

STARPOWER

SEMICONDUCTOR

IGBT

GD20PJX65L1S

650V/20A 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.

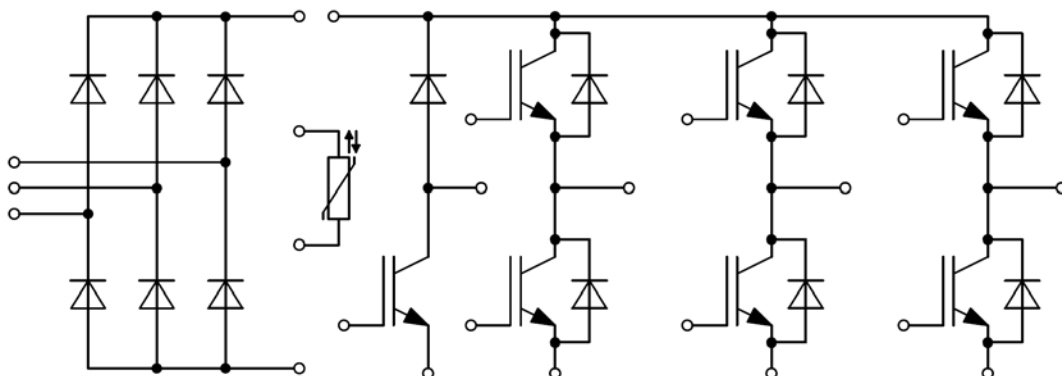
Features

- Low $V_{CE(sat)}$ Trench IGBT technology
- 6 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 heatsink 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	650	V
V_{GES}	Gate-Emitter Voltage	± 20	V
I_C	Collector Current @ $T_C=25^{\circ}\text{C}$ @ $T_C=100^{\circ}\text{C}$	35	A
		20	
I_{CM}	Pulsed Collector Current $t_p=1\text{ms}$	40	A
P_D	Maximum Power Dissipation @ $T_j=175^{\circ}\text{C}$	102	W

Diode-inverter

Symbol	Description	Value	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	650	V
I_F	Diode Continuous Forward Current	20	A
I_{FM}	Diode Maximum Forward Current $t_p=1\text{ms}$	40	A

Diode-rectifier

Symbol	Description	Value	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	1600	V
I_O	Average Output Current 50Hz/60Hz,sine wave	20	A
I_{FSM}	Surge Forward Current $V_R=0\text{V}, t_p=10\text{ms}, T_j=45^{\circ}\text{C}$	270	A
I^2t	I^2t -value, $V_R=0\text{V}, t_p=10\text{ms}, T_j=45^{\circ}\text{C}$	360	A^2s

IGBT-brake

Symbol	Description	Value	Unit
V_{CES}	Collector-Emitter Voltage	650	V
V_{GES}	Gate-Emitter Voltage	± 20	V
I_C	Collector Current @ $T_C=25^{\circ}\text{C}$ @ $T_C=100^{\circ}\text{C}$	35	A
		20	
I_{CM}	Pulsed Collector Current $t_p=1\text{ms}$	40	A
P_D	Maximum Power Dissipation @ $T_j=175^{\circ}\text{C}$	102	W

