

STARPOWER

SEMICONDUCTOR

IGBT

GD50PIA120C5SN

1200V/50A 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.

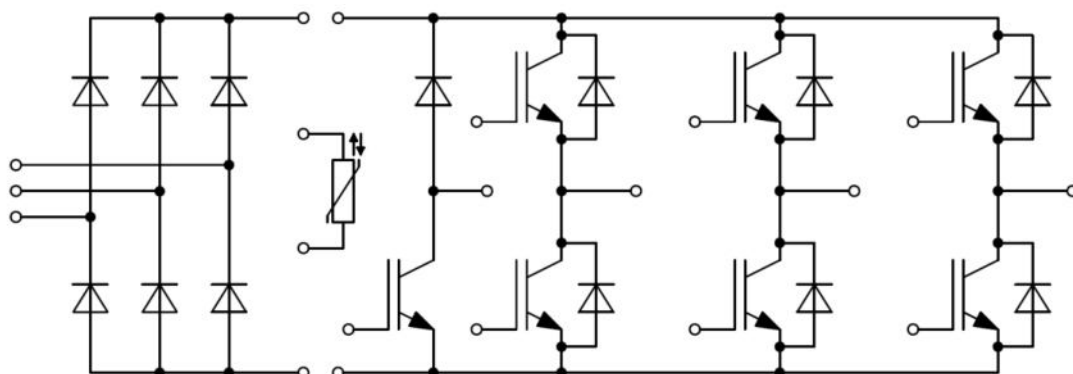
Features

- Low $V_{CE(sat)}$ Trench IGBT technology
- 8 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	± 20	V
I_C	Collector Current @ $T_C=100^{\circ}\text{C}$	50	A
I_{CRM}	Repetitive Peak Collector Current tp limited by T_{vjop}	100	A

Diode-inverter

Symbol	Description	Value	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	1200	V
I_F	Diode Continuous Forward Current	50	A
I_{FRM}	Repetitive Peak Forward Current tp limited by T_{vjop}	100	A
I_{FSM}	Surge Forward Current $t_p=10\text{ms}$ @ $T_{vj}=125^{\circ}\text{C}$ @ $T_{vj}=150^{\circ}\text{C}$	251 233	A
I^2t	I^2t -value, $t_p=10\text{ms}$ @ $T_{vj}=125^{\circ}\text{C}$ @ $T_{vj}=150^{\circ}\text{C}$	315 271	A^2s

Diode-rectifier

Symbol	Description	Value	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	1600	V
I_{FRMSM}	Maximum RMS Forward Current per Chip @ $T_C=80^{\circ}\text{C}$	70	A
I_{RMSM}	Maximum RMS Current at Rectifier Output @ $T_C=80^{\circ}\text{C}$	100	A
I_{FSM}	Surge Forward Current $t_p=10\text{ms}$ @ $T_{vj}=25^{\circ}\text{C}$ @ $T_{vj}=150^{\circ}\text{C}$	450 370	A
I^2t	I^2t -value, $t_p=10\text{ms}$ @ $T_{vj}=25^{\circ}\text{C}$ @ $T_{vj}=150^{\circ}\text{C}$	1000 685	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 @ $T_C=100^{\circ}\text{C}$	25	A
I_{CRM}	Repetitive Peak Collector Current tp limited by T_{vjop}	50	A

Diode-brake

Symbol	Description	Value	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	1200	V
I_F	Diode Continuous Forward Current	25	A
I_{FRM}	Repetitive Peak Forward Current tp limited by T_{vjop}	50	A
I_{FSM}	Surge Forward Current $t_p=10\text{ms}$ @ $T_{vj}=125^{\circ}\text{C}$ @ $T_{vj}=150^{\circ}\text{C}$	107 107	A
I^2t	I^2t -value, $t_p=10\text{ms}$ @ $T_{vj}=125^{\circ}\text{C}$ @ $T_{vj}=150^{\circ}\text{C}$	57 57	A^2s

