Silicon Carbide (SiC) Module – EliteSiC, 6 mohm SiC M1 MOSFET, 1200 V, 2-PACK Half Bridge Topology, F2 Package

NXH006P120MNF2PTG

The NXH006P120MNF2 is a power module containing an 6 mΩ / 1200 V SiC MOSFET half−bridge and a thermistor in an F2 package.

Features

- 6 mΩ / 1200 V SiC MOSFET Half−Bridge
- Thermistor
- Options with Pre−Applied Thermal Interface Material (TIM) and without Pre−Applied TIM
- Options with Solderable Pins and Press−Fit Pins
- These Devices are Pb−Free, Halide Free and are RoHS Compliant

Typical Applications

- Solar Inverter
- Uninterruptible Power Supplies
- Electric Vehicle Charging Stations
- Industrial Power

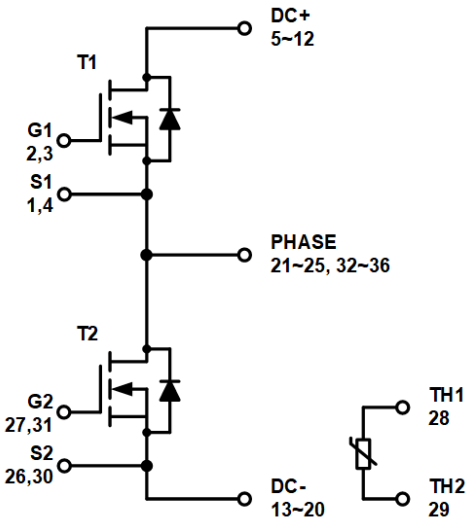
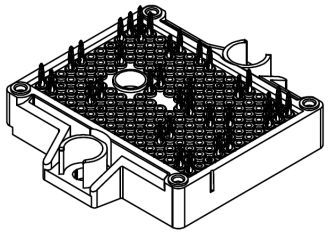


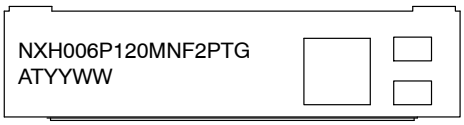
Figure 1. NXH006P120MNF2 Schematic Diagram

PACKAGE PICTURE



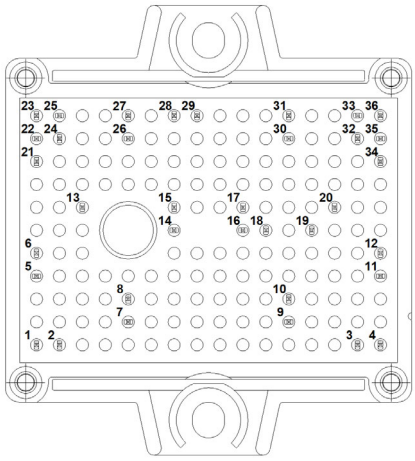
PIM36 56.7x42.5 (PRESS FIT)
CASE 180BY

MARKING DIAGRAM



XXXXX = Specific Device Code
AT = Assembly & Test Site Code
YWW = Year and Work Week Code

PIN CONNECTIONS



See Pin Function Description for pin names

ORDERING INFORMATION

See detailed ordering and shipping information on page 4 of this data sheet.

PIN FUNCTION DESCRIPTION

Pin	Name	Description
1	S1	Q1 Kelvin Emitter (High side switch)
2	G1	Q1 Gate (High side switch)
3	G1	Q1 Gate (High side switch)
4	S1	Q1 Kelvin Emitter (High side switch)
5	DC+	DC Positive Bus connection
6	DC+	DC Positive Bus connection
7	DC+	DC Positive Bus connection
8	DC+	DC Positive Bus connection
9	DC+	DC Positive Bus connection
10	DC+	DC Positive Bus connection
11	DC+	DC Positive Bus connection
12	DC+	DC Positive Bus connection
13	DC−	DC Negative Bus connection
14	DC−	DC Negative Bus connection
15	DC−	DC Negative Bus connection
16	DC−	DC Negative Bus connection
17	DC−	DC Negative Bus connection
18	DC−	DC Negative Bus connection
19	DC−	DC Negative Bus connection
20	DC−	DC Negative Bus connection
21	PHASE	Center point of half bridge
22	PHASE	Center point of half bridge
23	PHASE	Center point of half bridge
24	PHASE	Center point of half bridge
25	PHASE	Center point of half bridge
26	S2	Q2 Kelvin Emitter (Low side switch)
27	G2	Q2 Gate (Low side switch)
28	TH1	Thermistor Connection 1
29	TH2	Thermistor Connection 2
30	S2	Q2 Kelvin Emitter (Low side switch)
31	G2	Q2 Gate (Low side switch)
32	PHASE	Center point of half bridge
33	PHASE	Center point of half bridge
34	PHASE	Center point of half bridge
35	PHASE	Center point of half bridge
36	PHASE	Center point of half bridge

