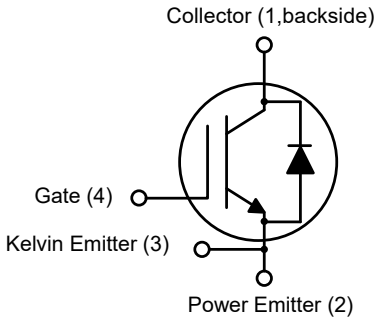
BGH50N65ZF1

Hybrid SiC Discrete Devices

Product Summary

V_{CE}	650V
I_C	50A @T_C=100°C
$V_{CE(sat).Typ}$	1.55V @I_C=50A

Package: TO-247-4



Trench Field Stop IGBT Co-packed with SiC Schottky Barrier Diode

Features

- Low $V_{CE(sat)}$
- Trench FS Technology
- High Speed Switching
- Hybrid SiC Discrete Device
- Halogen Free, RoHS Complian

Applications

- UPS
- PV Inverter
- Welding Machine
- On-board Charger
- Totem Pole Bridgeless PFC

Package Pin Definitions

- Pin1 and backside - Collector
- Pin2 - Power Emitter
- Pin3 - Kelvin Emitter
- Pin4 - Gate

Package Parameters

Part Number	Marking	Package
BGH50N65ZF1	BGH50N65ZF1	TO-247-4

Maximum Ratings(T_C=25°C Unless Otherwise Noted)

Symbol	Parameter		Value	Unit
V_{CE}	Collector-Emitter Breakdown Voltage		650	V
V_{GE}	Continuous Gate-Emitter Voltage		±20	
	Transient Gate-Emitter Voltage		±30	
I_C	DC Collector Current, limited by T_{jmax}	T_C=25°C	100	A
		T_C=100°C	50	
I_F	Diode Forward Current, limited by T_{jmax}	T_C=25°C	50	A
		T_C=100°C	34	
$I_{C,pulse}$	Pulse Collector Current	V_{GE}=15V, limited by T_{jmax}	200	A
P_{tot}	Power Dissipation	T_C=25°C	357	W
T_j	Operating Junction Temperature		-40~175	°C
T_{stg}	Storage Temperature		-55~150	°C
M_d	TO-247 mounting torque	M3 Screw	0.7	Nm

Thermal Characteritics

Symbol	Parameter	Value	Unit
$R_{th(j-c)}$	IGBT Thermal Resistance-Junction to Case	0.42	K/W
$R_{th(j-c)}$	Diode Thermal Resistance-Junction to Case	0.81	K/W
$R_{th(j-a)}$	Thermal Resistance-Junction to Ambient	32	K/W

Electrical Characteristics (Defined at T_j=25°C Unless Otherwise Specified)
IGBT Static Characteristics

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	V_{GE}=15V, I_C=50A	T_j=25°C		1.55	2.1	V
			T_j=100°C		1.75		
			T_j=175°C		2		
I_{CES}	Zero Gate Voltage Collector Current	V_{CE}=650V, V_{GE}=0V	T_j=25°C		2	100	μA
			T_j=175°C		110	2000	
		V_{CE}=480V, V_{GE}=0V	T_j=25°C			80	
$V_{GE(th)}$	Gate Threshold Voltage	V_{GE}=V_{CE}, I_C=500μA	T_j=25°C	4.2	5	5.8	V
I_{GES}	Gate-Emitter Leakage Current	V_{CE}=0V, V_{GE}=±20V	T_j=25°C			100	nA
g_{fs}	Transconductance	V_{CE}=20V, I_C=50A			82		S

Dynamic Characteristics

Symbol	Parameter	Test conditions	Value			Unit
			Min.	Typ.	Max.	
C_{ies}	Input Capacitance	V_{GE}=0V, V_{CE}=25V f=250kHz		5692		pF
C_{oes}	Output Capacitance			339		pF
C_{res}	Reverse Transfer Capacitance			95		pF
Q_G	Total Gate Charge	V_{CC}=520V, V_{GE}=15V, I_C=50A		308		nC

