

# STARPOWER

SEMICONDUCTOR

**IGBT**

## GD400HFF120C2S

**1200V/400A 2 in one-package**

### General Description

STARPOWER IGBT Power Module provides ultra switching speed as well as short circuit ruggedness. They are designed for the applications such as electronic welder and inductive heating.

### Features

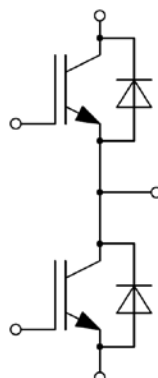
- Low  $V_{CE(sat)}$  Trench IGBT technology
- $V_{CE(sat)}$  with positive temperature coefficient
- Low switching losses
- Maximum junction temperature 175°C
- Low inductance case
- Fast & soft reverse recovery anti-parallel FWD
- Isolated copper baseplate using DBC technology



### Typical Applications

- Switching mode power supply
- Inductive heating
- Electronic welder

### 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	$\pm 20$	V
$I_C$	Collector Current @ $T_C=25^{\circ}\text{C}$	620	A
	@ $T_C=90^{\circ}\text{C}$	400	
$I_{CM}$	Pulsed Collector Current $t_p=1\text{ms}$	800	A
$P_D$	Maximum Power Dissipation @ $T_j=175^{\circ}\text{C}$	2272	W

**Diode**

Symbol	Description	Value	Unit
$V_{RRM}$	Repetitive Peak Reverse Voltage	1200	V
$I_F$	Diode Continuous Forward Current	400	A
$I_{FM}$	Diode Maximum Forward Current $t_p=1\text{ms}$	800	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	$I_C=400\text{A}, V_{GE}=15\text{V}, T_j=25^\circ\text{C}$		1.90	2.35	V	
		$I_C=400\text{A}, V_{GE}=15\text{V}, T_j=125^\circ\text{C}$		2.40			
		$I_C=400\text{A}, V_{GE}=15\text{V}, T_j=150^\circ\text{C}$		2.55			
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=10.0\text{mA}, V_{CE}=V_{GE}, T_j=25^\circ\text{C}$	5.2	6.0	6.8	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	$V_{GE}=V_{GES}, V_{CE}=0\text{V}, T_j=25^\circ\text{C}$			100	nA	
$R_{Gint}$	Internal Gate Resistance			1.9		$\Omega$	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=400\text{A}, R_G=0.38\Omega, V_{GE}=\pm 15\text{V}, T_j=25^\circ\text{C}$		374		ns	
$t_r$	Rise Time			50		ns	
$t_{d(off)}$	Turn-Off Delay Time			326		ns	
$t_f$	Fall Time			204		ns	
$E_{on}$	Turn-On Switching Loss				27.6		mJ
$E_{off}$	Turn-Off Switching Loss				20.8		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=400\text{A}, R_G=0.38\Omega, V_{GE}=\pm 15\text{V}, T_j=125^\circ\text{C}$		419		ns	
$t_r$	Rise Time			63		ns	
$t_{d(off)}$	Turn-Off Delay Time			383		ns	
$t_f$	Fall Time			218		ns	
$E_{on}$	Turn-On Switching Loss				41.6		mJ
$E_{off}$	Turn-Off Switching Loss				23.6		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=400\text{A}, R_G=0.38\Omega, V_{GE}=\pm 15\text{V}, T_j=150^\circ\text{C}$		419		ns	
$t_r$	Rise Time			65		ns	
$t_{d(off)}$	Turn-Off Delay Time			388		ns	
$t_f$	Fall Time			222		ns	
$E_{on}$	Turn-On Switching Loss				46.0		mJ
$E_{off}$	Turn-Off Switching Loss				24.0		mJ

