

# STARPOWER

SEMICONDUCTOR

**IGBT**

## GD450HFY120P1S

**1200V/450A 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.



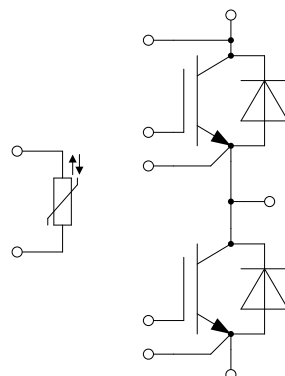
### Features

- Low  $V_{CE(sat)}$  Trench IGBT technology
- 10 $\mu$ s short circuit capability
- $V_{CE(sat)}$  with positive temperature coefficient
- Maximum junction temperature 175 $^{\circ}$ 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**  $T_C=25^{\circ}\text{C}$  unless otherwise noted**IGBT**

Symbol	Description	Value	Unit
$V_{CES}$	Collector-Emitter Voltage	1200	V
$V_{GES}$	Gate-Emitter Voltage	$\pm 20$	V
$I_C$	Collector Current @ $T_C=25^{\circ}\text{C}$	761	A
	@ $T_C=100^{\circ}\text{C}$	450	A
$I_{CM}$	Pulsed Collector Current $t_p=1\text{ms}$	900	A
$P_D$	Maximum Power Dissipation @ $T_j=175^{\circ}\text{C}$	2.6	kW

**Diode**

Symbol	Description	Value	Unit
$V_{RRM}$	Repetitive Peak Reverse Voltage	1200	V
$I_F$	Diode Continuous Forward Current	450	A
$I_{FM}$	Diode Maximum Forward Current $t_p=1\text{ms}$	900	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 +125	$^{\circ}\text{C}$
$V_{ISO}$	Isolation Voltage RMS, $f=50\text{Hz}$ , $t=1\text{min}$	2500	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	$I_C=450\text{A}, V_{GE}=15\text{V}, T_j=25^\circ\text{C}$		1.70	2.05	V	
		$I_C=450\text{A}, V_{GE}=15\text{V}, T_j=125^\circ\text{C}$		1.95			
		$I_C=450\text{A}, V_{GE}=15\text{V}, T_j=150^\circ\text{C}$		2.00			
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=11.3\text{mA}, V_{CE}=V_{GE}, T_j=25^\circ\text{C}$	5.2	6.0	6.8	V	
$I_{CES}$	Collector Cut-Off Current	$V_{CE}=V_{CES}, V_{GE}=0\text{V}, T_j=25^\circ\text{C}$			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			2.4		$\Omega$	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=450\text{A}, R_{Gon}=2.5\Omega, R_{Goff}=3.1\Omega, V_{GE}=\pm 15\text{V}, T_j=25^\circ\text{C}$		235		ns	
$t_r$	Rise Time			96		ns	
$t_{d(off)}$	Turn-Off Delay Time			618		ns	
$t_f$	Fall Time			93		ns	
$E_{on}$	Turn-On Switching Loss				44.9		mJ
$E_{off}$	Turn-Off Switching Loss				41.2		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=450\text{A}, R_{Gon}=2.5\Omega, R_{Goff}=3.1\Omega, V_{GE}=\pm 15\text{V}, T_j=125^\circ\text{C}$		268		ns	
