Si/SiC Hybrid Module – EliteSiC, 3 Channel Symmetric Boost 1000 V, 150 A IGBT, 1200 V, 30 A SiC Diode, Q2 Package

NXH450B100H4Q2F2, NXH450B100H4Q2F2PG-R

Description

The NXH450B100H4Q2 is a Si/SiC Hybrid three channel symmetric boost module. Each channel contains two 1000 V, 150 A IGBTs, two 1200 V, 30 A SiC diodes and two 1600 V, 30 A bypass diodes. The module contains an NTC thermistor.

Features

- Silicon/SiC Hybrid Technology Maximizes Power Density
- Low Switching Loss Reduces System Power Dissipation
- Low Inductive Layout
- Press−fit and Solder Pin Options
- This Device is Pb−Free, Halogen Free and is RoHS Compliant

Typical Applications

- Solar Inverter
- Uninterruptible Power Supplies

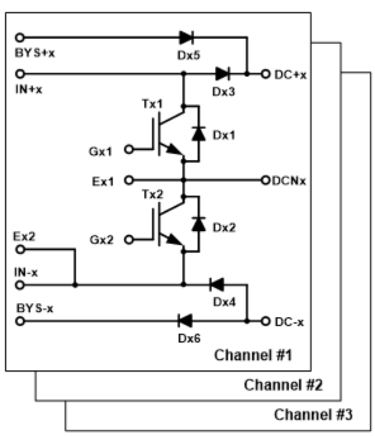
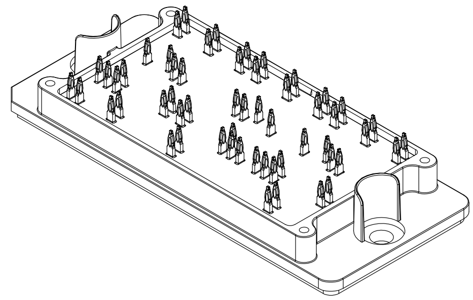
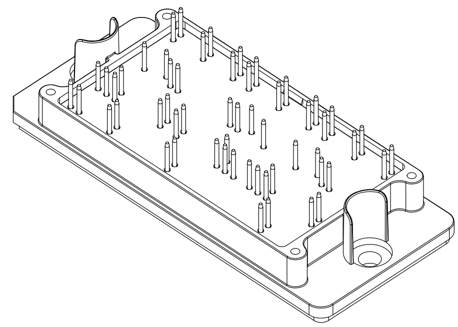


Figure 1. NXH450B100H4Q2F2PG/PG−R/SG Schematic Diagram

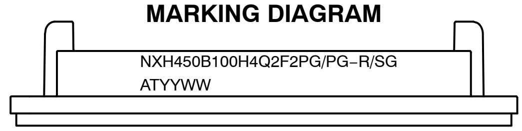


Q2BOOST 3−CHANNEL PRESS FIT PINS CASE 180BG



Q2BOOST 3−CHANNEL SOLDER PINS CASE 180BR

MARKING DIAGRAM



G	= Pb− Free Package
AT	= Assembly & Test Site Code
YYWW	= Year and Work Week Code
NXH450B100H4Q2F2PG/PG−R/SG	= Specific Device Code

PIN CONNECTIONS

See details pin connections on page 2 of this data sheet.

ORDERING INFORMATION

See detailed ordering and shipping information on page 5 of this data sheet.

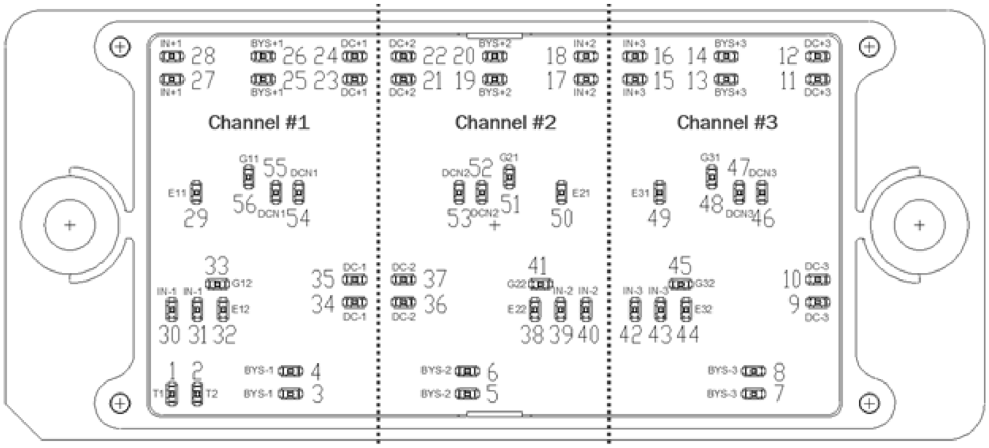


Figure 2. Pins Assignments

ABSOLUTE MAXIMUM RATINGS (Note 1) (T_j = 25°C unless otherwise noted)

Rating	Symbol	Value	Unit
IGBT (Tx1, Tx2)			
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 (@ V_{GE} = 20 V, T_c = 80°C)	I_C	101	A
Pulsed Peak Collector Current @ Tc = 80°C (T_J = 150°C)	$I_{C(Pulse)}$	303	A
Power Dissipation (T_C = 80°C, T_J = 150°C)	P_{tot}	234	W
Minimum Operating Junction Temperature	T_{JMIN}	−40	°C
Maximum Operating Junction Temperature (Note 2)	T_{JMAX}	150	°C
IGBT INVERSE DIODE (Dx1, Dx2) AND BYPASS DIODE (Dx5, Dx6)			
Peak Repetitive Reverse Voltage	V_{RRM}	1600	V
Continuous Forward Current @ T_C = 80°C	I_F	36	A
Repetitive Peak Forward Current (T_J = 150°C, T_J limited by T_{Jmax})	I_{FRM}	108	A
Maximum Power Dissipation @ T_C = 80°C (T_J = 150°C)	P_{tot}	79	W
Minimum Operating Junction Temperature	T_{JMIN}	−40	°C
Maximum Operating Junction Temperature	T_{JMAX}	150	°C
SILICON CARBIDE SCHOTTKY DIODE (Dx3, Dx4)			
Peak Repetitive Reverse Voltage	V_{RRM}	1200	V
Continuous Forward Current @ T_C = 80°C	I_F	36	A
Repetitive Peak Forward Current (T_J = 150°C, T_J limited by T_{Jmax})	I_{FRM}	108	A
Maximum Power Dissipation @ T_C = 80°C (T_J = 150 °C)	P_{tot}	104	W
Minimum Operating Junction Temperature	T_{JMIN}	−40	°C
Maximum Operating Junction Temperature	T_{JMAX}	175	°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.

1. Refer to ELECTRICAL CHARACTERISTICS, RECOMMENDED OPERATING RANGES and/or APPLICATION INFORMATION for Safe Operating parameters.
2. Qualification at 175°C per discrete TO247.

