

STARPOWER

SEMICONDUCTOR

IGBT

GD650HFX170P1S

1700V/650A 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 and solar power.

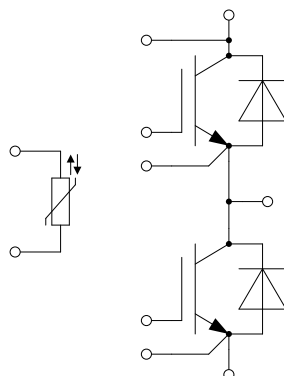
Features

- 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 and Solar Power
- Traction Drive

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 @ $T_C=25^{\circ}\text{C}$ @ $T_C=100^{\circ}\text{C}$	1073 650	A
I_{CM}	Pulsed Collector Current $t_p=1\text{ms}$	1300	A
P_D	Maximum Power Dissipation @ $T_j=175^{\circ}\text{C}$	4.2	kW

Diode

Symbol	Description	Value	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	1700	V
I_F	Diode Continuous Forward Current	650	A
I_{FM}	Diode Maximum Forward Current $t_p=1\text{ms}$	1300	A

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 +150	$^{\circ}\text{C}$
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	$I_C=650\text{A}, V_{GE}=15\text{V}, T_j=25^{\circ}\text{C}$		1.90	2.35	V
		$I_C=650\text{A}, V_{GE}=15\text{V}, T_j=125^{\circ}\text{C}$		2.35		
		$I_C=650\text{A}, V_{GE}=15\text{V}, T_j=150^{\circ}\text{C}$		2.45		
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=24.0\text{mA}, V_{CE}=V_{GE}, T_j=25^{\circ}\text{C}$	5.6	6.2	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			2.3		Ω
C_{ies}	Input Capacitance	$V_{CE}=25\text{V}, f=1\text{MHz}, V_{GE}=0\text{V}$		72.3		nF
C_{res}	Reverse Transfer Capacitance			1.75		nF
Q_G	Gate Charge	$V_{GE}=-15\ldots+15\text{V}$		5.66		μC
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=900\text{V}, I_C=650\text{A}, R_{Gon}=1.8\Omega, R_{Goff}=2.7\Omega, V_{GE}=\pm 15\text{V}, T_j=25^{\circ}\text{C}$		468		ns
t_r	Rise Time			86		ns
$t_{d(off)}$	Turn-Off Delay Time			850		ns
t_f	Fall Time			363		ns
E_{on}	Turn-On Switching Loss			226		mJ
E_{off}	Turn-Off Switching Loss			161		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=900\text{V}, I_C=650\text{A}, R_{Gon}=1.8\Omega, R_{Goff}=2.7\Omega, V_{GE}=\pm 15\text{V}, T_j=125^{\circ}\text{C}$		480		ns
t_r	Rise Time			110		ns
$t_{d(off)}$	Turn-Off Delay Time			1031		ns
t_f	Fall Time			600		ns
E_{on}	Turn-On Switching Loss			338		mJ
E_{off}	Turn-Off Switching Loss			226		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=900\text{V}, I_C=650\text{A}, R_{Gon}=1.8\Omega, R_{Goff}=2.7\Omega, V_{GE}=\pm 15\text{V}, T_j=150^{\circ}\text{C}$		480		ns
t_r	Rise Time			120		ns
$t_{d(off)}$	Turn-Off Delay Time			1040		ns
t_f	Fall Time			684		ns
E_{on}	Turn-On Switching Loss			368		mJ
E_{off}	Turn-Off Switching Loss			242		mJ
I_{SC}	SC Data	$t_p \leq 10\mu\text{s}, V_{GE}=15\text{V}, T_j=150^{\circ}\text{C}, V_{CC}=1000\text{V}, V_{CEM} \leq 1700\text{V}$		2600		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	$I_F=650\text{A}, V_{GE}=0\text{V}, T_j=25^{\circ}\text{C}$		1.85	2.30	V
		$I_F=650\text{A}, V_{GE}=0\text{V}, T_j=125^{\circ}\text{C}$		1.98		
		$I_F=650\text{A}, V_{GE}=0\text{V}, T_j=150^{\circ}\text{C}$		2.02		
Q_r	Recovered Charge	$V_R=900\text{V}, I_F=650\text{A},$ $-di/dt=5980\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=25^{\circ}\text{C}$		176		μC
I_{RM}	Peak Reverse Recovery Current			765		A
E_{rec}	Reverse Recovery Energy			87.4		mJ
Q_r	Recovered Charge	$V_R=900\text{V}, I_F=650\text{A},$ $-di/dt=5980\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=125^{\circ}\text{C}$		292		μC
I_{RM}	Peak Reverse Recovery Current			798		A
E_{rec}	Reverse Recovery Energy			159		mJ
Q_r	Recovered Charge	$V_R=900\text{V}, I_F=650\text{A},$ $-di/dt=5980\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=150^{\circ}\text{C}$		341		μC
I_{RM}	Peak Reverse Recovery Current			805		A
E_{rec}	Reverse Recovery Energy			192		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		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 $T_C=25^{\circ}\text{C}$ unless otherwise noted