Diode-brake

Symbol	Description	Value	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	650	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	$I_C=20\text{A}, V_{GE}=15\text{V}, T_j=25^\circ\text{C}$		1.45	1.90	V	
		$I_C=20\text{A}, V_{GE}=15\text{V}, T_j=125^\circ\text{C}$		1.60			
		$I_C=20\text{A}, V_{GE}=15\text{V}, T_j=150^\circ\text{C}$		1.70			
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=0.32\text{mA}, V_{CE}=V_{GE}, T_j=25^\circ\text{C}$	5.1	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			0		Ω	
C_{ies}	Input Capacitance	$V_{CE}=25\text{V}, f=1\text{MHz}, V_{GE}=0\text{V}$		2.32		nF	
C_{res}	Reverse Transfer Capacitance				0.05		nF
Q_G	Gate Charge	$V_{GE}=-15\dots+15\text{V}$		0.14		μC	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=300\text{V}, I_C=20\text{A}, R_G=18\Omega, V_{GE}=\pm 15\text{V}, T_j=25^\circ\text{C}$		15		ns	
t_r	Rise Time			13		ns	
$t_{d(off)}$	Turn-Off Delay Time			96		ns	
t_f	Fall Time			56		ns	
E_{on}	Turn-On Switching Loss			0.32		mJ	
E_{off}	Turn-Off Switching Loss			0.35		mJ	
$t_{d(on)}$	Turn-On Delay Time		$V_{CC}=300\text{V}, I_C=20\text{A}, R_G=18\Omega, V_{GE}=\pm 15\text{V}, T_j=125^\circ\text{C}$		15		ns
t_r	Rise Time				16		ns
$t_{d(off)}$	Turn-Off Delay Time			112		ns	
t_f	Fall Time			76		ns	
E_{on}	Turn-On Switching Loss			0.44		mJ	
E_{off}	Turn-Off Switching Loss			0.45		mJ	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=300\text{V}, I_C=20\text{A}, R_G=18\Omega, V_{GE}=\pm 15\text{V}, T_j=150^\circ\text{C}$			15		ns
t_r	Rise Time				17		ns
$t_{d(off)}$	Turn-Off Delay Time			120		ns	
t_f	Fall Time			80		ns	
E_{on}	Turn-On Switching Loss			0.49		mJ	
E_{off}	Turn-Off Switching Loss			0.47		mJ	
I_{SC}	SC Data		$t_p \leq 6\mu\text{s}, V_{GE}=15\text{V}, T_j=150^\circ\text{C}, V_{CC}=360\text{V}, V_{CEM} \leq 650\text{V}$		100		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	$I_C=20\text{A}, V_{GE}=0\text{V}, T_j=25^\circ\text{C}$		1.60	2.05	V
		$I_C=20\text{A}, V_{GE}=0\text{V}, T_j=125^\circ\text{C}$		1.55		
		$I_C=20\text{A}, V_{GE}=0\text{V}, T_j=150^\circ\text{C}$		1.50		
Q_r	Recovered Charge	$V_R=300\text{V}, I_F=20\text{A},$ $-di/dt=1800\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=25^\circ\text{C}$		1.00		μC
I_{RM}	Peak Reverse Recovery Current			30.0		A
E_{rec}	Reverse Recovery Energy			0.21		mJ
Q_r	Recovered Charge	$V_R=300\text{V}, I_F=20\text{A},$ $-di/dt=1800\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=125^\circ\text{C}$		1.75		μC
I_{RM}	Peak Reverse Recovery Current			32.0		A
E_{rec}	Reverse Recovery Energy			0.37		mJ
Q_r	Recovered Charge	$V_R=300\text{V}, I_F=20\text{A},$ $-di/dt=1800\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=150^\circ\text{C}$		2.20		μC
I_{RM}	Peak Reverse Recovery Current			34.0		A
E_{rec}	Reverse Recovery Energy			0.47		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	$I_C=20\text{A}, V_{GE}=0\text{V}, T_j=150^\circ\text{C}$		1.05		V
I_R	Reverse Current	$T_j=150^\circ\text{C}, V_R=1600\text{V}$			1.0	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	$I_C=20\text{A}, V_{GE}=15\text{V}, T_j=25^\circ\text{C}$		1.45	1.90	V	
		$I_C=20\text{A}, V_{GE}=15\text{V}, T_j=125^\circ\text{C}$		1.60			
		$I_C=20\text{A}, V_{GE}=15\text{V}, T_j=150^\circ\text{C}$		1.70			
