ALPHA & OMEGA
SEMICONDUCTOR

AOK042A60FD
600V, aMOS5 ^{TM} N-Channel Power Transistor

General Description

• Proprietary $\alpha MOS5^{TM}$ technology
• Low $R_{DS(ON)}$
• Optimized switching parameters for better EMI performance
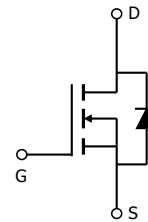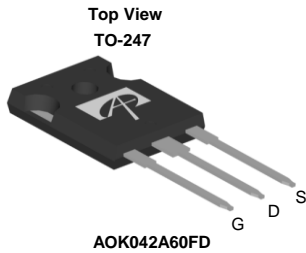• Enhanced body diode for robustness and fast reverse recovery

Applications

• PFC and PWM stages (LLC, FSFB,TTF) of Server, Telecom, Industrial, UPS, and Solar Inverters

Product Summary

V_{DS} @ $T_{j,max}$	700V
I_{DM}	250A
$R_{DS(ON),max}$	< 0.042Ω
$Q_{g,typ}$	175nC
E_{oss} @ 400V	17.2μJ

100% UIS Tested
100% R_g Tested

RoHS Compliant

Top View
TO-247

AOK042A60FD

Orderable Part Number	Package Type	Form	Minimum Order Quantity
AOK042A60FD	TO247	Tube	240

Absolute Maximum Ratings T_A=25°C unless otherwise noted

Parameter		Symbol	Maximum	Units
Drain-Source Voltage		V_{DS}	600	V
Gate-Source Voltage		V_{GS}	±20	V
Gate-Source Voltage (dynamic) AC(f>1Hz)		V_{GS}	±30	V
Continuous Drain Current	T_C=25°C	I_D	70	A
	T_C=100°C		44	
Pulsed Drain Current ^{C}		I_{DM}	250	
Avalanche Current ^{C} L=1mH		I_{AR}	20	A
Repetitive avalanche energy ^{C}		E_{AR}	200	mJ
Single pulsed avalanche energy ^{G}		E_{AS}	1687	mJ
MOSFET dv/dt ruggedness		dv/dt	100	V/ns
Diode reverse recovery		dv/dt	20	V/ns
V_{DS}=0 to 400V,I_F<=50A,T_J=25°C		di/dt	900	A/us
Power Dissipation ^{B}	T_C=25°C	P_D	500	W
	Derate above 25°C		4.0	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	Maximum	Units
Maximum Junction-to-Ambient ^{A,D}	$R_{θJA}$	40	°C/W
Maximum Case-to-sink ^{A}	$R_{θCS}$	0.5	°C/W
Maximum Junction-to-Case	$R_{θJC}$	0.25	°C/W

