Flying Capacitor BOOST Module

Product Preview
NXH500B100H7F5SHG

The NXH500B100H7F5SHG is a power module in F5BP package containing two independent flying capacitor boost converters. The integrated field stop trench IGBTs and Si/SiC Diodes provide lower conduction and switching losses, enabling designers to achieve high efficiency, high power density and superior reliability.

Features

- Flying Capacitor Boost Module
- 1000V Field Stop 7 IGBTs and 1200V SiC Diodes
- Low Inductive Layout
- Solder Pins
- Integrated NTC Thermistor
- This is a Pb−Free and Halide Free Device

Typical Applications

- Solar Inverter
- Energy Storage System

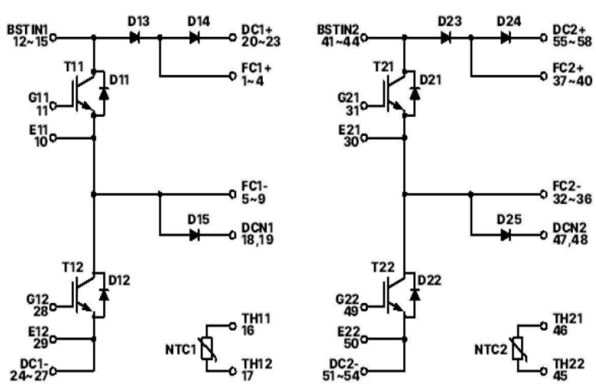
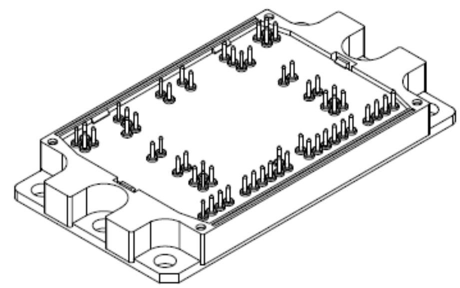


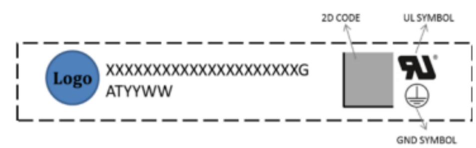
Figure 1. NXH500B100H7F5SHG Schematic Diagram

This document contains information on a product under development. **onsemi** reserves the right to change or discontinue this product without notice.



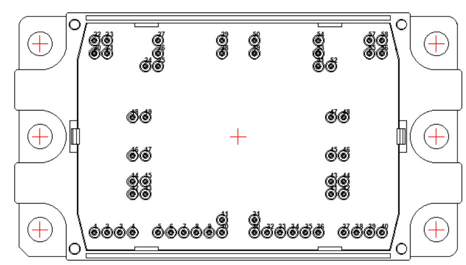
PIM58 112x62 (SOLDER PIN)
CASE 180CZ

MARKING DIAGRAM



XXXXX = Device Code
G = Pb−Free Package
AT = Assembly & Test Site Code
YYWW = Year and Work Week Code

PIN CONNECTIONS



ORDERING INFORMATION

See detailed ordering and shipping information on page 4 of this data sheet.

MODULE CHARACTERISTICS

Rating	Symbol	Value	Unit
Operating Temperature under Switching Condition	T_{VJOP}	–40 to 150	°C
Storage Temperature Range	T_{stg}	–40 to 125	°C
Isolation Test Voltage, t = 2 sec, 50 Hz (Note 1)	V_{is}	4800	V_{RMS}
Stray Inductance	$L_{s\,CE}$	15	nH
Terminal Connection Torque (M5, Screw) torque	M	3 to 5	Nm
Weight	G	245	g
Creepage Distance (terminal to heatsink)		17.46	mm
Creepage Distance (terminal to terminal)		6.48	mm
Clearance Distance (terminal to heatsink)		15.62	mm
Clearance Distance (terminal to terminal)		5.05	mm
Comparative Tracking Index	CTI	>600	

1. 4800 VAC_{RMS} for 2 second duration is equivalent to 2833 VAC_{RMS} for 1 minute duration.

ABSOLUTE MAXIMUM RATINGS T_J = 25°C unless otherwise noted (Note 2)

Rating	Symbol	Value	Unit
IGBT (T11, T12, T21, T22)			
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°C (T_J = 175°C)	I_C	210	A
Pulsed Peak Collector Current @ T_C = 80°C (T_J = 175°C)	$I_{C(Pulse)}$	630	A
Power Dissipation (T_J = 175°C, T_C = 80°C)	P_{tot}	503	W
Minimum Operating Junction Temperature	T_{JMIN}	–40	°C
Maximum Operating Junction Temperature	T_{JMAX}	175	°C
IGBT INVERSE DIODE (D11, D12, D21, D22)			
Peak Repetitive Reverse Voltage	V_{RRM}	1200	V
Continuous Forward Current @ T_C = 80°C	I_F	125	A
Repetitive Peak Forward Current (T_J = 175°C)	I_{FRM}	375	A
Maximum Power Dissipation @ T_C = 80°C (T_J = 175°C)	P_{tot}	203	W
Minimum Operating Junction Temperature	T_{JMIN}	–40	°C
Maximum Operating Junction Temperature	T_{JMAX}	175	°C
BOOST SILICON CARBIDE SCHOTTKY DIODE (D13, D14, D23, D24)			
Peak Repetitive Reverse Voltage	V_{RRM}	1200	V
Continuous Forward Current @ T_C = 80°C (T_J = 175°C)	I_F	141	A
Repetitive Peak Forward Current (T_J = 175°C)	I_{FRM}	423	A
Maximum Power Dissipation @ T_C = 80°C (T_J = 175°C)	P_{tot}	305	W
Minimum Operating Junction Temperature	T_{JMIN}	–40	°C
Maximum Operating Junction Temperature	T_{JMAX}	175	°C
START–UP DIODE (D15, D25)			
Peak Repetitive Reverse Voltage	V_{RRM}	1200	V
Continuous Forward Current @ T_C = 80°C (T_J = 175°C)	I_F	78	A
Repetitive Peak Forward Current (T_J = 175°C)	I_{FRM}	234	A

ABSOLUTE MAXIMUM RATINGS T_J = 25°C unless otherwise noted (Note 2)

Rating	Symbol	Value	Unit
START−UP DIODE (D15, D25)			
Maximum Power Dissipation (T_J = 175°C)	P_{tot}	203	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.

