

-40V P-Channel Power MOSFET

• **General Description**

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

• **Features**

- AEC-Q101 Qualified
- Low $R_{DS(ON)}$ to minimize conductive loss
- High GOX reliability
- Low Thermal resistance

• **Application**

- BLDC Motor driver
- DC-DC
- Battery protection

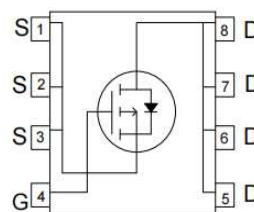
• **Ordering Information:**

Part NO.	ZMA040P04N
Marking	ZM040P04
Packing Information	REEL TAPE
Basic ordering unit (pcs)	3000

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

Parameter	Symbol	Conditions	Value	Unit
Drain-Source Voltage	V_{DS}		-40	V
Gate-Source Voltage ^①	V_{GS}		± 20	V
Continuous Drain Current	I_D	$T_C=25^{\circ}\text{C}$	-80	A
	I_D	$T_C=75^{\circ}\text{C}$	-80	A
	I_D	$T_C=100^{\circ}\text{C}$	-76	A
Pulsed Drain Current	I_{DM}	Pulsed; $t_p \leq 10 \mu\text{s}$; $T_{mb} = 25^{\circ}\text{C}$;	-320	A
Total Power Dissipation	P_D	$T_C=25^{\circ}\text{C}$	115	W
Total Power Dissipation	P_D	$T_A=25^{\circ}\text{C}$	3.3	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}	$L=0.1\text{mH}$, $V_{GS}=-10\text{V}$, $R_g=25\Omega$,	240	mJ
		$L=0.5\text{mH}$, $V_{GS}=-10\text{V}$, $R_g=25\Omega$,	504	mJ
ESD Level (HBM)	CLASS 2			

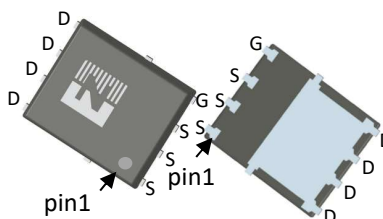
• **Product Summary**



$$V_{DS} = -40\text{V}$$

$$R_{DS(ON)} = 4\text{m}\Omega$$

$$I_D = -80\text{A}$$





•Thermal resistance

Parameter	Symbol	Min.	Typ.	Max.	Unit
Thermal resistance, junction - case	R_{thJC}		-	1.3	°C/W
Thermal resistance, junction-ambient ^②	R_{thJA}		-	45	°C/W
Soldering temperature	T_{sold}		-	260	°C

•Electronic Characteristics

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Drain-Source Breakdown Voltage	BV_{DSS}	$V_{GS}=0V, I_D=-250\mu A$	-40			V
Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS}=V_{DS}, I_D=-250\mu A$	-1.3	-1.8	-2.5	V
Drain-Source Leakage Current	I_{DSS}	$V_{GS}=0V, V_{DS}=-40V$			-1.0	μA
Gate- Source Leakage Current	I_{GSS}	$V_{GS}=\pm 20V, V_{DS}=0V$			± 100	nA
Static Drain-source On Resistance	$R_{DS(ON)}$	$V_{GS}=-10V, I_D=-40A$		4.0	5.2	m Ω
		$V_{GS}=-4.5V, I_D=-25A$		6.5	8.4	m Ω
Forward Transconductance	g_{FS}	$V_{DS}=-5V, I_{SD}=-20A$		28		S
Diode Forward Voltage	V_{FSD}	$V_{GS}=0V, I_{SD}=-40A$			-1.3	V

