

● General Description

It combines trench MOSFET technology with a low resistance package to provide extremely low $R_{DS(ON)}$.

● Features

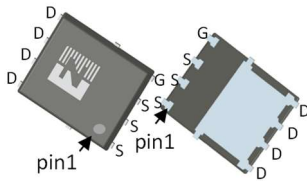
- Low $R_{DS(ON)}$ to minimize conductive loss
- Low Gate Charge for fast switching
- Low thermal resistance
- AEC-Q101 qualified

● Application

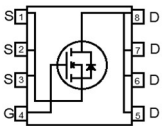
- BLDC motor driver
- DC-DC
- Load switch



● Product Summary



DFN5*6



$V_{DS}=40V$

$R_{DS(ON)}=2.9m\Omega$

$I_D=100A$



● Ordering Information

Part NO.	ZMA023N04N
Marking	ZM023N04
Packing information	REEL TAPE
Basic ordering unit (pcs)	3000

● Absolute Maximum Ratings ($T_A=25^\circ C$, unless otherwise specified)

Parameter	Symbol	Conditions	Min.	Max.	Unit
Drain-source voltage	V_{DS}		-	40	V
Gate-source voltage ^①	V_{GS}		-20	20	V
Continuous drain current	I_D	$V_{GS}=10V, T_C=25^\circ C$	-	100	A
	I_D	$V_{GS}=10V, T_C=75^\circ C$	-	100	A
	I_D	$V_{GS}=10V, T_C=100^\circ C$	-	100	A
Pulsed drain current	I_{DM}	Pulsed; $t_p \leq 10 \mu s; T_C = 25^\circ C$	-	400	A
Diode continuous current	I_S	$V_{GS}=0V, T_C=25^\circ C$	-	100	A
Diode pulse current	$I_{S,pulse}$	$V_{GS}=0V$, Pulsed, $t_p \leq 10 \mu s, T_C = 25^\circ C$	-	400	A
Total power dissipation	P_D	$T_C=25^\circ C$	-	197	W
Total power dissipation	P_D	$T_A=25^\circ C$	-	3.3	W
Operating junction temperature	T_J		-55	175	$^\circ C$
Storage temperature	T_{STG}		-55	175	$^\circ C$
Single pulse avalanche energy	E_{AS}	$L=0.1mH, V_{GS}=10V, R_g=25\Omega$	-	180	mJ
		$L=0.5mH, V_{GS}=10V, R_g=25\Omega$	-	324	mJ

ESD level (HBM)		CLASS 2
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● Thermal resistance

Parameter	Symbol	Min.	Typ.	Max.	Unit
Thermal resistance, junction - case	R_{thJC}	-	-	0.76	°C/W
Thermal resistance, junction - ambient	$R_{thJA}^{\circledast}$	-	-	45	°C/W
Soldering temperature	T_{sold}	-	-	260	°C

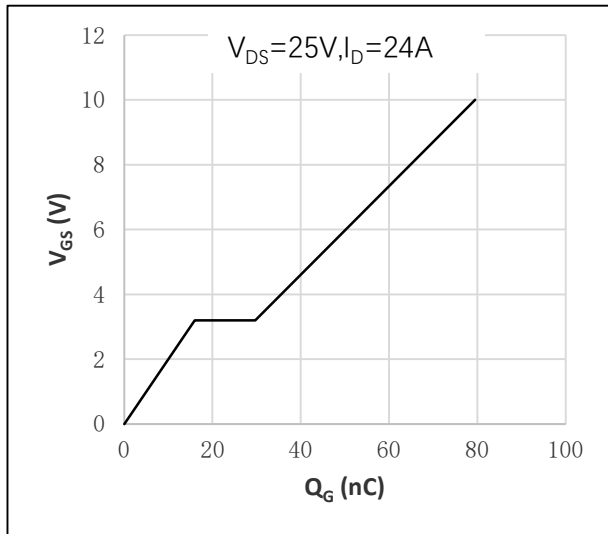
● Electronic Characteristics ($T_J=25^{\circ}\text{C}$, unless otherwise specified)

