

STARPOWER

SEMICONDUCTOR

IGBT

GD40PIK120C5S

1200V/40A 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.



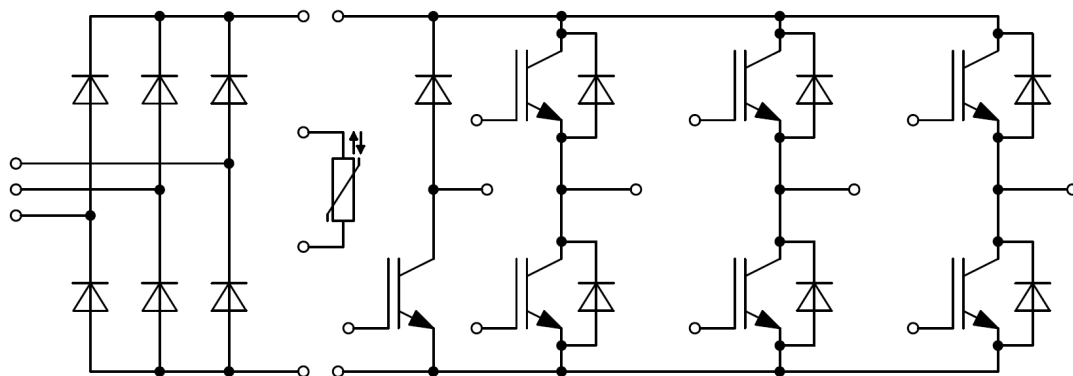
Features

- 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 @ $T_C=25^{\circ}\text{C}$ @ $T_C=85^{\circ}\text{C}$	65 40	A
I_{CM}	Pulsed Collector Current $t_p=1\text{ms}$	80	A
P_D	Maximum Power Dissipation @ $T_j=150^{\circ}\text{C}$	262	W

Diode-inverter

Symbol	Description	Value	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

Diode-rectifier

Symbol	Description	Value	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	1600	V
I_O	Average Output Current 50Hz/60Hz,sine wave	40	A
I_{FSM}	Surge Forward Current $V_R=0\text{V}, t_p=10\text{ms}, T_j=45^{\circ}\text{C}$	600	A
I^2t	I^2t -value, $V_R=0\text{V}, t_p=10\text{ms}, T_j=45^{\circ}\text{C}$	1800	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 @ $T_C=25^{\circ}\text{C}$ @ $T_C=100^{\circ}\text{C}$	30 15	A
I_{CM}	Pulsed Collector Current $t_p=1\text{ms}$	30	A
P_D	Maximum Power Dissipation @ $T_j=150^{\circ}\text{C}$	141	W

Diode-brake

Symbol	Description	Value	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	1200	V
I_F	Diode Continuous Forward Current	15	A
I_{FM}	Diode Maximum Forward Current $t_p=1\text{ms}$	30	A

