

# STARPOWER

SEMICONDUCTOR

# IGBT

## GD75PIL120C6S

**1200V/75A 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

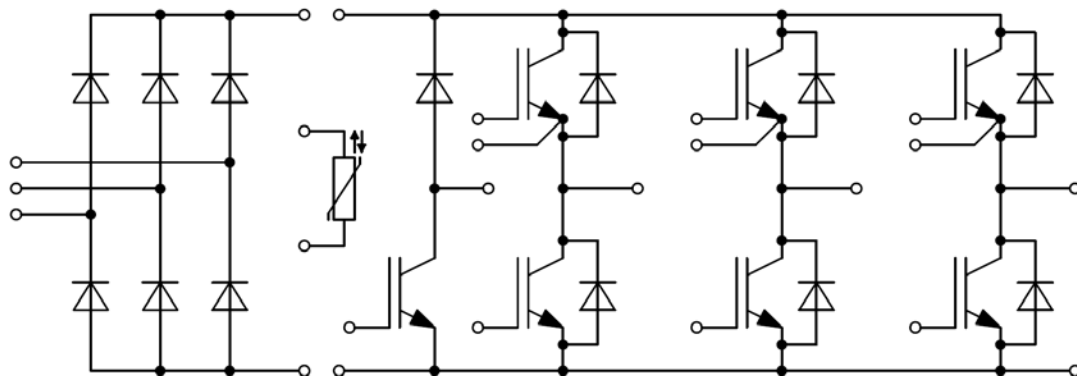
- Low  $V_{CE(sat)}$  SPT+ IGBT technology
- 10 $\mu$ s short circuit capability
- $V_{CE(sat)}$  with positive temperature coefficient
- Maximum junction temperature 175 °C
- Low inductance case
- Fast & soft reverse recovery anti-parallel FWD
- Isolated copper baseplate using DBC technology



### 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	Values	Unit
$V_{CES}$	Collector-Emitter Voltage	1200	V
$V_{GES}$	Gate-Emitter Voltage	$\pm 20$	V
$I_C$	Collector Current @ $T_C=25^{\circ}\text{C}$	140	A
	@ $T_C=100^{\circ}\text{C}$	75	
$I_{CM}$	Pulsed Collector Current $t_p=1\text{ms}$	150	A
$P_D$	Maximum Power Dissipation @ $T_j=175^{\circ}\text{C}$	538	W

**Diode-inverter**

Symbol	Description	Values	Unit
$V_{RRM}$	Repetitive Peak Reverse Voltage	1200	V
$I_F$	Diode Continuous Forward Current	75	A
$I_{FM}$	Diode Maximum Forward Current $t_p=1\text{ms}$	150	A

**Diode-rectifier**

Symbol	Description	Values	Unit
$V_{RRM}$	Repetitive Peak Reverse Voltage	1600	V
$I_O$	Average Output Current @ $T_C=80^{\circ}\text{C}$	75	A
$I_{FSM}$	Surge Forward Current $V_R=0\text{V}, t_p=10\text{ms}, T_j=45^{\circ}\text{C}$	1100	A
$I^2t$	$I^2t$ -value, $V_R=0\text{V}, t_p=10\text{ms}, T_j=45^{\circ}\text{C}$	6050	$\text{A}^2\text{s}$

**IGBT-brake**

Symbol	Description	Values	Unit
$V_{CES}$	Collector-Emitter Voltage	1200	V
$V_{GES}$	Gate-Emitter Voltage	$\pm 30$	V
$I_C$	Collector Current @ $T_C=25^{\circ}\text{C}$	80	A
	@ $T_C=100^{\circ}\text{C}$	40	
$I_{CM}$	Pulsed Collector Current $t_p=1\text{ms}$	80	A
$P_D$	Maximum Power Dissipation @ $T_j=175^{\circ}\text{C}$	337	W

**Diode-brake**

Symbol	Description	Values	Unit
$V_{RRM}$	Repetitive Peak Reverse Voltage	1200	V
$I_F$	Diode Continuous Forward Current	40	A
$I_{FM}$	Diode Maximum Forward Current $t_p=1\text{ms}$	80	A

**Module**

Symbol	Description	Values	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, $f=50\text{Hz}, t=1\text{min}$	4000	V
M	Mounting Torque, Screw M5	3.0 to 6.0	N.m

