# Silicon Carbide (SiC) Module – 8 mohm SiC M3S MOSFET, 1200 V, 2-PACK Half Bridge Topology, F1 Package

*Product Preview*

## NXH008P120M3F1PTG, NXH008P120M3F1PG

The NXH008P120M3F1 is a power module containing 8 mΩ / 1200 V SiC MOSFET half−bridge and a thermistor in an F1 package.

### Features

- 8 mΩ / 1200 V M3S SiC MOSFET Half−Bridge
- Thermistor
- Options with Pre−Applied Thermal Interface Material (TIM) and without Pre−Applied TIM
- 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

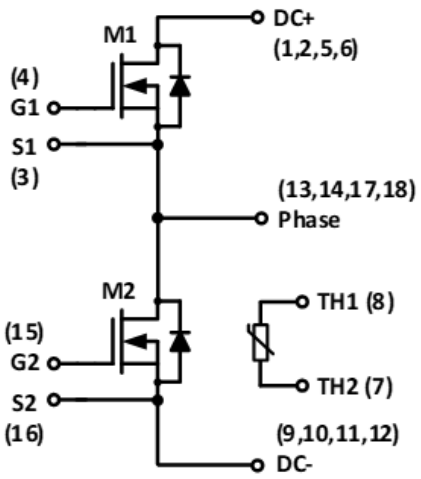
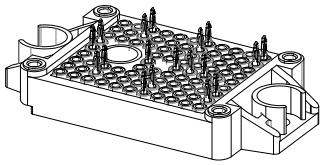



**Figure 1. NXH008P120M3F1 Schematic Diagram**

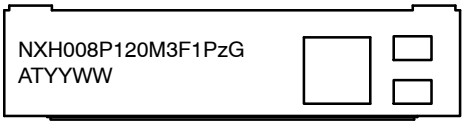
This document contains information on a product under development. **onsemi** reserves the right to change or discontinue this product without notice.

### PACKAGE PICTURE



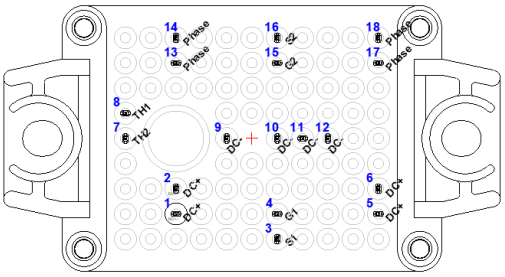
**PIM18 33.8x42.5 (PRESS FIT)**
**CASE 180BW**

### MARKING DIAGRAM




| | |
|---|---|
| NXH008P120M3F1PzG | = Specific Device Code |
| z | = T (with TIM), blank (without TIM) |
| 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.

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## PIN FUNCTION DESCRIPTION

| Pin | Name | Description |
|---|---|---|
| 1 | DC+ | DC Positive Bus connection |
| 2 | DC+ | DC Positive Bus connection |
| 3 | S1 | M1 Kelvin Source (High side switch) |
| 4 | G1 | M1 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 | M2 Gate (Low side switch) |
| 16 | S2 | M2 Kelvin Source (Low side switch) |
| 17 | PHASE | Center point of half bridge |
| 18 | PHASE | Center point of half bridge |



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## MAXIMUM RATINGS

| Rating | Symbol | Value | Unit |
|---|---|---|---|
| **SiC MOSFET** | | | |
| Drain−Source Voltage | $V_{DSS}$ | 1200 | V |
| Gate−Source Voltage | $V_{GS}$ | +22/−10 | V |
| Continuous Drain Current @ $T_c$ = 80°C ($T_J$ = 175°C) | $I_D$ | 145 | A |
| Pulsed Drain Current ($T_J$ = 150°C) | $I_{Dpulse}$ | 436 | A |
| Maximum Power Dissipation ($T_J$ = 175°C) | $P_{tot}$ | 382 | W |
| 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 |
| CTI | | 600 | |
| Substrate Ceramic Material | | $Al_2O_3$ | |
| 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.

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** | | | | | | |
| Zero Gate Voltage Drain Current | $V_{GS}$ = 0 V, $V_{DS}$ = 1200 V, $T_J$ = 25°C | $I_{DSS}$ | – | – | 400 | μA |
| Drain−Source On Resistance | $V_{GS}$ = 18 V, $I_D$ = 120 A, $T_J$ = 25°C | $R_{DS(ON)}$ | – | 7.7 | 10.9 | mΩ |
| | $V_{GS}$ = 18 V, $I_D$ = 120 A, $T_J$ = 125°C | | – | 12.6 | – | |
| | $V_{GS}$ = 18 V, $I_D$ = 120 A, $T_J$ = 150°C | | – | 14.4 | – | |
| | $V_{GS}$ = 18 V, $I_D$ = 120 A, $T_J$ = 175°C | | – | 18.1 | – | |
| Gate−Source Threshold Voltage | $V_{GS}$ = $V_{DS}$, $I_D$ = 60 mA | $V_{GS(TH)}$ | 2.04 | 2.4 | 4.4 | V |
| Internal Gate Resistance | | $R_{GINT}$ | – | 0.8 | – | Ω |
| Gate Leakage Current | $V_{GS}$ = −10 V / 22 V, $V_{DS}$ = 0 V | $I_{GSS}$ | −4 | – | 4 | μA |
| Input Capacitance | $V_{DS}$ = 800 V, $V_{GS}$ = 0 V, f = 1 MHz | $C_{ISS}$ | – | 8334 | – | pF |
| Reverse Transfer Capacitance | | $C_{RSS}$ | – | 37 | – | |
| Output Capacitance | | $C_{OSS}$ | – | 472 | – | |
| Total Gate Charge | $V_{DS}$ = 800 V, $V_{GS}$ = −3/18 V, $I_D$ = 120 A | $Q_{G(TOTAL)}$ | – | 419 | – | nC |
| Gate−Source Charge | | $Q_{GS}$ | – | 61 | – | nC |
| Gate−Drain Charge | | $Q_{GD}$ | – | 96 | – | nC |