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	600			V
		I$_D$=10mA, V$_{GS}$=0V, T$_J$=150°C		700		
BV$_{DSS}$/∆TJ	Breakdown Voltage Temperature Coefficient	I$_D$=10mA, V$_{GS}$=0V		0.42		V/°C
I$_{DSS}$	Zero Gate Voltage Drain Current	V$_{DS}$=600V, V$_{GS}$=0V			10	µA
		V$_{DS}$=480V, T$_J$=125°C		90		
I$_{GSS}$	Gate-Body leakage current	V$_{DS}$=0V, V$_{GS}$=±20V			±100	nA
V$_{GS(th)}$	Gate Threshold Voltage	V$_{DS}$=5V, I$_D$=250µA	3	3.6	4.2	V
R$_{DS(ON)}$	Static Drain-Source On-Resistance	V$_{GS}$=10V, I$_D$=25A		0.036	0.042	Ω
g$_{FS}$	Forward Transconductance	V$_{DS}$=10V, I$_D$=25A		41		S
V$_{SD}$	Diode Forward Voltage	I$_S$=25A,V$_{GS}$=0V		0.83	1.2	V
I$_S$	Maximum Body-Diode Continuous Current				70	A
I$_{SM}$	Maximum Body-Diode Pulsed Current [C]				250	A
DYNAMIC PARAMETERS						
C$_{iss}$	Input Capacitance	V$_{GS}$=0V, V$_{DS}$=100V, f=1MHz		9165		pF
C$_{oss}$	Output Capacitance			230		pF
C$_{o(er)}$	Effective output capacitance, energy related [H]	V$_{GS}$=0V, V$_{DS}$=0 to 480V, f=1MHz		197		pF
C$_{o(tr)}$	Effective output capacitance, time related [I]			872		pF
C$_{rss}$	Reverse Transfer Capacitance	V$_{GS}$=0V, V$_{DS}$=100V, f=1MHz		2		pF
R$_g$	Gate resistance	f=1MHz		2.3		Ω
SWITCHING PARAMETERS						
Q$_g$	Total Gate Charge	V$_{GS}$=10V, V$_{DS}$=480V, I$_D$=25A		175		nC
Q$_{gs}$	Gate Source Charge			56		nC
Q$_{gd}$	Gate Drain Charge			52		nC
T$_{d(on)}$	Turn-On DelayTime	V$_{GS}$=10V, V$_{DS}$=400V, I$_D$=25A, R$_G$=5Ω		75		ns
T$_r$	Turn-On Rise Time			82		ns
T$_{d(off)}$	Turn-Off DelayTime			176		ns
T$_f$	Turn-Off Fall Time			56		ns
T$_{rr}$	Body Diode Reverse Recovery Time	I$_F$=25A, dI/dt=100A/µs, V$_{DS}$=400V		252		ns
I$_{rm}$	Peak Reverse Recovery Current			22		A
Q$_{rr}$	Body Diode Reverse Recovery Charge			3		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 impedance from junction to case R$_{θJC}$ and case to ambient.

E. The static characteristics in Figures 1 to 6 are obtained using <300µs 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°C. The SOA curve provides a single pulse rating.

G. L=60mH, I$_{AS}$=7.5A, R$_G$=25Ω, Starting T$_J$=25°C.

H. C$_{o(er)}$ is a fixed capacitance that gives the same stored energy as C$_{oss}$ while V$_{DS}$ is rising from 0 to 80% V$_{(BR)DSS}$.

I. C$_{o(tr)}$ is a fixed capacitance that gives the same charging time as C$_{oss}$ while V$_{DS}$ is rising from 0 to 80% V$_{(BR)DSS}$.

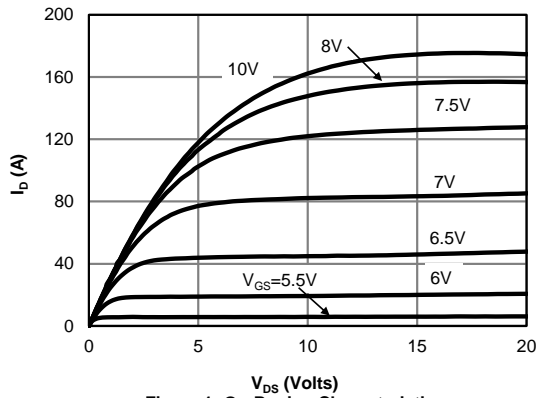## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

