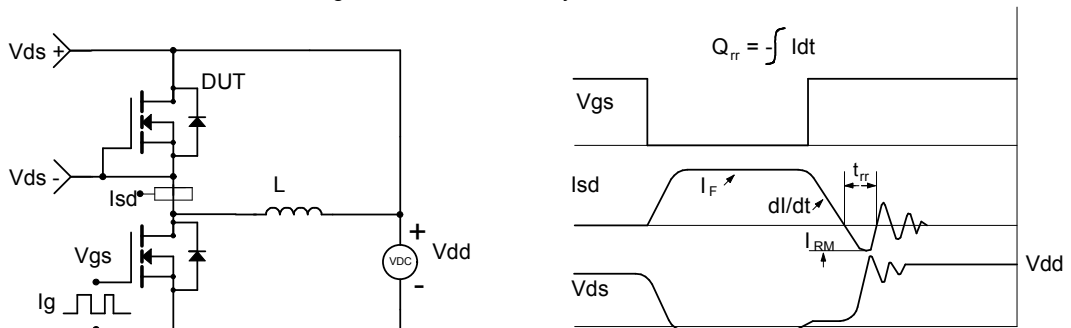


Figure D: Diode Recovery Test Circuit & Waveforms



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