

### Product Summary

$V_{CE}$	650 V
$I_C$	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
- DC/DC Converters with high Switching frequency

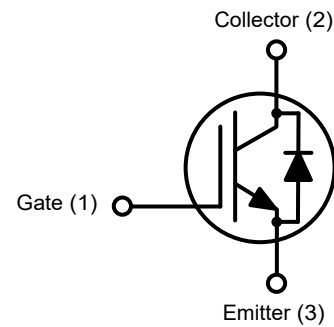
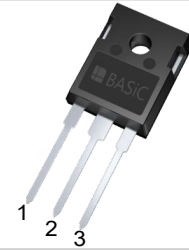
#### Package Pin Definitions

- Pin1 - Gate
- Pin2 - Collector & Backside
- Pin3 - Emitter

#### Package Parameters

Part Number	Marking	Package
BGH50N65HS1	BGH50N65HS1	TO-247-3

### Package: TO-247-3



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

Symbol	Parameter		Value	Unit
$V_{CE}$	Collector-Emitter Breakdown Voltage		650	V
$V_{GE}$	Continuous Gate-Emitter Voltage		$\pm 20$	
	Transient Gate-Emitter Voltage		$\pm 30$	
$I_C$	DC Collector Current	$T_c=25^\circ\text{C}$	114	A
		$T_c=100^\circ\text{C}$	50	
$I_F$	Diode Forward Current	$T_c=25^\circ\text{C}$	70	A
		$T_c=100^\circ\text{C}$	47	
$I_{CM}$	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		-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	0.62	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	$V_{CE}=650\text{V}$ , $V_{GE}=0\text{A}$	$T_j=25^\circ\text{C}$		100	$\mu\text{A}$	
			$T_j=150^\circ\text{C}$		1000		
		$V_{CE}=480\text{V}$ , $V_{GE}=0\text{A}$	$T_j=25^\circ\text{C}$		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	$V_{CE}=20\text{V}$ , $I_C=40\text{A}$		82			S

**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
$C_{rss}$	Reverse Transfer Capacitance			95		pF
$Q_G$	Total Gate Charge	$V_{CC}=520V, V_{GE}=15V, I_C=50A$		308		nC

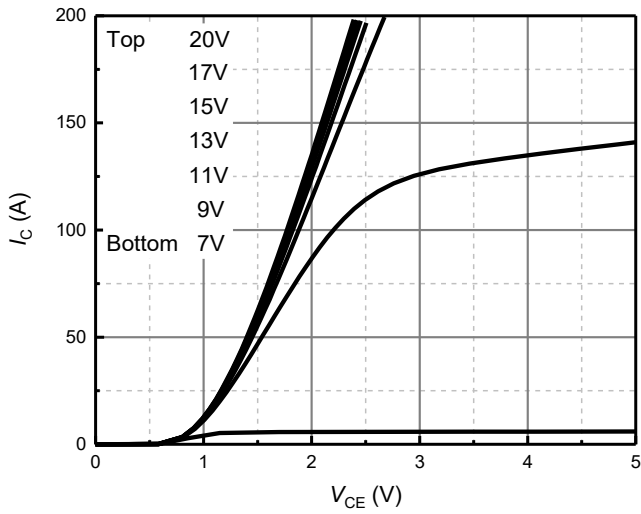
**Switching Characteristics, Inductive Load**

