

# STARPOWER

SEMICONDUCTOR

IGBT

## GD450HFX120C2SA

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 general inverters and UPS.

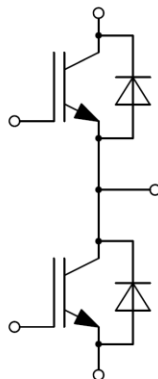
### Features

- Low  $V_{CE(sat)}$  Trench IGBT technology
- 10 $\mu$ s short circuit capability
- $V_{CE(sat)}$  with positive temperature coefficient
- Maximum junction temperature 175°C
- Low inductance case
- Fast & soft reverse recovery anti-parallel FWD
- Isolated copper baseplate using DBC technology

### Typical Applications

- Inverter for motor drive
- AC and DC servo drive amplifier
- Uninterruptible power supply

### 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 @ $T_C=25^{\circ}\text{C}$	704	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 @ $T_{vj}=175^{\circ}\text{C}$	2307	W

**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
$T_{vjmax}$	Maximum Junction Temperature	175	$^{\circ}\text{C}$
$T_{vjop}$	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	$I_C=450\text{A}, V_{GE}=15\text{V}, T_{vj}=25^\circ\text{C}$		1.70	2.15	V	
		$I_C=450\text{A}, V_{GE}=15\text{V}, T_{vj}=125^\circ\text{C}$		1.95			
		$I_C=450\text{A}, V_{GE}=15\text{V}, T_{vj}=150^\circ\text{C}$		2.00			
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=18.0\text{mA}, V_{CE}=V_{GE}, T_{vj}=25^\circ\text{C}$	5.6	6.2	6.8	V	
$I_{CES}$	Collector Cut-Off Current	$V_{CE}=V_{CES}, V_{GE}=0\text{V}, T_{vj}=25^\circ\text{C}$			1.0	mA	
$I_{GES}$	Gate-Emitter Leakage Current	$V_{GE}=V_{GES}, V_{CE}=0\text{V}, T_{vj}=25^\circ\text{C}$			400	nA	
$R_{Gint}$	Internal Gate Resistance			0.7		$\Omega$	
$C_{ies}$	Input Capacitance	$V_{CE}=25\text{V}, f=1\text{MHz}, V_{GE}=0\text{V}$		46.6		nF	
$C_{res}$	Reverse Transfer Capacitance				1.31		nF
$Q_G$	Gate Charge	$V_{GE}=-15\dots+15\text{V}$		3.50		$\mu\text{C}$	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=450\text{A}, R_G=1.5\Omega, V_{GE}=\pm 15\text{V}, L_S=45\text{nH}, T_{vj}=25^\circ\text{C}$		284		ns	
$t_r$	Rise Time			78		ns	
$t_{d(off)}$	Turn-Off Delay Time			388		ns	
$t_f$	Fall Time			200		ns	
$E_{on}$	Turn-On Switching Loss			45.0		mJ	
$E_{off}$	Turn-Off Switching Loss			33.4		mJ	
$t_{d(on)}$	Turn-On Delay Time		$V_{CC}=600\text{V}, I_C=450\text{A}, R_G=1.5\Omega, V_{GE}=\pm 15\text{V}, L_S=45\text{nH}, T_{vj}=125^\circ\text{C}$		288		ns
$t_r$	Rise Time				86		ns
$t_{d(off)}$	Turn-Off Delay Time			456		ns	
$t_f$	Fall Time			305		ns	
$E_{on}$	Turn-On Switching Loss			60.1		mJ	
$E_{off}$	Turn-Off Switching Loss			48.4		mJ	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=450\text{A}, R_G=1.5\Omega, V_{GE}=\pm 15\text{V}, L_S=45\text{nH}, T_{vj}=150^\circ\text{C}$			291		ns
$t_r$	Rise Time				88		ns
$t_{d(off)}$	Turn-Off Delay Time			472		ns	
$t_f$	Fall Time			381		ns	
$E_{on}$	Turn-On Switching Loss			63.5		mJ	
$E_{off}$	Turn-Off Switching Loss			52.1		mJ	
$I_{SC}$	SC Data		$t_p \leq 10\mu\text{s}, V_{GE}=15\text{V}, T_{vj}=150^\circ\text{C}, V_{CC}=800\text{V}, V_{CEM} \leq 1200\text{V}$		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	$I_F=450\text{A}, V_{GE}=0\text{V}, T_{vj}=25^\circ\text{C}$		1.90	2.35	V
		$I_F=450\text{A}, V_{GE}=0\text{V}, T_{vj}=125^\circ\text{C}$		2.00		
		$I_F=450\text{A}, V_{GE}=0\text{V}, T_{vj}=150^\circ\text{C}$		2.05		
$Q_r$	Recovered Charge	$V_R=600\text{V}, I_F=450\text{A},$ $-di/dt=4500\text{A}/\mu\text{s}, V_{GE}=-15\text{V},$ $L_S=45\text{nH}, T_{vj}=25^\circ\text{C}$		39.4		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current			296		A
$E_{rec}$	Reverse Recovery Energy			11.8		mJ
$Q_r$	Recovered Charge	$V_R=600\text{V}, I_F=450\text{A},$ $-di/dt=4100\text{A}/\mu\text{s}, V_{GE}=-15\text{V},$ $L_S=45\text{nH}, T_{vj}=125^\circ\text{C}$		58.6		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current			309		A
$E_{rec}$	Reverse Recovery Energy			17.7		mJ
$Q_r$	Recovered Charge	$V_R=600\text{V}, I_F=450\text{A},$ $-di/dt=4000\text{A}/\mu\text{s}, V_{GE}=-15\text{V},$ $L_S=45\text{nH}, T_{vj}=150^\circ\text{C}$		83.6		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current			330		A
$E_{rec}$	Reverse Recovery Energy			20.3		mJ