Module

Symbol	Description	Value	Unit
T _{vjmax}	Maximum Junction Temperature(inverter,brake)	175	°C
	Maximum Junction Temperature (rectifier)	150	
T _{vjop}	Operating Junction Temperature	-40 to +150	°C
T _{STG}	Storage Temperature Range	-40 to +125	°C
V _{ISO}	Isolation Voltage RMS,f=50Hz,t=1 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	$I_C=50\text{A}, V_{GE}=15\text{V}, T_{vj}=25^{\circ}\text{C}$		1.50	1.95	V
		$I_C=50\text{A}, V_{GE}=15\text{V}, T_{vj}=125^{\circ}\text{C}$		1.70		
		$I_C=50\text{A}, V_{GE}=15\text{V}, T_{vj}=150^{\circ}\text{C}$		1.80		
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=1.00\text{mA}, V_{CE}=V_{GE}, T_{vj}=25^{\circ}\text{C}$	5.3	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	μA
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			0		Ω
C_{ies}	Input Capacitance	$V_{CE}=25\text{V}, f=1\text{MHz}, V_{GE}=0\text{V}$		4.42		nF
C_{res}	Reverse Transfer Capacitance			0.04		nF
Q_G	Gate Charge	$V_{GE}=-15\dots+15\text{V}$		0.32		μC
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=50\text{A}, R_G=18\Omega, L_S=35\text{nH}, V_{GE}=\pm 15\text{V}, T_{vj}=25^{\circ}\text{C}$		68		ns
t_r	Rise Time			39		ns
$t_{d(off)}$	Turn-Off Delay Time			303		ns
t_f	Fall Time			165		ns
E_{on}	Turn-On Switching Loss			4.77		mJ
E_{off}	Turn-Off Switching Loss			3.64		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=50\text{A}, R_G=18\Omega, L_S=35\text{nH}, V_{GE}=\pm 15\text{V}, T_{vj}=125^{\circ}\text{C}$		69		ns
t_r	Rise Time			42		ns
$t_{d(off)}$	Turn-Off Delay Time			370		ns
t_f	Fall Time			268		ns
E_{on}	Turn-On Switching Loss			6.06		mJ
E_{off}	Turn-Off Switching Loss			5.35		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=50\text{A}, R_G=18\Omega, L_S=35\text{nH}, V_{GE}=\pm 15\text{V}, T_{vj}=150^{\circ}\text{C}$		70		ns
t_r	Rise Time			44		ns
$t_{d(off)}$	Turn-Off Delay Time			380		ns
t_f	Fall Time			291		ns
E_{on}	Turn-On Switching Loss			6.45		mJ
E_{off}	Turn-Off Switching Loss			5.65		mJ
I_{SC}	SC Data	$t_p \leq 8\mu\text{s}, V_{GE}=15\text{V}, T_{vj}=150^{\circ}\text{C}, V_{CC}=600\text{V}, V_{CEM} \leq 1200\text{V}$		150		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	$I_F=50\text{A}, V_{GE}=0\text{V}, T_{vj}=25^{\circ}\text{C}$		1.60	2.05	V
		$I_F=50\text{A}, V_{GE}=0\text{V}, T_{vj}=125^{\circ}\text{C}$		1.65		
		$I_F=50\text{A}, V_{GE}=0\text{V}, T_{vj}=150^{\circ}\text{C}$		1.65		
Q_r	Recovered Charge	$V_R=600\text{V}, I_F=50\text{A},$ $-di/dt=1200\text{A}/\mu\text{s}, L_S=35\text{nH},$ $V_{GE}=-15\text{V}, T_{vj}=25^{\circ}\text{C}$		4.23		μC
I_{RM}	Peak Reverse Recovery Current			38		A
E_{rec}	Reverse Recovery Energy			1.22		mJ
Q_r	Recovered Charge	$V_R=600\text{V}, I_F=50\text{A},$ $-di/dt=1070\text{A}/\mu\text{s}, L_S=35\text{nH},$ $V_{GE}=-15\text{V}, T_{vj}=25^{\circ}\text{C}$		7.37		μC
I_{RM}	Peak Reverse Recovery Current			42		A
E_{rec}	Reverse Recovery Energy			2.48		mJ
Q_r	Recovered Charge	$V_R=600\text{V}, I_F=50\text{A},$ $-di/dt=1050\text{A}/\mu\text{s}, L_S=35\text{nH},$ $V_{GE}=-15\text{V}, T_{vj}=25^{\circ}\text{C}$		8.25		μC
I_{RM}	Peak Reverse Recovery Current			43		A
E_{rec}	Reverse Recovery Energy			2.84		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	$I_F=50\text{A}, V_{GE}=0\text{V}, T_{vj}=150^{\circ}\text{C}$		1.00		V
I_R	Reverse Current	$T_{vj}=150^{\circ}\text{C}, V_R=1600\text{V}$			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	$I_C=25\text{A}, V_{GE}=15\text{V}, T_{vj}=25^{\circ}\text{C}$		1.50	1.95	V
		$I_C=25\text{A}, V_{GE}=15\text{V}, T_{vj}=125^{\circ}\text{C}$		1.70		
		$I_C=25\text{A}, V_{GE}=15\text{V}, T_{vj}=150^{\circ}\text{C}$		1.80		
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=0.50\text{mA}, V_{CE}=V_{GE}, T_{vj}=25^{\circ}\text{C}$	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	μA
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			0		Ω
C_{ies}	Input Capacitance	$V_{CE}=25\text{V}, f=1\text{MHz}, V_{GE}=0\text{V}$		2.21		nF
C_{res}	Reverse Transfer Capacitance			0.02		nF
Q_G	Gate Charge	$V_{GE}=-15\dots+15\text{V}$		0.16		μC
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=25\text{A}, R_G=20\Omega, L_S=35\text{nH}, V_{GE}=\pm 15\text{V}, T_{vj}=25^{\circ}\text{C}$		30		ns
t_r	Rise Time			26		ns
$t_{d(off)}$	Turn-Off Delay Time			219		ns
t_f	Fall Time			197		ns
E_{on}	Turn-On Switching Loss			2.00		mJ
E_{off}	Turn-Off Switching Loss			1.78		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=25\text{A}, R_G=20\Omega, L_S=35\text{nH}, V_{GE}=\pm 15\text{V}, T_{vj}=125^{\circ}\text{C}$		28		ns
t_r	Rise Time			29		ns
$t_{d(off)}$	Turn-Off Delay Time			258		ns
t_f	Fall Time			294		ns
E_{on}	Turn-On Switching Loss			2.56		mJ
E_{off}	Turn-Off Switching Loss			2.45		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=25\text{A}, R_G=20\Omega, L_S=35\text{nH}, V_{GE}=\pm 15\text{V}, T_{vj}=150^{\circ}\text{C}$		27		ns
t_r	Rise Time			30		ns
$t_{d(off)}$	Turn-Off Delay Time			272		ns
t_f	Fall Time			329		ns
E_{on}	Turn-On Switching Loss			2.76		mJ
E_{off}	Turn-Off Switching Loss			2.62		mJ
I_{SC}	SC Data	$t_p \leq 8\mu\text{s}, V_{GE}=15\text{V}, T_{vj}=150^{\circ}\text{C}, V_{CC}=600\text{V}, V_{CEM} \leq 1200\text{V}$		75		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	$I_F=25\text{A}, V_{GE}=0\text{V}, T_{vj}=25^{\circ}\text{C}$		1.60	2.05	V
		$I_F=25\text{A}, V_{GE}=0\text{V}, T_{vj}=125^{\circ}\text{C}$		1.65		
		$I_F=25\text{A}, V_{GE}=0\text{V}, T_{vj}=150^{\circ}\text{C}$		1.65		

