Silicon Carbide (SiC) Module – EliteSiC, 6 mohm, 1200 V, SiC M3 MOSFET, 2-PACK Half Bridge Topology, F2 Package with HPS DBC

NXH006P120M3F2PTHG

The NXH006P120M3F2PTHG is a power module containing 6 mΩ / 1200 V SiC MOSFET half–bridge and a thermistor with HPS DBC in an F2 package.

Features

- 6 mΩ / 1200 V M3S SiC MOSFET Half–Bridge
- HPS DBC
- Thermistor
- Pre–Applied Thermal Interface Material (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

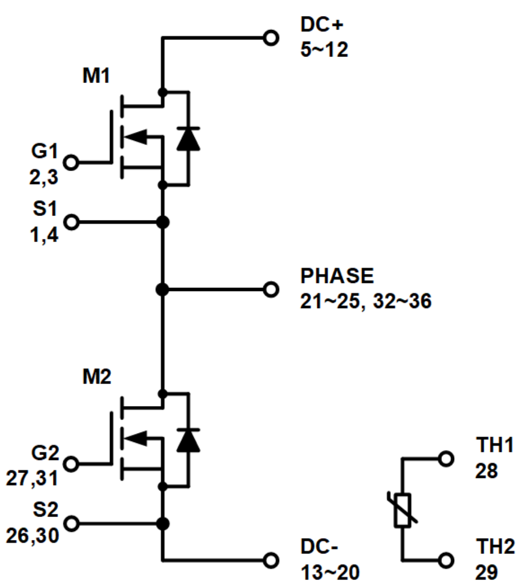
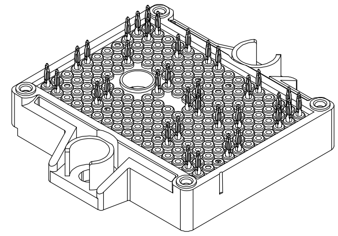


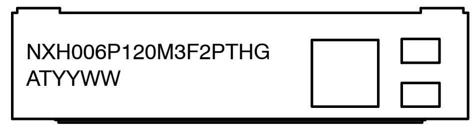
Figure 1. NXH006P120M3F2 Schematic Diagram

PACKAGE PICTURE



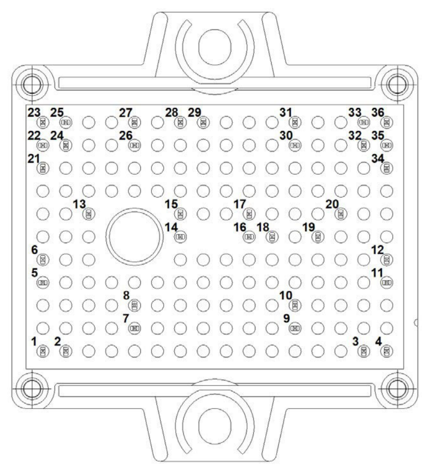
PIM36 56.7x42.5 (PRESS FIT)
CASE 180BY

MARKING DIAGRAM



NXH006P120M3F2PTHG	= Specific Device Code
AT	= Assembly & Test Site Code
YWW	= 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.

PIN FUNCTION DESCRIPTION

Pin	Name	Description
1	S1	Q1 Kelvin Emitter (High side switch)
2	G1	Q1 Gate (High side switch)
3	G1	Q1 Gate (High side switch)
4	S1	Q1 Kelvin Emitter (High side switch)
5	DC+	DC Positive Bus connection
6	DC+	DC Positive Bus connection
7	DC+	DC Positive Bus connection
8	DC+	DC Positive Bus connection
9	DC+	DC Positive Bus connection
10	DC+	DC Positive Bus connection
11	DC+	DC Positive Bus connection
12	DC+	DC Positive Bus connection
13	DC−	DC Negative Bus connection
14	DC−	DC Negative Bus connection
15	DC−	DC Negative Bus connection
16	DC−	DC Negative Bus connection
17	DC−	DC Negative Bus connection
18	DC−	DC Negative Bus connection
19	DC−	DC Negative Bus connection
20	DC−	DC Negative Bus connection
21	PHASE	Center point of half bridge
22	PHASE	Center point of half bridge
23	PHASE	Center point of half bridge
24	PHASE	Center point of half bridge
25	PHASE	Center point of half bridge
26	S2	Q2 Kelvin Emitter (Low side switch)
27	G2	Q2 Gate (Low side switch)
28	TH1	Thermistor Connection 1
29	TH2	Thermistor Connection 2
30	S2	Q2 Kelvin Emitter (Low side switch)
31	G2	Q2 Gate (Low side switch)
32	PHASE	Center point of half bridge
33	PHASE	Center point of half bridge
34	PHASE	Center point of half bridge
35	PHASE	Center point of half bridge
36	PHASE	Center point of half bridge

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	191	A
Pulsed Drain Current (T_J = 175°C)	I_{Dpulse}	382	A
Maximum Power Dissipation @ T_c = 80°C (T_J = 175°C)	P_{tot}	556	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
TIM Layer Thickness	T_{TIM}	160 ±20	μm
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		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	°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	I_{DSS}	–	–	300	μA
Drain−Source On Resistance	V_{GS} = 18 V, I_D = 100 A, T_J = 25°C	$R_{DS(ON)}$	–	6.5	8	mΩ
	V_{GS} = 18 V, I_D = 100 A, T_J = 125°C		–	10.8	–	
	V_{GS} = 18 V, I_D = 100 A, T_J = 150°C		–	12.4	–	
	V_{GS} = 18 V, I_D = 100 A, T_J = 175°C		–	14.6	–	
Gate−Source Threshold Voltage	V_{GS} = V_{DS}, I_D = 80 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}	−400	–	400	nA
Input Capacitance	V_{DS} = 800 V, V_{GS} = 0 V, f = 100 kHz	C_{ISS}	–	11914	–	pF
Reverse Transfer Capacitance		C_{RSS}	–	48	–	
Output Capacitance		C_{OSS}	–	669	–	

