STARPOWER

SEMICONDUCTOR **IGBT**

GD200TLQ120L3S

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.

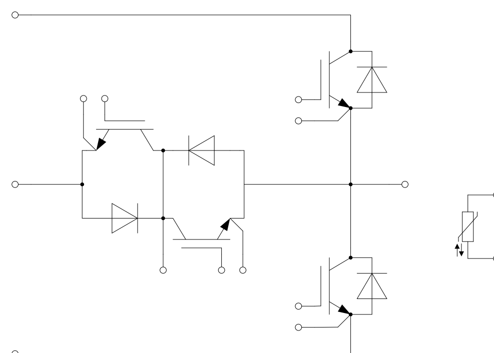
Features

- Low $V_{CE(sat)}$ Trench IGBT technology
- Low switching loss
- 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
- Isolated heatsink using DBC technology

Typical Applications

- Solar power
- UPS
- 3-level-application

Equivalent Circuit Schematic



Absolute Maximum Ratings T_C=25°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°C @ T_C=100°C	339 200	A
I_{CM}	Pulsed Collector Current t_p=1ms	400	A
P_D	Maximum Power Dissipation @ T_j=175°C	1456	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=1ms	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°C @ T_C=95°C	158 100	A
I_{CM}	Pulsed Collector Current t_p=1ms	200	A
P_D	Maximum Power Dissipation @ T_j=175°C	441	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=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	2500	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=100A,V_{GE}=15V, T_j=25°C		1.40	1.85	V
		I_C=100A,V_{GE}=15V, T_j=125°C		1.65		
		I_C=100A,V_{GE}=15V, T_j=150°C		1.70		
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	I_C=5.0mA,V_{CE}=V_{GE}, T_j=25°C	5.2	6.0	6.8	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			3.8		Ω
C_{ies}	Input Capacitance	V_{CE}=25V,f=1MHz, V_{GE}=0V		20.7		nF
C_{res}	Reverse Transfer Capacitance			0.58		nF
Q_G	Gate Charge	V_{GE}=-15…+15V		1.56		μC
$t_{d(on)}$	Turn-On Delay Time	V_{CC}=400V,I_C=100A, R_G=1.1Ω,V_{GE}=±15V, T_j=25°C		142		ns
t_r	Rise Time			25		ns
$t_{d(off)}$	Turn-Off Delay Time			352		ns
t_f	Fall Time			33		ns
E_{on}	Turn-On Switching Loss			1.21		mJ
E_{off}	Turn-Off Switching Loss			3.90		mJ
$t_{d(on)}$	Turn-On Delay Time	V_{CC}=400V,I_C=100A, R_G=1.1Ω,V_{GE}=±15V, T_j=125°C		155		ns
t_r	Rise Time			29		ns
$t_{d(off)}$	Turn-Off Delay Time			440		ns
t_f	Fall Time			61		ns
E_{on}	Turn-On Switching Loss			2.02		mJ
E_{off}	Turn-Off Switching Loss			5.83		mJ
$t_{d(on)}$	Turn-On Delay Time	V_{CC}=400V,I_C=100A, R_G=1.1Ω,V_{GE}=±15V, T_j=150°C		161		ns
t_r	Rise Time			30		ns
$t_{d(off)}$	Turn-Off Delay Time			462		ns
t_f	Fall Time			66		ns
E_{on}	Turn-On Switching Loss			2.24		mJ
E_{off}	Turn-Off Switching Loss			6.49		mJ
I_{SC}	SC Data	t_P≤10μs,V_{GE}=15V, T_j=150°C,V_{CC}=800V, V_{CEM}≤1200V		800		A

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=75A,V_{GE}=0V,T_j=25°C		1.70	2.15	V
		I_F=75A,V_{GE}=0V,T_j=125°C		1.65		
		I_F=75A,V_{GE}=0V,T_j=150°C		1.65		
Q_r	Recovered Charge	V_R=400V,I_F=75A, -di/dt=3500A/μs,V_{GE}=-15V T_j=25°C		8.7		μC
I_{RM}	Peak Reverse Recovery Current			122		A
E_{rec}	Reverse Recovery Energy			2.91		mJ
Q_r	Recovered Charge	V_R=400V,I_F=75A, -di/dt=3500A/μs,V_{GE}=-15V T_j=125°C		17.2		μC
I_{RM}	Peak Reverse Recovery Current			143		A
E_{rec}	Reverse Recovery Energy			5.72		mJ
Q_r	Recovered Charge	V_R=400V,I_F=75A, -di/dt=3500A/μs,V_{GE}=-15V T_j=150°C		19.4		μC
I_{RM}	Peak Reverse Recovery Current			152		A
E_{rec}	Reverse Recovery Energy			6.30		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=100A,V_{GE}=15V, T_j=25°C		1.45	1.90	V
		I_C=100A,V_{GE}=15V, T_j=125°C		1.60		
		I_C=100A,V_{GE}=15V, T_j=150°C		1.70		
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	I_C=1.60mA,V_{CE}=V_{GE}, T_j=25°C	5.0	5.8	6.5	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			2.0		Ω
C_{ies}	Input Capacitance	V_{CE}=25V,f=1MHz, V_{GE}=0V		11.6		nF
C_{res}	Reverse Transfer Capacitance			0.23		nF
Q_G	Gate Charge	V_{GE}=-15…+15V		0.69		μC
$t_{d(on)}$	Turn-On Delay Time	V_{CC}=400V,I_C=100A, R_G=3.3Ω,V_{GE}=±15V, T_j=25°C		44		ns
t_r	Rise Time			20		ns
$t_{d(off)}$	Turn-Off Delay Time			200		ns
t_f	Fall Time			28		ns
E_{on}	Turn-On Switching Loss			1.48		mJ
E_{off}	Turn-Off Switching Loss			2.48		mJ
$t_{d(on)}$	Turn-On Delay Time	V_{CC}=400V,I_C=100A, R_G=3.3Ω,V_{GE}=±15V, T_j=125°C		48		ns
t_r	Rise Time			24		ns
$t_{d(off)}$	Turn-Off Delay Time			216		ns
t_f	Fall Time			40		ns
E_{on}	Turn-On Switching Loss			2.24		mJ
E_{off}	Turn-Off Switching Loss			3.28		mJ
$t_{d(on)}$	Turn-On Delay Time	V_{CC}=400V,I_C=100A, R_G=3.3Ω,V_{GE}=±15V, T_j=150°C		52		ns
t_r	Rise Time			24		ns
$t_{d(off)}$	Turn-Off Delay Time			224		ns
t_f	Fall Time			48		ns
E_{on}	Turn-On Switching Loss			2.64		mJ
E_{off}	Turn-Off Switching Loss			3.68		mJ
I_{SC}	SC Data	t_P≤6μs,V_{GE}=15V, T_j=150°C,V_{CC}=360V, V_{CEM}≤650V		500		A

