

STARPOWER

SEMICONDUCTOR

IGBT

GD150PIY120C6SN

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.



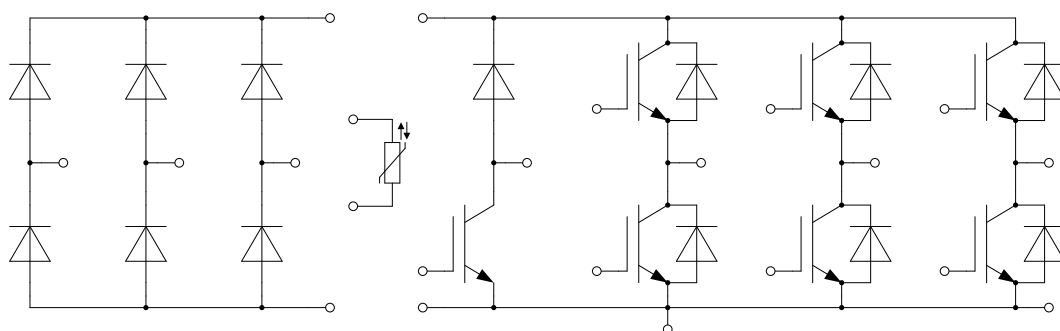
Features

- 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	Value	Unit
V_{CES}	Collector-Emitter Voltage	1200	V
V_{GES}	Gate-Emitter Voltage	± 30	V
I_C	Collector Current @ $T_C=25^{\circ}\text{C}$	290	A
	@ $T_C=110^{\circ}\text{C}$	150	A
I_{CM}	Pulsed Collector Current $t_p=1\text{ms}$	300	A
P_D	Maximum Power Dissipation @ $T_j=175^{\circ}\text{C}$	1087	W

Diode-inverter

Symbol	Description	Value	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 $V_R=0\text{V}, t_p=10\text{ms}, T_j=45^{\circ}\text{C}$	1800	A
I^2t	I^2t -value, $V_R=0\text{V}, t_p=10\text{ms}, T_j=45^{\circ}\text{C}$	16200	A^2s

