

STARPOWER

SEMICONDUCTOR

IGBT

GD450HFX120C6HA

1200V/450A 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.

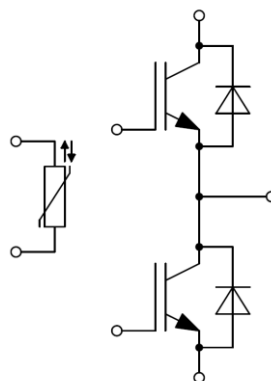
Features

- Low $V_{CE(sat)}$ Trench IGBT technology
- 10 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 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	Value	Unit
V_{CES}	Collector-Emitter Voltage	1200	V
V_{GES}	Gate-Emitter Voltage	± 20	V
I_C	Collector Current @ $T_C=25^{\circ}\text{C}$ @ $T_C=95^{\circ}\text{C}$	679 450	A
I_{CM}	Pulsed Collector Current $t_p=1\text{ms}$	900	A
P_D	Maximum Power Dissipation @ $T_{vj}=175^{\circ}\text{C}$	2173	W

Diode

Symbol	Description	Value	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	1200	V
I_F	Diode Continuous Forward Current	450	A
I_{FM}	Diode Maximum Forward Current $t_p=1\text{ms}$	900	A

Module

Symbol	Description	Value	Unit
T_{vjmax}	Maximum Junction Temperature	175	$^{\circ}\text{C}$
T_{vioop}	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, $f=50\text{Hz}$, $t=1\text{min}$	2500	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	$I_C=450\text{A}, V_{GE}=15\text{V}, T_{vj}=25^{\circ}\text{C}$		1.70	2.15	V
		$I_C=450\text{A}, V_{GE}=15\text{V}, T_{vj}=125^{\circ}\text{C}$		1.95		
		$I_C=450\text{A}, V_{GE}=15\text{V}, T_{vj}=150^{\circ}\text{C}$		2.00		
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=18.0\text{mA}, V_{CE}=V_{GE}, T_{vj}=25^{\circ}\text{C}$	5.0	5.8	6.5	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			0.7		Ω
C_{ies}	Input Capacitance	$V_{CE}=25\text{V}, f=1\text{MHz}, V_{GE}=0\text{V}$		46.6		nF
C_{res}	Reverse Transfer Capacitance			1.31		nF
Q_G	Gate Charge	$V_{GE}=-15\dots+15\text{V}$		3.50		μC
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=450\text{A}, R_G=1.5\Omega, V_{GE}=\pm 15\text{V}, L_S=40\text{nH}, T_{vj}=25^{\circ}\text{C}$		95		ns
t_r	Rise Time			87		ns
$t_{d(off)}$	Turn-Off Delay Time			315		ns
t_f	Fall Time			218		ns
E_{on}	Turn-On Switching Loss			44.7		mJ
E_{off}	Turn-Off Switching Loss			35.0		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=450\text{A}, R_G=1.5\Omega, V_{GE}=\pm 15\text{V}, L_S=40\text{nH}, T_{vj}=125^{\circ}\text{C}$		103		ns
t_r	Rise Time			95		ns
$t_{d(off)}$	Turn-Off Delay Time			417		ns
t_f	Fall Time			271		ns
E_{on}	Turn-On Switching Loss			61.0		mJ
E_{off}	Turn-Off Switching Loss			45.6		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=450\text{A}, R_G=1.5\Omega, V_{GE}=\pm 15\text{V}, L_S=40\text{nH}, T_{vj}=150^{\circ}\text{C}$		109		ns
t_r	Rise Time			97		ns
$t_{d(off)}$	Turn-Off Delay Time			421		ns
t_f	Fall Time			296		ns
E_{on}	Turn-On Switching Loss			65.0		mJ
E_{off}	Turn-Off Switching Loss			48.1		mJ
I_{SC}	SC Data	$t_p \leq 10\mu\text{s}, V_{GE}=15\text{V}, T_{vj}=150^{\circ}\text{C}, V_{CC}=800\text{V}, V_{CEM} \leq 1200\text{V}$		1800		A