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

Symbol	Parameter	Min.	Typ.	Max.	Unit
$L_{CE}$	Stray Inductance			20	nH
$R_{CC'+EE'}$	Module Lead Resistance, Terminal to Chip		0.35		m $\Omega$
$R_{thJC}$	Junction-to-Case (per IGBT)			0.065	K/W
	Junction-to-Case (per Diode)			0.119	
$R_{thCH}$	Case-to-Heatsink (per IGBT)		0.031		K/W
	Case-to-Heatsink (per Diode)		0.057		
	Case-to-Heatsink (per Module)		0.010		
M	Terminal Connection Torque, Screw M6	2.5		5.0	N.m
	Mounting Torque, Screw M6	3.0		5.0	
G	Weight of Module		300		g

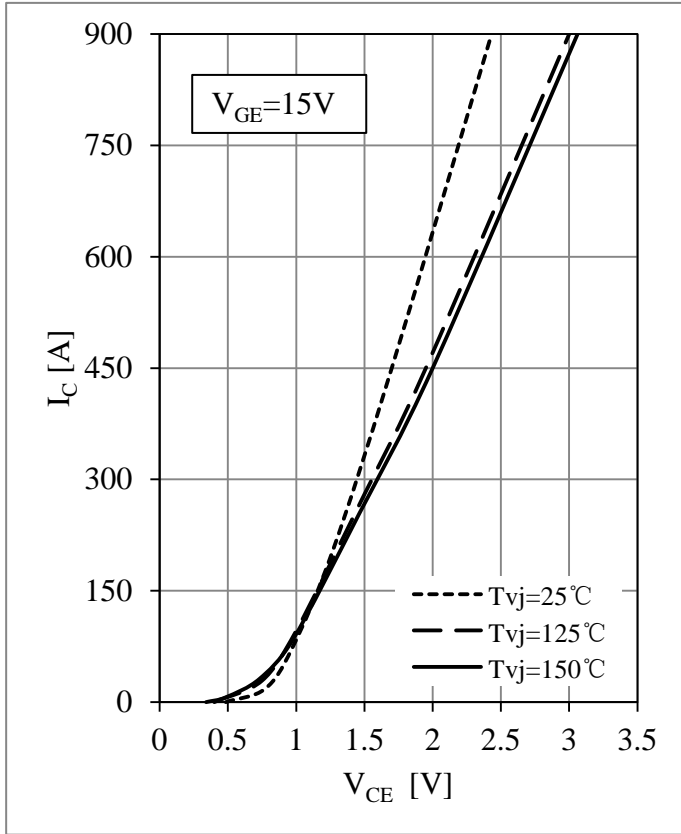


Fig 1. IGBT Output Characteristics

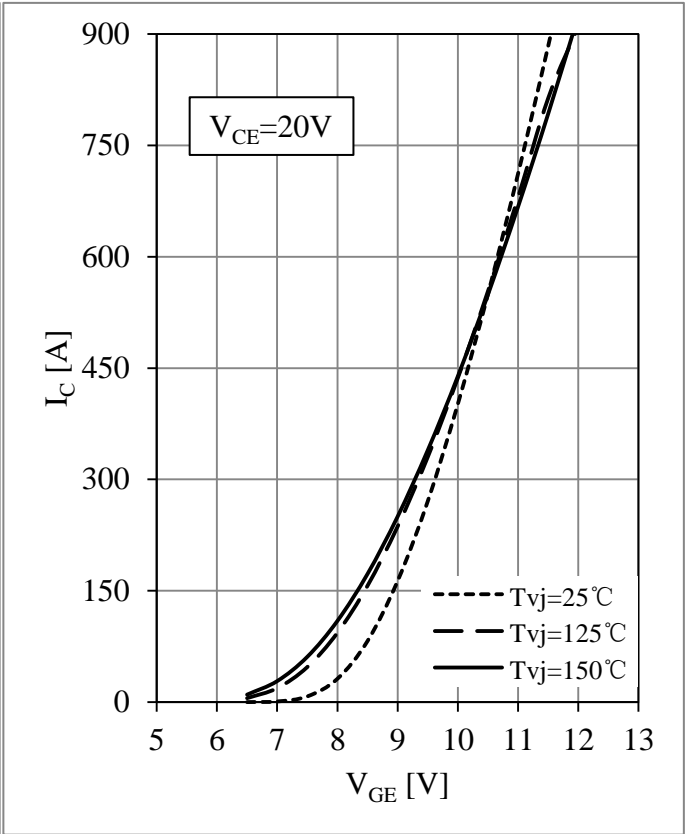


Fig 2. IGBT Transfer Characteristics

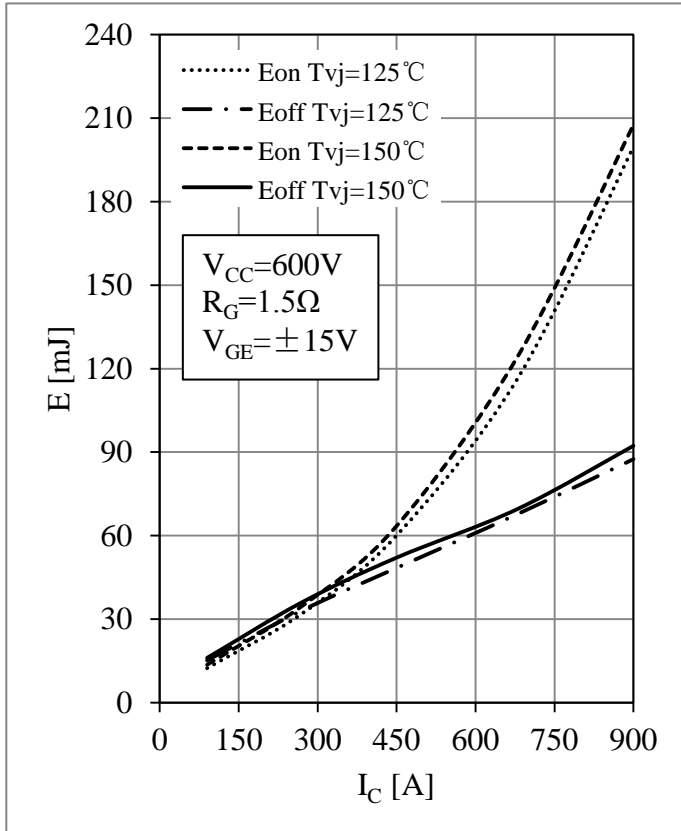


Fig 3. IGBT Switching Loss vs.  $I_C$

