

Silicon Carbide (SiC) Module – EliteSiC, 10 mohm SiC M2 MOSFET, 900 V, 2-PACK Half Bridge Topology, F1 Package

NXH010P90MNF1PTG, NXH010P90MNF1PG

The NXH010P120MNF1 is a power module containing an 10 mΩ/900 V SiC MOSFET half bridge and a thermistor in an F1 package.

Features

- 10 mΩ/900 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

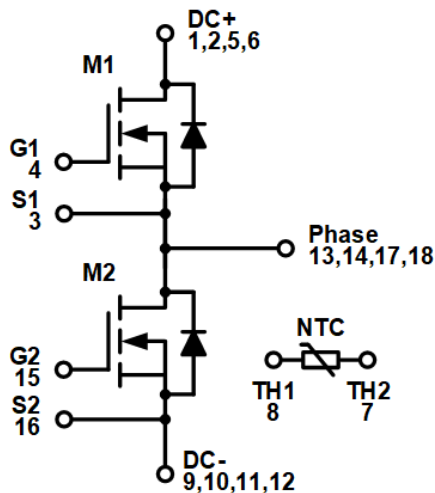
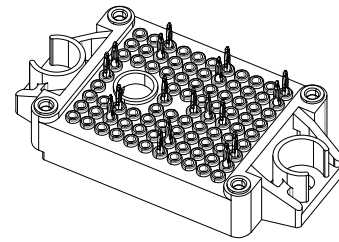
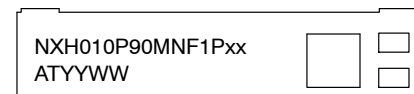


Figure 1. NXH010P90MNF1 Schematic Diagram



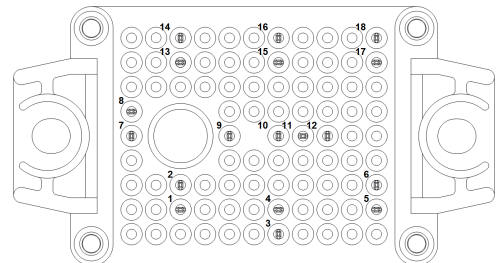
PIM18 33.8x42.5 (PRESS FIT)
CASE 180BW

MARKING DIAGRAM



NXH010P90MNF1PTG = Specific Device Code
 NXH010P90MNF1PG = 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.

NXH010P90MNF1PTG, NXH010P90MNF1PG

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} | 900 | V |
| Gate-Source Voltage | V_{GS} | +18/-8 | V |
| Continuous Drain Current @ $T_C = 80^\circ\text{C}$ ($T_J = 175^\circ\text{C}$) | I_D | 154 | A |
| Pulsed Drain Current ($T_J = 175^\circ\text{C}$) | I_{Dpulse} | 308 | A |
| Maximum Power Dissipation @ $T_C = 80^\circ\text{C}$ ($T_J = 175^\circ\text{C}$) | P_{tot} | 328 | W |
| 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, $t = 1$ 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.

NXH010P90MNF1PTG, NXH010P90MNF1PG

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 = 400 μA | V _{(BR)DSS} | 900 | - | - | V | |
| Zero Gate Voltage Drain Current | V _{GS} = 0 V, V _{DS} = 900 V | I _{DSS} | - | - | 200 | μA | |
| Drain-Source On Resistance | V _{GS} = 15 V, I _D = 100 A, T _J = 25°C | R _{DS(ON)} | - | 10.03 | 14 | mΩ | |
| | V _{GS} = 15 V, I _D = 100 A, T _J = 125°C | | - | 10.08 | - | | |
| | V _{GS} = 15 V, I _D = 100 A, T _J = 150°C | | - | 11.61 | - | | |
| Gate-Source Threshold Voltage | V _{GS} = V _{DS} , I _D = 40 mA | V _{GS(TH)} | 1.8 | 2.74 | 4.3 | V | |
| Gate Leakage Current | V _{GS} = -5/15 V, V _{DS} = 0 V | I _{GSS} | -500 | - | 500 | nA | |
| Internal Gate Resistance | | R _G | | 0.8 | | Ω | |
| Input Capacitance | V _{DS} = 450 V, V _{GS} = 0 V, f = 1 MHz | C _{ISS} | - | 7007 | - | pF | |
| Reverse Transfer Capacitance | | C _{RSS} | - | 44 | - | | |
| Output Capacitance | | C _{OSS} | - | 665 | - | | |
| C _{OSS} Stored Energy | V _{DS} = 0 V to 800 V, V _{GS} = 0 V | E _{OSS} | - | 251 | - | μJ | |
| Total Gate Charge | V _{DS} = 720 V, V _{GS} = -15/15 V, I _D = 100 A | Q _{G(TOTAL)} | - | 546.4 | - | nC | |
| Gate-Source Charge | | Q _{GS} | - | 105.45 | - | nC | |
| Gate-Drain Charge | | Q _{GD} | - | 122.7 | - | nC | |
| Turn-on Delay Time | T _J = 25°C V _{DS} = 600 V, I _D = 100 A V _{GS} = -5 V/18 V, R _G = 1.5 Ω | t _{d(on)} | - | 53 | - | ns | |
| Rise Time | | t _r | - | 16 | - | | |
| Turn-off Delay Time | | t _{d(off)} | - | 150 | - | | |
| Fall Time | | t _f | - | 12 | - | | |
| Turn-on Switching Loss per Pulse | | E _{ON} | - | 1.13 | - | | mJ |
| Turn off Switching Loss per Pulse | | E _{OFF} | - | 0.65 | - | | |
| Turn-on Delay Time | T _J = 150°C V _{DS} = 600 V, I _D = 100 A V _{GS} = -5 V/18 V, R _G = 1.5 Ω | t _{d(on)} | - | 50.4 | - | ns | |
| Rise Time | | t _r | - | 15.5 | - | | |
| Turn-off Delay Time | | t _{d(off)} | - | 165 | - | | |
| Fall Time | | t _f | - | 13 | - | | |
| Turn-on Switching Loss per Pulse | | E _{ON} | - | 1.24 | - | | mJ |
| Turn off Switching Loss per Pulse | | E _{OFF} | - | 0.67 | - | | |
| Diode Forward Voltage | I _D = 100 A, T _J = 25°C | V _{SD} | - | 4.47 | 6 | V | |
| | I _D = 100 A, T _J = 150°C | | - | 3.92 | - | | |
| Thermal Resistance - Chip-to-Case | M1, M2 | R _{thJC} | - | 0.29 | - | °C/W | |
| Thermal Resistance - Chip-to-Heatsink | Thermal grease, Thickness = 2 Mil _2%, A = 2.8 W/mK | R _{thJH} | - | 0.46 | - | °C/W | |

