

1200 V, 50 A Fast Field-Stop IGBT with SiC Diode

APT50GH120BSC20



Product Overview

1200 V, 50 A Fast Field-Stop IGBT with co-packaged, anti-parallel SiC diode, TO-247

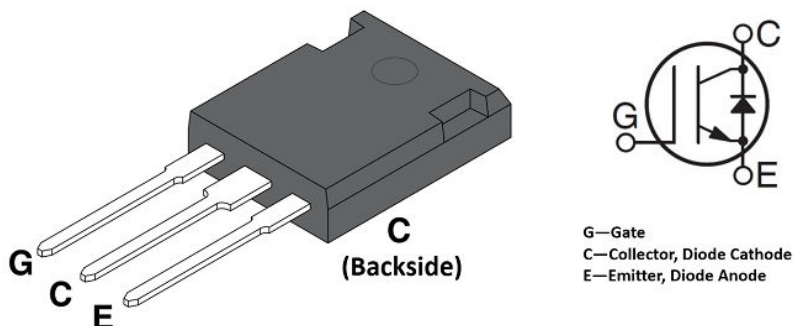


Table 1. Ordering Information

Catalog Part Number (CPN)	Package	Packing Media	Qualification
APT50GH120BSC20	TO-247	Tube	Industrial

Features

- Low conduction loss and saturation voltage
- Fast switching
- Low gate charge
- Ultrafast tail current shutoff
- No reverse recovery
- Reverse-bias safe operating area (RBSOA) rated
- Easy to parallel
- RoHS compliant
- Zero E_{on} switching loss from co-packaged, anti-parallel diode

1. Device Specifications: IGBT

This section shows the specifications of this device.

1.1. Absolute Maximum Ratings

The following table shows the absolute maximum ratings of this device. $T_C = 25\text{ }^\circ\text{C}$ unless otherwise specified.

Table 1-1. Absolute Maximum Ratings

Symbol	Parameter	Ratings	Unit
V_{CES}	Collector-emitter voltage	1200	V
V_{GE}	Gate-emitter voltage	± 20	
I_{C1}	Continuous collector current ¹ ($T_C = 25\text{ }^\circ\text{C}$)	119	A
I_{C2}	Continuous collector current ¹ ($T_C = 100\text{ }^\circ\text{C}$)	73	
I_{CM}	Pulsed collector current ² ($T_C = 175\text{ }^\circ\text{C}$)	200	
RBSOA	Reverse-bias safe operating area ($T_J = 150\text{ }^\circ\text{C}$, 960 V)	200	A
P_D	Total power dissipation	492	W

Notes:

- Limited by maximum lead temperature.
- Repetitive rating: Pulse width and case temperature are limited by the maximum junction temperature.

1.2. Thermal and Mechanical Characteristics

The following table shows the thermal and mechanical characteristics of this device.

Table 1-2. Thermal and Mechanical Characteristics

Symbol	Characteristic	Min.	Typ.	Max.	Unit
$R_{\theta JC}$	Junction-to-case thermal resistance (IGBT)		0.21	0.31	$^\circ\text{C}/\text{W}$
	Junction-to-case thermal resistance (diode)		0.65	0.95	
T_J, T_{STG}	Operating and storage junction temperature	-40		175	$^\circ\text{C}$
T_L	Lead temperature for 10 seconds			300	
τ_M	Mounting torque, M3 screw for heat sink attachment (requires 1, not included)		0.8		N·m
Wt	Package weight		6.2		g

1.3. Electrical Performance

The following table shows the static characteristics of this device. $T_C = 25\text{ }^\circ\text{C}$ unless otherwise specified.

Table 1-3. Static Characteristics

Symbol	Characteristic	Test Conditions	Min.	Typ.	Max.	Unit
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}, I_C = 0.8\text{ mA}$	4.7	5.5	6.2	V
$V_{CE(ON)}$	Collector-emitter on voltage	$V_{GE} = 15\text{ V}, I_C = 50\text{ A}$		1.7	2.2	
		$V_{GE} = 15\text{ V}, I_C = 50\text{ A}, T_J = 175\text{ }^\circ\text{C}$		2.1		
I_{CES}	Collector cut-off current ¹	$V_{CE} = 1200\text{ V}, V_{GE} = 0\text{ V}$			240	μA
		$V_{CE} = 1200\text{ V}, V_{GE} = 0\text{ V}, T_J = 175\text{ }^\circ\text{C}$		3600		
I_{GES}	Gate-emitter leakage current	$V_{GE} = \pm 20\text{ V}$			± 100	nA

Note:

1. I_{CES} includes both IGBT and diode leakages.

The following table shows the dynamic characteristics of this device. $T_C = 25\text{ }^\circ\text{C}$ unless otherwise specified.

