

STARPOWER

SEMICONDUCTOR

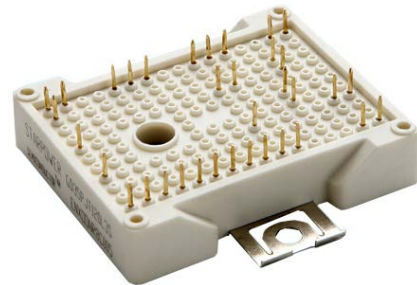
IGBT

GD200TLY120L3S

1200V/200A 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.



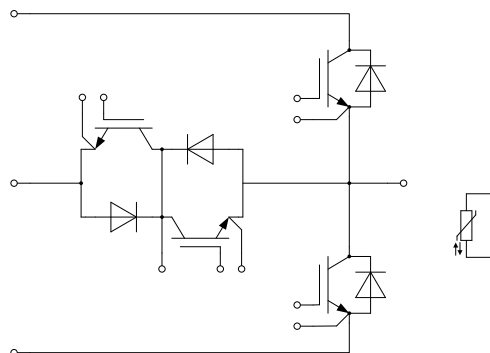
Features

- Low $V_{CE(sat)}$ Trench IGBT technology
- Low switching loss
- 10 μ s short circuit capability
- $V_{CE(sat)}$ with positive temperature coefficient
- Maximum junction temperature 175°C
- Fast & soft reverse recovery anti-parallel FWD
- Low inductance case

Typical Applications

- Solar power
- UPS
- 3-level-application

Equivalent Circuit Schematic



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

Symbol	Description	Values	Unit
V_{CES}	Collector-Emitter Voltage	1200	V
V_{GES}	Gate-Emitter Voltage	± 20	V
I_C	Collector Current @ $T_C=25^{\circ}\text{C}$	311	A
	@ $T_C=100^{\circ}\text{C}$	200	A
I_{CM}	Pulsed Collector Current $t_p=1\text{ms}$	400	A
P_D	Maximum Power Dissipation @ $T_j=175^{\circ}\text{C}$	1013	W

D1,D4 Diode

Symbol	Description	Value	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	1200	V
I_F	Diode Continuous Forward Current	75	A
I_{FM}	Diode Maximum Forward Current $t_p=1\text{ms}$	150	A

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 @ $T_C=25^{\circ}\text{C}$	124	A
	@ $T_C=65^{\circ}\text{C}$	100	A
I_{CM}	Pulsed Collector Current $t_p=1\text{ms}$	200	A
P_D	Maximum Power Dissipation @ $T_j=175^{\circ}\text{C}$	309	W

D2,D3 Diode

Symbol	Description	Value	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	650	V
I_F	Diode Continuous Forward Current	100	A
I_{FM}	Diode Maximum Forward Current $t_p=1\text{ms}$	200	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

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	$I_C=200\text{A}, V_{GE}=15\text{V}, T_j=25^\circ\text{C}$		1.70	2.15	V	
		$I_C=200\text{A}, V_{GE}=15\text{V}, T_j=125^\circ\text{C}$		1.95			
		$I_C=200\text{A}, V_{GE}=15\text{V}, T_j=150^\circ\text{C}$		2.00			
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=8.0\text{mA}, V_{CE}=V_{GE}, T_j=25^\circ\text{C}$	5.3	5.8	6.3	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			4.0		Ω	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=200\text{A}, R_G=1.1\Omega, V_{GE}=\pm 15\text{V}, T_j=25^\circ\text{C}$		150		ns	
t_r	Rise Time			32		ns	
$t_{d(off)}$	Turn-Off Delay Time			330		ns	
t_f	Fall Time			93		ns	
E_{on}	Turn-On Switching Loss				11.2		mJ
E_{off}	Turn-Off Switching Loss				11.3		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=200\text{A}, R_G=1.1\Omega, V_{GE}=\pm 15\text{V}, T_j=125^\circ\text{C}$		161		ns	
t_r	Rise Time			37		ns	
$t_{d(off)}$	Turn-Off Delay Time			412		ns	
t_f	Fall Time			165		ns	
E_{on}	Turn-On Switching Loss				19.8		mJ
E_{off}	Turn-Off Switching Loss				17.0		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=200\text{A}, R_G=1.1\Omega, V_{GE}=\pm 15\text{V}, T_j=150^\circ\text{C}$		161		ns	
t_r	Rise Time			43		ns	
$t_{d(off)}$	Turn-Off Delay Time			433		ns	
t_f	Fall Time			185		ns	
E_{on}	Turn-On Switching Loss				21.9		mJ
E_{off}	Turn-Off Switching Loss				19.1		mJ
I_{SC}	SC Data	$t_P \leq 10\mu\text{s}, V_{GE}=15\text{V}, T_j=150^\circ\text{C}, V_{CC}=900\text{V}, V_{CEM} \leq 1200\text{V}$		800		A	

