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

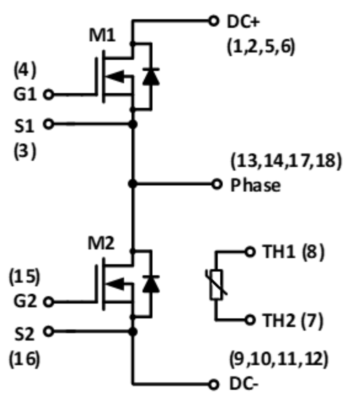
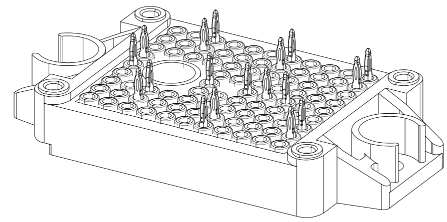


Figure 1. NXH010P120M3F1 Schematic Diagram

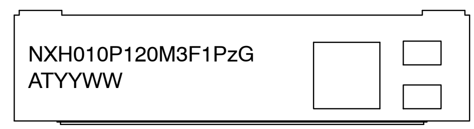
This document contains information on a product under development. **onsemi** reserves the right to change or discontinue this product without notice.

PACKAGE PICTURE



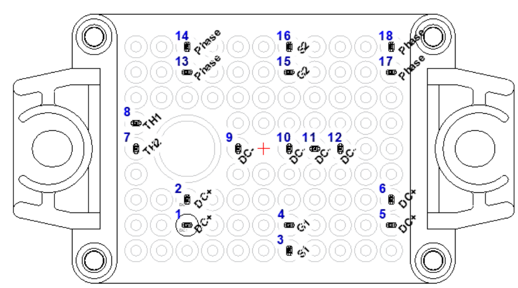
PIM18 33.8x42.5 (PRESS FIT)
CASE 180BW

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.

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

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	105	A
Pulsed Drain Current (T_J = 150°C)	I_{Dpulse}	316	A
Maximum Power Dissipation (T_J = 175°C)	P_{tot}	272	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 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	°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, T_J = 25°C	I_{DSS}	–	–	300	µA
Drain−Source On Resistance	V_{GS} = 18 V, I_D = 90 A, T_J = 25°C	$R_{DS(ON)}$	–	10.5	14.5	mΩ
	V_{GS} = 18 V, I_D = 90 A, T_J = 125°C		–	17.8	–	
	V_{GS} = 18 V, I_D = 90 A, T_J = 150°C		–	20.5	–	
	V_{GS} = 18 V, I_D = 90 A, T_J = 175°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	–	

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

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
SiC MOSFET CHARACTERISTICS						
Total Gate Charge	V_{DS} = 800 V, V_{GS} = −3/18 V, I_D = 90 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°C V_{DS}= 800 V, I_D = 90 A V_{GS} = −3 V/18 V, R_G = 2.7 Ω	$t_{d(on)}$	–	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°C V_{DS}= 800 V, I_D = 90 A V_{GS} = −3 V/18 V, R_G = 2.7 Ω	$t_{d(on)}$	–	20	–	ns
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 V, I_{SD} = 90 A, T_J = 25°C	V_{SD}	–	4.67	6	V
	V_{GS} = −3 V, I_{SD} = 90 A, T_J = 125°C		–	4.45	–	
	V_{GS} = −3 V, I_{SD} = 90 A, T_J = 150°C		–	4.4	–	
Thermal Resistance − Chip−to−Case	M1, M2	R_{thJC}	–	0.349	–	°C/W
Thermal Resistance − Chip−to−Heatsink	Thermal grease, Thickness = 2 Mil +2%, A = 2.8 W/mK	R_{thJH}	–	0.594	–	°C/W
THERMISTOR CHARACTERISTICS						
Nominal Resistance	T = 25°C	R_{25}	–	5	–	kΩ
	T = 100°C	R_{100}	–	493	–	Ω
	T = 150°C	R_{150}	–	159.5	–	Ω
Deviation of R_{100}	T = 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
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

