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# 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

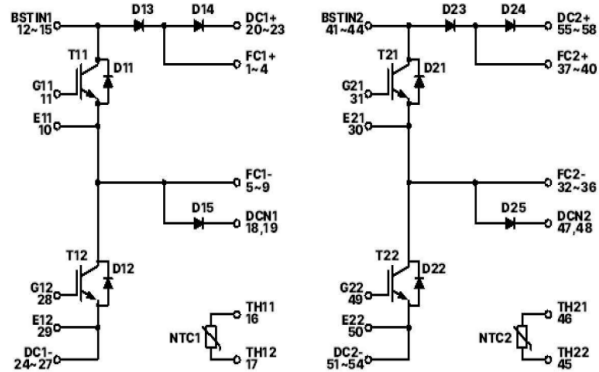
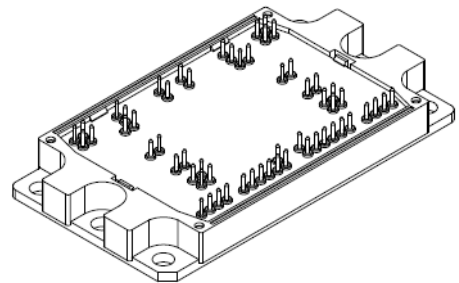


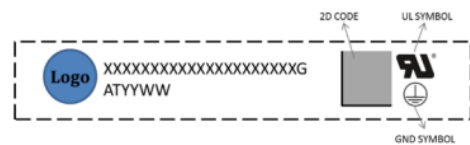
Figure 1. NXH500B100H7F5SHG Schematic Diagram

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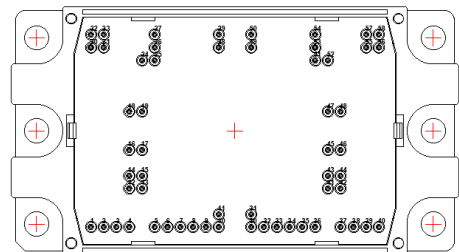
PIM58 112x62 (SOLDER PIN)  
CASE 180CZ

#### 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 <sub>stg</sub>	-40 to 125	°C
Isolation Test Voltage, t = 2 sec, 50 Hz (Note 1)	V <sub>is</sub>	4800	V <sub>RMS</sub>
Stray Inductance	L <sub>s</sub> 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<sub>RMS</sub> for 2 second duration is equivalent to 2833 VAC<sub>RMS</sub> for 1 minute duration.

## ABSOLUTE MAXIMUM RATINGS T<sub>J</sub> = 25°C unless otherwise noted (Note 2)

Rating	Symbol	Value	Unit
--------	--------	-------	------

### IGBT (T11, T12, T21, T22)

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

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

Peak Repetitive Reverse Voltage	V <sub>RRM</sub>	1200	V
Continuous Forward Current @ T <sub>C</sub> = 80°C	I <sub>F</sub>	125	A
Repetitive Peak Forward Current (T <sub>J</sub> = 175°C)	I <sub>FRM</sub>	375	A
Maximum Power Dissipation @ T <sub>C</sub> = 80°C (T <sub>J</sub> = 175°C)	P <sub>tot</sub>	203	W
Minimum Operating Junction Temperature	T <sub>JMIN</sub>	-40	°C
Maximum Operating Junction Temperature	T <sub>JMAX</sub>	175	°C

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

Peak Repetitive Reverse Voltage	V <sub>RRM</sub>	1200	V
Continuous Forward Current @ T <sub>C</sub> = 80°C (T <sub>J</sub> = 175°C)	I <sub>F</sub>	141	A
Repetitive Peak Forward Current (T <sub>J</sub> = 175°C)	I <sub>FRM</sub>	423	A
Maximum Power Dissipation @ T <sub>C</sub> = 80°C (T <sub>J</sub> = 175°C)	P <sub>tot</sub>	305	W
Minimum Operating Junction Temperature	T <sub>JMIN</sub>	-40	°C
Maximum Operating Junction Temperature	T <sub>JMAX</sub>	175	°C

### START-UP DIODE (D15, D25)

Peak Repetitive Reverse Voltage	V <sub>RRM</sub>	1200	V
Continuous Forward Current @ T <sub>C</sub> = 80°C (T <sub>J</sub> = 175°C)	I <sub>F</sub>	108	A
Repetitive Peak Forward Current (T <sub>J</sub> = 175°C)	I <sub>FRM</sub>	324	A

