

STARPOWER

SEMICONDUCTOR

IGBT

GD450HFY120C6S

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.

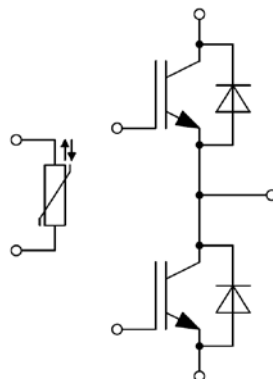
Features

- 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 @ $T_C=25^{\circ}\text{C}$	680	A
	@ $T_C=100^{\circ}\text{C}$	450	A
I_{CM}	Pulsed Collector Current $t_p=1\text{ms}$	900	A
P_D	Maximum Power Dissipation @ $T_j=175^{\circ}\text{C}$	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_{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	$I_C=450\text{A}, V_{GE}=15\text{V}, T_j=25^\circ\text{C}$		1.70	2.15	V	
		$I_C=450\text{A}, V_{GE}=15\text{V}, T_j=125^\circ\text{C}$		1.95			
		$I_C=450\text{A}, V_{GE}=15\text{V}, T_j=150^\circ\text{C}$		2.00			
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=11.3\text{mA}, V_{CE}=V_{GE}, T_j=25^\circ\text{C}$	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	$V_{CE}=25\text{V}, f=1\text{MHz}, V_{GE}=0\text{V}$		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	$V_{CC}=600\text{V}, I_C=450\text{A}, R_G=1.3\Omega, V_{GE}=\pm 15\text{V}, T_j=25^\circ\text{C}$		203		ns	
t_r	Rise Time			64		ns	
$t_{d(off)}$	Turn-Off Delay Time			491		ns	
t_f	Fall Time			79		ns	
E_{on}	Turn-On Switching Loss			16.1		mJ	
E_{off}	Turn-Off Switching Loss			38.0		mJ	
$t_{d(on)}$	Turn-On Delay Time		$V_{CC}=600\text{V}, I_C=450\text{A}, R_G=1.3\Omega, V_{GE}=\pm 15\text{V}, T_j=125^\circ\text{C}$		235		ns
t_r	Rise Time				75		ns
$t_{d(off)}$	Turn-Off Delay Time			581		ns	
t_f	Fall Time			109		ns	
E_{on}	Turn-On Switching Loss			27.8		mJ	
E_{off}	Turn-Off Switching Loss			55.5		mJ	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=450\text{A}, R_G=1.3\Omega, V_{GE}=\pm 15\text{V}, T_j=150^\circ\text{C}$			235		ns
t_r	Rise Time				75		ns
$t_{d(off)}$	Turn-Off Delay Time			621		ns	
t_f	Fall Time			119		ns	
E_{on}	Turn-On Switching Loss			30.5		mJ	
E_{off}	Turn-Off Switching Loss			61.5		mJ	
I_{SC}	SC Data		$t_p \leq 10\mu\text{s}, V_{GE}=15\text{V}, T_j=150^\circ\text{C}, V_{CC}=800\text{V}, V_{CEM} \leq 1200\text{V}$		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	$I_F=450\text{A}, V_{GE}=0\text{V}, T_j=25^{\circ}\text{C}$		1.65	2.10	V
		$I_F=450\text{A}, V_{GE}=0\text{V}, T_j=125^{\circ}\text{C}$		1.65		
		$I_F=450\text{A}, V_{GE}=0\text{V}, T_j=150^{\circ}\text{C}$		1.65		
Q_r	Recovered Charge	$V_{CC}=600\text{V}, I_F=450\text{A},$ $-di/dt=6600\text{A}/\mu\text{s}, V_{GE}=-15\text{V},$ $T_j=25^{\circ}\text{C}$		46		μC
I_{RM}	Peak Reverse Recovery Current			428		A
E_{rec}	Reverse Recovery Energy			25.2		mJ
Q_r	Recovered Charge	$V_{CC}=600\text{V}, I_F=450\text{A},$ $-di/dt=6600\text{A}/\mu\text{s}, V_{GE}=-15\text{V},$ $T_j=125^{\circ}\text{C}$		87		μC
I_{RM}	Peak Reverse Recovery Current			523		A
E_{rec}	Reverse Recovery Energy			46.1		mJ
Q_r	Recovered Charge	$V_{CC}=600\text{V}, I_F=450\text{A},$ $-di/dt=6600\text{A}/\mu\text{s}, V_{GE}=-15\text{V},$ $T_j=150^{\circ}\text{C}$		100		μC
I_{RM}	Peak Reverse Recovery Current			546		A
E_{rec}	Reverse Recovery Energy			52.3		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		$\text{k}\Omega$
$\Delta R/R$	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)			0.069	K/W
	Junction-to-Case (per Diode)			0.108	
R_{thCH}	Case-to-Heatsink (per IGBT)		0.030		K/W
	Case-to-Heatsink (per Diode)		0.046		
	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