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

| Parameter | Test Conditions | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **SiC MOSFET CHARACTERISTICS** | | | | | | |
| Turn−on Delay Time | $T_J$ = 25°C<br>$V_{DS}$= 800 V, $I_D$ = 120 A<br>$V_{GS}$ = −3 V / 18 V, $R_G$ = 2 Ω | $t_{d(on)}$ | – | 17 | – | ns |
| Rise Time | | $t_r$ | – | 17 | – | |
| Turn−off Delay Time | | $t_{d(off)}$ | – | 97 | – | |
| Fall Time | | $t_f$ | – | 12 | – | |
| Turn−on Switching Loss per Pulse | | $E_{ON}$ | – | 1760 | – | μJ |
| Turn−off Switching Loss per Pulse | | $E_{OFF}$ | – | 588 | – | |
| Turn−on Delay Time | $T_J$ = 150°C<br>$V_{DS}$= 800 V, $I_D$ = 120 A<br>$V_{GS}$ = −3 V / 18 V, $R_G$ = 2 Ω | $t_{d(on)}$ | – | 15 | – | ns |
| Rise Time | | $t_r$ | – | 15 | – | |
| Turn−off Delay Time | | $t_{d(off)}$ | – | 110 | – | |
| Fall Time | | $t_f$ | – | 13 | – | |
| Turn−on Switching Loss per Pulse | | $E_{ON}$ | – | 2155 | – | μJ |
| Turn−off Switching Loss per Pulse | | $E_{OFF}$ | – | 745 | – | |
| Diode Forward Voltage | $V_{GS}$ = −3 V, $I_{SD}$ = 120 A, $T_J$ = 25°C | $V_{SD}$ | – | 4.67 | 6.2 | V |
| | $V_{GS}$ = −3 V, $I_{SD}$ = 120 A, $T_J$ = 125°C | | – | 4.45 | – | |
| | $V_{GS}$ = −3 V, $I_{SD}$ = 120 A, $T_J$ = 150°C | | – | 4.4 | – | |
| Thermal Resistance − Chip−to−Case | M1, M2 | $R_{thJC}$ | – | 0.249 | – | °C/W |
| Thermal Resistance − Chip−to−Heatsink | Thermal grease, Thickness = 2 Mil +2%, A = 2.8 W/mK | $R_{thJH}$ | – | 0.466 | – | °C/W |
| **THERMISTOR CHARACTERISTICS** | | | | | | |
| Nominal Resistance | T = 25°C | $R_{25}$ | – | 5 | – | kΩ |
| | T = 100°C | $R_{100}$ | – | 493 | – | Ω |
| | T = 150°C | $R_{150}$ | – | 159.5 | – | Ω |
| Deviation of $R_{100}$ | 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 Maxiu-mum | 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 |
|---|---|---|---|
| NXH008P120M3F1PTG | NXH008P120M3F1PTG | F1HALFBR: Case 180BW Press−fit Pins with pre−applied thermal interface material (TIM) (Pb-Free / Halide Free) | 28 Units / Blister Tray |
| NXH008P120M3F1PG | NXH008P120M3F1PG | F1HALFBR: Case 180BW Press−fit Pins (Pb-Free / Halide Free) | 28 Units / Blister Tray |



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## TYPICAL CHARACTERISTIC

(M1/M2 SiC MOSFET CHARACTERISTIC)