$t_r$	Rise Time			107		ns	
$t_{d(off)}$	Turn-Off Delay Time			721		ns	
$t_f$	Fall Time			144		ns	
$E_{on}$	Turn-On Switching Loss				63.1		mJ
$E_{off}$	Turn-Off Switching Loss				53.4		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=450\text{A}, R_{Gon}=2.5\Omega, R_{Goff}=3.1\Omega, V_{GE}=\pm 15\text{V}, T_j=150^\circ\text{C}$		278		ns	
$t_r$	Rise Time			107		ns	
$t_{d(off)}$	Turn-Off Delay Time			762		ns	
$t_f$	Fall Time			165		ns	
$E_{on}$	Turn-On Switching Loss				68.5		mJ
$E_{off}$	Turn-Off Switching Loss				60.8		mJ
$I_{SC}$	SC Data	$t_p \leq 10\mu\text{s}, V_{GE}=15\text{V}, T_j=150^\circ\text{C}, V_{CC}=800\text{V}, V_{CEM} \leq 1200\text{V}$		1800		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	$I_F=450\text{A}, V_{GE}=0\text{V}, T_j=25^{\circ}\text{C}$		1.65	2.10	V
		$I_F=450\text{A}, V_{GE}=0\text{V}, T_j=125^{\circ}\text{C}$		1.65		
		$I_F=450\text{A}, V_{GE}=0\text{V}, T_j=150^{\circ}\text{C}$		1.65		
$Q_r$	Recovered Charge	$V_{CC}=600\text{V}, I_F=450\text{A},$ $-di/dt=3800\text{A}/\mu\text{s}, V_{GE}=-15\text{V},$ $T_j=25^{\circ}\text{C}$		38		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current			228		A
$E_{rec}$	Reverse Recovery Energy			18.1		mJ
$Q_r$	Recovered Charge	$V_{CC}=600\text{V}, I_F=450\text{A},$ $-di/dt=3800\text{A}/\mu\text{s}, V_{GE}=-15\text{V},$ $T_j=125^{\circ}\text{C}$		76		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current			290		A
$E_{rec}$	Reverse Recovery Energy			31.4		mJ
$Q_r$	Recovered Charge	$V_{CC}=600\text{V}, I_F=450\text{A},$ $-di/dt=3800\text{A}/\mu\text{s}, V_{GE}=-15\text{V},$ $T_j=150^{\circ}\text{C}$		86		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current			318		A
$E_{rec}$	Reverse Recovery Energy			34.2		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		18		nH
$R_{CC'+EE'}$	Module Lead Resistance, Terminal to Chip		0.30		m $\Omega$
$R_{thJC}$	Junction-to-Case (per IGBT) Junction-to-Case (per Diode)			57.2 101.9	K/kW
$R_{thCH}$	Case-to-Heatsink (per IGBT) Case-to-Heatsink (per Diode) Case-to-Heatsink (per Module)		14.1 25.0 4.5		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		825		g

