●General Description

It combines trench MOSFET technology with a low resistance package to provide extremely low $R_{DS(ON)}$. It combines one N-channel MOSFET and one P-channel MOSFET.

●Features

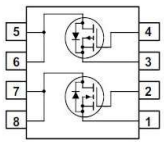
- ■Low $R_{DS(ON)}$ to minimize conductive loss
- ■Dual die in one package
- ■Low thermal resistance
- ■AEC-Q101 qualified

●Application

- ■BLDC motor driver
- ■Load switch

●Product Summary

DFN5*6



V_{DS1}=40V V_{DS2}=-40V

$R_{DS(ON)1}$ =8mR $R_{DS(ON)2}$ =12mR

I_{D1}=38A I_{D1}=-33A

RoHS REACH HF

●Ordering Information

Part NO.	ZMCA88401N
Marking	ZMC88401
Packing information	REEL TAPE
Basic ordering unit (pcs)	3000

●N-Channel Absolute Maximum Ratings（T_A=25℃,unless otherwise specified）

Parameter	Symbol	Conditions	Min.	Max.	Unit
Drain-source voltage	V_{DS}		-	40	V
Gate-source voltage①	V_{GS}		-20	20	V
Continuous drain current	I_D	V_{GS}=10V, T_C=25℃	-	38	A
	I_D	V_{GS}=10V, T_C=75℃	-	32	A
	I_D	V_{GS}=10V, T_C=100℃	-	27	A
Pulsed drain current ①	I_{DM}	Pulsed; t_p ≤ 10 μs; T_C = 25 °C;	-	114	A
Total power dissipation	P_D	T_C=25℃	-	39	W
Total power dissipation	P_D	T_A=25℃	-	3.3	W
Operating junction temperature	T_J		-55	175	℃
Storage temperature	T_{STG}		-55	175	℃
Single pulse avalanche energy	E_{AS}	L=0.1mH, V_{GS}=10V, R_g=25Ω,	-	40	mJ
		L=0.5mH, V_{GS}=10V, R_g=25Ω,	-	84	mJ

ESD level (HBM)		CLASS 1C

●P-Channel Absolute Maximum Ratings（T_A=25℃,unless otherwise specified）

Parameter	Symbol	Conditions	Min.	Max.	Unit
Drain-source voltage	V_{DS}		-	-40	V
Gate-source voltage①	V_{GS}		-20	20	V
Continuous drain current	I_D	V_{GS}=-10V, T_C=25℃	-	-33	A
	I_D	V_{GS}=-10V, T_C=75℃	-	-27	A
	I_D	V_{GS}=-10V, T_C=100℃	-	-24	A
Pulsed drain current ①	I_{DM}	Pulsed; t_p ≤ 10 μs; T_C = 25 °C;	-	-99	A
Total power dissipation	P_D	T_C=25℃	-	39	W
Total power dissipation	P_D	T_A=25℃	-	3.3	W
Operating junction temperature	T_J		-55	175	℃
Storage temperature	T_{STG}		-55	175	℃
Single pulse avalanche energy	E_{AS}	L=0.1mH, V_{GS}=-10V, R_g=25Ω,	-	60	mJ
		L=0.5mH, V_{GS}=-10V, R_g=25Ω,	-	108	mJ
ESD level (HBM)			CLASS 2		

●Thermal Resistance

Parameter	Symbol	Min.	Typ.	Max.	Unit
Thermal resistance, junction - case	R_{thJC}	-	-	3.8	°C/W
Thermal resistance, junction - ambient②	R_{thJA}	-	-	45	°C/W
Soldering temperature(total time<10s)	T_{sold}	-	-	260	°C

●N-Channel Electronic Characteristics (T_j=25°C, unless otherwise specified)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Drain-source breakdown voltage	BV_{DSS}	V_{GS} =0V, I_D =250uA	40	-	-	V
Gate threshold voltage	$V_{GS(th)}$	V_{GS}=V_{DS}, I_D=250uA	1.3	1.7	2.5	V
Drain-source leakage current	I_{DSS}	V_{GS}=0V, V_{DS}=40V	-	-	1	uA
Gate- source leakage current	I_{GSS}	V_{GS}=±20V, V_{DS} =0V	-	-	±100	nA
Static drain-source on resistance	$R_{DS(ON)}$	V_{GS}=10V, I_D=8A, T_j=25℃	-	8	12	mΩ
		V_{GS}=4.5V, I_D=6A, T_j=25℃	-	13	17	mΩ
Forward transconductance	g_{FS}	V_{DS} =5V, I_{SD} = 8A	-	11	-	S

Diode forward voltage	V_{FSD}	V_{GS} =0V, I_{SD} = 8A	-	-	1.3	V

●N-Channel Dynamic Characteristics (T_j=25°C, unless otherwise specified)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Input capacitance	C_{iss}	f = 1MHz, V_{DS}=25V, V_{GS}=0V	-	1930	-	pF
Output capacitance	C_{oss}		-	154	-	pF
Reverse transfer capacitance	C_{rss}		-	110	-	pF
Gate resistance	R_g	f = 1MHz	-	1.4	-	Ω
Total gate charge	Q_g	V_{DD} = 15V, I_D = 20A, V_{GS} = 10V	-	30	-	nC
Total gate charge	$Q_{g(4.5V)}$		-	16	-	nC
Gate-source charge	Q_{gs}		-	5.4	-	nC
Gate-drain charge	Q_{gd}		-	5.9	-	nC
Turn-on delay time	$t_{D(on)}$	V_{GS}=10V, V_{DS}=15V, R_G =3.3Ω, I_D =20A	-	8	-	ns
Turn-on rise time	t_r		-	2.5	-	ns
Turn-off delay time	$t_{D(off)}$		-	41	-	ns
Turn-off fall time	t_f		-	8	-	ns
Reverse recovery time	t_{rr}	V_{DD}=20V, dIs/dt = 100A/us, I_S=20A	-	11	-	ns
Reverse recovery charge	Q_{rr}		-	13	-	nC