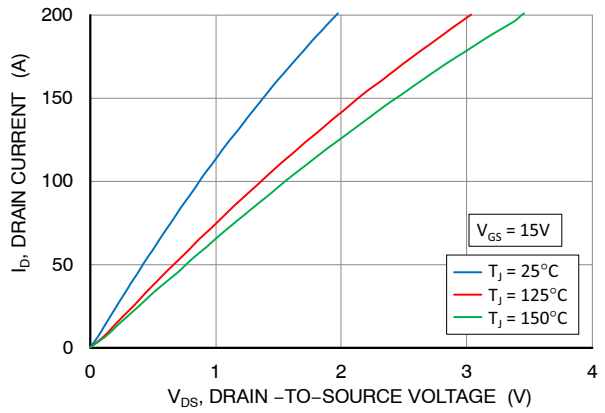


**Figure 2. MOSFET Typical Output Characteristic $V_{GS}$ = 15 V**

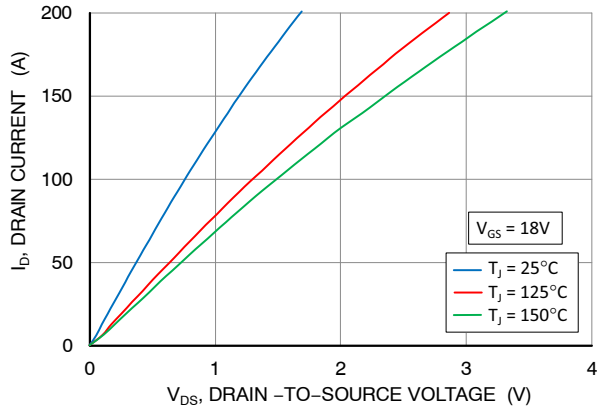


**Figure 3. MOSFET Typical Output Characteristic $V_{GS}$ = 18 V**

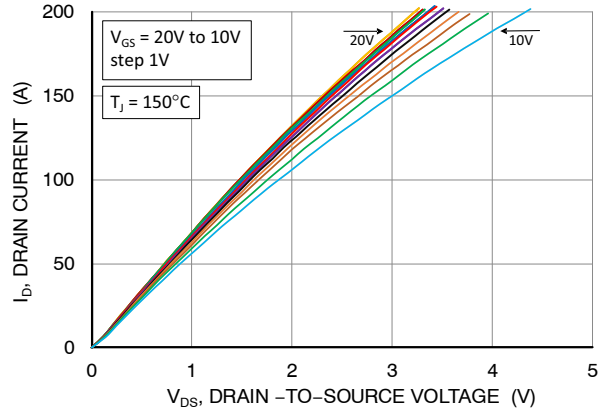


**Figure 4. MOSFET Typical Output Characteristic $V_{GS}$ = Var.**

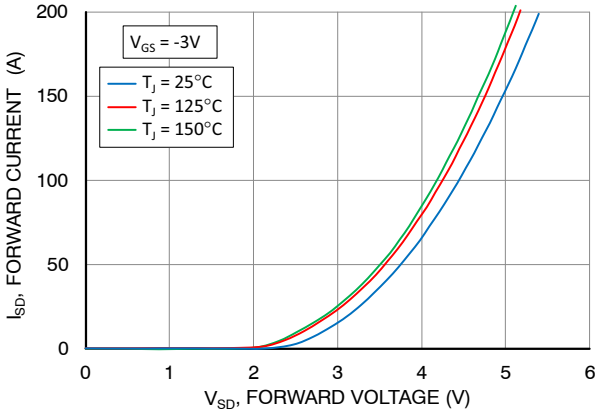


**Figure 5. Body Diode Forward Characteristic**

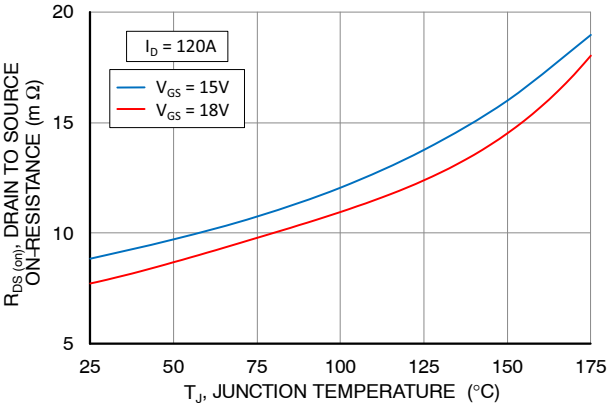


**Figure 6. $R_{DS(on)}$ Drain−to−Source ON Resistance vs. Junction Temperature**

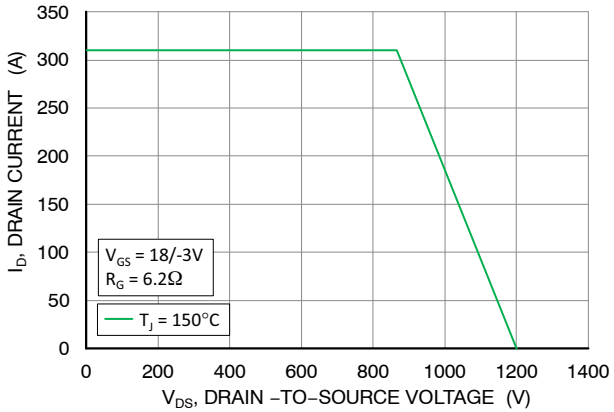


**Figure 7. Reverse Bias Safe Operating Area (RBSOA)**



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## TYPICAL CHARACTERISTICS

