

STARPOWER

SEMICONDUCTOR

IGBT

GD660HFX75N5HY_B29

750V/660A 2 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 hybrid and electric vehicle.

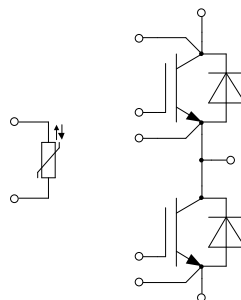
Features

- Low $V_{CE(sat)}$ Trench IGBT technology
- Low switching losses
- 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 copper pinfin baseplate using Si₃N₄ AMB technology

Typical Applications

- Automotive application
- Hybrid and electric vehicle
- Inverter for motor drive

Equivalent Circuit Schematic



Absolute Maximum Ratings $T_J=25^{\circ}\text{C}$ unless otherwise noted**IGBT**

Symbol	Description	Values	Unit
V_{CES}	Collector-Emitter Voltage	750	V
V_{GES}	Gate-Emitter Voltage	± 20	V
I_{CN}	Implemented Collector Current	660	A
I_C	Collector Current @ $T_F=65^{\circ}\text{C}$ $T_{vj}=175^{\circ}\text{C}$	390	A
I_{CM}	Pulsed Collector Current $t_p=1\text{ms}$	1320	A
P_D	Maximum Power Dissipation @ $T_F=65^{\circ}\text{C}$ $T_{vj}=175^{\circ}\text{C}$	846	W

Diode

Symbol	Description	Values	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	750	V
I_{FN}	Implemented Collector Current	660	A
I_F	Diode Continuous Forward Current @ $T_F=65^{\circ}\text{C}$ $T_{vj}=175^{\circ}\text{C}$	335	A
I_{FM}	Diode Maximum Forward Current $t_p=1\text{ms}$	1320	A

Module

Symbol	Description	Value	Unit
T_{vjmax}	Maximum Junction Temperature	175	$^{\circ}\text{C}$
T_{jop}	Operating Junction Temperature continuous For 10s within a period of 30s, occurrence maximum 3000 times over lifetime	-40 to +150 +150 to +175	$^{\circ}\text{C}$
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
d_{Creep}	Terminal to Heatsink Terminal to Terminal	8.7 5.6	mm
d_{Clear}	Terminal to Heatsink Terminal to Terminal	6.8 3.0	mm

IGBT Characteristics $T_j=25^{\circ}\text{C}$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	$I_C=300\text{A}, V_{GE}=15\text{V}, T_{vj}=25^{\circ}\text{C}$		1.35	1.60	V
		$I_C=300\text{A}, V_{GE}=15\text{V}, T_{vj}=150^{\circ}\text{C}$		1.60		
		$I_C=300\text{A}, V_{GE}=15\text{V}, T_{vj}=175^{\circ}\text{C}$		1.65		
		$I_C=660\text{A}, V_{GE}=15\text{V}, T_{vj}=25^{\circ}\text{C}$		1.80		
		$I_C=660\text{A}, V_{GE}=15\text{V}, T_{vj}=175^{\circ}\text{C}$		2.45		
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=9.60\text{mA}, V_{CE}=V_{GE}, T_{vj}=25^{\circ}\text{C}$	4.9	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			1.0		Ω
C_{ies}	Input Capacitance	$V_{CE}=50\text{V}, f=100\text{kHz}, V_{GE}=0\text{V}$		46.1		nF
C_{oes}	Output Capacitance			1.54		nF
C_{res}	Reverse Transfer Capacitance			0.70		nF
Q_G	Gate Charge	$V_{CE}=400\text{V}, I_C=300\text{A}, V_{GE}=\pm 15\text{V}$		2.19		μC
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=400\text{V}, I_C=350\text{A}, R_G=2.0\Omega, V_{GE}=\pm 15\text{V}, L_S=16\text{nH}, T_{vj}=25^{\circ}\text{C}$		201		ns
t_r	Rise Time			58		ns
$t_{d(off)}$	Turn-Off Delay Time			290		ns
t_f	Fall Time			158		ns
E_{on}	Turn-On Switching Loss			14.1		mJ
E_{off}	Turn-Off Switching Loss			11.6		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=400\text{V}, I_C=350\text{A}, R_G=2.0\Omega, V_{GE}=\pm 15\text{V}, L_S=16\text{nH}, T_{vj}=150^{\circ}\text{C}$		222		ns
t_r	Rise Time			65		ns
$t_{d(off)}$	Turn-Off Delay Time			308		ns
t_f	Fall Time			203		ns
E_{on}	Turn-On Switching Loss			18.1		mJ
E_{off}	Turn-Off Switching Loss			13.7		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=400\text{V}, I_C=350\text{A}, R_G=2.0\Omega, V_{GE}=\pm 15\text{V}, L_S=16\text{nH}, T_{vj}=175^{\circ}\text{C}$		229		ns
t_r	Rise Time			68		ns
$t_{d(off)}$	Turn-Off Delay Time			315		ns
t_f	Fall Time			204		ns
E_{on}	Turn-On Switching Loss			18.6		mJ
E_{off}	Turn-Off Switching Loss			14.4		mJ
I_{SC}	SC Data	$t_p \leq 3\mu\text{s}, V_{GE}=15\text{V}, T_{vj}=175^{\circ}\text{C}, V_{CC}=450\text{V}, V_{CEM} \leq 750\text{V}$		3021		A

