

# STARPOWER

SEMICONDUCTOR

**IGBT**

## GD25PIX120C5S

**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.

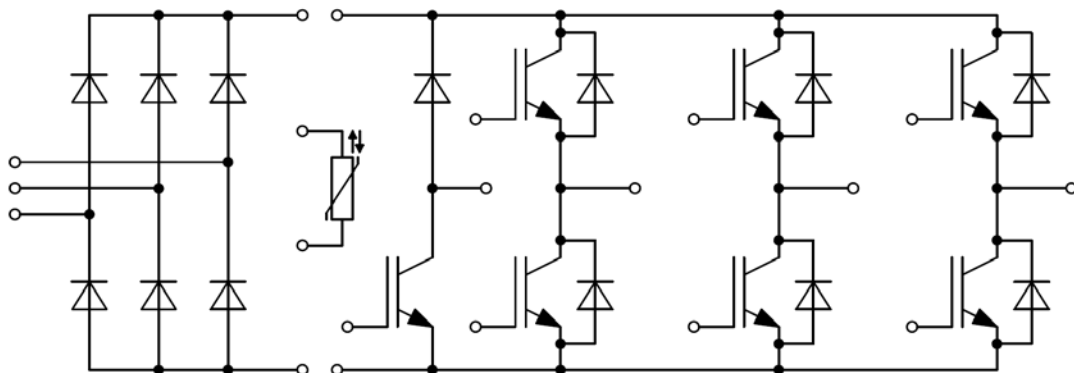
### Features

- Low  $V_{CE(sat)}$  Trench IGBT technology
- 10 $\mu$ 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	$\pm 20$	V
$I_C$	Collector Current @ $T_C=25^{\circ}\text{C}$ @ $T_C=100^{\circ}\text{C}$	50	A
		25	
$I_{CM}$	Pulsed Collector Current $t_p=1\text{ms}$	50	A
$P_D$	Maximum Power Dissipation @ $T_j=175^{\circ}\text{C}$	200	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 $t_p=10\text{ms}$ @ $T_j=25^{\circ}\text{C}$ @ $T_j=150^{\circ}\text{C}$	450	A
		370	
$I^2t$	$I^2t$ -value, $t_p=10\text{ms}$ @ $T_j=25^{\circ}\text{C}$ @ $T_j=150^{\circ}\text{C}$	1000	$\text{A}^2\text{s}$
		685	