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
SiC MOSFET			
Drain−Source Voltage	V_{DSS}	1200	V
Gate−Source Voltage	V_{GS}	+25/−15	V
Continuous Drain Current @ T_c = 80°C (T_J = 175°C)	I_D	304	A
Pulsed Drain Current (T_J = 175°C) (Note 2)	I_{Dpulse}	912	A
Maximum Power Dissipation (T_J = 175°C)	P_{tot}	950	W
Short Circuit Withstand Time @ V_{GE} = 15 V, V_{CE} = 600 V, $T_J \leq$ 150°C	T_{sc}	2.0	μs
Minimum Operating Junction Temperature	T_{JMIN}	−40	°C
Maximum Operating Junction Temperature	T_{JMAX}	175	°C
THERMAL PROPERTIES			
Storage Temperature Range	T_{stg}	−40 to 150	°C
TIM Layer Thickness	T_{TIM}	160 ± 20	μm
INSULATION PROPERTIES			
Isolation test voltage, t = 1 sec, 60 Hz	V_{is}	4800	V_{RMS}
Creepage distance		12.7	mm
CTI		600	
Substrate Ceramic Material		HPS	
Substrate Ceramic Material Thickness		0.38	mm
Substrate Warpage (Note 3)	W	Max 0.18	mm

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Refer to ELECTRICAL CHARACTERISTICS, RECOMMENDED OPERATING RANGES and/or APPLICATION INFORMATION for Safe Operating parameters.
2. Calculated for 1 ms pulse, package limitation at 400 A.
3. Height difference between horizontal plane and substrate bottom copper.

RECOMMENDED OPERATING RANGES

Rating	Symbol	Min	Max	Unit
Module Operating Junction Temperature	T_J	−40	175	°C

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

ELECTRICAL CHARACTERISTICS

T_J = 25 °C unless otherwise noted

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
SiC MOSFET CHARACTERISTICS						
Drain−Source Breakdown Voltage	V_{GS} = 0 V, I_D = 800 μA	$V_{(BR)DSS}$	1200	–	–	V
Zero Gate Voltage Drain Current	V_{GS} = 0 V, V_{DS} = 1200 V	I_{DSS}	–	–	300	μA
Drain−Source On Resistance	V_{GS} = 20 V, I_D = 200 A, T_J = 25°C	$R_{DS(ON)}$	–	5.48	7.2	mΩ
	V_{GS} = 20 V, I_D = 200 A, T_J = 125°C		–	6.52	–	
	V_{GS} = 20 V, I_D = 200 A, T_J = 150°C		–	7.28	–	
Gate−Source Threshold Voltage	V_{GS} = V_{DS}, I_D = 80 mA	$V_{GS(TH)}$	1.8	2.83	4.3	V
Gate Leakage Current	V_{GS} = −10 V / 20 V, V_{DS} = 0 V	I_{GSS}	−1000	–	1000	nA

