

# F1-2PACK SiC MOSFET Module



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## Product Preview

# NXH010P120MNF1PTNG, NXH010P120MNF1PNG

### General Description

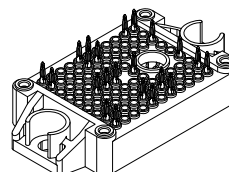
The NXH010P120MNF1 is a power module containing an 10 mΩ/1200 V SiC MOSFET half bridge and a thermistor in an F1 package.

### Features

- 10 mΩ/1200V SiC MOSFET Half Bridge
- Thermistor
- Options With Pre-Applied Thermal Interface Material (TIM) and Without Pre-Applied TIM
- Press-Fit Pins

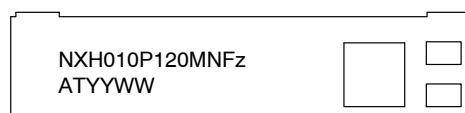
### Typical Applications

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



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

### MARKING DIAGRAM



NXH010P120MNFz = Specific Device Code  
z = PTNG/PNG  
AT = Assembly & Test Site Code  
YYWW = Year and Work Week Code

### ORDERING INFORMATION

See detailed ordering and shipping information on page of this data sheet.

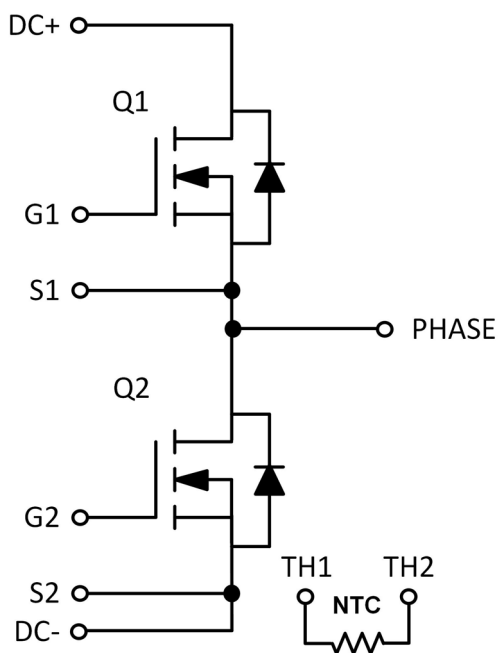


Figure 1. NXH010P120MNF1 Schematic Diagram

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

# NXH010P120MNF1PTNG, NXH010P120MNF1PNG

## PIN CONNECTIONS

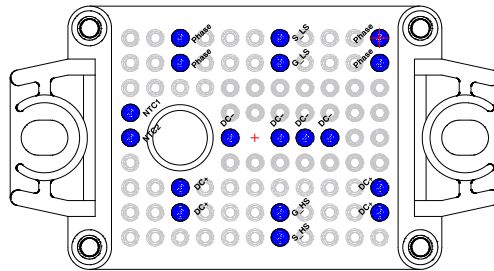


Figure 2. Pin Connections

### PIN FUNCTION DESCRIPTION

| Pin No. | Symbol | Description                          |
|---------|--------|--------------------------------------|
| A5      | TH1    | Thermistor Connection 1              |
| A6      | TH2    | Thermistor Connection 2              |
| C2      | DC+    | DC Positive Bus connection           |
| C3      | DC+    | DC Positive Bus connection           |
| C8      | PHASE  | Center point of half bridge          |
| C9      | PHASE  | Center point of half bridge          |
| E5      | DC-    | DC Negative Bus connection           |
| G1      | S1     | Q1 Kelvin Emitter (High side switch) |
| G2      | G1     | Q1 Gate (High side switch)           |
| G5      | DC-    | DC Negative Bus connection           |
| G8      | G2     | Q2 Gate (Low side switch)            |
| G9      | S2     | Q2 Kelvin Emitter (High side switch) |
| H5      | DC-    | DC Negative Bus connection           |
| I5      | DC-    | DC Negative Bus connection           |
| K2      | DC+    | DC Positive Bus connection           |
| K3      | DC+    | DC Positive Bus connection           |
| K8      | PHASE  | Center point of half bridge          |
| K9      | PHASE  | Center point of half bridge          |

