ALPHA & OMEGA SEMICONDUCTOR

# AOD1N60 / AOU1N60

## 1.3A, 600V N-Channel MOSFET

*formerly engineering part number AOD9600*

RoHS Compliant

## General Description

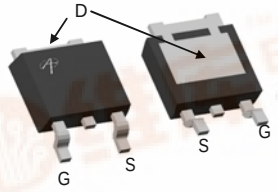
The AOD1N60 has been fabricated using an advanced high voltage MOSFET process that is designed to deliver high levels of performance and robustness in popular AC-DC applications.
By providing low $R_{DS(on)}$, $C_{iss}$ and $C_{rss}$ along with guaranteed avalanche capability these parts can be adopted quickly into new and existing offline power supply designs.

## Features

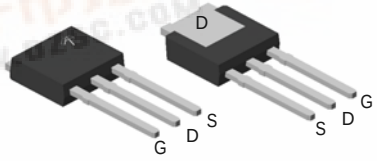
$V_{DS}$ (V) = 600V
$I_D$ = 1.3A
$R_{DS(ON)}$ < 9Ω ($V_{GS}$ = 10V)

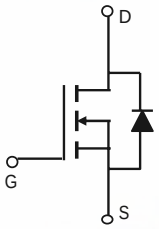
***100% UIS Tested!***
***100% $R_g$ Tested!***
***$C_{iss}$, $C_{oss}$, $C_{rss}$ Tested!***

TO-252
D-PAK
Top View Bottom View




TO-251
Top View Bottom View




**Absolute Maximum Ratings $T_A$=25°C unless otherwise noted**

| Parameter | | Symbol | Maximium | Units |
|---|---|---|---|---|
| Drain-Source Voltage | | $V_{DS}$ | 600 | V |
| Gate-Source Voltage | | $V_{GS}$ | ±30 | V |
| Continuous Drain Current [B] | $T_C$=25°C | $I_D$ | 1.3 | A |
| | $T_C$=100°C | | 0.8 | |
| Pulsed Drain Current [C] | | $I_{DM}$ | 4.0 | |
| Avalanche Current [C] | | $I_{AR}$ | 1.0 | A |
| Repetitive avalanche energy [C] | | $E_{AR}$ | 15 | mJ |
| Single pulsed avalanche energy [H] | | $E_{AS}$ | 30 | mJ |
| Peak diode recovery dv/dt | | dv/dt | 5 | V/ns |
| Power Dissipation [B] | $T_C$=25°C | $P_D$ | 45 | W |
| | Derate above 25°C | | 0.36 | W/ °C |
| Junction and Storage Temperature Range | | $T_J$, $T_{STG}$ | -50 to 150 | °C |
| Maximum lead temperature for soldering purpose, 1/8" from case for 5 seconds | | $T_L$ | 300 | °C |

**Thermal Characteristics**

| Parameter | Symbol | Typical | Maximum | Units |
|---|---|---|---|---|
| Maximum Junction-to-Ambient [A,G] | $R_{\theta JA}$ | 45 | 55 | °C/W |
| Maximum Case-to-Sink [A] | $R_{\theta CS}$ | - | 0.5 | °C/W |
| Maximum Junction-to-Case [D,F] | $R_{\theta JC}$ | 2.3 | 2.8 | °C/W |

