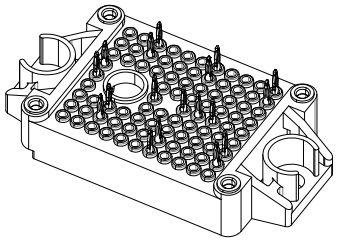
Silicon Carbide (SiC) Module – EliteSiC, 10 mohm SiC M1 MOSFET, 1200 V, 2-PACK Half Bridge Topology, F1 Package

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 4 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/1200 V 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

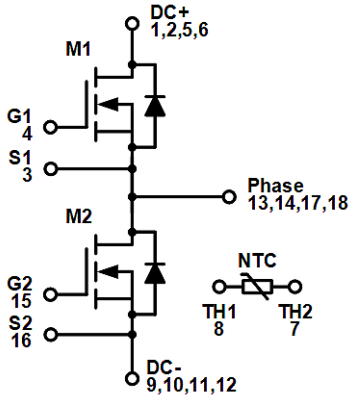


Figure 1. NXH010P120MNF1 Schematic Diagram

PIN CONNECTIONS

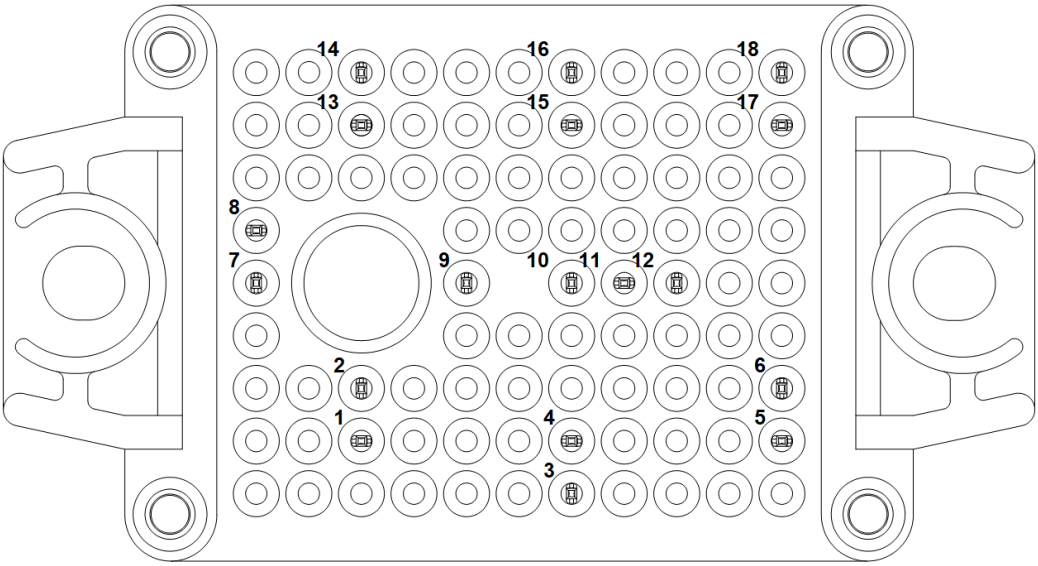


Figure 2. Pin Connections

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}	228	A
Maximum Power Dissipation @ T_c = 80°C (T_J = 175°C)	P_{tot}	413	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 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} = −5 V/18 V, R_G = 2 Ω	$t_{d(on)}$	–	36	–	ns
Rise Time		t_r	–	16.2	–	
Turn−off Delay Time		$t_{d(off)}$	–	135.2	–	
Fall Time		t_f	–	13	–	
Turn−on Switching Loss per Pulse		E_{ON}	–	1.47	–	mJ
Turn off Switching Loss per Pulse		E_{OFF}	–	0.33	–	
Turn−on Delay Time	T_J = 150°C V_{DS} = 600 V, I_D = 100 A V_{GS} = −5 V/18 V, R_G = 2 Ω	$t_{d(on)}$	–	30.5	–	ns
Rise Time		t_r	–	15.2	–	
Turn−off Delay Time		$t_{d(off)}$	–	149	–	
Fall Time		t_f	–	15	–	
Turn−on Switching Loss per Pulse		E_{ON}	–	1.77	–	mJ
Turn off Switching Loss per Pulse		E_{OFF}	–	0.41	–	
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	–	
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_{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	Specific Device Marking	Package Type	Shipping†
NXH010P120MNF1PNG	NXH010P120MNF1PNG	F1−2PACK: Case 180BW Press−fit Pins, Ni−Plated DBC (Pb−Free and Halide−Free)	28 Units / Blister Tray
NXH010P120MNF1PTNG	NXH010P120MNF1PTNG	F1−2PACK: Case 180BW Press−fit Pins, Ni−Plated DBC with pre−applied thermal interface material (TIM) (Pb−Free and Halide−Free)	28 Units / Blister Tray
NXH010P120MNF1PG	NXH010P120MNF1PG	F1−2PACK: Case 180BW Press−fit Pins, Copper DBC (Pb−Free and Halide−Free)	28 Units / Blister Tray
NXH010P120MNF1PTG	NXH010P120MNF1PTG	F1−2PACK: Case 180BW Press−fit Pins, Copper DBC with pre−applied thermal interface material (TIM) (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.

