

# STARPOWER

SEMICONDUCTOR

**IGBT**

## GD950HTA75P6HFT

**750V/950A 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.

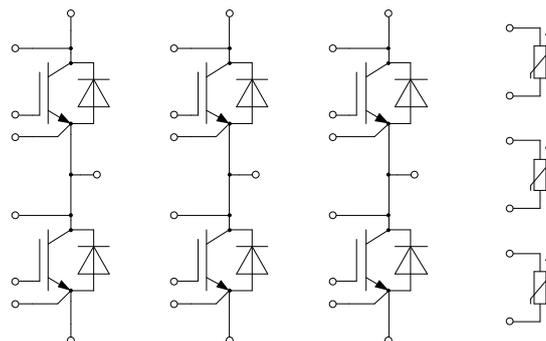
### Features

- Low  $V_{CE(sat)}$  Trench IGBT technology
- Low switching losses
- 6 $\mu$ 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 Si<sub>3</sub>N<sub>4</sub> AMB 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	$\pm 20$	V
$I_{CN}$	Implemented Collector Current	950	A
$I_C$	Collector Current @ $T_F=120^{\circ}\text{C}$	450	A
$I_{CM}$	Pulsed Collector Current $t_p=1\text{ms}$	1900	A
$P_D$	Maximum Power Dissipation @ $T_F=75^{\circ}\text{C}$ $T_j=175^{\circ}\text{C}$	1162	W

**Diode**

Symbol	Description	Values	Unit
$V_{RRM}$	Repetitive Peak Reverse Voltage	750	V
$I_{FN}$	Implemented Collector Current	950	A
$I_F$	Diode Continuous Forward Current	450	A
$I_{FM}$	Diode Maximum Forward Current $t_p=1\text{ms}$	1900	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	$I_C=450\text{A}, V_{GE}=15\text{V}, T_j=25^\circ\text{C}$		1.10	1.35	V
		$I_C=450\text{A}, V_{GE}=15\text{V}, T_j=150^\circ\text{C}$		1.15		
		$I_C=450\text{A}, V_{GE}=15\text{V}, T_j=175^\circ\text{C}$		1.15		
		$I_C=950\text{A}, V_{GE}=15\text{V}, T_j=25^\circ\text{C}$		1.40		
		$I_C=950\text{A}, V_{GE}=15\text{V}, T_j=175^\circ\text{C}$		1.65		
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=12.9\text{mA}, V_{CE}=V_{GE}, T_j=25^\circ\text{C}$	5.5	6.5	7.0	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			1.0		$\Omega$
$C_{ies}$	Input Capacitance			72.3		nF
$C_{oes}$	Output Capacitance	$V_{CE}=50\text{V}, f=100\text{kHz}, V_{GE}=0\text{V}$		1.51		nF
$C_{res}$	Reverse Transfer Capacitance	$V_{GE}=0\text{V}$		0.32		nF
$Q_G$	Gate Charge	$V_{CE}=400\text{V}, I_C=450\text{A}, V_{GE}=-15\dots+15\text{V}$		4.77		$\mu\text{C}$
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=400\text{V}, I_C=450\text{A}, R_G=2.4\Omega, V_{GE}=-8\text{V}/+15\text{V}, L_S=24\text{nH}, T_j=25^\circ\text{C}$		315		ns
$t_r$	Rise Time			61		ns
$t_{d(off)}$	Turn-Off Delay Time			729		ns
$t_f$	Fall Time			70		ns
$E_{on}$	Turn-On Switching Loss				12.4	
$E_{off}$	Turn-Off Switching Loss			18.3		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=400\text{V}, I_C=450\text{A}, R_G=2.4\Omega, V_{GE}=-8\text{V}/+15\text{V}, L_S=24\text{nH}, T_j=150^\circ\text{C}$		338		ns
$t_r$	Rise Time			74		ns
$t_{d(off)}$	Turn-Off Delay Time			826		ns
$t_f$	Fall Time			151		ns
$E_{on}$	Turn-On Switching Loss				20.7	
$E_{off}$	Turn-Off Switching Loss			25.3		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=400\text{V}, I_C=450\text{A}, R_G=2.4\Omega, V_{GE}=-8\text{V}/+15\text{V}, L_S=24\text{nH}, T_j=175^\circ\text{C}$		343		ns
$t_r$	Rise Time			77		ns
$t_{d(off)}$	Turn-Off Delay Time			846		ns
$t_f$	Fall Time			171		ns
$E_{on}$	Turn-On Switching Loss				25.0	
$E_{off}$	Turn-Off Switching Loss			27.3		mJ
$I_{SC}$	SC Data	$t_p \leq 6\mu\text{s}, V_{GE}=15\text{V}, T_j=25^\circ\text{C}, V_{CC}=400\text{V}, V_{CEM} \leq 750\text{V}$		4500		A

