Silicon Carbide (SiC) Module – EliteSiC, 2 x 10 mohm SiC M1 MOSFET, 1200 V, 2 x 100 A, Vienna Module 900 V, F2 Package

NXH020U90MNF2PTG

The NXH020U90MNF2 is a power module containing a Vienna Rectifier module consisting of two 10 mΩ, 900 V SiC MOSFETs, two 100 A, 1200 V SiC diodes and a thermistor in an F2 package.

Features

- Neutral Point: 10 mΩ, 900 V SiC MOSFETs
- Boost Diodes: 100 A, 1200 V SiC Diodes
- Thermistor
- Pre−Applied TIM
- Press−Fit Pins
- These Devices are Pb−Free, Halide Free and are RoHS Compliant

Typical Applications

- Electric Vehicle Charging Stations
- Uninterruptible Power Supplies
- Energy Storage Systems

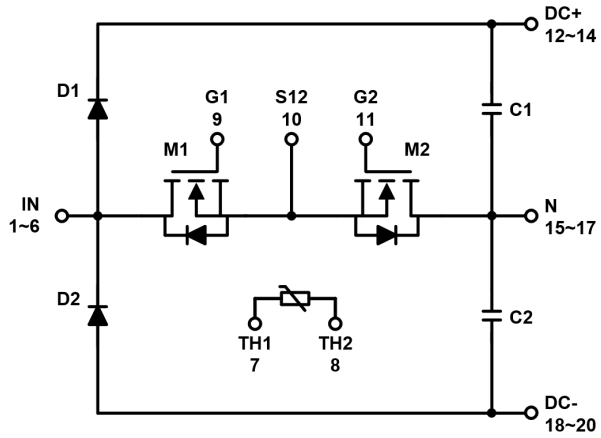
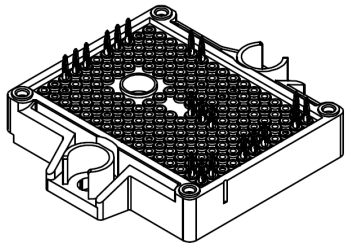


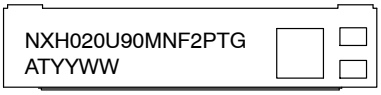
Figure 1. NXH020U90MNF2 Schematic Diagram

PACKAGE PICTURE



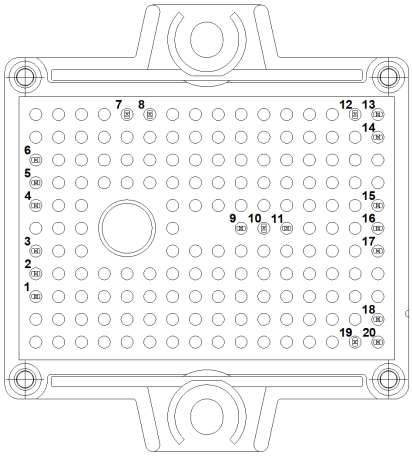
PIM20 56.7x42.5 (PRESS FIT)
CASE 180BZ

MARKING DIAGRAM



NXH020U90MNF2PTG = Specific Device Code
G = Pb−Free Package
AT = Assembly & Test Site Code
YYWW = Year and Work Week Code

PIN CONNECTIONS



See Pin Function Description for pin names

ORDERING INFORMATION

See detailed ordering and shipping information on page 5 of this data sheet.

PIN FUNCTION DESCRIPTION

Pin	Name	Description
1	IN	Phase Connection
2	IN	Phase Connection
3	IN	Phase Connection
4	IN	Phase Connection
5	IN	Phase Connection
6	IN	Phase Connection
7	TH1	Thermistor Connection 1
8	TH2	Thermistor Connection 2
9	G1	M1 Gate
10	S12	Common Source M1 M2
11	G2	M2 Gate
12	DC+	DC Positive Bus connection
13	DC+	DC Positive Bus connection
14	DC+	DC Positive Bus connection
15	N	N connection
16	N	N connection
17	N	N connection
18	DC−	DC Negative Bus connection
19	DC−	DC Negative Bus connection
20	DC−	DC Negative Bus connection

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
SiC MOSFET			
Drain−Source Voltage	V_{DSS}	900	V
Gate−Source Voltage	V_{GS}	+18/−8	V
Continuous Drain Current @ T_c = 80°C (T_J = 175°C)	I_D	149	A
Pulsed Drain Current (T_J = 175°C)	I_{Dpulse}	447	A
Maximum Power Dissipation (T_J = 175°C)	P_{tot}	352	W
Minimum Junction Temperature	T_{JMIN}	−40	°C
Maximum Junction Temperature	T_{JMAX}	175	°C
SiC DIODE			
Peak Repetitive Reverse Voltage	V_{RRM}	1200	V
Continuous Forward Current @ T_c = 80 °C (T_J = 175°C)	I_F	118	A
Surge Forward Current, tp = 10 ms	I_{FSM}	354	A
Power Dissipation per Diode (T_J = 175°C, T_c = 80°C)	P_{tot}	365	W
Minimum Operating Junction Temperature	T_{JMIN}	−40	°C
Maximum Operating Junction Temperature	T_{JMAX}	175	°C
THERMAL PROPERTIES			
Maximum Operating Junction Temperature under Switching Conditions	T_{VJOP}	150	°C
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 2)	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. Height difference between horizontal plane and substrate bottom copper.