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

ELECTRICAL CHARACTERISTICS T_J = 25°C unless otherwise noted

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
IGBT (T11, T12, T21, T22)						
Collector−Emitter Cutoff Current	V_{GE} = 0 V, V_{CE} = 1000 V	I_{CES}	–	–	500	μA
Collector−Emitter Saturation Voltage	V_{GE} = 15 V, I_C = 240 A, T_C = 25°C	$V_{CE(SAT)}$	–	1.7	2.3	V
	V_{GE} = 15 V, I_C = 240 A, T_C = 150°C		–	2.1	–	
Gate−Emitter Threshold Voltage	V_{GE} = V_{CE}, I_C = 240 mA	$V_{GE(TH)}$	4.0	5.7	6.9	V
Gate Leakage Current	V_{GE} = ±20 V, V_{CE} = 0 V	I_{GES}	–	–	1	μA
Internal Gate Resistor		R_g		1.5		Ω
Turn−Off safe operating area	V_{CC} < 800 V, $R_{g,off}$ ≥ 30 Ω, T_{vj} < 150°C			200		A
Turn−On Delay Time	T_J = 25°C, V_{CE} = 600 V, I_C = 100 A V_{GE} = −9 V, +15 V, $R_{G,on}$ = 7 Ω, $R_{G,off}$ = 22 Ω	$t_{d(on)}$	–	132	–	ns
Rise Time		t_r	–	30	–	
Turn−Off Delay Time		$t_{d(off)}$	–	400	–	
Fall time		t_f	–	29	–	
Turn on switching loss		E_{on}	–	1070	–	uJ
Turn off switching loss		E_{off}	–	3500	–	
Turn−On Delay Time	T_J = 125°C, V_{CE} = 600 V, I_C = 100 A V_{GE} = −9 V, +15 V, $R_{G,on}$ = 7 Ω, $R_{G,off}$ = 22 Ω	$t_{d(on)}$	–	127	–	ns
Rise Time		t_r	–	33	–	
Turn−Off Delay Time		$t_{d(off)}$	–	460	–	
Fall time		t_f	–	40	–	
Turn on switching loss		E_{on}	–	1280	–	uJ
Turn off switching loss		E_{off}	–	5000	–	
Input capacitance	V_{CE} = 20 V, V_{GE} = 0 V, f = 100 kHz	C_{ies}	–	18488	–	ϱF
Output capacitance		C_{oes}	–	797	–	
Reverse transfer capacitance		C_{res}	–	116	–	
Gate Charge	V_{CE} = 600 V, V_{GE} = −15/+20 V, I_C = 40 A	Q_g	–	1140	–	nC
Thermal Resistance − chip−to−heatsink	Thermal grease, Thickness = 2.1 Mil ± 2%, λ = 2.9 W/mK	R_{thJH}	–	0.263	–	K/W
Thermal Resistance − chip−to−case		R_{thJC}	–	0.198	–	K/W
IGBT INVERSE DIODE (D11, D12, D21, D22)						
Diode Forward Voltage	I_F = 75 A, T_J = 25°C	V_F	–	1.10	1.5	V
	I_F = 75 A, T_J = 150°C		–	1.00	–	
Surge Forward Current	t_p = 10 ms, T_{vj} = 150°C	I_{FSM}	–	500	–	A

ELECTRICAL CHARACTERISTICS T_J = 25°C unless otherwise noted

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
IGBT INVERSE DIODE (D11, D12, D21, D22)						
I^2t	t_p = 10 ms, T_{vj} = 150°C	I^2t	–	1250	–	A^2s
Thermal Resistance – chip–to–heatsink	Thermal grease, Thickness = 2.1 Mil ±2% λ = 2.9 W/mK	R_{thJH}	–	0.61	–	K/W
Thermal Resistance – chip–to–case		R_{thJC}		0.47		
BOOST SILICON CARBIDE SCHOTTKY DIODE (D13, D14, D23, D24)						
Reverse Leakage Current	V_F = 1200 V, T_J = 25°C	I_R	–	–	1.5	mA
Surge Forward Current	t_p = 10 ms, T_{vj} = 150 °C	I_{FSM}	–	500	–	A
I^2t	t_p = 10 ms, T_{vj} = 150 °C	I^2t	–	1250	–	A^2s
Diode Forward Voltage	I_F = 120 A, T_J = 25°C	V_F	–	1.45	1.7	V
	I_F = 120 A, T_J = 150°C		–	1.74	–	
Reverse Recovery Time	T_J = 25°C V_R = 600 V, I_C = 100 A V_{GE} = –9 V, 15 V, $R_{G,on}$ = 7 Ω	t_{rr}	–	25.5	–	ns
Reverse Recovery Charge		Q_{rr}	–	575	–	nC
Peak Reverse Recovery Current		I_{RRM}	–	33	–	A
Peak Rate of Fall of Recovery Current		di/dt	–	2800	–	A/μs
Reverse Recovery Energy		E_{rr}	–	270	–	μJ
Reverse Recovery Time	T_J = 125°C V_{DS} = 600 V, I_C = 100 A V_{GE} = –9 V, 15 V, $R_{G,on}$ = 7 Ω	t_{rr}	–	26	–	ns
Reverse Recovery Charge		Q_{rr}	–	615	–	nC
Peak Reverse Recovery Current		I_{RRM}	–	36	–	A
Peak Rate of Fall of Recovery Current		di/dt	–	2550	–	A/μs
Reverse Recovery Energy		E_{rr}	–	279	–	μJ
Thermal Resistance – chip–to–heatsink	Thermal grease, Thickness = 2.1 Mil ±2% λ = 2.9 W/mK	R_{thJH}	–	0.405	–	K/W
Thermal Resistance – chip–to–case		R_{thJC}	–	0.316	–	K/W
START–UP DIODE (D15, D25)						
Diode Forward Voltage	I_F = 75 A, T_J = 25°C	V_F	–	2.87	3.5	V
	I_F = 75 A, T_J = 150°C		–	2.19	–	
Surge Forward Current	t_p = 10 ms, T_{vj} = 150°C	I_{FSM}	–	450	–	A
I^2t	t_p = 10 ms, T_{vj} = 150°C	I^2t	–	1013	–	A^2s
Thermal Resistance – chip–to–heatsink	Thermal grease, Thickness = 2.1 Mil ±2% λ = 2.9 W/mK	R_{thJH}	–	0.61	–	K/W
Thermal Resistance – chip–to–case		R_{thJC}	–	0.47	–	K/W
THERMISTOR CHARACTERISTICS						
Nominal resistance	T = 25°C	R_{25}	–	5	–	kΩ
Nominal resistance	T = 100°C	R_{100}	–	492.2	–	Ω
Deviation of R25		ΔR/R	–1	–	1	%
Power dissipation		P_D	–	5	–	mW
Power dissipation constant			–	1.3	–	mW/K
B–value	B(25/85), tolerance ±1%		–	3430	–	K

