

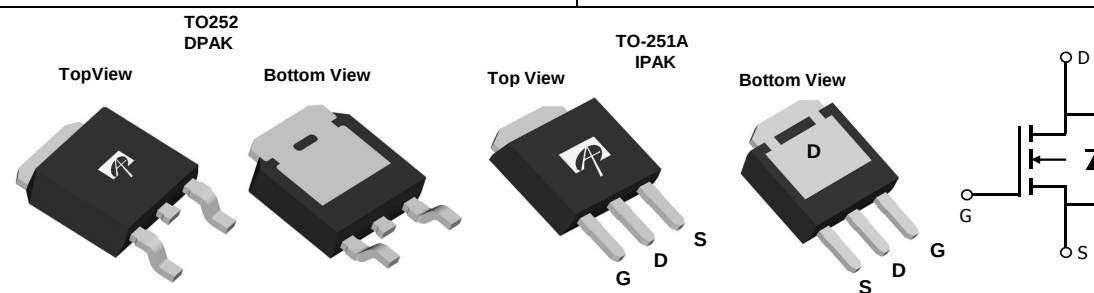
### General Description

The AOD4146/AOI4146 is fabricated with SDMOS™ trench technology that combines excellent  $R_{DS(ON)}$  with low gate charge. The result is outstanding efficiency with controlled switching behavior. This universal technology is well suited for PWM, load switching and general purpose applications.

### Product Summary

|                                    |         |
|------------------------------------|---------|
| $V_{DS}$                           | 30V     |
| $I_D$ (at $V_{GS}=10V$ )           | 55A     |
| $R_{DS(ON)}$ (at $V_{GS}=10V$ )    | < 5.6mΩ |
| $R_{DS(ON)}$ (at $V_{GS} = 4.5V$ ) | < 9.5mΩ |

100% UIS Tested  
100%  $R_g$  Tested



### 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                             | $V_{GS}$         | $\pm 20$   | V                |
| Continuous Drain Current <sup>G</sup>           | $I_D$            | 55         | A                |
| $T_C=25^\circ\text{C}$                          |                  |            |                  |
| $T_C=100^\circ\text{C}$                         |                  | 43         |                  |
| Pulsed Drain Current <sup>C</sup>               | $I_{DM}$         | 190        |                  |
| Continuous Drain Current                        | $I_{DSM}$        | 15         | A                |
| $T_A=25^\circ\text{C}$                          |                  |            |                  |
| $T_A=70^\circ\text{C}$                          |                  | 12         |                  |
| Avalanche Current <sup>C</sup>                  | $I_{AS}, I_{AR}$ | 50         | A                |
| Avalanche energy $L=0.05\text{mH}$ <sup>C</sup> | $E_{AS}, E_{AR}$ | 63         | mJ               |
| Power Dissipation <sup>B</sup>                  | $P_D$            | 62         | W                |
| $T_C=25^\circ\text{C}$                          |                  |            |                  |
| $T_C=100^\circ\text{C}$                         |                  | 31         |                  |
| Power Dissipation <sup>A</sup>                  | $P_{DSM}$        | 2.5        | W                |
| $T_A=25^\circ\text{C}$                          |                  |            |                  |
| $T_A=70^\circ\text{C}$                          |                  | 1.6        |                  |
| 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>   | $R_{\theta JA}$ | 15  | 20  | $^\circ\text{C/W}$ |
| $t \leq 10\text{s}$                        |                 |     |     |                    |
| Maximum Junction-to-Ambient <sup>A D</sup> |                 | 41  | 50  | $^\circ\text{C/W}$ |
| Steady-State                               |                 |     |     |                    |
| Maximum Junction-to-Case                   | $R_{\theta JC}$ | 2   | 2.4 | $^\circ\text{C/W}$ |
| Steady-State                               |                 |     |     |                    |