**IGBT-brake**

Symbol	Description	Value	Unit
$V_{CES}$	Collector-Emitter Voltage	1200	V
$V_{GES}$	Gate-Emitter Voltage	$\pm 20$	V
$I_C$	Collector Current @ $T_C=25^{\circ}\text{C}$ @ $T_C=100^{\circ}\text{C}$	30	A
		15	
$I_{CM}$	Pulsed Collector Current $t_p=1\text{ms}$	30	A
$P_D$	Maximum Power Dissipation @ $T_j=175^{\circ}\text{C}$	147	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	
$T_{jop}$	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	$I_C=25\text{A}, V_{GE}=15\text{V}, T_j=25^\circ\text{C}$		1.75	2.10	V	
		$I_C=25\text{A}, V_{GE}=15\text{V}, T_j=125^\circ\text{C}$		2.00			
		$I_C=25\text{A}, V_{GE}=15\text{V}, T_j=150^\circ\text{C}$		2.05			
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=1.00\text{mA}, V_{CE}=V_{GE}, T_j=25^\circ\text{C}$	5.6	6.2	6.8	V	
$I_{CES}$	Collector Cut-Off Current	$V_{CE}=V_{CES}, V_{GE}=0\text{V}, T_j=25^\circ\text{C}$			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			0		$\Omega$	
$C_{ies}$	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		$\mu\text{C}$	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=25\text{A}, R_G=20\Omega, V_{GE}=\pm 15\text{V}, T_j=25^\circ\text{C}$		22		ns	
$t_r$	Rise Time			14		ns	
$t_{d(off)}$	Turn-Off Delay Time			186		ns	
$t_f$	Fall Time			176		ns	
$E_{on}$	Turn-On Switching Loss			1.37		mJ	
$E_{off}$	Turn-Off Switching Loss			1.42		mJ	
$t_{d(on)}$	Turn-On Delay Time		$V_{CC}=600\text{V}, I_C=25\text{A}, R_G=20\Omega, V_{GE}=\pm 15\text{V}, T_j=125^\circ\text{C}$		22		ns
$t_r$	Rise Time				17		ns
$t_{d(off)}$	Turn-Off Delay Time			274		ns	
$t_f$	Fall Time			205		ns	
$E_{on}$	Turn-On Switching Loss			2.06		mJ	
$E_{off}$	Turn-Off Switching Loss			2.10		mJ	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=25\text{A}, R_G=20\Omega, V_{GE}=\pm 15\text{V}, T_j=150^\circ\text{C}$			22		ns
$t_r$	Rise Time				18		ns
$t_{d(off)}$	Turn-Off Delay Time			294		ns	
$t_f$	Fall Time			216		ns	
$E_{on}$	Turn-On Switching Loss			2.22		mJ	
$E_{off}$	Turn-Off Switching Loss			2.30		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	$I_F=25\text{A}, V_{GE}=0\text{V}, T_j=25^\circ\text{C}$		1.85	2.30	V
		$I_F=25\text{A}, V_{GE}=0\text{V}, T_j=125^\circ\text{C}$		1.90		
		$I_F=25\text{A}, V_{GE}=0\text{V}, T_j=150^\circ\text{C}$		1.95		
$Q_r$	Recovered Charge	$V_R=600\text{V}, I_F=25\text{A},$ $-di/dt=900\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=25^\circ\text{C}$		2.9		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current			55		A
$E_{rec}$	Reverse Recovery Energy			0.93		mJ
$Q_r$	Recovered Charge	$V_R=600\text{V}, I_F=25\text{A},$ $-di/dt=900\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=125^\circ\text{C}$		5.1		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current			58		A
$E_{rec}$	Reverse Recovery Energy			1.72		mJ
$Q_r$	Recovered Charge	$V_R=600\text{V}, I_F=25\text{A},$ $-di/dt=900\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=150^\circ\text{C}$		5.6		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current			60		A
$E_{rec}$	Reverse Recovery Energy			2.01		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	$I_F=25\text{A}, V_{GE}=0\text{V}, T_j=150^\circ\text{C}$		0.85		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	$I_C=15\text{A}, V_{GE}=15\text{V}, T_j=25^\circ\text{C}$		1.75	2.20	V	
		$I_C=15\text{A}, V_{GE}=15\text{V}, T_j=125^\circ\text{C}$		2.00			
		$I_C=15\text{A}, V_{GE}=15\text{V}, T_j=150^\circ\text{C}$		2.05			
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=0.60\text{mA}, V_{CE}=V_{GE}, T_j=25^\circ\text{C}$	5.6	6.2	6.8	V	
$I_{CES}$	Collector Cut-Off Current	$V_{CE}=V_{CES}, V_{GE}=0\text{V}, T_j=25^\circ\text{C}$			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			0		$\Omega$	
$C_{ies}$	Input Capacitance	$V_{CE}=25\text{V}, f=1\text{MHz}, V_{GE}=0\text{V}$		1.55		nF	
$C_{res}$	Reverse Transfer Capacitance				0.04		nF
$Q_G$	Gate Charge	$V_{GE}=-15\dots+15\text{V}$		0.12		$\mu\text{C}$	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=15\text{A}, R_G=39\Omega, V_{GE}=\pm 15\text{V}, T_j=25^\circ\text{C}$		47		ns	
$t_r$	Rise Time			50		ns	
$t_{d(off)}$	Turn-Off Delay Time			191		ns	
$t_f$	Fall Time			142		ns	
$E_{on}$	Turn-On Switching Loss			1.11		mJ	
$E_{off}$	Turn-Off Switching Loss			0.81		mJ	
$t_{d(on)}$	Turn-On Delay Time		$V_{CC}=600\text{V}, I_C=15\text{A}, R_G=39\Omega, V_{GE}=\pm 15\text{V}, T_j=125^\circ\text{C}$		47		ns
$t_r$	Rise Time				56		ns
$t_{d(off)}$	Turn-Off Delay Time			269		ns	
$t_f$	Fall Time			186		ns	
$E_{on}$	Turn-On Switching Loss			1.50		mJ	
$E_{off}$	Turn-Off Switching Loss			1.18		mJ	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=15\text{A}, R_G=39\Omega, V_{GE}=\pm 15\text{V}, T_j=150^\circ\text{C}$			47		ns
$t_r$	Rise Time				56		ns
$t_{d(off)}$	Turn-Off Delay Time			274		ns	
$t_f$	Fall Time			210		ns	
$E_{on}$	Turn-On Switching Loss			1.67		mJ	
$E_{off}$	Turn-Off Switching Loss			1.32		mJ	
$I_{SC}$	SC Data		$t_p \leq 10\mu\text{s}, V_{GE}=15\text{V}, T_j=150^\circ\text{C}, V_{CC}=900\text{V}, V_{CEM} \leq 1200\text{V}$		60		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
		$I_F=10\text{A}, V_{GE}=0\text{V}, T_j=125^\circ\text{C}$		1.90		
		$I_F=10\text{A}, V_{GE}=0\text{V}, T_j=150^\circ\text{C}$		1.95		
$Q_r$	Recovered Charge	$V_R=600\text{V}, I_F=10\text{A},$ $-di/dt=490\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=25^\circ\text{C}$		1.0		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current			14		A
$E_{rec}$	Reverse Recovery Energy			0.24		mJ
$Q_r$	Recovered Charge	$V_R=600\text{V}, I_F=10\text{A},$ $-di/dt=490\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=125^\circ\text{C}$		2.0		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current			12		A
$E_{rec}$	Reverse Recovery Energy			0.51		mJ
$Q_r$	Recovered Charge	$V_R=600\text{V}, I_F=10\text{A},$ $-di/dt=490\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=150^\circ\text{C}$		2.2		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current			9		A
$E_{rec}$	Reverse Recovery Energy			0.58		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
$R_{CC'+EE'}$ $R_{AA'+CC'}$	Module Lead Resistance, Terminal to Chip		4.00 3.00		m $\Omega$
$R_{thJC}$	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)			0.748 1.250 0.884 1.016 1.632	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)		0.317 0.530 0.375 0.431 0.692 0.020		K/W
M	Mounting Torque, Screw:M5	3.0		6.0	N.m
G	Weight of Module		200		g