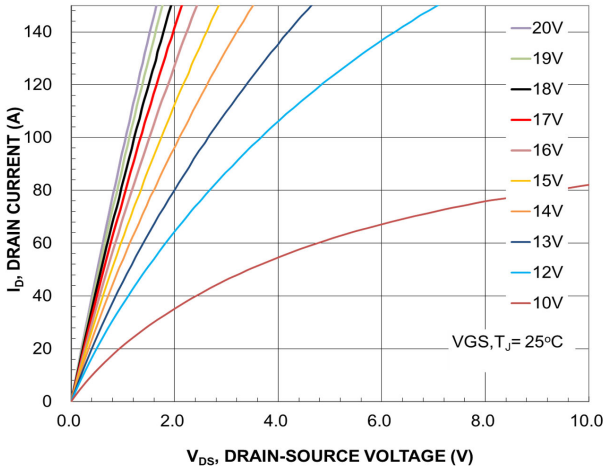


Figure 3. MOSFET Typical Output Characteristics

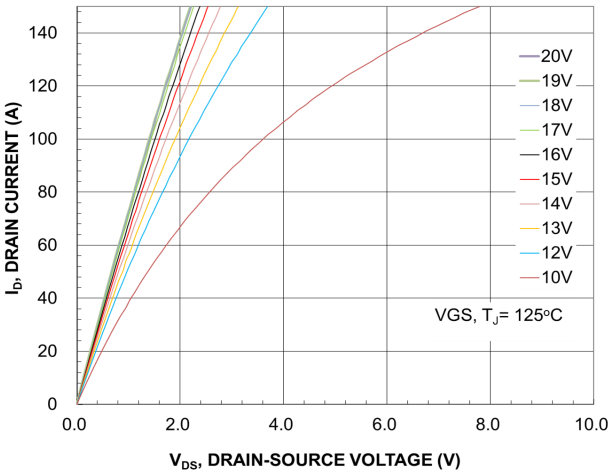


Figure 4. MOSFET Typical Output Characteristics

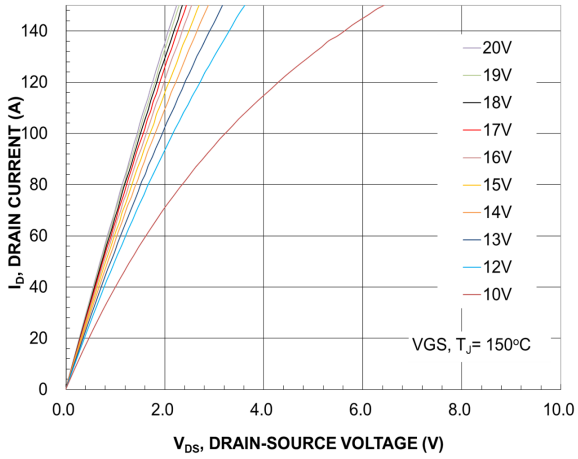


Figure 5. MOSFET Typical Output Characteristics

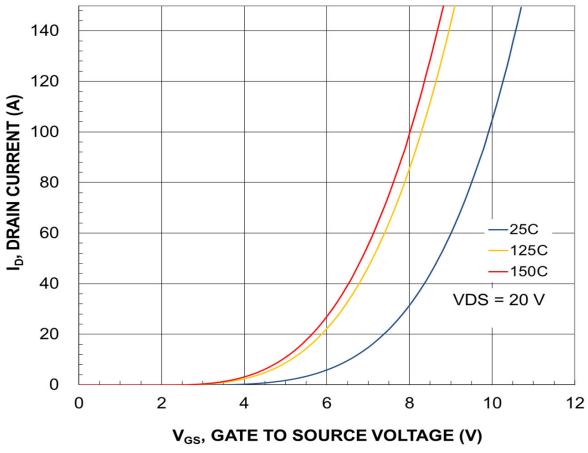


Figure 6. MOSFET Typical Transfer Characteristics

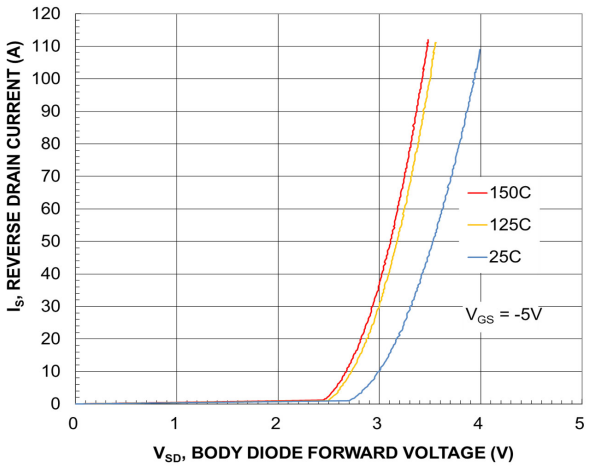


Figure 7. Body Diode Forward Characteristic

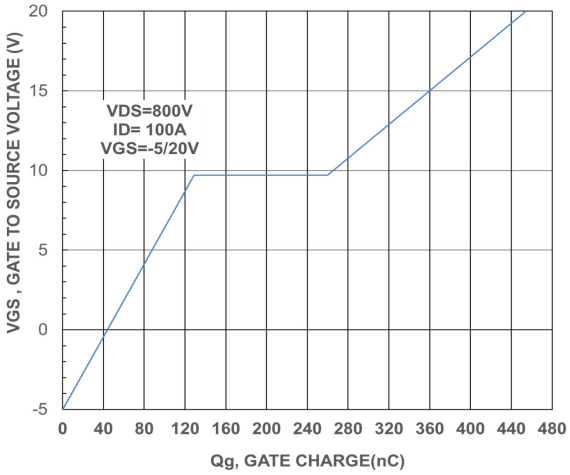


Figure 8. Gate−to−Source Voltage vs. Total Charge

TYPICAL CHARACTERISTICS

SIC MOSFET (M1, M2)