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_F$	Diode Forward Voltage	$I_F=400\text{A}, V_{GE}=0\text{V}, T_j=25^{\circ}\text{C}$		1.90	2.35	V
		$I_F=400\text{A}, V_{GE}=0\text{V}, T_j=125^{\circ}\text{C}$		1.90		
		$I_F=400\text{A}, V_{GE}=0\text{V}, T_j=150^{\circ}\text{C}$		1.90		
$Q_r$	Recovered Charge			20.4		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current	$V_R=600\text{V}, I_F=400\text{A},$ $-di/dt=6400\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=25^{\circ}\text{C}$		180		A
$E_{rec}$	Reverse Recovery Energy			6.8		mJ
$Q_r$	Recovered Charge			52.4		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current	$V_R=600\text{V}, I_F=400\text{A},$ $-di/dt=6400\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=125^{\circ}\text{C}$		264		A
$E_{rec}$	Reverse Recovery Energy			19.5		mJ
$Q_r$	Recovered Charge			60.8		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current	$V_R=600\text{V}, I_F=400\text{A},$ $-di/dt=6400\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=150^{\circ}\text{C}$		284		A
$E_{rec}$	Reverse Recovery Energy			22.6		mJ

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

Symbol	Parameter	Min.	Typ.	Max.	Unit
$L_{CE}$	Stray Inductance		15		nH
$R_{CC'+EE'}$	Module Lead Resistance, Terminal to Chip		0.25		m $\Omega$
$R_{thJC}$	Junction-to-Case (per IGBT)			0.066	K/W
	Junction-to-Case (per Diode)			0.093	
$R_{thCH}$	Case-to-Heatsink (per IGBT)		0.034		K/W
	Case-to-Heatsink (per Diode)		0.048		
	Case-to-Heatsink (per Module)		0.010		
M	Terminal Connection Torque, Screw M6	2.5		5.0	N.m
	Mounting Torque, Screw M6	3.0		5.0	
G	Weight of Module		300		g

