

STARPOWER

SEMICONDUCTOR

IGBT

GD20PWX65F1S_B22

650V/20A 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.

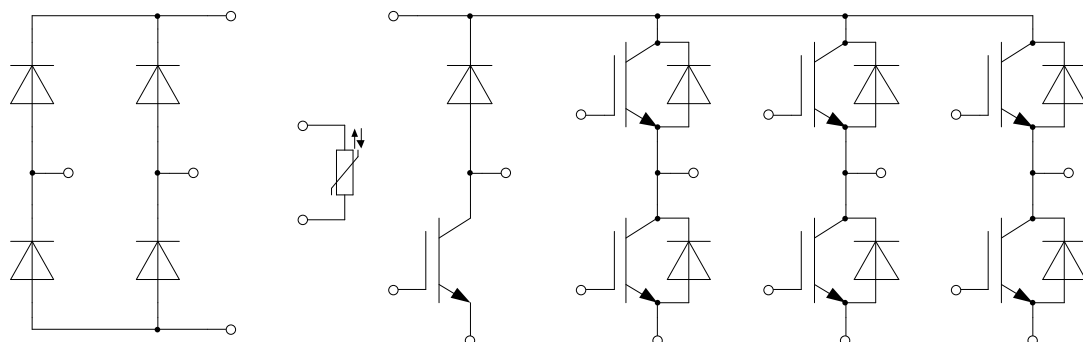
Features

- 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
- Pre-applied phase change material

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 @ $T_C=25^{\circ}\text{C}$ @ $T_C=100^{\circ}\text{C}$	40 20	A
I_{CM}	Pulsed Collector Current $t_p=1\text{ms}$	40	A
P_D	Maximum Power Dissipation @ $T_{vj}=175^{\circ}\text{C}$	123	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 $t_p=10\text{ms}$ @ $T_{vj}=25^{\circ}\text{C}$ @ $T_{vj}=150^{\circ}\text{C}$	250 220	A
I^2t	I^2t -value, $t_p=10\text{ms}$ @ $T_{vj}=25^{\circ}\text{C}$ @ $T_{vj}=150^{\circ}\text{C}$	312 242	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 @ $T_C=25^{\circ}\text{C}$ @ $T_C=100^{\circ}\text{C}$	20 15	A
I_{CM}	Pulsed Collector Current $t_p=1\text{ms}$	30	A
P_D	Maximum Power Dissipation @ $T_{vj}=175^{\circ}\text{C}$	67	W