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_F	Diode Forward Voltage	$I_F=450\text{A}, V_{GE}=0\text{V}, T_{vj}=25^{\circ}\text{C}$		1.85	2.30	V
		$I_F=450\text{A}, V_{GE}=0\text{V}, T_{vj}=125^{\circ}\text{C}$		1.90		
		$I_F=450\text{A}, V_{GE}=0\text{V}, T_{vj}=150^{\circ}\text{C}$		1.95		
Q_r	Recovered Charge	$V_{CC}=600\text{V}, I_F=450\text{A},$ $-di/dt=5350\text{A}/\mu\text{s}, V_{GE}=-15\text{V},$ $L_S=40\text{nH}, T_{vj}=25^{\circ}\text{C}$		42.9		μC
I_{RM}	Peak Reverse Recovery Current			277		A
E_{rec}	Reverse Recovery Energy			12.6		mJ
Q_r	Recovered Charge	$V_{CC}=600\text{V}, I_F=450\text{A},$ $-di/dt=4654\text{A}/\mu\text{s}, V_{GE}=-15\text{V},$ $L_S=40\text{nH}, T_{vj}=125^{\circ}\text{C}$		83.9		μC
I_{RM}	Peak Reverse Recovery Current			310		A
E_{rec}	Reverse Recovery Energy			28.7		mJ
Q_r	Recovered Charge	$V_{CC}=600\text{V}, I_F=450\text{A},$ $-di/dt=4387\text{A}/\mu\text{s}, V_{GE}=-15\text{V},$ $L_S=40\text{nH}, T_{vj}=150^{\circ}\text{C}$		87.5		μC
I_{RM}	Peak Reverse Recovery Current			315		A
E_{rec}	Reverse Recovery Energy			30.1		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		1.10		m Ω
R_{thJC}	Junction-to-Case (per IGBT)		0.060	0.069	K/W
	Junction-to-Case (per Diode)		0.110	0.127	
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

