STARPOWER

SEMICONDUCTOR **IGBT**

GD400HTX120P6H

1200V/400A 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.

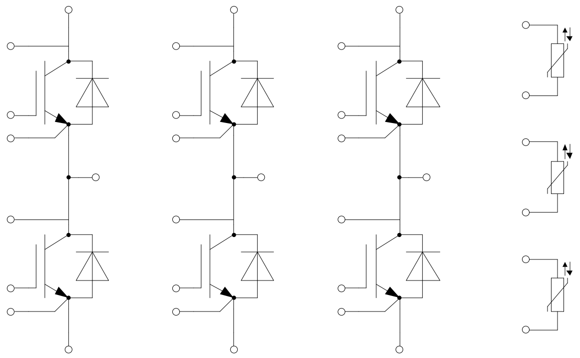
Features

- Low $V_{CE(sat)}$ Trench IGBT technology
- Low switching losses
- 6μs 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_3N_4AMB technology

Typical Applications

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

Equivalent Circuit Schematic



Absolute Maximum Ratings T_F=25°C unless otherwise noted

IGBT

Symbol	Description	Values	Unit
V_{CES}	Collector-Emitter Voltage	1200	V
V_{GES}	Gate-Emitter Voltage	±20	V
I_{CN}	Implemented Collector Current	400	A
I_C	Collector Current @ T_F=100°C	250	A
I_{CM}	Pulsed Collector Current t_p=1ms	800	A
P_D	Maximum Power Dissipation @ T_F=75°C T_j=175°C	862	W

Diode

Symbol	Description	Values	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	1200	V
I_{FN}	Implemented Collector Current	400	A
I_F	Diode Continuous Forward Current	250	A
I_{FM}	Diode Maximum Forward Current t_p=1ms	800	A
I^2t	I^2t-value,t_p=10ms @ T_j=125°C @ T_j=150°C	17860 15664	A^2s

Module

Symbol	Description	Value	Unit
T_{jmax}	Maximum Junction Temperature	175	°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	°C
T_{STG}	Storage Temperature Range	-40 to +125	°C
V_{ISO}	Isolation Voltage RMS,f=50Hz,t=1min	2500	V

IGBT Characteristics T_F=25°C unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	I_C=250A,V_{GE}=15V, T_j=25°C		1.45	1.80	V
		I_C=250A,V_{GE}=15V, T_j=125°C		1.65		
		I_C=250A,V_{GE}=15V, T_j=150°C		1.70		
		I_C=380A,V_{GE}=15V, T_j=25°C		1.70		
		I_C=380A,V_{GE}=15V, T_j=150°C		2.15		
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	I_C=9.75mA,V_{CE}=V_{GE}, T_j=25°C	5.6	6.2	6.8	V
I_{CES}	Collector Cut-Off Current	V_{CE}=V_{CES},V_{GE}=0V, T_j=25°C			1.0	mA
I_{GES}	Gate-Emitter Leakage Current	V_{GE}=V_{GES},V_{CE}=0V, T_j=25°C			400	nA
R_{Gint}	Internal Gate Resistance			2.4		Ω
C_{ies}	Input Capacitance	V_{CE}=25V,f=100kHz, V_{GE}=0V		33.6		nF
C_{oes}	Output Capacitance			1.43		nF
C_{res}	Reverse Transfer Capacitance			0.82		nF
Q_G	Gate Charge	V_{CE} =600V,I_C =250A, V_{GE}=-8…+15V		1.98		μC
$t_{d(on)}$	Turn-On Delay Time	V_{CC}=600V,I_C=250A, R_G=2.2Ω,L_S=24nH, V_{GE}=-8V/+15V, T_j=25°C		231		ns
t_r	Rise Time			50		ns
$t_{d(off)}$	Turn-Off Delay Time			545		ns
t_f	Fall Time			172		ns
E_{on}	Turn-On Switching Loss			19.6		mJ
E_{off}	Turn-Off Switching Loss			23.2		mJ
$t_{d(on)}$	Turn-On Delay Time	V_{CC}=600V,I_C=250A, R_G=2.2Ω,L_S=24nH, V_{GE}=-8V/+15V, T_j=125°C		241		ns
t_r	Rise Time			57		ns
$t_{d(off)}$	Turn-Off Delay Time			619		ns
t_f	Fall Time			247		ns
E_{on}	Turn-On Switching Loss			26.6		mJ
E_{off}	Turn-Off Switching Loss			28.7		mJ
$t_{d(on)}$	Turn-On Delay Time	V_{CC}=600V,I_C=250A, R_G=2.2Ω,L_S=24nH, V_{GE}=-8V/+15V, T_j=150°C		245		ns
t_r	Rise Time			57		ns
$t_{d(off)}$	Turn-Off Delay Time			641		ns
t_f	Fall Time			269		ns
E_{on}	Turn-On Switching Loss			30.1		mJ
E_{off}	Turn-Off Switching Loss			30.9		mJ
I_{SC}	SC Data	t_P≤6μs,V_{GE}=15V, T_j=150°C,V_{CC}=800V, V_{CEM}≤1200V		1200		A

