

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

NXH600B100H4Q2F2PG, NXH600B100H4Q2F2SG, NXH600B100H4Q2F2SG-R

The NXH600B100H4Q2 is a Si/SiC Hybrid three channel symmetric 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

- Extremely Efficient Trench with Field Stop Technology
- Low Switching Loss Reduces System Power Dissipation
- Module Design Offers High Power Density
- Low Inductive Layout
- Low Package Height
- Pb-Free, Halogen Free/BFR Free and RoHS Compliant

Typical Applications

- Solar Inverters
- Uninterruptable Power Supplies Systems

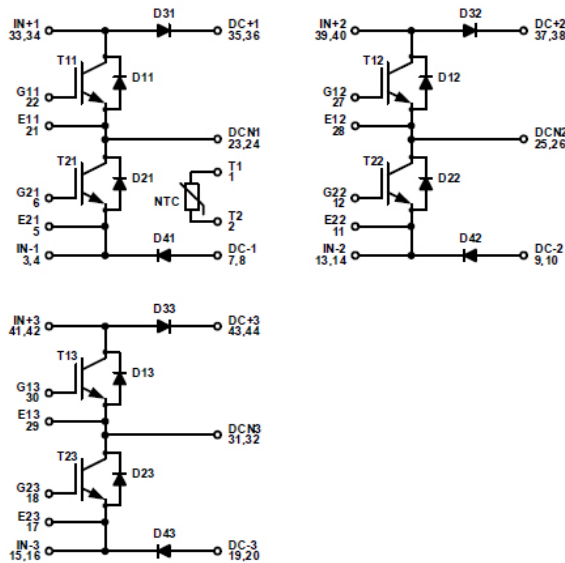
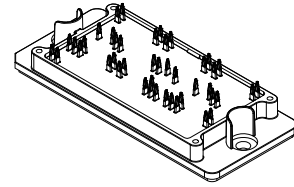
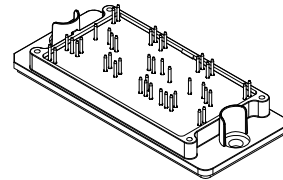


Figure 1. NXH600B100H4Q2F2 Schematic Diagram

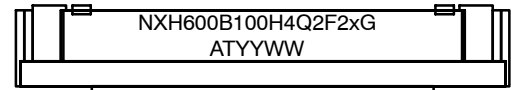


PIM44, 93x47 (PRESS FIT)
CASE 180HF



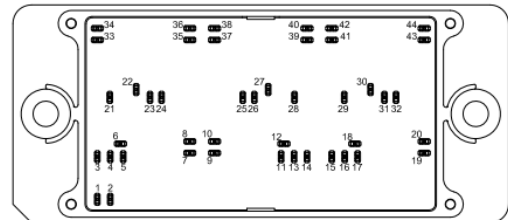
PIM44, 93x47 (SOLDER PIN)
CASE 180HE

MARKING DIAGRAM



NXH600B100H4Q2F2xG = Device Code
 X = P or S
 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 11 of this data sheet.

NXH600B100H4Q2F2PG, NXH600B100H4Q2F2SG, NXH600B100H4Q2F2SG-R

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

Parameter	Symbol	Value	Unit
IGBT (T11, T21, T12, T22, T13, T23)			
Collector-Emitter Voltage	V_{CES}	1000	V
Gate-Emitter Voltage Positive Transient Gate – Emitter Voltage (tpulse = 5 μs , $D < 0.10$)	V_{GE}	± 20 30	V
Continuous Collector Current @ $T_c = 80^\circ\text{C}$	I_C	192	A
Pulsed Peak Collector Current @ $T_c = 80^\circ\text{C}$ ($T_J = 175^\circ\text{C}$)	$I_{C(\text{Pulse})}$	576	A
Maximum Power Dissipation ($T_J = 175^\circ\text{C}$)	P_{tot}	511	W
Minimum Operating Junction Temperature	$T_{J\text{MIN}}$	-40	$^\circ\text{C}$
Maximum Operating Junction Temperature (Note 2)	$T_{J\text{MAX}}$	175	$^\circ\text{C}$

IGBT INVERSE DIODE (D11, D21, D12, D22, D13, D23)

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}	198	A
Maximum Power Dissipation ($T_J = 175^\circ\text{C}$)	P_{tot}	101	W
Minimum Operating Junction Temperature	$T_{J\text{MIN}}$	-40	$^\circ\text{C}$
Maximum Operating Junction Temperature	$T_{J\text{MAX}}$	175	$^\circ\text{C}$

SILICON CARBIDE SCHOTTKY DIODE (D31, D41, D32, D42, D33, D43)

Peak Repetitive Reverse Voltage	V_{RRM}	1200	V
Continuous Forward Current @ $T_c = 80^\circ\text{C}$	I_F	73	A
Repetitive Peak Forward Current ($T_J = 175^\circ\text{C}$)	I_{FRM}	219	A
Maximum Power Dissipation ($T_J = 175^\circ\text{C}$)	P_{tot}	217	W
Minimum Operating Junction Temperature	$T_{J\text{MIN}}$	-40	$^\circ\text{C}$
Maximum Operating Junction Temperature	$T_{J\text{MAX}}$	175	$^\circ\text{C}$

THERMAL PROPERTIES

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

INSULATION PROPERTIES

Isolation Test Voltage, $t = 1 \text{ s}$, 50 Hz	V_{is}	4000	V_{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°C per discrete TO247.

