

# STARPOWER

SEMICONDUCTOR

**IGBT**

## GD150FFA120C6S

**1200V/150A 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.

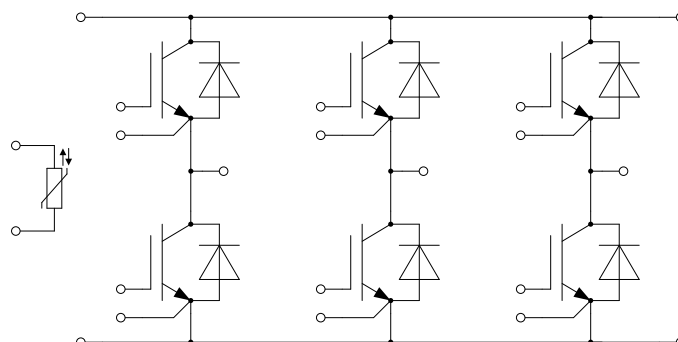
### Features

- Low  $V_{CE(sat)}$  Trench IGBT technology
- 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
- UL file number:E340089

### 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 @ $T_C=85^{\circ}\text{C}$	150	A
$I_{CRM}$	Repetitive Peak Collector Current $t_p=1\text{ms}$	300	A

**Diode**

Symbol	Description	Value	Unit
$V_{RRM}$	Repetitive Peak Reverse Voltage	1200	V
$I_F$	Diode Continuous Forward Current	150	A
$I_{FRM}$	Repetitive Peak Forward Current $t_p=1\text{ms}$	300	A
$I_{FSM}$	Surge Forward Current $t_p=10\text{ms}$ @ $T_{vj}=125^{\circ}\text{C}$ @ $T_{vj}=150^{\circ}\text{C}$	575	A
		542	
$I^2t$	$I^2t$ -value, $t_p=10\text{ms}$ @ $T_{vj}=125^{\circ}\text{C}$ @ $T_{vj}=150^{\circ}\text{C}$	1653	$\text{A}^2\text{s}$
		1469	

**Module**

Symbol	Description	Value	Unit
$T_{vjmax}$	Maximum Junction Temperature	175	$^{\circ}\text{C}$
$T_{vjop}$	Operating Junction Temperature	-40 to +175	$^{\circ}\text{C}$
$T_{STG}$	Storage Temperature Range	-40 to +125	$^{\circ}\text{C}$
$V_{ISO}$	Isolation Voltage RMS, $f=50\text{Hz}$ , $t=1\text{min}$	2500	V
$d_{Creep}$	Terminal to Heatsink	10.0	mm
$d_{Clear}$	Terminal to Heatsink	7.5	mm
CTI	Comperative Tracking Index	$\geq 200$	
RTI	RTI Elec. Housing	140	$^{\circ}\text{C}$
Internal Isolation	Basic Insulation (class 1, IEC 61140)	$\text{Al}_2\text{O}_3$	

Note:  $T_{vjop} > 150^{\circ}\text{C}$  is allowed for operation at overload conditions.