Module

Symbol	Description	Value	Unit
T_{jmax}	Maximum Junction Temperature	150	$^{\circ}\text{C}$
T_{jop}	Operating Junction Temperature	-40 to +125	$^{\circ}\text{C}$
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	$I_C=40\text{A}, V_{GE}=15\text{V}, T_j=25^{\circ}\text{C}$		2.15	2.60	V
		$I_C=40\text{A}, V_{GE}=15\text{V}, T_j=125^{\circ}\text{C}$		2.65		
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=1.0\text{mA}, V_{CE}=V_{GE}, T_j=25^{\circ}\text{C}$	5.2	5.9	6.5	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			/		Ω
C_{ies}	Input Capacitance	$V_{CE}=25\text{V}, f=1\text{MHz}, V_{GE}=0\text{V}$		2.62		nF
C_{res}	Reverse Transfer Capacitance			0.17		nF
Q_G	Gate Charge	$V_{GE}=-15\dots+15\text{V}$		410		nC
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=40\text{A}, R_G=24\Omega, V_{GE}=\pm 15\text{V}, T_j=25^{\circ}\text{C}$		225		ns
t_r	Rise Time			50		ns
$t_{d(off)}$	Turn-Off Delay Time			270		ns
t_f	Fall Time			238		ns
E_{on}	Turn-On Switching Loss			3.70		mJ
E_{off}	Turn-Off Switching Loss			2.85		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=40\text{A}, R_G=24\Omega, V_{GE}=\pm 15\text{V}, T_j=125^{\circ}\text{C}$		230		ns
t_r	Rise Time			55		ns
$t_{d(off)}$	Turn-Off Delay Time			280		ns
t_f	Fall Time			340		ns
E_{on}	Turn-On Switching Loss			4.60		mJ
E_{off}	Turn-Off Switching Loss			4.05		mJ
I_{SC}	SC Data	$t_p \leq 10\mu\text{s}, V_{GE}=15\text{V}, T_j=125^{\circ}\text{C}, V_{CC}=900\text{V}, V_{CEM} \leq 1200\text{V}$		180		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	$I_F=40\text{A}, V_{GE}=0\text{V}, T_j=25^{\circ}\text{C}$		2.10	2.55	V
		$I_F=40\text{A}, V_{GE}=0\text{V}, T_j=125^{\circ}\text{C}$		2.00		
Q_r	Recovered Charge	$V_R=600\text{V}, I_F=40\text{A},$ $-di/dt=800\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=25^{\circ}\text{C}$		2.6		μC
I_{RM}	Peak Reverse Recovery Current			27		A
E_{rec}	Reverse Recovery Energy			1.40		mJ
Q_r	Recovered Charge	$V_R=600\text{V}, I_F=40\text{A},$ $-di/dt=800\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=125^{\circ}\text{C}$		5.0		μC
I_{RM}	Peak Reverse Recovery Current			37		A
E_{rec}	Reverse Recovery Energy			2.60		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	$I_F=40\text{A}, T_j=150^{\circ}\text{C}$		1.06		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	$I_C=15\text{A}, V_{GE}=15\text{V}, T_j=25^{\circ}\text{C}$		2.05	2.50	V
		$I_C=15\text{A}, V_{GE}=15\text{V}, T_j=125^{\circ}\text{C}$		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	5.8	6.5	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			/		Ω
C_{ies}	Input Capacitance	$V_{CE}=25\text{V}, f=1\text{MHz}, V_{GE}=0\text{V}$		0.99		nF
C_{res}	Reverse Transfer Capacitance			0.07		nF
Q_G	Gate Charge	$V_{GE}=-15\dots+15\text{V}$		156		nC
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=15\text{A}, R_G=68\Omega, V_{GE}=\pm 15\text{V}, T_j=25^{\circ}\text{C}$		182		ns
t_r	Rise Time			64		ns
$t_{d(off)}$	Turn-Off Delay Time			306		ns
t_f	Fall Time			335		ns
E_{on}	Turn-On Switching Loss			2.98		mJ
E_{off}	Turn-Off Switching Loss			1.17		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=15\text{A}, R_G=68\Omega, V_{GE}=\pm 15\text{V}, T_j=125^{\circ}\text{C}$		186		ns
t_r	Rise Time			64		ns
$t_{d(off)}$	Turn-Off Delay Time			321		ns
t_f	Fall Time			383		ns
E_{on}	Turn-On Switching Loss			3.32		mJ
E_{off}	Turn-Off Switching Loss			1.65		mJ
I_{SC}	SC Data	$t_p \leq 10\mu\text{s}, V_{GE}=15\text{V}, T_j=150^{\circ}\text{C}, V_{CC}=900\text{V}, V_{CEM} \leq 1200\text{V}$		150		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	$I_F=15\text{A}, V_{GE}=0\text{V}, T_j=25^\circ\text{C}$		2.05	2.50	V
		$I_F=15\text{A}, V_{GE}=0\text{V}, T_j=125^\circ\text{C}$		2.20		
Q_r	Recovered Charge	$V_R=600\text{V}, I_F=15\text{A},$ $-di/dt=480\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=25^\circ\text{C}$		0.5		μC
I_{RM}	Peak Reverse Recovery Current			15		A
E_{rec}	Reverse Recovery Energy			0.29		mJ
Q_r	Recovered Charge	$V_R=600\text{V}, I_F=15\text{A},$ $-di/dt=480\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=125^\circ\text{C}$		1.0		μC
I_{RM}	Peak Reverse Recovery Current			16		A
E_{rec}	Reverse Recovery Energy			0.64		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 3.00		$\text{m}\Omega$
R_{thJC}	Junction-to-Case (per IGBT-inverter)			0.477	K/W
	Junction-to-Case (per Diode-inverter)			1.055	
	Junction-to-Case (per Diode-rectifier)			0.913	
	Junction-to-Case (per IGBT-brake)			0.882	
	Junction-to-Case (per Diode-brake)			1.670	
R_{thCH}	Case-to-Heatsink (per IGBT-inverter)		0.253		K/W
	Case-to-Heatsink (per Diode-inverter)		0.561		
	Case-to-Heatsink (per Diode-rectifier)		0.485		
	Case-to-Heatsink (per IGBT-brake)		0.469		
	Case-to-Heatsink (per Diode-brake)		0.887		
	Case-to-Sink (per Module)		0.02		
M	Mounting Torque, Screw:M5	3.0		6.0	N.m
G	Weight of Module		200		g

