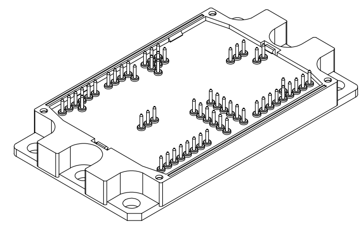
3-Level NPC Inverter Module

Product Preview

NXH600N105H7F5S1HG



PIM57 112.00x62.00x12.00
CASE 180CV

The NXH600N105H7F5S1HG is a power module in F5BP containing an I-type neutral point clamped three-level inverter. The integrated field stop trench IGBTs and FRDs provide lower conduction and switching losses, enabling designers to achieve high efficiency, higher power and superior reliability.

Features

- I-type Neutral Point Clamped Three-level Inverter Module
- 1050 V Field Stop 7 IGBTs
- Low Inductive Layout
- Solder Pins
- Integrated NTC Thermistor
- This Device is Pb-Free, Halide Free and is RoHS Compliant

Typical Applications

- Energy Storage System
- Solar Inverters

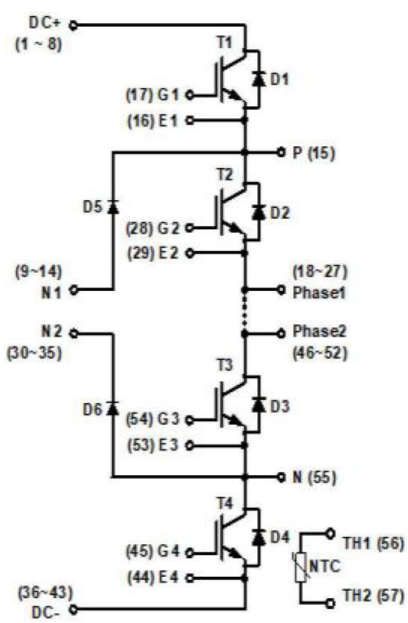
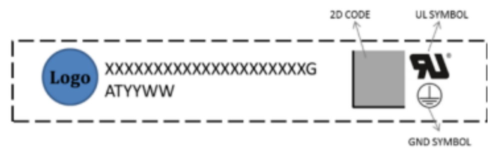


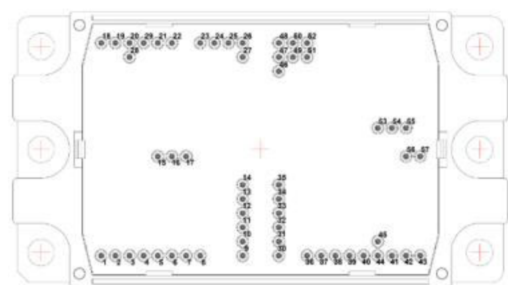
Figure 1. NXH600N105H7F5S1HG Schematic Diagram

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 5 of this data sheet.

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

May, 2025 − Rev. P5
Publication Order Number:
NXH600N105H7F5SP1/D

MODULE CHARACTERISTICS

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 s, 50 Hz (Note 1)	V_{is}	4800	V_{RMS}
Stray Inductance	L_{sCE}	15	nH
Terminal Connection Torque (M5, Screw)	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 4000 VAC_{RMS} for 1 minute duration.

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

Parameter	Symbol	Value	Unit
OUTER IGBT (T1, T4)			
Collector-Emitter Voltage	V_{CES}	1050	V
Gate-Emitter Voltage Positive Transient Gate-Emitter Voltage (T_{pulse} = 5 μs, D < 0.10)	V_{GE}	±20 30	V
Continuous Collector Current @ T_c = 80 °C (T_J = 175 °C)	I_C	429	A
Pulsed Peak Collector Current @ Tc = 80 °C (T_J = 175 °C), T_{pulse} = 1 ms	I_{Cpulse}	1287	A
Power Dissipation (T_J = 175 °C, Tc = 80 °C)	P_{tot}	1080	W
Minimum Operating Junction Temperature	T_{JMIN}	−40	°C
Maximum Operating Junction Temperature	T_{JMAX}	175	°C
INNER IGBT (T2, T3)			
Collector-Emitter Voltage	V_{CES}	1050	V
Gate-Emitter Voltage Positive Transient Gate-Emitter Voltage (T_{pulse} = 5 μs, D < 0.10)	V_{GE}	+20 30	V
Continuous Collector Current @ T_c = 80 °C (T_J = 175 °C)	I_C	429	A
Pulsed Peak Collector Current @ Tc = 80 °C (T_J = 175 °C), T_{pulse} = 1 ms	I_{Cpulse}	1287	A
Power Dissipation (T_J = 175 °C, Tc = 80 °C)	P_{tot}	1080	W
Minimum Operating Junction Temperature	T_{JMIN}	−40	°C
Maximum Operating Junction Temperature	T_{JMAX}	175	°C
SiC NEUTRAL POINT DIODE (D5, D6)			
Peak Repetitive Reverse Voltage	V_{RRM}	1200	V
Continuous Forward Current @ Tc = 80 °C	I_F	195	A
Repetitive Peak Forward Current (T_J = 175 °C), T_{pulse} = 1 ms	I_{FRM}	585	A
Maximum Power Dissipation @ Tc = 80 °C (T_J = 175 °C)	P_{tot}	419	W
Minimum Operating Junction Temperature	T_{JMIN}	−40	°C
Maximum Operating Junction Temperature	T_{JMAX}	175	°C
SiC INVERSE DIODES (D1, D4)			
Peak Repetitive Reverse Voltage	V_{RRM}	1200	V
Continuous Forward Current @ Tc = 80 °C	I_F	287	A
Repetitive Peak Forward Current (T_J = 175 °C), T_{pulse} = 1 ms	I_{FRM}	861	A

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

Parameter	Symbol	Value	Unit
SiC INVERSE DIODES (D1, D4)			
Maximum Power Dissipation @ Tc = 80 °C (T_J = 175 °C)	P_{tot}	646	W
Minimum Operating Junction Temperature	T_{JMIN}	–40	°C
Maximum Operating Junction Temperature	T_{JMAX}	175	°C
INVERSE DIODES (D2, D3)			
Peak Repetitive Reverse Voltage	V_{RRM}	1050	V
Continuous Forward Current @ Tc = 80 °C	I_F	303	A
Repetitive Peak Forward Current (T_J = 175 °C), T_{pulse} = 1 ms	I_{FRM}	909	A
Maximum Power Dissipation @ Tc = 80 °C (T_J = 175°C)	P_{tot}	833	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
OUTER IGBT (T1, T4)						
Collector-Emitter Cutoff Current	V_{GE} = 0 V, V_{CE} = 1050 V	I_{CES}	–	–	500	μA
Collector-Emitter Saturation Voltage	V_{GE} = 15 V, I_C = 600 A, T_J = 25 °C	$V_{CE(sat)}$	–	1.6	2.3	V
	V_{GE} = 15 V, I_C = 600 A, T_J = 150 °C		–	2.0	–	
Gate-Emitter Threshold Voltage	V_{GE} = V_{CE}, I_C = 600 mA	$V_{GE(TH)}$	4.0	5.5	6.9	V
Gate Leakage Current	V_{GE} = 20 V, V_{CE} = 0 V	I_{GES}	–	–	1	μA
Internal Gate Resistor		R_g	–	0.58	–	Ω
Turn-off safe operating area	V_{CC} < 800 V, $R_{G, off}$ ≥ 30 Ω, T_{vj} < 150 °C		–	800	–	A
Turn-on Delay Time	T_J = 25 °C V_{CE} = 600 V, I_C = 200 A V_{GE} = –9 V to +15 V, $R_{G, on}$ = 7 Ω, $R_{G, off}$ = 21 Ω	$t_{d(on)}$	–	235	–	ns
Rise Time		t_r	–	48	–	
Turn-off Delay Time		$t_{d(off)}$	–	1500	–	
Fall Time		t_f	–	18	–	
Turn-on Switching Loss per Pulse		E_{on}	–	6310	–	μJ
Turn off Switching Loss per Pulse		E_{off}	–	9000	–	
Turn-on Delay Time	T_J = 125 °C V_{CE} = 600 V, I_C = 200 A V_{GE} = –9 V to +15 V, $R_{G, on}$ = 7 Ω, $R_{G, off}$ = 21 Ω	$t_{d(on)}$	–	212	–	ns
Rise Time		t_r	–	52	–	
Turn-off Delay Time		$t_{d(off)}$	–	1641	–	
Fall Time		t_f	–	16	–	
Turn-on Switching Loss per Pulse		E_{on}	–	6860	–	μJ
Turn-off Switching Loss per Pulse		E_{off}	–	12020	–	
Input Capacitance	V_{CE} = 20 V, V_{GE} = 0 V, f = 100 kHz	C_{ies}	–	48597	–	pF
Output Capacitance		C_{oes}	–	1836	–	
Reverse Transfer Capacitance		C_{res}	–	277	–	
Total Gate Charge	V_{CE} = 600 V, I_C = 57 A, V_{GE} = –15/+20 V	Q_g	–	3048	–	nC

