

AOK033V120X2Q

1200 V \alpha SiC Silicon Carbide Power MOSFET

Features

- Proprietary αSiC MOSFET technology
- Low loss, with low R_{DS, ON}
- Fast switching with low R_G and low capacitance
- Optimized gate drive voltage (V_{GS} = 15 V)
- Low reverse recovery diode (Qrr)
- AEC-Q101 Automotive Qualified

Applications

- xEV Charger
- Electric Vehicle Supply Equipment (EVSE)
- **Motor Drives**

Automotive Inverters Pin Configuration



V _{DS} @ T _{J, max}	1200 V
I_{DM}	120A
R _{DS(ON), typ}	$33\text{m}\Omega$
Q _{rr}	226 nC
E _{OSS} @ 800 V	63 µJ
100% UIS Tested	



Top View	Bottom View	(2) (2) (3) (1)
(1) (2)		(1) S (3)

Ordering Part Number	Package Type	Form	Shipping Quantity	
AOK033V120X2Q	TO-247-3L	Tube	30/Tube	

Absolute Maximum Ratings

 $(T_A = 25^{\circ}C, unless otherwise noted)$

Symbol		Parameter		
V _{DS}	Drain-Source Voltage		1200	V
V _{GS, MAX}		Maximum	-8/+18	
V _{GS,OP,TRANS}	Gate-Source Voltage	Max Transient ^(A)	-8/+20	V
$V_{GS,OP}$		Recommended Operating (B)	-5/+15	
1	Continuous Drain Current	T _C =25°C	68	
D	Continuous Drain Current	T _C =100°C	48	Α
I _{DM}	Pulsed Drain Current ^(C)		120	
E _{AS}	Single Pulsed Avalanche Energy ^(D)		1000	mJ
P _D	Power Dissipation ^(C)		300	W
T _J , T _{STG}	Junction and Storage Temperature Range		-55 to 175	°C
T _L	Maximum lead temperature for soldering purpose, 1/8" from case for 5 seconds		300	°C



Thermal Characteristics

Symbol	Parameter	AOK033V120X2Q	Units	
R _{0JA}	Maximum Junction-to-Ambient (E,F)	40	°C/W	
R _{0JC}	Maximum Junction-to-Case ^(G)	0.5	°C/W	

Electrical Characteristics

 $(T_A = 25^{\circ}C, unless otherwise noted)$

Symbol	Parameter	Parameter Conditions		Min	Тур	Max	Units
STATIC PAR	AMETERS				, , , ,		
DV/	Drain Source Prockdown Voltage	·B =		1200			V
BV _{DSS}	Drain-Source Breakdown Voltage	$I_D = 250 \mu\text{A}, V_{GS} = 0 \text{V},$	T _J =150°C		1200		V
I _{DSS}	Zero Gate Voltage Drain Current	V _{DS} =1200 V, V _{GS} =0	V, T _J =25°C			100	μA
I _{GSS}	Gate-Body Leakage Current	V _{DS} =0 V, V _{GS} =+15/-	5 V			±100	nA
V _{GS(th)}	Gate Threshold Voltage	$V_{DS} = V_{GS}$, $I_{D} = 17.5 \text{ mA}$			2.8		V
	Static Drain-Source On-Resistance	\/ -15\/ -20 A	T _J =25°C		33	43	mΩ
R _{DS(ON)}	Static Dialii-Source Off-Nesistance	$V_{GS} = 15 \text{ V}, I_D = 20 \text{ A}$	T _J =150°C		45		
g _{FS}	Forward Transconductance	$V_{DS} = 20 \text{ V}, I_{D} = 20 \text{ A}$			15	-	S
V_{SD}	Diode Forward Voltage	I _S =17.5A, V _{GS} =-5V			4	5	V
DYNAMIC PA	RAMETERS						
C _{iss}	Input Capacitance			2908		pF	
C _{oss}	Output Capacitance	0000			128		pF
C _{rss}	Reverse Transfer Capacitance			9.9		pF	
E _{oss}	Coss Stored Energy				63		μJ
R_{G}	Gate Resistance	f=1MHz			1.7		Ω
SWITCHING	PARAMETERS						
Q_g	Total Gate Charge				104		nC
Q_{gs}	Gate Source Charge	V _{GS} =-5/+15 V, V _{DS} =800 V, I _D =20 A			37		nC
Q_{gd}	Gate Drain Charge				32		nC
t _{d(on)}	Turn-On Delay Time				12.7		ns
t _r	Turn-On Rise Time	V _{GS} =-5V/+15V, V _{DS}	=800 V,		40.5		ns
t _{d(off)}	Turn-Off Delay Time	L = 40 A B = 20			16.4		ns
t _f	Turn-Off Fall Time	$I_D=40A$, $R_G=2\Omega$			4.7		ns
E _{on}	Turn-On Energy	L=60 µH			980		μJ
E _{off}	Turn-Off Energy	FWD: AOK033V120X2Q			72		μJ
E _{tot}	Total Switching Energy				1052		μJ
t _{rr}	Body Diode Reverse Recovery Time				61.3		ns
I _{rm}	Peak Reverse Recovery Current	I _F =20A, dl/dt=1500 V _{GS} =-5V V _{DS} =800 \			11.4		Α
Q _{rr}	Body Diode Reverse Recovery Charge	e vGS5 v vDS-800 v			227		nC