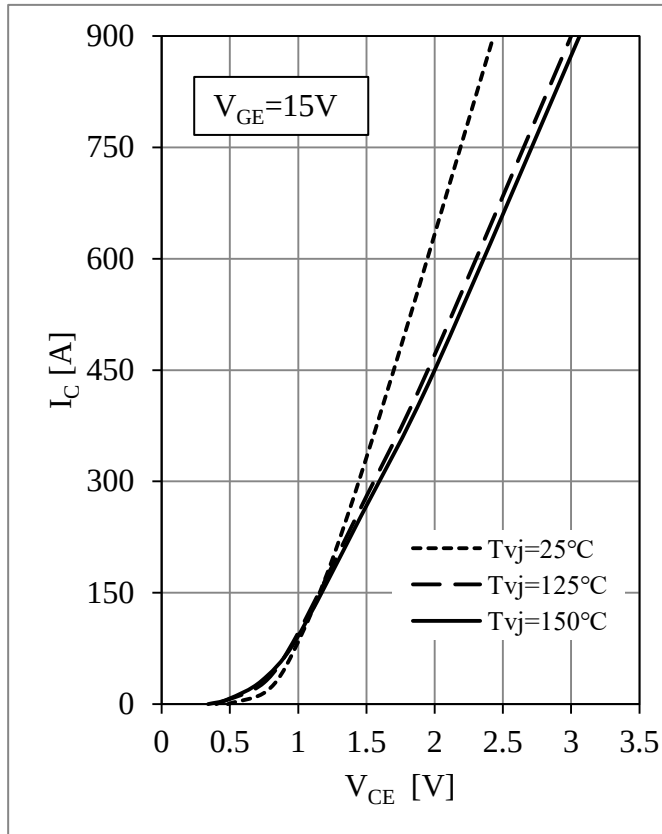


Fig 1. IGBT Output Characteristics

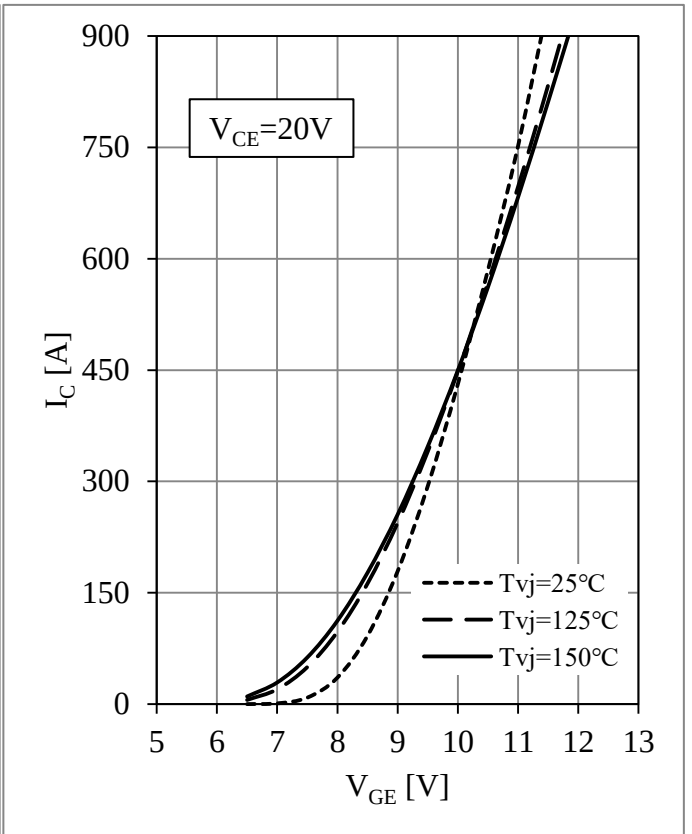
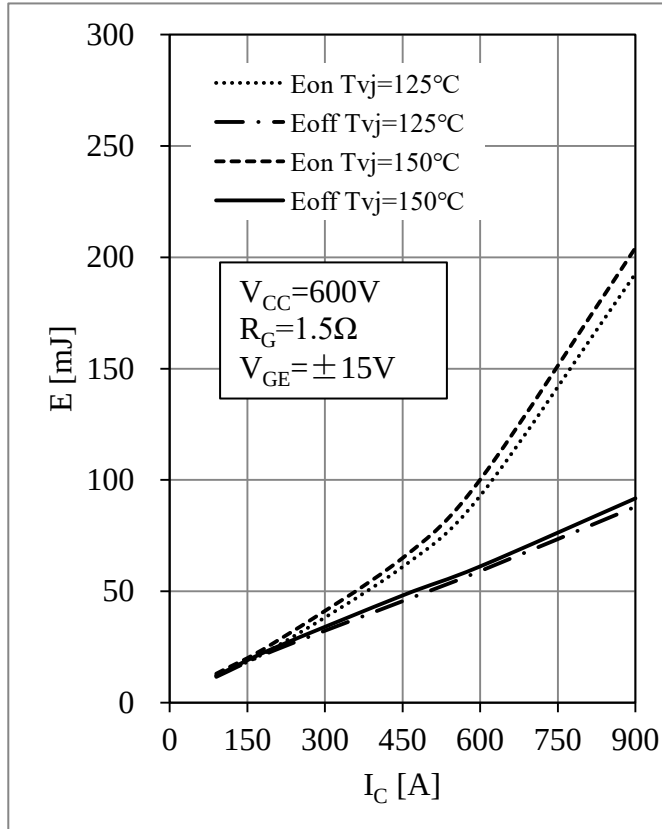
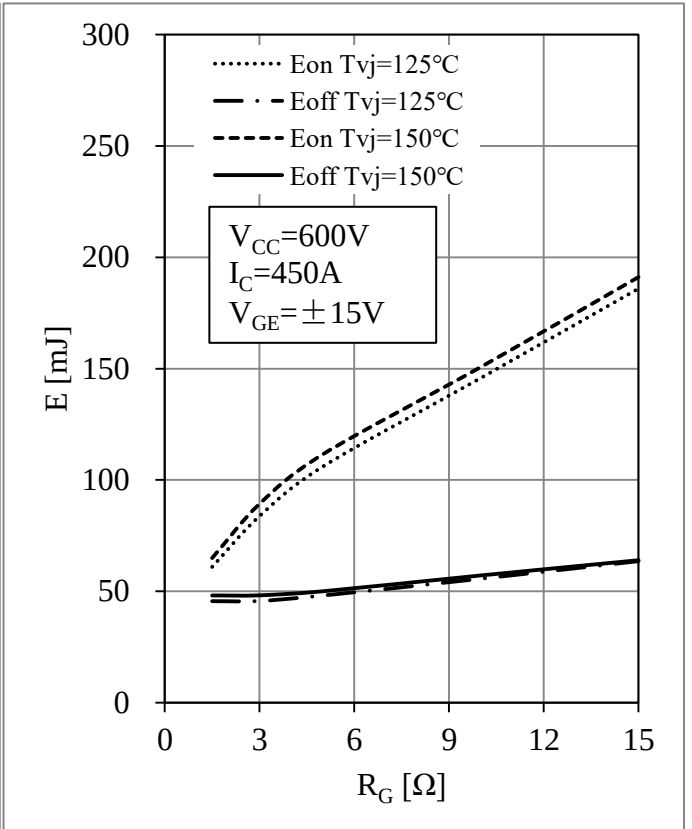


