F1-2 PACK SiC MOSFET Module

Product Preview

NXH040P120MNF1PTG, NXH040P120MNF1PG

The NXH040P120MNF1 is a power module containing an 40 mΩ/1200 V SiC MOSFET half bridge and a thermistor in an F1 package.

Features

- 40 mΩ/1200 V SiC MOSFET Half Bridge
- Thermistor
- Options with Pre−applied Thermal Interface Material (TIM) and without Pre−applied TIM
- Press−fit Pins

Typical Applications

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

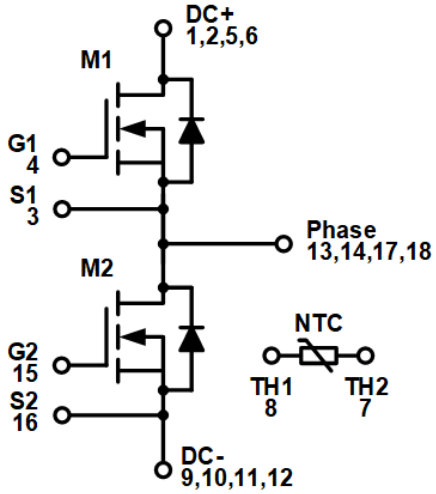
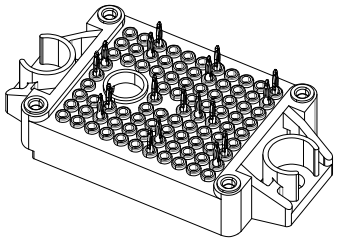


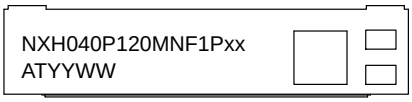
Figure 1. NXH040P120MNF1 Schematic Diagram

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



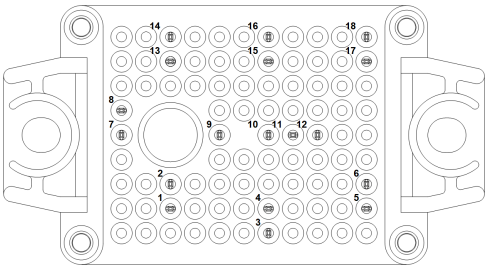
PIM18 33.8x42.5 (PRESS FIT)
CASE 180BW

MARKING DIAGRAM



NXH040P120MNF1PTG= Specific Device Code
NXH040P120MNF1PG = 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.

© Semiconductor Components Industries, LLC, 2021

PIN FUNCTION DESCRIPTION

Pin	Name	Description
1	DC+	DC Positive Bus connection
2	DC+	DC Positive Bus connection
3	S1	Q1 Kelvin Emitter (High side switch)
4	G1	Q1 Gate (High side switch)
5	DC+	DC Positive Bus connection
6	DC+	DC Positive Bus connection
7	TH2	Thermistor Connection 2
8	TH1	Thermistor Connection 1
9	DC−	DC Negative Bus connection
10	DC−	DC Negative Bus connection
11	DC−	DC Negative Bus connection
12	DC−	DC Negative Bus connection
13	PHASE	Center point of half bridge
14	PHASE	Center point of half bridge
15	G2	Q2 Gate (Low side switch)
16	S2	Q2 Kelvin Emitter (High side switch)
17	PHASE	Center point of half bridge
18	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	30	A
Pulsed Drain Current (T_J = 175°C)	I_{Dpulse}	90	A
Maximum Power Dissipation (T_J = 175°C)	P_{tot}	74	W
Short Circuit Withstand Time @ V_{GE} = −5V/20 V, V_{CE} = 600 V, $T_J \leq$ 150 °C	T_{sc}	TBD	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
INSULATION PROPERTIES			
Isolation test voltage, t = 1 s, 60 Hz	V_{is}	4800	V_{RMS}
Creepage distance		12.7	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.

