

Flying Capacitor BOOST Module

Product Preview

NXH500B100H7F5SHG

The NXH500B100H7F5SHG is a power module in F5BP package containing two independent flying capacitor boost converters. The integrated field stop trench IGBTs and Si/SiC Diodes provide lower conduction and switching losses, enabling designers to achieve high efficiency, high power density and superior reliability.

Features

- Flying Capacitor Boost Module
- 1000V Field Stop 7 IGBTs and 1200V SiC Diodes
- Low Inductive Layout
- Solder Pins
- Integrated NTC Thermistor
- This is a Pb-Free and Halide Free Device

Typical Applications

- Solar Inverter
- Energy Storage System

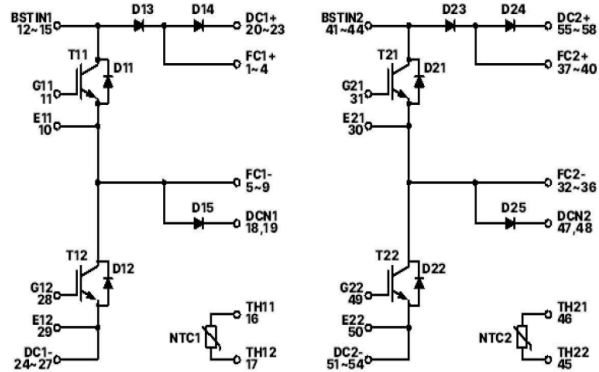
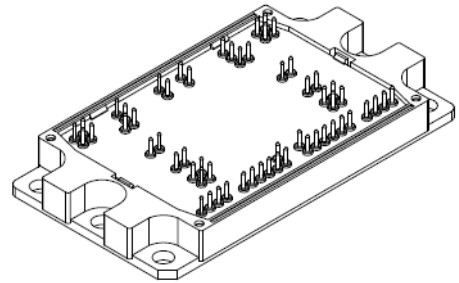


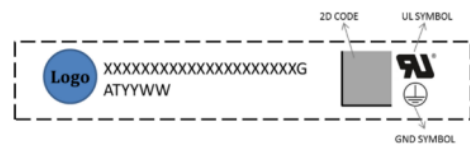
Figure 1. NXH500B100H7F5SHG Schematic Diagram

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



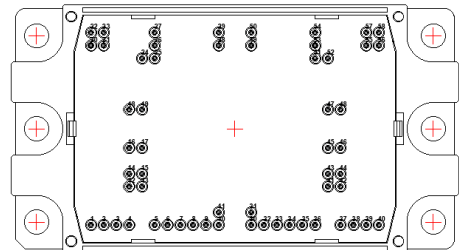
PIM58 112x62 (SOLDER PIN)
CASE 180CZ

MARKING DIAGRAM



XXXXXX = Device Code
G = Pb-Free Package
AT = Assembly & Test Site Code
YYWW = Year and Work Week Code

PIN CONNECTIONS



ORDERING INFORMATION

See detailed ordering and shipping information on page 4 of this data sheet.

NXH500B100H7F5SHG

MODULE CHARACTERISTICS

Rating	Symbol	Value	Unit
Operating Temperature under Switching Condition	TVJOP	-40 to 150	°C
Storage Temperature Range	T _{stg}	-40 to 125	°C
Isolation Test Voltage, t = 2 sec, 50 Hz (Note 1)	V _{is}	4800	V _{RMS}
Stray Inductance	L _s CE	15	nH
Terminal Connection Torque (M5, Screw) torque	M	3 to 5	Nm
Weight	G	245	g
Creepage Distance (terminal to heatsink)		17.46	mm
Creepage Distance (terminal to terminal)		6.48	mm
Clearance Distance (terminal to heatsink)		15.62	mm
Clearance Distance (terminal to terminal)		5.05	mm
Comparative Tracking Index	CTI	>600	

1. 4800 VAC_{RMS} for 2 second duration is equivalent to 2833 VAC_{RMS} for 1 minute duration.

ABSOLUTE MAXIMUM RATINGS T_J = 25°C unless otherwise noted (Note 2)

Rating	Symbol	Value	Unit
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IGBT (T11, T12, T21, T22)

Collector-emitter voltage	V _{CES}	1000	V
Gate-Emitter Voltage	V _{GE}	±20	V
Positive transient gate-emitter voltage (Tpulse = 5 μs, D < 0.10)		30	
Continuous Collector Current @ T _C = 80°C (T _J = 175°C)	I _C	210	A
Pulsed Peak Collector Current @ T _C = 80°C (T _J = 175°C)	I _{C(Pulse)}	630	A
Power Dissipation (T _J = 175°C, T _C = 80°C)	P _{tot}	503	W
Minimum Operating Junction Temperature	T _{JMIN}	-40	°C
Maximum Operating Junction Temperature	T _{JMAX}	175	°C

IGBT INVERSE DIODE (D11, D12, D21, D22)

Peak Repetitive Reverse Voltage	V _{RRM}	1200	V
Continuous Forward Current @ T _C = 80°C	I _F	125	A
Repetitive Peak Forward Current (T _J = 175°C)	I _{FRM}	375	A
Maximum Power Dissipation @ T _C = 80°C (T _J = 175°C)	P _{tot}	203	W
Minimum Operating Junction Temperature	T _{JMIN}	-40	°C
Maximum Operating Junction Temperature	T _{JMAX}	175	°C

BOOST SILICON CARBIDE SCHOTTKY DIODE (D13, D14, D23, D24)

Peak Repetitive Reverse Voltage	V _{RRM}	1200	V
Continuous Forward Current @ T _C = 80°C (T _J = 175°C)	I _F	141	A
Repetitive Peak Forward Current (T _J = 175°C)	I _{FRM}	423	A
Maximum Power Dissipation @ T _C = 80°C (T _J = 175°C)	P _{tot}	305	W
Minimum Operating Junction Temperature	T _{JMIN}	-40	°C
Maximum Operating Junction Temperature	T _{JMAX}	175	°C

START-UP DIODE (D15, D25)

Peak Repetitive Reverse Voltage	V _{RRM}	1200	V
Continuous Forward Current @ T _C = 80°C (T _J = 175°C)	I _F	78	A
Repetitive Peak Forward Current (T _J = 175°C)	I _{FRM}	234	A

NXH500B100H7F5SHG

ABSOLUTE MAXIMUM RATINGS $T_J = 25^\circ\text{C}$ unless otherwise noted (Note 2)

Rating	Symbol	Value	Unit
START-UP DIODE (D15, D25)			
Maximum Power Dissipation ($T_J = 175^\circ\text{C}$)	P_{tot}	203	W
Minimum Operating Junction Temperature	T_{JMIN}	-40	$^\circ\text{C}$
Maximum Operating Junction Temperature	T_{JMAX}	175	$^\circ\text{C}$

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.

2. Refer to ELECTRICAL CHARACTERISTICS, RECOMMENDED OPERATING RANGES and/or APPLICATION INFORMATION for Safe Operating parameters.

