

STARPOWER

SEMICONDUCTOR

IGBT

GD650HTA75P8HFLT

750V/650A 6 in one-package

General Description

STARPOWER IGBT Power Module provides ultra low conduction loss as well as short circuit ruggedness. They are designed for the applications such as hybrid and electric vehicle.

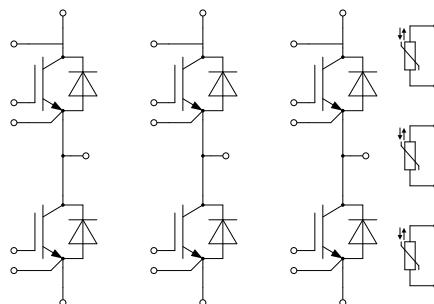
Features

- Low $V_{CE(sat)}$ Trench IGBT technology
- Low switching losses
- 6 μ s short circuit capability
- $V_{CE(sat)}$ with positive temperature coefficient
- Maximum junction temperature 175°C
- Low inductance case
- Fast & soft reverse recovery anti-parallel FWD
- Isolated copper pinfin baseplate using Si₃N₄ AMB technology
- PressFIT contact technology

Typical Applications

- Automotive application
- Hybrid and electric vehicle
- Inverter for motor drive

Equivalent Circuit Schematic



Absolute Maximum Ratings $T_F=25^{\circ}\text{C}$ unless otherwise noted**IGBT**

Symbol	Description	Values	Unit
V_{CES}	Collector-Emitter Voltage	750	V
V_{GES}	Gate-Emitter Voltage	± 20	V
I_{CN}	Implemented Collector Current	650	A
I_C	Collector Current @ $T_F=100^{\circ}\text{C}$	300	A
I_{CRM}	Repetitive Peak Collector Current tp limited by T_{vjop}	1300	A
P_D	Maximum Power Dissipation @ $T_F=75^{\circ}\text{C}$ $T_{vj}=175^{\circ}\text{C}$	800	W

Diode

Symbol	Description	Values	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	750	V
I_{FN}	Implemented Collector Current	650	A
I_F	Diode Continuous Forward Current	300	A
I_{FRM}	Repetitive Peak Forward Current tp limited by T_{vjop}	1300	A

Module

Symbol	Description	Value	Unit
T_{vjmax}	Maximum Junction Temperature	175	$^{\circ}\text{C}$
T_{vjop}	Operating Junction Temperature continuous For 10s within a period of 30s, occurrence maximum 3000 times over lifetime	-40 to +160 +160 to +175	$^{\circ}\text{C}$
T_{STG}	Storage Temperature Range	-40 to +125	$^{\circ}\text{C}$
V_{ISO}	Isolation Voltage RMS, $f=50\text{Hz}$, $t=1\text{min}$	2500	V

IGBT Characteristics $T_F=25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	$I_C=300\text{A}, V_{GE}=15\text{V}, T_{vj}=25^\circ\text{C}$		1.10	1.35	V
		$I_C=300\text{A}, V_{GE}=15\text{V}, T_{vj}=150^\circ\text{C}$		1.15		
		$I_C=300\text{A}, V_{GE}=15\text{V}, T_{vj}=175^\circ\text{C}$		1.15		
		$I_C=650\text{A}, V_{GE}=15\text{V}, T_{vj}=25^\circ\text{C}$		1.40		
		$I_C=650\text{A}, V_{GE}=15\text{V}, T_{vj}=175^\circ\text{C}$		1.65		
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=8.60\text{mA}, V_{CE}=V_{GE}, T_{vj}=25^\circ\text{C}$	5.5	6.5	7.0	V
I_{CES}	Collector Cut-Off Current	$V_{CE}=V_{CES}, V_{GE}=0\text{V}, T_{vj}=25^\circ\text{C}$			1.0	mA
I_{GES}	Gate-Emitter Leakage Current	$V_{GE}=V_{GES}, V_{CE}=0\text{V}, T_{vj}=25^\circ\text{C}$			400	nA
R_{Gint}	Internal Gate Resistance			1.0		Ω
C_{ies}	Input Capacitance			48.2		nF
C_{oes}	Output Capacitance	$V_{CE}=50\text{V}, f=100\text{kHz}, V_{GE}=0\text{V}$		1.01		nF
C_{res}	Reverse Transfer Capacitance	$V_{GE}=0\text{V}$		0.21		nF
Q_G	Gate Charge	$V_{CE}=400\text{V}, I_C=300\text{A}, V_{GE}=-15\dots+15\text{V}$		3.18		μC
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=400\text{V}, I_C=300\text{A}, R_G=3.6\Omega, V_{GE}=-8\text{V}/+15\text{V}, L_S=30\text{nH}, T_{vj}=25^\circ\text{C}$		440		ns
t_r	Rise Time			79		ns
$t_{d(off)}$	Turn-Off Delay Time			750		ns
t_f	Fall Time			64		ns
E_{on}	Turn-On Switching Loss				9.28	
E_{off}	Turn-Off Switching Loss			11.9		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=400\text{V}, I_C=300\text{A}, R_G=3.6\Omega, V_{GE}=-8\text{V}/+15\text{V}, L_S=30\text{nH}, T_{vj}=150^\circ\text{C}$		444		ns
t_r	Rise Time			94		ns
$t_{d(off)}$	Turn-Off Delay Time			886		ns
t_f	Fall Time			148		ns
E_{on}	Turn-On Switching Loss				14.7	
E_{off}	Turn-Off Switching Loss			16.9		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=400\text{V}, I_C=300\text{A}, R_G=3.6\Omega, V_{GE}=-8\text{V}/+15\text{V}, L_S=30\text{nH}, T_{vj}=175^\circ\text{C}$		442		ns
t_r	Rise Time			99		ns
$t_{d(off)}$	Turn-Off Delay Time			923		ns
t_f	Fall Time			168		ns
E_{on}	Turn-On Switching Loss				16.0	
E_{off}	Turn-Off Switching Loss			17.5		mJ
I_{SC}	SC Data	$t_p \leq 6\mu\text{s}, V_{GE}=15\text{V}, T_{vj}=25^\circ\text{C}, V_{CC}=400\text{V}, V_{CEM} \leq 750\text{V}$		2400		A