Table 1-4. Dynamic Characteristics

Symbol	Characteristic	Test Conditions	Min.	Typ.	Max.	Unit	
C_{ies}	Input capacitance	$V_{GE} = 0\text{ V}, V_{CE} = 25\text{ V}, f = 200\text{ kHz}$		6885		pF	
C_{res}	Reverse transfer capacitance			95			
C_{oes}	Output capacitance			36			
V_{GEP}	Gate-to-emitter plateau voltage	$V_{GE} = 15\text{ V}, V_{CE} = 960\text{ V}, I_C = 50\text{ A}$		7.5		V	
Q_G	Total gate charge ¹			375			
Q_{GE}	Gate-emitter charge			46			
Q_{GC}	Gate-collector ("Miller") charge			143			
RBSOA	Reverse-bias safe operating area	$T_J = 175\text{ }^\circ\text{C}, R_G = 23\text{ }\Omega, V_{GE} = 15\text{ V}, V_{CE} = 800\text{ V}, L = 100\text{ }\mu\text{H}$	200			A	
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 800\text{ V}, V_{GE} = 15\text{ V}, I_C = 50\text{ A}, R_G = 5\text{ }\Omega, T_J = 25\text{ }^\circ\text{C}$		22		ns	
t_r	Current rise time			31			
$t_{d(off)}$	Turn-off delay time			222			
t_f	Current fall time			33			
E_{on}	Turn-on switching energy ²			2220			μJ
E_{off}	Turn-off switching energy ³			1470			
$t_{d(on)}$	Turn-on delay time		$V_{CC} = 800\text{ V}, V_{GE} = 15\text{ V}, I_C = 50\text{ A}, R_G = 5\text{ }\Omega, T_J = 175\text{ }^\circ\text{C}$		22		
t_r	Current rise time			31			
$t_{d(off)}$	Turn-off delay time			259			
t_f	Current fall time			51			
E_{on}	Turn-on switching energy ²			2300		μJ	
E_{off}	Turn-off switching energy ³			2440			

Notes:

1. See MIL-STD-750 Method 3471.
2. E_{on} is the clamped inductive turn-on-energy of this device; there is no contribution to E_{on} from the SiC diode. (See [Figure 1-19](#), [Figure 1-20](#)).
3. E_{off} is the clamped inductive turn-off energy measured in accordance with JEDEC standard JESD24-1. (See [Figure 1-19](#), [Figure 1-21](#).)

1.4. Typical Performance Curves: IGBT

Data for performance curves are characterized, not 100% tested.

