60V N-Channel Dual DIE Power MOSFET

• 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

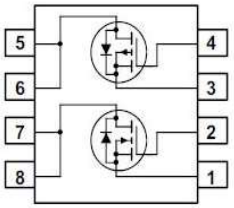
■Low Thermal resistance

•Application

■BLDC Motor driver

■Load switch

• Product Summary



V_{DS1}= 60V

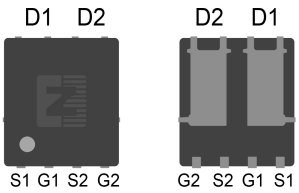
V_{DS2}= -60V

$R_{DS(ON)1}$ = 30mΩ

$R_{DS(ON)1}$ = 57mΩ

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℃)

Parameter	Symbol	Conditions	Value	Unit
Drain-Source Voltage	V_{DS}		60	V
Gate-Source Voltage①	V_{GS}		±20	V
Continuous Drain Current	I_D	T_C=25℃	20	A
	I_D	T_C=75℃	16	A
	I_D	T_C=100℃	14	A
Pulsed Drain Current	I_{DM}	Pulsed; t_p ≤ 10 μs; T_{mb} = 25 °C;	60	A
Total Power Dissipation	P_D	T_C=25℃	33	W
Total Power Dissipation	P_D	T_A=25℃	3.3	W
Operating Junction Temperature	T_J		-55 to +175	℃
Storage Temperature	T_{STG}		-55 to +175	℃
Single Pulse Avalanche Energy	E_{AS}	L=0.1mH, V_{GS}=10V, Rg=25Ω,	20	mJ
		L=0.5mH, V_{GS}=10V, Rg=25Ω,	38	mJ
ESD Level (HBM)			CLASS 1C	

●P Channel Absolute Maximum Ratings (T_C=25℃)

Parameter	Symbol	Conditions	Value	Unit
Drain-Source Voltage	V_{DS}		-60	V
Gate-Source Voltage②	V_{GS}		±20	V
Continuous Drain Current	I_D	T_C=25℃	-16	A
	I_D	T_C=75℃	-13	A
	I_D	T_C=100℃	-11	A
Pulsed Drain Current	I_{DM}	Pulsed; t_p ≤ 10 μs; T_{mb} = 25 °C;	-48	A
Total Power Dissipation	P_D	T_C=25℃	33	W
Total Power Dissipation	P_D	T_A=25℃	3.3	W
Operating Junction Temperature	T_J		-55 to +175	℃
Storage Temperature	T_{STG}		-55 to +175	℃
Single Pulse Avalanche Energy	E_{AS}	L=0.1mH, V_{GS}=-10V, Rg=25Ω,	20	mJ
		L=0.5mH, V_{GS}=-10V, Rg=25Ω,	36	mJ
ESD Level (HBM)	CLASS 1C			

●Thermal resistance

Parameter	Symbol	Min.	Typ.	Max.	Unit
Thermal resistance, junction - case	R_{thJC}		-	4.6	°C/W
Thermal resistance, junction-ambient③	R_{thJA}		-	45	°C/W
Soldering temperature	Tsold		-	260	°C

●N Channel Electronic Characteristics

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Drain-Source Breakdown Voltage	BV_{DSS}	V_{GS} =0V, I_D =250uA	60			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}= 60V			1.0	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= 12A		30	39	mΩ
		V_{GS}=4.5V, I_D= 8A		34	45	mΩ
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	Ciss	f = 1MHz, V_{DS}=25V	-	1300	-	pF
Output capacitance	Coss		-	53	-	
Reverse transfer capacitance	Crss		-	31	-	
Gate Risistance	Rg	f = 1MHz	-	1.5		Ω
Total gate charge	Qg	V_{DD} =15V, I_D =12A, V_{GS} =10V	-	17	-	nC
	Qg (4.5v)		-	9	-	
Gate - Source charge	Qgs		-	4.1	-	
Gate - Drain charge	Qgd		-	2.5	-	
Turn-ON Delay time	$t_{D(on)}$	V_{GS}=10V,V_{DS}=15V, R_G =3.3Ω, 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/us, I_S=20A	-	50	-	ns
Reverse Recovery Charge	Qrr		-	45	-	nC

