STARPOWER

SEMICONDUCTOR **IGBT**

GD1400HFX120P2SA

1200V/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 electric vehicle and solar power.

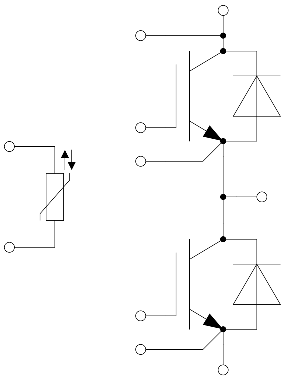
Features

- Low $V_{CE(sat)}$ Trench IGBT technology
- 10μs short circuit capability
- $V_{CE(sat)}$ with positive temperature coefficient
- Maximum junction temperature 175°C
- Low inductance case
- Isolated copper baseplate using DBC technology
- High power and thermal cycling capability

Typical Applications

- High Power Converter
- Solar Power
- Hybrid and Electric Vehicle

Equivalent Circuit Schematic



Absolute Maximum Ratings T_C=25°C unless otherwise noted

IGBT

Symbol	Description	Value	Unit
V_{CES}	Collector-Emitter Voltage	1200	V
V_{GES}	Gate-Emitter Voltage	±20	V
I_C	Collector Current @ T_C=25°C @ T_C=100°C	2286 1400	A
I_{CM}	Pulsed Collector Current t_p=1ms	2800	A
P_D	Maximum Power Dissipation @ T_j=175°C	7.77	kW

Diode

Symbol	Description	Value	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	1200	V
I_F	Diode Continuous Forward Current	1400	A
I_{FM}	Diode Maximum Forward Current t_p=1ms	2800	A

Module

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

IGBT Characteristics T_C=25°C unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	I_C=1400A,V_{GE}=15V, T_j=25°C		1.70	2.15	V
		I_C=1400A,V_{GE}=15V, T_j=125°C		1.95		
		I_C=1400A,V_{GE}=15V, T_j=150°C		2.00		
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	I_C=33.0mA,V_{CE}=V_{GE}, T_j=25°C	5.2	6.0	6.8	V
I_{CES}	Collector Cut-Off Current	V_{CE}=V_{CES},V_{GE}=0V, T_j=25°C			5.0	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			0.3		Ω
C_{ies}	Input Capacitance	V_{CE}=25V,f=1MHz, V_{GE}=0V		137		nF
C_{res}	Reverse Transfer Capacitance			3.83		nF
Q_G	Gate Charge	V_{GE}=-15…+15V		10.3		μC
$t_{d(on)}$	Turn-On Delay Time	V_{CC}=600V,I_C=1400A, R_G=1.0Ω,V_{GE}=±15V, T_j=25°C		190		ns
t_r	Rise Time			114		ns
$t_{d(off)}$	Turn-Off Delay Time			783		ns
t_f	Fall Time			180		ns
E_{on}	Turn-On Switching Loss			61.8		mJ
E_{off}	Turn-Off Switching Loss			194		mJ
$t_{d(on)}$	Turn-On Delay Time	V_{CC}=600V,I_C=1400A, R_G=1.0Ω,V_{GE}=±15V, T_j=125°C		200		ns
t_r	Rise Time			124		ns
$t_{d(off)}$	Turn-Off Delay Time			855		ns
t_f	Fall Time			207		ns
E_{on}	Turn-On Switching Loss			76.0		mJ
E_{off}	Turn-Off Switching Loss			252		mJ
$t_{d(on)}$	Turn-On Delay Time	V_{CC}=600V,I_C=1400A, R_G=1.0Ω,V_{GE}=±15V, T_j=150°C		200		ns
t_r	Rise Time			124		ns
$t_{d(off)}$	Turn-Off Delay Time			873		ns
t_f	Fall Time			207		ns
E_{on}	Turn-On Switching Loss			90.3		mJ
E_{off}	Turn-Off Switching Loss			284		mJ
I_{SC}	SC Data	t_P≤10μs,V_{GE}=15V, T_j=150°C,V_{CC}=800V, V_{CEM}≤1200V		5600		A