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

ORDERING INFORMATION

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

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

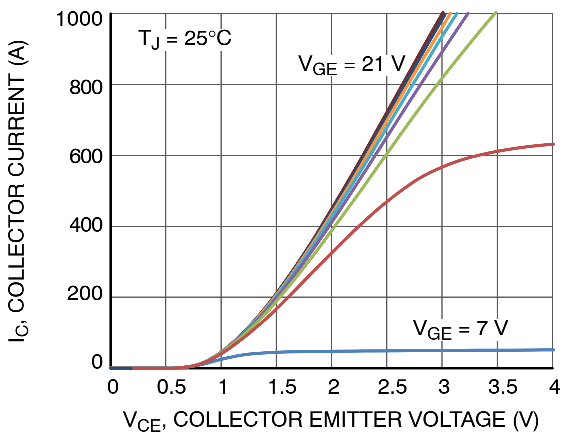


Figure 2. Typical Output Characteristics – IGBT

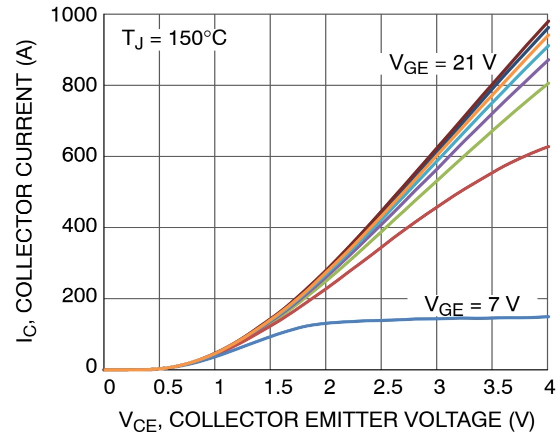


Figure 3. Typical Output Characteristics – IGBT

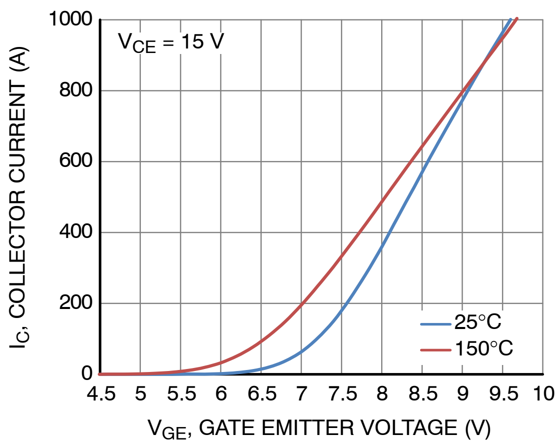


Figure 4. Transfer Characteristics – IGBT

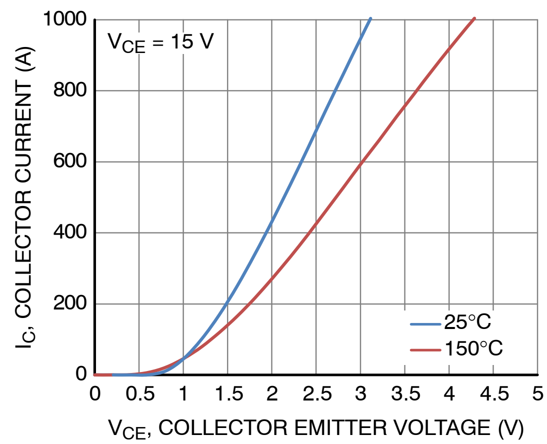


Figure 5. Saturation Voltage Characteristic – IGBT

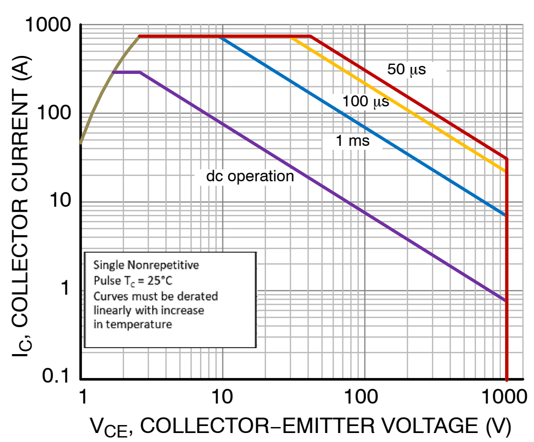


Figure 6. FBSOA

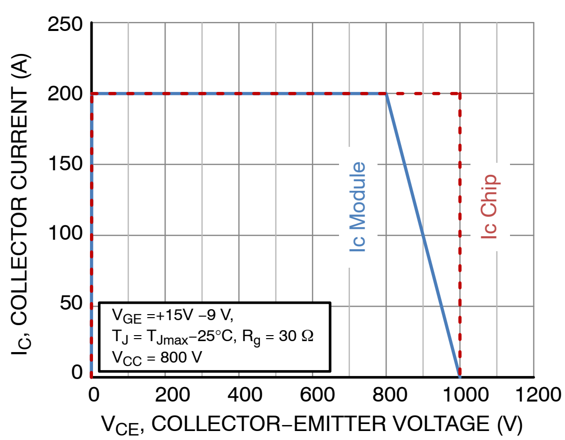


Figure 7. RBSOA

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

