

STARPOWER

SEMICONDUCTOR

IGBT

GD25PIY120C5SN

1200V/25A 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

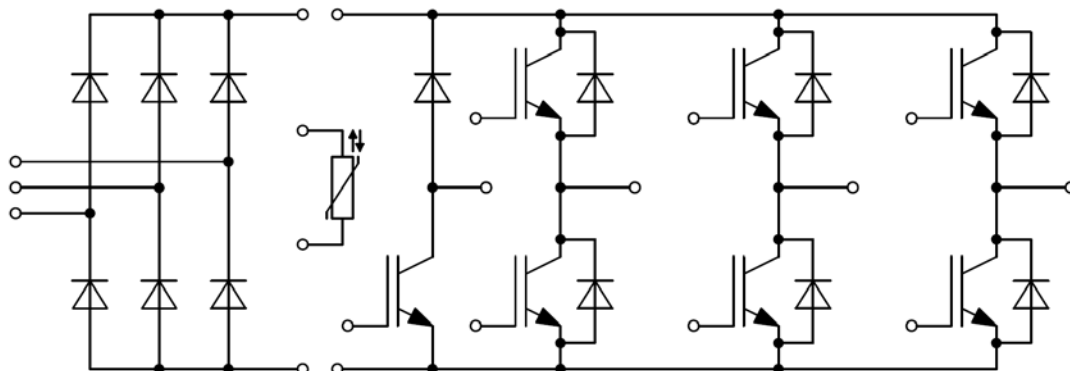
- Low $V_{CE(sat)}$ Trench IGBT technology
- 10 μ s short circuit capability
- $V_{CE(sat)}$ with positive temperature coefficient
- Maximum junction temperature 175°C
- Low inductance case
- Fast & soft reverse recovery anti-parallel FWD
- Isolated copper baseplate using DBC technology



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	± 20	V
I_C	Collector Current @ $T_C=25^{\circ}\text{C}$	50	A
	@ $T_C=100^{\circ}\text{C}$	25	A
I_{CM}	Pulsed Collector Current $t_p=1\text{ms}$	50	A
P_D	Maximum Power Dissipation @ $T_j=175^{\circ}\text{C}$	206	W

Diode-inverter

Symbol	Description	Value	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	1200	V
I_F	Diode Continuous Forward Current	25	A
I_{FM}	Diode Maximum Forward Current $t_p=1\text{ms}$	50	A

Diode-rectifier

Symbol	Description	Value	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	1600	V
I_O	Average Output Current 50Hz/60Hz,sine wave	25	A
I_{FSM}	Surge Forward Current $V_R=0\text{V}, t_p=10\text{ms}, T_j=45^{\circ}\text{C}$	320	A
I^2t	I^2t -value, $V_R=0\text{V}, t_p=10\text{ms}, T_j=45^{\circ}\text{C}$	510	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 @ $T_C=25^{\circ}\text{C}$	50	A
	@ $T_C=100^{\circ}\text{C}$	25	A
I_{CM}	Pulsed Collector Current $t_p=1\text{ms}$	50	A
P_D	Maximum Power Dissipation @ $T_j=175^{\circ}\text{C}$	206	W