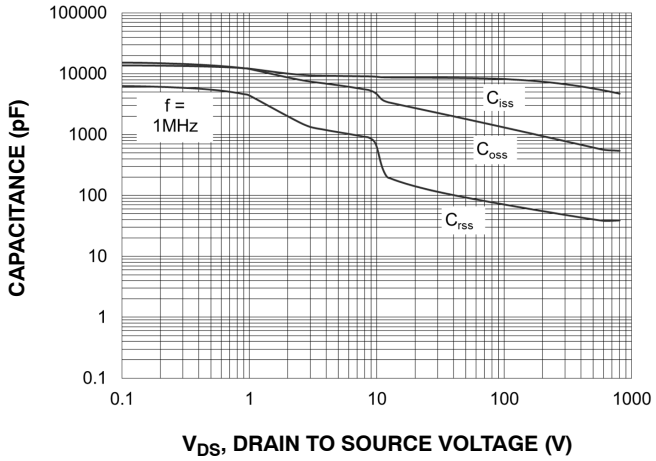


Figure 9. Capacitance vs. Drain−to−Source Voltage

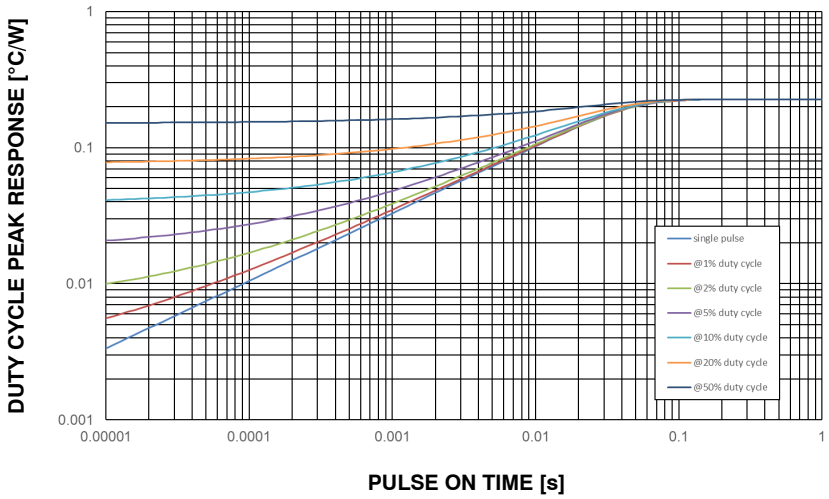


Figure 10. SiC Mosfet Junction− to−Case Transient Thermal Impedance

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

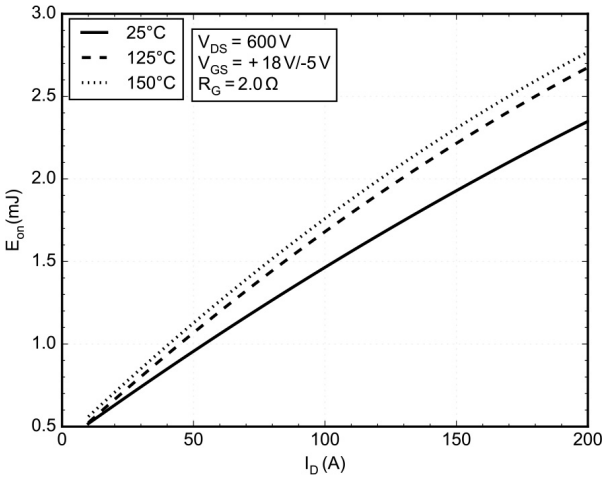


Figure 12. Typical Switching Loss E_{ON} vs. ID

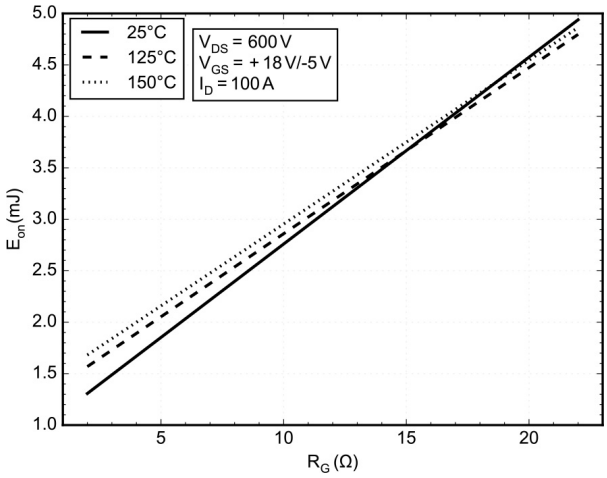


Figure 13. Typical Switching Loss E_{ON} vs. R_G

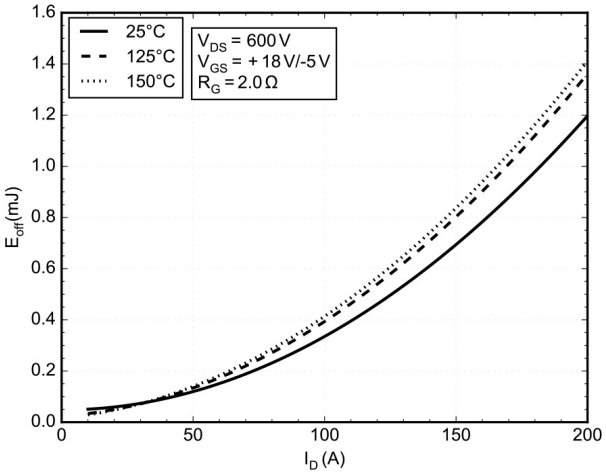