## 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 | 600 | | | V |
| $BV_{DSS}$ /$\Delta T_J$ | Breakdown Voltage Temperature Coefficient | $I_D$=250µA, $V_{GS}$=0V | | 0.6 | | V/ °C |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$=600V, $V_{GS}$=0V | | | 1 | µA |
| | | $V_{DS}$=480V, $T_J$=125°C | | | 10 | |
| $I_{GSS}$ | Gate-Body leakage current | $V_{DS}$=0V, $V_{GS}$=±30V | | | 100 | nA |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}$=$V_{GS}$, $I_D$=250µA | 3 | 4.1 | 5 | V |
| $R_{DS(ON)}$ | Static Drain-Source On-Resistance | $V_{GS}$=10V, $I_D$=0.65A | | 7.5 | 9 | Ω |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$=40V, $I_D$=0.65A | | 0.9 | | S |
| $V_{SD}$ | Diode Forward Voltage | $I_S$=1A, $V_{GS}$=0V | | 0.65 | 1 | V |
| $I_S$ | Maximum Body-Diode Continuous Current | | | | 1 | A |
| $I_{SM}$ | Maximum Body-Diode Pulsed Current | | | | 4 | A |
| **DYNAMIC PARAMETERS** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{GS}$=0V, $V_{DS}$=25V, f=1MHz | 105 | 130 | 160 | pF |
| $C_{oss}$ | Output Capacitance | | 12 | 14.5 | 17.5 | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | 1.5 | 1.8 | 2.2 | pF |
| $R_g$ | Gate resistance | $V_{GS}$=0V, $V_{DS}$=0V, f=1MHz | 2.9 | 3.5 | 5.3 | Ω |
| **SWITCHING PARAMETERS** | | | | | | |
| $Q_g$ | Total Gate Charge | $V_{GS}$=10V, $V_{DS}$=480V, $I_D$=1A | | 6.1 | 8 | nC |
| $Q_{gs}$ | Gate Source Charge | | | 1.3 | 2 | nC |
| $Q_{gd}$ | Gate Drain Charge | | | 3.1 | 4 | nC |
| $t_{D(on)}$ | Turn-On DelayTime | $V_{GS}$=10V, $V_{DS}$=300V, $I_D$=1A, $R_G$=25Ω | | 10 | 13 | ns |
| $t_r$ | Turn-On Rise Time | | | 6.7 | 13 | ns |
| $t_{D(off)}$ | Turn-Off DelayTime | | | 20 | 26 | ns |
| $t_f$ | Turn-Off Fall Time | | | 11.5 | 23 | ns |
| $t_{rr}$ | Body Diode Reverse Recovery Time | $I_F$=1.3A,dI/dt=100A/µs,$V_{DS}$=100V | | 114 | 137 | ns |
| $Q_{rr}$ | Body Diode Reverse Recovery Charge | $I_F$=1.3A,dI/dt=100A/µs,$V_{DS}$=100V | | 0.63 | 0.76 | µC |

A: The value of $R_{\theta JA}$ is measured with the device in a still air environment with $T_A$=25°C.

B. The power dissipation $P_D$ is based on $T_{J(MAX)}$=150°C in a TO220 package, 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 $T_{J(MAX)}$=150°C.

D. The $R_{\theta JA}$ is the sum of the thermal impedence from junction to case $R_{\theta JC}$ and case to ambient.

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

F. These curves are based on the junction-to-case thermal impedence which is measured with the device mounted to a large heatsink, assuming a maximum junction temperature of $T_{J(MAX)}$=150°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 $T_A$=25°C.

