

# STARPOWER

SEMICONDUCTOR

**IGBT**

## GD1200HFA120V6S

**1200V/1200A 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 Motor drives and High-power converters.

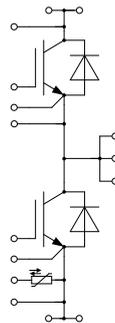
### Features

- 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

- High-power converters
- Motor drives
- Traction drives

### 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 @ $T_C=25^{\circ}\text{C}$	1836	A
	@ $T_C=90^{\circ}\text{C}$	1200	
$I_{CRM}$	Repetitive Peak Collector Current $t_p=1\text{ms}$	2400	A
$P_D$	Maximum Power Dissipation @ $T_{vj}=175^{\circ}\text{C}$	4477	W

**Diode**

Symbol	Description	Value	Unit
$V_{RRM}$	Repetitive Peak Reverse Voltage	1200	V
$I_F$	Diode Continuous Forward Current	1200	A
$I_{FRM}$	Repetitive Peak Forward Current $t_p=1\text{ms}$	2400	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, $f=50\text{Hz}$ , $t=1\text{min}$	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	$I_C=1200\text{A}, V_{GE}=15\text{V}, T_{vj}=25^\circ\text{C}$		1.30	1.75	V	
		$I_C=1200\text{A}, V_{GE}=15\text{V}, T_{vj}=125^\circ\text{C}$		1.45			
		$I_C=1200\text{A}, V_{GE}=15\text{V}, T_{vj}=150^\circ\text{C}$		1.50			
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=48.0\text{mA}, V_{CE}=V_{GE}, T_{vj}=25^\circ\text{C}$	5.5	6.1	7.0	V	
$I_{CES}$	Collector Cut-Off Current	$V_{CE}=V_{CES}, V_{GE}=0\text{V}, T_{vj}=25^\circ\text{C}$			5.0	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			0.25		$\Omega$	
$C_{ies}$	Input Capacitance	$V_{CE}=25\text{V}, f=100\text{kHz}, V_{GE}=0\text{V}$		234		nF	
$C_{res}$	Reverse Transfer Capacitance				1.65		nF
$Q_G$	Gate Charge	$V_{GE}=-8\dots+15\text{V}$		15.5		$\mu\text{C}$	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=1200\text{A}, R_{Gon}=1.0\Omega, R_{Goff}=3.3\Omega, L_S=50\text{nH}, V_{GE}=-10/+15\text{V}, T_{vj}=25^\circ\text{C}$		757		ns	
$t_r$	Rise Time			216		ns	
$t_{d(off)}$	Turn-Off Delay Time			2424		ns	
$t_f$	Fall Time			179		ns	
$E_{on}$	Turn-On Switching Loss			195		mJ	
$E_{off}$	Turn-Off Switching Loss			231		mJ	
$t_{d(on)}$	Turn-On Delay Time		$V_{CC}=600\text{V}, I_C=1200\text{A}, R_{Gon}=1.0\Omega, R_{Goff}=3.3\Omega, L_S=50\text{nH}, V_{GE}=-10/+15\text{V}, T_{vj}=125^\circ\text{C}$		1031		ns
$t_r$	Rise Time				300		ns
$t_{d(off)}$	Turn-Off Delay Time			3058		ns	
$t_f$	Fall Time			189		ns	
$E_{on}$	Turn-On Switching Loss			377		mJ	
$E_{off}$	Turn-Off Switching Loss			275		mJ	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=1200\text{A}, R_{Gon}=1.0\Omega, R_{Goff}=3.3\Omega, L_S=50\text{nH}, V_{GE}=-10/+15\text{V}, T_{vj}=150^\circ\text{C}$			1100		ns
$t_r$	Rise Time				316		ns
$t_{d(off)}$	Turn-Off Delay Time			3213		ns	
$t_f$	Fall Time			191		ns	
$E_{on}$	Turn-On Switching Loss			416		mJ	
$E_{off}$	Turn-Off Switching Loss			286		mJ	
$I_{SC}$	SC Data		$t_p \leq 8\mu\text{s}, V_{GE}=15\text{V}, T_{vj}=150^\circ\text{C}, V_{CC}=800\text{V}, V_{CEM} \leq 1200\text{V}$		4800		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	$I_F=1200\text{A}, V_{GE}=0\text{V}, T_{vj}=25^\circ\text{C}$		1.80	2.25	V
		$I_F=1200\text{A}, V_{GE}=0\text{V}, T_{vj}=125^\circ\text{C}$		1.90		
		$I_F=1200\text{A}, V_{GE}=0\text{V}, T_{vj}=150^\circ\text{C}$		1.95		
$Q_r$	Recovered Charge	$V_R=600\text{V}, I_F=1200\text{A},$ $-di/dt=4870\text{A}/\mu\text{s}, L_s=50\text{nH},$ $V_{GE}=-10\text{V}, T_{vj}=25^\circ\text{C}$		104		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current			529		A
$E_{rec}$	Reverse Recovery Energy			25.9		mJ
$Q_r$	Recovered Charge	$V_R=600\text{V}, I_F=1200\text{A},$ $-di/dt=3360\text{A}/\mu\text{s}, L_s=50\text{nH},$ $V_{GE}=-10\text{V}, T_{vj}=125^\circ\text{C}$		207		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current			527		A
$E_{rec}$	Reverse Recovery Energy			53.2		mJ
$Q_r$	Recovered Charge	$V_R=600\text{V}, I_F=1200\text{A},$ $-di/dt=3100\text{A}/\mu\text{s}, L_s=50\text{nH},$ $V_{GE}=-10\text{V}, T_{vj}=150^\circ\text{C}$		229		$\mu\text{C}$
$I_{RM}$	Peak Reverse Recovery Current			522		A
$E_{rec}$	Reverse Recovery Energy			59.2		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		10		nH
$R_{CC'+EE'}$	Module Lead Resistance, Terminal to Chip		0.35		m $\Omega$
$R_{thJC}$	Junction-to-Case (per IGBT)			33.5	K/kW
	Junction-to-Case (per Diode)			46.1	
M	Terminal Connection Torque, Screw M3	0.9		1.1	N.m
	Terminal Connection Torque, Screw M8	8.0		10.0	
	Mounting Torque, Screw M6	3.0		6.0	
G	Weight of Module		1030		g

