ALPHA & OMEGA SEMICONDUCTOR

AOK040A60

600V, αMOS5™ N-Channel Power Transistor

General Description

- Proprietary αMOS5™ technology
- Low $R_{DS(ON)}$
- Optimized switching parameters for better EMI performance
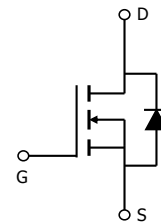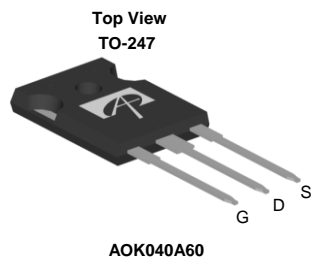- Enhanced body diode for robustness and fast reverse recovery

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
$R_{DS(ON),max}$	< 0.04Ω
$Q_{g,typ}$	175nC
E_{oss} @ 400V	17μJ

100% UIS Tested
100% R_g Tested

RoHS Compliant

Top View
TO-247

AOK040A60

Orderable Part Number	Package Type	Form	Minimum Order Quantity
AOK040A60	TO-247	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]		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			20	
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]	$R_{\theta JA}$	40	°C/W
Maximum Case-to-sink [A]	$R_{\theta CS}$	0.5	°C/W
Maximum Junction-to-Case	$R_{\theta JC}$	0.25	°C/W

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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	600			V
		I$_D$=250uA, V$_{GS}$=0V, T$_J$=125°C		700		
BV$_{DSS}$/∆TJ	Breakdown Voltage Temperature Coefficient	I$_D$=1mA, V$_{GS}$=0V		0.56		V/°C
I$_{DSS}$	Zero Gate Voltage Drain Current	V$_{DS}$=600V, V$_{GS}$=0V			1	µA
		V$_{DS}$=480V, T$_J$=125°C			10	
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	2.4	3	3.6	V
R$_{DS(ON)}$	Static Drain-Source On-Resistance	V$_{GS}$=10V, I$_D$=25A		0.035	0.04	Ω
g$_{FS}$	Forward Transconductance	V$_{DS}$=10V, I$_D$=25A		47		S
V$_{SD}$	Diode Forward Voltage	I$_S$=25A,V$_{GS}$=0V		0.8	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		9320		pF
C$_{oss}$	Output Capacitance			220		pF
C$_{o(er)}$	Effective output capacitance, energy related [H]	V$_{GS}$=0V, V$_{DS}$=0 to 480V, f=1MHz		195		pF
C$_{o(tr)}$	Effective output capacitance, time related [I]			866		pF
C$_{rss}$	Reverse Transfer Capacitance	V$_{GS}$=0V, V$_{DS}$=100V, f=1MHz		5		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			50		nC
Q$_{gd}$	Gate Drain Charge			55		nC
t$_{D(on)}$	Turn-On DelayTime	V$_{GS}$=10V, V$_{DS}$=400V, I$_D$=25A, R$_G$=5Ω		68		ns
t$_r$	Turn-On Rise Time			82		ns
t$_{D(off)}$	Turn-Off DelayTime			178		ns
t$_f$	Turn-Off Fall Time			65		ns
t$_{rr}$	Body Diode Reverse Recovery Time	I$_F$=25A, dI/dt=100A/µs, V$_{DS}$=400V		525		ns
I$_{rm}$	Peak Reverse Recovery Current			40		A
Q$_{rr}$	Body Diode Reverse Recovery Charge			15		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 heatsin k, 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$_{(BR)DSS}$.

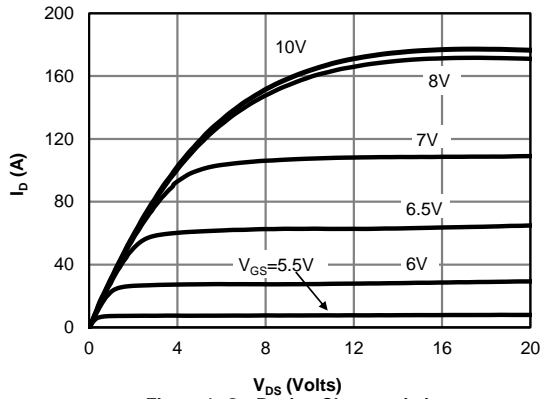## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