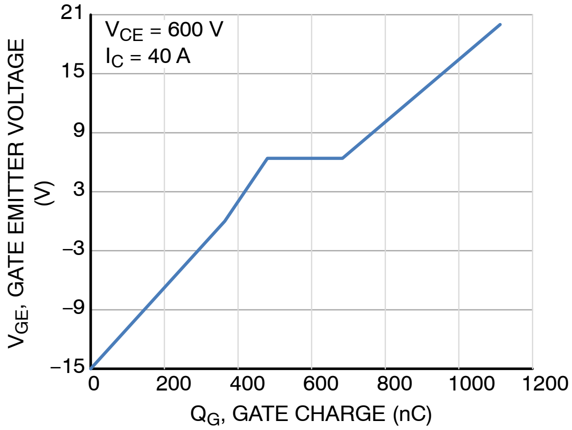


Figure 8. Gate Voltage vs. Gate Charge

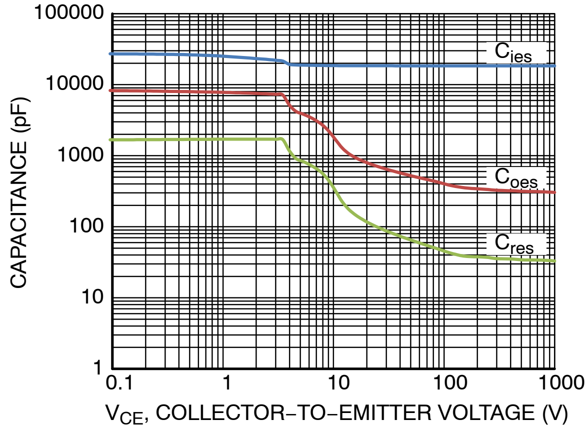


Figure 9. Capacitance vs. V_{CE}

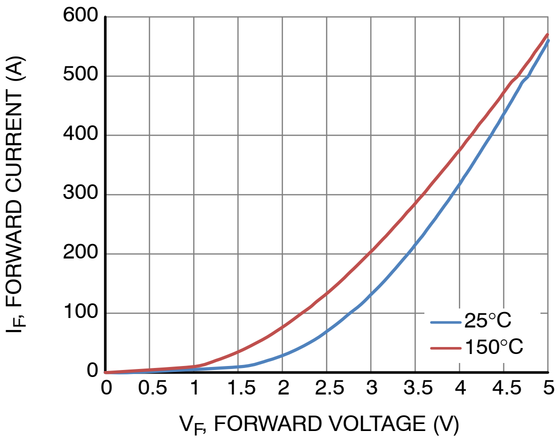


Figure 10. Start−up Diode Forward Characteristics

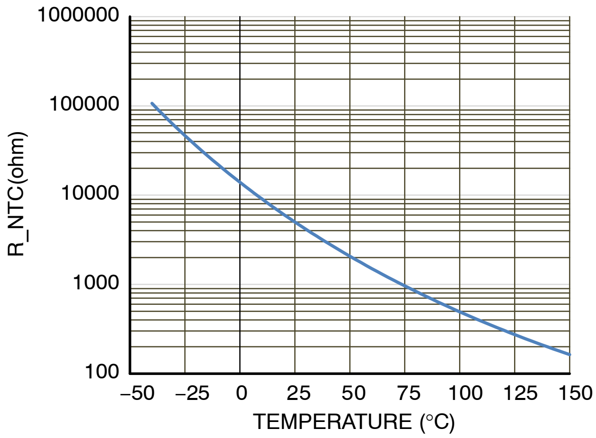


Figure 11. Thermistor Characteristic

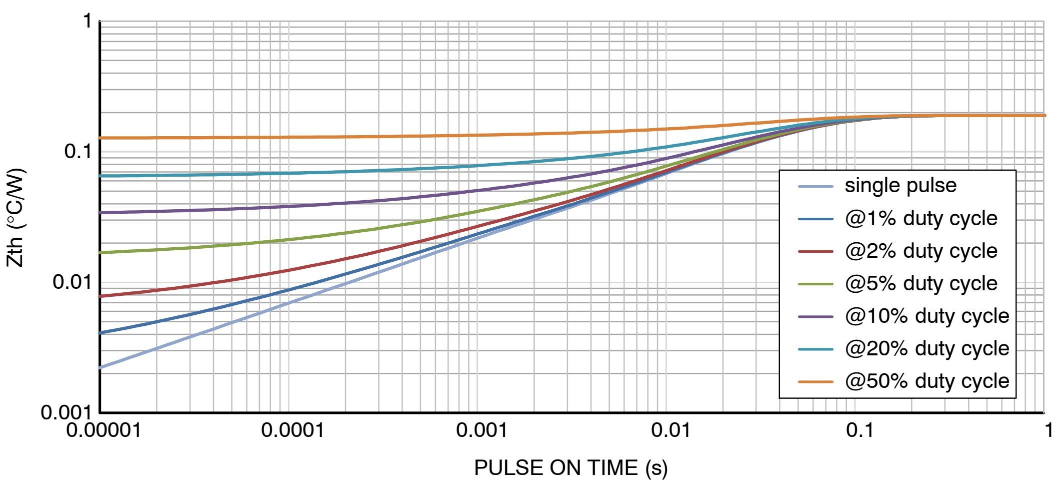


Figure 12. MOSFET Junction−to−Case Transient Thermal Impedance

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

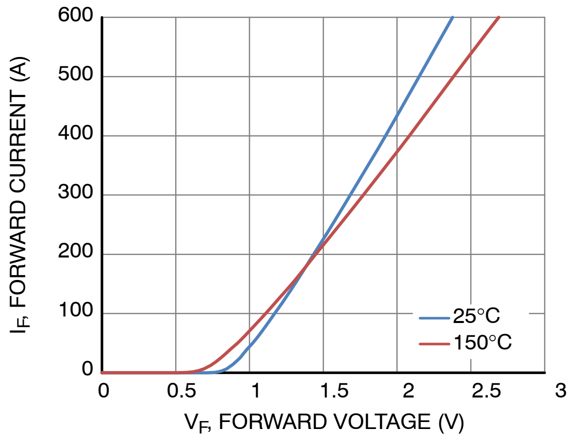


Figure 13. Inverse Diode Forward Characteristics

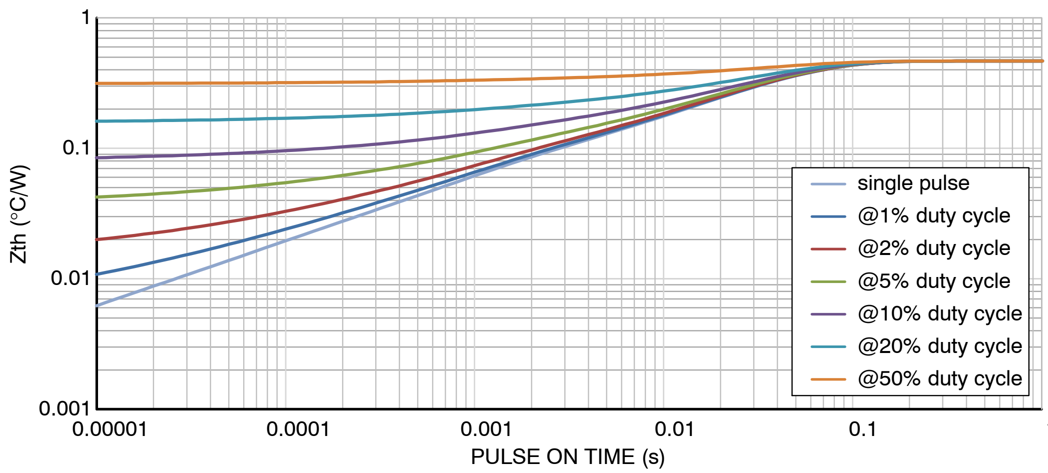


Figure 14. Transient Thermal Impedance (Inverse Diode Zthjc)