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	μA
Gate- source leakage current	I_{GSS}	$V_{GS}=\pm 20V, V_{DS}=0V$	-	-	± 100	nA
Static drain-source on resistance	$R_{DS(on)}$	$V_{GS}=10V, I_D=24A, T_J=25^{\circ}\text{C}$	-	2.9	3.5	m Ω
		$V_{GS}=10V, I_D=24A, T_J=175^{\circ}\text{C}$	-	5.4	-	m Ω
		$V_{GS}=4.5V, I_D=12A, T_J=25^{\circ}\text{C}$	-	4.1	-	m Ω
Forward transconductance	g_{FS}	$V_{DS}=5V, I_{SD}=10A$	-	26	-	S
Diode forward voltage	V_{FSD}	$V_{GS}=0V, I_{SD}=24A$	-	0.8	1.3	V

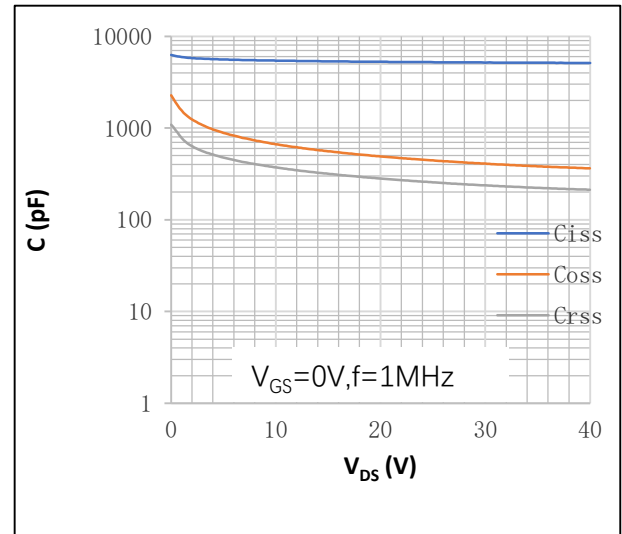
● Dynamic characteristics ($T_J=25^{\circ}\text{C}$, unless otherwise specified)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Input capacitance	C_{iss}	$f=1\text{MHz}, V_{DS}=25V, V_{GS}=0V$	-	5236	-	pF
Output capacitance	C_{oss}		-	445	-	pF
Reverse transfer capacitance	C_{rss}		-	257	-	pF
Gate resistance	R_g	$f=1\text{MHz}$	-	1.2	-	Ω
Total gate charge	Q_g	$V_{DD}=25V, I_D=24A, V_{GS}=10V$	-	79.5	-	nC
Total gate charge	$Q_{g(4.5V)}$		-	39.2	-	nC
Gate-source charge	Q_{gs}		-	16	-	nC
Gate-drain charge	Q_{gd}		-	13.7	-	nC
Turn-on delay time	$t_{D(on)}$	$V_{GS}=10V, V_{DS}=25V, R_G=3.3\Omega, I_D=24A$	-	12	-	ns
Turn-on rise time	t_r		-	7	-	ns
Turn-off delay time	$t_{D(off)}$		-	53	-	ns
Turn-off fall time	t_f		-	14	-	ns
Reverse recovery time	t_{rr}	$V_{DD}=25V, dI_S/dt=100A/\mu s, I_S=24A$	-	22	-	ns
Reverse recovery charge	Q_{rr}		-	18	-	nC

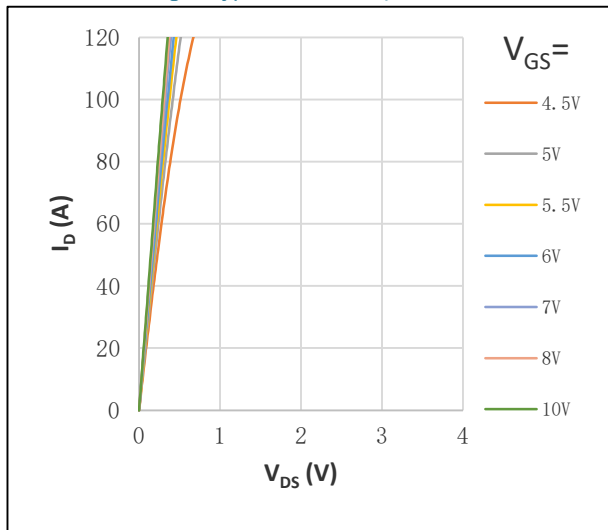
● Fig.1 Gate-source voltage as a function of gate charge; Typical values; $T_J=25^\circ\text{C}$