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=100A,V_{GE}=0V,T_j=25°C		1.55	2.00	V
		I_F=100A,V_{GE}=0V,T_j=125°C		1.50		
		I_F=100A,V_{GE}=0V,T_j=150°C		1.45		
Q_r	Recovered Charge	V_R=400V,I_F=100A, -di/dt=4070A/μs,V_{GE}=-15V T_j=25°C		3.57		μC
I_{RM}	Peak Reverse Recovery Current			99		A
E_{rec}	Reverse Recovery Energy			1.04		mJ
Q_r	Recovered Charge	V_R=400V,I_F=100A, -di/dt=4070A/μs,V_{GE}=-15V T_j=125°C		6.49		μC
I_{RM}	Peak Reverse Recovery Current			110		A
E_{rec}	Reverse Recovery Energy			1.70		mJ
Q_r	Recovered Charge	V_R=400V,I_F=100A, -di/dt=4070A/μs,V_{GE}=-15V T_j=150°C		7.04		μC
I_{RM}	Peak Reverse Recovery Current			110		A
E_{rec}	Reverse Recovery Energy			1.81		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°C unless otherwise noted

Symbol	Parameter	Min.	Typ.	Max.	Unit
R_{thJC}	Junction-to-Case (per T1,T4 IGBT)		0.094	0.103	K/W
	Junction-to-Case (per D1,D4 Diode)		0.405	0.446	
	Junction-to-Case (per T2,T3 IGBT)		0.309	0.340	
	Junction-to-Case (per D2,D3 Diode)		0.544	0.598	
R_{thCH}	Case-to-Heatsink (per T1,T4 IGBT)		0.126		K/W
	Case-to-Heatsink (per D1,D4 Diode)		0.547		
	Case-to-Heatsink (per T2,T3 IGBT)		0.417		
	Case-to-Heatsink (per D2,D3 Diode)		0.733		
	Case-to-Heatsink (per Module)		0.037		
F	Mounting Force Per Clamp	40		80	N
G	Weight of Module		39		g

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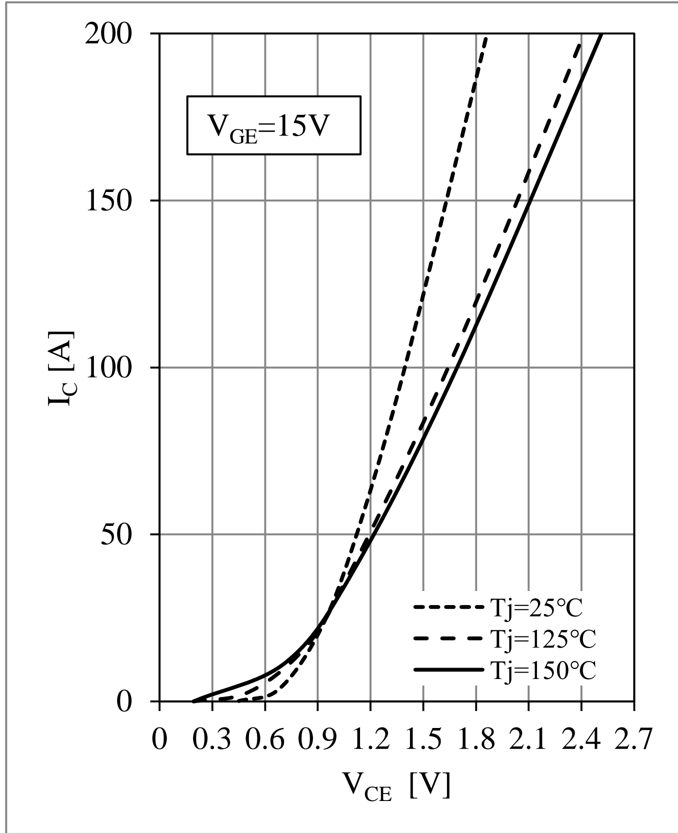