ELECTRICAL CHARACTERISTICS (continued)
T_J = 25 °C unless otherwise noted

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
SiC MOSFET CHARACTERISTICS						
Input Capacitance	V_{DS} = 800 V, V_{GS} = 0 V, f = 1 MHz	C_{ISS}	–	6687	–	pF
Reverse Transfer Capacitance		C_{RSS}	–	49	–	
Output Capacitance		C_{OSS}	–	1092	–	
Total Gate Charge	V_{DS} = 800 V, V_{GS} = 20 V, I_D = 200 A	$Q_{G(TOTAL)}$	–	847	–	nC
Gate−Source Charge		Q_{GS}	–	231	–	nC
Gate−Drain Charge		Q_{GD}	–	195	–	nC
Turn−on Delay Time	T_J = 25°C V_{DS}= 600 V, I_D = 200 A V_{GS} = −5 V / 20 V, R_G = 1.8 Ω	$t_{d(on)}$	–	54	–	ns
Rise Time		t_r	–	21	–	
Turn−off Delay Time		$t_{d(off)}$	–	174	–	
Fall Time		t_f	–	22	–	
Turn−on Switching Loss per Pulse		E_{ON}	–	2.1	–	mJ
Turn−off Switching Loss per Pulse		E_{OFF}	–	2.75	–	
Turn−on Delay Time	T_J = 150°C V_{DS} = 600 V, I_D = 200 A V_{GS} = −5 V / 20 V, R_G = 1.8 Ω	$t_{d(on)}$	–	48	–	ns
Rise Time		t_r	–	19	–	
Turn−off Delay Time		$t_{d(off)}$	–	196	–	
Fall Time		t_f	–	22	–	
Turn−on Switching Loss per Pulse		E_{ON}	–	2.3	–	mJ
Turn off Switching Loss per Pulse		E_{OFF}	–	2.93	–	
Diode Forward Voltage	I_D = 200 A, T_J = 25°C	V_{SD}	–	4.0	6	V
	I_D = 200 A, T_J = 150°C		–	3.6	–	
Thermal Resistance − Chip−to−Case	M1, M2	R_{thJC}	–	0.10	–	°C/W
Thermal Resistance − Chip−to−Heatsink	Thermal grease, Thickness = 2 Mil +2%, A = 2.8 W/mK	R_{thJH}	–	0.21	–	°C/W
THERMISTOR CHARACTERISTICS						
Nominal Resistance	T = 25°C	R_{25}	–	5	–	kΩ
	T = 100°C	R_{100}	–	457	–	Ω
Deviation of R25		ΔR/R	−3	–	3	%
Power Dissipation		P_D	–	50	–	mW
Power Dissipation Constant			–	5	–	mW/K
B−value	B(25/50), tolerance ±3%		–	3375	–	K
B−value	B(25/100), tolerance ±3%		–	3455	–	K

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

ORDERING INFORMATION

Orderable Part Number	Marking	Package	Shipping
NXH006P120MNF2PTG	NXH006P120MNF2PTG	F2HALFBR: Case 180BY Press−fit Pins with pre−applied thermal interface material (TIM) (Pb-Free / Halide Free)	20 Units / Blister Tray

