# ALPHA & OMEGA SEMICONDUCTOR

# AOT2146L/AOB2146L
## 40V N-Channel AlphaSGT™

## General Description

• Trench Power AlphaSGT™ technology
• Low R$_{DS(ON)}$
• Low Gate Charge
• Optimized Ruggedness
• RoHS and Halogen-Free Compliant

## Applications

• DC Motor Driver
• Synchronous Rectification in DC/DC and AC/DC Converters
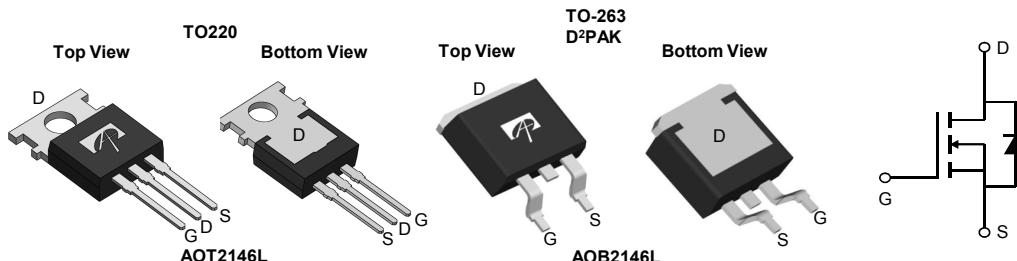
## Product Summary

| | |
|---|---|
| V$_{DS}$ | 40V |
| I$_D$ (at V$_{GS}$=10V) | 105A |
| R$_{DS(ON)}$ (at V$_{GS}$=10V) | < 2.8mΩ |
| R$_{DS(ON)}$ (at V$_{GS}$=4.5V) | < 3.9mΩ |

100% UIS Tested
100% Rg Tested

Green Product



TO220 — Top View, Bottom View — AOT2146L
TO-263 D²PAK — Top View, Bottom View — AOB2146L

| Orderable Part Number | Package Type | Form | Minimum Order Quantity |
|---|---|---|---|
| AOT2146L | TO-220 | Tube | 1000 |
| AOB2146L | TO-263 | Tape & Reel | 800 |

## Absolute Maximum Ratings  T$_A$=25°C unless otherwise noted

| Parameter | | Symbol | Maximum | Units |
|---|---|---|---|---|
| Drain-Source Voltage | | V$_{DS}$ | 40 | V |
| Gate-Source Voltage | | V$_{GS}$ | ±20 | V |
| Continuous Drain Current [G] | T$_C$=25°C | I$_D$ | 105 | A |
| | T$_C$=100°C | | 100 | |
| Pulsed Drain Current [C] | | I$_{DM}$ | 345 | |
| Continuous Drain Current | T$_A$=25°C | I$_{DSM}$ | 42 | A |
| | T$_A$=70°C | | 33.5 | |
| Avalanche Current [C] | | I$_{AS}$ | 38 | A |
| Avalanche energy  L=0.3mH [C] | | E$_{AS}$ | 217 | mJ |
| Power Dissipation [B] | T$_C$=25°C | P$_D$ | 119 | W |
| | T$_C$=100°C | | 47.5 | |
| Power Dissipation [A] | T$_A$=25°C | P$_{DSM}$ | 8.3 | W |
| | T$_A$=70°C | | 5.3 | |
| Junction and Storage Temperature Range | | T$_J$, T$_{STG}$ | -55 to 150 | °C |

## Thermal Characteristics

| Parameter | | Symbol | Typ | Max | Units |
|---|---|---|---|---|---|
| Maximum Junction-to-Ambient [A] | t ≤ 10s | R$_{θJA}$ | 12 | 15 | °C/W |
| Maximum Junction-to-Ambient [A D] | Steady-State | | 50 | 60 | °C/W |
| Maximum Junction-to-Case | Steady-State | R$_{θJC}$ | 0.85 | 1.05 | °C/W |