THERMAL AND INSULATION PROPERTIES (Note 3) (T_j = 25°C unless otherwise noted)

Rating	Symbol	Value	Unit
THERMAL PROPERTIES			
Operating Temperature under Switching Condition	T_{VJOP}	−40 to (Tjmax – 25)	°C
Storage Temperature Range	T_{stg}	−40 to 125	°C
THERMAL PROPERTIES			
Isolation Test Voltage, t = 2 sec, 50 Hz (Note 4)	V_{is}	4000	V_{RMS}
Creepage Distance		12.7	Mm
Comparative Tracking Index	CTI	>600	

3. Refer to ELECTRICAL CHARACTERISTICS, RECOMMENDED OPERATING RANGES and/or APPLICATION INFORMATION for Safe Operating parameters.
4. 4000 VAC_{RMS} for 1 second duration is equivalent to 3333 VAC_{RMS} for 1 minute duration.

ELECTRICAL CHARACTERISTICS (Note 5) (T_J = 25°C unless otherwise noted)

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
IGBT (Tx1, Tx2)						
Collector−Emitter Breakdown Voltage	V_{GE} = 0 V, I_C =2 mA	$V_{(BR)CES}$	1000	–	–	V
Collector−Emitter Saturation Voltage	V_{GE} = 15 V, I_C = 150 A, T_C = 25°C	V_{CESAT}	–	1.70	2.25	V
	V_{GE} = 15 V, I_C = 150 A, T_C = 150°C		–	2.03	–	
Gate−Emitter Threshold Voltage	V_{GE} = V_{CE}, I_C = 150 mA	$V_{GE(TH)}$	4.1	4.66	5.7	V
Collector−Emitter Cutoff Current	V_{GE} = 0 V, V_{CE} = 1000 V	I_{CES}	–	–	600	μA
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} = 600 V, I_C = 50 A V_{GE} = −8 V, +15 V, R_G = 4 Ω	$t_{d(on)}$	–	28	–	ns
Rise Time		t_r	–	10	–	
Turn−Off Delay Time		$t_{d(off)}$	–	157	–	
Fall time		t_f	–	22	–	
Turn on Switching Loss		E_{on}	–	403	–	μJ
Turn off Switching Loss		E_{off}	–	1651	–	
Turn−On Delay Time	T_j = 125°C V_{CE} = 600 V, I_C = 50 A V_{GE} = −8 V, +15 V, R_G = 4 Ω	$t_{d(on)}$	–	27	–	ns
Rise Time		t_r	–	12	–	
Turn−Off Delay Time		$t_{d(off)}$	–	192	–	
Fall time		t_f	–	32	–	
Turn on Switching Loss		E_{on}	–	594	–	μJ
Turn off Switching Loss		E_{off}	–	2138	–	
Input Capacitance	V_{CE} = 20 V, V_{GE} = 0 V, f = 1 MHz	C_{ies}	–	9342	–	pF
Output Capacitance		C_{oes}	–	328	–	
Reverse Transfer Capacitance		C_{res}	–	52	–	
Gate Charge	V_{CE} = 600 V, V_{GE} = 15 V, I_C = 75 A	Q_g	–	252	–	nC
Thermal Resistance − Chip−to−Heatsink	Thermal grease, Thickness = 2.1 Mil ± 2% λ = 2.9 W/mK	R_{thJH}	–	0.45	–	K/W
Thermal Resistance − Chip−to−Case		R_{thJC}	–	0.30	–	K/W
IGBT INVERSE DIODE (Dx1, Dx2) AND BYPASS DIODE (Dx5, Dx6)						
Diode Forward Voltage	I_F = 30 A, T_J = 25°C	V_F	–	1.04	1.7	V
	I_F = 30 A, T_J = 150°C		–	0.94	–	
Thermal Resistance − Chip−to−Heatsink	Thermal grease, Thickness = 2.1 Mil ± 2% λ = 2.9 W/mK	R_{thJH}	–	1.09	–	K/W
Thermal Resistance − Chip−to−Case		R_{thJC}	–	0.89	–	K/W

ELECTRICAL CHARACTERISTICS (Note 5) (T_J = 25°C unless otherwise noted) (continued)

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
SIC DIODE (Dx3, Dx4)						
Diode Reverse Leakage Current	V_R = 1200 V, T_J = 25°C	I_R	–	–	600	μA
Diode Forward Voltage	I_F = 30 A, T_J = 25°C	V_F	–	1.42	1.7	V
	I_F = 30 A, T_J = 150°C		–	1.85	–	
Reverse Recovery Time	T_J = 25°C V_{DS} = 600 V, I_C = 50 A V_{GE} = −8 V, 15 V, R_G = 4 Ω	t_{rr}	–	20	–	ns
Reverse Recovery Charge		Q_{rr}	–	88	–	nC
Peak Reverse Recovery Current		I_{RRM}	–	10	–	A
Peak Rate of Fall of Recovery Current		di/dt	–	4200	–	A/μs
Reverse Recovery Energy		E_{rr}	–	38	–	μJ
Reverse Recovery Time	T_J = 125°C V_{DS} = 600 V, I_C = 50 A V_{GE} = −8 V, 15 V, R_G = 4 Ω	t_{rr}	–	19	–	ns
Reverse Recovery Charge		Q_{rr}	–	87	–	nC
Peak Reverse Recovery Current		I_{RRM}	–	9	–	A
Peak Rate of Fall of Recovery Current		di/dt	–	3154	–	A/μs
Reverse Recovery Energy		E_{rr}	–	35	–	μJ
Thermal Resistance − Chip−to−Heatsink	Thermal grease, Thickness = 2.1 Mil ± 2% λ = 2.9 W/mK	R_{thJH}	–	0.97	–	K/W
Thermal Resistance − Chip−to−Case		Rt_{hJC}	–	0.67	–	K/W
THERMISTOR CHARACTERISTICS						
Nominal Resistance		R_{25}	–	22	–	kΩ
Nominal Resistance	T = 100°C	R_{100}	–	1486	–	Ω
Deviation of R25		ΔR/R	−5	–	5	%
Power Dissipation		P_D	–	200	–	mW
Power Dissipation Constant			–	2	–	mW/K
B−Value	B (25/50), tolerance ±3%		–	3950	–	K
B−Value	B (25/100), tolerance ±3%		–	3998	–	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.