TYPICAL CHARACTERISTICS

M1/M2 SIC MOSFET CHARACTERISTIC

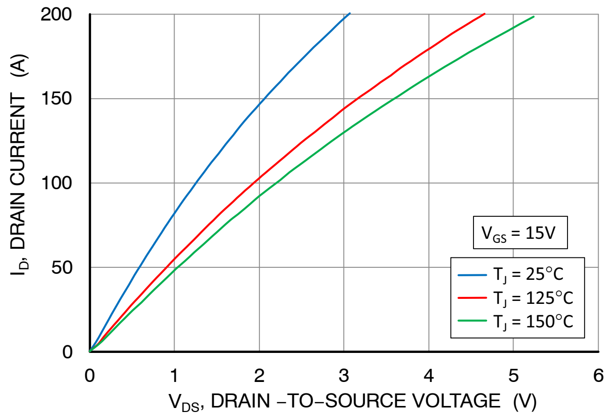


Figure 2. MOSFET Typical Output Characteristic V_{GS} = 15 V

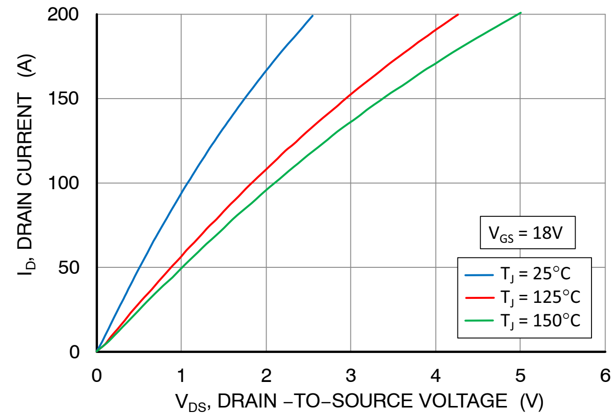


Figure 3. MOSFET Typical Output Characteristic V_{GS} = 18 V

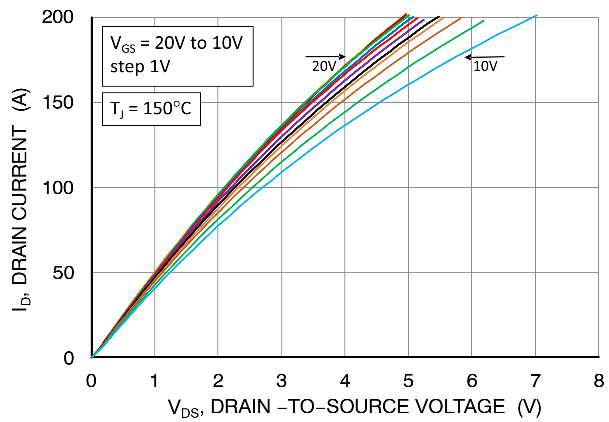


Figure 4. MOSFET Typical Output Characteristic V_{GS} = Var.

