ALPHA & OMEGA SEMICONDUCTOR

AOT22N50/AOTF22N50
## 500V,22A N-Channel MOSFET

General Description

The AOT22N50 & AOTF22N50 have 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.

For Halogen Free add "L" suffix to part number:
AOT22N50L&AOTF22N50L
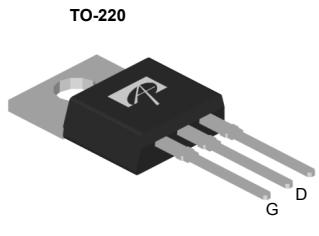
Product Summary

V_{DS}	600V@150℃
I_D (at V_{GS}=10V)	22A
$R_{DS(ON)}$ (at V_{GS}=10V)	< 0.26Ω
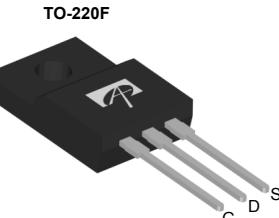
100% UIS Tested
100% R_g Tested

RoHS Compliant
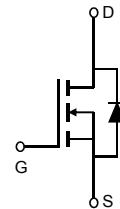
Top View

TO-220   TO-220F

AOT22N50   AOTF22N50

Orderable Part Number	Package Type	Form	Minimum Order Quantity
AOT22N50L	TO220 Green	Tube	1000
AOTF22N50	TO-220F Pb Free	Tube	1000
AOTF22N50L	TO-220F Green	Tube	1000

Absolute Maximum Ratings T_A=25°C unless otherwise noted

Parameter		Symbol	AOT22N50	AOTF22N50	AOTF22N50L	Units
Drain-Source Voltage		V_{DS}	500			V
Gate-Source Voltage		V_{GS}	±30			V
Continuous Drain Current	T_C=25°C	I_D	22	22*	22*	A
	T_C=100°C		15	15*	15*	
Pulsed Drain Current [C]		I_{DM}	88			
Avalanche Current [C]		I_{AR}	7			A
Repetitive avalanche energy [C]		E_{AR}	735			mJ
Single plused avalanche energy [G]		E_{AS}	1470			mJ
Peak diode recovery dv/dt		dv/dt	5			V/ns
Power Dissipation [B]	T_C=25°C	P_D	417	50	39	W
	Derate above 25°C		3.3	0.4	0.3	W/°C
Junction and Storage Temperature Range		T_J, T_{STG}	-55 to 150			°C
Maximum lead temperature for soldering purpose, 1/8" from case for 5 seconds		T_L	300			°C
Thermal Characteristics						
Parameter		Symbol	AOT22N50	AOTF22N50	AOTF22N50L	Units
Maximum Junction-to-Ambient [A,D]		$R_{\theta JA}$	65	65	65	°C/W
Maximum Case-to-sink [A]		$R_{\theta CS}$	0.5	--	--	°C/W
Maximum Junction-to-Case		$R_{\theta JC}$	0.3	2.5	3.2	°C/W

* Drain current limited by maximum junction temperature.

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, T$_J$=25°C	500			V
		I$_D$=250µA, V$_{GS}$=0V, T$_J$=150°C		600		
BV$_{DSS}$/∆TJ	Breakdown Voltage Temperature Coefficient	I$_D$=250µA, V$_{GS}$=0V		0.57		V/°C
I$_{DSS}$	Zero Gate Voltage Drain Current	V$_{DS}$=500V, V$_{GS}$=0V			1	µA
		V$_{DS}$=400V, 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$_{DS}$=5V I$_D$=250µA	3.4	4	4.5	V
R$_{DS(ON)}$	Static Drain-Source On-Resistance	V$_{GS}$=10V, I$_D$=11A		0.21	0.26	Ω
g$_{FS}$	Forward Transconductance	V$_{DS}$=40V, I$_D$=11A		25		S
V$_{SD}$	Diode Forward Voltage	I$_S$=1A,V$_{GS}$=0V		0.7	1	V
I$_S$	Maximum Body-Diode Continuous Current				22	A
I$_{SM}$	Maximum Body-Diode Pulsed Current				88	A
DYNAMIC PARAMETERS						
C$_{iss}$	Input Capacitance	V$_{GS}$=0V, V$_{DS}$=25V, f=1MHz	2465	3086	3710	pF
C$_{oss}$	Output Capacitance		200	290	380	pF
C$_{rss}$	Reverse Transfer Capacitance		14	24	35	pF
R$_g$	Gate resistance	V$_{GS}$=0V, V$_{DS}$=0V, f=1MHz	0.7	1.4	2.1	Ω
SWITCHING PARAMETERS						
Q$_g$	Total Gate Charge	V$_{GS}$=10V, V$_{DS}$=400V, I$_D$=22A	55	69	83	nC
Q$_{gs}$	Gate Source Charge		17	22	27	nC
Q$_{gd}$	Gate Drain Charge		12	24	36	nC
t$_{D(on)}$	Turn-On DelayTime	V$_{GS}$=10V, V$_{DS}$=250V, I$_D$=22A, R$_G$=25Ω		60		ns
t$_r$	Turn-On Rise Time			122		ns
t$_{D(off)}$	Turn-Off DelayTime			124		ns
t$_f$	Turn-Off Fall Time			77		ns
t$_{rr}$	Body Diode Reverse Recovery Time	I$_F$=22A,dI/dt=100A/µs,V$_{DS}$=100V	415	524	630	ns
Q$_{rr}$	Body Diode Reverse Recovery Charge	I$_F$=22A,dI/dt=100A/µs,V$_{DS}$=100V	7.5	9.6	12	µC