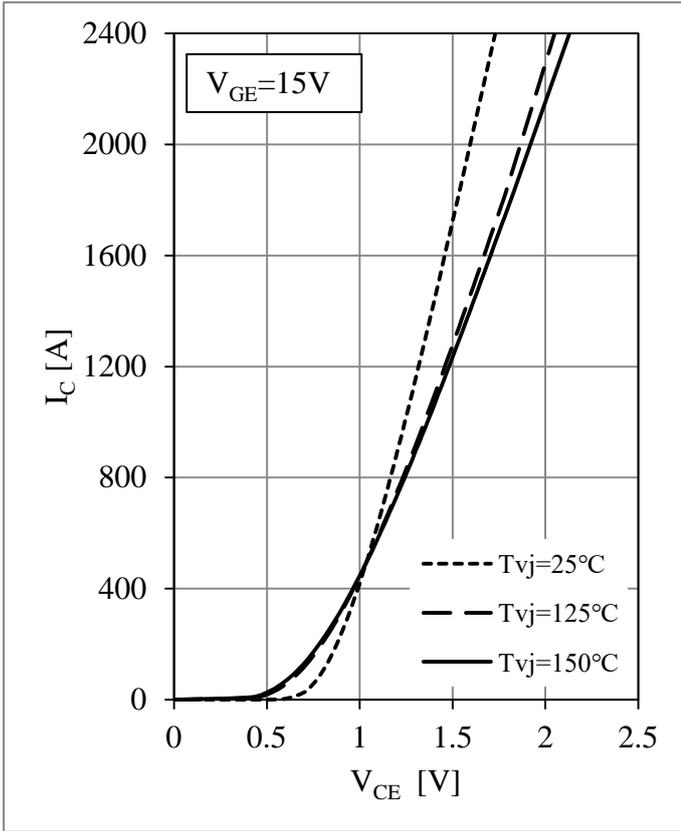


Fig 1. IGBT Output Characteristics

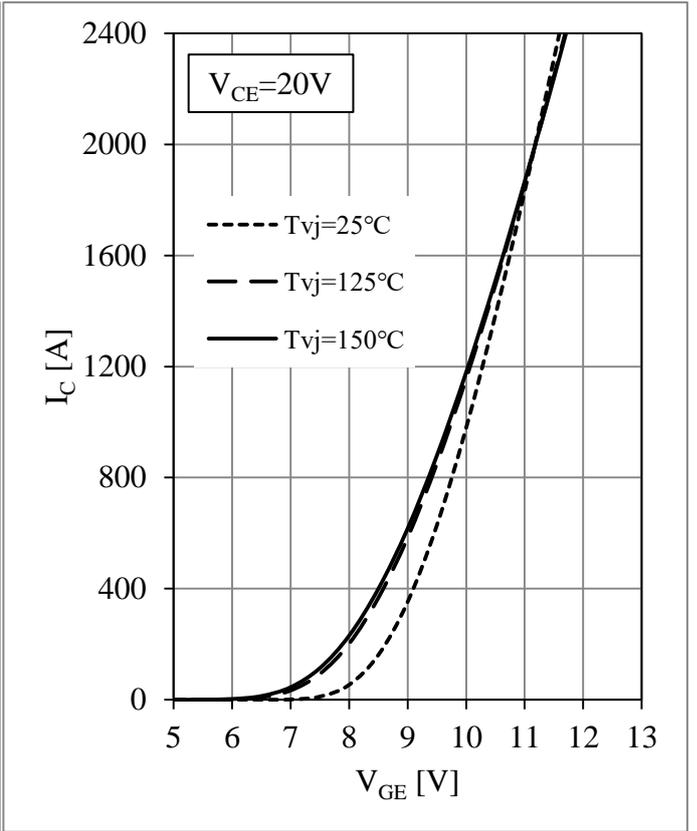


Fig 2. IGBT Transfer Characteristics

