

• General Description

It combines advanced 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
- Load switch

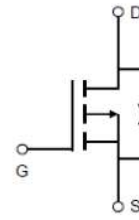
• Ordering Information:

Part NO.	ZMA060P04D
Marking	ZM060P04
Packing Information	REEL TAPE
Basic ordering unit (pcs)	2500

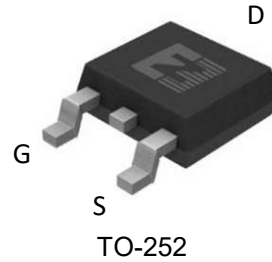
• Absolute Maximum Ratings ( $T_C=25^\circ\text{C}$ )

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	$I_D$	$T_C=25^\circ\text{C}$	-74	A
	$I_D$	$T_C=75^\circ\text{C}$	-60	A
	$I_D$	$T_C=100^\circ\text{C}$	-52	A
Pulsed Drain Current	$I_{DM}$	Pulsed; $t_p \leq 10 \mu\text{s}$ ; $T_{mb} = 25^\circ\text{C}$ ;	-296	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, $V_{GS}=-10\text{V}$ , $R_g=25\Omega$ ,	180	mJ
		L=0.5mH, $V_{GS}=-10\text{V}$ , $R_g=25\Omega$ ,	378	mJ
ESD Level (HBM)	CLASS 2			

• Product Summary



$V_{DS} = -40\text{V}$   
 $R_{DS(ON)} = 6.8\text{m}\Omega$   
 $I_D = -74\text{A}$



**•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	$T_{sold}$		-	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	$I_{GSS}$	$V_{GS} = \pm 20V, V_{DS} = 0V$			$\pm 100$	nA
Static Drain-source On Resistance	$R_{DS(ON)}$	$V_{GS} = -10V, I_D = -40A$		6.8	8.8	m $\Omega$
		$V_{GS} = -4.5V, I_D = -25A$		10	12	m $\Omega$
Forward Transconductance	$g_{FS}$	$V_{DS} = -5V, I_{SD} = -10A$		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	$C_{iss}$	$f = 1MHz, V_{DS} = -25V$	-	6210	-	pF	
Output capacitance	$C_{oss}$		-	468	-		
Reverse transfer capacitance	$C_{rss}$		-	397	-		
Gate Resistance	$R_g$	$f = 1MHz$	-	3		$\Omega$	
Total gate charge	$Q_g$	$V_{DD} = -15V, I_D = -20A, V_{GS} = -10V$	-	106	-	nC	
	$Q_g(-4.5v)$		-	51	-		
	Gate - Source charge		$Q_{gs}$	-	13		-
	Gate - Drain charge		$Q_{gd}$	-	20		-
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

