

STARPOWER

SEMICONDUCTOR

IGBT

GD400TUX65C2S

650V/400A 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 3-level-applications.

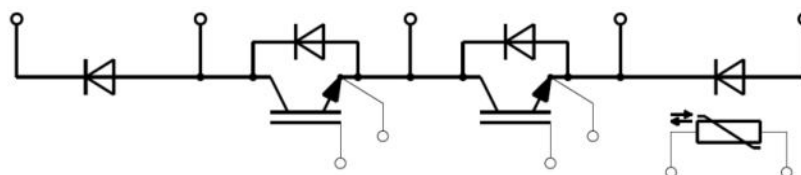
Features

- Low $V_{CE(sat)}$ trench IGBT technology
- 6 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

- Solar power
- UPS
- 3-level-applications

Equivalent Circuit Schematic



Absolute Maximum Ratings $T_C=25^{\circ}\text{C}$ unless otherwise noted**T2 T3 IGBT**

Symbol	Description	Value	Unit
V_{CES}	Collector-Emitter Voltage	650	V
V_{GES}	Gate-Emitter Voltage	± 20	V
I_C	Collector Current @ $T_C=25^{\circ}\text{C}$ @ $T_C=65^{\circ}\text{C}$	505 400	A
I_{CM}	Pulsed Collector Current $t_p=1\text{ms}$	800	A
P_D	Maximum Power Dissipation @ $T_j=175^{\circ}\text{C}$	1261	W

D2 D3 Diode

Symbol	Description	Value	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	650	V
I_F	Diode Continuous Forward Current	50	A
I_{FM}	Diode Maximum Forward Current $t_p=1\text{ms}$	100	A

D1 D4 Diode

Symbol	Description	Value	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	650	V
I_F	Diode Continuous Forward Current	400	A
I_{FM}	Diode Maximum Forward Current $t_p=1\text{ms}$	800	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

T2 T3 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	$I_C=400\text{A}, V_{GE}=15\text{V}, T_j=25^{\circ}\text{C}$		1.45	1.90	V
		$I_C=400\text{A}, V_{GE}=15\text{V}, T_j=125^{\circ}\text{C}$		1.60		
		$I_C=400\text{A}, V_{GE}=15\text{V}, T_j=150^{\circ}\text{C}$		1.70		
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=6.40\text{mA}, V_{CE}=V_{GE}, T_j=25^{\circ}\text{C}$	5.1	5.8	6.5	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			1.0		Ω
C_{ies}	Input Capacitance	$V_{CE}=25\text{V}, f=1\text{MHz}, V_{GE}=0\text{V}$		46.4		nF
C_{res}	Reverse Transfer Capacitance			0.91		nF
Q_G	Gate Charge	$V_{GE}=-15\dots+15\text{V}$		2.77		μC
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=300\text{V}, I_C=400\text{A}, R_G=1.8\Omega, V_{GE}=\pm 15\text{V}, T_j=25^{\circ}\text{C}$		80		ns
t_r	Rise Time			64		ns
$t_{d(off)}$	Turn-Off Delay Time			368		ns
t_f	Fall Time			40		ns
E_{on}	Turn-On Switching Loss			2.3		mJ
E_{off}	Turn-Off Switching Loss			10.4		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=300\text{V}, I_C=400\text{A}, R_G=1.8\Omega, V_{GE}=\pm 15\text{V}, T_j=125^{\circ}\text{C}$		88		ns
t_r	Rise Time			64		ns
$t_{d(off)}$	Turn-Off Delay Time			400		ns
t_f	Fall Time			56		ns
E_{on}	Turn-On Switching Loss			3.4		mJ
E_{off}	Turn-Off Switching Loss			12.8		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=300\text{V}, I_C=400\text{A}, R_G=1.8\Omega, V_{GE}=\pm 15\text{V}, T_j=150^{\circ}\text{C}$		96		ns
t_r	Rise Time			64		ns
$t_{d(off)}$	Turn-Off Delay Time			400		ns
t_f	Fall Time			64		ns
E_{on}	Turn-On Switching Loss			3.6		mJ
E_{off}	Turn-Off Switching Loss			13.6		mJ
I_{SC}	SC Data	$t_p \leq 6\mu\text{s}, V_{GE}=15\text{V}, T_j=150^{\circ}\text{C}, V_{CC}=360\text{V}, V_{CEM} \leq 650\text{V}$		2000		A

