

Silicon Carbide (SiC) Module – EliteSiC, 20 mohm SiC M1 MOSFET, 1200 V, 2-PACK Half Bridge Topology, F1 Package

Product Preview

NXH020P120MNF1PTG, NXH020P120MNF1PG

The NXH020P120MNF1 is a power module containing an 20 mΩ/1200 V SiC MOSFET half bridge and a thermistor in an F1 package.

Features

- 20 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

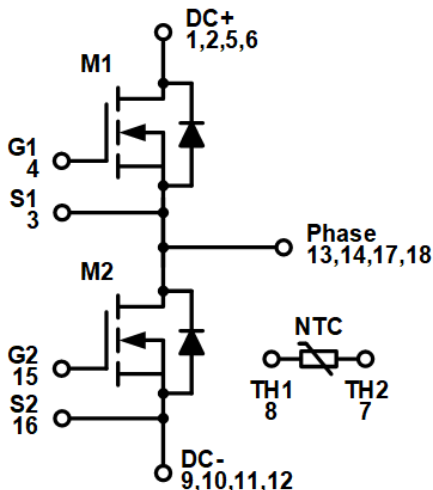
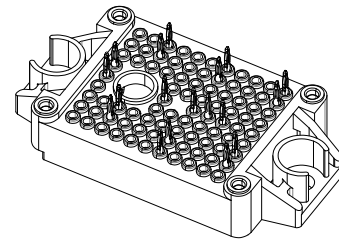


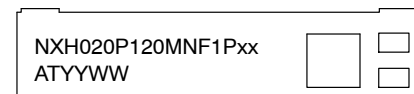
Figure 1. NXH020P120MNF1 Schematic Diagram

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



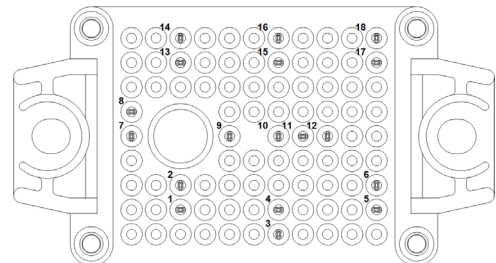
PIM18 33.8x42.5 (PRESS FIT)
CASE 180BW

MARKING DIAGRAM



NXH020P120MNF1PTG= Specific Device Code
NXH020P120MNF1PG = 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.

NXH020P120MNF1PTG, NXH020P120MNF1PG

PIN FUNCTION DESCRIPTION

Pin	Name	Description
1	DC+	DC Positive Bus connection
2	DC+	DC Positive Bus connection
3	S1	Q1 Kelvin Emitter (High side switch)
4	G1	Q1 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	Q2 Gate (Low side switch)
16	S2	Q2 Kelvin Emitter (High 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_{DS}	1200	V
Gate-Source Voltage	V_{GS}	+25/-15	V
Continuous Drain Current @ $T_C = 80^\circ\text{C}$ ($T_J = 175^\circ\text{C}$)	I_D	51	A
Pulsed Drain Current ($T_J = 175^\circ\text{C}$)	I_{Dpulse}	102	A
Maximum Power Dissipation ($T_J = 175^\circ\text{C}$)	P_{tot}	119	W
Short Circuit Withstand Time @ $V_{GE} = -5V/20\text{ V}$, $V_{CE} = 600\text{ V}$, $T_J \leq 150^\circ\text{C}$	T_{sc}	TBD	μs
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, $t = 1\text{ s}$, 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	$^\circ\text{C}$

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.

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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 = 50 A, T _J = 25°C	R _{DS(ON)}	–	20	30	mΩ
	V _{GS} = 20 V, I _D = 50 A, T _J = 125°C		–	28	–	
	V _{GS} = 20 V, I _D = 50 A, T _J = 150°C		–	31	–	
Gate–Source Threshold Voltage	V _{GS} = V _{DS} , I _D = 20 mA	V _{GS(TH)}	1.8	2.81	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		1.1		Ω
Input Capacitance	V _{DS} = 800 V, V _{GS} = 0 V, f = 1 MHz	C _{ISS}	–	2420	–	pF
Reverse Transfer Capacitance		C _{RSS}	–	19	–	
Output Capacitance		C _{OSS}	–	193	–	
C _{OSS} Stored Energy	V _{DS} = 0 V to 800 V, V _{GS} = 0 V	E _{OSS}	–	124	–	μJ
Total Gate Charge	V _{DS} = 800 V, V _{GS} = 20 V, I _D = 50 A	Q _{G(TOTAL)}	–	213.5	–	nC
Gate–Source Charge		Q _{GS}	–	50	–	nC
Gate–Drain Charge		Q _{GD}	–	61.2	–	nC
Turn–on Delay Time	T _J = 25°C V _{DS} = 600 V, I _D = 50 A V _{GS} = –5 V/18 V, R _G = 2.7 Ω	t _{d(on)}	–	51	–	ns
Rise Time		t _r	–	10	–	
Turn–off Delay Time		t _{d(off)}	–	112	–	
Fall Time		t _f	–	8.6	–	
Turn–on Switching Loss per Pulse		E _{ON}	–	0.18	–	mJ
Turn off Switching Loss per Pulse		E _{OFF}	–	0.43	–	
Turn–on Delay Time	T _J = 150°C V _{DS} = 600 V, I _D = 50 A V _{GS} = –5 V/18 V, R _G = 2.7 Ω	t _{d(on)}	–	48	–	ns
Rise Time		t _r	–	8.9	–	
Turn–off Delay Time		t _{d(off)}	–	120	–	
Fall Time		t _f	–	9.8	–	
Turn–on Switching Loss per Pulse		E _{ON}	–	0.21	–	mJ
Turn off Switching Loss per Pulse		E _{OFF}	–	0.46	–	
Diode Forward Voltage	I _D = 50 A, T _J = 25°C	V _{SD}	–	3.93	6	V
	I _D = 50 A, T _J = 150°C		–	3.39	–	
Reverse Recovery Time	T _J = 25°C V _{DS} = 600 V, I _D = 50 A V _{GS} = –5 V/18 V, R _G = 2.7 Ω	t _{rr}	–	19	–	ns
Reverse Recovery Charge		Q _{rr}	–	517	–	nC
Peak Reverse Recovery Current		I _{RRM}	–	43	–	A
Peak Rate of Fall of Recovery Current		di/dt	–	5326	–	A/μs
Reverse Recovery Energy		E _{rr}	–	278	–	μJ
Reverse Recovery Time	T _J = 150°C V _{DS} = 600 V, I _D = 50 A V _{GS} = –5 V/18 V, R _G = 2.7 Ω	t _{rr}	–	24	–	ns
Reverse Recovery Charge		Q _{rr}	–	1312	–	μC
Peak Reverse Recovery Current		I _{RRM}	–	88	–	A
Peak Rate of Fall of Recovery Current		di/dt	–	10774	–	A/μs
Reverse Recovery Energy		E _{rr}	–	718	–	μJ
Thermal Resistance – chip–to–case	M1, M2	R _{thJC}	–	0.4495	–	°C/W
Thermal Resistance – chip–to–heatsink	Thermal grease, Thickness = 2 Mil _2%, A = 2.8 W/mK	R _{thJH}	–	0.7971	–	°C/W

