

STARPOWER

SEMICONDUCTOR

IGBT

GD225MJS120L6S

1200V/225A 3-level in one-package

General Description

STARPOWER IGBT Power Module provides ultra low conduction loss. They are designed for the applications such as 3-level-application.

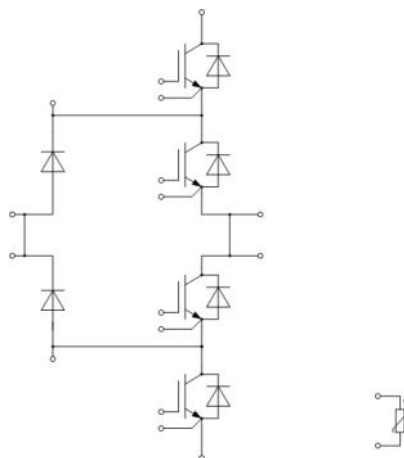
Features

- Low $V_{CE(sat)}$ Trench IGBT technology
- $V_{CE(sat)}$ with positive temperature coefficient
- Maximum junction temperature 175 °C
- Fast & soft reverse recovery anti-parallel FWD
- Isolated copper baseplate using DBC technology

Typical Applications

- Solar power
- 3-level-application

Equivalent Circuit Schematic



Absolute Maximum Ratings $T_C=25^{\circ}\text{C}$ unless otherwise noted**T1/T4 IGBT**

Symbol	Description	Value	Unit
V_{CES}	Collector-Emitter Voltage	1200	V
V_{GES}	Gate-Emitter Voltage	± 20	V
I_{CN}	Implemented Collector Current	225	A
I_C	Collector Current @ $T_C=100^{\circ}\text{C}$	112	A
I_{CRM}	Repetitive Peak Collector Current tp limited by T_{vjop}	450	A

T2/T3 IGBT

Symbol	Description	Value	Unit
V_{CES}	Collector-Emitter Voltage	1200	V
V_{GES}	Gate-Emitter Voltage	± 20	V
I_{CN}	Implemented Collector Current	225	A
I_C	Collector Current @ $T_C=100^{\circ}\text{C}$	112	A
I_{CRM}	Repetitive Peak Collector Current tp limited by T_{vjop}	450	A

D1/D4 Diode

Symbol	Description	Value	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	1200	V
I_{FN}	Implemented Forward Current	300	A
I_F	Diode Continuous Forward Current @ $T_C=100^{\circ}\text{C}$	130	A
I_{FRM}	Repetitive Peak Forward Current tp limited by T_{vjop}	600	A

D2/D3 Diode

Symbol	Description	Value	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	1200	V
I_{FN}	Implemented Forward Current	225	A
I_F	Diode Continuous Forward Current @ $T_C=100^{\circ}\text{C}$	115	A
I_{FRM}	Repetitive Peak Forward Current tp limited by T_{vjop}	450	A

D5/D6 Diode

Symbol	Description	Value	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	1200	V
I_{FN}	Implemented Forward Current	300	A
I_F	Diode Continuous Forward Current @ $T_C=100^{\circ}\text{C}$	130	A
I_{FRM}	Repetitive Peak Forward Current tp limited by T_{vjop}	600	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, $f=50\text{Hz}$, $t=1\text{min}$	3200	V

T1/T4 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	$I_C=225\text{A}, V_{GE}=15\text{V}, T_{vj}=25^{\circ}\text{C}$		2.00	2.45	V
		$I_C=225\text{A}, V_{GE}=15\text{V}, T_{vj}=125^{\circ}\text{C}$		2.70		
		$I_C=225\text{A}, V_{GE}=15\text{V}, T_{vj}=150^{\circ}\text{C}$		2.90		
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=9.00\text{mA}, V_{CE}=V_{GE}, T_{vj}=25^{\circ}\text{C}$	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			1.7		Ω
C_{ies}	Input Capacitance	$V_{CE}=25\text{V}, f=100\text{kHz}, V_{GE}=0\text{V}$		38.1		nF
C_{res}	Reverse Transfer Capacitance			0.66		nF
Q_G	Gate Charge	$V_{GE}=-15\dots+15\text{V}$		2.52		μC
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=225\text{A}, R_G=2.0\Omega, L_S=20\text{nH}, V_{GE}=-8/+15\text{V}, T_{vj}=25^{\circ}\text{C}$		154		ns
t_r	Rise Time			45		ns
$t_{d(off)}$	Turn-Off Delay Time			340		ns
t_f	Fall Time			76		ns
E_{on}	Turn-On Switching Loss			13.4		mJ
E_{off}	Turn-Off Switching Loss			8.08		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=225\text{A}, R_G=2.0\Omega, L_S=20\text{nH}, V_{GE}=-8/+15\text{V}, T_{vj}=125^{\circ}\text{C}$		160		ns
t_r	Rise Time			49		ns
$t_{d(off)}$	Turn-Off Delay Time			388		ns
t_f	Fall Time			112		ns
E_{on}	Turn-On Switching Loss			17.6		mJ
E_{off}	Turn-Off Switching Loss			11.2		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=225\text{A}, R_G=2.0\Omega, L_S=20\text{nH}, V_{GE}=-8/+15\text{V}, T_{vj}=150^{\circ}\text{C}$		163		ns
t_r	Rise Time			51		ns
$t_{d(off)}$	Turn-Off Delay Time			397		ns
t_f	Fall Time			114		ns
E_{on}	Turn-On Switching Loss			18.7		mJ
E_{off}	Turn-Off Switching Loss			12.0		mJ

