

STARPOWER

SEMICONDUCTOR

IGBT

GD950HTX75P6H

750V/950A 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.

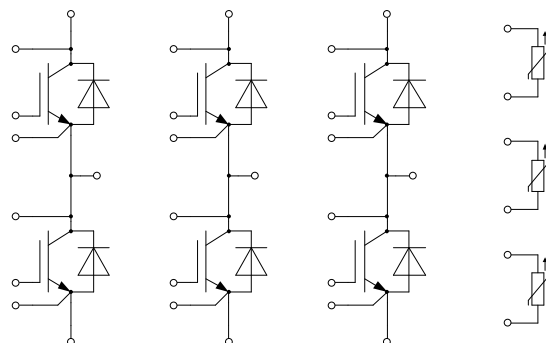
Features

- 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 DBC 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	950	A
I_C	Collector Current @ $T_F=75^{\circ}\text{C}$	450	A
I_{CM}	Pulsed Collector Current $t_p=1\text{ms}$	1900	A
P_D	Maximum Power Dissipation @ $T_F=75^{\circ}\text{C}$ $T_{vj}=175^{\circ}\text{C}$	877	W

Diode

Symbol	Description	Values	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	750	V
I_{FN}	Implemented Collector Current	950	A
I_F	Diode Continuous Forward Current	450	A
I_{FM}	Diode Maximum Forward Current $t_p=1\text{ms}$	1900	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 +150 +150 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	$I_C=450\text{A}, V_{GE}=15\text{V}, T_{vj}=25^{\circ}\text{C}$		1.35	1.60	V
		$I_C=450\text{A}, V_{GE}=15\text{V}, T_{vj}=150^{\circ}\text{C}$		1.60		
		$I_C=450\text{A}, V_{GE}=15\text{V}, T_{vj}=175^{\circ}\text{C}$		1.65		
		$I_C=950\text{A}, V_{GE}=15\text{V}, T_{vj}=25^{\circ}\text{C}$		1.75		
		$I_C=950\text{A}, V_{GE}=15\text{V}, T_{vj}=175^{\circ}\text{C}$		2.35		
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=9.60\text{mA}, V_{CE}=V_{GE}, T_{vj}=25^{\circ}\text{C}$	4.9	5.8	6.5	V
		$I_C=9.60\text{mA}, V_{CE}=V_{GE}, T_{vj}=175^{\circ}\text{C}$		4.1		
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			0.7		Ω
C_{ies}	Input Capacitance	$V_{CE}=50\text{V}, f=100\text{kHz}, V_{GE}=0\text{V}$		69.1		nF
C_{oes}	Output Capacitance			2.31		nF
C_{res}	Reverse Transfer Capacitance			1.05		nF
Q_G	Gate Charge	$V_{CE}=400\text{V}, I_C=450\text{A}, V_{GE}=-8\dots+15\text{V}$		3.29		μC
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=400\text{V}, I_C=450\text{A}, R_G=2.4\Omega, V_{GE}=-8\text{V}/+15\text{V}, L_S=24\text{nH}, T_{vj}=25^{\circ}\text{C}$		191		ns
t_r	Rise Time			83		ns
$t_{d(off)}$	Turn-Off Delay Time			543		ns
t_f	Fall Time			158		ns
E_{on}	Turn-On Switching Loss			16.8		mJ
E_{off}	Turn-Off Switching Loss			20.5		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=400\text{V}, I_C=450\text{A}, R_G=2.4\Omega, V_{GE}=-8\text{V}/+15\text{V}, L_S=24\text{nH}, T_{vj}=150^{\circ}\text{C}$		207		ns
t_r	Rise Time			96		ns
$t_{d(off)}$	Turn-Off Delay Time			594		ns
t_f	Fall Time			190		ns
E_{on}	Turn-On Switching Loss			22.5		mJ
E_{off}	Turn-Off Switching Loss			24.5		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=400\text{V}, I_C=450\text{A}, R_G=2.4\Omega, V_{GE}=-8\text{V}/+15\text{V}, L_S=24\text{nH}, T_{vj}=175^{\circ}\text{C}$		208		ns
t_r	Rise Time			103		ns
$t_{d(off)}$	Turn-Off Delay Time			613		ns
t_f	Fall Time			190		ns
E_{on}	Turn-On Switching Loss			26.7		mJ
E_{off}	Turn-Off Switching Loss			26.9		mJ
I_{SC}	SC Data	$t_p \leq 6\mu\text{s}, V_{GE}=15\text{V}$		4800		A