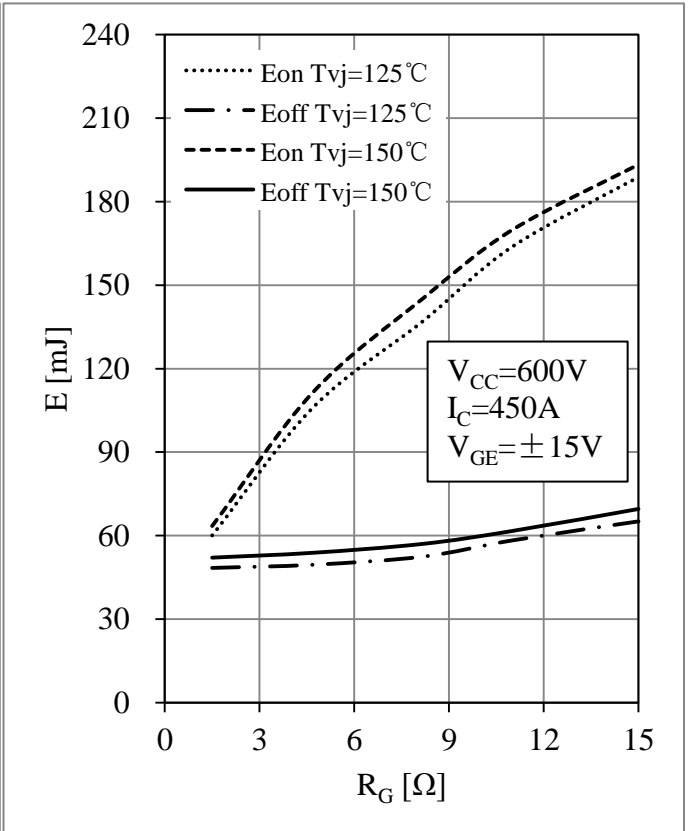


Fig 4. IGBT Switching Loss vs.  $R_G$

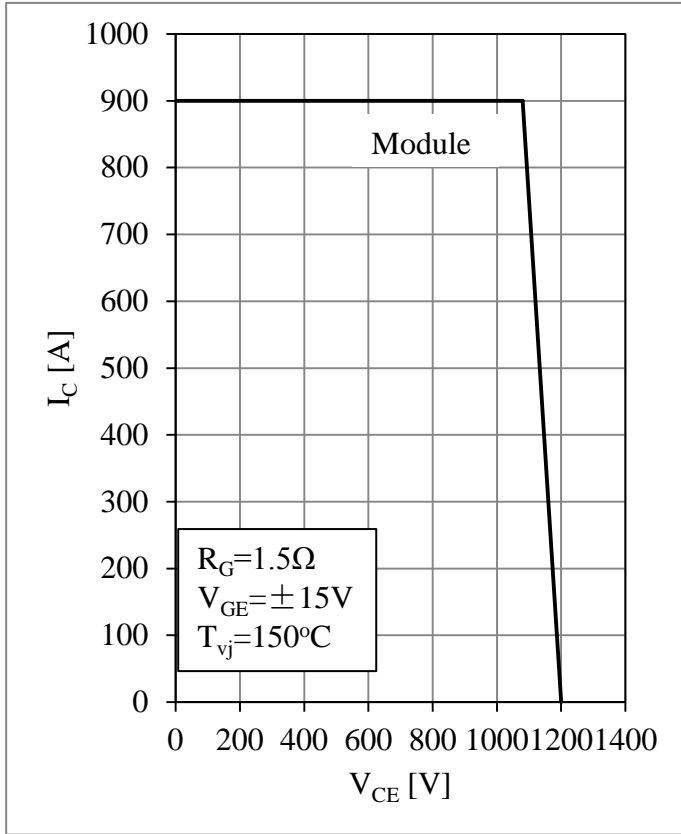


Fig 5. RBSOA

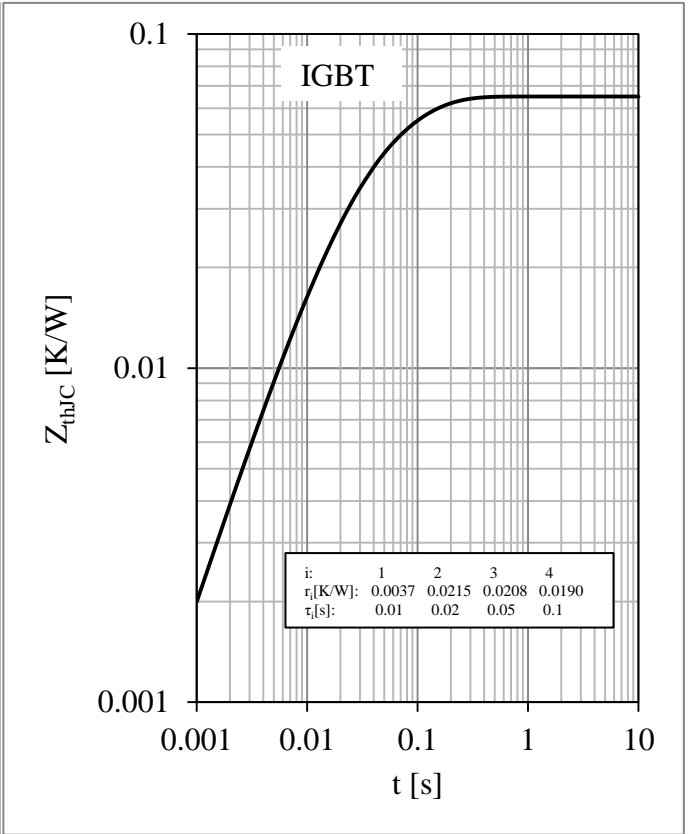


Fig 6. IGBT Transient Thermal Impedance

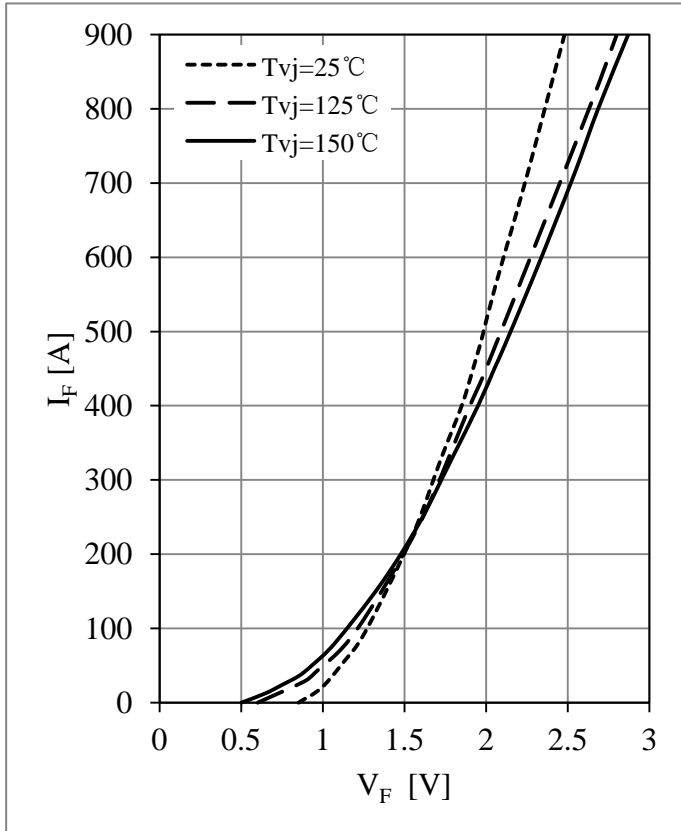


Fig 7. Diode Forward Characteristics