		$t_p \leq 3\mu s, V_{GE}=15V,$ $T_j=175^\circ C, V_{CC}=400V,$ $V_{CEM} \leq 750V$		3300		
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### Diode Characteristics $T_F=25^\circ C$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_F$	Diode Forward Voltage	$I_F=450A, V_{GE}=0V, T_j=25^\circ C$		1.40	1.65	V
		$I_F=450A, V_{GE}=0V, T_j=150^\circ C$		1.35		
		$I_F=450A, V_{GE}=0V, T_j=175^\circ C$		1.30		
		$I_F=950A, V_{GE}=0V, T_j=25^\circ C$		1.75		
		$I_F=950A, V_{GE}=0V, T_j=175^\circ C$		1.75		
$Q_r$	Recovered Charge			10.1		$\mu C$
$I_{RM}$	Peak Reverse Recovery Current	$V_R=400V, I_F=450A,$ $-di/dt=7760A/\mu s, V_{GE}=-8V$		287		A
$E_{rec}$	Reverse Recovery Energy	$L_S=24nH, T_j=25^\circ C$		4.83		mJ
$Q_r$	Recovered Charge			25.6		$\mu C$
$I_{RM}$	Peak Reverse Recovery Current	$V_R=400V, I_F=450A,$ $-di/dt=6300A/\mu s, V_{GE}=-8V$		341		A
$E_{rec}$	Reverse Recovery Energy	$L_S=24nH, T_j=150^\circ C$		9.32		mJ
$Q_r$	Recovered Charge			30.4		$\mu C$
$I_{RM}$	Peak Reverse Recovery Current	$V_R=400V, I_F=450A,$ $-di/dt=5990A/\mu s, V_{GE}=-8V$		354		A
$E_{rec}$	Reverse Recovery Energy	$L_S=24nH, T_j=175^\circ C$		10.6		mJ

### NTC Characteristics $T_F=25^\circ C$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$R_{25}$	Rated Resistance			5.0		k $\Omega$
$\Delta R/R$	Deviation of $R_{100}$	$T_C=100^\circ C, R_{100}=493.3\Omega$	-5		5	%
$P_{25}$	Power Dissipation				20.0	mW
$B_{25/50}$	B-value	$R_2=R_{25}\exp[B_{25/50}(1/T_2-1/(298.15K))]$		3375		K
$B_{25/80}$	B-value	$R_2=R_{25}\exp[B_{25/80}(1/T_2-1/(298.15K))]$		3411		K
$B_{25/100}$	B-value	$R_2=R_{25}\exp[B_{25/100}(1/T_2-1/(298.15K))]$		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 $\Omega$
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) $\Delta V/\Delta t=10.0\text{dm}^3/\text{min}, T_F=75^{\circ}\text{C}$		0.075 0.118	0.086 0.136	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

