

STARPOWER

SEMICONDUCTOR

IGBT

GD50PIX170C6S

1700V/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.

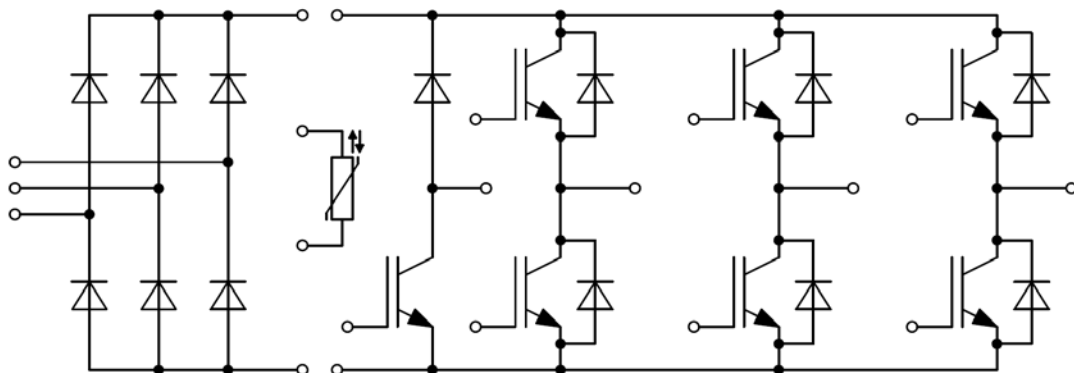
Features

- Low $V_{CE(sat)}$ Trench IGBT technology
- 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	1700	V
V_{GES}	Gate-Emitter Voltage	± 20	V
I_C	Collector Current @ $T_C=25^{\circ}\text{C}$	100	A
	@ $T_C=100^{\circ}\text{C}$	50	
I_{CM}	Pulsed Collector Current $t_p=1\text{ms}$	100	A
P_D	Maximum Power Dissipation @ $T_j=175^{\circ}\text{C}$	418	W

Diode-inverter

Symbol	Description	Value	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	1700	V
I_F	Diode Continuous Forward Current	50	A
I_{FM}	Diode Maximum Forward Current $t_p=1\text{ms}$	100	A

Diode-rectifier

Symbol	Description	Value	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	1800	V
I_O	Average Output Current 50Hz/60Hz,sine wave	50	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	A^2s

IGBT-brake

Symbol	Description	Value	Unit
V_{CES}	Collector-Emitter Voltage	1700	V
V_{GES}	Gate-Emitter Voltage	± 20	V
I_C	Collector Current @ $T_C=25^{\circ}\text{C}$	100	A
	@ $T_C=100^{\circ}\text{C}$	50	
I_{CM}	Pulsed Collector Current $t_p=1\text{ms}$	100	A
P_D	Maximum Power Dissipation @ $T_j=175^{\circ}\text{C}$	418	W

