

STARPOWER

SEMICONDUCTOR

IGBT

GD450HFX65C6S

650V/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 inverters and UPS.

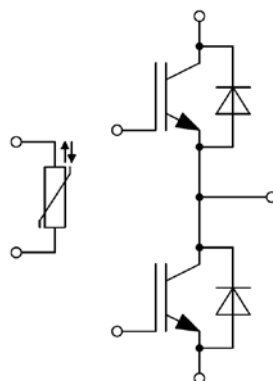
Features

- Low $V_{CE(sat)}$ Trench IGBT technology
- $V_{CE(sat)}$ with positive temperature coefficient
- 6 μ s short circuit capability
- 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	Values	Unit
V_{CES}	Collector-Emitter Voltage	650	V
V_{GES}	Gate-Emitter Voltage	± 20	V
I_C	Collector Current @ $T_C=25^{\circ}\text{C}$	536	A
	@ $T_C=55^{\circ}\text{C}$	450	
I_{CM}	Pulsed Collector Current $t_p=1\text{ms}$	900	A
P_D	Maximum Power Dissipation @ $T_j=175^{\circ}\text{C}$	1190	W

Diode

Symbol	Description	Values	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	650	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	Values	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	$I_C=450\text{A}, V_{GE}=15\text{V}, T_j=25^{\circ}\text{C}$		1.45	1.90	V
		$I_C=450\text{A}, V_{GE}=15\text{V}, T_j=125^{\circ}\text{C}$		1.60		
		$I_C=450\text{A}, V_{GE}=15\text{V}, T_j=150^{\circ}\text{C}$		1.70		
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=7.20\text{mA}, V_{CE}=V_{GE}, T_j=25^{\circ}\text{C}$	5.1	5.8	6.5	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			0.67		Ω
C_{ies}	Input Capacitance	$V_{CE}=25\text{V}, f=1\text{MHz}, V_{GE}=0\text{V}$		52.2		nF
C_{res}	Reverse Transfer Capacitance			1.03		nF
Q_G	Gate Charge	$V_{GE}=-15\dots+15\text{V}$		3.12		μC
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=300\text{V}, I_C=450\text{A}, R_G=1.5\Omega, V_{GE}=\pm 15\text{V}, T_j=25^{\circ}\text{C}$		75		ns
t_r	Rise Time			65		ns
$t_{d(off)}$	Turn-Off Delay Time			376		ns
t_f	Fall Time			56		ns
E_{on}	Turn-On Switching Loss			4.95		mJ
E_{off}	Turn-Off Switching Loss			12.0		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=300\text{V}, I_C=450\text{A}, R_G=1.5\Omega, V_{GE}=\pm 15\text{V}, T_j=125^{\circ}\text{C}$		80		ns
t_r	Rise Time			70		ns
$t_{d(off)}$	Turn-Off Delay Time			400		ns
t_f	Fall Time			76		ns
E_{on}	Turn-On Switching Loss			6.30		mJ
E_{off}	Turn-Off Switching Loss			14.0		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=300\text{V}, I_C=450\text{A}, R_G=1.5\Omega, V_{GE}=\pm 15\text{V}, T_j=150^{\circ}\text{C}$		85		ns
t_r	Rise Time			75		ns
$t_{d(off)}$	Turn-Off Delay Time			400		ns
t_f	Fall Time			80		ns
E_{on}	Turn-On Switching Loss			6.90		mJ
E_{off}	Turn-Off Switching Loss			14.8		mJ
I_{SC}	SC Data	$t_p \leq 6\mu\text{s}, V_{GE}=15\text{V}, T_j=150^{\circ}\text{C}, V_{CC}=360\text{V}, V_{CEM} \leq 650\text{V}$		2250		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	$I_C=450\text{A}, V_{GE}=0\text{V}, T_j=25^{\circ}\text{C}$		1.55	2.00	V
		$I_C=450\text{A}, V_{GE}=0\text{V}, T_j=125^{\circ}\text{C}$		1.50		
		$I_C=450\text{A}, V_{GE}=0\text{V}, T_j=150^{\circ}\text{C}$		1.45		
Q_r	Recovered Charge	$V_R=300\text{V}, I_F=450\text{A},$ $-di/dt=5900\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=25^{\circ}\text{C}$		16.5		μC
I_{RM}	Peak Reverse Recovery Current			230		A
E_{rec}	Reverse Recovery Energy			3.75		mJ
Q_r	Recovered Charge	$V_R=300\text{V}, I_F=450\text{A},$ $-di/dt=5900\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=125^{\circ}\text{C}$		30.0		μC
I_{RM}	Peak Reverse Recovery Current			290		A
E_{rec}	Reverse Recovery Energy			7.50		mJ
Q_r	Recovered Charge	$V_R=300\text{V}, I_F=450\text{A},$ $-di/dt=5900\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=150^{\circ}\text{C}$		35.0		μC
I_{RM}	Peak Reverse Recovery Current			310		A
E_{rec}	Reverse Recovery Energy			9.00		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		mΩ
R_{thJC}	Junction-to-Case (per IGBT)			0.116	K/W
	Junction-to-Case (per Diode)			0.217	
R_{thCH}	Case-to-Heatsink (per IGBT)		0.028		K/W
	Case-to-Heatsink (per Diode)		0.052		
	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

