STARPOWER

SEMICONDUCTOR **IGBT**

GD400TAS100L6S

1000V/400A 3-level 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-application.

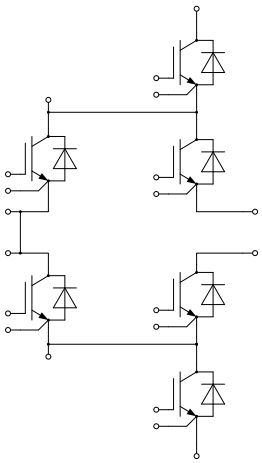
Features

- 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	1000	V
V_{GES}	Gate-Emitter Voltage	±20	V
I_{CN}	Implemented Collector Current	400	A
I_C	Collector Current @ T_C=95°C	220	A
I_{CM}	Pulsed Collector Current t_p=1ms	800	A

T2/T3 IGBT

Symbol	Description	Value	Unit
V_{CES}	Collector-Emitter Voltage	1000	V
V_{GES}	Gate-Emitter Voltage	±20	V
I_{CN}	Implemented Collector Current	400	A
I_C	Collector Current @ T_C=105°C	300	A
I_{CM}	Pulsed Collector Current t_p=1ms	800	A

D1-D4 Diode

Symbol	Description	Value	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	1000	V
I_{FN}	Implemented Forward Current	200	A
I_F	Diode Continuous Forward Current	150	A
I_{FM}	Diode Maximum Forward Current t_p=1ms	400	A

T5/T6 IGBT

Symbol	Description	Value	Unit
V_{CES}	Collector-Emitter Voltage	1000	V
V_{GES}	Gate-Emitter Voltage	±20	V
I_{CN}	Implemented Collector Current	200	A
I_C	Collector Current @ T_C=85°C	120	A
I_{CM}	Pulsed Collector Current t_p=1ms	400	A

D5/D6 Diode

Symbol	Description	Value	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	1200	V
I_F	Diode Continuous Forward Current	100	A
I_{FM}	Diode Maximum Forward Current t_p=1ms	200	A

Module

Symbol	Description	Value	Unit
T_{jmax}	Maximum Junction Temperature	175	°C
T_{jop}	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=150A,V_{GE}=15V, T_j=25°C		1.45	1.90	V
		I_C=150A,V_{GE}=15V, T_j=125°C		1.60		
		I_C=150A,V_{GE}=15V, T_j=150°C		1.65		
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	I_C=6.00mA,V_{CE}=V_{GE}, T_j=25°C	3.25	4.00	4.75	V
I_{CES}	Collector Cut-Off Current	V_{CE}=V_{CES},V_{GE}=0V, T_j=25°C			1.0	mA
I_{GES}	Gate-Emitter Leakage Current	V_{GE}=V_{GES},V_{CE}=0V, T_j=25°C			400	nA
R_{Gint}	Internal Gate Resistance			0.75		Ω
C_{ies}	Input Capacitance	V_{CE}=25V,f=100kHz, V_{GE}=0V		34.0		nF
C_{res}	Reverse Transfer Capacitance			0.54		nF
Q_G	Gate Charge	V_{GE}=-15…+15V		2.28		μC
$t_{d(on)}$	Turn-On Delay Time	V_{CC}=500V,I_C=150A, R_{Gon}=5Ω,R_{Goff}=20Ω, L_S=26nH,V_{GE}= ±15V, T_j=25°C		108		ns
t_r	Rise Time			39		ns
$t_{d(off)}$	Turn-Off Delay Time			1717		ns
t_f	Fall Time			73		ns
E_{on}	Turn-On Switching Loss			1.61		mJ
E_{off}	Turn-Off Switching Loss			10.1		mJ
$t_{d(on)}$	Turn-On Delay Time	V_{CC}=500V,I_C=150A, R_{Gon}=5Ω,R_{Goff}=20Ω, L_S=26nH,V_{GE}= ±15V, T_j=125°C		110		ns
t_r	Rise Time			38		ns
$t_{d(off)}$	Turn-Off Delay Time			1789		ns
t_f	Fall Time			82		ns
E_{on}	Turn-On Switching Loss			1.56		mJ
E_{off}	Turn-Off Switching Loss			8.85		mJ
$t_{d(on)}$	Turn-On Delay Time	V_{CC}=500V,I_C=150A, R_{Gon}=5Ω,R_{Goff}=20Ω, L_S=26nH,V_{GE}= ±15V, T_j=150°C		107		ns
t_r	Rise Time			39		ns
$t_{d(off)}$	Turn-Off Delay Time			1824		ns
t_f	Fall Time			76		ns
E_{on}	Turn-On Switching Loss			1.58		mJ
E_{off}	Turn-Off Switching Loss			8.77		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=150A,V_{GE}=15V, T_j=25°C		1.02	1.47	V
		I_C=150A,V_{GE}=15V, T_j=125°C		0.98		
		I_C=150A,V_{GE}=15V, T_j=150°C		0.97		
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	I_C=6.00mA,V_{CE}=V_{GE}, T_j=25°C	4.75	5.50	6.25	V
I_{CES}	Collector Cut-Off Current	V_{CE}=V_{CES},V_{GE}=0V, T_j=25°C			1.0	mA
I_{GES}	Gate-Emitter Leakage Current	V_{GE}=V_{GES},V_{CE}=0V, T_j=25°C			400	nA
R_{Gint}	Internal Gate Resistance			0.75		Ω
C_{ies}	Input Capacitance	V_{CE}=25V,f=100kHz, V_{GE}=0V		36.2		nF
C_{res}	Reverse Transfer Capacitance			0.19		nF
Q_G	Gate Charge	V_{GE}=-15…+15V		2.46		μC
$t_{d(on)}$	Turn-On Delay Time	V_{CC}=500V,I_C=150A, R_{Gon}=4.7Ω,R_{Goff}=4.7Ω, L_S=26nH,V_{GE}= ±15V, T_j=25°C		203		ns
t_r	Rise Time			84		ns
$t_{d(off)}$	Turn-Off Delay Time			674		ns
t_f	Fall Time			553		ns
E_{on}	Turn-On Switching Loss			2.32		mJ
E_{off}	Turn-Off Switching Loss			26.2		mJ
$t_{d(on)}$	Turn-On Delay Time	V_{CC}=500V,I_C=150A, R_{Gon}=4.7Ω,R_{Goff}=4.7Ω, L_S=26nH,V_{GE}= ±15V, T_j=125°C		192		ns
t_r	Rise Time			89		ns
$t_{d(off)}$	Turn-Off Delay Time			766		ns
t_f	Fall Time			807		ns
E_{on}	Turn-On Switching Loss			3.05		mJ
E_{off}	Turn-Off Switching Loss			36.0		mJ
$t_{d(on)}$	Turn-On Delay Time	V_{CC}=500V,I_C=150A, R_{Gon}=4.7Ω,R_{Goff}=4.7Ω, L_S=26nH,V_{GE}= ±15V, T_j=150°C		183		ns
t_r	Rise Time			93		ns
$t_{d(off)}$	Turn-Off Delay Time			781		ns
t_f	Fall Time			865		ns
E_{on}	Turn-On Switching Loss			3.28		mJ
E_{off}	Turn-Off Switching Loss			36.3		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=150A,V_{GE}=0V,T_j=25°C		2.00	2.45	V
		I_F=150A,V_{GE}=0V,T_j=125°C		2.00		
		I_F=150A,V_{GE}=0V,T_j=150°C		2.00		
Q_r	Recovered Charge	V_R=500V,I_F=150A, -di/dt=2580A/μs,V_{GE}=-15V L_S=26nH,T_j=25°C		4.17		μC
I_{RM}	Peak Reverse Recovery Current			76		A
E_{rec}	Reverse Recovery Energy			1.64		mJ
Q_r	Recovered Charge	V_R=500V,I_F=150A, -di/dt=2580A/μs,V_{GE}=-15V L_S=26nH,T_j=125°C		8.13		μC
I_{RM}	Peak Reverse Recovery Current			95		A
E_{rec}	Reverse Recovery Energy			2.99		mJ
Q_r	Recovered Charge	V_R=500V,I_F=150A, -di/dt=2580A/μs,V_{GE}=-15V L_S=26nH,T_j=150°C		8.95		μC
I_{RM}	Peak Reverse Recovery Current			98		A
E_{rec}	Reverse Recovery Energy			3.29		mJ

