Silicon Carbide (SiC) Module – EliteSiC, 3 mohm SiC M3 MOSFET, 1200 V, 2-PACK Half Bridge Topology, F2 Package with HPS DBC

NXH003P120M3F2PTHG

The NXH003P120M3F2PTHG is a power module containing 3 m Ω / 1200 V SiC MOSFET half–bridge and a thermistor with HPS DBC in an F2 package.

Features

- 3 m Ω / 1200 V M3S SiC MOSFET Half-Bridge
- HPS DBC
- Thermistor
- Pre-Applied Thermal Interface Material (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

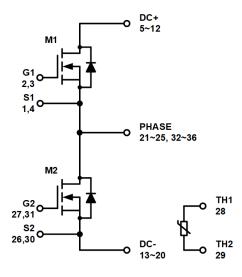
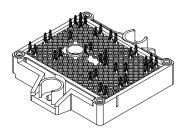


Figure 1. NXH003P120M3F2 Schematic Diagram

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PACKAGE PICTURE



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

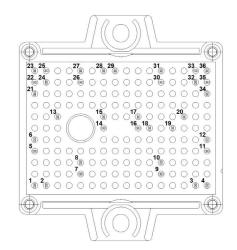
MARKING DIAGRAM



NXH003P120M3F2PTHG = Specific Device Code AT = Assembly & Test Site Code

YWW = Year and Work Week

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}	+22/-10	V
Continuous Drain Current @ T _c = 80°C (T _J = 175°C)	I _D	350	А
Pulsed Drain Current (T _J = 175°C)	I _{Dpulse}	700	А
Maximum Power Dissipation @ T _c = 80°C (T _J = 175°C)	P _{tot}	979	W
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 s, 60 Hz	V _{is}	4800	V_{RMS}
Creepage Distance		12.7	mm
СТІ		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.

RECOMMENDED OPERATING RANGES

Rating	Symbol	Min	Max	Unit
Module Operating Junction Temperature	T_J	-40	150	°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 ($T_J = 25^{\circ}C$ unless otherwise noted)

Parameter	Test Conditions	Symbol	Min	Тур	Max	Unit
SIC MOSFET CHARACTERISTICS						
Zero Gate Voltage Drain Current	V _{GS} = 0 V, V _{DS} = 1200 V	I _{DSS}	=	-	300	μΑ
Drain-Source On Resistance	V _{GS} = 18 V, I _D = 200 A, T _J = 25°C	R _{DS(ON)}	_	3.19	5	mΩ
	V _{GS} = 18 V, I _D = 200 A, T _J = 125°C		_	5.25	-	
	V _{GS} = 18 V, I _D = 200 A, T _J = 150°C	1	-	5.88	=	1
Gate-Source Threshold Voltage	V _{GS} = V _{DS} , I _D = 160 mA	V _{GS(TH)}	1.8	2.4	4.4	V
Gate Leakage Current	$V_{GS} = -10 \text{ V} / 20 \text{ V}, V_{DS} = 0 \text{ V}$	I _{GSS}	-800	-	800	nA
Input Capacitance	V _{DS} = 800 V, V _{GS} = 0 V, f = 100 kHz	C _{ISS}	=	20889	=	pF
Reverse Transfer Capacitance		C _{RSS}	=	90	=	1
Output Capacitance		C _{OSS}	_	1225	-	1

^{1.} Refer to ELECTRICAL CHĂRACTERISTICS, RECOMMENDED OPERATING RANGES and/or APPLICATION INFORMATION for Safe Operating parameters.

^{2.} Height difference between horizontal plane and substrate copper bottom.