ELECTRICAL CHARACTERISTICS

T_J = 25 °C unless otherwise noted

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
SiC MOSFET CHARACTERISTICS (M1, M2)						
Drain−Source Breakdown Voltage	V_{GS} = 0 V, I_D = 200 μA	$V_{(BR)DSS}$	900	–	–	V
Zero Gate Voltage Drain Current	V_{GS} = 0 V, V_{DS} = 900 V	I_{DSS}	–	–	300	μA
Drain−Source On Resistance	V_{GS} = 15 V, I_D = 100 A, T_J = 25°C	$R_{DS(ON)}$	–	10.03	14	mΩ
	V_{GS} = 15 V, I_D = 100 A, T_J = 125°C		–	10.80	–	
	V_{GS} = 15 V, I_D = 100 A, T_J = 150°C		–	11.61	–	
Gate−Source Threshold Voltage	V_{GS} = V_{DS}, I_D = 40 mA	$V_{GS(TH)}$	1.8	2.74	4.3	V
Gate Leakage Current	V_{GS} = −5 V / 15 V, V_{DS} = 0 V	I_{GSS}	−1	–	1	μA

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

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
Input Capacitance	V_{DS} = 450 V, V_{GS} = 0 V, f = 1 MHz	C_{ISS}	–	7007	–	pF
Reverse Transfer Capacitance		C_{RSS}	–	44	–	
Output Capacitance		C_{OSS}	–	665	–	
Total Gate Charge	V_{DS} = 720 V, V_{GS} = −5 V / 15 V, I_D = 100 A	$Q_{G(TOTAL)}$	–	546.4	–	nC
Gate−Source Charge		Q_{GS}	–	105.45	–	nC
Gate−Drain Charge		Q_{GD}	–	122.7	–	nC
Turn−on Delay Time	T_J = 25°C V_{DS} = 450 V, I_D = 100 A V_{GS} = −5 V / 15 V, R_G = 2 Ω	$t_{d(on)}$	–	43.2	–	ns
Rise Time		t_r	–	19.8	–	
Turn−off Delay Time		$t_{d(off)}$	–	110	–	
Fall Time		t_f	–	12.8	–	
Turn−on Switching Loss per Pulse		E_{ON}	–	0.75	–	mJ
Turn−off Switching Loss per Pulse		E_{OFF}	–	0.71	–	
Turn−on Delay Time	T_J = 150°C V_{DS} = 450 V, I_D = 100 A V_{GS} = −5 V / 15 V, R_G = 2 Ω	$t_{d(on)}$	–	41.6	–	ns
Rise Time		t_r	–	18	–	
Turn−off Delay Time		$t_{d(off)}$	–	128	–	
Fall Time		t_f	–	12.8	–	
Turn−on Switching Loss per Pulse		E_{ON}	–	0.63	–	mJ
Turn−off Switching Loss per Pulse		E_{OFF}	–	0.77	–	
Diode Forward Voltage	I_D = 100 A	V_{SD}	–	4.47	6	V
	I_D = 100 A, T_J = 150°C		–	3.92	–	
Thermal Resistance − Chip−to−Case	M1, M2	R_{thJC}	–	0.27	–	°C/W
Thermal Resistance − Chip−to−Heatsink	Thermal grease, Thickness = 2 Mil +2%, A = 2.8 W/mK	R_{thJH}	–	0.49	–	°C/W

SiC DIODE CHARACTERISTICS (D1, D2)

Diode Reverse Leakage Current	V_R = 1200 V	I_R	–	–	400	μA
Diode Forward Voltage	I_F = 100 A, T_J = 25°C	V_F	–	1.54	2.30	V
	I_F = 100 A, T_J = 125°C		–	1.84	–	
	I_F = 100 A, T_J = 150°C		–	1.93	–	
Reverse Recovery Time	T_J = 25°C V_{DS} = 450 V, I_D = 100 A V_{GS} = −5 V / 15 V, R_G = 2 Ω	t_{rr}	–	19.5	–	ns
Reverse Recovery Charge		Q_{rr}	–	439	–	nC
Peak Reverse Recovery Current		I_{RRM}	–	33.4	–	A
Peak Rate of Fall of Recovery Current		di/dt	–	2803	–	A/μs
Reverse Recovery Time	T_J = 150°C V_{DS} = 450 V, I_D = 100 A V_{GS} = −5 V / 15 V, R_G = 2 Ω	t_{rr}	–	20.5	–	ns
Reverse Recovery Charge		Q_{rr}	–	525	–	nC
Peak Reverse Recovery Current		I_{RRM}	–	40.1	–	A
Peak Rate of Fall of Recovery Current		di/dt	–	4002	–	A/μs
Thermal Resistance − Chip−to−Case	D1, D2	R_{thJC}	–	0.26	–	°C/W
Thermal Resistance − Chip−to−Heatsink	Thermal grease, Thickness = 2 Mil +2%, A = 2.8 W/mK	R_{thJH}	–	0.49	–	°C/W

THERMISTOR CHARACTERISTICS

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

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
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
NXH020U90MNF2PTG	NXH020U90MNF2PTG	F2–VIENNA: Case 180BZ Press–fit Pins with pre–applied thermal interface material (TIM) (Pb-Free / Halide Free)	20 Units / Blister Tray

TYPICAL CHARACTERISTICS

SiC MOSFET (M1/M2)