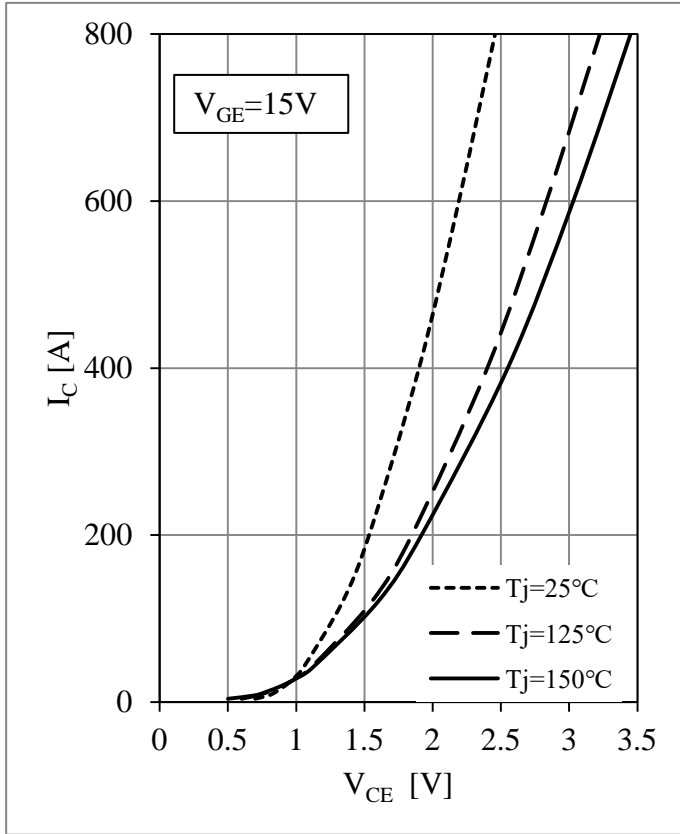


Fig 1. IGBT Output Characteristics

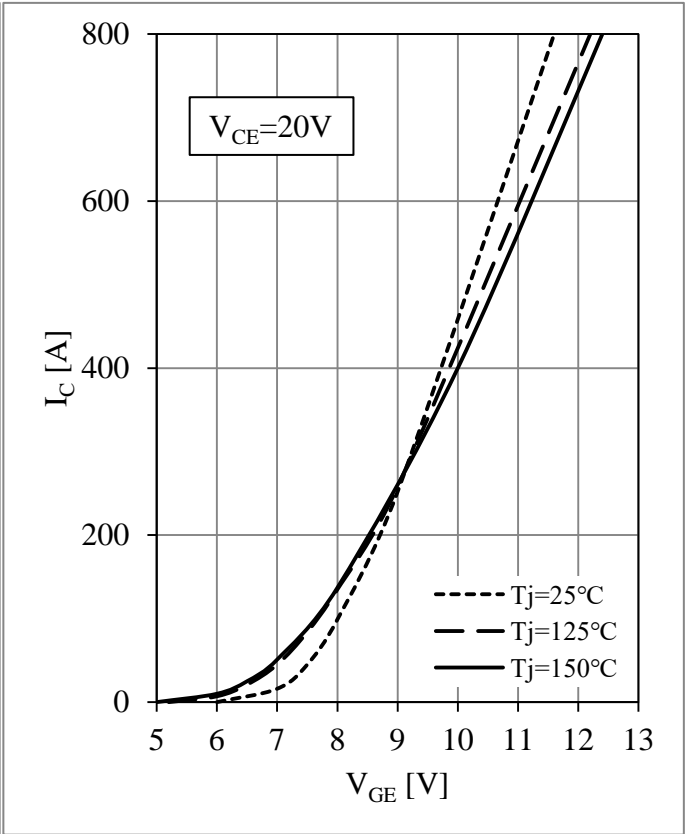


Fig 2. IGBT Transfer Characteristics

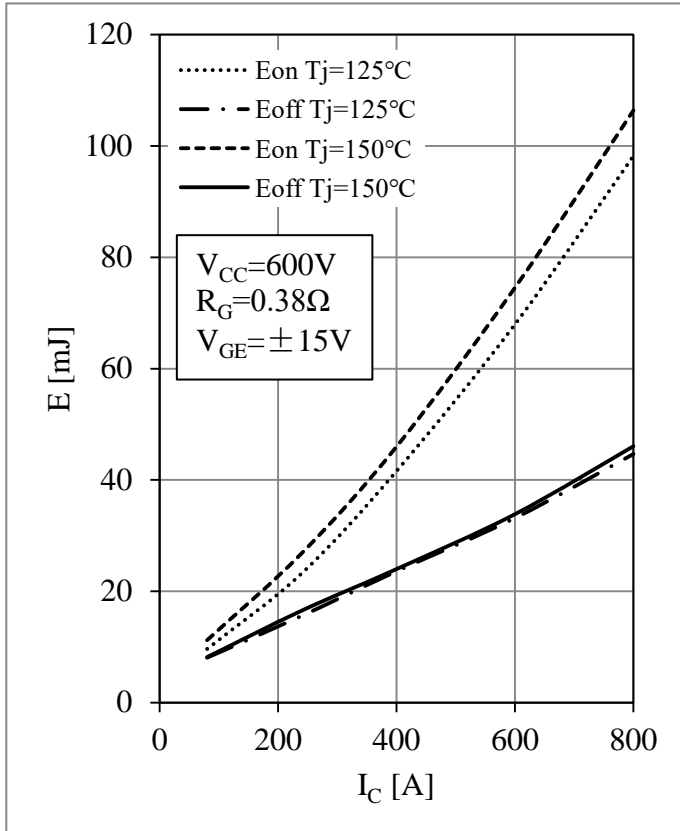


