

# STARPOWER

SEMICONDUCTOR

**IGBT**

## GD50FFX120C5S

**1200V/50A 6 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.

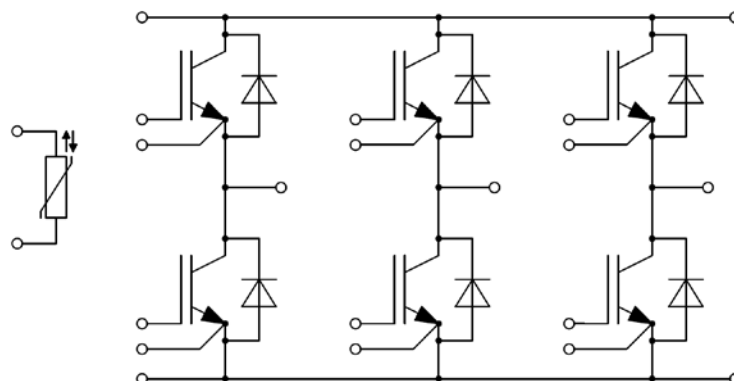
### Features

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

- 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	1200	V
$V_{GES}$	Gate-Emitter Voltage	$\pm 20$	V
$I_C$	Collector Current @ $T_C=25^{\circ}\text{C}$	84	A
	@ $T_C=100^{\circ}\text{C}$	50	A
$I_{CM}$	Pulsed Collector Current $t_p=1\text{ms}$	100	A
$P_D$	Maximum Power Dissipation @ $T_j=175^{\circ}\text{C}$	288	W

**Diode**

Symbol	Description	Value	Unit
$V_{RRM}$	Repetitive Peak Reverse Voltage	1200	V
$I_F$	Diode Continuous Forward Current	50	A
$I_{FM}$	Diode Maximum Forward Current $t_p=1\text{ms}$	100	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	$I_C=50\text{A}, V_{GE}=15\text{V}, T_j=25^\circ\text{C}$		1.75	2.20	V	
		$I_C=50\text{A}, V_{GE}=15\text{V}, T_j=125^\circ\text{C}$		2.00			
		$I_C=50\text{A}, V_{GE}=15\text{V}, T_j=150^\circ\text{C}$		2.05			
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=1.25\text{mA}, V_{CE}=V_{GE}, T_j=25^\circ\text{C}$	5.2	6.0	6.8	V	
$I_{CES}$	Collector Cut-Off Current	$V_{CE}=V_{CES}, V_{GE}=0\text{V}, T_j=25^\circ\text{C}$			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		$\Omega$	
$C_{ies}$	Input Capacitance	$V_{CE}=25\text{V}, f=1\text{MHz}, V_{GE}=0\text{V}$		4.66		nF	
$C_{res}$	Reverse Transfer Capacitance			0.13		nF	
$Q_G$	Gate Charge	$V_{GE}=-15\dots+15\text{V}$		0.35		$\mu\text{C}$	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=50\text{A}, R_G=15\Omega, V_{GE}=\pm 15\text{V}, T_j=25^\circ\text{C}$		137		ns	
$t_r$	Rise Time			26		ns	
$t_{d(off)}$	Turn-Off Delay Time			323		ns	
$t_f$	Fall Time			78		ns	
$E_{on}$	Turn-On Switching Loss			4.88		mJ	
$E_{off}$	Turn-Off Switching Loss			2.74		mJ	
$t_{d(on)}$	Turn-On Delay Time		$V_{CC}=600\text{V}, I_C=50\text{A}, R_G=15\Omega, V_{GE}=\pm 15\text{V}, T_j=125^\circ\text{C}$		146		ns
$t_r$	Rise Time				34		ns
$t_{d(off)}$	Turn-Off Delay Time			421		ns	
$t_f$	Fall Time			147		ns	