**ALPHA & OMEGA**
*SEMICONDUCTOR*

**Electrical Characteristics (T$_J$=25°C unless otherwise noted)**

| Symbol | Parameter | Conditions | | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|---|
| **STATIC PARAMETERS** | | | | | | | |
| BV$_{DSS}$ | Drain-Source Breakdown Voltage | I$_D$=250µA, V$_{GS}$=0V | | 40 | | | V |
| I$_{DSS}$ | Zero Gate Voltage Drain Current | V$_{DS}$=40V, V$_{GS}$=0V | | | | 1 | µA |
| | | | T$_J$=55°C | | | 5 | |
| I$_{GSS}$ | Gate-Body leakage current | V$_{DS}$=0V, V$_{GS}$=±20V | | | | ±100 | nA |
| V$_{GS(th)}$ | Gate Threshold Voltage | V$_{DS}$=V$_{GS,}$ I$_D$=250µA | | 1.5 | 1.95 | 2.5 | V |
| R$_{DS(ON)}$ | Static Drain-Source On-Resistance | V$_{GS}$=10V, I$_D$=20A | | | 2.3 | 2.8 | mΩ |
| | | | T$_J$=125°C | | 3.5 | 4.3 | |
| | | V$_{GS}$=4.5V, I$_D$=20A | | | 3.1 | 3.9 | mΩ |
| g$_{FS}$ | Forward Transconductance | V$_{DS}$=5V, I$_D$=20A | | | 100 | | S |
| V$_{SD}$ | Diode Forward Voltage | I$_S$=1A, V$_{GS}$=0V | | | 0.68 | 1 | V |
| I$_S$ | Maximum Body-Diode Continuous Current [G] | | | | | 105 | A |
| **DYNAMIC PARAMETERS** | | | | | | | |
| C$_{iss}$ | Input Capacitance | V$_{GS}$=0V, V$_{DS}$=20V, f=1MHz | | | 3830 | | pF |
| C$_{oss}$ | Output Capacitance | | | | 630 | | pF |
| C$_{rss}$ | Reverse Transfer Capacitance | | | | 45 | | pF |
| R$_g$ | Gate resistance | f=1MHz | | 1 | 2 | 3 | Ω |
| **SWITCHING PARAMETERS** | | | | | | | |
| Q$_g$(10V) | Total Gate Charge | V$_{GS}$=10V, V$_{DS}$=20V, I$_D$=20A | | | 50 | 70 | nC |
| Q$_g$(4.5V) | Total Gate Charge | | | | 20 | 30 | nC |
| Q$_{gs}$ | Gate Source Charge | | | | 13.5 | | nC |
| Q$_{gd}$ | Gate Drain Charge | | | | 3 | | nC |
| Q$_{oss}$ | Output Charge | V$_{GS}$=0V, V$_{DS}$=20V | | | 27 | | nC |
| t$_{D(on)}$ | Turn-On DelayTime | V$_{GS}$=10V, V$_{DS}$=20V, R$_L$=1.0Ω, R$_{GEN}$=3Ω | | | 12 | | ns |
| t$_r$ | Turn-On Rise Time | | | | 12 | | ns |
| t$_{D(off)}$ | Turn-Off DelayTime | | | | 44 | | ns |
| t$_f$ | Turn-Off Fall Time | | | | 9 | | ns |
| t$_{rr}$ | Body Diode Reverse Recovery Time | I$_F$=20A, di/dt=500A/µs | | | 18.5 | | ns |
| Q$_{rr}$ | Body Diode Reverse Recovery Charge | I$_F$=20A, di/dt=500A/µs | | | 50 | | nC |

