

STARPOWER

SEMICONDUCTOR

IGBT

GD600HTX75P6HL

750V/600A 6 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.

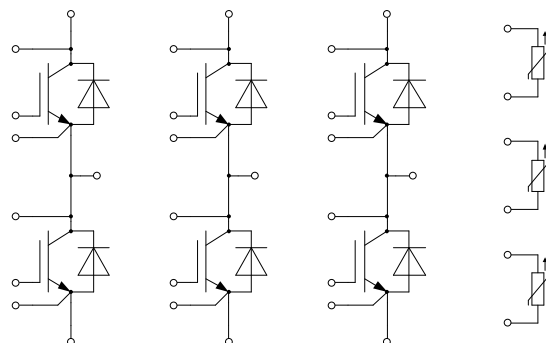
Features

- 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 DBC technology

Typical Applications

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

Equivalent Circuit Schematic



Absolute Maximum Ratings $T_F=25^{\circ}\text{C}$ 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	600	A
I_C	Collector Current @ $T_F=65^{\circ}\text{C}$	400	A
I_{CM}	Pulsed Collector Current $t_p=1\text{ms}$	1200	A
P_D	Maximum Power Dissipation @ $T_F=75^{\circ}\text{C}$ $T_j=175^{\circ}\text{C}$	719	W

Diode

Symbol	Description	Values	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	750	V
I_{FN}	Implemented Collector Current	600	A
I_F	Diode Continuous Forward Current	400	A
I_{FM}	Diode Maximum Forward Current $t_p=1\text{ms}$	1200	A

Module

Symbol	Description	Value	Unit
T_{jmax}	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

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	$I_C=450\text{A}, V_{GE}=15\text{V}, T_j=25^{\circ}\text{C}$		1.40	1.65	V
		$I_C=450\text{A}, V_{GE}=15\text{V}, T_j=150^{\circ}\text{C}$		1.70		
		$I_C=450\text{A}, V_{GE}=15\text{V}, T_j=175^{\circ}\text{C}$		1.75		
		$I_C=600\text{A}, V_{GE}=15\text{V}, T_j=25^{\circ}\text{C}$		1.55		
		$I_C=600\text{A}, V_{GE}=15\text{V}, T_j=175^{\circ}\text{C}$		2.00		
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=12.0\text{mA}, V_{CE}=V_{GE}, T_j=25^{\circ}\text{C}$	4.9	5.9	6.9	V
		$I_C=12.0\text{mA}, V_{CE}=V_{GE}, T_j=175^{\circ}\text{C}$		3.8		
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			0.7		Ω
C_{ies}	Input Capacitance	$V_{CE}=50\text{V}, f=100\text{kHz}, V_{GE}=0\text{V}$		65.4		nF
C_{oes}	Output Capacitance			6.27		nF
C_{res}	Reverse Transfer Capacitance			1.02		nF
Q_G	Gate Charge	$V_{CE}=400\text{V}, I_C=600\text{A}, V_{GE}=-8\dots+15\text{V}$		4.08		μC
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=400\text{V}, I_C=450\text{A}, R_G=2\Omega, V_{GE}=-8\text{V}/+15\text{V}, T_j=25^{\circ}\text{C}$		119		ns
t_r	Rise Time			77		ns
$t_{d(off)}$	Turn-Off Delay Time			467		ns
t_f	Fall Time			70		ns
E_{on}	Turn-On Switching Loss			18.1		mJ
E_{off}	Turn-Off Switching Loss			19.8		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=400\text{V}, I_C=450\text{A}, R_G=2\Omega, V_{GE}=-8\text{V}/+15\text{V}, T_j=150^{\circ}\text{C}$		122		ns
t_r	Rise Time			84		ns
$t_{d(off)}$	Turn-Off Delay Time			536		ns
t_f	Fall Time			77		ns
E_{on}	Turn-On Switching Loss			25.2		mJ
E_{off}	Turn-Off Switching Loss			26.5		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=400\text{V}, I_C=450\text{A}, R_G=2\Omega, V_{GE}=-8\text{V}/+15\text{V}, T_j=175^{\circ}\text{C}$		125		ns
t_r	Rise Time			84		ns
$t_{d(off)}$	Turn-Off Delay Time			548		ns
t_f	Fall Time			79		ns
E_{on}	Turn-On Switching Loss			27.8		mJ
E_{off}	Turn-Off Switching Loss			27.8		mJ
I_{SC}	SC Data	$t_p \leq 6\mu\text{s}, V_{GE}=15\text{V}$		4300		A

		$T_j=25^{\circ}\text{C}, V_{CC}=400\text{V},$ $V_{CEM}\leq 750\text{V}$				
		$t_p\leq 3\mu\text{s}, V_{GE}=15\text{V},$ $T_j=175^{\circ}\text{C}, V_{CC}=400\text{V},$ $V_{CEM}\leq 750\text{V}$		3400		