Notes:

A. $t_{pulse} < 1 \,\mu s$, $f > 1 \,Hz$

D. L=5mH, I_{AS} =20A, R_{G} =25 Ω , Starting T_{J} =25 $^{\circ}$ C.

- F. The $R_{\theta JA}$ is the sum of the thermal impedance from junction to case $R_{\theta JC}$ and case to ambient.
- G. The value of Reuc is measured with the device mounted to a large heatsink, assuming a maximum junction temperature of T_{J(MAX)}=175°C. H. The static characteristics in Figures 1 to 8 are obtained using <300 ms
- pulses, duty cycle 0.5% max.
- I. These curves are based on Reuc which is measured with the device mounted to a large heatsink, assuming a maximum junction temperature of $T_{J(MAX)} = 175^{\circ}C$. The SOA curve provides a single pulse rating.

B. Device can be operated at Vos=0/15 V. Actual operating VGS will depend on application specifics such as parasitic inductance and dV/dt but should not exceed maximum ratings. C. The power dissipation P_D is based on $T_{J(MAX)}$ = 175°C, using junction-

to-case thermal resistance, and is more useful in setting the upper dissipation limit for cases where additional heatsinking is used.

E. The value of R_{eJA} is measured with the device in a still air environment with $T_A = 25$ °C.



Typical Electrical and Thermal Characteristics

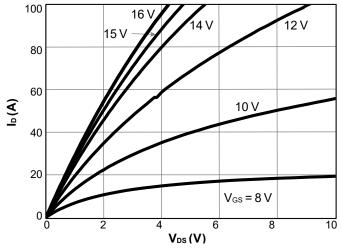


Figure 1. On-Region Characteristics T_J = 25°C

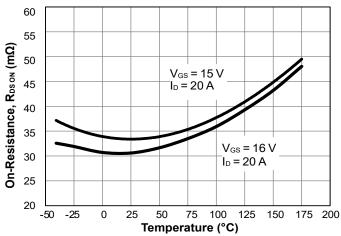