Symbol	Parameter	Min.	Typ.	Max.	Unit
L_{CE}	Stray Inductance		18		nH
$R_{CC'+EE'}$	Module Lead Resistance, Terminal to Chip		0.30		m Ω
R_{thJC}	Junction-to-Case (per IGBT)			35.8	K/kW
	Junction-to-Case (per Diode)			71.3	
R_{thCH}	Case-to-Heatsink (per IGBT)		13.5		K/kW
	Case-to-Heatsink (per Diode)		26.9		
	Case-to-Heatsink (per Module)		4.5		
M	Terminal Connection Torque, Screw M4	1.8		2.1	N.m
	Terminal Connection Torque, Screw M8	8.0		10.0	
	Mounting Torque, Screw M5	3.0		6.0	
G	Weight of Module		810		g

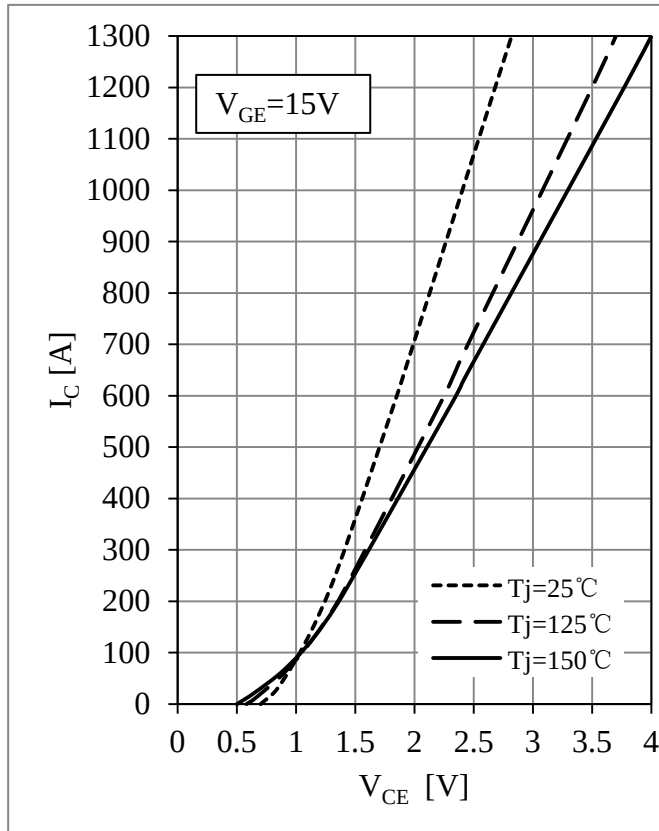


Fig 1. IGBT Output Characteristics

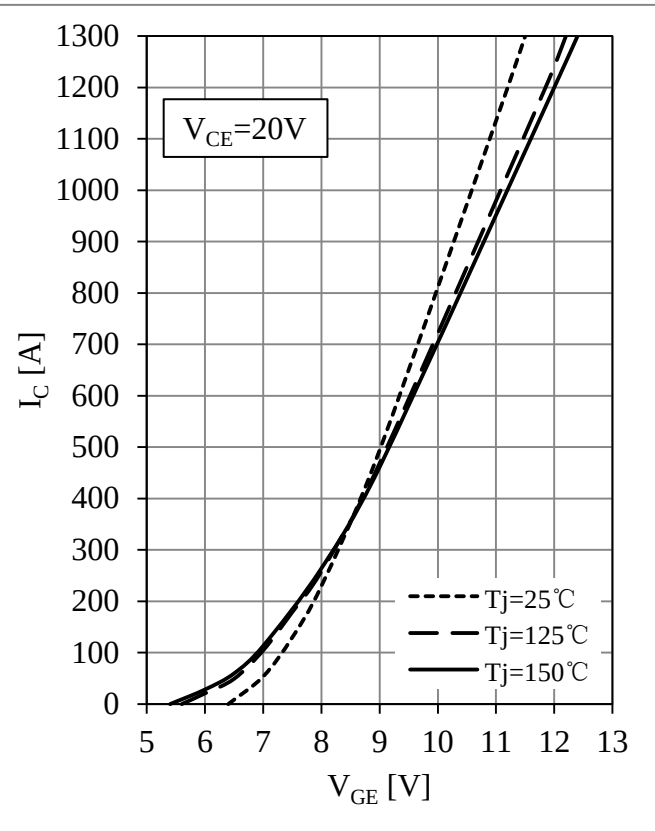
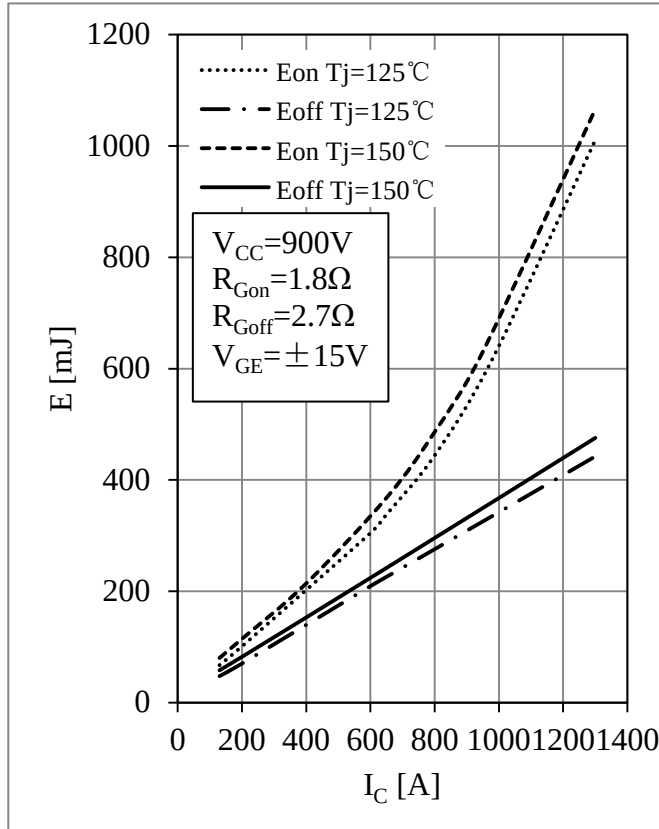
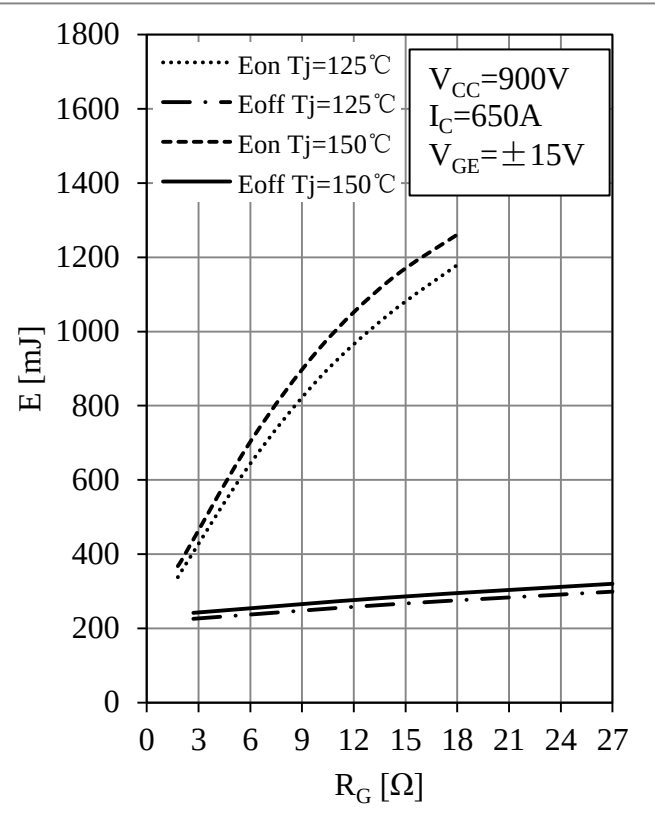