Fig 3. IGBT Switching Loss vs.  $I_C$

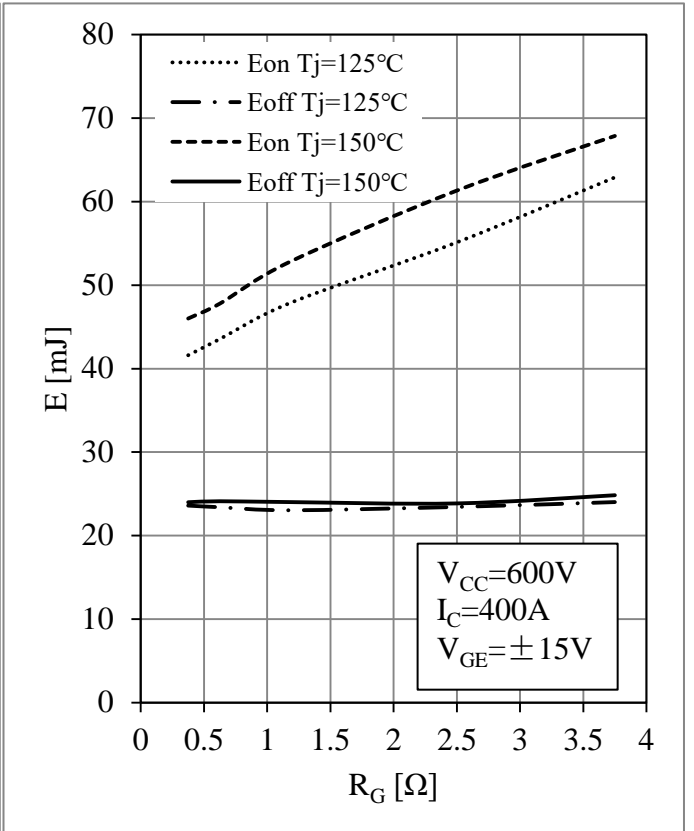


Fig 4. IGBT Switching Loss vs.  $R_G$

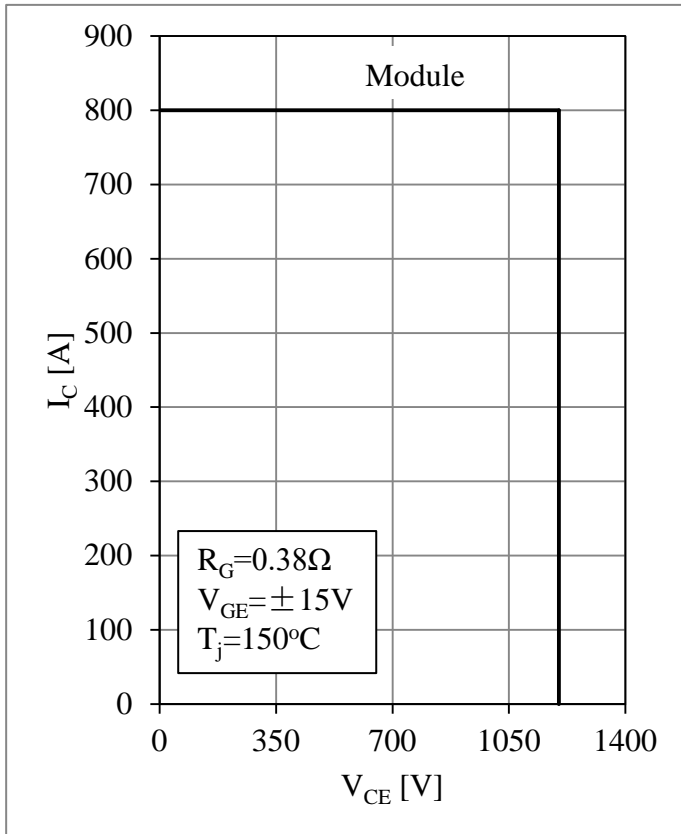


Fig 5. RBSOA

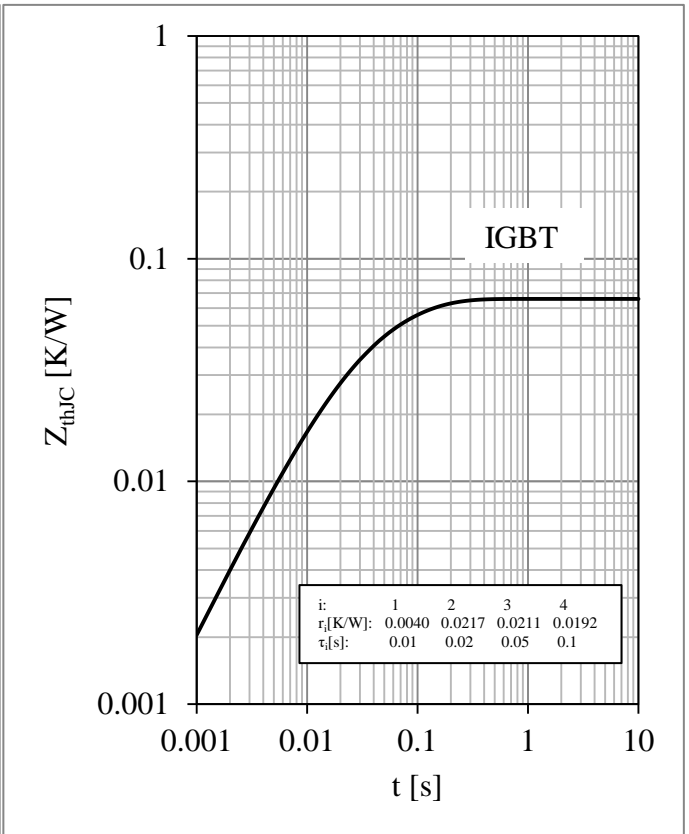