Diode-brake

Symbol	Description	Value	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	1700	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	
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	$I_C=50\text{A}, V_{GE}=15\text{V}, T_j=25^\circ\text{C}$		1.85	2.20	V	
		$I_C=50\text{A}, V_{GE}=15\text{V}, T_j=125^\circ\text{C}$		2.25			
		$I_C=50\text{A}, V_{GE}=15\text{V}, T_j=150^\circ\text{C}$		2.35			
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=2.0\text{mA}, V_{CE}=V_{GE}, T_j=25^\circ\text{C}$	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			9.5		Ω	
C_{ies}	Input Capacitance	$V_{CE}=25\text{V}, f=1\text{MHz}, V_{GE}=0\text{V}$		6.02		nF	
C_{res}	Reverse Transfer Capacitance			0.15		nF	
Q_G	Gate Charge	$V_{GE}=-15\dots+15\text{V}$		0.47		μC	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=900\text{V}, I_C=50\text{A}, R_G=9.6\Omega, V_{GE}=\pm 15\text{V}, T_j=25^\circ\text{C}$		187		ns	
t_r	Rise Time			31		ns	
$t_{d(off)}$	Turn-Off Delay Time			434		ns	
t_f	Fall Time			363		ns	
E_{on}	Turn-On Switching Loss			9.25		mJ	
E_{off}	Turn-Off Switching Loss			10.4		mJ	
$t_{d(on)}$	Turn-On Delay Time		$V_{CC}=900\text{V}, I_C=50\text{A}, R_G=9.6\Omega, V_{GE}=\pm 15\text{V}, T_j=125^\circ\text{C}$		194		ns
t_r	Rise Time				44		ns
$t_{d(off)}$	Turn-Off Delay Time			503		ns	
t_f	Fall Time			637		ns	
E_{on}	Turn-On Switching Loss			15.2		mJ	
E_{off}	Turn-Off Switching Loss			16.1		mJ	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=900\text{V}, I_C=50\text{A}, R_G=9.6\Omega, V_{GE}=\pm 15\text{V}, T_j=150^\circ\text{C}$			202		ns
t_r	Rise Time				55		ns
$t_{d(off)}$	Turn-Off Delay Time			512		ns	
t_f	Fall Time			720		ns	
E_{on}	Turn-On Switching Loss			16.5		mJ	
E_{off}	Turn-Off Switching Loss			17.4		mJ	
I_{SC}	SC Data		$t_p \leq 10\mu\text{s}, V_{GE}=15\text{V}, T_j=150^\circ\text{C}, V_{CC}=1000\text{V}, V_{CEM} \leq 1700\text{V}$		200		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	$I_F=50\text{A}, V_{GE}=0\text{V}, T_j=25^\circ\text{C}$		1.80	2.25	V
		$I_F=50\text{A}, V_{GE}=0\text{V}, T_j=125^\circ\text{C}$		1.90		
		$I_F=50\text{A}, V_{GE}=0\text{V}, T_j=150^\circ\text{C}$		1.95		
Q_r	Recovered Charge	$V_R=900\text{V}, I_F=50\text{A},$ $-di/dt=1775\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=25^\circ\text{C}$		8.9		μC
I_{RM}	Peak Reverse Recovery Current			52		A
E_{rec}	Reverse Recovery Energy			4.89		mJ
Q_r	Recovered Charge	$V_R=900\text{V}, I_F=50\text{A},$ $-di/dt=1775\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=125^\circ\text{C}$		16.9		μC
I_{RM}	Peak Reverse Recovery Current			54		A
E_{rec}	Reverse Recovery Energy			9.7		mJ
Q_r	Recovered Charge	$V_R=900\text{V}, I_F=50\text{A},$ $-di/dt=1775\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=150^\circ\text{C}$		18.7		μC
I_{RM}	Peak Reverse Recovery Current			53		A
E_{rec}	Reverse Recovery Energy			11.9		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	$I_C=50\text{A}, T_j=150^\circ\text{C}$		0.95		V
I_R	Reverse Current	$T_j=150^\circ\text{C}, V_R=1800\text{V}$			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	$I_C=50\text{A}, V_{GE}=15\text{V}, T_j=25^\circ\text{C}$		1.85	2.20	V	
		$I_C=50\text{A}, V_{GE}=15\text{V}, T_j=125^\circ\text{C}$		2.25			
		$I_C=50\text{A}, V_{GE}=15\text{V}, T_j=150^\circ\text{C}$		2.35			
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=2.0\text{mA}, V_{CE}=V_{GE}, T_j=25^\circ\text{C}$	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			9.5		Ω	
C_{ies}	Input Capacitance	$V_{CE}=25\text{V}, f=1\text{MHz}, V_{GE}=0\text{V}$		6.02		nF	
C_{res}	Reverse Transfer Capacitance			0.15		nF	
Q_G	Gate Charge	$V_{GE}=-15\dots+15\text{V}$		0.47		μC	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=900\text{V}, I_C=50\text{A}, R_G=9.6\Omega, V_{GE}=\pm 15\text{V}, T_j=25^\circ\text{C}$		187		ns	
t_r	Rise Time			31		ns	
$t_{d(off)}$	Turn-Off Delay Time			434		ns	
t_f	Fall Time			363		ns	
E_{on}	Turn-On Switching Loss			9.25		mJ	
E_{off}	Turn-Off Switching Loss			10.4		mJ	
$t_{d(on)}$	Turn-On Delay Time		$V_{CC}=900\text{V}, I_C=50\text{A}, R_G=9.6\Omega, V_{GE}=\pm 15\text{V}, T_j=125^\circ\text{C}$		194		ns
t_r	Rise Time				44		ns
$t_{d(off)}$	Turn-Off Delay Time			503		ns	
t_f	Fall Time			637		ns	
E_{on}	Turn-On Switching Loss			15.2		mJ	
E_{off}	Turn-Off Switching Loss			16.1		mJ	
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t_r	Rise Time				55		ns
$t_{d(off)}$	Turn-Off Delay Time			512		ns	
t_f	Fall Time			720		ns	
E_{on}	Turn-On Switching Loss			16.5		mJ	
E_{off}	Turn-Off Switching Loss			17.4		mJ	
I_{SC}	SC Data		$t_p \leq 10\mu\text{s}, V_{GE}=15\text{V}, T_j=150^\circ\text{C}, V_{CC}=1000\text{V}, V_{CEM} \leq 1700\text{V}$		200		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	$I_F=50\text{A}, V_{GE}=0\text{V}, T_j=25^\circ\text{C}$		1.80	2.25	V
		$I_F=50\text{A}, V_{GE}=0\text{V}, T_j=125^\circ\text{C}$		1.90		
		$I_F=50\text{A}, V_{GE}=0\text{V}, T_j=150^\circ\text{C}$		1.95		
Q_r	Recovered Charge	$V_R=900\text{V}, I_F=50\text{A},$ $-di/dt=1775\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=25^\circ\text{C}$		8.9		μC
I_{RM}	Peak Reverse Recovery Current			52		A
E_{rec}	Reverse Recovery Energy			4.89		mJ
Q_r	Recovered Charge	$V_R=900\text{V}, I_F=50\text{A},$ $-di/dt=1775\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=125^\circ\text{C}$		16.9		μC
I_{RM}	Peak Reverse Recovery Current			54		A
E_{rec}	Reverse Recovery Energy			9.7		mJ
Q_r	Recovered Charge	$V_R=900\text{V}, I_F=50\text{A},$ $-di/dt=1775\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=150^\circ\text{C}$		18.7		μC
I_{RM}	Peak Reverse Recovery Current			53		A
E_{rec}	Reverse Recovery Energy			11.9		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 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) Junction-to-Case (per Diode-brake)			0.358 0.630 0.535 0.358 0.630	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)		0.135 0.237 0.202 0.135 0.237 0.009		K/W
M	Mounting Torque, Screw:M5	3.0		6.0	N.m
G	Weight of Module		300		g