NXH600B100H4Q2F2PG, NXH600B100H4Q2F2SG, NXH600B100H4Q2F2SG-R

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

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit	
IGBT (T11, T21, T12, T22, T13, T23) CHARACTERISTICS							
Collector-Emitter Breakdown Voltage	$V_{GE} = 0\text{ V}, I_C = 1\text{ mA}$	$V_{(BR)CES}$	1000	1165	–	V	
Collector-Emitter Cutoff Current	$V_{GE} = 0\text{ V}, V_{CE} = 1000\text{V}$	I_{CES}	–	–	10	μA	
Collector-Emitter Saturation Voltage	$V_{GE} = 15\text{ V}, I_C = 200\text{ A}, T_J = 25^\circ\text{C}$	$V_{CE(sat)}$	–	1.69	2.3	V	
	$V_{GE} = 15\text{ V}, I_C = 200\text{ A}, T_J = 175^\circ\text{C}$		–	2.15	–		
Gate-Emitter Threshold Voltage	$V_{GE} = V_{CE}, I_C = 200\text{ mA}$	$V_{GE(TH)}$	3.8	4.75	6.6	V	
Gate Leakage Current	$V_{GE} = \pm 20\text{ V}, V_{CE} = 0\text{ V}$	I_{GES}	–	–	± 1	μA	
Internal Gate Resistor		r_g	–	2	–	Ω	
Turn-on Delay Time	$T_J = 25^\circ\text{C}$ $V_{CE} = 600\text{ V}, I_C = 50\text{ A}$ $V_{GE} = -9\text{ V}, 15\text{ V}, R_{gon} = 6\ \Omega,$ $R_{goff} = 6\ \Omega$	$t_{d(on)}$	–	111	–	ns	
Rise Time		t_r	–	15	–		
Turn-off Delay Time		$t_{d(off)}$	–	338	–		
Fall Time		t_f	–	113	–		
Turn-on Switching Loss per Pulse		E_{on}	–	460	–		μJ
Turn off Switching Loss per Pulse		E_{off}	–	1930	–		
Turn-on Delay Time	$T_J = 125^\circ\text{C}$ $V_{CE} = 600\text{ V}, I_C = 50\text{ A}$ $V_{GE} = -9\text{ V}, 15\text{ V}, R_{gon} = 6\ \Omega,$ $R_{goff} = 6\ \Omega$	$t_{d(on)}$	–	111	–	ns	
Rise Time		t_r	–	17	–		
Turn-off Delay Time		$t_{d(off)}$	–	406	–		
Fall Time		t_f	–	142	–		
Turn-on Switching Loss per Pulse		E_{on}	–	660	–		μJ
Turn off Switching Loss per Pulse		E_{off}	–	2860	–		
Input Capacitance	$V_{CE} = 20\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$	C_{ies}	–	13256	–	pF	
Output Capacitance		C_{oes}	–	456	–		
Reverse Transfer Capacitance		C_{res}	–	78	–		
Total Gate Charge	$V_{CE} = 600\text{ V}, I_C = 40\text{ A}, V_{GE} = -15\text{V}\sim 15\text{ V}$	Q_g	–	766	–	nC	
Thermal Resistance – Chip-to-Heatsink	Thermal grease, Thickness = 2.1 Mil $\pm 2\%$ $\lambda = 2.87\text{ W/mK}$	R_{thJH}	–	0.45	–	K/W	
Thermal Resistance – Chip-to-Case		R_{thJC}	–	0.186	–	K/W	
IGBT INVERSE DIODE (D11, D21, D12, D22, D13, D23) CHARACTERISTICS							
Diode Forward Voltage	$I_F = 50\text{ A}, T_J = 25^\circ\text{C}$	V_F	–	1.10	1.55	V	
	$I_F = 50\text{ A}, T_J = 175^\circ\text{C}$		–	0.975	–		
Thermal Resistance – Chip-to-Heatsink	Thermal grease, Thickness = 2.1 Mil $\pm 2\%$ $\lambda = 2.87\text{ W/mK}$	R_{thJH}	–	0.98	–	K/W	
Thermal Resistance – Chip-to-Case		R_{thJC}	–	0.65	–	K/W	
DIODES (D31, D41, D32, D42, D33, D43) CHARACTERISTICS							
Diode Forward Voltage	$I_F = 60\text{ A}, T_J = 25^\circ\text{C}$	V_F	–	1.54	1.85	V	
	$I_F = 60\text{ A}, T_J = 175^\circ\text{C}$		–	2.27	–		
Reverse Recovery Time	$T_J = 25^\circ\text{C}$ $V_{CE} = 600\text{ V}, I_C = 50\text{ A}$ $V_{GE} = -9\text{ V}, 15\text{ V}, R_{gon} = 6\ \Omega$	t_{rr}	–	13	–	ns	
Reverse Recovery Charge		Q_{rr}	–	93	–	nC	
Peak Reverse Recovery Current		I_{RRM}	–	11	–	A	
Peak Rate of Fall of Recovery Current		di/dt	–	2767	–	A/ μs	
Reverse Recovery Energy		E_{rr}	–	45	–	μJ	

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

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
Reverse Recovery Time	$T_J = 125^\circ\text{C}$ $V_{CE} = 600\text{ V}, I_C = 50\text{ A}$ $V_{GE} = -9\text{ V}, 15\text{ V}, R_{gon} = 6\ \Omega$	t_{rr}	–	12	–	ns
Reverse Recovery Charge		Q_{rr}	–	90	–	nC
Peak Reverse Recovery Current		I_{RRM}	–	11	–	A
Peak Rate of Fall of Recovery Current		di/dt	–	2287	–	A/ μs
Reverse Recovery Energy		E_{rr}	–	32	–	μJ
Thermal Resistance – Chip-to-Heatsink	Thermal grease, Thickness = 2.1 Mil $\pm 2\%$ $\lambda = 2.87\text{ W/mK}$	R_{thJH}	–	0.68	–	K/W
Thermal Resistance – Chip-to-Case		R_{thJC}	–	0.438	–	K/W

THERMISTOR CHARACTERISTICS

Nominal Resistance	$T = 25^\circ\text{C}$	R_{25}	–	22	–	k Ω
Nominal Resistance	$T = 100^\circ\text{C}$	R_{100}	–	1504	–	Ω
Deviation of R25		$\Delta R/R$	–1	–	1	%
Power Dissipation		P_D	–	187.5	–	mW
Power Dissipation Constant			–	1.5	–	mW/K
B-value	$B (25/100)$, tolerance $\pm 1\%$		–	3980	–	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.

