

-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

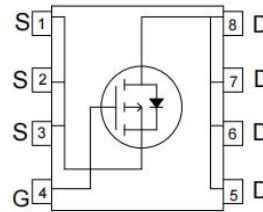
• Ordering Information:

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

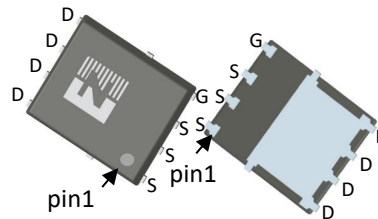
• Absolute Maximum Ratings ( $T_C=25^\circ\text{C}$ )

Parameter	Symbol	Conditions	Value	Unit
Drain-Source Voltage	$V_{DS}$		-40	V
Gate-Source Voltage <sup>①</sup>	$V_{GS}$		$\pm 20$	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



$V_{DS} = -40\text{V}$   
 $R_{DS(ON)} = 4\text{m}\Omega$   
 $I_D = -80\text{A}$



DFN5\*6



**•Thermal resistance**

Parameter	Symbol	Min.	Typ.	Max.	Unit
Thermal resistance, junction - case	$R_{thJC}$		-	1.3	°C/W
Thermal resistance, junction-ambient <sup>②</sup>	$R_{thJA}$		-	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	$\mu A$
Gate- Source Leakage Current	$I_{GSS}$	$V_{GS} = \pm 20V, V_{DS} = 0V$			100	nA
Static Drain-source On Resistance	$R_{DS(ON)}$	$V_{GS} = -10V, I_D = -40A$		4.0	5.2	m $\Omega$
		$V_{GS} = -4.5V, I_D = -25A$		6.5	8.4	m $\Omega$
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		$\Omega$	
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

