ALPHA & OMEGA SEMICONDUCTOR

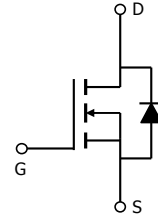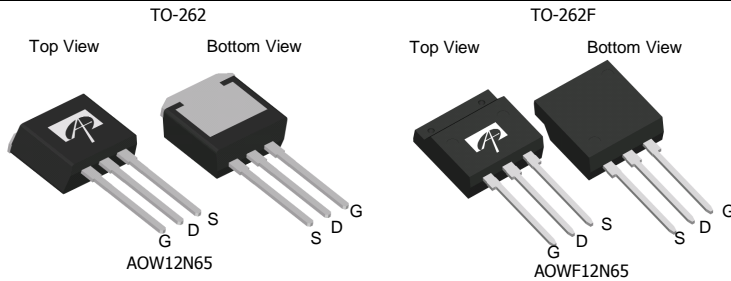# AOW12N65/AOWF12N65
650V, 12A N-Channel MOSFET

General Description

The AOW12N65 & AOWF12N65 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}	750V@150℃
I_D (at V_{GS}=10V)	12A
$R_{DS(ON)}$ (at V_{GS}=10V)	< 0.72Ω

100% UIS Tested
100% R_g Tested

Green Product

TO-262   TO-262F

Top View   Bottom View   Top View   Bottom View

AOW12N65   AOWF12N65

Absolute Maximum Ratings T_A=25℃ unless otherwise noted

Parameter		Symbol	AOW12N65	AOWF12N65	Units
Drain-Source Voltage		V_{DS}	650		V
Gate-Source Voltage		V_{GS}	±30		V
Continuous Drain Current	T_C=25℃	I_D	12	12*	A
	T_C=100℃		7.7	7.7*	
Pulsed Drain Current [C]		I_{DM}	48		
Avalanche Current [C]		I_{AR}	5		A
Repetitive avalanche energy [C]		E_{AR}	375		mJ
Single plused avalanche energy [G]		E_{AS}	750		mJ
Peak diode recovery dv/dt		dv/dt	5		V/ns
Power Dissipation [B]	T_C=25℃	P_D	278	28	W
	Derate above 25°C		2.2	0.22	W/ °C
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		T_L	300		℃

Thermal Characteristics

Parameter	Symbol	AOW12N65	AOWF12N65	Units
Maximum Junction-to-Ambient [A,D]	$R_{\theta JA}$	65	65	℃/W
Maximum Case-to-sink [A]	$R_{\theta CS}$	0.5	--	℃/W
Maximum Junction-to-Case	$R_{\theta JC}$	0.45	4.5	℃/W

* Drain current limited by maximum junction temperature.

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S E M I C O N D U C T O R

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℃	650			V
		I_D=250µA, V_{GS}=0V, T_J=150℃		750		
$BV_{DSS}/\Delta TJ$	Zero Gate Voltage Drain Current	ID=250µA, VGS=0V		0.72		V/℃
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS}=650V, V_{GS}=0V			1	µA
		V_{DS}=520V, T_J=125℃			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	3.9	4.5	V
$R_{DS(ON)}$	Static Drain-Source On-Resistance	V_{GS}=10V, I_D=6A		0.57	0.72	Ω
g_{FS}	Forward Transconductance	V_{DS}=40V, I_D=6A		17		S
V_{SD}	Diode Forward Voltage	I_S=1A,V_{GS}=0V		0.71	1	V
I_S	Maximum Body-Diode Continuous Current				12	A
I_{SM}	Maximum Body-Diode Pulsed Current				48	A
DYNAMIC PARAMETERS						
C_{iss}	Input Capacitance	V_{GS}=0V, V_{DS}=25V, f=1MHz	1430	1792	2150	pF
C_{oss}	Output Capacitance		105	152	198	pF
C_{rss}	Reverse Transfer Capacitance		6.5	11.5	18	pF
R_g	Gate resistance	V_{GS}=0V, V_{DS}=0V, f=1MHz	1.7	3.5	5.3	Ω
SWITCHING PARAMETERS						
Q_g	Total Gate Charge	V_{GS}=10V, V_{DS}=520V, I_D=12A	32	39.8	48	nC
Q_{gs}	Gate Source Charge		7.5	9.2	11	nC
Q_{gd}	Gate Drain Charge		8	16.8	25	nC
$t_{D(on)}$	Turn-On DelayTime	V_{GS}=10V, V_{DS}=325V, I_D=12A, R_G=25Ω		36		ns
t_r	Turn-On Rise Time			77		ns
$t_{D(off)}$	Turn-Off DelayTime			120		ns
t_f	Turn-Off Fall Time			63		ns
t_{rr}	Body Diode Reverse Recovery Time	I_F=12A,dI/dt=100A/µs,V_{DS}=100V	300	375	450	ns
Q_{rr}	Body Diode Reverse Recovery Charge	I_F=12A,dI/dt=100A/µs,V_{DS}=100V	6	7.5	9	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 impedence 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. L=60mH, I_{AS}=5A, V_{DD}=150V, R_G=25Ω, Starting T_J=25℃