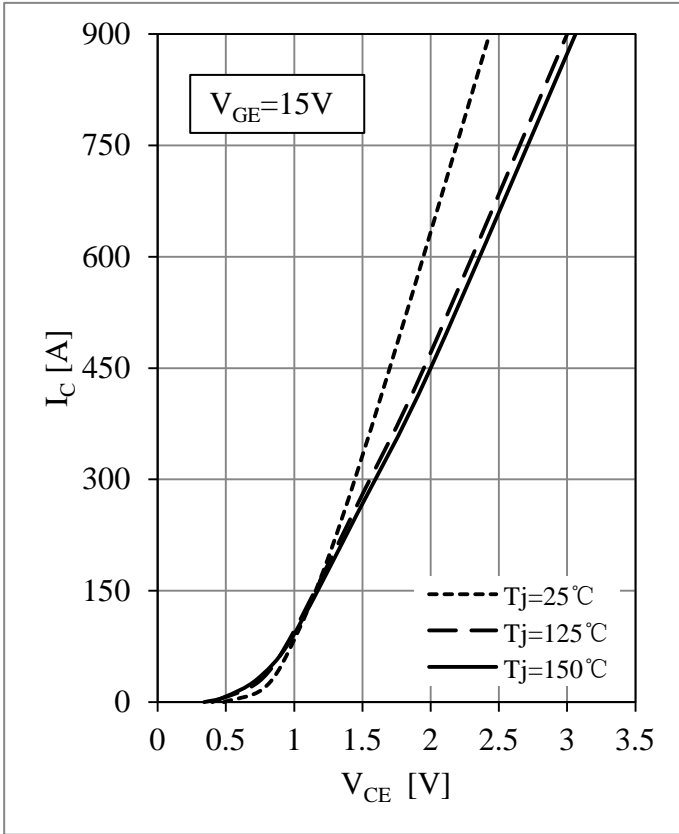


Fig 1. IGBT Output Characteristics

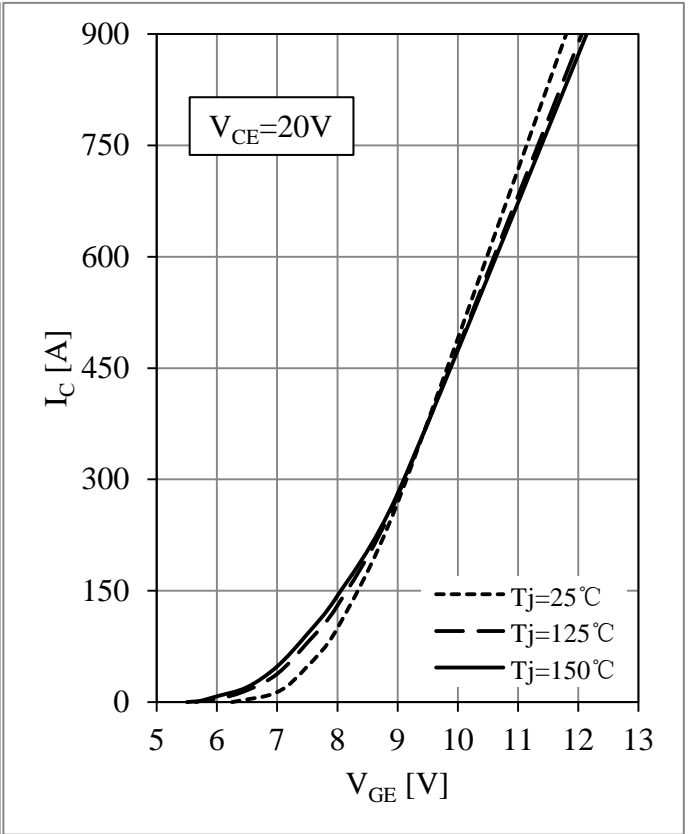


Fig 2. IGBT Transfer Characteristics

