

Product Summary

V_{CE}	650V
I_C	50A @$T_c=100^\circ\text{C}$
$V_{CE(sat),Typ}$	1.55V @$I_c=50\text{A}$

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 Compliant

Applications

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

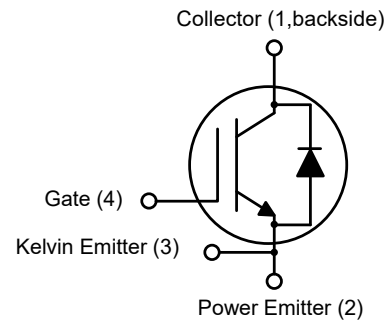
Package Pin Definitions

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

Package Parameters

Part Number	Marking	Package
BGH50N65ZF1	BGH50N65ZF1	TO-247-4

Package: TO-247-4



Maximum Ratings ($T_c=25^\circ\text{C}$ Unless Otherwise Noted)

Symbol	Parameter	Value	Unit	
V_{CE}	Collector-Emitter Breakdown Voltage, $T_j \geq 25^\circ\text{C}$	650	V	
V_{GE}	Continuous Gate-Emitter Voltage	± 20		
	Transient Gate-Emitter Voltage	± 30		
I_C	DC Collector Current, limited by T_{jmax}	$T_c=25^\circ\text{C}$	114	A
		$T_c=100^\circ\text{C}$	50	
I_F	Diode Forward Current, limited by T_{jmax}	$T_c=25^\circ\text{C}$	48	A
		$T_c=100^\circ\text{C}$	28	
$I_{C,pulse}$	Pulse Collector Current	$V_{GE}=15\text{V}$, limited by T_{jmax}	200	A
P_{tot}	Power Dissipation	$T_c=25^\circ\text{C}$	297	W
T_j	Operating Junction Temperature		-40~150	$^\circ\text{C}$
T_{stg}	Storage Temperature Range		-55~150	$^\circ\text{C}$

Thermal Characteristics

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 $T_j=25^\circ\text{C}$ Unless Otherwise Specified)
IGBT Static Characteristics

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit	
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$V_{GE}=15\text{V}$, $I_C=50\text{A}$	$T_j=25^\circ\text{C}$	1.55	2.1	V	
			$T_j=100^\circ\text{C}$	1.75			
			$T_j=150^\circ\text{C}$	1.88			
I_{CES}	Zero Gate Voltage Collector Current	$V_{CE}=650\text{V}$, $V_{GE}=0\text{V}$	$T_j=25^\circ\text{C}$		100	μA	
			$T_j=150^\circ\text{C}$		1000		
		$V_{CE}=480\text{V}$, $V_{GE}=0\text{V}$	$T_j=25^\circ\text{C}$		80		
$V_{GE(th)}$	Gate Threshold Voltage	$V_{GE}=V_{CE}$, $I_C=500\mu\text{A}$	$T_j=25^\circ\text{C}$	4.2	5	5.8	V
I_{GES}	Gate-Emitter Leakage Current	$V_{CE}=0\text{V}$, $V_{GE}=\pm 20\text{V}$	$T_j=25^\circ\text{C}$			100	nA

g_{fs}	Transconductance	$V_{CE}=20V, I_C=40A$		82		S
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Dynamic Characteristics

Symbol	Parameter	Test conditions	Value			Unit
			Min.	Typ.	Max.	
C_{iss}	Input Capacitance	$V_{GE}=0V, V_{CE}=25V$ $f=250kHz$		5692		pF
C_{oss}	Output Capacitance			339		pF
C_{riss}	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	$T_j=25^\circ C$ $V_{DC}=400V, I_C=25A$ $V_{GE}=0/15V, R_{G(ext)}=10\Omega$ $L_\sigma=60nH$		21		ns	
t_r	Rise Time			16			
$t_{d(off)}$	Turn-Off Delay Time			330			
t_f	Fall Time			48			
E_{on}	Turn-On Energy			203		uJ	
E_{off}	Turn-Off Energy			298			
E_{total}	Total Switching Energy			501			
$t_{d(on)}$	Turn-On Delay Time		$T_j=25^\circ C$ $V_{DC}=400V, I_C=50A$ $V_{GE}=0/15V, R_{G(ext)}=10\Omega$ $L_\sigma=60nH$		25		ns
t_r	Rise Time				26		
$t_{d(off)}$	Turn-Off Delay Time			322			
t_f	Fall Time			30			
E_{on}	Turn-On Energy			403		uJ	
E_{off}	Turn-Off Energy			623			
E_{total}	Total Switching Energy			1026			