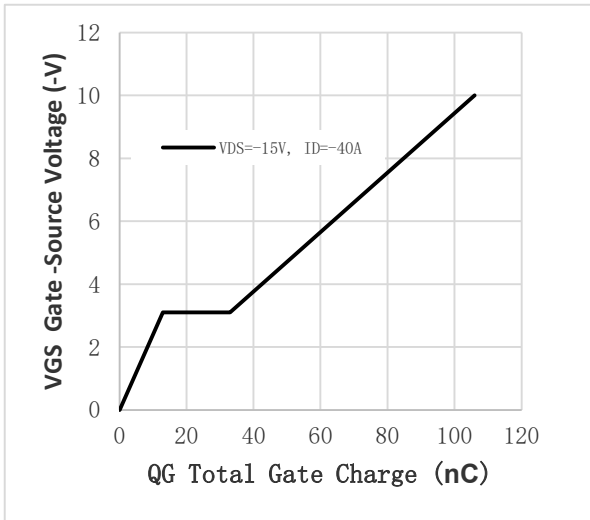


Fig.2 Capacitance Characteristics

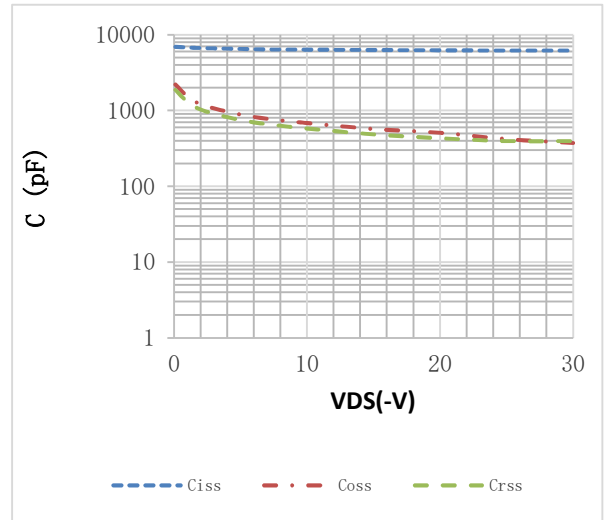


Fig.3 Power Dissipation

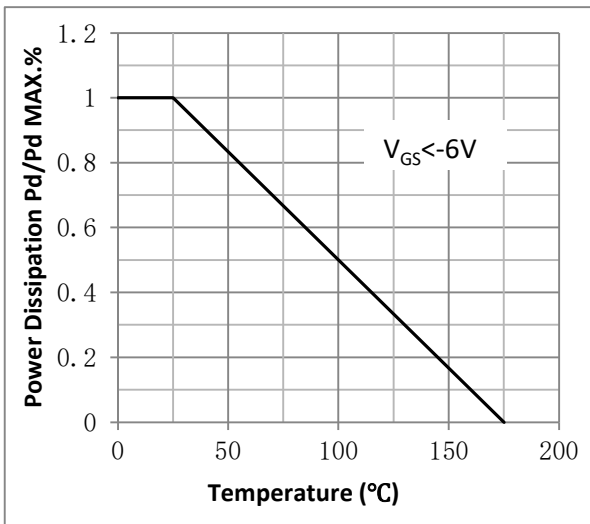


Fig.4 Typical output Characteristics

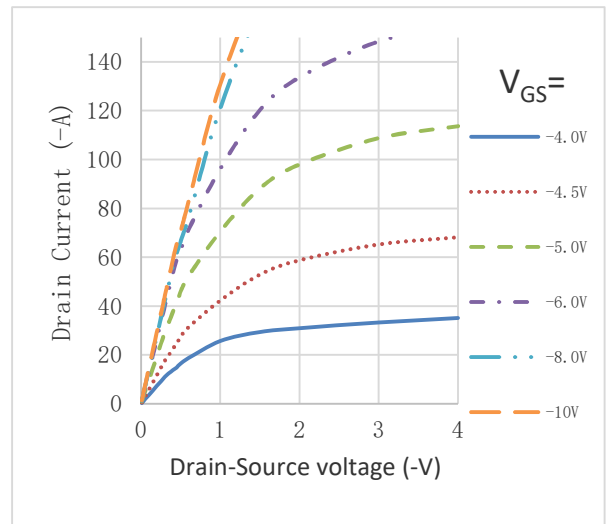


