

60V N-Channel Power MOSFET

● **General Description**

It combines trench MOSFET technology with a low resistance package to provide extremely low $R_{DS(ON)}$. It is suitable for automotive application.

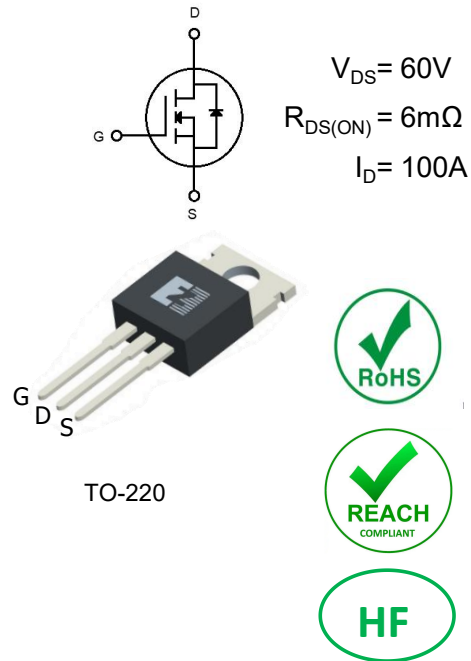
● **Features**

- AEC-Q101 Qualified
- Low $R_{DS(ON)}$ to minimize conductive loss
- Low Gate Charge for fast switching
- Low Thermal resistance

● **Application**

- BLDC Motor driver
- DC-DC
- Load Switch

● **Product Summary**



● **Ordering Information:**

Part NO.	ZMA060N06P
Marking	ZM060N06
Packing Information	TUBE
Basic ordering unit (pcs)	1000

● **Absolute Maximum Ratings** ($T_C=25^\circ C$)

Parameter	Symbol	Conditions	Value	Unit
Drain-Source Voltage	V_{DS}		60	V
Gate-Source Voltage ^①	V_{GS}		± 20	V
Continuous Drain Current	I_D	$T_C=25^\circ C$	100	A
	I_D	$T_C=75^\circ C$	81	A
	I_D	$T_C=100^\circ C$	70	A
Pulsed Drain Current	I_{DM}	Pulsed; $t_p \leq 10 \mu s$; $T_{mb} = 25^\circ C$;	400	A
Total Power Dissipation	P_D	$T_C=25^\circ C$	167	W
Total Power Dissipation	P_D	$T_A=25^\circ C$	5.0	W
Operating Junction Temperature	T_J		-55 to +175	$^\circ C$
Storage Temperature	T_{STG}		-55 to +175	$^\circ C$
Single Pulse Avalanche Energy	E_{AS}	$L=0.1mH$, $V_{GS}=10V$, $R_g=25\Omega$,	120	mJ
		$L=0.5mH$, $V_{GS}=10V$, $R_g=25\Omega$,	228	mJ
ESD Level (HBM)	CLASS 2			

•Thermal resistance

Parameter	Symbol	Min.	Typ.	Max.	Unit
Thermal resistance, junction - case	R_{thJC}		-	0.9	°C/W
Thermal resistance, junction-ambient	$R_{thJA}^{②}$		-	30	°C/W
Soldering temperature	Tsold		-	260	°C

•Electronic Characteristics

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Drain-Source Breakdown Voltage	BV_{DSS}	$V_{GS}=0V, I_D=250\mu A$	60			V
Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS}=V_{DS}, I_D=250\mu A$	1.3	1.7	2.5	V
Drain-Source Leakage Current	I_{DSS}	$V_{GS}=0V, V_{DS}=60V$			1.0	μA
Gate- Source Leakage Current	I_{GSS}	$V_{GS}=\pm 20V, V_{DS}=0V$			100	nA
Static Drain-source On Resistance	$R_{DS(ON)}$	$V_{GS}=10V, I_D=20A$		6	8	m Ω
	$R_{DS(ON)}$	$V_{GS}=10V, I_D=16$		8	12	m Ω
Forward Transconductance	g_{FS}	$V_{DS}=5V, I_{SD}=10A$		28		S
Diode Forward Voltage	V_{FSD}	$V_{GS}=0V, I_{SD}=20A$			1.3	V