TYPICAL CHARACTERISTICS – IGBT, INVERSE DIODE AND BOOST DIODE

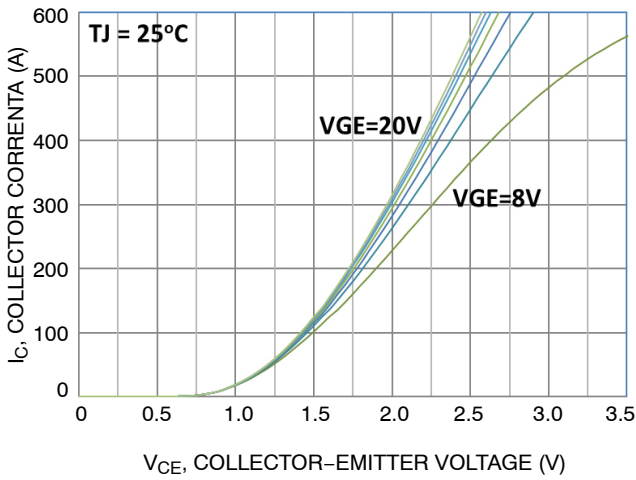


Figure 2. Typical Output Characteristics

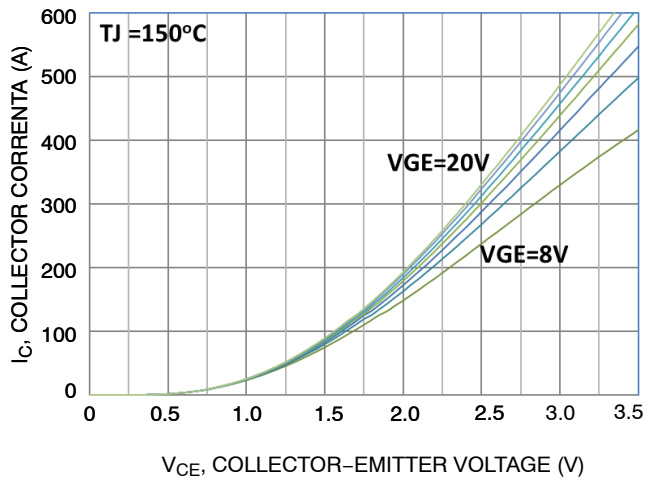


Figure 3. Typical Output Characteristics

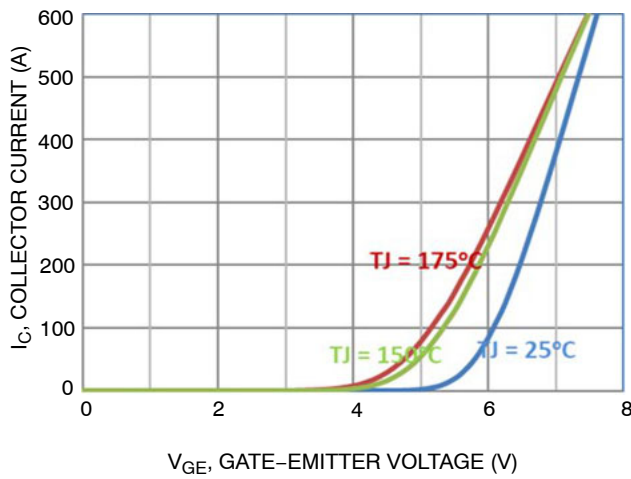


Figure 4. Transfer Characteristics

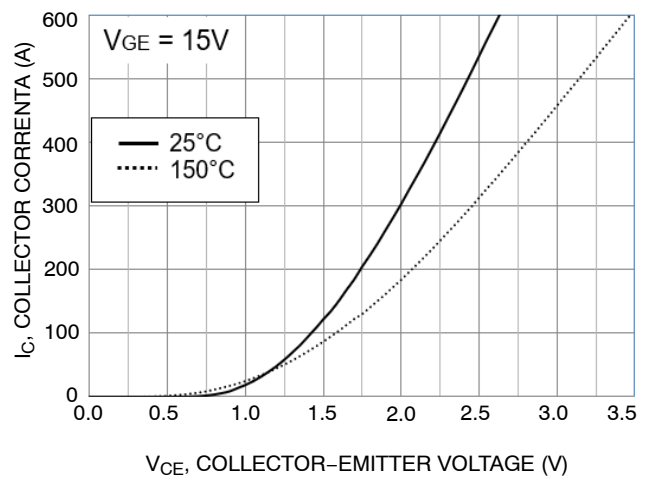


Figure 5. Saturation Voltage Characteristic

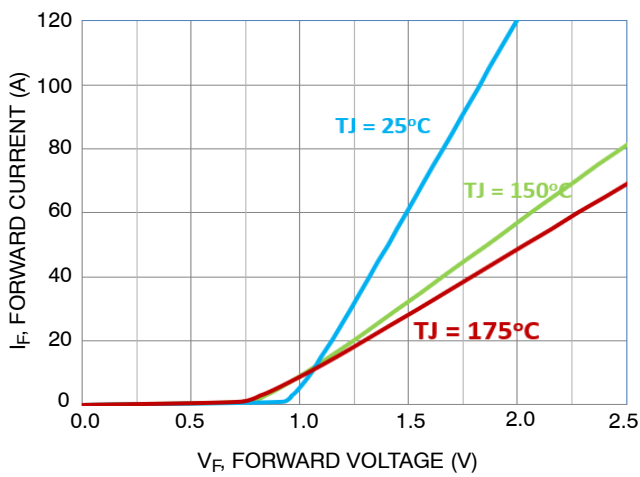


Figure 6. Boost Diode Forward Characteristics

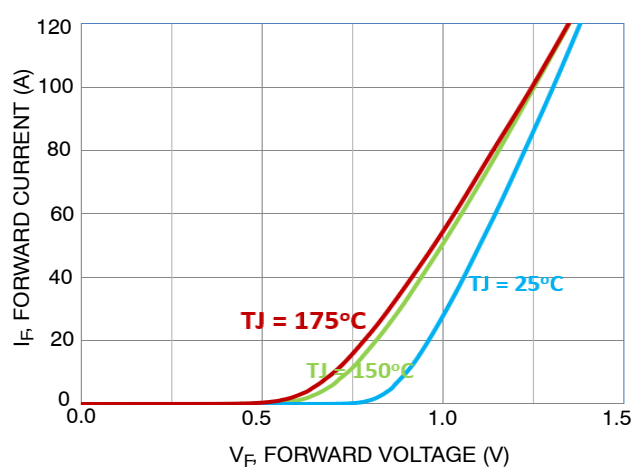


Figure 7. Inverse Diode Forward Characteristics

TYPICAL CHARACTERISTICS – IGBT AND BOOST DIODE