Symbol	Parameter	Test conditions	Value			Unit
			Min.	Typ.	Max.	
$t_{d(on)}$	Turn-On Delay Time	$T_j=25^\circ C$ $V_{DC}=400V, I_C=25A$ $V_{GE}=0/15V, R_{G(ext)}=3.3\Omega$ $L_\sigma=60nH$		18		ns
$t_r$	Rise Time			28		
$t_{d(off)}$	Turn-Off Delay Time			166		
$t_f$	Fall Time			49		
$E_{on}$	Turn-On Energy			318		uJ
$E_{off}$	Turn-Off Energy			326		
$E_{total}$	Total Switching Energy			644		
$t_{d(on)}$	Turn-On Delay Time	$T_j=25^\circ C$ $V_{DC}=400V, I_C=50A$ $V_{GE}=0/15V, R_{G(ext)}=3.3\Omega$ $L_\sigma=60nH$		23		ns
$t_r$	Rise Time			54		
$t_{d(off)}$	Turn-Off Delay Time			152		
$t_f$	Fall Time			51		
$E_{on}$	Turn-On Energy			952		uJ
$E_{off}$	Turn-Off Energy			672		
$E_{total}$	Total Switching Energy			1624		

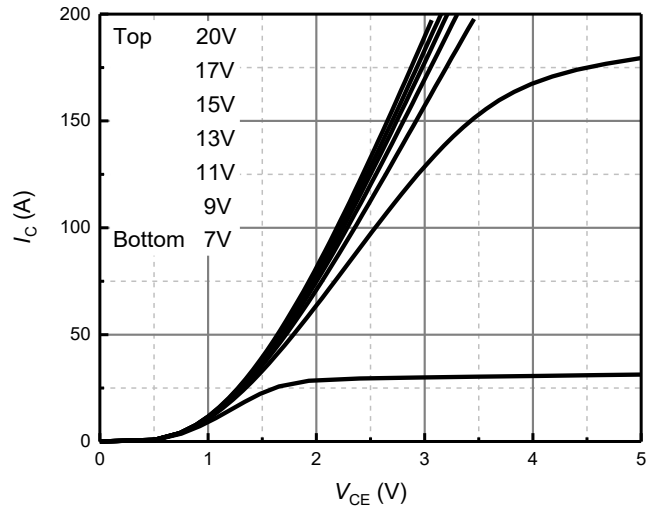
**SiC Schottky Barrier Diode Characteristics**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit	
$V_F$	Diode Forward Voltage	$V_{GE}=0V,$ $I_F=30A$	$T_j=25^\circ C$		1.42	1.70	V
			$T_j=100^\circ C$		1.55		
			$T_j=125^\circ C$		1.64		
			$T_j=150^\circ C$		1.72		
$Q_C$	Diode Capacitive Charge	$V_R=400V, T_j=25^\circ C$		64		nC	
C	Diode Capacitance	$V_R=1V, f=1MHz$		998		pF	
		$V_R=300V, f=1MHz$		110			