		$t_p \leq 3\mu s, V_{GE}=15V,$ $T_{vj}=175^\circ C, V_{CC}=400V,$ $V_{CEM} \leq 750V$		2000		
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Diode Characteristics $T_F=25^\circ C$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_F	Diode Forward Voltage	$I_F=300A, V_{GE}=0V, T_{vj}=25^\circ C$		1.40	1.65	V
		$I_F=300A, V_{GE}=0V, T_{vj}=150^\circ C$		1.35		
		$I_F=300A, V_{GE}=0V, T_{vj}=175^\circ C$		1.30		
		$I_F=650A, V_{GE}=0V, T_{vj}=25^\circ C$		1.75		
		$I_F=650A, V_{GE}=0V, T_{vj}=175^\circ C$		1.75		
Q_r	Recovered Charge			10.6		μC
I_{RM}	Peak Reverse Recovery Current	$V_R=400V, I_F=300A,$ $-di/dt=4246A/\mu s, V_{GE}=-8V$		215		A
E_{rec}	Reverse Recovery Energy	$L_S=30nH, T_{vj}=25^\circ C$		1.91		mJ
Q_r	Recovered Charge			23.6		μC
I_{RM}	Peak Reverse Recovery Current	$V_R=400V, I_F=300A,$ $-di/dt=3443A/\mu s, V_{GE}=-8V$		249		A
E_{rec}	Reverse Recovery Energy	$L_S=30nH, T_{vj}=150^\circ C$		5.21		mJ
Q_r	Recovered Charge			26.6		μC
I_{RM}	Peak Reverse Recovery Current	$V_R=400V, I_F=300A,$ $-di/dt=3353A/\mu s, V_{GE}=-8V$		258		A
E_{rec}	Reverse Recovery Energy	$L_S=30nH, T_{vj}=175^\circ C$		5.76		mJ

NTC Characteristics $T_F=25^\circ C$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
R_{25}	Rated Resistance			5.0		k Ω
$\Delta R/R$	Deviation of R_{100}	$T_C=100^\circ C, R_{100}=493.3\Omega$	-5		5	%
P_{25}	Power Dissipation				20.0	mW
$B_{25/50}$	B-value	$R_2=R_{25}\exp[B_{25/50}(1/T_2-1/(298.15K))]$		3375		K
$B_{25/80}$	B-value	$R_2=R_{25}\exp[B_{25/80}(1/T_2-1/(298.15K))]$		3411		K
$B_{25/100}$	B-value	$R_2=R_{25}\exp[B_{25/100}(1/T_2-1/(298.15K))]$		3433		K

Module Characteristics $T_F=25^{\circ}\text{C}$ unless otherwise noted

Symbol	Parameter	Min.	Typ.	Max.	Unit
L_{CE}	Stray Inductance		13		nH
$R_{CC'+EE'}$	Module Lead Resistance, Terminal to Chip		0.83		m Ω
R_{thJF}	Junction-to-Cooling Fluid (per IGBT)			0.125	K/W
	Junction-to-Cooling Fluid (per Diode) $\Delta V/\Delta t=10.0\text{dm}^3/\text{min}, T_F=75^{\circ}\text{C}$			0.172	
G	Weight of Module		550		g