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_F	Diode Forward Voltage	$I_F=450\text{A}, V_{GE}=0\text{V}, T_j=25^{\circ}\text{C}$		1.40	1.65	V
		$I_F=450\text{A}, V_{GE}=0\text{V}, T_j=150^{\circ}\text{C}$		1.35		
		$I_F=450\text{A}, V_{GE}=0\text{V}, T_j=175^{\circ}\text{C}$		1.30		
		$I_F=600\text{A}, V_{GE}=0\text{V}, T_j=25^{\circ}\text{C}$		1.55		
		$I_F=600\text{A}, V_{GE}=0\text{V}, T_j=175^{\circ}\text{C}$		1.45		
Q_r	Recovered Charge	$V_R=400\text{V}, I_F=450\text{A},$ $-di/dt=5040\text{A}/\mu\text{s}, V_{GE}=-8\text{V}$ $T_j=25^{\circ}\text{C}$		14.0		μC
I_{RM}	Peak Reverse Recovery Current			192		A
E_{rec}	Reverse Recovery Energy			4.98		mJ
Q_r	Recovered Charge	$V_R=400\text{V}, I_F=450\text{A},$ $-di/dt=4690\text{A}/\mu\text{s}, V_{GE}=-8\text{V}$ $T_j=150^{\circ}\text{C}$		31.2		μC
I_{RM}	Peak Reverse Recovery Current			264		A
E_{rec}	Reverse Recovery Energy			10.2		mJ
Q_r	Recovered Charge	$V_R=400\text{V}, I_F=450\text{A},$ $-di/dt=4560\text{A}/\mu\text{s}, V_{GE}=-8\text{V}$ $T_j=175^{\circ}\text{C}$		35.7		μC
I_{RM}	Peak Reverse Recovery Current			276		A
E_{rec}	Reverse Recovery Energy			11.6		mJ

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

Symbol	Parameter	Min.	Typ.	Max.	Unit
L_{CE}	Stray Inductance		8		nH
$R_{CC'+EE'}$	Module Lead Resistance, Terminal to Chip		0.75		m Ω
Δp	$\Delta V/\Delta t=10.0\text{dm}^3/\text{min}, T_F=75^{\circ}\text{C}$		64		mbar
p	Maximum Pressure In Cooling Circuit $T_{\text{baseplate}} < 40^{\circ}\text{C}$ $T_{\text{baseplate}} > 40^{\circ}\text{C}$ (relative pressure)			2.5 2.0	bar
R_{thJF}	Junction-to-Cooling Fluid (per IGBT) Junction-to-Cooling Fluid (per Diode) $\Delta V/\Delta t=10.0\text{dm}^3/\text{min}, T_F=75^{\circ}\text{C}$			0.139 0.195	K/W
M	Terminal Connection Torque, Screw M5 Mounting Torque, Screw M4	3.6 1.8		4.4 2.2	N.m
G	Weight of Module		750		g