A. The value of R$_{θJA}$ 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, 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, Ratings are based on low frequency and duty cycles to keep initial T$_J$ =25° C.
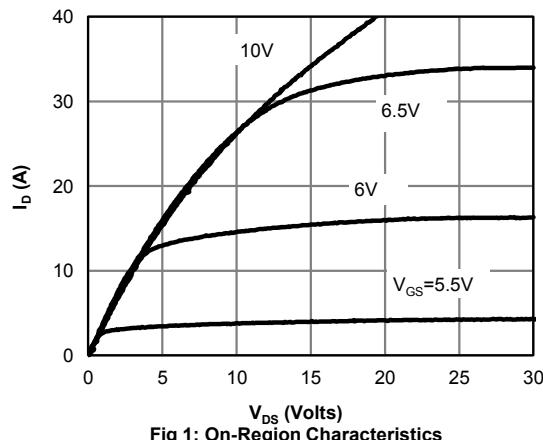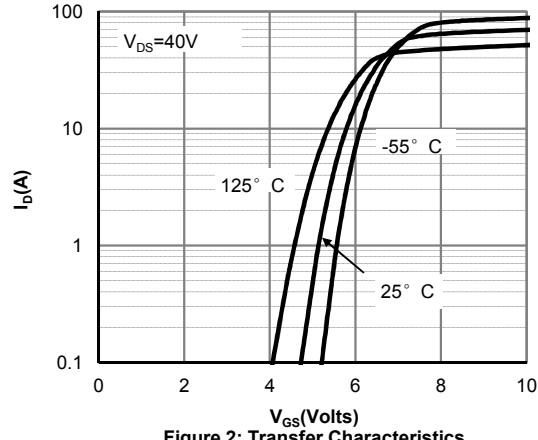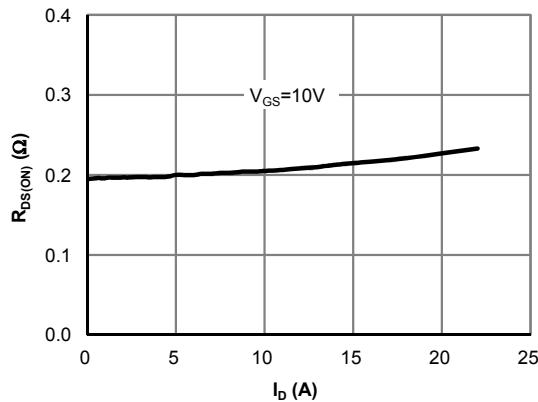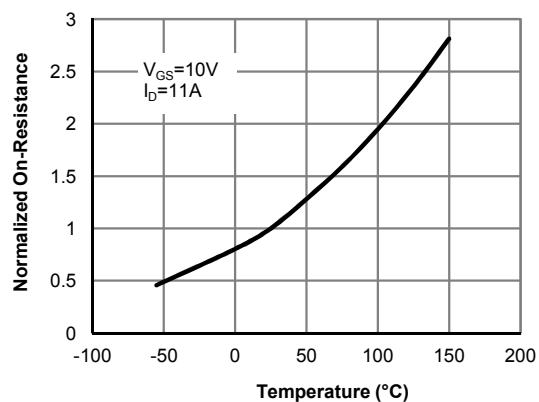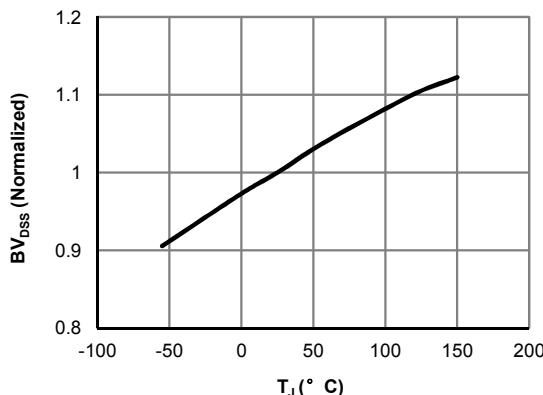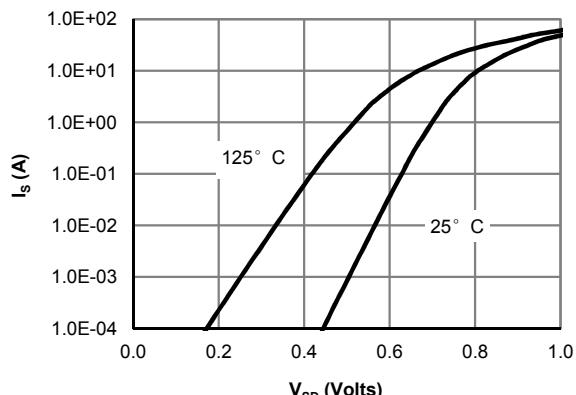
D. The R$_{θJA}$ is the sum of the thermal impedence from junction to case R$_{θJC}$ and case to ambient.