M1/M2 SIC MOSFET CHARACTERISTIC

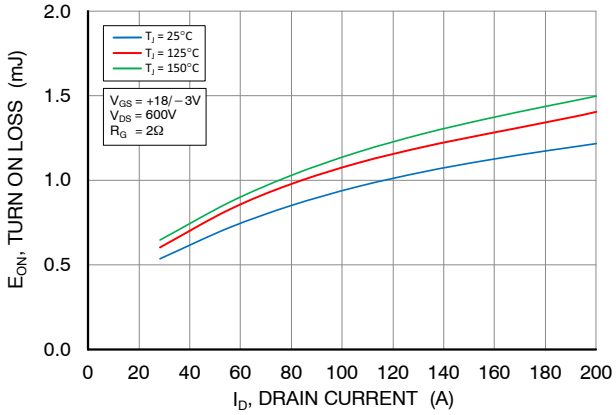


**Figure 8. Switching on Loss vs. Drain Current $V_{DS}$ = 600 V**

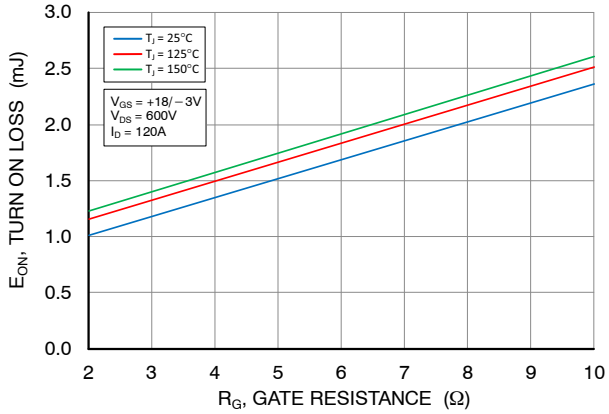


**Figure 9. Switching on Loss vs. Gate Resistance $V_{DS}$ = 600 V**

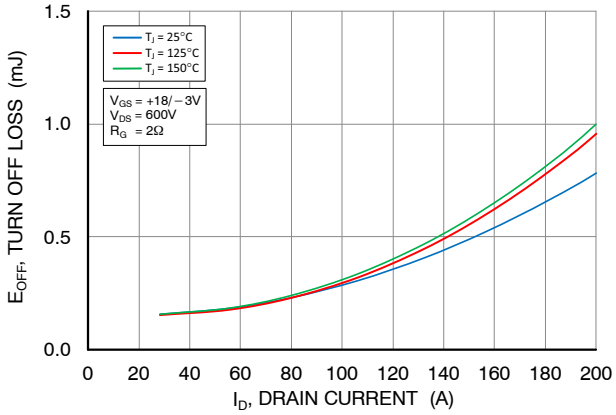


**Figure 10. Switching off Loss vs. Drain Current $V_{DS}$ = 600 V**

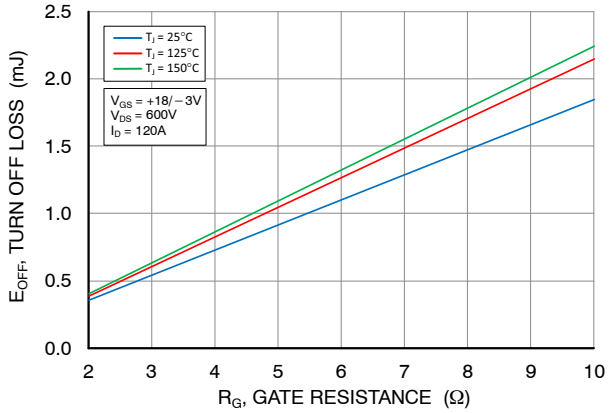


**Figure 11. Switching off Loss vs. Gate Resistance $V_{DS}$ = 600 V**

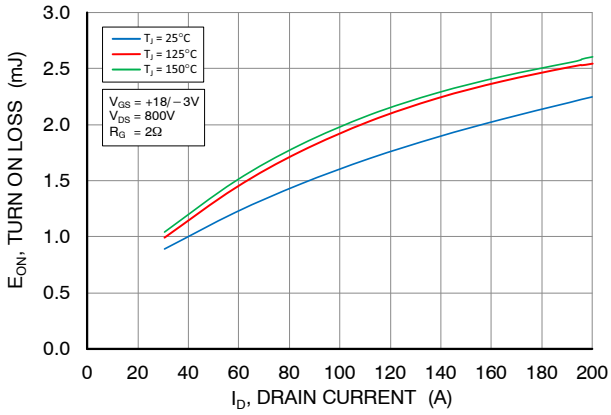


**Figure 12. Switching on Loss vs. Drain Current $V_{DS}$ = 800 V**

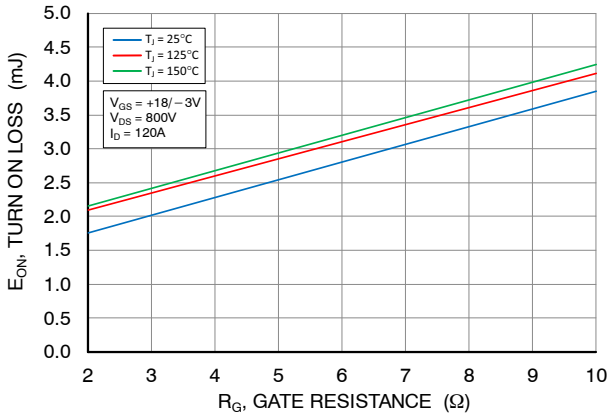


**Figure 13. Switching on Loss vs. Gate Resistance $V_{DS}$ = 800 V**



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## TYPICAL CHARACTERISTICS