Diode Characteristics T_F=25°C unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_F	Diode Forward Voltage	I_F=250A,V_{GE}=0V,T_j=25°C		1.50	1.90	V
		I_F=250A,V_{GE}=0V,T_j=125°C		1.45		
		I_F=250A,V_{GE}=0V,T_j=150°C		1.40		
		I_F=380A,V_{GE}=0V,T_j=25°C		1.65		
		I_F=380A,V_{GE}=0V,T_j=150°C		1.60		
Q_r	Recovered Charge	V_R=600V,I_F=250A, -di/dt=4860A/μs,V_{GE}=-8V L_S=24nH,T_j=25°C		9.10		μC
I_{RM}	Peak Reverse Recovery Current			160		A
E_{rec}	Reverse Recovery Energy			4.39		mJ
Q_r	Recovered Charge	V_R=600V,I_F=250A, -di/dt=4300A/μs,V_{GE}=-8V L_S=24nH,T_j=125°C		21.4		μC
I_{RM}	Peak Reverse Recovery Current			192		A
E_{rec}	Reverse Recovery Energy			8.43		mJ
Q_r	Recovered Charge	V_R=600V,I_F=250A, -di/dt=4120A/μs,V_{GE}=-8V L_S=24nH,T_j=150°C		25.7		μC
I_{RM}	Peak Reverse Recovery Current			203		A
E_{rec}	Reverse Recovery Energy			9.97		mJ

NTC Characteristics T_F=25°C unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
R_{25}	Rated Resistance			5.0		kΩ
ΔR/R	Deviation of R_{100}	T_C=100 °C,R_{100}=493.3Ω	-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°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		mΩ
Δp	ΔV/Δt=10.0dm³/min,T_F=75°C		64		mbar
p	Maximum Pressure In Cooling Circuit			2.5	bar
R_{thJF}	Junction-to-Cooling Fluid (per IGBT) Junction-to-Cooling Fluid (per Diode)		0.098 0.128	0.116 0.150	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