TYPICAL CHARACTERISTICS

HALFBRIDGE MOSFET

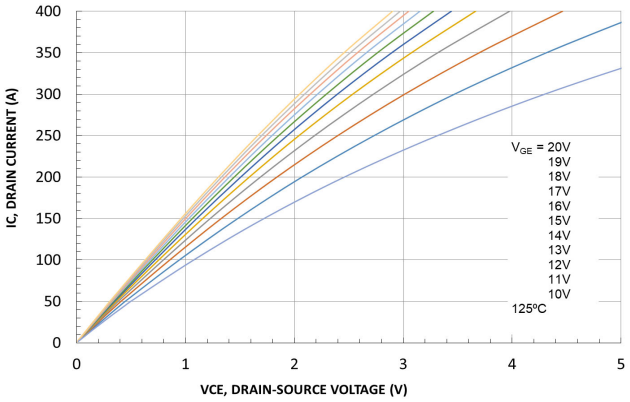


Figure 2. MOSFET Typical Output Characteristic at 125°C

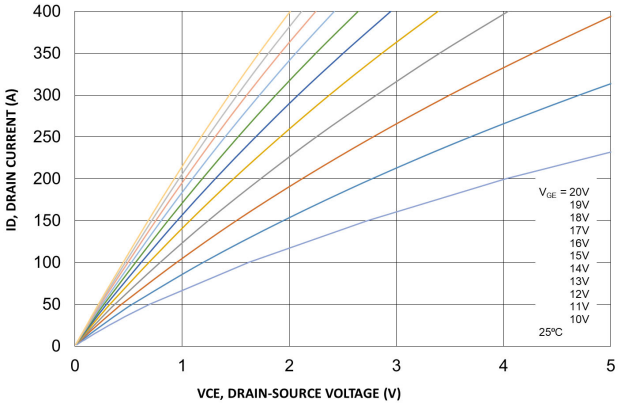


Figure 3. MOSFET Typical Output Characteristic

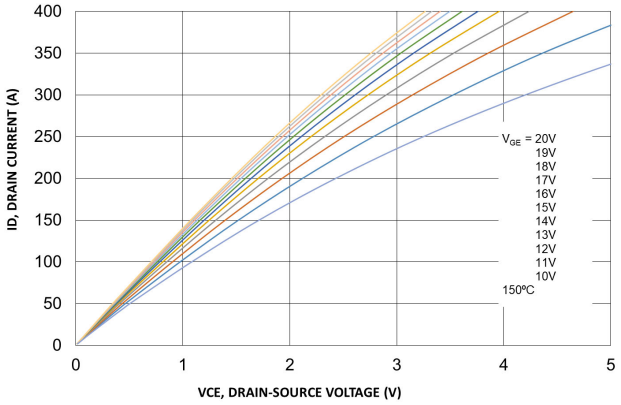


Figure 4. MOSFET Typical Output Characteristic

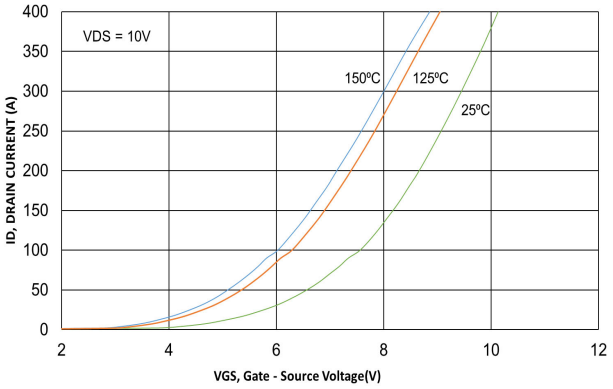


Figure 5. MOSFET Typical Transfer Characteristic

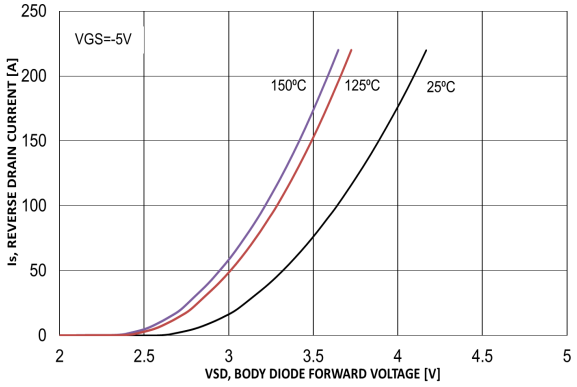


Figure 6. Body Diode Forward Characteristic

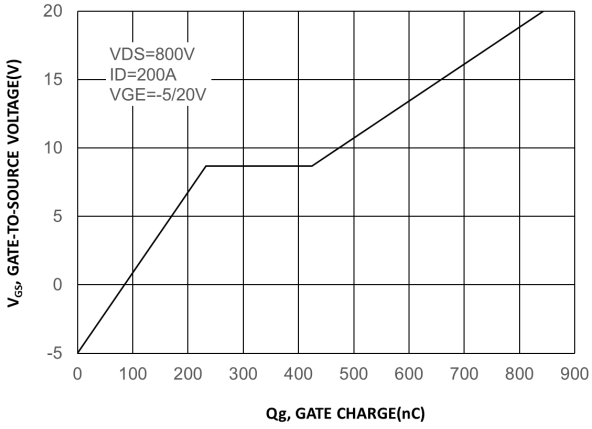


Figure 7. Gate−to−Source Voltage vs. Total Charge

TYPICAL CHARACTERISTICS

(25°C unless otherwise noted)

