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Silicon Carbide (SiC) Module – EliteSiC, 7 m Ω , 1200 V, SiC M3S MOSFET, Full Bridge, F2 Package

Product Preview

NXH007F120M3F2PTHG

The NXH007F120M3F2PTHG is a power module containing 7 m Ω / 1200 V SiC MOSFET full-bridge and a thermistor with HPS DBC in an F2 package.

Features

- 7 m Ω / 1200 V M3S SiC MOSFET Full-Bridge
- HPS DBC
- Thermistor
- Options with Pre-Applied Thermal Interface Material (TIM) and without Pre-Applied TIM
- 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

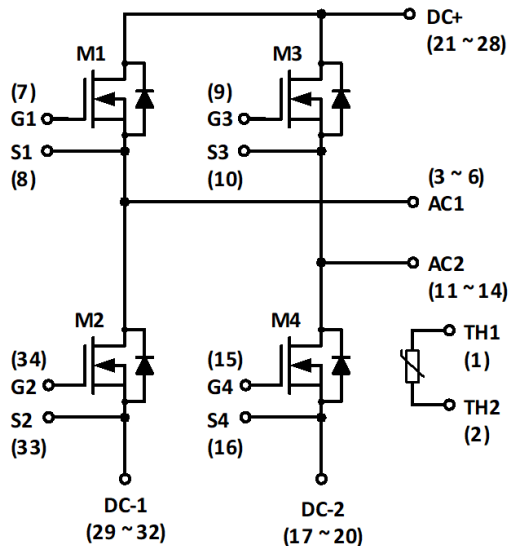
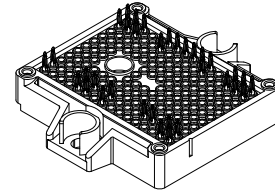


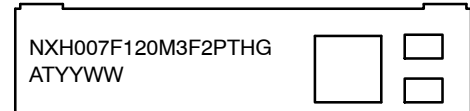
Figure 1. NXH007F120M3F2PTHG Schematic Diagram

This document contains information on a product under development. onsemi reserves the right to change or discontinue this product without notice.



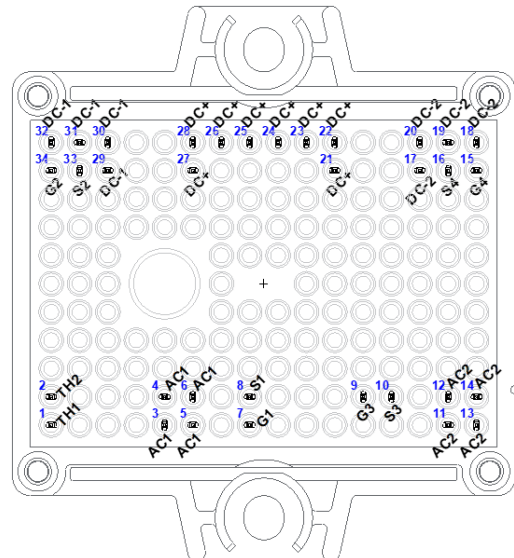
PIM34 56.7x42.5 (PRESS FIT)
CASE 180HU

MARKING DIAGRAM



NXH007F120M3F2PTHG = Specific Device Code
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 4 of this data sheet.

NXH007F120M3F2PTHG

PIN FUNCTION DESCRIPTION

Pin	Name	Description
1	TH1	Thermistor Connection 1
2	TH2	Thermistor Connection 2
3	AC1	Center point of full bridge 1
4	AC1	Center point of full bridge 1
5	AC1	Center point of full bridge 1
6	AC1	Center point of full bridge 1
7	G1	M1 Gate (High side switch)
8	S1	M1 Kelvin Source (High side switch)
9	G3	M3 Gate (High side switch)
10	S3	M3 Kelvin Source (High side switch)
11	AC2	Center point of full bridge 2
12	AC2	Center point of full bridge 2
13	AC2	Center point of full bridge 2
14	AC2	Center point of full bridge 2
15	G4	M4 Gate (Low side switch)
16	S4	M4 Kelvin Source (Low side switch)
17	DC-2	DC Negative Bus connection
18	DC-2	DC Negative Bus connection
19	DC-2	DC Negative Bus connection
20	DC-2	DC Negative Bus connection
21	DC+	DC Positive Bus connection
22	DC+	DC Positive Bus connection
23	DC+	DC Positive Bus connection
24	DC+	DC Positive Bus connection
25	DC+	DC Positive Bus connection
26	DC+	DC Positive Bus connection
27	DC+	DC Positive Bus connection
28	DC+	DC Positive Bus connection
29	DC-1	DC Negative Bus connection
30	DC-1	DC Negative Bus connection
31	DC-1	DC Negative Bus connection
32	DC-1	DC Negative Bus connection
33	S2	M2 Kelvin Source (Low side switch)
34	G2	M2 Gate (Low side switch)

NXH007F120M3F2PTHG

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
SiC MOSFET			
Drain–Source Voltage	V_{DS}	1200	V
Gate–Source Voltage	V_{GS}	+22/–10	V
Continuous Drain Current @ $T_c = 80^\circ\text{C}$ ($T_J = 175^\circ\text{C}$)	I_D	149	A
Pulsed Drain Current ($T_J = 175^\circ\text{C}$) (Note 2)	I_{Dpulse}	447	A
Maximum Power Dissipation ($T_J = 175^\circ\text{C}$)	P_{tot}	353	W
Minimum Operating Junction Temperature	T_{JMIN}	–40	$^\circ\text{C}$
Maximum Operating Junction Temperature	T_{JMAX}	175	$^\circ\text{C}$

THERMAL PROPERTIES

Storage Temperature Range	T_{stg}	–40 to 150	$^\circ\text{C}$
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INSULATION PROPERTIES

Isolation Test Voltage, $t = 1\text{ s}$, 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

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 copper bottom.

