

STARPOWER

SEMICONDUCTOR

IGBT

GD50PIK120C6S

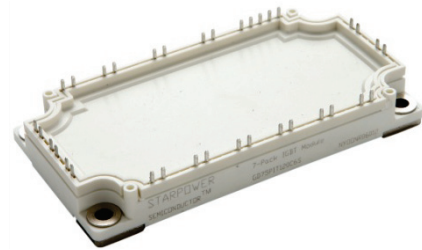
1200V/50A PIM in one-package

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

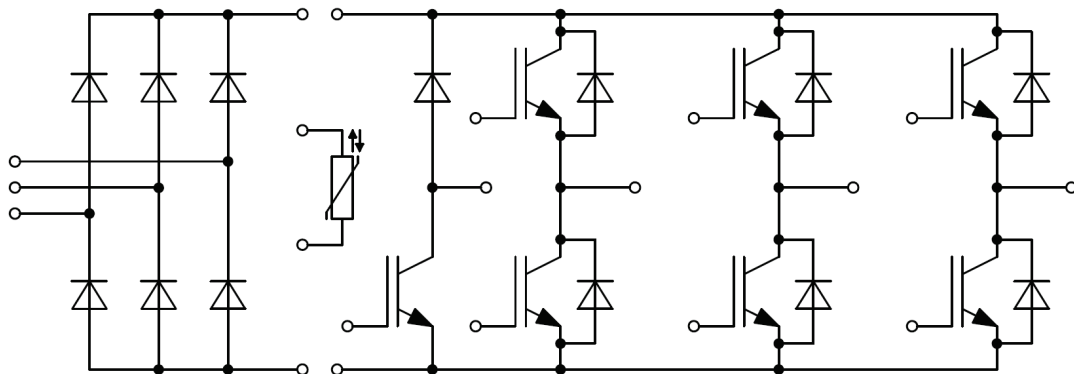
- Low $V_{CE(sat)}$ NPT IGBT technology
- Low switching loss
- 10 μ s short circuit capability
- $V_{CE(sat)}$ with positive temperature coefficient
- Fast & soft reverse recovery anti-parallel FWD
- Isolated copper baseplate using DBC technology



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 @ $T_C=25^{\circ}\text{C}$	90	A
	@ $T_C=95^{\circ}\text{C}$	50	
I_{CM}	Pulsed Collector Current $t_p=1\text{ms}$	100	A
P_D	Maximum Power Dissipation @ $T_j=150^{\circ}\text{C}$	370	W

Diode-inverter

Symbol	Description	Value	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	1200	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	1600	V
I_O	Average Output Current 50Hz/60Hz,sine wave	50	A
I_{FSM}	Surge Forward Current $V_R=0\text{V}, t_p=10\text{ms}, T_j=45^{\circ}\text{C}$	850	A
I^2t	I^2t -value, $V_R=0\text{V}, t_p=10\text{ms}, T_j=45^{\circ}\text{C}$	3610	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	
I_{CM}	Pulsed Collector Current $t_p=1\text{ms}$	50	A
P_D	Maximum Power Dissipation @ $T_j=150^{\circ}\text{C}$	217	W

Diode-brake

Symbol	Description	Value	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	1200	V
I_F	Diode Continuous Forward Current	30	A
I_{FM}	Diode Maximum Forward Current $t_p=1\text{ms}$	60	A

