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Alpha & Omega Semiconductor Inc.
AOD11S60

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ALPHA & OMEGA SEMICONDUCTOR

# AOD11S60/AOI11S60

## 600V 11A αMOS™ Power Transistor

### General Description

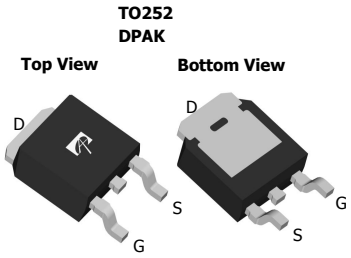
The AOD11S60 & AOI11S60 have been fabricated using the advanced αMOS™ high voltage process that is designed to deliver high levels of performance and robustness in switching applications.
By providing low $R_{DS(on)}$, $Q_g$ and $E_{OSS}$ along with guaranteed avalanche capability these parts can be adopted quickly into new and existing offline power supply designs.

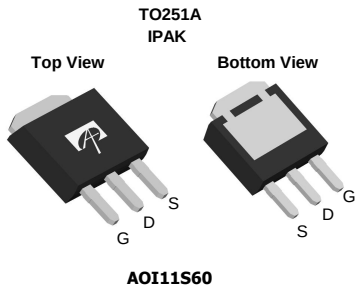
### Product Summary

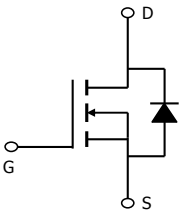
| | |
|---|---|
| $V_{DS}$ @ $T_{j,max}$ | 700V |
| $I_{DM}$ | 45A |
| $R_{DS(ON),max}$ | 0.399Ω |
| $Q_{g,typ}$ | 11nC |
| $E_{oss}$ @ 400V | 2.7µJ |

100% UIS Tested
100% $R_g$ Tested

Green Product




**Absolute Maximum Ratings $T_A$=25℃ unless otherwise noted**

| Parameter | | Symbol | Maximum | Units |
|---|---|---|---|---|
| Drain-Source Voltage | | $V_{DS}$ | 600 | V |
| Gate-Source Voltage | | $V_{GS}$ | ±30 | V |
| Continuous Drain Current | $T_C$=25℃ | $I_D$ | 11 | A |
| | $T_C$=100℃ | | 8.5 | |
| Pulsed Drain Current [C] | | $I_{DM}$ | 45 | |
| Avalanche Current [C] | | $I_{AR}$ | 2 | A |
| Repetitive avalanche energy [C] | | $E_{AR}$ | 60 | mJ |
| Single pulsed avalanche energy [H] | | $E_{AS}$ | 120 | mJ |
| Power Dissipation [B] | $T_C$=25℃ | $P_D$ | 208 | W |
| | Derate above 25°C | | 1.67 | W/ °C |
| MOSFET dv/dt ruggedness | | dv/dt | 100 | V/ns |
| Peak diode recovery dv/dt | | | 20 | |
| Junction and Storage Temperature Range | | $T_J$, $T_{STG}$ | -55 to 150 | ℃ |
| Maximum lead temperature for soldering purpose, 1/8" from case for 5 seconds [K] | | $T_L$ | 300 | ℃ |

**Thermal Characteristics**

| Parameter | Symbol | Typical | Maximum | Units |
|---|---|---|---|---|
| Maximum Junction-to-Ambient [A,D] | $R_{\theta JA}$ | 45 | 55 | ℃/W |
| Maximum Case-to-sink [A] | $R_{\theta CS}$ | -- | 0.5 | ℃/W |
| Maximum Junction-to-Case [D,F] | $R_{\theta JC}$ | 0.45 | 0.6 | ℃/W |