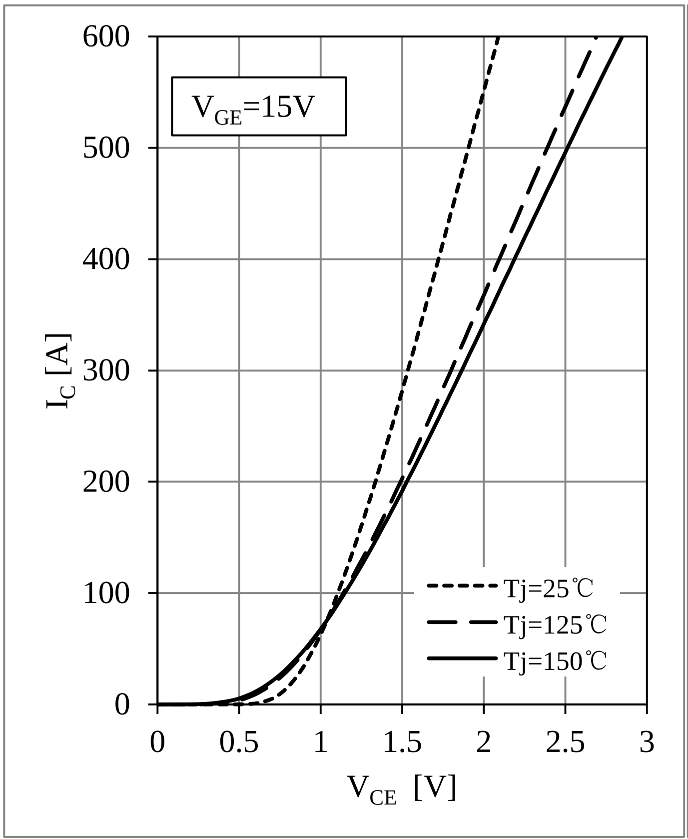


Fig 1. IGBT Output Characteristics

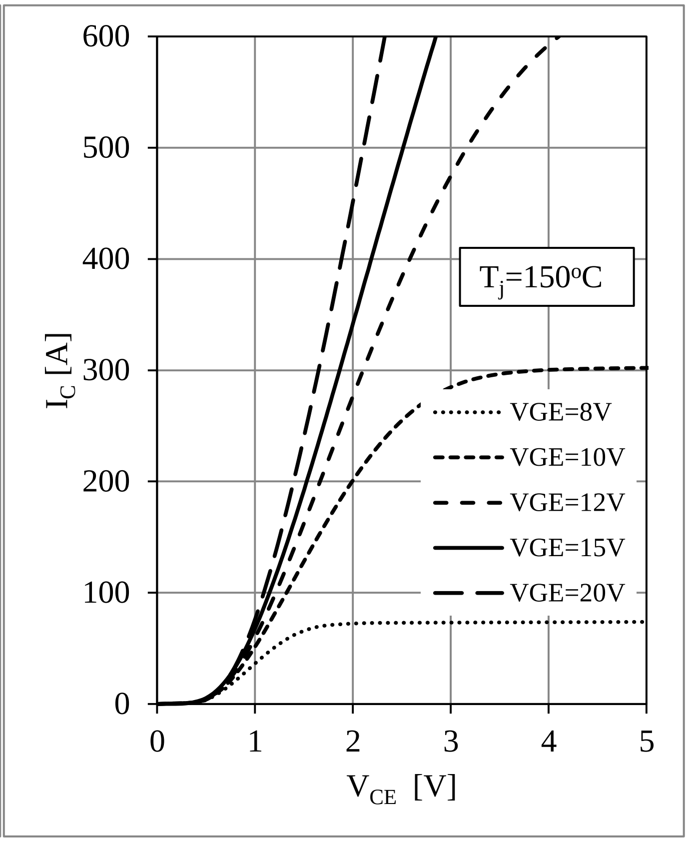


Fig 2. IGBT Output Characteristics