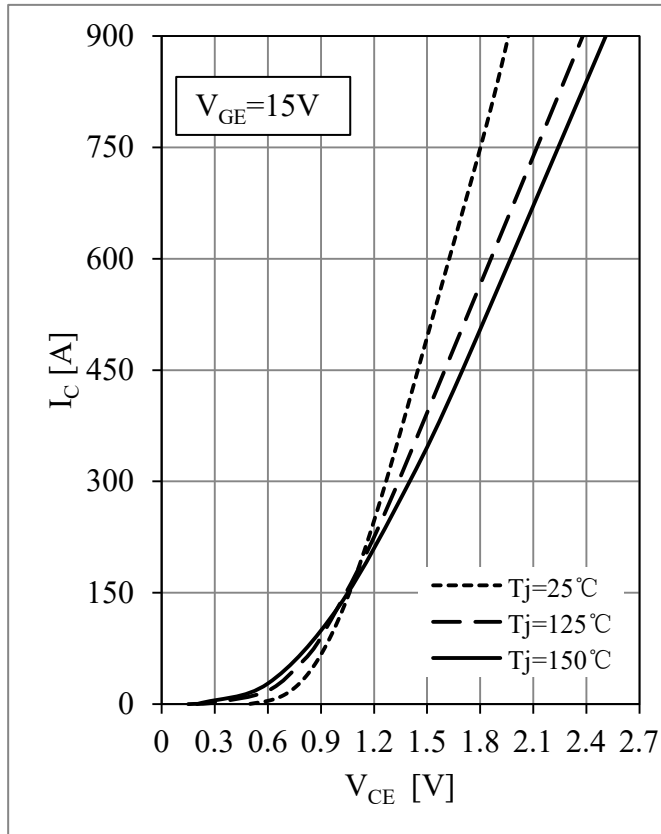


Fig 1. IGBT Output Characteristics

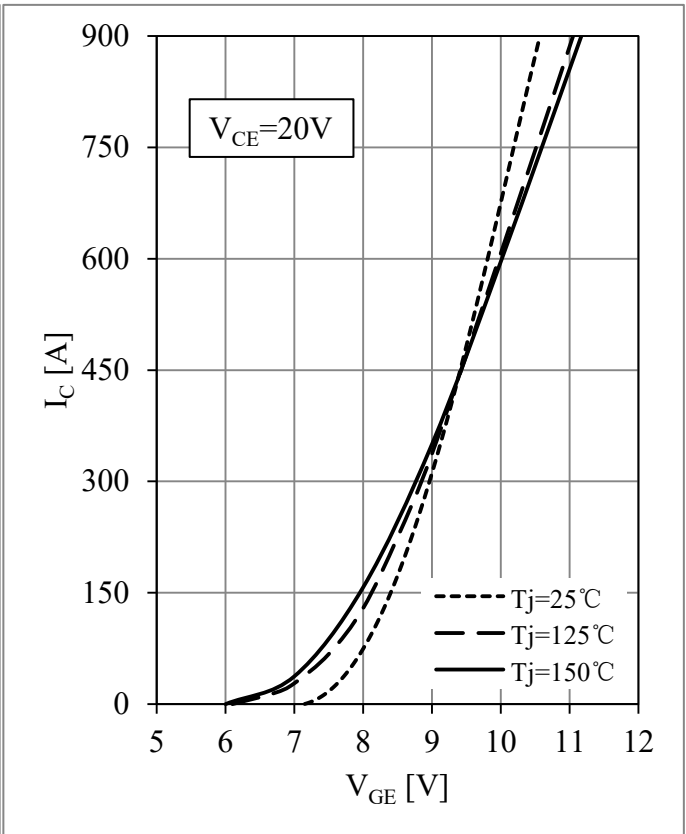