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°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 = 200 μA	$V_{(BR)DSS}$	1200	−	−	V
Zero Gate Voltage Drain Current	V_{GS} = 0 V, V_{DS} = 1200 V	I_{DSS}	−	−	100	μA
Drain−Source On Resistance	V_{GS} = 20 V, I_D = 25 A, T_J = 25°C	$R_{DS(ON)}$	−	42	56	mΩ
	V_{GS} = 20 V, I_D = 25 A, T_J = 125°C		−	55	−	
	V_{GS} = 20 V, I_D = 25 A, T_J = 150°C		−	61	−	
Gate−Source Threshold Voltage	V_{GS} = V_{DS}, I_D = 10 mA	$V_{GS(TH)}$	1.8	2.81	4.3	V
Gate Leakage Current	V_{GS} = −10/20 V, V_{DS} = 0 V	I_{GSS}	−250	−	250	nA
Internal Gate Resistance		R_G		2.2		Ω
Input Capacitance	V_{DS} = 800 V, V_{GS} = 0 V, f = 1 MHz	C_{ISS}	−	1505	−	pF
Reverse Transfer Capacitance		C_{RSS}	−	12	−	
Output Capacitance		C_{OSS}	−	159	−	
C_{OSS} Stored Energy	V_{DS} = 0 V to 800 V, V_{GS} = 0 V	E_{OSS}	−	66	−	μJ
Total Gate Charge	V_{DS} = 800 V, V_{GS} = 20 V, I_D = 25 A	$Q_{G(TOTAL)}$	−	122.1	−	nC
Gate−Source Charge		Q_{GS}	−	32.2	−	nC
Gate−Drain Charge		Q_{GD}	−	34.7	−	nC
Turn−on Delay Time	T_J = 25°C V_{DS} = 600 V, I_D = 25 A V_{GS} = −5 V/18 V, R_G = TBD Ω	$t_{d(on)}$	−	TBD	−	ns
Rise Time		t_r	−	TBD	−	
Turn−off Delay Time		$t_{d(off)}$	−	TBD	−	
Fall Time		t_f	−	TBD	−	
Turn−on Switching Loss per Pulse		E_{ON}	−	TBD	−	mJ
Turn off Switching Loss per Pulse		E_{OFF}	−	TBD	−	
Turn−on Delay Time	T_J = 150°C V_{DS} = 6 V, I_D = 25 A V_{GS} = −5 V/18 V , R_G = TBD Ω	$t_{d(on)}$	−	TBD	−	ns
Rise Time		t_r	−	TBD	−	
Turn−off Delay Time		$t_{d(off)}$	−	TBD	−	
Fall Time		t_f	−	TBD	−	
Turn−on Switching Loss per Pulse		E_{ON}	−	TBD	−	mJ
Turn off Switching Loss per Pulse		E_{OFF}	−	TBD	−	
Diode Forward Voltage	I_D = 25 A, T_J = 25°C	V_{SD}	−	3.97	6	V
	I_D = 25 A, T_J = 150°C		−	3.44	−	
Reverse Recovery Time	T_J = 25°C V_{DS} = 600 V, I_D = 25 A V_{GS} = −5 V/18 V, R_G = TBD Ω	t_{rr}	−	TBD	−	ns
Reverse Recovery Charge		Q_{rr}	−	TBD	−	nC
Peak Reverse Recovery Current		I_{RRM}	−	TBD	−	A
Peak Rate of Fall of Recovery Current		di/dt	−	TBD	−	A/μs
Reverse Recovery Energy		E_{rr}	−	TBD	−	μJ
Reverse Recovery Time	T_J = 150°C V_{DS} = 600 V, I_D = 25 A V_{GS} = −5 V/18 V , R_G = TBD Ω	t_{rr}	−	TBD	−	ns
Reverse Recovery Charge		Q_{rr}	−	TBD	−	μC
Peak Reverse Recovery Current		I_{RRM}	−	TBD	−	A
Peak Rate of Fall of Recovery Current		di/dt	−	TBD	−	A/μs
Reverse Recovery Energy		E_{rr}	−	TBD	−	μJ
Thermal Resistance − chip−to−case	M1, M2	R_{thJC}	−	0.8356	−	°C/W
Thermal Resistance − chip−to−heatsink	Thermal grease, Thickness = 2 Mil _2%, A = 2.8 W/mK	R_{thJH}	−	1.291	−	°C/W

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

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
THERMISTOR CHARACTERISTICS						
Nominal resistance	T = 25°C	R_{25}	–	5	–	kΩ
Nominal resistance	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

ORDERING INFORMATION

Orderable Part Number	Marking	Package	Shipping
NXH040P120MNF1PG	NXH040P120MNF1PG	F1−2PACK: Case 180BW Press−fit Pins (Pb – Free and Halide – Free)	28 Units / Blister Tray
NXH040P120MNF1PTG	NXH040P120MNF1PTG	F1−2PACK: Case 180BW Press−fit Pins with pre – applied thermal interface material (TIM) (Pb – Free and Halide – Free)	28 Units / Blister Tray

