

IV3B20023BA2 – 2000V 22.5mohm SiC MODULE

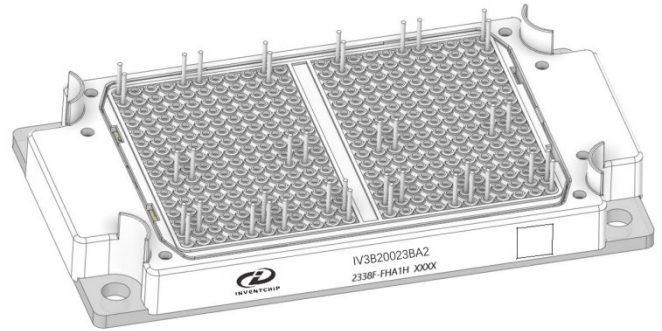
Features

- High blocking voltage with low on-resistance
- High speed switching with low capacitance
- High operating junction temperature capability

Applications

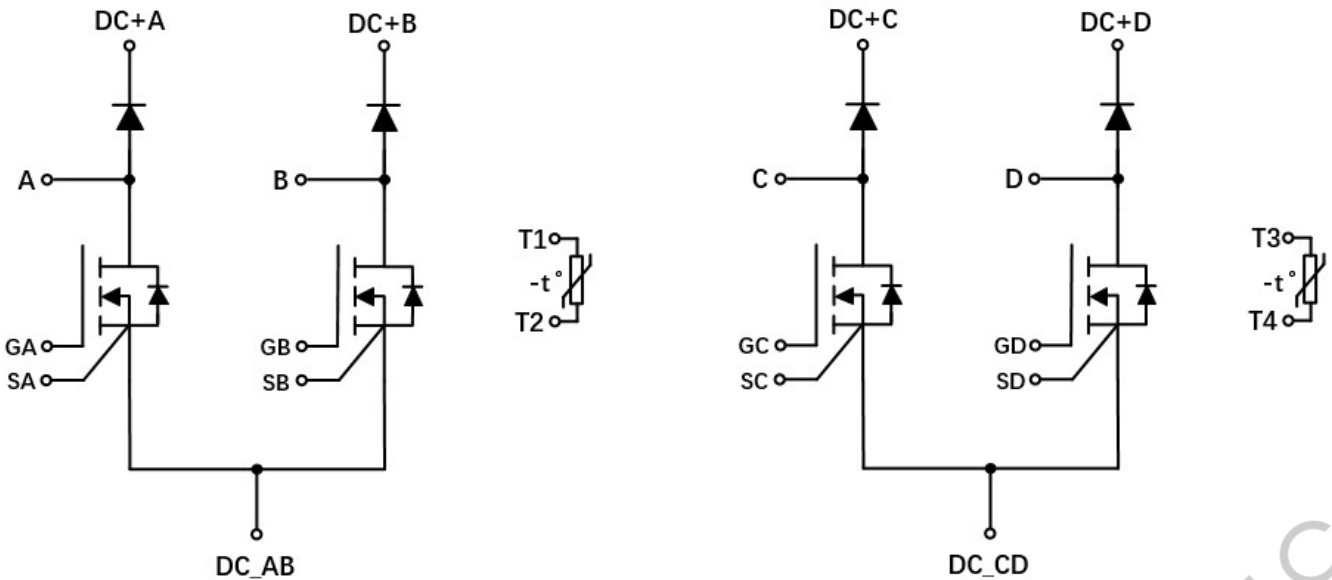
- Solar applications

Package



Marking Diagram

IV3B20023BA2	Specific Device Code	
YYWWZ-XXXXX	YY	Year
	WW	Work Week
	Z	Assembly Location
	XXXXX	Lot Traceability



Absolute Maximum Ratings (Per MOSFET, $T_c=25^\circ\text{C}$ unless otherwise specified)

Symbol	Parameter	Value	Unit	Test Conditions	Note
V_{DS}	Drain-Source voltage	2000	V	$V_{GS}=0\text{V}$, $I_D=300\mu\text{A}$	
$V_{GSmax}(\text{DC})$	Maximum DC voltage	-5 to 20	V	Static (DC)	
$V_{GSmax}(\text{Spike})$	Maximum spike voltage	-10 to 23	V	Duty cycle<1%, and pulse width<200ns	
V_{GSon}	Recommended turn-on voltage	18 ± 0.5	V		
V_{GSoff}	Recommended turn-off voltage	-3.5 to -2	V		
I_D	Drain current (continuous)	50	A	$V_{GS}=18\text{V}$, $T_c=132^\circ\text{C}$, $T_J\leq 175^\circ\text{C}$	
P_{TOT}	Total power dissipation	600	W	$T_c=25^\circ\text{C}$	
T_{stg}	Storage temperature range	-40 to 125	$^\circ\text{C}$		
T_J	Maximum virtual junction temperature under switching conditions	-40 to 150	$^\circ\text{C}$	Operation	
		-55 to 175	$^\circ\text{C}$	Intermittent with reduced life	

Absolute Maximum Ratings (Per SBD boost, $T_c=25^\circ\text{C}$ unless otherwise specified)