**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	$I_C=75\text{A}, V_{GE}=15\text{V}, T_j=25^\circ\text{C}$		1.90	2.35	V
		$I_C=75\text{A}, V_{GE}=15\text{V}, T_j=125^\circ\text{C}$		2.10		
		$I_C=75\text{A}, V_{GE}=15\text{V}, T_j=150^\circ\text{C}$		2.20		
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=3.0\text{mA}, V_{CE}=V_{GE}, T_j=25^\circ\text{C}$	5.0	6.5	7.0	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			3.0		$\Omega$
$C_{ies}$	Input Capacitance	$V_{CE}=25\text{V}, f=1\text{MHz}, V_{GE}=0\text{V}$		5.52		nF
$C_{res}$	Reverse Transfer Capacitance				0.26	
$Q_G$	Gate Charge	$V_{GE}=-15 \dots +15\text{V}$		0.78		$\mu\text{C}$
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=75\text{A}, R_G=1.0\Omega, V_{GE}=\pm 15\text{V}, T_j=25^\circ\text{C}$		519		ns
$t_r$	Rise Time			103		ns
$t_{d(off)}$	Turn-Off Delay Time			492		ns
$t_f$	Fall Time			215		ns
$E_{on}$	Turn-On Switching Loss			9.76		mJ
$E_{off}$	Turn-Off Switching Loss			5.03		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=75\text{A}, R_G=1.0\Omega, V_{GE}=\pm 15\text{V}, T_j=125^\circ\text{C}$		519		ns
$t_r$	Rise Time			104		ns
$t_{d(off)}$	Turn-Off Delay Time			517		ns
$t_f$	Fall Time			344		ns
$E_{on}$	Turn-On Switching Loss			11.9		mJ
$E_{off}$	Turn-Off Switching Loss			7.01		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=75\text{A}, R_G=1.0\Omega, V_{GE}=\pm 15\text{V}, T_j=150^\circ\text{C}$		527		ns
$t_r$	Rise Time			105		ns
$t_{d(off)}$	Turn-Off Delay Time			527		ns
$t_f$	Fall Time			395		ns
$E_{on}$	Turn-On Switching Loss			13.5		mJ
$E_{off}$	Turn-Off Switching Loss			8.30		mJ
$I_{SC}$	SC Data	$t_p \leq 10\mu\text{s}, V_{GE}=15\text{V}, T_j=150^\circ\text{C}, V_{CC}=900\text{V}, V_{CEM} \leq 1200\text{V}$		350		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	$I_C=75\text{A}, V_{GE}=0\text{V}, T_j=25^\circ\text{C}$		1.80	2.25	V
		$I_C=75\text{A}, V_{GE}=0\text{V}, T_j=125^\circ\text{C}$		1.85		
		$I_C=75\text{A}, V_{GE}=0\text{V}, T_j=150^\circ\text{C}$		1.85		
$Q_r$	Recovered Charge			3.7		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current	$V_R=600\text{V}, I_F=75\text{A}, R_G=1.0\Omega, V_{GE}=-15\text{V}$		42		A
$E_{rec}$	Reverse Recovery Energy	$T_j=25^\circ\text{C}$		2.24		mJ
$Q_r$	Recovered Charge			13.6		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current	$V_R=600\text{V}, I_F=75\text{A}, R_G=1.0\Omega, V_{GE}=-15\text{V}$		64		A
$E_{rec}$	Reverse Recovery Energy	$T_j=125^\circ\text{C}$		5.30		mJ
$Q_r$	Recovered Charge			15.9		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current	$V_R=600\text{V}, I_F=75\text{A}, R_G=1.0\Omega, V_{GE}=-15\text{V}$		69		A
$E_{rec}$	Reverse Recovery Energy	$T_j=150^\circ\text{C}$		6.36		mJ

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$V_F$	Diode Forward Voltage	$I_C=75\text{A}, T_j=150^\circ\text{C}$		1.08		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	$I_C=40\text{A}, V_{GE}=15\text{V}, T_j=25^\circ\text{C}$		1.80	2.25	V
		$I_C=40\text{A}, V_{GE}=15\text{V}, T_j=125^\circ\text{C}$		2.00		
		$I_C=40\text{A}, V_{GE}=15\text{V}, T_j=150^\circ\text{C}$		2.05		
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=2.4\text{mA}, V_{CE}=V_{GE}, T_j=25^\circ\text{C}$	5.0	6.1	7.5	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			/		$\Omega$
$C_{ies}$	Input Capacitance	$V_{CE}=30\text{V}, f=1\text{MHz}, V_{GE}=0\text{V}$		6.24		nF
$C_{res}$	Reverse Transfer Capacitance			0.15		nF
$Q_G$	Gate Charge	$V_{GE}=15\text{V}$		0.23		$\mu\text{C}$
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=40\text{A}, R_G=24\Omega, V_{GE}=\pm 15\text{V}, T_j=25^\circ\text{C}$		370		ns
$t_r$	Rise Time			84		ns
$t_{d(off)}$	Turn-Off Delay Time			334		ns
$t_f$	Fall Time			276		ns
$E_{on}$	Turn-On Switching Loss			5.45		mJ
$E_{off}$	Turn-Off Switching Loss			2.21		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=40\text{A}, R_G=24\Omega, V_{GE}=\pm 15\text{V}, T_j=125^\circ\text{C}$		375		ns
$t_r$	Rise Time			87		ns
$t_{d(off)}$	Turn-Off Delay Time			350		ns
$t_f$	Fall Time			328		ns
$E_{on}$	Turn-On Switching Loss			6.05		mJ
$E_{off}$	Turn-Off Switching Loss			3.45		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=40\text{A}, R_G=24\Omega, V_{GE}=\pm 15\text{V}, T_j=150^\circ\text{C}$		376		ns
$t_r$	Rise Time			92		ns
$t_{d(off)}$	Turn-Off Delay Time			350		ns
$t_f$	Fall Time			338		ns
$E_{on}$	Turn-On Switching Loss			6.30		mJ
$E_{off}$	Turn-Off Switching Loss			3.70		mJ
$I_{SC}$	SC Data	$t_p \leq 10\mu\text{s}, V_{GE}=15\text{V}, T_j=150^\circ\text{C}, V_{CC}=900\text{V}, V_{CEM} \leq 1200\text{V}$		500		A

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$V_F$	Diode Forward Voltage	$I_C=40\text{A}, V_{GE}=0\text{V}, T_j=25^\circ\text{C}$		2.10	2.55	V
		$I_C=40\text{A}, V_{GE}=0\text{V}, T_j=125^\circ\text{C}$		2.00		
		$I_C=40\text{A}, V_{GE}=0\text{V}, T_j=150^\circ\text{C}$		1.97		
$Q_r$	Recovered Charge			2.5		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current	$V_R=600\text{V}, I_F=40\text{A}, R_G=24\Omega, V_{GE}=-15\text{V}$		22		A
$E_{rec}$	Reverse Recovery Energy	$T_j=25^\circ\text{C}$		1.28		mJ
$Q_r$	Recovered Charge			4.8		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current	$V_R=600\text{V}, I_F=40\text{A}, R_G=24\Omega, V_{GE}=-15\text{V}$		26		A
$E_{rec}$	Reverse Recovery Energy	$T_j=125^\circ\text{C}$		2.40		mJ
$Q_r$	Recovered Charge			5.0		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current	$V_R=600\text{V}, I_F=40\text{A}, R_G=24\Omega, V_{GE}=-15\text{V}$		28		A
$E_{rec}$	Reverse Recovery Energy	$T_j=150^\circ\text{C}$		2.50		mJ