Fig 2. IGBT Transfer Characteristics

Fig 3. IGBT Switching Loss vs. I_C Fig 4. IGBT Switching Loss vs. R_G

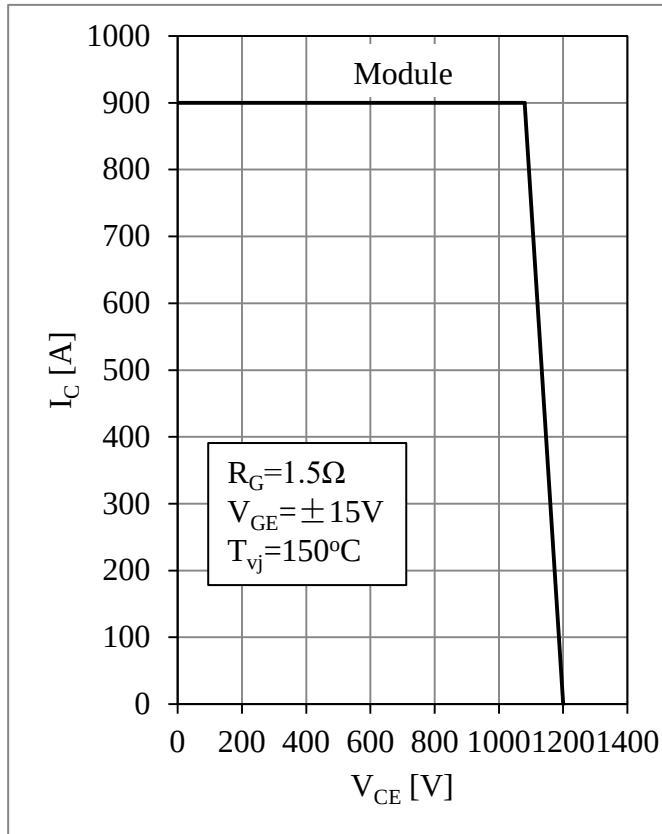


Fig 5. RBSOA