# NXH010P120MNF1PTNG, NXH010P120MNF1PNG

**Table 1. ABSOLUTE MAXIMUM RATINGS** (Note 1)

| Rating   | Symbol       | Value      | Unit             |
|--|--------------|------------|------------------|
| <b>SIC MOSFET</b>  |              |            |                  |
| Drain–Source Voltage   | $V_{DSS}$    | 1200       | V                |
| Gate–Source Voltage  | $V_{GS}$     | +25/–15    | V                |
| Continuous Drain Current @ $T_c = 80^\circ\text{C}$ ( $T_J = 175^\circ\text{C}$ )  | $I_D$        | 114        | A                |
| Pulsed Drain Current ( $T_J = 175^\circ\text{C}$ )   | $I_{Dpulse}$ | 342        | A                |
| Maximum Power Dissipation ( $T_J = 175^\circ\text{C}$ )  | $P_{tot}$    | 250        | W                |
| Short Circuit Withstand Time @ $V_{GE} = -5\text{V}/20\text{ V}$ ,<br>$V_{CE} = 600\text{ V}$ , $T_J \leq 150^\circ\text{C}$ | $T_{sc}$     | 2          | $\mu\text{s}$    |
| Minimum Operating Junction Temperature   | $T_{JMIN}$   | –40        | $^\circ\text{C}$ |
| Maximum Operating Junction Temperature   | $T_{JMAX}$   | 175        | $^\circ\text{C}$ |
| <b>THERMAL PROPERTIES</b>  |              |            |                  |
| Storage Temperature range  | $T_{stg}$    | –40 to 150 | $^\circ\text{C}$ |
| <b>INSULATION PROPERTIES</b>   |              |            |                  |
| Isolation test voltage, $t = 1\text{ sec}$ , 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.

## ELECTRICAL CHARACTERISTICS

$T_A = 25^\circ\text{C}$  unless otherwise noted

| Parameter                         | Test Conditions  | Symbol        | Min   | Typ  | Max  | Unit          |
|-----------------------------------|--|---------------|-------|------|------|---------------|
| <b>SIC MOSFET CHARACTERISTICS</b> |  |               |       |      |      |               |
| Drain–Source Breakdown Voltage    | $V_{GS} = 0\text{ V}$ , $I_D = 400\ \mu\text{A}$                             | $V_{(BR)DSS}$ | 1200  | –    | –    | V             |
| Zero Gate Voltage Drain Current   | $V_{GS} = 0\text{ V}$ , $V_{DS} = 1200\text{ V}$                             | $I_{DSS}$     | –     | –    | 200  | $\mu\text{A}$ |
| Drain–Source On Resistance        | $V_{GS} = 20\text{ V}$ , $I_D = 100\text{ A}$ ,<br>$T_J = 25^\circ\text{C}$  | $R_{DS(ON)}$  | –     | 10.5 | 14   | m $\Omega$    |
|                                   | $V_{GS} = 20\text{ V}$ , $I_D = 100\text{ A}$ ,<br>$T_J = 125^\circ\text{C}$ |               | –     | 14.1 | –    |               |
|                                   | $V_{GS} = 20\text{ V}$ , $I_D = 100\text{ A}$ ,<br>$T_J = 150^\circ\text{C}$ |               | –     | 14.5 | –    |               |
| Gate–Source Threshold Voltage     | $V_{GS} = V_{DS}$ , $I_D = 40\text{ mA}$                                     | $V_{GS(TH)}$  | 1.8   | 2.90 | 4.3  | V             |
| Gate Leakage Current              | $V_{GS} = -10/20\text{ V}$ , $V_{DS} = 0\text{ V}$                           | $I_{GSS}$     | –1000 | –    | 1000 | nA            |
| Forward Transconductance          | $V_{DS} = 10\text{ V}$ , $I_D = 100\text{ A}$                                | $g_{FS}$      |       | 31   |      | S             |
| Internal Gate Resistance          |  | $R_G$         |       | TBD  |      | $\Omega$      |
| Input Capacitance                 | $V_{DS} = 800\text{ V}$ , $V_{GS} = 0\text{ V}$ .<br>$f = 1\text{ MHz}$      | $C_{ISS}$     | –     | 4707 | –    | pF            |
| Reverse Transfer Capacitance      |  | $C_{RSS}$     | –     | 39   | –    |               |
| Output Capacitance                |  | $C_{OSS}$     | –     | 548  | –    |               |
| $C_{OSS}$ Stored Energy           | $V_{DS} = 0\text{ V to } 800\text{ V}$ , $V_{GS} = 0\text{ V}$               | $E_{OSS}$     | –     | TBD  | –    | $\mu\text{J}$ |