●P-Channel Electronic Characteristics (T_j=25°C, unless otherwise specified)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Drain-source breakdown voltage	BV_{DSS}	V_{GS} =0V, I_D =-250uA	-40	-	-	V
Gate threshold voltage	$V_{GS(th)}$	V_{GS}=V_{DS}, I_D=-250uA	-1.3	-1.7	-2.5	V
Drain-source leakage current	I_{DSS}	V_{GS}=0V, V_{DS}=-40V	-	-	-1	uA
Gate- source leakage current	I_{GSS}	V_{GS}=±20V, V_{DS} =0V	-	-	±100	nA
Static drain-source on resistance	$R_{DS(ON)}$	V_{GS}=-10V, I_D=-8A, T_j=25℃	-	12	17	mΩ
		V_{GS}=-4.5V, I_D=-6A, T_j=25℃	-	20	24	mΩ
Forward transconductance	g_{FS}	V_{DS} =-5V, I_{SD} = -8A	-	18	-	S
Diode forward voltage	V_{FSD}	V_{GS} =0V, I_{SD} = -8A	-	-	-1.3	V

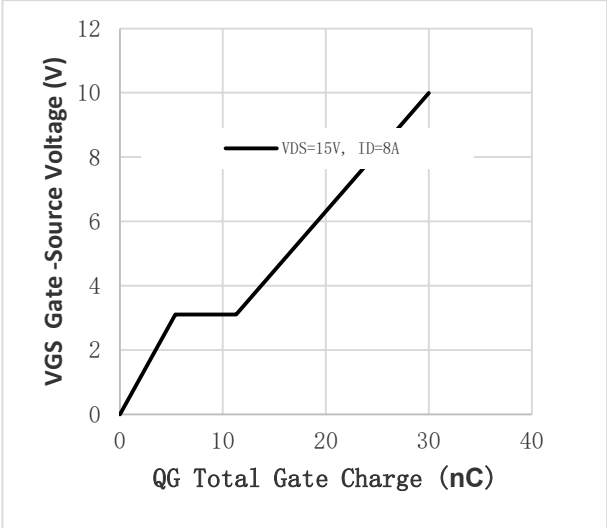
●P-Channel Dynamic Characteristics (T_j=25°C, unless otherwise specified)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Input capacitance	C_{iss}	f = 1MHz, V_{DS}=-25V, V_{GS}=0V	-	3430	-	pF
Output capacitance	C_{oss}		-	262	-	pF
Reverse transfer capacitance	C_{rss}		-	206	-	pF

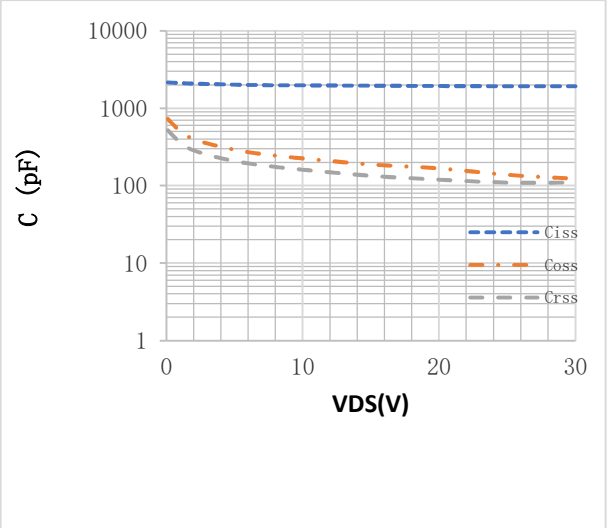
Gate resistance	R_g	f = 1MHz	-	8.6	-	Ω
Total gate charge	Q_g	V_{DD} = -15V, I_D = -10A, V_{GS} = -10V	-	56	-	nC
Total gate charge	$Q_{g(-4.5V)}$		-	25	-	nC
Gate-source charge	Q_{gs}		-	7.6	-	nC
Gate-drain charge	Q_{gd}		-	10.8	-	nC
Turn-on delay time	$t_{D(on)}$	V_{GS}=-15V, V_{DS}=-10V, R_G =3.3Ω, I_D =-20A	-	20	-	ns
Turn-on rise time	t_r		-	174	-	ns
Turn-off delay time	$t_{D(off)}$		-	43	-	ns
Turn-off fall time	t_f		-	10.4	-	ns
Reverse recovery time	t_{rr}	V_{DD}=-20V, dI_S/dt =-100A/us, I_S=-20A	-	58	-	ns
Reverse recovery charge	Q_{rr}		-	75	-	nC

●N-Channel Characteristics Curve (T_j=25°C, unless otherwise specified)

