

• General Description

It combines advanced 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

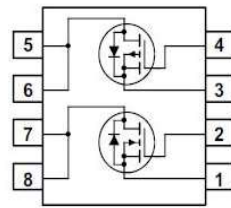
• Features

- Low $R_{DS(ON)}$ to minimize conductive loss
- Dual DIE in one package
- Low Thermal resistance

• Application

- BLDC Motor driver
- Load switch

• Product Summary



$$V_{DS1} = 60V$$

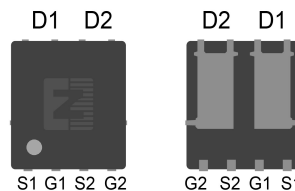
$$V_{DS2} = -60V$$

$$R_{DS(ON)1} = 30m\Omega$$

$$R_{DS(ON)1} = 57m\Omega$$

$$I_{D1} = 20A$$

$$I_{D2} = -16A$$



pin1

DFN5*6



• Ordering Information:

Part NO.	ZMC88602N
Marking	ZMC88602
Packing Information	REEL TAPE
Basic ordering unit (pcs)	3000

• N Channel Absolute Maximum Ratings ($T_C=25^\circ C$)

Parameter	Symbol	Conditions	Value	Unit
Drain-Source Voltage	V_{DS}		60	V
Gate-Source Voltage ^①	V_{GS}		± 20	V
Continuous Drain Current	I_D	$T_C=25^\circ C$	20	A
	I_D	$T_C=75^\circ C$	16	A
	I_D	$T_C=100^\circ C$	14	A
Pulsed Drain Current	I_{DM}	Pulsed; $t_p \leq 10 \mu s$; $T_{mb} = 25^\circ C$;	60	A
Total Power Dissipation	P_D	$T_C=25^\circ C$	33	W
Total Power Dissipation	P_D	$T_A=25^\circ C$	3.3	W
Operating Junction Temperature	T_J		-55 to +175	$^\circ C$
Storage Temperature	T_{STG}		-55 to +175	$^\circ C$
Single Pulse Avalanche Energy	E_{AS}	$L=0.1mH$, $V_{GS}=10V$, $R_g=25\Omega$,	20	mJ
		$L=0.5mH$, $V_{GS}=10V$, $R_g=25\Omega$,	38	mJ
ESD Level (HBM)	CLASS 1C			

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

Parameter	Symbol	Conditions	Value	Unit
Drain-Source Voltage	V_{DS}		-60	V
Gate-Source Voltage ^②	V_{GS}		± 20	V
Continuous Drain Current	I_D	$T_C=25^{\circ}\text{C}$	-16	A
	I_D	$T_C=75^{\circ}\text{C}$	-13	A
	I_D	$T_C=100^{\circ}\text{C}$	-11	A
Pulsed Drain Current	I_{DM}	Pulsed; $t_p \leq 10 \mu\text{s}$; $T_{mb} = 25^{\circ}\text{C}$;	-48	A
Total Power Dissipation	P_D	$T_C=25^{\circ}\text{C}$	33	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}	$L=0.1\text{mH}$, $V_{GS}=-10\text{V}$, $R_g=25\Omega$,	20	mJ
		$L=0.5\text{mH}$, $V_{GS}=-10\text{V}$, $R_g=25\Omega$,	36	mJ
ESD Level (HBM)	CLASS 1C			

•Thermal resistance

Parameter	Symbol	Min.	Typ.	Max.	Unit
Thermal resistance, junction - case	R_{thJC}		-	4.6	$^{\circ}\text{C/W}$
Thermal resistance, junction-ambient ^③	R_{thJA}		-	45	$^{\circ}\text{C/W}$
Soldering temperature	T_{sld}		-	260	$^{\circ}\text{C}$

•N Channel Electronic Characteristics

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Drain-Source Breakdown Voltage	BV_{DSS}	$V_{GS}=0V, I_D=250\mu A$	60			V
Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS}=V_{DS}, I_D=250\mu A$	1.3	1.7	2.5	V
Drain-Source Leakage Current	I_{DSS}	$V_{GS}=0V, V_{DS}=60V$			1.0	μA
Gate- Source Leakage Current	I_{GSS}	$V_{GS}=\pm 20V, V_{DS}=0V$			100	nA
Static Drain-source On Resistance	$R_{DS(ON)}$	$V_{GS}=10V, I_D=12A$		30	39	$m\Omega$
		$V_{GS}=4.5V, I_D=8A$		34	45	$m\Omega$
Forward Transconductance	g_{FS}	$V_{DS}=5V, I_{SD}=5A$		7		s
Diode Forward Voltage	V_{FSD}	$V_{GS}=0V, I_{SD}=12A$			1.3	V