M1/M2 SIC MOSFET CHARACTERISTIC

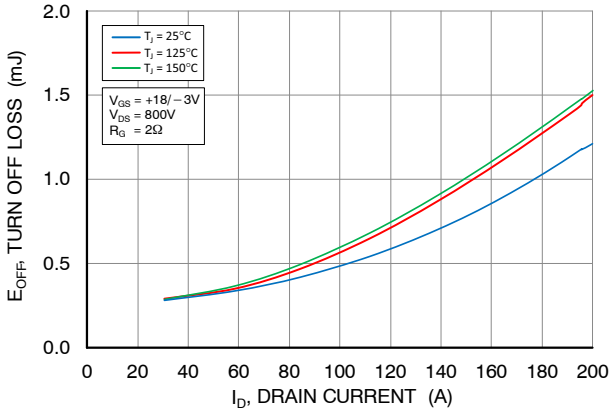


**Figure 14. Switching off Loss vs. Drain Current $V_{DS}$ = 800 V**

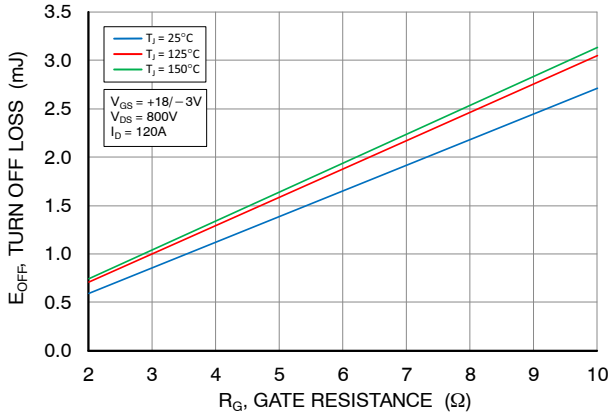


**Figure 15. Switching off Loss vs. Gate Resistance $V_{DS}$ = 800 V**

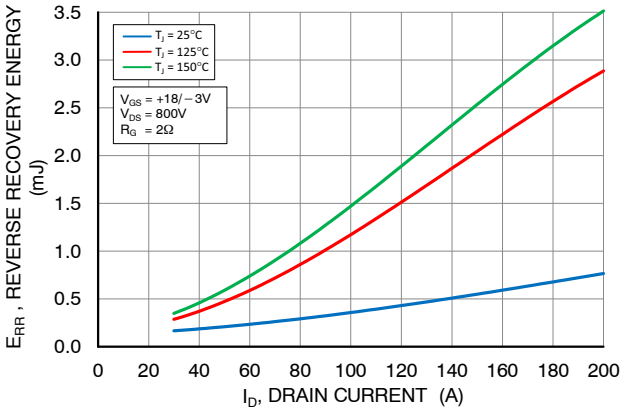


**Figure 16. Reverse Recovery Energy vs. Drain Current $V_{DS}$ = 800 V**

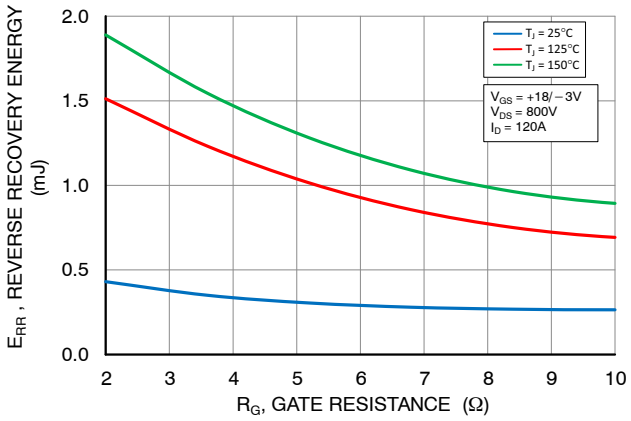


**Figure 17. Reverse Recovery Energy vs. Gate Resistance $V_{DS}$ = 800 V**

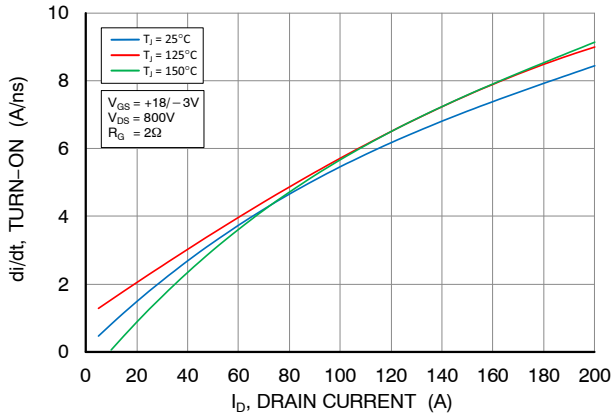


**Figure 18. di/dt Turn ON vs. Drain Current $V_{DS}$ = 800 V**

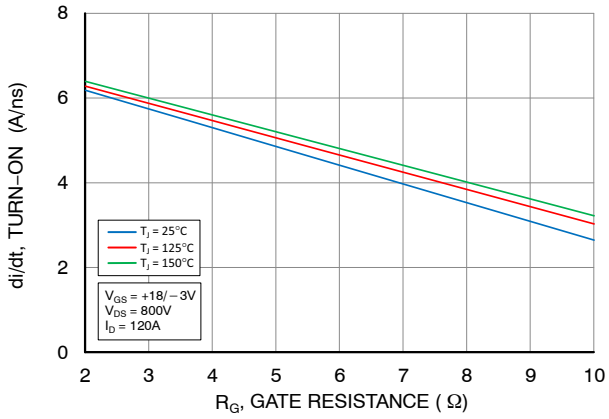