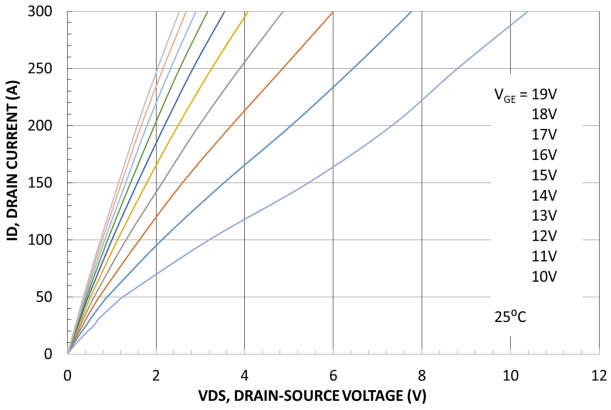


Figure 2. MOSFET Typical Output Characteristic

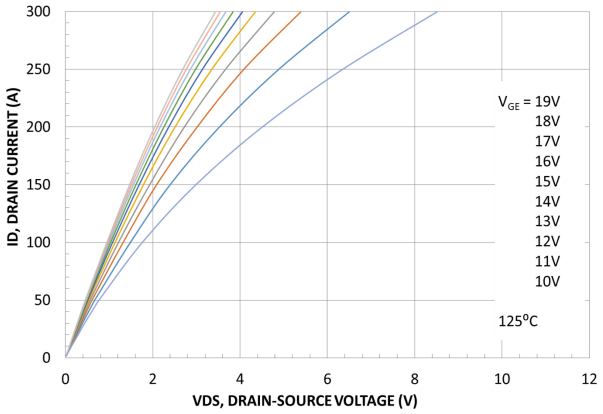


Figure 3. MOSFET Typical Output Characteristic

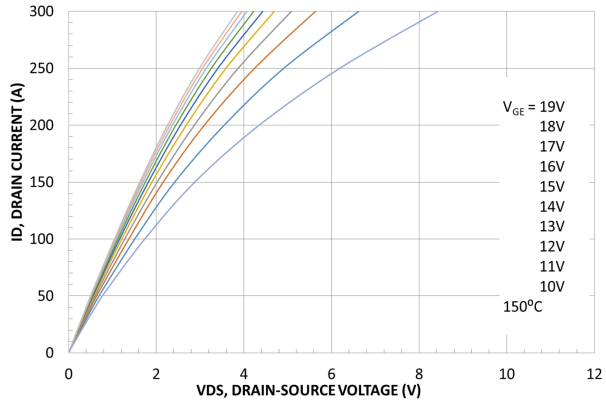


Figure 4. MOSFET Typical Output Characteristic

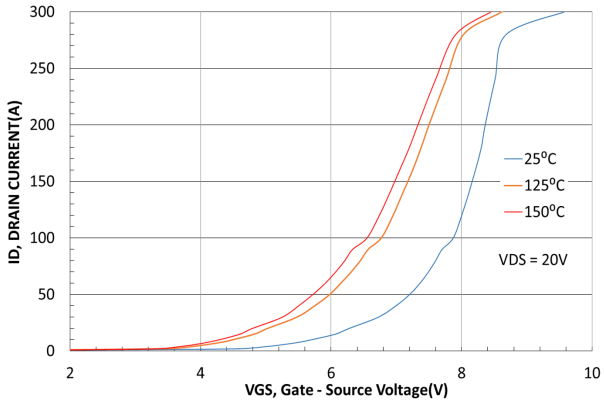


Figure 5. MOSFET Typical Transfer Characteristic

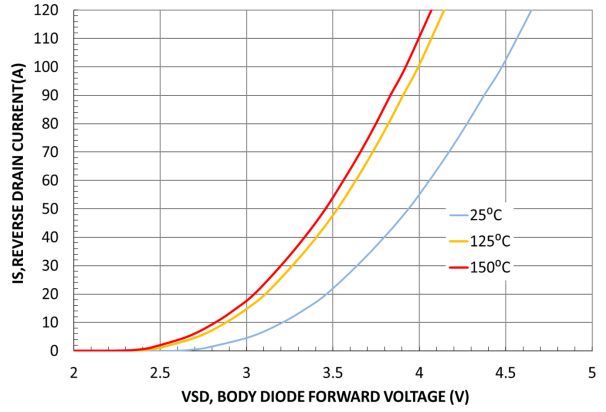


Figure 6. Body Diode Forward Characteristic

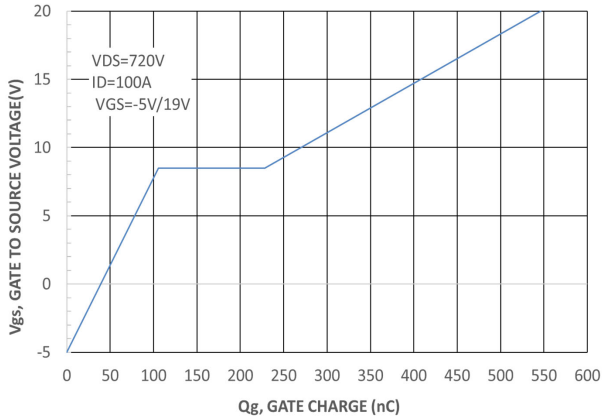


Figure 7. Gate−to−Source Voltage vs. Total Charge

TYPICAL CHARACTERISTICS

SiC DIODE (D1/D2)