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

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
OUTER IGBT (T1, T4)						
Thermal Resistance – Chip-to-heatsink	Thermal grease, Thickness = 2 Mil ±2%, = 2.9 W/mK	R_{thJH}	–	0.139	–	°C/W
Thermal Resistance – Chip-to-case		R_{thJC}	–	0.088	–	°C/W
SiC NEUTRAL POINT DIODE (D5, D6)						
Diode Forward Voltage	I_F = 200 A, T_J = 25 °C	V_F	–	1.6	1.75	V
	I_F = 200 A, T_J = 150 °C		–	2.1	–	
Reverse Recovery Time	T_J = 25 °C V_{CE} = 600 V, I_C = 200 A V_{GE} = −9 V to +15 V, $R_{G,\ on}$ =7 Ω	t_{rr}	–	21	–	ns
Reverse Recovery Charge		Q_{rr}	–	595	–	nC
Peak Reverse Recovery Current		I_{RRM}	–	43	–	A
Peak Rate of Fall of Recovery Current		di/dt	–	3.5	–	A/ns
Reverse Recovery Energy		E_{rr}	–	117	–	μJ
Reverse Recovery Time	T_J = 125 °C V_{CE} = 600 V, I_C = 200 A V_{GE} = −9 V to +15 V, $R_{G,\ on}$ = 7 Ω	t_{rr}	–	20	–	ns
Reverse Recovery Charge		Q_{rr}	–	602	–	nC
Peak Reverse Recovery Current		I_{RRM}	–	42	–	A
Peak Rate of Fall of Recovery Current		di/dt	–	3.2	–	A/ns
Reverse Recovery Energy		E_{rr}	–	150	–	μJ
Thermal Resistance – Chip-to-heatsink	Thermal grease, Thickness = 2 Mil ±2%, = 2.87 W/mK	R_{thJH}	–	0.297	–	°C/W
Thermal Resistance – Chip-to-case		R_{thJC}	–	0.227	–	°C/W
INNER IGBT (T2, T3)						
Collector-Emitter Cutoff Current	V_{GE} = 0 V, V_{CE} = 1050 V	I_{CES}	–	–	500	μA
Collector-Emitter Saturation Voltage	V_{GE} = 15 V, I_C = 600 A, T_J = 25°C	$V_{CE(sat)}$	–	1.6	2.3	V
	V_{GE} = 15 V, I_C = 600 A, T_J = 150°C		–	2.0	–	
Gate-Emitter Threshold Voltage	V_{GE} = V_{CE}, I_C = 600 mA	$V_{GE(TH)}$	4.0	5.5	6.9	V
Gate Leakage Current	V_{GE} = 20 V, V_{CE} = 0 V	I_{GES}	–	–	1	μA
Internal Gate Resistor		R_g	–	0.58	–	Ω
Turn-off Safe Operating Area	V_{CC} < 800V, $R_{G,\ off}$ ≥ 30 Ω, T_{vj} < 150 °C		–	800	–	A
Turn-on Delay Time	T_J = 25 °C V_{CE} = 600 V, I_C = 200 A V_{GE} = −9 V to +15 V, $R_{G,\ on}$ = 7 Ω, $R_{G,\ off}$ = 21 Ω	$t_{d(on)}$	–	238	–	ns
Rise Time		t_r	–	56	–	
Turn-off Delay Time		$t_{d(off)}$	–	1506	–	
Fall Time		t_f	–	7.2	–	
Turn-on Switching Loss per Pulse		E_{on}	–	6570	–	μJ
Turn off Switching Loss per Pulse		E_{off}	–	9090	–	
Turn-on Delay Time	T_J = 125 °C V_{CE} = 600 V, I_C = 200 A V_{GE} = −9 V to +15 V, $R_{G,\ on}$ = 7 Ω, $R_{G,\ off}$ = 21 Ω	$t_{d(on)}$	–	216	–	ns
Rise Time		t_r	–	57	–	
Turn-off Delay Time		$t_{d(off)}$	–	1638	–	
Fall Time		t_f	–	17	–	
Turn-on Switching Loss per Pulse		E_{on}	–	6890	–	μJ
Turn-off Switching Loss per Pulse		E_{off}	–	10910	–	
Input Capacitance	V_{CE} = 20 V, V_{GE} = 0 V, f = 100 kHz	C_{ies}	–	48597	–	pF
Output Capacitance		C_{oes}	–	1836	–	
Reverse Transfer Capacitance		C_{res}	–	277	–	
Total Gate Charge	V_{CE} = 600 V, I_C = 57 A, V_{GE} = −15/+20 V	Q_g	–	3048	–	nC

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

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
INNER IGBT (T2, T3)						
Thermal Resistance – Chip-to-heatsink	Thermal grease, Thickness = 2 Mil ±2%, = 2.87 W/mK	R_{thJH}	–	0.139	–	°C/W
Thermal Resistance – Chip-to-case		R_{thJC}	–	0.088	–	°C/W
SiC INVERSE DIODES (D1, D4)						
Diode Forward Voltage	I_F = 300 A, T_J = 25 °C	V_F	–	1.6	1.75	V
	I_F = 300 A, T_J = 175 °C		–	2.1	–	
Reverse Recovery Time	T_J = 25 °C V_{CE} = 600 V, I_C = 200 A V_{GE} = −9 V to +15 V, $R_{G, on}$ = 7 Ω	t_{rr}	–	37	–	ns
Reverse Recovery Charge		Q_{rr}	–	1167	–	nC
Peak Reverse Recovery Current		I_{RRM}	–	53	–	A
Peak Rate of Fall of Recovery Current		di/dt	–	2.92	–	A/ns
Reverse Recovery Energy		E_{rr}	–	235	–	μJ
Reverse Recovery Time	T_J = 125 °C V_{CE} = 600 V, I_C = 200 A V_{GE} = −9 V to +15 V, $R_{G, on}$ = 7 Ω	t_{rr}	–	40	–	ns
Reverse Recovery Charge		Q_{rr}	–	1419	–	nC
Peak Reverse Recovery Current		I_{RRM}	–	61	–	A
Peak Rate of Fall of Recovery Current		di/dt	–	2.84	–	A/ns
Reverse Recovery Energy		E_{rr}	–	279	–	μJ
Thermal Resistance – Chip-to-heatsink	Thermal grease, Thickness = 2 Mil ±2%, = 2.87 W/mK	R_{thJH}	–	0.202	–	°C/W
Thermal Resistance – Chip-to-case		R_{thJC}	–	0.147	–	°C/W
INVERSE DIODES (D2, D3)						
Diode Forward Voltage	I_F = 500 A, T_J = 25 °C	V_F	–	2.8	3.4	V
	I_F = 500 A, T_J = 175 °C		–	2.2	–	
Thermal Resistance – Chip-to-heatsink	Thermal grease, Thickness = 2 Mil ±2%, = 2.87 W/mK	R_{thJH}	–	0.194	–	°C/W
Thermal Resistance – Chip-to-case		R_{thJC}	–	0.124	–	°C/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		R/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

Device	Marking	Package	Shipping
NXH600N105H7F5S1HG	NXH600N105H7F5S1HG	F5 – PIM57 112x62 (Solder PIN) (Pb-Free / Halide Free)	8 Units / Blister Tray

TYPICAL CHARACTERISTIC – T1, T2, T3, T4 (IGBT)

