

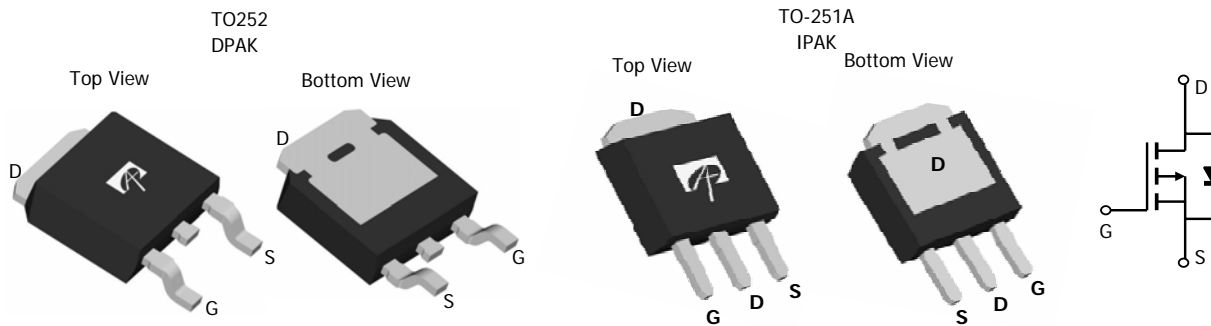
**AOD409/AOI409**
**P-Channel Enhancement Mode Field Effect Transistor**
**General Description**

The AOD/I409 uses advanced trench technology to provide excellent  $R_{DS(ON)}$ , low gate charge and low gate resistance. With the excellent thermal resistance of the DPAK package, this device is well suited for high current load applications.

**Features**

$V_{DS}$  (V) = -60V  
 $I_D$  = -26A ( $V_{GS}$  = -10V)  
 $R_{DS(ON)} < 40m\Omega$  ( $V_{GS}$  = -10V) @ -20A  
 $R_{DS(ON)} < 55m\Omega$  ( $V_{GS}$  = -4.5V)

**UIS TESTED!**  
**Rg,Ciss,Coss,Crss Tested**


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

Parameter	Symbol	Maximum	Units
Drain-Source Voltage	$V_{DS}$	-60	V
Gate-Source Voltage	$V_{GS}$	$\pm 20$	V
Continuous Drain Current <sup>G</sup>	$I_D$	$T_C=25^\circ\text{C}$	-26
		$T_C=100^\circ\text{C}$	-18
Pulsed Drain Current <sup>C</sup>	$I_{DM}$	-60	A
Avalanche Current <sup>C</sup>	$I_{AR}$	-26	A
Repetitive avalanche energy L=0.1mH <sup>C</sup>	$E_{AR}$	33.8	mJ
Power Dissipation <sup>B</sup>	$P_D$	$T_C=25^\circ\text{C}$	60
		$T_C=100^\circ\text{C}$	30
Power Dissipation <sup>A</sup>	$P_{DSM}$	$T_A=25^\circ\text{C}$	2.5
		$T_A=70^\circ\text{C}$	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>	$R_{\theta JA}$	$t \leq 10s$	16.7	$^\circ\text{C/W}$
Maximum Junction-to-Ambient <sup>A</sup>		Steady-State	40	$^\circ\text{C/W}$
Maximum Junction-to-Case <sup>C</sup>	$R_{\theta JC}$	1.9	2.5	$^\circ\text{C/W}$