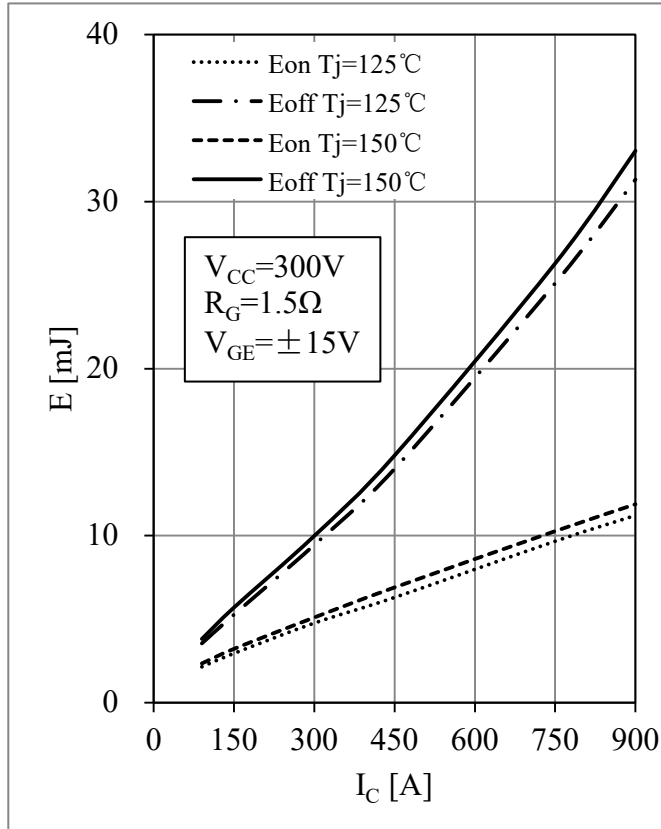
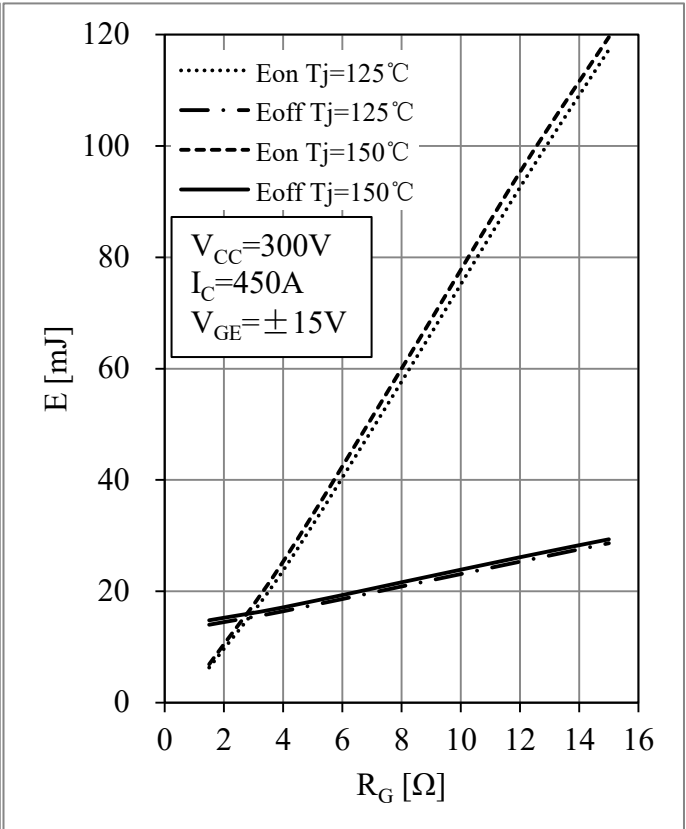