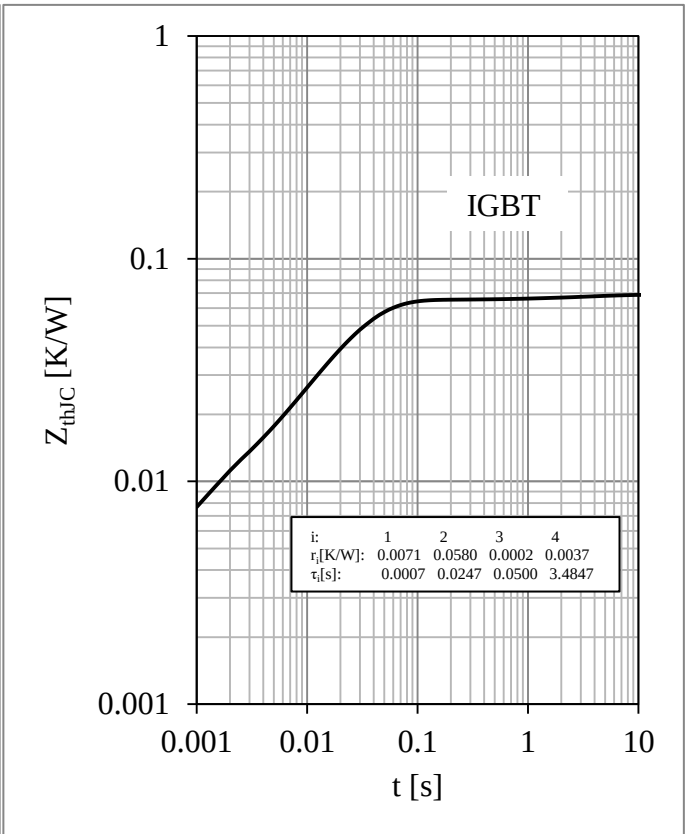


Fig 6. IGBT Transient Thermal Impedance

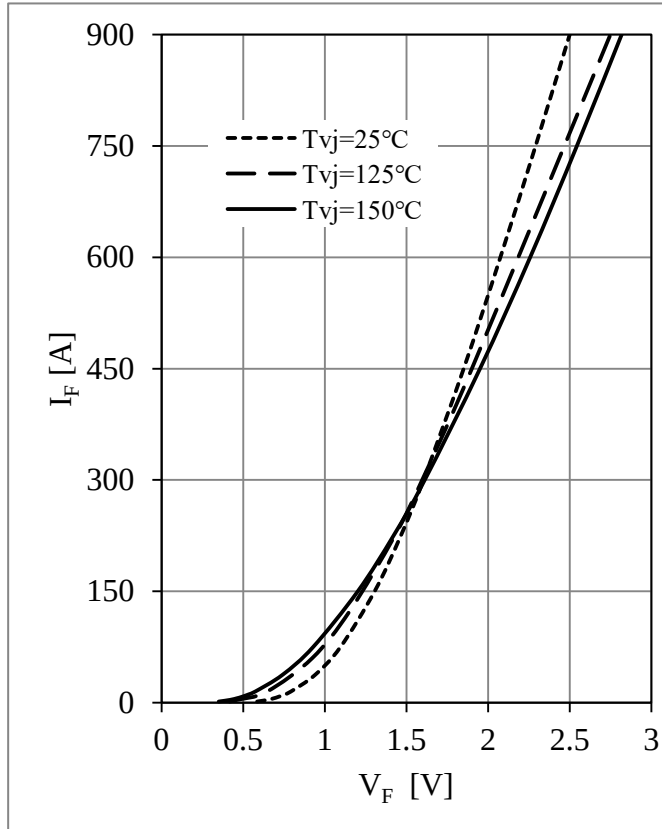
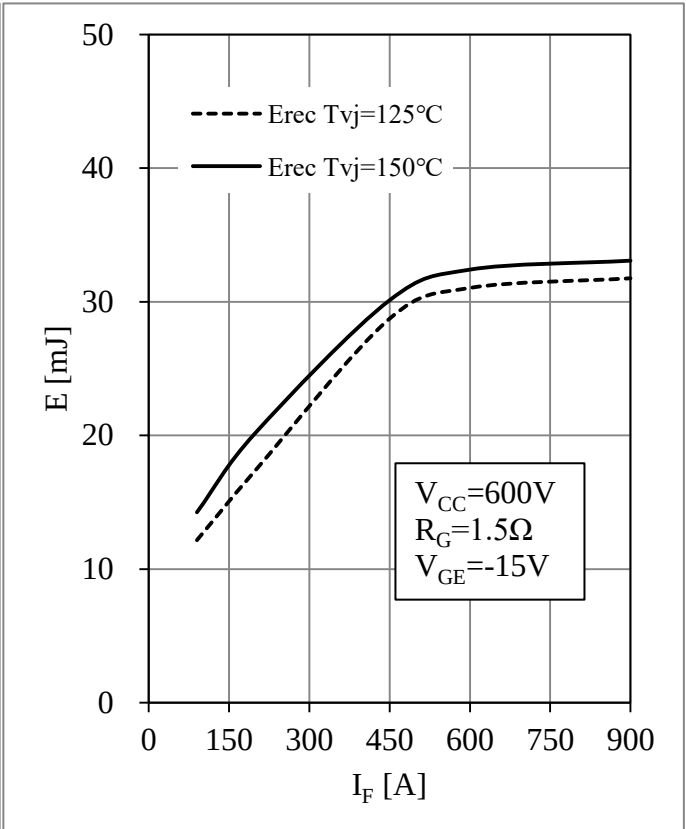