Switching Characteristics, Inductive Load

Symbol	Parameter	Test conditions	Value			Unit
			Min.	Typ.	Max.	
$t_{d(on)}$	Turn-On Delay Time	T_j=25°C V_{DC}=400V, I_C=25A V_{GE}=0/15V, $R_{G(ext)}$=10Ω L_σ=70nH		35		ns
t_r	Rise Time			15		
$t_{d(off)}$	Turn-Off Delay Time			363		
t_f	Fall Time			47		
E_{on}	Turn-On Energy			202		uJ
E_{off}	Turn-Off Energy			382		
E_{total}	Total Switiching Energy			584		
$t_{d(on)}$	Turn-On Delay Time	T_j=150°C V_{DC}=400V, I_C=25A V_{GE}=0/15V, $R_{G(ext)}$=10Ω L_σ=70nH		31		ns
t_r	Rise Time			16		
$t_{d(off)}$	Turn-Off Delay Time			428		
t_f	Fall Time			72		
E_{on}	Turn-On Energy			235		uJ
E_{off}	Turn-Off Energy			554		
E_{total}	Total Switiching Energy			789		

Switching Characteristics, Inductive Load

Symbol	Parameter	Test conditions	Value			Unit
			Min.	Typ.	Max.	
$t_{d(on)}$	Turn-On Delay Time	T_j=25°C V_{DC}=400V, I_C=50A V_{GE}=0/15V, $R_{G(ext)}$=10Ω L_σ=70nH		38		ns
t_r	Rise Time			23		
$t_{d(off)}$	Turn-Off Delay Time			342		
t_f	Fall Time			24		
E_{on}	Turn-On Energy			409		uJ
E_{off}	Turn-Off Energy			720		
E_{total}	Total Switiching Energy			1129		
$t_{d(on)}$	Turn-On Delay Time	T_j=150°C V_{DC}=400V, I_C=50A V_{GE}=0/15V, $R_{G(ext)}$=10Ω L_σ=70nH		34		ns
t_r	Rise Time			20		
$t_{d(off)}$	Turn-Off Delay Time			410		
t_f	Fall Time			66		
E_{on}	Turn-On Energy			427		uJ
E_{off}	Turn-Off Energy			773		
E_{total}	Total Switiching Energy			1200		

SiC Schottky Barrier Diode Characteristics

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
V_F	Diode Forward Voltage	V_{GE}=0V, I_F=15A	T_j=25°C		1.39	1.7	V
			T_j=100°C		1.43		
			T_j=175°C		1.65		
Q_C	Diode Capacitive Charge	V_R=400V,T_j=25°C			46		nC
C	Diode Capacitance	V_R=1V, f=1MHz			713		pF
		V_R=300V, f=1MHz			79		

Typical Performance

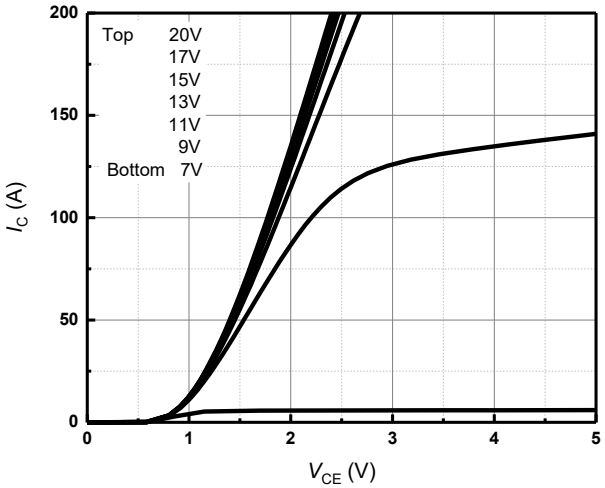


Figure 1 Output Characteristics (T_j=25°C)

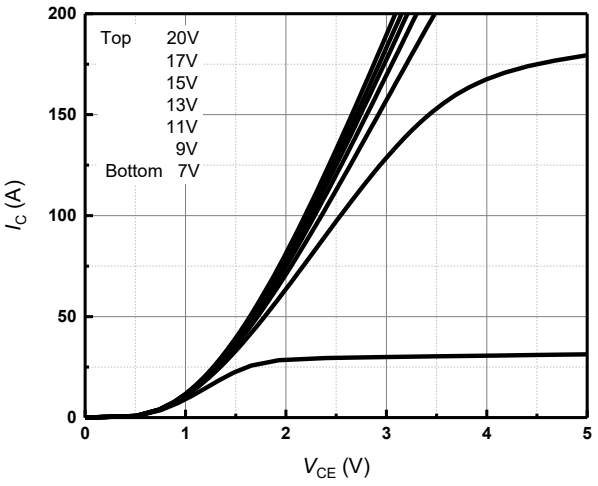


Figure 2 Output Characteristics (T_j=150°C)