T5/T6 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=150A,V_{GE}=15V, T_j=25°C		1.75	2.20	V
		I_C=150A,V_{GE}=15V, T_j=125°C		2.00		
		I_C=150A,V_{GE}=15V, T_j=150°C		2.10		
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	I_C=3.00mA,V_{CE}=V_{GE}, T_j=25°C	3.25	4.00	4.75	V
I_{CES}	Collector Cut-Off Current	V_{CE}=V_{CES},V_{GE}=0V, T_j=25°C			1.0	mA
I_{GES}	Gate-Emitter Leakage Current	V_{GE}=V_{GES},V_{CE}=0V, T_j=25°C			400	nA
R_{Gint}	Internal Gate Resistance			1.5		Ω
C_{ies}	Input Capacitance	V_{CE}=25V,f=100kHz, V_{GE}=0V		17.0		nF
C_{res}	Reverse Transfer Capacitance			0.27		nF
Q_G	Gate Charge	V_{GE}=-15…+15V		1.14		μC
$t_{d(on)}$	Turn-On Delay Time	V_{CC}=500V,I_C=150A, R_{Gon}=5Ω,R_{Goff}=30Ω, L_S=26nH,V_{GE}=±15V, T_j=25°C		93		ns
t_r	Rise Time			61		ns
$t_{d(off)}$	Turn-Off Delay Time			1177		ns
t_f	Fall Time			122		ns
E_{on}	Turn-On Switching Loss			5.20		mJ
E_{off}	Turn-Off Switching Loss			7.17		mJ
$t_{d(on)}$	Turn-On Delay Time	V_{CC}=500V,I_C=150A, R_{Gon}=5Ω,R_{Goff}=30Ω, L_S=26nH,V_{GE}=±15V, T_j=125°C		100		ns
t_r	Rise Time			73		ns
$t_{d(off)}$	Turn-Off Delay Time			1263		ns
t_f	Fall Time			97		ns
E_{on}	Turn-On Switching Loss			6.42		mJ
E_{off}	Turn-Off Switching Loss			7.94		mJ
$t_{d(on)}$	Turn-On Delay Time	V_{CC}=500V,I_C=150A, R_{Gon}=5Ω,R_{Goff}=30Ω, L_S=26nH,V_{GE}=±15V, T_j=150°C		105		ns
t_r	Rise Time			73		ns
$t_{d(off)}$	Turn-Off Delay Time			1288		ns
t_f	Fall Time			88		ns
E_{on}	Turn-On Switching Loss			6.79		mJ
E_{off}	Turn-Off Switching Loss			8.00		mJ

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=100A,V_{GE}=0V,T_j=25°C		1.40	1.85	V
		I_F=100A,V_{GE}=0V,T_j=125°C		1.70		
		I_F=100A,V_{GE}=0V,T_j=150°C		1.80		

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°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)			0.155	K/W
	Junction-to-Case (per D1-D4 Diode)			0.359	
	Junction-to-Case (per T2/T3 IGBT)			0.153	
	Junction-to-Case (per T5/T6 IGBT)			0.307	
	Junction-to-Case (per D5/D6 Diode)			0.298	
R_{thCH}	Case-to-Heatsink (per T1/T4 IGBT)		0.036		K/W
	Case-to-Heatsink (per D1-D4 Diode)		0.051		
	Case-to-Heatsink (per T2/T3 IGBT)		0.038		
	Case-to-Heatsink (per T5/T6 IGBT)		0.054		
	Case-to-Heatsink (per D5/D6 Diode)		0.065		
M	Mounting Torque, Screw:M5	3.0		5.0	N.m
G	Weight of Module		250		g