Diode-brake

Symbol	Description	Value	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	650	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_{vjmax}	Maximum Junction Temperature(inverter,brake) Maximum Junction Temperature (rectifier)	175 150	$^{\circ}\text{C}$
T_{vjop}	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	$I_C=20\text{A}, V_{GE}=15\text{V}, T_{vj}=25^{\circ}\text{C}$		1.45	1.90	V
		$I_C=20\text{A}, V_{GE}=15\text{V}, T_{vj}=125^{\circ}\text{C}$		1.60		
		$I_C=20\text{A}, V_{GE}=15\text{V}, T_{vj}=150^{\circ}\text{C}$		1.70		
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=0.32\text{mA}, V_{CE}=V_{GE}, T_{vj}=25^{\circ}\text{C}$	5.1	5.8	6.5	V
I_{CES}	Collector Cut-Off Current	$V_{CE}=V_{CES}, V_{GE}=0\text{V}, T_{vj}=25^{\circ}\text{C}$			1.0	mA
I_{GES}	Gate-Emitter Leakage Current	$V_{GE}=V_{GES}, V_{CE}=0\text{V}, T_{vj}=25^{\circ}\text{C}$			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	$V_{CC}=300\text{V}, I_C=20\text{A}, R_G=18\Omega, V_{GE}=\pm 15\text{V}, L_S=30\text{nH}, T_{vj}=25^{\circ}\text{C}$		13		ns
t_r	Rise Time			16		ns
$t_{d(off)}$	Turn-Off Delay Time			70		ns
t_f	Fall Time			131		ns
E_{on}	Turn-On Switching Loss			0.30		mJ
E_{off}	Turn-Off Switching Loss			0.29		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=300\text{V}, I_C=20\text{A}, R_G=18\Omega, V_{GE}=\pm 15\text{V}, L_S=30\text{nH}, T_{vj}=125^{\circ}\text{C}$		11		ns
t_r	Rise Time			17		ns
$t_{d(off)}$	Turn-Off Delay Time			79		ns
t_f	Fall Time			169		ns
E_{on}	Turn-On Switching Loss			0.39		mJ
E_{off}	Turn-Off Switching Loss			0.38		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=300\text{V}, I_C=20\text{A}, R_G=18\Omega, V_{GE}=\pm 15\text{V}, L_S=30\text{nH}, T_{vj}=150^{\circ}\text{C}$		11		ns
t_r	Rise Time			18		ns
$t_{d(off)}$	Turn-Off Delay Time			79		ns
t_f	Fall Time			174		ns
E_{on}	Turn-On Switching Loss			0.43		mJ
E_{off}	Turn-Off Switching Loss			0.39		mJ
I_{SC}	SC Data	$t_p \leq 6\mu\text{s}, V_{GE}=15\text{V}, T_{vj}=150^{\circ}\text{C}, V_{CC}=360\text{V}, V_{CEM} \leq 650\text{V}$		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	$I_C=20\text{A}, V_{GE}=0\text{V}, T_{vj}=25^{\circ}\text{C}$		1.60	2.05	V
		$I_C=20\text{A}, V_{GE}=0\text{V}, T_{vj}=125^{\circ}\text{C}$		1.55		
		$I_C=20\text{A}, V_{GE}=0\text{V}, T_{vj}=150^{\circ}\text{C}$		1.50		
Q_r	Recovered Charge	$V_R=300\text{V}, I_F=20\text{A},$ $-di/dt=1400\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $L_s=30\text{nH}, T_{vj}=25^{\circ}\text{C}$		0.33		μC
I_{RM}	Peak Reverse Recovery Current			120		A
E_{rec}	Reverse Recovery Energy			0.07		mJ
Q_r	Recovered Charge	$V_R=300\text{V}, I_F=20\text{A},$ $-di/dt=1200\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $L_s=30\text{nH}, T_{vj}=125^{\circ}\text{C}$		0.82		μC
I_{RM}	Peak Reverse Recovery Current			21		A
E_{rec}	Reverse Recovery Energy			0.19		mJ
Q_r	Recovered Charge	$V_R=300\text{V}, I_F=20\text{A},$ $-di/dt=1200\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $L_s=30\text{nH}, T_{vj}=150^{\circ}\text{C}$		0.90		μC
I_{RM}	Peak Reverse Recovery Current			21		A
E_{rec}	Reverse Recovery Energy			0.22		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	$I_F=20\text{A}, T_{vj}=150^{\circ}\text{C}$		1.05		V
I_R	Reverse Current	$T_{vj}=150^{\circ}\text{C}, V_R=1600\text{V}$			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	$I_C=15\text{A}, V_{GE}=15\text{V}, T_{vj}=25^{\circ}\text{C}$		1.45	1.90	V
		$I_C=15\text{A}, V_{GE}=15\text{V}, T_{vj}=125^{\circ}\text{C}$		1.60		
		$I_C=15\text{A}, V_{GE}=15\text{V}, T_{vj}=150^{\circ}\text{C}$		1.70		
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=0.24\text{mA}, V_{CE}=V_{GE}, T_{vj}=25^{\circ}\text{C}$	5.1	5.8	6.5	V
I_{CES}	Collector Cut-Off Current	$V_{CE}=V_{CES}, V_{GE}=0\text{V}, T_{vj}=25^{\circ}\text{C}$			1.0	mA
I_{GES}	Gate-Emitter Leakage Current	$V_{GE}=V_{GES}, V_{CE}=0\text{V}, T_{vj}=25^{\circ}\text{C}$			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	$V_{CC}=300\text{V}, I_C=15\text{A}, R_G=22\Omega, V_{GE}=\pm 15\text{V}, L_s=30\text{nH}, T_{vj}=25^{\circ}\text{C}$		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	$V_{CC}=300\text{V}, I_C=15\text{A}, R_G=22\Omega, V_{GE}=\pm 15\text{V}, L_s=30\text{nH}, T_{vj}=125^{\circ}\text{C}$		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	$V_{CC}=300\text{V}, I_C=15\text{A}, R_G=22\Omega, V_{GE}=\pm 15\text{V}, L_s=30\text{nH}, T_{vj}=150^{\circ}\text{C}$		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	$t_p \leq 6\mu\text{s}, V_{GE}=15\text{V}, T_{vj}=150^{\circ}\text{C}, V_{CC}=360\text{V}, V_{CEM} \leq 650\text{V}$		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	$I_C=15\text{A}, V_{GE}=0\text{V}, T_{vj}=25^{\circ}\text{C}$		1.60	2.05	V
		$I_C=15\text{A}, V_{GE}=0\text{V}, T_{vj}=125^{\circ}\text{C}$		1.55		
		$I_C=15\text{A}, V_{GE}=0\text{V}, T_{vj}=150^{\circ}\text{C}$		1.50		
Q_r	Recovered Charge	$V_R=300\text{V}, I_F=15\text{A},$ $-di/dt=1600\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $L_s=30\text{nH}, T_{vj}=25^{\circ}\text{C}$		0.8		μC
I_{RM}	Peak Reverse Recovery Current			18.0		A
E_{rec}	Reverse Recovery Energy			0.11		mJ
Q_r	Recovered Charge	$V_R=300\text{V}, I_F=15\text{A},$ $-di/dt=1600\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $L_s=30\text{nH}, T_{vj}=125^{\circ}\text{C}$		0.85		μC
I_{RM}	Peak Reverse Recovery Current			19.0		A
E_{rec}	Reverse Recovery Energy			0.20		mJ
Q_r	Recovered Charge	$V_R=300\text{V}, I_F=15\text{A},$ $-di/dt=1600\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $L_s=30\text{nH}, T_{vj}=150^{\circ}\text{C}$		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			22.0		$\text{k}\Omega$
$\Delta R/R$	Deviation of R_{100}	$T_C=100^{\circ}\text{C}, R_{100}=1486.1\Omega$	-5		5	%
P_{25}	Power Dissipation				200	mW
$B_{25/50}$	B-value	$R_2=R_{25}\exp[B_{25/50}(1/T_2-1/(298.15\text{K}))]$		4000		K