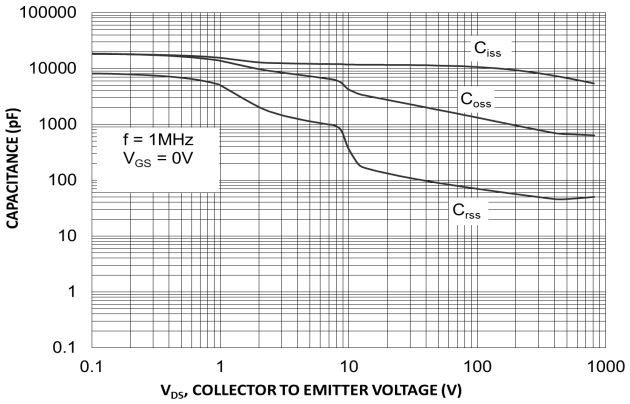


Figure 8. Capacitance vs. Drain−to−Source Voltage

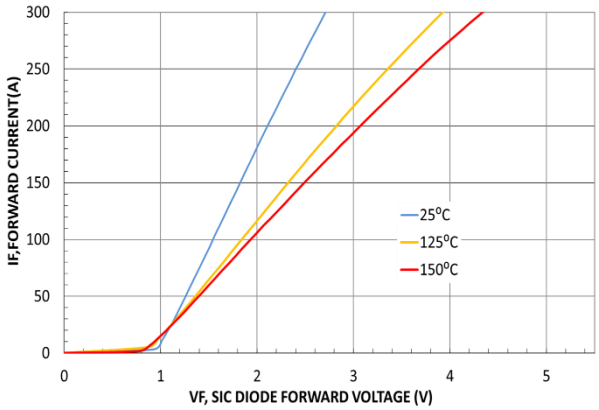


Figure 9. SiC Diode Forward Characteristic

TYPICAL CHARACTERISTICS

M1/M2 MOSFET SWITCHING CHARACTERISTICS

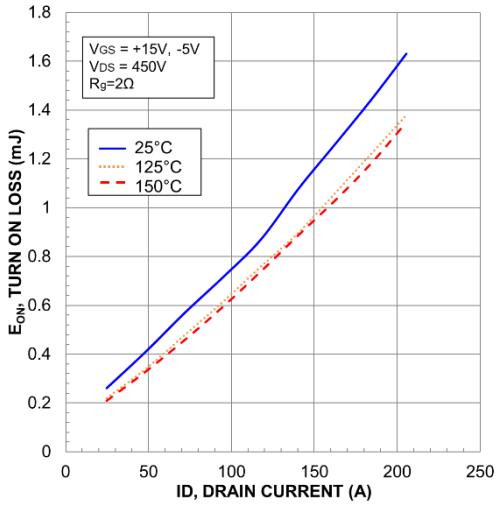


Figure 10. Typical Switching Loss E_{on} vs. ID

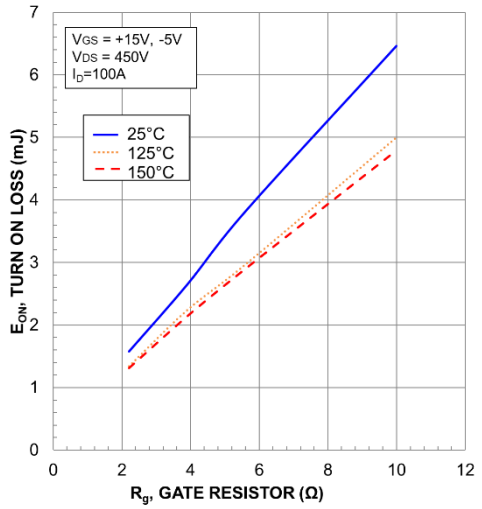


Figure 11. Typical Switching Loss E_{on} vs. R_G

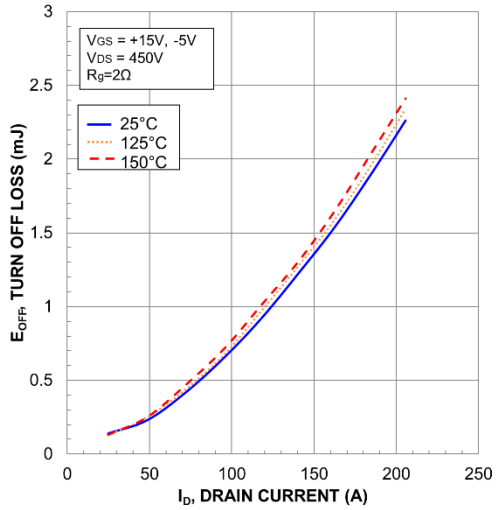


Figure 12. Typical Switching Loss E_{off} vs. ID

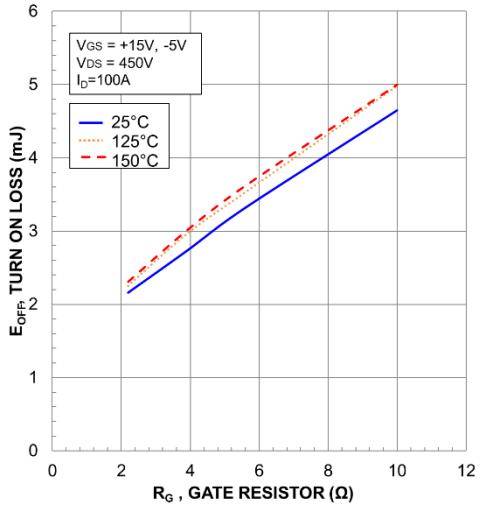


Figure 13. Typical Switching Loss E_{off} vs. R_G

