

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.

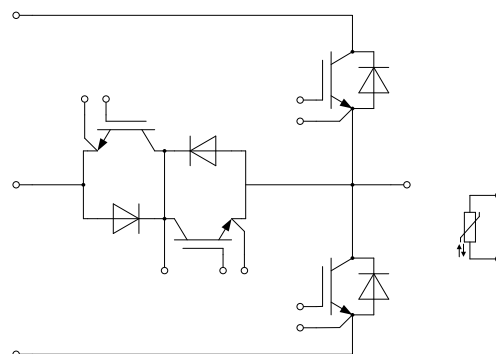
Features

- 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 $T_C=25^{\circ}\text{C}$ 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 @ $T_C=25^{\circ}\text{C}$ @ $T_C=100^{\circ}\text{C}$	200 100	A
I_{CM}	Pulsed Collector Current $t_p=1\text{ms}$	400	A
P_D	Maximum Power Dissipation @ $T_j=175^{\circ}\text{C}$	666	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 @ $T_C=25^{\circ}\text{C}$ @ $T_C=60^{\circ}\text{C}$	119 100	A
I_{CM}	Pulsed Collector Current $t_p=1\text{ms}$	200	A
P_D	Maximum Power Dissipation @ $T_j=175^{\circ}\text{C}$	290	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	$I_C=100\text{A}, V_{GE}=15\text{V}, T_j=25^{\circ}\text{C}$		1.45	1.90	V
		$I_C=100\text{A}, V_{GE}=15\text{V}, T_j=125^{\circ}\text{C}$		1.70		
		$I_C=100\text{A}, V_{GE}=15\text{V}, T_j=150^{\circ}\text{C}$		1.75		
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=8.0\text{mA}, V_{CE}=V_{GE}, T_j=25^{\circ}\text{C}$	5.6	6.2	6.8	V
I_{CES}	Collector Cut-Off Current	$V_{CE}=V_{CES}, V_{GE}=0\text{V}, T_j=25^{\circ}\text{C}$			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			1.0		Ω
C_{ies}	Input Capacitance	$V_{CE}=25\text{V}, f=100\text{kHz}, V_{GE}=0\text{V}$		21.3		nF
C_{res}	Reverse Transfer Capacitance			0.60		nF
Q_G	Gate Charge	$V_{GE}=-15\dots+15\text{V}$		1.65		μC
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=400\text{V}, I_C=100\text{A}, R_G=1.0\Omega, V_{GE}=-8/+15\text{V}, T_j=25^{\circ}\text{C}$		90		ns
t_r	Rise Time			19		ns
$t_{d(off)}$	Turn-Off Delay Time			254		ns
t_f	Fall Time			44		ns
E_{on}	Turn-On Switching Loss			0.65		mJ
E_{off}	Turn-Off Switching Loss			2.44		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=400\text{V}, I_C=100\text{A}, R_G=1.0\Omega, V_{GE}=-8/+15\text{V}, T_j=125^{\circ}\text{C}$		91		ns
t_r	Rise Time			21		ns
$t_{d(off)}$	Turn-Off Delay Time			299		ns
t_f	Fall Time			68		ns
E_{on}	Turn-On Switching Loss			1.18		mJ
E_{off}	Turn-Off Switching Loss			3.46		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=400\text{V}, I_C=100\text{A}, R_G=1.0\Omega, V_{GE}=-8/+15\text{V}, T_j=150^{\circ}\text{C}$		93		ns
t_r	Rise Time			21		ns
$t_{d(off)}$	Turn-Off Delay Time			314		ns
t_f	Fall Time			77		ns
E_{on}	Turn-On Switching Loss			1.33		mJ
E_{off}	Turn-Off Switching Loss			3.72		mJ
I_{SC}	SC Data	$t_p \leq 10\mu\text{s}, V_{GE}=15\text{V}, T_j=150^{\circ}\text{C}, V_{CC}=800\text{V}, V_{CEM} \leq 1200\text{V}$		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	$I_F=75\text{A}, V_{GE}=0\text{V}, T_j=25^{\circ}\text{C}$		1.85	2.30	V
		$I_F=75\text{A}, V_{GE}=0\text{V}, T_j=125^{\circ}\text{C}$		1.90		
		$I_F=75\text{A}, V_{GE}=0\text{V}, T_j=150^{\circ}\text{C}$		1.95		
Q_r	Recovered Charge	$V_R=400\text{V}, I_F=100\text{A},$ $-di/dt=4700\text{A}/\mu\text{s}, V_{GE}=-8\text{V}$ $T_j=25^{\circ}\text{C}$		5.70		μC
I_{RM}	Peak Reverse Recovery Current			120		A
E_{rec}	Reverse Recovery Energy			1.26		mJ
Q_r	Recovered Charge	$V_R=400\text{V}, I_F=100\text{A},$ $-di/dt=3900\text{A}/\mu\text{s}, V_{GE}=-8\text{V}$ $T_j=125^{\circ}\text{C}$		11.1		μC