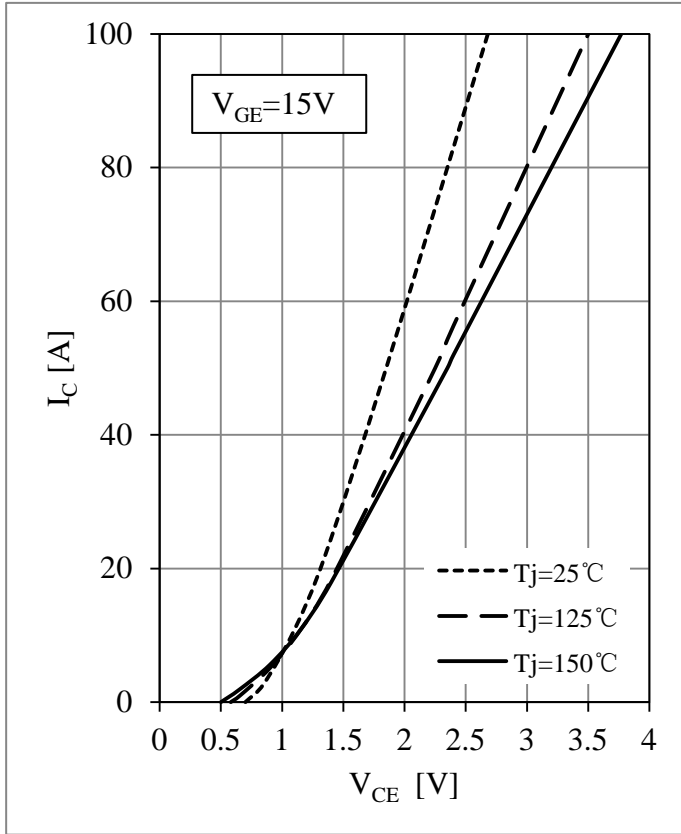


Fig 1. IGBT-inverter Output Characteristics

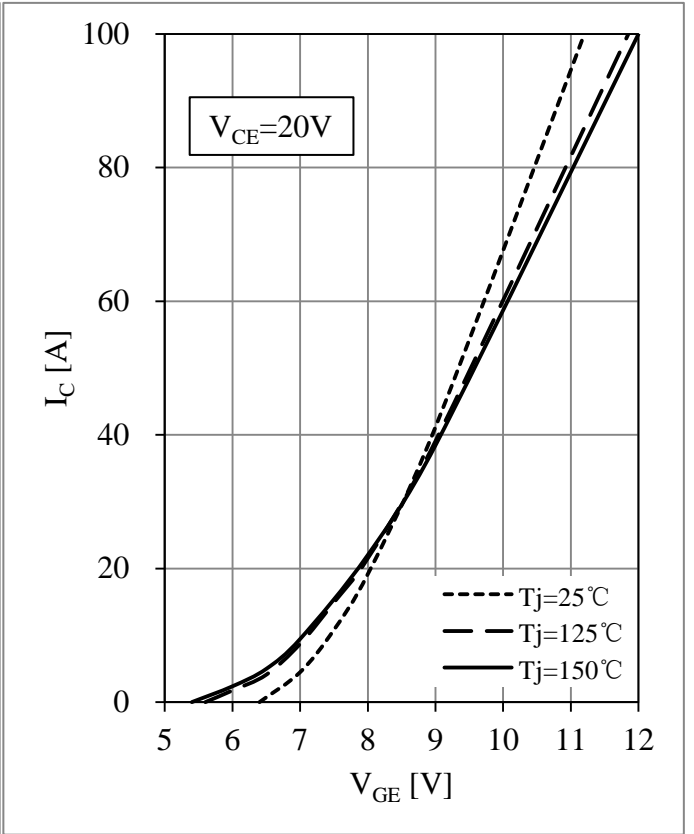


Fig 2. IGBT-inverter Transfer Characteristics

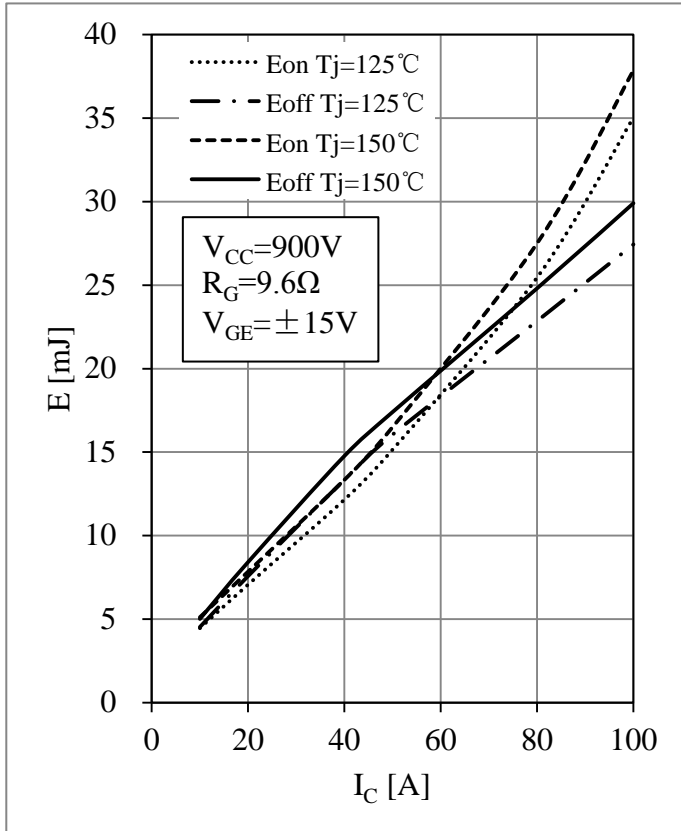


Fig 3. IGBT-inverter Switching Loss vs. I_C