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

Symbol	Parameter	Min.	Typ.	Max.	Unit
R_{thJC}	Junction-to-Case (per IGBT-inverter)		1.211	1.332	K/W
	Junction-to-Case (per Diode-inverter)		1.962	2.158	
	Junction-to-Case (per Diode-rectifier)		1.266	1.393	
	Junction-to-Case (per IGBT-brake)		1.436	1.580	
	Junction-to-Case (per Diode-brake)		2.214	2.435	
R_{thCH}	Case-to-Heatsink (per IGBT-inverter)		0.865		K/W
	Case-to-Heatsink (per Diode-inverter)		1.402		
	Case-to-Heatsink (per Diode-rectifier)		0.905		
	Case-to-Heatsink (per IGBT-brake)		1.026		
	Case-to-Heatsink (per Diode-brake)		1.582		
	Case-to-Sink (per Module)		0.058		
M	Mounting Torque, Screw M4	2.0		2.2	N.m
G	Weight of Module		26		g

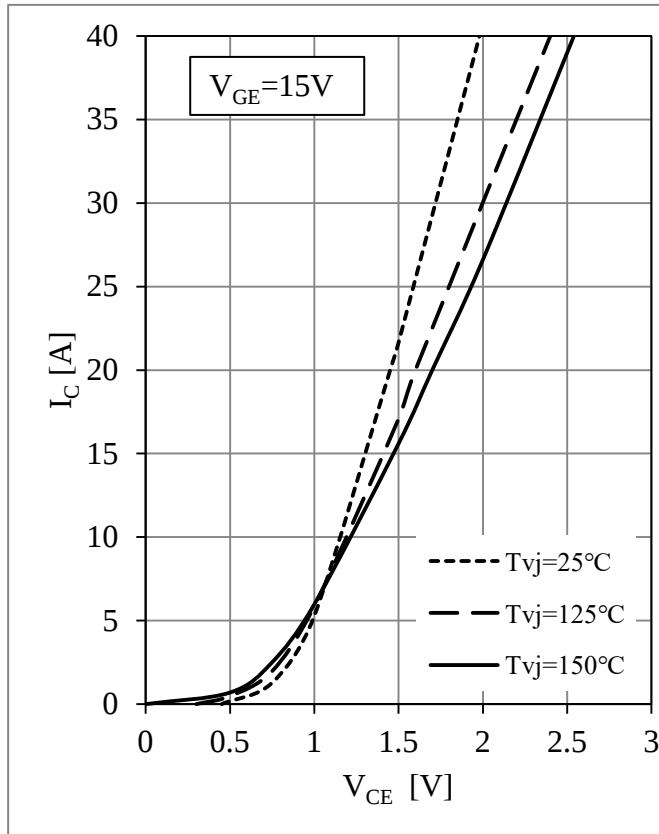


Fig 1. IGBT-inverter Output Characteristics

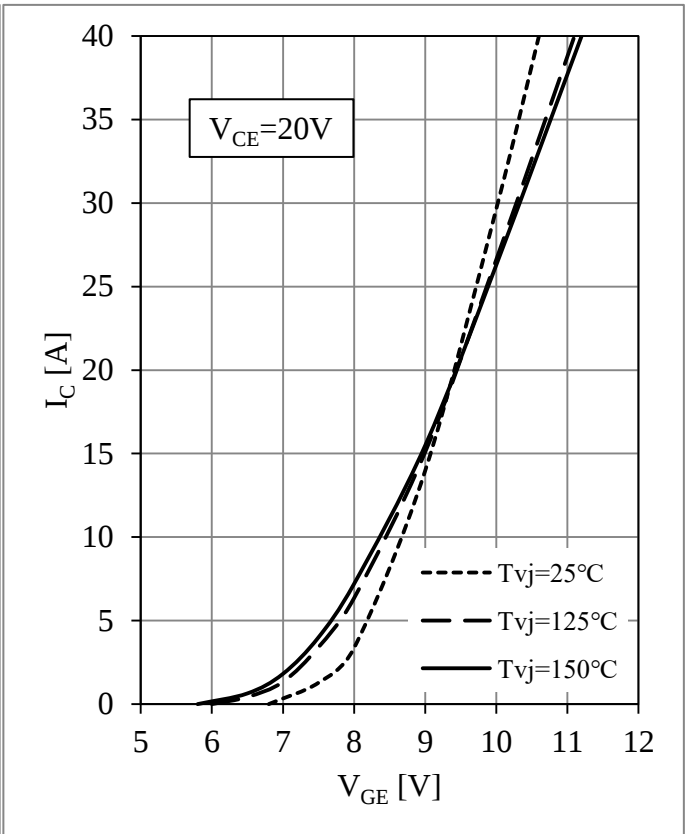
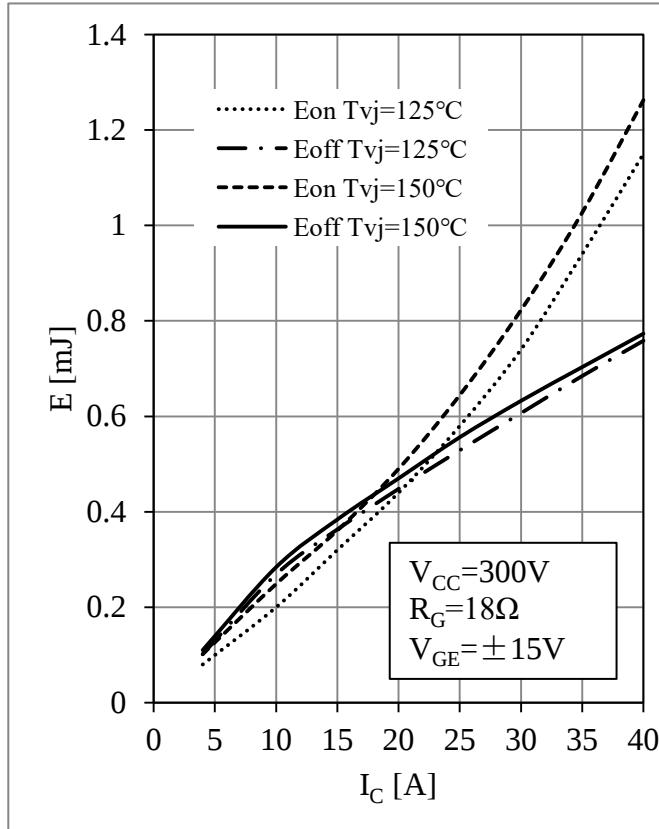
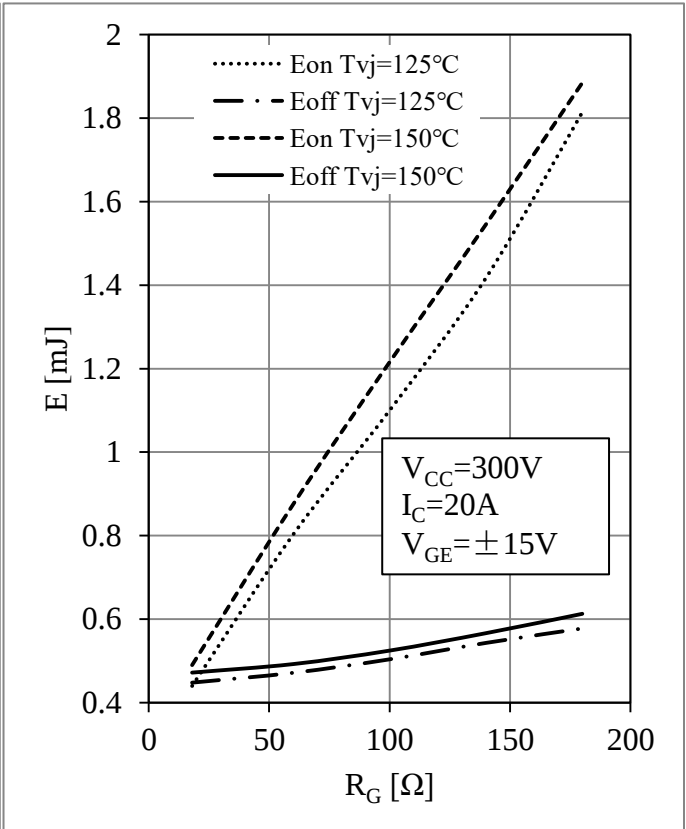