Fig 1. T1,T4 IGBT Output Characteristics

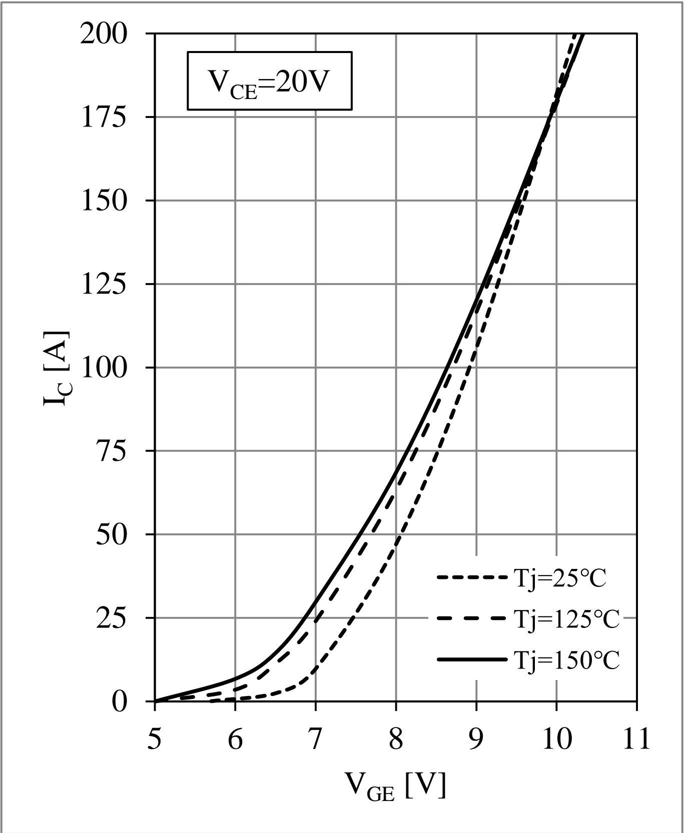


Fig 2. T1,T4 IGBT Transfer Characteristics

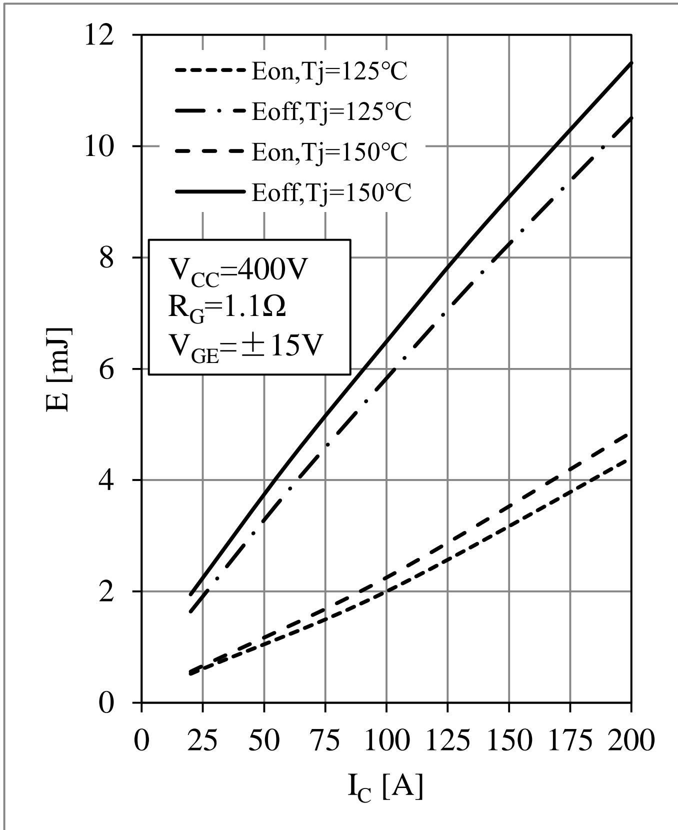


Fig 3. T1,T4 IGBT Switching Loss vs. I_C

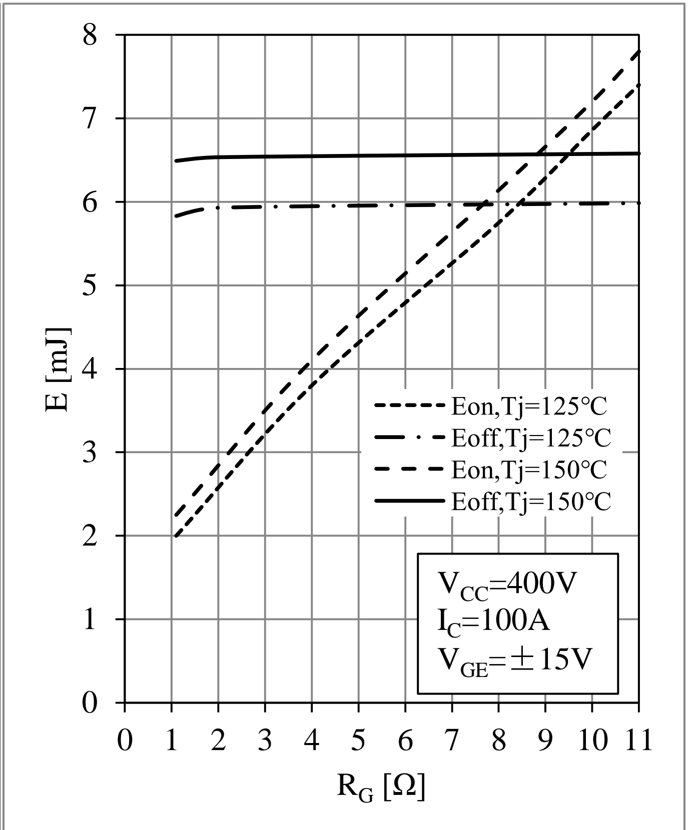


