

STARPOWER

SEMICONDUCTOR

IGBT

GD600HFY120C6S

1200V/600A 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.

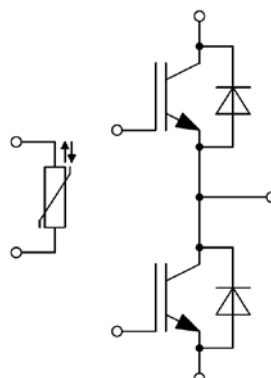
Features

- 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 @ $T_C=25^{\circ}\text{C}$ @ $T_C=100^{\circ}\text{C}$	1090 600	A
I_{CM}	Pulsed Collector Current $t_p=1\text{ms}$	1200	A
P_D	Maximum Power Dissipation @ $T_j=175^{\circ}\text{C}$	3947	W

Diode

Symbol	Description	Value	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	1200	V
I_F	Diode Continuous Forward Current	600	A
I_{FM}	Diode Maximum Forward Current $t_p=1\text{ms}$	1200	A

Module

Symbol	Description	Value	Unit
T_{jmax}	Maximum Junction Temperature	175	$^{\circ}\text{C}$
T_{jop}	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	$I_C=600\text{A}, V_{GE}=15\text{V}, T_j=25^{\circ}\text{C}$		1.70	2.15	V
		$I_C=600\text{A}, V_{GE}=15\text{V}, T_j=125^{\circ}\text{C}$		1.90		
		$I_C=600\text{A}, V_{GE}=15\text{V}, T_j=150^{\circ}\text{C}$		1.95		
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=24.0\text{mA}, V_{CE}=V_{GE}, T_j=25^{\circ}\text{C}$	5.2	5.8	6.4	V
I_{CES}	Collector Cut-Off Current	$V_{CE}=V_{CES}, V_{GE}=0\text{V}, T_j=25^{\circ}\text{C}$			1.0	mA
I_{GES}	Gate-Emitter Leakage Current	$V_{GE}=V_{GES}, V_{CE}=0\text{V}, T_j=25^{\circ}\text{C}$			400	nA
R_{Gint}	Internal Gate Resistance			0.7		Ω
C_{ies}	Input Capacitance	$V_{CE}=25\text{V}, f=1\text{MHz}, V_{GE}=0\text{V}$		62.1		nF
C_{res}	Reverse Transfer Capacitance			1.74		nF
Q_G	Gate Charge	$V_{GE}=-15\dots+15\text{V}$		4.62		μC
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=600\text{A}, R_G=1.5\Omega, V_{GE}=\pm 15\text{V}, T_j=25^{\circ}\text{C}$		136		ns
t_r	Rise Time			77		ns
$t_{d(off)}$	Turn-Off Delay Time			494		ns
t_f	Fall Time			72		ns
E_{on}	Turn-On Switching Loss			53.1		mJ
E_{off}	Turn-Off Switching Loss			48.4		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=600\text{A}, R_G=1.5\Omega, V_{GE}=\pm 15\text{V}, T_j=125^{\circ}\text{C}$		179		ns
t_r	Rise Time			77		ns
$t_{d(off)}$	Turn-Off Delay Time			628		ns
t_f	Fall Time			113		ns
E_{on}	Turn-On Switching Loss			70.6		mJ
E_{off}	Turn-Off Switching Loss			74.2		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=600\text{A}, R_G=1.5\Omega, V_{GE}=\pm 15\text{V}, T_j=150^{\circ}\text{C}$		179		ns
t_r	Rise Time			85		ns
$t_{d(off)}$	Turn-Off Delay Time			670		ns
t_f	Fall Time			124		ns
E_{on}	Turn-On Switching Loss			76.5		mJ
E_{off}	Turn-Off Switching Loss			81.9		mJ
I_{SC}	SC Data	$t_p \leq 10\mu\text{s}, V_{GE}=15\text{V}, T_j=150^{\circ}\text{C}, V_{CC}=800\text{V}, V_{CEM} \leq 1200\text{V}$		2400		A