$E_{on}$	Turn-On Switching Loss			6.59		mJ	
$E_{off}$	Turn-Off Switching Loss			4.21		mJ	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=50\text{A}, R_G=15\Omega, V_{GE}=\pm 15\text{V}, T_j=150^\circ\text{C}$			146		ns
$t_r$	Rise Time				34		ns
$t_{d(off)}$	Turn-Off Delay Time			441		ns	
$t_f$	Fall Time			166		ns	
$E_{on}$	Turn-On Switching Loss			7.19		mJ	
$E_{off}$	Turn-Off Switching Loss			4.69		mJ	
$I_{SC}$	SC Data		$t_p \leq 10\mu\text{s}, V_{GE}=15\text{V}, T_j=150^\circ\text{C}, V_{CC}=900\text{V}, V_{CEM} \leq 1200\text{V}$		180		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	$I_F=50\text{A}, V_{GE}=0\text{V}, T_j=25^\circ\text{C}$		1.70	2.15	V
		$I_F=50\text{A}, V_{GE}=0\text{V}, T_j=125^\circ\text{C}$		1.65		
		$I_F=50\text{A}, V_{GE}=0\text{V}, T_j=150^\circ\text{C}$		1.65		
$Q_r$	Recovered Charge	$V_R=600\text{V}, I_F=50\text{A},$ $-di/dt=1400\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=25^\circ\text{C}$		5.5		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current			54		A
$E_{rec}$	Reverse Recovery Energy			1.70		mJ
$Q_r$	Recovered Charge	$V_R=600\text{V}, I_F=50\text{A},$ $-di/dt=1400\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=125^\circ\text{C}$		8.8		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current			60		A
$E_{rec}$	Reverse Recovery Energy			2.99		mJ
$Q_r$	Recovered Charge	$V_R=600\text{V}, I_F=50\text{A},$ $-di/dt=1400\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=150^\circ\text{C}$		10.0		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current			63		A
$E_{rec}$	Reverse Recovery Energy			3.70		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		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		19		nH
$R_{CC'+EE'}$	Module Lead Resistance, Terminal to Chip		1.80		m $\Omega$
$R_{thJC}$	Junction-to-Case (per IGBT)			0.520	K/W
	Junction-to-Case (per Diode)			0.793	
$R_{thCH}$	Case-to-Heatsink (per IGBT)		0.199		K/W
	Case-to-Heatsink (per Diode)		0.303		
	Case-to-Heatsink (per Module)		0.020		
$M$	Mounting Torque, Screw M5	3.0		6.0	N.m
$G$	Weight of Module		200		g