●P Channel Electronic Characteristics

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Drain-Source Breakdown Voltage	BV_{DSS}	V_{GS} =0V, I_D =-250uA	-60			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}= -60V			1.0	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= -10A		57	74	mΩ
		V_{GS}=-4.5V, I_D= -8A		76	100	mΩ
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	Ciss	f = 1MHz, V_{DS}=-25V	-	1380	-	pF
Output capacitance	Coss		-	101	-	
Reverse transfer capacitance	Crss		-	67	-	
Gate Risistance	Rg	f = 1MHz	-	7.5		Ω
Total gate charge	Qg	V_{DD} = -15V, I_D = -10A, V_{GS} = -10V	-	20	-	nC
	Qg (4.5v)		-	25	-	
Gate - Source charge	Qgs		-	3.5	-	
Gate - Drain charge	Qgd		-	3.6	-	
Turn-ON Delay time	$t_{D(on)}$	V_{GS}=-10V,V_{DS}=-15V, R_G =3.3Ω, 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/us, I_S=-20A	-	56	-	ns
Reverse Recovery Charge	Q_{RR}		-	84	-	nC

• N Channel characteristics curve

Fig.1 Gate-Charge Characteristics

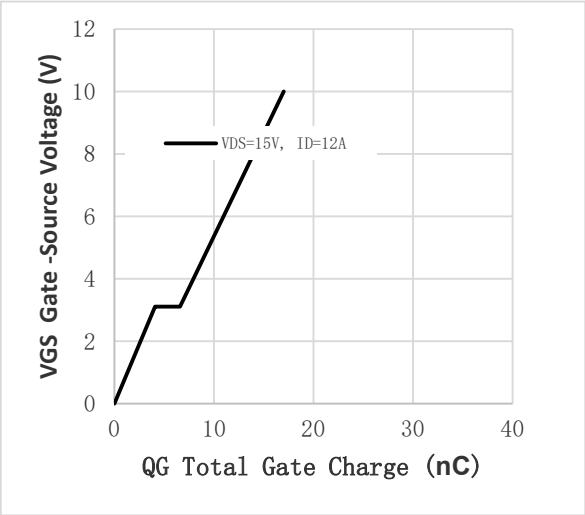


Fig.2 Capacitance Characteristics

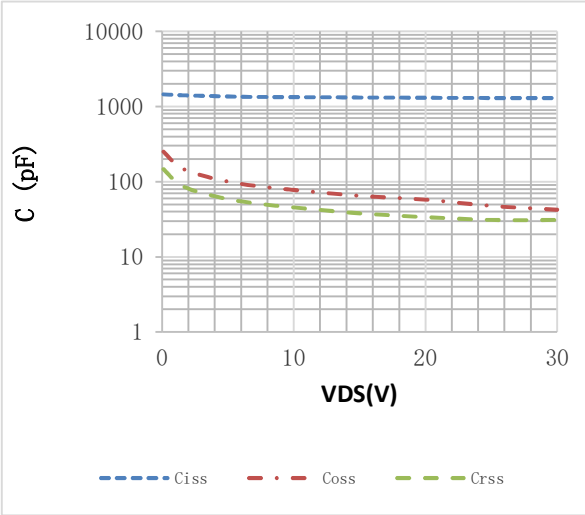


Fig.3 Power Dissipation

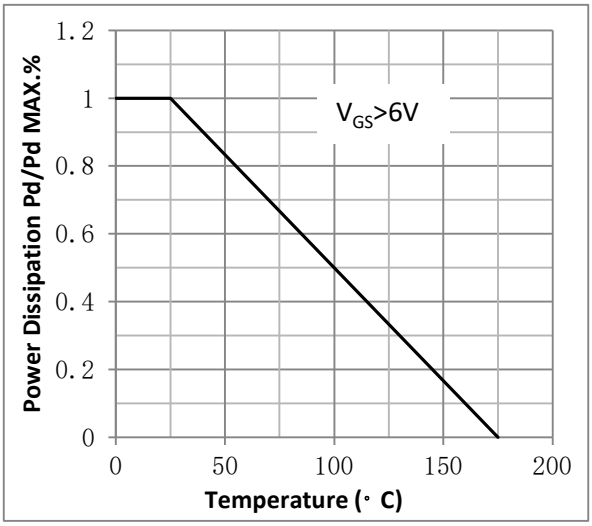


Fig.4 Typical output Characteristics

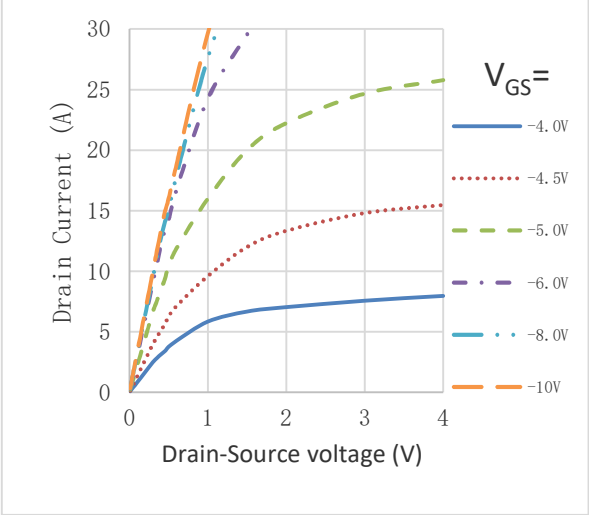