•N Channel Dynamic characteristics

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Input capacitance	C_{iss}	$f=1MHz, V_{DS}=25V$	-	1300	-	pF
Output capacitance	C_{oss}		-	53	-	
Reverse transfer capacitance	C_{rss}		-	31	-	
Gate Resistance	R_g	$f=1MHz$	-	1.5		Ω
Total gate charge	Q_g	$V_{DD}=15V, I_D=12A, V_{GS}=10V$	-	17	-	nC
	$Q_g(4.5v)$		-	9	-	
Gate - Source charge	Q_{gs}		-	4.1	-	
Gate - Drain charge	Q_{gd}		-	2.5	-	
Turn-ON Delay time	$t_{D(on)}$	$V_{GS}=10V, V_{DS}=15V, R_G=3.3\Omega, I_D=20A$	-	9	-	ns
Turn-ON Rise time	t_r		-	32	-	ns
Turn-Off Delay time	$t_{D(off)}$		-	44	-	ns
Turn-Off Fall time	t_f		-	30	-	ns
Reverse Recovery Time	t_{rr}	$V_{DD}=20V, dI_S/dt=100A/\mu s, I_S=20A$	-	50	-	ns
Reverse Recovery Charge	Q_{rr}		-	45	-	nC

•P Channel Electronic Characteristics

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Drain-Source Breakdown Voltage	BV_{DSS}	$V_{GS}=0V, I_D=-250\mu A$	-60			V
Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS}=V_{DS}, I_D=-250\mu A$	-1.3	-1.7	-2.5	V
Drain-Source Leakage Current	I_{DSS}	$V_{GS}=0V, V_{DS}=-60V$			1.0	μA
Gate- Source Leakage Current	I_{GSS}	$V_{GS}=\pm 20V, V_{DS}=0V$			100	nA
Static Drain-source On Resistance	$R_{DS(ON)}$	$V_{GS}=-10V, I_D=-10A$		57	74	$m\Omega$
		$V_{GS}=-4.5V, I_D=-8A$		76	100	$m\Omega$
Forward Transconductance	g_{FS}	$V_{DS}=-5V, I_{SD}=-5A$		18		s
Diode Forward Voltage	V_{FSD}	$V_{GS}=0V, I_{SD}=-10A$			1.3	V

•P Channel Dynamic characteristics

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Input capacitance	C_{iss}	$f=1MHz, V_{DS}=-25V$	-	1380	-	pF
Output capacitance	C_{oss}		-	101	-	
Reverse transfer capacitance	C_{rss}		-	67	-	
Gate Resistance	R_g	$f=1MHz$	-	7.5		Ω
Total gate charge	Q_g	$V_{DD}=-15V, I_D=-10A, V_{GS}=-10V$	-	20	-	nC
	$Q_g(4.5V)$		-	25	-	
Gate - Source charge	Q_{gs}		-	3.5	-	
Gate - Drain charge	Q_{gd}		-	3.6	-	
Turn-ON Delay time	$t_{D(on)}$	$V_{GS}=-10V, V_{DS}=-15V, R_G=3.3\Omega, I_D=-20A$	-	17	-	ns
Turn-ON Rise time	t_r		-	18	-	ns
Turn-Off Delay time	$t_{D(off)}$		-	43	-	ns
Turn-Off Fall time	t_f		-	20	-	ns
Reverse Recovery Time	t_{RR}	$V_{DD}=-20V, di_S/dt=100A/\mu s, I_S=-20A$	-	56	-	ns
Reverse Recovery Charge	Q_{RR}		-	84	-	nC