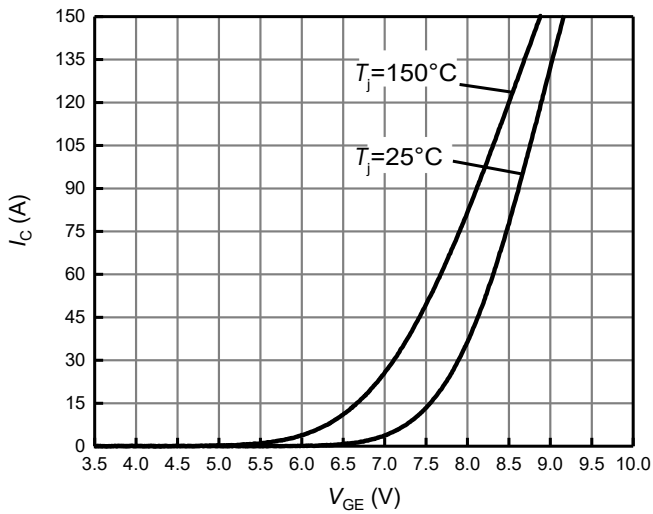
**Typical Performance**



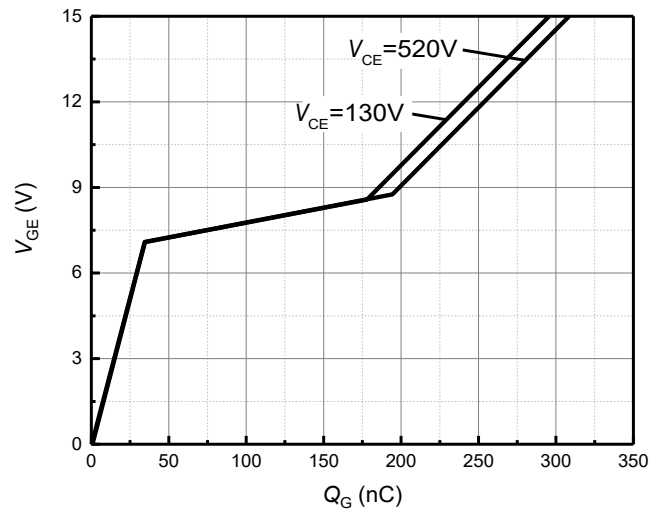
**Figure 1 Output Characteristics**  
( $T_j=25^\circ\text{C}$ )



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

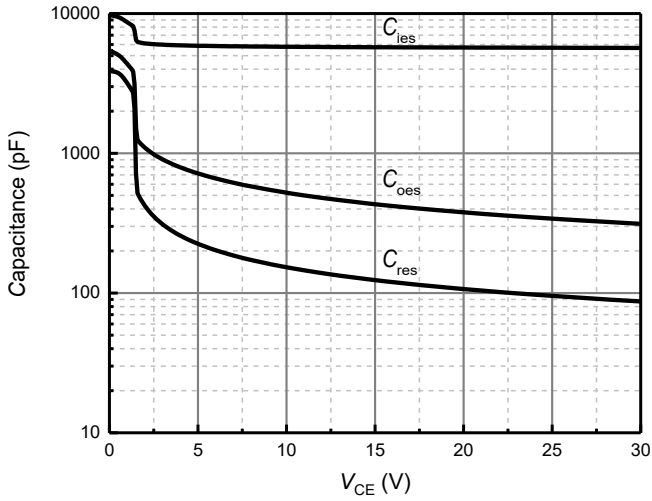


**Figure 3 Transfer Characteristics for Various Temperature**  
( $T_j=25^\circ\text{C}$  and  $T_j=150^\circ\text{C}$ , at  $V_{CE}=20\text{V}$ )