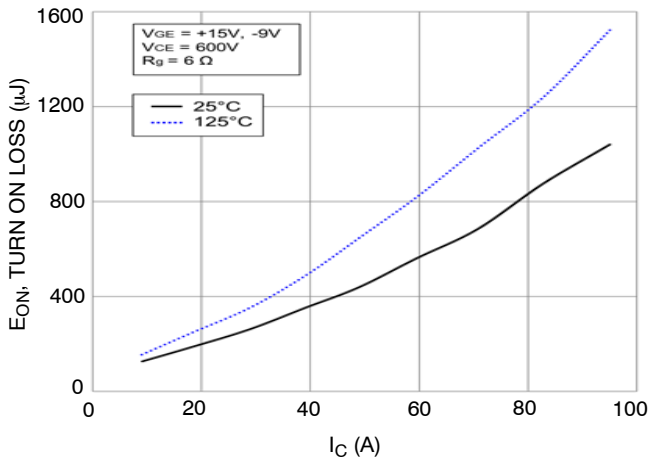


Figure 8. Typical Turn On Loss vs. Ic

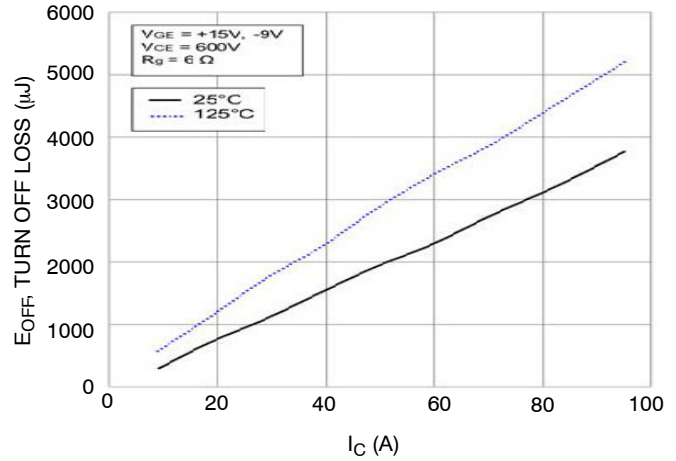


Figure 9. Typical Turn Off Loss vs. Ic

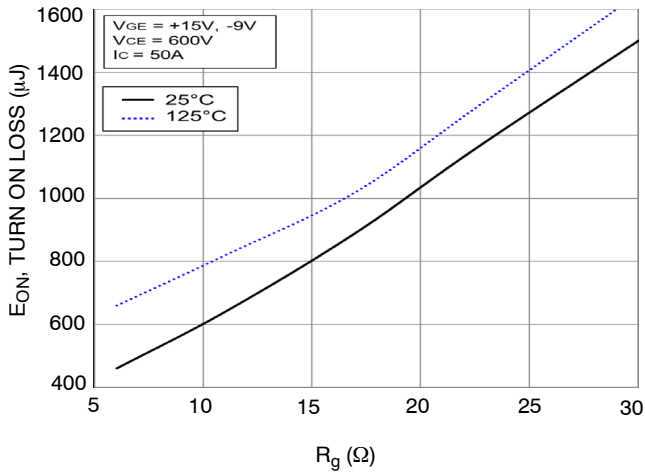


Figure 10. Typical Turn On Loss vs. Rg

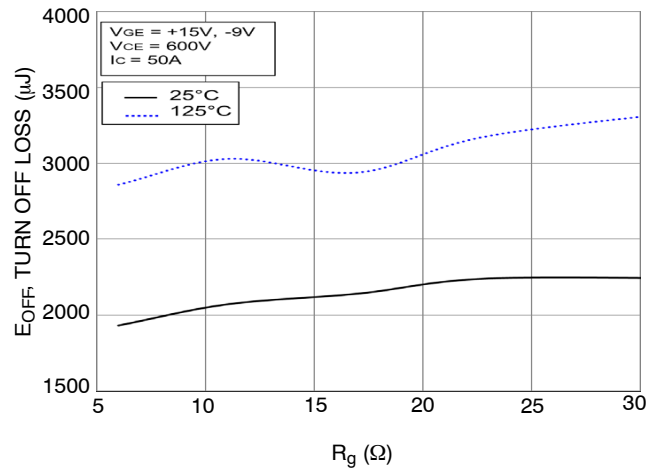


Figure 11. Typical Turn Off Loss vs. Rg

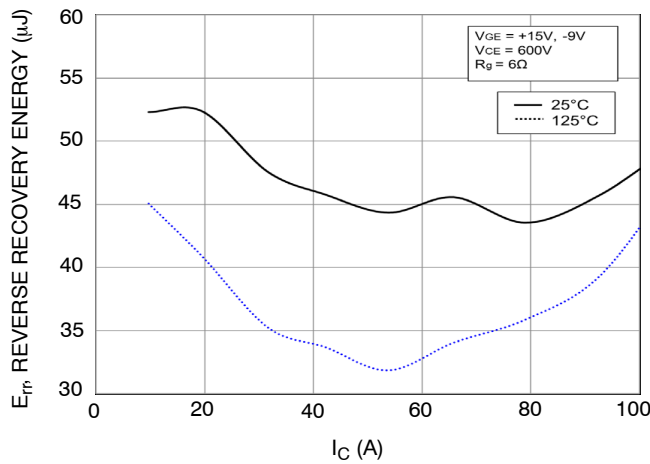


Figure 12. Typical Reverse Recovery Energy Loss vs. Ic

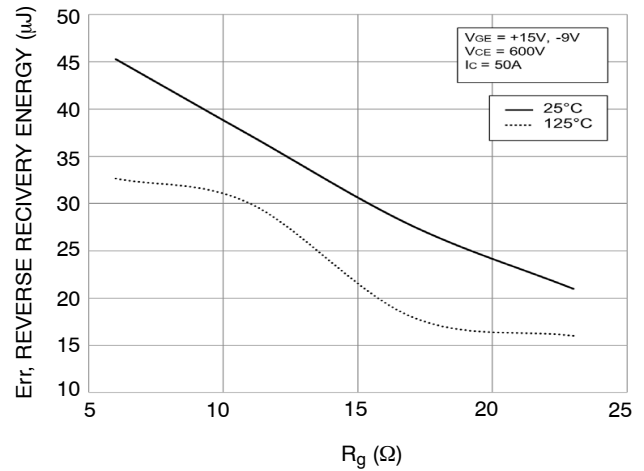


Figure 13. Typical Reverse Recovery Energy Loss vs. Rg

TYPICAL CHARACTERISTICS – IGBT AND BOOST DIODE (CONTINUED)