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_F	Diode Forward Voltage	$I_F=600\text{A}, V_{GE}=0\text{V}, T_j=25^{\circ}\text{C}$		1.95	2.40	V
		$I_F=600\text{A}, V_{GE}=0\text{V}, T_j=125^{\circ}\text{C}$		2.05		
		$I_F=600\text{A}, V_{GE}=0\text{V}, T_j=150^{\circ}\text{C}$		2.10		
Q_r	Recovered Charge	$V_{CC}=600\text{V}, I_F=600\text{A},$ $-di/dt=4300\text{A}/\mu\text{s}, V_{GE}=-15\text{V},$ $T_j=25^{\circ}\text{C}$		58.9		μC
I_{RM}	Peak Reverse Recovery Current			276		A
E_{rec}	Reverse Recovery Energy			20.9		mJ
Q_r	Recovered Charge	$V_{CC}=600\text{V}, I_F=600\text{A},$ $-di/dt=4300\text{A}/\mu\text{s}, V_{GE}=-15\text{V},$ $T_j=125^{\circ}\text{C}$		109		μC
I_{RM}	Peak Reverse Recovery Current			399		A
E_{rec}	Reverse Recovery Energy			41.8		mJ
Q_r	Recovered Charge	$V_{CC}=600\text{V}, I_F=600\text{A},$ $-di/dt=4300\text{A}/\mu\text{s}, V_{GE}=-15\text{V},$ $T_j=150^{\circ}\text{C}$		124		μC
I_{RM}	Peak Reverse Recovery Current			428		A
E_{rec}	Reverse Recovery Energy			48.5		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
R_{thJC}	Junction-to-Case (per IGBT)			0.038	K/W
	Junction-to-Case (per Diode)			0.066	
R_{thCH}	Case-to-Heatsink (per IGBT)		0.028		K/W
	Case-to-Heatsink (per Diode)		0.049		
	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