Symbol	Parameter	Value	Unit	Test Conditions	Note
V_{DC}	DC blocking voltage	2000	V		
V_{RRM}	Reverse voltage (repetitive peak)	2000	V		
I_{FSM}	Surge non-repetitive forward current	200	A	Sine halfwave @ $T_c=25^\circ\text{C}$, $t_p=10\text{ms}$	
I_{FRM}	Surge repetitive forward current	160	A	Sine halfwave @ $T_{amb}=25^\circ\text{C}$, $t_p=10\text{ms}$	
$\int i^2 t$	$I^2 t$ value	200	A^2s	@ $T_c=25^\circ\text{C}$, $t_p=10\text{ms}$	

Thermal Data

Symbol	Parameter	Value	Unit	Note
$R_{\theta(j-c)}$ per MOSFET	Thermal Resistance from Junction to Case	0.250	$^\circ\text{C}/\text{W}$	Fig.18
$R_{\theta(j-c)}$ per SBD	Thermal Resistance from Junction to Case	0.266	$^\circ\text{C}/\text{W}$	Fig.20

Electrical Characteristics (Per MOSFET, $T_c=25^\circ\text{C}$ unless otherwise specified)

Symbol	Parameter	Value			Unit	Test Conditions	Note
		Min.	Typ.	Max.			
I_{DSS}	Zero gate voltage drain current			40	μA	$V_{DS}=2000\text{V}, V_{GS}=0\text{V}$	
I_{GSS}	Gate leakage current			± 200	nA	$V_{DS}=0\text{V}, V_{GS}=-5\sim 20\text{V}$	
V_{TH}	Gate threshold voltage	1.8	3.5	5.0	V	$V_{GS}=V_{DS}, I_D=16\text{mA}$	Fig.8, Fig.9
			2.5		V	$V_{GS}=V_{DS}, I_D=16\text{mA}$ @ $T_J=175^\circ\text{C}$	
R_{ON}	Static drain-source on-resistance		22.5	30	$\text{m}\Omega$	$V_{GS}=18\text{V}, I_D=40\text{A}$ @ $T_J=25^\circ\text{C}$	Fig.4, Fig.5
			50	67.5	$\text{m}\Omega$	$V_{GS}=18\text{V}, I_D=40\text{A}$ @ $T_J=175^\circ\text{C}$	
C_{iss}	Input capacitance		8.24		nF	$V_{DS}=1200\text{V}, V_{GS}=0\text{V},$ $f=100\text{kHz}, V_{AC}=25\text{mV}$	Fig.11
C_{oss}	Output capacitance		323.5		pF		
C_{rss}	Reverse transfer capacitance		19.50		pF		
E_{oss}	C_{oss} stored energy		263.9		μJ		
Q_g	Total gate charge		370		nC	$V_{DS}=1200\text{V}, I_D=20\text{A},$ $V_{GS}=-3$ to 18V	Fig.10
Q_{gs}	Gate-source charge		68		nC		
Q_{gd}	Gate-drain charge		152		nC		
R_g	Gate input resistance		0.97		Ω	$f=1\text{MHz}$	
E_{ON}	Turn-on switching energy	$T_J=25^\circ$	0.964		mJ	$V_{DS}=1200\text{V}, I_D=60\text{A},$ $V_{GS}=-3$ to $18\text{V},$ $R_{G(ext)}=1.9\Omega,$ $L=200\mu\text{H}$	Fig.12, Fig.13
		$T_J=125^\circ$	0.977				
		$T_J=150^\circ$	0.970				
E_{OFF}	Turn-off switching energy	$T_J=25^\circ$	0.781		mJ		
		$T_J=125^\circ$	0.800				
		$T_J=150^\circ$	0.800				
$t_{d(on)}$	Turn-on delay time	$T_J=25^\circ$	17.7		ns		
		$T_J=125^\circ$	18.0				
		$T_J=150^\circ$	17.5				
t_r	Rise time	$T_J=25^\circ$	17.1		ns		
		$T_J=125^\circ$	16.0				
		$T_J=150^\circ$	16.1				
$t_{d(off)}$	Turn-off delay time	$T_J=25^\circ$	67.6		ns		
		$T_J=125^\circ$	76.6				
		$T_J=150^\circ$	80.3				
t_f	Fall time	$T_J=25^\circ$	22.0		ns		
		$T_J=125^\circ$	20.7				
		$T_J=150^\circ$	20.7				
L_{SCE}	Stray inductance		14		nH		

Electrical Characteristics (Per body diode, $T_c=25^\circ\text{C}$ unless otherwise specified)

Symbol	Parameter	Value			Unit	Test Conditions	Note
		Min.	Typ.	Max.			
V_{SD}	Diode forward voltage		4.0		V	$I_F=40\text{A}, V_{GS}=0\text{V}, T_J=25^\circ\text{C}$	
			3.85		V	$I_F=40\text{A}, V_{GS}=0\text{V}, T_J=175^\circ\text{C}$	

Electrical Characteristics (Per SBD boost, $T_c=25^\circ\text{C}$ unless otherwise specified)

Symbol	Parameter	Value			Unit	Test Conditions	Note
		Min.	Typ.	Max.			
V_F	Diode forward voltage		1.55	1.80	V	$I_F=40\text{A}, T_J=25^\circ\text{C}$	Fig.19
			2.50	3.00	V	$I_F=40\text{A}, T_J=175^\circ\text{C}$	
I_F	Forward current (continuous)		40		A		
I_R	Diode reverse current		10	600	μA	$V_F=2000\text{V}, T_J=25^\circ\text{C}$	
			100	2000		$V_F=2000\text{V}, T_J=175^\circ\text{C}$	