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ELECTRICAL CHARACTERISTICS ($T_J = 25^\circ\text{C}$ unless otherwise noted) (continued)

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
THERMISTOR CHARACTERISTICS						
Nominal resistance	$T = 25^\circ\text{C}$	R_{25}	–	5	–	$\text{k}\Omega$
Nominal resistance	$T = 100^\circ\text{C}$	R_{100}	–	457	–	Ω
Deviation of R_{25}		$\Delta R/R$	–3	–	3	%
Power dissipation		P_D	–	50	–	mW
Power dissipation constant			–	5	–	mW/K
B-value	$B(25/50)$, tolerance $\pm 3\%$		–	3375	–	K
B-value	$B(25/100)$, tolerance $\pm 3\%$		–	3455	–	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
NXH020P120MNF1PG	NXH020P120MNF1PG	F1-2PACK: Case 180BW Press-fit Pins (Pb – Free and Halide – Free)	28 Units / Blister Tray
NXH020P120MNF1PTG	NXH020P120MNF1PTG	F1-2PACK: Case 180BW Press-fit Pins with pre – applied thermal interface material (TIM) (Pb – Free and Halide – Free)	28 Units / Blister Tray

NXH020P120MNF1PTG, NXH020P120MNF1PG

TYPICAL CHARACTERISTICS

SiC MOSFET (M1, M2)