D2 D3 Diode Characteristics $T_C=25^{\circ}\text{C}$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_F	Diode Forward Voltage	$I_F=50\text{A}, V_{GE}=0\text{V}, T_j=25^{\circ}\text{C}$		1.55	2.05	V
		$I_F=50\text{A}, V_{GE}=0\text{V}, T_j=125^{\circ}\text{C}$		1.50		
		$I_F=50\text{A}, V_{GE}=0\text{V}, T_j=150^{\circ}\text{C}$		1.45		
Q_r	Recovered Charge	$V_R=300\text{V}, I_F=50\text{A},$ $-di/dt=2420\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=25^{\circ}\text{C}$		2.2		μC
I_{RM}	Peak Reverse Recovery Current			55		A
E_{rec}	Reverse Recovery Energy			0.55		mJ
Q_r	Recovered Charge	$V_R=300\text{V}, I_F=50\text{A},$ $-di/dt=2420\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=125^{\circ}\text{C}$		4.3		μC
I_{RM}	Peak Reverse Recovery Current			66		A
E_{rec}	Reverse Recovery Energy			1.10		mJ
Q_r	Recovered Charge	$V_R=300\text{V}, I_F=50\text{A},$ $-di/dt=2420\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=150^{\circ}\text{C}$		4.8		μC
I_{RM}	Peak Reverse Recovery Current			72		A
E_{rec}	Reverse Recovery Energy			1.27		mJ

D1 D4 Diode Characteristics $T_C=25^{\circ}\text{C}$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_F	Diode Forward Voltage	$I_F=400\text{A}, V_{GE}=0\text{V}, T_j=25^{\circ}\text{C}$		1.65	2.10	V
		$I_F=400\text{A}, V_{GE}=0\text{V}, T_j=125^{\circ}\text{C}$		1.65		
		$I_F=400\text{A}, V_{GE}=0\text{V}, T_j=150^{\circ}\text{C}$		1.65		
Q_r	Recovered Charge	$V_R=400\text{V}, I_F=400\text{A},$ $-di/dt=4700\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=25^{\circ}\text{C}$		10.5		μC
I_{RM}	Peak Reverse Recovery Current			216		A
E_{rec}	Reverse Recovery Energy			3.52		mJ
Q_r	Recovered Charge	$V_R=400\text{V}, I_F=400\text{A},$ $-di/dt=4300\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=125^{\circ}\text{C}$		18		μC
I_{RM}	Peak Reverse Recovery Current			250		A
E_{rec}	Reverse Recovery Energy			7.10		mJ
Q_r	Recovered Charge	$V_R=400\text{V}, I_F=400\text{A},$ $-di/dt=4200\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=150^{\circ}\text{C}$		21		μC
I_{RM}	Peak Reverse Recovery Current			276		A
E_{rec}	Reverse Recovery Energy			7.80		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
R_{thJC}	Junction-to-Case (per T2 T3 IGBT)			0.119	K/W
	Junction-to-Case (per D2 D3 Diode)			1.066	
	Junction-to-Case (per D1 D4 Diode)			0.218	
R_{thCH}	Case-to-Sink (per T2 T3 IGBT)		0.033		K/W
	Case-to-Sink (per D2 D3 Diode)		0.297		
	Case-to-Sink (per D1 D4 Diode)		0.061		
	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