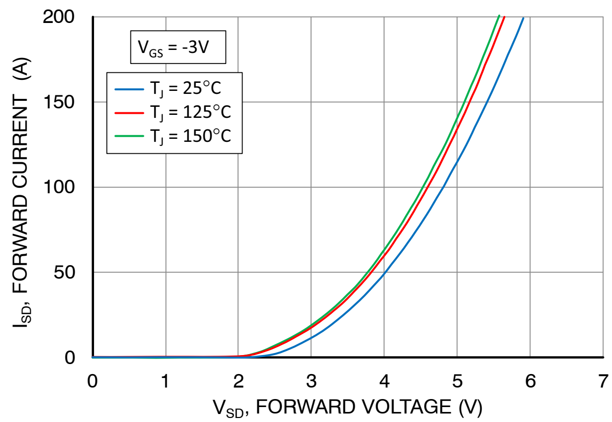


Figure 5. Body Diode Forward Characteristic

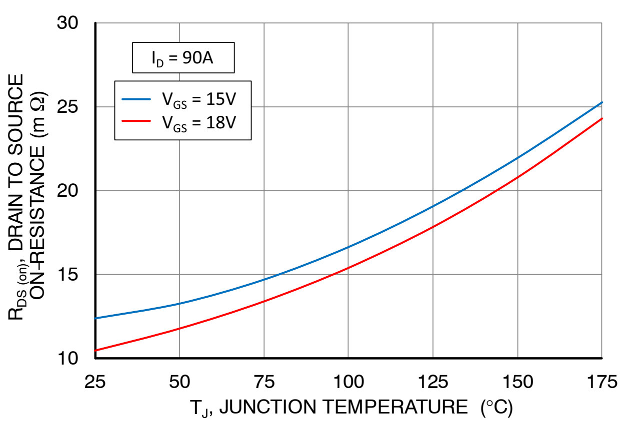


Figure 6. $R_{DS(on)}$ Drain−to−Source ON Resistance vs. Junction Temperature

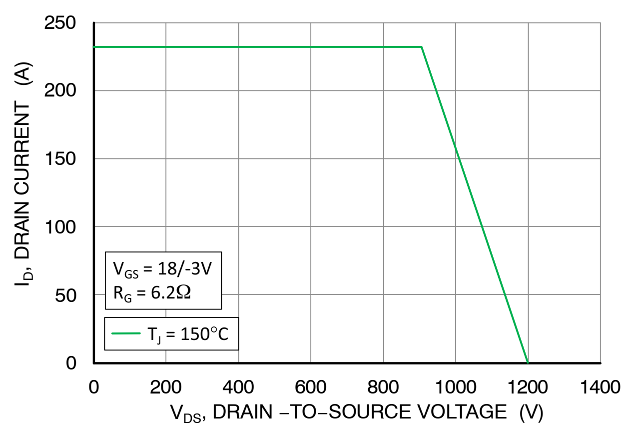


Figure 7. Reverse Bias Safe Operating Area (RBSOA)