**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	$I_C=150\text{A}, V_{GE}=15\text{V}, T_{vj}=25^\circ\text{C}$		1.50	1.95	V	
		$I_C=150\text{A}, V_{GE}=15\text{V}, T_{vj}=125^\circ\text{C}$		1.70			
		$I_C=150\text{A}, V_{GE}=15\text{V}, T_{vj}=150^\circ\text{C}$		1.80			
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=3.0\text{mA}, V_{CE}=V_{GE}, T_{vj}=25^\circ\text{C}$	5.4	6.2	7.0	V	
$I_{CES}$	Collector Cut-Off Current	$V_{CE}=V_{CES}, V_{GE}=0\text{V}, T_{vj}=25^\circ\text{C}$			50	$\mu\text{A}$	
$I_{GES}$	Gate-Emitter Leakage Current	$V_{GE}=V_{GES}, V_{CE}=0\text{V}, T_{vj}=25^\circ\text{C}$			100	nA	
$R_{Gint}$	Internal Gate Resistance			1.0		$\Omega$	
$C_{ies}$	Input Capacitance	$V_{CE}=25\text{V}, f=1\text{MHz}, V_{GE}=0\text{V}$		13.3		nF	
$C_{res}$	Reverse Transfer Capacitance				0.12		nF
$Q_G$	Gate Charge	$V_{GE}=-15\dots+15\text{V}$		0.96		$\mu\text{C}$	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=150\text{A}, R_G=3.9\Omega, L_S=35\text{nH}, V_{GE}=\pm 15\text{V}, T_{vj}=25^\circ\text{C}$		70		ns	
$t_r$	Rise Time			29		ns	
$t_{d(off)}$	Turn-Off Delay Time			246		ns	
$t_f$	Fall Time			175		ns	
$E_{on}$	Turn-On Switching Loss			11.8		mJ	
$E_{off}$	Turn-Off Switching Loss			10.9		mJ	
$t_{d(on)}$	Turn-On Delay Time		$V_{CC}=600\text{V}, I_C=150\text{A}, R_G=3.9\Omega, L_S=35\text{nH}, V_{GE}=\pm 15\text{V}, T_{vj}=125^\circ\text{C}$		80		ns
$t_r$	Rise Time				36		ns
$t_{d(off)}$	Turn-Off Delay Time			297		ns	
$t_f$	Fall Time			285		ns	
$E_{on}$	Turn-On Switching Loss			16.0		mJ	
$E_{off}$	Turn-Off Switching Loss			15.3		mJ	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=150\text{A}, R_G=3.9\Omega, L_S=35\text{nH}, V_{GE}=\pm 15\text{V}, T_{vj}=150^\circ\text{C}$			83		ns
$t_r$	Rise Time				38		ns
$t_{d(off)}$	Turn-Off Delay Time			306		ns	
$t_f$	Fall Time			315		ns	
$E_{on}$	Turn-On Switching Loss			17.2		mJ	
$E_{off}$	Turn-Off Switching Loss			16.2		mJ	
$I_{SC}$	SC Data		$t_p \leq 8\mu\text{s}, V_{GE}=15\text{V}, T_{vj}=150^\circ\text{C}, V_{CC}=600\text{V}, V_{CEM} \leq 1200\text{V}$		450		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	$I_F=150\text{A}, V_{GE}=0\text{V}, T_{vj}=25^\circ\text{C}$		1.60	2.05	V
		$I_F=150\text{A}, V_{GE}=0\text{V}, T_{vj}=125^\circ\text{C}$		1.65		
		$I_F=150\text{A}, V_{GE}=0\text{V}, T_{vj}=150^\circ\text{C}$		1.65		
$Q_r$	Recovered Charge			14.9		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current	$V_R=600\text{V}, I_F=150\text{A},$ $-di/dt=4519\text{A}/\mu\text{s}, L_S=35\text{nH},$ $V_{GE}=-15\text{V}, T_{vj}=25^\circ\text{C}$		133		A
$E_{rec}$	Reverse Recovery Energy			4.97		mJ
$Q_r$	Recovered Charge			24.6		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current	$V_R=600\text{V}, I_F=150\text{A},$ $-di/dt=3578\text{A}/\mu\text{s}, L_S=35\text{nH},$ $V_{GE}=-15\text{V}, T_{vj}=125^\circ\text{C}$		135		A
$E_{rec}$	Reverse Recovery Energy			8.76		mJ
$Q_r$	Recovered Charge			27.1		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current	$V_R=600\text{V}, I_F=150\text{A},$ $-di/dt=3365\text{A}/\mu\text{s}, L_S=35\text{nH},$ $V_{GE}=-15\text{V}, T_{vj}=150^\circ\text{C}$		136		A
$E_{rec}$	Reverse Recovery Energy			9.67		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		21		nH
$R_{CC'+EE'}$	Module Lead Resistance, Terminal to Chip		1.80		m $\Omega$
$R_{thJC}$	Junction-to-Case (per IGBT)			0.293	K/W
	Junction-to-Case (per Diode)			0.465	
$R_{thCH}$	Case-to-Heatsink (per IGBT)		0.128		K/W
	Case-to-Heatsink (per Diode)		0.143		
$M$	Mounting Torque, Screw:M5	3.0		6.0	N.m
$G$	Weight of Module		300		g