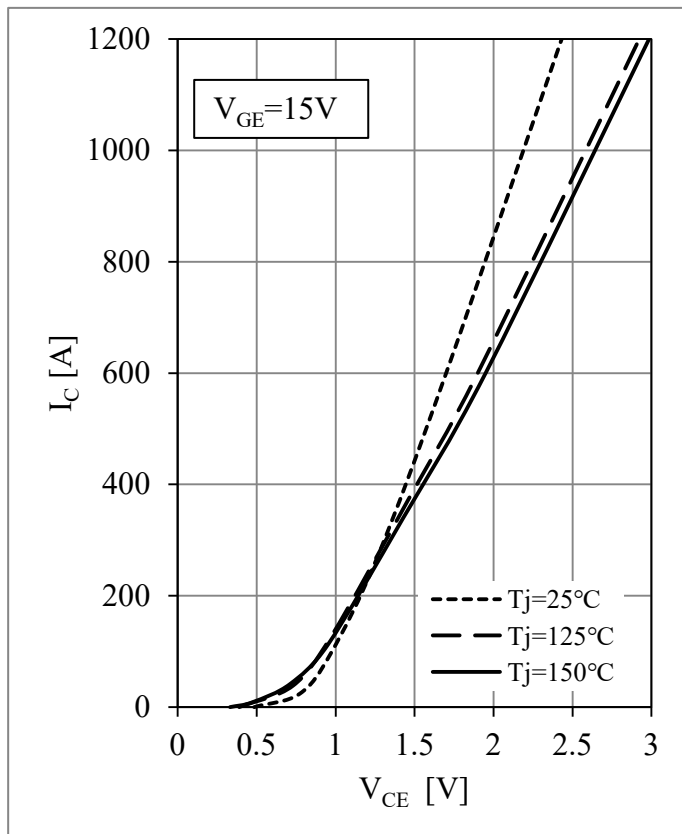


Fig 1. IGBT Output Characteristics

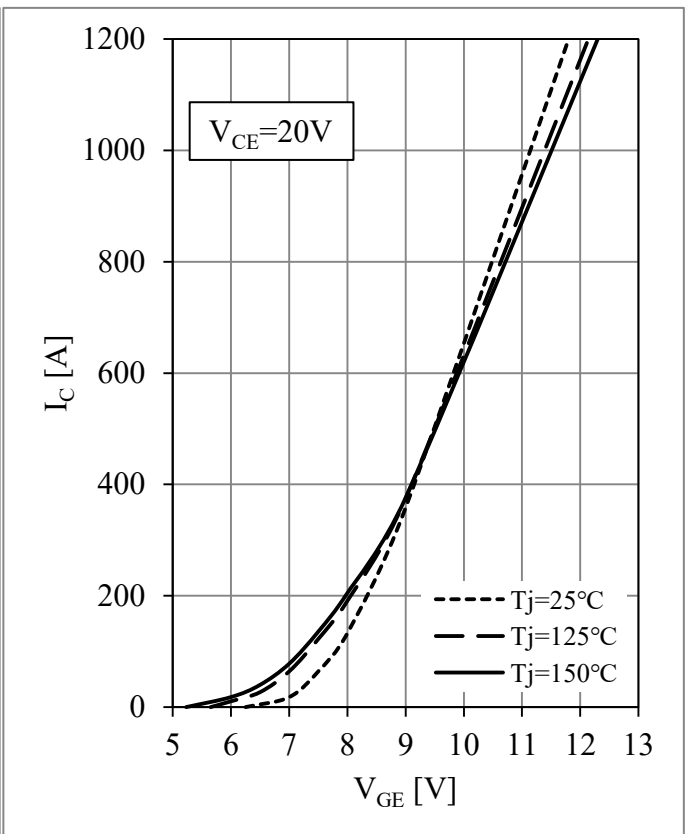
