

STARPOWER

SEMICONDUCTOR

IGBT

GD1000HTA75P6HT

750V/1000A 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.

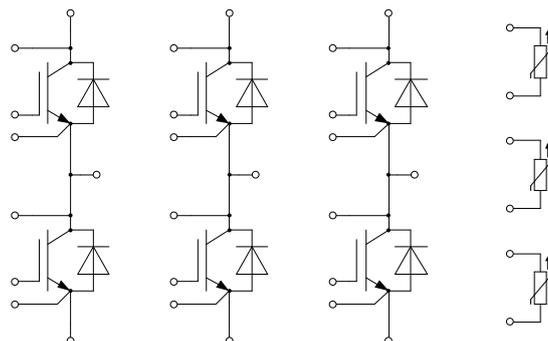
Features

- 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

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	1000	A
I_C	Collector Current @ $T_F=125^{\circ}\text{C}$	450	A
I_{CM}	Pulsed Collector Current $t_p=1\text{ms}$	2000	A
P_D	Maximum Power Dissipation @ $T_F=75^{\circ}\text{C}$ $T_{vj}=175^{\circ}\text{C}$	1282	W

Diode

Symbol	Description	Values	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	750	V
I_{FN}	Implemented Collector Current	1000	A
I_F	Diode Continuous Forward Current	450	A
I_{FM}	Diode Maximum Forward Current $t_p=1\text{ms}$	2000	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
d_{Creep}	Terminal to Heatsink Terminal to Terminal	9.0 9.0	mm
d_{Clear}	Terminal to Heatsink Terminal to Terminal	4.5 4.5	mm

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	$I_C=450\text{A}, V_{GE}=15\text{V}, T_{vj}=25^{\circ}\text{C}$		1.10	1.35	V	
		$I_C=450\text{A}, V_{GE}=15\text{V}, T_{vj}=150^{\circ}\text{C}$		1.10			
		$I_C=450\text{A}, V_{GE}=15\text{V}, T_{vj}=175^{\circ}\text{C}$		1.10			
		$I_C=1000\text{A}, V_{GE}=15\text{V}, T_{vj}=25^{\circ}\text{C}$		1.40			
		$I_C=1000\text{A}, V_{GE}=15\text{V}, T_{vj}=175^{\circ}\text{C}$		1.60			
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=12.9\text{mA}, V_{CE}=V_{GE}, T_{vj}=25^{\circ}\text{C}$	5.5	6.4	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			1.2		Ω	
C_{ies}	Input Capacitance			66.7		nF	
C_{oes}	Output Capacitance	$V_{CE}=50\text{V}, f=100\text{kHz}, V_{GE}=0\text{V}$		1.50		nF	
C_{res}	Reverse Transfer Capacitance	$V_{GE}=0\text{V}$		0.35		nF	
Q_G	Gate Charge	$V_{CE}=400\text{V}, I_C=450\text{A}, V_{GE}=-15\dots+15\text{V}$		4.74		μC	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=400\text{V}, I_C=450\text{A}, R_{Gon}=1.2\Omega, R_{Goff}=1.0\Omega, V_{GE}=-8\text{V}/+15\text{V}, L_S=24\text{nH}, T_{vj}=25^{\circ}\text{C}$		244		ns	
t_r	Rise Time			61		ns	
$t_{d(off)}$	Turn-Off Delay Time			557		ns	
t_f	Fall Time			133		ns	
E_{on}	Turn-On Switching Loss			11.0		mJ	
E_{off}	Turn-Off Switching Loss			22.8		mJ	
$t_{d(on)}$	Turn-On Delay Time		$V_{CC}=400\text{V}, I_C=450\text{A}, R_{Gon}=1.2\Omega, R_{Goff}=1.0\Omega, V_{GE}=-8\text{V}/+15\text{V}, L_S=24\text{nH}, T_{vj}=150^{\circ}\text{C}$		260		ns
t_r	Rise Time				68		ns
$t_{d(off)}$	Turn-Off Delay Time			636		ns	
t_f	Fall Time			226		ns	
E_{on}	Turn-On Switching Loss			16.9		mJ	
E_{off}	Turn-Off Switching Loss			32.2		mJ	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=400\text{V}, I_C=450\text{A}, R_{Gon}=1.2\Omega, R_{Goff}=1.0\Omega, V_{GE}=-8\text{V}/+15\text{V}, L_S=24\text{nH}, T_{vj}=175^{\circ}\text{C}$			264		ns
t_r	Rise Time				70		ns
$t_{d(off)}$	Turn-Off Delay Time			673		ns	
t_f	Fall Time			239		ns	
E_{on}	Turn-On Switching Loss			19.2		mJ	
E_{off}	Turn-Off Switching Loss			33.6		mJ	
I_{SC}	SC Data		$t_p \leq 6\mu\text{s}, V_{GE}=15\text{V}, T_{vj}=25^{\circ}\text{C}, V_{CC}=400\text{V}, V_{CEM} \leq 750\text{V}$		4900		A