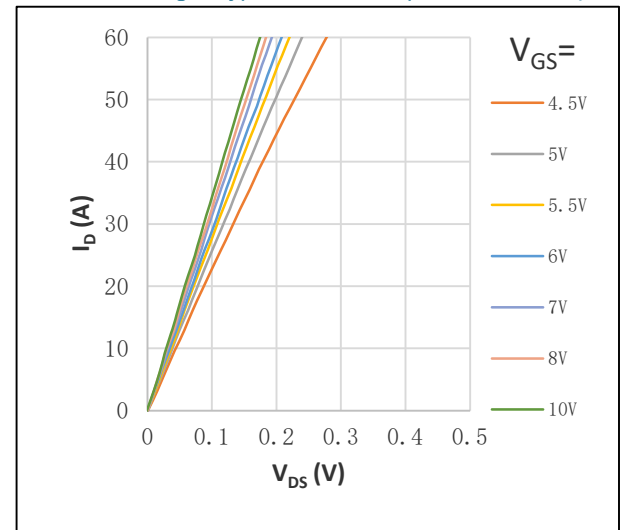
● Fig.2 Input, output and reverse transfer capacitances as a function of drain-source voltage; Typical values; $T_J=25^\circ\text{C}$



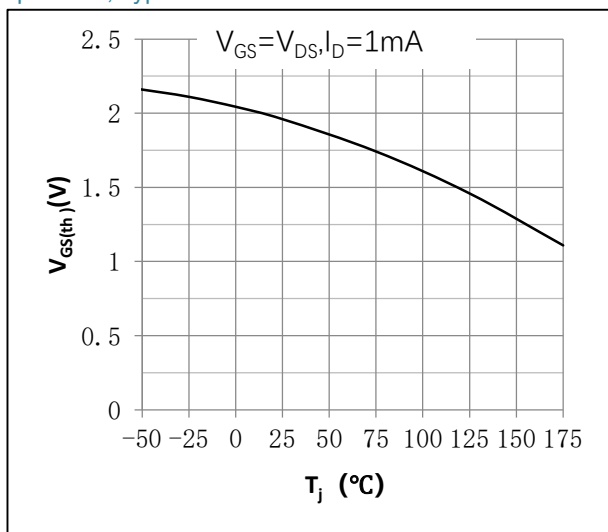
● Fig.3 Output characteristics: drain current as a function of drain-source voltage; Typical values; $T_J=25^\circ\text{C}$



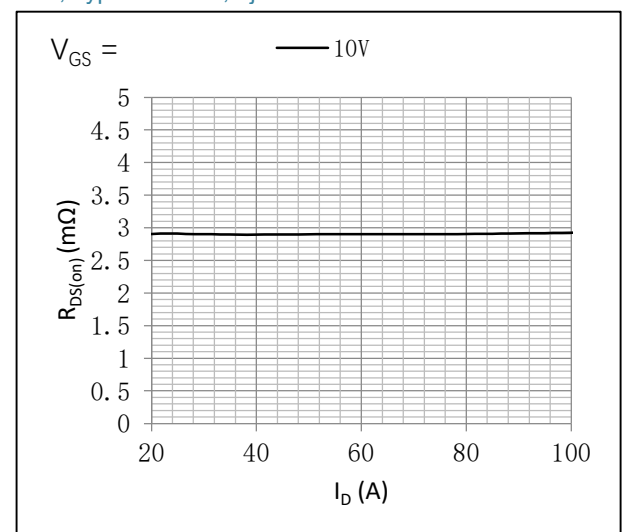
● Fig.4 Output characteristics: drain current as a function of drain-source voltage; Typical values: Expanded curve; $T_J=25^\circ\text{C}$