Fig 4. T1,T4 IGBT Switching Loss vs. R_G

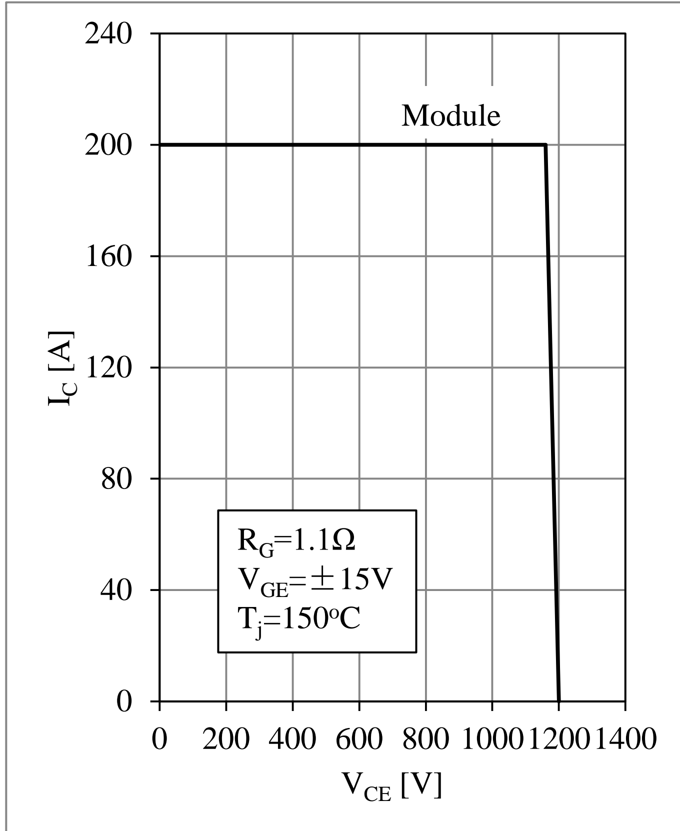


Fig 5. T1,T4 RBSOA

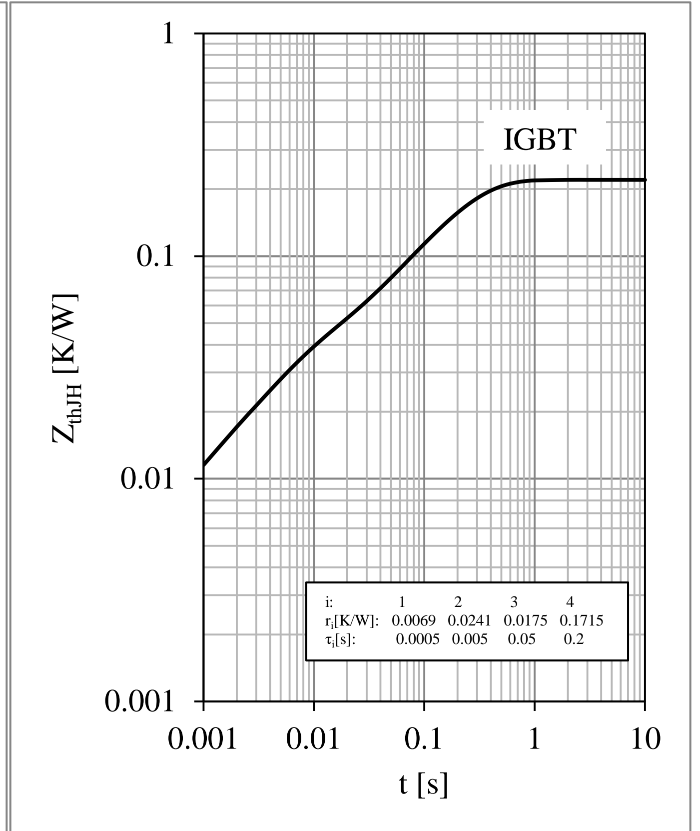


Fig 6. T1,T4 IGBT Transient Thermal Impedance

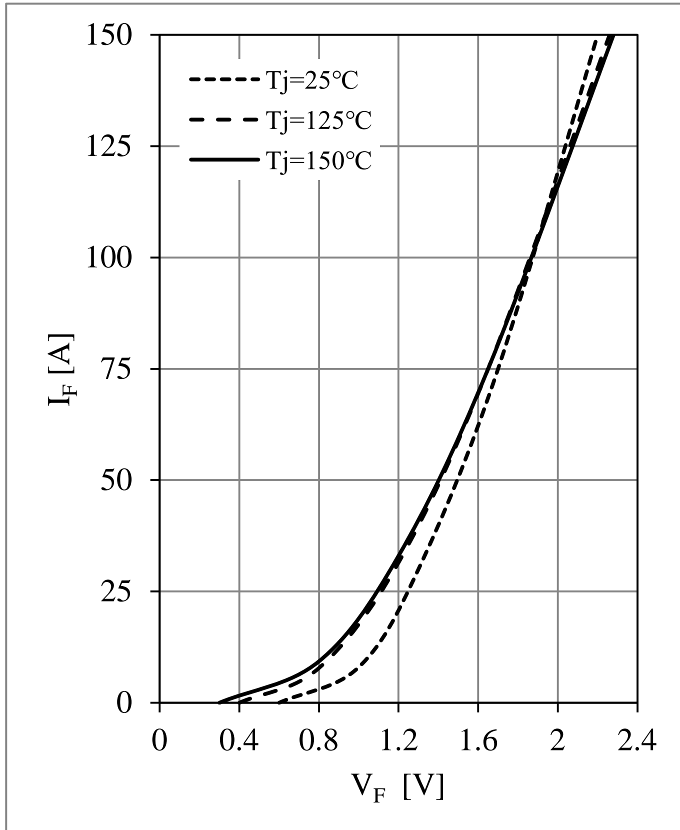


