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# Silicon Carbide (SiC) Module – 30 mohm SiC M3S MOSFET, 1200 V, 4-PACK Full Bridge Topology, F1 Package

Product Preview

# NXH030F120M3F1PTG

The NXH030F120M3F1PTG is a power module containing 30 m $\Omega$ /1200 V SiC MOSFET full-bridge and a thermistor with Al<sub>2</sub>O<sub>3</sub> DBC in an F1 package.

#### **Features**

- $\bullet~30~\text{m}\Omega$  /1200 V M3S SiC MOSFET Full–Bridge
- Al<sub>2</sub>O<sub>3</sub> DBC
- 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

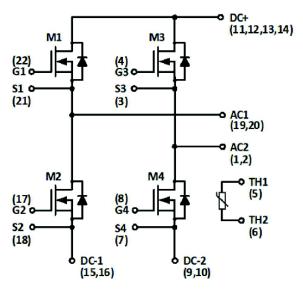
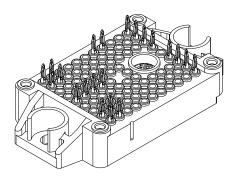


Figure 1. NXH030F120M3F1PTG Schematic Diagram

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

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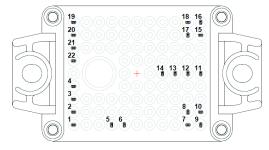
PIM22 33.8x42.5 (PRESS FIT) CASE 180HL

#### **MARKING DIAGRAM**



NXH030F120M3F1PTG = 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

#### PIN FUNCTION DESCRIPTION

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

#### **MAXIMUM RATINGS**

Rating	Symbol	Value	Unit
SIC MOSFET			
Drain-Source Voltage	V <sub>DSS</sub>	1200	V
Gate-Source Voltage	V <sub>GS</sub>	+22/–10	V
Continuous Drain Current @ T <sub>C</sub> = 80°C (T <sub>J</sub> = 175°C)	I <sub>D</sub>	38	Α
Pulsed Drain Current (T <sub>J</sub> = 175°C)	I <sub>Dpulse</sub>	115	А
Maximum Power Dissipation (T <sub>J</sub> = 175°C)	P <sub>tot</sub>	100	W
Minimum Operating Junction Temperature	T <sub>JMIN</sub>	-40	°C
Maximum Operating Junction Temperature	T <sub>JMAX</sub>	175	°C
THERMAL PROPERTIES			
Storage Temperature Range	T <sub>stg</sub>	-40 to 150	°C
INSULATION PROPERTIES			
Isolation Test Voltage, t = 1 s, 60 Hz	V <sub>is</sub>	4800	$V_{RMS}$
Creepage Distance		12.7	mm
СТІ		600	
Substrate Ceramic Material		Al <sub>2</sub> O <sub>3</sub>	
Substrate Ceramic Material Thickness		0.32	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.

<sup>1.</sup> Refer to ELECTRICAL CHĂRACTERISTICS, RECOMMENDED OPERATING RANGES and/or APPLICATION INFORMATION for Safe Operating parameters.