RECOMMENDED OPERATING RANGES

Rating	Symbol	Min	Max	Unit
Module Operating Junction Temperature	T_J	–40	150	$^\circ\text{C}$

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 ($T_J = 25^\circ\text{C}$ unless otherwise noted)

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
SiC MOSFET CHARACTERISTICS						
Zero Gate Voltage Drain Current	$V_{GS} = 0\text{ V}$, $V_{DS} = 1200\text{ V}$, $T_J = 25^\circ\text{C}$	I_{DSS}	–	–	300	μA
Drain–Source On Resistance	$V_{GS} = 18\text{ V}$, $I_D = 120\text{ A}$, $T_J = 25^\circ\text{C}$	$R_{DS(ON)}$	–	7.5	10	$\text{m}\Omega$
	$V_{GS} = 18\text{ V}$, $I_D = 120\text{ A}$, $T_J = 125^\circ\text{C}$		–	12.1	–	
	$V_{GS} = 18\text{ V}$, $I_D = 120\text{ A}$, $T_J = 150^\circ\text{C}$		–	13.6	–	
	$V_{GS} = 18\text{ V}$, $I_D = 120\text{ A}$, $T_J = 175^\circ\text{C}$		–	15.9	–	
Gate–Source Threshold Voltage	$V_{GS} = V_{DS}$, $I_D = 60\text{ mA}$	$V_{GS(TH)}$	2.04	2.72	4.4	V
Recommended Gate Voltage		V_{GOP}	–3	–	+18	V
Gate Leakage Current	$V_{GS} = -10\text{ V} / 22\text{ V}$, $V_{DS} = 0\text{ V}$	I_{GSS}	–	–	± 3	μA
Input Capacitance	$V_{GS} = 0\text{ V}$, $f = 1\text{ MHz}$, $V_{DS} = 800\text{ V}$	C_{ISS}	–	9090	–	pF
Reverse Transfer Capacitance		C_{RSS}	–	37	–	
Output Capacitance		C_{OSS}	–	484	–	

NXH007F120M3F2PTHG

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

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
SiC MOSFET CHARACTERISTICS						
Total Gate Charge	V _{GS} = -3/18 V, V _{DS} = 800 V, I _D = 40 A	Q _{G(TOTAL)}	—	407	—	nC
Gate–Source Charge		Q _{GS}	—	42	—	
Gate–Drain Charge		Q _{GD}	—	93	—	
Internal Gate Resistance	f = 1 MHz	R _{GINT}	—	0.5	—	Ω
Turn–on Delay Time	T _J = 25°C V _{DS} = 800 V, I _D = 120 A V _{GS} = -3/18 V, R _G = 2 Ω	t _{d(on)}	—	37.2	—	ns
Rise Time		t _r	—	12	—	
Turn–off Delay Time		t _{d(off)}	—	121.6	—	
Fall Time		t _f	—	13.2	—	
Turn–on Switching Loss per Pulse		E _{ON}	—	1.69	—	mJ
Turn–off Switching Loss per Pulse		E _{OFF}	—	0.5	—	
Turn–on Delay Time	T _J = 150°C V _{DS} = 800 V, I _D = 120 A V _{GS} = -3/18 V, R _G = 2 Ω	t _{d(on)}	—	34.8	—	ns
Rise Time		t _r	—	14	—	
Turn–off Delay Time		t _{d(off)}	—	131.6	—	
Fall Time		t _f	—	14	—	
Turn–on Switching Loss per Pulse		E _{ON}	—	2.23	—	mJ
Turn off Switching Loss per Pulse		E _{OFF}	—	0.6	—	
Diode Forward Voltage	I _{SD} = 120 A, T _J = 25°C, V _{GS} = -3 V	V _{SD}	—	5.03	6	V
	I _{SD} = 120 A, T _J = 125°C, V _{GS} = -3 V		—	4.81	—	
	I _{SD} = 120 A, T _J = 150°C, V _{GS} = -3 V		—	4.73	—	
Thermal Resistance – Chip–to–Case	M1, M2, M3, M4	R _{thJC}	—	0.269	—	°C/W
Thermal Resistance – Chip–to–Heatsink	Thermal grease, Thickness = 2 Mil ±2%, A = 2.8 W/mK	R _{thJH}	—	0.462	—	°C/W

THERMISTOR CHARACTERISTICS

Nominal Resistance	T = 25°C	R ₂₅	—	5	—	kΩ
	T = 100°C	R ₁₀₀	—	493	—	Ω
	T = 150°C	R ₁₅₀	—	159.5	—	Ω
Deviation of R ₁₀₀	T = 100°C	ΔR/R	-5	—	5	%
Power Dissipation – Recommended Limit	0.15 mA, Non–self–heating Effect	P _D	—	0.1	—	mW
Power Dissipation – Absolute Maximum	5 mA	P _D	—	34.2	—	mW
Power Dissipation Constant			—	1.4	—	mW/K
B–value	B(25/50), tolerance ±2%		—	3375	—	K
B–value	B(25/100), tolerance ±2%		—	3436	—	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
NXH007F120M3F2PTHG	NXH007F120M3F2PTHG	F2FULLBR: Case 180HU Press-fit Pins with pre-applied thermal interface material (TIM) (Pb–Free / Halide Free)	20 Units / Blister Tray

TYPICAL CHARACTERISTIC (M1/M2 SiC MOSFET CHARACTERISTIC)