Module

Symbol	Description	Value	Unit
T_{jmax}	Maximum Junction Temperature	150	$^{\circ}\text{C}$
T_{jop}	Operating Junction Temperature(inverter,brake)	-40 to +125	$^{\circ}\text{C}$
	Operating Junction Temperature(rectifier)	-40 to +150	
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	$I_C=50\text{A}, V_{GE}=15\text{V}, T_j=25^\circ\text{C}$		2.15	2.50	V	
		$I_C=50\text{A}, V_{GE}=15\text{V}, T_j=125^\circ\text{C}$		2.60			
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=1.0\text{mA}, V_{CE}=V_{GE}, T_j=25^\circ\text{C}$	5.0	5.4	6.0	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			/		Ω	
C_{ies}	Input Capacitance	$V_{CE}=25\text{V}, f=1\text{MHz}, V_{GE}=0\text{V}$		3.30		nF	
C_{res}	Reverse Transfer Capacitance				0.22		nF
Q_G	Gate Charge	$V_{GE}=-15\dots+15\text{V}$		520		nC	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=50\text{A}, R_G=13\Omega, V_{GE}=\pm 15\text{V}, T_j=25^\circ\text{C}$		240		ns	
t_r	Rise Time			56		ns	
$t_{d(off)}$	Turn-Off Delay Time			250		ns	
t_f	Fall Time			260		ns	
E_{on}	Turn-On Switching Loss				6.02		mJ
E_{off}	Turn-Off Switching Loss				3.89		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=50\text{A}, R_G=13\Omega, V_{GE}=\pm 15\text{V}, T_j=125^\circ\text{C}$		257		ns	
t_r	Rise Time			58		ns	
$t_{d(off)}$	Turn-Off Delay Time			275		ns	
t_f	Fall Time			325		ns	
E_{on}	Turn-On Switching Loss				7.05		mJ
E_{off}	Turn-Off Switching Loss				5.41		mJ
I_{sc}	SC Data	$t_p \leq 10\mu\text{s}, V_{GE}=15\text{V}, T_j=125^\circ\text{C}, V_{CC}=900\text{V}, V_{CEM} \leq 1200\text{V}$		500		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	2.20	V
		$I_F=50\text{A}, V_{GE}=0\text{V}, T_j=125^\circ\text{C}$		1.85		
Q_r	Recovered Charge	$V_R=600\text{V}, I_F=50\text{A},$ $-di/dt=1020\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=25^\circ\text{C}$		4.1		μC
I_{RM}	Peak Reverse Recovery Current			44		A
E_{rec}	Reverse Recovery Energy			1.69		mJ
Q_r	Recovered Charge			7.9		μC
I_{RM}	Peak Reverse Recovery Current	$V_R=600\text{V}, I_F=50\text{A},$ $-di/dt=1020\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=125^\circ\text{C}$		53		A
E_{rec}	Reverse Recovery Energy			3.11		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	$I_F=50\text{A}, V_{GE}=0\text{V}, T_j=150^\circ\text{C}$		1.03		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	$I_C=25\text{A}, V_{GE}=15\text{V}, T_j=25^\circ\text{C}$		2.05	2.50	V
		$I_C=25\text{A}, V_{GE}=15\text{V}, T_j=125^\circ\text{C}$		2.40		
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=1.0\text{mA}, V_{CE}=V_{GE}, T_j=25^\circ\text{C}$	5.0	5.6	6.2	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			/		Ω
C_{ies}	Input Capacitance	$V_{CE}=25\text{V}, f=1\text{MHz}, V_{GE}=0\text{V}$		1.65		nF
C_{res}	Reverse Transfer Capacitance				0.11	
Q_G	Gate Charge	$V_{GE}=-15\dots+15\text{V}$		260		nC
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=25\text{A}, R_G=33\Omega, V_{GE}=\pm 15\text{V}, T_j=25^\circ\text{C}$		186		ns
t_r	Rise Time			54		ns
$t_{d(off)}$	Turn-Off Delay Time			255		ns
t_f	Fall Time			317		ns
E_{on}	Turn-On Switching Loss			2.67		mJ
E_{off}	Turn-Off Switching Loss			1.75		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=25\text{A}, R_G=33\Omega, V_{GE}=\pm 15\text{V}, T_j=125^\circ\text{C}$		227		ns
t_r	Rise Time			74		ns
$t_{d(off)}$	Turn-Off Delay Time			280		ns
t_f	Fall Time			325		ns
E_{on}	Turn-On Switching Loss			3.70		mJ
E_{off}	Turn-Off Switching Loss			1.76		mJ
I_{SC}	SC Data	$t_p \leq 10\mu\text{s}, V_{GE}=15\text{V}, T_j=125^\circ\text{C}, V_{CC}=900\text{V}, V_{CEM} \leq 1200\text{V}$		250		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	$I_F=30\text{A}, V_{GE}=0\text{V}, T_j=25^\circ\text{C}$		1.90	2.35	V
		$I_F=30\text{A}, V_{GE}=0\text{V}, T_j=125^\circ\text{C}$		1.80		
Q_r	Recovered Charge	$V_R=600\text{V}, I_F=30\text{A},$ $-di/dt=400\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=25^\circ\text{C}$		2.1		μC
I_{RM}	Peak Reverse Recovery Current			19		A
E_{rec}	Reverse Recovery Energy			1.00		mJ
Q_r	Recovered Charge			4.1		μC
I_{RM}	Peak Reverse Recovery Current	$V_R=600\text{V}, I_F=30\text{A},$ $-di/dt=4010\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=125^\circ\text{C}$		22		A
E_{rec}	Reverse Recovery Energy			2.04		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

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		$\text{m}\Omega$
$R_{\theta JC}$	Junction-to-Case (per IGBT-inverter)			0.332	K/W
	Junction-to-Case (per Diode-inverter)			0.643	
	Junction-to-Case (per Diode-rectifier)			0.654	
	Junction-to-Case (per IGBT-brake-chopper)			0.576	
	Junction-to-Case (per Diode-brake-chopper)			1.082	
$R_{\theta CS}$	Case-to-Sink (per IGBT-inverter)		0.117		K/W
	Case-to-Sink (per Diode-inverter)		0.227		
	Case-to-Sink (per Diode-rectifier)		0.231		
	Case-to-Sink (per IGBT-brake-chopper)		0.203		
	Case-to-Sink (per Diode-brake-chopper)		0.382		
$R_{\theta CS}$	Case-to-Sink		0.009		K/W
M	Mounting Torque, Screw:M5	3.0		6.0	N.m
G	Weight of Module		300		g