**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> =30V, V <sub>GS</sub> =0V<br>T <sub>J</sub> =55°C                          |      |            | 100<br>500 | 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                                     | 1.6  | 2.1        | 3          | V     |
| I <sub>D(ON)</sub>          | On state drain current                | V <sub>GS</sub> =10V, V <sub>DS</sub> =5V                                                  | 190  |            |            | 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                         |      | 4.7<br>7.4 | 5.6<br>8.9 | mΩ    |
|                             |                                       | V <sub>GS</sub> =4.5V, I <sub>D</sub> =10A                                                 |      | 7.9        | 9.5        | mΩ    |
| g <sub>FS</sub>             | Forward Transconductance              | V <sub>DS</sub> =5V, I <sub>D</sub> =20A                                                   |      | 50         |            | S     |
| V <sub>SD</sub>             | Diode Forward Voltage                 | I <sub>S</sub> =1A, V <sub>GS</sub> =0V                                                    |      | 0.7        | 1          | V     |
| I <sub>S</sub>              | Maximum Body-Diode Continuous Current |                                                                                            |      |            | 55         | A     |
| <b>DYNAMIC PARAMETERS</b>   |                                       |                                                                                            |      |            |            |       |
| C <sub>iss</sub>            | Input Capacitance                     | V <sub>GS</sub> =0V, V <sub>DS</sub> =15V, f=1MHz                                          | 1630 | 2037       | 2440       | pF    |
| C <sub>oss</sub>            | Output Capacitance                    |                                                                                            | 260  | 375        | 490        | pF    |
| C <sub>rss</sub>            | Reverse Transfer Capacitance          |                                                                                            | 130  | 220        | 300        | pF    |
| R <sub>g</sub>              | Gate resistance                       | V <sub>GS</sub> =0V, V <sub>DS</sub> =0V, f=1MHz                                           | 0.5  | 1.1        | 1.7        | Ω     |
| <b>SWITCHING PARAMETERS</b> |                                       |                                                                                            |      |            |            |       |
| Q <sub>g(10V)</sub>         | Total Gate Charge                     | V <sub>GS</sub> =10V, V <sub>DS</sub> =15V, I <sub>D</sub> =20A                            | 28   | 35         | 42         | nC    |
| Q <sub>g(4.5V)</sub>        | Total Gate Charge                     |                                                                                            | 13   | 16         | 20         | nC    |
| Q <sub>gs</sub>             | Gate Source Charge                    |                                                                                            | 6.8  | 8.6        | 10         | nC    |
| Q <sub>gd</sub>             | Gate Drain Charge                     |                                                                                            | 2.8  | 4.6        | 6.4        | 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 |      | 8.8        |            | ns    |
| t <sub>r</sub>              | Turn-On Rise Time                     |                                                                                            |      | 26         |            | ns    |
| t <sub>D(off)</sub>         | Turn-Off DelayTime                    |                                                                                            |      | 23         |            | ns    |
| t <sub>f</sub>              | Turn-Off Fall Time                    |                                                                                            |      | 6          |            | ns    |
| t <sub>rr</sub>             | Body Diode Reverse Recovery Time      | I <sub>F</sub> =20A, dI/dt=500A/μs                                                         | 8    | 10         | 12         | ns    |
| Q <sub>rr</sub>             | Body Diode Reverse Recovery Charge    | I <sub>F</sub> =20A, dI/dt=500A/μs                                                         | 12   | 15         | 18         | 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> 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. Repetitive rating, pulse width limited by junction temperature T<sub>J(MAX)</sub>=175° C. Ratings are based on low frequency and duty cycles to keep initial T<sub>J</sub>=25° 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 limited by bond-wires.

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.