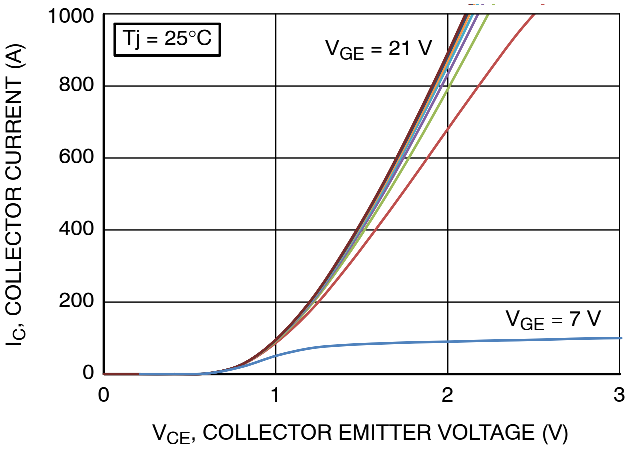


Figure 2. Typical Output Characteristics – IGBT

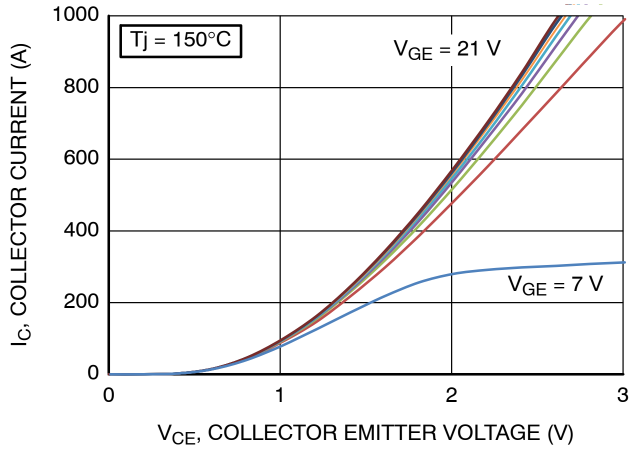


Figure 3. Typical Output Characteristics – IGBT

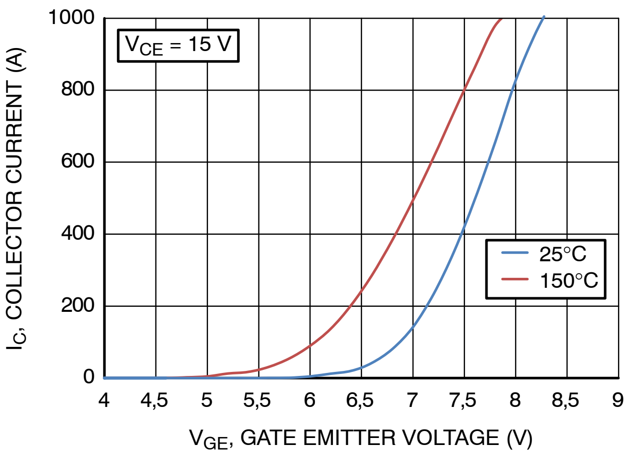


Figure 4. Transfer Characteristics – IGBT

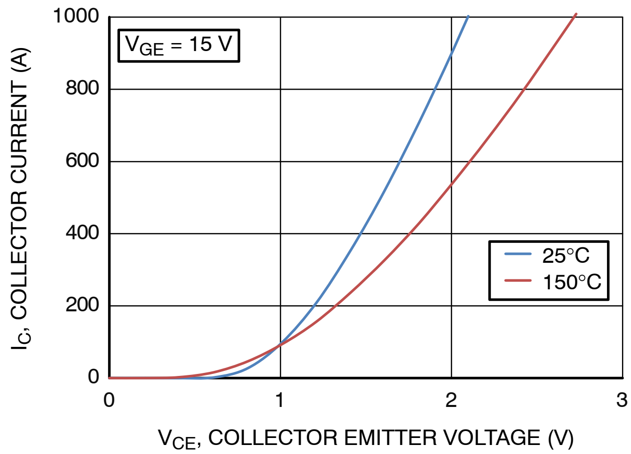


Figure 5. Saturation Voltage Characteristic – IGBT

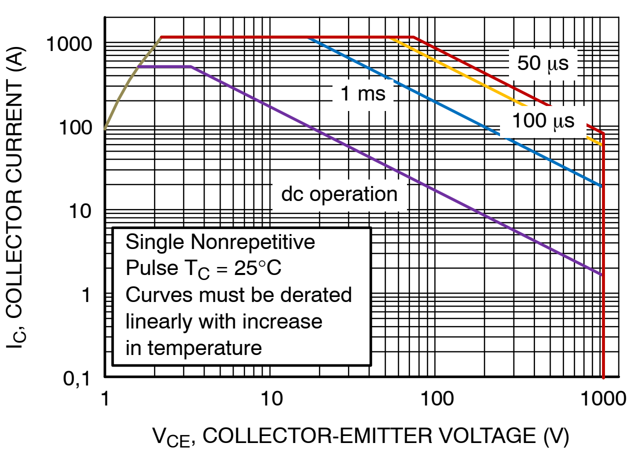


Figure 6. FBSOA

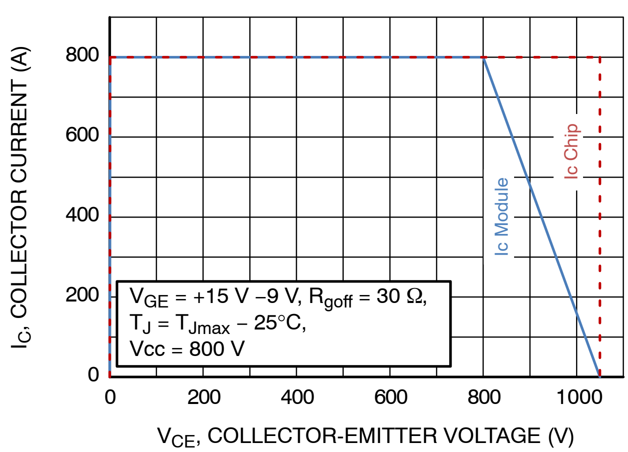


Figure 7. RBSOA (T1−T4)

TYPICAL CHARACTERISTIC – T1, T2, T3, T4 (IGBT) (CONTINUED)

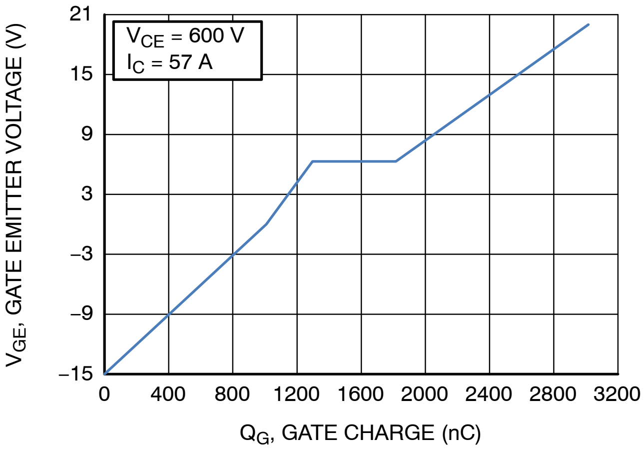


Figure 8. Gate Voltage vs. Gate Charge

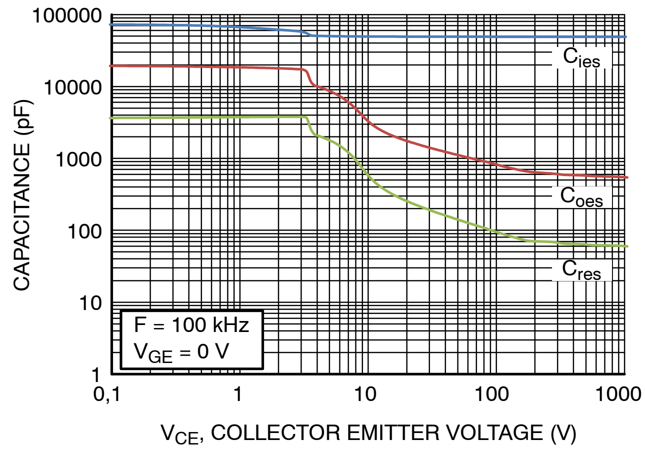


Figure 9. Capacitance vs. V_{CE}

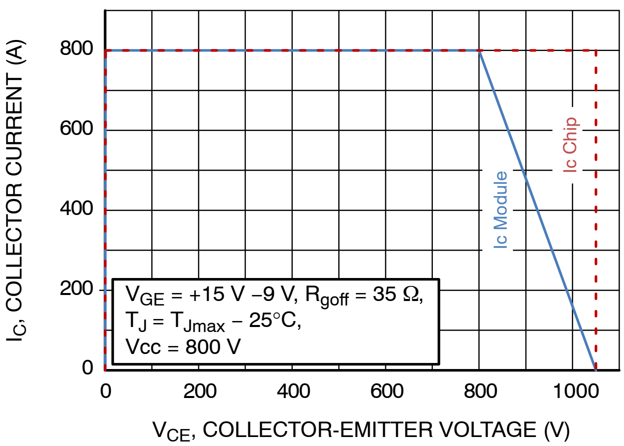


Figure 10. RBSOA (T2–T3)

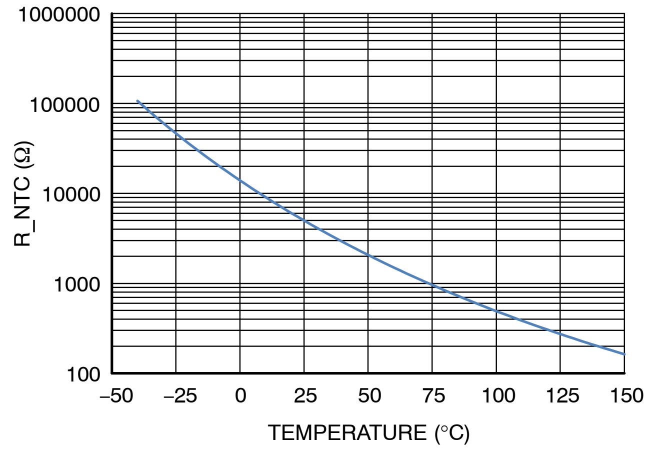


Figure 11. Temperature vs. NTC Value

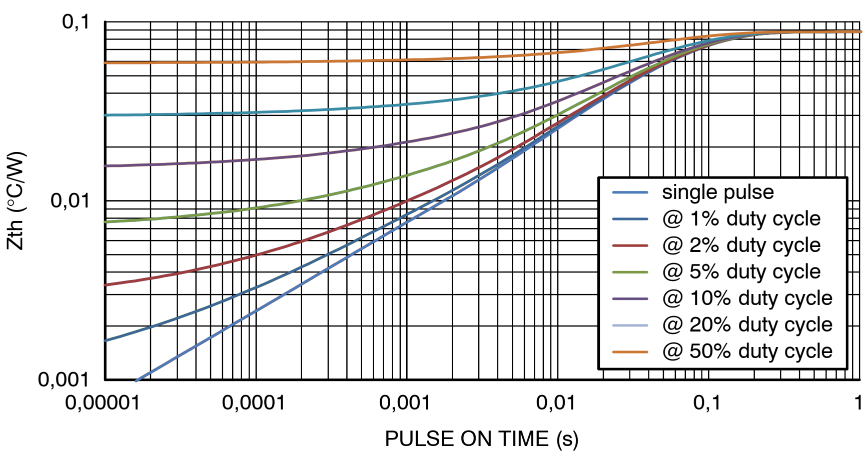


Figure 12. Transient Thermal Impedance (IGBT Zthjc)

TYPICAL CHARACTERISTIC – D1, D4 (SiC INVERSE DIODE)