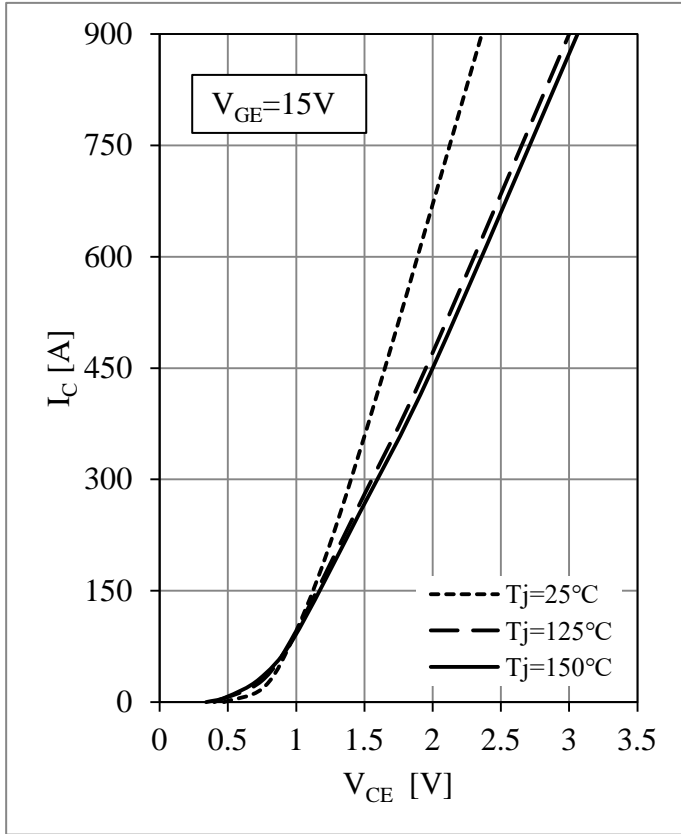


Fig 1. IGBT Output Characteristics

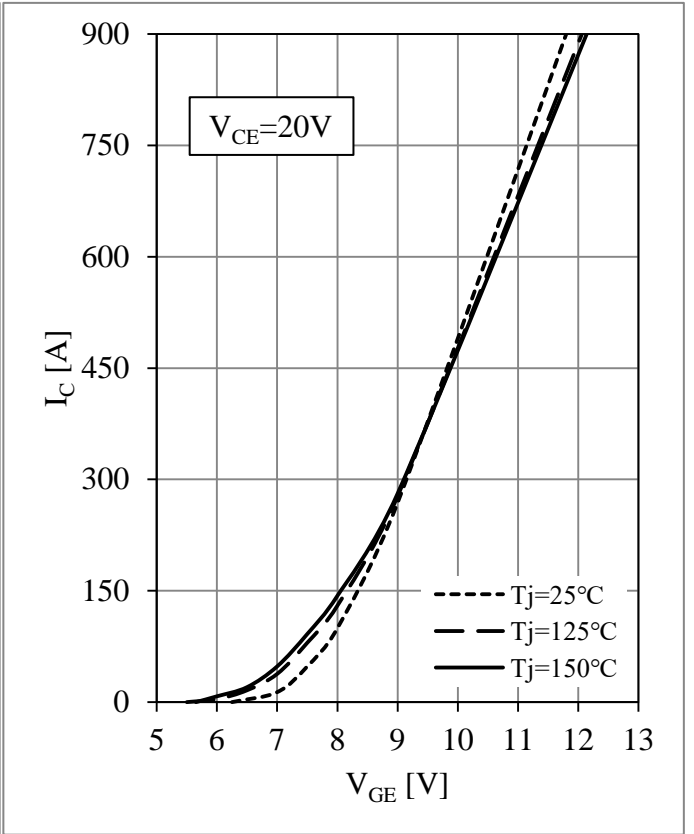


Fig 2. IGBT Transfer Characteristics

