Si/SiC Hybrid Module – EliteSiC, 3-channel, 1200 V IGBT + SiC Boost, 80 A IGBT and 20 A SiC Diode, Q1 Package

NXH240B120H3Q1PG, NXH240B120H3Q1PG-R, NXH240B120H3Q1SG

The NXH240B120H3Q1PG is a case power module containing a three channel BOOST stage. The integrated field stop trench IGBTs and SiC Diodes provide lower conduction losses and switching losses, enabling designers to achieve high efficiency and superior reliability.

Features

- 1200 V Ultra Field Stop IGBTs
- Low Reverse Recovery and Fast Switching SiC Diodes
- Low Inductive Layout
- Press−fit Pins
- Thermistor

Typical Applications

- Solar Inverters
- ESS

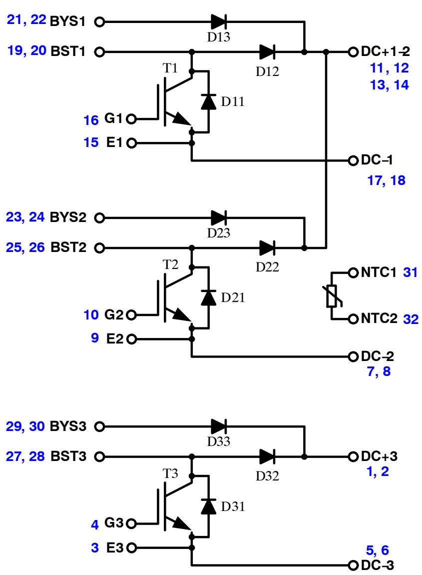
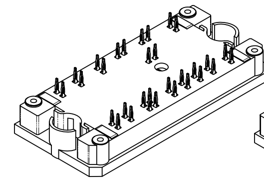
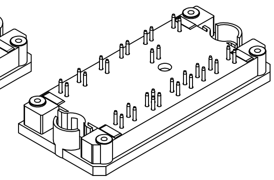


Figure 1. Schematic Diagram

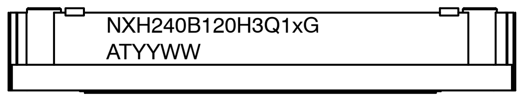


PIM32
(PRESS−FIT)
CASE 180AX



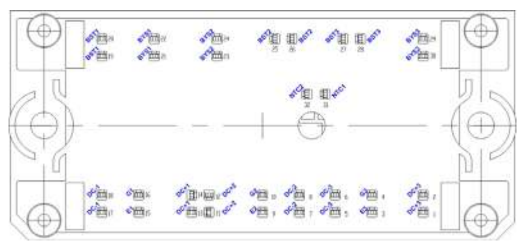
PIM32
(SOLDER−PINS)
CASE 180BQ

MARKING DIAGRAM



NXH240B120H3Q1xG = Specific Device Code
x = P or S
G = Pb−Free Package
AT = Assembly & Test Site Code
YYWW = Year and Work Week Code

PIN ASSIGNMENTS



ORDERING INFORMATION

See detailed ordering and shipping information in the dimensions section on page 12 of this data sheet.

Table 1. MAXIMUM RATINGS (Note 1)

Rating	Symbol	Value	Unit
IGBT (T1, T2, T3)			
Collector−Emitter Voltage	V_{CES}	1200	V
Gate−Emitter Voltage	V_{GE}	±20	V
Continuous Collector Current @ T_h = 80°C (T_J = 175°C)	I_C	68	A
Pulsed Collector Current (T_J = 175°C)	I_{Cpulse}	204	A
Maximum Power Dissipation (T_J = 175°C)	P_{tot}	158	W
Minimum Operating Junction Temperature	T_{JMIN}	−40	°C
Maximum Operating Junction Temperature	T_{JMAX}	150	°C
PROTECTION DIODE (D11, D21, D31)			
Peak Repetitive Reverse Voltage	V_{RRM}	1200	V
Continuous Forward Current @ T_h = 80°C (T_J = 150°C)	I_F	30	A
Repetitive Peak Forward Current (T_J = 150°C)	I_{FRM}	120	A
Maximum Power Dissipation (T_J = 150°C)	P_{tot}	44	W
Minimum Operating Junction Temperature	T_{JMIN}	−40	°C
Maximum Operating Junction Temperature	T_{JMAX}	150	°C
SILICON CARBIDE BOOST DIODE (D12, D22, D32)			
Peak Repetitive Reverse Voltage	V_{RRM}	1200	V
Continuous Forward Current @ T_h = 80°C (T_J = 175°C)	I_F	25	A
Repetitive Peak Forward Current (T_J = 175°C)	I_{FRM}	75	A
Maximum Power Dissipation (T_J = 175°C)	P_{tot}	73	W
Minimum Operating Junction Temperature	T_{JMIN}	−40	°C
Maximum Operating Junction Temperature	T_{JMAX}	175	°C
BYPASS DIODE (D13, D23, D33)			
Peak Repetitive Reverse Voltage	V_{RRM}	1200	V
Continuous Forward Current @ T_h = 80°C (T_J = 150°C)	I_F	42	A
Repetitive Peak Forward Current (T_J = 150°C)	I_{FRM}	126	A
Maximum Power Dissipation (T_J = 150°C)	P_{tot}	50	W
Minimum Operating Junction Temperature	T_{JMIN}	−40	°C
Maximum Operating Junction Temperature	T_{JMAX}	150	°C
THERMAL PROPERTIES			
Storage Temperature range	T_{stg}	−40 to 150	°C
INSULATION PROPERTIES			
Isolation test voltage, t = 1 sec, 60 Hz	V_{is}	3000	V_{RMS}
Creepage distance		12.7	mm