H. L=60mH, $I_{AS}$=1A, $V_{DD}$=150V, $R_G$=10Ω, Starting $T_J$=25°C

Rev0: May 2008

## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

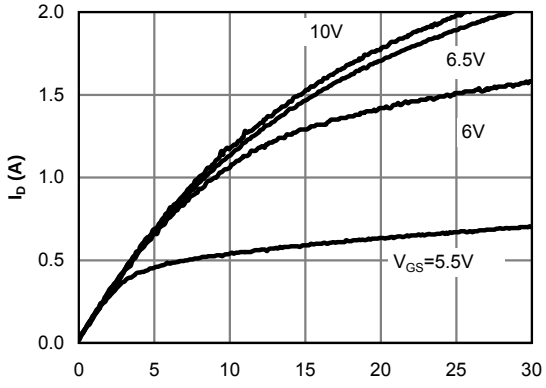



Fig 1: On-Region Characteristics

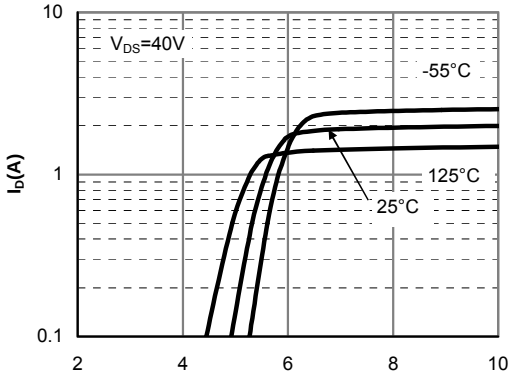



Figure 2: Transfer Characteristics

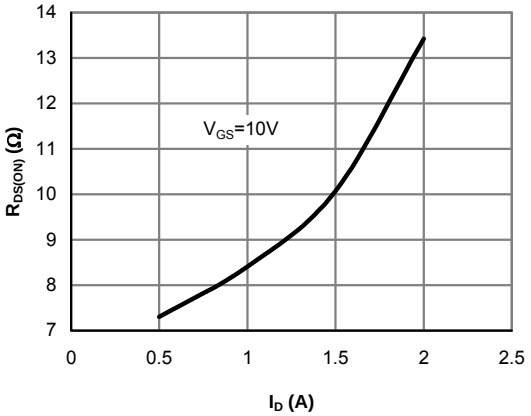



Figure 3: On-Resistance vs. Drain Current and Gate Voltage

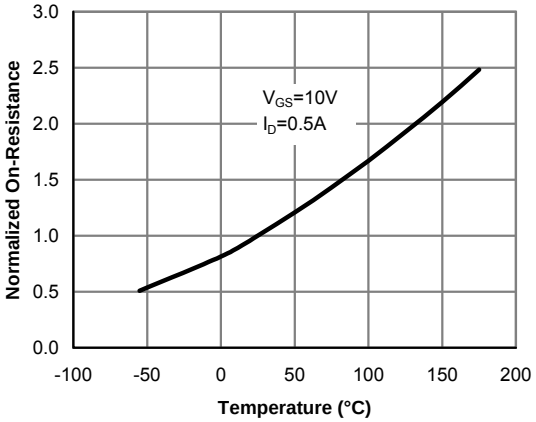



Figure 4: On-Resistance vs. Junction Temperature

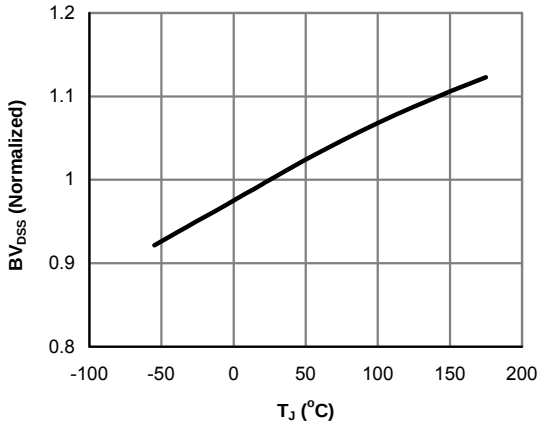



Figure 5: Break Down vs. Junction Temperature

