

# Si/SiC Hybrid Module – EliteSiC, 3 Channel Flying Capacitor Boost 1000 V, 200 A IGBT, 1200 V, 60 A SiC Diode, Q2 Package

## NXH600B100H4Q2F2S1G, SNXH600B100H4Q2F2S1G-S

The NXH600B100H4Q2S1G is a Si/SiC Hybrid three channel flying capacitor boost module. Each channel contains two 1000 V, 200 A IGBTs, and two 1200 V, 60 A SiC diodes. The module contains an NTC thermistor.

### Features

- 3-channel Boost in Q2 Package
- Extremely Efficient Trench with Field Stop Technology
- Low Switching Loss Reduces System Power Dissipation
- Module Design Offers High Power Density
- Low Inductive Layout

### Typical Applications

- Solar Inverters
- Uninterruptible Power Supplies Systems

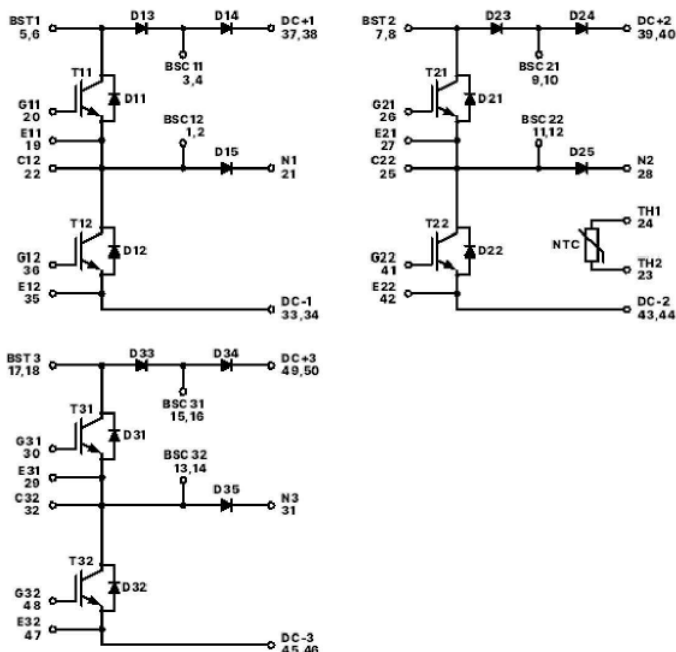
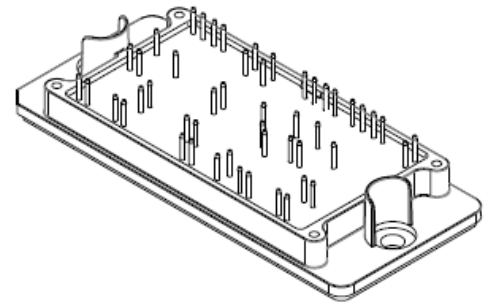
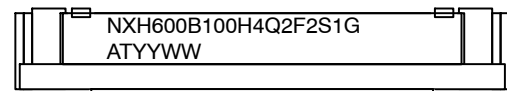


Figure 1. NXH600B100H4Q2F2S1G Schematic Diagram



PIM56, 93x47 (SOLDER PIN)  
CASE 180BK

### MARKING DIAGRAM



NXH600B100H4Q2F2S1G = Specific 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 in the package dimensions section on page 4 of this data sheet.

# NXH600B100H4Q2F2S1G, SNXH600B100H4Q2F2S1G-S

**Table 1. ABSOLUTE MAXIMUM RATINGS** (Note 1) ( $T_J = 25^\circ\text{C}$  unless otherwise noted)

Rating	Symbol	Value	Unit
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## IGBT (T11, T12, T21, T22, T31, T32)

Collector-Emitter Voltage	$V_{CES}$	1000	V
Gate-Emitter Voltage	$V_{GE}$	$\pm 20$	V
Positive Transient Gate-Emitter Voltage ( $t_{\text{pulse}} = 5 \mu\text{s}$ , $D < 0.10$ )		30	
Continuous Collector Current @ $T_C = 80^\circ\text{C}$	$I_C$	173	A
Pulsed Peak Collector Current @ $T_C = 80^\circ\text{C}$ ( $T_J = 175^\circ\text{C}$ )	$I_{C(\text{Pulse})}$	519	A
Maximum Power Dissipation ( $T_J = 175^\circ\text{C}$ )	$P_{\text{tot}}$	422	W
Minimum Junction Temperature	$T_{J\text{MIN}}$	-40	$^\circ\text{C}$
Maximum Junction Temperature (Note 2)	$T_{J\text{MAX}}$	175	$^\circ\text{C}$

## IGBT INVERSE DIODE (D11, D12, D21, D22, D31, D32)

Peak Repetitive Reverse Voltage	$V_{RRM}$	1200	V
Continuous Forward Current @ $T_C = 80^\circ\text{C}$	$I_F$	66	A
Repetitive Peak Forward Current ( $T_J = 175^\circ\text{C}$ )	$I_{FRM}$	98	A
Maximum Power Dissipation ( $T_J = 175^\circ\text{C}$ )	$P_{\text{tot}}$	101	W
Minimum Junction Temperature	$T_{J\text{MIN}}$	-40	$^\circ\text{C}$
Maximum Junction Temperature	$T_{J\text{MAX}}$	175	$^\circ\text{C}$

## SILICON CARBIDE SCHOTTKY DIODE (D13, D14, D23, D24, D33, D34)

Peak Repetitive Reverse Voltage	$V_{RRM}$	1200	V
Continuous Forward Current @ $T_C = 80^\circ\text{C}$	$I_F$	63	A
Repetitive Peak Forward Current ( $T_J = 175^\circ\text{C}$ )	$I_{FRM}$	189	A
Maximum Power Dissipation ( $T_J = 175^\circ\text{C}$ )	$P_{\text{tot}}$	204	W
Minimum Junction Temperature	$T_{J\text{MIN}}$	-40	$^\circ\text{C}$
Maximum Junction Temperature	$T_{J\text{MAX}}$	175	$^\circ\text{C}$

## START-UP DIODE (D15, D25, D35)

Peak Repetitive Reverse Voltage	$V_{RRM}$	1200	V
Continuous Forward Current @ $T_C = 80^\circ\text{C}$	$I_F$	35	A
Repetitive Peak Forward Current ( $T_J = 175^\circ\text{C}$ )	$I_{FRM}$	105	A
Maximum Power Dissipation ( $T_J = 175^\circ\text{C}$ )	$P_{\text{tot}}$	84	W
Minimum Junction Temperature	$T_{J\text{MIN}}$	-40	$^\circ\text{C}$
Maximum Junction Temperature	$T_{J\text{MAX}}$	175	$^\circ\text{C}$

## THERMAL AND INSULATION PROPERTIES

### THERMAL PROPERTIES

Operating Temperature under Switching Condition	$T_{VJOP}$	-40 to 150	$^\circ\text{C}$
Storage Temperature range	$T_{\text{stg}}$	-40 to 125	$^\circ\text{C}$

### INSULATION PROPERTIES

Isolation test voltage, $t = 1 \text{ sec}$ , 50 Hz	$V_{\text{is}}$	4000	$V_{\text{RMS}}$
Creepage distance		12.7	mm
Comparative tracking index	CTI	>600	

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.
2. Qualification at  $175^\circ\text{C}$  per discrete TO247.