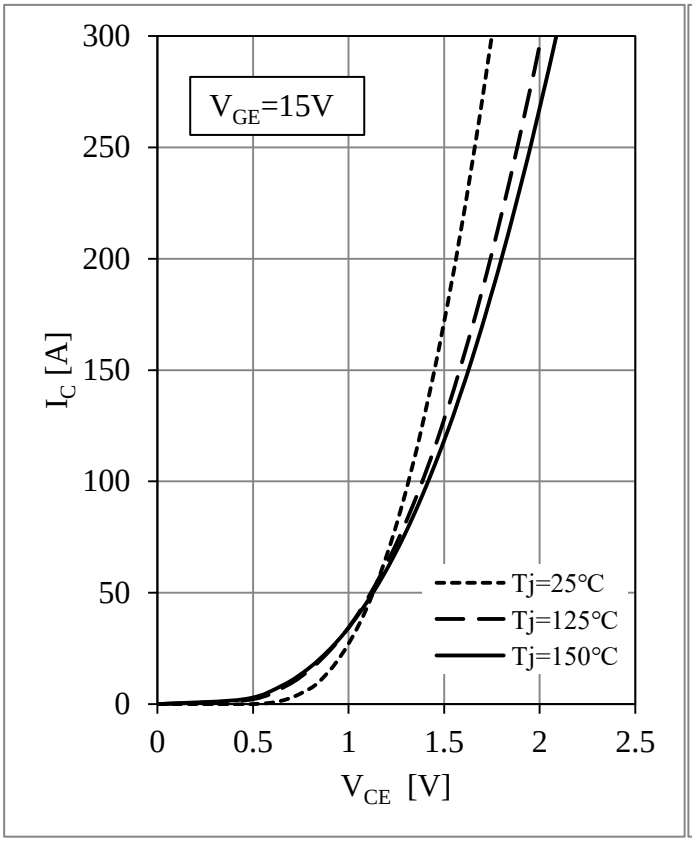


Fig 1. T1/T4 IGBT Output Characteristics

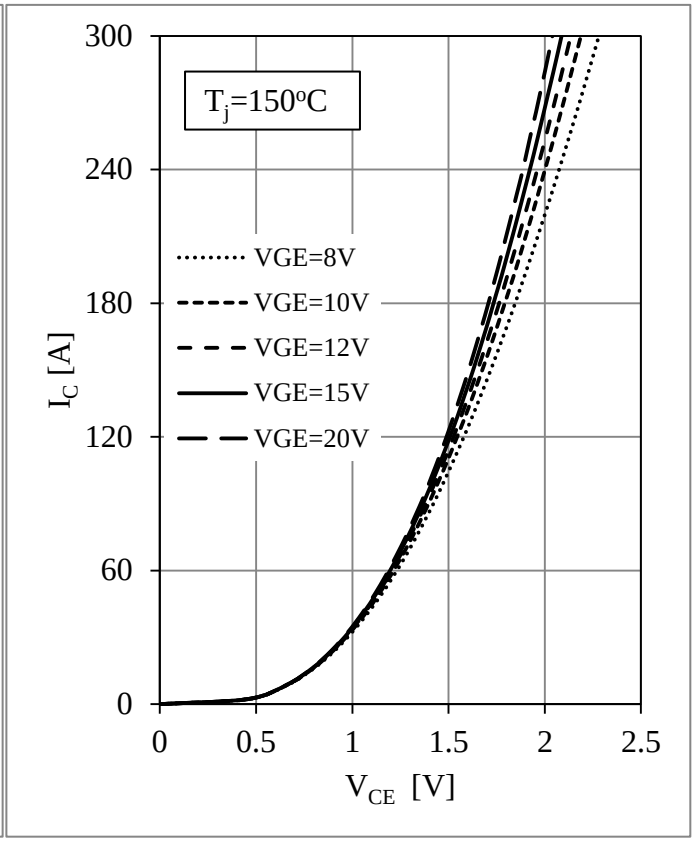


Fig 2. T1/T4 IGBT Output Characteristics

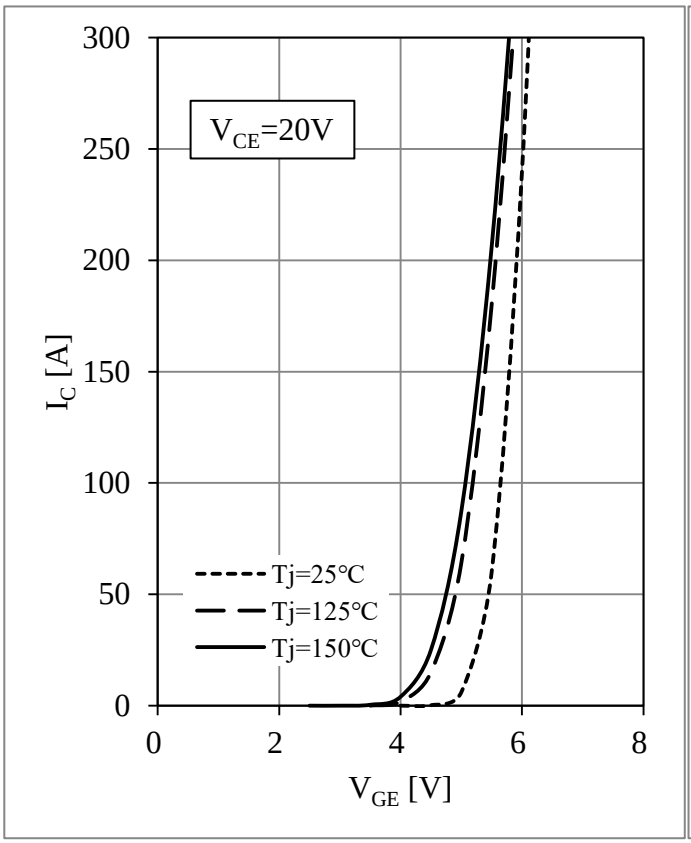


Fig 3. 1/T4 IGBT Transfer Characteristics

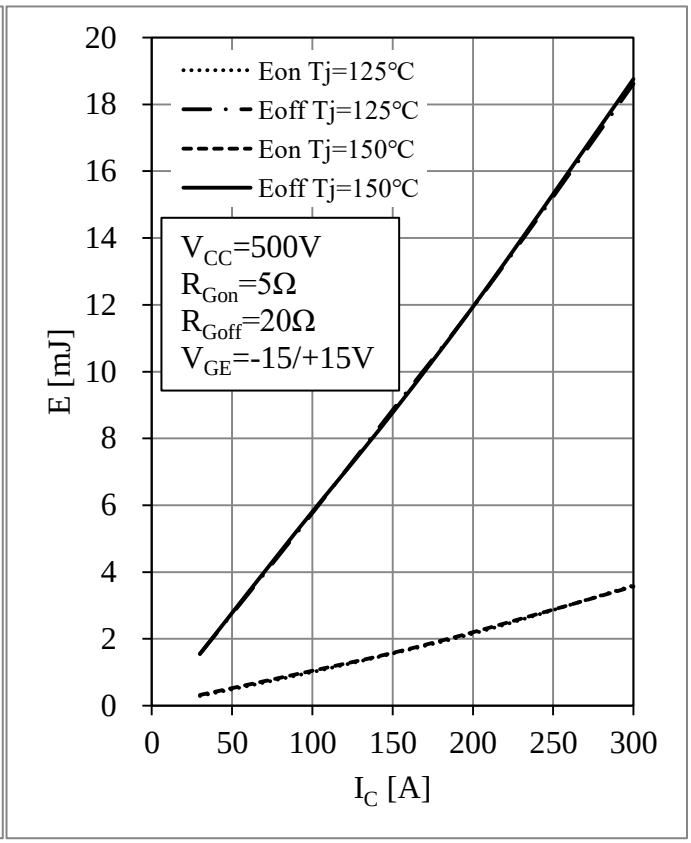


Fig 4. T1/T4 IGBT Switching Loss vs. I_C

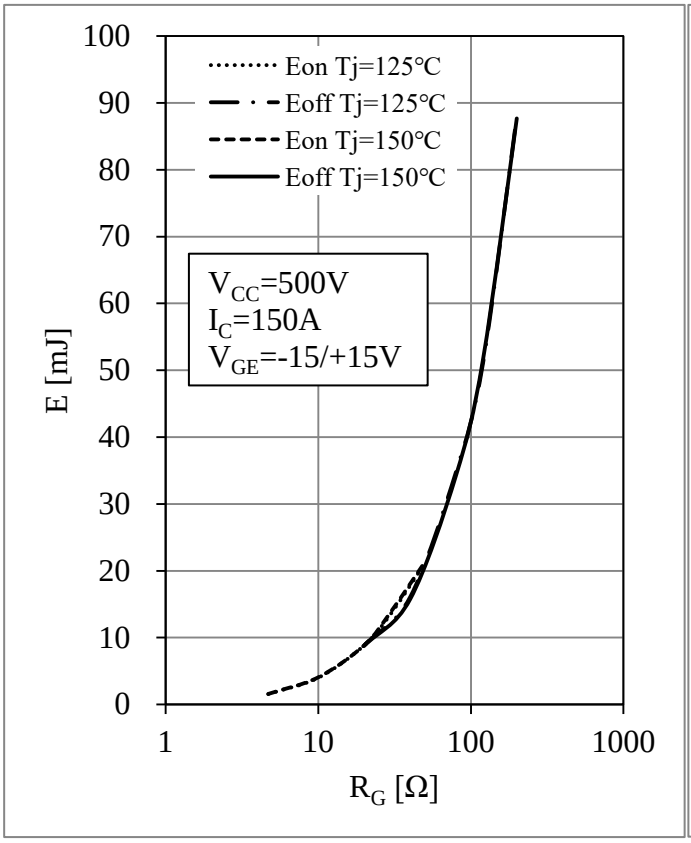