Diode-brake

Symbol	Description	Value	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	1200	V
I_F	Diode Continuous Forward Current	10	A
I_{FM}	Diode Maximum Forward Current $t_p=1\text{ms}$	20	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, $f=50\text{Hz}, t=1\text{min}$	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	$I_C=25\text{A}, V_{GE}=15\text{V}, T_j=25^\circ\text{C}$		1.70	2.15	V	
		$I_C=25\text{A}, V_{GE}=15\text{V}, T_j=125^\circ\text{C}$		1.95			
		$I_C=25\text{A}, V_{GE}=15\text{V}, T_j=150^\circ\text{C}$		2.00			
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=0.63\text{mA}, V_{CE}=V_{GE}, T_j=25^\circ\text{C}$	5.2	6.0	6.8	V	
I_{CES}	Collector Cut-Off Current	$V_{CE}=V_{CES}, V_{GE}=0\text{V}, T_j=25^\circ\text{C}$			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			0		Ω	
C_{ies}	Input Capacitance	$V_{CE}=25\text{V}, f=1\text{MHz}, V_{GE}=0\text{V}$		2.59		nF	
C_{res}	Reverse Transfer Capacitance			0.07		nF	
Q_G	Gate Charge	$V_{GE}=-15\dots+15\text{V}$		0.19		μC	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=25\text{A}, R_G=20\Omega, V_{GE}=\pm 15\text{V}, T_j=25^\circ\text{C}$		28		ns	
t_r	Rise Time			17		ns	
$t_{d(off)}$	Turn-Off Delay Time			196		ns	
t_f	Fall Time			185		ns	
E_{on}	Turn-On Switching Loss			1.71		mJ	
E_{off}	Turn-Off Switching Loss			1.49		mJ	
$t_{d(on)}$	Turn-On Delay Time		$V_{CC}=600\text{V}, I_C=25\text{A}, R_G=20\Omega, V_{GE}=\pm 15\text{V}, T_j=125^\circ\text{C}$		28		ns
t_r	Rise Time				21		ns
$t_{d(off)}$	Turn-Off Delay Time			288		ns	
t_f	Fall Time			216		ns	
E_{on}	Turn-On Switching Loss			2.57		mJ	
E_{off}	Turn-Off Switching Loss			2.21		mJ	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=25\text{A}, R_G=20\Omega, V_{GE}=\pm 15\text{V}, T_j=150^\circ\text{C}$			28		ns
t_r	Rise Time				22		ns
$t_{d(off)}$	Turn-Off Delay Time			309		ns	
t_f	Fall Time			227		ns	
E_{on}	Turn-On Switching Loss			2.78		mJ	
E_{off}	Turn-Off Switching Loss			2.42		mJ	
I_{SC}	SC Data		$t_p \leq 10\mu\text{s}, V_{GE}=15\text{V}, T_j=150^\circ\text{C}, V_{CC}=900\text{V}, V_{CEM} \leq 1200\text{V}$		100		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	$I_F=25\text{A}, V_{GE}=0\text{V}, T_j=25^\circ\text{C}$		2.10	2.55	V
		$I_F=25\text{A}, V_{GE}=0\text{V}, T_j=125^\circ\text{C}$		2.15		
		$I_F=25\text{A}, V_{GE}=0\text{V}, T_j=150^\circ\text{C}$		2.15		
Q_r	Recovered Charge	$V_R=600\text{V}, I_F=25\text{A},$ $-di/dt=800\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=25^\circ\text{C}$		1.3		μC
I_{RM}	Peak Reverse Recovery Current			31		A
E_{rec}	Reverse Recovery Energy			0.68		mJ
Q_r	Recovered Charge	$V_R=600\text{V}, I_F=25\text{A},$ $-di/dt=800\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=125^\circ\text{C}$		2.2		μC
I_{RM}	Peak Reverse Recovery Current			38		A
E_{rec}	Reverse Recovery Energy			1.46		mJ
Q_r	Recovered Charge	$V_R=600\text{V}, I_F=25\text{A},$ $-di/dt=800\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=150^\circ\text{C}$		2.4		μC
I_{RM}	Peak Reverse Recovery Current			40		A
E_{rec}	Reverse Recovery Energy			1.91		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	$I_F=25\text{A}, T_j=150^\circ\text{C}$		1.02		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	$I_C=25\text{A}, V_{GE}=15\text{V}, T_j=25^\circ\text{C}$		1.70	2.15	V	
		$I_C=25\text{A}, V_{GE}=15\text{V}, T_j=125^\circ\text{C}$		1.95			
		$I_C=25\text{A}, V_{GE}=15\text{V}, T_j=150^\circ\text{C}$		2.00			
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=0.63\text{mA}, V_{CE}=V_{GE}, T_j=25^\circ\text{C}$	5.2	6.0	6.8	V	
I_{CES}	Collector Cut-Off Current	$V_{CE}=V_{CES}, V_{GE}=0\text{V}, T_j=25^\circ\text{C}$			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			0		Ω	
C_{ies}	Input Capacitance	$V_{CE}=25\text{V}, f=1\text{MHz}, V_{GE}=0\text{V}$		2.59		nF	
C_{res}	Reverse Transfer Capacitance				0.07		nF
Q_G	Gate Charge	$V_{GE}=-15\dots+15\text{V}$		0.19		μC	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=25\text{A}, R_G=20\Omega, V_{GE}=\pm 15\text{V}, T_j=25^\circ\text{C}$		28		ns	
t_r	Rise Time			17		ns	
$t_{d(off)}$	Turn-Off Delay Time			196		ns	
t_f	Fall Time			185		ns	
E_{on}	Turn-On Switching Loss			1.71		mJ	
E_{off}	Turn-Off Switching Loss			1.49		mJ	
$t_{d(on)}$	Turn-On Delay Time		$V_{CC}=600\text{V}, I_C=25\text{A}, R_G=20\Omega, V_{GE}=\pm 15\text{V}, T_j=125^\circ\text{C}$		28		ns
t_r	Rise Time				21		ns
$t_{d(off)}$	Turn-Off Delay Time			288		ns	
t_f	Fall Time			216		ns	
E_{on}	Turn-On Switching Loss			2.57		mJ	
E_{off}	Turn-Off Switching Loss			2.21		mJ	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=25\text{A}, R_G=20\Omega, V_{GE}=\pm 15\text{V}, T_j=150^\circ\text{C}$			28		ns
t_r	Rise Time				22		ns
$t_{d(off)}$	Turn-Off Delay Time			309		ns	
t_f	Fall Time			227		ns	
E_{on}	Turn-On Switching Loss			2.78		mJ	
E_{off}	Turn-Off Switching Loss			2.42		mJ	
I_{SC}	SC Data		$t_p \leq 10\mu\text{s}, V_{GE}=15\text{V}, T_j=150^\circ\text{C}, V_{CC}=900\text{V}, V_{CEM} \leq 1200\text{V}$		100		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	$I_F=10\text{A}, V_{GE}=0\text{V}, T_j=25^\circ\text{C}$		1.85	2.30	V
		$I_F=10\text{A}, V_{GE}=0\text{V}, T_j=125^\circ\text{C}$		2.05		
		$I_F=10\text{A}, V_{GE}=0\text{V}, T_j=150^\circ\text{C}$		2.10		
Q_r	Recovered Charge	$V_R=600\text{V}, I_F=10\text{A},$ $-di/dt=500\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=25^\circ\text{C}$		0.86		μC
I_{RM}	Peak Reverse Recovery Current			8		A
E_{rec}	Reverse Recovery Energy			0.23		mJ
Q_r	Recovered Charge	$V_R=600\text{V}, I_F=10\text{A},$ $-di/dt=500\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=125^\circ\text{C}$		1.6		μC
I_{RM}	Peak Reverse Recovery Current			10		A
E_{rec}	Reverse Recovery Energy			0.49		mJ
Q_r	Recovered Charge	$V_R=600\text{V}, I_F=10\text{A},$ $-di/dt=500\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=150^\circ\text{C}$		1.8		μC
I_{RM}	Peak Reverse Recovery Current			11		A
E_{rec}	Reverse Recovery Energy			0.56		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		60		nH
$R_{CC'+EE'}$	Module Lead Resistance, Terminal to Chip		4.00 2.00		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-chopper) Junction-to-Case (per Diode-brake-chopper)			0.728 1.285 1.021 0.728 1.575	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-chopper) Case-to-Heatsink (per Diode-brake-chopper) Case-to-Heatsink (per Module)		0.303 0.534 0.425 0.303 0.655 0.020		K/W
M	Mounting Torque, Screw:M5	3.0		6.0	N.m
G	Weight of Module		180		g