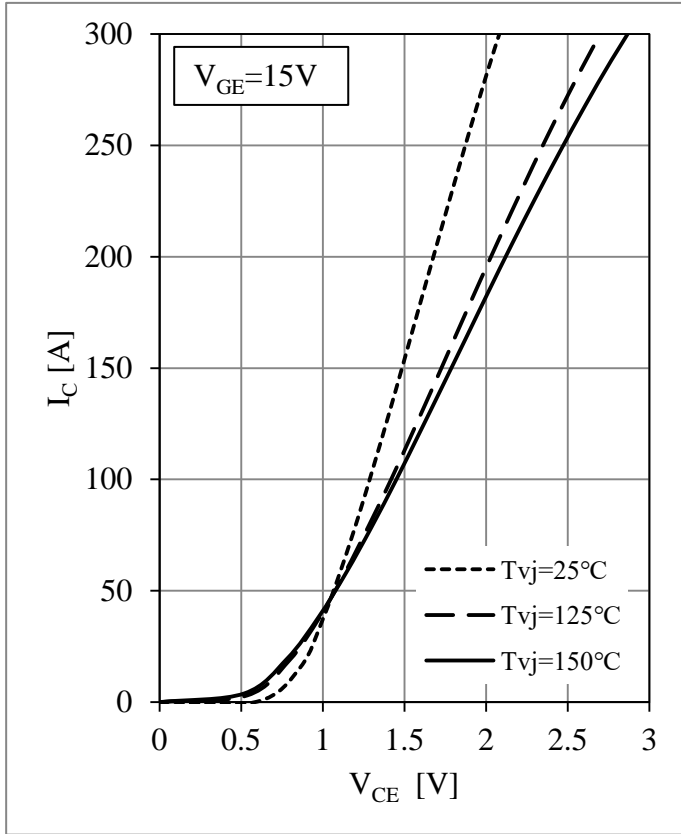


Fig 1. IGBT Output Characteristics

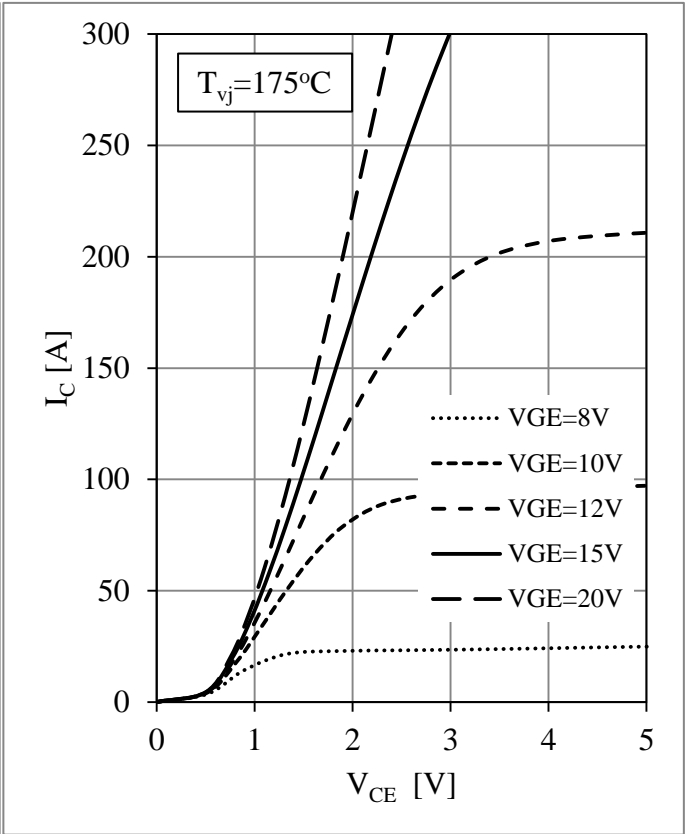


Fig 2. IGBT Output Characteristics

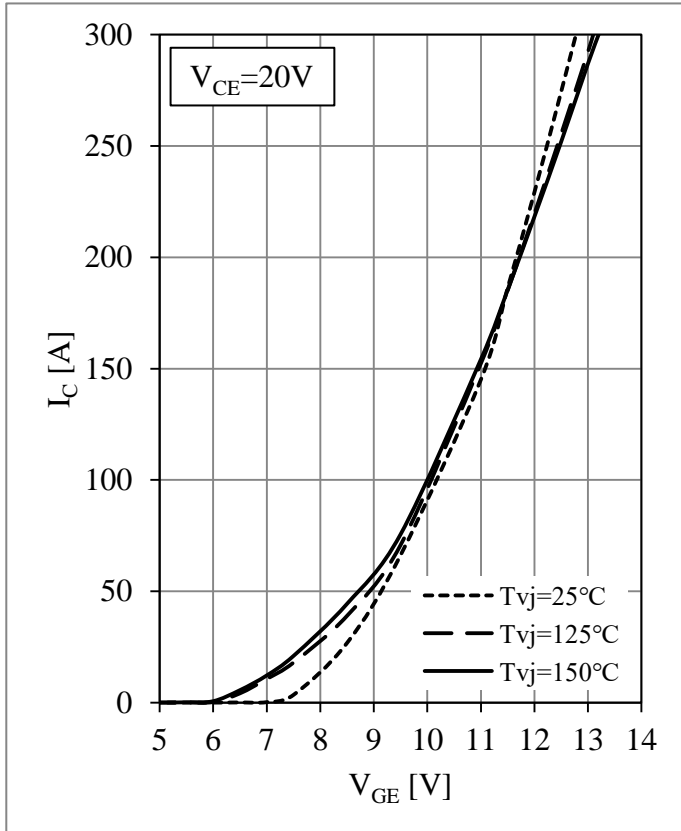


Fig 3. IGBT Transfer Characteristics

