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.

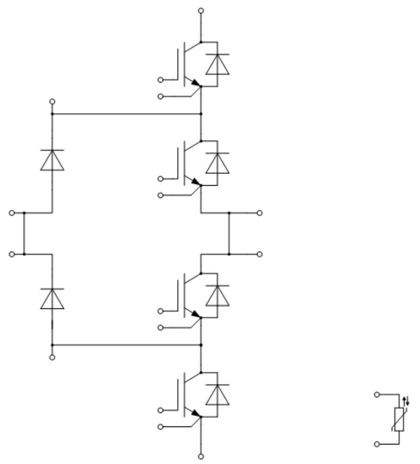
Features

- Low $V_{CE(sat)}$ Trench IGBT technology
- $V_{CE(sat)}$ with positive temperature coefficient
- Maximum junction temperature 175 ^{o}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°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°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°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°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°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°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	°C
T_{vjop}	Operating Junction Temperature	-40 to +150	°C
T_{STG}	Storage Temperature Range	-40 to +125	°C
V_{ISO}	Isolation Voltage RMS,f=50Hz,t=1min	3200	V

T1/T4 IGBT Characteristics T_C=25°C unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	I_C=225A,V_{GE}=15V, T_{vj}=25°C		2.00	2.45	V
		I_C=225A,V_{GE}=15V, T_{vj}=125°C		2.70		
		I_C=225A,V_{GE}=15V, T_{vj}=150°C		2.90		
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	I_C=9.00mA,V_{CE}=V_{GE}, T_{vj}=25°C	5.6	6.2	6.8	V
I_{CES}	Collector Cut-Off Current	V_{CE}=V_{CES},V_{GE}=0V, T_{vj}=25°C			1.0	mA
I_{GES}	Gate-Emitter Leakage Current	V_{GE}=V_{GES},V_{CE}=0V, T_{vj}=25°C			400	nA
R_{Gint}	Internal Gate Resistance			1.7		Ω
C_{ies}	Input Capacitance	V_{CE}=25V,f=100kHz, V_{GE}=0V		38.1		nF
C_{res}	Reverse Transfer Capacitance			0.66		nF
Q_G	Gate Charge	V_{GE}=-15…+15V		2.52		μC
$t_{d(on)}$	Turn-On Delay Time	V_{CC}=600V,I_C=225A, R_G=2.0Ω,L_S=20nH, V_{GE}=-8/+15V, T_{vj}=25°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}=600V,I_C=225A, R_G=2.0Ω,L_S=20nH, V_{GE}=-8/+15V, T_{vj}=125°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}=600V,I_C=225A, R_G=2.0Ω,L_S=20nH, V_{GE}=-8/+15V, T_{vj}=150°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°C unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	I_C=225A,V_{GE}=15V, T_{vj}=25°C		2.00	2.45	V
		I_C=225A,V_{GE}=15V, T_{vj}=125°C		2.70		
		I_C=225A,V_{GE}=15V, T_{vj}=150°C		2.90		
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	I_C=9.00mA,V_{CE}=V_{GE}, T_{vj}=25°C	5.6	6.2	6.8	V
I_{CES}	Collector Cut-Off Current	V_{CE}=V_{CES},V_{GE}=0V, T_{vj}=25°C			1.0	mA
I_{GES}	Gate-Emitter Leakage Current	V_{GE}=V_{GES},V_{CE}=0V, T_{vj}=25°C			400	nA
R_{Gint}	Internal Gate Resistance			1.7		Ω
C_{ies}	Input Capacitance	V_{CE}=25V,f=100kHz, V_{GE}=0V		38.1		nF
C_{res}	Reverse Transfer Capacitance			0.66		nF
Q_G	Gate Charge	V_{GE}=-15…+15V		2.52		μC
$t_{d(on)}$	Turn-On Delay Time	V_{CC}=600V,I_C=225A, R_G=2.0Ω,L_S=20nH, V_{GE}=-8/+15V, T_{vj}=25°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}=600V,I_C=225A, R_G=2.0Ω,L_S=20nH, V_{GE}=-8/+15V, T_{vj}=125°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}=600V,I_C=225A, R_G=2.0Ω,L_S=20nH, V_{GE}=-8/+15V, T_{vj}=150°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°C unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_F	Diode Forward Voltage	I_F=300A,V_{GE}=0V,T_{vj}=25°C		1.60	2.05	V
		I_F=300A,V_{GE}=0V,T_{vj}=125°C		1.60		
		I_F=300A,V_{GE}=0V,T_{vj}=150°C		1.60		
Q_r	Recovered Charge	V_R=600V,I_F=225A, -di/dt=5350A/µs,L_S=20nH, V_{GE}=-8V,T_{vj}=25°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=600V,I_F=225A, -di/dt=5080A/µs,L_S=20nH, V_{GE}=-8V,T_{vj}=125°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=600V,I_F=225A, -di/dt=4930A/µs,L_S=20nH, V_{GE}=-8V,T_{vj}=150°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°C unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_F	Diode Forward Voltage	I_F=225A,V_{GE}=0V,T_{vj}=25°C		1.60	2.05	V
		I_F=225A,V_{GE}=0V,T_{vj}=125°C		1.60		
		I_F=225A,V_{GE}=0V,T_{vj}=150°C		1.60		

D5/D6 Diode Characteristics T_C=25°C unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_F	Diode Forward Voltage	I_F=300A,V_{GE}=0V,T_{vj}=25°C		1.60	2.05	V
		I_F=300A,V_{GE}=0V,T_{vj}=125°C		1.60		
		I_F=300A,V_{GE}=0V,T_{vj}=150°C		1.60		
Q_r	Recovered Charge	V_R=600V,I_F=225A, -di/dt=5050A/μs,L_S=20nH, V_{GE}=-8V,T_{vj}=25°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=600V,I_F=225A, -di/dt=4720A/μs,L_S=20nH, V_{GE}=-8V,T_{vj}=125°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=600V,I_F=225A, -di/dt=4720A/μs,L_S=20nH, V_{GE}=-8V,T_{vj}=150°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°C unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
R_{25}	Rated Resistance			5.0		kΩ
ΔR/R	Deviation of R_{100}	T_C=100°C,R_{100}=493.3Ω	-5		5	%
P_{25}	Power Dissipation				20.0	mW
$B_{25/50}$	B-value	$R_2=R_{25}exp[B_{25/50}(1/T_2-1/(298.15K))]$		3375		K
$B_{25/80}$	B-value	$R_2=R_{25}exp[B_{25/80}(1/T_2-1/(298.15K))]$		3411		K
$B_{25/100}$	B-value	$R_2=R_{25}exp[B_{25/100}(1/T_2-1/(298.15K))]$		3433		K

Module Characteristics T_C=25^{o}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) Junction-to-Case (per D1/D4 Diode) Junction-to-Case (per D2/D3 Diode) Junction-to-Case (per D5/D6 Diode)			0.231 0.338 0.373 0.338	K/W
M	Mounting Torque, Screw:M5	3.0		5.0	N.m
G	Weight of Module		250		g