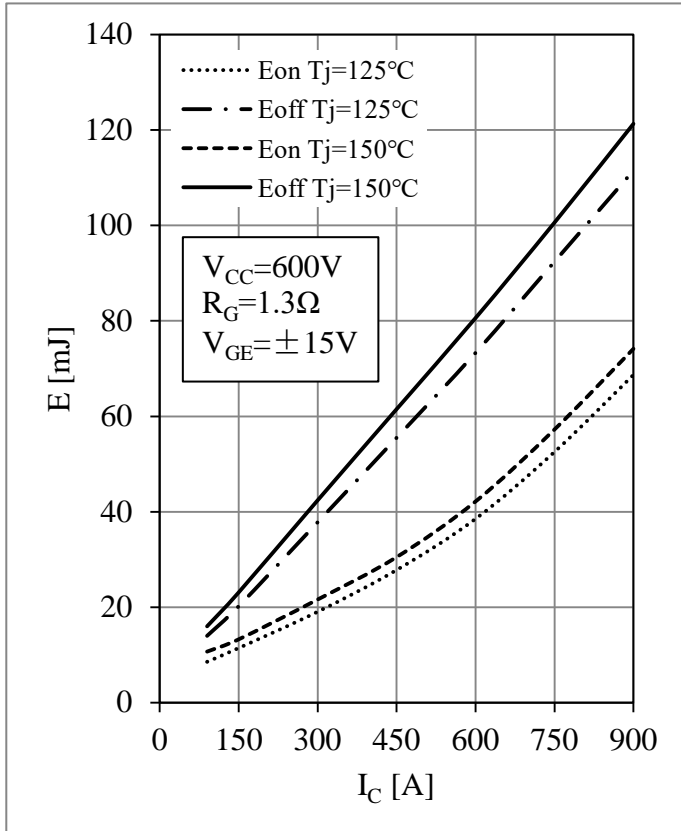


Fig 3. IGBT Switching Loss vs. I_c

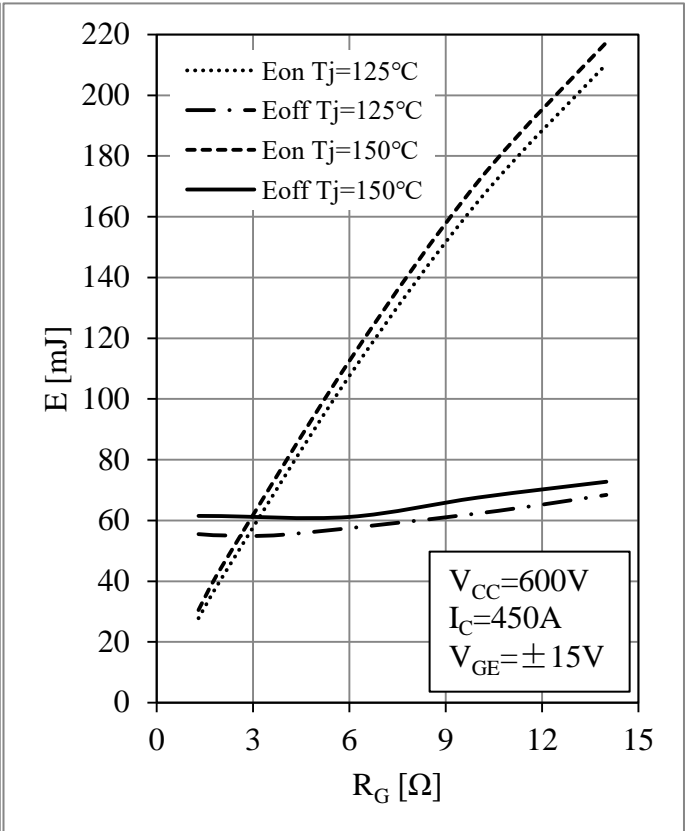


Fig 4. IGBT Switching Loss vs. R_g

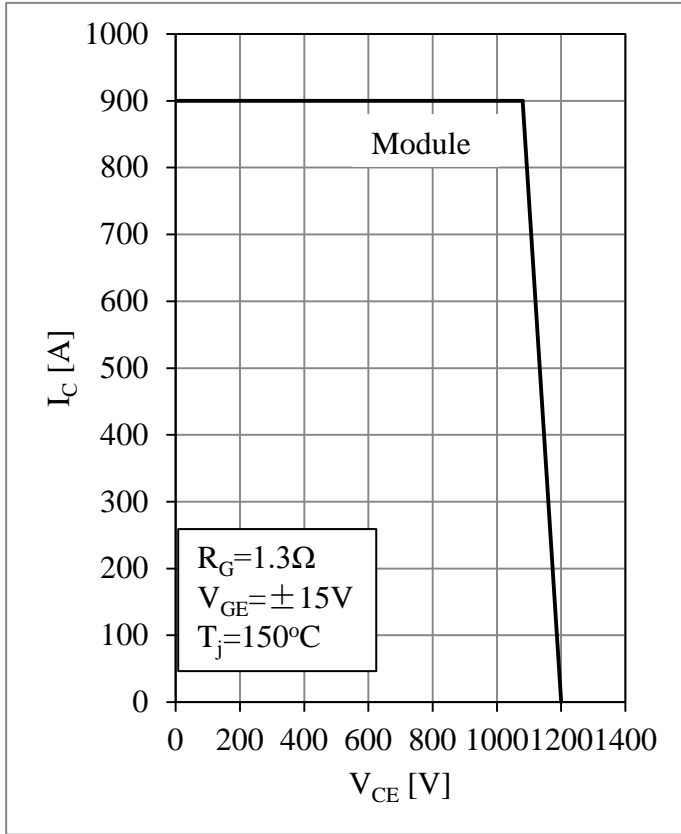