IGBT-brake

Symbol	Description	Value	Unit
V_{CES}	Collector-Emitter Voltage	1200	V
V_{GES}	Gate-Emitter Voltage	± 30	V
I_C	Collector Current @ $T_C=25^{\circ}\text{C}$	200	A
	@ $T_C=110^{\circ}\text{C}$	100	A
I_{CM}	Pulsed Collector Current $t_p=1\text{ms}$	200	A
P_D	Maximum Power Dissipation @ $T_j=175^{\circ}\text{C}$	829	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)	175	$^{\circ}\text{C}$
	Maximum Junction Temperature(rectifier)	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, $f=50\text{Hz}, t=1\text{min}$	4000	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	$I_C=6.0\text{mA}, V_{CE}=V_{GE}, T_j=25^{\circ}\text{C}$	5.0	5.5	6.5	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			2.0		Ω
C_{ies}	Input Capacitance	$V_{CE}=25\text{V}, f=1\text{MHz}, V_{GE}=0\text{V}$		13.0		nF
C_{res}	Reverse Transfer Capacitance			0.42		nF
Q_G	Gate Charge	$V_{GE}=15\text{V}$		0.82		μC
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=150\text{A}, R_G=1.0\Omega, V_{GE}=\pm 15\text{V}, T_j=25^{\circ}\text{C}$		292		ns
t_r	Rise Time			59		ns
$t_{d(off)}$	Turn-Off Delay Time			344		ns
t_f	Fall Time			191		ns
E_{on}	Turn-On Switching Loss			4.55		mJ
E_{off}	Turn-Off Switching Loss			11.6		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=150\text{A}, R_G=1.0\Omega, V_{GE}=\pm 15\text{V}, T_j=125^{\circ}\text{C}$		297		ns
t_r	Rise Time			65		ns
$t_{d(off)}$	Turn-Off Delay Time			370		ns
t_f	Fall Time			315		ns
E_{on}	Turn-On Switching Loss			6.85		mJ
E_{off}	Turn-Off Switching Loss			16.1		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=150\text{A}, R_G=1.0\Omega, V_{GE}=\pm 15\text{V}, T_j=150^{\circ}\text{C}$		288		ns
t_r	Rise Time			65		ns
$t_{d(off)}$	Turn-Off Delay Time			373		ns
t_f	Fall Time			342		ns
E_{on}	Turn-On Switching Loss			7.45		mJ
E_{off}	Turn-Off Switching Loss			18.8		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.	Unit
V_F	Diode Forward Voltage	$I_C=150\text{A}, V_{GE}=0\text{V}, T_j=25^{\circ}\text{C}$		1.90	2.35	V
		$I_C=150\text{A}, V_{GE}=0\text{V}, T_j=125^{\circ}\text{C}$		2.00		
		$I_C=150\text{A}, V_{GE}=0\text{V}, T_j=150^{\circ}\text{C}$		2.00		
Q_r	Recovered Charge	$V_R=600\text{V}, I_F=150\text{A},$ $-di/dt=3200\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=25^{\circ}\text{C}$		12.6		μC
I_{RM}	Peak Reverse Recovery Current			150		A
E_{rec}	Reverse Recovery Energy			6.28		mJ
Q_r	Recovered Charge	$V_R=600\text{V}, I_F=150\text{A},$ $-di/dt=3200\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=125^{\circ}\text{C}$		25.1		μC
I_{RM}	Peak Reverse Recovery Current			175		A
E_{rec}	Reverse Recovery Energy			11.3		mJ
Q_r	Recovered Charge	$V_R=600\text{V}, I_F=150\text{A},$ $-di/dt=3200\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=150^{\circ}\text{C}$		28.0		μC
I_{RM}	Peak Reverse Recovery Current			180		A
E_{rec}	Reverse Recovery Energy			12.9		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	$I_C=150\text{A}, T_j=150^{\circ}\text{C}$		1.17		V
I_R	Reverse Current	$T_j=150^{\circ}\text{C}, V_R=1600\text{V}$			2.0	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	$I_C=4.0\text{mA}, V_{CE}=V_{GE}, T_j=25^{\circ}\text{C}$	5.0	5.5	6.5	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			2		Ω
C_{ies}	Input Capacitance	$V_{CE}=25\text{V}, f=1\text{MHz}, V_{GE}=0\text{V}$		9.90		nF
C_{res}	Reverse Transfer Capacitance			0.30		nF
Q_G	Gate Charge	$V_{GE}=15\text{V}$		0.60		μC
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=100\text{A}, R_G=4.7\Omega, V_{GE}=\pm 15\text{V}, T_j=25^{\circ}\text{C}$		280		ns
t_r	Rise Time			54		ns
$t_{d(off)}$	Turn-Off Delay Time			313		ns
t_f	Fall Time			232		ns
E_{on}	Turn-On Switching Loss			3.50		mJ
E_{off}	Turn-Off Switching Loss			7.35		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=100\text{A}, R_G=4.7\Omega, V_{GE}=\pm 15\text{V}, T_j=125^{\circ}\text{C}$		281		ns
t_r	Rise Time			56		ns
$t_{d(off)}$	Turn-Off Delay Time			330		ns
t_f	Fall Time			379		ns
E_{on}	Turn-On Switching Loss			5.15		mJ
E_{off}	Turn-Off Switching Loss			11.3		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=100\text{A}, R_G=4.7\Omega, V_{GE}=\pm 15\text{V}, T_j=150^{\circ}\text{C}$		285		ns
t_r	Rise Time			56		ns
$t_{d(off)}$	Turn-Off Delay Time			350		ns
t_f	Fall Time			390		ns
E_{on}	Turn-On Switching Loss			5.60		mJ
E_{off}	Turn-Off Switching Loss			13.0		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	$I_C=50\text{A}, V_{GE}=0\text{V}, T_j=25^{\circ}\text{C}$		1.80	2.25	V
		$I_C=50\text{A}, V_{GE}=0\text{V}, T_j=125^{\circ}\text{C}$		1.85		
		$I_C=50\text{A}, V_{GE}=0\text{V}, T_j=150^{\circ}\text{C}$		1.85		
Q_r	Recovered Charge	$V_R=600\text{V}, I_F=50\text{A},$ $-di/dt=1000\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=25^{\circ}\text{C}$		6.5		μC
I_{RM}	Peak Reverse Recovery Current			45		A
E_{rec}	Reverse Recovery Energy			2.40		mJ
Q_r	Recovered Charge	$V_R=600\text{V}, I_F=50\text{A},$ $-di/dt=1000\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=125^{\circ}\text{C}$		12.7		μC
I_{RM}	Peak Reverse Recovery Current			55		A
E_{rec}	Reverse Recovery Energy			5.00		mJ
Q_r	Recovered Charge	$V_R=600\text{V}, I_F=50\text{A},$ $-di/dt=1000\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=150^{\circ}\text{C}$		14.0		μC
I_{RM}	Peak Reverse Recovery Current			57		A
E_{rec}	Reverse Recovery Energy			5.50		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

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 2.00		m Ω
$R_{\theta JC}$	Junction-to-Case (per IGBT-inverter) Junction-to-Case (per Diode-inverter) Junction-to-Case (per Diode-rectifier) Junction-to-Case (per IGBT-brake-chopper) Junction-to-Case (per Diode-brake-chopper)			0.138 0.302 0.247 0.181 0.401	K/W
$R_{\theta CS}$	Case-to-Sink (per IGBT-inverter) Case-to-Sink (per Diode-inverter) Case-to-Sink (per Diode-rectifier) Case-to-Sink (per IGBT-brake-chopper) Case-to-Sink (per Diode-brake-chopper)		0.119 0.260 0.213 0.156 0.345		K/W
$R_{\theta CS}$	Case-to-Sink		0.009		K/W
M	Mounting Torque, Screw:M5	3.0		6.0	N.m
G	Weight of Module		300		g