Fig 2. IGBT Transfer Characteristics

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

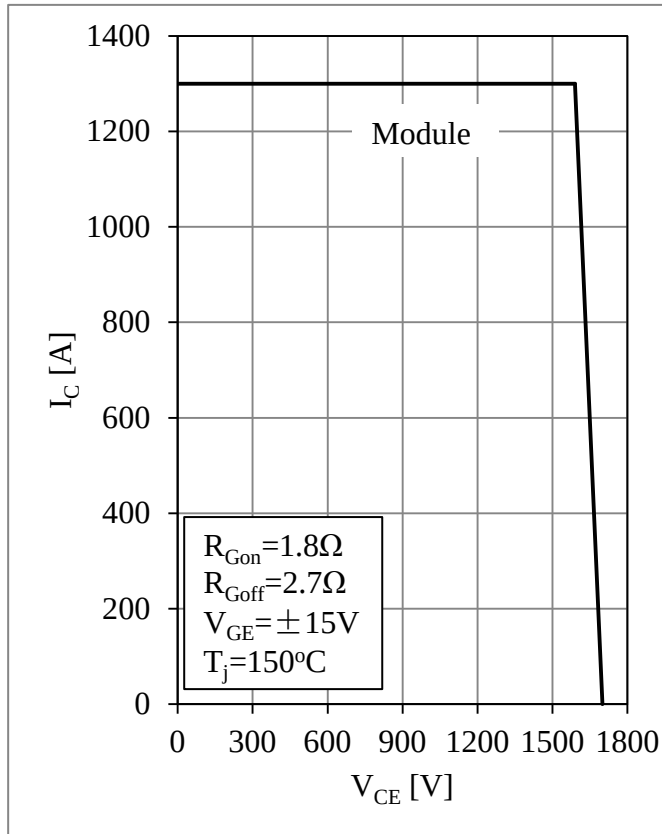


Fig 5. RBSOA