THERMISTOR CHARACTERISTICS

| | | | | | | |
|---------------------------------------|----------------------------------|------------------|----|-------|---|------|
| Nominal Resistance | T _{NTC} = 25°C | R ₂₅ | - | 5 | - | kΩ |
| Nominal Resistance | T _{NTC} = 100°C | R ₁₀₀ | - | 493 | - | Ω |
| Nominal Resistance | 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.

NXH010P90MNF1PTG, NXH010P90MNF1PG

ORDERING INFORMATION

| Orderable Part Number | Marking | Package | Shipping |
|-----------------------|------------------|--------------------------------------------------------------------------------------------------------------------------|-------------------------|
| NXH010P90MNF1PG | NXH010P90MNF1PG | F1-2PACK: Case 180BW Press-fit Pins (Pb-Free and Halide-Free) | 28 Units / Blister Tray |
| NXH010P90MNF1PTG | NXH010P90MNF1PTG | F1-2PACK: Case 180BW Press-fit Pins with pre-applied thermal interface material (TIM) (Pb-Free and Halide-Free) | 28 Units / Blister Tray |

NXH010P90MNF1PTG, NXH010P90MNF1PG

TYPICAL CHARACTERISTICS SIC MOSFET (M1/M2)

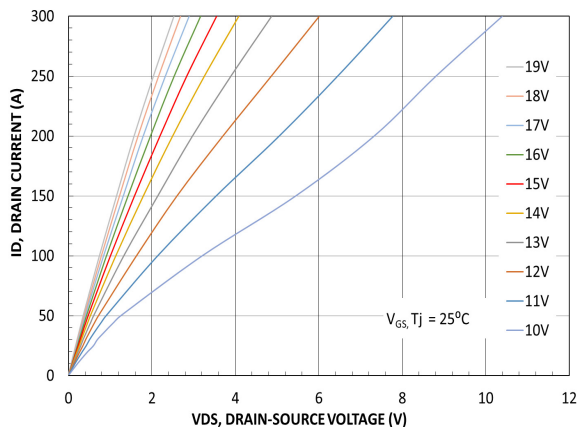


Figure 2. MOSFET Typical Output Characteristics

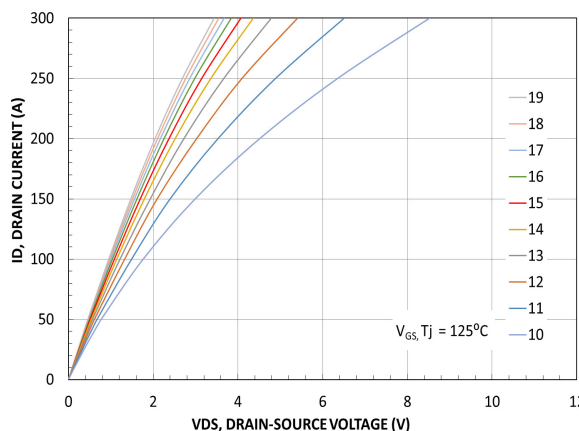


Figure 3. MOSFET Typical Output Characteristics

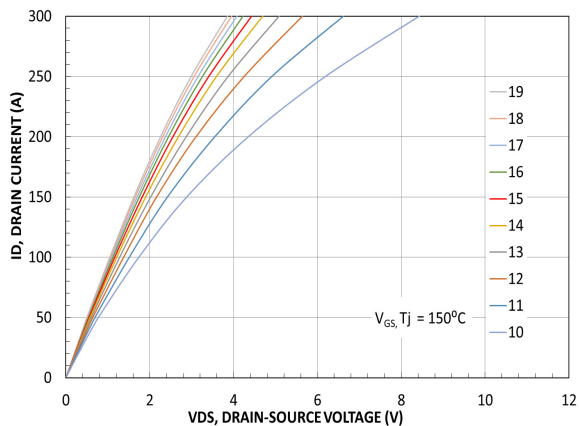


Figure 4. MOSFET Typical Output Characteristics

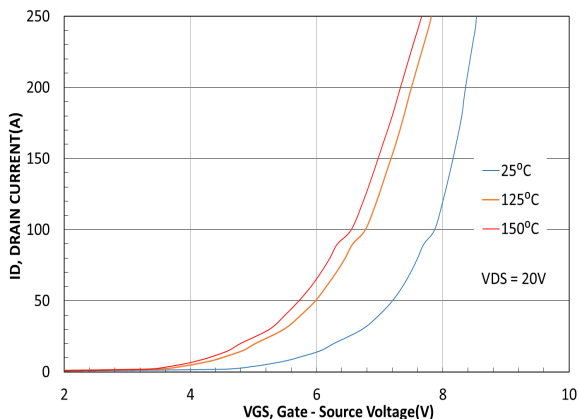


Figure 5. MOSFET Typical Transfer Characteristics

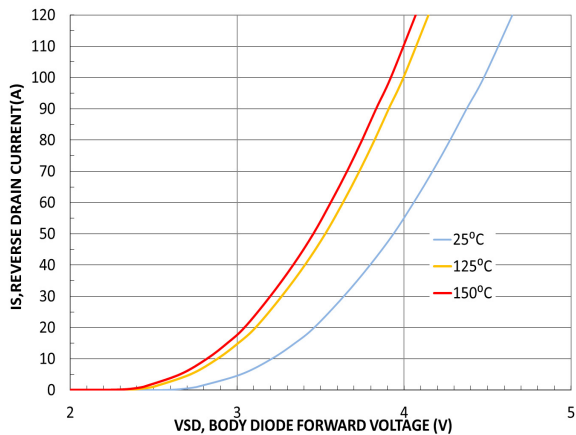


Figure 6. Body Diode Forward Characteristics

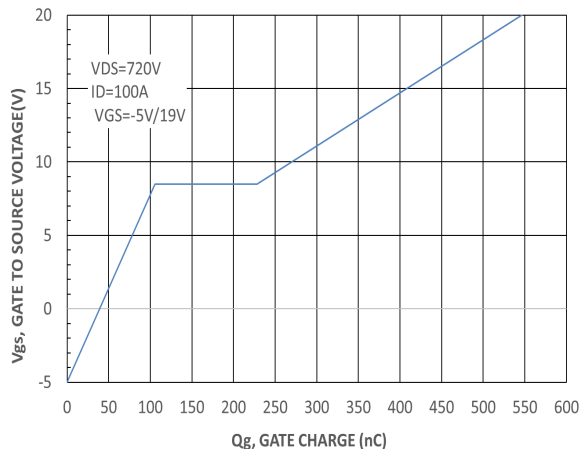


Figure 7. Gate-to-Source Voltage vs. Total Charge

TYPICAL CHARACTERISTICS

SIC MOSFET (M1/M2)