#### **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<sub>J</sub> = 25 °C unless otherwise noted)

Parameter	Test Conditions	Symbol	Min	Тур	Max	Unit
SIC MOSFET CHARACTERISTICS	•	<u>'</u>		•		
Zero Gate Voltage Drain Current	V <sub>GS</sub> = 0 V, V <sub>DS</sub> = 1200 V, T <sub>J</sub> = 25°C	I <sub>DSS</sub>	=	_	100	μА
Drain-Source On Resistance	V <sub>GS</sub> = 18 V, I <sub>D</sub> = 30 A, T <sub>J</sub> = 25°C	R <sub>DS(ON)</sub>	=	30.6	38.5	mΩ
	V <sub>GS</sub> = 18 V, I <sub>D</sub> = 30 A, T <sub>J</sub> = 125°C	1	=	51.1	-	
	V <sub>GS</sub> = 18 V, I <sub>D</sub> = 30 A, T <sub>J</sub> = 150°C	1 I	=	59.3	=	
	V <sub>GS</sub> = 18 V, I <sub>D</sub> = 30 A, T <sub>J</sub> = 175°C	1 I	=	68.2	=	
Gate-Source Threshold Voltage	V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = 15 mA	V <sub>GS(TH)</sub>	2.04	2.6	4.4	V
Recommended Gate Voltage		$V_{GOP}$	-3	-	+18	V
Gate-to-Source Leakage Current	V <sub>GS</sub> = +22/-10 V, V <sub>DS</sub> = 0 V	I <sub>GSS</sub>	-	_	±1	μΑ
Input Capacitance	V <sub>GS</sub> = 0 V, f = 1 Mhz, V <sub>DS</sub> = 800 V	C <sub>ISS</sub>	=	2246	=	pF
Reverse Transfer Capacitance		C <sub>RSS</sub>	=	12.1	-	
Output Capacitance		Coss	=	156	-	
Total Gate Charge	$V_{GS} = -3/18 \text{ V}, V_{DS} = 800 \text{ V}, I_D = 30 \text{ A}$	Q <sub>G(TOTAL)</sub>	=	110	-	nC
Gate-Source Charge		Q <sub>GS</sub>	=	19	-	
Gate-Drain Charge		$Q_{GD}$	=	30	-	
Internal Gate Resistance	f = 1 MHz	R <sub>GINT</sub>	=	3.3	=	Ω
Turn-on Delay Time	T <sub>J</sub> = 25°C,	t <sub>d(on)</sub>	=	40.4	=	ns
Rise Time	$V_{DS} = 800 \text{ V}, I_D = 30 \text{ A},$ $V_{GS} = -3 \text{ V}/18 \text{ V}, R_G = 4.7 \Omega$	t <sub>r</sub>	_	9	_	
Turn-off Delay Time		t <sub>d(off)</sub>	_	109.5	_	
Fall Time	7	t <sub>f</sub>	_	9.3	_	
Turn-on Switching Loss per Pulse	7	E <sub>ON</sub>	_	520	-	μJ
Turn off Switching Loss per Pulse	7	E <sub>OFF</sub>	_	80	-	
Turn-on Delay Time	T <sub>J</sub> = 150°C,	t <sub>d(on)</sub>	_	39.9	-	ns
Rise Time	$V_{DS} = 800 \text{ V}, I_D = 30 \text{ A}, V_{GS} = -3 \text{ V}/18 \text{ V}, R_G = 4.7 \Omega$	t <sub>r</sub>	_	6.8	-	
Turn-off Delay Time	1	t <sub>d(off)</sub>	_	118.1	-	
Fall Time	7	t <sub>f</sub>	_	8.7	-	
Turn-on Switching Loss per Pulse	7	E <sub>ON</sub>	_	750	-	μJ
Turn off Switching Loss per Pulse	7	E <sub>OFF</sub>	_	96	-	
Diode Forward Voltage	$V_{GS} = -3 \text{ V}, I_{SD} = 30 \text{ A}, T_{J} = 25^{\circ}\text{C}$	$V_{SD}$	_	4.67	6	V
	V <sub>GS</sub> = -3 V, I <sub>SD</sub> = 30 A, T <sub>J</sub> = 125°C	1	_	4.45	_	1
	V <sub>GS</sub> = -3 V, I <sub>SD</sub> = 30 A, T <sub>J</sub> = 150°C	1 I	_	4.4	-	1
Thermal Resistance - Chip-to-Case	M1, M2	R <sub>thJC</sub>	_	0.95	-	°C/W
Thermal Resistance - Chip-to-Heatsink		$R_{thJH}$	-	1.54	-	°C/W

# **ELECTRICAL CHARACTERISTICS** (continued)(T<sub>J</sub> = 25 °C unless otherwise noted)

Parameter	Test Conditions		Min	Тур	Max	Unit
THERMISTOR CHARACTERISTICS						-
Nominal Resistance	T = 25°C	R <sub>25</sub>	-	5	_	kΩ
	T = 100°C	R <sub>100</sub>	-	493	_	Ω
	T = 150°C	R <sub>150</sub>	-	159.5	_	Ω
Deviation of R <sub>100</sub>	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
NXH030F120M3F1PTG	NXH030F120M3F1PTG	F1FULLBR: Case 180HL Press-fit Pins with pre-applied thermal interface material (TIM) (Pb-Free and Halide-Free)	28 Units / Blister Tray