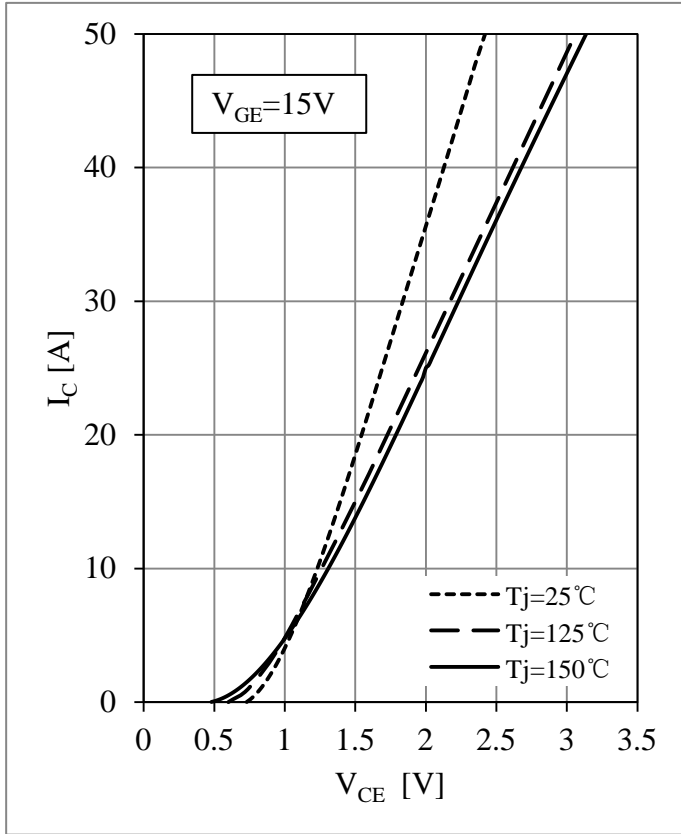


Fig 1. IGBT-inverter Output Characteristics

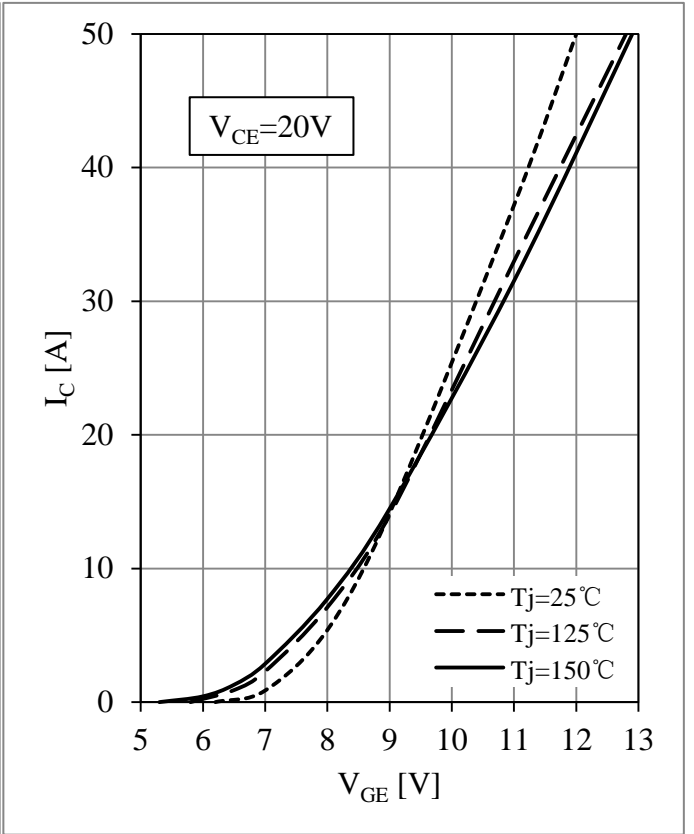


Fig 2. IGBT-inverter Transfer Characteristics

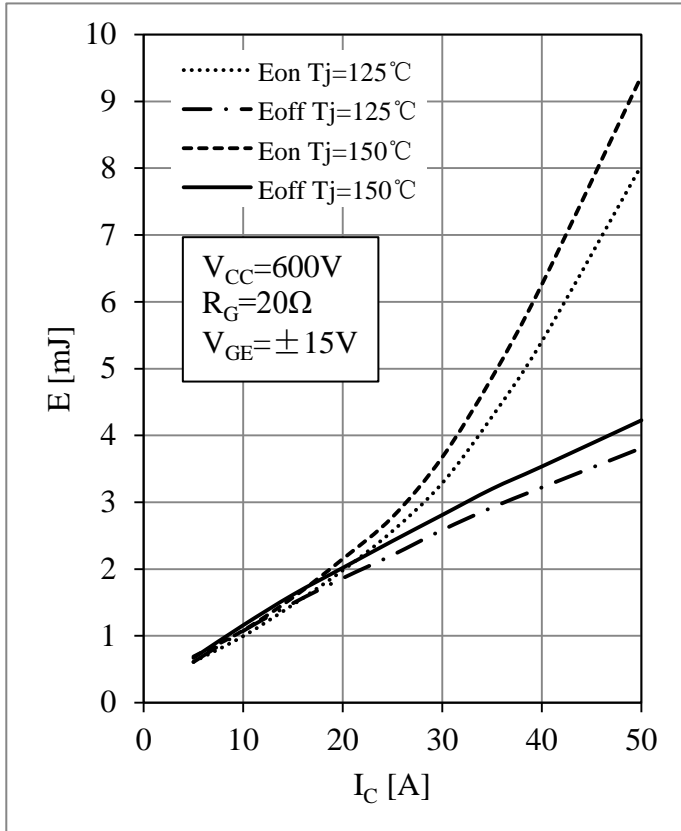


Fig 3. IGBT-inverter Switching Loss vs. I_C