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

PACKAGE MARKING AND ORDERING INFORMATION

Orderable Part Number	Marking	Package	Shipping
NXH450B100H4Q2F2PG, NXH450B100H4Q2F2PG−R PRESS FIT PINS	NXH450B100H4Q2F2PG, NXH450B100H4Q2F2PG−R	Q2BOOST − Case 180BG (Pb−Free and Halide−Free Press Fit Pins)	12 Units / Blister Tray
NXH450B100H4Q2F2SG SOLDER PINS	NXH450B100H4Q2F2SG	Q2BOOST − Case 180BR (Pb−Free and Halide−Free Solder Pins)	12 Units / Blister Tray

TYPICAL CHARACTERISTICS – IGBT, INVERSE DIODE AND BOOST DIODE

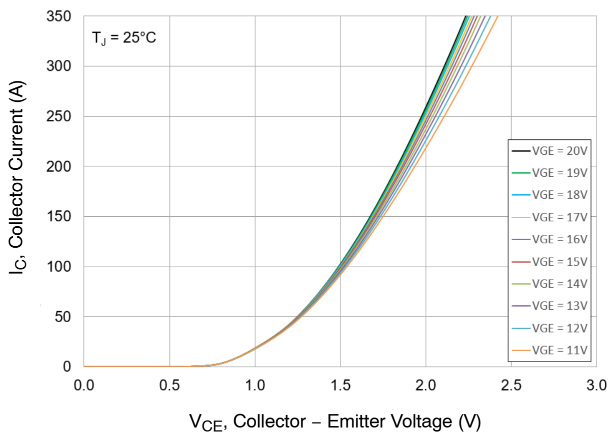


Figure 3. Typical Output Characteristics

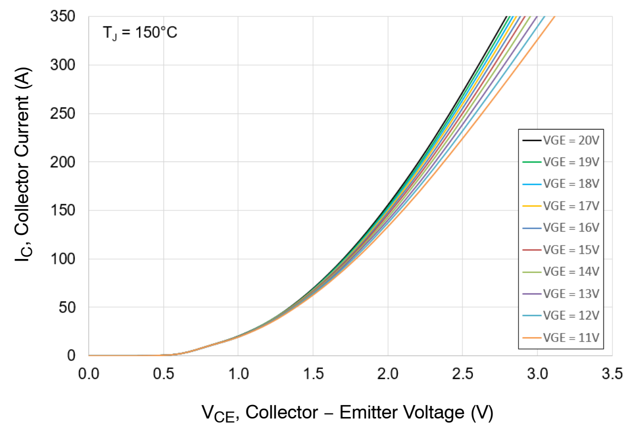


Figure 4. Typical Output Characteristics

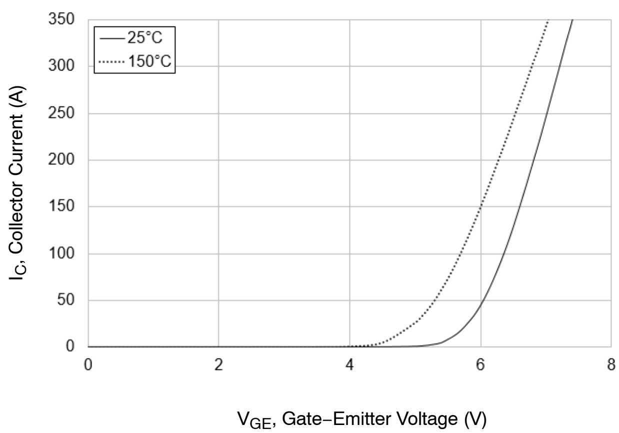


Figure 5. Transfer Characteristics

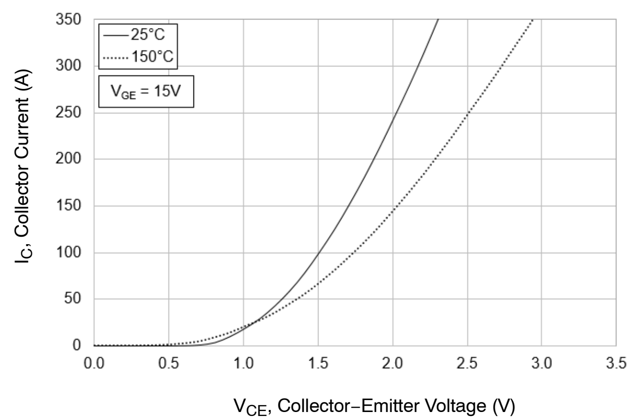


Figure 6. Typical Saturation Voltage Characteristics

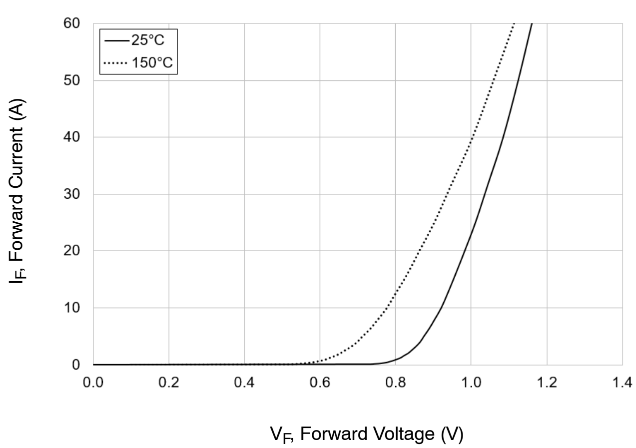


Figure 7. Inverse Diode Forward Characteristics

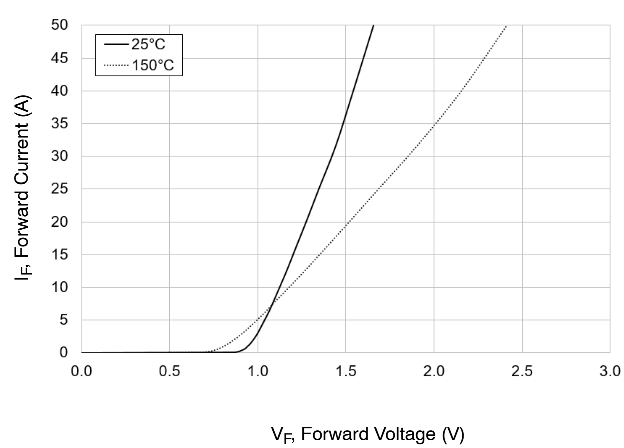


Figure 8. Boost Diode Forward Characteristics

TYPICAL CHARACTERISTICS − IGBT, INVERSE DIODE AND BOOST DIODE (CONTINUED)