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	$I_C=225\text{A}, V_{GE}=15\text{V}, T_{vj}=25^{\circ}\text{C}$		2.00	2.45	V
		$I_C=225\text{A}, V_{GE}=15\text{V}, T_{vj}=125^{\circ}\text{C}$		2.70		
		$I_C=225\text{A}, V_{GE}=15\text{V}, T_{vj}=150^{\circ}\text{C}$		2.90		
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=9.00\text{mA}, V_{CE}=V_{GE}, T_{vj}=25^{\circ}\text{C}$	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			1.7		Ω
C_{ies}	Input Capacitance	$V_{CE}=25\text{V}, f=100\text{kHz}, V_{GE}=0\text{V}$		38.1		nF
C_{res}	Reverse Transfer Capacitance			0.66		nF
Q_G	Gate Charge	$V_{GE}=-15\dots+15\text{V}$		2.52		μC
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=225\text{A}, R_G=2.0\Omega, L_S=20\text{nH}, V_{GE}=-8/+15\text{V}, T_{vj}=25^{\circ}\text{C}$		153		ns
t_r	Rise Time			46		ns
$t_{d(off)}$	Turn-Off Delay Time			280		ns
t_f	Fall Time			145		ns
E_{on}	Turn-On Switching Loss			13.5		mJ
E_{off}	Turn-Off Switching Loss			6.35		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=225\text{A}, R_G=2.0\Omega, L_S=20\text{nH}, V_{GE}=-8/+15\text{V}, T_{vj}=125^{\circ}\text{C}$		157		ns
t_r	Rise Time			50		ns
$t_{d(off)}$	Turn-Off Delay Time			349		ns
t_f	Fall Time			123		ns
E_{on}	Turn-On Switching Loss			16.9		mJ
E_{off}	Turn-Off Switching Loss			8.85		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=225\text{A}, R_G=2.0\Omega, L_S=20\text{nH}, V_{GE}=-8/+15\text{V}, T_{vj}=150^{\circ}\text{C}$		159		ns
t_r	Rise Time			50		ns
$t_{d(off)}$	Turn-Off Delay Time			363		ns
t_f	Fall Time			196		ns
E_{on}	Turn-On Switching Loss			18.1		mJ
E_{off}	Turn-Off Switching Loss			9.52		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	$I_F=300\text{A}, V_{GE}=0\text{V}, T_{vj}=25^{\circ}\text{C}$		1.60	2.05	V
		$I_F=300\text{A}, V_{GE}=0\text{V}, T_{vj}=125^{\circ}\text{C}$		1.60		
		$I_F=300\text{A}, V_{GE}=0\text{V}, T_{vj}=150^{\circ}\text{C}$		1.60		
Q_r	Recovered Charge	$V_R=600\text{V}, I_F=225\text{A},$ $-di/dt=5350\text{A}/\mu\text{s}, L_S=20\text{nH},$ $V_{GE}=-8\text{V}, T_{vj}=25^{\circ}\text{C}$		20.1		μC
I_{RM}	Peak Reverse Recovery Current			250		A
E_{rec}	Reverse Recovery Energy			6.84		mJ
Q_r	Recovered Charge	$V_R=600\text{V}, I_F=225\text{A},$ $-di/dt=5080\text{A}/\mu\text{s}, L_S=20\text{nH},$ $V_{GE}=-8\text{V}, T_{vj}=125^{\circ}\text{C}$		32.5		μC
I_{RM}	Peak Reverse Recovery Current			277		A
E_{rec}	Reverse Recovery Energy			12.5		mJ
Q_r	Recovered Charge	$V_R=600\text{V}, I_F=225\text{A},$ $-di/dt=4930\text{A}/\mu\text{s}, L_S=20\text{nH},$ $V_{GE}=-8\text{V}, T_{vj}=150^{\circ}\text{C}$		39.0		μC
I_{RM}	Peak Reverse Recovery Current			288		A
E_{rec}	Reverse Recovery Energy			14.0		mJ

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	$I_F=225\text{A}, V_{GE}=0\text{V}, T_{vj}=25^{\circ}\text{C}$		1.60	2.05	V
		$I_F=225\text{A}, V_{GE}=0\text{V}, T_{vj}=125^{\circ}\text{C}$		1.60		
		$I_F=225\text{A}, V_{GE}=0\text{V}, T_{vj}=150^{\circ}\text{C}$		1.60		

D5/D6 Diode Characteristics $T_C=25^{\circ}\text{C}$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_F	Diode Forward Voltage	$I_F=300\text{A}, V_{GE}=0\text{V}, T_{vj}=25^{\circ}\text{C}$		1.60	2.05	V
		$I_F=300\text{A}, V_{GE}=0\text{V}, T_{vj}=125^{\circ}\text{C}$		1.60		
		$I_F=300\text{A}, V_{GE}=0\text{V}, T_{vj}=150^{\circ}\text{C}$		1.60		
Q_r	Recovered Charge	$V_R=600\text{V}, I_F=225\text{A},$ $-di/dt=5050\text{A}/\mu\text{s}, L_S=20\text{nH},$ $V_{GE}=-8\text{V}, T_{vj}=25^{\circ}\text{C}$		18.6		μC
I_{RM}	Peak Reverse Recovery Current			189		A
E_{rec}	Reverse Recovery Energy			5.62		mJ
Q_r	Recovered Charge	$V_R=600\text{V}, I_F=225\text{A},$ $-di/dt=4720\text{A}/\mu\text{s}, L_S=20\text{nH},$ $V_{GE}=-8\text{V}, T_{vj}=125^{\circ}\text{C}$		34.1		μC
I_{RM}	Peak Reverse Recovery Current			250		A
E_{rec}	Reverse Recovery Energy			11.4		mJ
Q_r	Recovered Charge	$V_R=600\text{V}, I_F=225\text{A},$ $-di/dt=4720\text{A}/\mu\text{s}, L_S=20\text{nH},$ $V_{GE}=-8\text{V}, T_{vj}=150^{\circ}\text{C}$		38.9		μC
I_{RM}	Peak Reverse Recovery Current			265		A
E_{rec}	Reverse Recovery Energy			13.2		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		k Ω
$\Delta R/R$	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		15		nH
R_{thJC}	Junction-to-Case (per T1-T4 IGBT)			0.231	K/W
	Junction-to-Case (per D1/D4 Diode)			0.338	
	Junction-to-Case (per D2/D3 Diode)			0.373	
	Junction-to-Case (per D5/D6 Diode)			0.338	
M	Mounting Torque, Screw:M5	3.0		5.0	N.m
G	Weight of Module		250		g