**Figure 19. di/dt Turn ON vs. Gate Resistance $V_{DS}$ = 800 V**



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## TYPICAL CHARACTERISTICS

M1/M2 SIC MOSFET CHARACTERISTIC

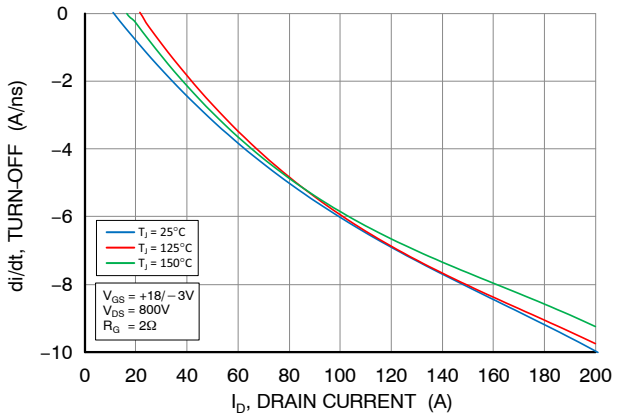


**Figure 20. di/dt Turn OFF vs. Drain Current $V_{DS}$ = 800 V**

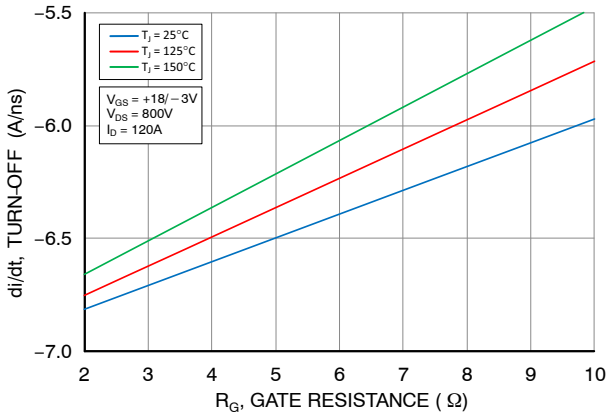


**Figure 21. di/dt Turn OFF vs. Gate Resistance $V_{DS}$ = 800 V**

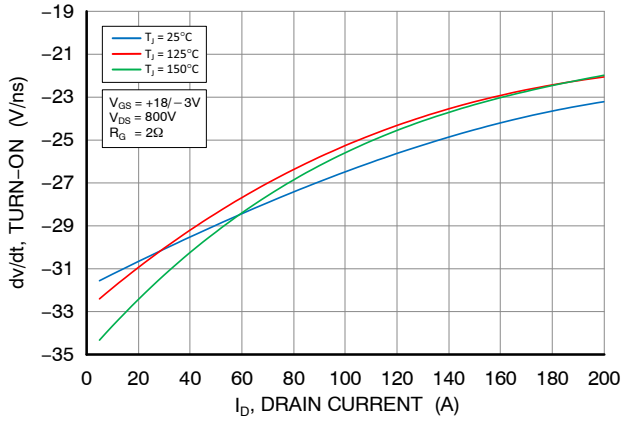


**Figure 22. dv/dt Turn ON vs. Drain Current $V_{DS}$ = 800 V**

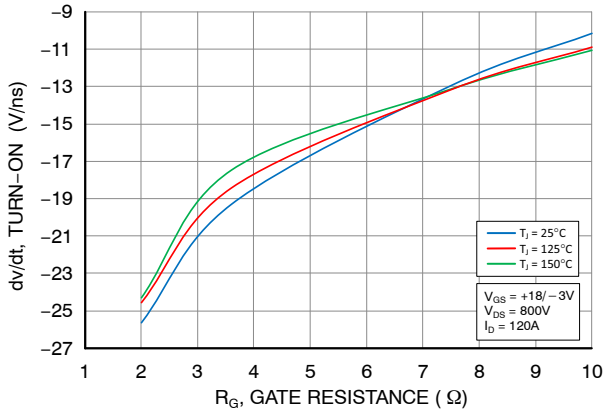


**Figure 23. dv/dt Turn ON vs. Gate Resistance $V_{DS}$ = 800 V**

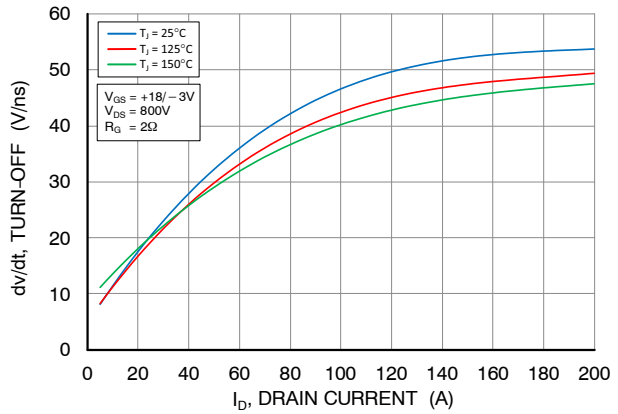


**Figure 24. dv/dt Turn OFF vs. Drain Current $V_{DS}$ = 800 V**

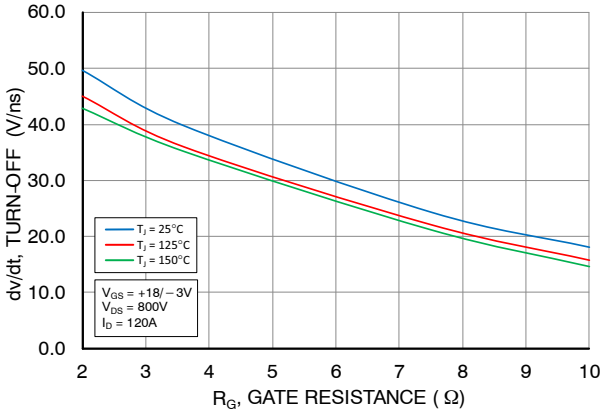