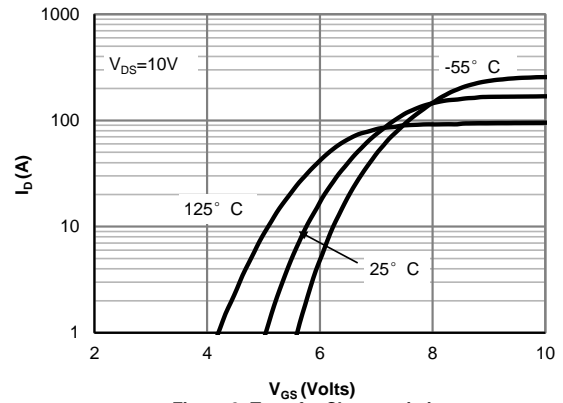Figure 1: On-Region Characteristics

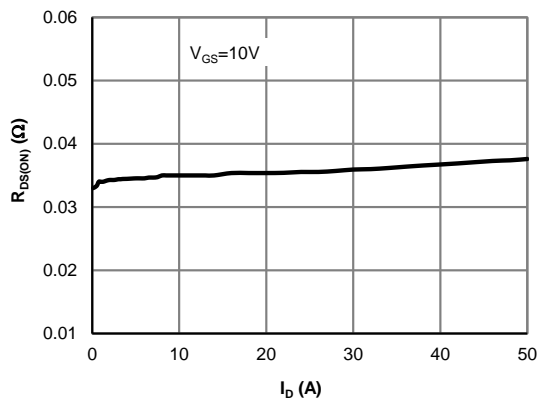Figure 2: Transfer Characteristics

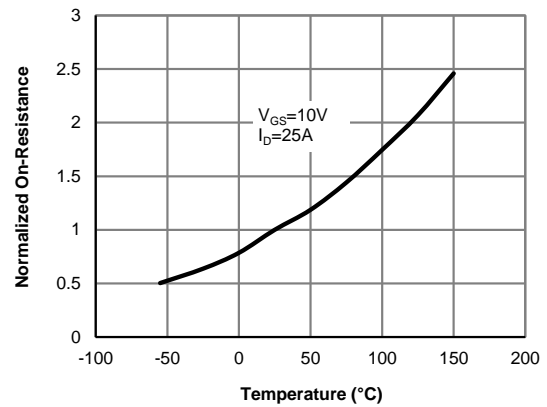Figure 3: On-Resistance vs. Drain Current and Gate Voltage
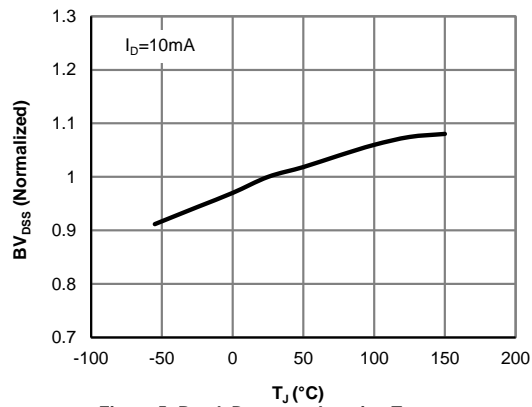

Figure 4: On-Resistance vs. Junction Temperature

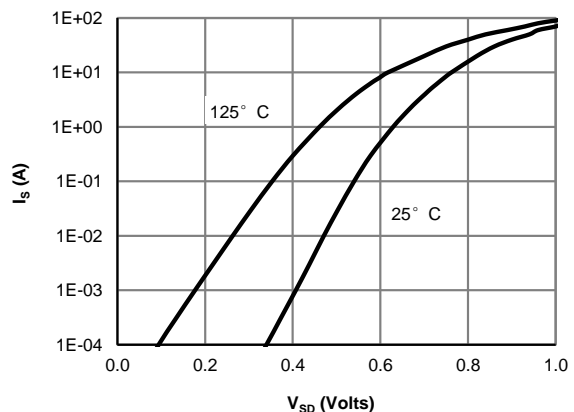Figure 5: Break Down vs. Junction Temparature

