

-40V P-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
- High GOX reliability
- Low Thermal resistance

• Application

- BLDC Motor driver
- DC-DC
- Load Switch

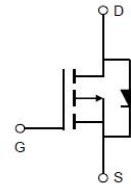
• Ordering Information:

Part NO.	ZMA120P04D
Marking	ZM120P04
Packing Information	REEL TAPE
Basic ordering unit (pcs)	2500

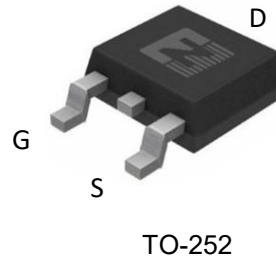
• Absolute Maximum Ratings ( $T_C=25^\circ\text{C}$ )

Parameter	Symbol	Conditions	Value	Unit
Drain-Source Voltage	$V_{DS}$		-40	V
Gate-Source Voltage <sup>①</sup>	$V_{GS}$		±20	V
Continuous Drain Current	$I_D$	$T_C=25^\circ\text{C}$	-45	A
	$I_D$	$T_C=75^\circ\text{C}$	-40	A
	$I_D$	$T_C=100^\circ\text{C}$	-34	A
Pulsed Drain Current	$I_{DM}$	Pulsed; $t_p \leq 10 \mu\text{s}$ ; $T_{mb} = 25^\circ\text{C}$ ;	-180	A
Total Power Dissipation	$P_D$	$T_C=25^\circ\text{C}$	75	W
Total Power Dissipation	$P_D$	$T_A=25^\circ\text{C}$	2.4	W
Operating Junction Temperature	$T_J$		-55 to +175	°C
Storage Temperature	$T_{STG}$		-55 to +175	°C
Single Pulse Avalanche Energy	$E_{AS}$	L=0.1mH, $V_{GS}=-10\text{V}$ , $R_g=25\Omega$ ,	80	mJ
		L=0.5mH, $V_{GS}=-10\text{V}$ , $R_g=25\Omega$ ,	168	mJ
ESD Level (HBM)	CLASS 2			

• Product Summary



$V_{DS} = -40\text{V}$   
 $R_{DS(ON)} = 12\text{m}\Omega$   
 $I_D = -45\text{A}$



**•Thermal resistance**

Parameter	Symbol	Min.	Typ.	Max.	Unit
Thermal resistance, junction - case	$R_{thJC}$		-	2	°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	$BV_{DSS}$	$V_{GS} = 0V, I_D = -250\mu A$	-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	$R_{DS(ON)}$	$V_{GS} = -10V, I_D = -15A$		12	16	m $\Omega$
		$V_{GS} = -4.5V, I_D = -10A$		17	21	m $\Omega$
Forward Transconductance	$g_{FS}$	$V_{DS} = -5V, I_{SD} = -10A$		18		S
Diode Forward Voltage	$V_{FSD}$	$V_{GS} = 0V, I_{SD} = -15A$			1.3	V

**•Dynamic characteristics**

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Input capacitance	$C_{iss}$	$f = 1MHz, V_{DS} = -25V$	-	3430	-	pF
Output capacitance	$C_{oss}$		-	262	-	
Reverse transfer capacitance	$C_{rss}$		-	206	-	
Gate Resistance	$R_g$	$f = 1MHz$	-	9		$\Omega$
Total gate charge	$Q_g$	$V_{DD} = -15V,$ $I_D = -20A,$ $V_{GS} = -10V$	-	56	-	nC
	$Q_g(-4.5v)$		-	25	-	
Gate - Source charge	$Q_{gs}$		-	7.6	-	
Gate - Drain charge	$Q_{gd}$		-	10.8	-	
Turn-ON Delay time	$t_{D(on)}$		-	12	-	
Turn-ON Rise time	$t_r$	$V_{GS} = -10V, V_{DS} = -15V,$ $R_G = 3.3\Omega, I_D = -20A$	-	19	-	ns
Turn-Off Delay time	$t_{D(off)}$		-	94	-	ns
Turn-Off Fall time	$t_f$		-	35	-	ns
Reverse Recovery Time	$t_{RR}$		$V_{DD} = -20V, di_S/dt =$	-	102	-
Reverse Recovery Charge	$Q_{RR}$	$100A/\mu s, I_S = -20A$	-	385	-	nC