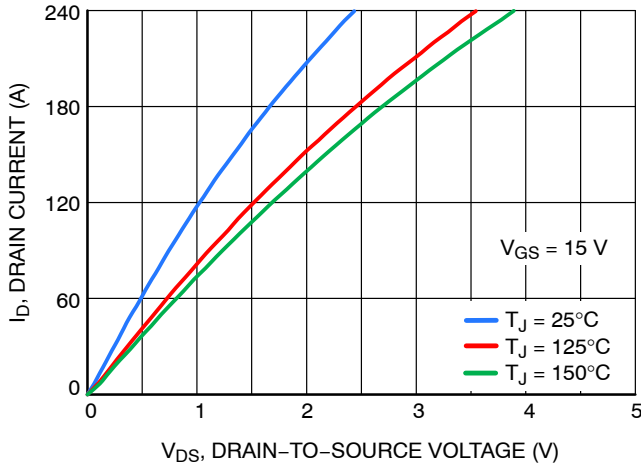


Figure 2. MOSFET Typical Output Characteristic $V_{GS} = 15\text{ V}$

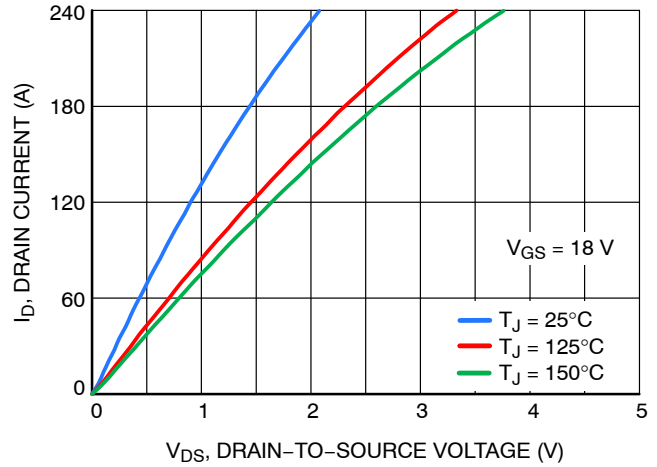


Figure 3. MOSFET Typical Output Characteristic $V_{GS} = 18\text{ V}$

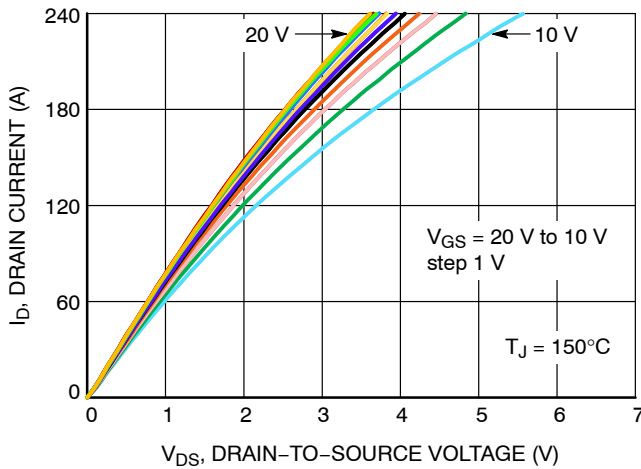


Figure 4. MOSFET Typical Output Characteristic $V_{GS} = \text{var.}$

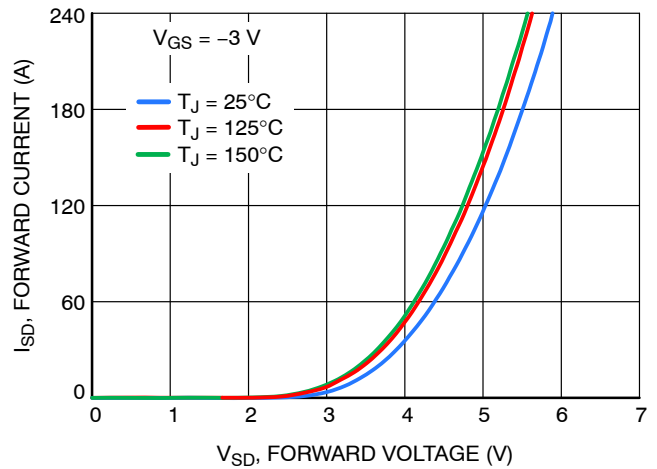


Figure 5. Body Diode Forward Characteristic

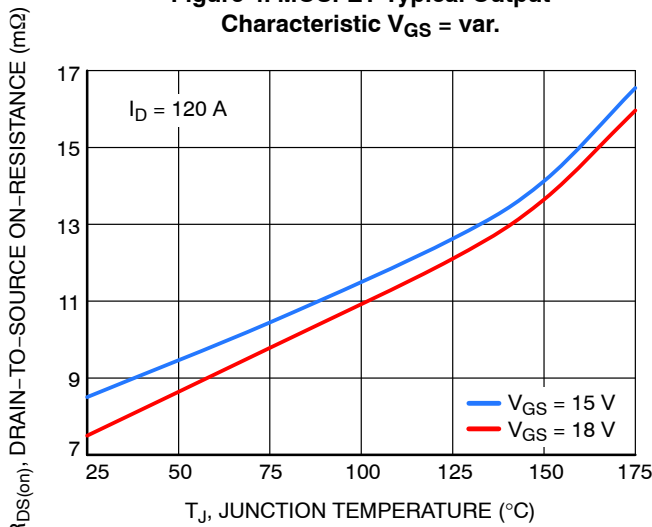


Figure 6. $R_{DS(ON)}$ Drain-to-Source ON Resistance vs. Junction Temperature

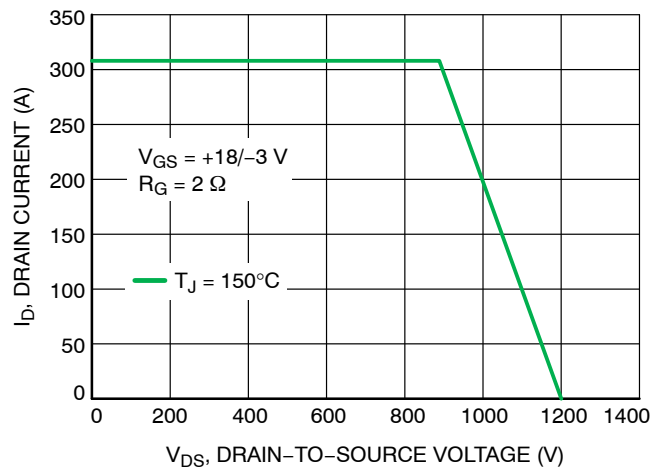


Figure 7. Reverse Bias Safe Operating Area (RBSOA)