# NXH010P120MNF1PTNG, NXH010P120MNF1PNG

## ELECTRICAL CHARACTERISTICS (continued)

T<sub>A</sub> = 25°C unless otherwise noted

| Parameter                             | Test Conditions   | Symbol   | Min                | Typ  | Max  | Unit |      |
|---------------------------------------|---|--|--------------------|------|------|------|------|
| <b>SiC MOSFET CHARACTERISTICS</b>     |   |  |                    |      |      |      |      |
| Total Gate Charge                     | V <sub>DS</sub> = 800 V, V <sub>GS</sub> = 20 V,<br>I <sub>D</sub> = 100 A  | Q <sub>G(TOTAL)</sub>  | –                  | 454  | –    | nC   |      |
| Gate–Source Charge                    |   | Q <sub>GS</sub>  | –                  | 129  | –    | nC   |      |
| Gate–Drain Charge                     |   | Q <sub>GD</sub>  | –                  | 131  | –    | nC   |      |
| Turn–on Delay Time                    | T <sub>J</sub> = 25°C<br>V <sub>DS</sub> = 800 V, I <sub>D</sub> = 100 A<br>V <sub>GS</sub> = –5V/18V, R <sub>G</sub> = 3.9 Ω | t <sub>d(on)</sub>   | –                  | TBD  | –    | ns   |      |
| Rise Time                             |   | t <sub>r</sub>   | –                  | TBD  | –    |      |      |
| Turn–off Delay Time                   |   | t <sub>d(off)</sub>  | –                  | TBD  | –    |      |      |
| Fall Time                             |   | t <sub>f</sub>   | –                  | TBD  | –    |      |      |
| Turn–on Switching Loss per Pulse      |   | T <sub>J</sub> = 150°C<br>V <sub>DS</sub> = 800 V, I <sub>D</sub> = 100 A<br>V <sub>GS</sub> = –5V/18V, R <sub>G</sub> = 3.9 Ω | E <sub>ON</sub>    | –    | 2.05 | –    | mJ   |
| Turn off Switching Loss per Pulse     |   |  | E <sub>OFF</sub>   | –    | 1.1  | –    |      |
| Turn–on Delay Time                    |   |  | t <sub>d(on)</sub> | –    | TBD  | –    | ns   |
| Rise Time                             |   |  | t <sub>r</sub>     | –    | TBD  | –    |      |
| Turn–off Delay Time                   | t <sub>d(off)</sub>   |  | –                  | TBD  | –    |      |      |
| Fall Time                             | t <sub>f</sub>  |  | –                  | TBD  | –    |      |      |
| Turn–on Switching Loss per Pulse      | T <sub>J</sub> = 25°C   |  | E <sub>ON</sub>    | –    | 1.95 | –    | mJ   |
| Turn off Switching Loss per Pulse     |   |  | E <sub>OFF</sub>   | –    | 1.3  | –    |      |
| Diode Forward Voltage                 | I <sub>D</sub> = 100 A, T <sub>J</sub> = 25°C   | V <sub>SD</sub>  | –                  | 3.94 | 6    | V    |      |
|                                       | I <sub>D</sub> = 100 A, T <sub>J</sub> = 150°C  |  | –                  | 3.42 | –    |      |      |
| Reverse Recovery Time                 | T <sub>J</sub> = 25°C<br>V <sub>DS</sub> = 800 V, I <sub>D</sub> = 100 A<br>V <sub>GS</sub> = –5V/18V, R <sub>G</sub> = 3.9 Ω | t <sub>rr</sub>  | –                  | TBD  | –    | ns   |      |
| Reverse Recovery Charge               |   | Q <sub>rr</sub>  | –                  | TBD  | –    | nC   |      |
| Peak Reverse Recovery Current         |   | I <sub>R(RM)</sub>   | –                  | TBD  | –    | A    |      |
| Peak Rate of Fall of Recovery Current |   | di/dt  | –                  | TBD  | –    | A/μs |      |
| Reverse Recovery Energy               |   | E <sub>rr</sub>  | –                  | TBD  | –    | μJ   |      |
| Reverse Recovery Time                 |   | T <sub>J</sub> = 25°C<br>V <sub>DS</sub> = 800 V, I <sub>D</sub> = 100 A<br>V <sub>GS</sub> = –5V/18V, R <sub>G</sub> = 3.9 Ω  | t <sub>rr</sub>    | –    | TBD  | –    | ns   |
| Reverse Recovery Charge               | Q <sub>rr</sub>   |  | –                  | TBD  | –    | μC   |      |
| Peak Reverse Recovery Current         | I <sub>R(RM)</sub>  |  | –                  | TBD  | –    | A    |      |
| Peak Rate of Fall of Recovery Current | di/dt   |  | –                  | TBD  | –    | A/μs |      |
| Reverse Recovery Energy               | E <sub>rr</sub>   |  | –                  | TBD  | –    | μJ   |      |
| Thermal Resistance – chip–to–case     | M1,M2   |  | R <sub>thJC</sub>  | –    | 0.23 | –    | °C/W |
| Thermal Resistance – chip–to–heatsink | Thermal Resistance – chip–to–heatsink, Thermal grease, Thickness = 2 Mil _2%, A = 2.8 W/mK                                    | R <sub>thJH</sub>  | –                  | 0.38 | –    | °C/W |      |