Fig 5. RBSOA

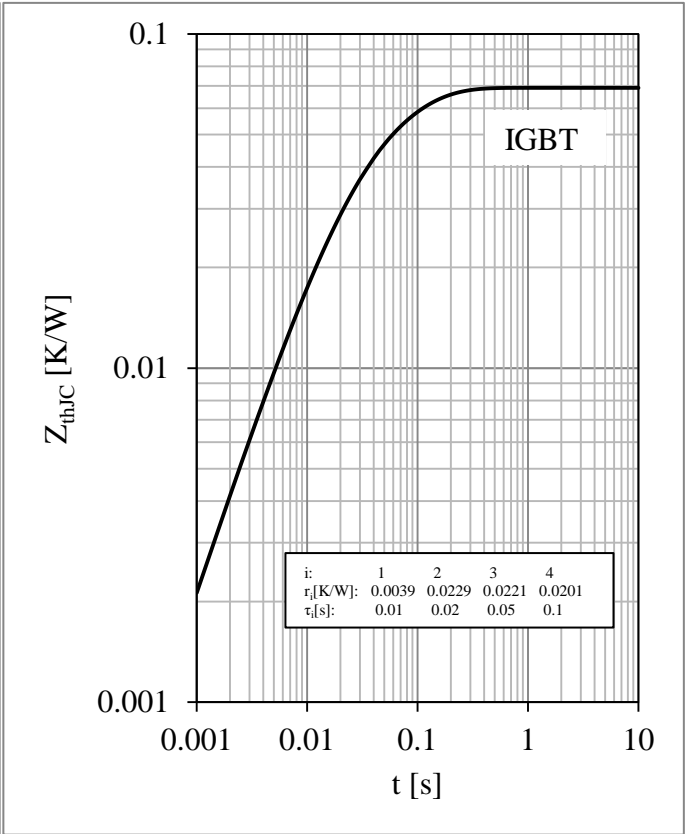


Fig 6. IGBT Transient Thermal Impedance

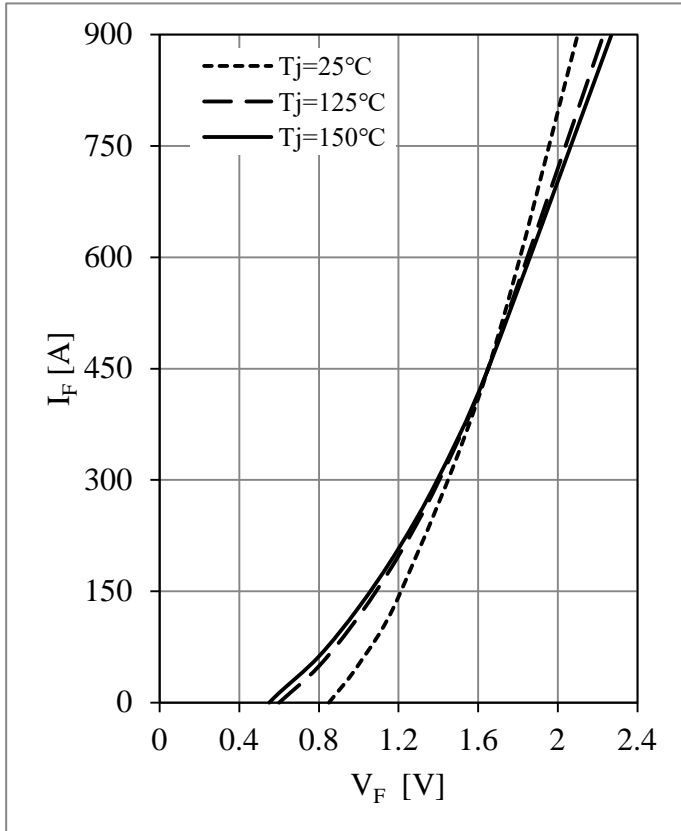


Fig 7. Diode Forward Characteristics