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## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

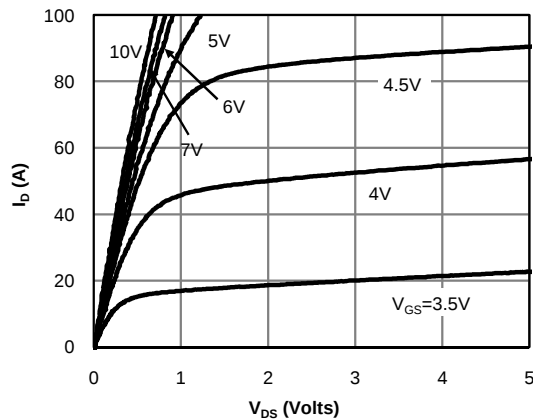


Fig 1: On-Region Characteristics (Note E)

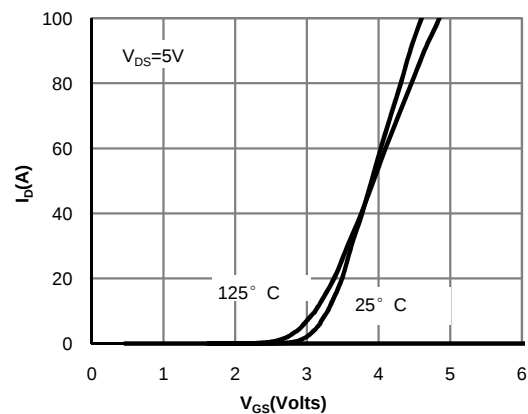


Figure 2: Transfer Characteristics (Note E)

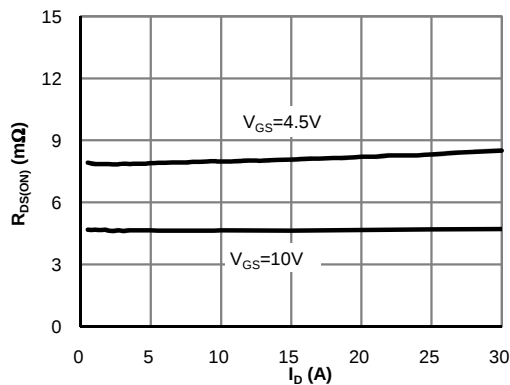


Figure 3: On-Resistance vs. Drain Current and Gate Voltage (Note E)

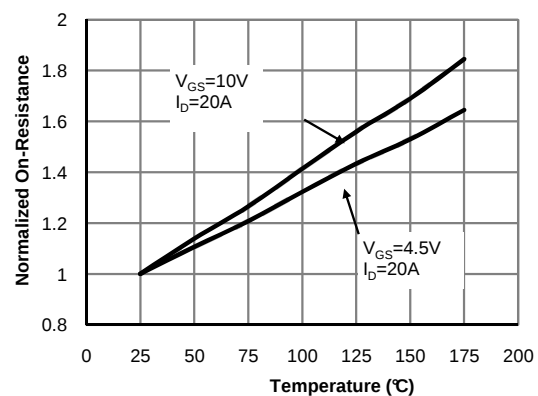


Figure 4: On-Resistance vs. Junction Temperature (Note E)

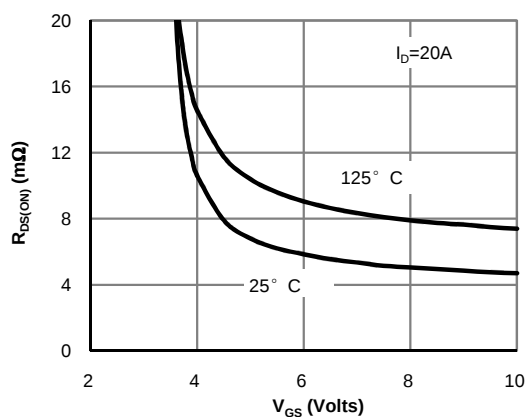


Figure 5: On-Resistance vs. Gate-Source Voltage (Note E)

