

STARPOWER

SEMICONDUCTOR

IGBT

GD450HFX170C6S

1700V/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 general inverters and UPS.

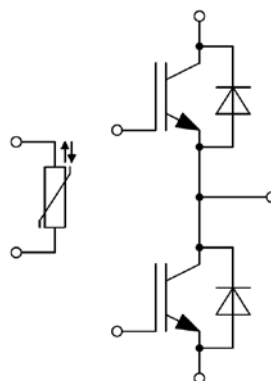
Features

- 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

- Inverter for motor drive
- AC and DC servo drive amplifier
- 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	1700	V
V_{GES}	Gate-Emitter Voltage	± 20	V
I_C	Collector Current @ $T_C=25^{\circ}\text{C}$	706	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 @ $T_j=175^{\circ}\text{C}$	2542	W

Diode

Symbol	Description	Value	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	1700	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, $f=50\text{Hz}$, $t=1\text{min}$	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	$I_C=450\text{A}, V_{GE}=15\text{V}, T_j=25^{\circ}\text{C}$		1.85	2.20	V
		$I_C=450\text{A}, V_{GE}=15\text{V}, T_j=125^{\circ}\text{C}$		2.25		
		$I_C=450\text{A}, V_{GE}=15\text{V}, T_j=150^{\circ}\text{C}$		2.35		
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=18.0\text{mA}, V_{CE}=V_{GE}, T_j=25^{\circ}\text{C}$	5.6	6.2	6.8	V
I_{CES}	Collector Cut-Off Current	$V_{CE}=V_{CES}, V_{GE}=0\text{V}, T_j=25^{\circ}\text{C}$			5.0	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			1.67		Ω
C_{ies}	Input Capacitance	$V_{CE}=25\text{V}, f=1\text{MHz}, V_{GE}=0\text{V}$		54.2		nF
C_{res}	Reverse Transfer Capacitance			1.32		nF
Q_G	Gate Charge	$V_{GE}=-15\dots+15\text{V}$		4.24		μC
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=900\text{V}, I_C=450\text{A}, R_G=3.3\Omega, V_{GE}=\pm 15\text{V}, T_j=25^{\circ}\text{C}$		179		ns
t_r	Rise Time			105		ns
$t_{d(off)}$	Turn-Off Delay Time			680		ns
t_f	Fall Time			375		ns
E_{on}	Turn-On Switching Loss			116		mJ
E_{off}	Turn-Off Switching Loss			113		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=900\text{V}, I_C=450\text{A}, R_G=3.3\Omega, V_{GE}=\pm 15\text{V}, T_j=125^{\circ}\text{C}$		208		ns
t_r	Rise Time			120		ns
$t_{d(off)}$	Turn-Off Delay Time			784		ns
t_f	Fall Time			613		ns
E_{on}	Turn-On Switching Loss			152		mJ
E_{off}	Turn-Off Switching Loss			171		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=900\text{V}, I_C=450\text{A}, R_G=3.3\Omega, V_{GE}=\pm 15\text{V}, T_j=150^{\circ}\text{C}$		208		ns
t_r	Rise Time			120		ns
$t_{d(off)}$	Turn-Off Delay Time			800		ns
t_f	Fall Time			720		ns
E_{on}	Turn-On Switching Loss			167		mJ
E_{off}	Turn-Off Switching Loss			179		mJ
I_{SC}	SC Data	$t_p \leq 10\mu\text{s}, V_{GE}=15\text{V}, T_j=150^{\circ}\text{C}, V_{CC}=1000\text{V}, V_{CEM} \leq 1700\text{V}$		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	$I_F=450\text{A}, V_{GE}=0\text{V}, T_j=25^{\circ}\text{C}$		1.80	2.25	V
		$I_F=450\text{A}, V_{GE}=0\text{V}, T_j=125^{\circ}\text{C}$		1.95		
		$I_F=450\text{A}, V_{GE}=0\text{V}, T_j=150^{\circ}\text{C}$		1.90		
Q_r	Recovered Charge	$V_R=900\text{V}, I_F=450\text{A},$ $-di/dt=4580\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=25^{\circ}\text{C}$		105		μC
I_{RM}	Peak Reverse Recovery Current			198		A
E_{rec}	Reverse Recovery Energy			69.0		mJ
Q_r	Recovered Charge	$V_R=900\text{V}, I_F=450\text{A},$ $-di/dt=4580\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=125^{\circ}\text{C}$		187		μC
I_{RM}	Peak Reverse Recovery Current			578		A
E_{rec}	Reverse Recovery Energy			129		mJ
Q_r	Recovered Charge	$V_R=900\text{V}, I_F=450\text{A},$ $-di/dt=4580\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=150^{\circ}\text{C}$		209		μC
I_{RM}	Peak Reverse Recovery Current			585		A
E_{rec}	Reverse Recovery Energy			150		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		$\text{m}\Omega$
R_{thJC}	Junction-to-Case (per IGBT)			0.059	K/W
	Junction-to-Case (per Diode)			0.083	
R_{thCH}	Case-to-Heatsink (per IGBT)		0.031		K/W
	Case-to-Heatsink (per Diode)		0.043		
	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