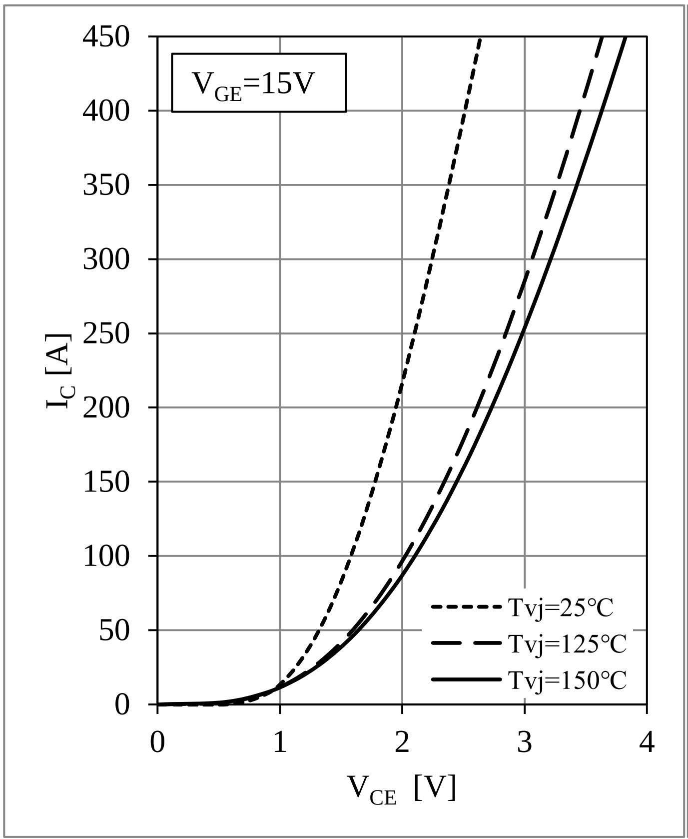


Fig 1. T1/T4 IGBT Output Characteristics

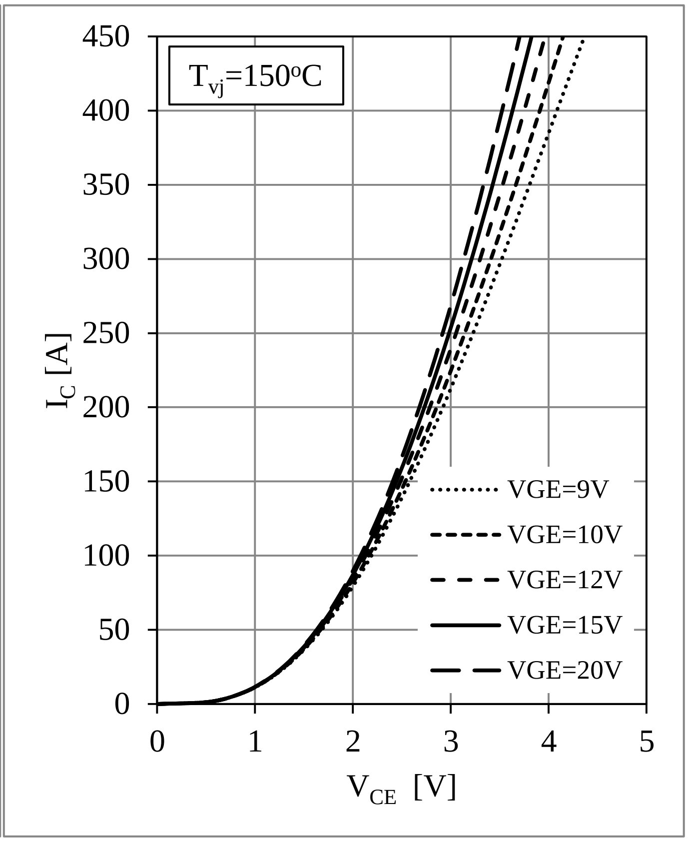


Fig 2. T1/T4 IGBT Output Characteristics

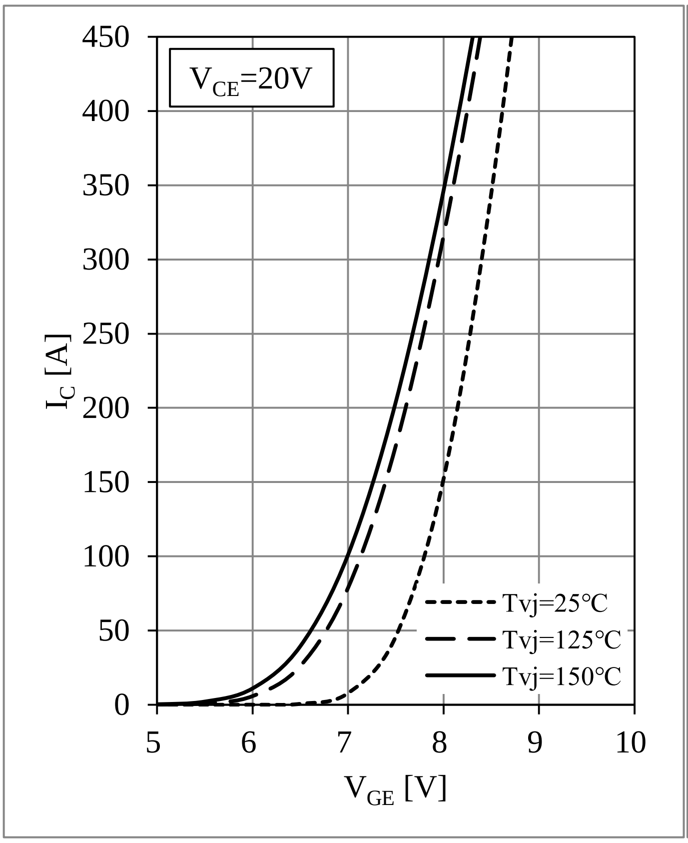


Fig 3. T1/T4 IGBT Transfer Characteristics

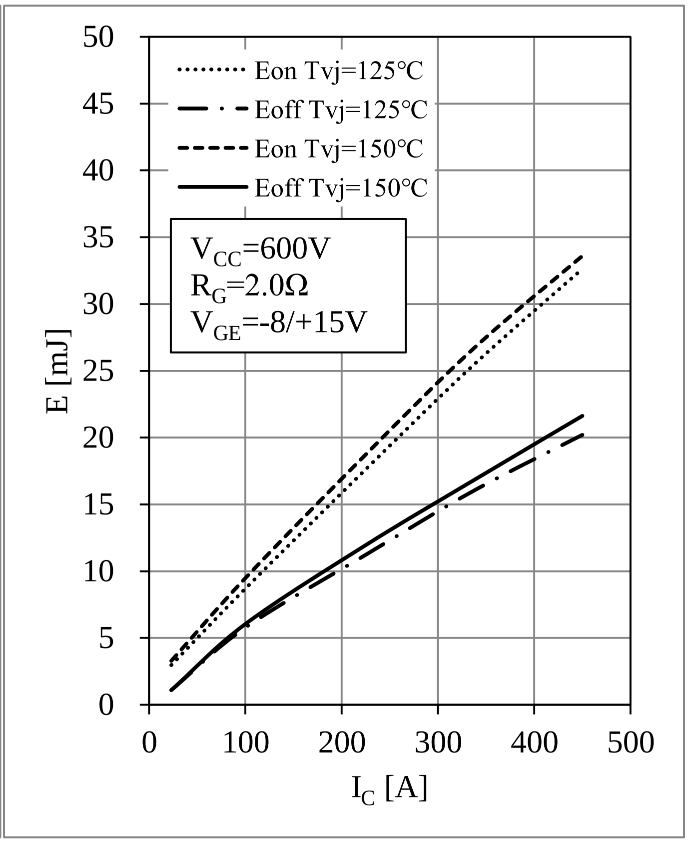


Fig 4. T1/T4 IGBT Switching Loss vs. I_C