TYPICAL CHARACTERISTICS

SiC MOSFET (M1, M2)

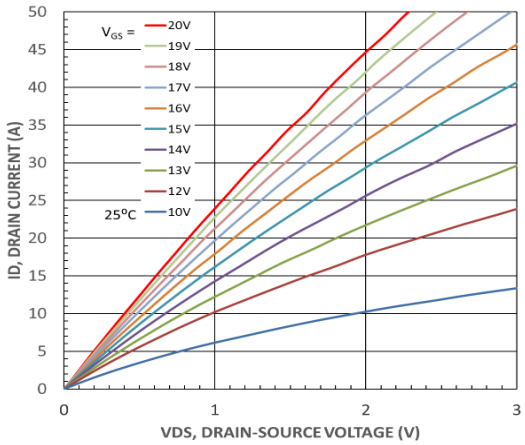


Figure 2. MOSFET Typical Output Characteristics

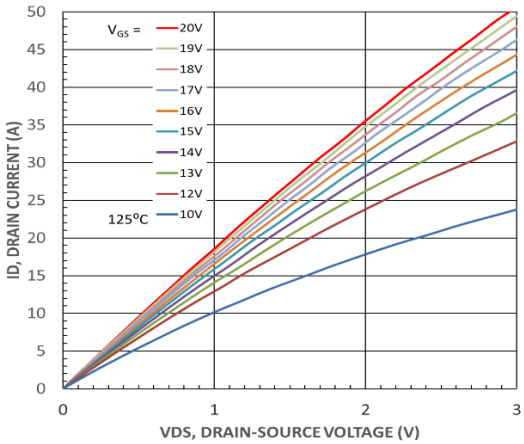


Figure 3. MOSFET Typical Output Characteristics

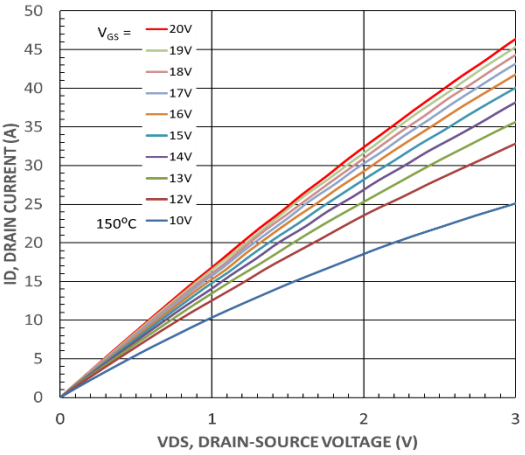


Figure 4. MOSFET Typical Output Characteristics

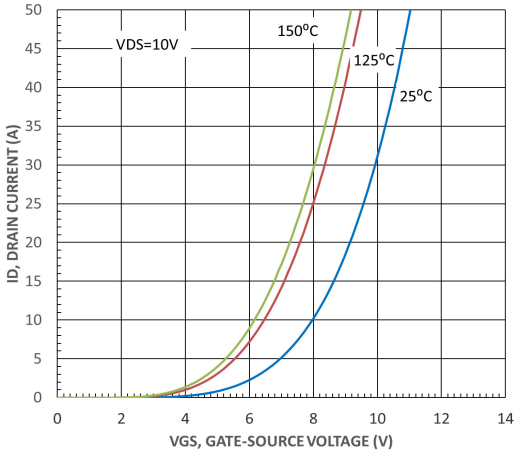


Figure 5. MOSFET Typical Transfer Characteristics

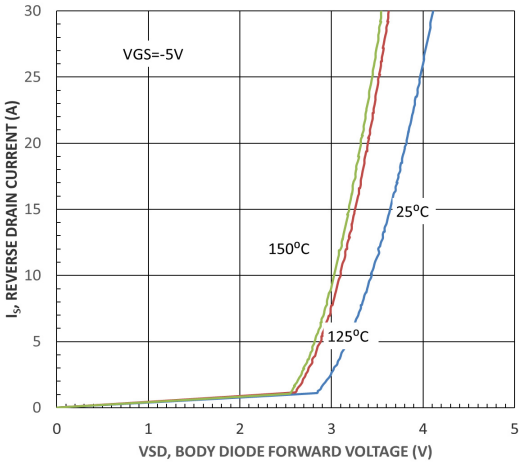


Figure 6. Body Diode Forward Characteristics

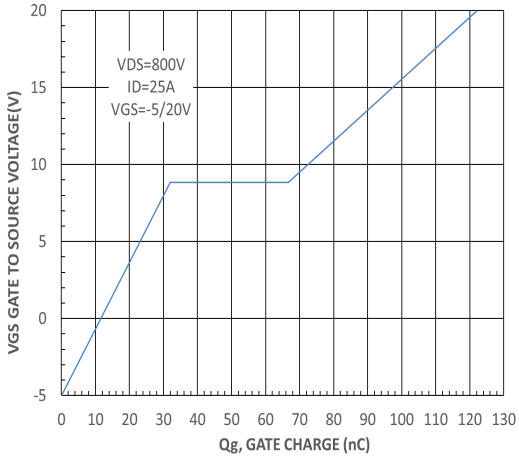


Figure 7. Gate−to−Source Voltage vs. Total Charge

TYPICAL CHARACTERISTICS

SiC MOSFET (M1, M2)

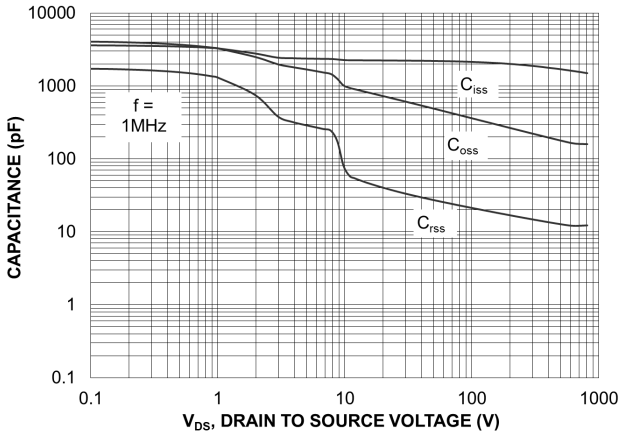


Figure 8. Capacitance vs. Drain−to−Source Voltage