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

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

Table 2. RECOMMENDED OPERATING RANGES

Rating	Symbol	Min	Max	Unit
Module Operating Junction Temperature	T_J	−40	150	°C

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

Table 3. ELECTRICAL CHARACTERISTICS T_J = 25°C unless otherwise noted

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
IGBT (T1, T2, T3)						
Collector−Emitter Cutoff Current	V_{GE} = 0 V, V_{CE} = 1200 V	I_{CES}	–	–	400	µA
Collector−Emitter Saturation Voltage	V_{GE} = 15 V, I_C = 80 A, T_J = 25°C	$V_{CE(sat)}$	–	1.65	2	V
	V_{GE} = 15 V, I_C = 80 A, T_J = 150°C		–	1.85	–	
Gate−Emitter Threshold Voltage	V_{GE} = V_{CE}, I_C = 1.0 mA	$V_{GE(TH)}$	4.50	5.87	6.50	V
Gate Leakage Current	V_{GE} = 20 V, V_{CE} = 0 V	I_{GES}	–	–	800	nA
Turn−on Delay Time	T_J = 25°C V_{CE} = 800 V, I_C = 50 A V_{GE} = +15 V, −9 V, R_G = 4.3 Ω	$t_{d(on)}$	–	13	–	ns
Rise Time		t_r	–	22	–	
Turn−off Delay Time		$t_{d(off)}$	–	262	–	
Fall Time		t_f	–	13	–	
Turn−on Switching Loss per Pulse		E_{on}	–	1258	–	µJ
Turn off Switching Loss per Pulse		E_{off}	–	1277	–	
Turn−on Delay Time	T_J = 125°C V_{CE} = 800 V, I_C = 50 A V_{GE} = +15 V, −9 V, R_G = 4.3 Ω	$t_{d(on)}$	–	32	–	ns
Rise Time		t_r	–	22	–	
Turn−off Delay Time		$t_{d(off)}$	–	315	–	
Fall Time		t_f	–	22	–	
Turn−on Switching Loss per Pulse		E_{on}	–	1306	–	µJ
Turn off Switching Loss per Pulse		E_{off}	–	2221	–	
Input Capacitance	V_{CE} = 20 V, V_{GE} = 0 V, f = 10 kHz	C_{ies}	–	18151	–	pF
Output Capacitance		C_{oes}	–	345	–	
Reverse Transfer Capacitance		C_{res}	–	294	–	
Total Gate Charge	V_{CE} = 600 V, I_C = 25 A, V_{GE} = ±15 V	Q_g	–	817	–	nC
Thermal Resistance − chip−to−heatsink	Thermal grease, Thickness = 2 Mil ±2%, λ = 0.63 W/mK	R_{thJH}	–	0.60	–	°C/W
Thermal Resistance − chip−to−case		R_{thJC}	–	0.29	–	°C/W
PROTECTION DIODE (D11, D21, D31)						
Diode Forward Voltage	I_F = 30 A, T_J = 25°C	V_F	–	1.09	1.3	V
	I_F = 30 A, T_J = 150°C		–	0.99	–	
Thermal Resistance − chip−to−heatsink	Thermal grease, Thickness = 2 Mil ±2%, λ = 0.63 W/mK	R_{thJH}	–	1.60	–	°C/W
Thermal Resistance − chip−to−case		R_{thJC}	–	0.98	–	°C/W
SILICON CARBIDE BOOST DIODE (D12, D22, D32)						
Diode Forward Voltage	I_F = 20 A, T_J = 25°C	V_F	–	1.48	1.75	V
	I_F = 20 A, T_J = 150°C		–	1.99	–	
Reverse Recovery Time	T_J = 25°C V_{CE} = 800 V, I_C = 50 A V_{GE} = +15 V, −9 V, R_G = 4.3 Ω	t_{rr}	–	21	–	ns
Reverse Recovery Charge		Q_{rr}	–	84	–	µC
Peak Reverse Recovery Current		I_{RRM}	–	7	–	A
Peak Rate of Fall of Recovery Current		di/dt	–	1750	–	A/µs
Reverse Recovery Energy		E_{rr}	–	65	–	µJ
Reverse Recovery Time	T_J = 125°C V_{CE} = 800 V, I_C = 50 A V_{GE} = +15 V, −9 V, R_G = 4.3 Ω	t_{rr}	–	22	–	ns
Reverse Recovery Charge		Q_{rr}	–	89	–	µC
Peak Reverse Recovery Current		I_{RRM}	–	8	–	A
Peak Rate of Fall of Recovery Current		di/dt	–	1800	–	A/µs
Reverse Recovery Energy		E_{rr}	–	99	–	µJ

Table 3. ELECTRICAL CHARACTERISTICS T_J = 25°C unless otherwise noted

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
SILICON CARBIDE BOOST DIODE (D12, D22, D32)						
Thermal Resistance − chip−to−heatsink	Thermal grease, Thickness = 2 Mil ±2%, λ = 0.63 W/mK	R_{thJH}	–	1.30	–	°C/W
Thermal Resistance − chip−to−case		R_{thJC}	–	0.85	–	°C/W
BYPASS DIODE (D13, D23, D33)						
Diode Forward Voltage	I_F = 50 A, T_J = 25°C	V_F	–	1.095	1.3	V
	I_F = 50 A, T_J = 150°C		–	1.004	–	
Thermal Resistance − chip−to−heatsink	Thermal grease, Thickness = 2 Mil ±2%, λ = 0.63 W/mK	R_{thJH}	–	1.40	–	°C/W
Thermal Resistance − chip−to−case		R_{thJC}	–	0.85	–	°C/W
THERMISTOR CHARACTERISTICS						
Nominal resistance	T = 25°C	R_{25}	–	5	–	kΩ
Nominal resistance	T = 100°C	R_{100}	–	493.3	–	Ω
Deviation of R25		ΔR/R	−5	–	5	%
Power dissipation		P_D	–	20	–	mW
Power dissipation constant			–	1.4	–	mW/K
B−value	B(25/50), tolerance ±2%		–	3375	–	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 (T1, T2, T3) and Silicon Carbide Schottky Diode (D12, D22, D32)