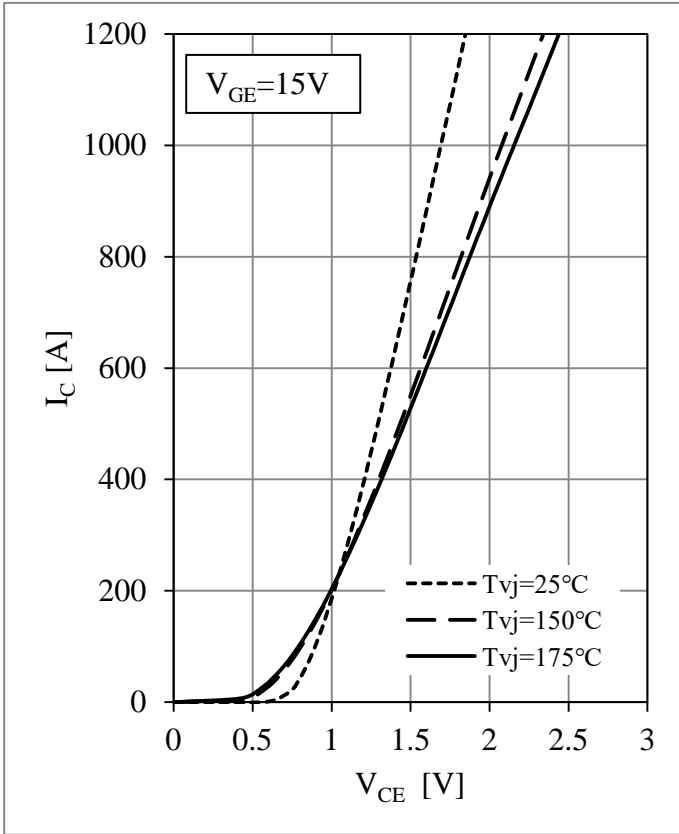


Fig 1. IGBT Output Characteristics

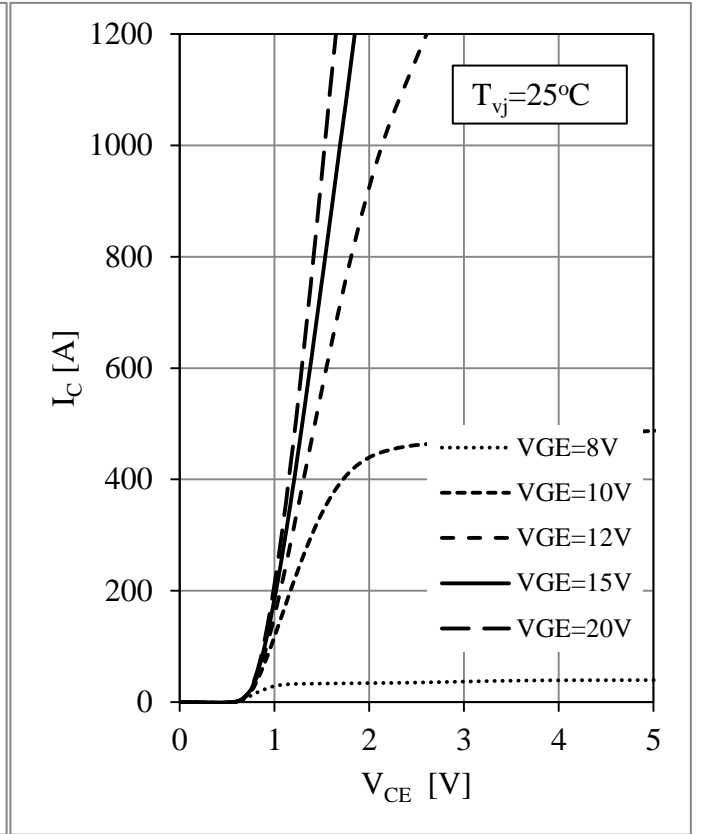


Fig 2. IGBT Output Characteristics

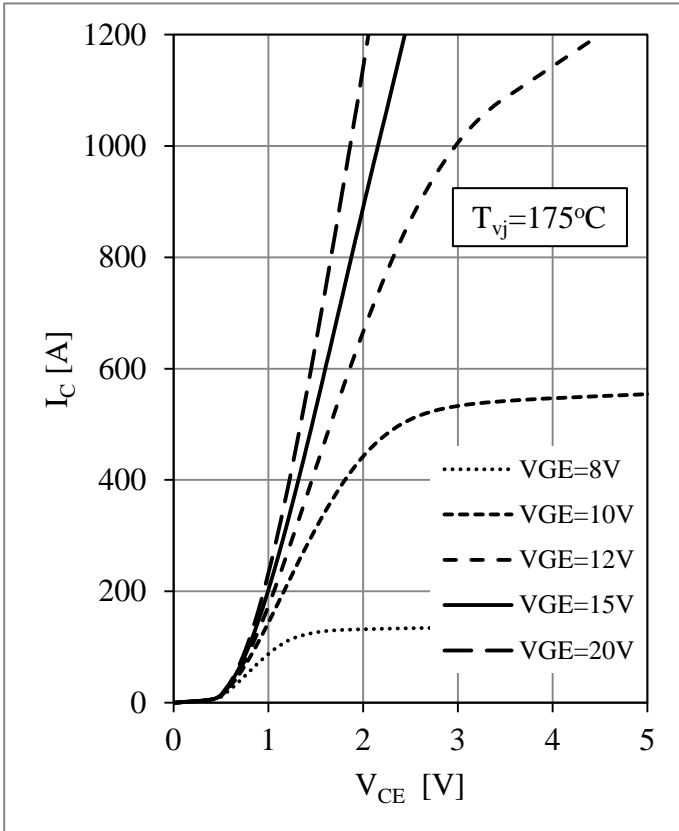


Fig 3. IGBT Output Characteristics