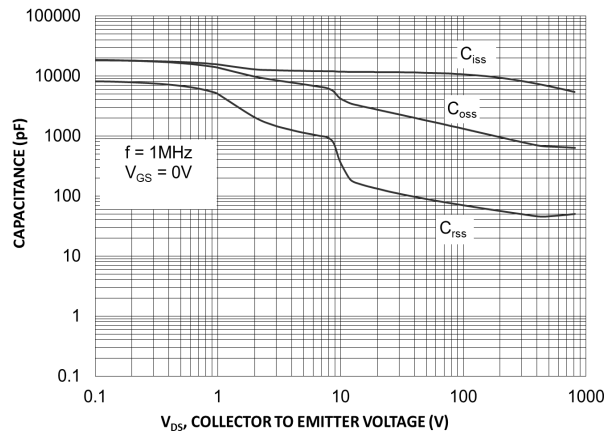


Figure 8. Capacitance vs. Drain-to-Source Voltage

NXH010P90MNF1PTG, NXH010P90MNF1PG

TYPICAL CHARACTERISTICS

M1/M2 MOSFET SWITCHING CHARACTERISTICS

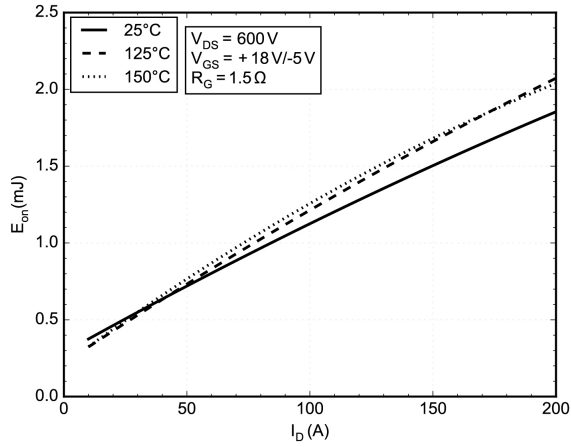


Figure 9. Typical Switching Loss E_{on} vs. I_D

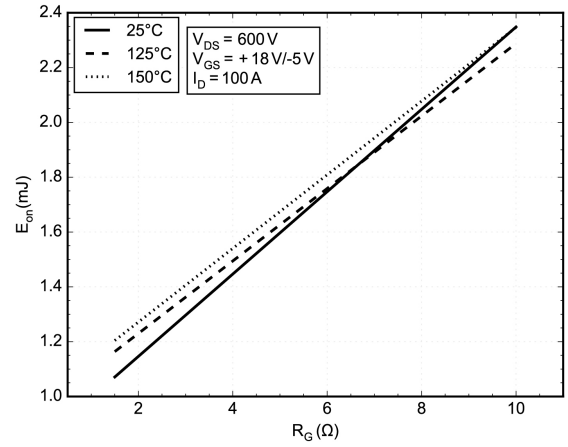


Figure 10. Typical Switching Loss E_{on} vs. R_G

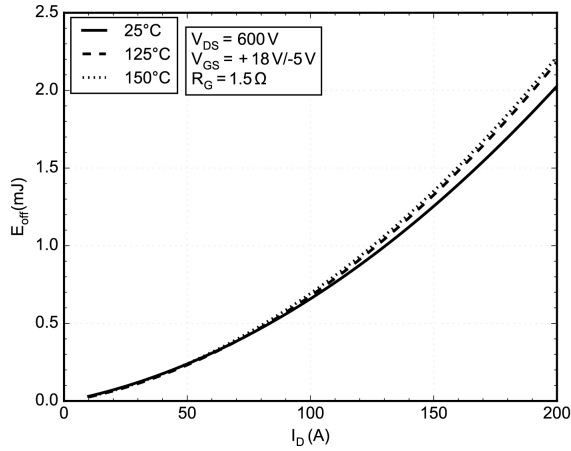


Figure 11. Typical Switching Loss E_{off} vs. I_D

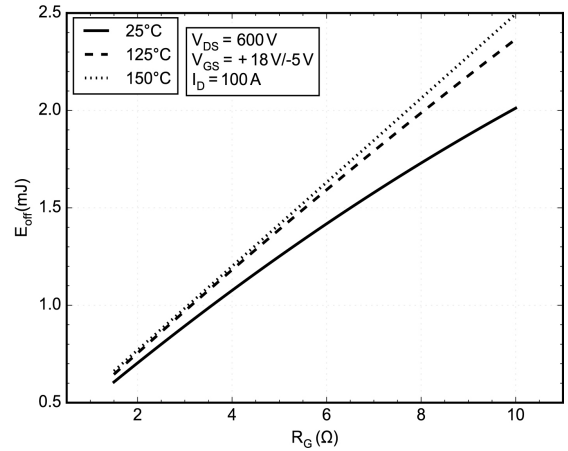


Figure 12. Typical Switching Loss E_{off} vs. R_G

