

STARPOWER

SEMICONDUCTOR

IGBT

GD150PIX120C6SNA

1200V/150A PIM 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.

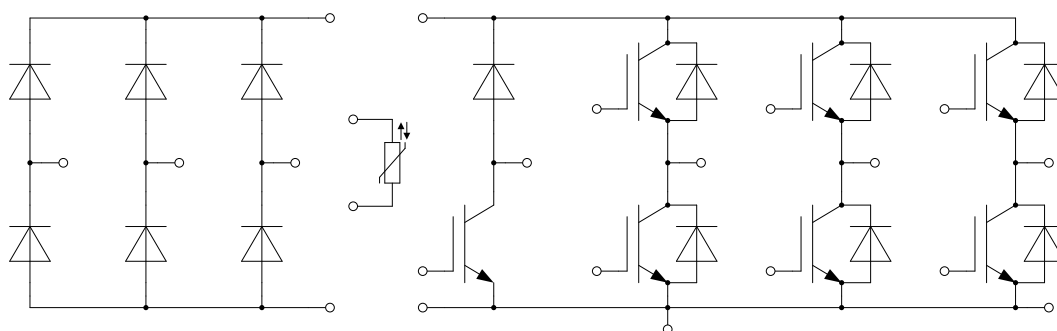
Features

- Low $V_{CE(sat)}$ Trench IGBT technology
- 10 μ 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-inverter**

Symbol	Description	Values	Unit
V_{CES}	Collector-Emitter Voltage	1200	V
V_{GES}	Gate-Emitter Voltage	± 20	V
I_C	Collector Current @ $T_C=25^{\circ}\text{C}$ @ $T_C=100^{\circ}\text{C}$	292 150	A
I_{CM}	Pulsed Collector Current $t_p=1\text{ms}$	300	A
P_D	Maximum Power Dissipation @ $T_j=175^{\circ}\text{C}$	1111	W

Diode-inverter

Symbol	Description	Values	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	1200	V
I_F	Diode Continuous Forward Current	150	A
I_{FM}	Diode Maximum Forward Current $t_p=1\text{ms}$	300	A

Diode-rectifier

Symbol	Description	Value	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	1600	V
I_O	Average Output Current 50Hz/60Hz,sine wave	150	A
I_{FSM}	Surge Forward Current $t_p=10\text{ms}$ @ $T_j=25^{\circ}\text{C}$ @ $T_j=150^{\circ}\text{C}$	1600 1400	A
I^2t	I^2t -value, $t_p=10\text{ms}$ @ $T_j=25^{\circ}\text{C}$ @ $T_j=150^{\circ}\text{C}$	13000 9800	A^2s

IGBT-brake

Symbol	Description	Value	Unit
V_{CES}	Collector-Emitter Voltage	1200	V
V_{GES}	Gate-Emitter Voltage	± 20	V
I_C	Collector Current @ $T_C=25^{\circ}\text{C}$ @ $T_C=100^{\circ}\text{C}$	200 100	A
I_{CM}	Pulsed Collector Current $t_p=1\text{ms}$	200	A
P_D	Maximum Power Dissipation @ $T_j=175^{\circ}\text{C}$	833	W

Diode-brake

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(inverter,brake) Maximum Junction Temperature (rectifier)	175 150	$^{\circ}\text{C}$
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-inverter 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	$I_C=150\text{A}, V_{GE}=15\text{V}, T_j=25^{\circ}\text{C}$		1.70	2.15	V
		$I_C=150\text{A}, V_{GE}=15\text{V}, T_j=125^{\circ}\text{C}$		1.95		
		$I_C=150\text{A}, V_{GE}=15\text{V}, T_j=150^{\circ}\text{C}$		2.00		
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=6.00\text{mA}, V_{CE}=V_{GE}, T_j=25^{\circ}\text{C}$	5.6	6.2	6.8	V
I_{CES}	Collector Cut-Off Current	$V_{CE}=V_{CES}, V_{GE}=0\text{V}, T_j=25^{\circ}\text{C}$			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			2.0		Ω
C_{ies}	Input Capacitance	$V_{CE}=25\text{V}, f=1\text{MHz}, V_{GE}=0\text{V}$		15.5		nF
C_{res}	Reverse Transfer Capacitance			0.44		nF
Q_G	Gate Charge	$V_{GE}=-15\dots+15\text{V}$		1.17		μC
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=150\text{A}, R_G=1.1\Omega, V_{GE}=\pm 15\text{V}, T_j=25^{\circ}\text{C}$		96		ns
t_r	Rise Time			30		ns
$t_{d(off)}$	Turn-Off Delay Time			255		ns
t_f	Fall Time			269		ns
E_{on}	Turn-On Switching Loss			8.59		mJ
E_{off}	Turn-Off Switching Loss			12.3		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=150\text{A}, R_G=1.1\Omega, V_{GE}=\pm 15\text{V}, T_j=125^{\circ}\text{C}$		117		ns
t_r	Rise Time			37		ns
$t_{d(off)}$	Turn-Off Delay Time			307		ns
t_f	Fall Time			371		ns
E_{on}	Turn-On Switching Loss			13.2		mJ
E_{off}	Turn-Off Switching Loss			16.8		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=150\text{A}, R_G=1.1\Omega, V_{GE}=\pm 15\text{V}, T_j=150^{\circ}\text{C}$		122		ns
t_r	Rise Time			38		ns
$t_{d(off)}$	Turn-Off Delay Time			315		ns
t_f	Fall Time			425		ns
E_{on}	Turn-On Switching Loss			14.8		mJ
E_{off}	Turn-Off Switching Loss			18.1		mJ
I_{SC}	SC Data	$t_p \leq 10\mu\text{s}, V_{GE}=15\text{V}, T_j=150^{\circ}\text{C}, V_{CC}=900\text{V}, V_{CEM} \leq 1200\text{V}$		600		A