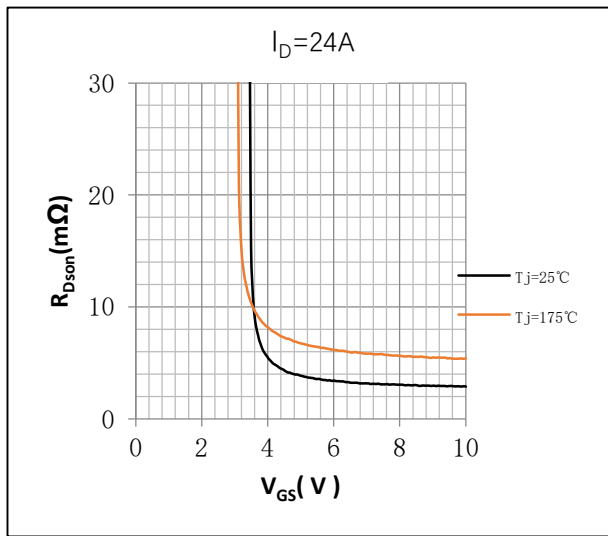
● Fig.5 Gate-source threshold voltage as a function of junction temperature; Typical values



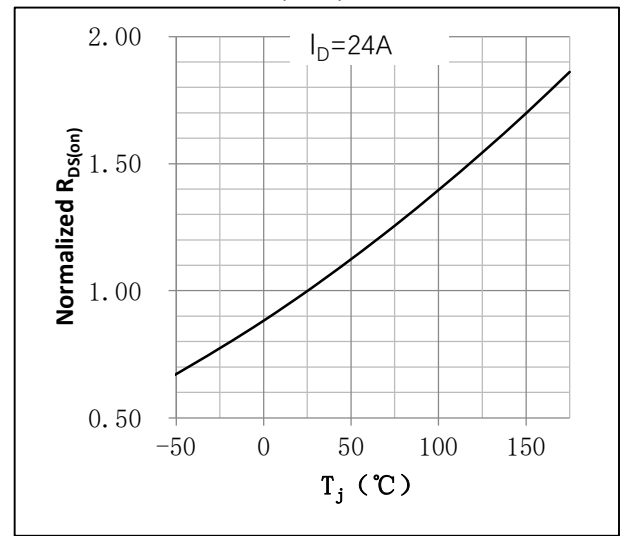
● Fig.6 Drain-source on-state resistance as a function of drain current; Typical values; $T_J=25^\circ\text{C}$



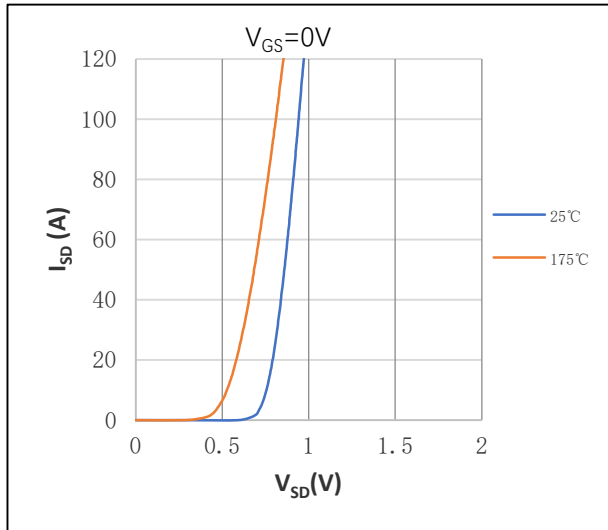
● Fig.7 Drain-source on-state resistance as a function of gate-source voltage; Typical values



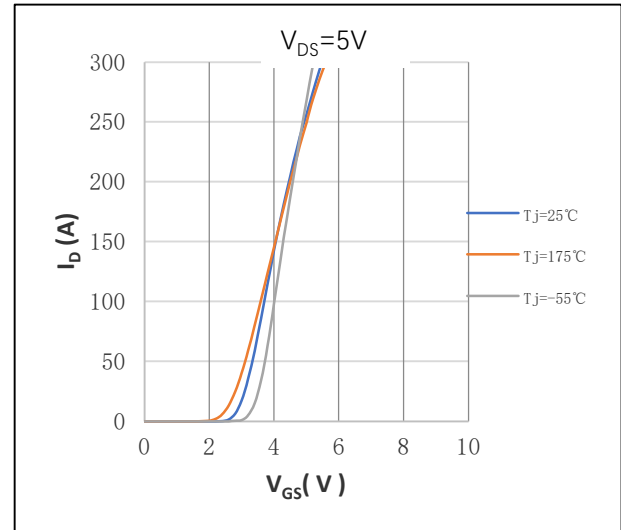
● Fig.8 Normalized drain-source on-state resistance factor as a function of junction temperature; Typical values Normalized On-Resistance = $R_{DS(on)}/R_{DS(on)}(25^{\circ}\text{C})$