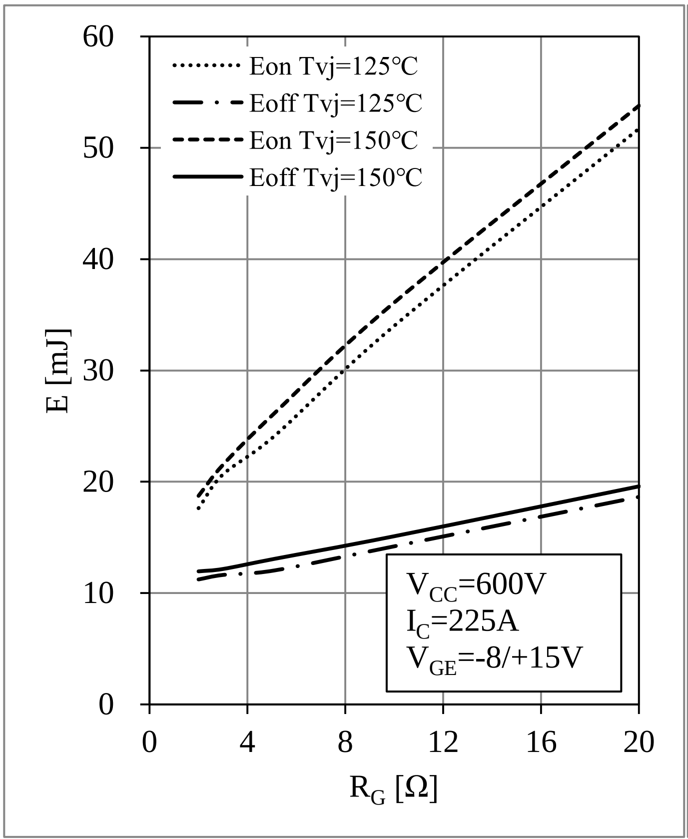


Fig 5. T1/T4 IGBT Switching Loss vs. R_G

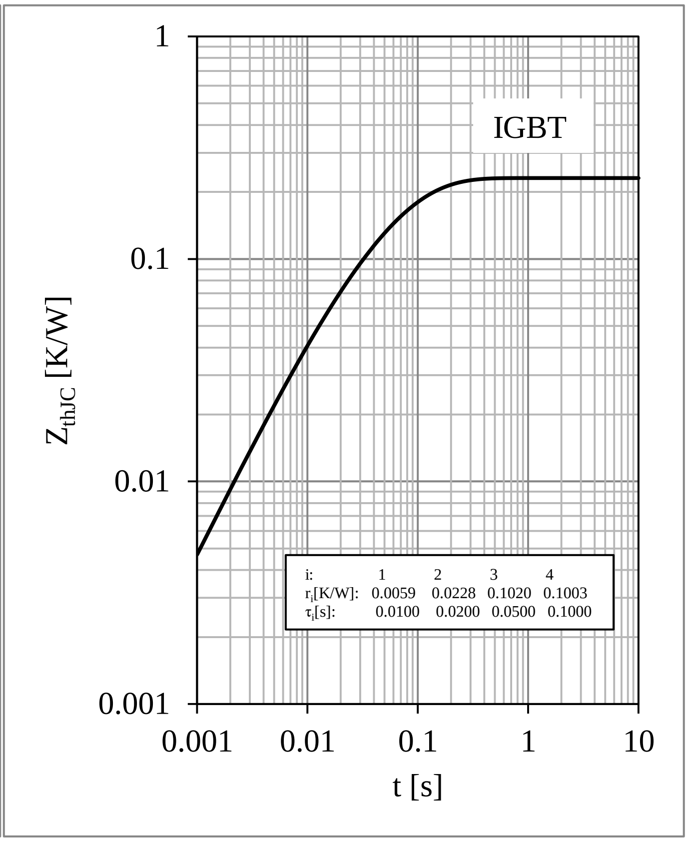


Fig 6. T1/T4 IGBT Transient Thermal Impedance

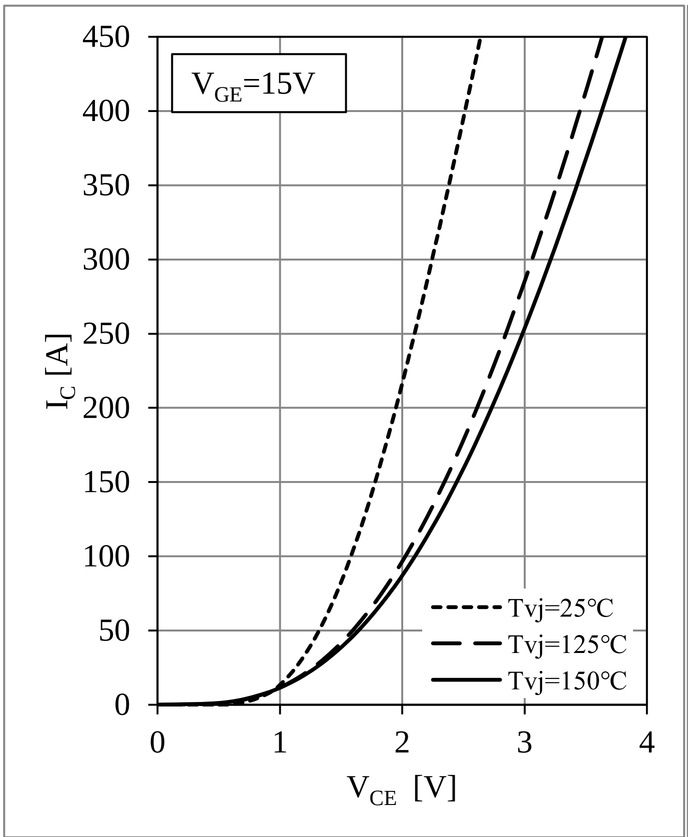


Fig 7. T2/T3 IGBT Output Characteristics

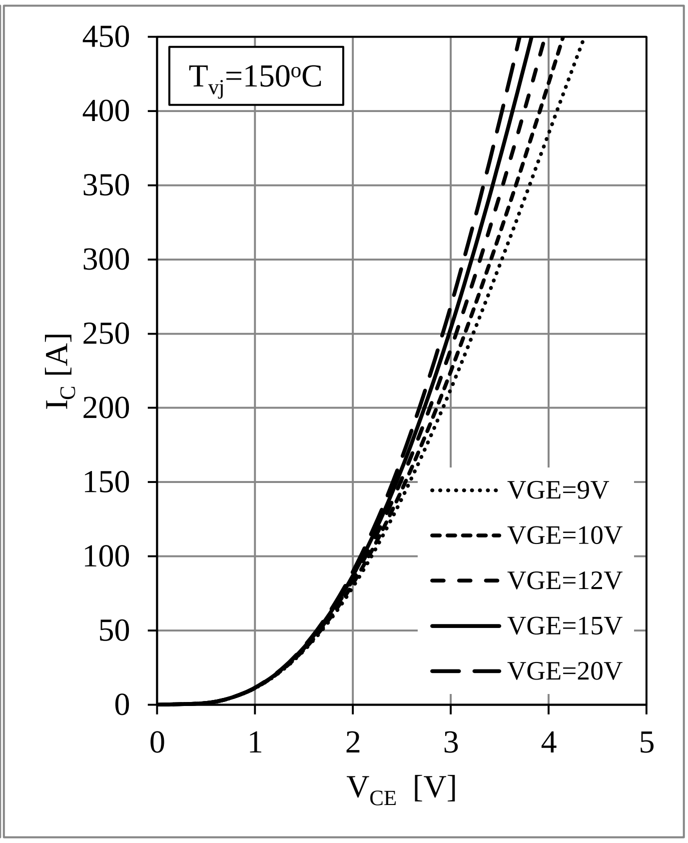


Fig 8. T2/T3 IGBT Output Characteristics

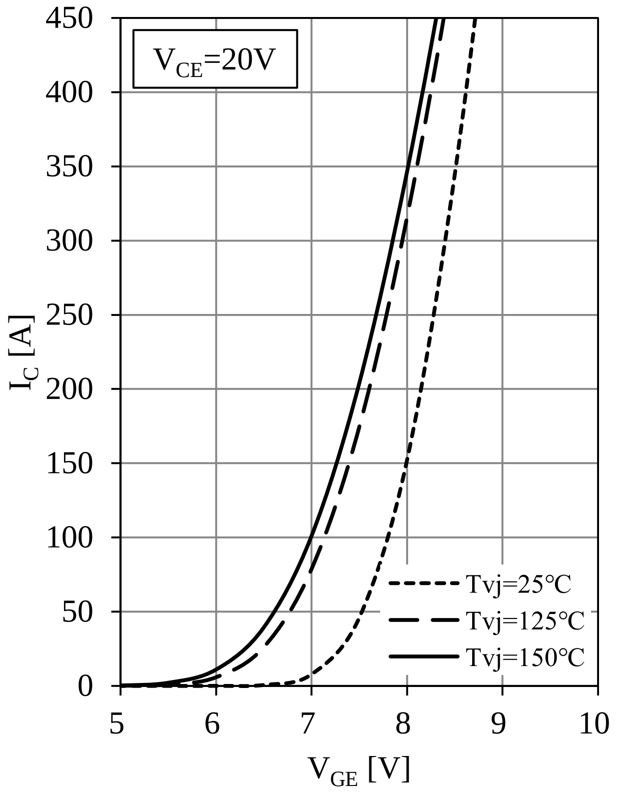