		$t_p \leq 3\mu s, V_{GE}=15V,$ $T_{vj}=175^\circ C, V_{CC}=400V,$ $V_{CEM} \leq 750V$		3800		
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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	$I_F=450A, V_{GE}=0V, T_{vj}=25^\circ C$		1.40	1.65	V
		$I_F=450A, V_{GE}=0V, T_{vj}=150^\circ C$		1.35		
		$I_F=450A, V_{GE}=0V, T_{vj}=175^\circ C$		1.30		
		$I_F=1000A, V_{GE}=0V, T_{vj}=25^\circ C$		1.80		
		$I_F=1000A, V_{GE}=0V, T_{vj}=175^\circ C$		1.80		
Q_r	Recovered Charge			18.5		μC
I_{RM}	Peak Reverse Recovery Current	$V_R=400V, I_F=450A,$ $-di/dt=7809A/\mu s, V_{GE}=-8V$ $L_S=24nH, T_{vj}=25^\circ C$		303		A
E_{rec}	Reverse Recovery Energy			3.72		mJ
Q_r	Recovered Charge			36.1		μC
I_{RM}	Peak Reverse Recovery Current	$V_R=400V, I_F=450A,$ $-di/dt=6940A/\mu s, V_{GE}=-8V$ $L_S=24nH, T_{vj}=150^\circ C$		376		A
E_{rec}	Reverse Recovery Energy			8.09		mJ
Q_r	Recovered Charge			40.1		μC
I_{RM}	Peak Reverse Recovery Current	$V_R=400V, I_F=450A,$ $-di/dt=6748A/\mu s, V_{GE}=-8V$ $L_S=24nH, T_{vj}=175^\circ C$		383		A
E_{rec}	Reverse Recovery Energy			9.01		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		8		nH
$R_{CC'+EE'}$	Module Lead Resistance, Terminal to Chip		0.75		m Ω
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) $\Delta V/\Delta t=10.0\text{dm}^3/\text{min}, T_F=75^{\circ}\text{C}$		0.068 0.105	0.078 0.120	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

