ALPHA & OMEGA SEMICONDUCTOR

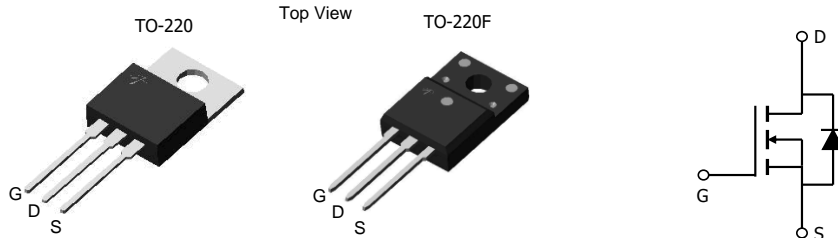# AOT9N50/AOTF9N50
500V, 9A N-Channel MOSFET

General Description

The AOT9N50 & AOTF9N50 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.

Product Summary

V_{DS}	600V@150℃
I_D (at V_{GS}=10V)	9A
$R_{DS(ON)}$ (at V_{GS}=10V)	< 0.85Ω

100% UIS Tested
100% R_g Tested

Green Product

TO-220   Top View   TO-220F

Absolute Maximum Ratings T_A=25°C unless otherwise noted

Parameter		Symbol	AOT9N50	AOTF9N50	Units
Drain-Source Voltage		V_{DS}	500		V
Gate-Source Voltage		V_{GS}	±30		V
Continuous Drain Current	T_C=25°C	I_D	9	9*	A
	T_C=100°C		6.0	6*	
Pulsed Drain Current C		I_{DM}	30		
Avalanche Current C		I_{AR}	3.2		A
Repetitive avalanche energy C		E_{AR}	154		mJ
Single plused avalanche energy G		E_{AS}	307		mJ
Peak diode recovery dv/dt		dv/dt	5		V/ns
Power Dissipation B	T_C=25°C	P_D	192	38.5	W
	Derate above 25°C		1.5	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	AOT9N50	AOTF9N50	Units
Maximum Junction-to-Ambient A,D	$R_{\theta JA}$	65	65	°C/W
Maximum Case-to-sink A	$R_{\theta CS}$	0.5	--	°C/W
Maximum Junction-to-Case	$R_{\theta JC}$	0.65	3.25	°C/W

* Drain current limited by maximum junction temperature.

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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		0.56		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$_D$=4.5A		0.66	0.85	Ω
g$_{FS}$	Forward Transconductance	V$_{DS}$=40V, I$_D$=4.5A		10		S
V$_{SD}$	Diode Forward Voltage	I$_S$=1A,V$_{GS}$=0V		0.74	1	V
I$_S$	Maximum Body-Diode Continuous Current				9	A
I$_{SM}$	Maximum Body-Diode Pulsed Current				30	A
DYNAMIC PARAMETERS						
C$_{iss}$	Input Capacitance	V$_{GS}$=0V, V$_{DS}$=25V, f=1MHz	694	868	1042	pF
C$_{oss}$	Output Capacitance		74	93	112	pF
C$_{rss}$	Reverse Transfer Capacitance		6.2	7.8	9.4	pF
R$_g$	Gate resistance	V$_{GS}$=0V, V$_{DS}$=0V, f=1MHz	2	4	6	Ω
SWITCHING PARAMETERS						
Q$_g$	Total Gate Charge	V$_{GS}$=10V, V$_{DS}$=400V, I$_D$=9A	15	23.6	28	nC
Q$_{gs}$	Gate Source Charge		4	5.2	6.2	nC
Q$_{gd}$	Gate Drain Charge		8.5	10.6	12.7	nC
t$_{D(on)}$	Turn-On DelayTime	V$_{GS}$=10V, V$_{DS}$=250V, I$_D$=9A, R$_G$=25Ω		19.5		ns
t$_r$	Turn-On Rise Time			47		ns
t$_{D(off)}$	Turn-Off DelayTime			51.5		ns
t$_f$	Turn-Off Fall Time			38.5		ns
t$_{rr}$	Body Diode Reverse Recovery Time	I$_F$=9A,dI/dt=100A/µs,V$_{DS}$=100V	195	248	300	ns
Q$_{rr}$	Body Diode Reverse Recovery Charge	I$_F$=9A,dI/dt=100A/µs,V$_{DS}$=100V	2.5	3.5	4.5	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$_{AS}$=3.2A, V$_{DD}$=150V, R$_G$=25Ω, Starting T$_J$=25°C
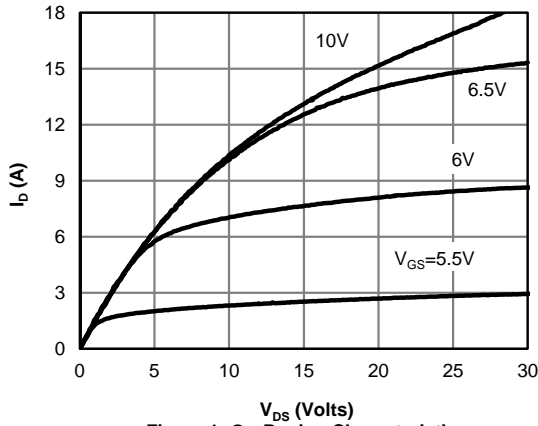
TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