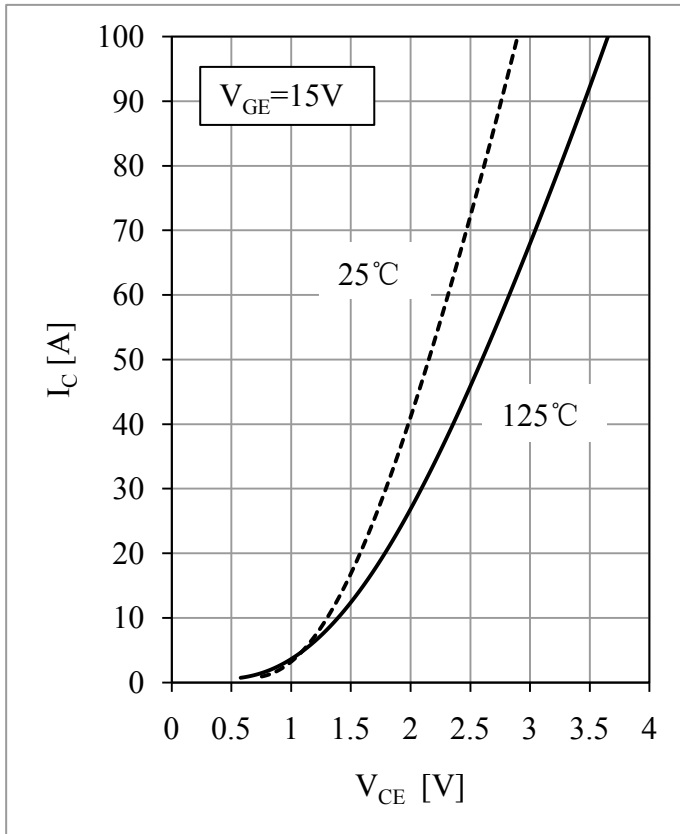


Fig 1. IGBT-inverter Output Characteristics

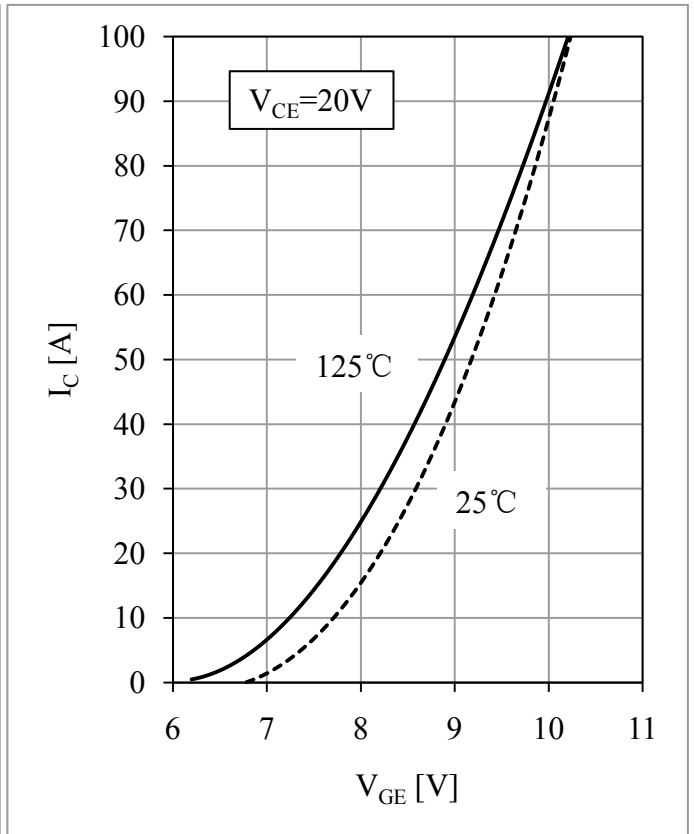


Fig 2. IGBT-inverter Transfer Characteristics

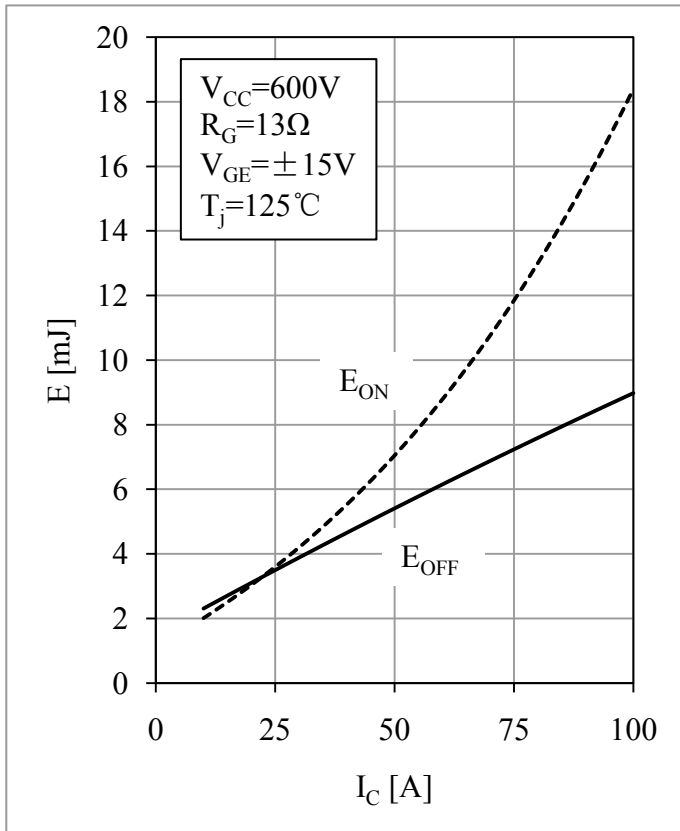