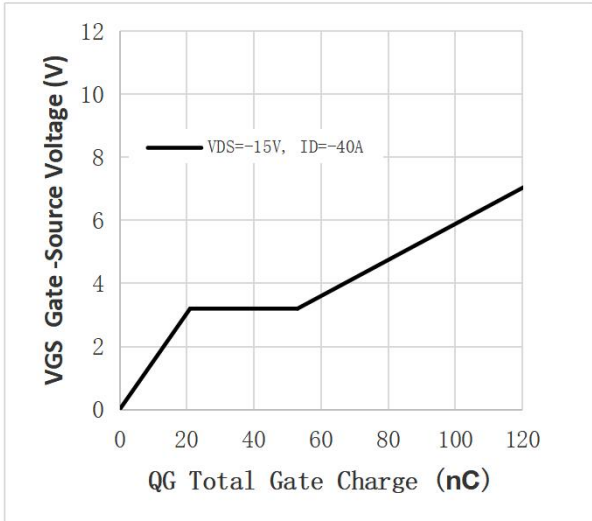


Fig.2 Capacitance Characteristics

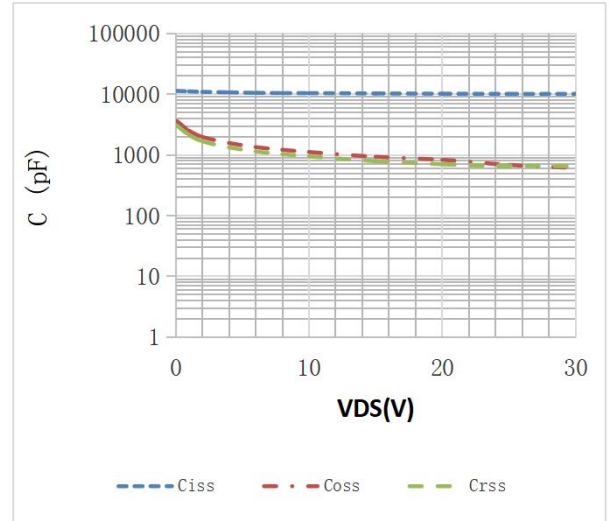


Fig.3 Power Dissipation

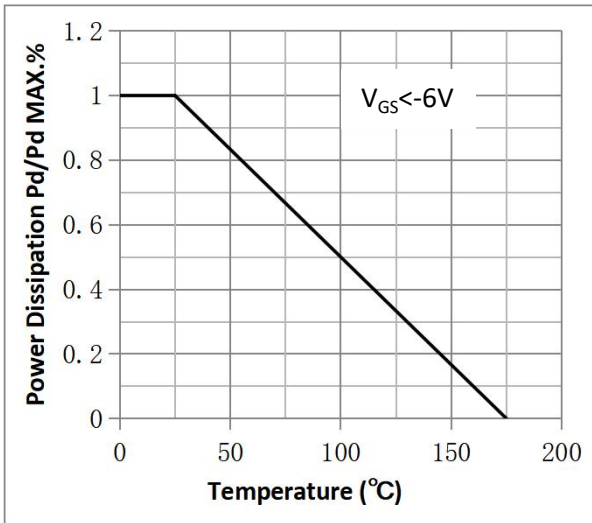


Fig.4 Typical output Characteristics

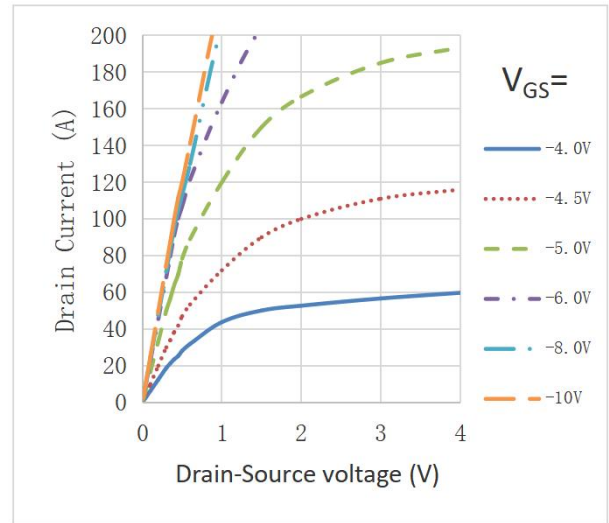


Fig.5 Threshold Voltage V.S Junction Temperature

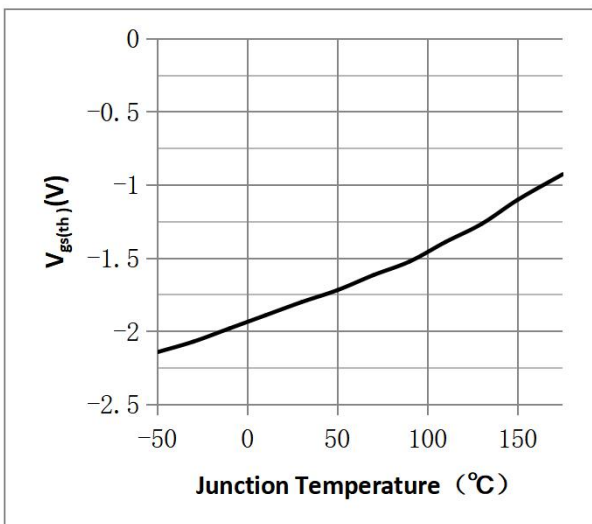


