

STARPOWER

SEMICONDUCTOR

IGBT

GD1400HFX170P2S

1700V/1400A 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 wind power.

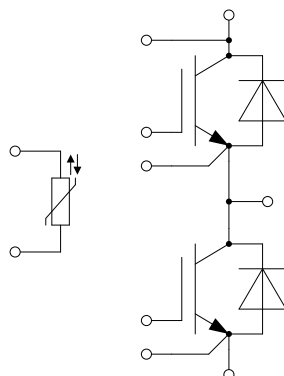
Features

- Low $V_{CE(sat)}$ Trench IGBT technology
- 10 μ s short circuit capability
- $V_{CE(sat)}$ with positive temperature coefficient
- Maximum junction temperature 175°C
- Enlarged Diode for regenerative operation
- Isolated copper baseplate using DBC technology
- High power and thermal cycling capability

Typical Applications

- High Power Converter
- Wind Power
- Auxiliary Inverter

Equivalent Circuit Schematic



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

Symbol	Description	Value	Unit
V_{CES}	Collector-Emitter Voltage	1700	V
V_{GES}	Gate-Emitter Voltage	± 20	V
I_C	Collector Current @ $T_C=25^{\circ}\text{C}$ @ $T_C=100^{\circ}\text{C}$	2377 1400	A
I_{CM}	Pulsed Collector Current $t_p=1\text{ms}$	2800	A
P_D	Maximum Power Dissipation @ $T_j=175^{\circ}\text{C}$	8.98	kW

Diode

Symbol	Description	Value	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	1700	V
I_F	Diode Continuous Forward Current	1400	A
I_{FM}	Diode Maximum Forward Current $t_p=1\text{ms}$	2800	A
I_{FSM}	Surge Forward Current $V_R=0\text{V}, t_p=10\text{ms}$, @ $T_j=25^{\circ}\text{C}$ @ $T_j=150^{\circ}\text{C}$	9380 8400	A
I^2t	I^2t -value, $V_R=0\text{V}, t_p=10\text{ms}, T_j=25^{\circ}\text{C}$ I^2t -value, $V_R=0\text{V}, t_p=10\text{ms}, T_j=150^{\circ}\text{C}$	439922 352800	A^2s

Module

Symbol	Description	Value	Unit
T_{jmax}	Maximum Junction Temperature	175	$^{\circ}\text{C}$
T_{jop}	Operating Junction Temperature	-40 to +150	$^{\circ}\text{C}$
T_{STG}	Storage Temperature Range	-40 to +125	$^{\circ}\text{C}$
V_{ISO}	Isolation Voltage RMS, $f=50\text{Hz}, t=1\text{min}$	4000	V

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	$I_C=1400\text{A}, V_{GE}=15\text{V}, T_j=25^{\circ}\text{C}$		1.85	2.30	V
		$I_C=1400\text{A}, V_{GE}=15\text{V}, T_j=125^{\circ}\text{C}$		2.20		
		$I_C=1400\text{A}, V_{GE}=15\text{V}, T_j=150^{\circ}\text{C}$		2.25		
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=56.0\text{mA}, V_{CE}=V_{GE}, T_j=25^{\circ}\text{C}$	5.2	6.0	6.8	V
I_{CES}	Collector Cut-Off Current	$V_{CE}=V_{CES}, V_{GE}=0\text{V}, T_j=25^{\circ}\text{C}$			5.0	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			0.5		Ω
C_{ies}	Input Capacitance	$V_{CE}=25\text{V}, f=1\text{MHz}, V_{GE}=0\text{V}$		169		nF
C_{res}	Reverse Transfer Capacitance			4.09		nF
Q_G	Gate Charge	$V_{GE}=-15\dots+15\text{V}$		13.2		μC
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=900\text{V}, I_C=1400\text{A}, R_{Gon}=1.0\Omega, R_{Goff}=3.3\Omega, L_S=26\text{nH}, V_{GE}=-10/+15\text{V}, T_j=25^{\circ}\text{C}$		456		ns
t_r	Rise Time			123		ns
$t_{d(off)}$	Turn-Off Delay Time			1177		ns
t_f	Fall Time			381		ns
E_{on}	Turn-On Switching Loss			482		mJ
E_{off}	Turn-Off Switching Loss			364		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=900\text{V}, I_C=1400\text{A}, R_{Gon}=1.0\Omega, R_{Goff}=3.3\Omega, L_S=26\text{nH}, V_{GE}=-10/+15\text{V}, T_j=125^{\circ}\text{C}$		543		ns
t_r	Rise Time			157		ns
$t_{d(off)}$	Turn-Off Delay Time			1423		ns
t_f	Fall Time			574		ns
E_{on}	Turn-On Switching Loss			760		mJ
E_{off}	Turn-Off Switching Loss			480		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=900\text{V}, I_C=1400\text{A}, R_{Gon}=1.0\Omega, R_{Goff}=3.3\Omega, L_S=26\text{nH}, V_{GE}=-10/+15\text{V}, T_j=150^{\circ}\text{C}$		557		ns
t_r	Rise Time			170		ns
$t_{d(off)}$	Turn-Off Delay Time			1469		ns
t_f	Fall Time			627		ns
E_{on}	Turn-On Switching Loss			835		mJ
E_{off}	Turn-Off Switching Loss			500		mJ
I_{SC}	SC Data	$t_p \leq 10\mu\text{s}, V_{GE}=15\text{V}, T_j=150^{\circ}\text{C}, V_{CC}=1100\text{V}, V_{CEM} \leq 1700\text{V}$		5600		A