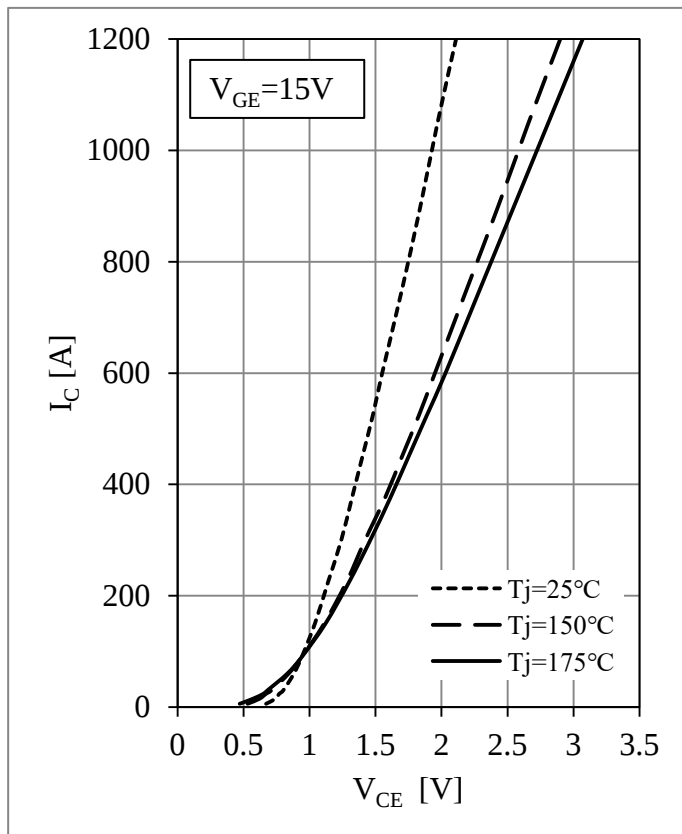


Fig 1. IGBT Output Characteristics

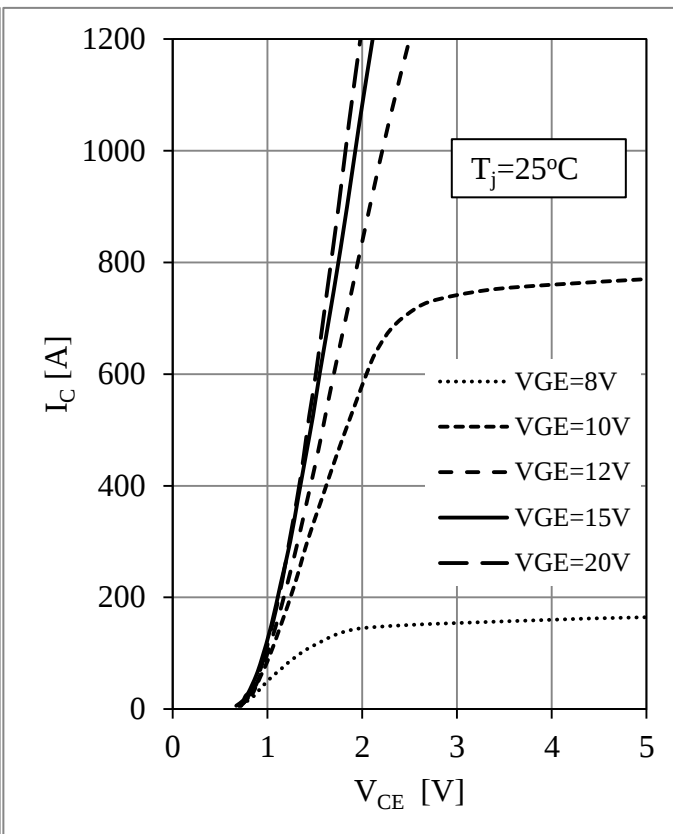


Fig 2. IGBT Output Characteristics

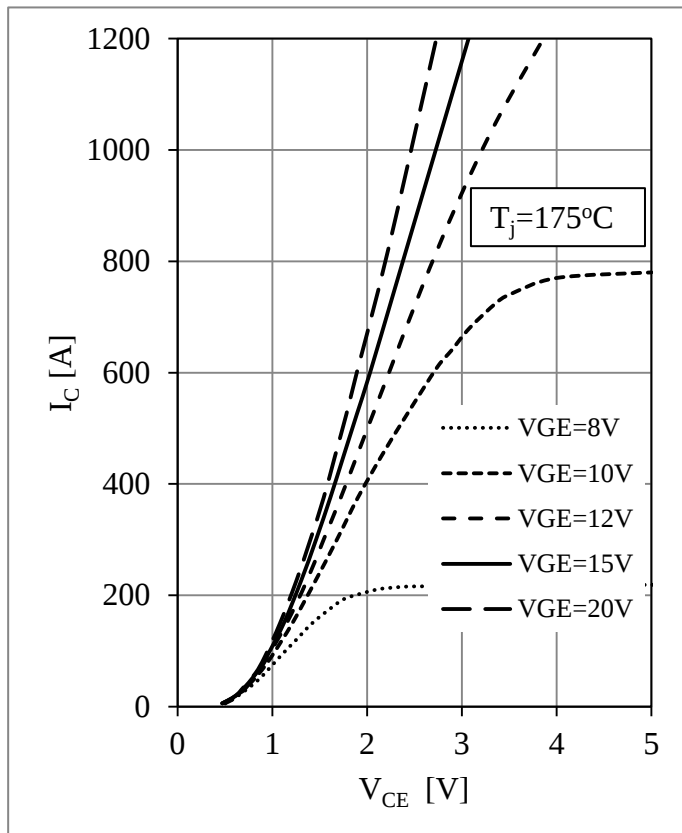


Fig 3. IGBT Output Characteristics