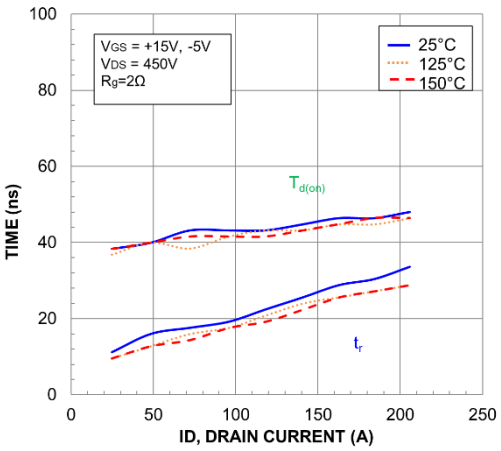


Figure 14. Typical Turn−On Switching $T_{don,tr}$ vs. ID

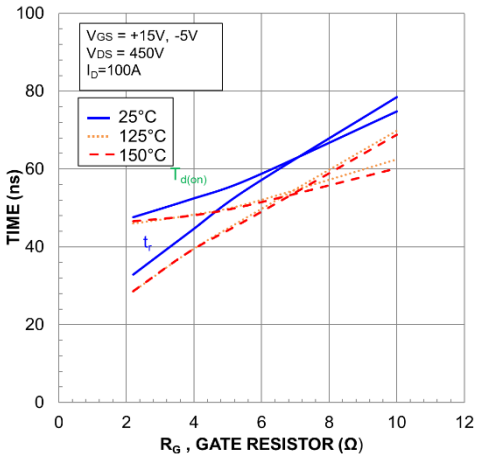


Figure 15. Typical Turn−On Switching $T_{don,tr}$ vs. R_G

TYPICAL CHARACTERISTICS

M1/M2 MOSFET SWITCHING CHARACTERISTICS

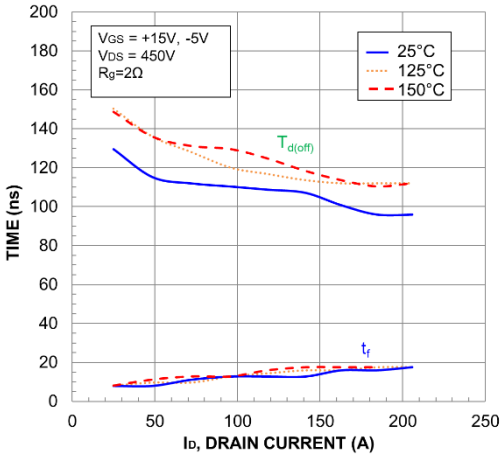


Figure 16. Typical Turn−Off Switching $T_{doff,tf}$ vs. ID

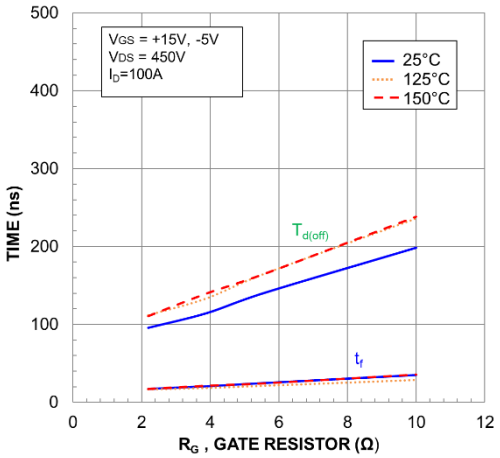


Figure 17. Typical Turn−Off Switching $T_{doff,tf}$ vs. R_G

TYPICAL CHARACTERISTICS

M1/M2 MOSFET COMMUTATE D1/D2 DIODE

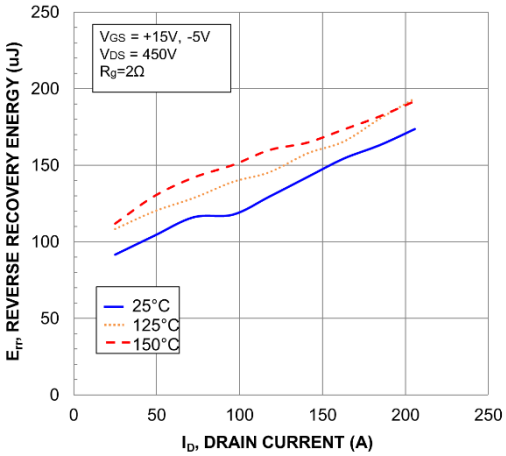