ELECTRICAL CHARACTERISTICS ($T_J = 25^{\circ}C$ unless otherwise noted) (continued)

Parameter	Test Conditions	Symbol	Min	Тур	Max	Unit	
SIC MOSFET CHARACTERISTICS						•	
Total Gate Charge	$V_{DS} = 800 \text{ V}, V_{GS} = -5/20 \text{ V}, I_D = 200 \text{ A}$	$Q_{G(TOTAL)}$	_	1195	-	nC	
Gate-Source Charge	1	Q _{GS}	=	232	=	nC	
Gate-Drain Charge	1	Q_{GD}	=	210	=	nC	
Turn-on Delay Time	T _J = 25°C	t _{d(on)}	_	49	_	ns	
Rise Time	$V_{DS} = 600 \text{ V}, I_D = 200 \text{ A}$ $V_{GS} = -5 \text{ V} / 18 \text{ V}, R_G = 1 \Omega$	t _r	-	17	-		
Turn-off Delay Time	1	t _{d(off)}	-	144	-		
Fall Time	1	t _f	_	16	-	1	
Turn-on Switching Loss per Pulse	1	E _{ON}	_	1.79	-	mJ	
Turn-off Switching Loss per Pulse	1	E _{OFF}	_	1.13	-	1	
Turn-on Delay Time	T _J = 150°C	t _{d(on)}	_	48	-	ns	
Rise Time	$V_{DS} = 600 \text{ V}, I_D = 200 \text{ A}$ $V_{GS} = -5 \text{ V} / 18 \text{ V}, R_G = 1 \Omega$	t _r	_	15	-	1	
Turn-off Delay Time	1	t _{d(off)}	_	154	-	1	
Fall Time	1	t _f	=	15	=	1	
Turn-on Switching Loss per Pulse	1	E _{ON}	_	1.94	-	mJ	
Turn off Switching Loss per Pulse	1	E _{OFF}	_	1.12	-	1	
Diode Forward Voltage	I _D = 200 A, T _J = 25°C	V_{SD}	-	4.8	7.5	V	
	I _D = 200 A, T _J = 125°C	-	-	4.5		7	
	I _D = 200 A, T _J = 150°C	-	-	4.4		1	
Thermal Resistance - Chip-to-Case	M1, M2	R_{thJC}	_	0.097	-	°C/W	
Thermal Resistance – Chip-to-Heatsink	Thermal grease, Thickness = 2 Mil +2%, A = 2.8 W/mK	R _{thJH}	-	0.202	=	°C/W	
THERMISTOR CHARACTERISTICS							
Nominal Resistance	T _{NTC} = 25°C	R ₂₅	-	5	-	kΩ	
	T _{NTC} = 100°C	R ₁₀₀	-	493		Ω	
	T _{NTC} = 150°C	R ₁₅₀	_	159.5	-	Ω	
Deviation of R ₁₀₀	T _{NTC} = 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
NXH003P120M3F2PTHG	NXH003P120M3F2PTHG	F2HALFBR: Case 180BY 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)

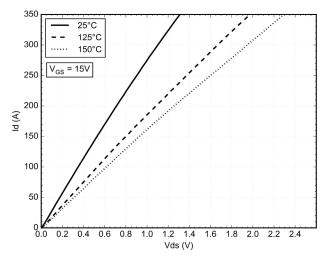


Figure 2. MOSFET Typical Output Characteristic

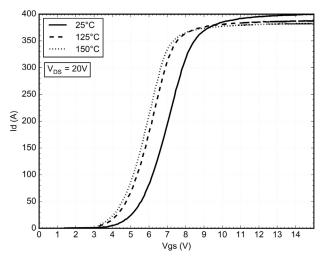


Figure 4. MOSFET Typical Transfer Characteristic

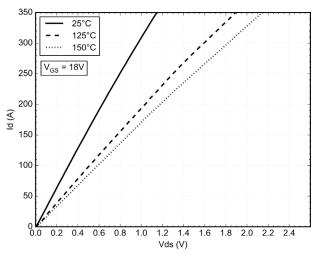


Figure 3. MOSFET Typical Output Characteristic

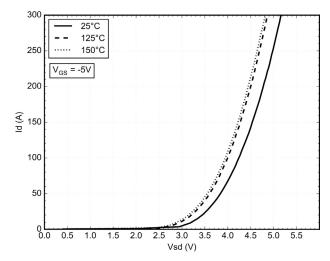


Figure 5. Body Diode Forward Characteristic

TYPICAL CHARACTERISTIC

(M1/M2 SiC MOSFET CHARACTERISTIC)