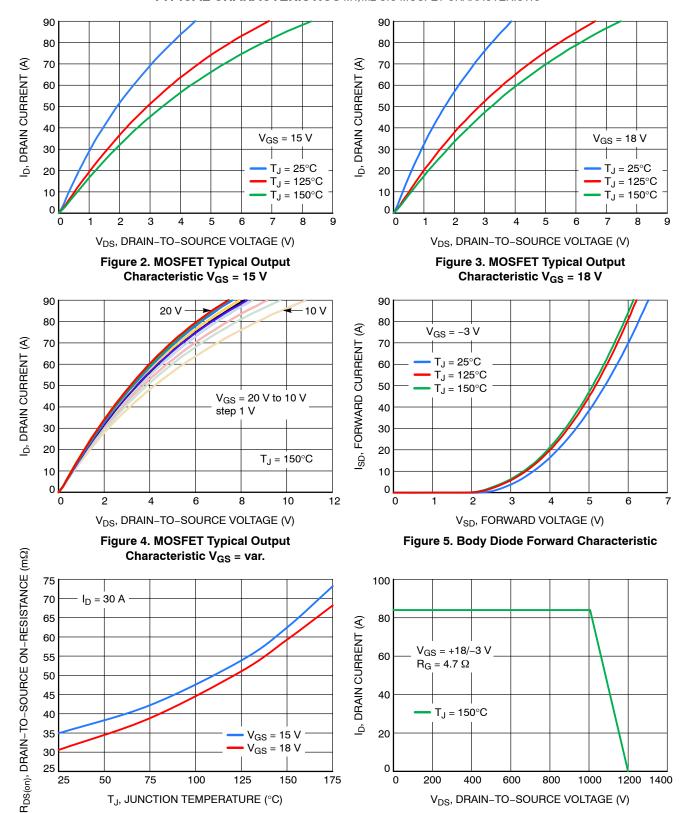


Figure 6. RDS(ON) Drain-to-Source ON Figure 7. Reverse Bias Safe Operating Area Resistance vs. Junction Temperature (RBSOA)