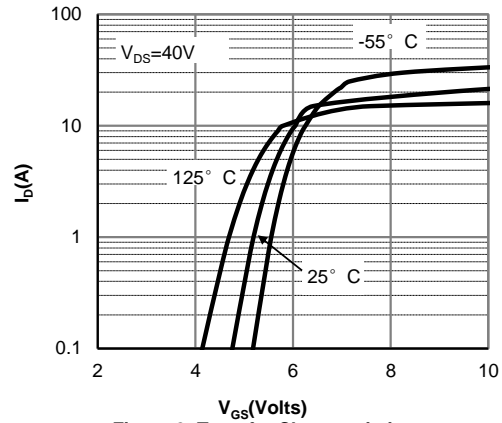Figure 1: On-Region Characteristics
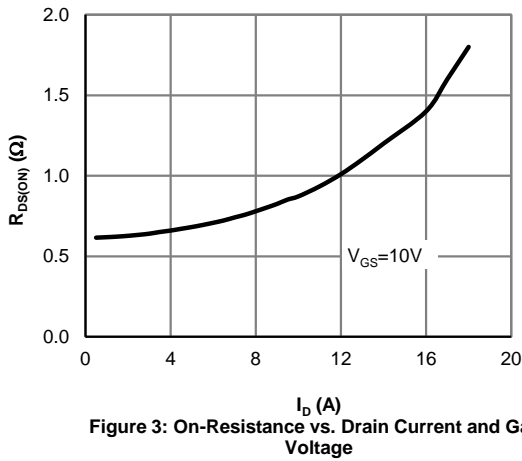

Figure 2: Transfer Characteristics

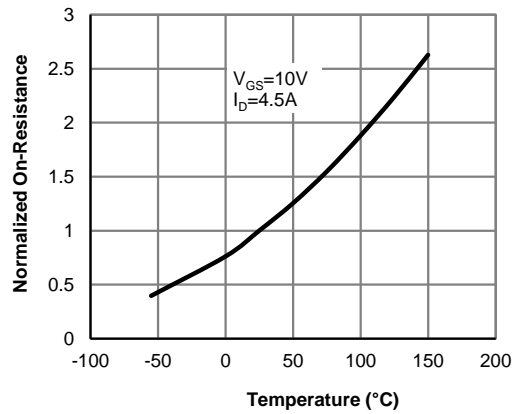Figure 3: On-Resistance vs. Drain Current and Gate Voltage