Fig.5 Threshold Voltage V.S Junction Temperature

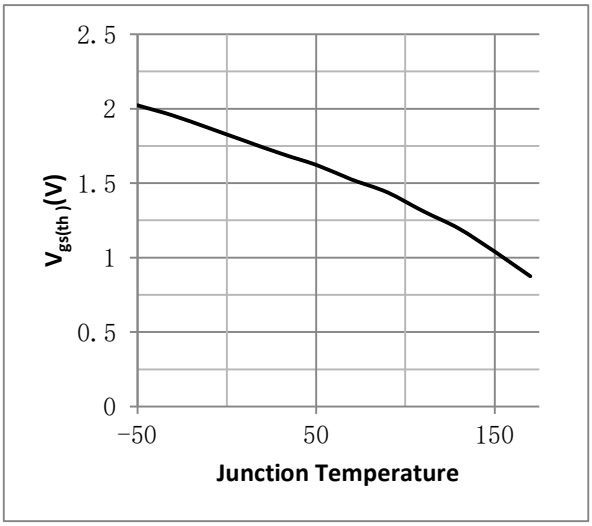


Fig.6 Resistance V.S Drain Current

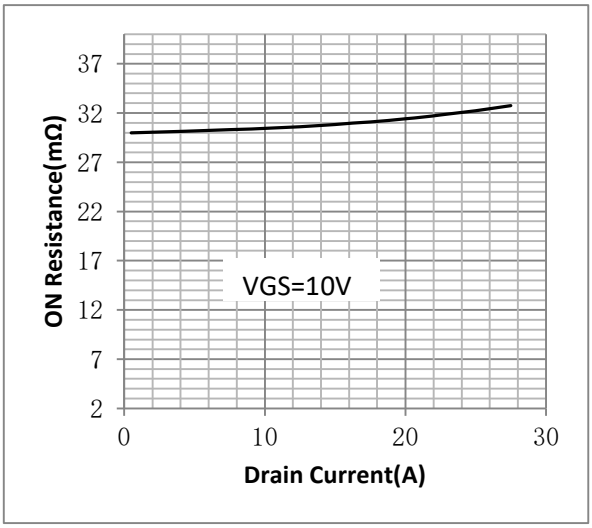


Fig.7 On-Resistance VS Gate Source Voltage

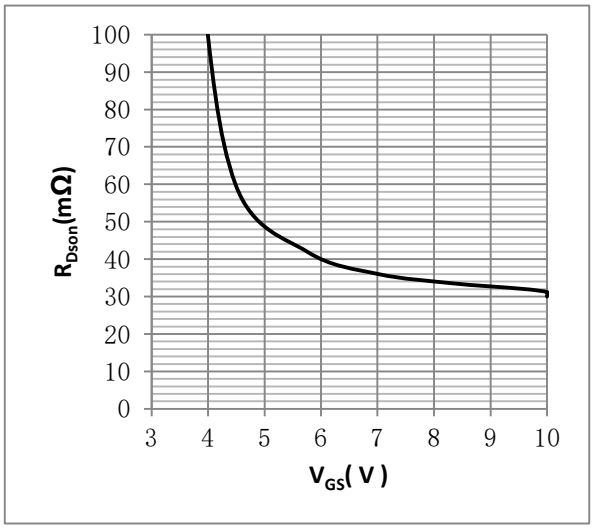


Fig.8 On-Resistance V.S Junction Temperature

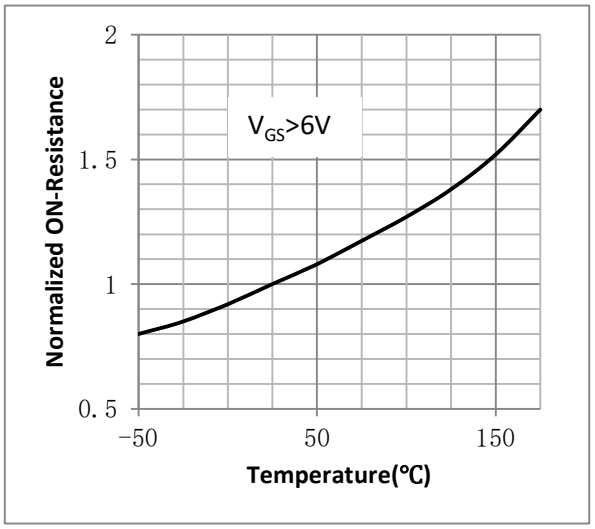


Figure 9. Diode Forward Voltage vs. Current

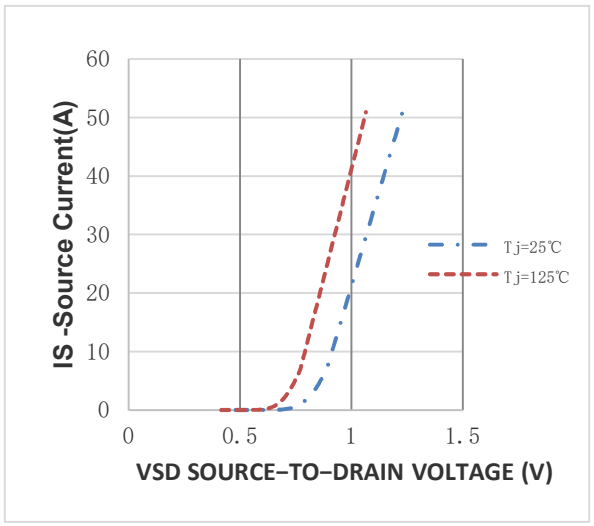


Figure 10. Transfer Characteristics

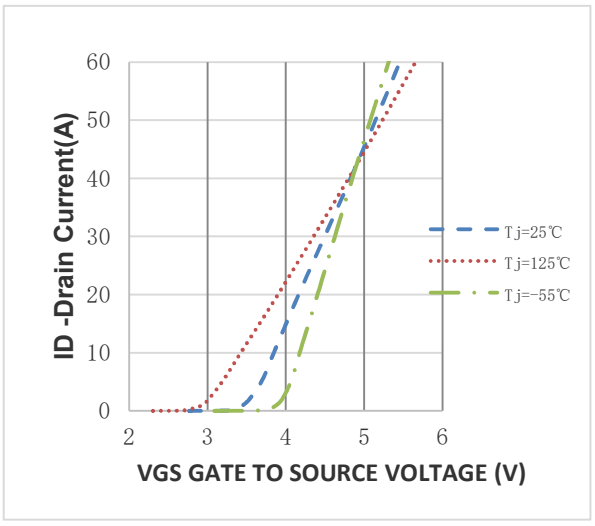


Fig.11 Safe Operating Area

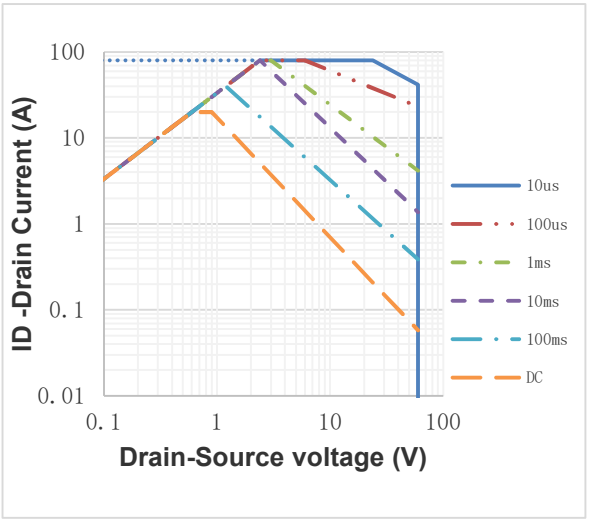
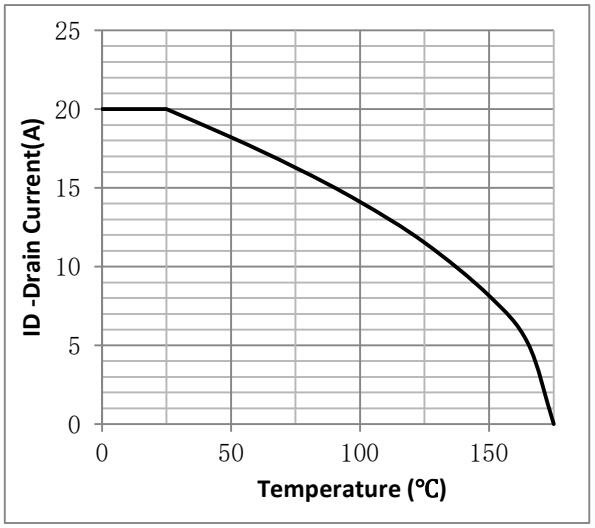