Diode Characteristics T_C=25°C unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_F	Diode Forward Voltage	I_F=1400A,V_{GE}=0V,T_j=25°C		1.85	2.30	V
		I_F=1400A,V_{GE}=0V,T_j=125°C		1.90		
		I_F=1400A,V_{GE}=0V,T_j=150°C		1.95		
Q_r	Recovered Charge	V_R=600V,I_F=1400A, -di/dt=8400A/μs,V_{GE}=-15V T_j=25°C		155		μC
I_{RM}	Peak Reverse Recovery Current			897		A
E_{rec}	Reverse Recovery Energy			68.6		mJ
Q_r	Recovered Charge	V_R=600V,I_F=1400A, -di/dt=8400A/μs,V_{GE}=-15V T_j=125°C		270		μC
I_{RM}	Peak Reverse Recovery Current			1150		A
E_{rec}	Reverse Recovery Energy			108		mJ
Q_r	Recovered Charge	V_R=600V,I_F=1400A, -di/dt=8400A/μs,V_{GE}=-15V T_j=150°C		311		μC
I_{RM}	Peak Reverse Recovery Current			1208		A
E_{rec}	Reverse Recovery Energy			127		mJ

NTC Characteristics T_C=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_C=25°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		mΩ
R_{thJC}	Junction-to-Case (per IGBT) Junction-to-Case (per Diode)			19.3 35.8	K/kW
R_{thCH}	Case-to-Heatsink (per IGBT) Case-to-Heatsink (per Diode) Case-to-Heatsink (per Module)		9.24 17.1 3.00		K/kW
M	Terminal Connection Torque, Screw M4 Terminal Connection Torque, Screw M8 Mounting Torque, Screw M5	1.8 8.0 3.0		2.1 10 6.0	N.m
G	Weight of Module		1210		g