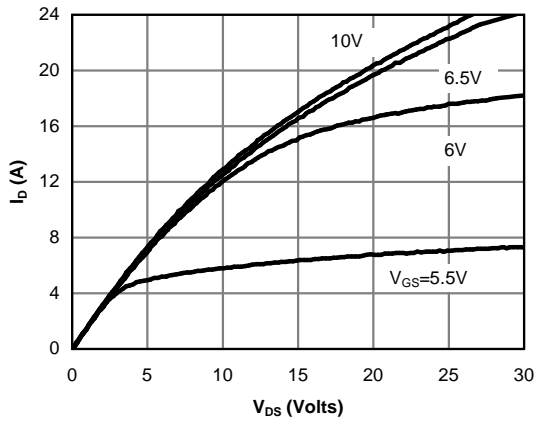## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS
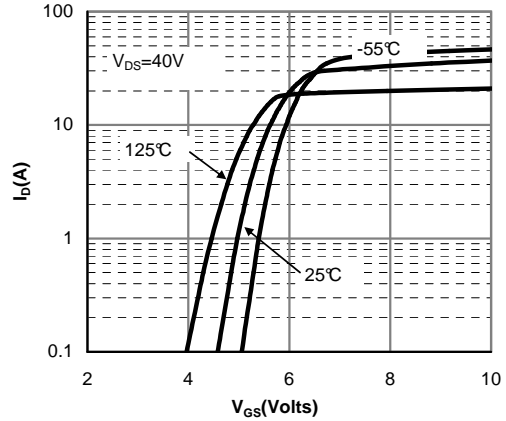

Fig 1: On-Region Characteristics

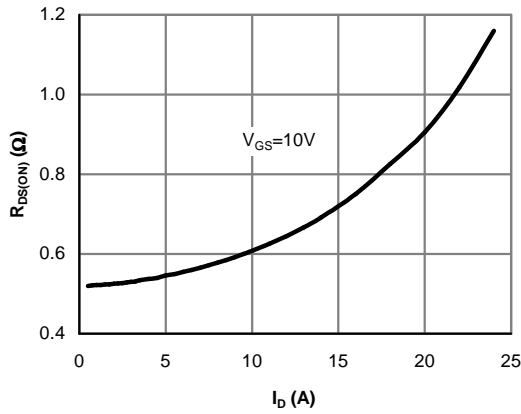**Figure 2: Transfer Characteristics**

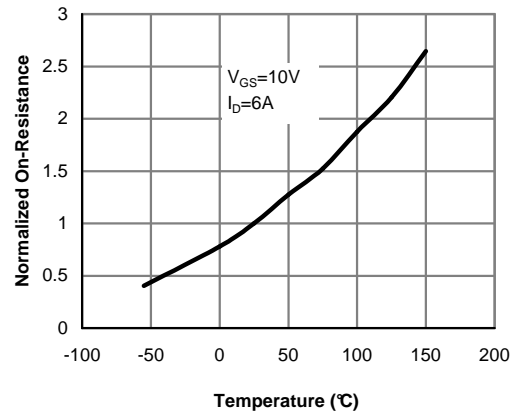**Figure 3: On-Resistance vs. Drain Current and Gate Voltage**