Fig.6 Resistance V.S Drain Current

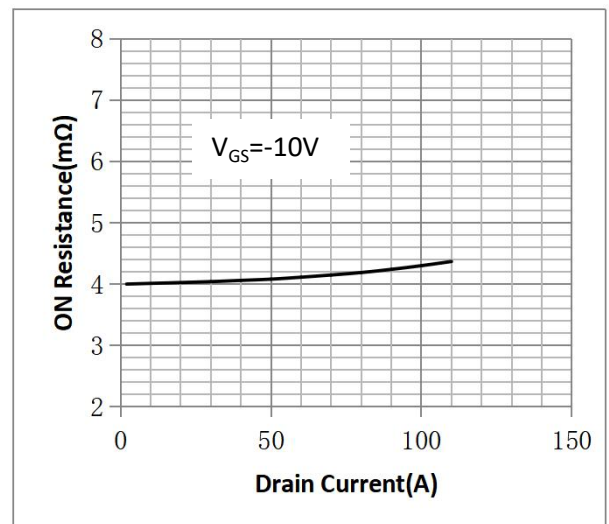


Fig.7 On-Resistance VS Gate Source Voltage

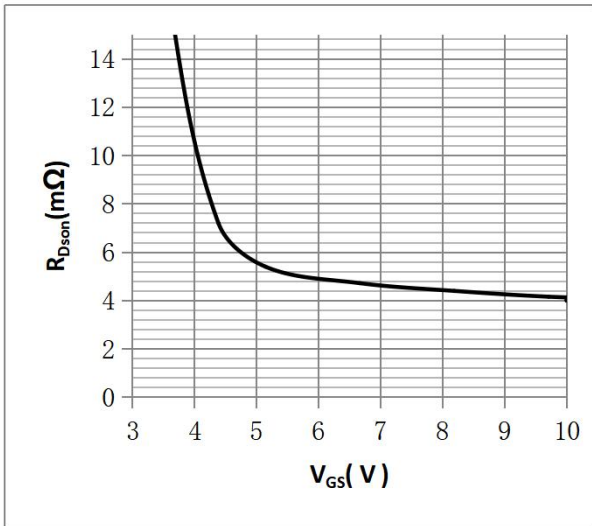


Fig.8 On-Resistance V.S Junction Temperature

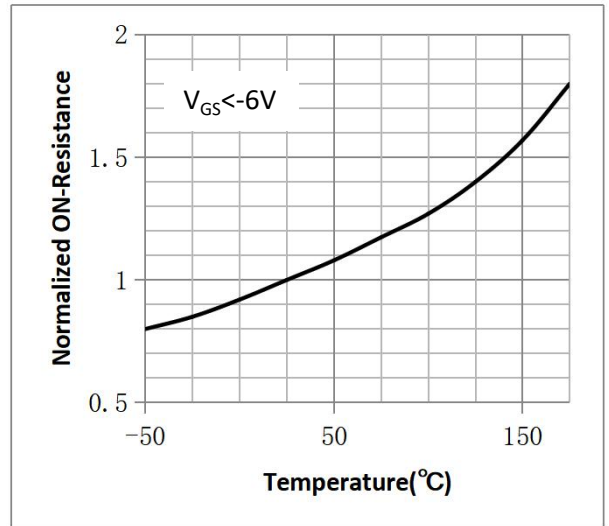


Figure 9. Diode Forward Voltage vs. Current

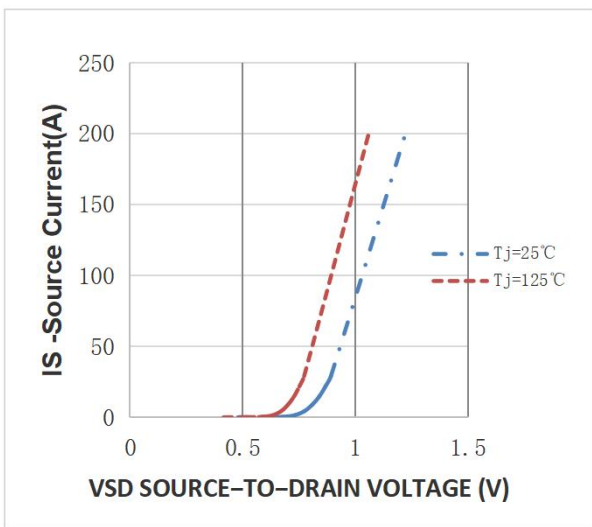