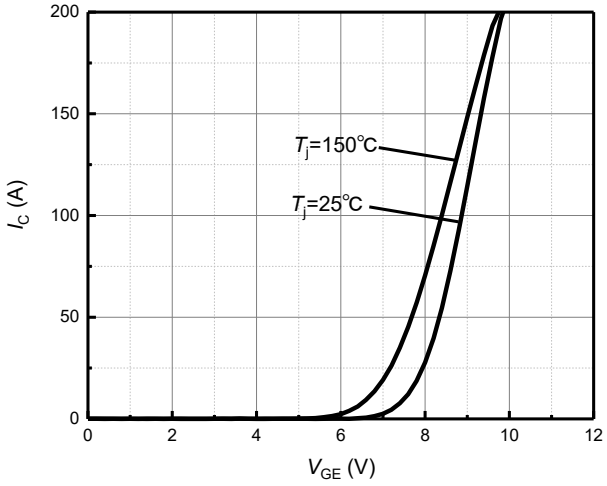


Figure 3 Transfer Characteristics for Various Temperature (V_{CE}=20V)

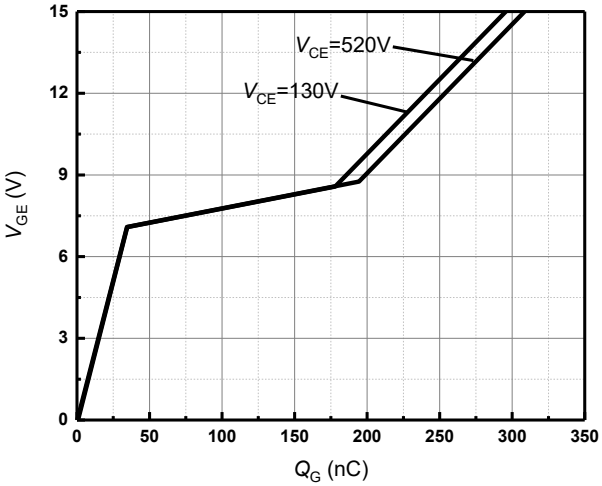


Figure 4 Gate Charge Characteristics (I_C=50A)

Typical Performance

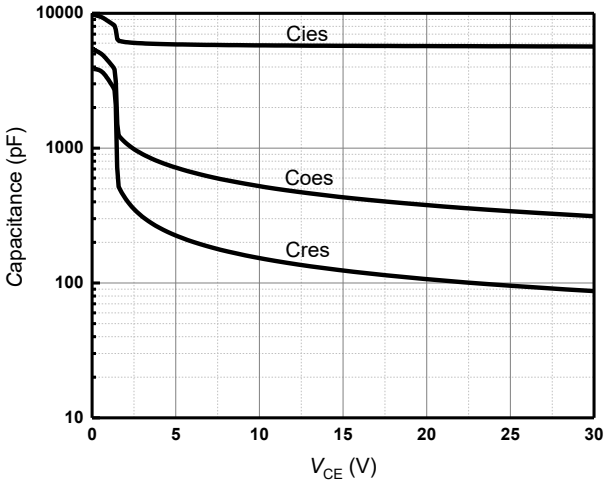


Figure 5 Capacitance Characteristics (V_{GE}=0V, f=250kHz)