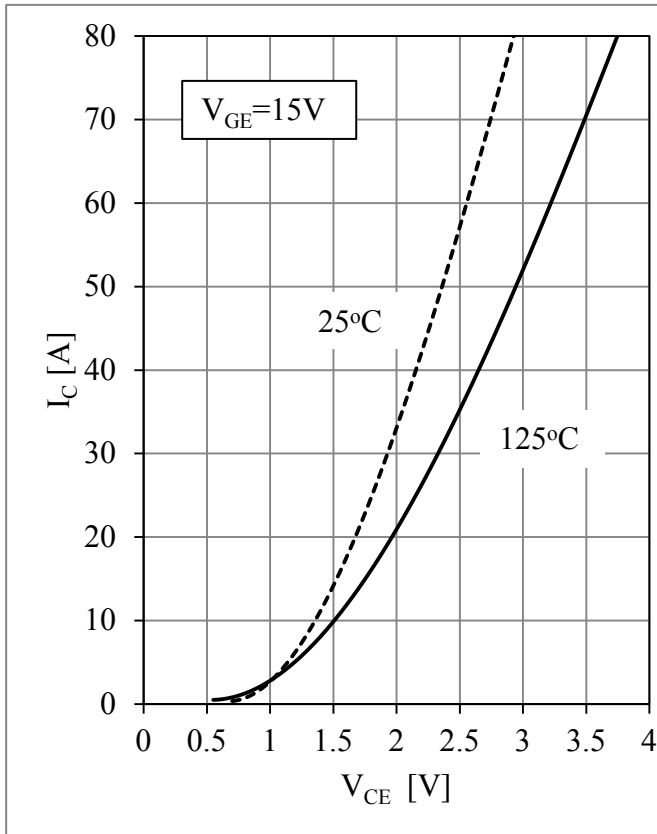


Fig 1. IGBT-inverter Output Characteristics

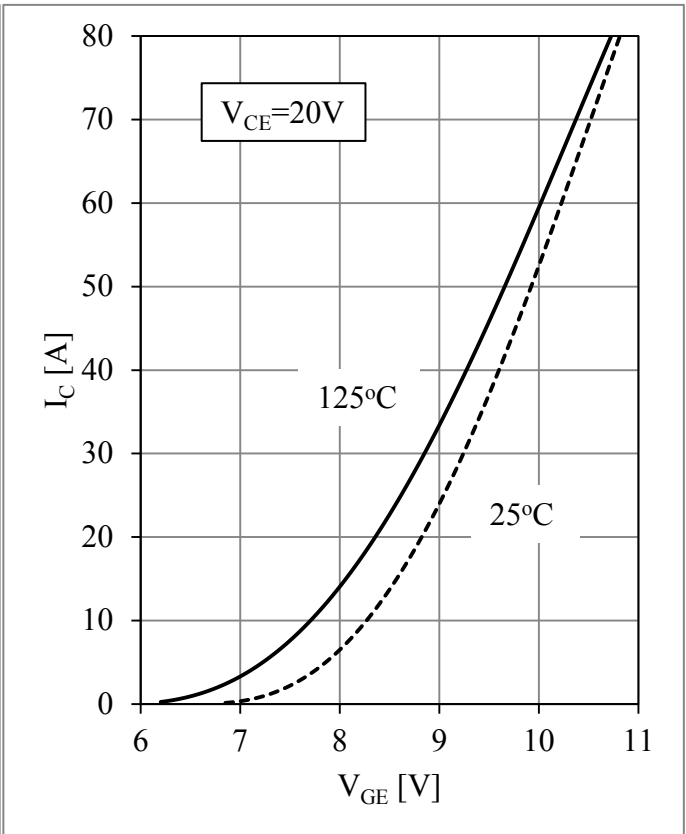
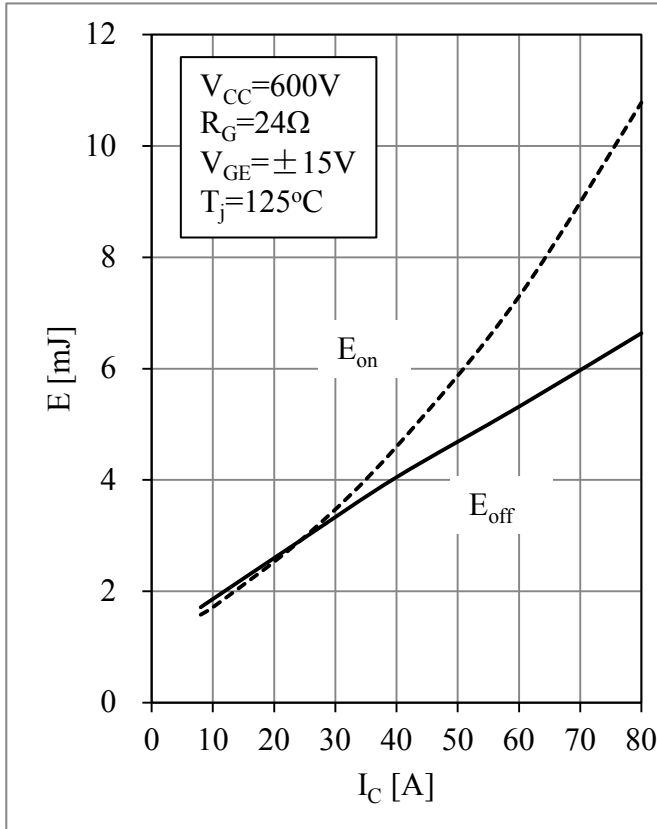
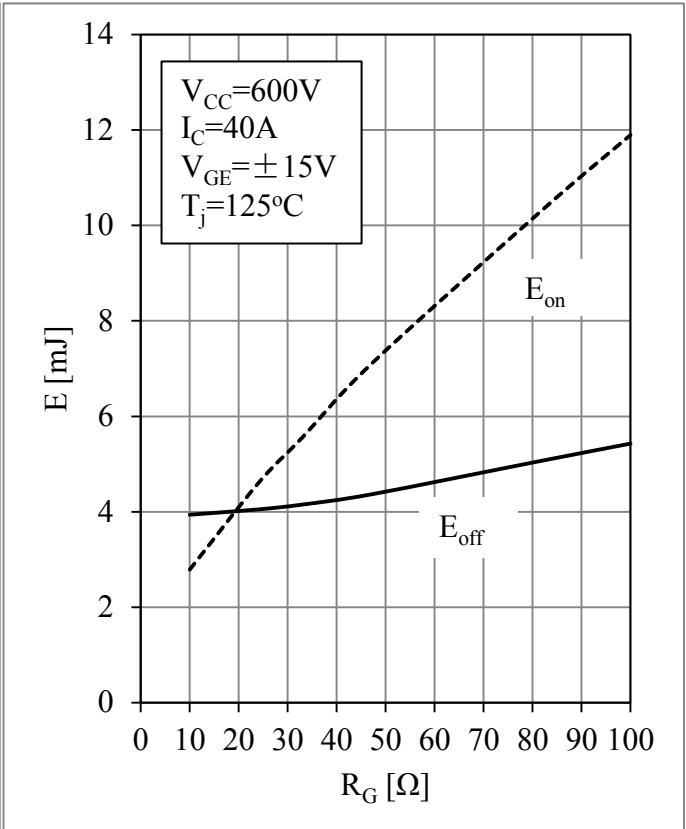