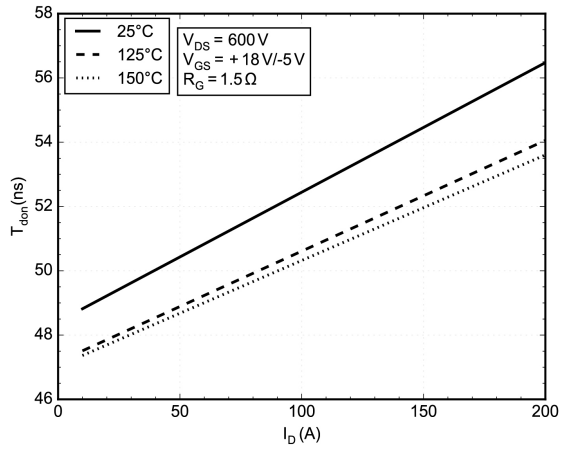


Figure 13. Typical Turn-On Switching $T_{d(on)}$ vs. I_D

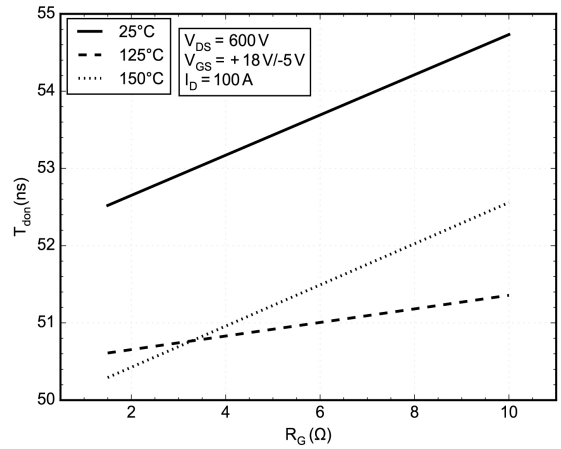


Figure 14. Typical Turn-On Switching $T_{d(on)}$ vs. R_G

NXH010P90MNF1PTG, NXH010P90MNF1PG

TYPICAL CHARACTERISTICS

M1/M2 MOSFET SWITCHING CHARACTERISTICS

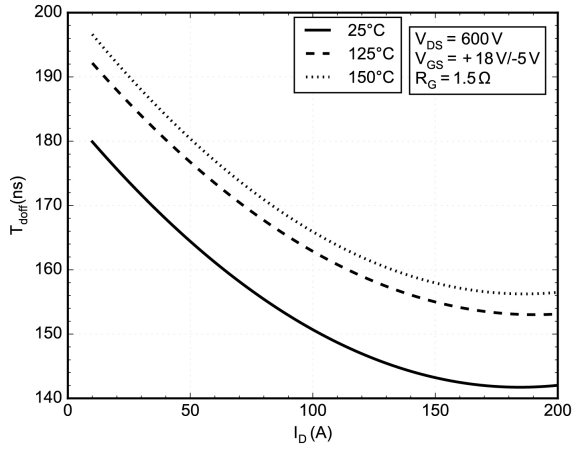


Figure 15. Typical Turn-off Switching $T_{d(off)}$ vs. I_D

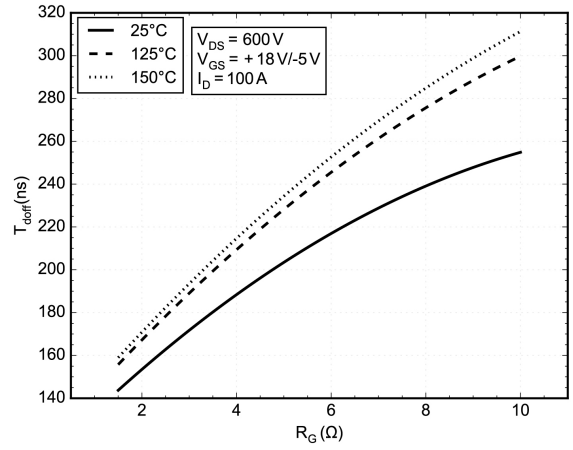


Figure 16. Typical Turn-off Switching $T_{d(off)}$ vs. R_G

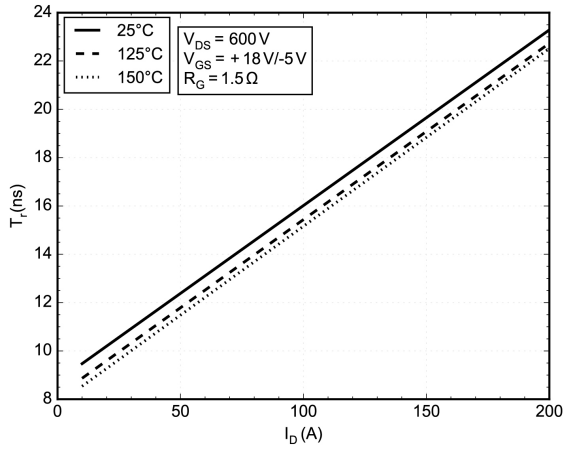


Figure 17. Typical Turn-On Switching T_r vs. I_D