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**Table 2. ELECTRICAL CHARACTERISTICS** ( $T_J = 25^\circ\text{C}$  unless otherwise noted)

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
IGBT (T11, T12, T21, T22, T31, T32) CHARACTERISTICS						
Collector–Emitter Breakdown Voltage	$V_{GE} = 0\text{ V}, I_C = 2\text{ mA}$	$V_{(BR)CES}$	1000	1150	–	V
Collector–Emitter Cutoff Current	$V_{GE} = 0\text{ V}, V_{CE} = 1000\text{ V}$	$I_{CES}$	–	–	20	$\mu\text{A}$
Collector–Emitter Saturation Voltage	$V_{GE} = 15\text{ V}, I_C = 200\text{ A}, T_J = 25^\circ\text{C}$	$V_{CE(sat)}$	–	1.88	2.3	V
	$V_{GE} = 15\text{ V}, I_C = 200\text{ A}, T_J = 150^\circ\text{C}$		–	2.4	–	
Gate–Emitter Threshold Voltage	$V_{GE} = V_{CE}, I_C = 200\text{ mA}$	$V_{GE(TH)}$	4	4.98	6	V
Gate Leakage Current	$V_{GE} = \pm 20\text{ V}, V_{CE} = 0\text{ V}$	$I_{GES}$	–	–	350	nA
Internal Gate Resistor		$r_G$	–	3	–	$\Omega$
Turn–on Delay Time	$T_J = 25^\circ\text{C}$ $V_{CE} = 600\text{ V}, I_C = 50\text{ A}$ $V_{GE} = -9\text{ V}, 15\text{ V}, R_{Gon} = 9\text{ }\Omega, R_{Goff} = 25\text{ }\Omega$	$t_{d(on)}$	–	119.75	–	ns
Rise Time		$t_r$	–	30.08	–	
Turn–off Delay Time		$t_{d(off)}$	–	614.57	–	
Fall Time		$t_f$	–	26.85	–	
Turn–on Switching Loss per Pulse		$E_{on}$	–	860	–	$\mu\text{J}$
Turn off Switching Loss per Pulse		$E_{off}$	–	1500	–	
Turn–on Delay Time	$T_J = 125^\circ\text{C}$ $V_{CE} = 600\text{ V}, I_C = 50\text{ A}$ $V_{GE} = -9\text{ V}, 15\text{ V}, R_{Gon} = 9\text{ }\Omega, R_{Goff} = 25\text{ }\Omega$	$t_{d(on)}$	–	119.97	–	ns
Rise Time		$t_r$	–	32.09	–	
Turn–off Delay Time		$t_{d(off)}$	–	706.72	–	
Fall Time		$t_f$	–	40.22	–	
Turn–on Switching Loss per Pulse		$E_{on}$	–	1120	–	$\mu\text{J}$
Turn off Switching Loss per Pulse		$E_{off}$	–	2750	–	
Input Capacitance	$V_{CE} = 20\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$	$C_{ies}$	–	12687.7	–	pF
Output Capacitance		$C_{oes}$	–	418.0	–	
Reverse Transfer Capacitance		$C_{res}$	–	73.9	–	
Total Gate Charge	$V_{CE} = 600\text{ V}, I_C = 40\text{ A}, V_{GE} = -15\text{ V} \sim 15\text{ V}$	$Q_g$	–	680	–	nC
Thermal Resistance – chip–to–heatsink	Thermal grease, Thickness = 2.1 Mil $\pm 2\%$ , $\lambda = 2.87\text{ W/mK}$	$R_{thJH}$	–	0.420	–	K/W
Thermal Resistance – chip–to–case		$R_{thJC}$	–	0.225	–	K/W
IGBT INVERSE DIODE (D11, D12, D21, D22, D31, D32) CHARACTERISTICS						
Diode Forward Voltage	$I_F = 50\text{ A}, T_J = 25^\circ\text{C}$	$V_F$	–	1.15	1.5	V
	$I_F = 50\text{ A}, T_J = 175^\circ\text{C}$		–	1.08	–	
Thermal Resistance – chip–to–heatsink	Thermal grease, Thickness = 2.1 Mil $\pm 2\%$ , $\lambda = 2.87\text{ W/mK}$	$R_{thJH}$	–	0.956	–	K/W
Thermal Resistance – chip–to–case		$R_{thJC}$	–	0.800	–	K/W
DIODES (D13, D14, D23, D24, D33, D34) CHARACTERISTICS						
Diode Forward Voltage	$I_F = 60\text{ A}, T_J = 25^\circ\text{C}$	$V_F$	–	1.51	2.2	V
	$I_F = 60\text{ A}, T_J = 175^\circ\text{C}$		–	2.14	–	
Reverse Recovery Time	$T_J = 25^\circ\text{C}$ $V_{CE} = 600\text{ V}, I_C = 50\text{ A}$ $V_{GE} = -9\text{ V}, 15\text{ V}, R_{Gon} = 9\text{ }\Omega$	$t_{rr}$	–	28.14	–	ns
Reverse Recovery Charge		$Q_{rr}$	–	304.98	–	nC
Peak Reverse Recovery Current		$I_{RRM}$	–	18.8	–	A
Peak Rate of Fall of Recovery Current		$di/dt$	–	1389.12	–	A/ $\mu\text{s}$
Reverse Recovery Energy		$E_{rr}$	–	105.08	–	$\mu\text{J}$

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**Table 2. ELECTRICAL CHARACTERISTICS** ( $T_J = 25^\circ\text{C}$  unless otherwise noted) (continued)

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
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## DIODES (D13, D14, D23, D24, D33, D34) CHARACTERISTICS

Reverse Recovery Time	$T_J = 125^\circ\text{C}$ $V_{CE} = 600\text{ V}, I_C = 50\text{ A}$ $V_{GE} = -9\text{ V}, 15\text{ V}, R_{Gon} = 9\ \Omega$	$t_{rr}$	—	45.73	—	ns
Reverse Recovery Charge		$Q_{rr}$	—	583.95	—	nC
Peak Reverse Recovery Current		$I_{RRM}$	—	24.08	—	A
Peak Rate of Fall of Recovery Current		$di/dt$	—	1236	—	A/ $\mu\text{s}$
Reverse Recovery Energy		$E_{rr}$	—	216.04	—	$\mu\text{J}$
Thermal Resistance – chip-to-heatsink	Thermal grease, Thickness = 2.1 Mil $\pm 2\%$ , $\lambda = 2.87\text{ W/mK}$	$R_{thJH}$	—	0.599	—	K/W
Thermal Resistance – chip-to-case		$R_{thJC}$	—	0.466	—	K/W

## START-UP DIODE (D15, D25, D35) CHARACTERISTICS

Diode Forward Voltage	$I_F = 30\text{ A}, T_J = 25^\circ\text{C}$	$V_F$	—	2.25	3.2	V
	$I_F = 30\text{ A}, T_J = 175^\circ\text{C}$		—	1.8	—	
Thermal Resistance – chip-to-heatsink	Thermal grease, Thickness = 2.1 Mil $\pm 2\%$ , $\lambda = 2.87\text{ W/mK}$	$R_{thJH}$	—	1.309	—	K/W
Thermal Resistance – chip-to-case		$R_{thJC}$	—	1.133	—	K/W