Fig 2. IGBT Transfer Characteristics

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

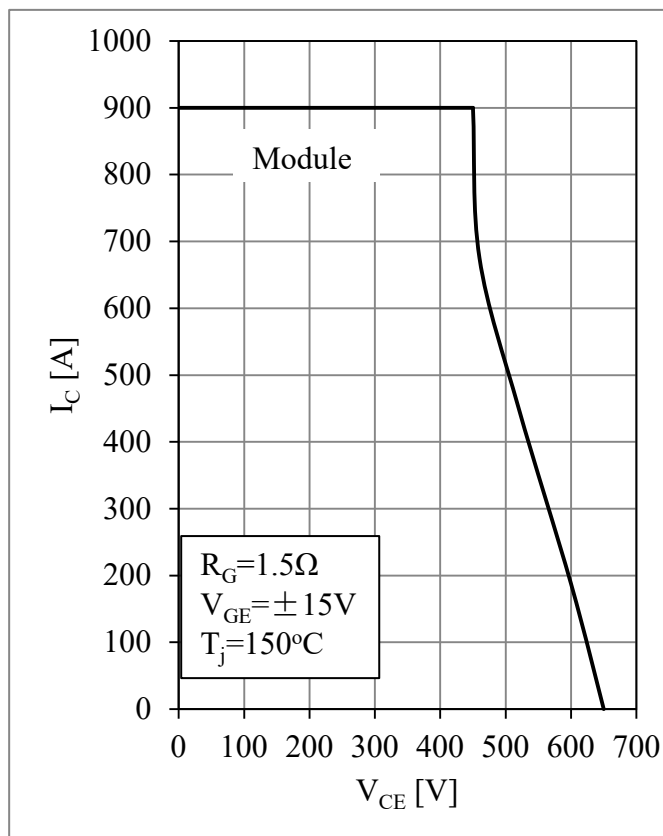


Fig 5. RBSOA

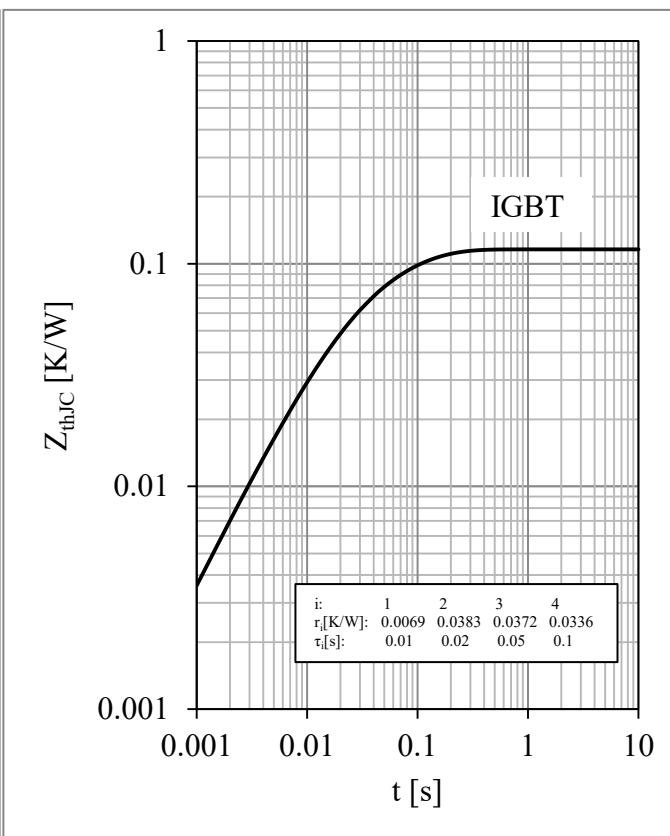