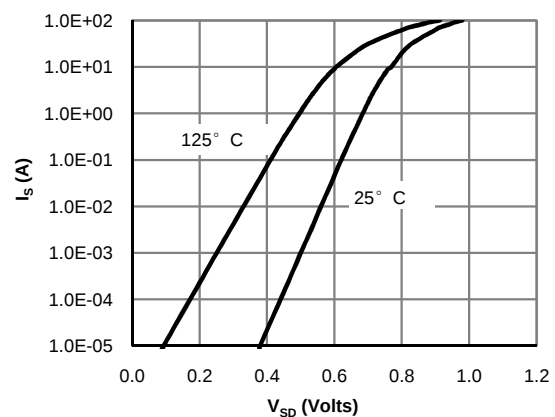
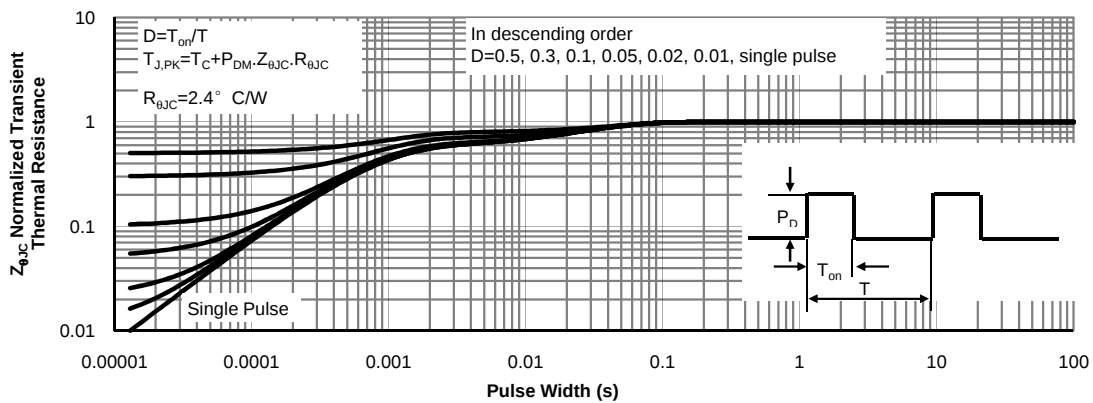
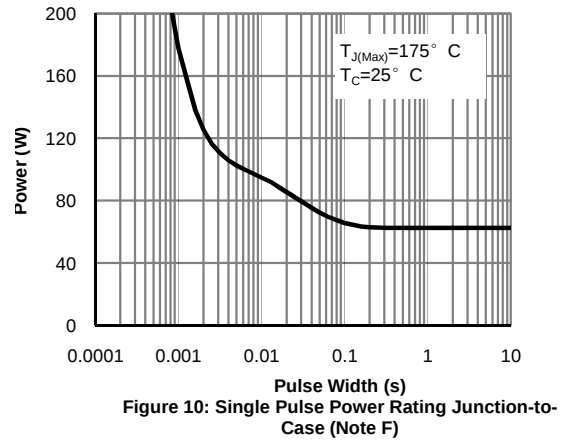
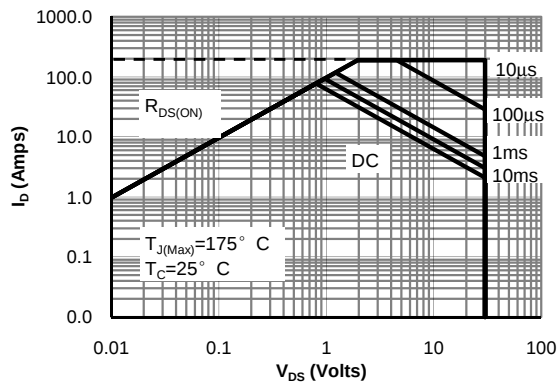
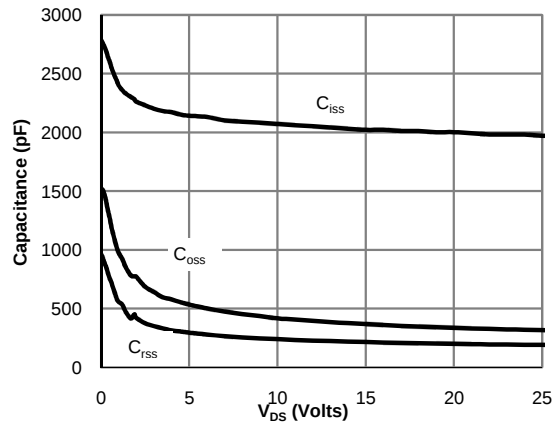
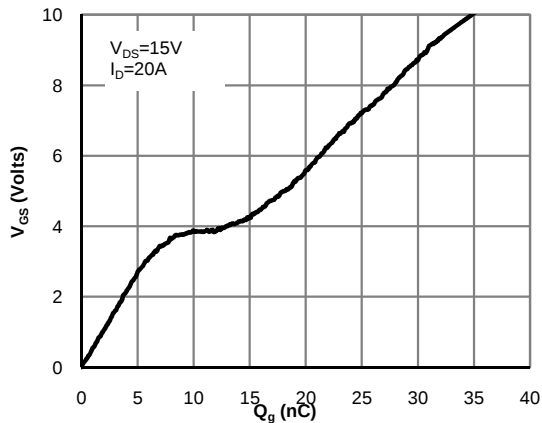