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_F	Diode Forward Voltage	$I_F=1400\text{A}, V_{GE}=0\text{V}, T_j=25^{\circ}\text{C}$		1.80	2.25	V
		$I_F=1400\text{A}, V_{GE}=0\text{V}, T_j=125^{\circ}\text{C}$		1.90		
		$I_F=1400\text{A}, V_{GE}=0\text{V}, T_j=150^{\circ}\text{C}$		1.95		
Q_r	Recovered Charge	$V_R=900\text{V}, I_F=1400\text{A},$ $-di/dt=9700\text{A}/\mu\text{s}, V_{GE}=-10\text{V},$ $L_S=26\text{nH}, T_j=25^{\circ}\text{C}$		78.8		μC
I_{RM}	Peak Reverse Recovery Current			722		A
E_{rec}	Reverse Recovery Energy			77.1		mJ
Q_r	Recovered Charge	$V_R=900\text{V}, I_F=1400\text{A},$ $-di/dt=7200\text{A}/\mu\text{s}, V_{GE}=-10\text{V},$ $L_S=26\text{nH}, T_j=125^{\circ}\text{C}$		188		μC
I_{RM}	Peak Reverse Recovery Current			855		A
E_{rec}	Reverse Recovery Energy			88.0		mJ
Q_r	Recovered Charge	$V_R=900\text{V}, I_F=1400\text{A},$ $-di/dt=6500\text{A}/\mu\text{s}, V_{GE}=-10\text{V},$ $L_S=26\text{nH}, T_j=150^{\circ}\text{C}$		211		μC
I_{RM}	Peak Reverse Recovery Current			900		A
E_{rec}	Reverse Recovery Energy			98.0		mJ

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

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

Symbol	Parameter	Min.	Typ.	Max.	Unit
L_{CE}	Stray Inductance		10		nH
$R_{CC'+EE'}$	Module Lead Resistance, Terminal to Chip		0.20		m Ω
R_{thJC}	Junction-to-Case (per IGBT)			16.7	K/kW
	Junction-to-Case (per Diode)			35.9	
R_{thCH}	Case-to-Heatsink (per IGBT)		8.8		K/kW
	Case-to-Heatsink (per Diode)		18.9		
	Case-to-Heatsink (per Module)		3.0		
M	Terminal Connection Torque, Screw M4	1.8		2.1	N.m
	Terminal Connection Torque, Screw M8	8.0		10	
	Mounting Torque, Screw M5	3.0		6.0	
G	Weight of Module		1220		g