SiC Schottky Barrier Diode Characteristics

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit	
V_F	Diode Forward Voltage	$V_{GE}=0V,$ $I_F=20A$	$T_j=25^\circ C$		1.51		V
			$T_j=100^\circ C$		1.62		
			$T_j=150^\circ C$		1.76		
Q_C	Diode Capacitive Charge	$V_R=400V, T_j=25^\circ C$		46		nC	
C	Diode Capacitance	$V_R=1V, f=1MHz$		713		pF	
		$V_R=300V, f=1MHz$		79			

Typical Performance

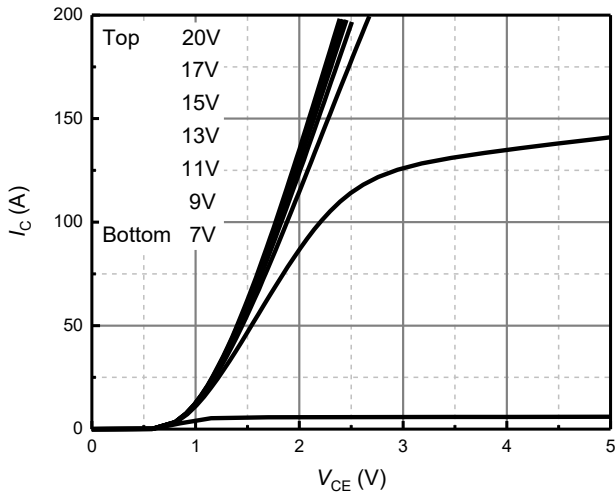


Figure 1 Output Characteristics
($T_j=25^\circ\text{C}$)

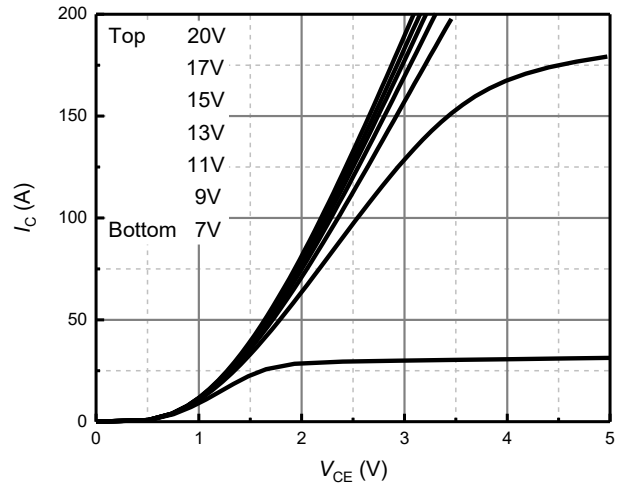


Figure 2 Output Characteristics
($T_j=150^\circ\text{C}$)

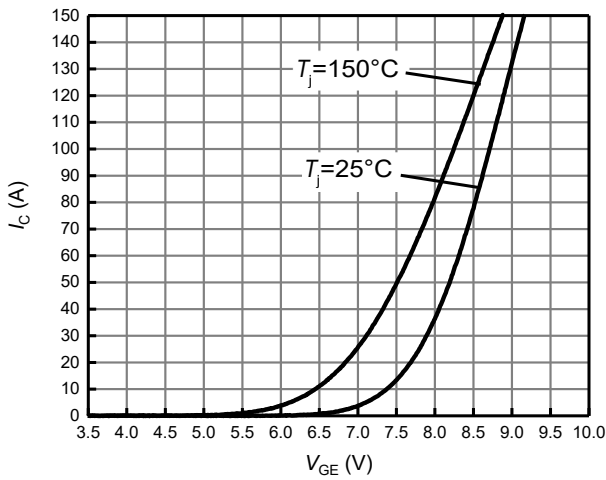


Figure 3 Transfer Characteristics for Various Temperature
($V_{CE}=20\text{V}$)