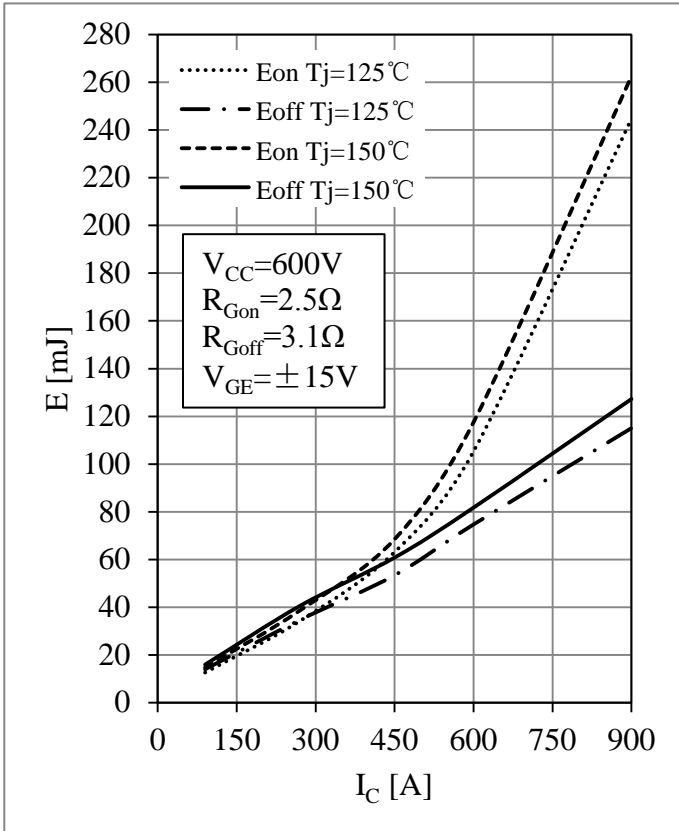


Fig 3. IGBT Switching Loss vs.  $I_c$

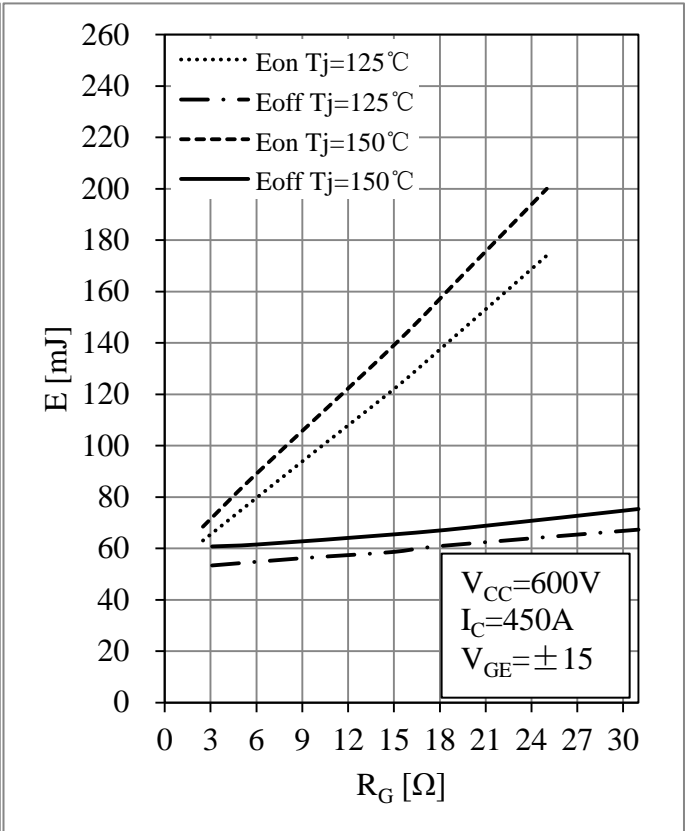


Fig 4. IGBT Switching Loss vs.  $R_g$

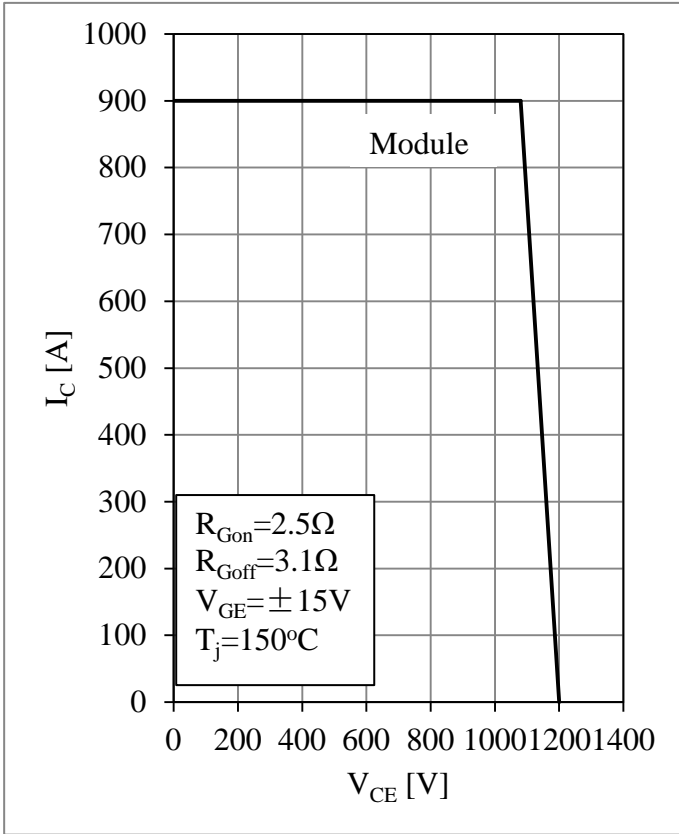