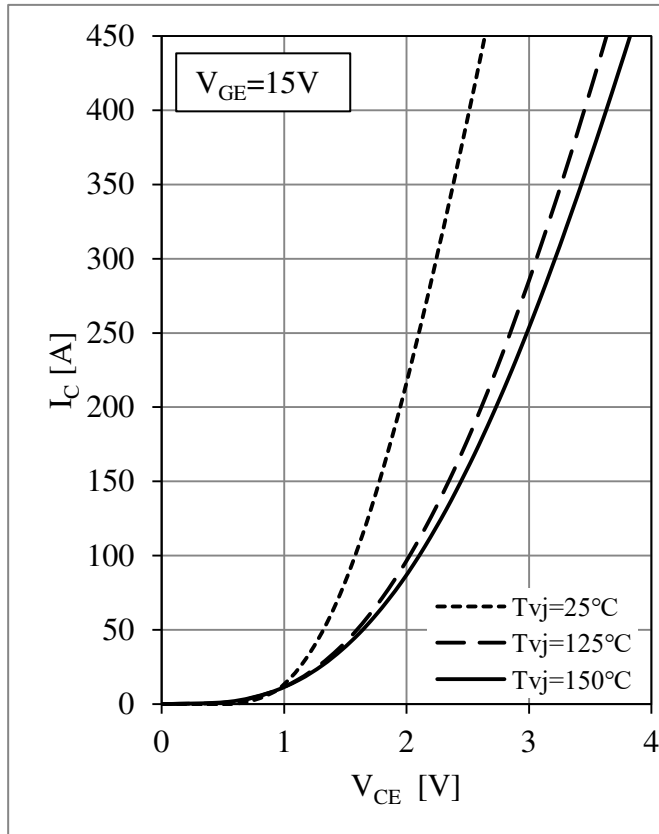


Fig 1. T1/T4 IGBT Output Characteristics

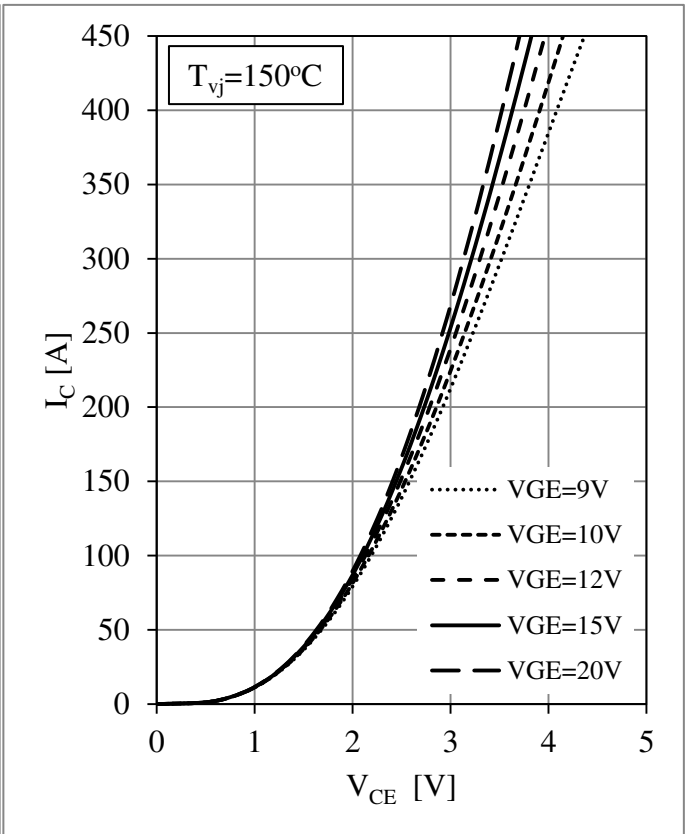


Fig 2. T1/T4 IGBT Output Characteristics

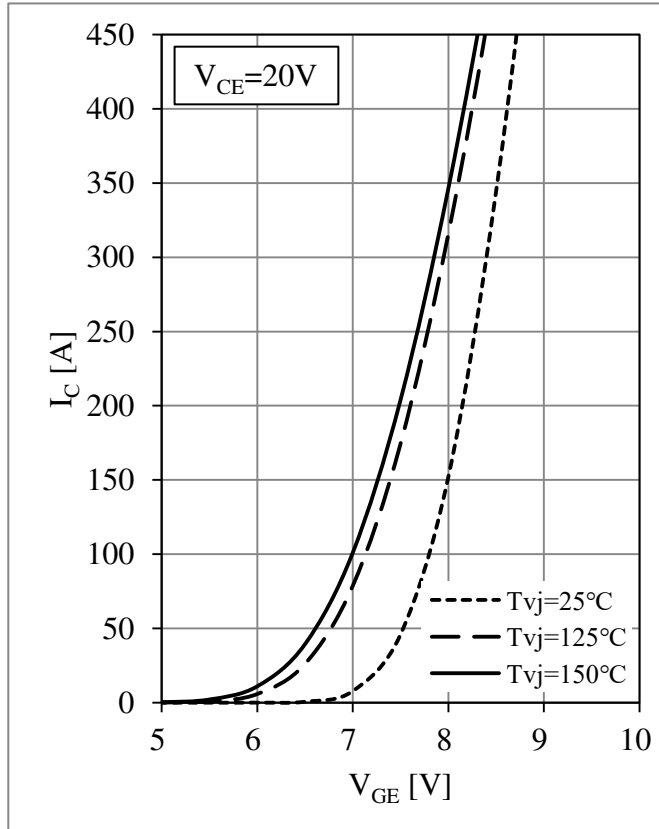