TYPICAL CHARACTERISTICS

M1/M2 SIC MOSFET CHARACTERISTIC

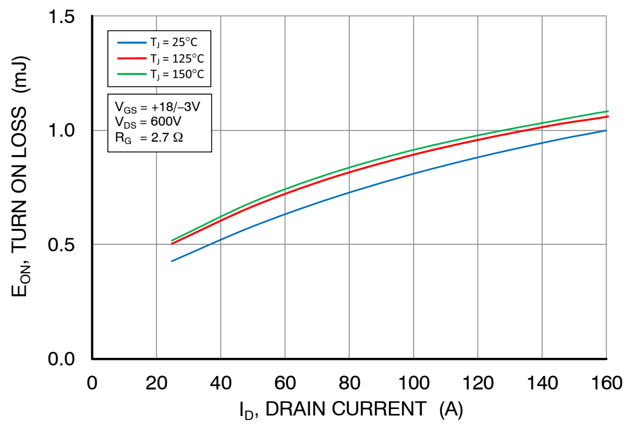


Figure 8. Switching on Loss vs. Drain Current V_{DS} = 600 V

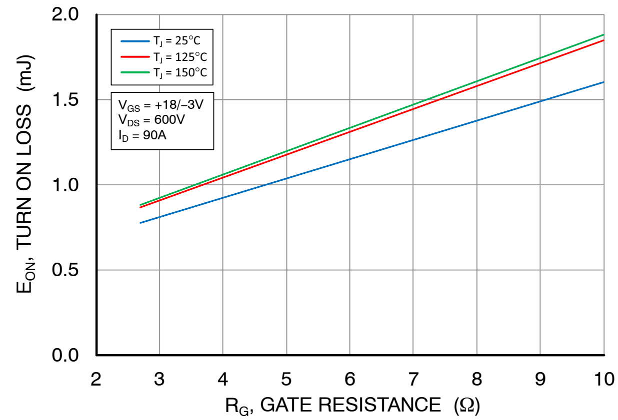


Figure 9. Switching on Loss vs. Gate Resistance V_{DS} = 600 V

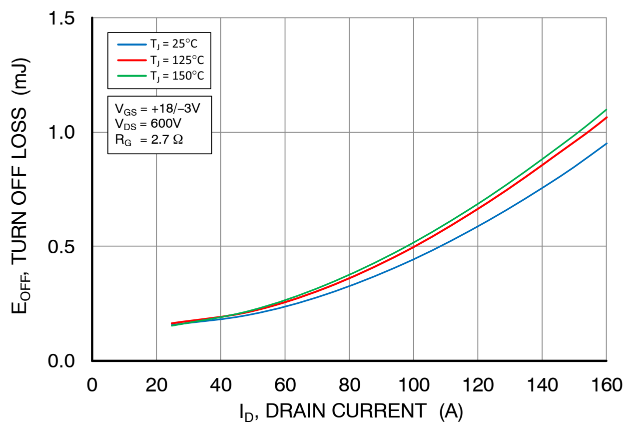


Figure 10. Switching off Loss vs. Drain Current V_{DS} = 600 V

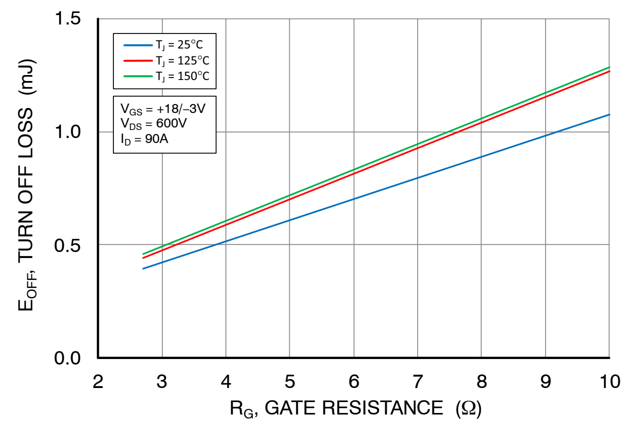


Figure 11. Switching off Loss vs. Gate Resistance V_{DS} = 600 V

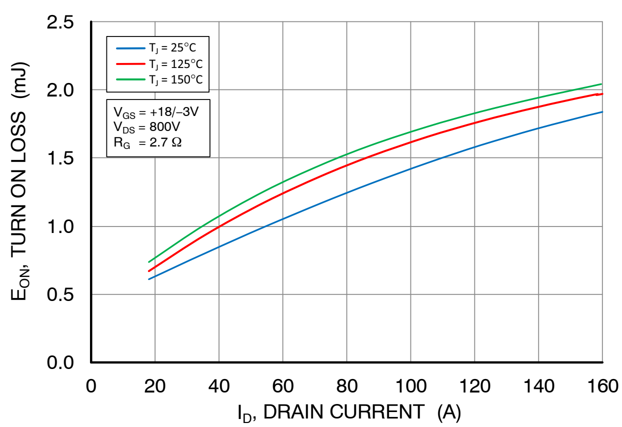


Figure 12. Switching on Loss vs. Drain Current V_{DS} = 800 V

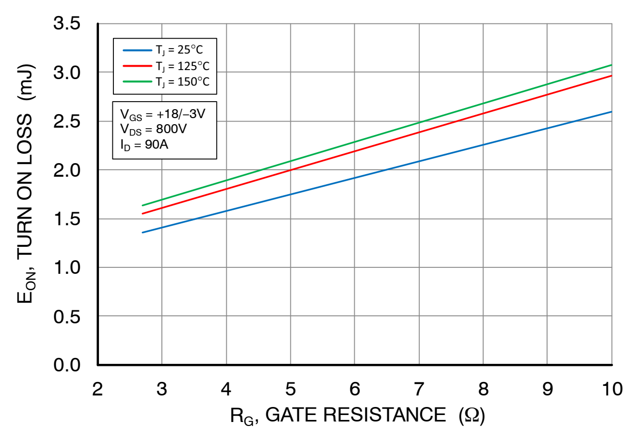