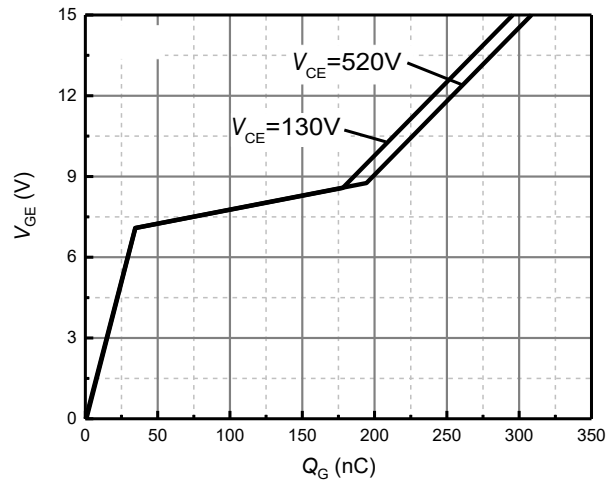


Figure 4 Gate Charge Characteristics
($I_C=50\text{A}$)

Typical Performance

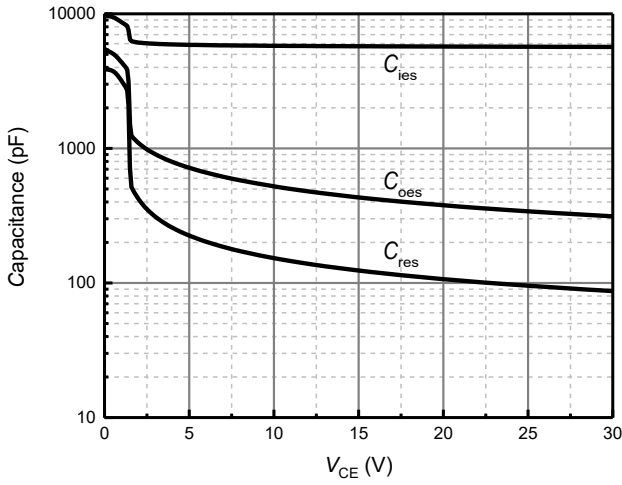


Figure 5 Capacitance Characteristics
($V_{GE}=0V$, $f=250kHz$)

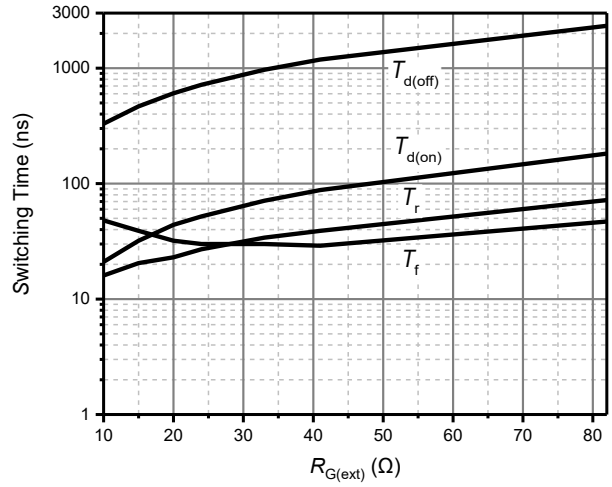


Figure 6 Switching Times vs. Gate Resistor
($V_{DC}=400V$, $V_{GE}=0/15V$, $I_C=25A$, $T_j=25^\circ C$)

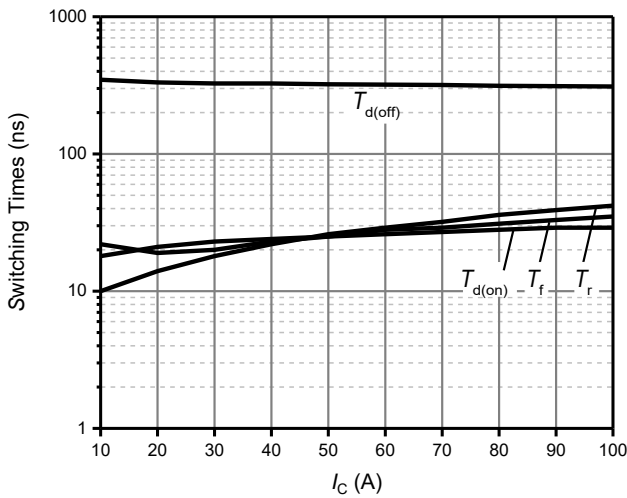


Figure 7 Switching Times vs. Collector Current
($V_{DC}=400V$, $V_{GE}=0/15V$, $R_{G(ext)}=10\Omega$, $T_j=25^\circ C$)