Diode Characteristics $T_j=25^{\circ}\text{C}$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_F	Diode Forward Voltage	$I_F=300\text{A}, V_{GE}=0\text{V}, T_{vj}=25^{\circ}\text{C}$		1.40	1.65	V
		$I_F=300\text{A}, V_{GE}=0\text{V}, T_{vj}=150^{\circ}\text{C}$		1.35		
		$I_F=300\text{A}, V_{GE}=0\text{V}, T_{vj}=175^{\circ}\text{C}$		1.30		
		$I_F=660\text{A}, V_{GE}=0\text{V}, T_{vj}=25^{\circ}\text{C}$		1.80		
		$I_F=660\text{A}, V_{GE}=0\text{V}, T_{vj}=175^{\circ}\text{C}$		1.75		
Q_r	Recovered Charge	$V_R=400\text{V}, I_F=350\text{A},$ $-di/dt=6210\text{A}/\mu\text{s}, V_{GE}=-15\text{V},$ $L_S=16\text{nH}, T_{vj}=25^{\circ}\text{C}$		10.0		μC
I_{RM}	Peak Reverse Recovery Current			185		A
E_{rec}	Reverse Recovery Energy			2.47		mJ
Q_r	Recovered Charge	$V_R=400\text{V}, I_F=350\text{A},$ $-di/dt=5450\text{A}/\mu\text{s}, V_{GE}=-15\text{V},$ $L_S=16\text{nH}, T_{vj}=150^{\circ}\text{C}$		16.0		μC
I_{RM}	Peak Reverse Recovery Current			206		A
E_{rec}	Reverse Recovery Energy			3.82		mJ
Q_r	Recovered Charge	$V_R=400\text{V}, I_F=350\text{A},$ $-di/dt=5240\text{A}/\mu\text{s}, V_{GE}=-15\text{V},$ $L_S=16\text{nH}, T_{vj}=175^{\circ}\text{C}$		18.0		μC
I_{RM}	Peak Reverse Recovery Current			213		A
E_{rec}	Reverse Recovery Energy			4.17		mJ

NTC Characteristics $T_j=25^{\circ}\text{C}$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
R_{25}	Rated Resistance			5.0		k Ω
$\Delta R/R$	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 $T_j=25^{\circ}\text{C}$ unless otherwise noted

Symbol	Parameter	Min.	Typ.	Max.	Unit
L_{CE}	Stray Inductance		6.5		nH
p	Maximum Pressure In Cooling Circuit			2.5	bar
R_{thJF}	Junction-to-Cooling Fluid (per IGBT) Junction-to-Cooling Fluid (per Diode) $\Delta V/\Delta t=3.3\text{ L/min}, T_F=65^{\circ}\text{C}$		0.113 0.164	0.130 0.189	K/W
M	Terminal Connection Torque, Screw M5 Mounting Torque, Screw M5	3.6 5.4		4.4 6.6	N.m
G	Weight of Module		220		g