Fig 9. T2/T3 IGBT Transfer Characteristics

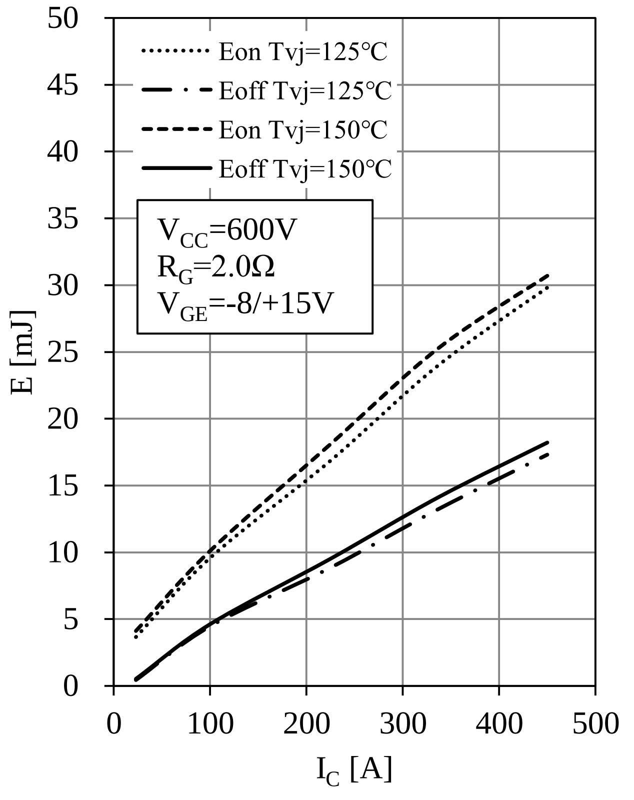


Fig 10. T2/T3 IGBT Switching Loss vs. I_C

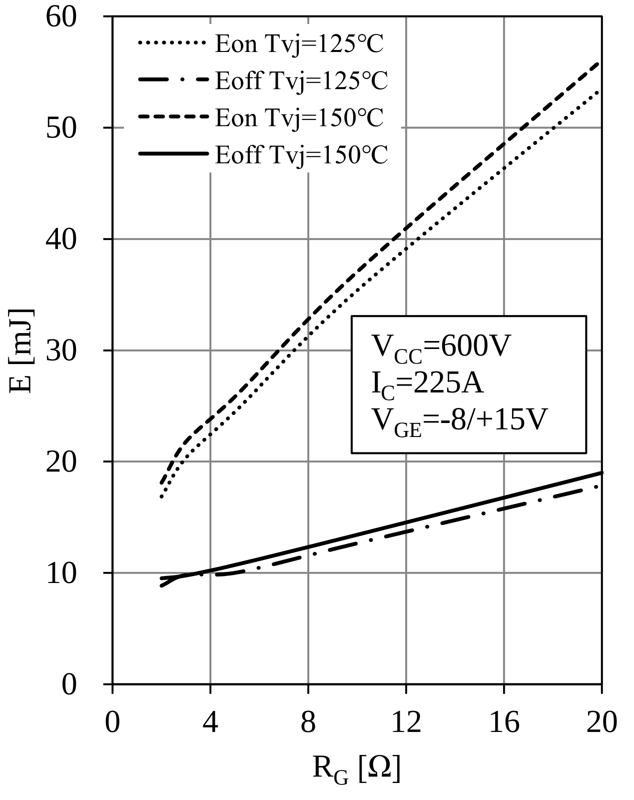
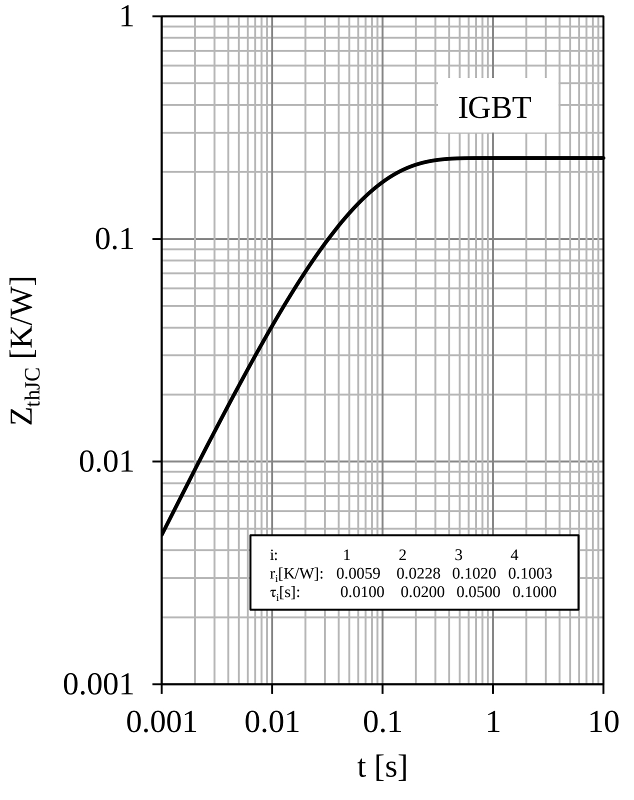


Fig 11. T2/T3 IGBT Switching Loss vs. R_G



i:	1	2	3	4
r_i[K/W]:	0.0059	0.0228	0.1020	0.1003
τ_i[s]:	0.0100	0.0200	0.0500	0.1000

