

# Silicon Carbide (SiC) Module – 8 mohm SiC M3S MOSFET, 1200 V, TNPC Topology, F2 Package

## Product Preview

### NXH008T120M3F2PTHG

The NXH008T120M3F2PTHG is a power module containing an 8 mΩ / 1200 V SiC MOSFET TNPC and a thermistor with HPS DBC in an F2 package.

#### Features

- 8 mΩ / 1200 V M3S SiC MOSFET TNPC
- HPS DBC
- Thermistor
- Options with Pre-Applied Thermal Interface Material (TIM) and without Pre-Applied TIM
- Options with Solderable Pins and 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

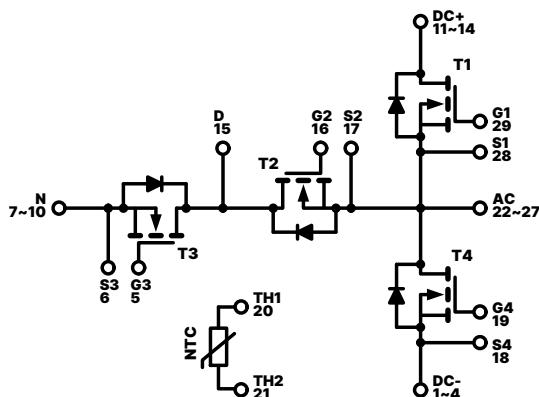
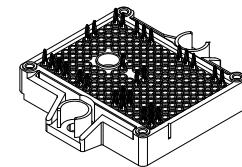


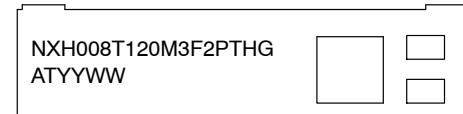
Figure 1. NXH008T120M3F2PTHG Schematic Diagram

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



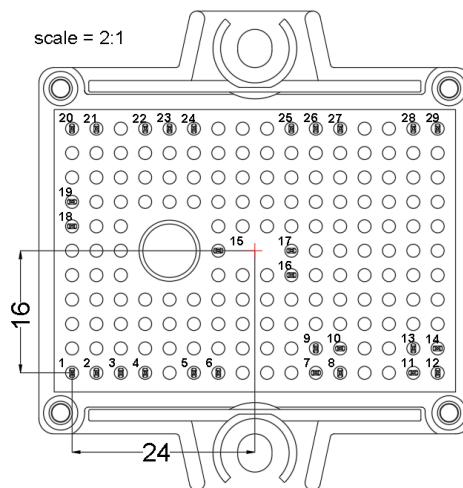
PIM29 56.7x42.5 (PRESS FIT)  
CASE 180HR

#### MARKING DIAGRAM



NXH008T120M3F2PTHG = 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.

# NXH008T120M3F2PTHG

## PIN FUNCTION DESCRIPTION

Pin	Name	Description
1	DC-	DC Negative Bus connection
2	DC-	DC Negative Bus connection
3	DC-	DC Negative Bus connection
4	DC-	DC Negative Bus connection
5	G3	T3 Gate
6	S3	T3 Source
7	N	DC Neutral Point
8	N	DC Neutral Point
9	N	DC Neutral Point
10	N	DC Neutral Point
11	DC+	DC Positive Bus connection
12	DC+	DC Positive Bus connection
13	DC+	DC Positive Bus connection
14	DC+	DC Positive Bus connection
15	D	Common point drain
16	G2	T2 Gate
17	S2	T2 Source
18	S4	T4 Source
19	G4	T4 Gate
20	TH1	Thermistor Connection 1
21	TH2	Thermistor Connection 2
22	AC	AC Phase Output
23	AC	AC Phase Output
24	AC	AC Phase Output
25	AC	AC Phase Output
26	AC	AC Phase Output
27	AC	AC Phase Output
28	S1	T1 Source
29	G1	T1 Gate

# NXH008T120M3F2PTHG

## MAXIMUM RATINGS

Rating	Symbol	Value	Unit
<b>SiC MOSFET</b>			
Drain-Source Voltage	$V_{DSS}$	1200	V
Gate-Source Voltage	$V_{GS}$	+22/-10	V
Continuous Drain Current @ $T_c = 80^\circ\text{C}$ ( $T_J = 175^\circ\text{C}$ )	$I_D$	129	A
Pulsed Drain Current ( $T_J = 175^\circ\text{C}$ ) (Note 2)	$I_{Dpulse}$	387	A
Maximum Power Dissipation ( $T_J = 175^\circ\text{C}$ )	$P_{tot}$	371	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	$^\circ\text{C}$
TIM Layer Thickness	$T_{TIM}$	$160 \pm 20$	$\mu\text{m}$

## INSULATION PROPERTIES

Isolation test voltage, $t = 1$ sec, 60 Hz	$V_{is}$	4800	$V_{RMS}$
Creepage distance		12.7	mm
CTI		600	
Substrate Ceramic Material		HPS	
Substrate Ceramic Material Thickness		0.38	mm
Substrate Warpage (Note 2)	W	Max 0.18	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.
2. Height difference between horizontal plane and substrate copper bottom.

## 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	$I_{DSS}$	-	-	300	$\mu\text{A}$
Drain-Source On Resistance	$V_{GS} = 18$ V, $I_D = 100$ A, $T_J = 25^\circ\text{C}$	$R_{DS(ON)}$	-	8.5	11.5	$\text{m}\Omega$
	$V_{GS} = 18$ V, $I_D = 100$ A, $T_J = 125^\circ\text{C}$		-	12.9	-	
	$V_{GS} = 18$ V, $I_D = 100$ A, $T_J = 150^\circ\text{C}$		-	15	-	
Gate-Source Threshold Voltage	$V_{GS} = V_{DS}$ , $I_D = 60$ mA	$V_{GS(TH)}$	1.8	2.8	4.4	V
Gate Leakage Current	$V_{GS} = -10$ V / 20 V, $V_{DS} = 0$ V	$I_{GSS}$	-600	-	600	nA
Input Capacitance	$V_{DS} = 800$ V, $V_{GS} = 0$ V, $f = 100$ kHz	$C_{ISS}$	-	9129	-	$\text{pF}$
Reverse Transfer Capacitance			$C_{RSS}$	39	-	
Output Capacitance			$C_{OSS}$	493	-	

# NXH008T120M3F2PTHG

## ELECTRICAL CHARACTERISTICS (continued)

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

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
<b>SiC MOSFET CHARACTERISTICS</b>						
Total Gate Charge	$V_{DS} = 800\text{ V}$ , $V_{GS} = -5/20\text{ V}$ , $I_D = 200\text{ A}$	$Q_{G(\text{TOTAL})}$	—	454	—	nC
Gate-Source Charge		$Q_{GS}$	—	43	—	nC
Gate-Drain Charge		$Q_{GD}$	—	101	—	nC
Turn-on Delay Time	$T_J = 25^\circ\text{C}$ $V_{DS} = 400\text{ V}$ , $I_D = 100\text{ A}$ $V_{GS} = -3\text{ V} / 18\text{ V}$ , $R_G = 2.7\ \Omega$	$t_{d(\text{on})}$	—	41.5	—	ns
Rise Time		$t_r$	—	20.6	—	
Turn-off Delay Time		$t_{d(\text{off})}$	—	137	—	
Fall Time		$t_f$	—	15	—	
Turn-on Switching Loss per Pulse		$E_{ON}$	—	0.60	—	mJ
Turn-off Switching Loss per Pulse		$E_{OFF}$	—	0.26	—	
Turn-on Delay Time	$T_J = 150^\circ\text{C}$ $V_{DS} = 400\text{ V}$ , $I_D = 100\text{ A}$ $V_{GS} = -3\text{ V} / 18\text{ V}$ , $R_G = 2.7\ \Omega$	$t_{d(\text{on})}$	—	39	—	ns
Rise Time		$t_r$	—	19.2	—	
Turn-off Delay Time		$t_{d(\text{off})}$	—	155	—	
Fall Time		$t_f$	—	17	—	
Turn-on Switching Loss per Pulse		$E_{ON}$	—	0.61	—	mJ
Turn off Switching Loss per Pulse		$E_{OFF}$	—	0.32	—	
Diode Forward Voltage	$I_D = 100\text{ A}$ , $T_J = 25^\circ\text{C}$ $I_D = 100\text{ A}$ , $T_J = 125^\circ\text{C}$ $I_D = 100\text{ A}$ , $T_J = 150^\circ\text{C}$	$V_{SD}$	—	4.8	7.5	V
			—	4.1	—	
			—	4.0	—	
Thermal Resistance – Chip-to-Case	T1, T2, T3, T4	$R_{thJC}$	—	0.256	—	°C/W
Thermal Resistance – Chip-to-Heatsink	Thermal grease, Thickness = 2 Mil +2%, $A = 2.8\text{ W/mK}$	$R_{thJH}$	—	0.451	—	°C/W