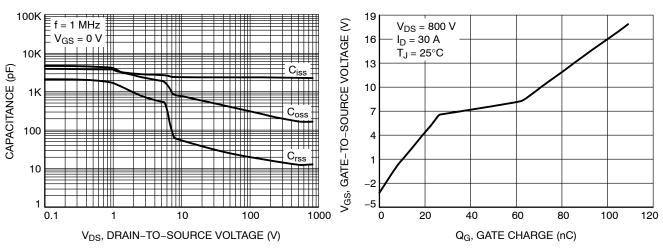


Figure 8. Capacitance vs. Drain-to-Source Voltage

Figure 9. Gate-to-Source Voltage vs. Gate Charge

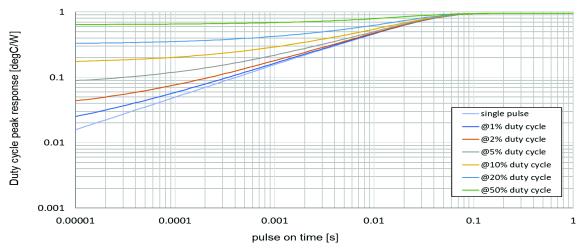


Figure 10. Duty Cycle vs. Junction-to-Case Transient Thermal Impedance

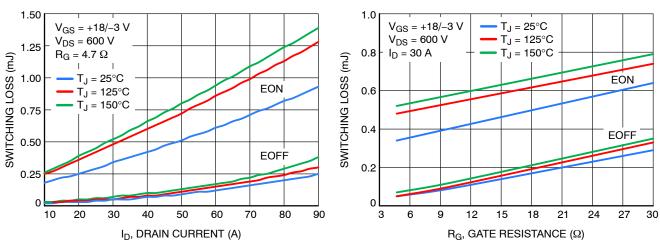
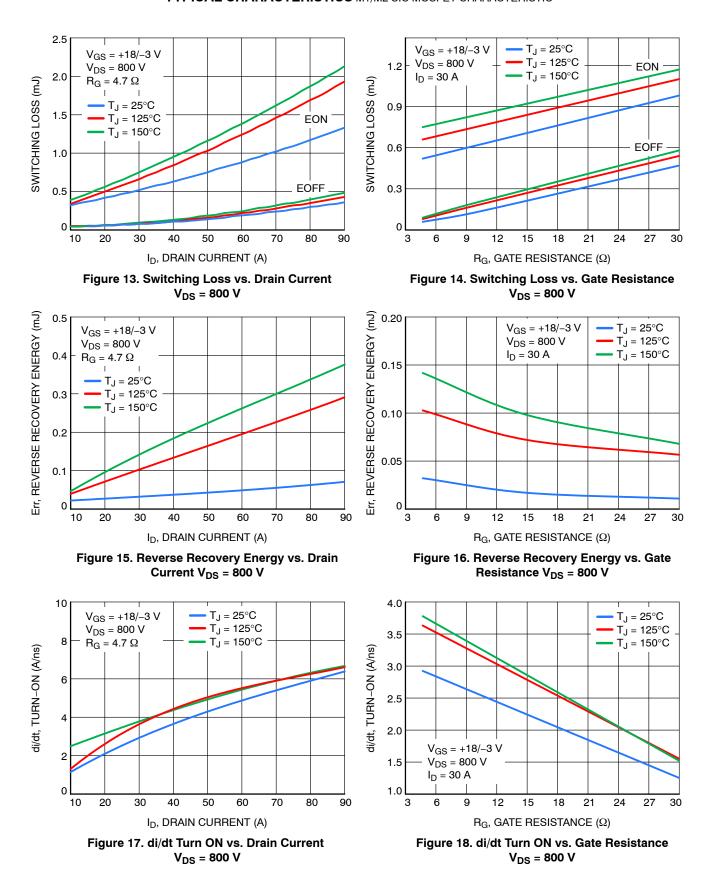
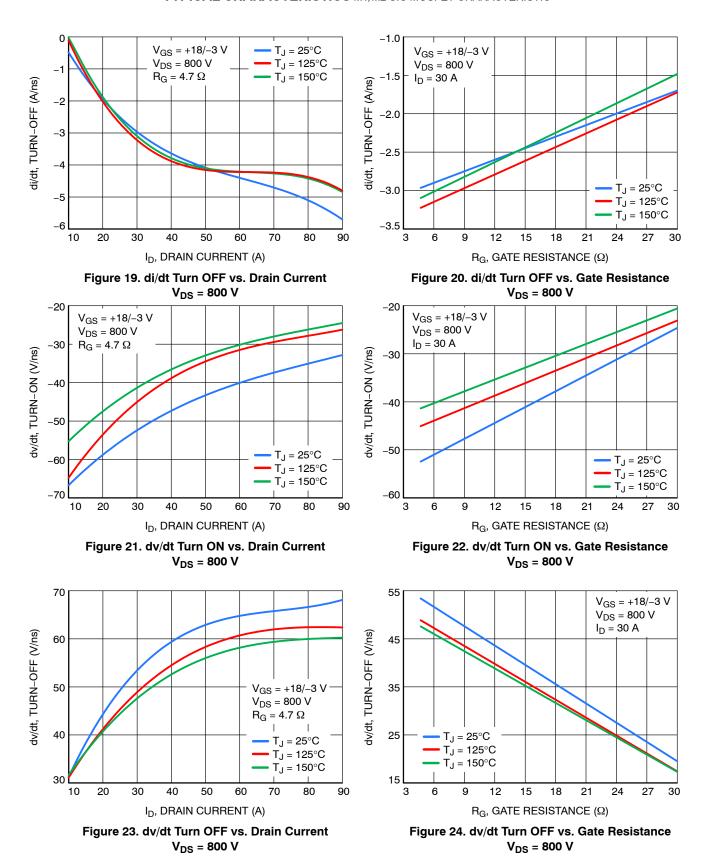


