

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

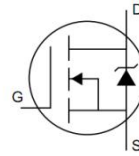
• Ordering Information:

Part NO.	ZMA098N06D
Marking	ZM098N06
Packing Information	REEL TAPE
Basic ordering unit (pcs)	2500

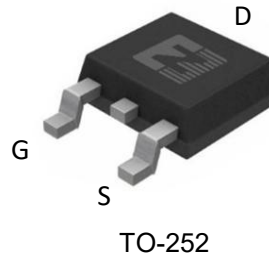
• Absolute Maximum Ratings ( $T_C=25^\circ\text{C}$ )

Parameter	Symbol	Conditions	Value	Unit
Drain-Source Voltage	$V_{DS}$		60	V
Gate-Source Voltage <sup>①</sup>	$V_{GS}$		$\pm 20$	V
Continuous Drain Current	$I_D$	$T_C=25^\circ\text{C}$	50	A
	$I_D$	$T_C=75^\circ\text{C}$	44	A
	$I_D$	$T_C=100^\circ\text{C}$	38	A
Pulsed Drain Current	$I_{DM}$	Pulsed; $t_p \leq 10 \mu\text{s}$ ; $T_{mb} = 25^\circ\text{C}$ ;	200	A
Total Power Dissipation	$P_D$	$T_C=25^\circ\text{C}$	83	W
Total Power Dissipation	$P_D$	$T_A=25^\circ\text{C}$	2.4	W
Operating Junction Temperature	$T_J$		-55 to +175	$^\circ\text{C}$
Storage Temperature	$T_{STG}$		-55 to +175	$^\circ\text{C}$
Single Pulse Avalanche Energy	$E_{AS}$	$L=0.1\text{mH}$ , $V_{GS}=10\text{V}$ , $R_g=25\Omega$ ,	47	mJ
		$L=0.5\text{mH}$ , $V_{GS}=10\text{V}$ , $R_g=25\Omega$ ,	99	mJ
ESD Level (HBM)	CLASS 2			

• Product Summary



$V_{DS} = 60\text{V}$   
 $R_{DS(ON)} = 10\text{m}\Omega$   
 $I_D = 50\text{A}$



**•Thermal resistance**

Parameter	Symbol	Min.	Typ.	Max.	Unit
Thermal resistance, junction - case	$R_{thJC}$		-	1.8	°C/W
Thermal resistance, junction-ambient <sup>②</sup>	$R_{thJA}$		-	62	°C/W
Soldering temperature (total time<10s)	$T_{sold}$		-	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	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_D = 250\mu A$	1.4	1.7	2.5	V
Drain-Source Leakage Current	$I_{DSS}$	$V_{GS} = 0V, V_{DS} = 60V$			1.0	$\mu A$
Gate- Source Leakage Current	$I_{GSS}$	$V_{GS} = \pm 20V, V_{DS} = 0V$			100	nA
Static Drain-source On Resistance	$R_{DS(ON)}$	$V_{GS} = 10V, I_D = 24A$		10	13	m $\Omega$
		$V_{GS} = 4.5V, I_D = 12A$		12	15	m $\Omega$
Forward Transconductance	$g_{FS}$	$V_{DS} = 5V, I_{SD} = 10A$		14		S
Diode Forward Voltage	$V_{FSD}$	$V_{GS} = 0V, I_{SD} = 24A$			1.3	V

**•Dynamic characteristics**

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	
Input capacitance	$C_{iss}$	$f = 1MHz, V_{DS} = 25V$	-	2750	-	pF	
Output capacitance	$C_{oss}$		-	185	-		
Reverse transfer capacitance	$C_{rss}$		-	135	-		
Gate Resistance	$R_g$	$f = 1MHz$	-	1.9		$\Omega$	
Total gate charge	$Q_g$	$V_{DD} = 15V, I_D = 20A, V_{GS} = 10V$	-	30	-	nC	
	$Q_g (4.5v)$		-	17	-		
	Gate - Source charge		$Q_{gs}$	-	8.4		-
	Gate - Drain charge		$Q_{gd}$	-	5.8		-
Turn-ON Delay time	$t_{D(on)}$	$V_{GS} = 10V, V_{DS} = 15V, R_G = 3.3\Omega, I_D = 20A$	-	17	-	ns	
Turn-ON Rise time	$t_r$		-	40	-	ns	
Turn-Off Delay time	$t_{D(off)}$		-	22	-	ns	
Turn-Off Fall time	$t_f$		-	12	-	ns	
Reverse Recovery Time	$t_{RR}$	$V_{DD} = 20V, di_S/dt = 100A/s,$	-	50	-	ns	
Reverse Recovery Charge	$Q_{RR}$	$I_S = 20A$	-	46	-	nC	