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

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
SiC MOSFET CHARACTERISTICS						
Total Gate Charge	V_{DS} = 800 V, V_{GS} = –5/20 V, I_D = 100 A	$Q_{G(TOTAL)}$	–	622	–	nC
Gate–Source Charge		Q_{GS}	–	109	–	nC
Gate–Drain Charge		Q_{GD}	–	120	–	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 Ω	$t_{d(on)}$	–	40.53	–	ns
Rise Time		t_r	–	13.61	–	
Turn–off Delay Time		$t_{d(off)}$	–	109	–	
Fall Time		t_f	–	8.54	–	
Turn–on Switching Loss per Pulse		E_{ON}	–	0.89	–	mJ
Turn–off Switching Loss per Pulse		E_{OFF}	–	0.44	–	
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 Ω	$t_{d(on)}$	–	38.21	–	ns
Rise Time		t_r	–	12.92	–	
Turn–off Delay Time		$t_{d(off)}$	–	118	–	
Fall Time		t_f	–	8.73	–	
Turn–on Switching Loss per Pulse		E_{ON}	–	1.12	–	mJ
Turn–off Switching Loss per Pulse		E_{OFF}	–	0.44	–	
Diode Forward Voltage	I_D = 100 A, T_J = 25°C	V_{SD}	–	5.31	7.5	V
	I_D = 100 A, T_J = 125°C		–	4.91	–	
	I_D = 100 A, T_J = 150°C		–	4.82	–	
Thermal Resistance – Chip–to–Case	M1, M2	R_{thJC}	–	0.171	–	°C/W
Thermal Resistance – Chip–to–Heatsink	Thermal grease, Thickness = 2 Mil +2%, A = 2.8 W/mK	R_{thJH}	–	0.288	–	°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.

ORDERING INFORMATION

Orderable Part Number	Marking	Package	Shipping
NXH006P120M3F2PTHG	NXH006P120M3F2PTHG	F2HALFBR: Case 180BY Press–fit Pins with pre–applied thermal interface material (TIM) (Pb-Free / Halide Free)	20 Units / Blister Tray

TYPICAL CHARACTERISTIC

(M1/M2 SiC MOSFET CHARACTERISTIC)