**NTC Characteristics**  $T_C=25^\circ\text{C}$  unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$R_{25}$	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		60		nH
$R_{CC'+EE'}$	Module Lead Resistance, Terminal to Chip @ $T_C=25^\circ\text{C}$		4.00 2.00		$\text{m}\Omega$
$R_{\theta JC}$	Junction-to-Case (per IGBT-inverter)			0.279	K/W
	Junction-to-Case (per Diode-inverter)			0.494	
	Junction-to-Case (per Diode-rectifier)			0.548	
	Junction-to-Case (per IGBT-brake-chopper)			0.445	
	Junction-to-Case (per Diode-brake-chopper)			0.967	
$R_{\theta CS}$	Case-to-Sink (per IGBT-inverter)		0.120		K/W
	Case-to-Sink (per Diode-inverter)		0.213		
	Case-to-Sink (per Diode-rectifier)		0.236		
	Case-to-Sink (per IGBT-brake-chopper)		0.192		
	Case-to-Sink (per Diode-brake-chopper)		0.417		
$R_{\theta CS}$	Case-to-Sink		0.009		K/W
G	Weight of Module		300		g

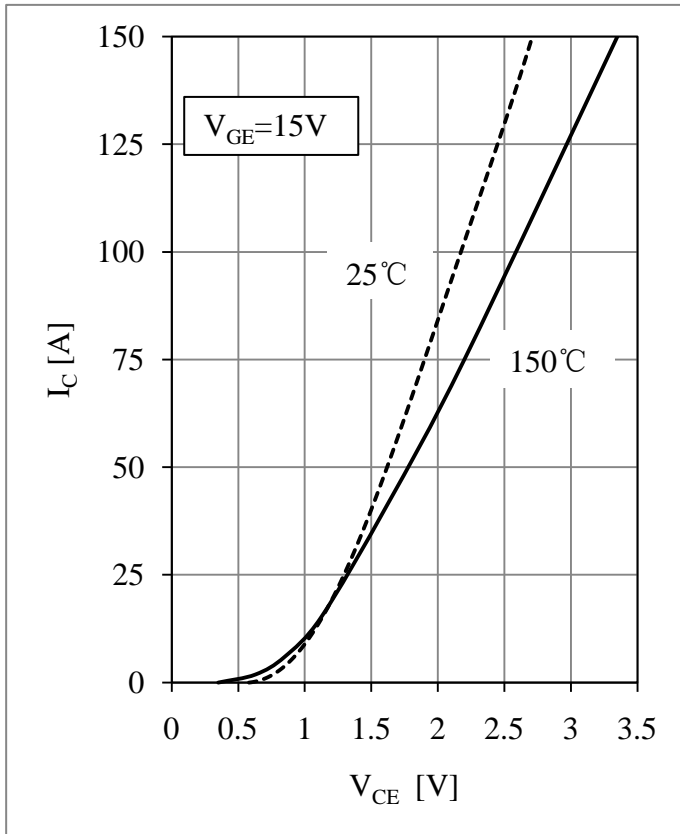


Fig 1. IGBT-inverter Output Characteristics

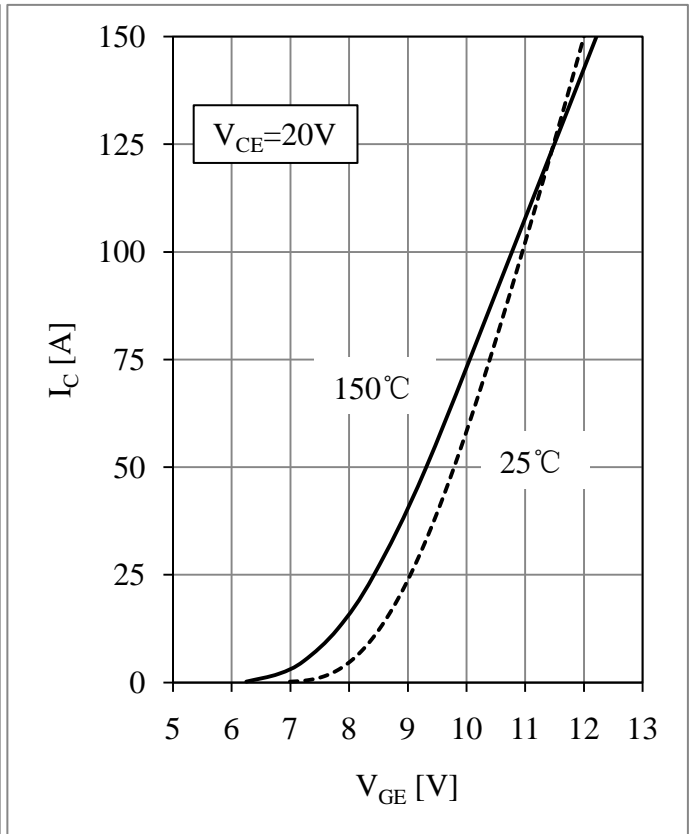


Fig 2. IGBT-inverter Transfer Characteristics

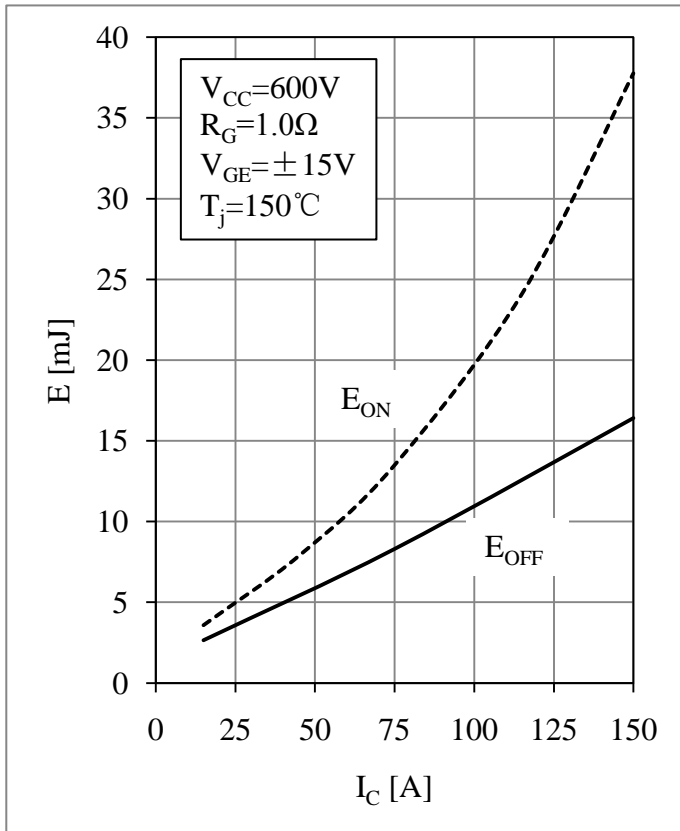


Fig 3. IGBT-inverter Switching Loss vs.  $I_C$

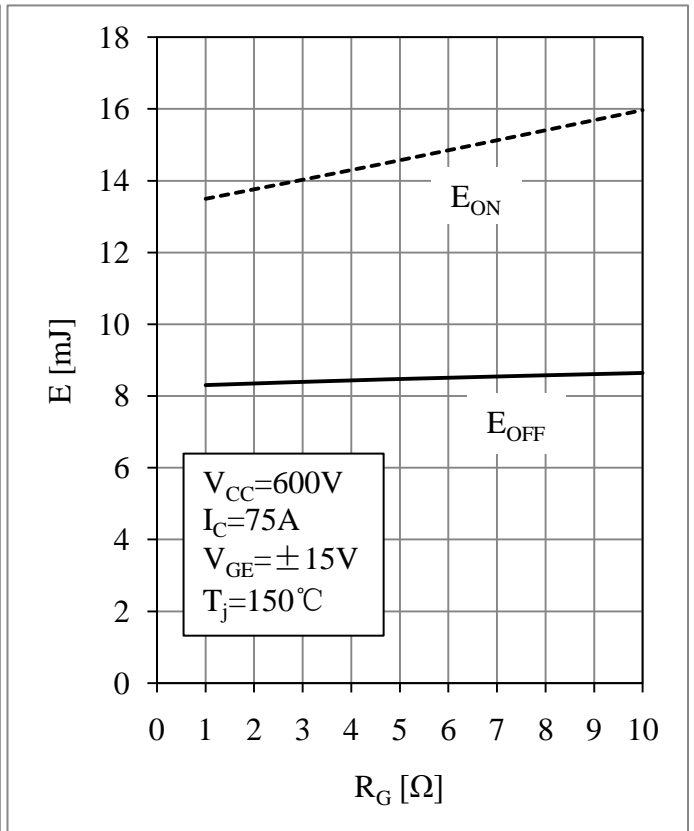


Fig 4. IGBT-inverter Switching Loss vs.  $R_G$

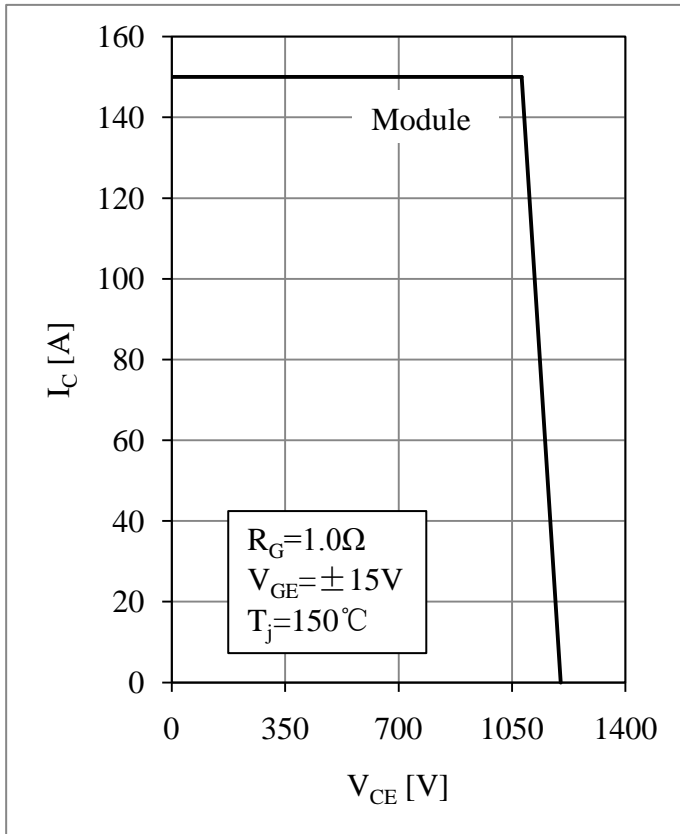