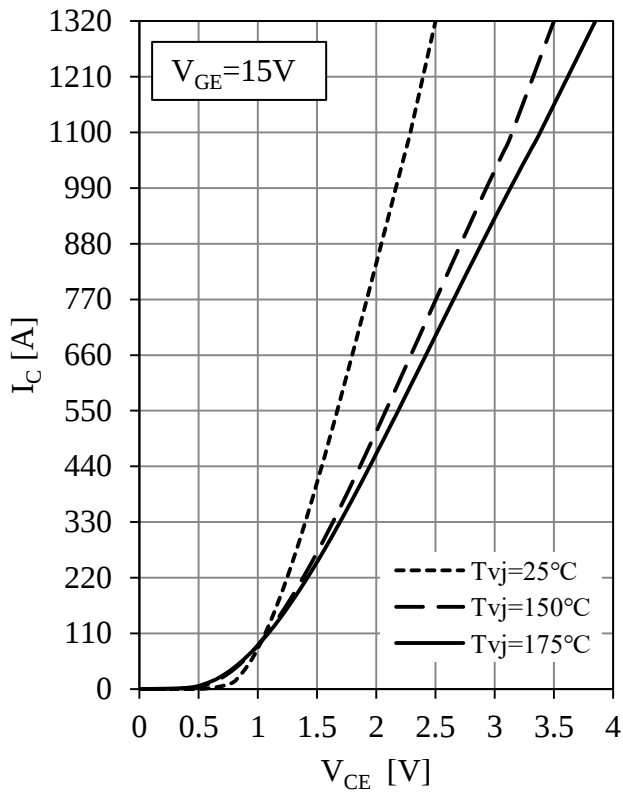


Fig 1. IGBT Output Characteristics

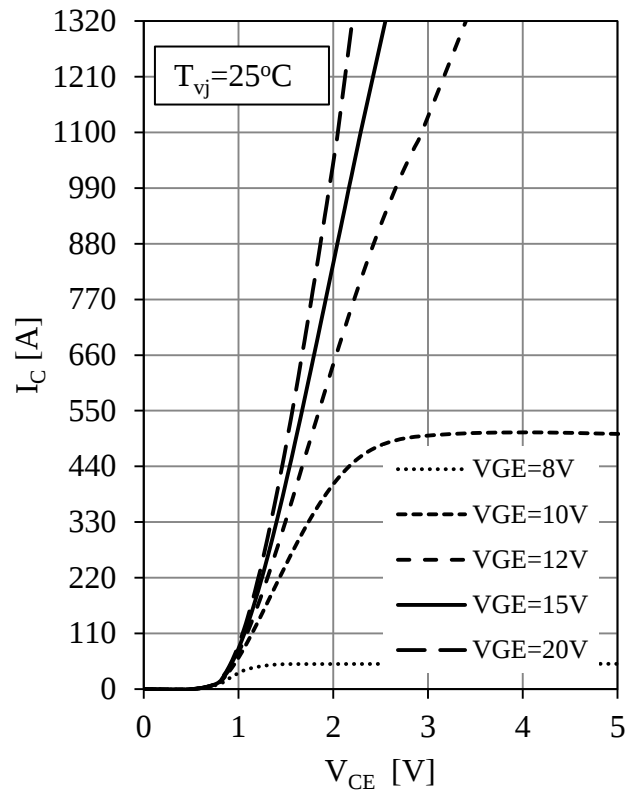


Fig 2. IGBT Output Characteristics