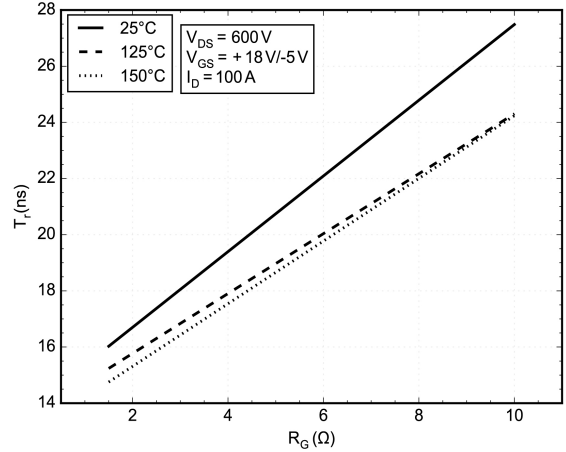


Figure 18. Typical Turn-On Switching T_r vs. R_G

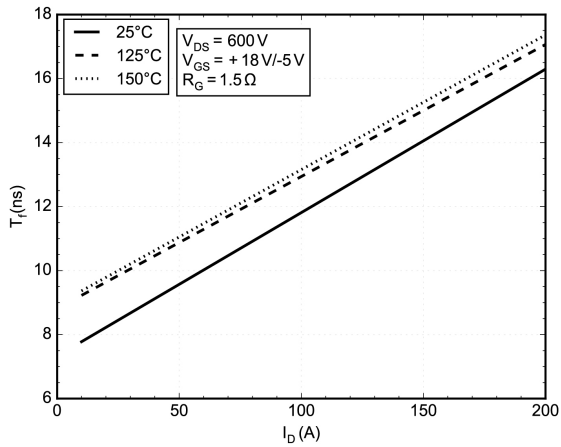


Figure 19. Typical Turn-Off Switching T_f vs. I_D

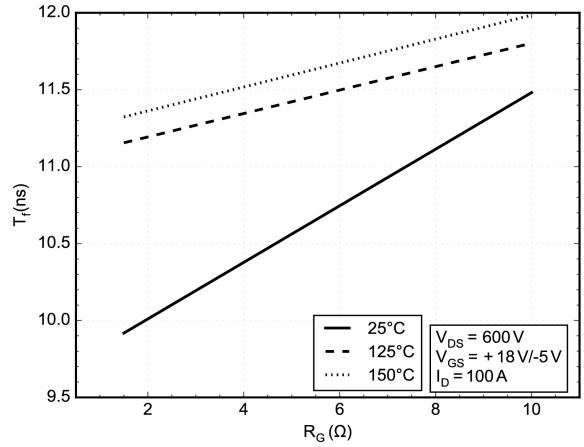


Figure 20. Typical Turn-Off Switching T_f vs. R_G

NXH010P90MNF1PTG, NXH010P90MNF1PG

TYPICAL CHARACTERISTICS

M1/M2 MOSFET SWITCHING CHARACTERISTICS

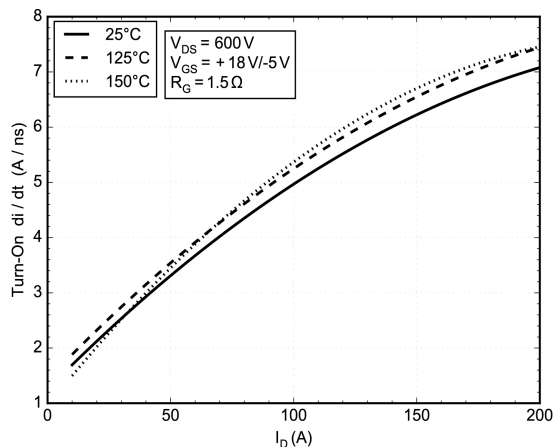


Figure 21. di/dt ON vs I_D

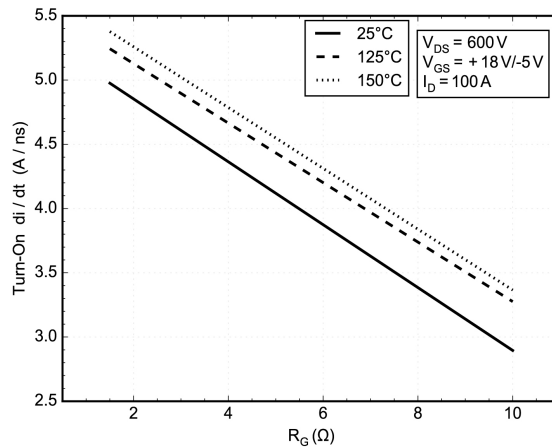


Figure 22. di/dt ON vs. R_G

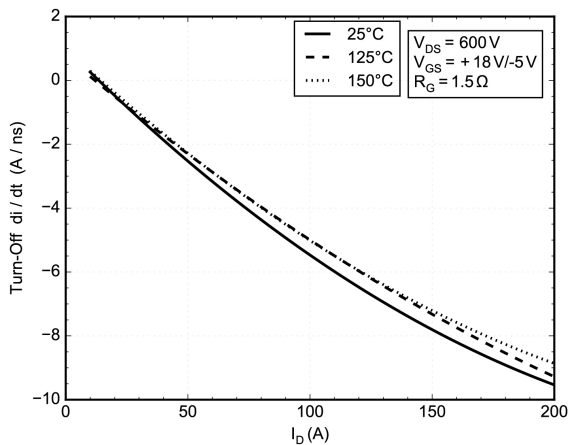