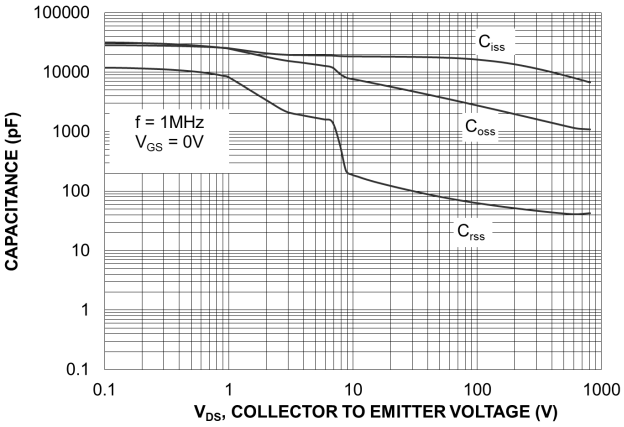


Figure 8. Capacitance vs. Drain−to−Source Voltage

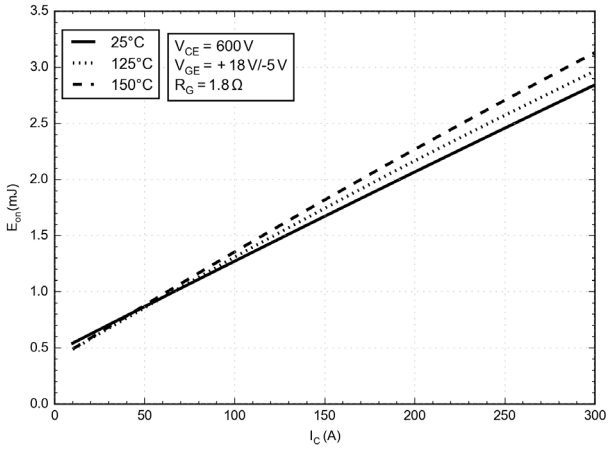


Figure 9. Typical Switching Loss Eon vs. IC

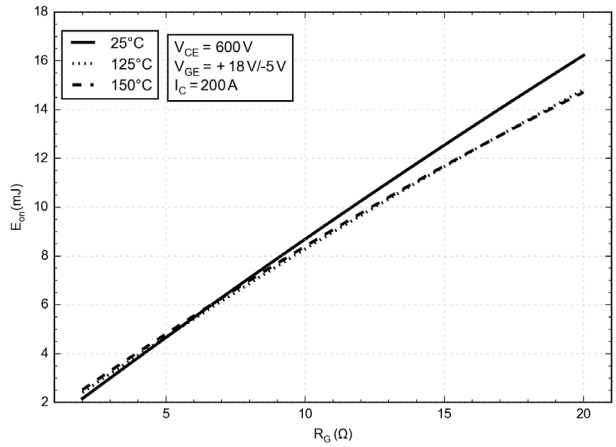


Figure 10. Typical Switching Loss Eon vs. Rg

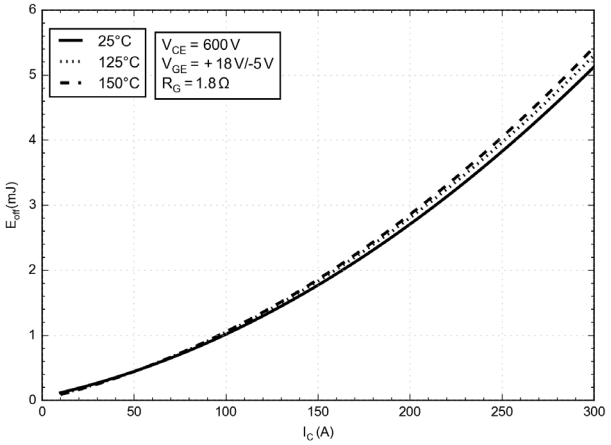


Figure 11. Typical Switching Loss Eoff vs. IC

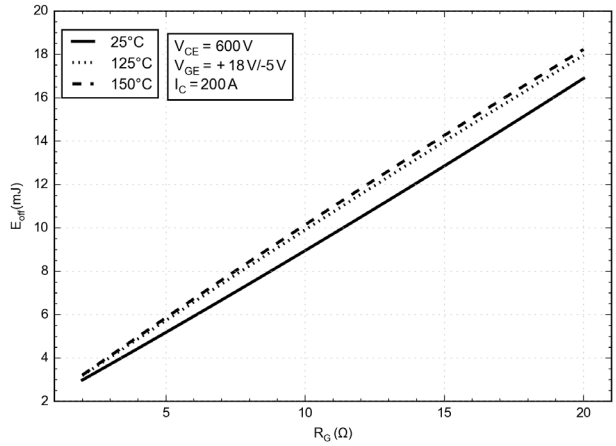


Figure 12. Typical Switching Loss Eoff vs. Rg

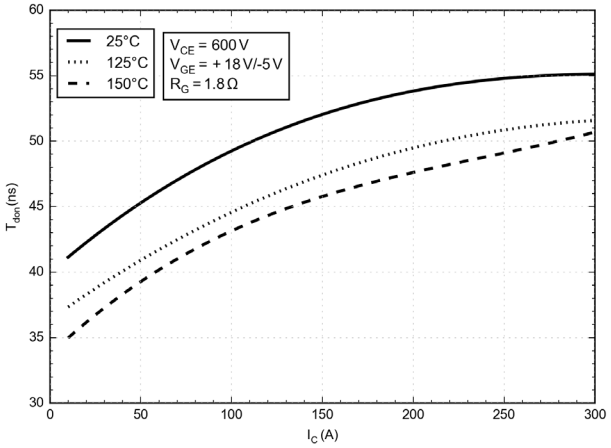


Figure 13. Typical Switching Loss Tdon vs. IC

TYPICAL CHARACTERISTICS

(25°C unless otherwise noted)