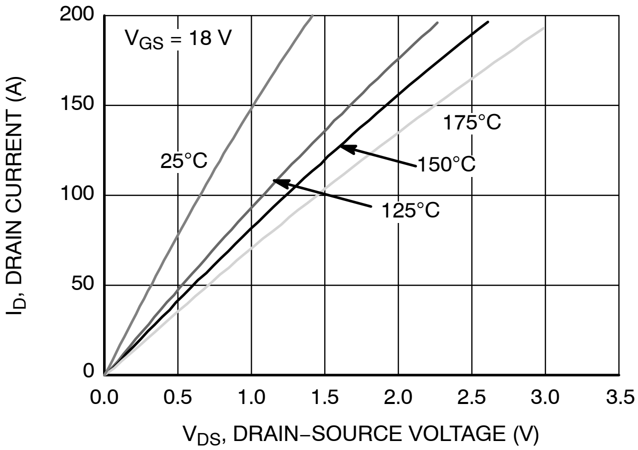


Figure 2. MOSFET Typical Output Characteristic

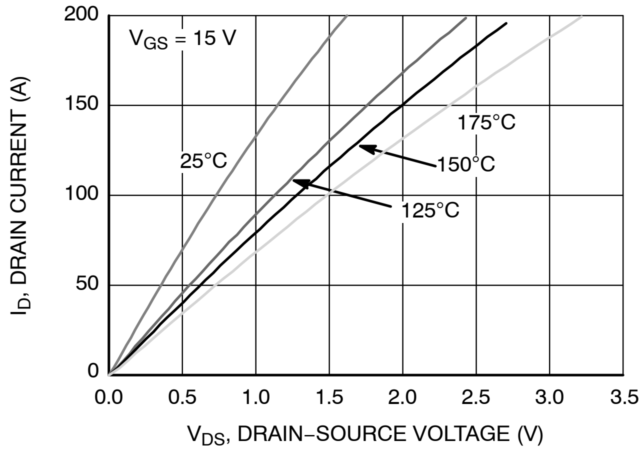


Figure 3. MOSFET Typical Output Characteristic

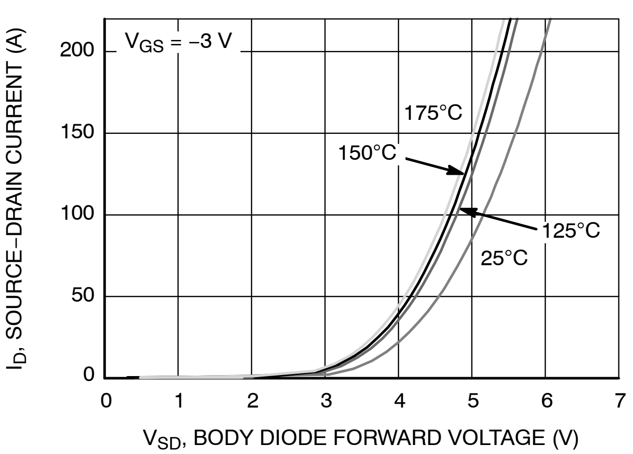


Figure 4. MOSFET Typical Transfer Characteristic

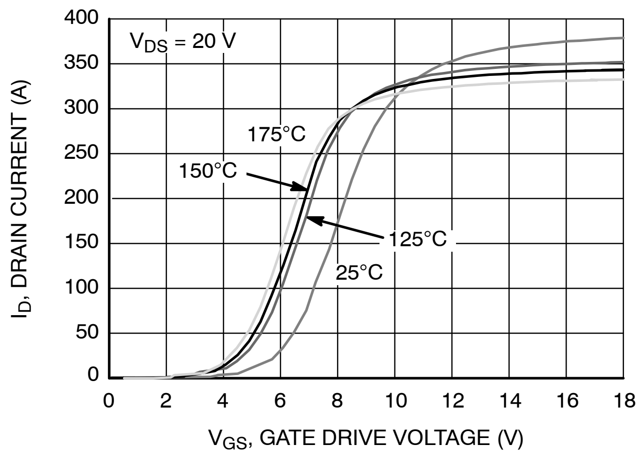


Figure 5. Body Diode Forward Characteristic

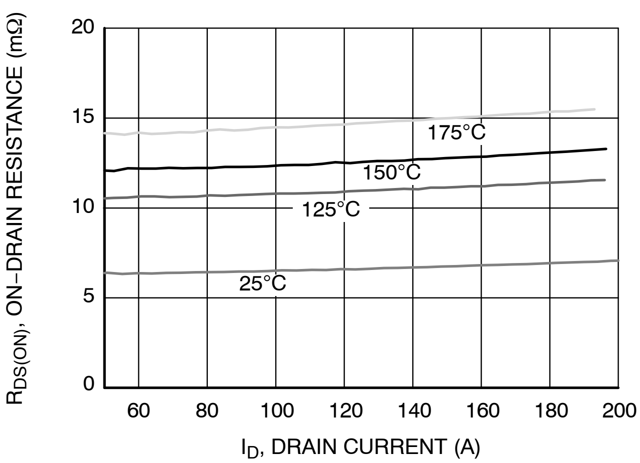


Figure 6. MOSFET $R_{DS(ON)}$ vs. I_D

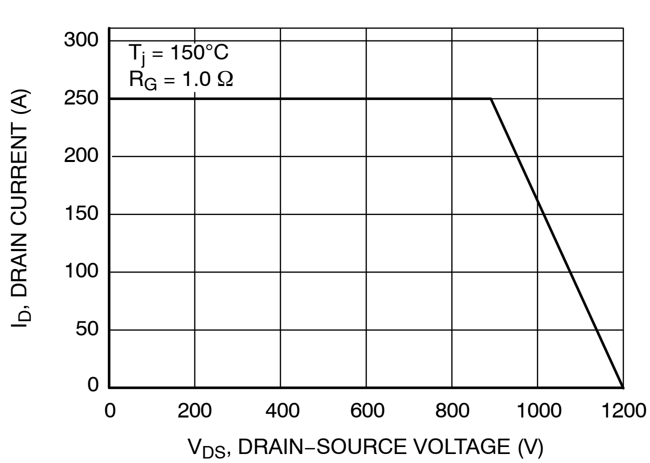


Figure 7. MOSFET RBSOA

TYPICAL CHARACTERISTIC

(M1/M2 SiC MOSFET CHARACTERISTIC)