Fig 5. RBSOA

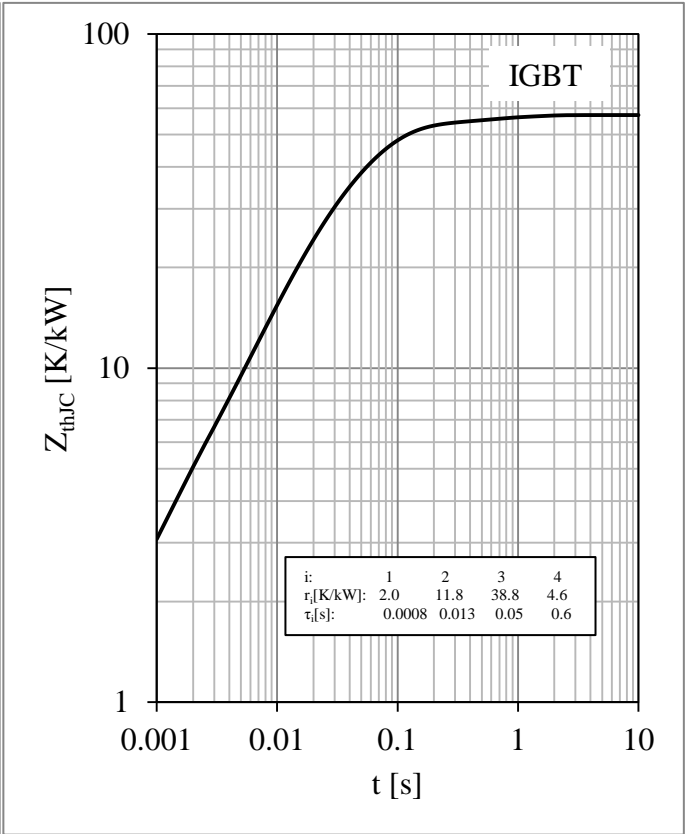


Fig 6. IGBT Transient Thermal Impedance

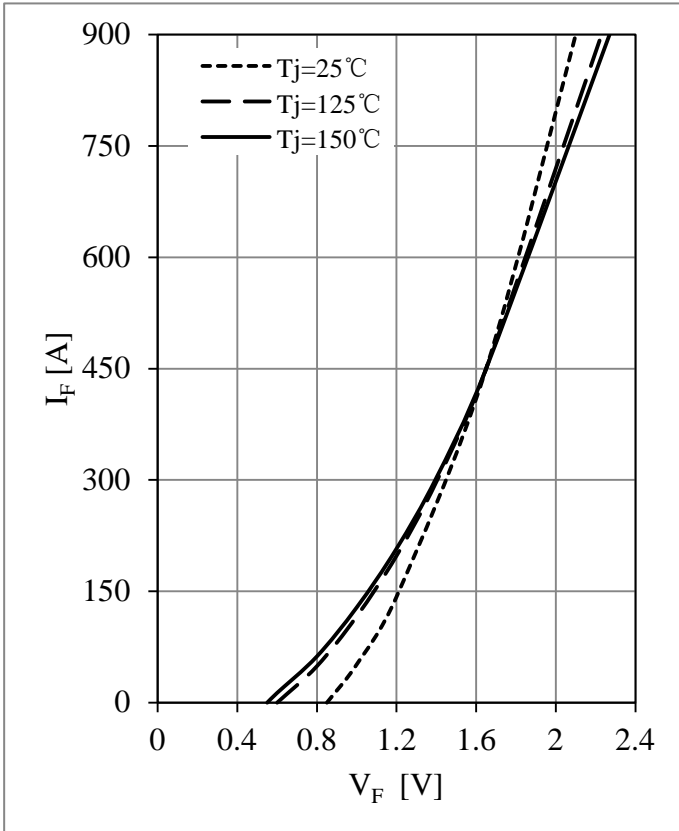


Fig 7. Diode Forward Characteristics