Figure 14. Typical Switching Loss E_{Off} vs. ID

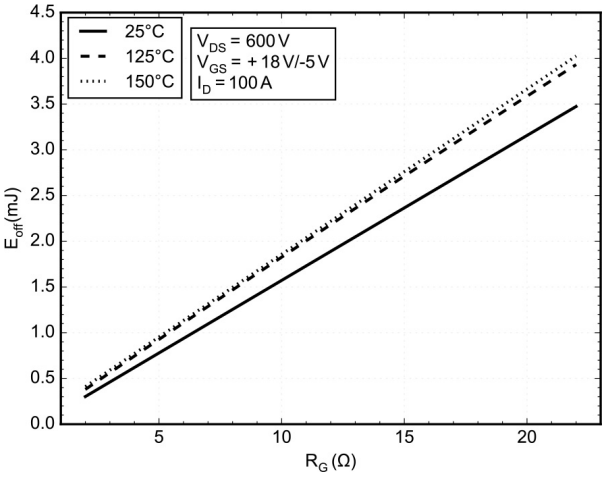


Figure 15. Typical Switching Loss E_{Off} vs. R_G

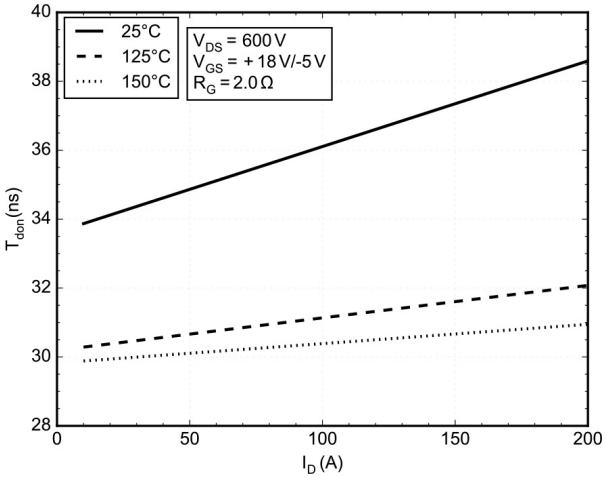


Figure 16. Typical Turn−On Switching T_{don} vs. ID

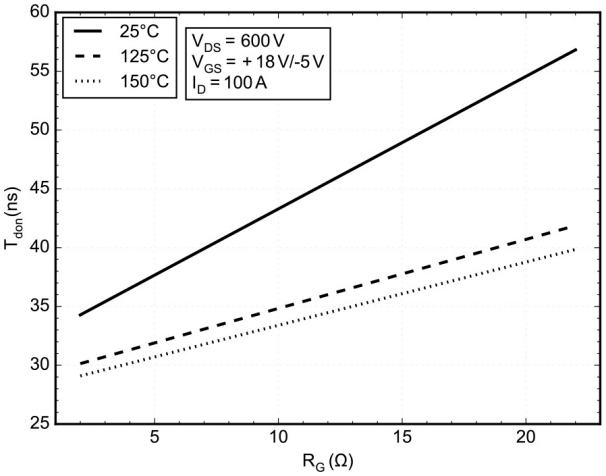


Figure 17. Typical Turn−On Switching T_{don} vs. R_G

TYPICAL CHARACTERISTICS

M1/M2 MOSFET SWITCHING CHARACTERISTICS

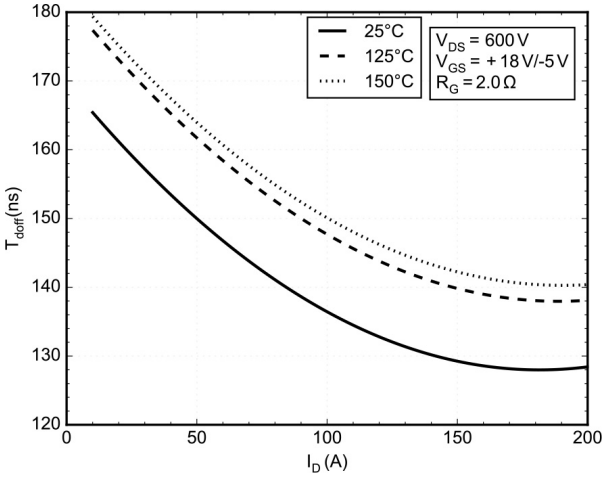


Figure 18. Typical Turn−Off Switching T_{doff} vs. ID

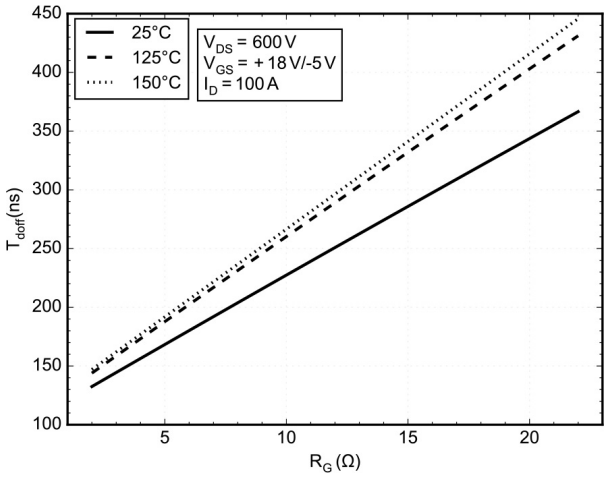