## THERMISTOR CHARACTERISTICS

Nominal Resistance	TNTC = 25°C	$R_{25}$	—	5	—	kΩ
	TNTC = 100°C	$R_{100}$	—	493	—	Ω
	TNTC = 150°C	$R_{150}$	—	159.5	—	Ω
Deviation of R100	TNTC = 100°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 ±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
NXH008T120M3F2PTHG	NXH008T120M3F2PTHG	F2-TNPC: Case 180HR Press-fit Pins with pre-applied thermal interface material (TIM) (Pb-Free / Halide Free)	20 Units / Blister Tray

## TYPICAL CHARACTERISTICS

M1/M2 SIC MOSFET CHARACTERISTIC

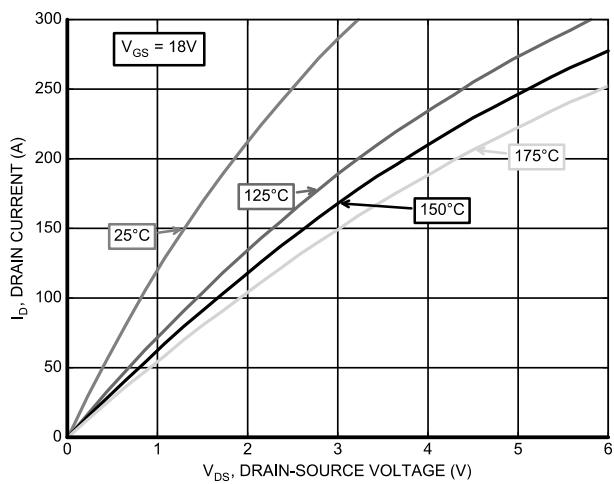


Figure 2. MOSFET Typical Output Characteristic

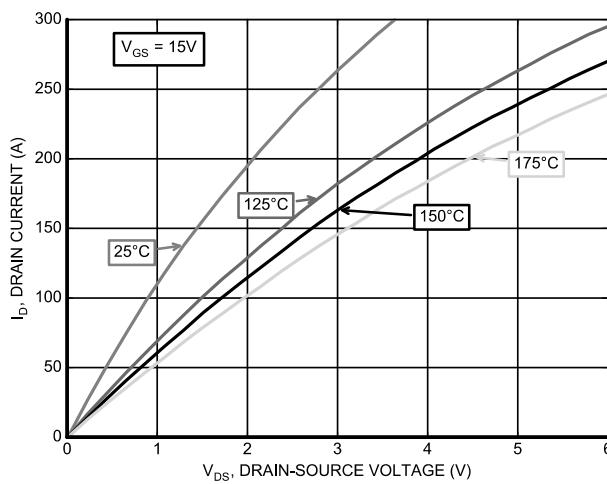


Figure 3. MOSFET Typical Output Characteristic