Fig 2. IGBT-inverter Transfer Characteristics

Fig 3. IGBT-inverter Switching Loss vs. I_C Fig 4. IGBT-inverter Switching Loss vs. R_G

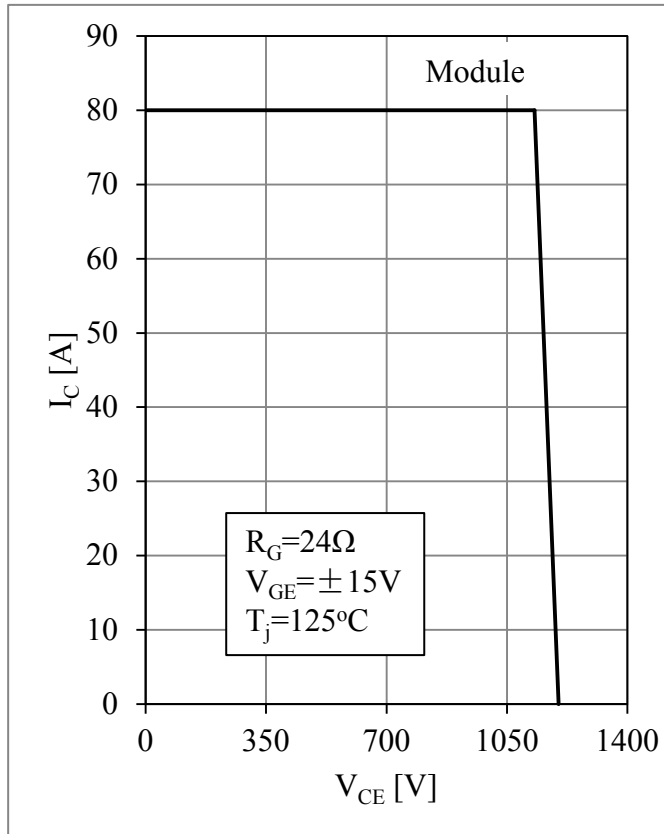


Fig 5. IGBT-inverter RBSOA

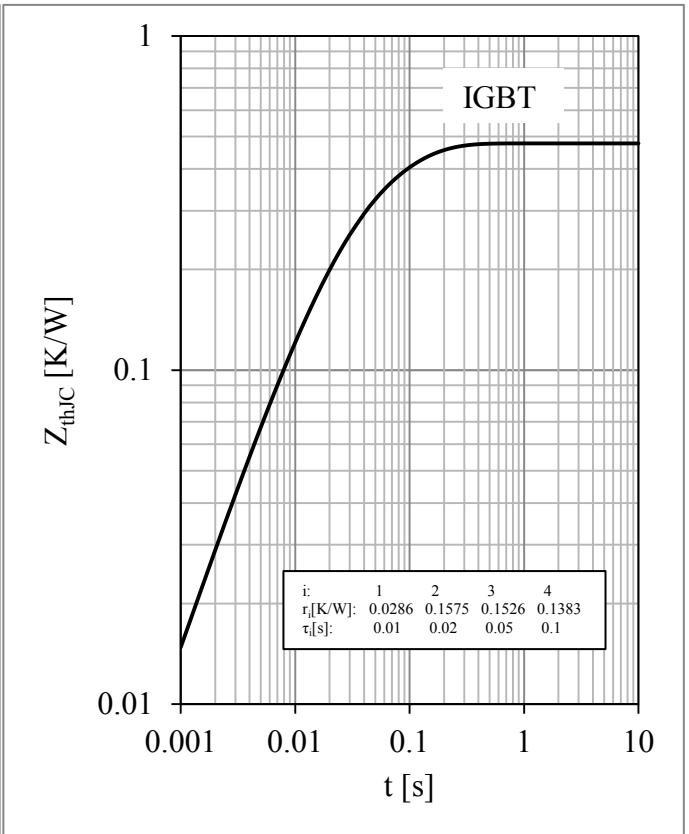


Fig 6. IGBT-inverter Transient Thermal Impedance

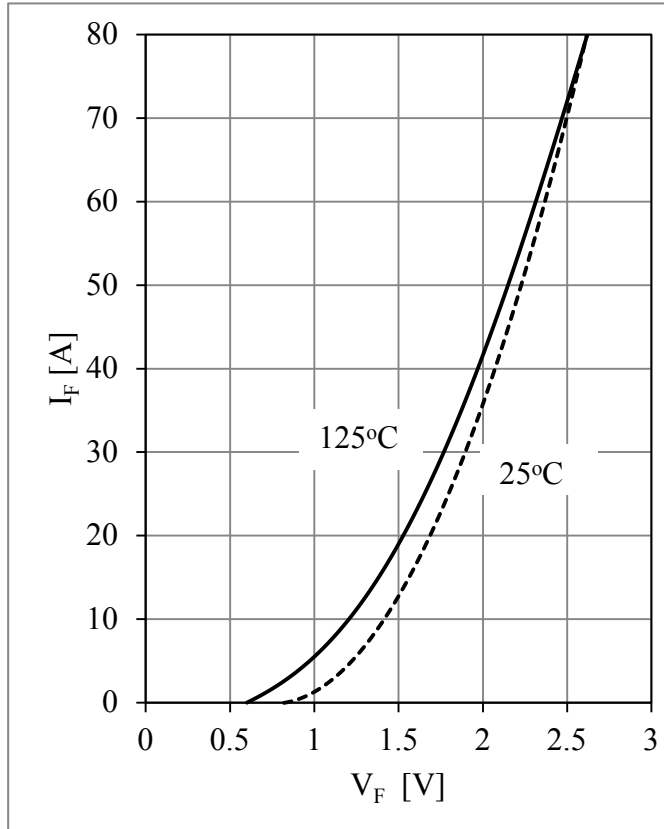
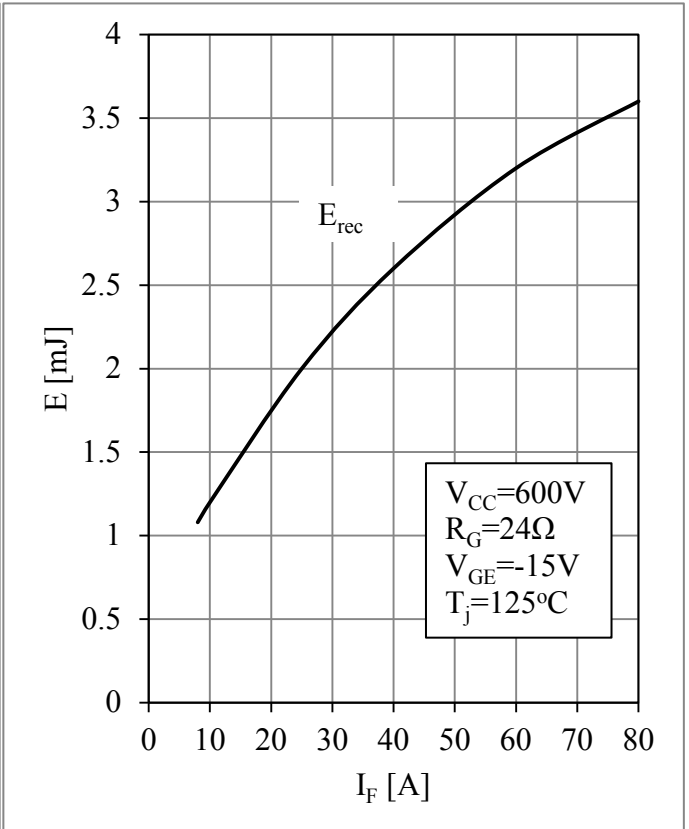