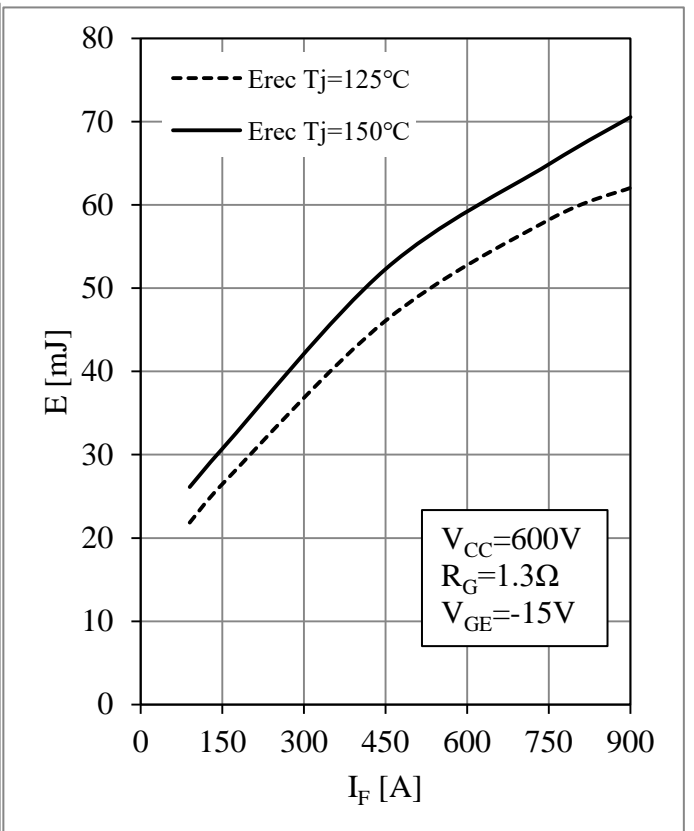


Fig 8. Diode Switching Loss vs. I_F

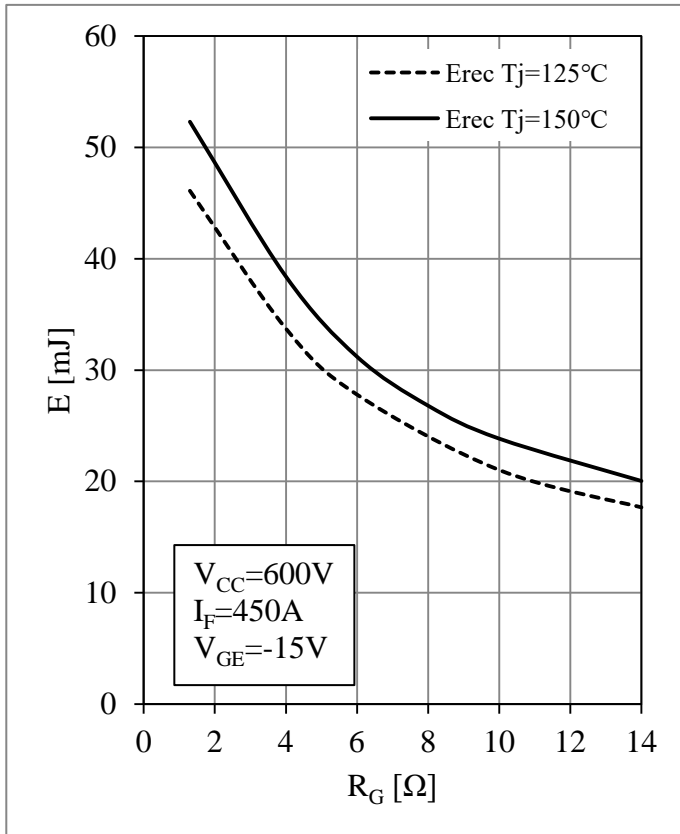


Fig 9. Diode Switching Loss vs. R_G