Fig 6. IGBT Transient Thermal Impedance

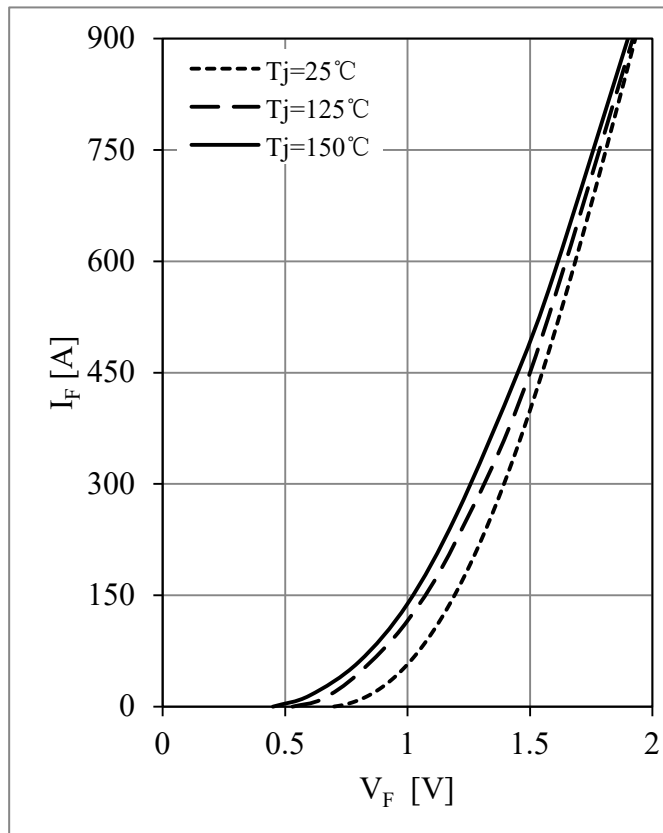
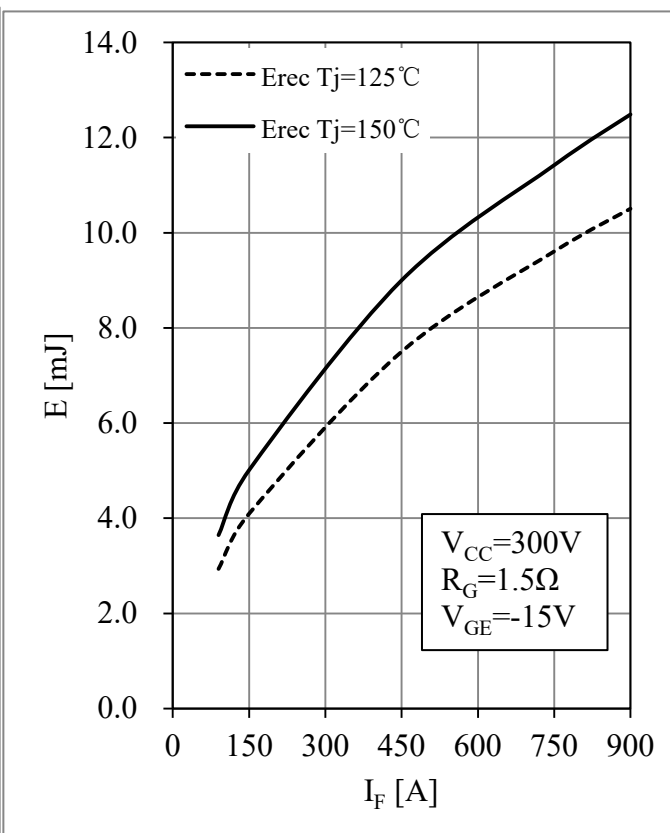
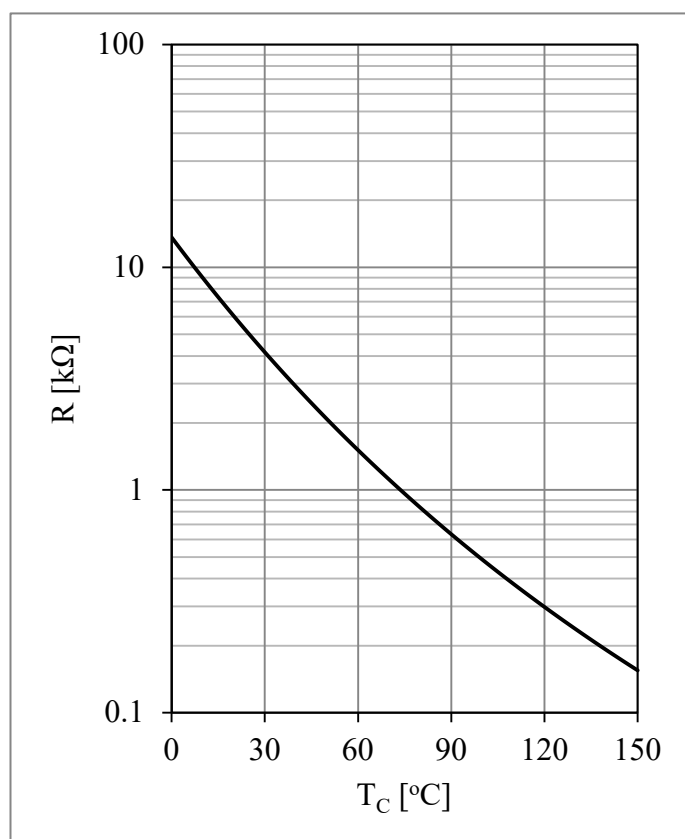
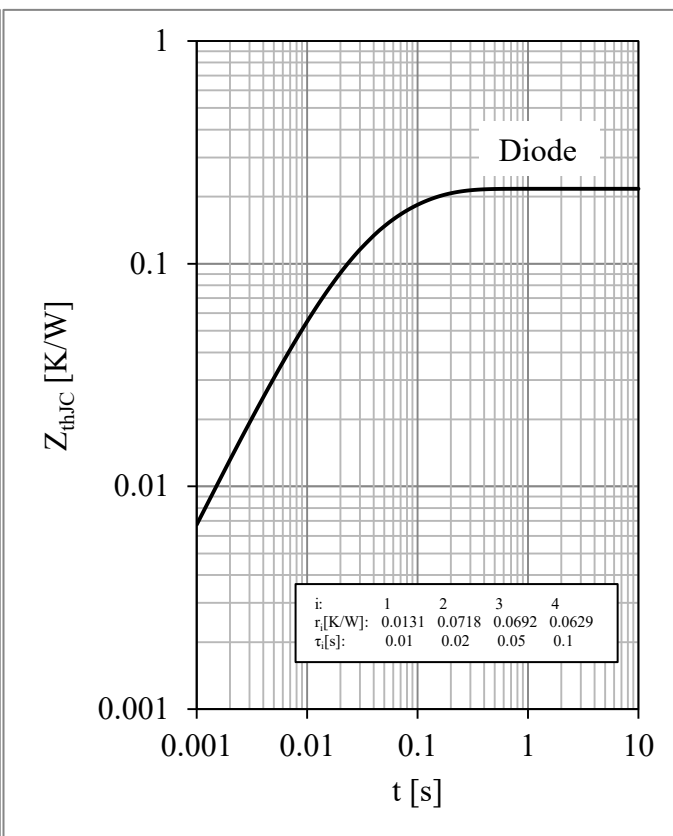
