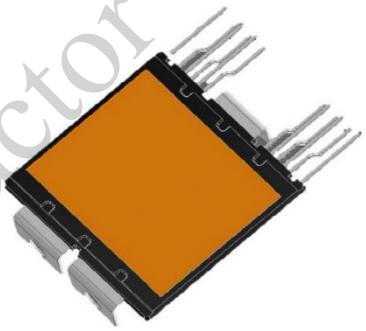
SiC Half-Bridge Module

PAAA12400EM

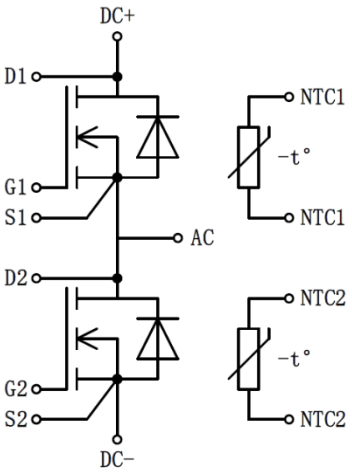


Features

- High Blocking Voltage with Low $R_{DS(on)}$
- Automotive Module
- High Temperature Operation
- Low Stray Inductance
- Sliver Sintering Technology

Applications

- Automotive Application
- EV/HEV



Standards Benefits

- Improve System Efficiency
- Improve Power Density
- Reduce System Size

Order Information

Part Number	Package	Marking
PAAA12400EM	HEPACK	PAAA12400EM

Contents

1. Maximum Ratings

At T_J= 25℃, unless specified otherwise

Parameter	Symbol	Value	Unit	Test Conditions
Drain - Source Voltage	V_{DSmax}	1200	V	
Gate - Source Voltage (Dynamic)	V_{GSmax}	-8 / +19	V	AC (f >1Hz)
Gate - Source Voltage(static) turn-on gate voltage turn-off gate voltage	$V_{GS,on}$ $V_{GS,off}$	+15/+18 -3	V	Static
Continuous Drain Current	I_D	400	A	V_{GS} =18V T_F = 25℃ T_J = 175℃
		370		V_{GS} =18V T_F = 65℃ T_J = 175℃
Power Dissipation	P_D	800	W	T_F =65℃
Operating Junction Temperature	T_J	-40 To +175	℃	
Storage Temperature	T_{stg}	-40 To +125	℃	

2. Electrical Characteristics

At T_J= 25℃, unless specified otherwise

Parameter	Symbol	Value			Unit	Test Conditions
		Min.	Typ.	Max.		
Drain-Source Breakdown Voltage	$V_{(BR)DSS}$	1200	/	/	V	V_{GS}=0V
Gate Threshold Voltage	$V_{GS(th)}$	1.8	2.3	/	V	V_{DS}= V_{GS} I_D= 140mA
Reverse Bias Drain Current	I_{DSS}	/	8	100	μA	V_{GS}= 0V V_{DS}= 1200V
Gate-Source Leakage Current	I_{GSS}	/	30	300	nA	V_{GS}= 18V V_{DS}= 0V
Drain-Source On-State Resistance	$R_{DS(on)}$	/	2.6	3.9	mΩ	V_{GS}= 18V I_D= 400A T_J= 25℃
		/	3.2	/		V_{GS}= 18V I_D= 400A T_J= 125℃
		/	3.9	/		V_{GS}= 18V I_D= 400A T_J= 175℃
Transconductance	g_{fs}	/	262	/	S	V_{DS}= 20V I_{DS}= 400A T_J= 25℃
Turn-on Energy	E_{on}	/	20.3	/	mJ	V_{DS}= 800V I_{DS}= 400A Rg_on=4Ω Rg_off=1Ω V_{GS}= -3V/18V L= 20μH
Turn-off Energy	E_{off}	/	10.5	/		
Turn-On Delay Time	$T_{d(on)}$	/	42.7	/	ns	
Rise Time	T_r	/	139.5	/		
Turn-Off Delay Time	$T_{d(off)}$	/	141.6	/		