Fig 6. IGBT Transient Thermal Impedance

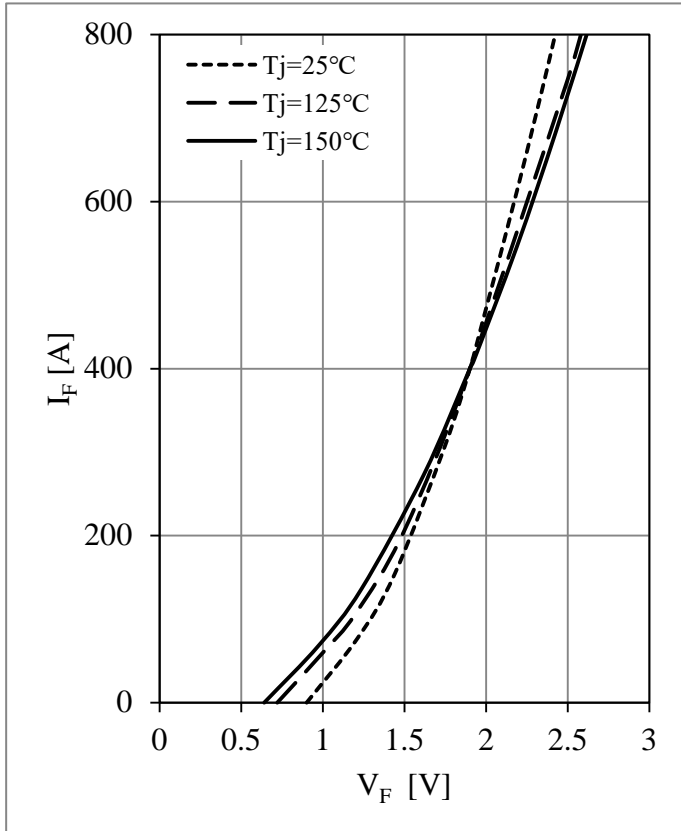


Fig 7. Diode Forward Characteristics

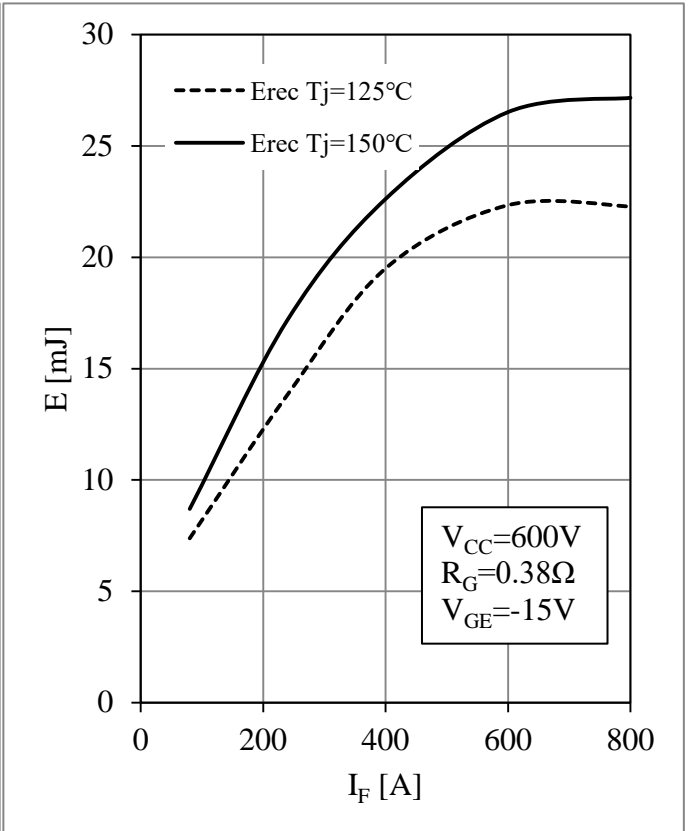


Fig 8. Diode Switching Loss vs.  $I_F$