Fig.1 Gate-Charge Characteristics

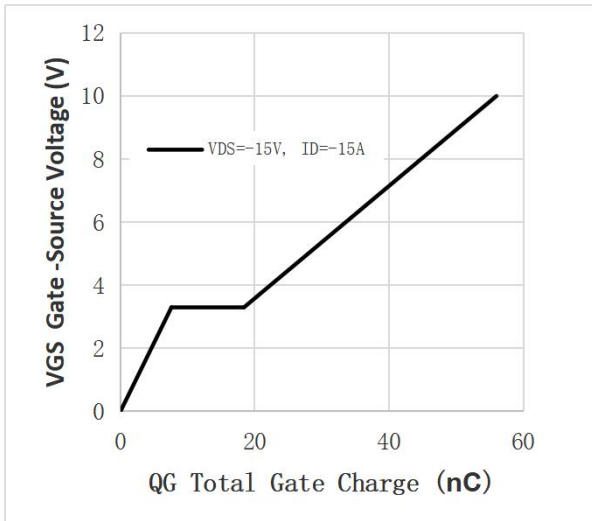


Fig.2 Capacitance Characteristics

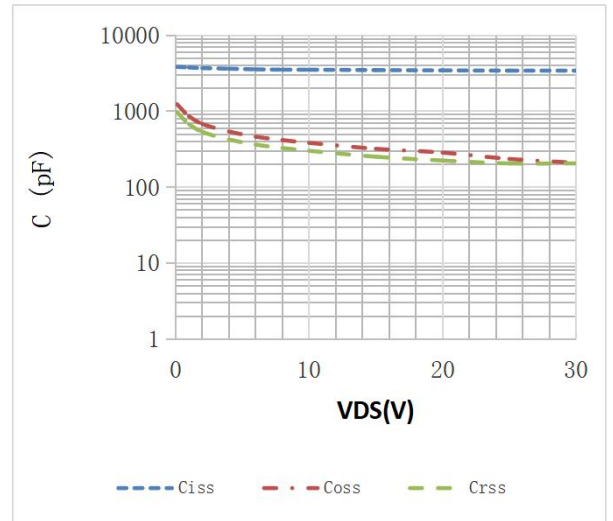


Fig.3 Power Dissipation

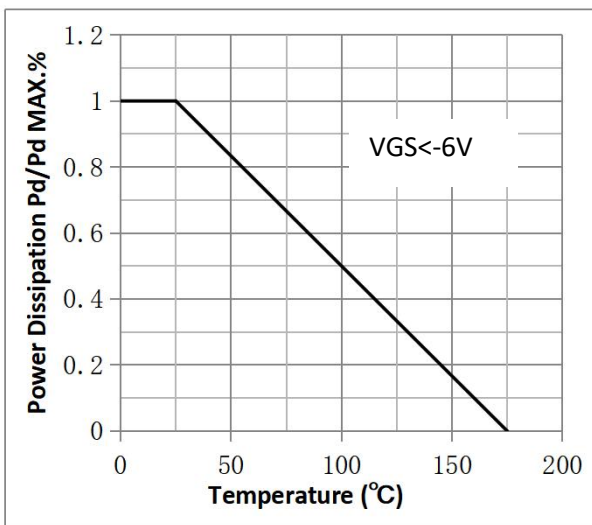


Fig.4 Typical output Characteristics

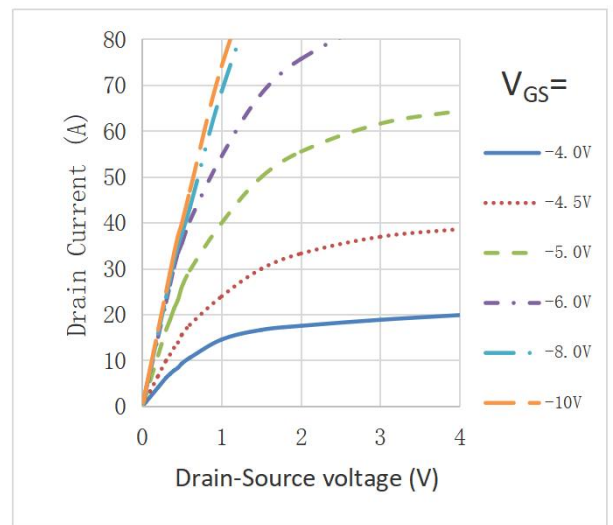