Fig 2. IGBT-inverter Transfer Characteristics

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

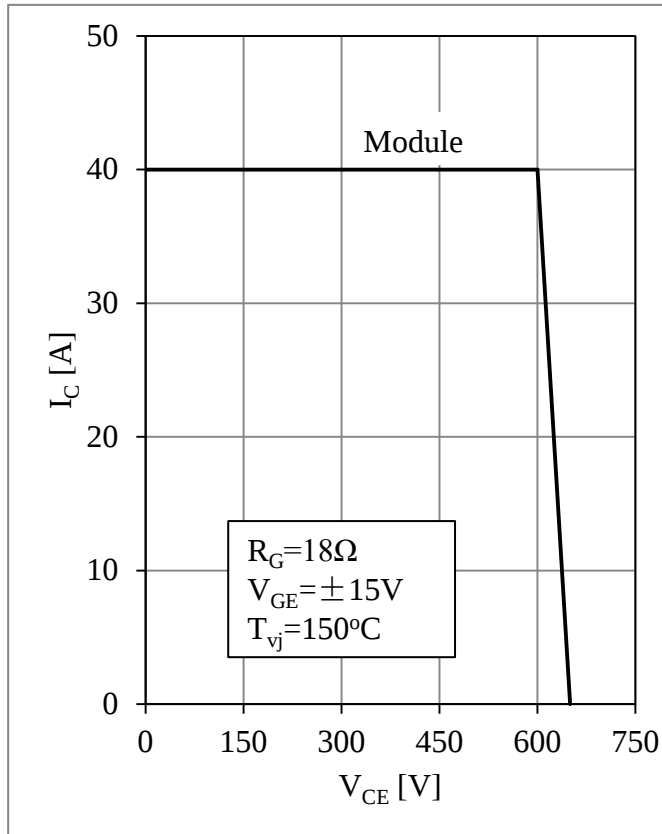


Fig 5. IGBT-inverter RBSOA

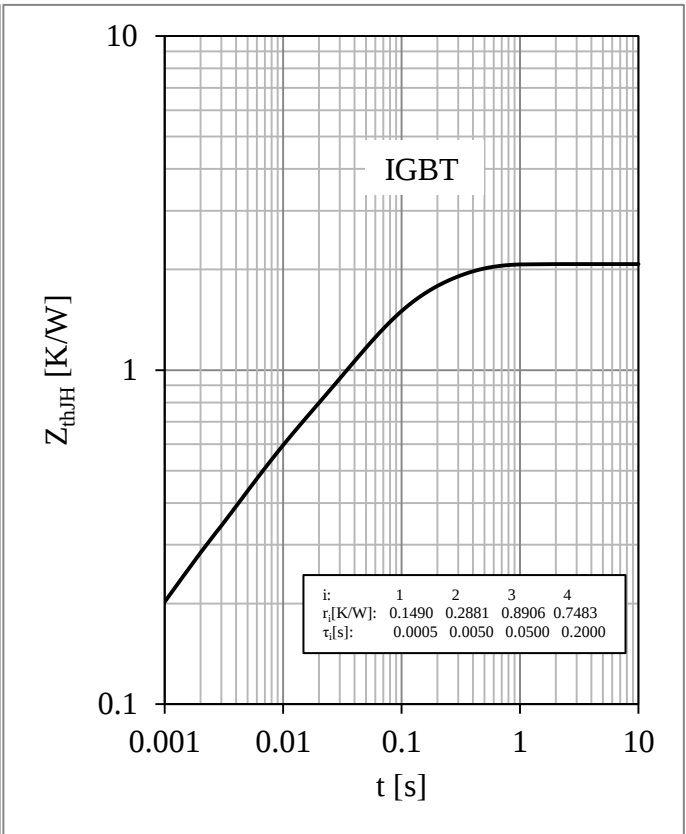


Fig 6. IGBT-inverter Transient Thermal Impedance

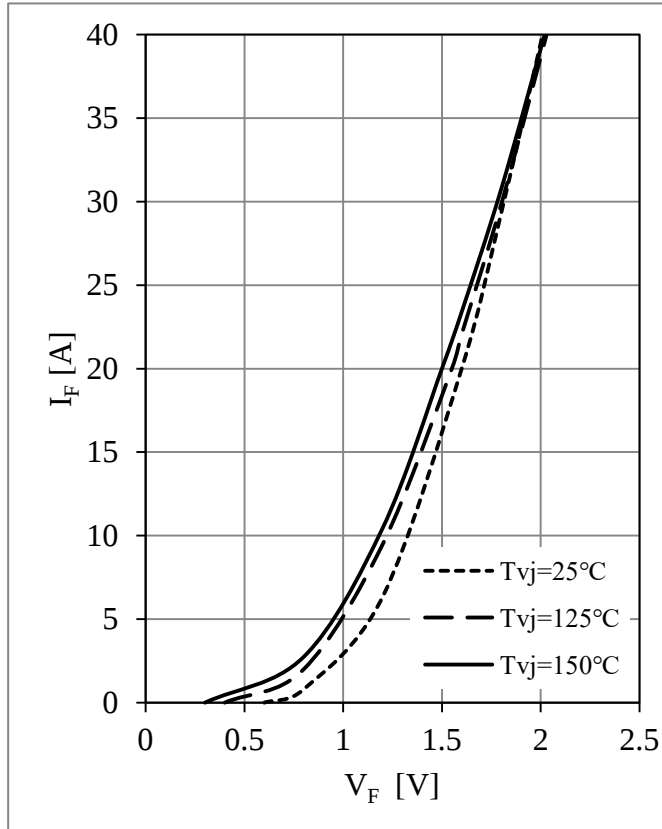
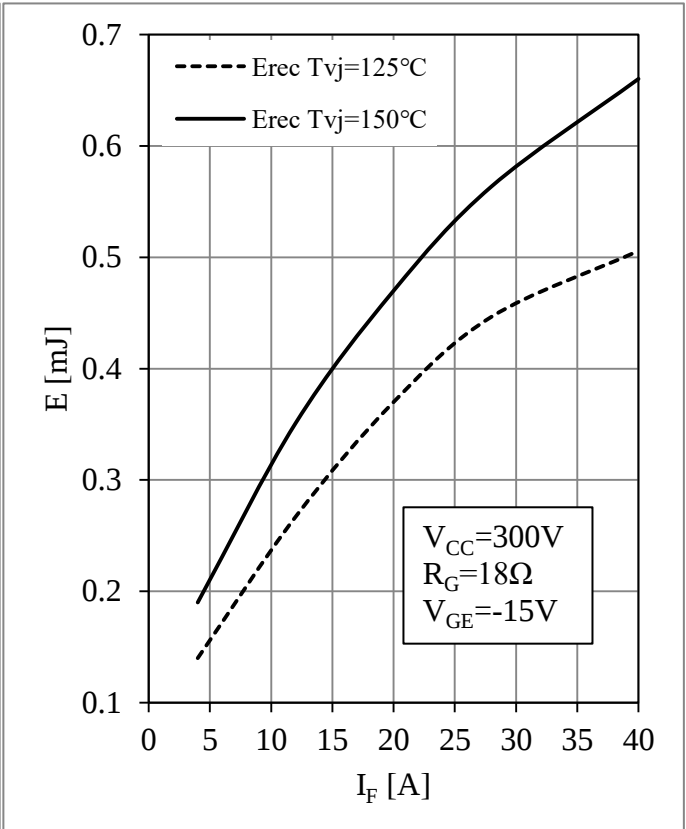