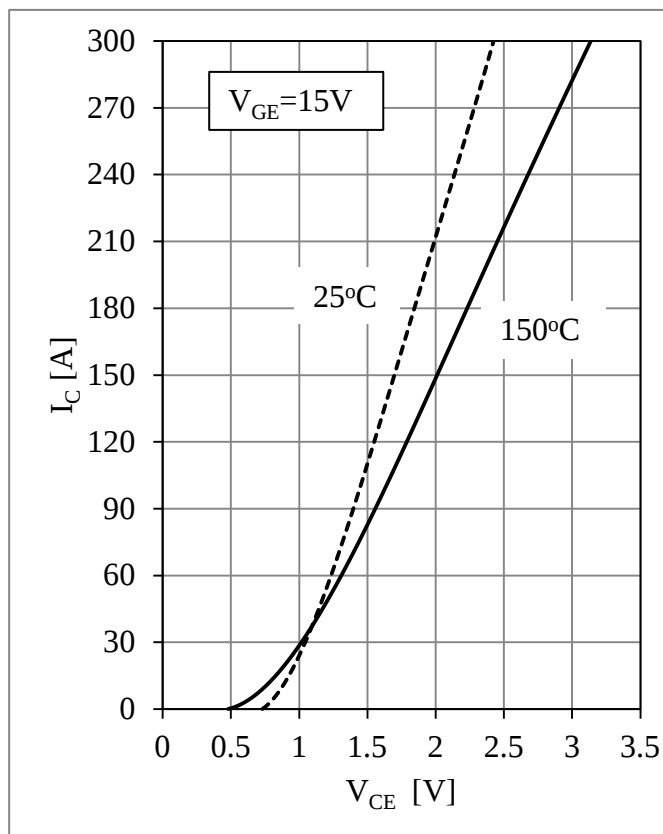


Fig 1. IGBT-inverter Output Characteristics

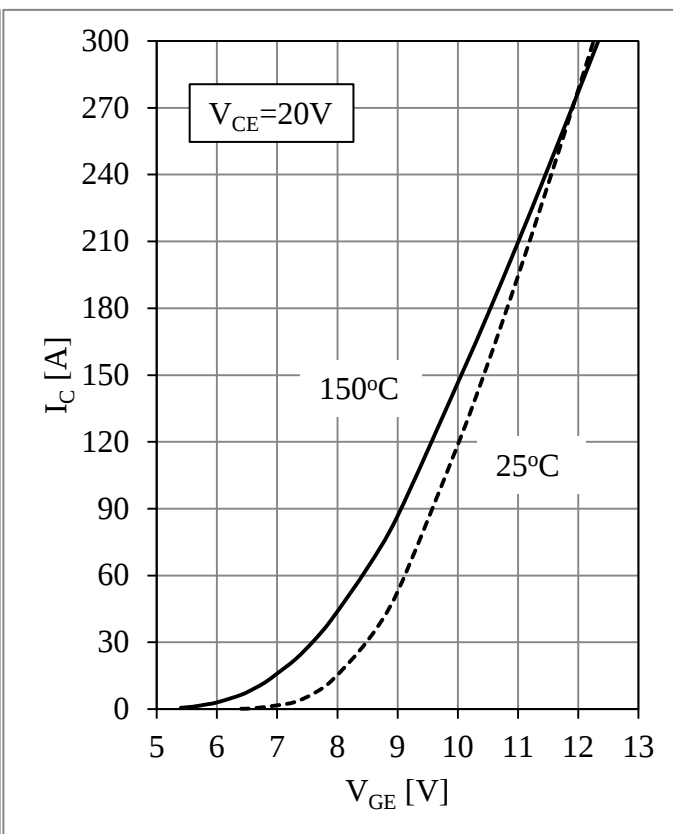
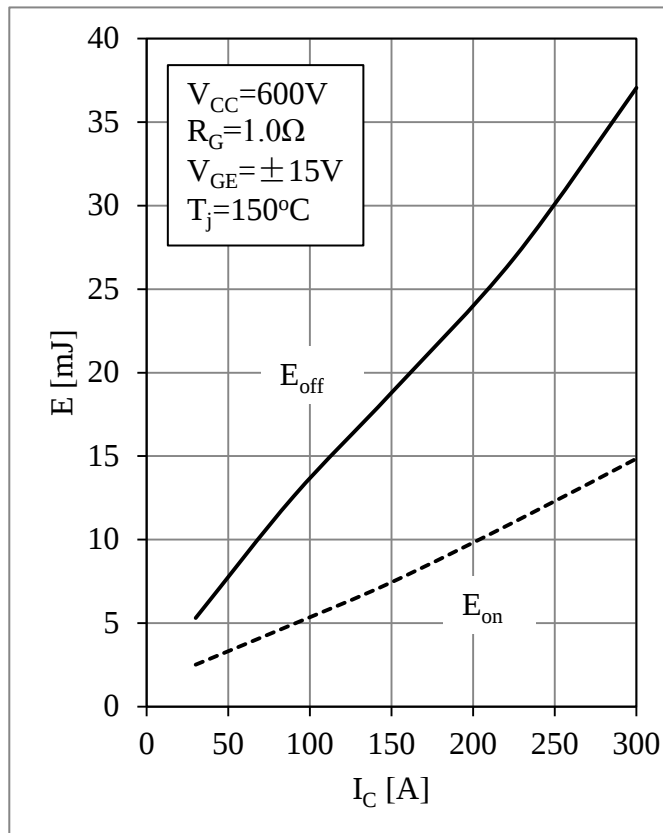
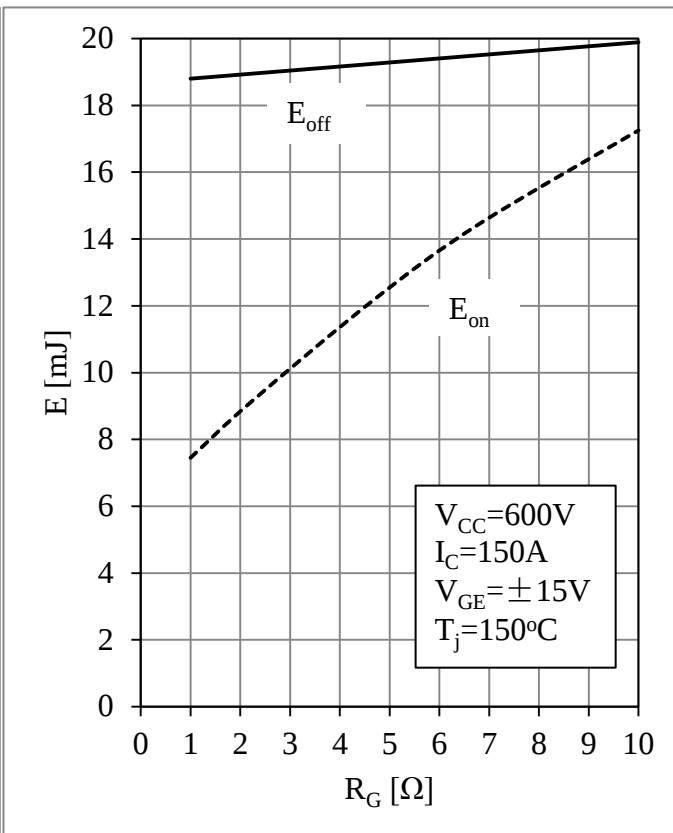