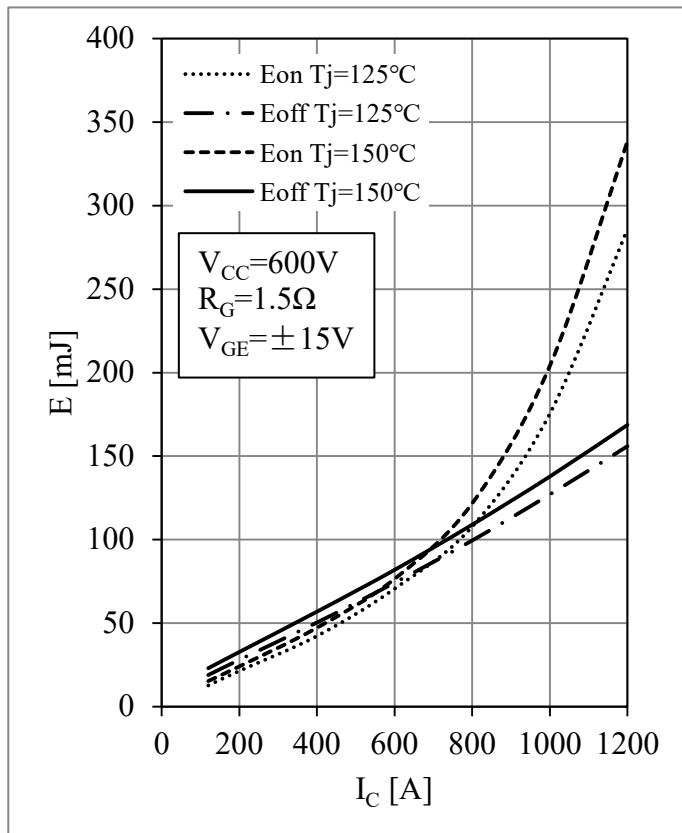
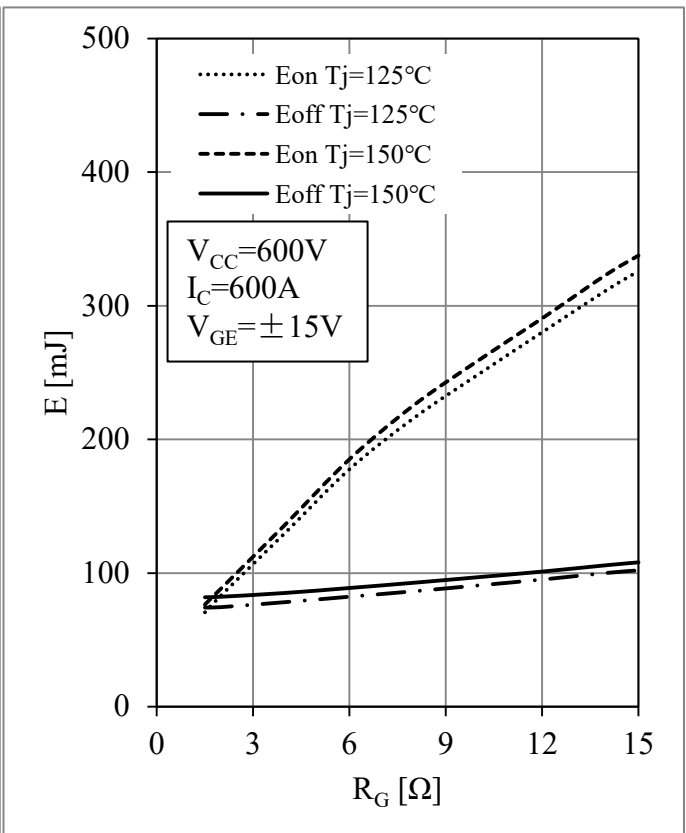


