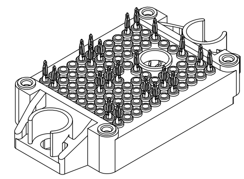
# F1-2PACK SiC MOSFET Module

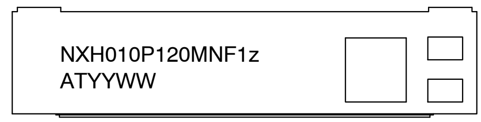
*Advance Information*

# NXH010P120MNF1PTNG, NXH010P120MNF1PNG, NXH010P120MNF1PTG, NXH010P120MNF1PG



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

### MARKING DIAGRAM




NXH010P120MNF1z = Specific Device Code
z = PTNG/PNG/PTG/PG
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.

### 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

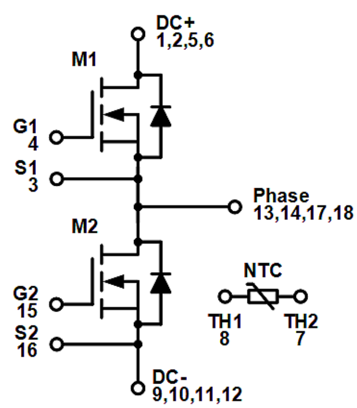



**Figure 1. NXH010P120MNF1 Schematic Diagram**

This document contains information on a new product. Specifications and information herein are subject to change without notice.

## PIN CONNECTIONS

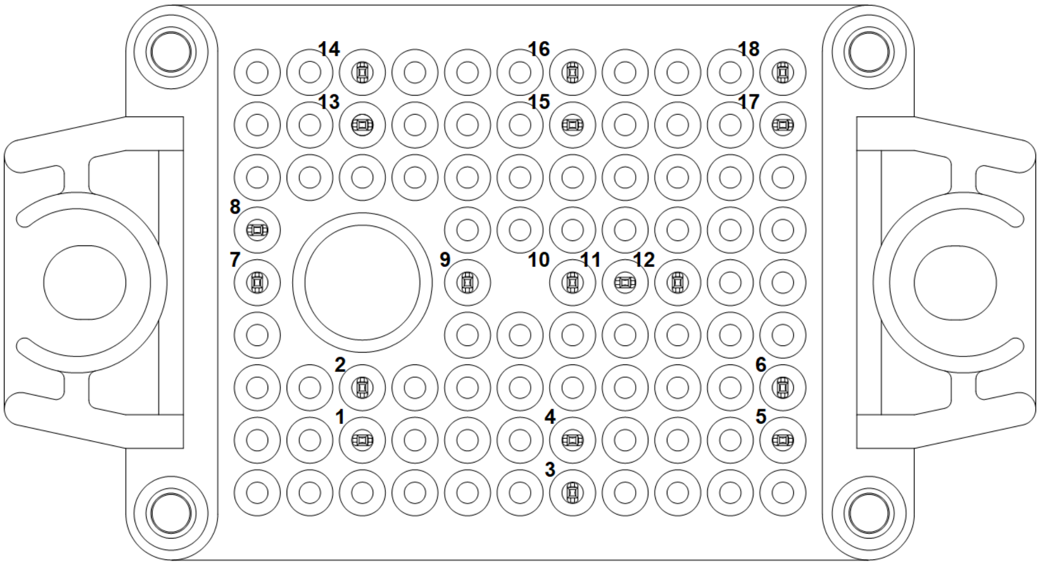



**Figure 2. Pin Connections**

### PIN FUNCTION DESCRIPTION

| Pin | Name | Description |
|---|---|---|
| 8 | TH1 | Thermistor Connection 1 |
| 7 | TH2 | Thermistor Connection 2 |
| 1 | DC+ | DC Positive Bus connection |
| 2 | DC+ | DC Positive Bus connection |
| 13 | PHASE | Center point of half bridge |
| 14 | PHASE | Center point of half bridge |
| 9 | DC− | DC Negative Bus connection |
| 3 | S1 | Q1 Kelvin Emitter (High side switch) |
| 4 | G1 | Q1 Gate (High side switch) |
| 10 | DC− | DC Negative Bus connection |
| 15 | G2 | Q2 Gate (Low side switch) |
| 16 | S2 | Q2 Kelvin Emitter (High side switch) |
| 11 | DC− | DC Negative Bus connection |
| 12 | DC− | DC Negative Bus connection |
| 5 | DC+ | DC Positive Bus connection |
| 6 | DC+ | DC Positive Bus connection |
| 17 | PHASE | Center point of half bridge |
| 18 | PHASE | Center point of half bridge |

