

# 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.

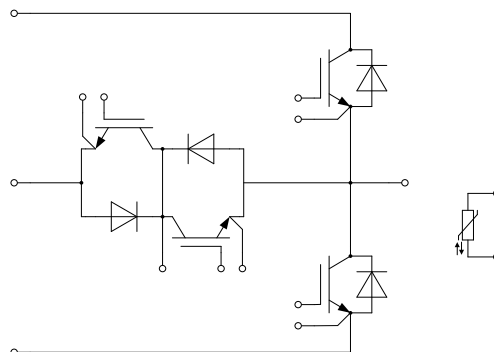
### Features

- 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	$\pm 20$	V
$I_C$	Collector Current @ $T_C=25^{\circ}\text{C}$	200	A
	@ $T_C=100^{\circ}\text{C}$	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	$\pm 20$	V
$I_C$	Collector Current @ $T_C=25^{\circ}\text{C}$	119	A
	@ $T_C=60^{\circ}\text{C}$	100	A
$I_{CM}$	Pulsed Collector Current $t_p=1\text{ms}$	200	A
$P_D$	Maximum Power Dissipation @ $T_j=175^{\circ}\text{C}$	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		$\Omega$	
$C_{ies}$	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		$\mu\text{C}$	
$t_{d(on)}$	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		$\mu\text{C}$
$I_{RM}$	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		$\mu\text{C}$
$I_{RM}$	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		$\mu\text{C}$
$I_{RM}$	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		$\Omega$	
$C_{ies}$	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		$\mu\text{C}$	
$t_{d(on)}$	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		$\mu\text{C}$
$I_{RM}$	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		$\mu\text{C}$
$I_{RM}$	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		$\mu\text{C}$
$I_{RM}$	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