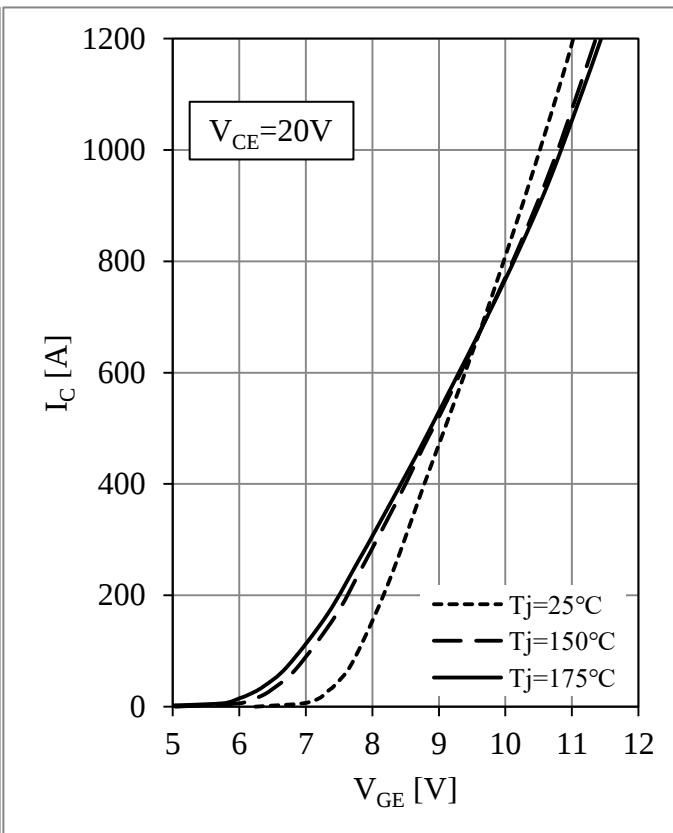


Fig 4. IGBT Transfer Characteristics

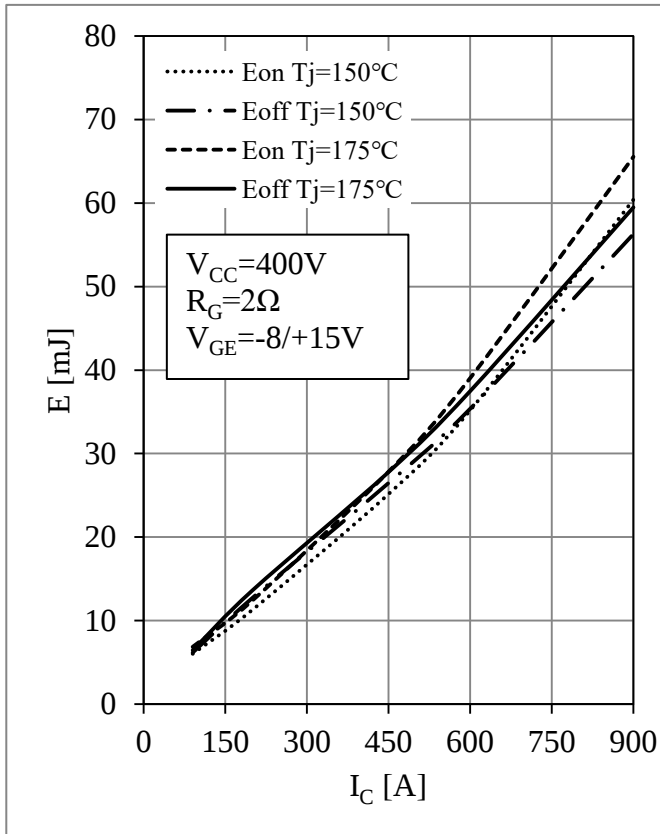
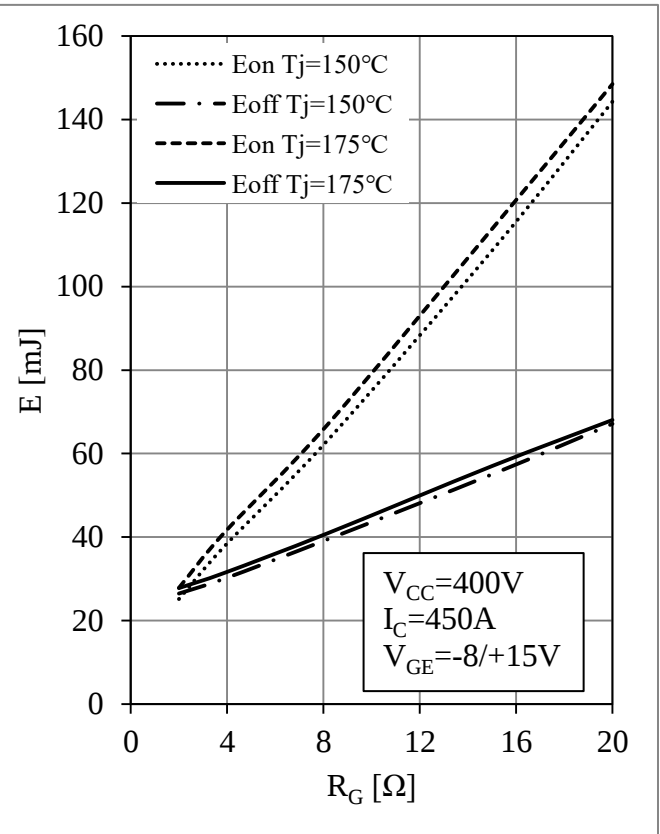
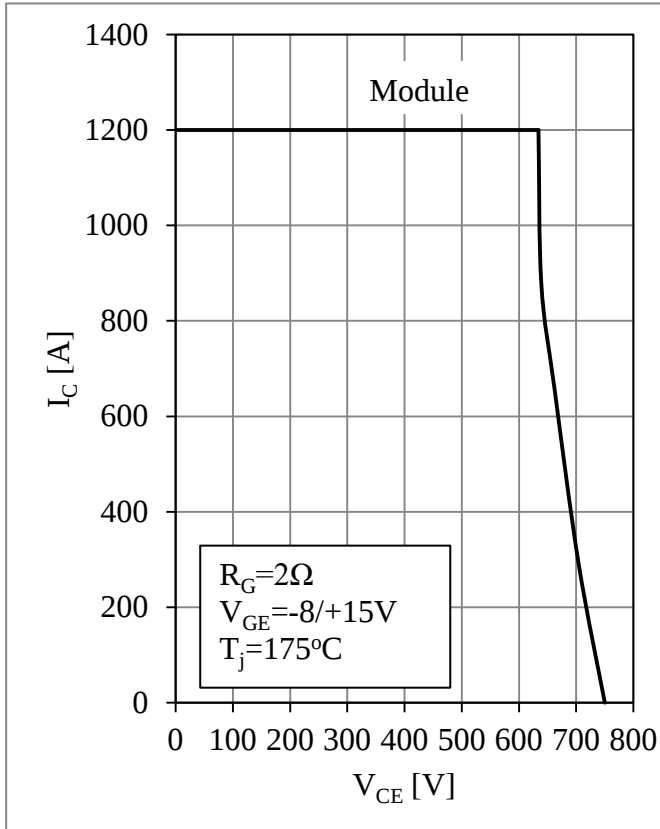
Fig 5. IGBT Switching Loss vs. I_C Fig 6. IGBT Switching Loss vs. R_G 

