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Silicon Carbide (SiC) Module – 10 mohm SiC M3S MOSFET, 1200 V, 2-PACK Half Bridge Topology, F1 Package

Product Preview

NXH010P120M3F1PTG, NXH010P120M3F1PG

The NXH010P120M3F1 is a power module containing 10 mΩ/1200 V SiC MOSFET half-bridge and a thermistor in an F1 package.

Features

- 10 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

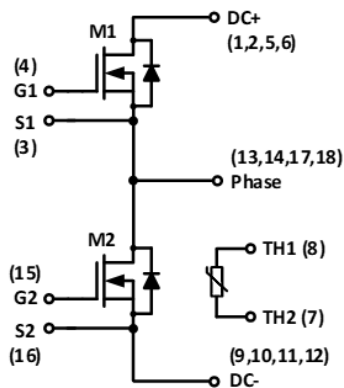
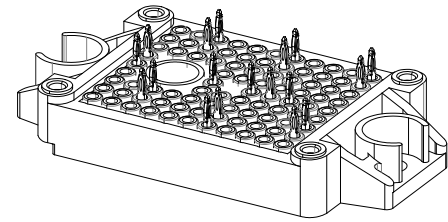


Figure 1. NXH010P120M3F1 Schematic Diagram

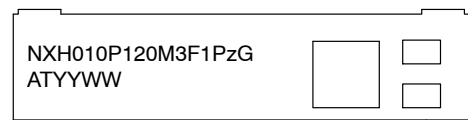
This document contains information on a product under development. onsemi reserves the right to change or discontinue this product without notice.

PACKAGE PICTURE



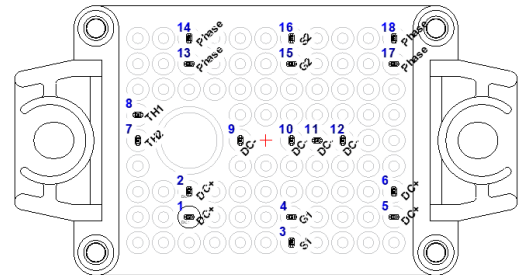
PIM18 33.8x42.5 (PRESS FIT)
CASE 180BW

MARKING DIAGRAM



NXH010P120M3F1PzG= 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 5 of this data sheet.

NXH010P120M3F1PTG, NXH010P120M3F1PG

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

NXH010P120M3F1PTG, NXH010P120M3F1PG

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 @ $T_c = 80^\circ\text{C}$ ($T_J = 175^\circ\text{C}$)	I_D	105	A
Pulsed Drain Current ($T_J = 150^\circ\text{C}$)	I_{Dpulse}	316	A
Maximum Power Dissipation ($T_J = 175^\circ\text{C}$)	P_{tot}	272	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	$^\circ\text{C}$
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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	$^\circ\text{C}$

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

$T_J = 25^\circ\text{C}$ 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, $T_J = 25^\circ\text{C}$	I_{DSS}	–	–	300	μA
Drain–Source On Resistance	$V_{GS} = 18$ V, $I_D = 90$ A, $T_J = 25^\circ\text{C}$	$R_{DS(ON)}$	–	10.5	14.5	m Ω
	$V_{GS} = 18$ V, $I_D = 90$ A, $T_J = 125^\circ\text{C}$		–	17.8	–	
	$V_{GS} = 18$ V, $I_D = 90$ A, $T_J = 150^\circ\text{C}$		–	20.5	–	
	$V_{GS} = 18$ V, $I_D = 90$ A, $T_J = 175^\circ\text{C}$		–	24.5	–	
Gate–Source Threshold Voltage	$V_{GS} = V_{DS}$, $I_D = 45$ mA	$V_{GS(TH)}$	2.04	2.4	4.4	V
Gate Leakage Current	$V_{GS} = -10$ V/22 V, $V_{DS} = 0$ V	I_{GSS}	–3	–	3	μA
Internal Gate Resistance		R_{GINT}	–	1.1	–	Ω
Input Capacitance	$V_{DS} = 800$ V, $V_{GS} = 0$ V, $f = 1$ MHz	C_{ISS}	–	6451	–	pF
Reverse Transfer Capacitance		C_{RSS}	–	29	–	
Output Capacitance		C_{OSS}	–	372	–	

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ELECTRICAL CHARACTERISTICS (continued)