NXH007F120M3F2PTHG

TYPICAL CHARACTERISTIC (M1/M2 SiC MOSFET CHARACTERISTIC)

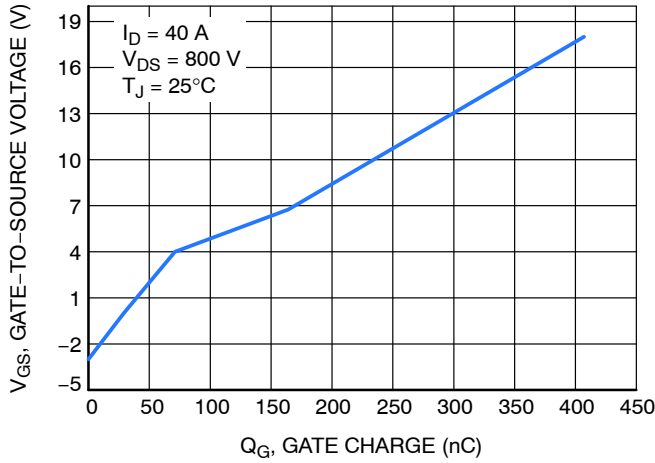


Figure 8. Gate-to-Source Voltage vs. Gate Charge

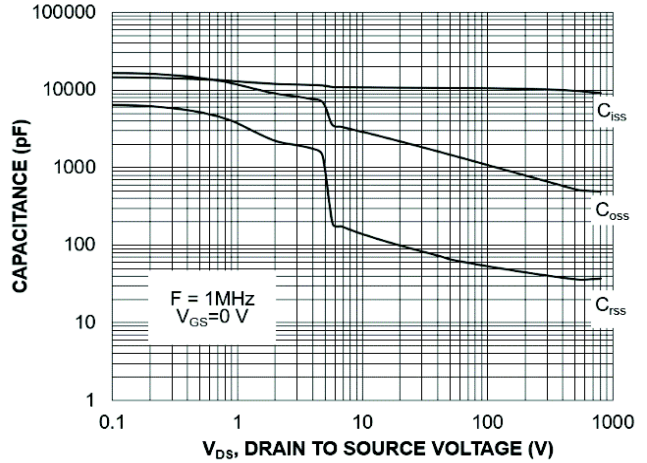


Figure 9. Capacitance vs. Voltage Drain-to-Source

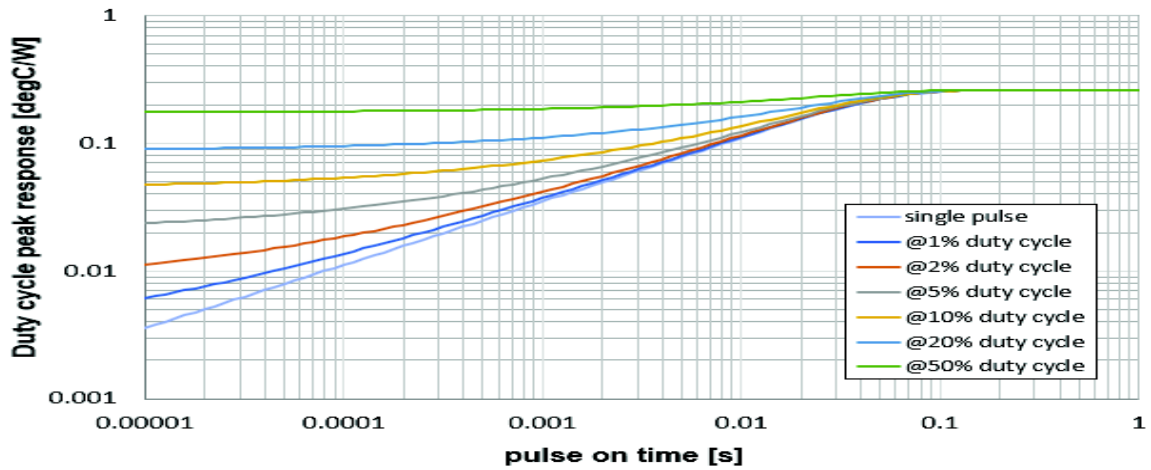


Figure 10. Duty Cycle Response vs. Pulse On Time

TYPICAL CHARACTERISTIC (M1/M2 SiC MOSFET CHARACTERISTIC)