Fig 7. RBSOA

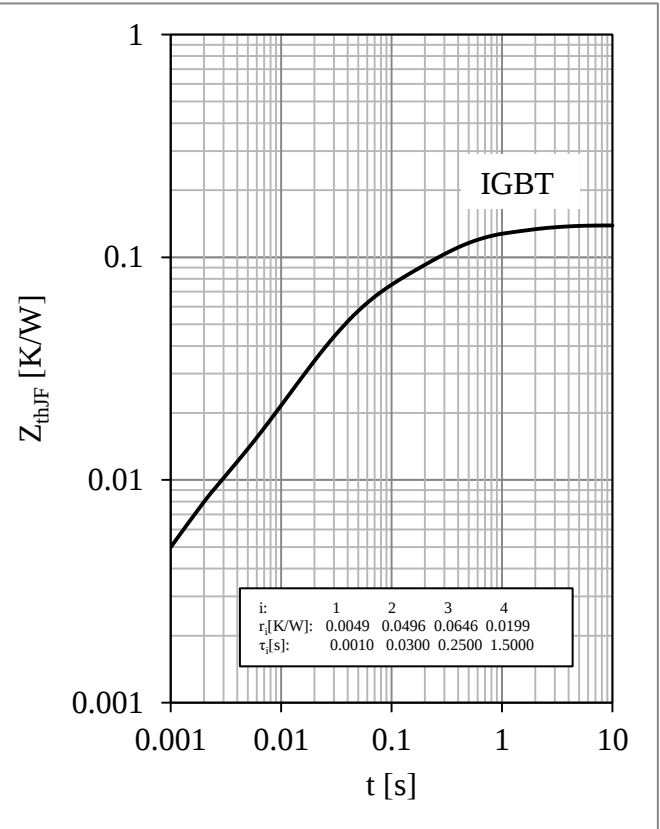


Fig 8. IGBT Transient Thermal Impedance

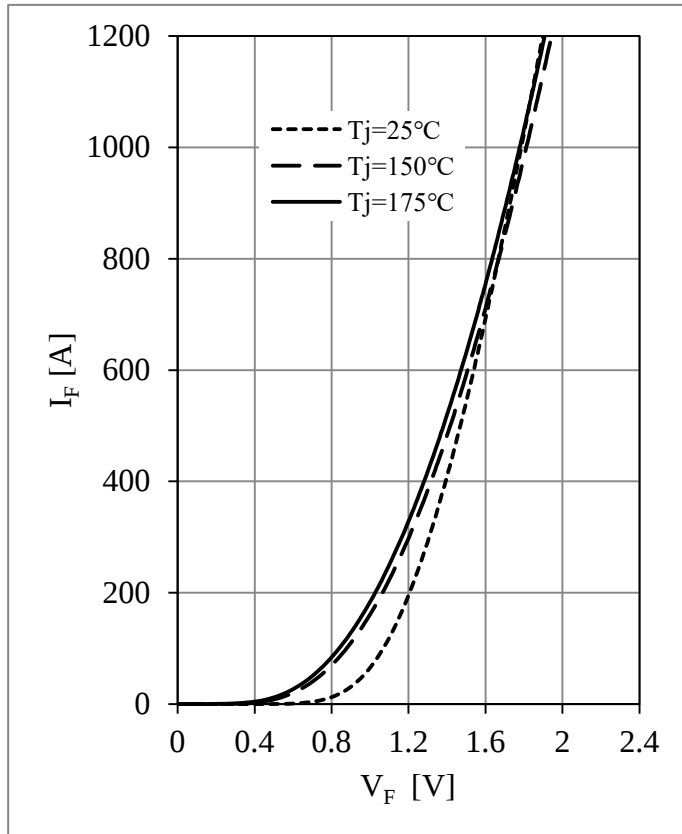


Fig 9. Diode Forward Characteristics