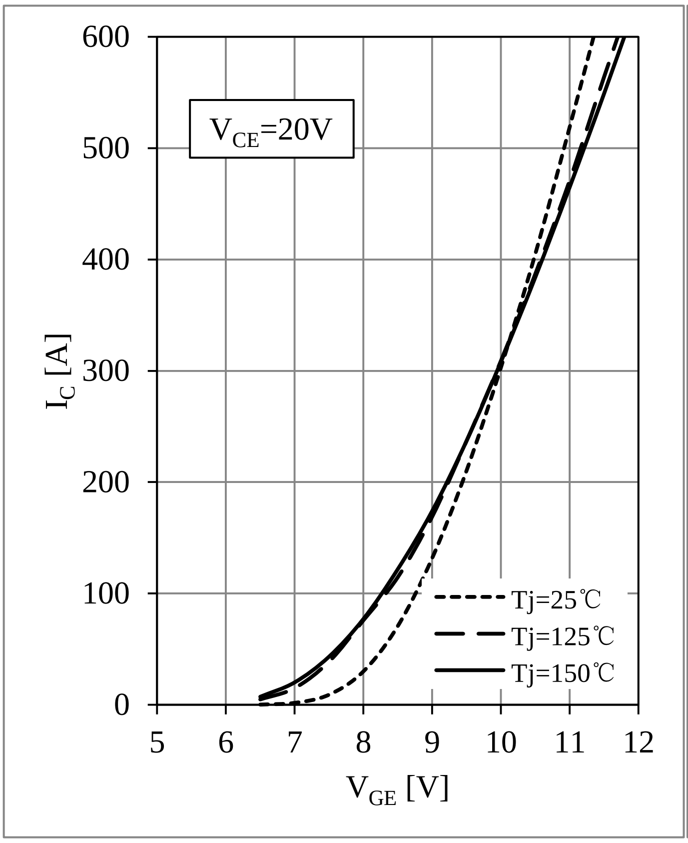


Fig 3. IGBT Transfer Characteristics

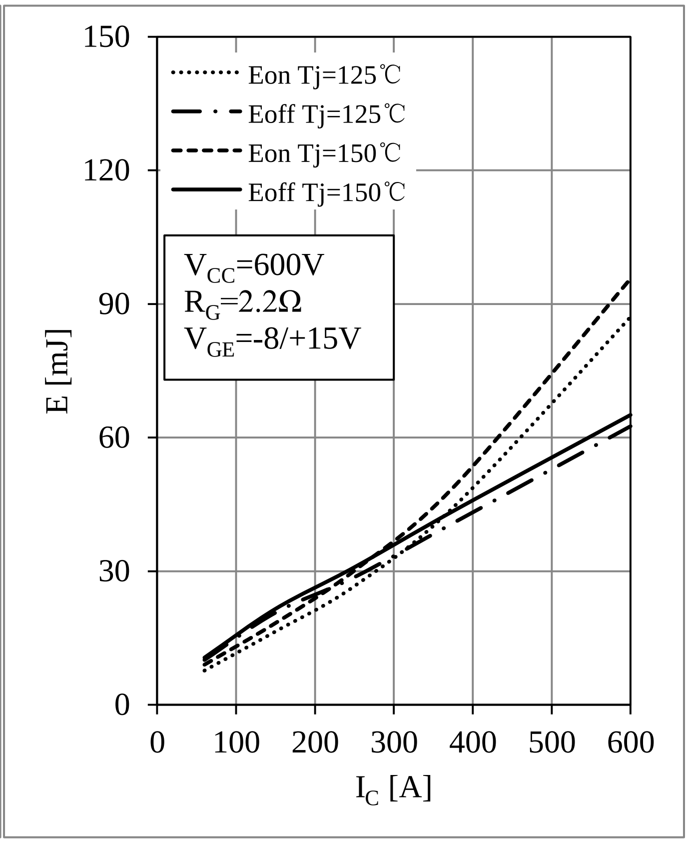
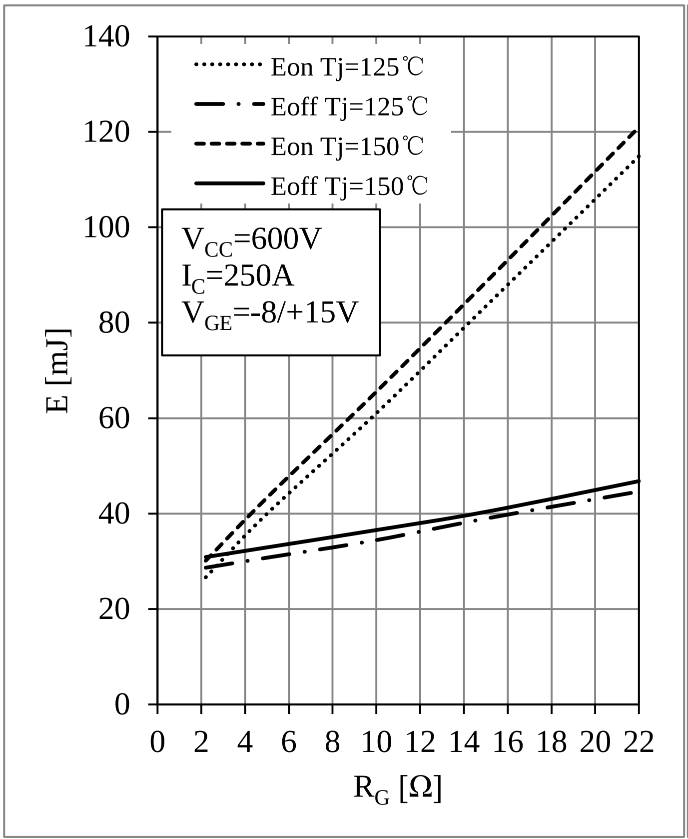


