

# STARPOWER

SEMICONDUCTOR

**IGBT**

## GD560HTX75P7HB

**750V/560A 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.

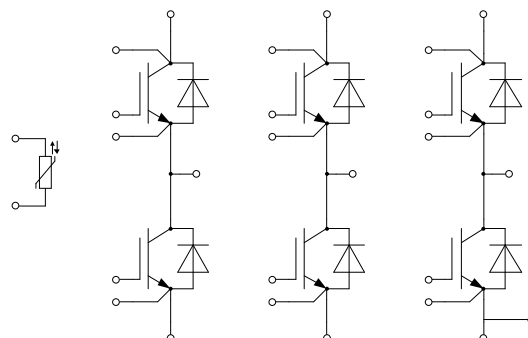
### Features

- 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 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	$\pm 20$	V
$I_{CN}$	Implemented Collector Current	560	A
$I_C$	Collector Current @ $T_F=75^{\circ}\text{C}$	300	A
$I_{CM}$	Pulsed Collector Current $t_p=1\text{ms}$	1120	A
$P_D$	Maximum Power Dissipation @ $T_F=75^{\circ}\text{C}$ $T_j=175^{\circ}\text{C}$	518	W

**Diode**

Symbol	Description	Values	Unit
$V_{RRM}$	Repetitive Peak Reverse Voltage	750	V
$I_{FN}$	Implemented Collector Current	560	A
$I_F$	Diode Continuous Forward Current	300	A
$I_{FM}$	Diode Maximum Forward Current $t_p=1\text{ms}$	1120	A

**Module**

Symbol	Description	Value	Unit
$T_{jmax}$	Maximum Junction Temperature	175	$^{\circ}\text{C}$
$T_{jop}$	Operating Junction Temperature continuous	-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 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	$I_C=300\text{A}, V_{GE}=15\text{V}, T_j=25^\circ\text{C}$		1.25	1.50	V	
		$I_C=300\text{A}, V_{GE}=15\text{V}, T_j=150^\circ\text{C}$		1.35			
		$I_C=300\text{A}, V_{GE}=15\text{V}, T_j=175^\circ\text{C}$		1.40			
		$I_C=560\text{A}, V_{GE}=15\text{V}, T_j=25^\circ\text{C}$		1.55			
		$I_C=560\text{A}, V_{GE}=15\text{V}, T_j=175^\circ\text{C}$		1.95			
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=6.40\text{mA}, V_{CE}=V_{GE}, T_j=25^\circ\text{C}$	5.0	5.7	7.0	V	
		$I_C=6.40\text{mA}, V_{CE}=V_{GE}, T_j=175^\circ\text{C}$		3.5			
$I_{CES}$	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			28.1		nF	
$C_{oes}$	Output Capacitance	$V_{CE}=50\text{V}, f=100\text{kHz}, V_{GE}=0\text{V}$		1.20		nF	
$C_{res}$	Reverse Transfer Capacitance			0.79		nF	
$Q_G$	Gate Charge	$V_{CE}=400\text{V}, I_C=300\text{A}, V_{GE}=-8\dots+15\text{V}$		2.01		$\mu\text{C}$	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=400\text{V}, I_C=450\text{A}, R_G=2.0\Omega, L_S=33\text{nH}, V_{GE}=\pm 15\text{V}, T_j=25^\circ\text{C}$		126		ns	
$t_r$	Rise Time			76		ns	
$t_{d(off)}$	Turn-Off Delay Time			373		ns	
$t_f$	Fall Time			81		ns	
$E_{on}$	Turn-On Switching Loss			15.1		mJ	
$E_{off}$	Turn-Off Switching Loss			19.3		mJ	
$t_{d(on)}$	Turn-On Delay Time		$V_{CC}=400\text{V}, I_C=450\text{A}, R_G=2.0\Omega, L_S=33\text{nH}, V_{GE}=\pm 15\text{V}, T_j=150^\circ\text{C}$		155		ns
$t_r$	Rise Time				85		ns
$t_{d(off)}$	Turn-Off Delay Time				423		ns
$t_f$	Fall Time				153		ns
$E_{on}$	Turn-On Switching Loss			22.8		mJ	
$E_{off}$	Turn-Off Switching Loss			24.9		mJ	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=400\text{V}, I_C=450\text{A}, R_G=2.0\Omega, L_S=33\text{nH}, V_{GE}=\pm 15\text{V}, T_j=175^\circ\text{C}$			159		ns
$t_r$	Rise Time				88		ns
$t_{d(off)}$	Turn-Off Delay Time				438		ns
$t_f$	Fall Time				183		ns
$E_{on}$	Turn-On Switching Loss			25.4		mJ	
$E_{off}$	Turn-Off Switching Loss			26.1		mJ	
$I_{SC}$	SC Data		$t_p \leq 6\mu\text{s}, V_{GE}=15\text{V}$		TBD		A