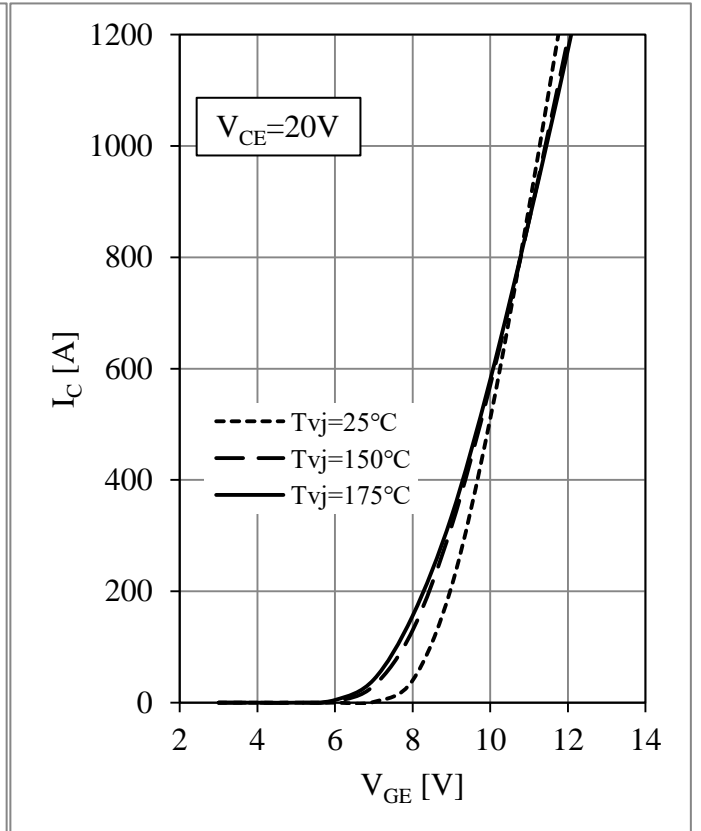


Fig 4. IGBT Transfer Characteristics

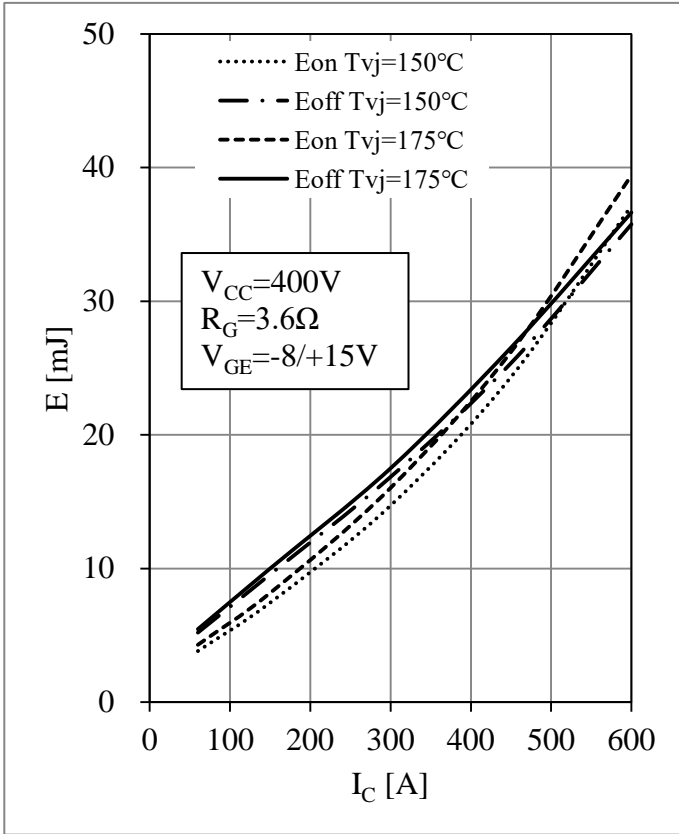


Fig 5. IGBT Switching Loss vs. I_C

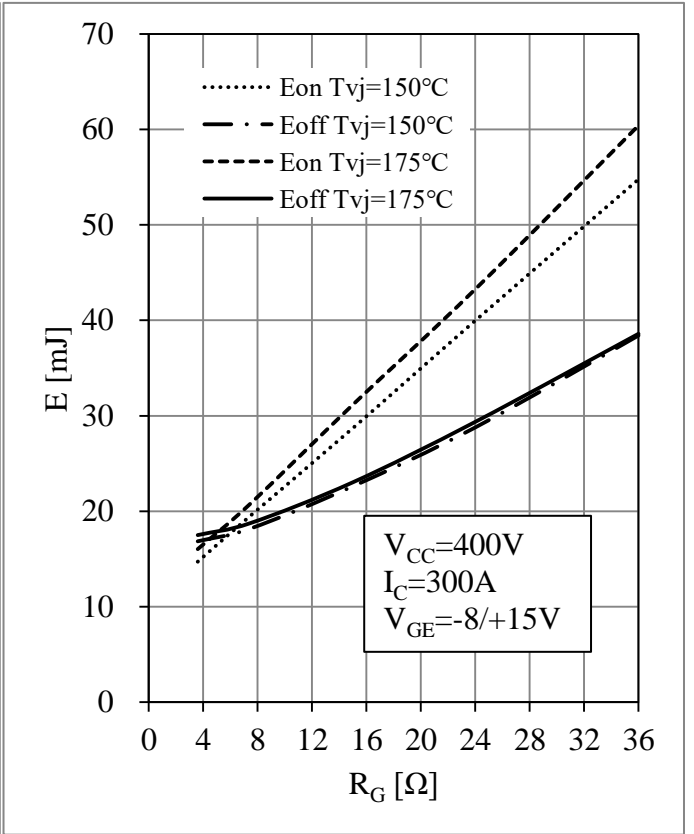