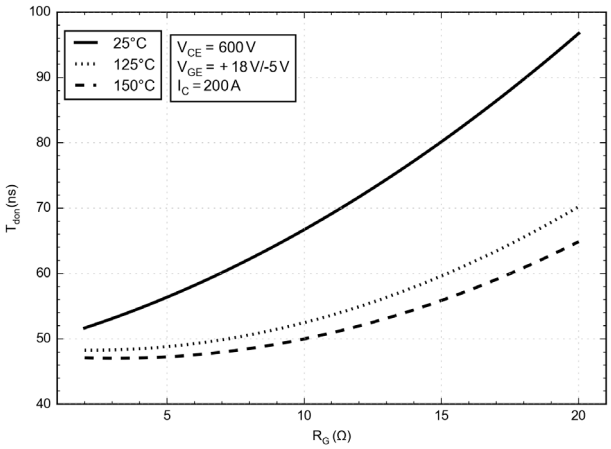


Figure 14. Typical Switching Loss Tdon vs. Rg

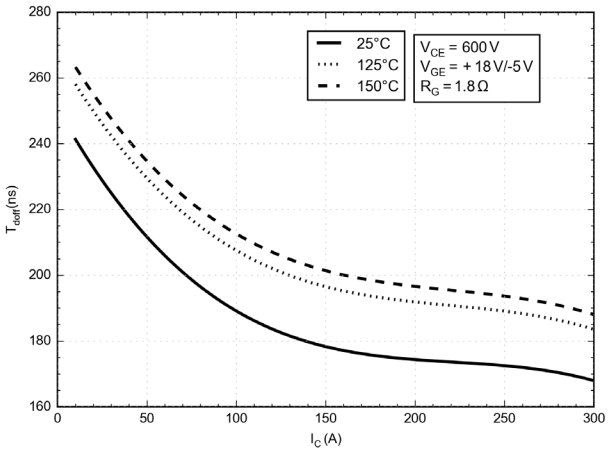


Figure 15. Typical Switching Loss Tdoff vs. IC

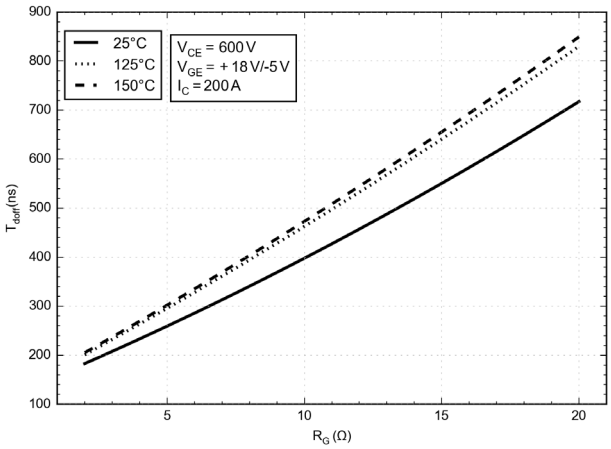


Figure 16. Typical Switching Loss Tdoff vs. Rg

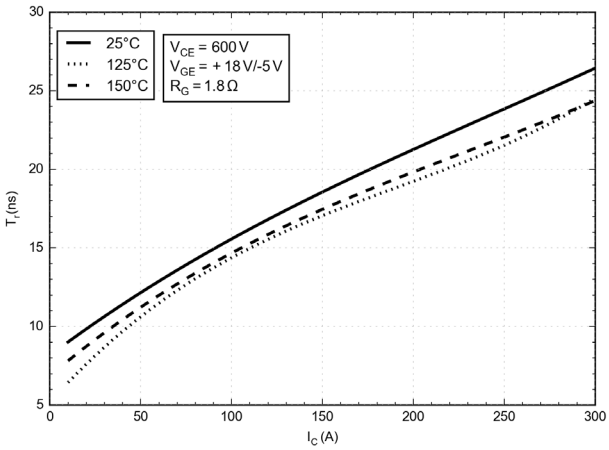


Figure 17. Typical Switching Loss Tr vs. IC

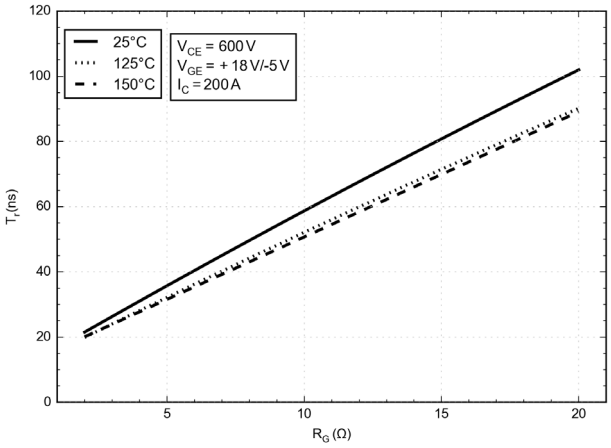


