

## AOD413A

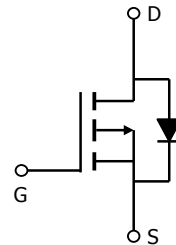
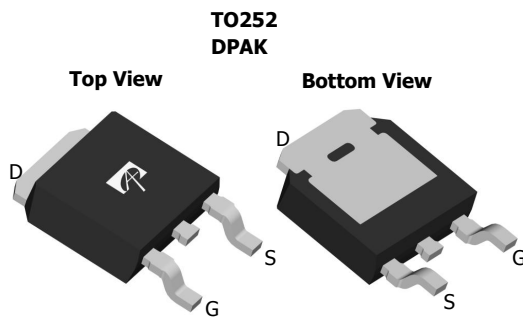
### 40V P-Channel MOSFET

#### General Description

The AOD413A uses advanced trench technology and design to provide excellent  $R_{DS(ON)}$  with low gate charge. With the excellent thermal resistance of the DPAK package, this device is well suited for high current load applications.

#### Features

$V_{DS}$  (V) = -40V  
 $I_D$  = -12A ( $V_{GS}$  = -10V)  
 $R_{DS(ON)} < 44m\Omega$  ( $V_{GS}$  = -10V)  
 $R_{DS(ON)} < 66m\Omega$  ( $V_{GS}$  = -4.5V)  
 100% UIS Tested  
 100% Rg Tested



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

Parameter	Symbol	Maximum	Units
Drain-Source Voltage	$V_{DS}$	-40	V
Gate-Source Voltage	$V_{GS}$	$\pm 20$	V
Continuous Drain Current <sup>B,H</sup>	$T_C=25^\circ\text{C}$	-12	A
	$T_C=100^\circ\text{C}$	-12	
Pulsed Drain Current <sup>C</sup>	$I_{DM}$	-30	
Avalanche Current <sup>C</sup>	$I_{AR}$	-20	
Repetitive avalanche energy $L=0.1\text{mH}$ <sup>C</sup>	$E_{AR}$	20	mJ
Power Dissipation <sup>B</sup>	$T_C=25^\circ\text{C}$	50	W
	$T_C=100^\circ\text{C}$	25	
Power Dissipation <sup>A</sup>	$T_A=25^\circ\text{C}$	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,G</sup>	$R_{\theta JA}$	16.7	25	$^\circ\text{C/W}$
Maximum Junction-to-Ambient <sup>A,G</sup>		Steady-State	40	
Maximum Junction-to-Case <sup>F</sup>	$R_{\theta JC}$	2	3	$^\circ\text{C/W}$

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	-40			V
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> = -40V, V <sub>GS</sub> =0V T <sub>J</sub> =55°C			-1 -5	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	-1.7	-2	-3	V
I <sub>D(ON)</sub>	On state drain current	V <sub>GS</sub> = -10V, V <sub>DS</sub> = -5V	-30			A
R <sub>DS(ON)</sub>	Static Drain-Source On-Resistance	V <sub>GS</sub> = -10V, I <sub>D</sub> = -12A T <sub>J</sub> =125°C		36 52	44 65	mΩ
		V <sub>GS</sub> = -4.5V, I <sub>D</sub> = -8A		52	66	
g <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> = -5V, I <sub>D</sub> = -12A		22		S
V <sub>SD</sub>	Diode Forward Voltage	I <sub>S</sub> = -1A, V <sub>GS</sub> =0V		-0.76	-1	V
I <sub>S</sub>	Maximum Body-Diode Continuous Current				-12	A
<b>DYNAMIC PARAMETERS</b>						
C <sub>iss</sub>	Input Capacitance	V <sub>GS</sub> =0V, V <sub>DS</sub> = -20V, f=1MHz		900	1125	pF
C <sub>oss</sub>	Output Capacitance			97		pF
C <sub>rss</sub>	Reverse Transfer Capacitance			68		pF
R <sub>g</sub>	Gate resistance	V <sub>GS</sub> =0V, V <sub>DS</sub> =0V, f=1MHz		14		Ω
<b>SWITCHING PARAMETERS</b>						
Q <sub>g</sub> (-10V)	Total Gate Charge	V <sub>GS</sub> = -10V, V <sub>DS</sub> = -20V, I <sub>D</sub> = -12A		16.2	21	nC
Q <sub>g</sub> (-4.5V)	Total Gate Charge			7.2	9.4	nC
Q <sub>gs</sub>	Gate Source Charge			3.8		nC
Q <sub>gd</sub>	Gate Drain Charge			3.5		nC
t <sub>D(on)</sub>	Turn-On DelayTime	V <sub>GS</sub> = -10V, V <sub>DS</sub> = -20V, R <sub>L</sub> =1.6Ω, R <sub>GEN</sub> =3Ω		6.2		ns
t <sub>r</sub>	Turn-On Rise Time			8.4		ns
t <sub>D(off)</sub>	Turn-Off DelayTime			44.8		ns
t <sub>f</sub>	Turn-Off Fall Time			41.2		ns
t <sub>rr</sub>	Body Diode Reverse Recovery Time		I <sub>F</sub> = -12A, dI/dt=100A/μs		21.2	
Q <sub>rr</sub>	Body Diode Reverse Recovery Charge	I <sub>F</sub> = -12A, dI/dt=100A/μs		13.8		nC