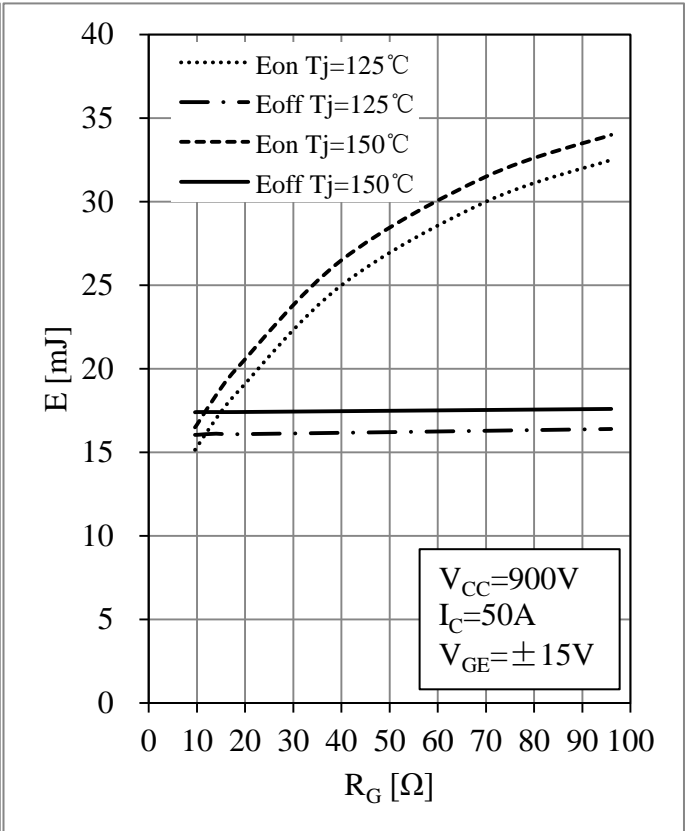


Fig 4. IGBT-inverter Switching Loss vs. R_G

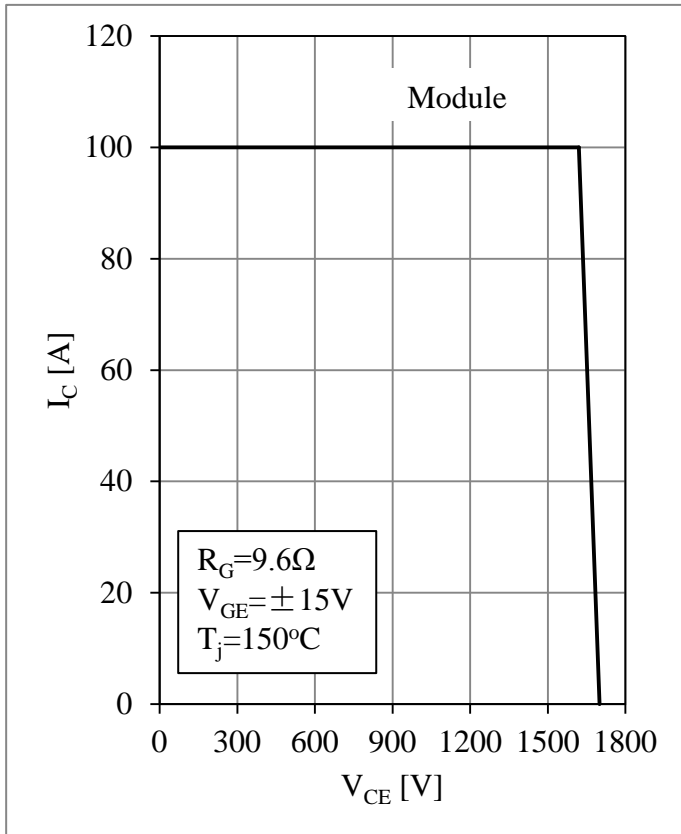


Fig 5. IGBT-inverter RBSOA

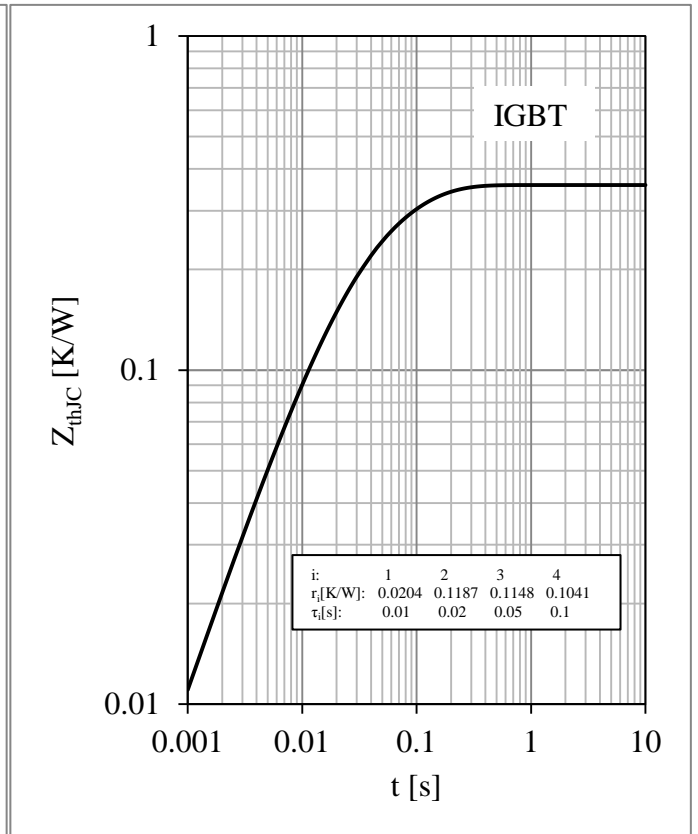


Fig 6. IGBT-inverter Transient Thermal Impedance

