

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

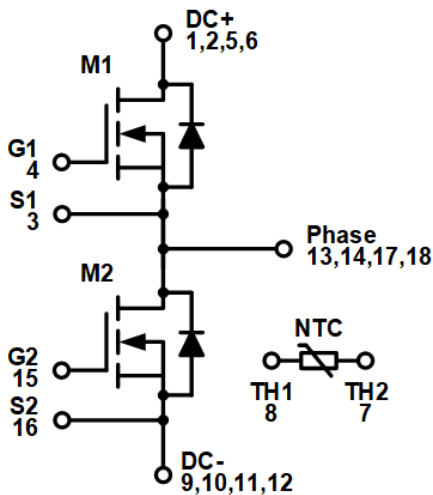
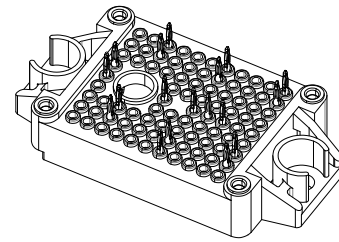


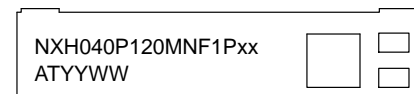
Figure 1. NXH040P120MNF1 Schematic Diagram

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



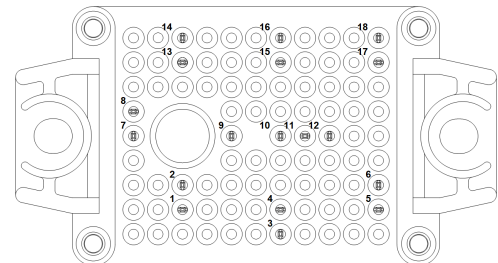
PIM18 33.8x42.5 (PRESS FIT)
CASE 180BW

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.

NXH040P120MNF1PTG, NXH040P120MNF1PG

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 @ $T_C = 80^\circ\text{C}$ ($T_J = 175^\circ\text{C}$) | I_D | 30 | A |
| Pulsed Drain Current ($T_J = 175^\circ\text{C}$) | I_{Dpulse} | 90 | A |
| Maximum Power Dissipation ($T_J = 175^\circ\text{C}$) | P_{tot} | 74 | W |
| Short Circuit Withstand Time @ $V_{GE} = -5V/20\text{ V}$, $V_{CE} = 600\text{ V}$, $T_J \leq 150^\circ\text{C}$ | T_{sc} | TBD | μs |
| 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 | $^\circ\text{C}$ |
|---------------------------|-----------|------------|------------------|

INSULATION PROPERTIES

| | | | |
|--|----------|------|-----------|
| Isolation test voltage, $t = 1\text{ s}$, 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 | $^\circ\text{C}$ |

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.

NXH040P120MNF1PTG, NXH040P120MNF1PG

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 | |

NXH040P120MNF1PTG, NXH040P120MNF1PG

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 |

NXH040P120MNF1PTG, NXH040P120MNF1PG

TYPICAL CHARACTERISTICS

SiC MOSFET (M1, M2)