Fig.5 Threshold Voltage V.S Junction Temperature

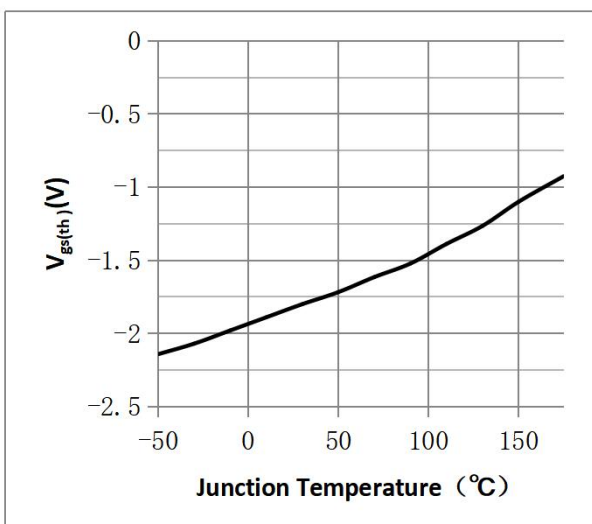


Fig.6 Resistance V.S Drain Current

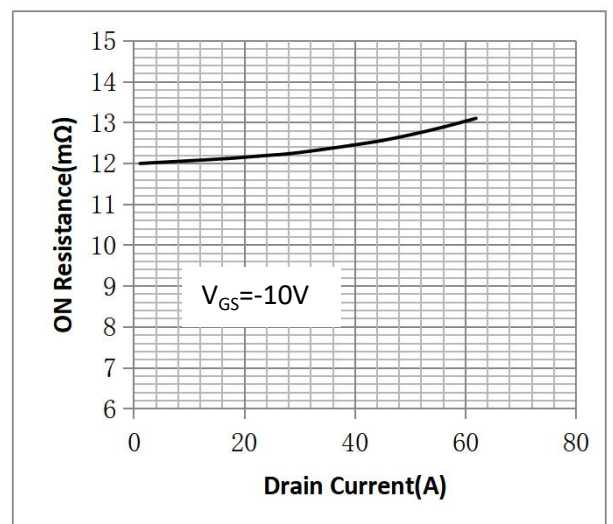


Fig.7 On-Resistance VS Gate Source Voltage

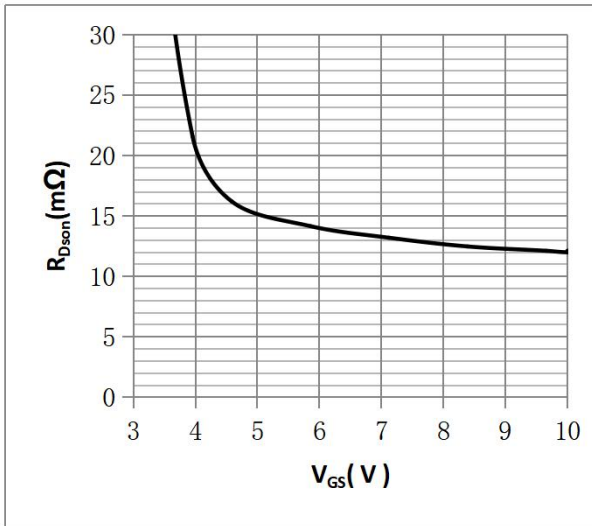


Fig.8 On-Resistance V.S Junction Temperature