		$T_{vj}=25^{\circ}\text{C}, V_{CC}=400\text{V},$ $V_{CEM}\leq 750\text{V}$				
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Diode Characteristics $T_F=25^{\circ}\text{C}$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_F	Diode Forward Voltage	$I_F=450\text{A}, V_{GE}=0\text{V}, T_{vj}=25^{\circ}\text{C}$		1.40	1.65	V
		$I_F=450\text{A}, V_{GE}=0\text{V}, T_{vj}=150^{\circ}\text{C}$		1.35		
		$I_F=450\text{A}, V_{GE}=0\text{V}, T_{vj}=175^{\circ}\text{C}$		1.30		
		$I_F=950\text{A}, V_{GE}=0\text{V}, T_{vj}=25^{\circ}\text{C}$		1.75		
		$I_F=950\text{A}, V_{GE}=0\text{V}, T_{vj}=175^{\circ}\text{C}$		1.75		
Q_r	Recovered Charge	$V_R=400\text{V}, I_F=450\text{A},$ $-di/dt=5520\text{A}/\mu\text{s}, V_{GE}=-8\text{V}$ $L_S=24\text{nH}, T_{vj}=25^{\circ}\text{C}$		16.4		μC
I_{RM}	Peak Reverse Recovery Current			222		A
E_{rec}	Reverse Recovery Energy			4.50		mJ
Q_r	Recovered Charge	$V_R=400\text{V}, I_F=450\text{A},$ $-di/dt=4810\text{A}/\mu\text{s}, V_{GE}=-8\text{V}$ $L_S=24\text{nH}, T_{vj}=150^{\circ}\text{C}$		32.2		μC
I_{RM}	Peak Reverse Recovery Current			283		A
E_{rec}	Reverse Recovery Energy			8.19		mJ
Q_r	Recovered Charge	$V_R=400\text{V}, I_F=450\text{A},$ $-di/dt=4630\text{A}/\mu\text{s}, V_{GE}=-8\text{V}$ $L_S=24\text{nH}, T_{vj}=175^{\circ}\text{C}$		36.3		μC
I_{RM}	Peak Reverse Recovery Current			292		A
E_{rec}	Reverse Recovery Energy			9.03		mJ

NTC Characteristics $T_F=25^{\circ}\text{C}$ 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}	$T_C=100^{\circ}\text{C}, R_{100}=493.3\Omega$	-5		5	%
P_{25}	Power Dissipation				20.0	mW
$B_{25/50}$	B-value	$R_2=R_{25}\exp[B_{25/50}(1/T_2-1/(298.15\text{K}))]$		3375		K
$B_{25/80}$	B-value	$R_2=R_{25}\exp[B_{25/80}(1/T_2-1/(298.15\text{K}))]$		3411		K
$B_{25/100}$	B-value	$R_2=R_{25}\exp[B_{25/100}(1/T_2-1/(298.15\text{K}))]$		3433		K

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

Symbol	Parameter	Min.	Typ.	Max.	Unit
L_{CE}	Stray Inductance		8		nH
$R_{CC'+EE'}$	Module Lead Resistance, Terminal to Chip		0.75		m Ω
Δp	$\Delta V/\Delta t=10.0\text{dm}^3/\text{min}, T_F=75^{\circ}\text{C}$		64		mbar
p	Maximum Pressure In Cooling Circuit $T_{\text{baseplate}} < 40^{\circ}\text{C}$ $T_{\text{baseplate}} > 40^{\circ}\text{C}$ (relative pressure)			2.5 2.0	bar
R_{thJF}	Junction-to-Cooling Fluid (per IGBT) Junction-to-Cooling Fluid (per Diode) $\Delta V/\Delta t=10.0\text{dm}^3/\text{min}, T_F=75^{\circ}\text{C}$		0.098 0.140	0.114 0.160	K/W
M	Terminal Connection Torque, Screw M5 Mounting Torque, Screw M4	3.6 1.8		4.4 2.2	N.m
G	Weight of Module		750		g