Figure 1-1. Output Characteristics

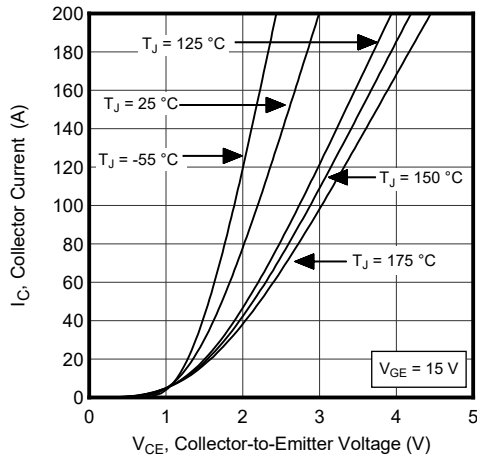


Figure 1-2. Transfer Characteristics

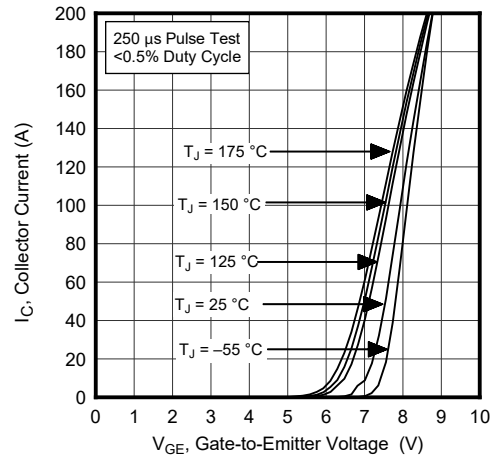


Figure 1-3. Gate Charge

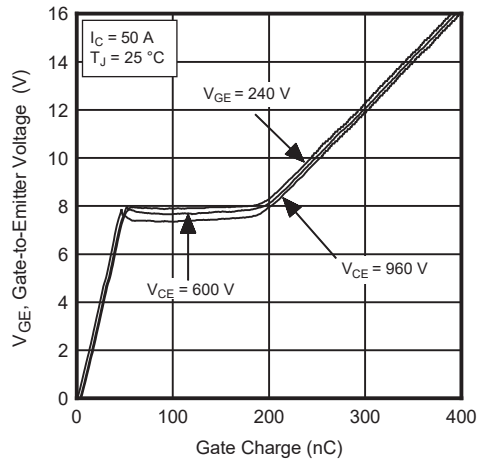


Figure 1-4. On-State Voltage vs. Gate-to-Emitter Voltage

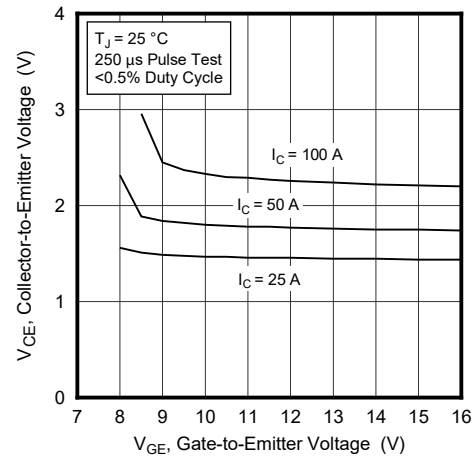


Figure 1-5. On-State Voltage vs. Junction Temperature

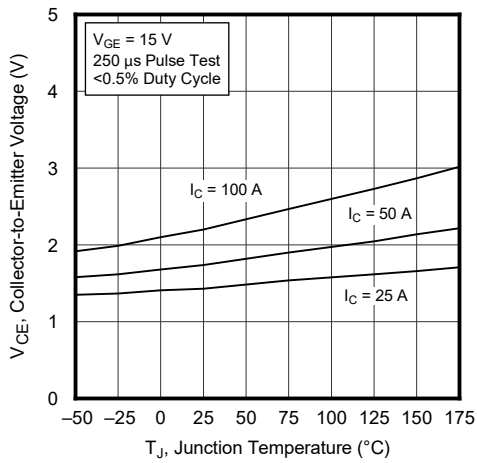


Figure 1-6. DC Collector Current vs. Case Temperature

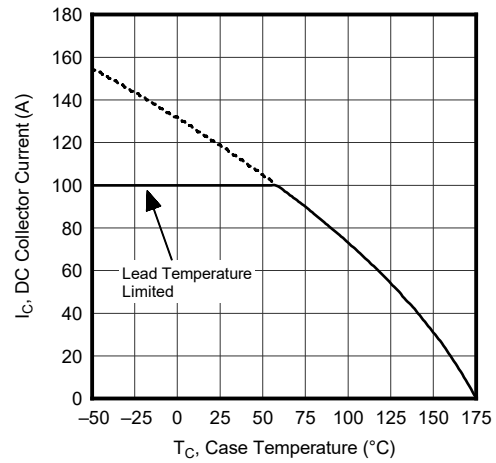


Figure 1-7. Turn-On Delay Time vs. Collector Current

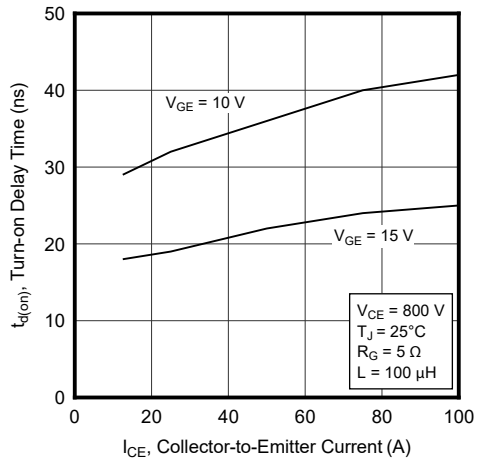


Figure 1-8. Turn-Off Delay Time vs. Collector Current

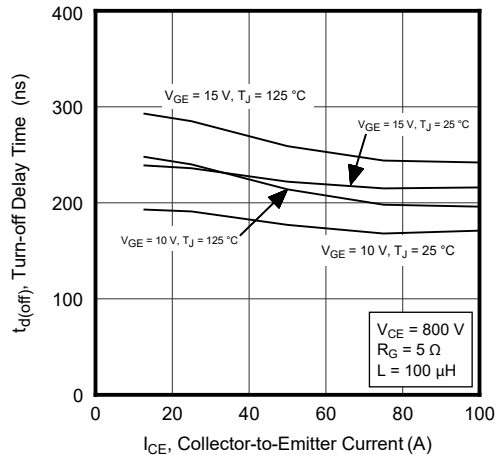


Figure 1-9. Current Rise Time vs. Collector Current

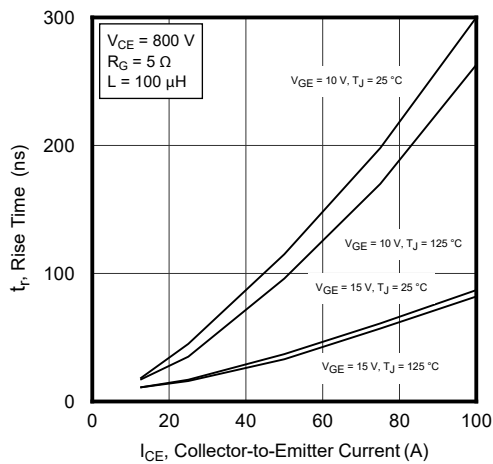