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
V_F	Diode Forward Voltage	$I_F=150\text{A}, V_{GE}=0\text{V}, T_j=25^{\circ}\text{C}$		1.85	2.25	V
		$I_F=150\text{A}, V_{GE}=0\text{V}, T_j=125^{\circ}\text{C}$		1.90		
		$I_F=150\text{A}, V_{GE}=0\text{V}, T_j=150^{\circ}\text{C}$		1.95		
Q_r	Recovered Charge	$V_R=600\text{V}, I_F=150\text{A},$ $-di/dt=4750\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=25^{\circ}\text{C}$		8.62		μC
I_{RM}	Peak Reverse Recovery Current			177		A
E_{rec}	Reverse Recovery Energy			5.68		mJ
Q_r	Recovered Charge	$V_R=600\text{V}, I_F=150\text{A},$ $-di/dt=3950\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=125^{\circ}\text{C}$		16.7		μC
I_{RM}	Peak Reverse Recovery Current			191		A
E_{rec}	Reverse Recovery Energy			10.2		mJ
Q_r	Recovered Charge	$V_R=600\text{V}, I_F=150\text{A},$ $-di/dt=3750\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=150^{\circ}\text{C}$		19.4		μC
I_{RM}	Peak Reverse Recovery Current			196		A
E_{rec}	Reverse Recovery Energy			12.1		mJ

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_F	Diode Forward Voltage	$I_C=150\text{A}, T_j=150^{\circ}\text{C}$		1.00		V
I_R	Reverse Current	$T_j=150^{\circ}\text{C}, V_R=1600\text{V}$			3.0	mA

IGBT-brake 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	$I_C=100\text{A}, V_{GE}=15\text{V}, T_j=25^{\circ}\text{C}$		1.70	2.15	V
		$I_C=100\text{A}, V_{GE}=15\text{V}, T_j=125^{\circ}\text{C}$		1.95		
		$I_C=100\text{A}, V_{GE}=15\text{V}, T_j=150^{\circ}\text{C}$		2.00		
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=4.00\text{mA}, V_{CE}=V_{GE}, T_j=25^{\circ}\text{C}$	5.6	6.2	6.8	V
I_{CES}	Collector Cut-Off Current	$V_{CE}=V_{CES}, V_{GE}=0\text{V}, T_j=25^{\circ}\text{C}$			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			7.5		Ω
C_{ies}	Input Capacitance	$V_{CE}=25\text{V}, f=1\text{MHz}, V_{GE}=0\text{V}$		10.4		nF
C_{res}	Reverse Transfer Capacitance			0.29		nF
Q_G	Gate Charge	$V_{GE}=-15\dots+15\text{V}$		0.08		μC
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=100\text{A}, R_G=1.6\Omega, V_{GE}=\pm 15\text{V}, T_j=25^{\circ}\text{C}$		170		ns
t_r	Rise Time			32		ns
$t_{d(off)}$	Turn-Off Delay Time			360		ns
t_f	Fall Time			86		ns
E_{on}	Turn-On Switching Loss			5.90		mJ
E_{off}	Turn-Off Switching Loss			6.05		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=100\text{A}, R_G=1.6\Omega, V_{GE}=\pm 15\text{V}, T_j=125^{\circ}\text{C}$		180		ns
t_r	Rise Time			42		ns
$t_{d(off)}$	Turn-Off Delay Time			470		ns
t_f	Fall Time			165		ns
E_{on}	Turn-On Switching Loss			9.10		mJ
E_{off}	Turn-Off Switching Loss			9.35		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=100\text{A}, R_G=1.6\Omega, V_{GE}=\pm 15\text{V}, T_j=150^{\circ}\text{C}$		181		ns
t_r	Rise Time			43		ns
$t_{d(off)}$	Turn-Off Delay Time			480		ns
t_f	Fall Time			186		ns
E_{on}	Turn-On Switching Loss			10.0		mJ
E_{off}	Turn-Off Switching Loss			10.5		mJ
I_{SC}	SC Data	$t_p \leq 10\mu\text{s}, V_{GE}=15\text{V}, T_j=150^{\circ}\text{C}, V_{CC}=900\text{V}, V_{CEM} \leq 1200\text{V}$		400		A

