

# STARPOWER

SEMICONDUCTOR

**IGBT**

## GD3600SGX170C4S

**1700V/3600A 1 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 high power converters.

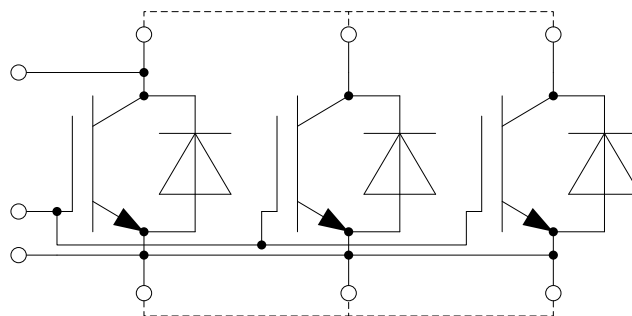
### Features

- Low  $V_{CE(sat)}$  Trench IGBT technology
- 10 $\mu$ 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

- High power converters
- Motor drives

### 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	$\pm 20$	V
$I_C$	Collector Current @ $T_C=100^{\circ}\text{C}$	3600	A
$I_{CM}$	Pulsed Collector Current $t_p=1\text{ms}$	7200	A
$P_D$	Maximum Power Dissipation @ $T_j=175^{\circ}\text{C}$	21.4	kW

**Diode**

Symbol	Description	Value	Unit
$V_{RRM}$	Repetitive Peak Reverse Voltage	1700	V
$I_F$	Diode Continuous Forward Current	3600	A
$I_{FM}$	Diode Maximum Forward Current $t_p=1\text{ms}$	7200	A
$I_{FSM}$	Surge Forward Current $V_R=0\text{V}, t_p=10\text{ms}, @T_j=25^{\circ}\text{C}$ $@T_j=150^{\circ}\text{C}$	23.22	kA
		19.95	
$I^2t$	$I^2t$ -value, $V_R=0\text{V}, t_p=10\text{ms}, T_j=25^{\circ}\text{C}$ $I^2t$ -value, $V_R=0\text{V}, t_p=10\text{ms}, T_j=150^{\circ}\text{C}$	2695	$\text{kA}^2\text{s}$
		1990	

**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	$I_C=3600\text{A}, V_{GE}=15\text{V}, T_j=25^\circ\text{C}$		1.85	2.30	V	
		$I_C=3600\text{A}, V_{GE}=15\text{V}, T_j=125^\circ\text{C}$		2.25			
		$I_C=3600\text{A}, V_{GE}=15\text{V}, T_j=150^\circ\text{C}$		2.30			
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=144.0\text{mA}, V_{CE}=V_{GE}, T_j=25^\circ\text{C}$	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			0.7		$\Omega$	
$C_{ies}$	Input Capacitance	$V_{CE}=25\text{V}, f=100\text{kHz}, V_{GE}=0\text{V}$		427		nF	
$C_{res}$	Reverse Transfer Capacitance				10.7		nF
$Q_G$	Gate Charge	$V_{GE}=-15\dots+15\text{V}$		35.3		$\mu\text{C}$	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=900\text{V}, I_C=3600\text{A}, R_{Gon}=1.2\Omega, R_{Goff}=0.9\Omega, V_{GE}=-9\text{V}/+15\text{V}, L_S=65\text{nH}, T_j=25^\circ\text{C}$		1161		ns	
$t_r$	Rise Time			413		ns	
$t_{d(off)}$	Turn-Off Delay Time			4761		ns	
$t_f$	Fall Time			430		ns	
$E_{on}$	Turn-On Switching Loss			1734		mJ	
$E_{off}$	Turn-Off Switching Loss			2580		mJ	
$t_{d(on)}$	Turn-On Delay Time		$V_{CC}=900\text{V}, I_C=3600\text{A}, R_{Gon}=1.2\Omega, R_{Goff}=0.9\Omega, V_{GE}=-9\text{V}/+15\text{V}, L_S=65\text{nH}, T_j=125^\circ\text{C}$		1370		ns
$t_r$	Rise Time				547		ns
$t_{d(off)}$	Turn-Off Delay Time				5303		ns
$t_f$	Fall Time				457		ns
$E_{on}$	Turn-On Switching Loss			2679		mJ	
$E_{off}$	Turn-Off Switching Loss			2881		mJ	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=900\text{V}, I_C=3600\text{A}, R_{Gon}=1.2\Omega, R_{Goff}=0.9\Omega, V_{GE}=-9\text{V}/+15\text{V}, L_S=65\text{nH}, T_j=150^\circ\text{C}$			1413		ns
$t_r$	Rise Time				585		ns
$t_{d(off)}$	Turn-Off Delay Time				5490		ns
$t_f$	Fall Time				473		ns
$E_{on}$	Turn-On Switching Loss			2863		mJ	
$E_{off}$	Turn-Off Switching Loss			2960		mJ	
$I_{SC}$	SC Data		$t_p \leq 10\mu\text{s}, V_{GE}=15\text{V}, T_j=150^\circ\text{C}, V_{CC}=1000\text{V}, V_{CEM} \leq 1700\text{V}$		14.0		kA