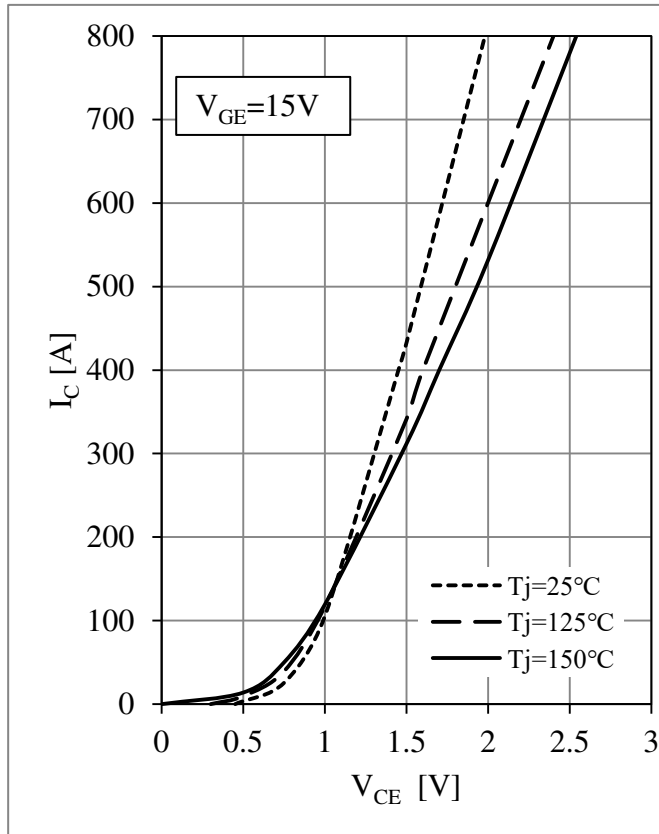


Fig 1. T2 T3 IGBT Output Characteristics

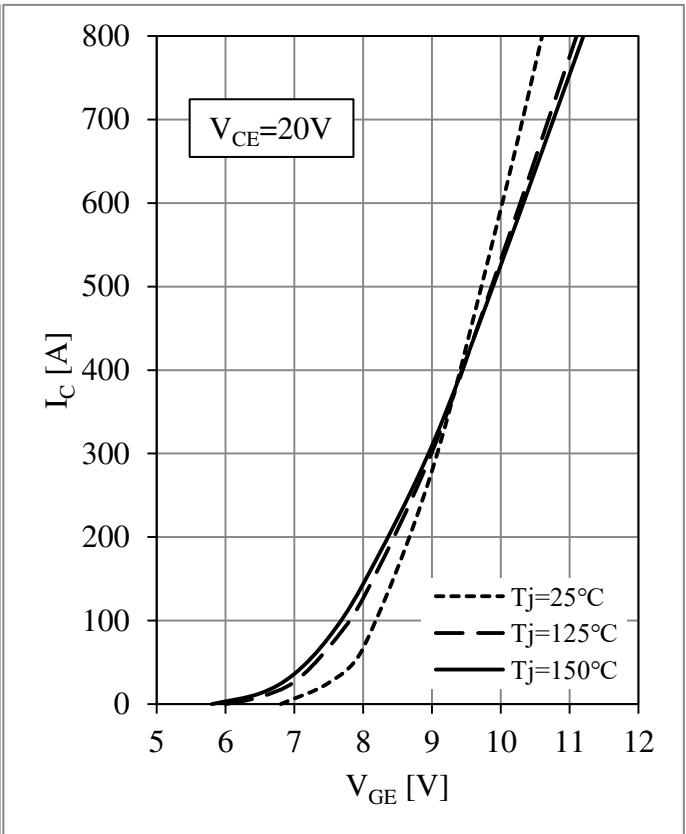
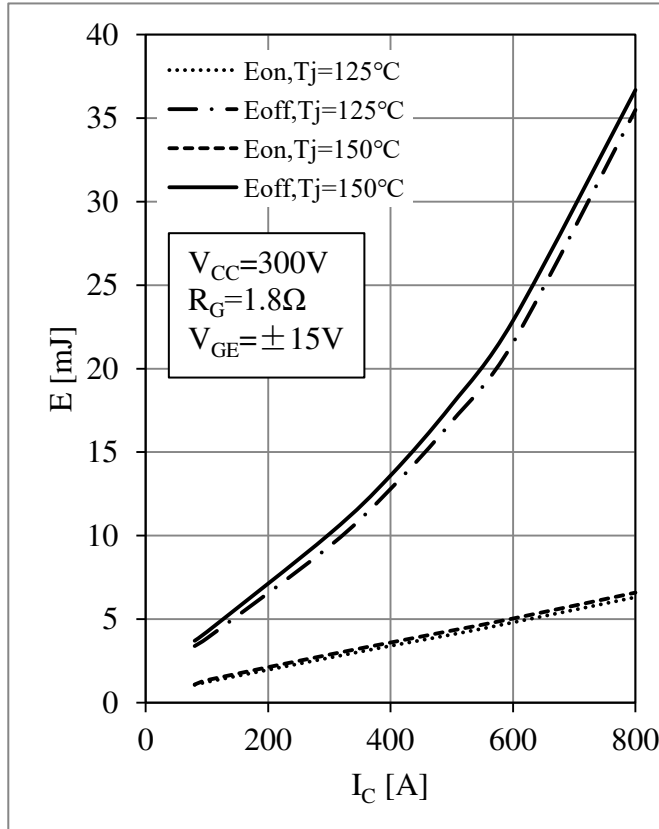
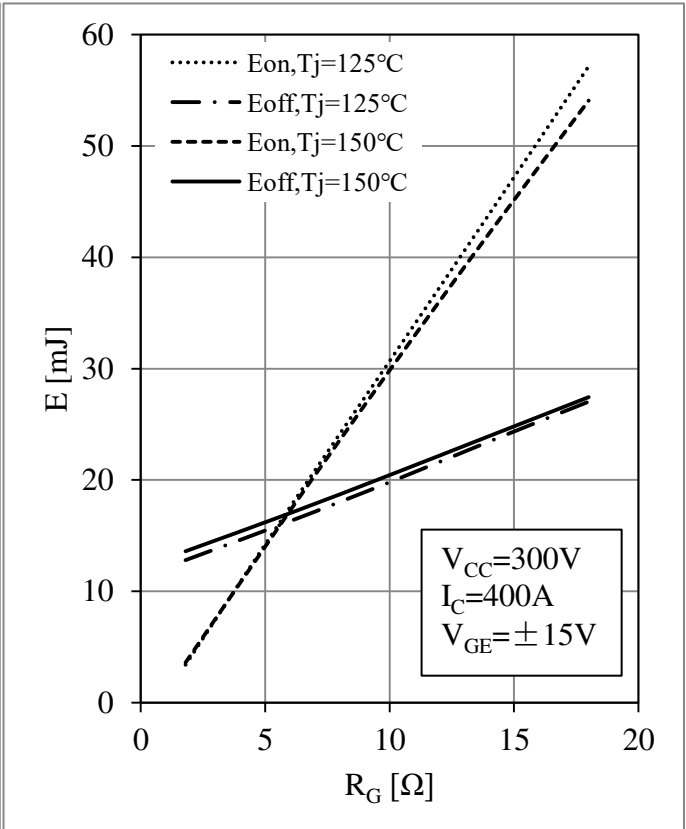