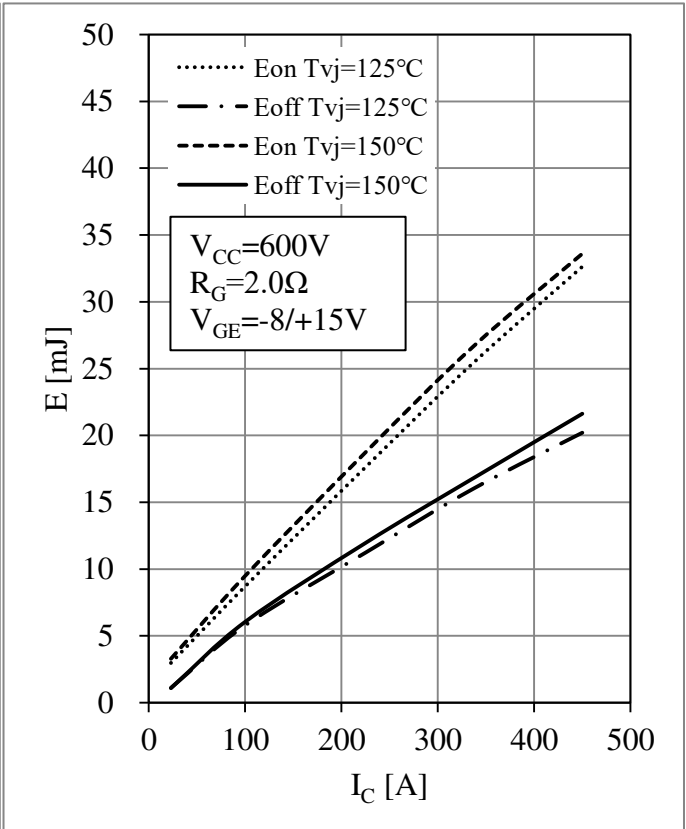


Fig 3. T1/T4 IGBT Transfer Characteristics

Fig 4. T1/T4 IGBT Switching Loss vs. I_C

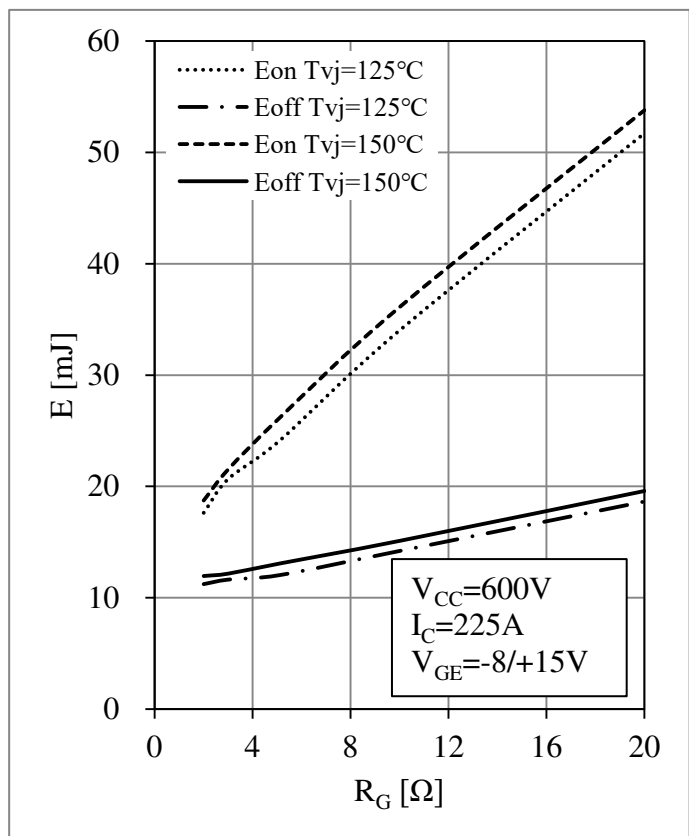
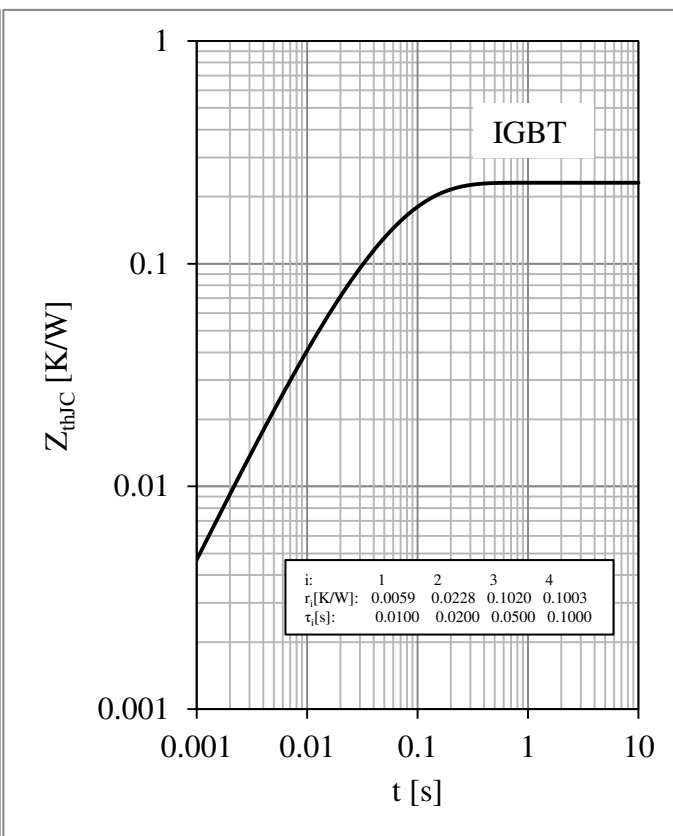
Fig 5. T1/T4 IGBT Switching Loss vs. R_G 