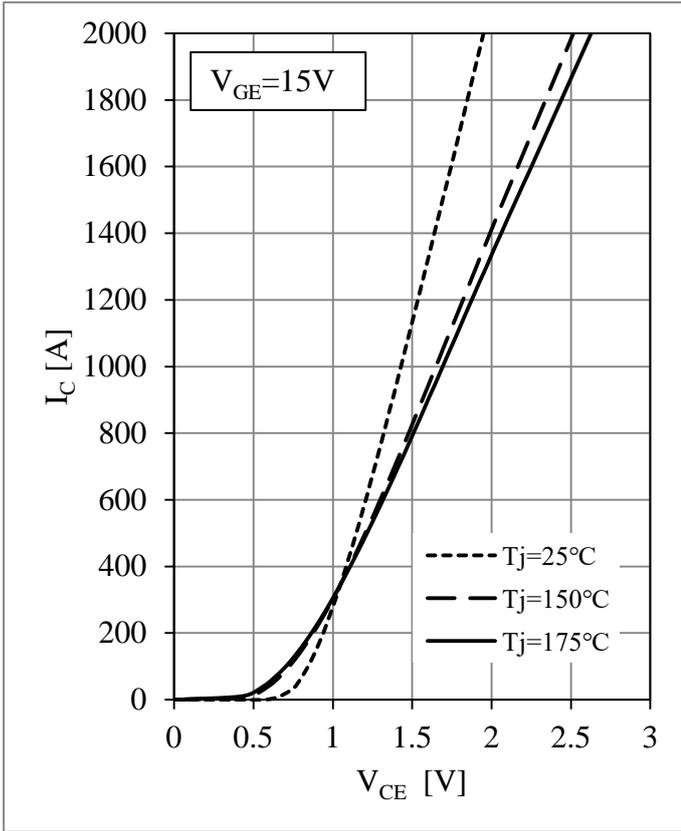


Fig 1. IGBT Output Characteristics

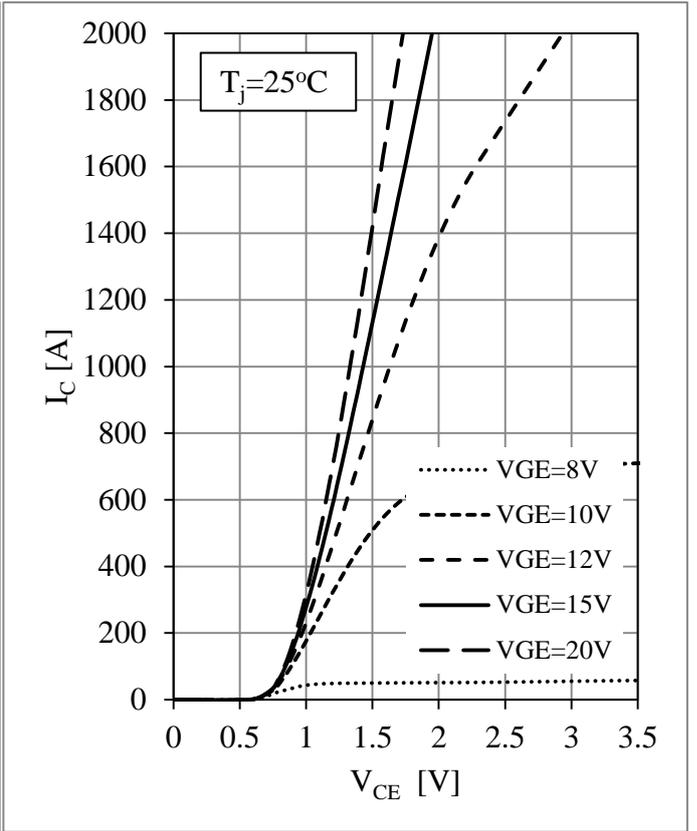


Fig 2. IGBT Output Characteristics

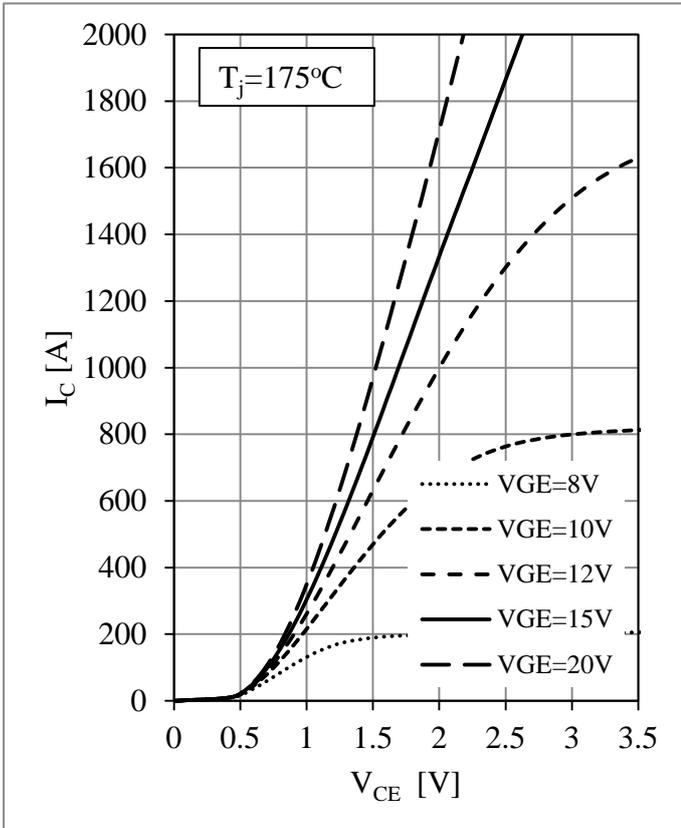


Fig 3. IGBT Output Characteristics