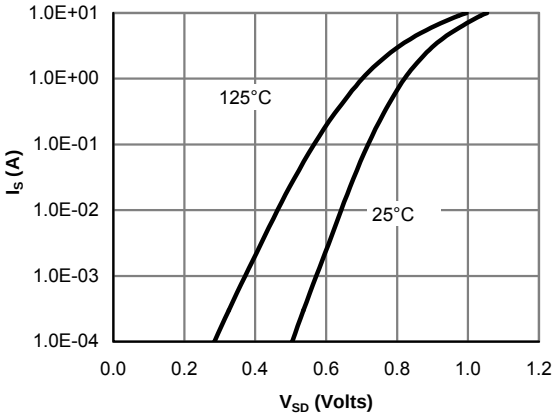



Figure 6: Body-Diode Characteristics

## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

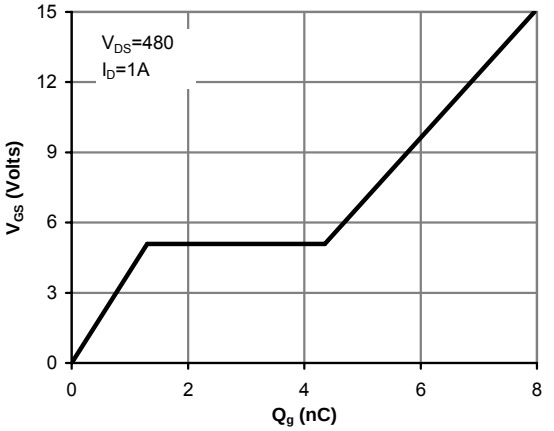



Figure 7: Gate-Charge Characteristics

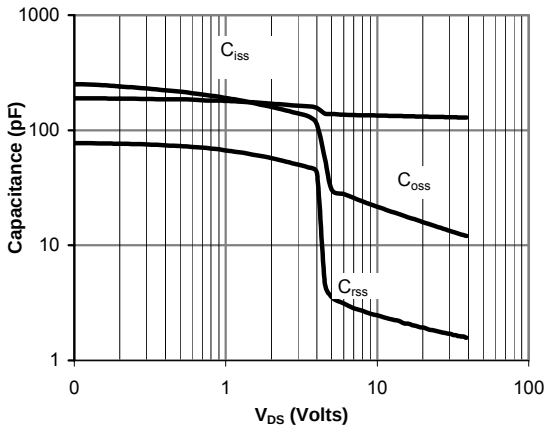



Figure 8: Capacitance Characteristics

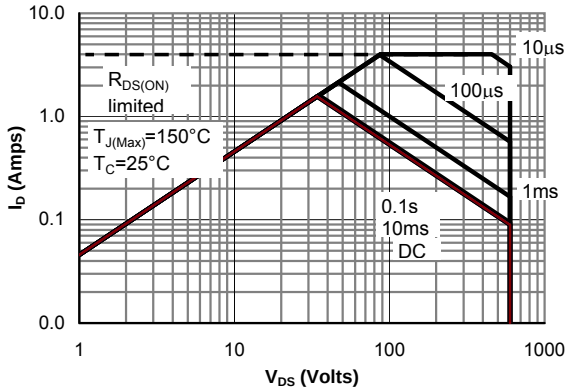



Figure 9: Maximum Forward Biased Safe Operating Area (Note F)

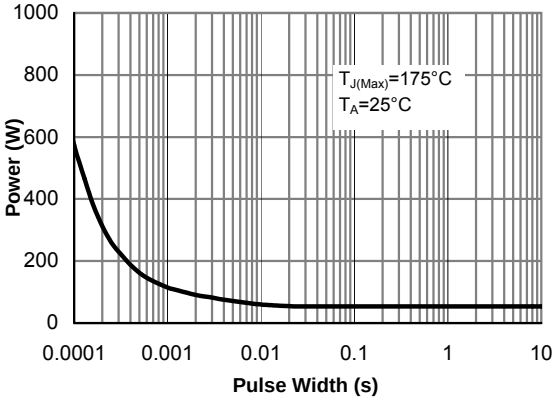



Figure 10: Single Pulse Power Rating Junction-to-Case (Note F)

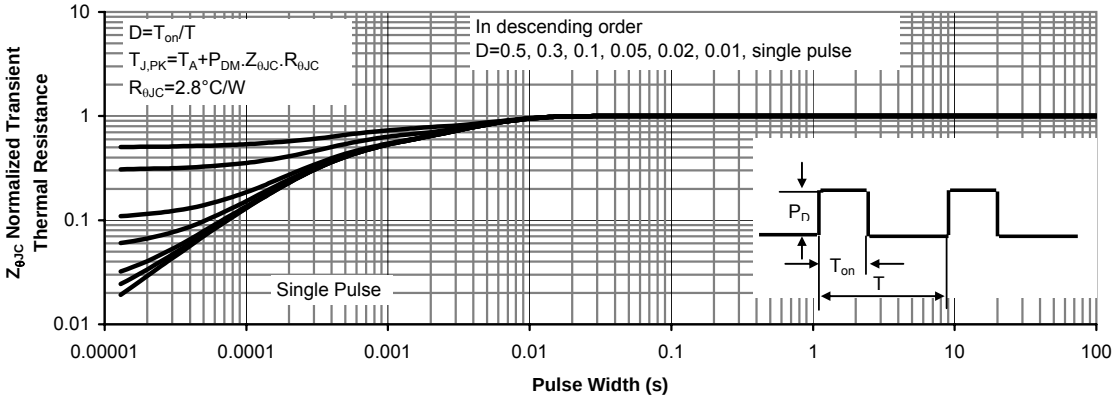



Figure 11: Normalized Maximum Transient Thermal Impedance (Note F)