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

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
SiC MOSFET CHARACTERISTICS						
Total Gate Charge	$V_{DS} = 800\text{ V}, V_{GS} = -3/18\text{ V}, I_D = 90\text{ A}$	$Q_{G(TOTAL)}$	–	314	–	nC
Gate–Source Charge		Q_{GS}	–	54	–	nC
Gate–Drain Charge		Q_{GD}	–	70	–	nC
Turn-on Delay Time	$T_J = 25\text{ }^\circ\text{C}$ $V_{DS} = 800\text{ V}, I_D = 90\text{ A}$ $V_{GS} = -3\text{ V}/18\text{ V}, R_G = 2.7\ \Omega$	$t_{d(on)}$	–	23	–	ns
Rise Time		t_r	–	15	–	
Turn-off Delay Time		$t_{d(off)}$	–	98	–	
Fall Time		t_f	–	15	–	
Turn-on Switching Loss per Pulse		E_{ON}	–	1356	–	μJ
Turn-off Switching Loss per Pulse		E_{OFF}	–	571	–	
Turn-on Delay Time		$T_J = 150\text{ }^\circ\text{C}$ $V_{DS} = 800\text{ V}, I_D = 90\text{ A}$ $V_{GS} = -3\text{ V}/18\text{ V}, R_G = 2.7\ \Omega$	$t_{d(on)}$	–	20	–
Rise Time	t_r		–	15	–	
Turn-off Delay Time	$t_{d(off)}$		–	110	–	
Fall Time	t_f		–	16	–	
Turn-on Switching Loss per Pulse	E_{ON}		–	1631	–	μJ
Turn-off Switching Loss per Pulse	E_{OFF}		–	675	–	
Diode Forward Voltage	$V_{GS} = -3\text{ V}, I_{SD} = 90\text{ A}, T_J = 25\text{ }^\circ\text{C}$	V_{SD}	–	4.67	6	V
	$V_{GS} = -3\text{ V}, I_{SD} = 90\text{ A}, T_J = 125\text{ }^\circ\text{C}$		–	4.45	–	
	$V_{GS} = -3\text{ V}, I_{SD} = 90\text{ A}, T_J = 150\text{ }^\circ\text{C}$		–	4.4	–	
Thermal Resistance – Chip-to-Case	M1, M2	R_{thJC}	–	0.349	–	$^\circ\text{C/W}$
Thermal Resistance – Chip-to-Heatsink	Thermal grease, Thickness = 2 Mil $\pm 2\%$, $A = 2.8\text{ W/mK}$	R_{thJH}	–	0.594	–	$^\circ\text{C/W}$

THERMISTOR CHARACTERISTICS

Nominal Resistance	$T = 25\text{ }^\circ\text{C}$	R_{25}	–	5	–	k Ω
	$T = 100\text{ }^\circ\text{C}$	R_{100}	–	493	–	Ω
	$T = 150\text{ }^\circ\text{C}$	R_{150}	–	159.5	–	Ω
Deviation of R_{100}	$T = 100\text{ }^\circ\text{C}$	$\Delta R/R$	–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 $\pm 2\%$		–	3375	–	K
B-value	B(25/100), tolerance $\pm 2\%$		–	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.

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ORDERING INFORMATION

Orderable Part Number	Marking	Package	Shipping
NXH010P120M3F1PTG	NXH010P120M3F1PTG	F1HALFBR: Case 180BW Press-fit Pins with pre-applied thermal interface material (TIM) (Pb-Free / Halide Free)	28 Units / Blister Tray
NXH010P120M3F1PG	NXH010P120M3F1PG	F1HALFBR: Case 180BW Press-fit Pins (Pb-Free / Halide Free)	28 Units / Blister Tray