Parameter	Symbol	Value			Unit	Test Conditions
		Min.	Typ.	Max.		
Fall Time	T_f	/	26.7	/		
Internal Gate Resistance	$R_{G(int)}$	/	0.67	/	Ω	f= 1MHz V_{AC}= 25mV
Coss Stored Energy	E_{oss}	/	670	/	μJ	V_{DS}= 800V f= 100kHz
Input Capacitance	C_{iss}	/	51	/	nF	V_{GS}= 0V V_{DS}= 800V f= 100kHz V_{AC}= 25mV
Output Capacitance	C_{oss}	/	1.8	/	nF	
Reverse Transfer Capacitance	C_{rss}	/	154	/	pF	
Gate to Source Charge	Q_{gs}	/	584	/	nC	V_{DS}= 800V I_{DS}= 400A V_{GS}= -3 to 18V
Gate to Drain Charge	Q_{gd}	/	248	/		
Total Gate Charge	Q_g	/	1376	/		

3. Reverse Diode Characteristics

At T_J= 25℃, unless specified otherwise

Parameter	Symbol	Value		Unit	Test Conditions
		Typ.	Max.		
Diode Forward Voltage	V_{SD}	5.4	/	V	V_{GS}= -3V I_{SD}= 200A T_J= 25℃
		4.7	/	V	V_{GS}= -3V I_{SD}= 200A T_J= 175℃

Reverse Recover Time	t_{rr}	51.2	/	ns	V_{DS}= 800V I_{SD}= 400A d_{if}/d_t= 9800A/μs Vgs = -3V T_J= 25℃
Reverse Recovery Charge	Q_{rr}	5.2	/	uC	
Peak Reverse Recovery Current	I_{rrm}	172	/	A	
Reverse Recovery Energy	E_{RR}	2062	/	uJ	

4. Thermal Characteristics

Parameter	Symbol	Value			Unit
		Min.	Typ.	Max.	
Thermal Resistance from Junction to Cooling Fluid	$R_{\theta JF}$	/	0.13	/	℃/W

5. NTC Thermistor Characteristics

Parameter	Symbol	Value			Unit	Test Conditions
		Min.	Typ.	Max.		
Rated Resistance	R_{NTC}	/	5	/	kΩ	T_{NTC}= 25℃
Resistance Tolerance	$\triangle R/R$	-5	/	5	%	T_{NTC}= 25℃
B-value	$B_{25/50}$	/	3380	/	K	T_2= 50℃
B-value	$B_{25/85}$	/	3435	/	K	T_2= 80℃

Parameter	Symbol	Value			Unit	Test Conditions
		Min.	Typ.	Max.		
B-value	$B_{25/100}$	/	3485	/	K	T_2= 100℃
Power Dissipation	P_{NTC}	/	/	10	mW	T_{NTC}= 25℃

