

STARPOWER

SEMICONDUCTOR

IGBT

GD750HFA120C6S

1200V/750A 2 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.

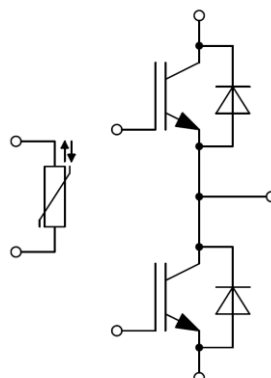
Features

- Low $V_{CE(sat)}$ Trench IGBT technology
- 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 baseplate using DBC technology

Typical Applications

- Hybrid and electric vehicle
- Inverter for motor drive
- Uninterruptible power supply

Equivalent Circuit Schematic



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

Symbol	Description	Values	Unit
V_{CES}	Collector-Emitter Voltage	1200	V
V_{GES}	Gate-Emitter Voltage	± 20	V
I_C	Collector Current @ $T_C=100^{\circ}\text{C}$	750	A
I_{CM}	Pulsed Collector Current $t_p=1\text{ms}$	1500	A
P_D	Maximum Power Dissipation @ $T_{vj}=175^{\circ}\text{C}$	3125	W

Diode

Symbol	Description	Values	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	1200	V
I_F	Diode Continuous Forward Current	900	A
I_{FM}	Diode Maximum Forward Current $t_p=1\text{ms}$	1500	A
I_{FSM}	Surge Forward Current $t_p=10\text{ms}$ @ $T_{vj}=25^{\circ}\text{C}$ @ $T_{vj}=150^{\circ}\text{C}$	3104 2472	A
I^2t	I^2t -value, $t_p=10\text{ms}$ @ $T_{vj}=25^{\circ}\text{C}$ @ $T_{vj}=150^{\circ}\text{C}$	48174 30554	A^2s

Module

Symbol	Description	Value	Unit
T_{vjmax}	Maximum Junction Temperature	175	$^{\circ}\text{C}$
T_{vjop}	Operating Junction Temperature	-40 to +150	$^{\circ}\text{C}$
T_{STG}	Storage Temperature Range	-40 to +125	$^{\circ}\text{C}$
V_{ISO}	Isolation Voltage RMS, $f=50\text{Hz}$, $t=1\text{min}$	4000	V

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	$I_C=750\text{A}, V_{GE}=15\text{V}, T_{vj}=25^{\circ}\text{C}$		1.35	1.85	V
		$I_C=750\text{A}, V_{GE}=15\text{V}, T_{vj}=125^{\circ}\text{C}$		1.55		
		$I_C=750\text{A}, V_{GE}=15\text{V}, T_{vj}=175^{\circ}\text{C}$		1.55		
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=24.0\text{mA}, V_{CE}=V_{GE}, T_{vj}=25^{\circ}\text{C}$	5.5	6.3	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			0.5		Ω
C_{ies}	Input Capacitance	$V_{CE}=25\text{V}, f=100\text{kHz}, V_{GE}=0\text{V}$		85.2		nF
C_{res}	Reverse Transfer Capacitance			0.45		nF
Q_G	Gate Charge	$V_{GE}=-15\dots+15\text{V}$		6.15		μC
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=750\text{A}, R_G=0.5\Omega, V_{GE}=-8\text{V}/+15\text{V}, L_S=40\text{nH}, T_{vj}=25^{\circ}\text{C}$		238		ns
t_r	Rise Time			76		ns
$t_{d(off)}$	Turn-Off Delay Time			622		ns
t_f	Fall Time			74		ns
E_{on}	Turn-On Switching Loss			68.0		mJ
E_{off}	Turn-Off Switching Loss			52.8		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=750\text{A}, R_G=0.5\Omega, V_{GE}=-8\text{V}/+15\text{V}, L_S=40\text{nH}, T_{vj}=125^{\circ}\text{C}$		266		ns
t_r	Rise Time			89		ns
$t_{d(off)}$	Turn-Off Delay Time			685		ns
t_f	Fall Time			139		ns
E_{on}	Turn-On Switching Loss			88.9		mJ
E_{off}	Turn-Off Switching Loss			67.4		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=750\text{A}, R_G=0.5\Omega, V_{GE}=-8\text{V}/+15\text{V}, L_S=40\text{nH}, T_{vj}=175^{\circ}\text{C}$		280		ns
t_r	Rise Time			95		ns
$t_{d(off)}$	Turn-Off Delay Time			715		ns
t_f	Fall Time			166		ns
E_{on}	Turn-On Switching Loss			102		mJ
E_{off}	Turn-Off Switching Loss			72.7		mJ
I_{SC}	SC Data	$t_p \leq 8\mu\text{s}, V_{GE}=15\text{V}, T_{vj}=150^{\circ}\text{C}, V_{CC}=800\text{V}, V_{CEM} \leq 1200\text{V}$		2500		A
		$t_p \leq 6\mu\text{s}, V_{GE}=15\text{V}, T_{vj}=175^{\circ}\text{C}, V_{CC}=800\text{V}, V_{CEM} \leq 1200\text{V}$		2400		A