Electrical Characteristics ( $T_J=25^\circ\text{C}$  unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
<b>STATIC PARAMETERS</b>						
$BV_{DSS}$	Drain-Source Breakdown Voltage	$I_D=-250\mu\text{A}$ , $V_{GS}=0\text{V}$	-60			V
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS}=-48\text{V}$ , $V_{GS}=0\text{V}$ $T_J=55^\circ\text{C}$		-0.003	-1	$\mu\text{A}$
$I_{GSS}$	Gate-Body leakage current	$V_{DS}=0\text{V}$ , $V_{GS}=\pm 20\text{V}$			$\pm 100$	nA
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS}=V_{GS}$ , $I_D=-250\mu\text{A}$	-1.2	-1.9	-2.4	V
$I_{D(ON)}$	On state drain current	$V_{GS}=-10\text{V}$ , $V_{DS}=-5\text{V}$	-60			A
$R_{DS(ON)}$	Static Drain-Source On-Resistance	$V_{GS}=-10\text{V}$ , $I_D=-20\text{A}$ $T_J=125^\circ\text{C}$		32	40	$\text{m}\Omega$
		$V_{GS}=-4.5\text{V}$ , $I_D=-20\text{A}$		53		$\text{m}\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS}=-5\text{V}$ , $I_D=-20\text{A}$		32		S
$V_{SD}$	Diode Forward Voltage	$I_S=-1\text{A}$ , $V_{GS}=0\text{V}$		-0.73	-1	V
$I_S$	Maximum Body-Diode Continuous Current				-30	A
<b>DYNAMIC PARAMETERS</b>						
$C_{iss}$	Input Capacitance	$V_{GS}=0\text{V}$ , $V_{DS}=-30\text{V}$ , $f=1\text{MHz}$		2977	3600	pF
$C_{oss}$	Output Capacitance			241		pF
$C_{rss}$	Reverse Transfer Capacitance			153		pF
$R_g$	Gate resistance	$V_{GS}=0\text{V}$ , $V_{DS}=0\text{V}$ , $f=1\text{MHz}$		2	2.4	$\Omega$
<b>SWITCHING PARAMETERS</b>						
$Q_g(10\text{V})$	Total Gate Charge	$V_{GS}=-10\text{V}$ , $V_{DS}=-30\text{V}$ , $I_D=-20\text{A}$		44	54	nC
$Q_g(4.5\text{V})$	Total Gate Charge			22.2	28	nC
$Q_{gs}$	Gate Source Charge			9		nC
$Q_{gd}$	Gate Drain Charge			10		nC
$t_{D(on)}$	Turn-On DelayTime	$V_{GS}=-10\text{V}$ , $V_{DS}=-30\text{V}$ , $R_L=1.5\Omega$ , $R_{GEN}=3\Omega$		12		ns
$t_r$	Turn-On Rise Time			14.5		ns
$t_{D(off)}$	Turn-Off DelayTime			38		ns
$t_f$	Turn-Off Fall Time			15		ns
$t_{rr}$	Body Diode Reverse Recovery Time		$I_F=-20\text{A}$ , $dI/dt=100\text{A}/\mu\text{s}$		40	50
$Q_{rr}$	Body Diode Reverse Recovery Charge	$I_F=-20\text{A}$ , $dI/dt=100\text{A}/\mu\text{s}$		59		nC

A: The value of  $R_{\theta JA}$  is measured with the device mounted on 1 in 2 FR-4 board with 2oz. Copper, in a still air environment with  $T_A=25^\circ\text{C}$ . The Power dissipation PDSM is based on  $R_{\theta JA}$  and the maximum allowed junction temperature of  $150^\circ\text{C}$ . The value in any a given application depends on the user's specific board design, and the maximum temperature fo  $175^\circ\text{C}$  may be used if the PCB allows it.

B. The power dissipation PD is based on  $T_{J(MAX)}=175^\circ\text{C}$ , 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  $T_{J(MAX)}=175^\circ\text{C}$ .

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  $<300$  ms 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  $T_{J(MAX)}=175^\circ\text{C}$ .

G. The maximum current rating is limited by bond-wires.

H. These tests are performed with the device mounted on 1 in 2 FR-4 board with 2oz. Copper, in a still air environment with  $T_A=25^\circ\text{C}$ . The SOA curve provides a single pulse rating.

\*This device is guaranteed green after data code 8X11 (Sep 1<sup>ST</sup> 2008).

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TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