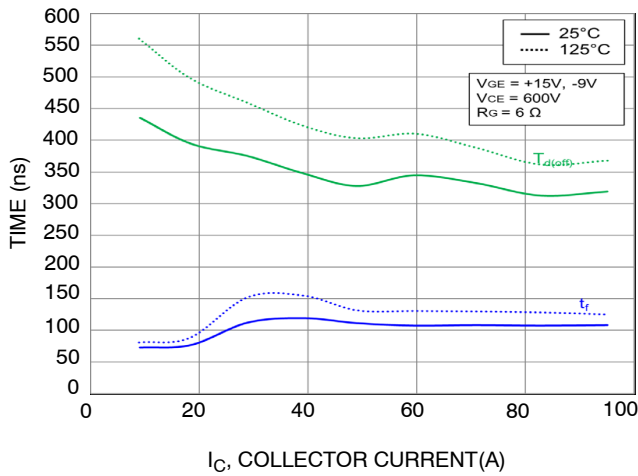


Figure 14. Typical Turn-Off Switching Time vs. I_C

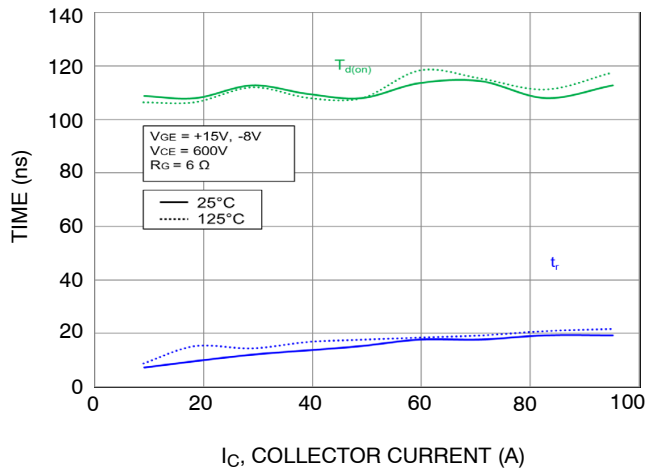


Figure 15. Typical Turn-On Switching Time vs. I_C

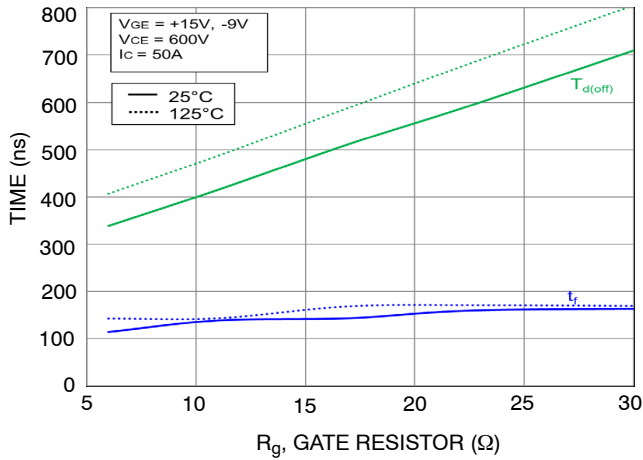


Figure 16. Typical Turn-Off Switching Time vs. R_g

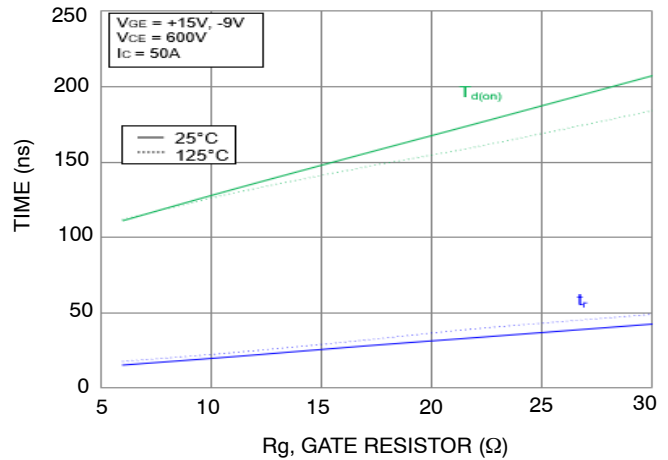


Figure 17. Typical Turn-On Switching Time vs. R_g

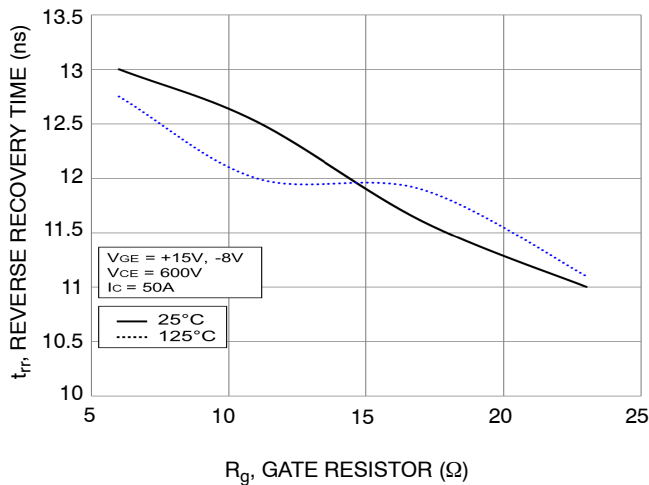


Figure 18. Typical Reverse Recovery Time vs. R_g

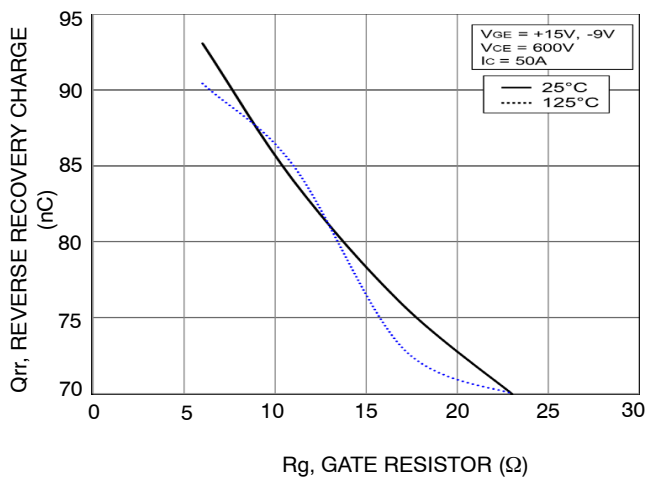


Figure 19. Typical Reverse Recovery Charge vs. R_g

TYPICAL CHARACTERISTICS – IGBT AND BOOST DIODE (CONTINUED)