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 Ω
$\Delta R/R$	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		35		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)			0.513	K/W
	Junction-to-Case (per Diode-inverter)			0.846	
	Junction-to-Case (per Diode-rectifier)			0.759	
	Junction-to-Case (per IGBT-brake)			0.847	
	Junction-to-Case (per Diode-brake)			1.403	
R_{thCH}	Case-to-Sink (per IGBT-inverter)		0.153		K/W
	Case-to-Sink (per Diode-inverter)		0.161		
	Case-to-Sink (per Diode-rectifier)		0.146		
	Case-to-Sink (per IGBT-brake)		0.187		
	Case-to-Sink (per Diode-brake)		0.172		
M	Mounting Torque, Screw:M5	3.0		6.0	N.m
G	Weight of Module		200		g

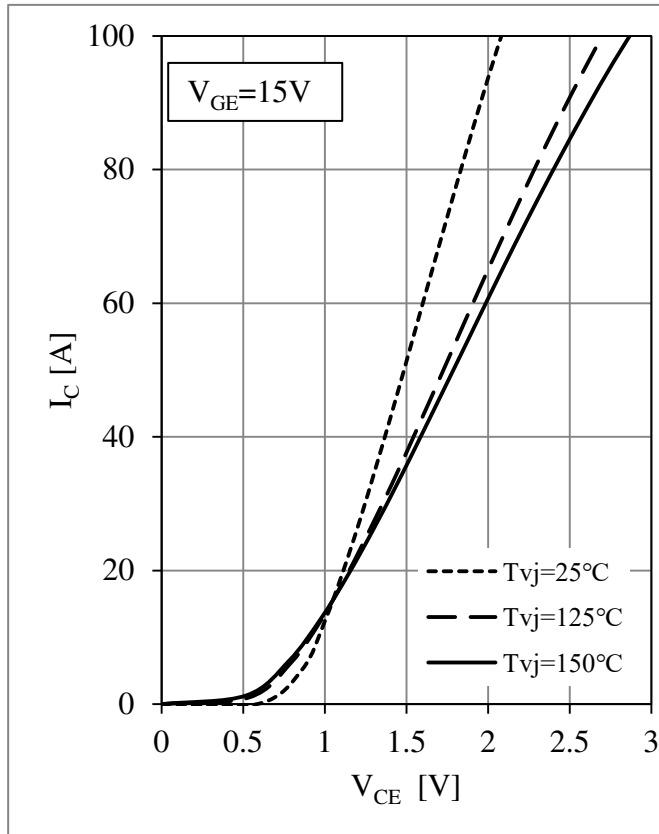


Fig 1. IGBT-inverter Output Characteristics

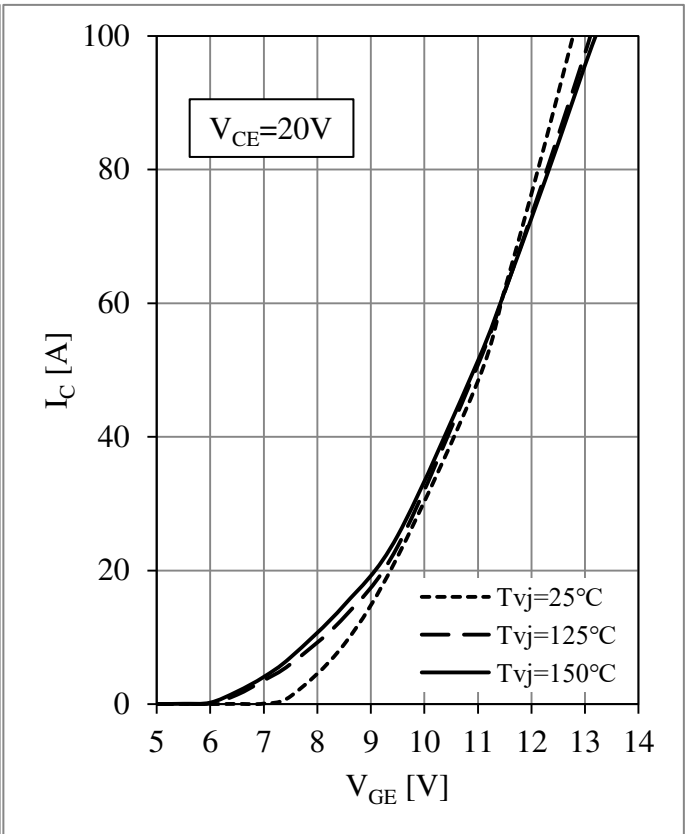
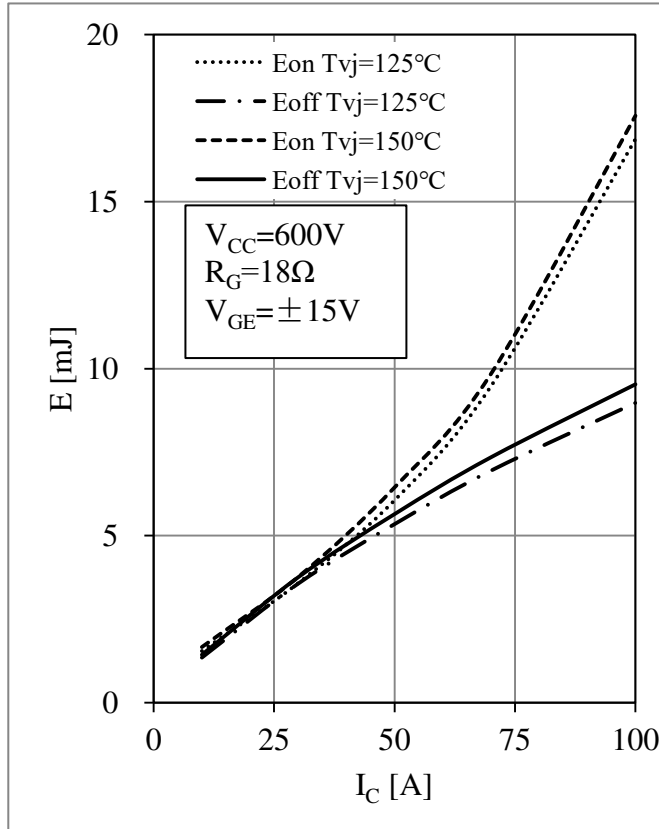
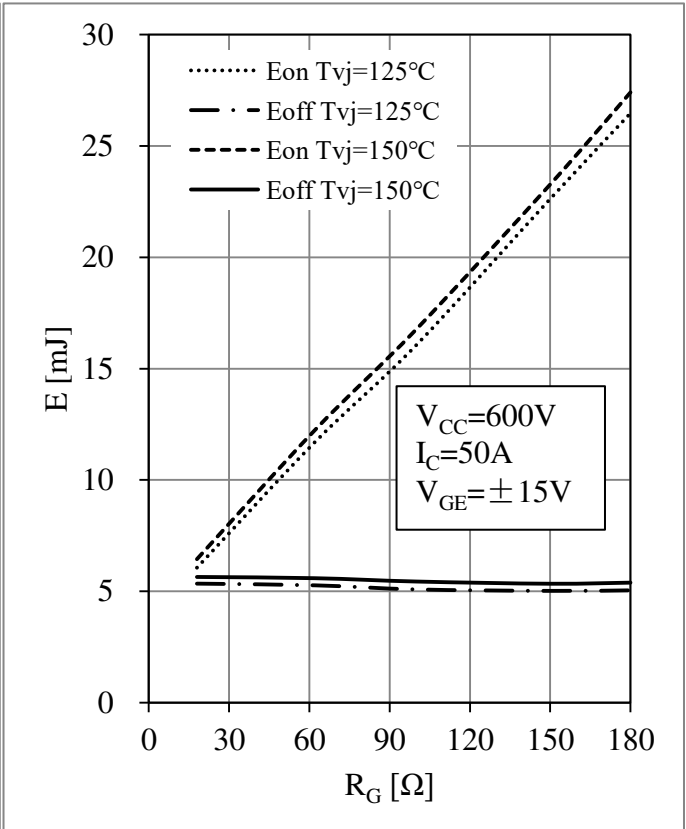