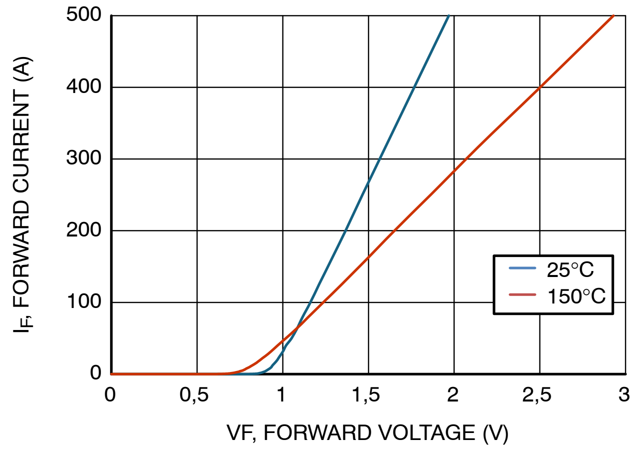


Figure 13. Inverse Diode Forward Characteristics

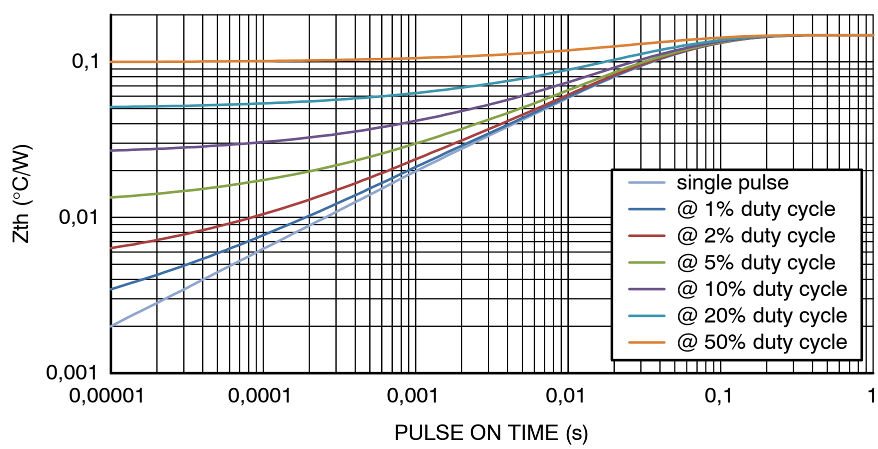


Figure 14. Transient Thermal Impedance (Inverse Diode Zthjc)

TYPICAL CHARACTERISTIC – D2, D3 (INVERSE DIODE)

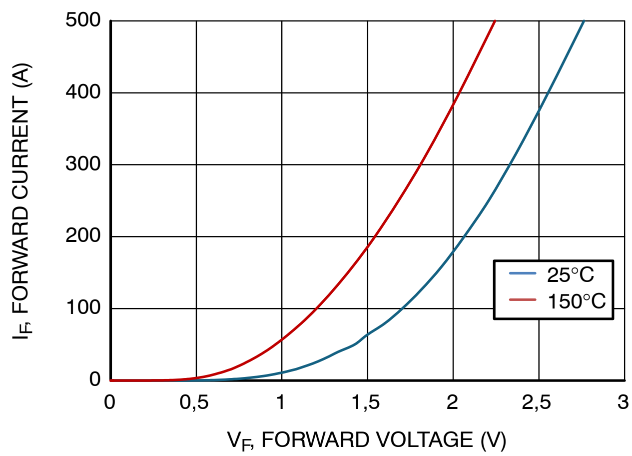


Figure 15. Inverse Diode Forward Characteristics

TYPICAL CHARACTERISTIC – D2, D3 (INVERSE DIODE) (CONTINUED)

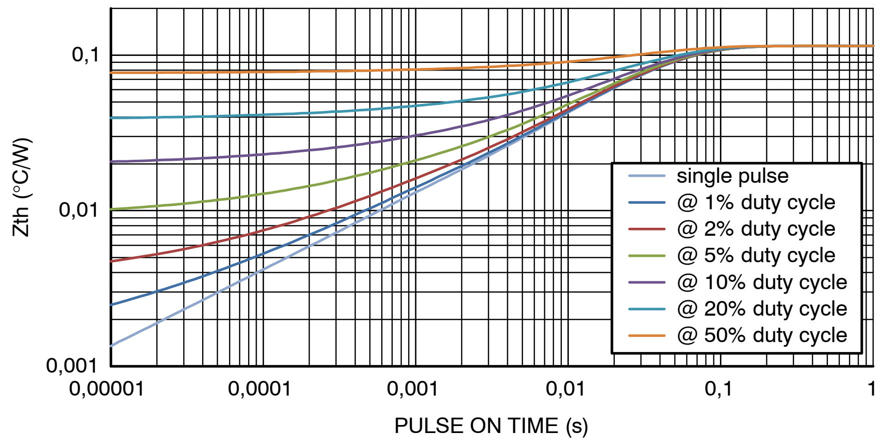


Figure 16. Transient Thermal Impedance (Inverse Diode Zthjc)

TYPICAL CHARACTERISTIC – D5, D6 (SiC NEUTRAL POINT DIODE)

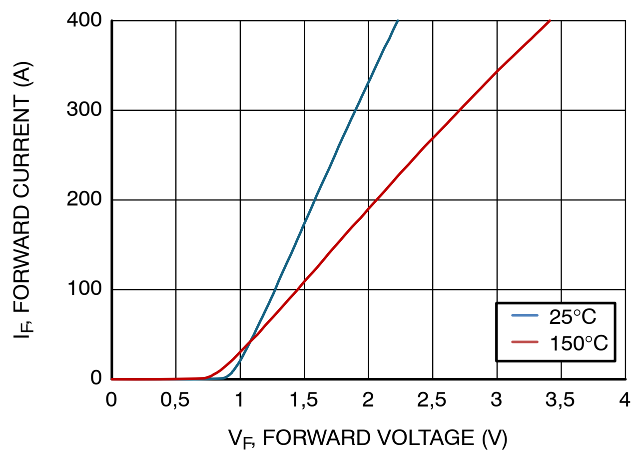


Figure 17. Neutral Diode Forward Characteristics

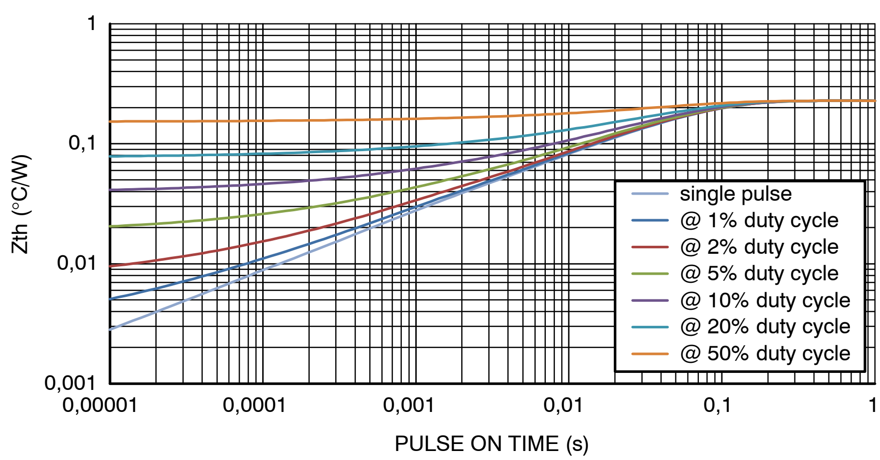


Figure 18. Transient Thermal Impedance (Neutral Point Diode Zthjc)