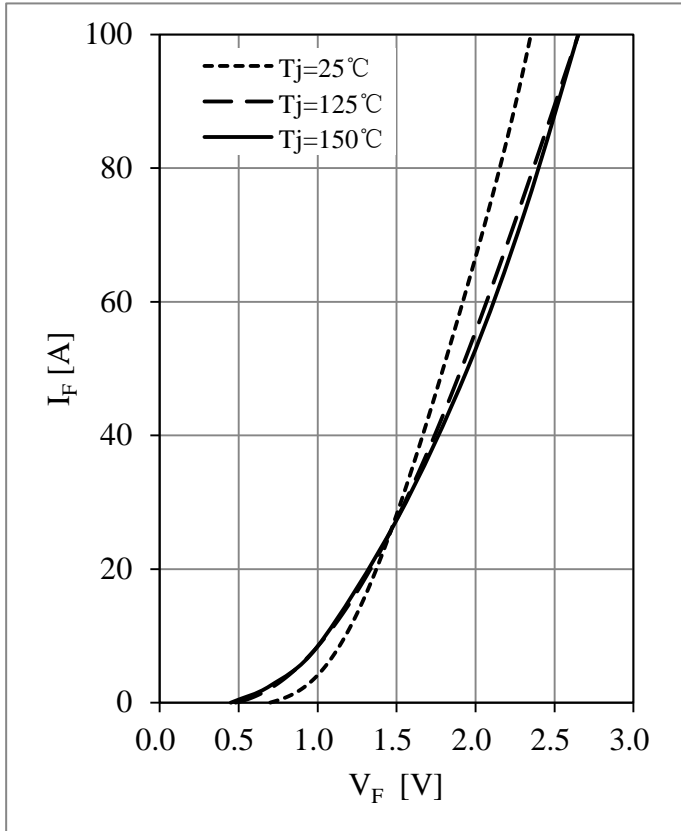


Fig 7. Diode-inverter Forward Characteristics

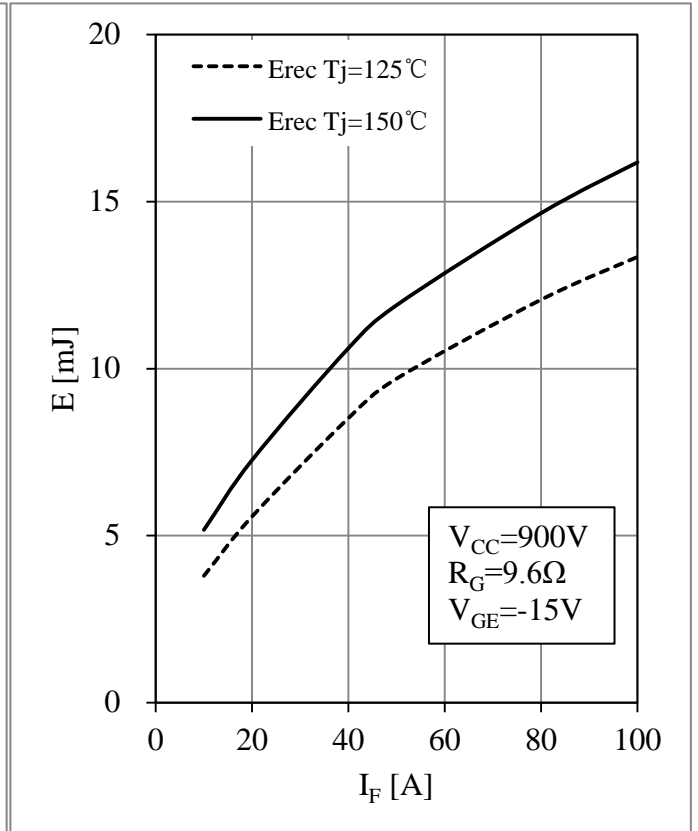


Fig 8. Diode-inverter Switching Loss vs. I_F

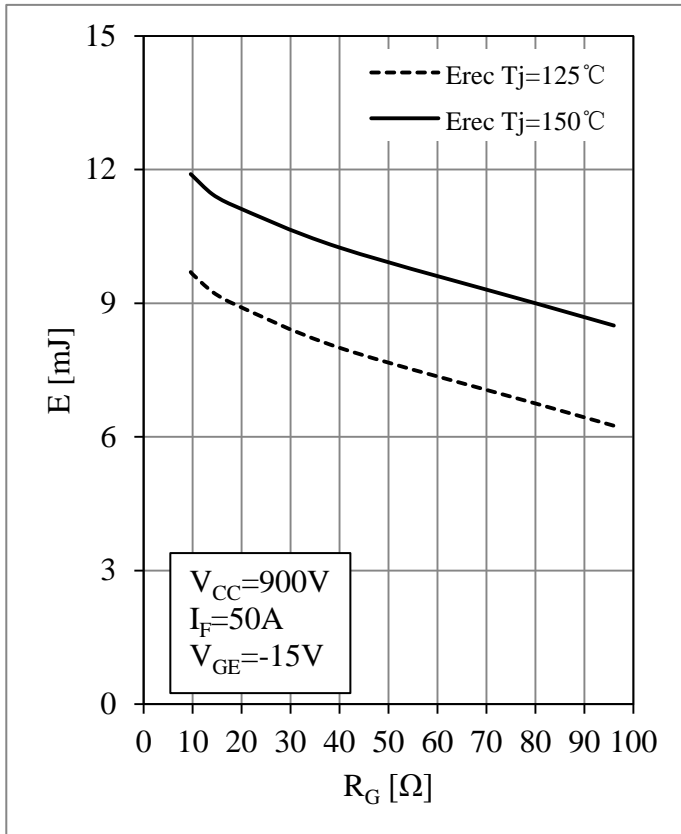