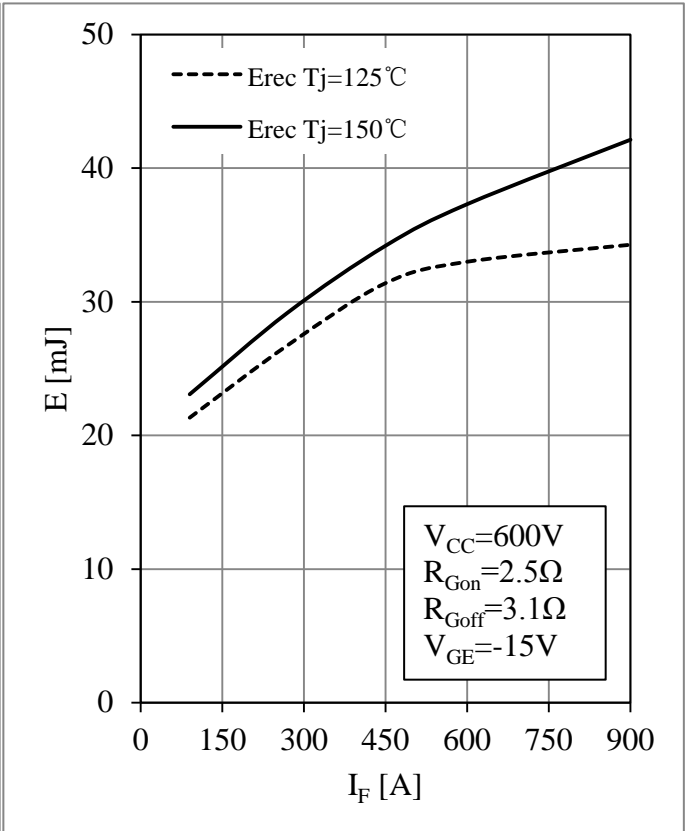


Fig 8. Diode Switching Loss vs.  $I_F$

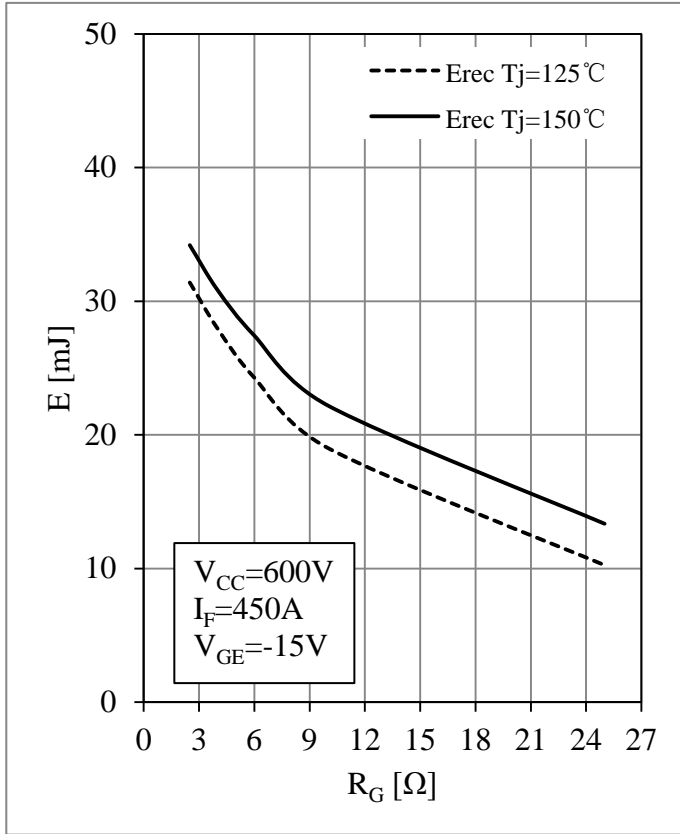


Fig 9. Diode Switching Loss vs.  $R_G$