Fig 3. IGBT-inverter Switching Loss vs. I_C

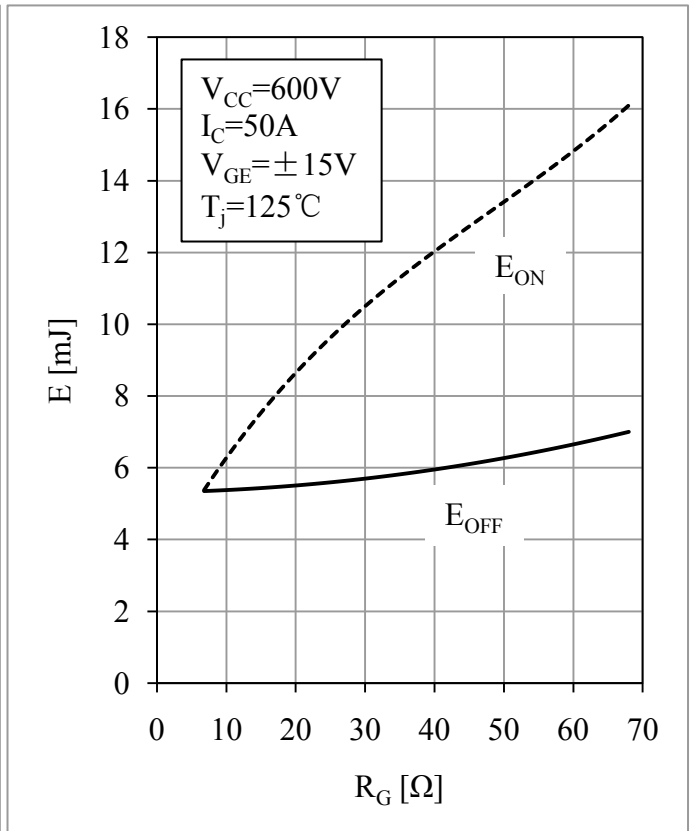


Fig 4. IGBT-inverter Switching Loss vs. R_G

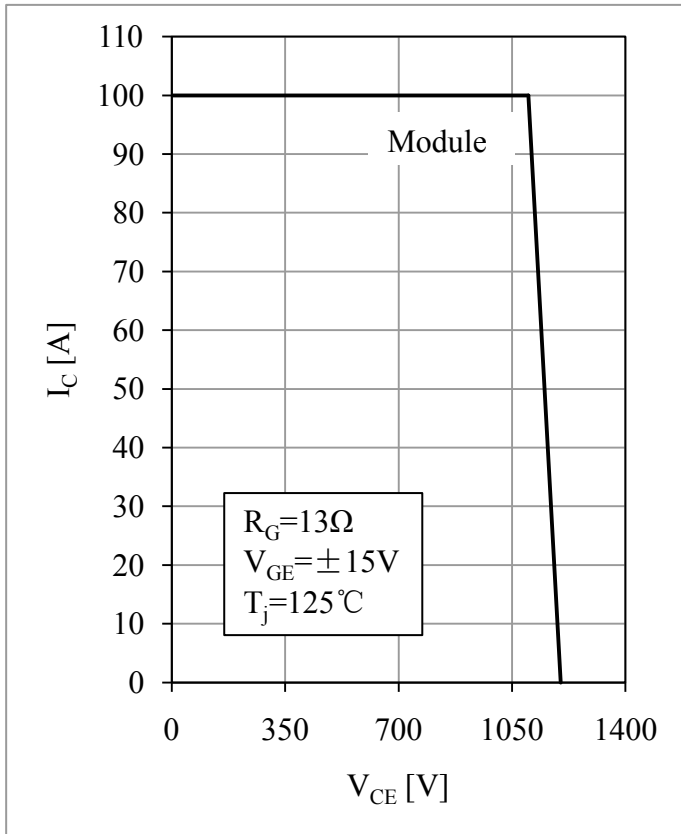


Fig 5. IGBT-inverter RBSOA

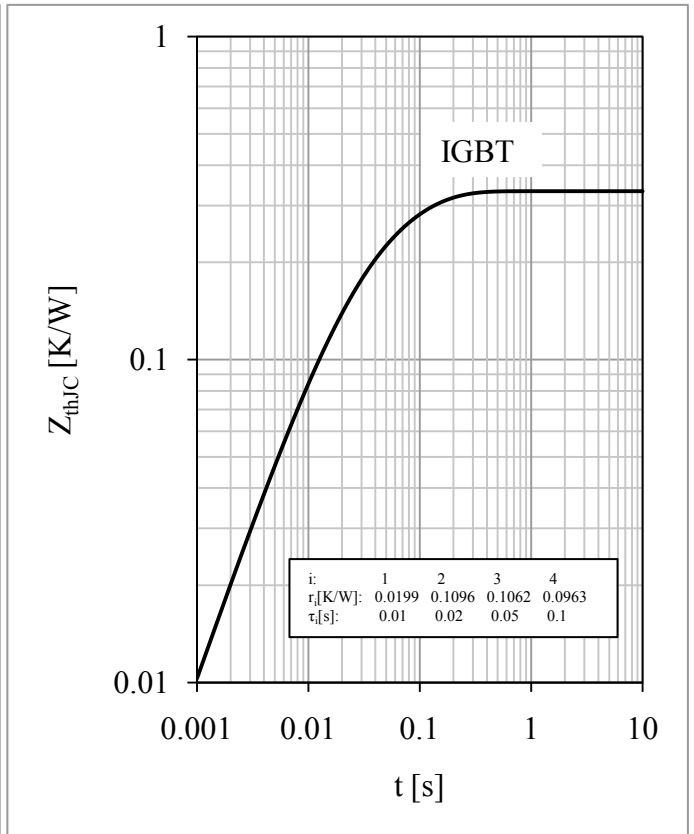