•Dynamic characteristics

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Input capacitance	C_{iss}	$f=1MHz, V_{DS}=25V$	-	4340	-	pF
Output capacitance	C_{oss}		-	323	-	
Reverse transfer capacitance	C_{rss}		-	201	-	
Gate Resistance	R_g	$f=1MHz$	-	1.6		Ω
Total gate charge	Q_g	$V_{DD}=15V, I_D=20A, V_{GS}=10V$	-	59	-	nC
Gate - Source charge	Q_{gs}		-	11.8	-	
Gate - Drain charge	Q_{gd}		-	12	-	
Turn-ON Delay time	$t_{D(on)}$	$V_{GS}=10V, V_{DS}=15V, R_G=3.3\Omega, I_D=20A$	-	11	-	ns
Turn-ON Rise time	t_r		-	65	-	ns
Turn-Off Delay time	$t_{D(off)}$		-	41	-	ns
Turn-Off Fall time	t_f		-	44	-	ns
Reverse Recovery Time	t_{RR}	$V_{DD}=20V, dI_S/dt=100A/\mu s, I_S=50A$	-	37	-	ns
Reverse Recovery Charge	Q_{RR}		-	43	-	nC

Fig.1 Gate-Charge Characteristics

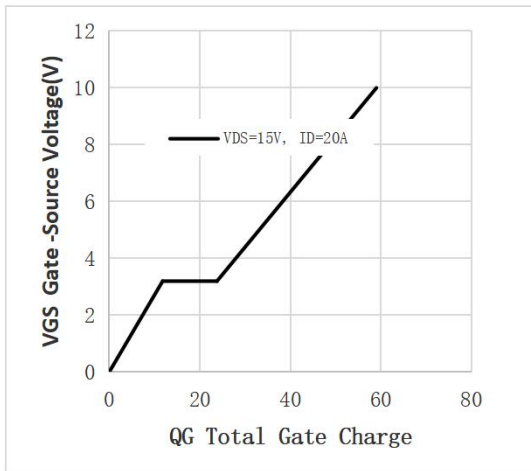


Fig.2 Capacitance Characteristics

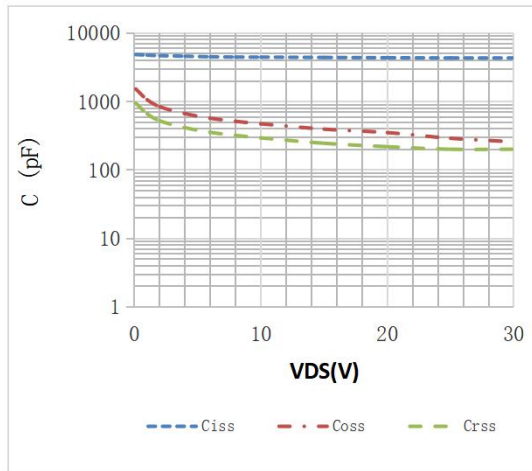


Fig.3 Power Dissipation

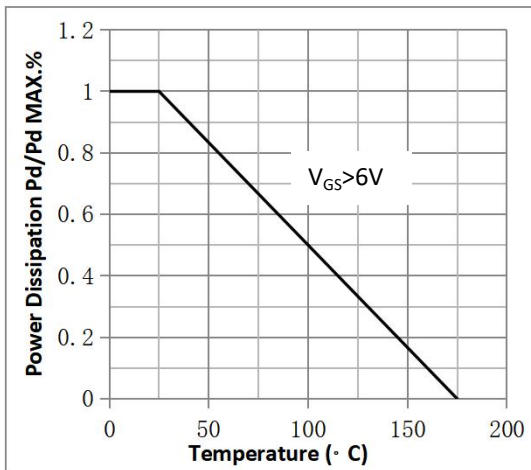


Fig.4 Typical output Characteristics

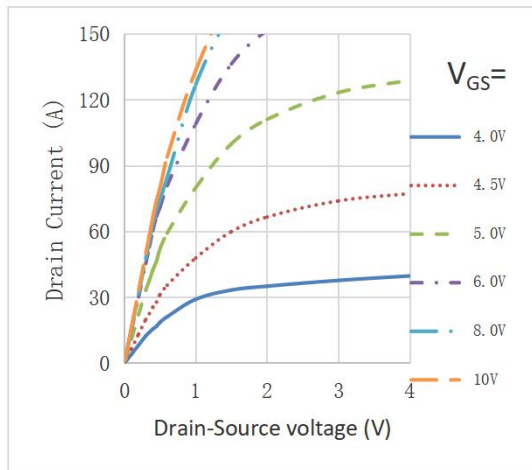


Fig.5 Threshold Voltage V.S Junction Temperature

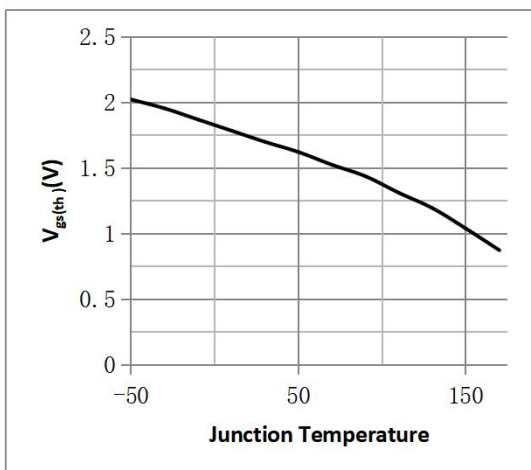