Fig 7. Diode-inverter Forward Characteristics

Fig 8. Diode-inverter Switching Loss vs. I_F

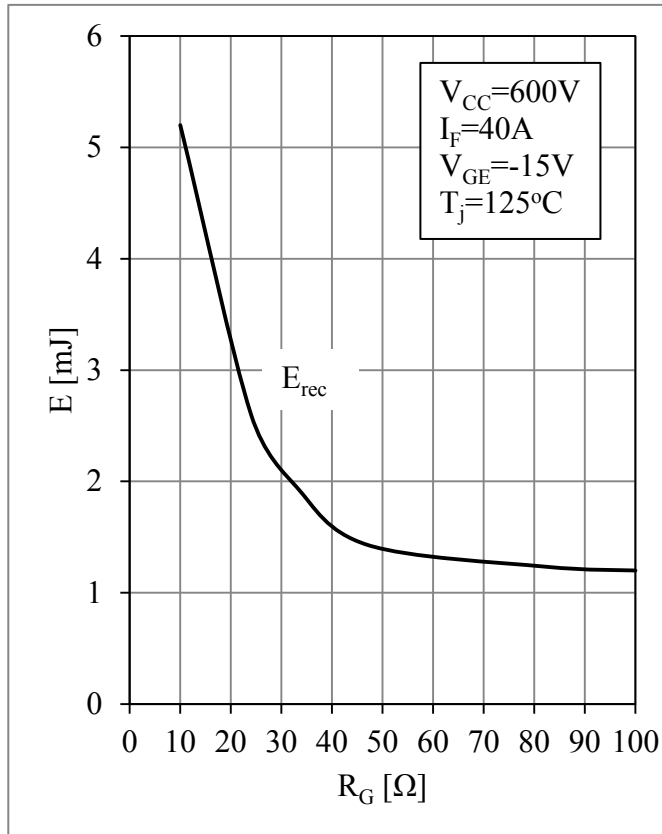
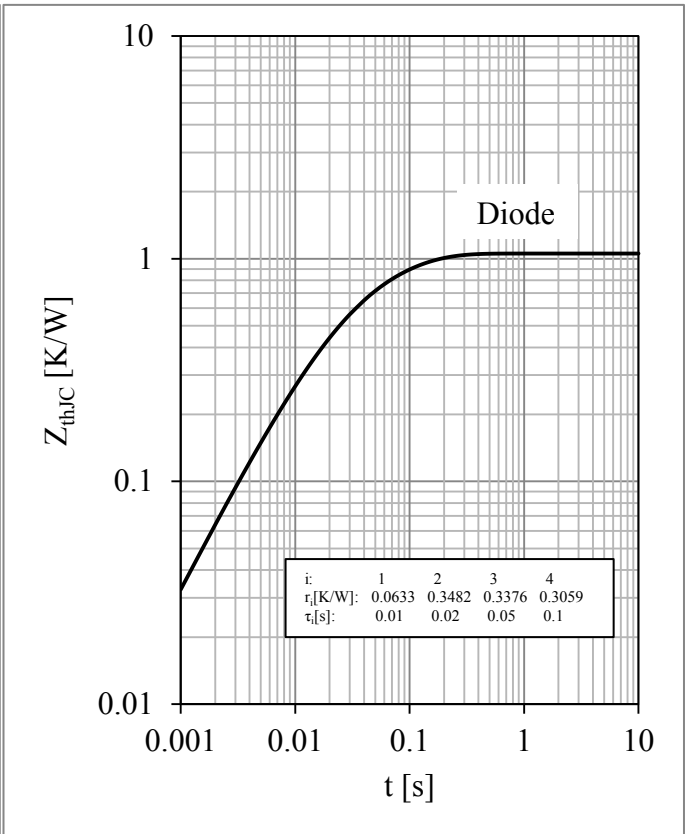
Fig 9. Diode-inverter Switching Loss vs. R_G 