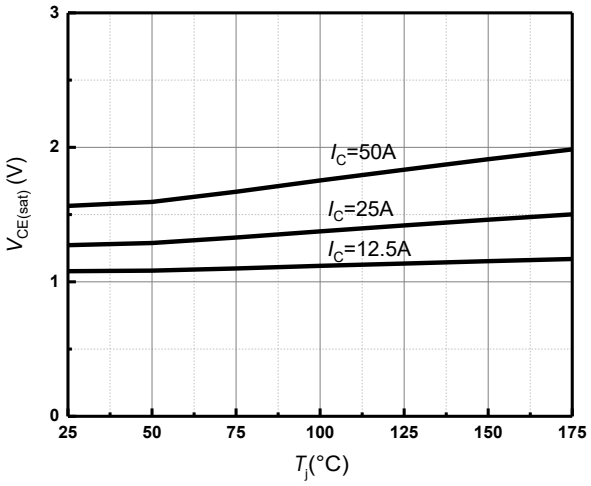


Figure 6 Collector-Emitter Saturation Voltage vs. Junction Temperature for Various Collector Current (V_{GE}=15V)

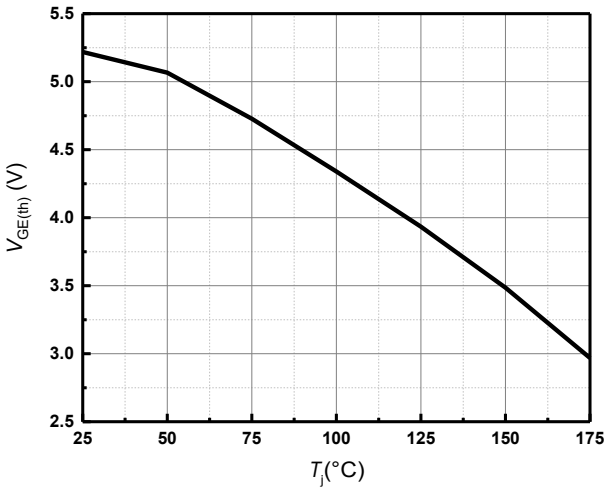


Figure 7 Gate-Emitter threshold Voltage vs. Junction Temperature (I_C=0.5mA)

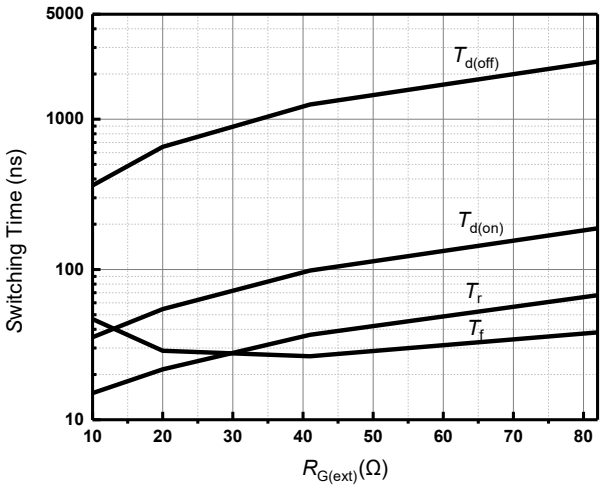


Figure 8 Switching Times vs. Gate Resistor (V_{DC}=400V, V_{GE}=0/15V, I_C=25A, T_j=25°C)

Typical Performance

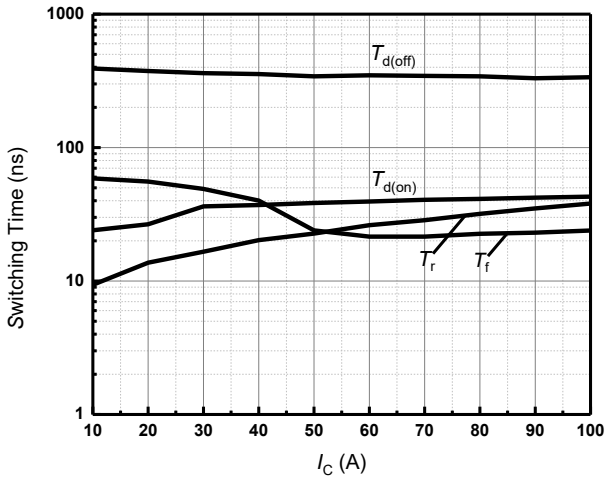


Figure 9 Switching Times vs. Collector Current(V_{DC}=400V, V_{GE}=0/15V, $R_{G(ext)}$=10Ω, T_j=25°C)