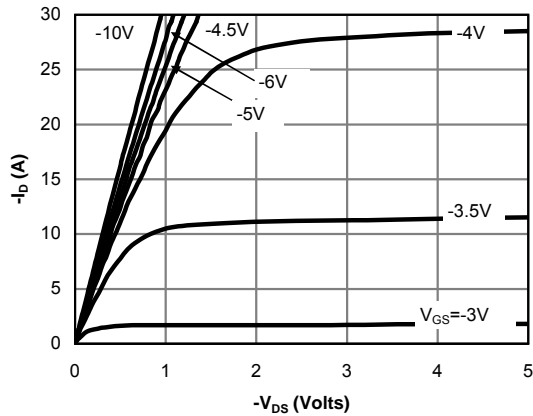


Fig 1: On-Region Characteristics

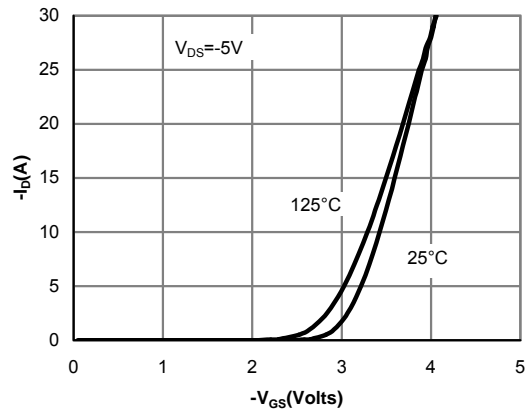


Figure 2: Transfer Characteristics

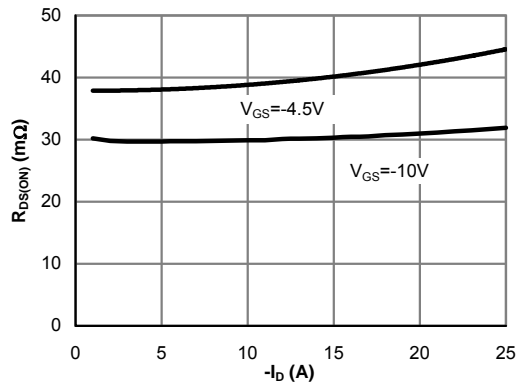


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

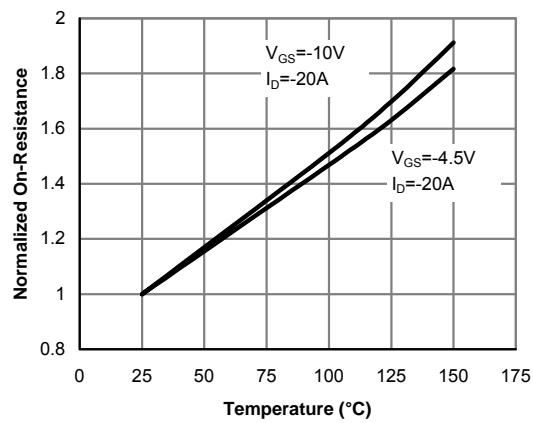


Figure 4: On-Resistance vs. Junction Temperature

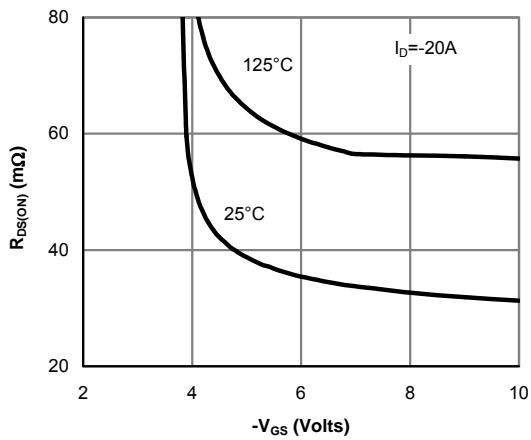


Figure 5: On-Resistance vs. Gate-Source Voltage

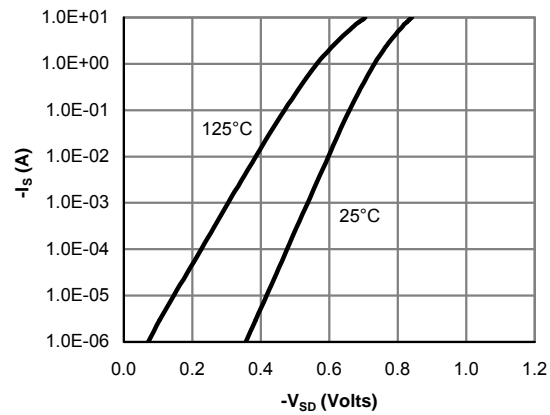


Figure 6: Body-Diode Characteristics