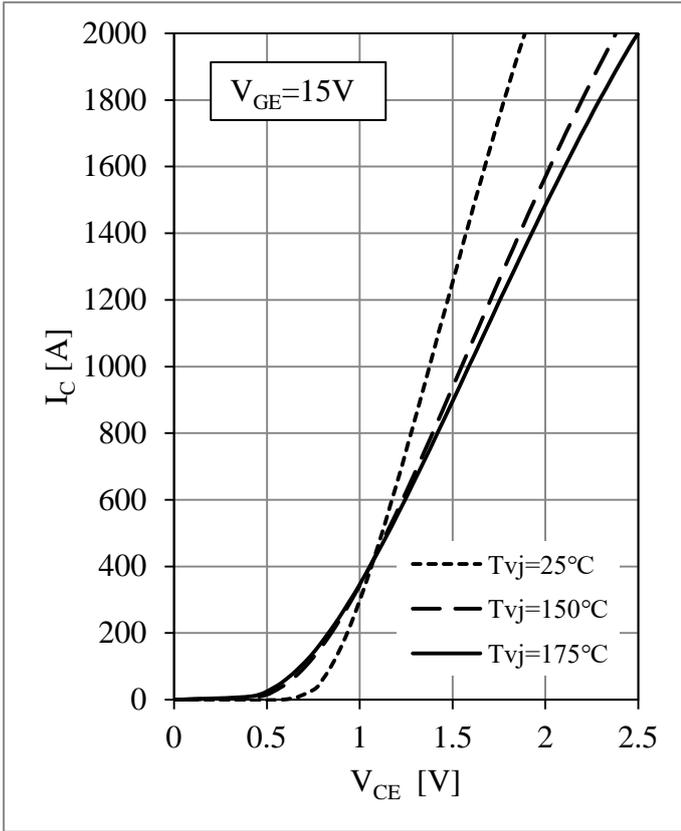


Fig 1. IGBT Output Characteristics

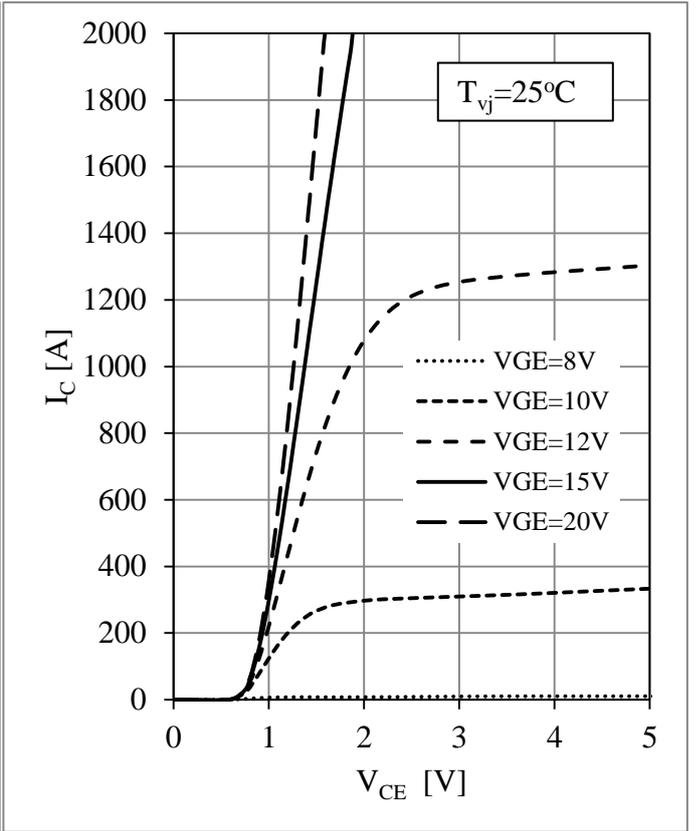


Fig 2. IGBT Output Characteristics

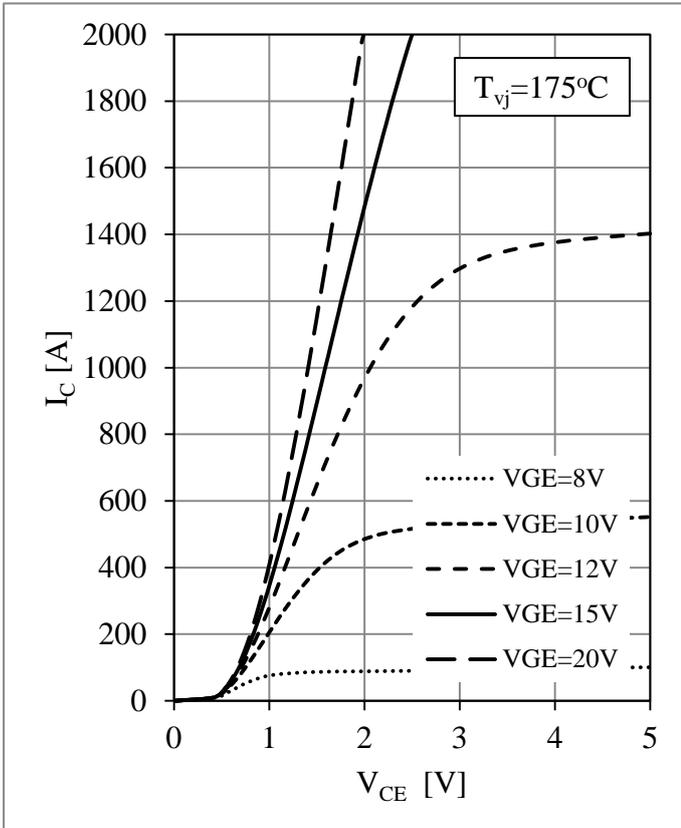


Fig 3. IGBT Output Characteristics