Figure 3. On-Resistance vs. Junction Temperature

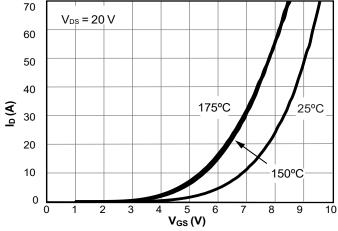


Figure 5. Transfer Characteristics

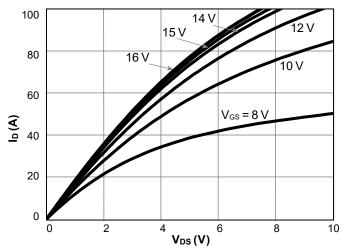


Figure 2. On-Region Characteristics T_J = 175°C

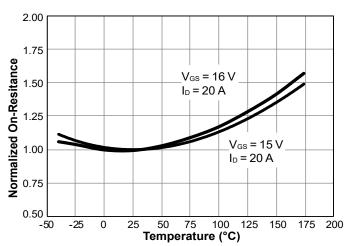


Figure 4. Normalized On-Resistance vs. Junction Temperature

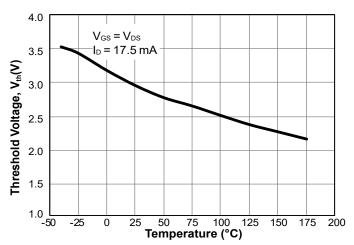


Figure 6. Threshold Voltage vs. Junction Temperature

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Typical Electrical and Thermal Characteristics (Continued)

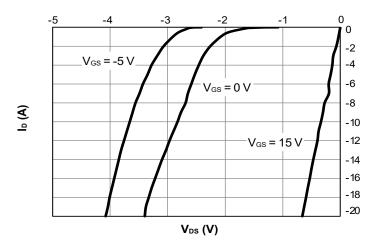


Figure 7. Body-Diode Characteristics at 25°C

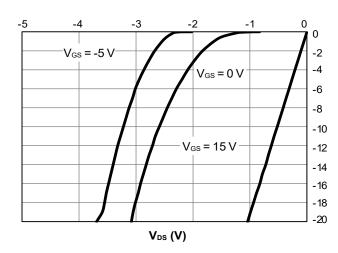


Figure 8. Body-Diode Characteristics at 175°C

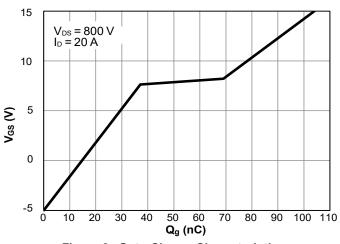


Figure 9. Gate-Charge Characteristics

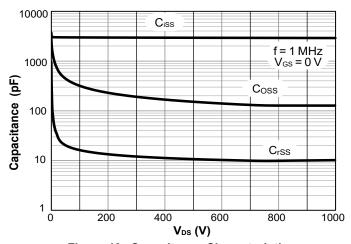


Figure 10. Capacitance Characteristics

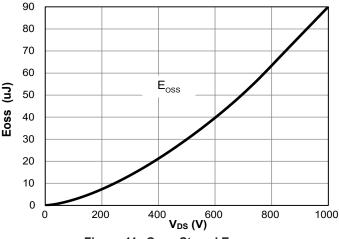


Figure 11. Coss Stored Energy

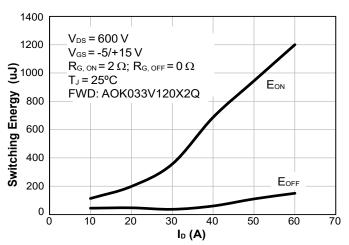


Figure 12. Switching Energy vs. Drain Current

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Typical Electrical and Thermal Characteristics (Continued)

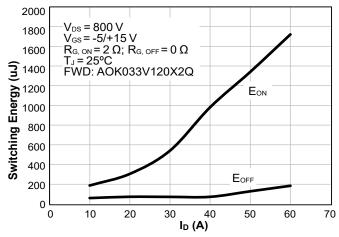


Figure 13. Switching Energy vs. Drain Current

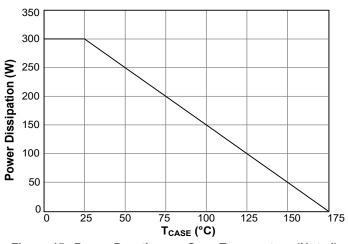


Figure 15. Power Derating vs. Case Temperature (Note I)