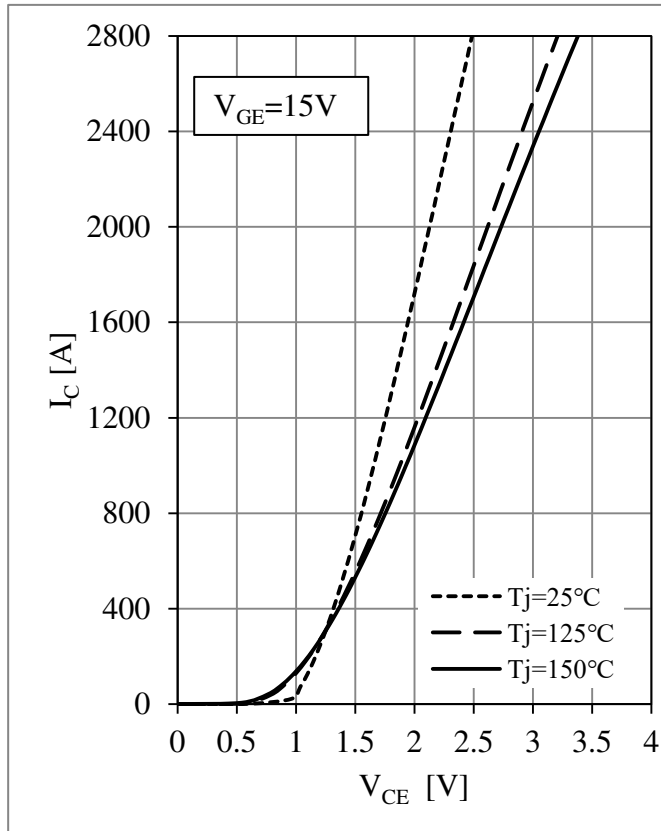


Fig 1. IGBT Output Characteristics

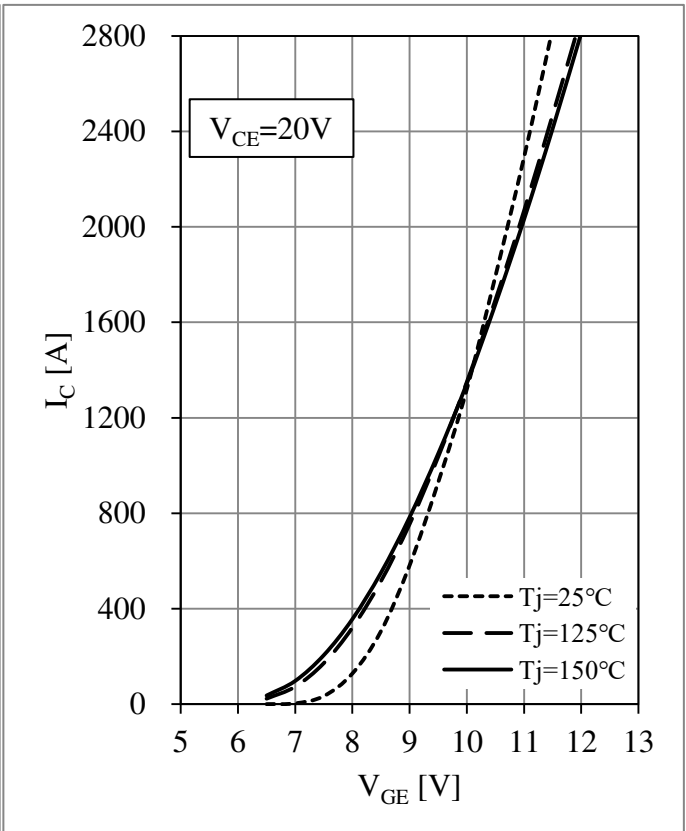
