

STARPOWER

SEMICONDUCTOR

IGBT

GD1600SGY120C3S

1200V/1600A 1 in one-package

General Description

STARPOWER IGBT Power Module provides ultra switching speed as well as short circuit ruggedness. They are designed for the applications such as general inverters and UPS.

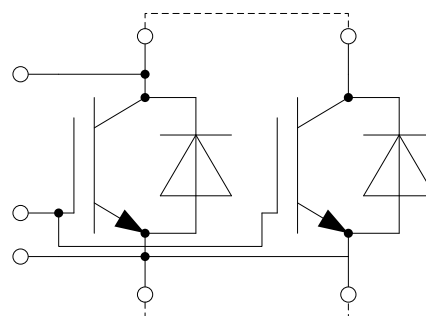
Features

- Low $V_{CE(sat)}$ Trench IGBT technology
- 10 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
- 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	± 20	V
I_C	Collector Current @ $T_C=25^{\circ}\text{C}$	2554	A
	@ $T_C=100^{\circ}\text{C}$	1600	A
I_{CM}	Pulsed Collector Current $t_p=1\text{ms}$	3200	A
P_D	Maximum Power Dissipation @ $T_j=175^{\circ}\text{C}$	8379	W

Diode

Symbol	Description	Value	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	1200	V
I_F	Diode Continuous Forward Current	1600	A
I_{FM}	Diode Maximum Forward Current $t_p=1\text{ms}$	3200	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, $f=50\text{Hz}$, $t=1\text{min}$	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	$I_C=1600\text{A}, V_{GE}=15\text{V}, T_j=25^{\circ}\text{C}$		1.70	2.15	V
		$I_C=1600\text{A}, V_{GE}=15\text{V}, T_j=125^{\circ}\text{C}$		1.95		
		$I_C=1600\text{A}, V_{GE}=15\text{V}, T_j=150^{\circ}\text{C}$		2.00		
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=64.0\text{mA}, V_{CE}=V_{GE}, T_j=25^{\circ}\text{C}$	5.6	6.2	6.8	V
I_{CES}	Collector Cut-Off Current	$V_{CE}=V_{CES}, V_{GE}=0\text{V}, T_j=25^{\circ}\text{C}$			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			1.4		Ω
C_{ies}	Input Capacitance	$V_{CE}=25\text{V}, f=1\text{MHz}, V_{GE}=0\text{V}$		166		nF
C_{res}	Reverse Transfer Capacitance			4.64		nF
Q_G	Gate Charge	$V_{GE}=-15\dots+15\text{V}$		12.4		μC
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=1600\text{A}, R_G=1.2\Omega, L_S=65\text{nH}, V_{GE}=-9\text{V}/+15\text{V}, T_j=25^{\circ}\text{C}$		676		ns
t_r	Rise Time			225		ns
$t_{d(off)}$	Turn-Off Delay Time			2110		ns
t_f	Fall Time			157		ns
E_{on}	Turn-On Switching Loss			270		mJ
E_{off}	Turn-Off Switching Loss			326		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=1600\text{A}, R_G=1.2\Omega, L_S=65\text{nH}, V_{GE}=-9\text{V}/+15\text{V}, T_j=125^{\circ}\text{C}$		927		ns
t_r	Rise Time			300		ns
$t_{d(off)}$	Turn-Off Delay Time			2592		ns
t_f	Fall Time			199		ns
E_{on}	Turn-On Switching Loss			482		mJ
E_{off}	Turn-Off Switching Loss			389		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=1600\text{A}, R_G=1.2\Omega, L_S=65\text{nH}, V_{GE}=-9\text{V}/+15\text{V}, T_j=150^{\circ}\text{C}$		1005		ns
t_r	Rise Time			311		ns
$t_{d(off)}$	Turn-Off Delay Time			2729		ns
t_f	Fall Time			204		ns
E_{on}	Turn-On Switching Loss			545		mJ
E_{off}	Turn-Off Switching Loss			407		mJ
I_{SC}	SC Data	$t_p \leq 10\mu\text{s}, V_{GE}=15\text{V}, T_j=150^{\circ}\text{C}, V_{CC}=800\text{V}, V_{CEM} \leq 1200\text{V}$		6400		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	$I_F=1600\text{A}, V_{GE}=0\text{V}, T_j=25^{\circ}\text{C}$		1.85	2.30	V
		$I_F=1600\text{A}, V_{GE}=0\text{V}, T_j=125^{\circ}\text{C}$		1.90		
		$I_F=1600\text{A}, V_{GE}=0\text{V}, T_j=150^{\circ}\text{C}$		1.95		
Q_r	Recovered Charge	$V_R=600\text{V}, I_F=1600\text{A},$ $-di/dt=6200\text{A}/\mu\text{s}, V_{GE}=-9\text{V}$ $L_S=65\text{nH}, T_j=25^{\circ}\text{C}$		66.5		μC
I_{RM}	Peak Reverse Recovery Current			572		A
E_{rec}	Reverse Recovery Energy			15.6		mJ
Q_r	Recovered Charge	$V_R=600\text{V}, I_F=1600\text{A},$ $-di/dt=6200\text{A}/\mu\text{s}, V_{GE}=-9\text{V}$ $L_S=65\text{nH}, T_j=125^{\circ}\text{C}$		121		μC
I_{RM}	Peak Reverse Recovery Current			554		A
E_{rec}	Reverse Recovery Energy			29.5		mJ
Q_r	Recovered Charge	$V_R=600\text{V}, I_F=1600\text{A},$ $-di/dt=6200\text{A}/\mu\text{s}, V_{GE}=-9\text{V}$ $L_S=65\text{nH}, T_j=150^{\circ}\text{C}$		129		μC
I_{RM}	Peak Reverse Recovery Current			540		A
E_{rec}	Reverse Recovery Energy			31.9		mJ