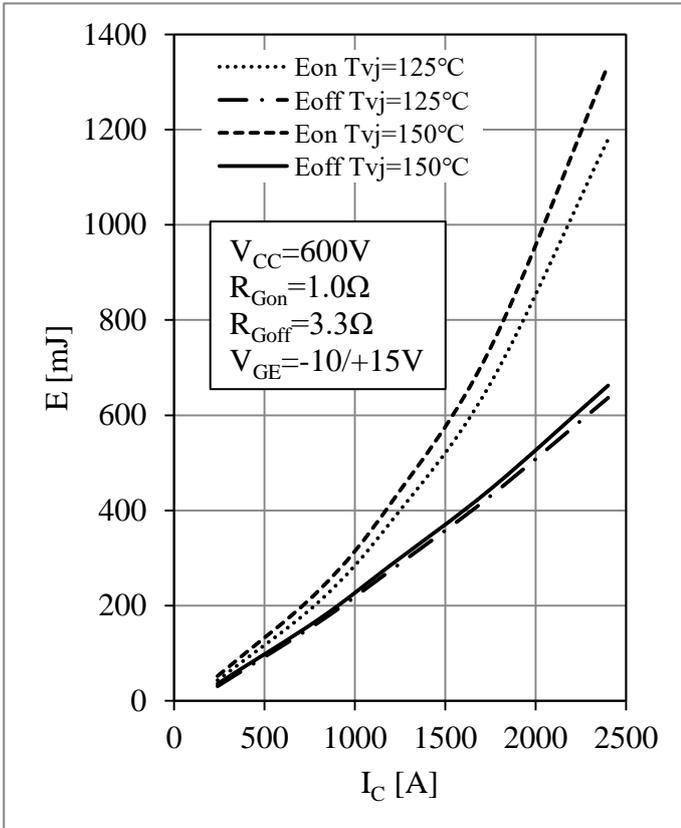


Fig 3. IGBT Switching Loss vs.  $I_C$

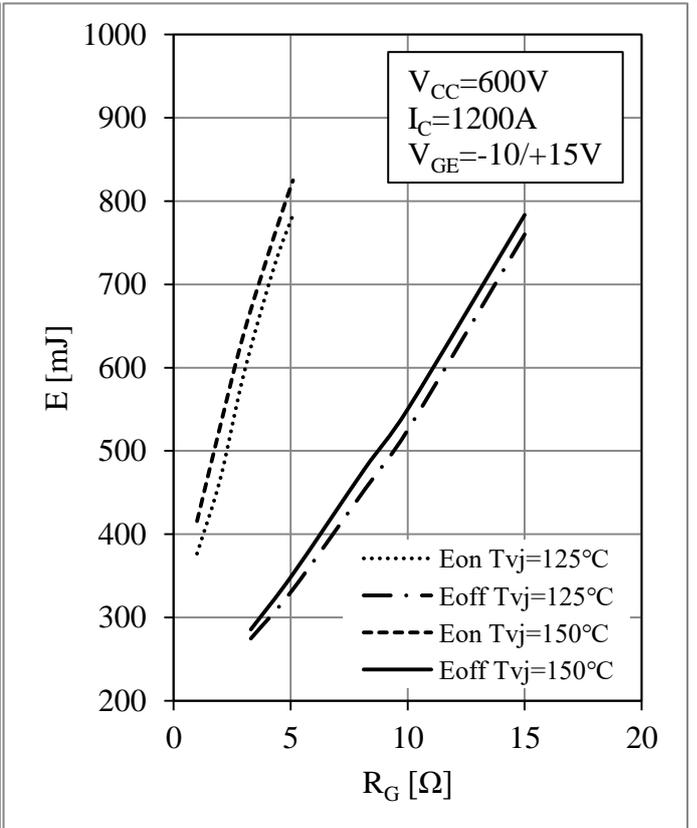


Fig 4. IGBT Switching Loss vs.  $R_G$