Figure 6: Body-Diode Characteristics (Note E)

## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS



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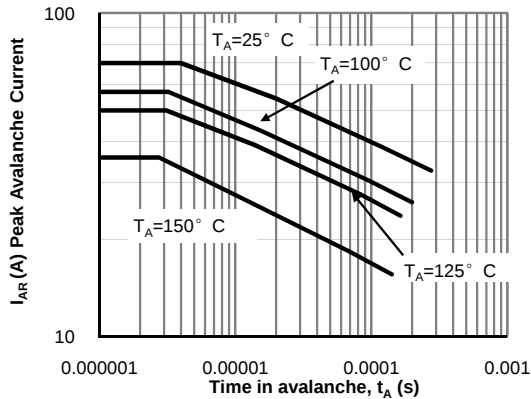


Figure 12: Single Pulse Avalanche capability (Note C)

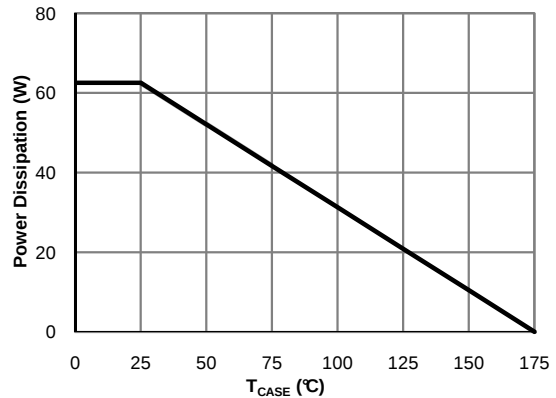


Figure 13: Power De-rating (Note F)

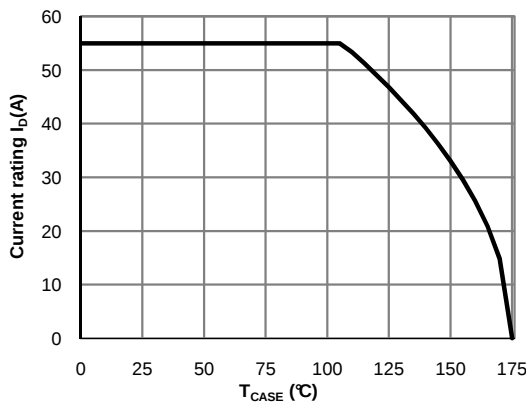


Figure 14: Current De-rating (Note F)

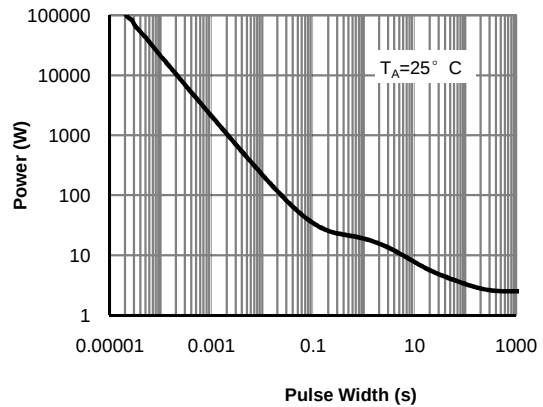


Figure 15: Single Pulse Power Rating Junction-to-Ambient (Note H)