# NXH500B100H7F5SHG

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

Rating	Symbol	Value	Unit
<b>START-UP DIODE (D15, D25)</b>			
Maximum Power Dissipation ( $T_J = 175^\circ\text{C}$ )	$P_{\text{tot}}$	305	W
Minimum Operating Junction Temperature	$T_{\text{JMIN}}$	-40	$^\circ\text{C}$
Maximum Operating Junction Temperature	$T_{\text{JMAX}}$	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	
<b>IGBT (T11, T12, T21, T22)</b>							
Collector-Emitter Cutoff Current	$V_{\text{GE}} = 0\text{ V}, V_{\text{CE}} = 1000\text{ V}$	$I_{\text{CES}}$	-	-	500	$\mu\text{A}$	
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	$V_{\text{GE}} = \pm 20\text{ V}, V_{\text{CE}} = 0\text{ V}$	$I_{\text{GES}}$	-	-	1	$\mu\text{A}$	
Internal Gate Resistor		$R_{\text{g}}$		1.5		$\Omega$	
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		$t_{\text{r}}$	-	30	-		
Turn-Off Delay Time		$t_{\text{d(off)}}$	-	400	-		
Fall time		$t_{\text{f}}$	-	29	-		
Turn on switching loss		$E_{\text{on}}$	-	1070	-		$\mu\text{J}$
Turn off switching loss		$E_{\text{off}}$	-	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		$t_{\text{r}}$	-	33	-		
Turn-Off Delay Time		$t_{\text{d(off)}}$	-	460	-		
Fall time		$t_{\text{f}}$	-	40	-		
Turn on switching loss		$E_{\text{on}}$	-	1280	-		$\mu\text{J}$
Turn off switching loss		$E_{\text{off}}$	-	5000	-		
Input capacitance	$V_{\text{CE}} = 20\text{ V}, V_{\text{GE}} = 0\text{ V}, f = 100\text{ kHz}$	$C_{\text{ies}}$	-	18488	-	$\mu\text{F}$	
Output capacitance		$C_{\text{oes}}$	-	797	-		
Reverse transfer capacitance		$C_{\text{res}}$	-	116	-		
Gate Charge	$V_{\text{CE}} = 600\text{ V}, V_{\text{GE}} = -15/+20\text{ V},$ $I_{\text{C}} = 40\text{ A}$	$Q_{\text{g}}$	-	1140	-	nC	
Thermal Resistance – chip-to-heatsink	Thermal grease, Thickness = 2.1 Mil $\pm$ 2%, $\lambda = 2.9\text{ W/mK}$	$R_{\text{thJH}}$	-	0.263	-	K/W	
Thermal Resistance – chip-to-case		$R_{\text{thJC}}$	-	0.198	-	K/W	
<b>IGBT INVERSE DIODE (D11, D12, D21, D22)</b>							
Diode Forward Voltage	$I_{\text{F}} = 75\text{ A}, T_J = 25^\circ\text{C}$	$V_{\text{F}}$	-	1.10	1.5	V	
	$I_{\text{F}} = 75\text{ A}, T_J = 150^\circ\text{C}$		-	1.00	-		
Surge Forward Current	$t_{\text{p}} = 10\text{ ms}, T_{\text{vj}} = 150^\circ\text{C}$	$I_{\text{FSM}}$	-	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 <sup>2</sup> t	$t_p = 10 \text{ ms}, T_{vj} = 150^\circ\text{C}$	I <sup>2</sup> t	–	1250	–	A <sup>2</sup> s
Thermal Resistance – chip-to-heatsink	Thermal grease, Thickness = 2.1 Mil $\pm 2\%$ $\lambda = 2.9 \text{ W/mK}$	R <sub>thJH</sub>	–	0.61	–	K/W
Thermal Resistance – chip-to-case		R <sub>thJC</sub>		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 <sub>R</sub>	–	–	1.5	mA
Surge Forward Current	$t_p = 10 \text{ ms}, T_{vj} = 150^\circ\text{C}$	I <sub>FSM</sub>	–	500	–	A
I <sup>2</sup> t	$t_p = 10 \text{ ms}, T_{vj} = 150^\circ\text{C}$	I <sup>2</sup> t	–	1250	–	A <sup>2</sup> s
Diode Forward Voltage	$I_F = 120 \text{ A}, T_J = 25^\circ\text{C}$	V <sub>F</sub>	–	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 <sub>rr</sub>	–	25.5	–	ns
Reverse Recovery Charge		Q <sub>rr</sub>	–	575	–	nC
Peak Reverse Recovery Current		I <sub>RRM</sub>	–	33	–	A
Peak Rate of Fall of Recovery Current		di/dt	–	2800	–	A/μs
Reverse Recovery Energy		E <sub>rr</sub>	–	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 <sub>rr</sub>	–	26	–
Reverse Recovery Charge	Q <sub>rr</sub>		–	615	–	nC
Peak Reverse Recovery Current	I <sub>RRM</sub>		–	36	–	A
Peak Rate of Fall of Recovery Current	di/dt		–	2550	–	A/μs
Reverse Recovery Energy	E <sub>rr</sub>		–	279	–	μJ
Thermal Resistance – chip-to-heatsink	Thermal grease, Thickness = 2.1 Mil $\pm 2\%$ $\lambda = 2.9 \text{ W/mK}$		R <sub>thJH</sub>	–	0.405	–
Thermal Resistance – chip-to-case		R <sub>thJC</sub>	–	0.316	–	K/W

### START-UP DIODE (D15, D25)

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

### THERMISTOR CHARACTERISTICS

Nominal resistance	$T = 25^\circ\text{C}$	R <sub>25</sub>	–	5	–	kΩ
Nominal resistance	$T = 100^\circ\text{C}$	R <sub>100</sub>	–	492.2	–	Ω
Deviation of R25		ΔR/R	–1	–	1	%
Power dissipation		P <sub>D</sub>	–	5	–	mW
Power dissipation constant			–	1.3	–	mW/K
B-value	B(25/85), tolerance $\pm 1\%$		–	3430	–	K

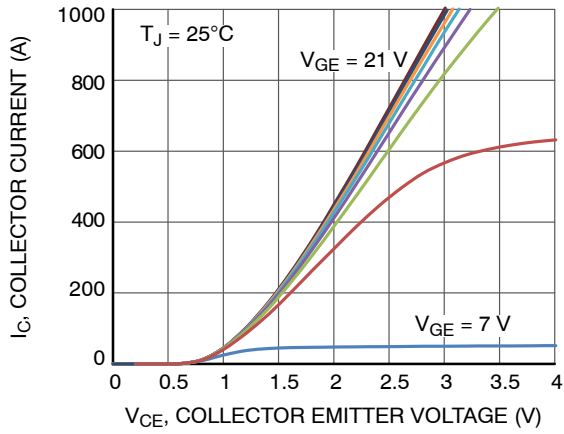
Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

### ORDERING INFORMATION

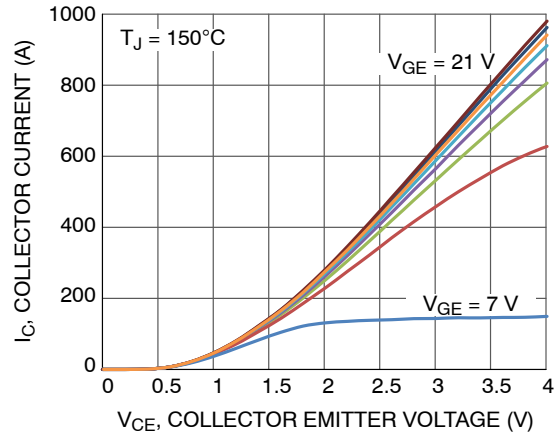
Orderable Part Number	Marking	Package	Shipping
NXH500B100H7F5SHG	NXH500B100H7F5SHG	F5 – PIM58 112x62 (Solder PIN) (Pb-Free and Halide-Free, Solder Pins)	8 Units / Blister Tray