$T_j=175^{\circ}\text{C}, V_{CC}=400\text{V},$ $V_{CEM}\leq 750\text{V}$
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### Diode Characteristics $T_f=25^{\circ}\text{C}$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_F$	Diode Forward Voltage	$I_F=300\text{A}, V_{GE}=0\text{V}, T_j=25^{\circ}\text{C}$		1.35	1.60	V
		$I_F=300\text{A}, V_{GE}=0\text{V}, T_j=150^{\circ}\text{C}$		1.30		
		$I_F=300\text{A}, V_{GE}=0\text{V}, T_j=175^{\circ}\text{C}$		1.25		
		$I_F=560\text{A}, V_{GE}=0\text{V}, T_j=25^{\circ}\text{C}$		1.60		
		$I_F=560\text{A}, V_{GE}=0\text{V}, T_j=175^{\circ}\text{C}$		1.60		
$Q_r$	Recovered Charge			13.0		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current	$V_R=400\text{V}, I_F=450\text{A},$ $-di/dt=5140\text{A}/\mu\text{s}, V_{GE}=-15\text{V},$ $L_s=33\text{nH}, T_j=25^{\circ}\text{C}$		192		A
$E_{rec}$	Reverse Recovery Energy			4.17		mJ
$Q_r$	Recovered Charge			26.0		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current	$V_R=400\text{V}, I_F=450\text{A},$ $-di/dt=4530\text{A}/\mu\text{s}, V_{GE}=-15\text{V},$ $L_s=33\text{nH}, T_j=150^{\circ}\text{C}$		240		A
$E_{rec}$	Reverse Recovery Energy			7.43		mJ
$Q_r$	Recovered Charge			29.8		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current	$V_R=400\text{V}, I_F=450\text{A},$ $-di/dt=4330\text{A}/\mu\text{s}, V_{GE}=-15\text{V},$ $L_s=33\text{nH}, T_j=175^{\circ}\text{C}$		252		A
$E_{rec}$	Reverse Recovery Energy			8.34		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 $\Omega$
$\Delta R/R$	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**  $T_F=25^{\circ}\text{C}$  unless otherwise noted

Symbol	Parameter	Min.	Typ.	Max.	Unit
$\Delta p$	Pressure Drop Cooling Circuit $\Delta V/\Delta t=10.0\text{dm}^3/\text{min}, T_F=75^{\circ}\text{C};$ Cooling Fluid=50% Water/50% Ethylene Glycol		50		mbar
p	Maximum Pressure In Cooling Circuit			2.0	bar
$R_{thJF}$	Junction-to-Cooling Fluid (per IGBT) Junction-to-Cooling Fluid (per Diode) $\Delta V/\Delta t=10.0\text{dm}^3/\text{min}, T_F=75^{\circ}\text{C}$			0.193 0.230	K/W
M	Terminal Connection Torque, Screw M6 Mounting Torque, Screw M5	3.0 3.0		6.0 6.0	N.m
G	Weight of Module		685		g