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

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit	
IGBT (T11, T12, T21, T22)							
Collector-Emitter Cutoff Current	$V_{\text{GE}} = 0 \text{ V}, V_{\text{CE}} = 1000 \text{ V}$	I_{CES}	-	-	500	μA	
Collector-Emitter Saturation Voltage	$V_{\text{GE}} = 15 \text{ V}, I_{\text{C}} = 240 \text{ A}, T_{\text{C}} = 25^\circ\text{C}$	$V_{\text{CE(SAT)}}$	-	1.7	2.3	V	
	$V_{\text{GE}} = 15 \text{ V}, I_{\text{C}} = 240 \text{ A}, T_{\text{C}} = 150^\circ\text{C}$		-	2.1	-		
Gate-Emitter Threshold Voltage	$V_{\text{GE}} = V_{\text{CE}}, I_{\text{C}} = 240 \text{ mA}$	$V_{\text{GE(TH)}}$	4.0	5.7	6.9	V	
Gate Leakage Current	$V_{\text{GE}} = \pm 20 \text{ V}, V_{\text{CE}} = 0 \text{ V}$	I_{GES}	-	-	1	μA	
Internal Gate Resistor		R_{g}		1.5		Ω	
Turn-Off safe operating area	$V_{\text{CC}} < 800 \text{ V},$ $R_{\text{g,off}} \geq 30 \Omega, T_{\text{vj}} < 150^\circ\text{C}$			200		A	
Turn-On Delay Time	$T_J = 25^\circ\text{C}, V_{\text{CE}} = 600 \text{ V}, I_{\text{C}} = 100 \text{ A}$ $V_{\text{GE}} = -9 \text{ V}, +15 \text{ V}, R_{\text{G,on}} = 7 \Omega,$ $R_{\text{G,off}} = 22 \Omega$	$t_{\text{d(on)}}$	-	132	-	ns	
Rise Time		t_{r}	-	30	-		
Turn-Off Delay Time		$t_{\text{d(off)}}$	-	400	-		
Fall time		t_{f}	-	29	-		
Turn on switching loss		E_{on}	-	1070	-		μJ
Turn off switching loss		E_{off}	-	3500	-		
Turn-On Delay Time	$T_J = 125^\circ\text{C}, V_{\text{CE}} = 600 \text{ V}, I_{\text{C}} = 100 \text{ A}$ $V_{\text{GE}} = -9 \text{ V}, +15 \text{ V}, R_{\text{G,on}} = 7 \Omega,$ $R_{\text{G,off}} = 22 \Omega$	$t_{\text{d(on)}}$	-	127	-	ns	
Rise Time		t_{r}	-	33	-		
Turn-Off Delay Time		$t_{\text{d(off)}}$	-	460	-		
Fall time		t_{f}	-	40	-		
Turn on switching loss		E_{on}	-	1280	-		μJ
Turn off switching loss		E_{off}	-	5000	-		
Input capacitance	$V_{\text{CE}} = 20 \text{ V}, V_{\text{GE}} = 0 \text{ V}, f = 100 \text{ kHz}$	C_{ies}	-	18488	-	μF	
Output capacitance		C_{oes}	-	797	-		
Reverse transfer capacitance		C_{res}	-	116	-		
Gate Charge	$V_{\text{CE}} = 600 \text{ V}, V_{\text{GE}} = -15/+20 \text{ V},$ $I_{\text{C}} = 40 \text{ A}$	Q_{g}	-	1140	-	nC	
Thermal Resistance – chip-to-heatsink	Thermal grease, Thickness = 2.1 Mil \pm 2%, $\lambda = 2.9 \text{ W/mK}$	R_{thJH}	-	0.263	-	K/W	
Thermal Resistance – chip-to-case		R_{thJC}	-	0.198	-	K/W	
IGBT INVERSE DIODE (D11, D12, D21, D22)							
Diode Forward Voltage	$I_{\text{F}} = 75 \text{ A}, T_J = 25^\circ\text{C}$	V_{F}	-	1.10	1.5	V	
	$I_{\text{F}} = 75 \text{ A}, T_J = 150^\circ\text{C}$		-	1.00	-		
Surge Forward Current	$t_{\text{p}} = 10 \text{ ms}, T_{\text{vj}} = 150^\circ\text{C}$	I_{FSM}	-	500	-	A	

NXH500B100H7F5SHG

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

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
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IGBT INVERSE DIODE (D11, D12, D21, D22)

I^2t	$t_p = 10 \text{ ms}, T_{vj} = 150^\circ\text{C}$	I^2t	–	1250	–	A^2s
Thermal Resistance – chip-to-heatsink	Thermal grease, Thickness = 2.1 Mil $\pm 2\%$ $\lambda = 2.9 \text{ W/mK}$	R_{thJH}	–	0.61	–	K/W
Thermal Resistance – chip-to-case		R_{thJC}		0.47		

BOOST SILICON CARBIDE SCHOTTKY DIODE (D13, D14, D23, D24)

Reverse Leakage Current	$V_F = 1200 \text{ V}, T_J = 25^\circ\text{C}$	I_R	–	–	1.5	mA
Surge Forward Current	$t_p = 10 \text{ ms}, T_{vj} = 150^\circ\text{C}$	I_{FSM}	–	500	–	A
I^2t	$t_p = 10 \text{ ms}, T_{vj} = 150^\circ\text{C}$	I^2t	–	1250	–	A^2s
Diode Forward Voltage	$I_F = 120 \text{ A}, T_J = 25^\circ\text{C}$	V_F	–	1.45	1.7	V
	$I_F = 120 \text{ A}, T_J = 150^\circ\text{C}$		–	1.74	–	
Reverse Recovery Time	$T_J = 25^\circ\text{C}$ $V_R = 600 \text{ V}, I_C = 100 \text{ A}$ $V_{GE} = -9 \text{ V}, 15 \text{ V}, R_{G,on} = 7 \Omega$	t_{rr}	–	25.5	–	ns
Reverse Recovery Charge		Q_{rr}	–	575	–	nC
Peak Reverse Recovery Current		I_{RRM}	–	33	–	A
Peak Rate of Fall of Recovery Current		di/dt	–	2800	–	$\text{A}/\mu\text{s}$
Reverse Recovery Energy		E_{rr}	–	270	–	μJ
Reverse Recovery Time		$T_J = 125^\circ\text{C}$ $V_{DS} = 600 \text{ V}, I_C = 100 \text{ A}$ $V_{GE} = -9 \text{ V}, 15 \text{ V}, R_{G,on} = 7 \Omega$	t_{rr}	–	26	–
Reverse Recovery Charge	Q_{rr}		–	615	–	nC
Peak Reverse Recovery Current	I_{RRM}		–	36	–	A
Peak Rate of Fall of Recovery Current	di/dt		–	2550	–	$\text{A}/\mu\text{s}$
Reverse Recovery Energy	E_{rr}		–	279	–	μJ
Thermal Resistance – chip-to-heatsink	Thermal grease, Thickness = 2.1 Mil $\pm 2\%$ $\lambda = 2.9 \text{ W/mK}$		R_{thJH}	–	0.405	–
Thermal Resistance – chip-to-case		R_{thJC}	–	0.316	–	K/W