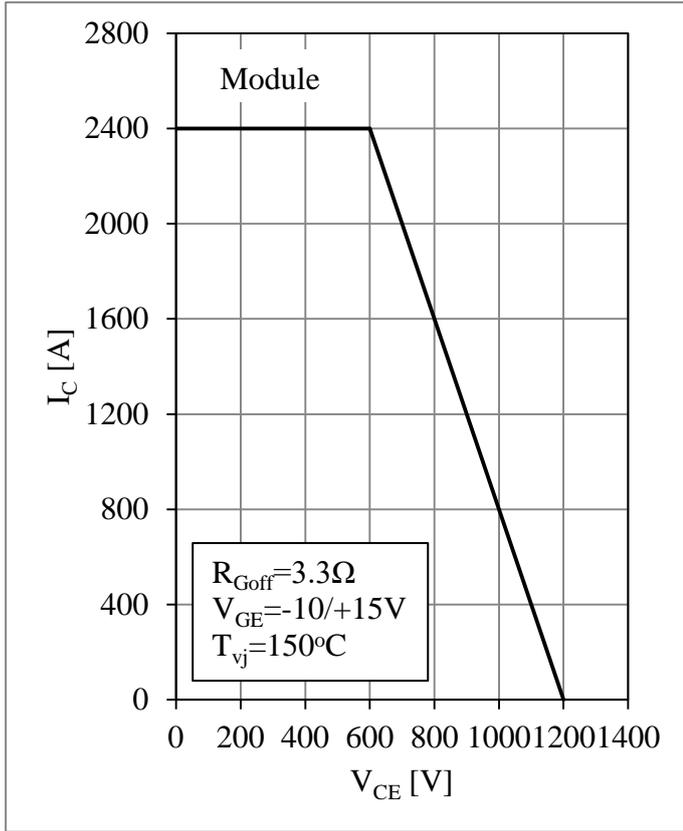


Fig 5. RBSOA

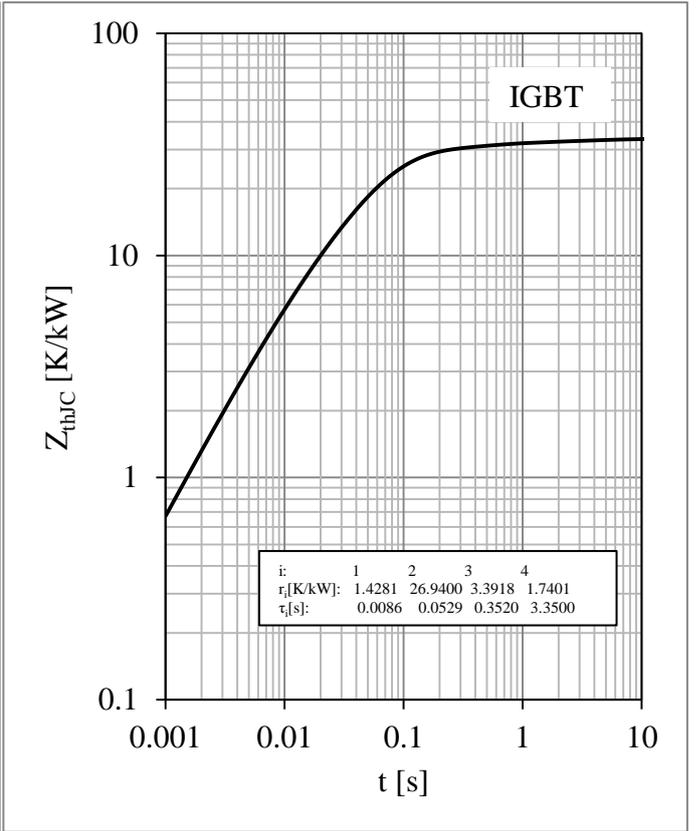


Fig 6. IGBT Transient Thermal Impedance