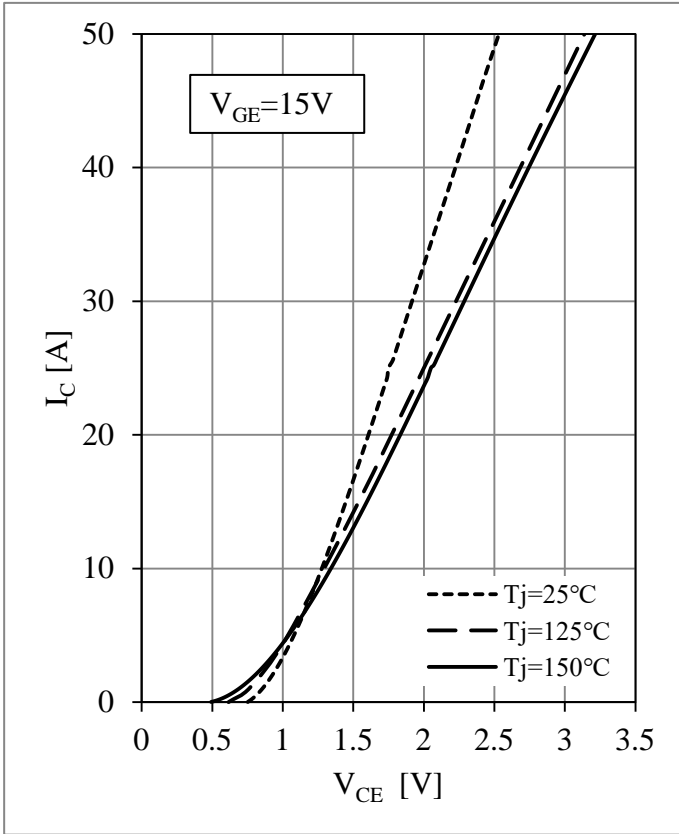


Fig 1. IGBT-inverter Output Characteristics

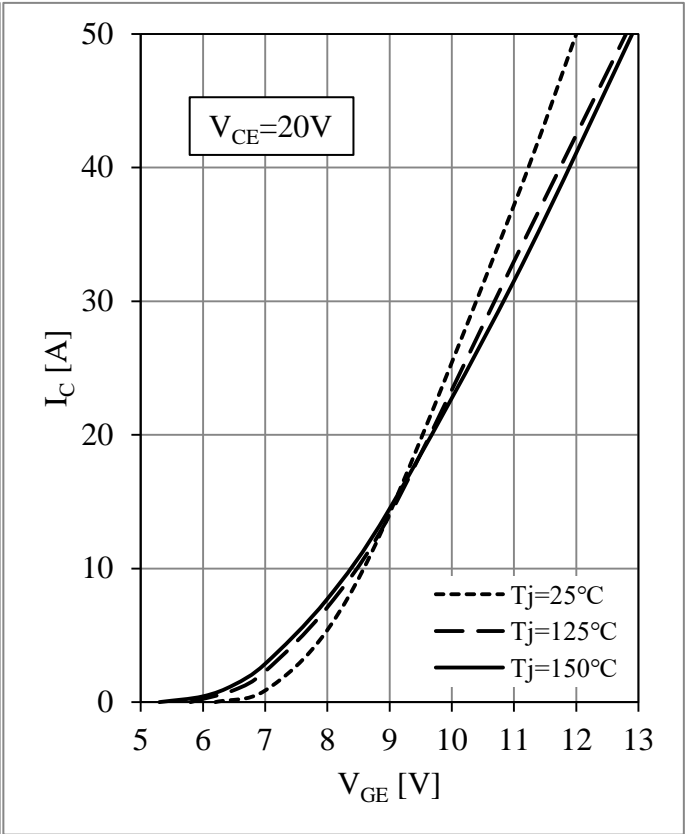


Fig 2. IGBT-inverter Transfer Characteristics

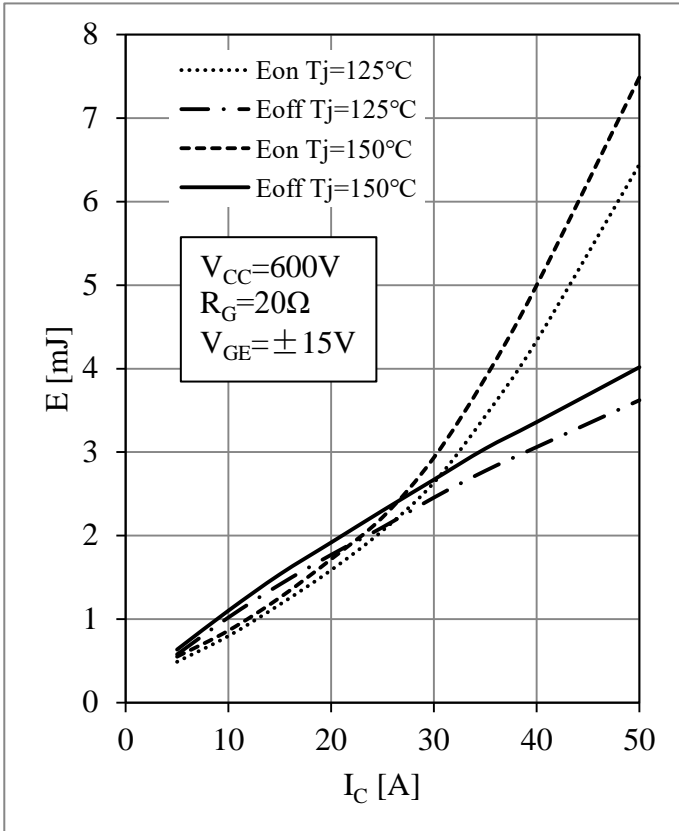