START-UP DIODE (D15, D25)

Diode Forward Voltage	$I_F = 75 \text{ A}, T_J = 25^\circ\text{C}$	V_F	–	2.87	3.5	V
	$I_F = 75 \text{ A}, T_J = 150^\circ\text{C}$		–	2.19	–	
Surge Forward Current	$t_p = 10 \text{ ms}, T_{vj} = 150^\circ\text{C}$	I_{FSM}	–	450	–	A
I^2t	$t_p = 10 \text{ ms}, T_{vj} = 150^\circ\text{C}$	I^2t	–	1013	–	A^2s
Thermal Resistance – chip-to-heatsink	Thermal grease, Thickness = 2.1 Mil $\pm 2\%$ $\lambda = 2.9 \text{ W/mK}$	R_{thJH}	–	0.61	–	K/W
Thermal Resistance – chip-to-case		R_{thJC}	–	0.47	–	K/W

THERMISTOR CHARACTERISTICS

Nominal resistance	$T = 25^\circ\text{C}$	R_{25}	–	5	–	k Ω
Nominal resistance	$T = 100^\circ\text{C}$	R_{100}	–	492.2	–	Ω
Deviation of R25		$\Delta R/R$	–1	–	1	%
Power dissipation		P_D	–	5	–	mW
Power dissipation constant			–	1.3	–	mW/K
B-value	B(25/85), tolerance $\pm 1\%$		–	3430	–	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
NXH500B100H7F5SHG	NXH500B100H7F5SHG	F5 – PIM58 112x62 (Solder PIN) (Pb-Free and Halide-Free, Solder Pins)	8 Units / Blister Tray

NXH500B100H7F5SHG

TYPICAL CHARACTERISTICS – T11, T12, T21, T22 (IGBT)

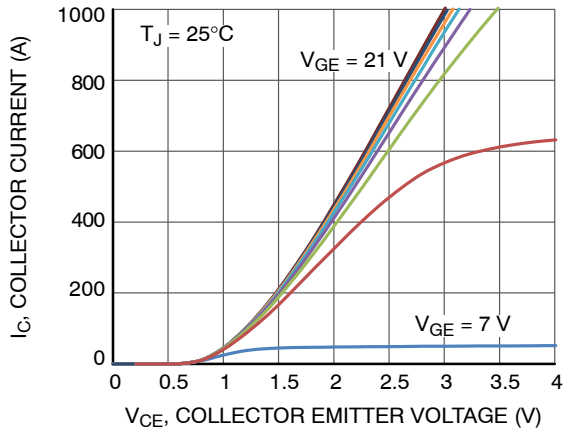


Figure 2. Typical Output Characteristics – IGBT

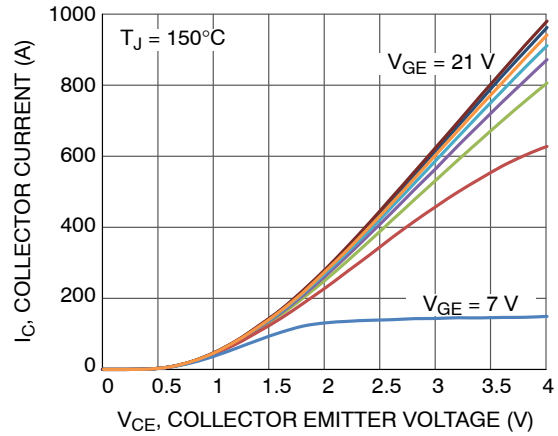


Figure 3. Typical Output Characteristics – IGBT

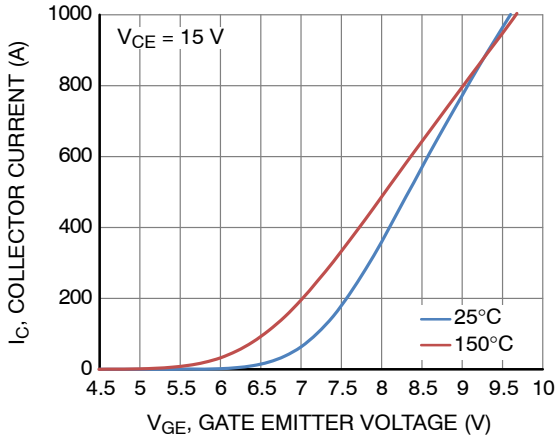


Figure 4. Transfer Characteristics – IGBT

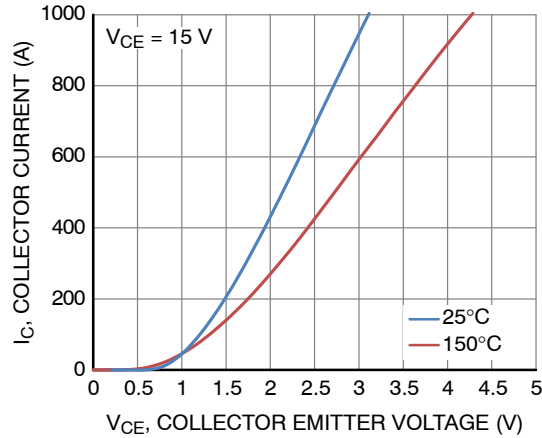


Figure 5. Saturation Voltage Characteristic – IGBT

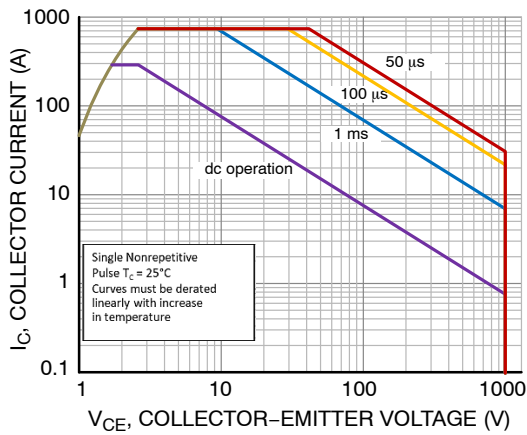


Figure 6. FBSOA

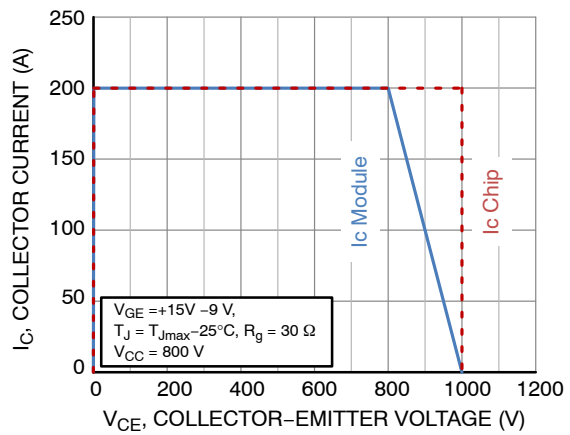


Figure 7. RBSOA

NXH500B100H7F5SHG

TYPICAL CHARACTERISTICS – T11, T12, T21, T22 (IGBT) (continued)