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

| 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) | $I_D$ | 114 | A |
| Pulsed Drain Current ( $T_J$ = 175°C) | $I_{Dpulse}$ | 342 | A |
| Maximum Power Dissipation ( $T_J$ = 175°C) | $P_{tot}$ | 250 | W |
| Short Circuit Withstand Time @ $V_{GE}$ = −5V/20 V, $V_{CE}$ = 600 V, $T_J \le$ 150°C | $T_{sc}$ | 2 | 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 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 | °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, $I_D$ = 400 μA | $V_{(BR)DSS}$ | 1200 | – | – | V |
| Zero Gate Voltage Drain Current | $V_{GS}$ = 0 V, $V_{DS}$ = 1200 V | $I_{DSS}$ | – | – | 200 | μA |
| Drain−Source On Resistance | $V_{GS}$ = 20 V, $I_D$ = 100 A, $T_J$ = 25°C | $R_{DS(ON)}$ | – | 10.5 | 14 | mΩ |
| | $V_{GS}$ = 20 V, $I_D$ = 100 A, $T_J$ = 125°C | | – | 14.1 | – | |
| | $V_{GS}$ = 20 V, $I_D$ = 100 A, $T_J$ = 150°C | | – | 14.5 | – | |
| Gate−Source Threshold Voltage | $V_{GS}$ = $V_{DS}$, $I_D$ =40 mA | $V_{GS(TH)}$ | 1.8 | 2.90 | 4.3 | V |
| Gate Leakage Current | $V_{GS}$ = −10/20 V, $V_{DS}$ = 0 V | $I_{GSS}$ | −500 | – | 500 | nA |
| Internal Gate Resistance | | $R_G$ | | 0.8 | | Ω |
| Input Capacitance | $V_{DS}$ = 800 V, $V_{GS}$ = 0 V. f = 1 MHz | $C_{ISS}$ | – | 4707 | – | pF |
| Reverse Transfer Capacitance | | $C_{RSS}$ | – | 39 | – | |
| Output Capacitance | | $C_{OSS}$ | – | 548 | – | |
| $C_{OSS}$ Stored Energy | $V_{DS}$ = 0 V to 800 V, $V_{GS}$ = 0 V | $E_{OSS}$ | – | 221 | – | μJ |
| Total Gate Charge | $V_{DS}$ = 800 V. $V_{GS}$ = 20 V. $I_D$ = 100 A | $Q_{G(TOTAL)}$ | – | 454 | – | nC |
| Gate−Source Charge | | $Q_{GS}$ | – | 129 | – | nC |
| Gate−Drain Charge | | $Q_{GD}$ | – | 131 | – | nC |

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

| Parameter | Test Conditions | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **SiC MOSFET CHARACTERISTICS** | | | | | | |
| Turn–on Delay Time | $T_J$ = 25°C, $V_{DS}$ = 600 V, $I_D$ = 100 A, $V_{GS}$ = –5V/18V, $R_G$ = 2 Ω | $t_{d(on)}$ | – | 44.2 | – | ns |
| Rise Time | | $t_r$ | – | 16.2 | – | |
| Turn–off Delay Time | | $t_{d(off)}$ | – | 136.6 | – | |
| Fall Time | | $t_f$ | – | 9.8 | – | |
| Turn–on Switching Loss per Pulse | | $E_{ON}$ | – | 0.95 | – | mJ |
| Turn off Switching Loss per Pulse | | $E_{OFF}$ | – | 0.72 | – | |
| Turn–on Delay Time | $T_J$ = 150°C, $V_{DS}$ = 600 V, $I_D$ = 100 A, $V_{GS}$ = –5V/18V, $R_G$ = 2 Ω | $t_{d(on)}$ | – | 40.2 | – | ns |
| Rise Time | | $t_r$ | – | 14.9 | – | |
| Turn–off Delay Time | | $t_{d(off)}$ | – | 150.3 | – | |
| Fall Time | | $t_f$ | – | 12.7 | – | |
| Turn–on Switching Loss per Pulse | | $E_{ON}$ | – | 1.1 | – | mJ |
| Turn off Switching Loss per Pulse | | $E_{OFF}$ | – | 0.81 | – | |
| Diode Forward Voltage | $I_D$ = 100 A, $T_J$ = 25°C | $V_{SD}$ | – | 3.94 | 6 | V |
| | $I_D$ = 100 A, $T_J$ = 150°C | | – | 3.42 | – | |
| Reverse Recovery Time | $T_J$ = 25°C, $V_{DS}$ = 600 V, $I_D$ = 100 A, $V_{GS}$ = –5V/18V, $R_G$ = 2 Ω | $t_{rr}$ | – | 24.2 | – | ns |
| Reverse Recovery Charge | | $Q_{rr}$ | – | 1207 | – | nC |
| Peak Reverse Recovery Current | | $I_{RRM}$ | – | 79.8 | – | A |
| Peak Rate of Fall of Recovery Current | | di/dt | – | 7570 | – | A/μs |
| Reverse Recovery Energy | | $E_{rr}$ | – | 516 | – | μJ |
| Reverse Recovery Time | $T_J$ = 150°C, $V_{DS}$ = 600 V, $I_D$ = 100 A, $V_{GS}$ = –5V/18V, $R_G$ = 2 Ω | $t_{rr}$ | – | 31.2 | – | ns |
| Reverse Recovery Charge | | $Q_{rr}$ | – | 2591 | – | μC |
| Peak Reverse Recovery Current | | $I_{RRM}$ | – | 134.2 | – | A |
| Peak Rate of Fall of Recovery Current | | di/dt | – | 11849 | – | A/μs |
| Reverse Recovery Energy | | $E_{rr}$ | – | 1198 | – | μJ |
| Thermal Resistance – chip–to–case | M1,M2 | $R_{thJC}$ | – | 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 | $R_{thJH}$ | – | 0.38 | – | °C/W |
| **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 | Specific Device Marking | Package Type | Shipping† |
|---|---|---|---|
| NXH010P120MNF1PNG | NXH010P120MNF1PNG | F1−2PACK: Case 180BW<br>Press−fit Pins, Ni−Plated DBC<br>(Pb−Free and Halide−Free) | 28 Units / Blister Tray |
| NXH010P120MNF1PTNG | NXH010P120MNF1PTNG | F1−2PACK: Case 180BW<br>Press−fit Pins, Ni−Plated DBC with<br>pre−applied thermal interface material (TIM)<br>(Pb−Free and Halide−Free) | 28 Units / Blister Tray |
| NXH010P120MNF1PG | NXH010P120MNF1PG | F1−2PACK: Case 180BW<br>Press−fit Pins, Copper DBC<br>(Pb−Free and Halide−Free) | 28 Units / Blister Tray |
| NXH010P120MNF1PTG | NXH010P120MNF1PTG | F1−2PACK: Case 180BW<br>Press−fit Pins, Copper DBC with pre−applied<br>thermal interface material (TIM)<br>(Pb−Free and Halide−Free) | 28 Units / Blister Tray |