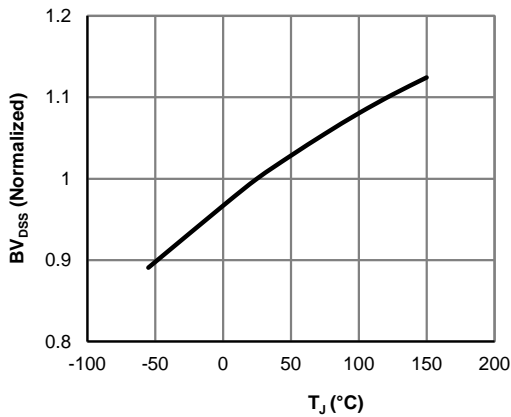Figure 4: On-Resistance vs. Junction Temperature
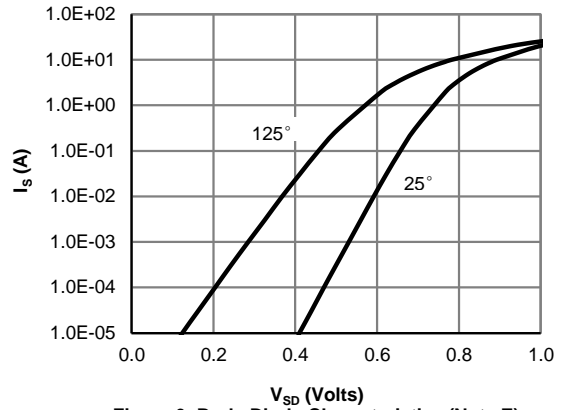

Figure 5:Break Down vs. Junction Temperature

Figure 6: Body-Diode Characteristics (Note E)
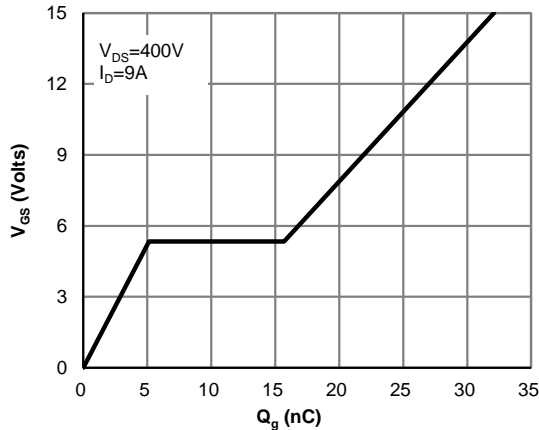
TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

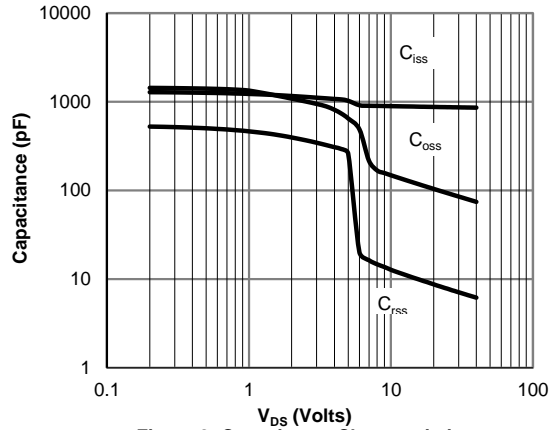Figure 7: Gate-Charge Characteristics
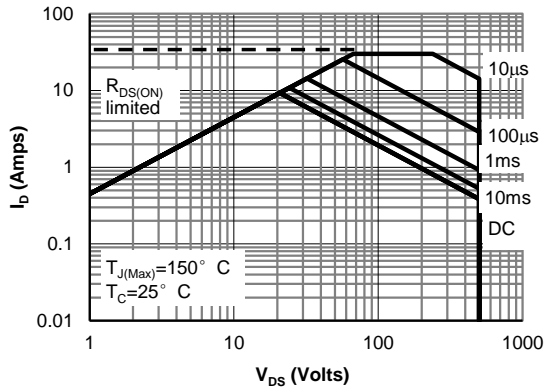

Figure 8: Capacitance Characteristics

Figure 9: Maximum Forward Biased Safe
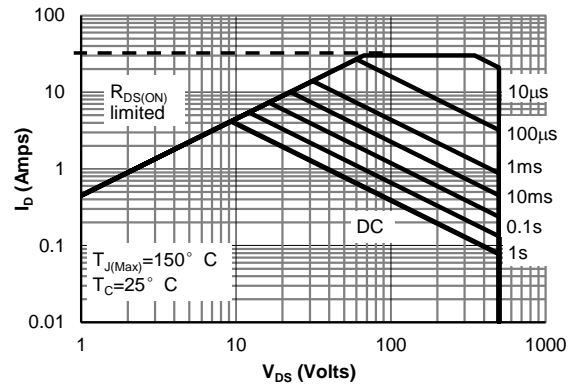Operating Area for AOT9N50 (Note F)