Figure 23. di/dt OFF vs I_D

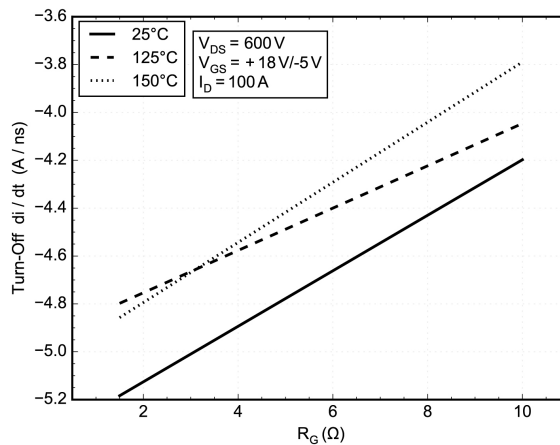


Figure 24. di/dt OFF vs. R_G

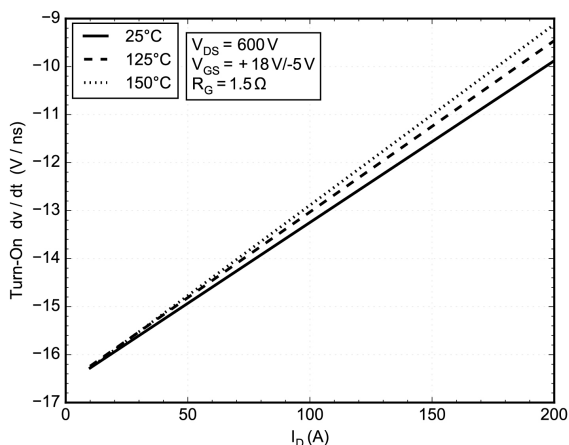


Figure 25. dv/dt ON vs I_D

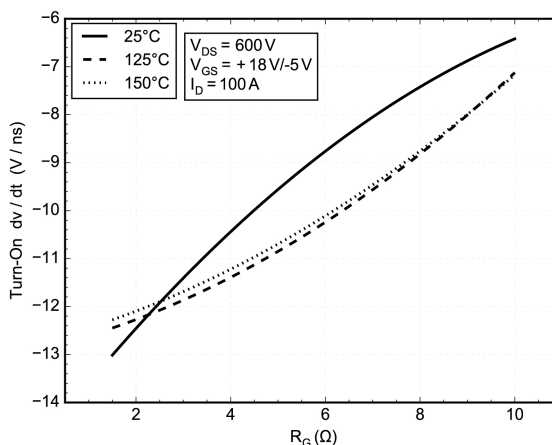


Figure 26. dv/dt ON vs. R_G

NXH010P90MNF1PTG, NXH010P90MNF1PG

TYPICAL CHARACTERISTICS
M1/M2 MOSFET SWITCHING CHARACTERISTICS

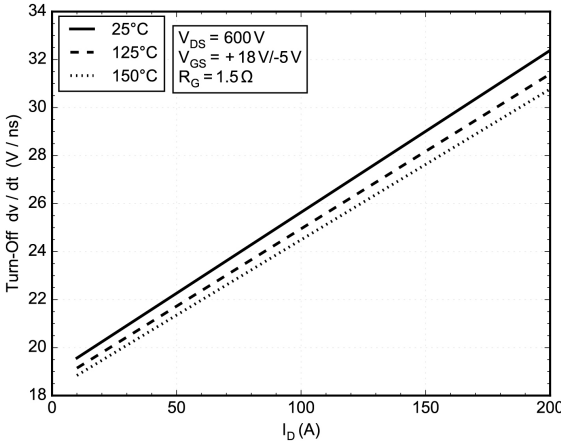


Figure 27. dv/dt OFF vs I_D

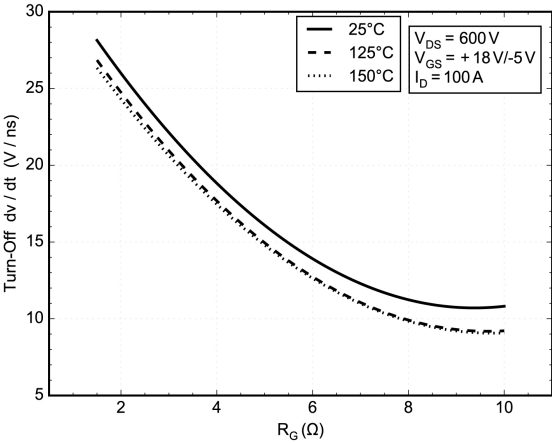


Figure 28. dv/dt OFF vs. R_G

NXH010P90MNF1PTG, NXH010P90MNF1PG

TYPICAL CHARACTERISTICS

SiC MOSFET (M1/M2)