Fig.1 Gate-Charge Characteristics

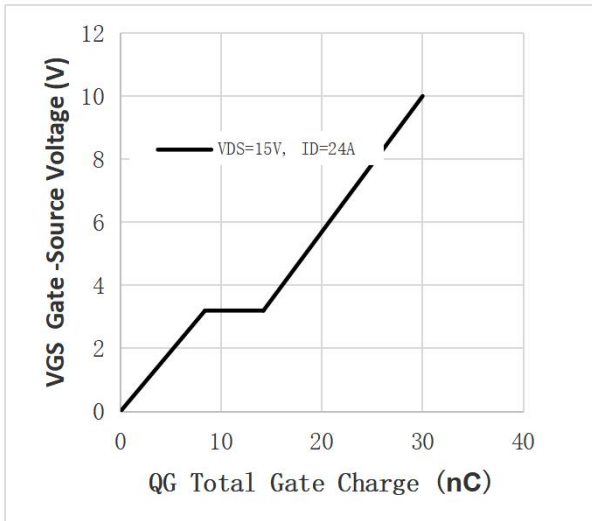


Fig.2 Capacitance Characteristics

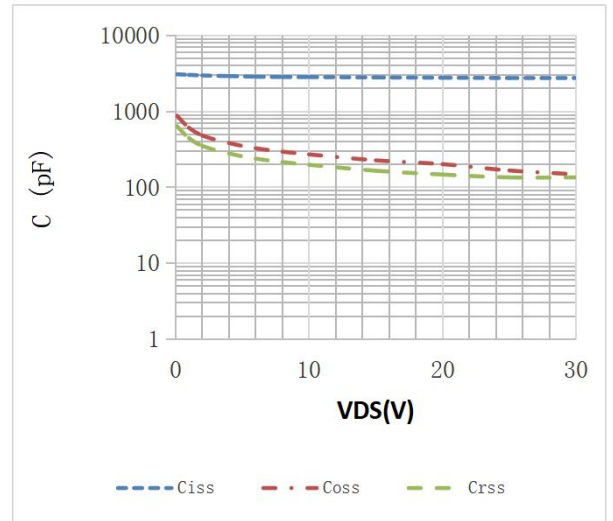


Fig.3 Power Dissipation

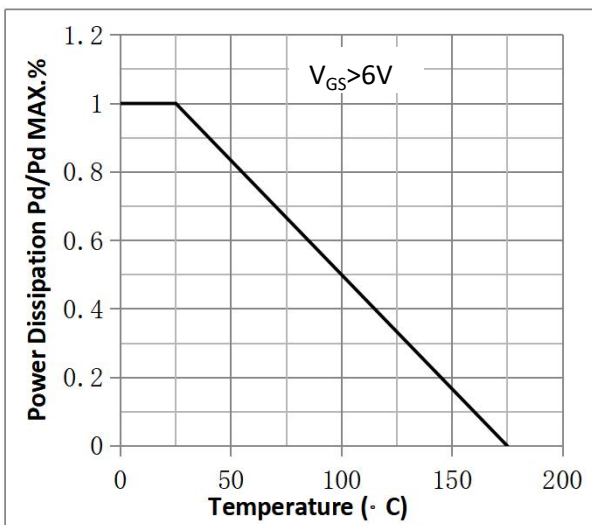


Fig.4 Typical output Characteristics

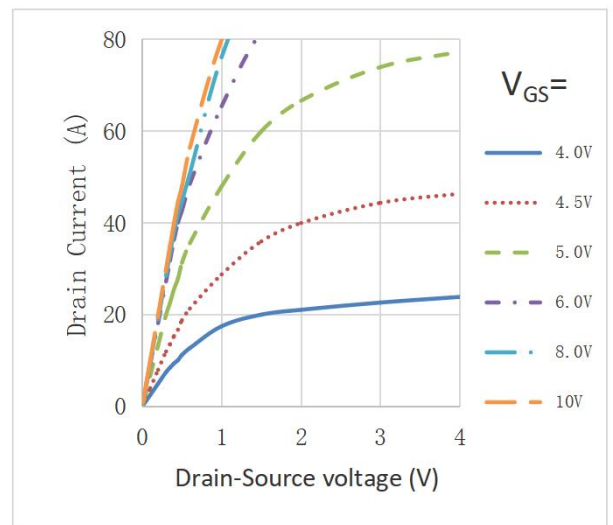


Fig.5 Threshold Voltage V.S Junction Temperature