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. The SOA curve provides a single pulse rating.

G. L=60mH, I$_{AS}$=7A, V$_{DD}$=150V, R$_G$=25Ω, Starting T$_J$=25° C

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 (Note E)

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS
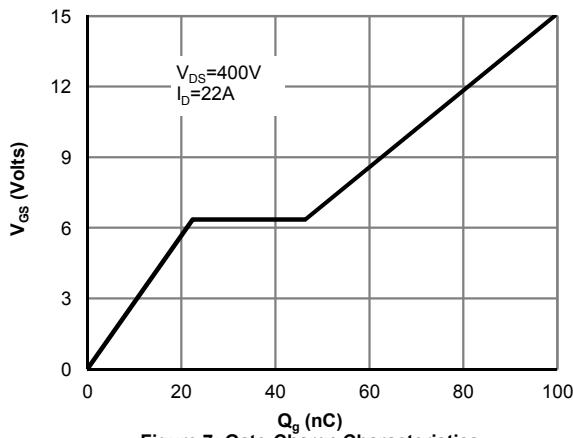

Figure 7: Gate-Charge Characteristics
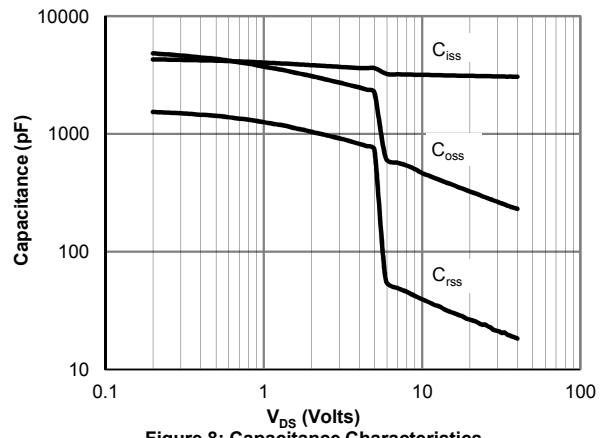
Figure 8: Capacitance Characteristics
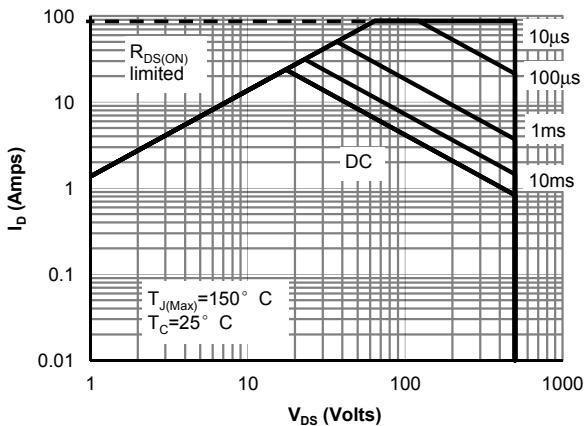
Figure 9: Maximum Forward Biased Safe Operating Area for AOT22N50 (Note F)
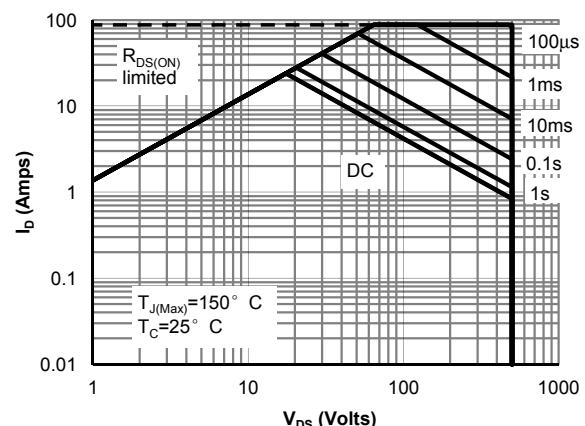