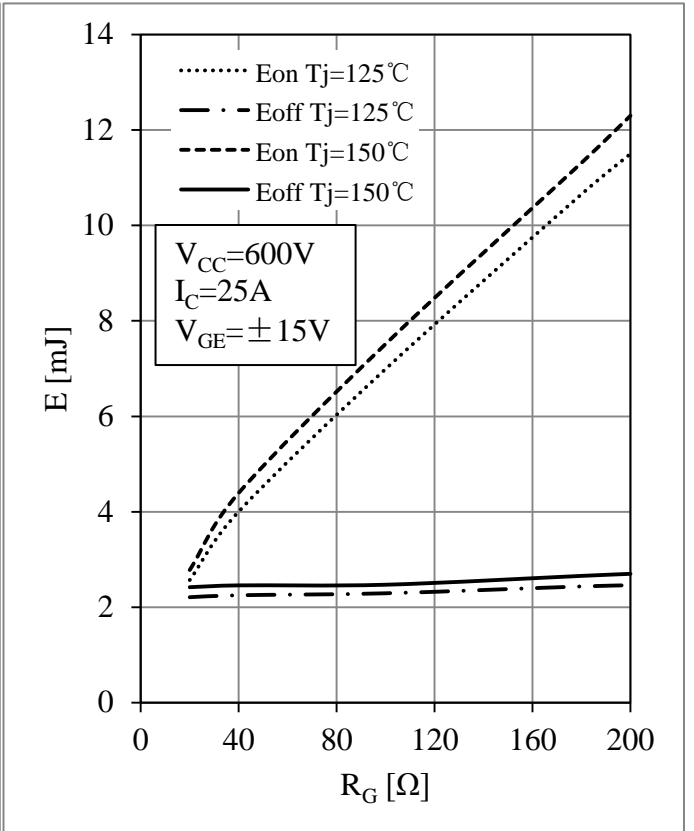


Fig 4. IGBT-inverter Switching Loss vs. R_G

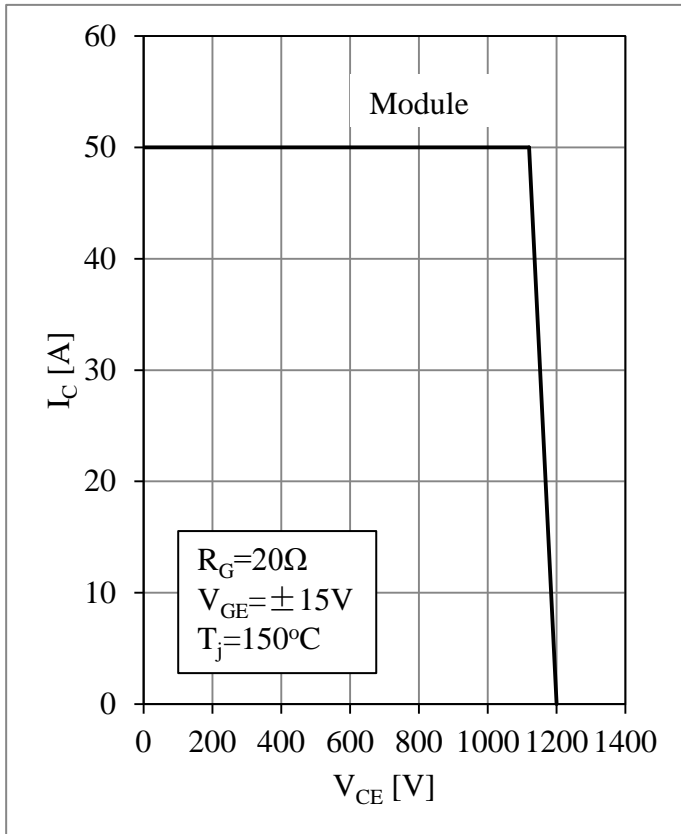


Fig 5. IGBT-inverter RBSOA

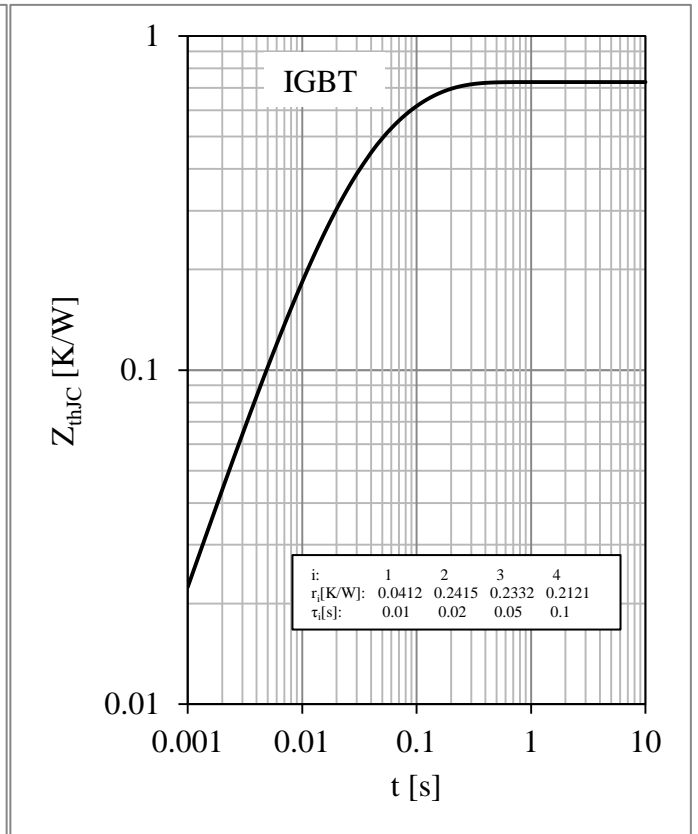


Fig 6. IGBT-inverter Transient Thermal Impedance