Figure 18. Typical Switching Loss Tr vs. Rg

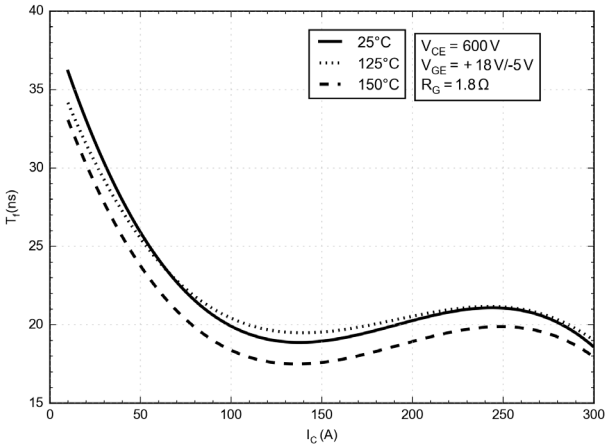


Figure 19. Typical Switching Loss Tf vs. IC

TYPICAL CHARACTERISTICS

(25°C unless otherwise noted)

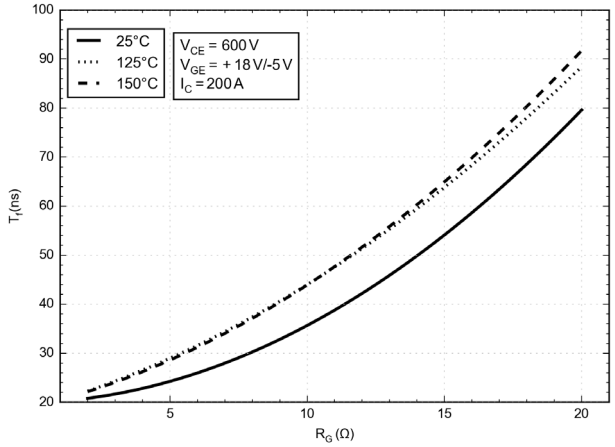


Figure 20. Typical Switching Loss Tf vs. Rg

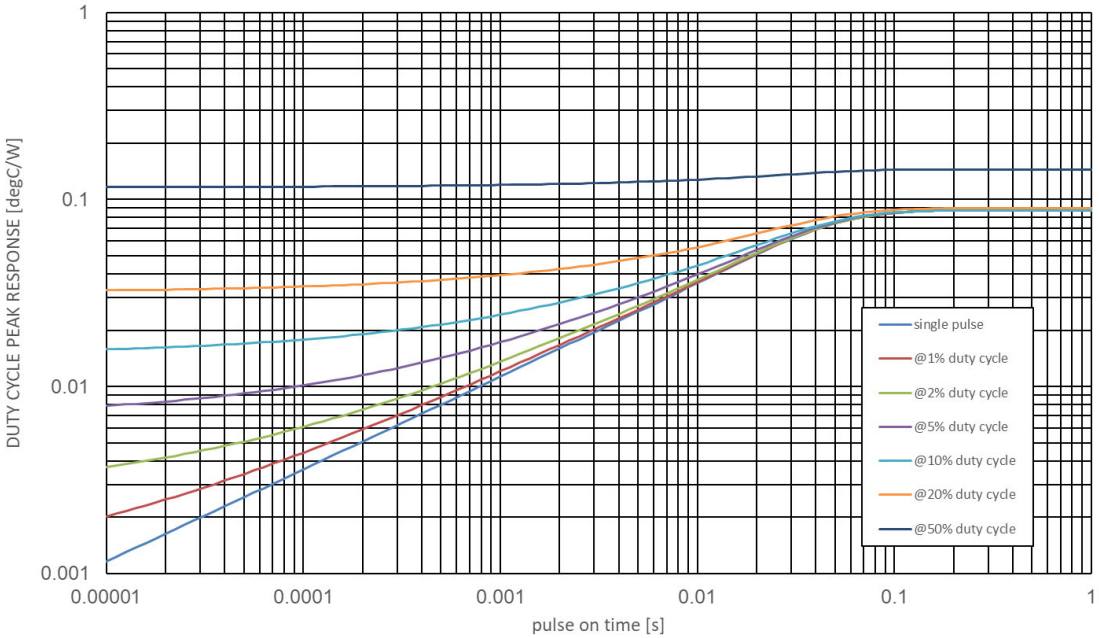
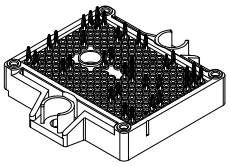