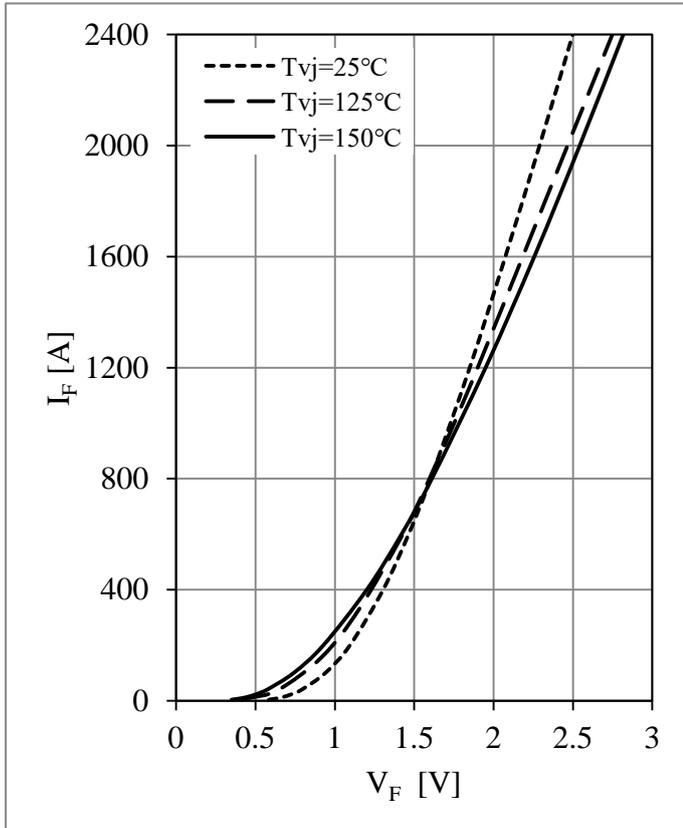


Fig 7. Diode Forward Characteristics

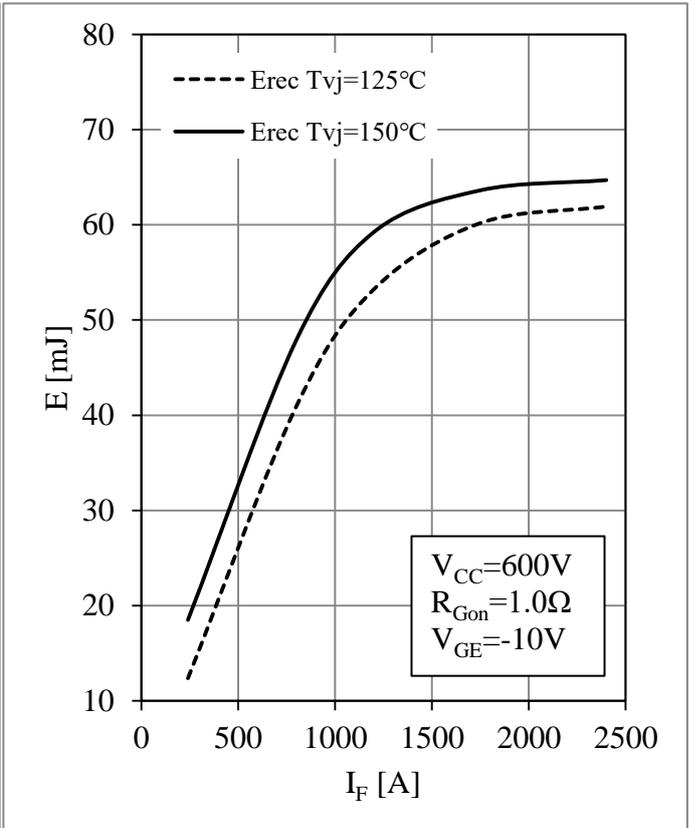


Fig 8. Diode Switching Loss vs.  $I_F$