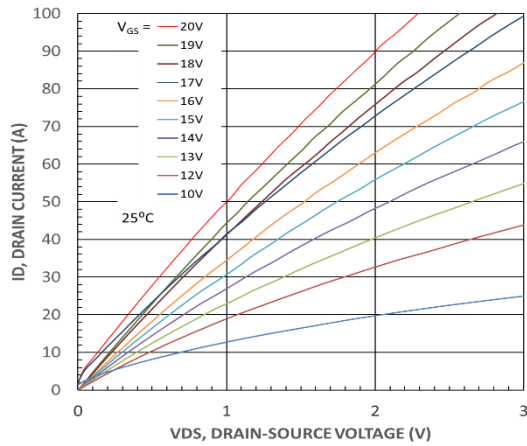


Figure 2. MOSFET Typical Output Characteristics

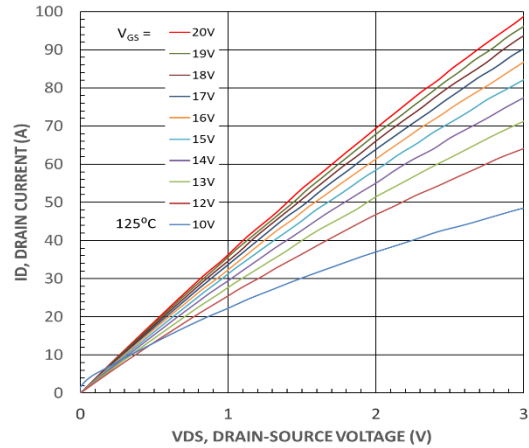


Figure 3. MOSFET Typical Output Characteristics

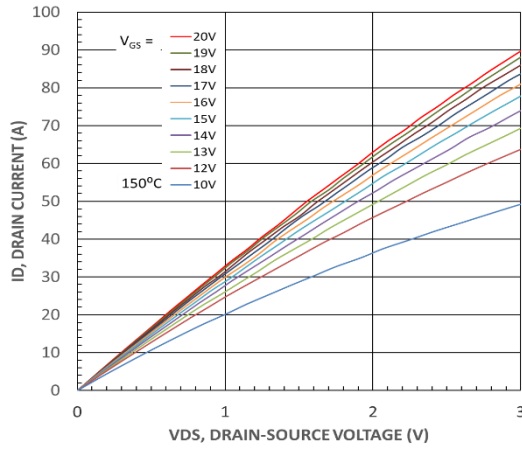


Figure 4. MOSFET Typical Output Characteristics

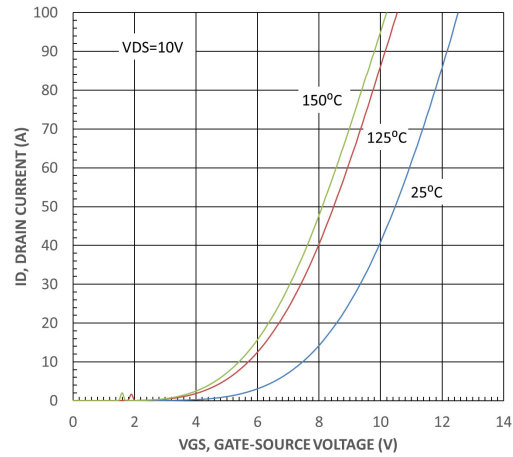


Figure 5. MOSFET Typical Transfer Characteristics

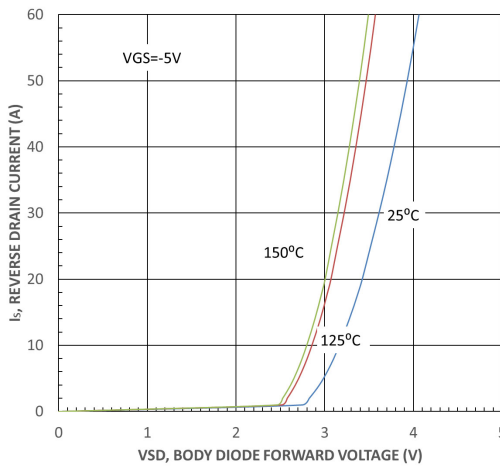


Figure 6. Body Diode Forward Characteristics

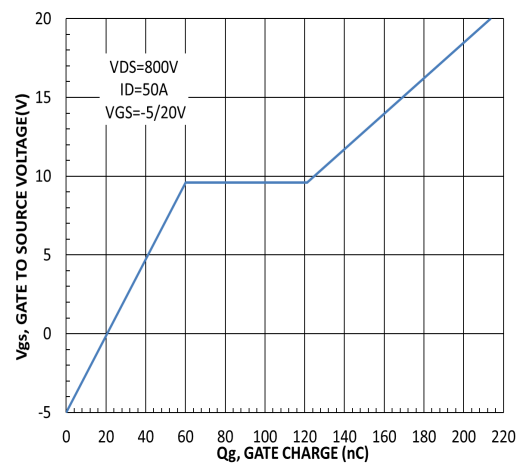


Figure 7. Gate-to-Source Voltage vs. Total Charge

TYPICAL CHARACTERISTICS

SiC MOSFET (M1, M2)