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

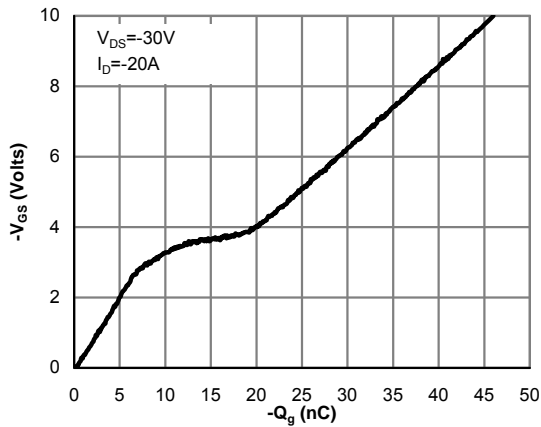


Figure 7: Gate-Charge Characteristics

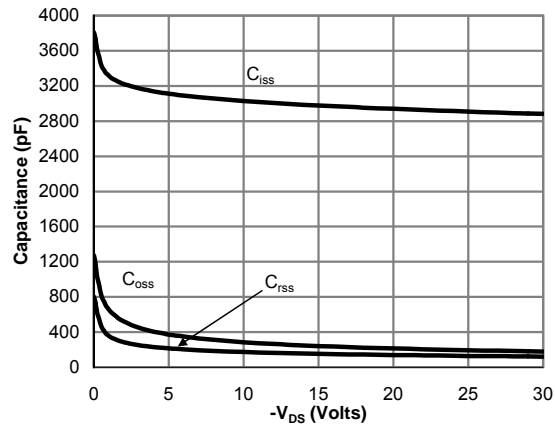


Figure 8: Capacitance Characteristics

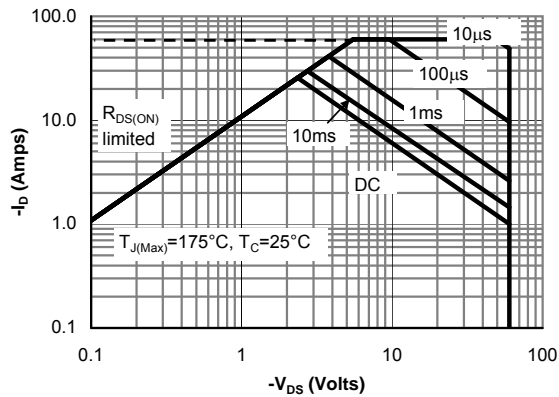


Figure 9: Maximum Forward Biased Safe Operating Area (Note F)

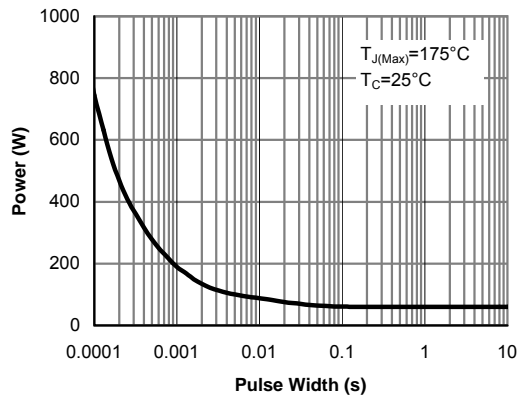


Figure 10: Single Pulse Power Rating Junction-to-Case (Note F)

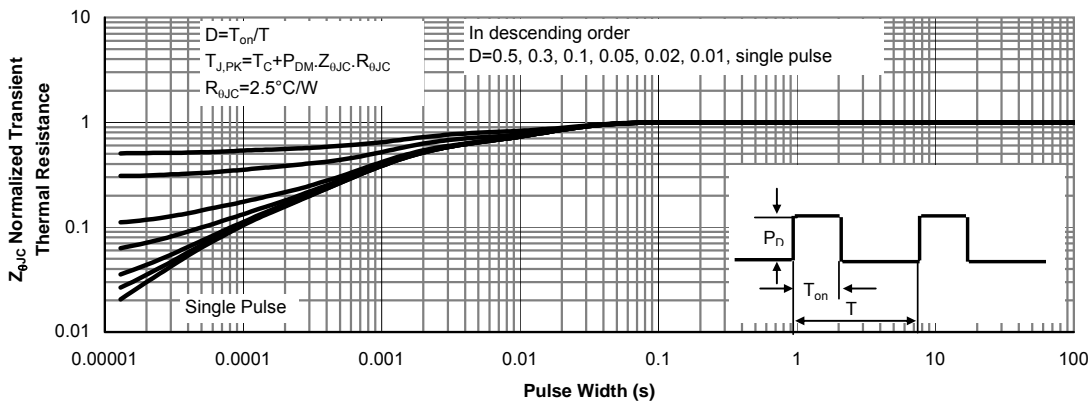


Figure 11: Normalized Maximum Transient Thermal Impedance (Note F)

