

STARPOWER

SEMICONDUCTOR

IGBT

GD2400SGX170A4S

1700V/2400A 1 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 high power converters.

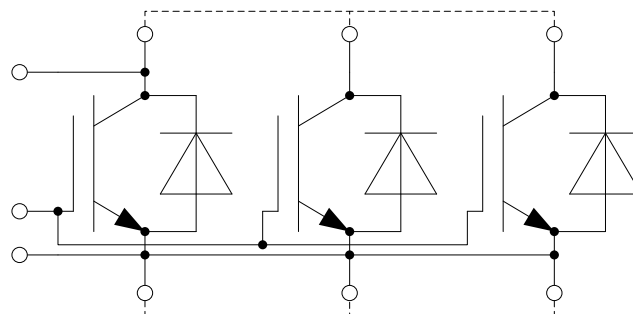
Features

- 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
- Low inductance case
- Fast & soft reverse recovery anti-parallel FWD
- AlSiC baseplate for high power cycling capability
- AlN substrate for low thermal resistance

Typical Applications

- High power converters
- Motor 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	1700	V
V_{GES}	Gate-Emitter Voltage	± 20	V
I_C	Collector Current @ $T_C=100^{\circ}\text{C}$	2400	A
I_{CM}	Pulsed Collector Current $t_p=1\text{ms}$	4800	A
P_D	Maximum Power Dissipation @ $T_j=175^{\circ}\text{C}$	13.7	kW

Diode

Symbol	Description	Value	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	1700	V
I_F	Diode Continuous Forward Current	2400	A
I_{FM}	Diode Maximum Forward Current $t_p=1\text{ms}$	4800	A
I_{FSM}	Surge Forward Current $V_R=0\text{V}, t_p=10\text{ms}$, @ $T_j=25^{\circ}\text{C}$ @ $T_j=150^{\circ}\text{C}$	18.65	kA
		15.25	
I^2t	I^2t -value, $V_R=0\text{V}, t_p=10\text{ms}, T_j=25^{\circ}\text{C}$	1739	kA^2s
	I^2t -value, $V_R=0\text{V}, t_p=10\text{ms}, T_j=150^{\circ}\text{C}$	1162	

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, $f=50\text{Hz}, t=1\text{min}$	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	$I_C=2400\text{A}, V_{GE}=15\text{V}, T_j=25^{\circ}\text{C}$		1.85	2.30	V
		$I_C=2400\text{A}, V_{GE}=15\text{V}, T_j=125^{\circ}\text{C}$		2.25		
		$I_C=2400\text{A}, V_{GE}=15\text{V}, T_j=150^{\circ}\text{C}$		2.35		
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=96.0\text{mA}, V_{CE}=V_{GE}, T_j=25^{\circ}\text{C}$	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			0.6		Ω
C_{ies}	Input Capacitance	$V_{CE}=25\text{V}, f=100\text{kHz}, V_{GE}=0\text{V}$		285		nF
C_{res}	Reverse Transfer Capacitance			7.13		nF
Q_G	Gate Charge	$V_{GE}=-15\ldots+15\text{V}$		23.5		μC
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=900\text{V}, I_C=2400\text{A}, R_G=0.82\Omega, L_S=32\text{nH}, V_{GE}=-9\text{V}/+15\text{V}, T_j=25^{\circ}\text{C}$		609		ns
t_r	Rise Time			232		ns
$t_{d(off)}$	Turn-Off Delay Time			1676		ns
t_f	Fall Time			192		ns
E_{on}	Turn-On Switching Loss			784		mJ
E_{off}	Turn-Off Switching Loss			785		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=900\text{V}, I_C=2400\text{A}, R_G=0.82\Omega, L_S=32\text{nH}, V_{GE}=-9\text{V}/+15\text{V}, T_j=125^{\circ}\text{C}$		732		ns
t_r	Rise Time			280		ns
$t_{d(off)}$	Turn-Off Delay Time			2171		ns
t_f	Fall Time			243		ns
E_{on}	Turn-On Switching Loss			1350		mJ
E_{off}	Turn-Off Switching Loss			1083		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=900\text{V}, I_C=2400\text{A}, R_G=0.82\Omega, L_S=32\text{nH}, V_{GE}=-9\text{V}/+15\text{V}, T_j=150^{\circ}\text{C}$		772		ns
t_r	Rise Time			298		ns
$t_{d(off)}$	Turn-Off Delay Time			2294		ns
t_f	Fall Time			298		ns
E_{on}	Turn-On Switching Loss			1533		mJ
E_{off}	Turn-Off Switching Loss			1126		mJ
I_{SC}	SC Data	$t_p \leq 10\mu\text{s}, V_{GE}=15\text{V}, T_j=150^{\circ}\text{C}, V_{CC}=1000\text{V}, V_{CEM} \leq 1700\text{V}$		10.5		kA