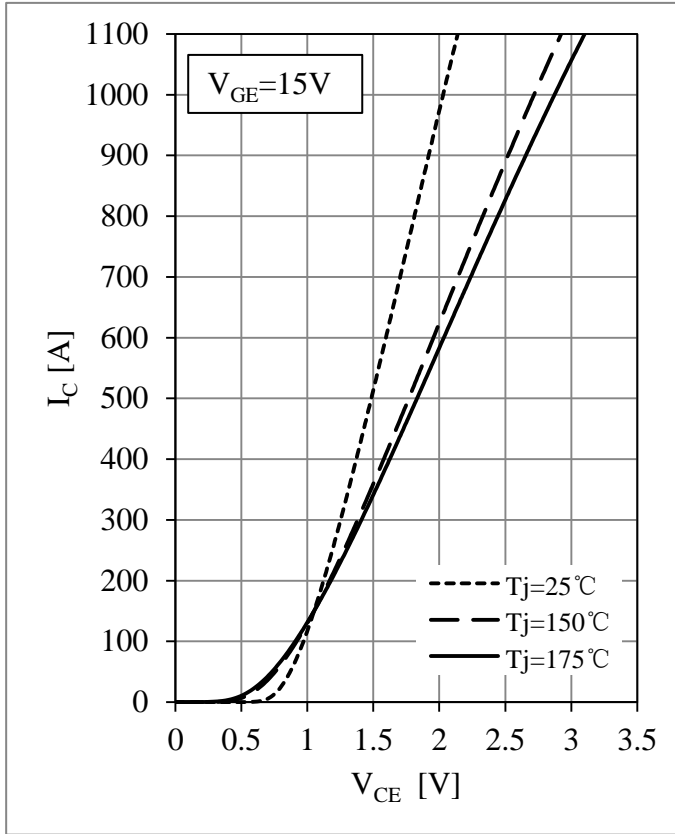


Fig 1. IGBT Output Characteristics

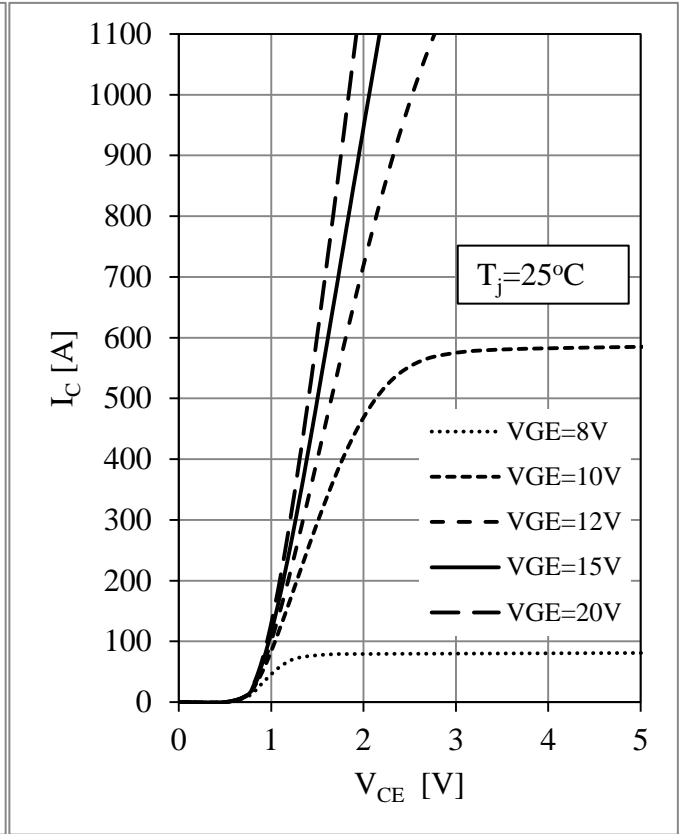


Fig 2. IGBT Output Characteristics

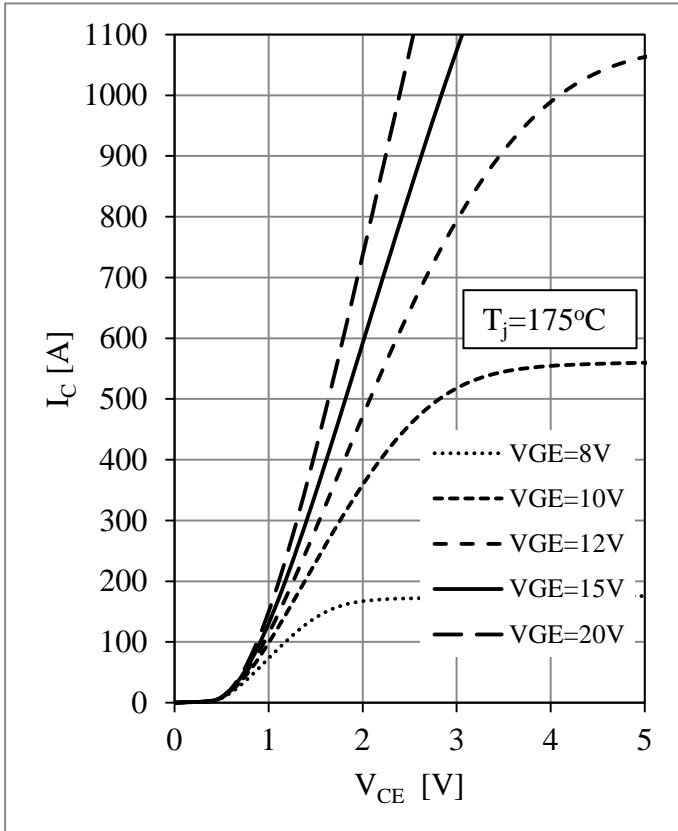


Fig 3. IGBT Output Characteristics