I_{RM}	Peak Reverse Recovery Current			125		A
E_{rec}	Reverse Recovery Energy			2.66		mJ
Q_r	Recovered Charge	$V_R=400\text{V}, I_F=100\text{A},$ $-di/dt=3600\text{A}/\mu\text{s}, V_{GE}=-8\text{V}$ $T_j=150^{\circ}\text{C}$		13.3		μC
I_{RM}	Peak Reverse Recovery Current			130		A
E_{rec}	Reverse Recovery Energy			2.90		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	$I_C=1.60\text{mA}, V_{CE}=V_{GE}, T_j=25^{\circ}\text{C}$	5.4	6.0	6.6	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	$V_{CE}=25\text{V}, f=100\text{kHz}, V_{GE}=0\text{V}$		11.9		nF
C_{res}	Reverse Transfer Capacitance			0.30		nF
Q_G	Gate Charge	$V_{GE}=-15\dots+15\text{V}$		0.72		μC
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=400\text{V}, I_C=100\text{A}, R_G=3.0\Omega, V_{GE}=-8/+15\text{V}, T_j=25^{\circ}\text{C}$		82		ns
t_r	Rise Time			22		ns
$t_{d(off)}$	Turn-Off Delay Time			184		ns
t_f	Fall Time			35		ns
E_{on}	Turn-On Switching Loss			2.64		mJ
E_{off}	Turn-Off Switching Loss			1.93		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=400\text{V}, I_C=100\text{A}, R_G=3.0\Omega, V_{GE}=-8/+15\text{V}, T_j=125^{\circ}\text{C}$		84		ns
t_r	Rise Time			25		ns
$t_{d(off)}$	Turn-Off Delay Time			200		ns
t_f	Fall Time			45		ns
E_{on}	Turn-On Switching Loss			3.92		mJ
E_{off}	Turn-Off Switching Loss			2.61		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=400\text{V}, I_C=100\text{A}, R_G=3.0\Omega, V_{GE}=-8/+15\text{V}, T_j=150^{\circ}\text{C}$		84		ns
t_r	Rise Time			27		ns
$t_{d(off)}$	Turn-Off Delay Time			205		ns
t_f	Fall Time			51		ns
E_{on}	Turn-On Switching Loss			4.45		mJ
E_{off}	Turn-Off Switching Loss			2.73		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	$I_F=100\text{A}, V_{GE}=0\text{V}, T_j=25^{\circ}\text{C}$		1.65	2.10	V
		$I_F=100\text{A}, V_{GE}=0\text{V}, T_j=125^{\circ}\text{C}$		1.65		
		$I_F=100\text{A}, V_{GE}=0\text{V}, T_j=150^{\circ}\text{C}$		1.65		
Q_r	Recovered Charge	$V_R=400\text{V}, I_F=100\text{A},$ $-di/dt=6500\text{A}/\mu\text{s}, V_{GE}=-8\text{V}$ $T_j=25^{\circ}\text{C}$		2.09		μC
I_{RM}	Peak Reverse Recovery Current			96		A
E_{rec}	Reverse Recovery Energy			0.76		mJ
Q_r	Recovered Charge	$V_R=400\text{V}, I_F=100\text{A},$ $-di/dt=6300\text{A}/\mu\text{s}, V_{GE}=-8\text{V}$ $T_j=125^{\circ}\text{C}$		3.69		μC
I_{RM}	Peak Reverse Recovery Current			124		A
E_{rec}	Reverse Recovery Energy			2.00		mJ
Q_r	Recovered Charge	$V_R=400\text{V}, I_F=100\text{A},$ $-di/dt=6000\text{A}/\mu\text{s}, V_{GE}=-8\text{V}$ $T_j=150^{\circ}\text{C}$		4.34		μC
I_{RM}	Peak Reverse Recovery Current			132		A
E_{rec}	Reverse Recovery Energy			2.35		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)		0.205	0.225	K/W
	Junction-to-Case (per D1,D4 Diode)		0.579	0.637	
	Junction-to-Case (per T2,T3 IGBT)		0.469	0.516	
	Junction-to-Case (per D2,D3 Diode)		0.505	0.556	
R_{thCH}	Case-to-Heatsink (per T1,T4 IGBT)		0.162		K/W
	Case-to-Heatsink (per D1,D4 Diode)		0.460		
	Case-to-Heatsink (per T2,T3 IGBT)		0.372		
	Case-to-Heatsink (per D2,D3 Diode)		0.401		
	Case-to-Heatsink (per Module)		0.037		
F	Mounting Force Per Clamp	40		80	N
G	Weight of Module		39		g