## THERMISTOR CHARACTERISTICS

|                            |                          |                  |    |      |   |      |
|----------------------------|--------------------------|------------------|----|------|---|------|
| Nominal resistance         | T = 25°C                 | R <sub>25</sub>  | –  | 5    | – | kΩ   |
| Nominal resistance         | T = 100°C                | R <sub>100</sub> | –  | 457  | – | Ω    |
| Deviation of R25           |                          | ΔR/R             | –3 | –    | 3 | %    |
| Power dissipation          |                          | P <sub>D</sub>   | –  | 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    |

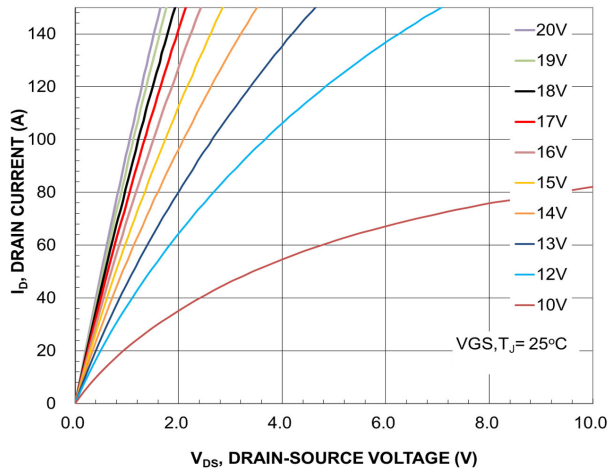
# NXH010P120MNF1PTNG, NXH010P120MNF1PNG

## ORDERING INFORMATION

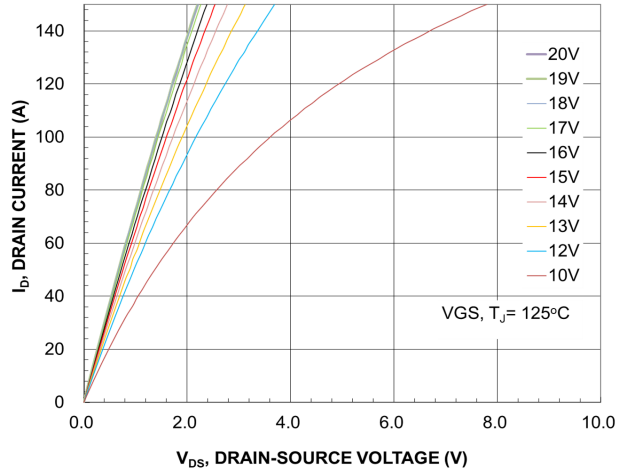
| Orderable Part Number | Specific Device Marking | Package Type   | Shipping <sup>†</sup>   |
|-----------------------|-------------------------|--|-------------------------|
| NXH010P120MNF1PNG     | NXH010P120MNF1PNG       | F1-2PACK: Case 180BW<br>Press-fit Pins<br>(Pb-Free and Halide-Free)  | 28 Units / Blister Tray |
| NXH010P120MNF1PTNG    | NXH010P120MNF1PTNG      | F1-2PACK: Case 180BW<br>Press-fit Pins with pre-applied<br>thermal interface material (TIM)<br>(Pb-Free and Halide-Free) | 28 Units / Blister Tray |

<sup>†</sup>For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

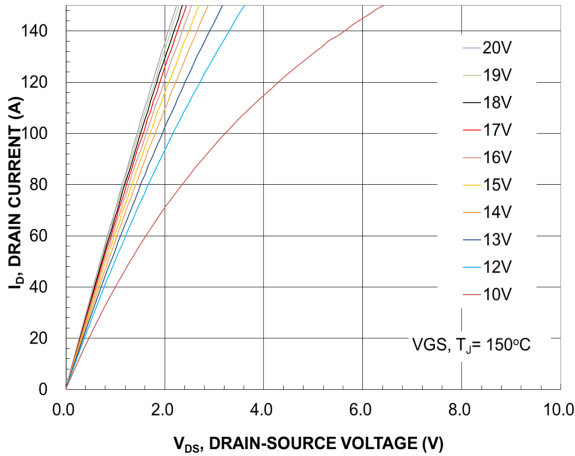
# NXH010P120MNF1PTNG, NXH010P120MNF1PNG



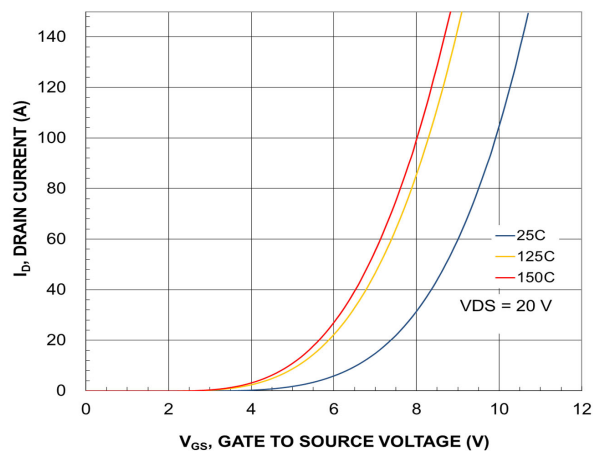
**Figure 3. MOSFET Typical Output Characteristics**