•Dynamic characteristics

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Input capacitance	C_{iss}	$f=1MHz, V_{DS}=-25V$	-	10120	-	pF
Output capacitance	C_{oss}		-	762	-	
Reverse transfer capacitance	C_{rss}		-	646	-	
Gate Resistance	R_g	$f=1MHz$	-	3		Ω
Total gate charge	Q_g	$V_{DD}=-15V, I_D=-20A, V_{GS}=-10V$	-	172	-	nC
	$Q_g(-4.5V)$		-	83	-	
Gate - Source charge	Q_{gs}		-	21	-	
Gate - Drain charge	Q_{gd}		-	32	-	
Turn-ON Delay time	$t_{D(on)}$	$V_{GS}=-10V, V_{DS}=-15V, R_G=3.3\Omega, I_D=-20A$	-	18	-	ns
Turn-ON Rise time	t_r		-	27	-	ns
Turn-Off Delay time	$t_{D(off)}$		-	105	-	ns
Turn-Off Fall time	t_f		-	45	-	ns



Fig.1 Gate-Charge Characteristics

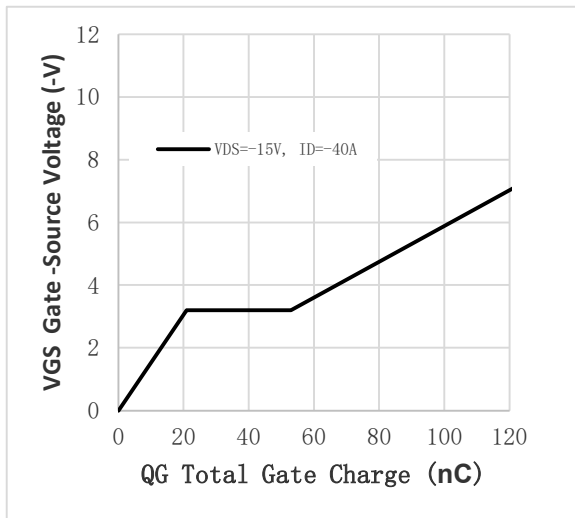


Fig.2 Capacitance Characteristics

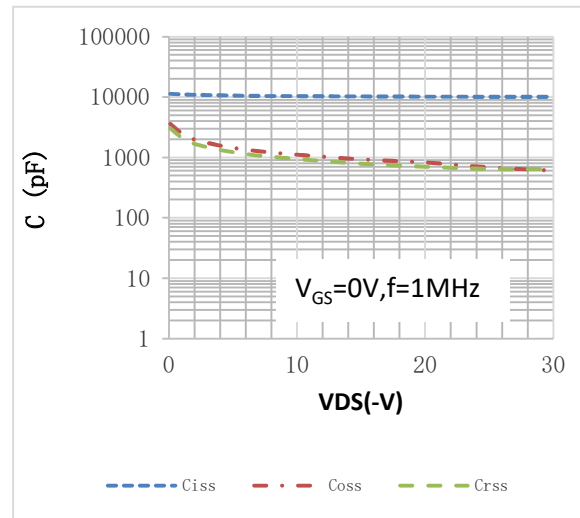


Fig.3 Power Dissipation

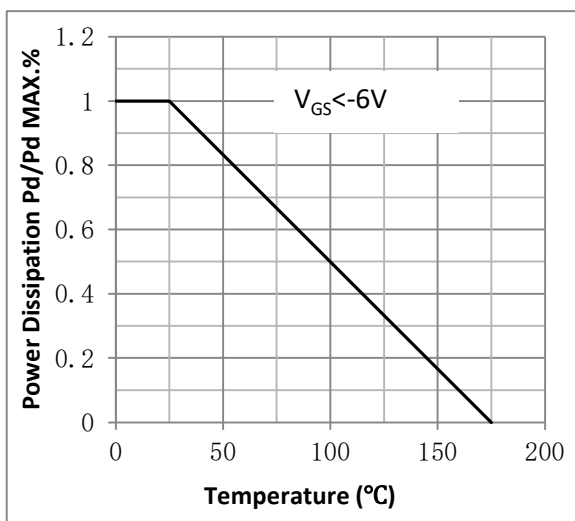


Fig.4 Typical output Characteristics

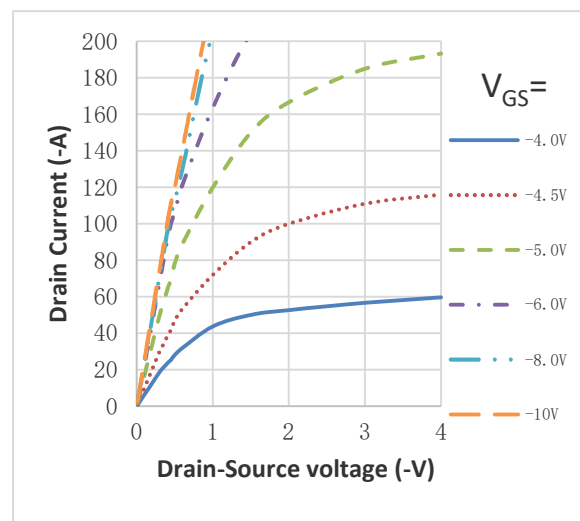


Fig.5 Threshold Voltage V.S Junction Temperature

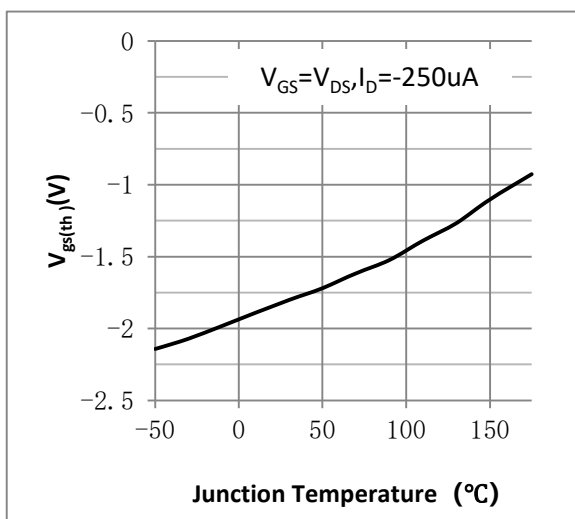


Fig.6 Resistance V.S Drain Current

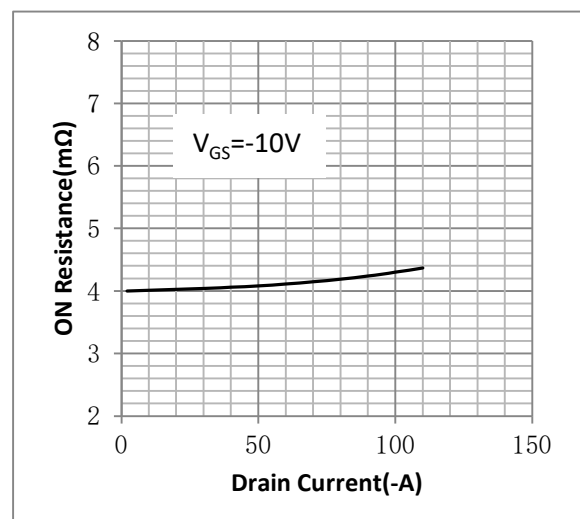