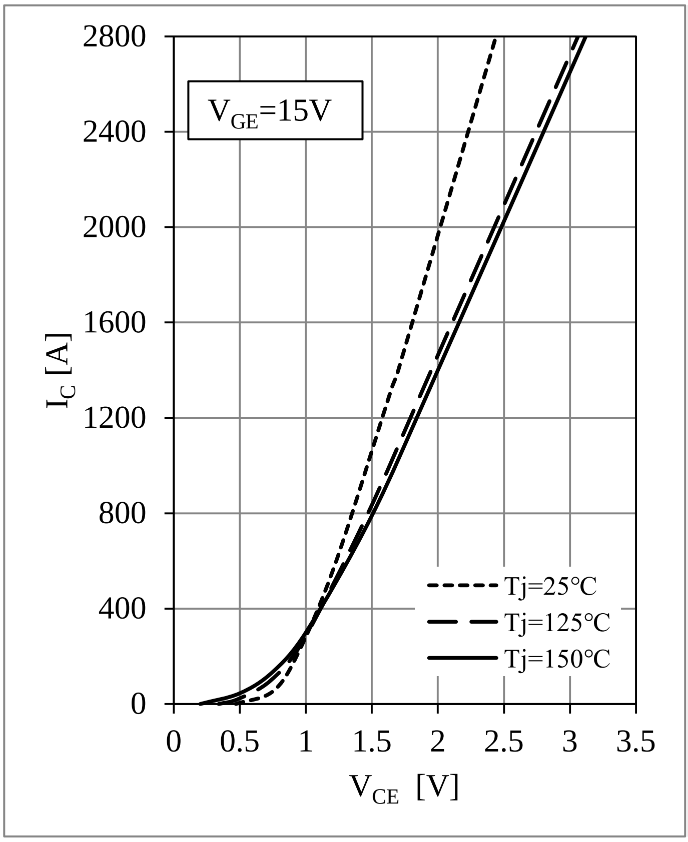


Fig 1. IGBT Output Characteristics

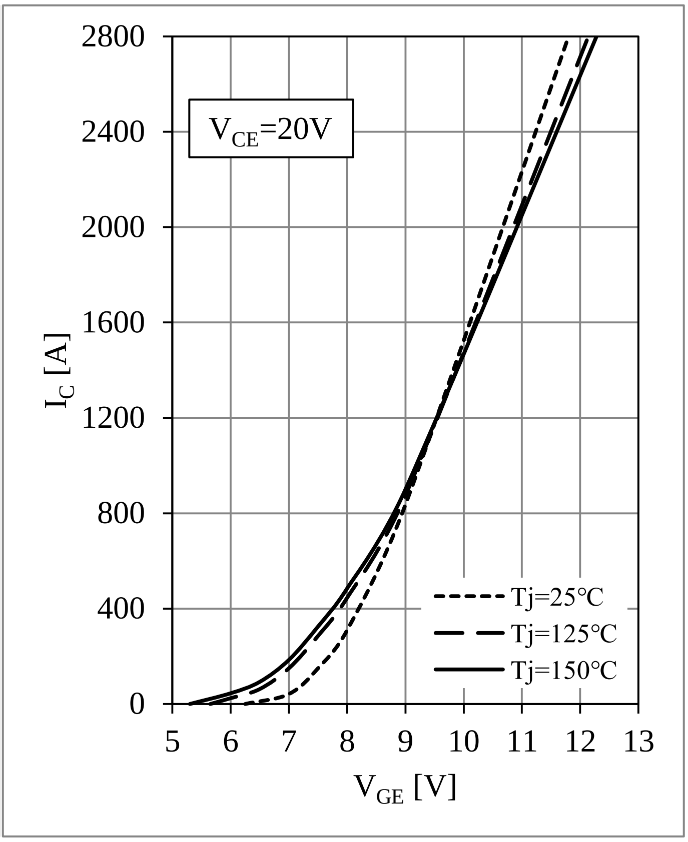