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

Symbol	Parameter	Min.	Typ.	Max.	Unit
L_{CE}	Stray Inductance		12		nH
$R_{CC'+EE'}$	Module Lead Resistance, Terminal to Chip		0.19		m Ω
R_{thJC}	Junction-to-Case (per IGBT)			17.9	K/kW
	Junction-to-Case (per Diode)			29.8	
R_{thCH}	Case-to-Heatsink (per IGBT)		9.6		K/kW
	Case-to-Heatsink (per Diode)		16.0		
	Case-to-Heatsink (per Module)		6.0		
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

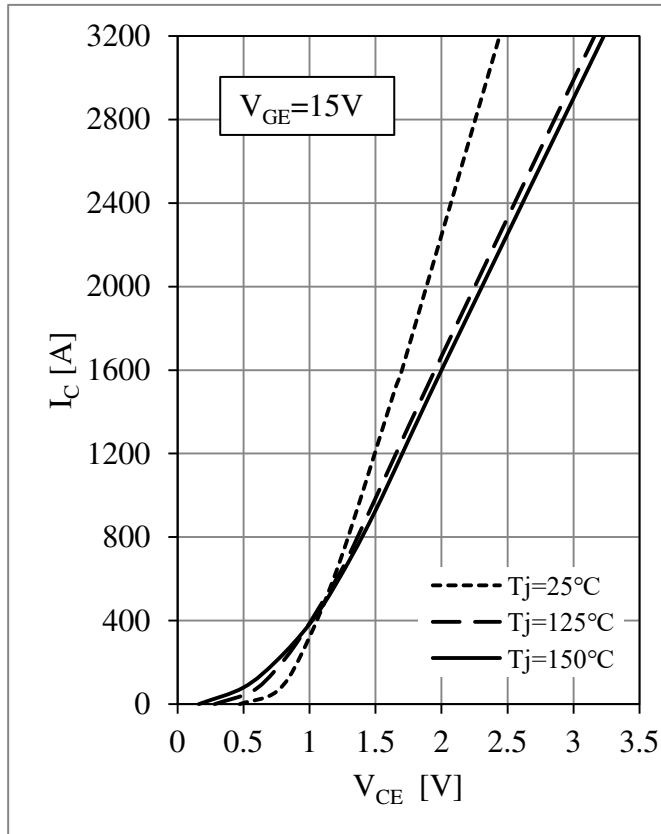


Fig 1. IGBT Output Characteristics

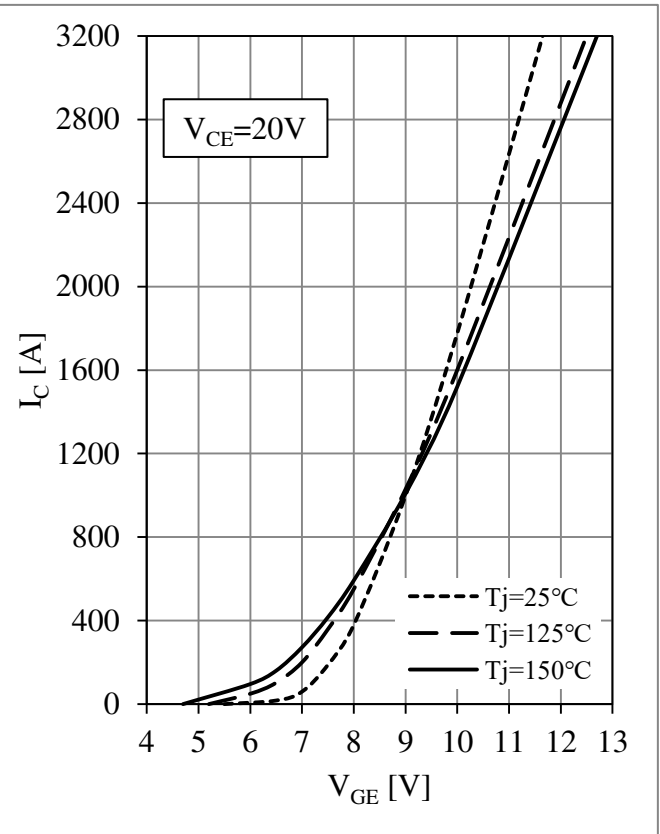
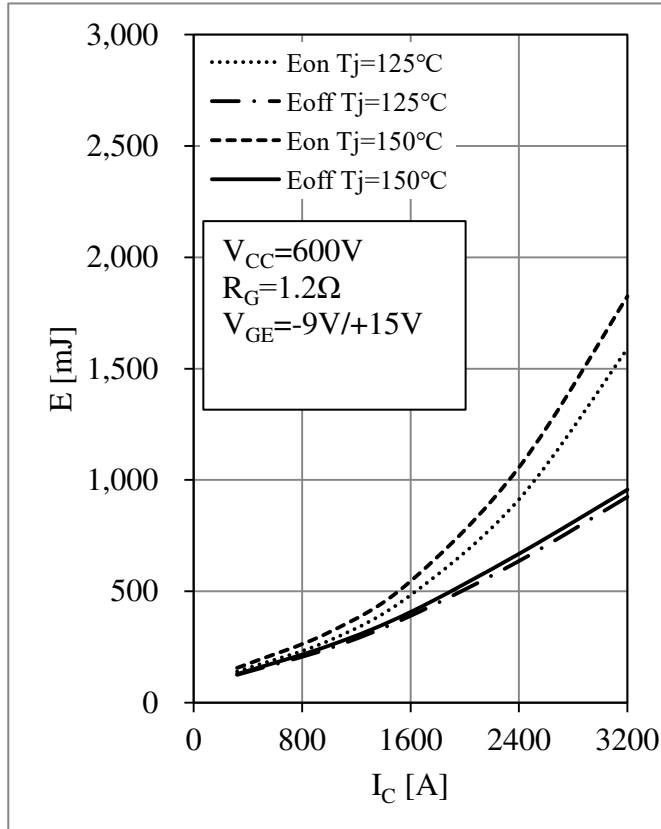
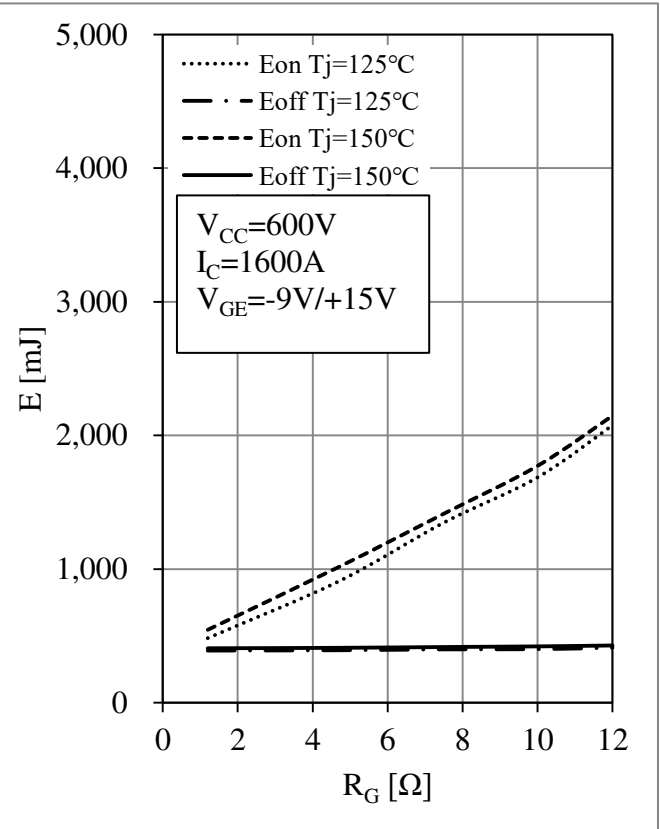