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_F	Diode Forward Voltage	$I_F=2400\text{A}, V_{GE}=0\text{V}, T_j=25^{\circ}\text{C}$		1.80	2.25	V
		$I_F=2400\text{A}, V_{GE}=0\text{V}, T_j=125^{\circ}\text{C}$		1.90		
		$I_F=2400\text{A}, V_{GE}=0\text{V}, T_j=150^{\circ}\text{C}$		1.95		
Q_r	Recovered Charge	$V_R=900\text{V}, I_F=2400\text{A},$ $-di/dt=9570\text{A}/\mu\text{s}, V_{GE}=-9\text{V},$ $L_S=32\text{nH}, T_j=25^{\circ}\text{C}$		243		μC
I_{RM}	Peak Reverse Recovery Current			1656		A
E_{rec}	Reverse Recovery Energy			274		mJ
Q_r	Recovered Charge	$V_R=900\text{V}, I_F=2400\text{A},$ $-di/dt=7500\text{A}/\mu\text{s}, V_{GE}=-9\text{V},$ $L_S=32\text{nH}, T_j=125^{\circ}\text{C}$		425		μC
I_{RM}	Peak Reverse Recovery Current			1692		A
E_{rec}	Reverse Recovery Energy			438		mJ
Q_r	Recovered Charge	$V_R=900\text{V}, I_F=2400\text{A},$ $-di/dt=6990\text{A}/\mu\text{s}, V_{GE}=-9\text{V},$ $L_S=32\text{nH}, T_j=150^{\circ}\text{C}$		534		μC
I_{RM}	Peak Reverse Recovery Current			1809		A
E_{rec}	Reverse Recovery Energy			563		mJ

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

Symbol	Parameter	Min.	Typ.	Max.	Unit
L_{CE}	Stray Inductance		6.0		nH
$R_{CC'+EE'}$	Module Lead Resistance, Terminal to Chip		0.10		m Ω
R_{thJC}	Junction-to-Case (per IGBT)			10.9	K/kW
	Junction-to-Case (per Diode)			20.9	
R_{thCH}	Case-to-Heatsink (per IGBT)		6.1		K/kW
	Case-to-Heatsink (per Diode)		11.7		
	Case-to-Heatsink (per Module)		4.0		
d_{Creep}	Terminal-to-Heatsink		32.2		mm
	Terminal-to-Terminal		32.2		
d_{Clear}	Terminal-to-Heatsink		19.1		mm
	Terminal-to-Terminal		19.1		
M	Terminal Connection Torque, Screw M4	1.8		2.1	N.m
	Terminal Connection Torque, Screw M8	8.0		10	
	Mounting Torque, Screw M6	4.25		5.75	
G	Weight of Module		1500		g