Fig 2. T2 T3 IGBT Transfer Characteristics

Fig 3. T2 T3 IGBT Switching Loss vs. I_C Fig 4. T2 T3 IGBT Switching Loss vs. R_G

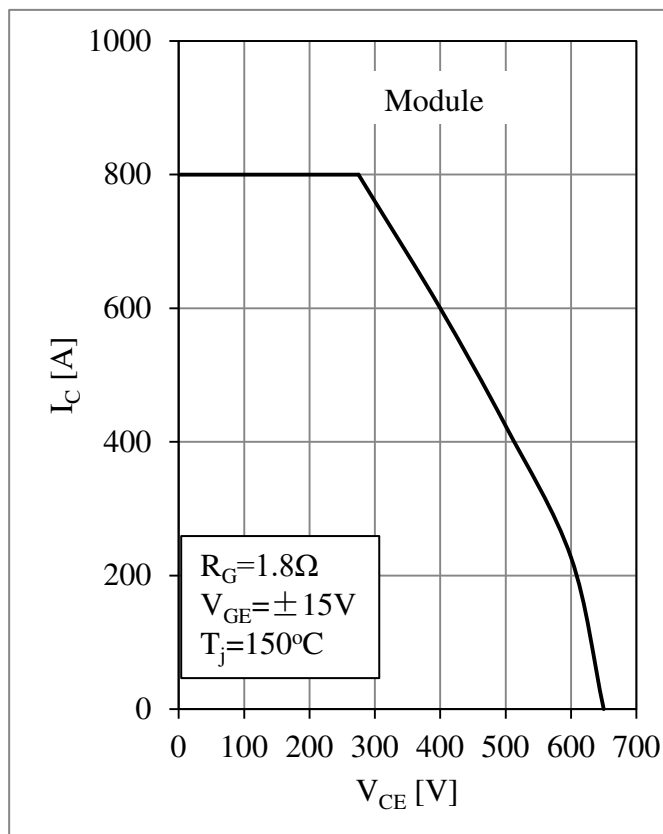