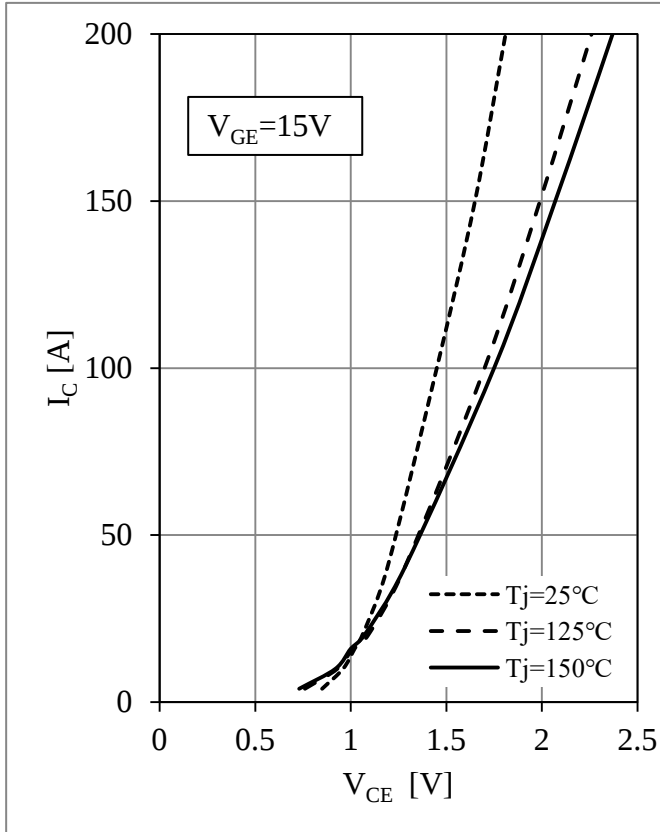


Fig 1. T1,T4 IGBT Output Characteristics

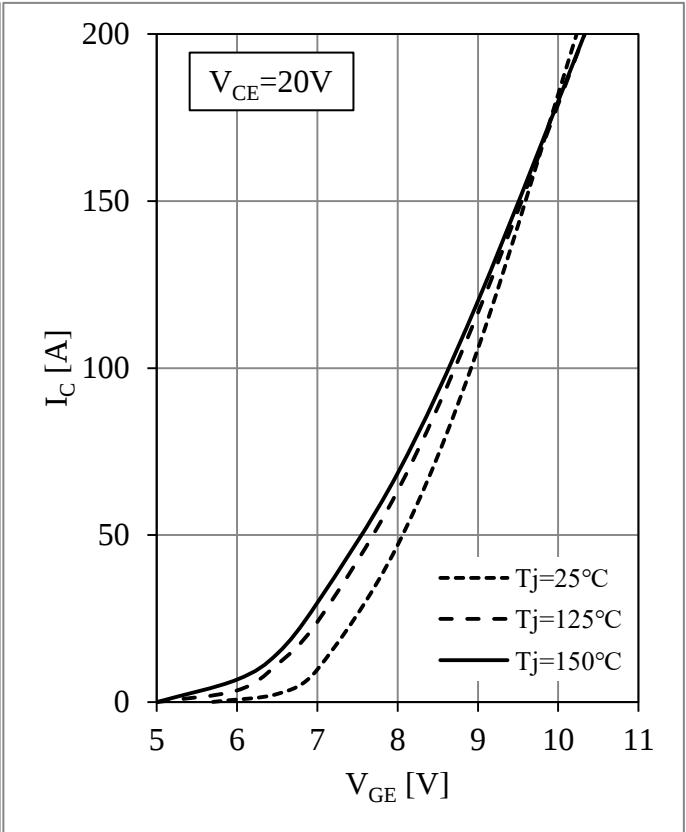
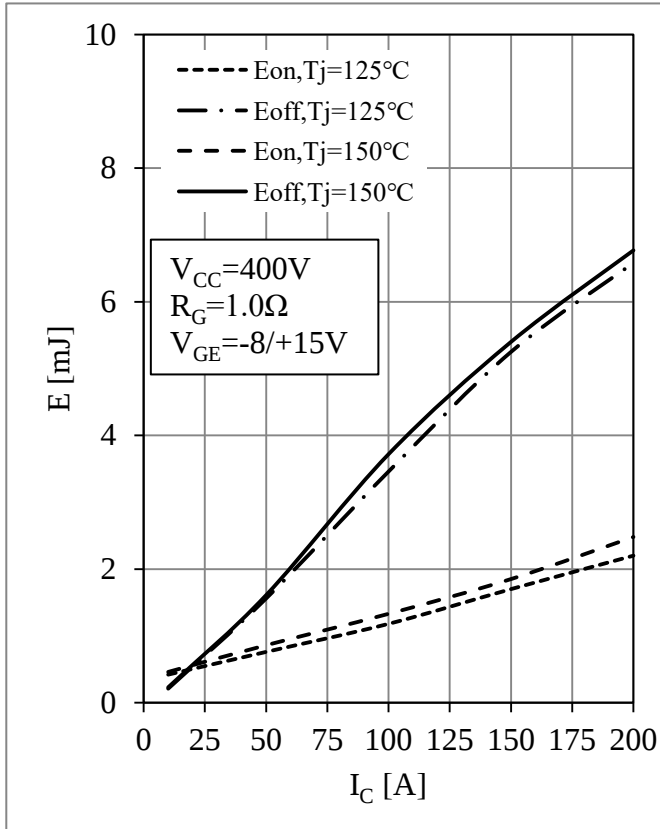
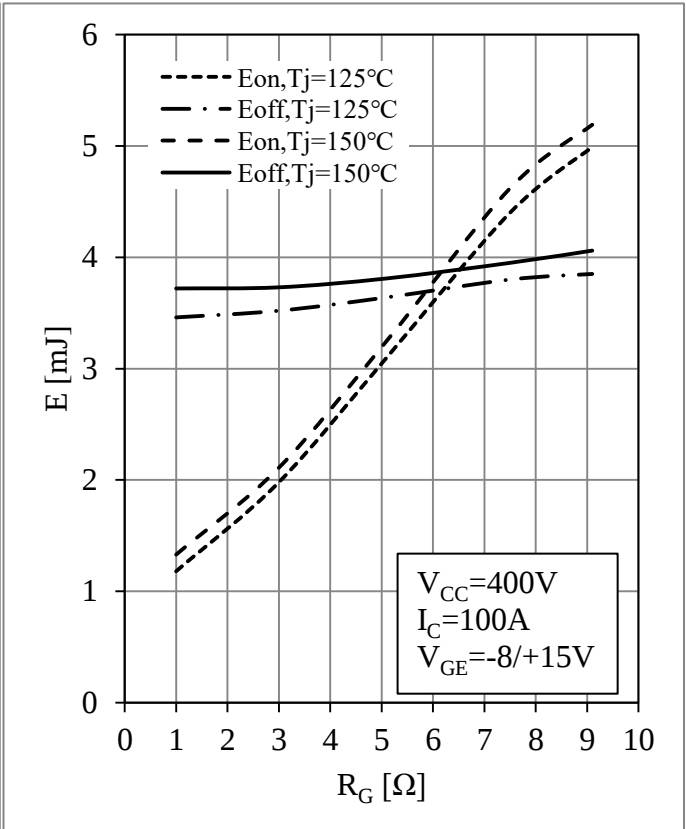


Fig 2. T1,T4 IGBT Transfer Characteristics

Fig 3. T1,T4 IGBT Switching Loss vs. I_C Fig 4. T1,T4 IGBT Switching Loss vs. R_G