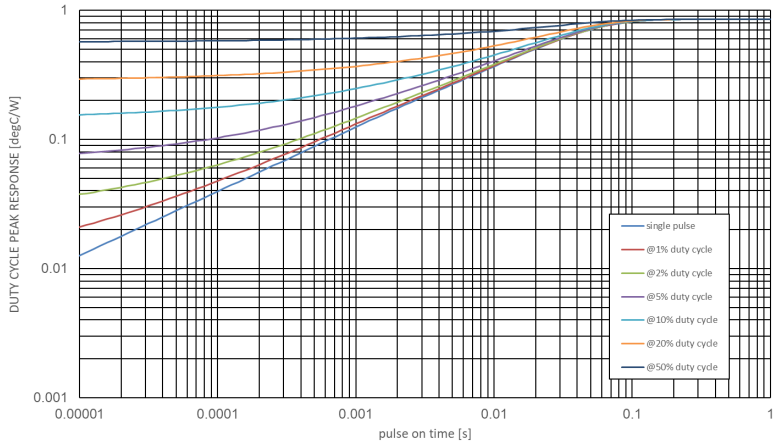


Figure 9. SiC MOSFET Junction−to−Case Transient Thermal Impedance

Table 1. FOSTER NETWORKS − M1, M2

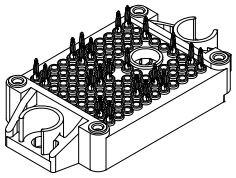
Foster Element #	M1		M2	
	Rth (K/W)	Cth (Ws/K)	Rth (K/W)	Cth (Ws/K)
1	0.051996	0.002404	0.054881	0.002284
2	0.046504	0.020373	0.010554	0.082427
3	0.008903	0.221087	0.064895	0.028973
4	0.165341	0.039489	0.094862	0.058574
5	0.600991	0.065660	0.610507	0.052914

Table 2. CAUER NETWORKS − M1, M2

Cauer Element #	M1		M2	
	Rth (K/W)	Cth (Ws/K)	Rth (K/W)	Cth (Ws/K)
1	0.076857	0.001961	0.076754	0.001921
2	0.141063	0.010485	0.182594	0.011596
3	0.274014	0.018050	0.136313	0.018196
4	0.113973	0.038620	0.215815	0.019717
5	0.267827	0.046224	0.224225	0.049799