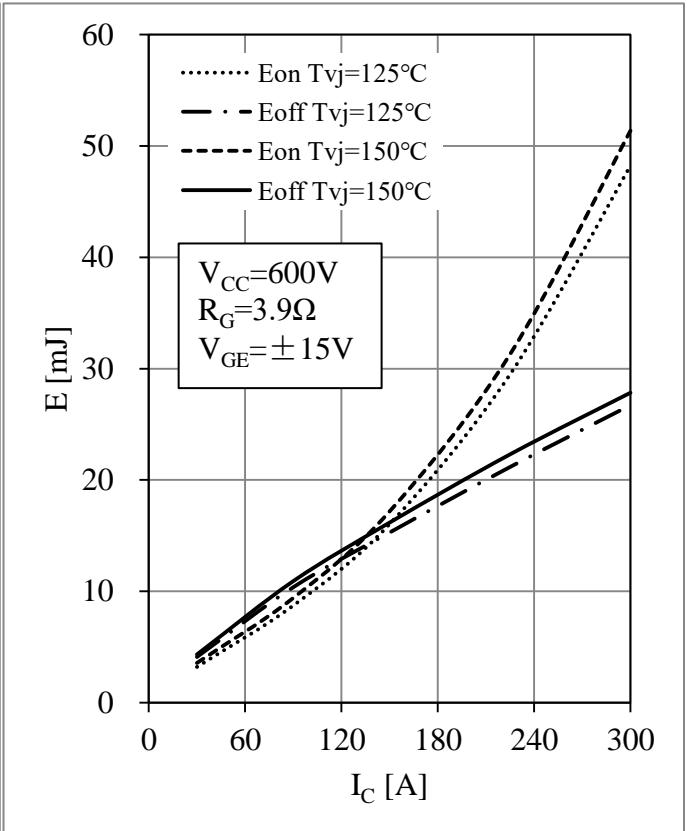


Fig 4. IGBT Switching Loss vs.  $I_C$

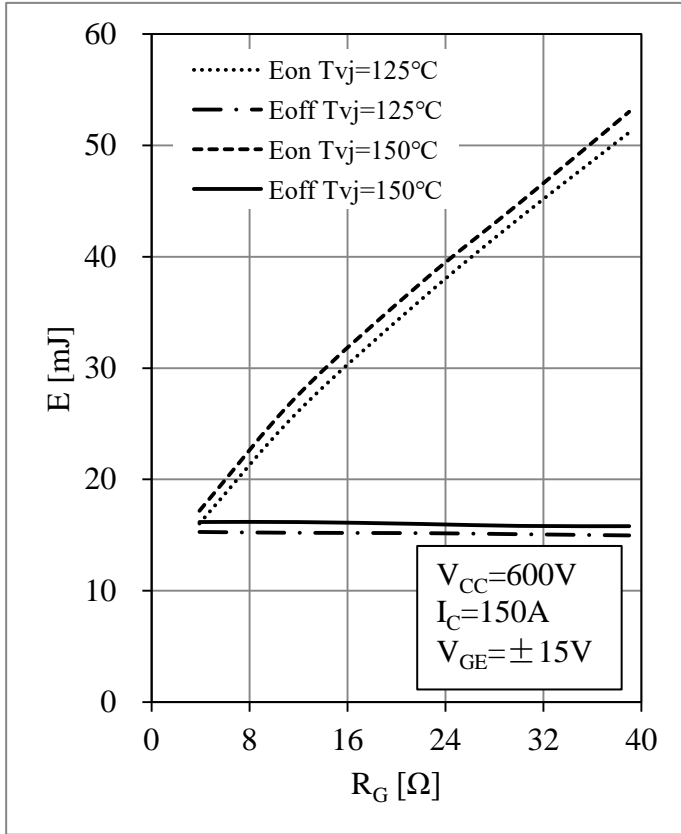


Fig 5. IGBT Switching Loss vs.  $R_G$

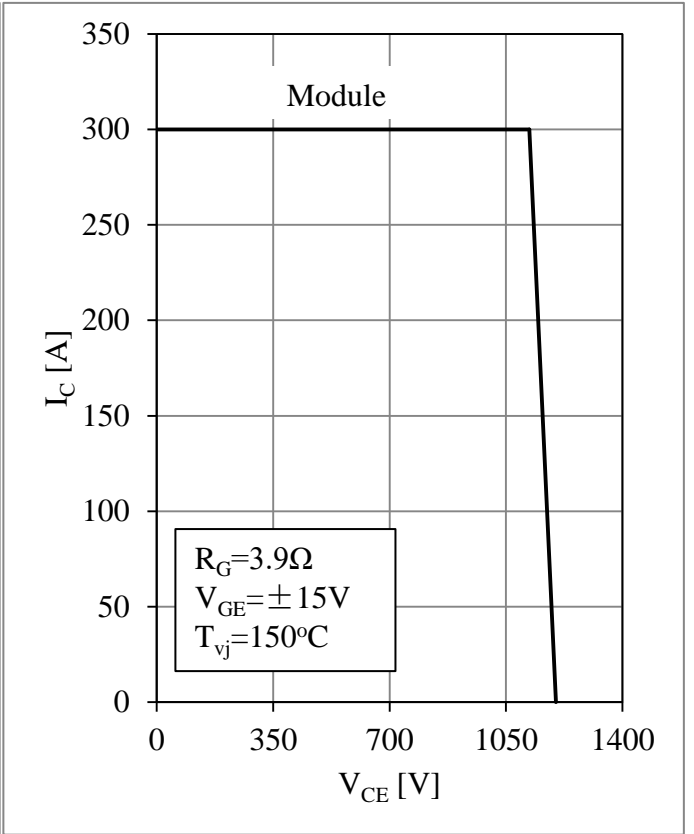