A: The value of R<sub>θJA</sub> is measured with the device in a still air environment with T<sub>A</sub>=25°C. The power dissipation P<sub>DSM</sub> and current rating I<sub>DSM</sub> are based on T<sub>J(MAX)</sub>=150°C, using t ≤ 10s junction-to-ambient thermal resistance.

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.

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 <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<sub>J(MAX)</sub>=175°C. The SOA curve provides a single pulse rating.

G: 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.

H: The maximum current rating is limited by bond-wires.

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

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TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

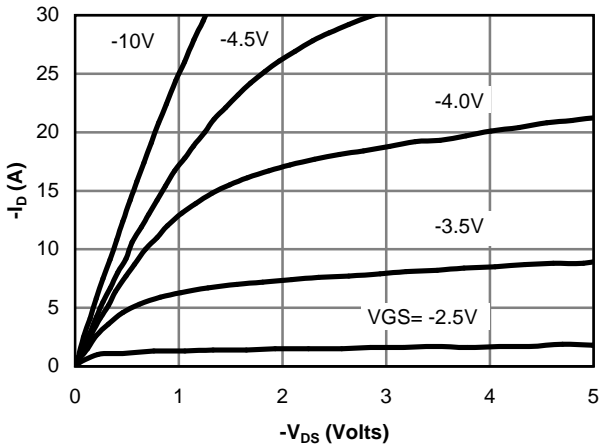


Figure 1: On-Region Characteristics

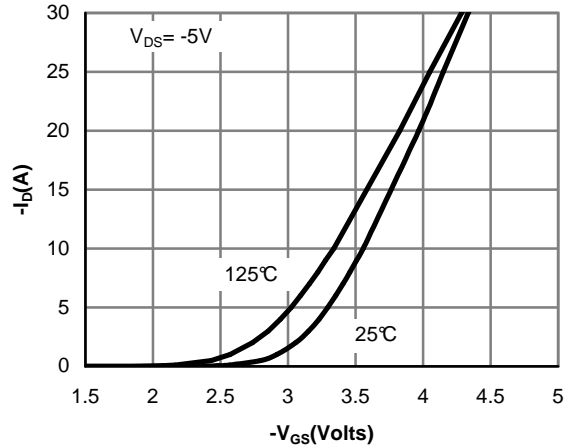


Figure 2: Transfer Characteristics

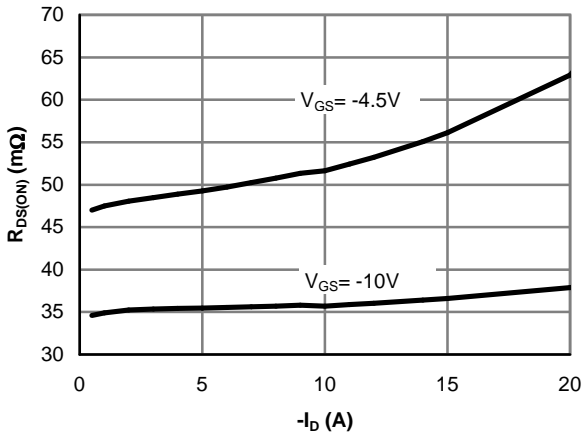


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

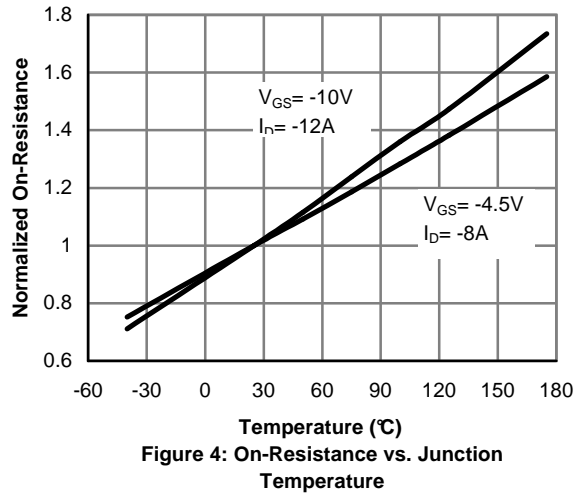


Figure 4: On-Resistance vs. Junction Temperature

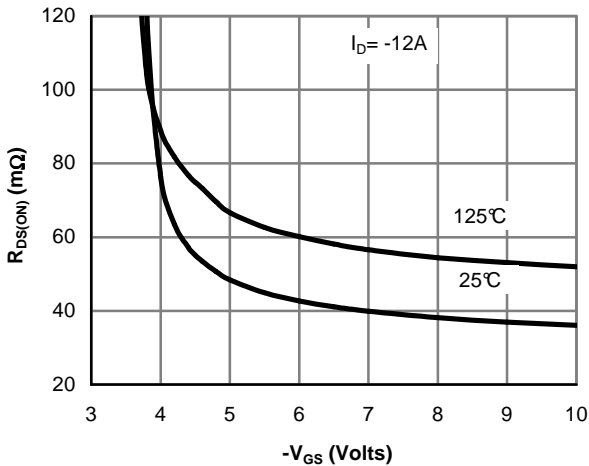


Figure 5: On-Resistance vs. Gate-Source Voltage

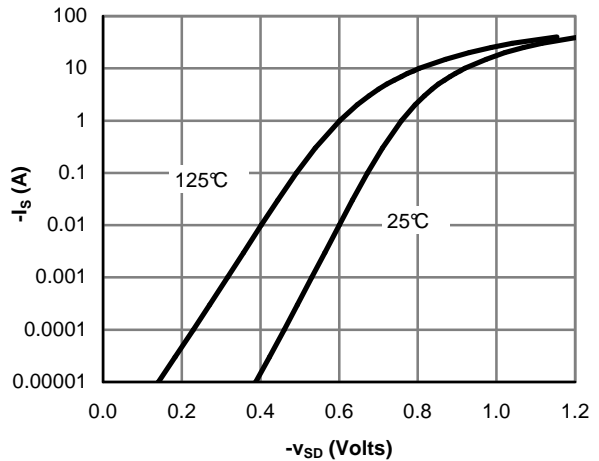


Figure 6: Body-Diode Characteristics