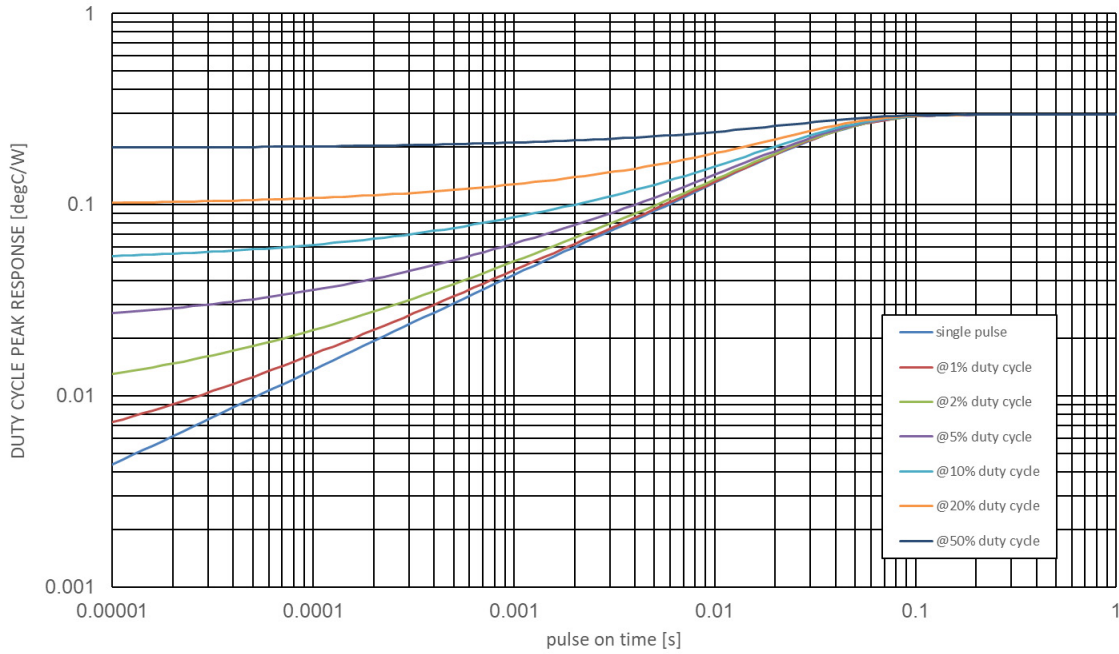


Figure 29. SiC MOSFET Junction-to-Case Transient Thermal Impedance

Table 1. FOSTER NETWORKS – M1, M2

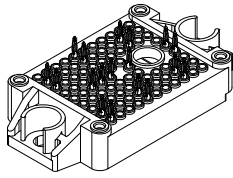
| Foster Element # | M1 | | M2 | |
|------------------|-----------|------------|-----------|------------|
| | Rth (K/W) | Cth (Ws/K) | Rth (K/W) | Cth (Ws/K) |
| 1 | 0.018018 | 0.006761 | 0.017423 | 0.006288 |
| 2 | 0.00725 | 0.110732 | 0.008856 | 0.083472 |
| 3 | 0.007012 | 0.219934 | 0.007085 | 0.218085 |
| 4 | 0.034121 | 0.121787 | 0.035241 | 0.119517 |
| 5 | 0.227927 | 0.132429 | 0.233897 | 0.129036 |

Table 2. CAUER NETWORKS – M1, M2

| Cauer Element # | M1 | | M2 | |
|-----------------|-----------|------------|-----------|------------|
| | Rth (K/W) | Cth (Ws/K) | Rth (K/W) | Cth (Ws/K) |
| 1 | 0.025529 | 0.005642 | 0.026977 | 0.005357 |