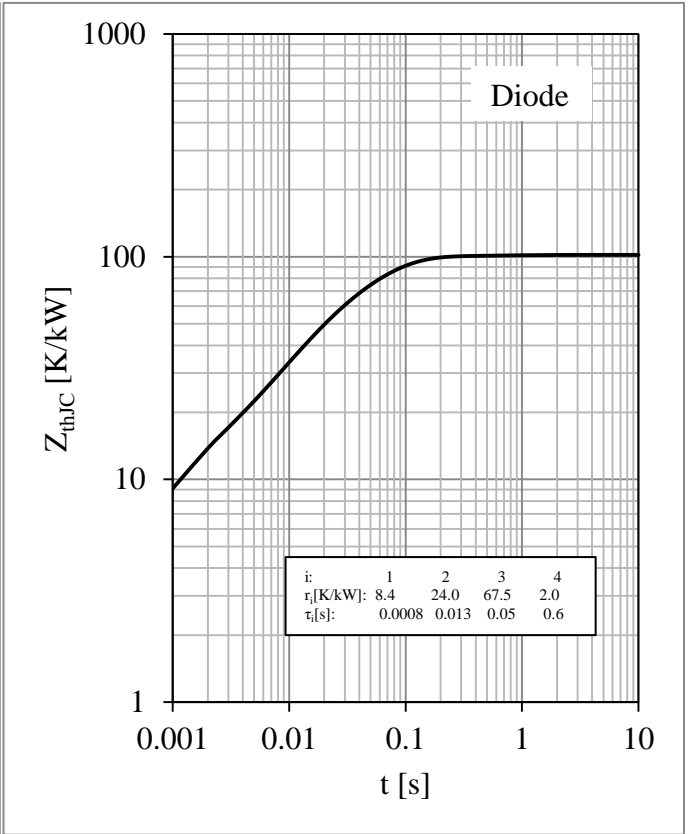


Fig 10. Diode Transient Thermal Impedance

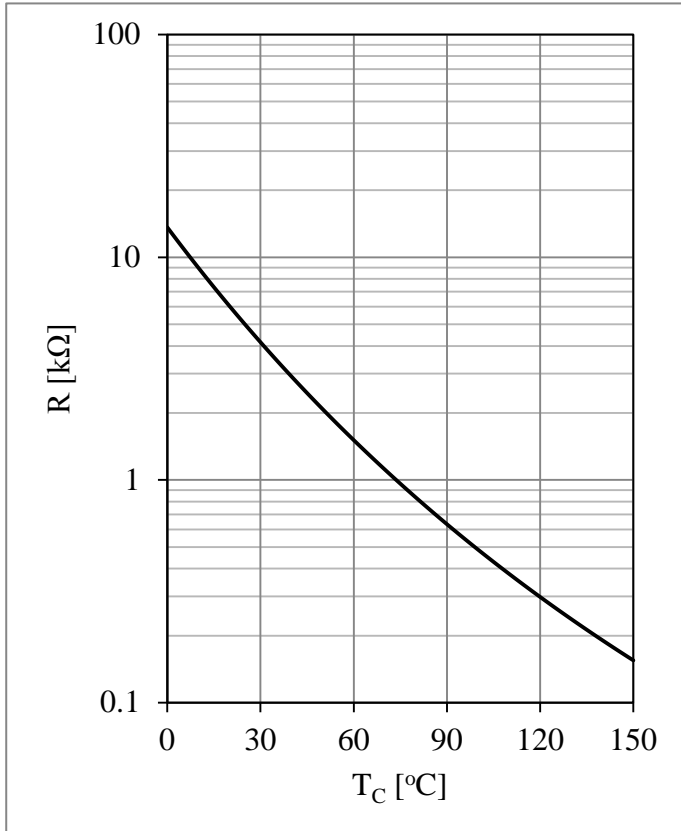
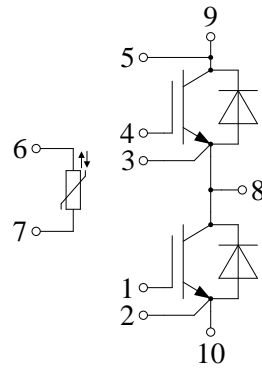