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	$I_F=75\text{A}, V_{GE}=0\text{V}, T_j=25^\circ\text{C}$		1.70	2.15	V
		$I_F=75\text{A}, V_{GE}=0\text{V}, T_j=125^\circ\text{C}$		1.65		
		$I_F=75\text{A}, V_{GE}=0\text{V}, T_j=150^\circ\text{C}$		1.65		
Q_r	Recovered Charge	$V_R=600\text{V}, I_F=75\text{A},$ $-di/dt=1900\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=25^\circ\text{C}$		6.9		μC
I_{RM}	Peak Reverse Recovery Current			84		A
E_{rec}	Reverse Recovery Energy			2.47		mJ
Q_r	Recovered Charge	$V_R=600\text{V}, I_F=75\text{A},$ $-di/dt=1900\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=125^\circ\text{C}$		12.4		μC
I_{RM}	Peak Reverse Recovery Current			85		A
E_{rec}	Reverse Recovery Energy			4.30		mJ
Q_r	Recovered Charge	$V_R=600\text{V}, I_F=75\text{A},$ $-di/dt=1900\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=150^\circ\text{C}$		13.8		μC
I_{RM}	Peak Reverse Recovery Current			86		A
E_{rec}	Reverse Recovery Energy			5.20		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	$I_C=100\text{A}, V_{GE}=15\text{V}, T_j=25^{\circ}\text{C}$		1.45	1.90	V
		$I_C=100\text{A}, V_{GE}=15\text{V}, T_j=125^{\circ}\text{C}$		1.60		
		$I_C=100\text{A}, V_{GE}=15\text{V}, T_j=150^{\circ}\text{C}$		1.70		
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=1.6\text{mA}, V_{CE}=V_{GE}, T_j=25^{\circ}\text{C}$	5.1	5.8	6.4	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			2.0		Ω
C_{ies}	Input Capacitance	$V_{CE}=25\text{V}, f=1\text{MHz}, V_{GE}=0\text{V}$		6.16		nF
C_{res}	Reverse Transfer Capacitance			0.18		nF
Q_G	Gate Charge	$V_{GE}=-15\dots+15\text{V}$		1.10		μC
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=300\text{V}, I_C=100\text{A}, R_G=3.3\Omega, V_{GE}=\pm 15\text{V}, T_j=25^{\circ}\text{C}$		51		ns
t_r	Rise Time			25		ns
$t_{d(off)}$	Turn-Off Delay Time			240		ns
t_f	Fall Time			48		ns
E_{on}	Turn-On Switching Loss			0.54		mJ
E_{off}	Turn-Off Switching Loss			2.52		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=300\text{V}, I_C=100\text{A}, R_G=3.3\Omega, V_{GE}=\pm 15\text{V}, T_j=125^{\circ}\text{C}$		60		ns
t_r	Rise Time			30		ns
$t_{d(off)}$	Turn-Off Delay Time			258		ns
t_f	Fall Time			65		ns
E_{on}	Turn-On Switching Loss			0.86		mJ
E_{off}	Turn-Off Switching Loss			3.34		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=300\text{V}, I_C=100\text{A}, R_G=3.3\Omega, V_{GE}=\pm 15\text{V}, T_j=150^{\circ}\text{C}$		64		ns
t_r	Rise Time			31		ns
$t_{d(off)}$	Turn-Off Delay Time			269		ns
t_f	Fall Time			76		ns
E_{on}	Turn-On Switching Loss			0.95		mJ
E_{off}	Turn-Off Switching Loss			3.50		mJ
I_{SC}	SC Data	$t_p \leq 6\mu\text{s}, V_{GE}=15\text{V}, T_j=150^{\circ}\text{C}, V_{CC}=360\text{V}, V_{CEM} \leq 650\text{V}$		500		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	$I_F=100\text{A}, V_{GE}=0\text{V}, T_j=25^\circ\text{C}$		1.55	1.95	V
		$I_F=100\text{A}, V_{GE}=0\text{V}, T_j=125^\circ\text{C}$		1.50		
		$I_F=100\text{A}, V_{GE}=0\text{V}, T_j=150^\circ\text{C}$		1.45		
Q_r	Recovered Charge	$V_R=300\text{V}, I_F=100\text{A},$ $-di/dt=3200\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=25^\circ\text{C}$		4.1		μC
I_{RM}	Peak Reverse Recovery Current			91		A
E_{rec}	Reverse Recovery Energy			1.22		mJ
Q_r	Recovered Charge	$V_R=300\text{V}, I_F=100\text{A},$ $-di/dt=3200\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=125^\circ\text{C}$		7.9		μC
I_{RM}	Peak Reverse Recovery Current			110		A
E_{rec}	Reverse Recovery Energy			2.16		mJ
Q_r	Recovered Charge	$V_R=300\text{V}, I_F=100\text{A},$ $-di/dt=3200\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=150^\circ\text{C}$		9.0		μC
I_{RM}	Peak Reverse Recovery Current			116		A
E_{rec}	Reverse Recovery Energy			2.40		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 T1,T4 IGBT)		0.135	0.148	K/W
	Junction-to-Case (per D1,D4 Diode)		0.574	0.631	
	Junction-to-Case (per T2,T3 IGBT)		0.441	0.485	
	Junction-to-Case (per D2,D3 Diode)		0.791	0.870	
R_{thCH}	Case-to-Heatsink (per T1,T4 IGBT)		0.127		K/W
	Case-to-Heatsink (per D1,D4 Diode)		0.539		
	Case-to-Heatsink (per T2,T3 IGBT)		0.415		
	Case-to-Heatsink (per D2,D3 Diode)		0.744		
	Case-to-Heatsink (per Module)		0.037		
F	Mounting Force Per Clamp	40		80	K/W
G	Weight of Module		39		g