Fig 7. Diode-inverter Forward Characteristics

Fig 8. Diode-inverter Switching Loss vs. I_F

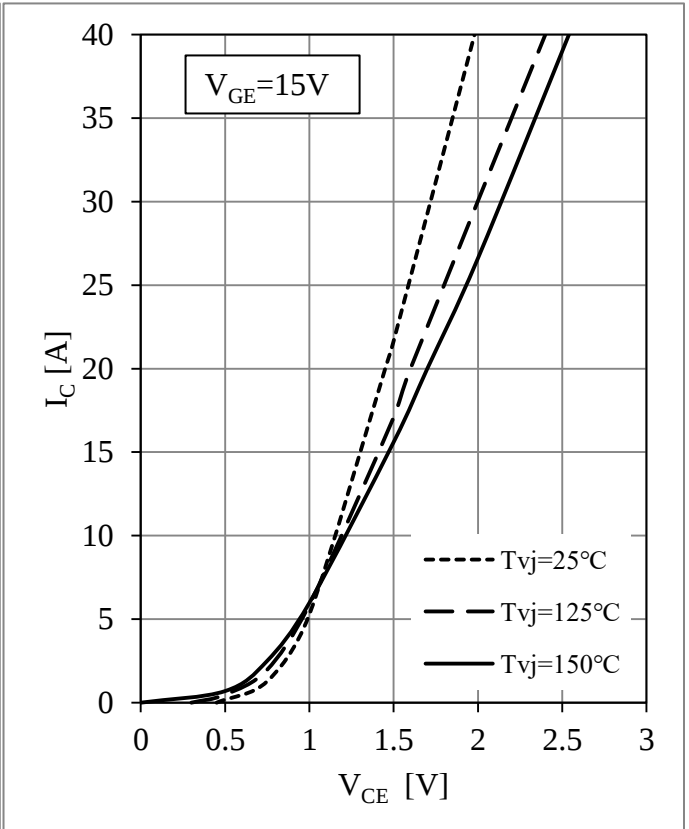
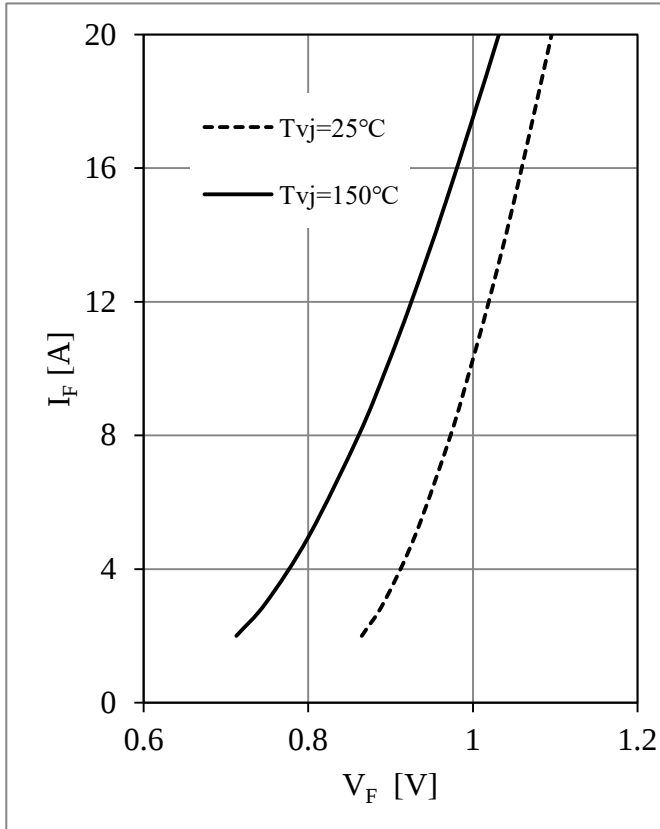
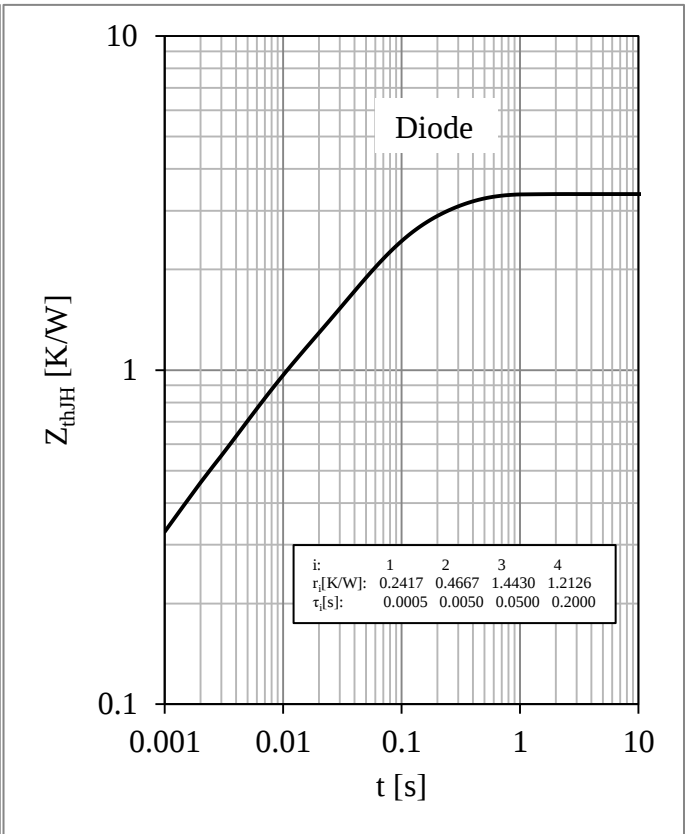
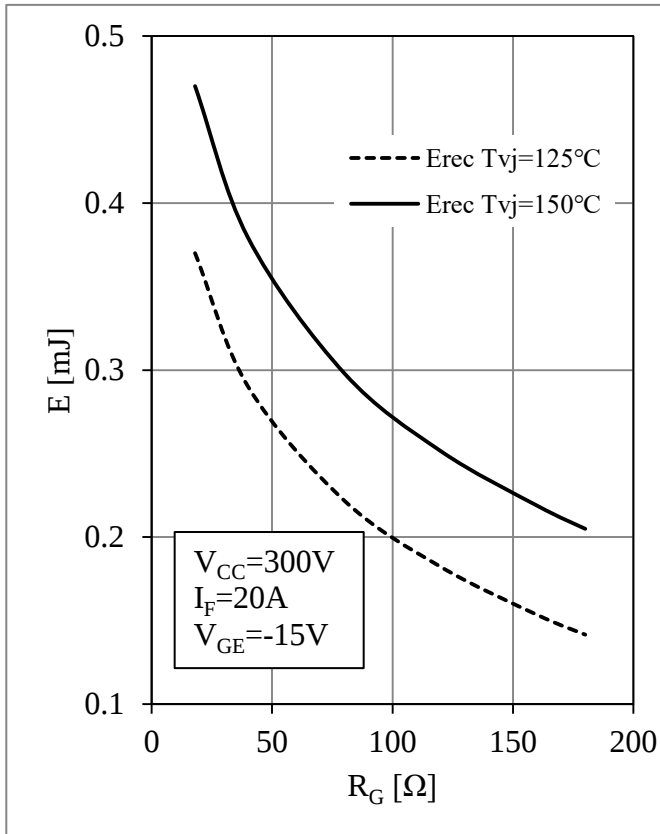