| 2 | 0.050904 | 0.03348 | 0.070046 | 0.034112 |
| 3 | 0.066724 | 0.042125 | 0.094049 | 0.071939 |
| 4 | 0.058571 | 0.063408 | 0.040991 | 0.068148 |
| 5 | 0.092598 | 0.079724 | 0.064984 | 0.039596 |

MECHANICAL CASE OUTLINE

PACKAGE DIMENSIONS

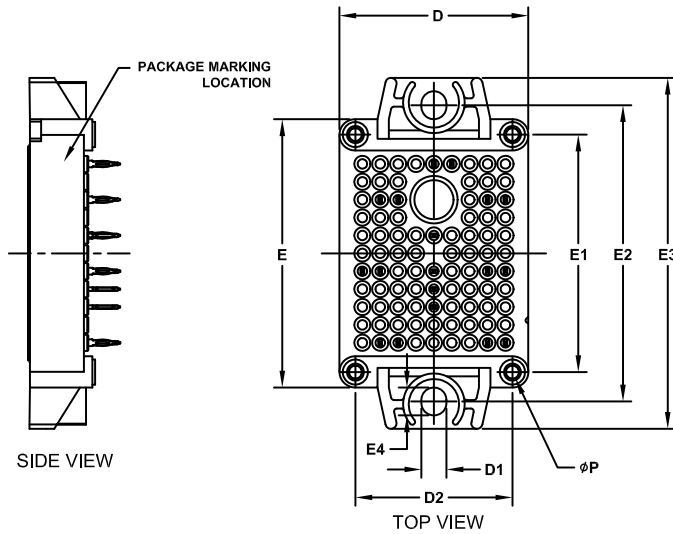


PIM18 33.8x42.5 (PRESS FIT)

CASE 180BW

ISSUE B

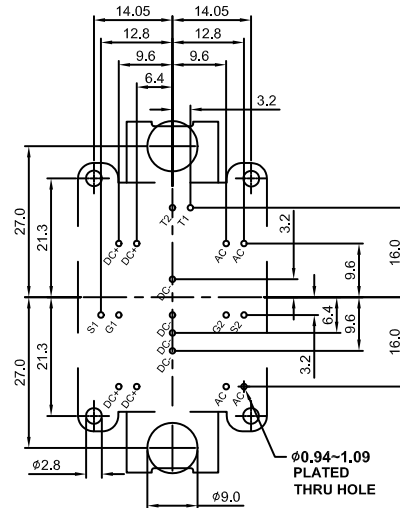
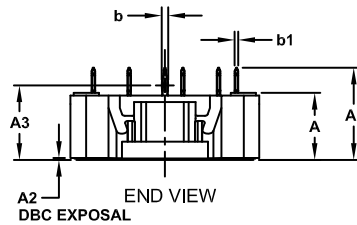
DATE 30 APR 2021



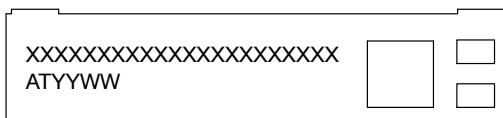
NOTES:

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 "", may or may not be present. Some products may not follow the Generic Marking.

| | | |
|-------------------------|------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
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| DESCRIPTION: | PIM18 33.8x42.5 (PRESS FIT) | PAGE 1 OF 1 |

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