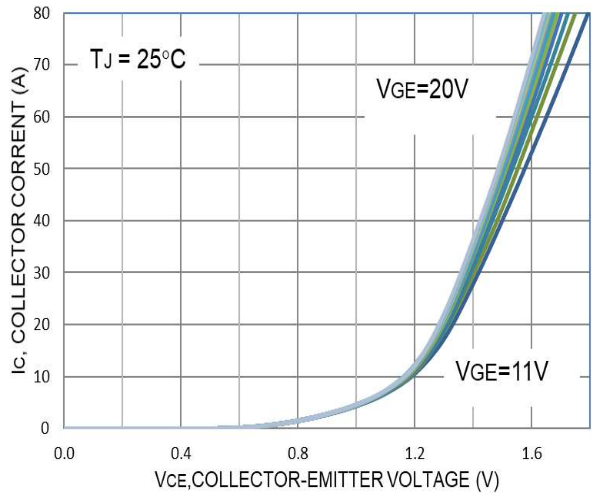


Figure 2. Typical Output Characteristics

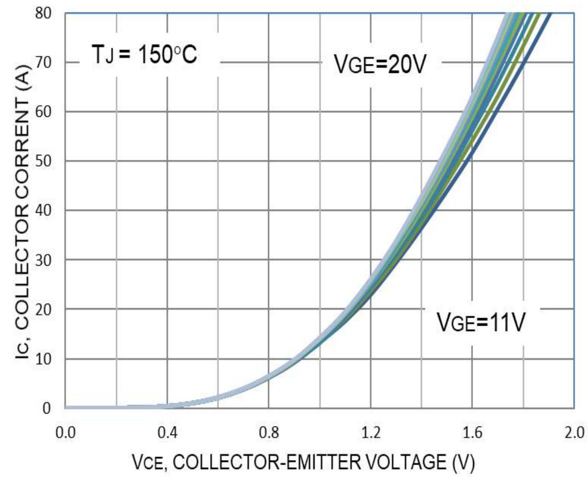


Figure 3. Typical Output Characteristics

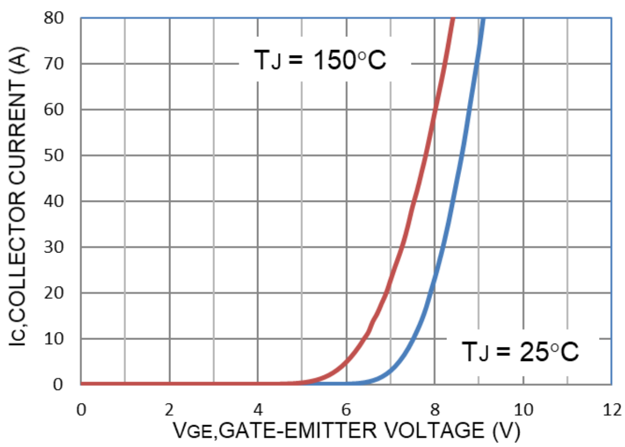


Figure 4. Typical Transfer Characteristics

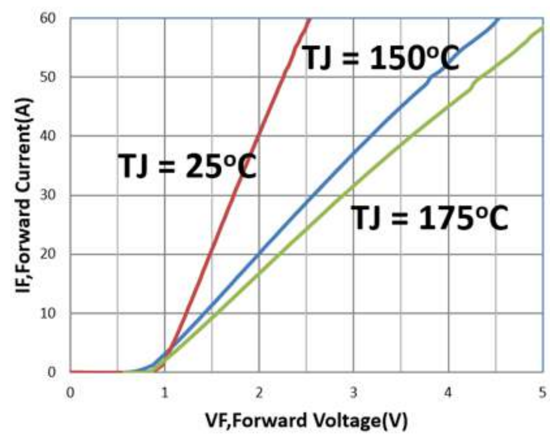


Figure 5. Diode Forward Characteristics

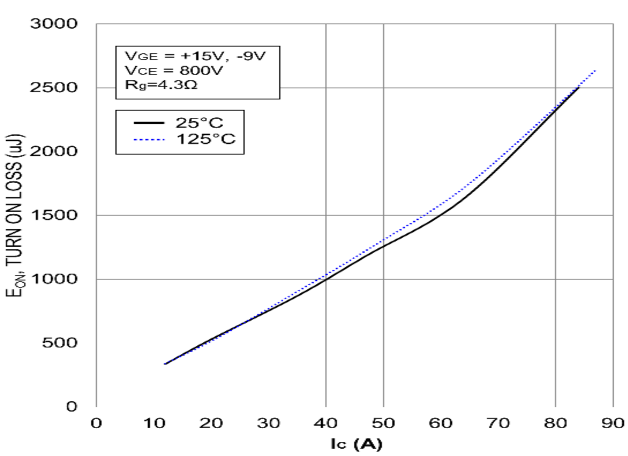


Figure 6. Typical Turn ON Loss vs. I_C

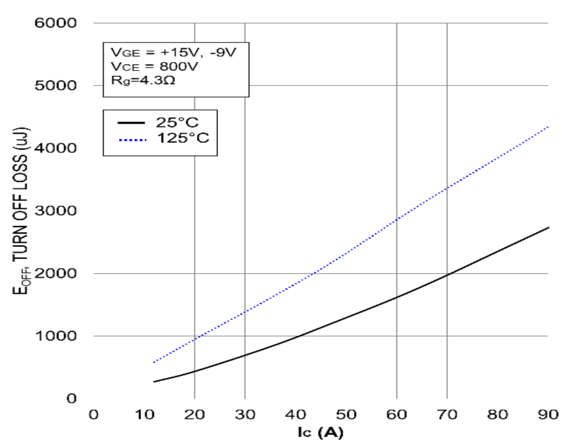


Figure 7. Typical Turn OFF Loss vs. I_C

TYPICAL CHARACTERISTICS − IGBT (T1, T2, T3) and Silicon Carbide Schottky Diode (D12, D22, D32)