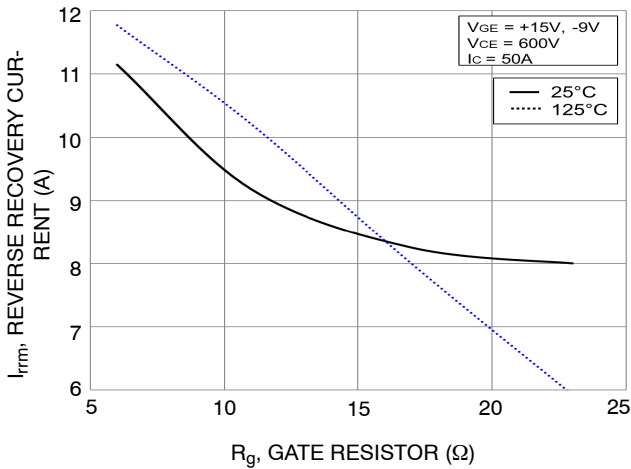


Figure 20. Typical Reverse Recovery Peak Current vs. R_g

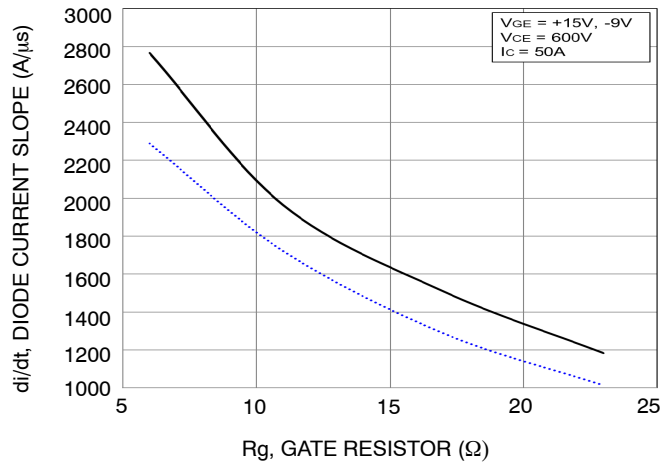


Figure 21. Typical di/dt vs. R_g

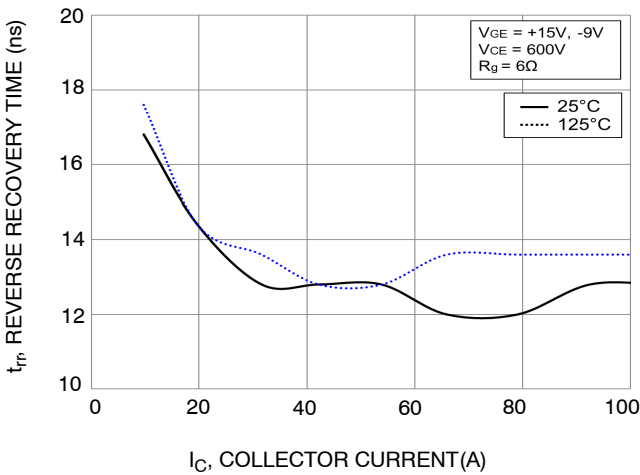


Figure 22. Typical Reverse Recovery Time vs. I_c

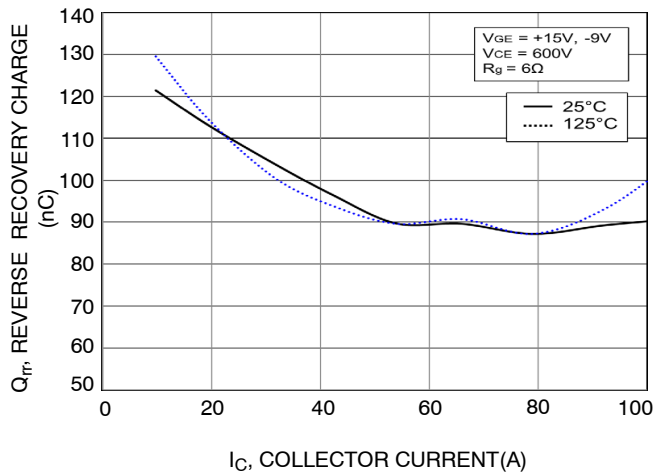


Figure 23. Typical Reverse Recovery Charge vs. I_c

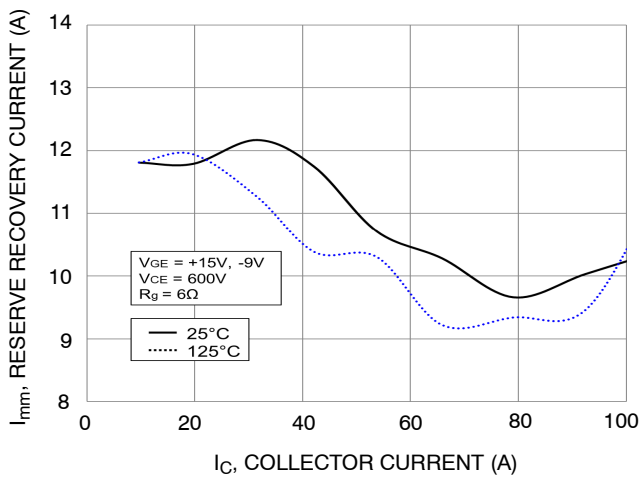


Figure 24. Typical Reserve Recovery Current vs. I_c

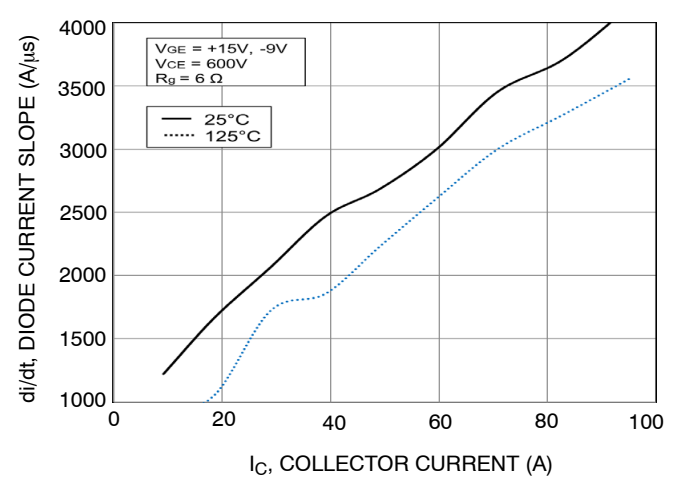


Figure 25. Typical di/dt vs. I_c

TYPICAL CHARACTERISTICS - IGBT

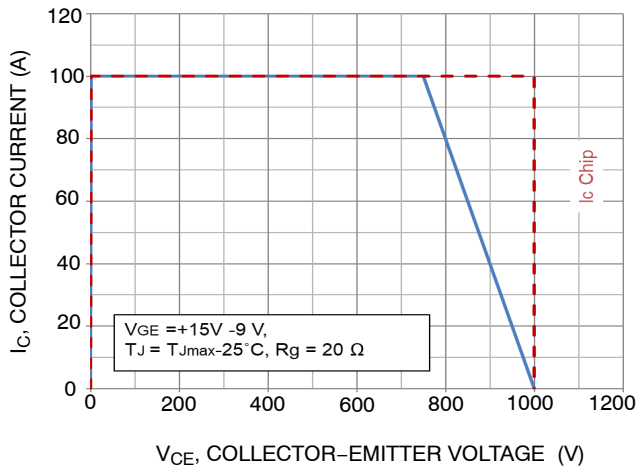


Figure 26. RBSOA

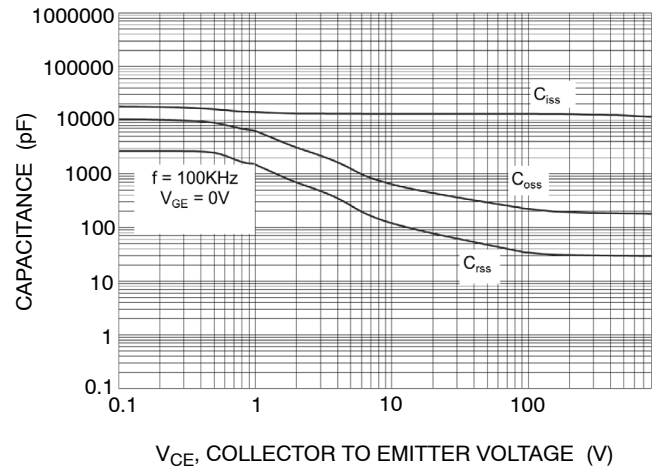


Figure 27. Capacitance Charge

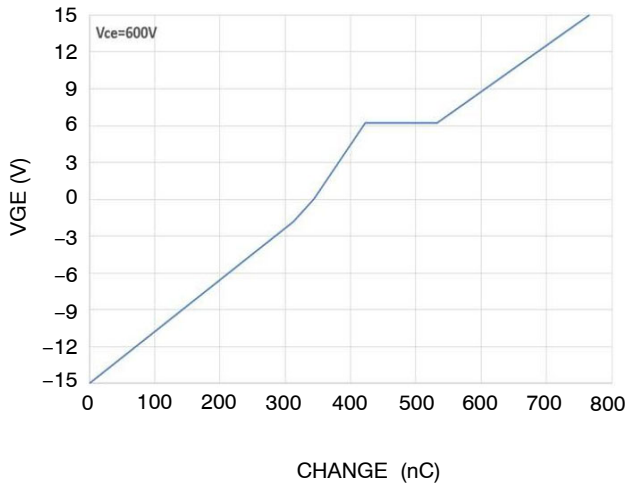


Figure 28. Gate Voltage vs. Gate Charge

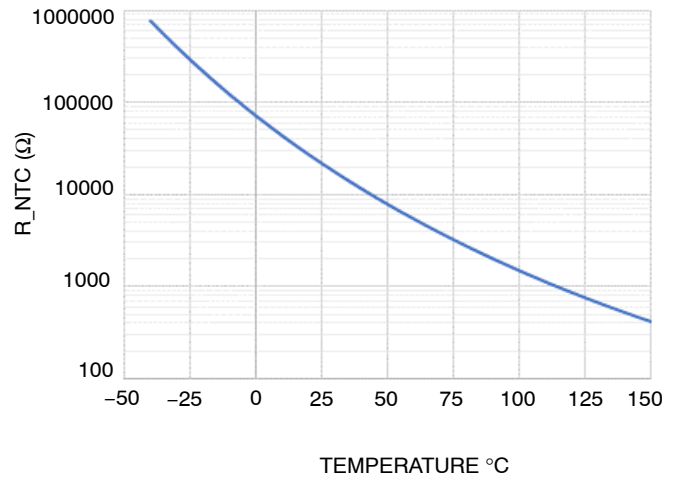


Figure 29. Temperature vs NTC Value

TYPICAL CHARACTERISTICS – IGBT, INVERSE DIODE AND BOOST DIODE

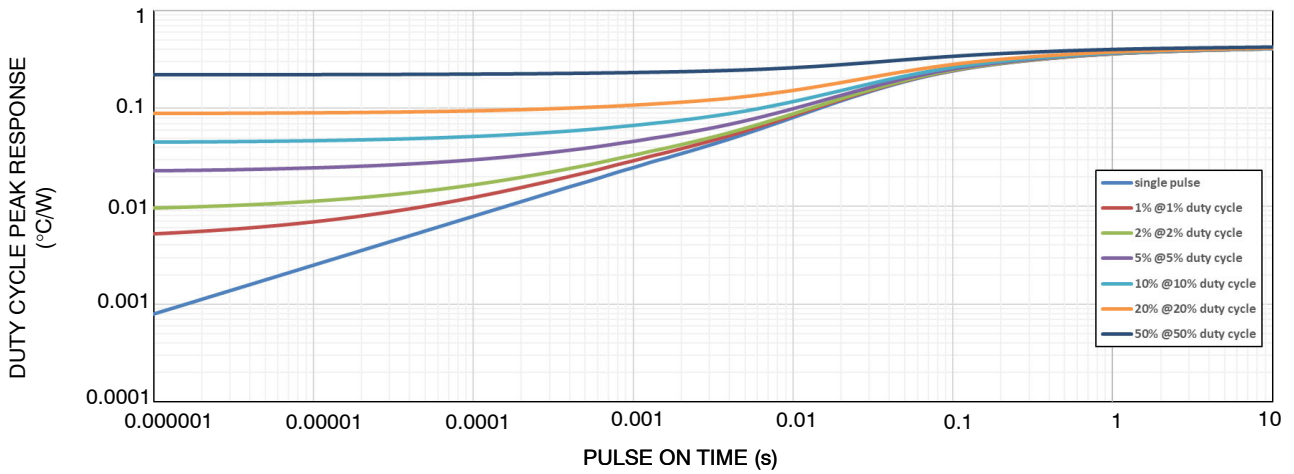


Figure 30. Transient Thermal Impedance (IGBT)