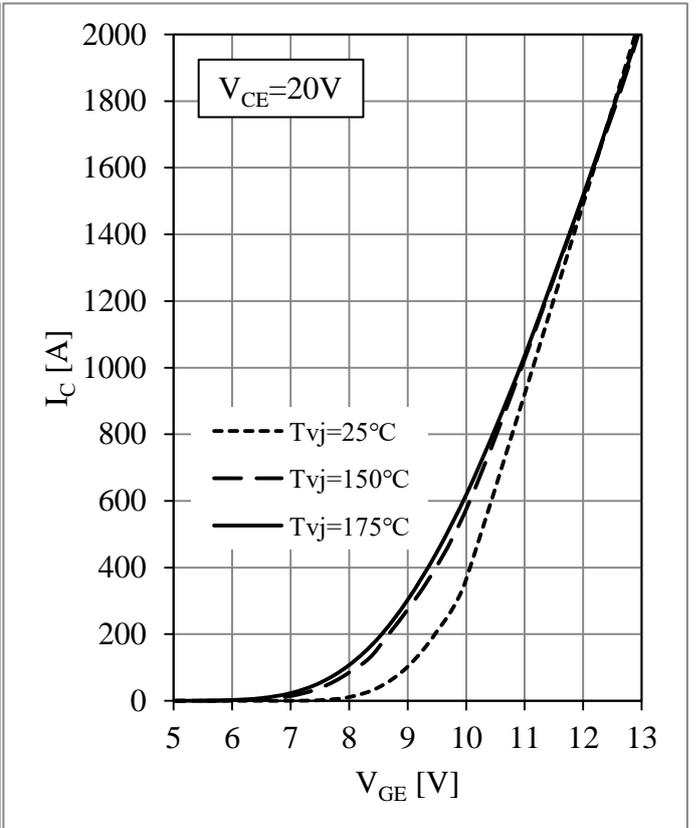


Fig 4. IGBT Transfer Characteristics

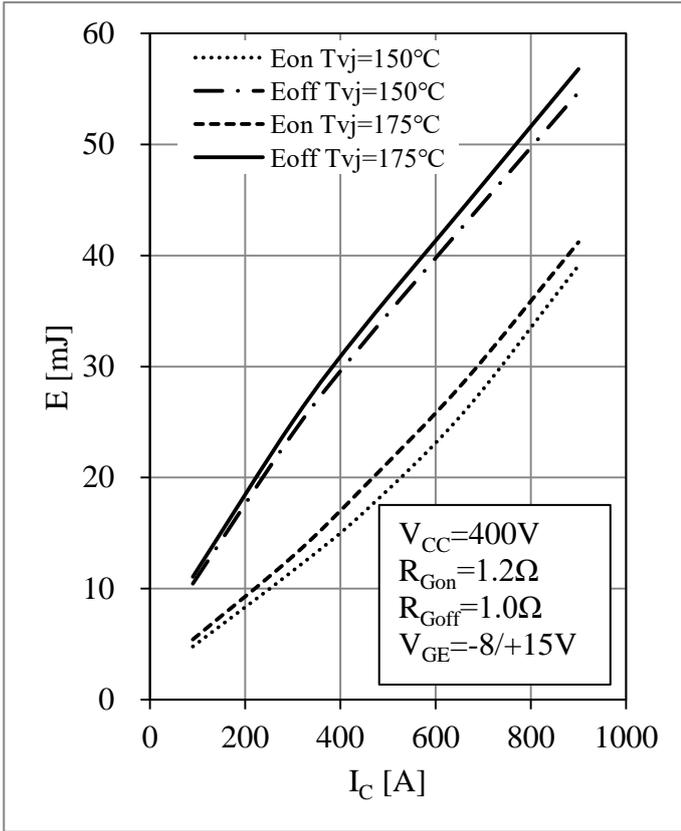


Fig 5. IGBT Switching Loss vs. I_C

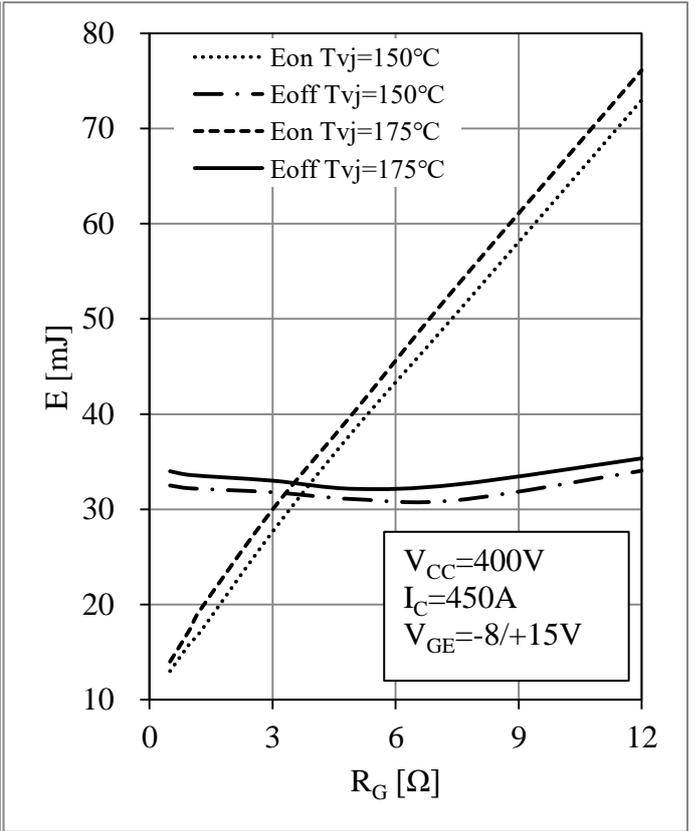


Fig 6. IGBT Switching Loss vs. R_G