A. The value of R$_{θJA}$ is measured with the device mounted on 1in² FR-4 board with 2oz. Copper, in a still air environment with T$_A$ =25° C. The Power dissipation P$_{DSM}$ is based on R $_{θJA}$ t≤ 10s and the maximum allowed junction temperature of 150° C. The value in any given application depends on the user's specific board design.
B. The power dissipation P$_D$ is based on T$_{J(MAX)}$=150° 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$_{J(MAX)}$=150° C.
D. The R$_{θJA}$ is the sum of the thermal impedance from junction to case R$_{θJC}$ 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$_{J(MAX)}$=150° 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 in² FR-4 board with 2oz. Copper, in a still air environment with T$_A$=25° C.
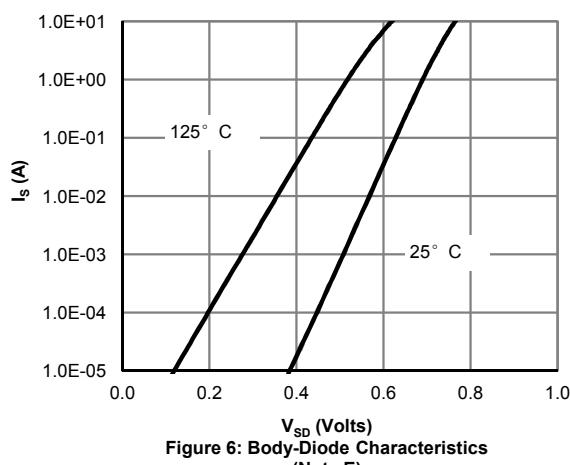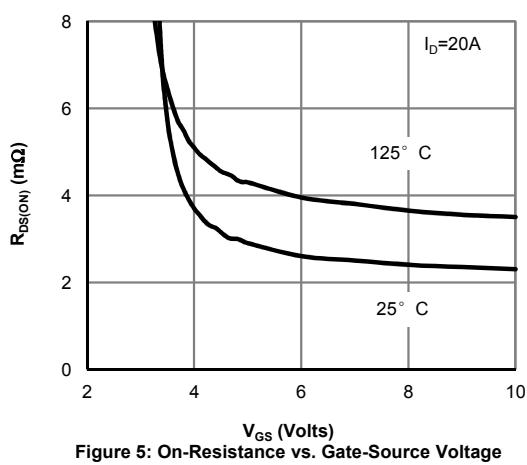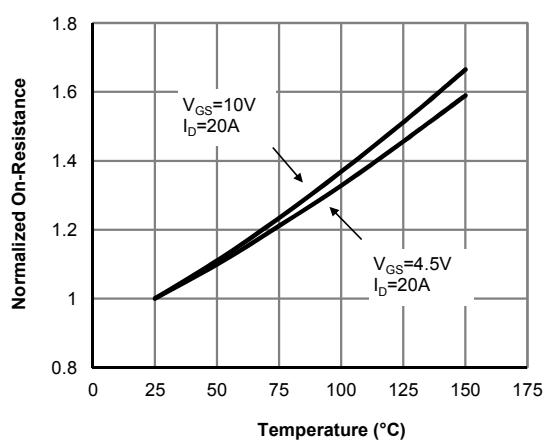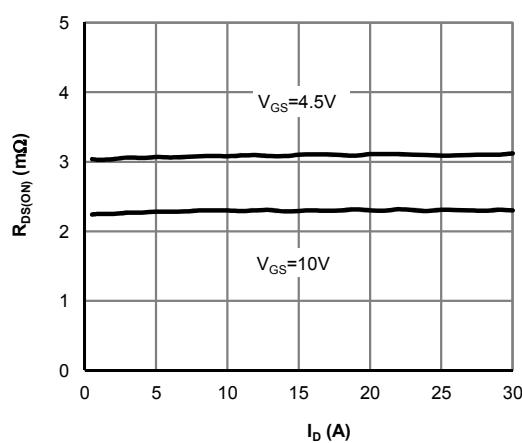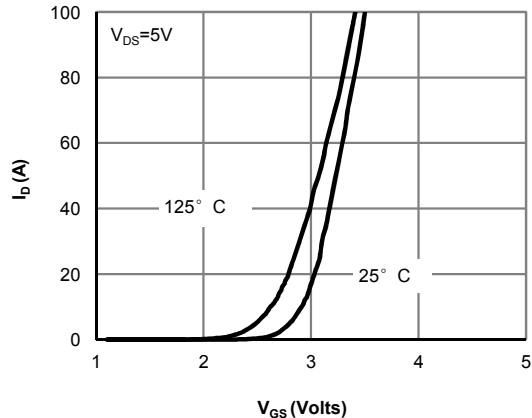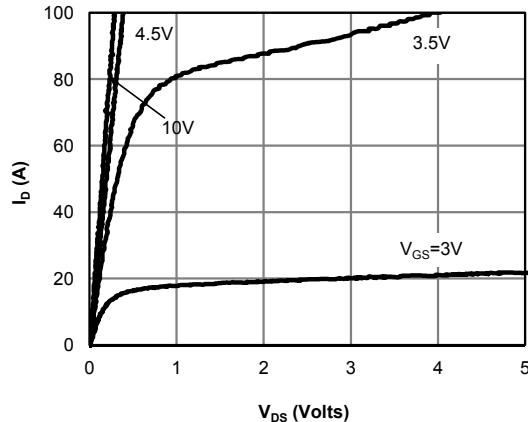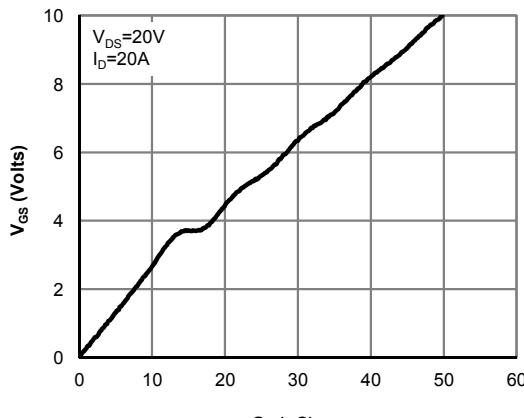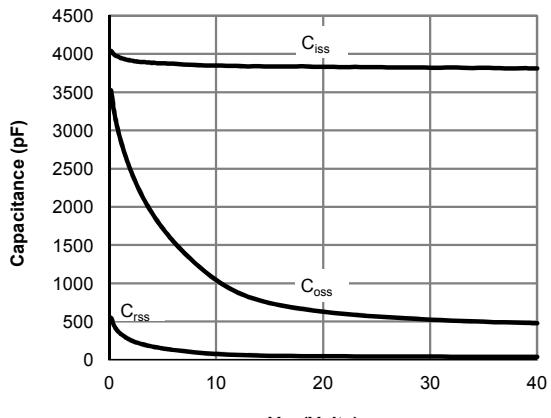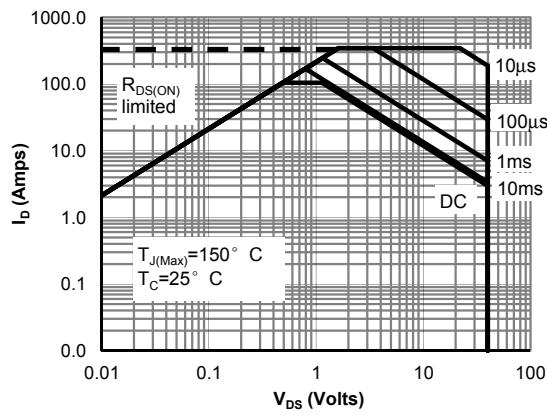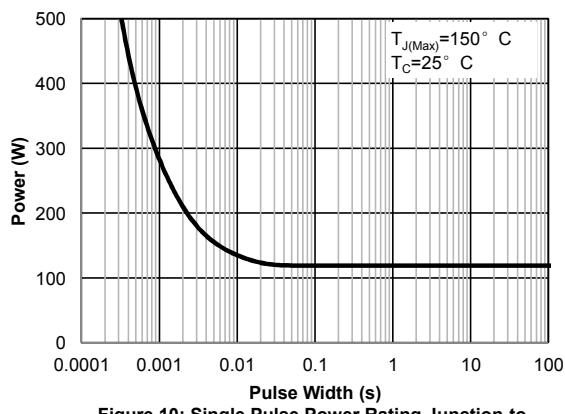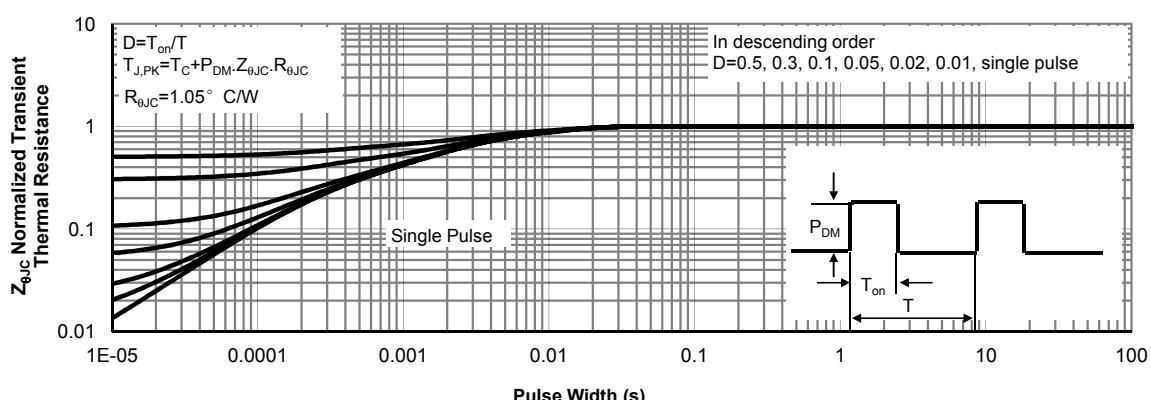
## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