## THERMISTOR CHARACTERISTICS

Nominal resistance	$T = 25^\circ\text{C}$	$R_{25}$	—	5	—	k $\Omega$
Nominal resistance	$T = 100^\circ\text{C}$	$R_{100}$	—	492.2	—	$\Omega$
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
NXH600B100H4Q2F2S1G	NXH600B100H4Q2F2S1G	Q2BOOST, Case 180BK (Pb-Free and Halide-Free Solder Pins)	12 Units / Blister Tray
SNXH600B100H4Q2F2S1G-S	SNXH600B100H4Q2F2S1G-S	Q2BOOST, Case 180BK (Pb-Free and Halide-Free Solder Pins)	12 Units / Blister Tray

# NXH600B100H4Q2F2S1G, SNXH600B100H4Q2F2S1G-S

## TYPICAL CHARACTERISTICS – T11||D13, T12||D14, T21||D23, T22||D24, T31||D33, T32||D34

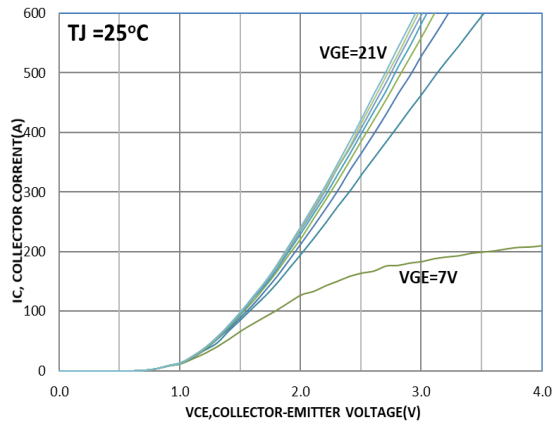


Figure 2. Typical Output Characteristics

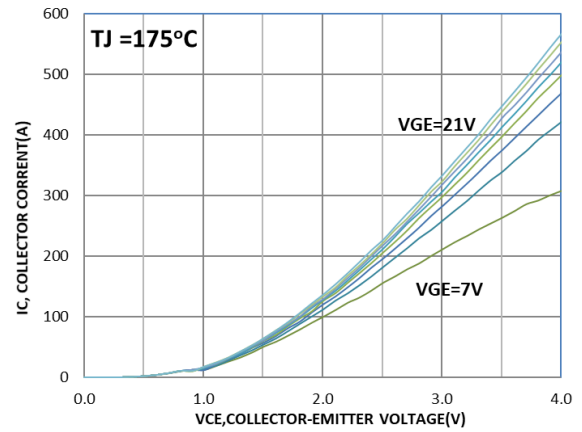


Figure 3. Typical Output Characteristics

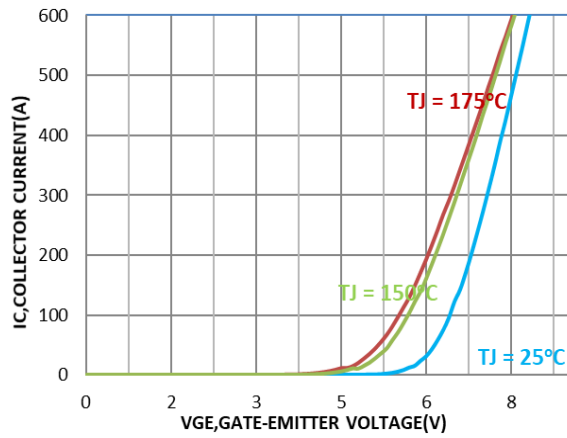


Figure 4. Transfer Characteristics

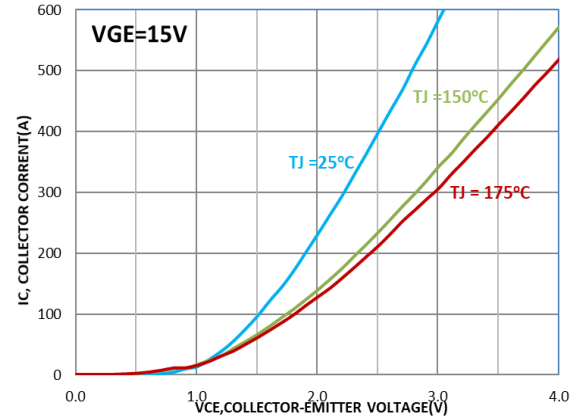


Figure 5. Saturation Voltage Characteristic

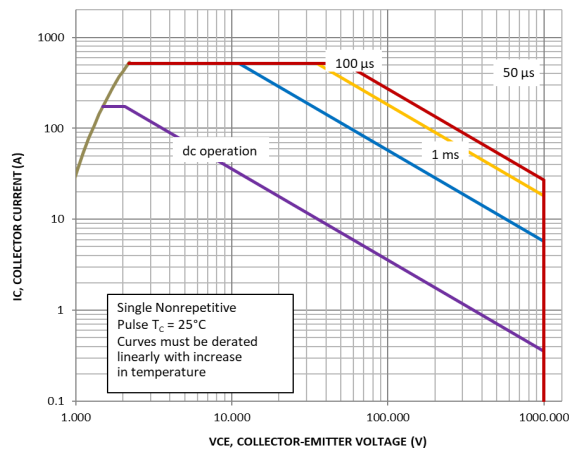


Figure 6. FBSOA

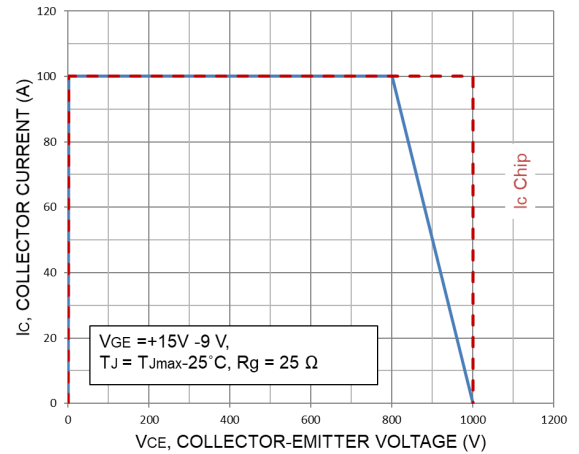


Figure 7. RBSOA

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TYPICAL CHARACTERISTICS – T11||D13, T12||D14, T21||D23, T22||D24, T31||D33, T32||D34 (CONTINUED)