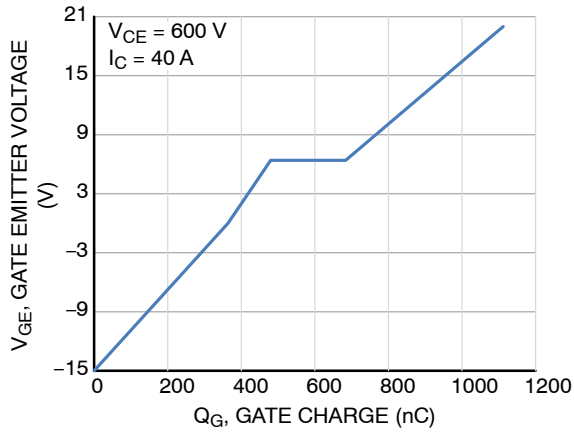


Figure 8. Gate Voltage vs. Gate Charge

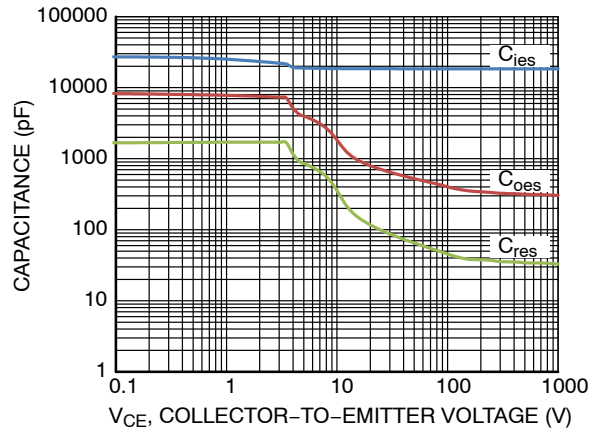


Figure 9. Capacitance vs. V_{CE}

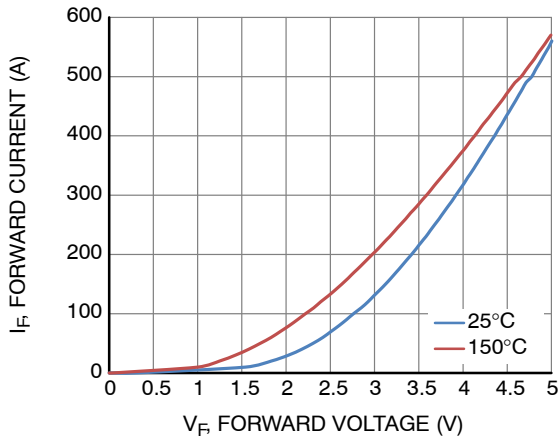


Figure 10. Start-up Diode Forward Characteristics

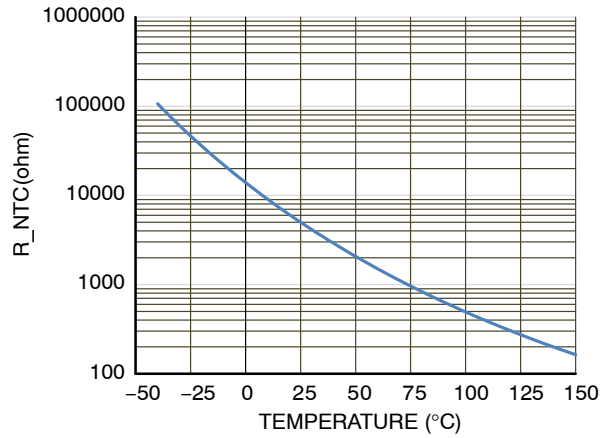


Figure 11. Thermistor Characteristic

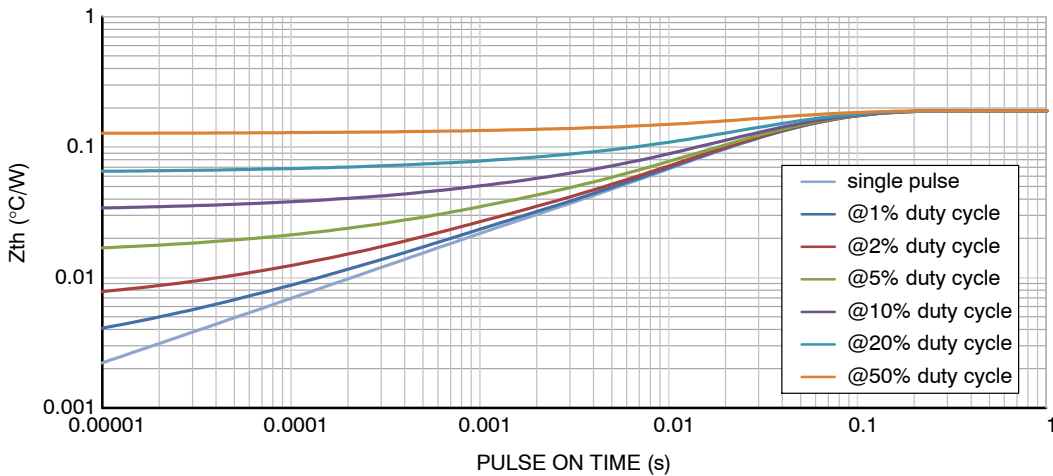


Figure 12. MOSFET Junction-to-Case Transient Thermal Impedance

NXH500B100H7F5SHG

TYPICAL CHARACTERISTIC – D11,D12,D21,D22 (INVERSE DIODE)

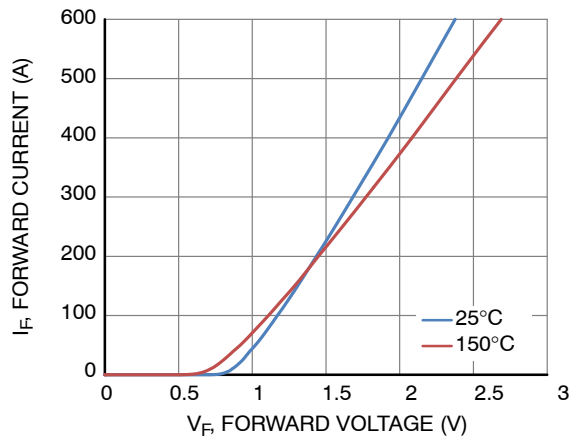


Figure 13. Inverse Diode Forward Characteristics

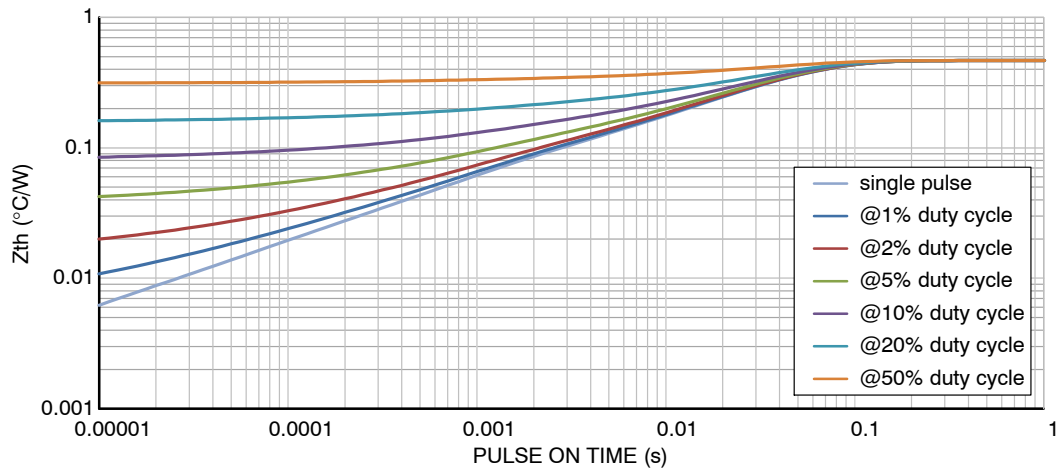


Figure 14. Transient Thermal Impedance (Inverse Diode Z_{thjc})