†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.

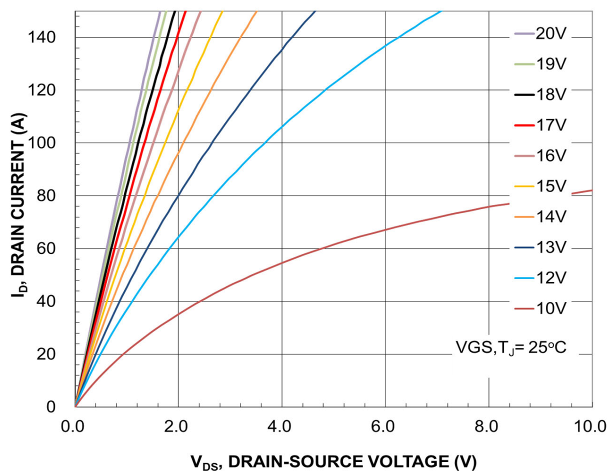



Figure 3. MOSFET Typical Output Characteristics

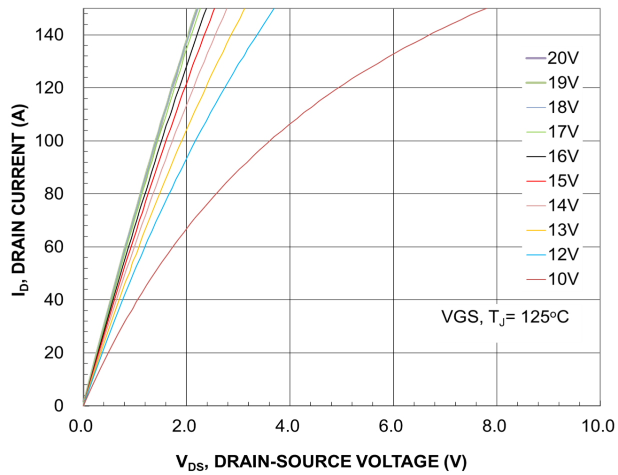



Figure 4. MOSFET Typical Output Characteristics

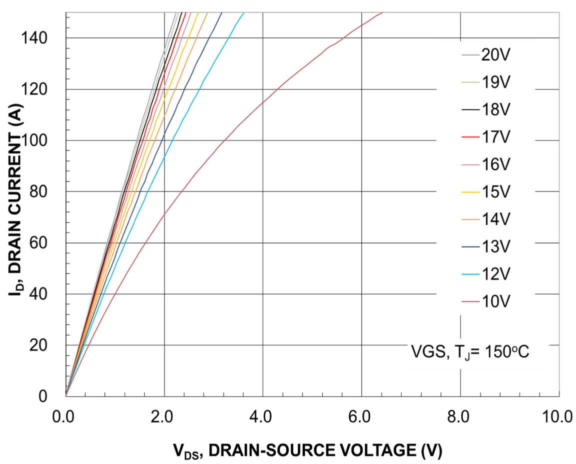



Figure 5. MOSFET Typical Output Characteristics

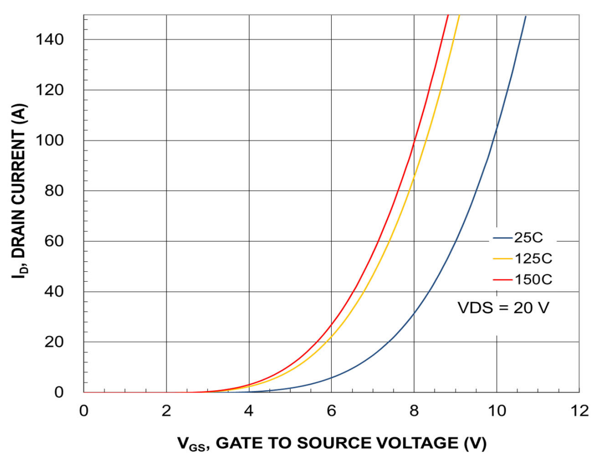



Figure 6. MOSFET Typical Transfer Characteristics

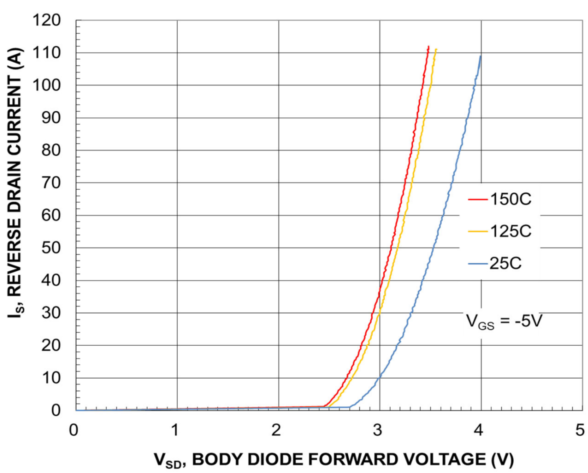



Figure 7. Body Diode Forward Characteristic

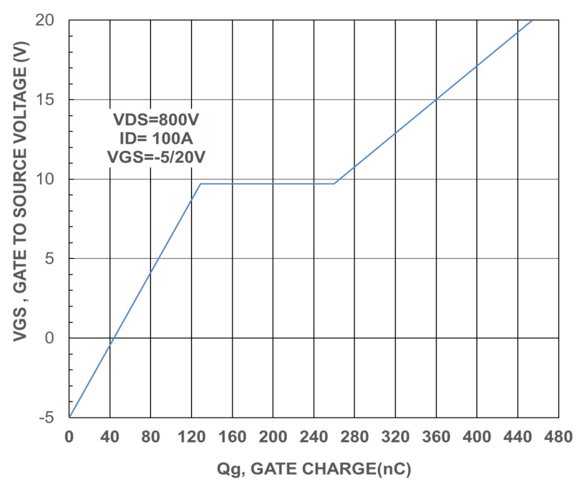



Figure 8. Gate−to−Source Voltage vs. Total Charge

## TYPICAL CHARACTERISTICS

SiC MOSFET (M1, M2)