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

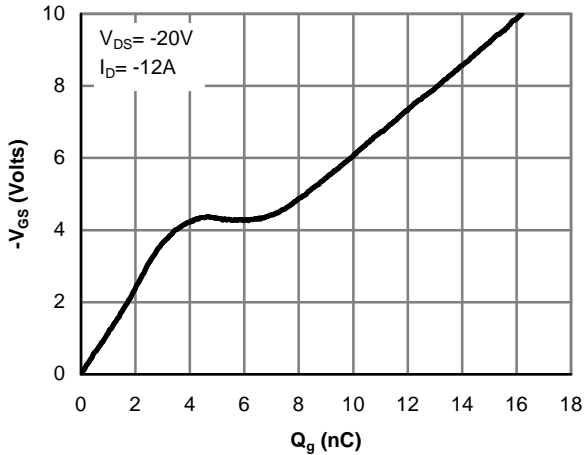


Figure 7: Gate-Charge Characteristics

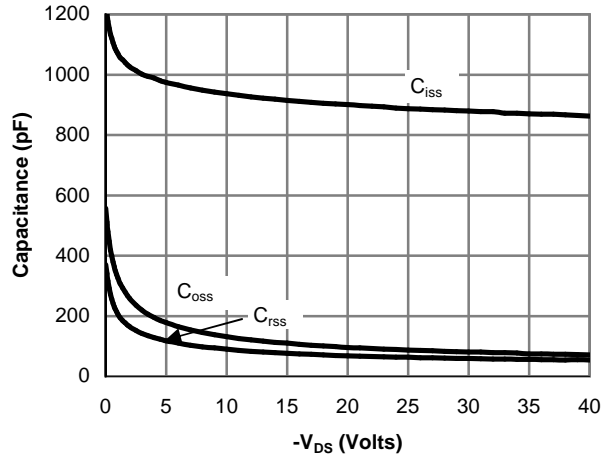


Figure 8: Capacitance Characteristics

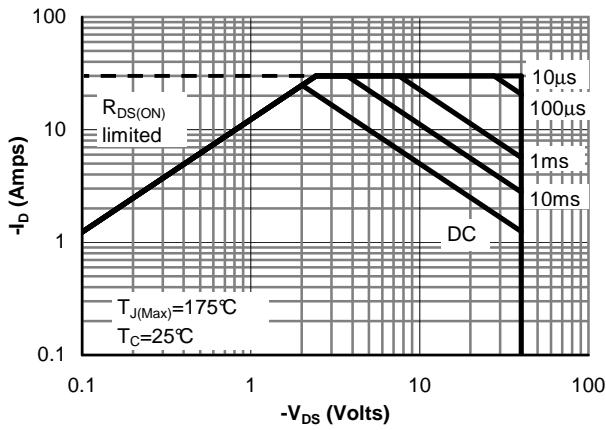


Figure 9: Maximum Forward Biased Safe Operating Area (Note F)

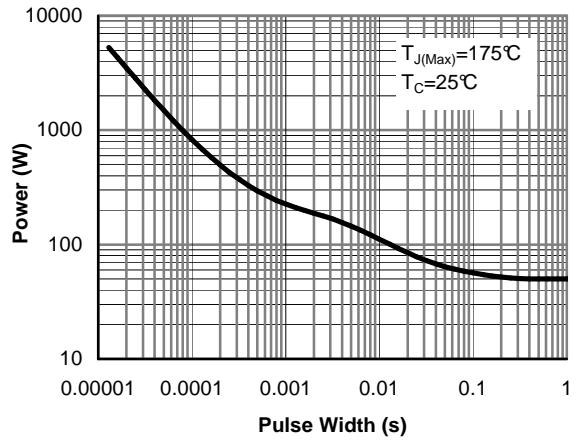


Figure 10: Single Pulse Power Rating Junction-to-Case (Note F)

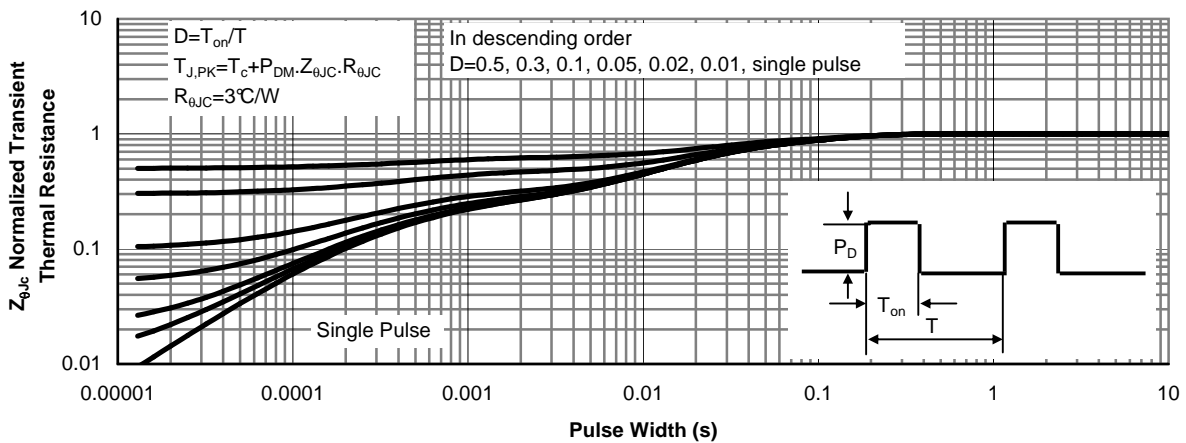


Figure 11: Normalized Maximum Transient Thermal Impedance (Note F)

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

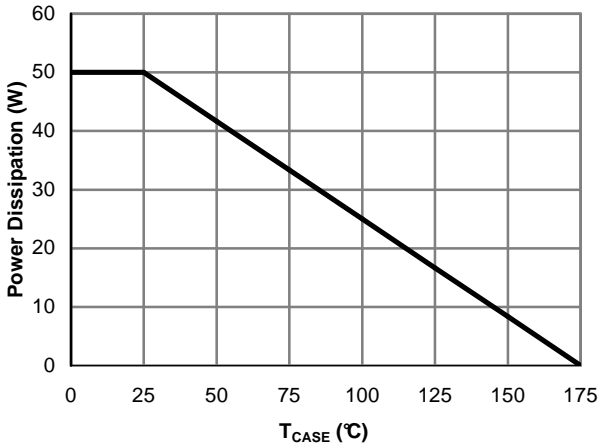


Figure 12: Power De-rating (Note B)