Figure 19. Typical Turn−Off Switching T_{doff} vs. R_G

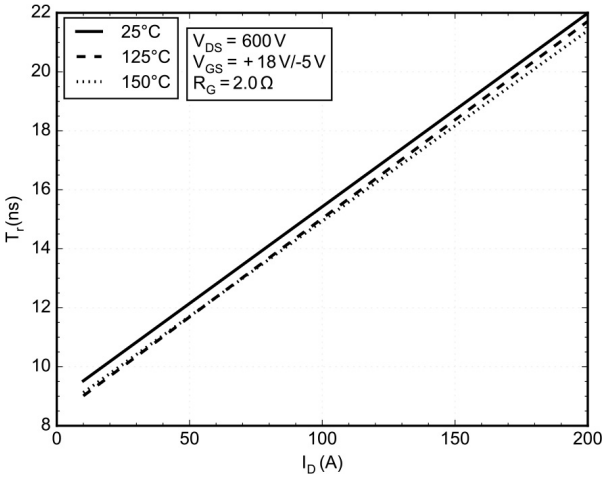


Figure 20. Typical Turn−On Switching T_r vs. ID

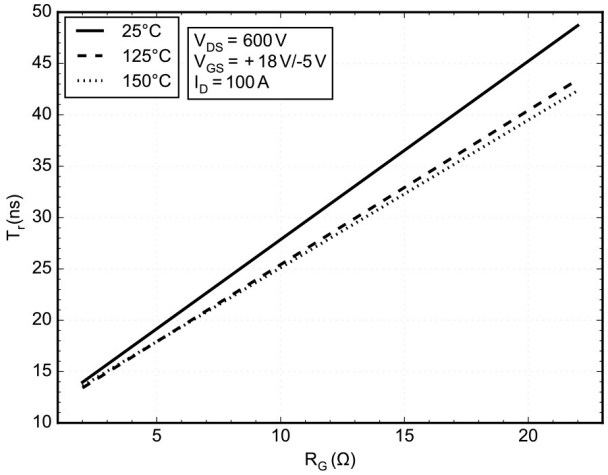


Figure 21. Typical Turn−On Switching T_r vs. R_G

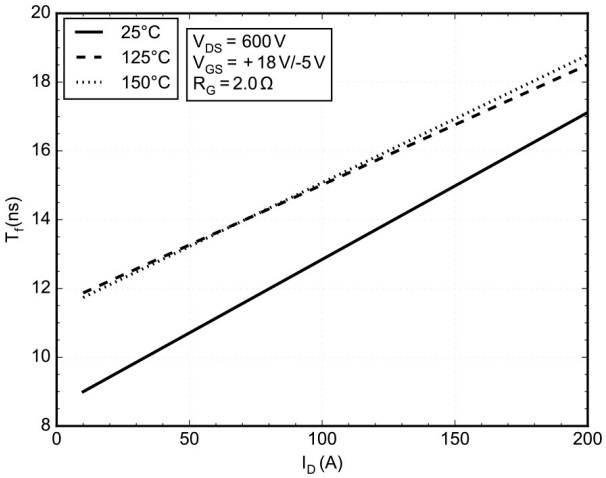


Figure 22. Typical Turn−Off Switching T_f vs. ID

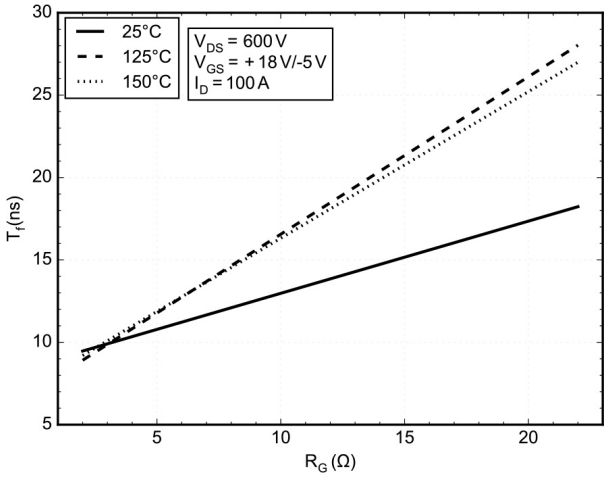


Figure 23. Typical Turn−Off Switching T_f vs. R_G

TYPICAL CHARACTERISTICS

M1/M2 MOSFET SWITCHING CHARACTERISTICS