Fig 6. IGBT Switching Loss vs. R_G

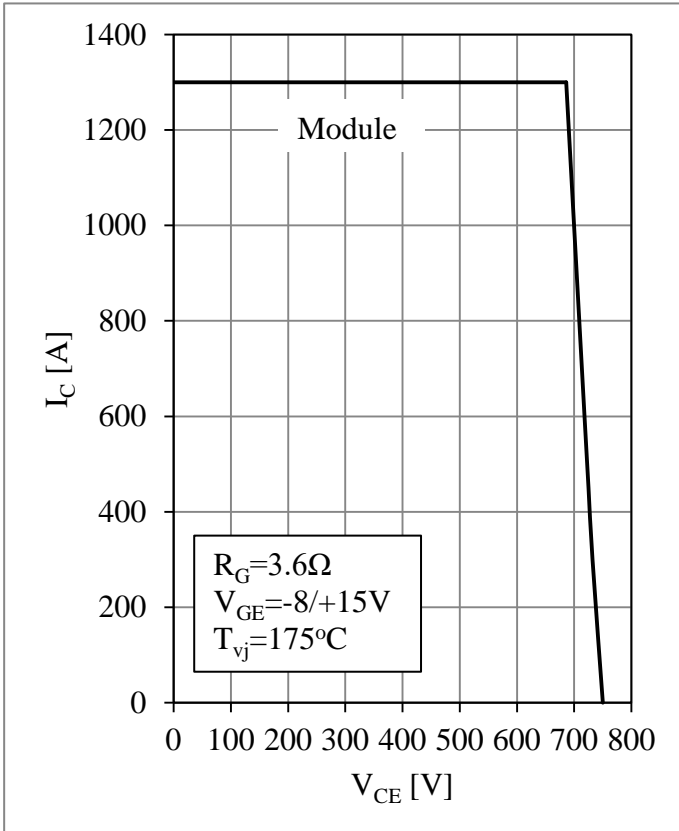


Fig 7. RBSOA

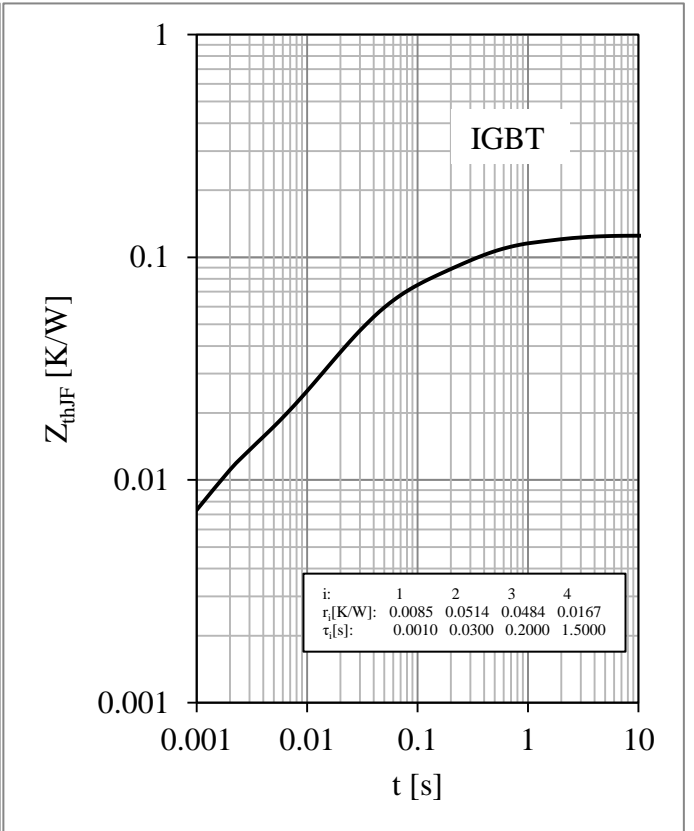


Fig 8. IGBT Transient Thermal Impedance

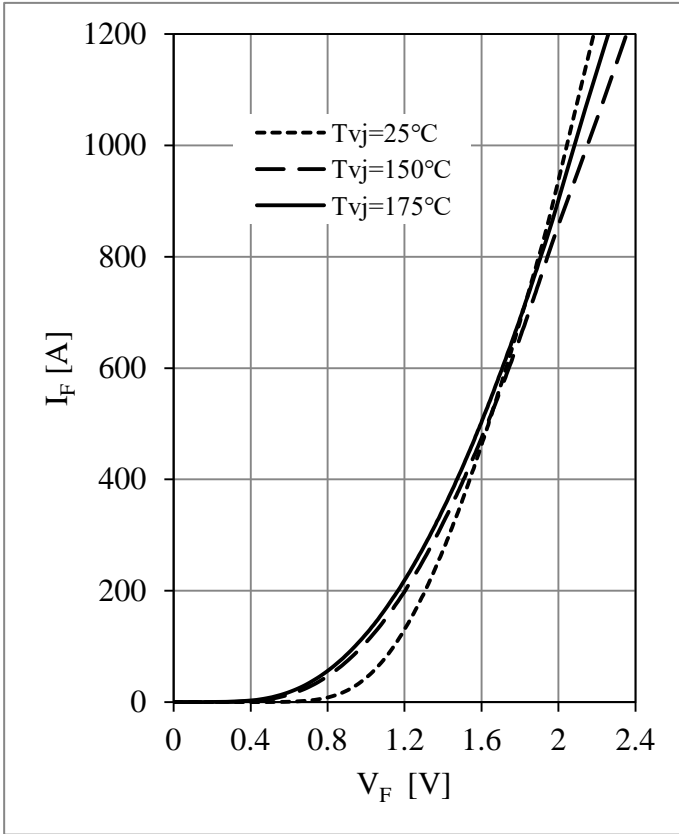