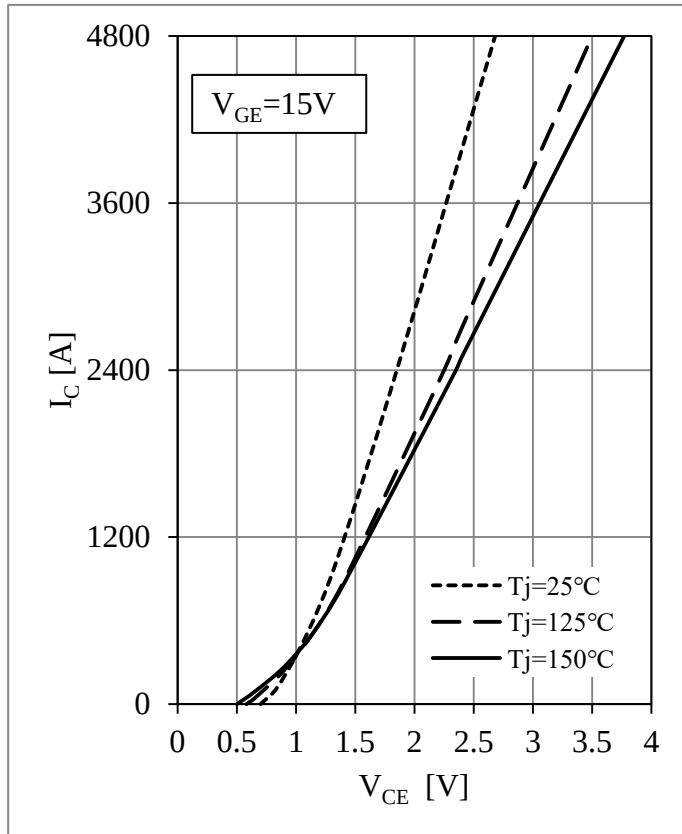


Fig 1. IGBT Output Characteristics

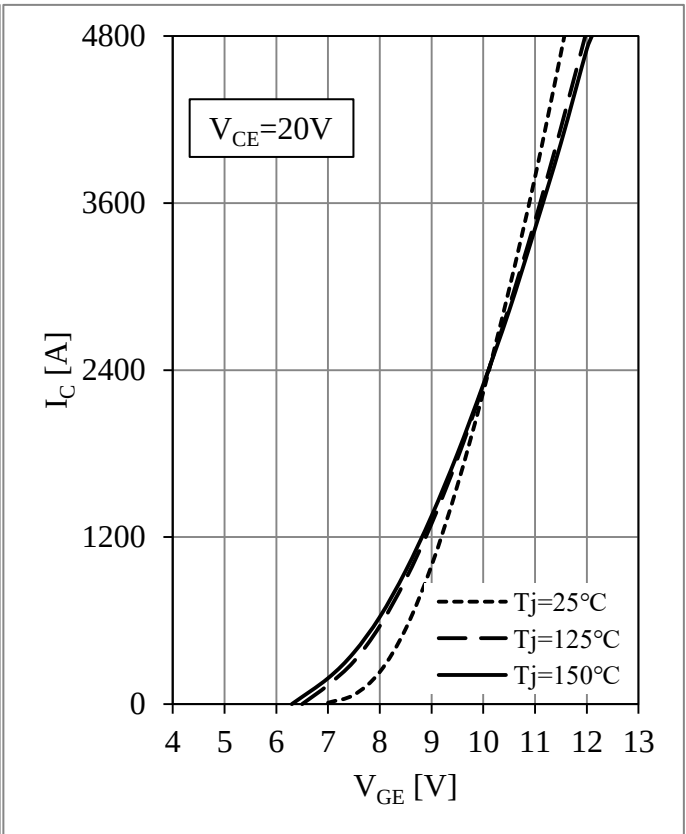