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

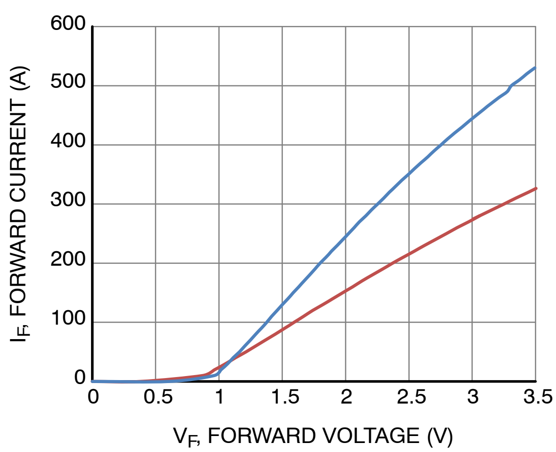


Figure 15. SiC Schottky Diode Forward Characteristics

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

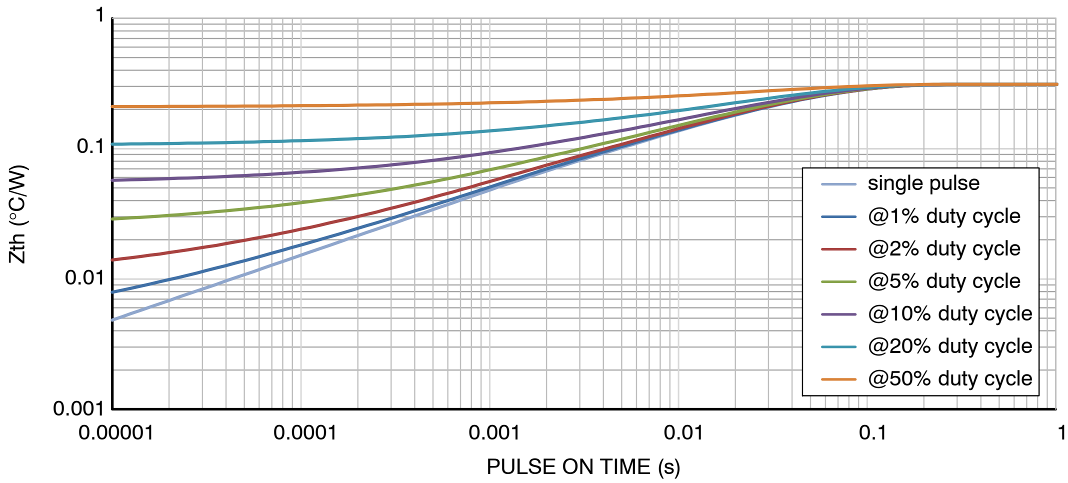


Figure 16. Transient Thermal Impedance (SiC Schottky Diode Zthjc)