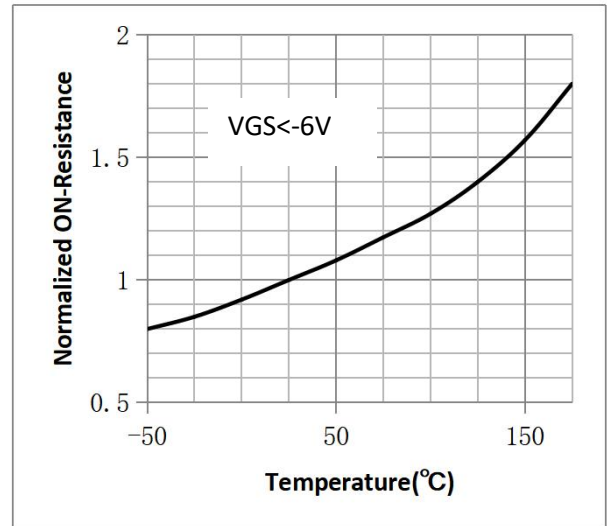


Figure 9. Diode Forward Voltage vs. Current

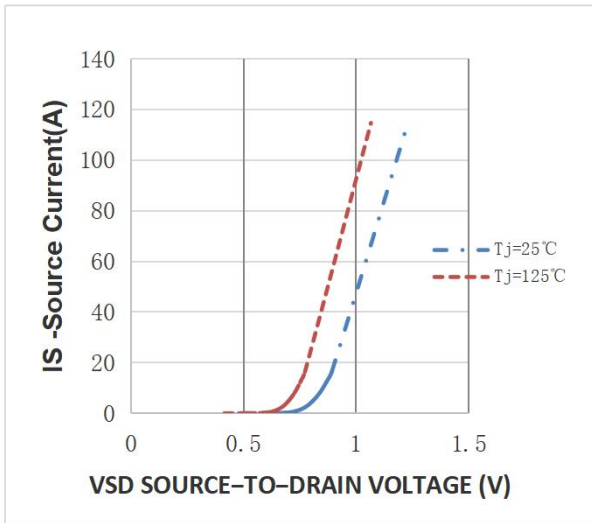


Figure 10. Transfer Characteristics

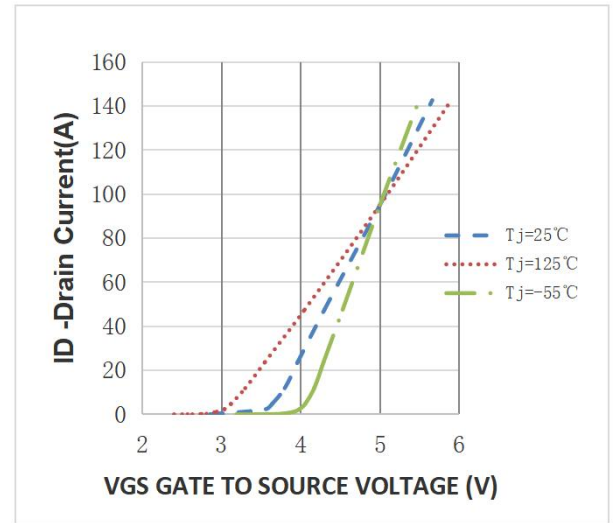


Fig.11 Safe Operating Area

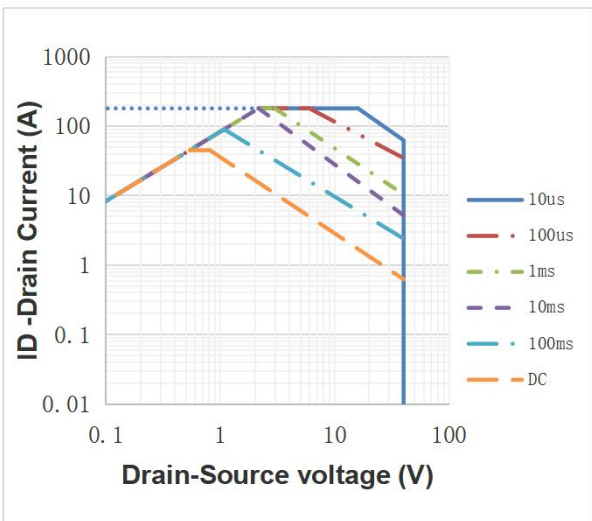
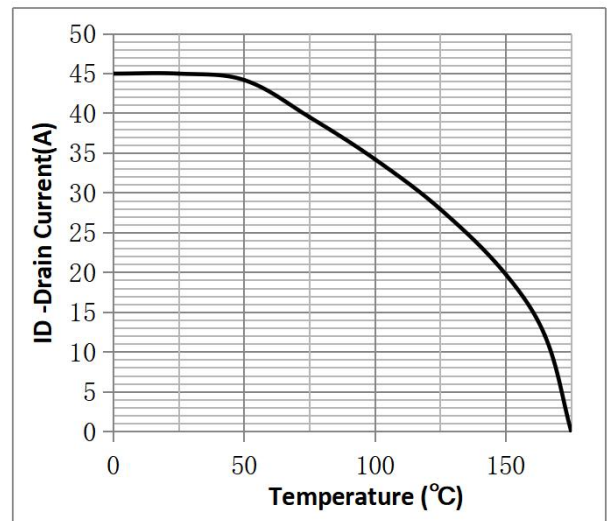