1. Recommended Rg：Rg_on = 6-12Ω，Rg_off = 1-3Ω

6. Typical Performance

At T_J= 25℃, unless specified otherwise

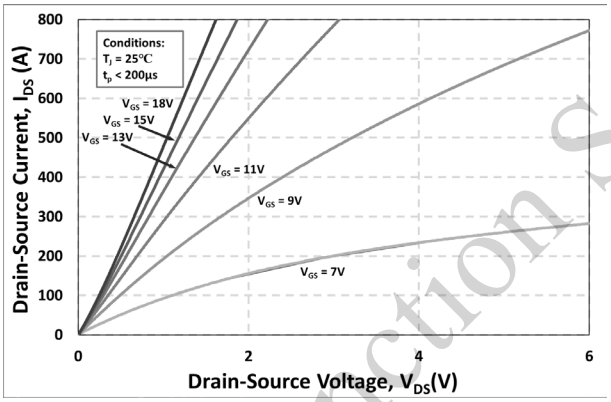


Figure 1. Output Characteristics T_J = 25℃

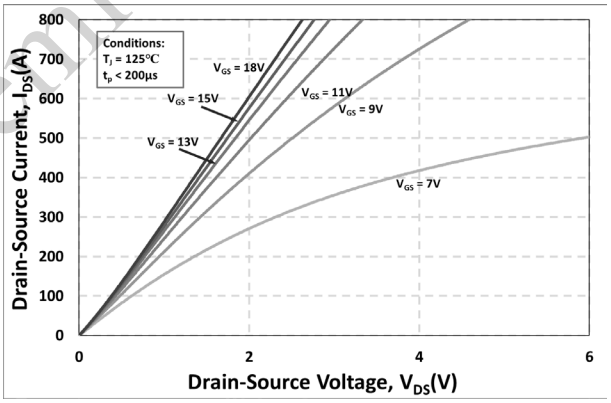


Figure 2. Output Characteristics T_J = 125℃

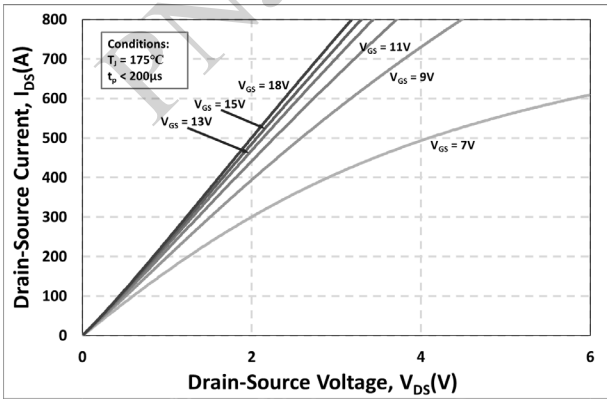


Figure 3. Output Characteristics T_J = 175℃

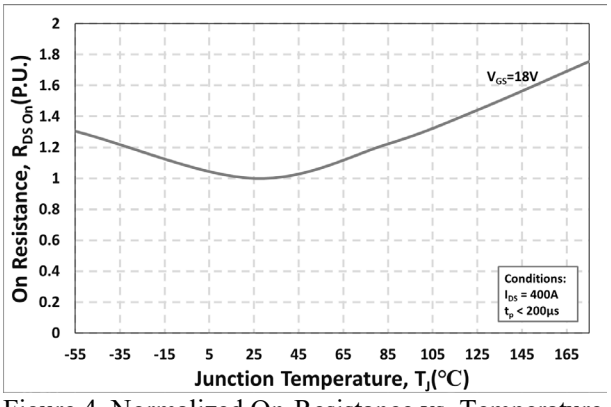