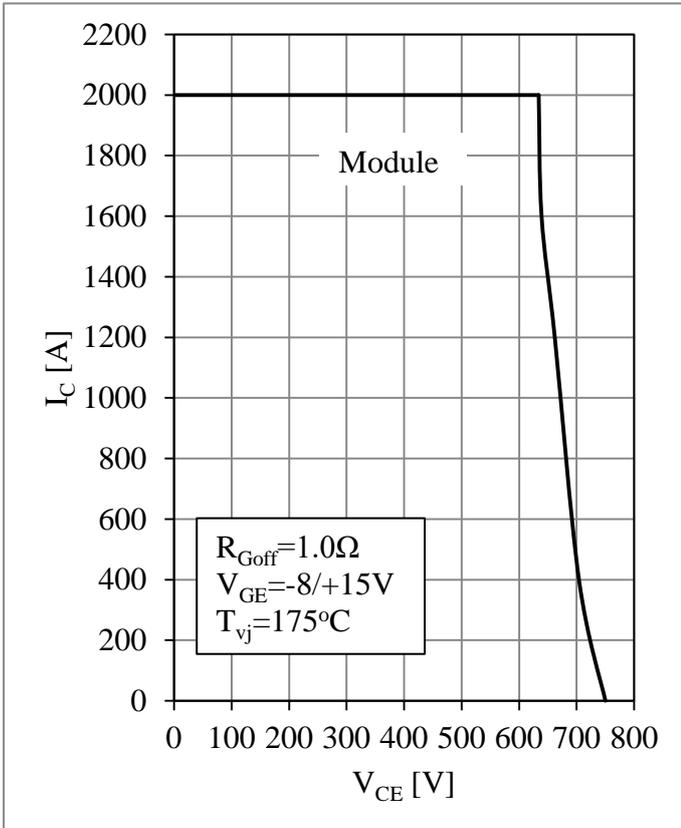


Fig 7. RBSOA

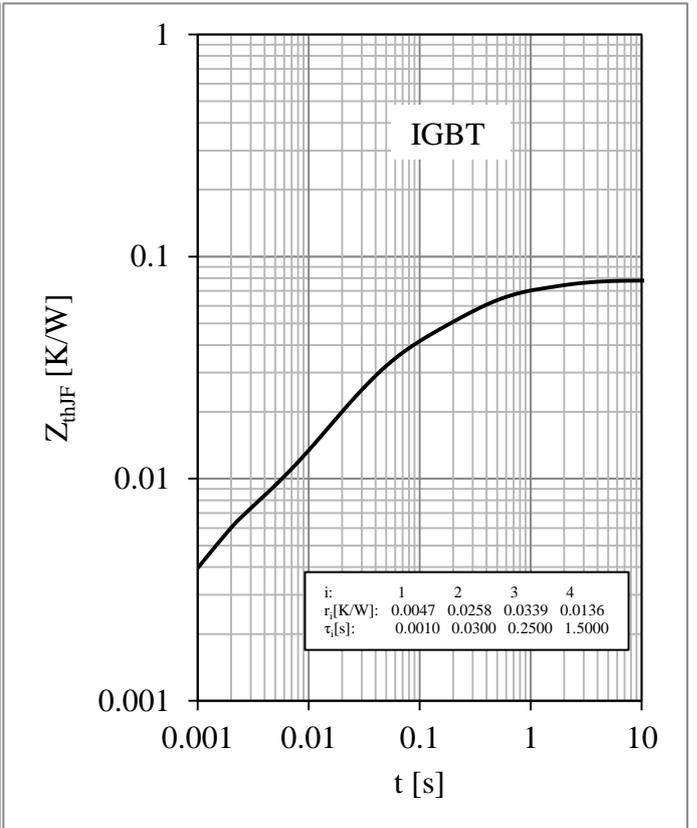


Fig 8. IGBT Transient Thermal Impedance

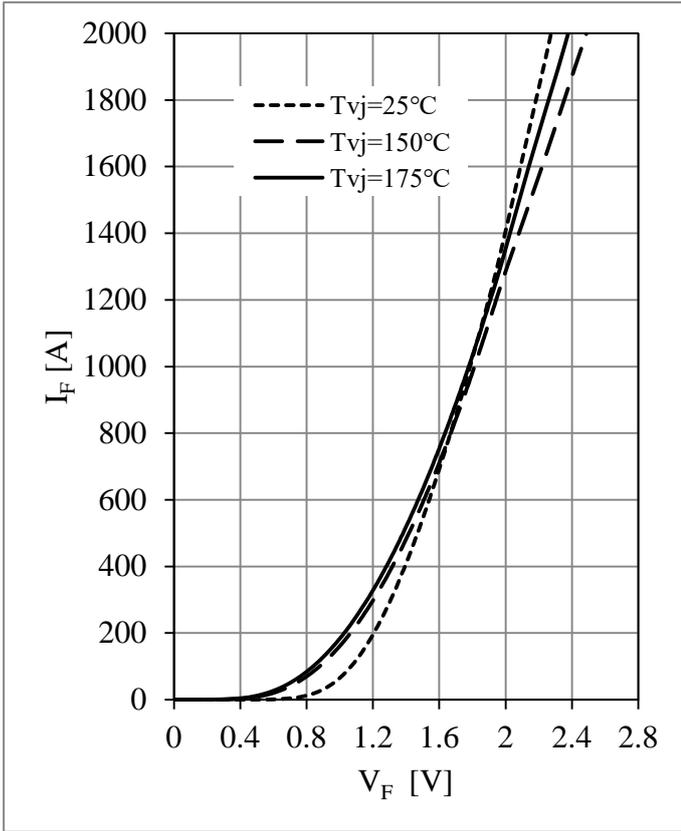


Fig 9. Diode Forward Characteristics