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_F	Diode Forward Voltage	$I_F=50\text{A}, V_{GE}=0\text{V}, T_j=25^{\circ}\text{C}$		1.85	2.30	V
		$I_F=50\text{A}, V_{GE}=0\text{V}, T_j=125^{\circ}\text{C}$		1.90		
		$I_F=50\text{A}, V_{GE}=0\text{V}, T_j=150^{\circ}\text{C}$		1.95		
Q_r	Recovered Charge	$V_R=600\text{V}, I_F=50\text{A},$ $-di/dt=1400\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=25^{\circ}\text{C}$		6.3		μC
I_{RM}	Peak Reverse Recovery Current			62		A
E_{rec}	Reverse Recovery Energy			1.67		mJ
Q_r	Recovered Charge	$V_R=600\text{V}, I_F=50\text{A},$ $-di/dt=1400\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=125^{\circ}\text{C}$		10.1		μC
I_{RM}	Peak Reverse Recovery Current			69		A
E_{rec}	Reverse Recovery Energy			2.94		mJ
Q_r	Recovered Charge	$V_R=600\text{V}, I_F=50\text{A},$ $-di/dt=1400\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=150^{\circ}\text{C}$		11.5		μC
I_{RM}	Peak Reverse Recovery Current			72		A
E_{rec}	Reverse Recovery Energy			3.63		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		40		nH
$R_{CC'+EE'}$ $R_{AA'+CC'}$	Module Lead Resistance, Terminal to Chip		4.00 3.00		m Ω
R_{thJC}	Junction-to-Case (per IGBT-inverter) Junction-to-Case (per Diode-inverter) Junction-to-Case (per Diode-rectifier) Junction-to-Case (per IGBT-brake) Junction-to-Case (per Diode-brake)			0.135 0.300 0.238 0.180 0.472	K/W
R_{thCH}	Case-to-Heatsink (per IGBT-inverter) Case-to-Heatsink (per Diode-inverter) Case-to-Heatsink (per Diode-rectifier) Case-to-Heatsink (per IGBT-brake) Case-to-Heatsink (per Diode-brake) Case-to-Heatsink (per Module)		0.118 0.263 0.208 0.158 0.413 0.009		K/W
M	Mounting Torque, Screw:M5	3.0		6.0	N.m
G	Weight of Module		300		g