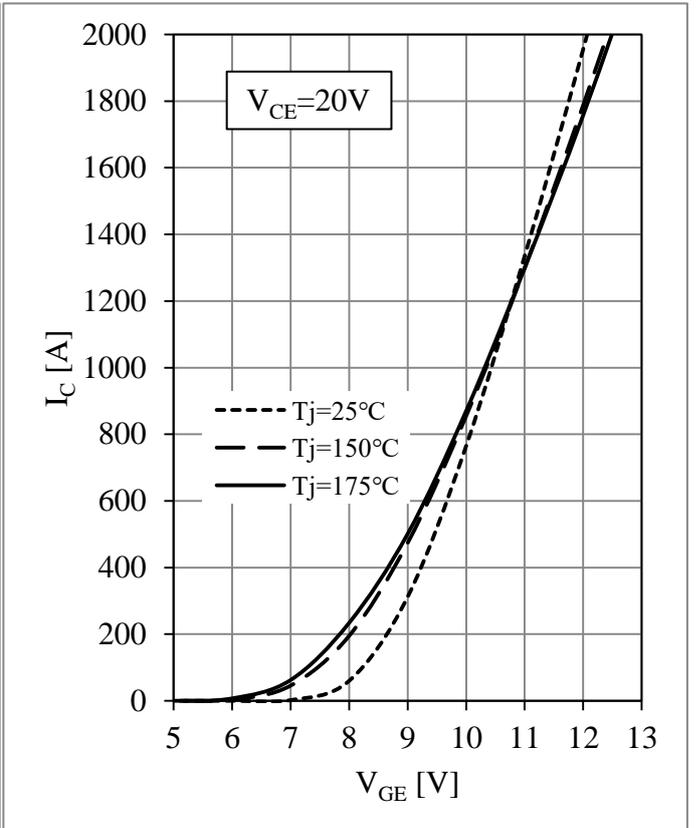


Fig 4. IGBT Transfer Characteristics

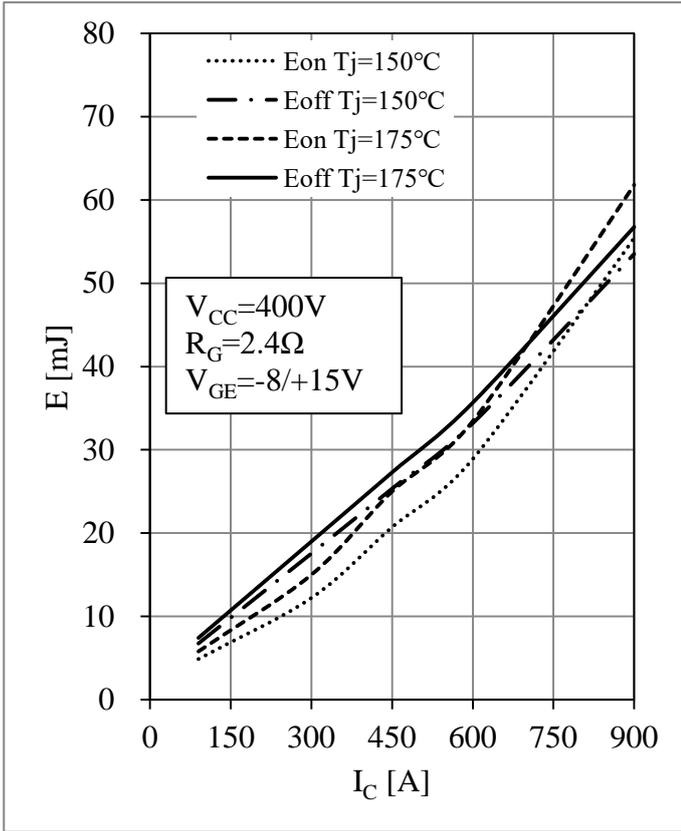


Fig 5. IGBT Switching Loss vs.  $I_C$

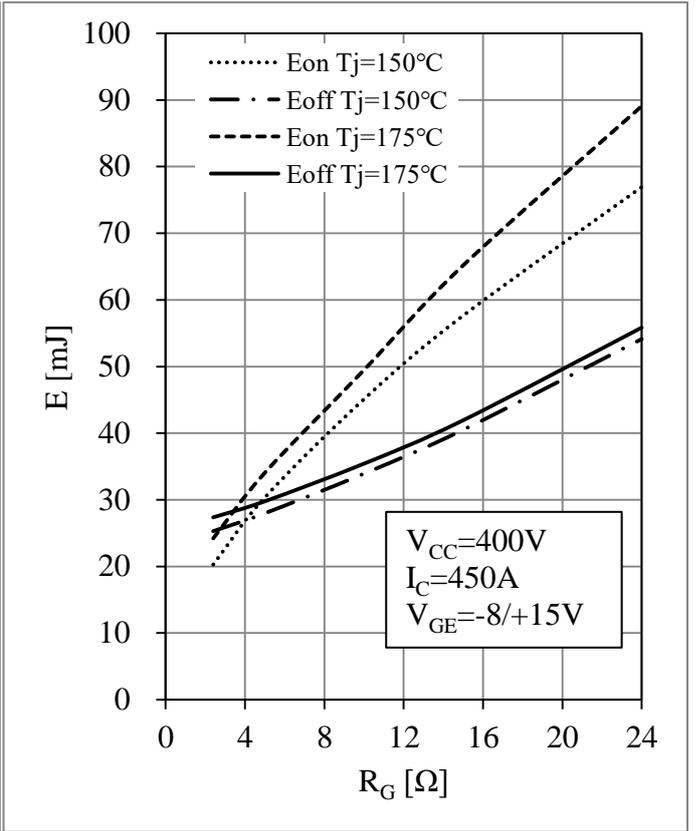


Fig 6. IGBT Switching Loss vs.  $R_G$