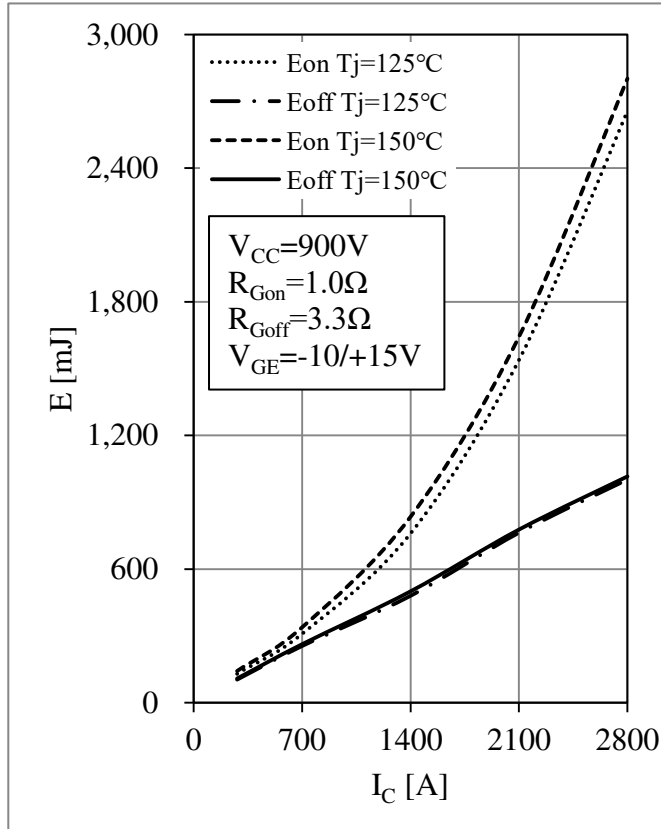
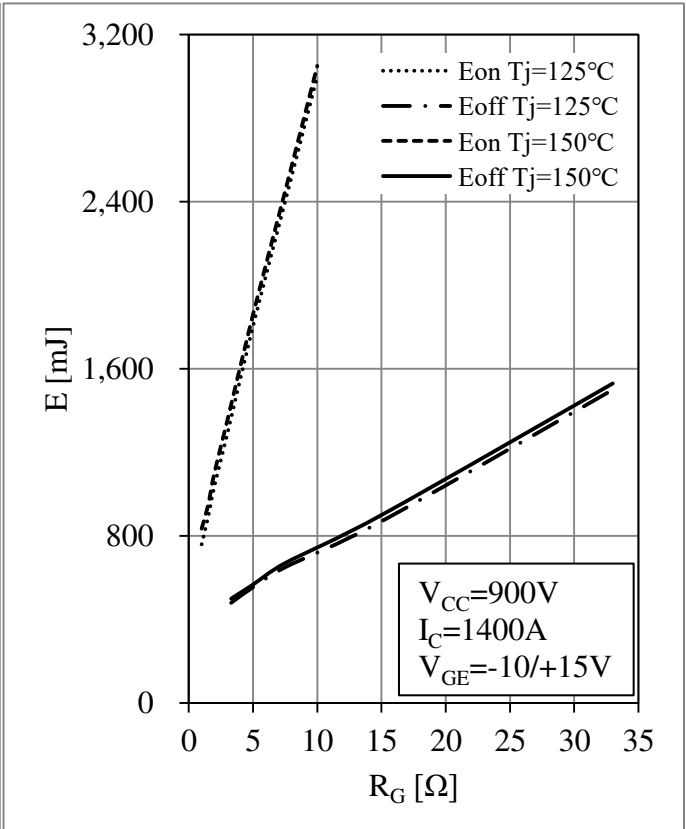