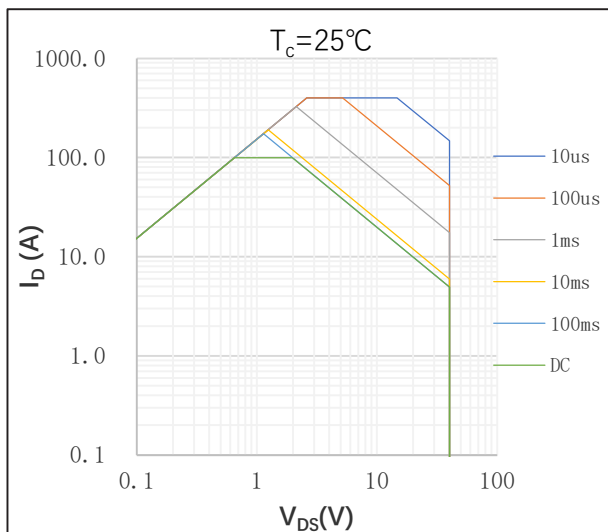
● Figure 9. Source (diode forward) current as a function of source-drain (diode forward) voltage; Typical values



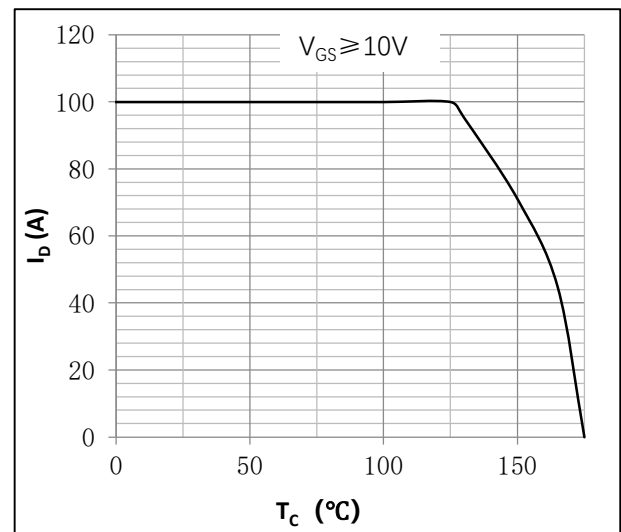
● Figure 10. Transfer characteristics: drain current as a function of gate-source voltage; Typical values



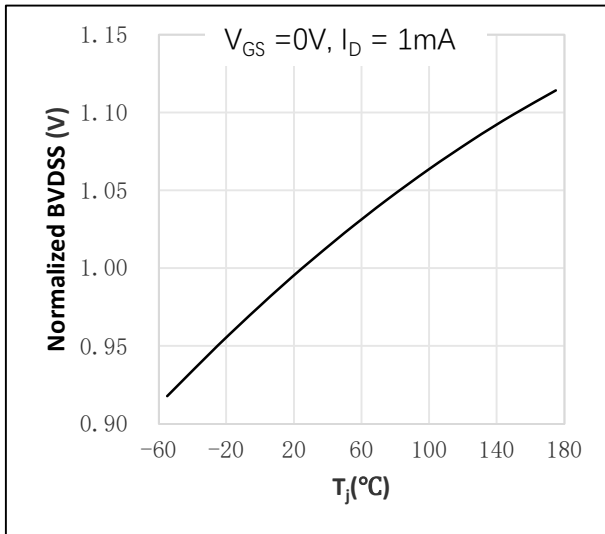
● Fig.11 Safe operating area: continuous and peak drain currents as a function of drain-source voltage; Calculative values



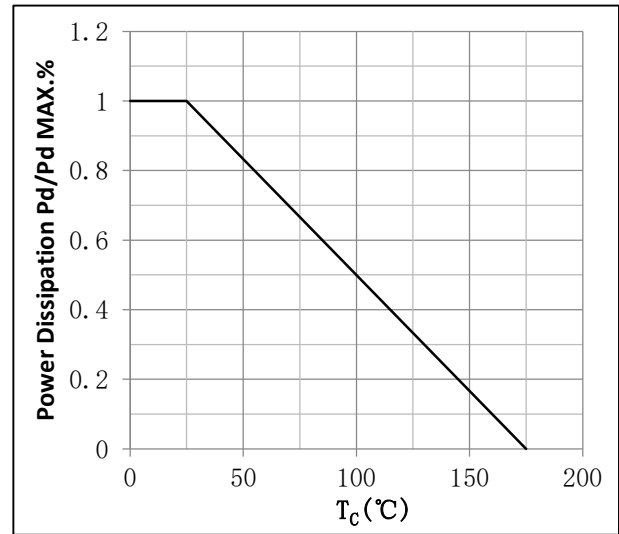
● Fig.12 Continuous drain current as a function of case temperature³; Calculative values