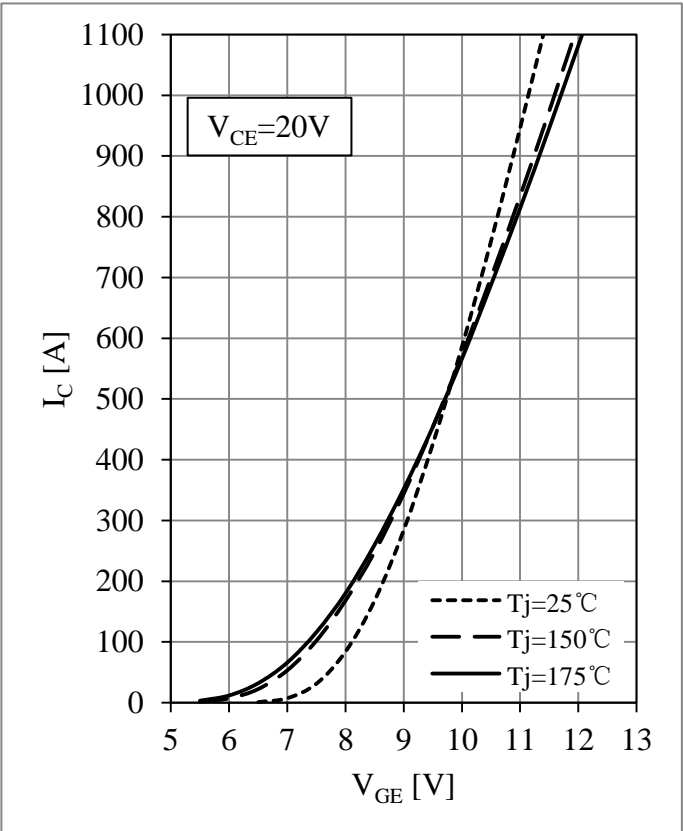


Fig 4. IGBT Transfer Characteristics

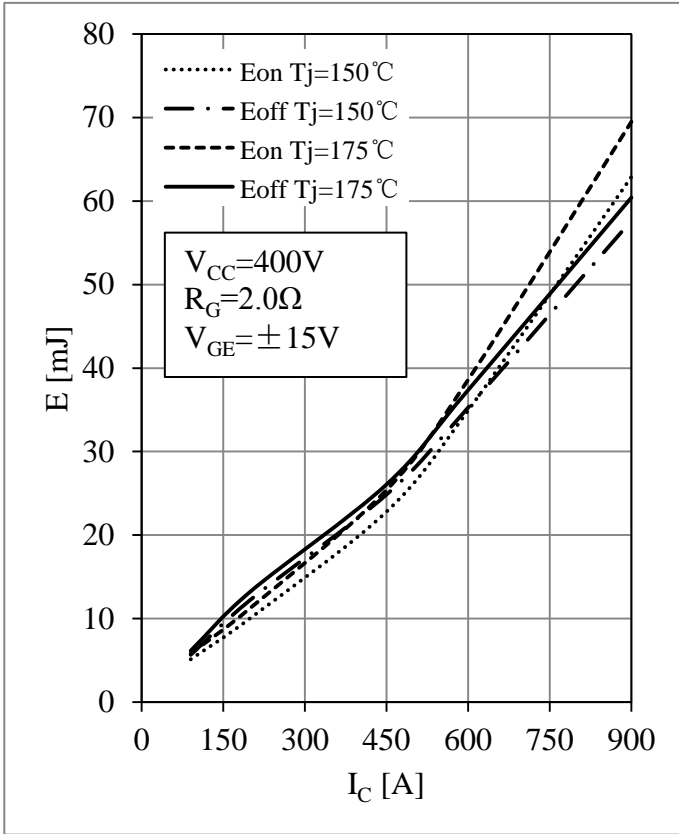


Fig 5. IGBT Switching Loss vs.  $I_C$

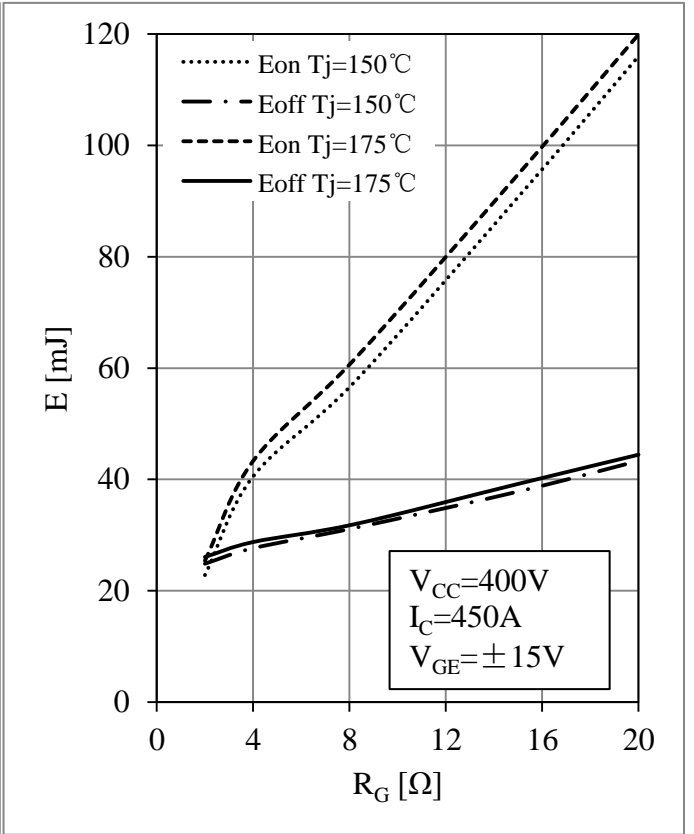


Fig 6. IGBT Switching Loss vs.  $R_G$