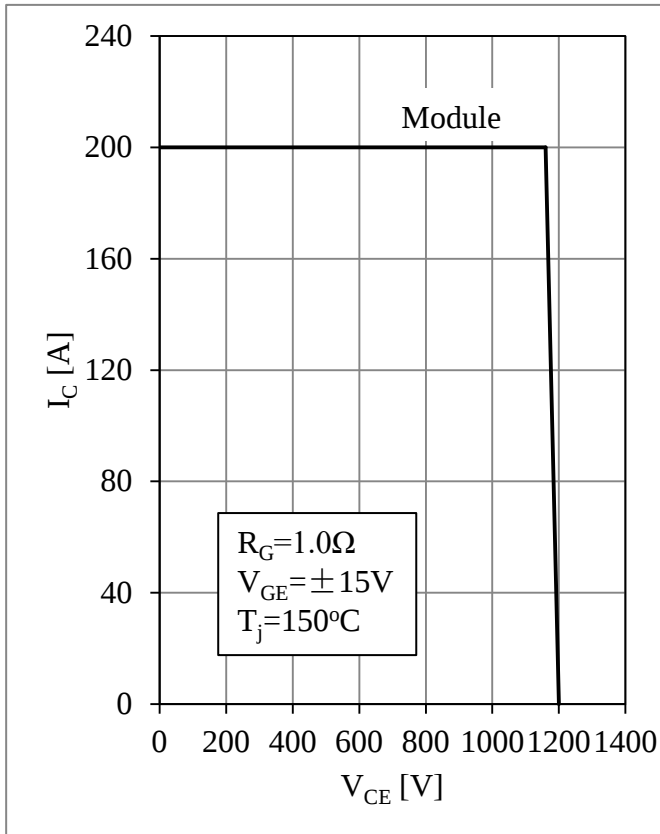


Fig 5. T1,T4 RBSOA

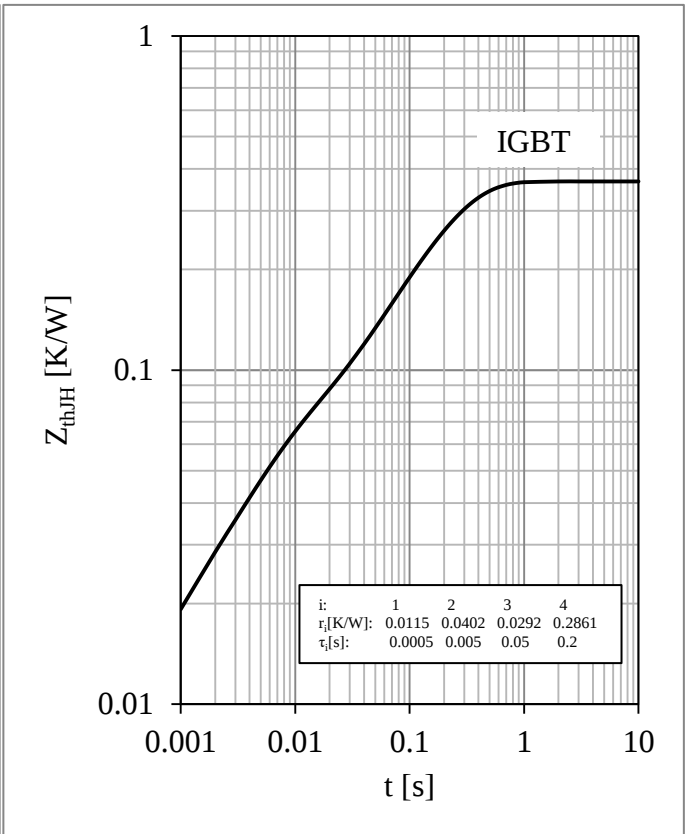


Fig 6. T1,T4 IGBT Transient Thermal Impedance

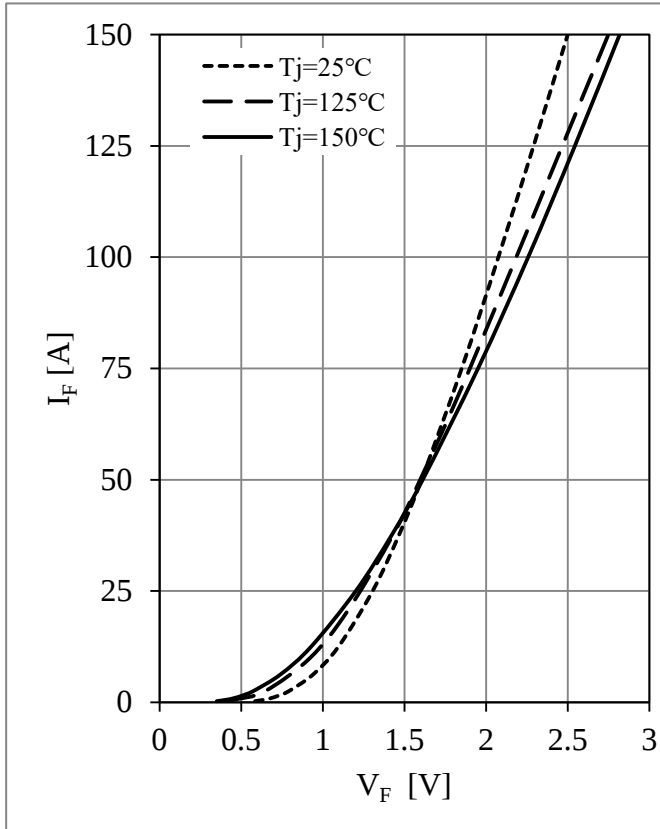