Fig 2. IGBT Transfer Characteristics

Fig 3. IGBT Switching Loss vs. I_C Fig 4. IGBT Switching Loss vs. R_G

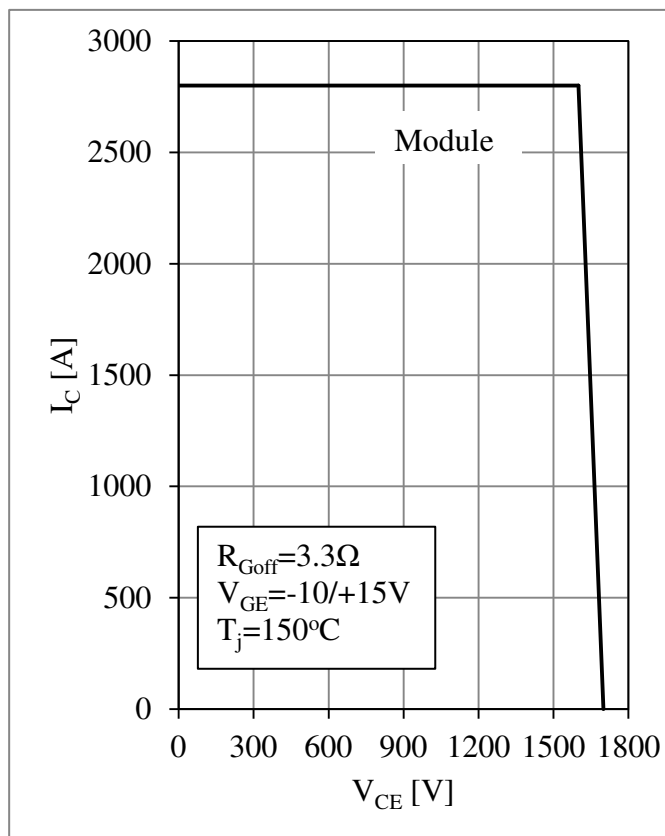


Fig 5. RBSOA