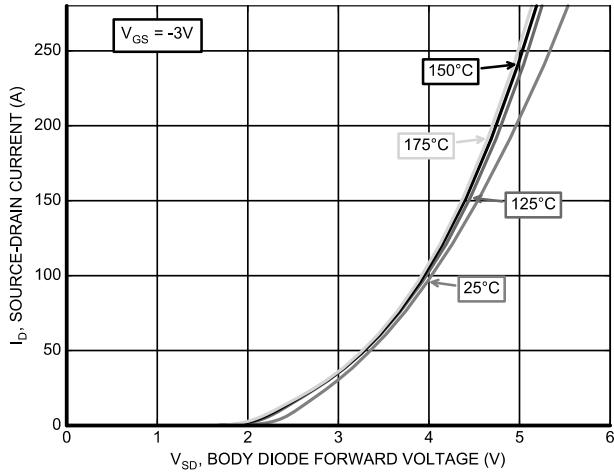


Figure 4.  $I_D$  vs.  $V_{SD}$

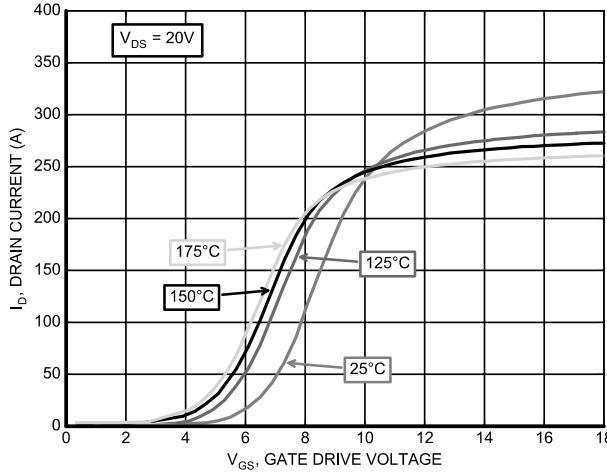


Figure 5.  $I_D$  vs.  $V_{GS}$

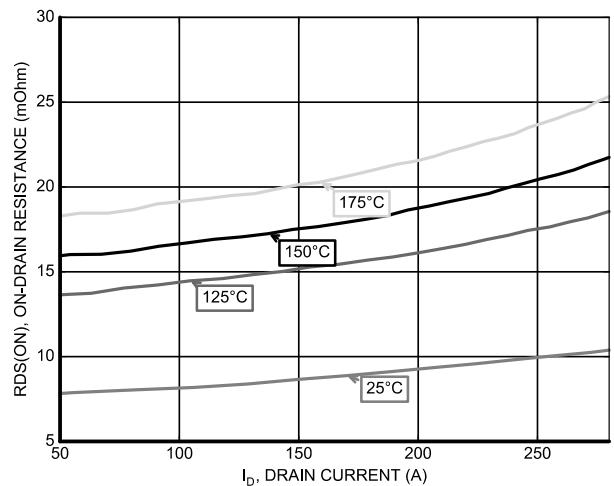


Figure 6.  $R_{DS(ON)}$  vs.  $I_D$

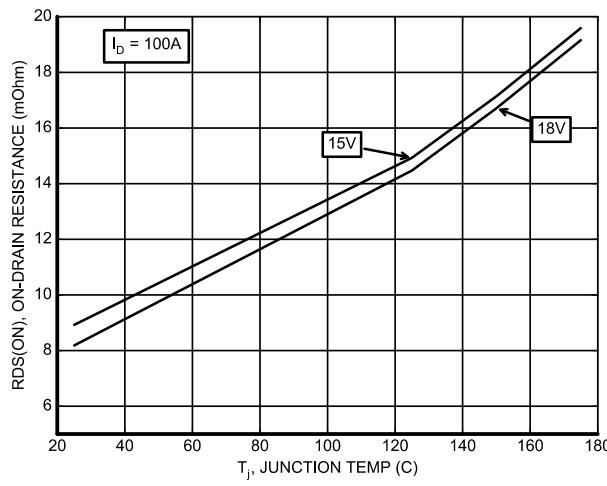
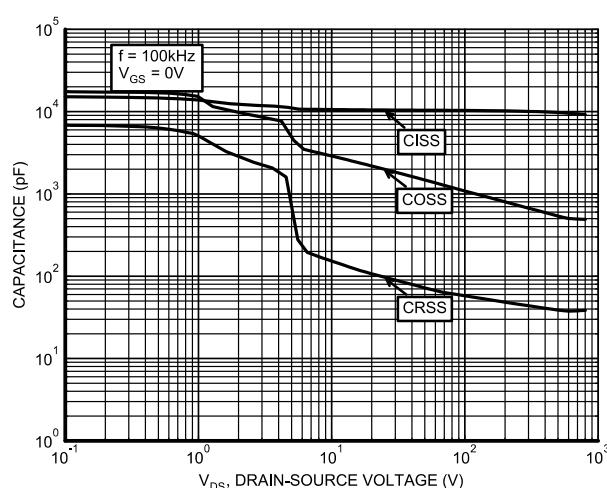
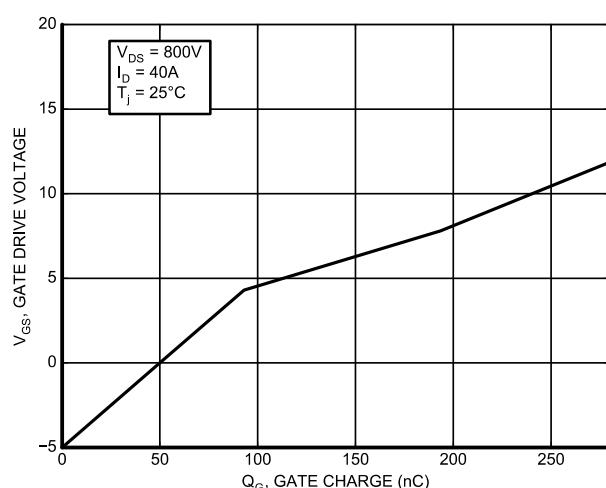
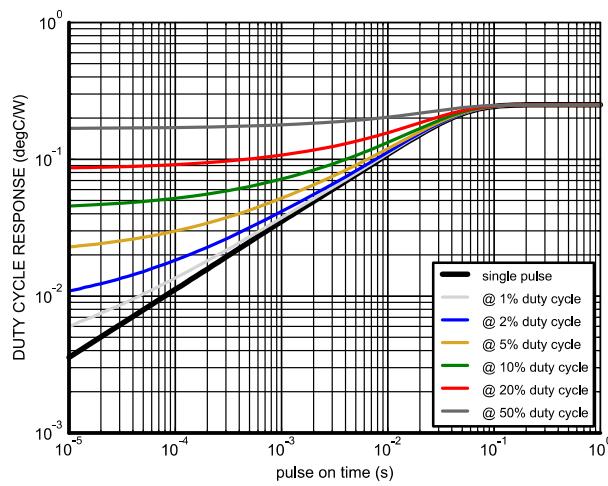
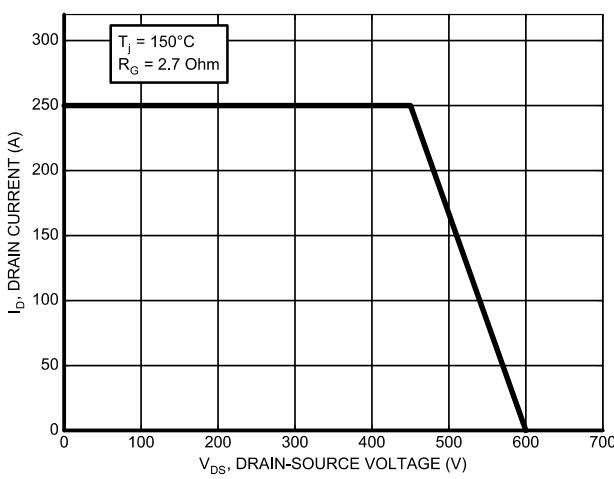
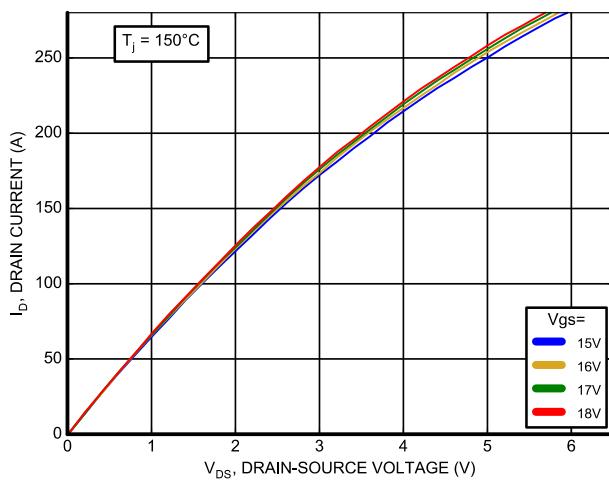
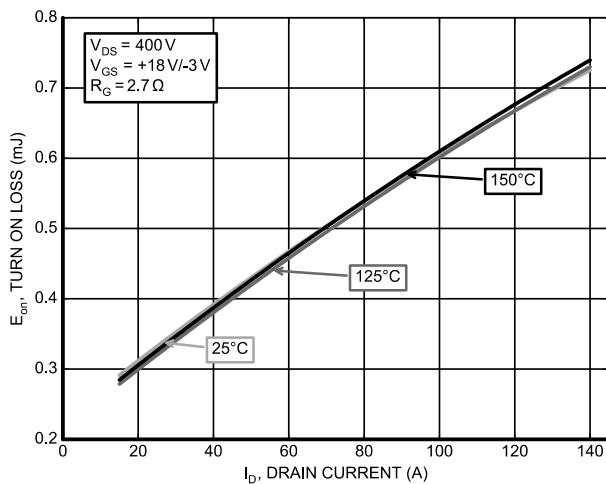
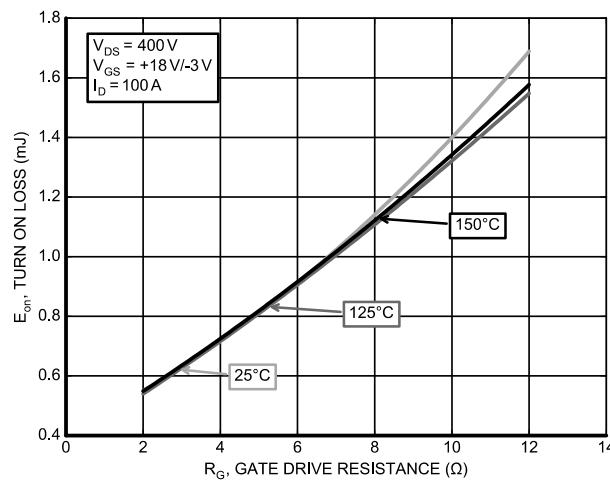
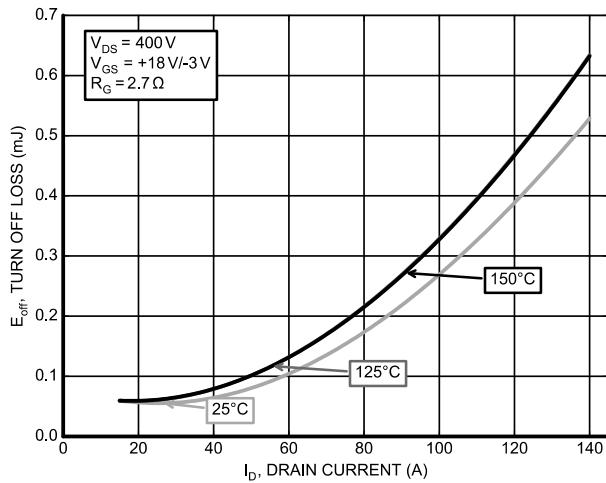
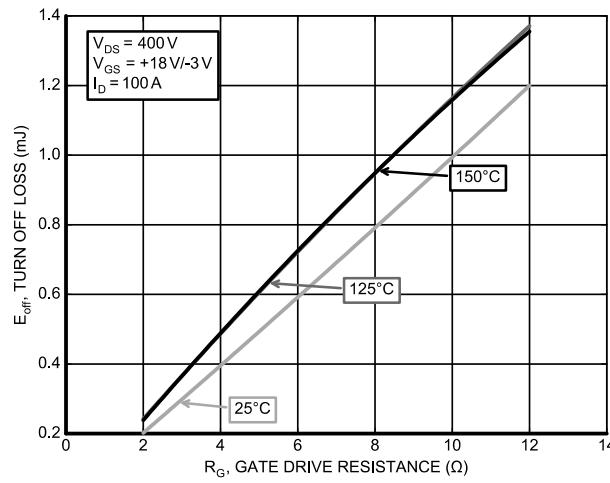
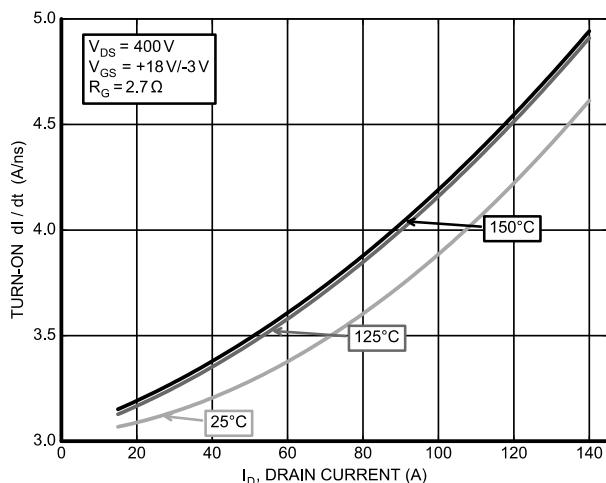
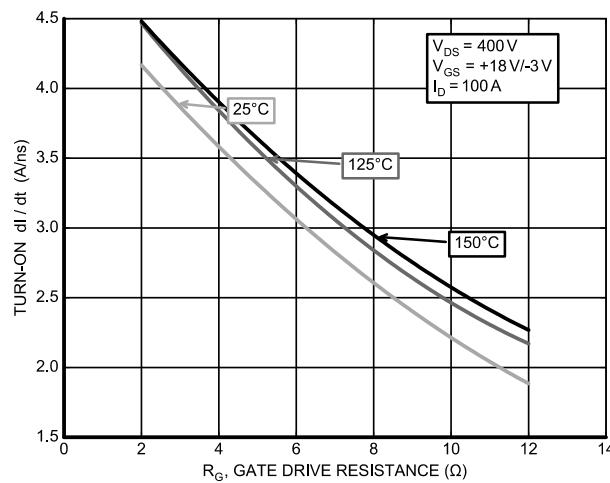