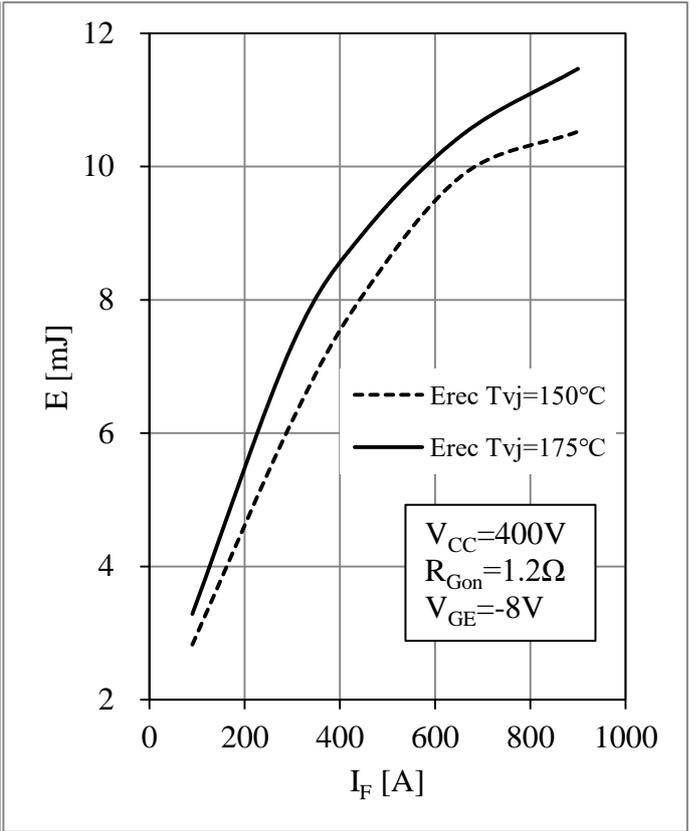


Fig 10. Diode Switching Loss vs. I_F

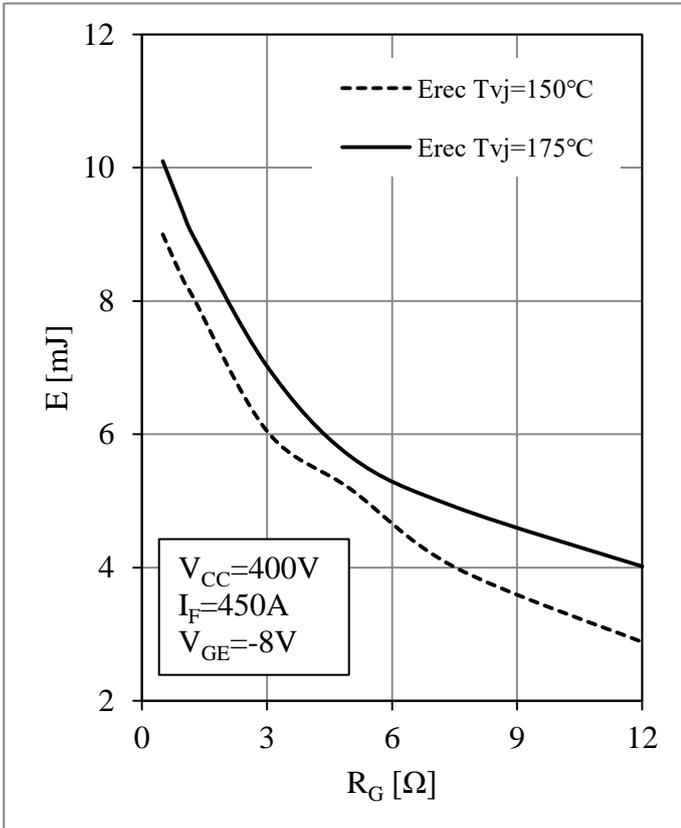


Fig 11. Diode Switching Loss vs. R_G

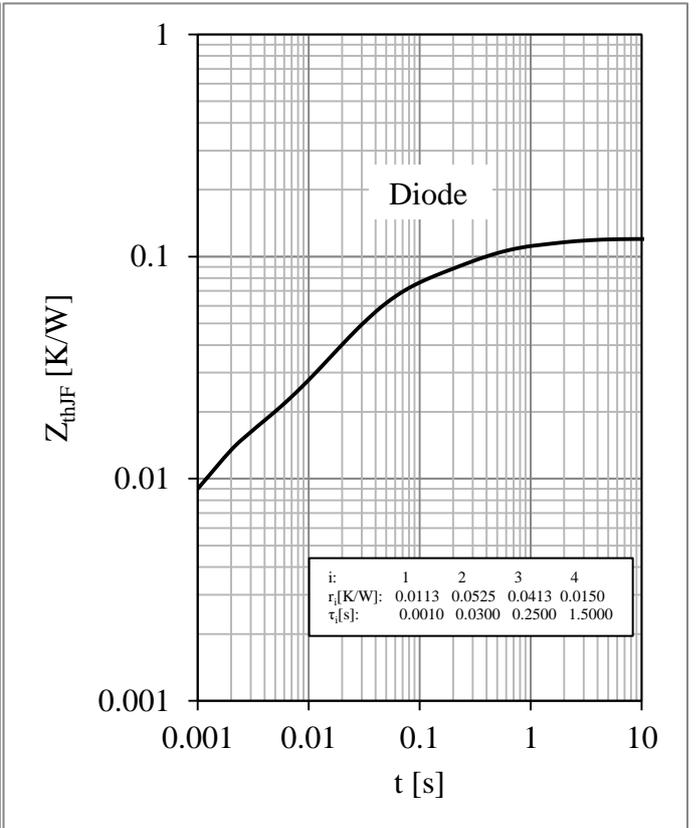


Fig 12. Diode Transient Thermal Impedance