Fig 6. T1/T4 IGBT Transient Thermal Impedance

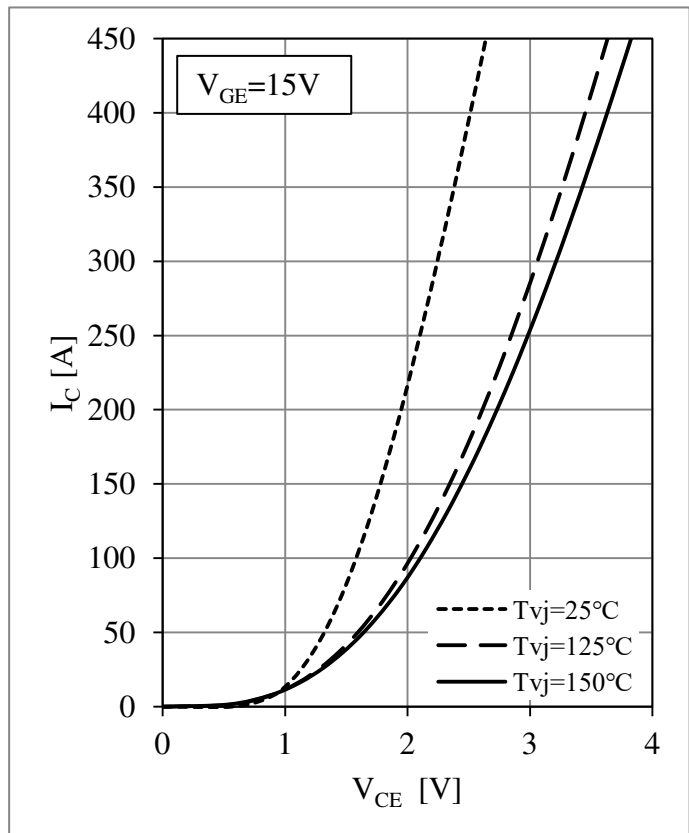


Fig 7. T2/T3 IGBT Output Characteristics

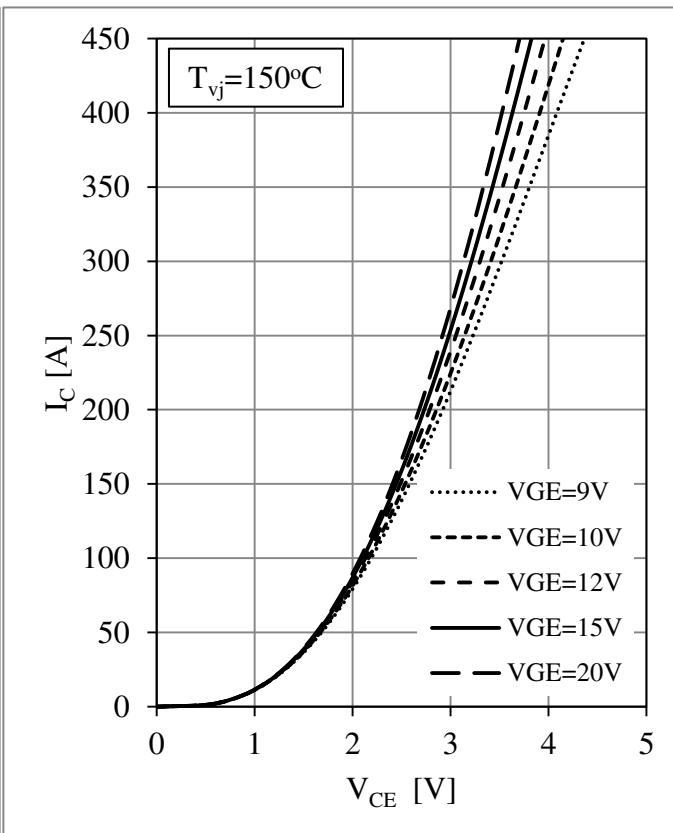


Fig 8. T2/T3 IGBT Output Characteristics

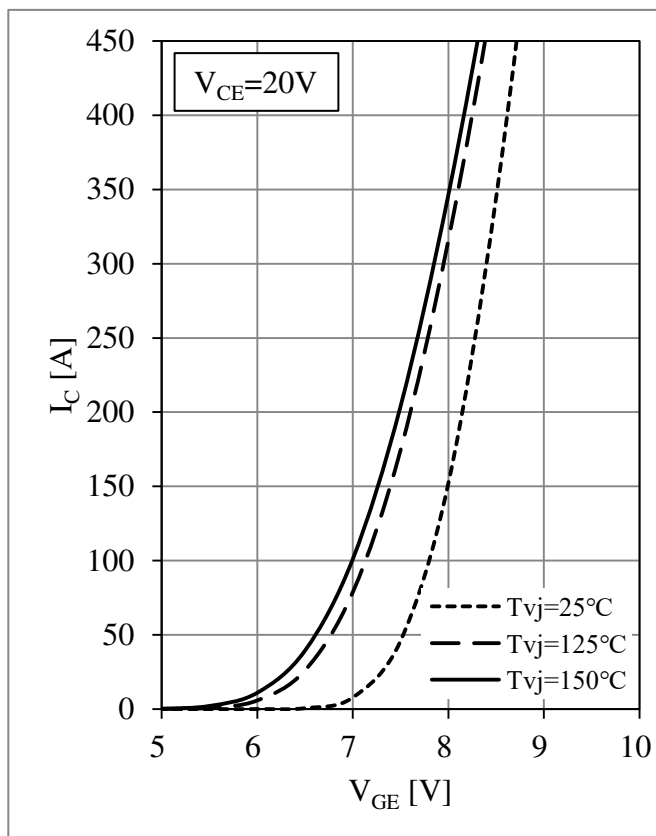


Fig 9. T2/T3 IGBT Transfer Characteristics

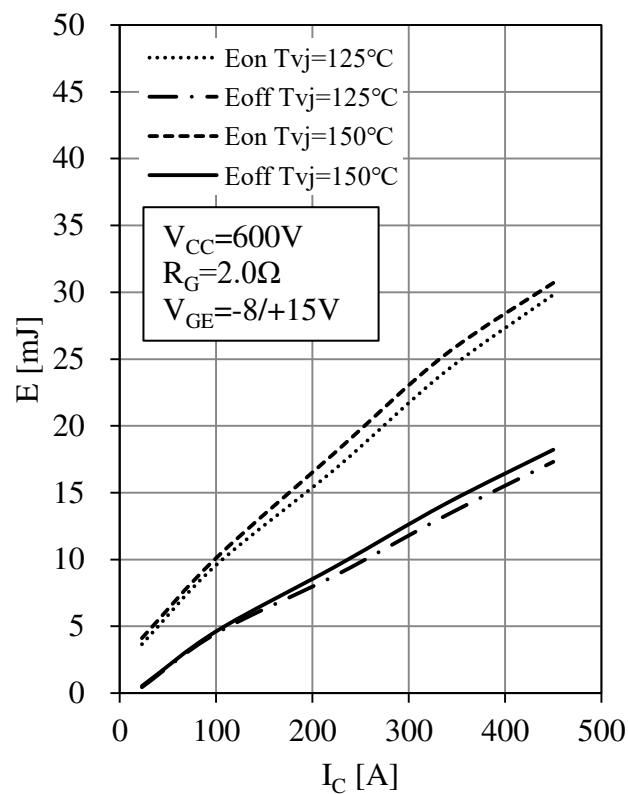
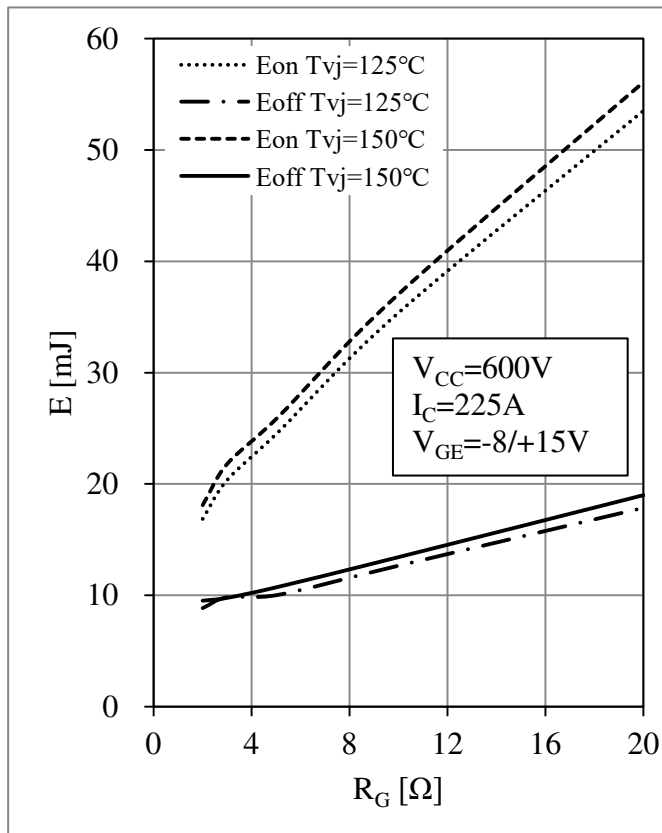
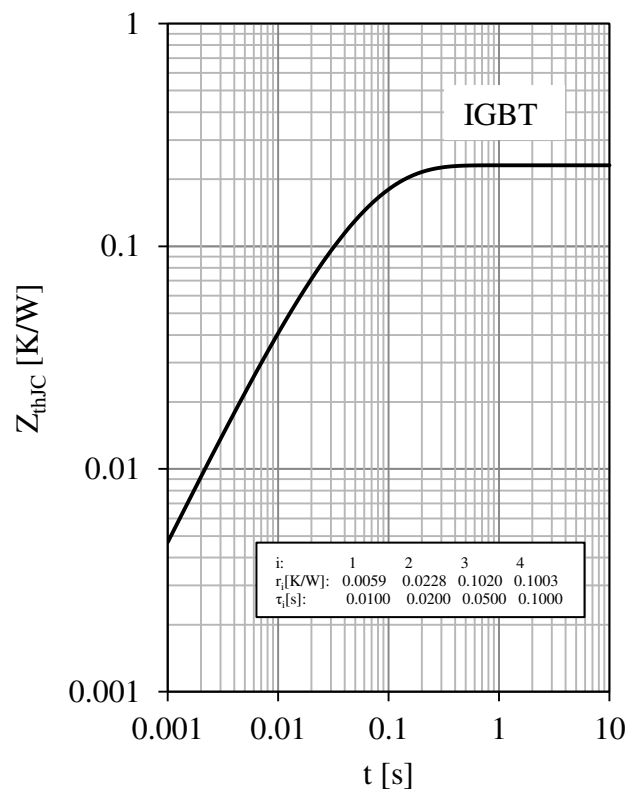
Fig 10. T2/T3 IGBT Switching Loss vs. I_C Fig 11. T2/T3 IGBT Switching Loss vs. R_G 