Fig 10. Diode-inverter Transient Thermal Impedance

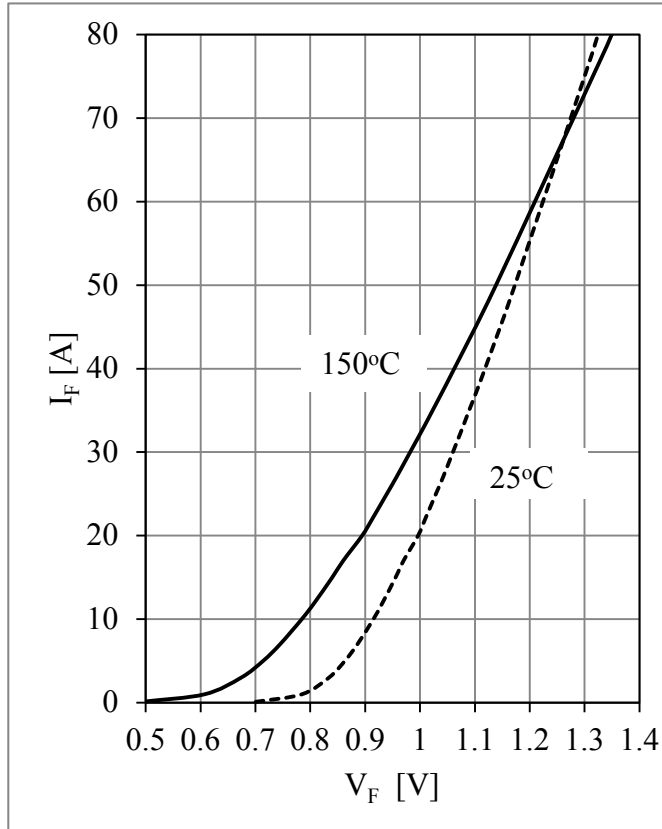


Fig 11. Diode-rectifier Forward Characteristics

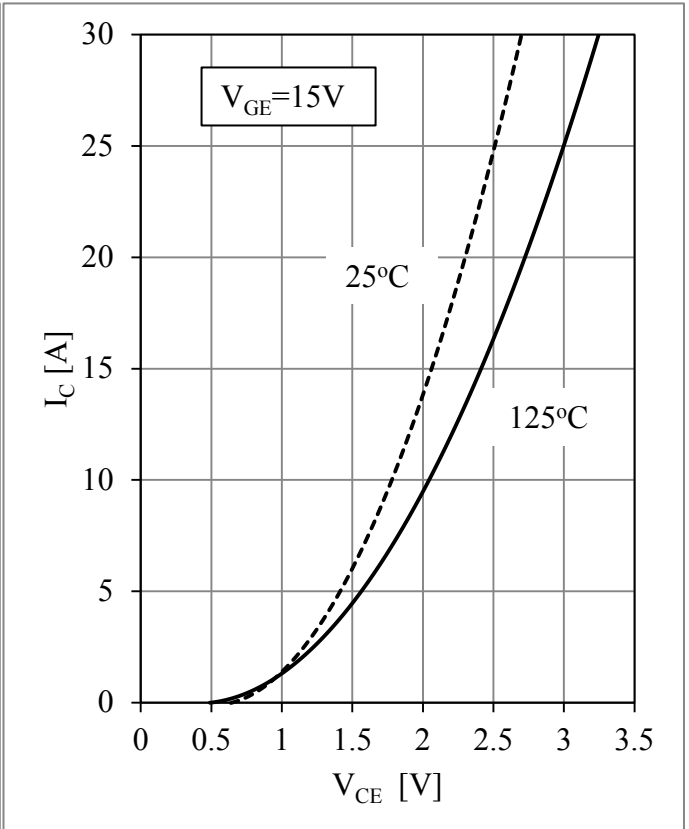