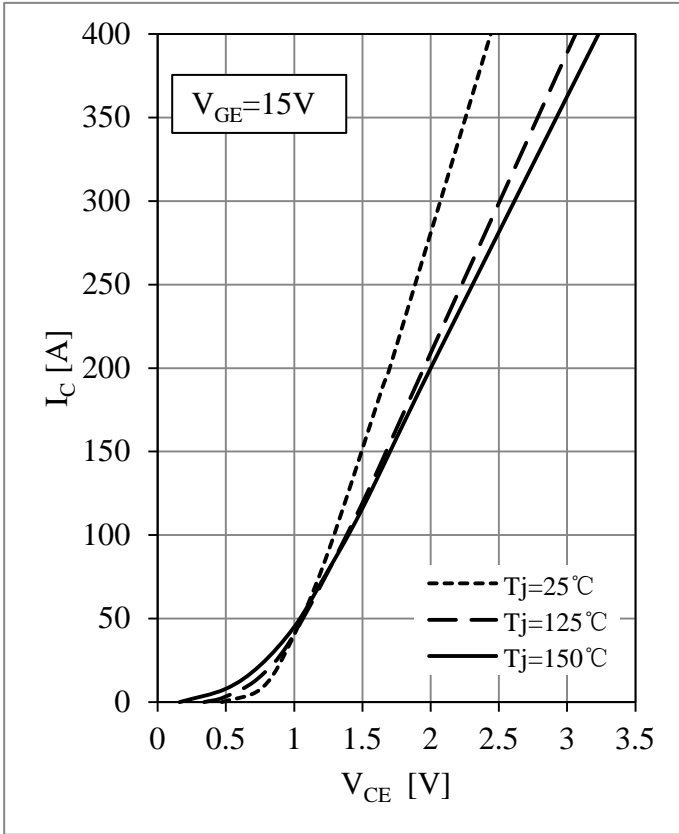


Fig 1. T1,T4 IGBT Output Characteristics

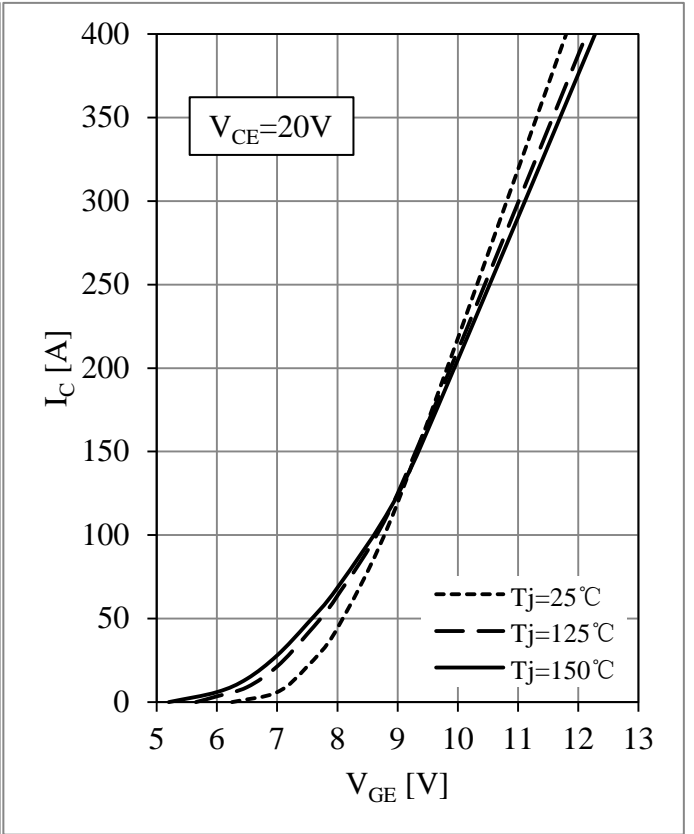


Fig 2. T1,T4 IGBT Transfer Characteristics

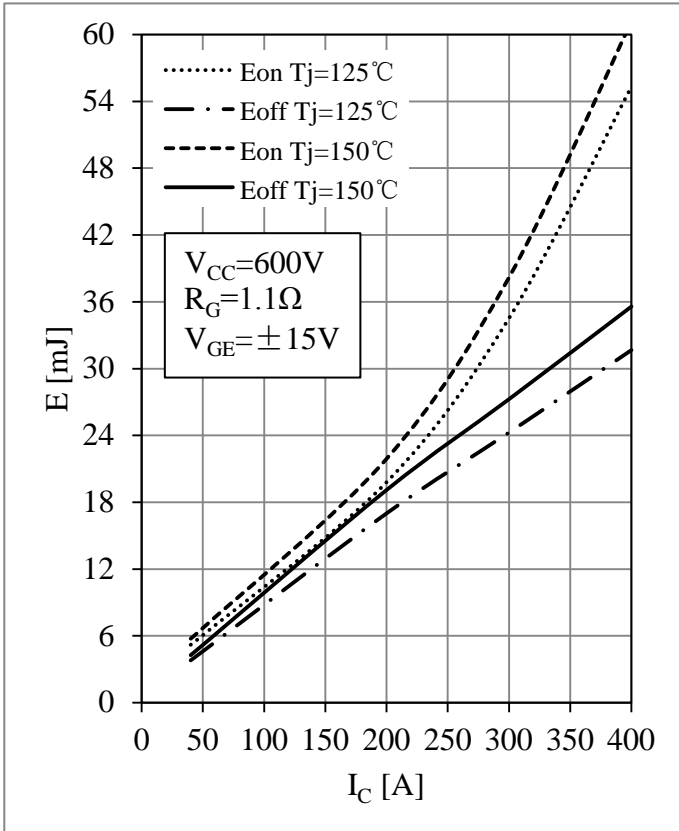


Fig 3. T1,T4 IGBT Switching Loss vs. I_C

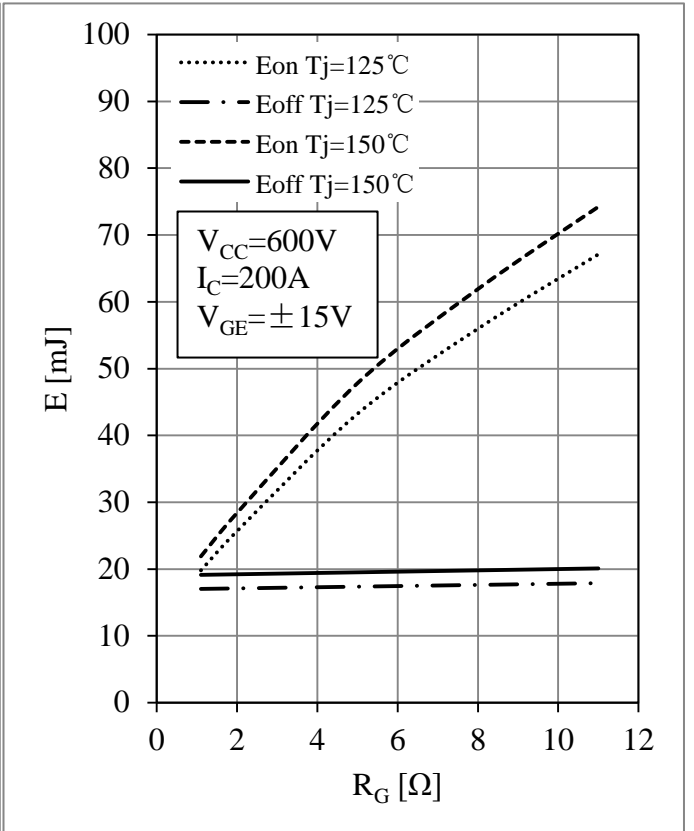