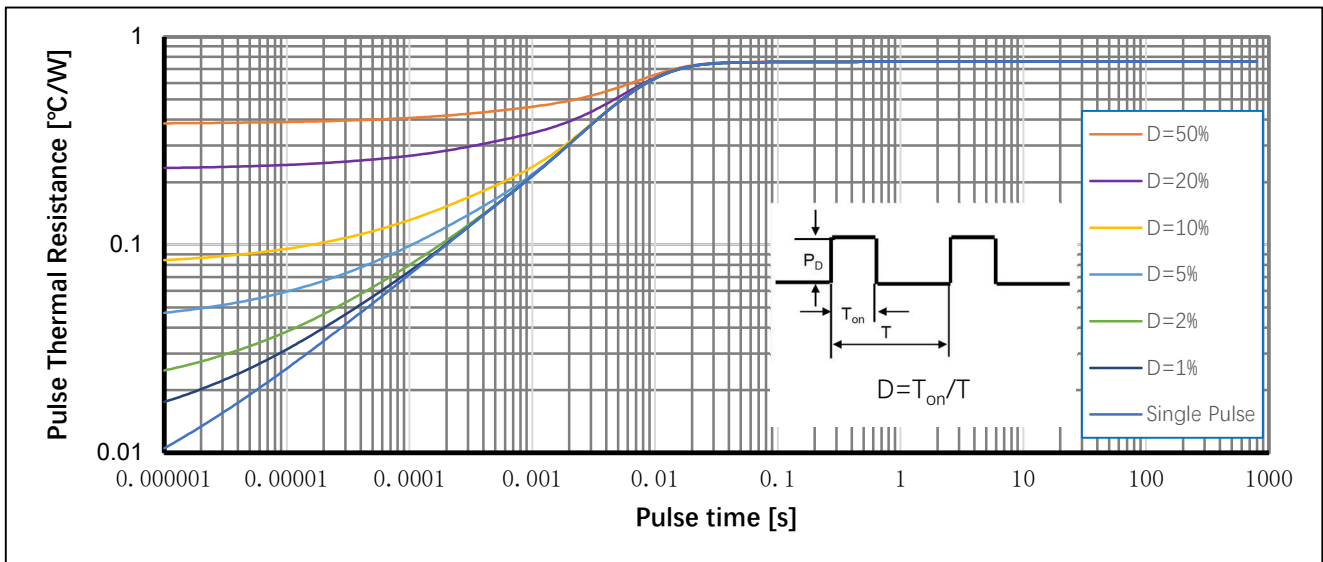
● Fig.13 Drain-source breakdown voltage as a function of junction temperature; Typical values Normalized $BV_{DSS} = BV_{DSS}/BV_{DSS}(25^{\circ}\text{C})$