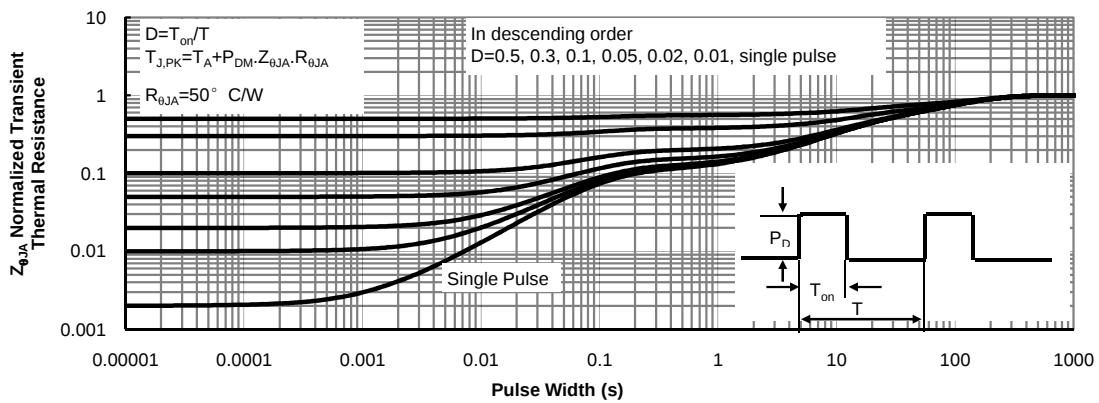


Figure 16: Normalized Maximum Transient Thermal Impedance (Note H)

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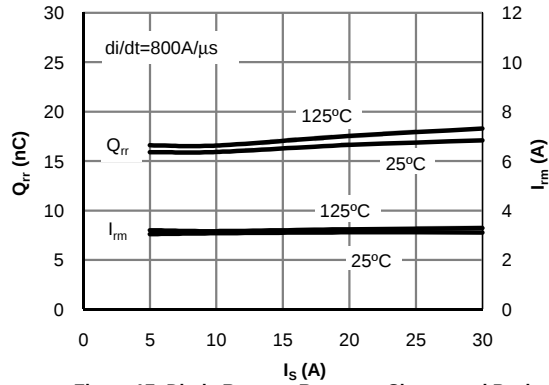


Figure 17: Diode Reverse Recovery Charge and Peak Current vs. Conduction Current

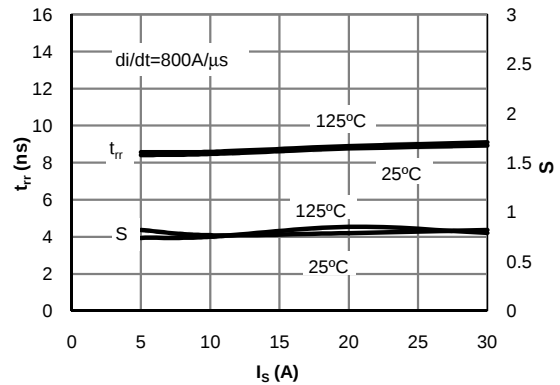


Figure 18: Diode Reverse Recovery Time and Softness Factor vs. Conduction Current