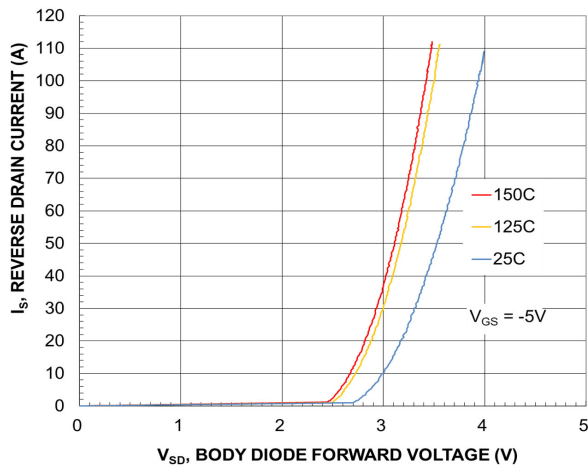
**Figure 4. MOSFET Typical Output Characteristics**



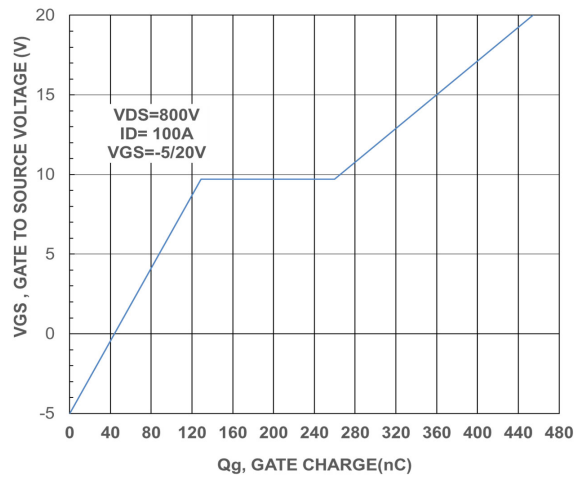
**Figure 5. MOSFET Typical Output Characteristics**



**Figure 6. MOSFET Typical Transfer Characteristics**



**Figure 7. Body Diode Forward Characteristic**



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

# NXH010P120MNF1PTNG, NXH010P120MNF1PNG

## TYPICAL CHARACTERISTICS

SiC MOSFET (M1, M2)