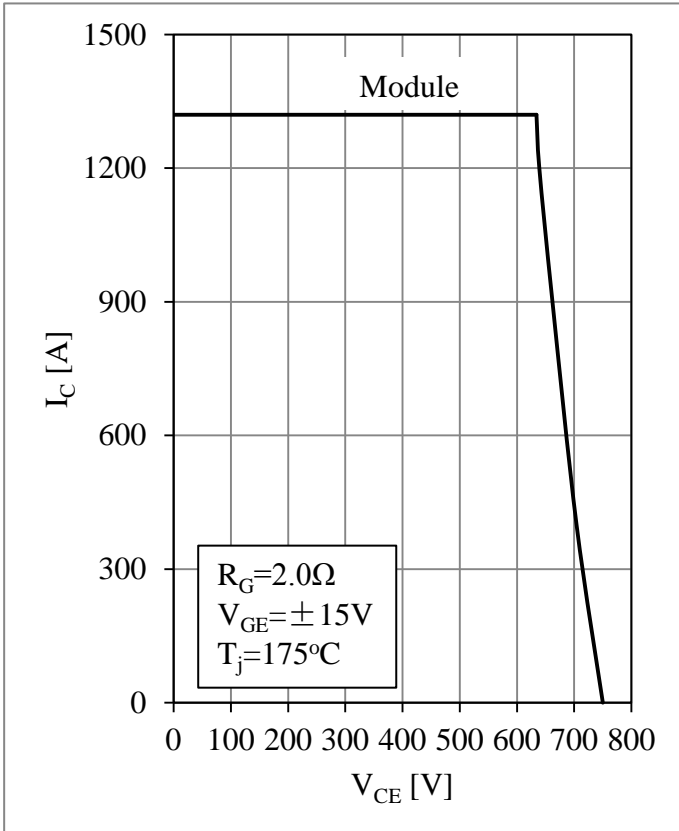


Fig 7. RBSOA

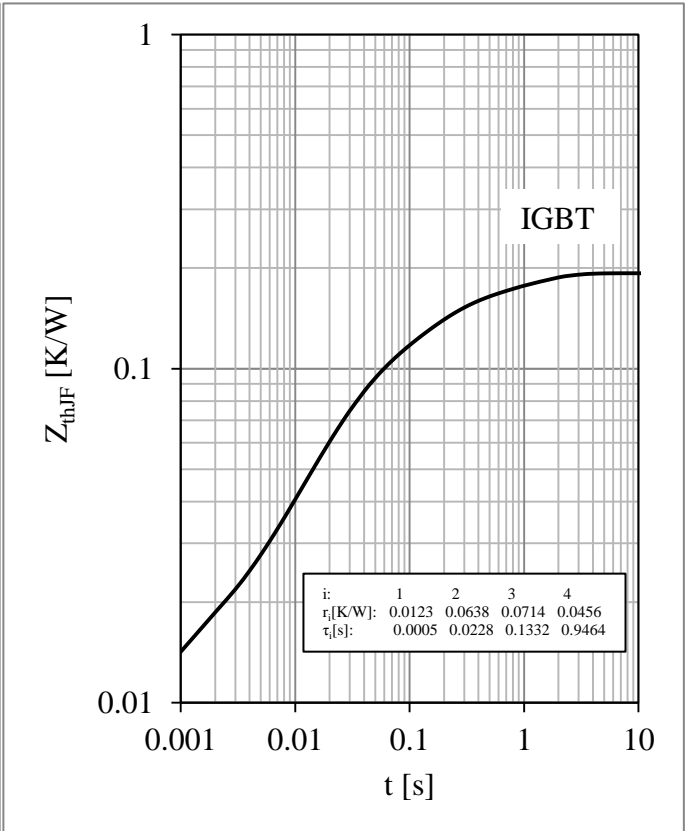


Fig 8. IGBT Transient Thermal Impedance

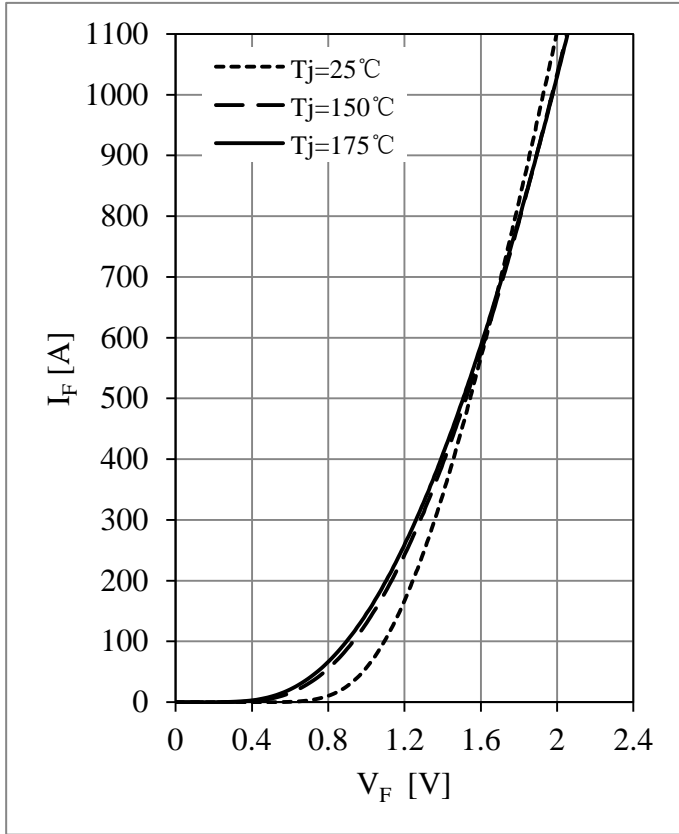


Fig 9. Diode Forward Characteristics

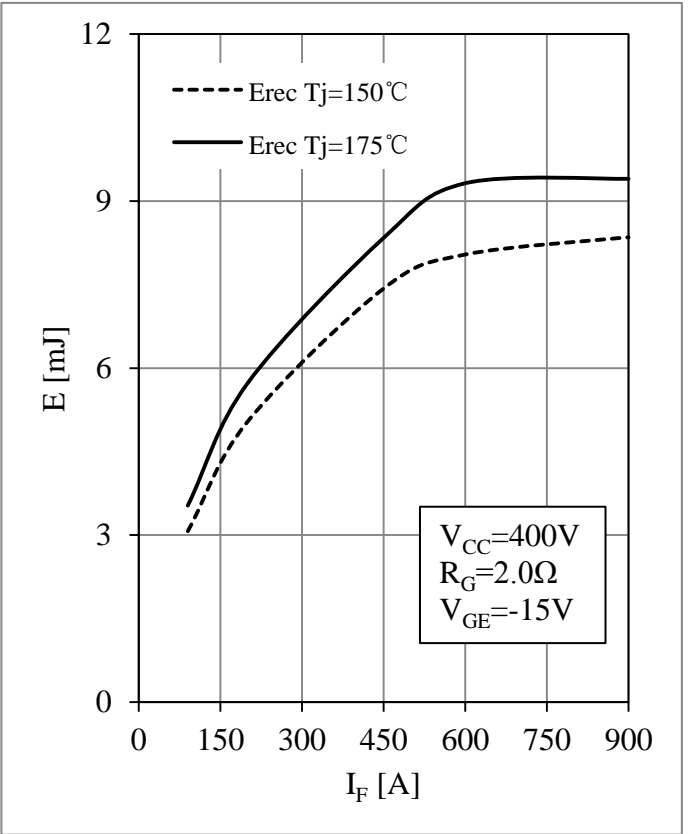