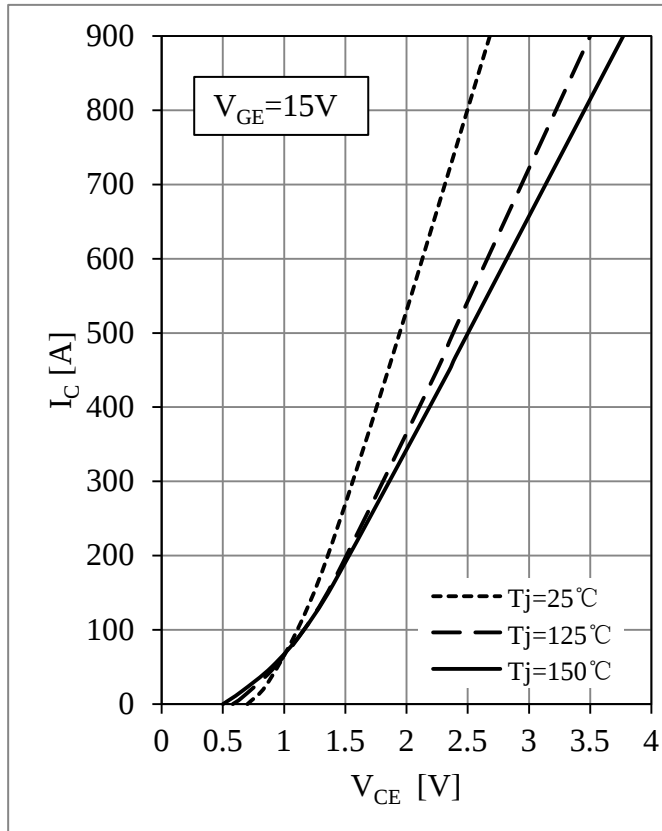


Fig 1. IGBT Output Characteristics

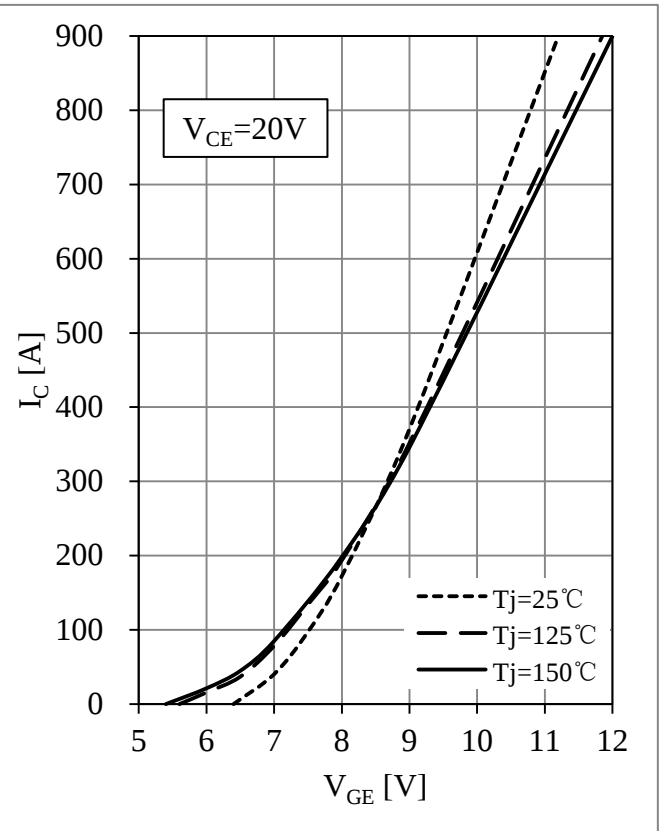