Fig 9. Diode Forward Characteristics

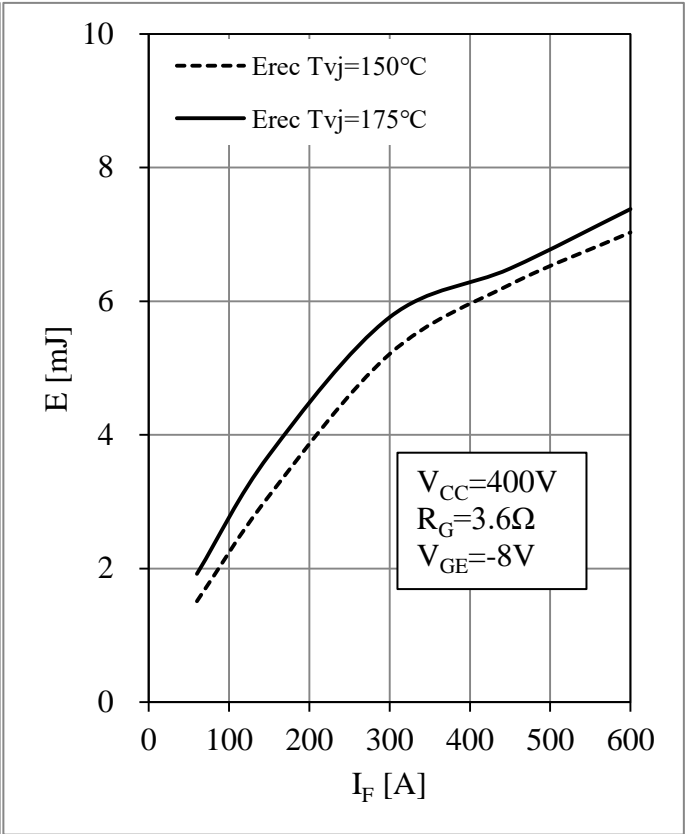


Fig 10. Diode Switching Loss vs. I_F

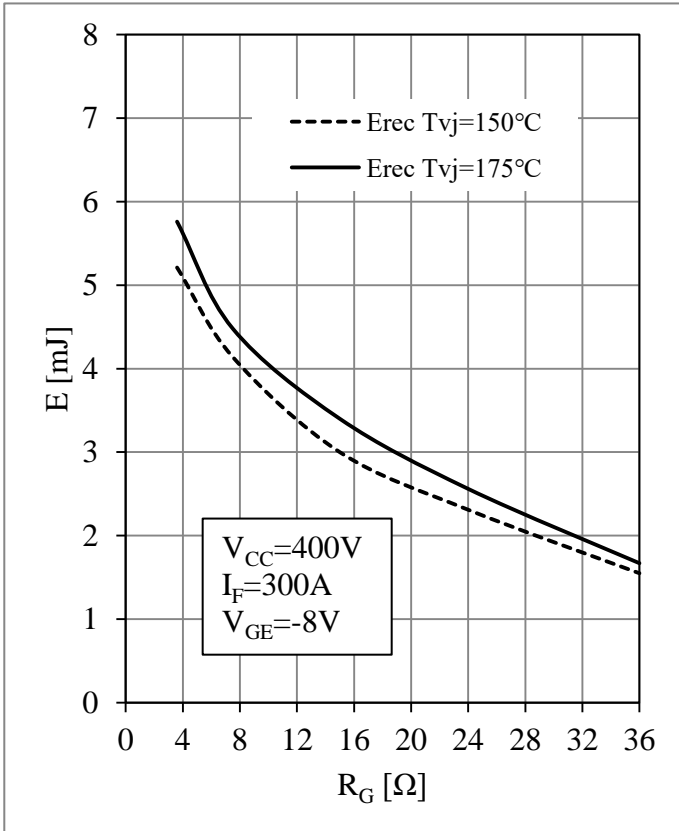


Fig 11. Diode Switching Loss vs. R_G

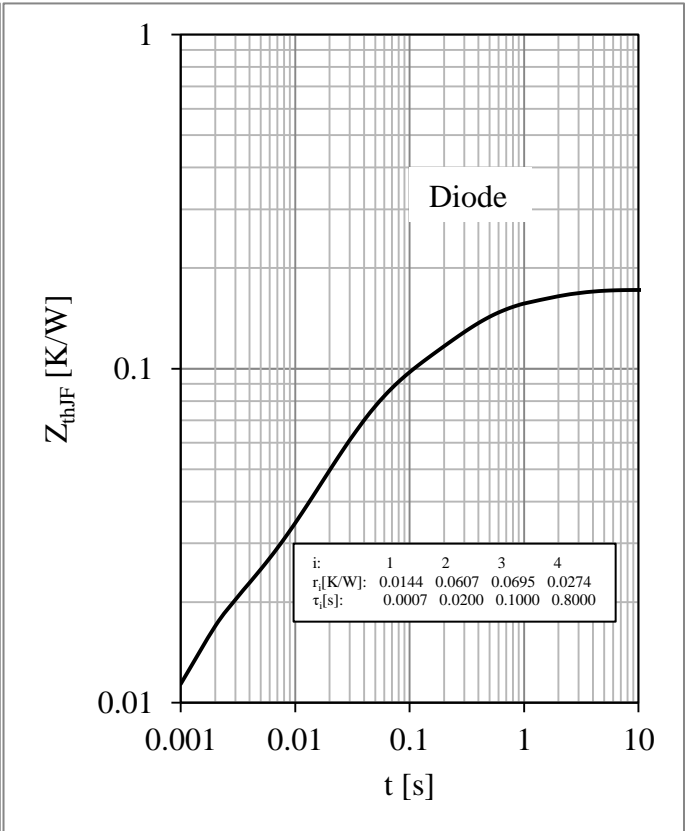