Fig 5. T1/T4 IGBT Switching Loss vs. R_G

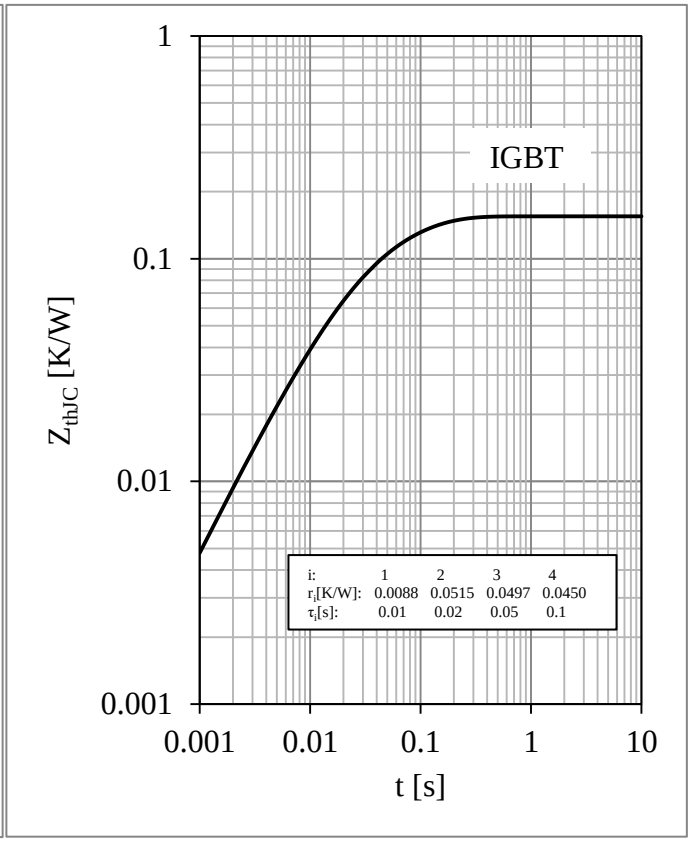


Fig 6. T1/T4 IGBT Transient Thermal Impedance

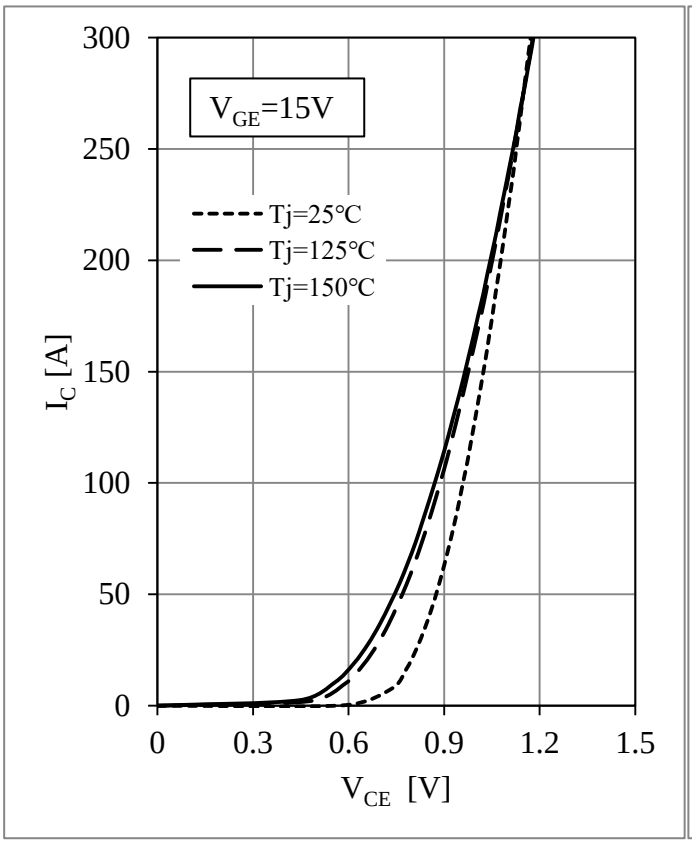


Fig 7. T2/T3 IGBT Output Characteristics

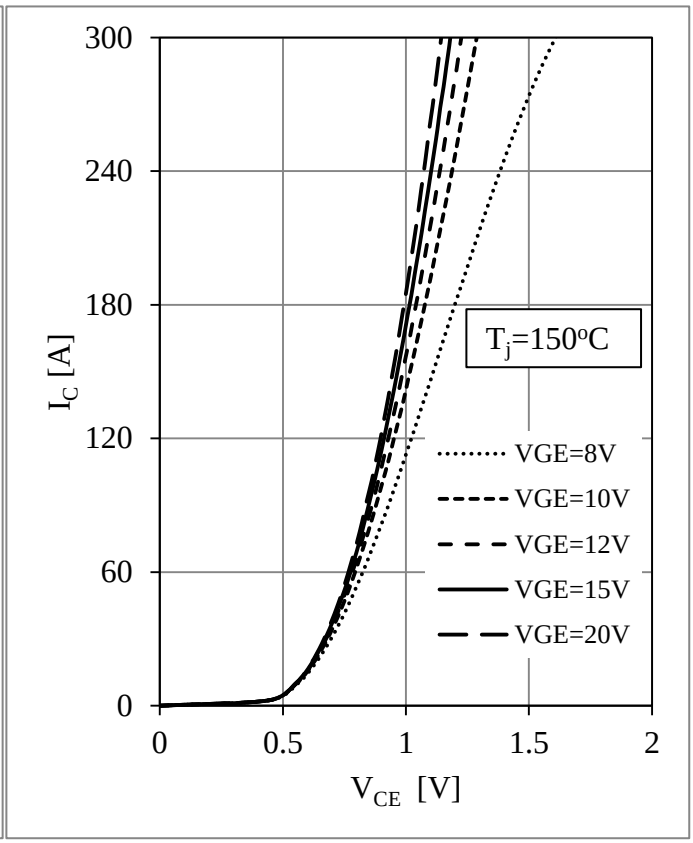


Fig 8. T2/T3 IGBT Output Characteristics

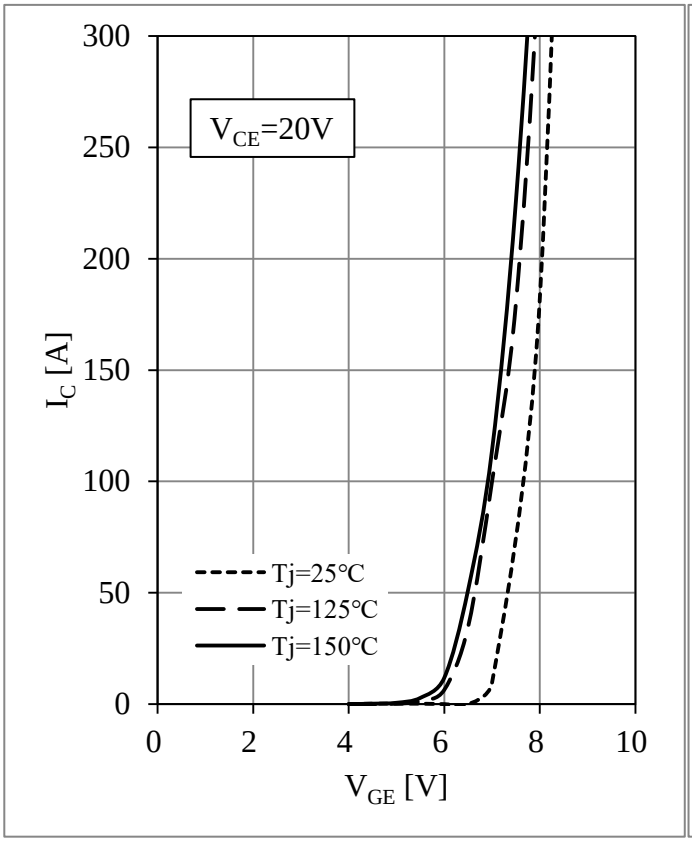


Fig 9. T2/T3 IGBT Transfer Characteristics