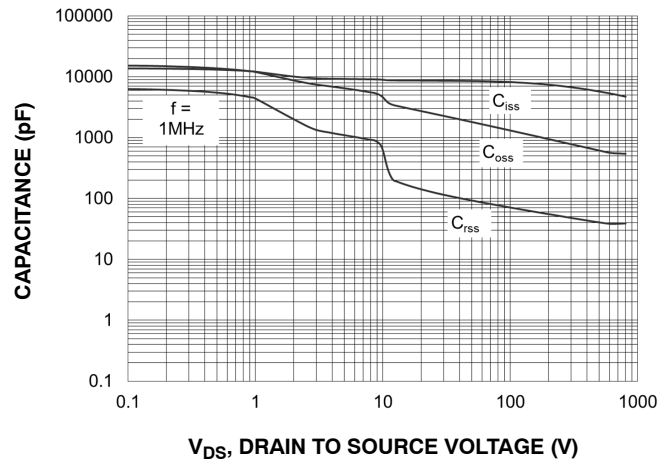


Figure 9. Capacitance vs. Drain-to-Source Voltage

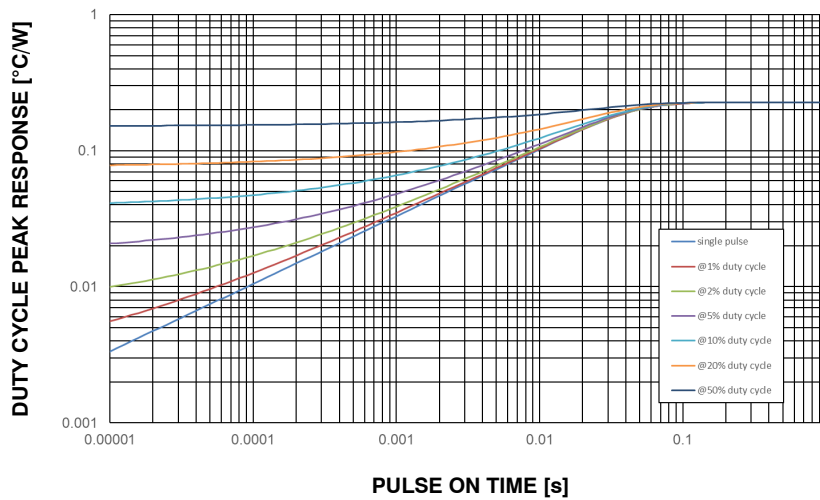


Figure 10. SiC Mosfet Junction-to-Case Transient Thermal Impedance

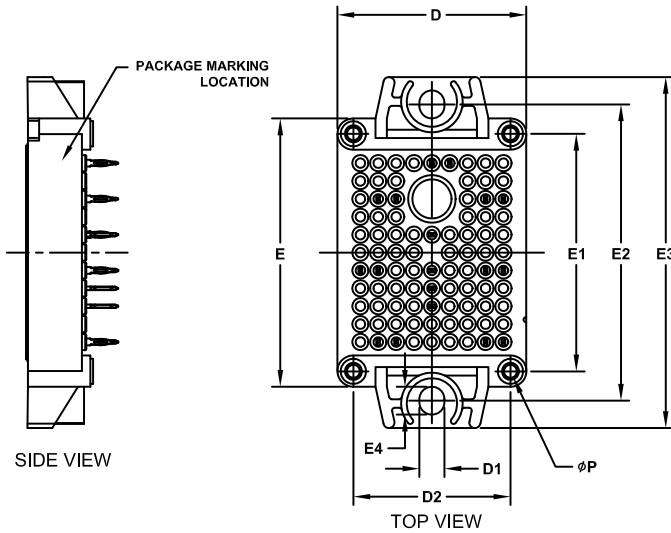
| Element # | M1        |            | M2        |            |
|-----------|-----------|------------|-----------|------------|
|           | Rth (K/W) | Cth (Ws/K) | Rth (K/W) | Cth (Ws/K) |
| 1         | 0.00569   | 0.00195    | 0.01290   | 0.00461    |
| 2         | 0.01079   | 0.00951    | 0.02387   | 0.02538    |