Fig 2. IGBT-inverter Transfer Characteristics

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

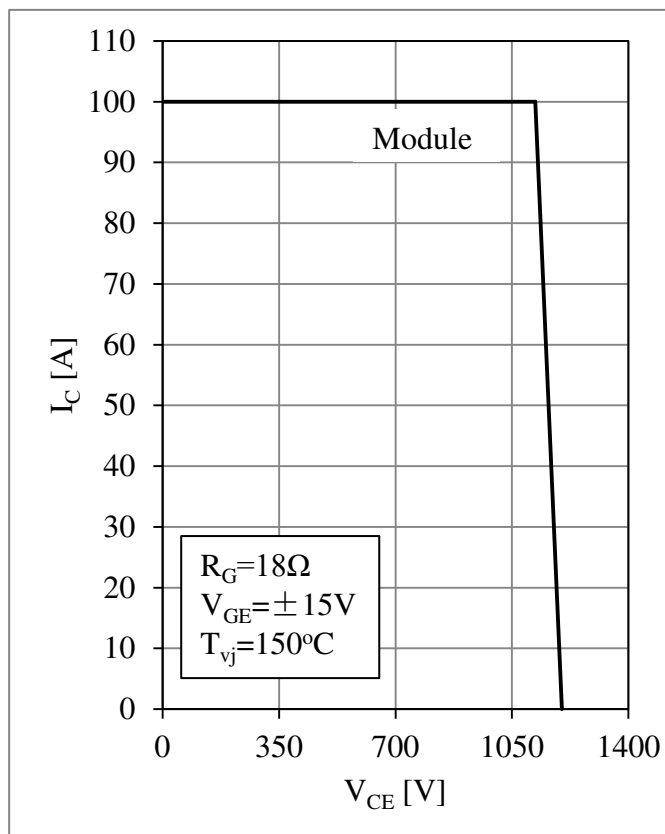


Fig 5. IGBT-inverter RBSOA