**Electrical Characteristics ($T_J$=25℃ unless otherwise noted)**

| Symbol | Parameter | Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| **STATIC PARAMETERS** | | | | | | |
| $BV_{DSS}$ | Drain-Source Breakdown Voltage | $I_D$=250µA, $V_{GS}$=0V, $T_J$=25℃ | 600 | - | - | V |
| | | $I_D$=250µA, $V_{GS}$=0V, $T_J$=150℃ | 650 | 700 | - | |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$=600V, $V_{GS}$=0V | - | - | 1 | µA |
| | | $V_{DS}$=480V, $T_J$=150℃ | - | 10 | - | |
| $I_{GSS}$ | Gate-Body leakage current | $V_{DS}$=0V, $V_{GS}$=±30V | - | - | ±100 | nA |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}$=5V,$I_D$=250µA | 2.8 | 3.5 | 4.1 | V |
| $R_{DS(ON)}$ | Static Drain-Source On-Resistance | $V_{GS}$=10V, $I_D$=3.8A, $T_J$=25℃ | - | 0.35 | 0.399 | Ω |
| | | $V_{GS}$=10V, $I_D$=3.8A, $T_J$=150℃ | - | 0.98 | 1.11 | Ω |
| $V_{SD}$ | Diode Forward Voltage | $I_S$=5.5A,$V_{GS}$=0V, $T_J$=25℃ | - | 0.84 | - | V |
| $I_S$ | Maximum Body-Diode Continuous Current | | - | - | 11 | A |
| $I_{SM}$ | Maximum Body-Diode Pulsed Current[C] | | - | - | 45 | A |
| **DYNAMIC PARAMETERS** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{GS}$=0V, $V_{DS}$=100V, f=1MHz | - | 545 | - | pF |
| $C_{oss}$ | Output Capacitance | | - | 37.3 | - | pF |
| $C_{o(er)}$ | Effective output capacitance, energy related[I] | $V_{GS}$=0V, $V_{DS}$=0 to 480V, f=1MHz | - | 30.8 | - | pF |
| $C_{o(tr)}$ | Effective output capacitance, time related[J] | | - | 93.6 | - | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | $V_{GS}$=0V, $V_{DS}$=100V, f=1MHz | - | 1.42 | - | pF |
| $R_g$ | Gate resistance | $V_{GS}$=0V, $V_{DS}$=0V, f=1MHz | - | 16.5 | - | Ω |
| **SWITCHING PARAMETERS** | | | | | | |
| $Q_g$ | Total Gate Charge | $V_{GS}$=10V, $V_{DS}$=480V, $I_D$=5.5A | - | 11 | - | nC |
| $Q_{gs}$ | Gate Source Charge | | - | 2.8 | - | nC |
| $Q_{gd}$ | Gate Drain Charge | | - | 3.8 | - | nC |
| $t_{D(on)}$ | Turn-On DelayTime | $V_{GS}$=10V, $V_{DS}$=400V, $I_D$=5.5A, $R_G$=25Ω | - | 20 | - | ns |
| $t_r$ | Turn-On Rise Time | | - | 20 | - | ns |
| $t_{D(off)}$ | Turn-Off DelayTime | | - | 59 | - | ns |
| $t_f$ | Turn-Off Fall Time | | - | 20 | - | ns |
| $t_{rr}$ | Body Diode Reverse Recovery Time | $I_F$=5.5A,dI/dt=100A/µs,$V_{DS}$=400V | - | 250 | - | ns |
| $I_{rm}$ | Peak Reverse Recovery Current | $I_F$=5.5A,dI/dt=100A/µs,$V_{DS}$=400V | - | 21 | - | A |
| $Q_{rr}$ | Body Diode Reverse Recovery Charge | $I_F$=5.5A,dI/dt=100A/µs,$V_{DS}$=400V | - | 3.3 | - | µC |

A. The value of $R_{\theta JA}$ is measured with the device in a still air environment with $T_A$=25℃.
B. The power dissipation $P_D$ is based on $T_{J(MAX)}$=150℃, 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℃, Ratings are based on low frequency and duty cycles to keep initial $T_J$ =25℃.
D. The $R_{\theta JA}$ is the sum of the thermal impedance 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 impedance which is measured with the device mounted to a large heatsink, assuming a maximum junction temperature of $T_{J(MAX)}$=150℃. The SOA curve provides a single pulse ratin g.
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℃.
H. L=60mH, $I_{AS}$=2A, $V_{DD}$=150V, Starting $T_J$=25℃
I. $C_{o(er)}$ is a fixed capacitance that gives the same stored energy as $C_{oss}$ while $V_{DS}$ is rising from 0 to 80% $V_{(BR)DSS}$.
J. $C_{o(tr)}$ is a fixed capacitance that gives the same charging time as $C_{oss}$ while $V_{DS}$ is rising from 0 to 80% $V_{(BR)DSS}$.
K. Wave soldering only allowed at leads.

## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

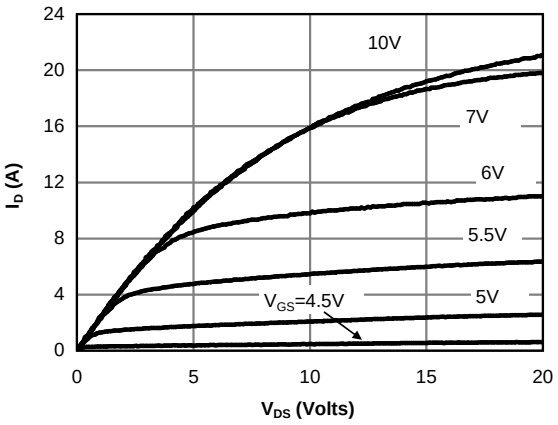



**Figure 1: On-Region Characteristics@25℃**

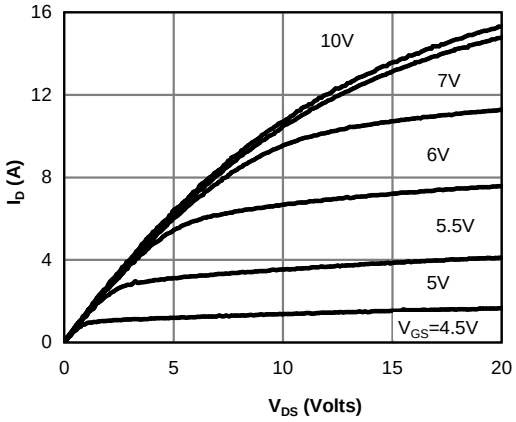



**Figure 2: On-Region Characteristics@125℃**

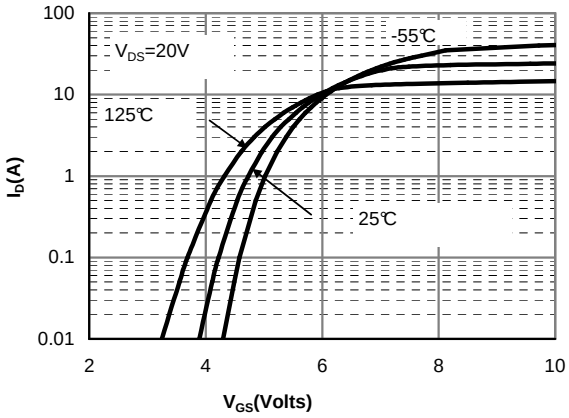



**Figure 3: Transfer Characteristics**

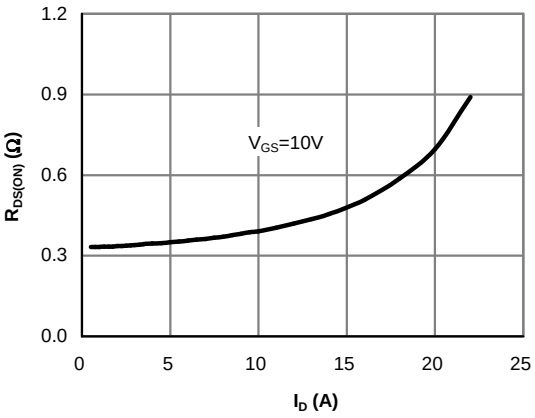