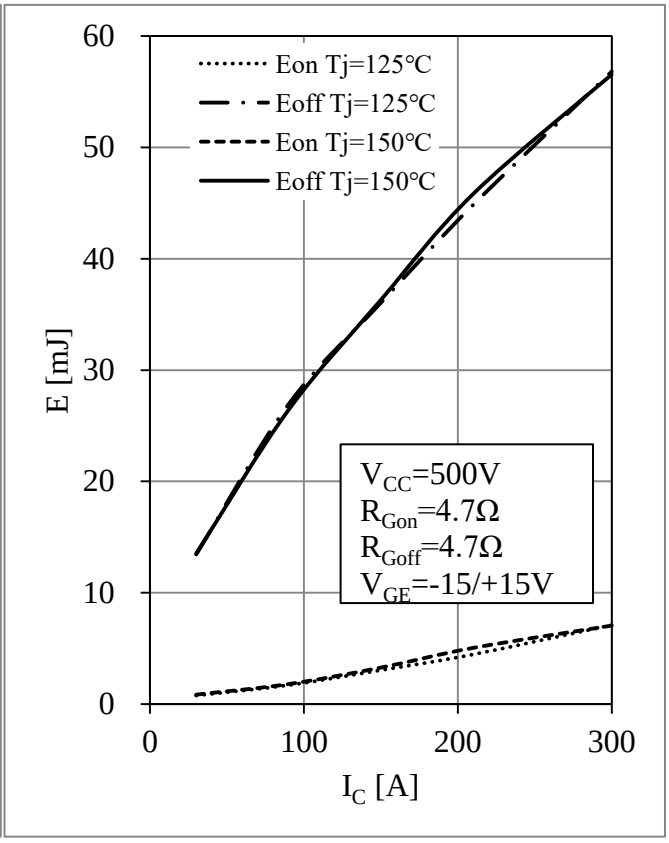


Fig 10. T2/T3 IGBT Switching Loss vs. I_C

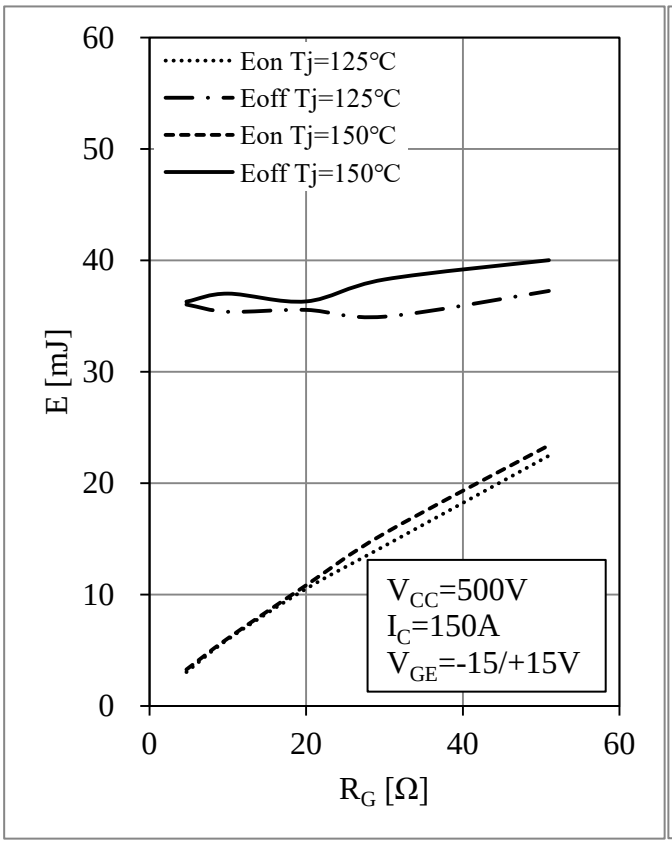


Fig 11. T2/T3 IGBT Switching Loss vs. R_G

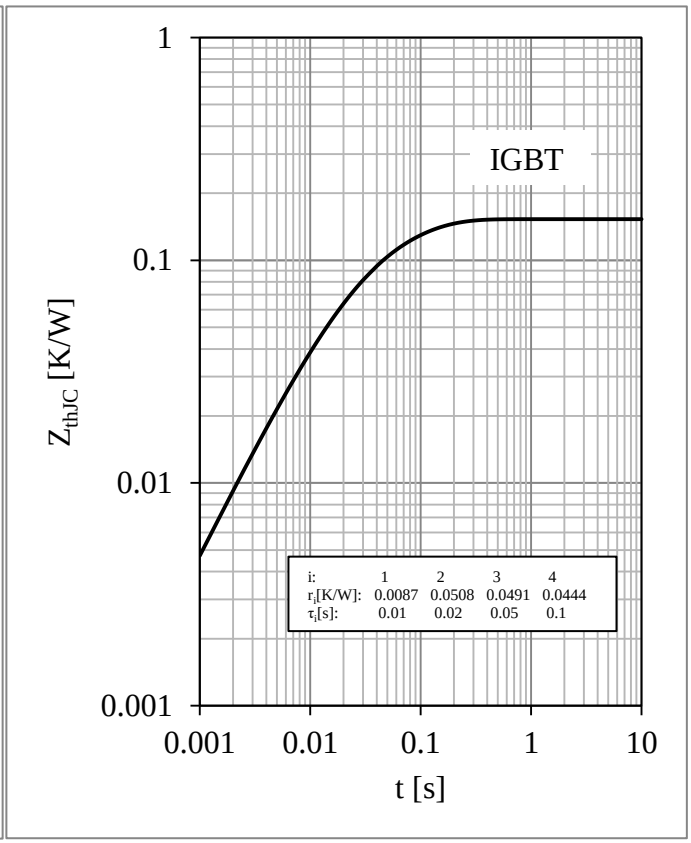


Fig 12. T2/T3 IGBT Transient Thermal Impedance

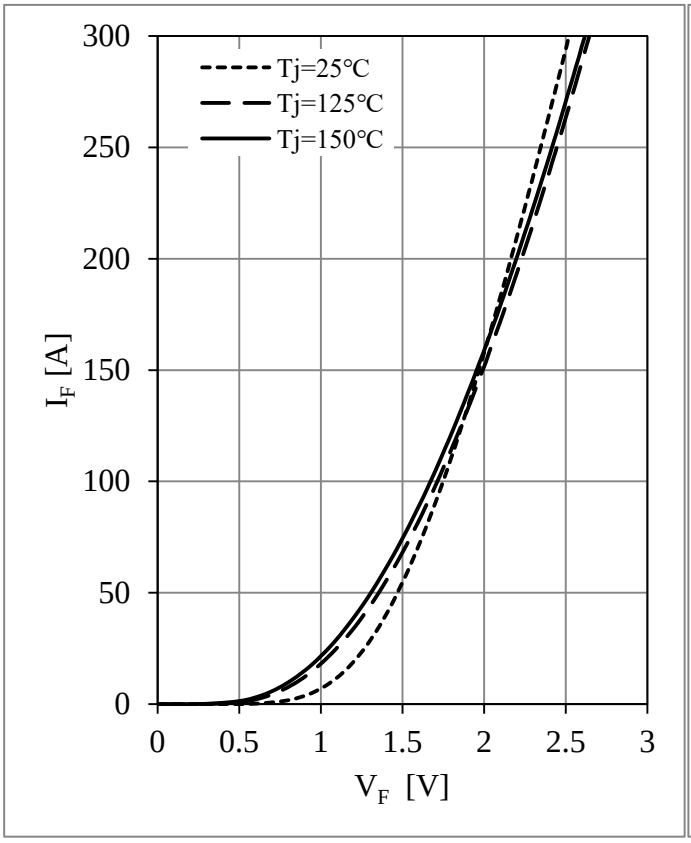


Fig 13. D1-D4 Diode Forward Characteristics

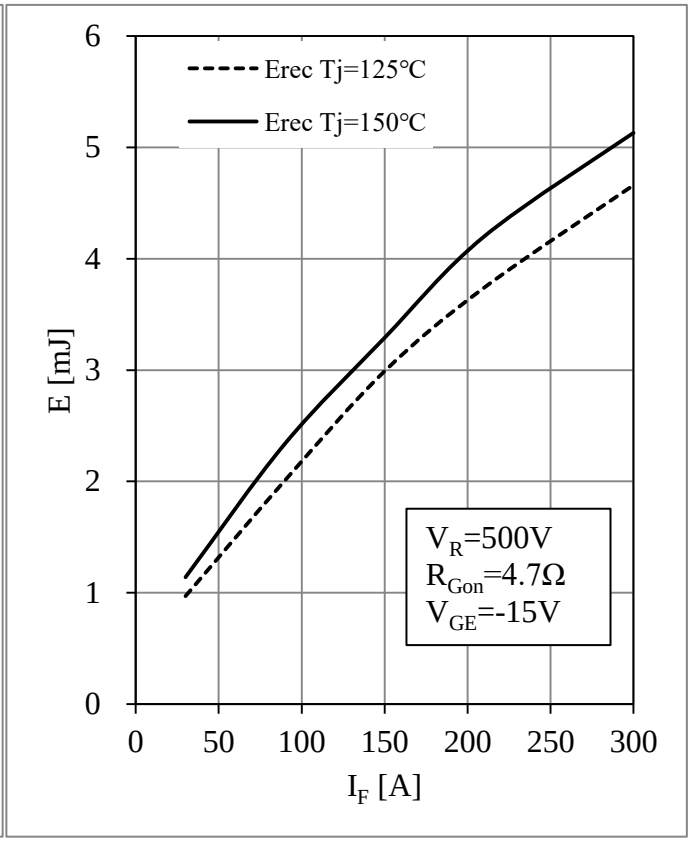