# NXH500B100H7F5SHG

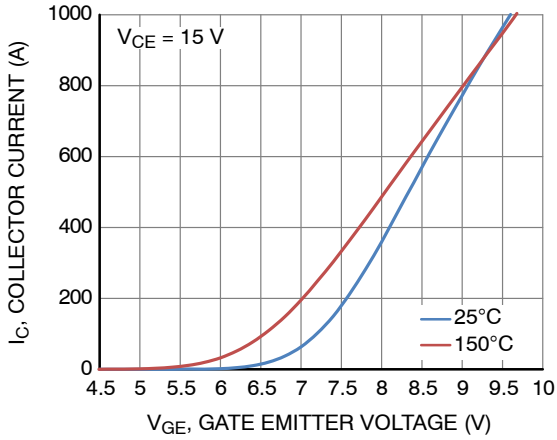
## TYPICAL CHARACTERISTICS – T11, T12, T21, T22 (IGBT)



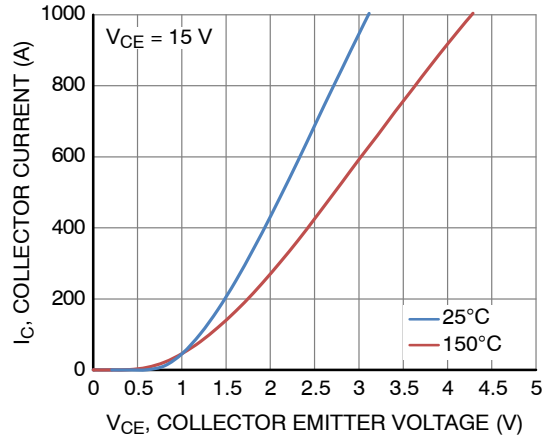
**Figure 2. Typical Output Characteristics – IGBT**



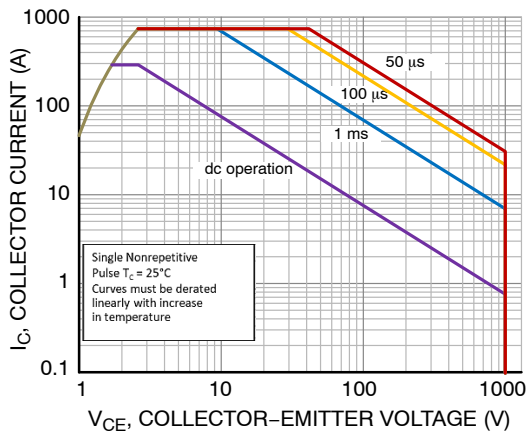
**Figure 3. Typical Output Characteristics – IGBT**



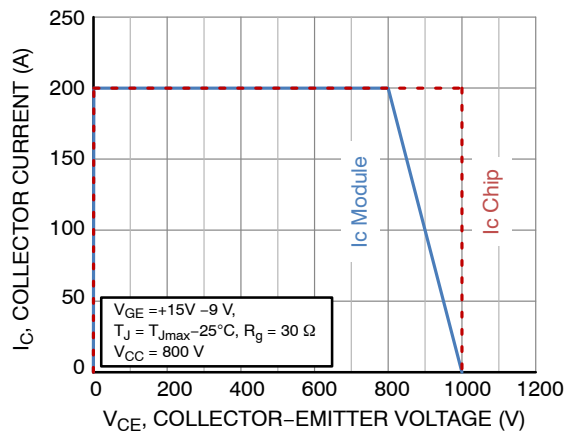
**Figure 4. Transfer Characteristics – IGBT**