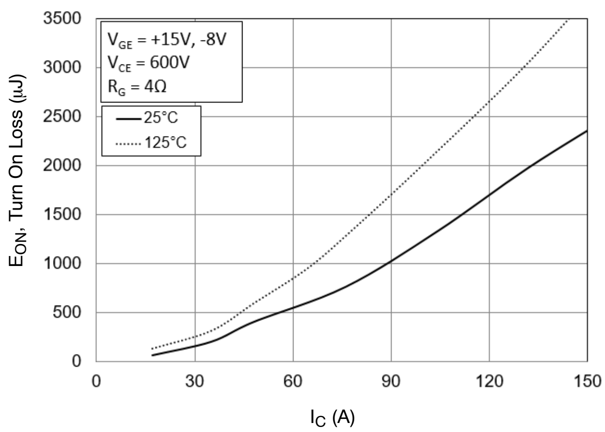


Figure 9. Typical Turn On Loss vs. I_C

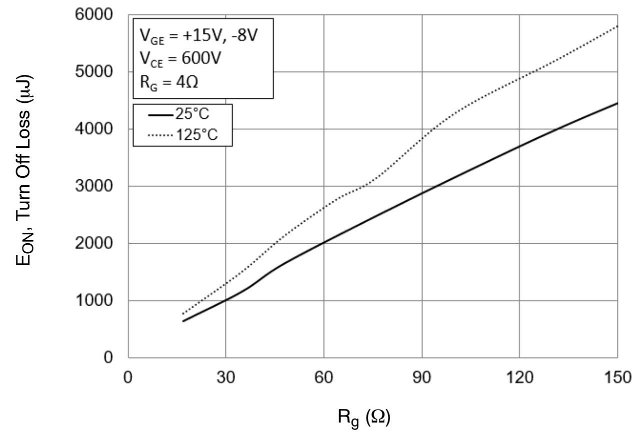


Figure 10. Typical Turn Off Loss vs. I_C

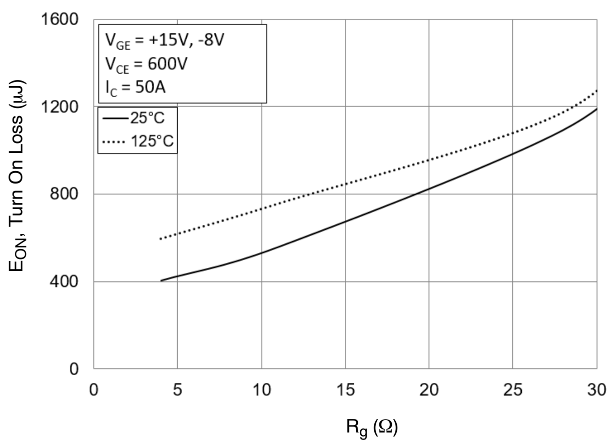


Figure 11. Typical Turn On Loss vs. R_G

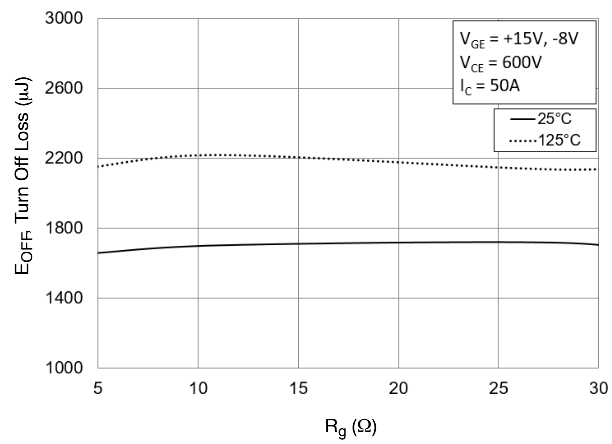


Figure 12. Typical Turn Off Loss vs. R_G

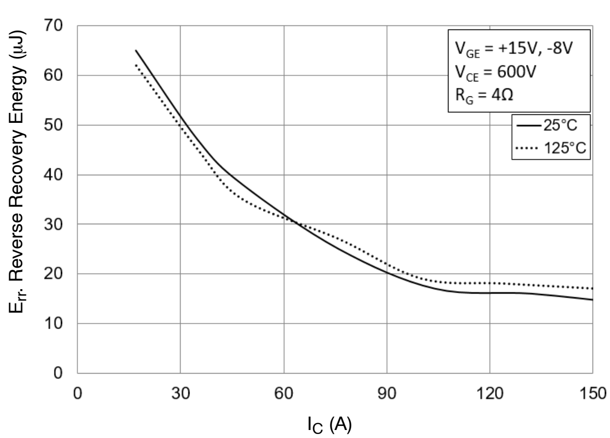


Figure 13. Typical Reverse Recovery Energy Loss vs. I_C

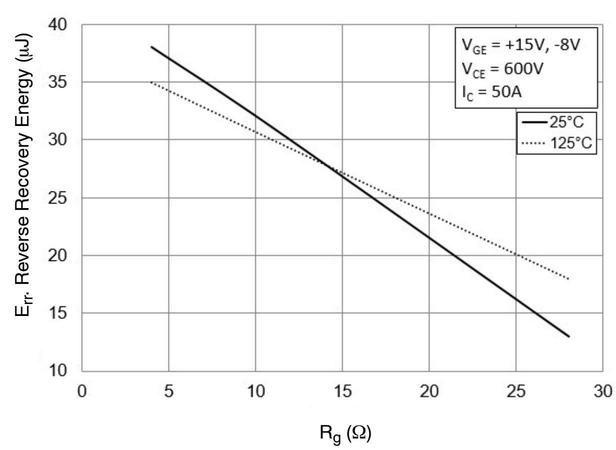


Figure 14. Typical Reverse Recovery Energy Loss vs. R_G

TYPICAL CHARACTERISTICS − IGBT, INVERSE DIODE AND BOOST DIODE (CONTINUED)