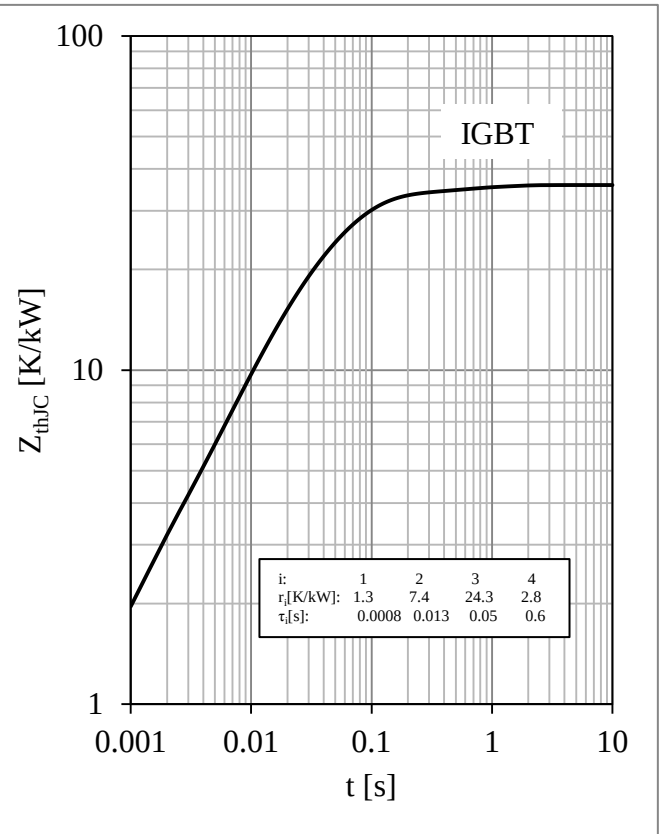


Fig 6. IGBT Transient Thermal Impedance

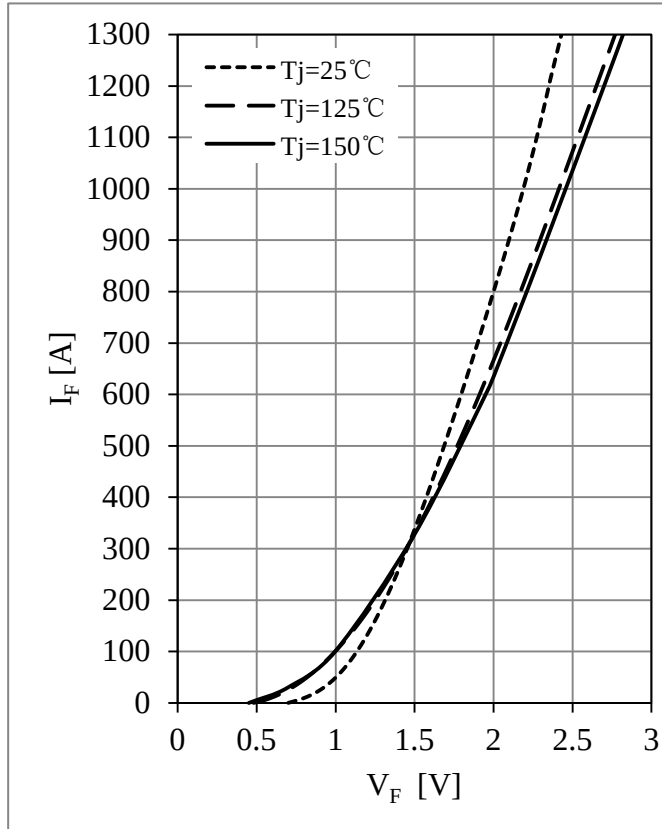
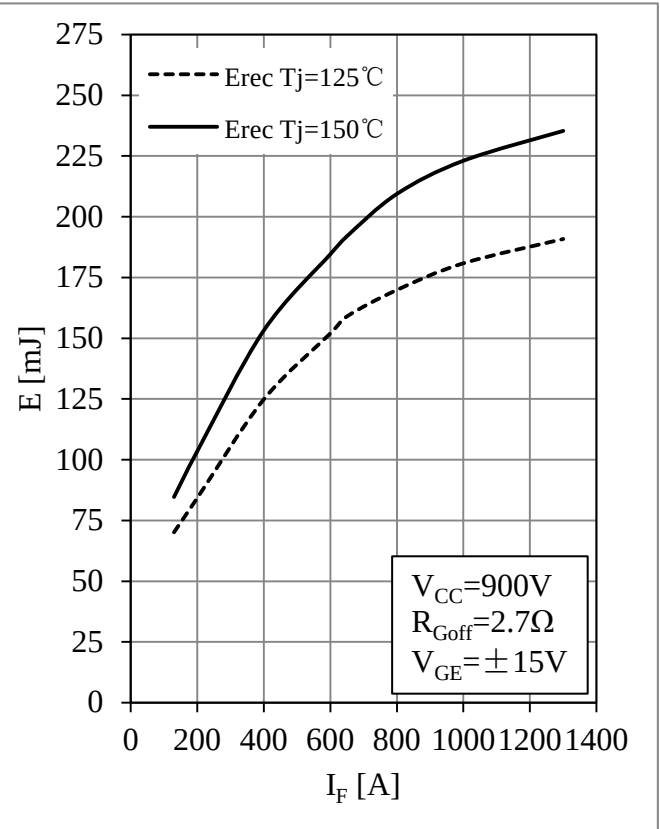