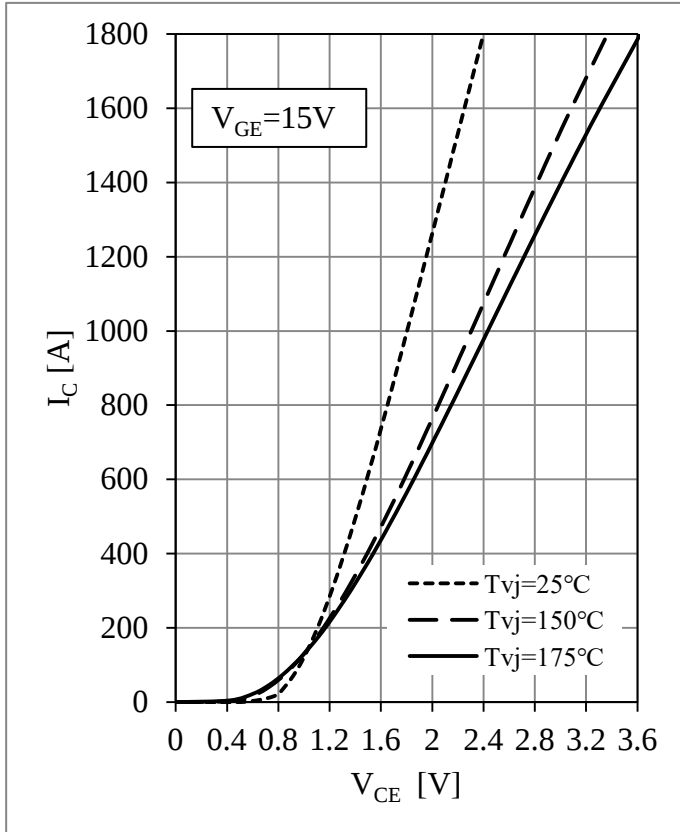


Fig 1. IGBT Output Characteristics

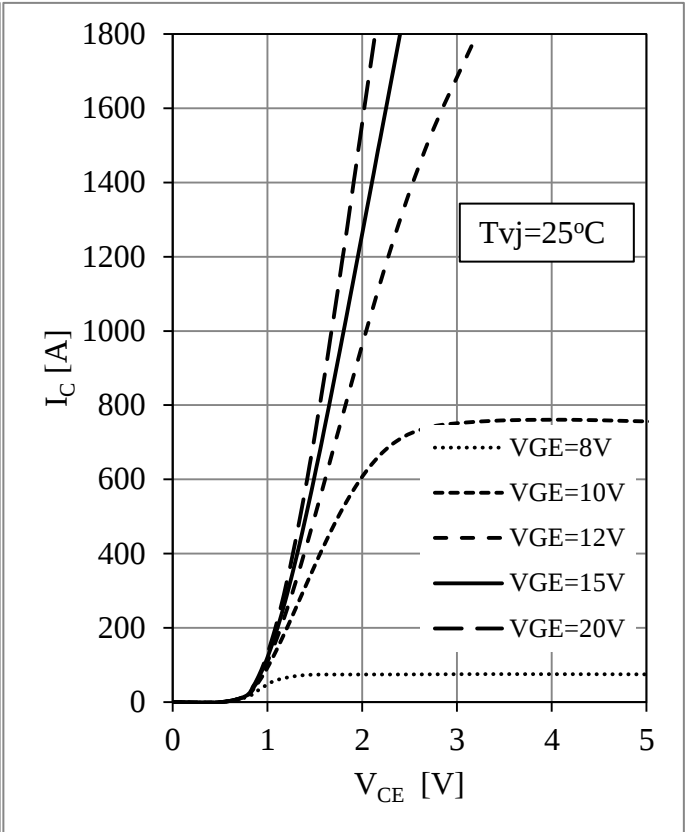


Fig 2. IGBT Output Characteristics

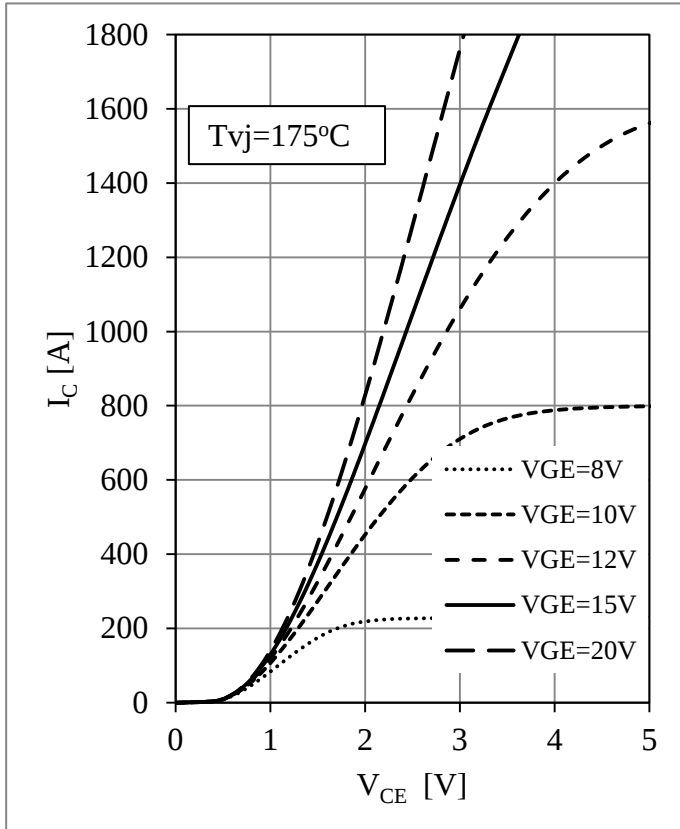


Fig 3. IGBT Output Characteristics