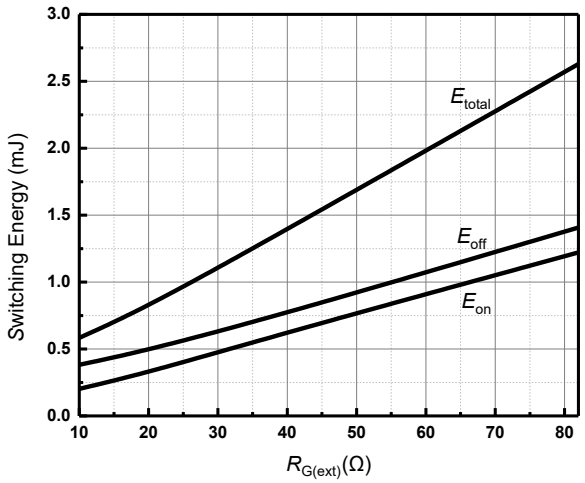


Figure 10 Switching Loss vs. Gate Resistor (V_{DC}=400V, V_{GE}=0/15V, I_C=25A, T_j=25°C)

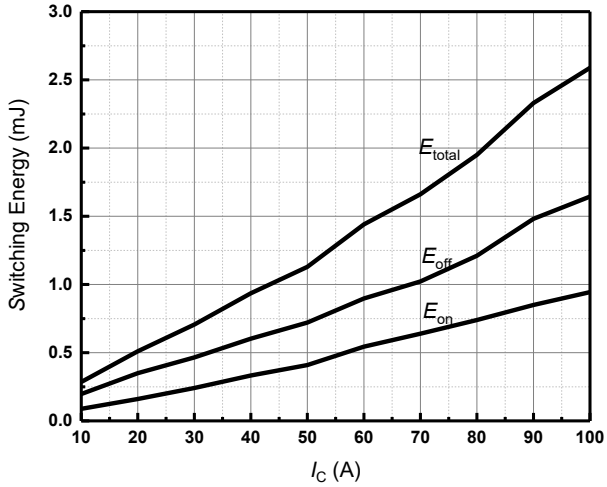


Figure 11 Switching Loss vs. Collector Current (V_{DC}=400V, V_{GE}=0/15V, $R_{G(ext)}$=10Ω, T_j=25°C)

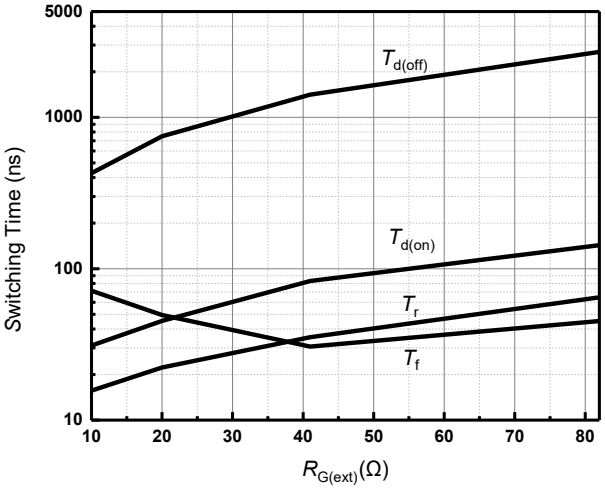


Figure 12 Switching Times vs. Gate Resistor (V_{DC}=400V, V_{GE}=0/15V, I_C=25A, T_j=150°C)

Typical Performance

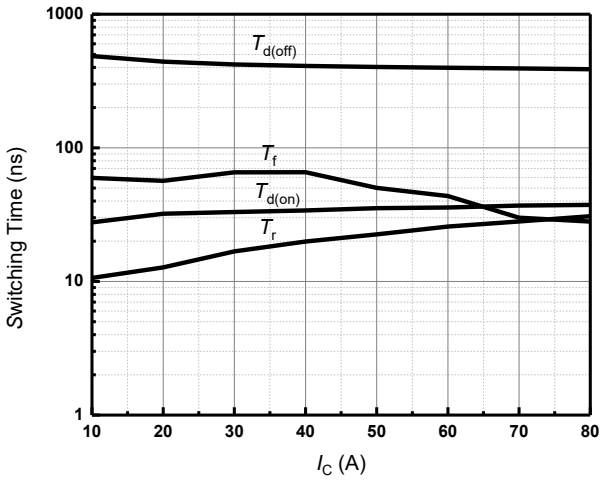


Figure 13 Switching Times vs. Collector Current (V_{DC}=400V, V_{GE}=0/15V, $R_{G(ext)}$=10Ω, T_j=150°C)