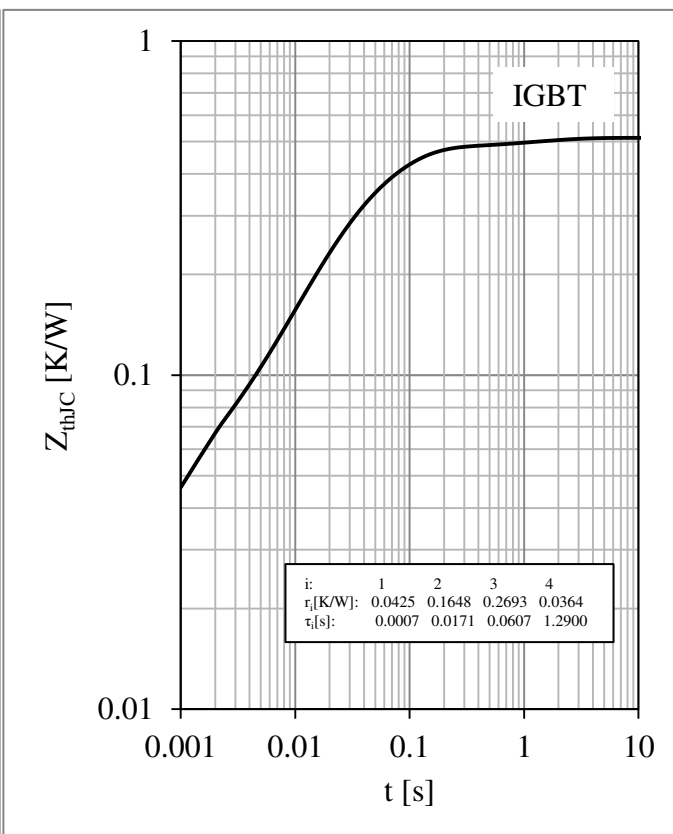


Fig 6. IGBT-inverter Transient Thermal Impedance

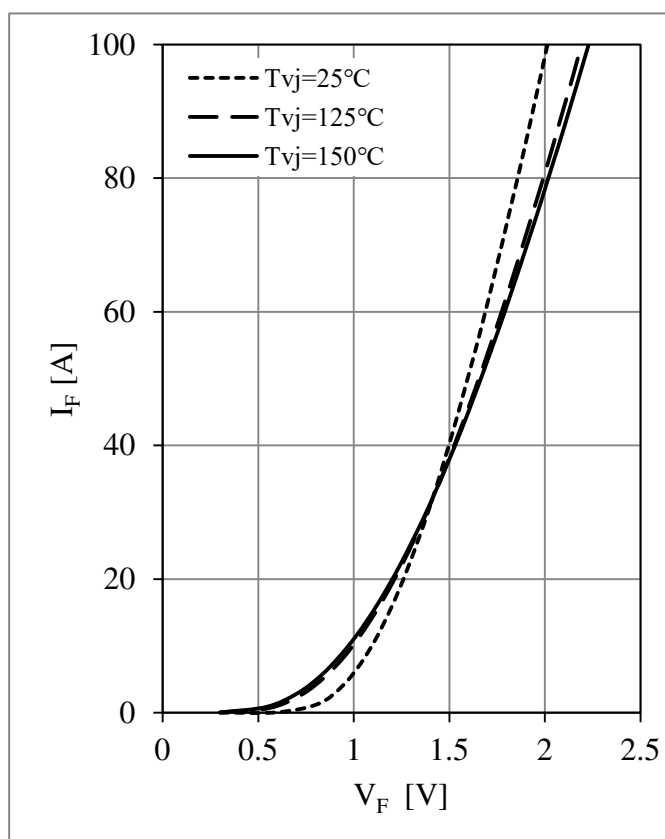
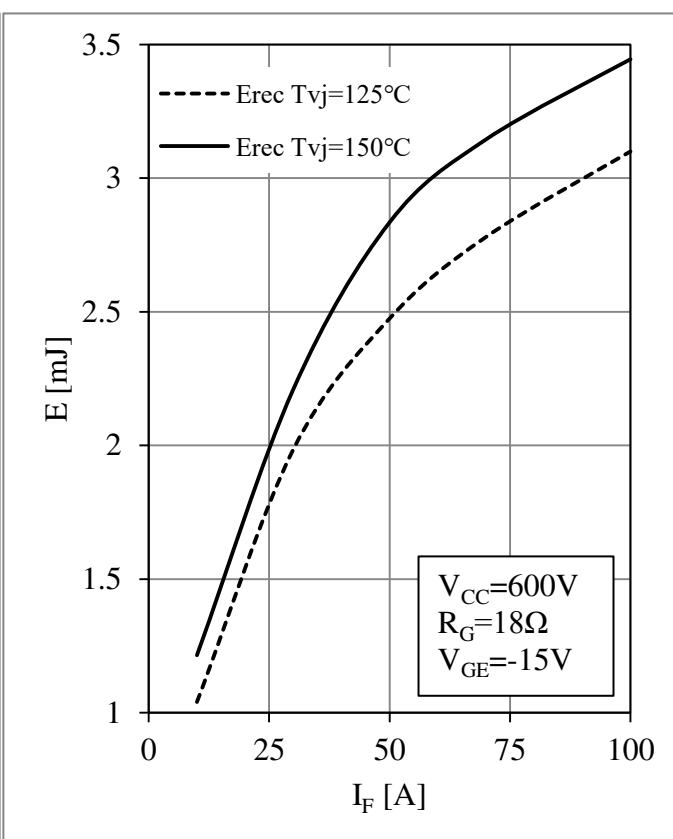