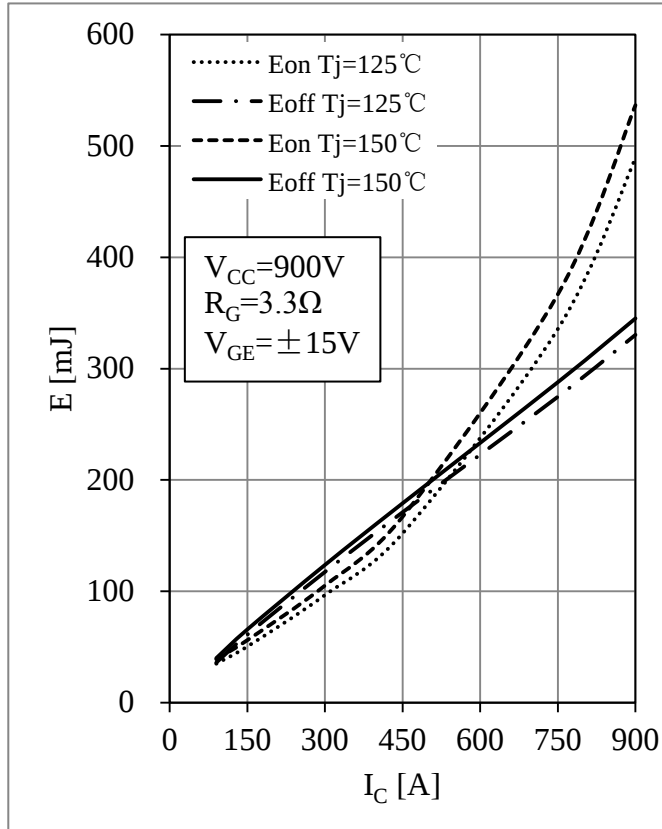
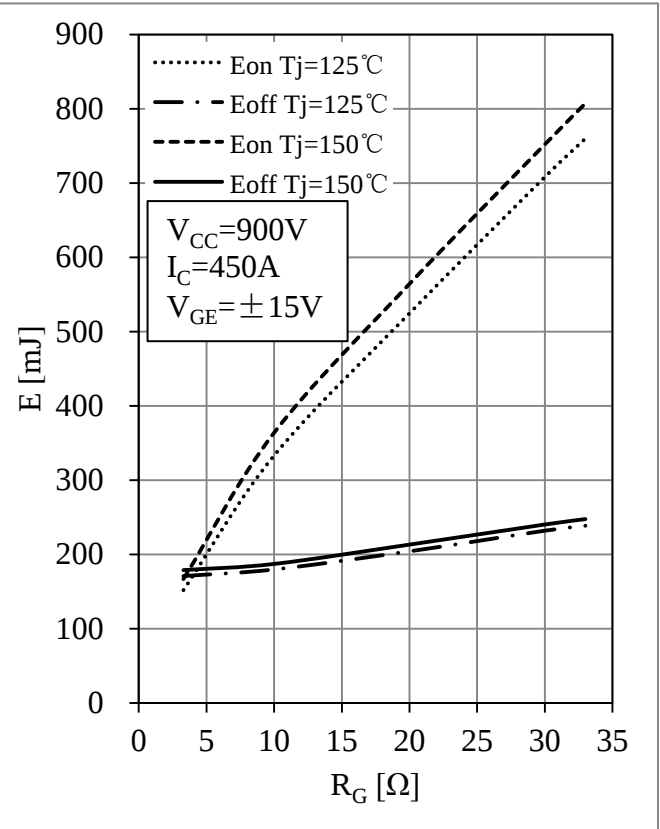