TYPICAL CHARACTERISTIC – T1 || D5 OR T4 || D6

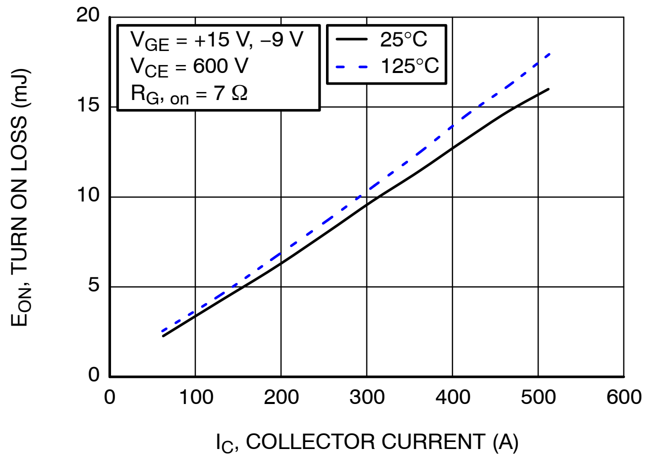


Figure 19. Typical Turn-On Loss vs. I_C

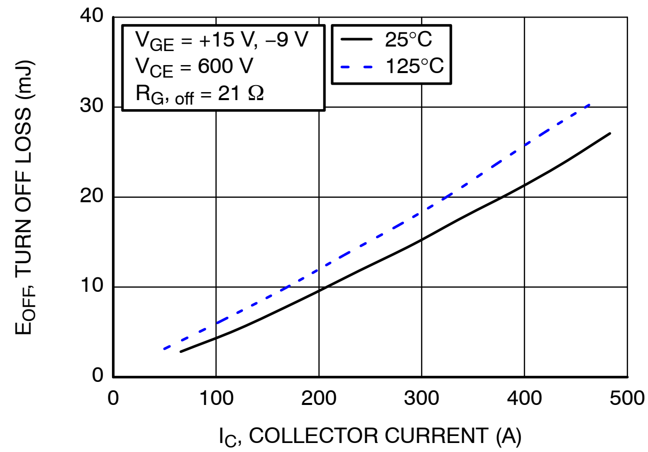


Figure 20. Typical Turn-Off Loss vs. I_C

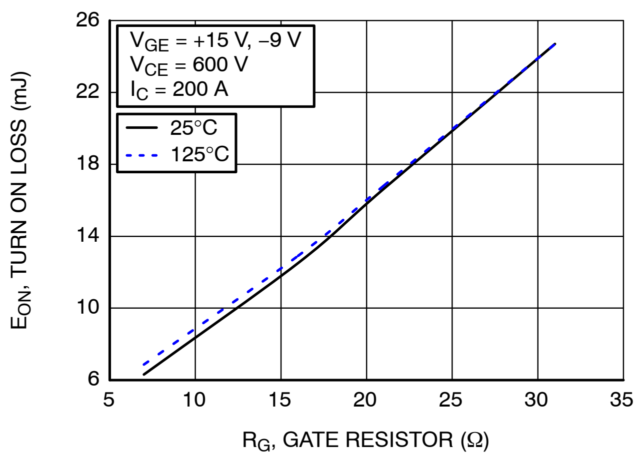


Figure 21. Typical Turn-On Loss vs. R_G

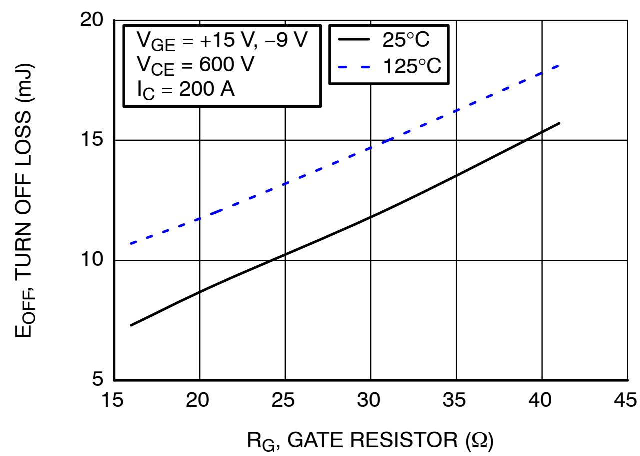


Figure 22. Typical Turn-Off Loss vs. R_G

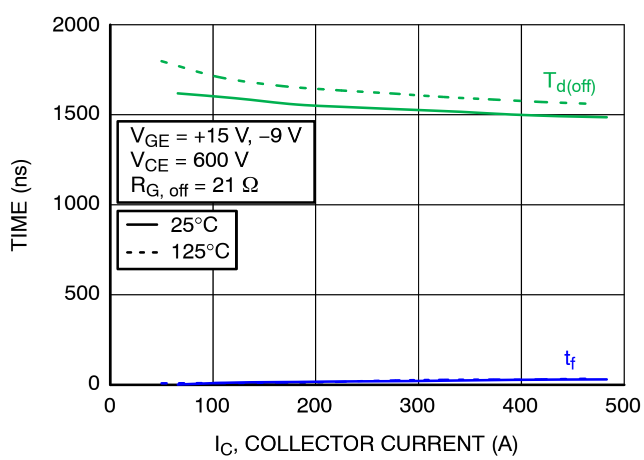


Figure 23. Typical Turn-Off Switching Time vs. I_C

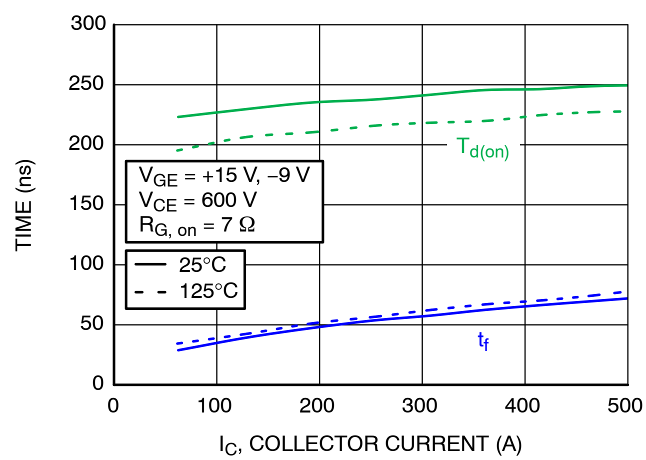


Figure 24. Typical Turn-On Switching Time vs. I_C

TYPICAL CHARACTERISTIC – T1 || D5 OR T4 || D6 (CONTINUED)

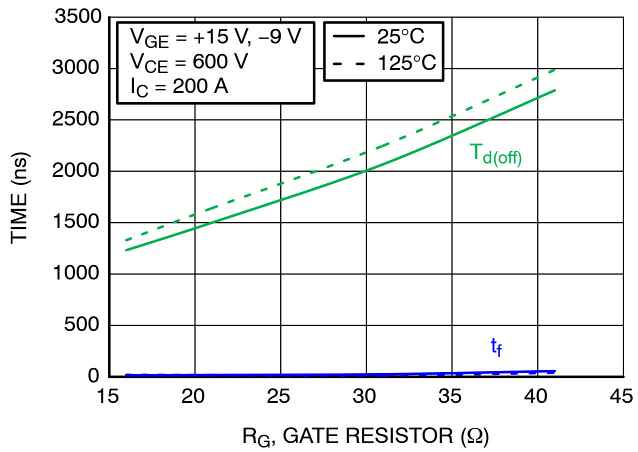


Figure 25. Typical Turn-Off Switching Time vs. R_G

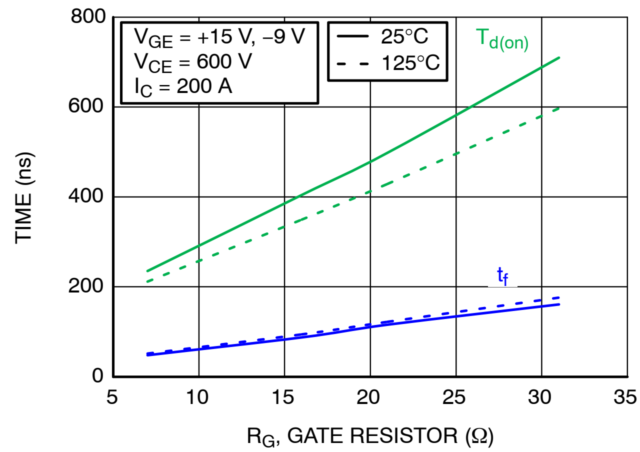


Figure 26. Typical Turn-On Switching Time vs. R_G

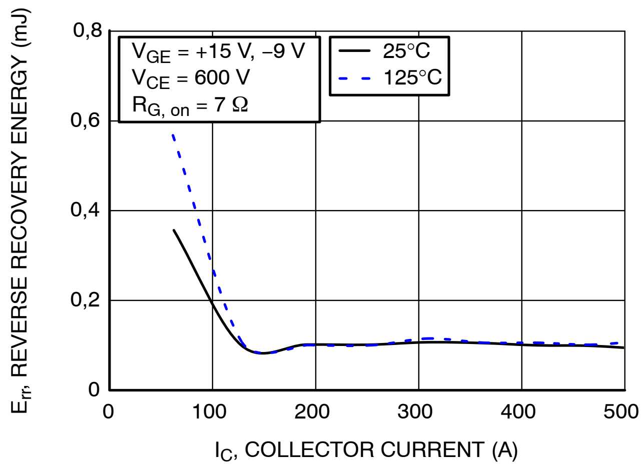


Figure 27. Typical Reverse Recovery Energy Loss vs. I_C

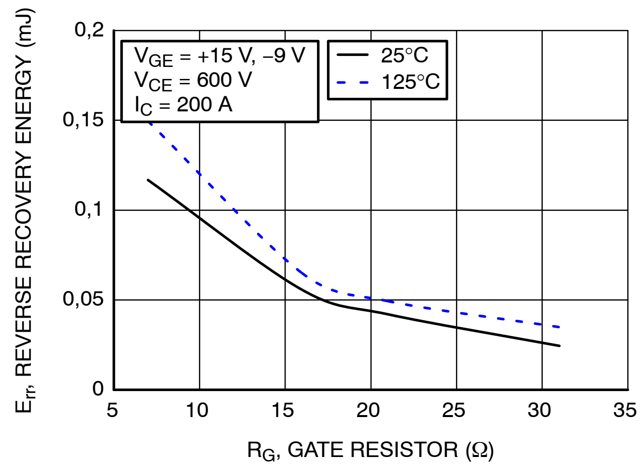


Figure 28. Typical Reverse Recovery Energy Loss vs. R_G

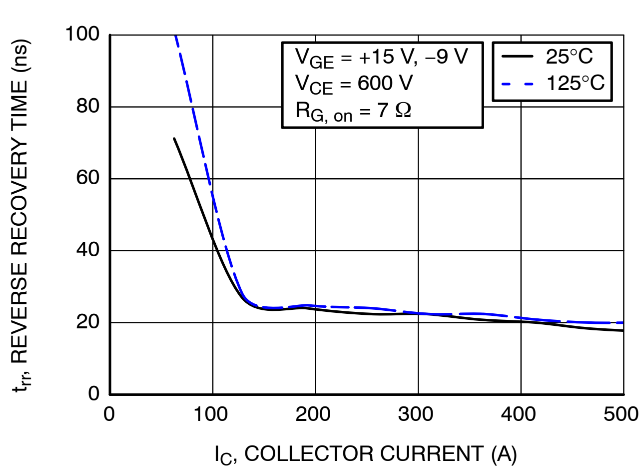


Figure 29. Typical Reverse Recovery Time vs. I_C

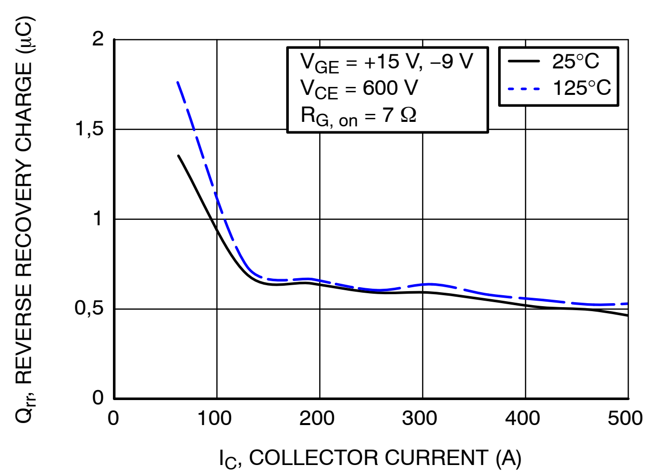


Figure 30. Typical Reverse Recovery Charge vs. I_C

TYPICAL CHARACTERISTIC – T1 || D5 OR T4 || D6 (CONTINUED)

