

## 650V 300A 2-Pack IGBT Module

### Features

- Trench & Field Stop technology
  - Low saturation voltage
  - 10 $\mu$ s Short Circuit current
  - Low turn-off losses
  - Positive temperature coefficient
- Free wheeling diodes with fast and soft reverse recovery
- Industrial standard package with copper base plate

### Applications

- Welder / Power supply
- UPS / Inverter
- Industrial motor driver

### Preliminary data



**62mm**

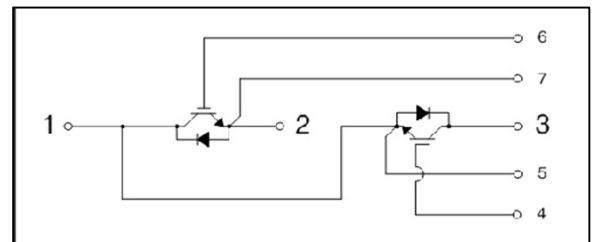
108.5 x 62 x 30.5 mm

### Absolute Maximum Ratings $T_j = 25^\circ\text{C}$ unless otherwise noted

Item	Symbol	Conditions	Value	Units
IGBT	V <sub>CES</sub>		650	V
	V <sub>GES</sub>		$\pm 30$	V
	I <sub>C</sub>	@ $T_j = 175^\circ\text{C}$ , $T_c = 25^\circ\text{C}$ , Continuous	450	A
		@ $T_j = 175^\circ\text{C}$ , $T_c = 80^\circ\text{C}$ , Continuous	300	A
	I <sub>CM</sub>	$t_P = 1\text{ ms}$	600	A
	T <sub>SC</sub>	Chip Level, @ $T_j = 125^\circ\text{C}$ , $V_{GE} = 15\text{ V}$ , $V_{CC} = 720\text{ V}$ , $V_{CE} < V_{CES}$	10	$\mu\text{s}$
	T <sub>j</sub>	Operating Junction Temperature *(1)	-40~150	$^\circ\text{C}$
	P <sub>D</sub>	@ $T_j = 175^\circ\text{C}$ , $T_c = 25^\circ\text{C}$	935	W
@ $T_j = 175^\circ\text{C}$ , $T_c = 80^\circ\text{C}$		590	W	
Diode	V <sub>R<sub>RM</sub></sub>		650	V
	I <sub>F</sub>		300	A
	I <sub>FRM</sub>	$t_P = 1\text{ ms}$	600	A
	T <sub>j</sub>	Operating Junction Temperature *(1)	-40~155	$^\circ\text{C}$
Module	T <sub>stg</sub>	Storage Temperature	-40~155	$^\circ\text{C}$
	V <sub>iso</sub>	@ AC 1 minute	2500	V
	M <sub>t</sub>	Main Terminal Mounting Torque (M6)	2.5~6.0	Nm
	M <sub>s</sub>	Heat Sink Mounting Torque (M6)	3.0~6.0	Nm
	W	Weight	310	g

### Internal Circuit & Pin Description

Pin Number	Pin Name	Pin Description
1	C2E1	Output
2	E2	Negative DC Link Output
3	C1	Positive DC Link Output
4	G1	Gate Input for High-side
5	E1	Emitter Input for High-side
6	G2	Gate Input for Low-side
7	E2	Emitter Input for Low-side



(Note \*1) The Maximum junction temperature of chip is 150  $^\circ\text{C}$ .