Figure 13. Switching on Loss vs. Gate Resistance V_{DS} = 800 V

TYPICAL CHARACTERISTICS

M1/M2 SIC MOSFET CHARACTERISTIC

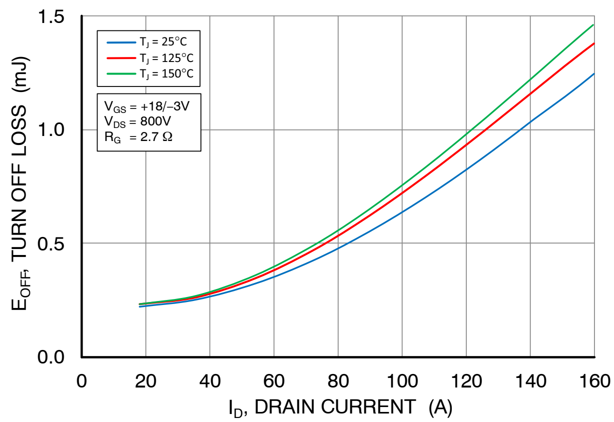


Figure 14. Switching off Loss vs. Drain Current V_{DS} = 800 V

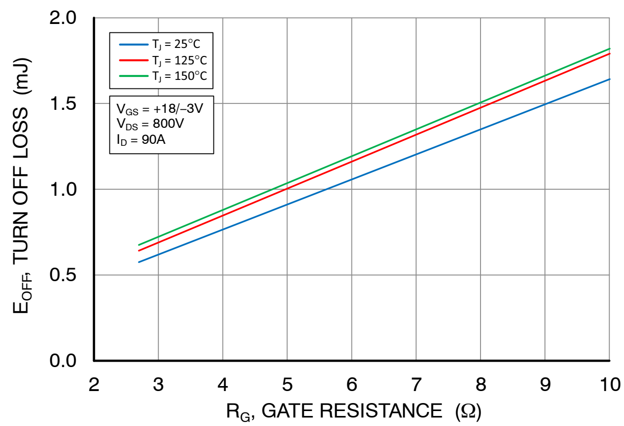


Figure 15. Switching off Loss vs. Gate Resistance V_{DS} = 800 V

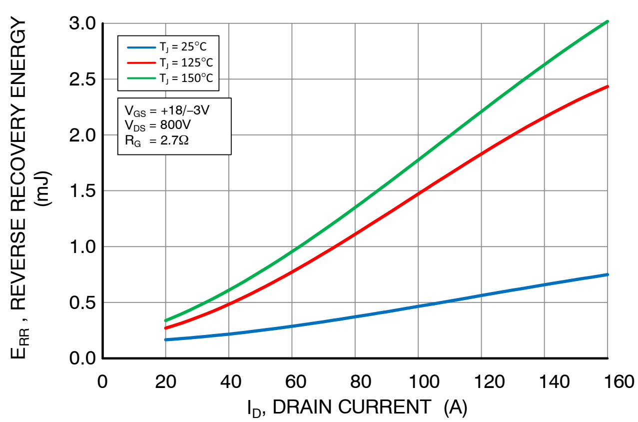


Figure 16. Reverse Recovery Energy vs. Drain Current V_{DS} = 800 V

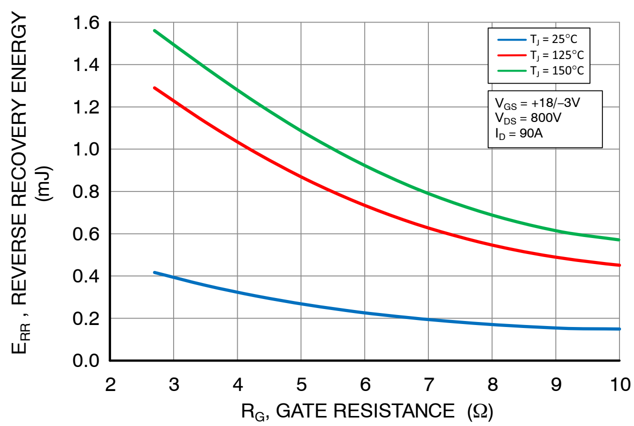


Figure 17. Reverse Recovery Energy vs. Gate Resistance V_{DS} = 800 V

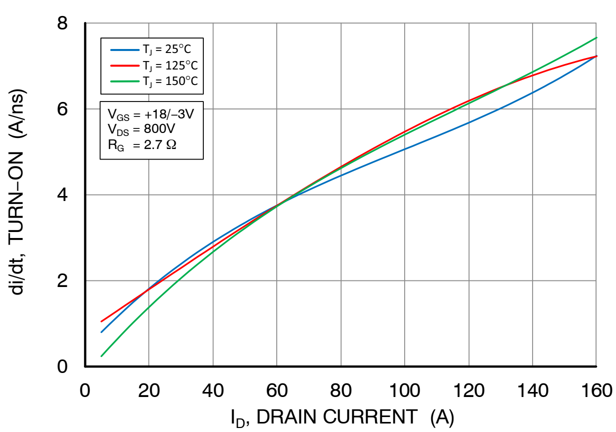