Fig 2. IGBT Transfer Characteristics

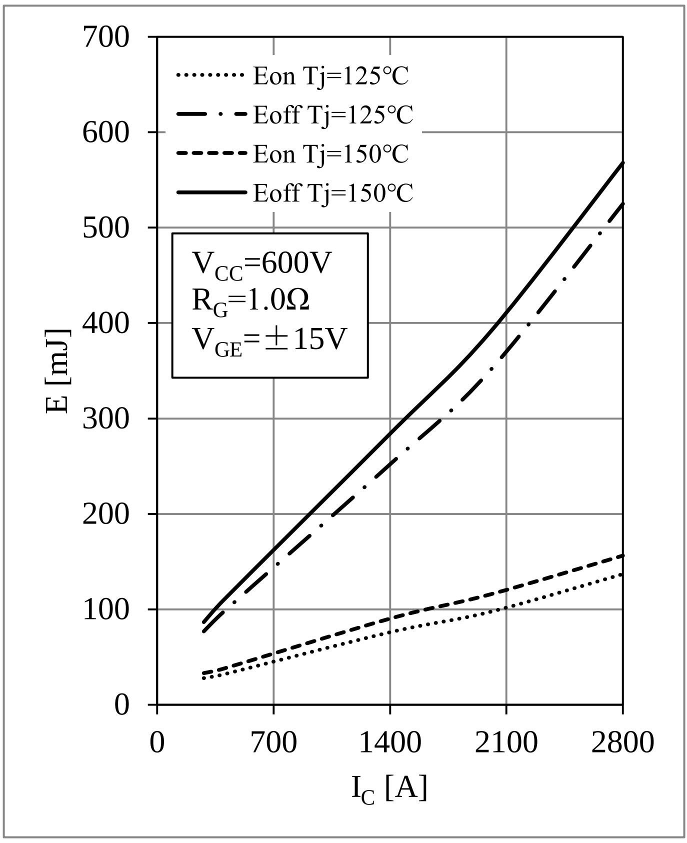


Fig 3. IGBT Switching Loss vs. I_C

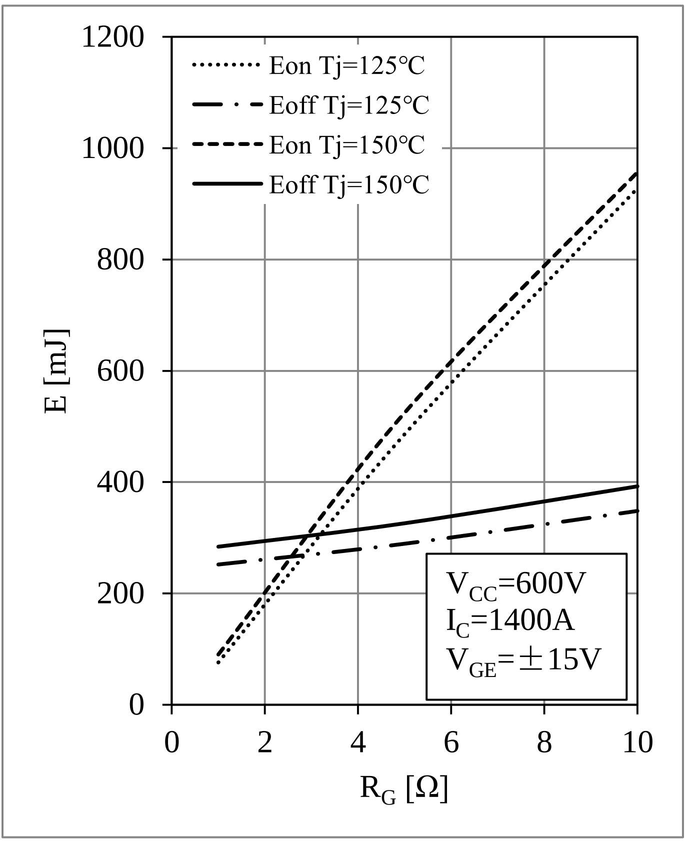