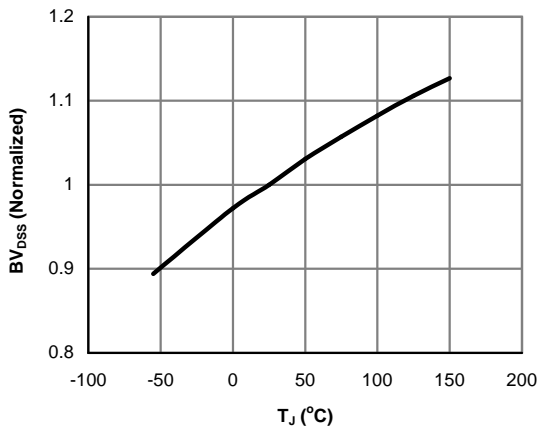

Figure 4: On-Resistance vs. Junction Temperature

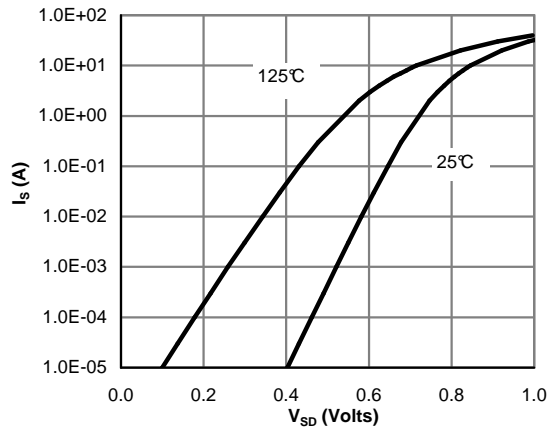**Figure 5: Break Down vs. Junction Temperature**

Figure 6: Body-Diode Characteristics   (Note E)

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TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS
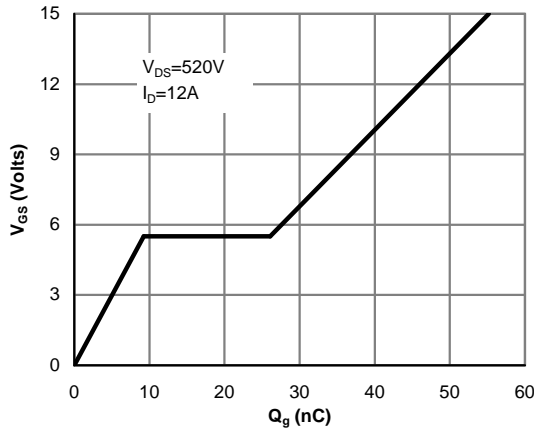
Figure 7: Gate-Charge Characteristics
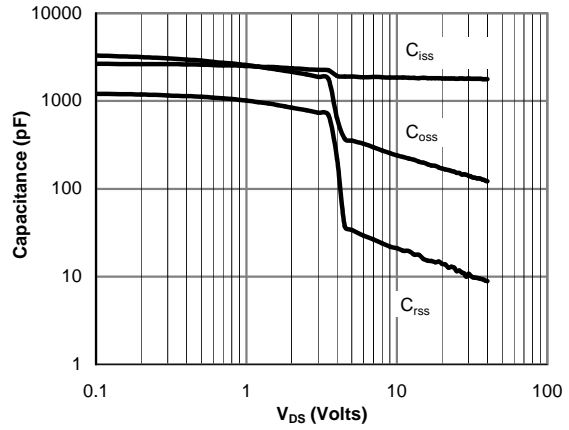
Figure 8: Capacitance Characteristics
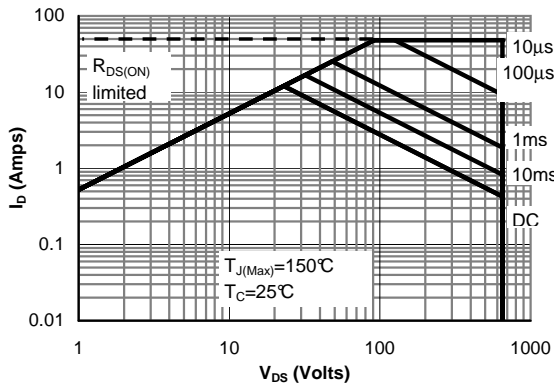
Figure 9: Maximum Forward Biased Safe
Operating Area for AOW12N65 (Note F)
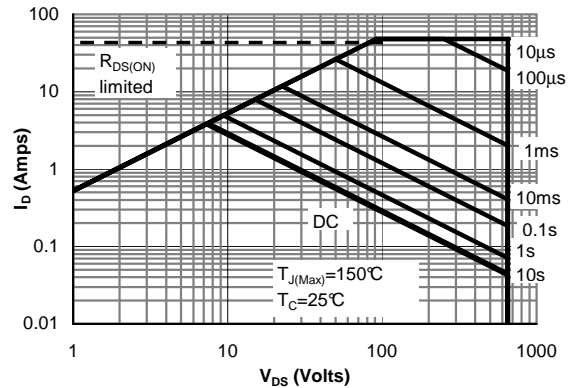
Figure 10: Maximum Forward Biased Safe Operating
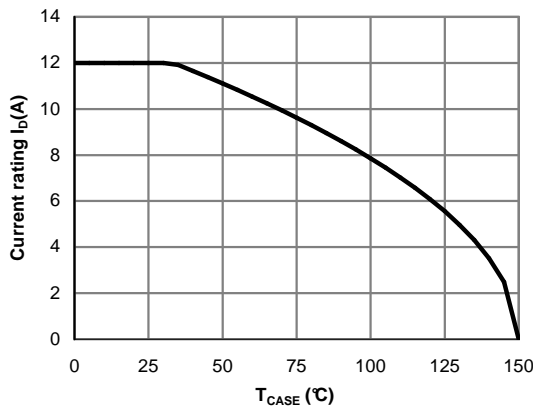Area for AOWF12N65 (Note F)