Fig.5 Threshold Voltage V.S Junction Temperature

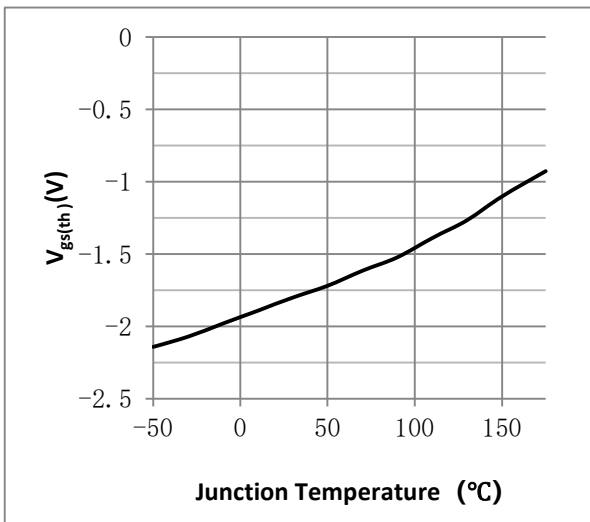


Fig.6 Resistance V.S Drain Current

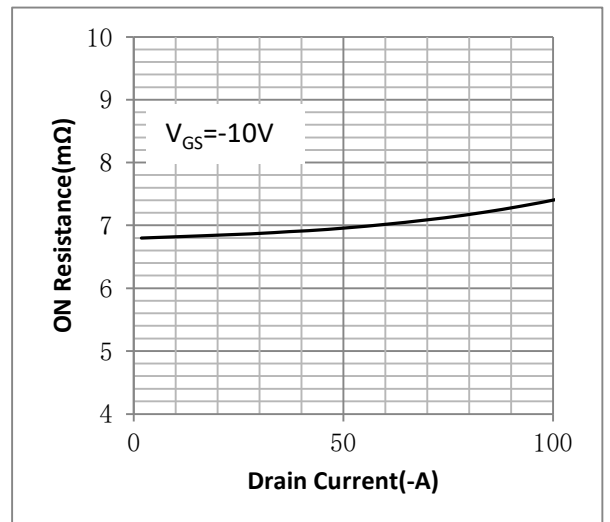


Fig.7 On-Resistance VS Gate Source Voltage

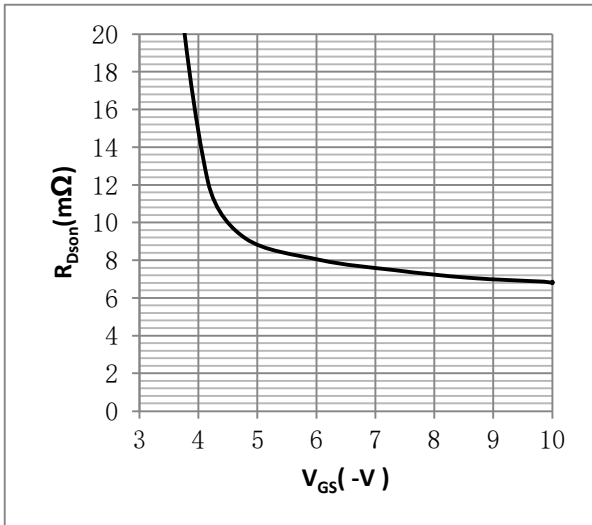