Figure 10. Transfer Characteristics

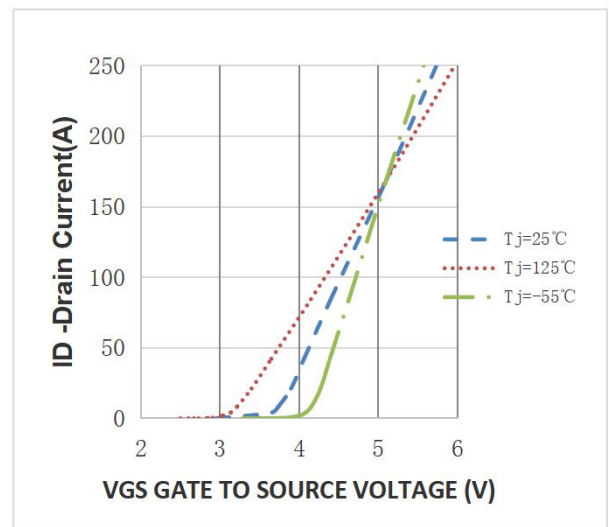


Fig.11 Safe Operating Area

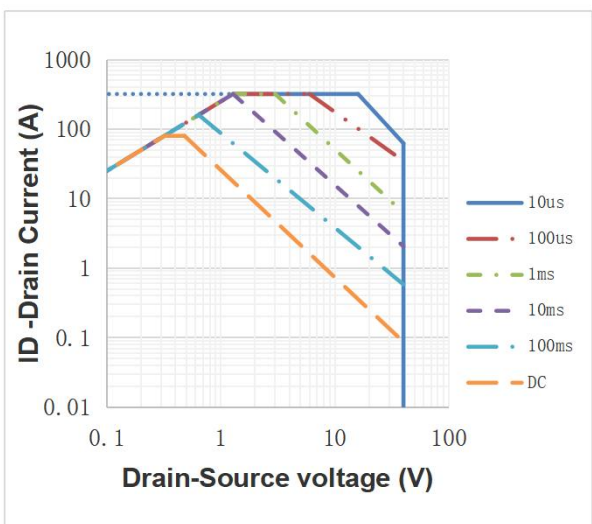
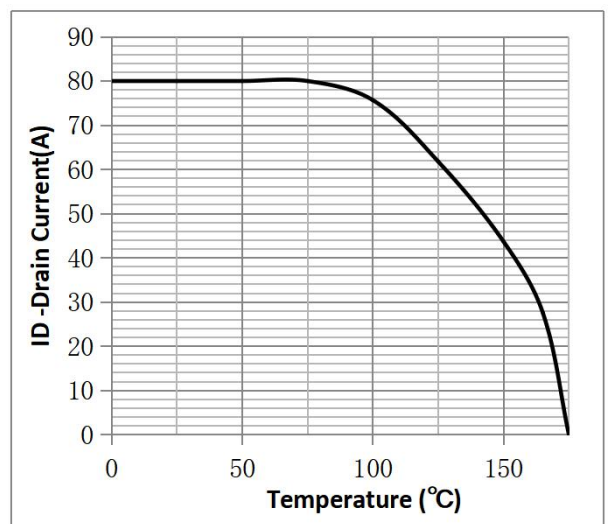
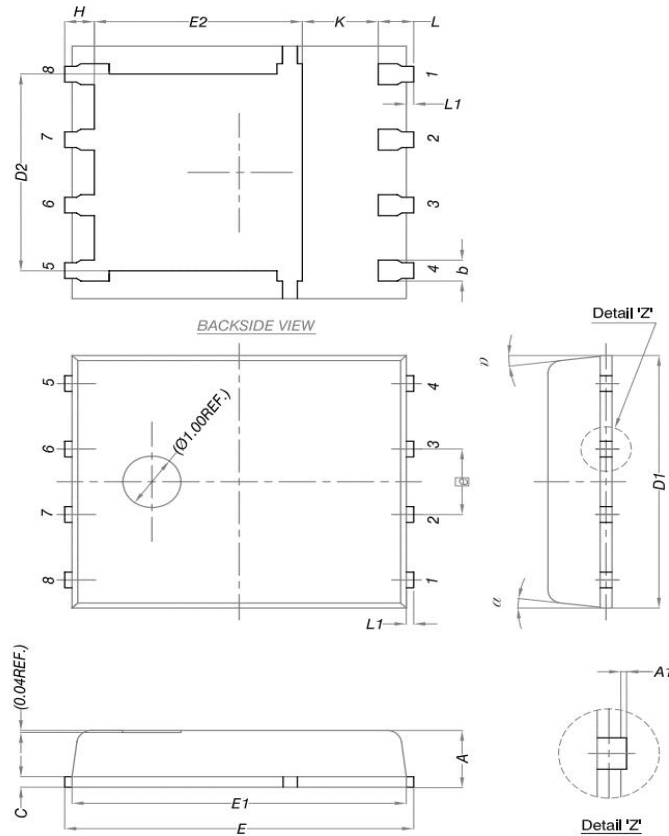


Fig.12  $I_D$  vs. Case Temperature<sup>③</sup>



•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