Figure 10: Maximum Forward Biased Safe
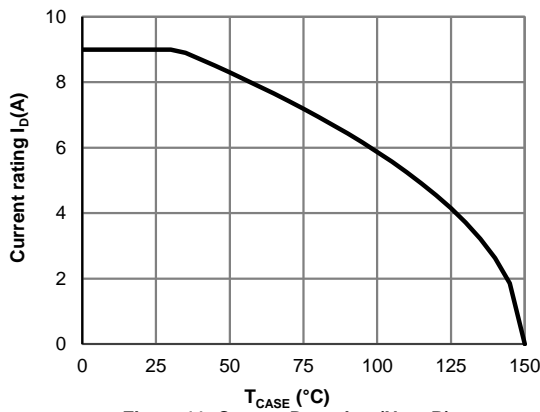Operating Area for AOTF9N50 (Note F)

Figure 11: Current De-rating (Note B)

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TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

$D = T_{on}/T$
$T_{J,PK} = T_C + P_{DM} \cdot Z_{\theta JC} \cdot R_{\theta JC}$
$R_{\theta JC} = 0.65°$ C/W

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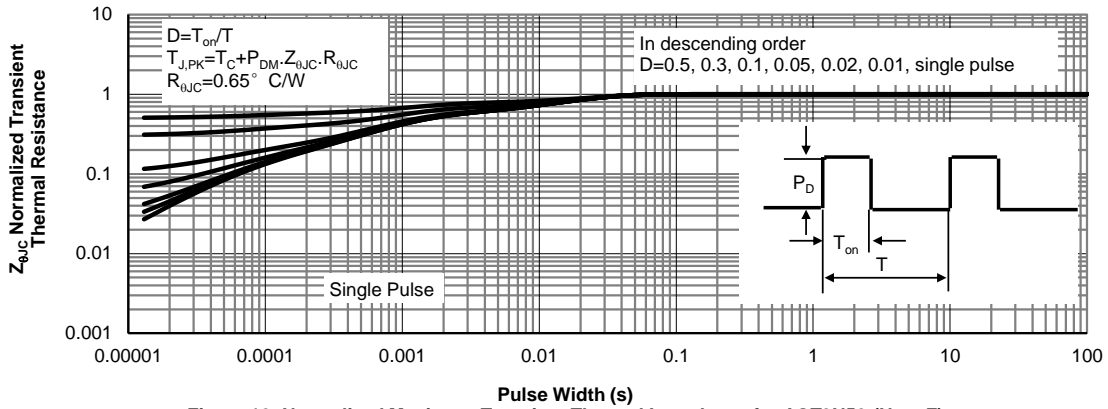
Single Pulse

P_D

T_{on}

T

Pulse Width (s)

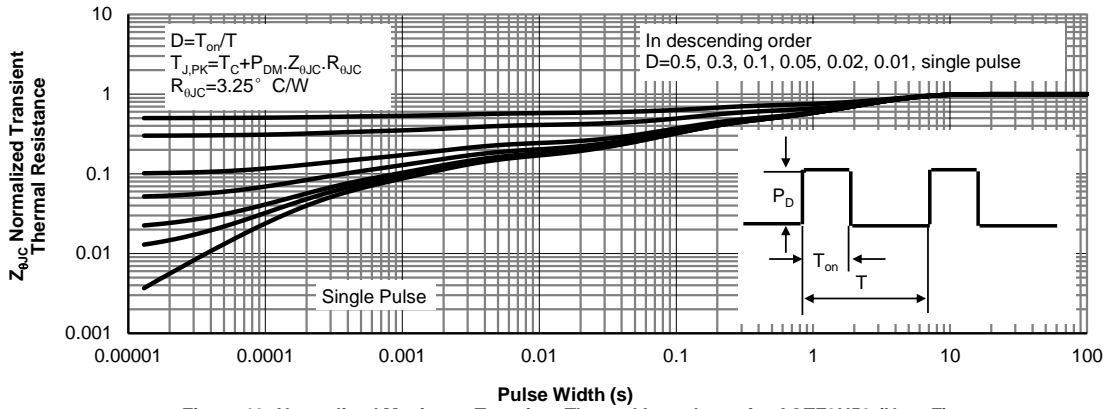**Figure 12: Normalized Maximum Transient Thermal Impedance for AOT9N50 (Note F)**