Fig 7. Diode Forward Characteristics

Fig 8. Diode Switching Loss vs. I_F

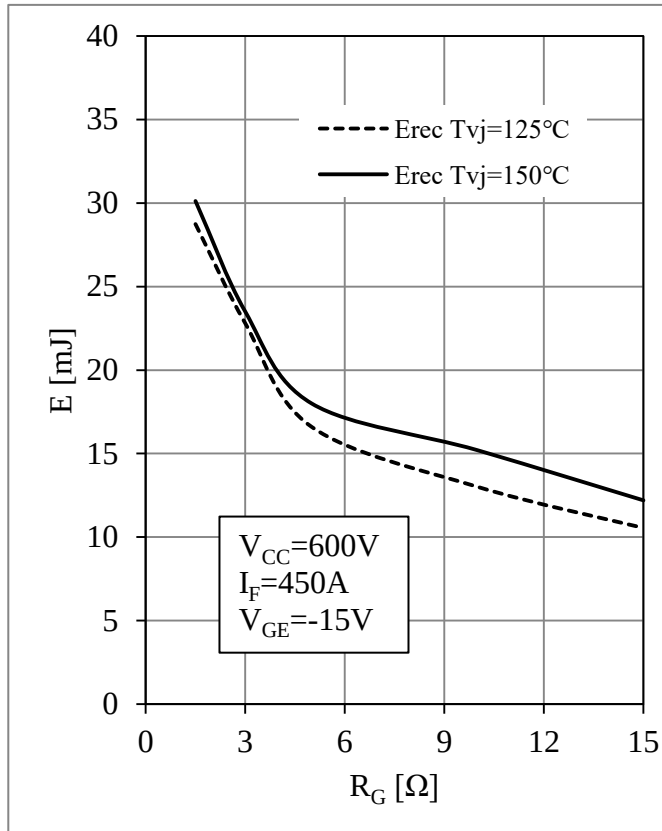
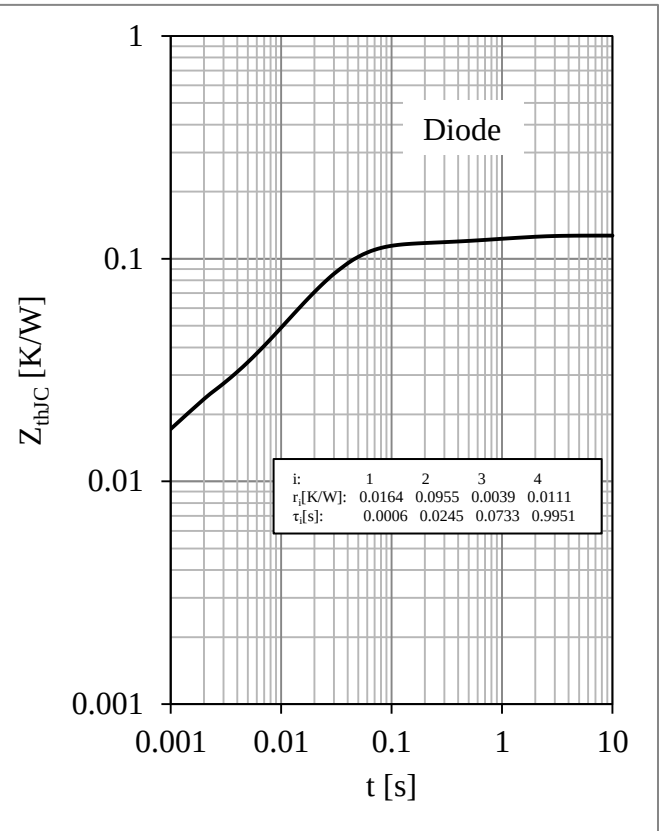
Fig 9. Diode Switching Loss vs. R_G 