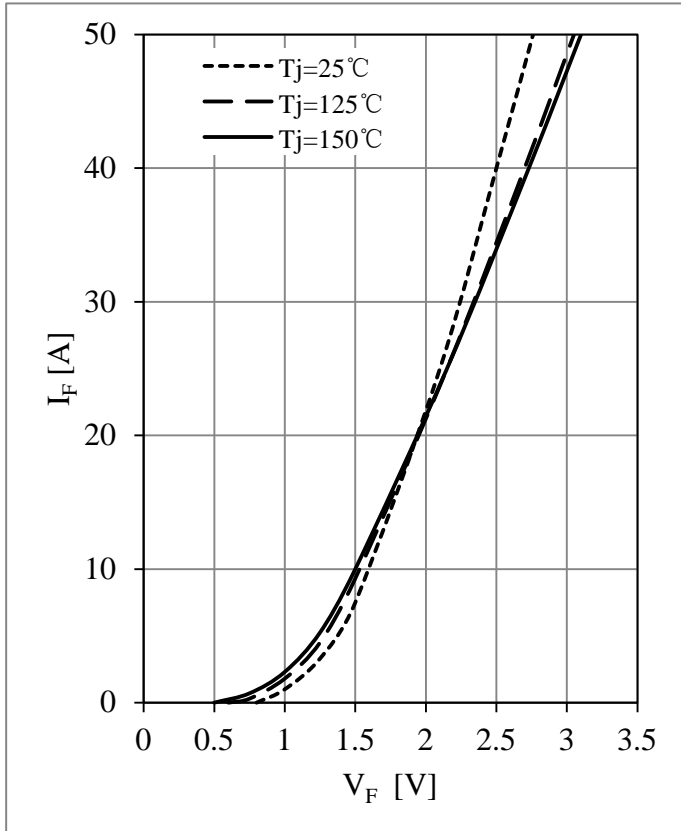


Fig 7. Diode-inverter Forward Characteristics

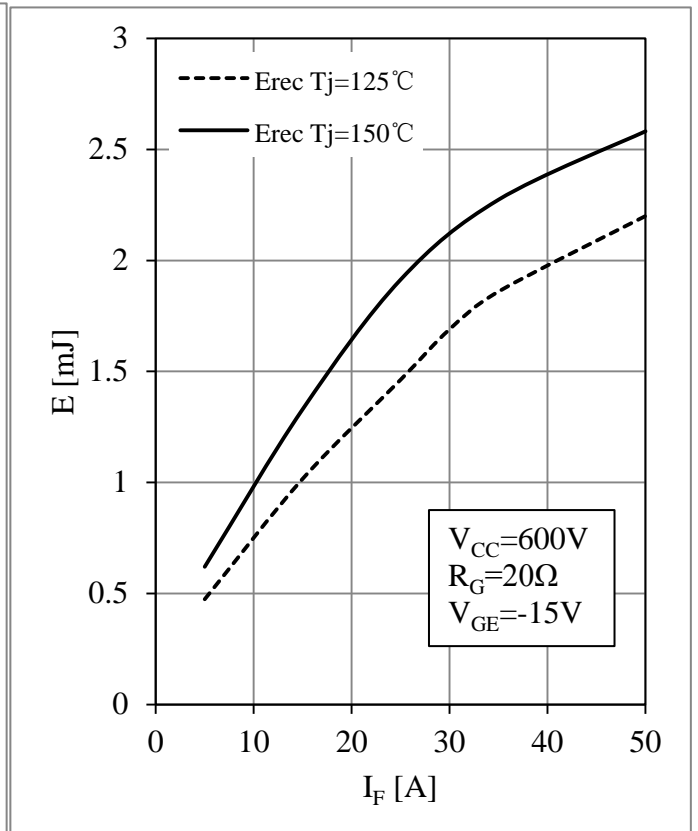


Fig 8. Diode-inverter Switching Loss vs. I_F

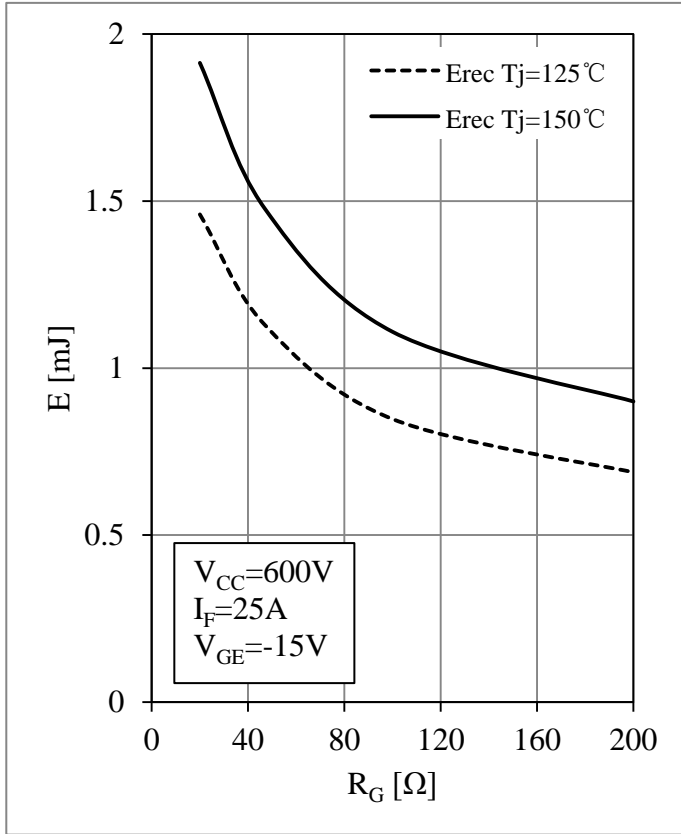