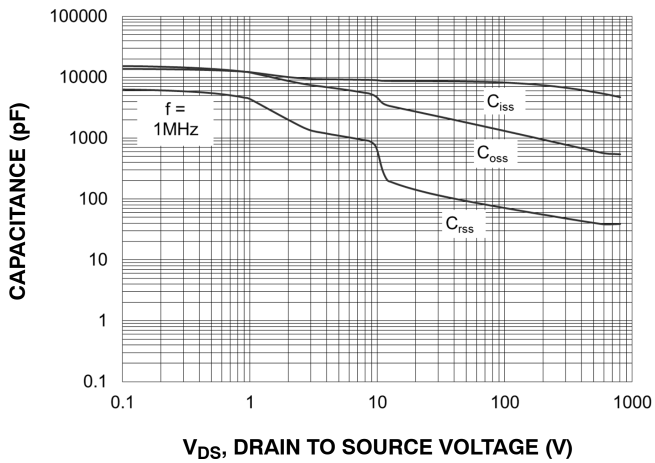



**Figure 9. Capacitance vs. Drain−to−Source Voltage**

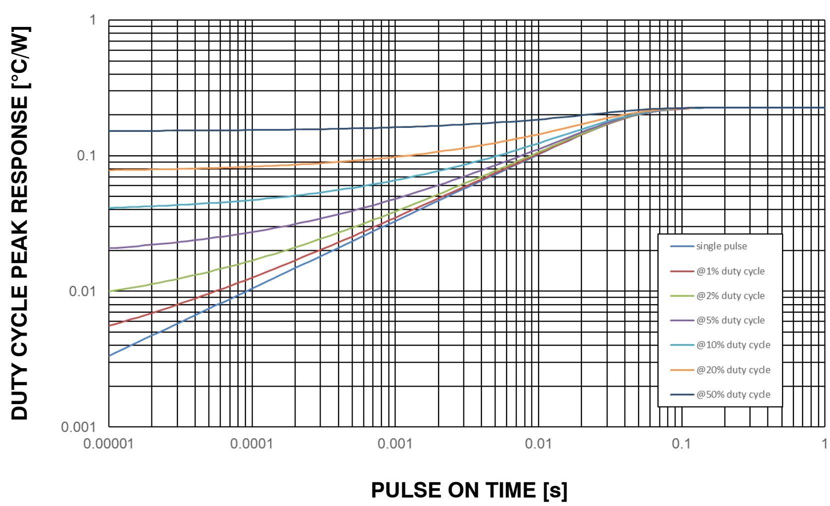



**Figure 10. SiC Mosfet Junction− to−Case Transient Thermal Impedance**

| 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**

## TYPICAL CHARACTERISTICS

M1/M2 MOSFET SWITCHING CHARACTERISTICS

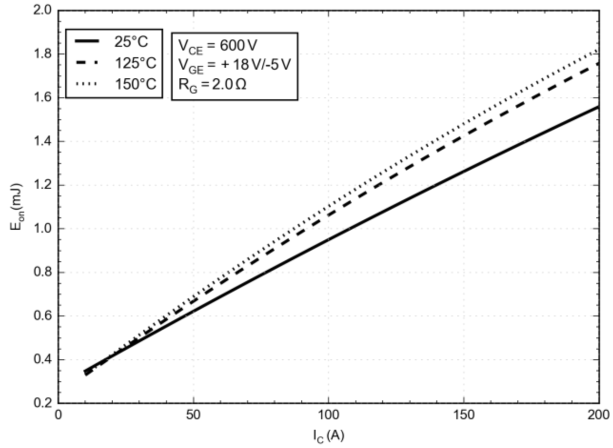



Figure 12. Typical Switching Loss $E_{ON}$ vs. IC

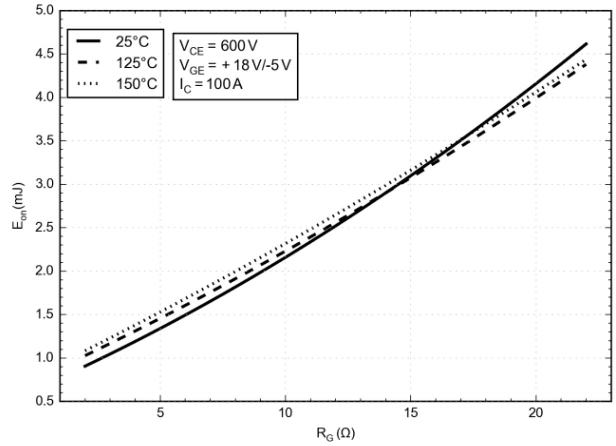



Figure 13. Typical Switching Loss $E_{ON}$ vs. $R_G$