NXH010P120M3F1PTG, NXH010P120M3F1PG

TYPICAL CHARACTERISTICS

M1/M2 SIC MOSFET CHARACTERISTIC

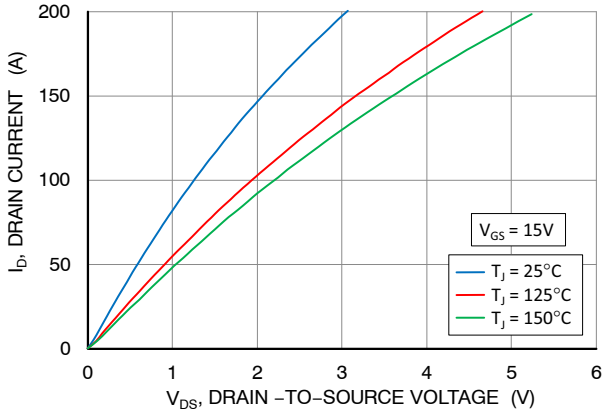


Figure 2. MOSFET Typical Output Characteristic $V_{GS} = 15\text{ V}$

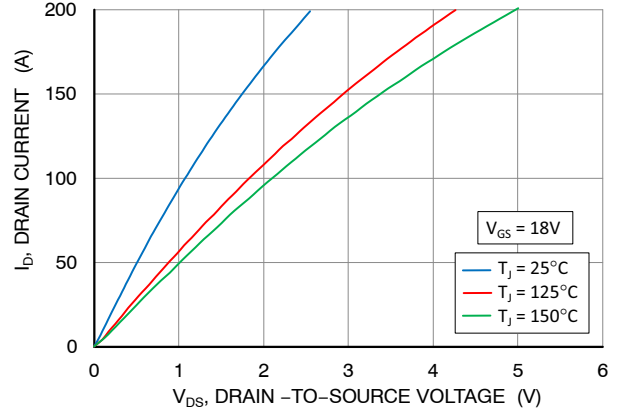


Figure 3. MOSFET Typical Output Characteristic $V_{GS} = 18\text{ V}$

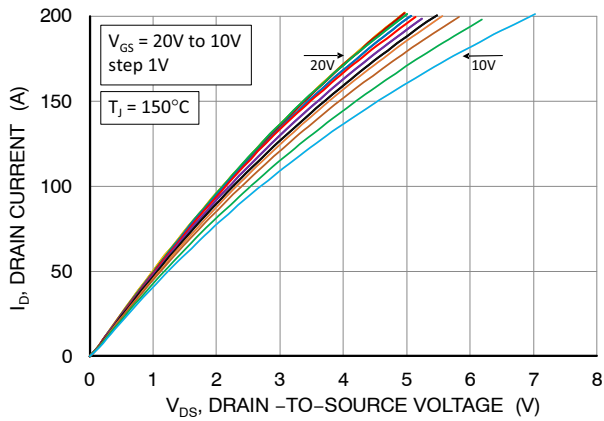


Figure 4. MOSFET Typical Output Characteristic $V_{GS} = \text{Var.}$

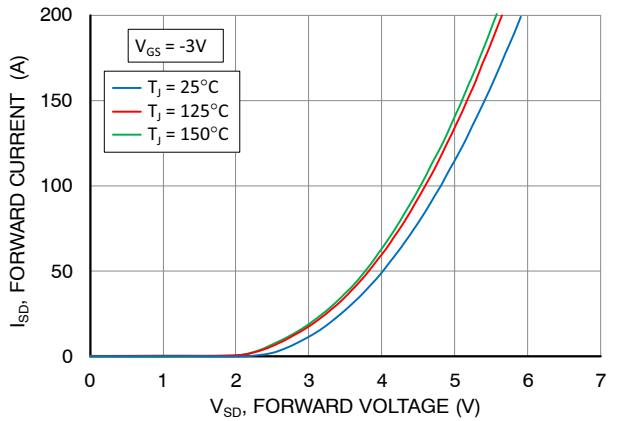


Figure 5. Body Diode Forward Characteristic

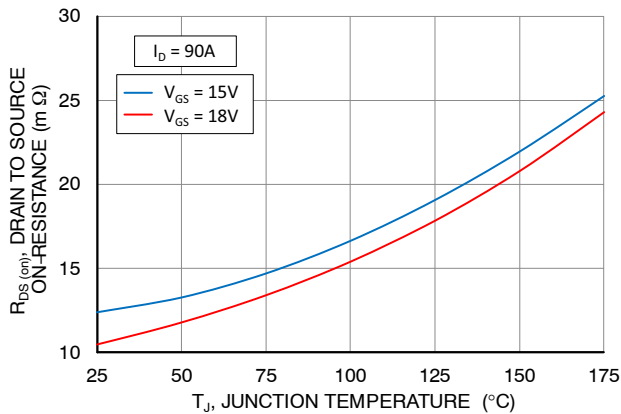


Figure 6. $R_{DS(on)}$ Drain-to-Source ON Resistance vs. Junction Temperature

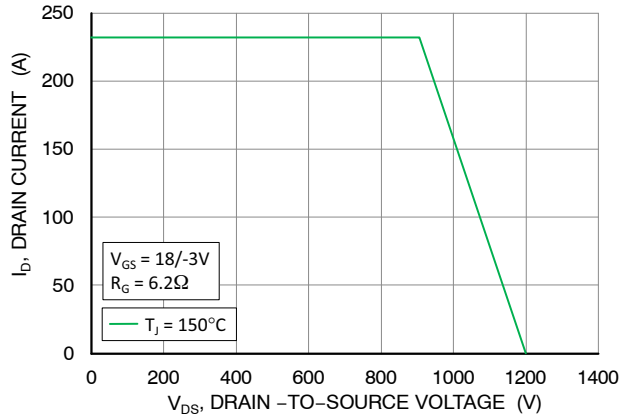


Figure 7. Reverse Bias Safe Operating Area (RBSOA)