Fig 4. IGBT Switching Loss vs. I_C



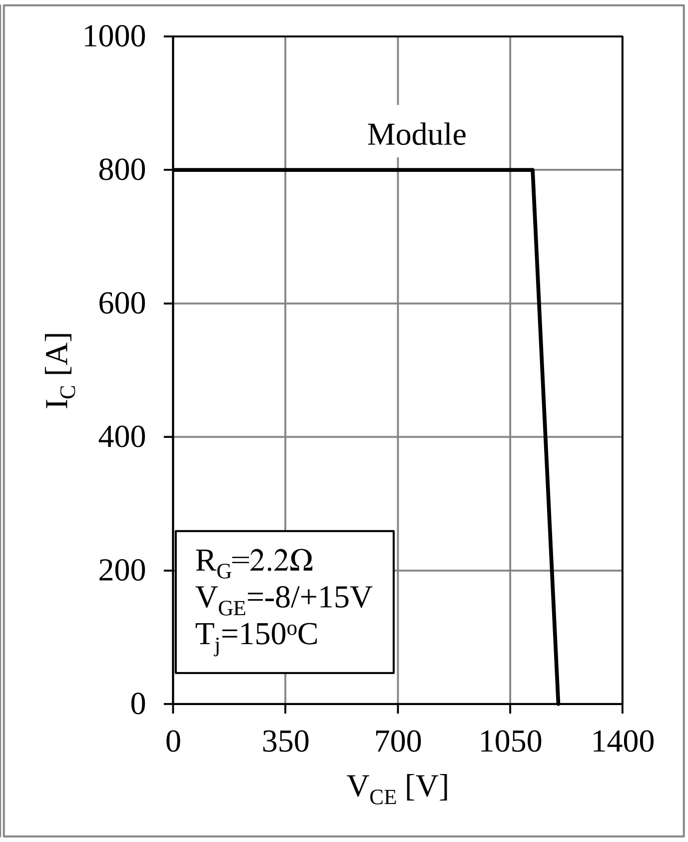
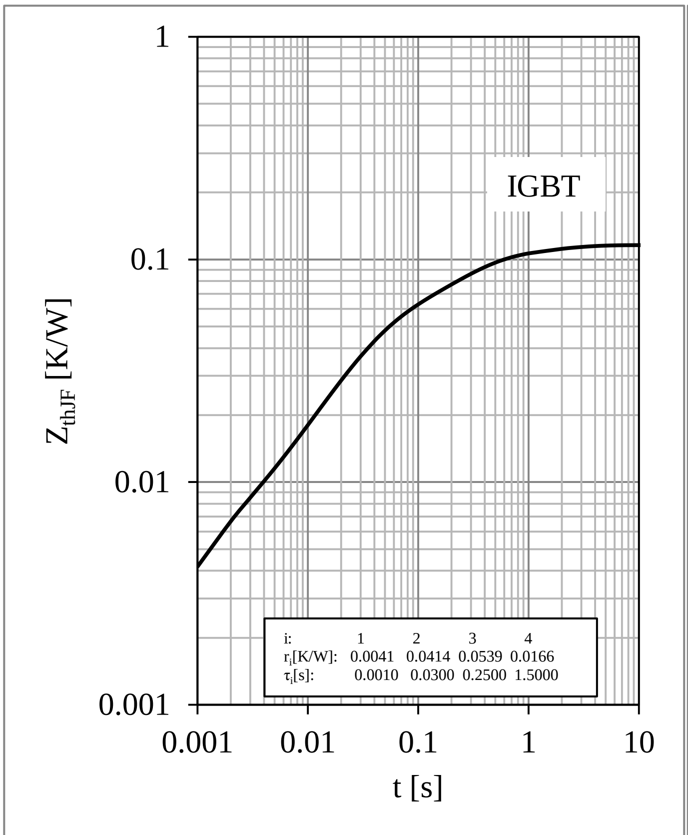