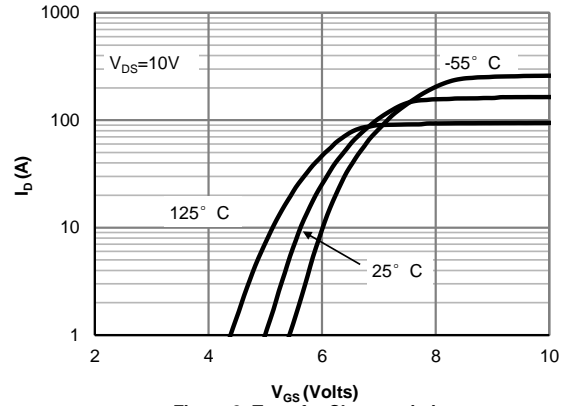Figure 1: On-Region Characteristics

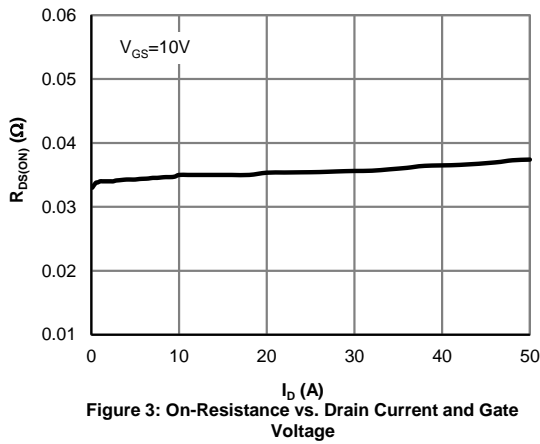Figure 2: Transfer Characteristics

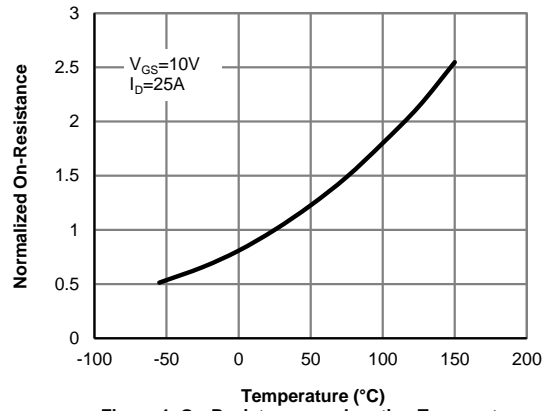Figure 3: On-Resistance vs. Drain Current and Gate Voltage
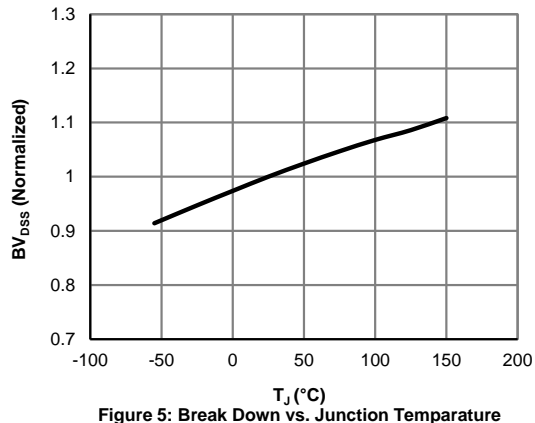

Figure 4: On-Resistance vs. Junction Temperature

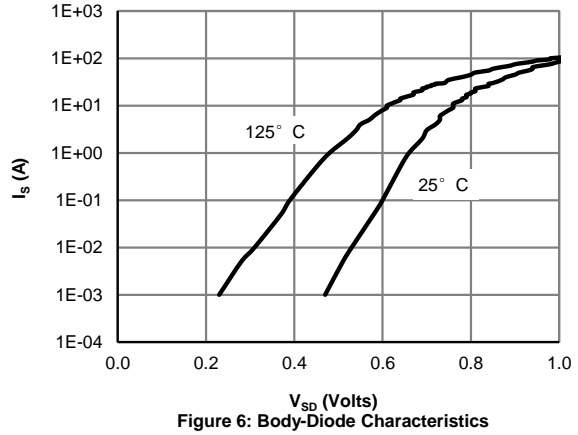Figure 5: Break Down vs. Junction Temparature