## Electrical Characteristics of IGBT and Diode $T_j = 25^\circ\text{C}$ unless otherwise noted

### Static Characteristics

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
BV <sub>CES</sub>	C-E Breakdown Voltage	V <sub>GE</sub> = 0 V, I <sub>C</sub> = 250 $\mu$ A	650	-		
I <sub>CES</sub>	C-E Cut-Off Current	V <sub>CE</sub> = V <sub>CES</sub> , V <sub>GE</sub> = 0 V	-	-	250	$\mu$ A
I <sub>GES</sub>	G-E Leakage Current	V <sub>GE</sub> = V <sub>GES</sub> , V <sub>CE</sub> = 0 V	-	-	$\pm 600$	nA
V <sub>GE(th)</sub>	G-E Threshold Voltage	V <sub>GE</sub> = V <sub>CE</sub> , I <sub>C</sub> = 300 mA	5.0	-	6.8	V
V <sub>CE(sat)</sub>	Collector to Emitter Saturation Voltage(Chip level)	I <sub>C</sub> = 300 A, V <sub>GE</sub> = 15 V, T <sub>j</sub> = 25 $^\circ\text{C}$	-	1.5	1.8	V
		I <sub>C</sub> = 300 A, V <sub>GE</sub> = 15 V, T <sub>j</sub> = 175 $^\circ\text{C}$	-	1.75	-	V
	Collector to Emitter Saturation Voltage	I <sub>C</sub> = 300 A, V <sub>GE</sub> = 15 V, T <sub>j</sub> = 25 $^\circ\text{C}$	-	1.6	1.9	V
		I <sub>C</sub> = 300 A, V <sub>GE</sub> = 15 V, T <sub>j</sub> = 125 $^\circ\text{C}$	-	1.8	-	V

### Dynamic Characteristics

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
I <sub>SC</sub>	Short Current	V <sub>GE</sub> $\leq$ 15 V, V <sub>CC</sub> = 400 V V <sub>CE</sub> $\leq$ V <sub>CES</sub> , T <sub>j</sub> = 125, T <sub>P</sub> $\leq$ 5.5 $\mu$ s	-	1100	-	A
C <sub>ies</sub>	Input Capacitance	V <sub>CE</sub> = 30 V, V <sub>GE</sub> = 0 V f = 1 MHz, T <sub>j</sub> = 25 $^\circ\text{C}$	-	19.8	-	nF
C <sub>oes</sub>	Output Capacitance		-	0.9	-	nF
C <sub>res</sub>	Reverse Transfer Capacitance		-	0.5	-	nF
t <sub>d(on)</sub>	Turn-On Delay Time	T <sub>j</sub> = 125 $^\circ\text{C}$ , R <sub>G</sub> = 15 $\Omega$ L = 50 $\mu$ H, V <sub>DC</sub> = 300 V V <sub>GE</sub> = 15 V ~ -15 V I <sub>C</sub> = 300 A	-	325	-	ns
t <sub>r</sub>	Rise Time		-	221	-	ns
t <sub>d(off)</sub>	Turn-Off Delay Time		-	421	-	ns
t <sub>f</sub>	Fall Time		-	64	-	ns
E <sub>on</sub>	Turn-On Switching Loss		-	24.6	-	mJ
E <sub>off</sub>	Turn-Off Switching Loss		-	9.1	-	mJ
E <sub>ts</sub>	Total Switching Loss		-	33.7	-	mJ
Q <sub>g</sub>	Total Gate Charge	V <sub>GE</sub> = 0 V ~ +15 V	-	630	-	nC
Q <sub>ge</sub>	Gate-Emitter Charge		-	220	-	nC
Q <sub>gc</sub>	Gate-Collector Charge		-	300	-	nC

### Electrical Characteristics of Diode

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units	
V <sub>F</sub>	Diode Forward Voltage	I <sub>F</sub> = 300 A V <sub>GE</sub> = 0V	T <sub>j</sub> = 25 $^\circ\text{C}$	-	1.7	2.2	V
			T <sub>j</sub> = 125 $^\circ\text{C}$	-	1.6	-	
t <sub>rr</sub>	Diode Reverse Recovery Time	R <sub>G</sub> = 15 $\Omega$ L = 50 $\mu$ H V <sub>DC</sub> = 300 V V <sub>GE</sub> = 15V ~ -15 V I <sub>C</sub> = 300 A	T <sub>j</sub> = 25 $^\circ\text{C}$	-	200	-	ns
			T <sub>j</sub> = 125 $^\circ\text{C}$	-	-	-	
I <sub>RRM</sub>	Diode Peak Reverse Recovery Current		T <sub>j</sub> = 25 $^\circ\text{C}$	-	-	-	A
			T <sub>j</sub> = 125 $^\circ\text{C}$	-	-	-	
Q <sub>rr</sub>	Diode Reverse Recovery Charge		T <sub>j</sub> = 25 $^\circ\text{C}$	-	-	-	$\mu$ C
			T <sub>j</sub> = 125 $^\circ\text{C}$	-	-	-	
E <sub>rr</sub>	Diode Reverse Recovery Energy		T <sub>j</sub> = 25 $^\circ\text{C}$	-	-	-	mJ
		T <sub>j</sub> = 125 $^\circ\text{C}$	-	-	-		