Fig 6. IGBT-inverter Transient Thermal Impedance

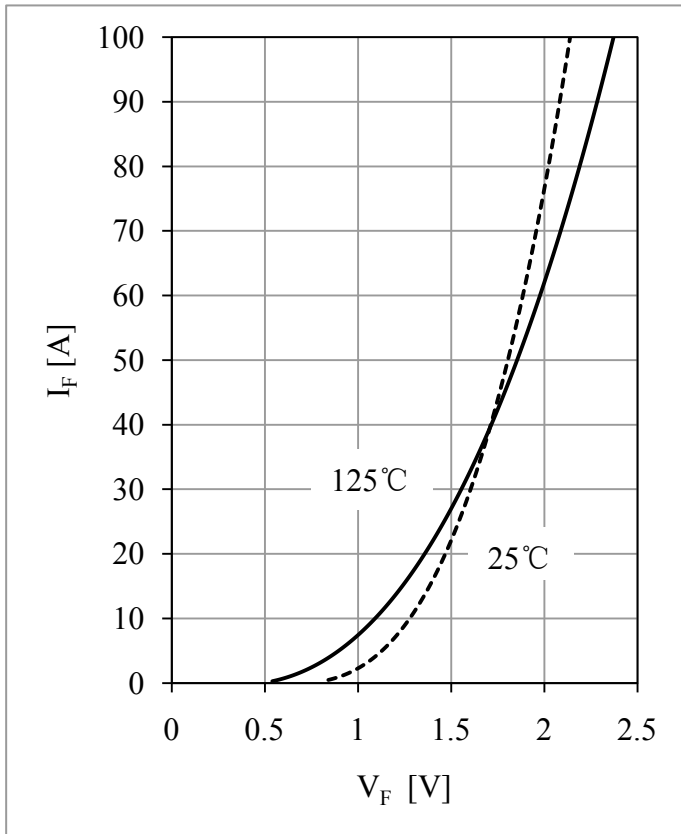


Fig 7. Diode-inverter Forward Characteristics

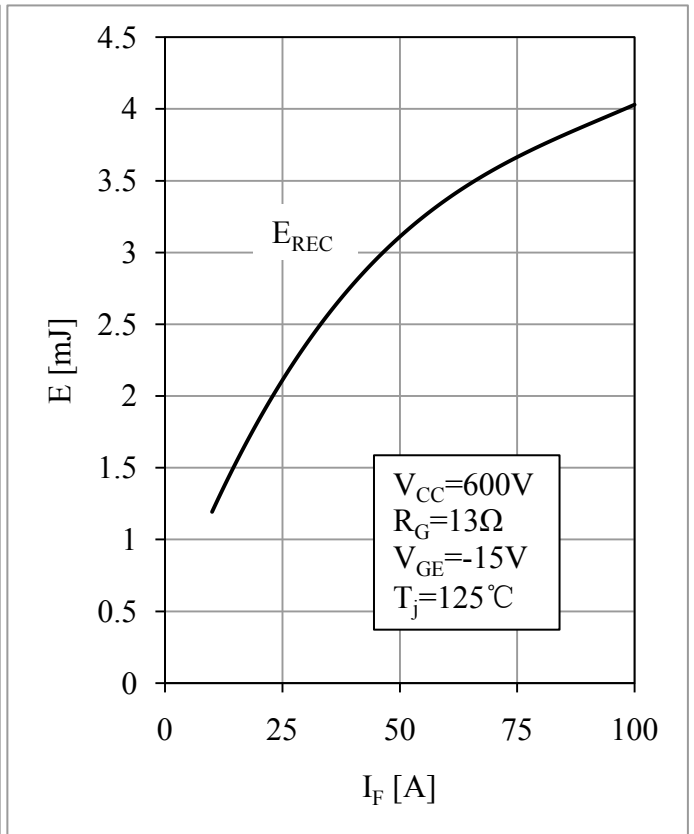


Fig 8. Diode-inverter Switching Loss vs. I_F