**Figure 5. Saturation Voltage Characteristic – IGBT**



**Figure 6. FBSOA**



**Figure 7. RBSOA**

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

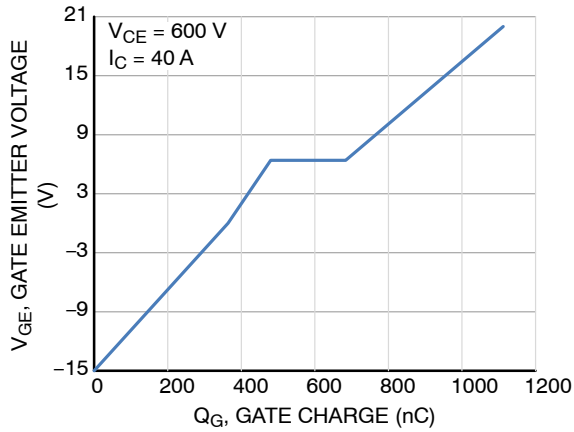


Figure 8. Gate Voltage vs. Gate Charge

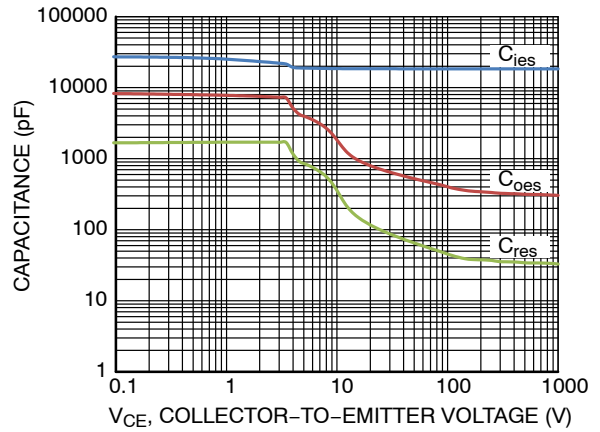


Figure 9. Capacitance vs.  $V_{CE}$

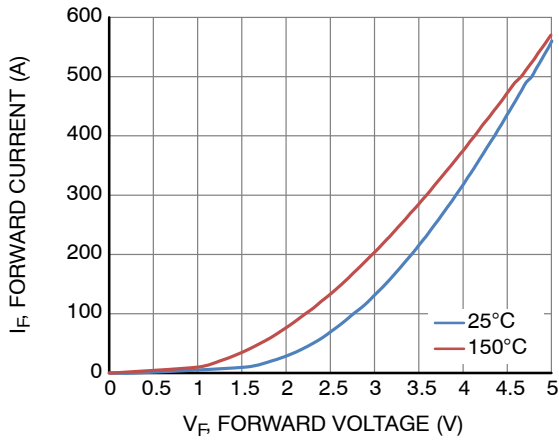


Figure 10. Start-up Diode Forward Characteristics

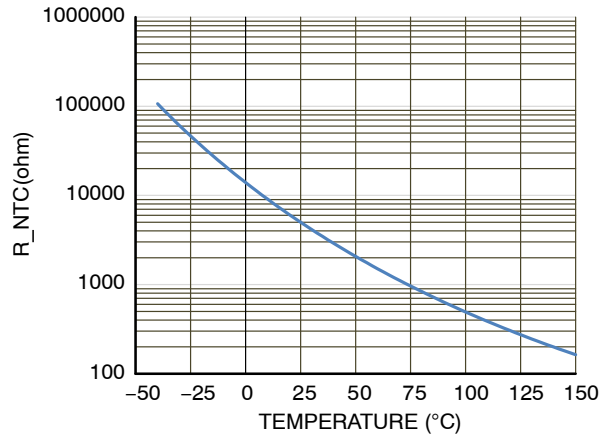


Figure 11. Thermistor Characteristic

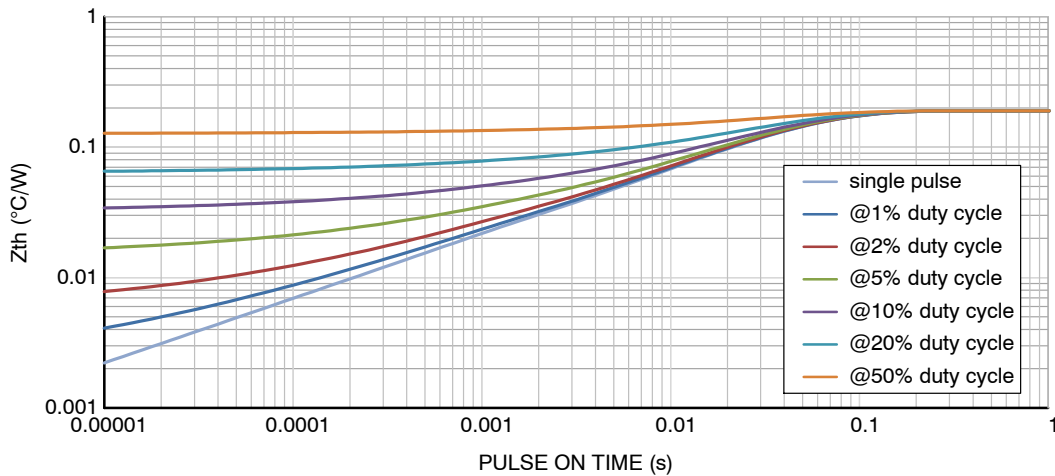


Figure 12. MOSFET Junction-to-Case Transient Thermal Impedance

# NXH500B100H7F5SHG

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

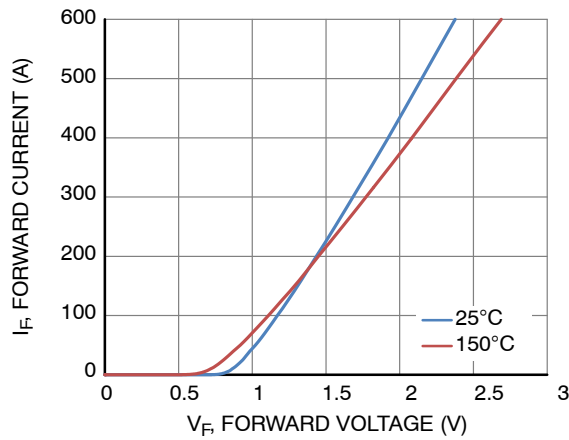


Figure 13. Inverse Diode Forward Characteristics

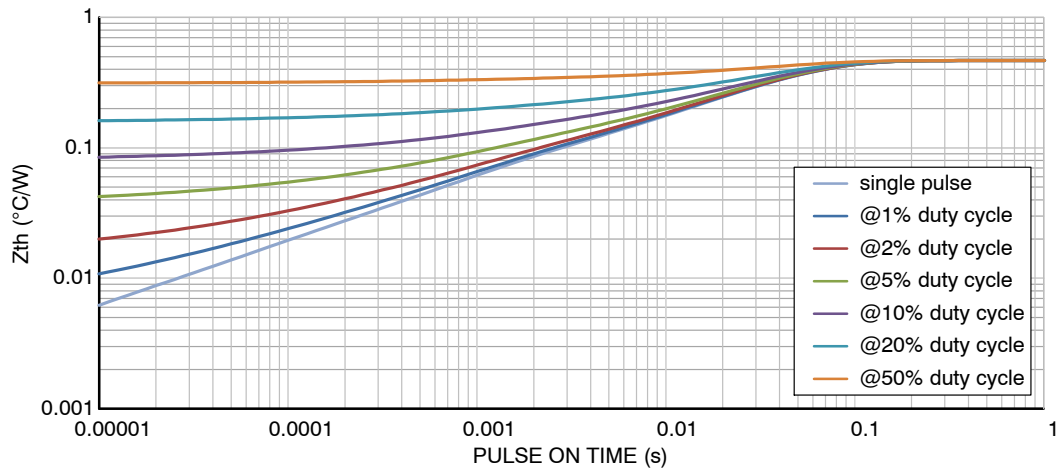


Figure 14. Transient Thermal Impedance (Inverse Diode  $Z_{thjc}$ )