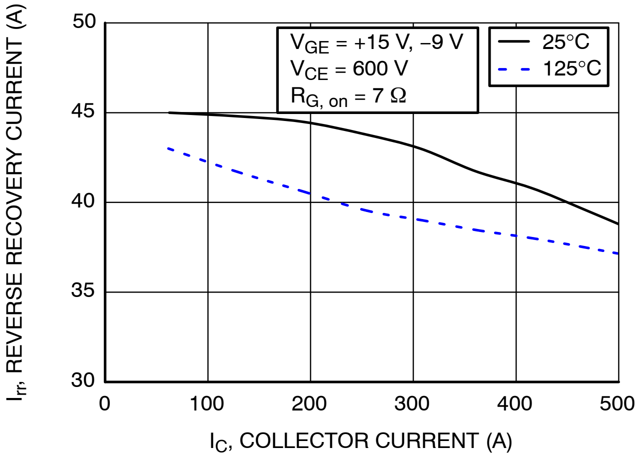


Figure 31. Typical Reverse Recovery Current vs. I_C

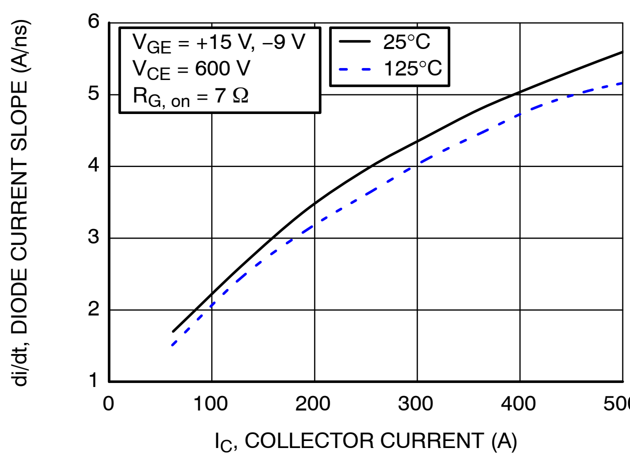


Figure 32. Typical di/dt vs. I_C

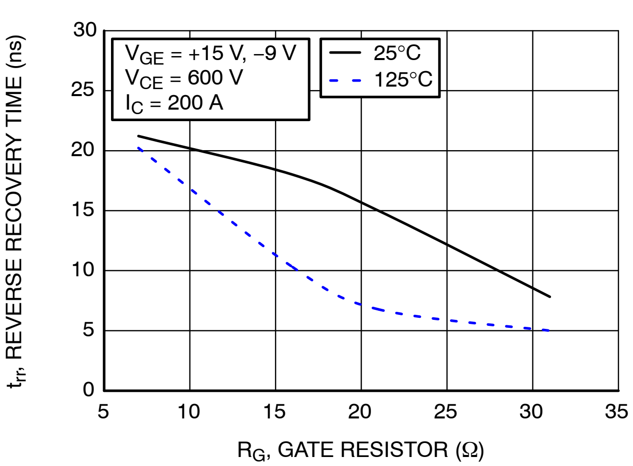


Figure 33. Typical Reverse Recovery Time vs. R_G

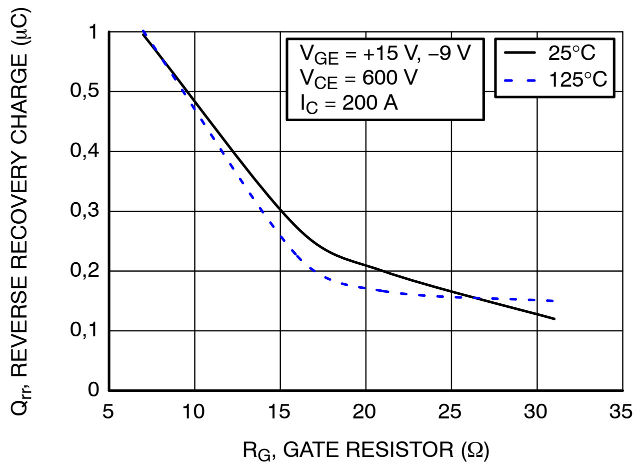


Figure 34. Typical Reverse Recovery Charge vs. R_G

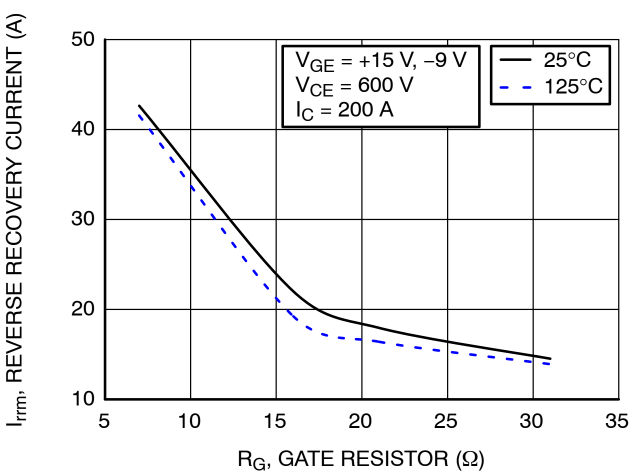


Figure 35. Typical Reverse Recovery Peak Current vs. R_G

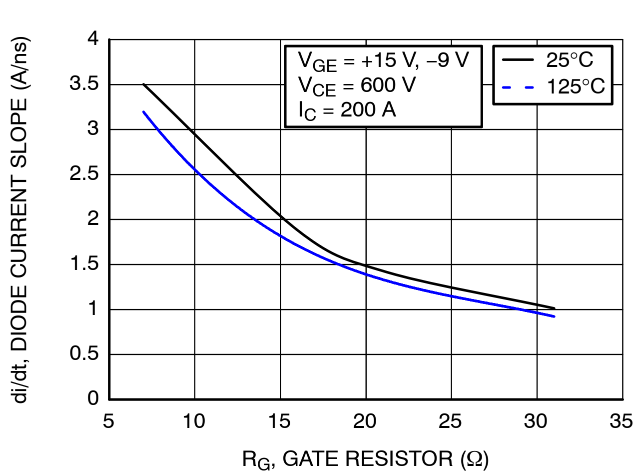


Figure 36. Typical di/dt vs. R_G

TYPICAL CHARACTERISTIC – T2 || D3,D4 OR T3 || D1,D2

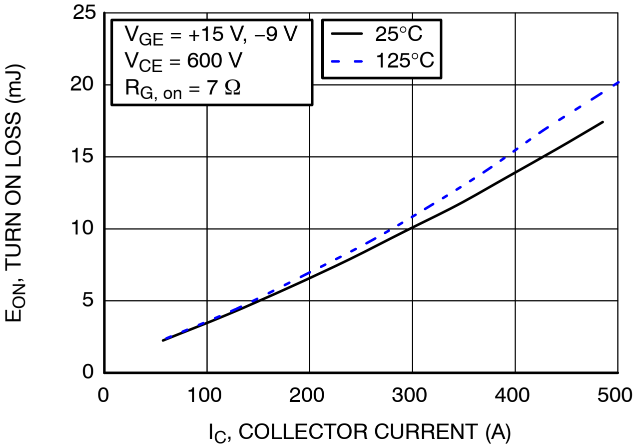


Figure 37. Typical Turn-On Loss vs. I_C

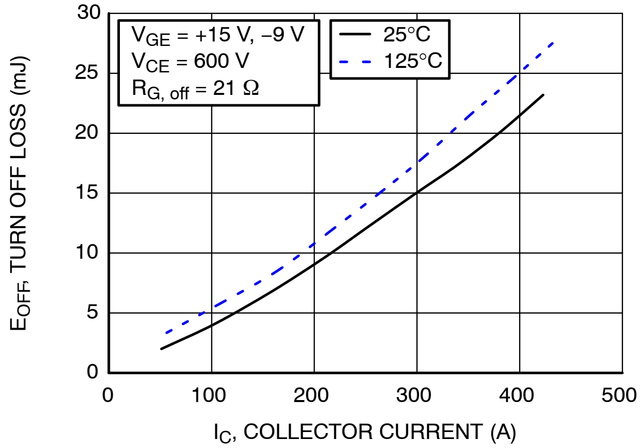


Figure 38. Typical Turn-Off Loss vs. I_C

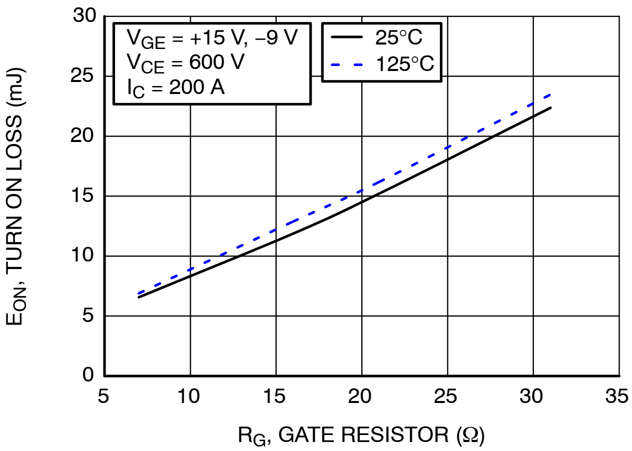


Figure 39. Typical Turn-On Loss vs. R_G

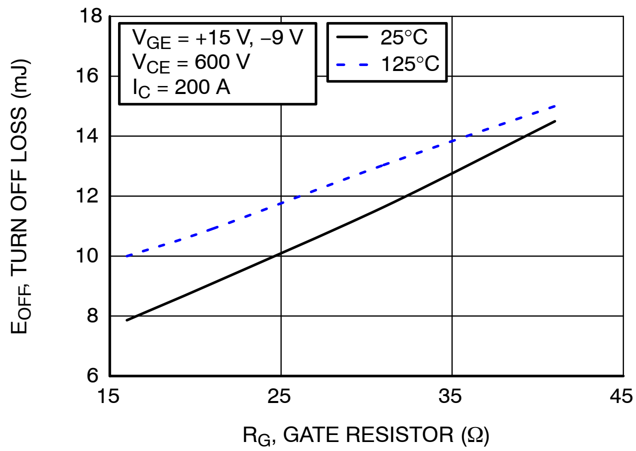


Figure 40. Typical Turn-Off Loss vs. R_G