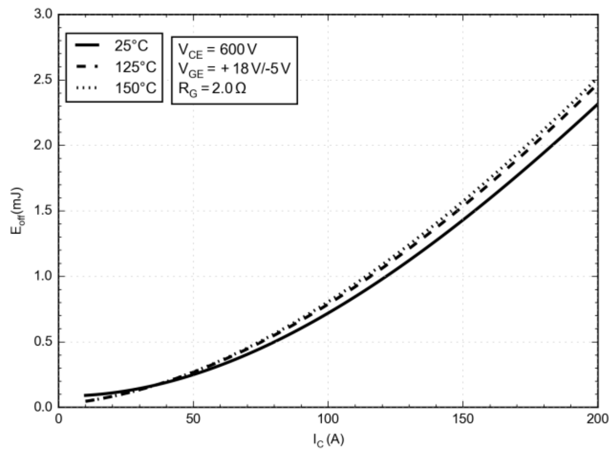



Figure 14. Typical Switching Loss $E_{Off}$ vs. IC

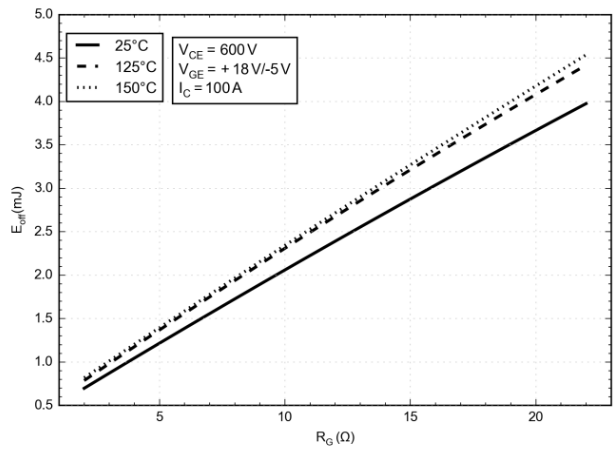



Figure 15. Typical Switching Loss $E_{Off}$ vs. $R_G$

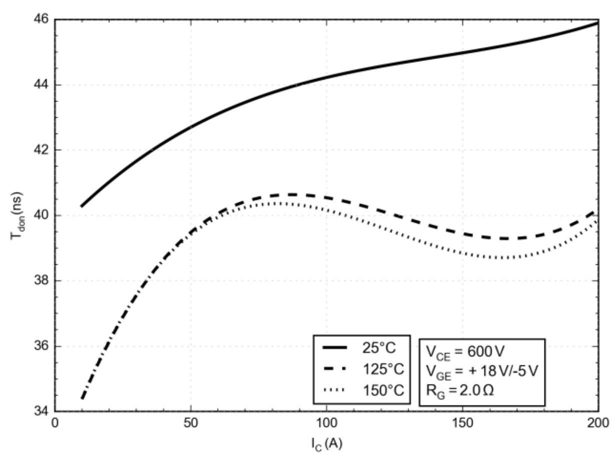



Figure 16. Typical Turn−On Switching $T_{don}$ vs. IC

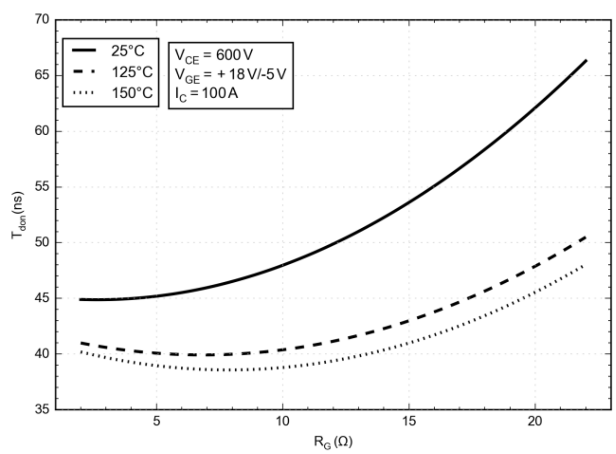



Figure 17. Typical Turn−On Switching $T_{don}$ vs. $R_G$

## TYPICAL CHARACTERISTICS

M1/M2 MOSFET SWITCHING CHARACTERISTICS

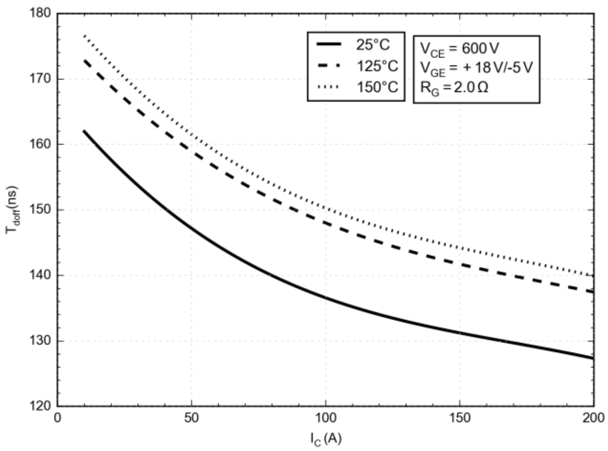