Fig 4. T1,T4 IGBT Switching Loss vs. R_G

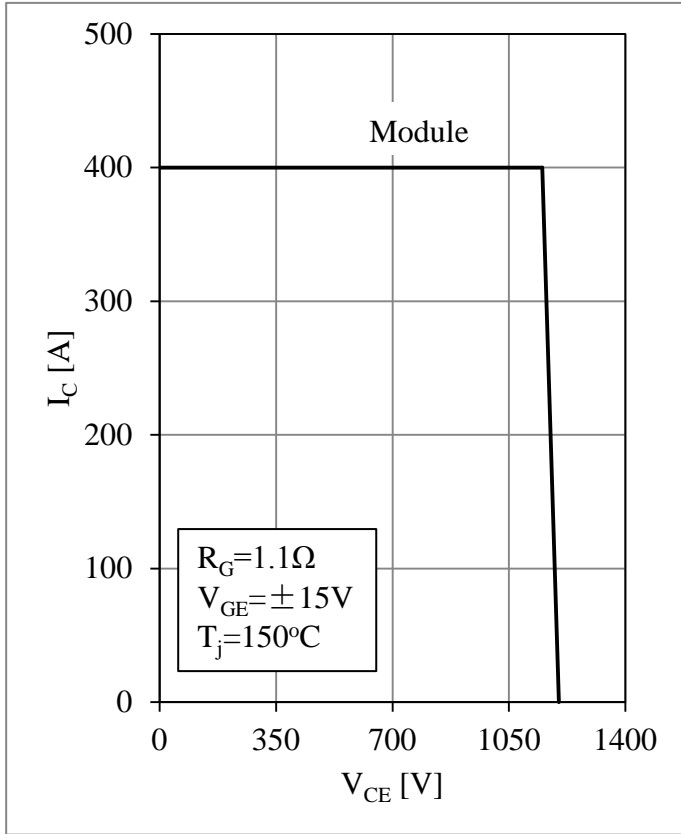


Fig 5. T1,T4 RBSOA

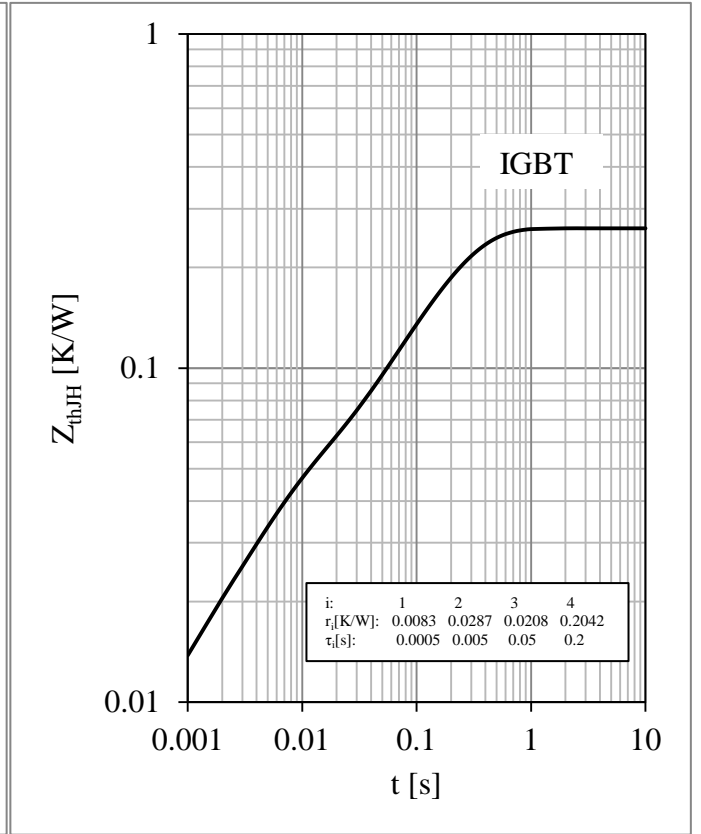


Fig 6. T1,T4 IGBT Transient Thermal Impedance

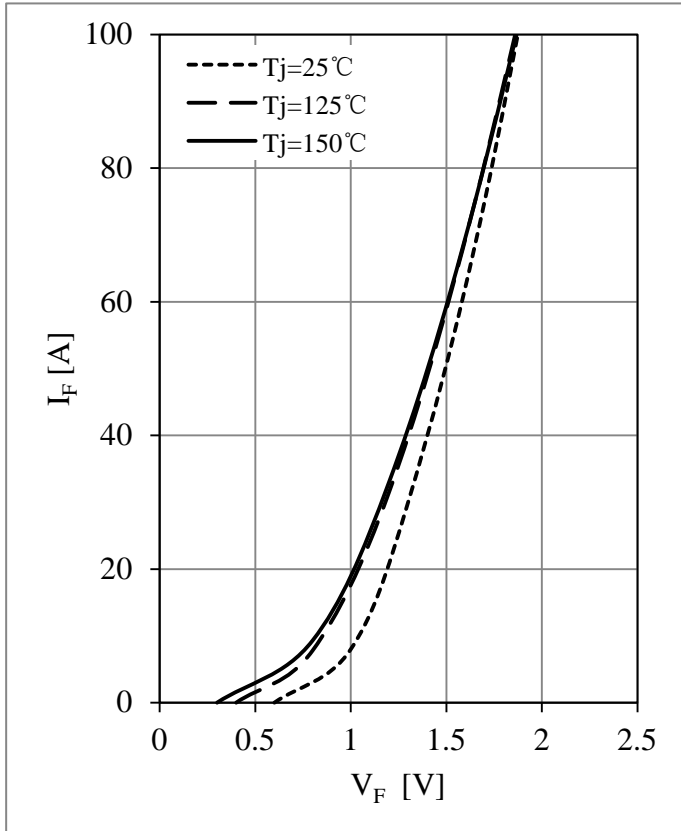


Fig 7. D1,D4 Diode Forward Characteristics

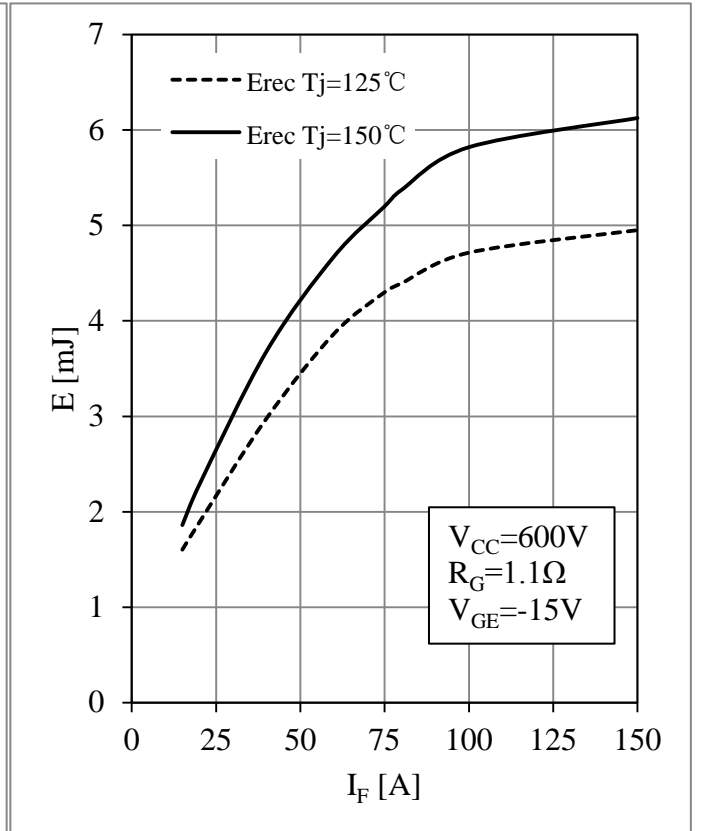