NTC Thermistor Characteristics

Symbol	Parameter	Value			Unit	Test Conditions	Note
		Min.	Typ.	Max.			
R_{NTC}	Rated Resistance		5		k Ω	$T_{NTC}=25^\circ\text{C}$	Fig.20
$\Delta R/R$	Resistance Tolerance at 25°C	-5		5	%		
$B_{25/50}$	B-Value		3380		K	$B_{a/b}=[(T_a \cdot T_b)/(T_b - T_a)] \cdot \ln(R_a/R_b)$	
P_{max}	Power Dissipation		10		mW		

Insulation Coordination

Symbol	Parameter	Note or Test Conditions	Value	Unit
V_{ISOL}	Isolation test voltage	RMS, $f=50\text{Hz}, t=30\text{s}$	3.2	KV
d_{Creep}	Creepage distance	Terminal to heatsink	16.6	mm
d_{Creep}	Creepage distance	Terminal to terminal	10.5	mm
d_{Clear}	Clearance	Terminal to heatsink	10.3	mm
d_{Clear}	Clearance	Terminal to terminal	8.9	mm
CTI			≥ 600	

Typical Performance (curves)

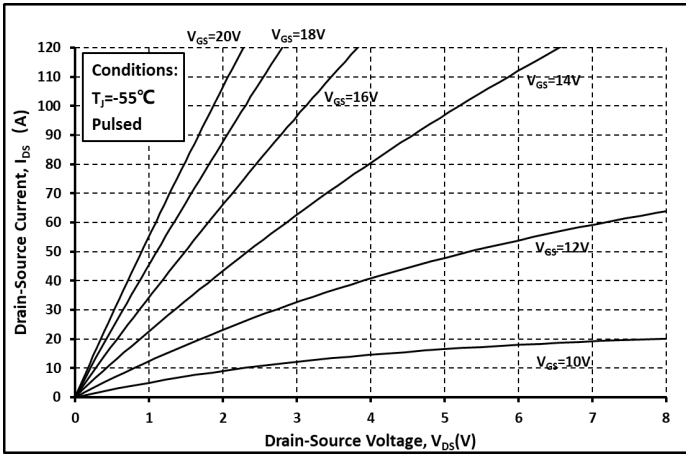


Fig. 1 Output Curve @ $T_j = -55^\circ\text{C}$

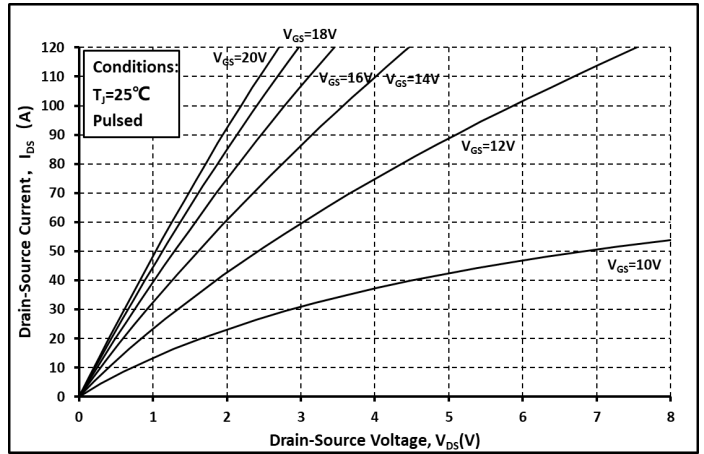


Fig. 2 Output Curve @ $T_j = 25^\circ\text{C}$

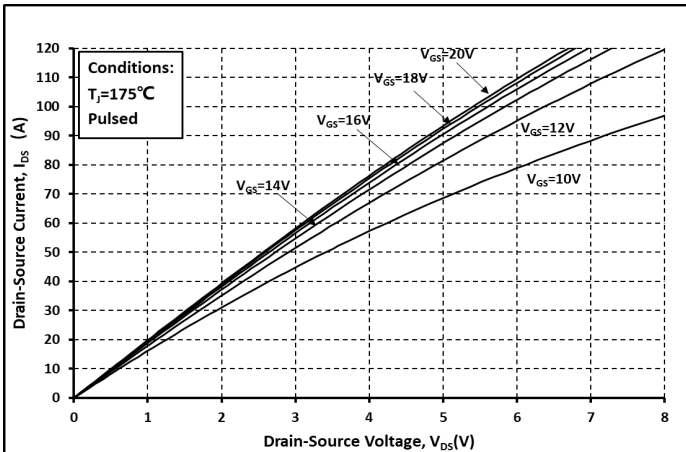


Fig. 3 Output Curve @ $T_j = 175^\circ\text{C}$

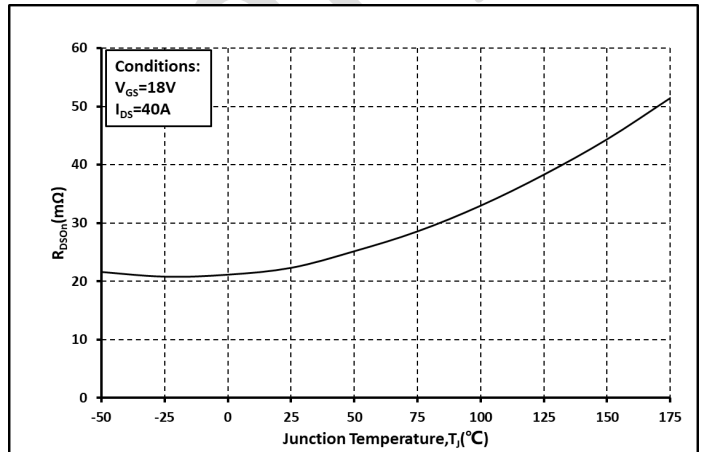


Fig. 4 $R_{DS(on)}$ vs. Temperature