**Figure 18. Typical Turn−Off Switching $T_{doff}$ vs. IC**

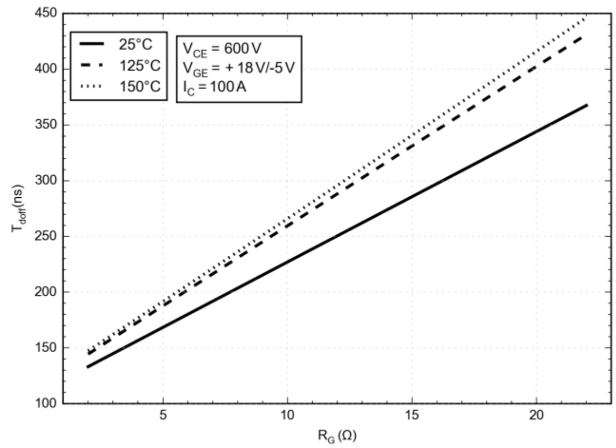



**Figure 19. Typical Turn−Off Switching $T_{doff}$ vs. $R_G$**

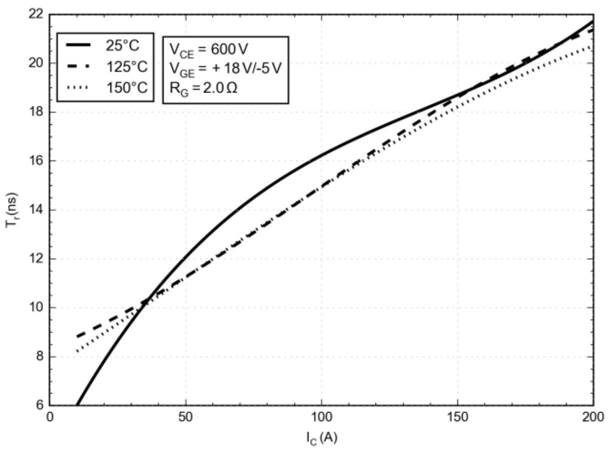



**Figure 20. Typical Turn−On Switching $T_r$ vs. IC**

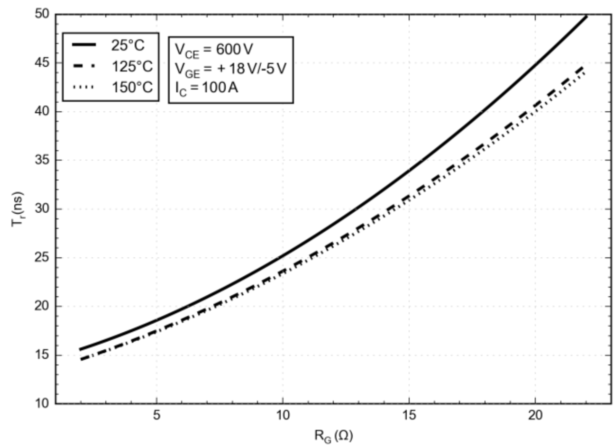



**Figure 21. Typical Turn−On Switching $T_r$ vs. $R_G$**

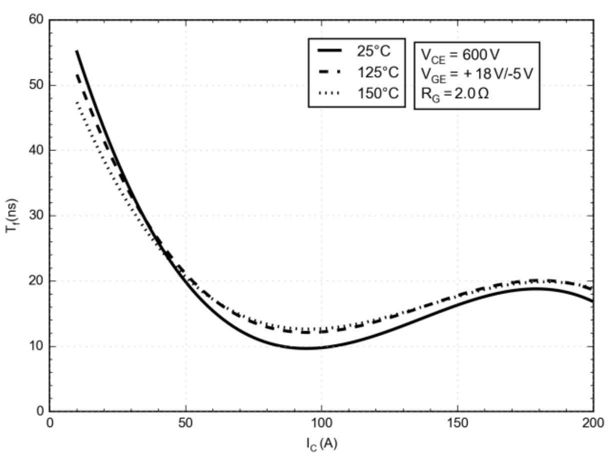



**Figure 22. Typical Turn−Off Switching $T_f$ vs. IC**

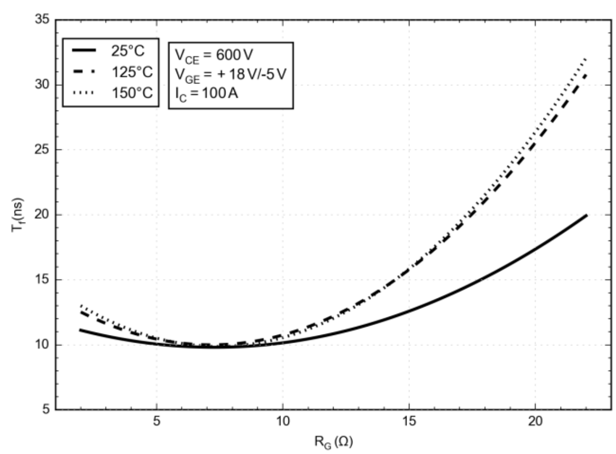



**Figure 23. Typical Turn−Off Switching $T_f$ vs. $R_G$**

## TYPICAL CHARACTERISTICS

M1/M2 MOSFET SWITCHING CHARACTERISTICS