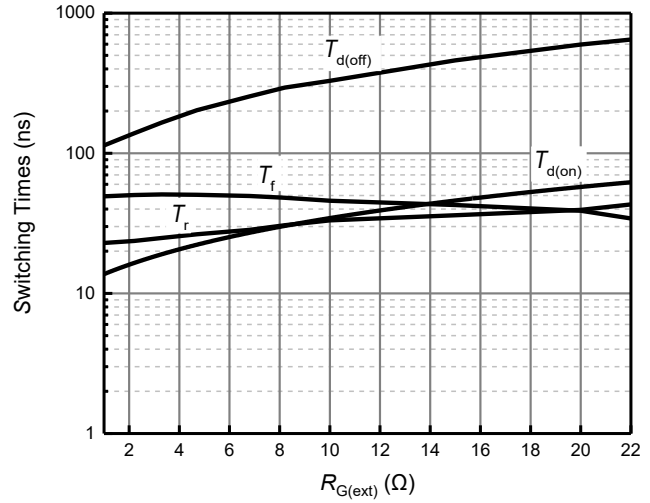


**Figure 4 Gate Charge Characteristics**  
( $I_C=50\text{A}$ )

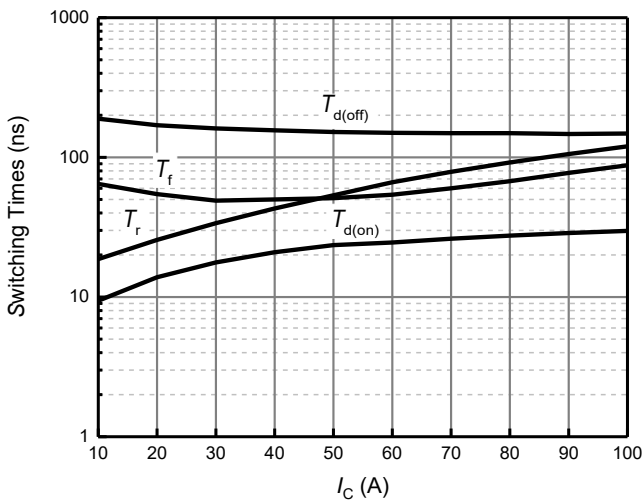
**Typical Performance**



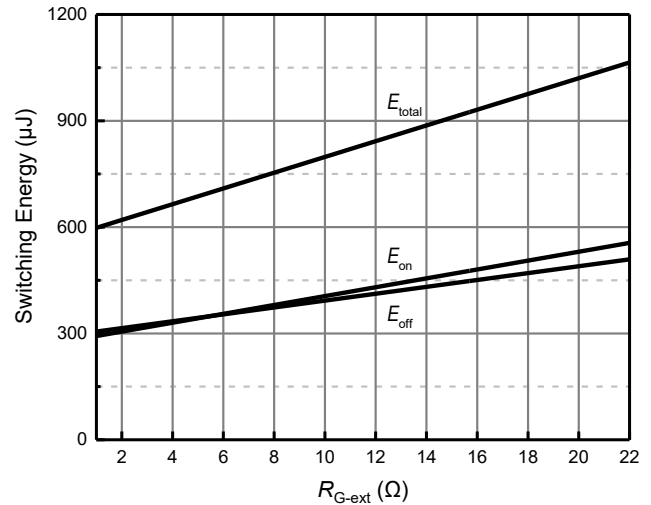
**Figure 5** Capacitance Characteristics  
( $V_{GE}=0V$ ,  $f=250kHz$ )



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

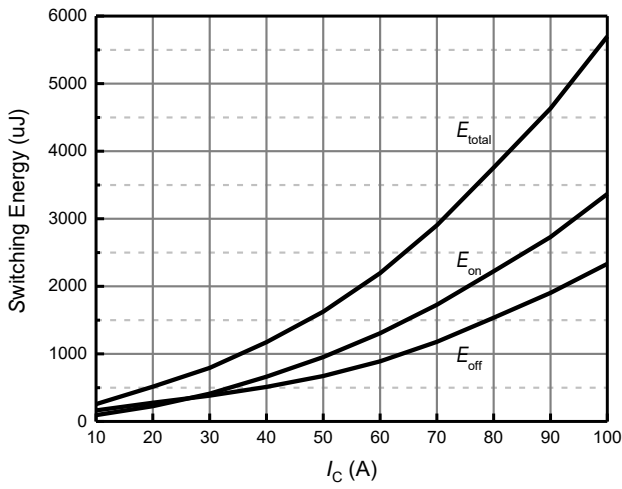


**Figure 7** Switching Times vs. Collector Current  
( $V_{DC}=400V$ ,  $V_{GE}=15V$ ,  
 $R_{G(ext)}=3.3\Omega$ ,  $T_j=25^\circ C$ )