Fig 12. T2/T3 IGBT Transient Thermal Impedance

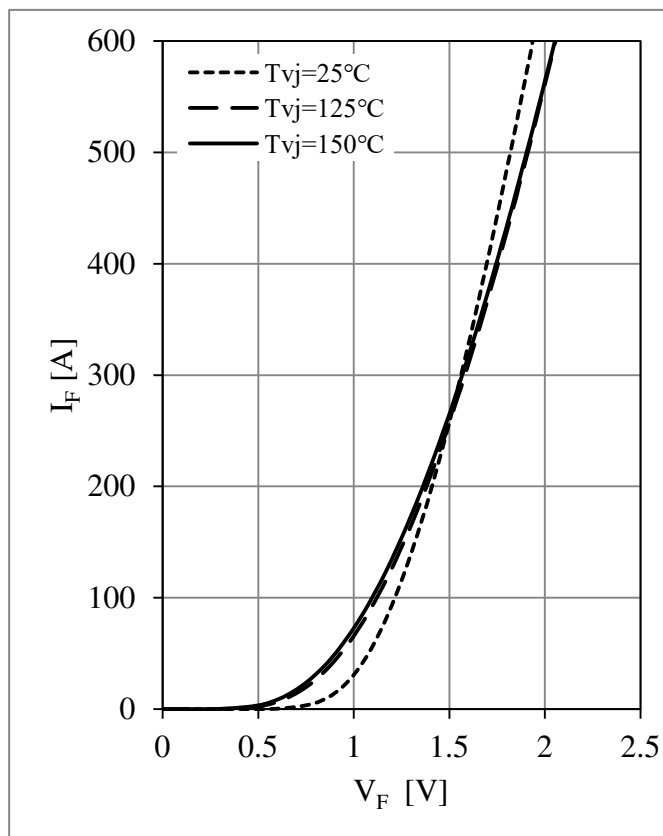


Fig 13. D1/D4 Diode Forward Characteristics

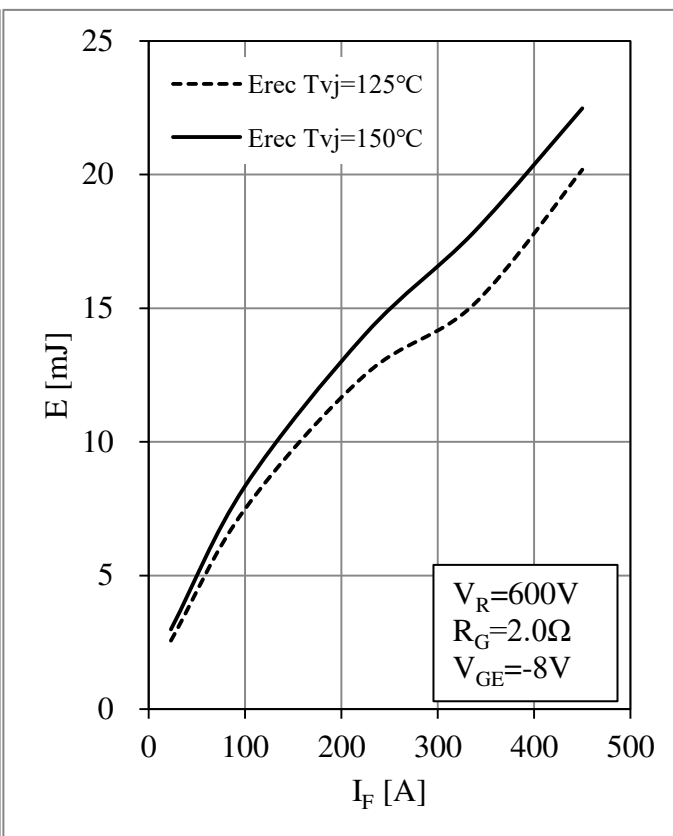
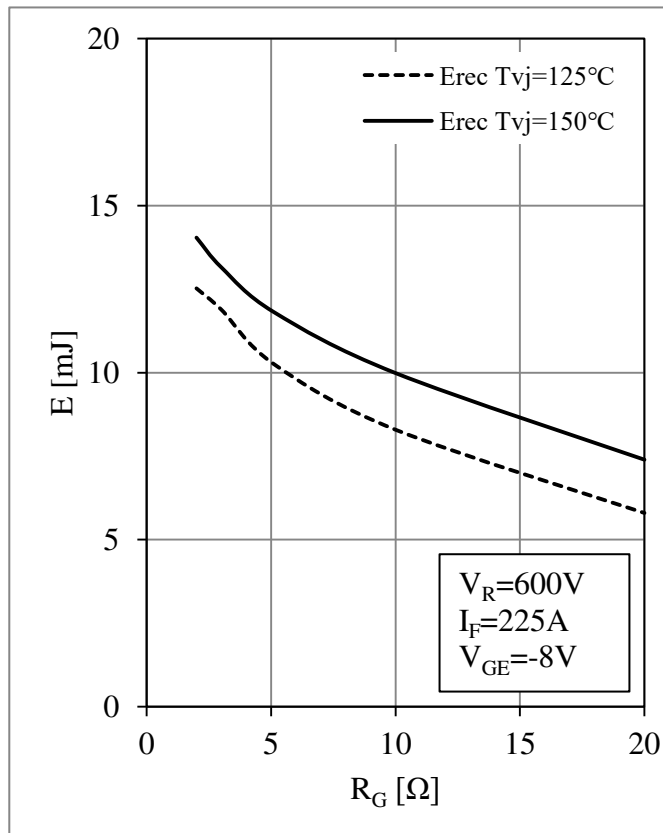
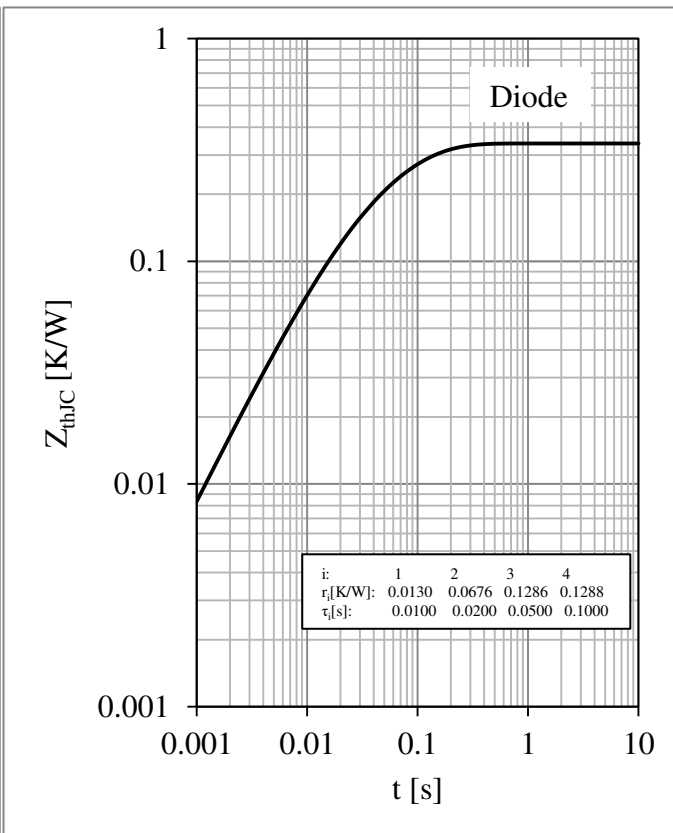
Fig 14. D1/D4 Diode Switching Loss vs. I_F Fig 15. D1/D4 Diode Switching Loss vs. R_G 