Fig.8 On-Resistance V.S Junction Temperature

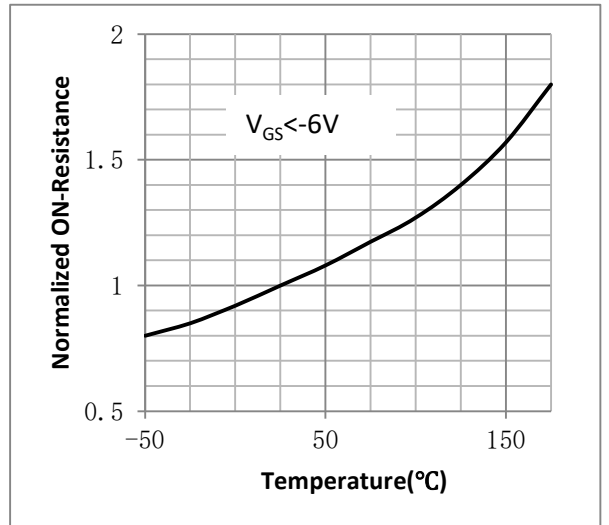


Figure 9. Diode Forward Voltage vs. Current

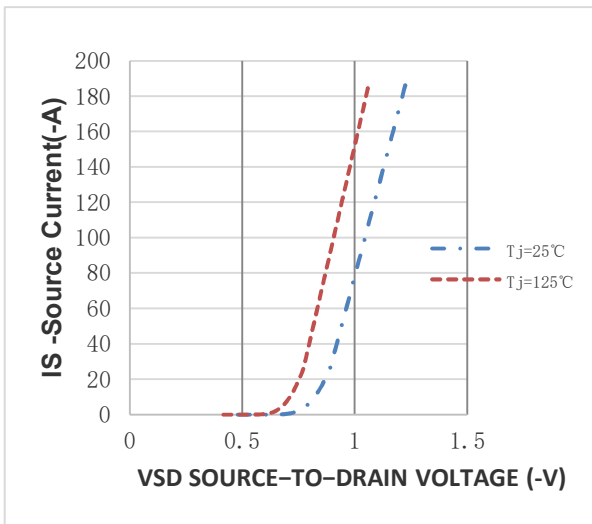


Figure 10. Transfer Characteristics

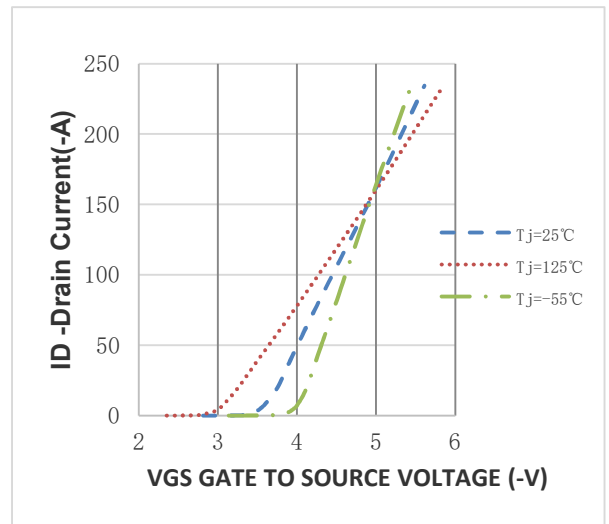


Fig.11 Safe Operating Area