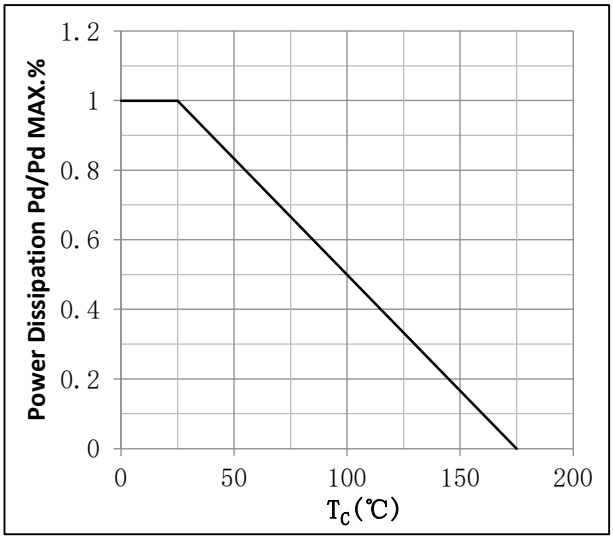
●Fig.1 Gate-source voltage as a function of gate charge; Typical values; T_j=25℃



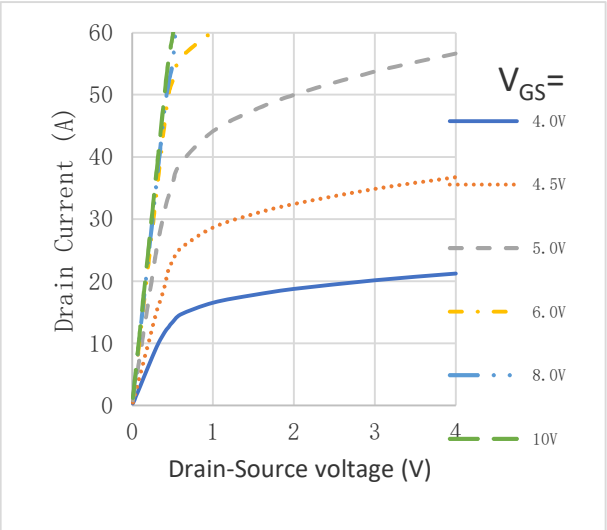
●Fig.2 Input, output and reverse transfer capacitances as a function of drain-source voltage; Typical values; T_j=25℃



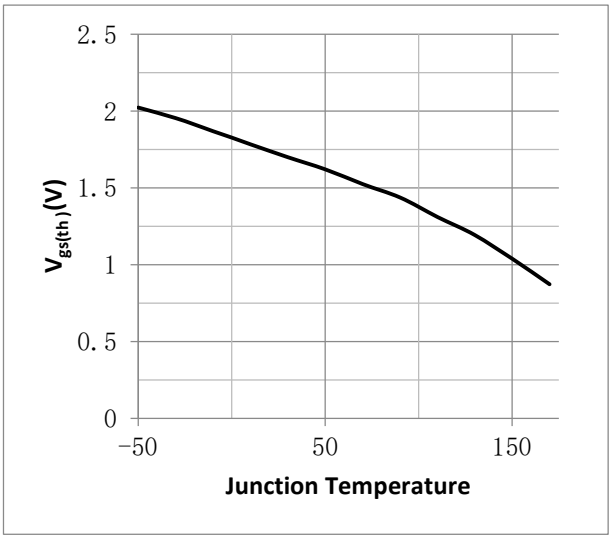
●Fig.4 Normalized total power dissipation as a function of case temperature; Calculative values Normalized Power Dissipation =P_d/P_d(25℃)



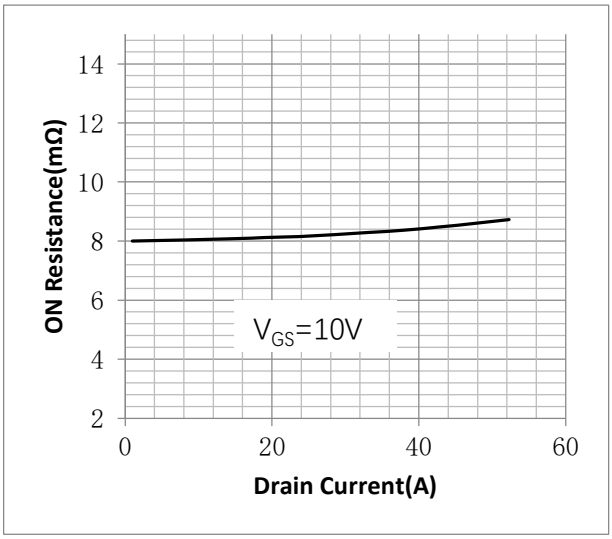
●Fig.4 Output characteristics: drain current as a function of drain-source voltage; Typical values; T_j=25℃



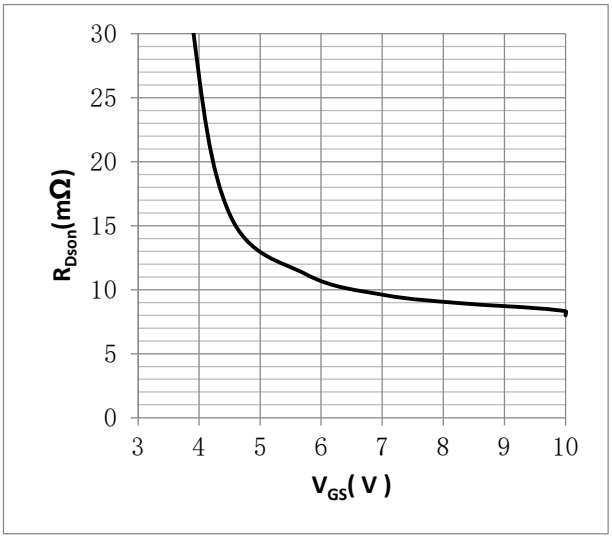
●Fig.5 Gate-source threshold voltage as a function of junction temperature; Typical values