Fig 8. D1,D4 Diode Switching Loss vs. I_F

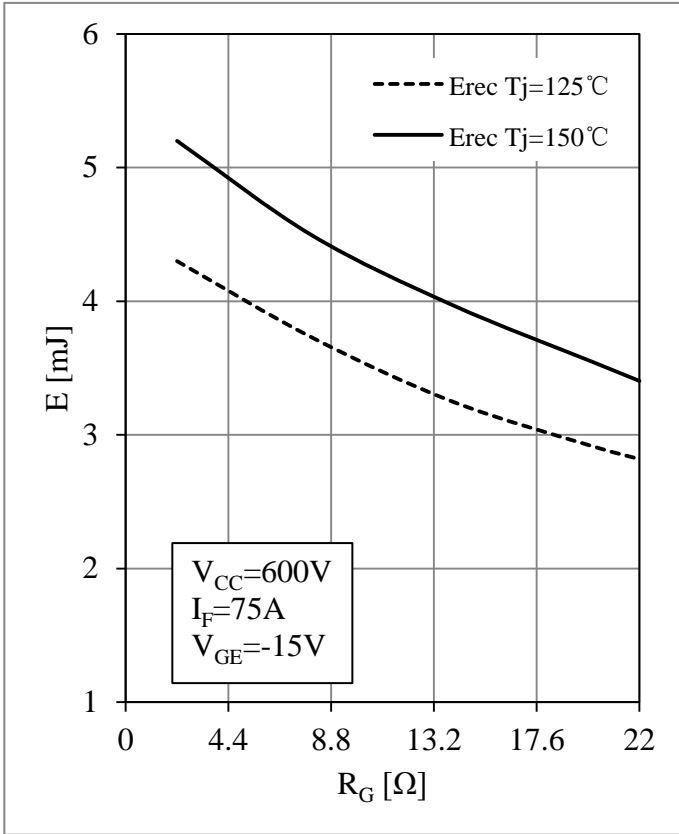


Fig 9. D1,D4 Diode Switching Loss vs. R_G

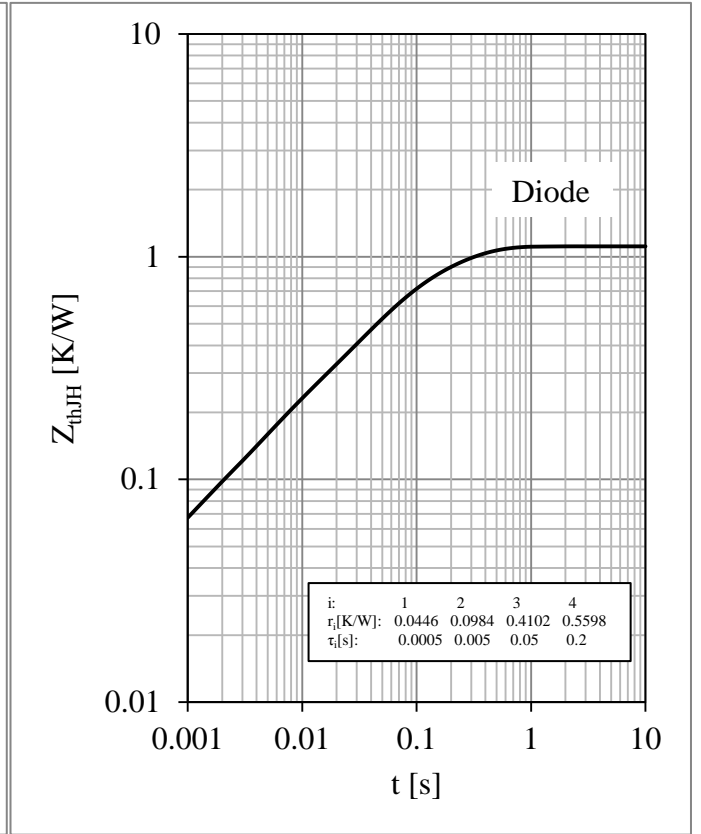


Fig 10. D1,D4 Diode Transient Thermal Impedance

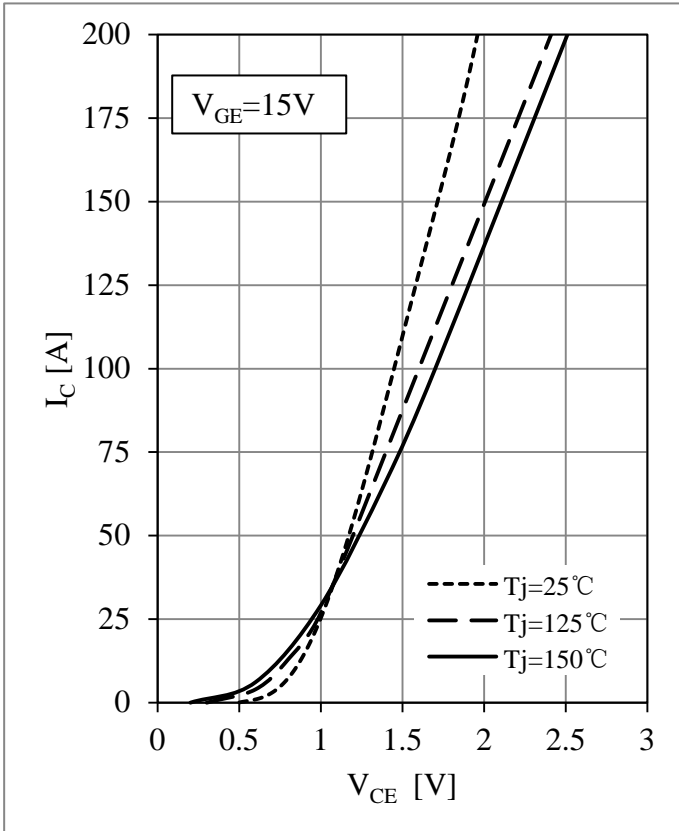


Fig 11. T2,T3 IGBT Output Characteristics