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=0.32\text{mA}, V_{CE}=V_{GE}, T_j=25^\circ\text{C}$	5.1	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			0		Ω	
C_{ies}	Input Capacitance	$V_{CE}=25\text{V}, f=1\text{MHz}, V_{GE}=0\text{V}$		2.32		nF	
C_{res}	Reverse Transfer Capacitance				0.05		nF
Q_G	Gate Charge	$V_{GE}=-15\dots+15\text{V}$		0.14		μC	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=300\text{V}, I_C=20\text{A}, R_G=18\Omega, V_{GE}=\pm 15\text{V}, T_j=25^\circ\text{C}$		15		ns	
t_r	Rise Time			13		ns	
$t_{d(off)}$	Turn-Off Delay Time			96		ns	
t_f	Fall Time			56		ns	
E_{on}	Turn-On Switching Loss			0.32		mJ	
E_{off}	Turn-Off Switching Loss			0.35		mJ	
$t_{d(on)}$	Turn-On Delay Time		$V_{CC}=300\text{V}, I_C=20\text{A}, R_G=18\Omega, V_{GE}=\pm 15\text{V}, T_j=125^\circ\text{C}$		15		ns
t_r	Rise Time				16		ns
$t_{d(off)}$	Turn-Off Delay Time			112		ns	
t_f	Fall Time			76		ns	
E_{on}	Turn-On Switching Loss			0.44		mJ	
E_{off}	Turn-Off Switching Loss			0.45		mJ	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=300\text{V}, I_C=20\text{A}, R_G=18\Omega, V_{GE}=\pm 15\text{V}, T_j=150^\circ\text{C}$			15		ns
t_r	Rise Time				17		ns
$t_{d(off)}$	Turn-Off Delay Time			120		ns	
t_f	Fall Time			80		ns	
E_{on}	Turn-On Switching Loss			0.49		mJ	
E_{off}	Turn-Off Switching Loss			0.47		mJ	
I_{SC}	SC Data		$t_p \leq 6\mu\text{s}, V_{GE}=15\text{V}, T_j=150^\circ\text{C}, V_{CC}=360\text{V}, V_{CEM} \leq 650\text{V}$		100		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	$I_C=10\text{A}, V_{GE}=0\text{V}, T_j=25^\circ\text{C}$		1.60	2.05	V
		$I_C=10\text{A}, V_{GE}=0\text{V}, T_j=125^\circ\text{C}$		1.55		
		$I_C=10\text{A}, V_{GE}=0\text{V}, T_j=150^\circ\text{C}$		1.50		
Q_r	Recovered Charge	$V_R=300\text{V}, I_F=10\text{A},$ $-di/dt=1500\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=25^\circ\text{C}$		0.50		μC
I_{RM}	Peak Reverse Recovery Current			18.0		A
E_{rec}	Reverse Recovery Energy			0.11		mJ
Q_r	Recovered Charge	$V_R=300\text{V}, I_F=10\text{A},$ $-di/dt=1500\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=125^\circ\text{C}$		0.85		μC
I_{RM}	Peak Reverse Recovery Current			19.0		A
E_{rec}	Reverse Recovery Energy			0.20		mJ
Q_r	Recovered Charge	$V_R=300\text{V}, I_F=10\text{A},$ $-di/dt=1500\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=150^\circ\text{C}$		1.10		μC
I_{RM}	Peak Reverse Recovery Current			21.0		A
E_{rec}	Reverse Recovery Energy			0.26		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		40		nH
$R_{CC'+EE'}$ $R_{AA'+CC'}$	Module Lead Resistance, Terminal to Chip		10.0 7.00		m Ω
R_{thJC}	Junction-to-Case (per IGBT-inverter)		1.332	1.465	K/W
	Junction-to-Case (per Diode-inverter)		2.158	2.374	
	Junction-to-Case (per Diode-rectifier)		1.305	1.436	
	Junction-to-Case (per IGBT-brake)		1.332	1.465	
	Junction-to-Case (per Diode-brake)		2.798	3.078	
R_{thCH}	Case-to-Heatsink (per IGBT-inverter)		0.519		K/W
	Case-to-Heatsink (per Diode-inverter)		0.841		
	Case-to-Heatsink (per Diode-rectifier)		0.509		
	Case-to-Heatsink (per IGBT-brake)		0.519		
	Case-to-Heatsink (per Diode-brake)		1.090		
	Case-to-Heatsink (per Module)		0.030		
F	Mounting Force Per Clamp	40		80	N
G	Weight of Module		36		g