Figure 7.  $R_{DS(ON)}$  vs.  $T_J$

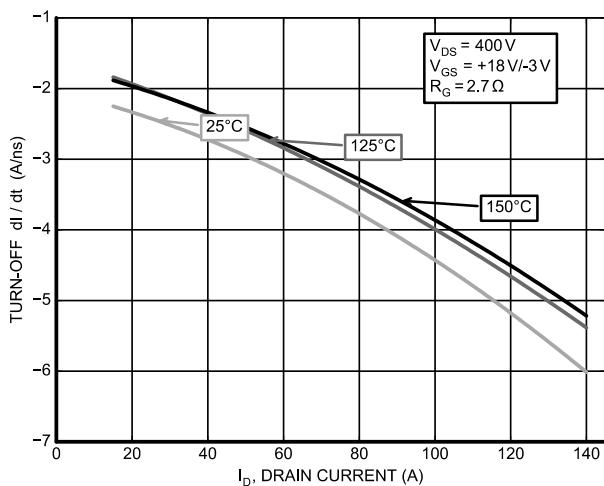
**TYPICAL CHARACTERISTICS**  
M1/M2 SIC MOSFET CHARACTERISTIC



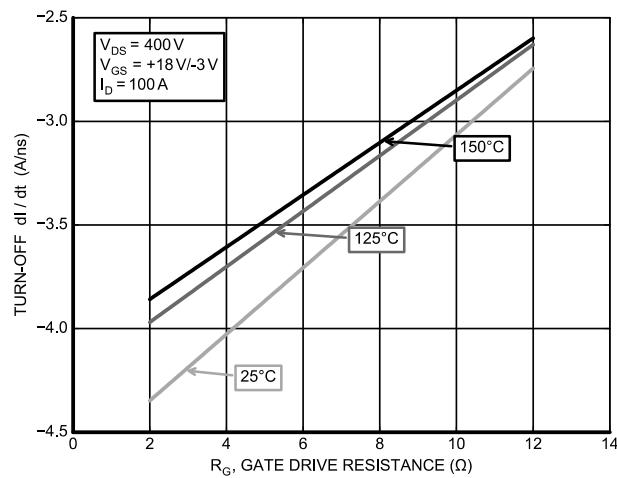
**TYPICAL CHARACTERISTICS – HB COMMUTATION PATH**  
M1/M2 SIC MOSFET SWITCHING CHARACTERISTIC

Figure 13.  $E_{on}$  vs.  $I_D$ Figure 14.  $E_{on}$  vs.  $R_G$ Figure 15.  $E_{off}$  vs.  $I_D$ Figure 16.  $E_{off}$  vs.  $R_G$ Figure 17. Turn-on  $dI/dt$  vs.  $I_D$ Figure 18. Turn-on  $dI/dt$  vs.  $R_G$

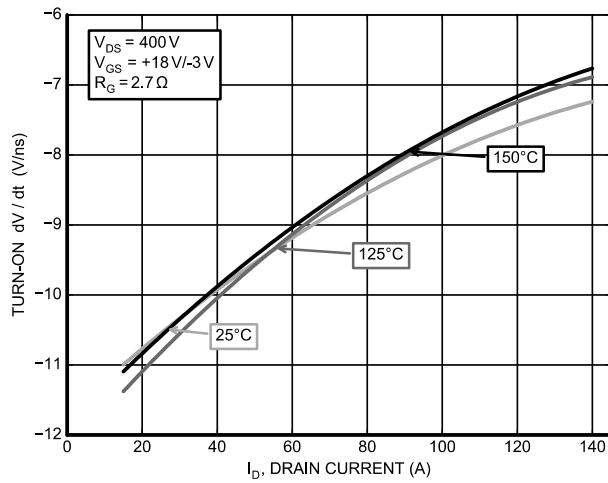
**TYPICAL CHARACTERISTICS – HB COMMUTATION PATH**  
M1/M2 SIC MOSFET SWITCHING CHARACTERISTIC



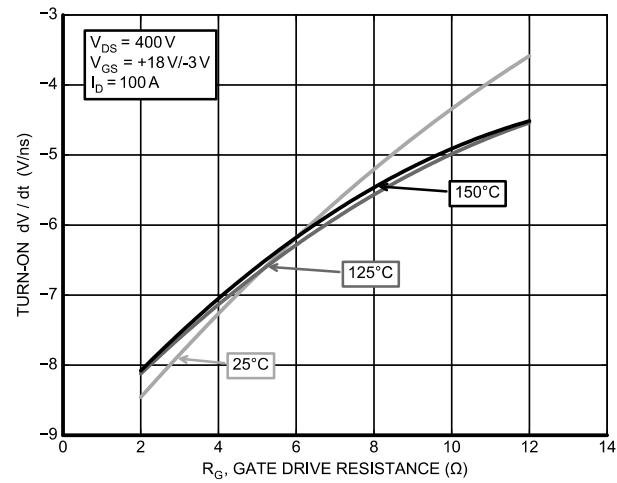
**Figure 19. Turn-off  $dI/dt$  vs.  $I_D$**