Figure 6: Body-Diode Characteristics

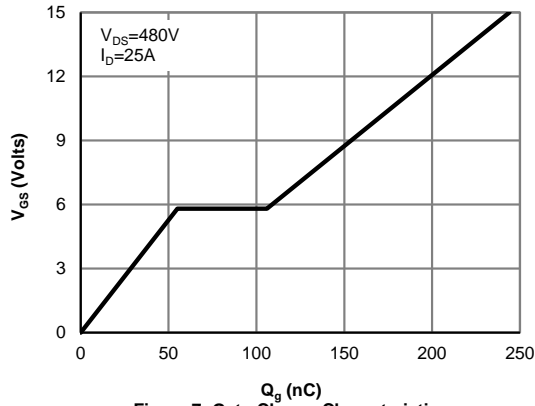**TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS**
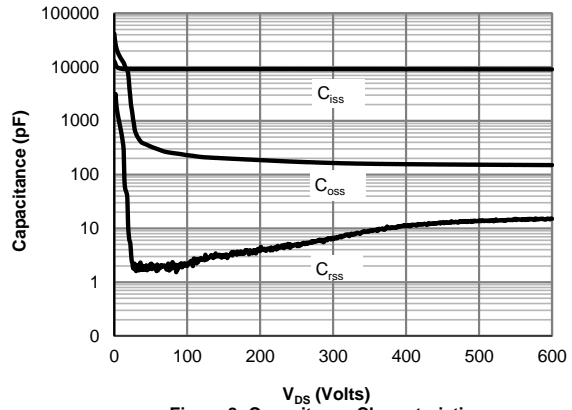

Figure 7: Gate-Charge Characteristics

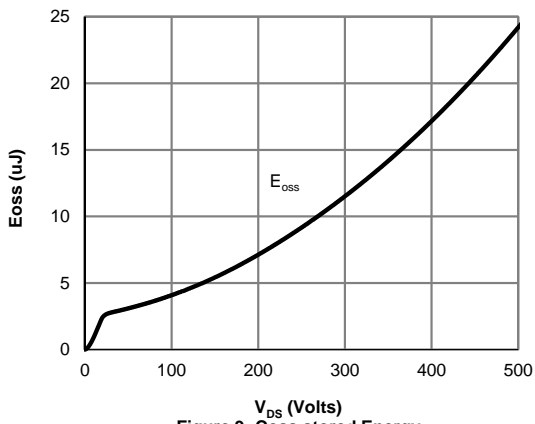Figure 8: Capacitance Characteristics

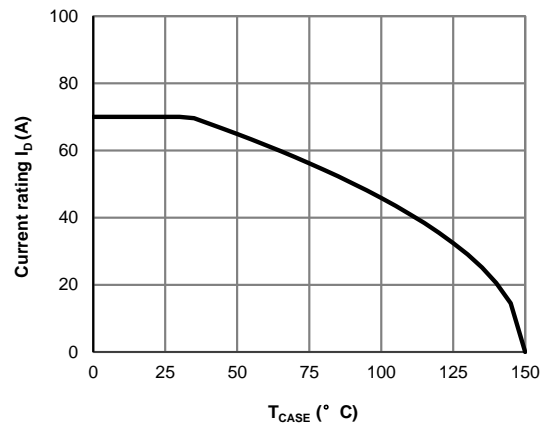Figure 9: Coss stored Energy

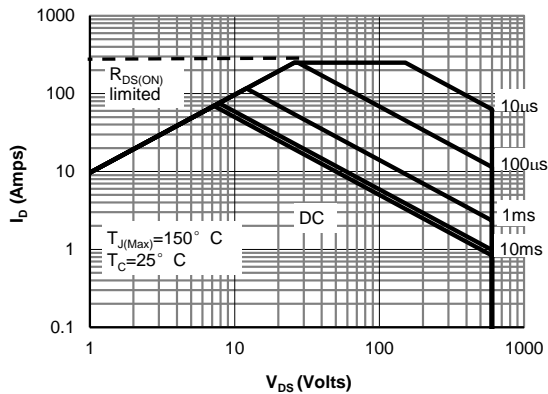Figure 10: Current De-rating (Note F)