• N Channel characteristics curve

Fig.1 Gate-Charge Characteristics

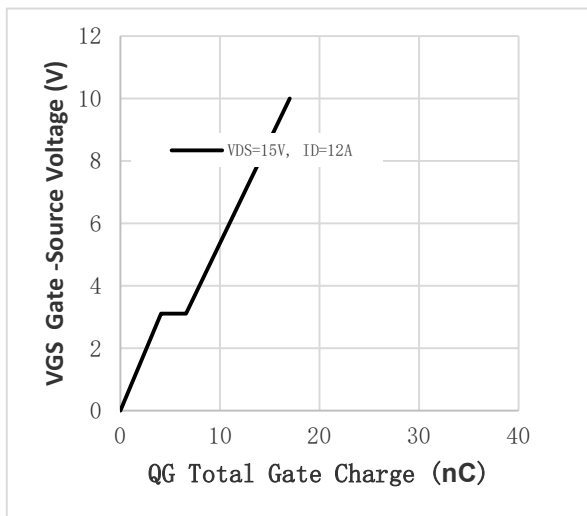


Fig.2 Capacitance Characteristics

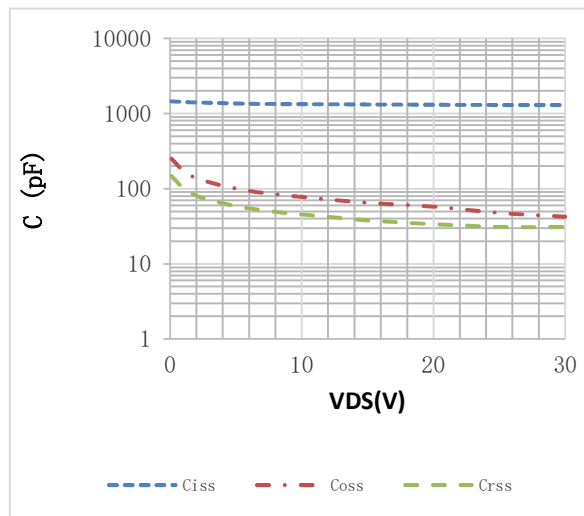


Fig.3 Power Dissipation

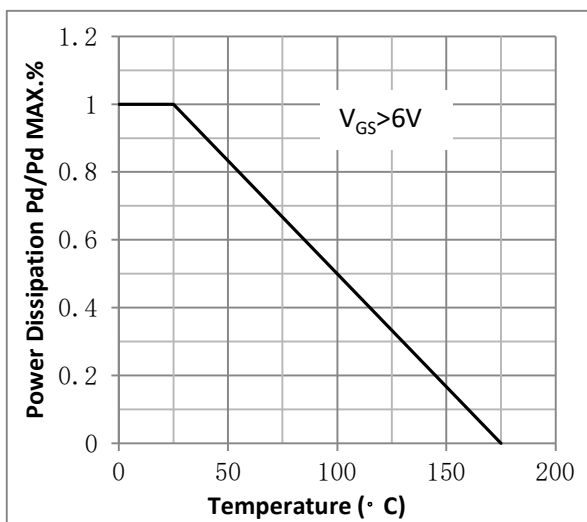


Fig.4 Typical output Characteristics

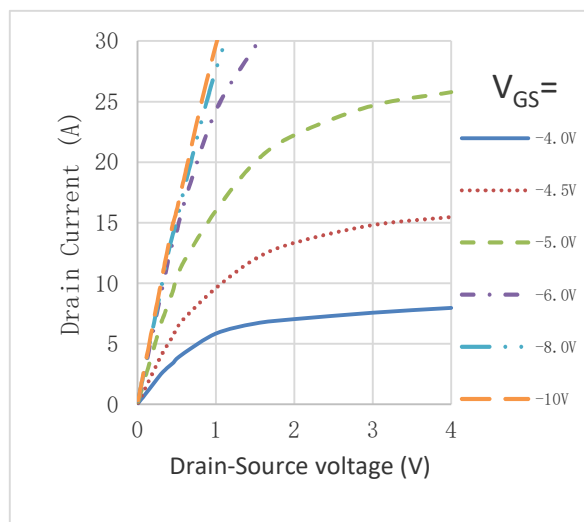