Fig 12. T2/T3 IGBT Transient Thermal Impedance

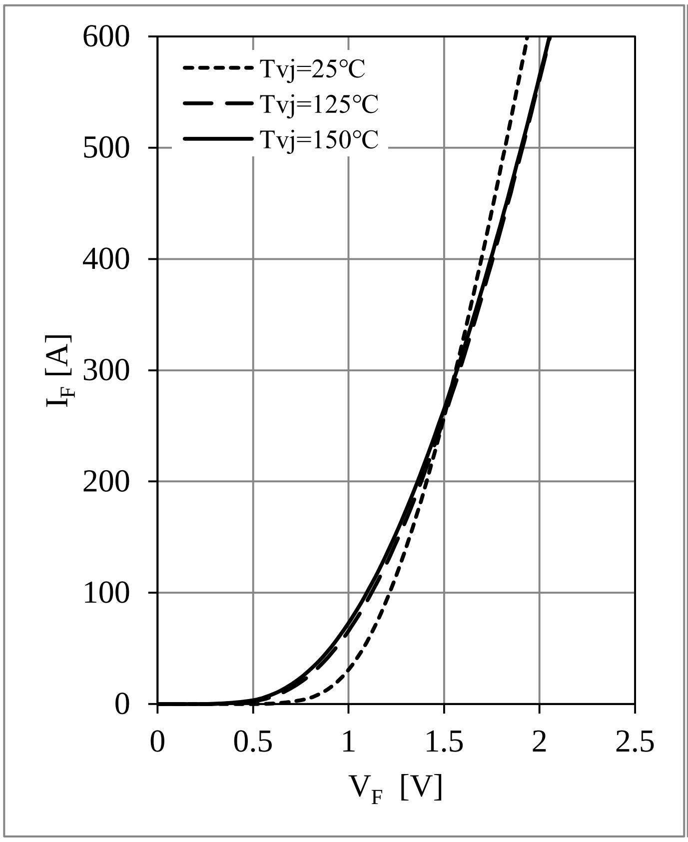


Fig 13. D1/D4 Diode Forward Characteristics

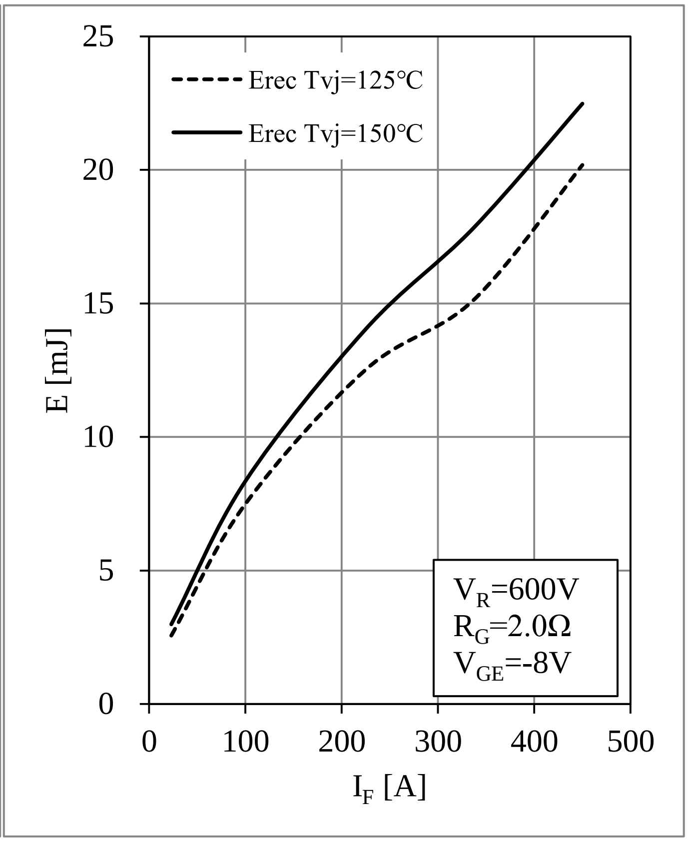


Fig 14. D1/D4 Diode Switching Loss vs. I_F

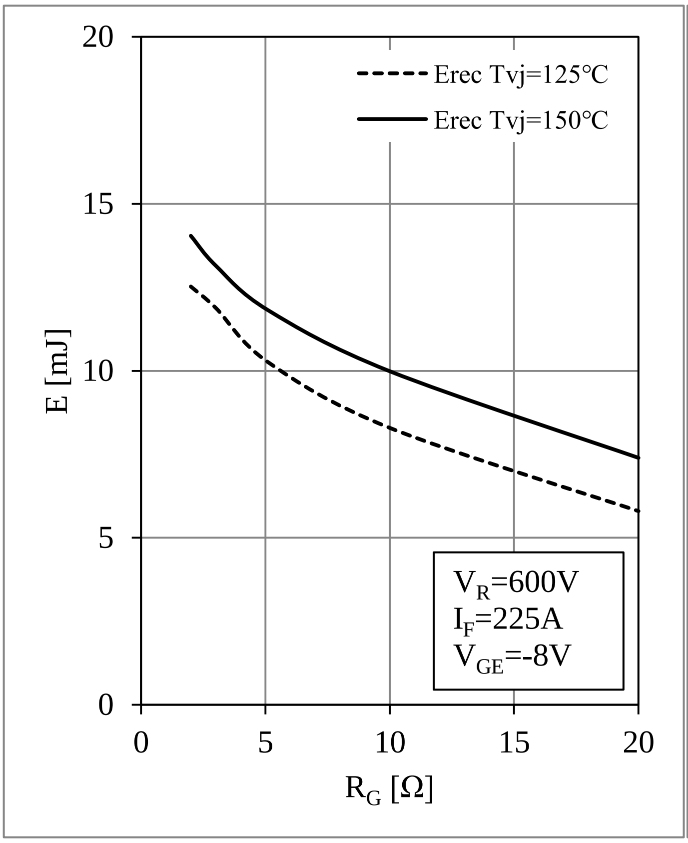