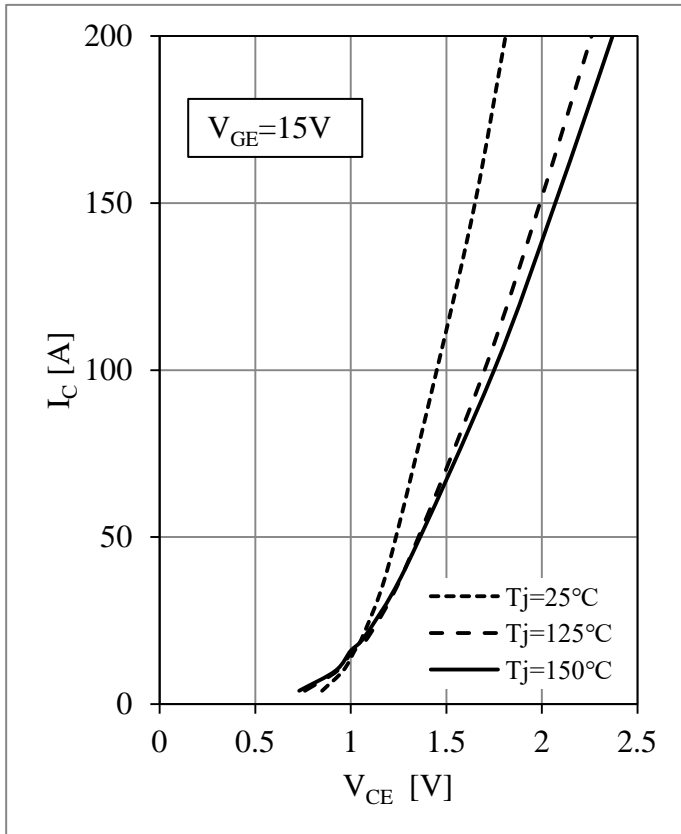


Fig 1. T1,T4 IGBT Output Characteristics

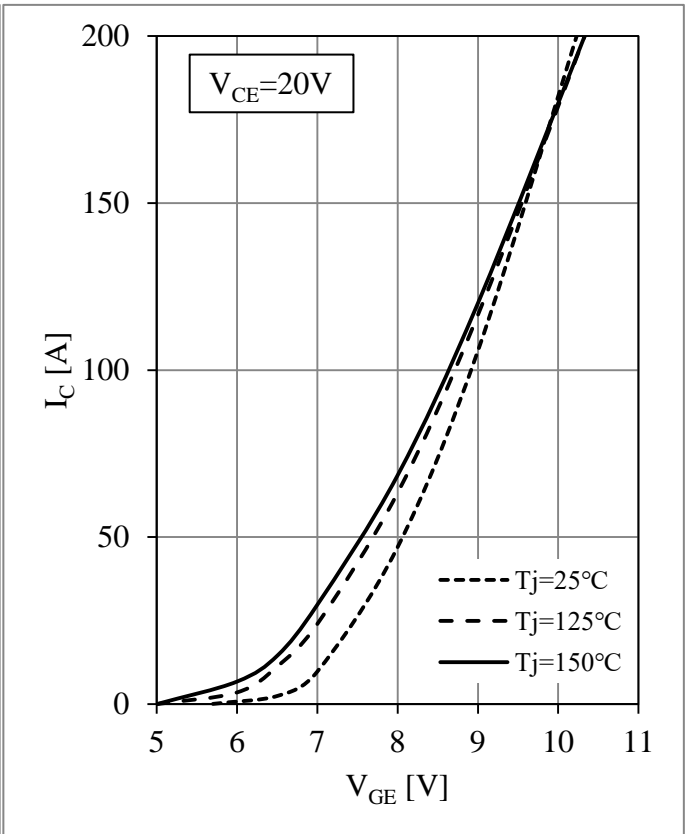


Fig 2. T1,T4 IGBT Transfer Characteristics