TYPICAL CHARACTERISTIC – D13,D14,D23,D24 (SiC SCHOTTKY DIODE)

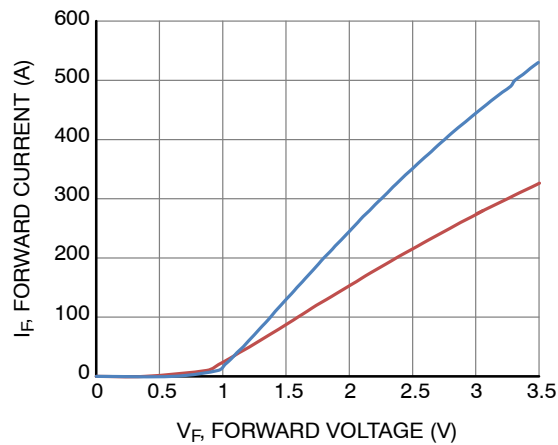


Figure 15. SiC Schottky Diode Forward Characteristics

NXH500B100H7F5SHG

TYPICAL CHARACTERISTIC – D13,D14,D23,D24 (SiC SCHOTTKY DIODE) (continued)

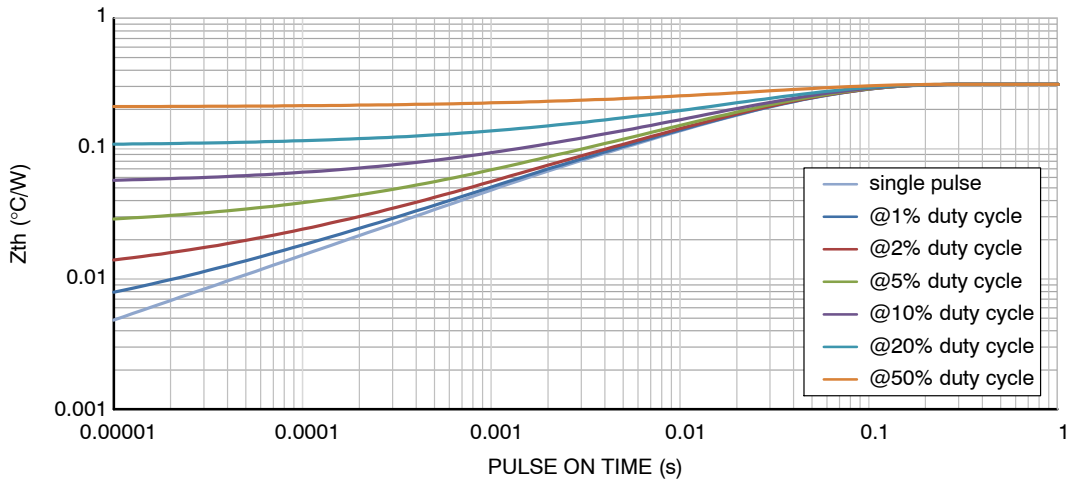


Figure 16. Transient Thermal Impedance (SiC Schottky Diode Z_{thjc})

TYPICAL CHARACTERISTICS – T11, T12, T21, T22 (IGBT)

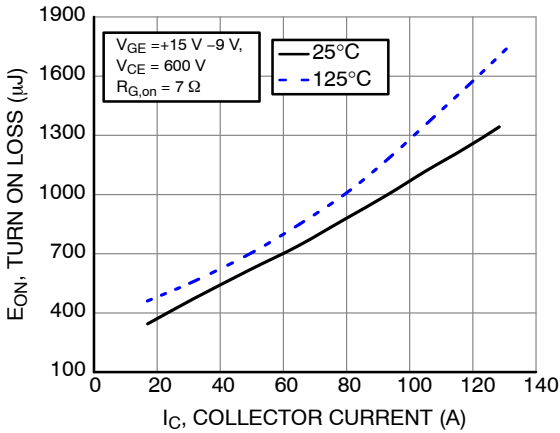


Figure 17. Typical Turn On Loss vs. I_c

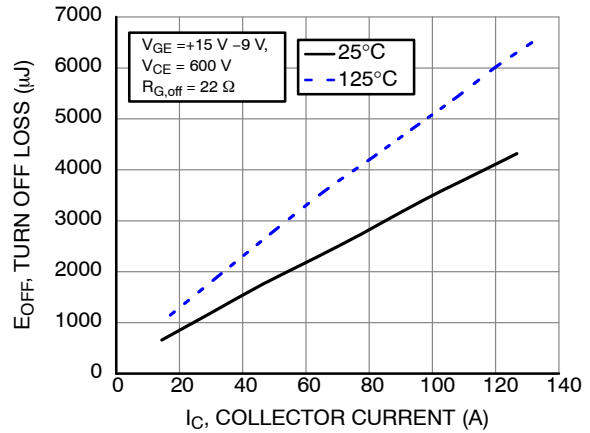


Figure 18. Typical Turn Off Loss vs. I_c

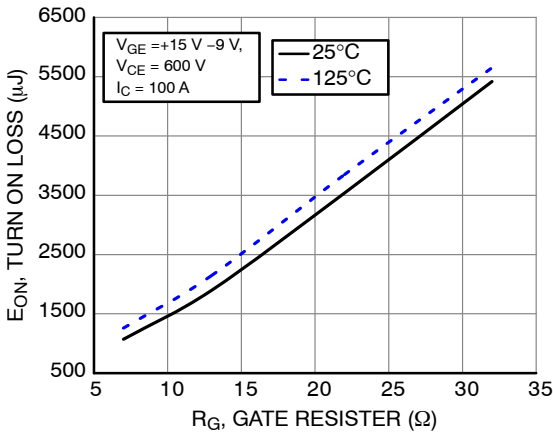


Figure 19. Typical Turn On Loss vs. R_G

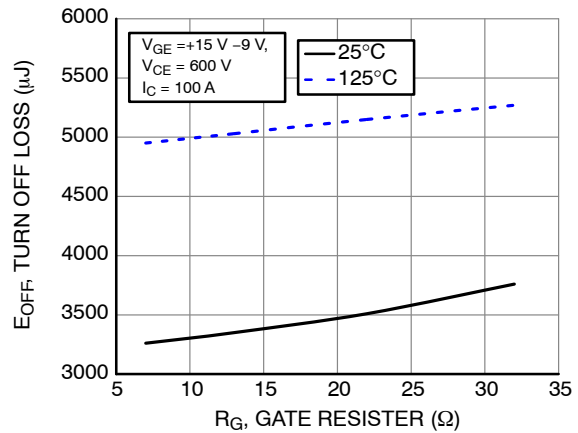


Figure 20. Typical Turn Off Loss vs. R_G

NXH500B100H7F5SHG

TYPICAL CHARACTERISTICS – T11, T12, T21, T22 (IGBT) (continued)