Fig 3. IGBT-inverter Switching Loss vs.  $I_C$

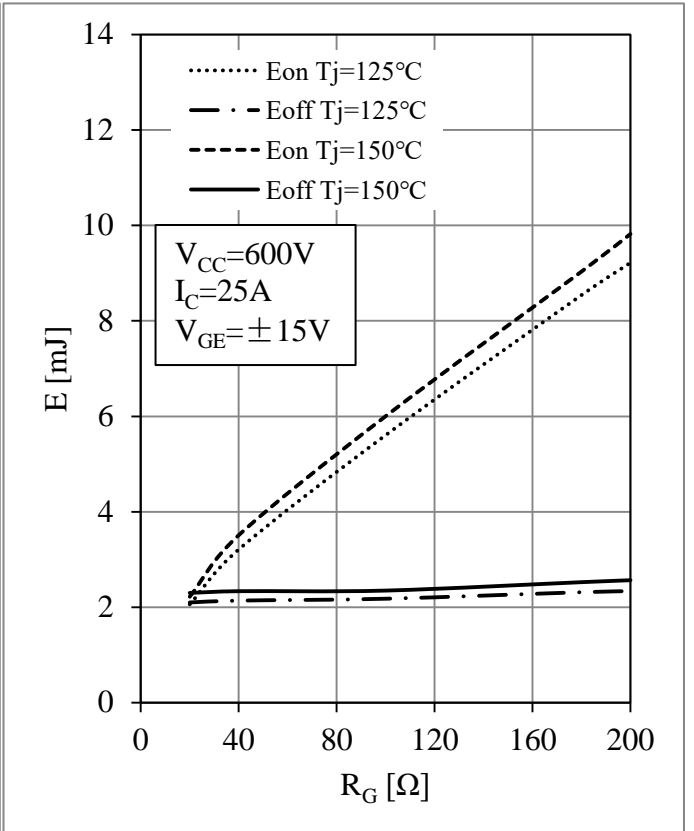


Fig 4. IGBT-inverter Switching Loss vs.  $R_G$



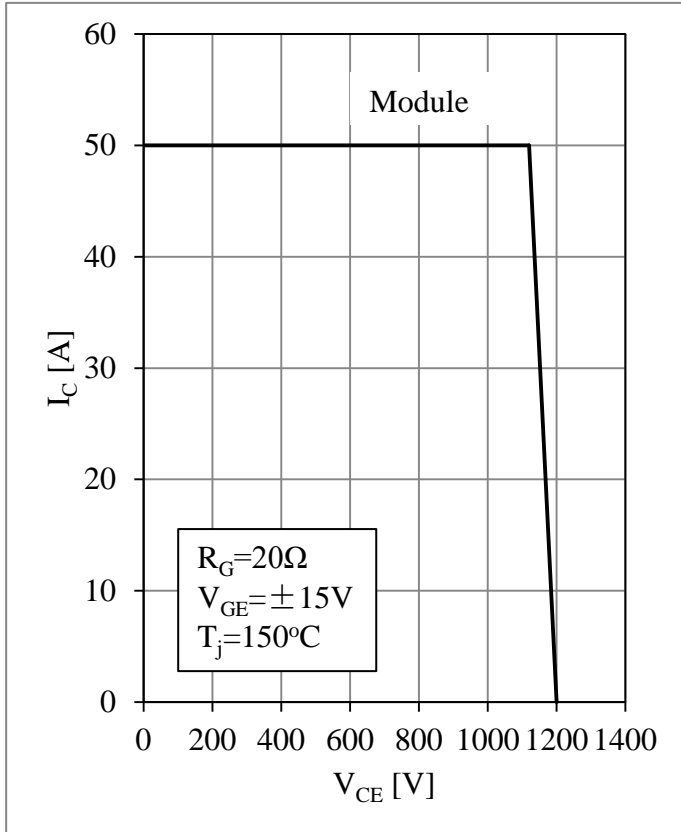


Fig 5. IGBT-inverter RBSOA

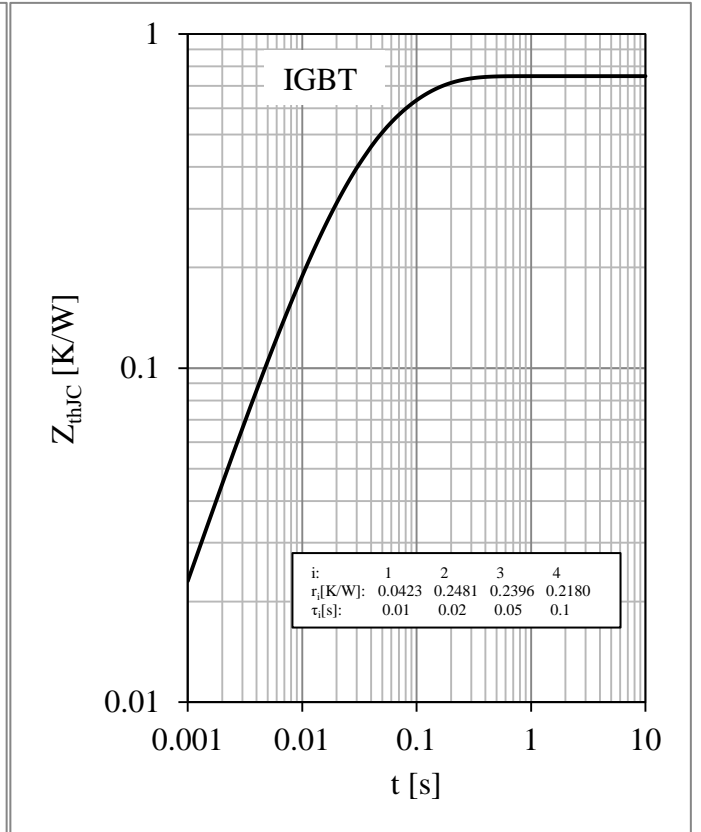