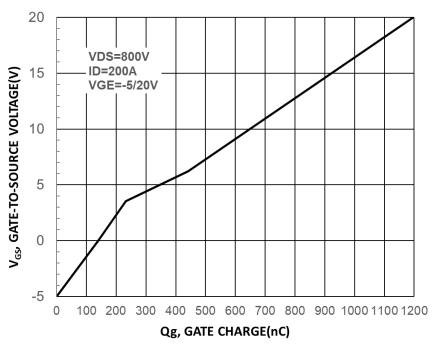


Figure 6. Gate-to-Source Voltage vs. Total Charge

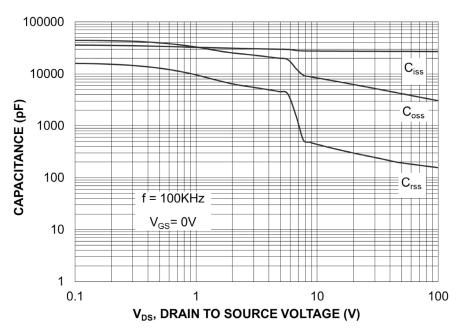


Figure 7. Capacitance vs. Drain-to-Source Voltage

TYPICAL CHARACTERISTIC

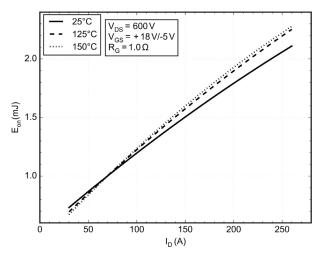


Figure 8. Typical Switching Loss Eon vs. ID

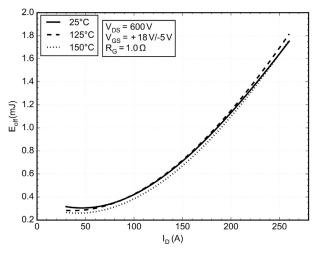


Figure 10. Typical Switching Loss Eoff vs. ID

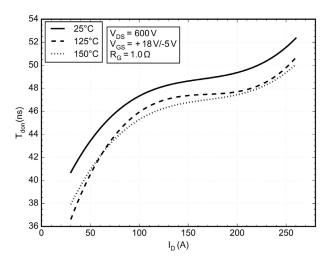


Figure 12. Typical Switching Loss Tdon vs. ID

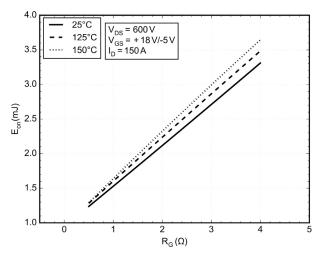


Figure 9. Typical Switching Loss Eon vs. Rg

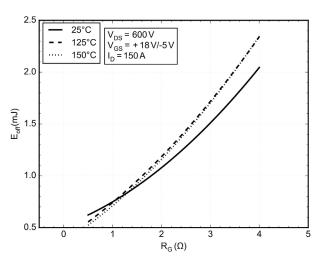


Figure 11. Typical Switching Loss Eoff vs. Rg

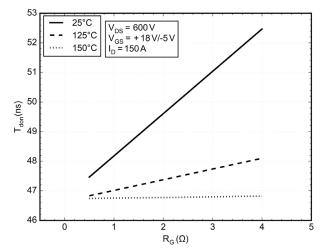


Figure 13. Typical Switching Loss Tdon vs. Rg

TYPICAL CHARACTERISTIC

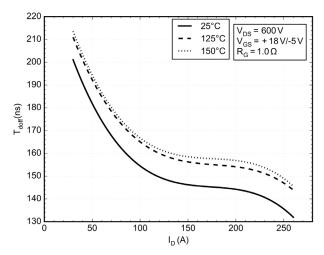


Figure 14. Typical Switching Loss Tdoff vs. ID

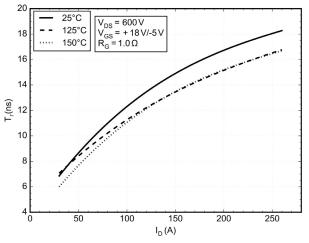


Figure 16. Typical Switching Loss Tr vs. ID

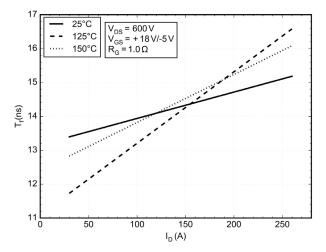