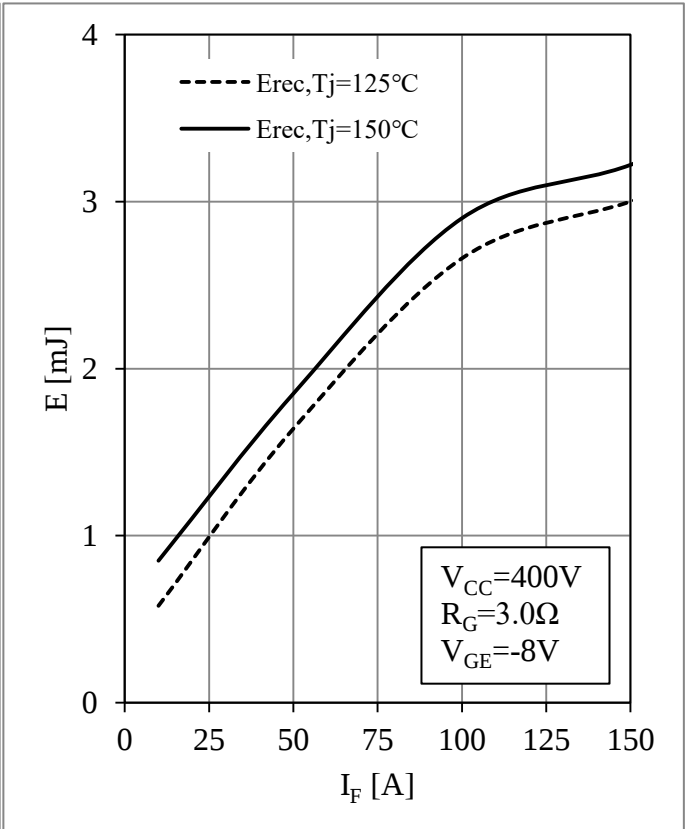
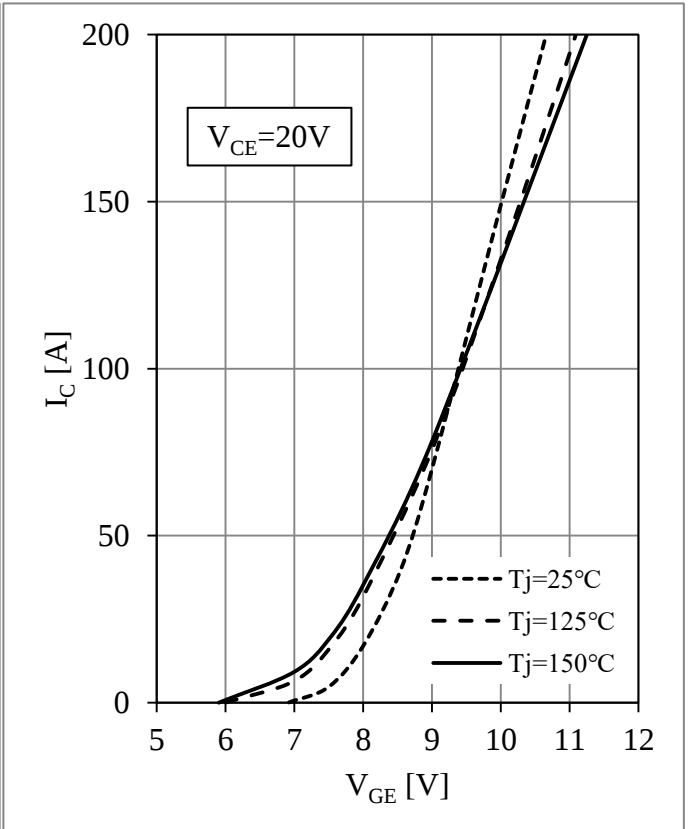
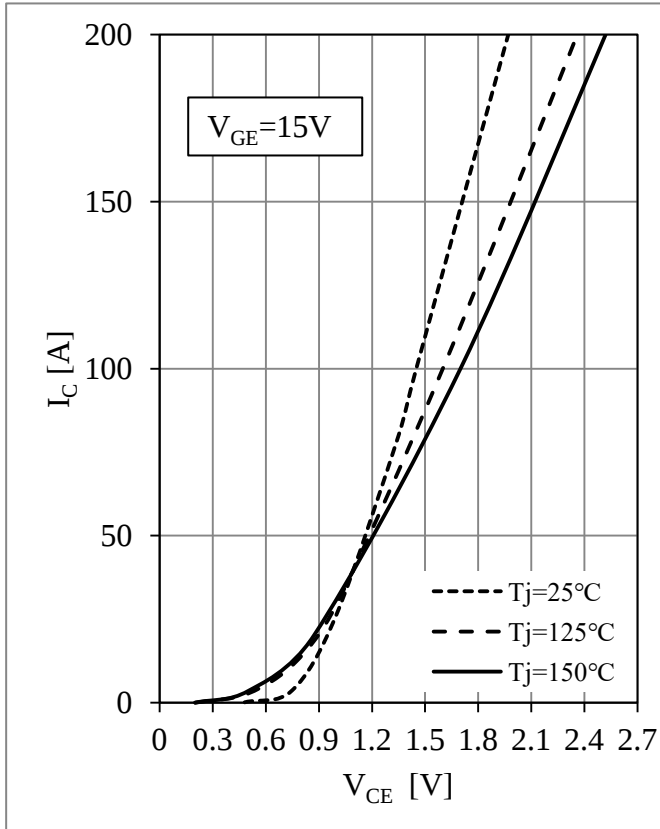
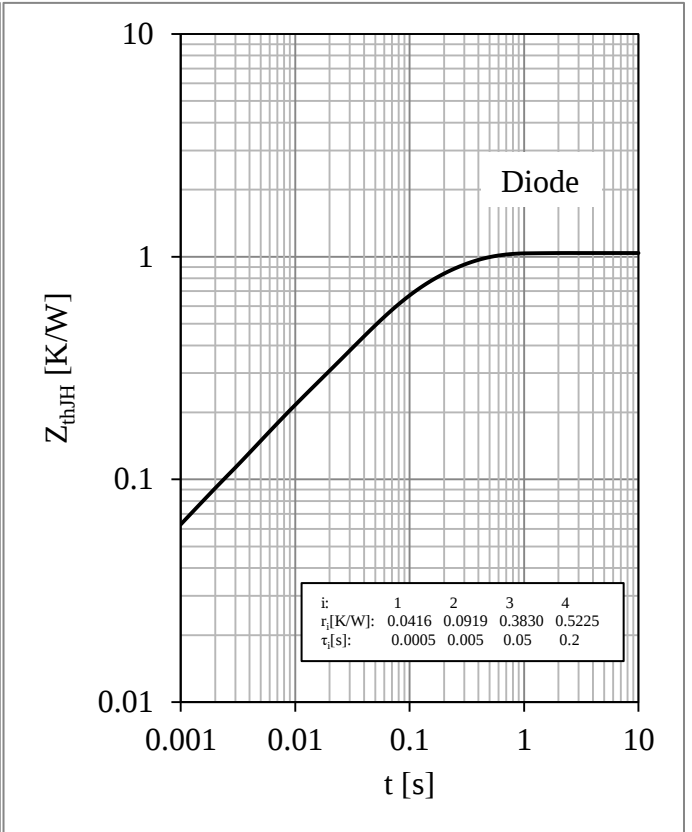
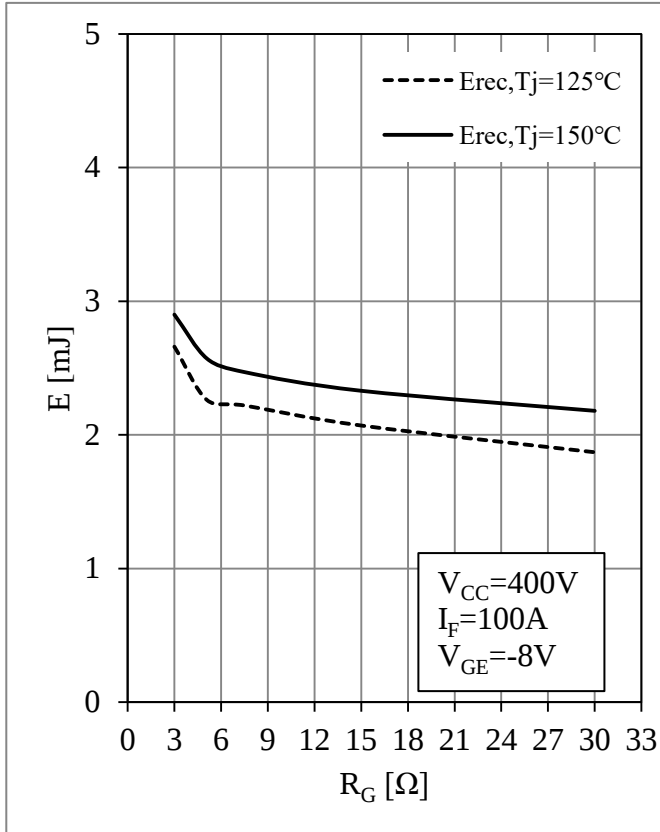