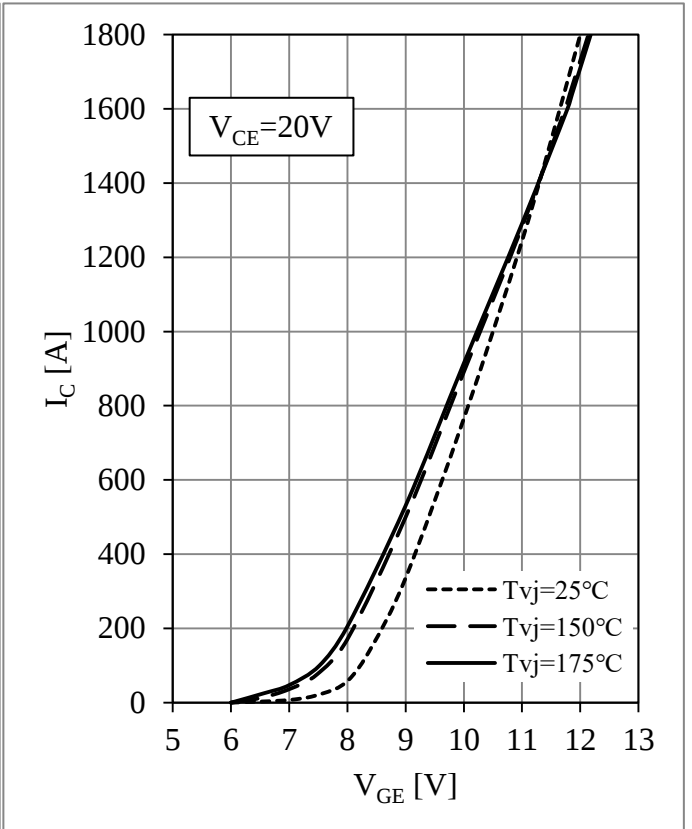


Fig 4. IGBT Transfer Characteristics

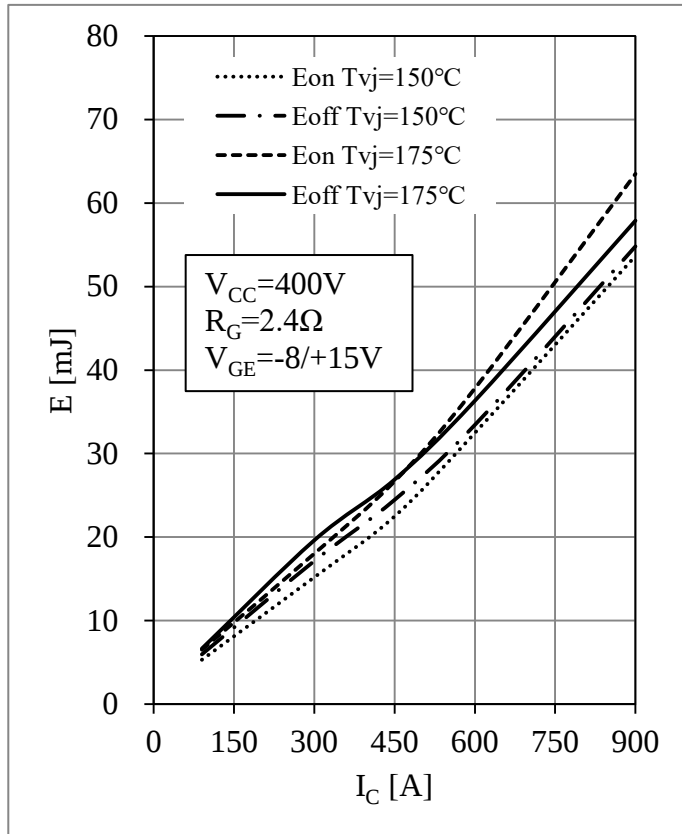
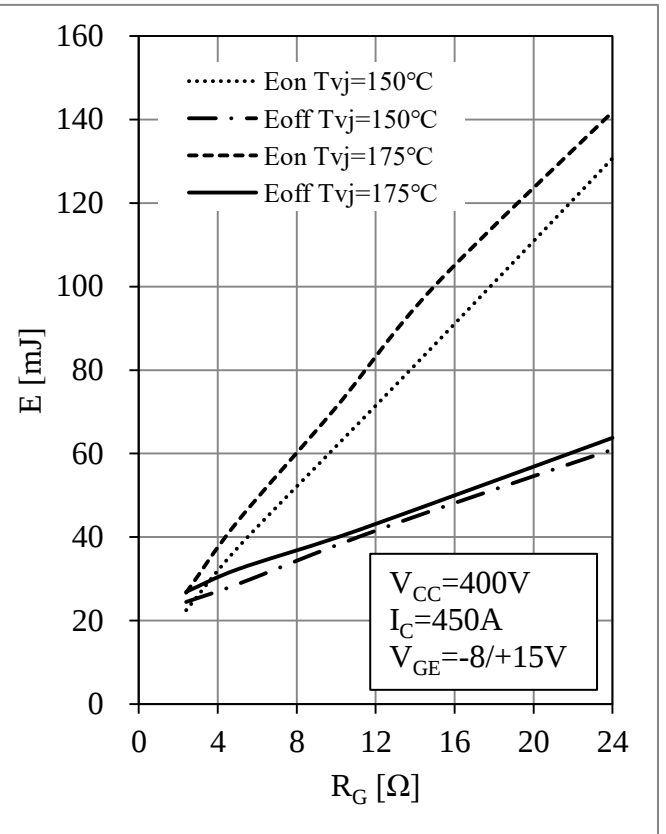
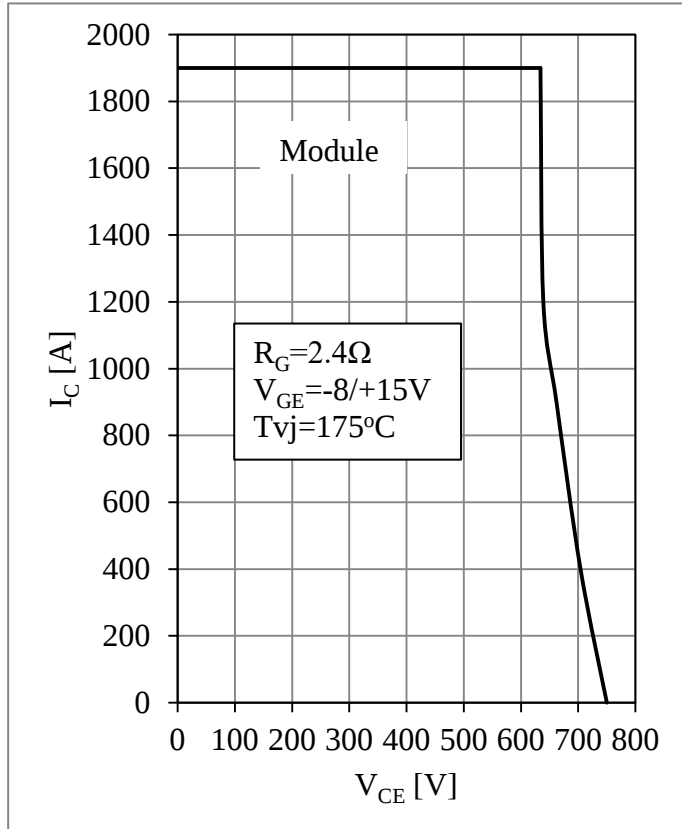
Fig 5. IGBT Switching Loss vs. I_C Fig 6. IGBT Switching Loss vs. R_G 