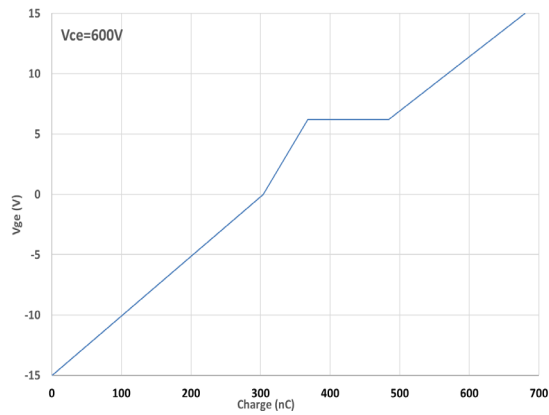


Figure 8. Gate Voltage vs. Gate Charge

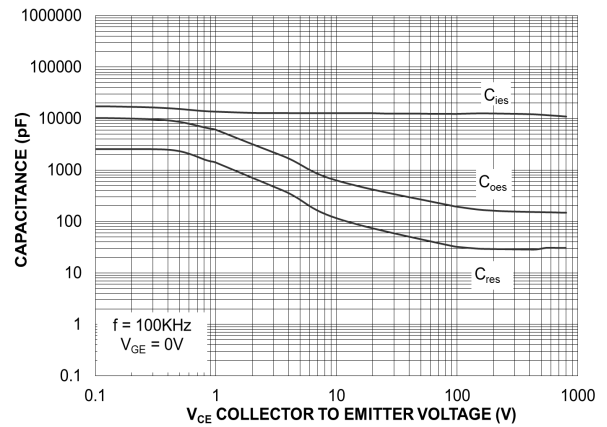


Figure 9. Capacitance

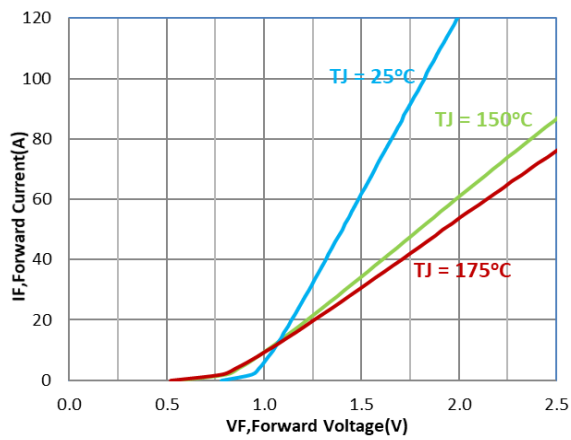


Figure 10. Diode Forward Characteristics

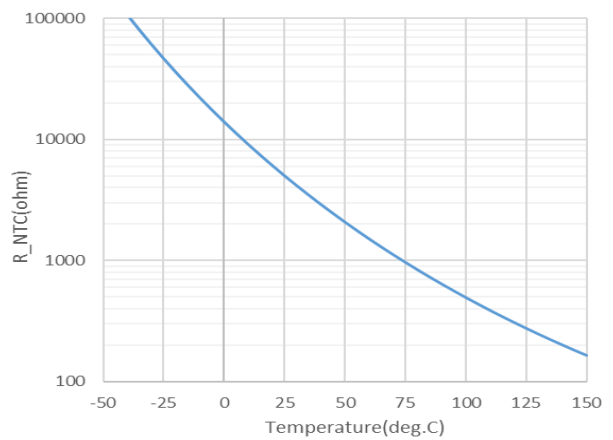


Figure 11. Temperature vs. NTC Value

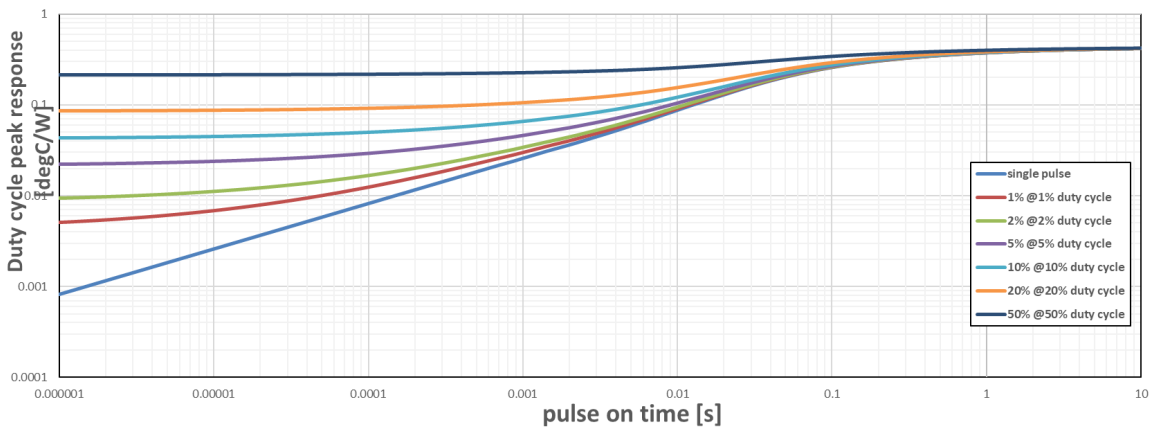


Figure 12. Transient Thermal Impedance (IGBT Rthjc)

# NXH600B100H4Q2F2S1G, SNXH600B100H4Q2F2S1G-S

## TYPICAL CHARACTERISTICS – T11||D13, T12||D14, T21||D23, T22||D24, T31||D33, T32||D34 (CONTINUED)

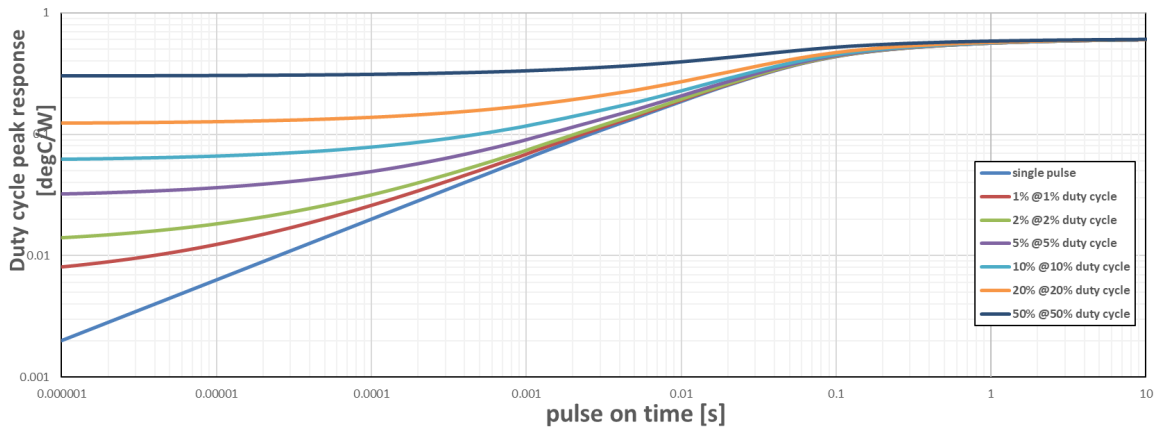


Figure 13. Transient Thermal Impedance (DIODE  $R_{thjc}$ )