Fig 5. IGBT-inverter RBSOA

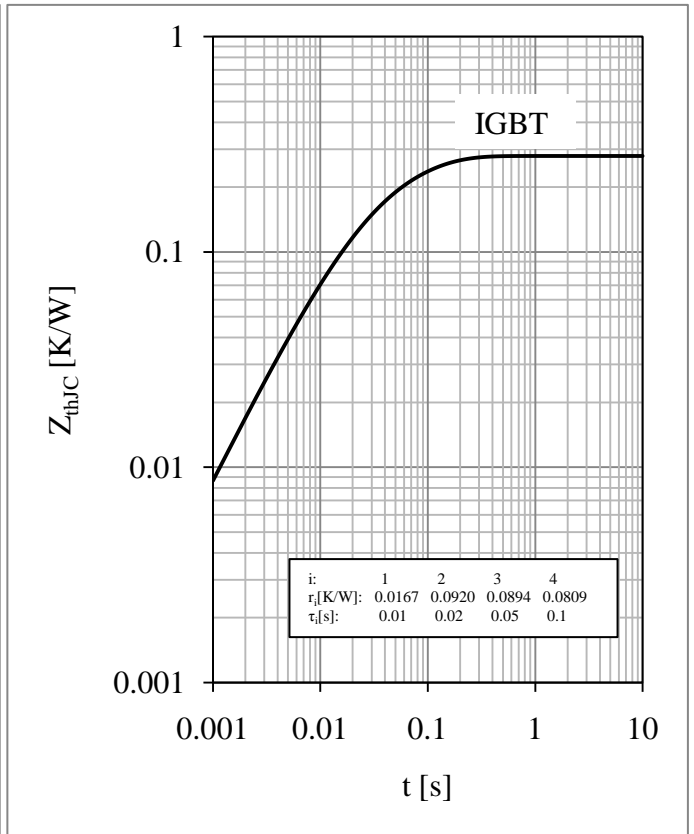


Fig 6. IGBT-inverter Transient Thermal Impedance

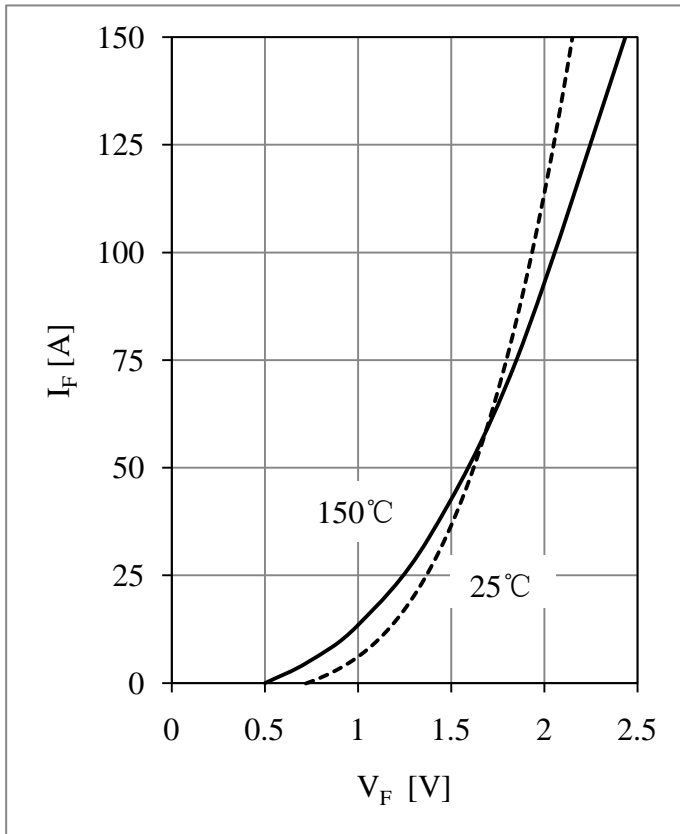


Fig 7. Diode-inverter Forward Characteristics

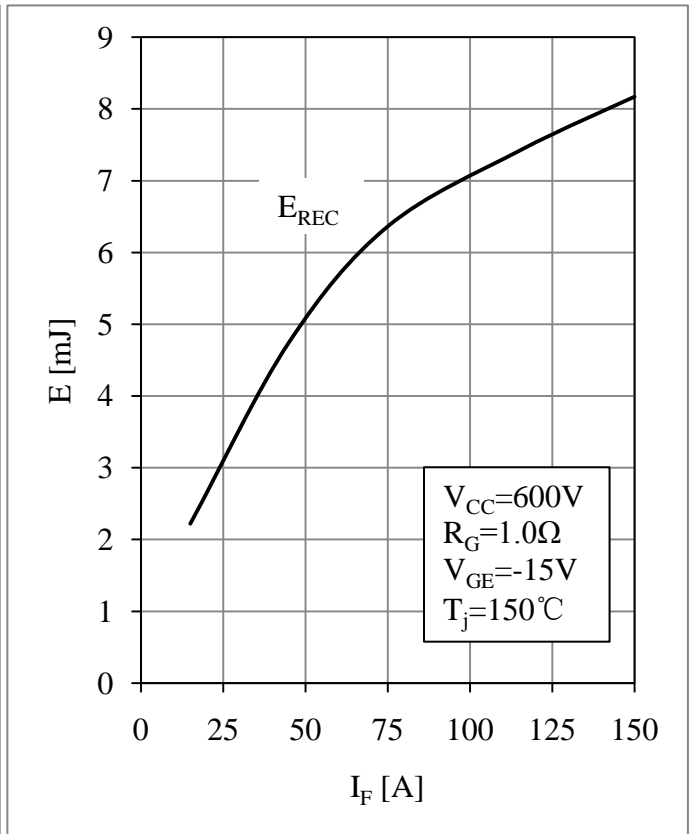


Fig 8. Diode-inverter Switching Loss vs.  $I_F$



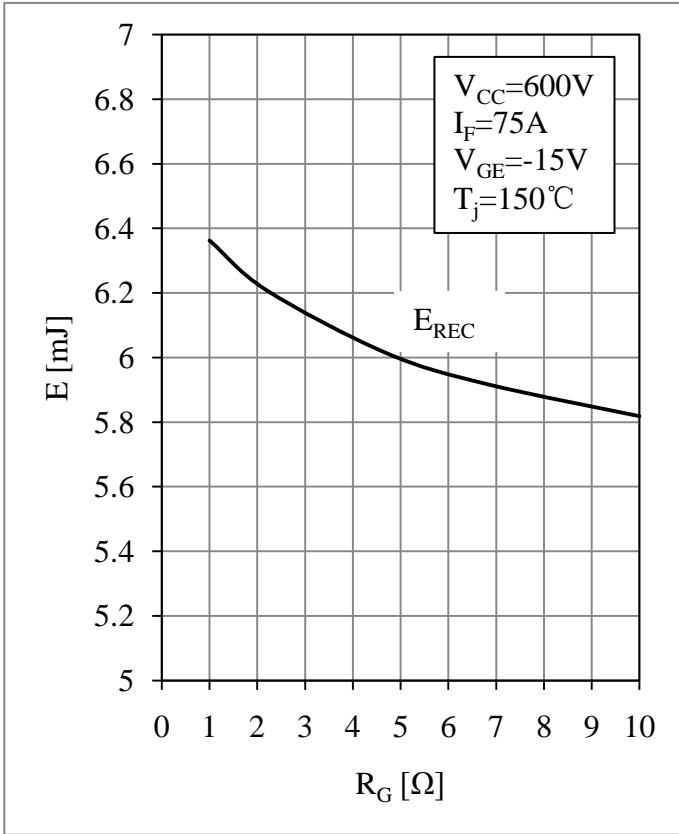


Fig 9. Diode-inverter Switching Loss vs.  $R_G$

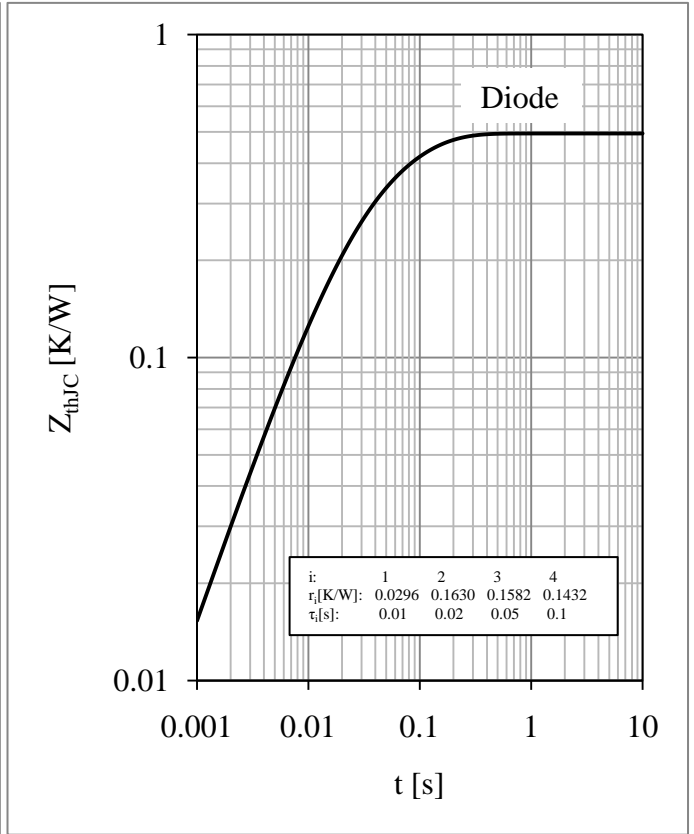