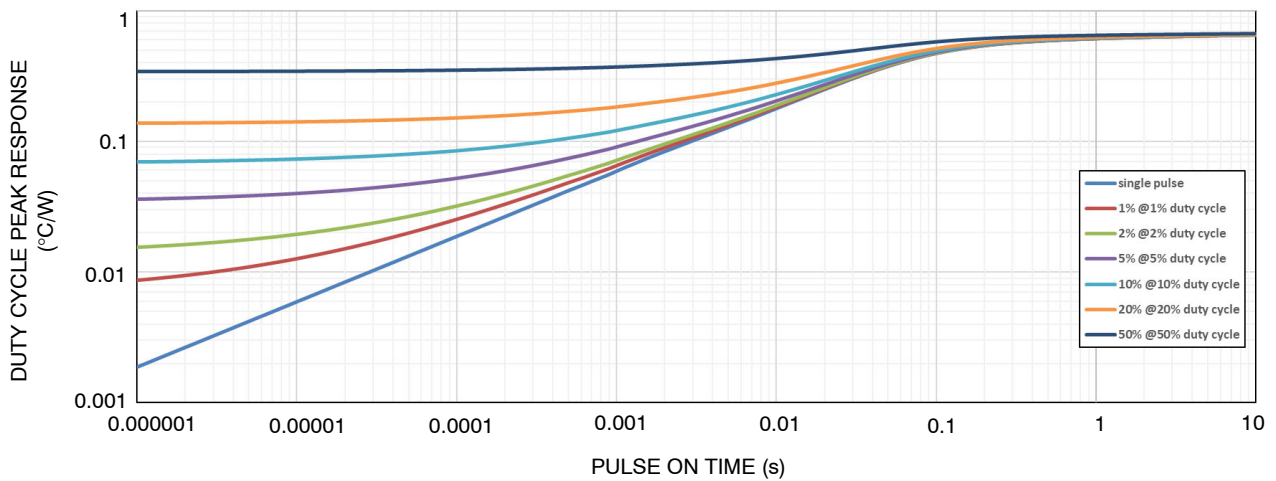


Figure 31. Transient Thermal Impedance (BOOST DIODE)

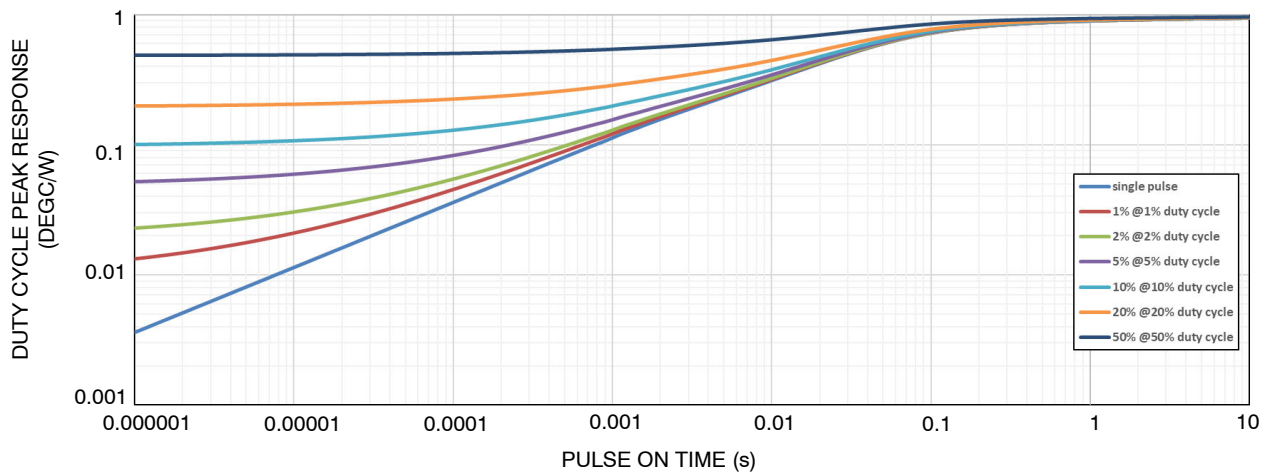
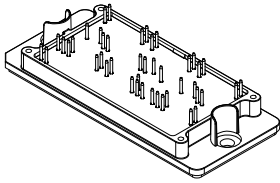


Figure 32. Transient Thermal Impedance (INVERSE DIODE)

NXH600B100H4Q2F2PG, NXH600B100H4Q2F2SG, NXH600B100H4Q2F2SG-R

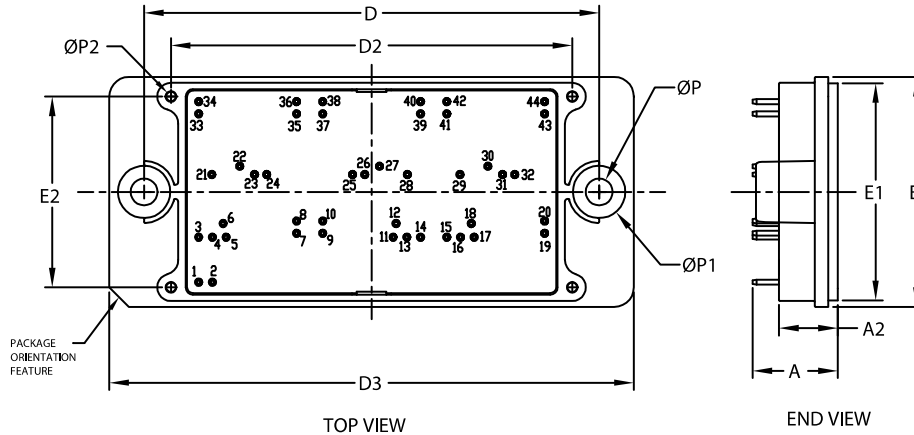
ORDERING INFORMATION

Device Order Number	Marking	Package	Shipping
NXH600B100H4Q2F2SG, NXH600B100H4Q2F2SG-R	NXH600B100H4Q2F2SG, NXH600B100H4Q2F2SG-R	Q2BOOST - Case 180HE (Pb-Free and Halide-Free Solder Pins)	12 Units / Blister Tray
NXH600B100H4Q2F2PG	NXH600B100H4Q2F2PG	Q2BOOST - Case 180HF (Pb-Free and Halide-Free Press Fit Pins)	12 Units / Blister Tray

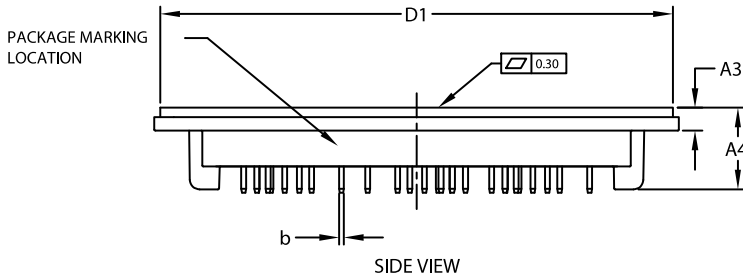


PIM44, 93x47 (SOLDER PIN)
CASE 180HE
ISSUE O

DATE 21 OCT 2021



DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	17.00	17.40	17.80
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



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 ± 0.4mm
5. PACKAGE MARKING IS LOCATED AS SHOWN ON THE SIDE OPPOSITE THE PACKAGE ORIENTATION FEATURES

NOTE 4

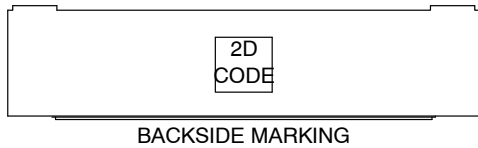
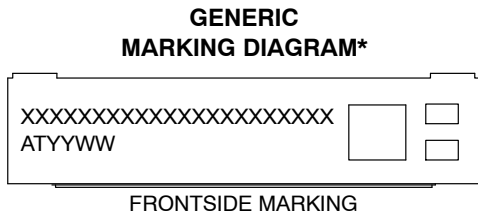
PIN	PIN POSITION		PIN	PIN POSITION	
	X	Y		X	Y
1	0.00	0.00	23	11.40	22.00
2	2.80	0.00	24	13.90	22.00
3	0.00	9.20	25	31.45	22.00
4	2.80	9.20	26	33.95	22.00
5	5.60	9.20	27	36.95	23.70
6	5.00	12.00	28	42.65	22.00
7	20.00	10.00	29	53.40	22.00
8	20.00	12.50	30	59.10	23.70
9	25.35	10.00	31	62.10	22.00
10	25.35	12.50	32	64.60	22.00
11	39.75	9.20	33	0.00	34.40
12	40.35	12.00	34	0.00	36.90
13	42.55	9.20	35	20.00	34.40
14	45.35	9.20	36	20.00	36.90
15	50.70	9.20	37	25.35	34.40
16	53.50	9.20	38	25.35	36.90
17	56.30	9.20	39	45.35	34.40
18	55.70	12.00	40	45.35	36.90
19	70.70	10.00	41	50.70	34.40
20	70.70	12.50	42	50.70	36.90
21	2.70	22.00	43	70.70	34.40
22	8.40	23.70	44	70.70	36.90