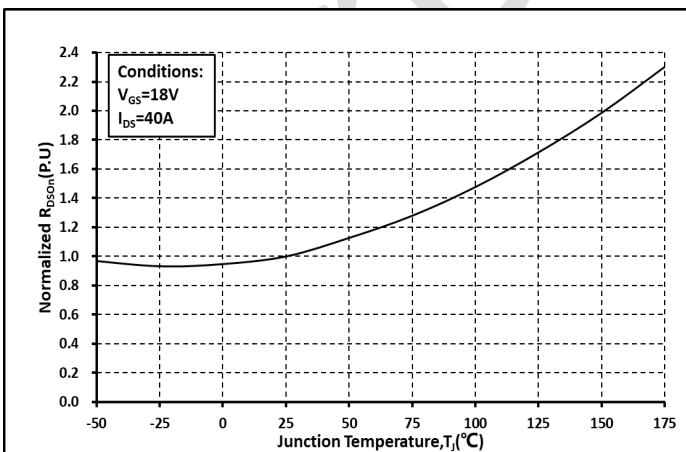


Fig. 5 Normalized $R_{DS(on)}$ vs. Temperature

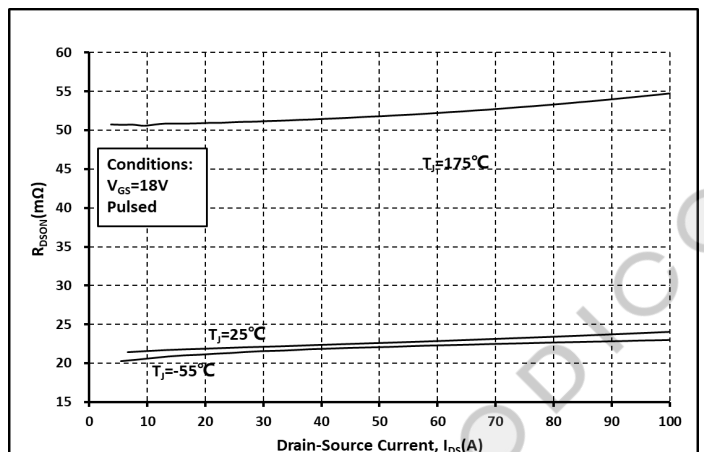


Fig. 6 $R_{DS(on)}$ vs. I_{DS} @ Various Temperature

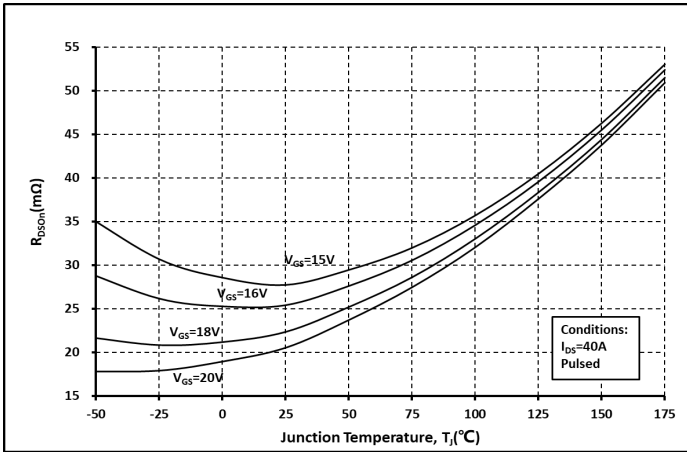


Fig. 7 Ron vs. Temperature @ Various V_{GS}

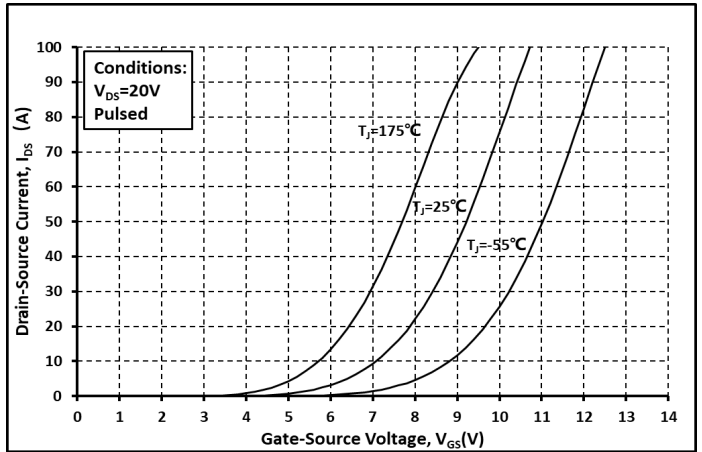


Fig. 8 Transfer Curves @ Various Temperature

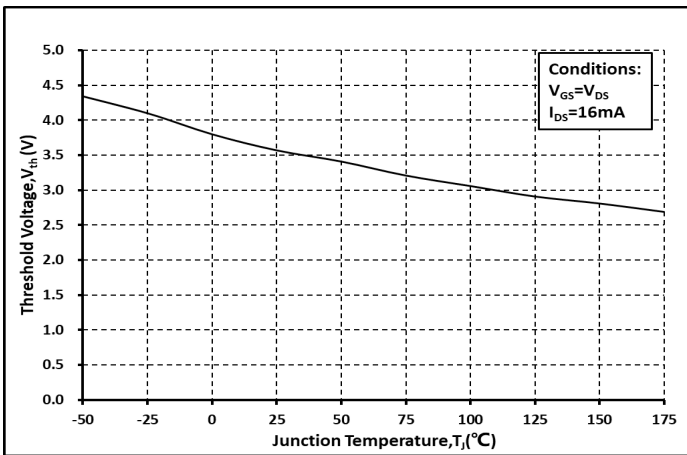


Fig. 9 Threshold Voltage vs. Temperature

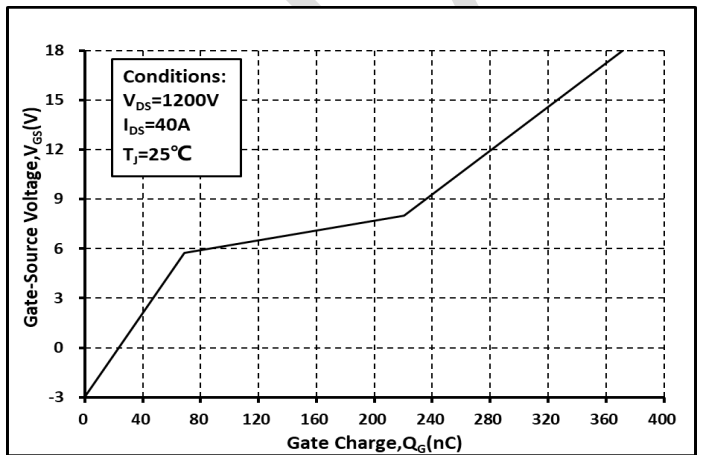


Fig. 10 Gate Charge Characteristics