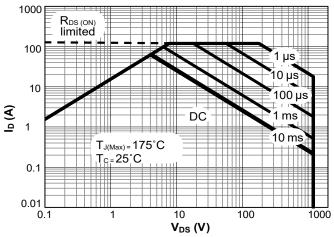


Figure 17. Maximum Forward Biased Safe Operating (Note I)

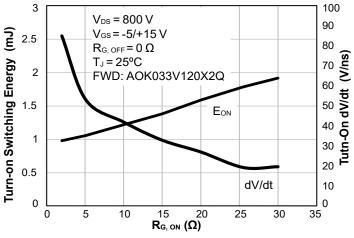


Figure 14. Turn-On Energy and dV/dt vs. External Gate Resistance

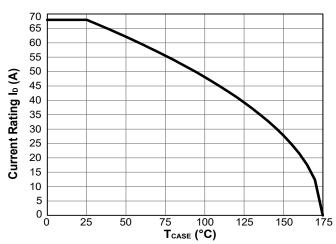


Figure 16. Current Derating vs. Case Temperature (Note I)



Typical Electrical and Thermal Characteristics (Continued)

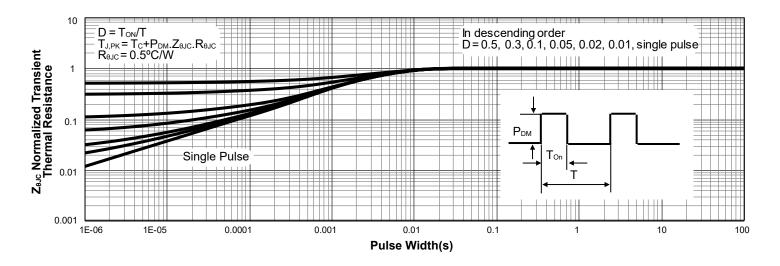


Figure 18. Normalized Maximum Transient Thermal Impedance for AOK033V120X2Q (Note I)