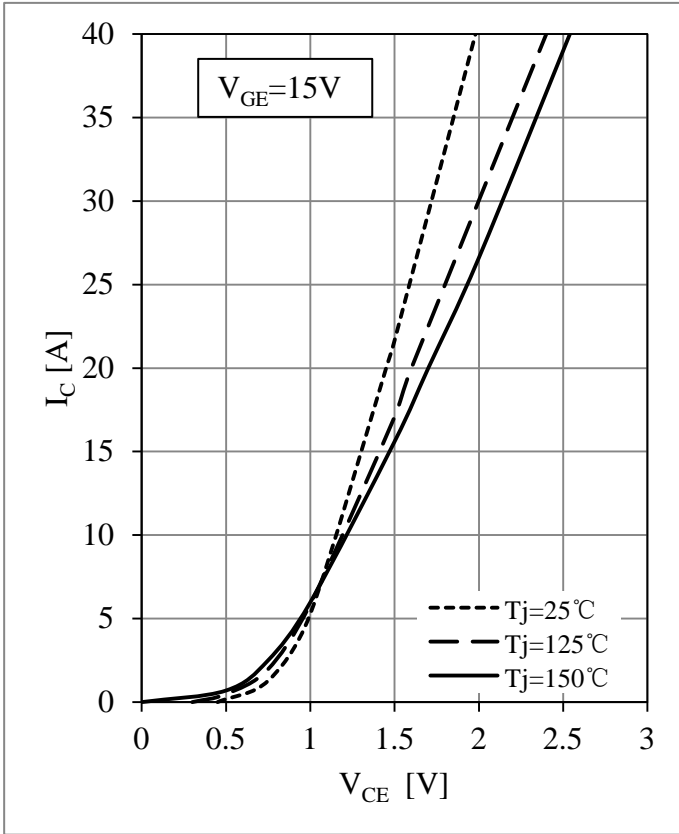


Fig 1. IGBT-inverter Output Characteristics

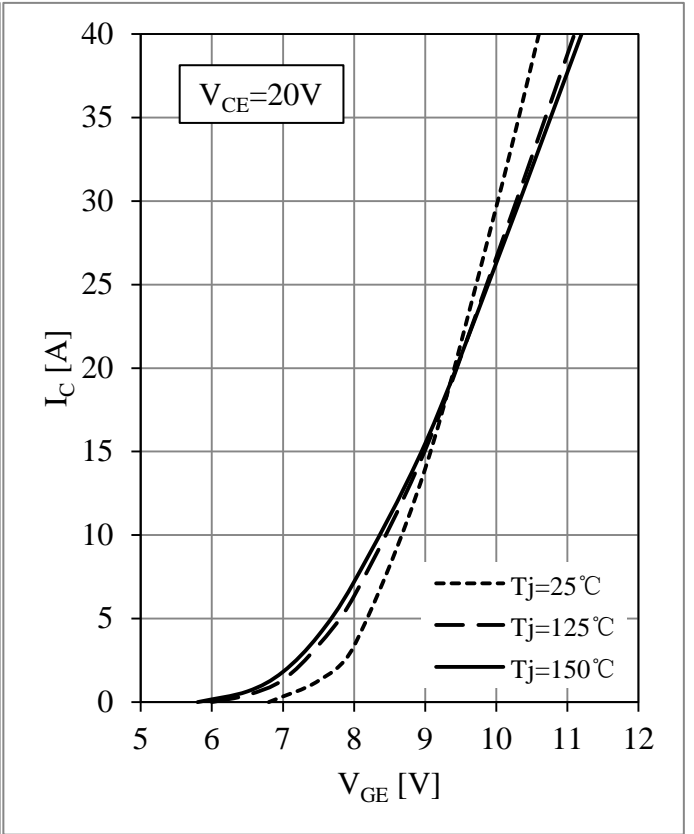


Fig 2. IGBT-inverter Transfer Characteristics

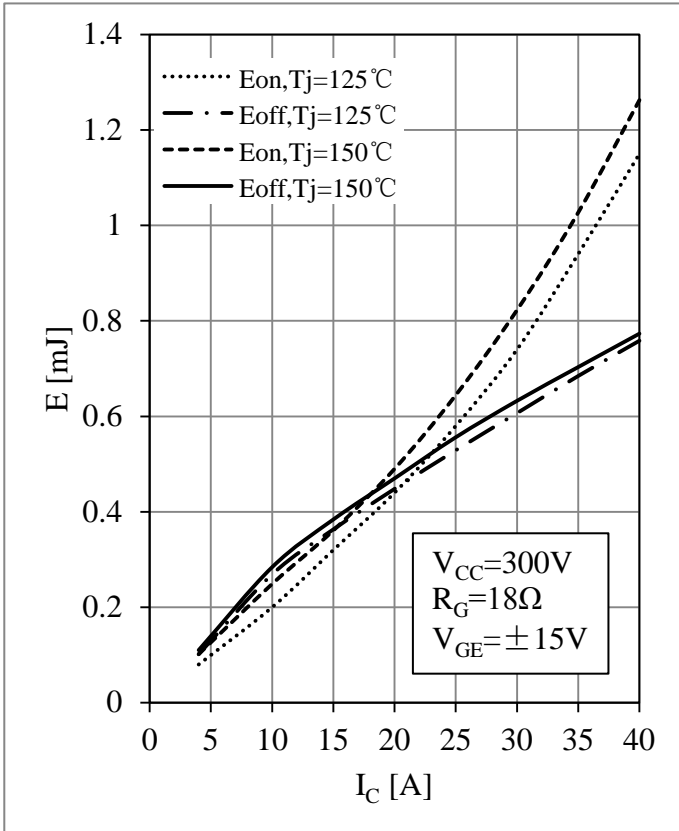


Fig 3. IGBT-inverter Switching Loss vs. I_C