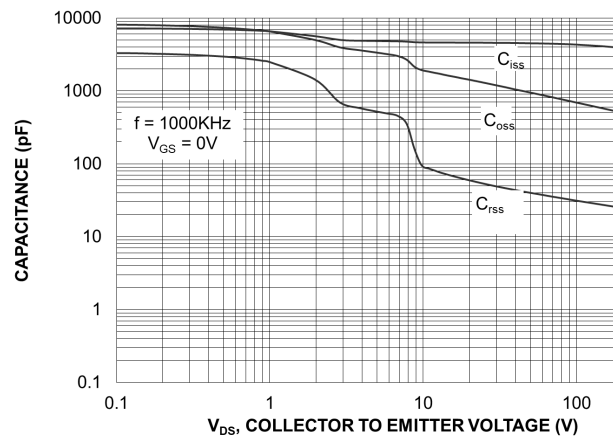


Figure 8. Capacitance vs. Drain-to-Source Voltage

TYPICAL CHARACTERISTICS

M1/M2 MOSFET SWITCHING CHARACTERISTICS

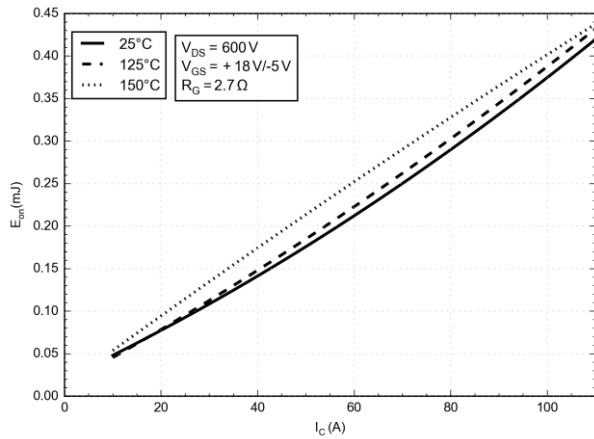


Figure 9. Typical Switching Loss Eon vs. IC

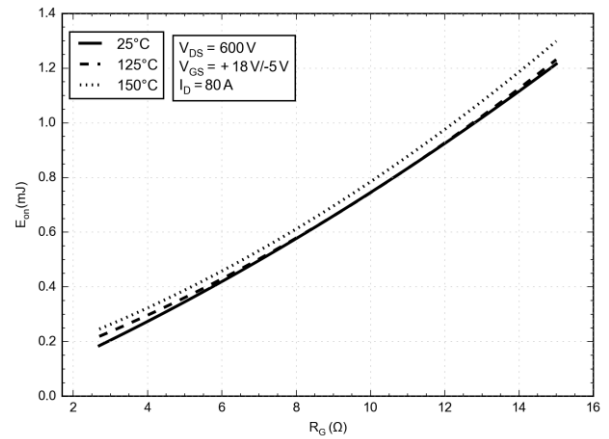


Figure 10. Typical Switching Loss Eon vs. R_G

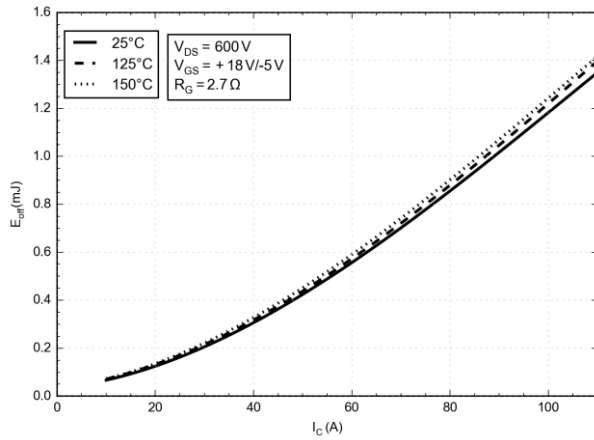


Figure 11. Typical Switching Loss Eoff vs. IC

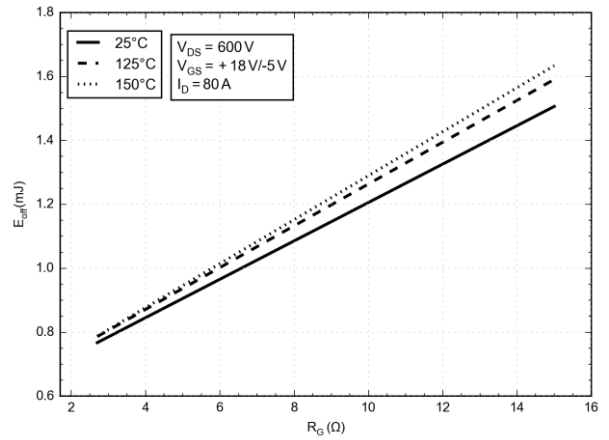


Figure 12. Typical Switching Loss Eoff vs. R_G

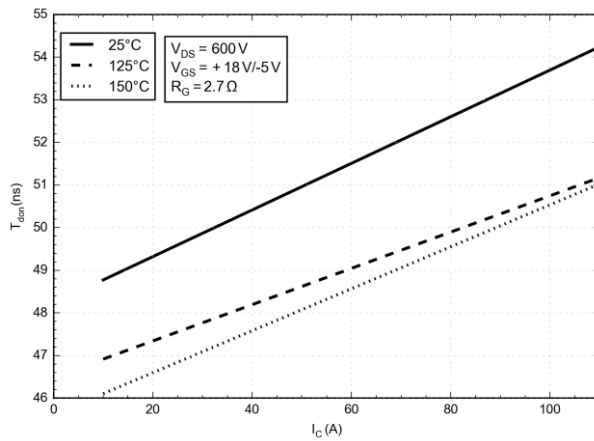


Figure 13. Typical Turn-On Switching Tdon vs. IC

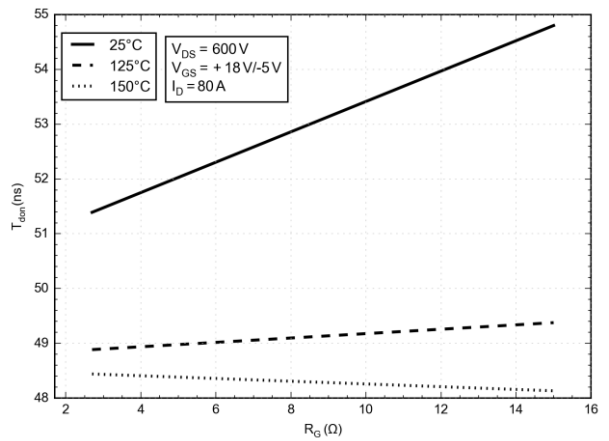


Figure 14. Typical Turn-On Switching Tdon vs. R_G

TYPICAL CHARACTERISTICS

M1/M2 MOSFET SWITCHING CHARACTERISTICS