Fig 10. Diode Switching Loss vs.  $I_F$

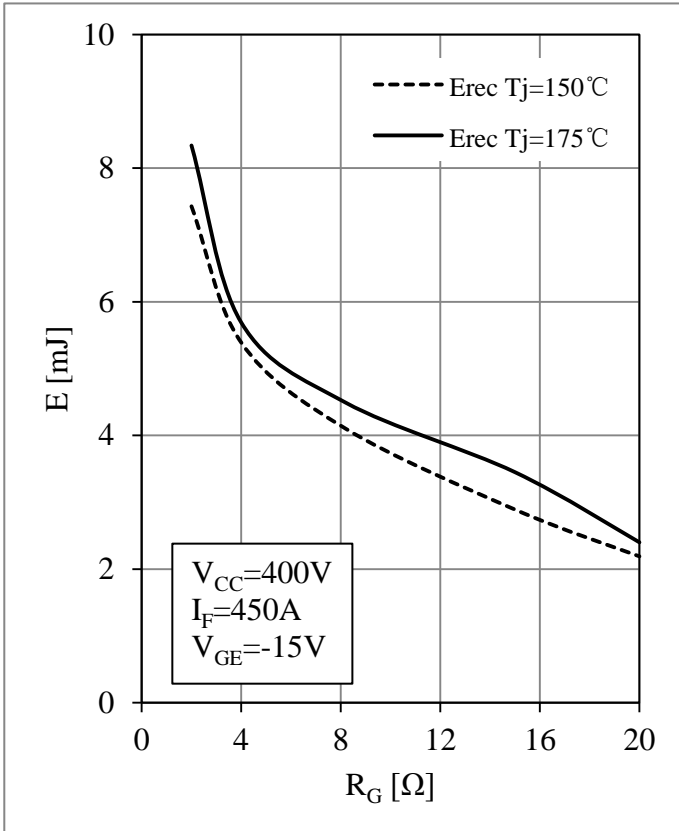


Fig 11. Diode Switching Loss vs.  $R_G$

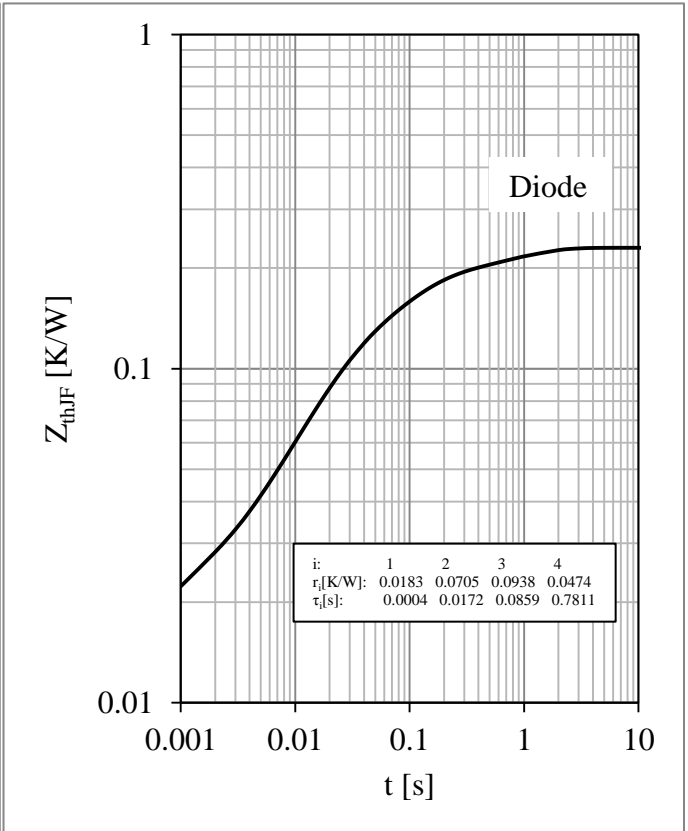


Fig 12. Diode Transient Thermal Impedance



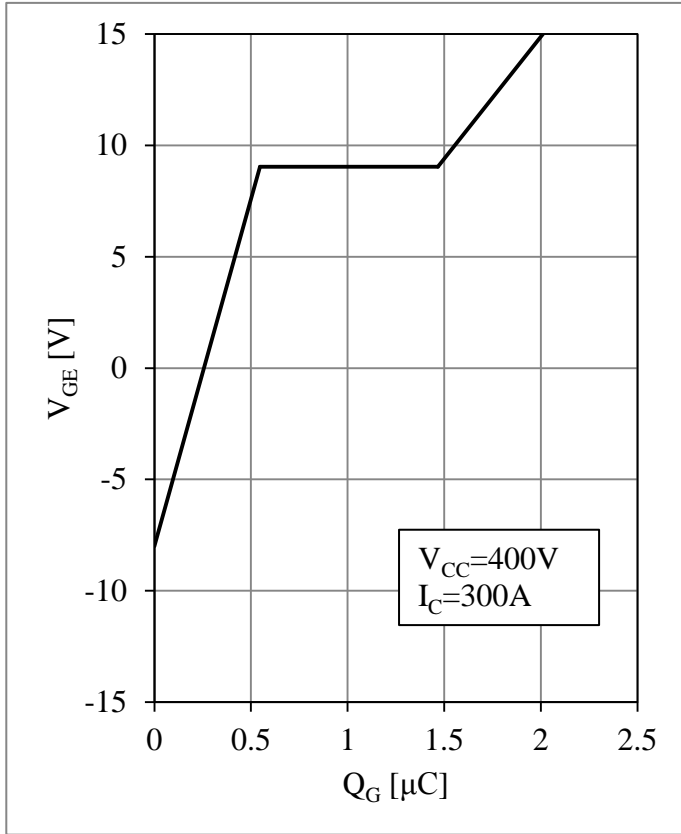