Fig 7. D1,D4 Diode Forward Characteristics

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



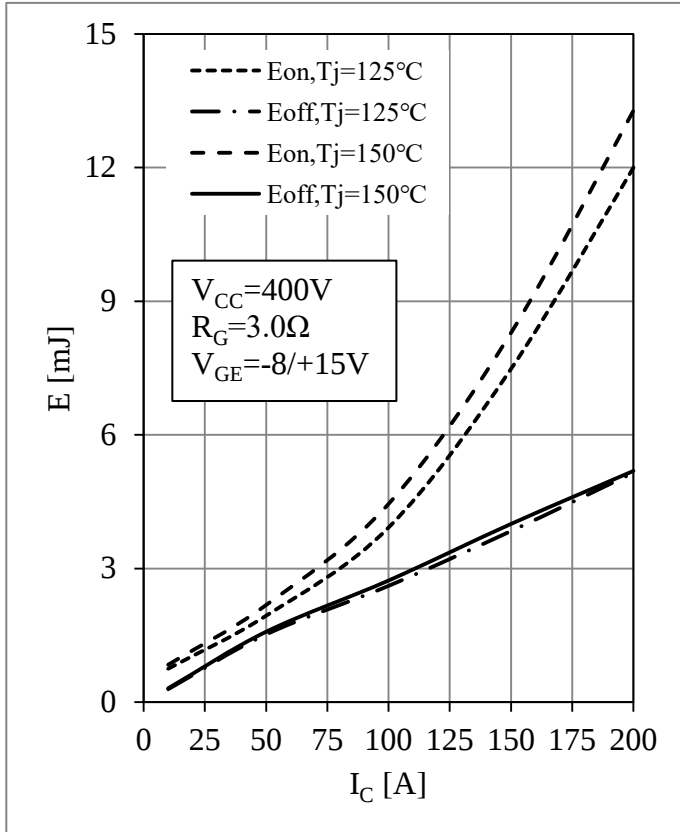
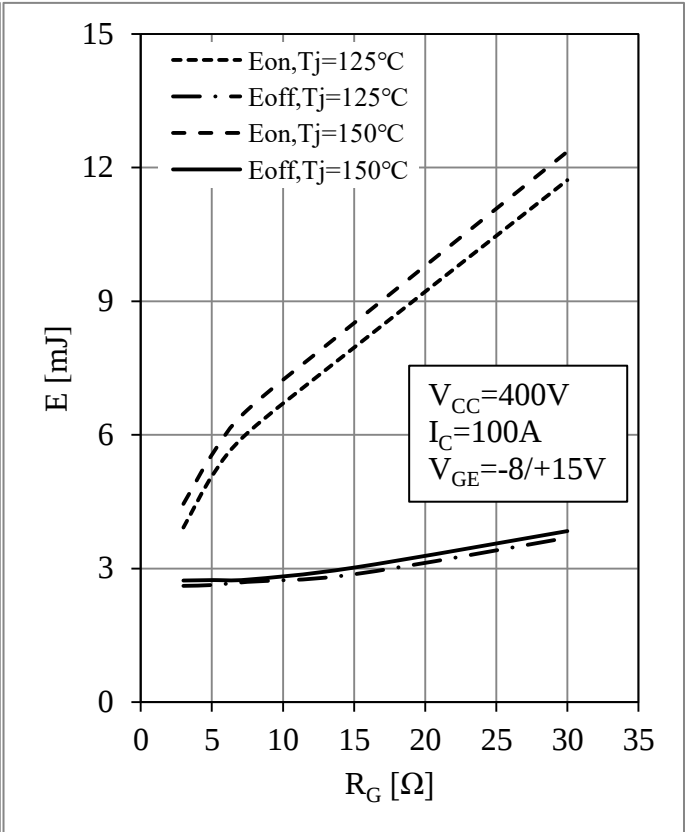
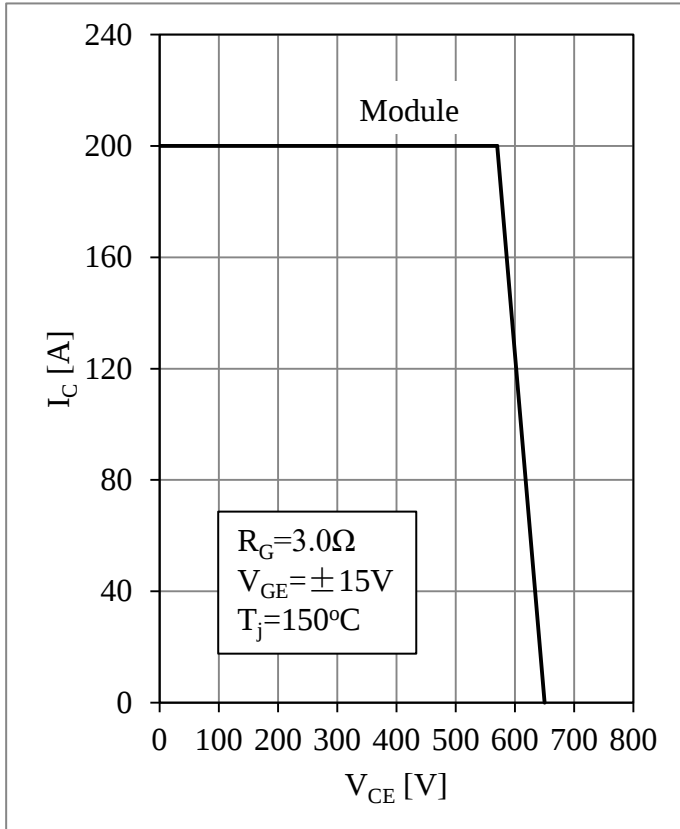
Fig 13. T2,T3 IGBT Switching Loss vs. I_C Fig 14. T2,T3 IGBT Switching Loss vs. R_G 