Fig 14. D1-D4 Diode Switching Loss vs. I_F

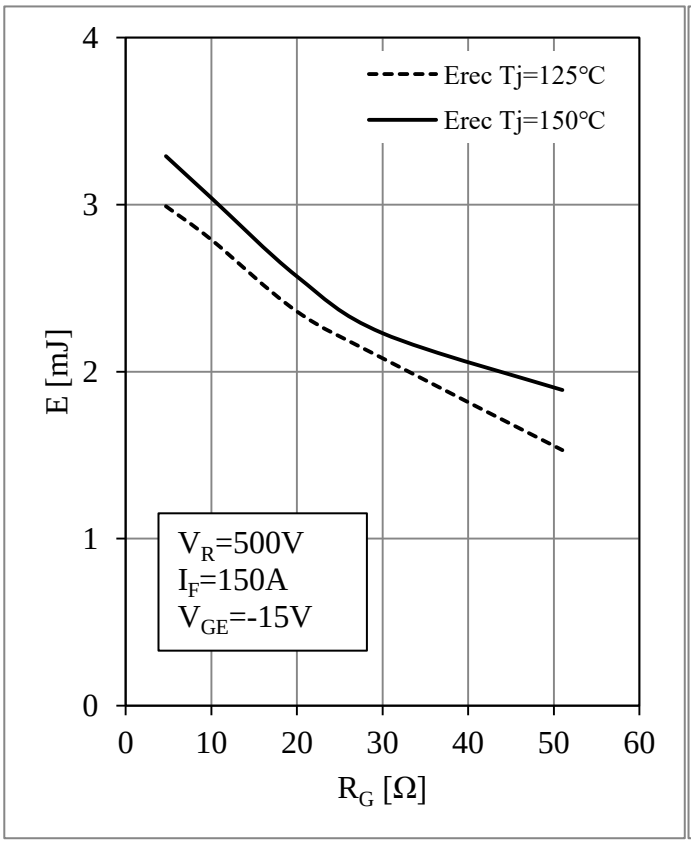


Fig 15. D1-D4 Diode Switching Loss vs. R_G

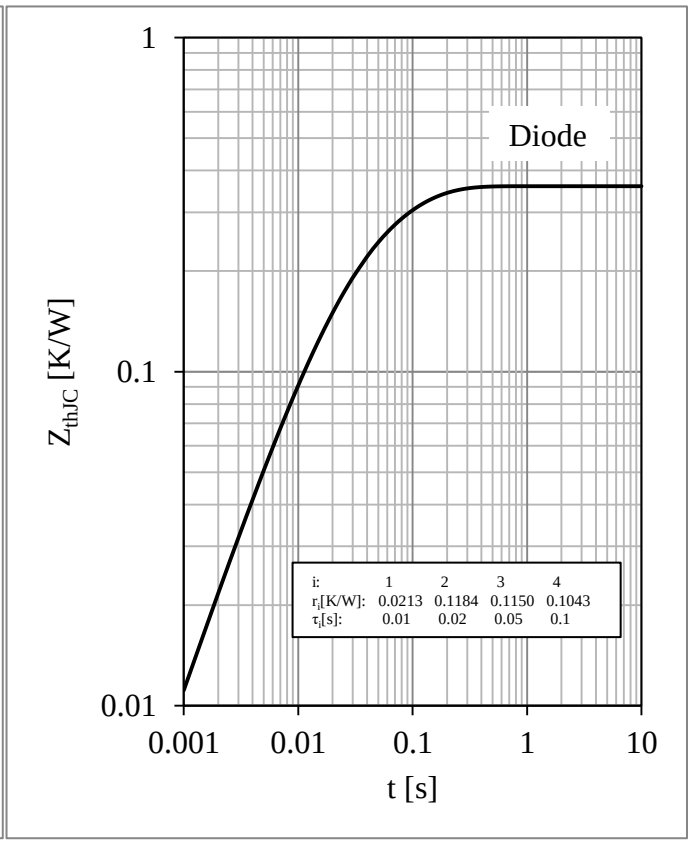


Fig 16. D1-D4 Diode Transient Thermal Impedance

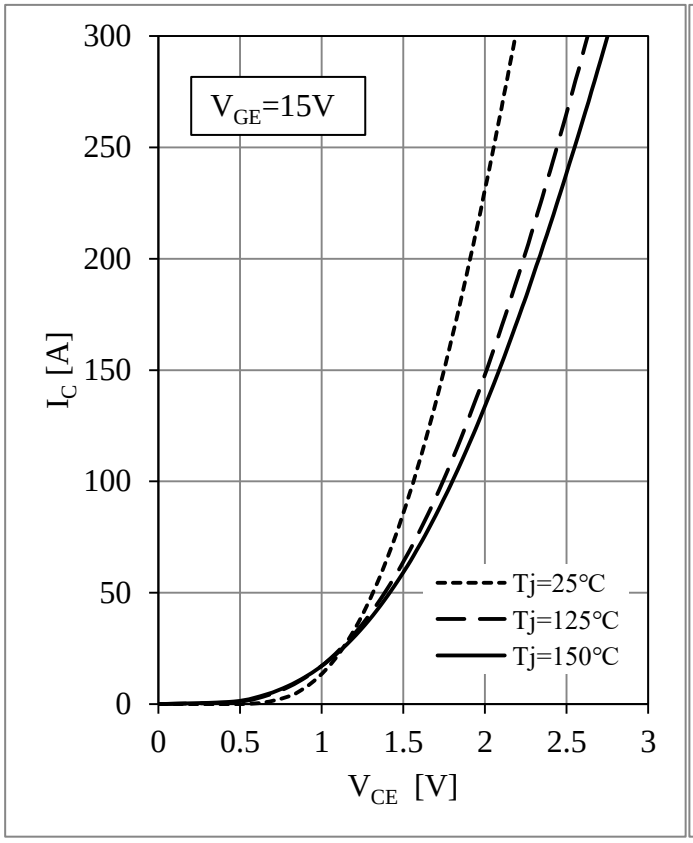


Fig 17. T5/T6 IGBT Output Characteristics

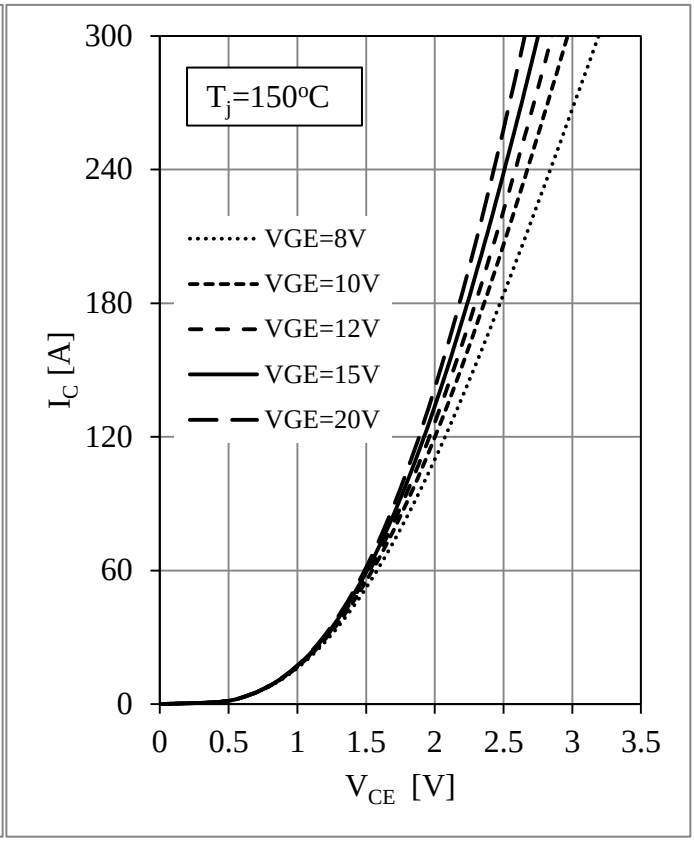