Figure 4. Normalized On-Resistance vs. Temperature

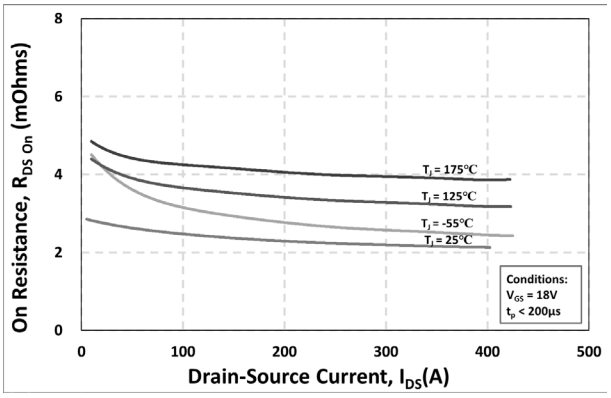


Figure 5. On-Resistance vs. Drain Current Various Temperatures

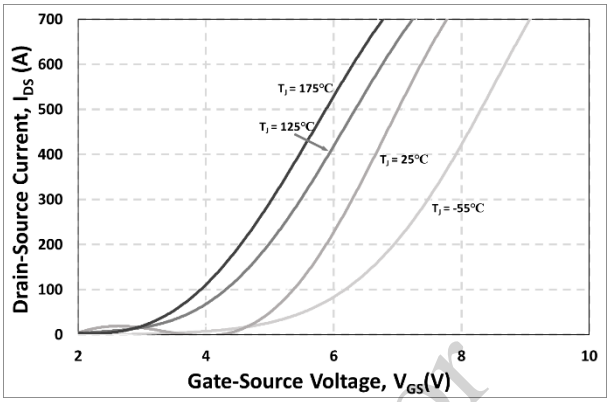


Figure 6. Transfer Characteristic for Various Junction Temperatures

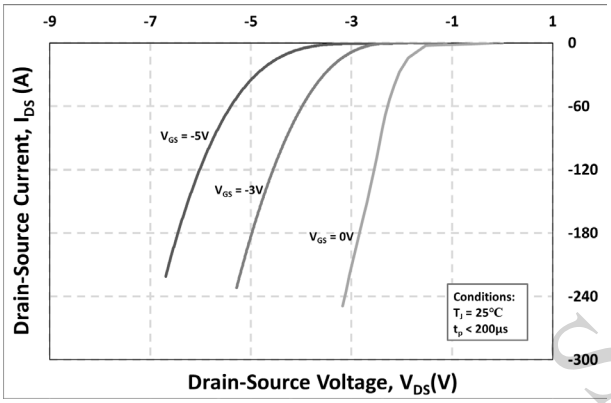


Figure 7. Body Diode Characteristic at 25°C

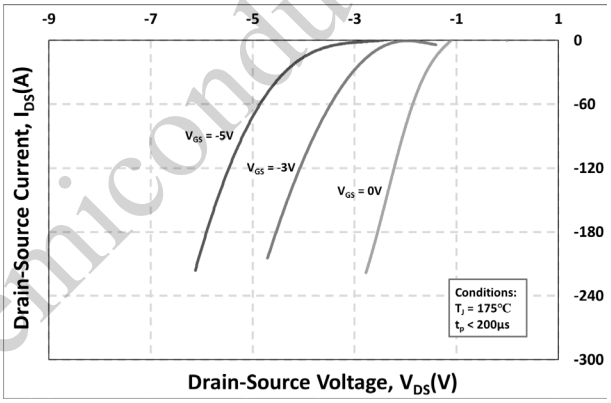