| 3         | 0.03005   | 0.01813    | 0.04253   | 0.02953    |
| 4         | 0.08398   | 0.08121    | 0.07199   | 0.08994    |
| 5         | 0.09325   | 0.11117    | 0.07823   | 0.06854    |

Figure 11. Table of Cauer Networks-M1, M2

# NXH010P120MNF1PTNG, NXH010P120MNF1PNG

## PACKAGE DIMENSIONS

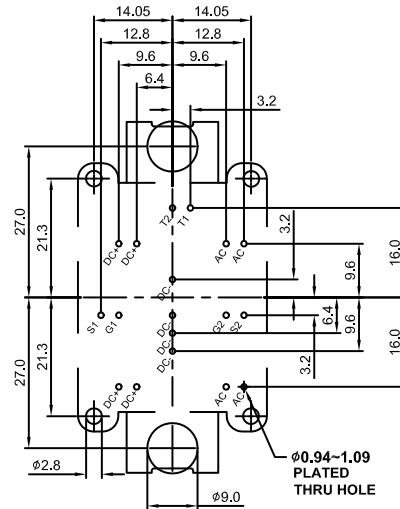
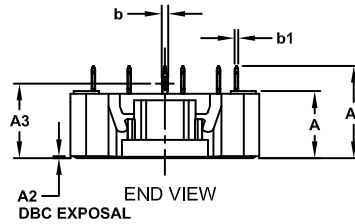
**PIM18 33.8x42.5 (PRESS FIT)**  
CASE 180BW  
ISSUE B



**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  |



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