## TYPICAL CHARACTERISTICS – D11, D12, D21, D22, D31, D32 DIODE

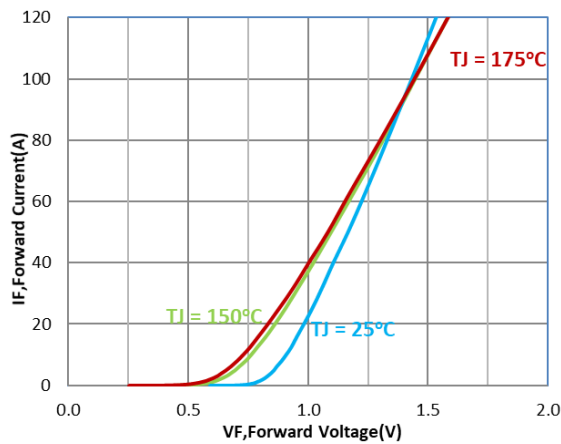


Figure 14. Diode Forward Characteristics

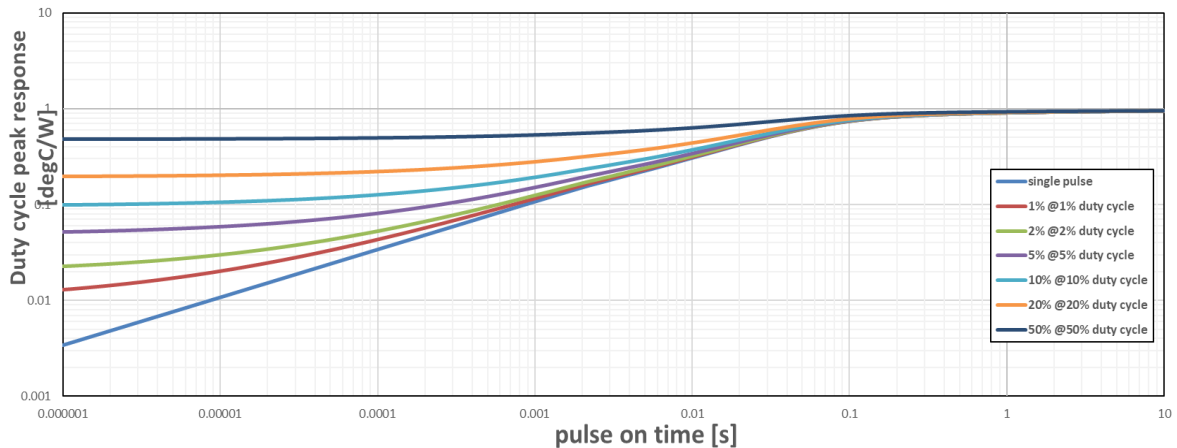


Figure 15. Transient Thermal Impedance ( $R_{thjc}$ )

# NXH600B100H4Q2F2S1G, SNXH600B100H4Q2F2S1G-S

## TYPICAL CHARACTERISTICS – D15, D25, D35 DIODE

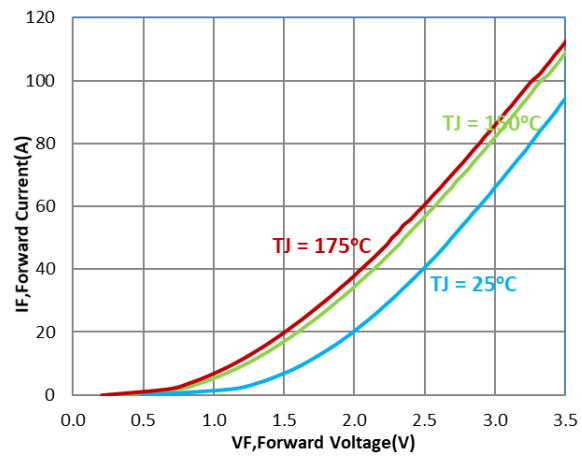


Figure 16. Diode Forward Characteristics

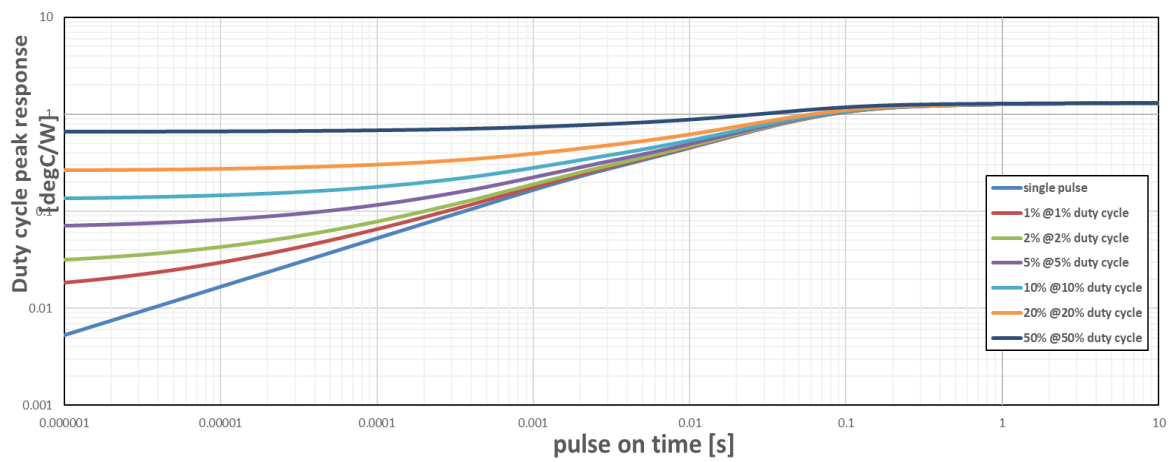


Figure 17. Transient Thermal Impedance ( $R_{thjc}$ )