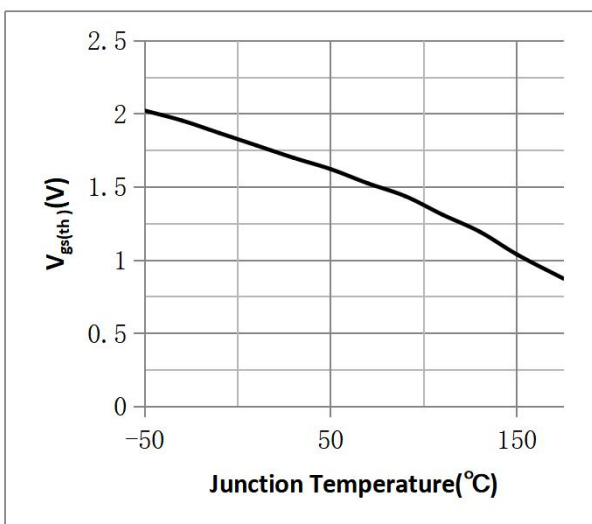


Fig.6 Resistance V.S Drain Current

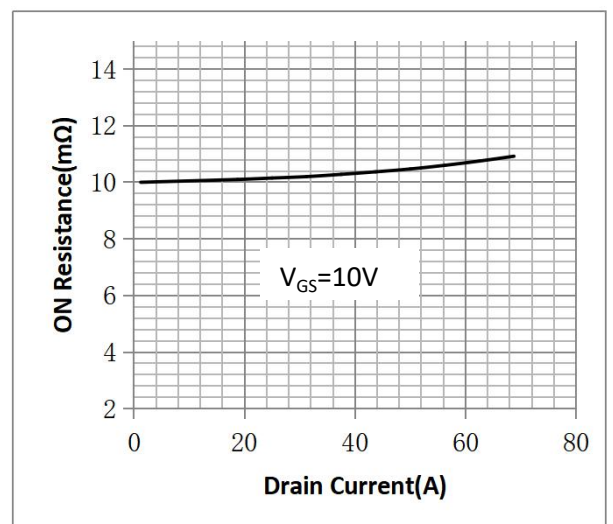


Fig.7 On-Resistance VS Gate Source Voltage

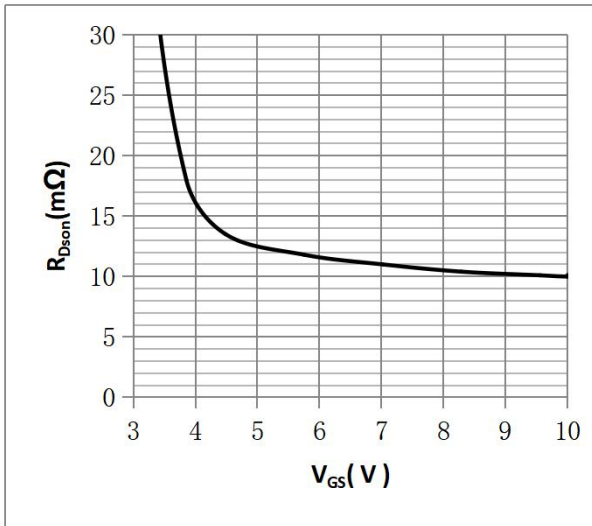


Fig.8 On-Resistance V.S Junction Temperature

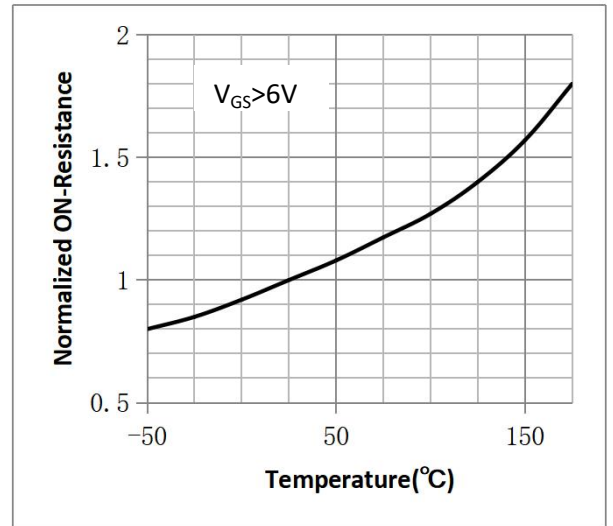


Figure 9. Diode Forward Voltage vs. Current

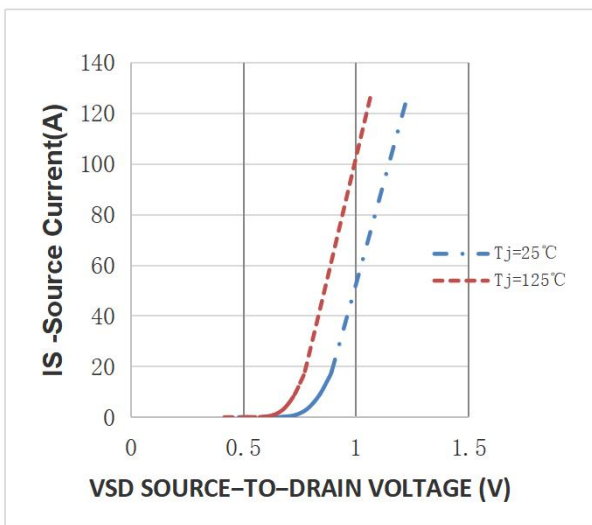