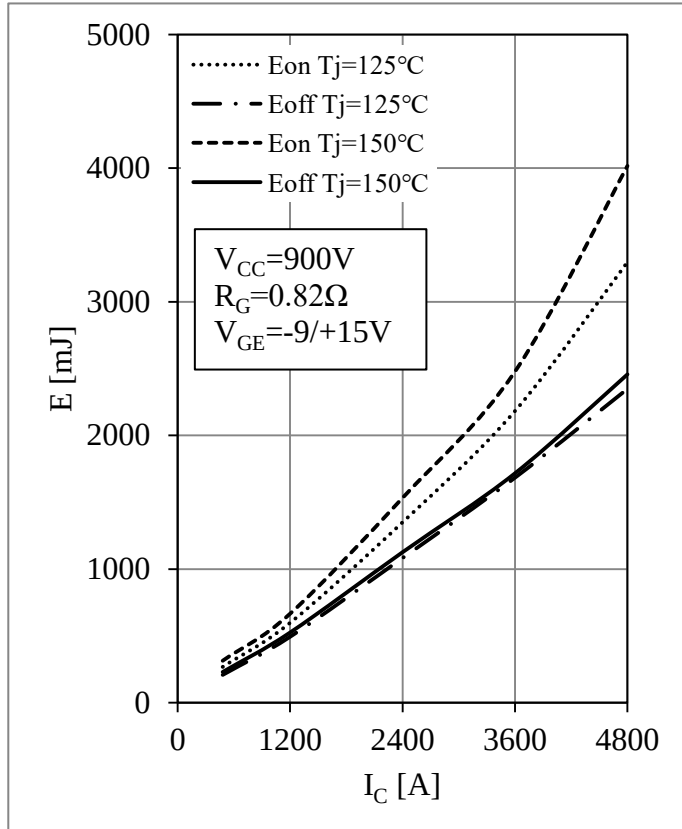
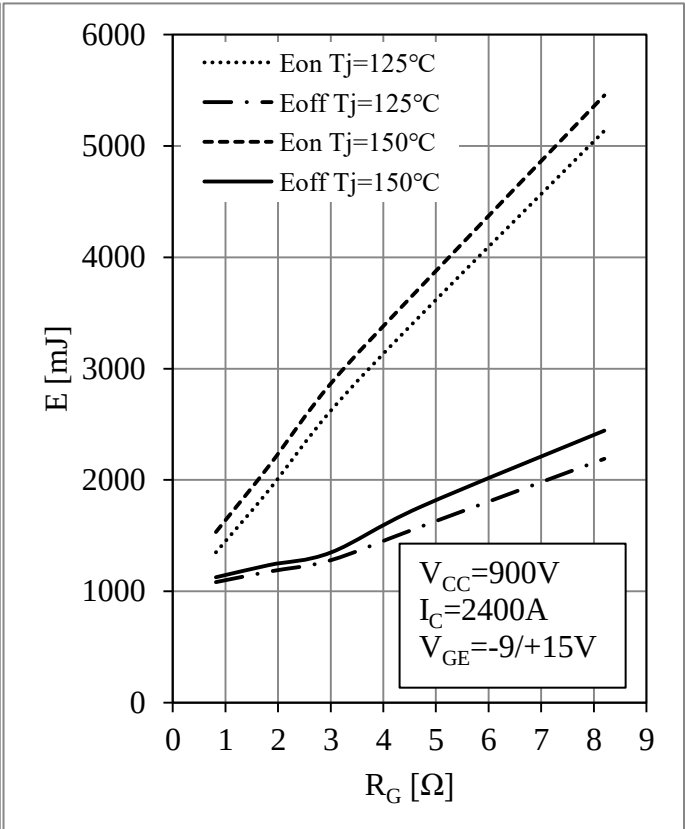