Fig 2. IGBT Transfer Characteristics

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

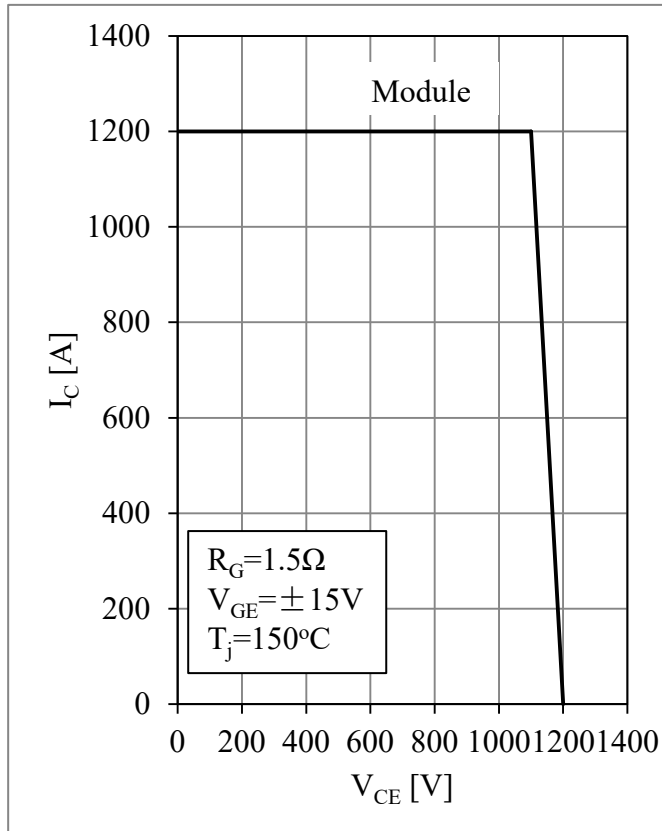


Fig 5. RBSOA

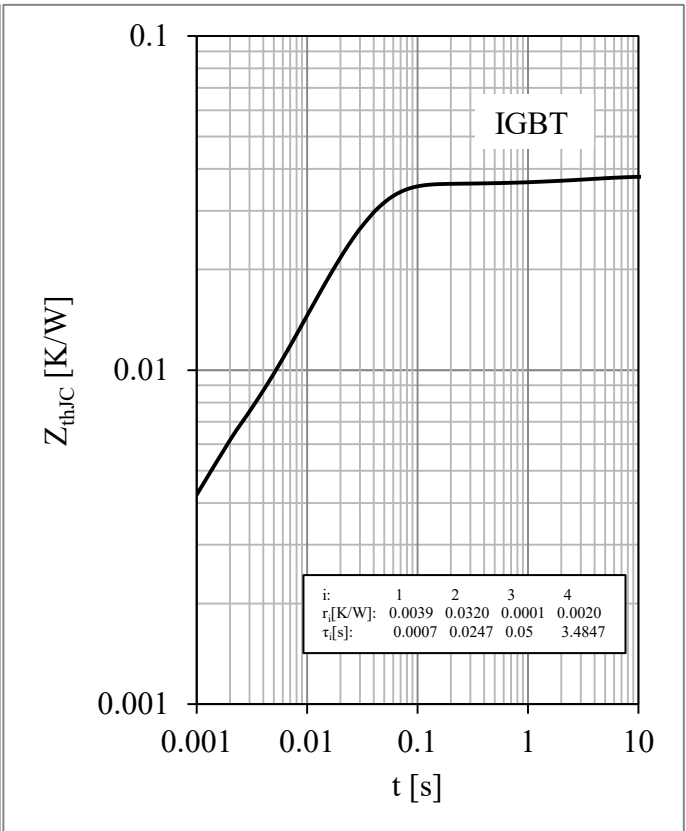


Fig 6. IGBT Transient Thermal Impedance

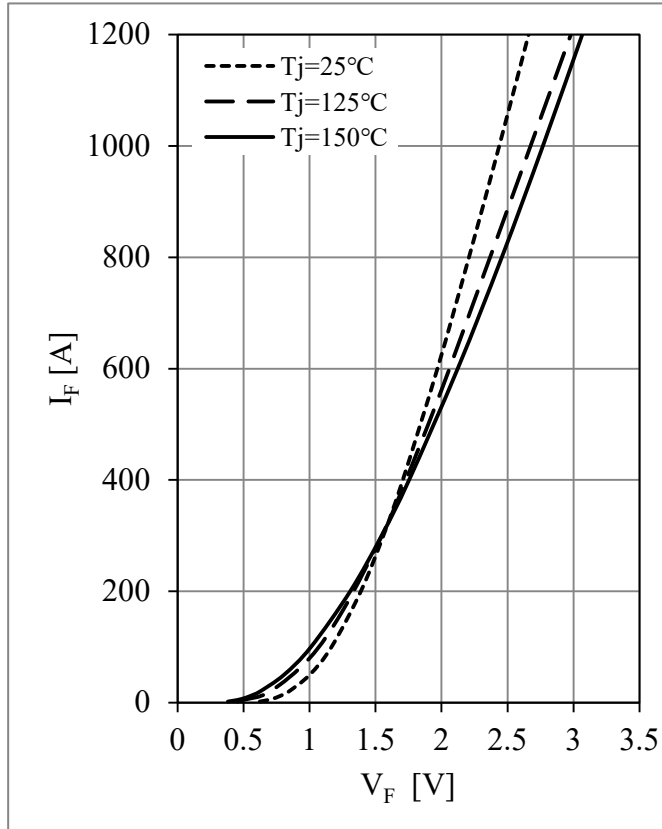
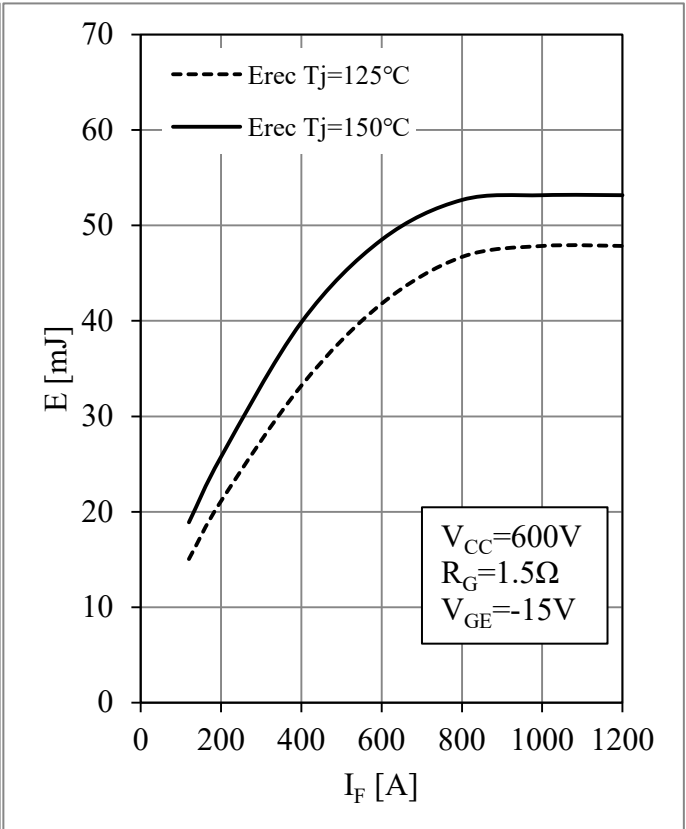