Figure 8. Body Diode Characteristic at 175°C

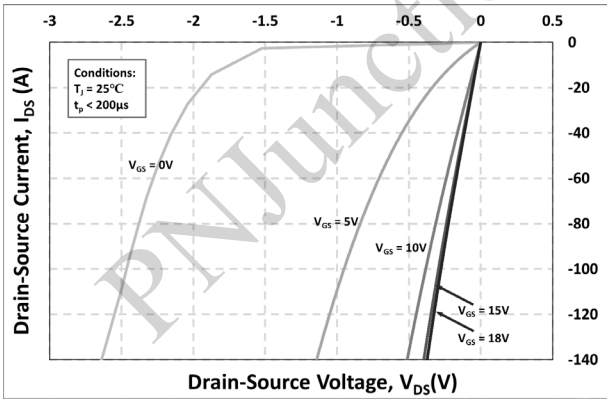


Figure 9. 3rd Quadrant Characteristic at 25°C

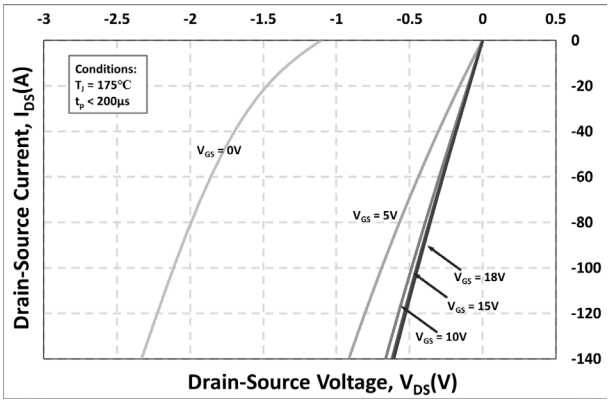


Figure 10. 3rd Quadrant Characteristic at 175°C

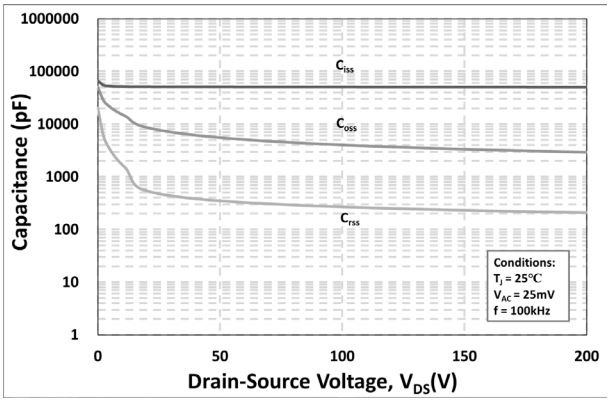


Figure 11. Capacitances vs. Drain-Source Voltage (0 - 200V)

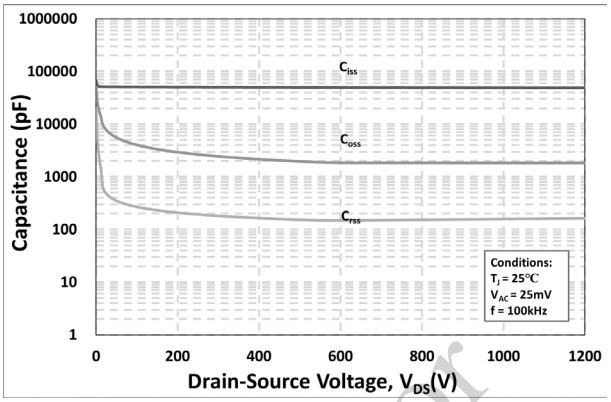


Figure 12. Capacitances vs. Drain-Source Voltage (0 - 1200V)