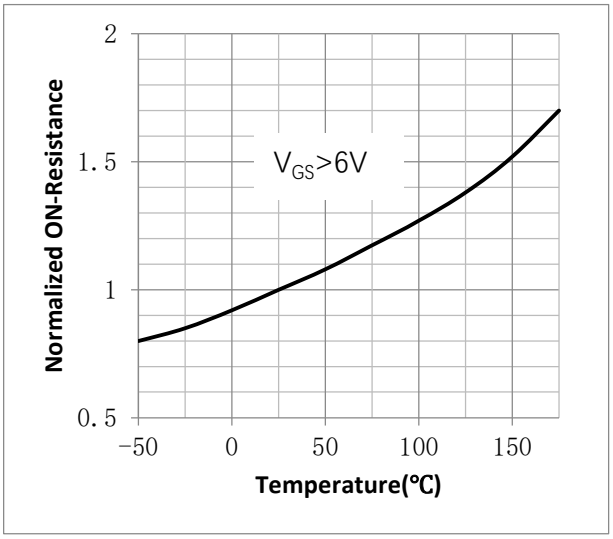
●Fig.6 Drain-source on-state resistance as a function of drain current; Typical values; Tj=25℃



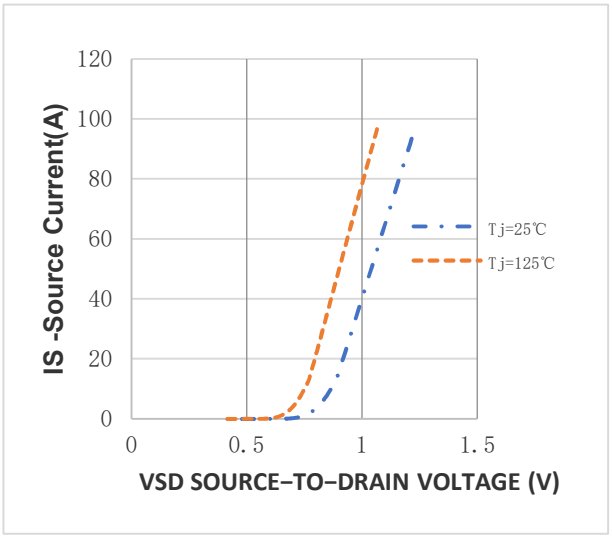
●Fig.7 Drain-source on-state resistance as a function of gate-source voltage; Typical values



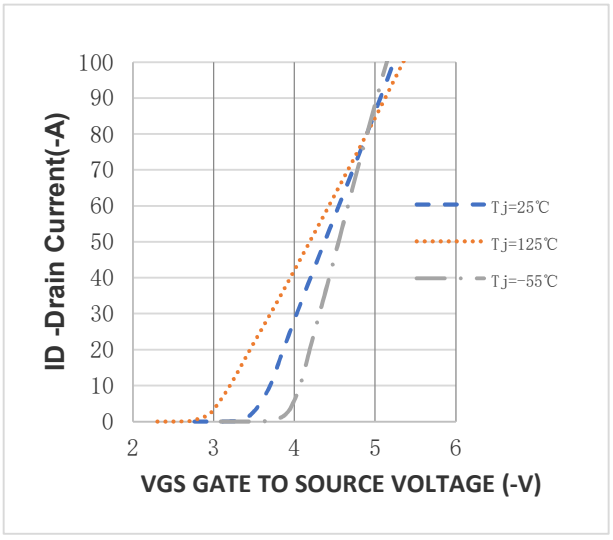
●Fig.8 Normalized drain-source on-state resistance factor as a function of junction temperature; Typical values Normalized On-Resistance=R_{DSon}/R_{DSon}(25℃)



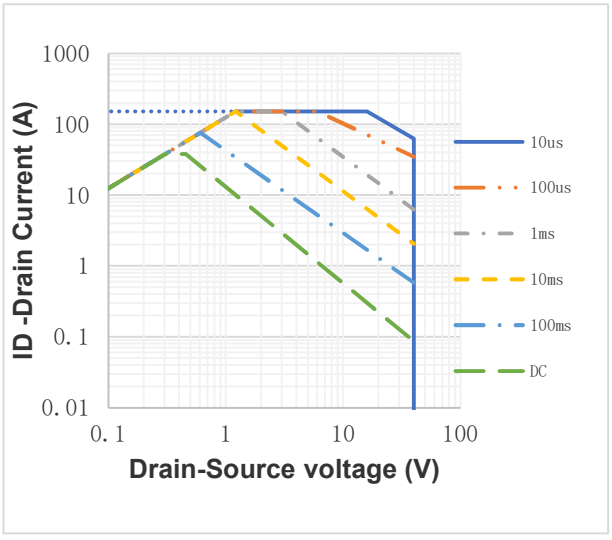
●Figure 9. Source (diode forward) current as a function of source-drain (diode forward) voltage; Typical values