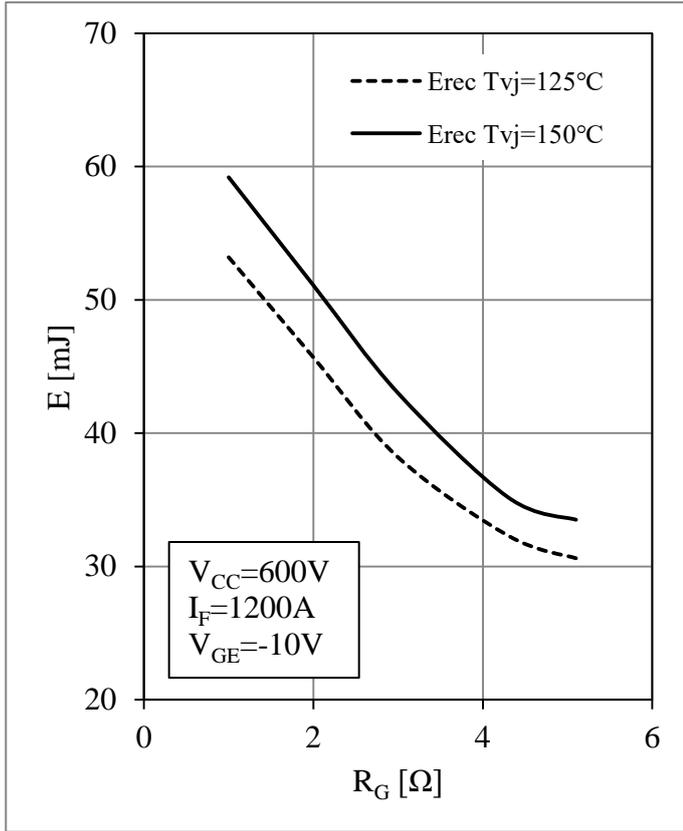


Fig 9. Diode Switching Loss vs.  $R_G$

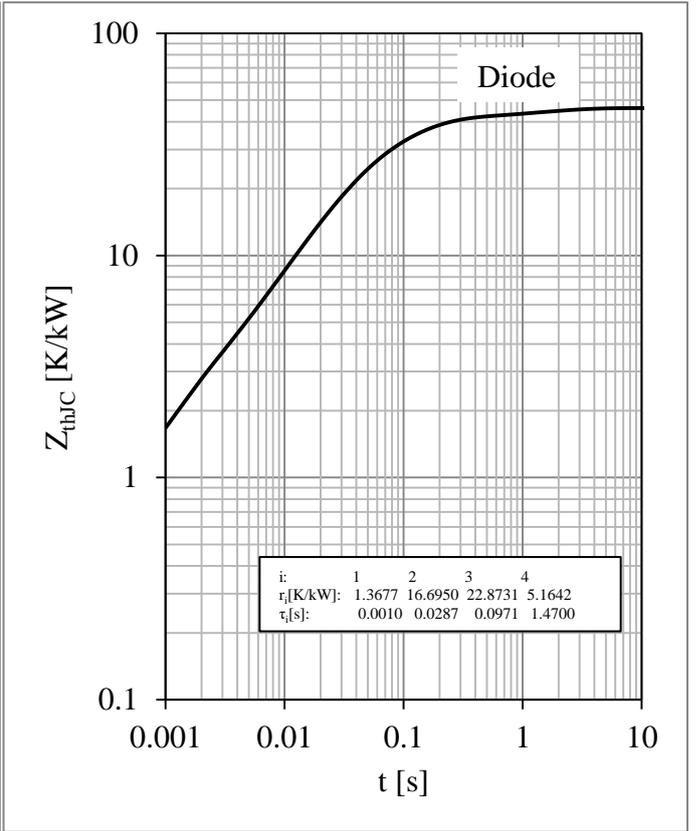
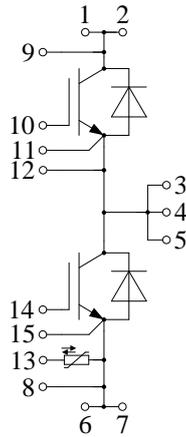