Fig 12. Diode Transient Thermal Impedance

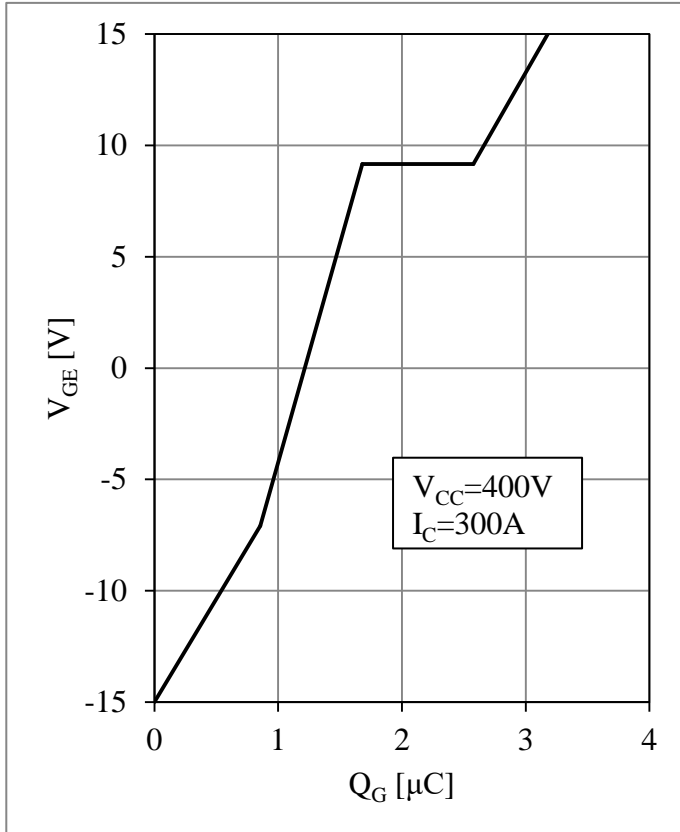


Fig 13. IGBT Gate Charge Characteristic

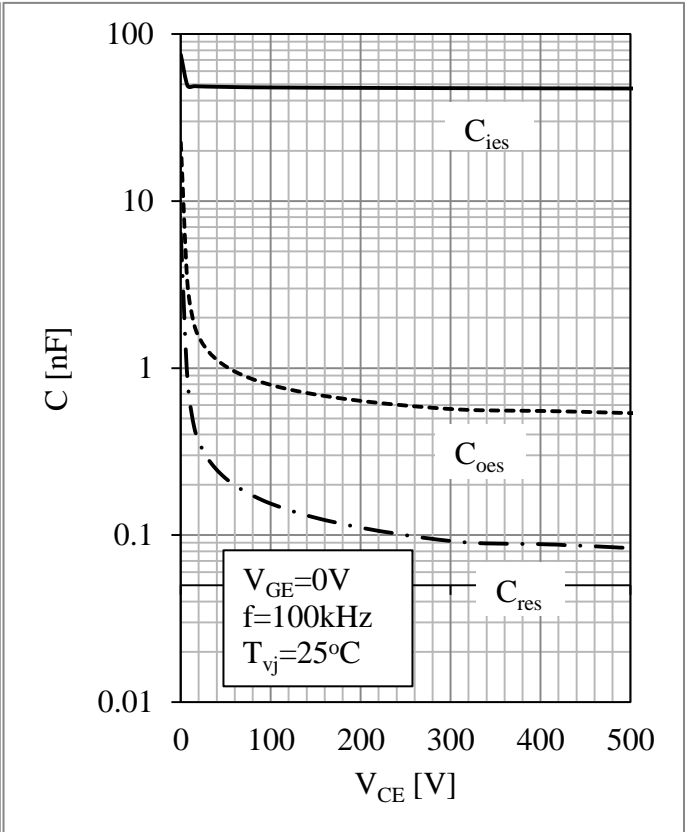


Fig 14. IGBT Capacity Characteristic