Fig.12 ID vs. Case Temperature④



•p Channel characteristics curve

Fig.1 Gate-Charge Characteristics

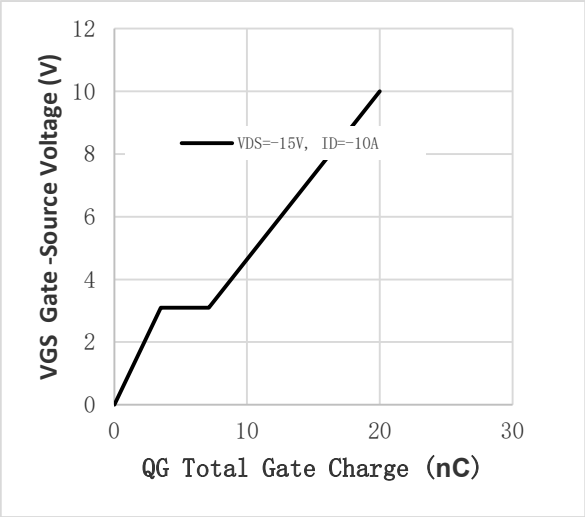


Fig.2 Capacitance Characteristics

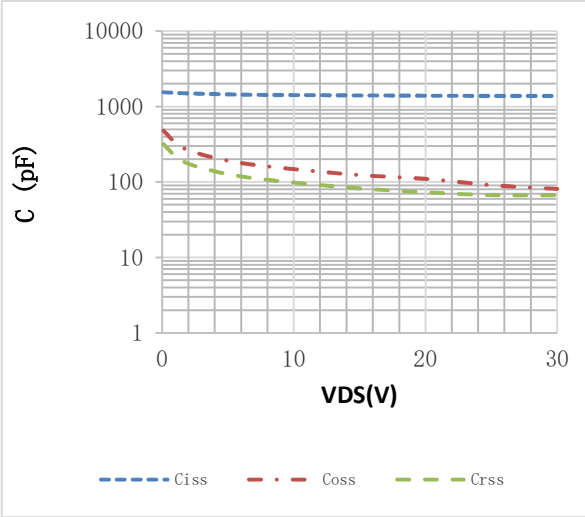


Fig.3 Power Dissipation

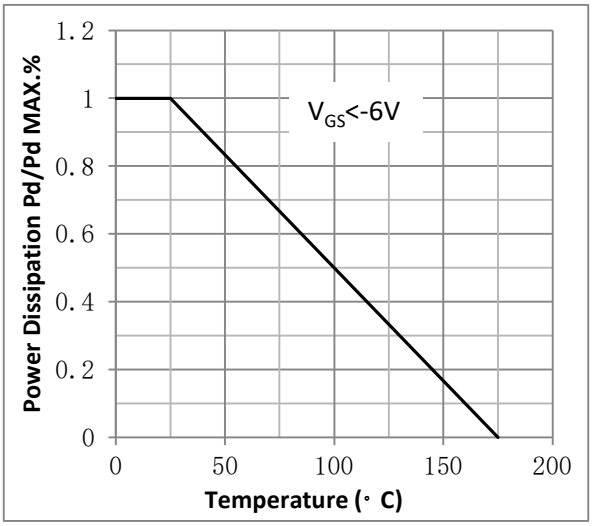


Fig.4 Typical output Characteristics

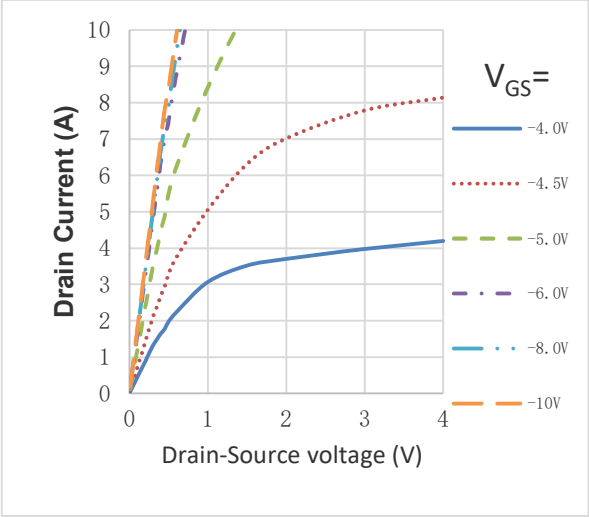


Fig.5 Threshold Voltage V.S Junction Temperature