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_F$	Diode Forward Voltage	$I_F=3600\text{A}, V_{GE}=0\text{V}, T_j=25^\circ\text{C}$		1.80	2.25	V
		$I_F=3600\text{A}, V_{GE}=0\text{V}, T_j=125^\circ\text{C}$		1.90		
		$I_F=3600\text{A}, V_{GE}=0\text{V}, T_j=150^\circ\text{C}$		1.95		
$Q_r$	Recovered Charge			207		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current	$V_R=900\text{V}, I_F=3600\text{A},$ $-di/dt=7000\text{A}/\mu\text{s}, V_{GE}=-9\text{V},$ $L_S=65\text{nH}, T_j=25^\circ\text{C}$		1030		A
$E_{rec}$	Reverse Recovery Energy			199		mJ
$Q_r$	Recovered Charge			288		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current	$V_R=900\text{V}, I_F=3600\text{A},$ $-di/dt=5700/\mu\text{s}, V_{GE}=-9\text{V},$ $L_S=65\text{nH}, T_j=125^\circ\text{C}$		1020		A
$E_{rec}$	Reverse Recovery Energy			339		mJ
$Q_r$	Recovered Charge			391		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current	$V_R=900\text{V}, I_F=3600\text{A},$ $-di/dt=5200\text{A}/\mu\text{s}, V_{GE}=-9\text{V},$ $L_S=65\text{nH}, T_j=150^\circ\text{C}$		996		A
$E_{rec}$	Reverse Recovery Energy			341		mJ

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

Symbol	Parameter	Min.	Typ.	Max.	Unit
$L_{CE}$	Stray Inductance		6.0		nH
$R_{CC'+EE'}$	Module Lead Resistance, Terminal to Chip		0.085		m $\Omega$
$R_{thJC}$	Junction-to-Case (per IGBT)			7.0	K/kW
	Junction-to-Case (per Diode)			12.8	
$R_{thCH}$	Case-to-Heatsink (per IGBT)		6.2		K/kW
	Case-to-Heatsink (per Diode)		11.3		
	Case-to-Heatsink (per Module)		4.0		
$d_{Creep}$	Terminal-to-Heatsink		32.2		mm
	Terminal-to-Terminal		32.2		
$d_{Clear}$	Terminal-to-Heatsink		19.1		mm
	Terminal-to-Terminal		19.1		
M	Terminal Connection Torque, Screw M4	1.8		2.1	N.m
	Terminal Connection Torque, Screw M8	8.0		10	
	Mounting Torque, Screw M6	4.25		5.75	
G	Weight of Module		2060		g