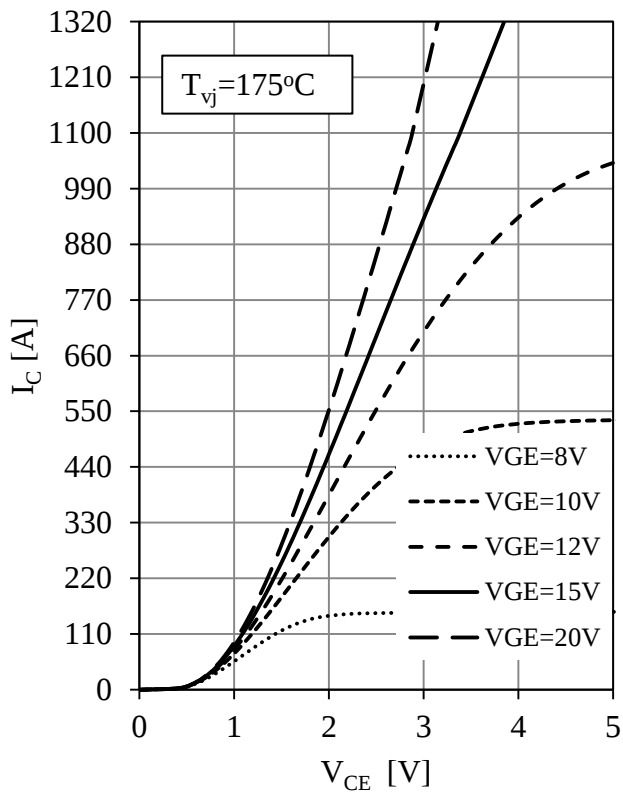


Fig 3. IGBT Output Characteristics

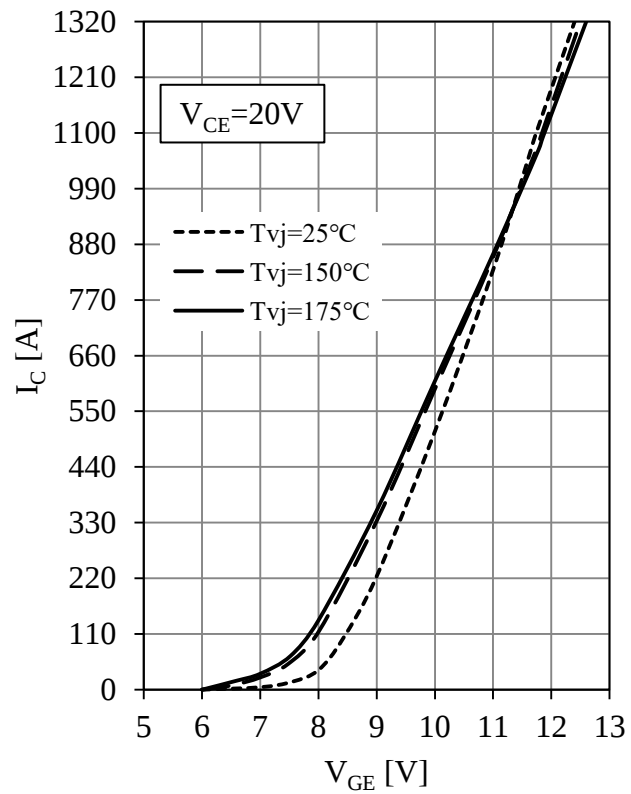


Fig 4. IGBT Transfer Characteristics

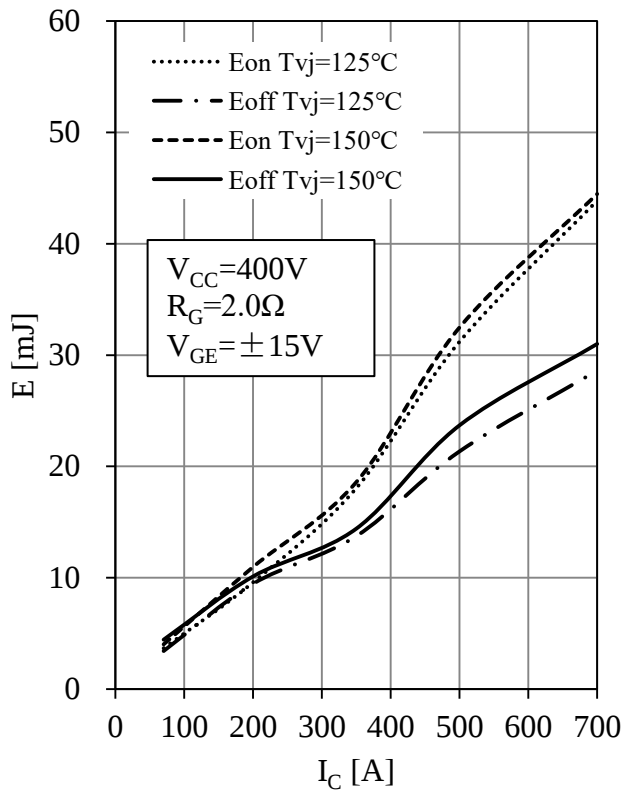