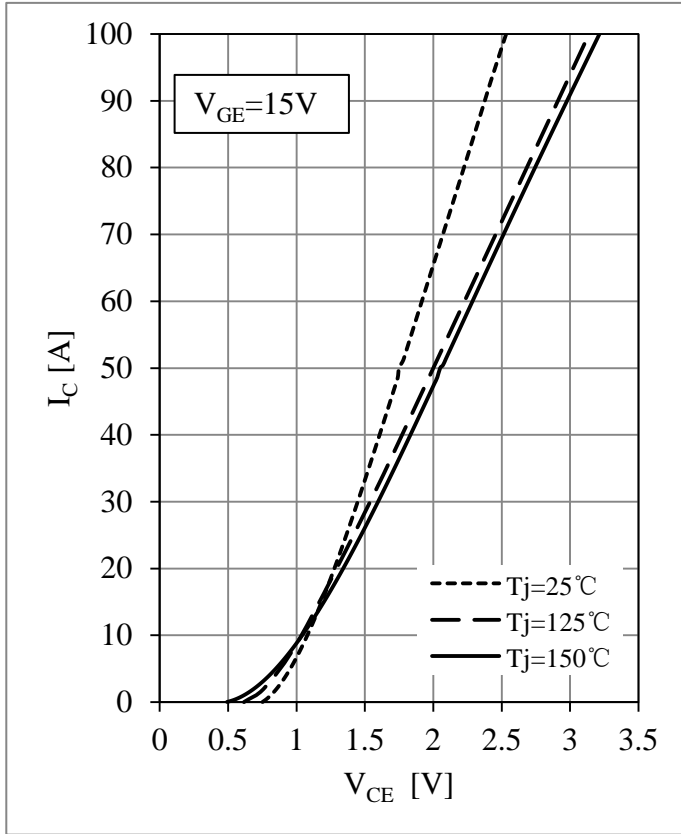


Fig 1. IGBT Output Characteristics

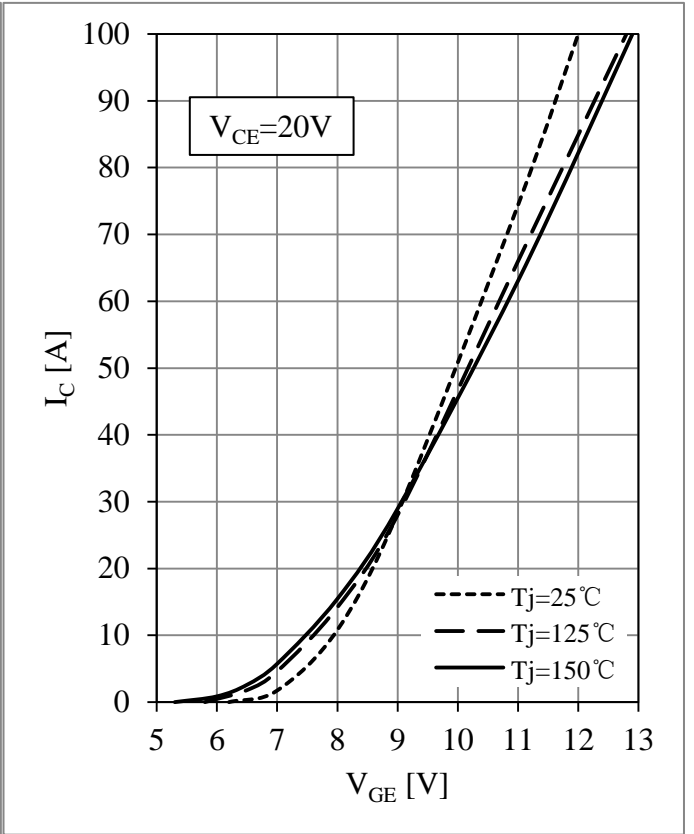


Fig 2. IGBT Transfer Characteristics