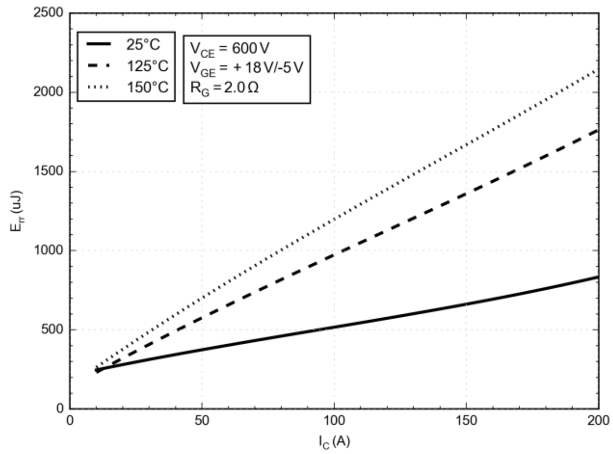



**Figure 24. Typical Reverse Recovery Energy vs. IC**

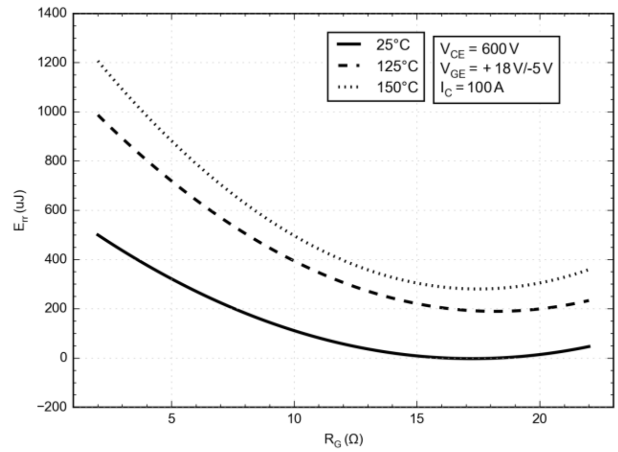



**Figure 25. Typical Reverse Recovery Energy vs. $R_G$**

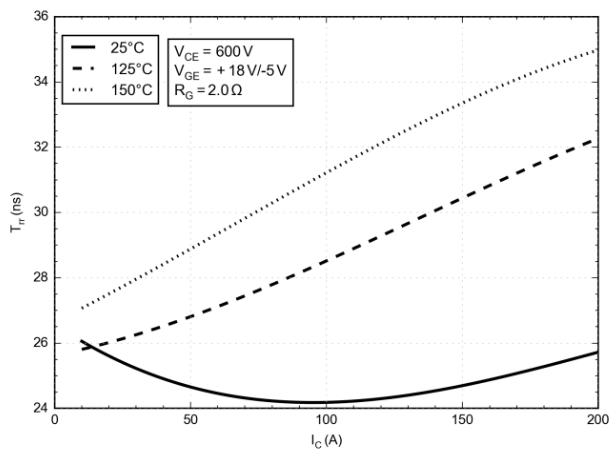



**Figure 26. Typical Reverse Recovery Time vs. IC**

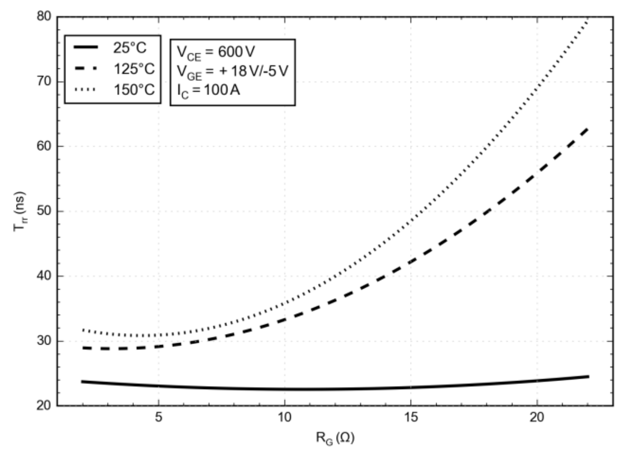



**Figure 27. Typical Reverse Recovery Time vs. $R_G$**

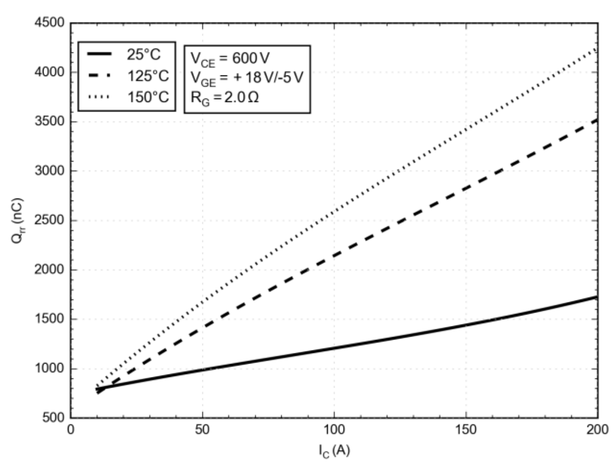