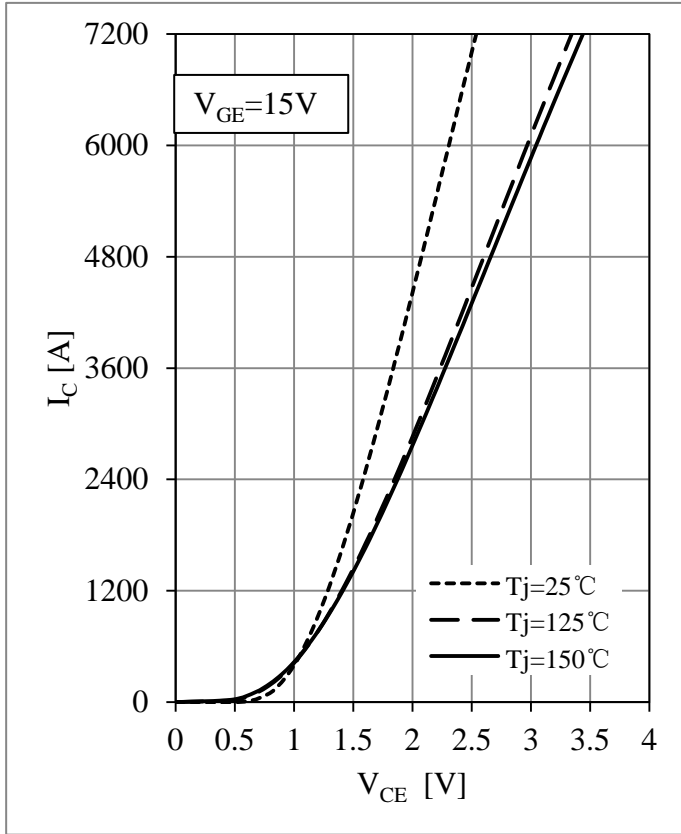


Fig 1. IGBT Output Characteristics

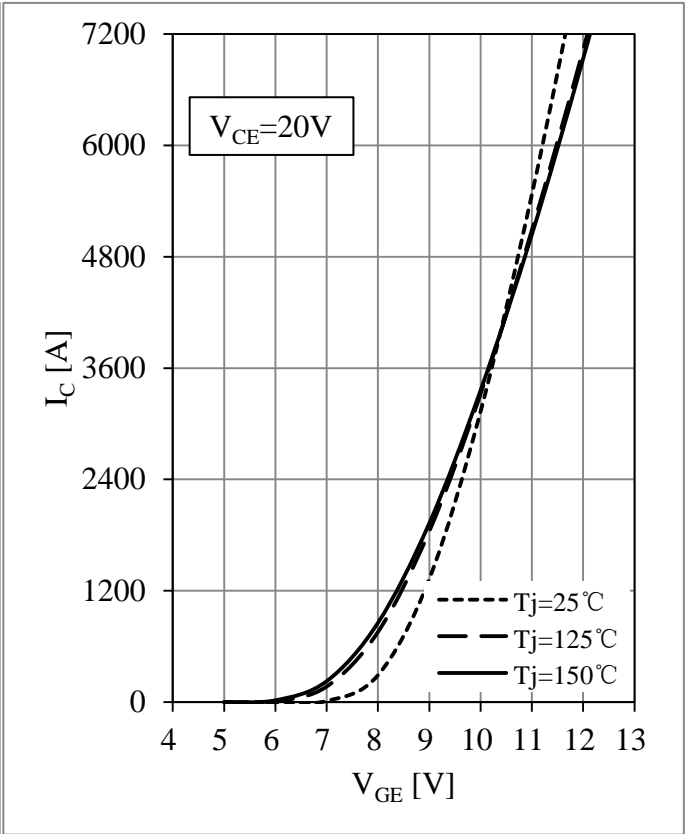


Fig 2. IGBT Transfer Characteristics