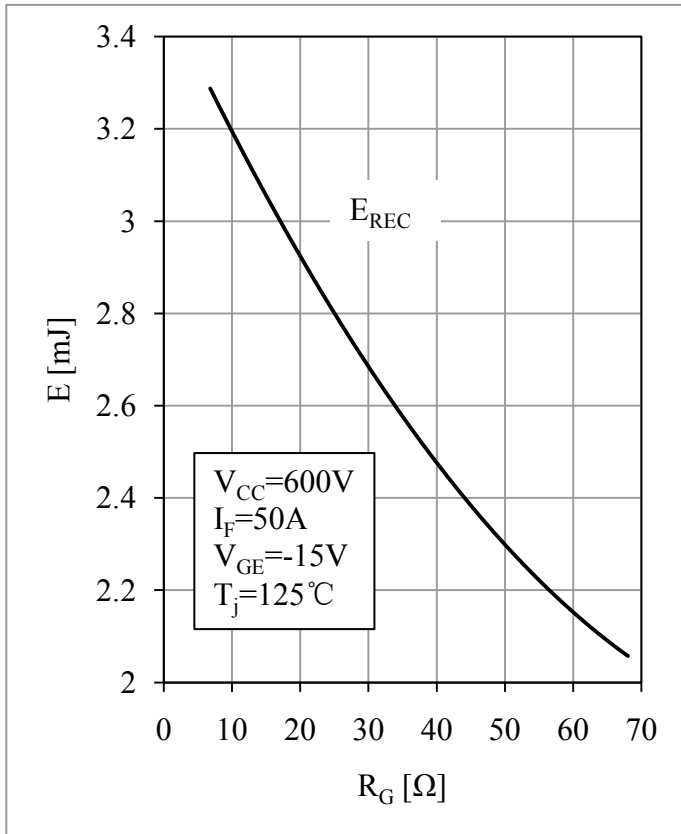


Fig 9. Diode-inverter Switching Loss vs. R_G

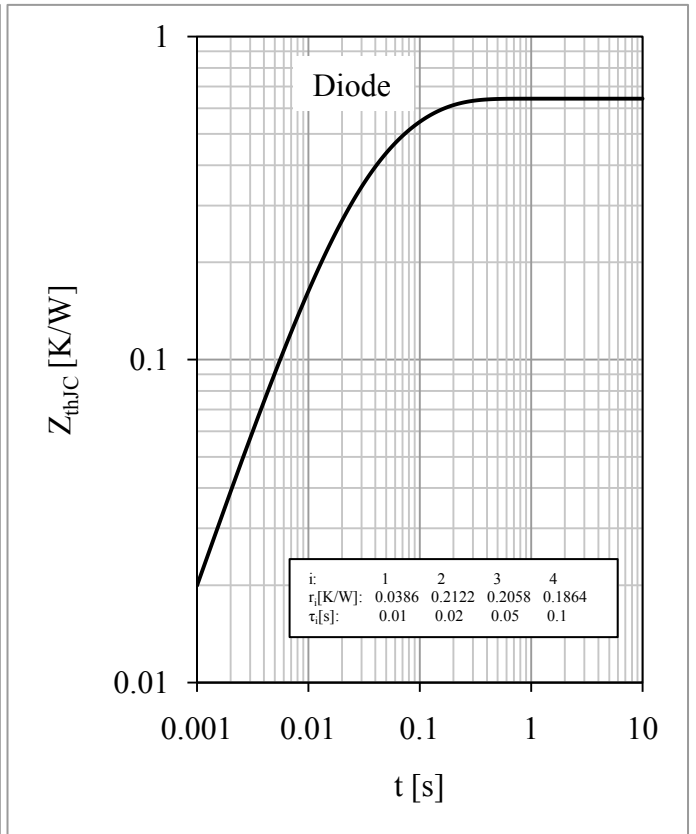


Fig 10. Diode-inverter Transient Thermal Impedance

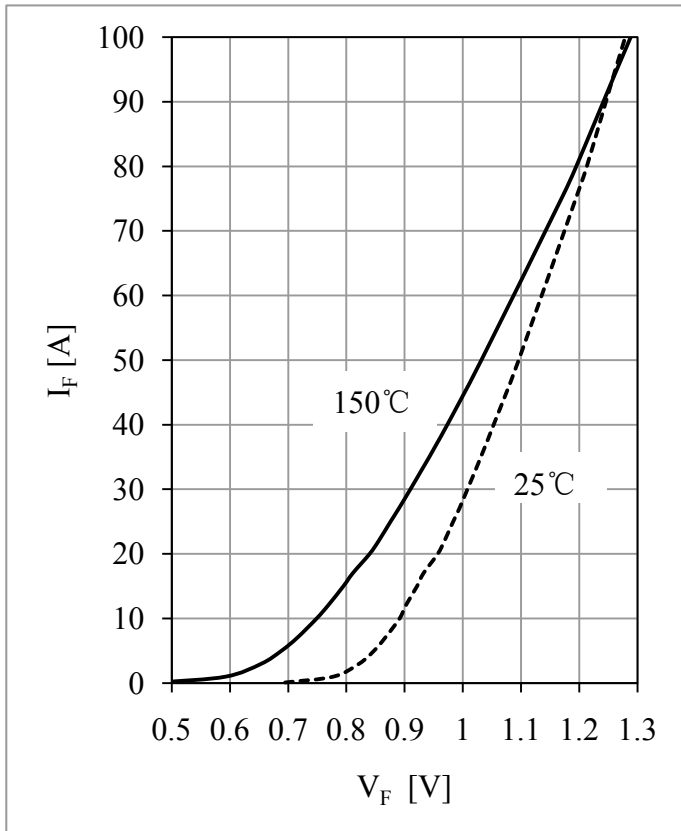


Fig 11. Diode-rectifier Forward Characteristics