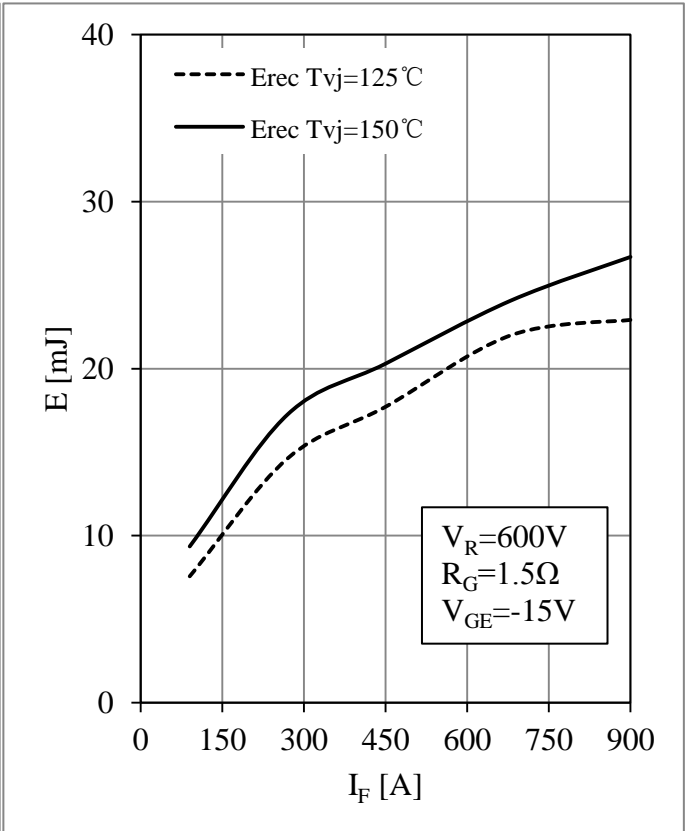


Fig 8. Diode Switching Loss vs.  $I_F$

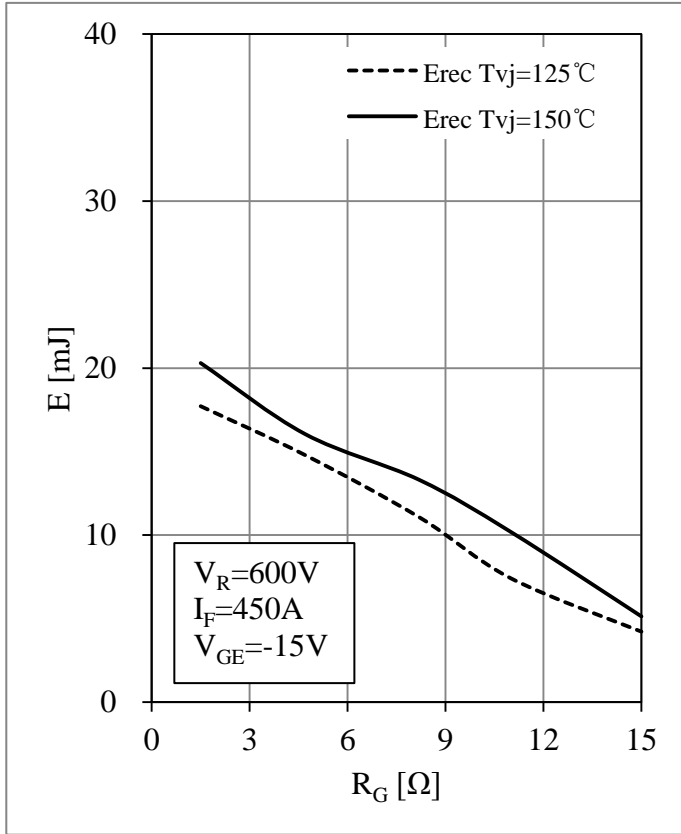


Fig 9. Diode Switching Loss vs.  $R_G$

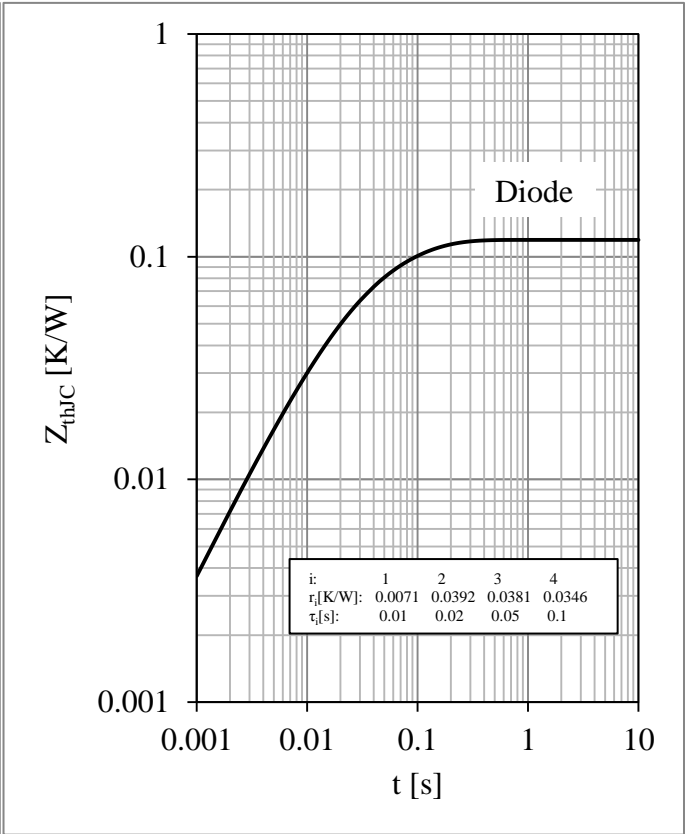
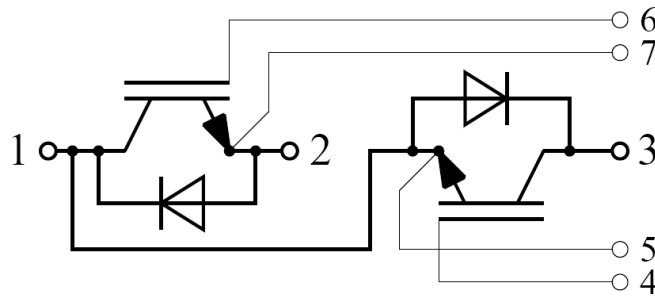