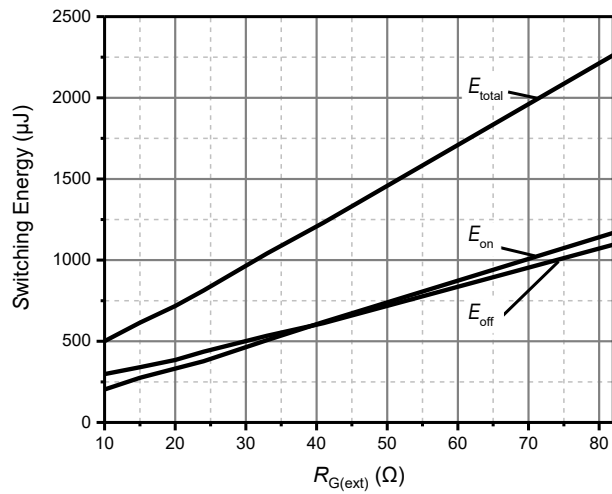


Figure 8 Switching Loss vs. Gate Resistor
($V_{DC}=400V$, $V_{GE}=0/15V$, $I_C=25A$, $T_j=25^\circ C$)

Typical Performance

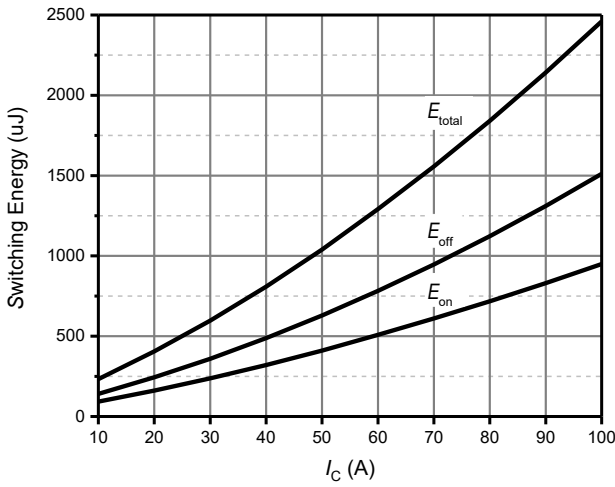


Figure 9 Switching Loss vs. Collector Current ($V_{DC}=400V$, $V_{GE}=0/15V$, $R_{G(ext)}=10\Omega$, $T_j=25^\circ C$)