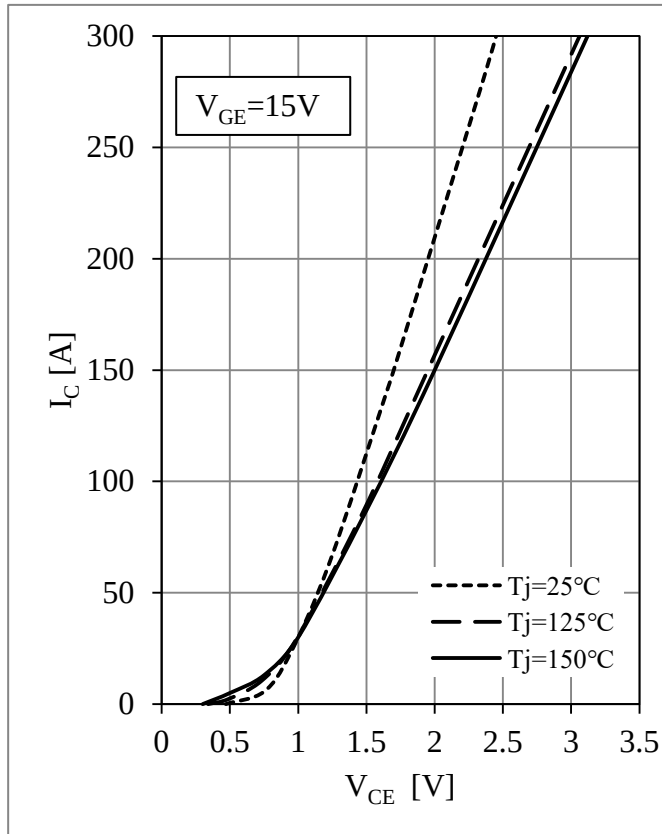


Fig 1. IGBT-inverter Output Characteristics

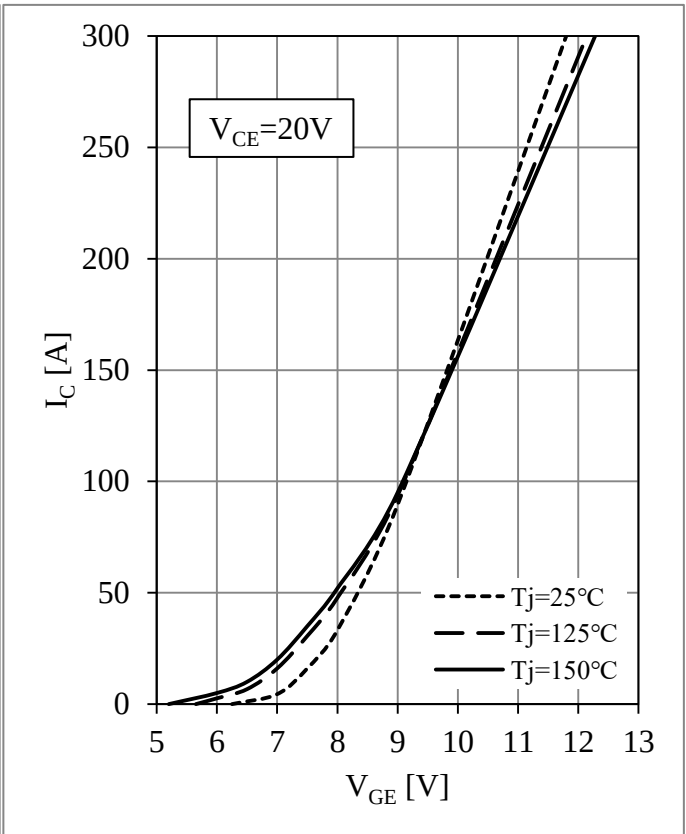
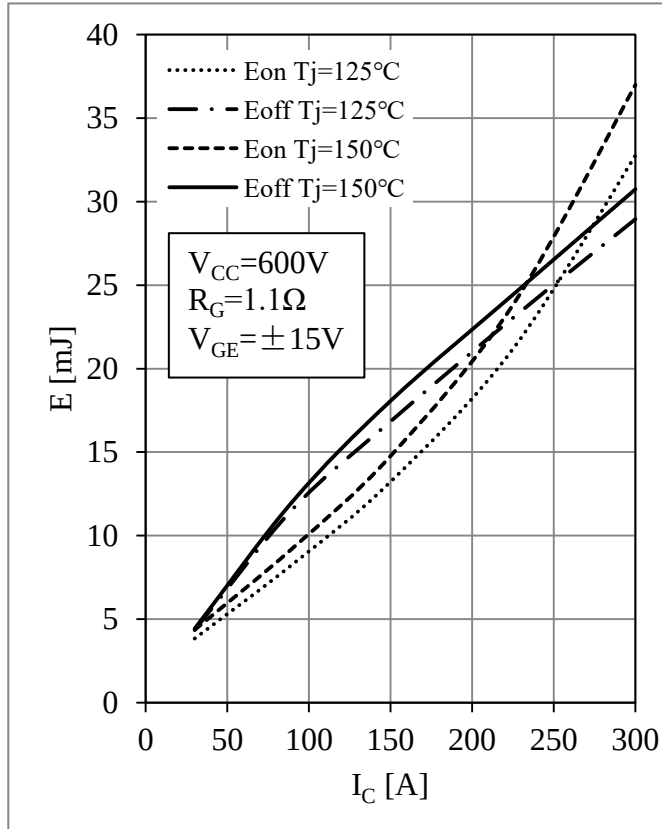
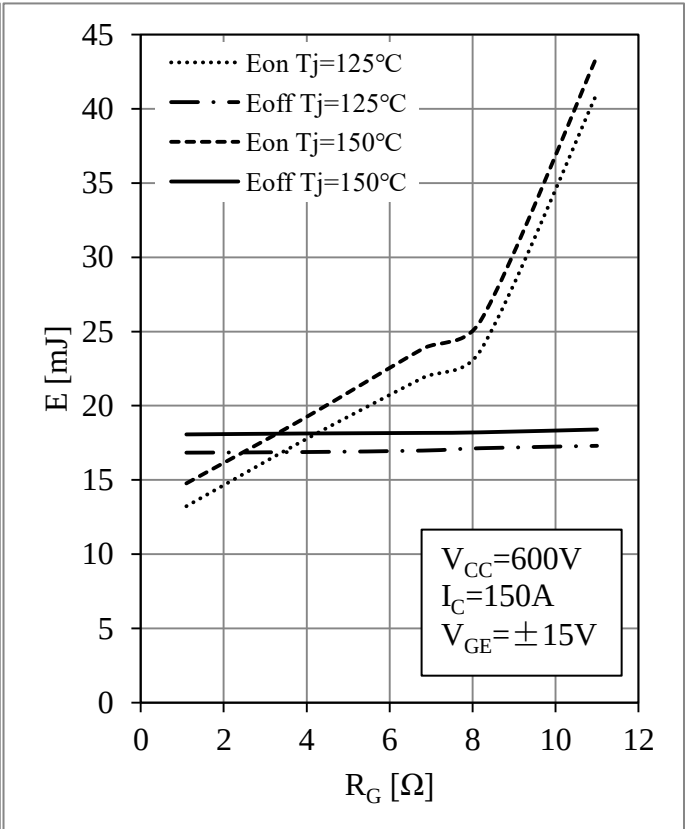