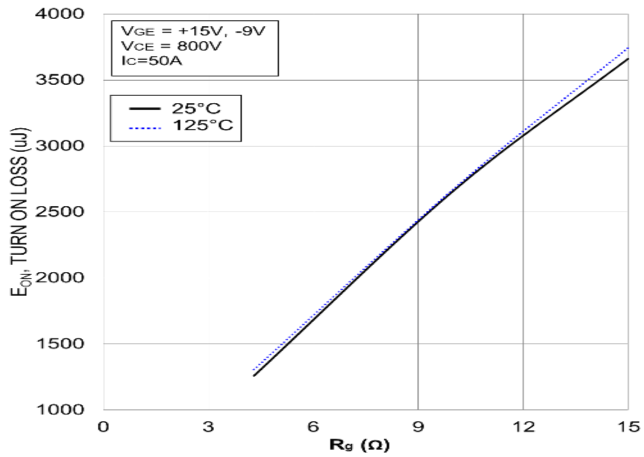


Figure 8. Typical Turn ON Loss vs. R_G

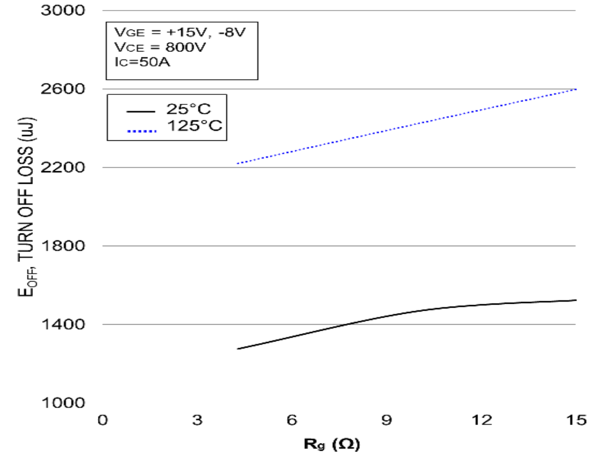


Figure 9. Typical Turn OFF Loss vs. R_G

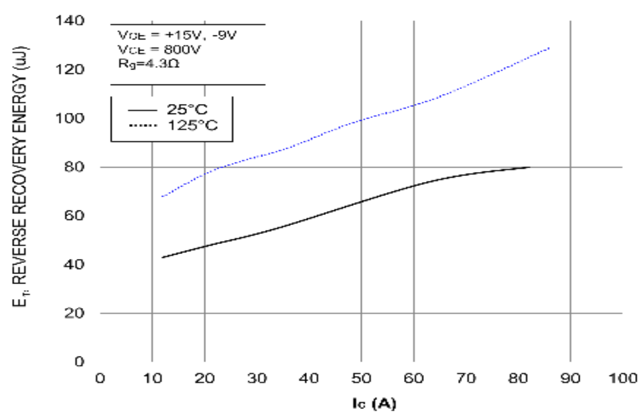


Figure 10. Typical Reverse Recovery Time vs. I_C

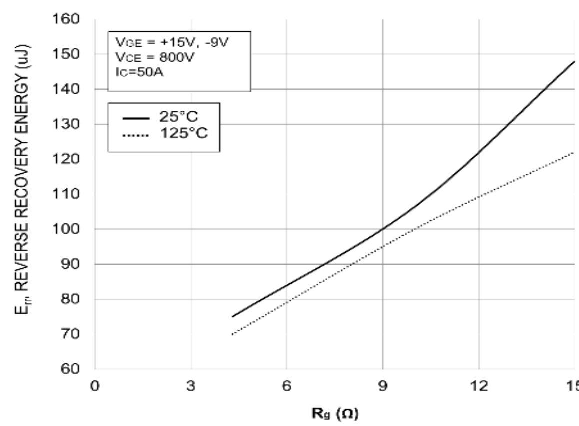


Figure 11. Typical Reverse Recovery Time vs. R_G

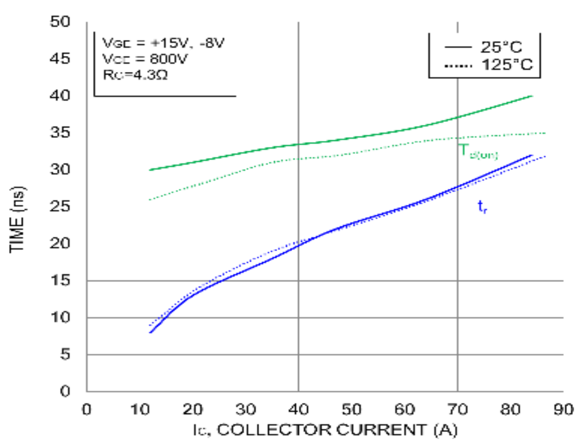


Figure 12. Typical Turn−On Switching Time vs. I_C

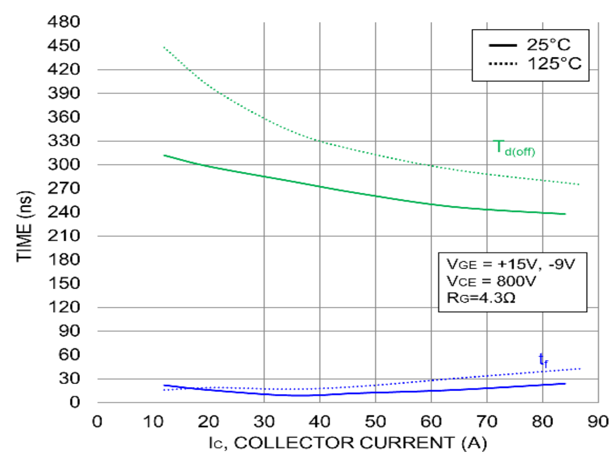


Figure 13. Typical Turn−Off Switching Time vs. I_C

TYPICAL CHARACTERISTICS − IGBT (T1, T2, T3) and Silicon Carbide Schottky Diode (D12, D22, D32)

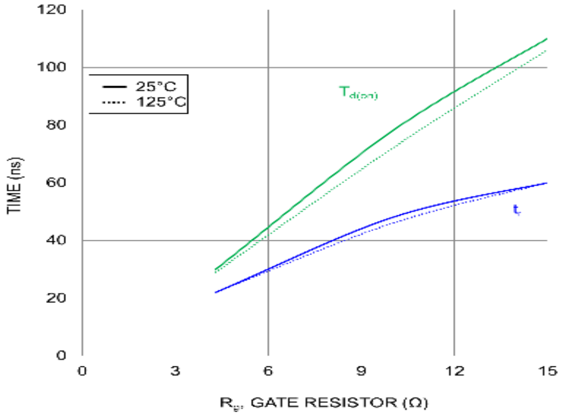


Figure 14. Typical Turn−On Switching Time vs. R_G

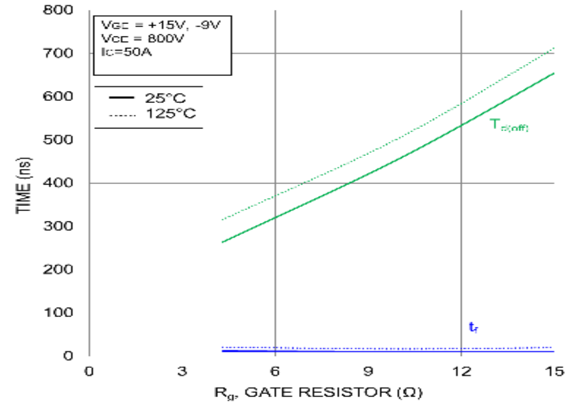


Figure 15. Typical Turn−Off Switching Time vs. R_G

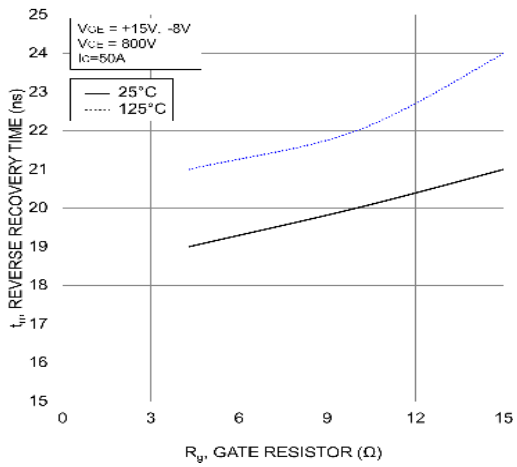


Figure 16. Typical Reverse Recovery Time vs. R_G

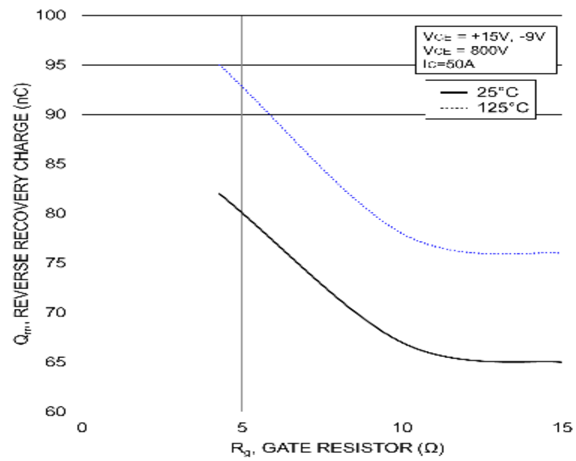


Figure 17. Typical Reverse Recovery Charge vs. R_G

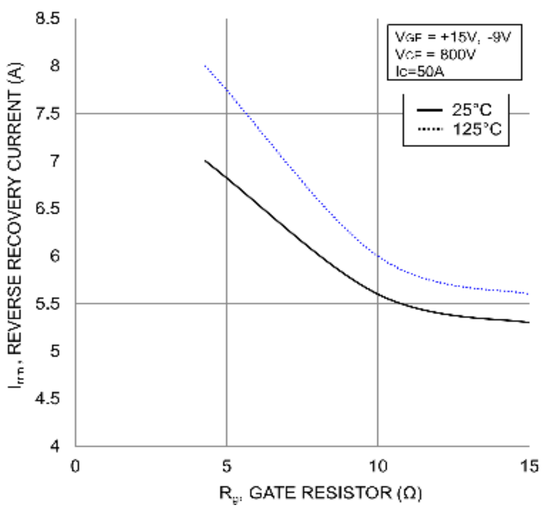


Figure 18. Typical Reverse Recovery Peak Current vs. R_G

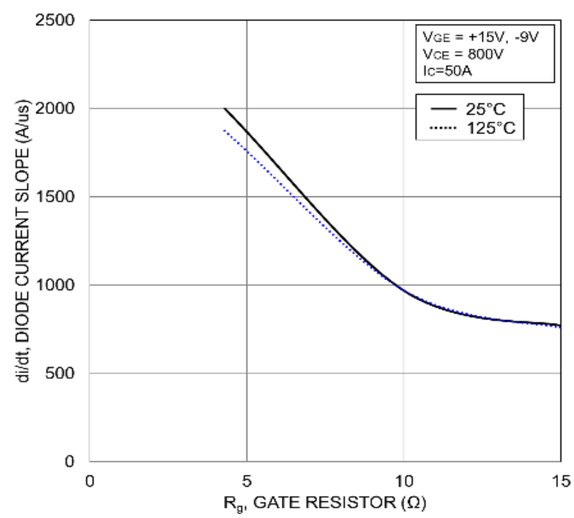


Figure 19. Typical di/dt vs. R_G

TYPICAL CHARACTERISTICS – IGBT (T1, T2, T3) and Silicon Carbide Schottky Diode (D12, D22, D32)