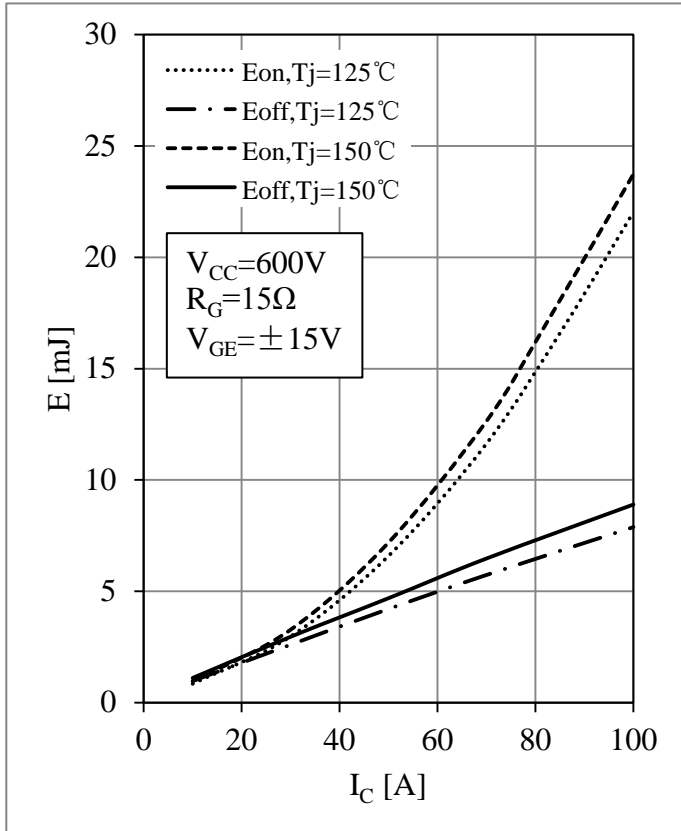


Fig 3. IGBT Switching Loss vs.  $I_C$

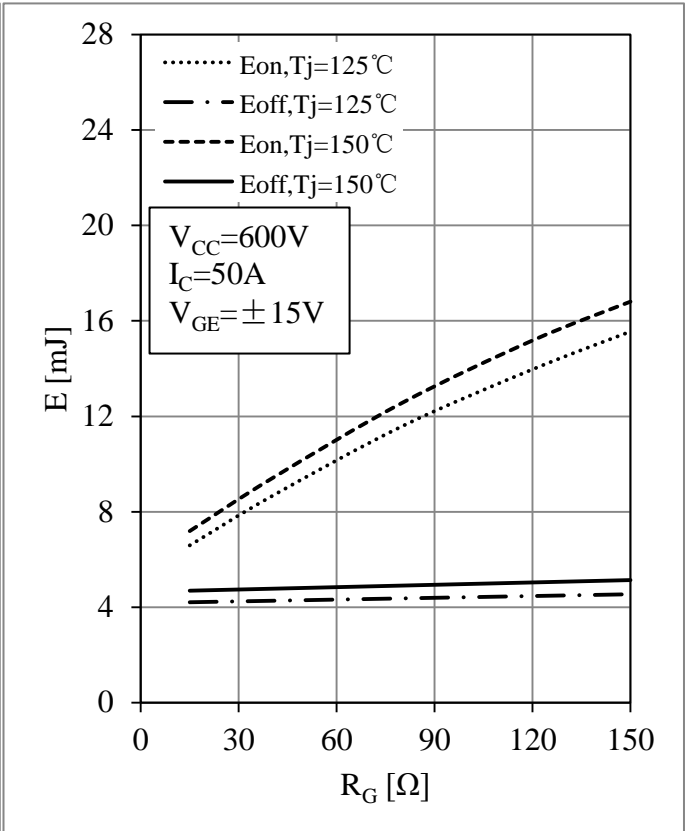


Fig 4. IGBT Switching Loss vs.  $R_G$

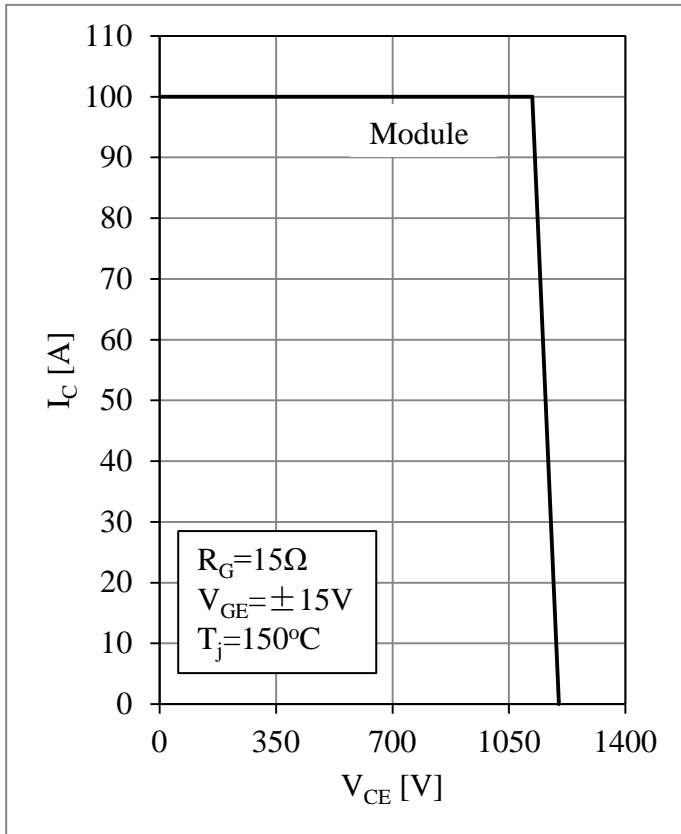