Fig.6 Resistance V.S Drain Current

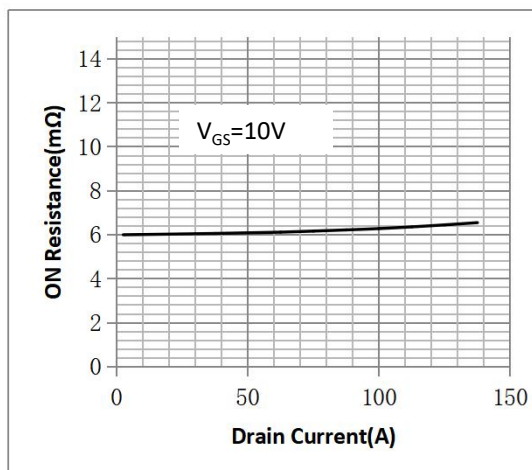


Fig.7 On-Resistance VS Gate Source Voltage

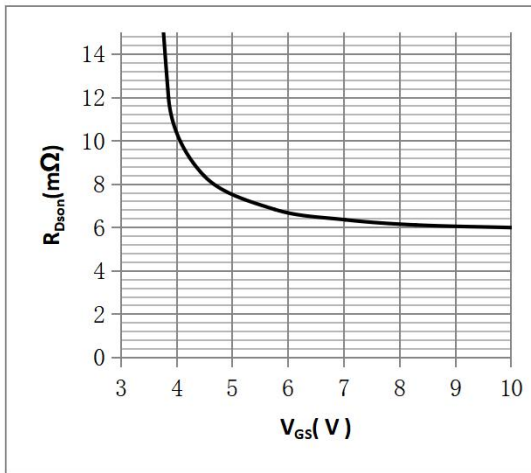


Fig.8 On-Resistance V.S Junction Temperature

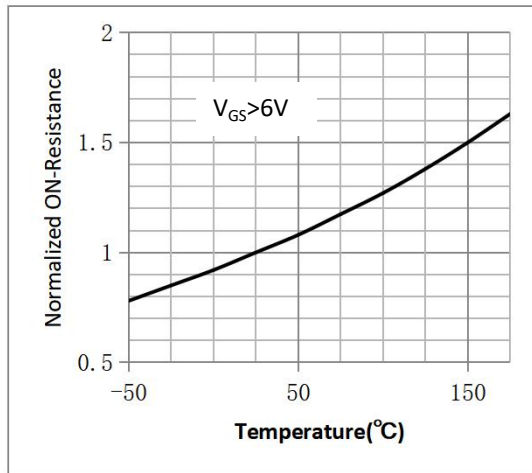


Figure 9. Diode Forward Voltage vs. Current

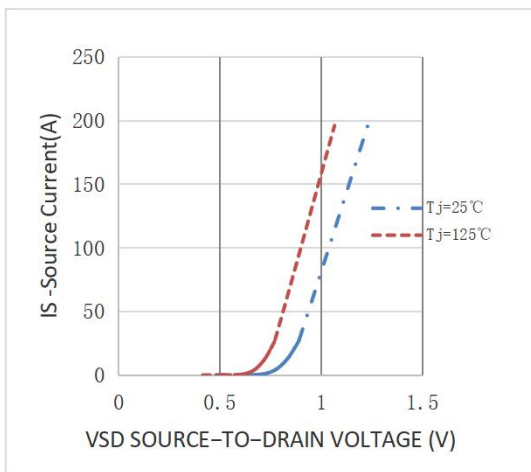


Figure 10. Transfer Characteristics

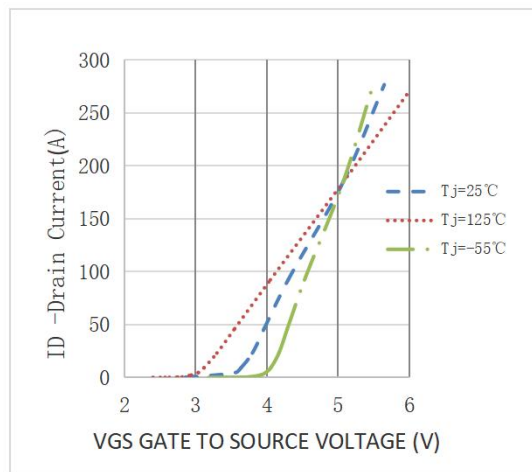


Fig.11 Safe Operating Area

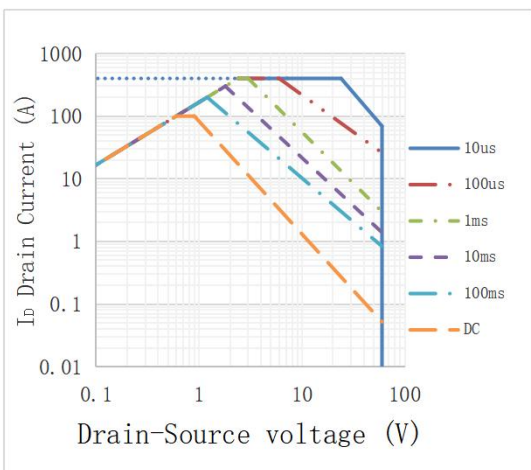
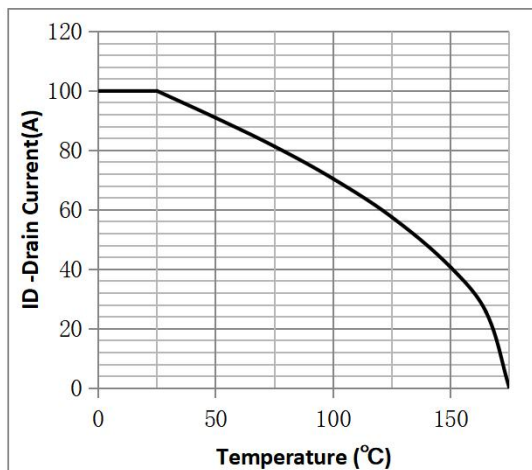
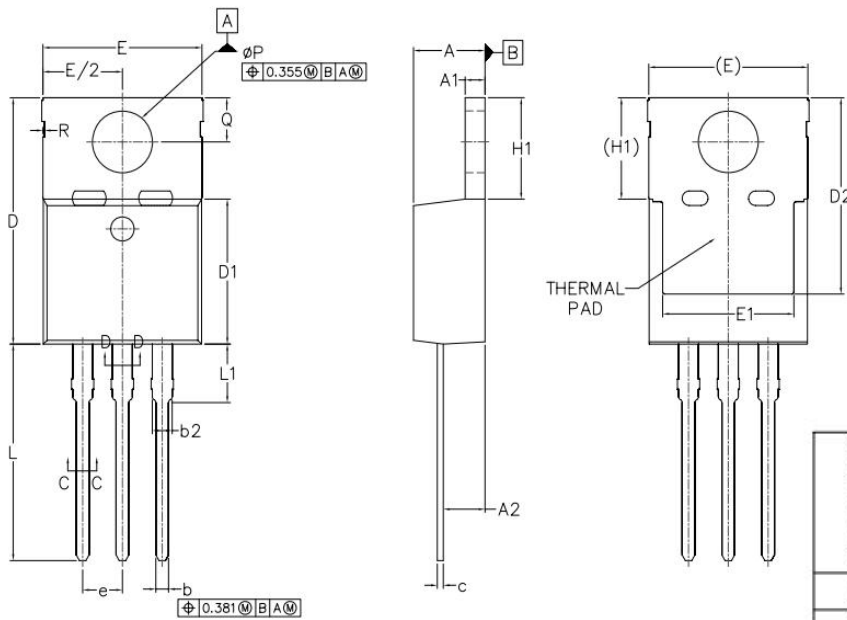