Fig 11. Diode-rectifier Forward Characteristics

Fig 12. IGBT-brake Output Characteristics

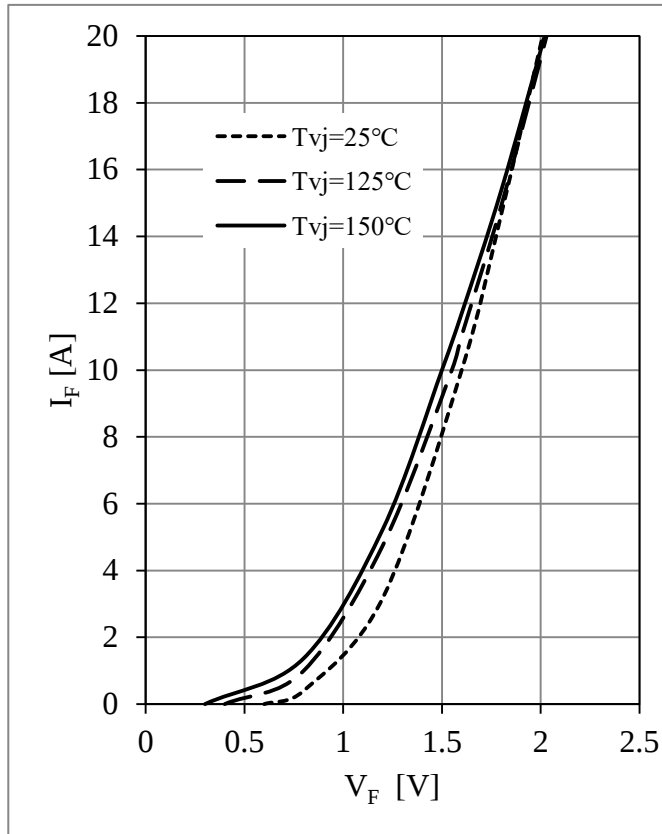


Fig 13. Diode-brake Forward Characteristics

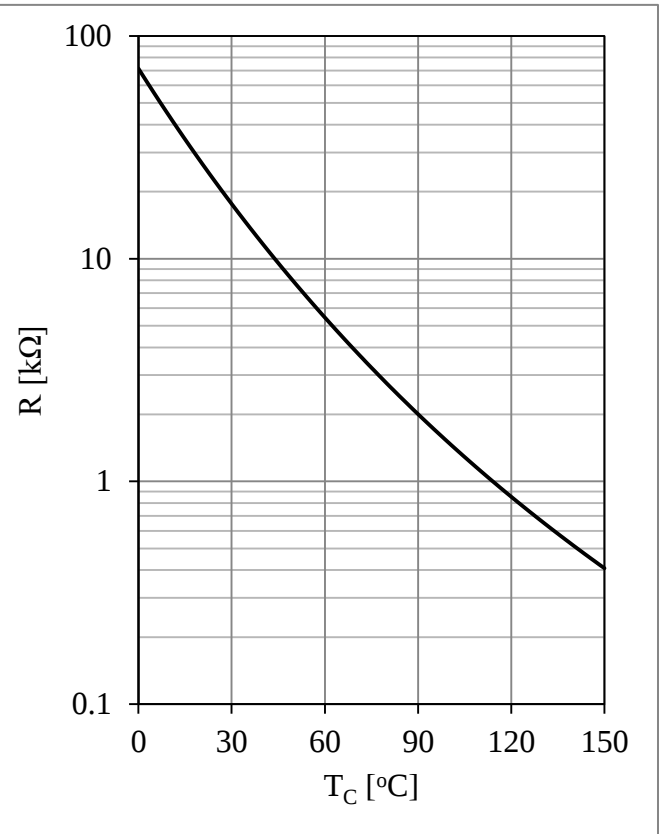
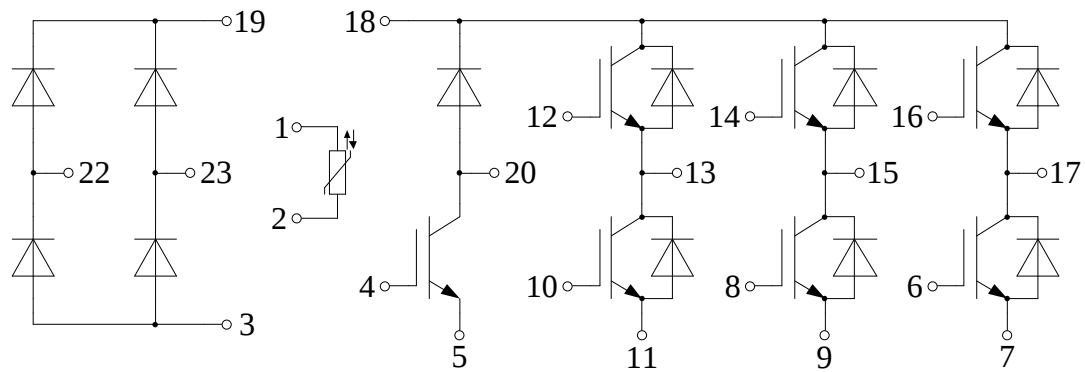