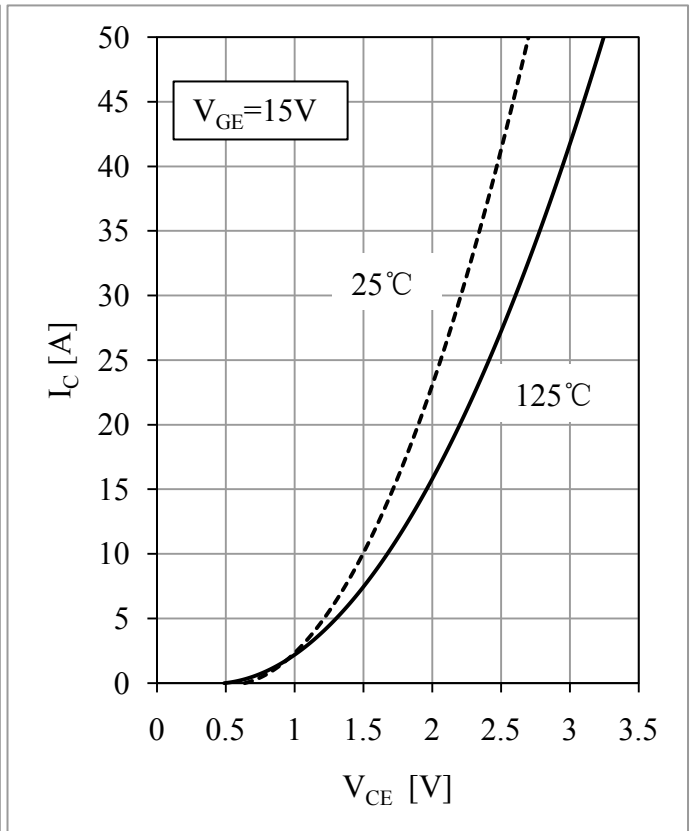


Fig 12. IGBT-brake-chopper Output Characteristics

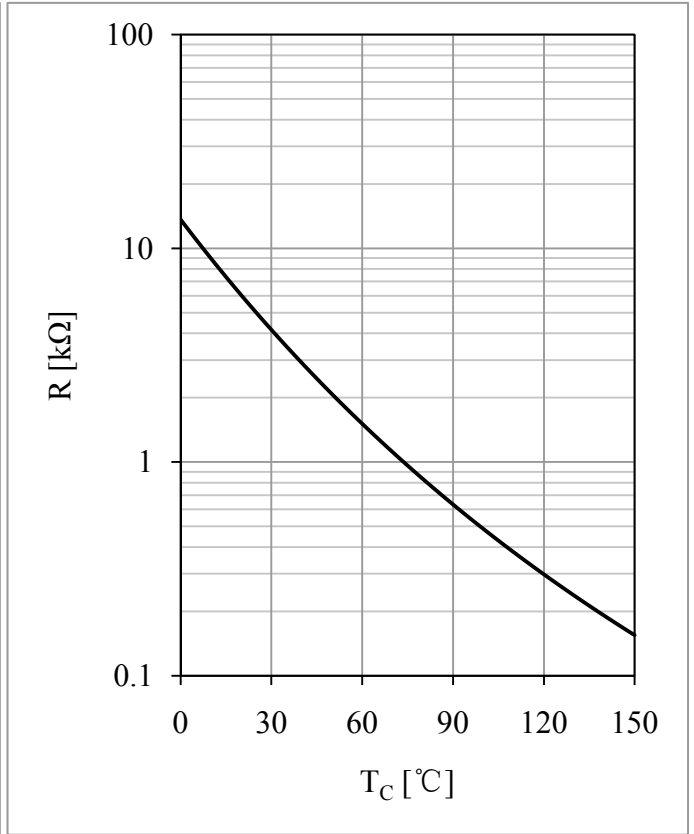
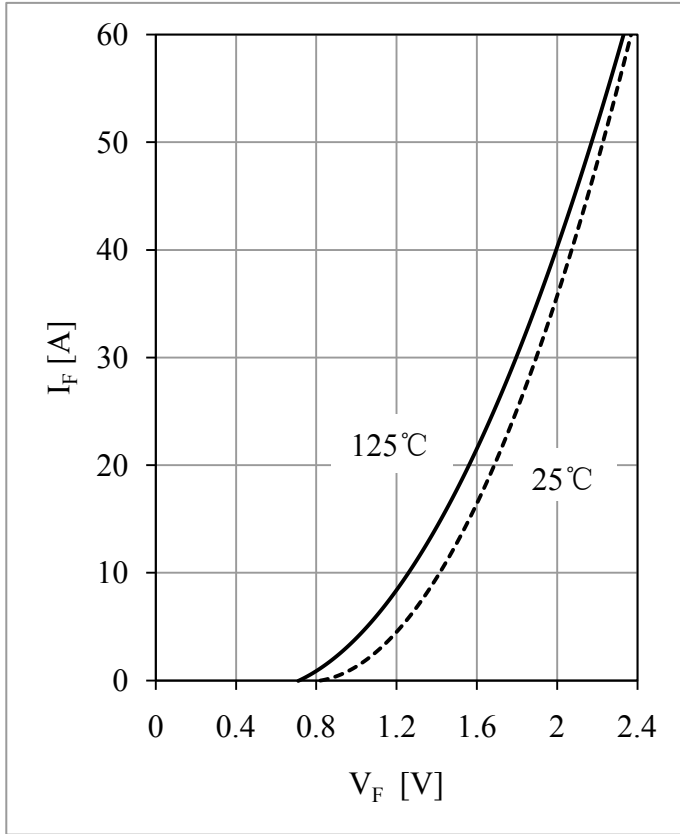
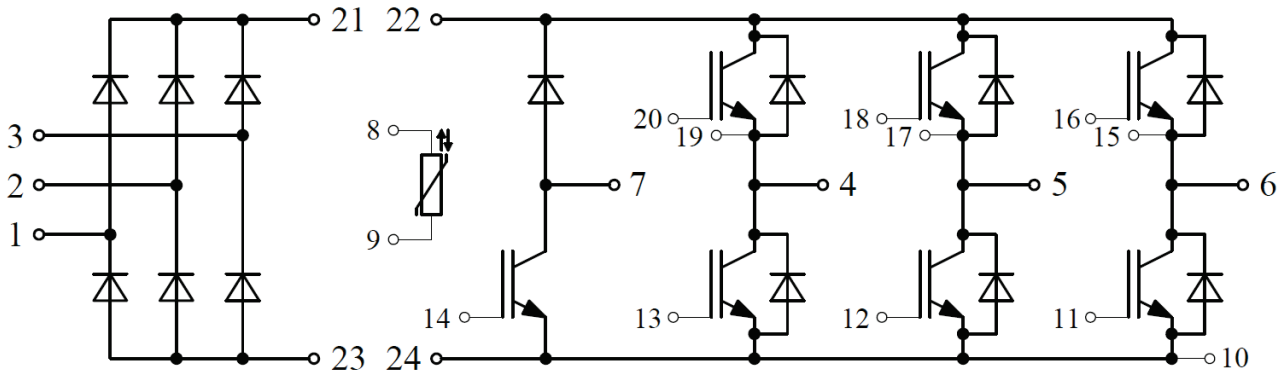