Fig 6. IGBT-inverter Transient Thermal Impedance

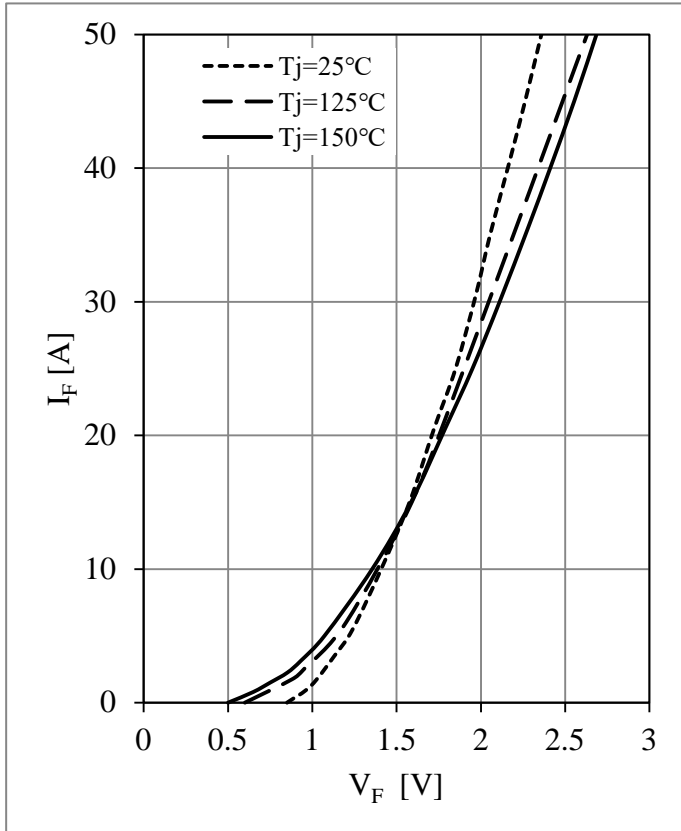


Fig 7. Diode-inverter Forward Characteristics

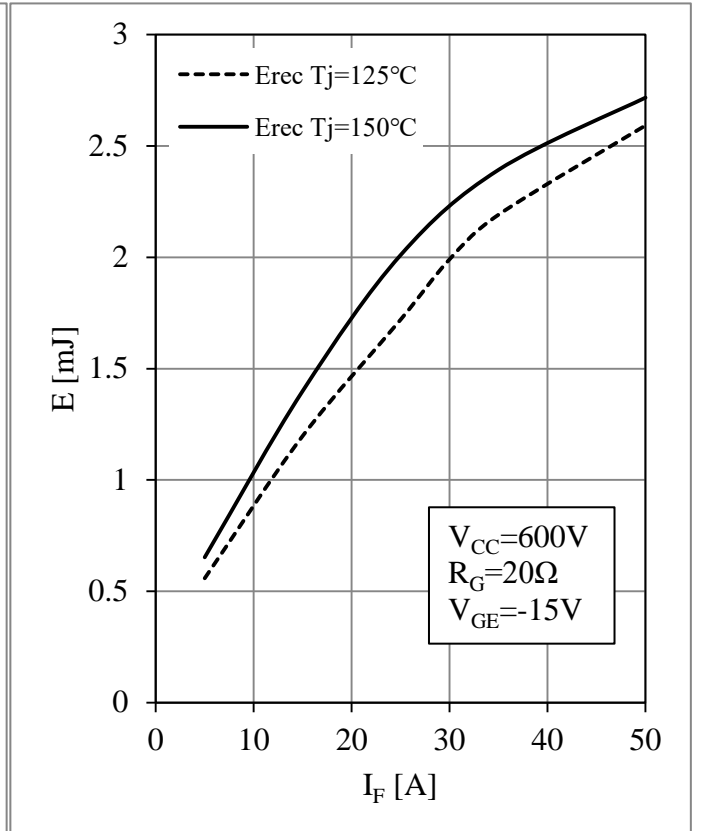


Fig 8. Diode-inverter Switching Loss vs.  $I_F$