Figure 10. Transfer Characteristics

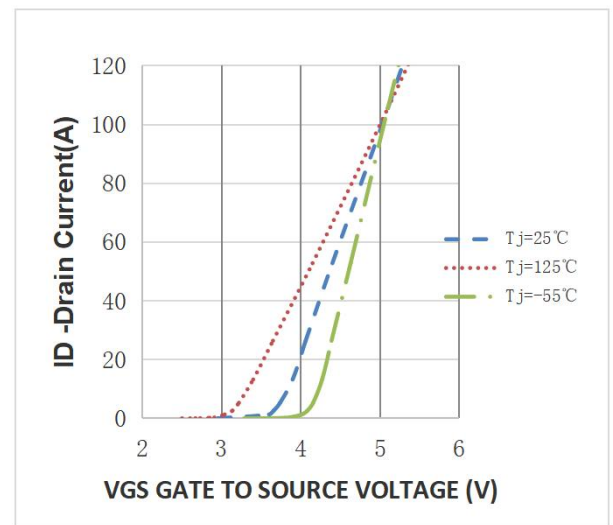


Fig.11 Safe Operating Area

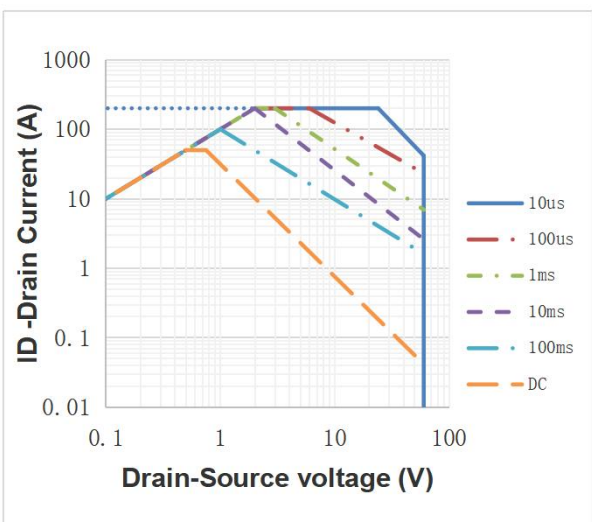
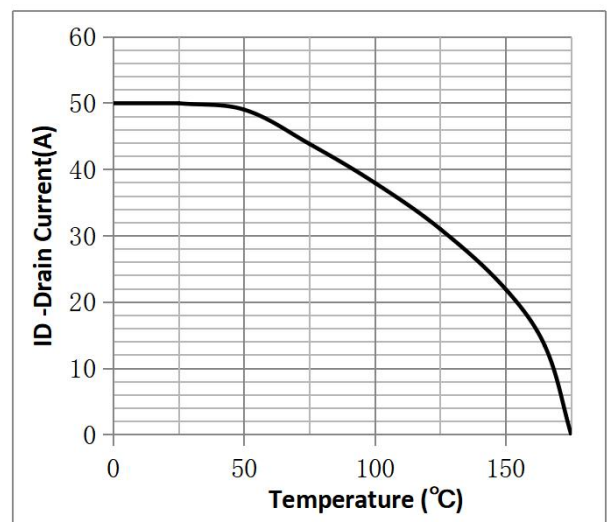
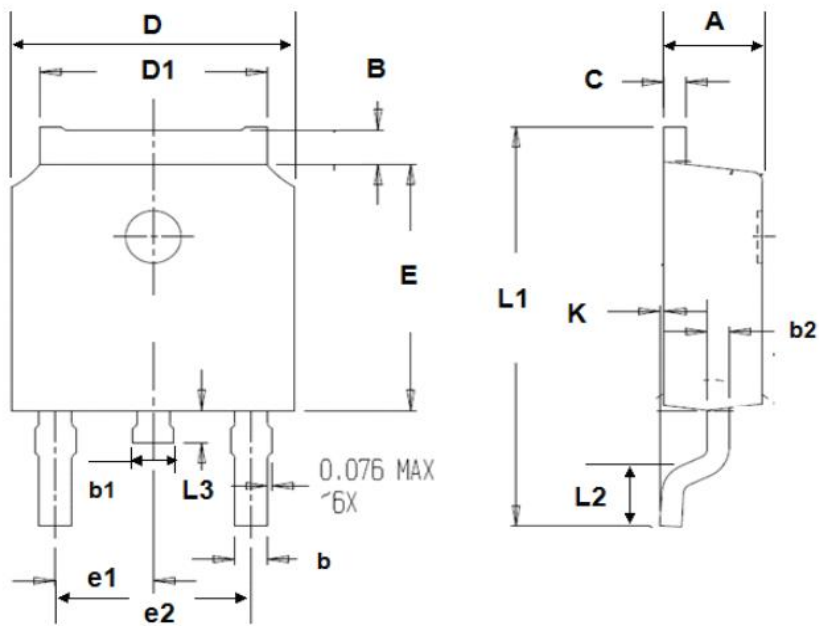


Fig.12 ID vs. Case Temperature<sup>③</sup>



•TO-252 Package Outline

SYMBOL	min	max	SYMBOL	min	max
A	2.10	2.50	B	0.85	1.25
b	0.50	0.90	b1	0.50	0.90
b2	0.45	0.70	C	0.45	0.70
D	6.30	6.75	D1	5.10	5.50
E	5.30	6.30	e1	2.24	2.35
L1	9.20	10.60	e2	4.43	4.75
L2	0.90	1.75	L3	0.60	1.10
K	0.00	0.23			



**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	2020.3.10	NEW
B	2021.11.23	1.Add dynamic characteristics
C	2022.10.12	1.Fig1~12 modify 2.Modify ID curve 4.Add Dynamic characteristics