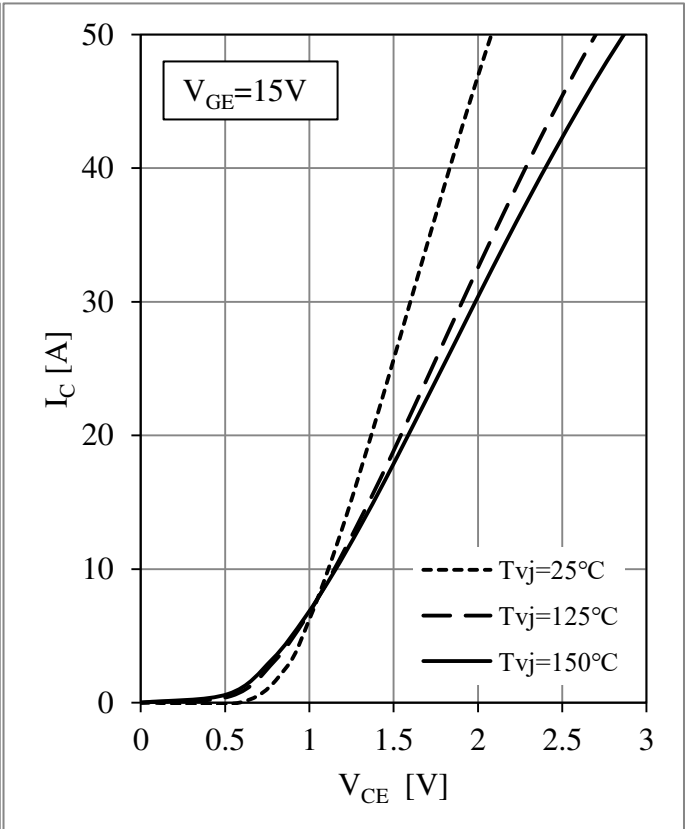
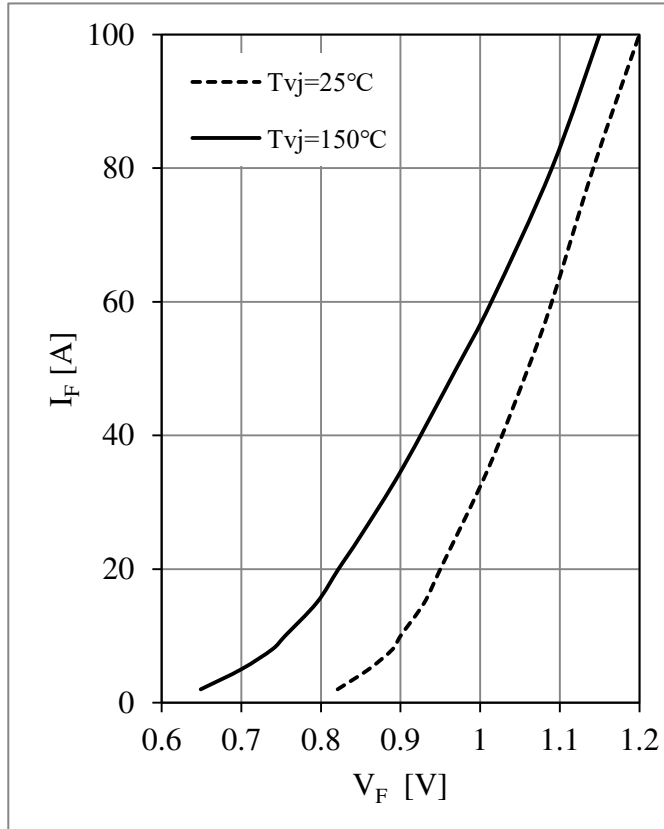
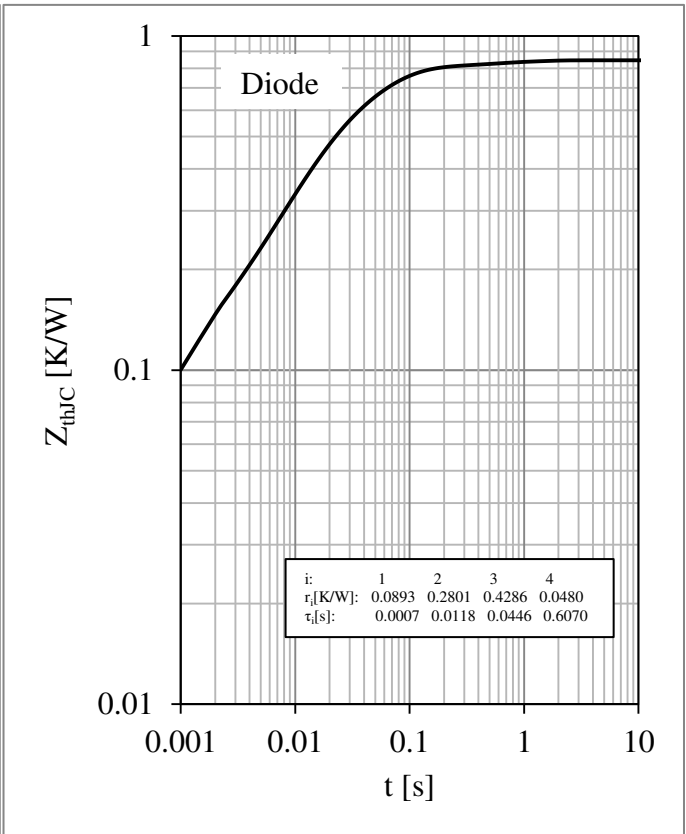
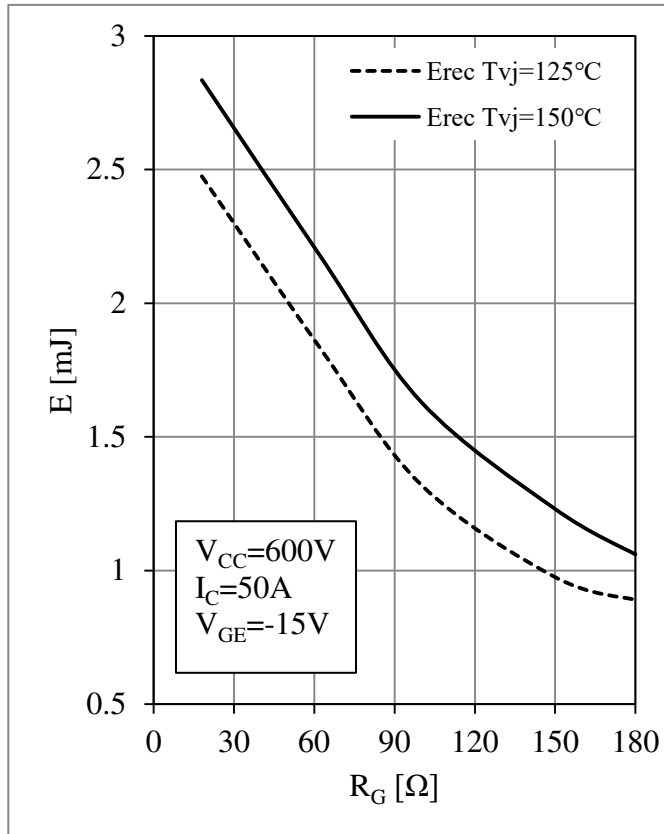