Fig 2. IGBT Transfer Characteristics

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

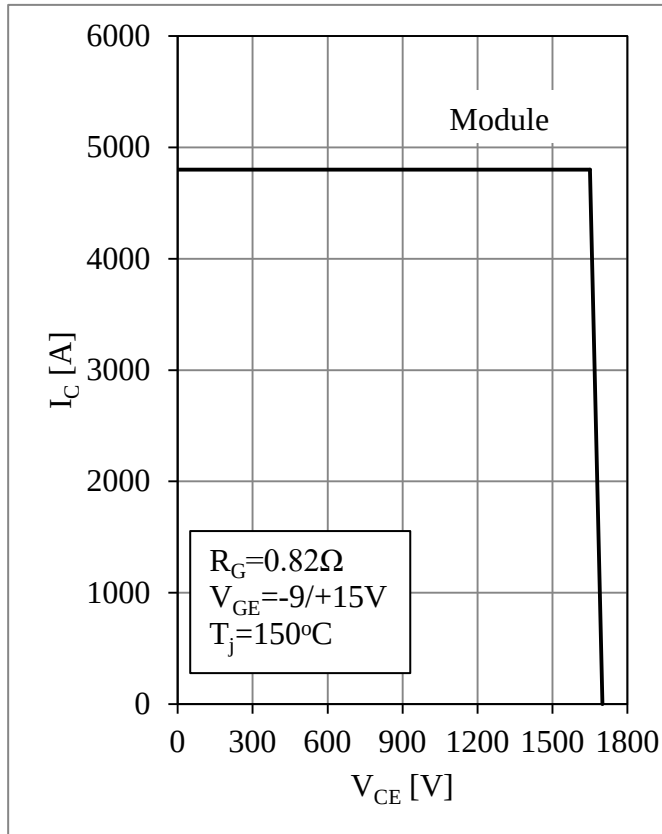


Fig 5. RBSOA

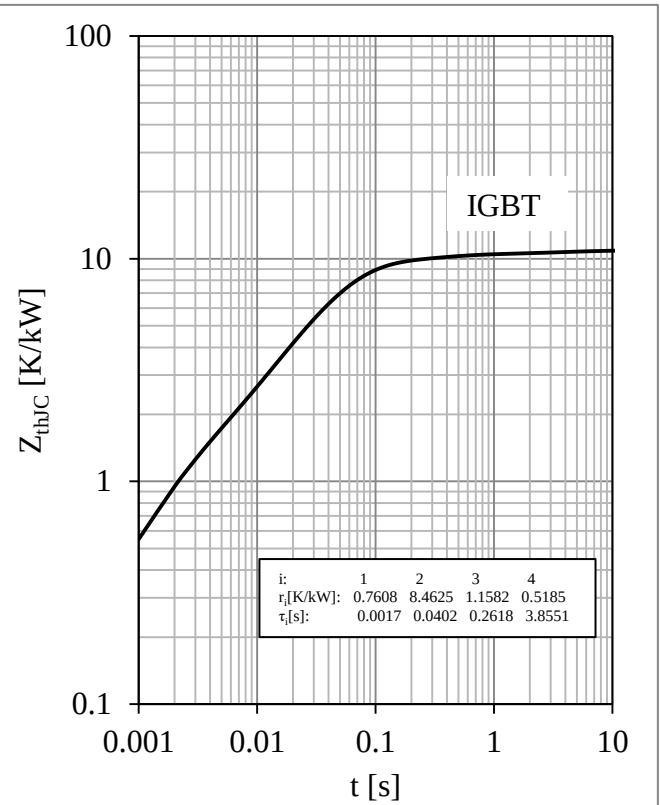


Fig 6. IGBT Transient Thermal Impedance

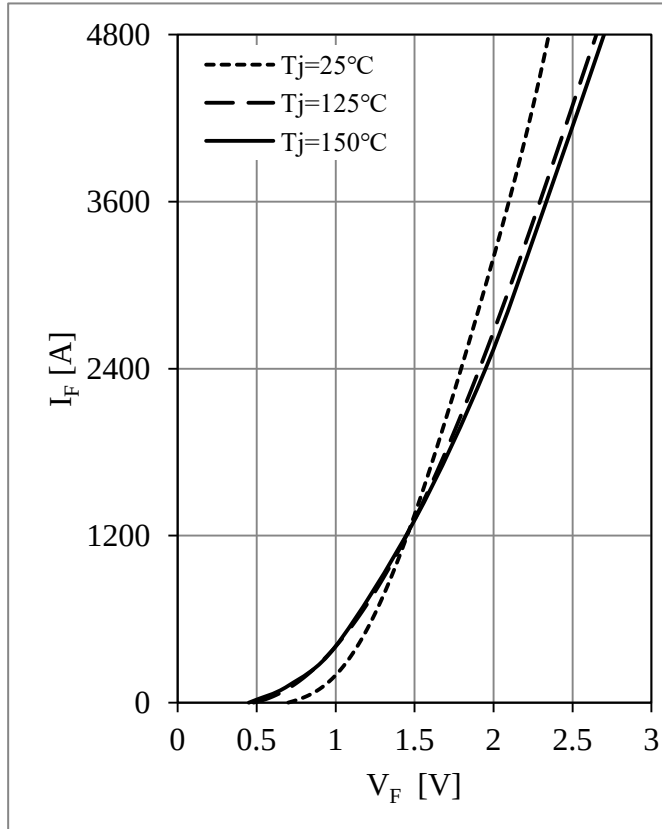
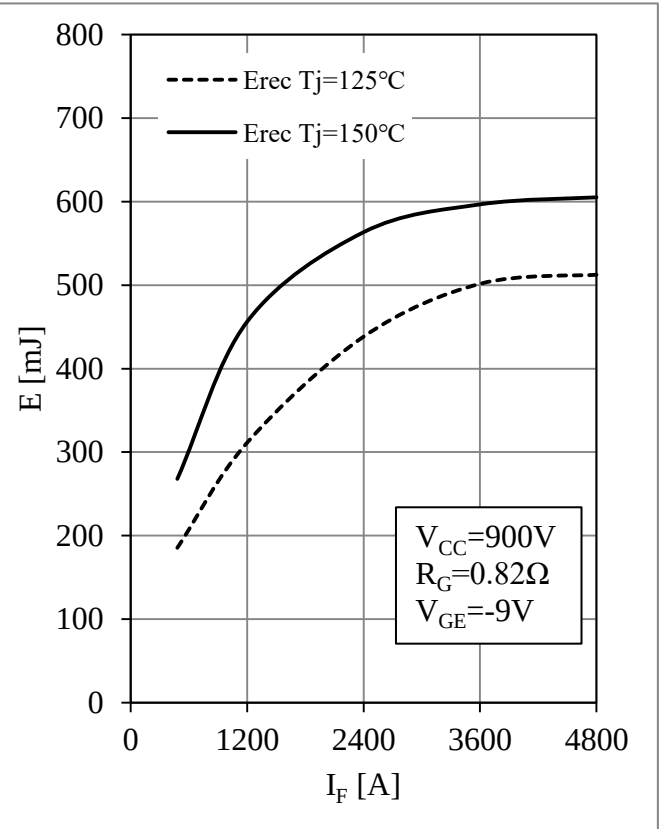