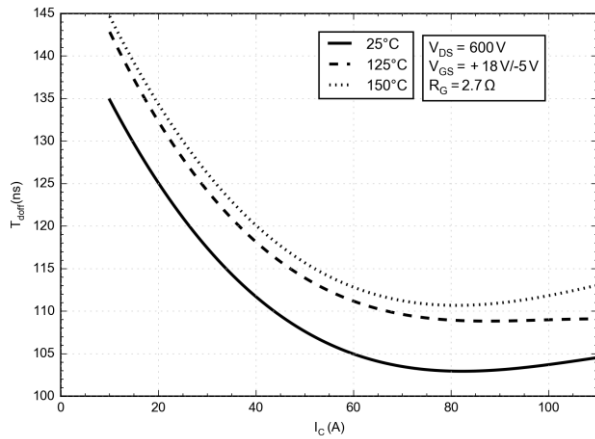


Figure 15. Typical Turn-Off Switching Tdon vs. IC

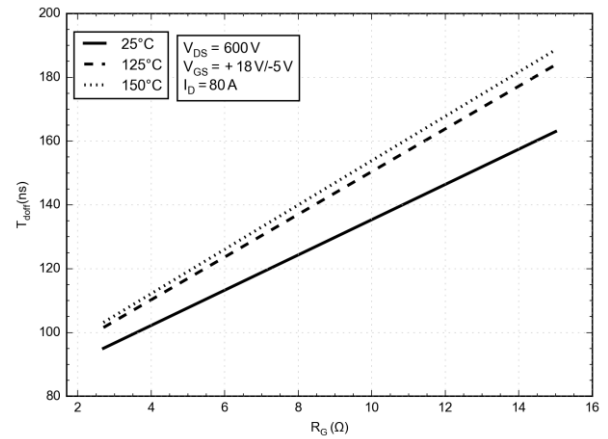


Figure 16. Typical Turn-Off Switching Tdon vs. R_G

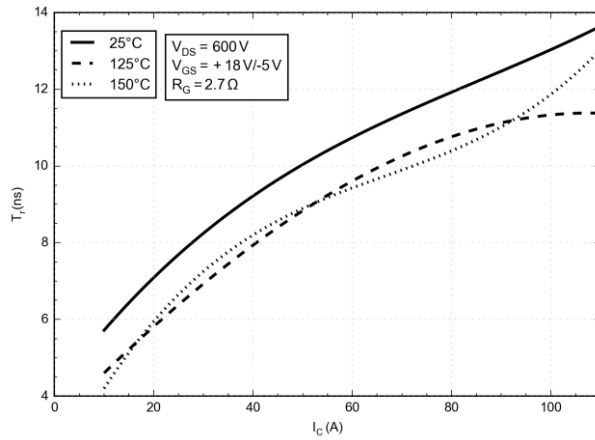


Figure 17. Typical Turn-On Switching Tr vs. IC

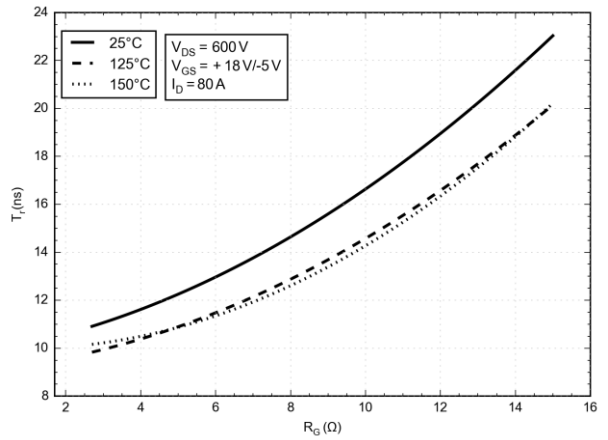


Figure 18. Typical Turn-On Switching Tr vs. R_G

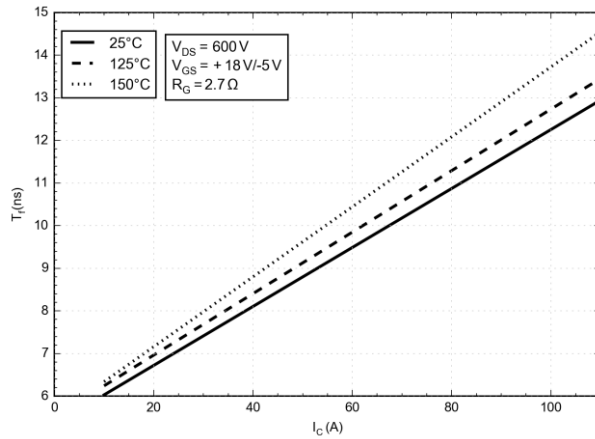


Figure 19. Typical Turn-Off Switching Tf vs. IC

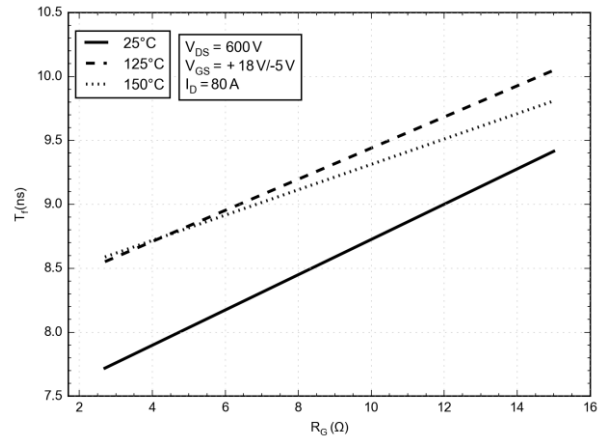


Figure 20. Typical Turn-Off Switching Tf vs. R_G

TYPICAL CHARACTERISTICS
M1/M2 MOSFET SWITCHING CHARACTERISTICS

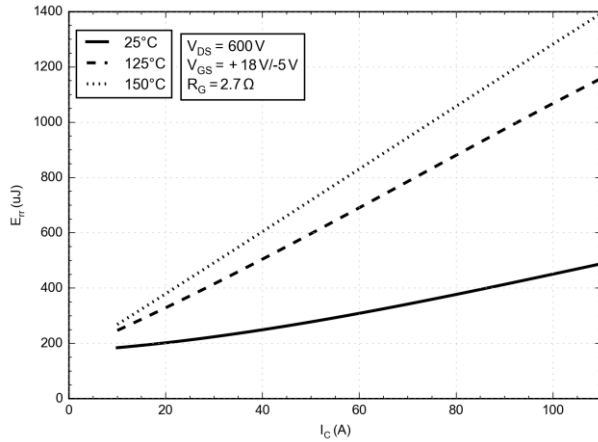


Figure 21. Typical Reverse Recovery Energy vs. I_C

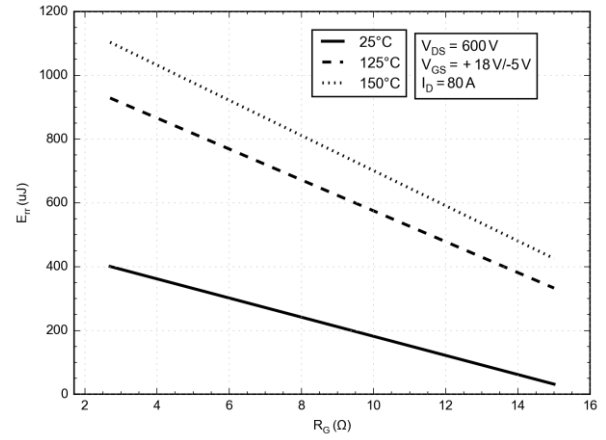