Figure 18. di/dt Turn ON vs. Drain Current V_{DS} = 800 V

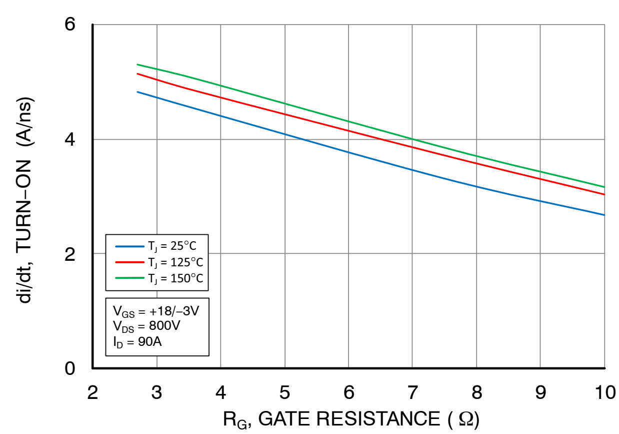


Figure 19. di/dt Turn ON vs. Gate Resistance V_{DS} = 800 V

TYPICAL CHARACTERISTICS

M1/M2 SIC MOSFET CHARACTERISTIC

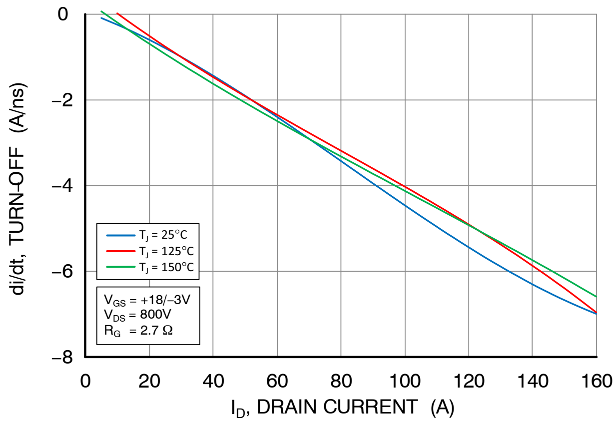


Figure 20. di/dt Turn OFF vs. Drain Current V_{DS} = 800 V

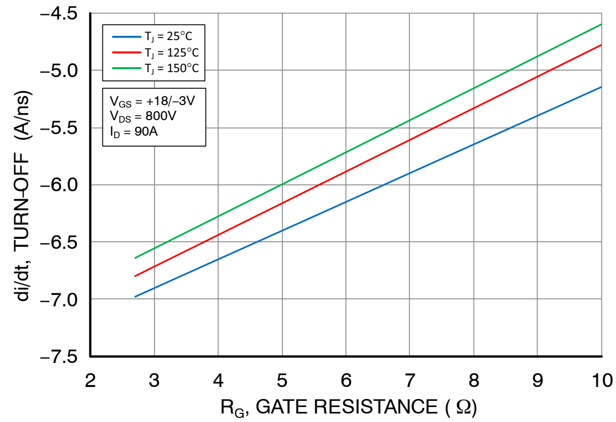


Figure 21. di/dt Turn OFF vs. Gate Resistance V_{DS} = 800 V

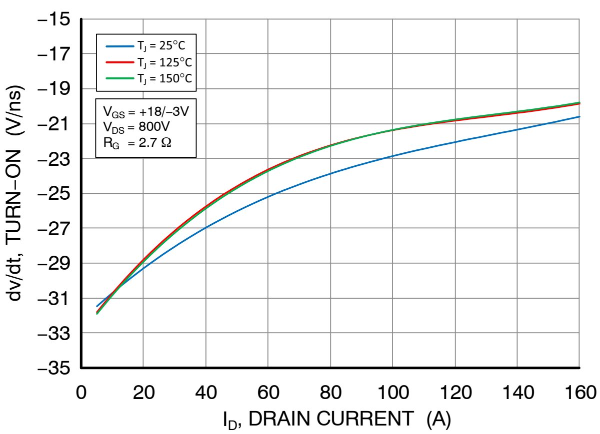


Figure 22. dv/dt Turn ON vs. Drain Current V_{DS} = 800 V

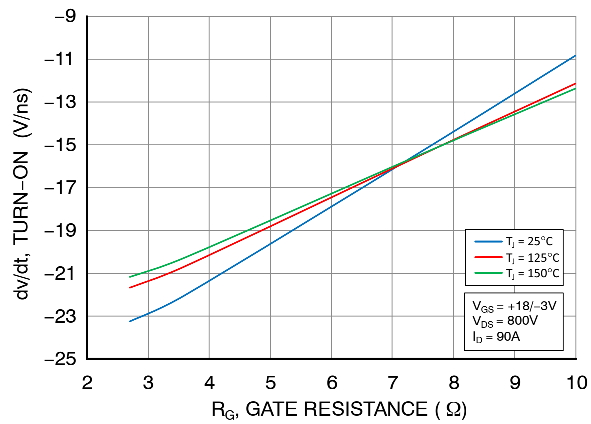


Figure 23. dv/dt Turn ON vs. Gate Resistance V_{DS} = 800 V