Fig 7. D1,D4 Diode Forward Characteristics

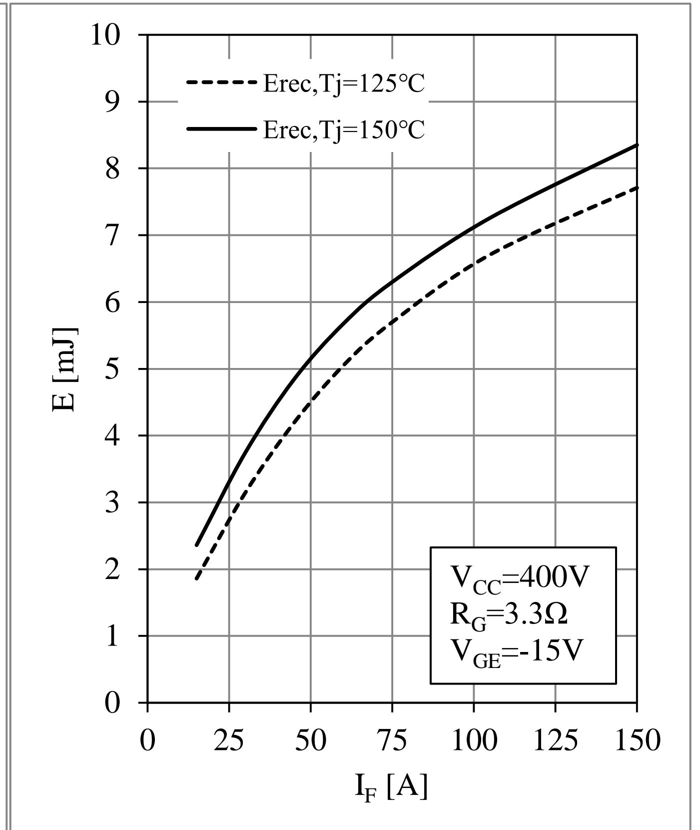


Fig 8. D1,D4 Diode Switching Loss vs. I_F

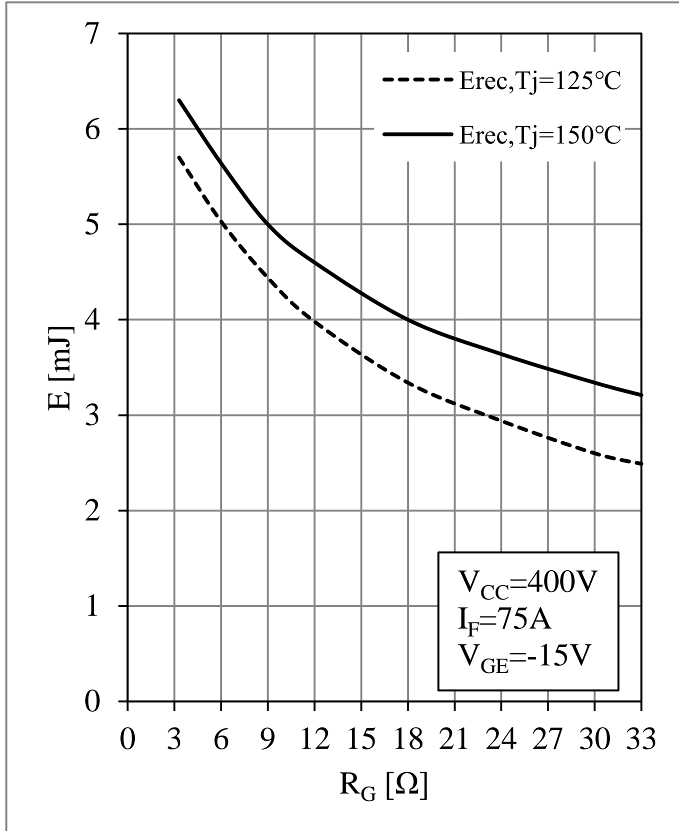


Fig 9. D1,D4 Diode Switching Loss vs. R_G

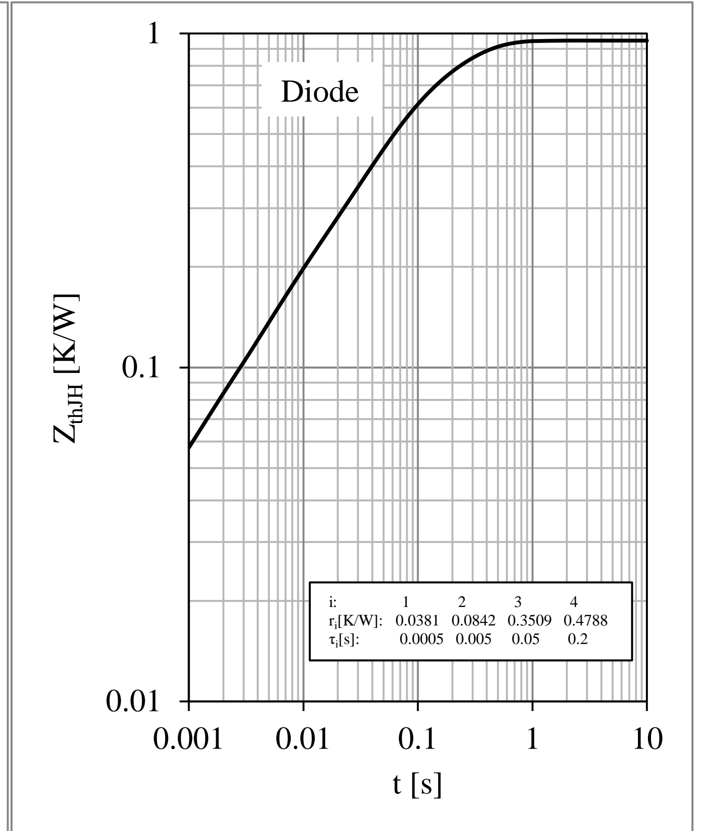