Fig 7. Diode-inverter Forward Characteristics

Fig 8. Diode-inverter Switching Loss vs. I_F



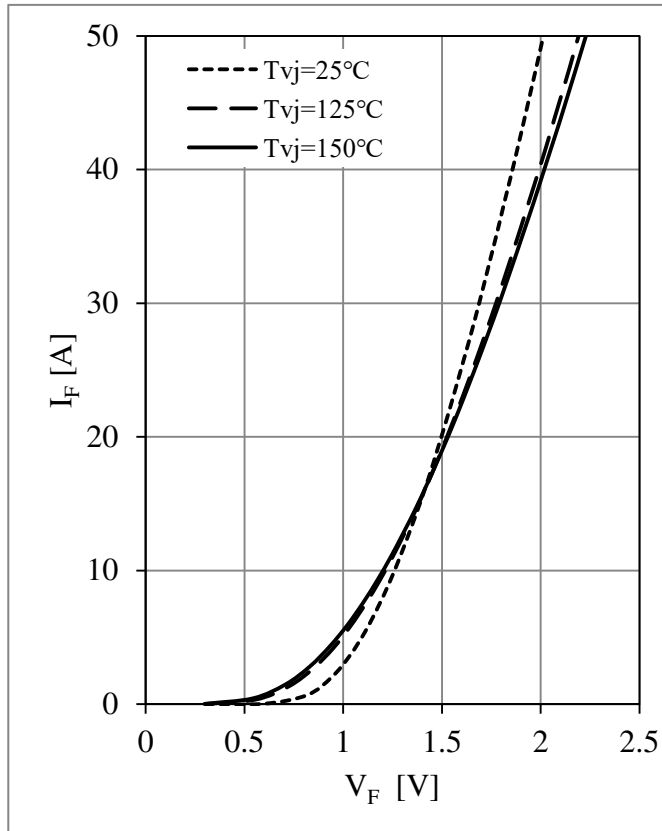


Fig 13. Diode-brake-chopper Forward Characteristics

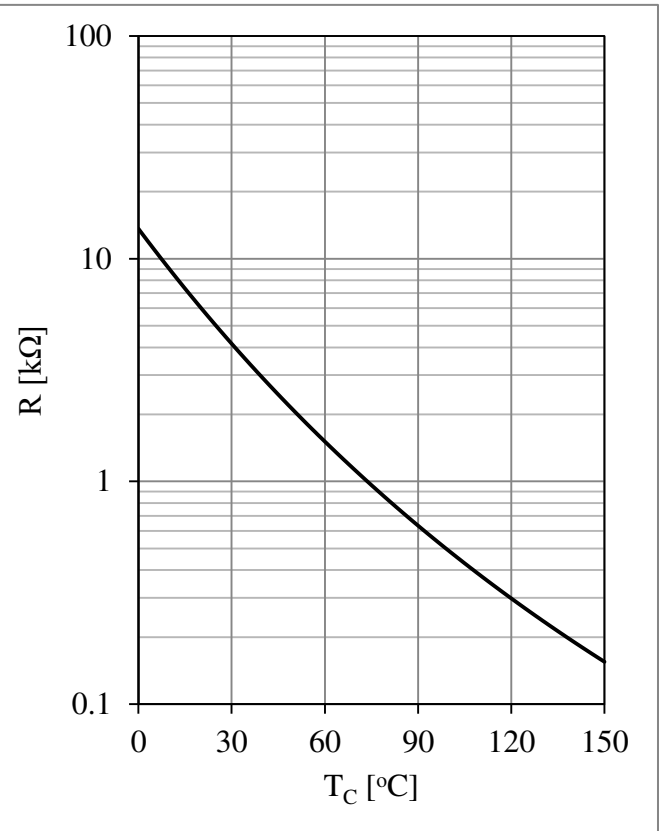
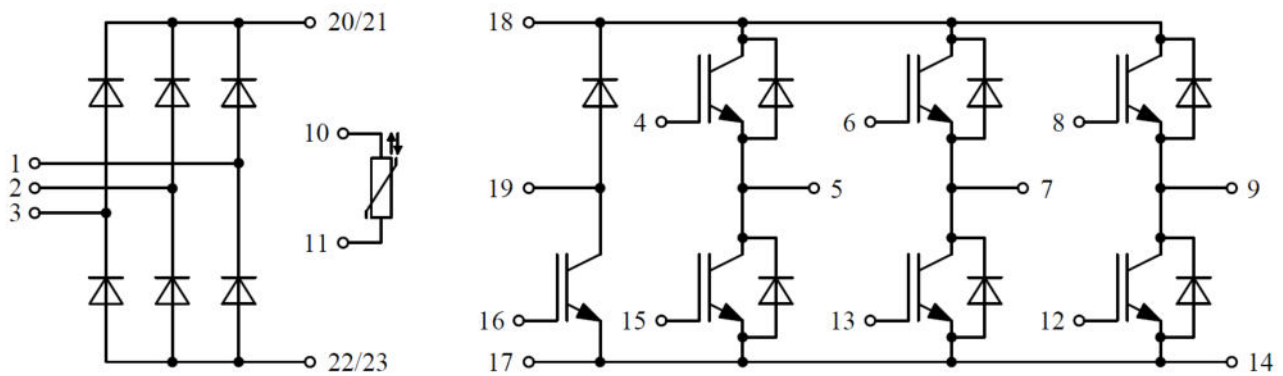