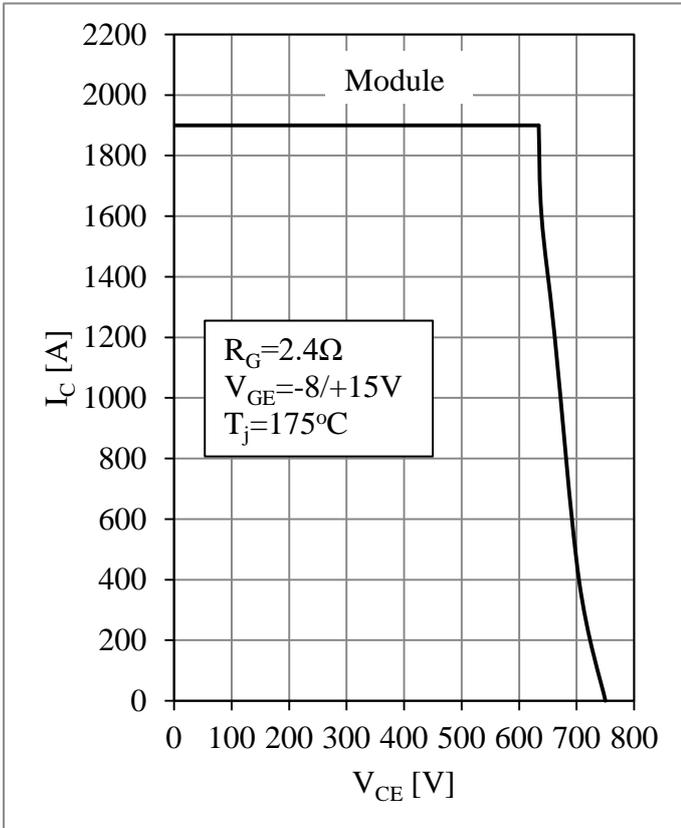


Fig 7. RBSOA

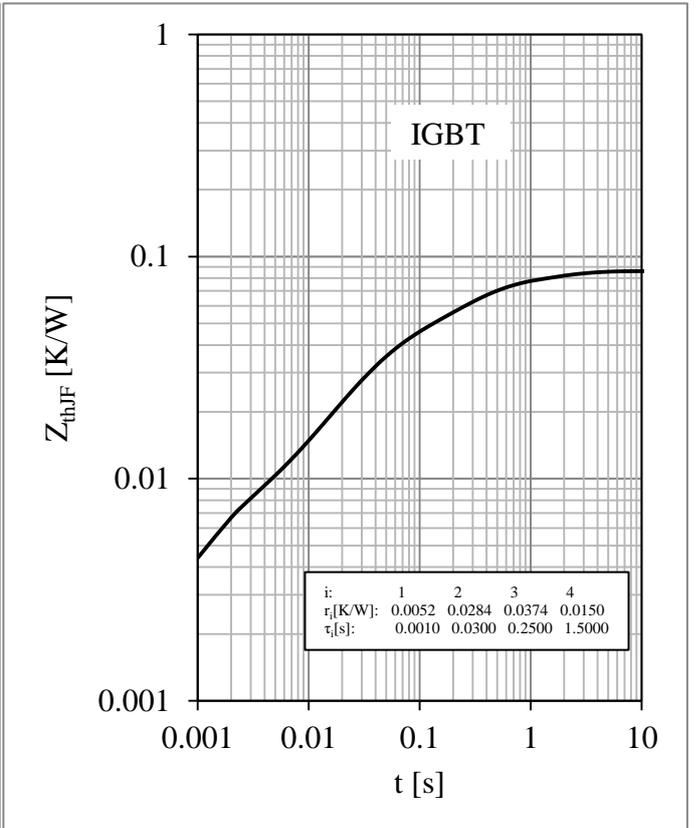


Fig 8. IGBT Transient Thermal Impedance

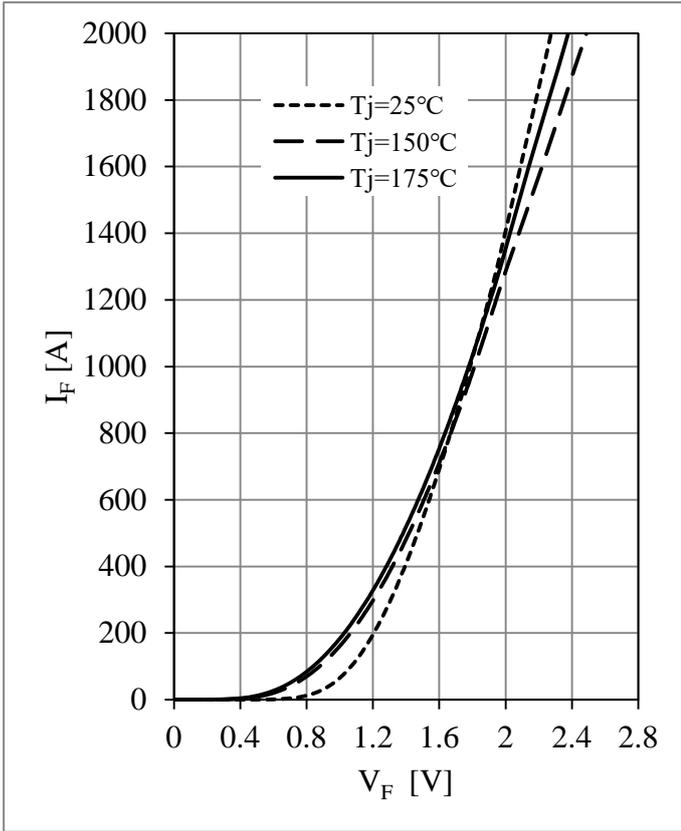


Fig 9. Diode Forward Characteristics