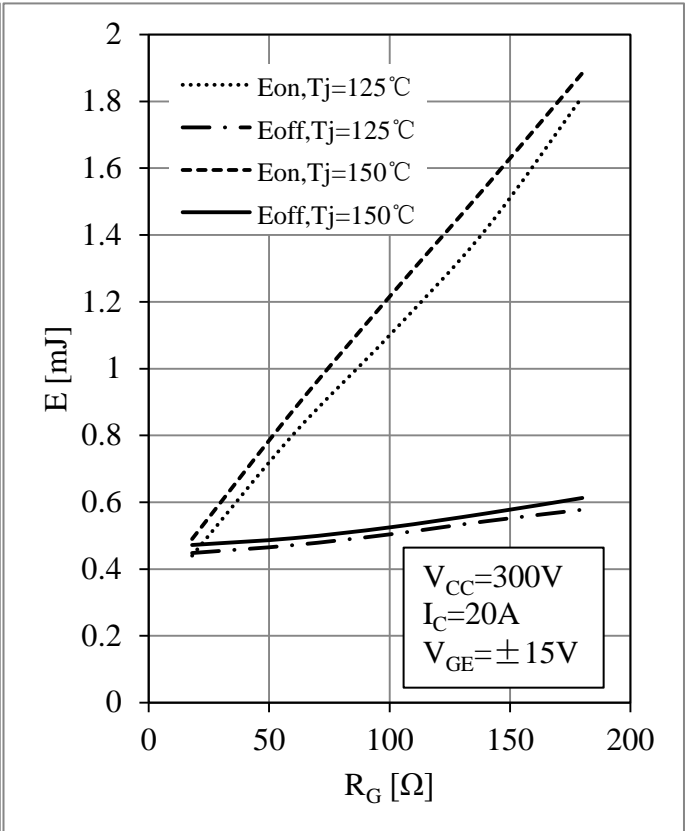


Fig 4. IGBT-inverter Switching Loss vs. R_G

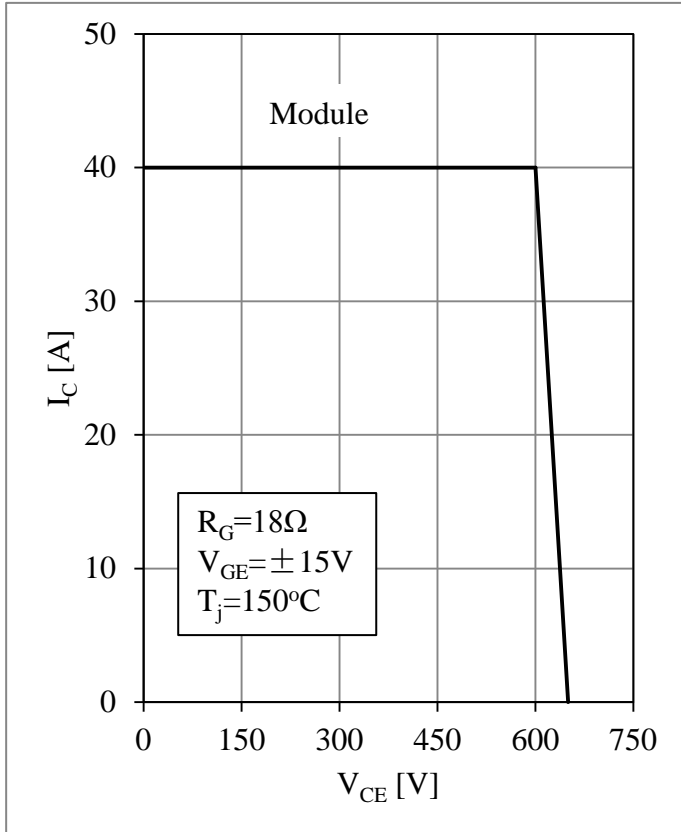


Fig 5. IGBT-inverter RBSOA

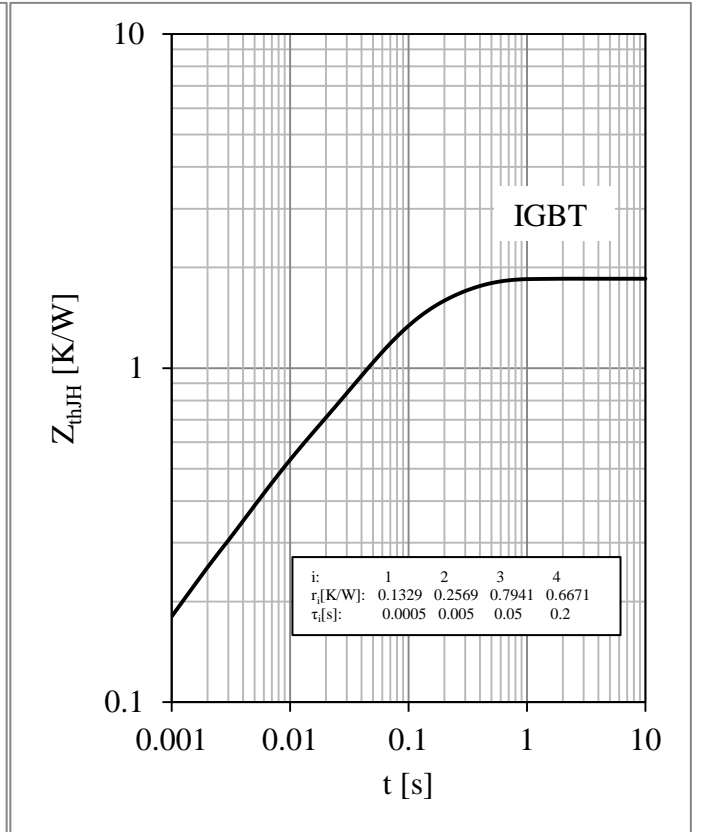


Fig 6. IGBT-inverter Transient Thermal Impedance

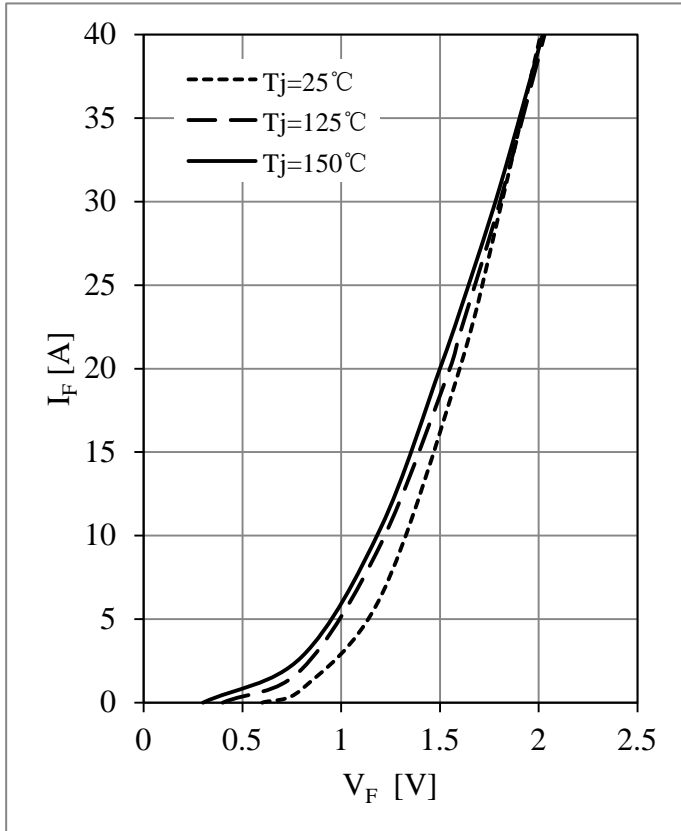