### Thermal Characteristics

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
R <sub>th(J-C)</sub>	Thermal Resistance (IGBT Part)	Junction-to-Case	-	0.16	-	$^\circ\text{C}/\text{W}$
R <sub>th(J-C)D</sub>	Thermal Resistance (Diode Part)	Junction-to-Case	-	0.25	-	$^\circ\text{C}/\text{W}$

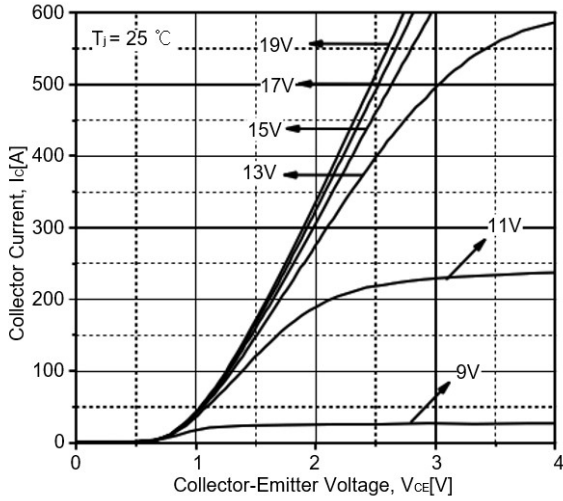


Fig 1. Typical IGBT Output Characteristics