Fig 16. D1/D4 Diode Transient Thermal Impedance

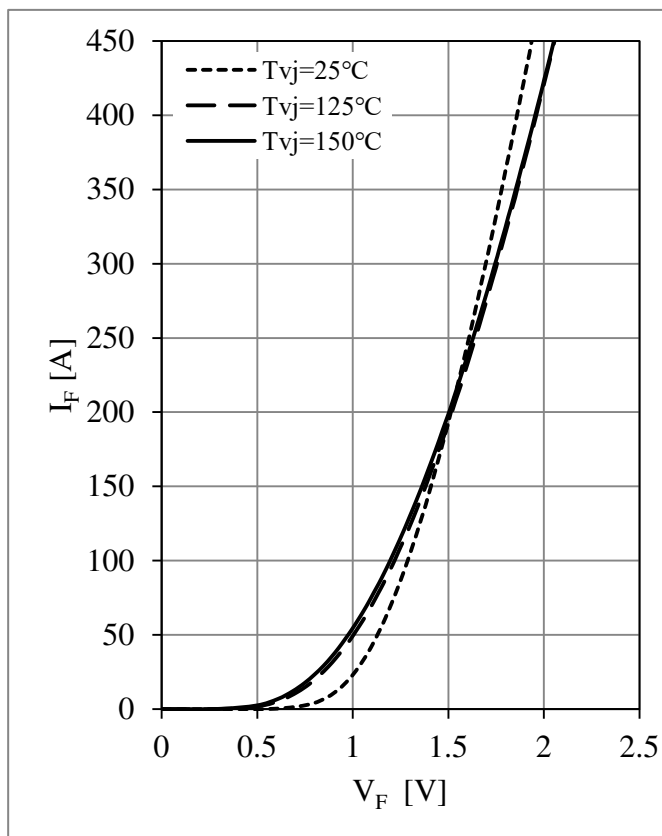


Fig 17. D2/D3 Diode Forward Characteristics

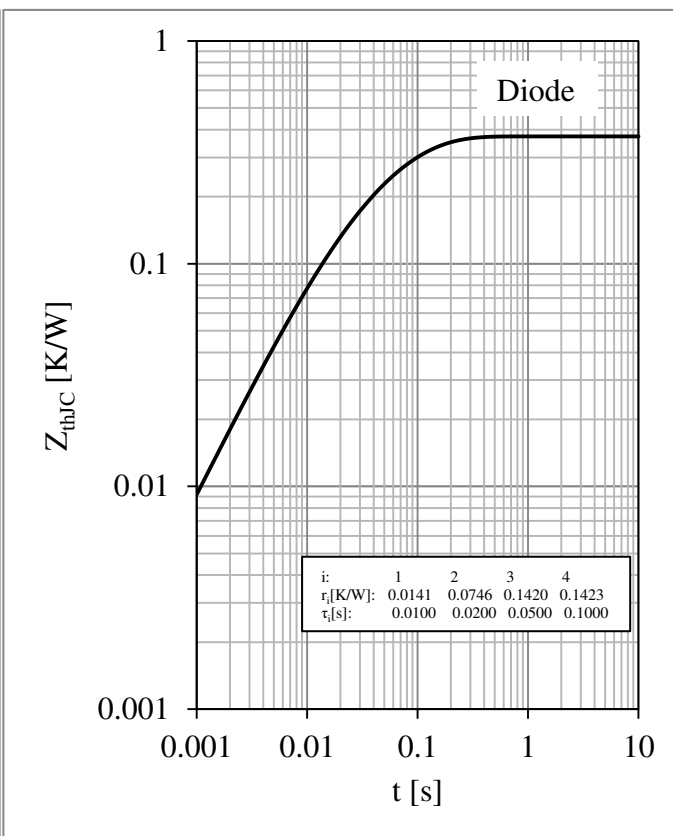


Fig 18. D2/D3 Diode Transient Thermal Impedance

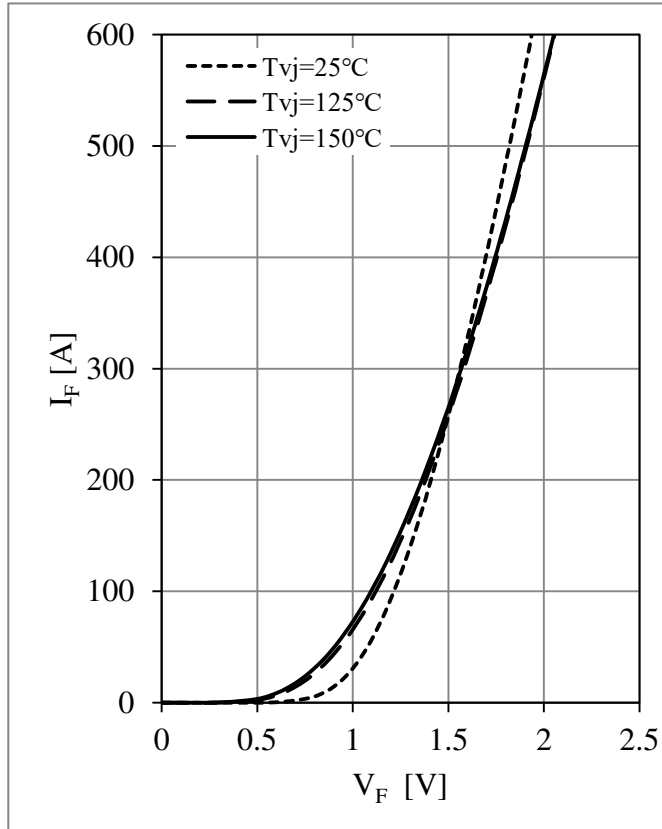
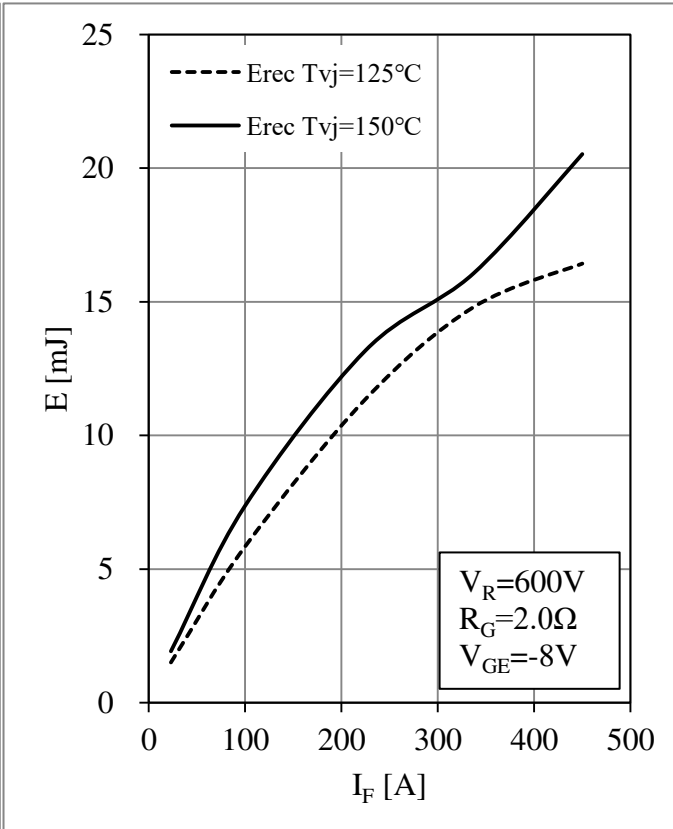
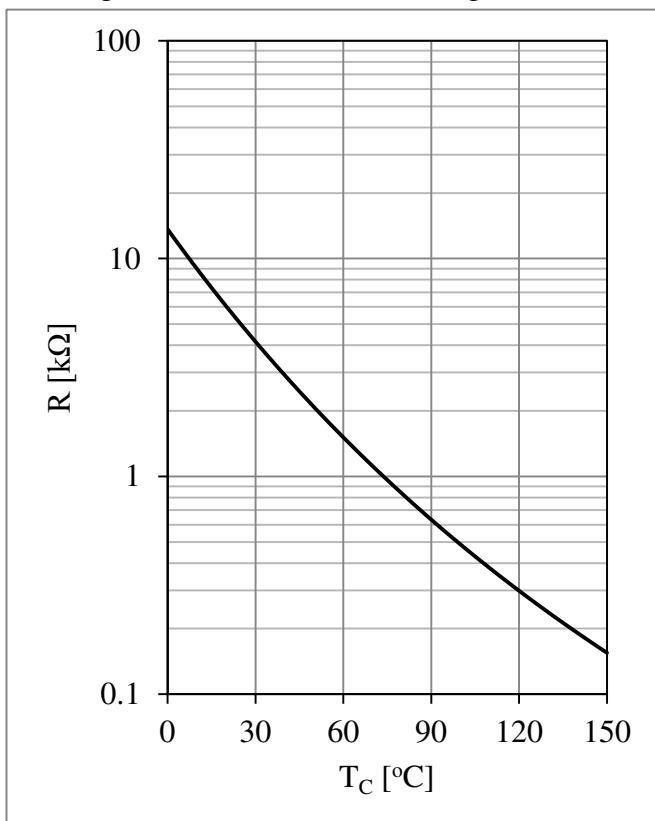
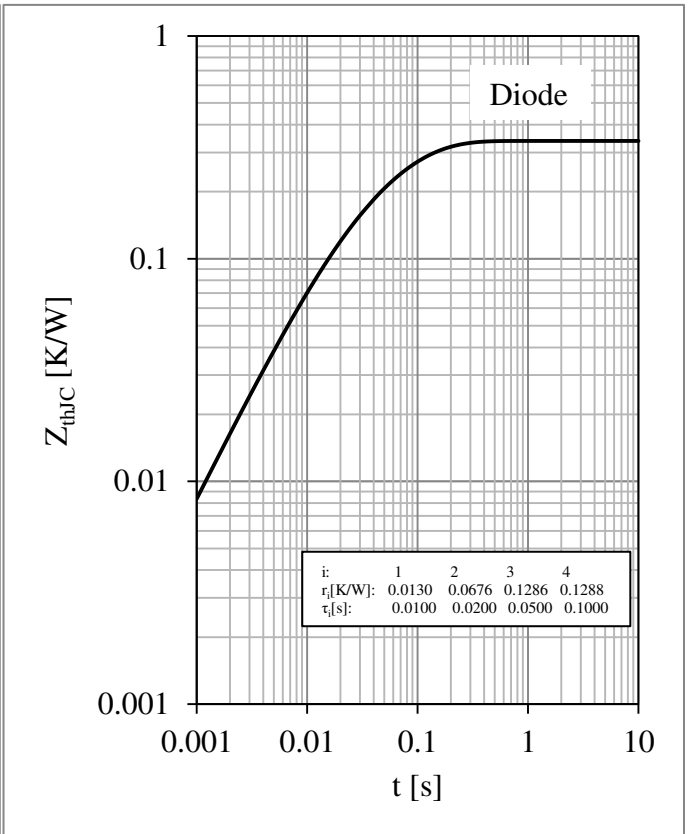