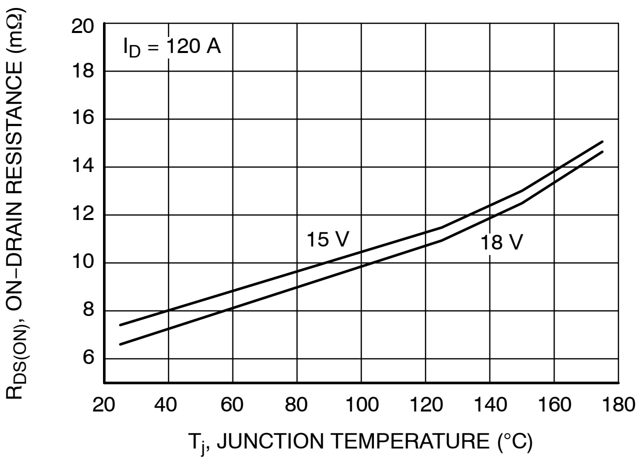


Figure 8. MOSFET $R_{DS(ON)}$ vs. T_j

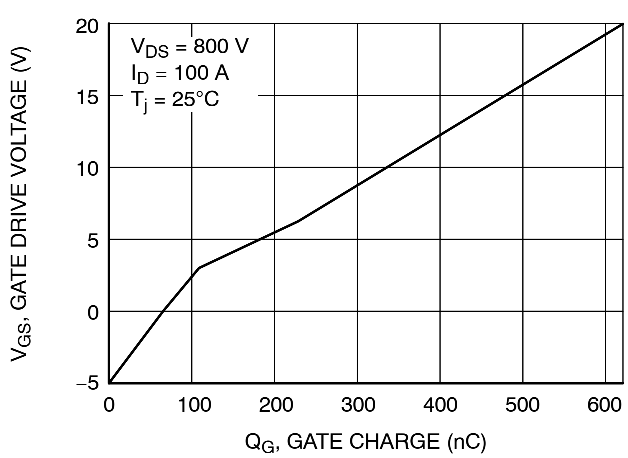


Figure 9. Gate−to−Source Voltage vs. Total Charge

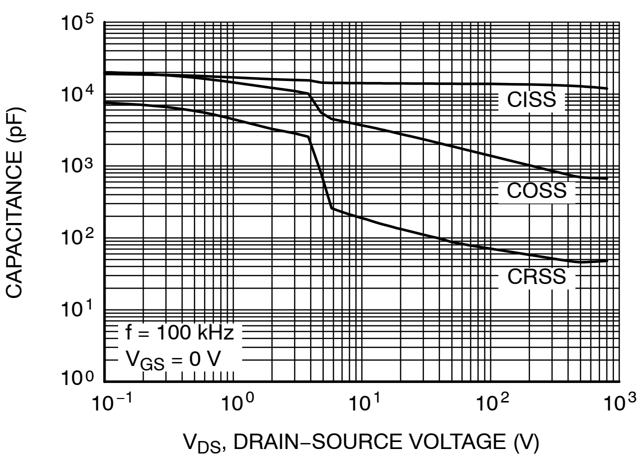


Figure 10. Capacitance vs. Drain−to−Source Voltage

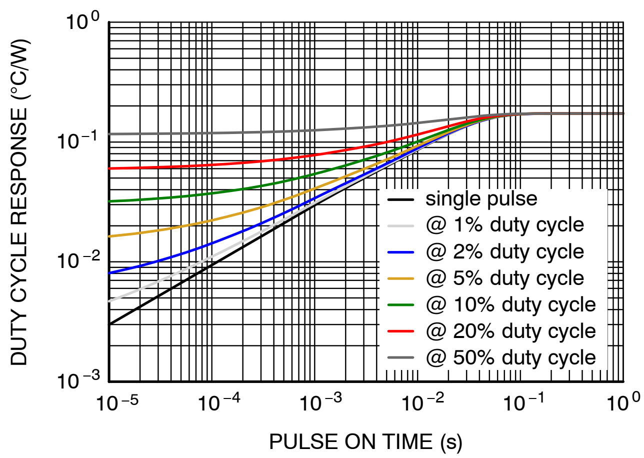


Figure 11. MOSFET Junction−to−Case Transient Thermal Impedance

TYPICAL CHARACTERISTIC

(M1/M1 SiC MOSFET SWITCHING CHARACTERISTIC)