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

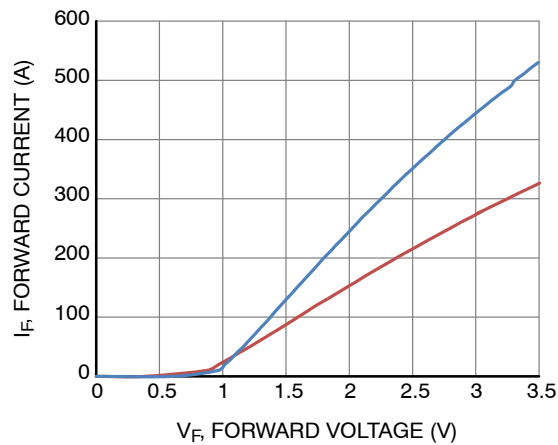


Figure 15. SiC Schottky Diode Forward Characteristics



# NXH500B100H7F5SHG

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

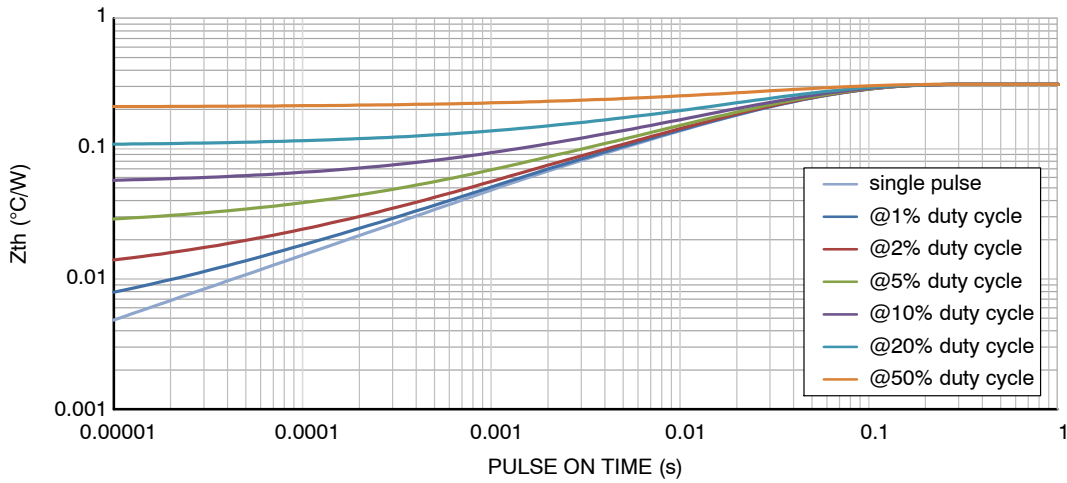


Figure 16. Transient Thermal Impedance (SiC Schottky Diode  $Z_{thjc}$ )

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

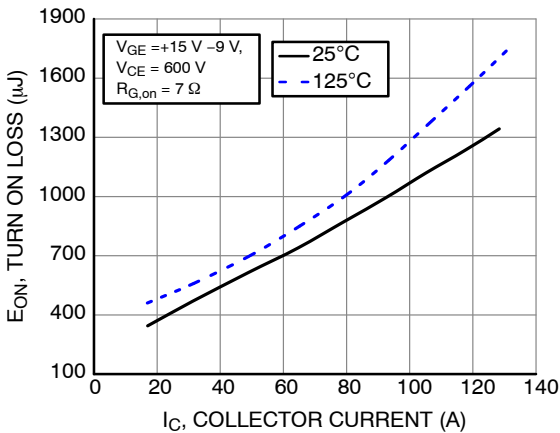


Figure 17. Typical Turn On Loss vs.  $I_c$

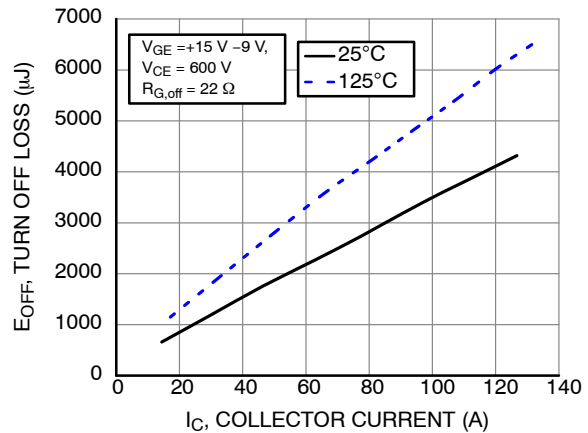


Figure 18. Typical Turn Off Loss vs.  $I_c$

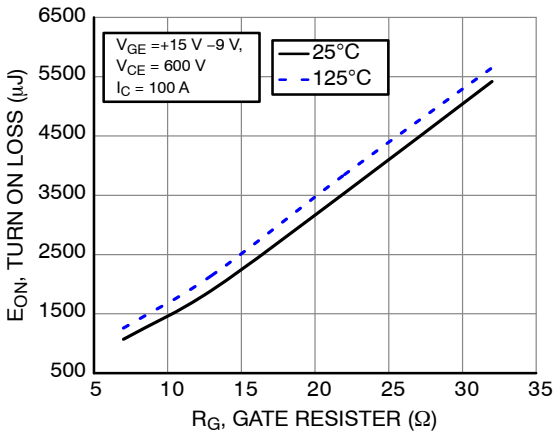


Figure 19. Typical Turn On Loss vs.  $R_G$

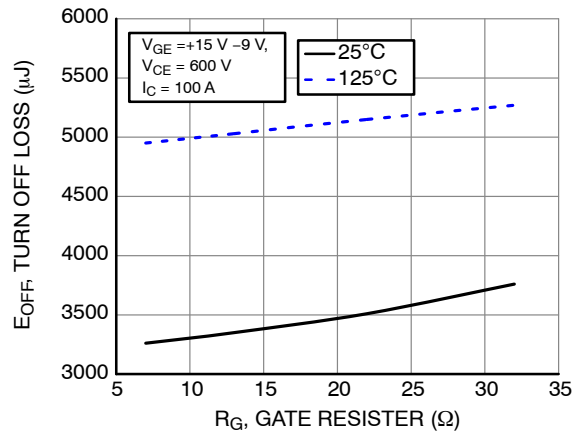
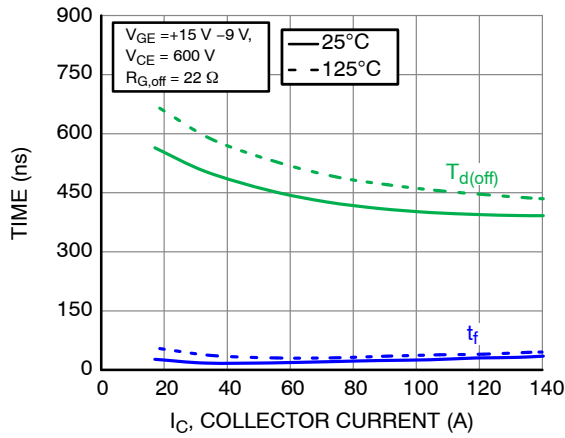