Fig.5 Threshold Voltage V.S Junction Temperature

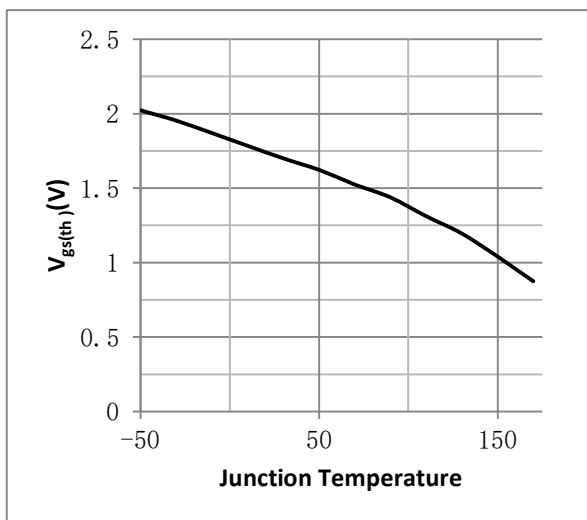


Fig.6 Resistance V.S Drain Current

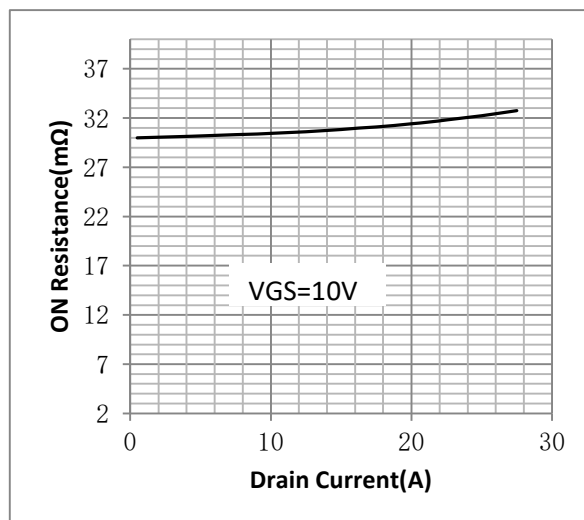


Fig.7 On-Resistance VS Gate Source Voltage

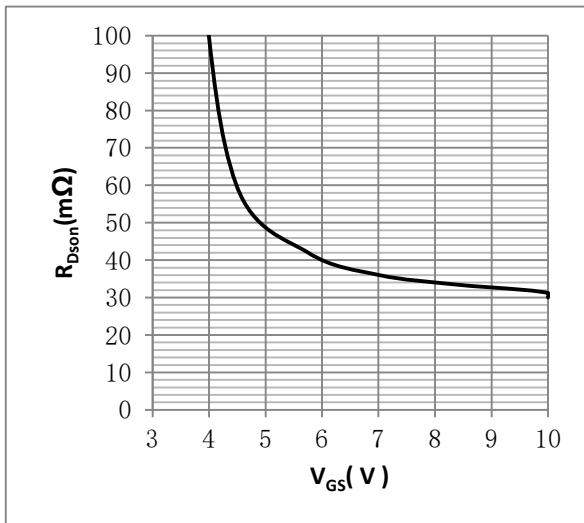


Fig.8 On-Resistance V.S Junction Temperature