**Figure 4: On-Resistance vs. Drain Current and Gate Voltage**

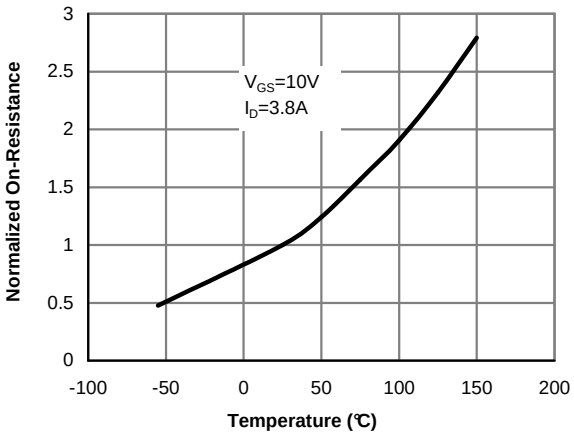



**Figure 5: On-Resistance vs. Junction Temperature**

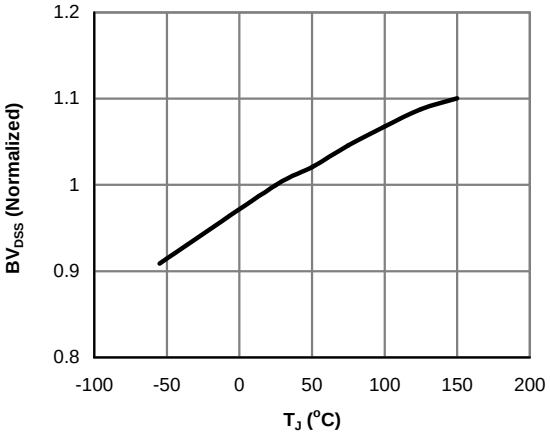



**Figure 6: Break Down vs. Junction Temperature**

## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

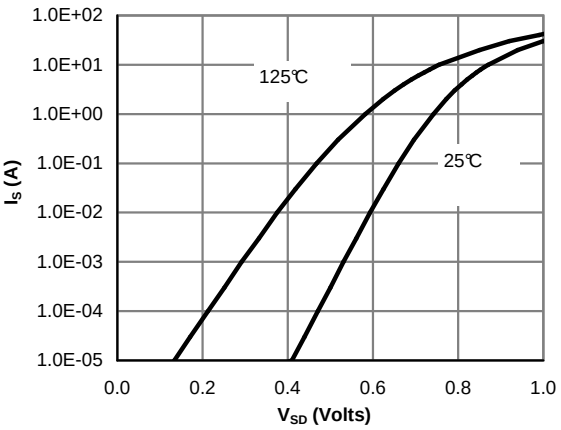



Figure 7: Body-Diode Characteristics (Note E)