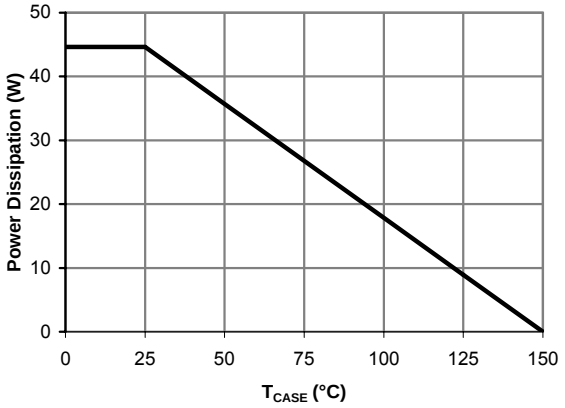



**Figure 12: Power De-rating (Note B)**

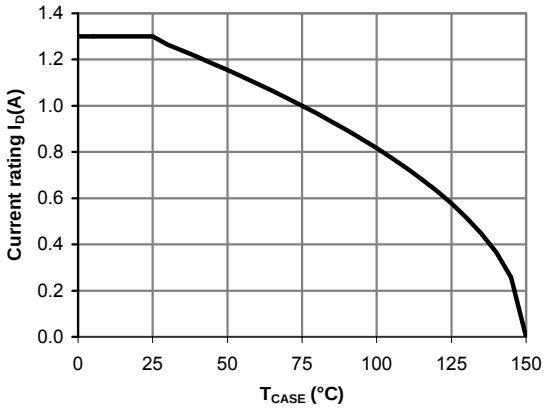



**Figure 13: Current De-rating (Note B)**

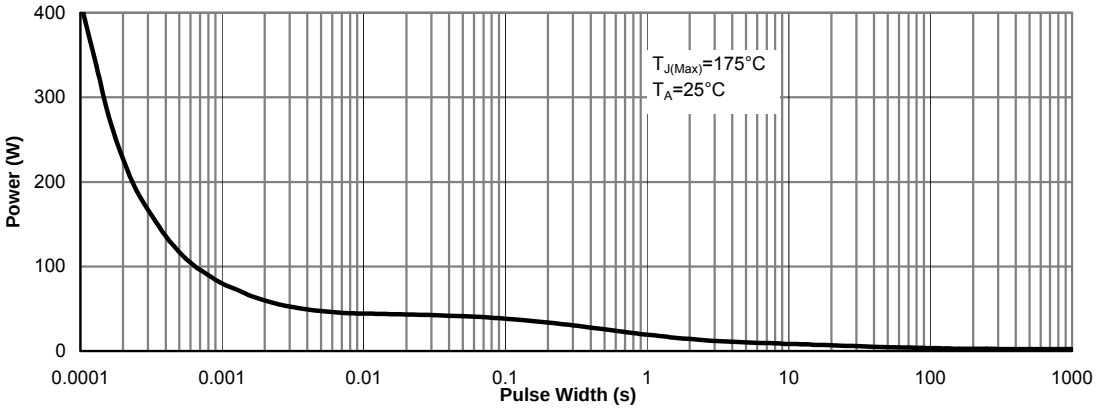



**Figure 14: Single Pulse Power Rating Junction-to-Case (Note G)**

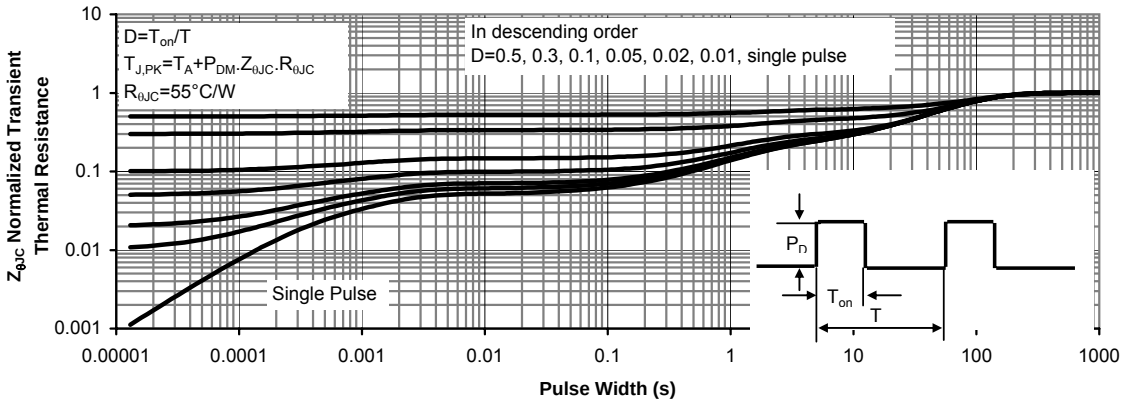
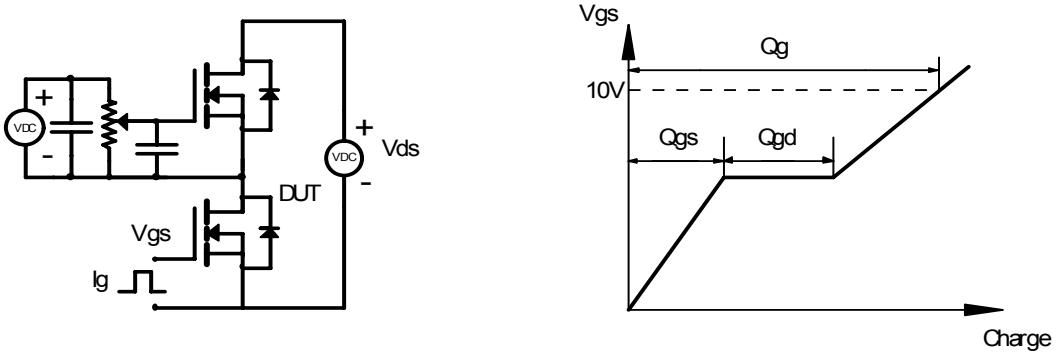