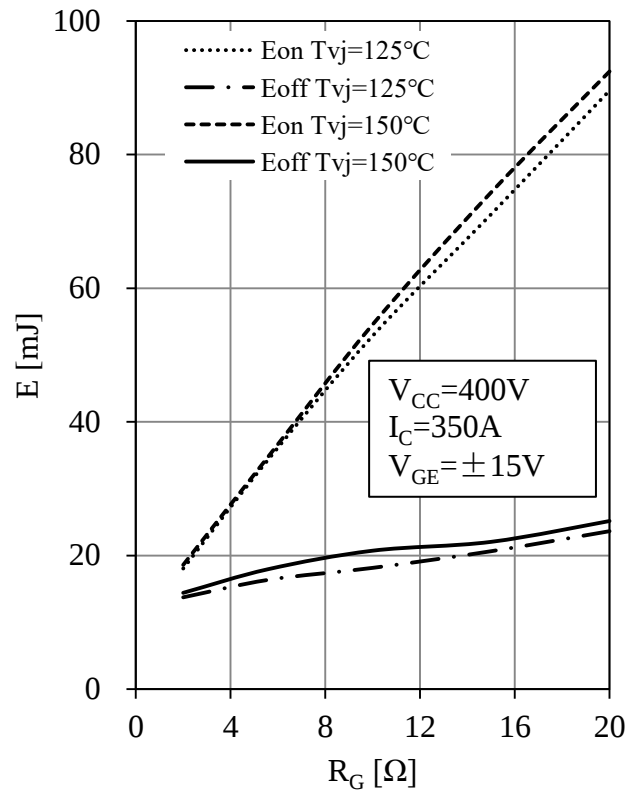
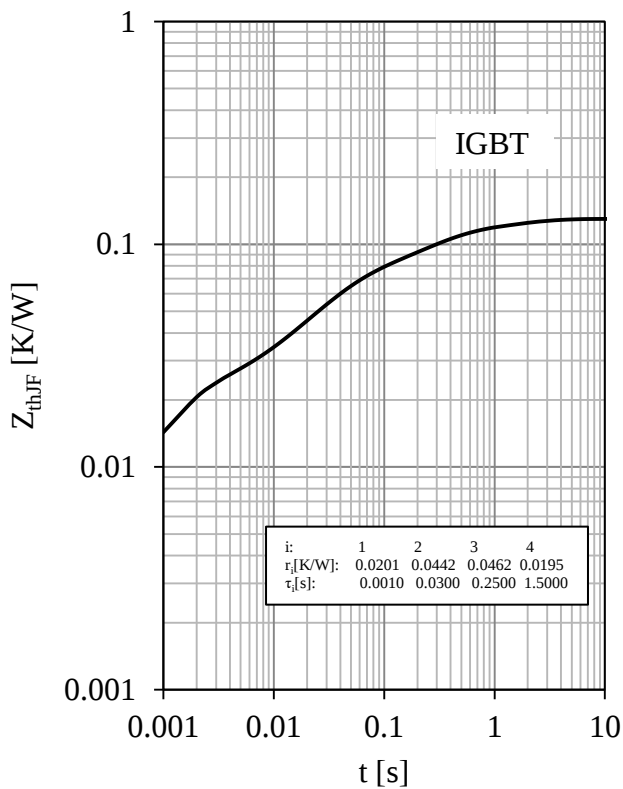
Fig 5. IGBT Switching Loss vs. I_C Fig 6. IGBT Switching Loss vs. R_G 