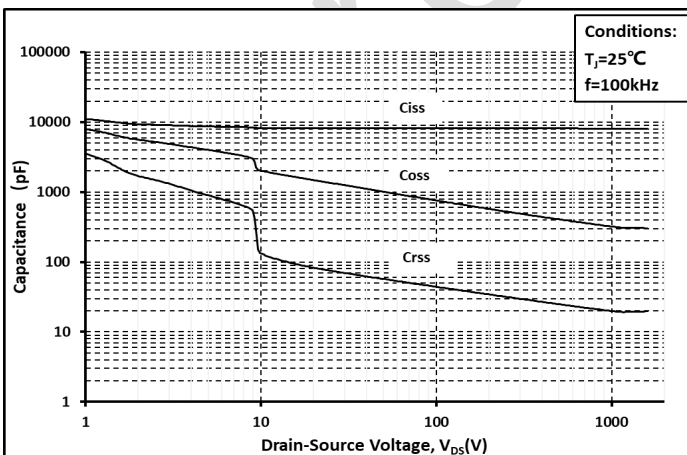


Fig. 11 Capacitance vs. V_{DS}

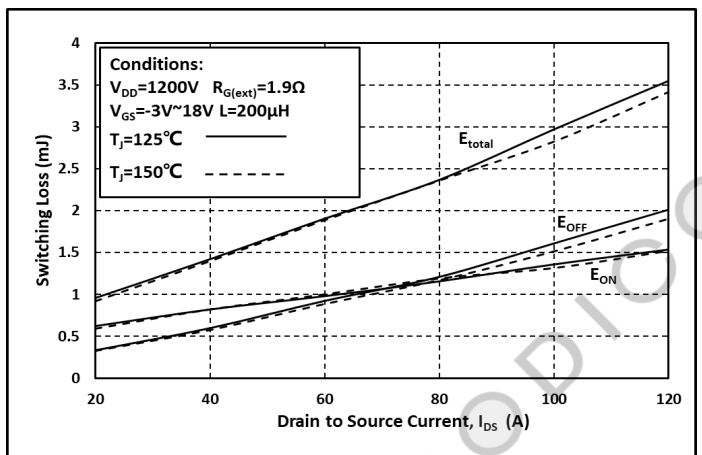


Fig. 12 Switching Energy vs. I_{DS}

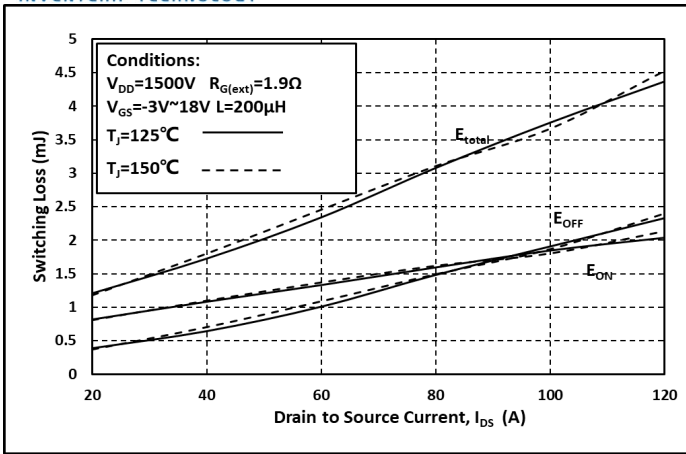


Fig. 13 Switching Energy vs. I_{DS}

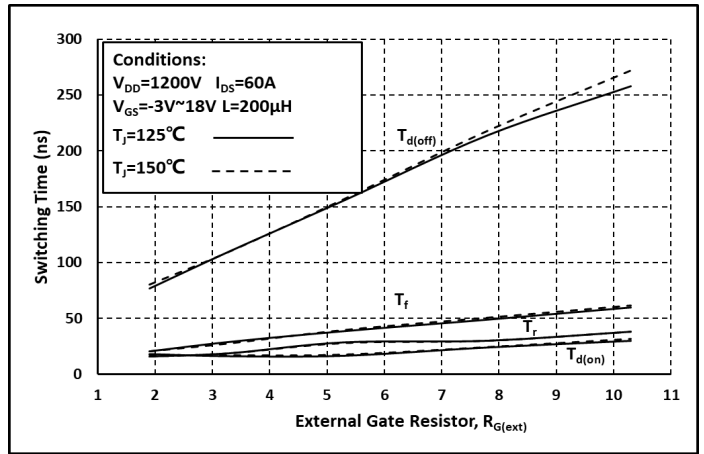


Fig. 14 Switching Times vs. $R_{G(ext)}$

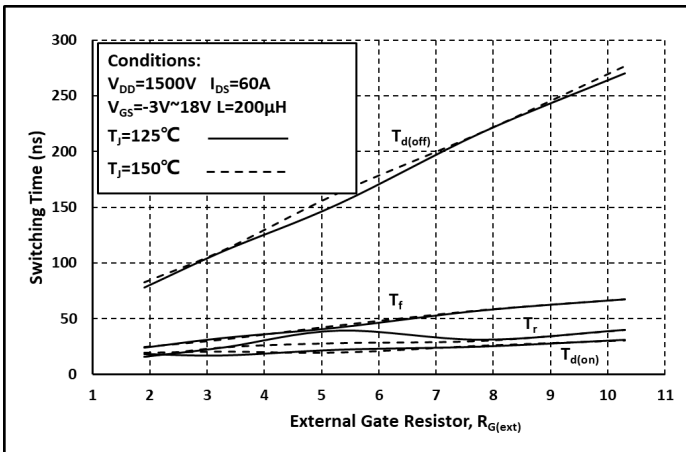


Fig. 15 Switching Times vs. $R_{G(ext)}$

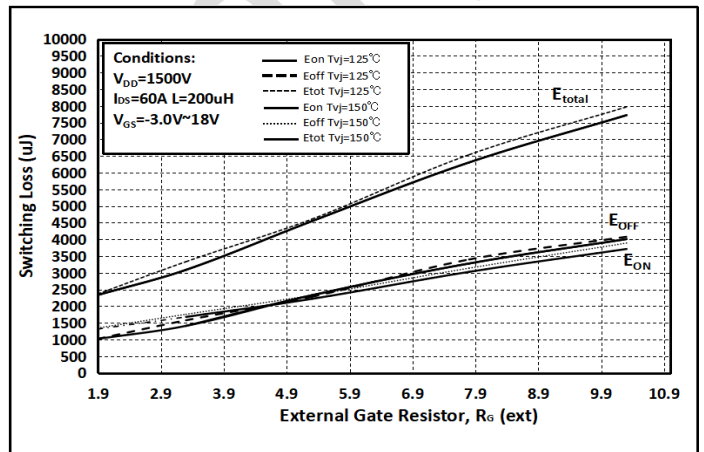


Fig. 16 Switching Energy vs. $R_{G(ext)}$

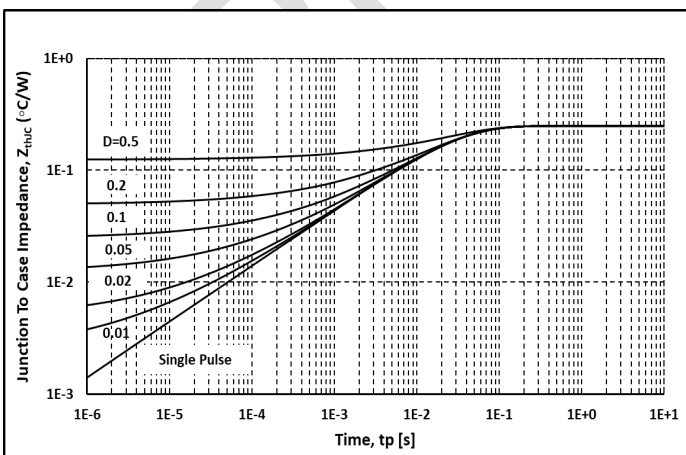


Fig. 17 Thermal impedance (MOSFET)