Fig 10. D1,D4 Diode Transient Thermal Impedance

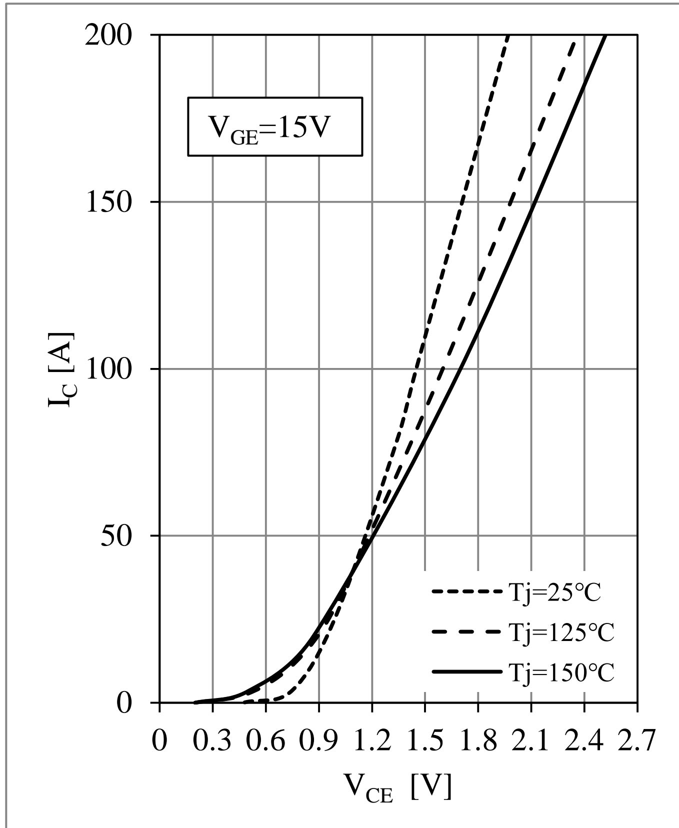


Fig 11. T2,T3 IGBT Output Characteristics

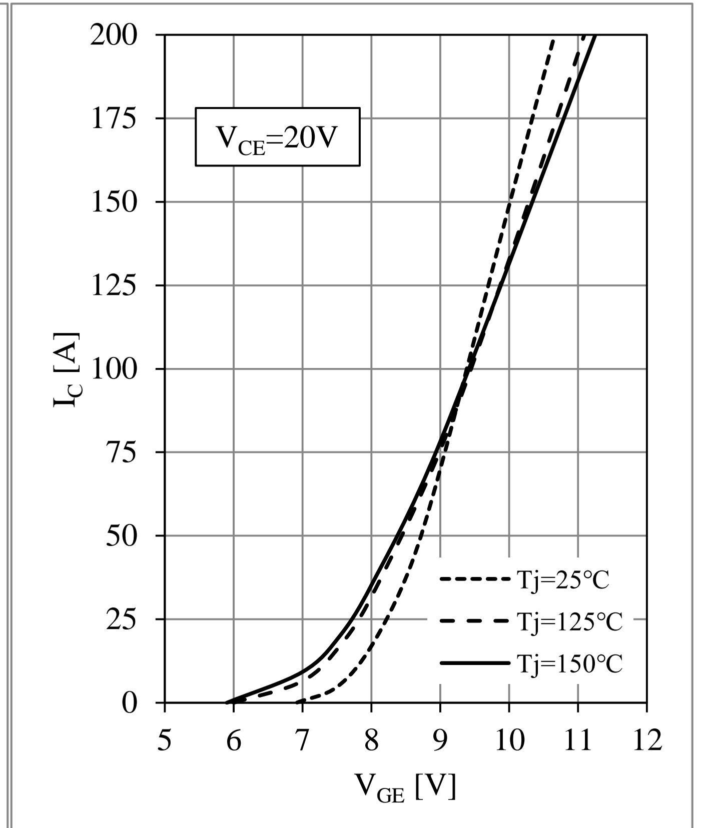


Fig 12. T2,T3 IGBT Transfer Characteristics