Fig 13. IGBT Gate Charge Characteristic

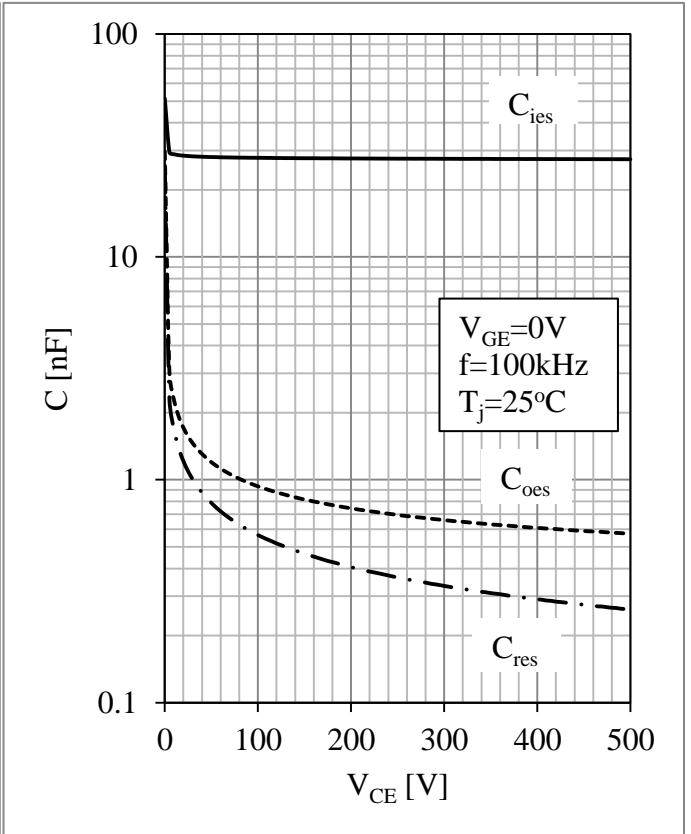


Fig 14. IGBT Capacity Characteristic

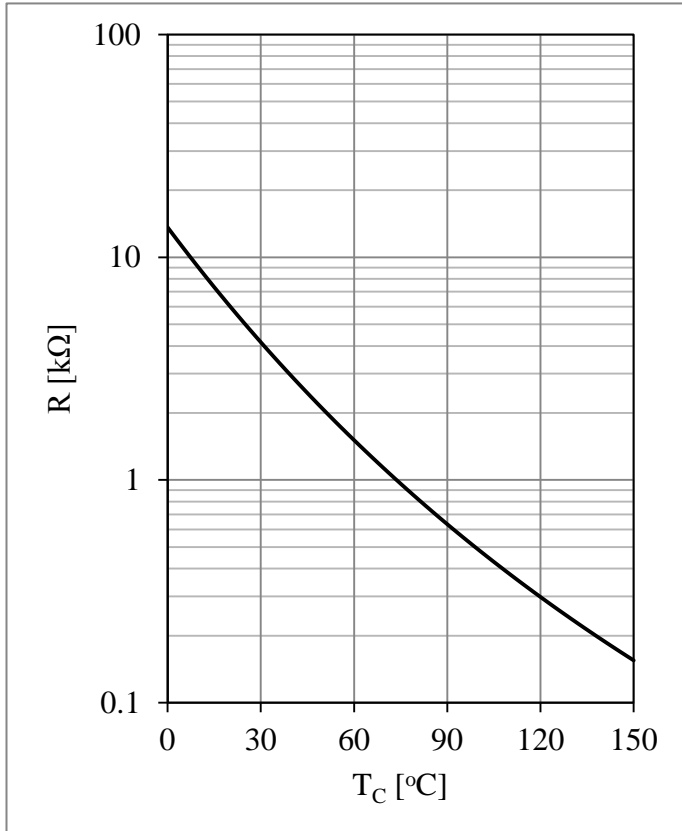
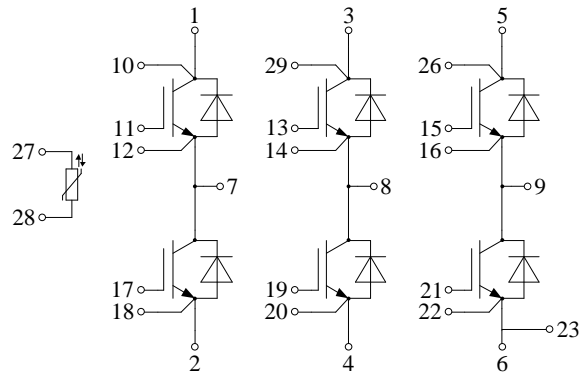


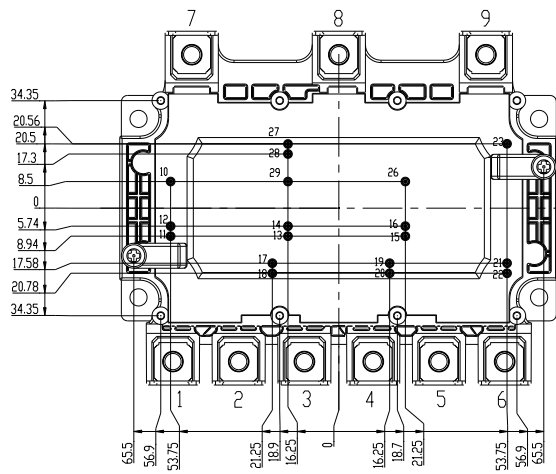