Figure 22. Typical Reverse Recovery Energy vs. R_G

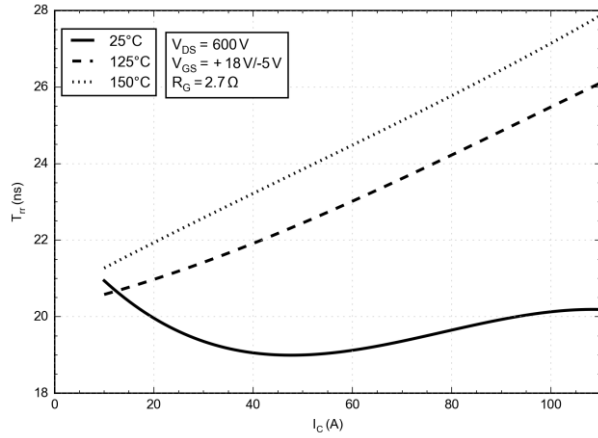


Figure 23. Typical Reverse Recovery Time vs. I_C

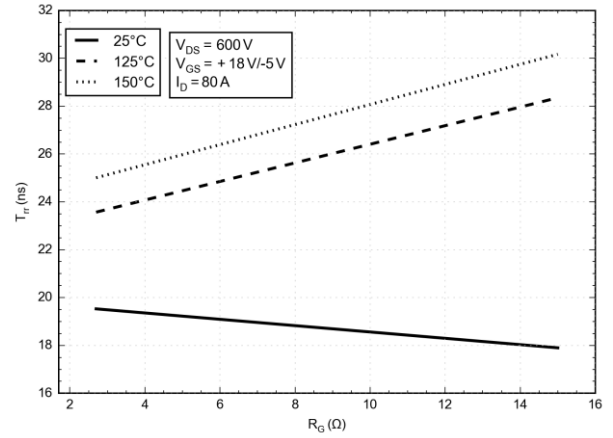


Figure 24. Typical Reverse Recovery Time vs. R_G

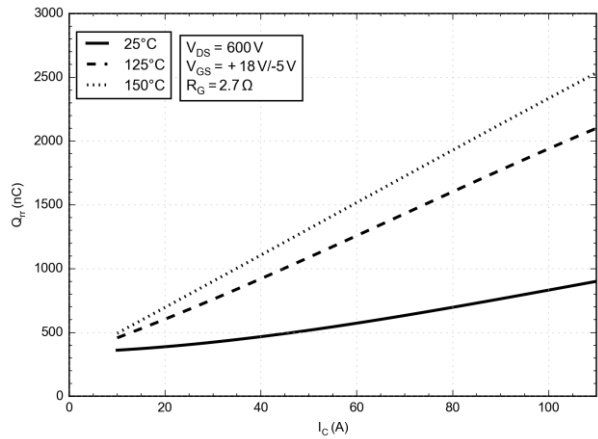


Figure 25. Typical Reverse Recovery Charge vs. I_C

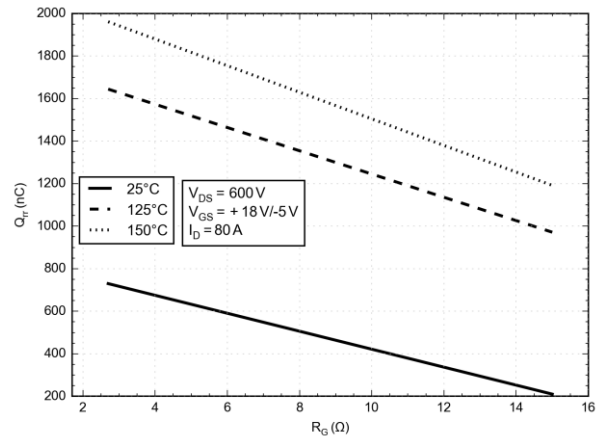


Figure 26. Typical Reverse Recovery Charge vs. R_G

TYPICAL CHARACTERISTICS

M1/M2 MOSFET SWITCHING CHARACTERISTICS

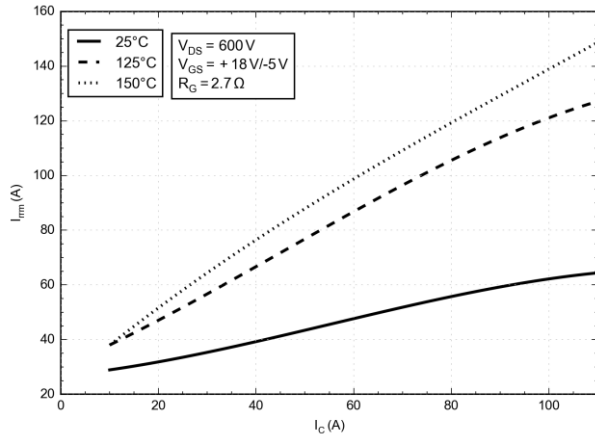


Figure 27. Typical Reverse Recovery Current vs. I_C

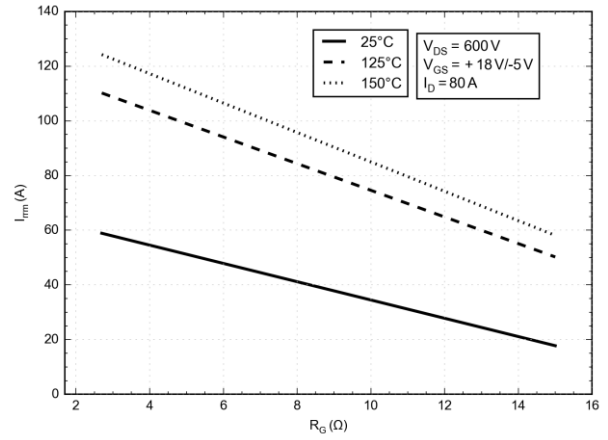


Figure 28. Typical Reverse Recovery Current vs. R_G

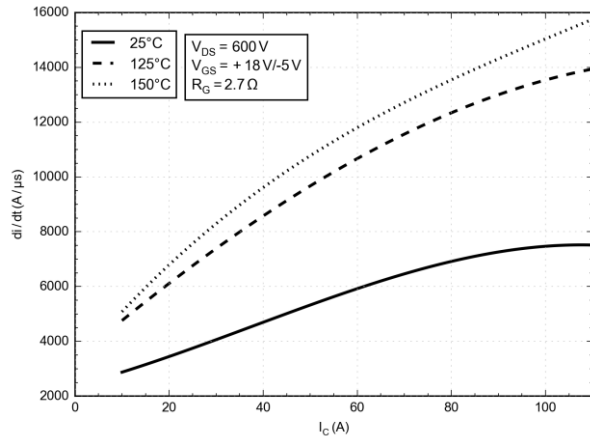


Figure 29. Typical di/dt vs. I_C

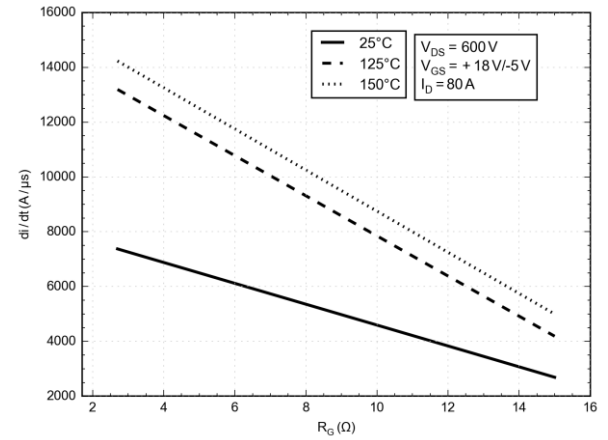