Fig 5. T2 T3 RBSOA

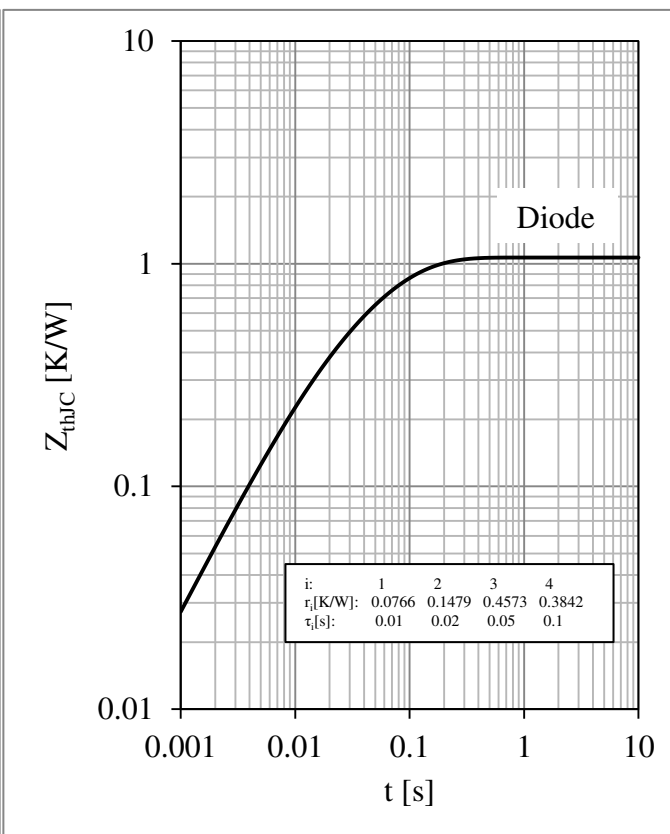


Fig 6. T2 T3 IGBT Transient Thermal Impedance

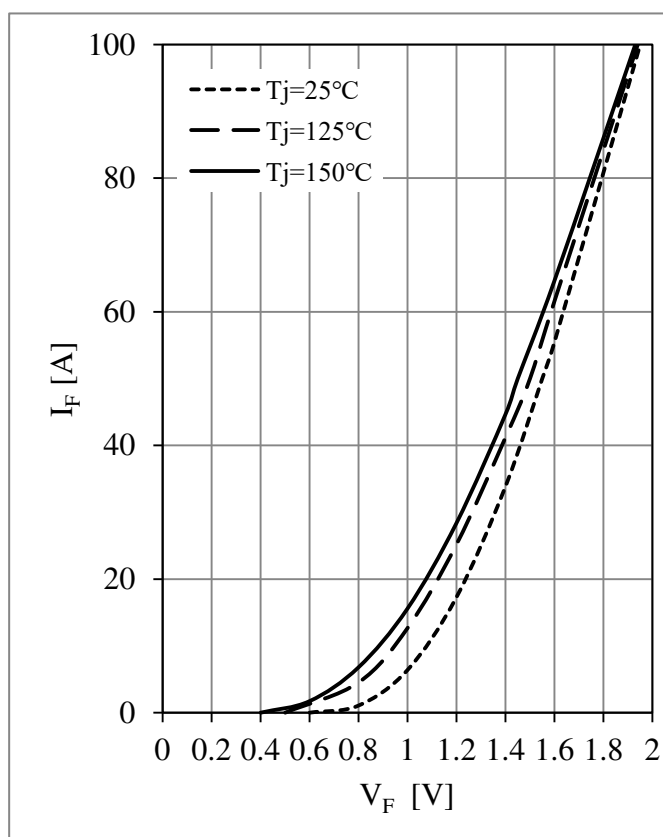