Fig 7. Diode Forward Characteristics

Fig 8. Diode Switching Loss vs. I_F

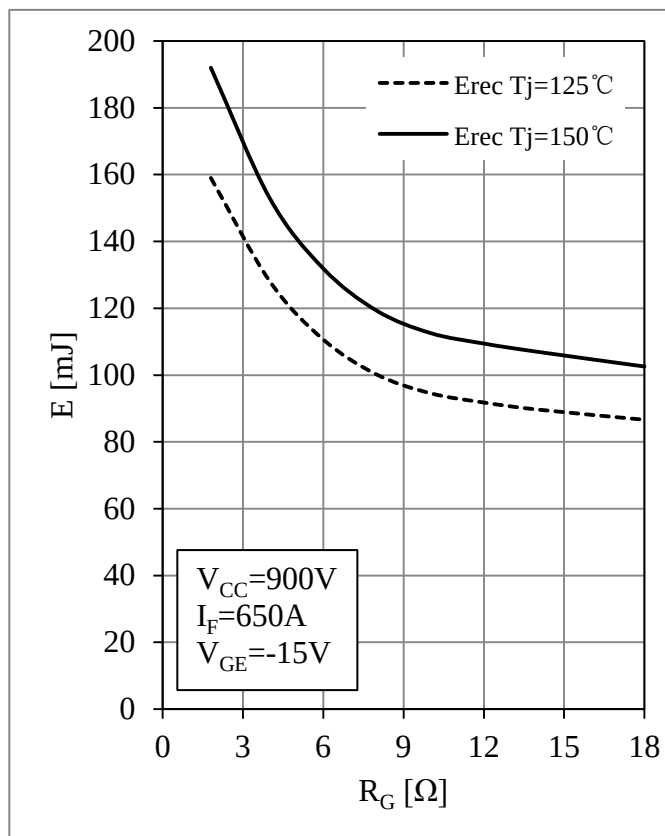
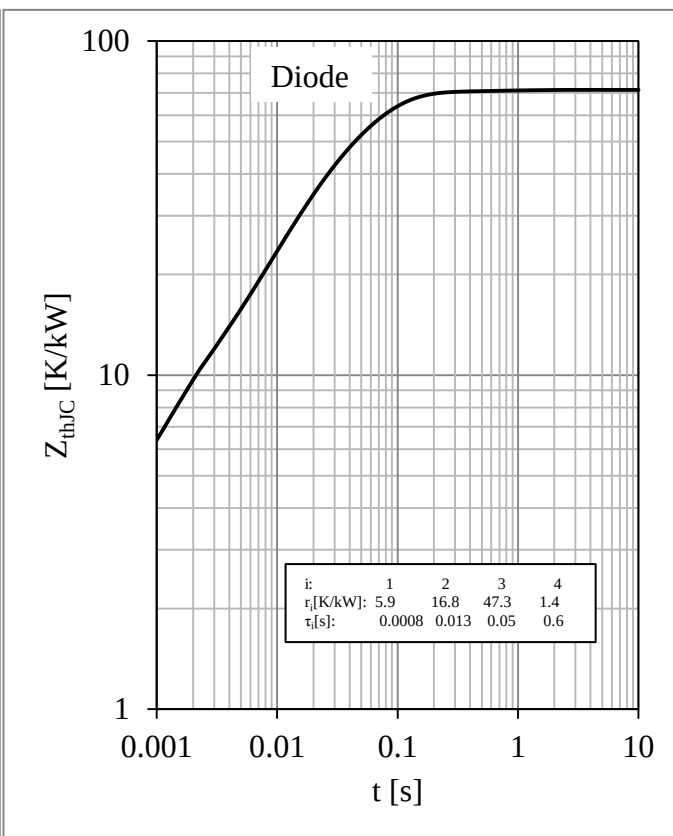
Fig 9. Diode Switching Loss vs. R_G 

Fig 10. Diode Transient Thermal Impedance

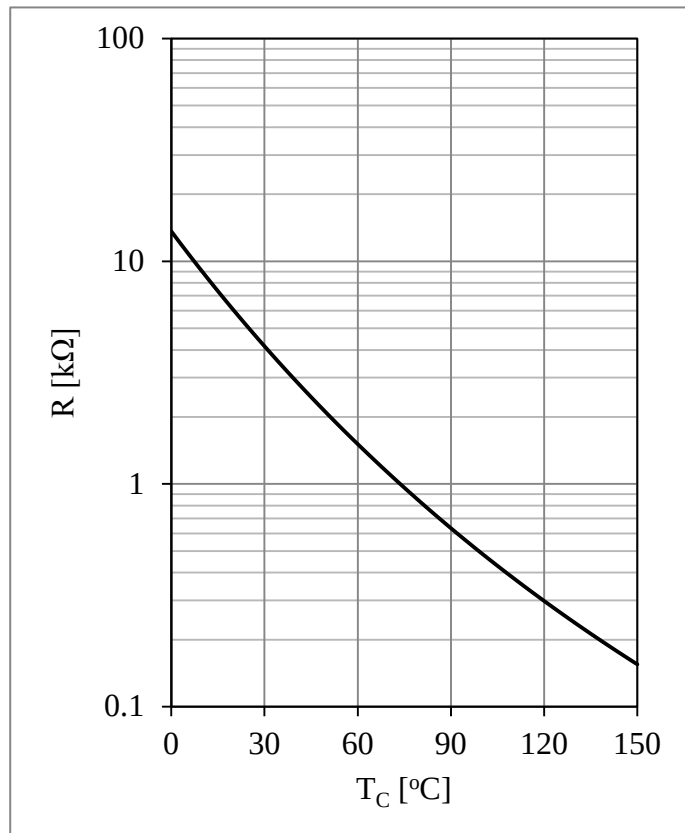
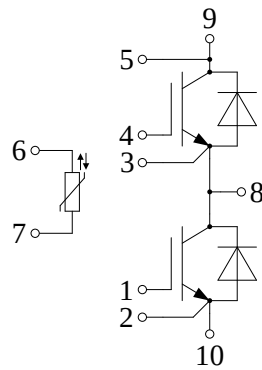