Fig 7. IGBT Transient Thermal Impedance

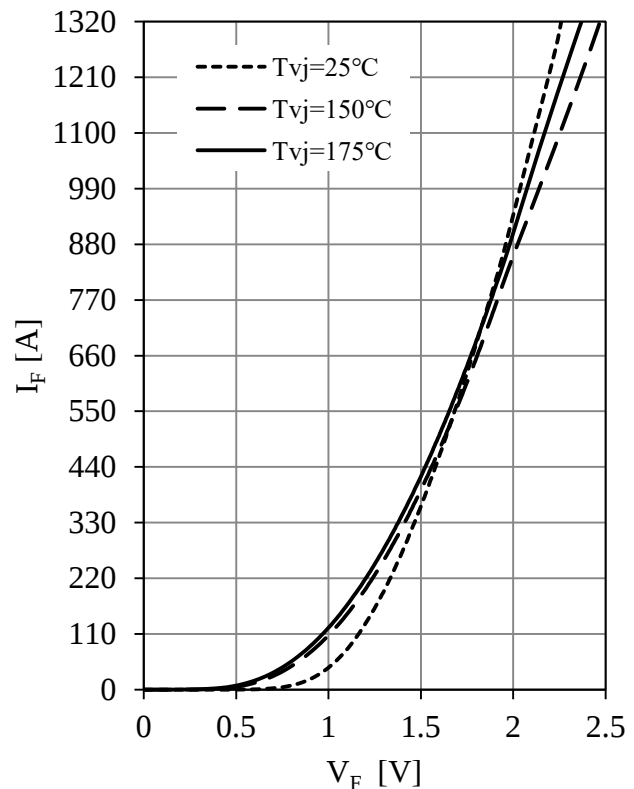


Fig 8. Diode Forward Characteristics

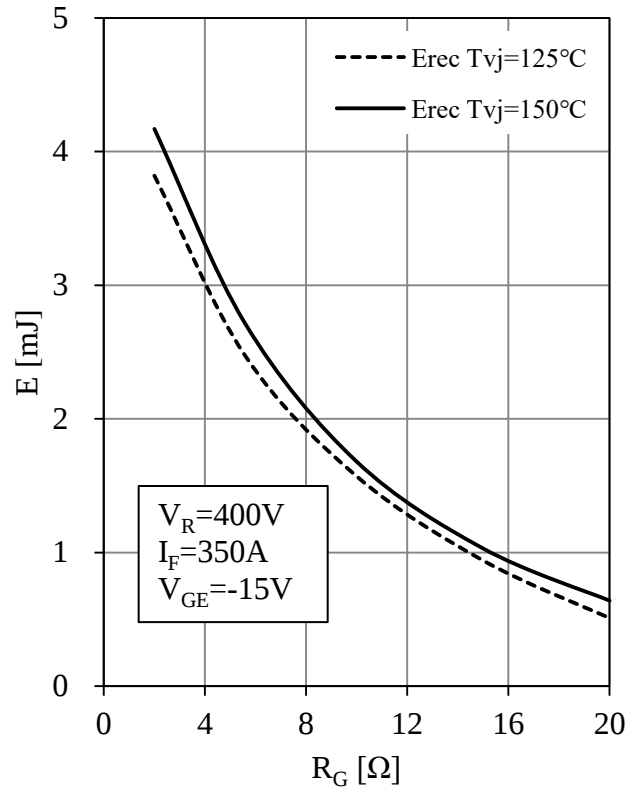
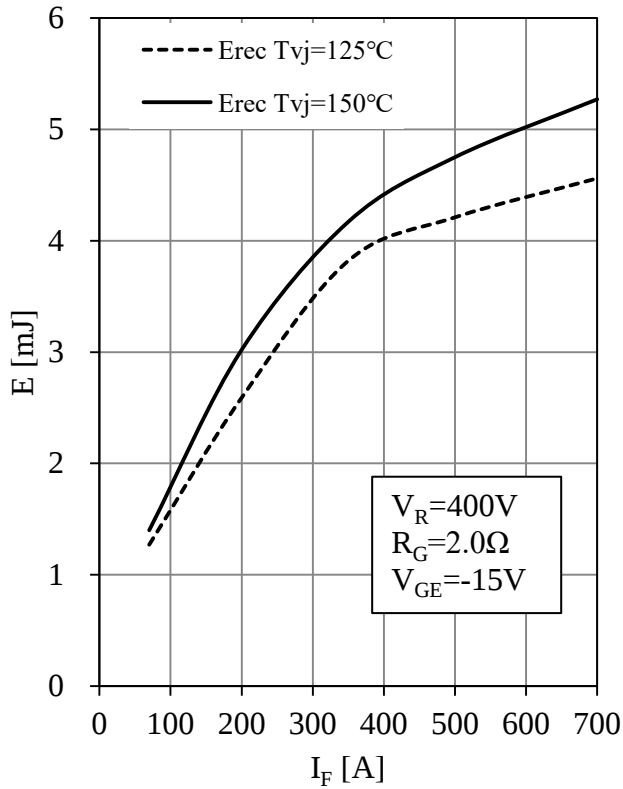
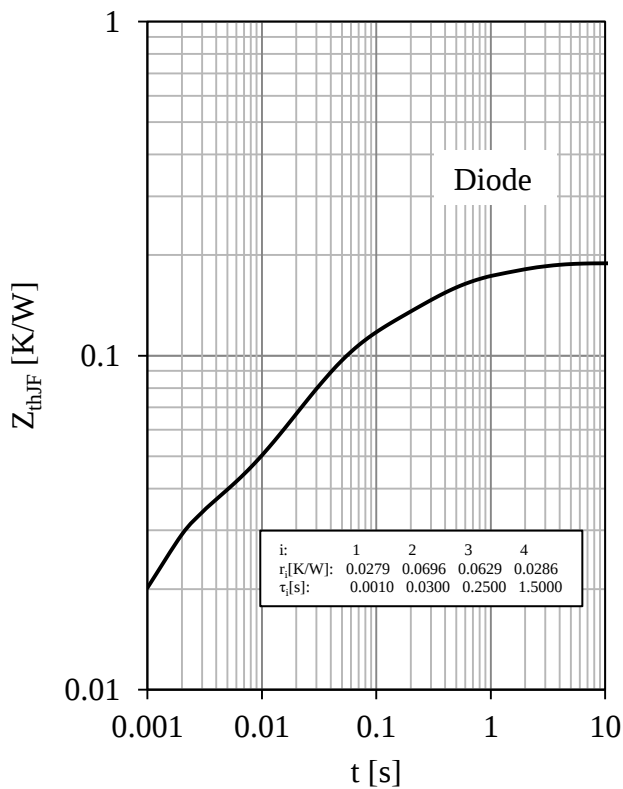
Fig 9. Diode Switching Loss vs. I_F Fig 10. Diode Switching Loss vs. R_G 