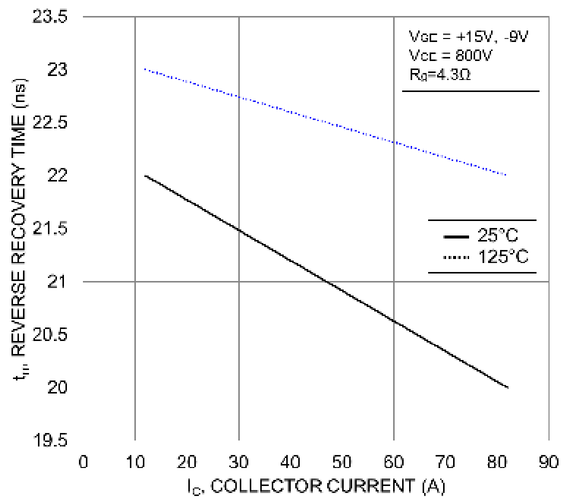


Figure 20. Typical Reverse Recovery Time vs. I_C

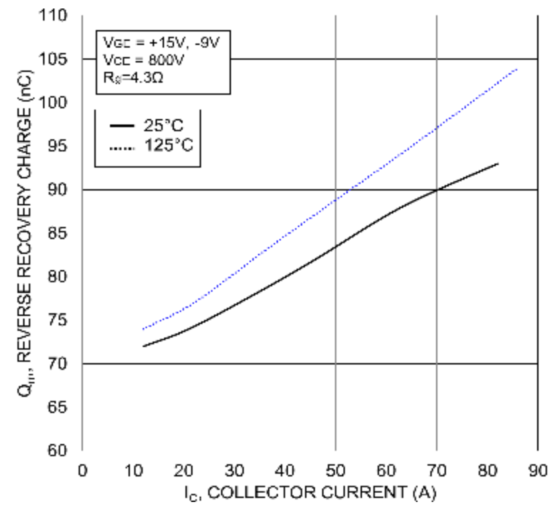


Figure 21. Typical Reverse Recovery Charge vs. I_C

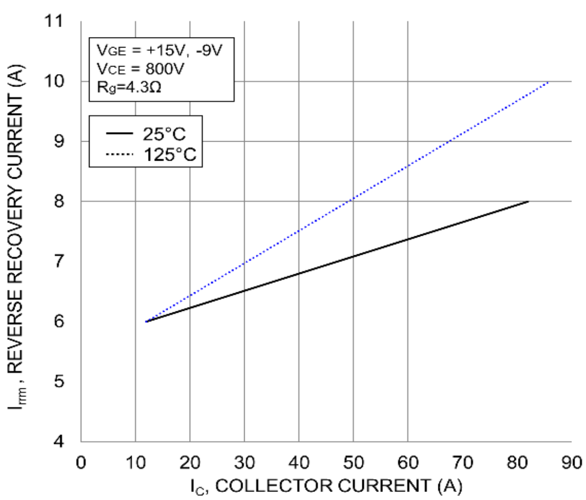


Figure 22. Typical Reverse Recovery Current vs. I_C

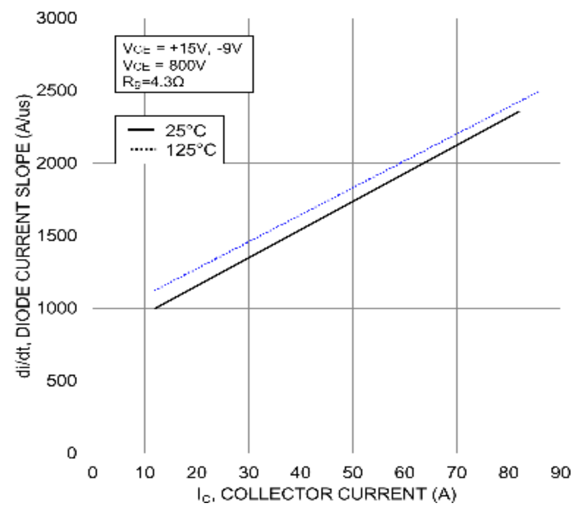


Figure 23. Typical di/dt Current Slope vs. I_C

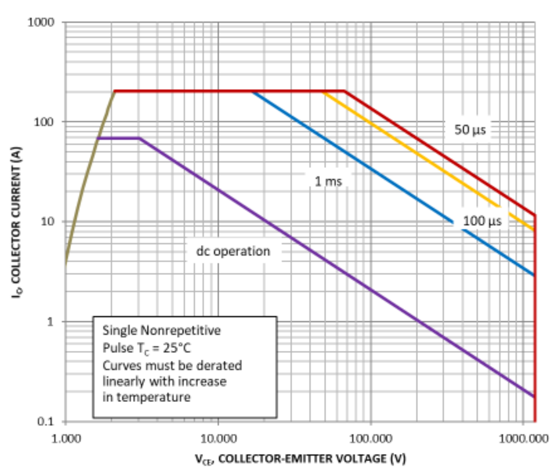


Figure 24. FBSOA

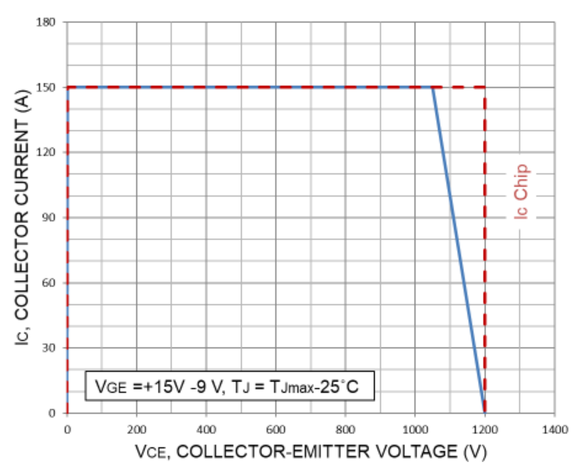


Figure 25. RBSOA

TYPICAL CHARACTERISTICS – IGBT (T1, T2, T3) and Silicon Carbide Schottky Diode (D12, D22, D32)

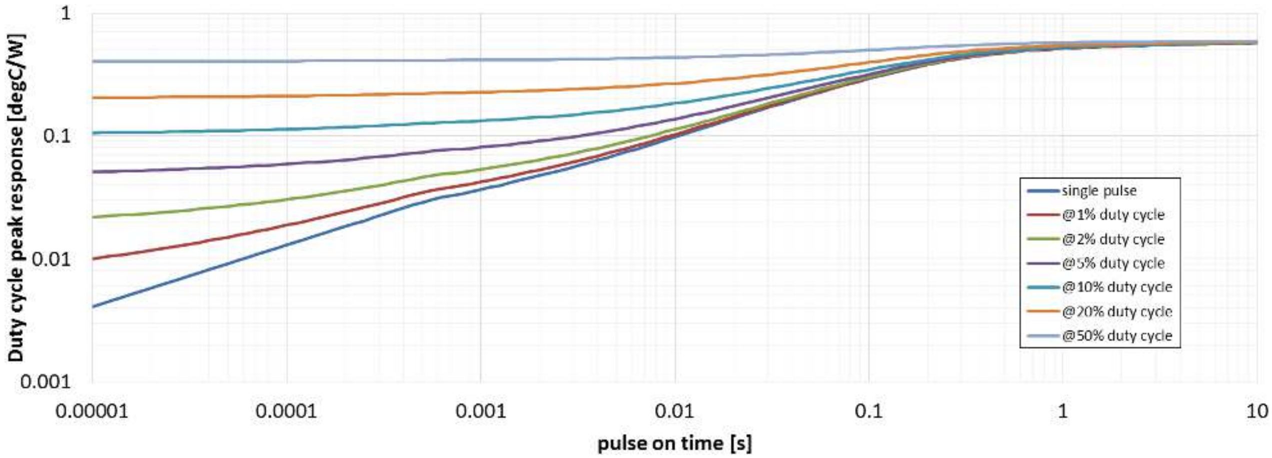


Figure 26. Transient Thermal Impedance (T1, T2, T3)