Fig 2. IGBT Transfer Characteristics

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

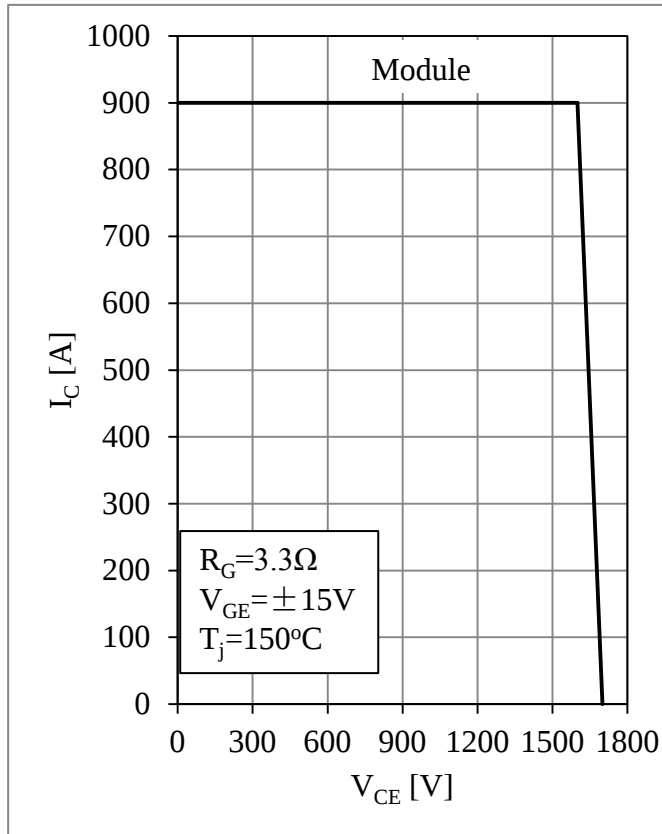


Fig 5. RBSOA