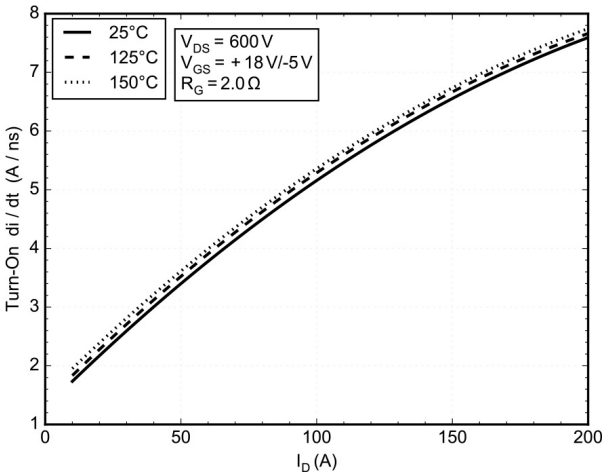


Figure 24. di/dt ON vs. ID

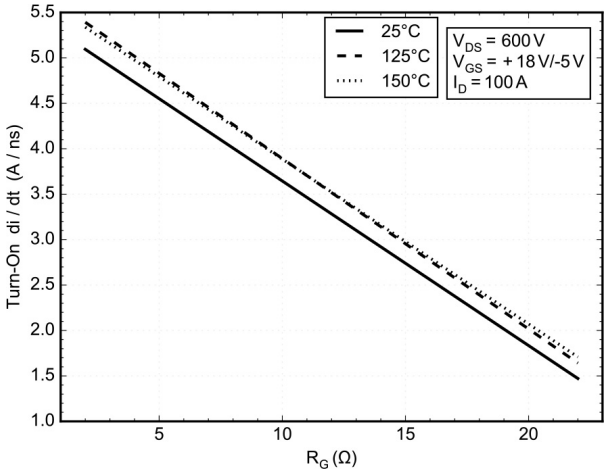


Figure 25. di/dt ON vs. R_G

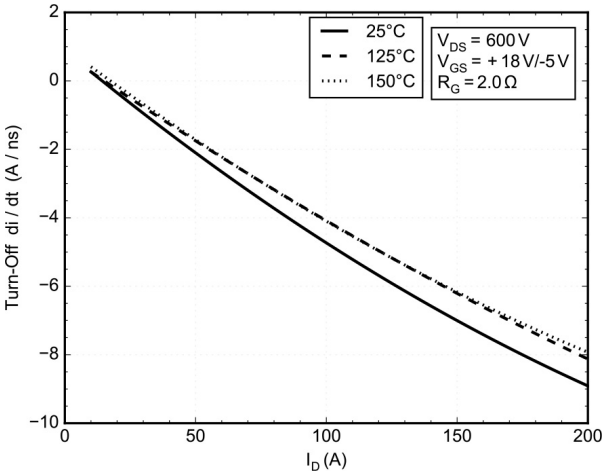


Figure 26. di/dt OFF vs. ID

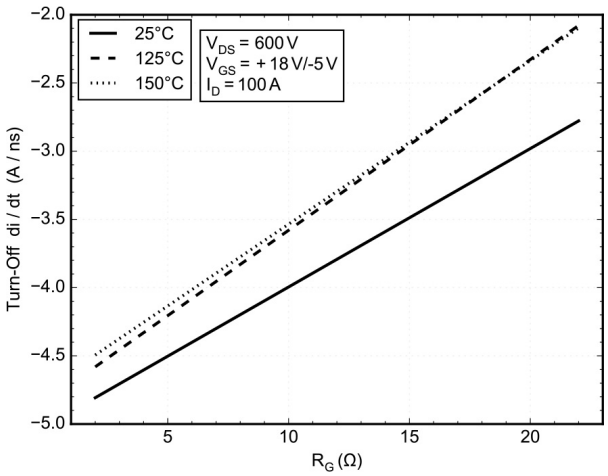


Figure 27. di/dt OFF vs. R_G

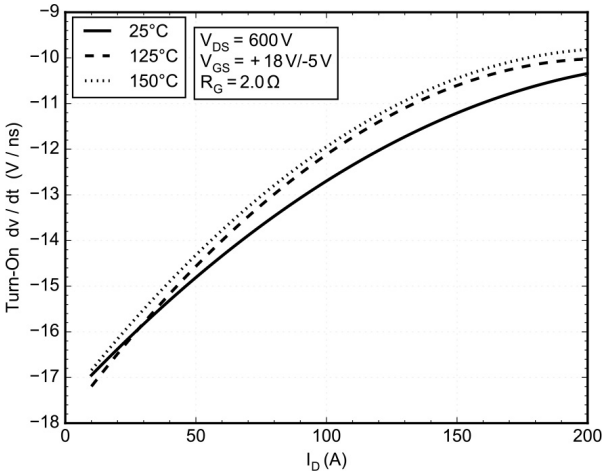


Figure 28. dv/dt ON vs. ID

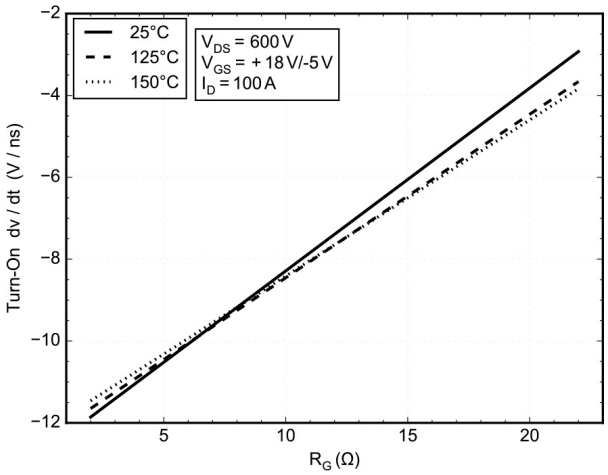


Figure 29. dv/dt ON vs. R_G

TYPICAL CHARACTERISTICS

M1/M2 MOSFET SWITCHING CHARACTERISTICS