Fig 5. RBSOA

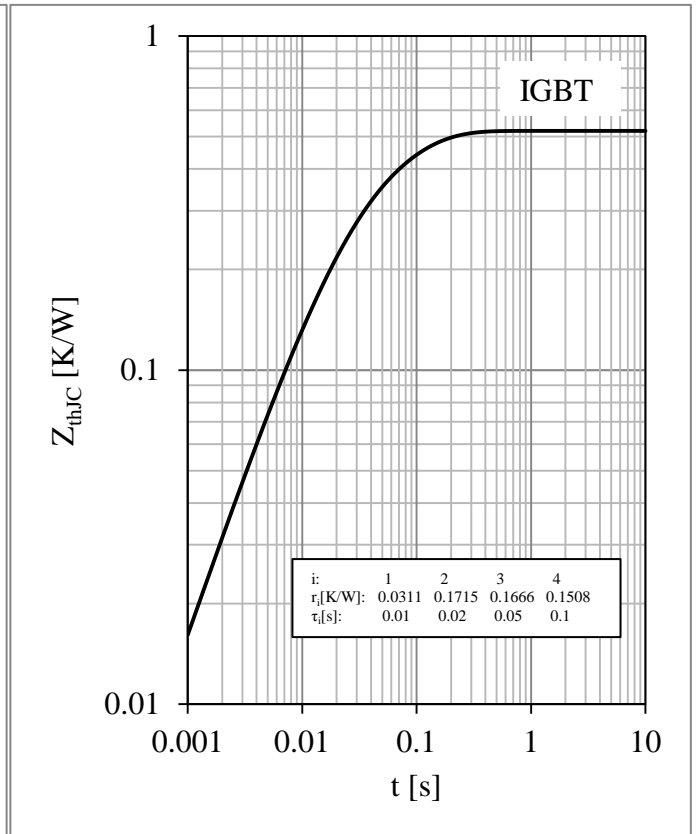


Fig 6. IGBT Transient Thermal Impedance

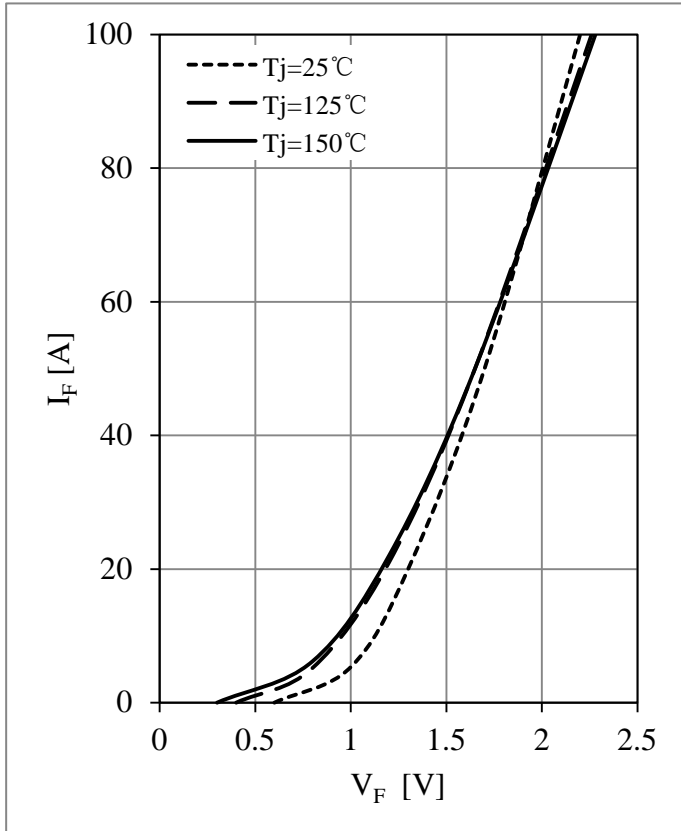


Fig 7. Diode Forward Characteristics