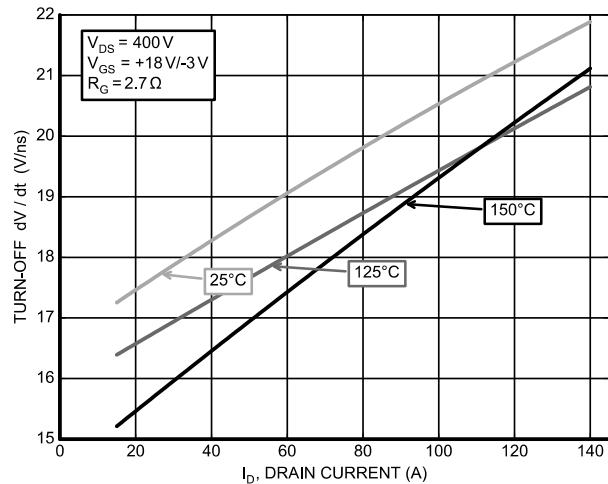
**Figure 20. Turn-off  $dI/dt$  vs.  $R_G$**



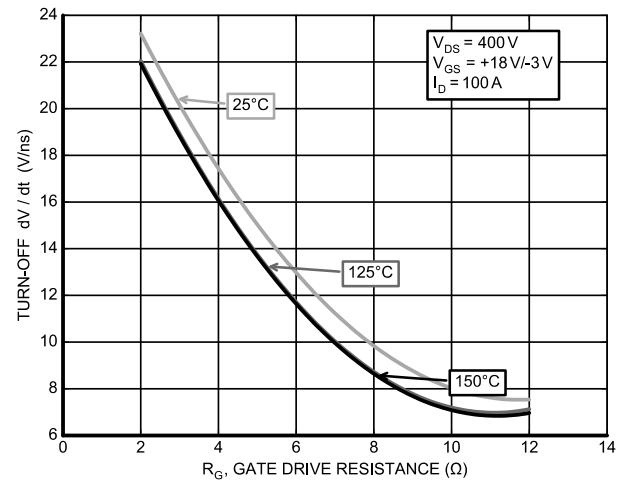
**Figure 21. Turn-on  $dV/dt$  vs.  $I_D$**



**Figure 22. Turn-on  $dV/dt$  vs.  $R_G$**

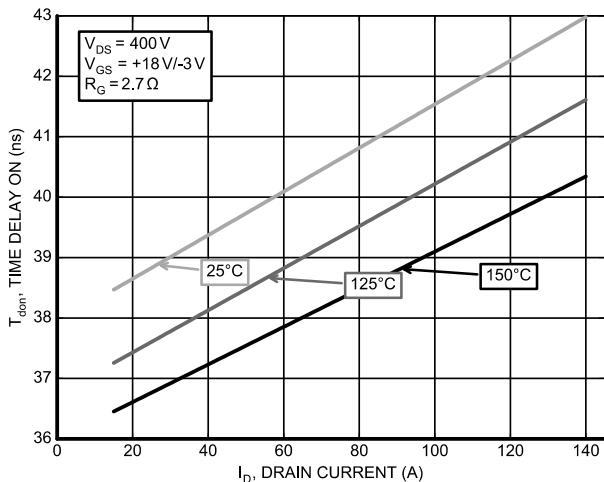
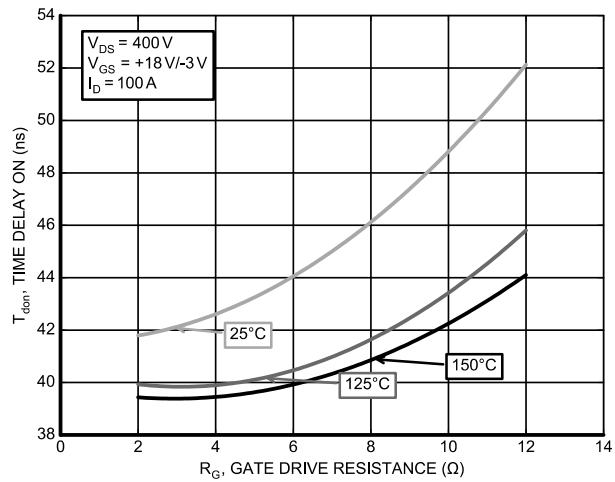
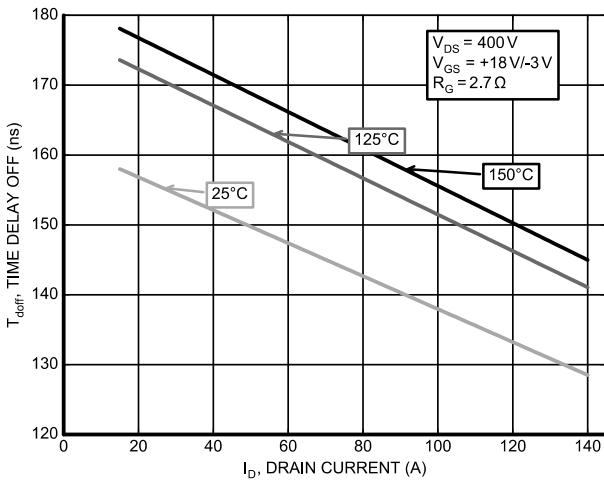
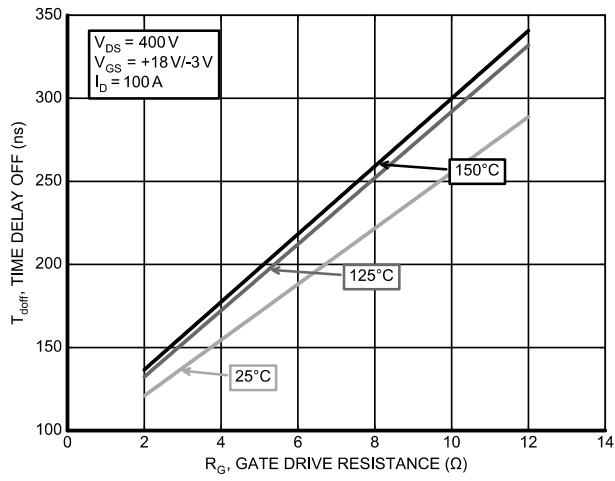