Fig 5. IGBT Switching Loss vs. R_G

Fig 6. RBSOA



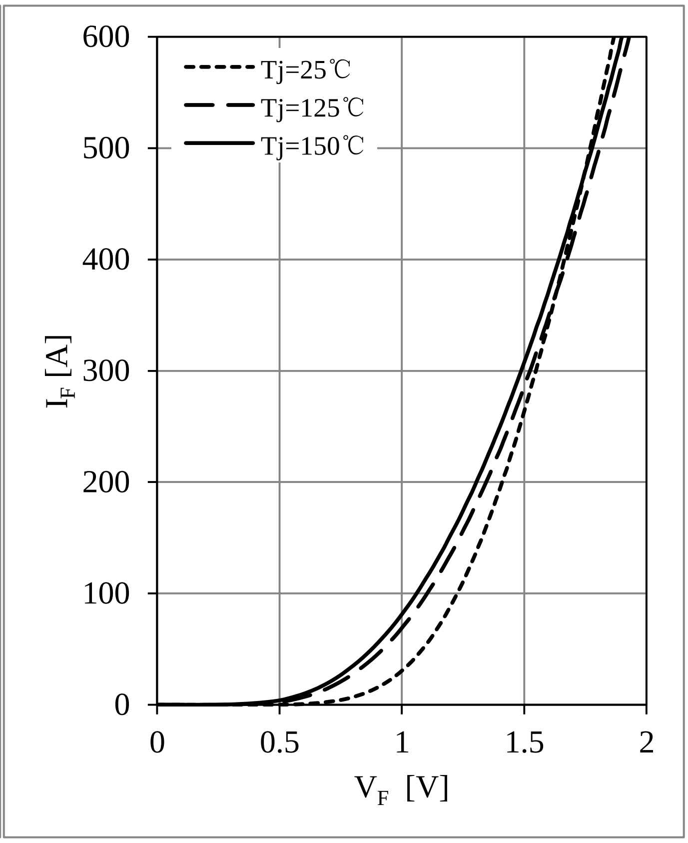


Fig 7. IGBT Transient Thermal Impedance

Fig 8. Diode Forward Characteristics

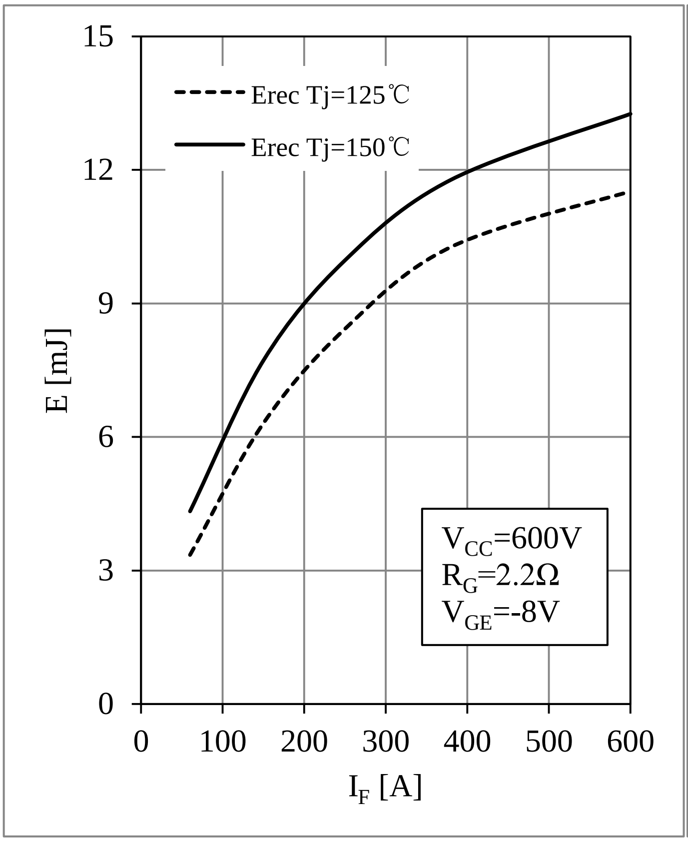


Fig 9. Diode Switching Loss vs. I_F