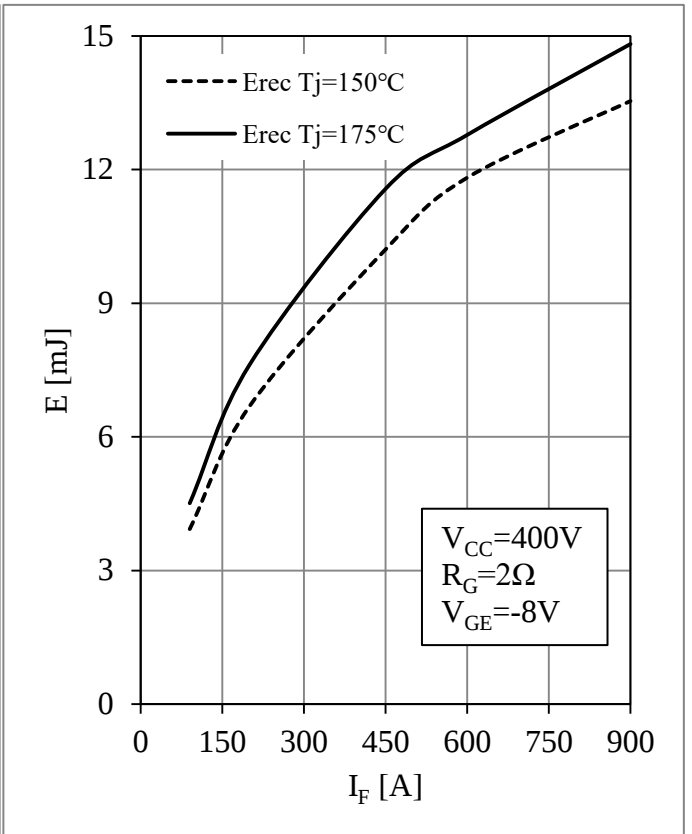
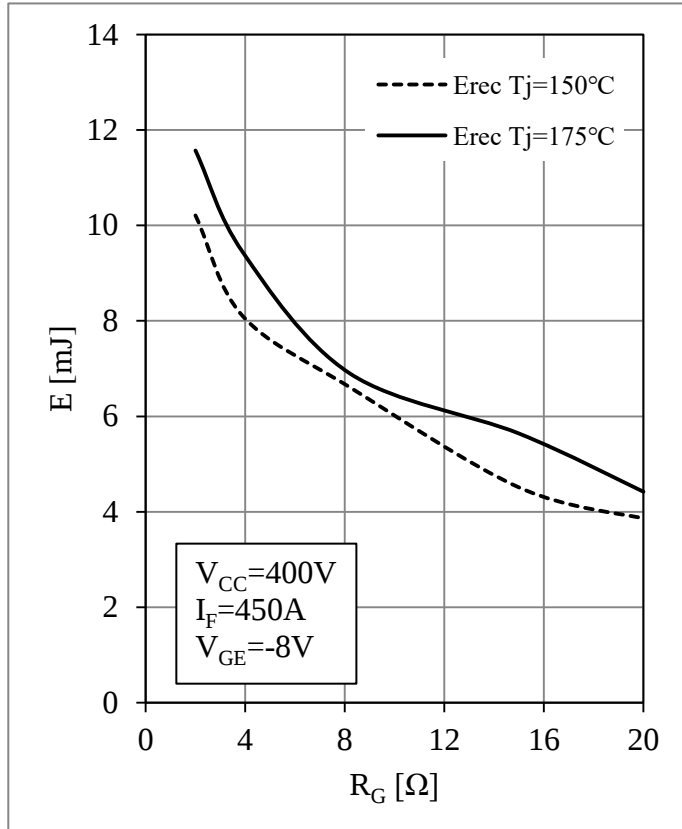
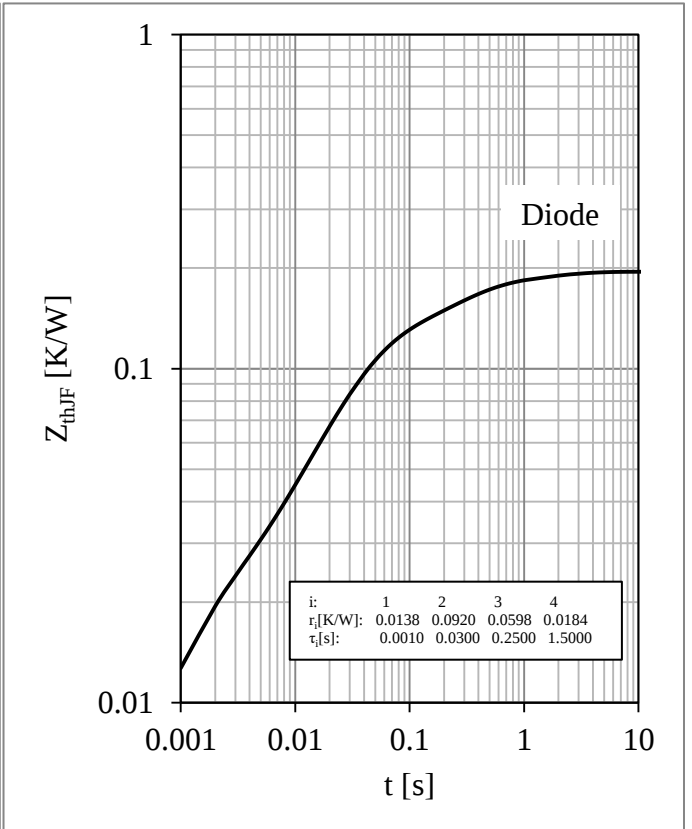
Fig 10. Diode Switching Loss vs. I_F Fig 11. Diode Switching Loss vs. R_G 