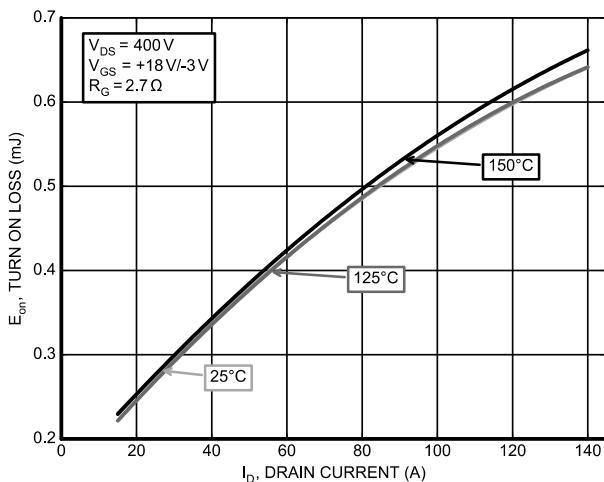
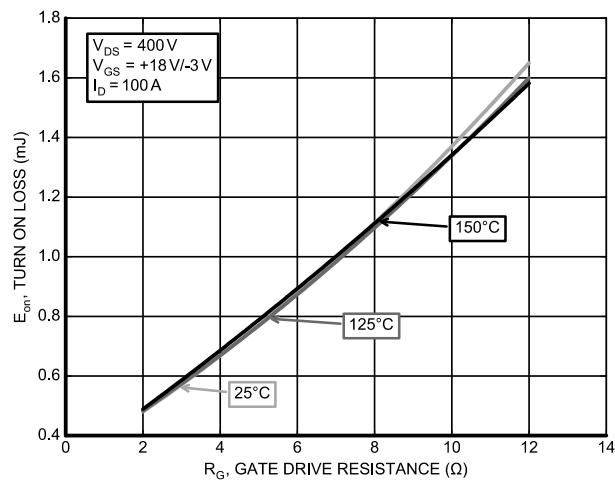
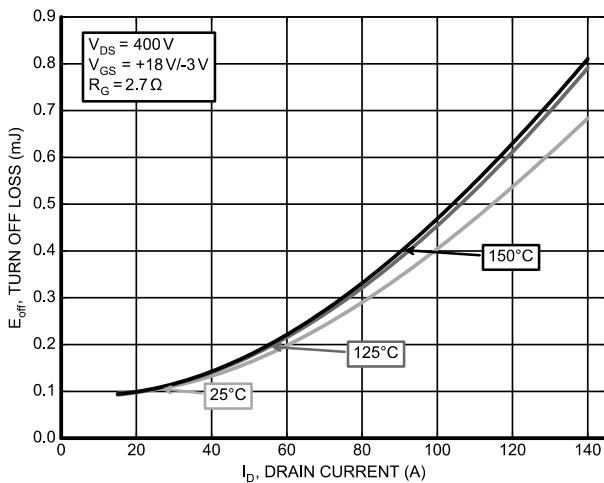
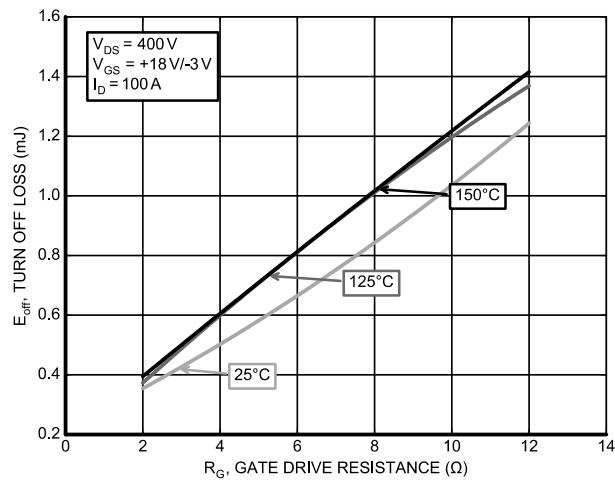
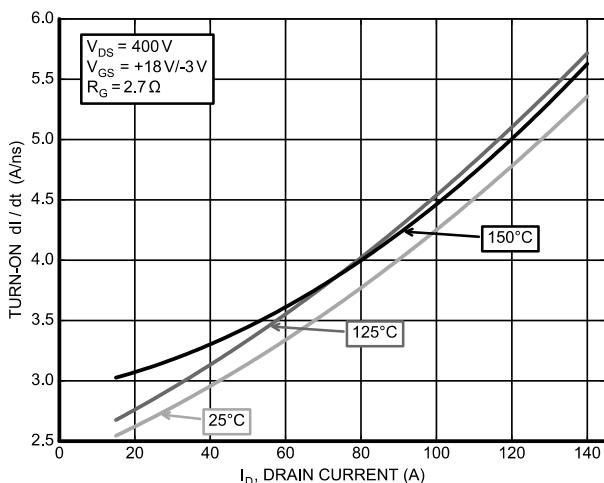
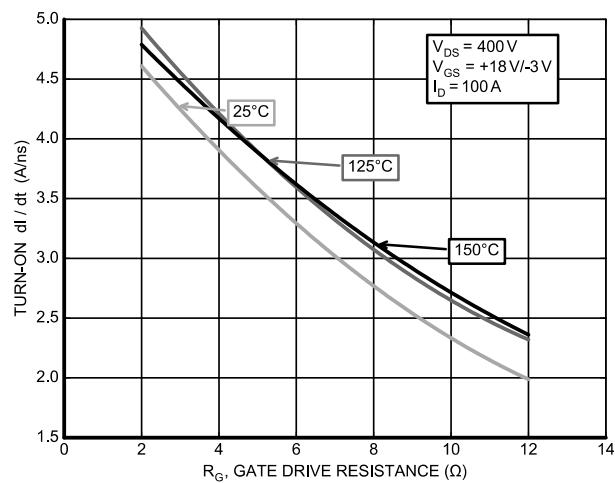
**Figure 23. Turn-off  $dV/dt$  vs.  $I_D$**



**Figure 24. Turn-off  $dV/dt$  vs.  $R_G$**

**TYPICAL CHARACTERISTICS – HB COMMUTATION PATH**  
M1/M2 SIC MOSFET SWITCHING CHARACTERISTIC

Figure 25.  $T_{don}$  vs.  $I_D$ Figure 26.  $T_{don}$  vs.  $R_G$ Figure 27.  $T_{doff}$  vs.  $I_D$ Figure 28.  $T_{doff}$  vs.  $R_G$