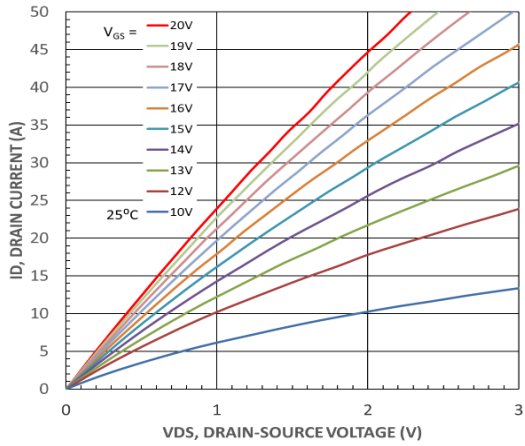


Figure 2. MOSFET Typical Output Characteristics

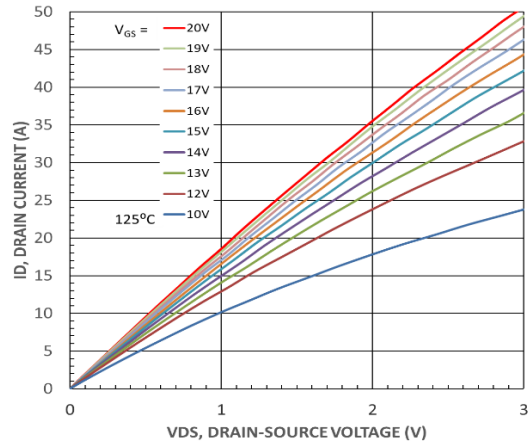


Figure 3. MOSFET Typical Output Characteristics

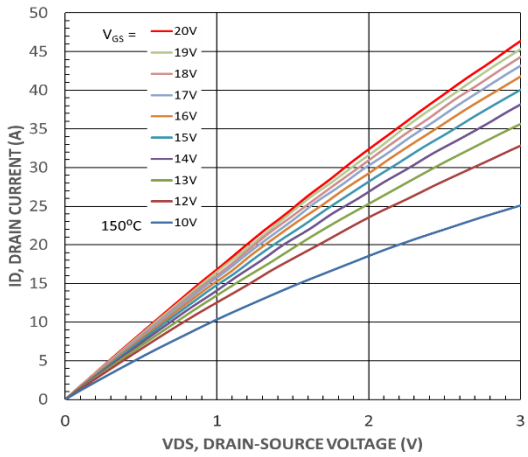


Figure 4. MOSFET Typical Output Characteristics

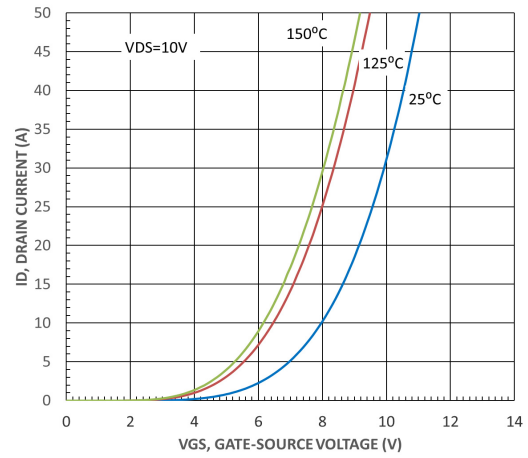


Figure 5. MOSFET Typical Transfer Characteristics

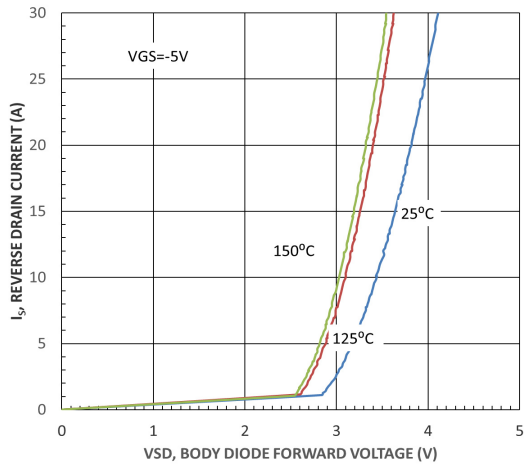


Figure 6. Body Diode Forward Characteristics

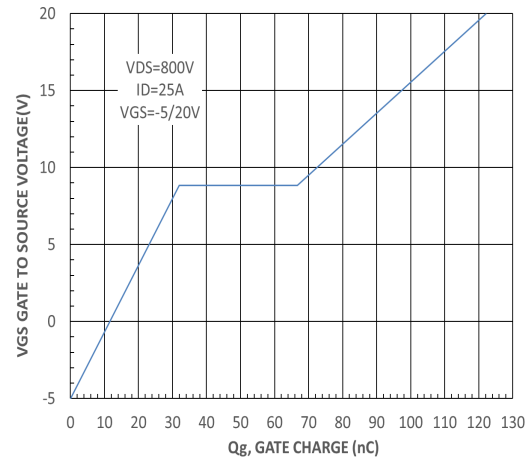


Figure 7. Gate-to-Source Voltage vs. Total Charge

NXH040P120MNF1PTG, NXH040P120MNF1PG

TYPICAL CHARACTERISTICS

SiC MOSFET (M1, M2)