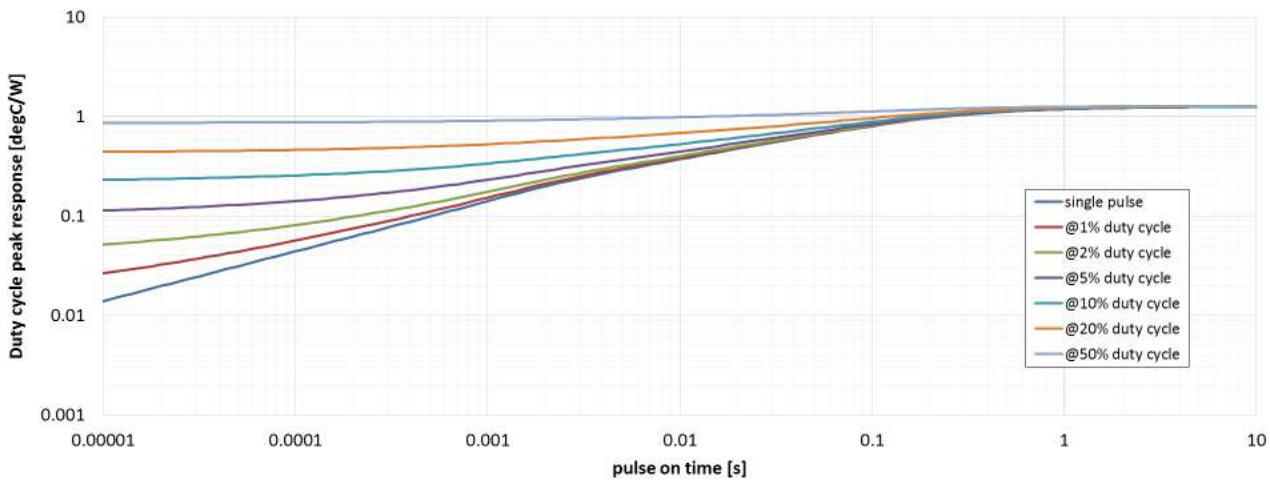


Figure 27. Transient Thermal Impedance (D12, D22, D32)

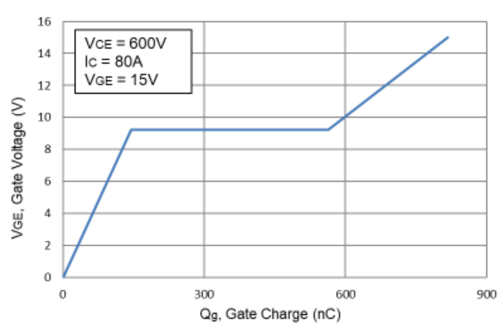


Figure 28. Gate Voltage vs. Gate Charge

TYPICAL CHARACTERISTICS − Diode (D13, D23, D33)

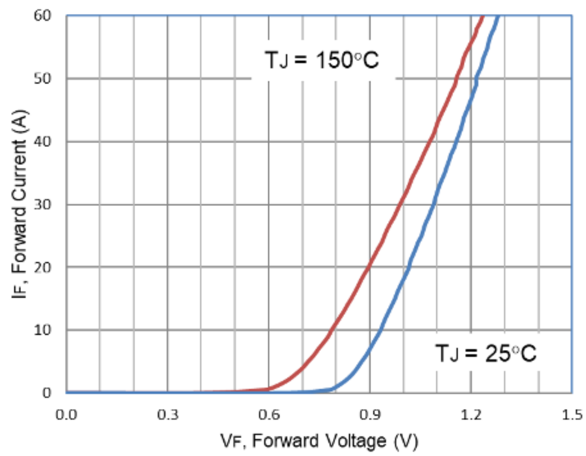


Figure 29. Diode Forward Characteristics

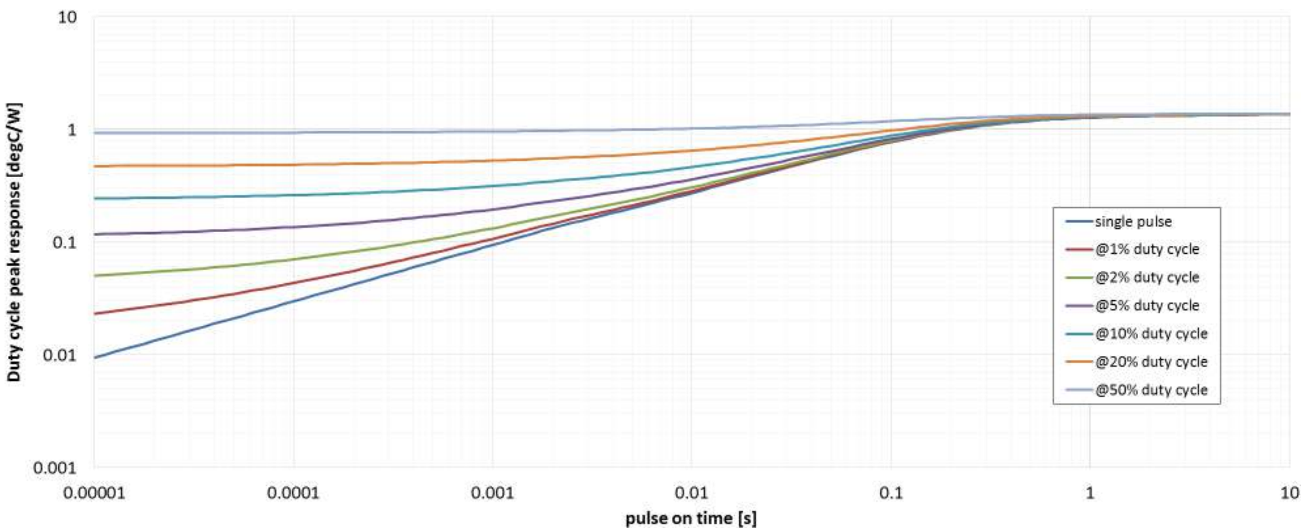


Figure 30. Transient Thermal Impedance

TYPICAL CHARACTERISTICS − Diode (D11, D21, D31)