**TYPICAL CHARACTERISTICS – NP COMMUTATION PATH**  
**M1/M2 SIC MOSFET SWITCHING CHARACTERISTIC**

**Figure 29.  $E_{on}$  vs.  $I_D$** 

**Figure 30.  $E_{on}$  vs.  $R_G$** 

**Figure 31.  $E_{off}$  vs.  $I_D$** 

**Figure 32.  $E_{off}$  vs.  $R_G$** 

**Figure 33. Turn-on  $di/dt$  vs.  $I_D$** 

**Figure 34. Turn-on  $di/dt$  vs.  $R_G$**

## TYPICAL CHARACTERISTICS – NP COMMUTATION PATH

M1/M2 SIC MOSFET SWITCHING CHARACTERISTIC

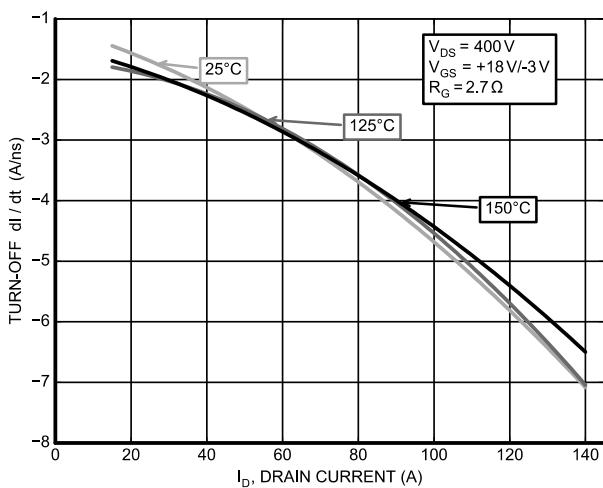


Figure 35. Turn-off  $dI/dt$  vs.  $I_D$

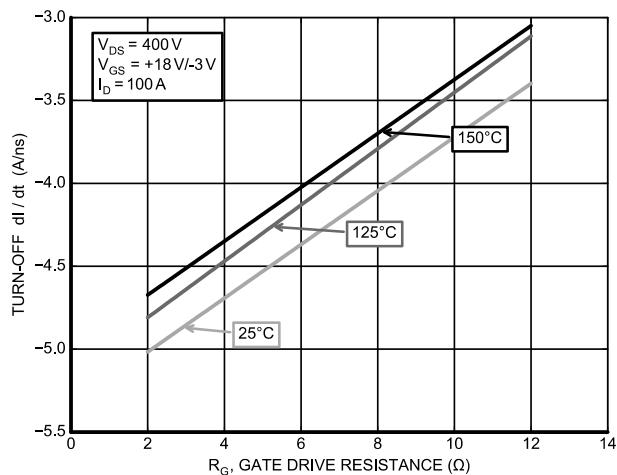


Figure 36. Turn-off  $dI/dt$  vs.  $R_G$

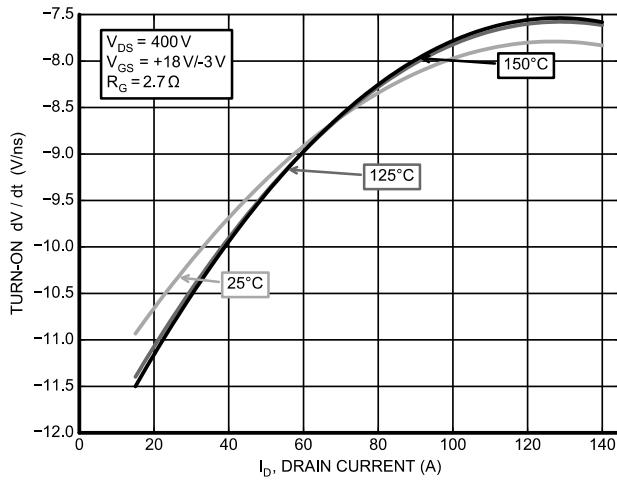


Figure 37. Turn-on  $dV/dt$  vs.  $I_D$

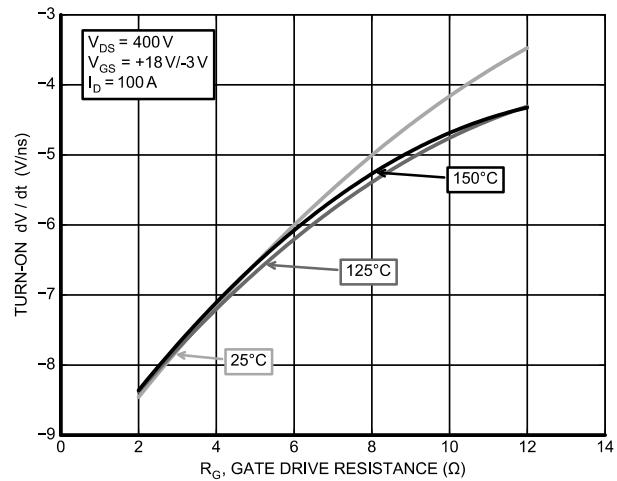


Figure 38. Turn-on  $dV/dt$  vs.  $R_G$

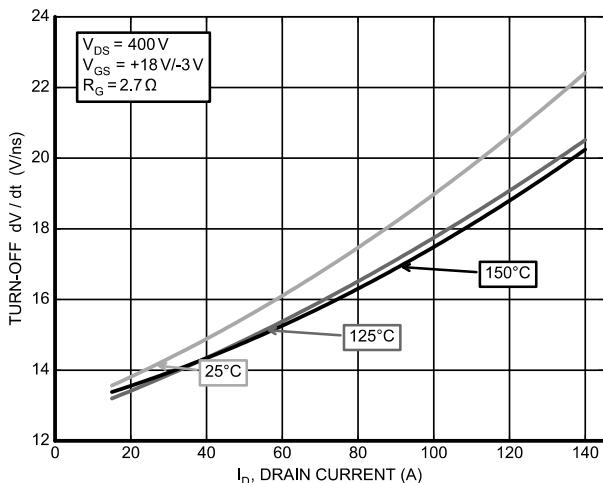


Figure 39. Turn-off  $dV/dt$  vs.  $I_D$

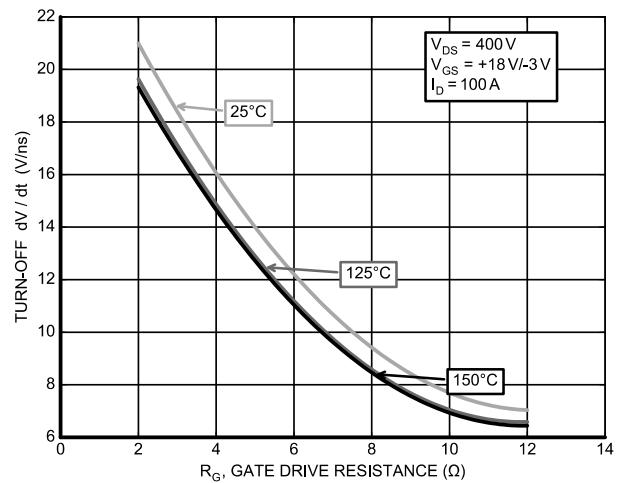
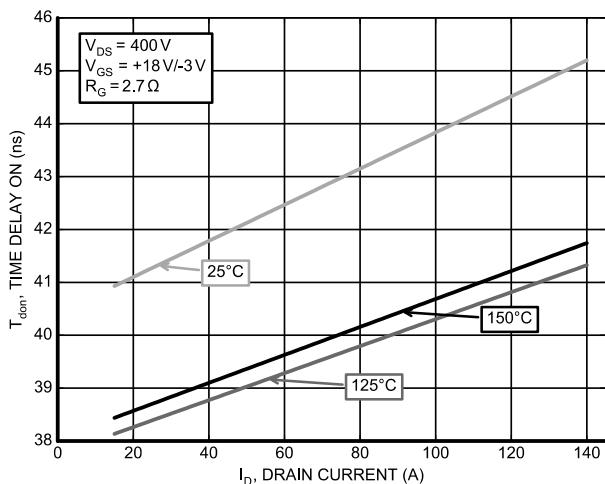
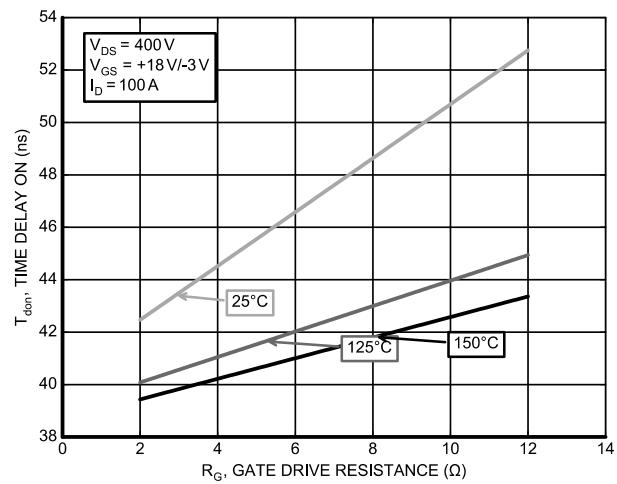
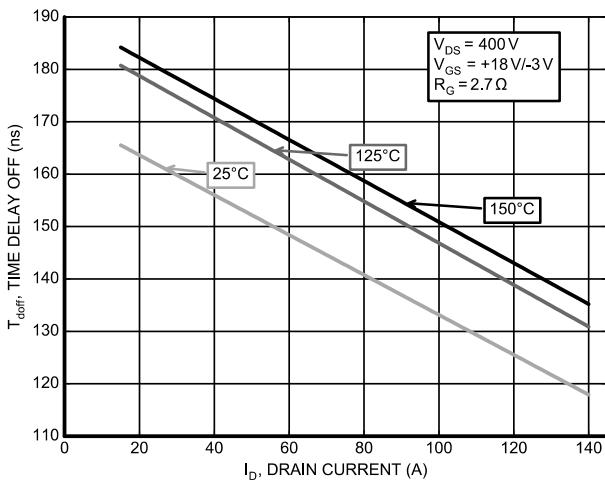
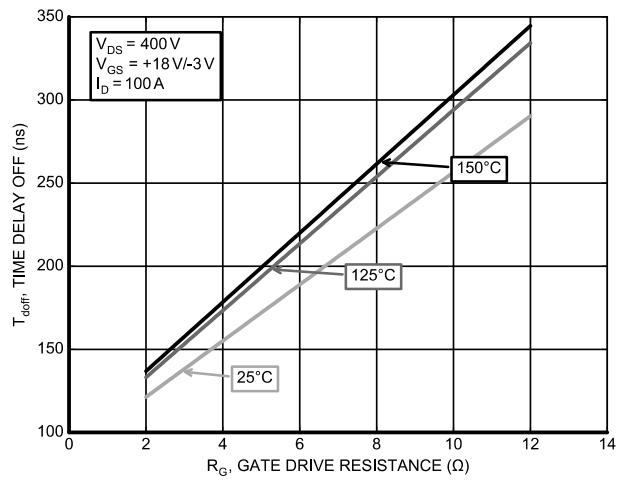