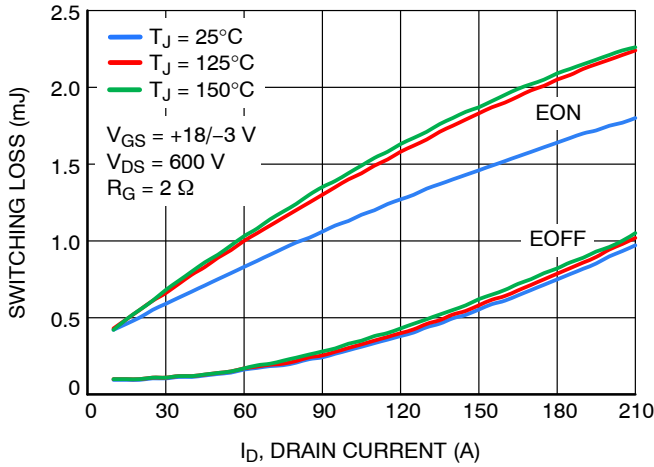


Figure 11. Switching Loss vs. Drain Current
 $V_{DS} = 600 \text{ V}$

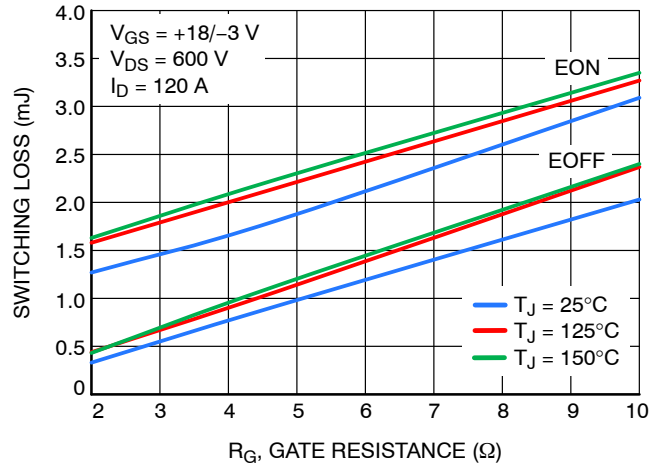


Figure 12. Switching Loss vs. Gate Resistance
 $V_{DS} = 600 \text{ V}$

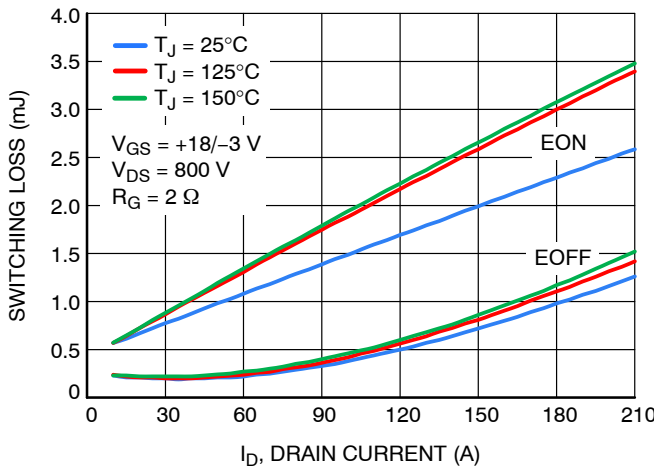


Figure 13. Switching Loss vs. Drain Current
 $V_{DS} = 800 \text{ V}$

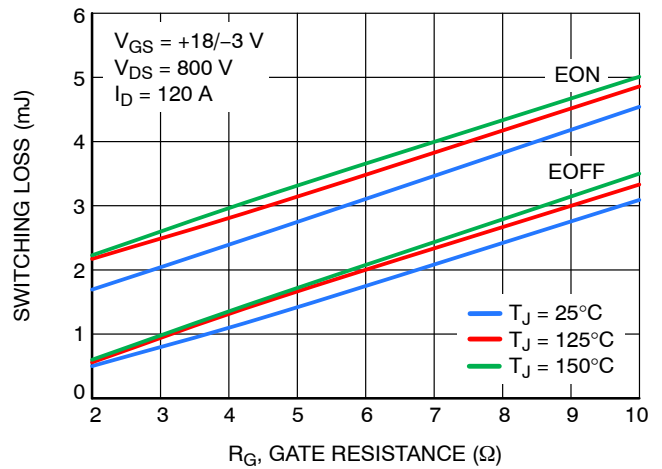


Figure 14. Switching Loss vs. Gate Resistance
 $V_{DS} = 800 \text{ V}$

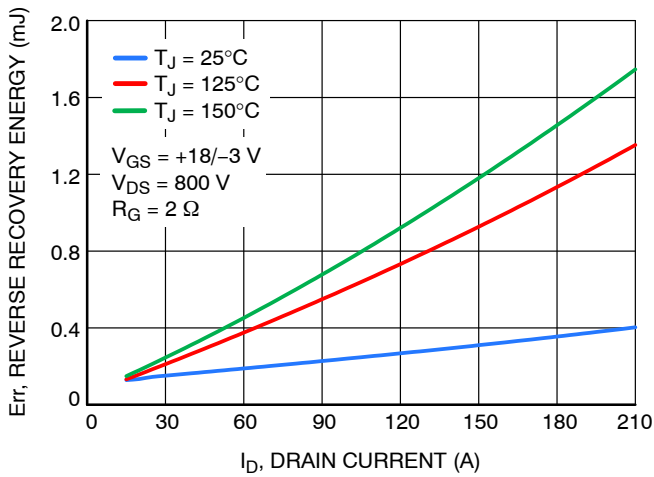


Figure 15. Reverse Recovery Energy vs. Drain Current
 $V_{DS} = 800 \text{ V}$

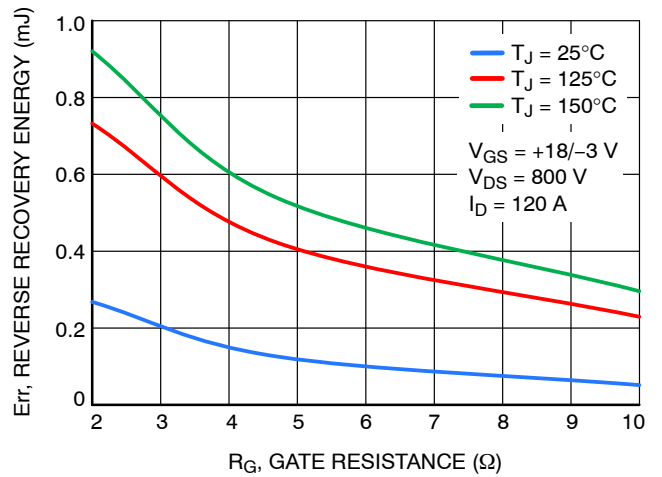


Figure 16. Reverse Recovery Energy vs. Gate Resistance
 $V_{DS} = 800 \text{ V}$

TYPICAL CHARACTERISTIC (M1/M2 SiC MOSFET CHARACTERISTIC)