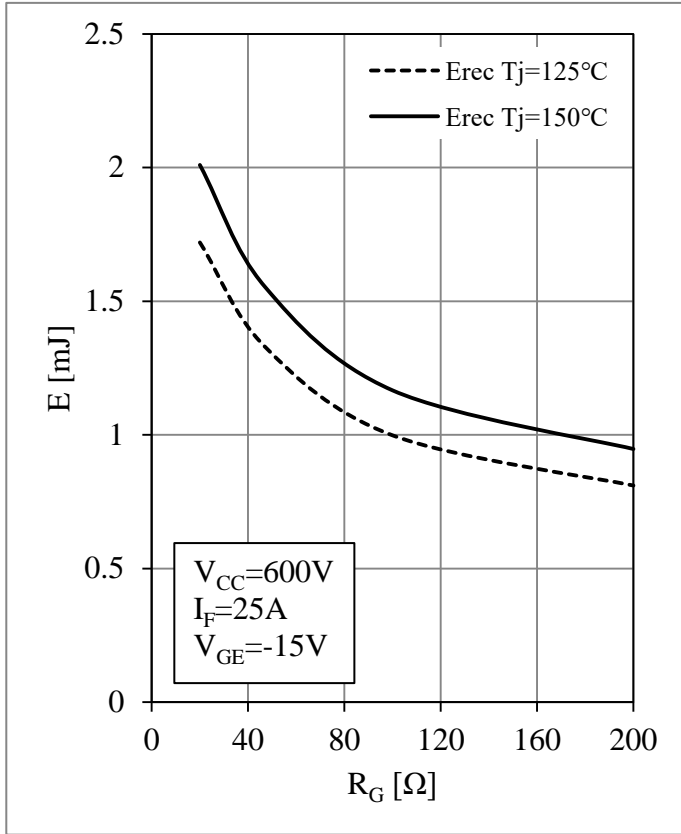


Fig 9. Diode-inverter Switching Loss vs.  $R_G$

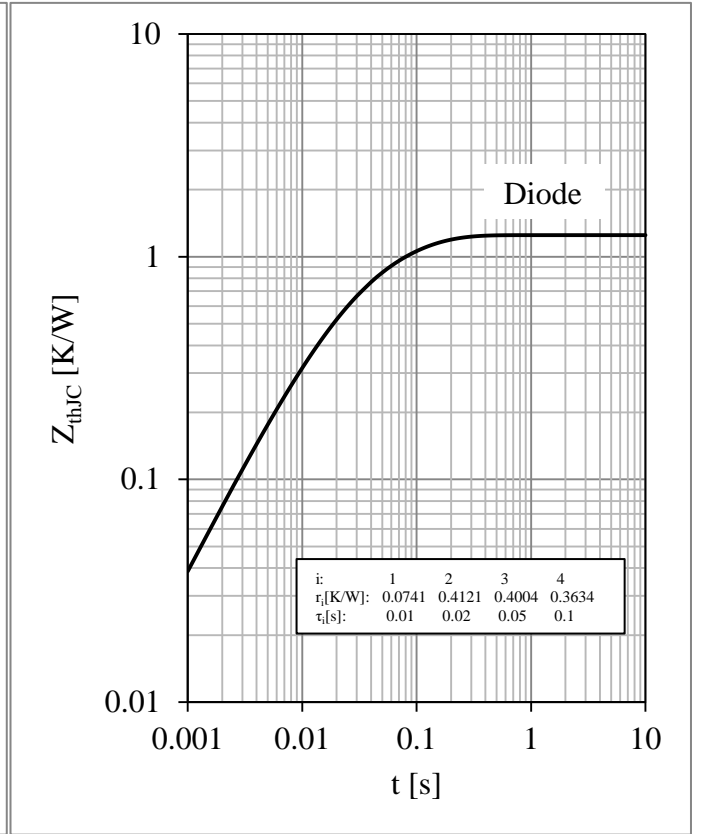


Fig 10. Diode-inverter Transient Thermal Impedance

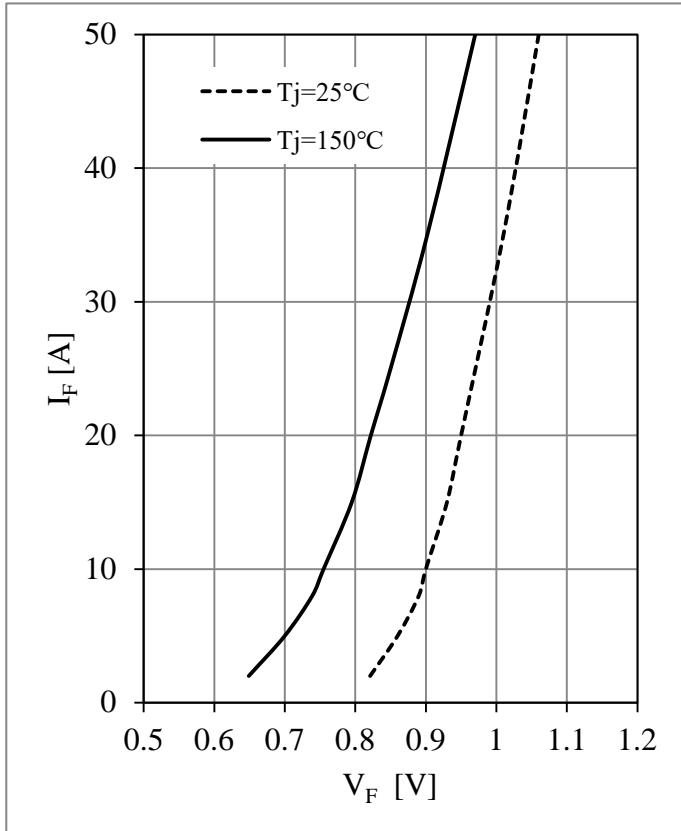


Fig 11. Diode-rectifier Forward Characteristics