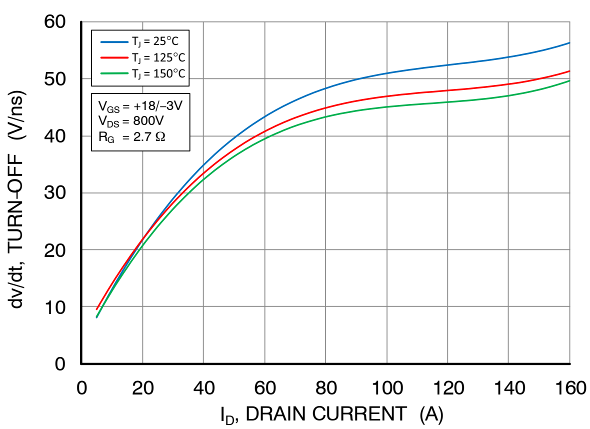


Figure 24. dv/dt Turn OFF vs. Drain Current V_{DS} = 800 V

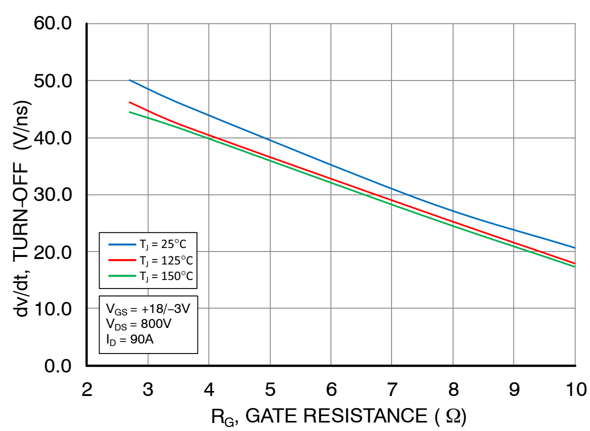


Figure 25. dv/dt Turn OFF vs. Gate Resistance V_{DS} = 800 V

TYPICAL CHARACTERISTICS

M1/M2 SIC MOSFET CHARACTERISTIC

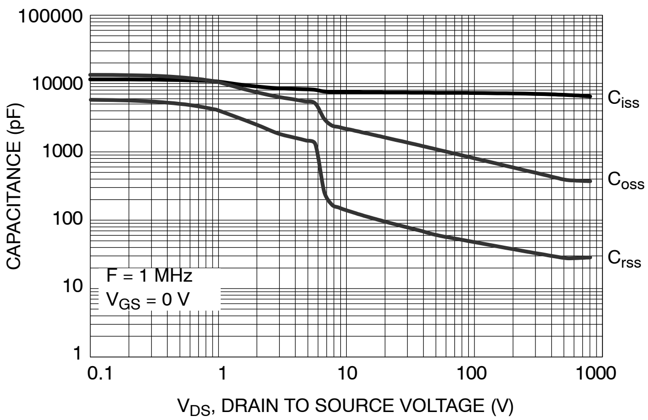


Figure 26. Capacitance vs Drain−to−Source Voltage

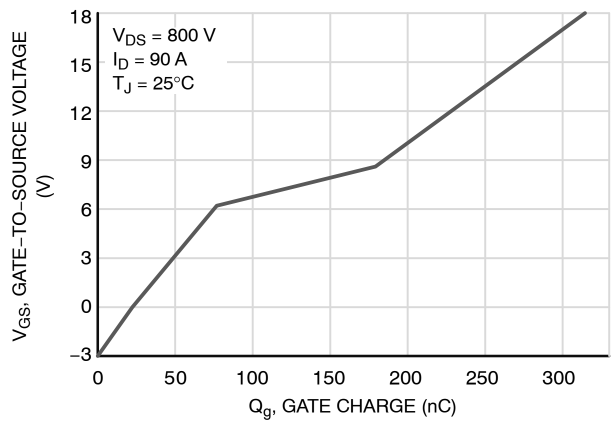


Figure 27. Gate−to−Source Voltage vs Gate Charge

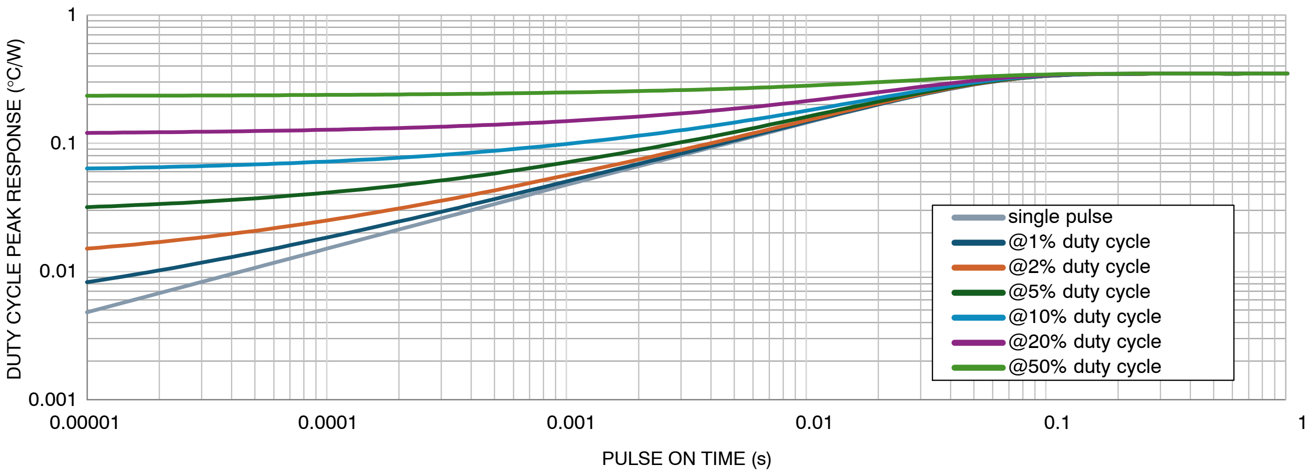


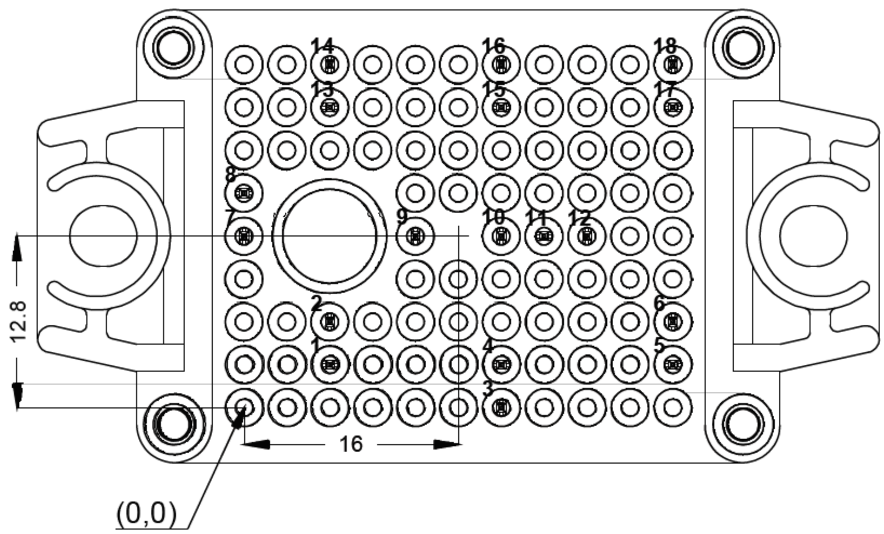
Figure 28. Capacitance vs Drain−to−Source Voltage

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