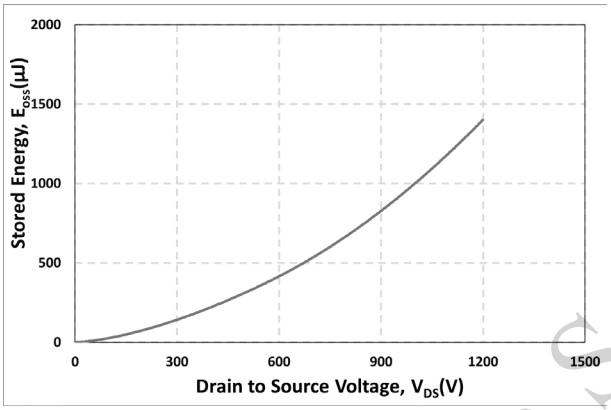


Figure 13. Output Capacitor Stored Energy

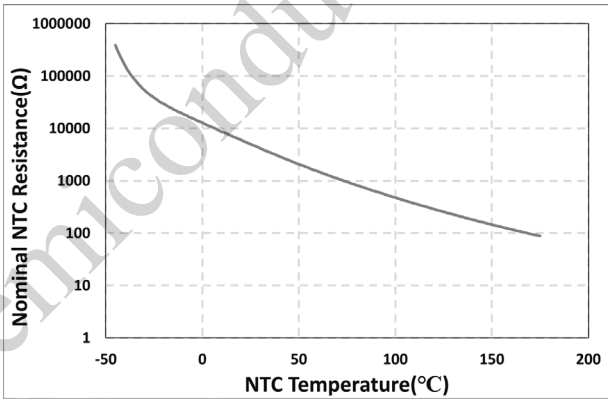


Figure 14. Nominal NTC Resistance vs. NTC Temperature

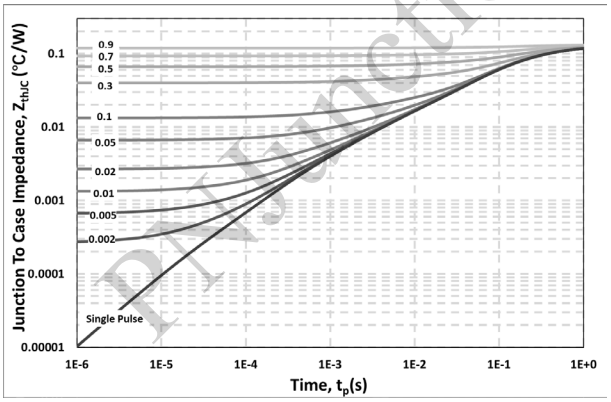


Figure 15. Transient Thermal Impedance (Junction - Case)

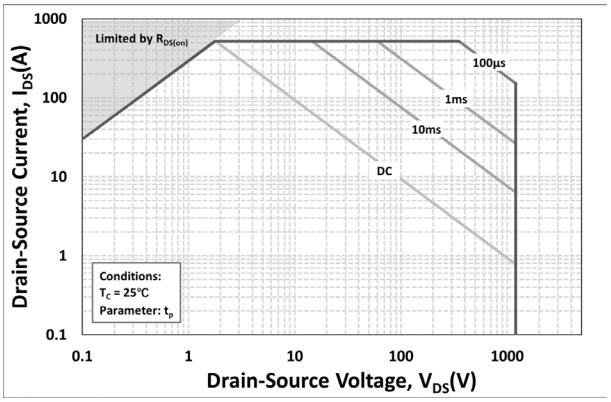


Figure 16. Forward Bias Safe Operating Area (FBSOA)

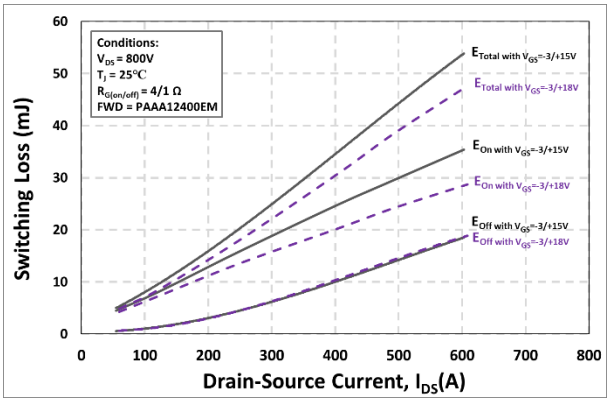


Figure 17. Switching Loss vs. Drain-Source Current (V_{DS} = 800 V)