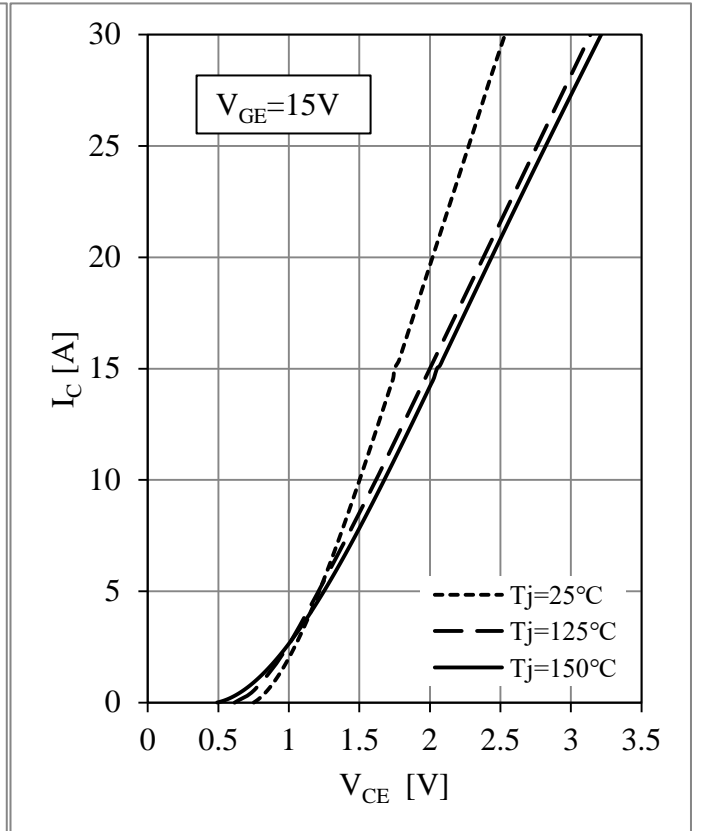


Fig 12. IGBT-brake-chopper Output Characteristics

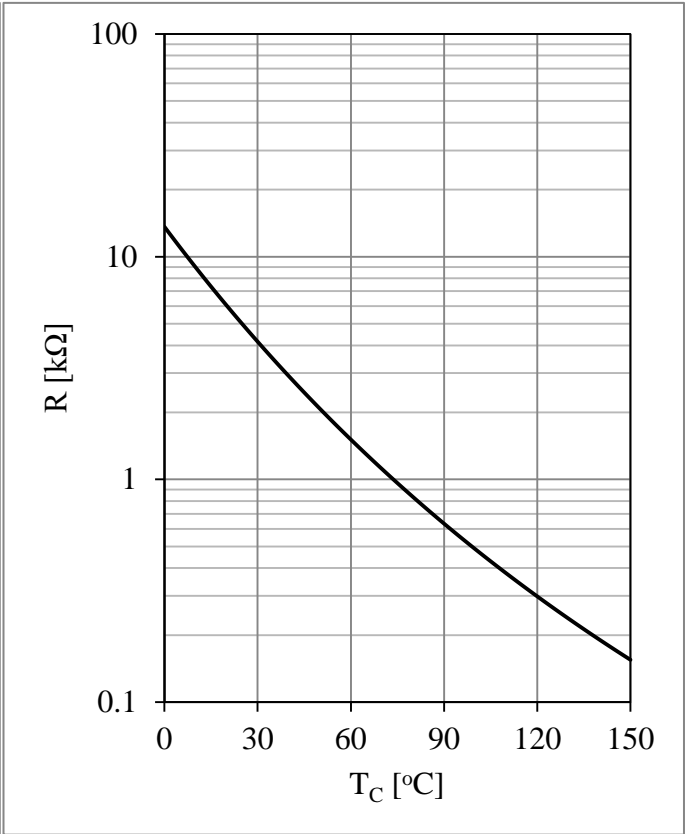
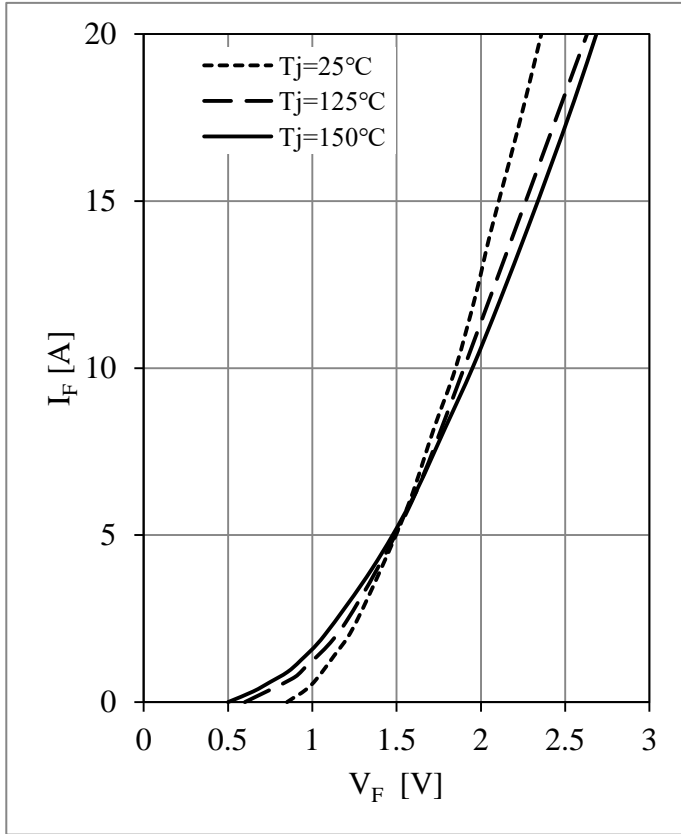
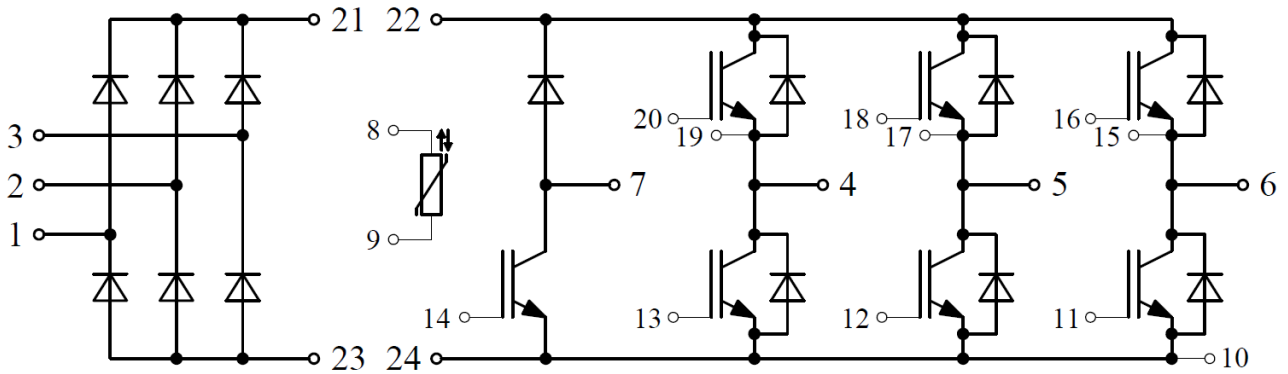