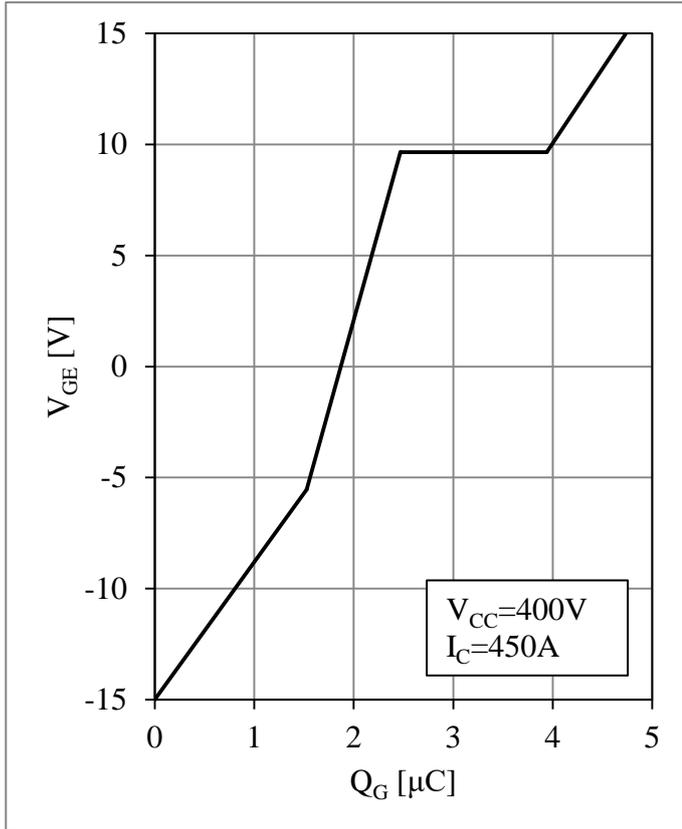


Fig 13. IGBT Gate Charge Characteristic

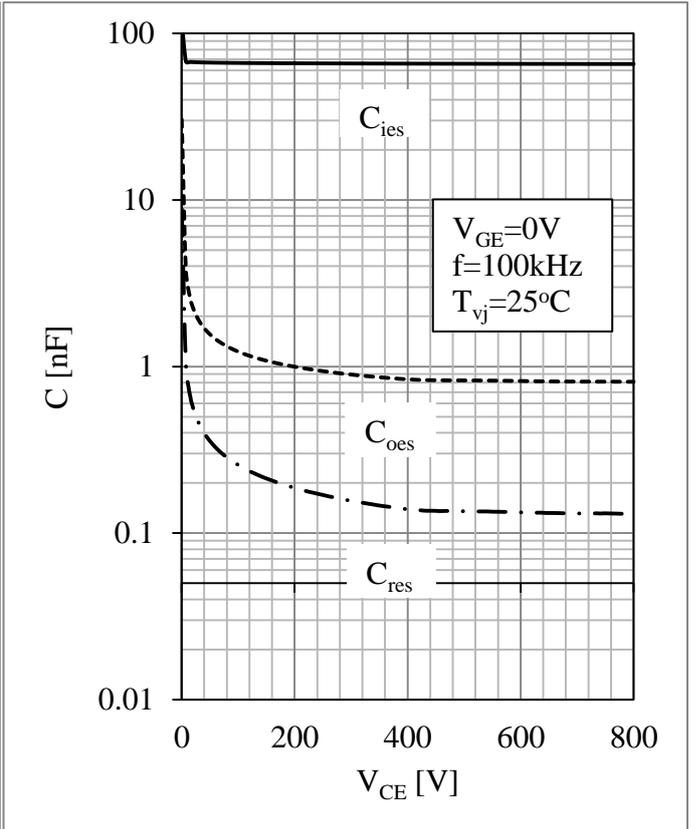


Fig 14. IGBT Capacity Characteristic

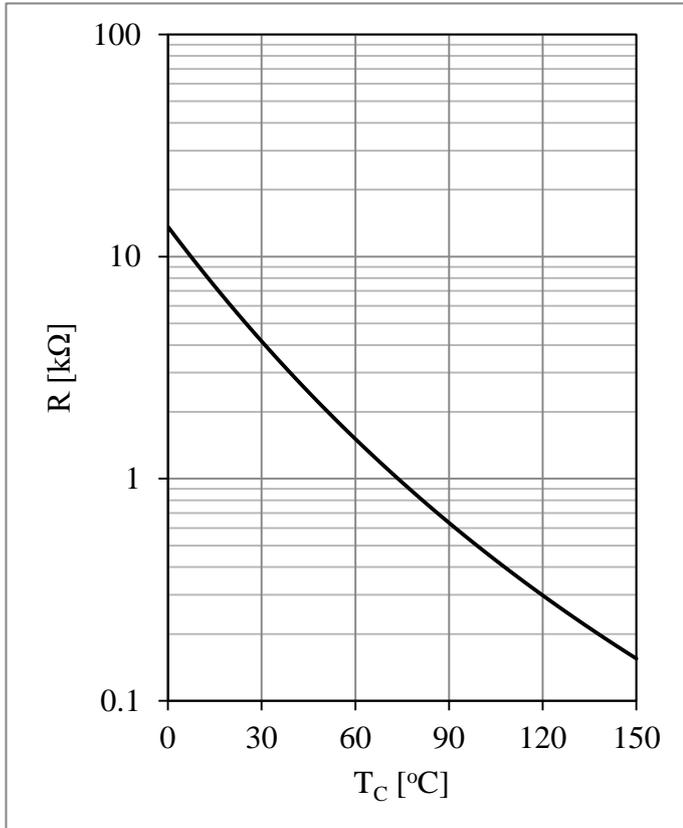
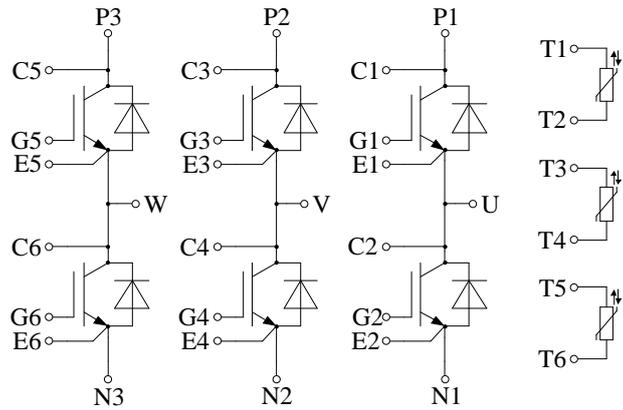