# NXH600B100H4Q2F2S1G, SNXH600B100H4Q2F2S1G-S

## TYPICAL CHARACTERISTICS – T11||D13, T12||D14, T21||D23, T22||D24, T31||D33, T32||D34

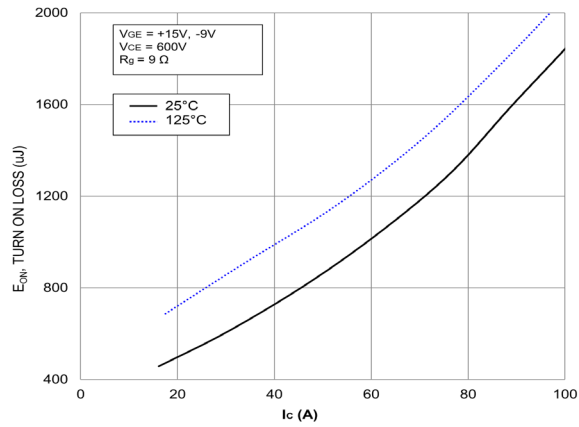


Figure 18. Typical Turn On Loss vs.  $I_C$

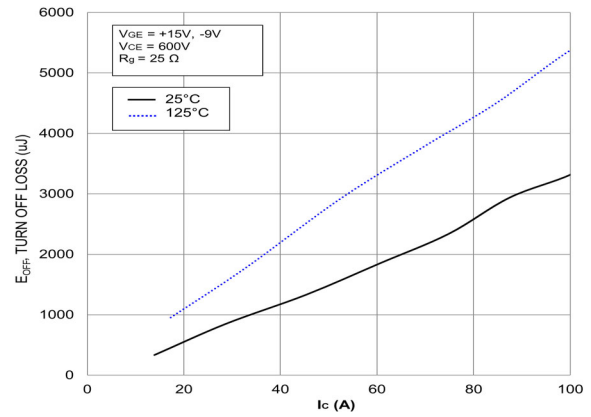


Figure 19. Typical Turn Off Loss vs.  $I_C$

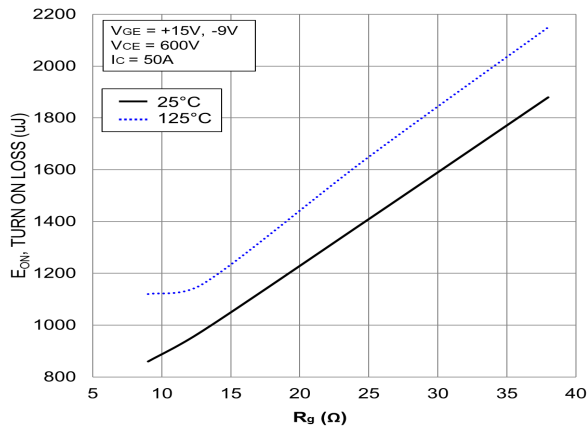


Figure 20. Typical Turn On Loss vs.  $R_G$

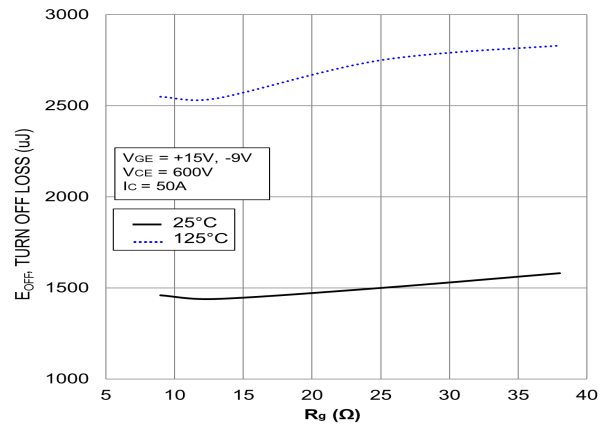


Figure 21. Typical Turn Off Loss vs.  $R_G$

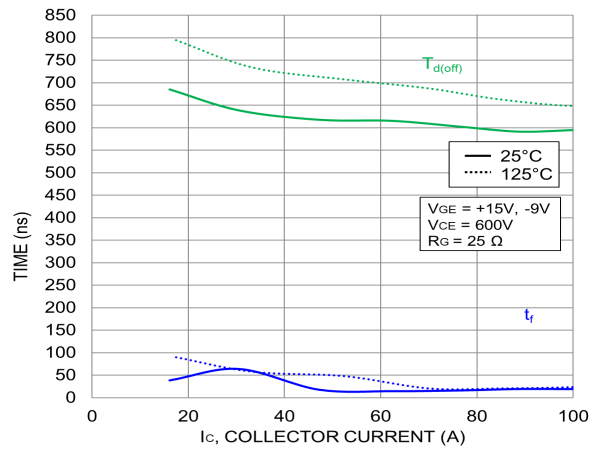


Figure 22. Typical Turn-Off Switching Time vs.  $I_C$

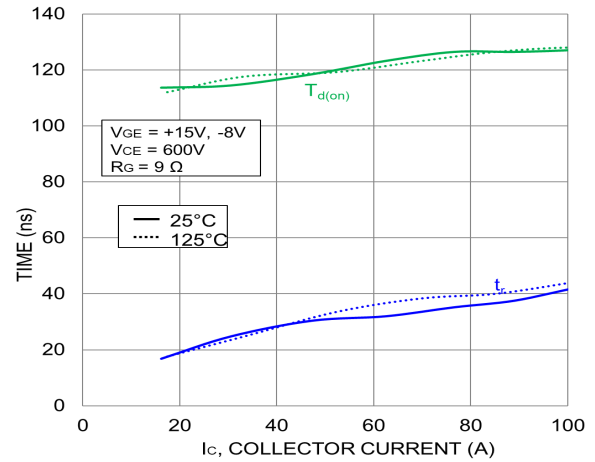


Figure 23. Typical Turn-On Switching Time vs.  $I_C$

# NXH600B100H4Q2F2S1G, SNXH600B100H4Q2F2S1G-S

## TYPICAL CHARACTERISTICS – T11||D13, T12||D14, T21||D23, T22||D24, T31||D33, T32||D34 (CONTINUED)

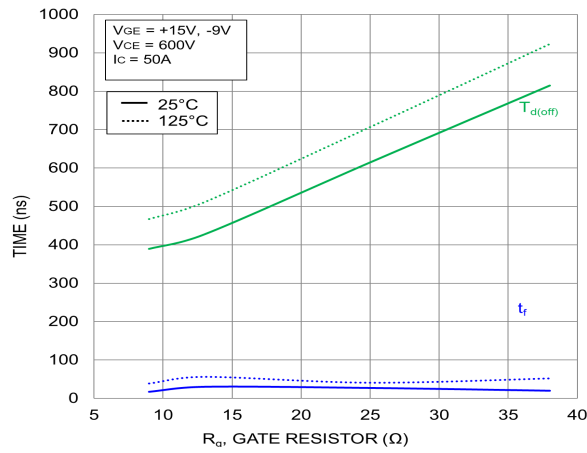


Figure 24. Typical Turn-Off Switching Time vs.  $R_g$

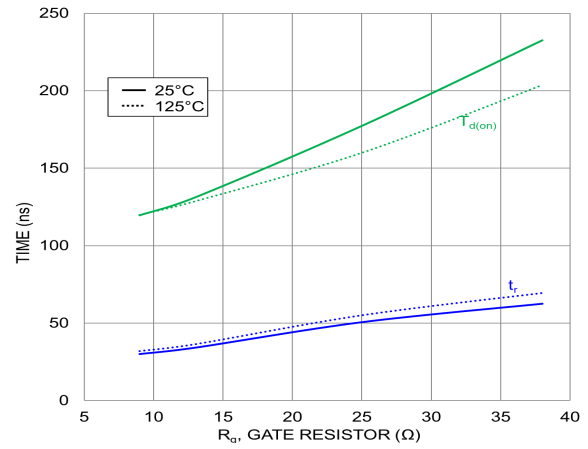