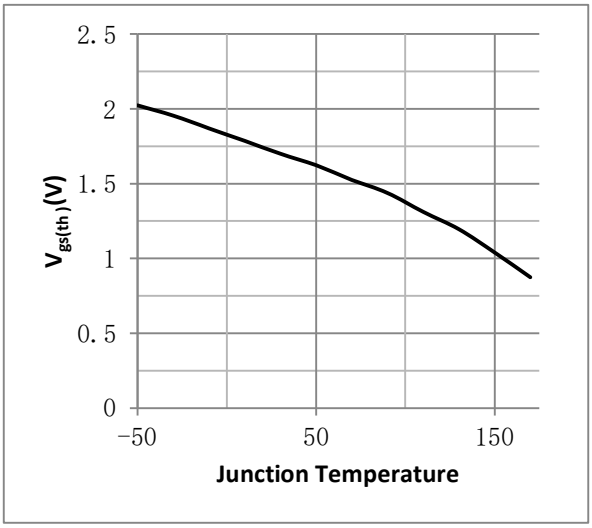


Fig.6 Resistance V.S Drain Current

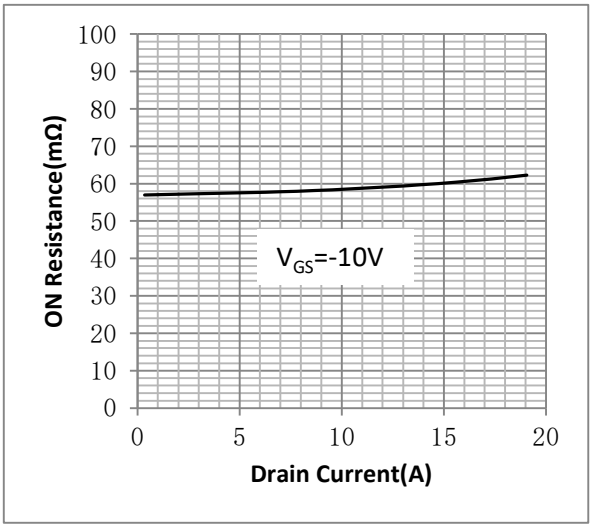


Fig.7 On-Resistance VS Gate Source Voltage

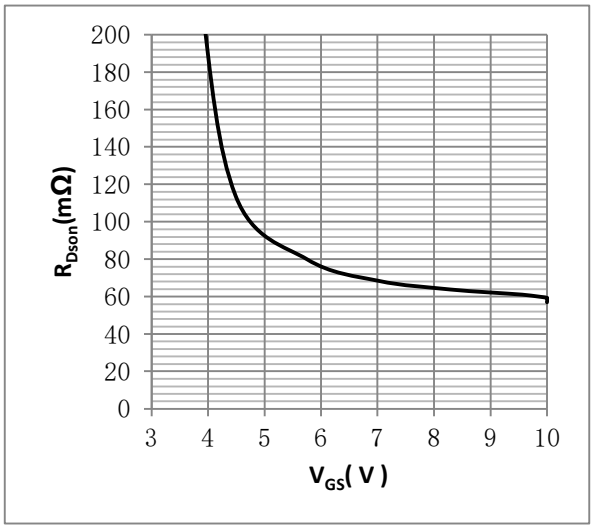


Fig.8 On-Resistance V.S Junction Temperature

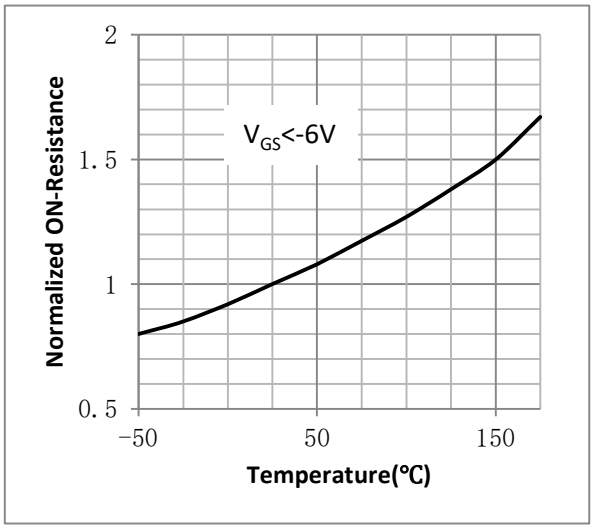


Figure 9. Diode Forward Voltage vs. Current

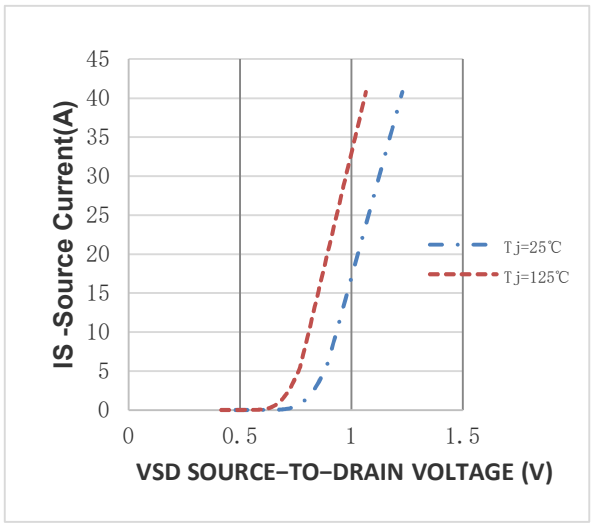