Fig 11. Diode Transient Thermal Impedance

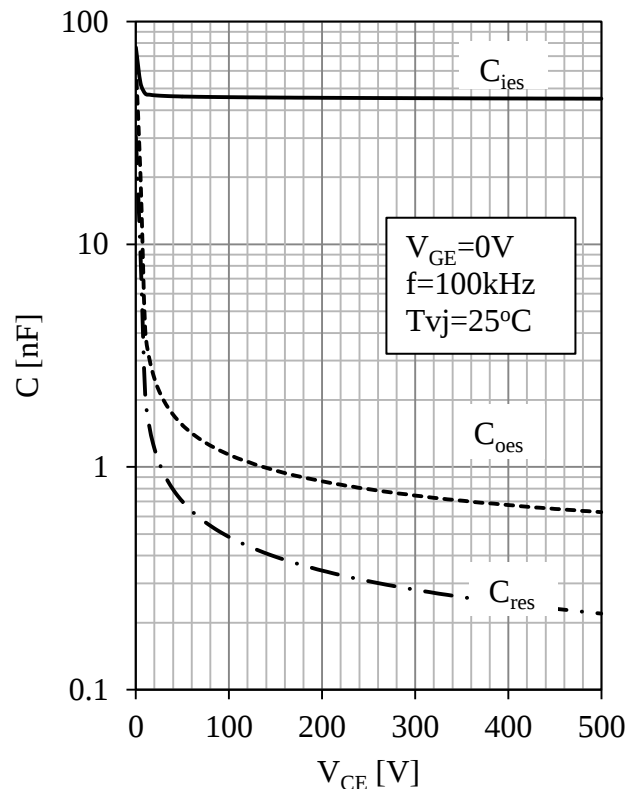


Fig 12. IGBT Capacity Characteristic

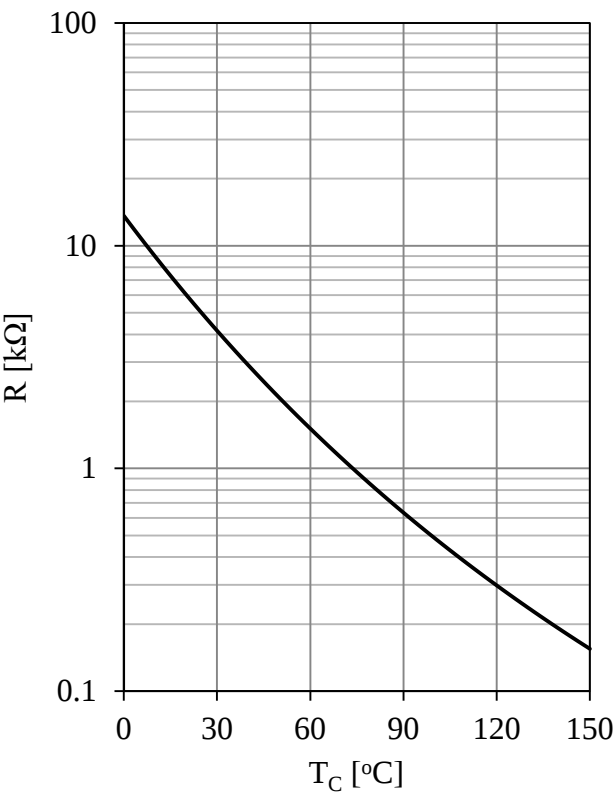


Fig 13.NTC Temperature Characteristic

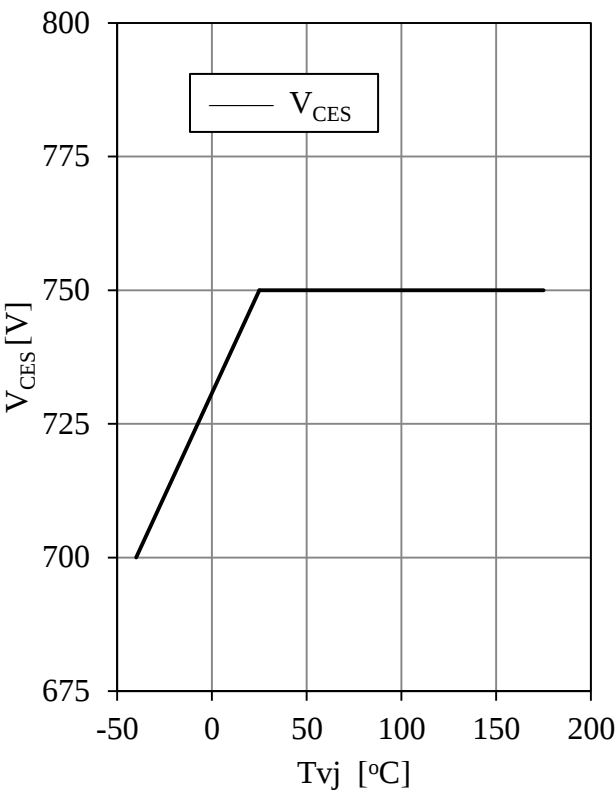
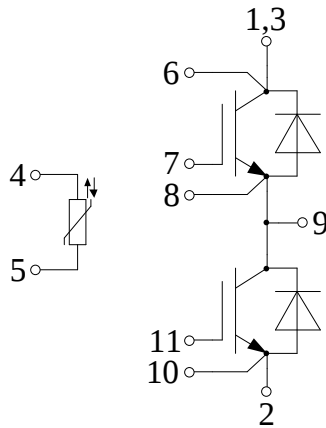