Fig 2. IGBT-inverter Transfer Characteristics

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

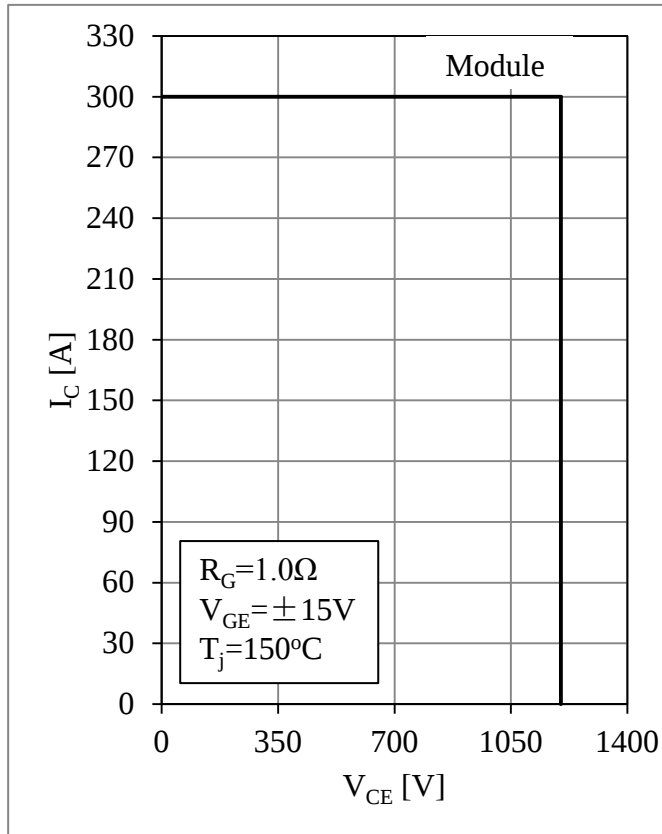


Fig 5. IGBT-inverter RBSOA

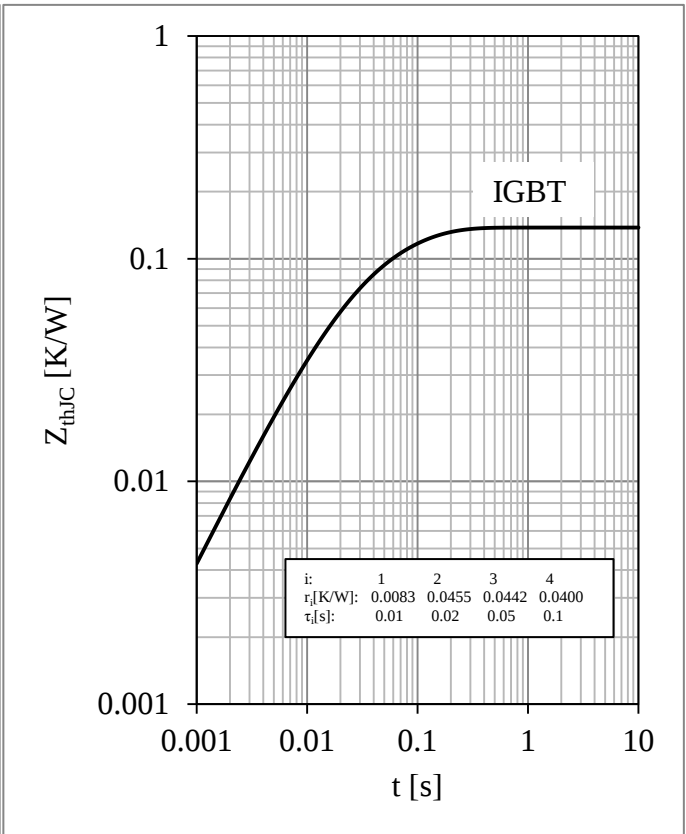


Fig 6. IGBT-inverter Transient Thermal Impedance

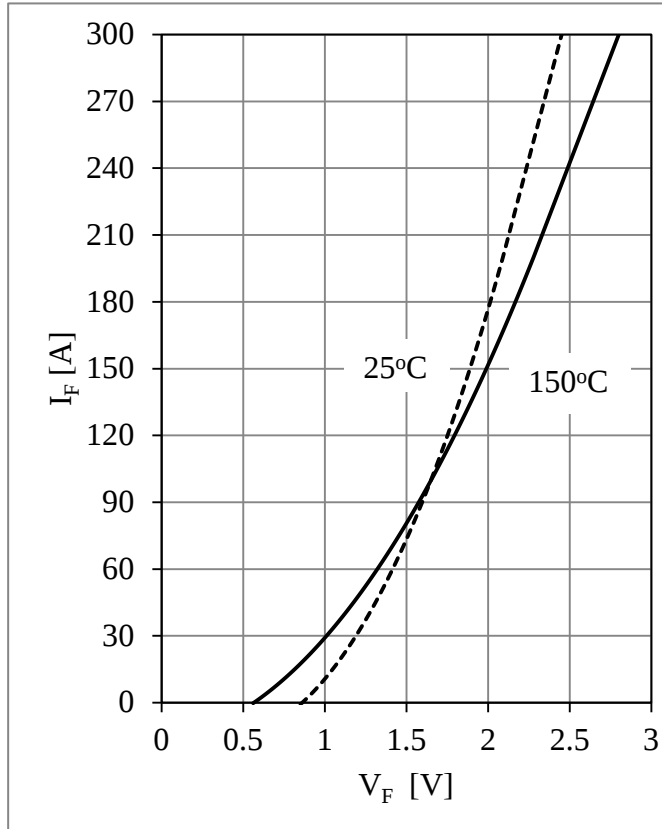
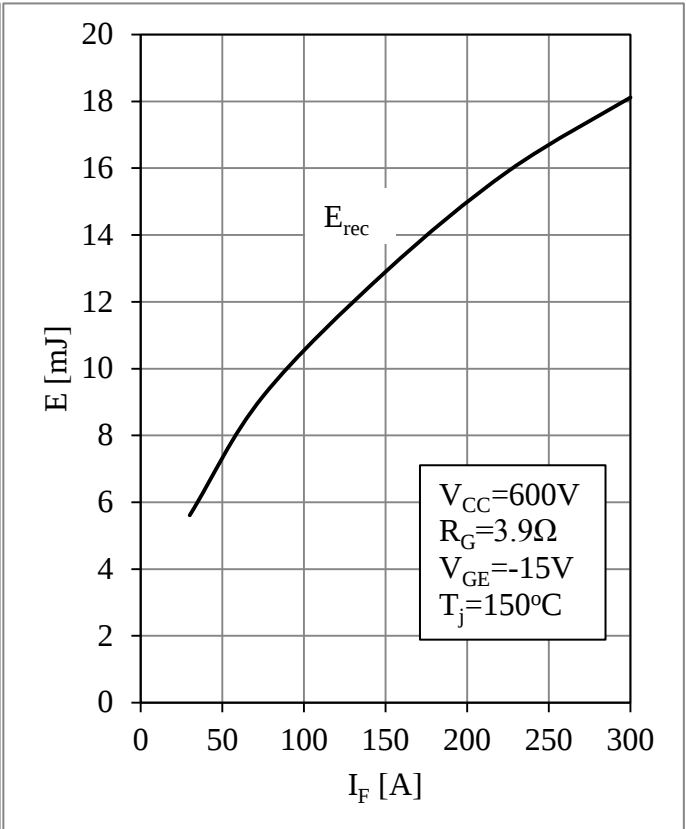