Fig 7. Diode Forward Characteristics

Fig 8. Diode Switching Loss vs. I_F

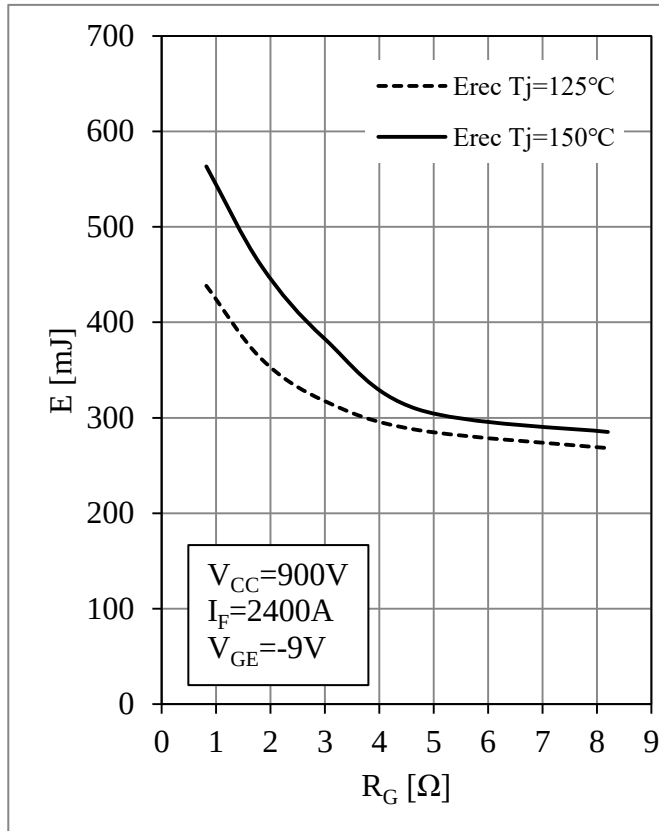
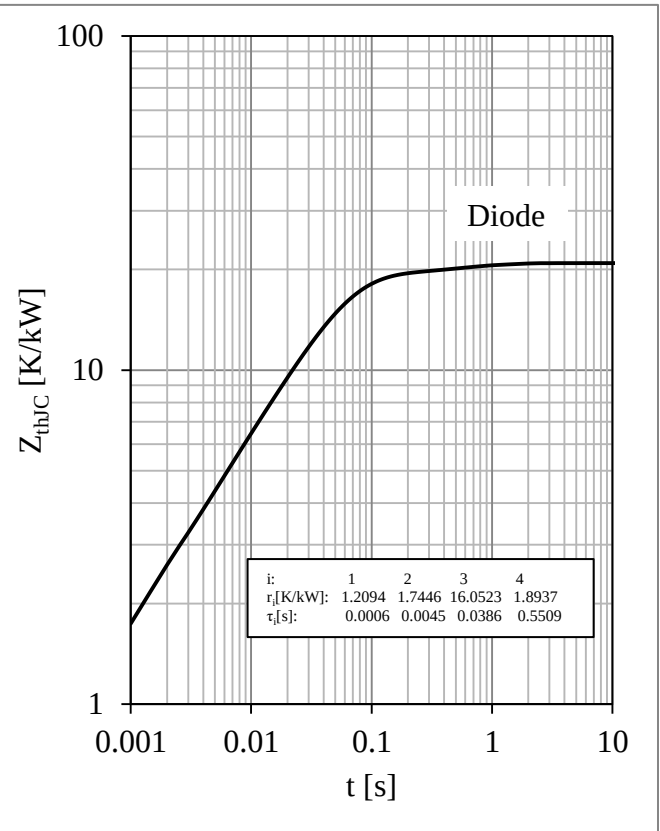
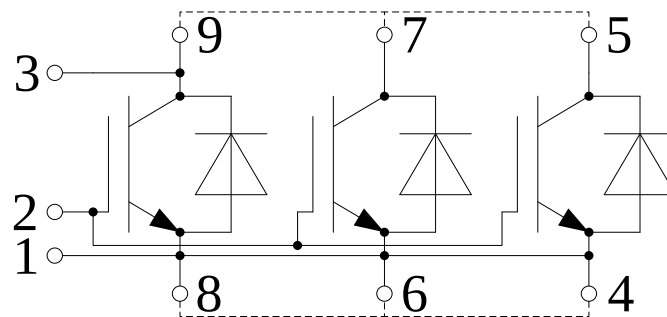
Fig 9. Diode Switching Loss vs. R_G 