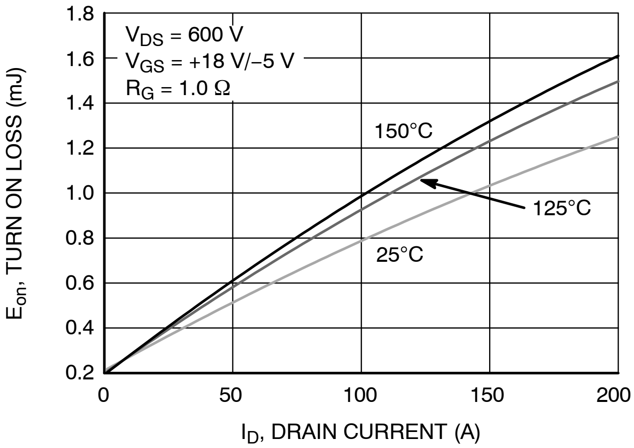


Figure 12. Typical Switching Loss E_{on} vs. I_D

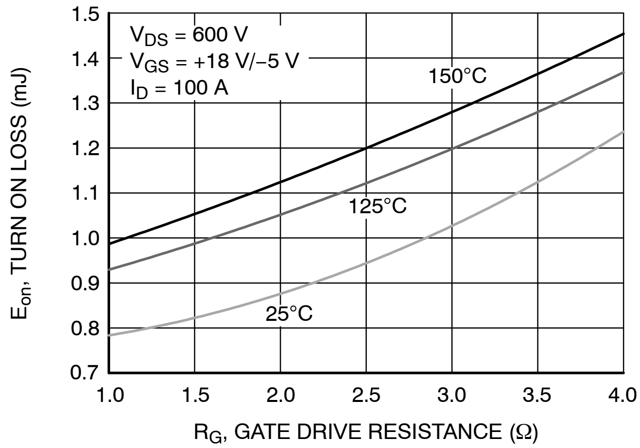


Figure 13. Typical Switching Loss E_{on} vs. R_G

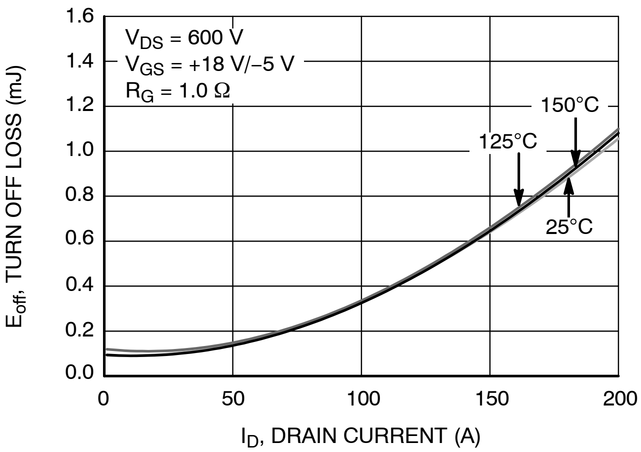


Figure 14. Typical Switching Loss E_{off} vs. I_D

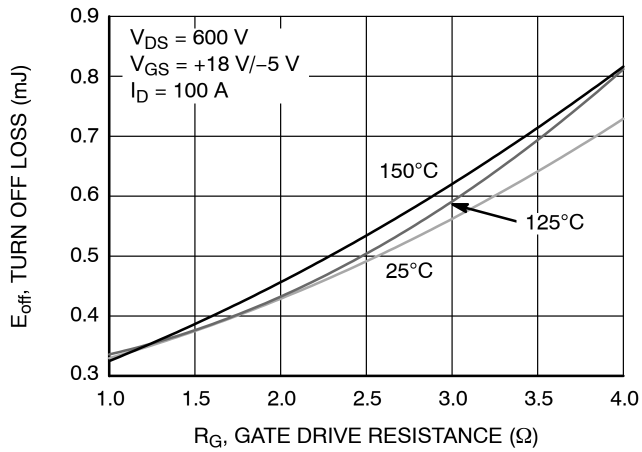


Figure 15. Typical Switching Loss E_{off} vs. R_G

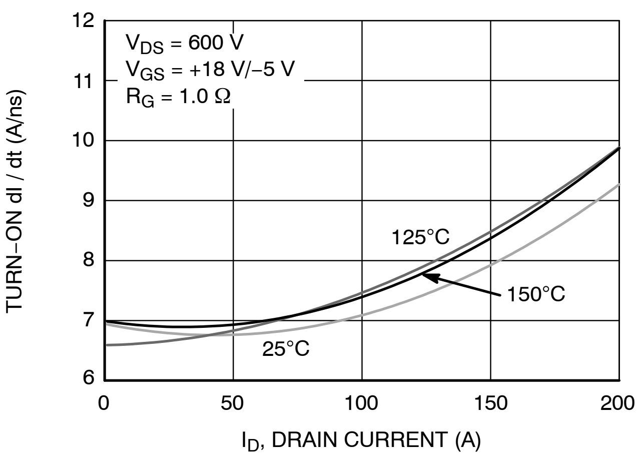


Figure 16. di/dt ON vs. I_D

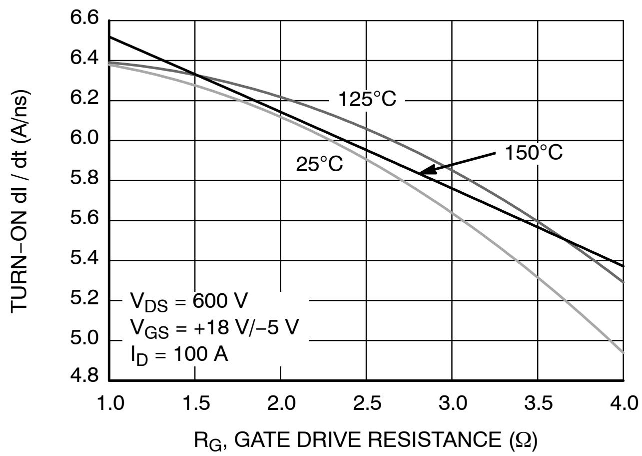


Figure 17. di/dt ON vs. I_D vs. R_G

TYPICAL CHARACTERISTIC

(M1/M1 SiC MOSFET SWITCHING CHARACTERISTIC)