Figure 18. Typical Switching Loss Tf vs. ID

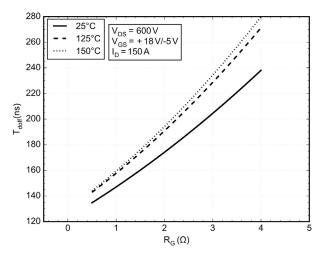


Figure 15. Typical Switching Loss Tdoff vs. Rg

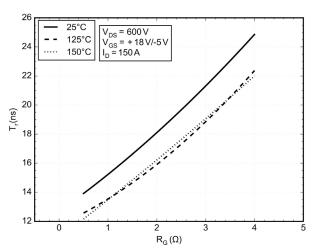


Figure 17. Typical Switching Loss Tr vs. Rg

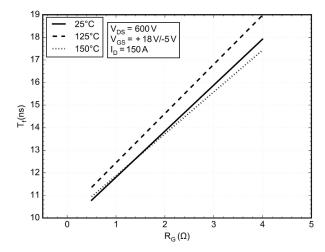


Figure 19. Typical Switching Loss Tf vs. Rg

TYPICAL CHARACTERISTIC

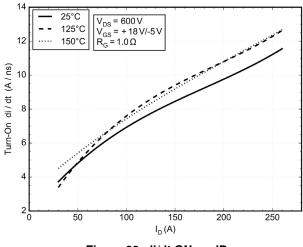


Figure 20. di/dt ON vs. ID

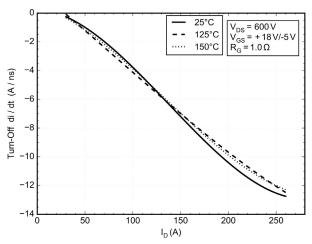


Figure 22. di/dt OFF vs. ID

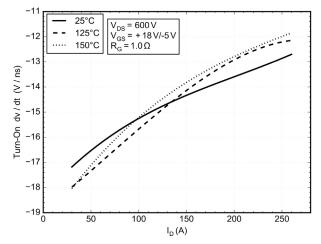


Figure 24. dv/dt ON vs. ID

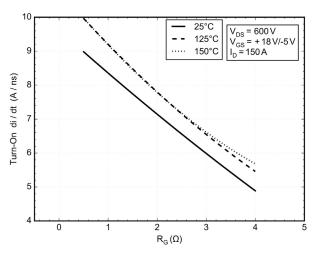


Figure 21. di/dt ON vs. RG

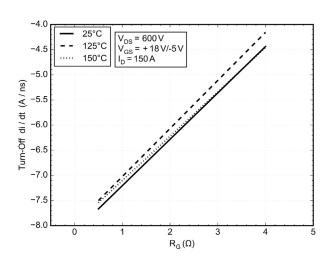


Figure 23. di/dt OFF vs. RG

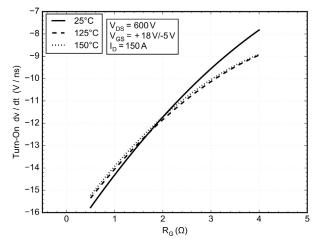


Figure 25. dv/dt ON vs. RG

TYPICAL CHARACTERISTIC

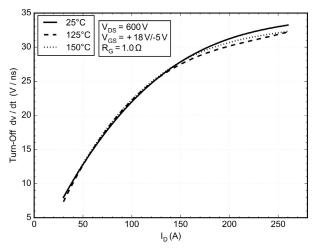


Figure 26. dv/dt OFF vs. ID

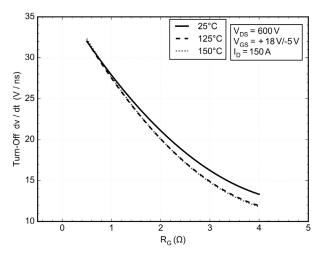


Figure 27. dv/dt OFF vs. RG

TYPICAL CHARACTERISTIC

(M1/M1 SiC MOSFET CHARACTERISTIC)