Fig 7. RBSOA

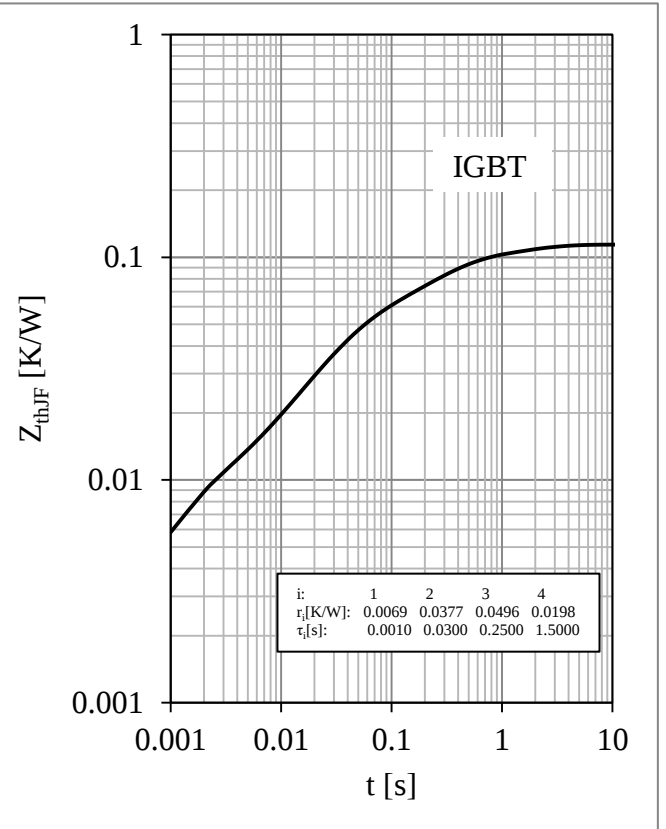


Fig 8. IGBT Transient Thermal Impedance

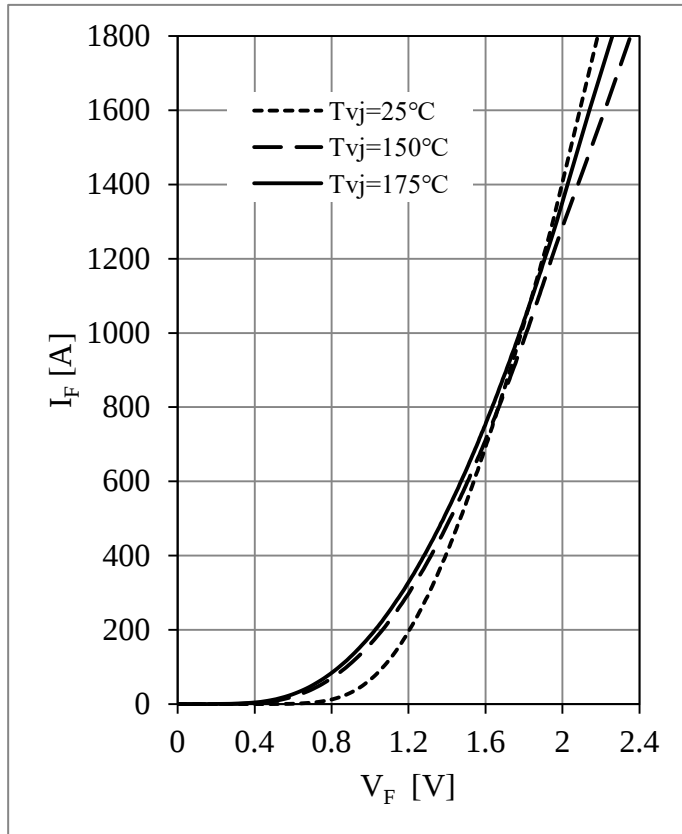


Fig 9. Diode Forward Characteristics