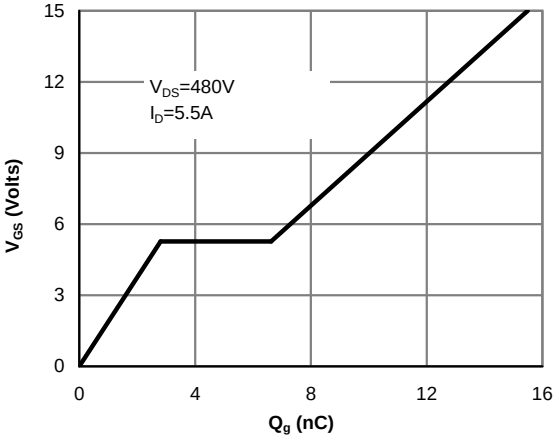



Figure 8: Gate-Charge Characteristics

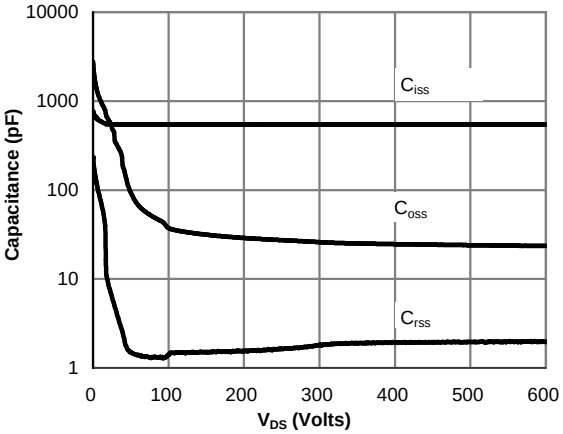



Figure 9: Capacitance Characteristics

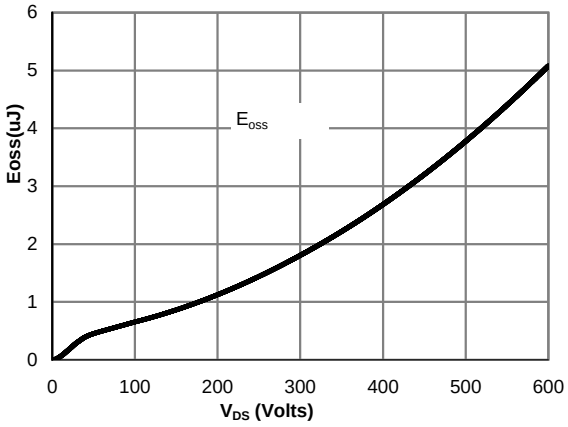



Figure 10: Coss stored Energy

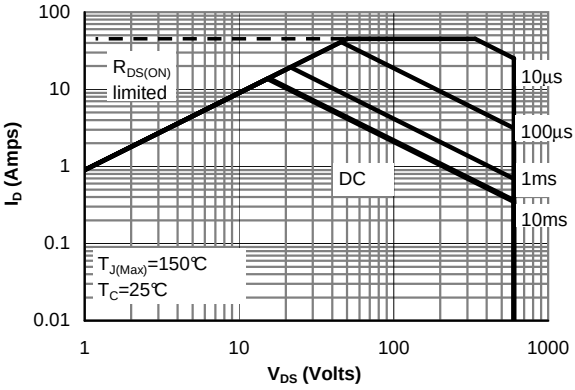



Figure 11: Maximum Forward Biased Safe Operating Area (Note F)

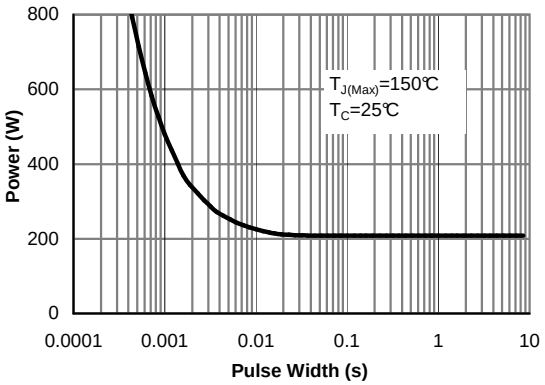



Figure 12: Single Pulse Power Rating Junction-to-Case (Note F)

## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

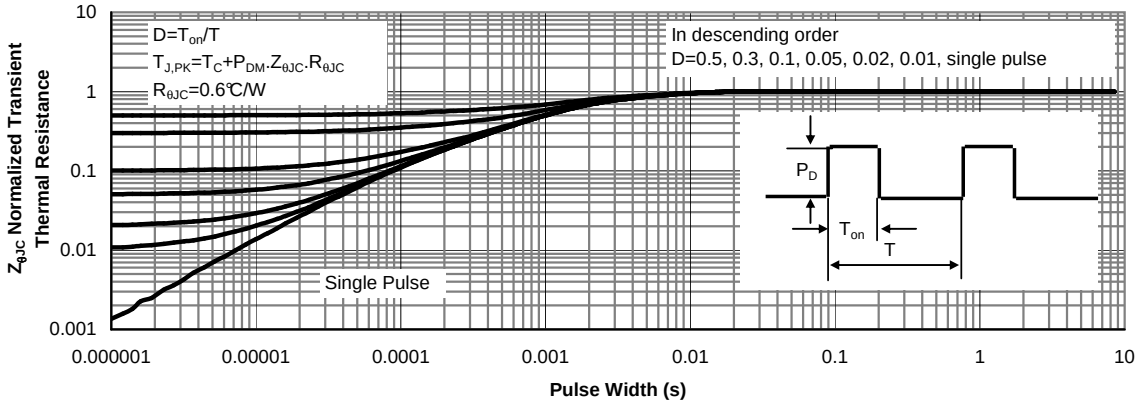



**Figure 13: Normalized Maximum Transient Thermal Impedance (Note F)**

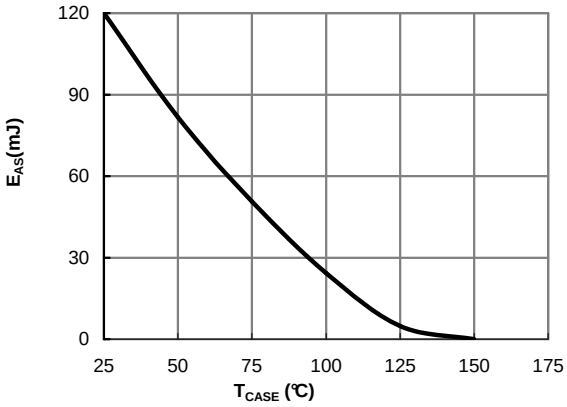



**Figure 14: Avalanche energy**

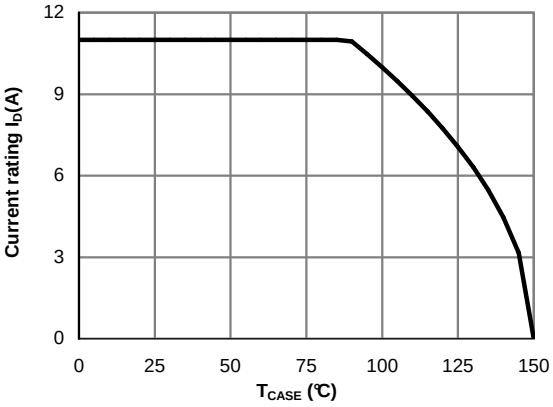



**Figure 15: Current De-rating (Note B)**

## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

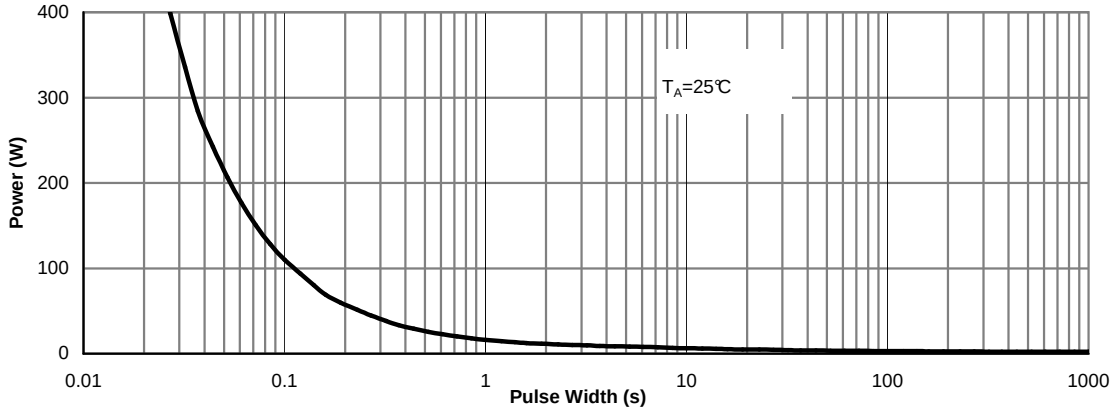