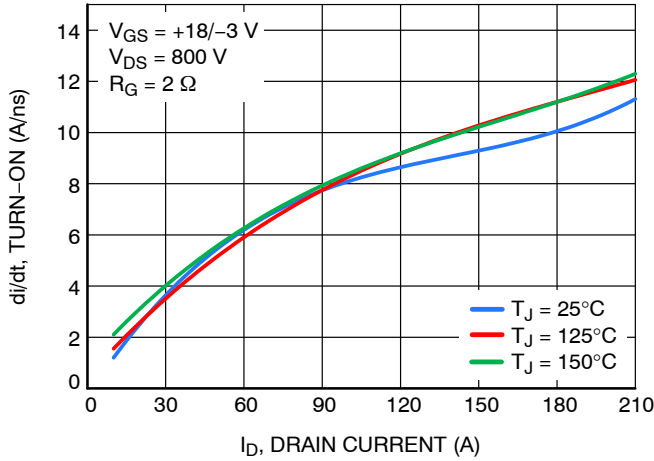


Figure 17. di/dt Turn ON vs. Drain Current
 $V_{DS} = 800 \text{ V}$

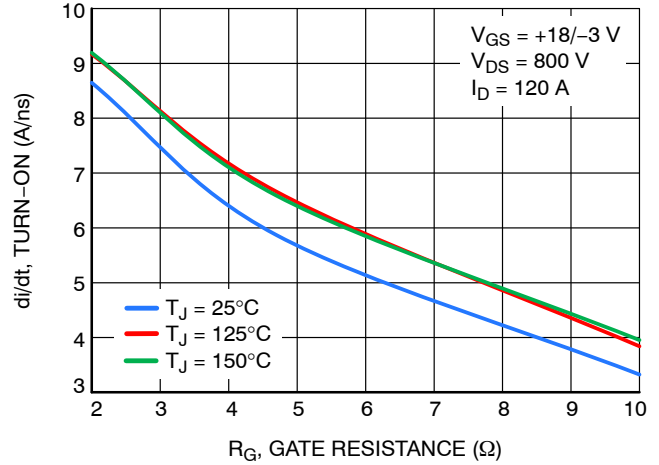


Figure 18. di/dt Turn ON vs. Gate Resistance
 $V_{DS} = 800 \text{ V}$

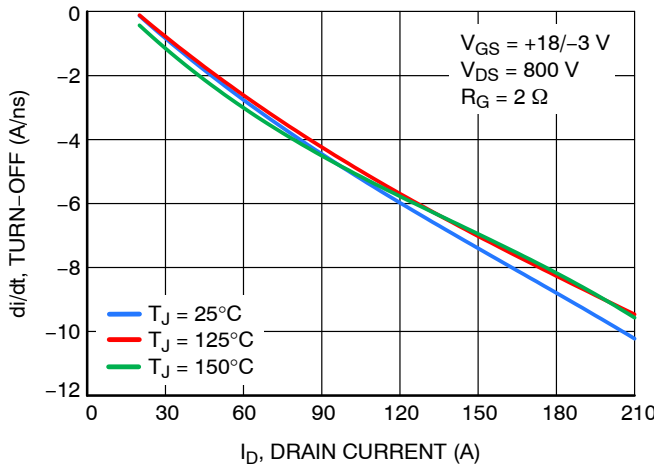


Figure 19. di/dt Turn OFF vs. Drain Current
 $V_{DS} = 800 \text{ V}$

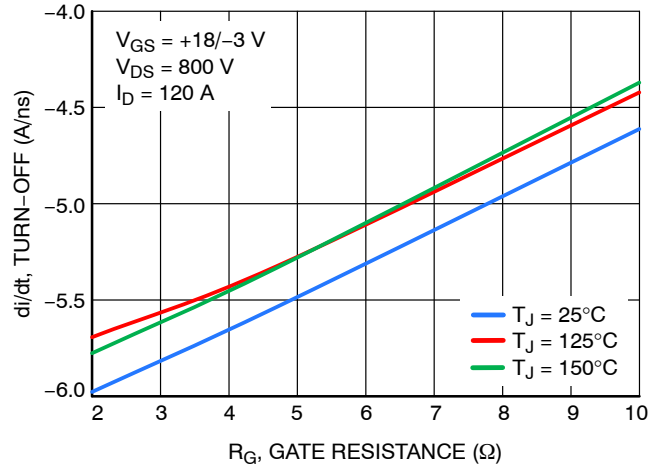


Figure 20. di/dt Turn OFF vs. Gate Resistance
 $V_{DS} = 800 \text{ V}$

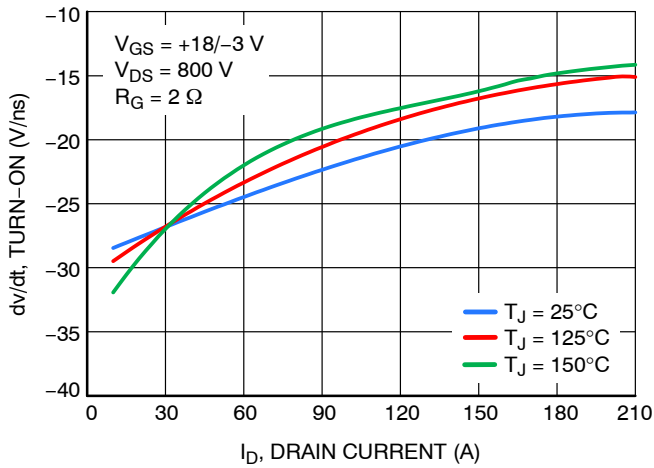


Figure 21. dv/dt Turn ON vs. Drain Current
 $V_{DS} = 800 \text{ V}$