Fig 2. IGBT-inverter Transfer Characteristics

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

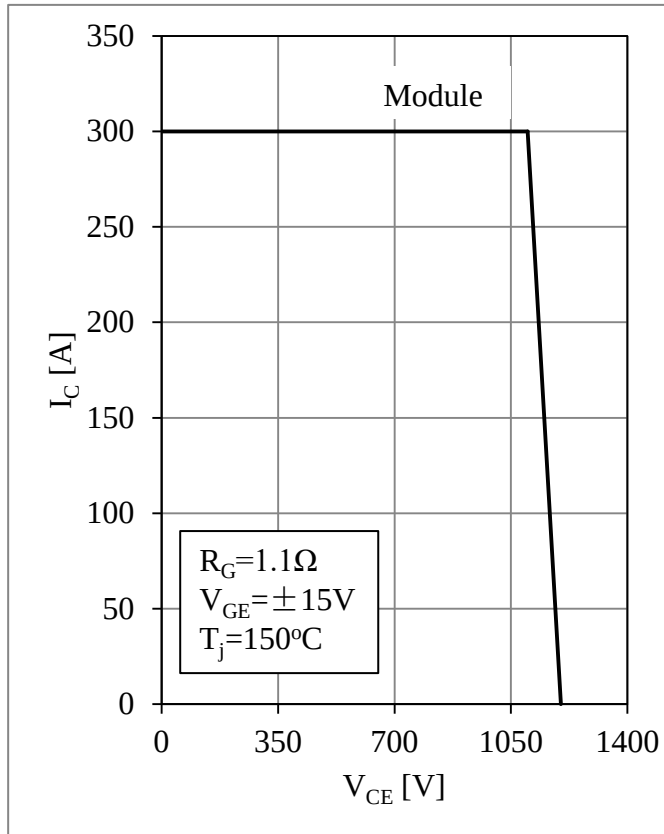


Fig 5. IGBT-inverter RBSOA

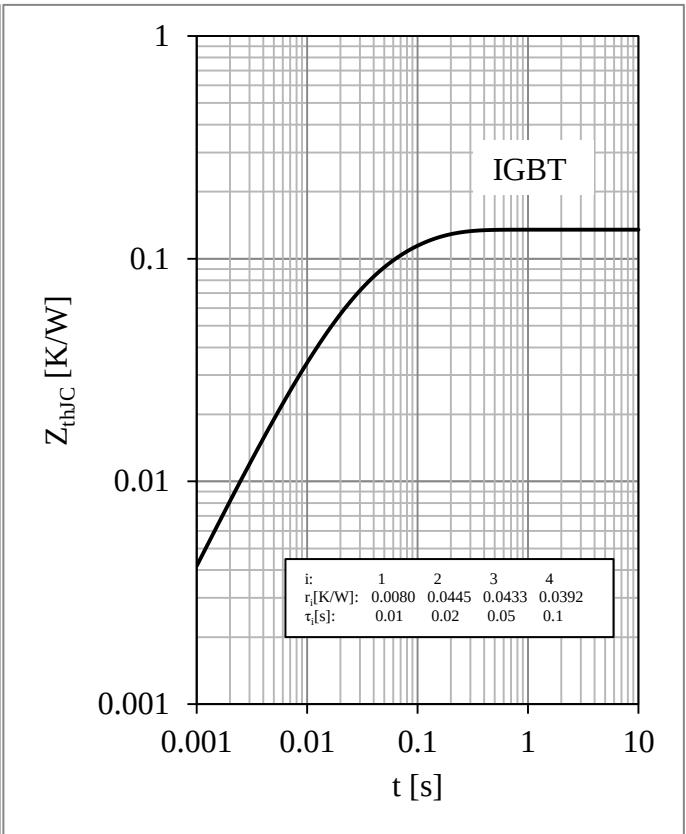


Fig 6. IGBT-inverter Transient Thermal Impedance