**Figure 25. dv/dt Turn OFF vs. Gate Resistance $V_{DS}$ = 800 V**



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## TYPICAL CHARACTERISTICS

M1/M2 SIC MOSFET CHARACTERISTIC

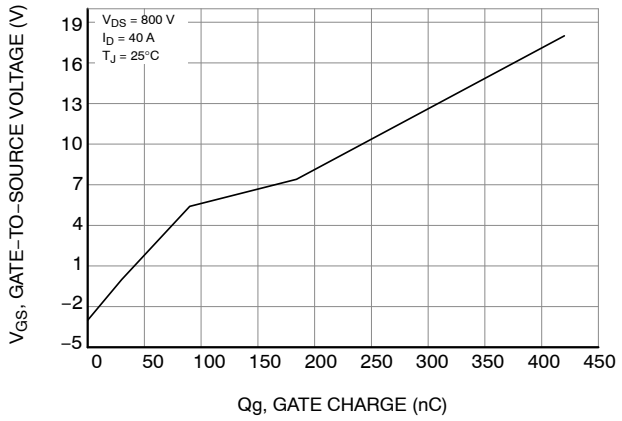


**Figure 26. Gate−to−Source Voltage vs. Total Charge**

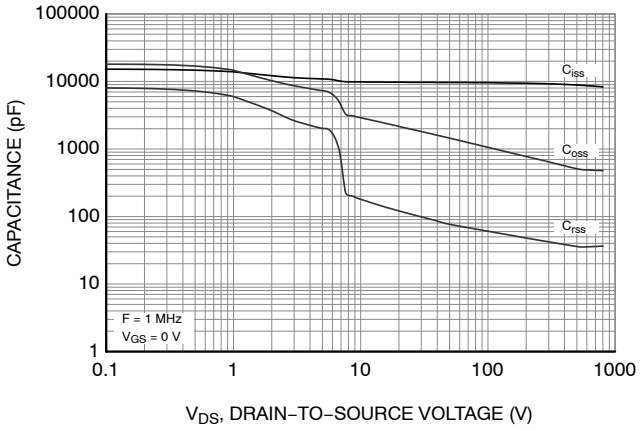


**Figure 27. Capacitance vs. Drain−to−Source Voltage**

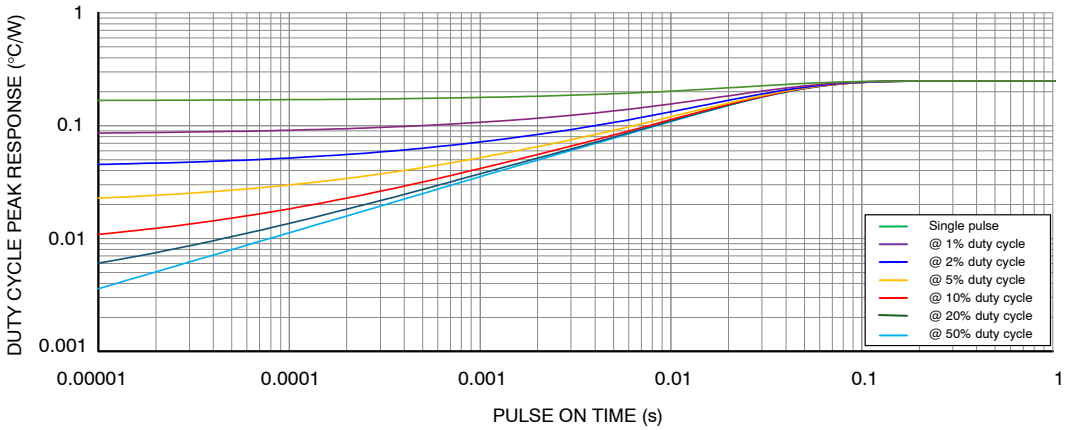


**Figure 28. Duty Cycle Response vs. Pulse On Time**

**Table 1. CAUER NETWORKS**

| Cauer Element # | Rth (K/W) | Cth (Ws/K) |
|---|---|---|
| 1 | 0.0015405 | 0.0032582 |
| 2 | 0.0034038 | 0.0011216 |
| 3 | 0.0167500 | 0.0053859 |
| 4 | 0.0498300 | 0.0154460 |
| 5 | 0.0925960 | 0.0870830 |
| 6 | 0.0540320 | 1.7250000 |