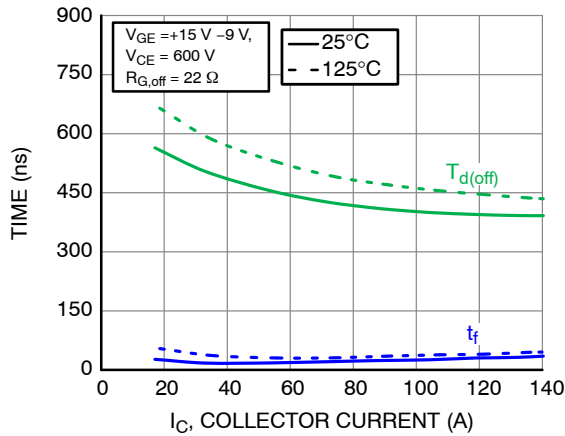


Figure 21. Typical Turn Off Switching Time vs. I_C

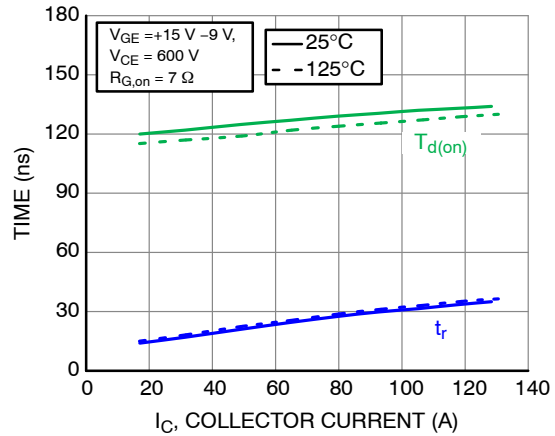


Figure 22. Typical Turn On Switching Time vs. I_C

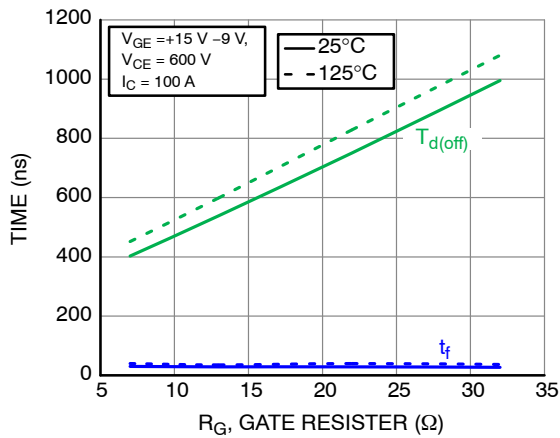


Figure 23. Typical Turn Off Switching Time vs. R_G

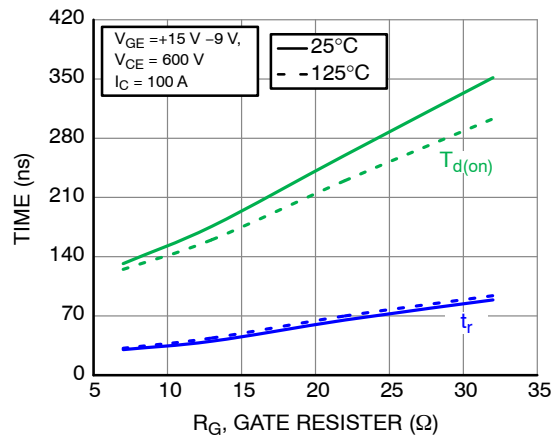


Figure 24. Typical Turn On Switching Time vs. R_G

TYPICAL CHARACTERISTICS – SIC SCHOTTKY DIODE (D13,D14,D23,D24)

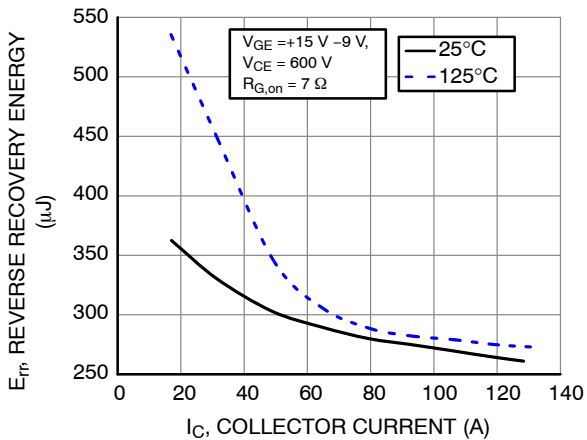


Figure 25. Typical Reverse Recovery Energy Loss vs. I_C

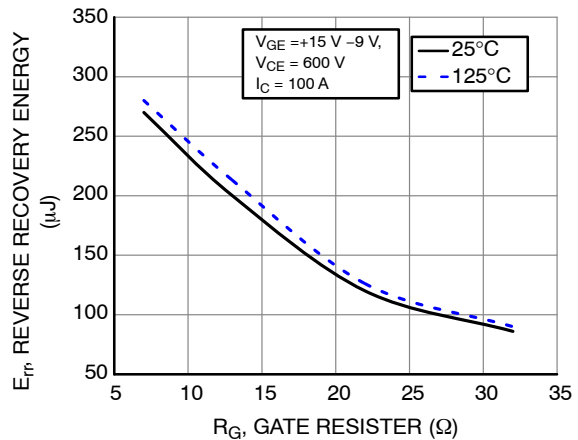


Figure 26. Typical Reverse Recovery Energy Loss vs. R_G

NXH500B100H7F5SHG

TYPICAL CHARACTERISTICS – SIC SCHOTTKY DIODE (D13,D14,D23,D24) (continued)