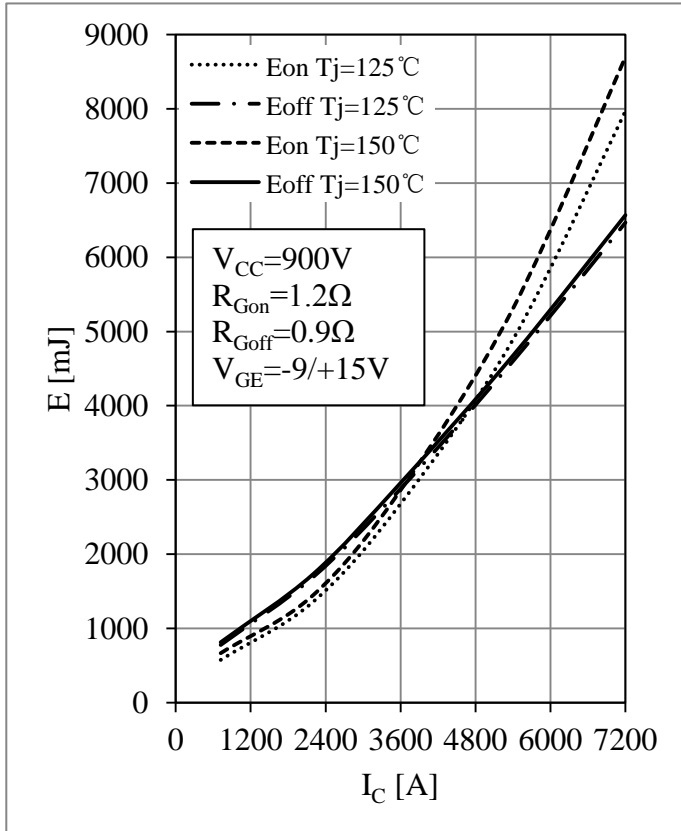


Fig 3. IGBT Switching Loss vs.  $I_C$

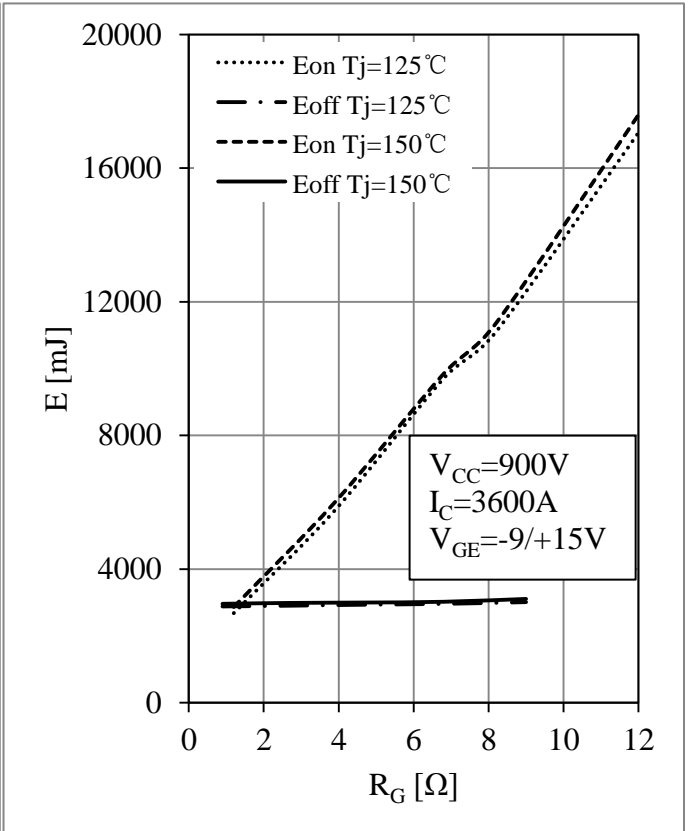


Fig 4. IGBT Switching Loss vs.  $R_G$