Diode Characteristics $T_C=25^{\circ}\text{C}$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
V_F	Diode Forward Voltage	$I_F=750\text{A}, V_{GE}=0\text{V}, T_{vj}=25^{\circ}\text{C}$		1.60	2.05	V
		$I_F=750\text{A}, V_{GE}=0\text{V}, T_{vj}=125^{\circ}\text{C}$		1.65		
		$I_F=750\text{A}, V_{GE}=0\text{V}, T_{vj}=175^{\circ}\text{C}$		1.65		
Q_r	Recovered Charge	$V_R=600\text{V}, I_F=750\text{A},$ $-di/dt=6500\text{A}/\mu\text{s}, V_{GE}=-8\text{V},$ $L_S=40\text{nH}, T_{vj}=25^{\circ}\text{C}$		79.7		μC
I_{RM}	Peak Reverse Recovery Current			369		A
E_{rec}	Reverse Recovery Energy			23.3		mJ
Q_r	Recovered Charge	$V_R=600\text{V}, I_F=750\text{A},$ $-di/dt=5600\text{A}/\mu\text{s}, V_{GE}=-8\text{V},$ $L_S=40\text{nH}, T_{vj}=125^{\circ}\text{C}$		120		μC
I_{RM}	Peak Reverse Recovery Current			400		A
E_{rec}	Reverse Recovery Energy			39.5		mJ
Q_r	Recovered Charge	$V_R=600\text{V}, I_F=750\text{A},$ $-di/dt=5200\text{A}/\mu\text{s}, V_{GE}=-8\text{V},$ $L_S=40\text{nH}, T_{vj}=175^{\circ}\text{C}$		151		μC
I_{RM}	Peak Reverse Recovery Current			423		A
E_{rec}	Reverse Recovery Energy			49.7		mJ

NTC Characteristics $T_C=25^{\circ}\text{C}$ 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 $T_C=25^{\circ}\text{C}$ unless otherwise noted

Symbol	Parameter	Min.	Typ.	Max.	Unit
L_{CE}	Stray Inductance		20		nH
$R_{CC'+EE'}$	Module Lead Resistance, Terminal to Chip		0.80		m Ω
R_{thJC}	Junction-to-Case (per IGBT)			0.048	K/W
	Junction-to-Case (per Diode)			0.088	
R_{thCH}	Case-to-Heatsink (per IGBT)		0.028		K/W
	Case-to-Heatsink (per Diode)		0.051		
	Case-to-Heatsink (per Module)		0.009		
M	Terminal Connection Torque, Screw M6	3.0		6.0	N.m
	Mounting Torque, Screw M5	3.0		6.0	
G	Weight of Module		350		g