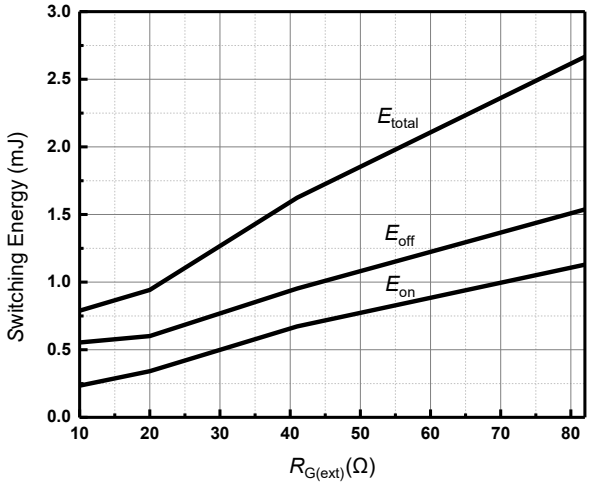


Figure 14 Switching Loss vs. Gate Resistor (V_{DC}=400V, V_{GE}=0/15V, I_C=25A, T_j=150°C)

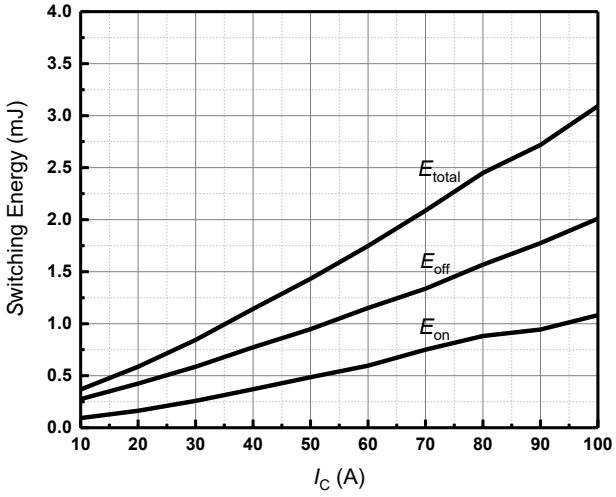


Figure 15 Switching Loss vs. Collector Current (V_{DC}=400V, V_{GE}=0/15V, $R_{G(ext)}$=10Ω, T_j=150°C)