Figure 40. Turn-off  $dV/dt$  vs.  $R_G$

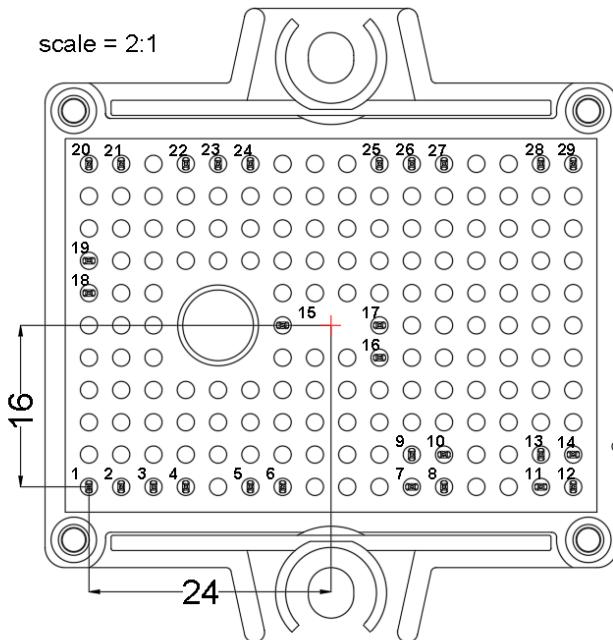
**TYPICAL CHARACTERISTICS – NP COMMUTATION PATH**  
M1/M2 SIC MOSFET SWITCHING CHARACTERISTIC

Figure 41.  $T_{don}$  vs.  $I_D$ Figure 42.  $T_{don}$  vs.  $R_G$ Figure 43.  $T_{doff}$  vs.  $I_D$ Figure 44.  $T_{doff}$  vs.  $R_G$

# **NXH008T120M3F2PTHG**

## **CAUER NETWORKS – M1, M2**

Cauer Element #	M1,2	
	Rth (K/W)	Cth (Ws/K)
1	0.0016488	0.0032258
2	0.0034479	0.0010545
3	0.017527	0.0051619
4	0.051792	0.014565
5	0.094906	0.085644
6	0.055154	1.6903
7	0.034307	4.576

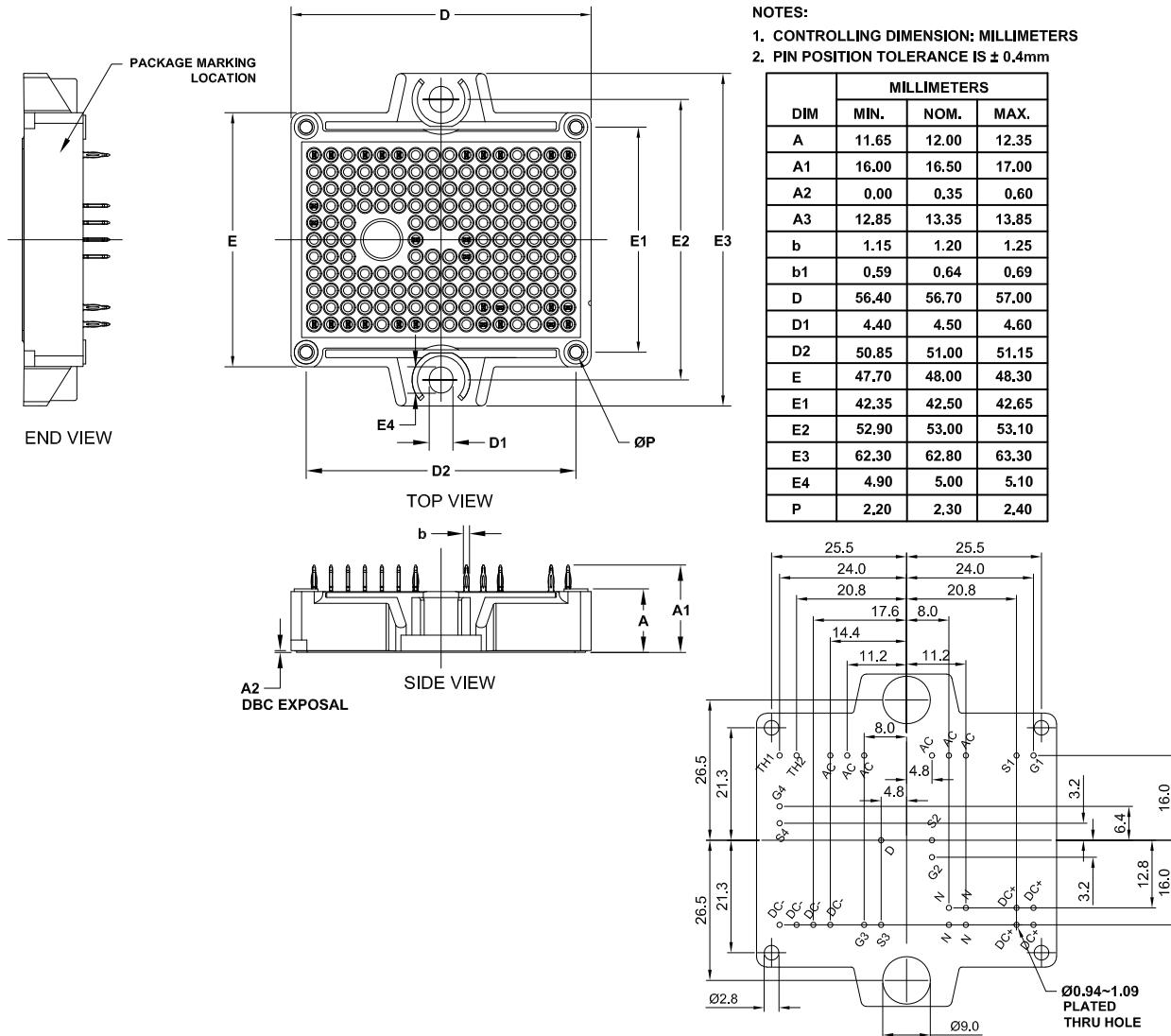

**Figure 45. Pin Connections**
**PIN FUNCTIONS**

Pin #	X	Y	Function		Pin #	X	Y	Function
1	0	0	DC-		16	28.8	12.8	G2
2	3.2	0	DC-		17	28.8	16	S2
3	6.4	0	DC-		18	0	19.2	S4
4	9.6	0	DC-		19	0	22.4	G4
5	16	0	G3		20	0	32	TH1
6	19.2	0	S3		21	3.2	32	TH2
7	32	0	N		22	9.6	32	AC
8	35.2	0	N		23	12.8	32	AC
9	32	3.2	N		24	16	32	AC
10	35.2	3.2	N		25	28.8	32	AC
11	44.8	0	DC+		26	32	32	AC
12	48	0	DC+		27	35.2	32	AC
13	44.8	3.2	DC+		28	44.8	32	S1
14	48	3.2	DC+		29	48	32	G1
15	19.2	16	D					

# NXH008T120M3F2PTHG

## PACKAGE DIMENSIONS

### PIM29, 56.7x42.5 (PRESS FIT) CASE 180HR ISSUE O



**onsemi**, **ONSEMI**, and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "**onsemi**" or its affiliates and/or subsidiaries in the United States and/or other countries. **onsemi** owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of **onsemi**'s product/patent coverage may be accessed at [www.onsemi.com/site/pdf/Patent-Marking.pdf](http://www.onsemi.com/site/pdf/Patent-Marking.pdf). **onsemi** reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided "as-is" and **onsemi** makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or suitability of its products for any particular purpose, nor does **onsemi** assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using **onsemi** products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by **onsemi**. "Typical" parameters which may be provided in **onsemi** data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. **onsemi** does not convey any license under any of its intellectual property rights nor the rights of others. **onsemi** products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use **onsemi** products for any such unintended or unauthorized application, Buyer shall indemnify and hold **onsemi** and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that **onsemi** was negligent regarding the design or manufacture of the part. **onsemi** is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

## ADDITIONAL INFORMATION

### TECHNICAL PUBLICATIONS:

Technical Library: [www.onsemi.com/design/resources/technical-documentation](http://www.onsemi.com/design/resources/technical-documentation)  
onsemi Website: [www.onsemi.com](http://www.onsemi.com)

### ONLINE SUPPORT: [www.onsemi.com/support](http://www.onsemi.com/support)

For additional information, please contact your local Sales Representative at  
[www.onsemi.com/support/sales](http://www.onsemi.com/support/sales)