Fig.7 On-Resistance VS Gate Source Voltage

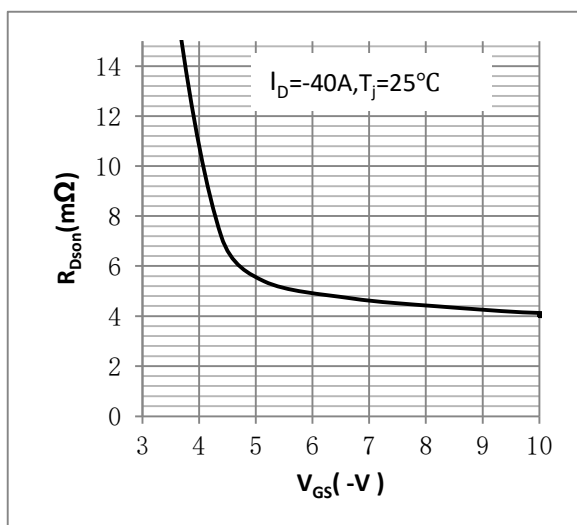


Fig.8 On-Resistance V.S Junction Temperature

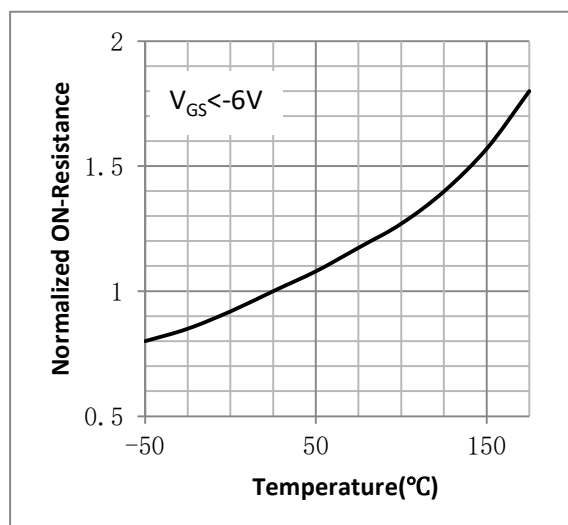


Figure 9. Diode Forward Voltage vs. Current

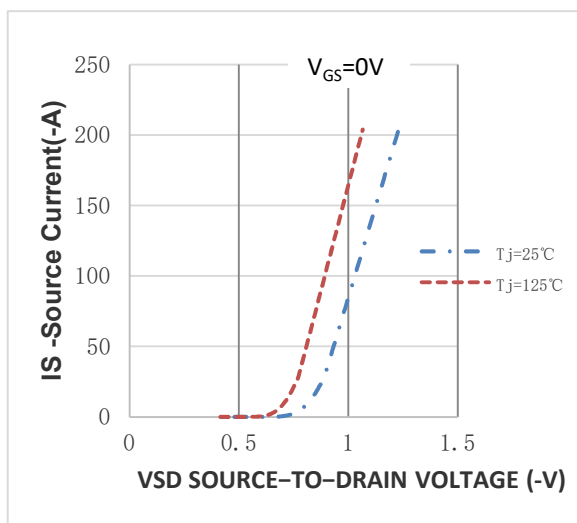


Figure 10. Transfer Characteristics

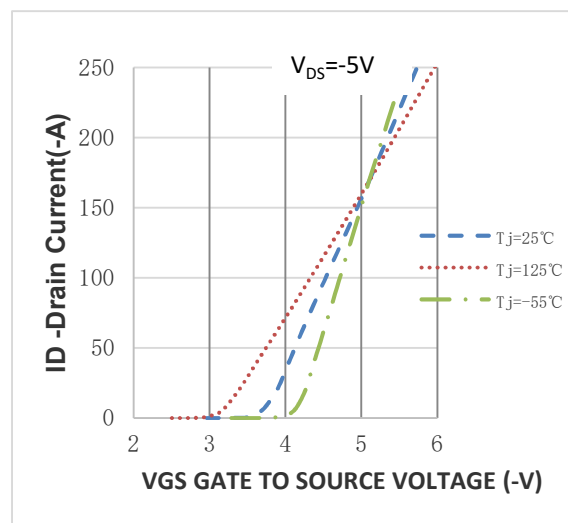


Fig.11 Safe Operating Area

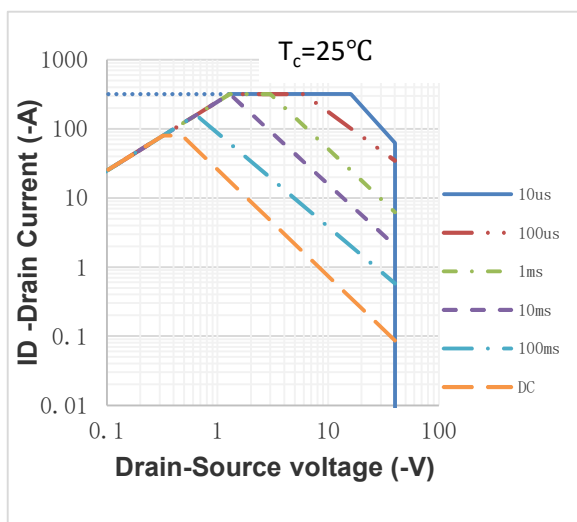
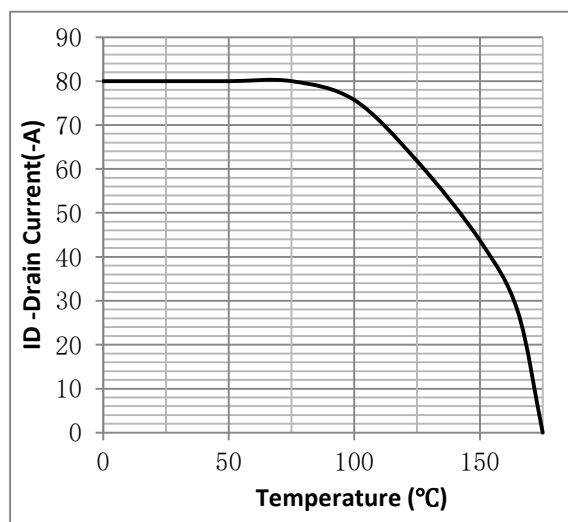
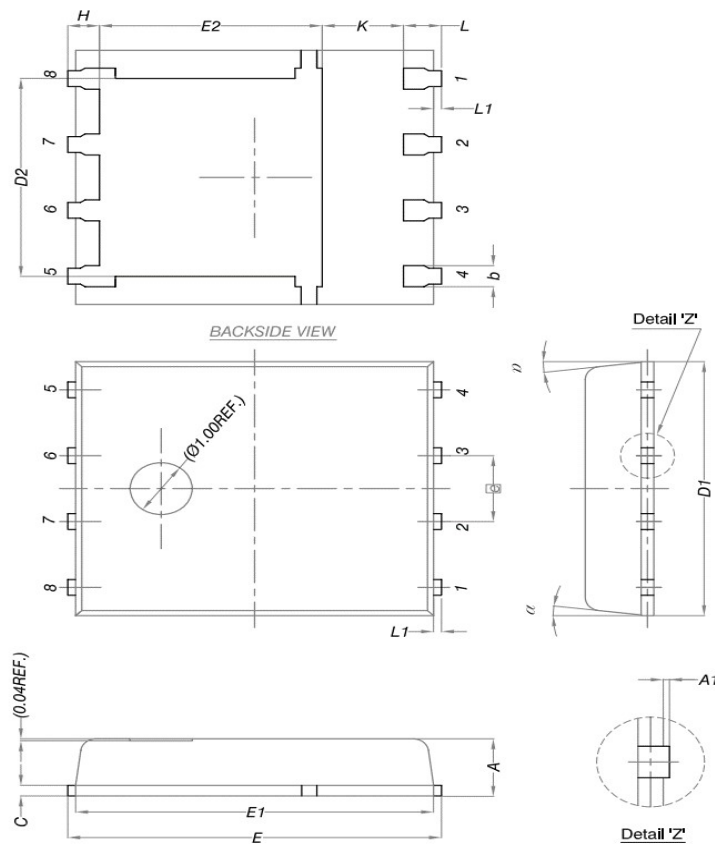


Fig.12 ID vs. Case Temperature^③





•DFN5*6 Package Outline



DIM.	MILLIMETERS		
	MIN.	NOM.	MAX.
A	0.90	1.00	1.10
A1	0	-	0.05
b	0.33	0.41	0.51
C	0.20	0.25	0.30
D1	4.80	4.90	5.00
D2	3.61	3.81	3.96
E	5.90	6.00	6.10
E1	5.70	5.75	5.80
E2	3.38	3.58	3.78
e	1.27 BSC		
H	0.41	0.51	0.61
K	1.10	-	-
L	0.51	0.61	0.71
L1	0.06	0.13	0.20
α	0°	-	12°

**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	2021.2.3	NEW
B	2022.5.7	1.Modified Typical output Characteristics curve
C	2022.9.20	1.Add Reach,HF figure
D	2023.6.29	1.Modified the symbol figure
E	2025.7.29	Correct the sign of the figure, and add test condition of characteristics curve.