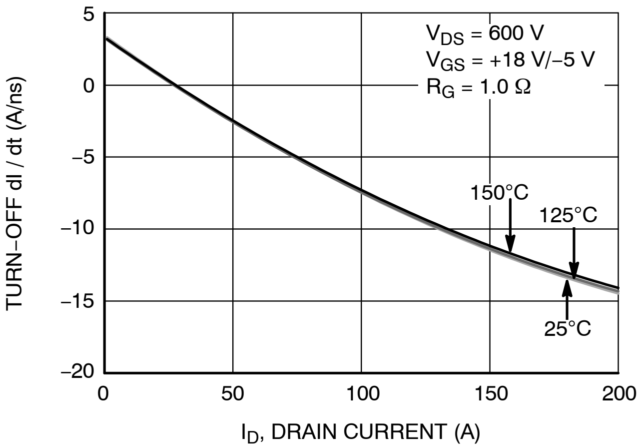


Figure 18. di/dt OFF vs. I_D

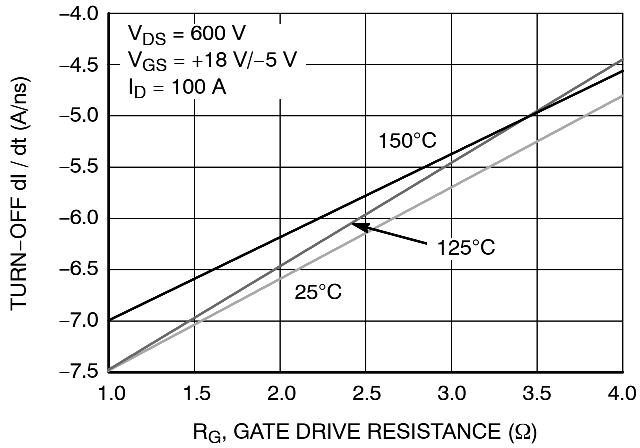


Figure 19. di/dt OFF vs. R_G

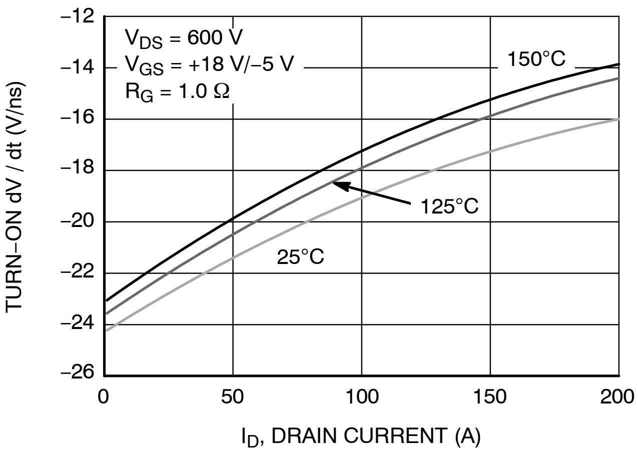


Figure 20. dv/dt ON vs. I_D

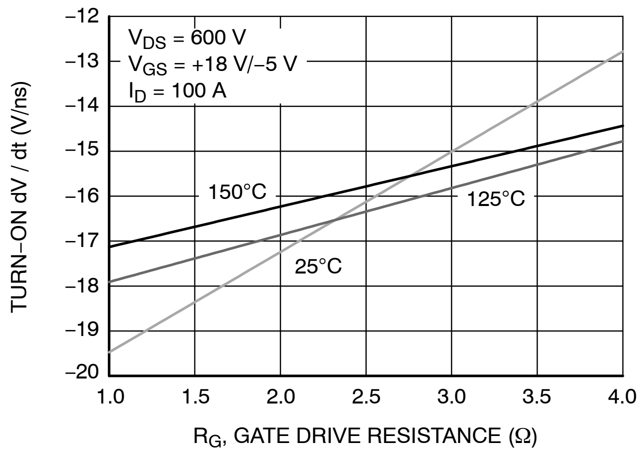


Figure 21. dv/dt ON vs. R_G

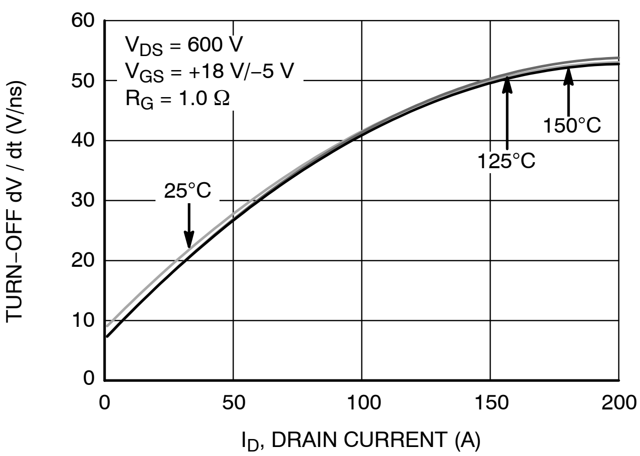


Figure 22. dv/dt OFF vs. I_D vs. I_D

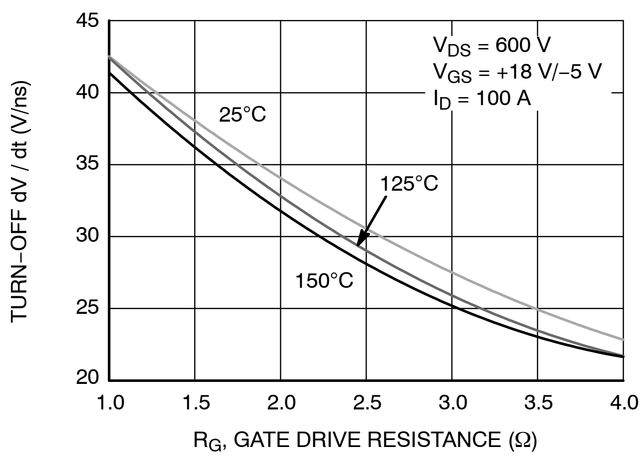


Figure 23. dv/dt OFF vs. I_D vs. R_G

TYPICAL CHARACTERISTIC

(M1/M1 SiC MOSFET SWITCHING CHARACTERISTIC)