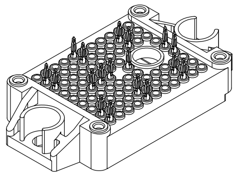
PIN POSITION INFORMATION

scale = 2.5 : 1



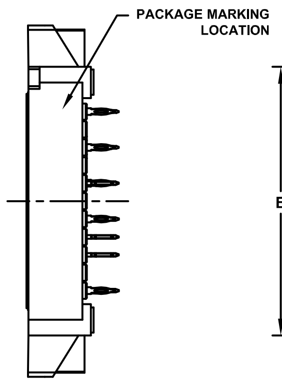
S Pin position

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

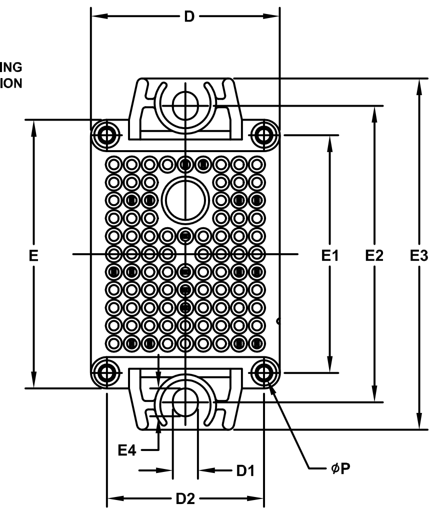


PIM18 33.8x42.5 (PRESS FIT)
CASE 180BW
ISSUE B

DATE 30 APR 2021



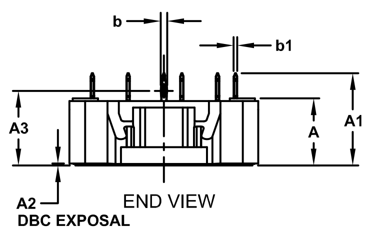
SIDE VIEW



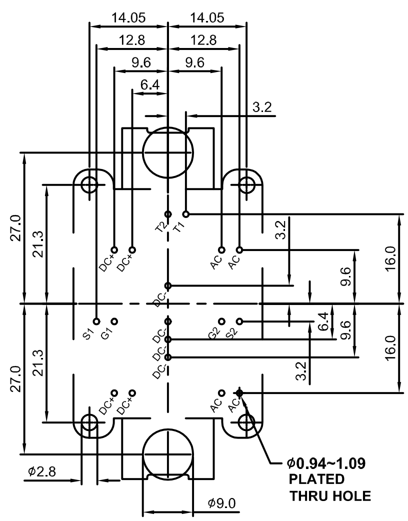
TOP VIEW

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

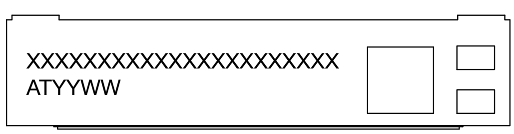


END VIEW



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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