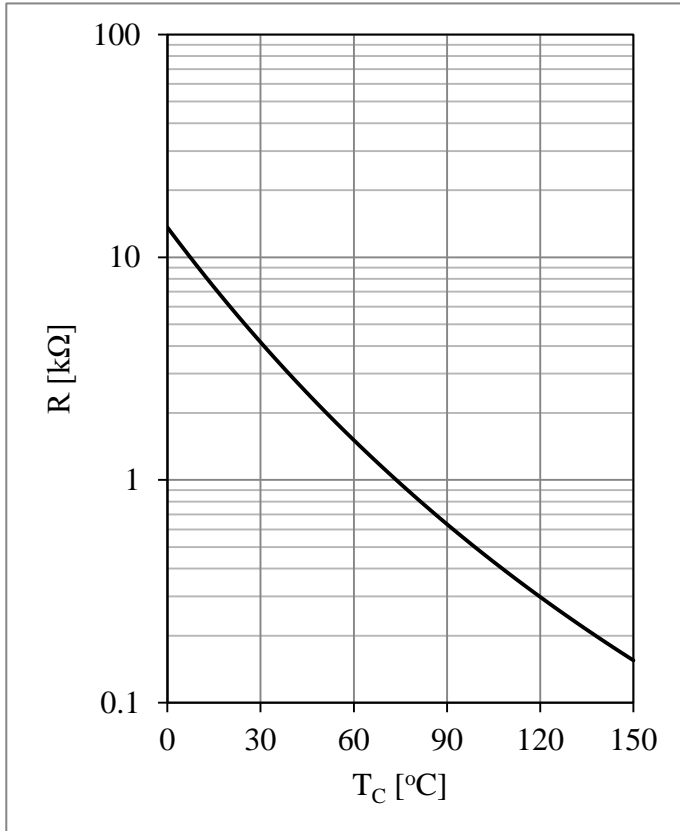


Fig 15. NTC Temperature Characteristic

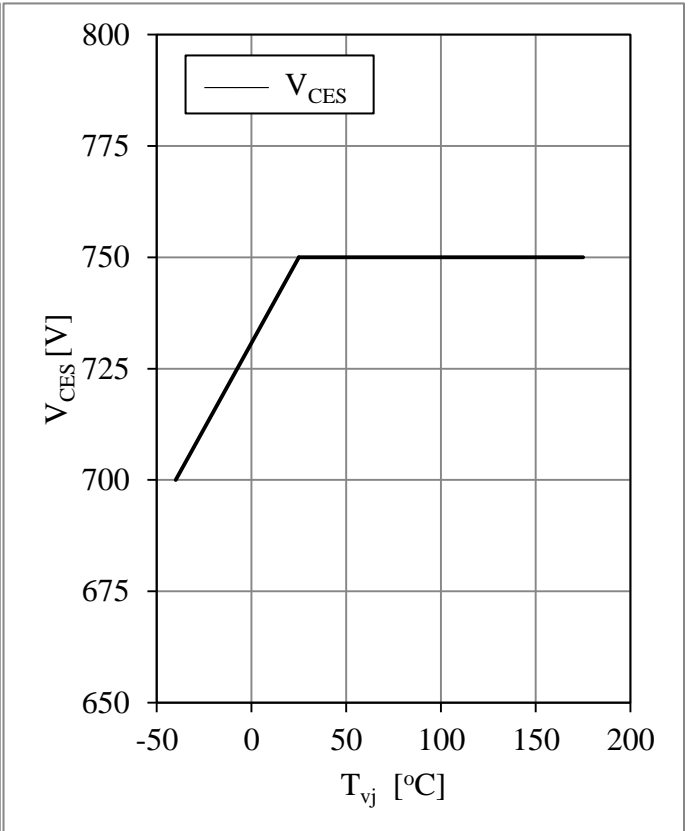


Fig 16. Maximum Allowed Collector-Emitter Voltage

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