Figure 6: Body-Diode Characteristics

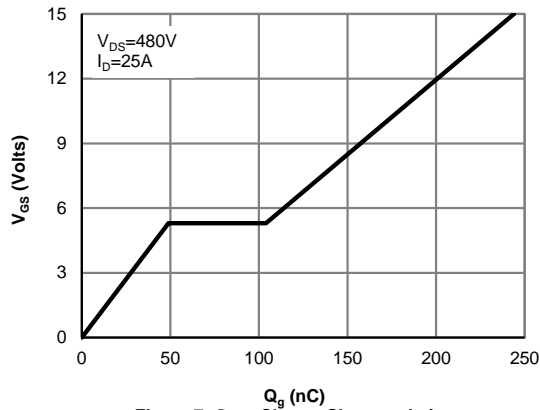## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS
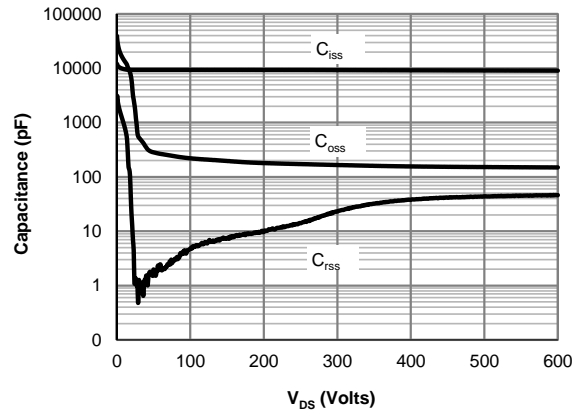
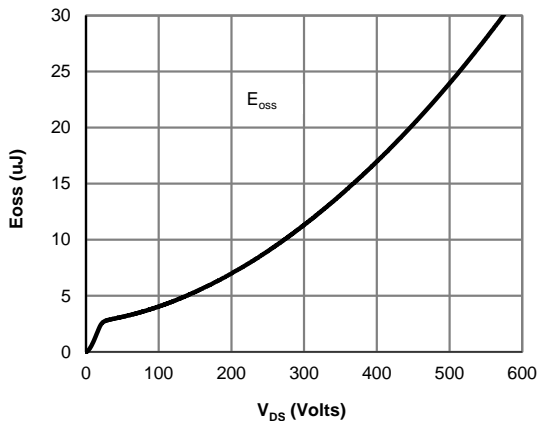Figure 7: Gate-Charge Characteristics

Figure 8: Capacitance Characteristics

Figure 9: Coss stored Energy
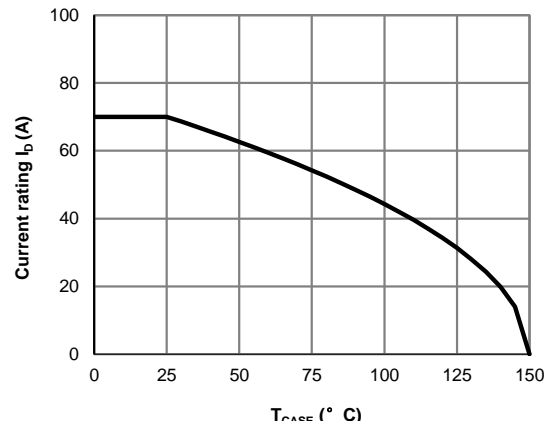
Figure 10: Current De-rating (Note F)
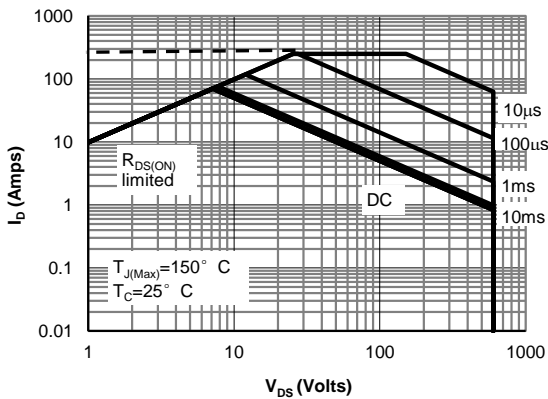
Figure 11: Maximum Forward Biased Safe Operating Area (Note F)

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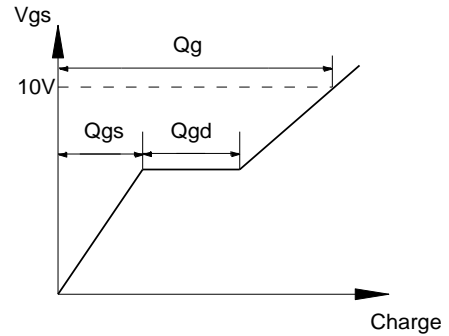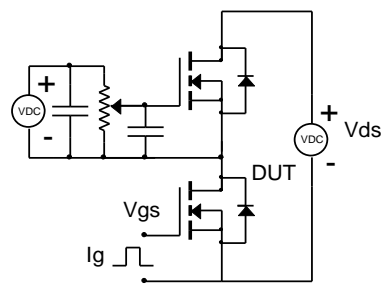*SEMICONDUCTOR*