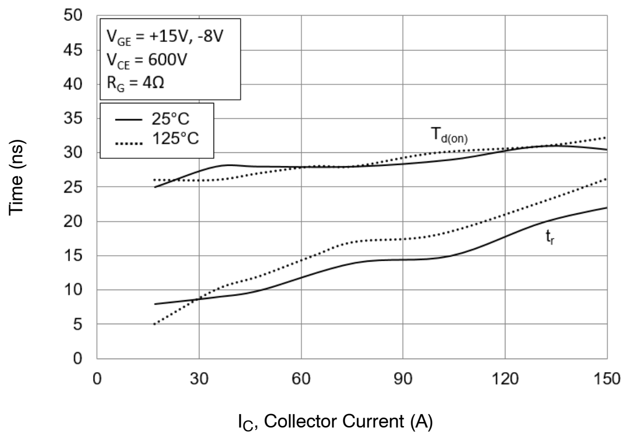


Figure 15. Typical Turn−On Switching Time vs. I_C

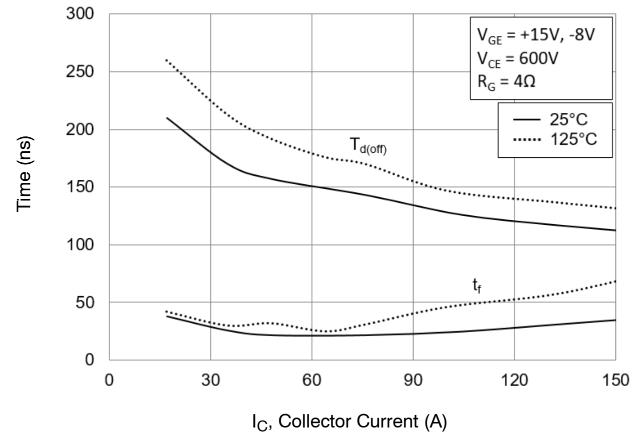


Figure 16. Typical Turn−Off Switching Time vs. I_C

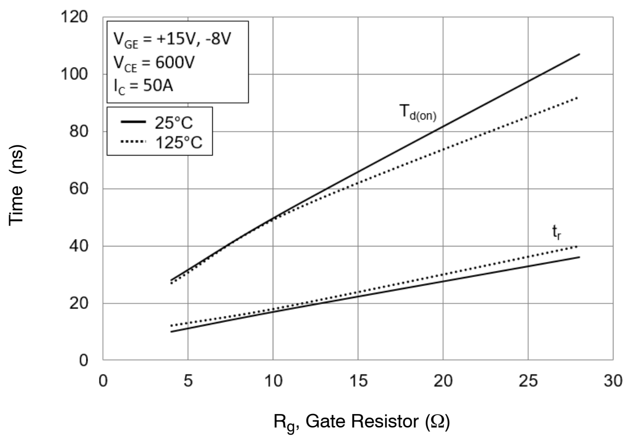


Figure 17. Typical Turn−On Switching Time vs. R_G

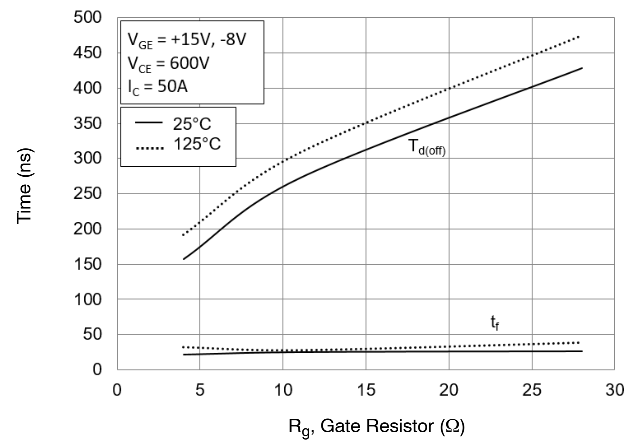


Figure 18. Typical Turn−Off Switching Time vs. R_G

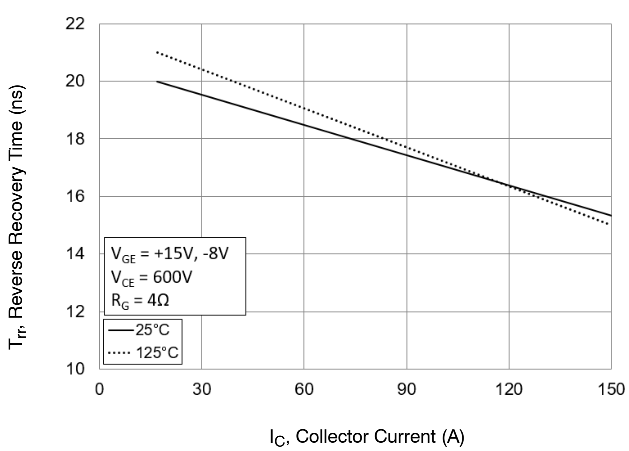


Figure 19. Typical Reverse Recovery Energy Loss vs. I_C

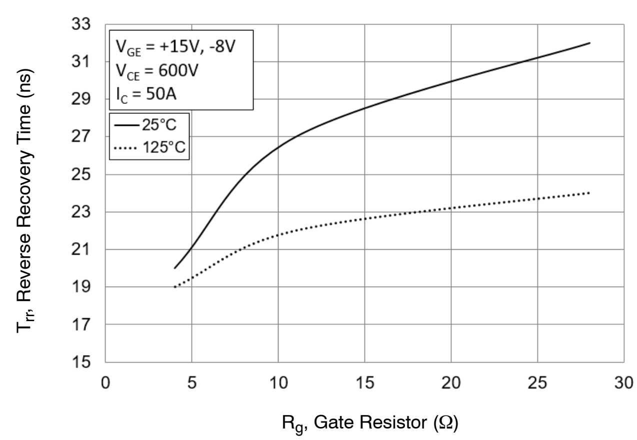


Figure 20. Typical Reverse Recovery Energy Loss vs. R_G

TYPICAL CHARACTERISTICS − IGBT, INVERSE DIODE AND BOOST DIODE (CONTINUED)