Figure 18. Typical Reverse Recovery Energy vs. ID

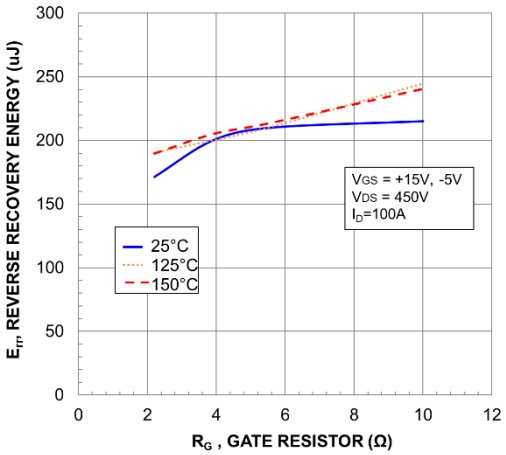


Figure 19. Typical Reverse Recovery Energy vs. R_G

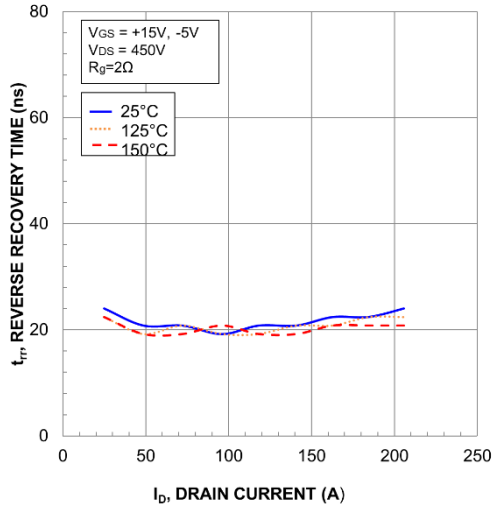


Figure 20. Typical Reverse Recovery Time vs. ID

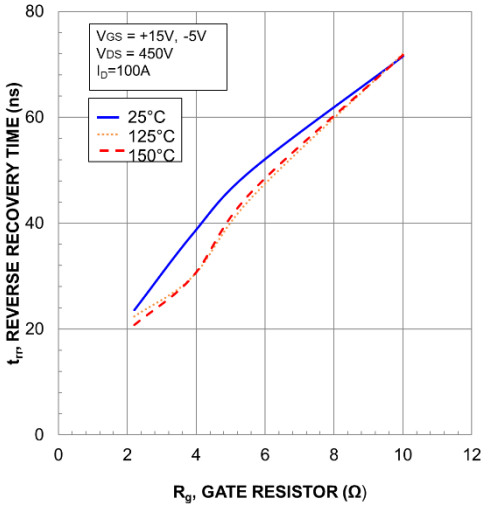


Figure 21. Typical Reverse Recovery Time vs. R_G

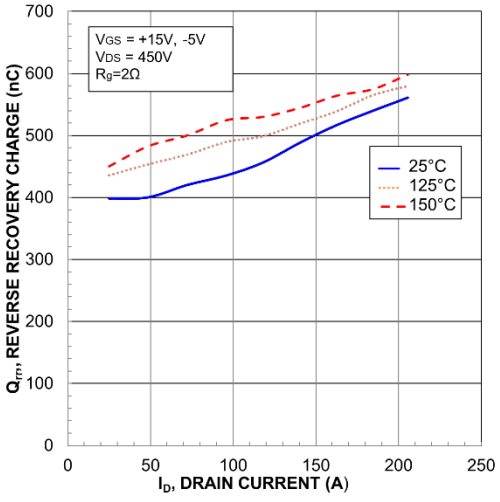


Figure 22. Typical Reverse Recovery Charge vs. ID

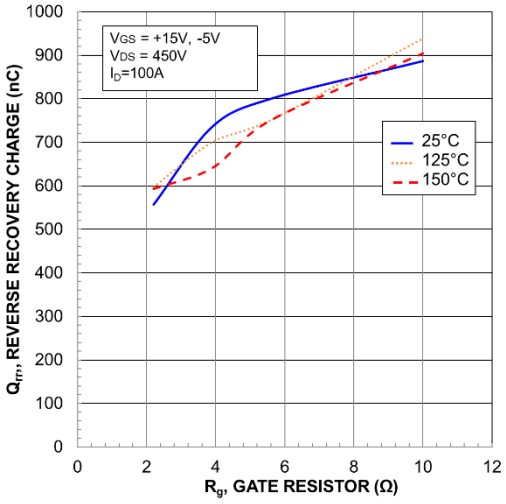


Figure 23. Typical Reverse Recovery Charge vs. R_G

TYPICAL CHARACTERISTICS

M1/M2 MOSFET COMMUTATE D1/D2 DIODE