Figure 10. Transfer Characteristics

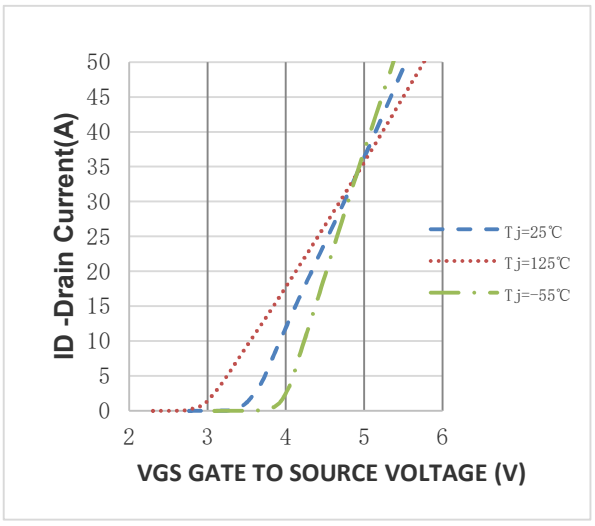


Fig.11 Safe Operating Area

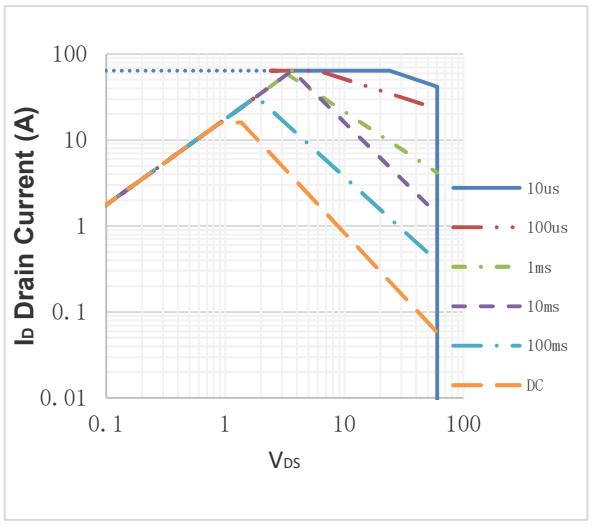
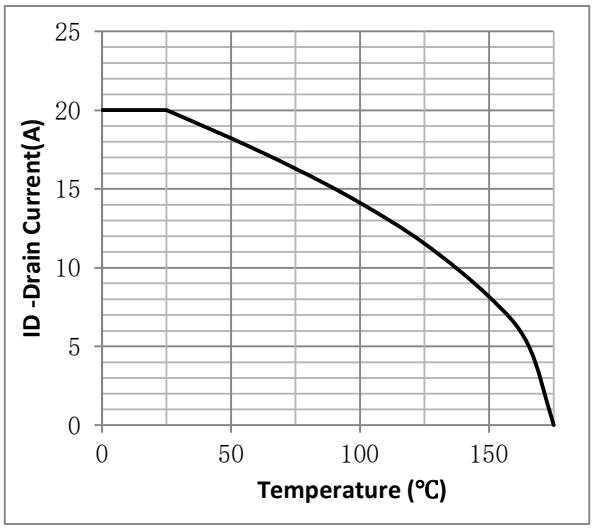
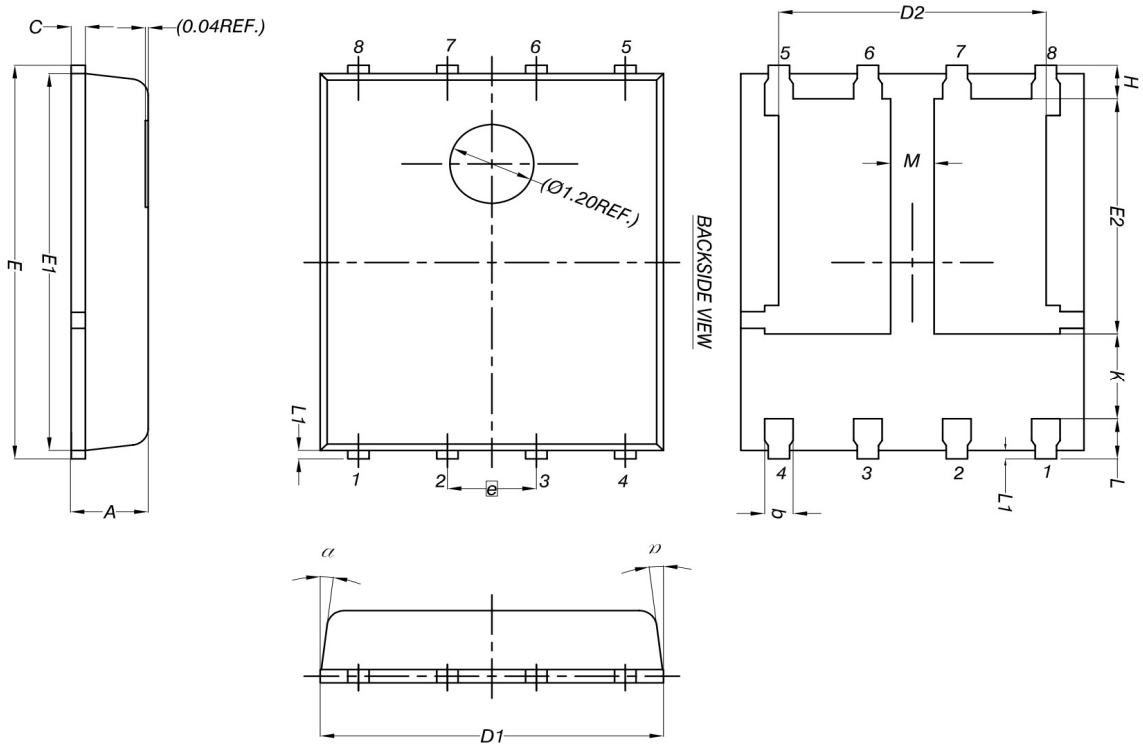


Fig.12 ID vs. Case Temperature④

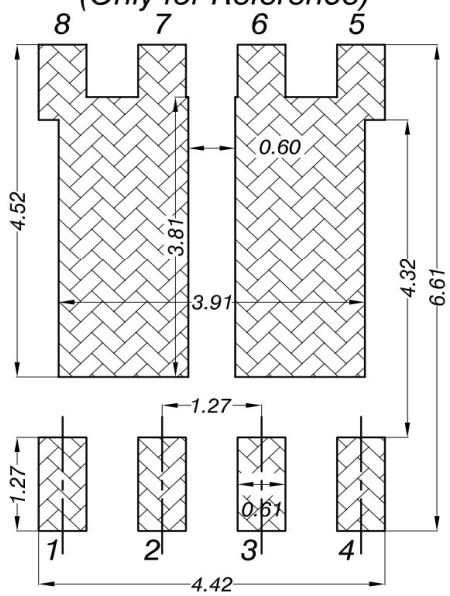


●DFN5*6 Package Outline



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)



Note:

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

② Pulse : VGS=+20V/-20V, Duty cycle=50%,Tj=175℃, t=1000 hours; For DC， the following test conditions can be passed: VGS=-20V/+10V, Tj=175℃, 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. VGS=10V (N channel)/-10V(P channel).

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Revision History

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