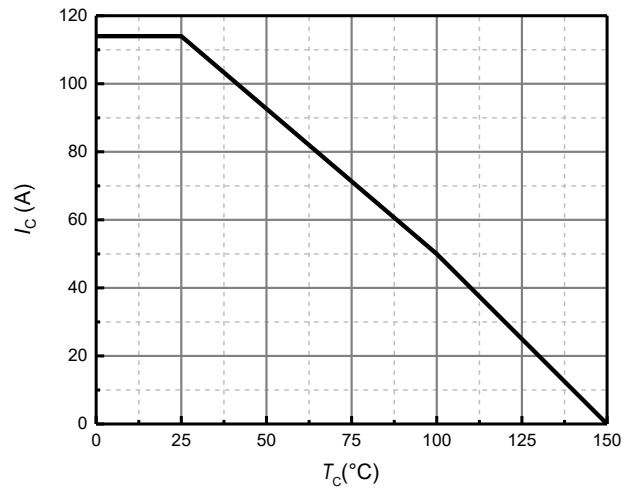


**Figure 8** Switching Loss vs. Gate Resistor  
( $V_{DC}=400V$ ,  $V_{GE}=15V$ ,  $I_C=25A$ ,  
 $T_j=25^\circ C$ )

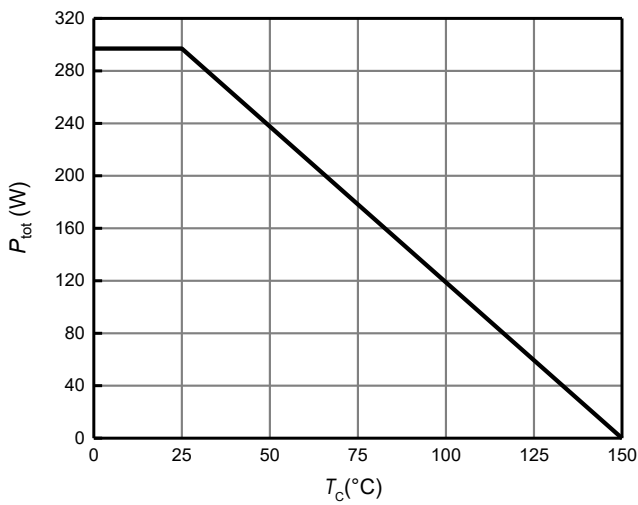
**Typical Performance**



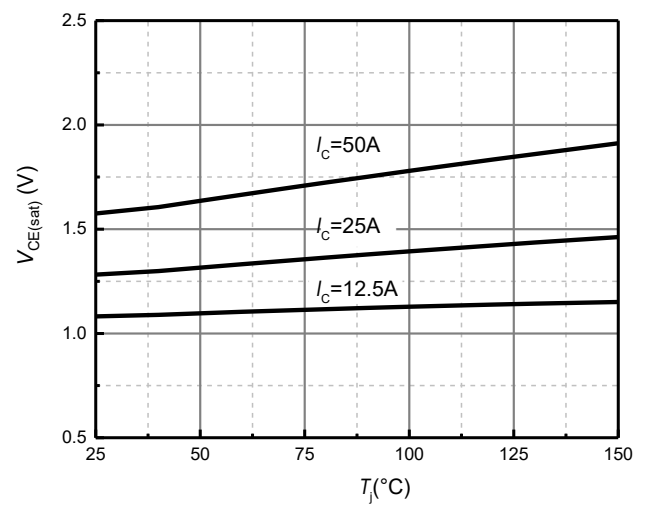
**Figure 9** Switching Loss vs. Collector Current ( $V_{DC}=400V$ ,  $V_{GE}=15V$ ,  $R_{G(ext)}=3.3\Omega$ ,  $T_j=25^\circ C$ )