Fig 13. Diode-brake-chopper Forward Characteristics

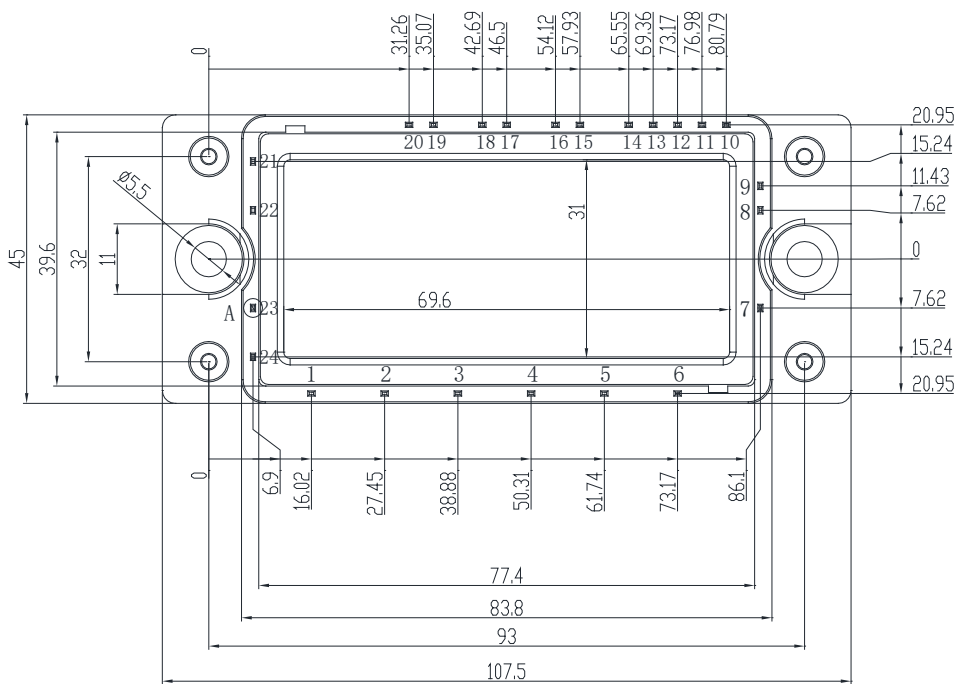
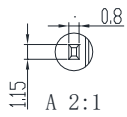
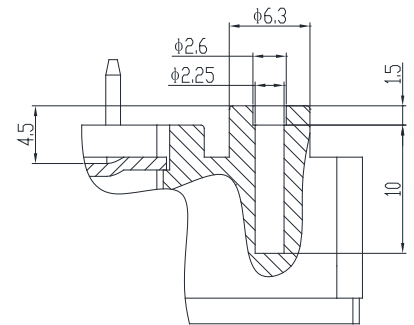
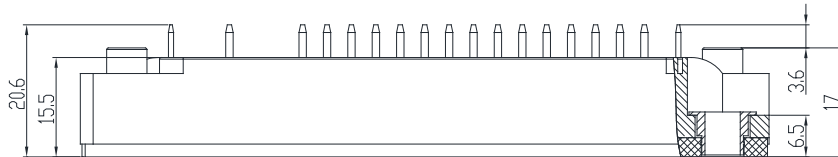
Fig 14. NTC Temperature Characteristic

**Circuit Schematic**



**Package Dimensions**

Dimensions in Millimeters



## Terms and Conditions of Usage

The data contained in this product datasheet is exclusively intended for technically trained staff. you and your technical departments will have to evaluate the suitability of the product for the intended application and the completeness of the product data with respect to such application.

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