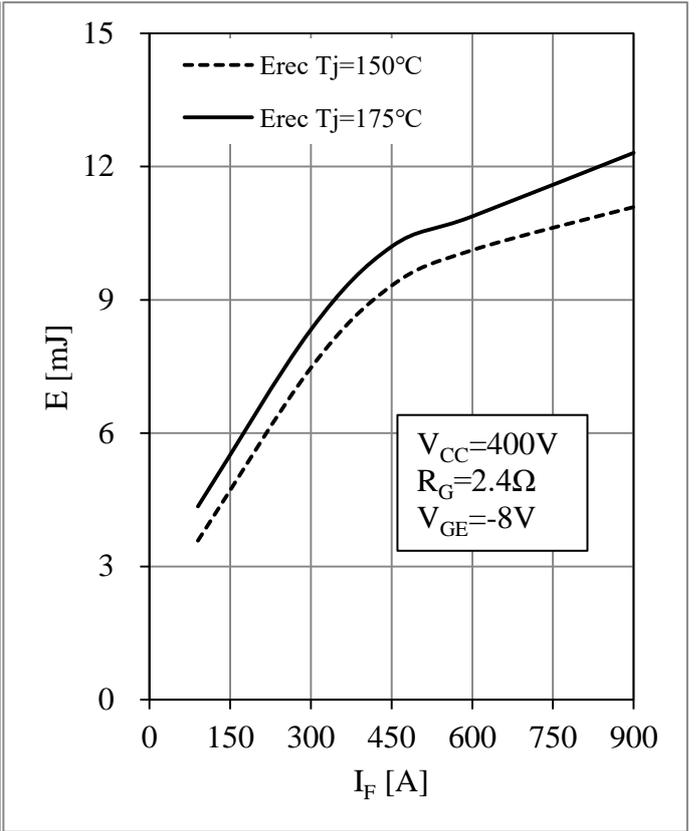


Fig 10. Diode Switching Loss vs.  $I_F$

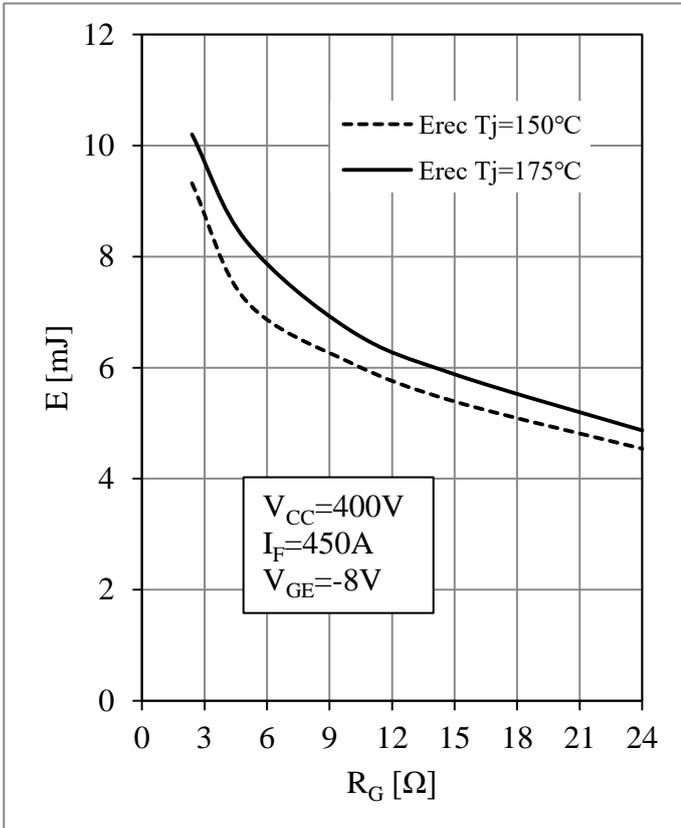


Fig 11. Diode Switching Loss vs.  $R_G$

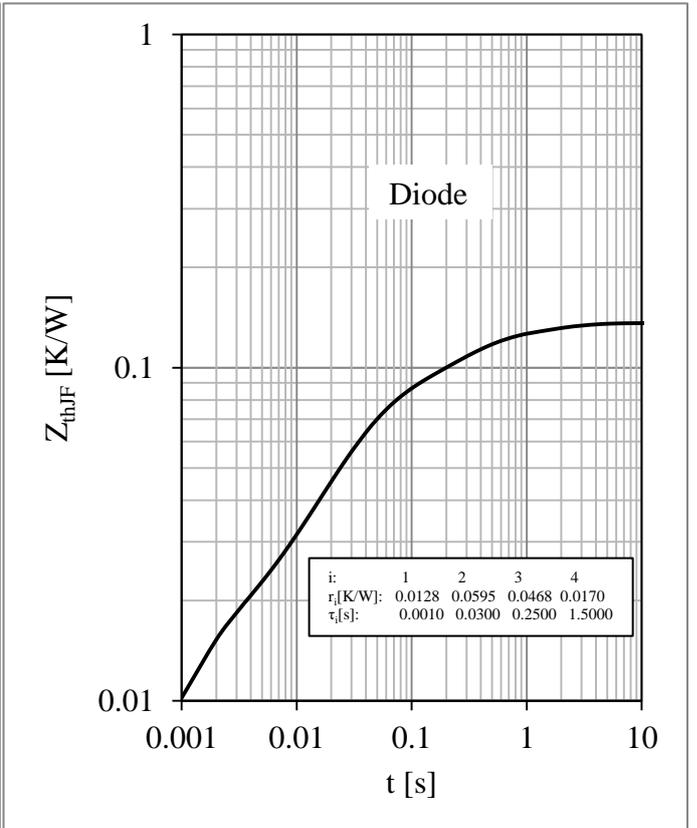


Fig 12. Diode Transient Thermal Impedance