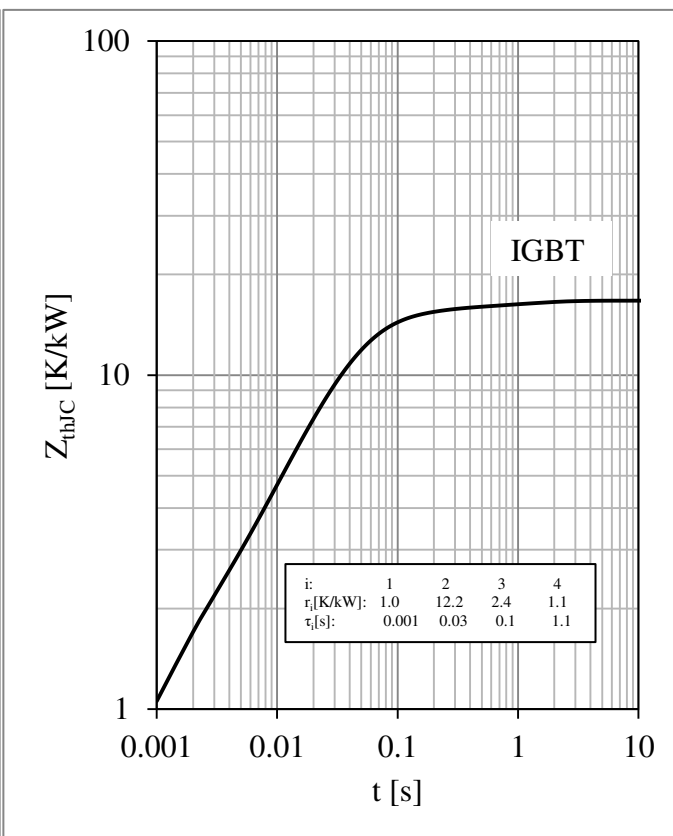


Fig 6. IGBT Transient Thermal Impedance

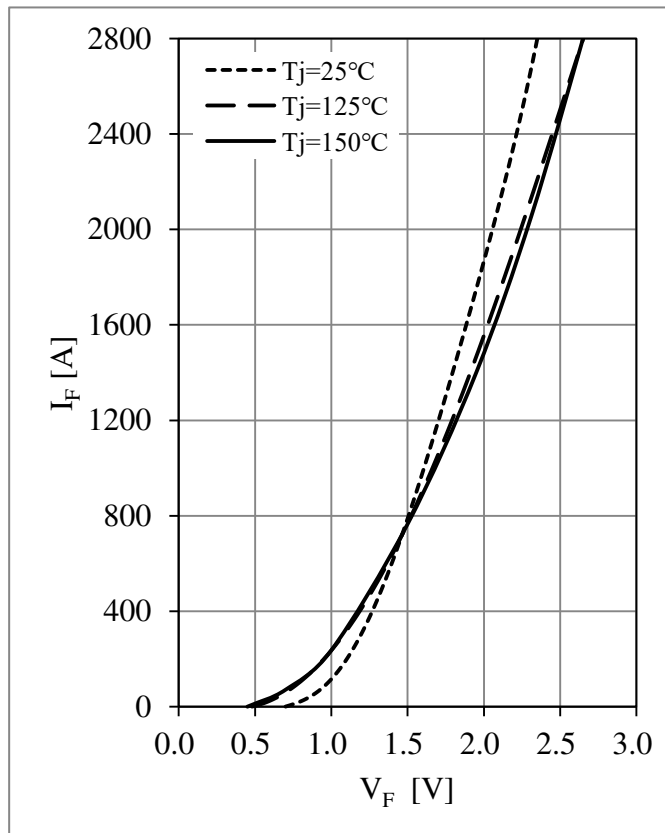
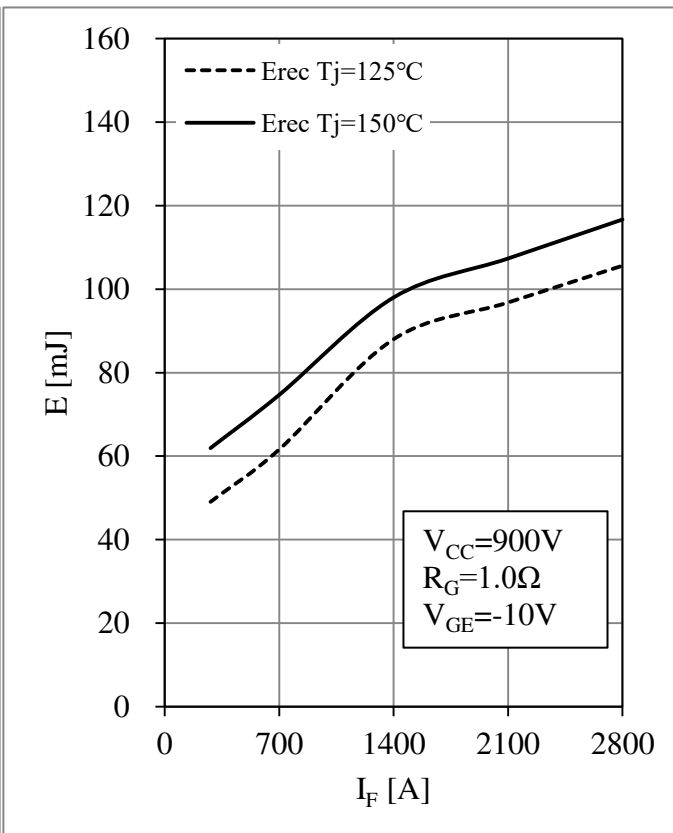