Fig 12. Diode Transient Thermal Impedance

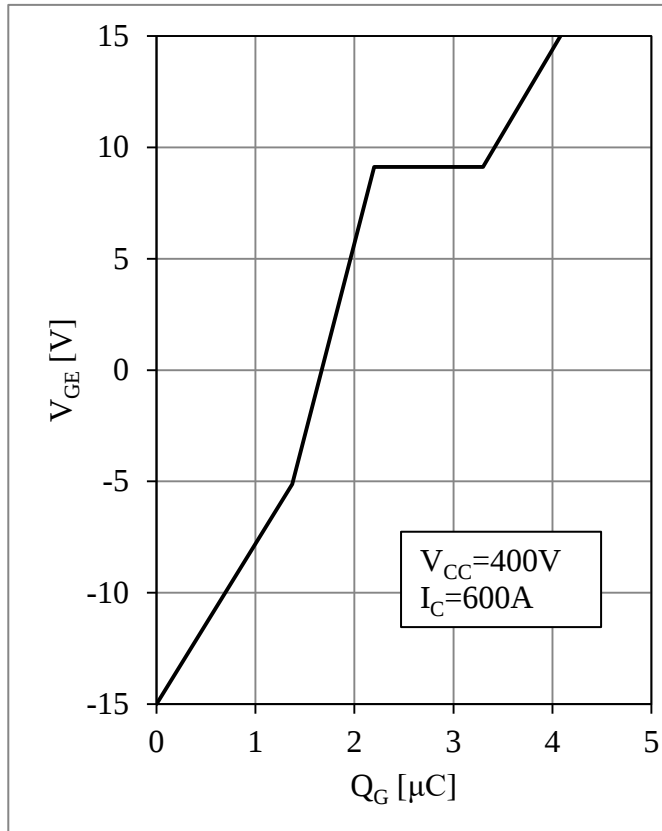


Fig 13. IGBT Gate Charge Characteristic

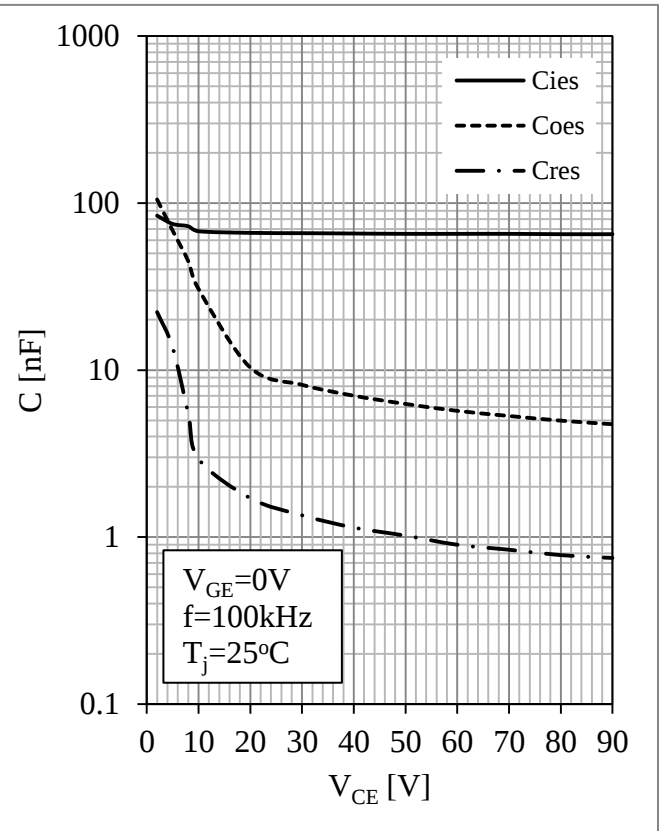


Fig 14. IGBT Capacity Characteristic

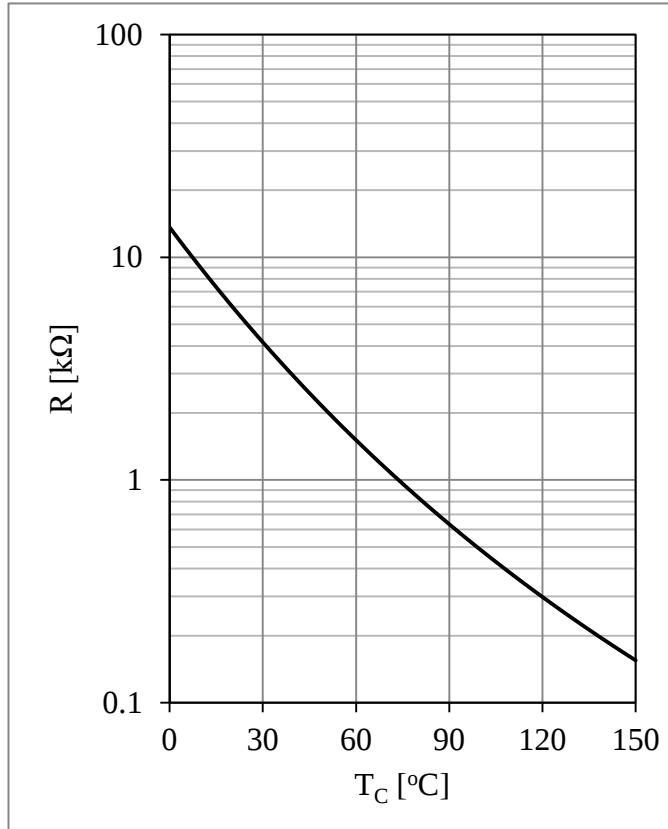


Fig 15. NTC Temperature Characteristic

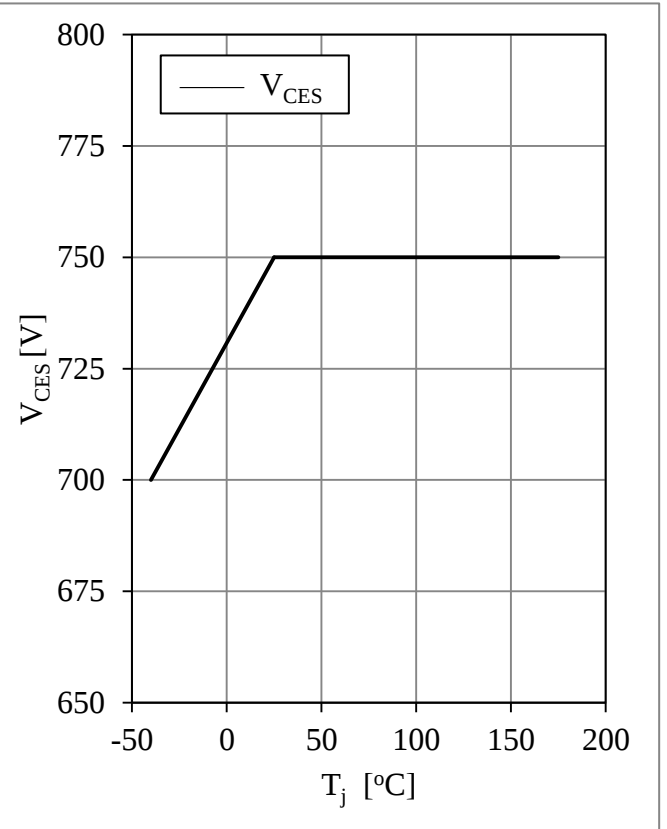
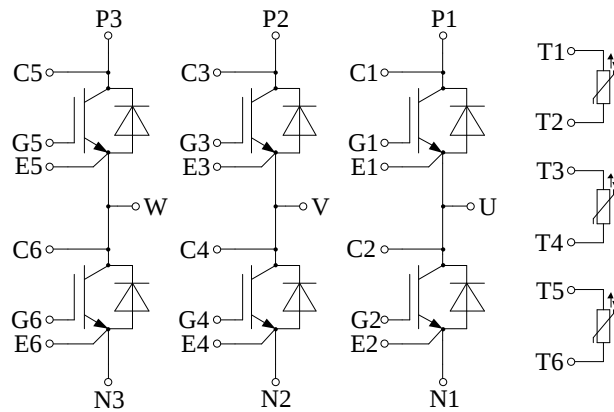