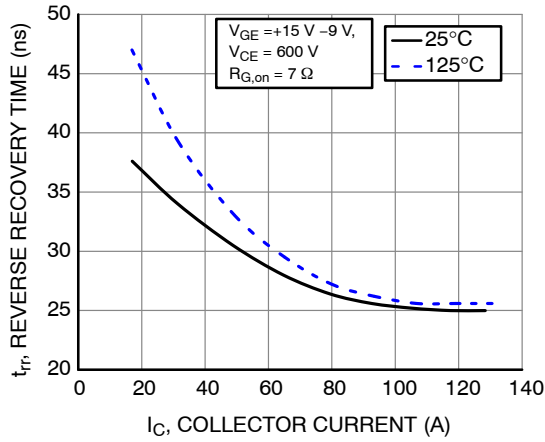


Figure 27. Typical Reverse Recovery Time vs. I_C

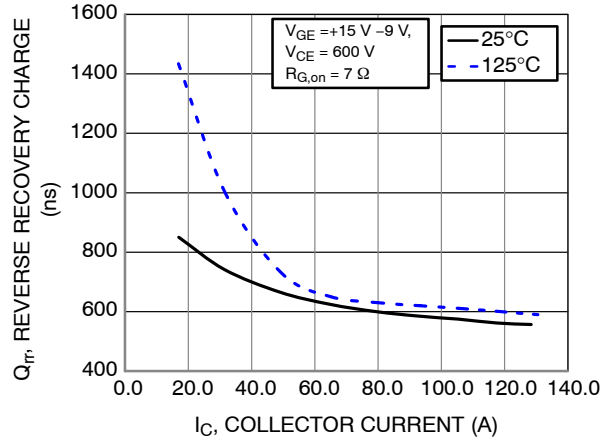


Figure 28. Typical Reverse Recovery Charge vs. I_C

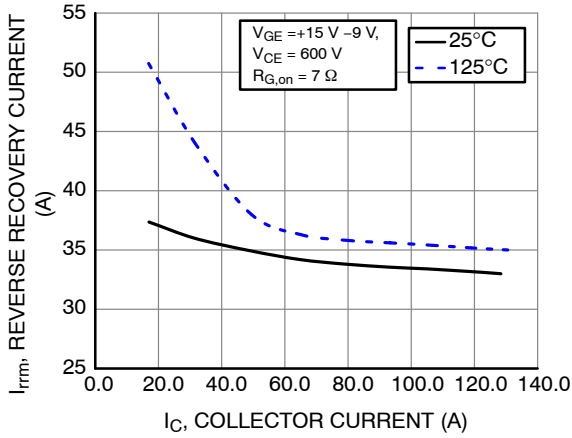


Figure 29. Typical Reverse Recovery Current vs. I_C

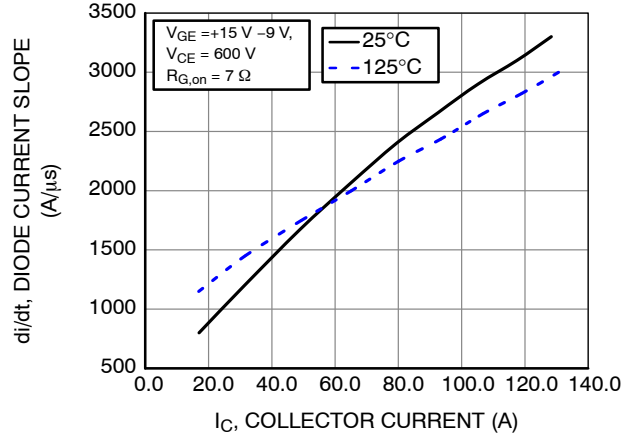


Figure 30. Typical Diode Current Slope vs. I_C

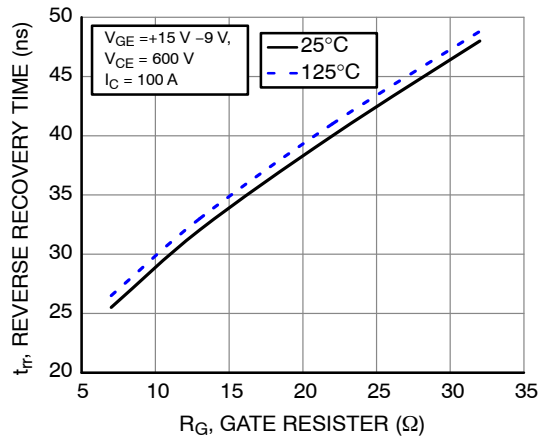


Figure 31. Typical Reverse Recovery Time vs. R_G

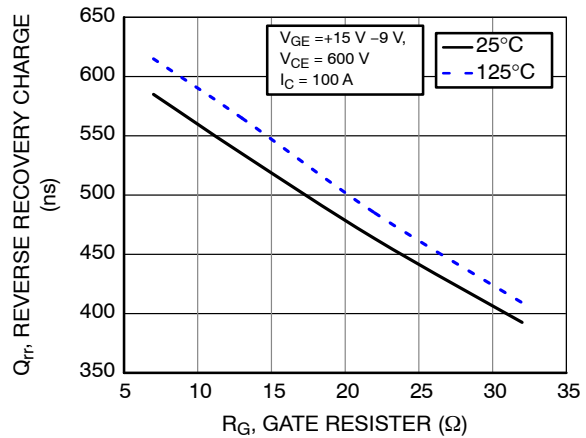


Figure 32. Typical Reverse Recovery Charge vs. R_G

NXH500B100H7F5SHG

TYPICAL CHARACTERISTICS – SIC SCHOTTKY DIODE (D13,D14,D23,D24) (continued)

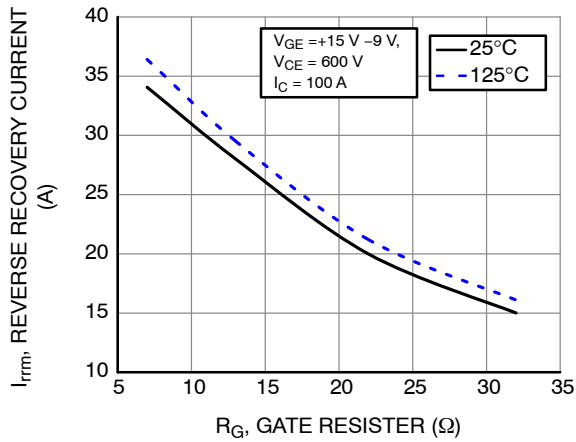


Figure 33. Typical Reverse Recovery Time vs. I_C

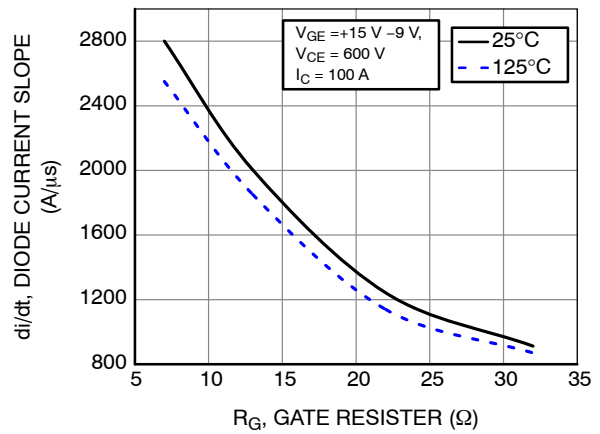


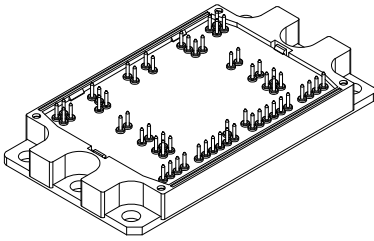
Figure 34. Typical Reverse Recovery Charge vs. I_C