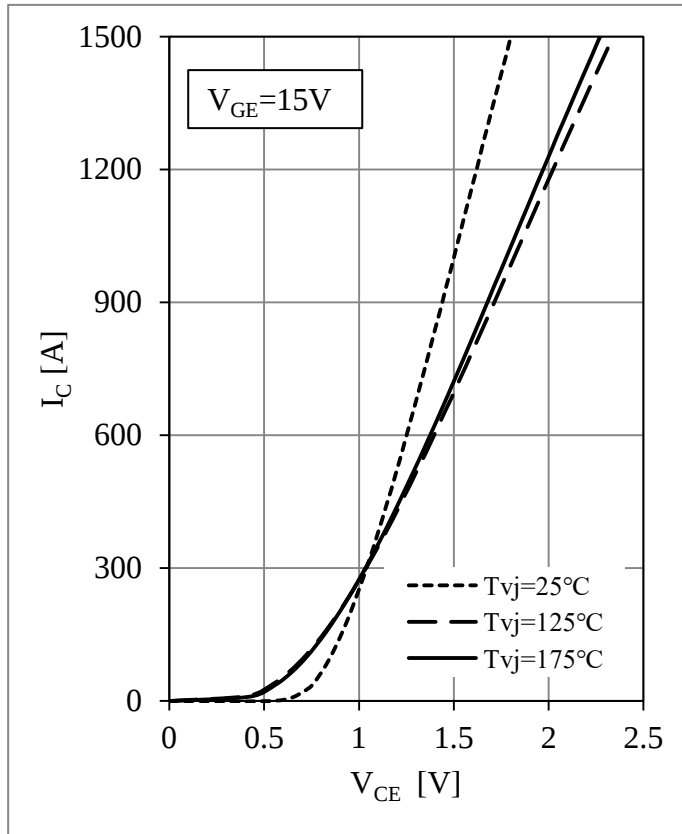


Fig 1. IGBT Output Characteristics

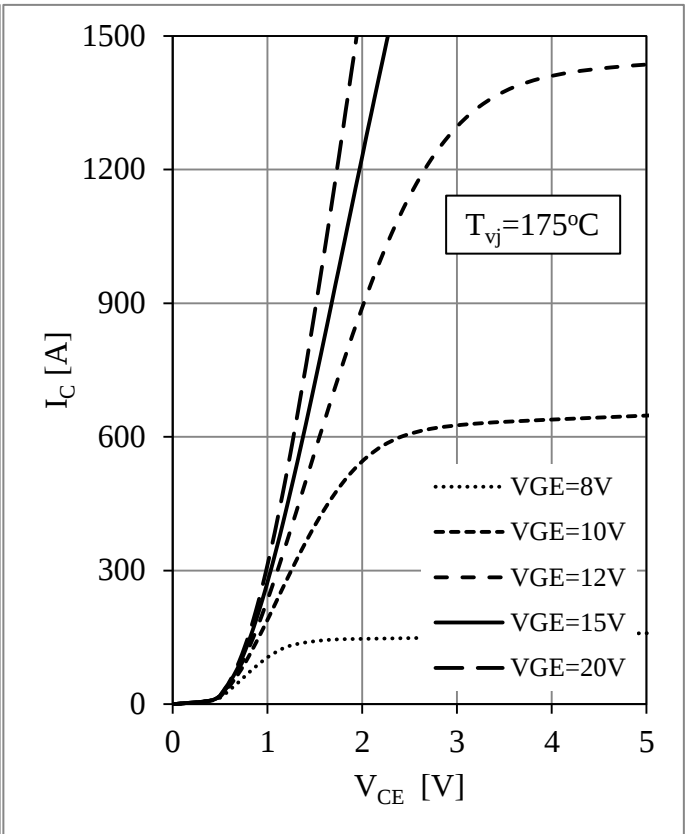


Fig 2. IGBT Transfer Characteristics

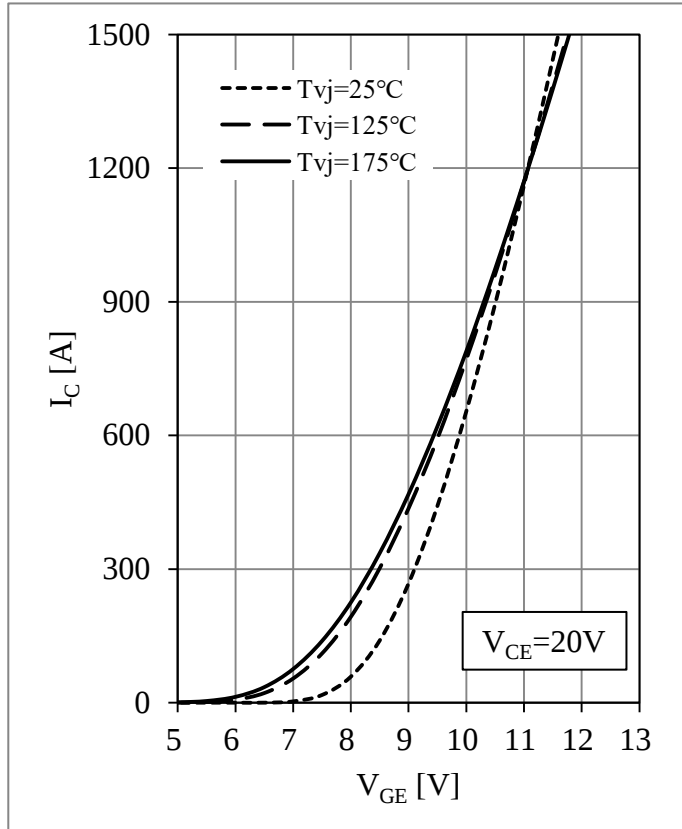