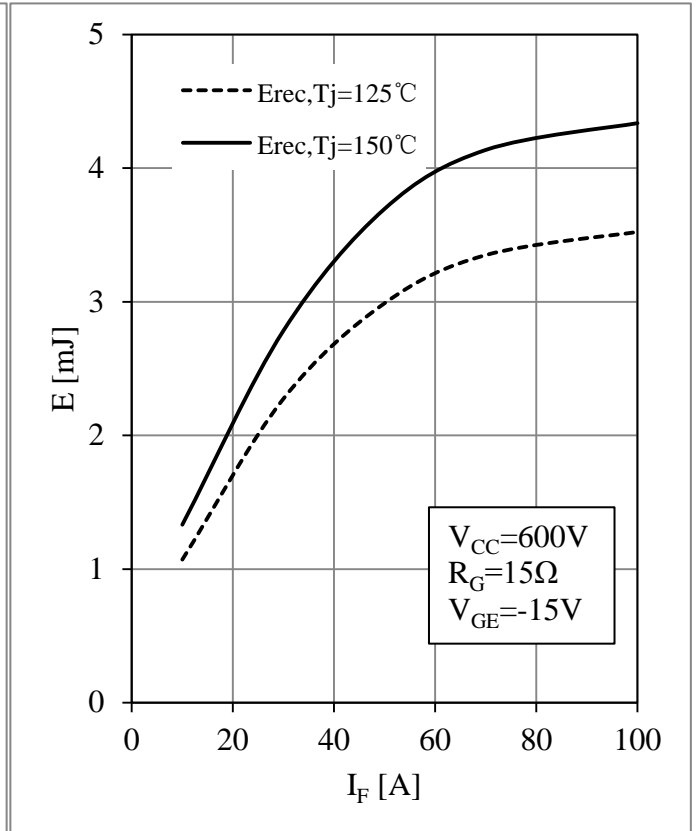


Fig 8. Diode Switching Loss vs.  $I_F$

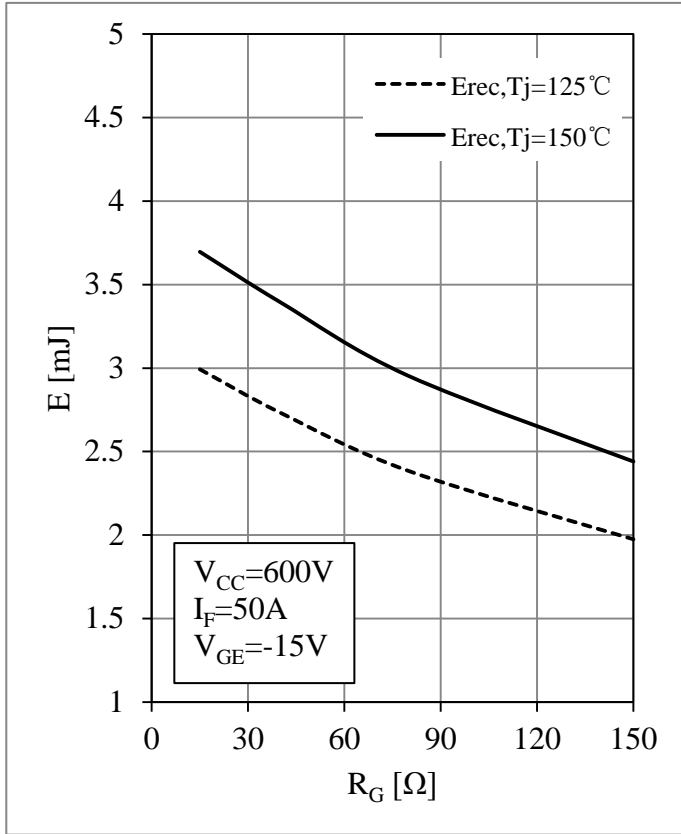


Fig 9. Diode Switching Loss vs.  $R_G$