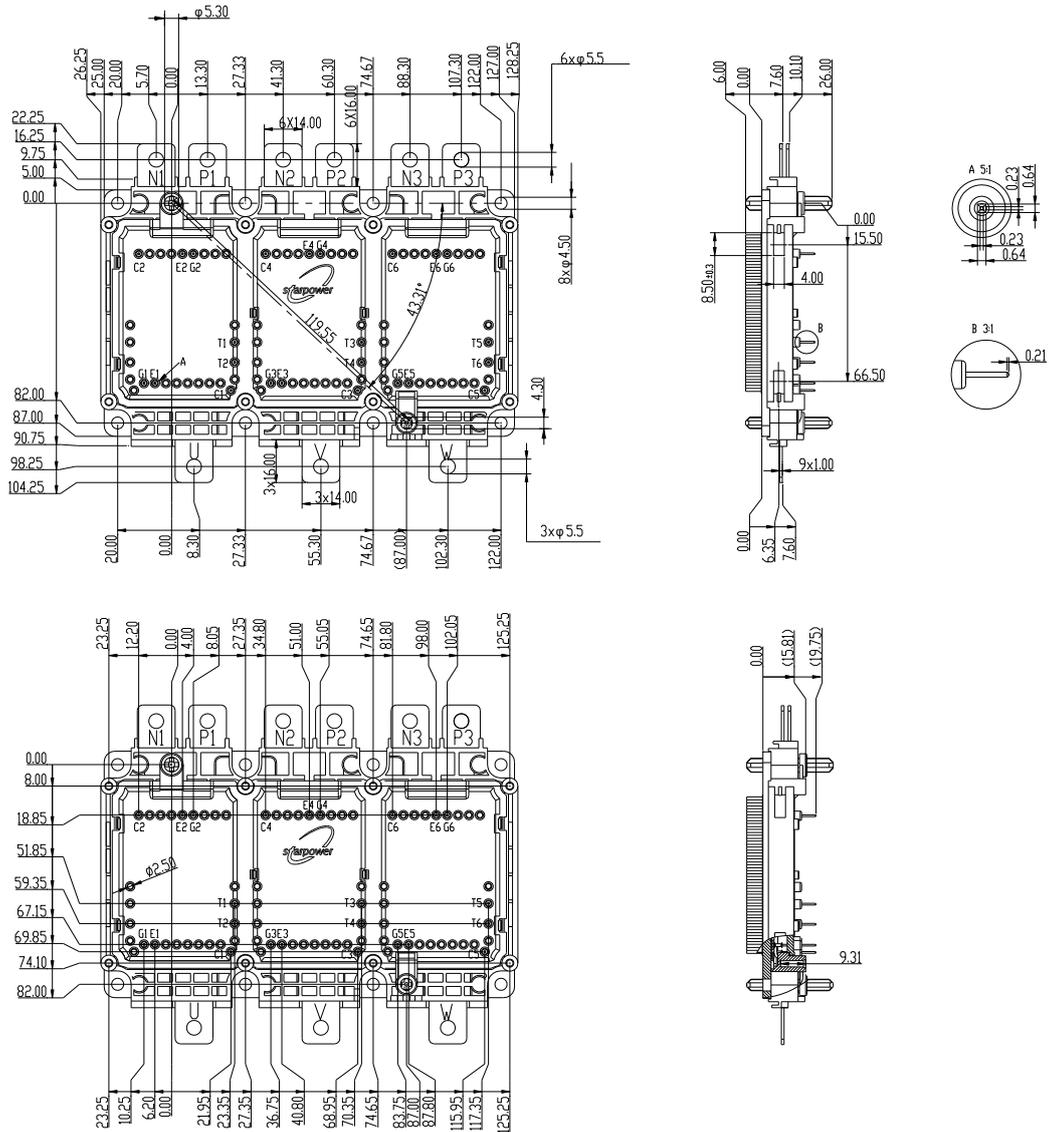
Fig 15. NTC Temperature Characteristic

Circuit Schematic



Package Dimensions

Dimensions in Millimeters



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