Fig 7. Diode-inverter Forward Characteristics

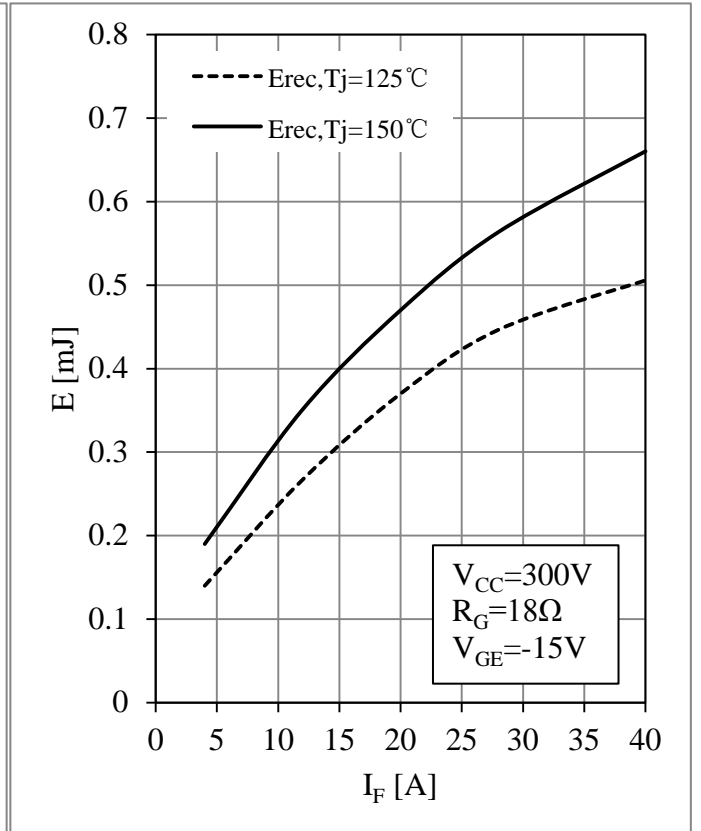


Fig 8. Diode-inverter Switching Loss vs. I_F

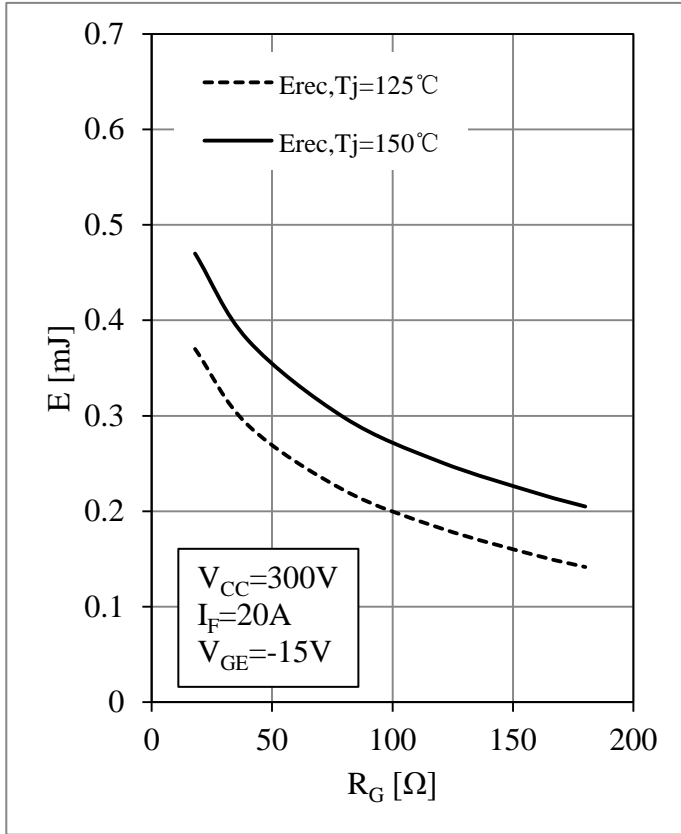


Fig 9. Diode-inverter Switching Loss vs. R_G

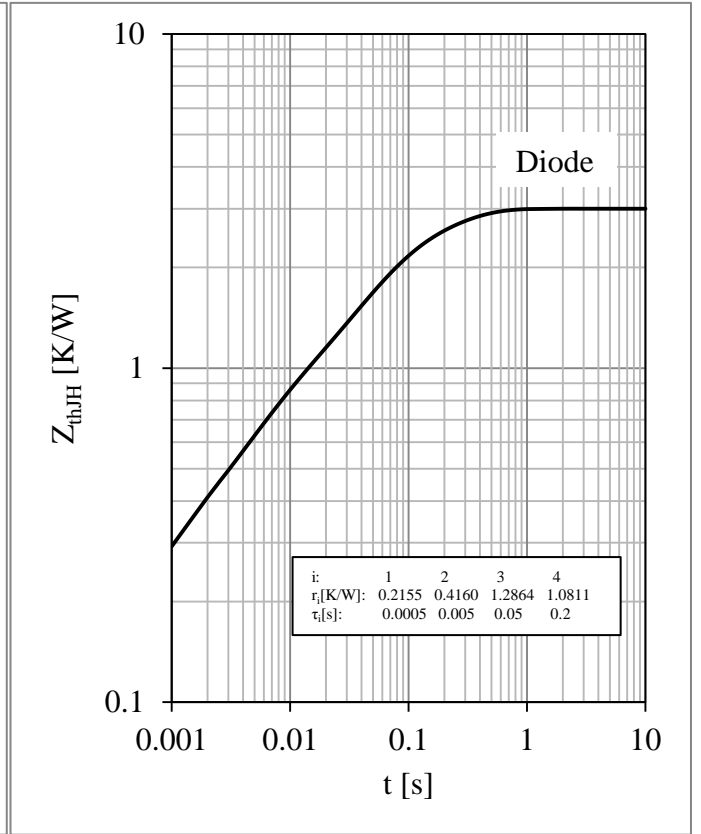