Figure 10: Maximum Forward Biased Safe Operating Area for AOTF22N50 (Note F)
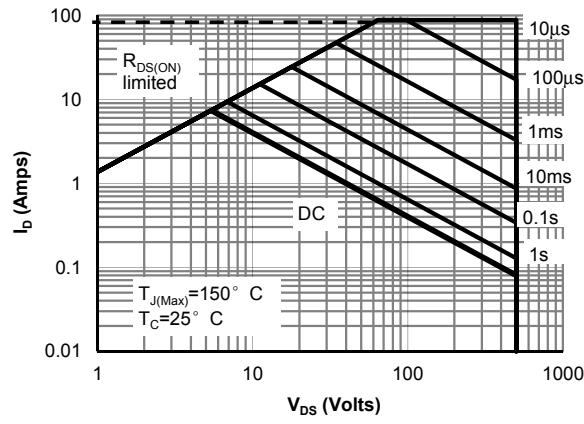
Figure 12: Maximum Forward Biased Safe Operating Area for AOTF22N50L (Note F)
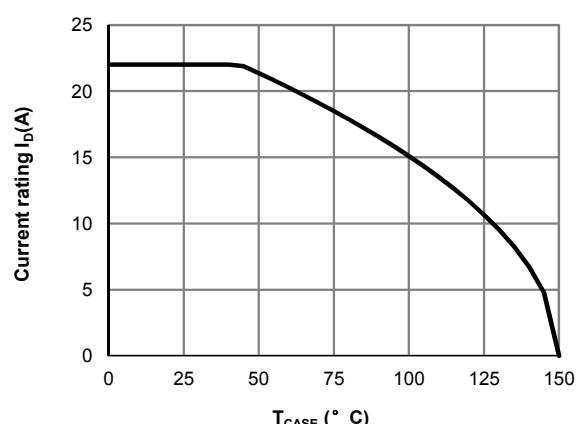

Figure 11: Current De-rating (Note B)

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

$D=T_{on}/T$
$T_{J,PK}=T_C+P_{DM}.Z_{\theta JC}.R_{\theta JC}$
$R_{\theta JC}=0.3°$ C/W

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

Single Pulse

P_{DM}
T_{on}
T
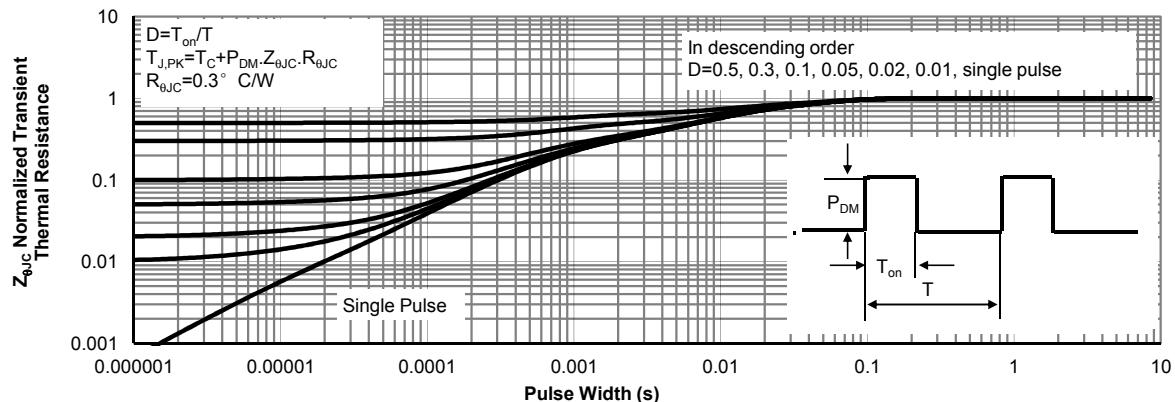
Figure 13: Normalized Maximum Transient Thermal Impedance for AOT22N50 (Note F)