Fig 2. IGBT Transfer Characteristics

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

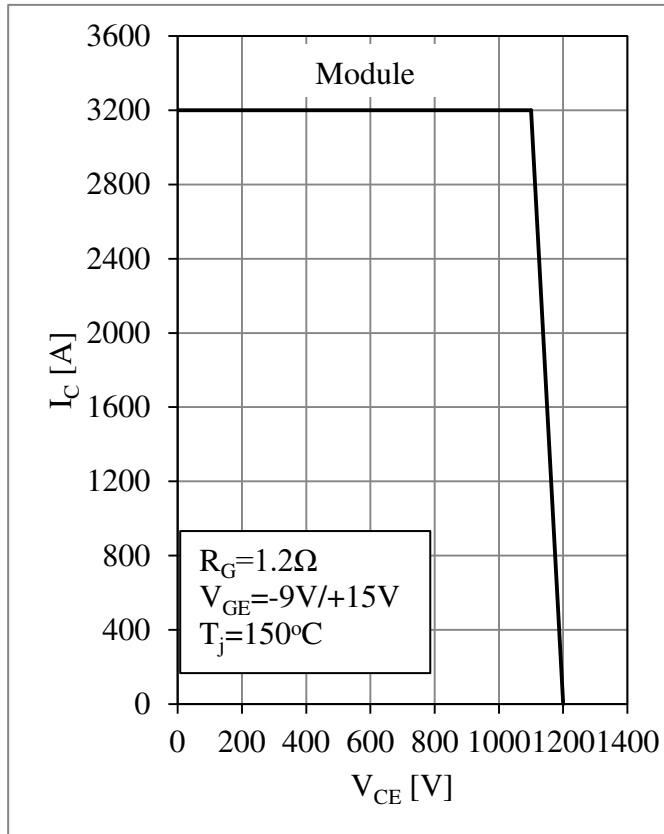


Fig 5. RBSOA