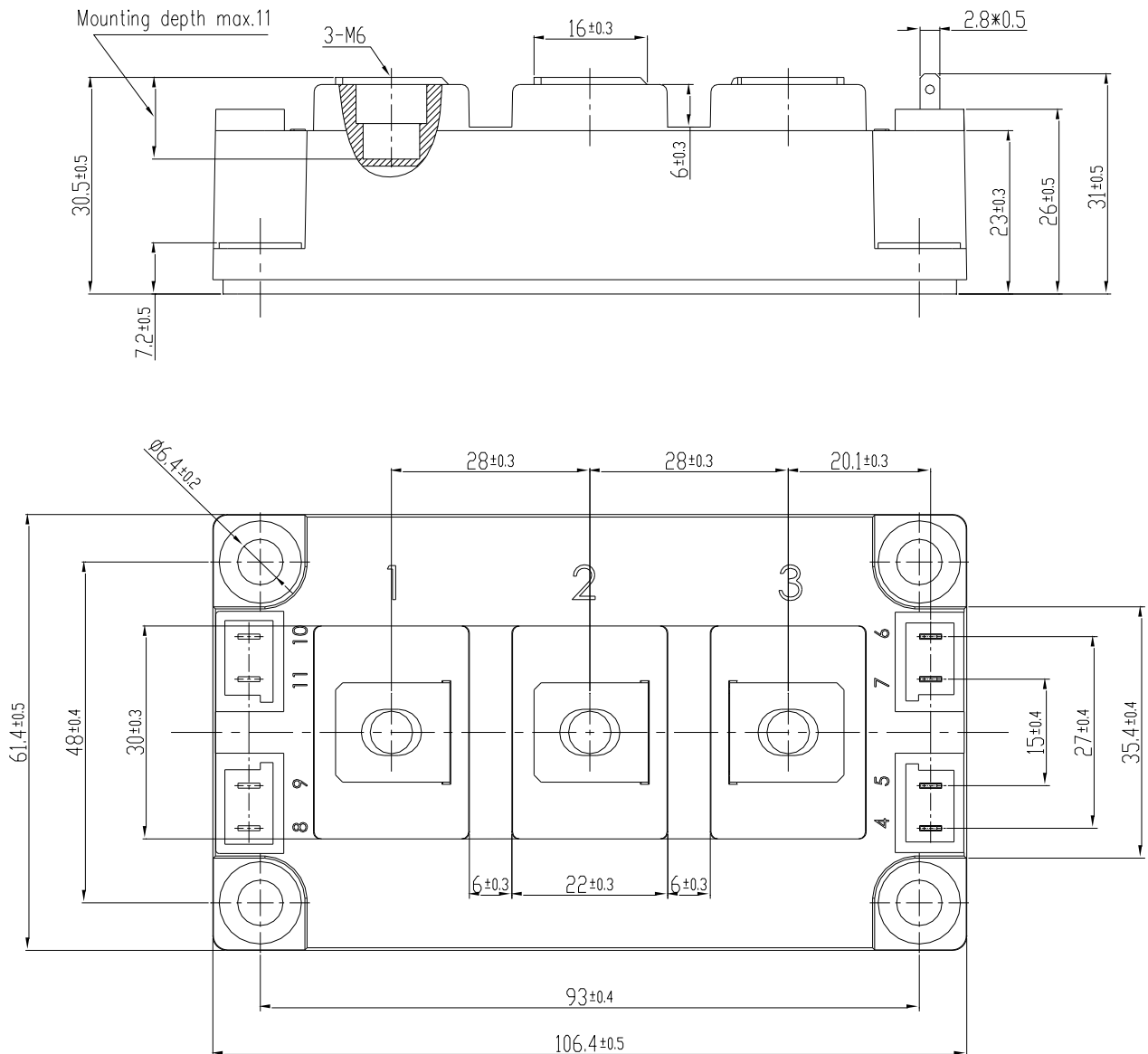
Fig 10. Diode Transient Thermal Impedance

**Circuit Schematic**



**Package Dimensions**

Dimensions in Millimeters





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