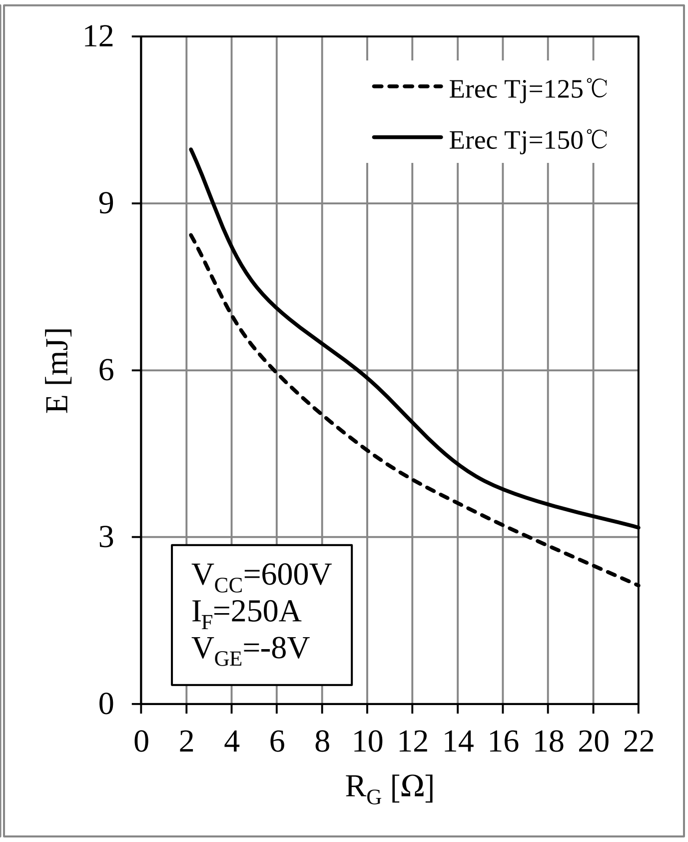


Fig 10. Diode Switching Loss vs. R_G

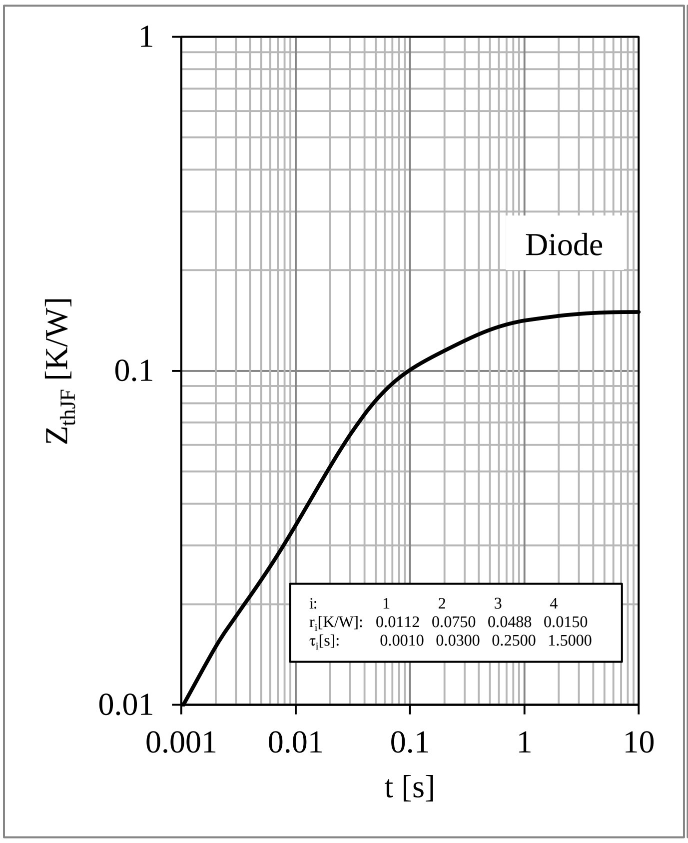


Fig 11. Diode Transient Thermal Impedance

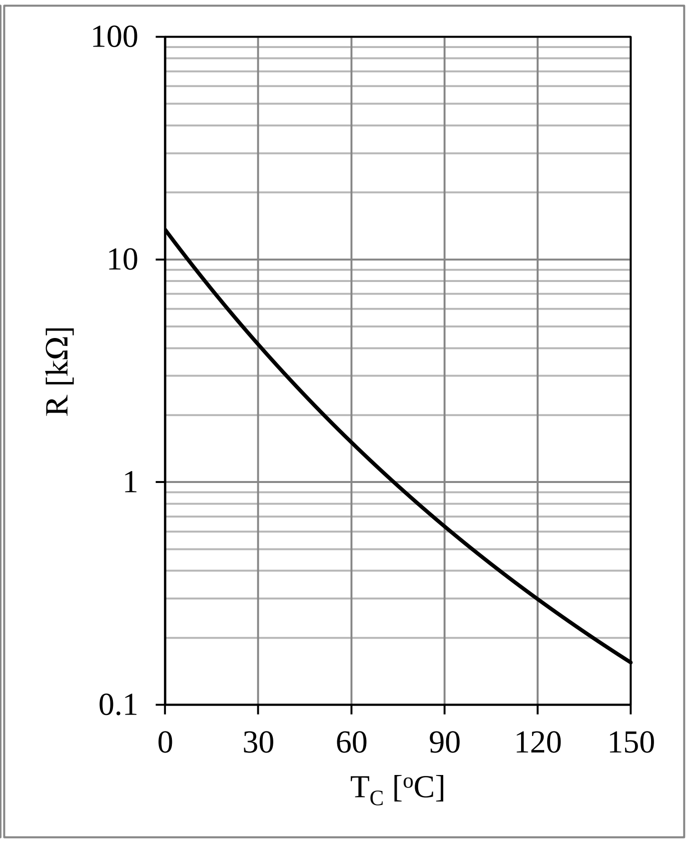
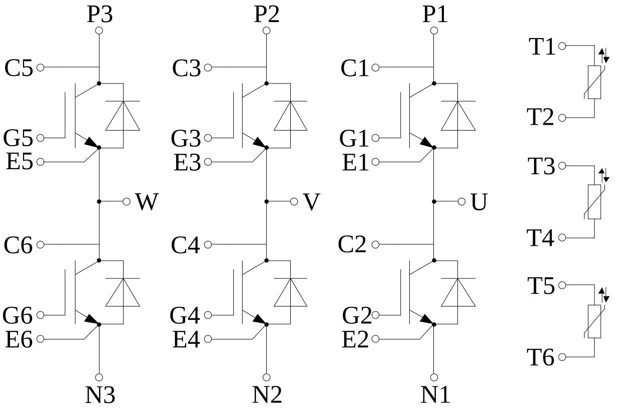