Fig 7. Diode Forward Characteristics

Fig 8. Diode Switching Loss vs. I_F

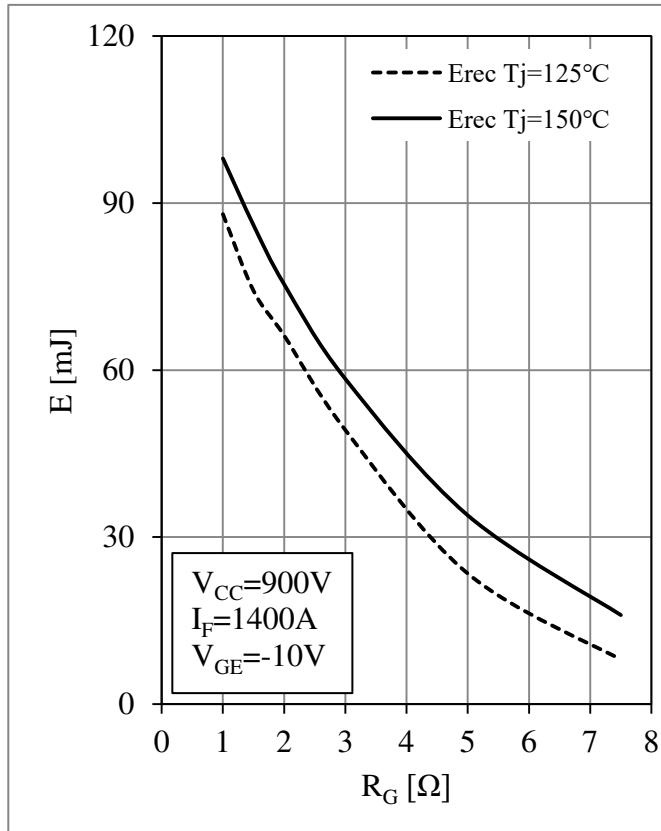
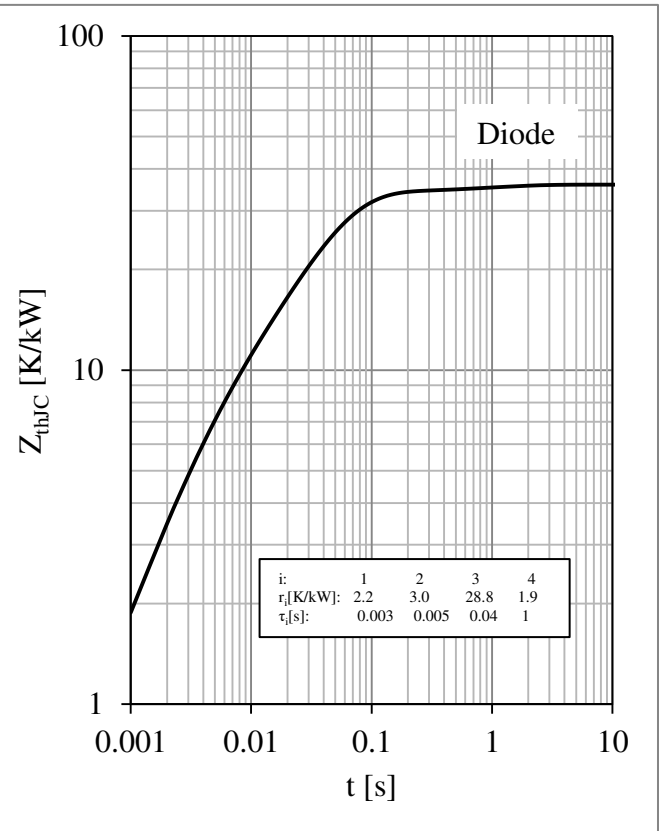
Fig 9. Diode Switching Loss vs. R_G 

Fig 10. Diode Transient Thermal Impedance

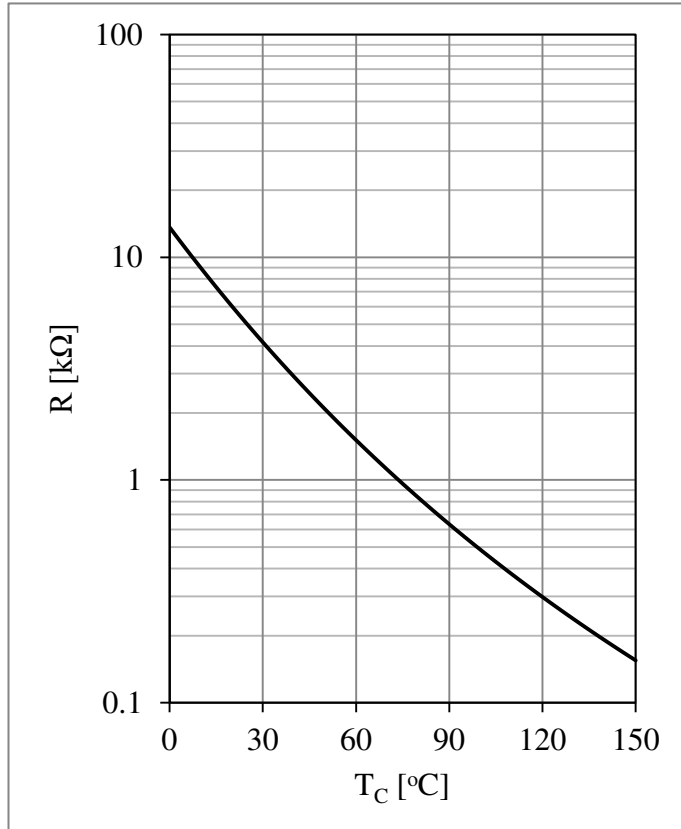
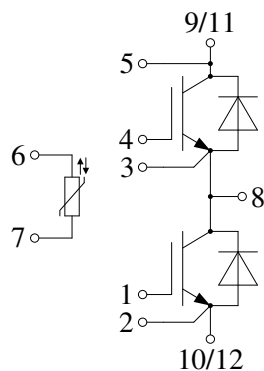