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

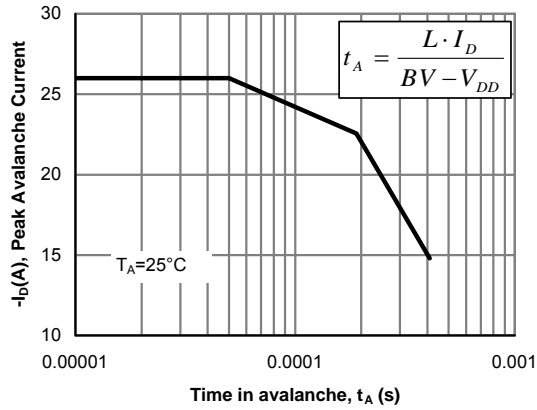


Figure 12: Single Pulse Avalanche capability

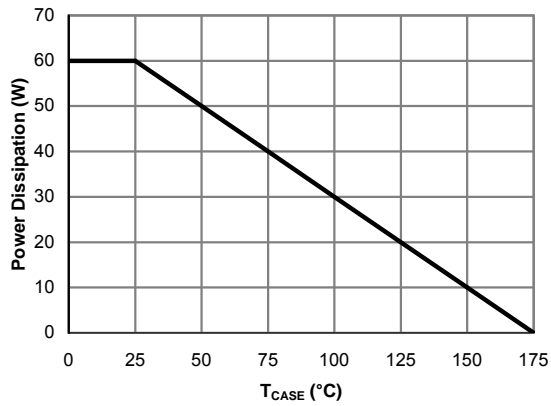


Figure 13: Power De-rating (Note B)

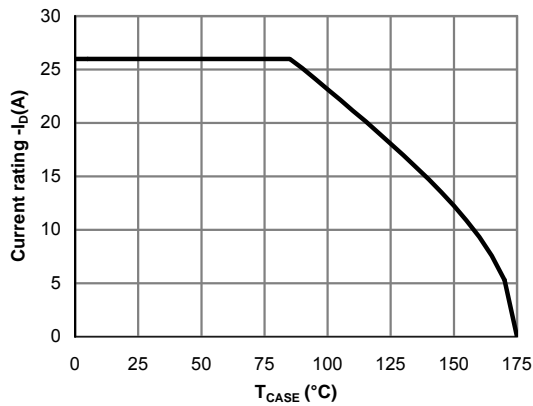


Figure 14: Current De-rating (Note B)

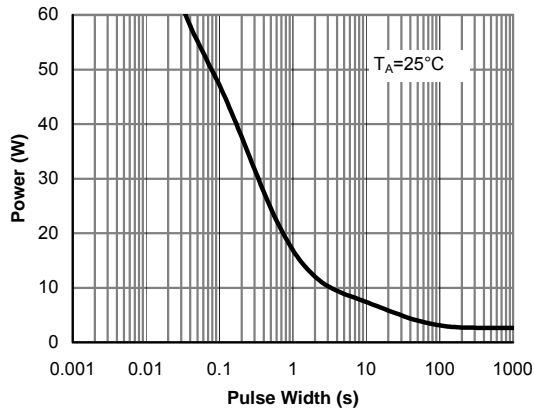


Figure 15: Single Pulse Power Rating Junction-to-Ambient (Note H)