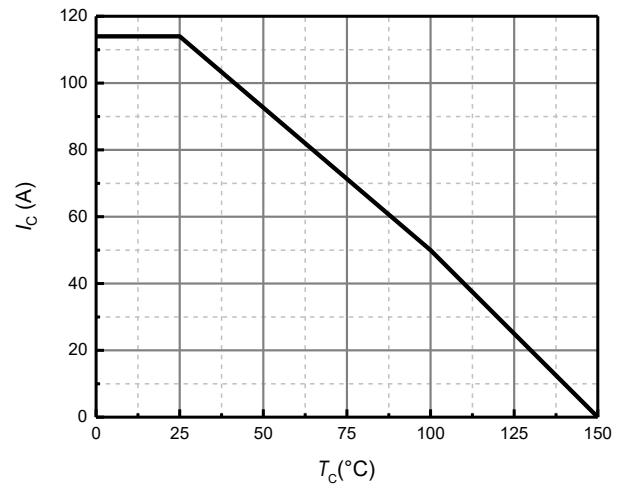


Figure 10 Maximum Collector-current vs. Case Temperature

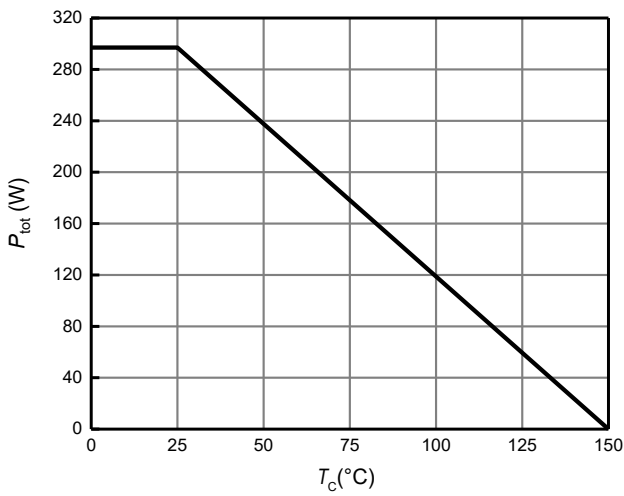


Figure 11 Power Dissipation vs. Case Temperature

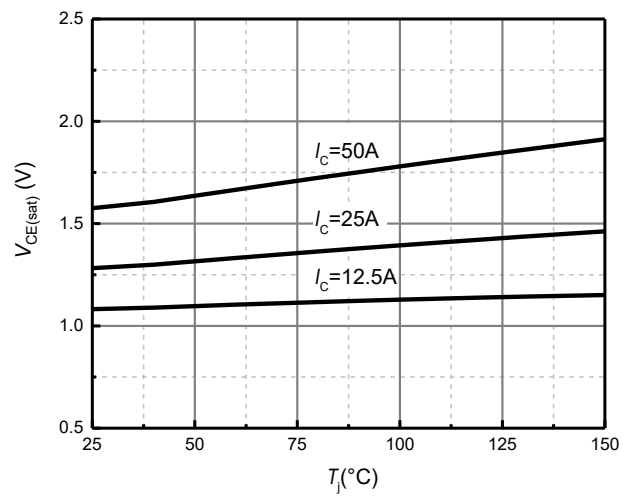


Figure 12 Collector-Emitter Saturation Voltage vs. Junction Temperature ($V_{GE}=15V$)