Figure 30. Typical di/dt vs. R_G

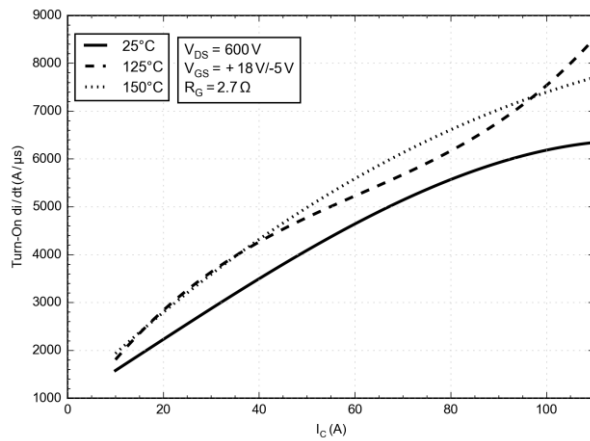


Figure 31. di/dt ON vs. I_C

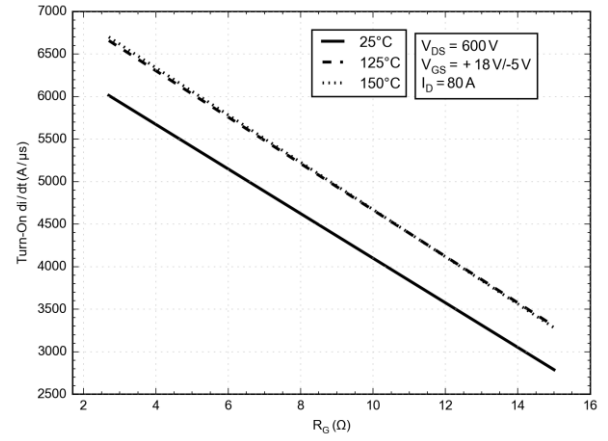


Figure 32. di/dt ON vs. R_G

NXH020P120MNF1PTG, NXH020P120MNF1PG

TYPICAL CHARACTERISTICS

M1/M2 MOSFET SWITCHING CHARACTERISTICS

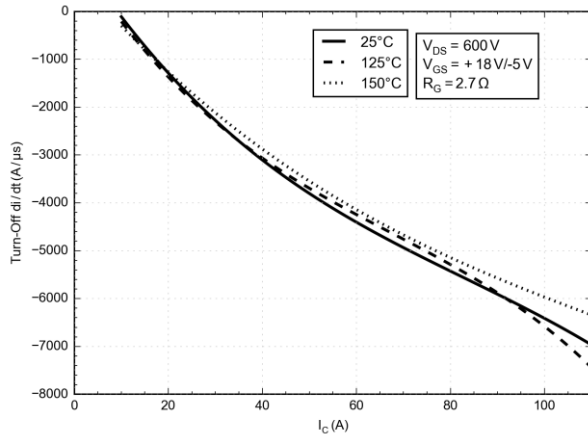


Figure 33. di/dt OFF vs. IC

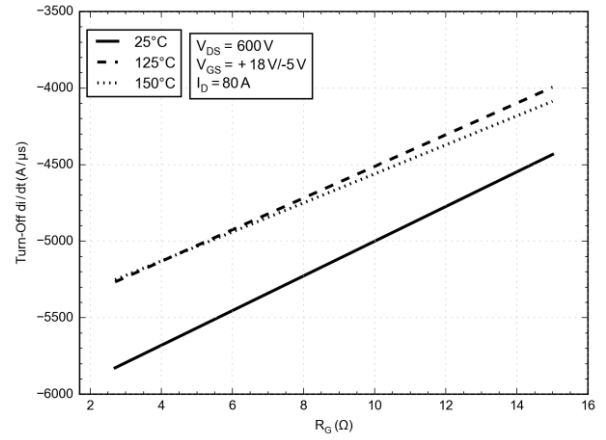


Figure 34. di/dt OFF vs. RG

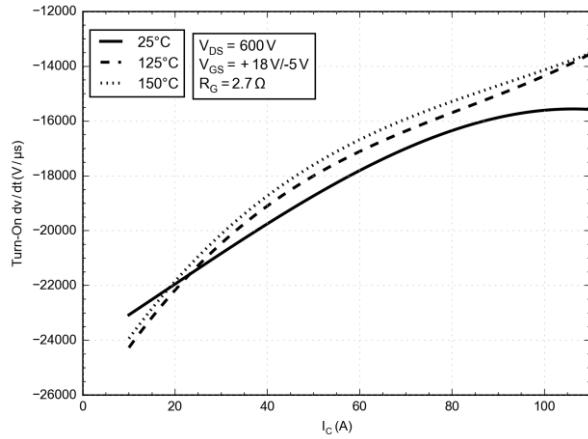


Figure 35. dv/dt ON vs. IC

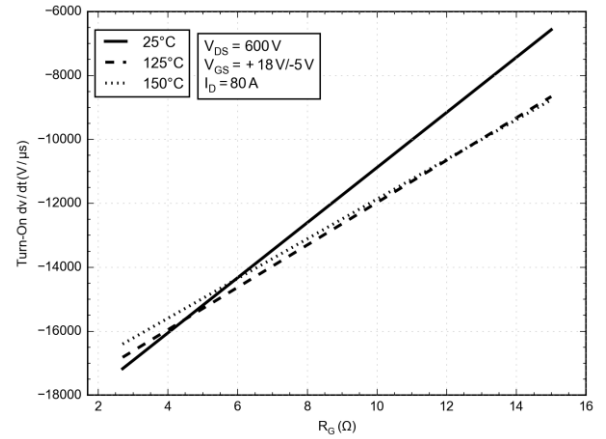


Figure 36. dv/dt ON vs. RG

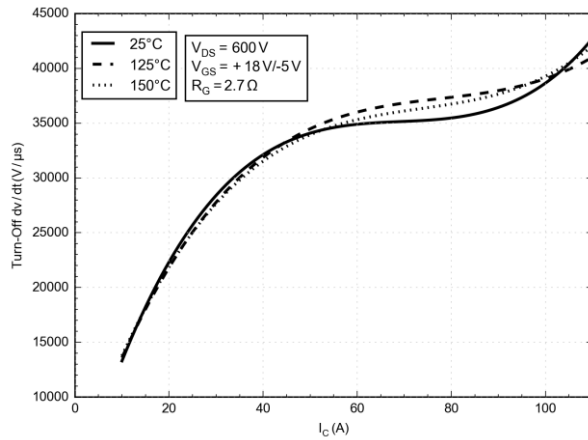


Figure 37. dv/dt OFF vs. IC

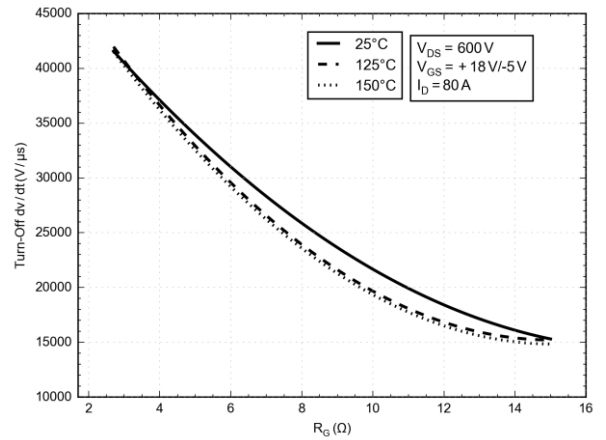


Figure 38. dv/dt OFF vs. RG

TYPICAL CHARACTERISTICS

SiC MOSFET (M1/M2)