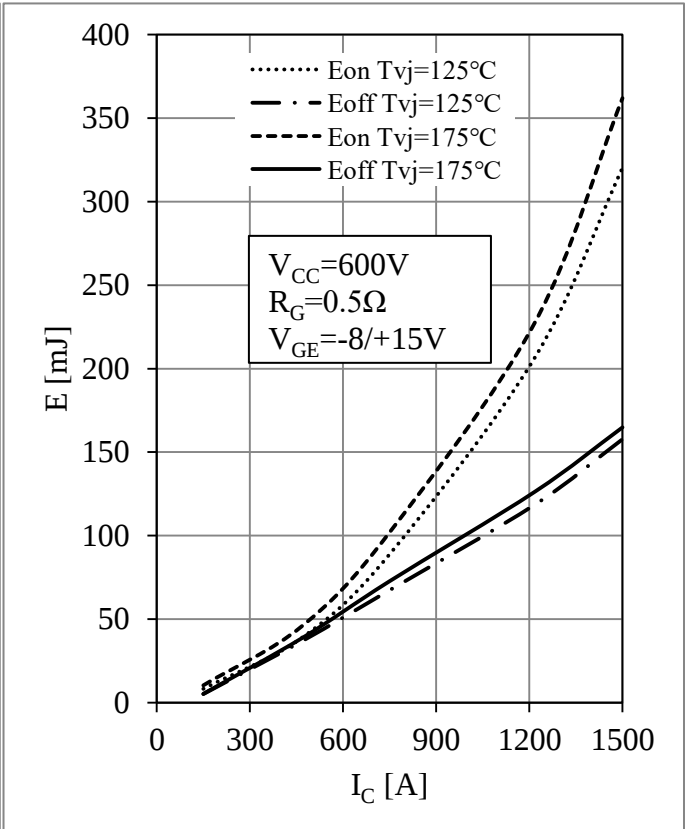


Fig 3. IGBT Transfer Characteristics

Fig 4. IGBT Switching Loss vs. I_C

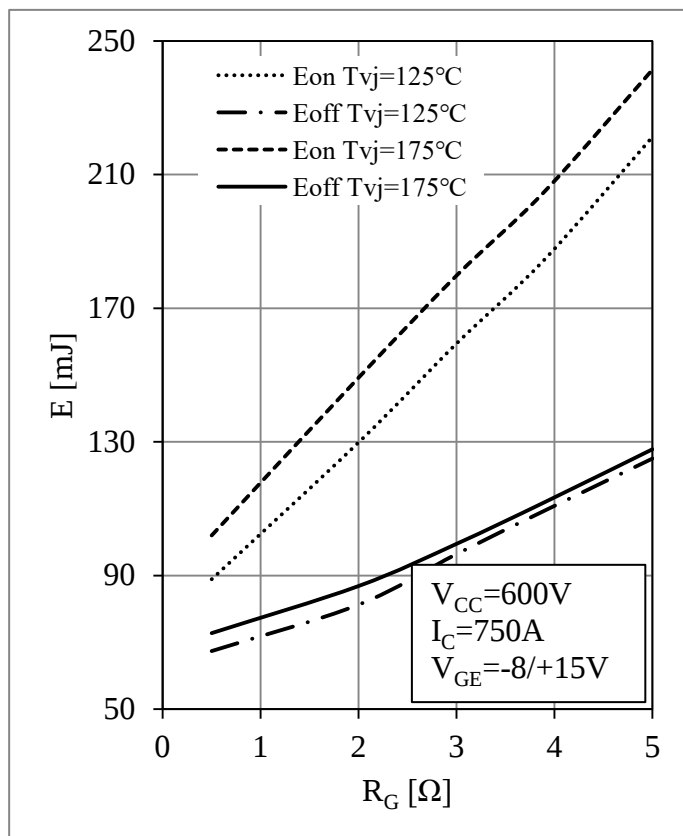
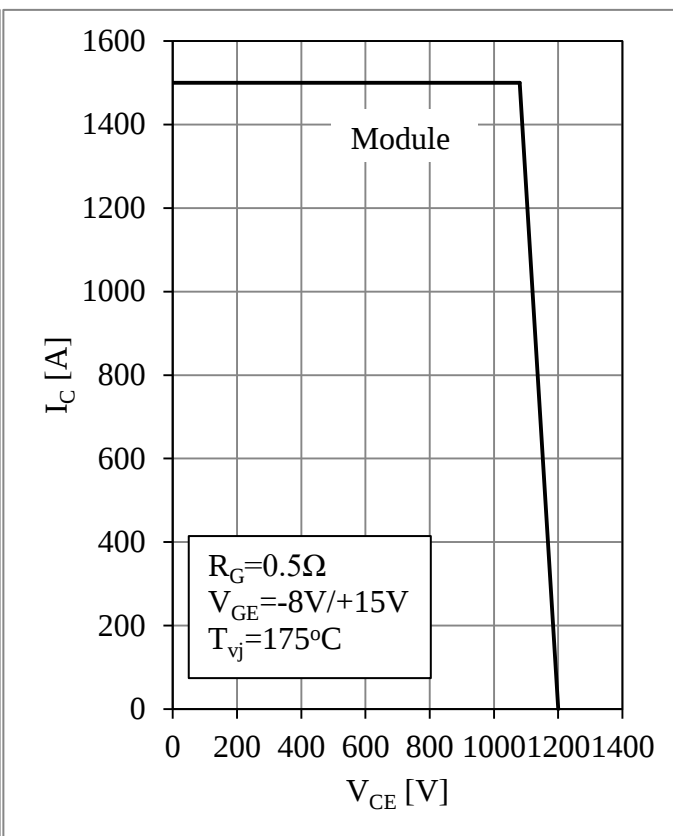
Fig 5. IGBT Switching Loss vs. R_G 