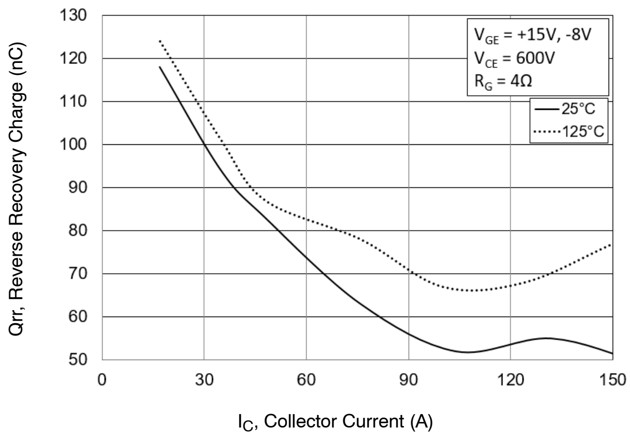


Figure 21. Typical Reverse Recovery Charge vs. I_C

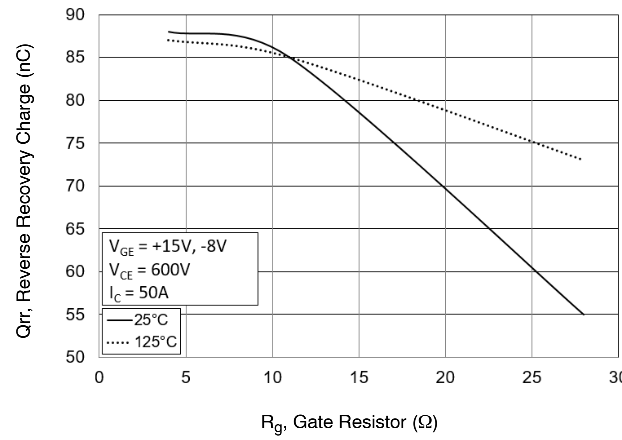


Figure 22. Typical Reverse Recovery Charge vs. R_G

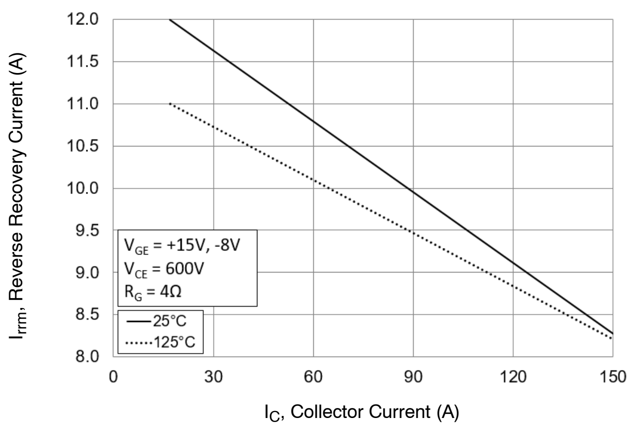


Figure 23. Typical Reverse Recovery Peak Current vs. I_C

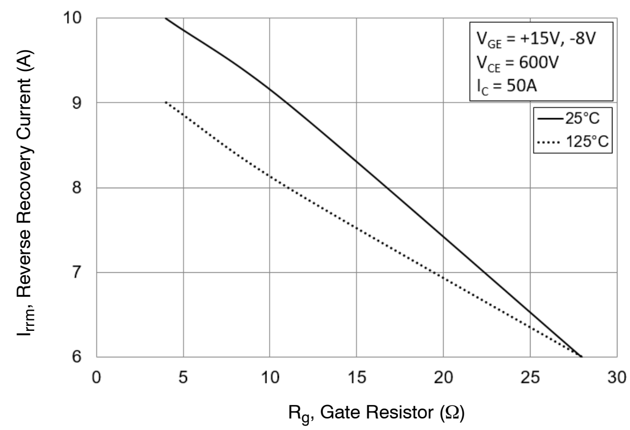


Figure 24. Typical Reverse Recovery Peak Current vs. R_G

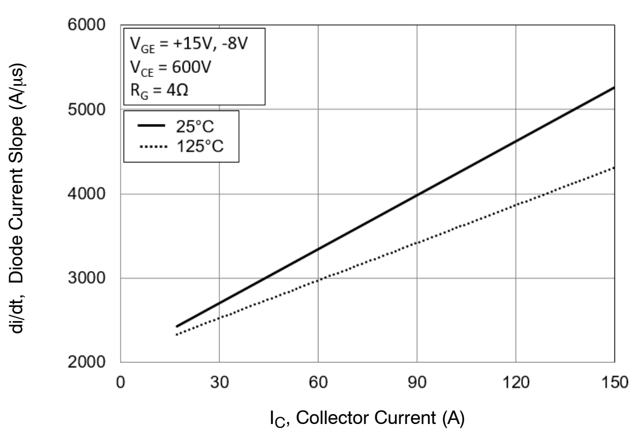


Figure 25. Typical di/dt Current Slope vs. I_C

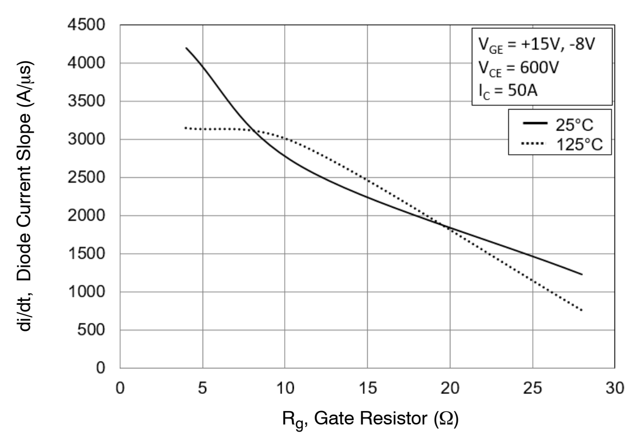


Figure 26. Typical di/dt Current Slope vs. R_G

TYPICAL CHARACTERISTICS − IGBT, INVERSE DIODE AND BOOST DIODE (CONTINUED)