**Figure 10** Maximum Collector Current vs. Case Temperature

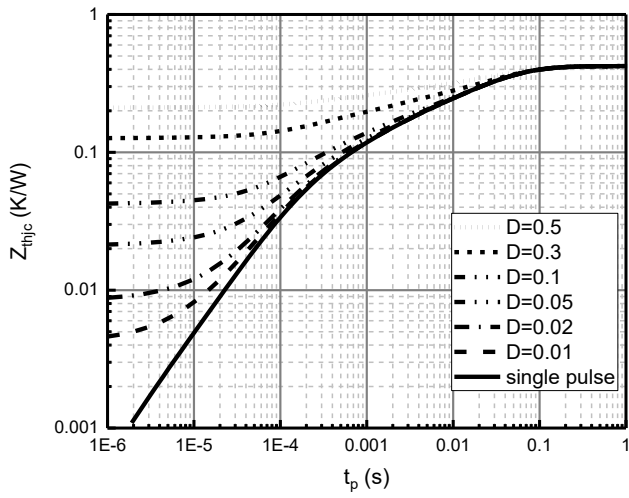


**Figure 11** Power Dissipation vs. Case Temperature

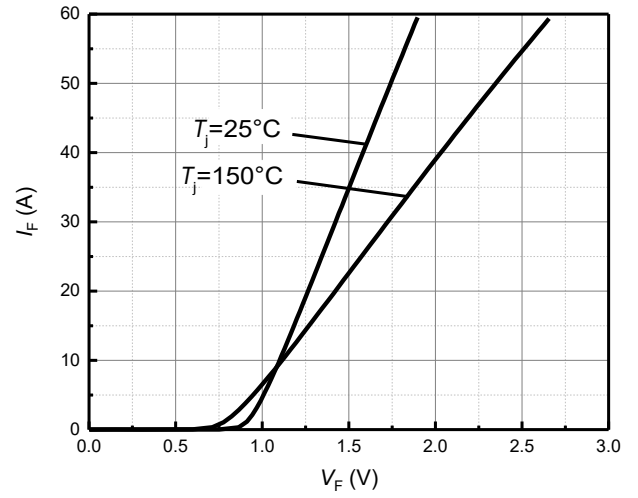


**Figure 12** Collector-Emitter Saturation Voltage vs. Junction Temperature for Various Collector Current ( $V_{GE}=15V$ )

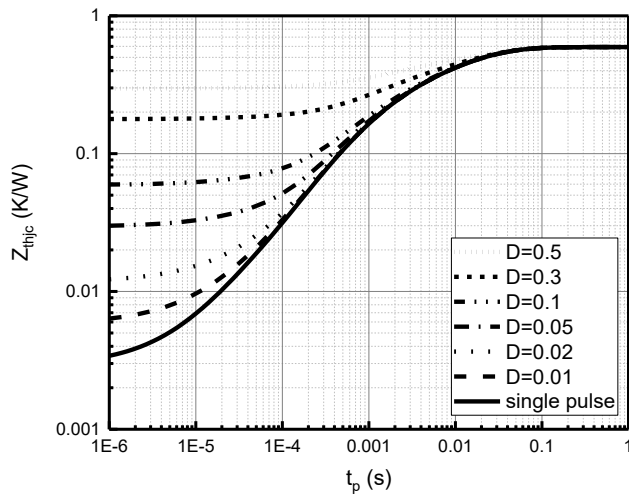
**Typical Performance**



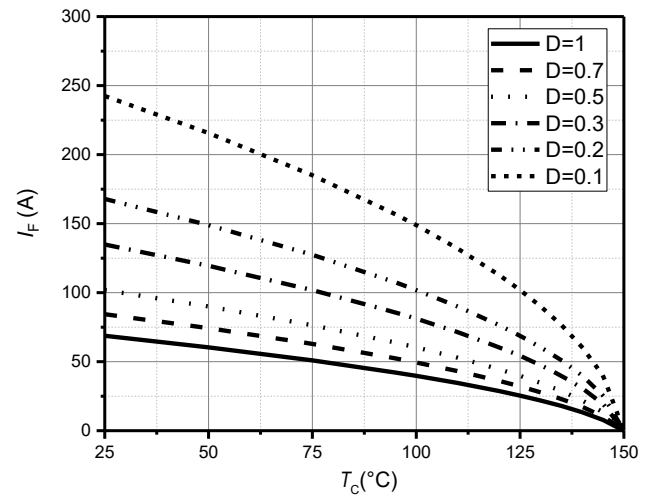
**Figure 13 IGBT Transient Thermal Response Curve**