Fig 6. RBSOA

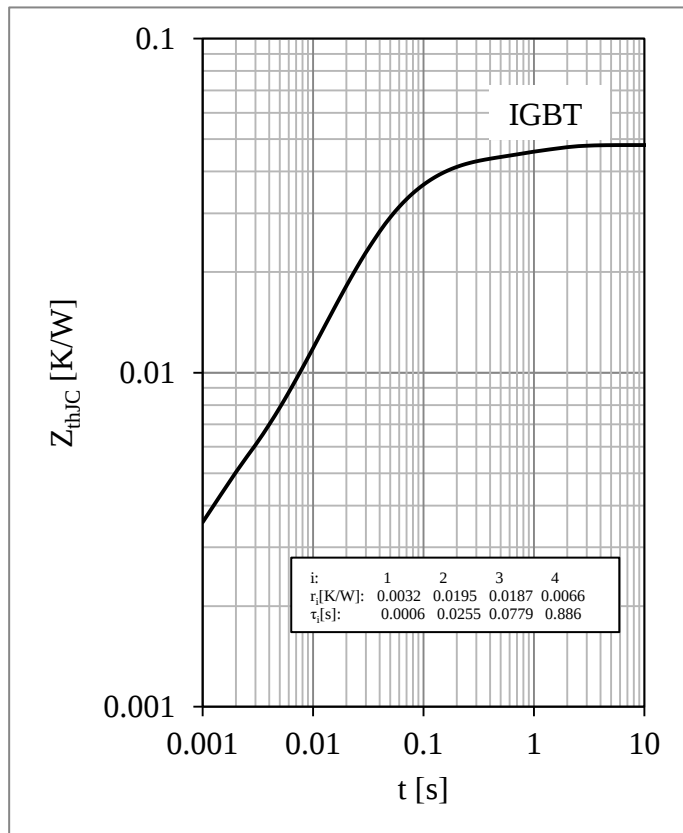


Fig 7. IGBT Transient Thermal Impedance

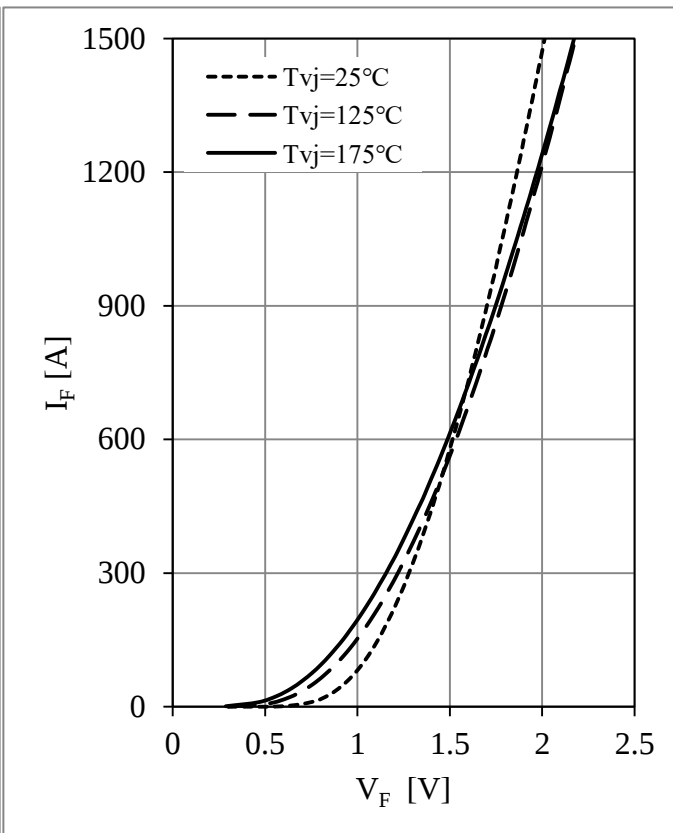


Fig 8. Diode Forward Characteristics