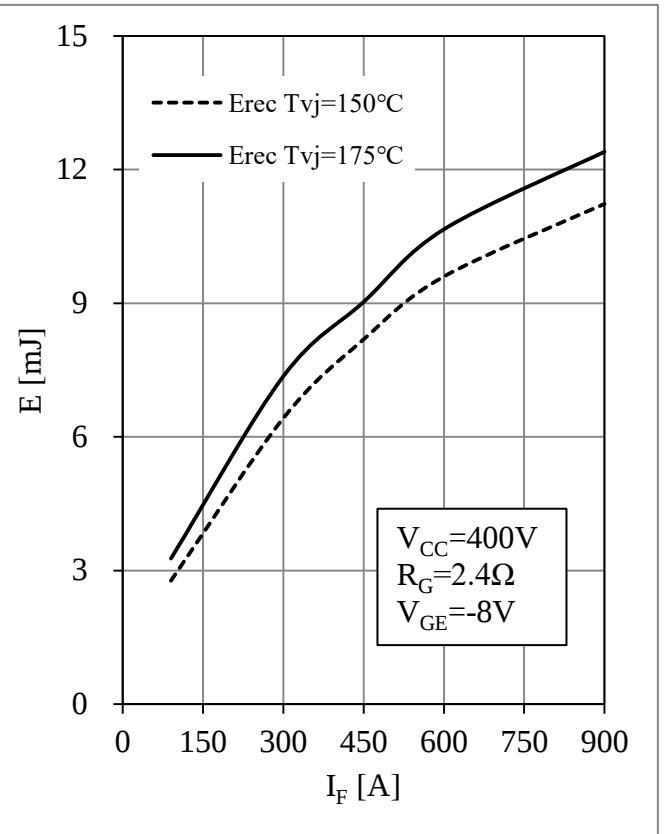
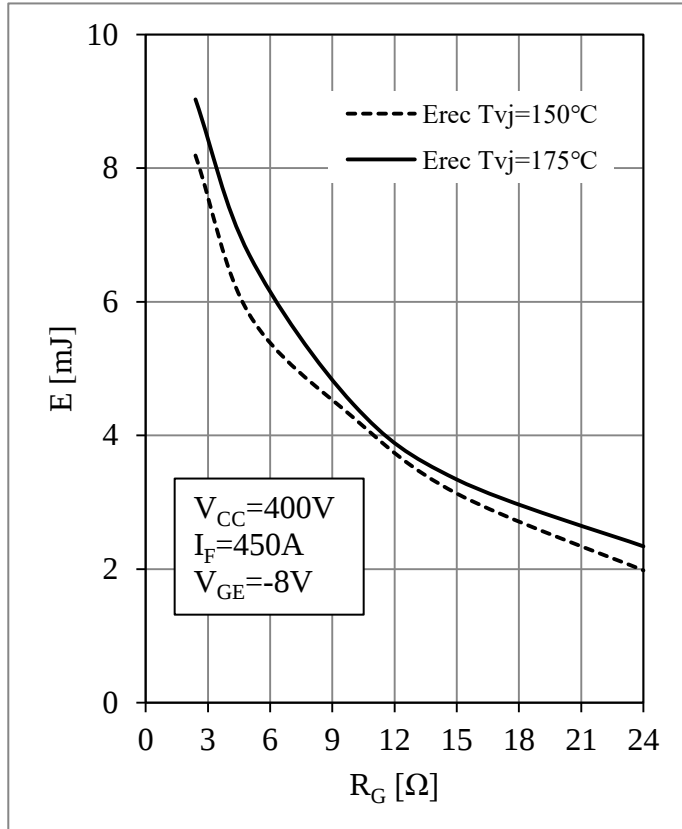
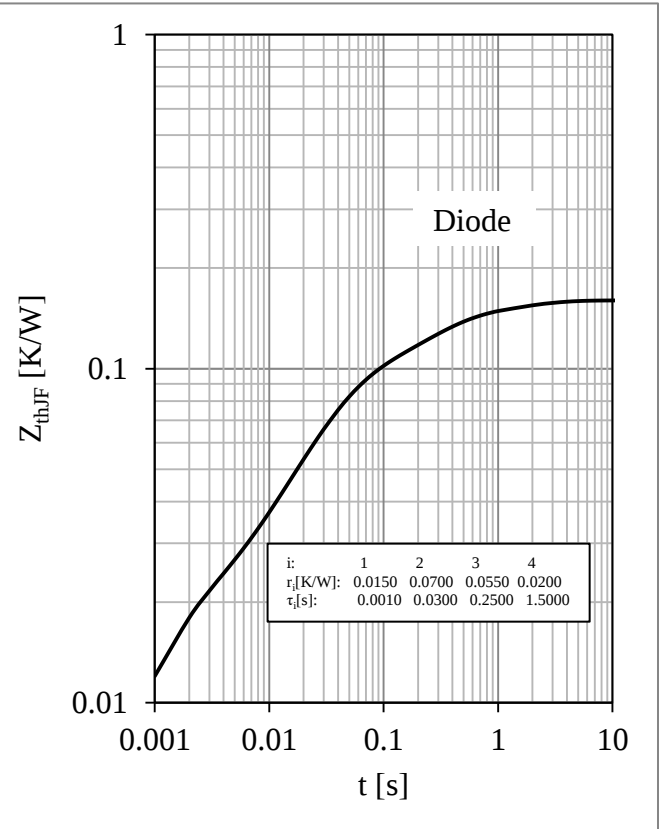
Fig 10. Diode Switching Loss vs. I_F Fig 11. Diode Switching Loss vs. R_G 