Figure 11. Switching Loss vs. Drain Current  $V_{DS} = 600 \text{ V}$ 

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



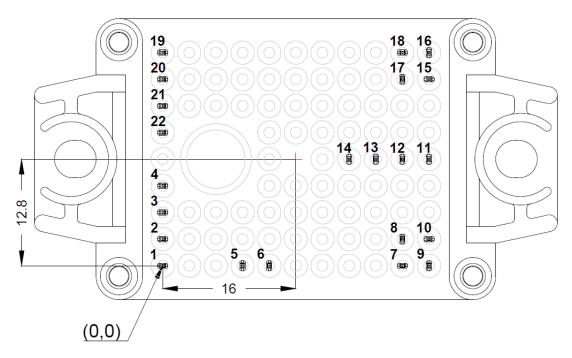


**Table 1. CAUER NETWORKS** 

Cauer Element #	Rth (K/W)	Cth (Ws/K)
1	0.0008598	0.0006888
2	0.0060273	0.0001577
3	0.0131590	0.0002630
4	0.0651160	0.0013257
5	0.1977800	0.0040903
6	0.3716200	0.0208140
7	0.1618000	0.5875200

# PIN POSITION INFORMATION

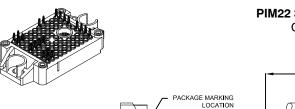
scale = 2.5 : 1



# Pin position

Pin#	X	Y	Function	Pin#	Х	Y	Function
1	0	0	AC2	12	28.8	12.8	DC+
2	0	3.2	AC2	13	25.6	12.8	DC+
3	0	6.4	S3	14	22.4	12.8	DC+
4	0	9.6	G3	15	32	22.4	DC-1
5	9.6	0	TH1	16	32	25.6	DC-1
6	12.8	0	TH2	17	28.8	22.4	G2
7	28.8	0	S4	18	28.8	25.6	S2
8	28.8	3.2	G4	19	0	25.6	AC1
9	32	0	DC-2	20	0	22.4	AC1
10	32	3.2	DC-2	21	0	19.2	S1
11	32	12.8	DC+	22	0	16	G1





**END VIEW** 

#### PIM22 33.80x42.50x10.00 CASE 180HL ISSUE O

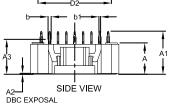
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#### **DATE 29 AUG 2023**

#### NOTES:

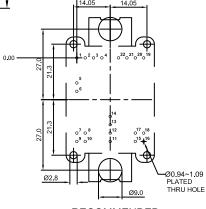
- 1. CONTROLLING DIMENSION: MILLIMETERS
- 2. PIN POSITION TOLERANCE IS ± 0.4mm
- 3. PRESS FIT PIN

	MI	MILLIMETERS				
DIM	MIN.	NOM.	MAX.			
Α	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	33.50	33.80	34.10			
D1	4.40	4.50	4.60			
D2	27.95	28.10	28.25			
Е	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			
Р	2.20	2.30	2.40			



#### PIN POSITION TABLE:

Pin	X	Υ	Function	Pin	Х	Υ	Function
1	0	0	AC2	12	28.8	12.8	DC+
2	0	3.2	AC2	13	25.6	12.8	DC+
3	0	6.4	S3	14	22.4	12.8	DC+
4	0	9.6	G3	15	32	22.4	DC-1
5	9.6	0	TH1	16	32	25.6	DC-1
6	12.8	0	TH2	17	28.8	22.4	G2
7	28.8	0	S4	18	28.8	25.6	S2
8	28.8	3.2	G4	19	0	25.6	AC1
9	32	0	DC-2	20	0	22.4	AC1
10	32	3.2	DC-2	21	0	19.2	S1
11	32	12.8	DC+	22	0	16	G1



#### RECOMMENDED MOUNTING PATTERN

\* For additional Information on our Pb—Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

#### **GENERIC MARKING DIAGRAM\***

XXXXX = Specific Device Code

= 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:	PIM22 33.80x42.50x10.00		PAGE 1 OF 1		

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