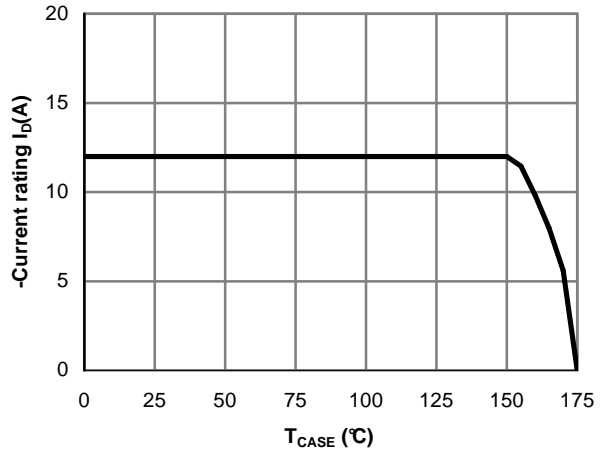


Figure 13: Current De-rating (Note B)

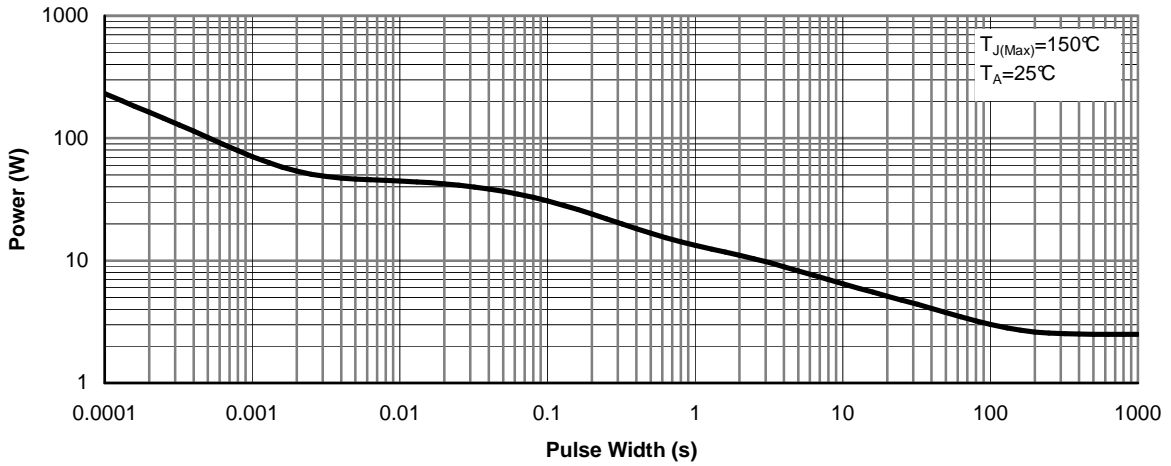


Figure 14: Single Pulse Power Rating Junction-to-Ambient (Note G)