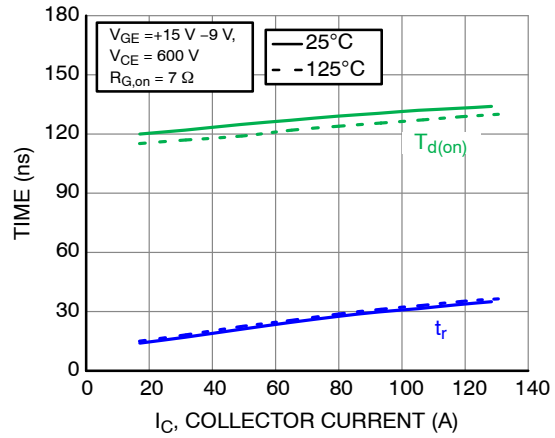
Figure 20. Typical Turn Off Loss vs.  $R_G$

# NXH500B100H7F5SHG

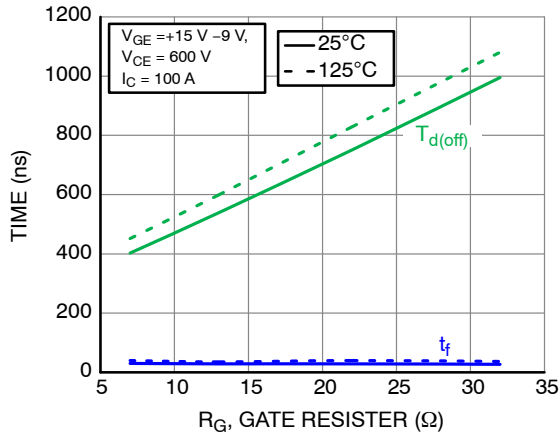
## TYPICAL CHARACTERISTICS – T11, T12, T21, T22 (IGBT) (continued)



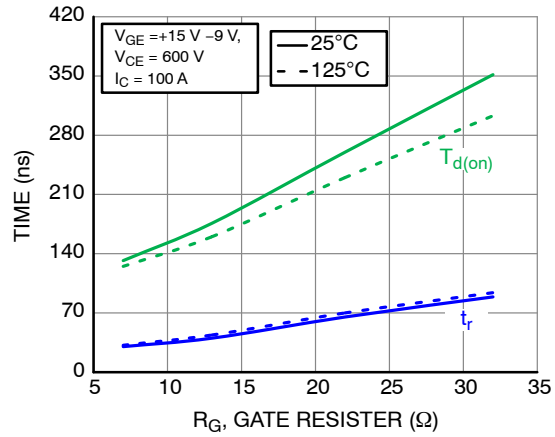
**Figure 21. Typical Turn Off Switching Time vs.  $I_C$**



**Figure 22. Typical Turn On Switching Time vs.  $I_C$**

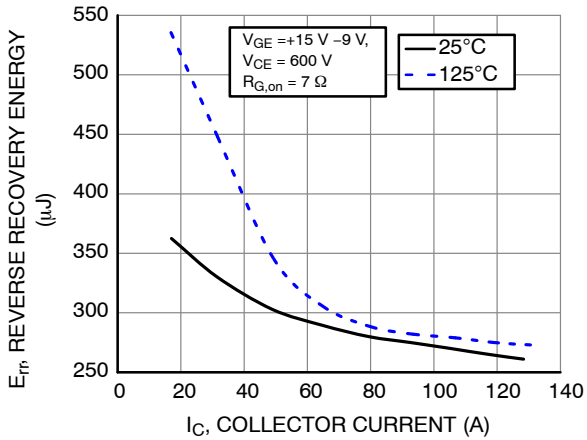


**Figure 23. Typical Turn Off Switching Time vs.  $R_G$**

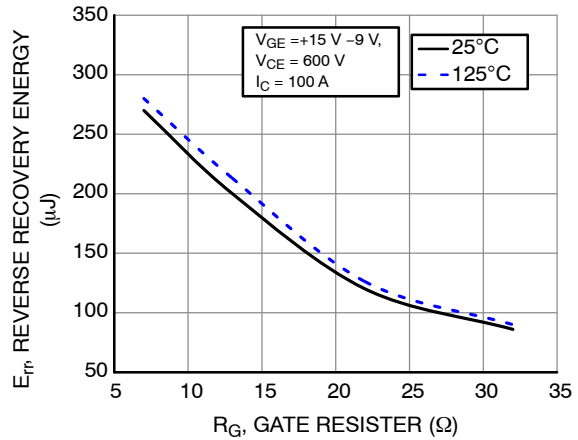


**Figure 24. Typical Turn On Switching Time vs.  $R_G$**

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



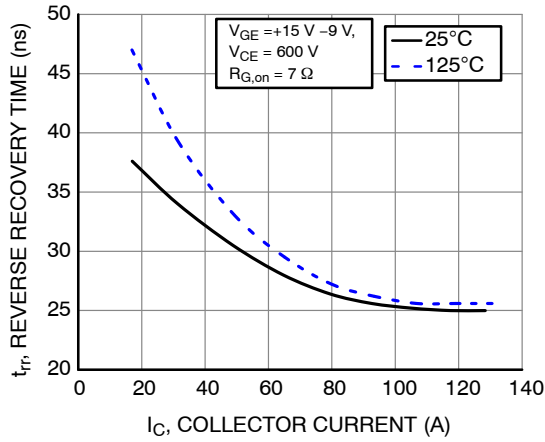
**Figure 25. Typical Reverse Recovery Energy Loss vs.  $I_C$**