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Test Circuits and Waveforms

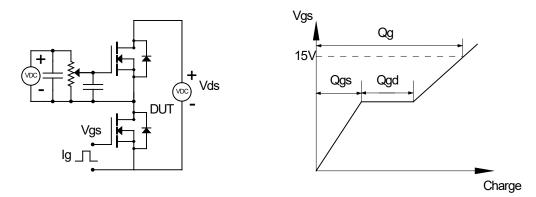


Figure 19. Gate Charge Test Circuits and Waveforms

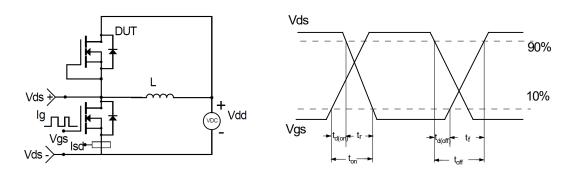


Figure 20. Inductive Switching Test Circuit and Waveforms

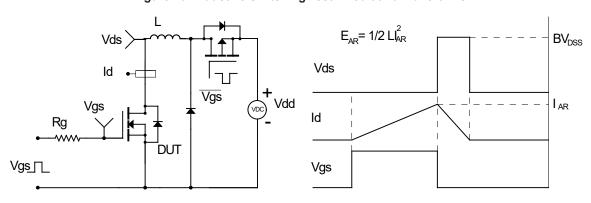


Figure 21. Unclamped Inductive Switching (UIS) Test Circuit and Waveforms

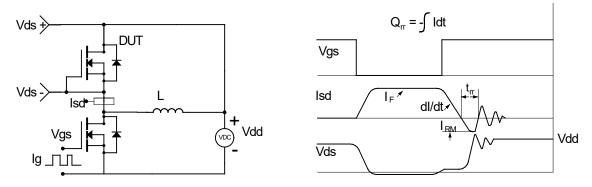
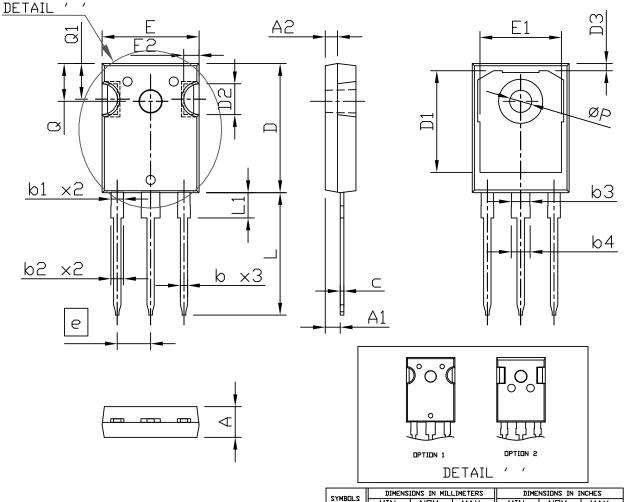


Figure 22. Diode Recovery Test Circuits and Waveforms

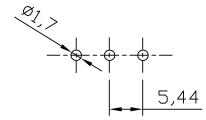
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Package Dimensions, TO-247-3L



RECOMMENDED LAND PATTERN



UNIT: mm

2.ID8MY2	DIMENS	DIMENSIONS IN MILLIMETERS DIMENSIONS IN INCHES			NSIONS IN MILLIMETERS		NCHES
SIMBULS	MIN	NDM	MAX	MIN NOM MA		MAX	
Α	4.90	5.00	5.10	0.193	0.197	0.201	
A1	2.31	2.42	2.52	0.091	0.095	0.099	
A2	1.90	2.00	2.10	0.075	0.079	0.083	
b	1.16	1.22	1.27	0.046	0.048	0.050	
b1	1.96	2.02	2.07	0.078	0.080	0.081	
b2	2.00	2.10	2.20	0.079	0.083	0.087	
b3	2.96	3.02	3.07	0.117	0.119	0.121	
b4	3.00	3.10	3.20	0.118	0.122	0.126	
C	0.59	0.62	0.66	0.023	0.024	0.026	
D	20.90	21.00	21.10	0.823	0.827	0.831	
D1	16.25	16.55	16.85	0.640	0.652	0.663	
D2		5.00 TYP			0.197 TY	Р	
D3	1.05	1.20	1.35	0.041	0.047	0.053	
е	5.44 BSC				0.214 BS0	C	
Ε	15.70	15.80	15.90	0.618	0.622	0.626	
E1	13.06	13.26	13.50	0.514	0.522	0.530	
E2	2.50 TYP			0.098 TYP			
Ĺ	19.72	19.92	20.12	0.776	0.784	0.792	
L1			4.30			0.169	
Q		6.15 BSC		0.242 BSC			
Q1	5.60	5.80	6.00	0.220	0.228	0.236	
ØΡ	3.55	3.60	3.70	0.140	0.142	0.146	

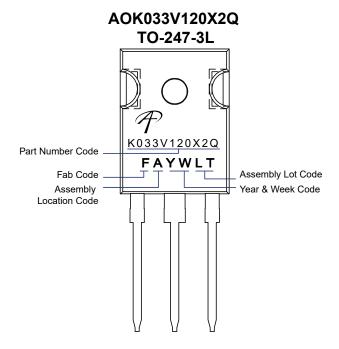
NOTE

- 1. PAKCAGE BODY SIZES EXCLUDE MOLD FLASH AND GATE BURRS. MOLD FLASH AT THE NON-LEAD SIDES SHOULD BE LESS THAN 6 MILS EACH.
- 2. CONTROLLING DIMENSION IS MILLIMETER. CONVERTED INCH DIMENSIONS ARE NOT NECESSARILY EXACT.

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Part Marking



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