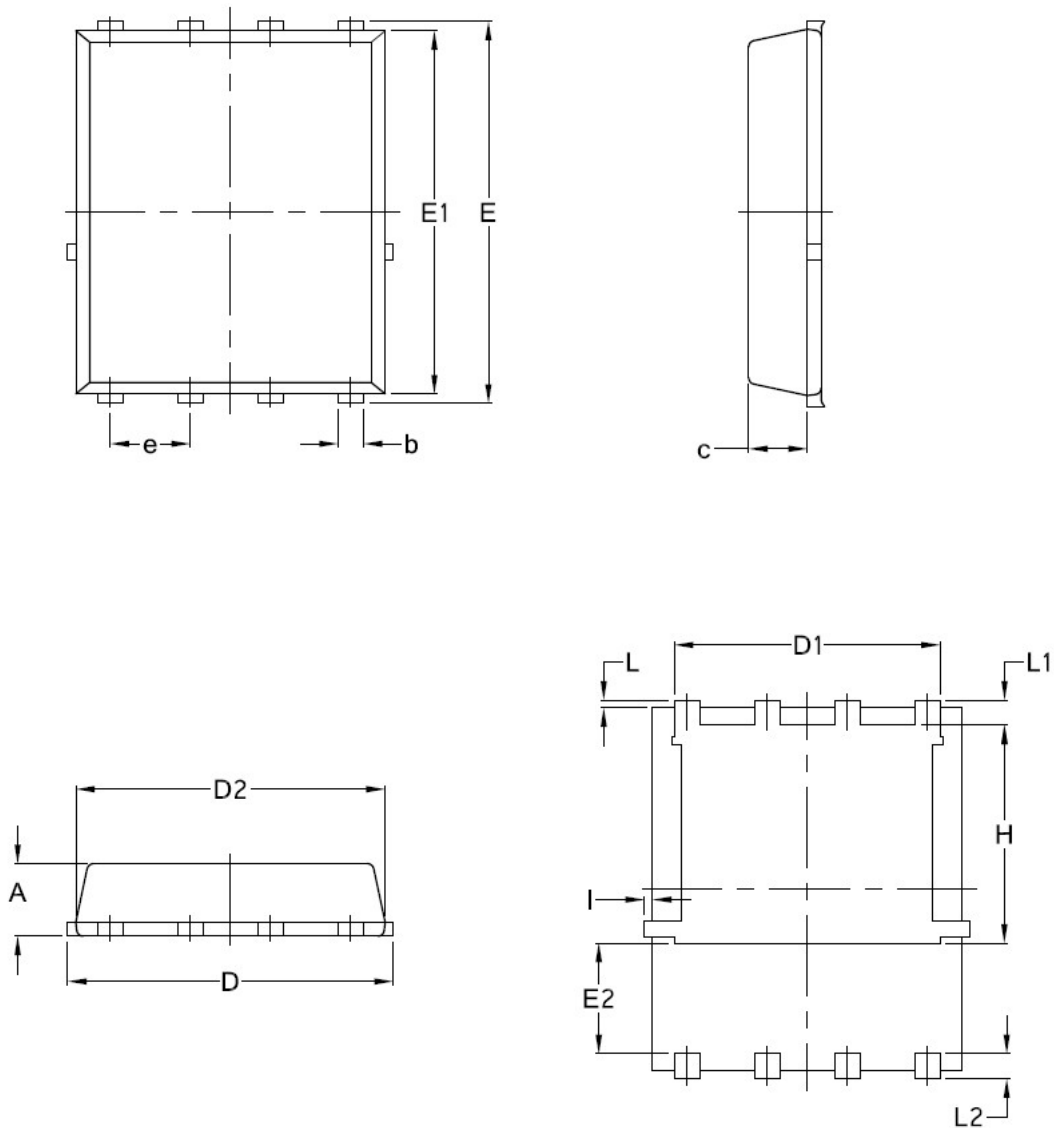
● Fig.14 Normalized total power dissipation as a function of case temperature; Calculative values Normalized Power Dissipation $= P_d/P_d(25^{\circ}\text{C})$



● Fig.15 Transient thermal impedance from junction to case as a function of pulse duration; max values



● Package Outline



SYMBOL	COMMON			
	MM		INCH	
	MIN.	MAX.	MIN.	MAX.
A	1.03	1.17	0.0406	0.0461
b	0.34	0.48	0.0134	0.0189
c	0.824	0.970	0.0324	0.0382
△ D	4.80	5.40	0.1890	0.2126
D1	4.11	4.31	0.1618	0.1697
△ D2	4.80	5.00	0.1890	0.1969
E	5.95	6.15	0.2343	0.2421
E1	5.65	5.85	0.2224	0.2303
E2	1.60	—	0.0630	—
e	1.27	BSC	0.05	BSC
△ L	0.05	0.25	0.0020	0.0098
L1	0.38	0.50	0.0150	0.0197
L2	0.38	0.50	0.0150	0.0197
△ H	3.30	3.50	0.1299	0.1378
I	—	0.18	—	0.0070

● 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	2021.5.10	New
B	2022.9.5	1. Add Reach, HF figure 2.ID modify
C	2022.11.30	Temperature change to case temperature
D	2026.1.20	Apply new datasheet format.