Fig 7. Diode-inverter Forward Characteristics

Fig 8. Diode-inverter Switching Loss vs. I_F

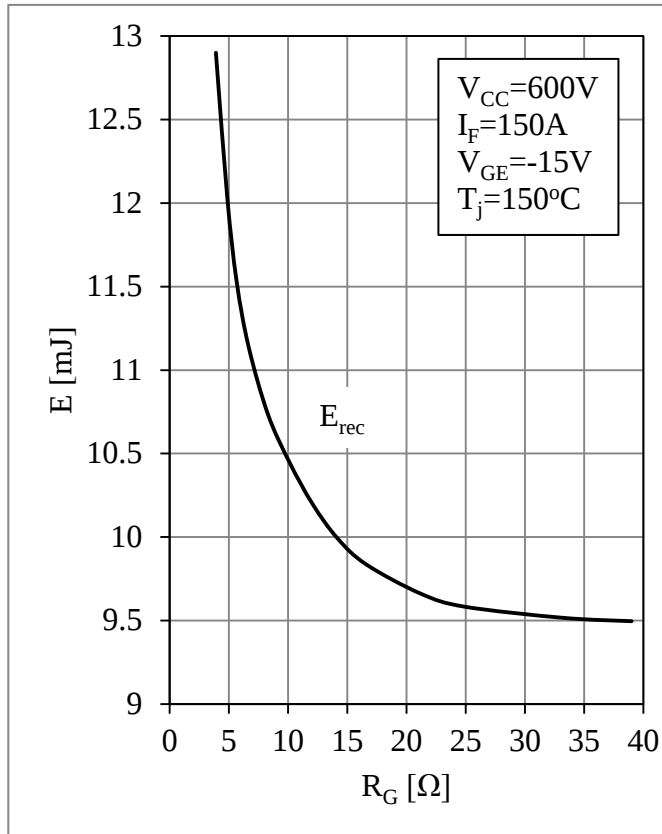
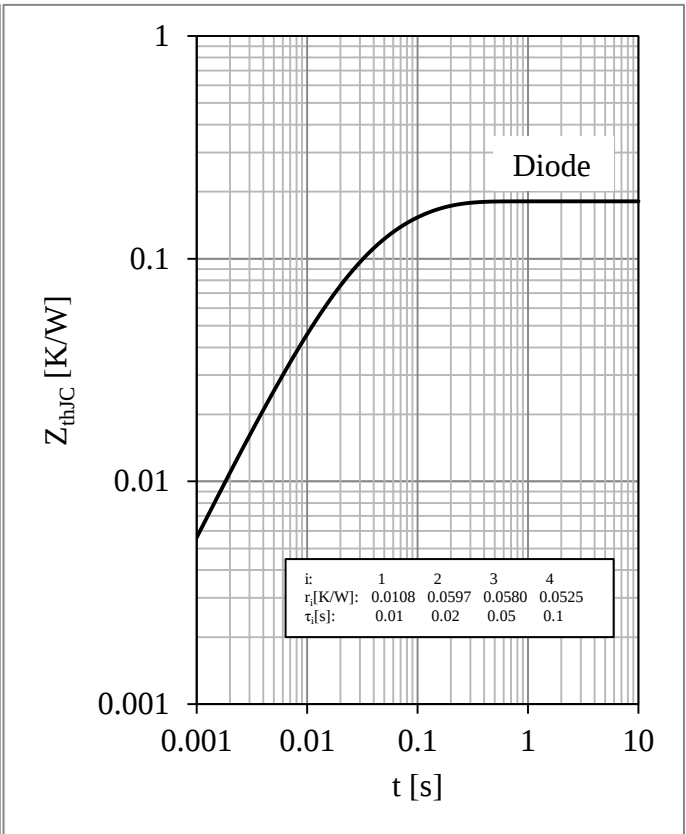
Fig 9. Diode-inverter Switching Loss vs. R_G 