NXH010P120M3F1PTG, NXH010P120M3F1PG

TYPICAL CHARACTERISTICS M1/M2 SIC MOSFET CHARACTERISTIC

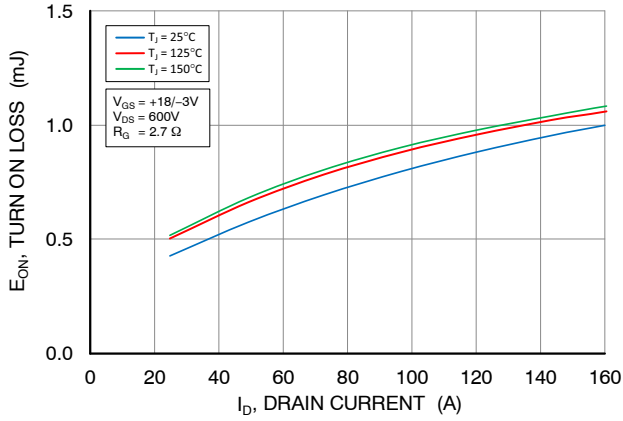


Figure 8. Switching on Loss vs. Drain Current
 $V_{DS} = 600\text{ V}$

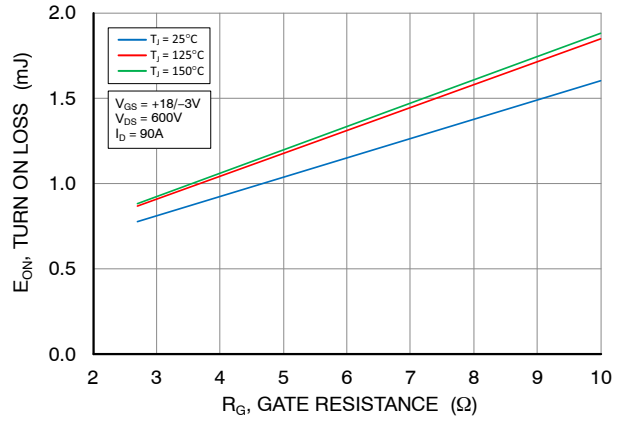


Figure 9. Switching on Loss vs. Gate Resistance
 $V_{DS} = 600\text{ V}$

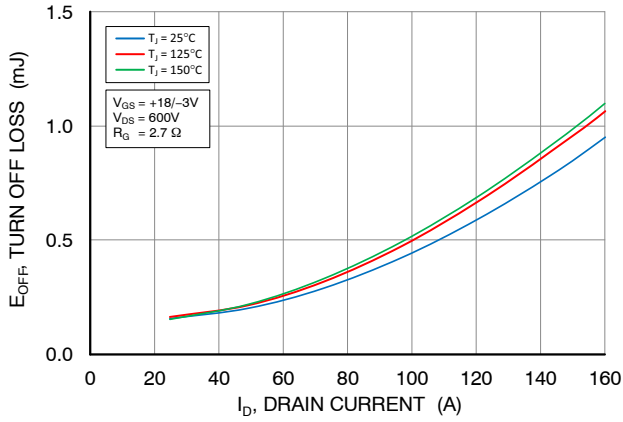


Figure 10. Switching off Loss vs. Drain Current
 $V_{DS} = 600\text{ V}$

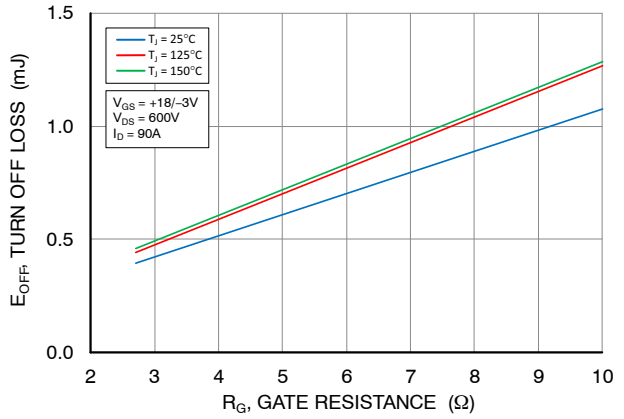


Figure 11. Switching off Loss vs. Gate Resistance
 $V_{DS} = 600\text{ V}$

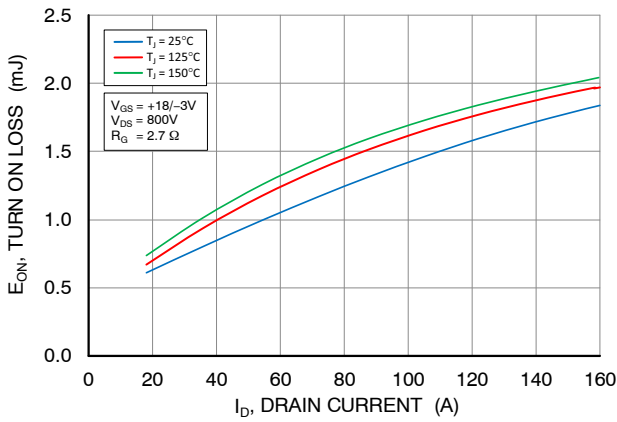


Figure 12. Switching on Loss vs. Drain Current