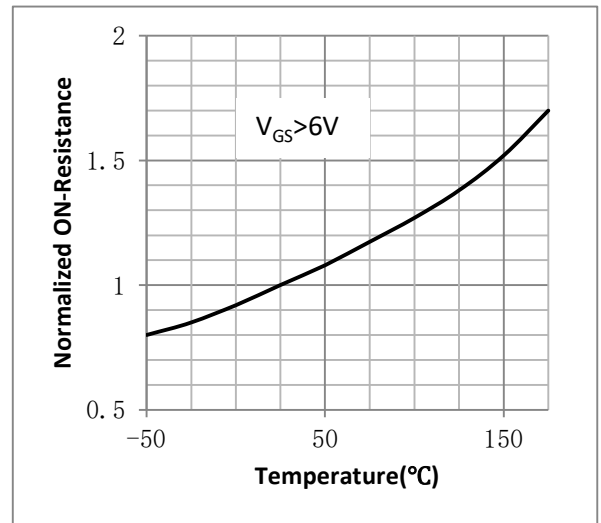


Figure 9. Diode Forward Voltage vs. Current

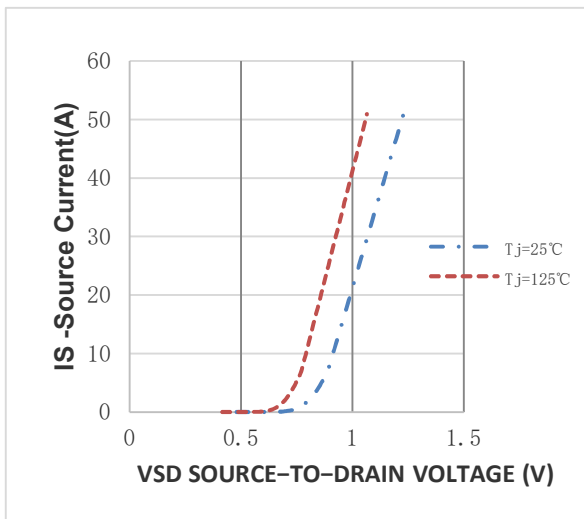


Figure 10. Transfer Characteristics

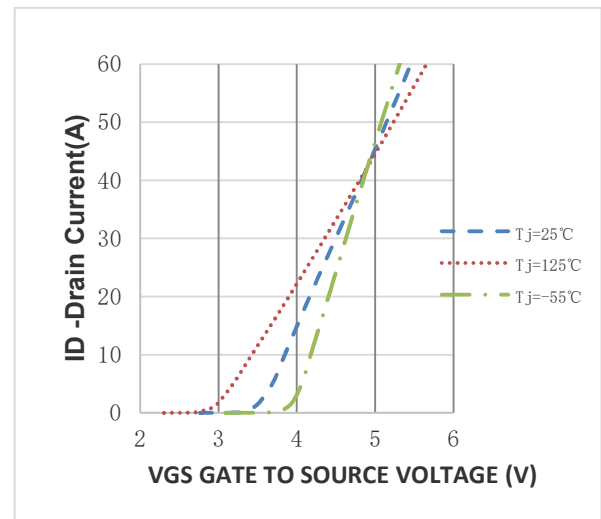


Fig.11 Safe Operating Area

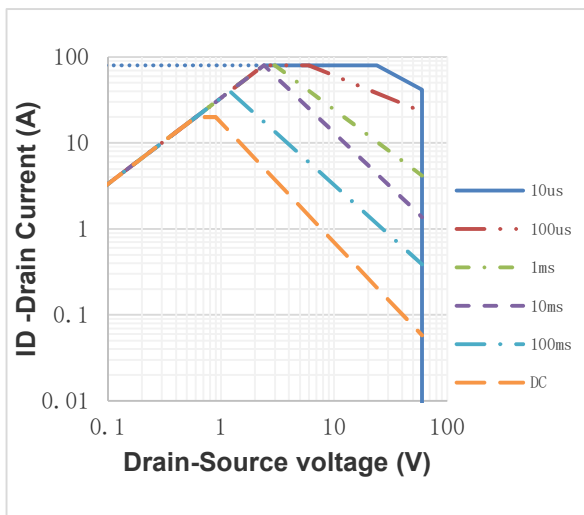
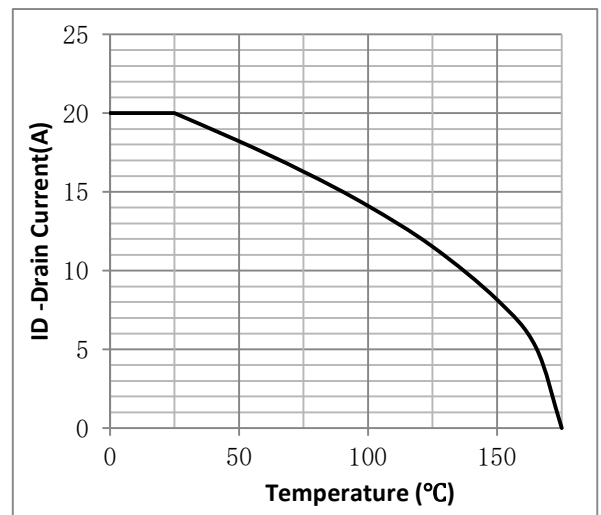