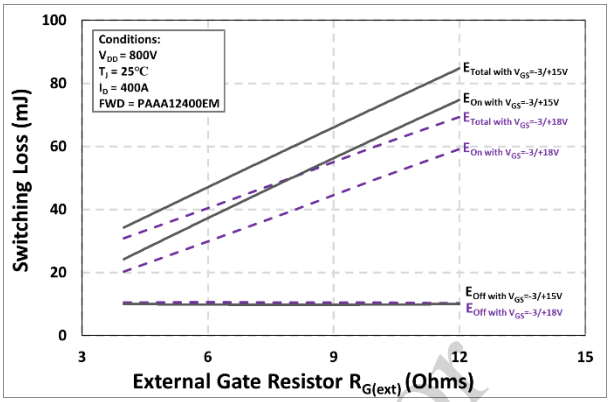


Figure 18. Switching Loss vs. External Gate Resistance

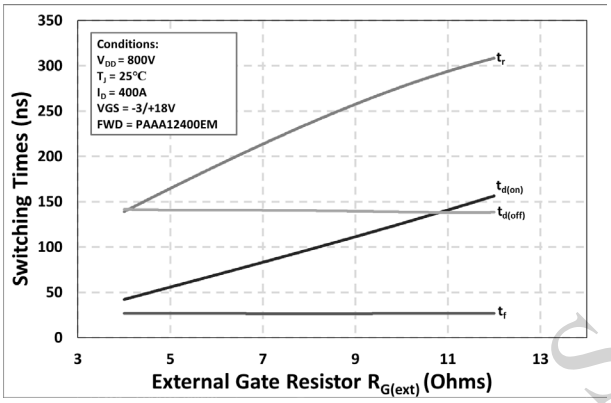


Figure 19. Switching Times vs. External Gate Resistance

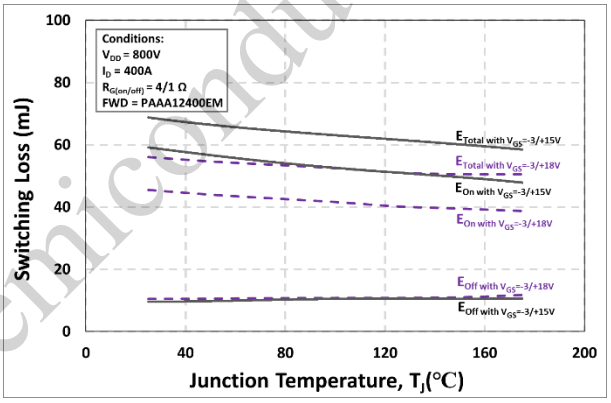
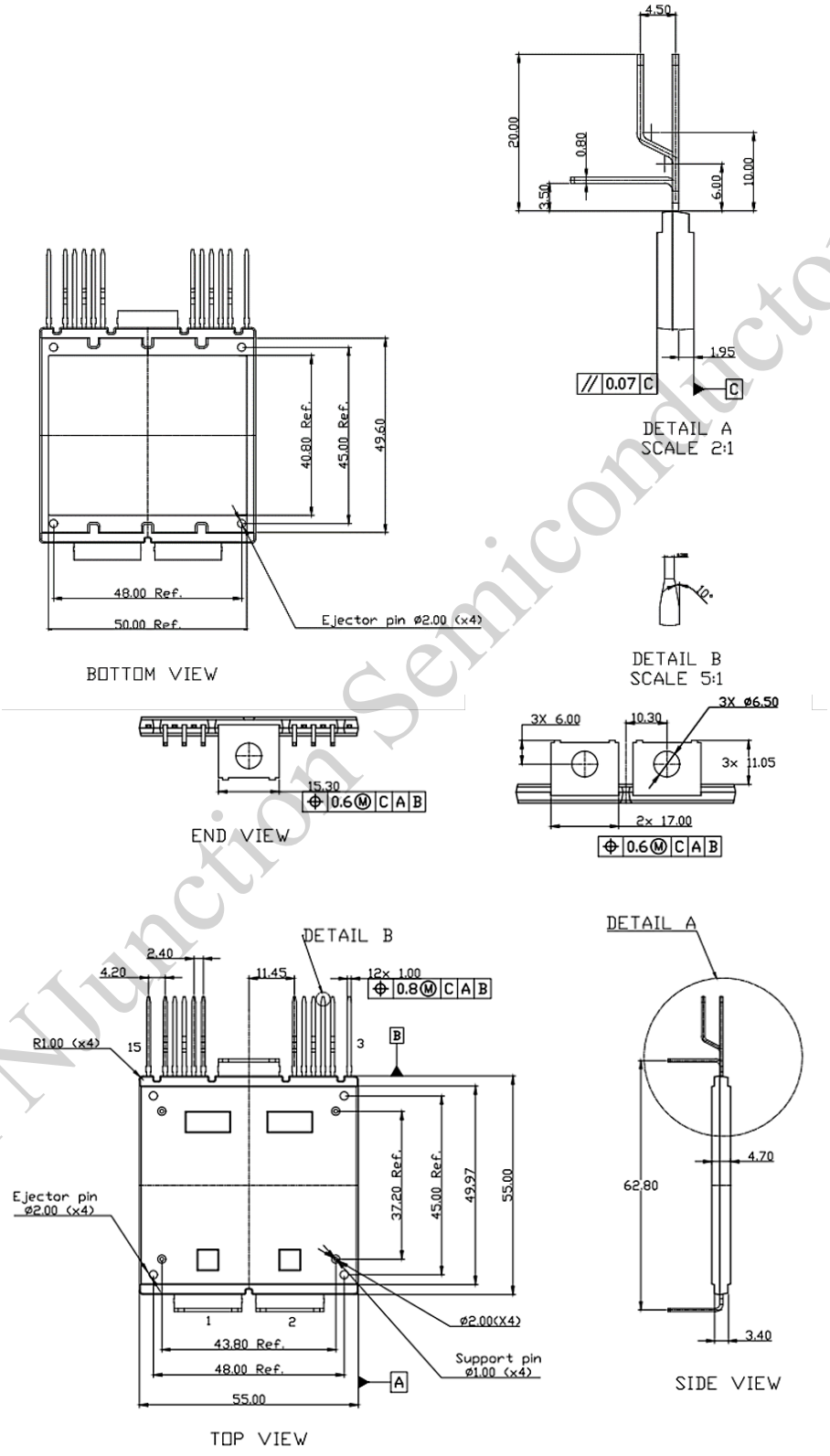