Fig 11. NTC Temperature Characteristic

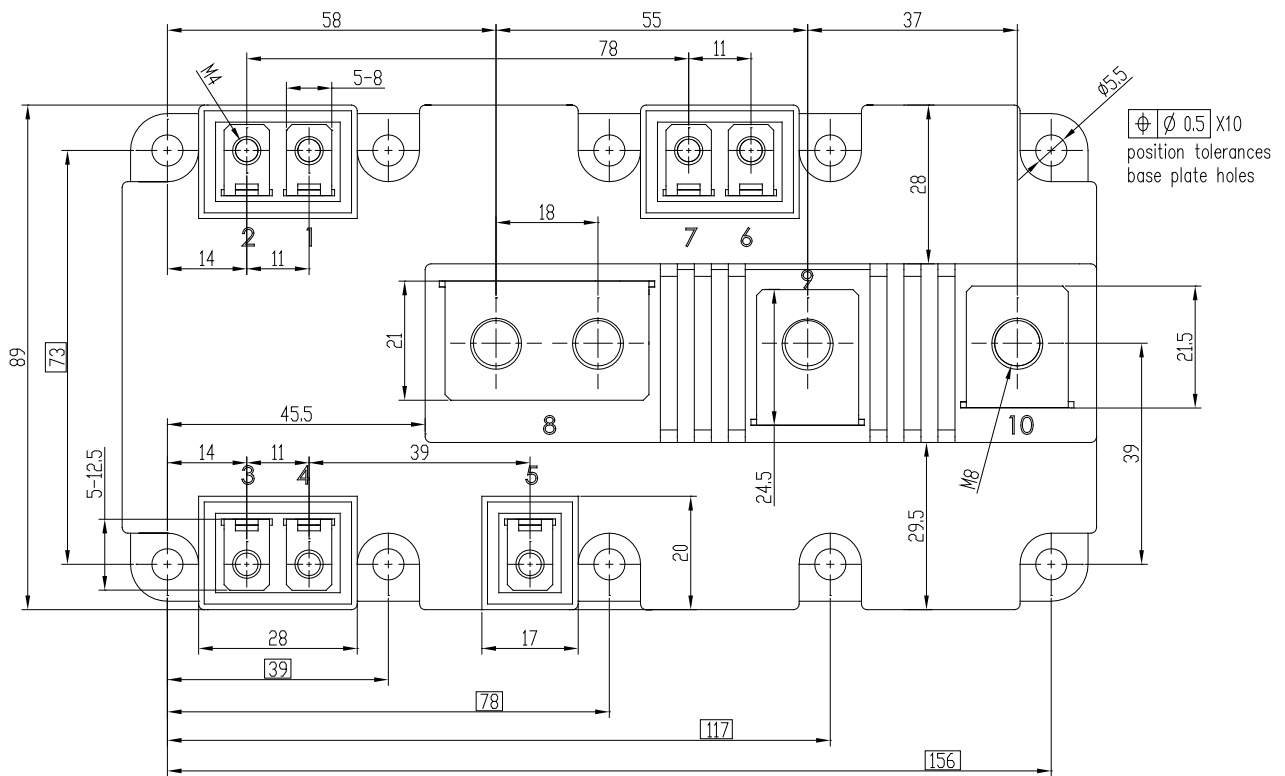
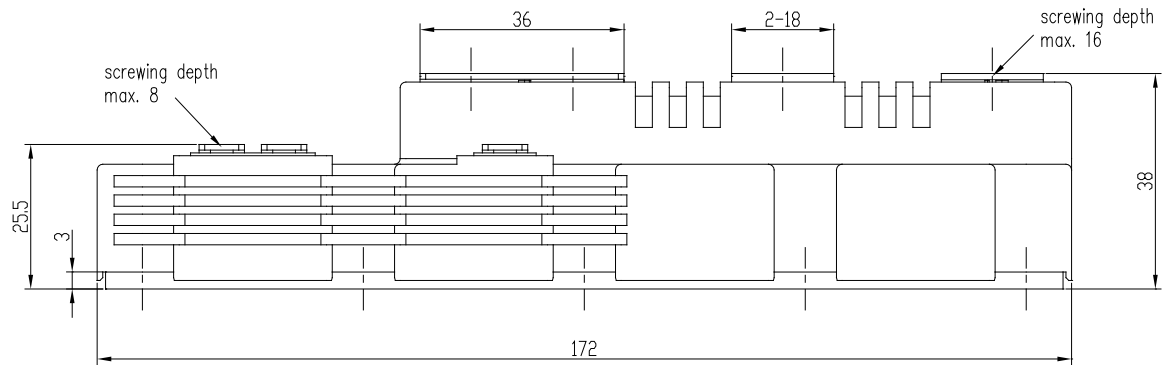


**Circuit Schematic**



**Package Dimensions**

Dimensions in Millimeters



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