Fig 9. Diode-inverter Switching Loss vs. R_G

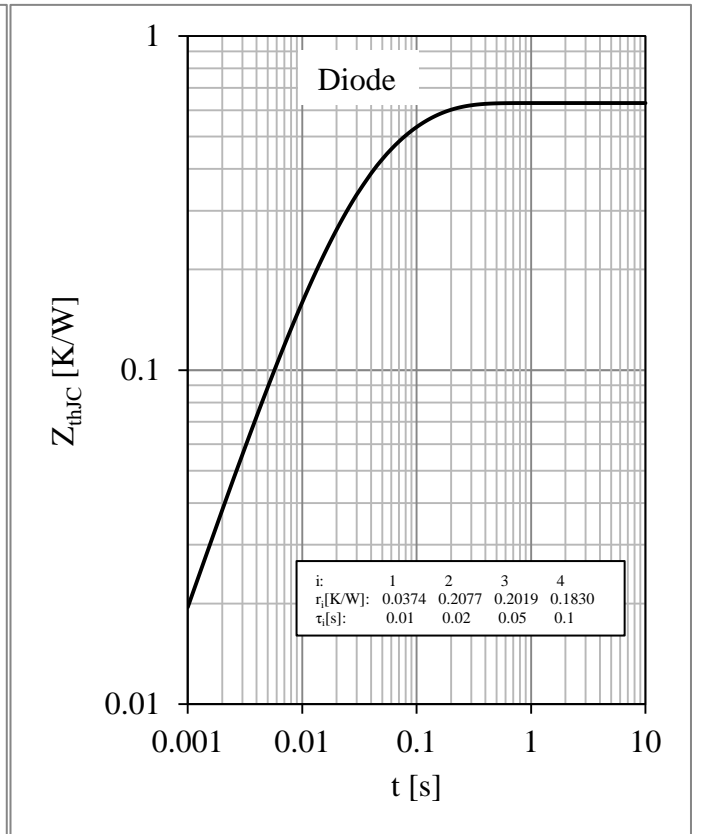


Fig 10. Diode-inverter Transient Thermal Impedance

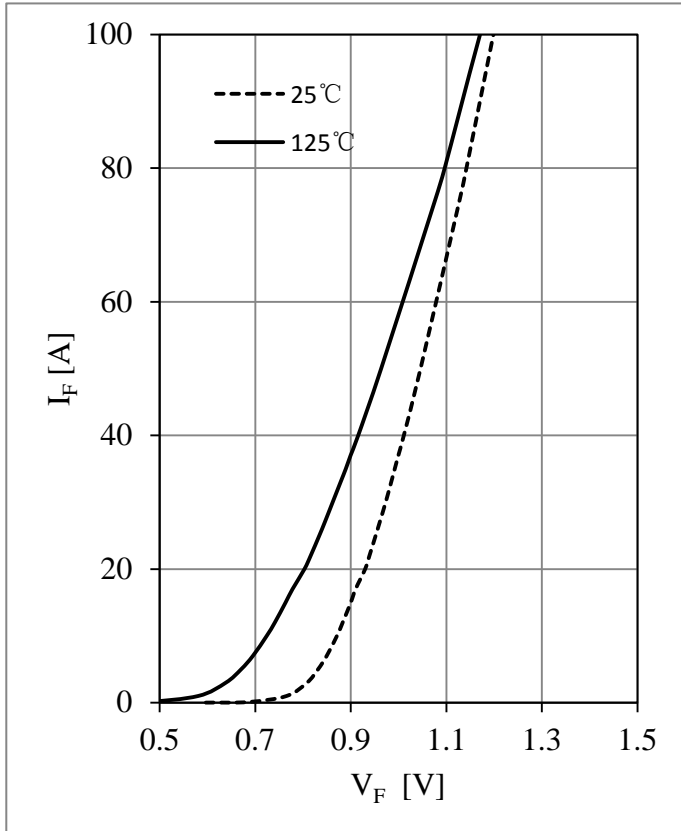


Fig 11. Diode-rectifier Forward Characteristics

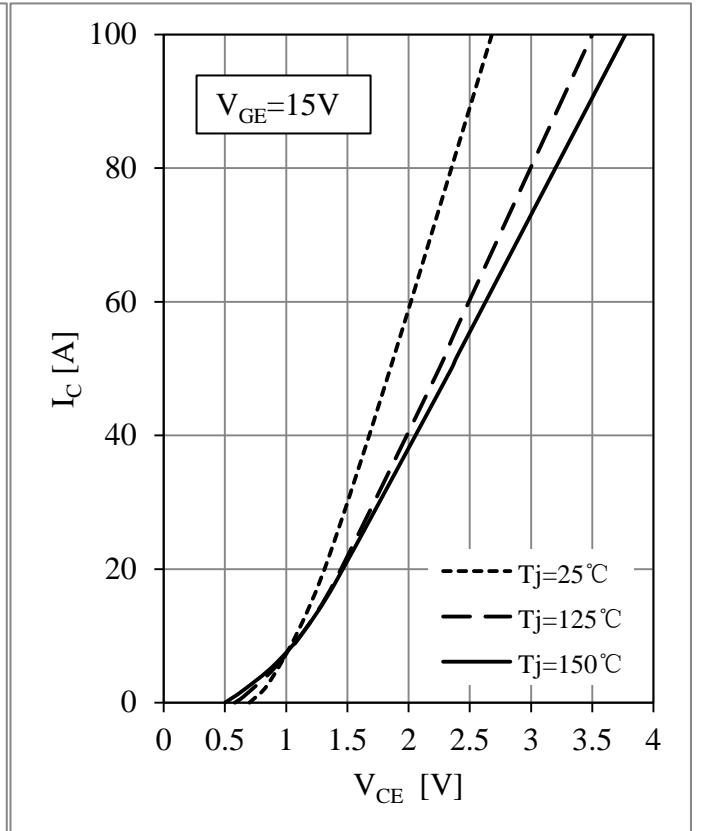