Fig 6. IGBT RBSOA

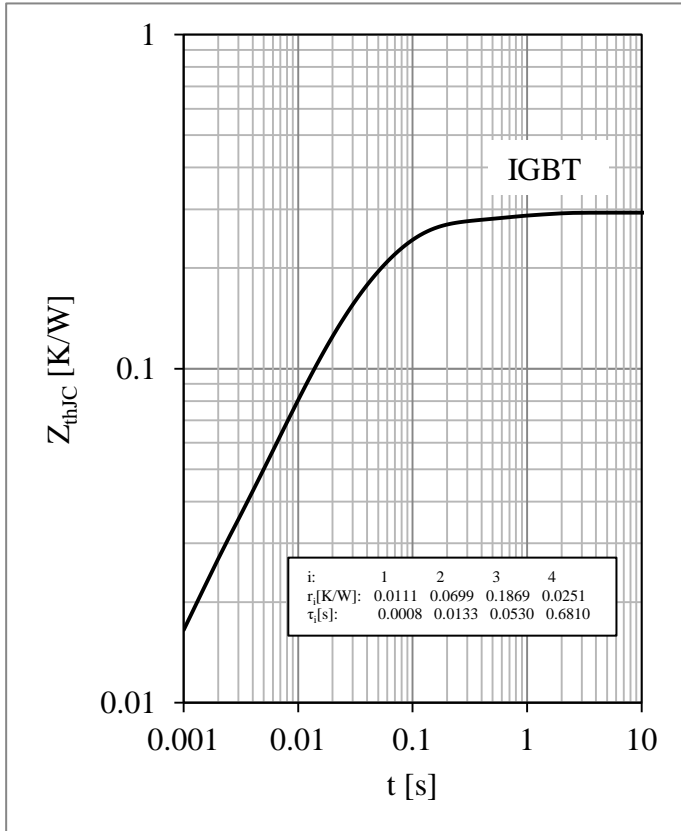


Fig 7. IGBT Transient Thermal Impedance

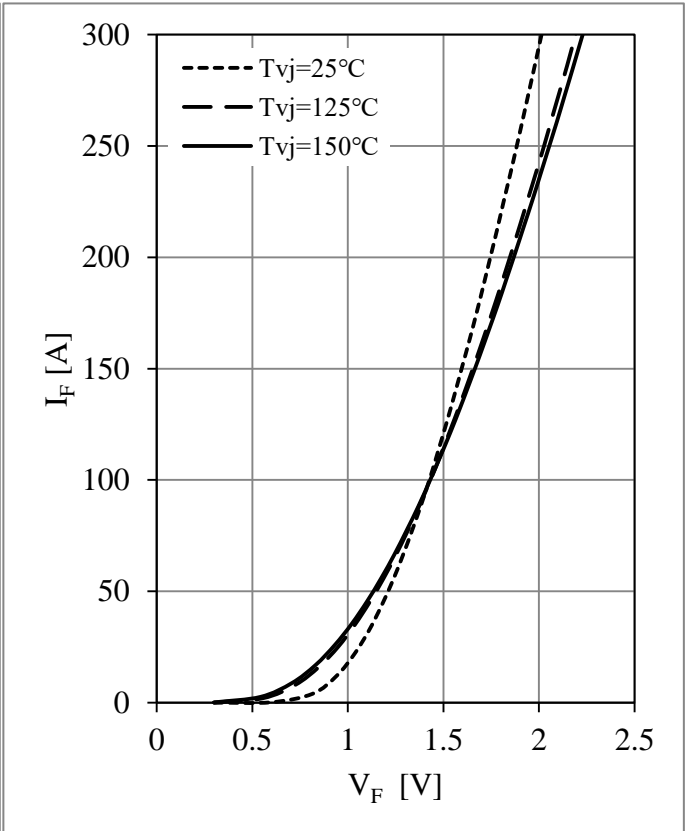


Fig 8. Diode Forward Characteristics

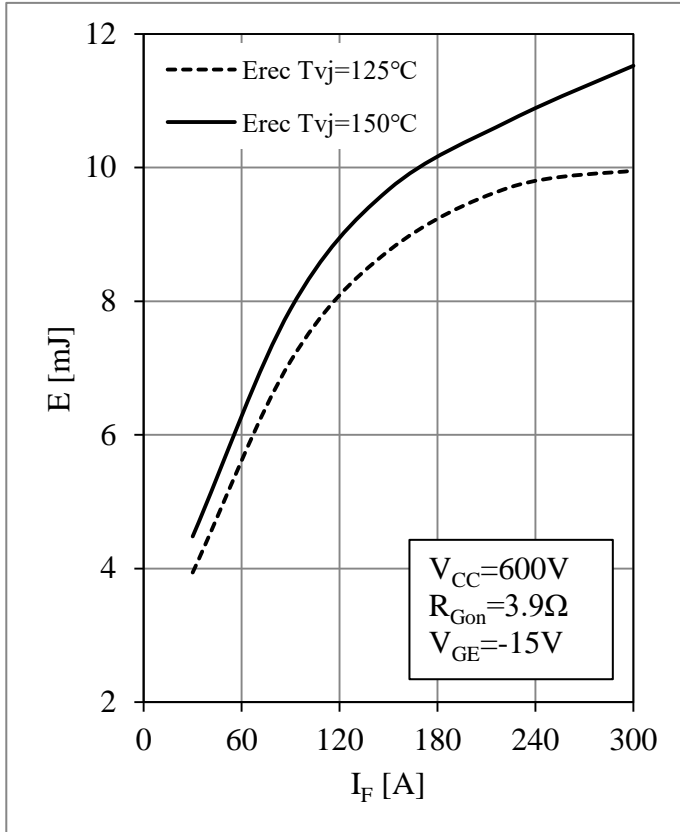