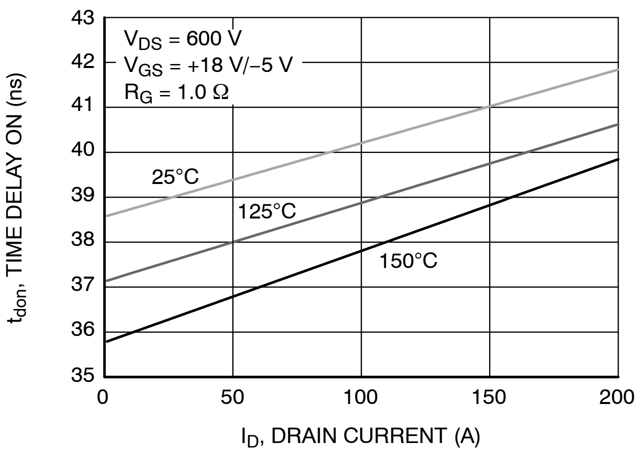


Figure 24. Typical Switching Loss t_{don} vs. I_D

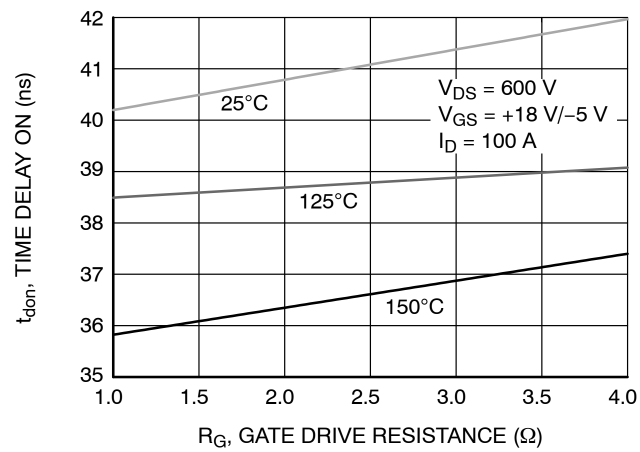


Figure 25. Typical Switching Loss t_{don} vs. R_G

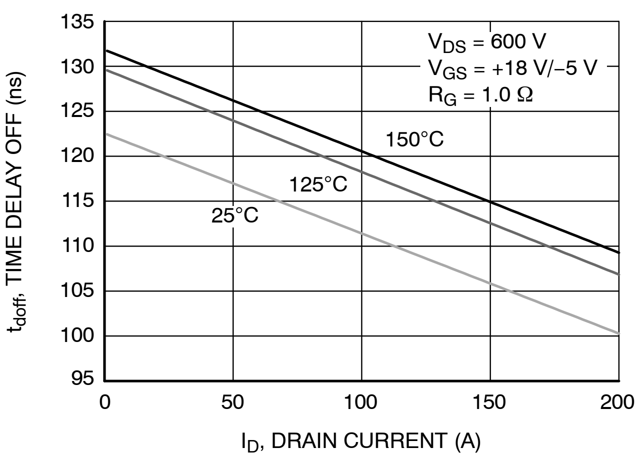


Figure 26. Typical Switching Loss t_{doff} vs. I_D

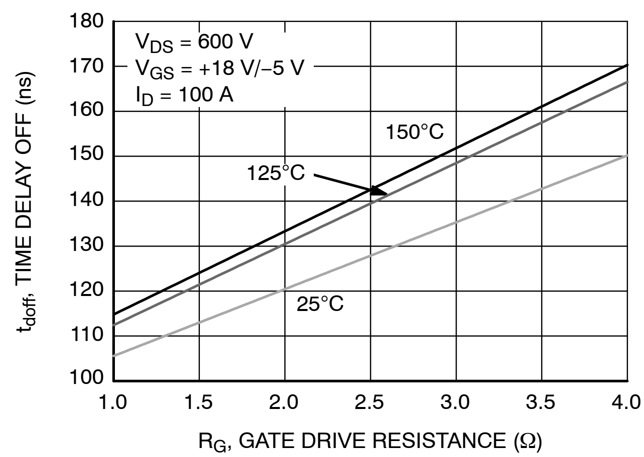


Figure 27. Typical Switching Loss t_{doff} vs. R_G

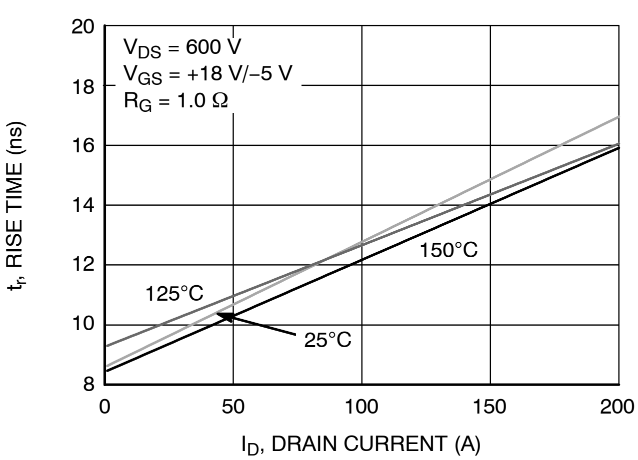


Figure 28. Typical Switching Loss t_r vs. I_D

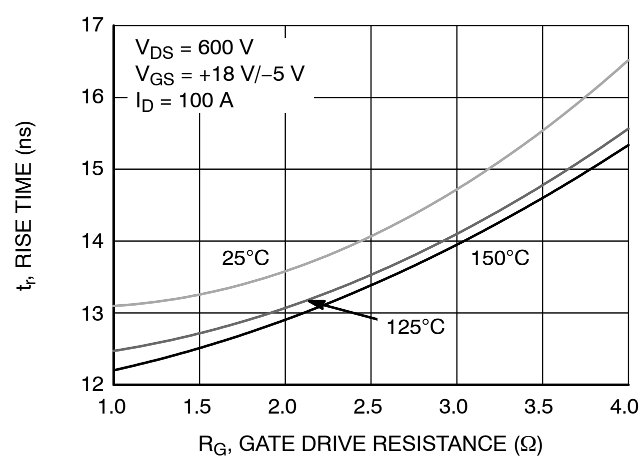


Figure 29. Typical Switching Loss t_r vs. R_G

TYPICAL CHARACTERISTIC

(M1/M1 SiC MOSFET SWITCHING CHARACTERISTIC)