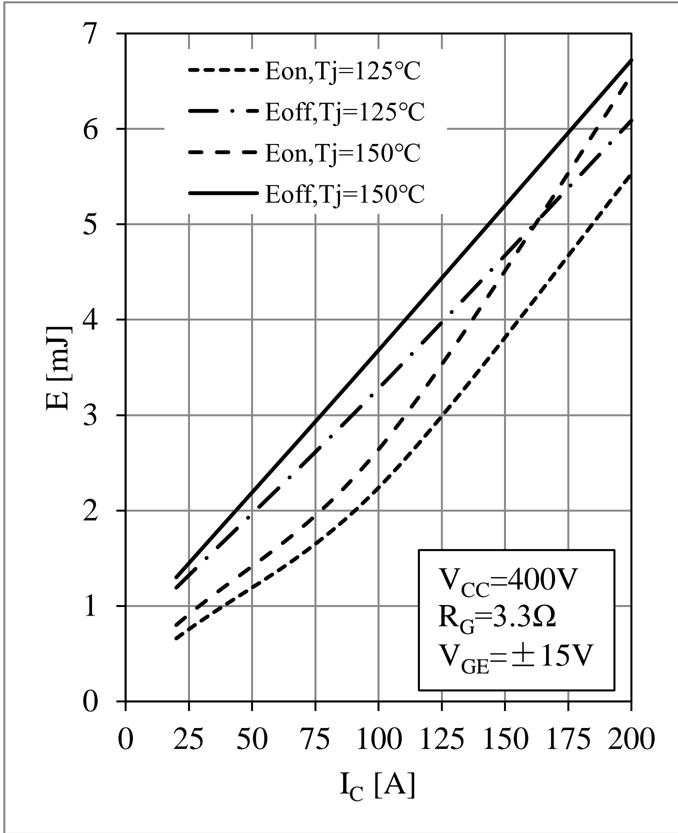


Fig 13. T2,T3 IGBT Switching Loss vs. I_C

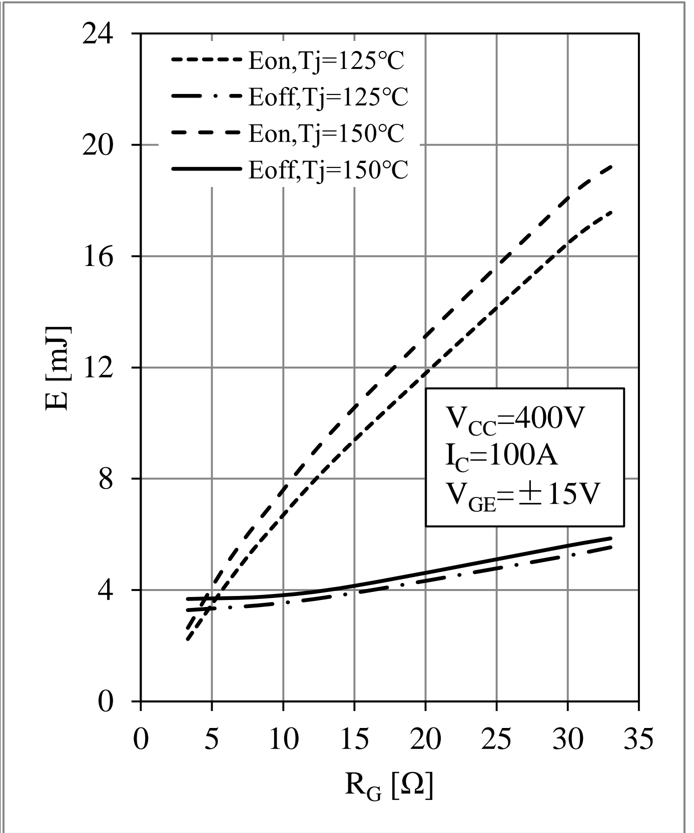


Fig 14. T2,T3 IGBT Switching Loss vs. R_G

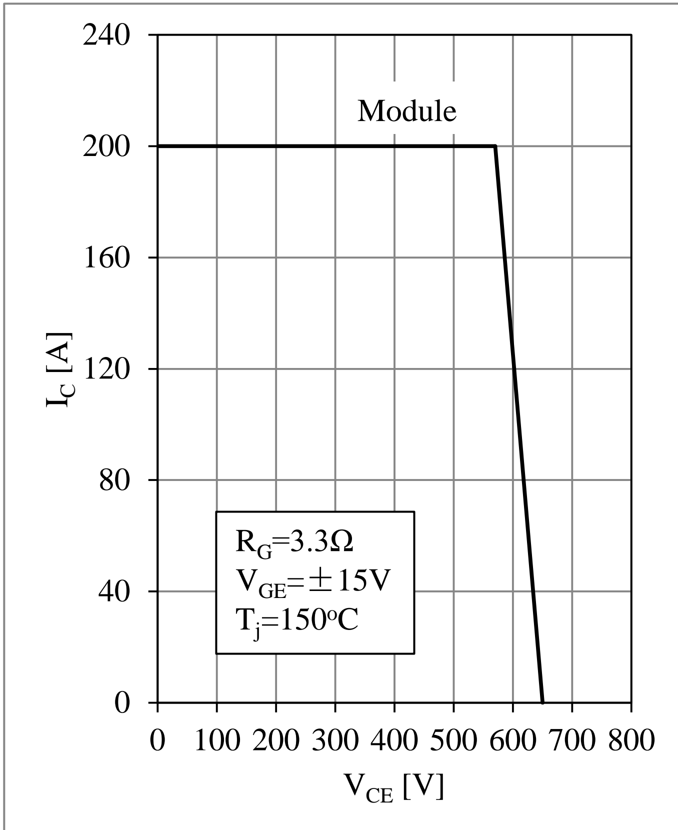
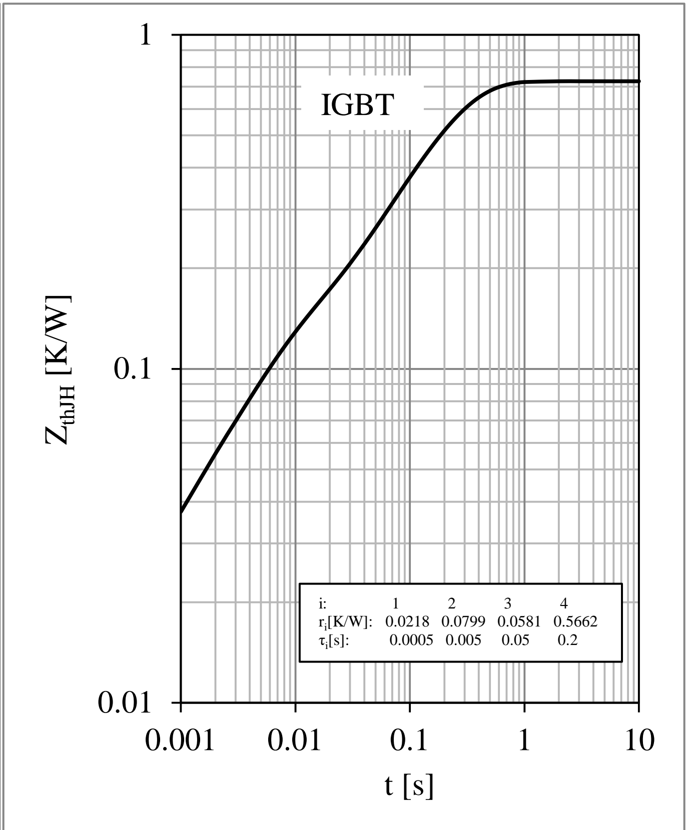