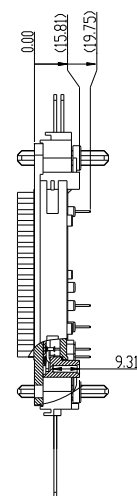
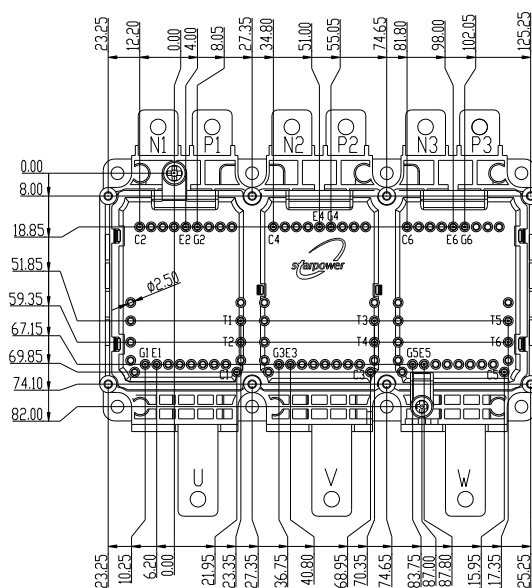
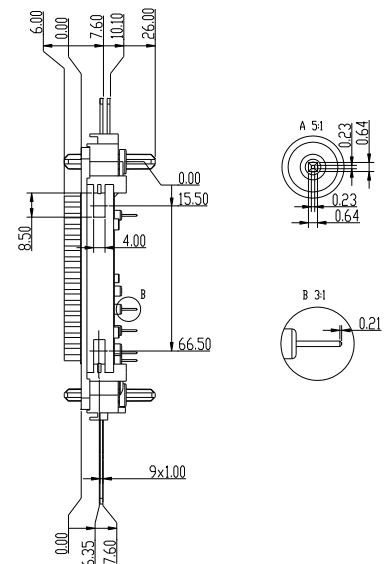
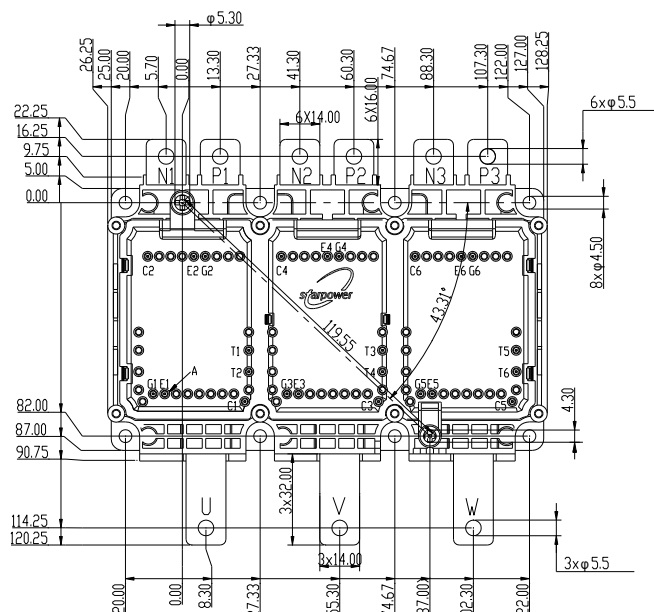
Fig 16. Maximum Allowed Collector-Emitter Voltage

Circuit Schematic



Package Dimensions

Dimensions in Millimeters



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