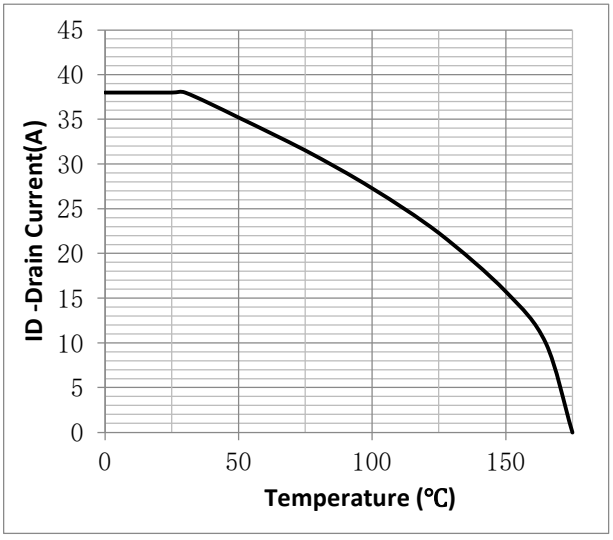
●Figure 10. Transfer characteristics: drain current as a function of gate-source voltage; Typical values



●Fig.11 Safe operating area: continuous and peak drain currents as a function of drain-source voltage; Calculative values

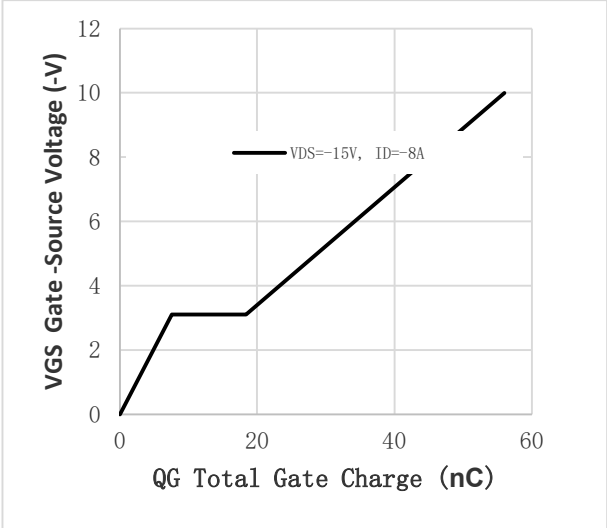


●Fig.12 Continuous drain current as a function of case temperature[3] ;Calculative values

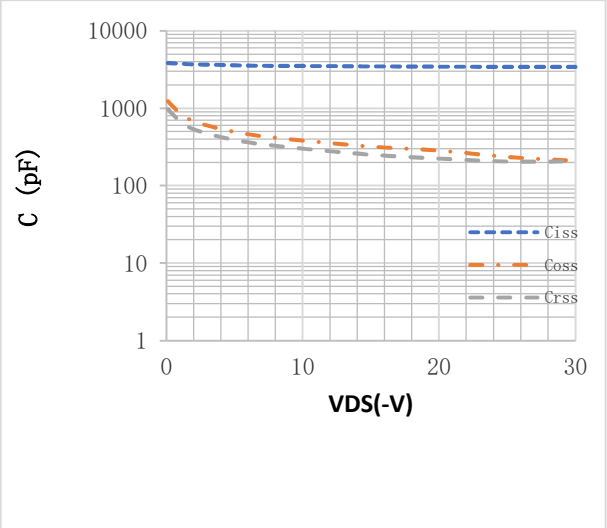


●P-Channel Characteristics Curve (T_j=25°C, unless otherwise specified)

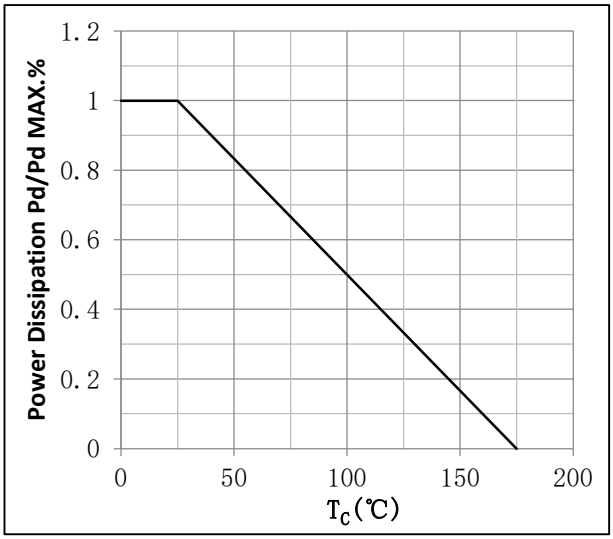
●Fig.1 Gate-source voltage as a function of gate charge; Typical values; T_j=25℃



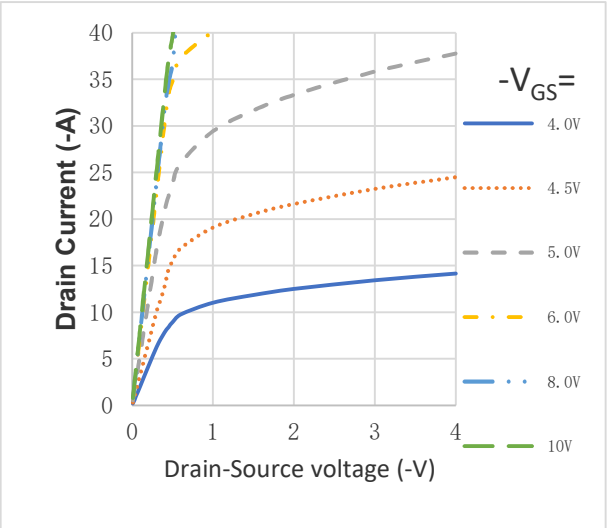
●Fig.2 Input, output and reverse transfer capacitances as a function of drain-source voltage; Typical values; T_j=25℃