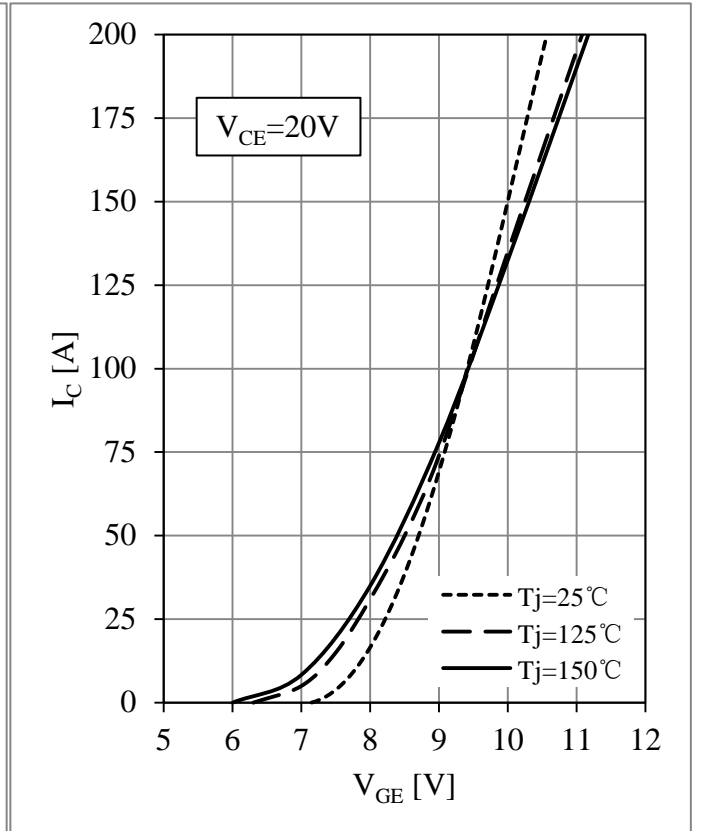


Fig 12. T2,T3 IGBT Transfer Characteristics

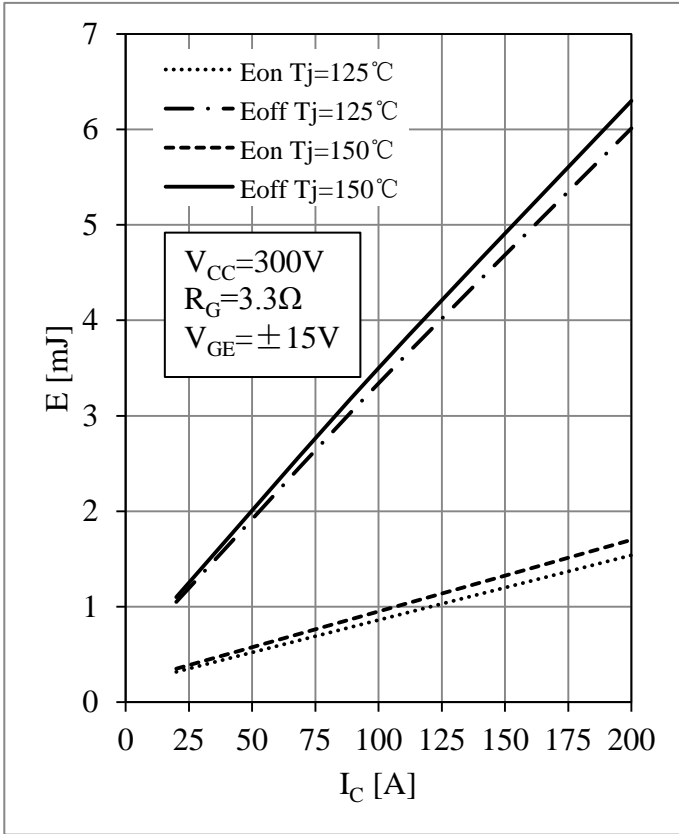


Fig 13. T2,T3 IGBT Switching Loss vs. I_C

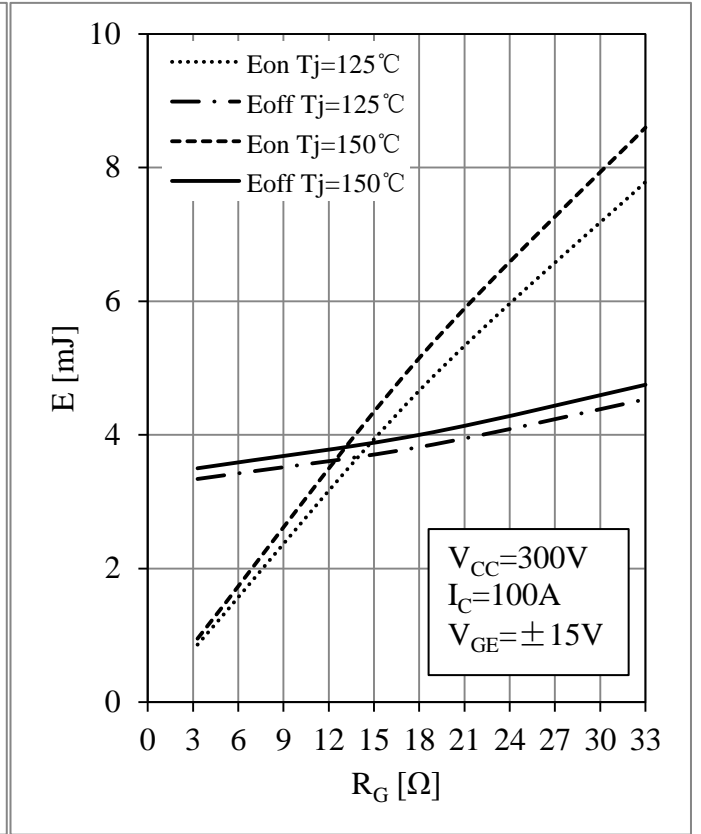


Fig 14. T2,T3 IGBT Switching Loss vs. R_G

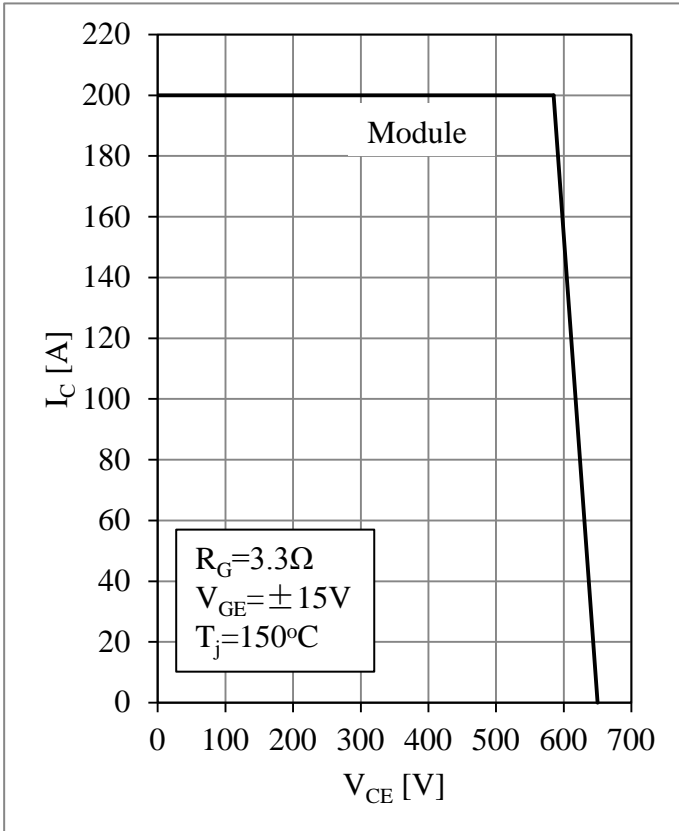