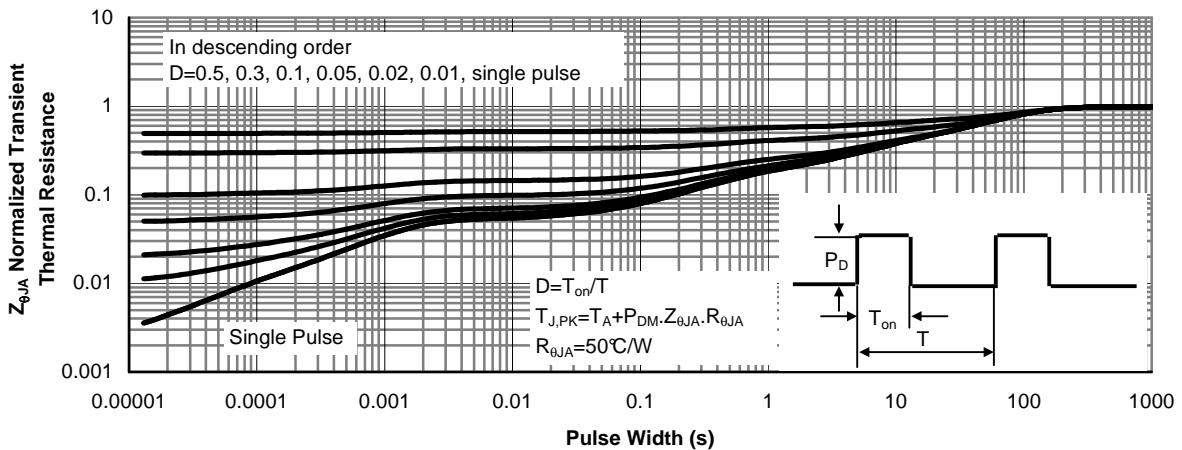
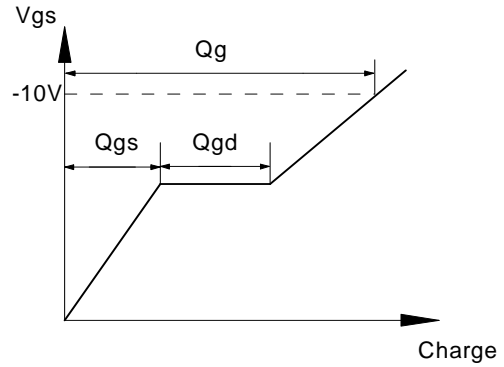
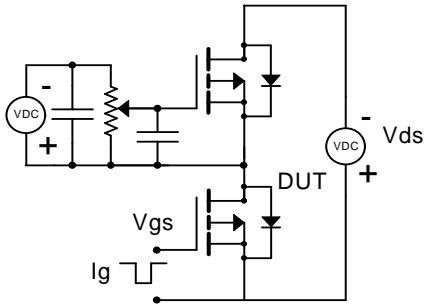
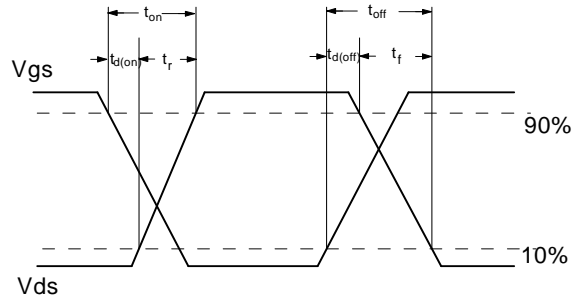
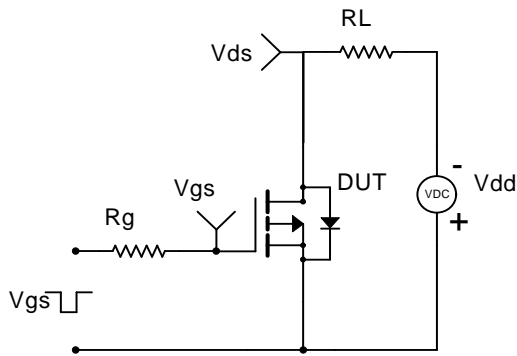


Figure 15: Normalized Maximum Transient Thermal Impedance (Note G)

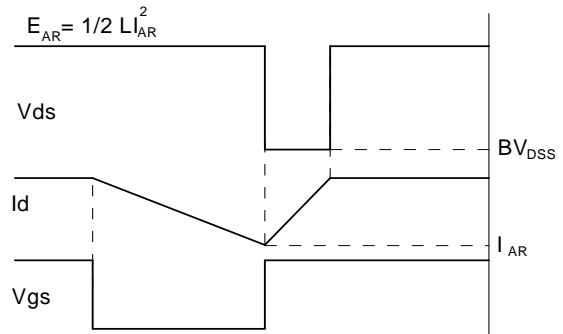
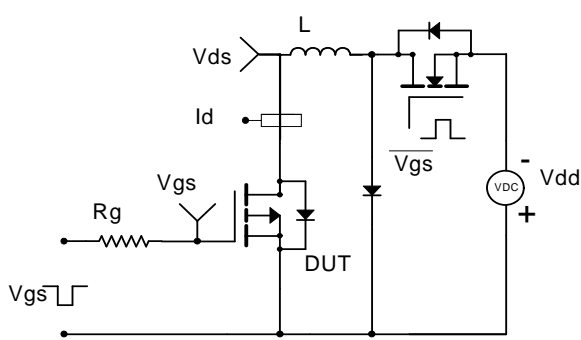
Gate Charge Test Circuit & Waveform



Resistive Switching Test Circuit & Waveforms



Unclamped Inductive Switching (UIS) Test Circuit & Waveforms



Diode Recovery Test Circuit & Waveforms