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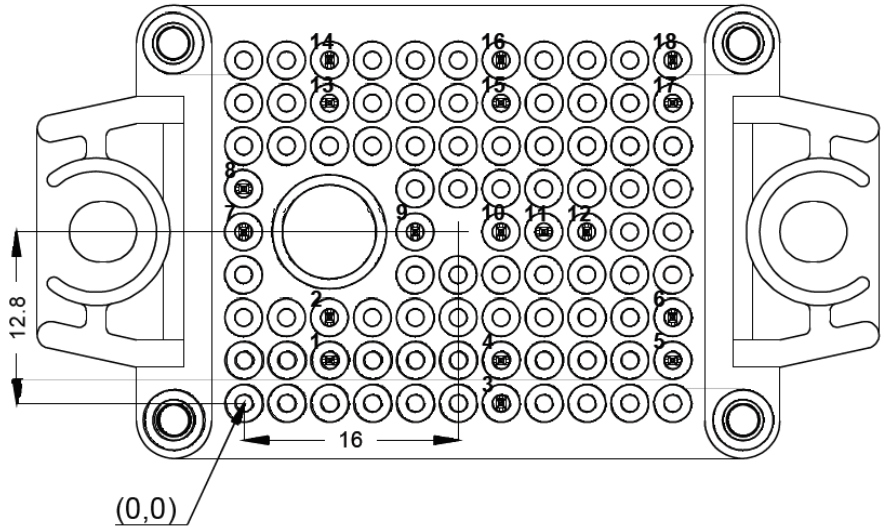
## PIN POSITION INFORMATION

scale = 2.5 : 1




## Pin position

| Pin # | X | Y | Function | Pin # | X | Y | Function |
|---|---|---|---|---|---|---|---|
| 1 | 6.4 | 3.2 | DC+ | 10 | 19.2 | 12.8 | DC- |
| 2 | 6.4 | 6.4 | DC+ | 11 | 22.4 | 12.8 | DC- |
| 3 | 19.2 | 0.0 | S1 | 12 | 25.6 | 12.8 | DC- |
| 4 | 19.2 | 3.2 | G1 | 13 | 6.4 | 22.4 | Phase |
| 5 | 32.0 | 3.2 | DC+ | 14 | 6.4 | 25.6 | Phase |
| 6 | 32.0 | 6.4 | DC+ | 15 | 19.2 | 22.4 | G2 |
| 7 | 0.0 | 12.8 | TH2 | 16 | 19.2 | 25.6 | S2 |
| 8 | 0.0 | 16.0 | TH1 | 17 | 32.0 | 22.4 | Phase |
| 9 | 12.8 | 12.8 | DC- | 18 | 32.0 | 25.6 | Phase |



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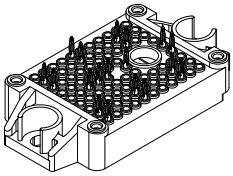
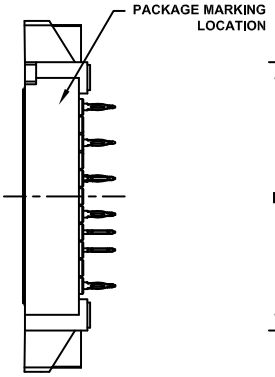
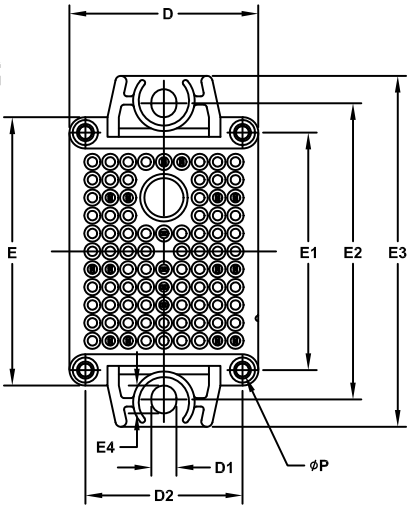


**PIM18 33.8x42.5 (PRESS FIT)**
CASE 180BW
ISSUE B

DATE 30 APR 2021



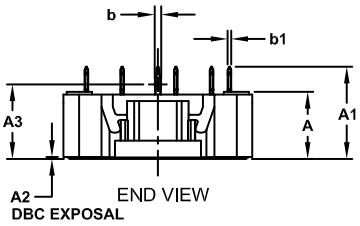

SIDE VIEW



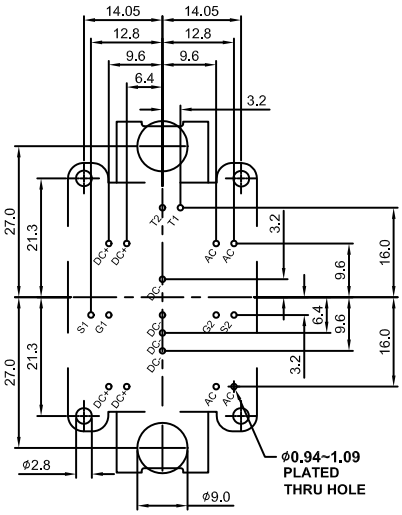

TOP VIEW

**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 |

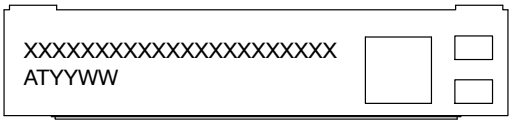



END VIEW




**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.

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

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