$D = T_{on}/T$
$T_{J,PK} = T_C + P_{DM} \cdot Z_{\theta JC} \cdot R_{\theta JC}$
$R_{\theta JC} = 3.25°$ C/W

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

Single Pulse

P_D

T_{on}

T

Pulse Width (s)

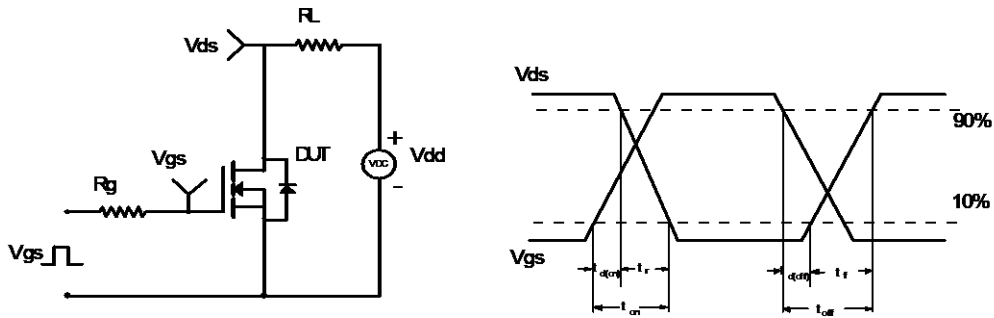**Figure 13: Normalized Maximum Transient Thermal Impedance for AOTF9N50 (Note F)**
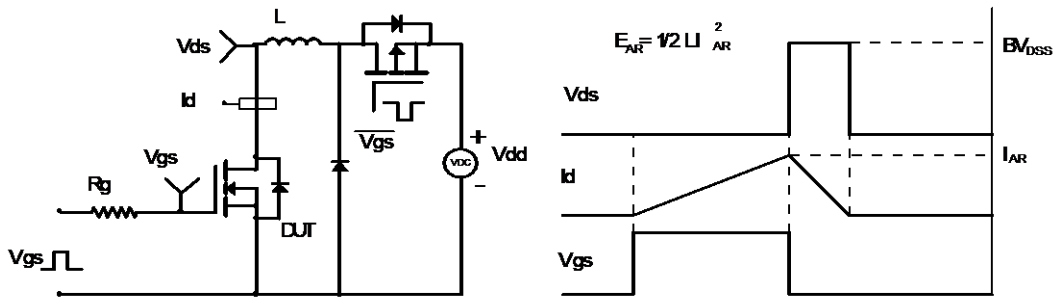
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Gate Charge Test Circuit & Waveform
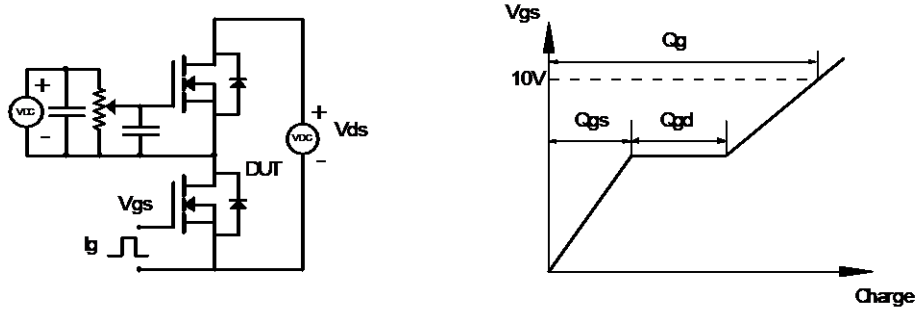
Resistive Switching Test Circuit & Waveforms

Unclamped Inductive Switching (UIS) Test Circuit & Waveforms

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

Diode Recovery Test Circuit & Waveforms

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