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

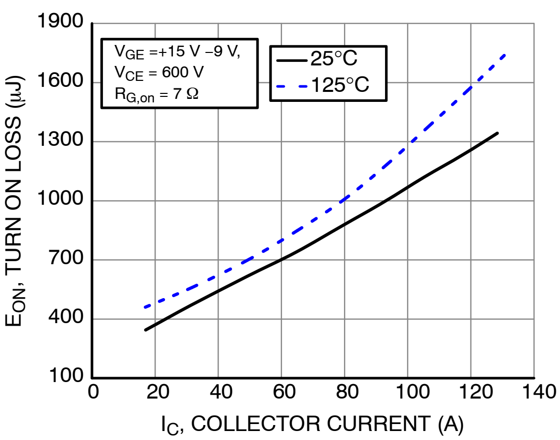


Figure 17. Typical Turn On Loss vs. I_C

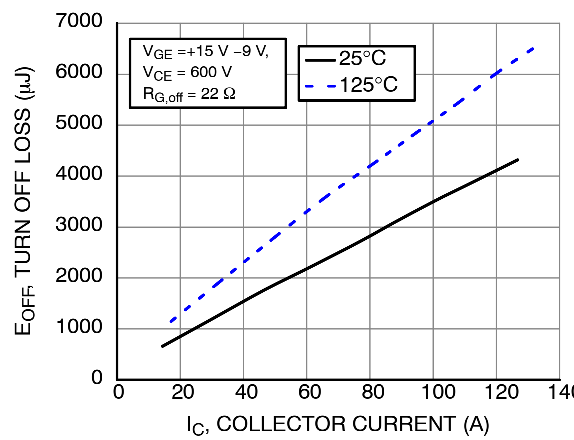


Figure 18. Typical Turn Off Loss vs. I_C

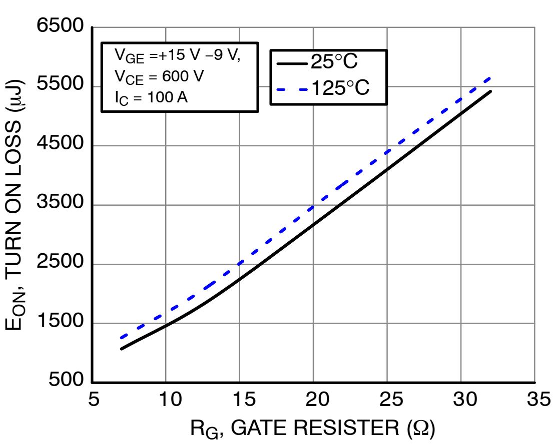


Figure 19. Typical Turn On Loss vs. R_G

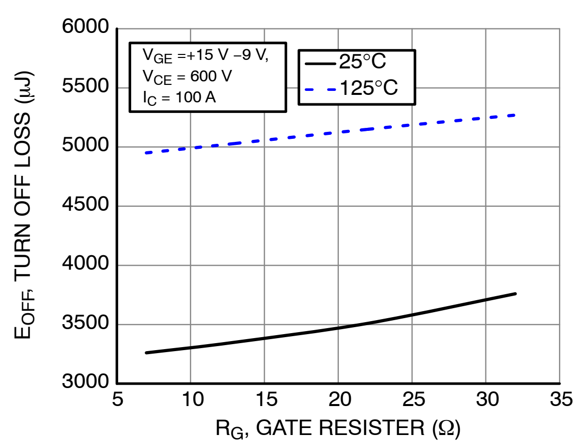


Figure 20. Typical Turn Off Loss vs. R_G

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

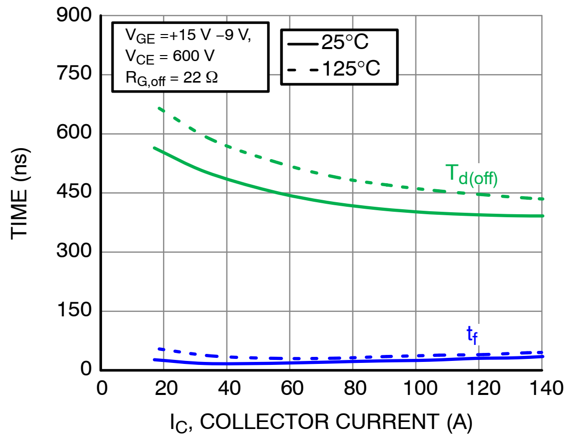


Figure 21. Typical Turn Off Switching Time vs. I_C

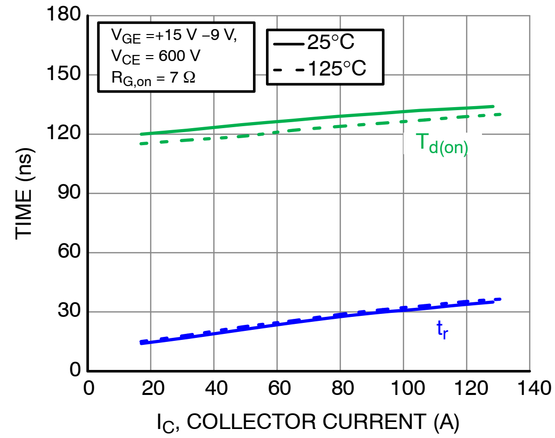


Figure 22. Typical Turn On Switching Time vs. I_C

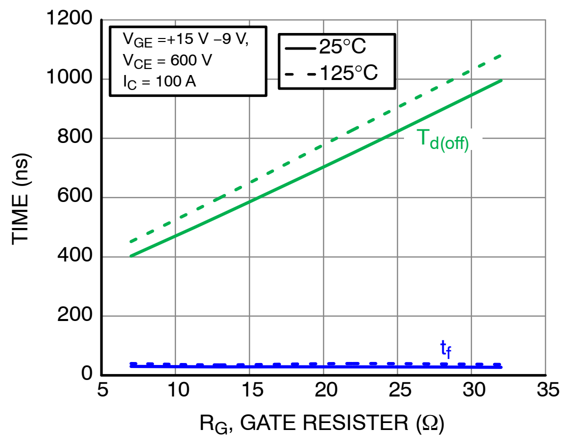


Figure 23. Typical Turn Off Switching Time vs. R_G

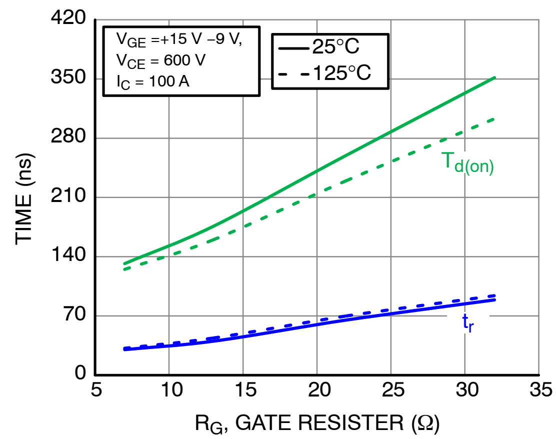


Figure 24. Typical Turn On Switching Time vs. R_G

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

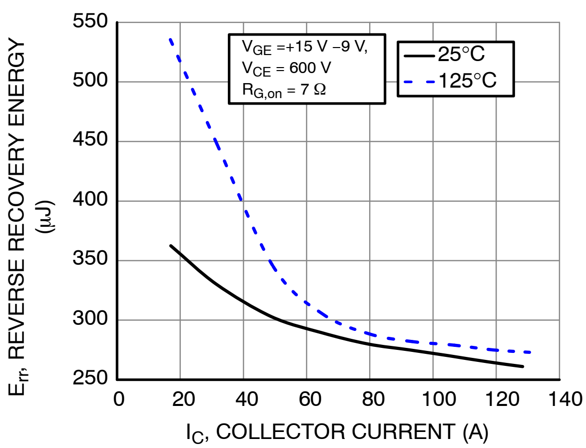


Figure 25. Typical Reverse Recovery Energy Loss vs. I_C