Fig 10. Diode-inverter Transient Thermal Impedance

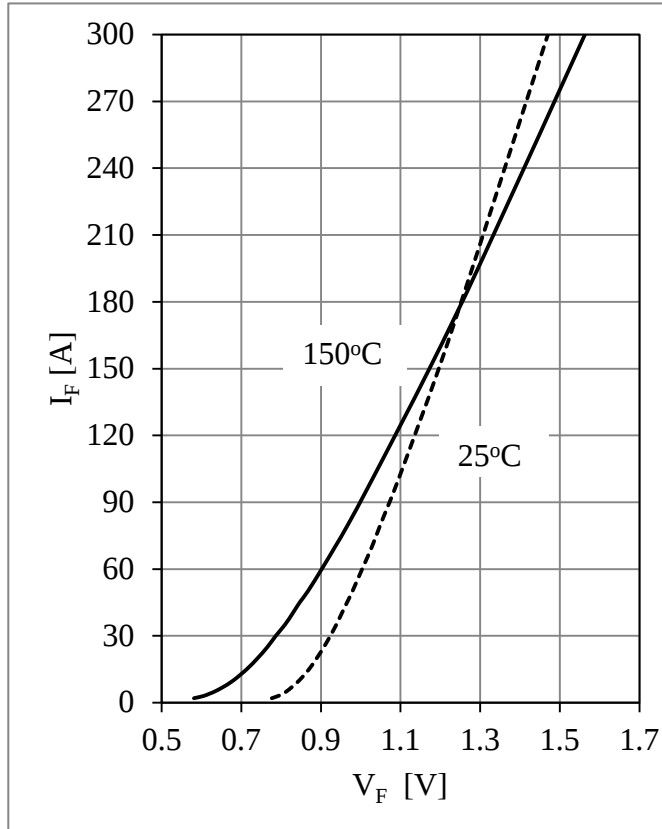


Fig 11. Diode-rectifier Forward Characteristics

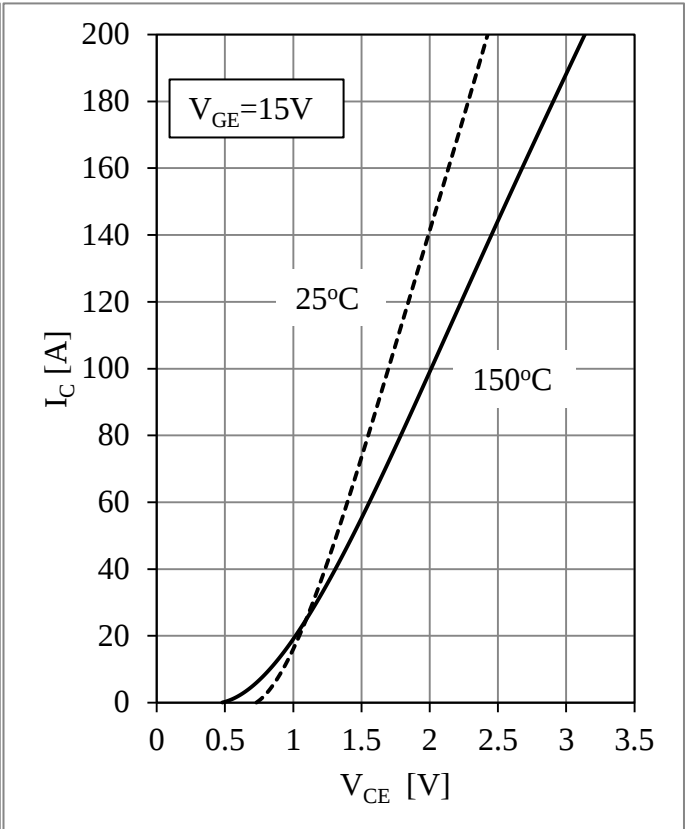