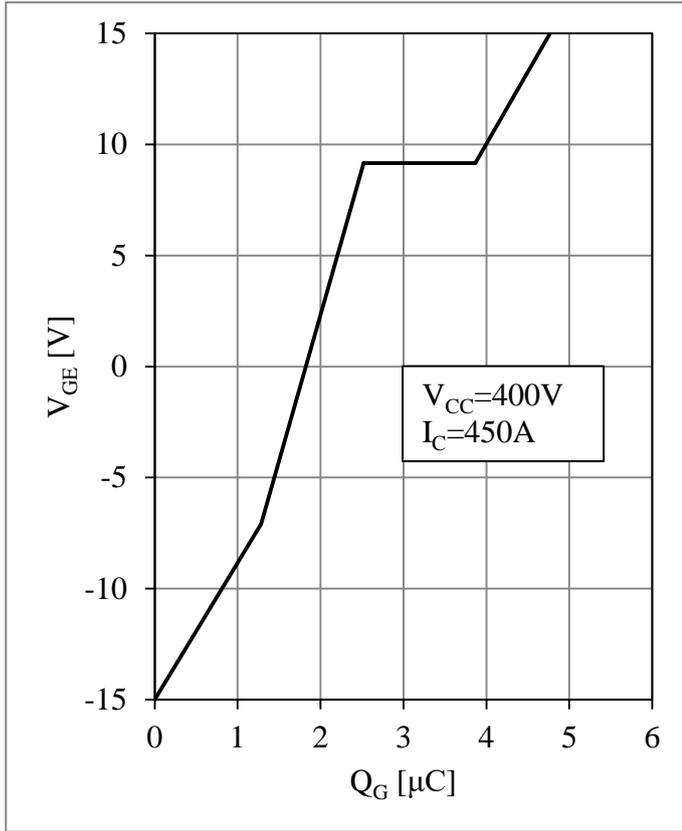


Fig 13. IGBT Gate Charge Characteristic

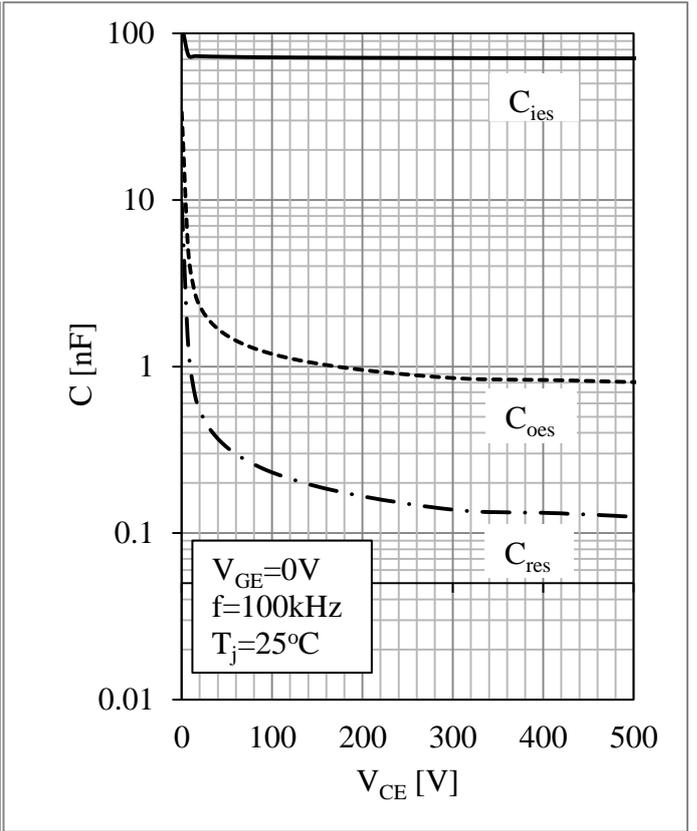


Fig 14. IGBT Capacity Characteristic

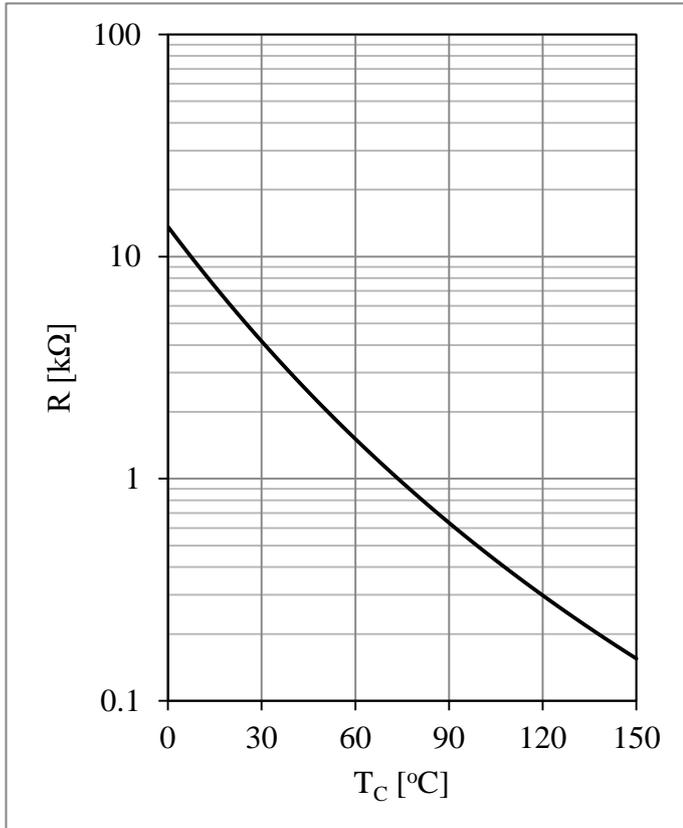
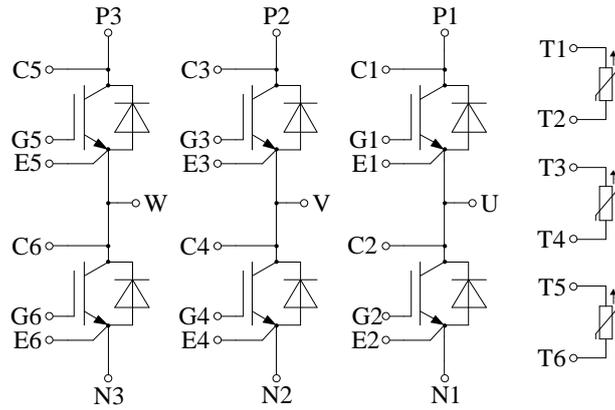