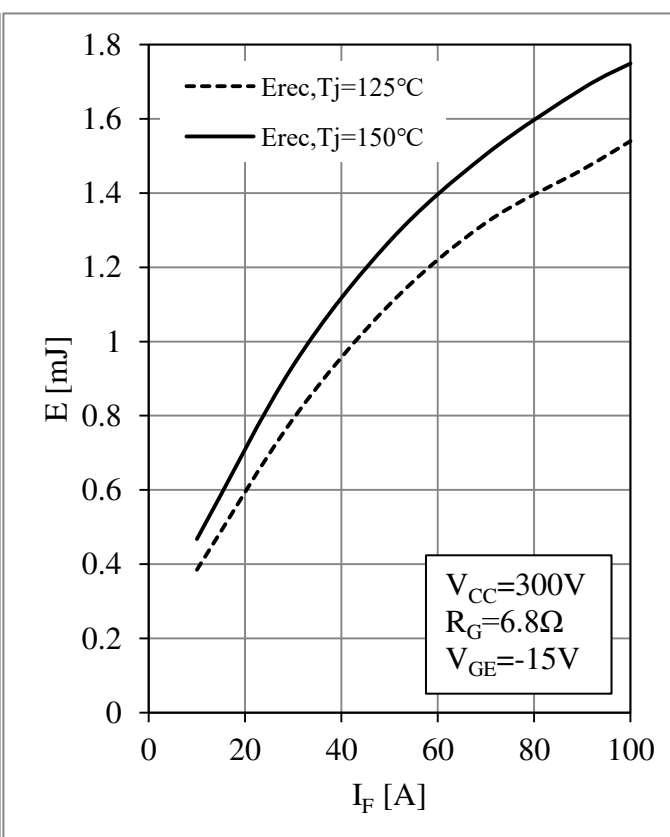
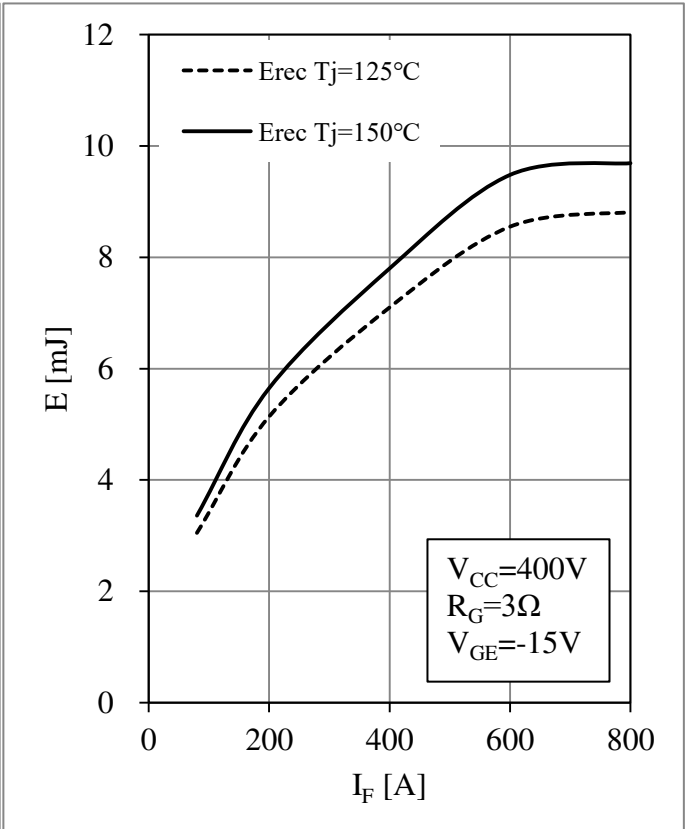
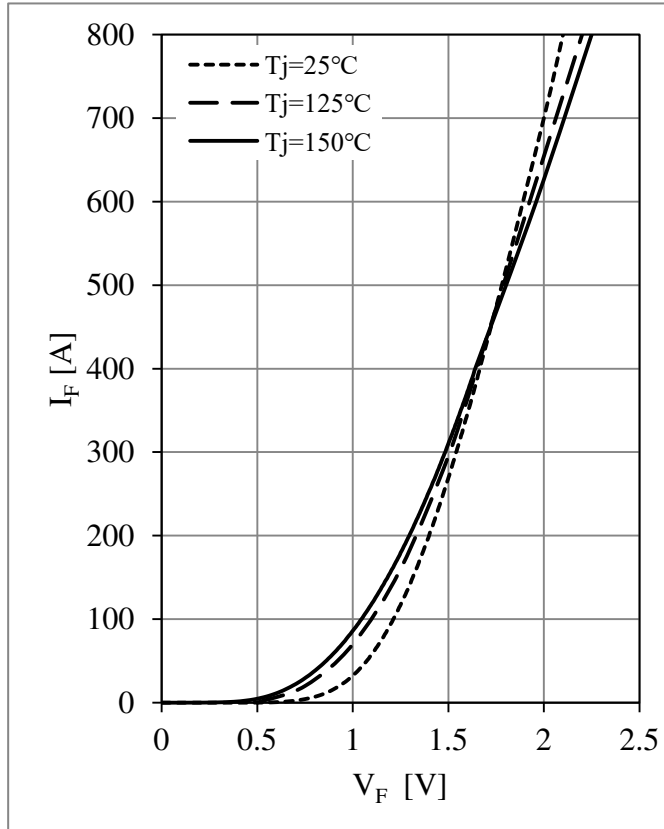
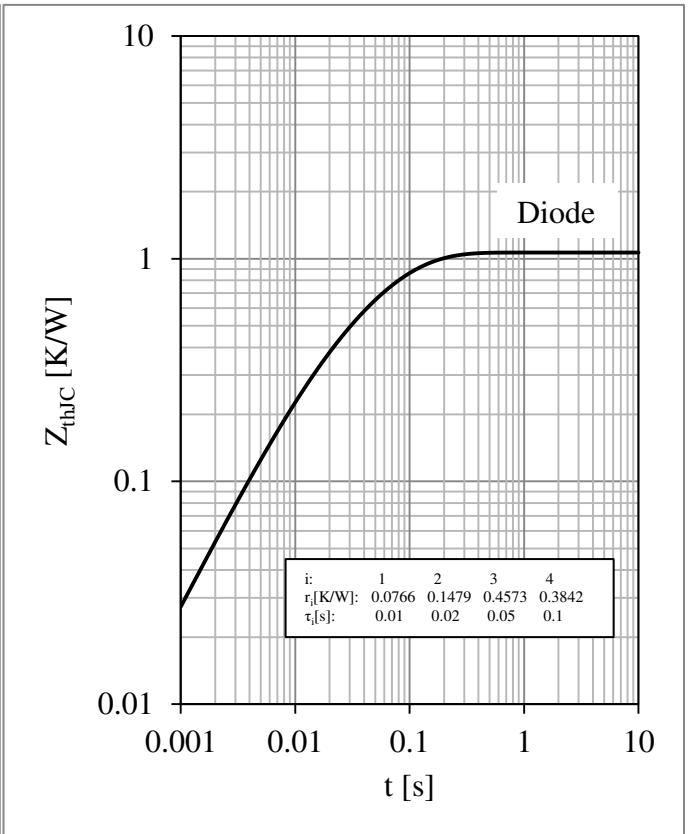