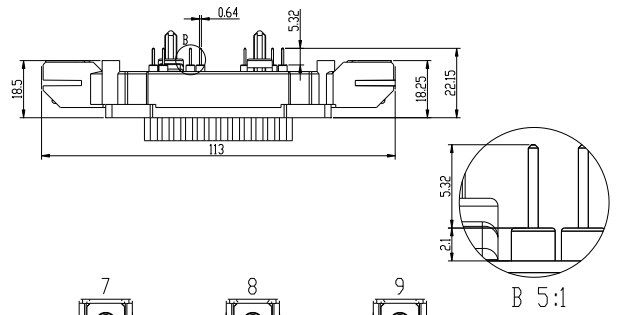
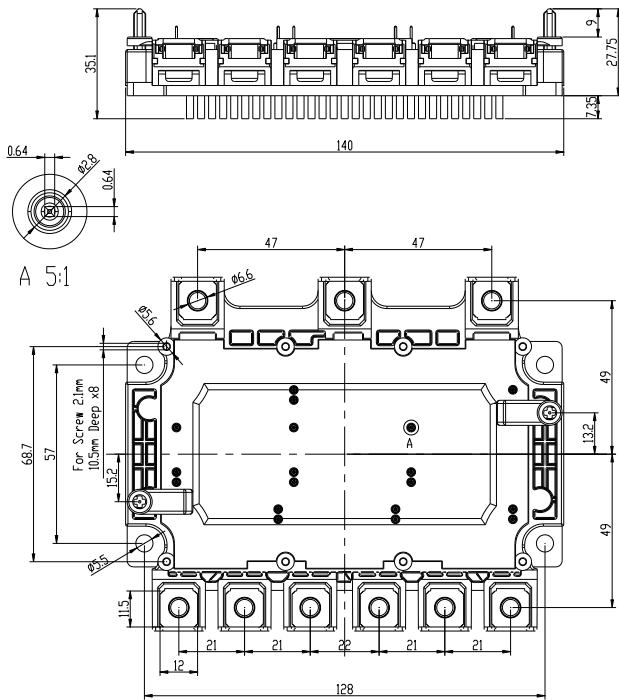
Fig 15. NTC Temperature Characteristic

Circuit Schematic



Package Dimensions

Dimensions in Millimeters



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