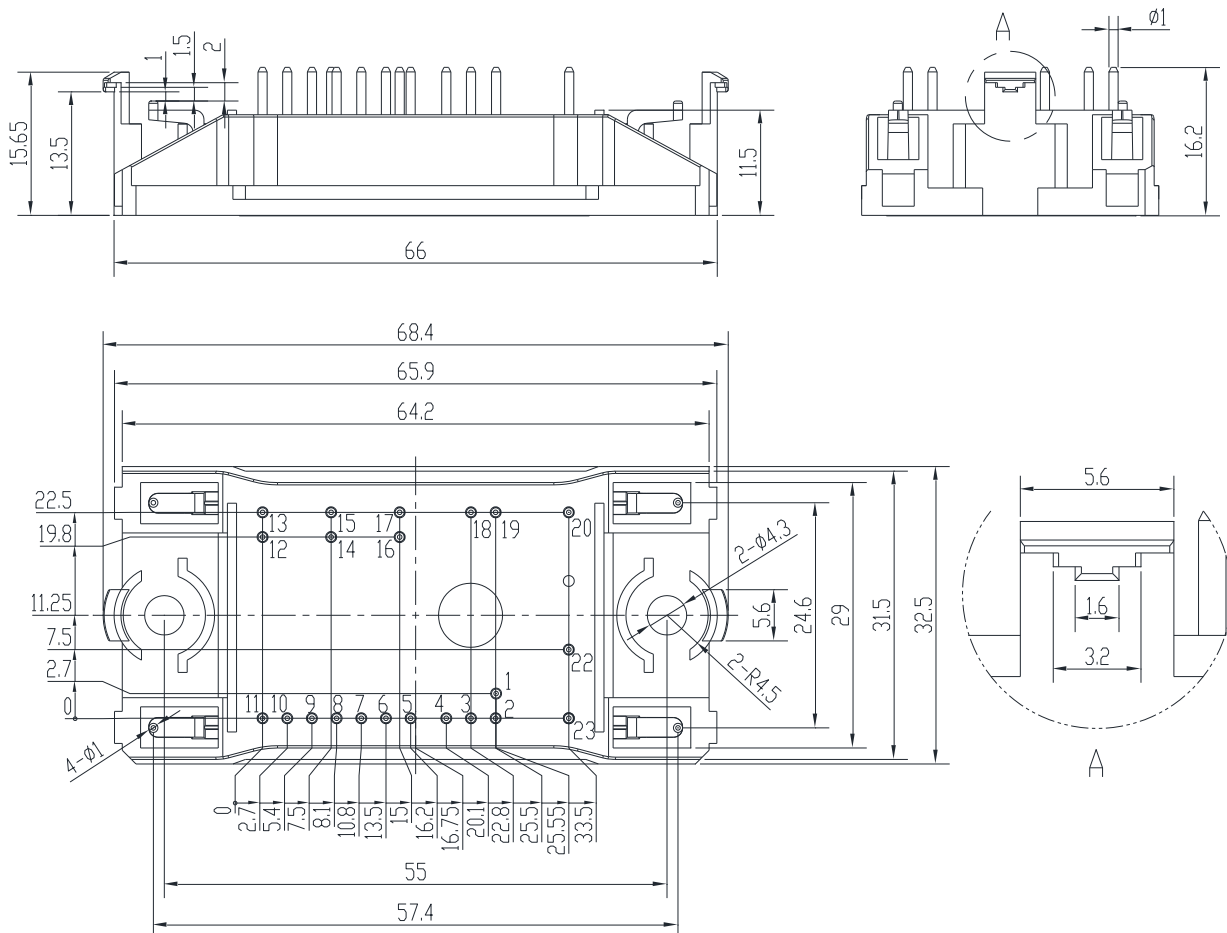
Fig 14. NTC Temperature Characteristic

Circuit Schematic



Package Dimensions

Dimensions in Millimeters



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