Figure 1-10. Current Fall Time vs. Collector Current

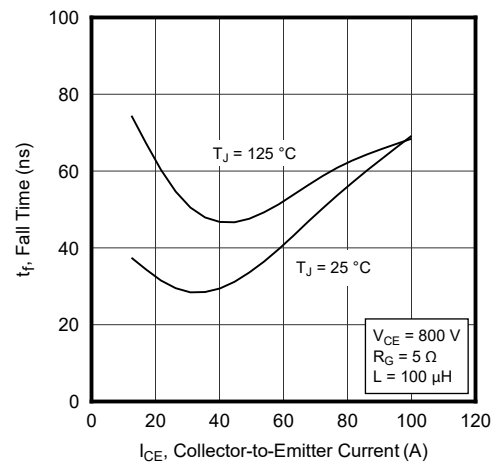


Figure 1-11. Turn-On Energy Loss vs. Collector Current

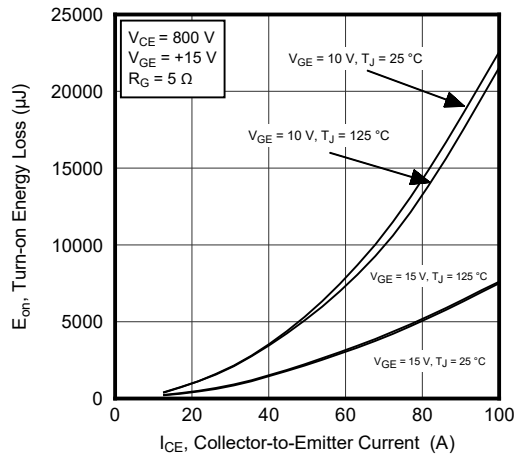


Figure 1-12. Turn-Off Energy Loss vs. Collector Current

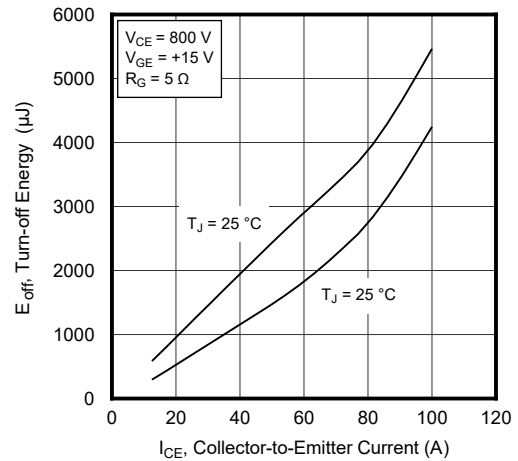


Figure 1-13. Switching Energy Losses vs. Gate Resistance

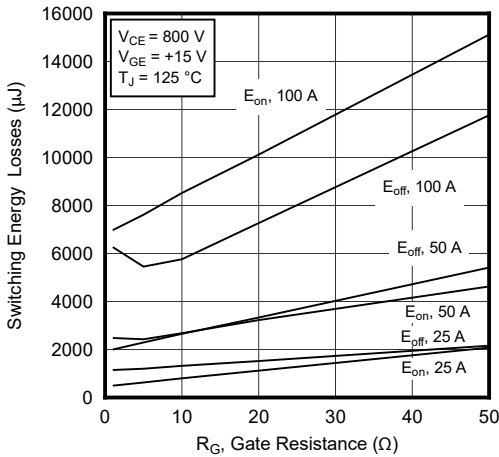


Figure 1-14. Switching Energy Losses vs. Junction Temperature

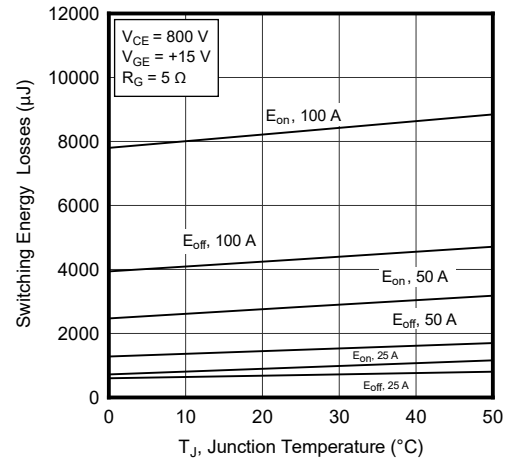


Figure 1-15. Capacitance vs. Collector-To-Emitter Voltage

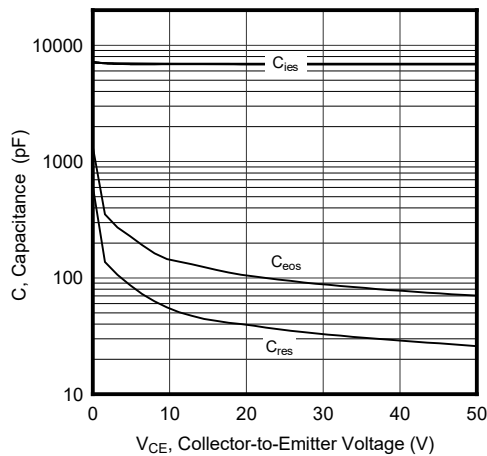


Figure 1-16. Reverse-bias Safe Operating Area

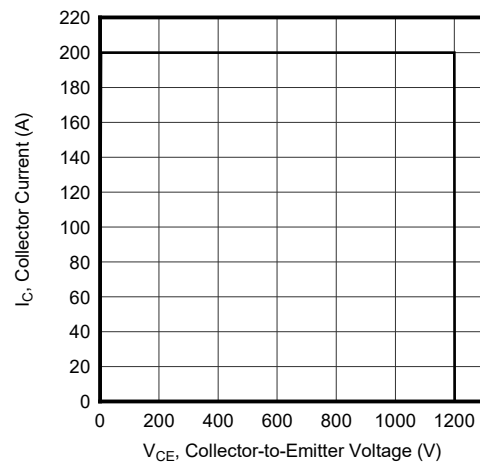


Figure 1-17. Maximum Transient Thermal Impedance

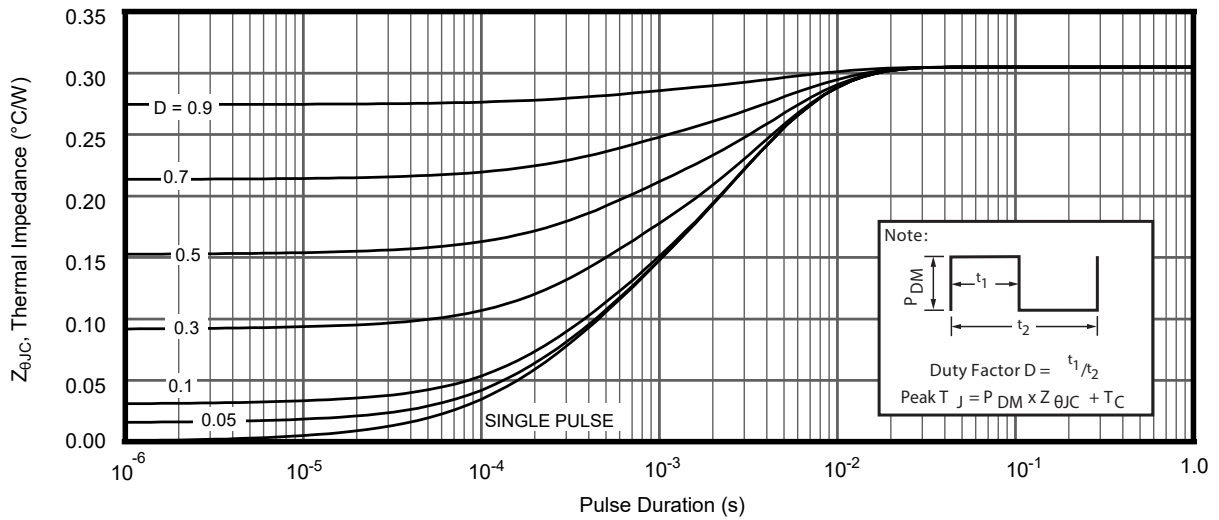


Figure 1-18. Transient Thermal Impedance Model

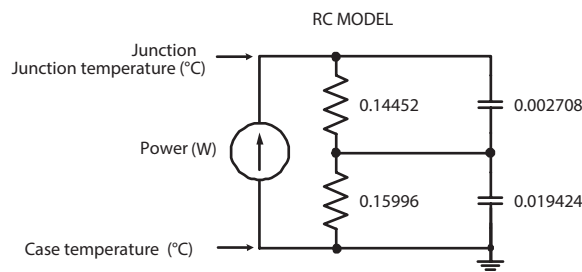