Fig 15. T2,T3 RBSOA



i:	1	2	3	4
r_i[K/W]:	0.0218	0.0799	0.0581	0.5662
τ_i[s]:	0.0005	0.005	0.05	0.2

Fig 16. T2,T3 IGBT Transient Thermal Impedance

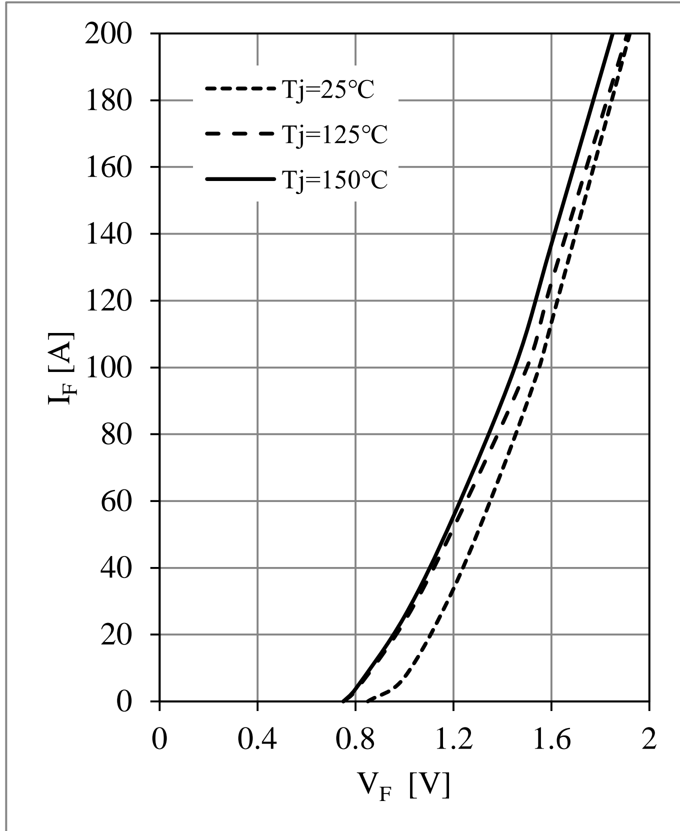


Fig 17. D2,D3 Diode Forward Characteristics

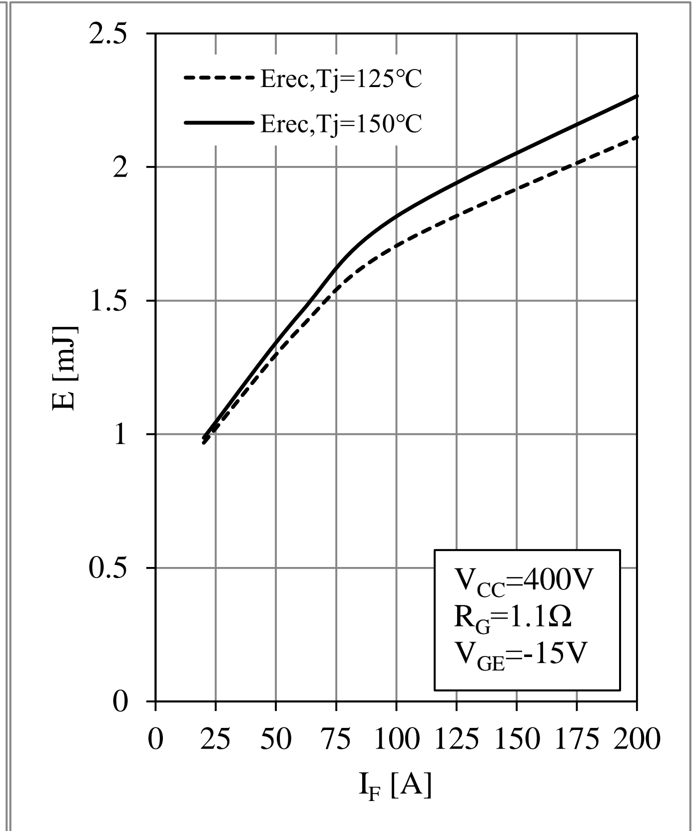


Fig 18. D2,D3 Diode Switching Loss vs. I_F

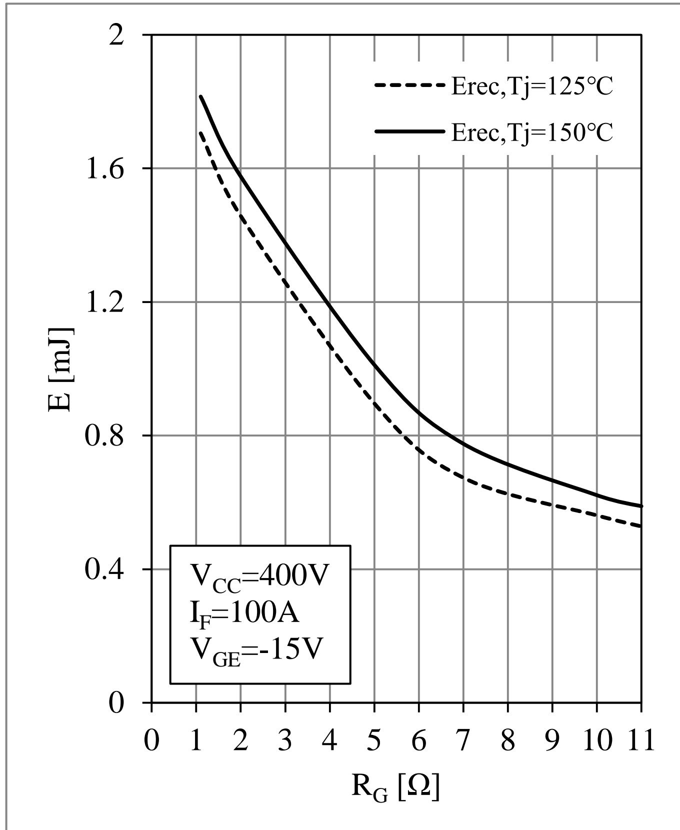
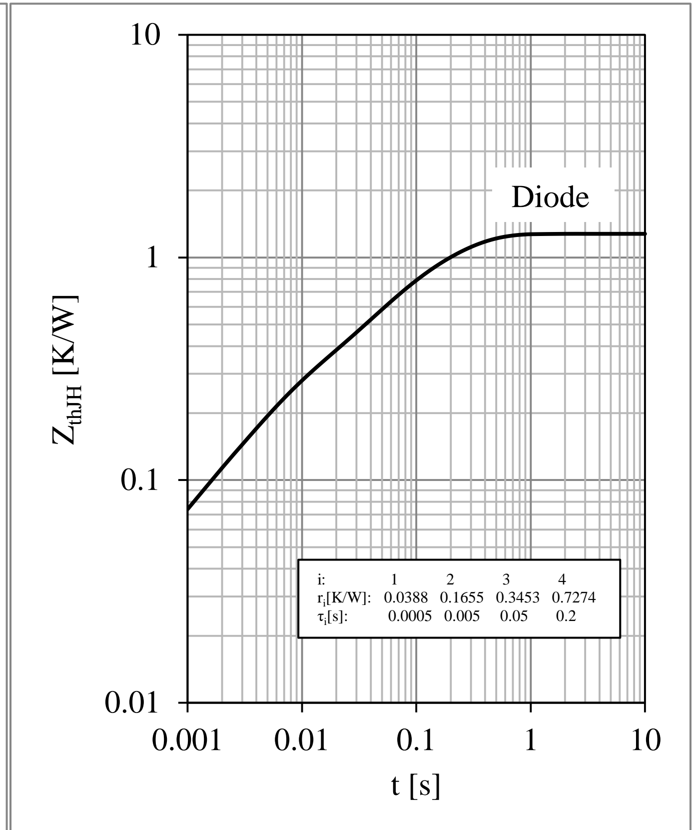


Fig 19. D2,D3 Diode Switching Loss vs. R_G



i:	1	2	3	4
r_i[K/W]:	0.0388	0.1655	0.3453	0.7274
τ_i[s]:	0.0005	0.005	0.05	0.2

Fig 20. D2,D3 Diode Transient Thermal Impedance

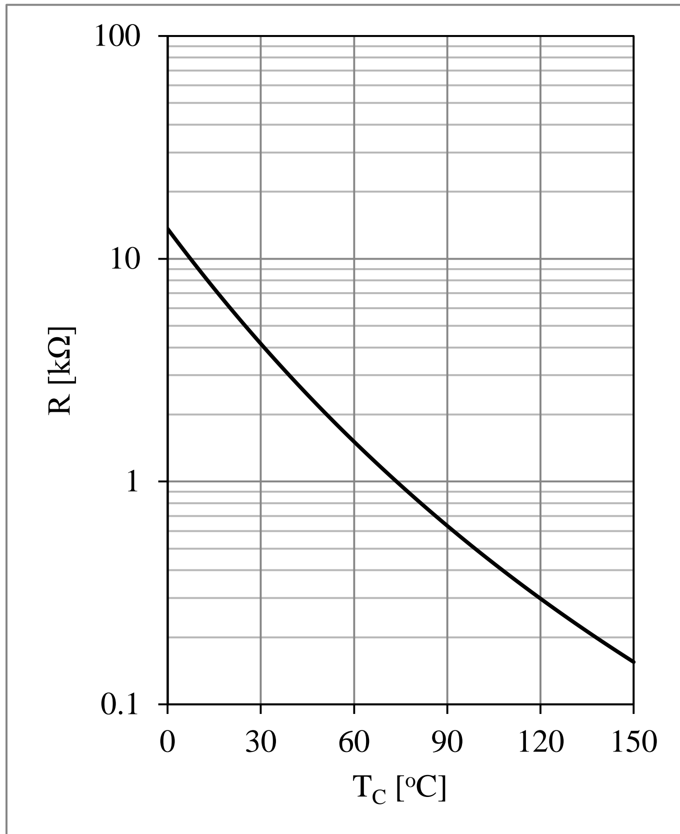


Fig 21. NTC Temperature Characteristic

Circuit Schematic

Package Dimensions

Dimensions in Millimeters

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