Fig 12. IGBT-brake-chopper Output Characteristics

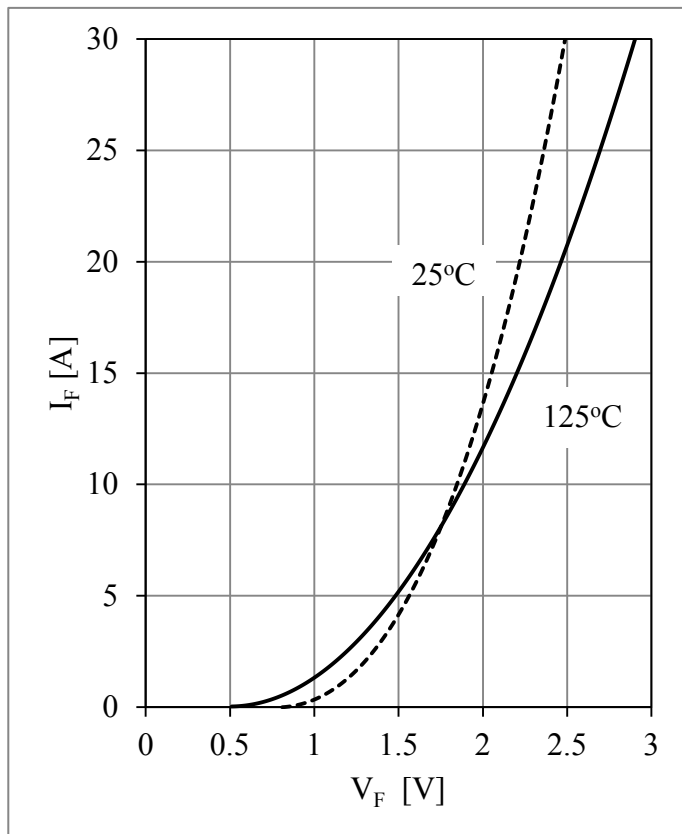


Fig 13. Diode-brake-chopper Forward Characteristics

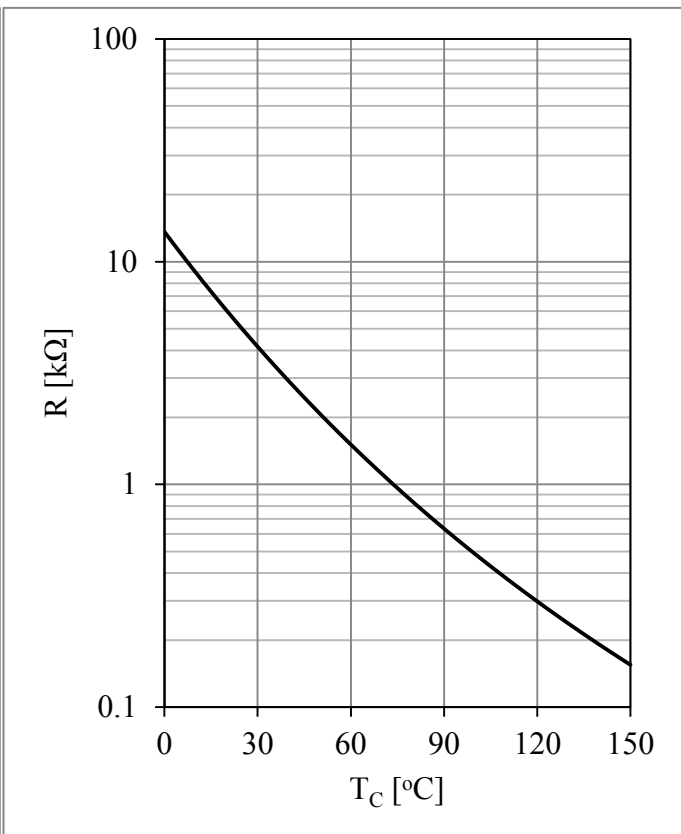
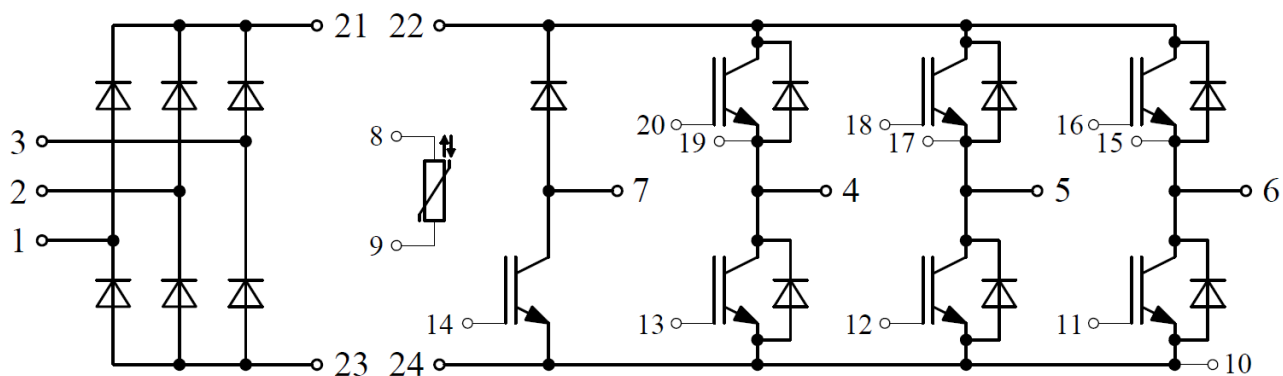