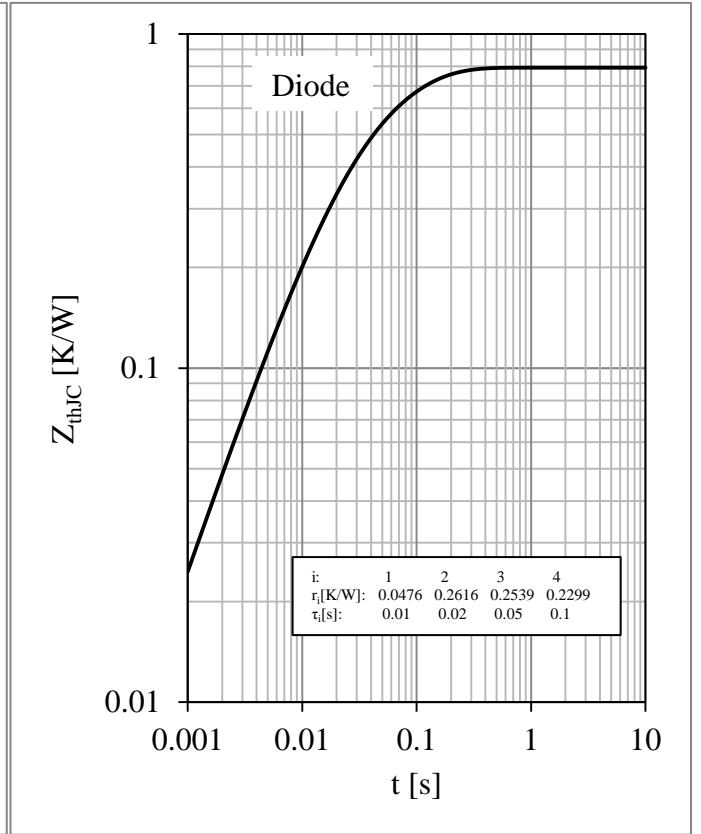


Fig 10. Diode Transient Thermal Impedance

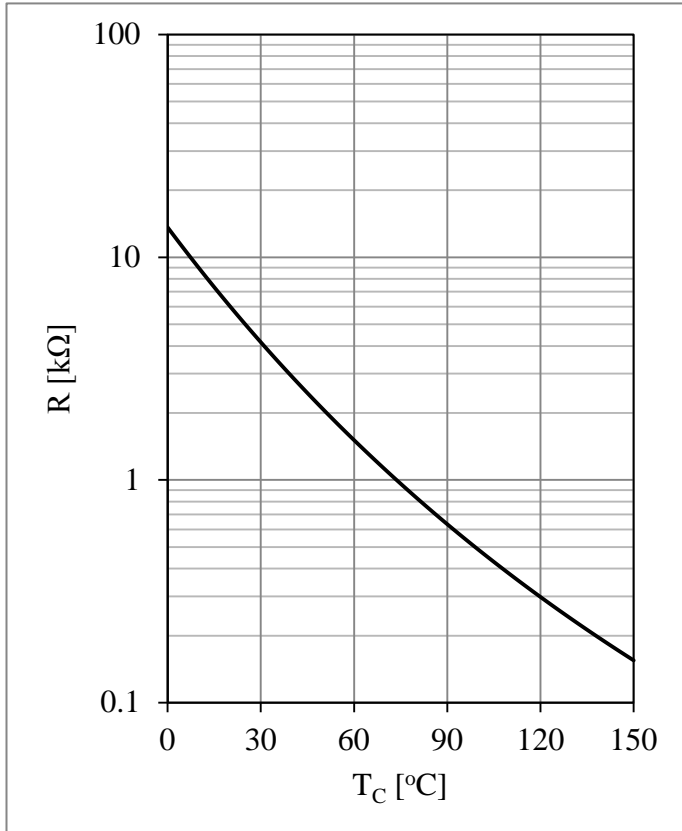
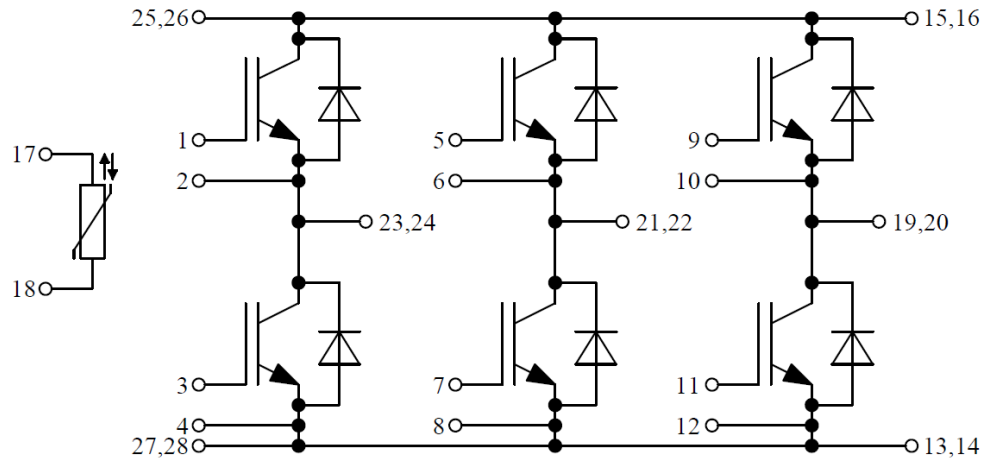