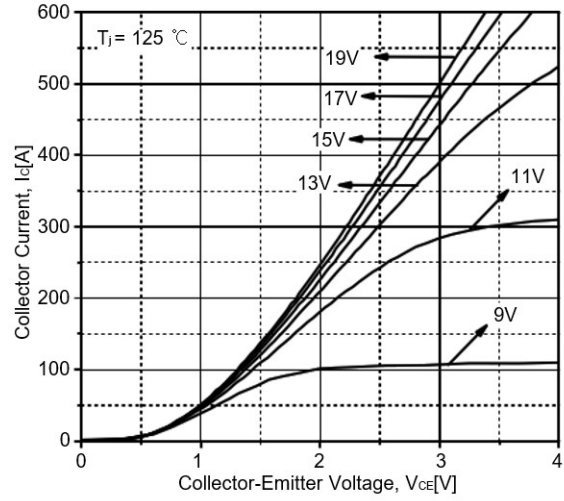


Fig 2. Typical IGBT Output Characteristics

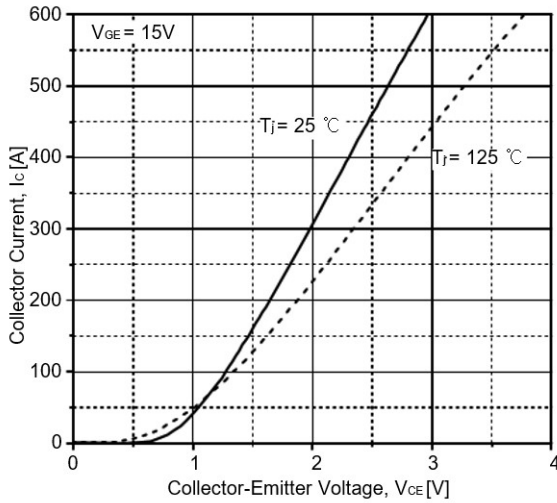


Fig 3. Typical IGBT Output Characteristics

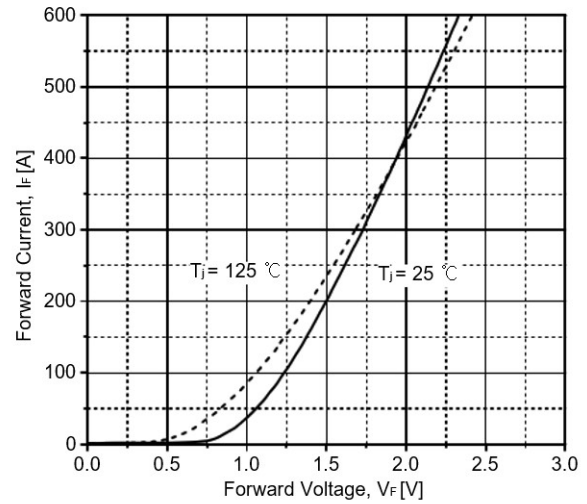


Fig 4. Typical Diode Forward Characteristics

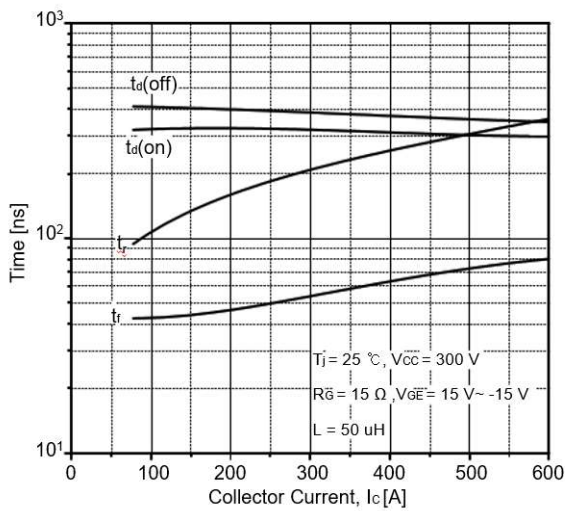


Fig 5. Typical Switching Time vs. Collector Current

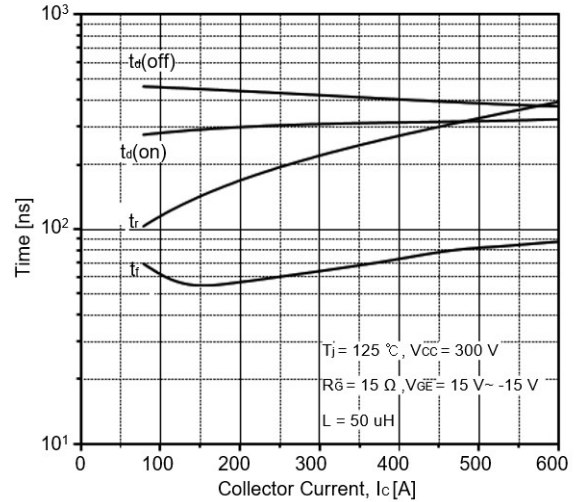