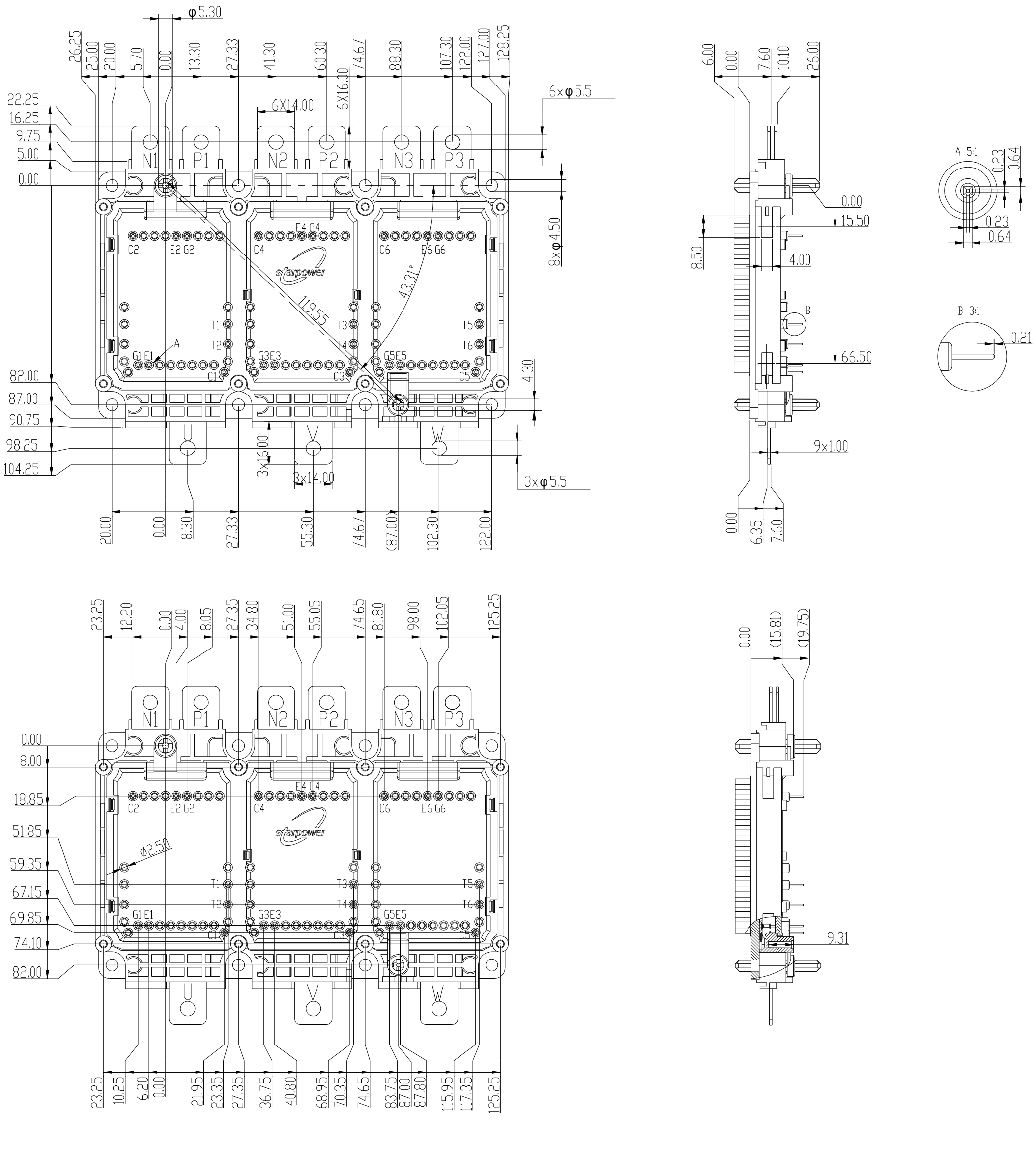
Fig 12. NTC Temperature Characteristic

Circuit Schematic



Package Dimensions

Dimensions in Millimeters



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