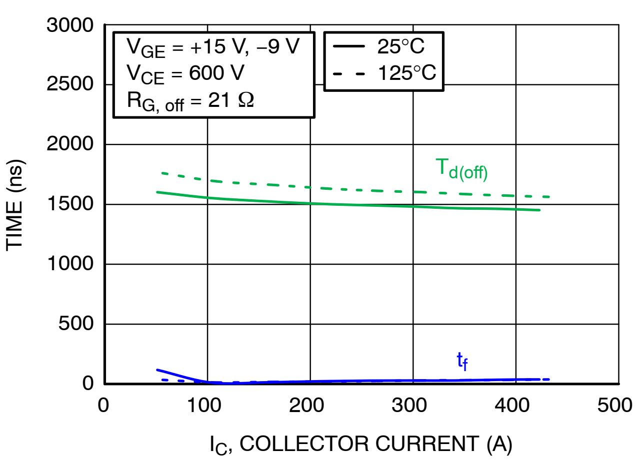


Figure 41. Typical Turn-Off Switching Time vs. I_C

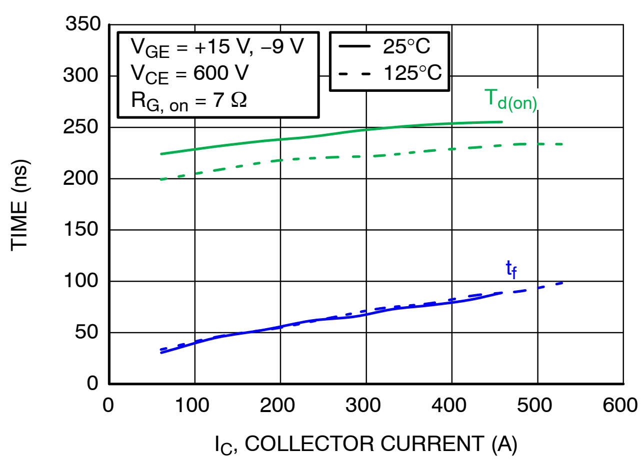


Figure 42. Typical Turn-On Switching Time vs. I_C

TYPICAL CHARACTERISTIC – T2 || D3,D4 OR T3 || D1,D2 (CONTINUED)

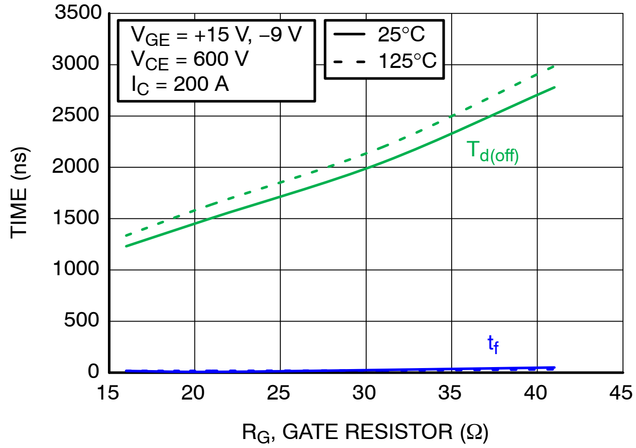


Figure 43. Typical Turn-Off Switching Time vs. R_G

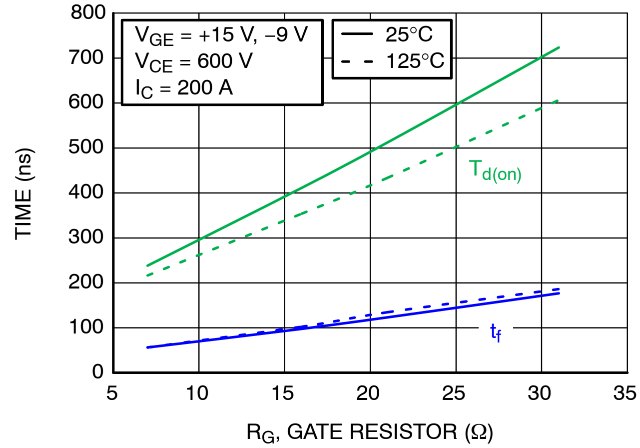


Figure 44. Typical Turn-On Switching Time vs. R_G

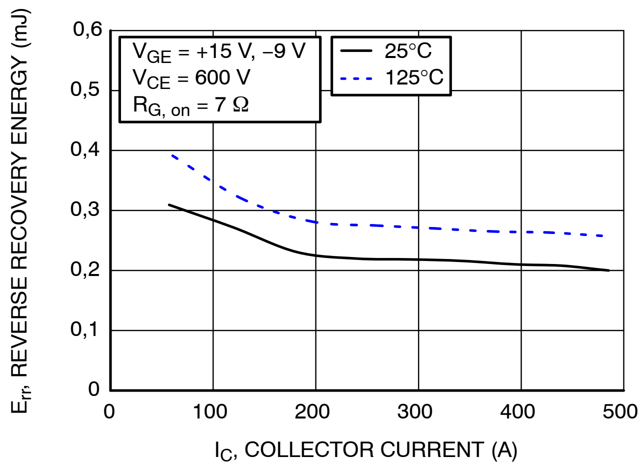


Figure 45. Typical Reverse Recovery Energy Loss vs. I_C

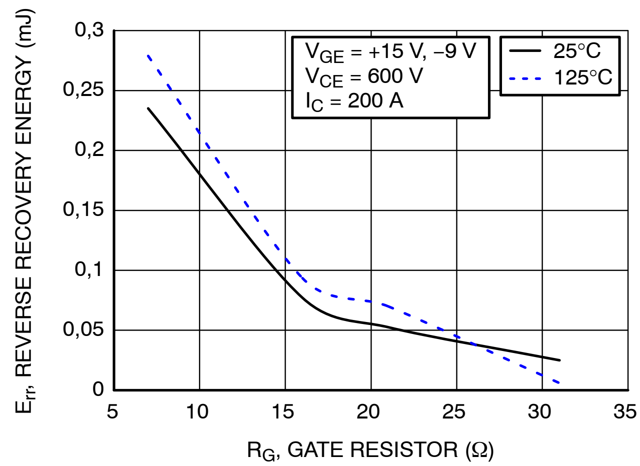


Figure 46. Typical Reverse Recovery Energy Loss vs. R_G

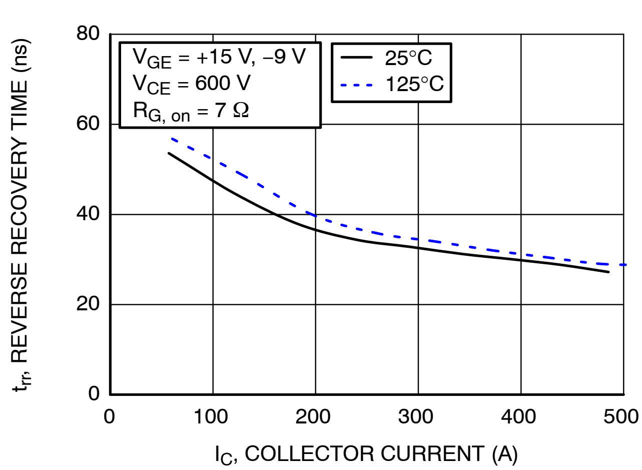


Figure 47. Typical Reverse Recovery Time vs. I_C

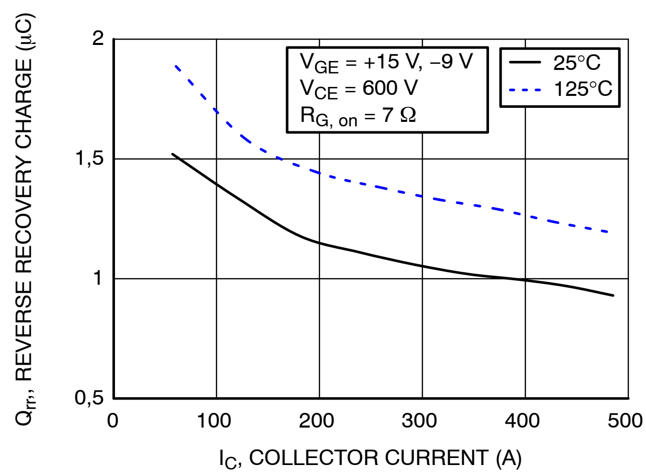


Figure 48. Typical Reverse Recovery Charge vs. I_C

TYPICAL CHARACTERISTIC – T2 || D3,D4 OR T3 || D1,D2 (CONTINUED)