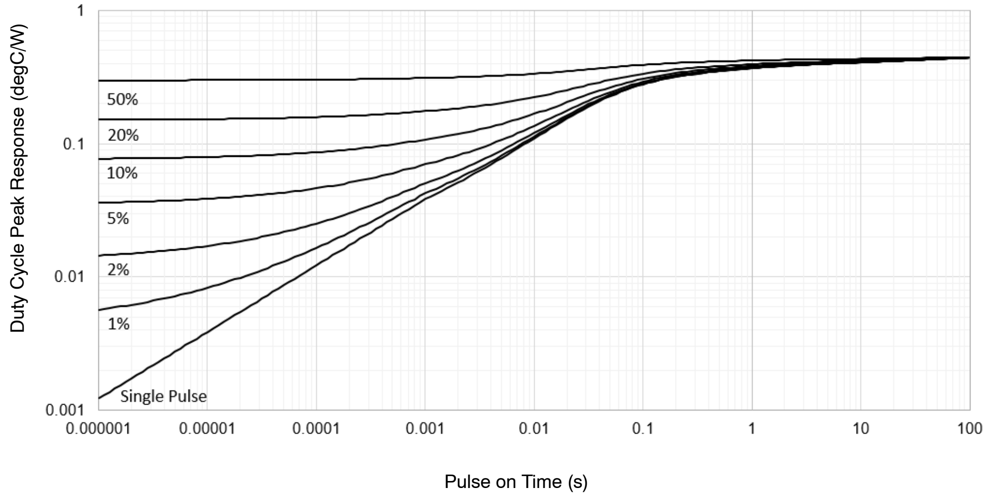


Figure 27. Transient Thermal Impedance − IGBT

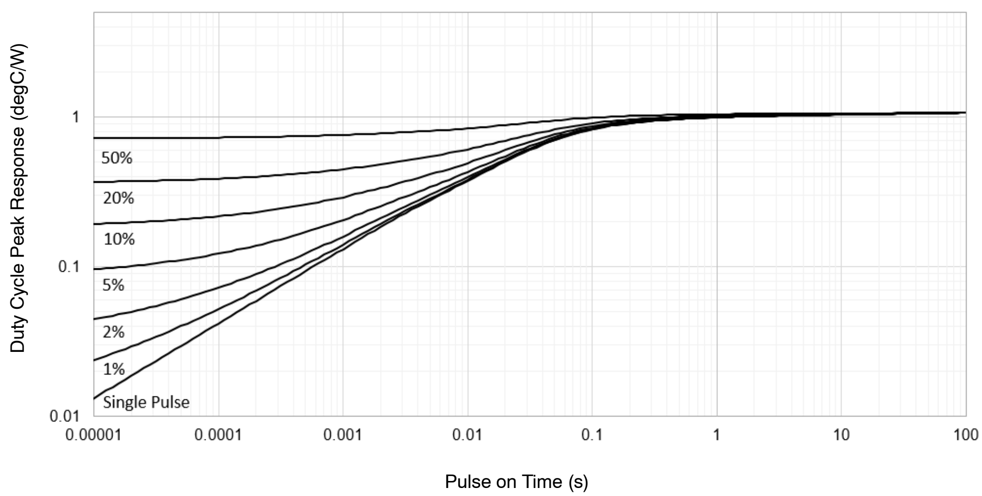


Figure 28. Transient Thermal Impedance − Inverse Diode

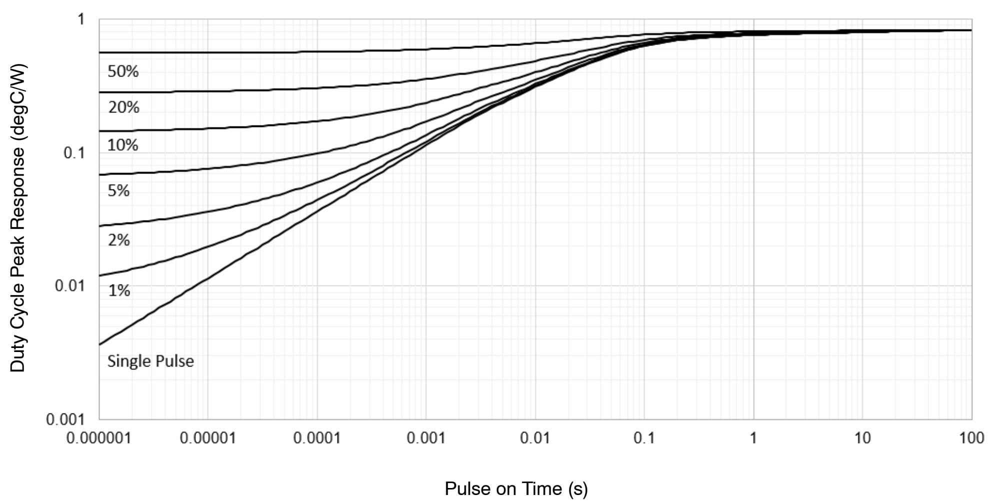


Figure 29. Transient Thermal Impedance − Boost Diode

TYPICAL CHARACTERISTICS − IGBT, INVERSE DIODE AND BOOST DIODE (CONTINUED)

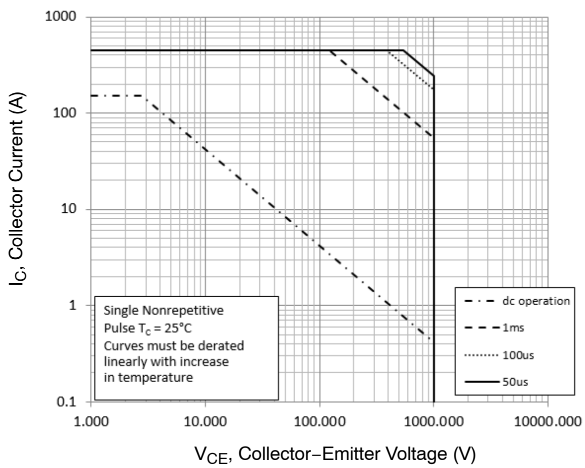


Figure 30. Forward Safe Operating Area

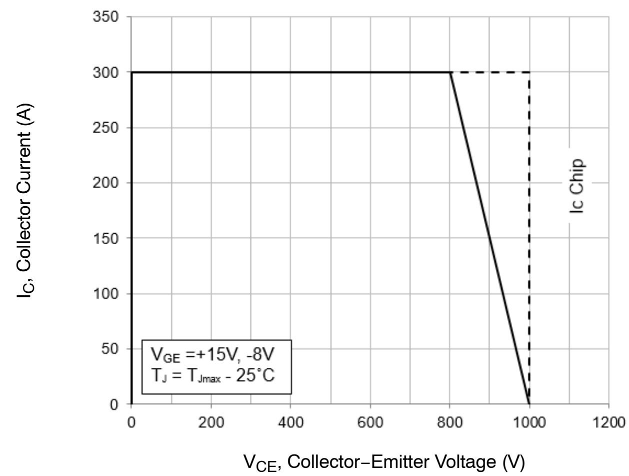


Figure 31. Reverse Safe Operating Area

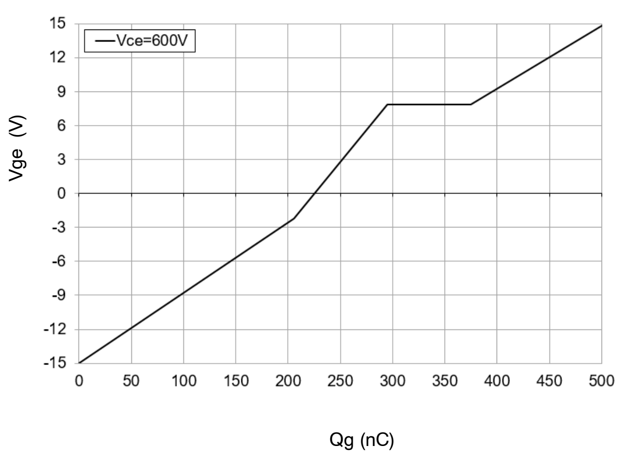


Figure 32. Gate Voltage vs. Gate Charge

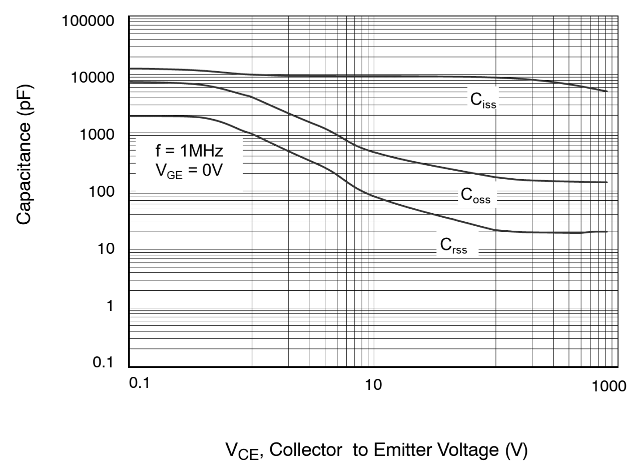


Figure 33. Capacitance Charge

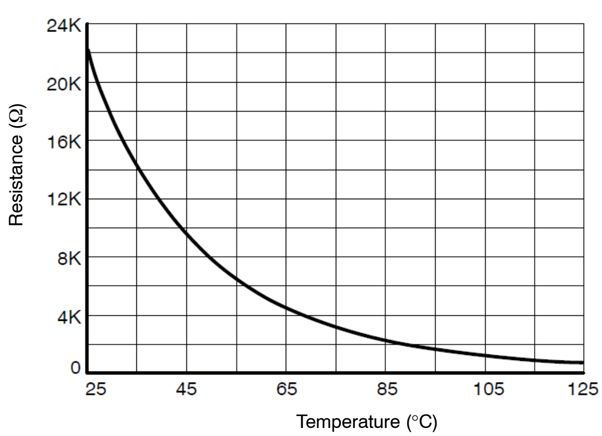
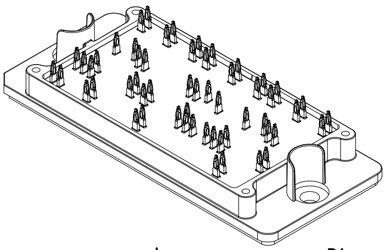
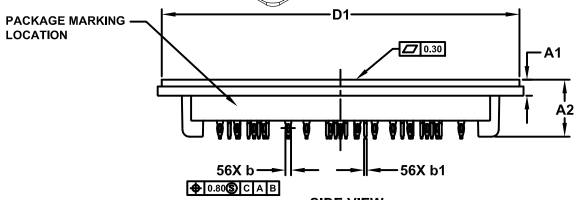