Fig 7. Diode Forward Characteristics

Fig 8. Diode Switching Loss vs. I_F

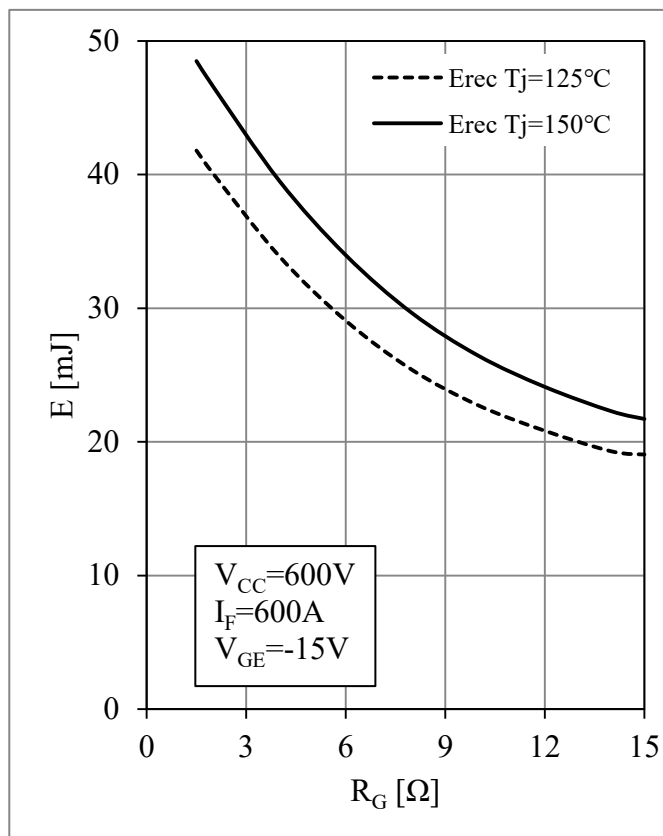
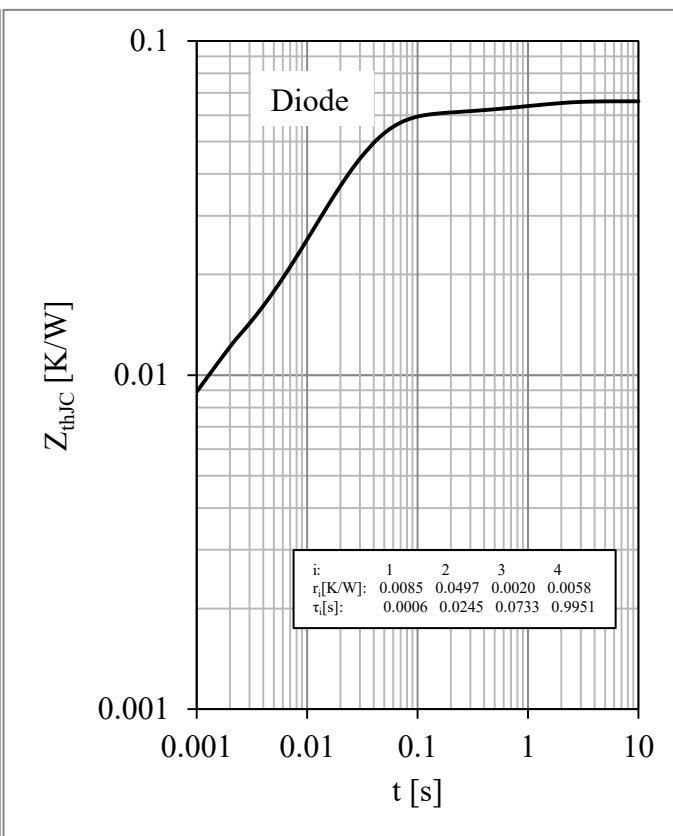
Fig 9. Diode Switching Loss vs. R_G 