 $V_{DS} = 800\text{ V}$

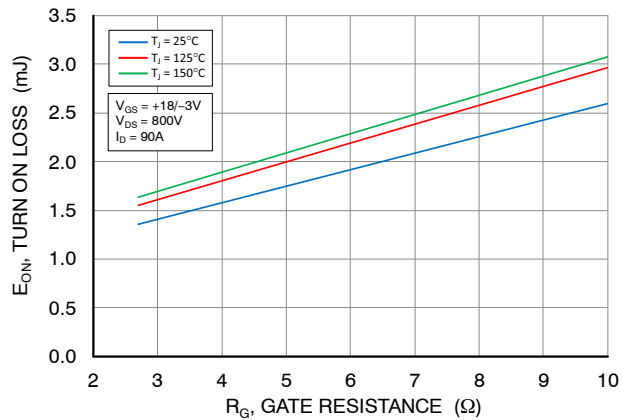


Figure 13. Switching on Loss vs. Gate Resistance
 $V_{DS} = 800\text{ V}$

NXH010P120M3F1PTG, NXH010P120M3F1PG

TYPICAL CHARACTERISTICS M1/M2 SIC MOSFET CHARACTERISTIC

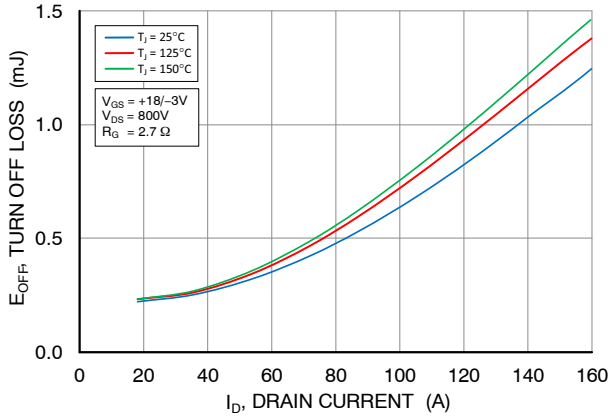


Figure 14. Switching off Loss vs. Drain Current $V_{DS} = 800\text{ V}$

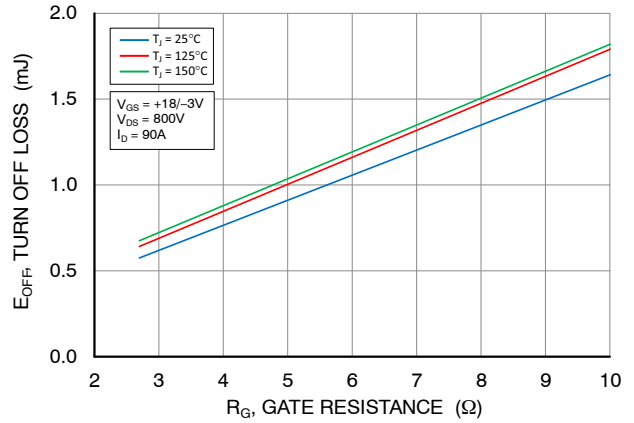


Figure 15. Switching off Loss vs. Gate Resistance $V_{DS} = 800\text{ V}$

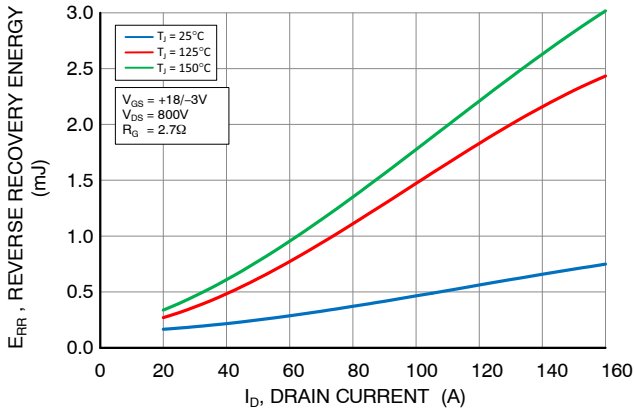


Figure 16. Reverse Recovery Energy vs. Drain Current $V_{DS} = 800\text{ V}$

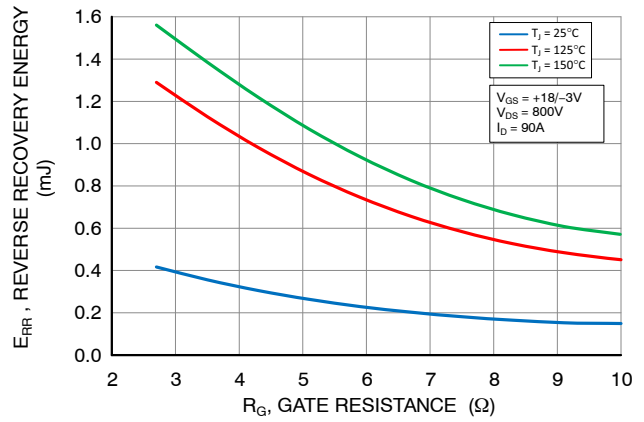