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS
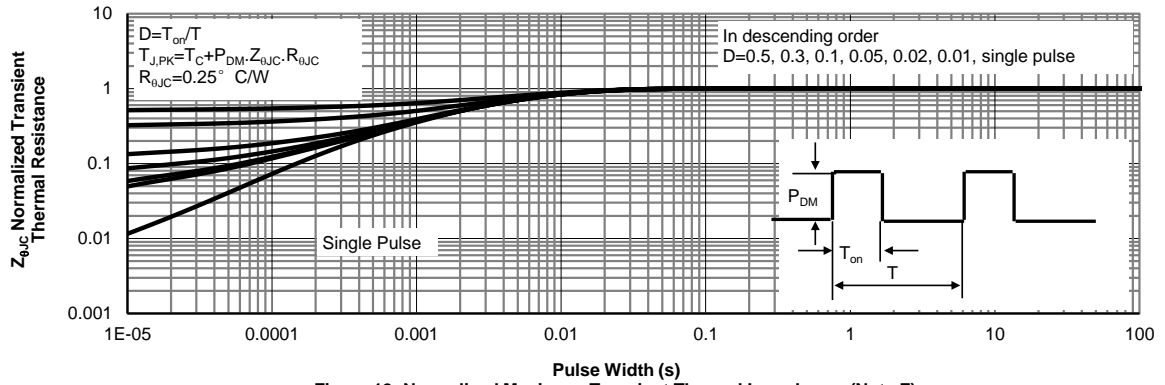
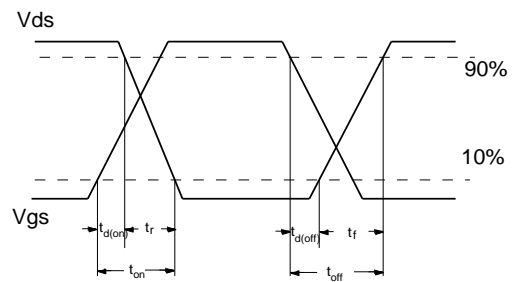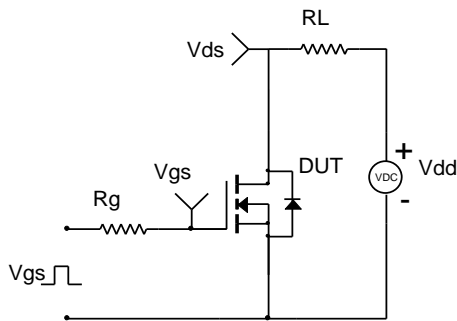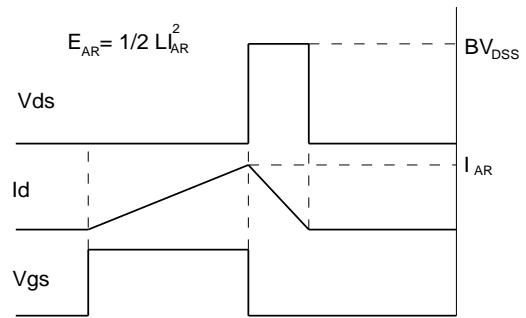**Figure 12: Normalized Maximum Transient Thermal Impedance (Note F)**
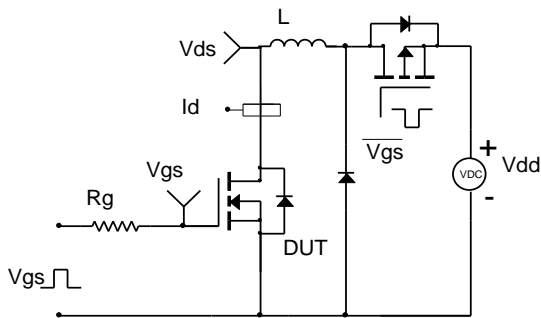
Gate Charge Test Circuit & Waveform

Resistive Switching Test Circuit & Waveforms

Unclamped Inductive Switching (UIS) Test Circuit & Waveforms

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

Diode Recovery Test Circuit & Waveforms

$Q_{rr} = -\int Idt$