Fig 4. IGBT Switching Loss vs. R_G

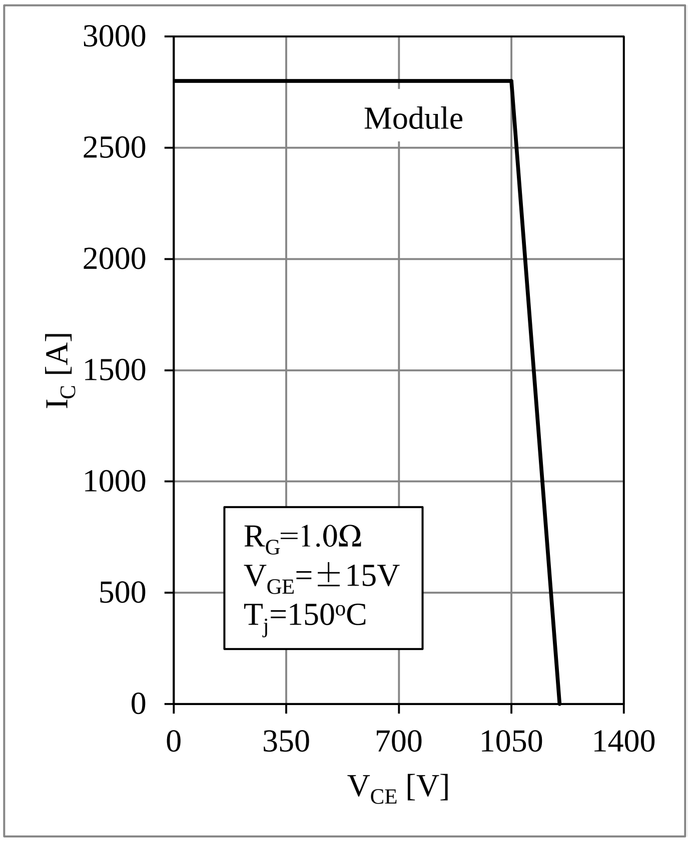
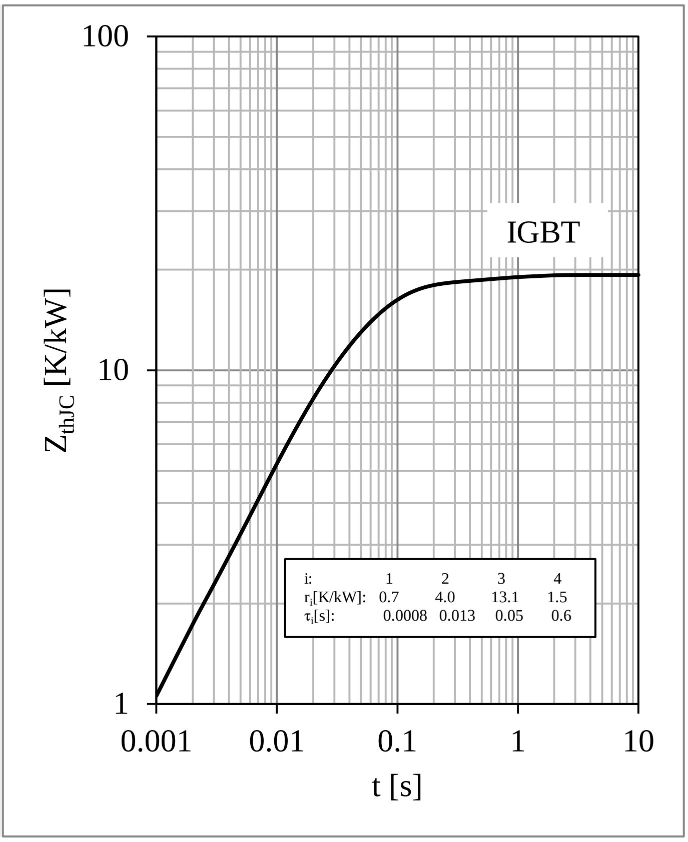