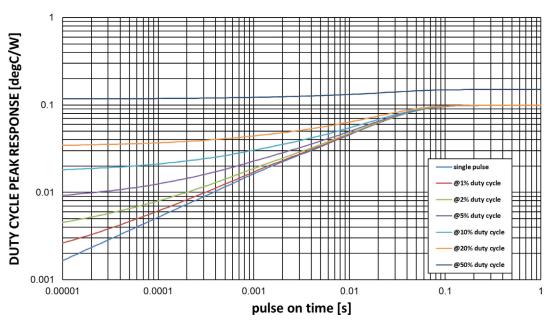


Figure 28. MOSFET Junction-to-Case Transient Thermal Impedance

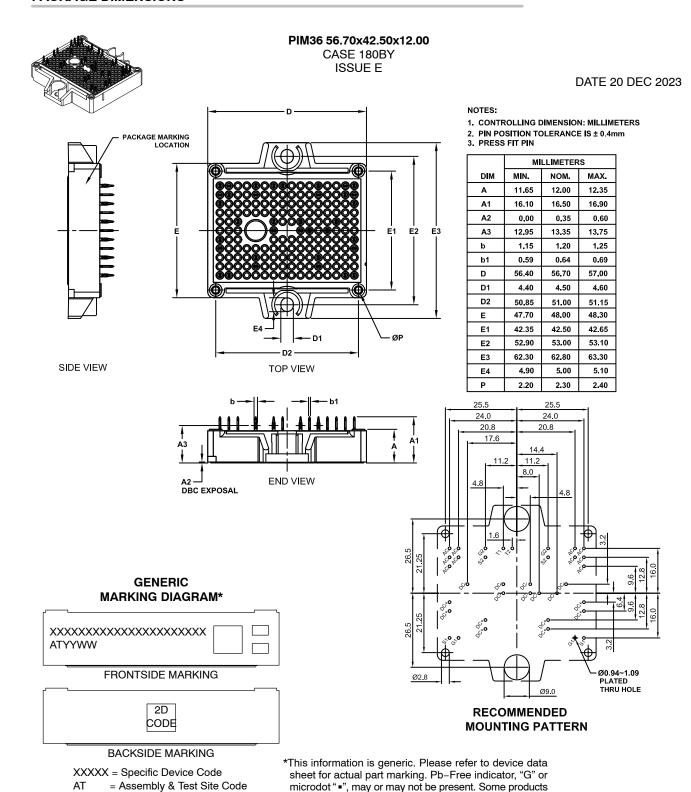
Table 1. FOSTER NETWORKS - M1, M2

	M1		N	M2	
Foster Element #	Rth (K/W)	Cth (Ws/K)	Rth (K/W)	Cth (Ws/K)	
1	0.002119710	0.006269327	0.002085717	0.005919216	
2	0.002237509	0.044417021	0.002262963	0.041549892	
3	0.010754082	0.080568359	0.011217723	0.075947544	
4	0.012973790	0.473570059	0.013624461	0.468022154	
5	0.071830979	0.438172158	0.07157749	0.444577769	

Table 2. CAUER NETWORKS - M1, M2

	M1		M	2
Cauer Element #	Rth (K/W)	Cth (Ws/K)	Rth (K/W)	Cth (Ws/K)
1	0.003228661	0.005029516	0.003176874	0.004749202
2	0.005914795	0.025033712	0.005878559	0.023599253
3	0.015486364	0.043255417	0.015761478	0.041433746
4	0.041123543	0.201827107	0.04214085	0.20355778
5	0.034162706	0.484541759	0.033810593	0.506186577





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