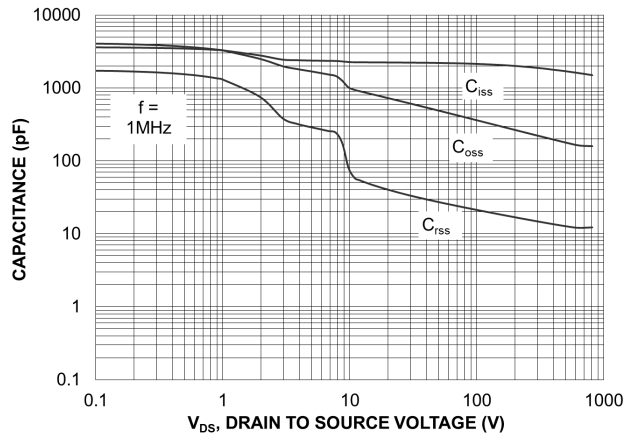


Figure 8. Capacitance vs. Drain-to-Source Voltage

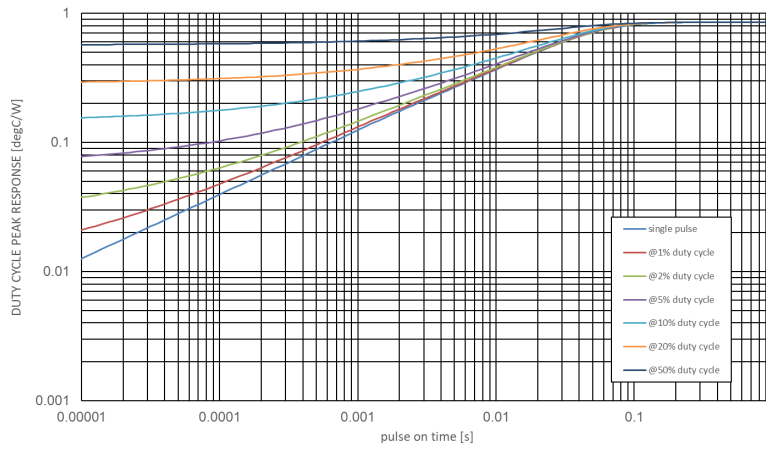


Figure 9. SiC MOSFET Junction-to-Case Transient Thermal Impedance

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

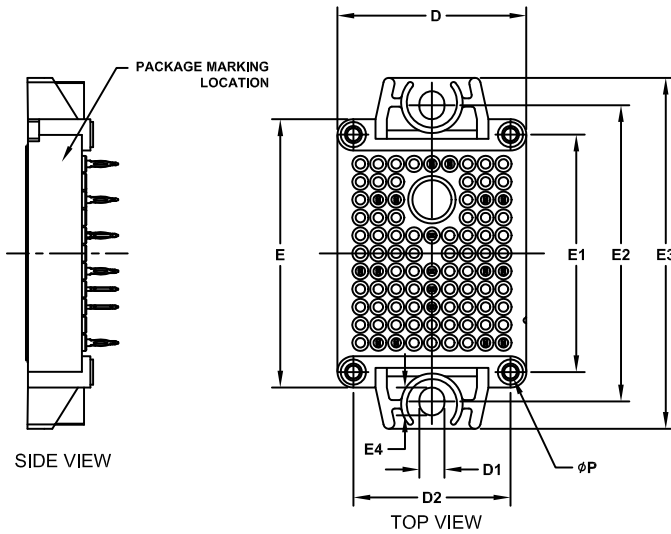
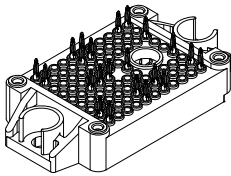
PACKAGE DIMENSIONS

ON Semiconductor®



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

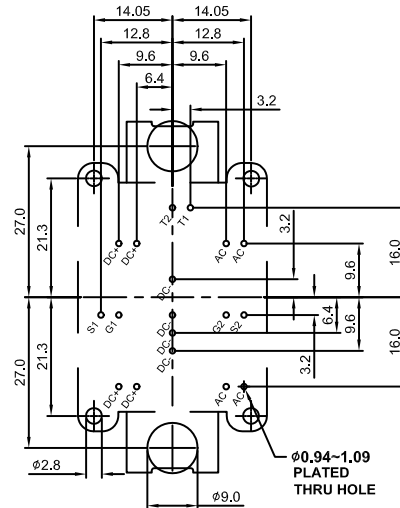
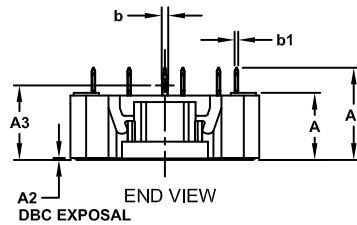
DATE 30 APR 2021



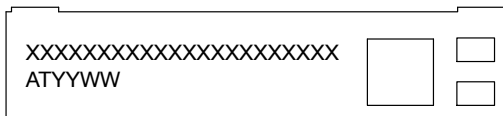
NOTES:

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

| 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 |



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 "μ", 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 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.

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