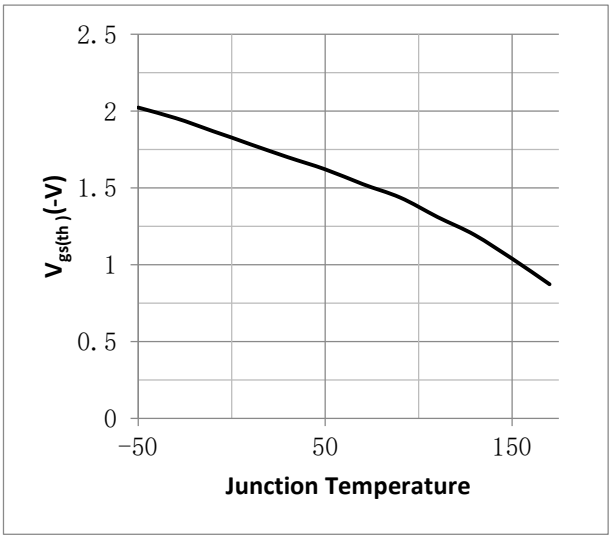
●Fig.3 Normalized total power dissipation as a function of case temperature; Calculative values Normalized Power Dissipation =P_d/P_d(25℃)



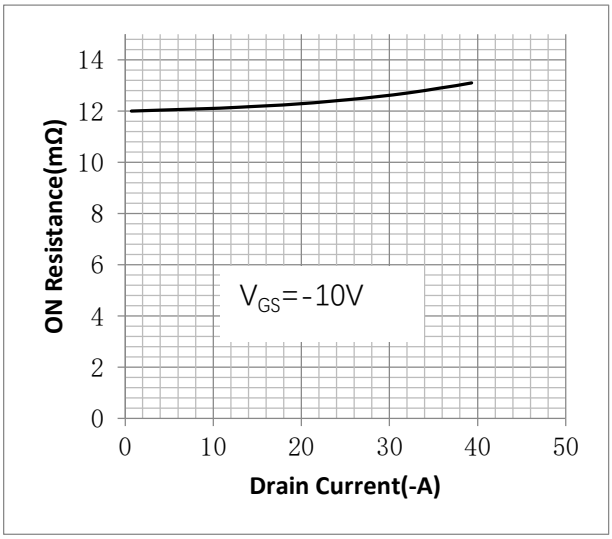
●Fig.4 Output characteristics: drain current as a function of drain-source voltage; Typical values; T_j=25℃



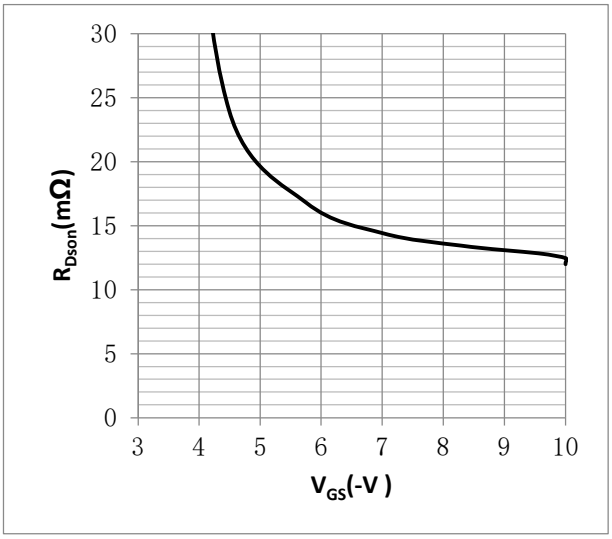
●Fig.5 Gate-source threshold voltage as a function of junction temperature; Typical values



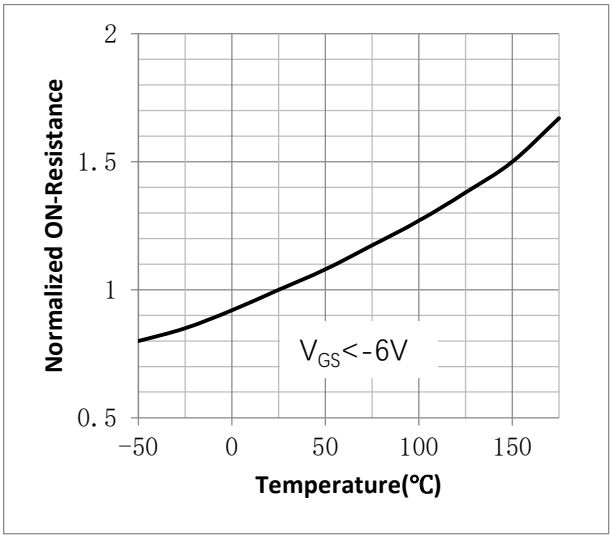
●Fig.6 Drain-source on-state resistance as a function of drain current; Typical values; Tj=25℃