Fig.12 ID vs. Case Temperature^④



•p Channel characteristics curve

Fig.1 Gate-Charge Characteristics

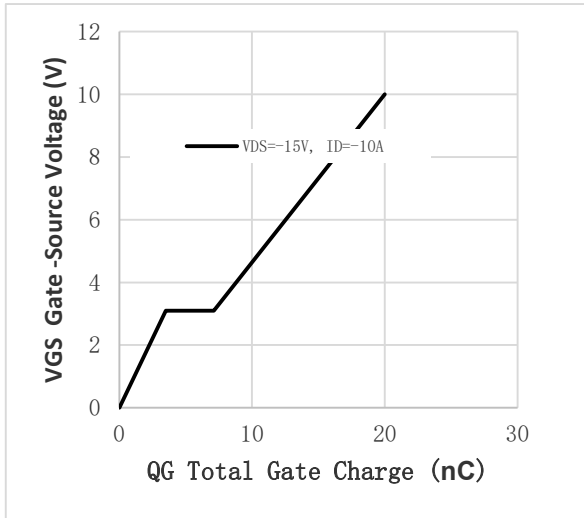


Fig.2 Capacitance Characteristics

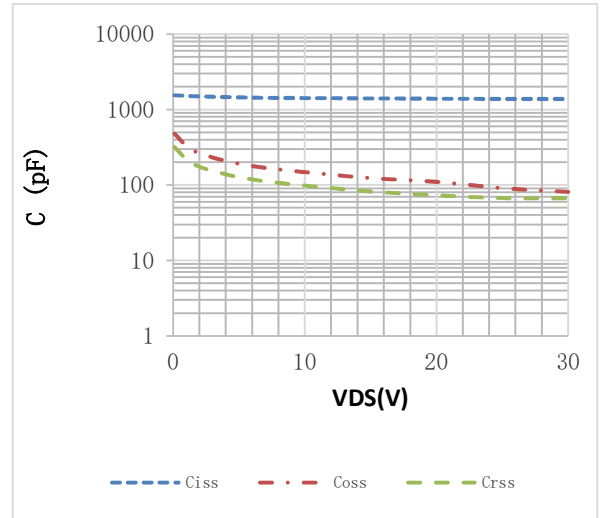


Fig.3 Power Dissipation

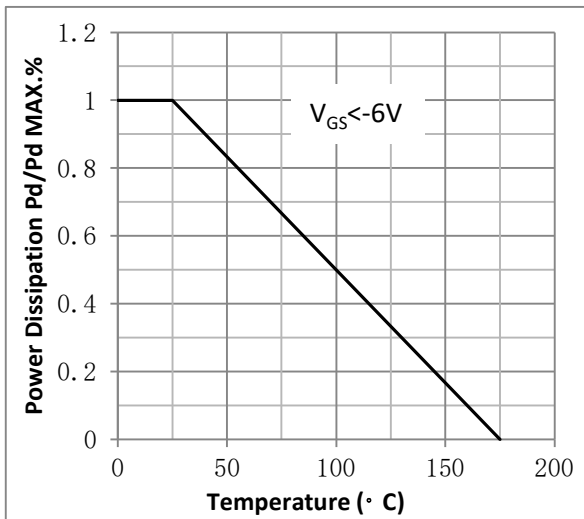


Fig.4 Typical output Characteristics

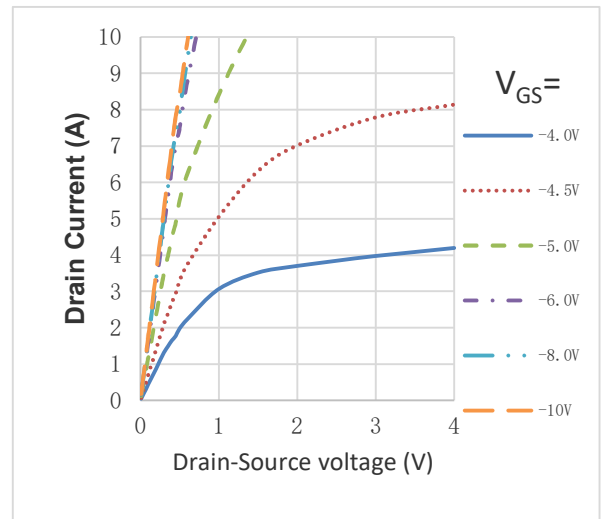


Fig.5 Threshold Voltage V.S Junction Temperature

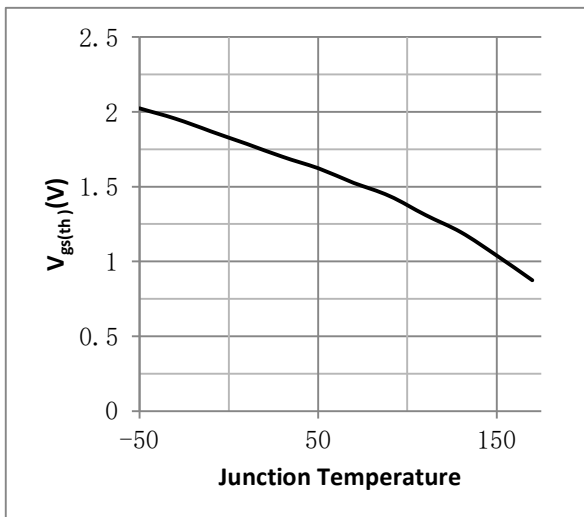


Fig.6 Resistance V.S Drain Current

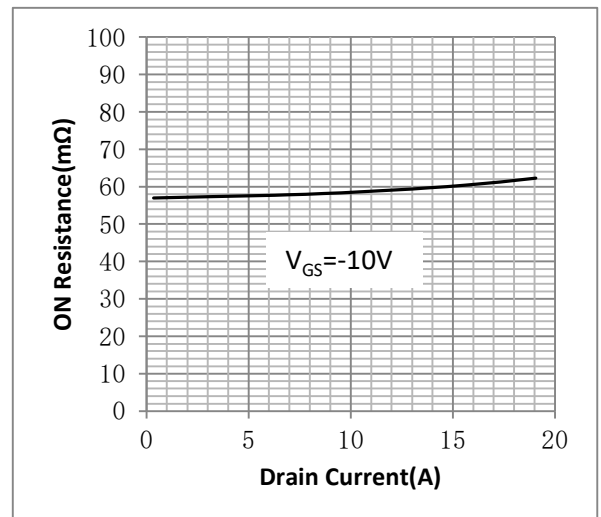


Fig.7 On-Resistance VS Gate Source Voltage