Figure 17. Reverse Recovery Energy vs. Gate Resistance $V_{DS} = 800\text{ V}$

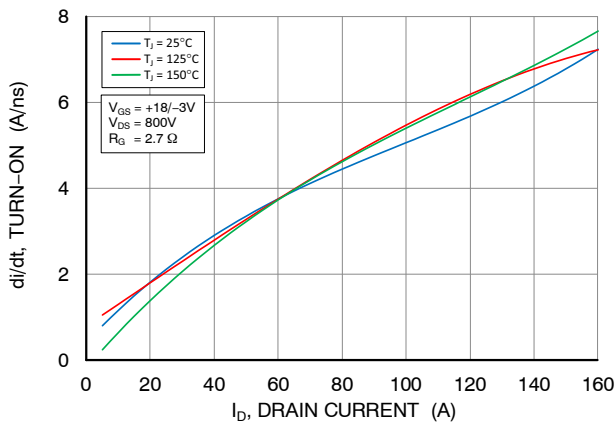


Figure 18. di/dt Turn ON vs. Drain Current $V_{DS} = 800\text{ V}$

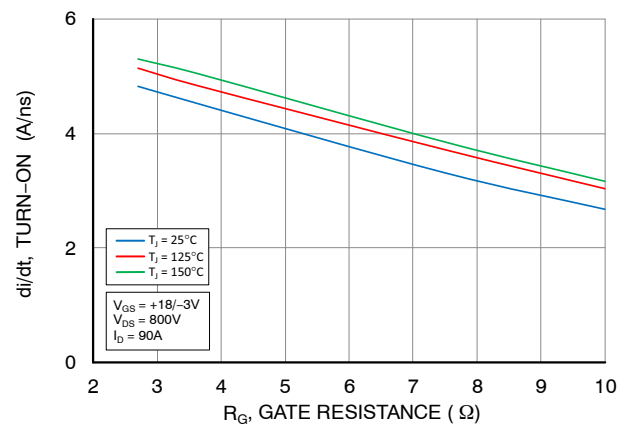


Figure 19. di/dt Turn ON vs. Gate Resistance $V_{DS} = 800\text{ V}$

NXH010P120M3F1PTG, NXH010P120M3F1PG

TYPICAL CHARACTERISTICS M1/M2 SIC MOSFET CHARACTERISTIC

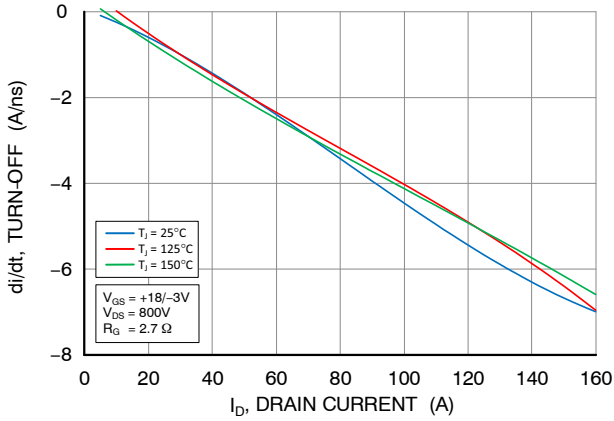


Figure 20. di/dt Turn OFF vs. Drain Current
 $V_{DS} = 800\text{ V}$

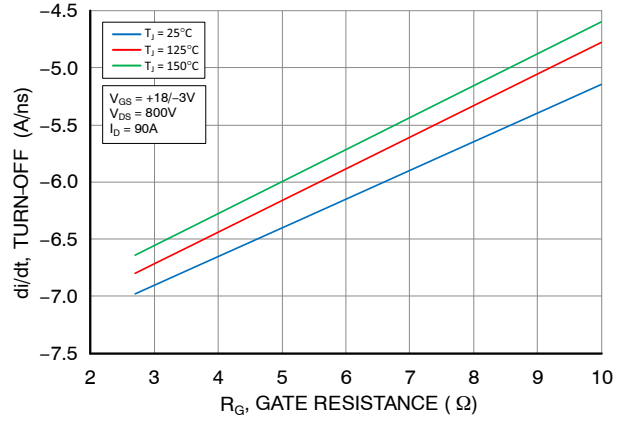


Figure 21. di/dt Turn OFF vs. Gate Resistance
 $V_{DS} = 800\text{ V}$