Fig 9. Diode-inverter Switching Loss vs. R_G

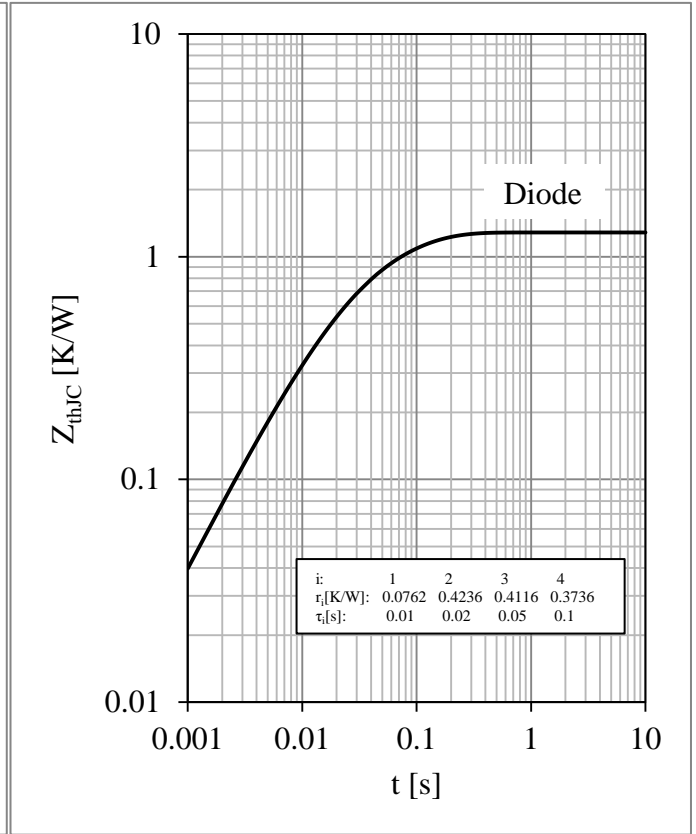


Fig 10. Diode-inverter Transient Thermal Impedance

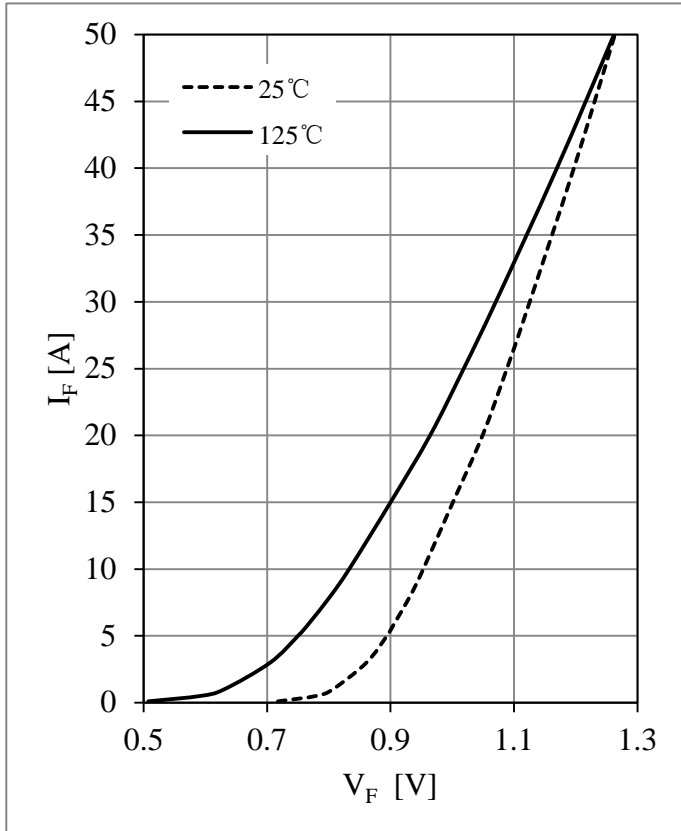


Fig 11. Diode-rectifier Forward Characteristics

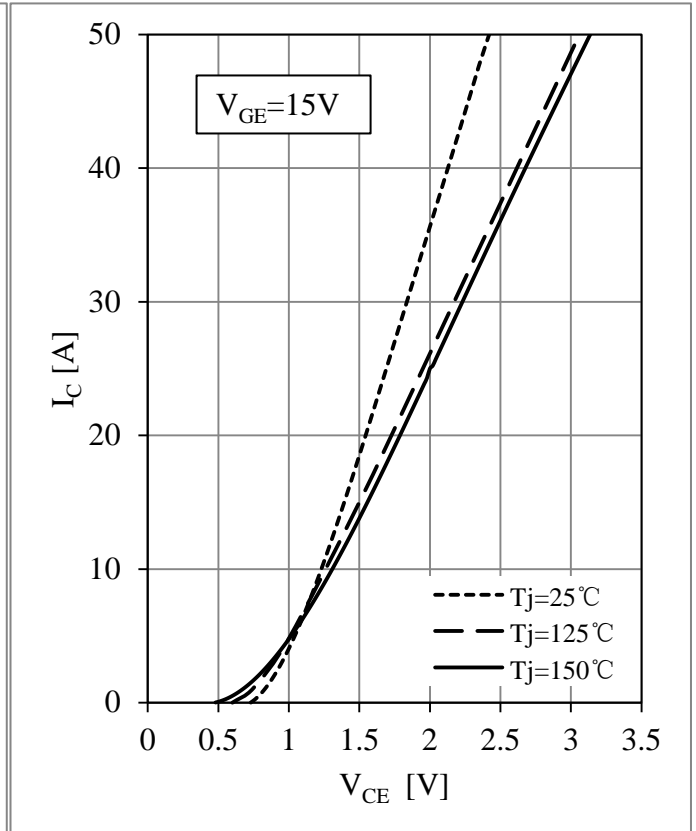