**Figure 14 Forward Characteristic of Diode**

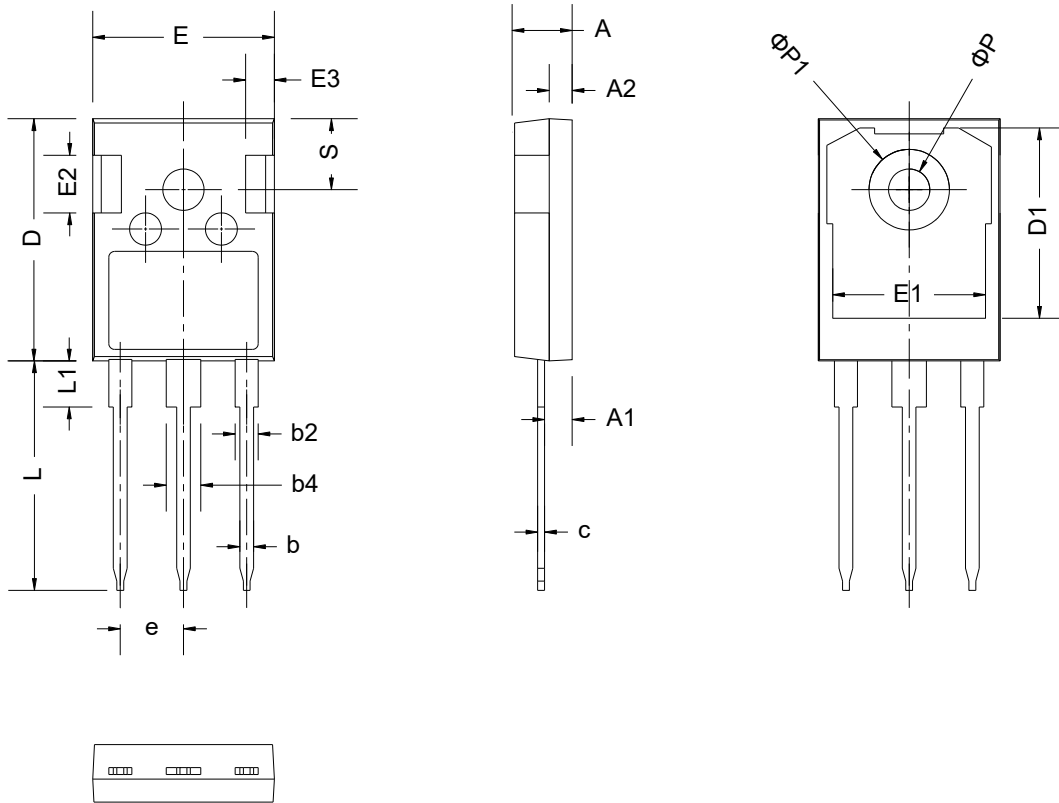


**Figure 15 Diode Transient Thermal Response Curve**



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



**Package Dimensions**


Items	mm		
	MIN	NOM	MAX
A	4.80	5.00	5.20
A1	2.21	2.41	2.59
A2	1.85	2.00	2.15
b	1.11	1.21	1.36
b2	1.91	2.01	2.21
b4	2.91	3.01	3.21
c	0.51	0.61	0.75
D	20.80	21.00	21.30
D1	16.25	16.55	16.85
E	15.50	15.80	16.10
E1	13.00	13.30	13.60
E2	4.8	5.00	5.20
E3	2.3	2.50	2.70
e	5.44 BSC		
L	19.62	19.92	20.22
L1	-	-	4.30
φ P	3.40	3.60	3.80
φ P1	-	-	7.30
S	6.16 BSC		

**Revision History**

<b>Document Version</b>	<b>Date of Release</b>	<b>Description of Changes</b>
Rev 0.0	2022-08-19	Draft datasheet created.

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