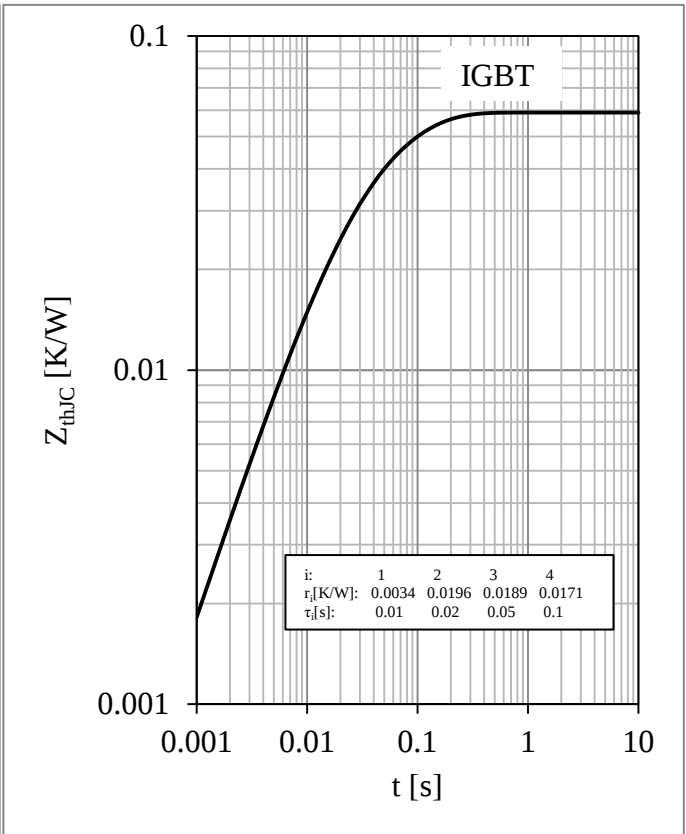


Fig 6. IGBT Transient Thermal Impedance

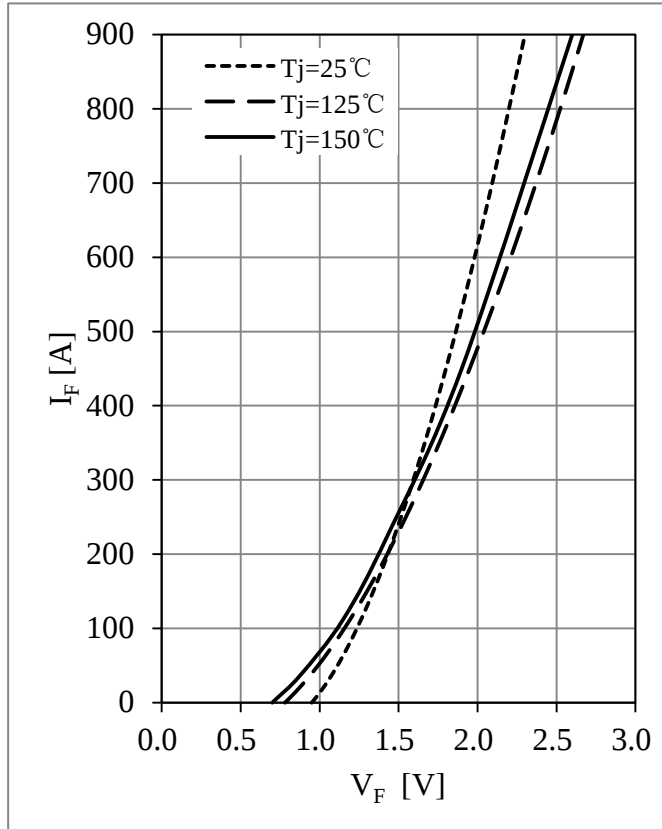
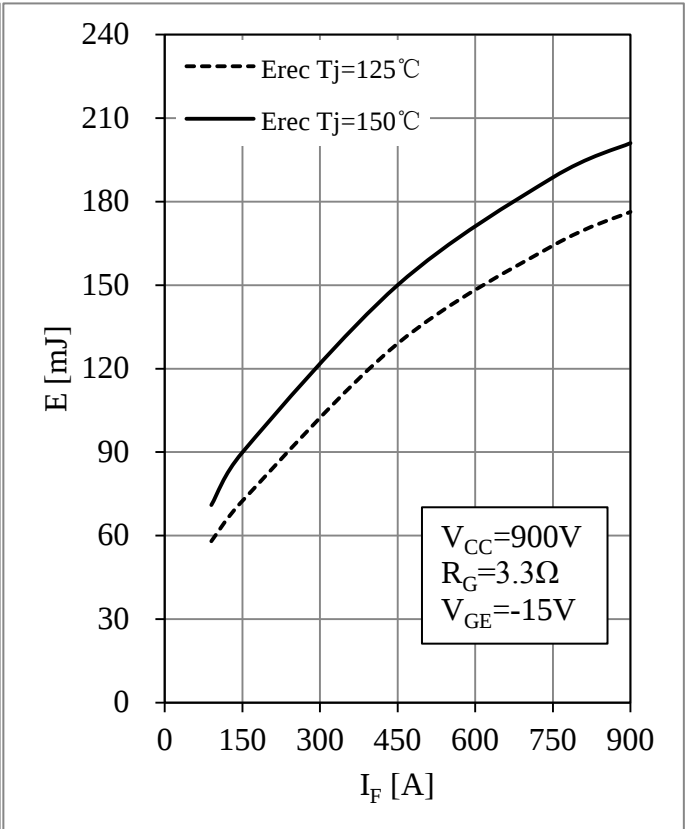