Figure 1-19. Inductive Switching Test Circuit

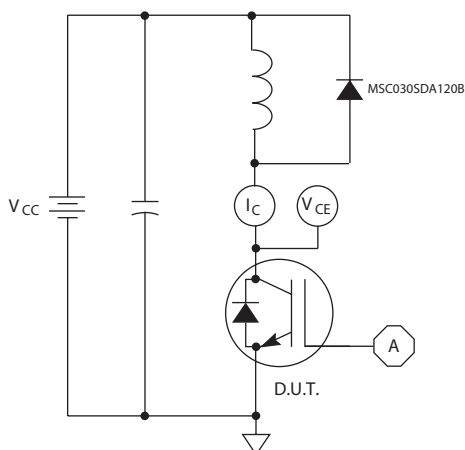


Figure 1-20. Turn-on Switching Waveform and Definitions

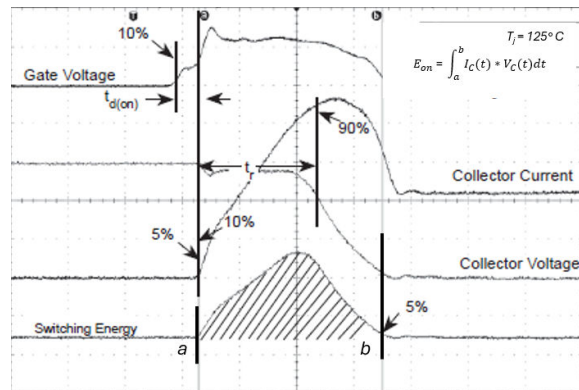
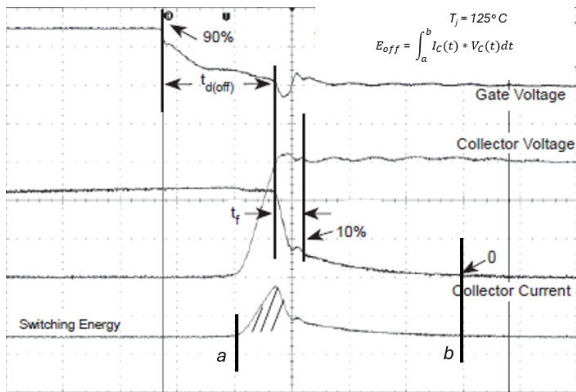


Figure 1-21. Turn-off Switching Waveform and Definitions



2. Device Specifications: Zero-Recovery SiC Anti-Parallel Diode

This section shows the specifications of the co-packaged, anti-parallel diode.

2.1. Absolute Maximum Ratings

The following table shows the absolute maximum ratings of the anti-parallel diode. $T_C = 25\text{ }^\circ\text{C}$ unless otherwise specified.

Table 2-1. Absolute Maximum Ratings

Symbol	Parameter	Ratings	Unit
I_F	Maximum DC forward current ($T_C = 25\text{ }^\circ\text{C}$)	49	A
	Maximum DC forward current ($T_C = 135\text{ }^\circ\text{C}$)	22	
	Maximum DC forward current ($T_C = 145\text{ }^\circ\text{C}$)	18	
I_{FRM}	Repetitive peak forward surge current ($t_p = 8.3\text{ ms}$, half sine wave)	64	
I_{FSM}	Non-repetitive forward surge current ($t_p = 8.3\text{ ms}$, half sine wave)	115	
P_{TOT}	Total power dissipation ($T_C = 25\text{ }^\circ\text{C}$)	186	W
	Total power dissipation ($T_C = 110\text{ }^\circ\text{C}$)	80	

2.2. Electrical Performance

The following table shows the static characteristics of the anti-parallel diode.

Table 2-2. Static Characteristics

Symbol	Characteristic	Test Conditions	Min.	Typ.	Max.	Unit
V_F	Forward voltage	$I_F = 20\text{ A}$, $T_C = 25\text{ }^\circ\text{C}$		1.5	1.8	V
		$I_F = 20\text{ A}$, $T_C = 175\text{ }^\circ\text{C}$		2.0		

2.3. Typical Performance Curves

Data for performance curves are characterized, not 100% tested.