Fig 6. Typical Switching Time vs. Collector Current

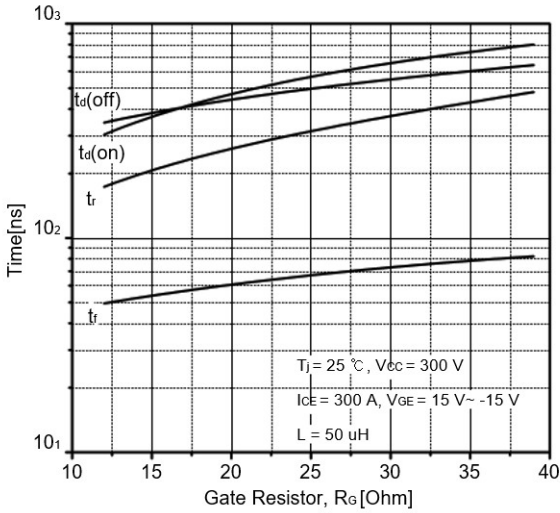


Fig 7. Typical Switching Time vs. Gate Resistor

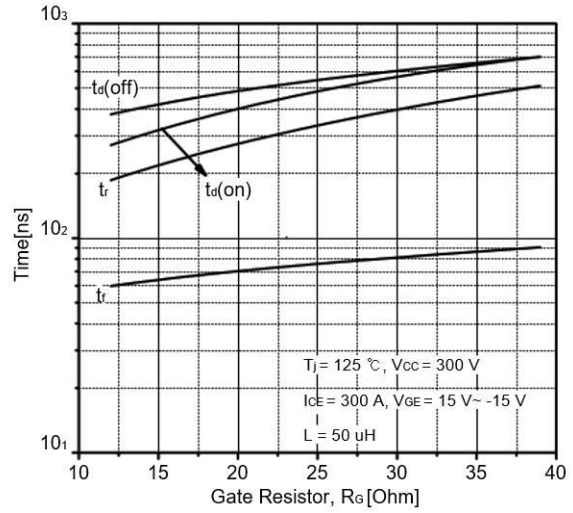


Fig 8. Typical Switching Time vs. Gate Resistor

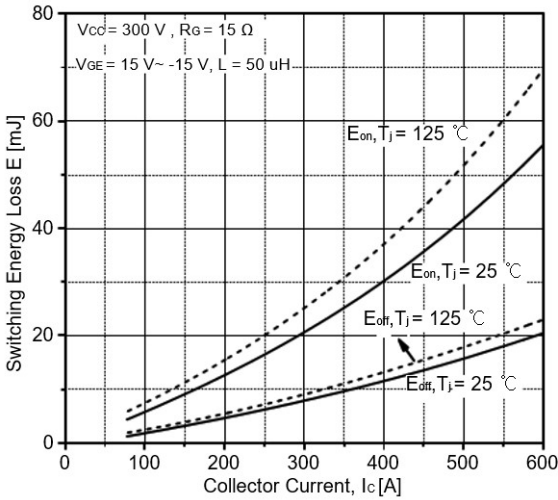


Fig 9. Typical IGBT Switching Loss

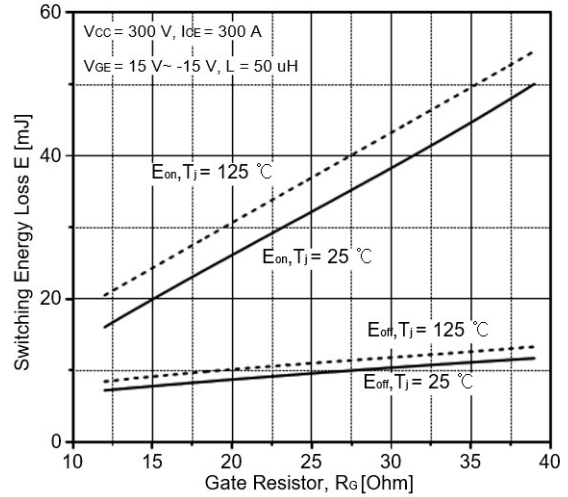


Fig 10. Typical IGBT Switching Loss