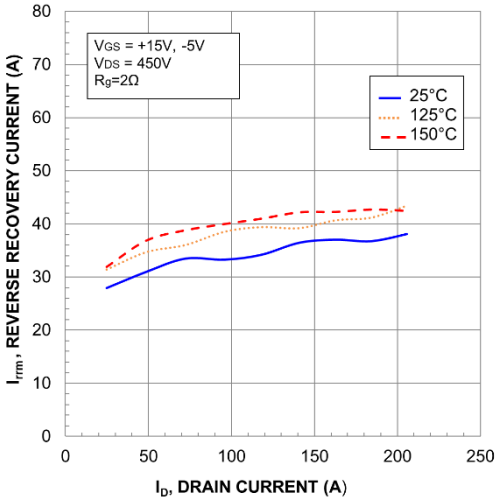


Figure 24. Typical Reverse Recovery Current vs. ID

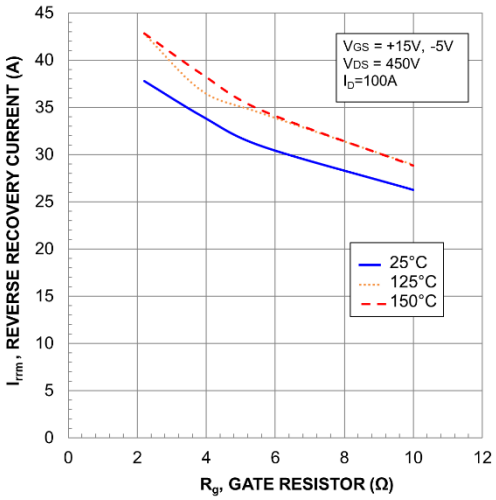


Figure 25. Typical Reverse Recovery Current vs. R_G

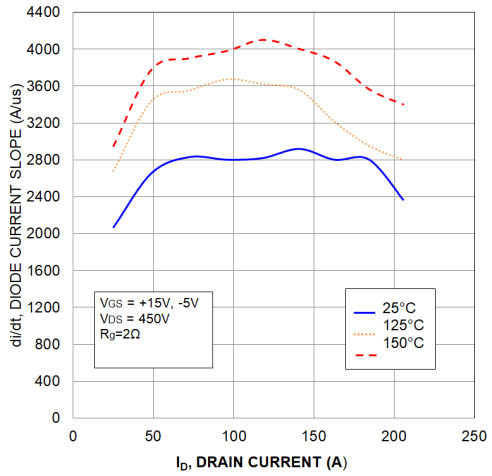


Figure 26. Typical di/dt vs. ID

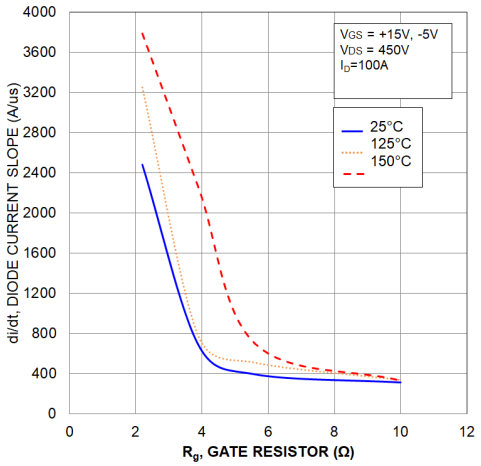


Figure 27. Typical di/dt vs. R_G

TYPICAL CHARACTERISTICS

M1/M2 MOSFET COMMUTATE D1/D2 DIODE

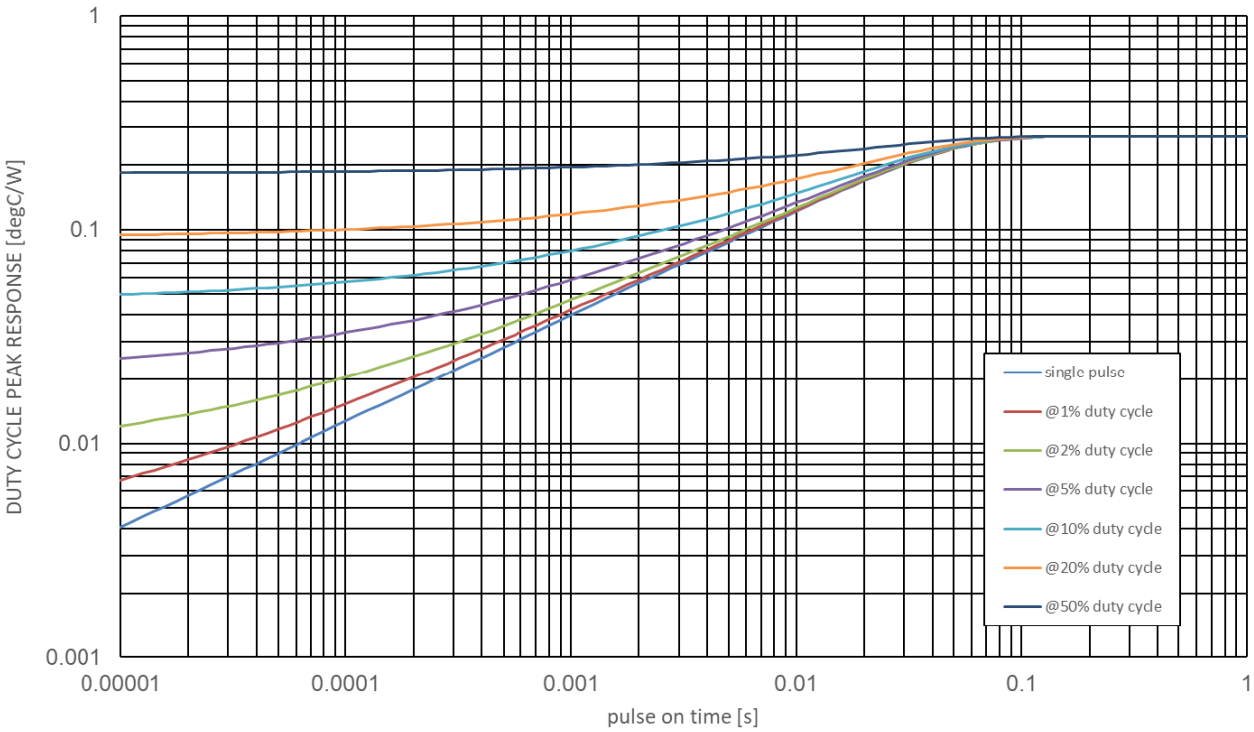


Figure 28. SiC MOSFET Junction−to−Case Transient Thermal Impedance

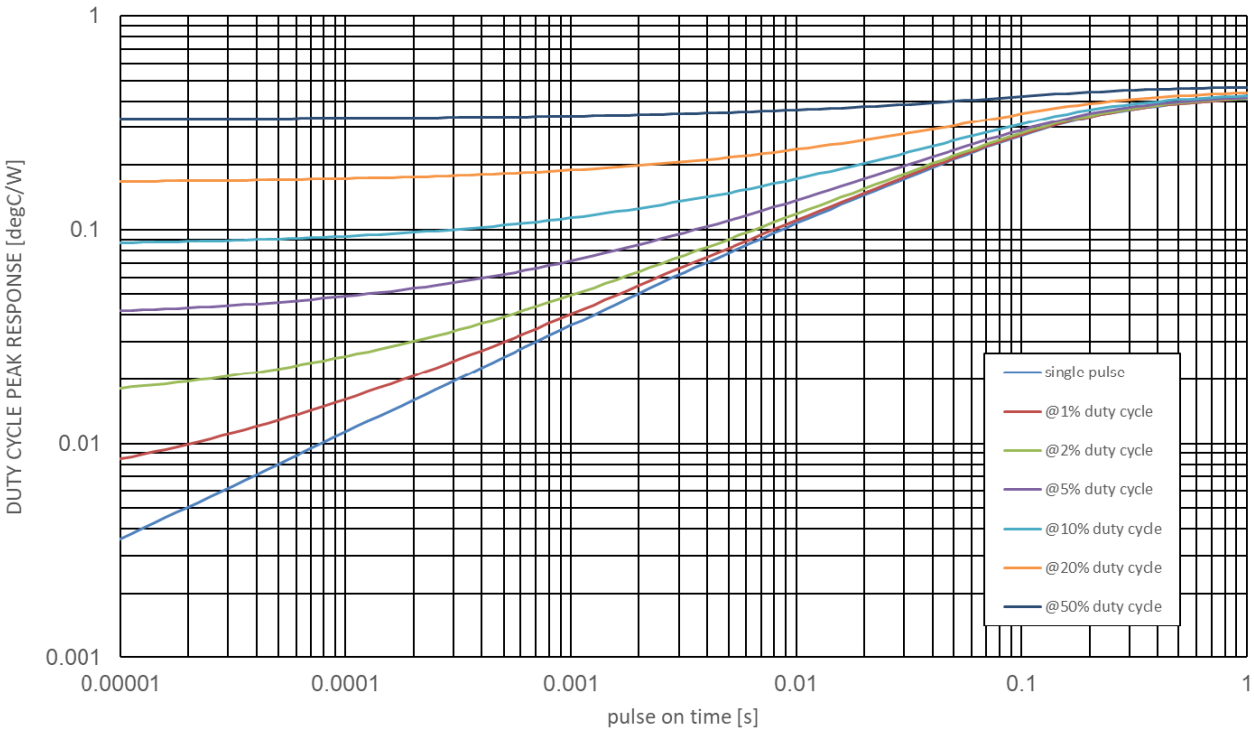
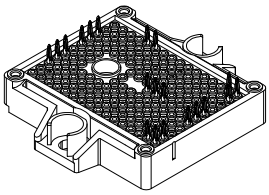