Fig 15. T2,T3 RBSOA

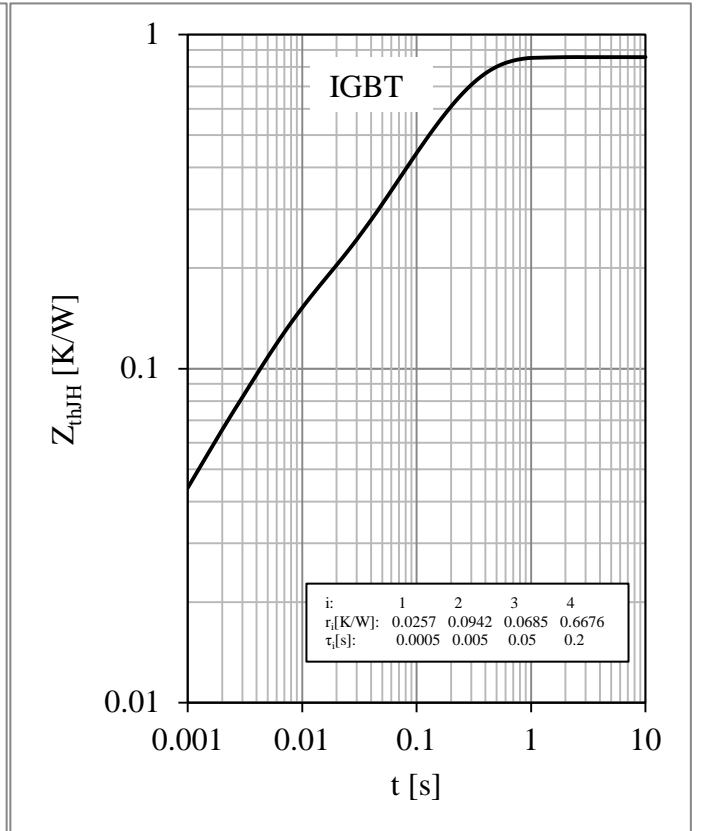


Fig 16. T2,T3 IGBT Transient Thermal Impedance

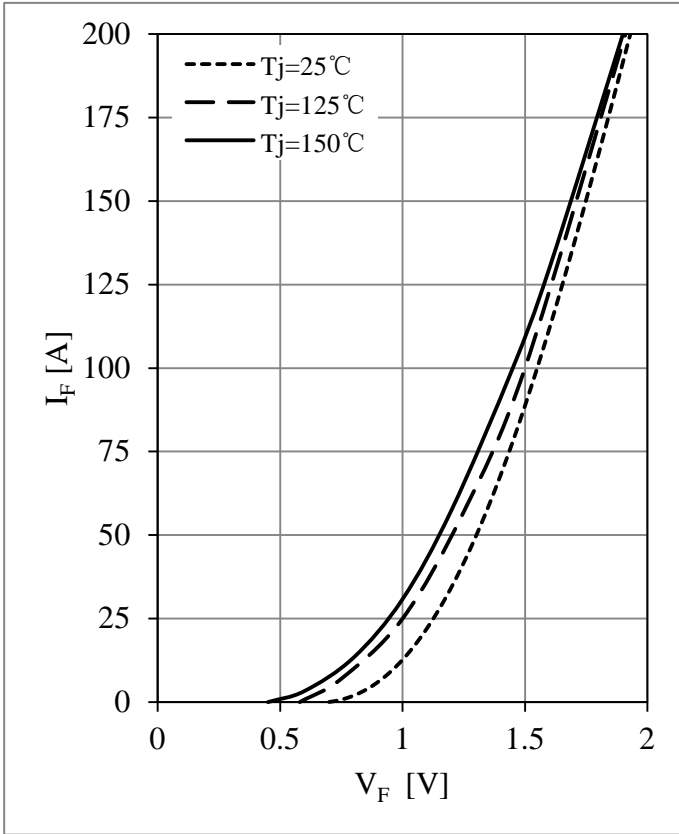


Fig 17. D2,D3 Diode Forward Characteristics

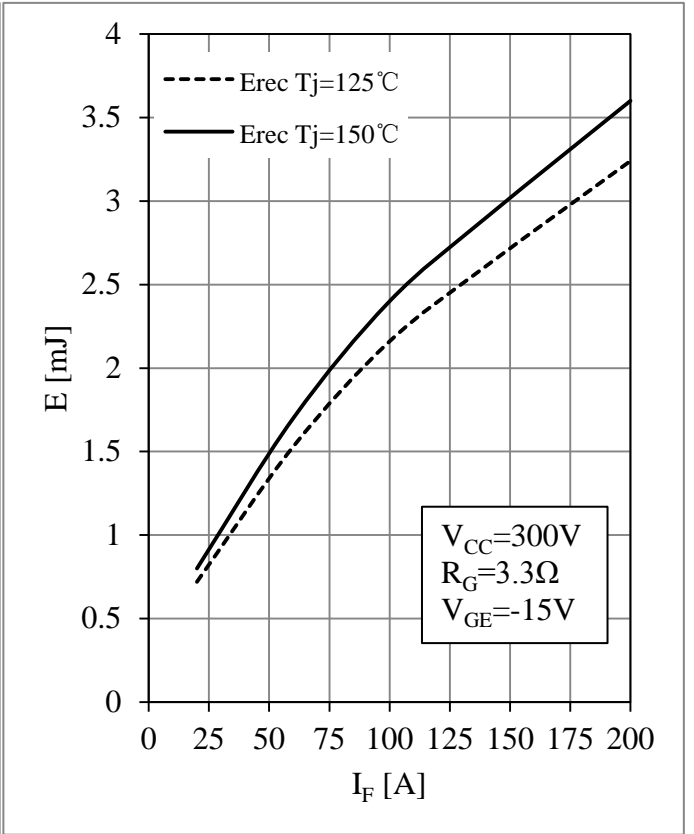


Fig 18. D2,D3 Diode Switching Loss vs. I_F