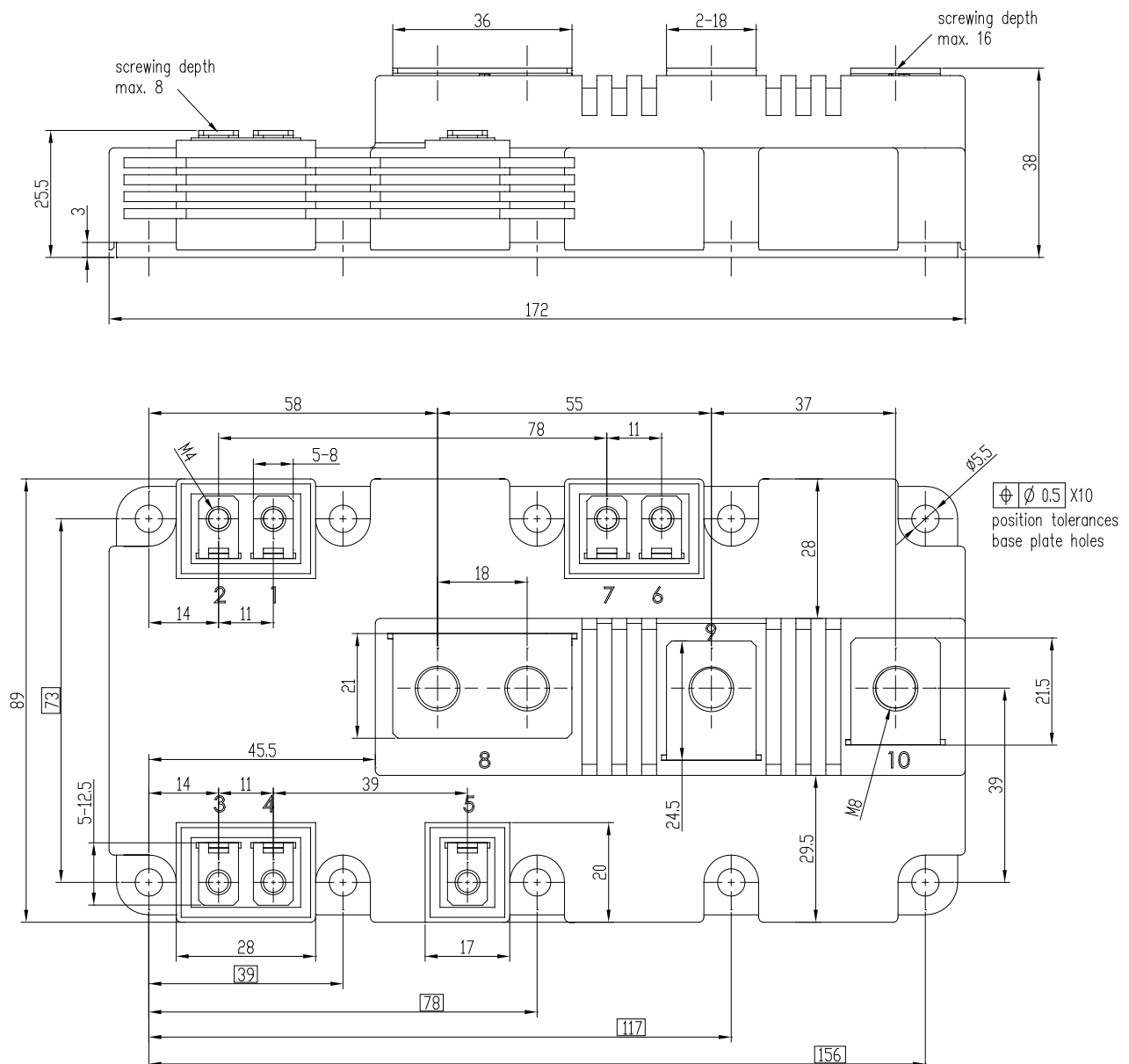
Fig 11. NTC Temperature Characteristic

Circuit Schematic



Package Dimensions

Dimensions in Millimeters



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