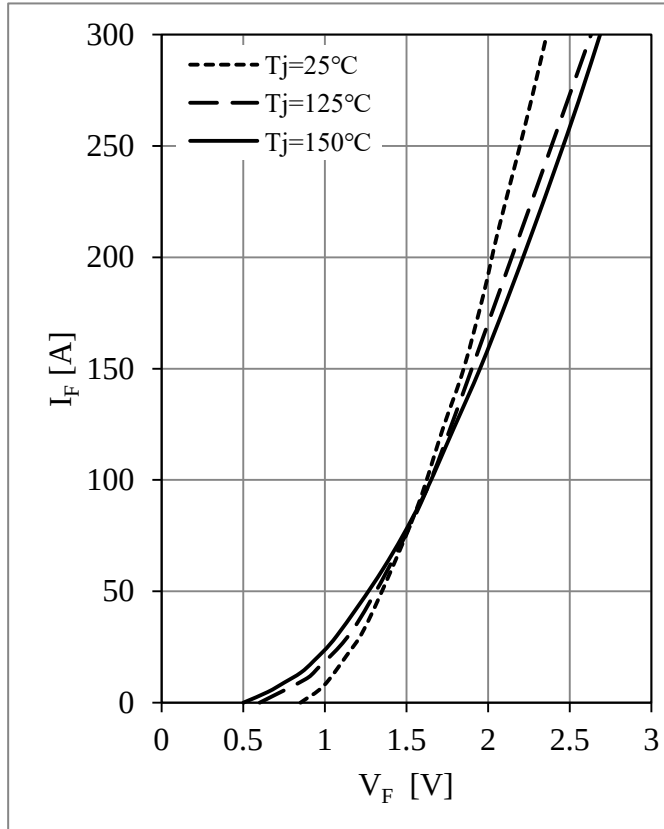
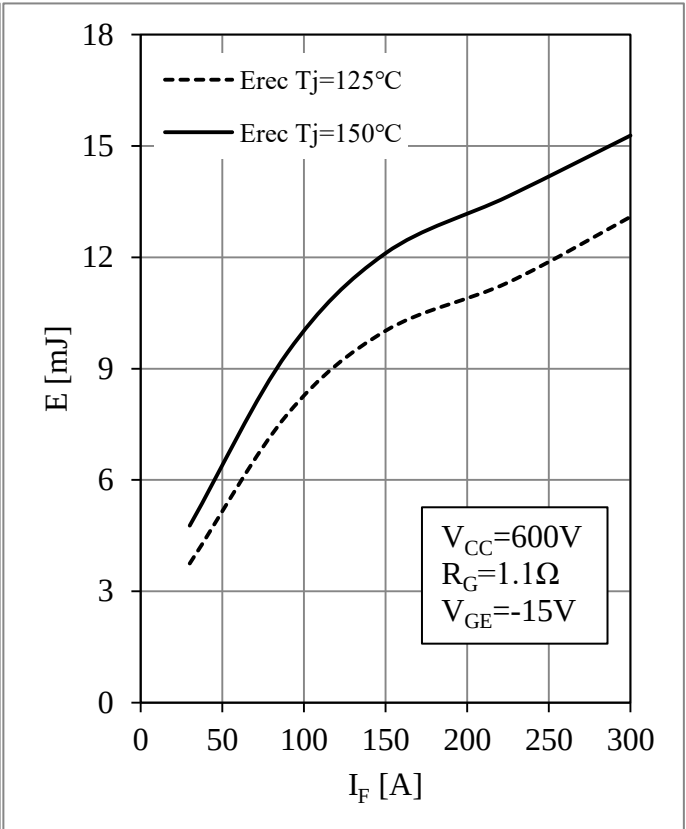
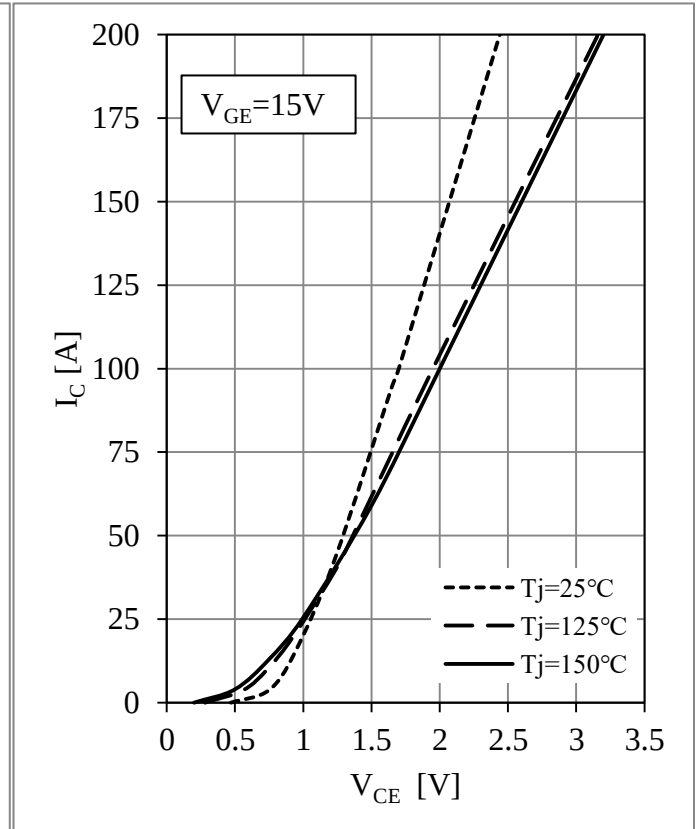
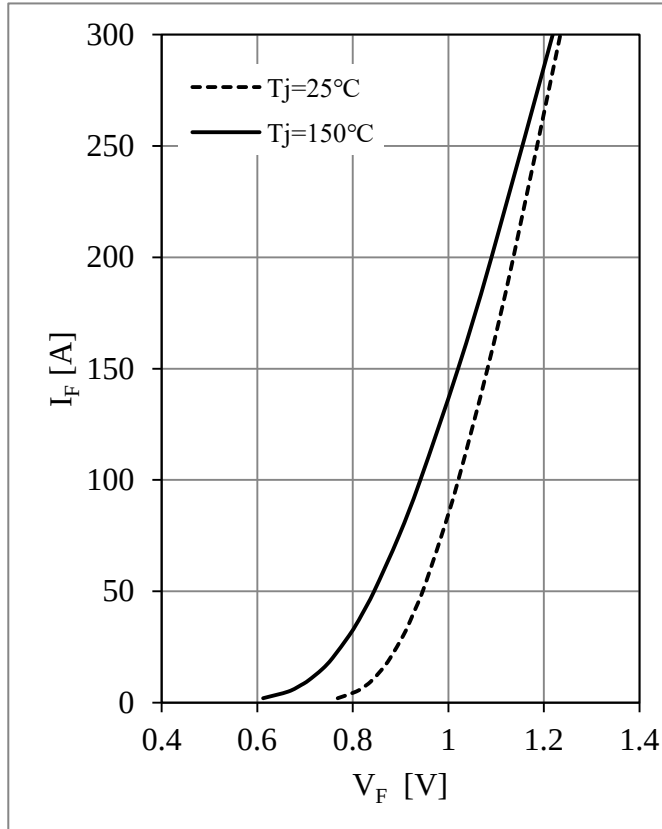
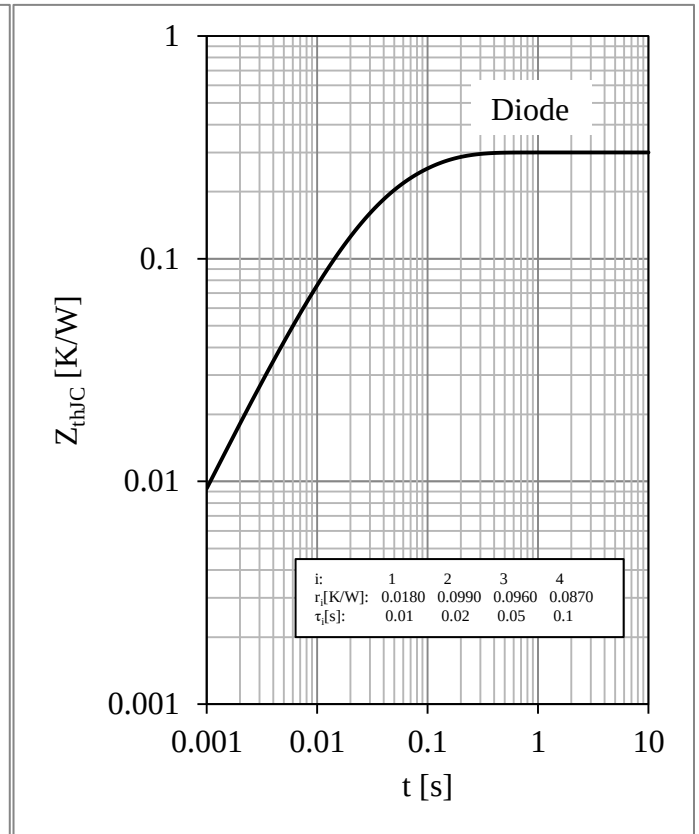
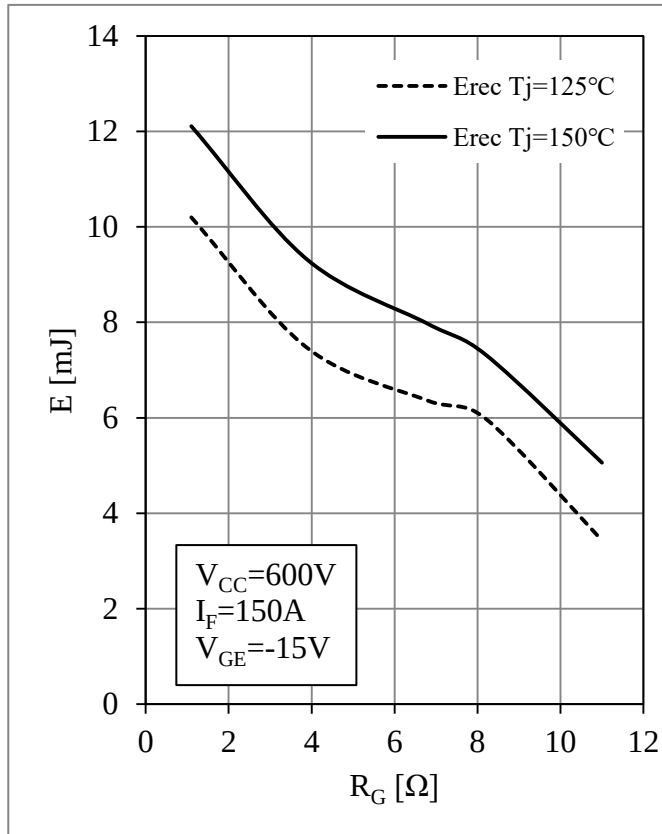