Fig 15. T2,T3 RBSOA

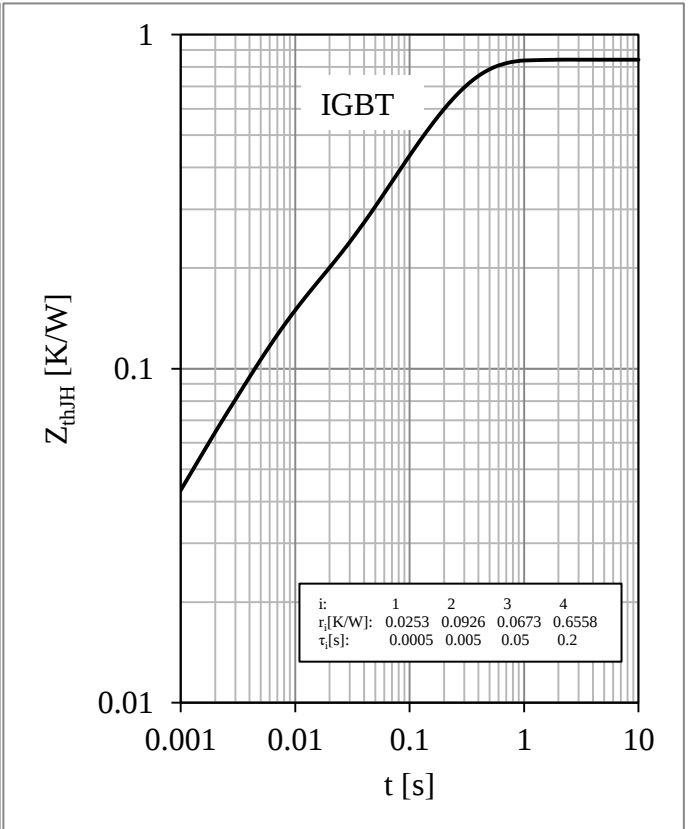


Fig 16. T2,T3 IGBT Transient Thermal Impedance

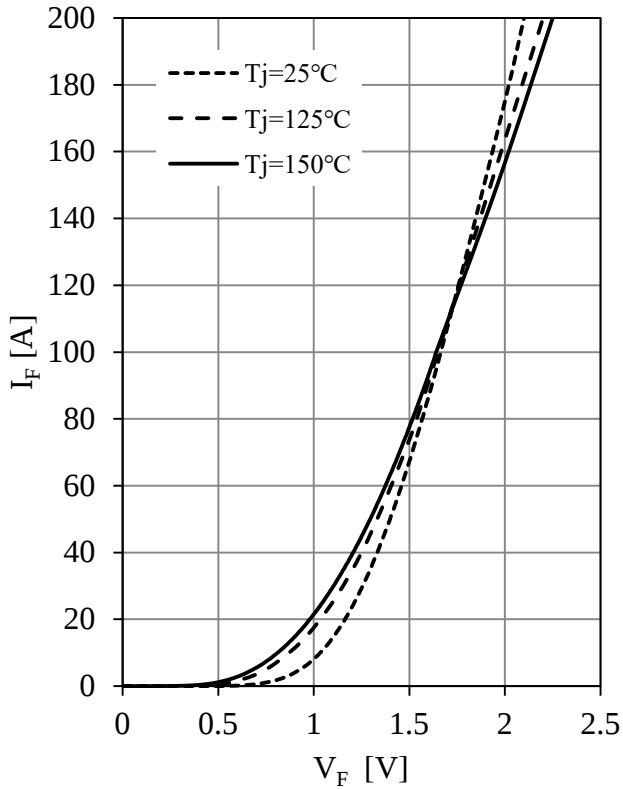


Fig 17. D2,D3 Diode Forward Characteristics

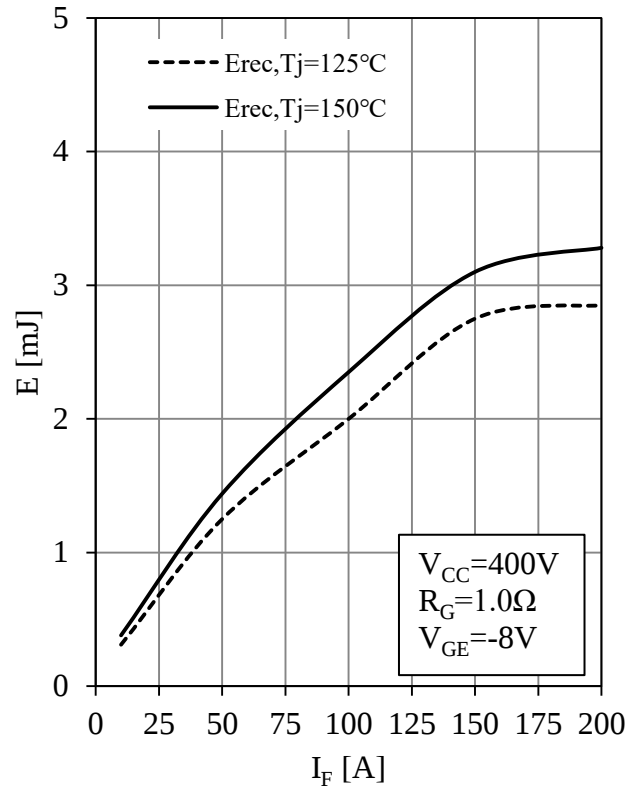
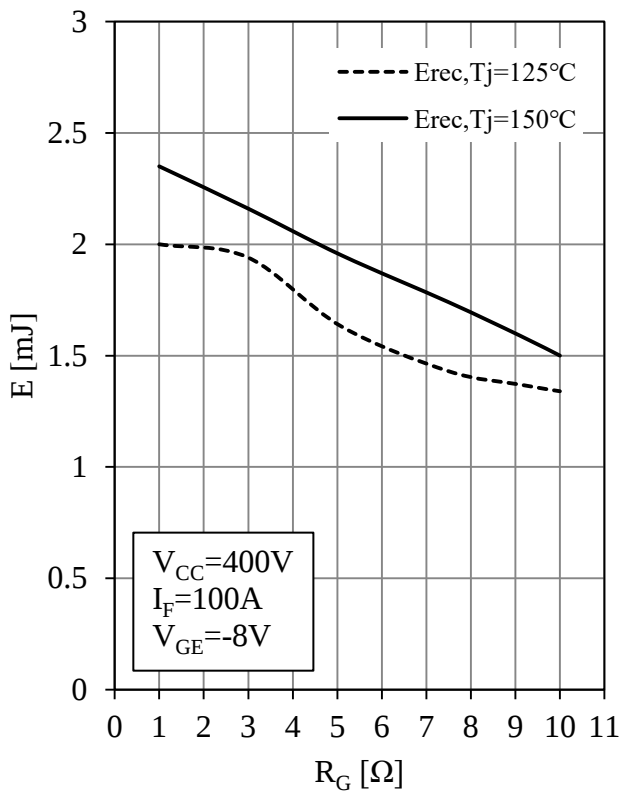
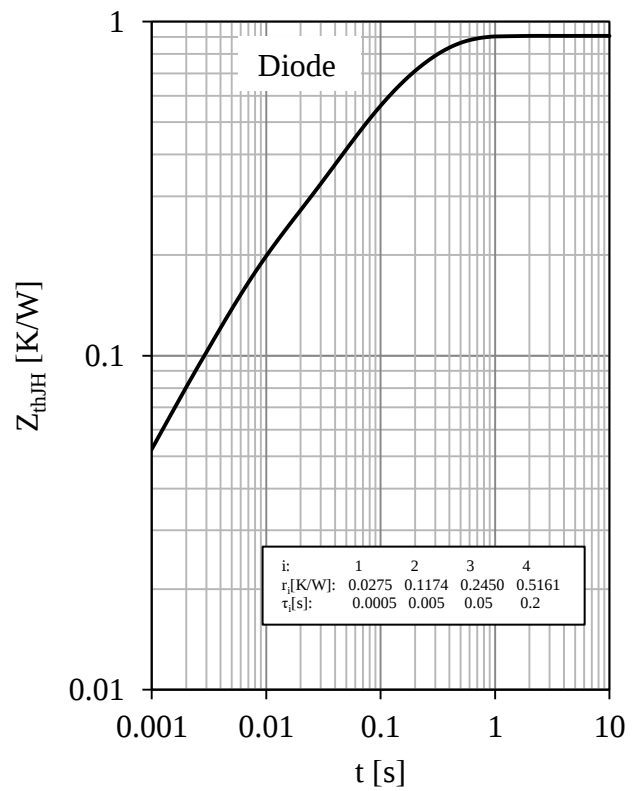
Fig 18. D2,D3 Diode Switching Loss vs. I_F Fig 19. D2,D3 Diode Switching Loss vs. R_G 