Fig 12. IGBT-brake-chopper Output Characteristics

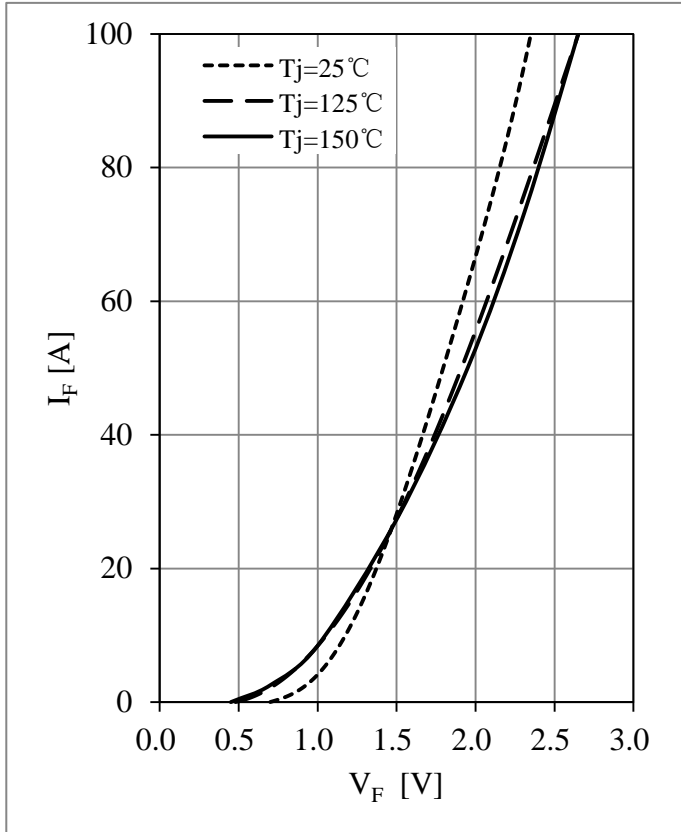


Fig 13. Diode-brake-chopper Forward Characteristics

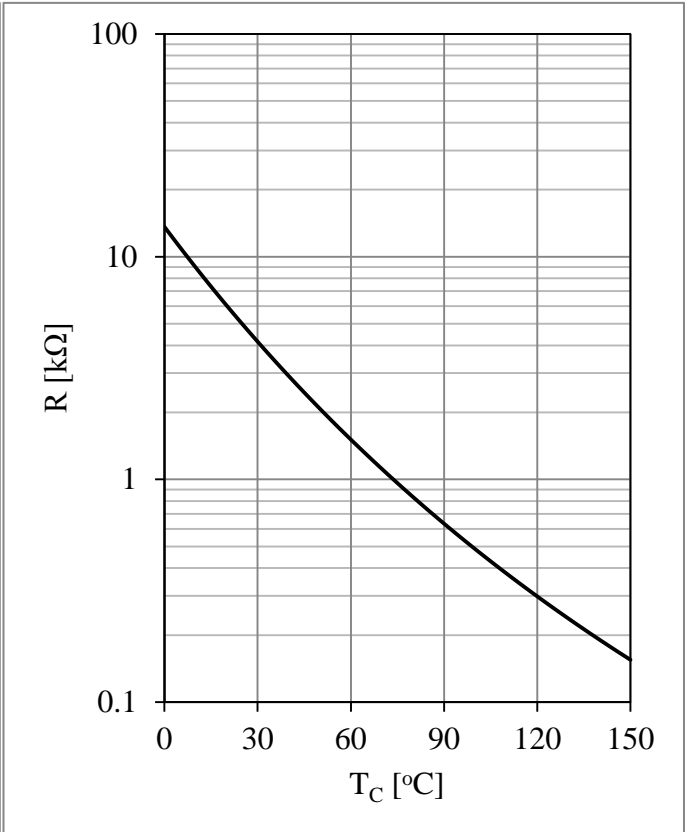
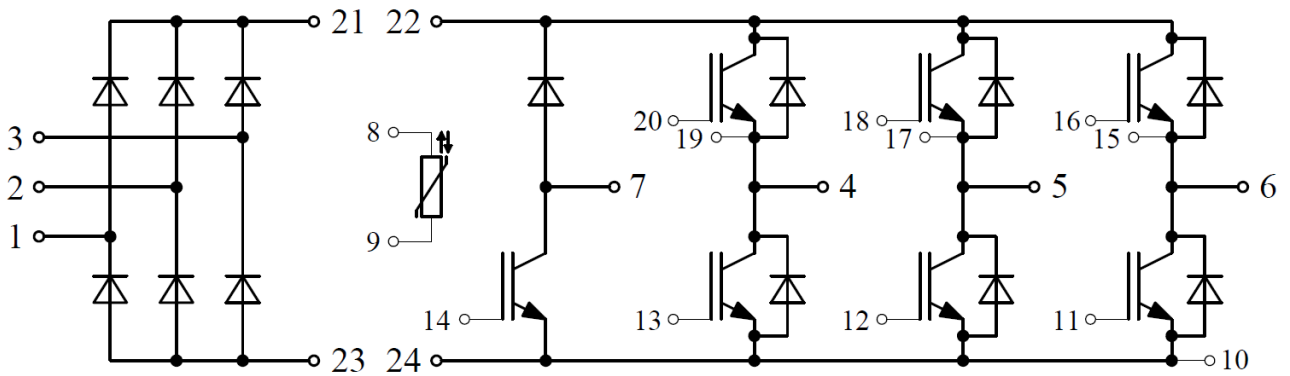