Fig 12. IGBT-brake-chopper Output Characteristics

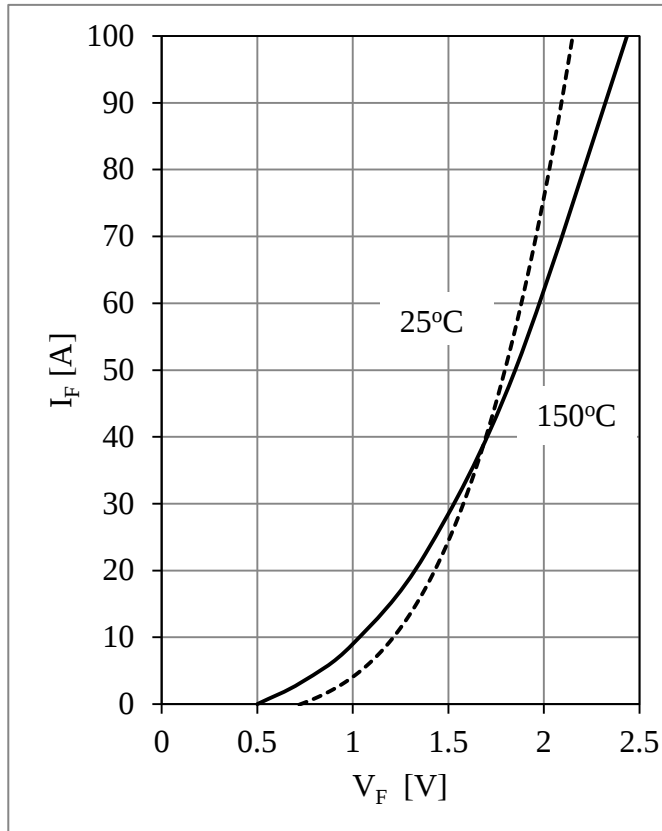


Fig 13. Diode-brake-chopper Forward Characteristics

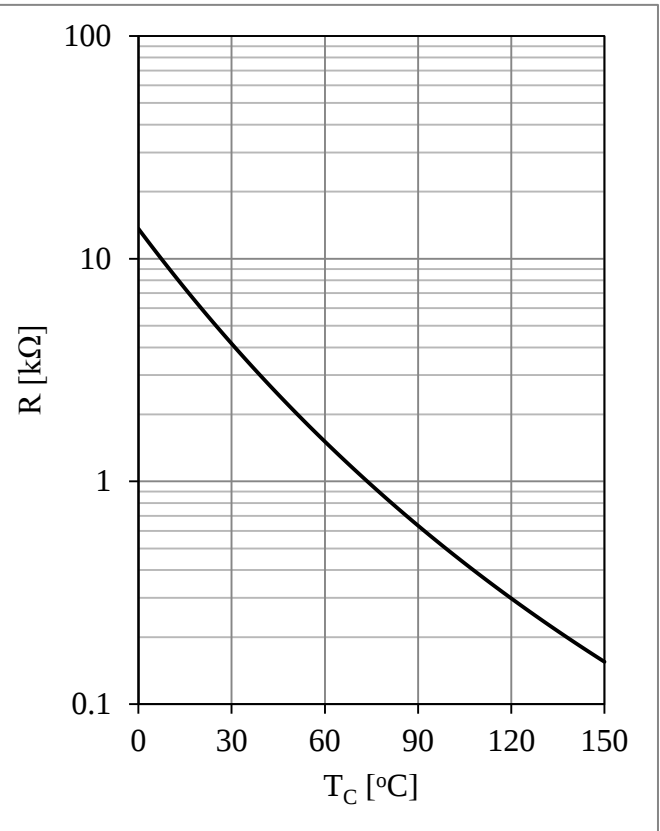
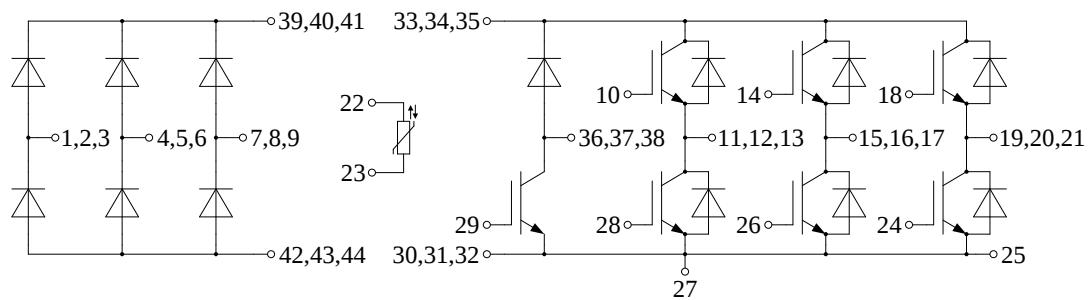