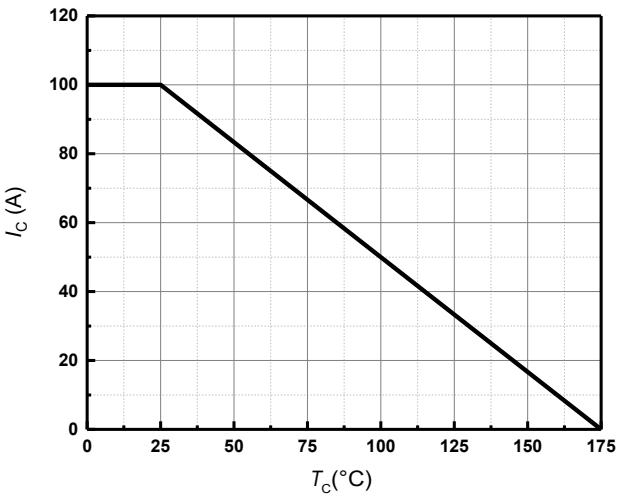


Figure 16 Maximum Collector current vs. Case Temperature

Typical Performance

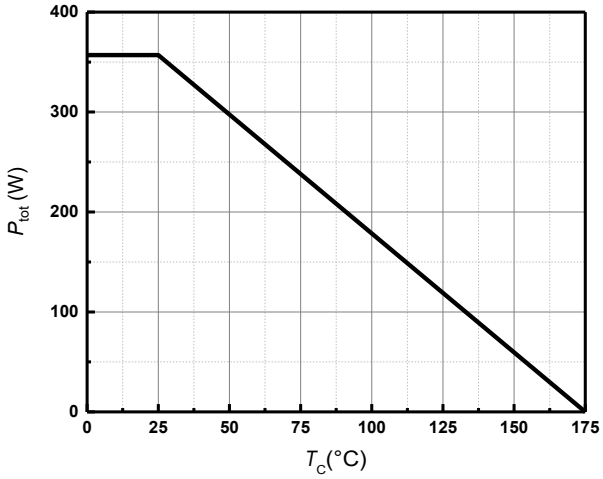


Figure 17 Power Dissipation as a Funcation of T_c

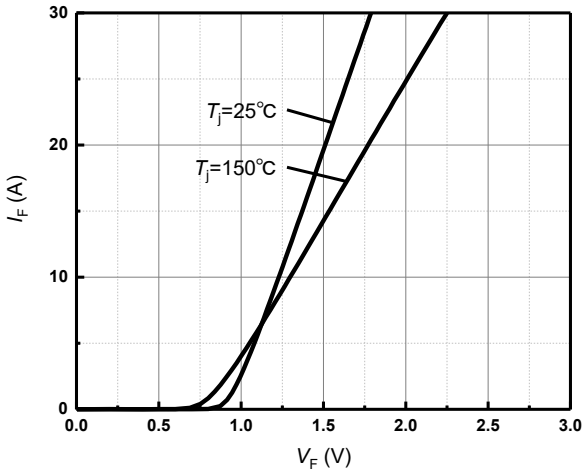


Figure 18 Forward characteristic of Diode

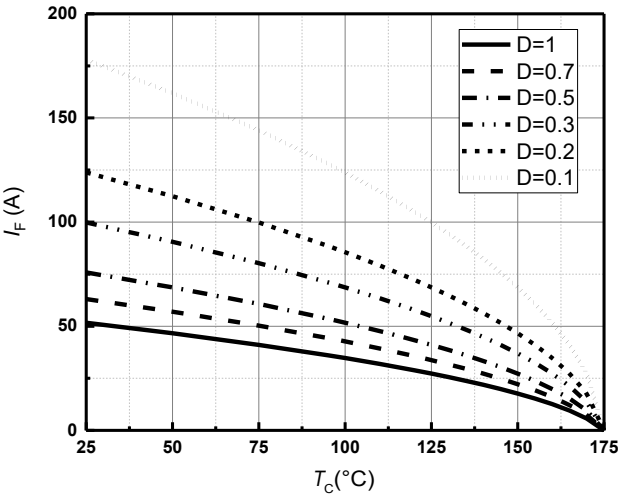


Figure 19 Diode forward current as function of temperature, D=duty cycle

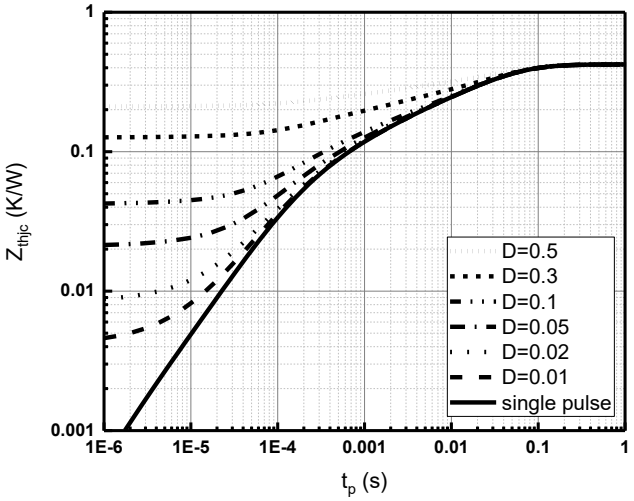


Figure 20 IGBT Transient Thermal Response Curve

Typical Performance

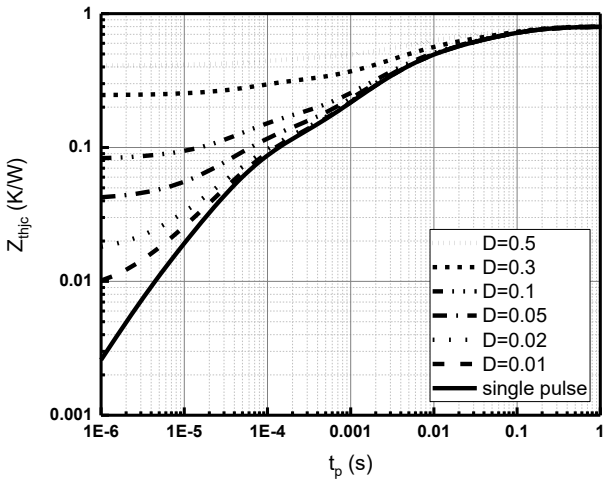
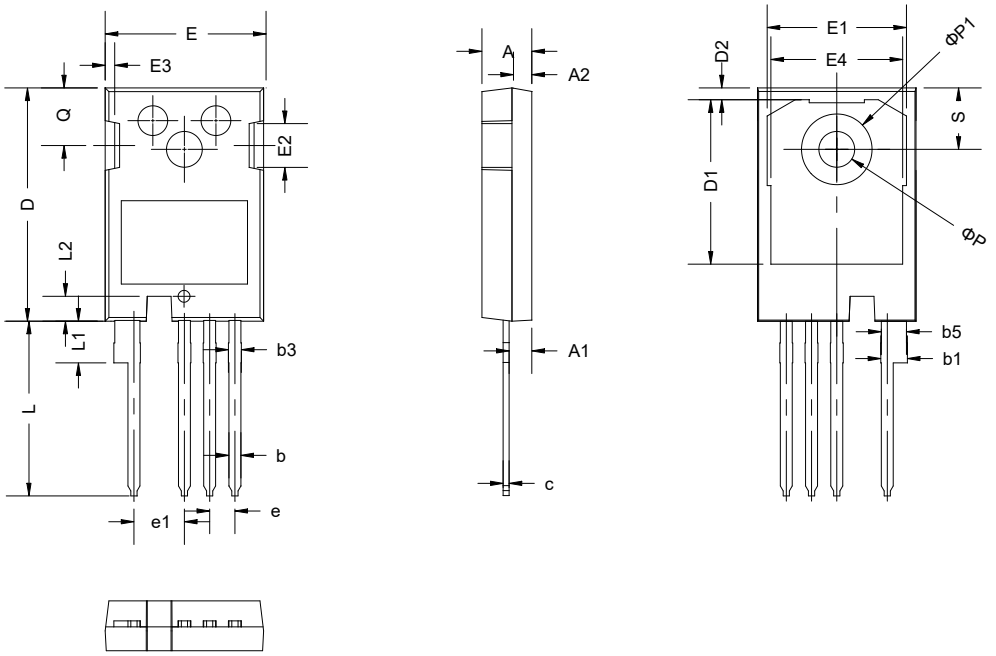


Figure 21 Diode Transient Thermal Response Curve

Package Dimensions



SYMBOL	mm		
	MIN	NOM	MAX
A	4.83	5.02	5.21
A1	2.29	2.41	2.54
A2	1.91	2.00	2.16
b	1.07	1.20	1.33
b1	2.39	2.67	2.84
b3	1.07	1.30	1.60
b5	2.39	2.53	2.69
c	0.55	0.60	0.68
D	23.30	23.45	23.60
D1	16.25	16.55	17.65
D2	0.95	1.19	1.25
E	15.75	15.94	16.13
E1	13.10	14.02	14.15
E2	3.68	4.40	5.10
E3	1.00	1.45	1.90
E4	12.38	13.26	13.43
e		2.54 BSC	
e1		5.08 BSC	
L	17.31	17.57	17.82
L1	3.97	4.19	4.37
L2	2.35	2.50	2.65
ϕP	3.51	3.61	3.65
ϕP1		7.19 REF	
Q	5.49	5.79	6.00
S	6.04	6.17	6.30

Revision History

Document Version	Date of Release	Description of Changes
Rev. 0.0	2022-10-11	Draft datasheet created.
Rev. 0.1	2023-05-05	Update features.

BASiC Semiconductor Ltd.
Shenzhen, China

Information

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