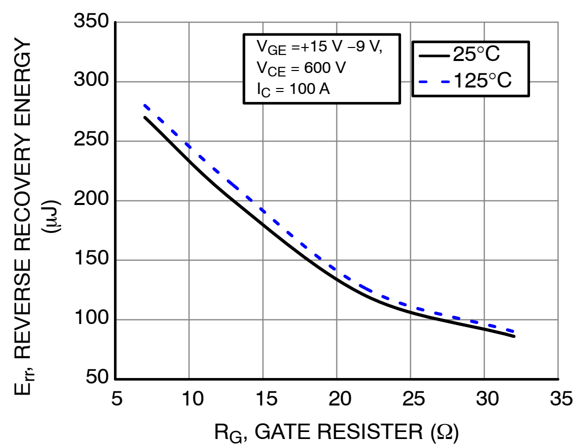


Figure 26. Typical Reverse Recovery Energy Loss vs. R_G

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

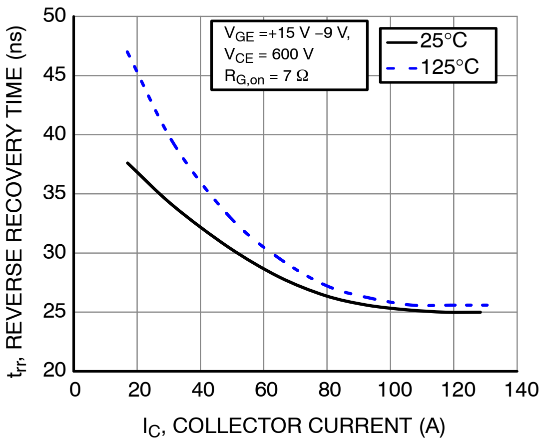


Figure 27. Typical Reverse Recovery Time vs. I_C

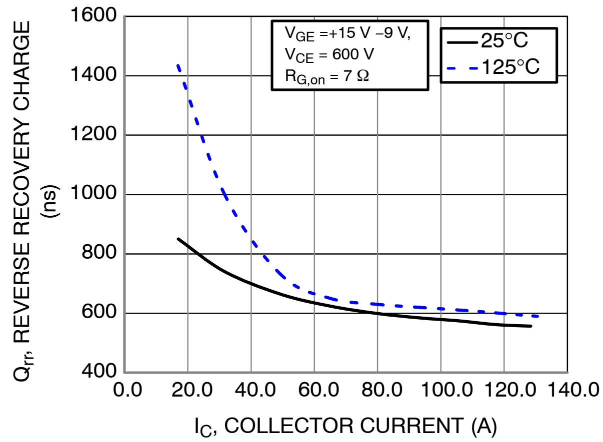


Figure 28. Typical Reverse Recovery Charge vs. I_C

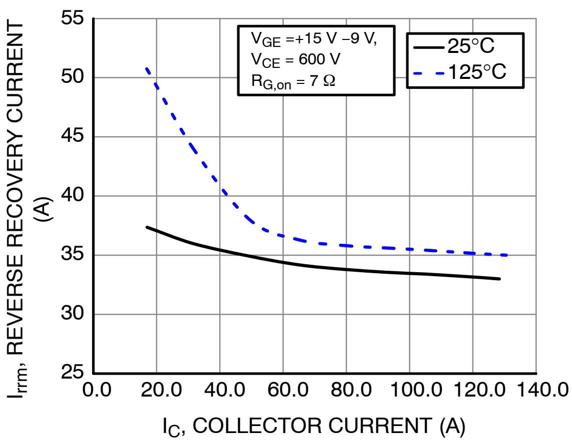


Figure 29. Typical Reverse Recovery Current vs. I_C

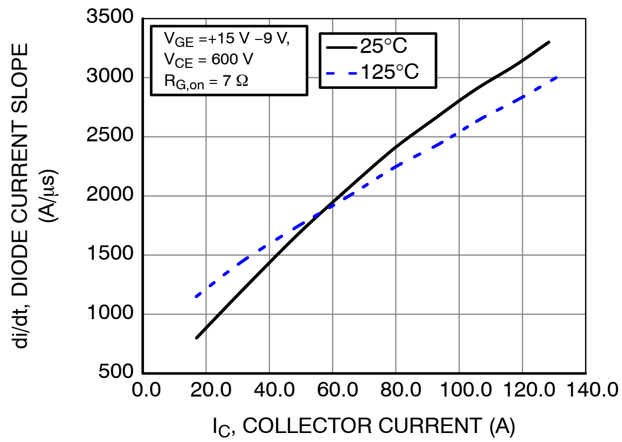


Figure 30. Typical Diode Current Slope vs. I_C

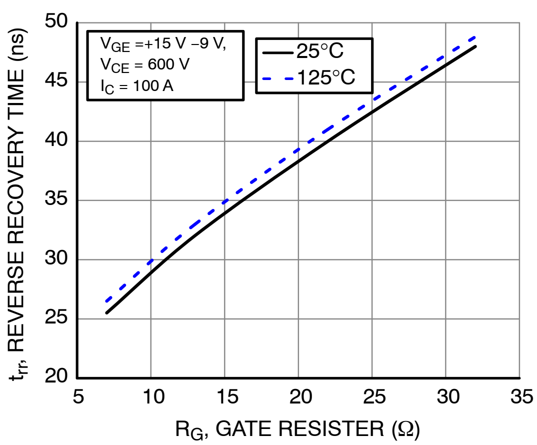


Figure 31. Typical Reverse Recovery Time vs. R_G

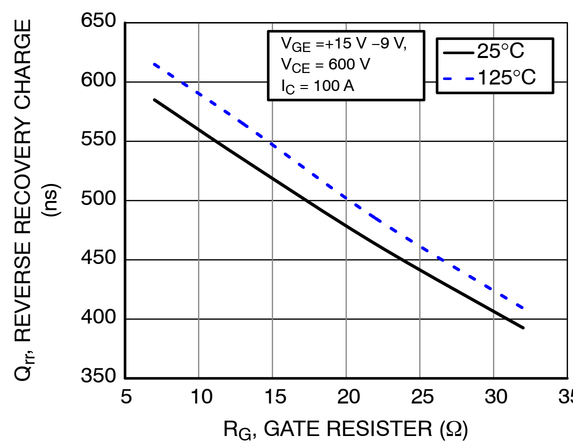


Figure 32. Typical Reverse Recovery Charge vs. R_G

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

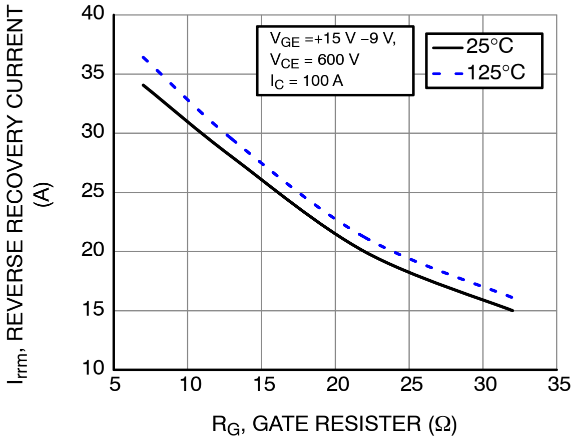


Figure 33. Typical Reverse Recovery Time vs. I_C

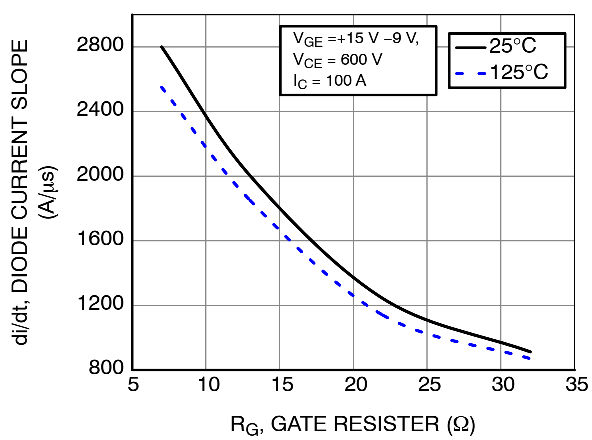
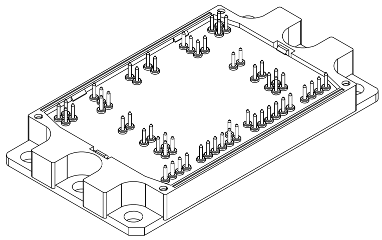