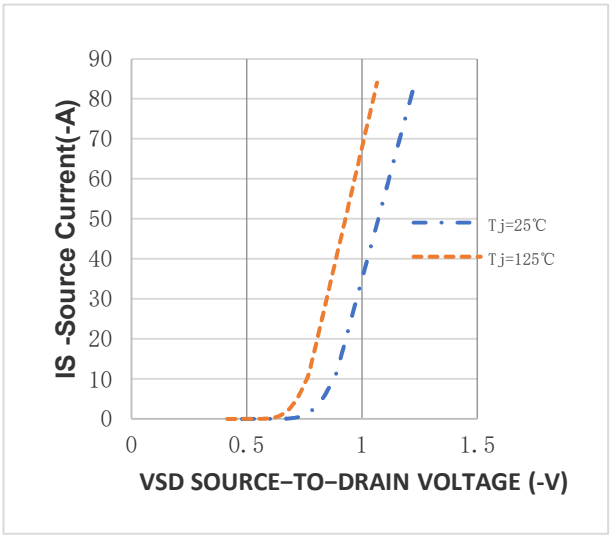
●Fig.7 Drain-source on-state resistance as a function of gate-source voltage; Typical values



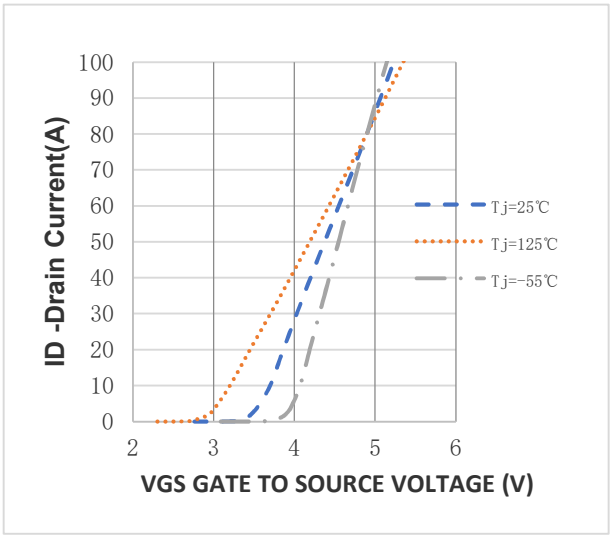
●Fig.8 Normalized drain-source on-state resistance factor as a function of junction temperature; Typical values Normalized On-Resistance=R_{DSon}/R_{DSon}(25℃)



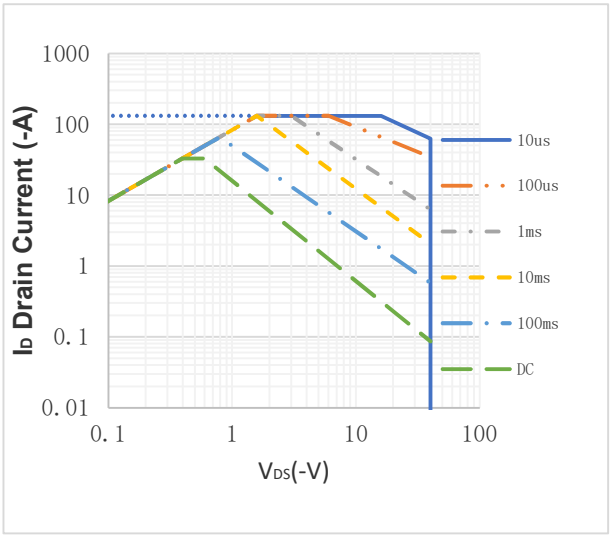
●Figure 9. Source (diode forward) current as a function of source-drain (diode forward) voltage; Typical values



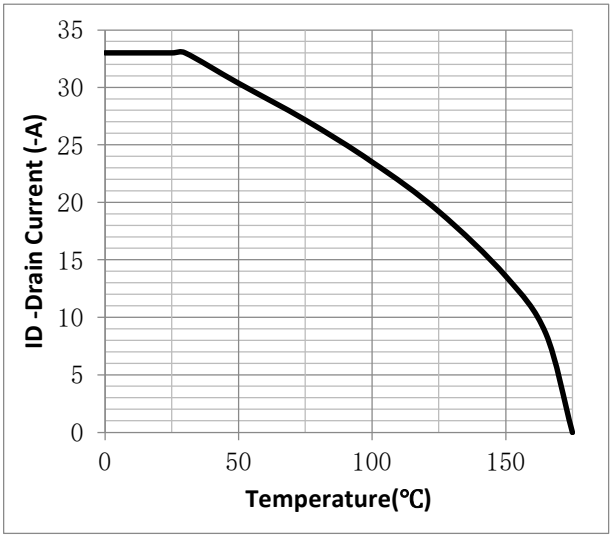
●Figure 10. Transfer characteristics: drain current as a function of gate-source voltage; Typical values