Fig 10. Diode-inverter Transient Thermal Impedance

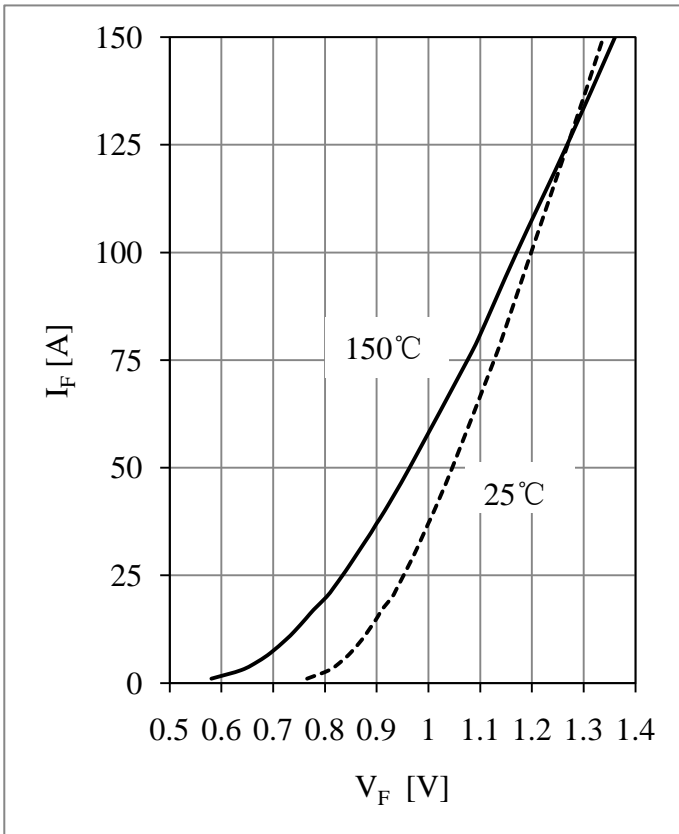


Fig 11. Diode-rectifier Forward Characteristics

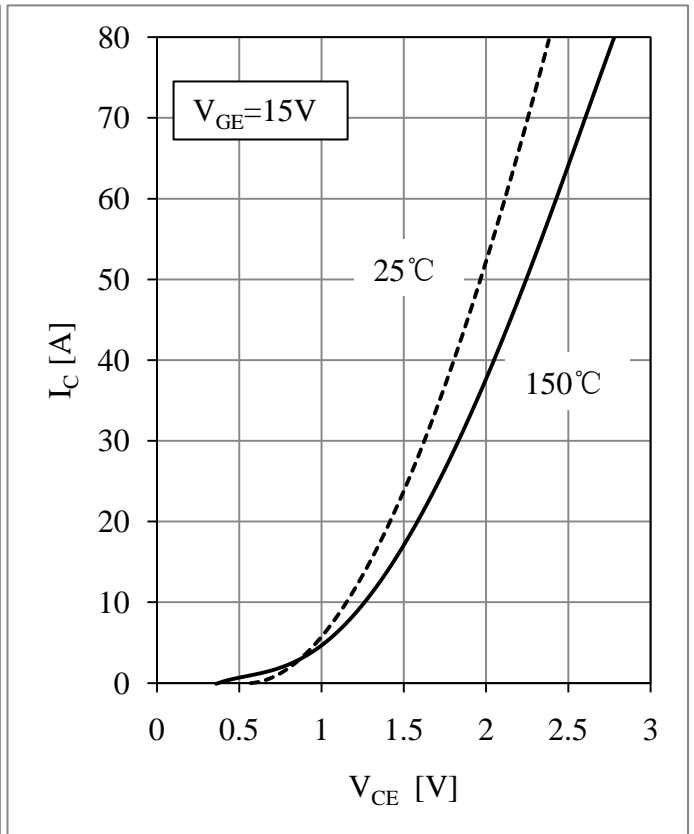


Fig 12. IGBT-brake-chopper Output Characteristics

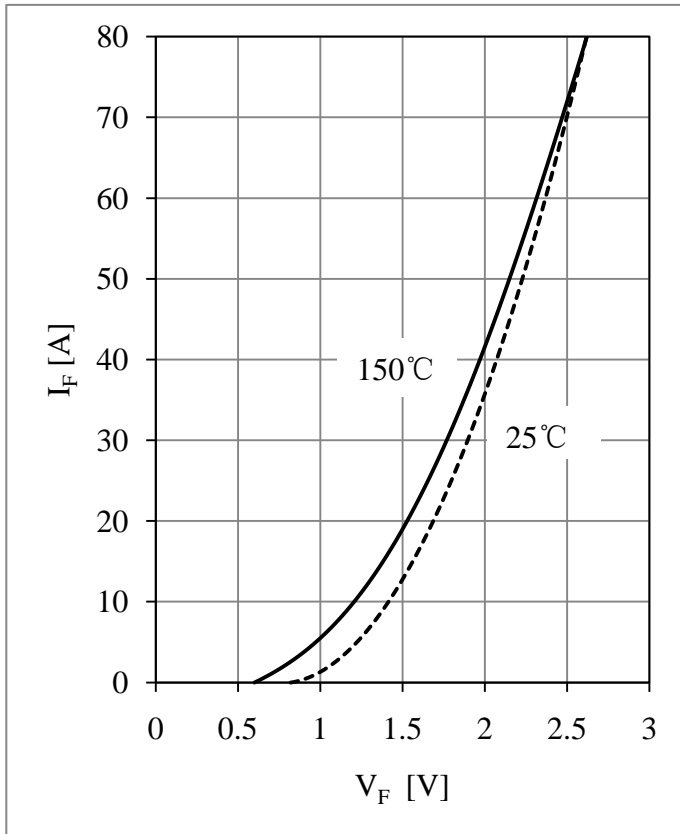


Fig 13. Diode-brake-chopper Forward Characteristics

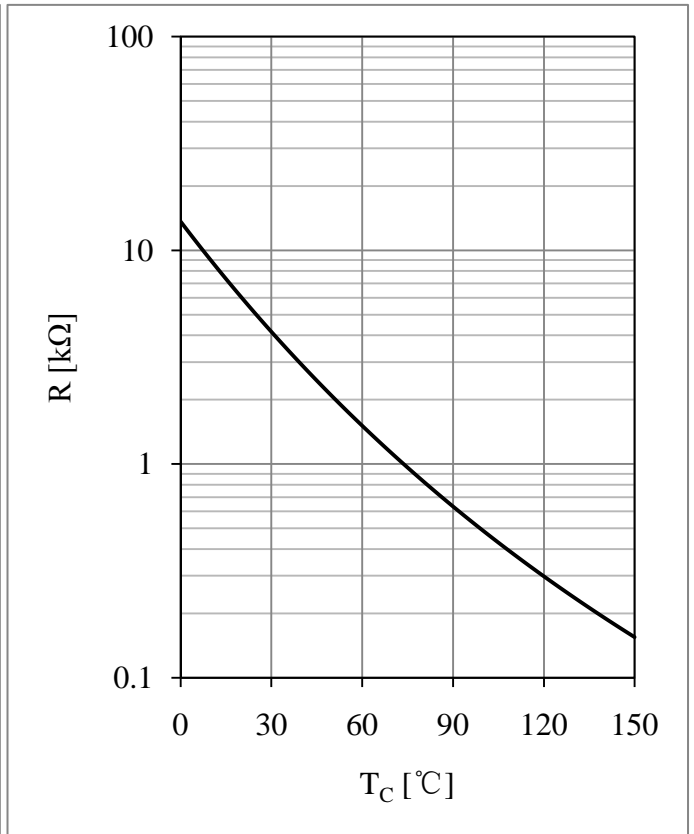
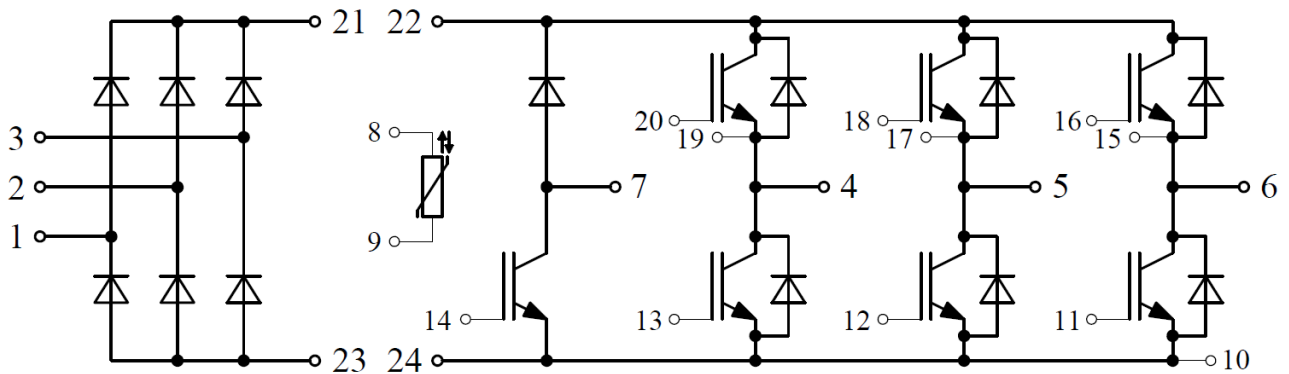