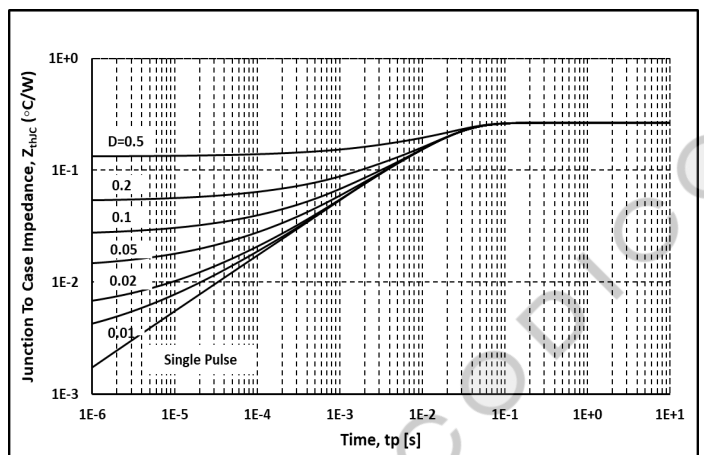


Fig. 18 Thermal impedance (SBD)

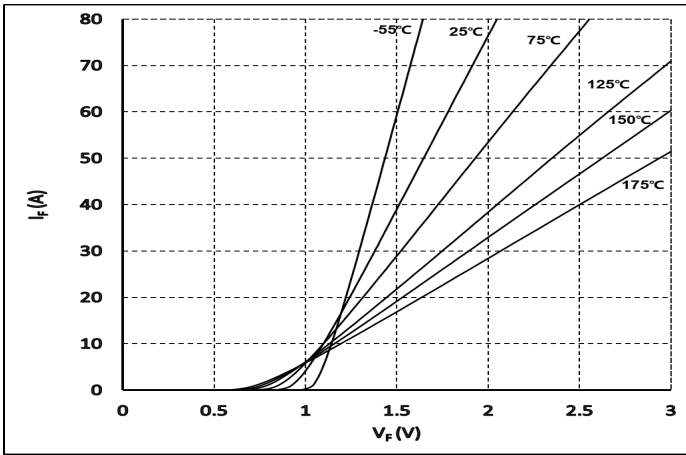


Fig. 19 Typical Forward Characteristics (SBD)