Fig 5. RBSOA



i:	1	2	3	4
r_i[K/kW]:	0.7	4.0	13.1	1.5
τ_i[s]:	0.0008	0.013	0.05	0.6

Fig 6. IGBT Transient Thermal Impedance

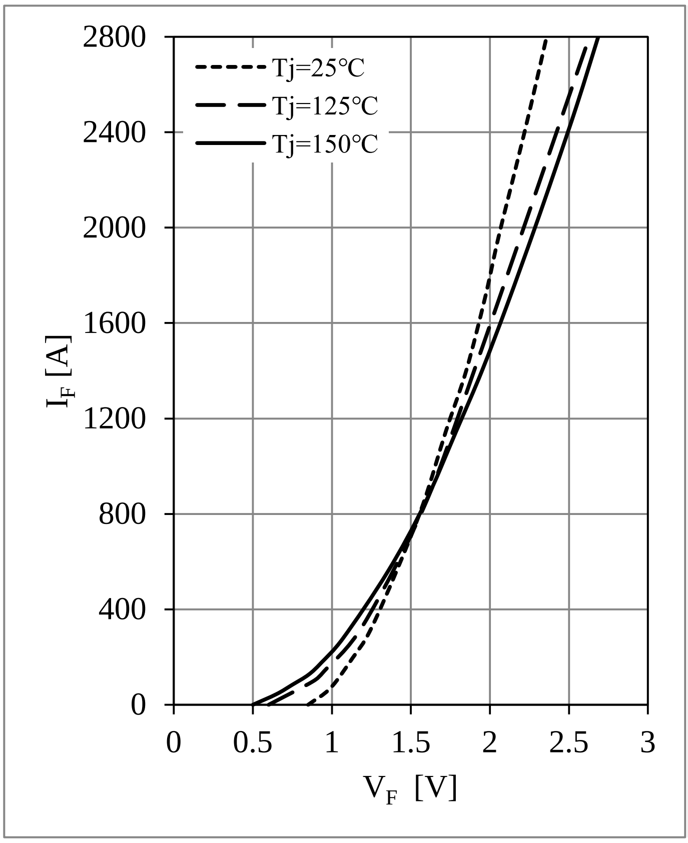


Fig 7. Diode Forward Characteristics

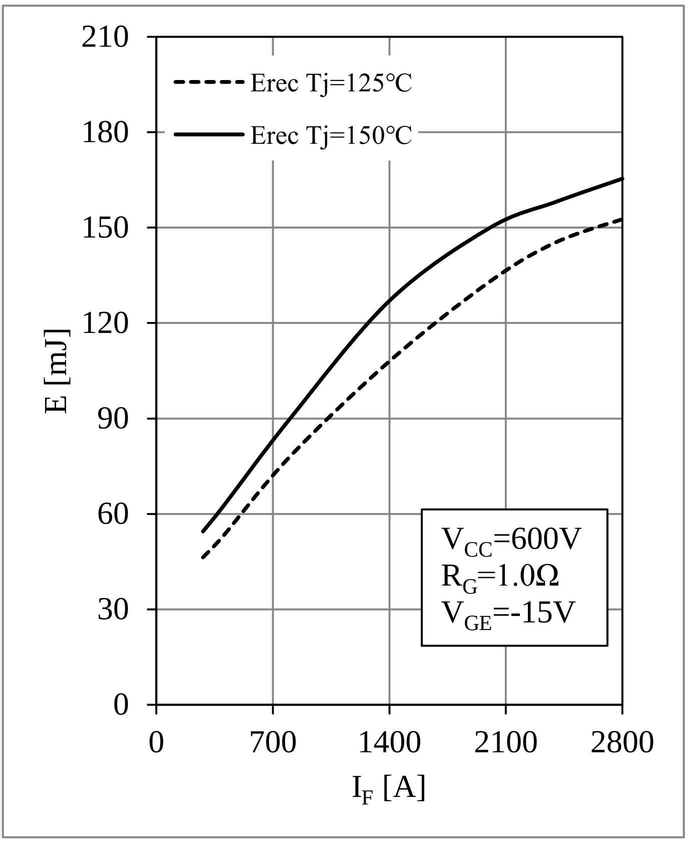