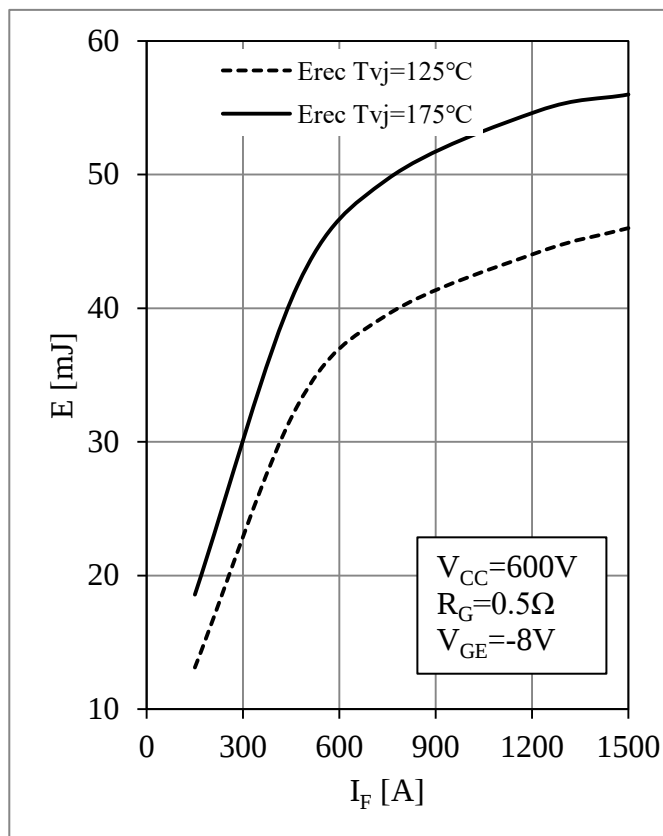
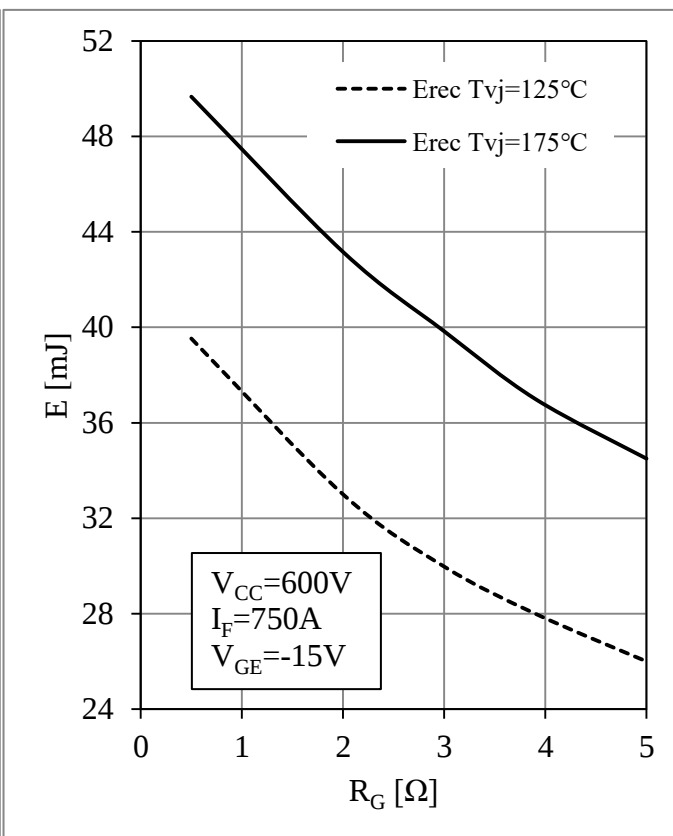
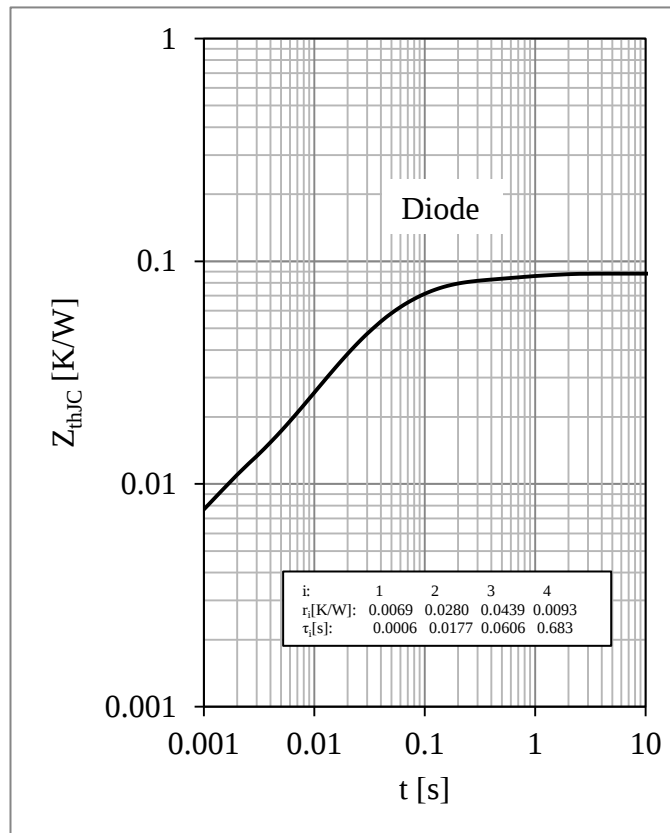
Fig 9. Diode Switching Loss vs. I_F Fig 10. Diode Switching Loss vs. R_G 