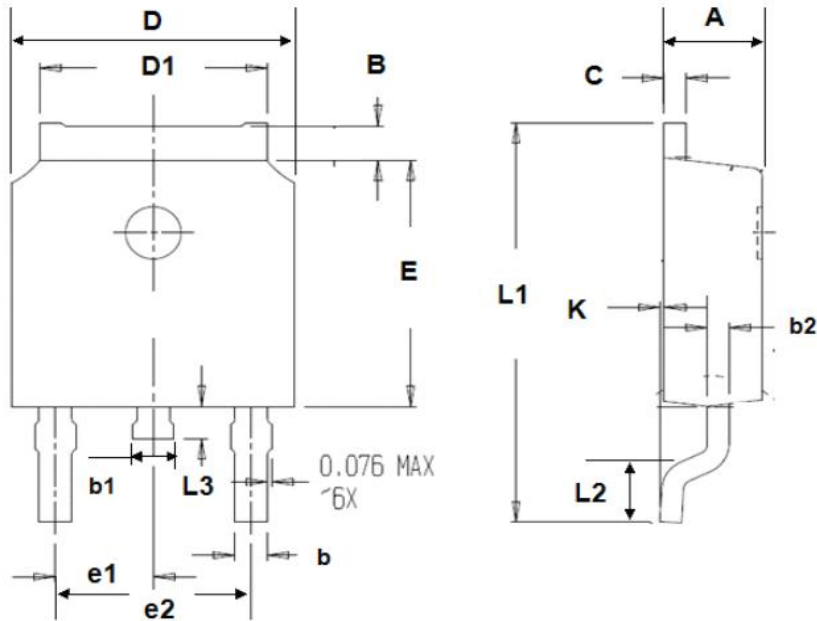


Fig.12 ID vs. Case Temperature<sup>③</sup>



•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	2021.2.25	
B	2022.6.7	1.Add Reach, HF figure, 2.ID modify
C	2022.10.20	1.Add It is suitable for automotive application. 2.Add total time<10s 3.ID curve modified
D	2023.12.19	Correct SOA