Fig 9. Diode Switching Loss vs.  $I_F$

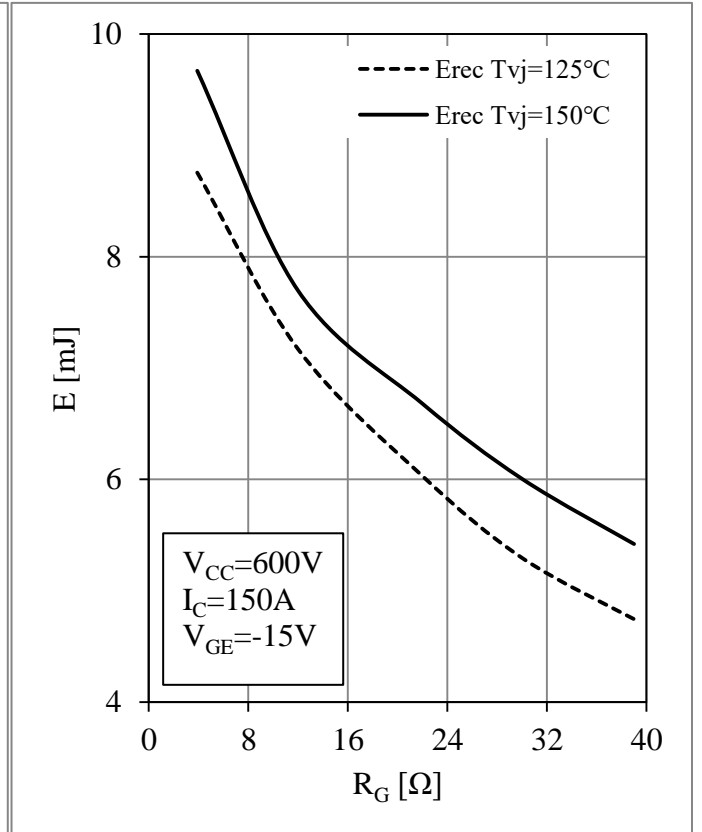


Fig 10. Diode Switching Loss vs.  $R_G$

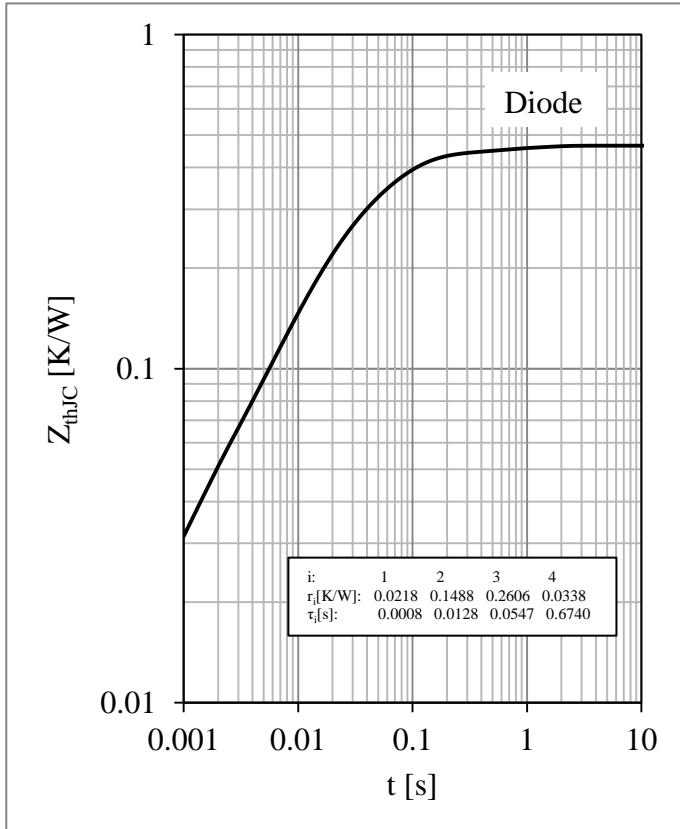


Fig 11. Diode Transient Thermal Impedance

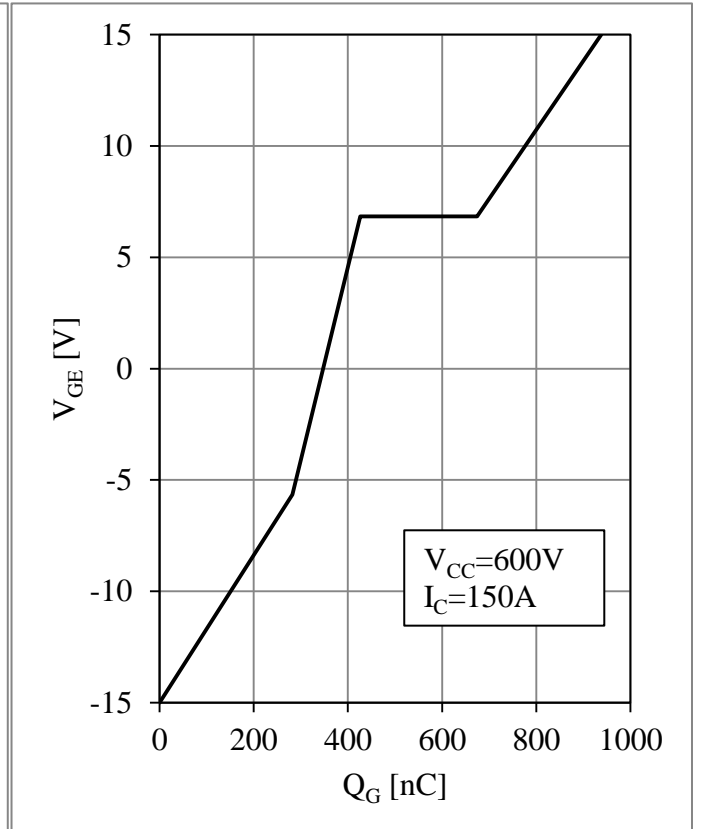