Fig 18. T5/T6 IGBT Output Characteristics

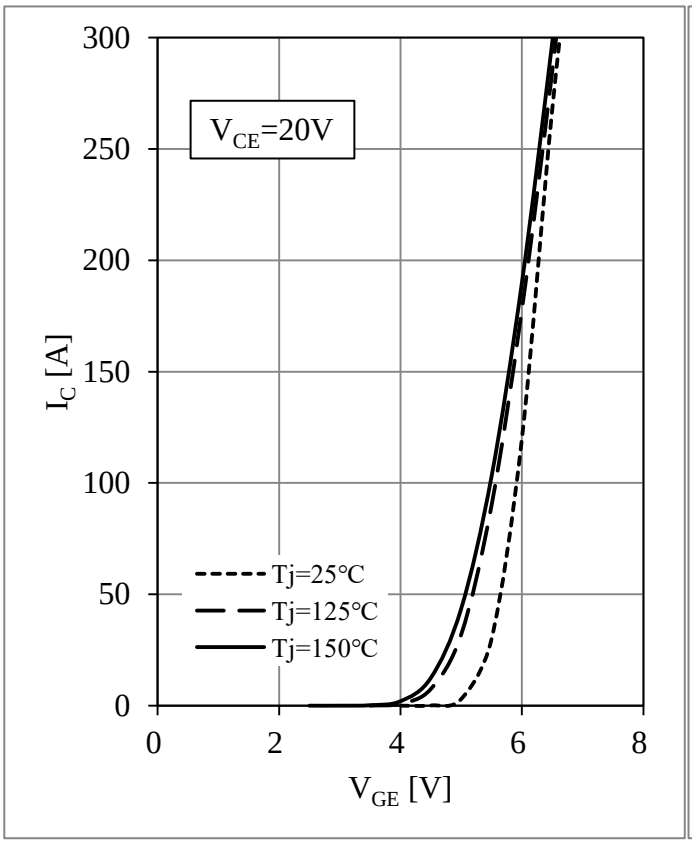


Fig 19. T5/T6 IGBT Transfer Characteristics

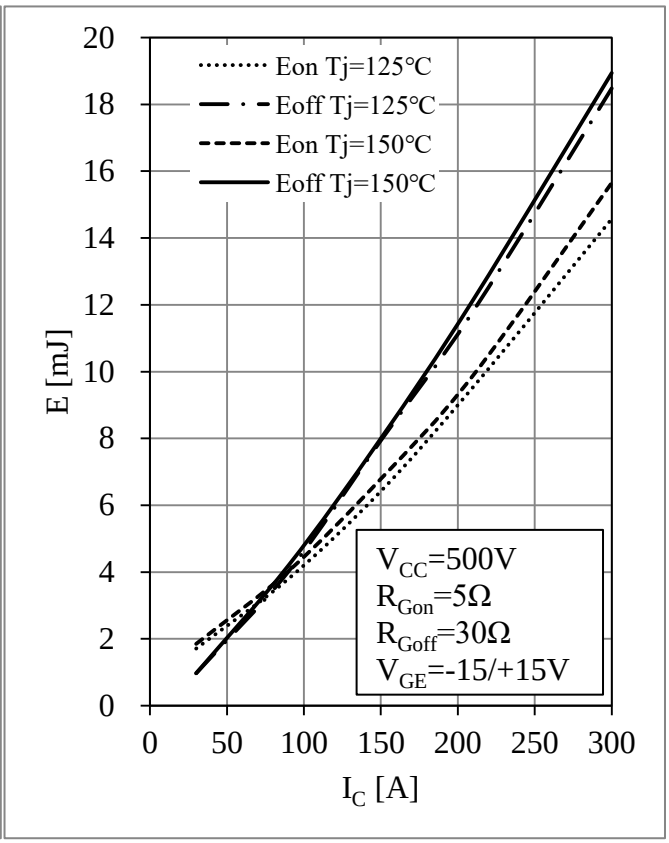


Fig 20. T5/T6 IGBT Switching Loss vs. I_C

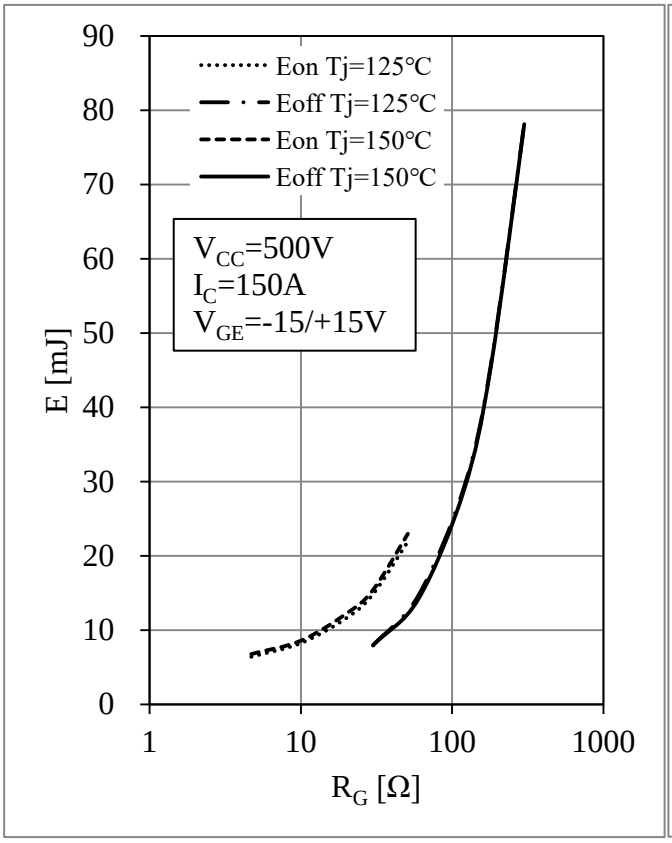


Fig 21. T5/T6 IGBT Switching Loss vs. R_G

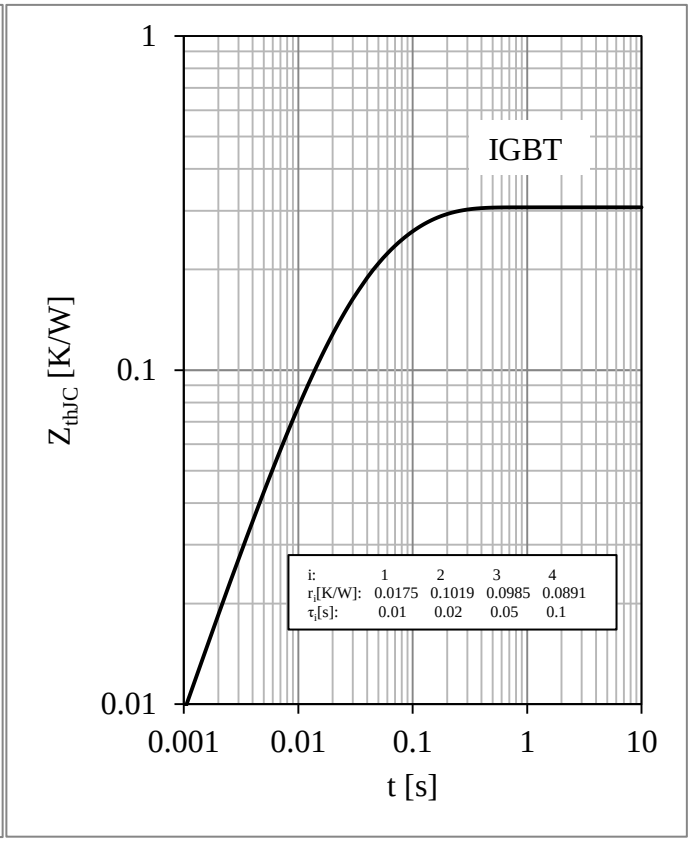


Fig 22. T5/T6 IGBT Transient Thermal Impedance