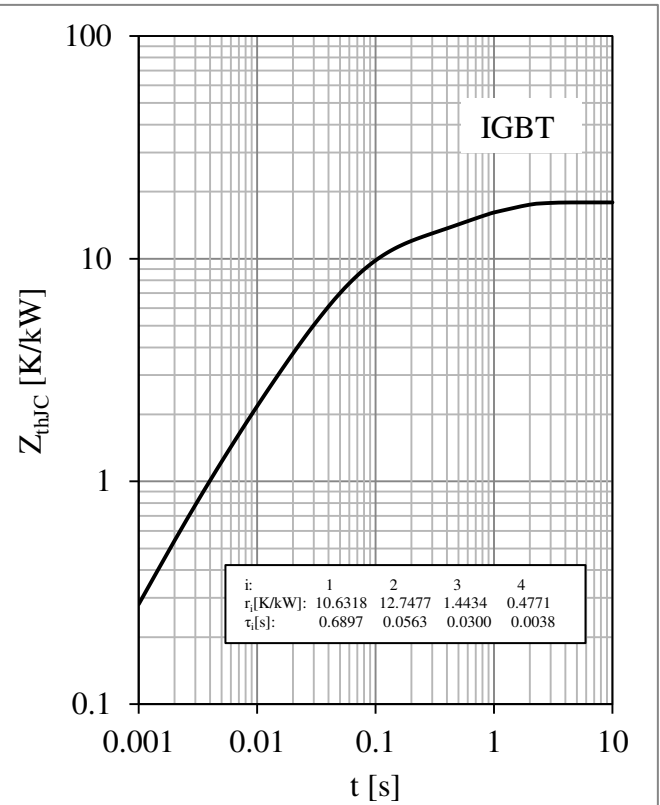


Fig 6. IGBT Transient Thermal Impedance

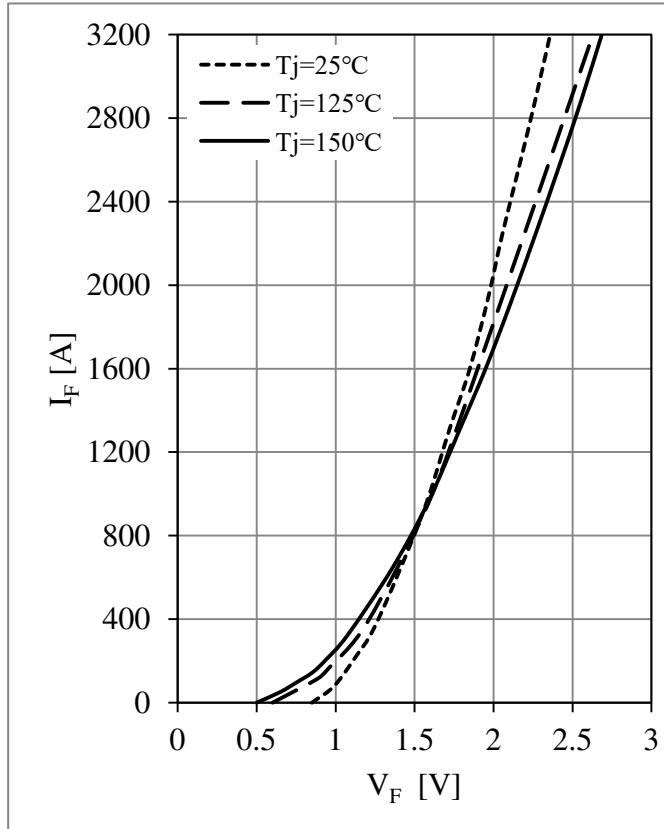
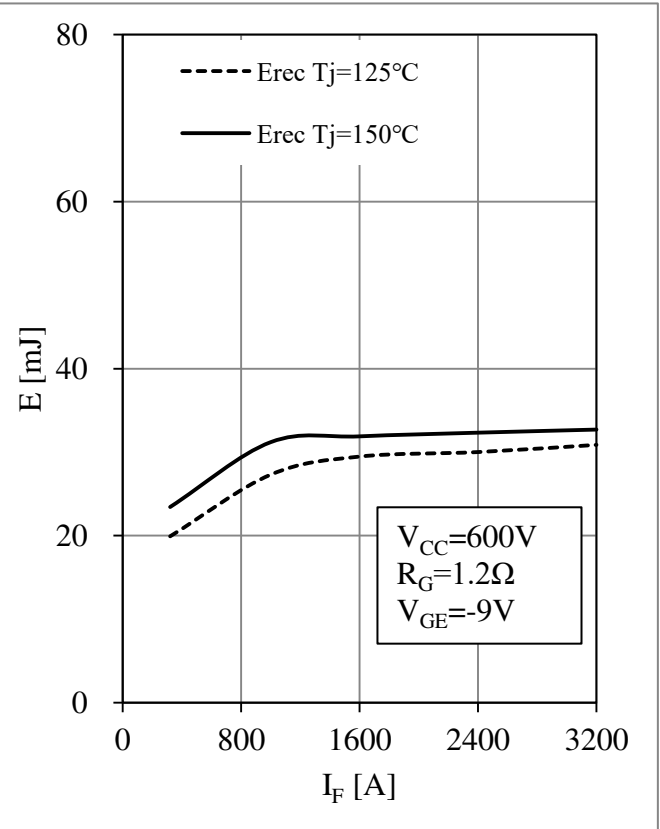