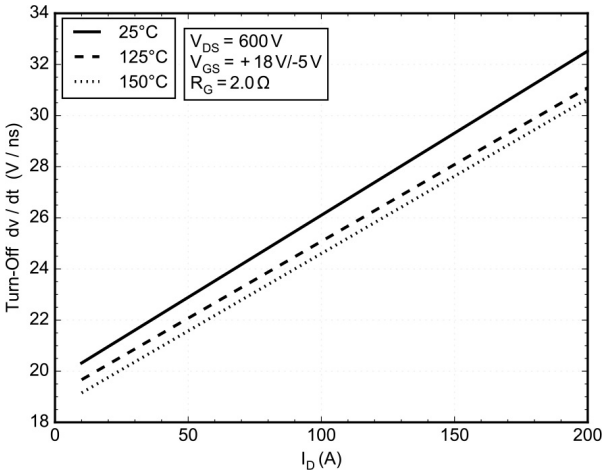


Figure 30. dv/dt OFF vs ID

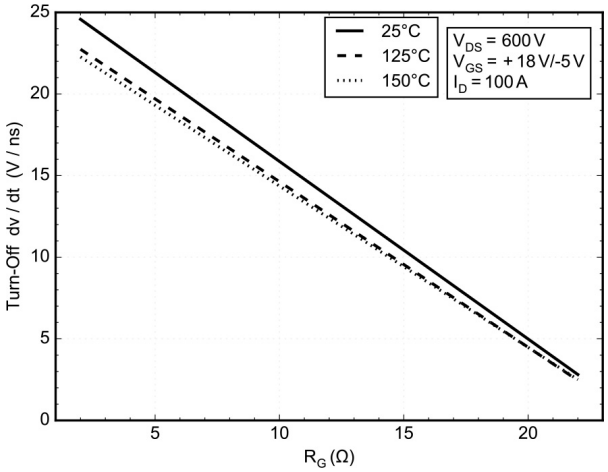
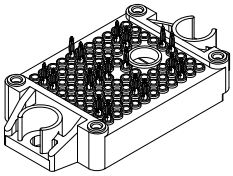


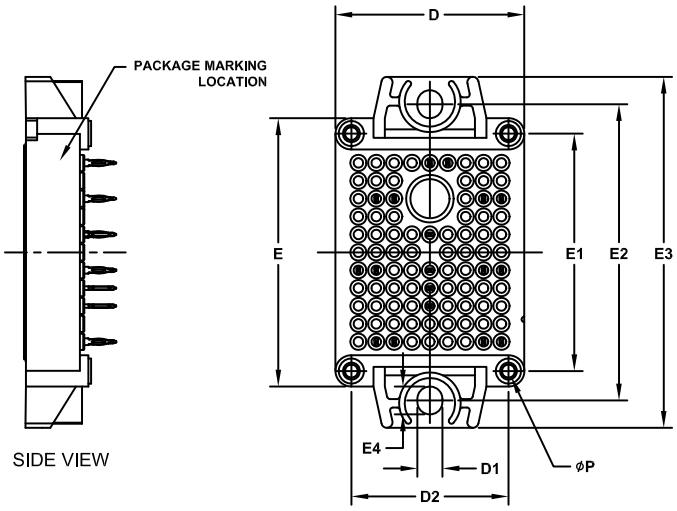
Figure 31. dv/dt OFF vs. R_G

MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS



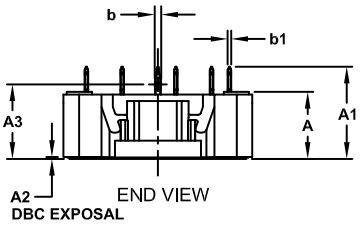
PIM18 33.8x42.5 (PRESS FIT)
CASE 180BW
ISSUE B

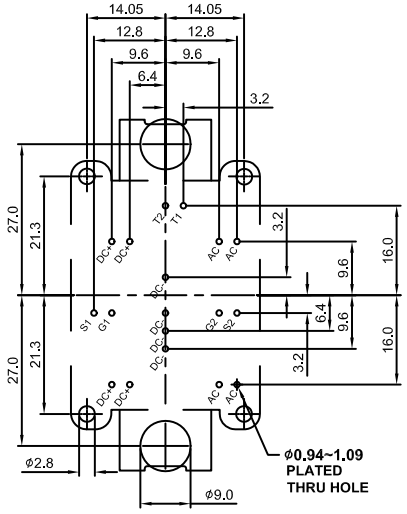
DATE 30 APR 2021



NOTES:
1. CONTROLLING DIMENSION: MILLIMETERS
2. PIN POSITION TOLERANCE IS ± 0.4mm

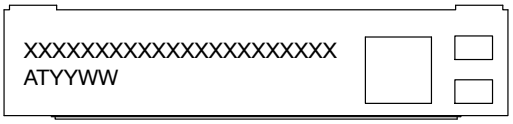
DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	11.65	12.00	12.35
A1	16.00	16.50	17.00
A2	0.00	0.35	0.60
A3	12.85	13.35	13.85
b	1.15	1.20	1.25
b1	0.59	0.64	0.69
D	33.50	33.80	34.10
D1	4.40	4.50	4.60
D2	27.95	28.10	28.25
E	47.70	48.00	48.30
E1	42.35	42.50	42.65
E2	52.90	53.00	53.10
E3	62.30	62.80	63.30
E4	4.90	5.00	5.10
P	2.20	2.30	2.40





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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