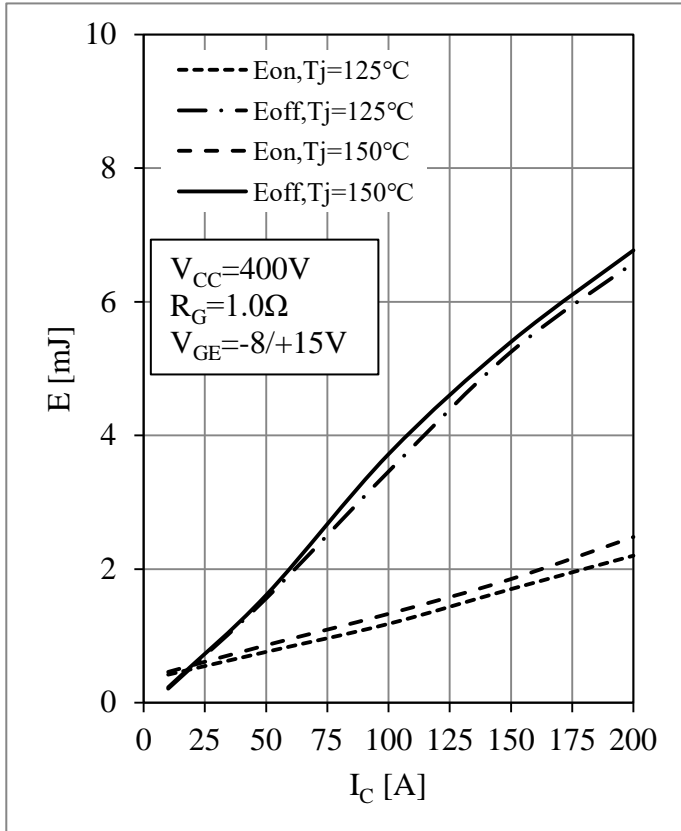


Fig 3. T1,T4 IGBT Switching Loss vs.  $I_c$

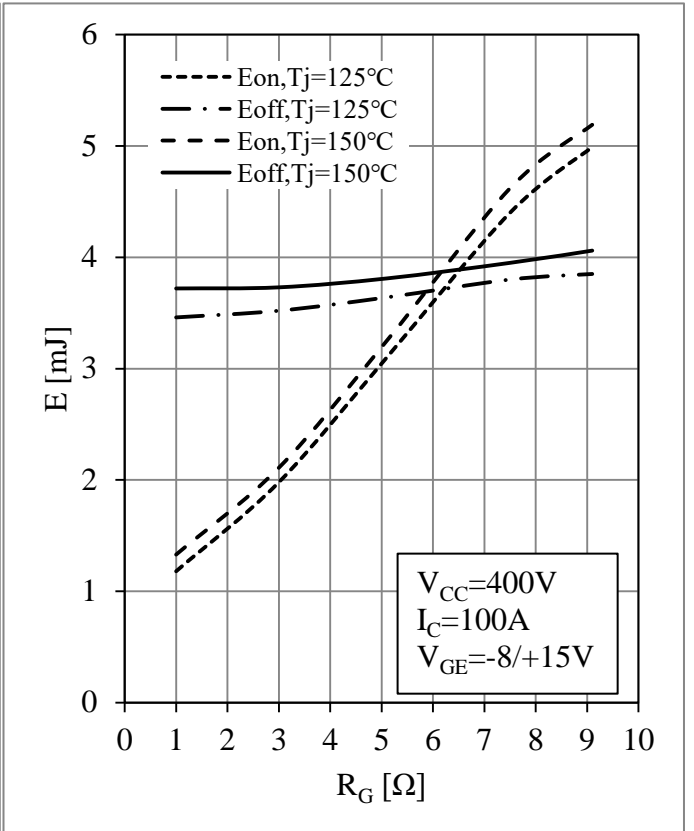


Fig 4. T1,T4 IGBT Switching Loss vs.  $R_g$



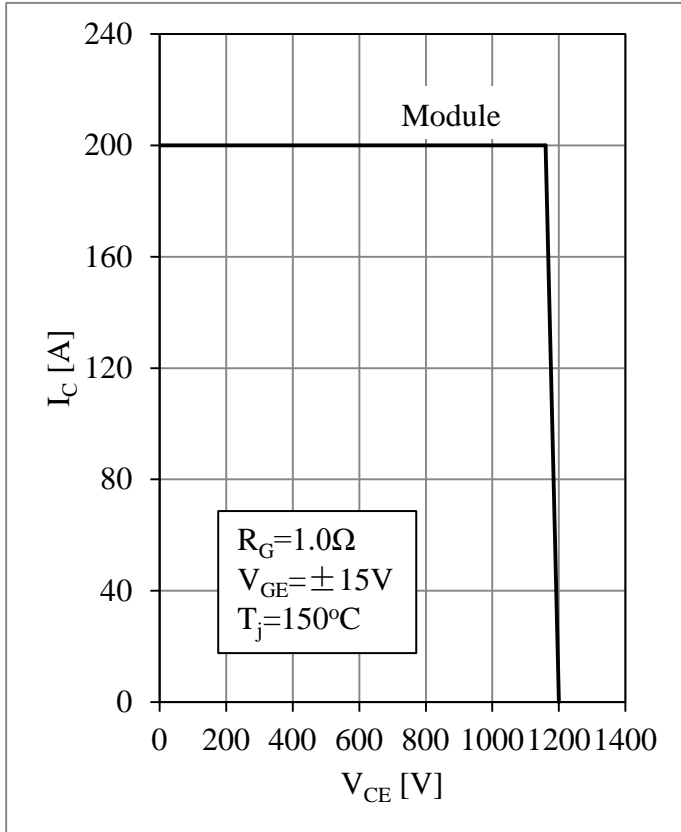