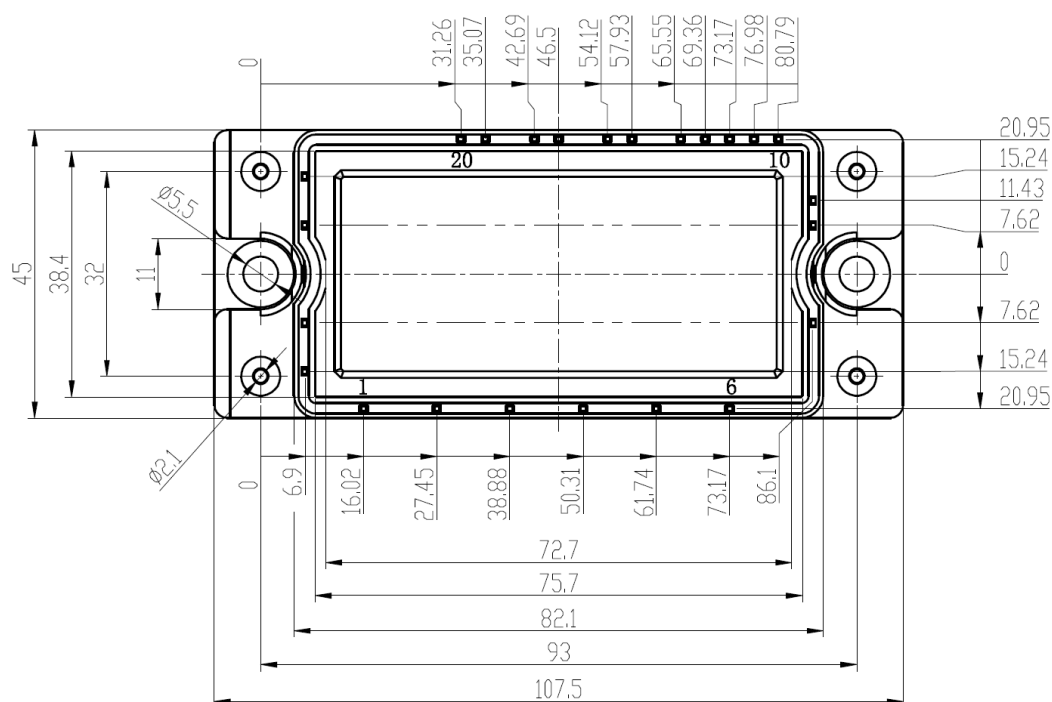
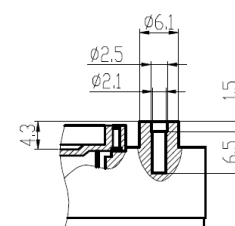
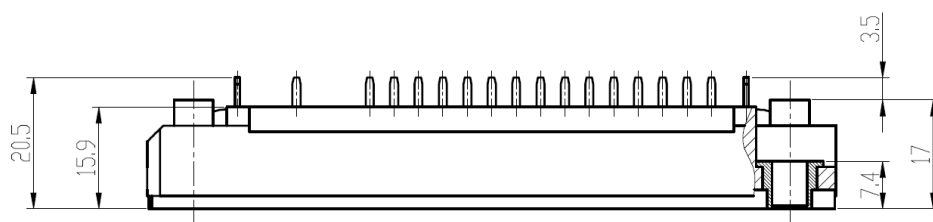
Fig 14. NTC Temperature Characteristic

Circuit Schematic



Package Dimensions

Dimensions in Millimeters



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