Figure 29. SiC Diode Junction−to−Case Transient Thermal Impedance

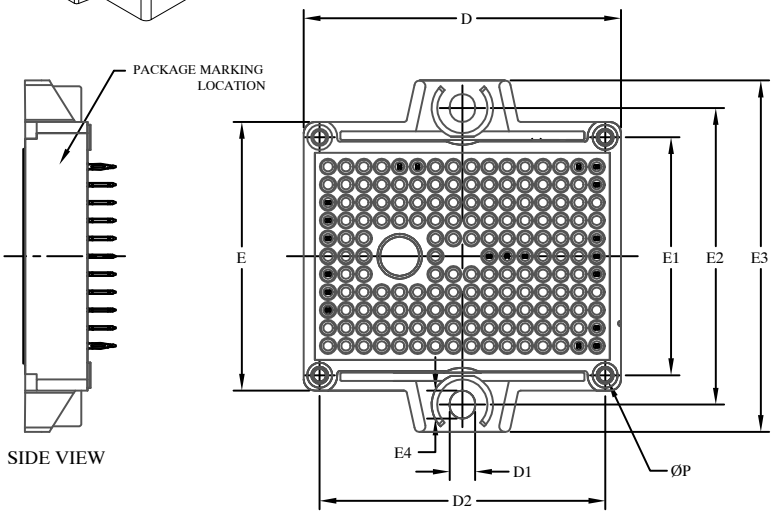
MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS

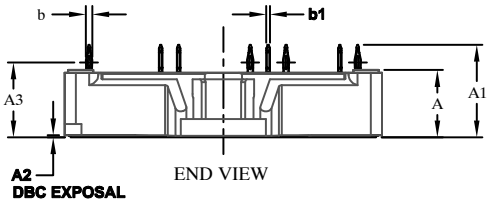
ON Semiconductor®



PIM20 56.7x42.5 (PRESS FIT)
CASE 180BZ
ISSUE C

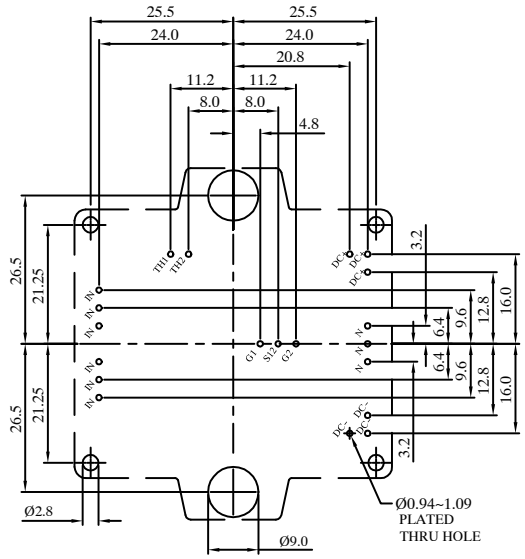
DATE 20 AUG 2021





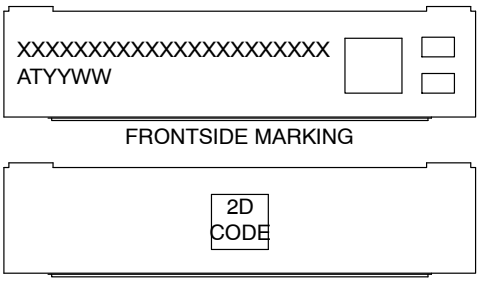
NOTES:
1. CONTROLLING DIMENSION: MILLIMETERS
2. PIN POSITION TOLERANCE IS ± 0.4mm

DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	11.65	12.00	12.35
A1	16.00	16.50	17.00
A2	0.00	0.35	0.60
A3	12.85	13.35	13.85
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



RECOMMENDED MOUNTING PATTERN

GENERIC MARKING DIAGRAM*



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.

DOCUMENT NUMBER:	**98AON19726H**	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped “CONTROLLED COPY” in red.	
DESCRIPTION:	**PIM20 56.7x42.5 (PRESS FIT)**		**PAGE 1 OF 1**

ADDITIONAL INFORMATION

TECHNICAL PUBLICATIONS:
Technical Library: www.onsemi.com/design/resources/technical−documentation
onsemi Website: www.onsemi.com

ONLINE SUPPORT: www.onsemi.com/support
For additional information, please contact your local Sales Representative at www.onsemi.com/support/sales