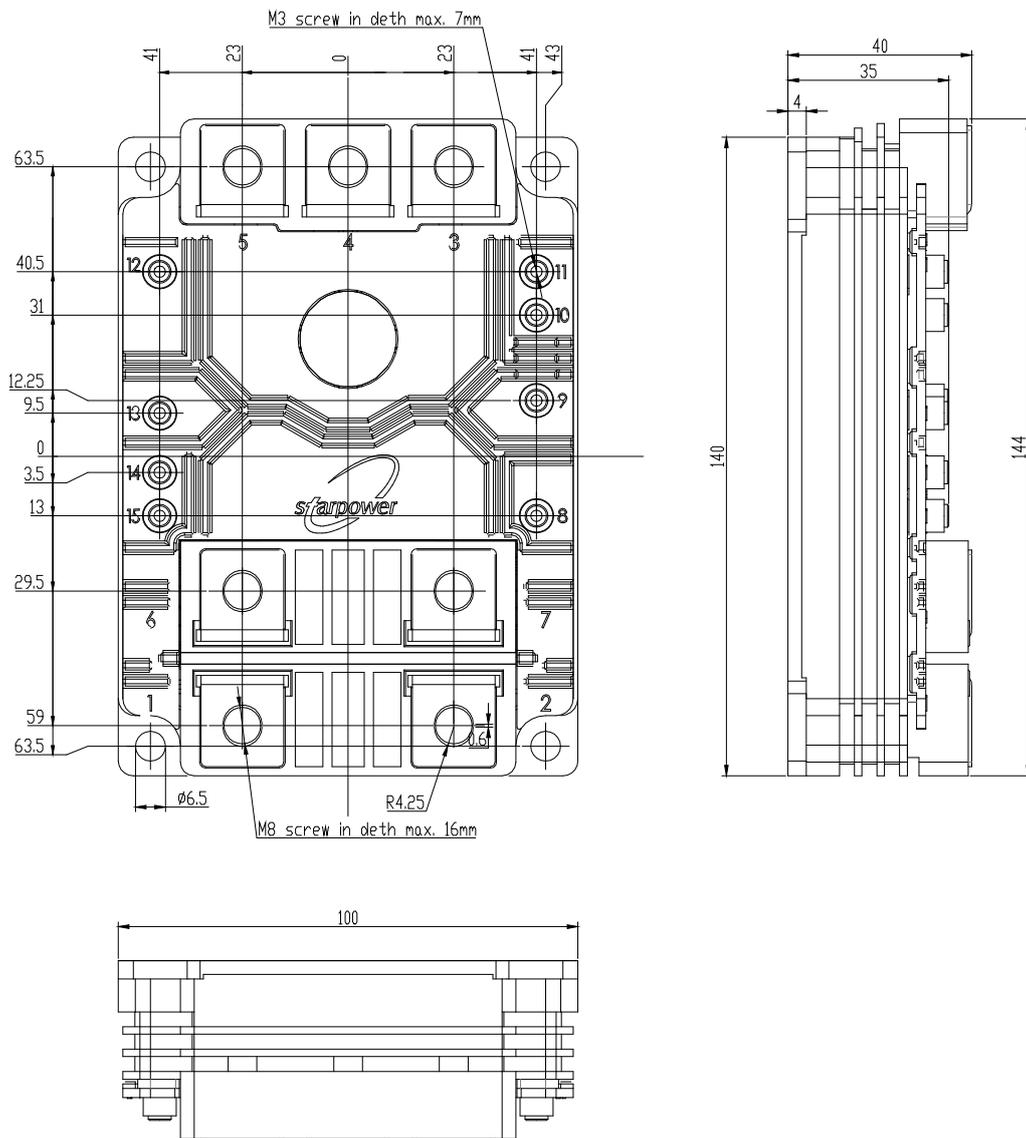
Fig 10. Diode Transient Thermal Impedance

**Circuit Schematic**



**Package Dimensions**

Dimensions in Millimeters



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