Fig 15. D1/D4 Diode Switching Loss vs. R_G

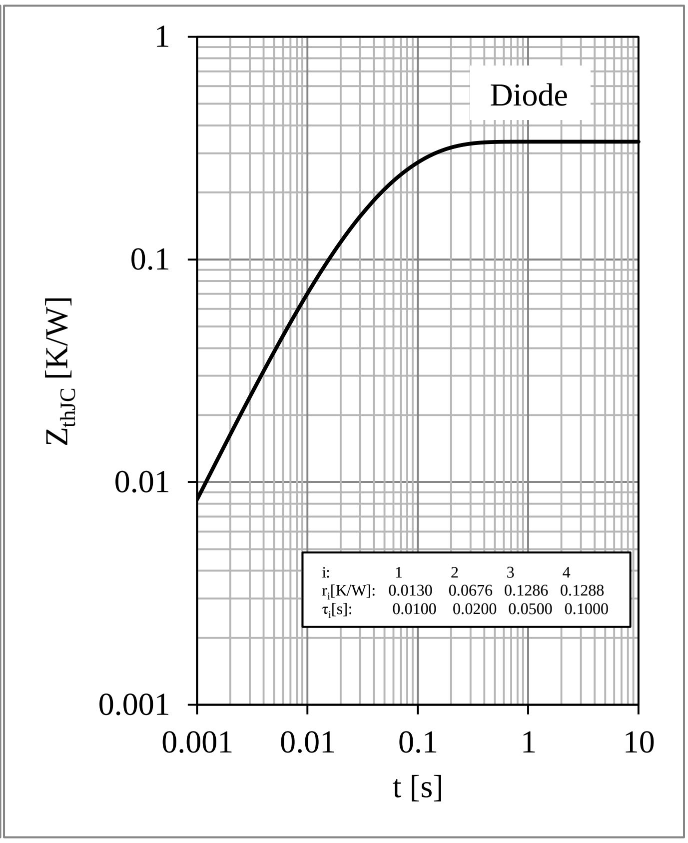


Fig 16. D1/D4 Diode Transient Thermal Impedance

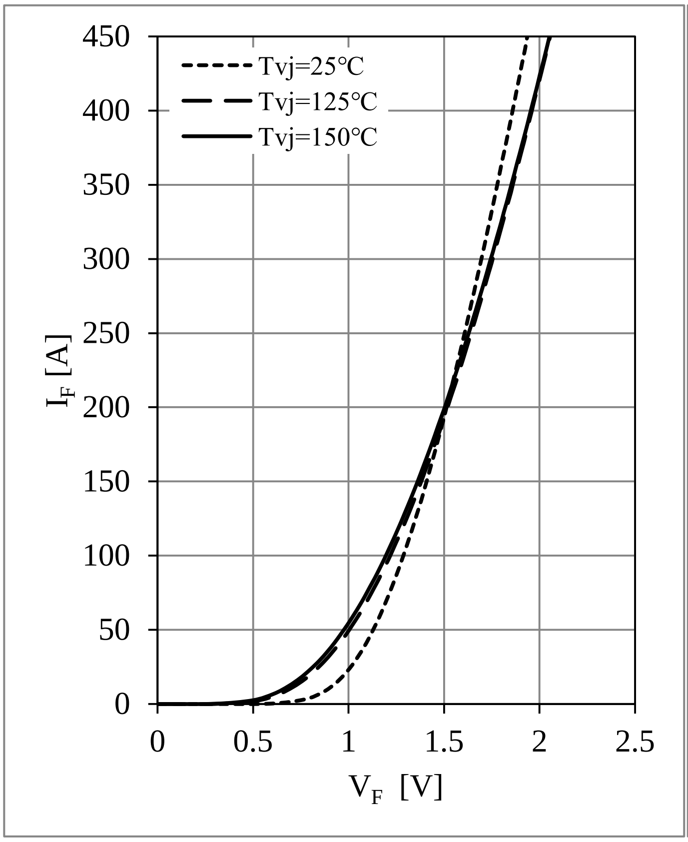


Fig 17. D2/D3 Diode Forward Characteristics