**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)**

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## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS



Figure 7: Gate-Charge Characteristics



Figure 8: Capacitance Characteristics



$V_{GS}$> or equal to 4.5V
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)
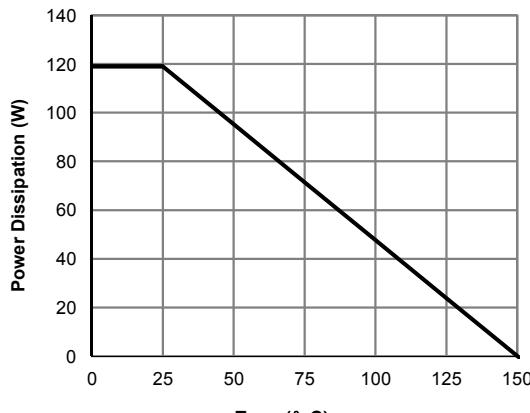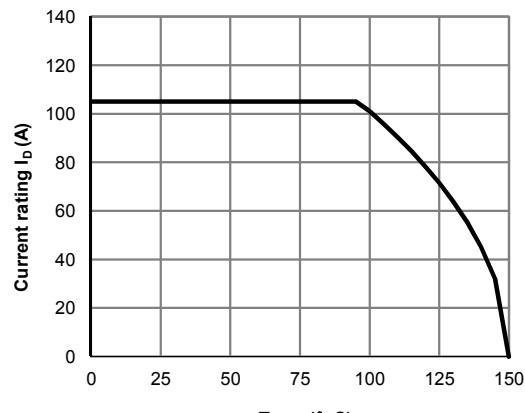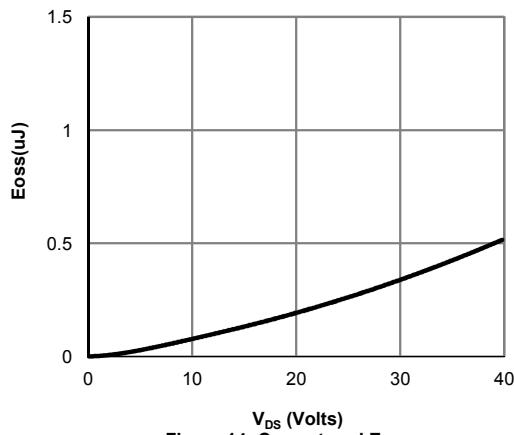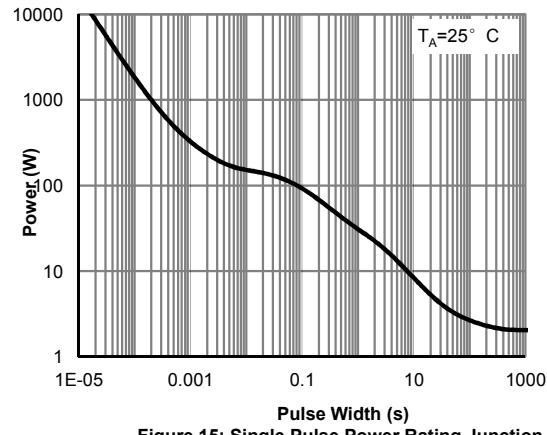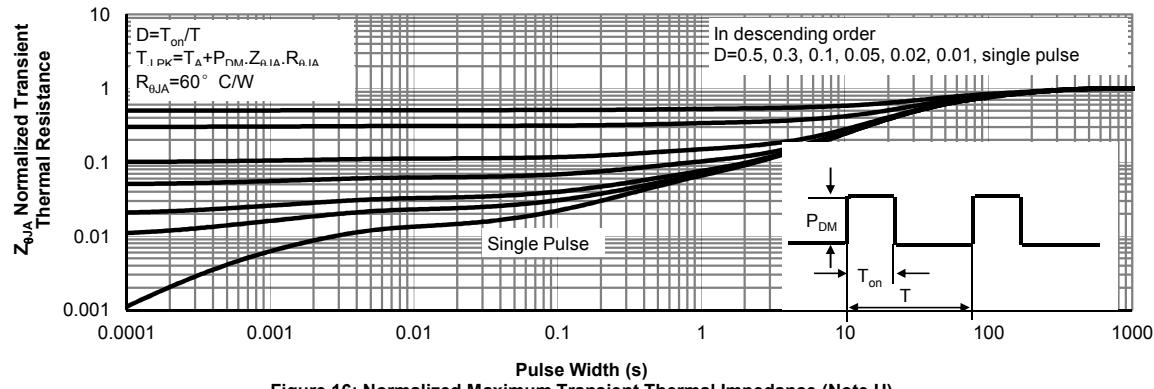
## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS


Figure 12: Power De-rating (Note F)


Figure 13: Current De-rating (Note F)


Figure 14: Coss stored Energy


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

$D=T_{on}/T$
$T_{J,PK}=T_A+P_{DM} \cdot Z_{\theta JA} \cdot R_{\theta JA}$
$R_{\theta JA}=60^{\circ}C/W$

In descending order
D=0.5, 0.3, 0.1, 0.05, 0.02, 0.01, single pulse

Single Pulse


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

Figure A: Gate Charge Test Circuit & Waveforms
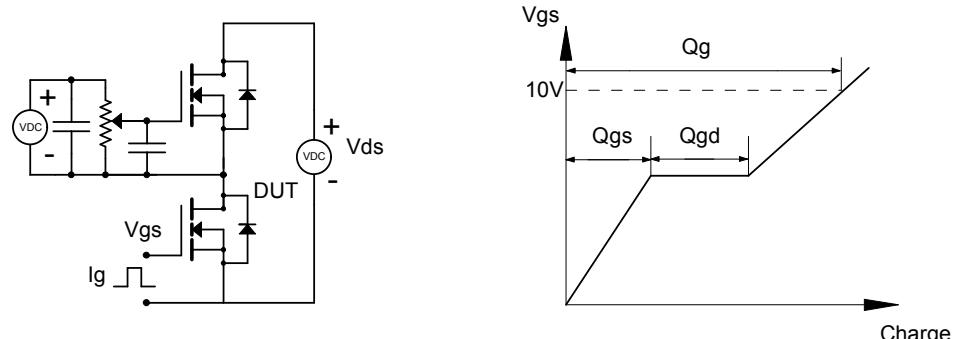
Figure B: Resistive Switching Test Circuit & Waveforms
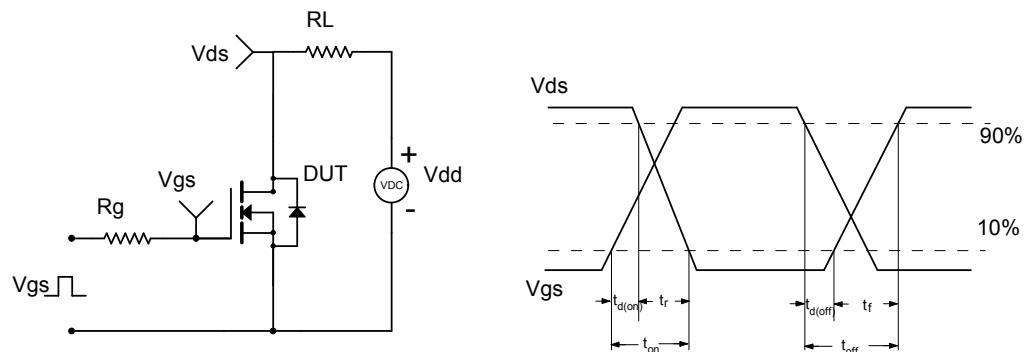
Figure C: Unclamped Inductive Switching (UIS) Test Circuit & Waveforms

$$E_{AR} = 1/2 \ LI_{AR}^2$$
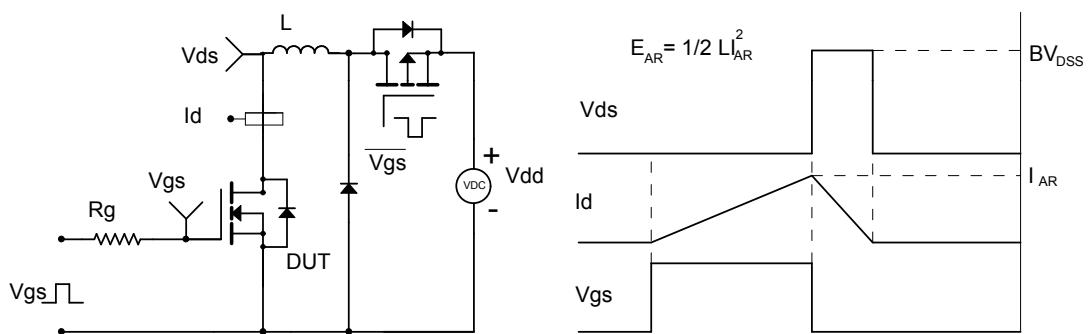
Figure D: Diode Recovery Test Circuit & Waveforms

$$Q_{rr} = -\int Idt$$