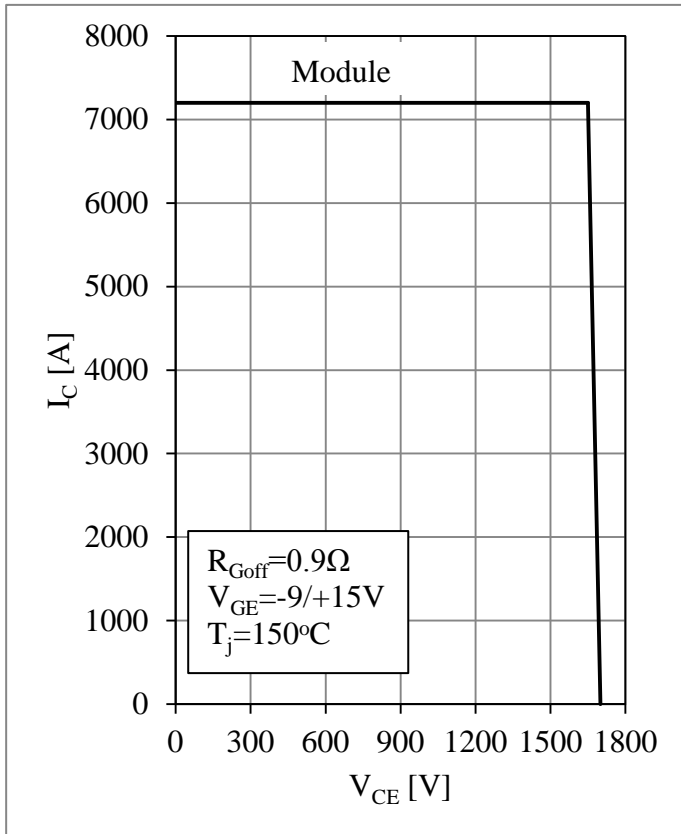


Fig 5. RBSOA

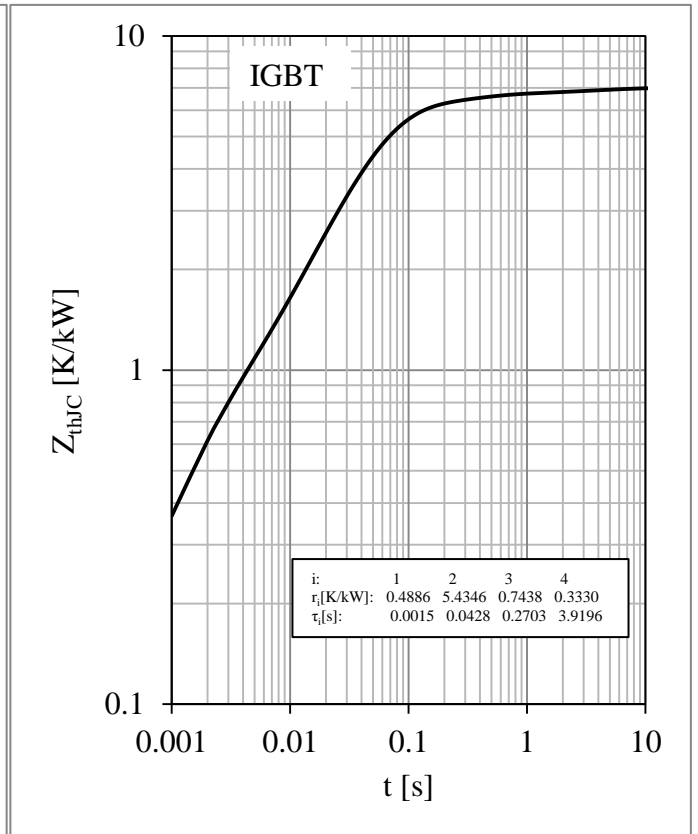


Fig 6. IGBT Transient Thermal Impedance

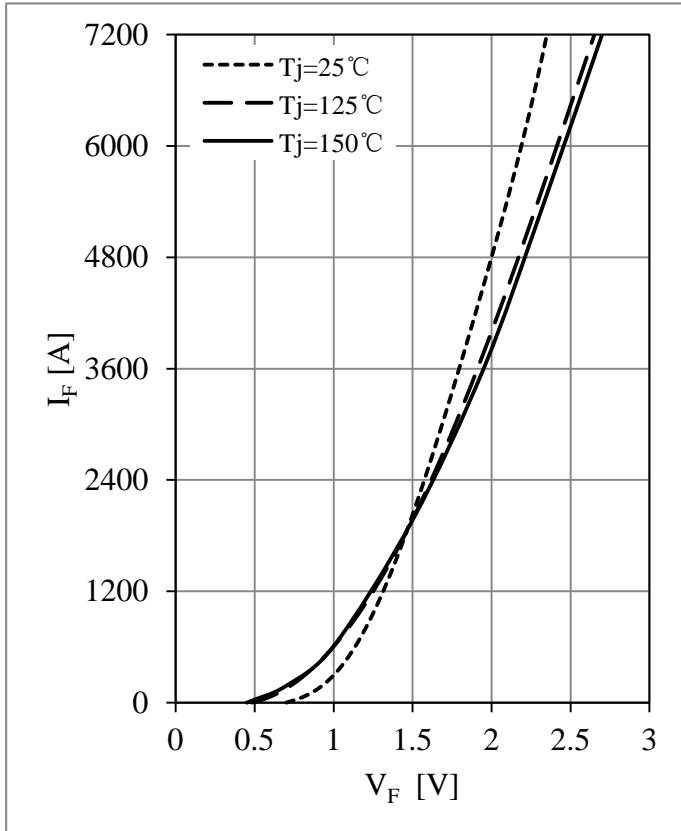