Fig 12. IGBT Gate Charge Characteristic

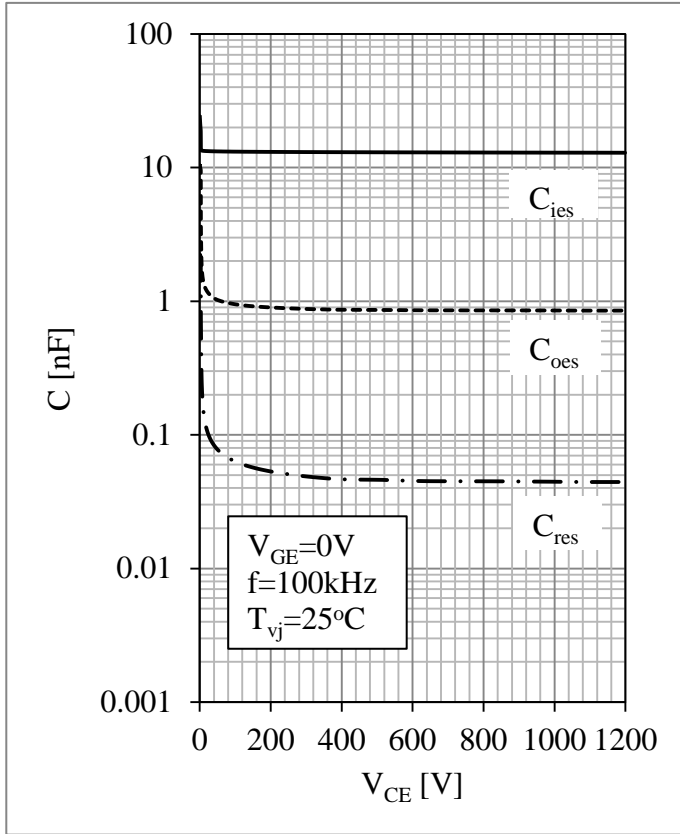


Fig 13. IGBT Capacity Characteristic

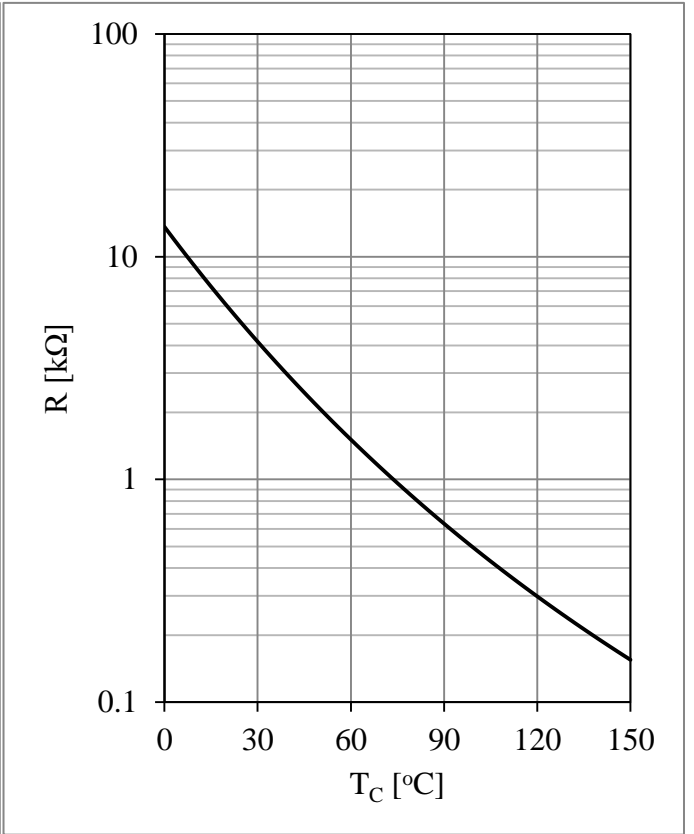
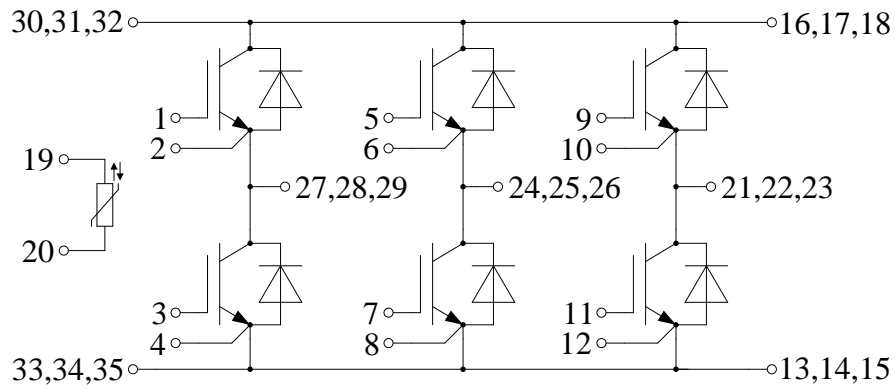