Figure 21. MOSFET Junction−to−Case Transient Thermal Impedance

MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS



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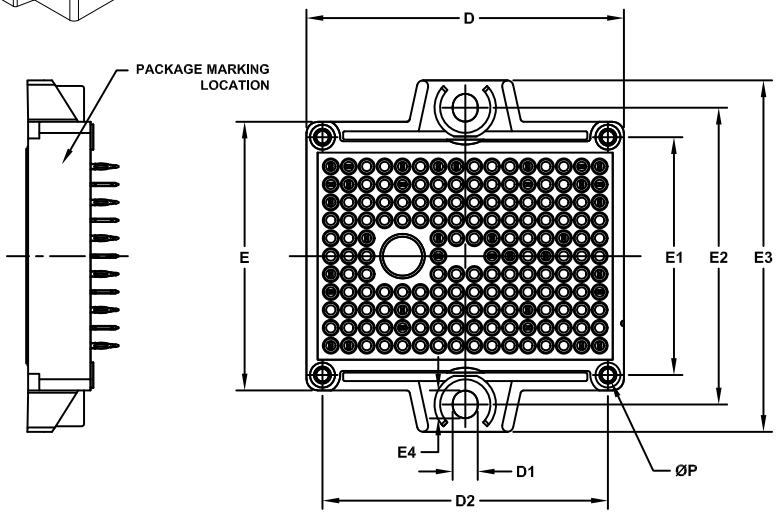
CASE 180BY
ISSUE E

DATE 20 DEC 2023

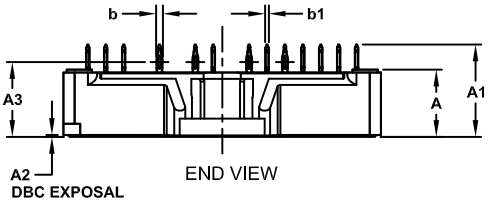


SIDE VIEW

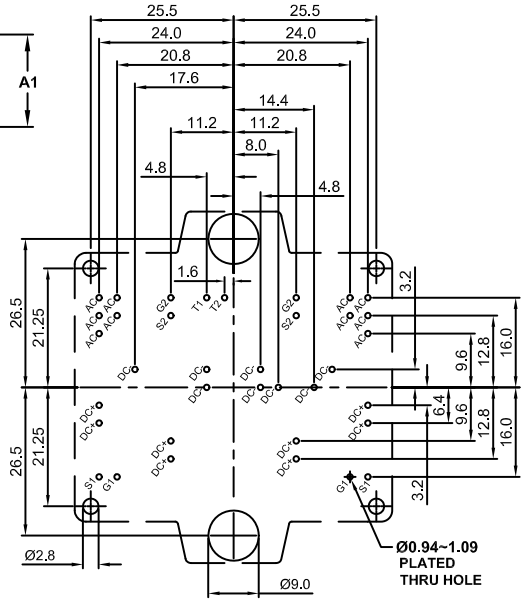
TOP VIEW

NOTES:
1. CONTROLLING DIMENSION: MILLIMETERS
2. PIN POSITION TOLERANCE IS ± 0.4mm
3. PRESS FIT PIN

DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	11.65	12.00	12.35
A1	16.10	16.50	16.90
A2	0.00	0.35	0.60
A3	12.95	13.35	13.75
b	1.15	1.20	1.25
b1	0.59	0.64	0.69
D	56.40	56.70	57.00
D1	4.40	4.50	4.60
D2	50.85	51.00	51.15
E	47.70	48.00	48.30
E1	42.35	42.50	42.65
E2	52.90	53.00	53.10
E3	62.30	62.80	63.30
E4	4.90	5.00	5.10
P	2.20	2.30	2.40

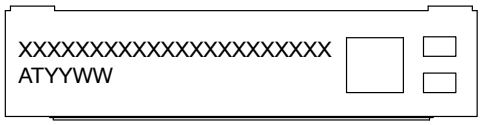


END VIEW

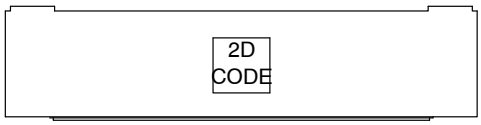


RECOMMENDED MOUNTING PATTERN

GENERIC MARKING DIAGRAM*



FRONTSIDE MARKING



BACKSIDE MARKING

XXXXX = Specific Device Code
AT = Assembly & Test Site Code
YYWW = Year and Work Week Code

*This information is generic. Please refer to device data sheet for actual part marking. Pb−Free indicator, “G” or microdot “ ▪”, may or may not be present. Some products may not follow the Generic Marking.

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