Fig 12. Diode Transient Thermal Impedance

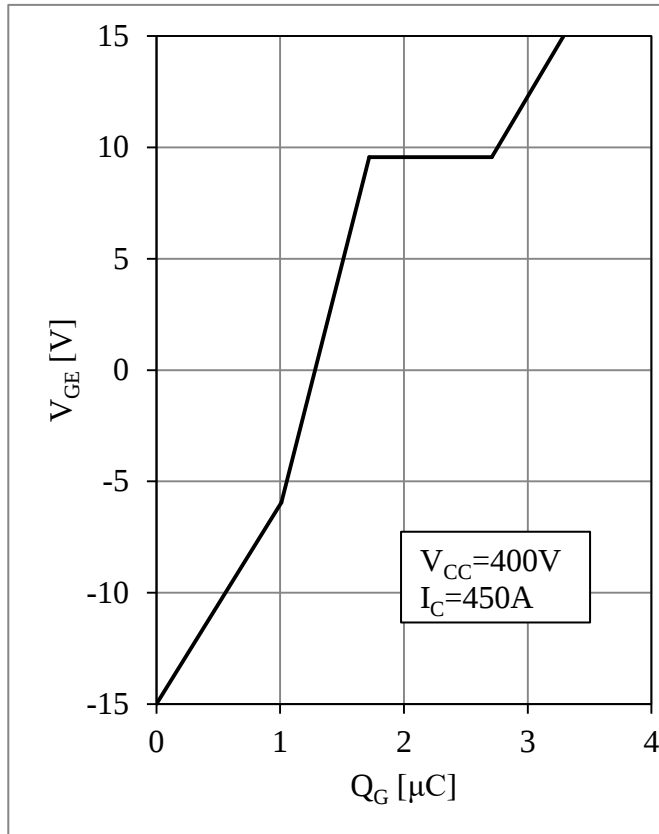


Fig 13. IGBT Gate Charge Characteristic

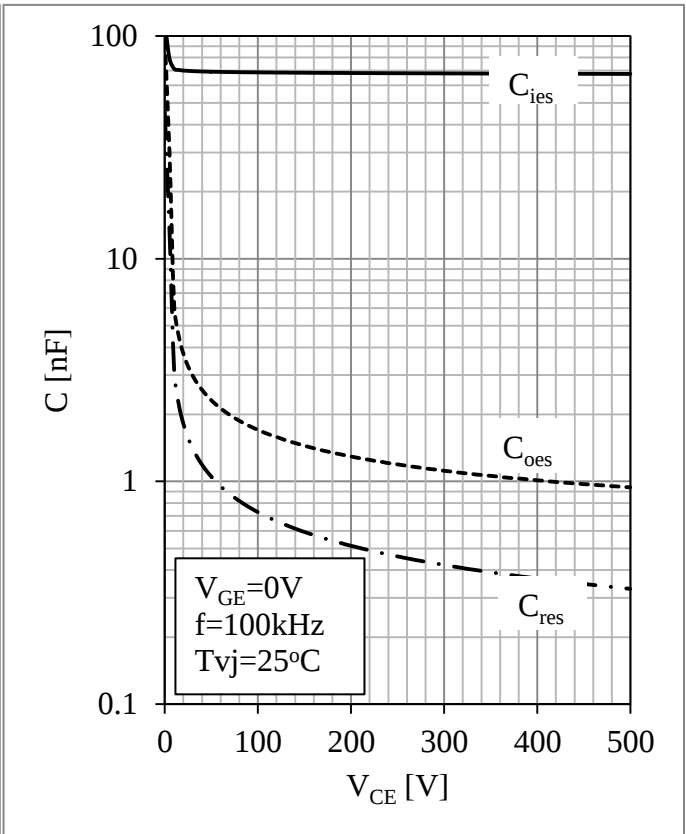


Fig 14. IGBT Capacity Characteristic

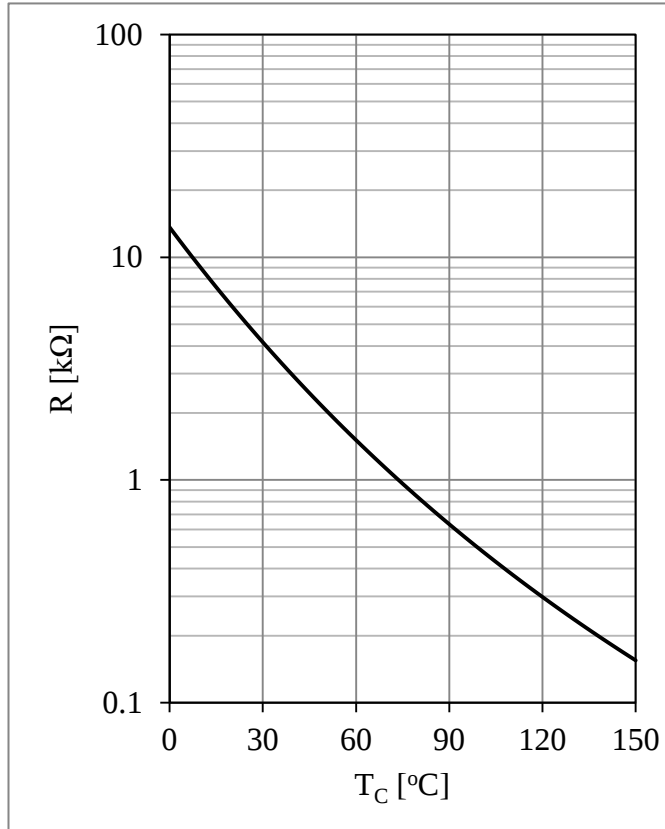


Fig 15. NTC Temperature Characteristic