Fig 13. Diode-brake-chopper Forward Characteristics

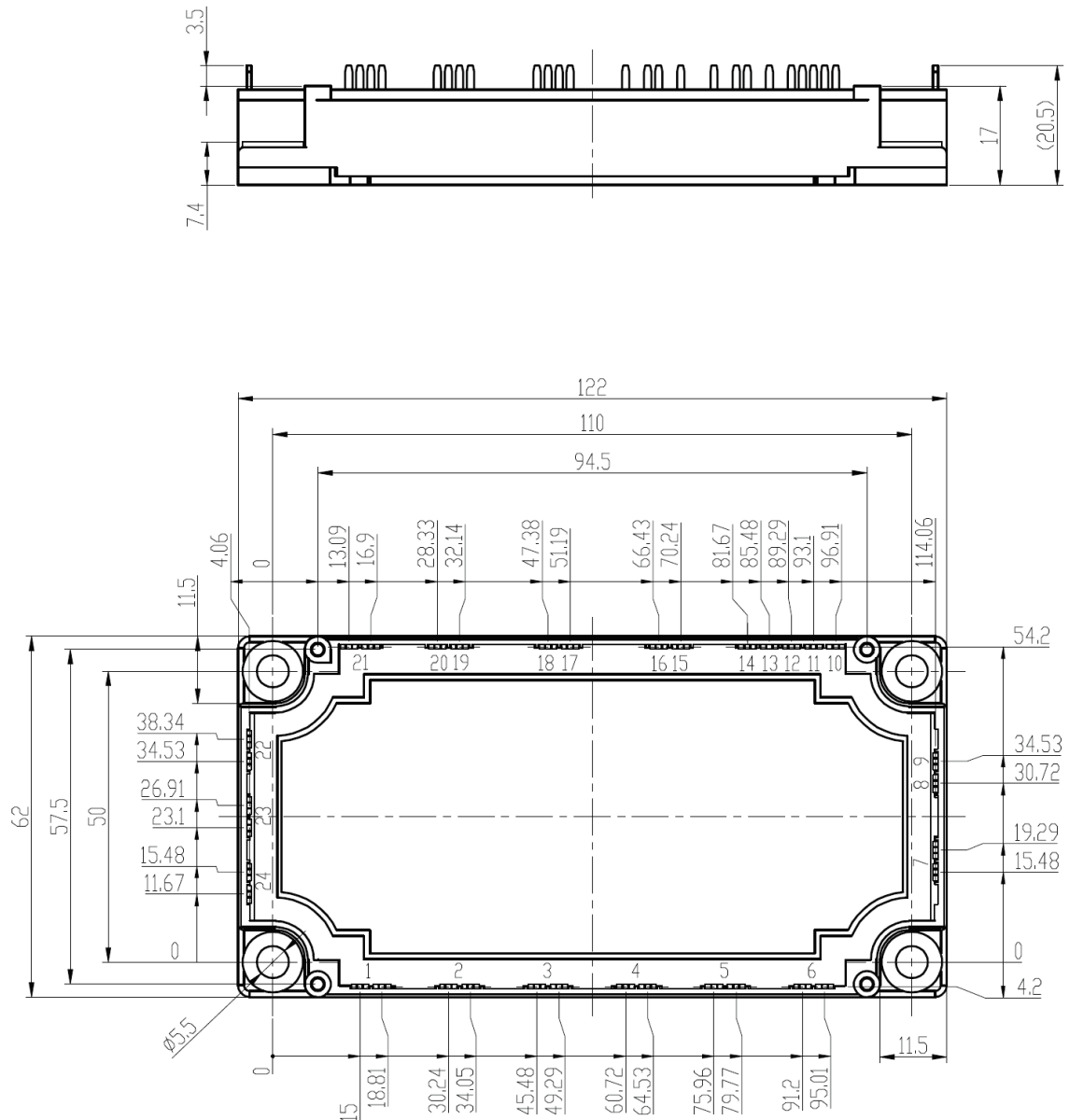
Fig 14. NTC Temperature Characteristic

Circuit Schematic



Package Dimensions

Dimensions in Millimeters



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