Fig 11. Diode Transient Thermal Impedance

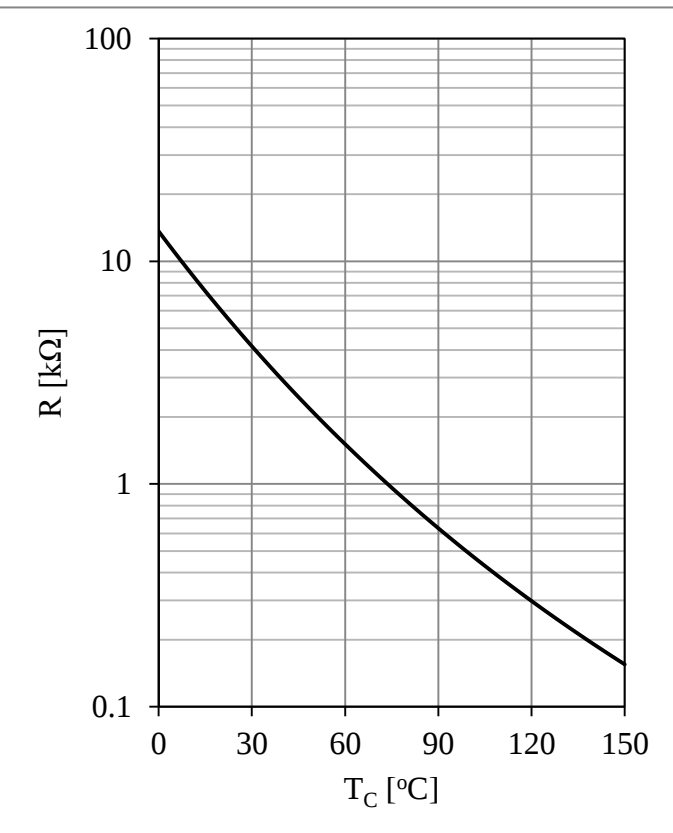
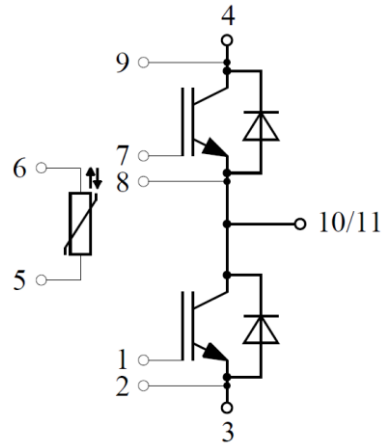