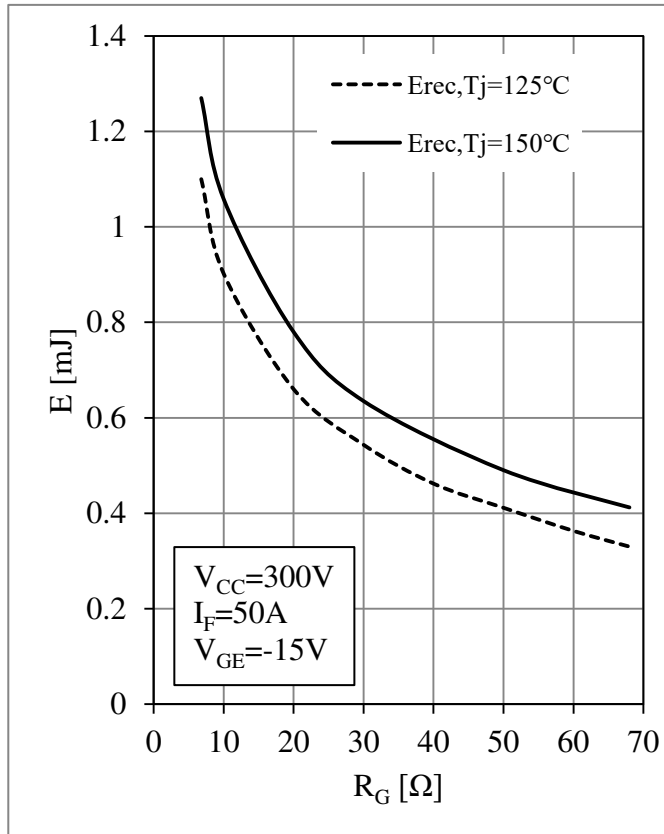
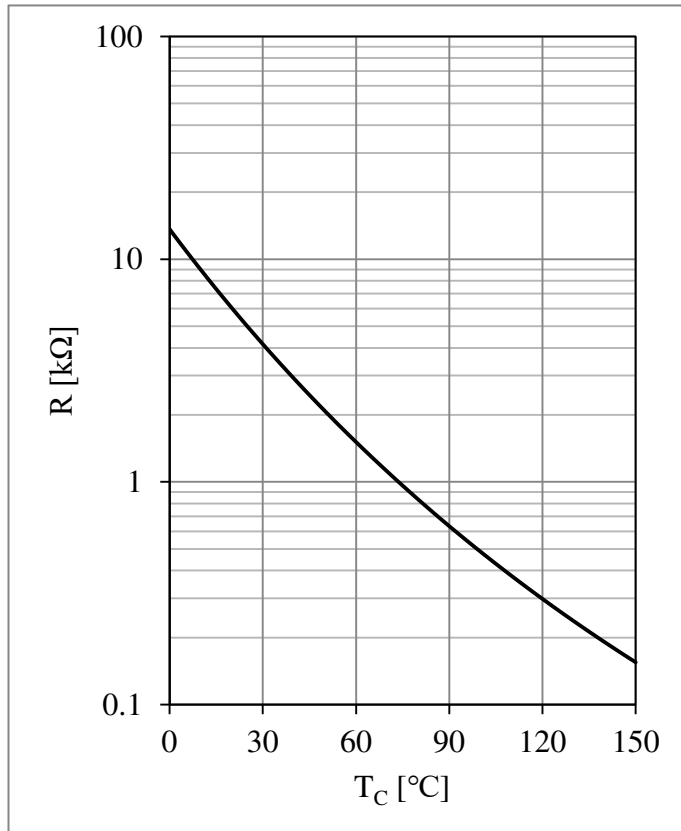
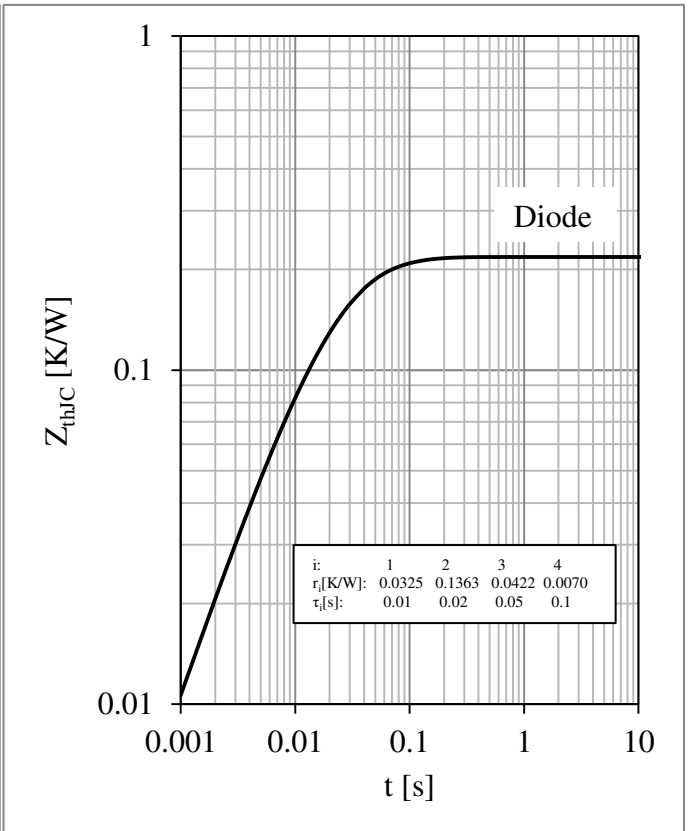
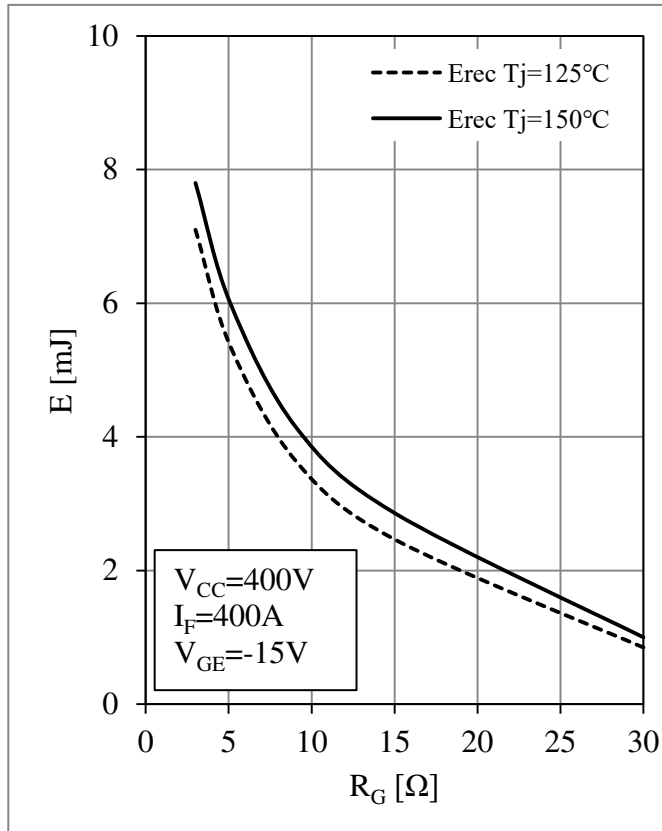