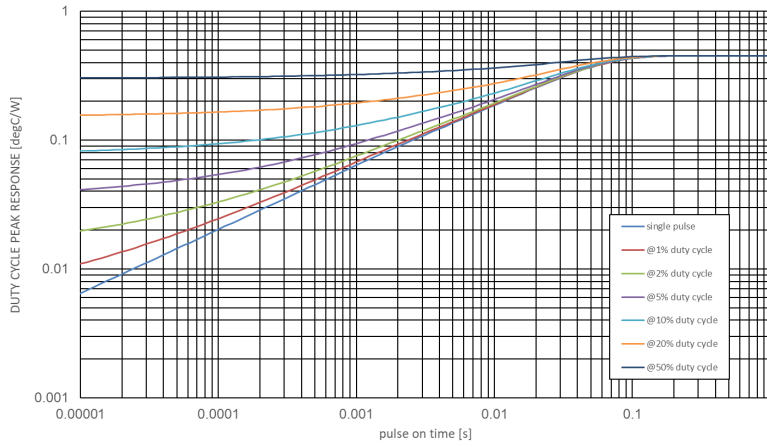


Figure 39. MOSFET Junction-to-Case Transient Thermal Impedance

Table 1. FOSTER NETWORKS – M1, M2

Foster Element #	M1		M2	
	Rth (K/W)	Cth (Ws/K)	Rth (K/W)	Cth (Ws/K)
1	0.017325	0.008638	0.026614	0.005297
2	0.022329	0.043836	0.014274	0.064284
3	0.016565	0.107000	0.006208	0.315671
4	0.041616	0.125888	0.075096	0.078283
5	0.338223	0.099402	0.338851	0.124492

Table 2. CAUER NETWORKS – M1, M2

Cauer Element #	M1		M2	
	Rth (K/W)	Cth (Ws/K)	Rth (K/W)	Cth (Ws/K)
1	0.034247	0.006027	0.038327	0.004380
2	0.073342	0.018048	0.072292	0.025045
3	0.106345	0.041141	0.118744	0.030910
4	0.100786	0.040901	0.069379	0.066961
5	0.121340	0.076490	0.162299	0.074739

MECHANICAL CASE OUTLINE

PACKAGE DIMENSIONS

ON Semiconductor®

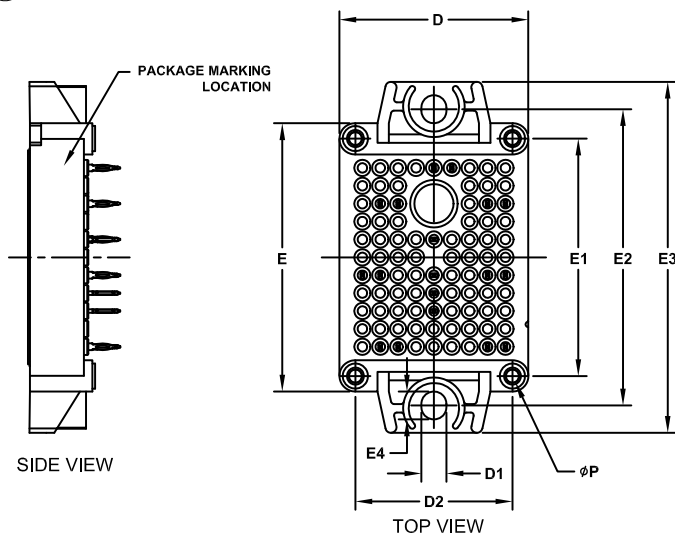
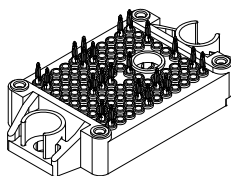


PIM18 33.8x42.5 (PRESS FIT)

CASE 180BW

ISSUE B

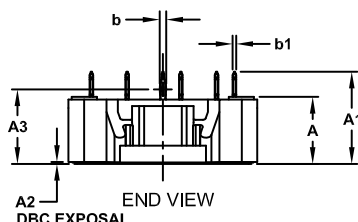
DATE 30 APR 2021



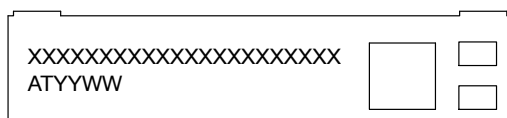
NOTES:

1. CONTROLLING DIMENSION: MILLIMETERS
2. PIN POSITION TOLERANCE IS $\pm 0.4\text{mm}$

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

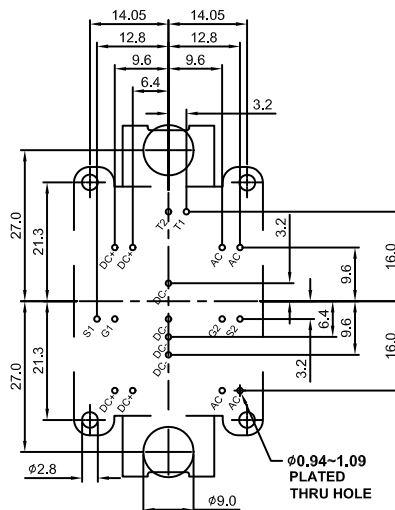


GENERIC MARKING DIAGRAM*



XXXXXX = 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.



RECOMMENDED MOUNTING PATTERN

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