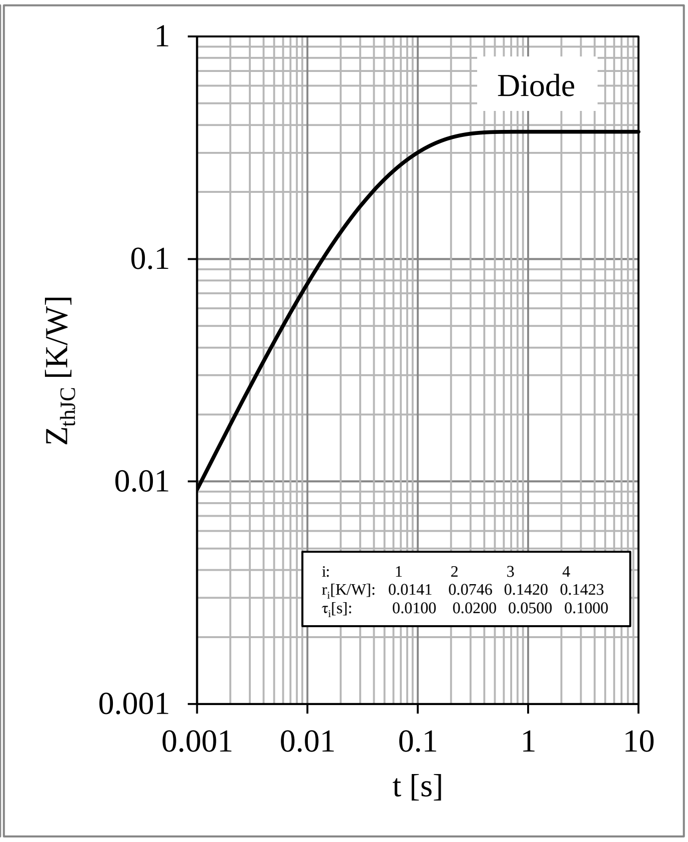


Fig 18. D2/D3 Diode Transient Thermal Impedance

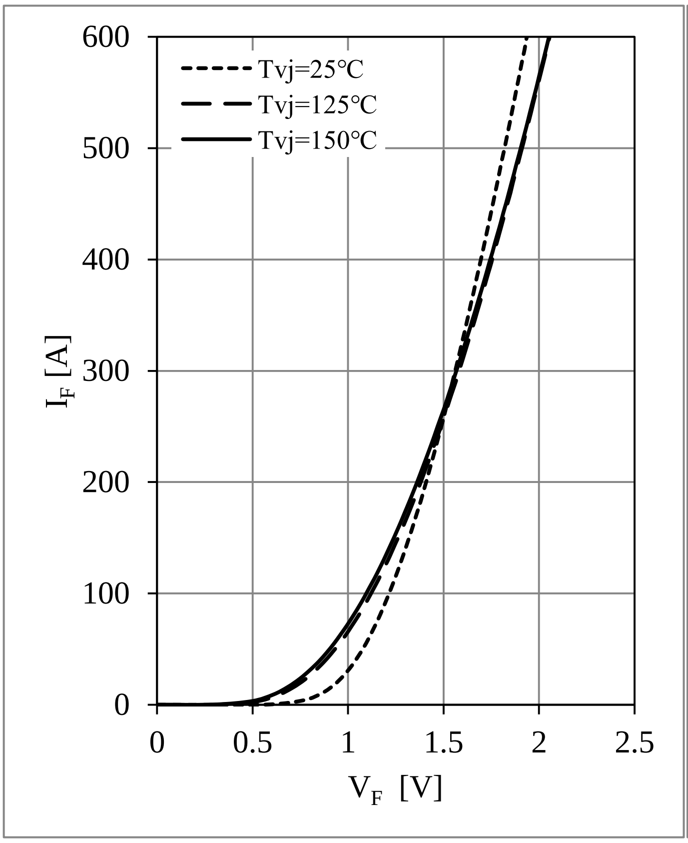


Fig 19. D5/D6 Diode Forward Characteristics

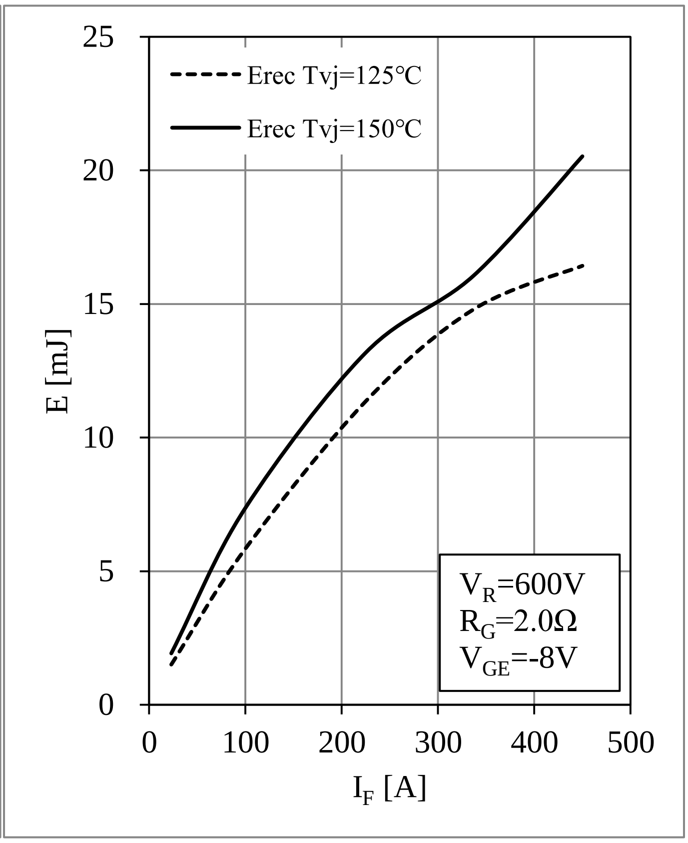
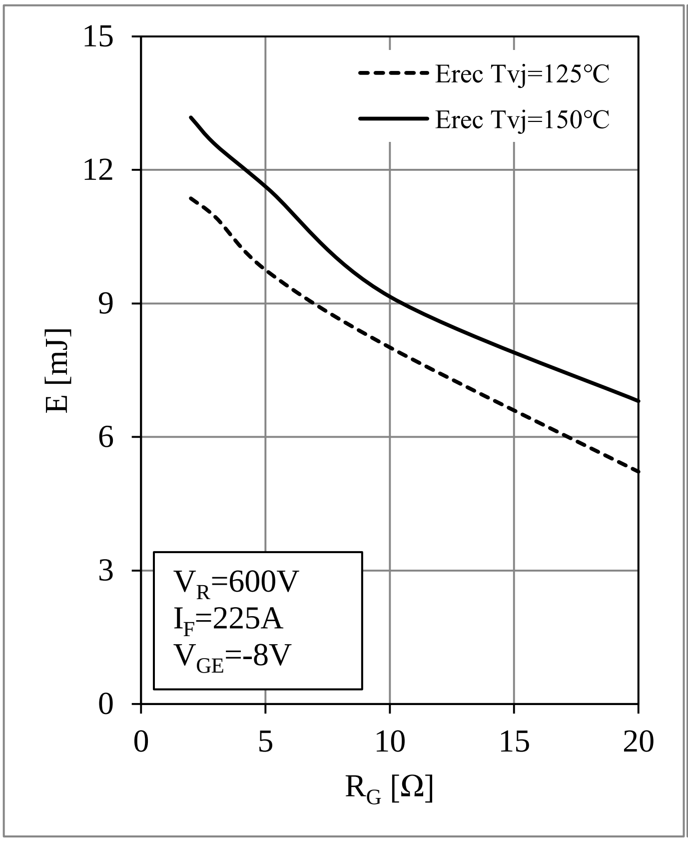