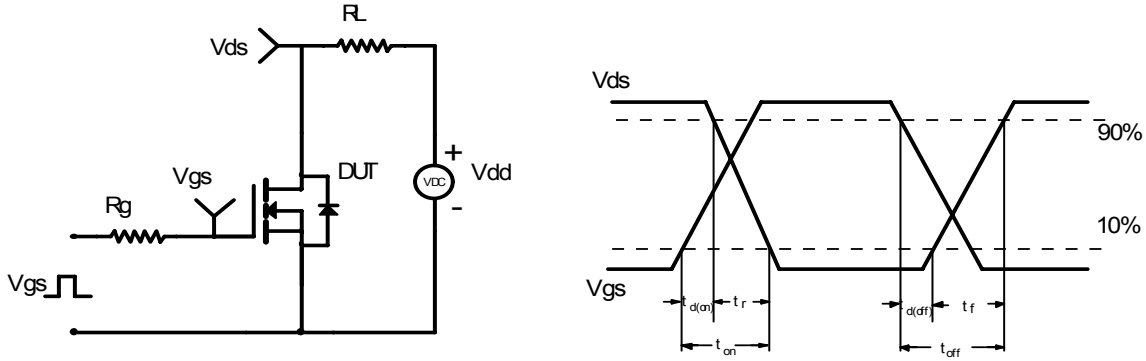



**Figure 15: Normalized Maximum Transient Thermal Impedance (Note G)**

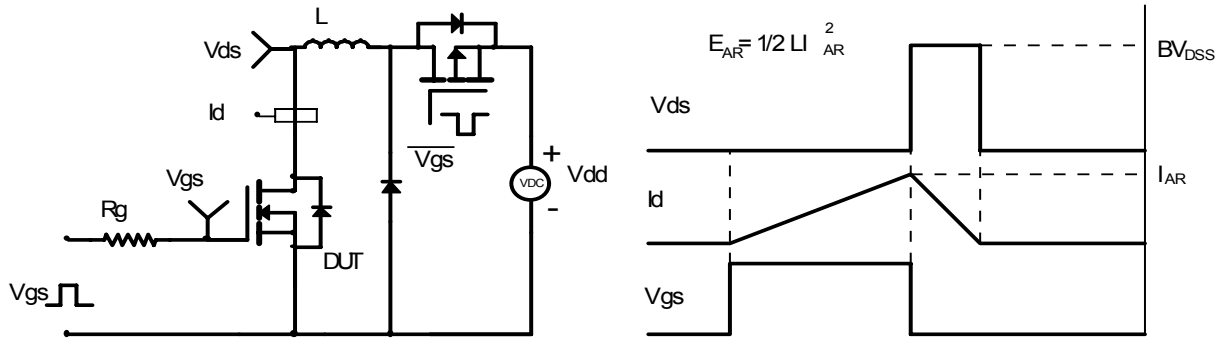
Gate Charge Test Circuit & Waveform




Resistive Switching Test Circuit & Waveforms




Unclamped Inductive Switching (UIS) Test Circuit & Waveforms




Diode Recovery Test Circuit & Waveforms