Fig 8. Diode Switching Loss vs. I_F

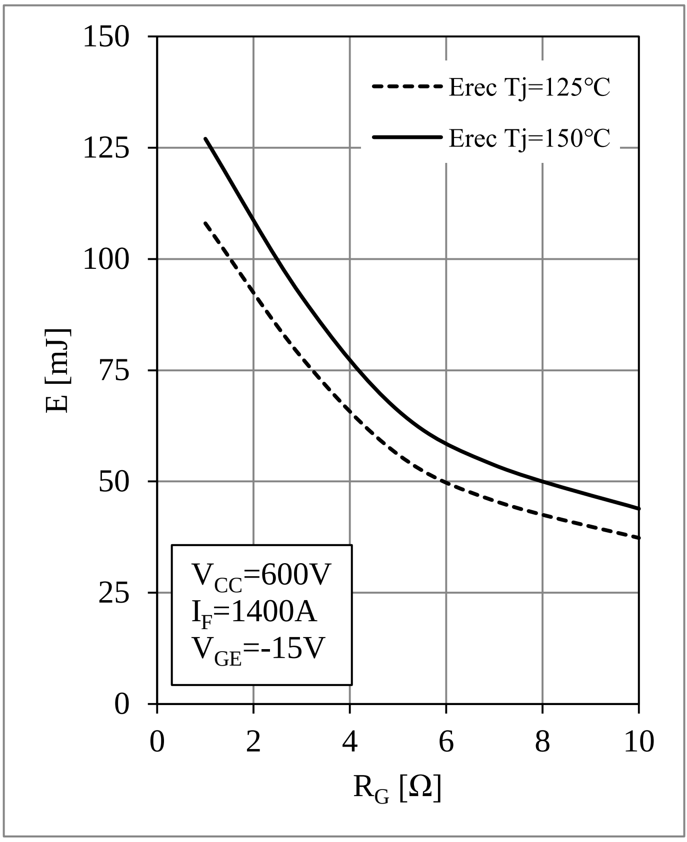


Fig 9. Diode Switching Loss vs. R_G

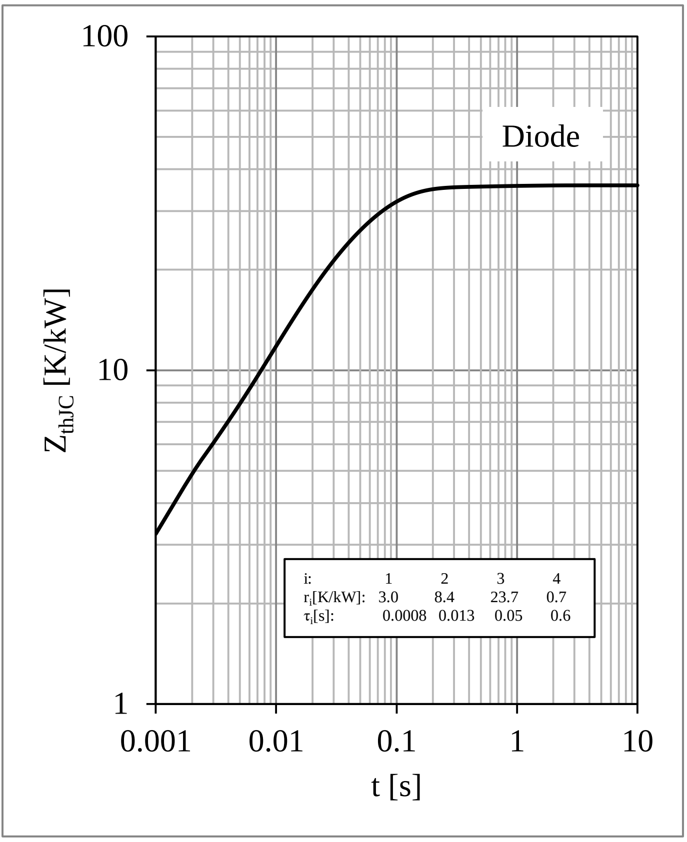


Fig 10. Diode Transient Thermal Impedance

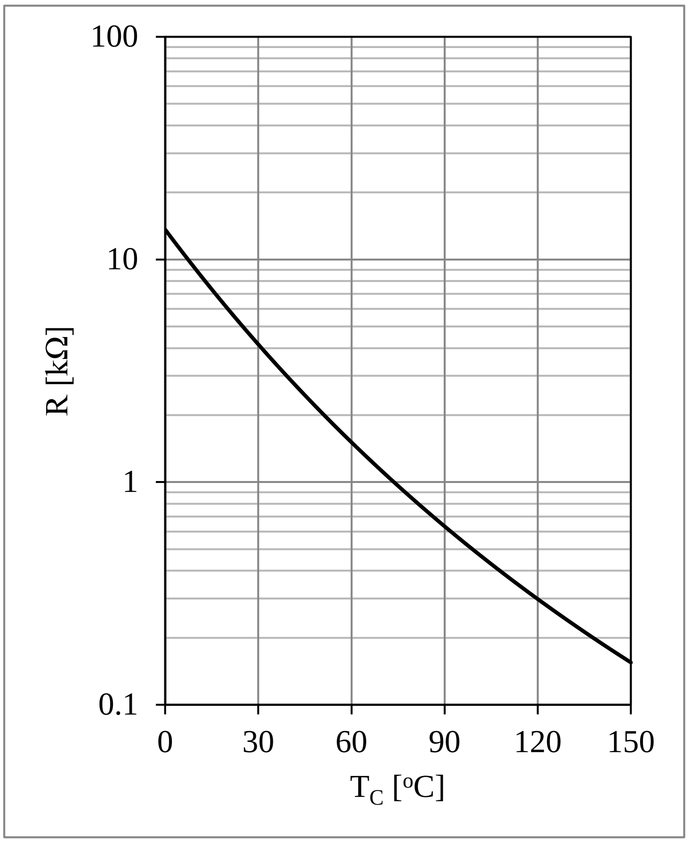
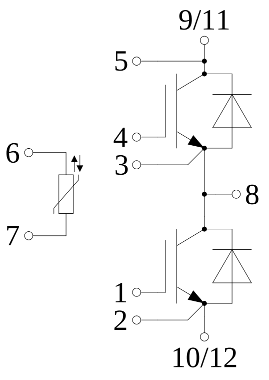