Fig 7. Diode Forward Characteristics

Fig 8. Diode Switching Loss vs. I_F

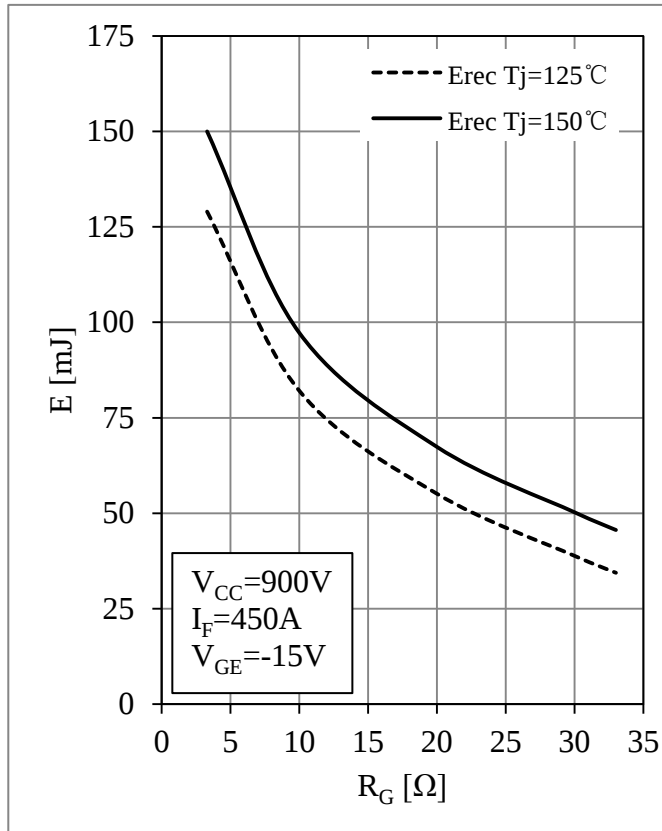
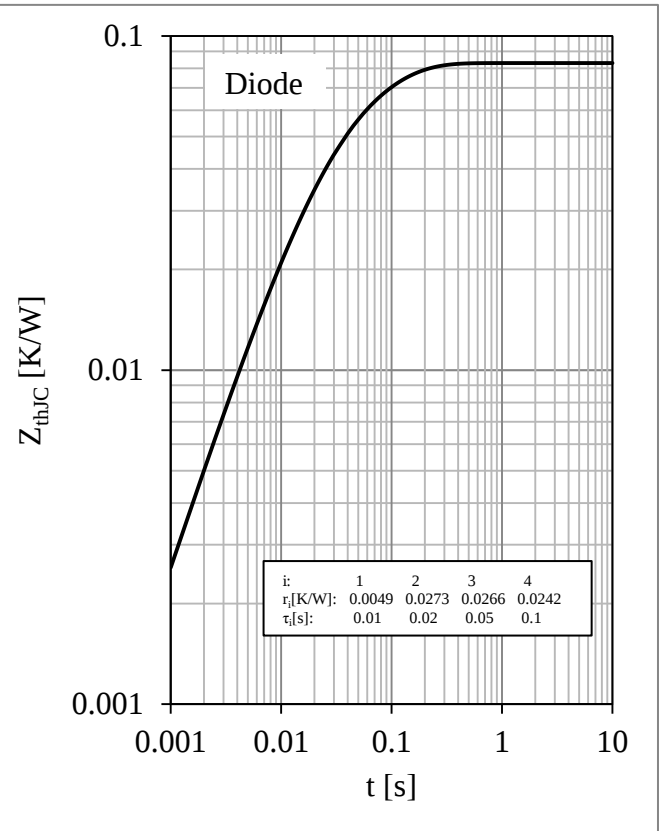
Fig 9. Diode Switching Loss vs. R_G 

Fig 10. Diode Transient Thermal Impedance

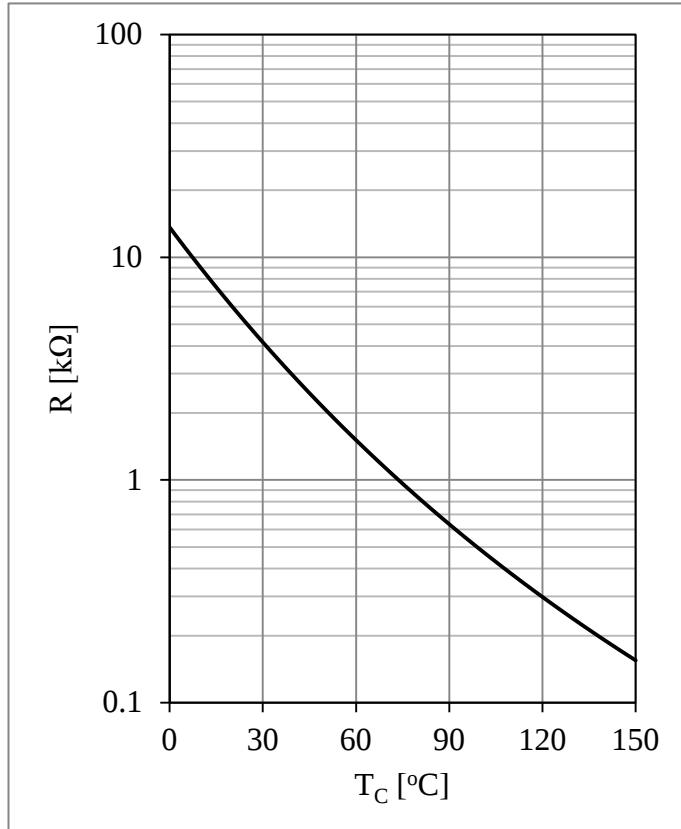


Fig 11. NTC Temperature Characteristic

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