Fig 5. T1,T4 RBSOA

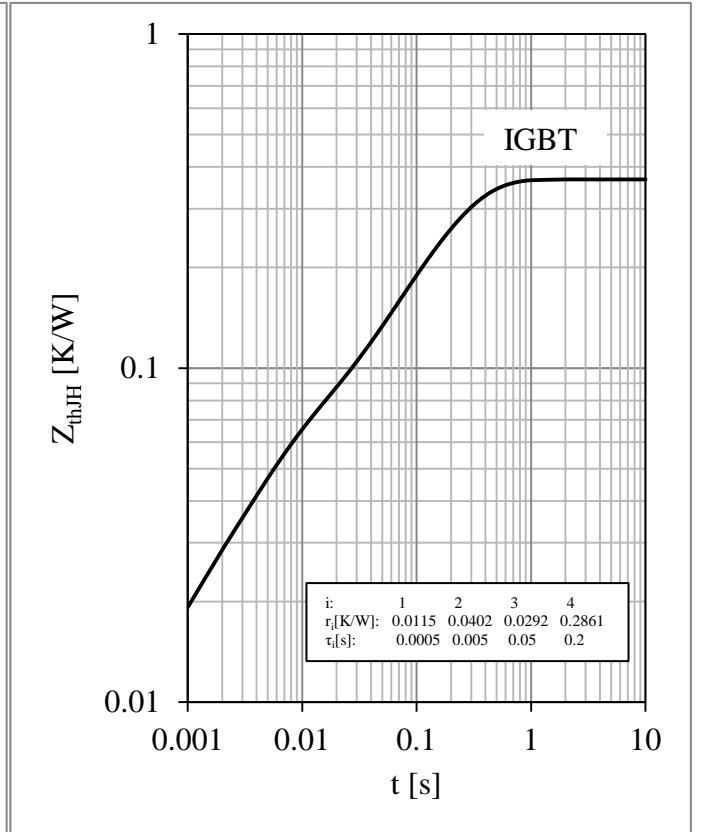


Fig 6. T1,T4 IGBT Transient Thermal Impedance

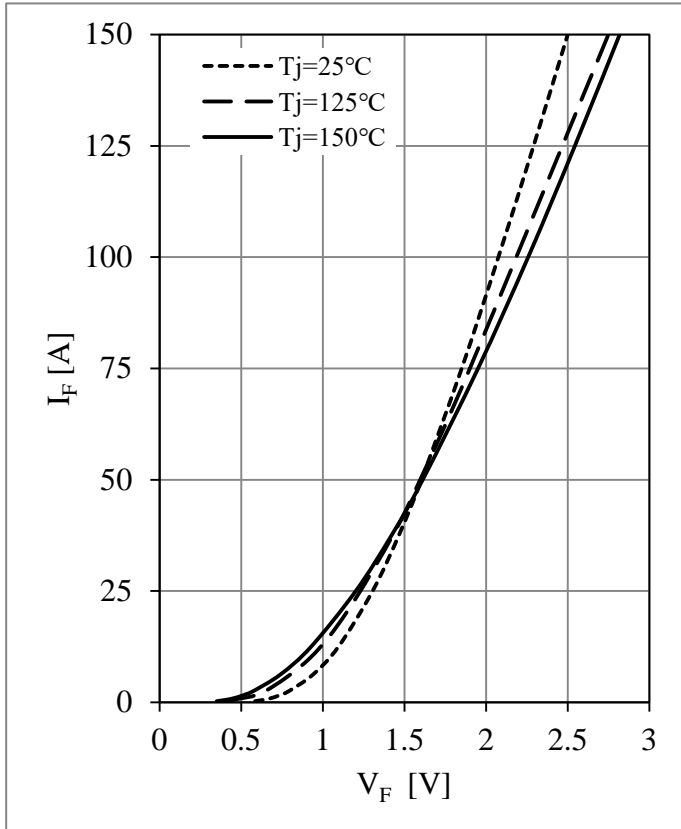


Fig 7. D1,D4 Diode Forward Characteristics