**Figure 28. Typical Reverse Recovery Charge vs. IC**

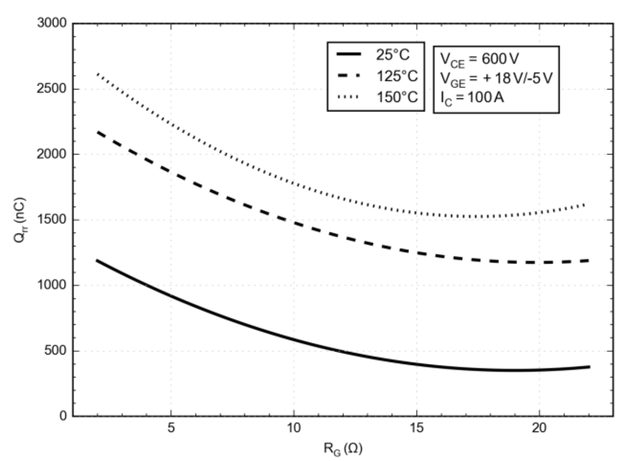



**Figure 29. Typical Reverse Recovery Charge vs. $R_G$**

## TYPICAL CHARACTERISTICS

M1/M2 MOSFET SWITCHING CHARACTERISTICS

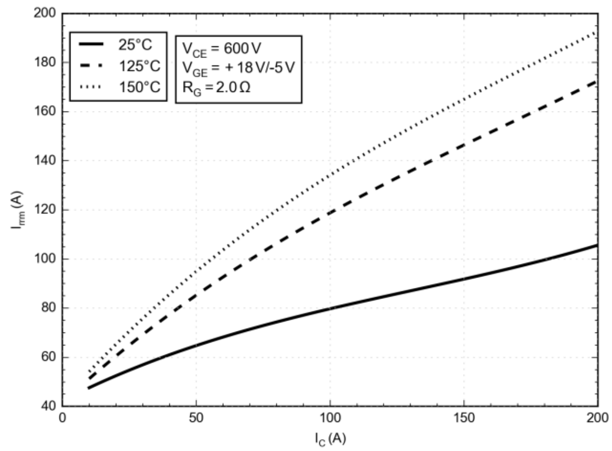



**Figure 30. Typical Reverse Recovery Current vs. IC**

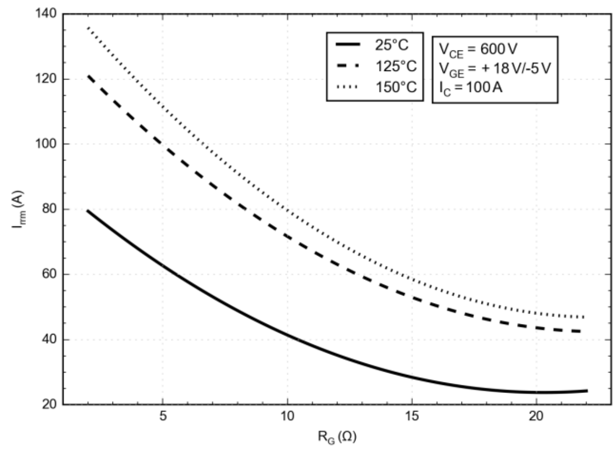



**Figure 31. Typical Reverse Recovery Current vs. $R_G$**

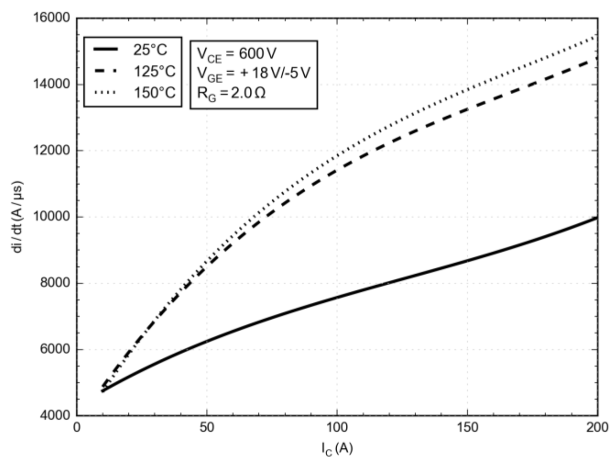



**Figure 32. Typical di/dt vs. IC**

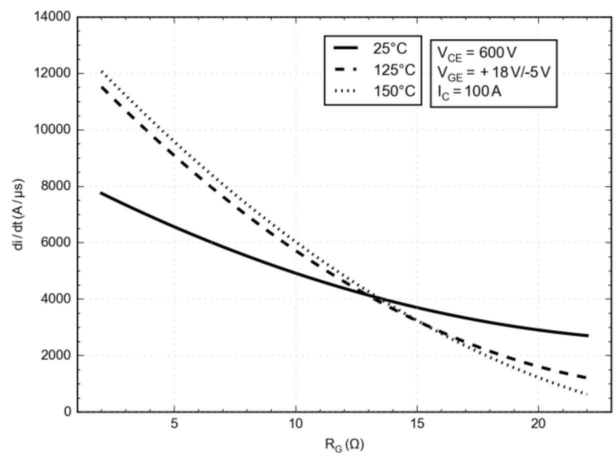



**Figure 33. Typical di/dt vs. $R_G$**