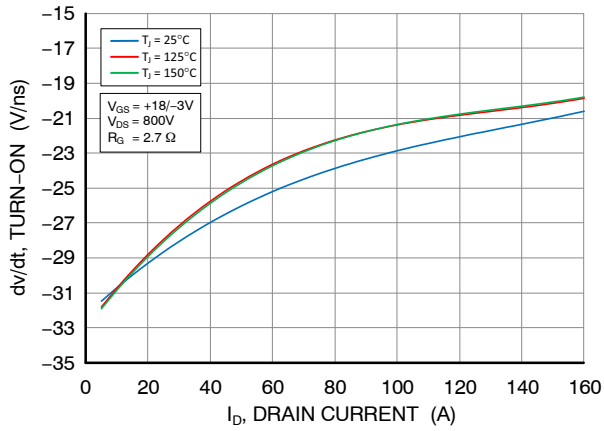


Figure 22. dv/dt Turn ON vs. Drain Current
 $V_{DS} = 800\text{ V}$

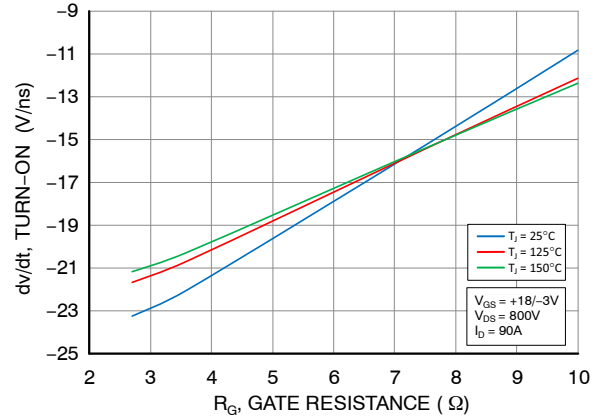


Figure 23. dv/dt Turn ON vs. Gate Resistance
 $V_{DS} = 800\text{ V}$

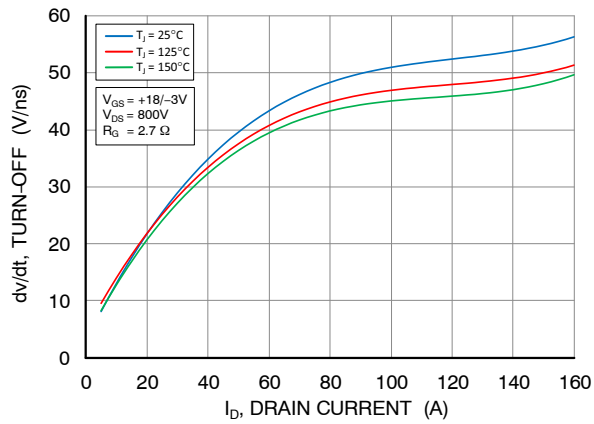


Figure 24. dv/dt Turn OFF vs. Drain Current
 $V_{DS} = 800\text{ V}$

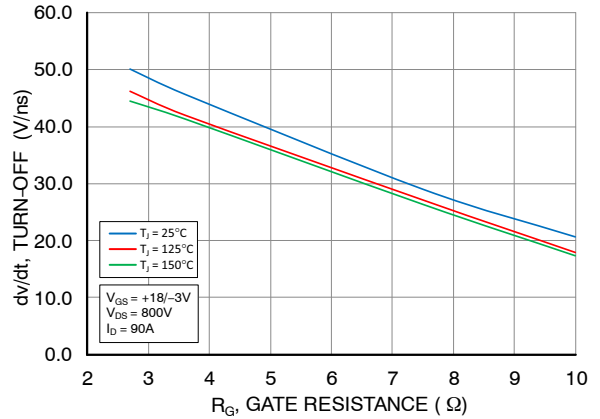


Figure 25. dv/dt Turn OFF vs. Gate Resistance
 $V_{DS} = 800\text{ V}$

NXH010P120M3F1PTG, NXH010P120M3F1PG

TYPICAL CHARACTERISTICS M1/M2 SIC MOSFET CHARACTERISTIC

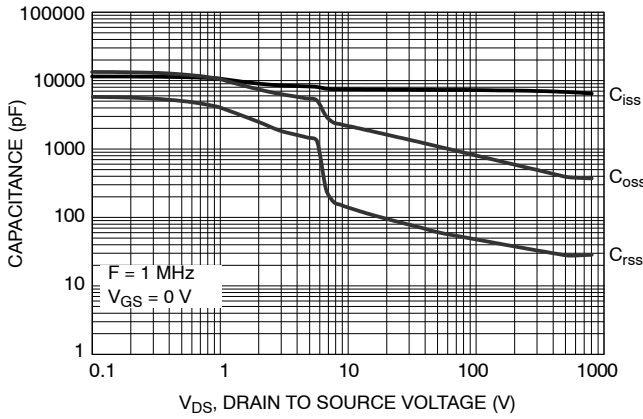


Figure 26. Capacitance vs Drain-to-Source Voltage