Figure 34. NTC Characteristics

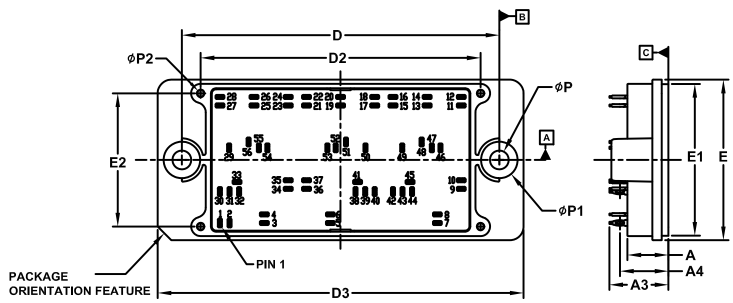
PIM56, 93x47 (PRESSFIT)
CASE 180BG
ISSUE O

DATE 31 JUL 2019



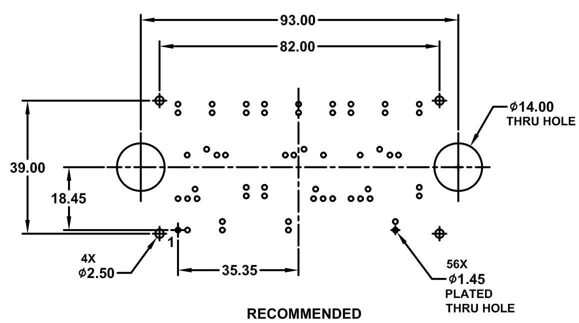


SIDE VIEW



TOP VIEW

END VIEW



RECOMMENDED MOUNTING PATTERN

NOTES:

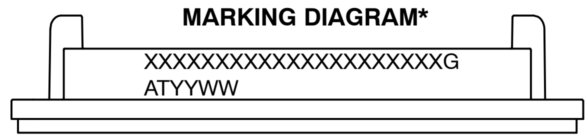
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
2. CONTROLLING DIMENSION: MILLIMETERS
3. DIMENSIONS b AND b1 APPLY TO THE PLATED TERMINALS AND ARE MEASURED AT DIMENSION A4.
4. POSITION OF THE CENTER OF THE TERMINALS IS DETERMINED FROM DATUM B THE CENTER OF DIMENSION D, X DIRECTION, AND FROM DATUM 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.

	MILLIMETERS		
DIM	MIN.	NOM.	MAX.
A	11.70	12.00	12.30
A1	4.40	4.70	5.00
A2	16.40	16.70	17.00
A3	16.90	17.30	17.70
A4	13.97	14.18	14.39
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	39.10
P	5.40	5.50	5.60
P1	10.60	10.70	10.80
P2	1.80	2.00	2.20

NOTE 4

	PIN POSITION			PIN POSITION	
PIN	X	Y	PIN	X	Y
1	0.00	0.00	29	2.70	22.00
2	2.80	0.00	30	0.00	9.20
3	13.00	0.00	31	2.80	9.20
4	13.00	2.50	32	5.60	9.20
5	32.35	0.00	33	5.00	12.00
6	32.35	2.50	34	20.00	10.00
7	63.70	0.00	35	20.00	12.50
8	63.70	2.50	36	25.35	10.00
9	70.70	10.00	37	25.35	12.50
10	70.70	12.50	38	39.75	9.20
11	70.70	34.40	39	42.55	9.20
12	70.70	36.90	40	45.35	9.20
13	60.70	34.40	41	40.35	12.00
14	60.70	36.90	42	50.70	9.20
15	50.70	34.40	43	53.50	9.20
16	50.70	36.90	44	56.30	9.20
17	45.35	34.40	45	55.70	12.00
18	45.35	36.90	46	64.60	22.00
19	35.35	34.40	47	62.10	22.00
20	35.35	36.90	48	59.10	23.70
21	25.35	34.40	49	53.40	22.00
22	25.35	36.90	50	42.65	22.00
23	20.00	34.40	51	36.95	23.70
24	20.00	36.90	52	33.95	22.00
25	10.00	34.40	53	31.45	22.00
26	10.00	36.90	54	13.90	22.00
27	0.00	34.40	55	11.40	22.00
28	0.00	36.90	56	8.40	23.70

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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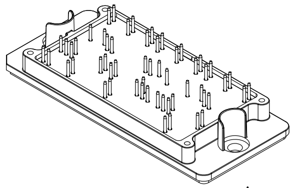
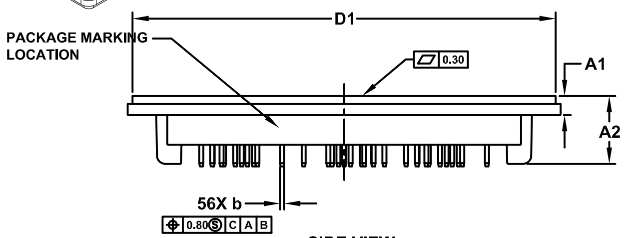
DESCRIPTION:	PIM56 93X47 (PRESS FIT)	PAGE 1 OF 1



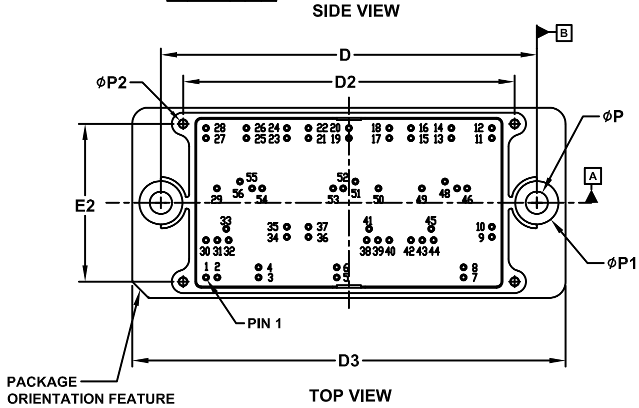
PIM56, 93x47 (SOLDER PIN)

CASE 180BR
ISSUE O

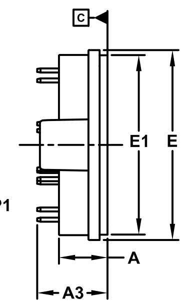
DATE 03 DEC 2019



SIDE VIEW



TOP VIEW



END VIEW

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A3	16.80	17.20	17.60
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
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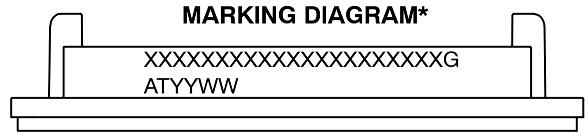
23	20.00	34.40	51	36.95	23.70
24	20.00	36.90	52	33.95	22.00
25	10.00	34.40	53	31.45	22.00
26	10.00	36.90	54	13.90	22.00
27	0.00	34.40	55	11.40	22.00
28	0.00	36.90	56	8.40	23.70

GENERIC MARKING DIAGRAM*



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DESCRIPTION:	PIM56 93X47 (SOLDER PIN)	PAGE 1 OF 1

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