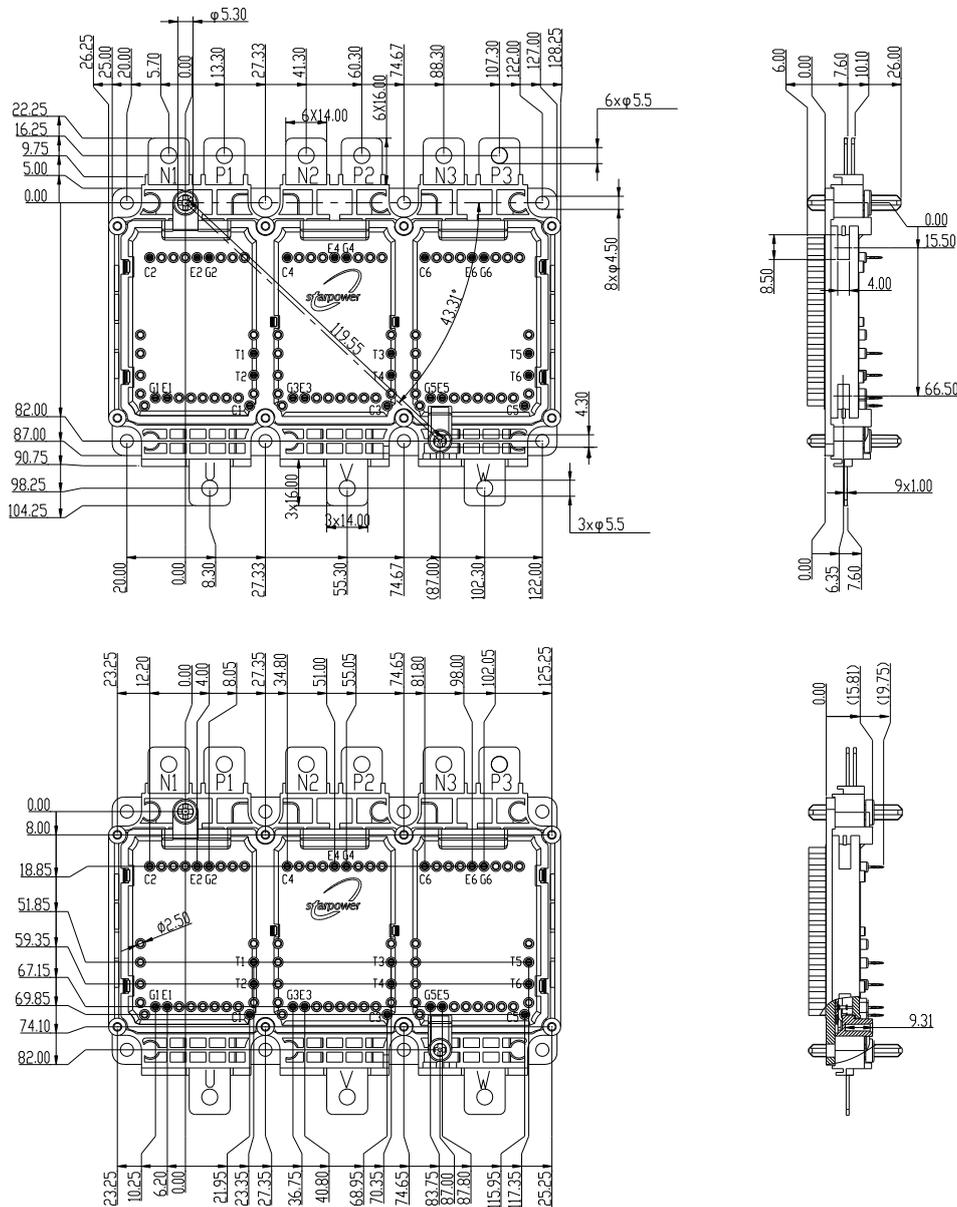
Fig 15. NTC Temperature Characteristic

Circuit Schematic



Package Dimensions

Dimensions in Millimeters



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