Figure 11: Maximum Forward Biased Safe Operating
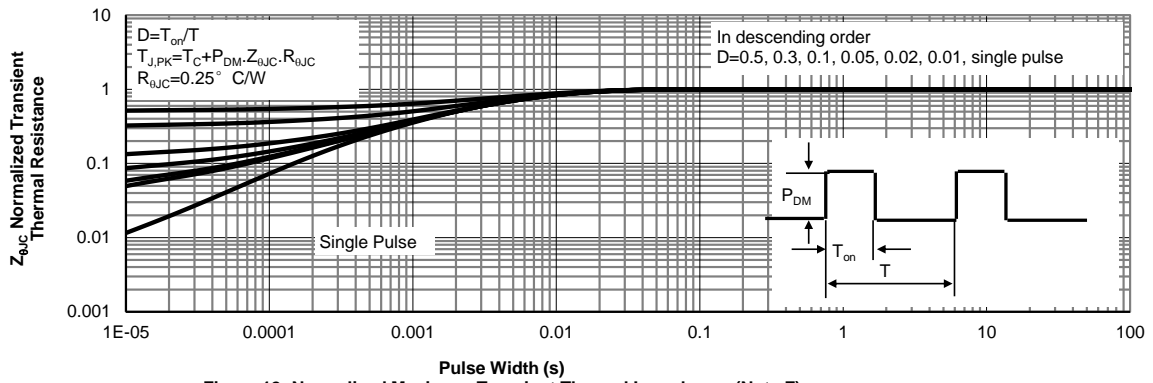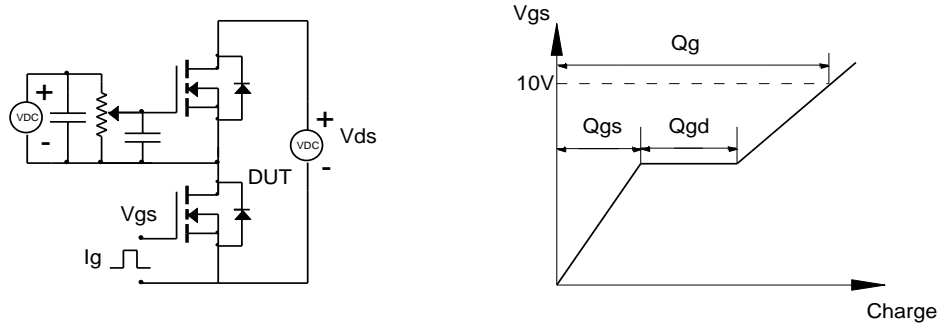Area (Note F)

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

$D = T_{on}/T$
$T_{J,PK} = T_C + P_{DM} \cdot Z_{\theta JC} \cdot R_{\theta JC}$
$R_{\theta JC} = 0.25^\circ C/W$

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

Single Pulse

$Z_{\theta JC}$ Normalized Transient Thermal Resistance

Pulse Width (s)

Figure 12: Normalized Maximum Transient Thermal Impedance (Note F)
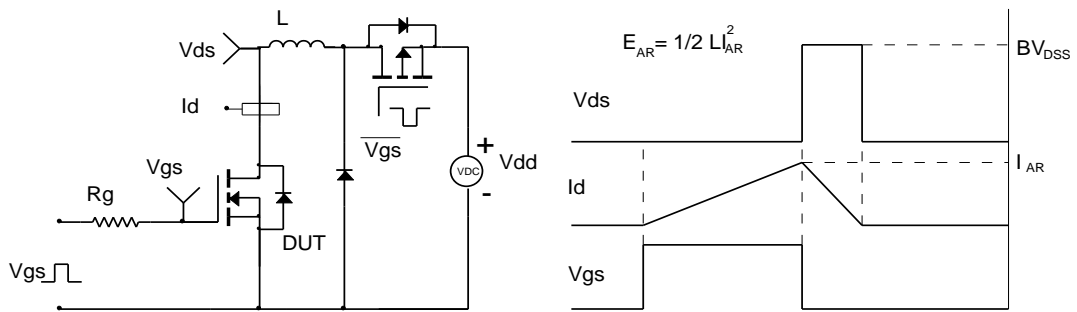
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Gate Charge Test Circuit & Waveform

Resistive Switching Test Circuit & Waveforms

Unclamped Inductive Switching (UIS) Test Circuit & Waveforms

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

Diode Recovery Test Circuit & Waveforms

$$Q_{rr} = \int Idt$$