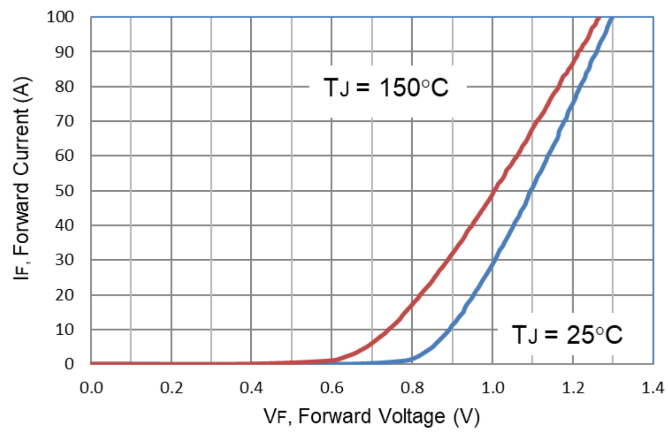


Figure 31. Diode Forward Characteristics

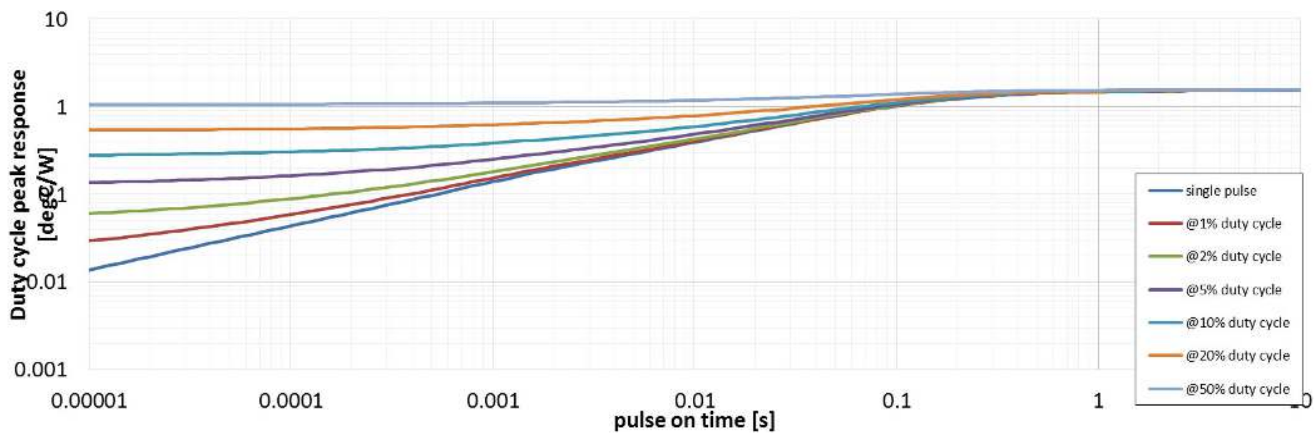


Figure 32. Transient Thermal Impedance

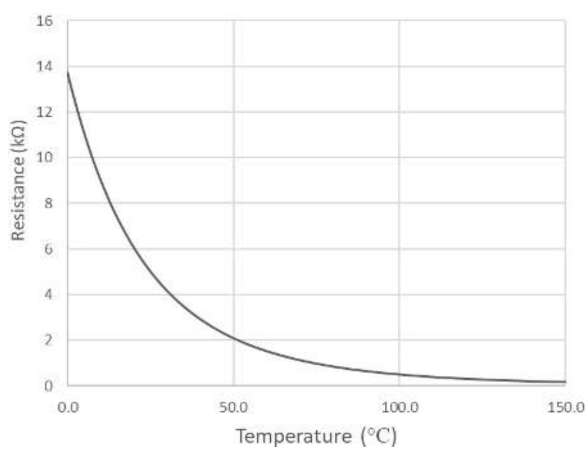


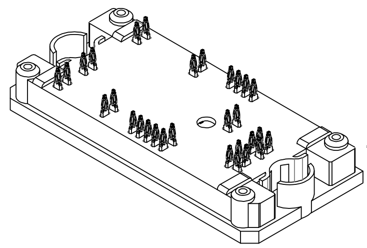
Figure 33. Thermistor Characteristic

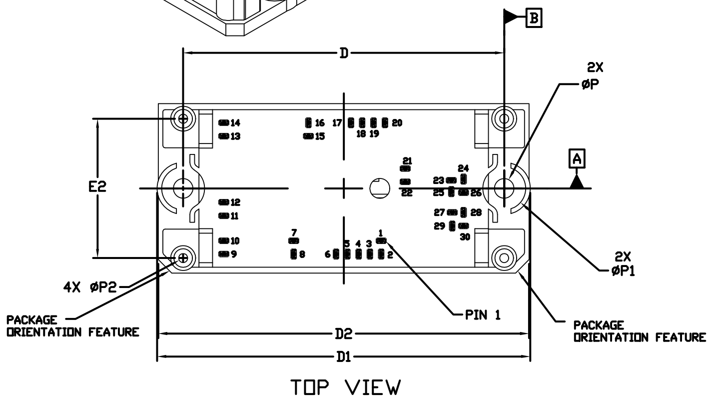
ORDERING INFORMATION

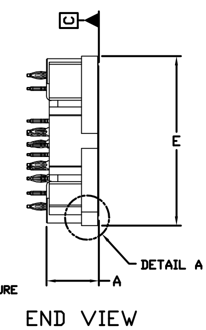
Orderable Part Number	Marking	Package	Shipping
NXH240B120H3Q1PG, NXH240B120H3Q1PG−R	NXH240B120H3Q1PG, NXH240B120H3Q1PG−R	Q1 BOOST, Case 180AX Press−fit Pins (Pb−Free)	21 Units / Blister Tray
NXH240B120H3Q1SG	NXH240B120H3Q1SG	Q1 BOOST, Case 180BQ Solder Pins (Pb−Free)	21 Units / Blister Tray

PIM30, 71x37.4
CASE 180AD
ISSUE E

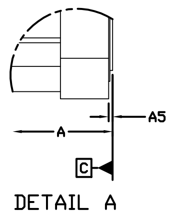
DATE 28 NOV 2017

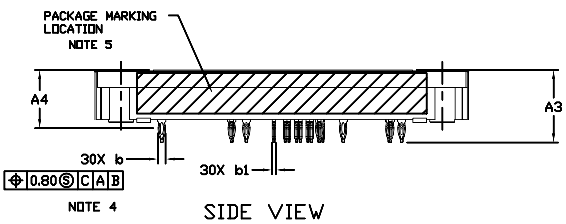






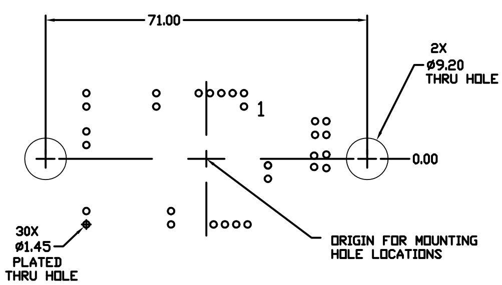
MOUNTING HOLE POSITION			MOUNTING HOLE POSITION		
PIN	X	Y	PIN	X	
1	8.30	11.55	16	−7.800	−14.50
2	8.30	14.50	17	1.60	−14.50
3	5.80	14.50	18	4.10	−14.50
4	3.30	14.50	19	6.60	−14.50
5	0.80	14.50	20	9.10	−14.50
6	−1.70	14.50	21	13.60	−4.40
7	−11.05	11.55	22	13.60	−1.45
8	−11.05	14.50	23	23.80	−1.80
9	−26.50	14.50	24	26.50	−2.05
10	−26.50	11.55	25	23.80	0Y70
11	−26.50	6.05	26	26.50	0.95
12	−26.50	3.05	27	24.00	5.30
13	−26.50	−11.55	28	26.50	5.30
14	−26.50	−14.50	29	24.00	8.30
15	−7.80	−11.55	30	26.50	8.30