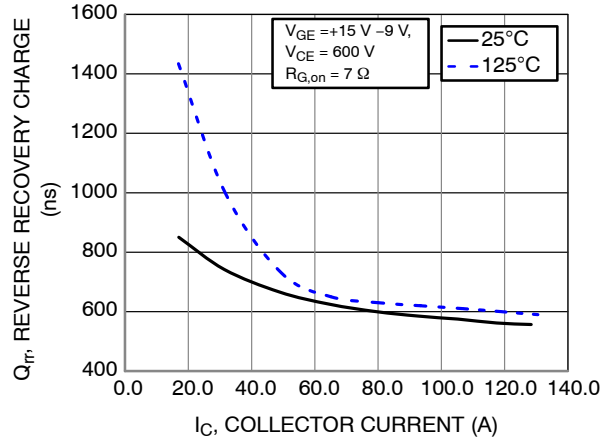
**Figure 26. Typical Reverse Recovery Energy Loss vs.  $R_G$**

# NXH500B100H7F5SHG

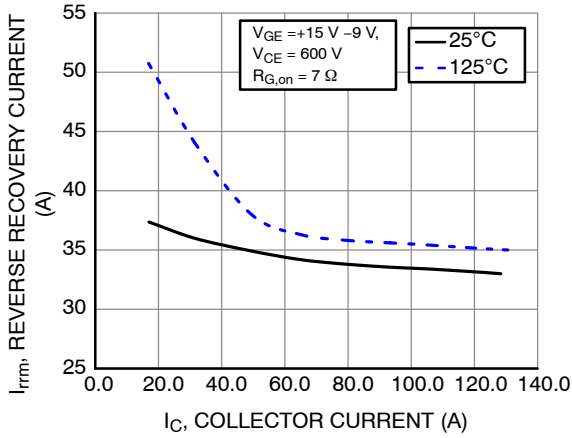
## TYPICAL CHARACTERISTICS – SIC SCHOTTKY DIODE (D13,D14,D23,D24) (continued)



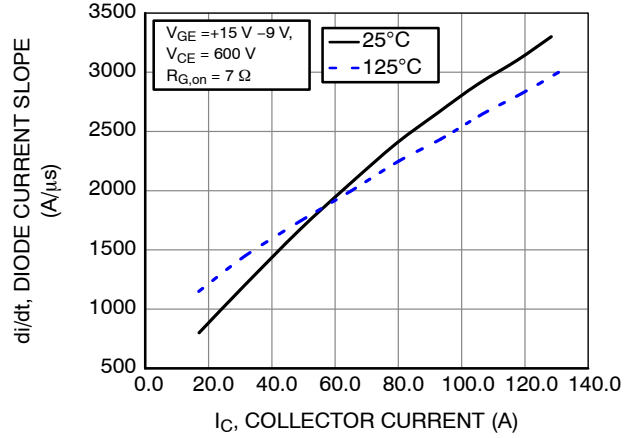
**Figure 27. Typical Reverse Recovery Time vs.  $I_C$**



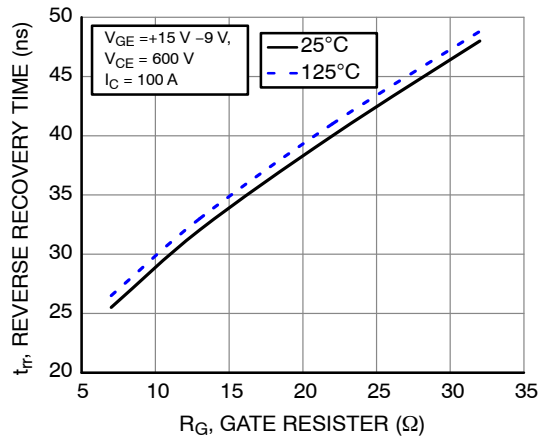
**Figure 28. Typical Reverse Recovery Charge vs.  $I_C$**



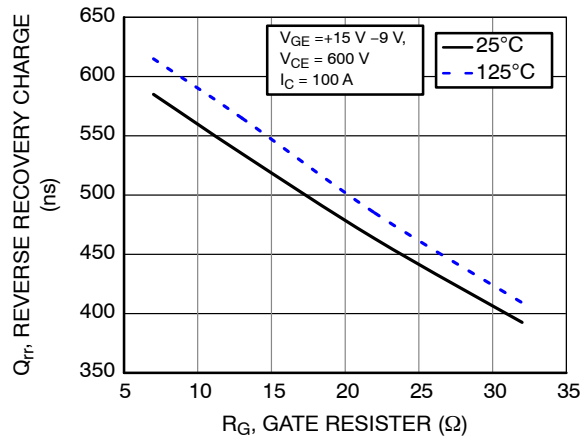
**Figure 29. Typical Reverse Recovery Current vs.  $I_C$**



**Figure 30. Typical Diode Current Slope vs.  $I_C$**



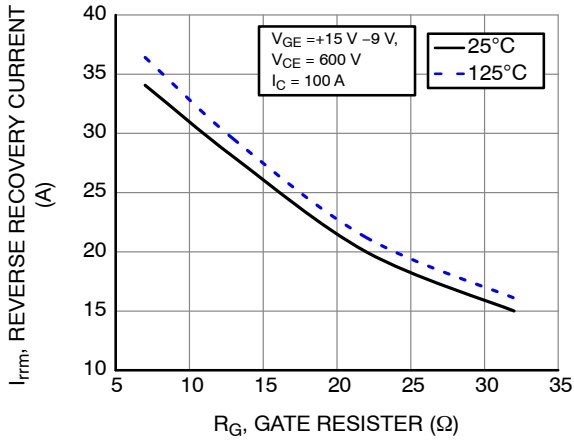
**Figure 31. Typical Reverse Recovery Time vs.  $R_G$**