Figure 25. Typical Turn-On Switching Time vs.  $R_g$

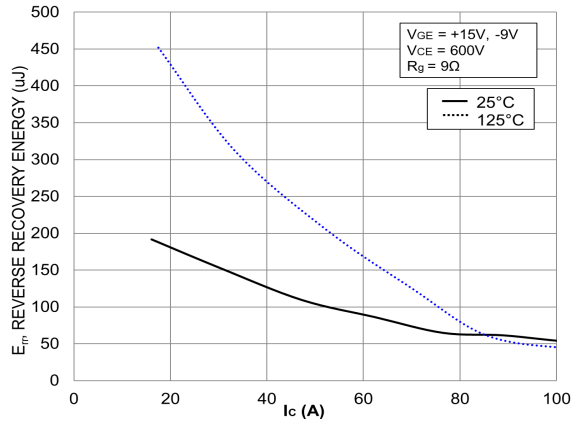


Figure 26. Typical Reverse Recovery Energy Loss vs.  $I_C$

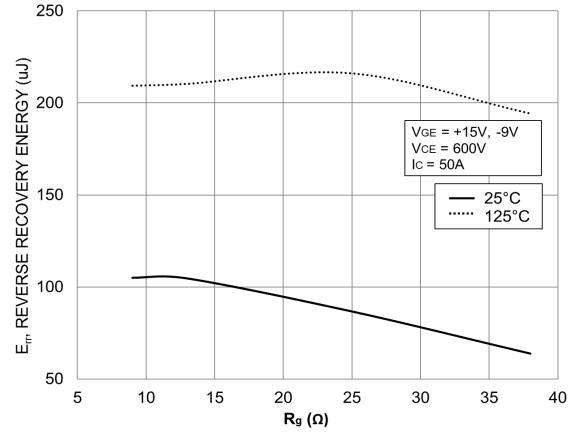


Figure 27. Typical Reverse Recovery Energy Loss vs.  $R_g$

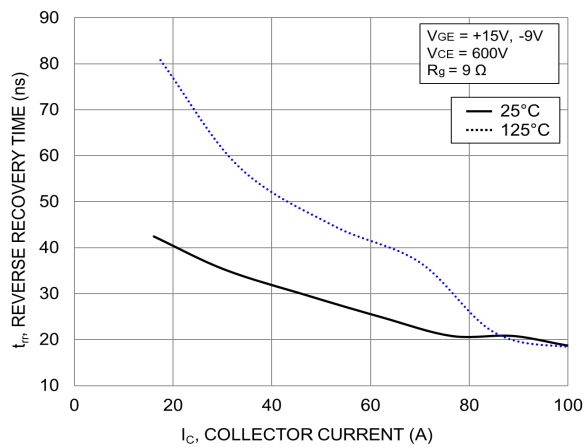


Figure 28. Typical Reverse Recovery Time vs.  $I_C$

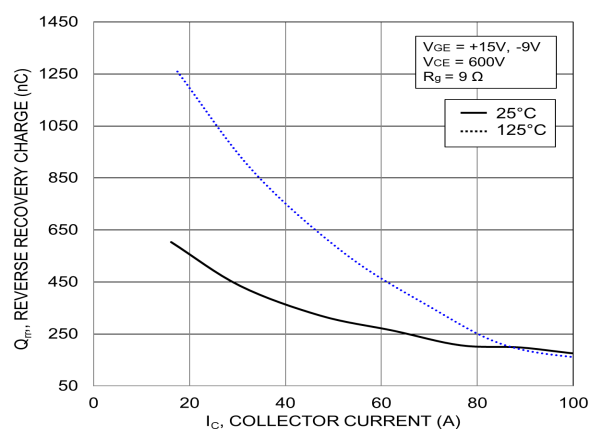
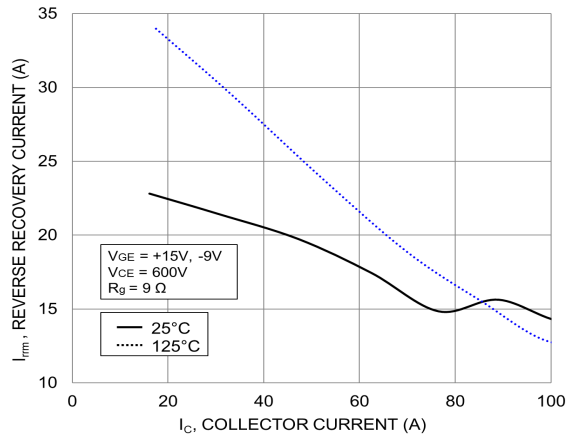


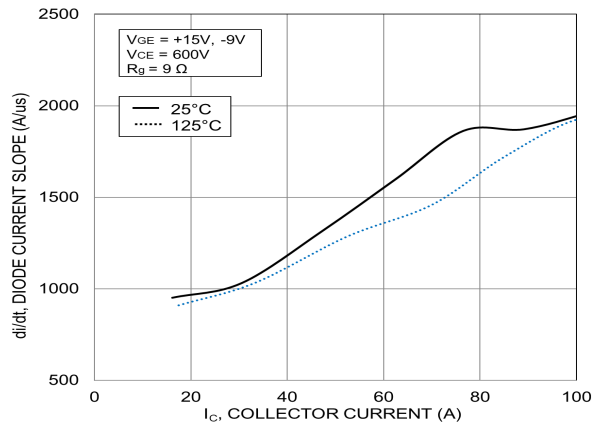
Figure 29. Typical Reverse Recovery Charge vs.  $I_C$

# NXH600B100H4Q2F2S1G, SNXH600B100H4Q2F2S1G-S

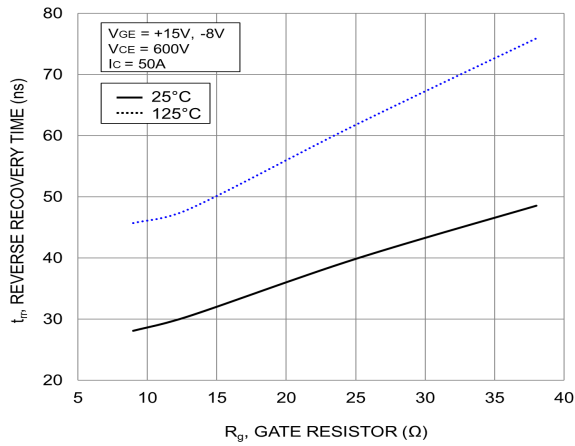
## TYPICAL CHARACTERISTICS – T11||D13, T12||D14, T21||D23, T22||D24, T31||D33, T32||D34 (CONTINUED)



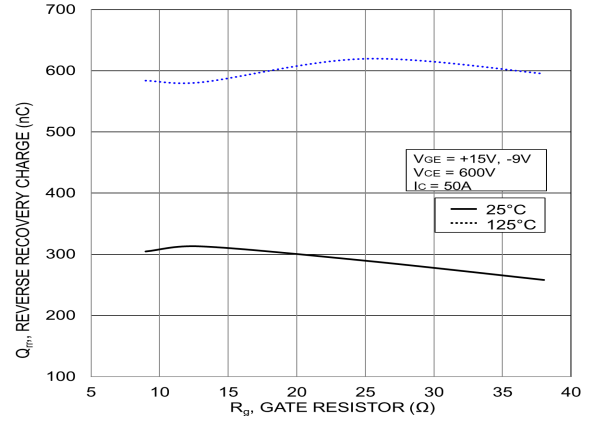
**Figure 30. Typical Reverse Recovery Current vs.  $I_C$**



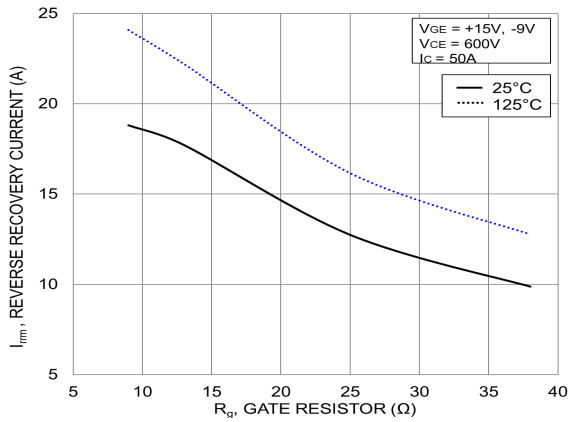
**Figure 31. Typical di/dt vs.  $I_C$**



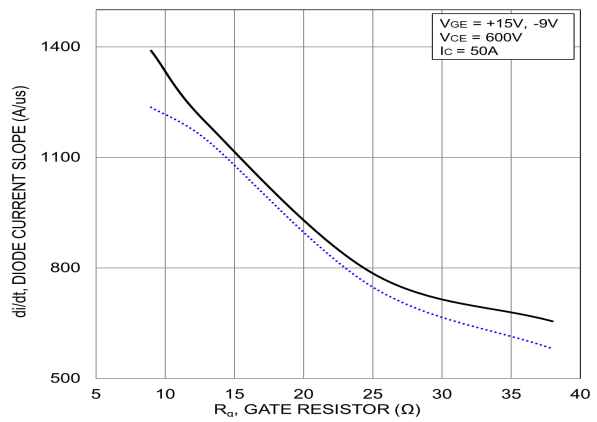
**Figure 32. Typical Reverse Recovery Time vs.  $R_g$**