Figure 11: Current De-rating (Note B)

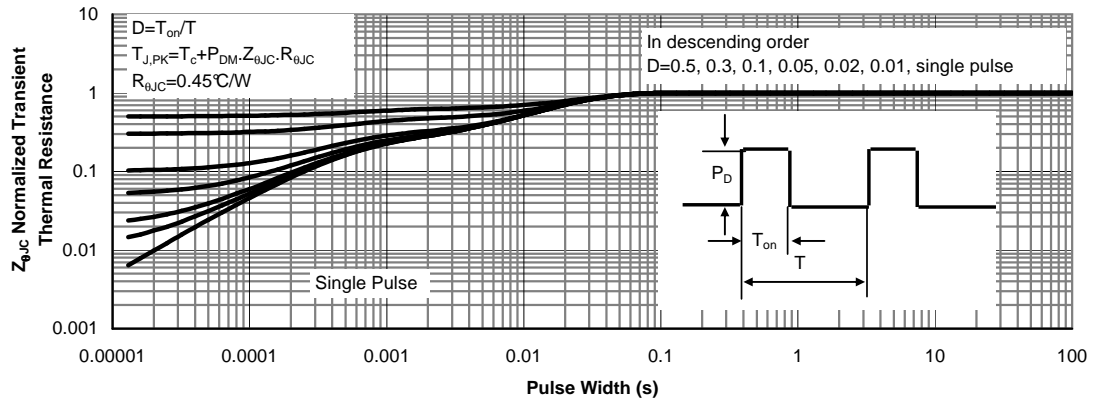**TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS**