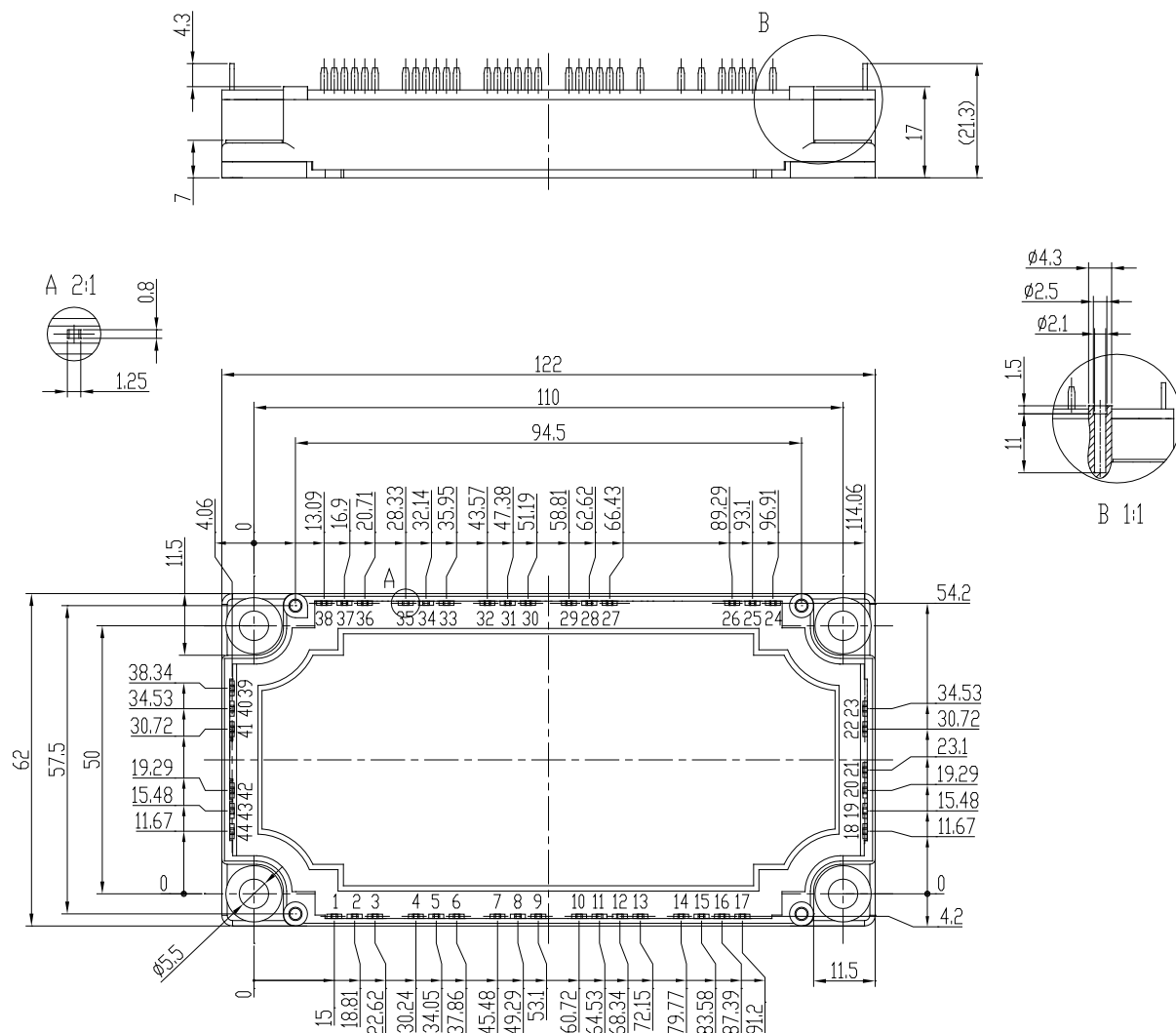
Fig 14. NTC Temperature Characteristic

Circuit Schematic



Package Dimensions

Dimensions in Millimeters



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