Fig 7. Diode Forward Characteristics

Fig 8. Diode Switching Loss vs. I_F

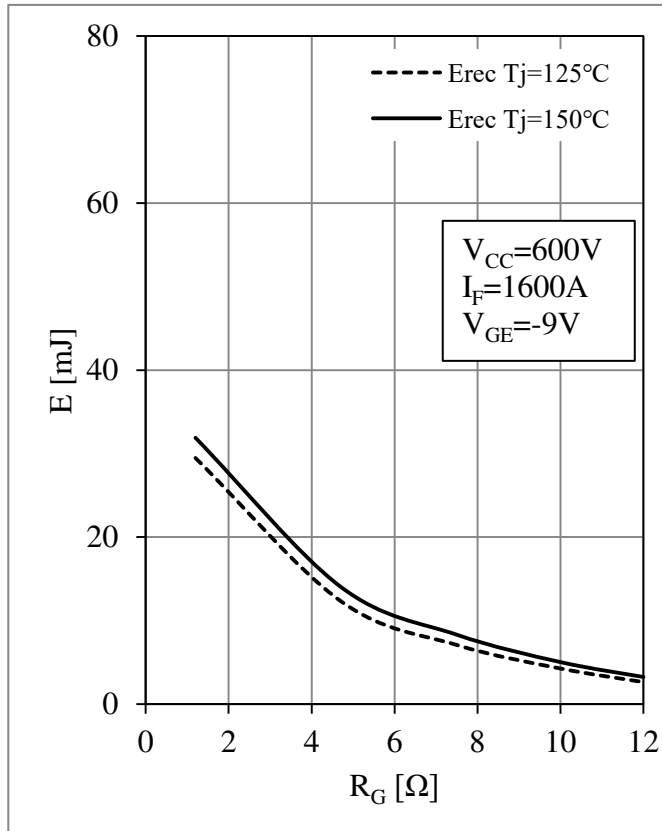
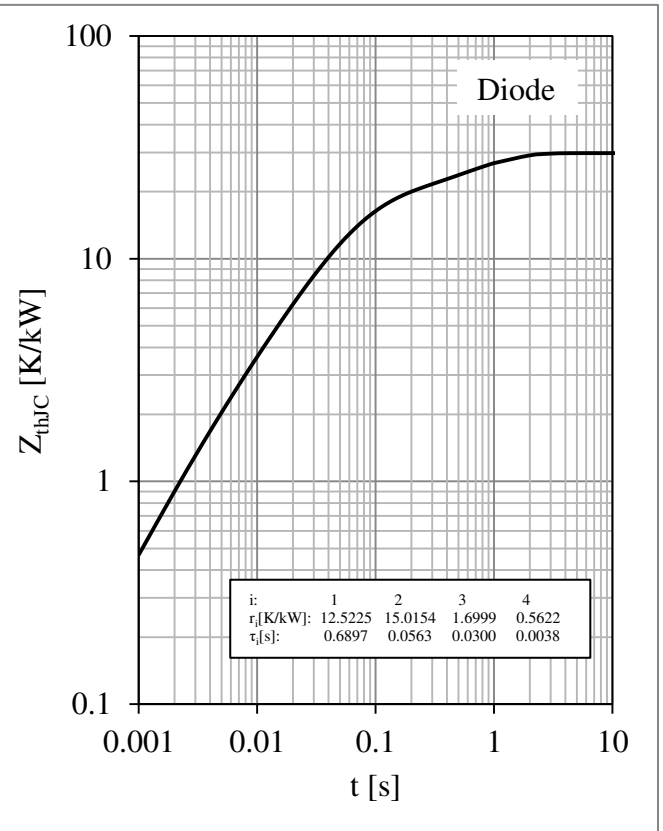
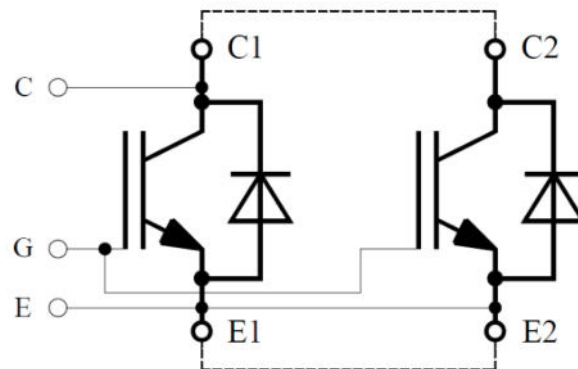
Fig 9. Diode Switching Loss vs. R_G 