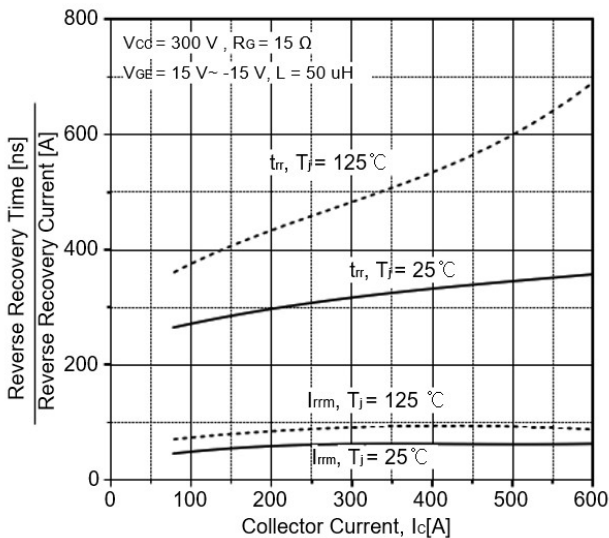


Fig 11. Typical Recovery Characteristics of Diode

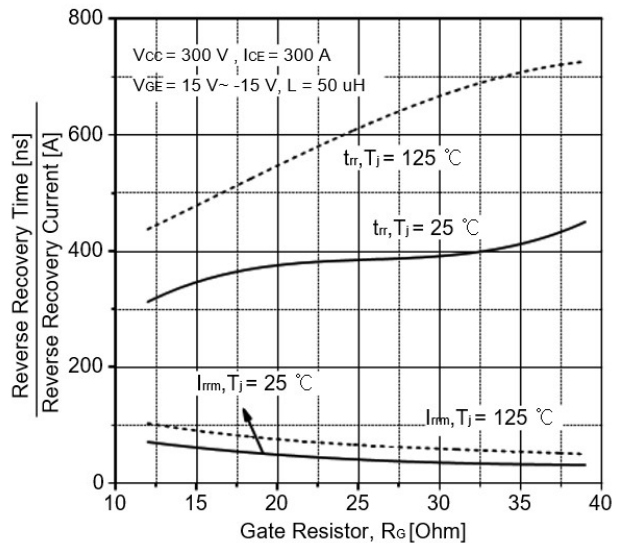
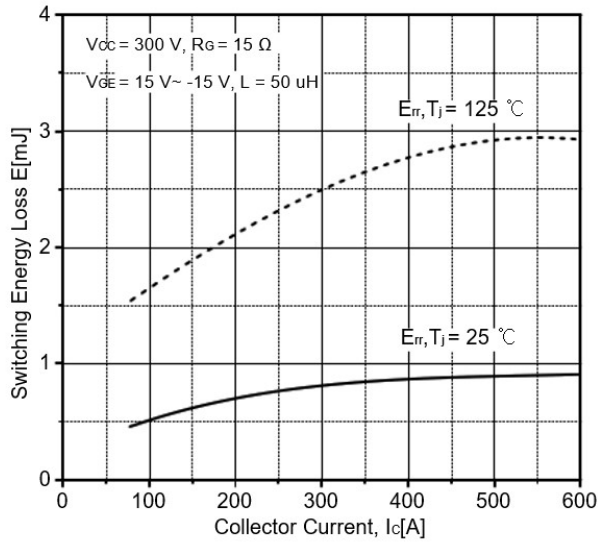
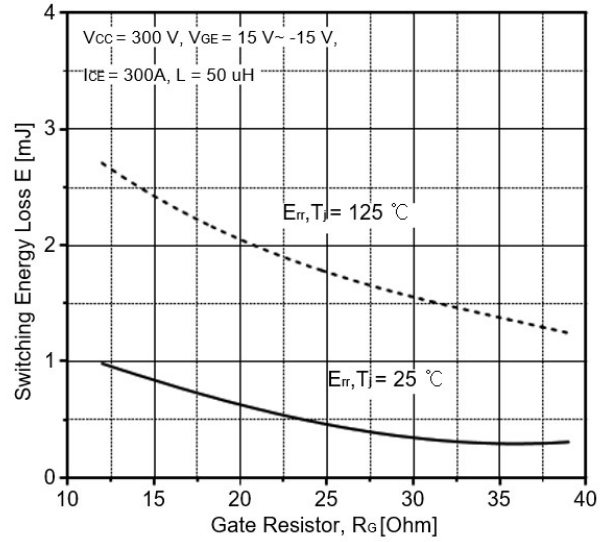


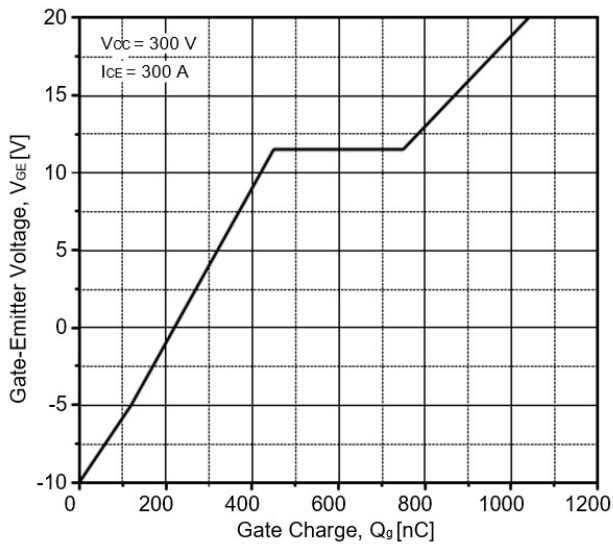
Fig 12. Typical Recovery Characteristics of Diode



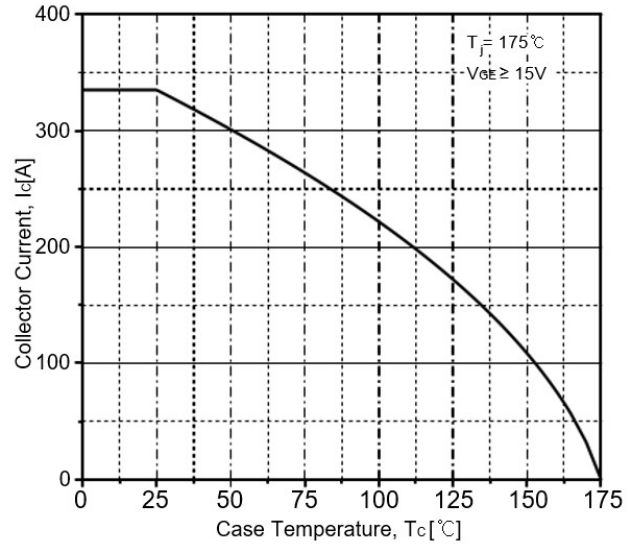
**Fig 13. Typical Diode Switching Loss**