Fig 12. IGBT-brake-chopper Output Characteristics

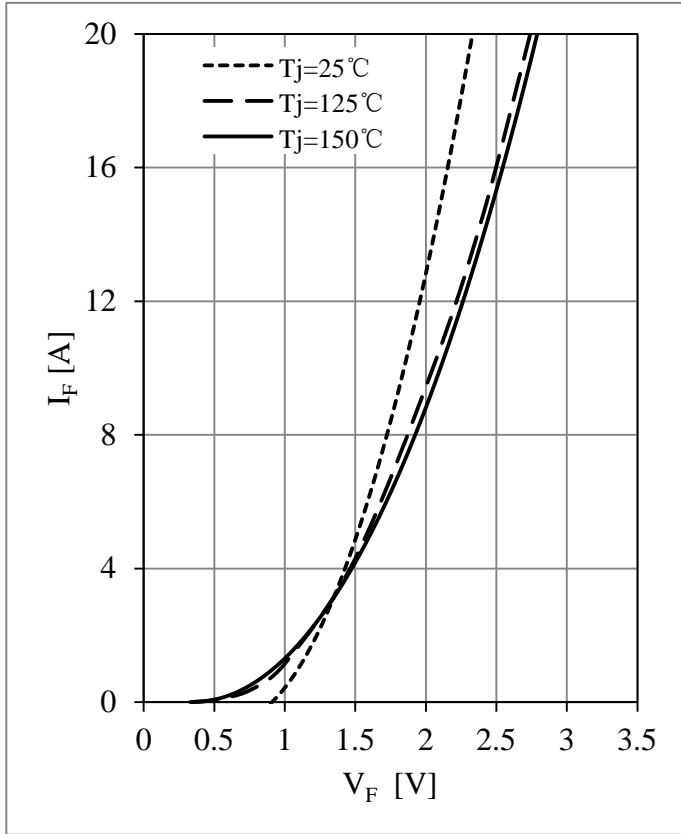


Fig 13. Diode-brake-chopper Forward Characteristics

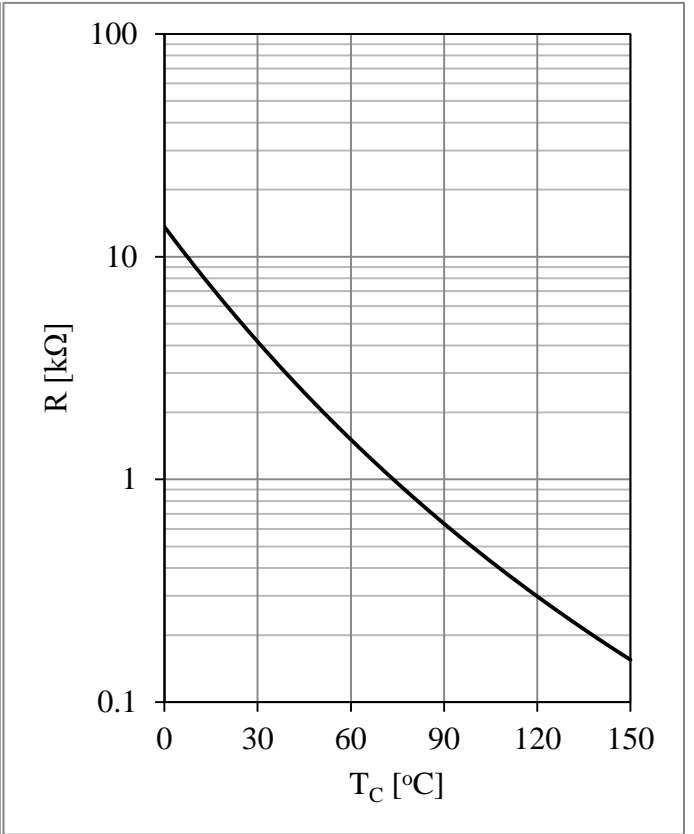
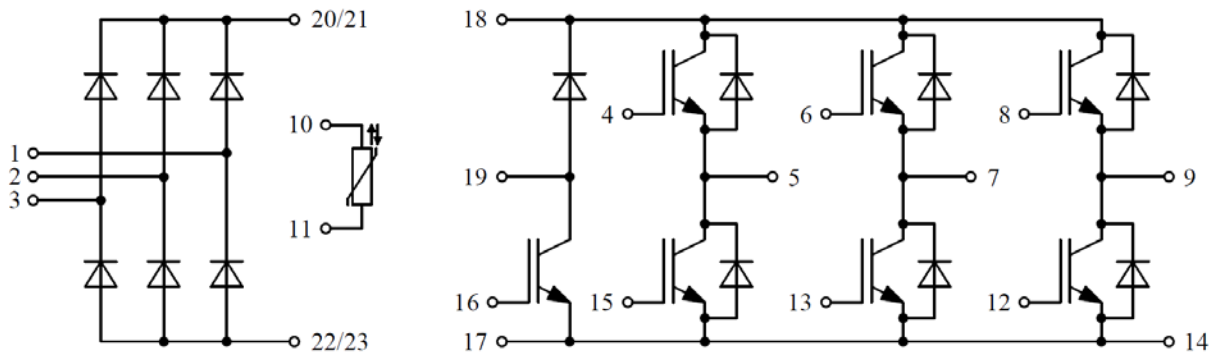