NOTE 4

	PIN POSITION			PIN POSITION	
PIN	X	Y	PIN	X	Y
1	8.30	−11.55	16	−7.800	14.50
2	8.30	−14.50	17	1.60	14.50
3	5.80	−14.50	18	4.10	14.50
4	3.30	−14.50	19	6.60	14.50
5	0.80	−14.50	20	9.10	14.50
6	−1.70	−14.50	21	13.60	4.40
7	−11.05	−11.55	22	13.60	1.45
8	−11.05	−14.50	23	23.80	1.80
9	−26.50	−14.50	24	26.50	2.05
10	−26.50	−11.55	25	23.80	−0.70
11	−26.50	−6.05	26	26.50	−0.95
12	−26.50	−3.05	27	24.00	−5.30
13	−26.50	11.55	28	26.50	−5.30
14	−26.50	14.50	29	24.00	−8.30
15	−7.80	11.55	30	26.50	−8.30



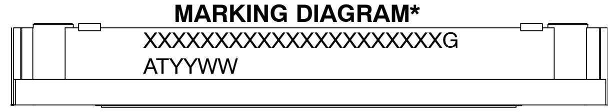
RECOMMENDED
MOUNTING PATTERN
(VIEW FROM MOUNTING SIDE)

	MILLIMETERS	
DIM	MIN.	NOM.
A	11.10	12.10
A3	15.50	16.50
A4	12.88 BSC	
A5	0.00	0.45
b	1.61	1.71
b1	0.75	0.85
D	70.50	71.50
D1	82.00	83.00
D2	81.50	82.50
E	36.90	37.90
E2	30.30	31.30
P	4.30	4.50
P1	9.30	9.70
P2	1.90	2.10

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 A4.
4. POSITION OF THE CENTER OF THE TERMINALS IS DETERMINED FROM DATUM B THE CENTER OF DIMENSION D, X DIRECTION, AND FROM DATUM A, Y DIRECTION. POSITIONAL TOLERANCE, AS NOTED IN DRAWING, APPLIES TO EACH TERMINAL IN BOTH DIRECTIONS.
5. PACKAGE MARKING IS LOCATED AS SHOWN ON THE SIDE OPPOSITE THE PACKAGE ORIENTATION FEATURES.

GENERIC
MARKING DIAGRAM*



XXXXX = Specific Device Code
G = Pb−Free Package
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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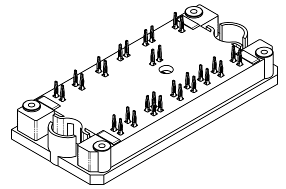
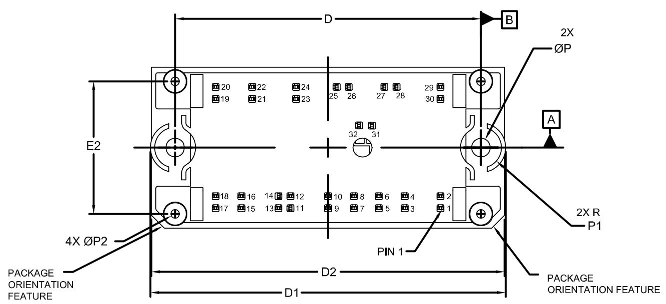


PIM32, 71x37.4 (PRESS−FIT)
CASE 180AX
ISSUE O

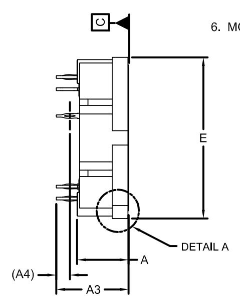
DATE 25 JAN 2019

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 A4.
4. POSITION OF THE CENTER OF THE TERMINALS AND MOUNTING HOLES IS DETERMINED FROM DATUM B THE CENTER OF DIMENSION D, X DIRECTION, AND FROM DATUM A, Y DIRECTION. POSITIONAL TOLERANCE, AS NOTED IN DRAWING, APPLIES TO BOTH TERMINALS AND MOUNTING HOLES IN BOTH DIRECTIONS.
5. PACKAGE MARKING IS LOCATED, AS SHOWN, ON THE SIDE OPPOSITE THE PACKAGE ORIENTATION FEATRUES.
6. MOUNTING RECOMMENDATION IS SHOWN AS VIEWED FROM THE PCB TOP LAYER LOOKING DOWN TO SUBSEQUENT LAYERS.



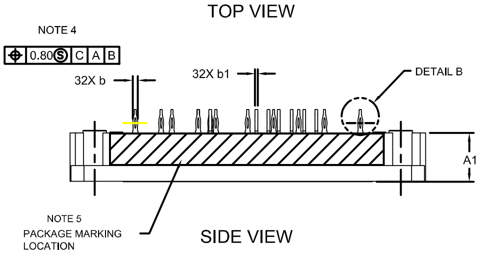
TOP VIEW



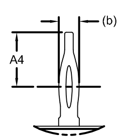
END VIEW

DIM	MILLIMETERS MIN.	NOM.	MAX.
A	11.44	11.94	12.44
A1	10.84	11.34	11.84
A3	16.27	16.77	17.27
A4	3.05	3.15	3.25
A5	0.04	0.24	0.44
b	1.13	1.18	1.23
b1	0.59	0.64	0.69
D	70.50	71.00	71.50
D1	82.00	82.50	83.00
D2	81.50	82.00	82.50
E	36.90	37.40	37.90
E2	30.30	30.80	31.30
P	4.30	4.40	4.50
P1	4.55	4.75	4.95
P2	2.00 REF		

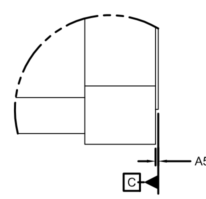
NOTE 4



SIDE VIEW

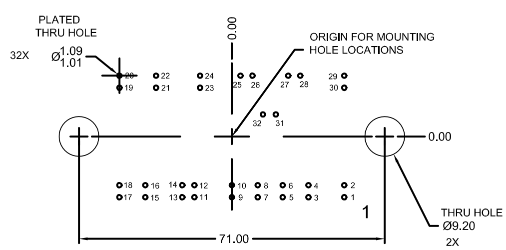


DETAIL B



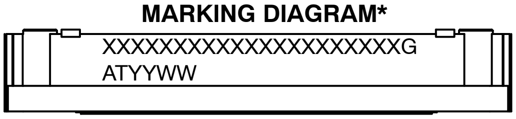
DETAIL A

PIN	PIN POSITION X	Y	PIN	PIN POSITION X	Y
1	26.10	-14.10	17	-26.10	-14.10
2	26.10	-11.30	18	-26.10	-11.30
3	17.80	-14.10	19	-26.10	11.30
4	17.80	-11.30	20	-26.10	14.10
5	11.80	-14.10	21	-17.60	11.30
6	11.80	-11.30	22	-17.60	14.10
7	6.00	-14.10	23	-7.40	11.30
8	6.00	-11.30	24	-7.40	14.10
9	0.00	-14.10	25	2.00	14.10
10	0.00	-11.30	26	4.80	14.10
11	-8.70	-14.10	27	13.10	14.10
12	-8.70	-11.30	28	15.90	14.10
13	-11.50	-14.10	29	26.10	14.10
14	-11.50	-11.30	30	26.10	11.30
15	-20.10	-14.10	31	10.20	5.10
16	-20.10	-11.30	32	7.20	5.10



RECOMMENDED MOUNTING PATTERN

GENERIC MARKING DIAGRAM*



XXXXX = Specific Device Code
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