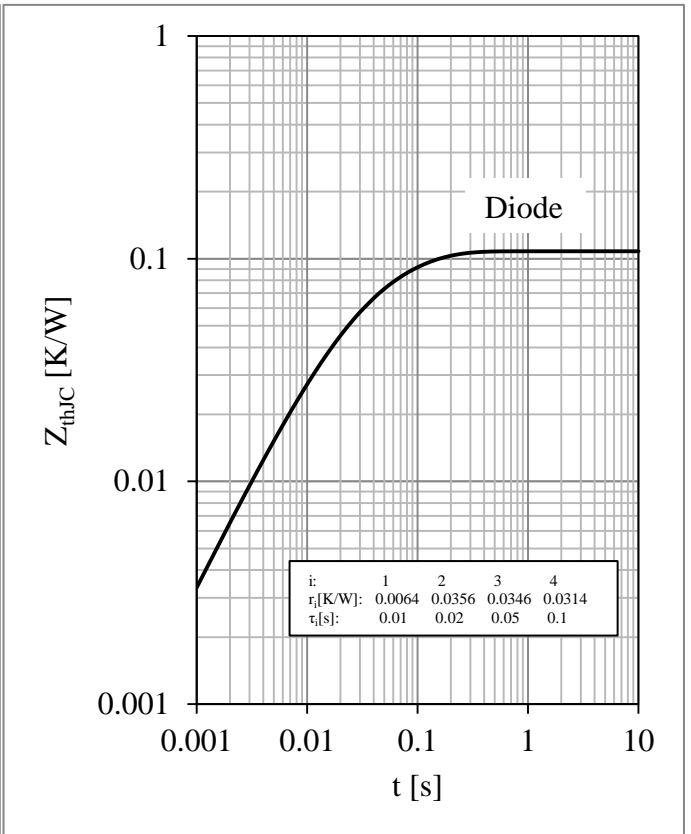


Fig 10. Diode Transient Thermal Impedance

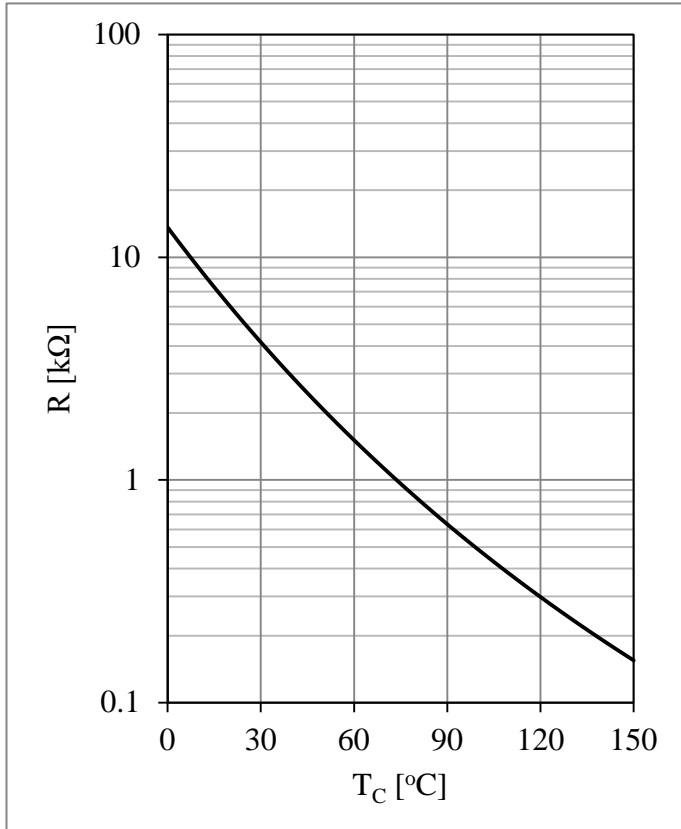
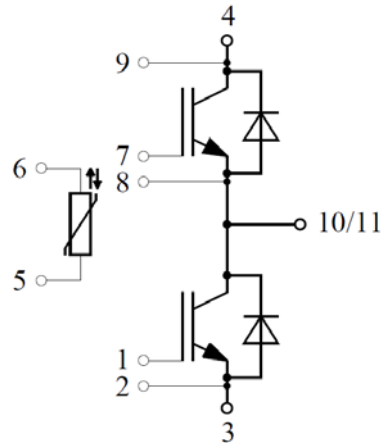