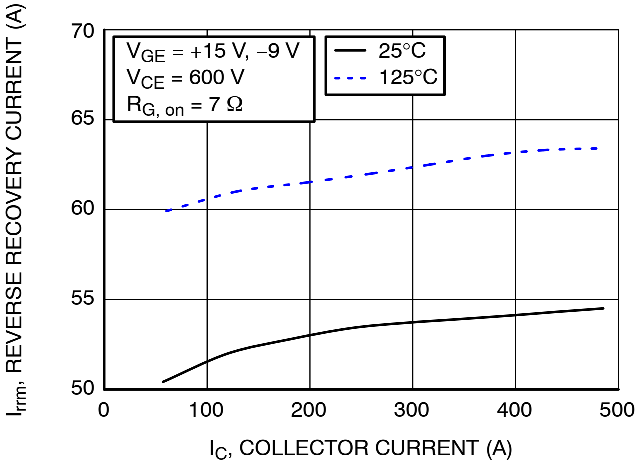


Figure 49. Typical Reverse Recovery Current vs. I_C

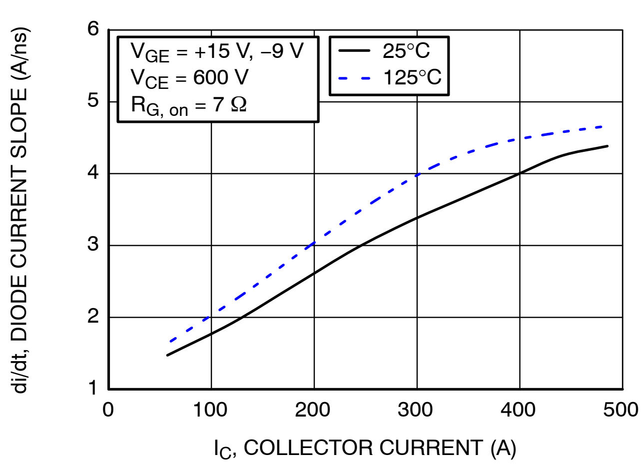


Figure 50. Typical di/dt vs. I_C

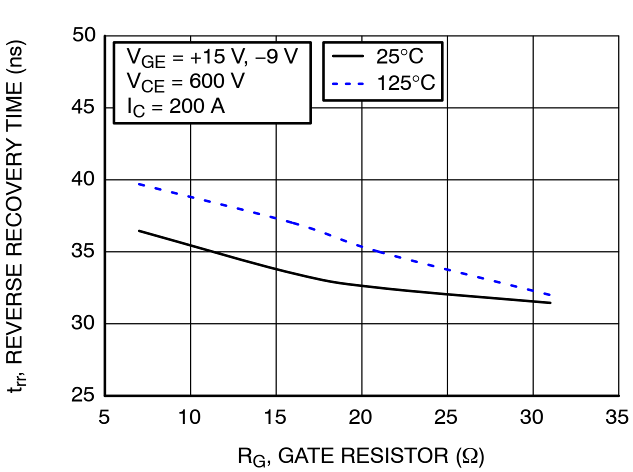


Figure 51. Typical Reverse Recovery Time vs. R_G

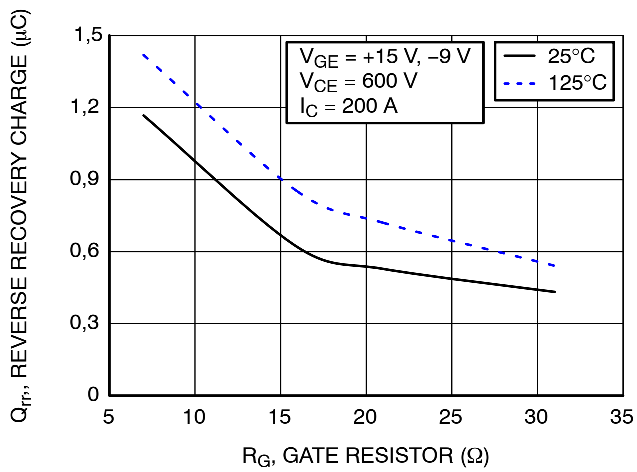


Figure 52. Typical Reverse Recovery Charge vs. R_G

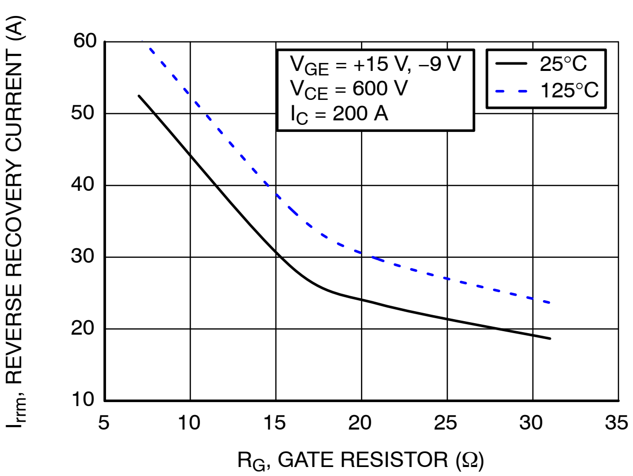


Figure 53. Typical Reverse Recovery Peak Current vs. R_G

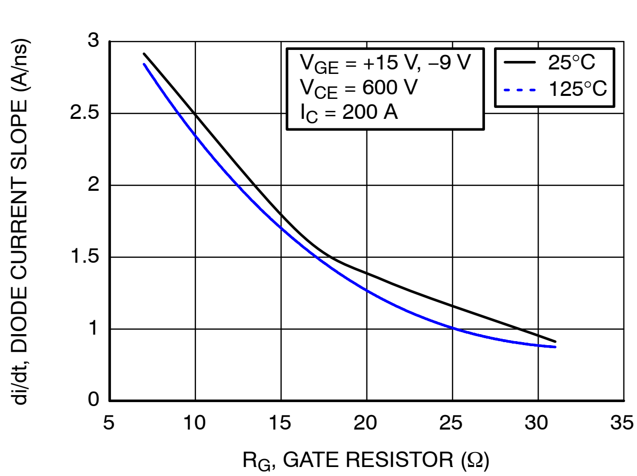
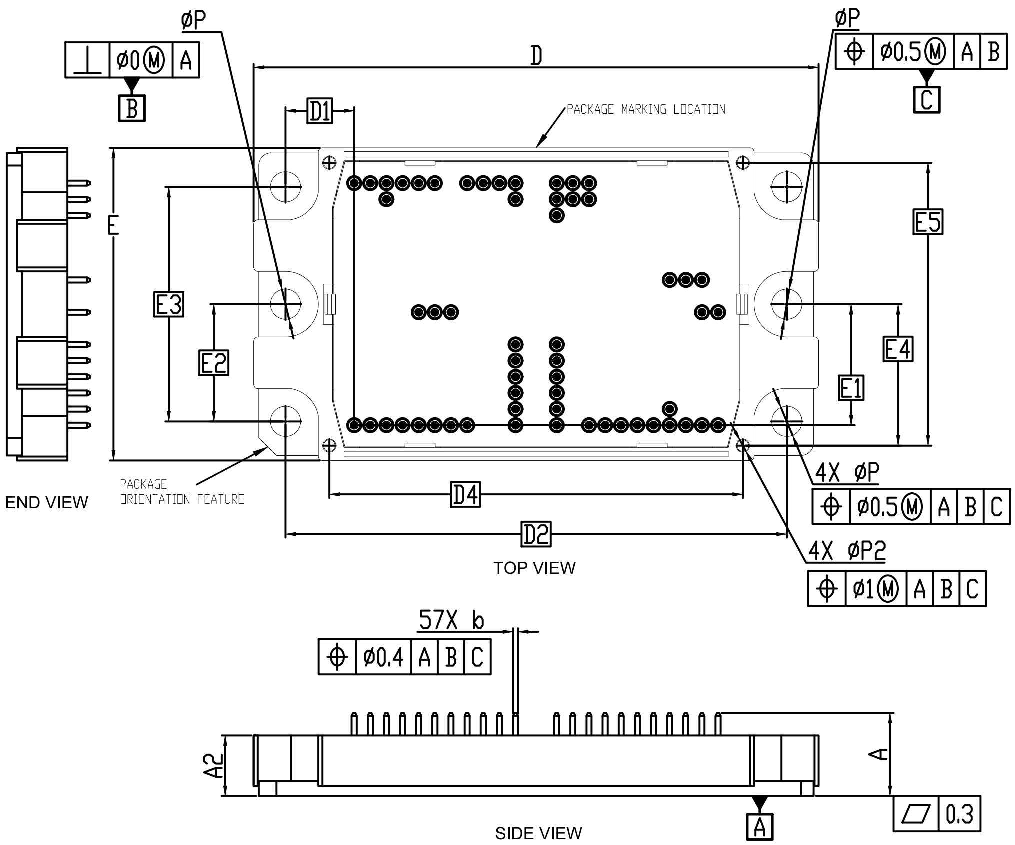


Figure 54. Typical di/dt vs. R_G

PACKAGE DIMENSIONS

PIM57 112.00x62.00x12.00
CASE 180CV
ISSUE O

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

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