Figure 2-1. Maximum Transient Thermal Impedance

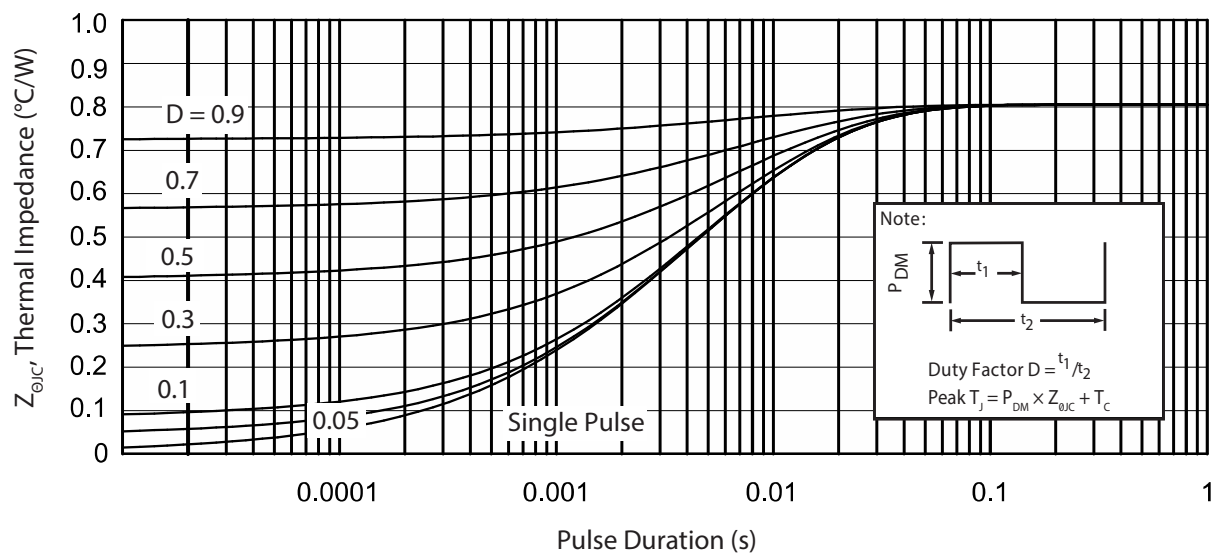


Figure 2-2. Forward Current vs. Forward Voltage

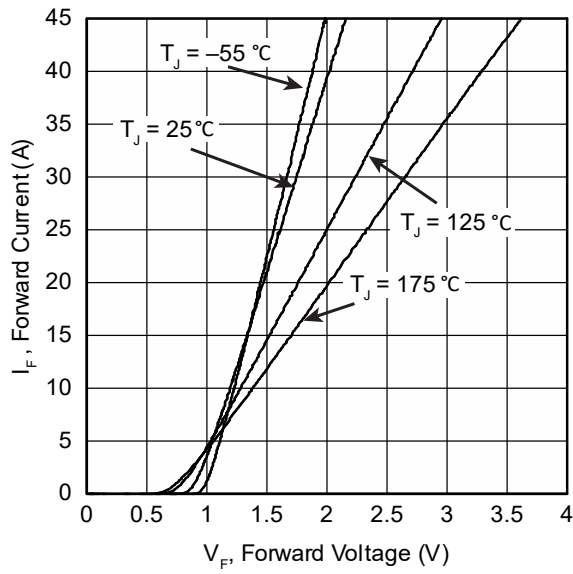


Figure 2-3. Max. Forward Current vs. Case Temp.

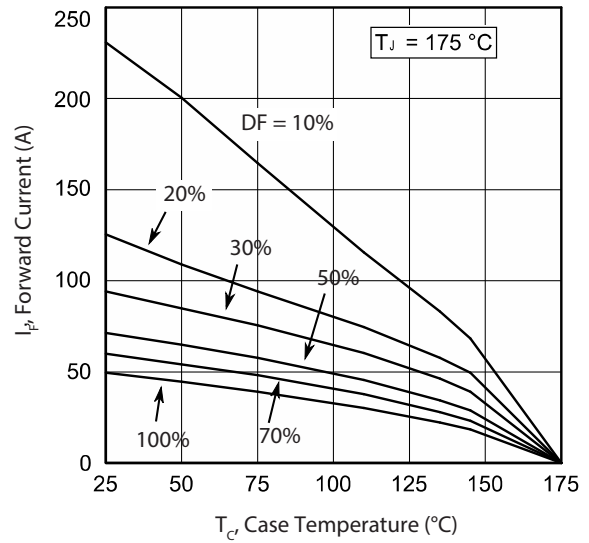


Figure 2-4. Max. Power Dissipation vs. Case Temp.