Fig 14. NTC Temperature Characteristic

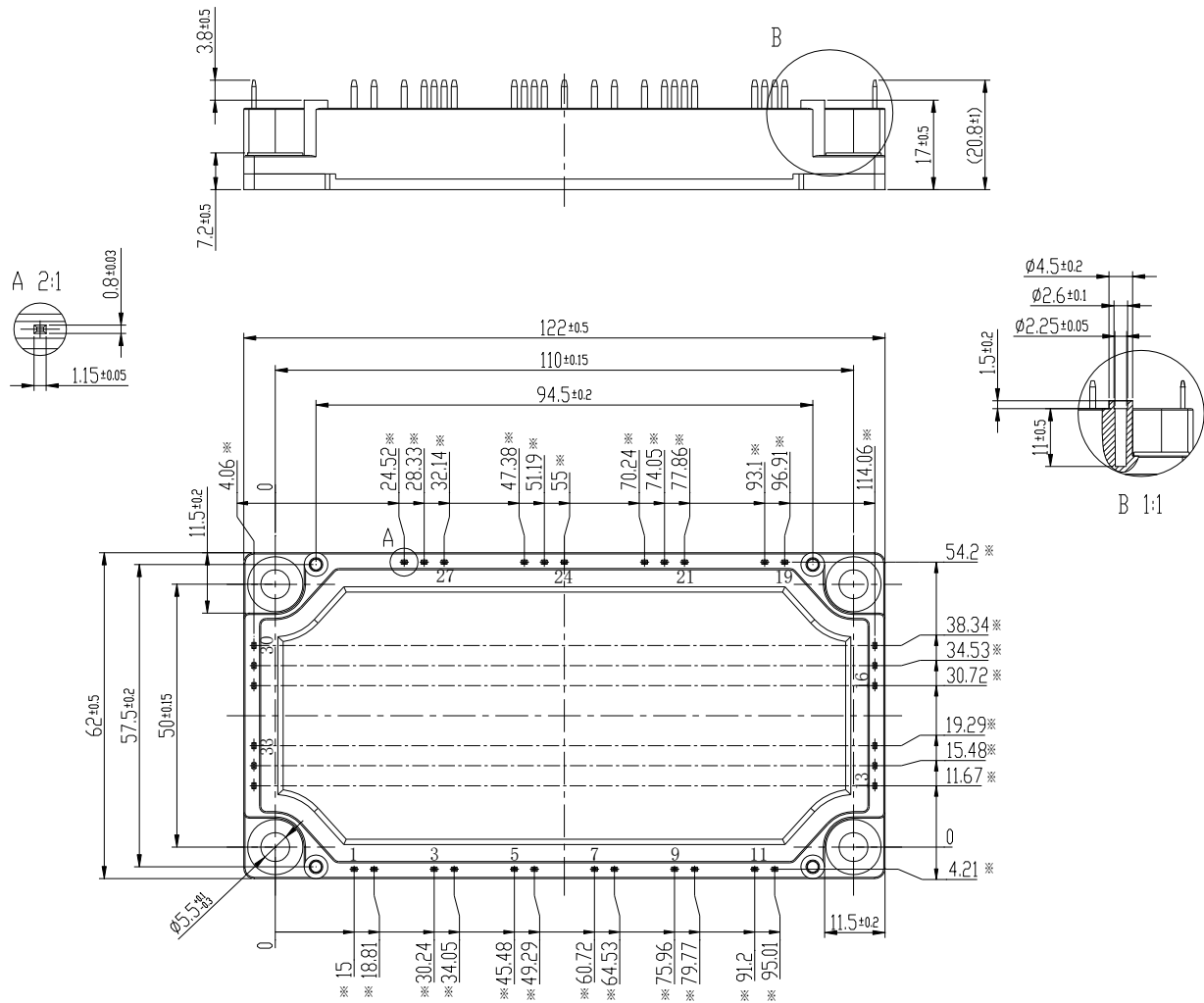


**Circuit Schematic**



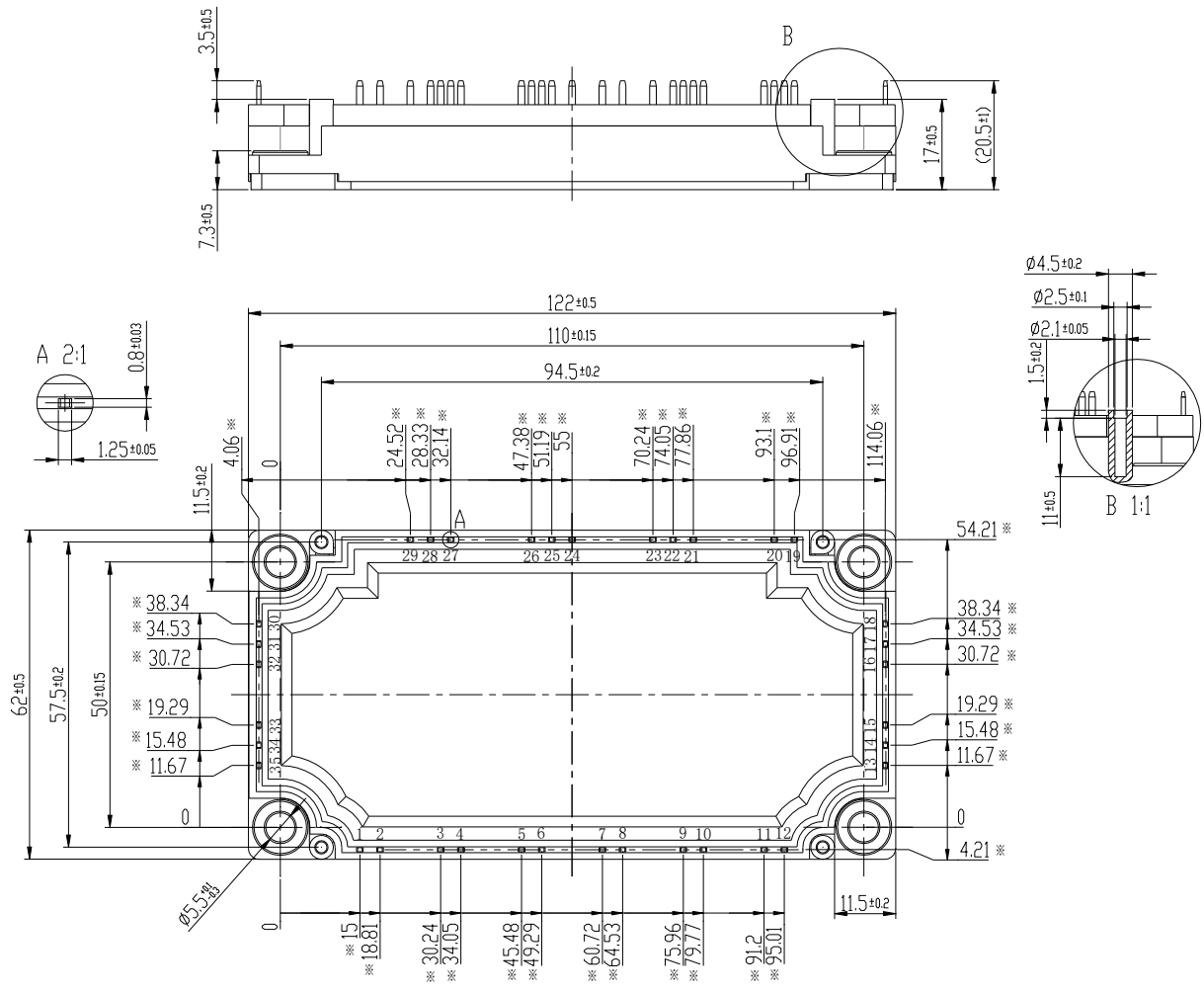
**Package Dimensions**

Dimensions in Millimeters



\*all dimensions with a tolerance of  $\pm 0.4$

Black package



White package

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