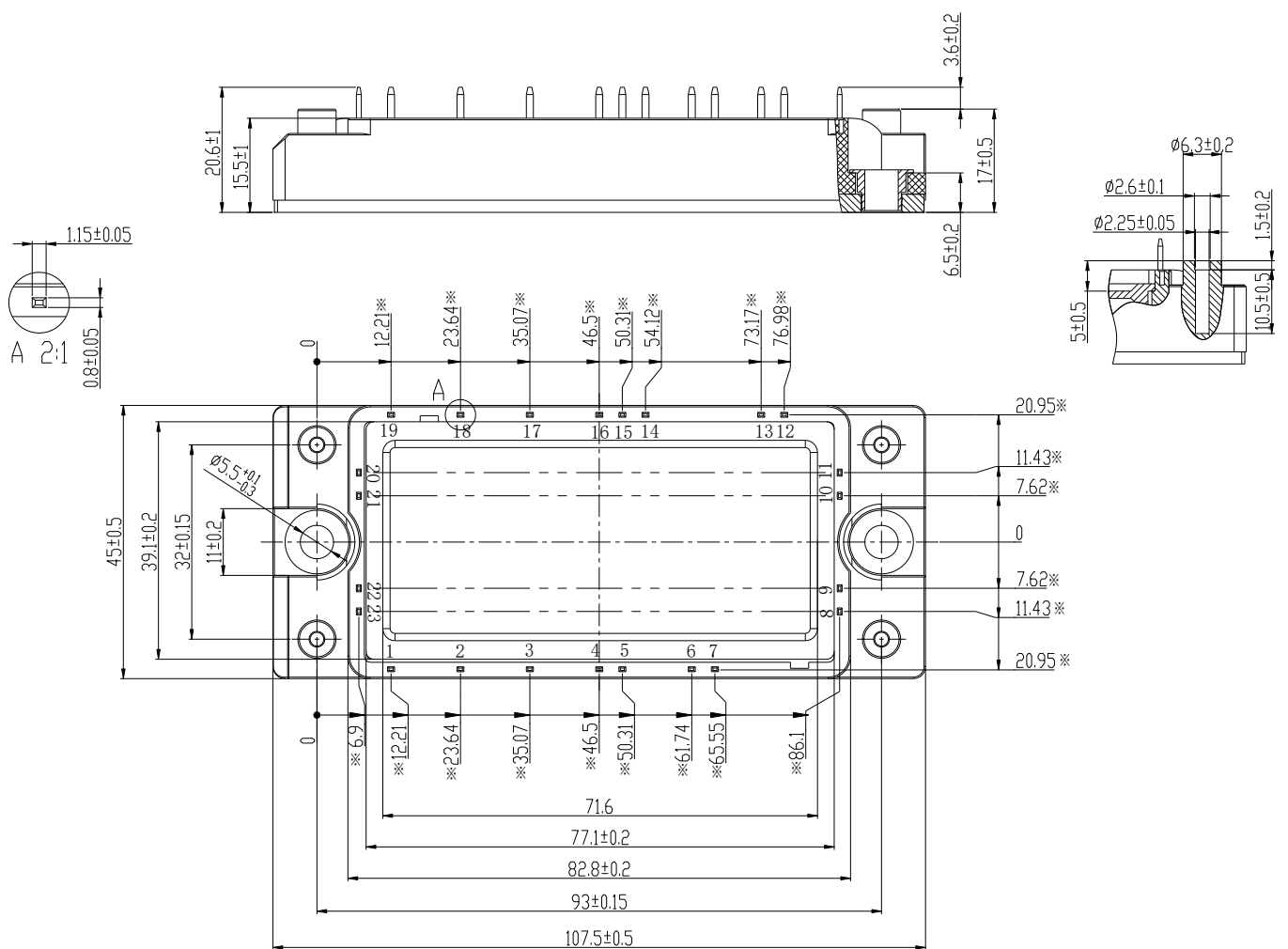
Fig 14. NTC Temperature Characteristic

Circuit Schematic



Package Dimensions

Dimensions in Millimeters



※: all dimensions with a tolerance of ± 0.4

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