Fig 10. Diode-inverter Transient Thermal Impedance

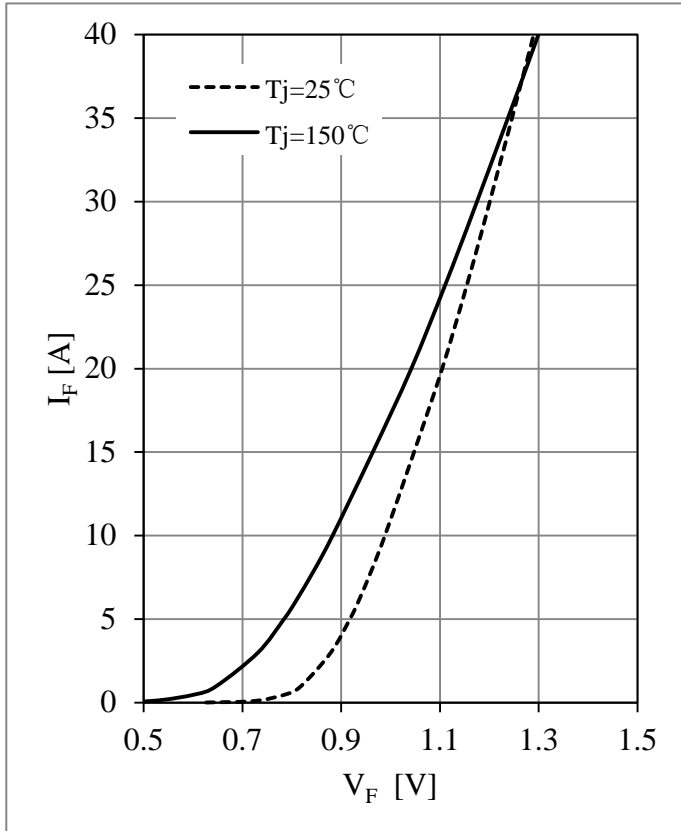


Fig 11. Diode-rectifier Forward Characteristics

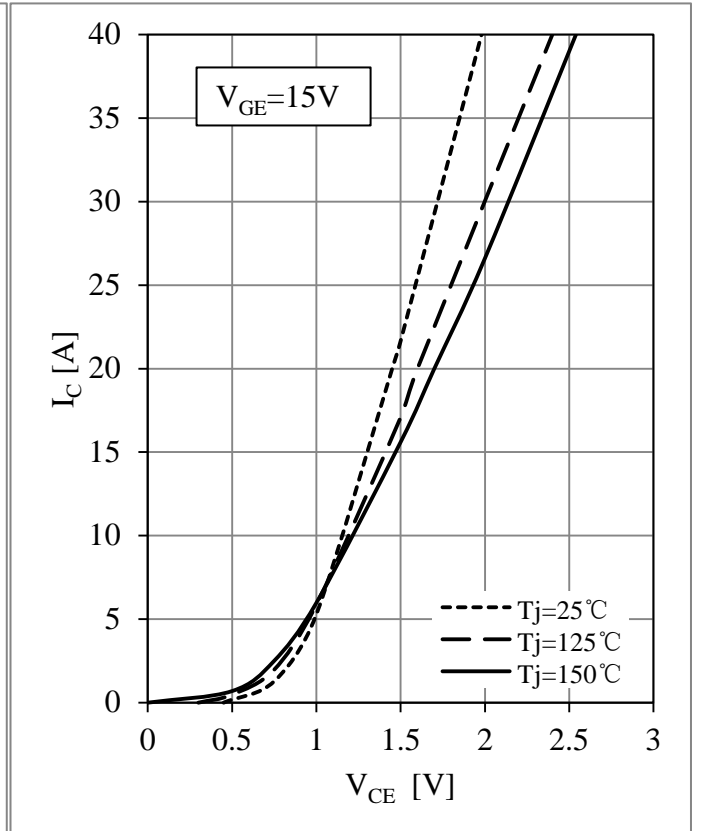


Fig 12. IGBT-brake Output Characteristics

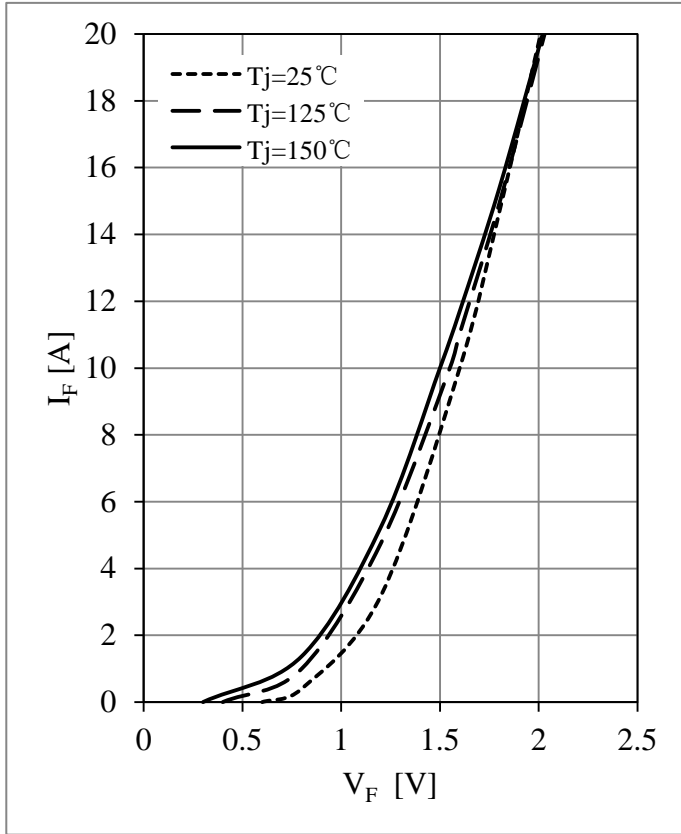