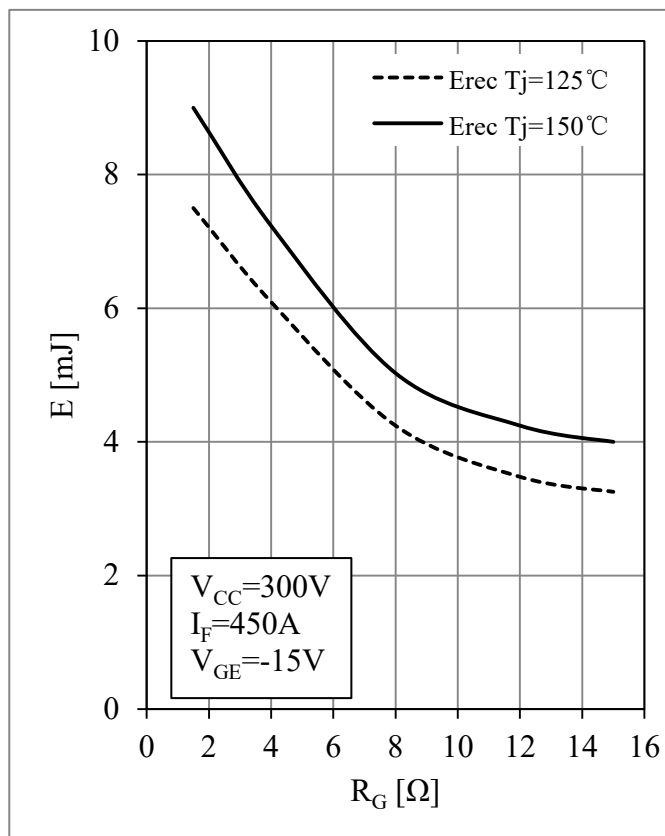


Fig 7. Diode Forward Characteristics

Fig 8. Diode Switching Loss vs. I_F



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