$D=T_{on}/T$
$T_{J,PK}=T_C+P_{DM}.Z_{\theta JC}.R_{\theta JC}$
$R_{\theta JC}=2.5°$ C/W

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

Single Pulse

P_{DM}
T_{on}
T
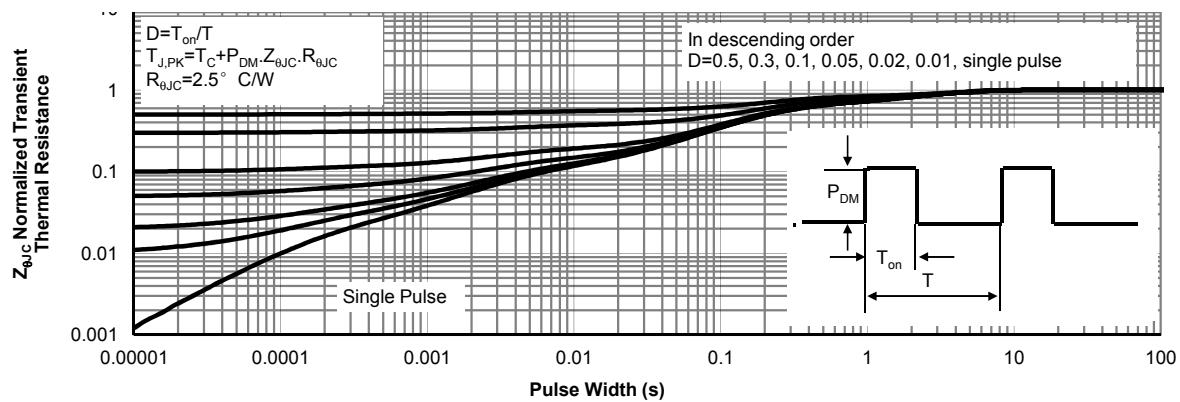
Figure 14: Normalized Maximum Transient Thermal Impedance for AOTF22N50 (Note F)

$D=T_{on}/T$
$T_{J,PK}=T_C+P_{DM}.Z_{\theta JC}.R_{\theta JC}$
$R_{\theta JC}=3.2°$ C/W