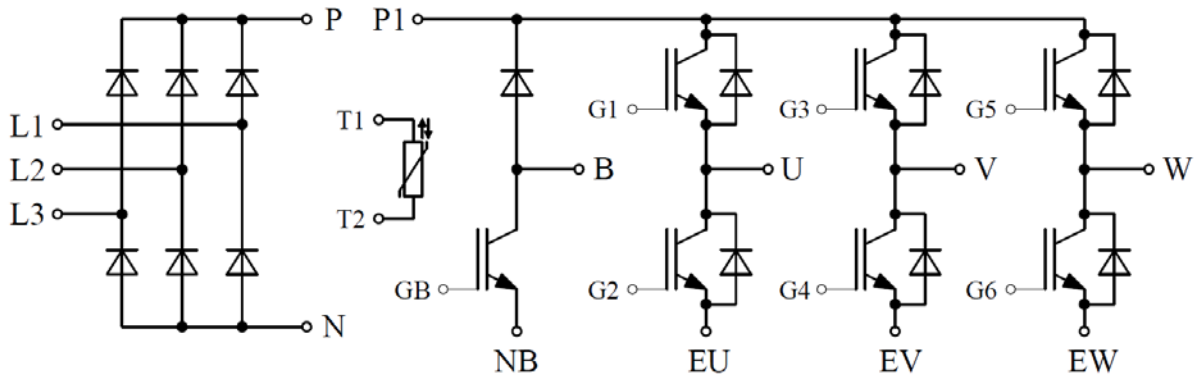


Fig 13. Diode-brake Forward Characteristics



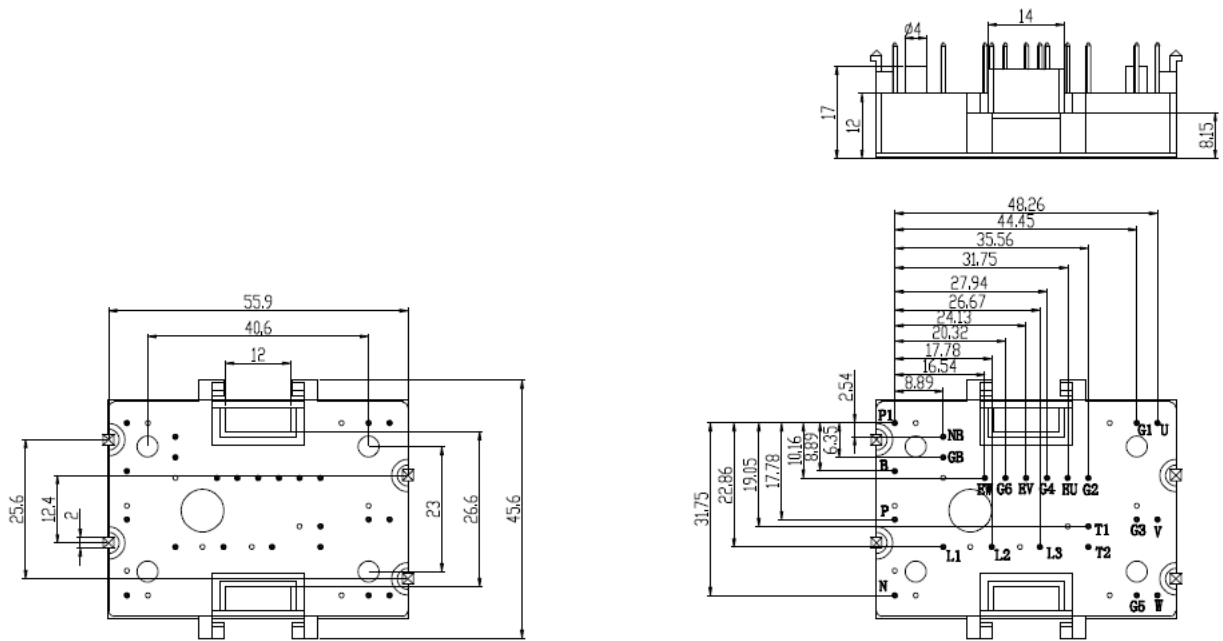
Fig 14. NTC Temperature Characteristic

Circuit Schematic



Package Dimensions

Dimensions in Millimeters



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