**Figure 33. Typical Reverse Recovery Charge vs.  $R_g$**

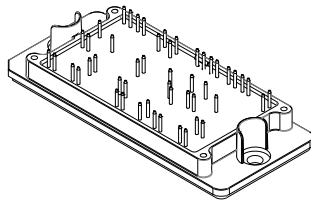


**Figure 34. Typical Reverse Recovery Peak Current vs.  $R_g$**



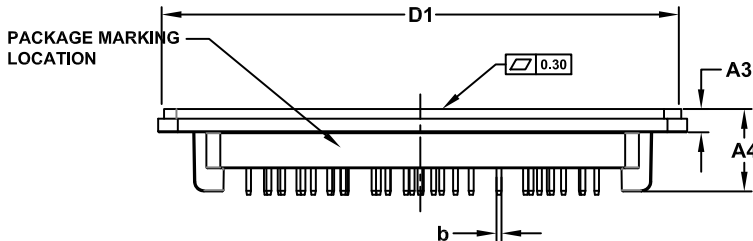
**Figure 35. Typical di/dt vs.  $R_g$**

# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS

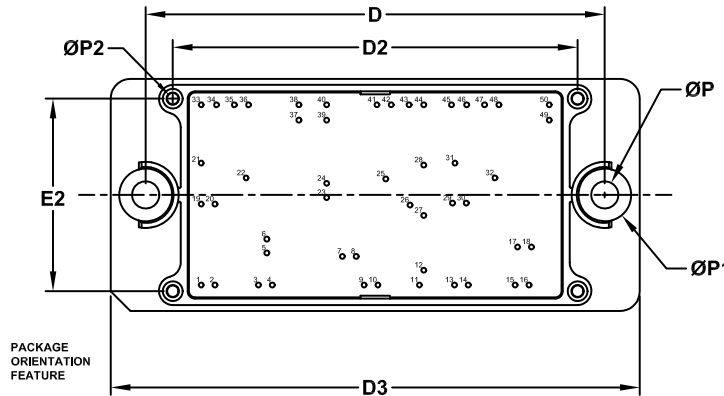


**PIM56, 93x47 (SOLDER PIN)**  
**CASE 180BK**  
**ISSUE O**

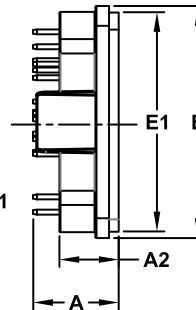
DATE 19 MAY 2022



**SIDE VIEW**



**TOP VIEW**



**END VIEW**

## NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009
2. CONTROLLING DIMENSION : MILLIMETERS
3. DIMENSIONS b AND b1 APPLY TO THE PLATED TERMINALS AND ARE MEASURED AT DIMENSION A1
4. PIN POSITION TOLERANCE IS  $\pm 0.4\text{mm}$
5. PACKAGE MARKING IS LOCATED AS SHOWN ON THE SIDE OPPOSITE THE PACKAGE ORIENTATION FEATURES

DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	16.80	17.20	17.60
A2	11.70	12.00	12.30
A3	4.40	4.70	5.00
A4	16.40	16.70	17.00
b	0.95	1.00	1.05
D	92.90	93.00	93.10
D1	104.45	104.75	105.05
D2	81.80	82.00	82.20
D3	106.90	107.20	107.50
E	46.70	47.00	47.30
E1	44.10	44.40	44.70
E2	38.80	39.00	39.20
P	5.40	5.50	5.60
P1	10.60	10.70	10.80
P2	1.80	2.00	2.20

NOTE 4

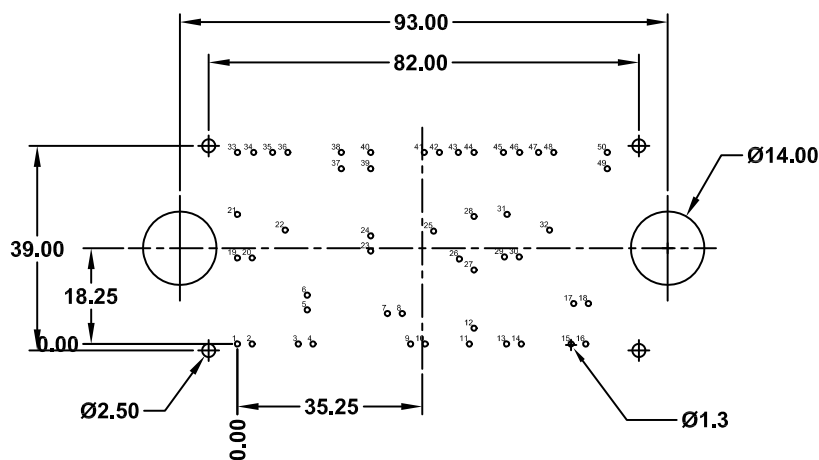
Pin #	X	Y	Function	Pin #	X	Y	Function
1	0	0	BSC12	26	42.3	16.2	G21
2	2.8	0	BSC12	27	45.1	14.1	E21
3	11.6	0	BSC11	28	45.1	24.3	N2
4	14.4	0	BSC11	29	50.9	16.6	E31
5	13.3	6.5	BST1	30	53.7	16.6	G31
6	13.3	9.3	BST1	31	51.4	24.7	N3
7	28.6	5.8	BST2	32	59.5	21.7	C32
8	31.4	5.8	BST2	33	0	36.5	DC-1
9	33	0	BSC21	34	3.1	36.5	DC-1
10	35.8	0	BSC21	35	6.7	36.5	E12
11	44.2	0	BSC22	36	9.6	36.5	G12
12	45.1	3	BSC22	37	19.8	33.4	DC+1
13	51.3	0	BSC32	38	19.8	36.5	DC+1
14	54.1	0	BSC32	39	25.4	33.4	DC+2
15	63.6	0	BSC31	40	25.4	36.5	DC+2
16	66.4	0	BSC31	41	35.6	36.5	G22
17	64.1	7.7	BST3	42	38.5	36.5	E22
18	66.9	7.7	BST3	43	42.1	36.5	DC-2
19	0	16.4	E11	44	45.1	36.5	DC-2
20	2.8	16.4	G11	45	50.7	36.5	DC-3
21	0	24.7	N1	46	53.8	36.5	DC-3
22	9.1	21.7	C12	47	57.4	36.5	E32
23	25.4	17.7	TH2	48	60.3	36.5	G32
24	25.4	20.6	TH1	49	70.5	33.4	DC+3
25	37.4	21.5	C22	50	70.5	36.5	DC+3

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**PIM56, 93x47 (SOLDER PIN)**  
**CASE 180BK**  
**ISSUE O**

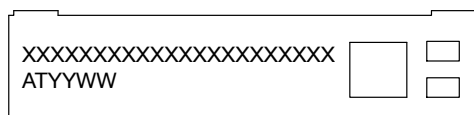
DATE 19 MAY 2022



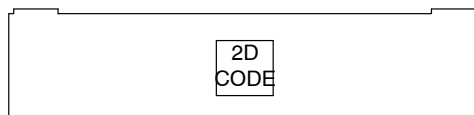
**RECOMMENDED  
MOUNTING PATTERN**

\* For additional Information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERM/D.

**GENERIC  
MARKING DIAGRAM\***



FRONTSIDE MARKING



BACKSIDE MARKING

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.

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