Fig 10. Diode Transient Thermal Impedance

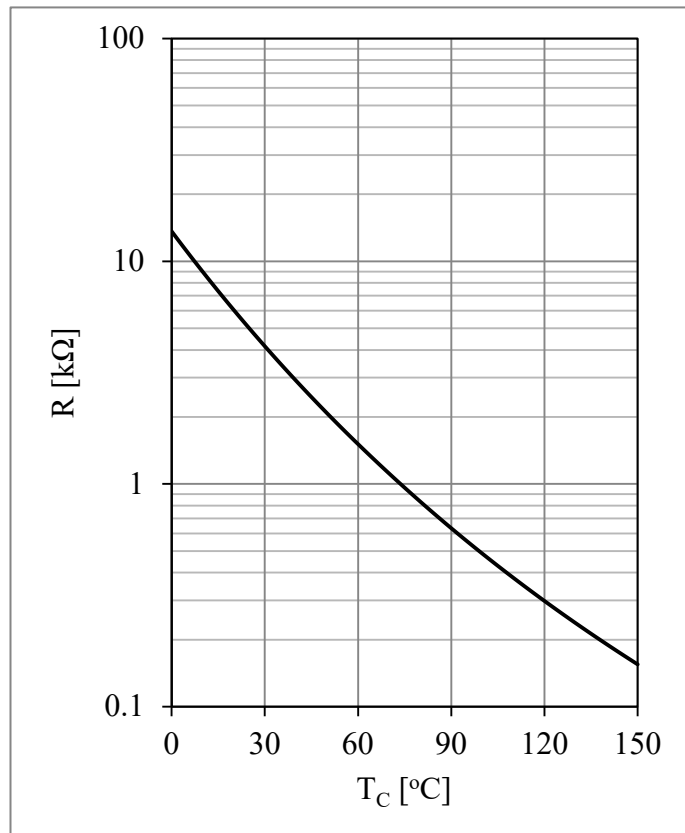
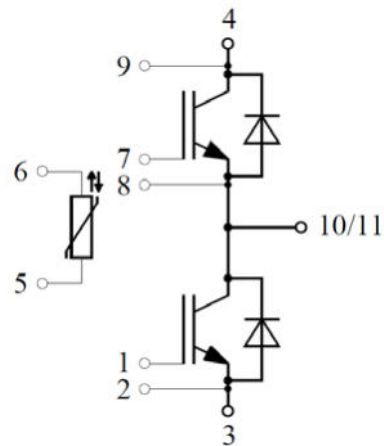