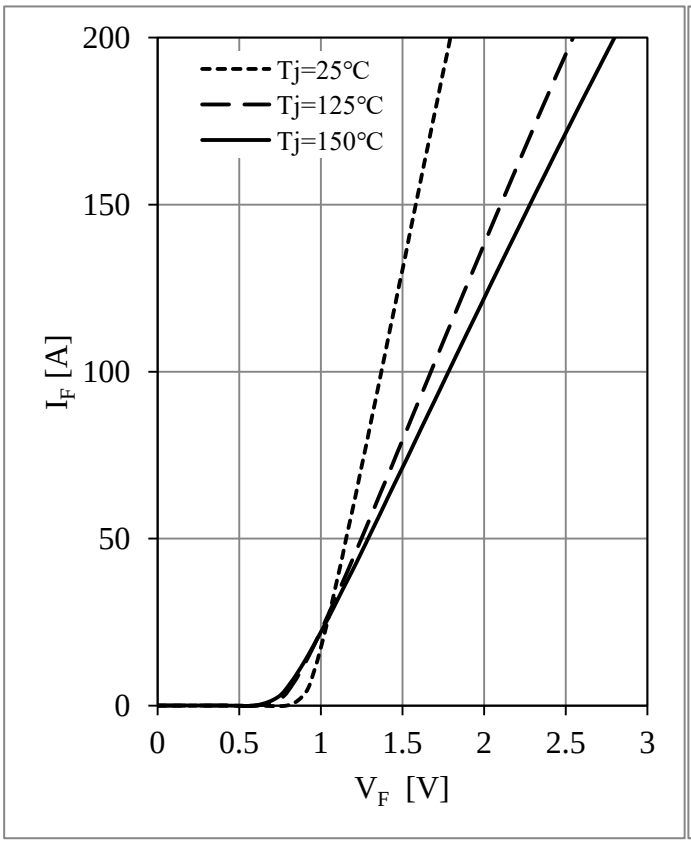


Fig 23. D5/D6 Diode Forward Characteristics

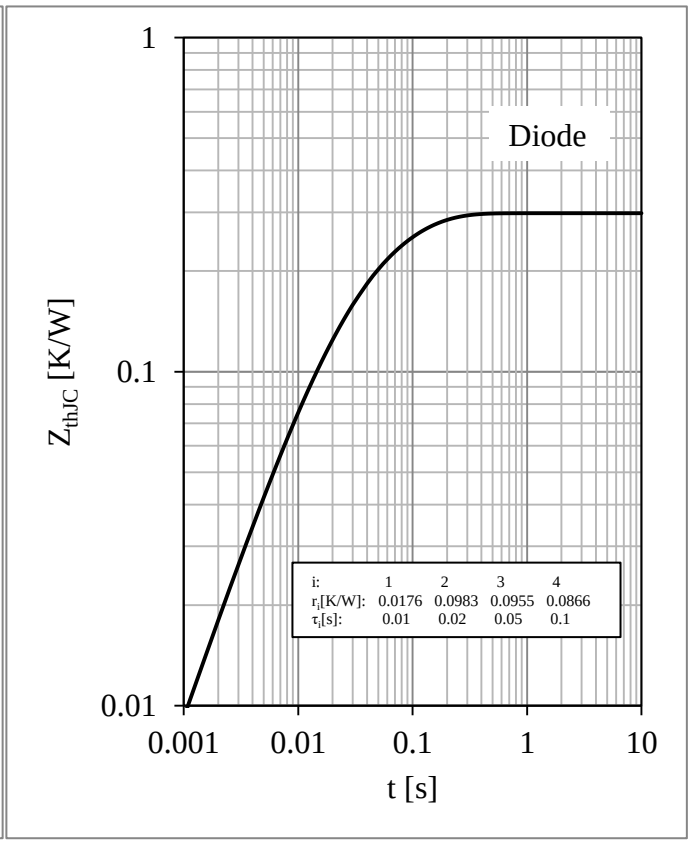
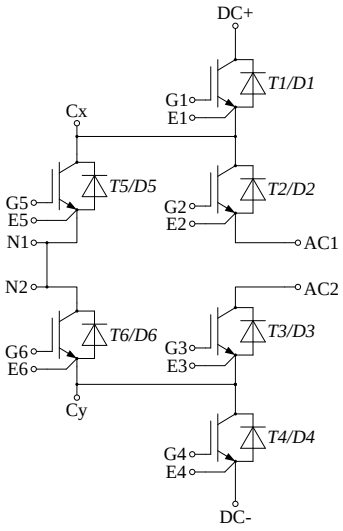


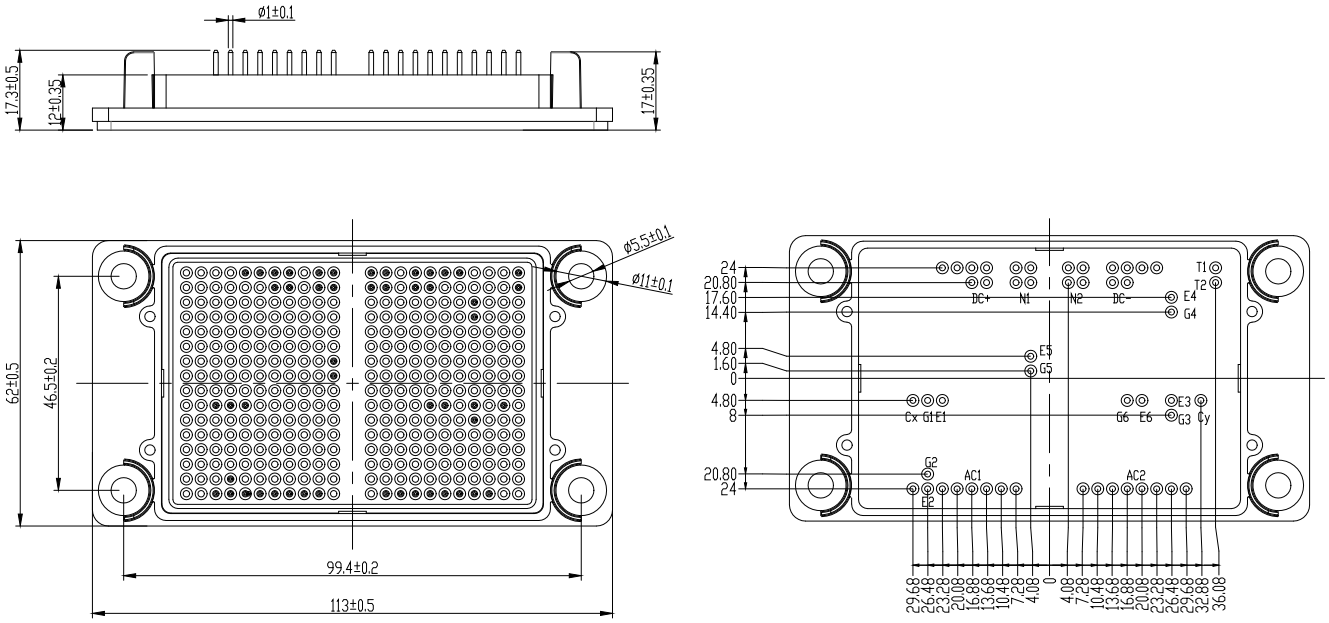
Fig 24. D5/D6 Diode Transient Thermal Impedance

Circuit Schematic



Package Dimensions

Dimensions in Millimeters



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