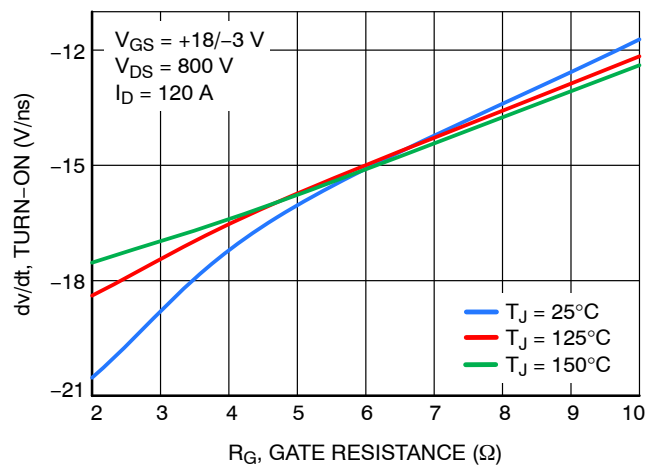


Figure 22. dv/dt Turn ON vs. Gate Resistance
 $V_{DS} = 800 \text{ V}$

NXH007F120M3F2PTHG

TYPICAL CHARACTERISTIC (M1/M2 SiC MOSFET CHARACTERISTIC)

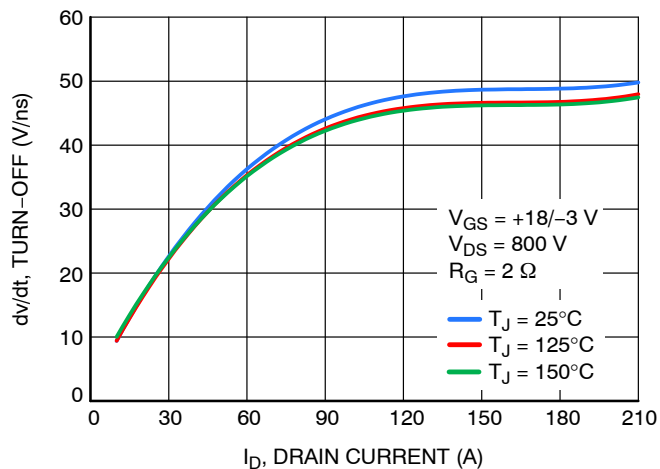


Figure 23. $\frac{dv}{dt}$ Turn OFF vs. Drain Current
 $V_{DS} = 800\text{ V}$

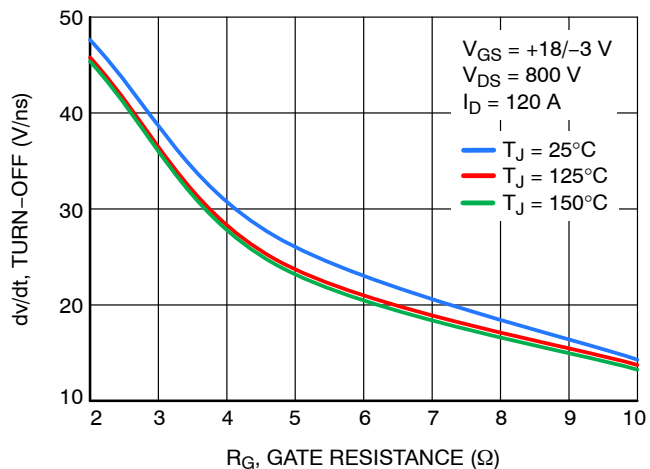


Figure 24. $\frac{dv}{dt}$ Turn OFF vs. Gate Resistance
 $V_{DS} = 800\text{ V}$

Table 1. CAUER NETWORKS

Cauer Element #	R_{th} (K/W)	C_{th} (Ws/K)
1	0.0197	0.0062
2	0.0360	0.0335
3	0.0915	0.0468
4	0.1151	0.1685
5	0.0162	0.1198