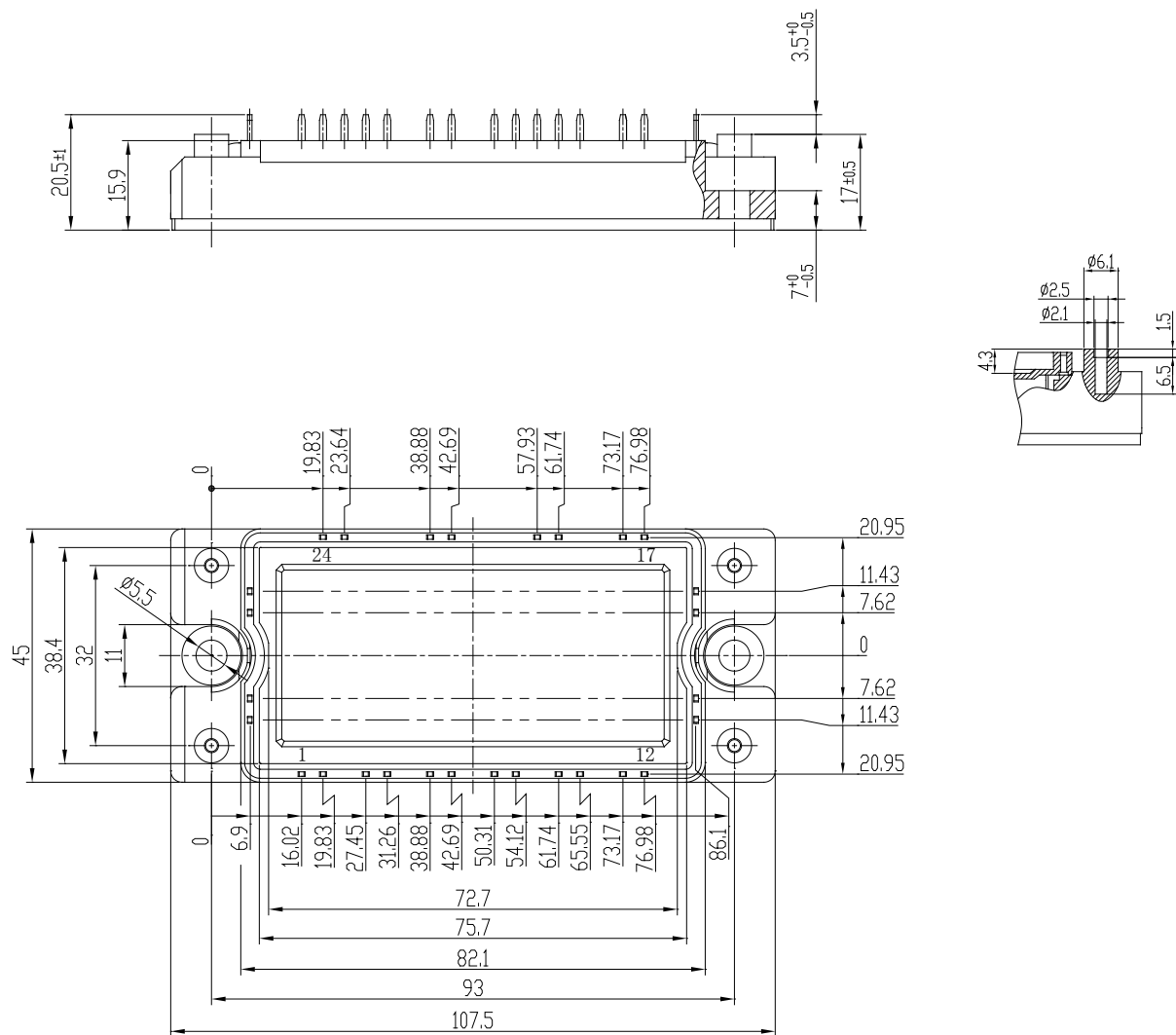
Fig 11. NTC Temperature Characteristic

**Circuit Schematic**



**Package Dimensions**

Dimensions in Millimeters





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