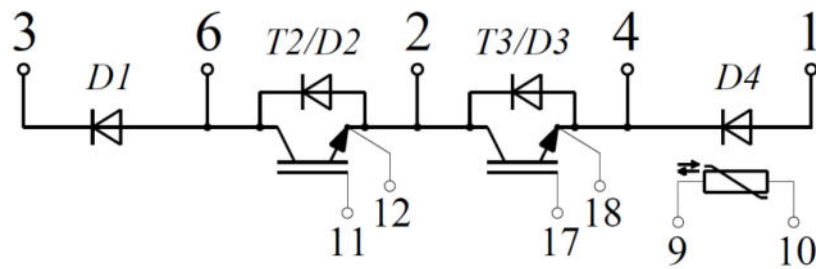
Fig 7. D2 D3 Diode Forward Characteristics

Fig 8. D2 D3 Diode Switching Loss vs. I_F



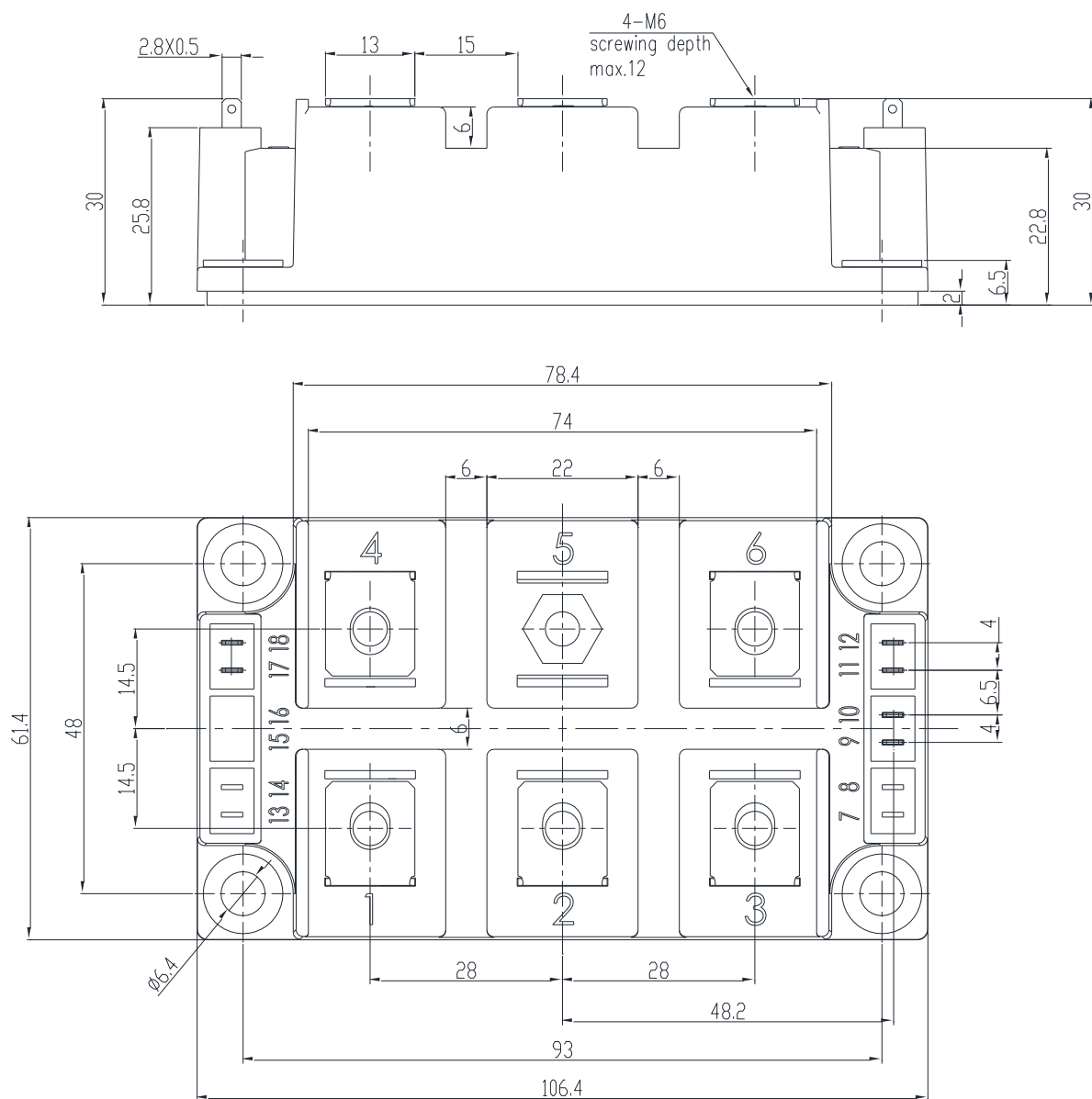


Circuit Schematic



Package Dimensions

Dimensions in Millimeters



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