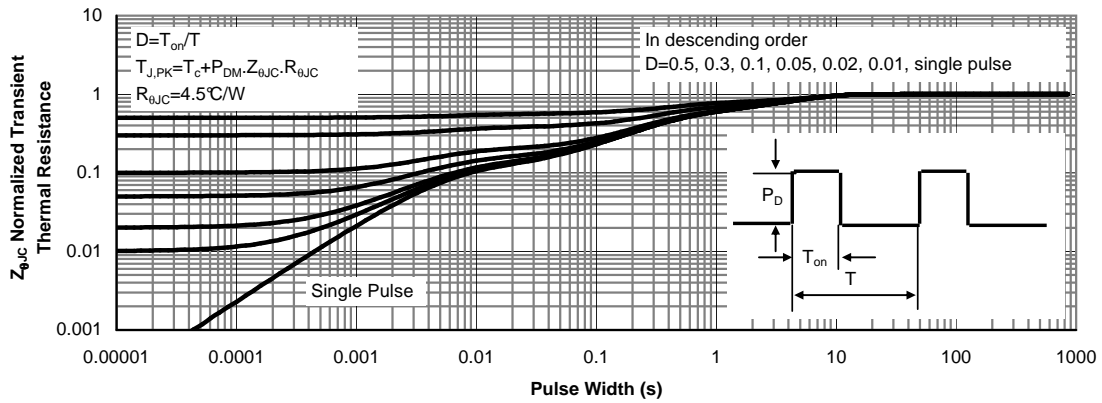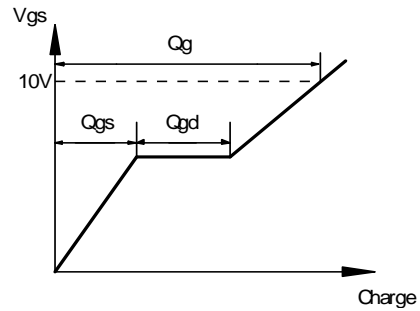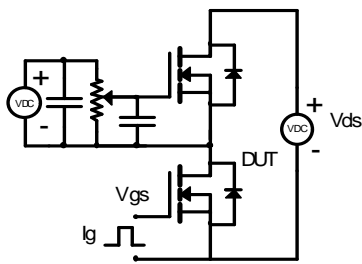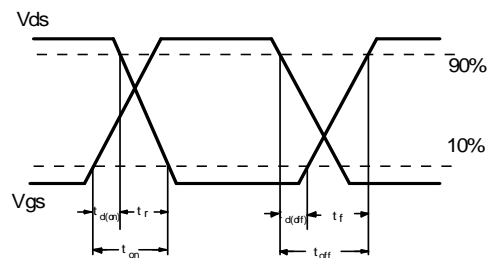Figure 12: Normalized Maximum Transient Thermal Impedance for AOW12N65 (Note F)

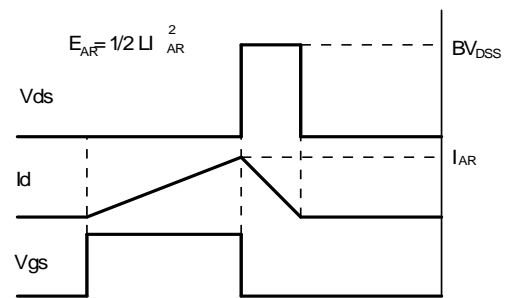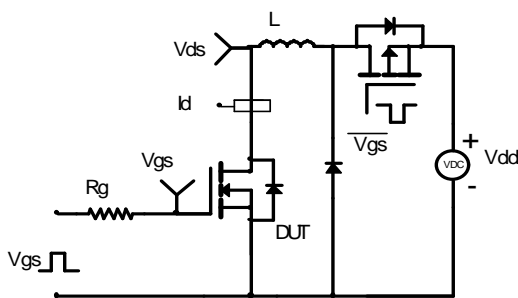Figure 13: Normalized Maximum Transient Thermal Impedance for AOWF12N65 (Note F)

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Gate Charge Test Circuit & Waveform

Vgs

Q_g

10V

Q_{gs} Q_{gd}

Charge

VDC

Vds

DUT

Vgs

Ig

Resistive Switching Test Circuit & Waveforms

RL

Vds

Rg

Vgs

DUT

VDC   Vdd

Vgs

Vds

90%

10%

Vgs

$t_{d(on)}$ t_r $t_{d(off)}$ t_f

t_{on} t_{off}
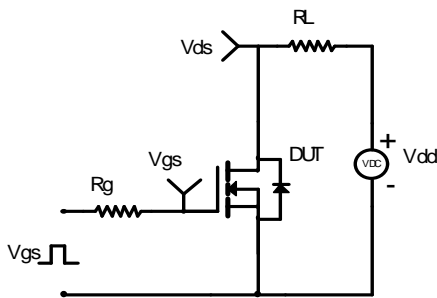
Unclamped Inductive Switching (UIS) Test Circuit & Waveforms

L

Vds

Id

$\overline{Vgs}$

Rg   Vgs

DUT

VDC   Vdd

Vgs

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

Vds

BV_{DSS}

Id

I_{AR}

Vgs

Diode Recovery Test Circuit & Waveforms

Vds +

DUT

Vds -

Isd

L

Vgs

VDC   Vdd

Ig

$Q_{rr} = - \int Idt$

Vgs

Isd

I_F dI/dt t_{rr}

I_{RM}

Vds

Vdd