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

Single Pulse

P_{DM}
T_{on}
T
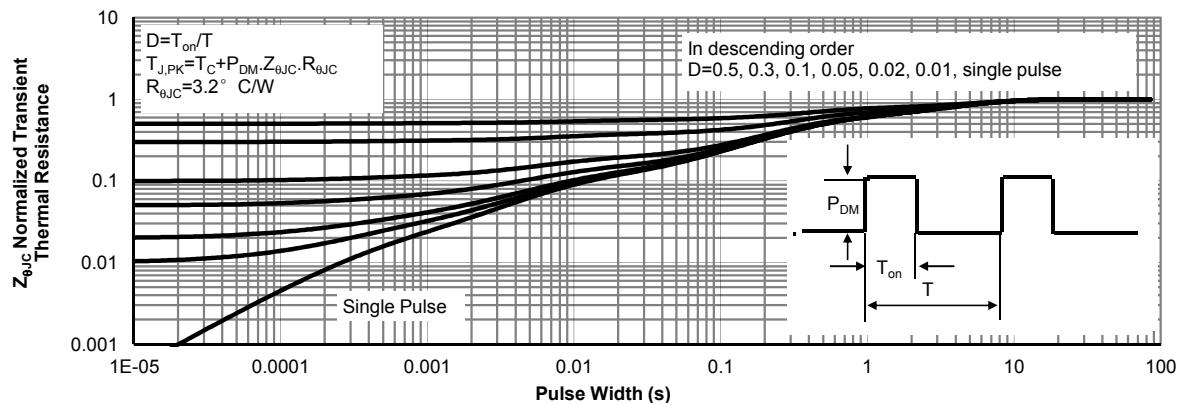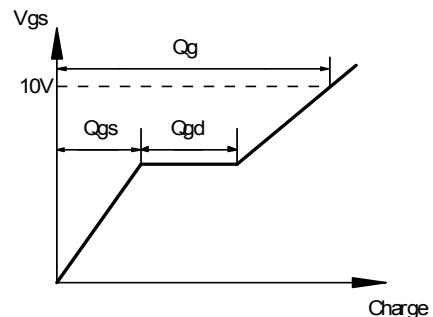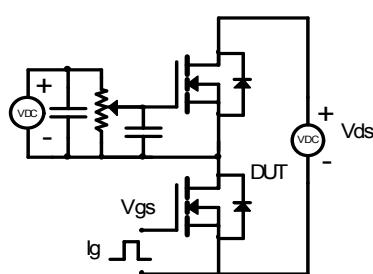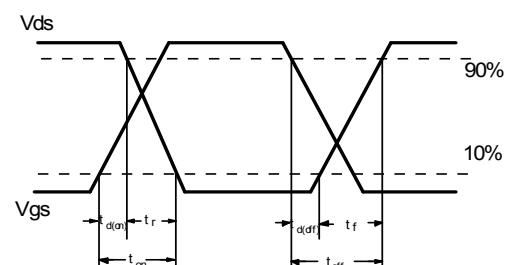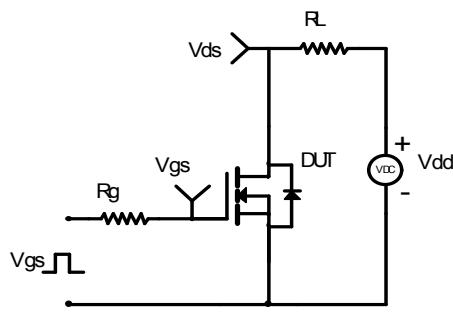
**Figure 15: Normalized Maximum Transient Thermal Impedance for AOTF22N50L (Note F)**
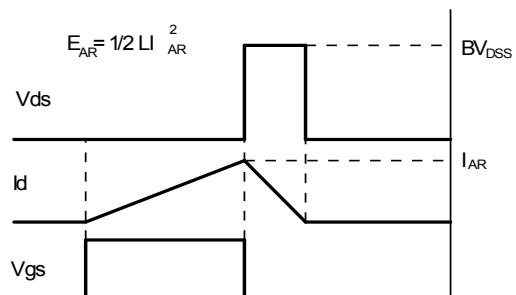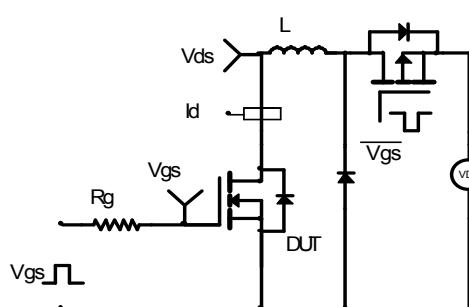
Gate Charge Test Circuit & Waveform
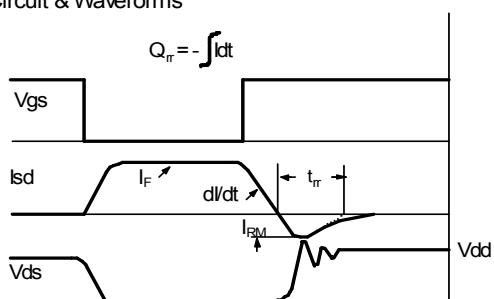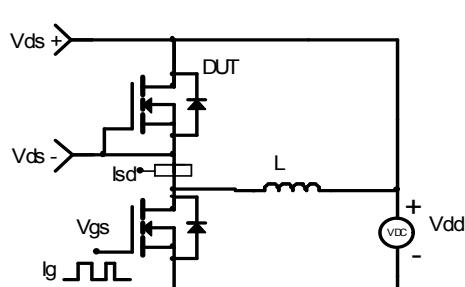
Resistive Switching Test Circuit & Waveforms

Unclamped Inductive Switching (UIS) Test Circuit & Waveforms

$$E_{AR} = 1/2 \, LI_{AR}^{2}$$

Diode Recovery Test Circuit & Waveforms

$$Q_{rr} = - \int I dt$$

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