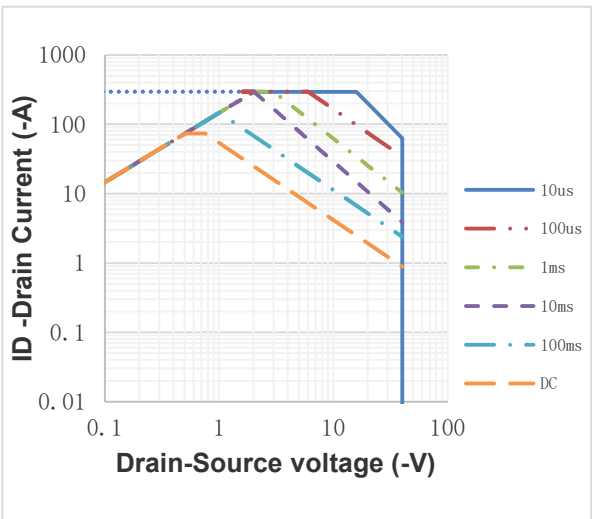
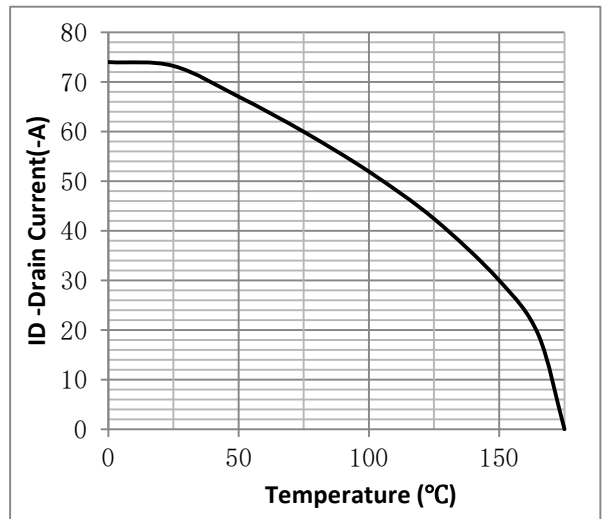
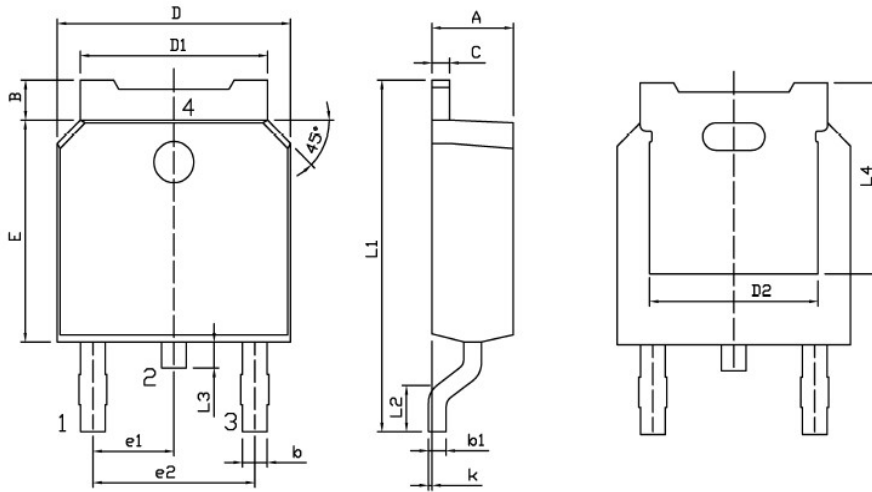


Fig.12  $I_D$  vs. Case Temperature<sup>③</sup>



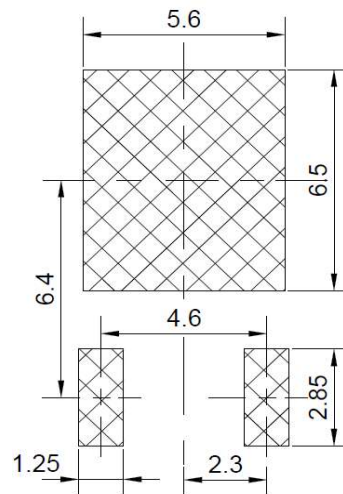
●T0-252 Package Outline

Option L:



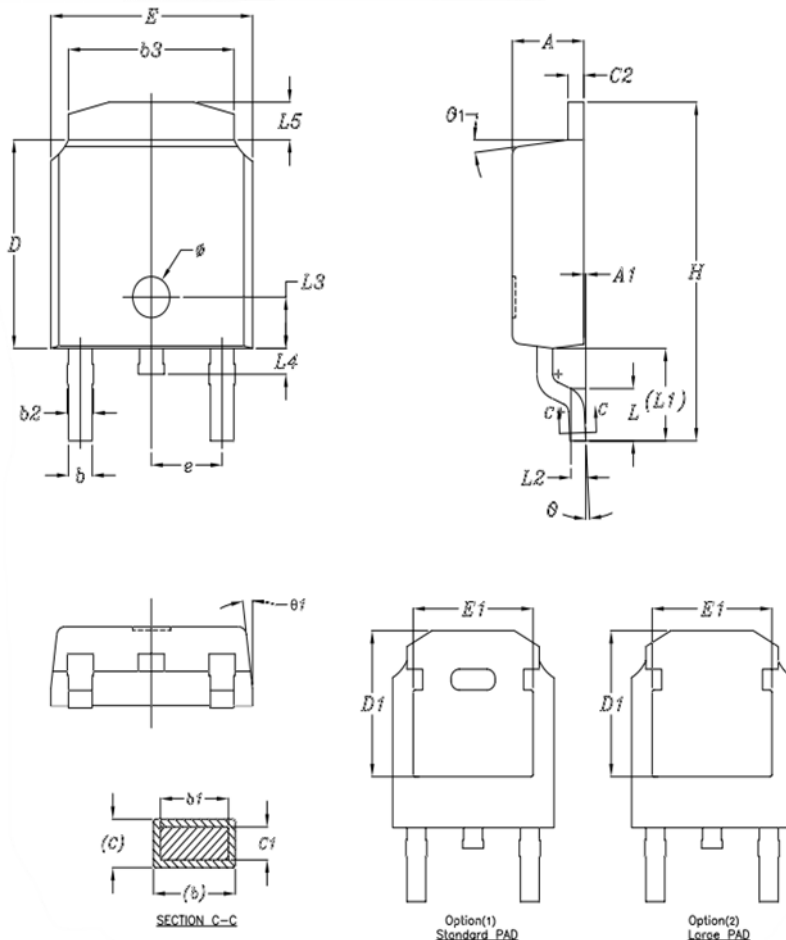
Dimensions In Millimeters					
Symbol	MIN	MAX	Symbol	MIN	MAX
A	2.20	2.40	E	5.95	6.25
B	0.95	1.25	e1	2.24	2.34
b	0.70	0.90	e2	4.43	4.73
b1	0.45	0.55	L1	9.85	10.35
C	0.45	0.55	L2	1.70	2.00
D	6.45	6.75	L3	0.60	0.90
D1	5.10	5.50	L4	5.05	
D2	4.85		k	0.00	0.10

Land Pattern  
(Only for Reference)



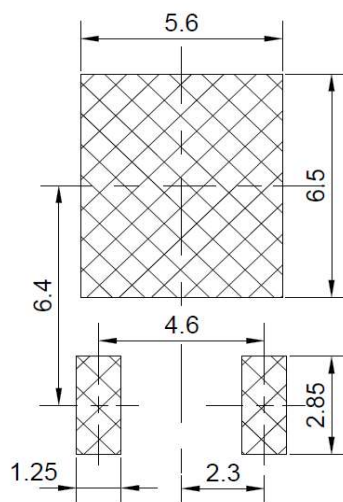
•TO-252 Package Outline

Option Q:



ITEM	DIMENSIONS			
	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	2.18	2.39	0.086	0.094
A1	—	0.13	—	0.005
b	0.70	0.89	0.028	0.035
b1	0.70	0.86	0.028	0.034
b2	0.76	1.14	0.030	0.045
b3	4.95	5.46	0.195	0.215
c	0.46	0.61	0.018	0.024
c1	0.41	0.56	0.016	0.022
c2	0.46	0.89	0.018	0.035
D	5.97	6.22	0.235	0.245
D1	5.21	—	0.205	—
E	6.35	6.73	0.250	0.265
E1	4.32	—	0.170	—
e	2.29 BSC		0.090 BSC	
H	9.40	10.41	0.370	0.410
L	1.40	1.78	0.055	0.070
L1	2.60	2.90	0.102	0.114
L2	0.51 BSC		0.020 BSC	
L3	1.65	1.95	0.065	0.077
L4	0.60	0.90	0.024	0.035
L5	0.89	1.27	0.035	0.050
∅	1"	5"	1"	5"
∅1	7" REF		7" REF	
∅	1.20 REF		1.20 REF	

Land Pattern  
(Only for Reference)



**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	2021.5.25	
B	2021.11.7	1.Modified Typical output Characteristics curve
C	2022.9.6	1.Add Reach,HF figure
D	2022.10.30	1.ID modify
E	2023.6.25	Correct VGS&SOA
F	2025.9.2	Update POD.
G	2025.11.14	Update POD.