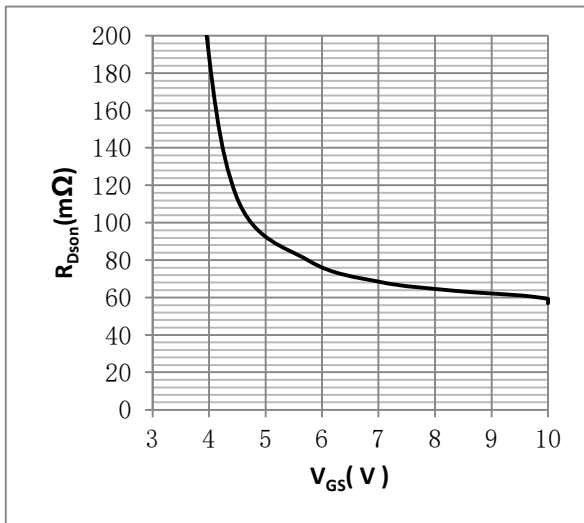


Fig.8 On-Resistance V.S Junction Temperature

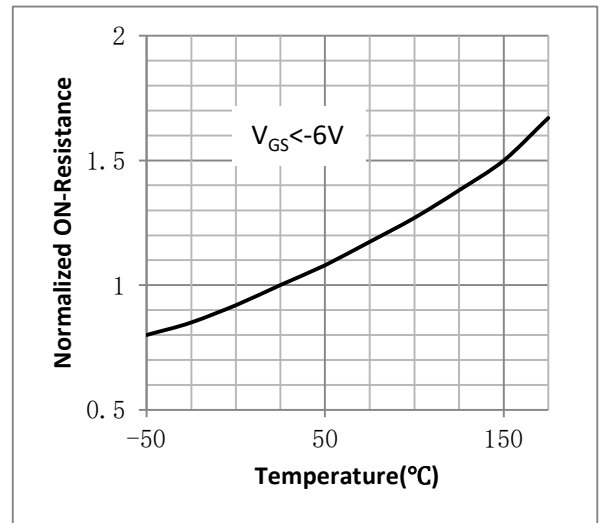


Figure 9. Diode Forward Voltage vs. Current

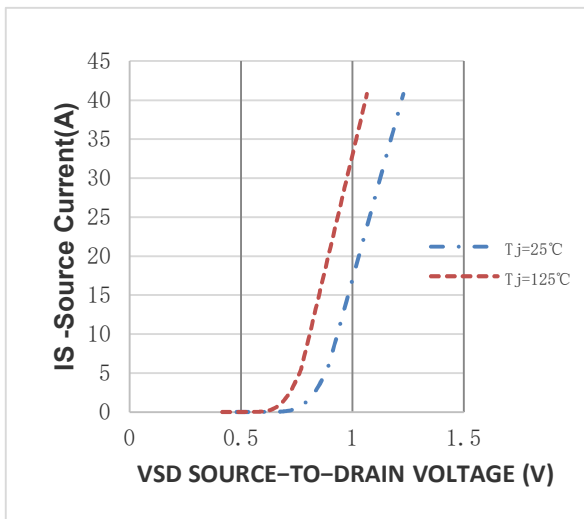


Figure 10. Transfer Characteristics

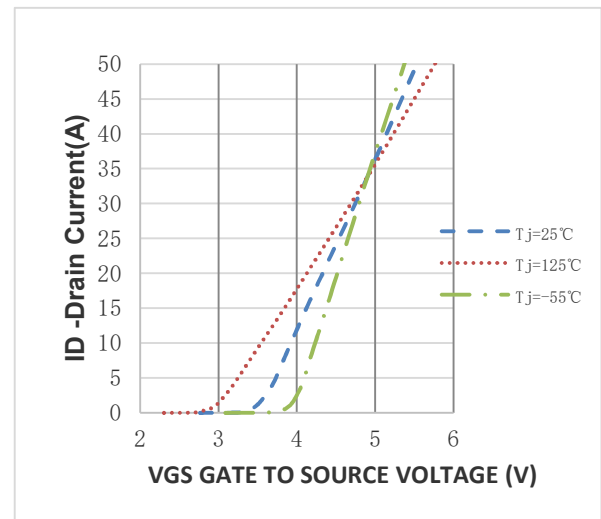


Fig.11 Safe Operating Area

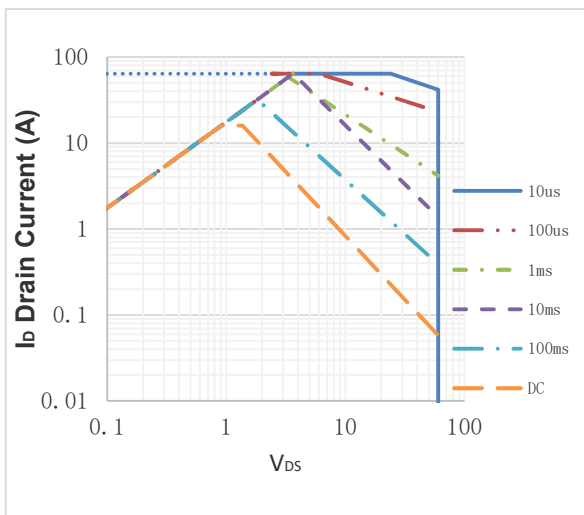
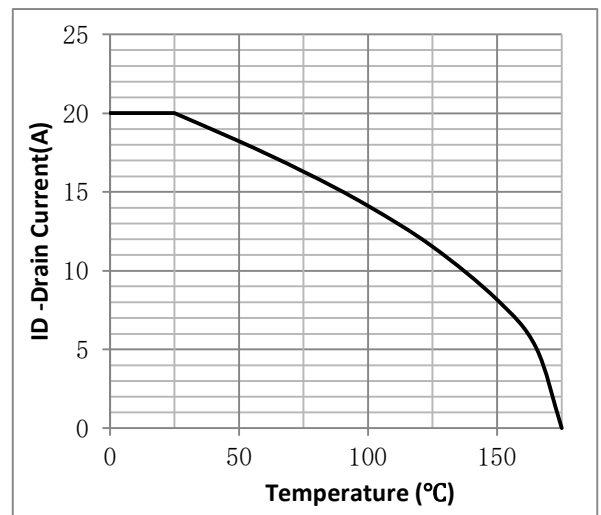
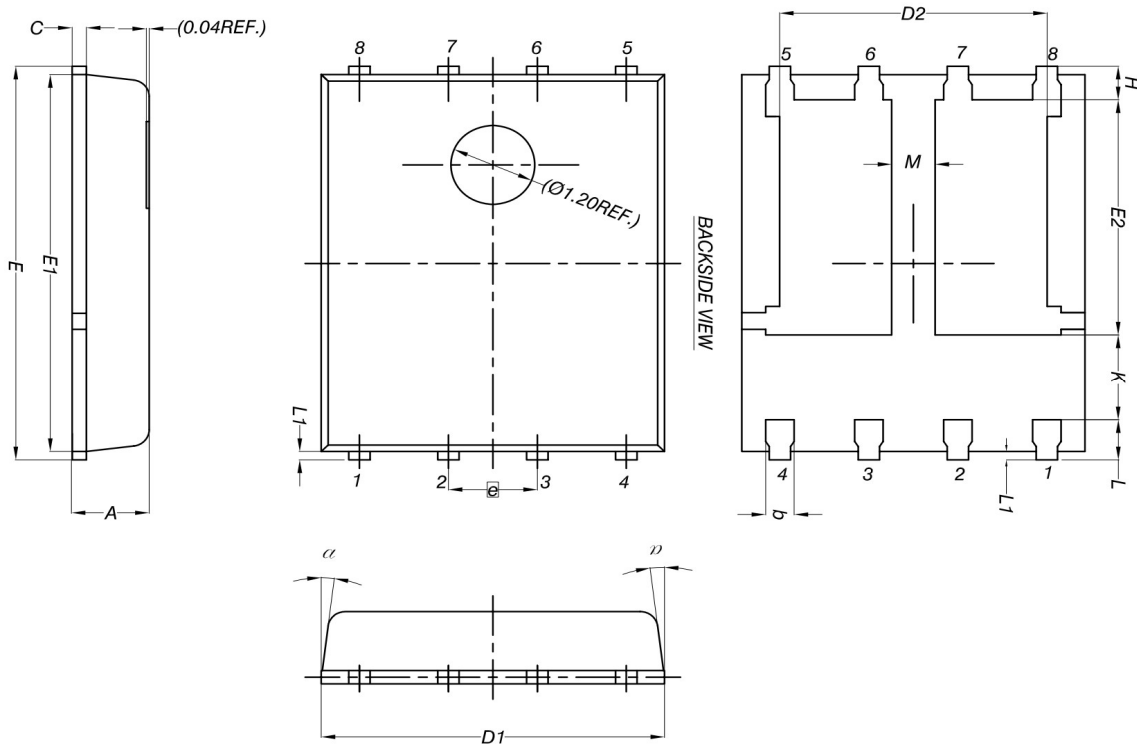


Fig.12 ID vs. Case Temperature^④

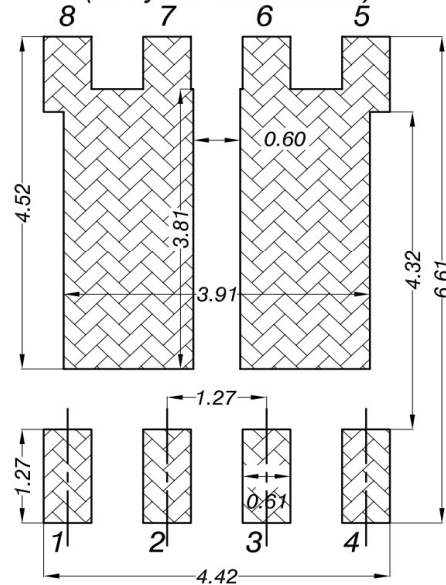


•DFN5*6 Package Outline



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°

Land Pattern
(Only for Reference)



60V N-Channel Dual DIE Power MOSFET**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 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 ;
- ③ Device mounted on FR-4 substrate PC board, 2oz copper, with thermal bias to bottom layer 1inch square copper plate;
- ④ Practically the current will be limited by PCB, thermal design and operating temperature.
 $V_{GS}=10V$ (N channel)/-10V(P channel).

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Revision History

Version	Date	Change
A	2022.2.16	NEW
B	2022.11.12	Modified the ID curve