Fig 7. Diode-inverter Forward Characteristics

Fig 8. Diode-inverter Switching Loss vs. I_F



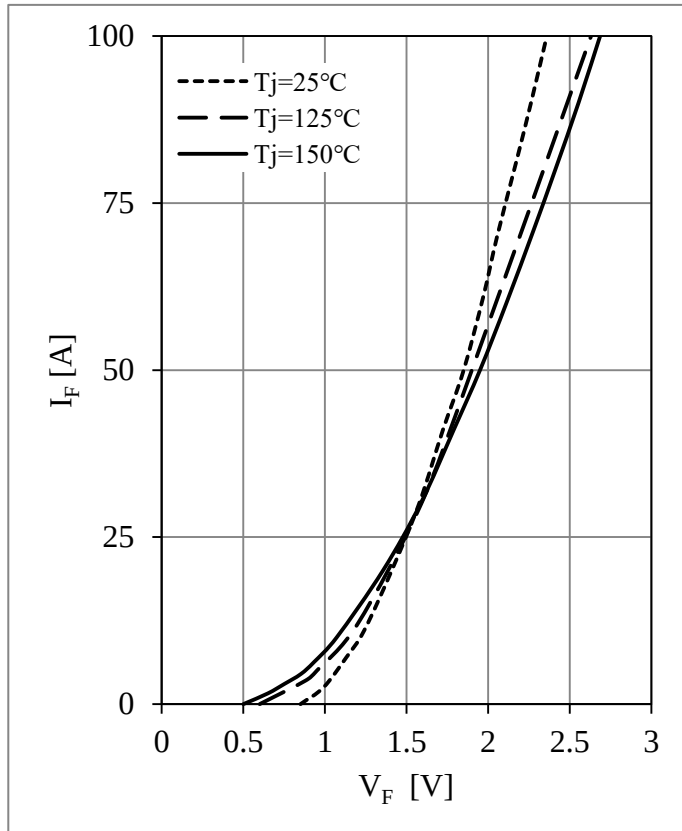


Fig 13. Diode-brake-chopper Forward Characteristics

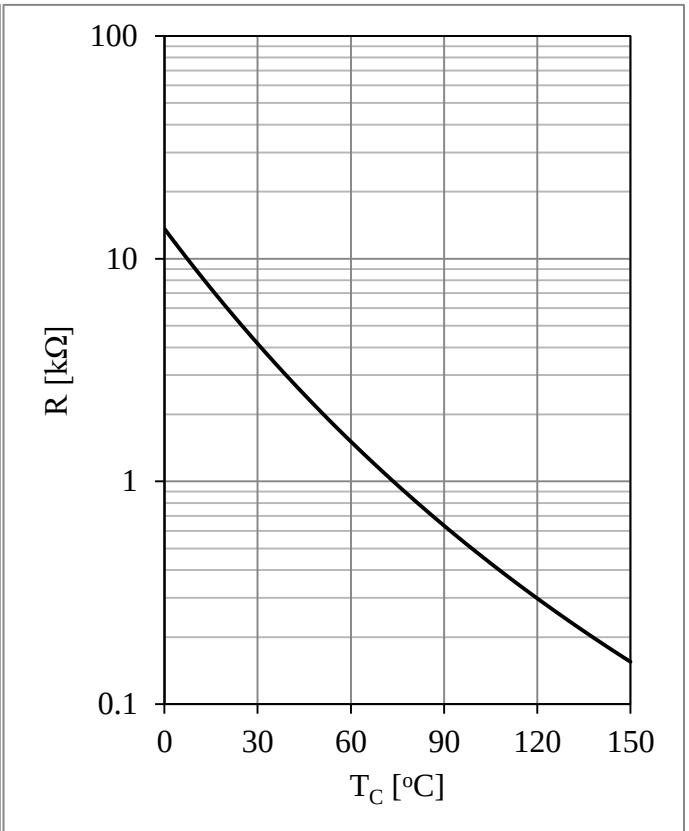
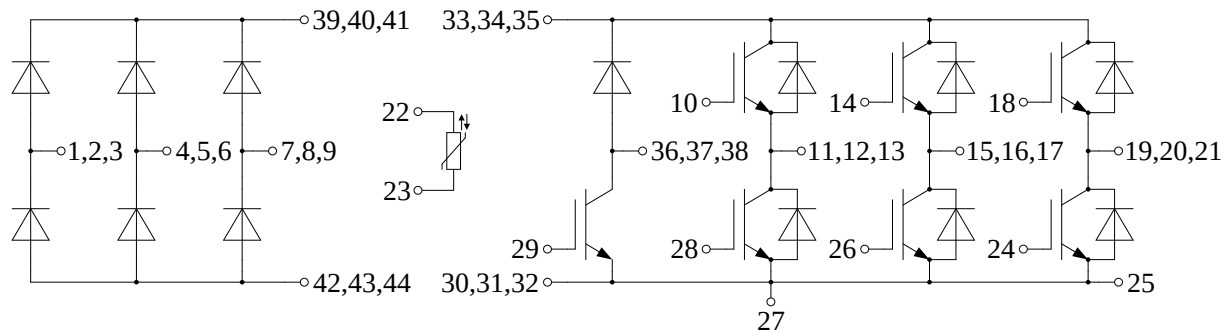