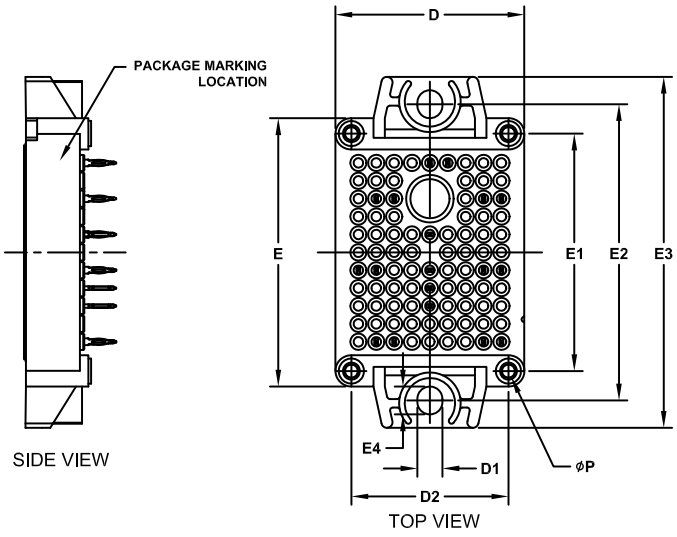
MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS

ON Semiconductor®



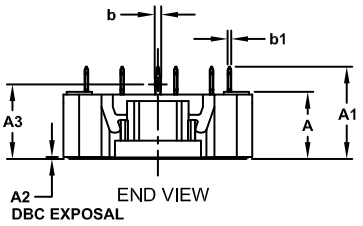
PIM18 33.8x42.5 (PRESS FIT)
CASE 180BW
ISSUE B

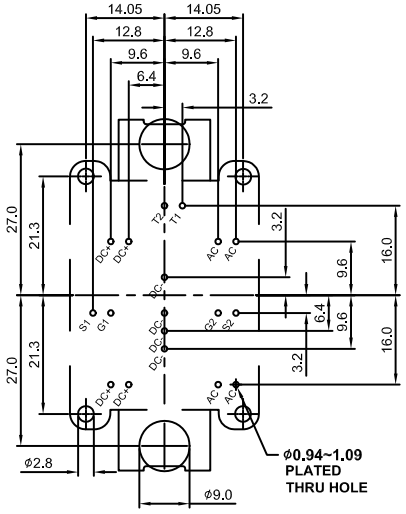
DATE 30 APR 2021



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

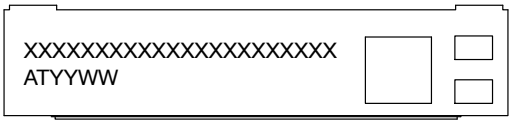
DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	11.65	12.00	12.35
A1	16.00	16.50	17.00
A2	0.00	0.35	0.60
A3	12.85	13.35	13.85
b	1.15	1.20	1.25
b1	0.59	0.64	0.69
D	33.50	33.80	34.10
D1	4.40	4.50	4.60
D2	27.95	28.10	28.25
E	47.70	48.00	48.30
E1	42.35	42.50	42.65
E2	52.90	53.00	53.10
E3	62.30	62.80	63.30
E4	4.90	5.00	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:	**98AON19723H**	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped “CONTROLLED COPY” in red.	
DESCRIPTION:	**PIM18 33.8x42.5 (PRESS FIT)**		**PAGE 1 OF 1**

ON Semiconductor and ON are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. ON Semiconductor does not convey any license under its patent rights nor the rights of others.

© Semiconductor Components Industries, LLC, 2018

onsemi, ONSEMI , and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "**onsemi**" or its affiliates and/or subsidiaries in the United States and/or other countries. **onsemi** owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of **onsemi**'s product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent−Marking.pdf. **onsemi** reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided "as−is" and **onsemi** makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or suitability of its products for any particular purpose, nor does **onsemi** assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using **onsemi** products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by **onsemi**. "Typical" parameters which may be provided in **onsemi** data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. **onsemi** does not convey any license under any of its intellectual property rights nor the rights of others. **onsemi** products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use **onsemi** products for any such unintended or unauthorized application, Buyer shall indemnify and hold **onsemi** and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that **onsemi** was negligent regarding the design or manufacture of the part. **onsemi** is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:
Email Requests to: orderlit@onsemi.com

onsemi Website: www.onsemi.com

TECHNICAL SUPPORT
North American Technical Support:
Voice Mail: 1 800−282−9855 Toll Free USA/Canada
Phone: 011 421 33 790 2910

Europe, Middle East and Africa Technical Support:
Phone: 00421 33 790 2910
For additional information, please contact your local Sales Representative

◊