Figure 34. Typical Reverse Recovery Charge vs. I_C

PACKAGE DIMENSIONS

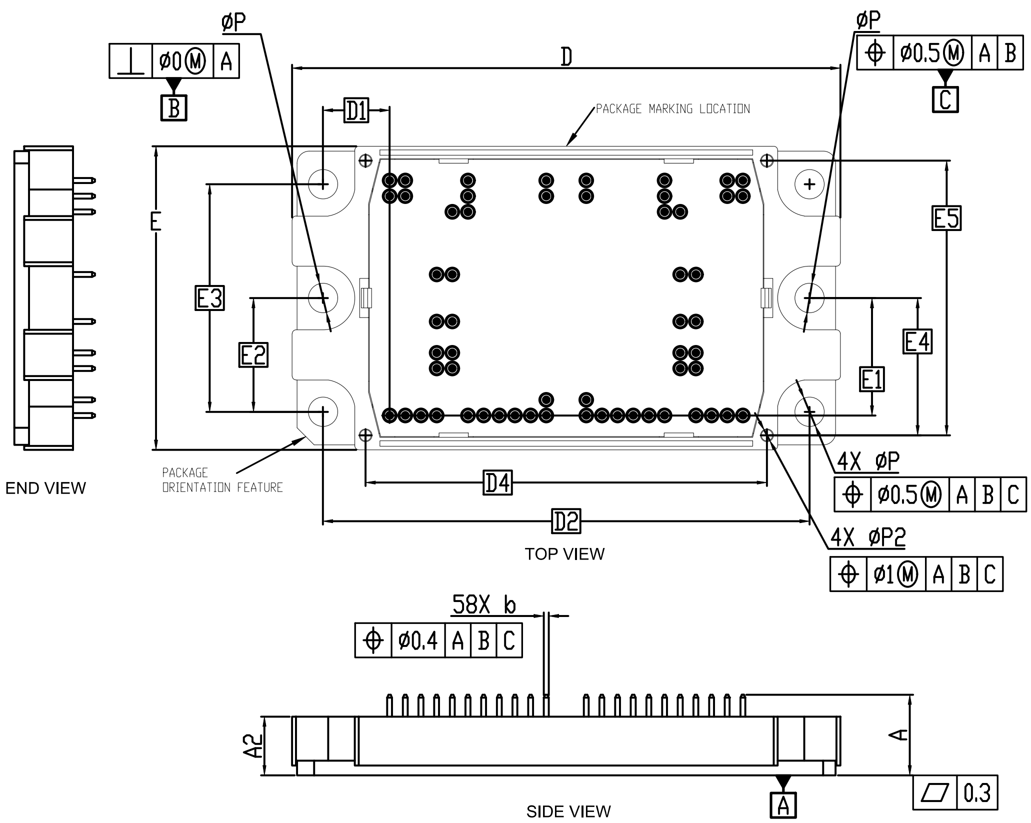


PIM58 112.00x62.00x12.00
CASE 180CZ
ISSUE O

DATE 30 JUL 2024

NOTES:

1. Dimensioning and tolerancing conform to ASME Y14.5
2. All dimensions are in millimeters.
3. Pin-grid is 3.2mm.
4. Package marking is located on the side opposite the package orientation feature.
5. The pins are gold-plated solder pin.

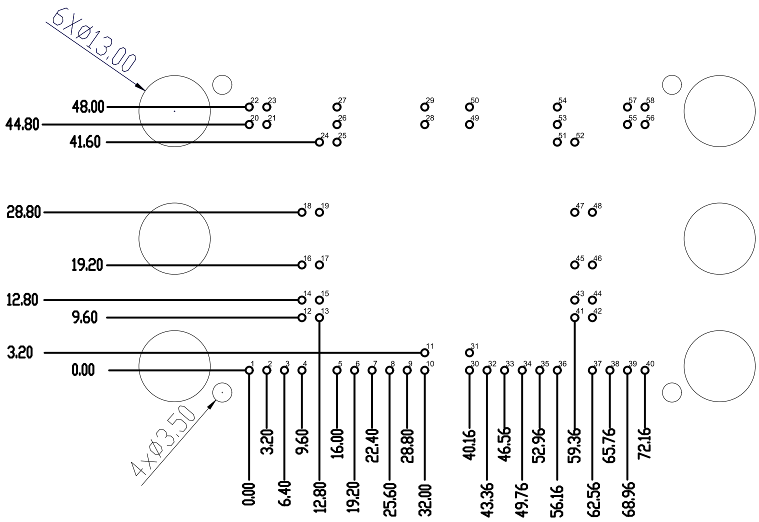


DIM	MILLIMETERS MIN.	NOM.	MAX.
A	16.10	16.50	16.90
A2	11.70	12.00	12.30
b	0.95	1.00	1.05
D	111.60	112.00	112.40
D1		13.62 BSC	
D2		99.40 BSC	
D4		82.00 BSC	
E	61.60	62.00	62.40
E1		24.00 BSC	
E2		23.25 BSC	
E3		46.50 BSC	
E4		28.05 BSC	
E5		56.10 BSC	
P	5.90	6.00	6.10
P2	2.20	2.30	2.40

PACKAGE DIMENSIONS

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

DATE 30 JUL 2024



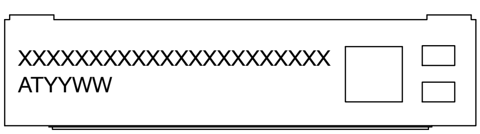
RECOMMENDED
MOUNTING PATTERN

* For additional Information on our Pb−Free strategy and soldering details, please download the Onsemi Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

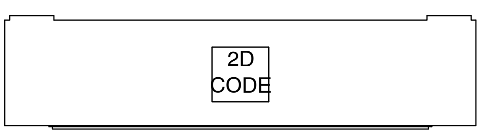
NOTE 2:

Pin table								
Pin	X	Y	Pin	X	Y	Pin	X	Y
1	0	0	24	12.8	41.6	47	59.36	28.8
2	3.2	0	25	16	41.6	48	62.56	28.8
3	6.4	0	26	16	44.8	49	40.16	44.8
4	9.6	0	27	16	48	50	40.16	48
5	16	0	28	32	44.8	51	56.16	41.6
6	19.2	0	29	32	48	52	59.36	41.6
7	22.4	0	30	40.16	0	53	56.16	44.8
8	25.6	0	31	40.16	3.2	54	56.16	48
9	28.8	0	32	43.36	0	55	68.96	44.8
10	32	0	33	46.56	0	56	72.16	44.8
11	32	3.2	34	49.76	0	57	68.96	48
12	9.6	9.6	35	52.96	0	58	72.16	48
13	12.8	9.6	36	56.16	0			
14	9.6	12.8	37	62.56	0			
15	12.8	12.8	38	65.76	0			
16	9.6	19.2	39	68.96	0			
17	12.8	19.2	40	72.16	0			
18	9.6	28.8	41	59.36	9.6			
19	12.8	28.8	42	62.56	9.6			
20	0	44.8	43	59.36	12.8			
21	3.2	44.8	44	62.56	12.8			
22	0	48	45	59.36	19.2			
23	3.2	48	46	62.56	19.2			

GENERIC
MARKING DIAGRAM*



FRONTSIDE MARKING



BACKSIDE MARKING

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

*This information is generic. Please refer to device data sheet for actual part marking. Pb−Free indicator, “G” or microdot “ ▪”, may or may not be present. Some products may not follow the Generic Marking.

ADDITIONAL INFORMATION

TECHNICAL PUBLICATIONS:
Technical Library: www.onsemi.com/design/resources/technical−documentation
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