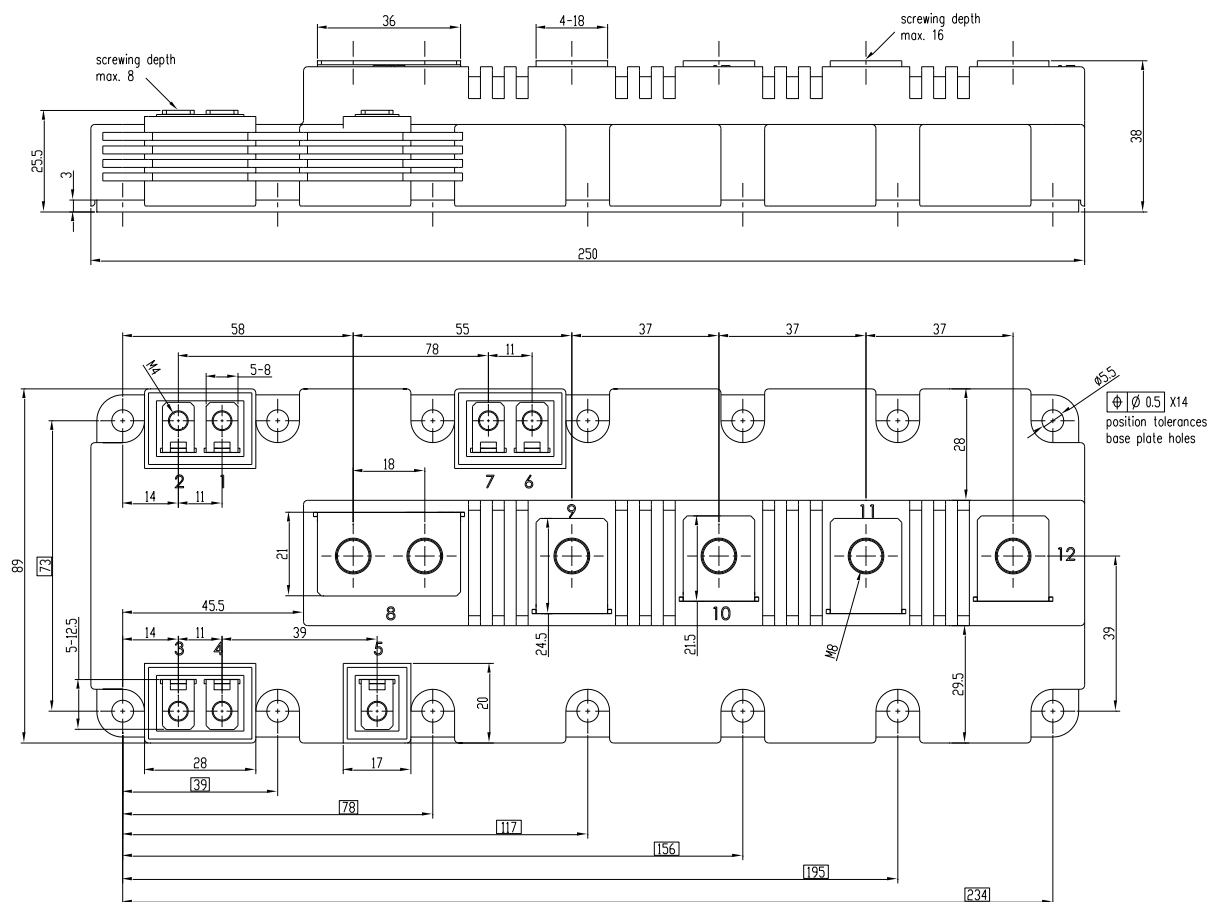
Fig 11. NTC Temperature Characteristic

Circuit Schematic



Package Dimensions

Dimensions in Millimeters



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