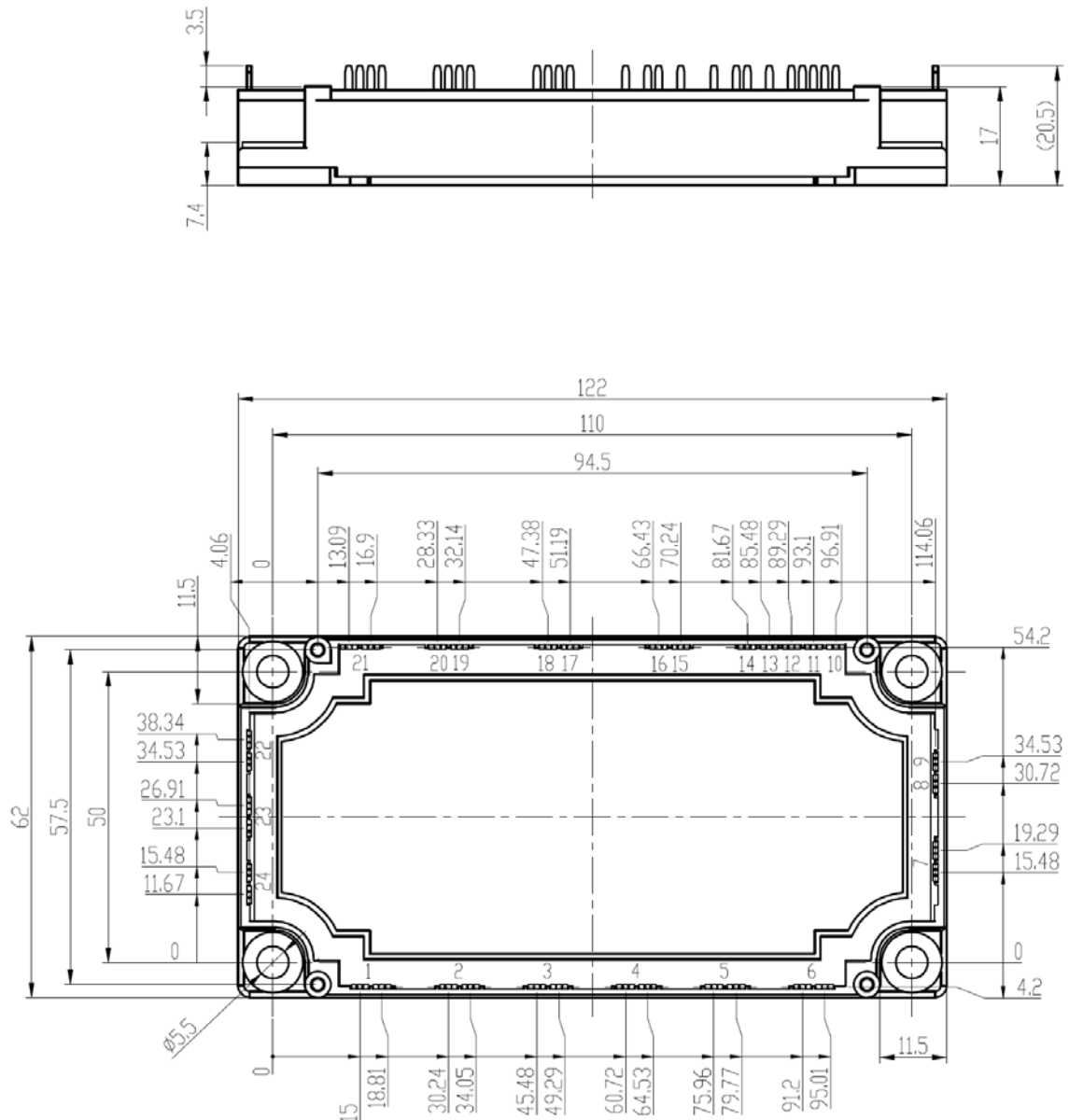
Fig 14. NTC Temperature Characteristic

**Circuit Schematic**



**Package Dimensions**

Dimensions in Millimeters



## Terms and Conditions of Usage

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