**Figure 16: Single Pulse Power Rating Junction-to-Ambient (Note G)**

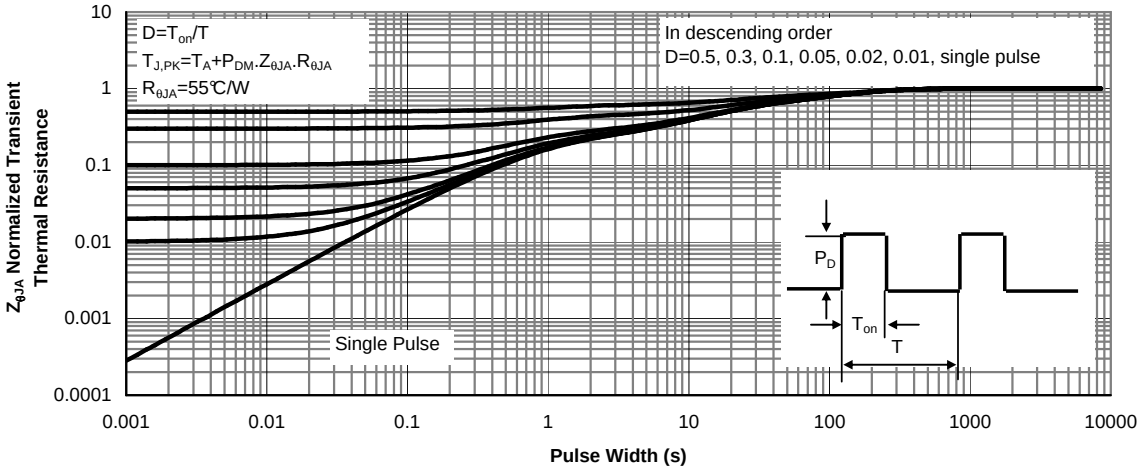
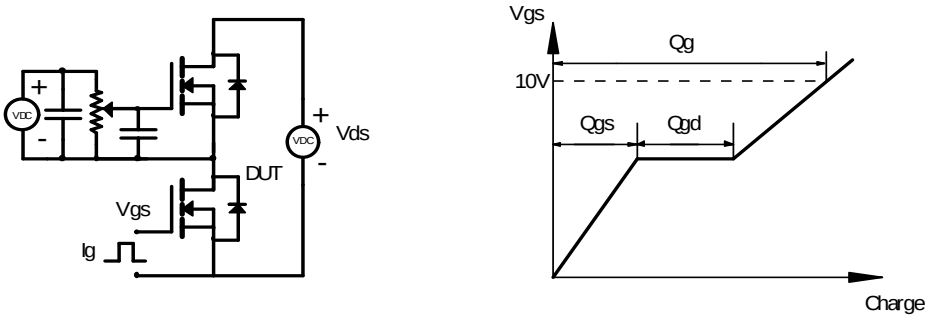
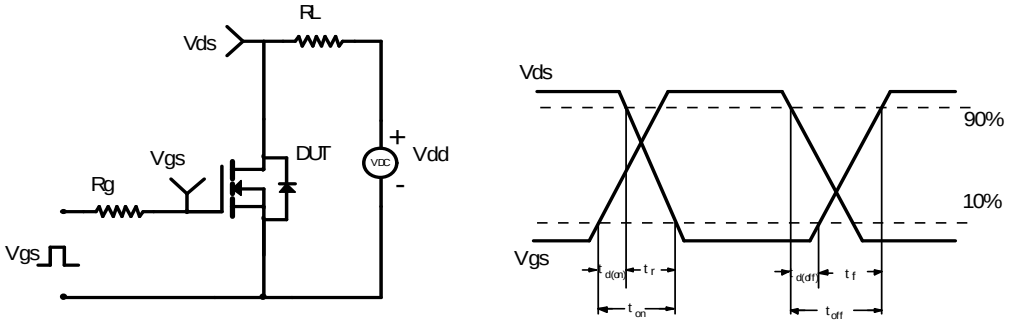



**Figure 17: Normalized Maximum Transient Thermal Impedance (Note G)**

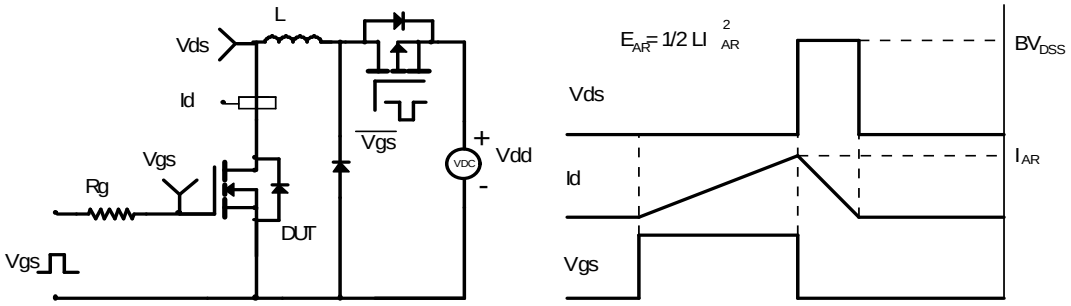
## Gate Charge Test Circuit & Waveform




## Resistive Switching Test Circuit & Waveforms




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




## Diode Recovery Test Circuit & Waveforms