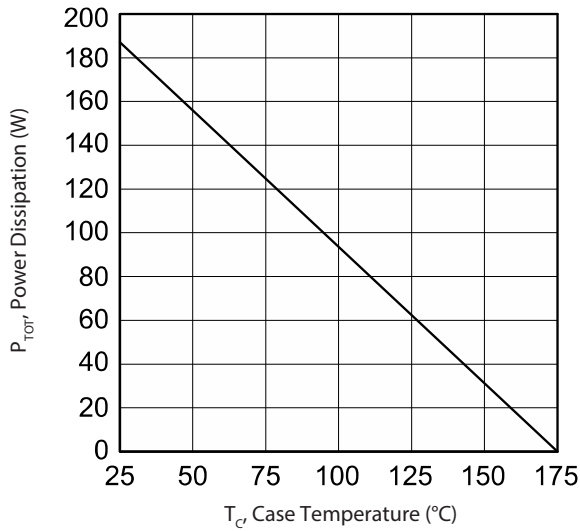


Figure 2-5. Total Capacitive Charge vs. Reverse Voltage

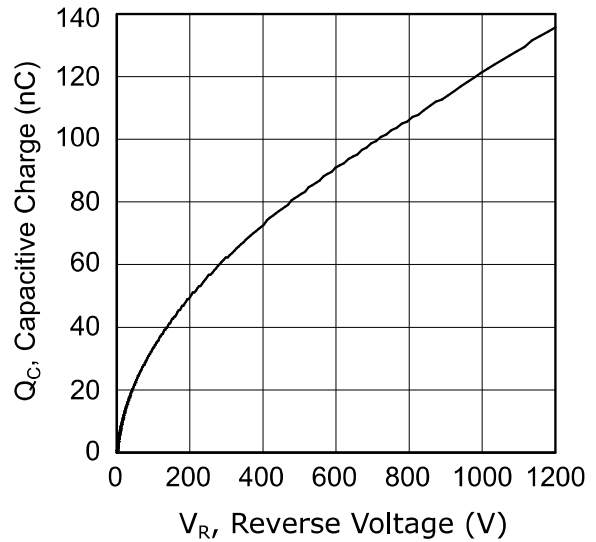


Table 3-1. TO-247 Dimensions (continued)

Dimension Limits		Dimensions (mm)	
		Min.	Max.
Lead thickness	c	0.41	0.79
Lead length	L	19.81	20.32
Lead shoulder length	L1	3.99	4.50
Molded body length	D	20.80	21.46
Thermal pad length	D1	16.25	17.65
Total width	E	15.49	16.26
Thermal pad width	E1	13.10	14.50
Hole center to tab edge	Q	6.15 REF	
Hole diameter	ØP	3.51	3.81
Thermal pad hole diameter	ØP1	7.18 REF	

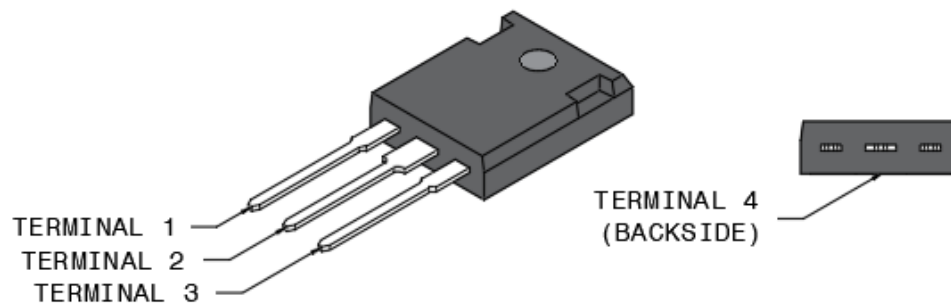
Notes: Dimensioning and tolerancing per ASME Y14.5M

- BSC: Basic dimension—Theoretically exact value shown without tolerances.
- REF: Reference dimension—Usually without tolerance, for information purposes only.

3.2. Terminal Pinout

The following figure illustrates the terminal pinout of this device.

Figure 3-2. Terminal Pinout



The following table shows the electrical signal terminal pinout of this device.

Table 3-2. Electrical Signal Terminal Pinout

Terminal	Definition
TERMINAL 1	Gate
TERMINAL 2	Collector, Diode Cathode
TERMINAL 3	Emitter, Diode Anode
TERMINAL 4	Collector, Diode Cathode

4. Revision History

The revision history describes the changes that were implemented in the document. The changes are listed by revision, starting with the most current publication.

Table 4-1. Revision History

Revision	Date	Description
A	07/2025	Document created.

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