Fig 20. D2,D3 Diode Transient Thermal Impedance

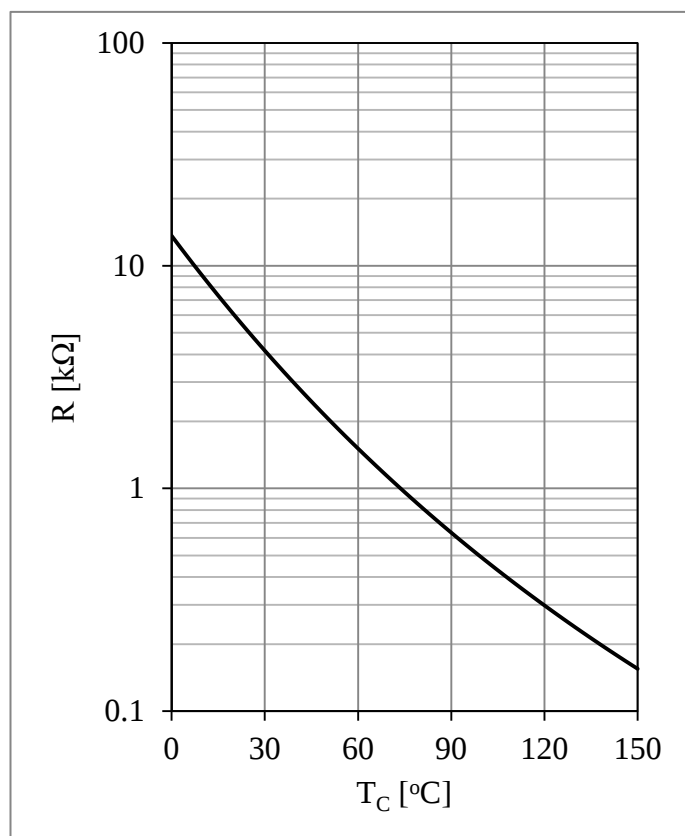
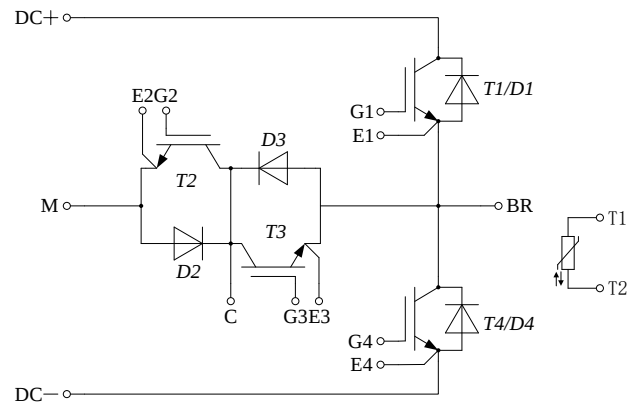


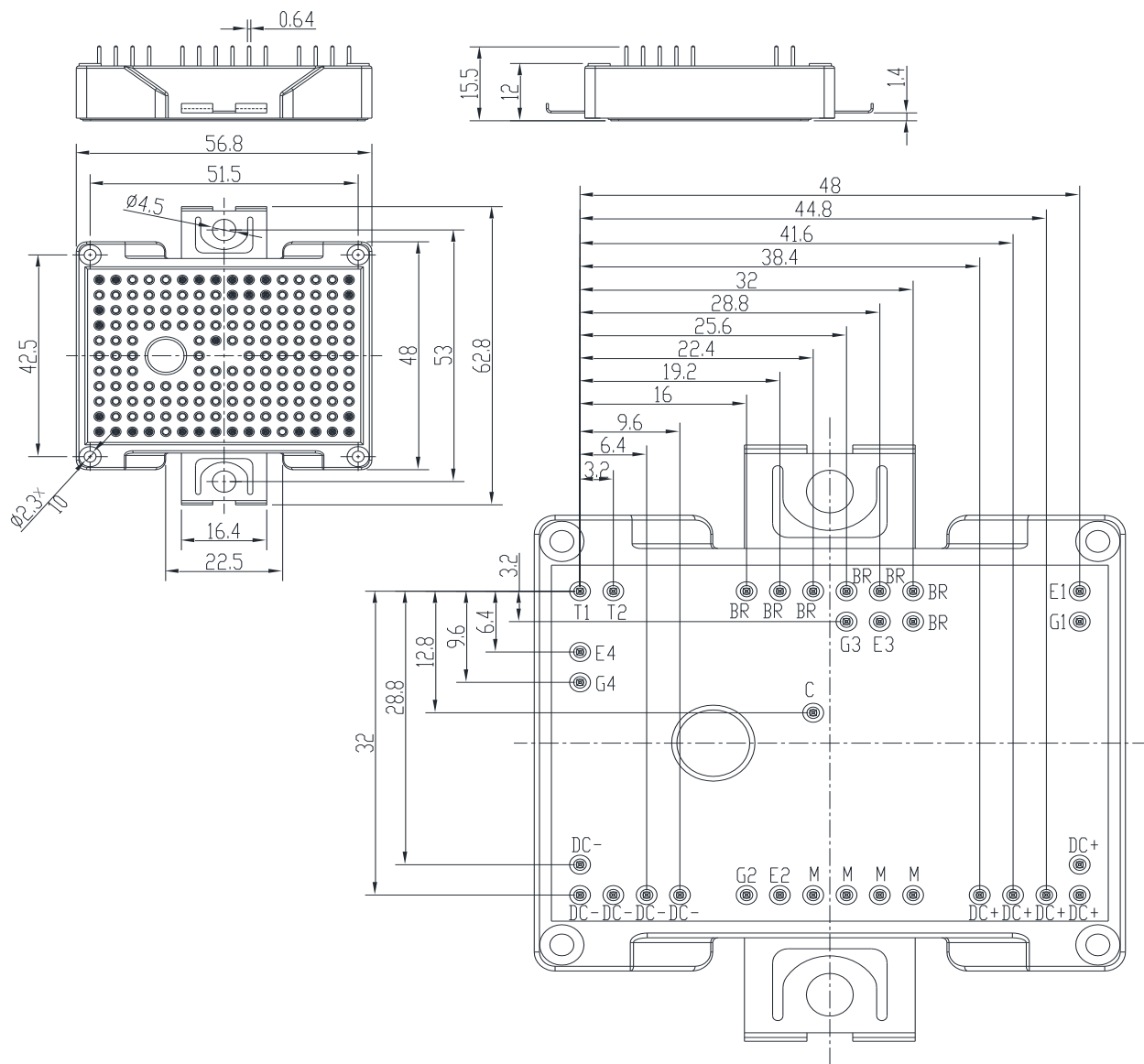
Fig 21. NTC Temperature Characteristic

Circuit Schematic



Package Dimensions

Dimensions in Millimeters



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