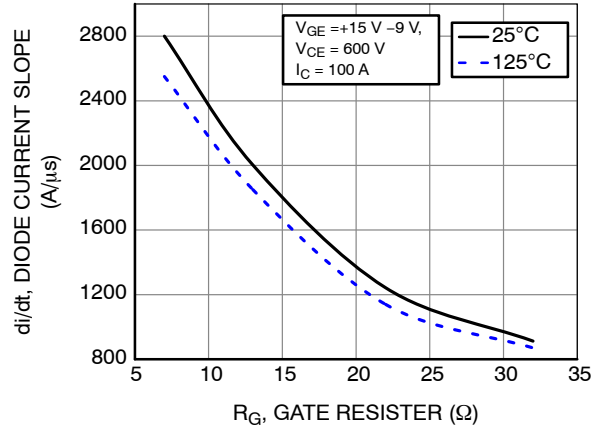
**Figure 32. Typical Reverse Recovery Charge vs.  $R_G$**

# NXH500B100H7F5SHG

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



**Figure 33. Typical Reverse Recovery Time vs.  $I_C$**



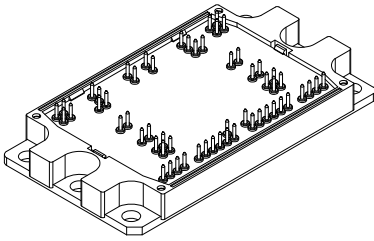
**Figure 34. Typical Reverse Recovery Charge vs.  $I_C$**

# NXH500B100H7F5SHG

## PACKAGE DIMENSIONS

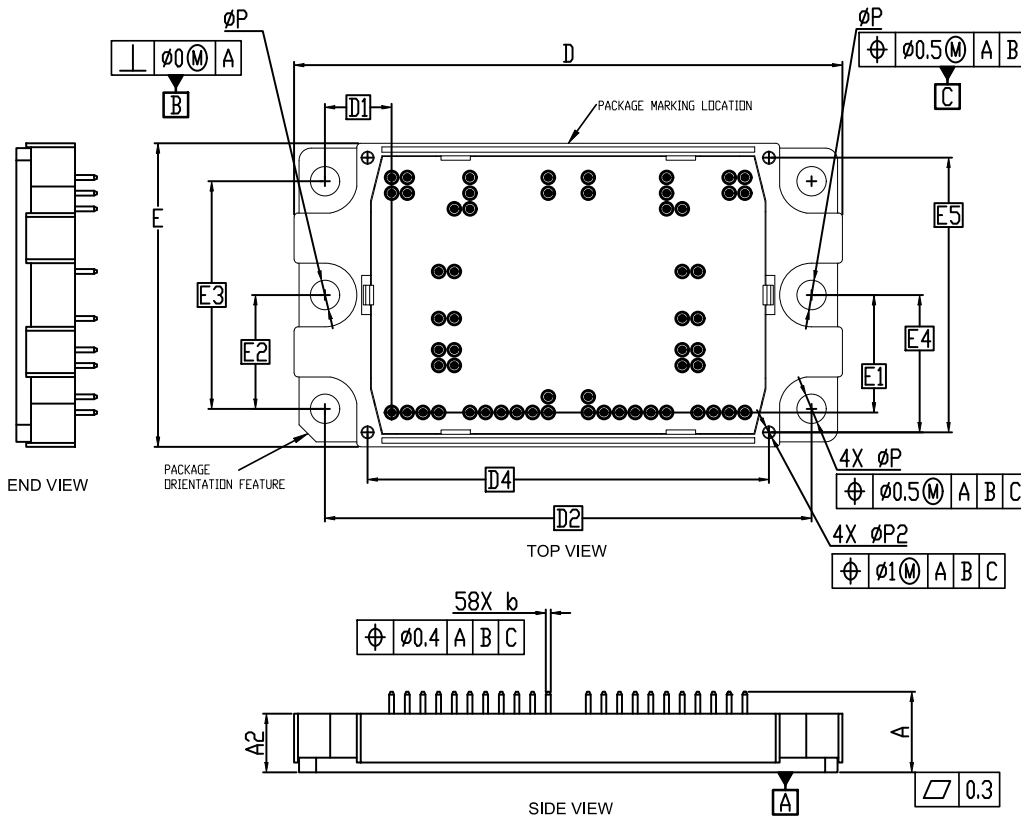
PIM58 112.00x62.00x12.00  
CASE 180CZ  
ISSUE O

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.



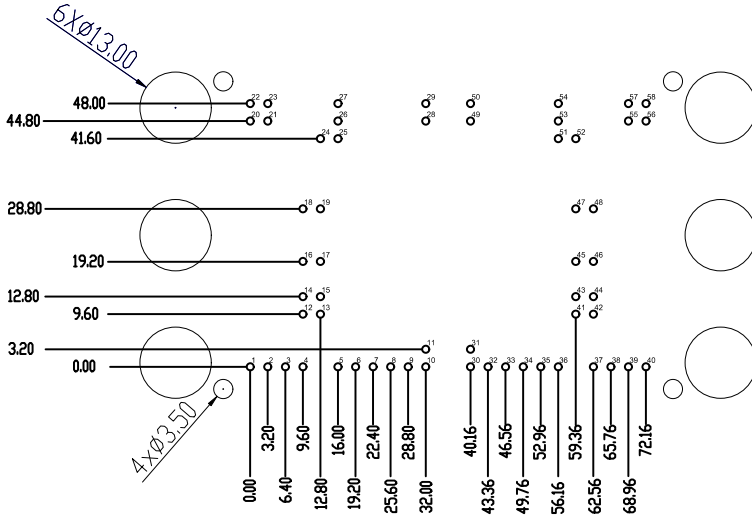
DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	16.10	16.50	16.90
A2	11.70	12.00	12.30
b	0.95	1.00	1.05
D	111.60	112.00	112.40
D1	13.62 BSC		
D2	99.40 BSC		
D4	82.00 BSC		
E	61.60	62.00	62.40
E1	24.00 BSC		
E2	23.25 BSC		
E3	46.50 BSC		
E4	28.05 BSC		
E5	56.10 BSC		
P	5.90	6.00	6.10
P2	2.20	2.30	2.40

# 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.

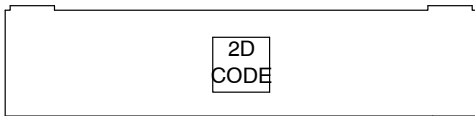
NOTE 2:

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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