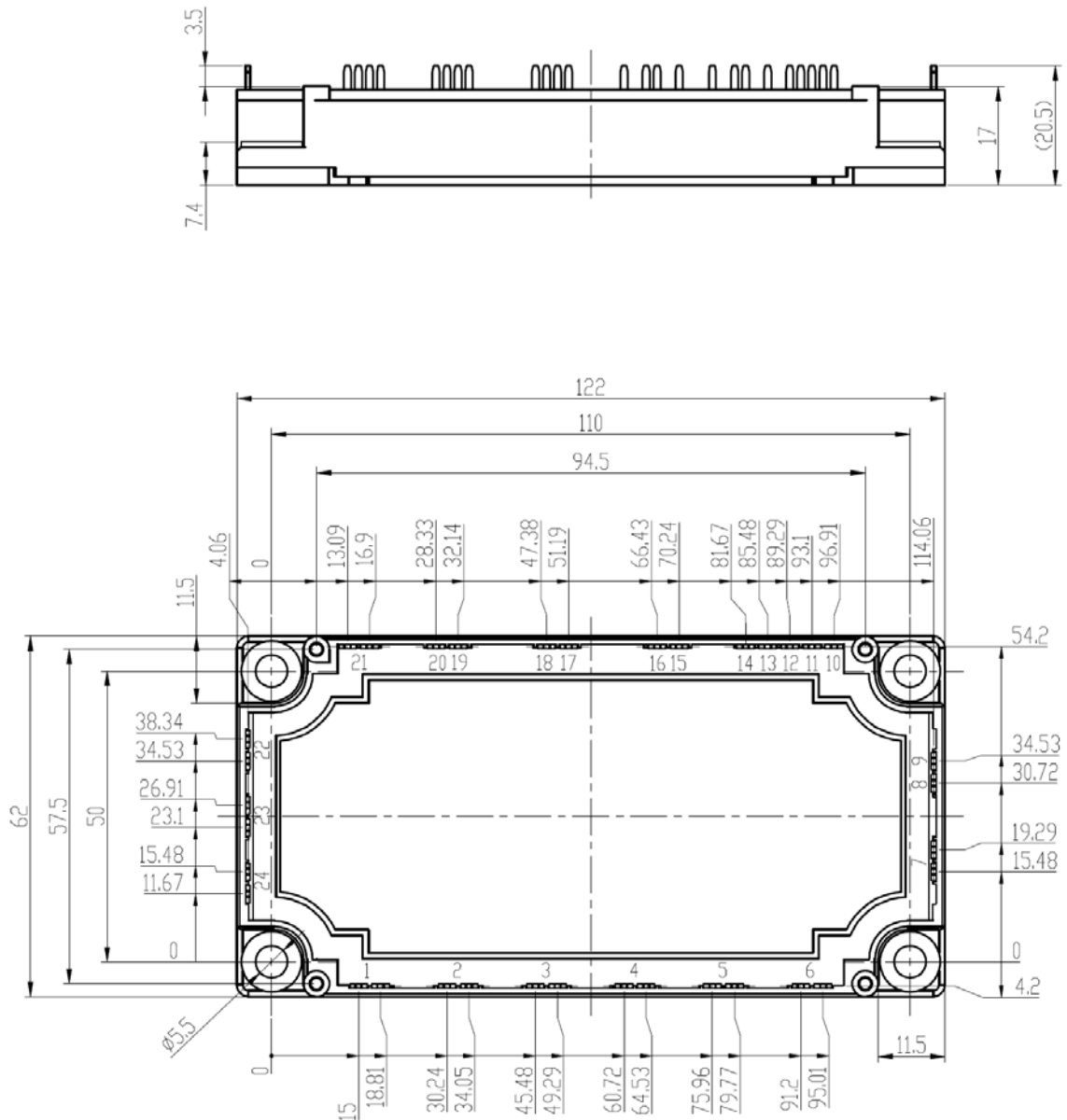
Fig 14. NTC Temperature Characteristic

Circuit Schematic



Package Dimensions

Dimensions in Millimeters



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