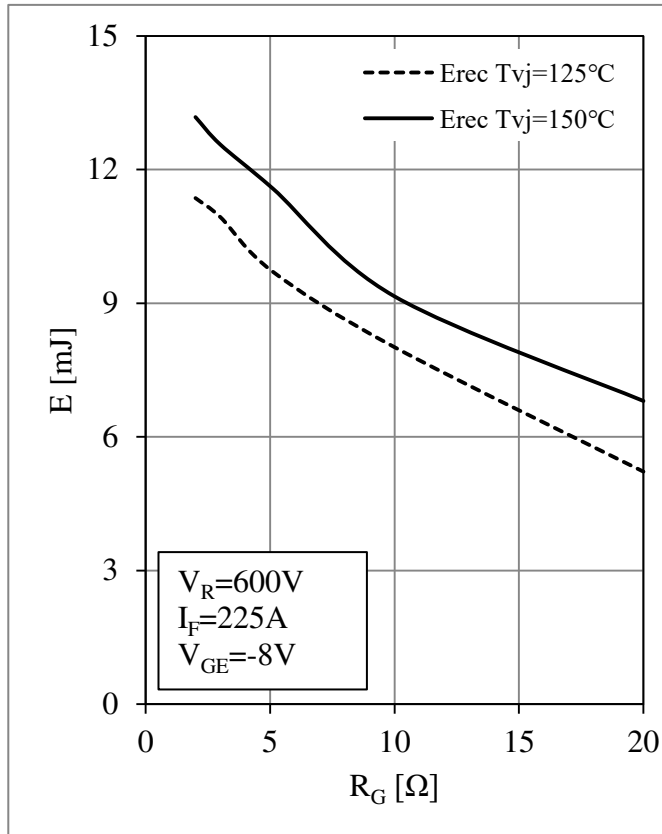
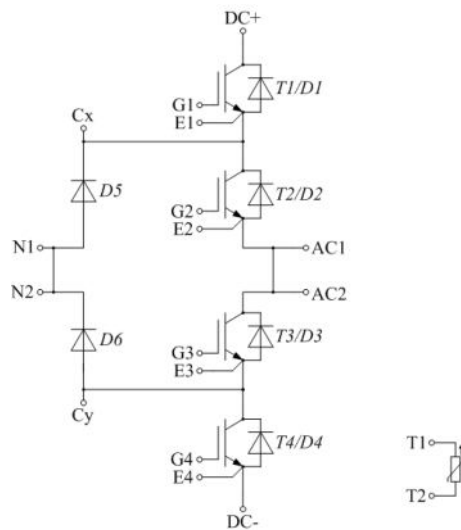


Fig 19. D5/D6 Diode Forward Characteristics

Fig 20. D5/D6 Diode Switching Loss vs. I_F

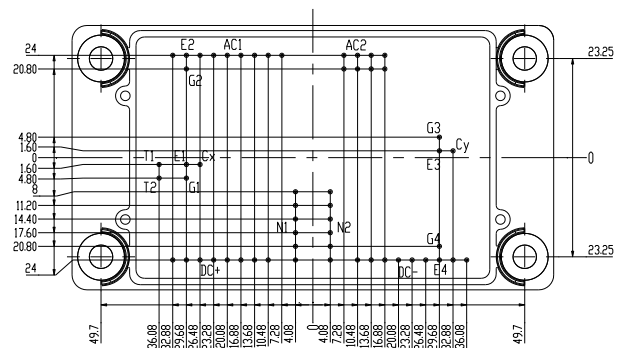
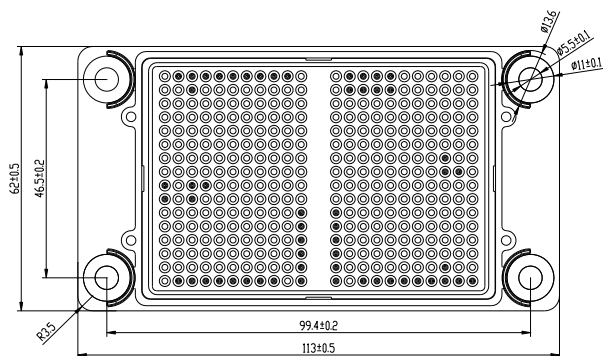
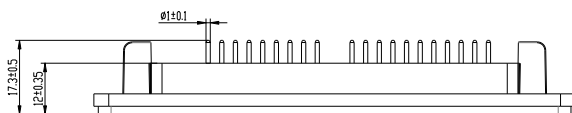


Circuit Schematic



Package Dimensions

Dimensions in Millimeters



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