Fig 10. Diode Transient Thermal Impedance

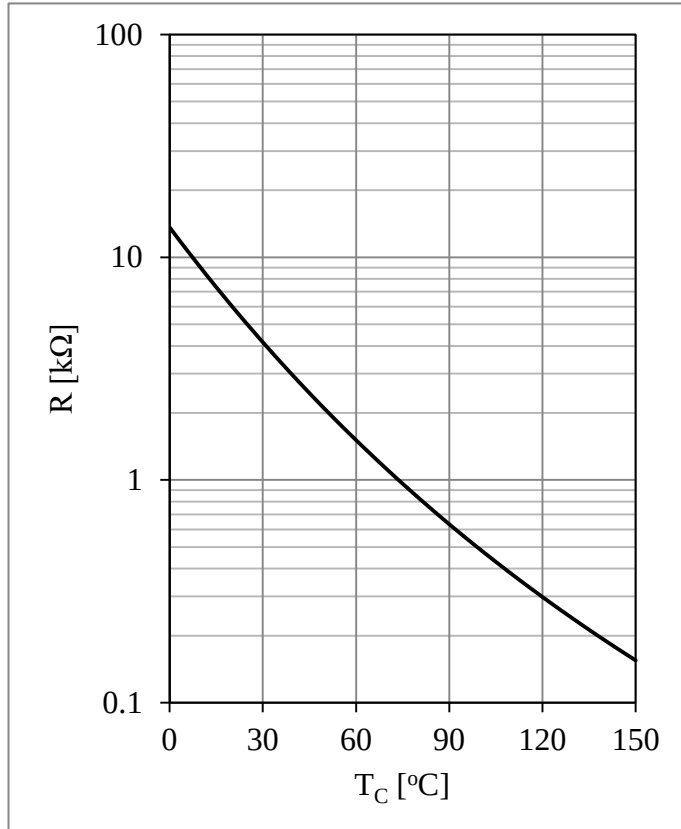
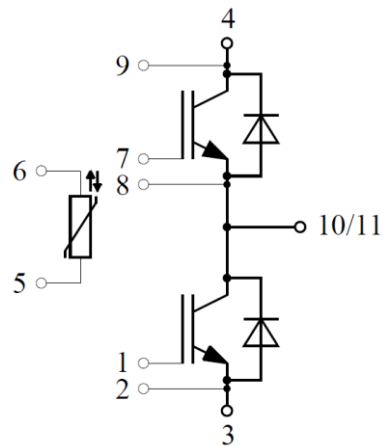


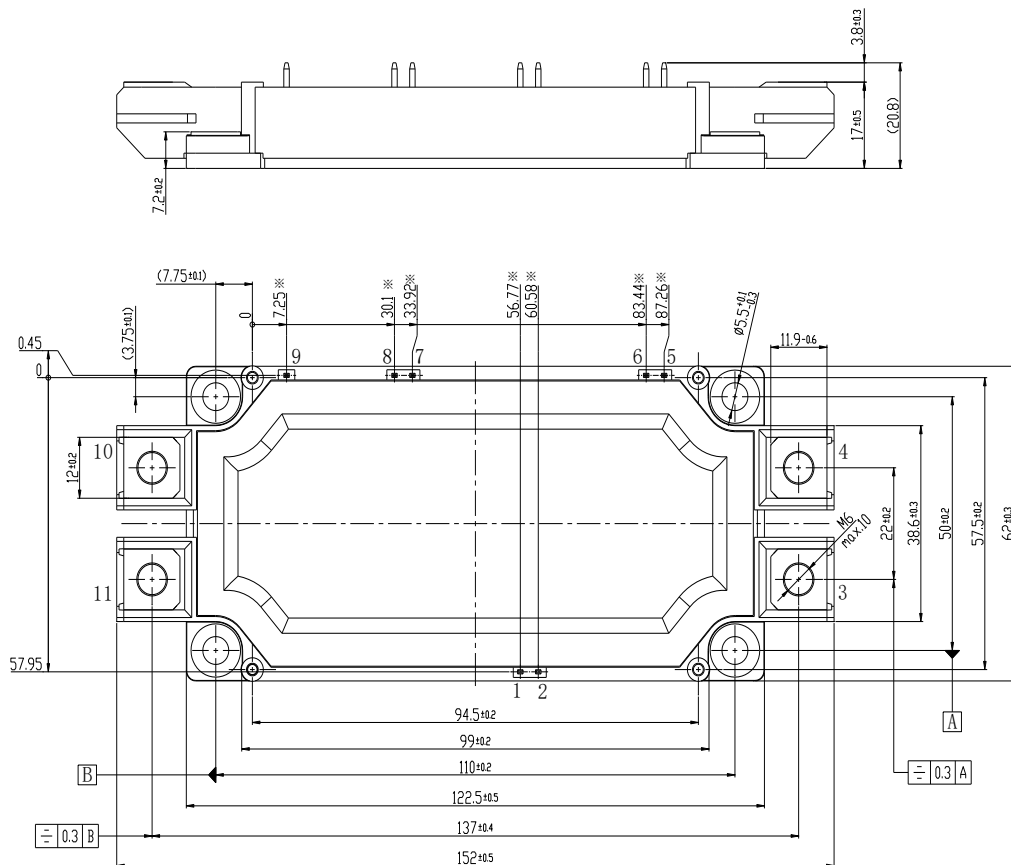
Fig 11. NTC Temperature Characteristic

Circuit Schematic



Package Dimensions

Dimensions in Millimeters



※: all dimensions with a tolerance of ± 0.5
dimensions valid in mounted condition

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