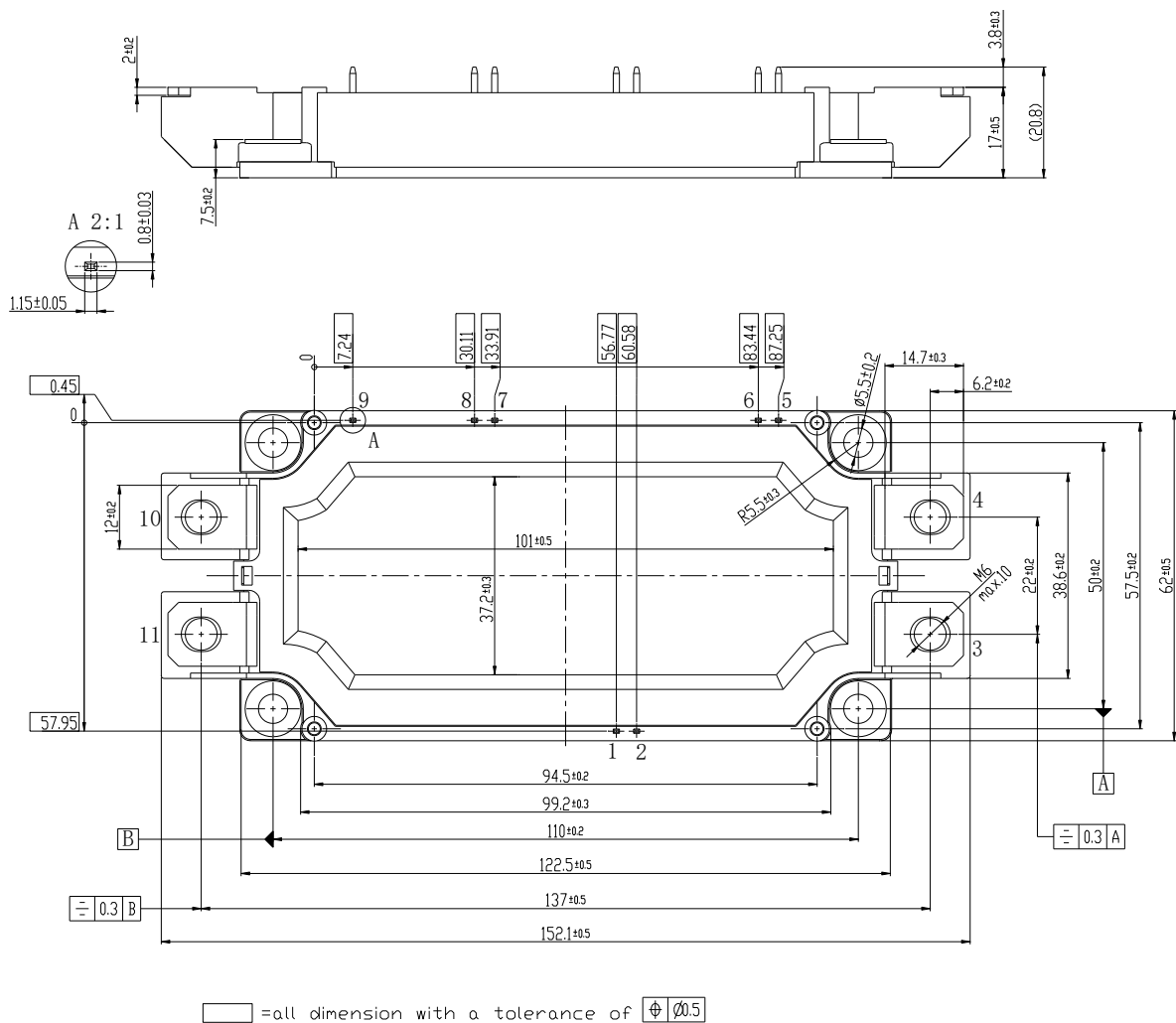
Fig12. NTC Temperature Characteristic

Circuit Schematic



Package Dimensions

Dimensions in Millimeters



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