Fig 10. Diode Transient Thermal Impedance

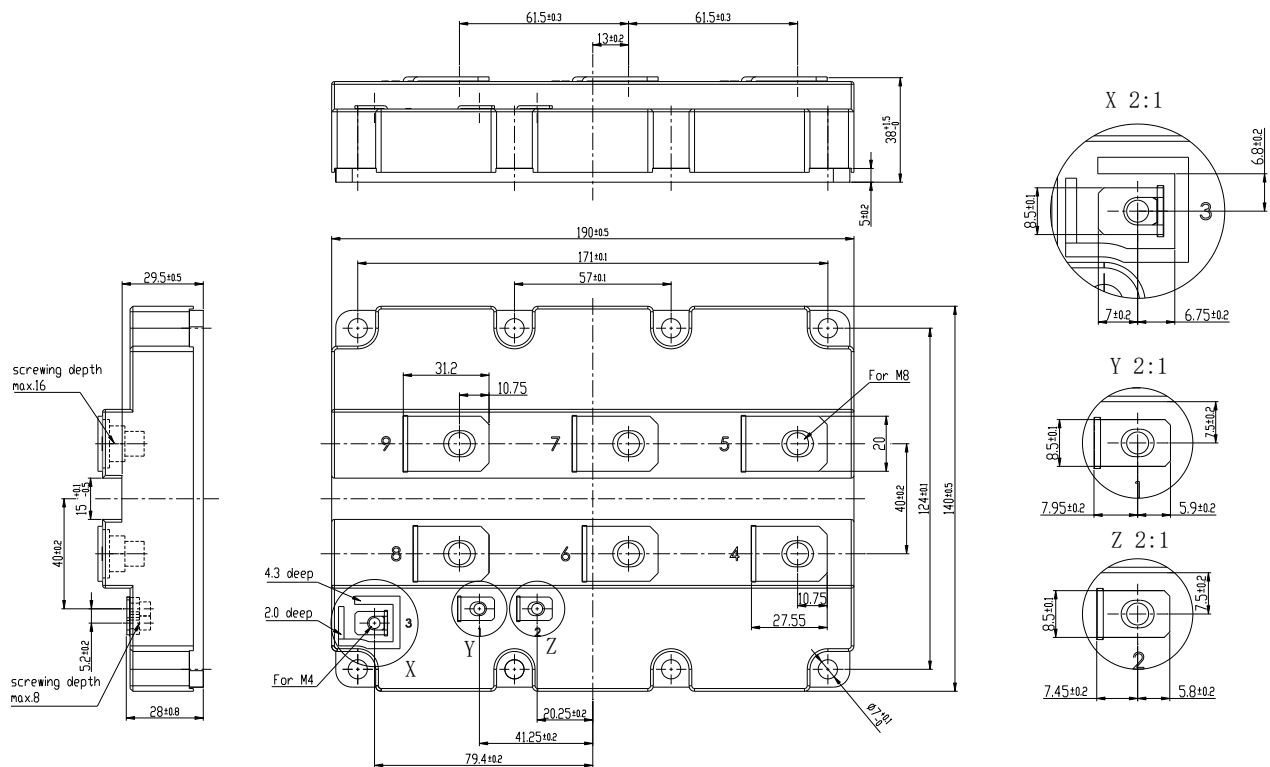
Circuit Schematic



external connection (to be done)

Package Dimensions

Dimensions in Millimeters



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