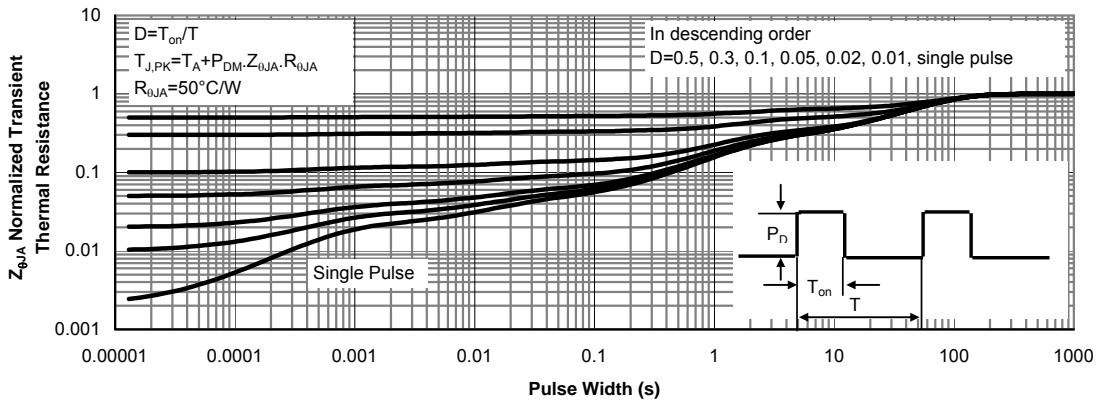
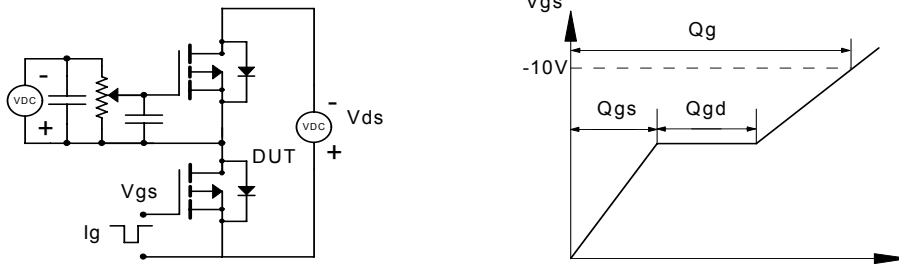
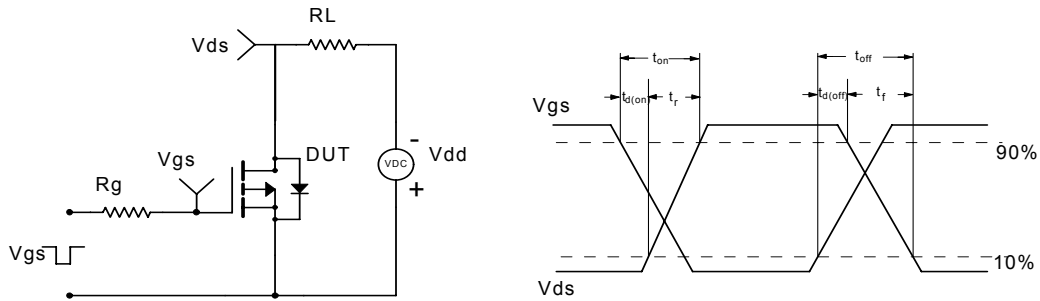


Figure 16: Normalized Maximum Transient Thermal Impedance (Note H)

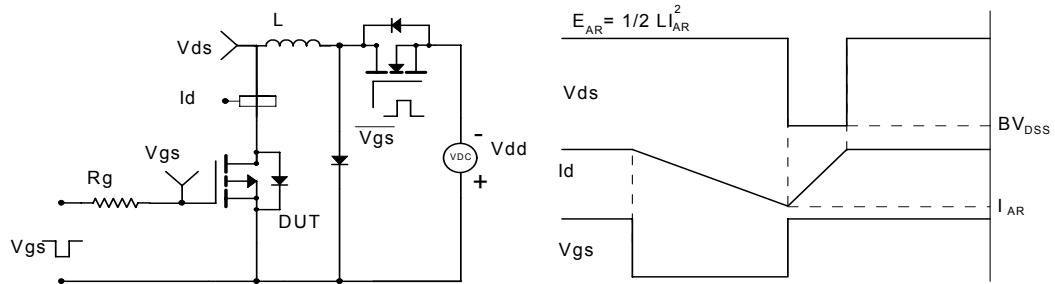
Gate Charge Test Circuit & Waveform



Resistive Switching Test Circuit & Waveforms



Unclamped Inductive Switching (UIS) Test Circuit & Waveforms



Diode Recovery Test Circuit & Waveforms