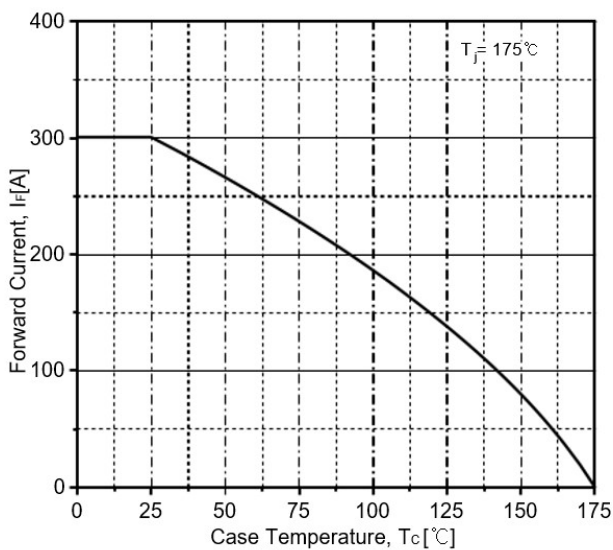
**Fig 14. Typical Diode Switching Loss**



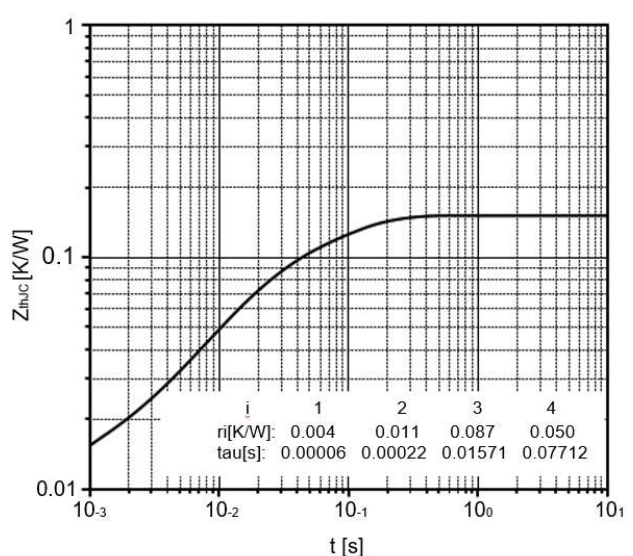
**Fig 15. Typical Gate Charge Characteristics**



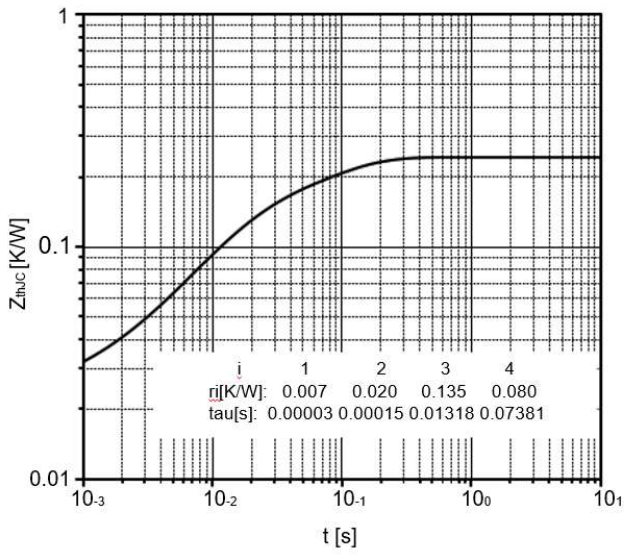
**Fig 16. Case Temperature vs. Collector Current**



**Fig 17. Case Temperature vs. Diode Current**



**Fig 18. Typical IGBT Thermal Impedance**



**Fig 19. Typical Diode Thermal Impedance**

## Package Dimension (Dimension in mm)