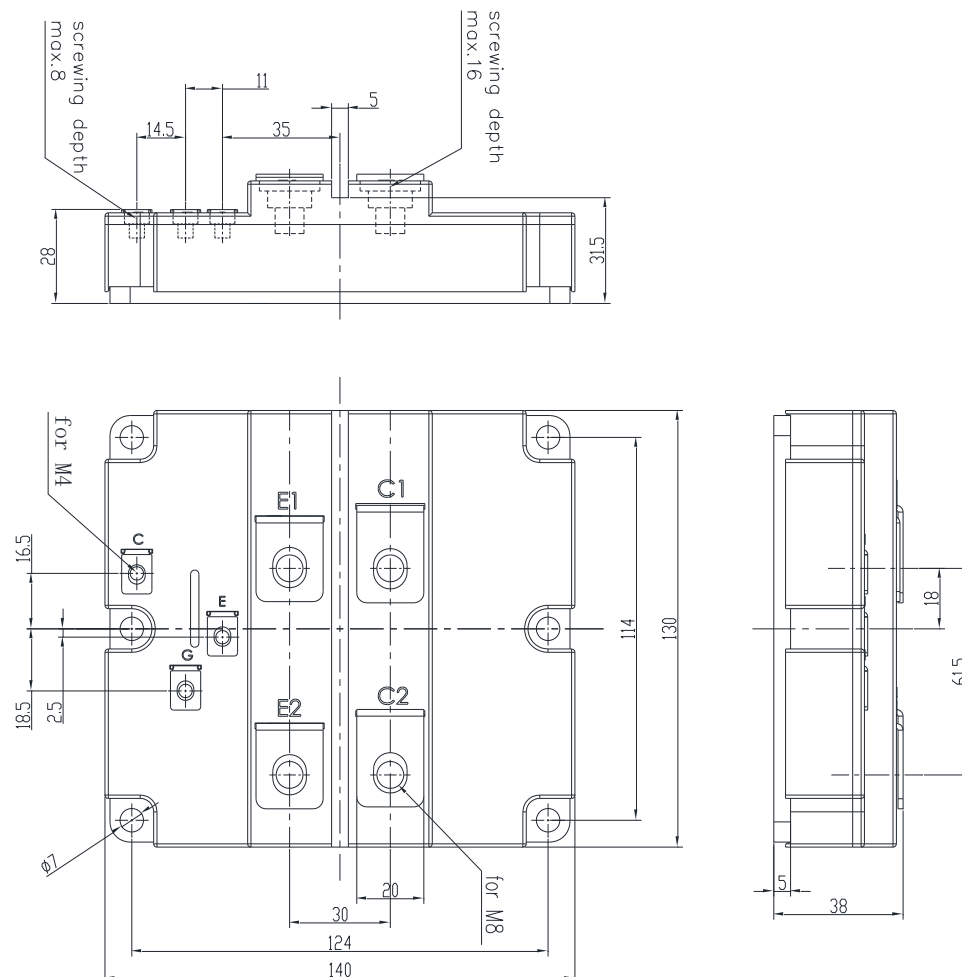
Fig 10. Diode Transient Thermal Impedance

Circuit Schematic



Package Dimensions

Dimensions in Millimeters



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