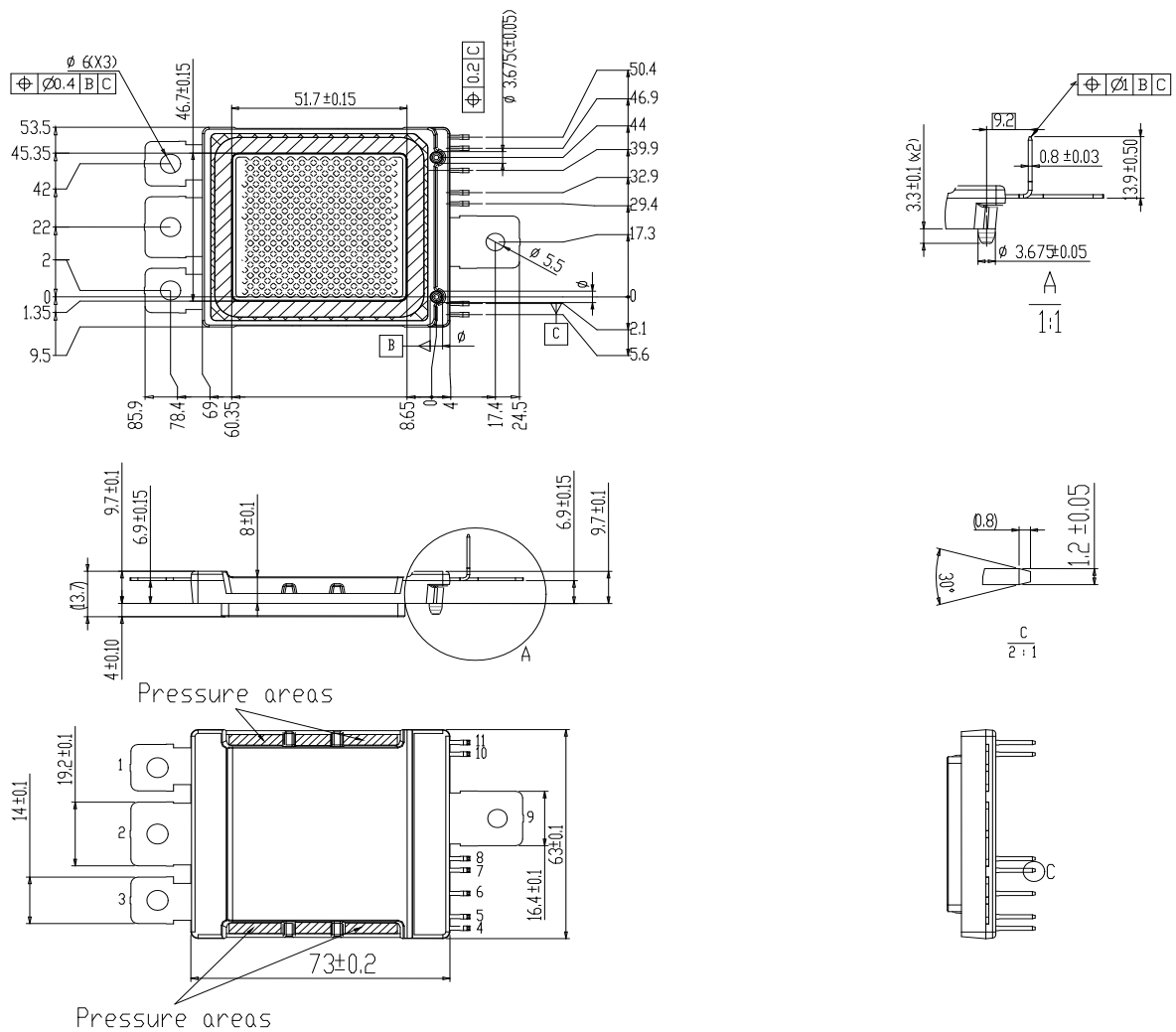
Fig 14. Maximum Allowed Collector-Emitter Voltage

Circuit Schematic



Package Dimensions

Dimensions in Millimeters



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