Typical Performance

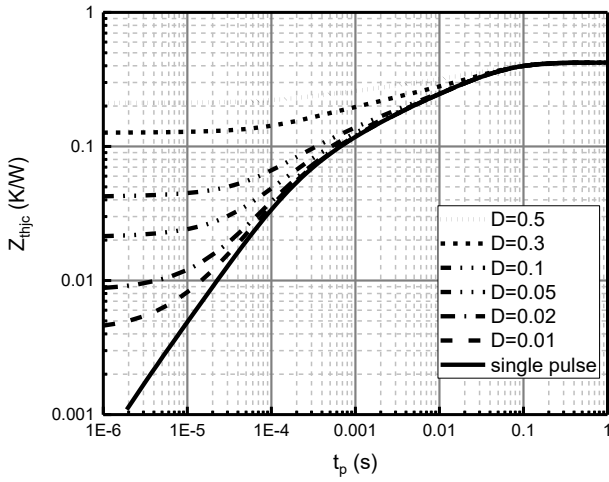


Figure 13 IGBT Transient Thermal Response Curve

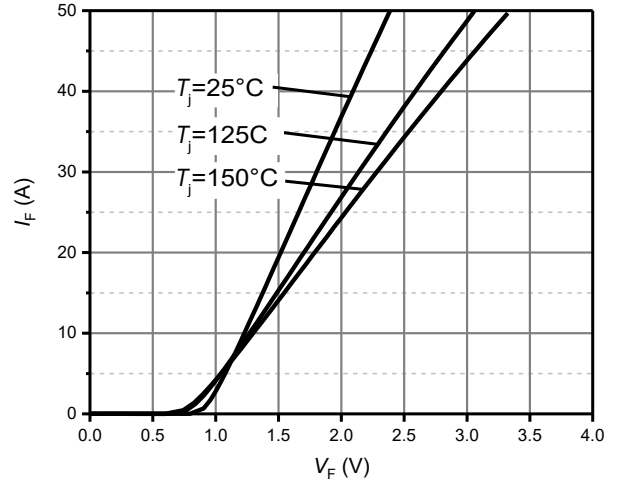


Figure 14 Forward characteristic of Diode

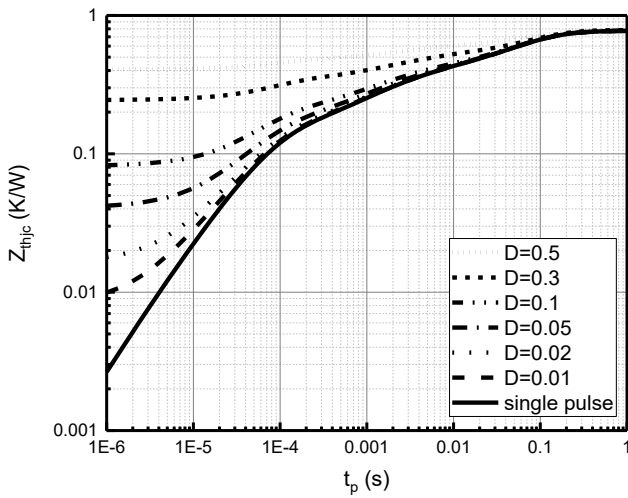


Figure 15 Diode Transient Thermal Response Curve

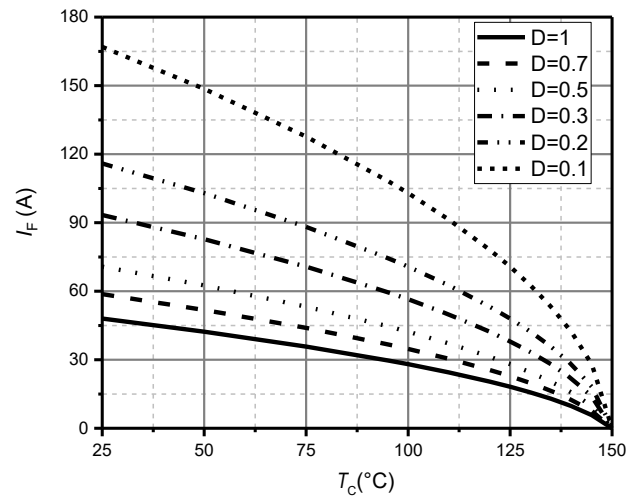
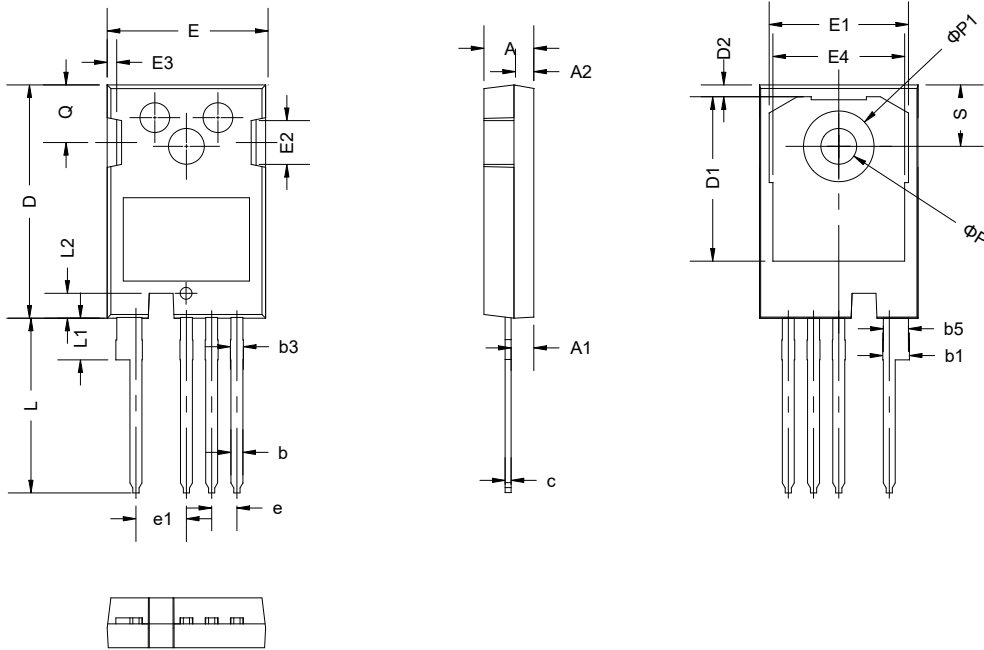


Figure 16 Diode Forward Current as Function of Temperature, D=duty cycle

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
φ P	3.51	3.61	3.65
φ P1	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.

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