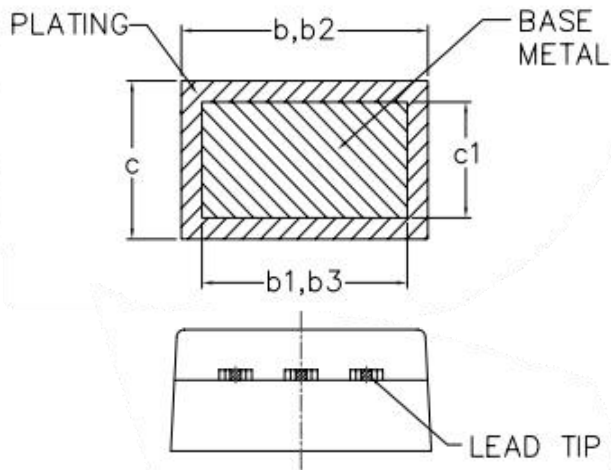
Fig.12 ID vs. Case Temperature^③



•TO-220 Package Outline



SYMBOLS	COMMON	
	MM	
	MIN.	MAX.
A	3.556	4.826
A1	0.508	1.397
A2	2.032	2.921
b	0.381	1.016
b1	0.381	0.965
b2	1.143	1.778
b3	1.143	1.727
c	0.356	0.610
c1	0.356	0.559
D	14.224	16.510
D1	8.382	9.017
D2	12.042	12.878
E	9.652	10.668
E1	6.858	8.890
e	2.540 BSC.	
H1	5.842	6.858
L	12.700	14.732
L1	3.560	4.060
ϕP	3.810	3.860
Q	2.540	3.048
R	0.127 BSC	



Note:

- ① Pulse : $V_{GS}=+20V/-20V$, Duty cycle=50%, $T_j=175^{\circ}C$, $t=1000$ hours; For DC , the following test conditions can be passed: $V_{GS}=+20V/-10V$, $T_j=175^{\circ}C$, $t=1000$ hours;
- ② Device mounted on FR-4 substrate PC board, 2oz copper, with thermal bias to bottom layer 1inch square copper plate;
- ③ Practically the current will be limited by PCB, thermal design and operating temperature. $V_{GS}=10V$.

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Revision History

Version	Date	Change
A	2021.11.6	NEW
B	2022.12.6	ADD Dynamic characteristics