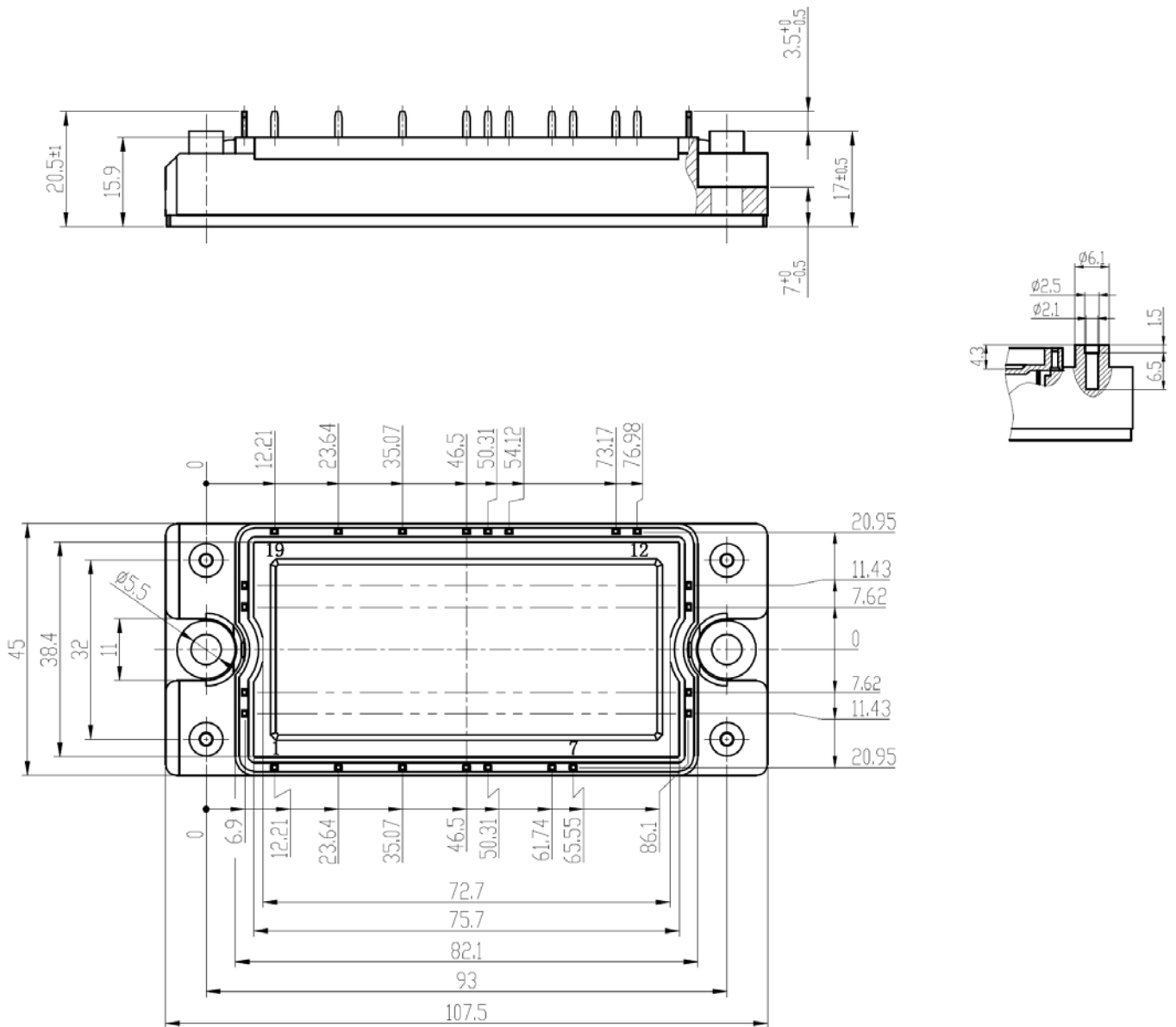
Fig 14. NTC Temperature Characteristic

Circuit Schematic



Package Dimensions

Dimensions in Millimeters



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