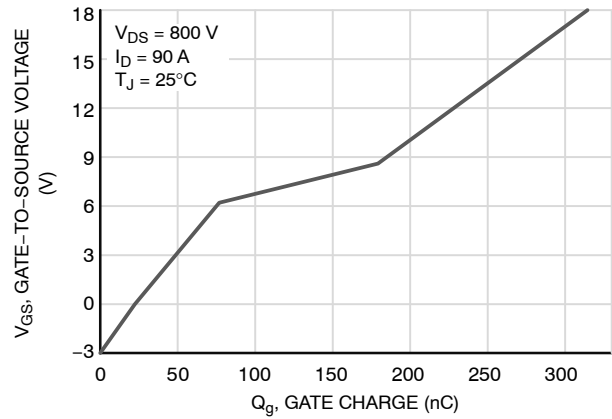


Figure 27. Gate-to-Source Voltage vs Gate Charge

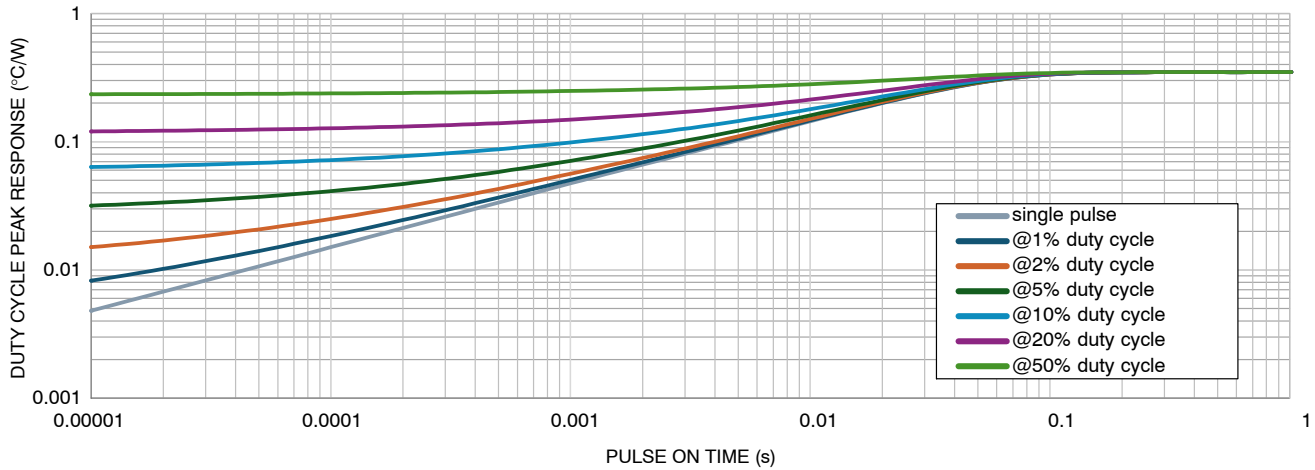


Figure 28. Capacitance vs Drain-to-Source Voltage

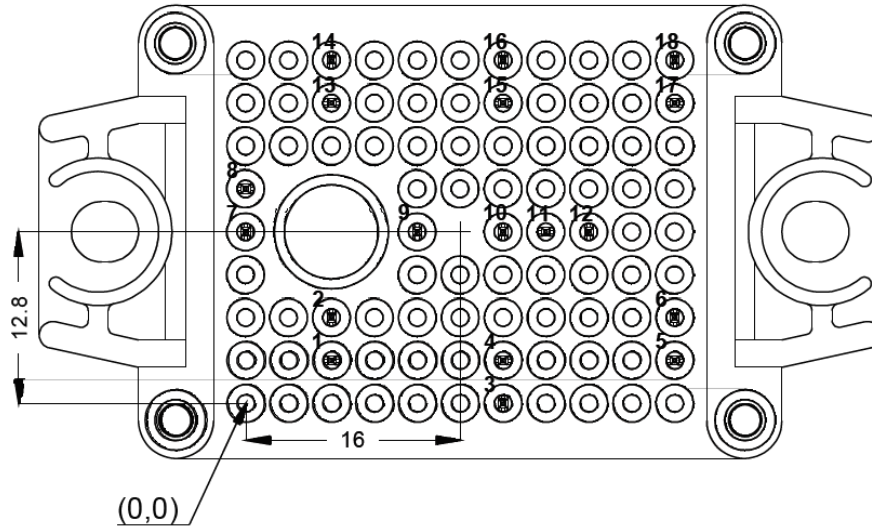
Table 1. CAUER NETWORKS

Cauer Element #	Rth (K/W)	Cth (Ws/K)
1	0.0019785	0.0024180
2	0.0046136	0.0008682
3	0.0223110	0.0040421
4	0.0664870	0.0115970
5	0.1231500	0.0650500
6	0.0671800	1.3946000

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PIN POSITION INFORMATION

scale = 2.5 : 1



S 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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