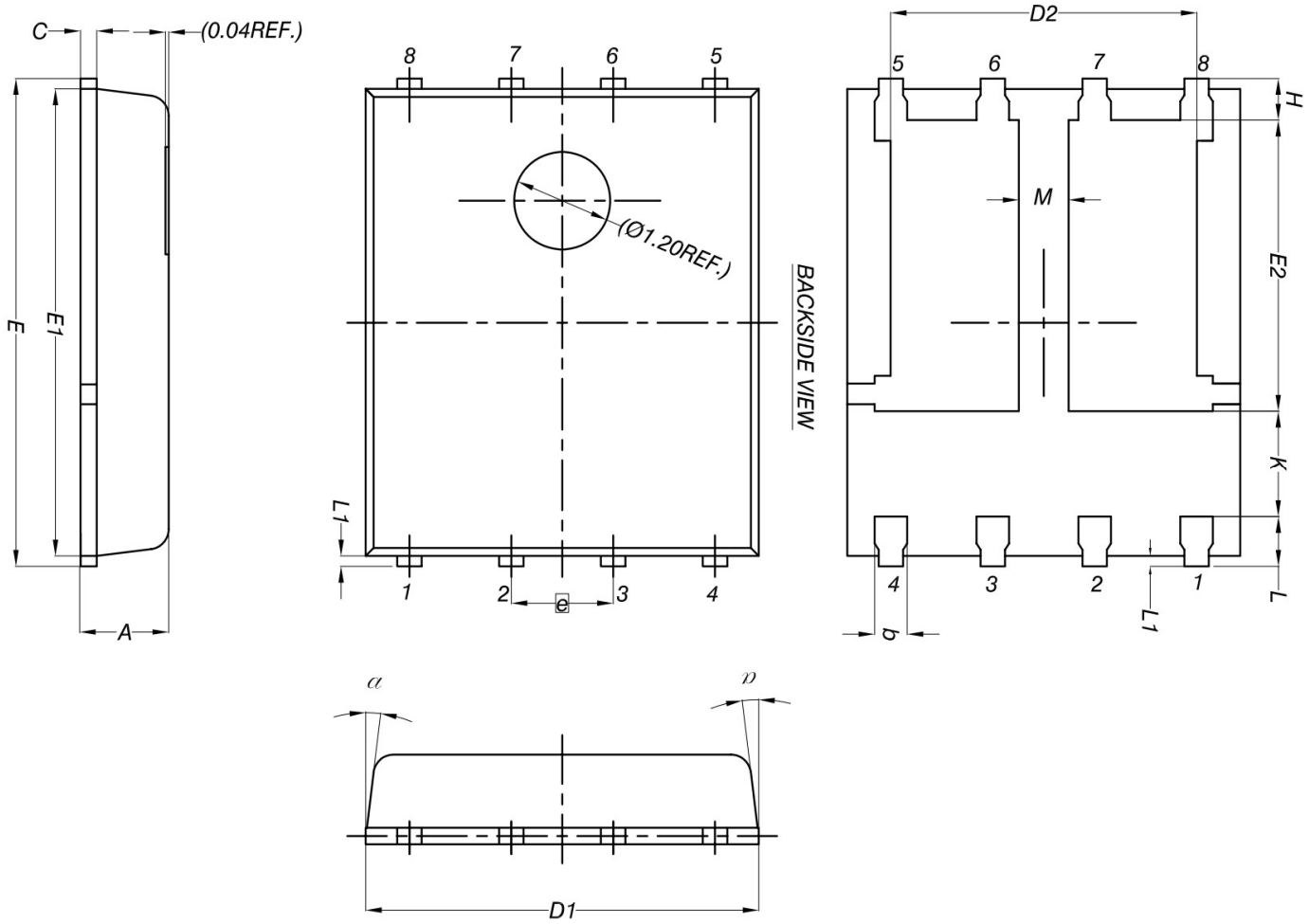
●Fig.11 Safe operating area: continuous and peak drain currents as a function of drain-source voltage; Calculative values



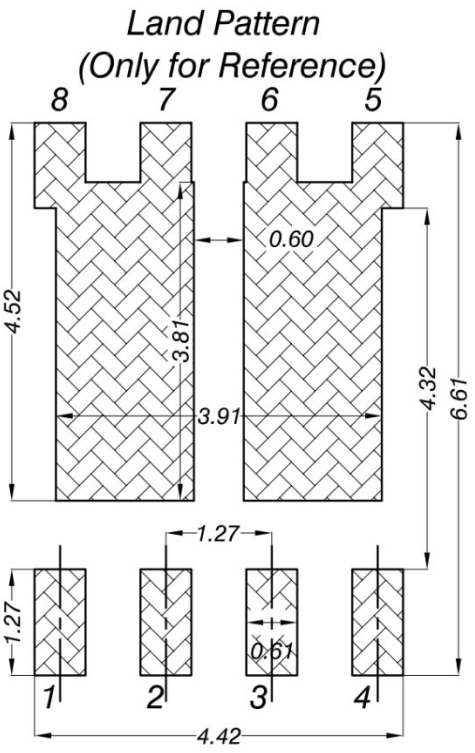
●Fig.12 Continuous drain current as a function of case temperature[3] ;Calculative values



Package Outline



DIM.	MILLIMETERS		
	MIN.	NOM.	MAX.
A	0.90	1.00	1.10
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
M	0.50	-	-
α	0°	-	12°



Note

① Pulse : V_{GS}=+20V/-20V, Duty cycle=50%,T_j=175℃, t=1000 hours; For DC, the following test conditions can be passed: V_{GS}=+20V/-10V, T_j=175℃, t=1000 hours;

②Device mounted on FR-4 substrate PC board, 2oz copper, with thermal bias to bottom layer 1inch square copper plate;

③Practically the current will be limited by PCB, thermal design and operating temperature. V_{GS}=10V (N-channel)/ -10V(P-channel).

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● Since ZMJ uses lot number as the tracking base, please provide the lot number for tracking when complaining.

●Revision History

Version	Date	Change
A	2021.10.16	New
B	2021.11.12	Modified the ID curve
C	2022.12.5	Add Dynamic Characteristics, correct the marking.
D	2023.11.21	Add Vgs>6v in the curve, correct ID
E	2025.9.17	P channel fig.12 corrected