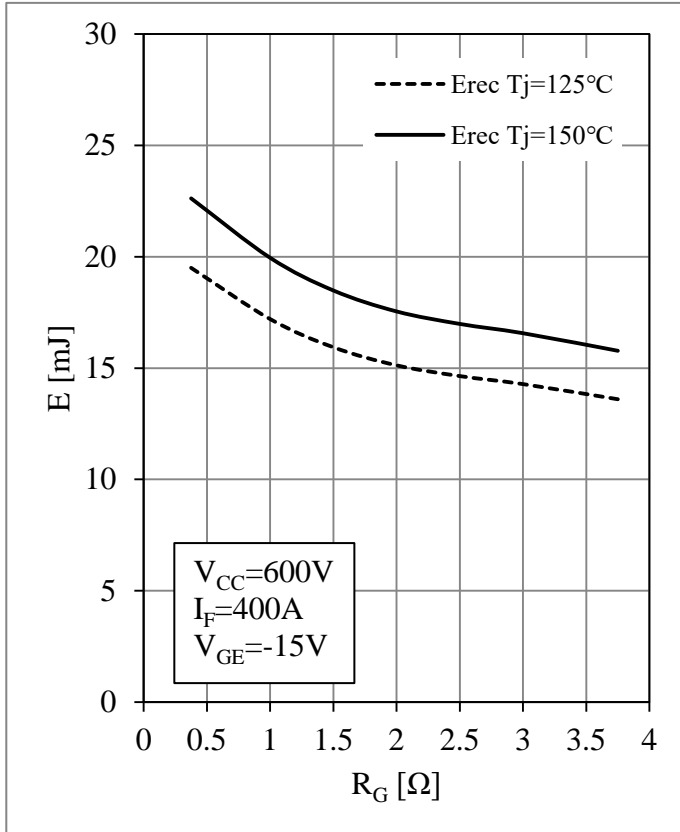


Fig 9. Diode Switching Loss vs.  $R_G$

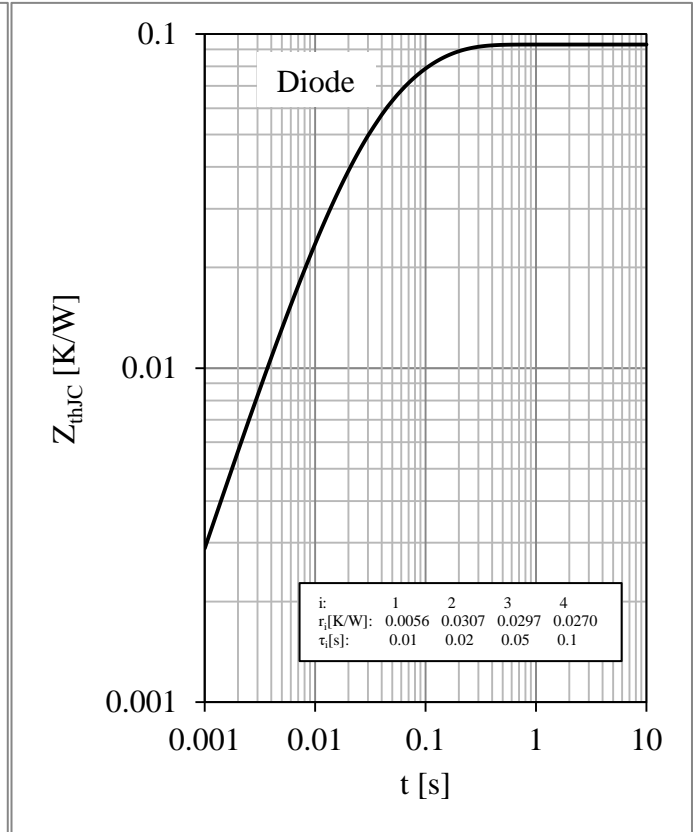


Fig 10. Diode Transient Thermal Impedance





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