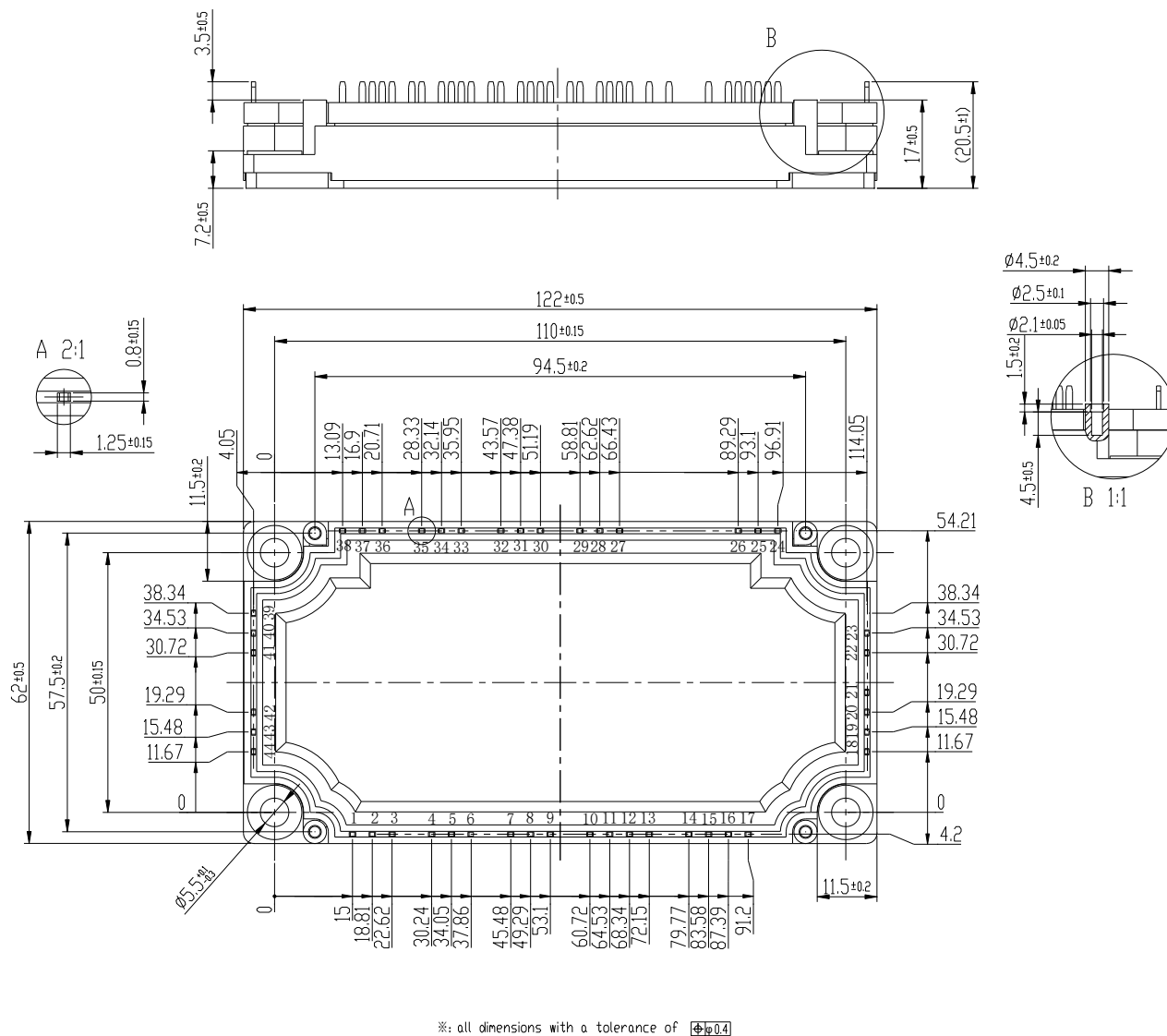
Fig 14. NTC Temperature Characteristic

Circuit Schematic



Package Dimensions

Dimensions in Millimeters



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