Fig 7. Diode Forward Characteristics

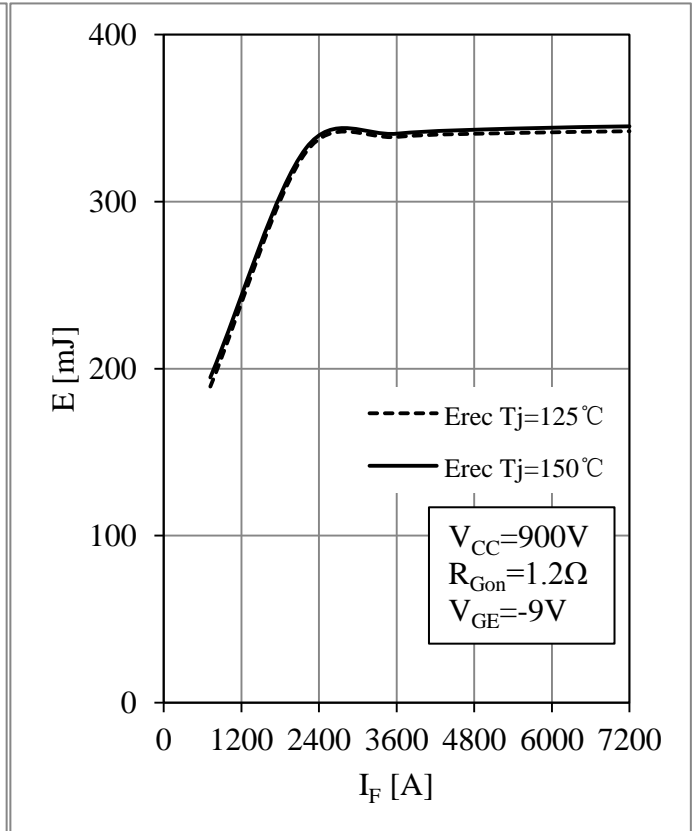


Fig 8. Diode Switching Loss vs.  $I_F$

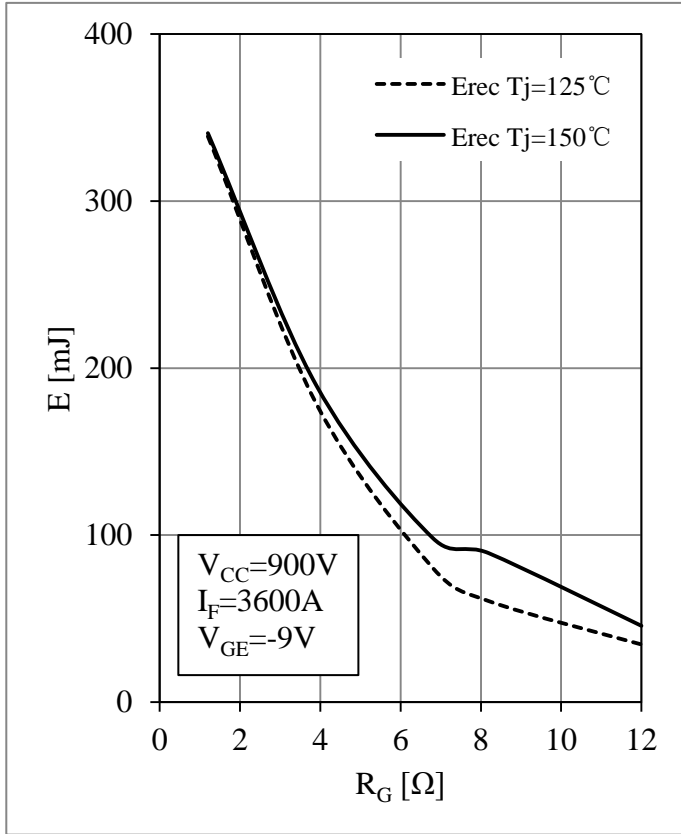