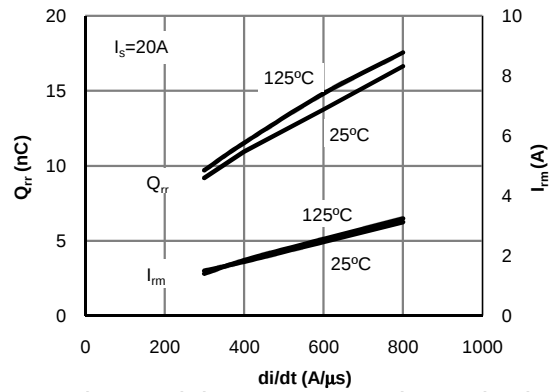


Figure 19: Diode Reverse Recovery Charge and Peak Current vs.  $di/dt$

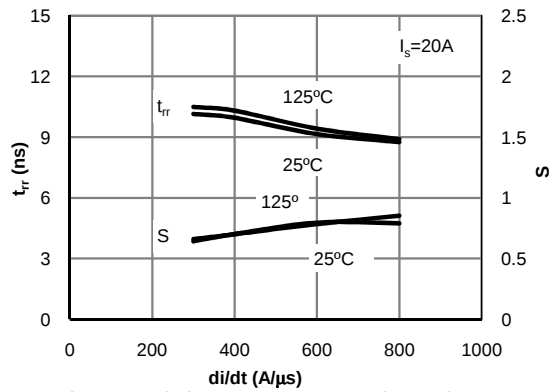
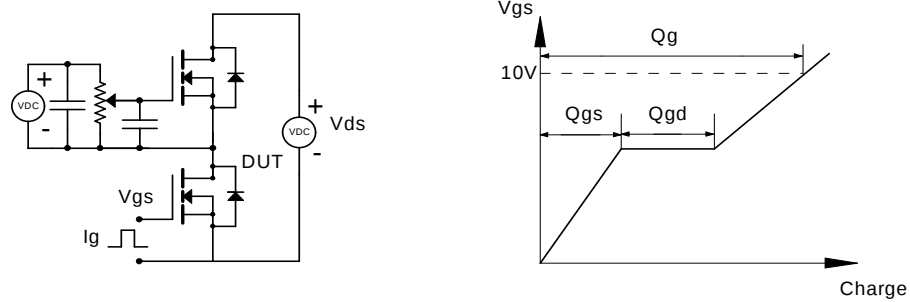
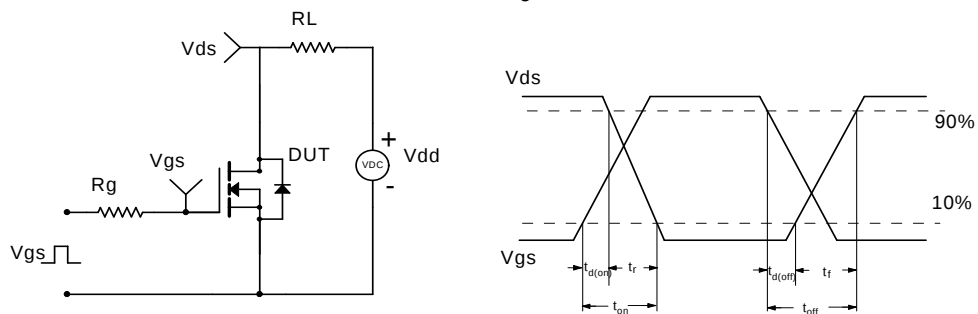


Figure 20: Diode Reverse Recovery Time and Softness Factor vs.  $di/dt$

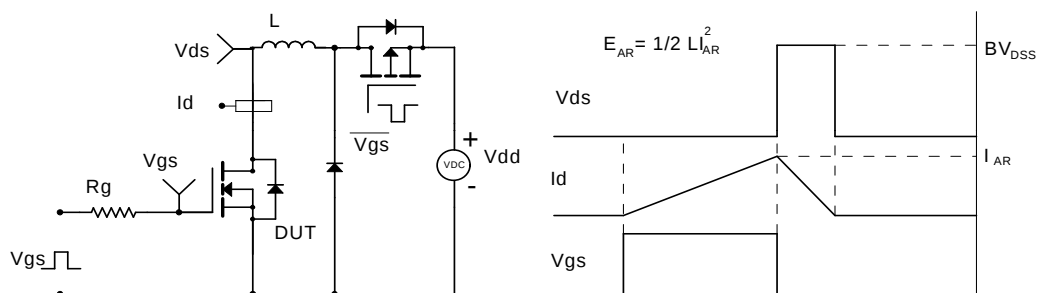
### Gate Charge Test Circuit & Waveform



### Resistive Switching Test Circuit & Waveforms



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



### Diode Recovery Test Circuit & Waveforms