Fig 20. D5/D6 Diode Switching Loss vs. I_F



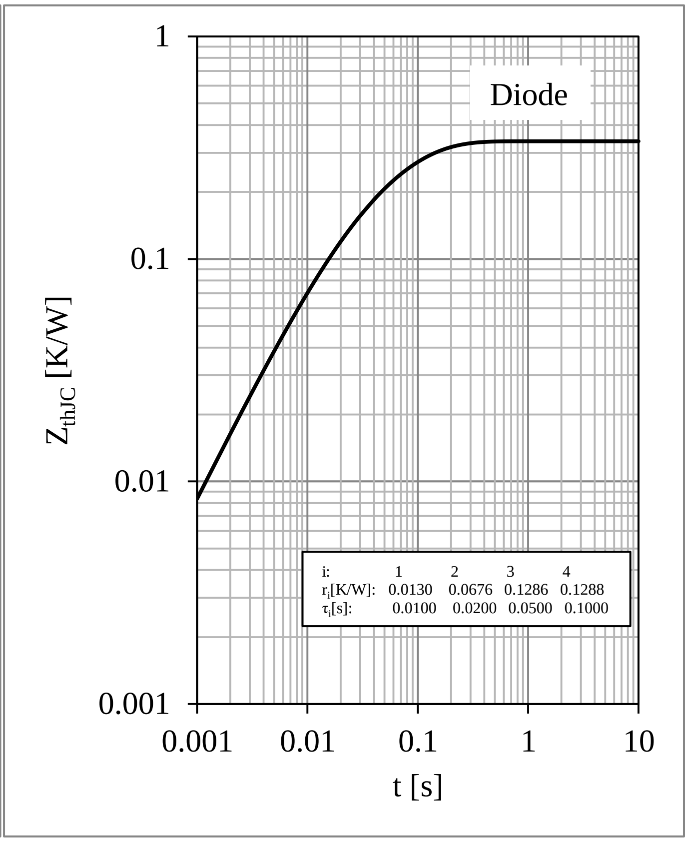


Fig 21. D5/D6 Diode Switching Loss vs. R_G

Fig 22. D5/D6 Diode Transient Thermal Impedance

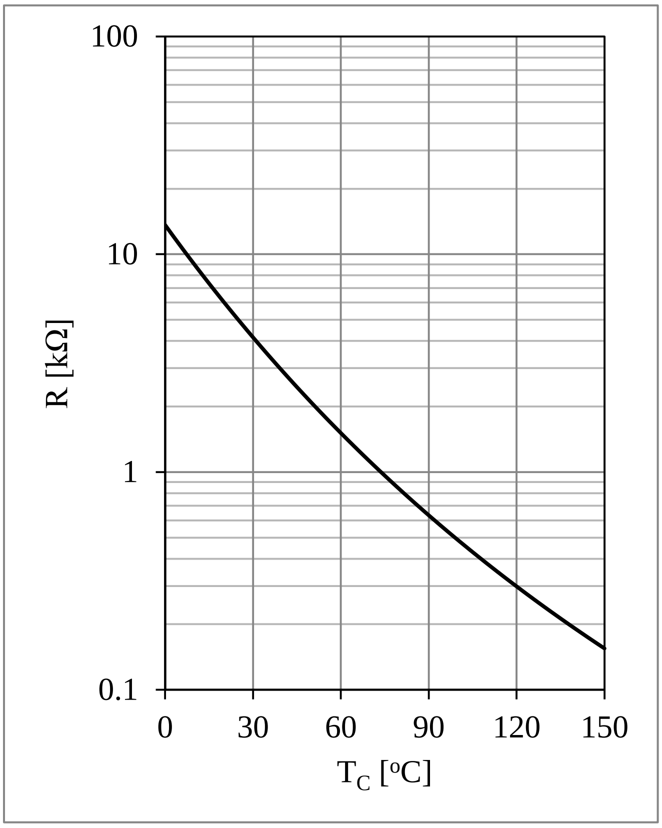
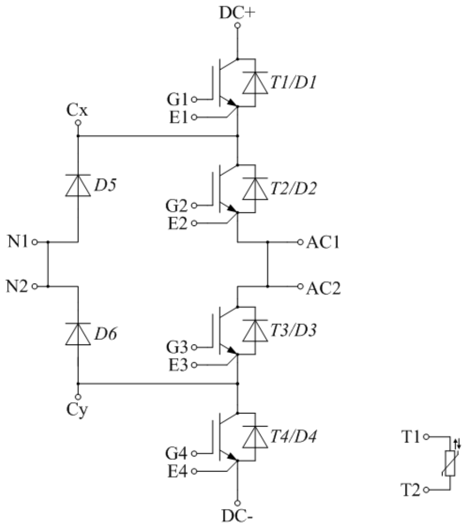


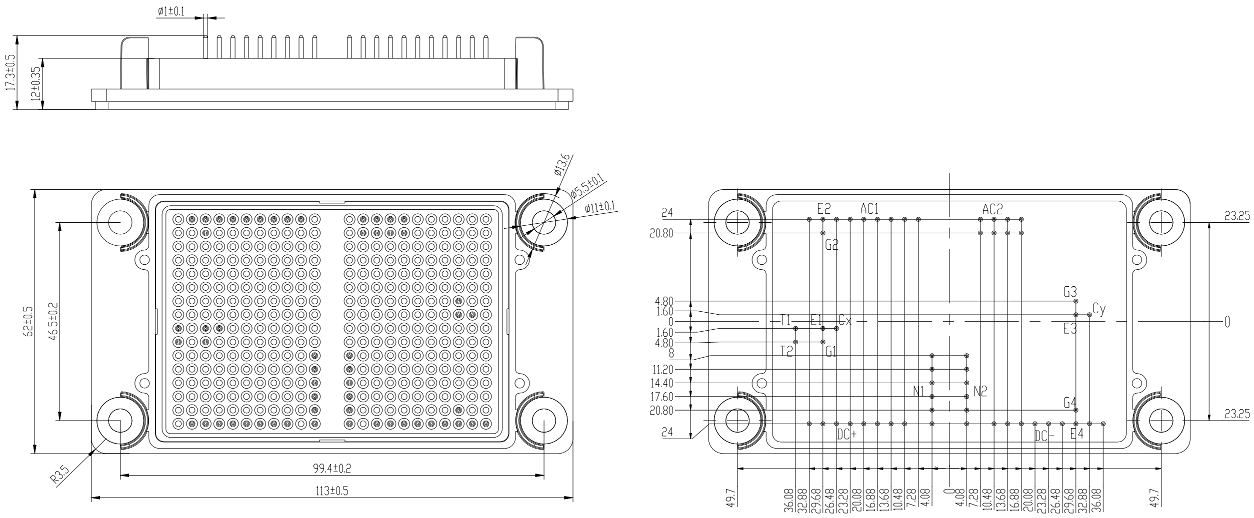
Fig 23. NTC Temperature Characteristic

Circuit Schematic



Package Dimensions

Dimensions in Millimeters



Terms and Conditions of Usage

The data contained in this product datasheet is exclusively intended for technically trained staff. you and your technical departments will have to evaluate the suitability of the product for the intended application and the completeness of the product data with respect to such application.

This product data sheet is describing the characteristics of this product for which a warranty is granted. Any such warranty is granted exclusively pursuant the terms and conditions of the supply agreement. There will be no guarantee of any kind for the product and its characteristics.

Should you require product information in excess of the data given in this product data sheet or which concerns the specific application of our product, please contact the sales office, which is responsible for you (see www.powersemi.cc), For those that are specifically interested we may provide application notes.

Due to technical requirements our product may contain dangerous substances. For information on the types in question please contact the sales office, which is responsible for you.

Should you intend to use the Product in aviation applications, in health or live endangering or life support applications, please notify.

If and to the extent necessary, please forward equivalent notices to your customers.
Changes of this product data sheet are reserved.