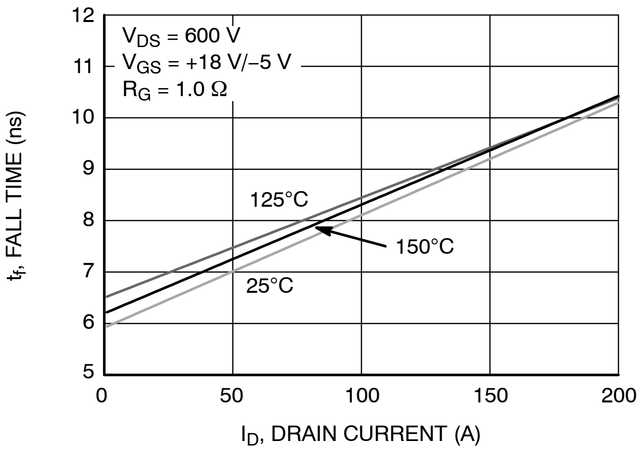


Figure 30. Typical Switching Loss t_f vs. I_D

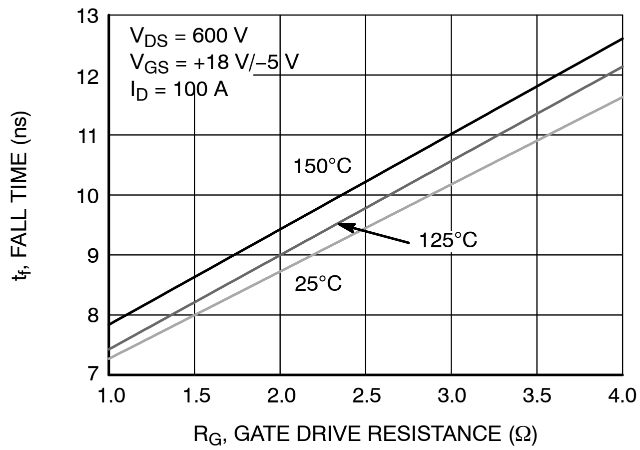


Figure 31. Typical Switching Loss t_f vs. R_G

Table 1. FOSTER NETWORKS – M1, M2

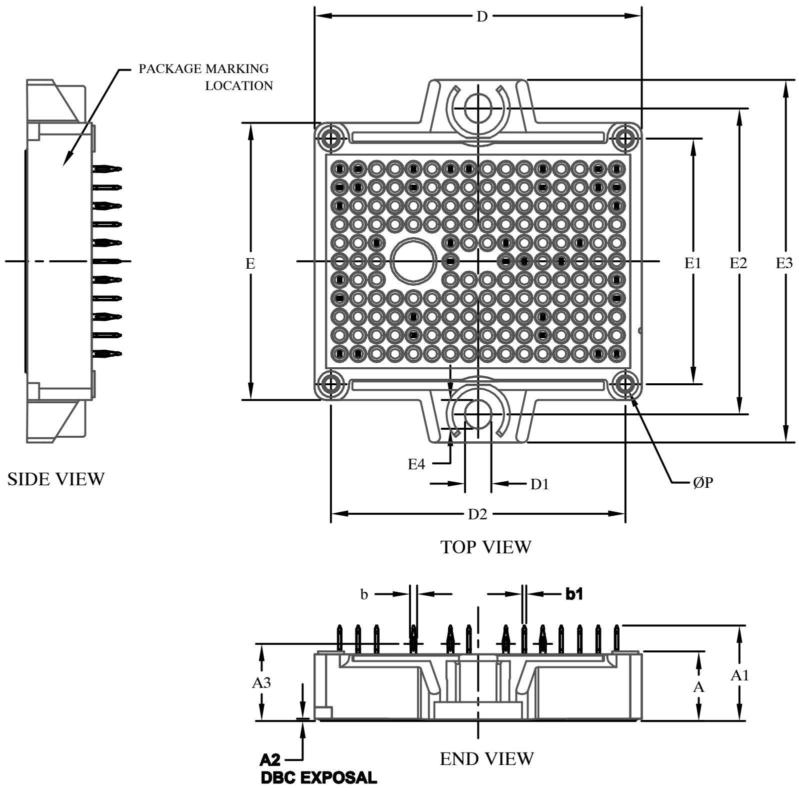
Foster Element #	M1		M2	
	Rth (K/W)	Cth (Ws/K)	Rth (K/W)	Cth (Ws/K)
1	0.007128913	0.014726553	0.007362625	0.014806718
2	0.012161919	0.065733420	0.012250209	0.068123520
3	0.007181004	0.193791778	0.008111627	0.172318664
4	0.016285510	0.295329029	0.015759800	0.310819905
5	0.129692183	0.184203426	0.130218477	0.185033159

Table 2. CAUER NETWORKS – M1, M2

Cauer Element #	M1		M2	
	Rth (K/W)	Cth (Ws/K)	Rth (K/W)	Cth (Ws/K)
1	0.014060112	0.010299454	0.014544451	0.010347568
2	0.031541811	0.030614887	0.032745986	0.030654208
3	0.047951752	0.086377861	0.047636505	0.089568373
4	0.041739058	0.071218233	0.042559339	0.069836041
5	0.037156796	0.209773695	0.036216457	0.216319284

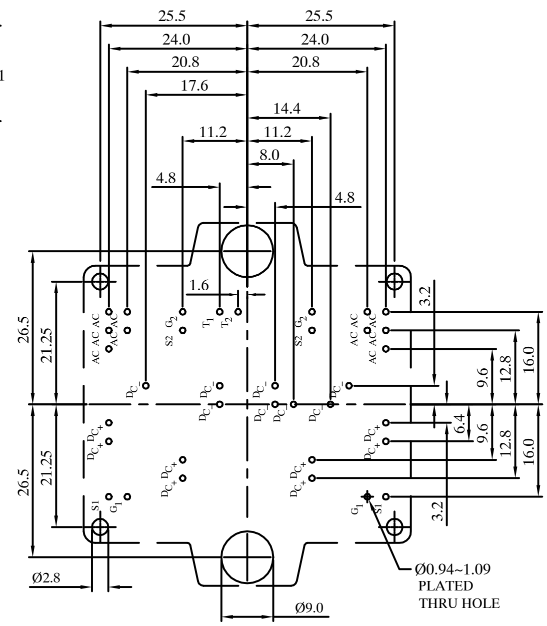
PACKAGE DIMENSIONS

PIM36 56.7x42.5 (PRESS FIT)
CASE 180BY
ISSUE C



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	56.40	56.70	57.00
D1	4.40	4.50	4.60
D2	50.85	51.00	51.15
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



RECOMMENDED MOUNTING PATTERN

ADDITIONAL INFORMATION

TECHNICAL PUBLICATIONS:
Technical Library: www.onsemi.com/design/resources/technical−documentation
onsemi Website: www.onsemi.com

ONLINE SUPPORT: www.onsemi.com/support
For additional information, please contact your local Sales Representative at www.onsemi.com/support/sales