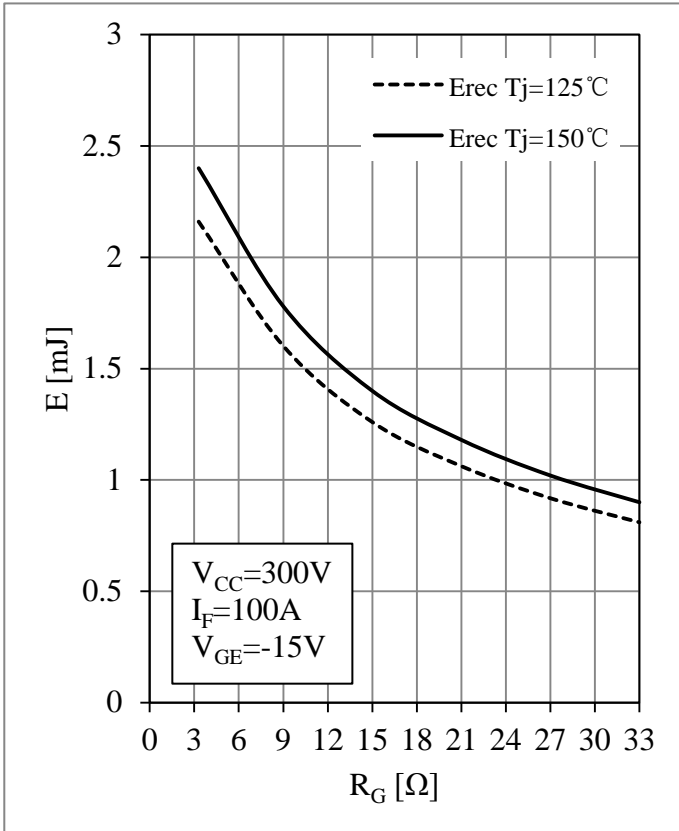


Fig 19. D2,D3 Diode Switching Loss vs. R_G

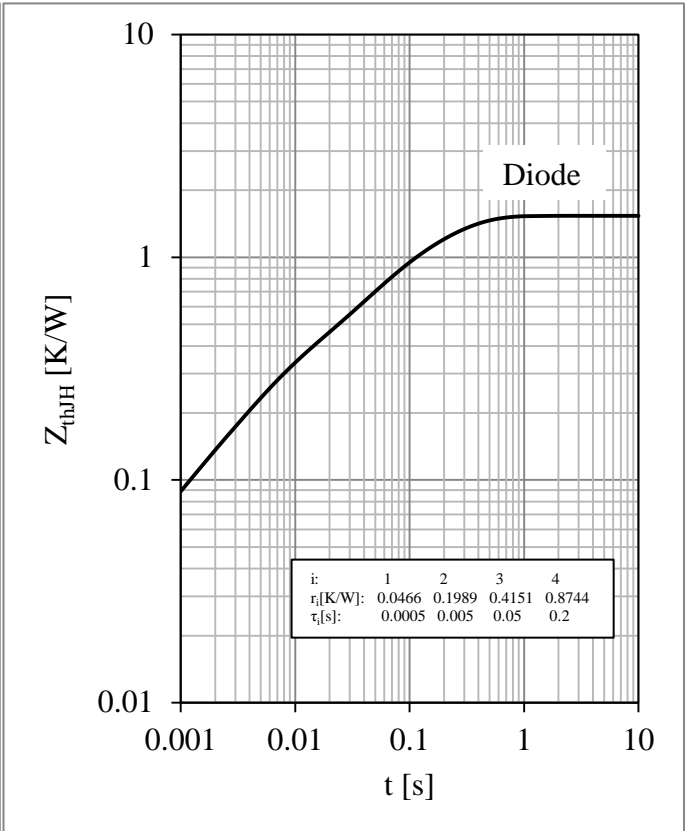


Fig 20. D2,D3 Diode Transient Thermal Impedance

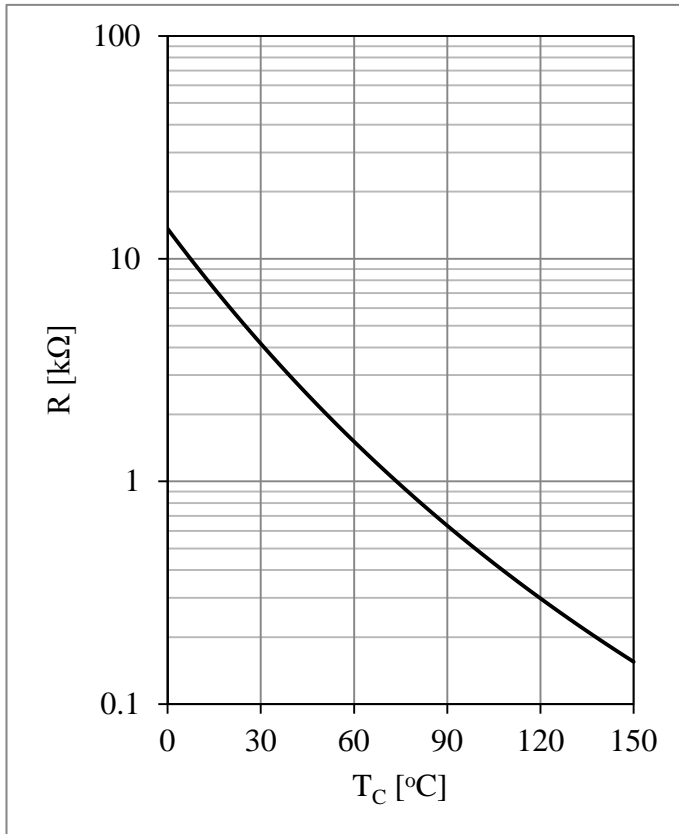


Fig 21. NTC Temperature Characteristic

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