NXH007F120M3F2PTHG

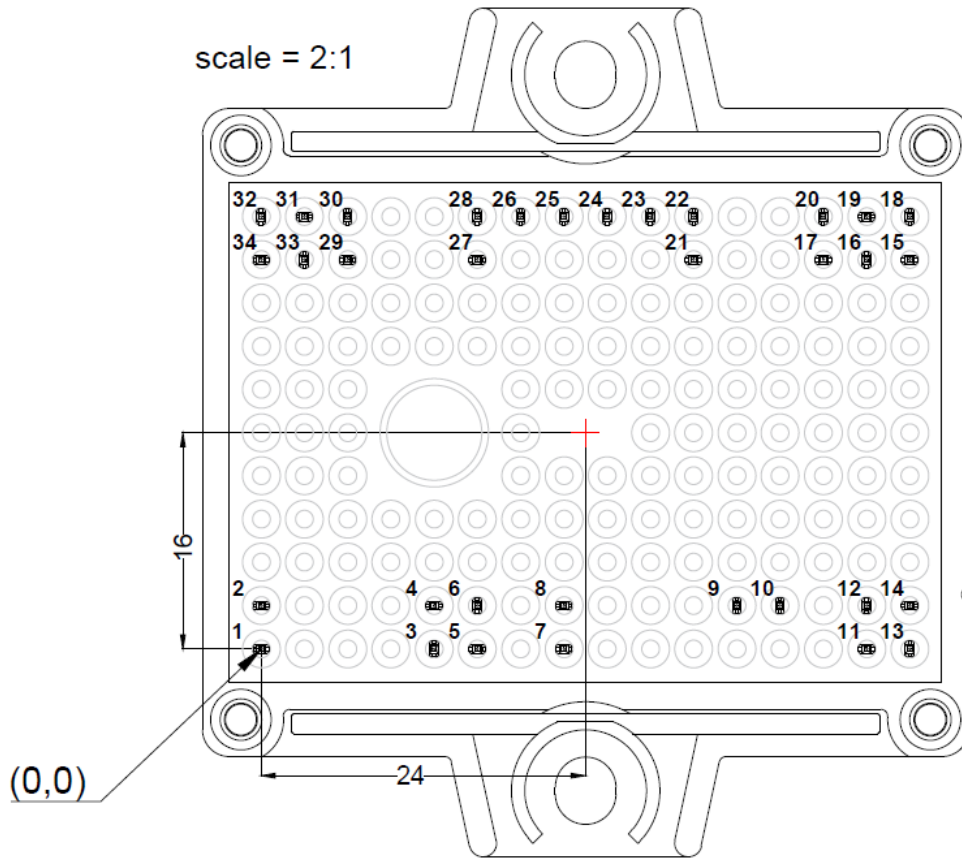


Figure 25.

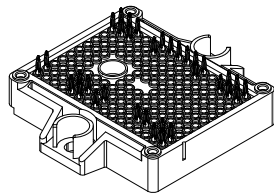
Pin position

Pin #	X	Y	Function	Pin #	X	Y	Function
1	0	0	TH1	18	48	32	DC-2
2	0	3.2	TH2	19	44.8	32	DC-2
3	12.8	0	AC1	20	41.6	32	DC-2
4	12.8	3.2	AC1	21	32	28.8	DC+
5	16	0	AC1	22	32	32	DC+
6	16	3.2	AC1	23	28.8	32	DC+
7	22.4	0	G1	24	25.6	32	DC+
8	22.4	3.2	S1	25	22.4	32	DC+
9	35.2	3.2	G3	26	19.2	32	DC+
10	38.4	3.2	S3	27	16	28.8	DC+
11	44.8	0	AC2	28	16	32	DC+
12	44.8	3.2	AC2	29	6.4	28.8	DC-1
13	48	0	AC2	30	6.4	32	DC-1
14	48	3.2	AC2	31	3.2	32	DC-1
15	48	28.8	G4	32	0	32	DC-1
16	44.8	28.8	S4	33	3.2	28.8	S2
17	41.6	28.8	DC-2	34	0	28.8	G2

Figure 26.

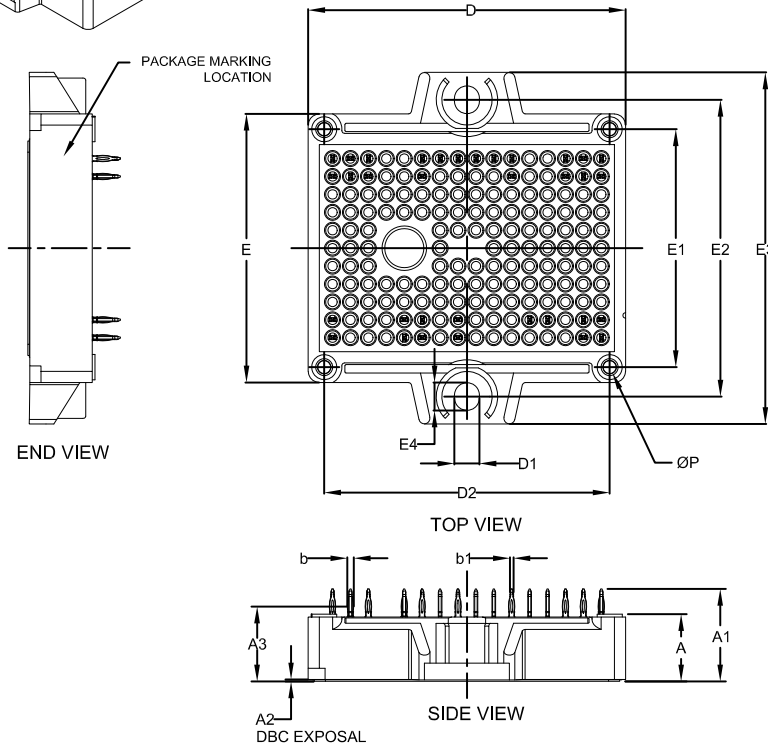
MECHANICAL CASE OUTLINE

PACKAGE DIMENSIONS



PIM34 56.70x42.50x12.00
CASE 180HU
ISSUE A

DATE 07 FEB 2024

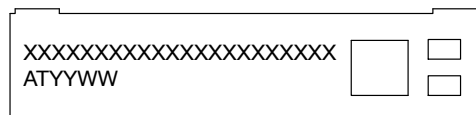


NOTES:

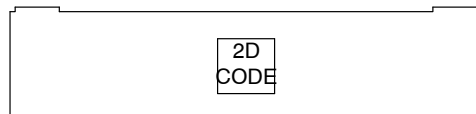
1. CONTROLLING DIMENSION: MILLIMETERS
2. PIN POSITION TOLERANCE IS $\pm 0.4\text{mm}$
3. PRESS FIT PIN

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	12.85	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

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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DESCRIPTION:	PIM34 56.70x42.50x12.00	PAGE 1 OF 2

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Note2:

Pin	X	Y	Pin	X	Y
1	0	0	18	48	32
2	0	3.2	19	44.8	32
3	12.8	0	20	41.6	32
4	12.8	3.2	21	32	28.8
5	16	0	22	32	32
6	16	3.2	23	28.8	32
7	22.4	0	24	25.6	32
8	22.4	3.2	25	22.4	32
9	35.2	3.2	26	19.2	32
10	38.4	3.2	27	16	28.8
11	44.8	0	28	16	32
12	44.8	3.2	29	6.4	28.8
13	48	0	30	6.4	32
14	48	3.2	31	3.2	32
15	48	28.8	32	0	32
16	44.8	28.8	33	3.2	28.8
17	41.6	28.8	34	0	28.8

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