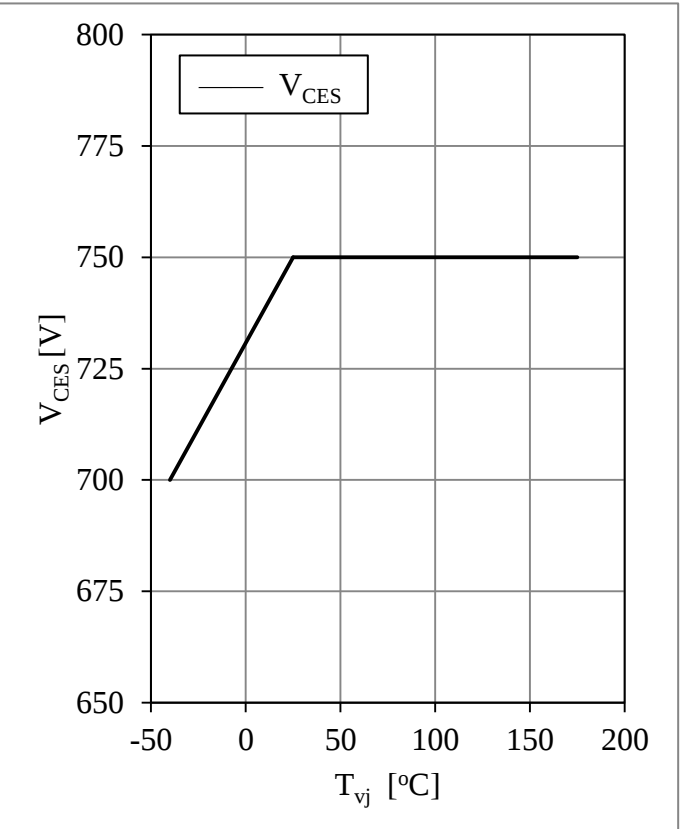
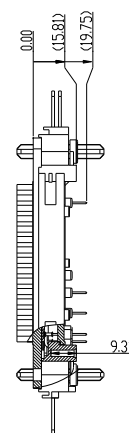
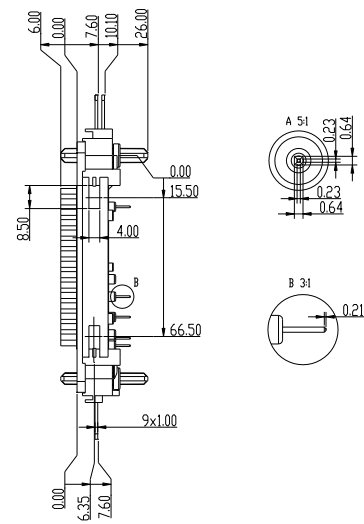


Fig 16. Maximum Allowed Collector-Emitter Voltage

Dimensions in Millimeters



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