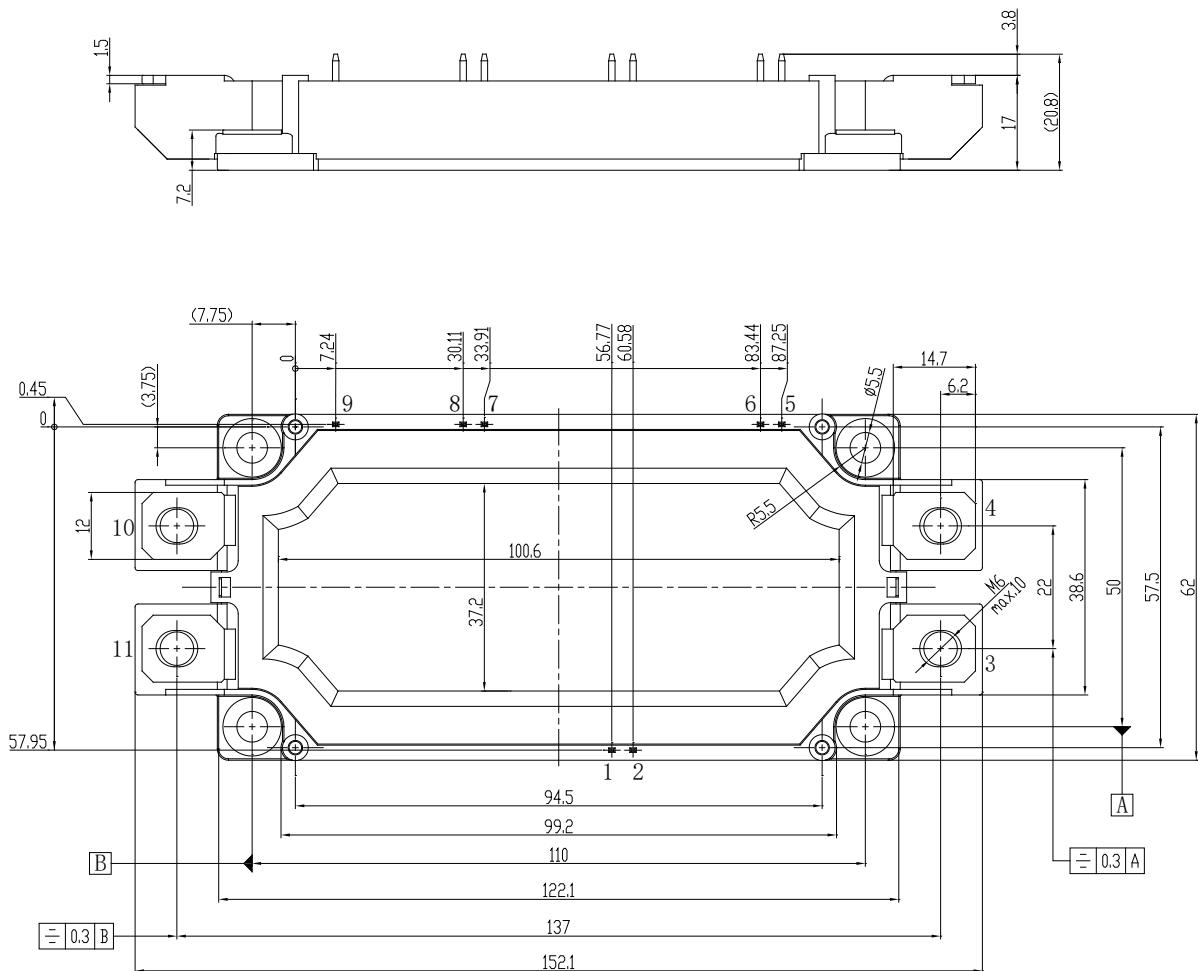
Fig 11. NTC Temperature Characteristic

Circuit Schematic



Package Dimensions

Dimensions in Millimeters



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