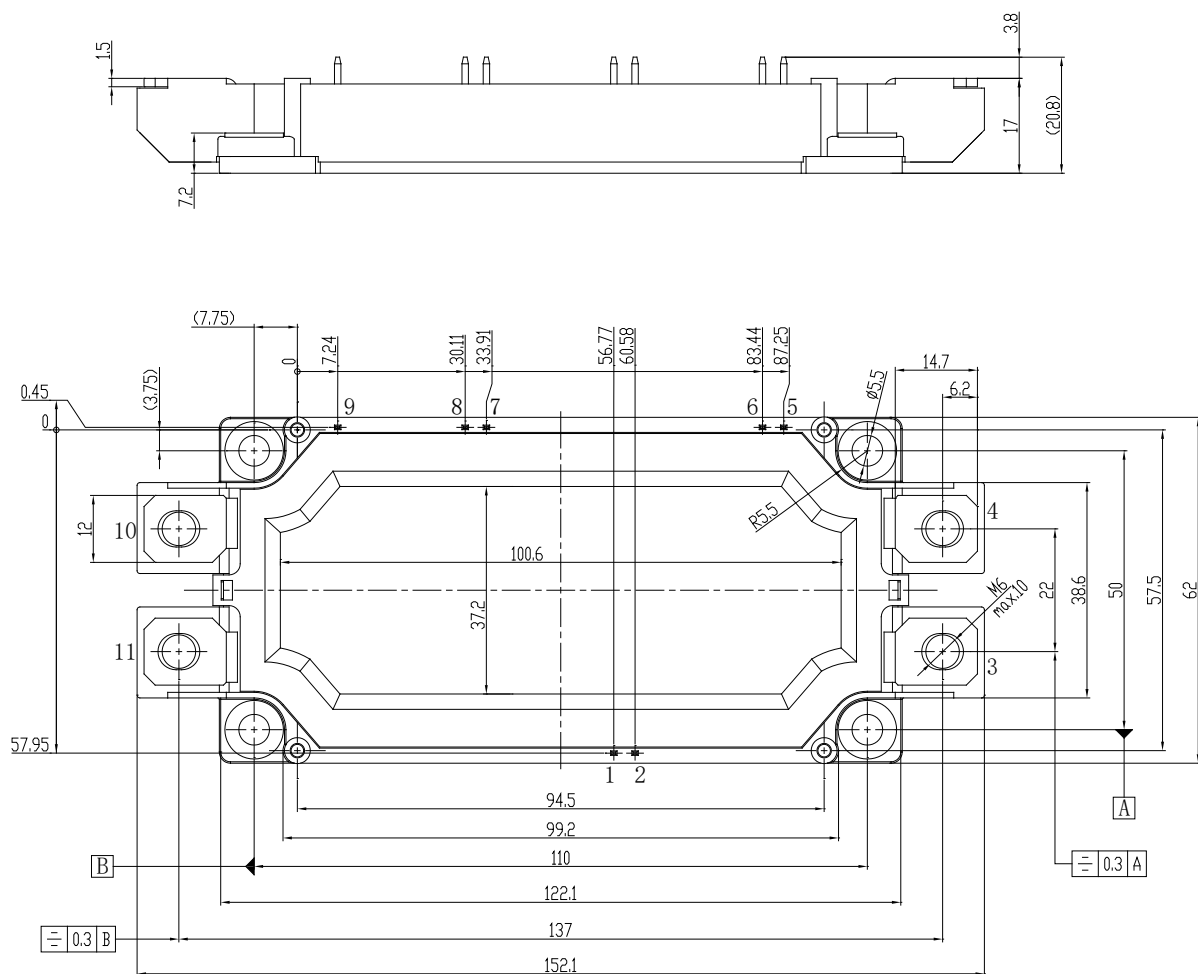
Fig 11. NTC Temperature Characteristic

Circuit Schematic



Package Dimensions

Dimensions in Millimeters



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