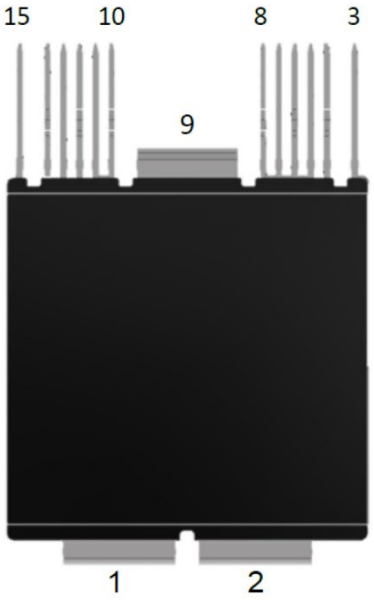
Figure 20. Clamped Inductive Switching Energy vs. Temperature

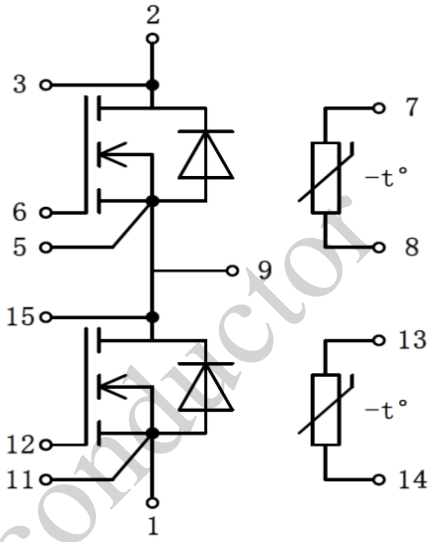
7. Package Outlines



Drawing and Dimensions

8. Pin Description





Pin No.	Pin Name	Pin Functional Description
1	N	Negative Power Termina
2	P	Positive Power Terminal
3	D1	High Side MOSFET (Q1) Drain Sense
4	N/C	No Connection
5	S1	High Side MOSFET (Q1) Source
6	G1	High Side MOSFET (Q1) Gate
7	NTC1	NTC 1
8	NTC1	NTC 1
9	AC	Phase Output
10	N/C	No Connection
11	S2	Low Side MOSFET (Q2) Source
12	G2	Low Side MOSFET (Q2) Gate
13	NTC2	NTC 2
14	NTC2	NTC 2
15	D2	Low Side MOSFET (Q2) Drain Sense

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