NXH500B100H7F5SHG

PACKAGE DIMENSIONS

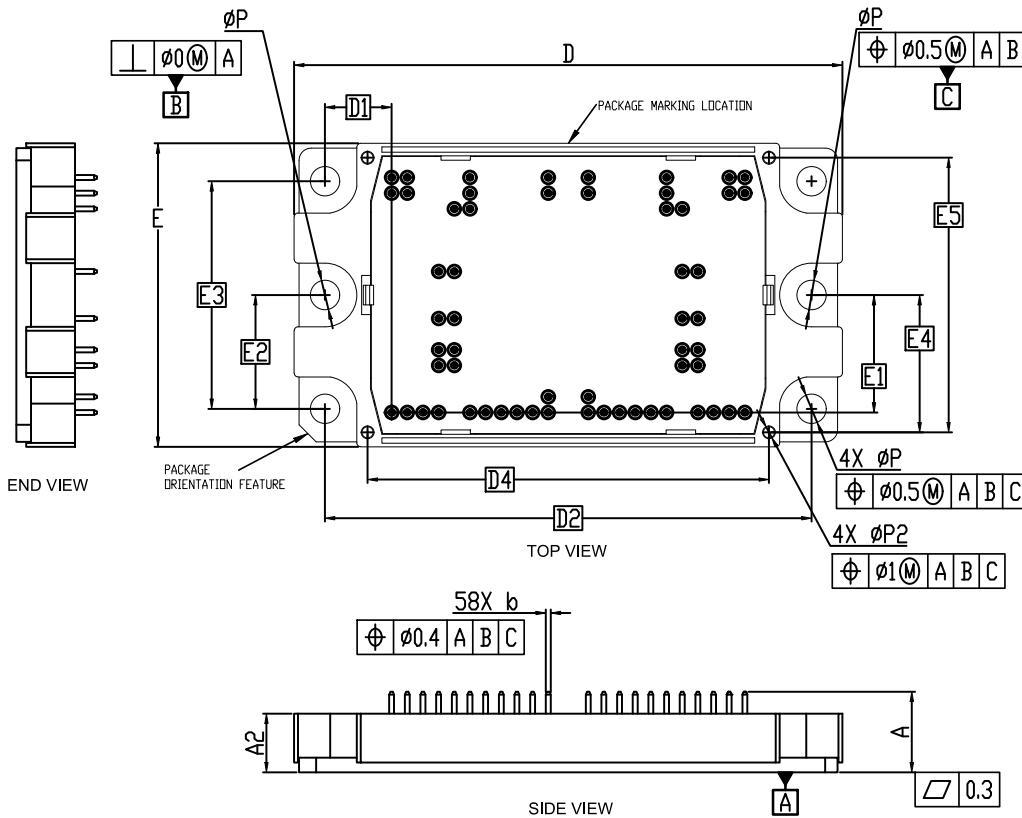
PIM58 112.00x62.00x12.00
CASE 180CZ
ISSUE O

DATE 30 JUL 2024



NOTES:

1. Dimensioning and tolerancing conform to ASME Y14.5
2. All dimensions are in millimeters.
3. Pin-grid is 3.2mm.
4. Package marking is located on the side opposite the package orientation feature.
5. The pins are gold-plated solder pin.



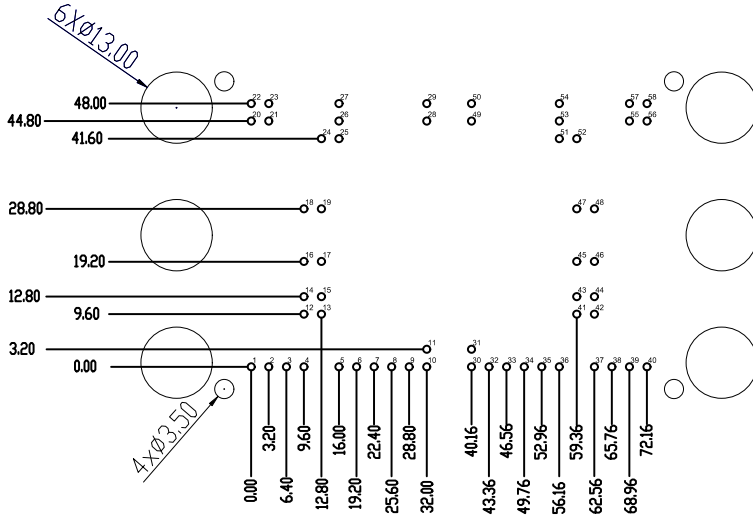
DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	16.10	16.50	16.90
A2	11.70	12.00	12.30
b	0.95	1.00	1.05
D	111.60	112.00	112.40
D1		13.62 BSC	
D2		99.40 BSC	
D4		82.00 BSC	
E	61.60	62.00	62.40
E1		24.00 BSC	
E2		23.25 BSC	
E3		46.50 BSC	
E4		28.05 BSC	
E5		56.10 BSC	
P	5.90	6.00	6.10
P2	2.20	2.30	2.40

NXH500B100H7F5SHG

PACKAGE DIMENSIONS

PIM58 112.00x62.00x12.00
CASE 180CZ
ISSUE O

DATE 30 JUL 2024



RECOMMENDED MOUNTING PATTERN

* For additional information on our Pb-Free strategy and soldering details, please download the Onsemi Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

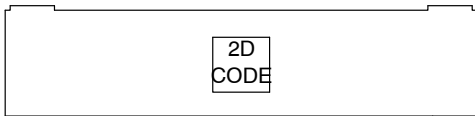
NOTE 2:

Pin table								
Pin	X	Y	Pin	X	Y	Pin	X	Y
1	0	0	24	12.8	41.6	47	59.36	28.8
2	3.2	0	25	16	41.6	48	62.56	28.8
3	6.4	0	26	16	44.8	49	40.16	44.8
4	9.6	0	27	16	48	50	40.16	48
5	16	0	28	32	44.8	51	56.16	41.6
6	19.2	0	29	32	48	52	59.36	41.6
7	22.4	0	30	40.16	0	53	56.16	44.8
8	25.6	0	31	40.16	3.2	54	56.16	48
9	28.8	0	32	43.36	0	55	68.96	44.8
10	32	0	33	46.56	0	56	72.16	44.8
11	32	3.2	34	49.76	0	57	68.96	48
12	9.6	9.6	35	52.96	0	58	72.16	48
13	12.8	9.6	36	56.16	0			
14	9.6	12.8	37	62.56	0			
15	12.8	12.8	38	65.76	0			
16	9.6	19.2	39	68.96	0			
17	12.8	19.2	40	72.16	0			
18	9.6	28.8	41	59.36	9.6			
19	12.8	28.8	42	62.56	9.6			
20	0	44.8	43	59.36	12.8			
21	3.2	44.8	44	62.56	12.8			
22	0	48	45	59.36	19.2			
23	3.2	48	46	62.56	19.2			

GENERIC MARKING DIAGRAM*



FRONTSIDE MARKING



BACKSIDE MARKING

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.

NXH500B100H7F5SHG

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