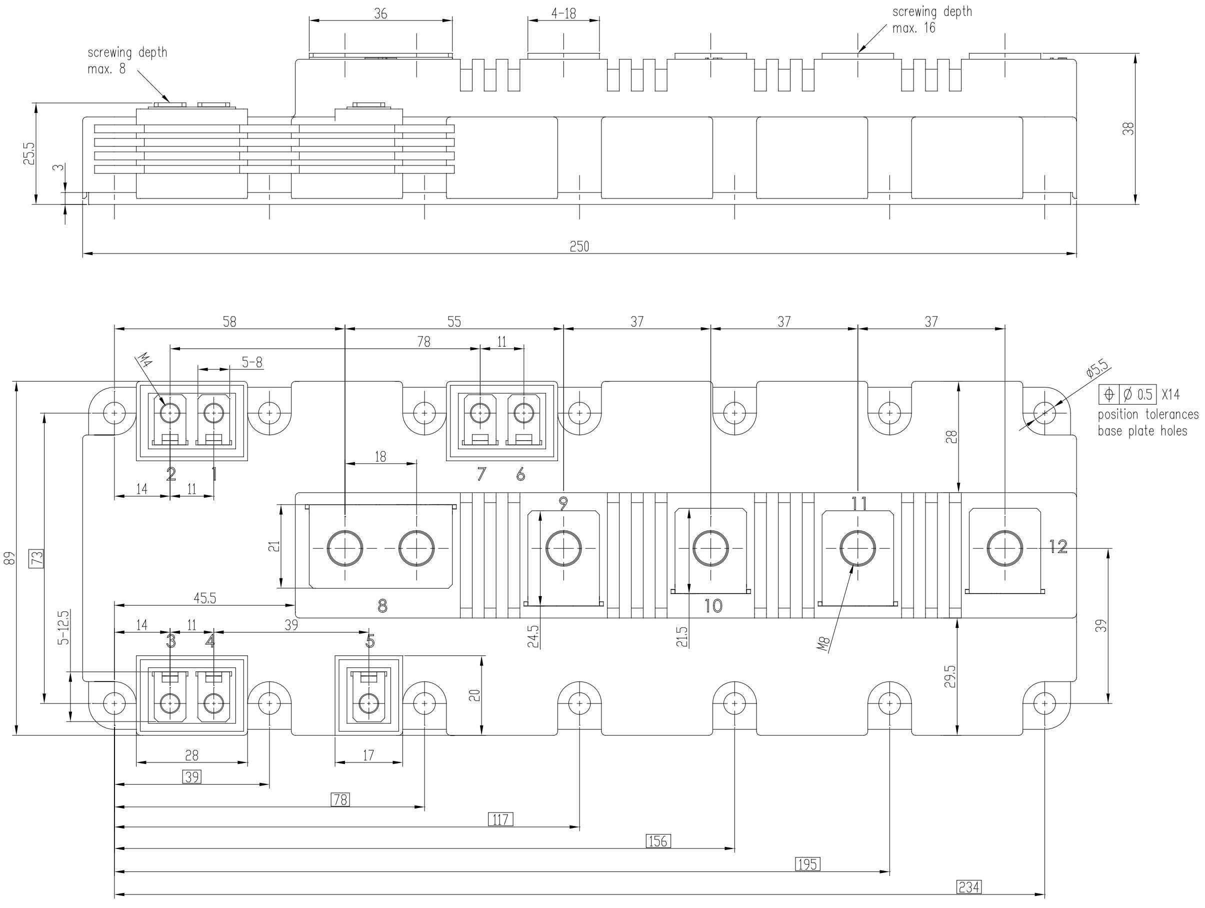
Fig 11. NTC Temperature Characteristic

Circuit Schematic



Package Dimensions

Dimensions in Millimeters



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