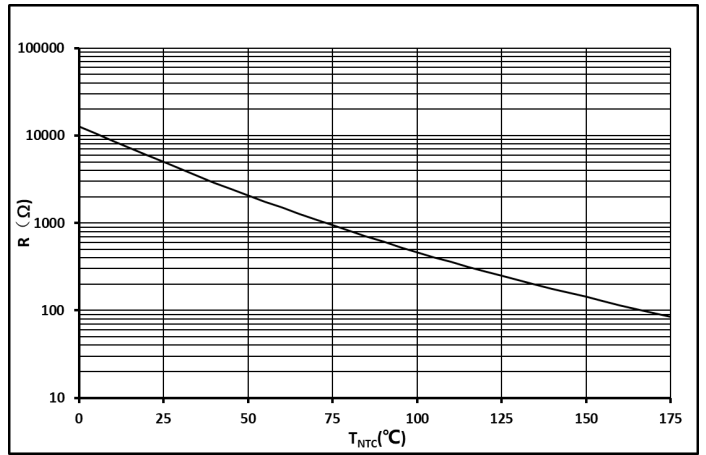
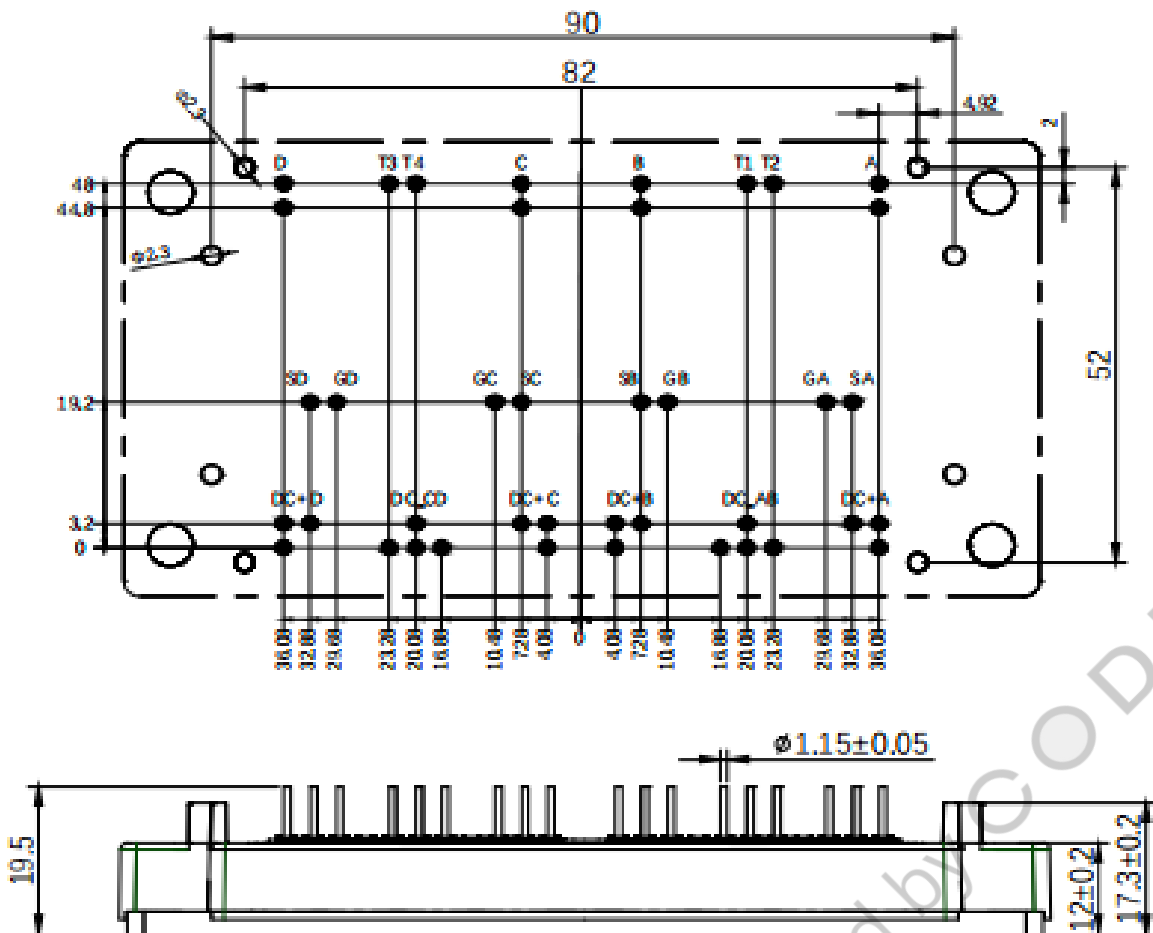
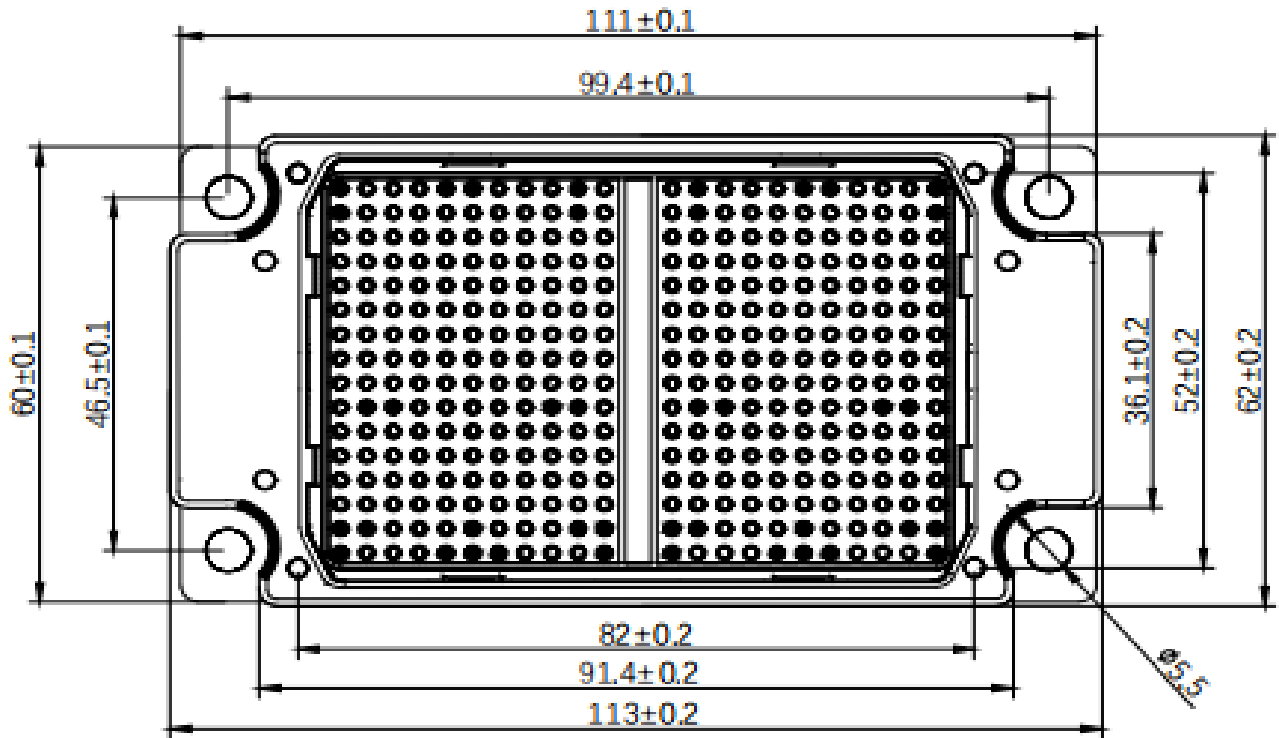


Fig. 20 Typical Temperature Characteristic (NTC)

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Package Dimensions (mm) note: two types of pre-keyholes, and choose one



Notes

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Revision History

Version	Changes	Date
V0.5	Initial release	April 1, 2024
V0.6	Update POD	April 2, 2024
V0.7	Update POD	April 11, 2024
V0.8	Update POD& add I _F & add creepage etc.	July 10, 2024

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