Fig 9. Diode Switching Loss vs.  $R_G$

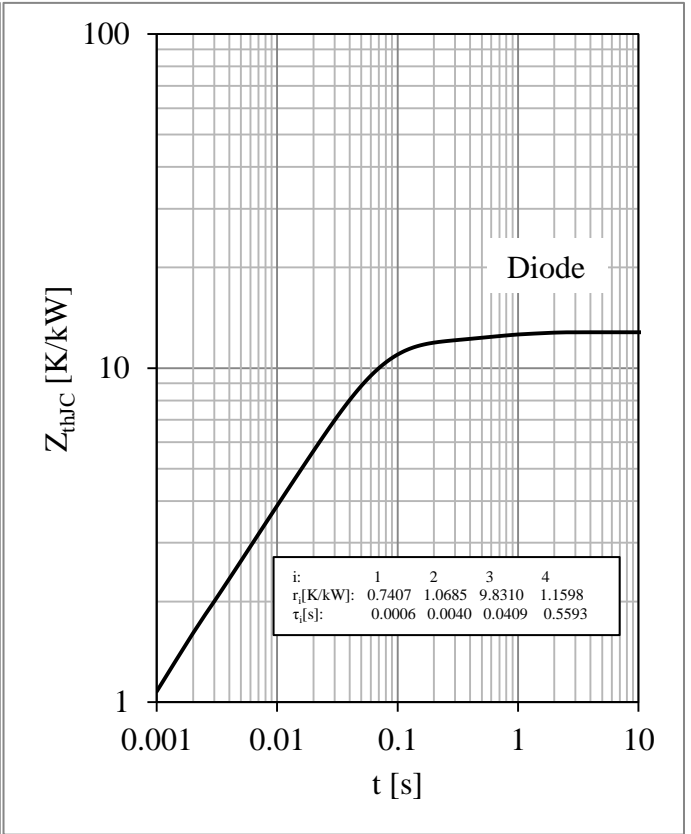


Fig 10. Diode Transient Thermal Impedance





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