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DESCRIPTION:	PIM44, 93x47 (SOLDER PIN)	PAGE 1 OF 2

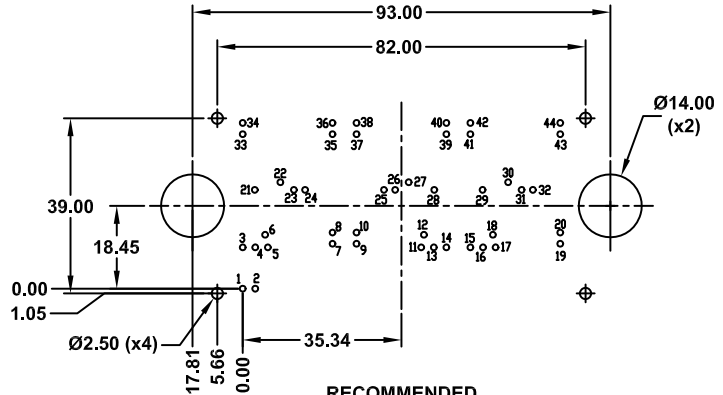
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PIM44, 93x47 (SOLDER PIN)
CASE 180HE
ISSUE O

DATE 21 OCT 2021



XXXXXX = Specific Device Code
AT = Assembly & Test Site Code
YYWW = Year and Work Week Code



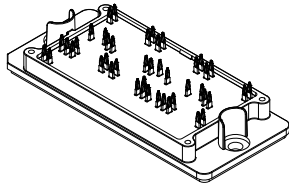
RECOMMENDED MOUNTING PATTERN

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

*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.

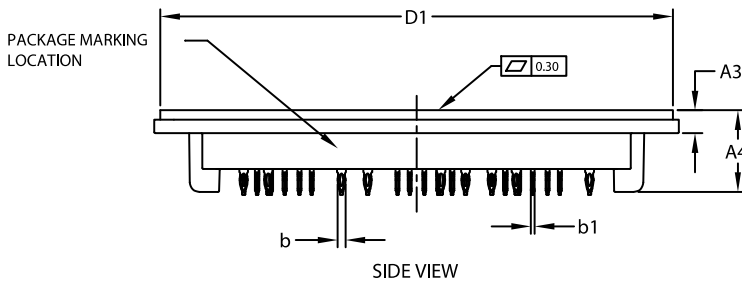
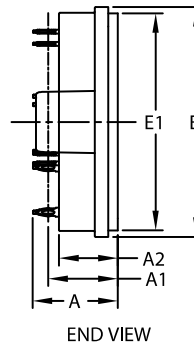
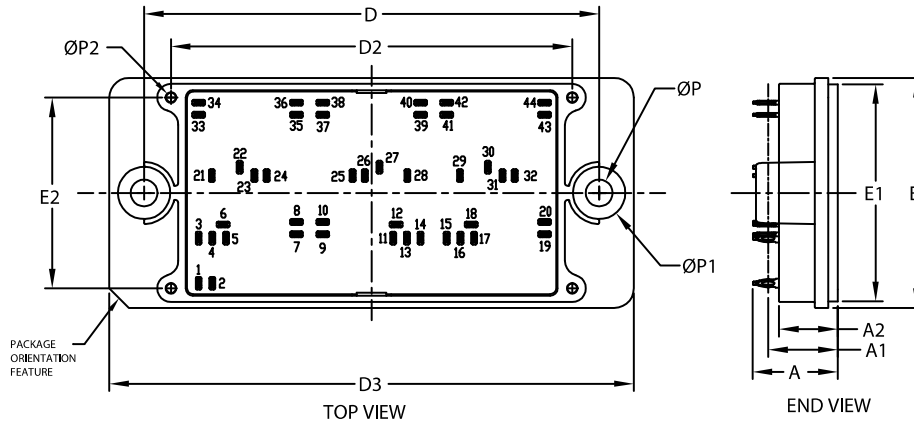
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PIM44, 93x47 (PRESS FIT)
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NOTES:

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	16.90	17.30	17.70
A1	14.18(REF)		
A2	11.70	12.00	12.30
A3	4.40	4.70	5.00
A4	16.40	16.70	17.00
b	1.61	1.66	1.71
b1	0.75	0.80	0.85
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

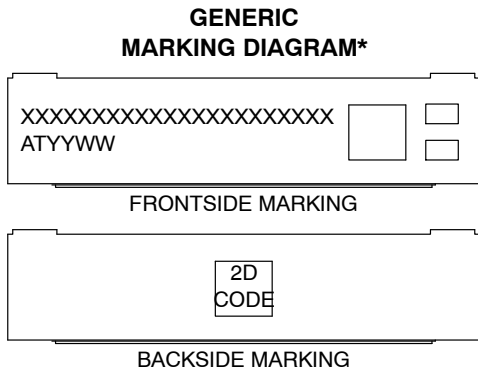
PIN	PIN POSITION		PIN	PIN POSITION	
	X	Y		X	Y
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2	2.80	0.00	24	13.90	22.00
3	0.00	9.20	25	31.45	22.00
4	2.80	9.20	26	33.95	22.00
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11	39.75	9.20	33	0.00	34.40
12	40.35	12.00	34	0.00	36.90
13	42.55	9.20	35	20.00	34.40
14	45.35	9.20	36	20.00	36.90
15	50.70	9.20	37	25.35	34.40
16	53.50	9.20	38	25.35	36.90
17	56.30	9.20	39	45.35	34.40
18	55.70	12.00	40	45.35	36.90
19	70.70	10.00	41	50.70	34.40
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22	8.40	23.70	44	70.70	36.90

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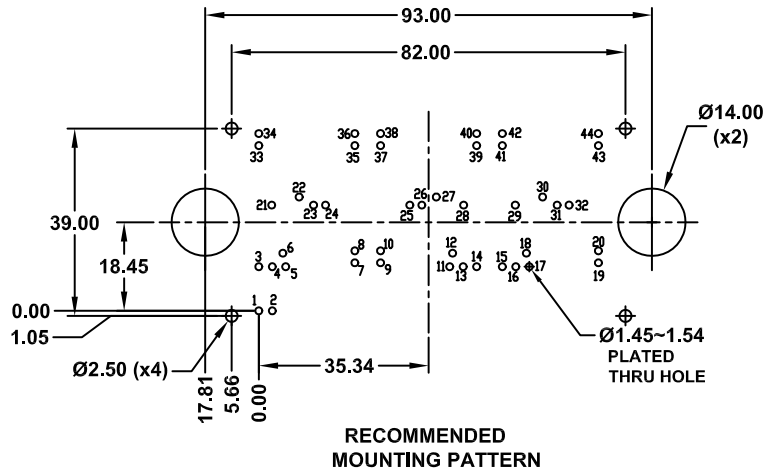
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PIM44, 93x47 (PRESS FIT)
CASE 180HF
ISSUE O

DATE 26 OCT 2021



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 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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DESCRIPTION:	PIM44, 93x47 (PRESS FIT)	PAGE 2 OF 2

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