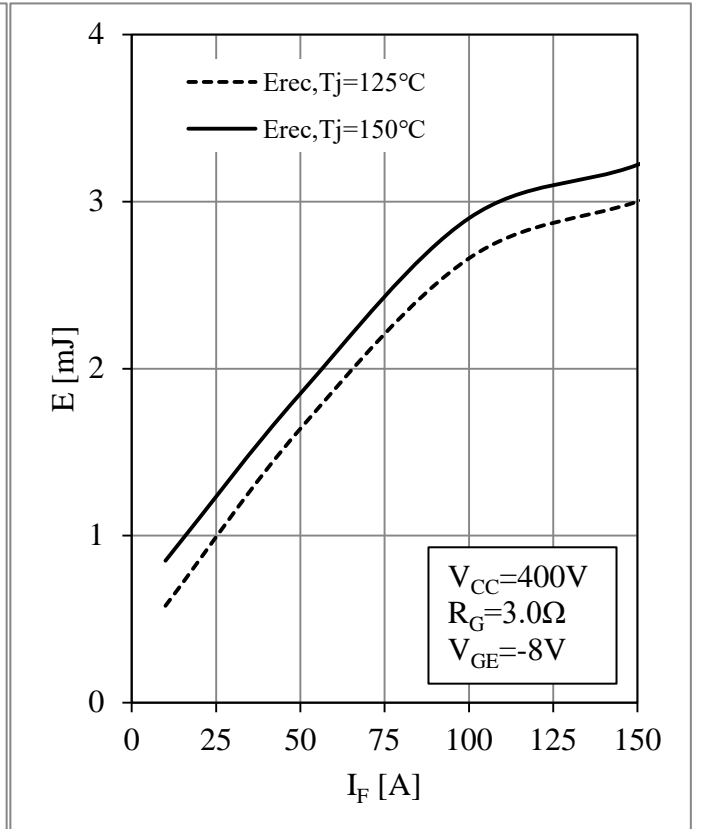


Fig 8. D1,D4 Diode Switching Loss vs.  $I_F$

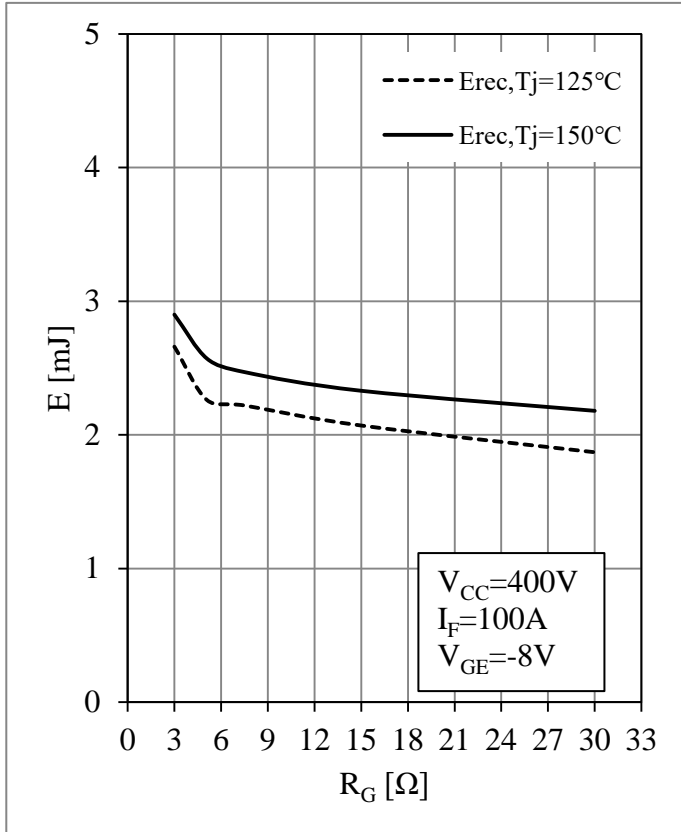


Fig 9. D1,D4 Diode Switching Loss vs.  $R_G$

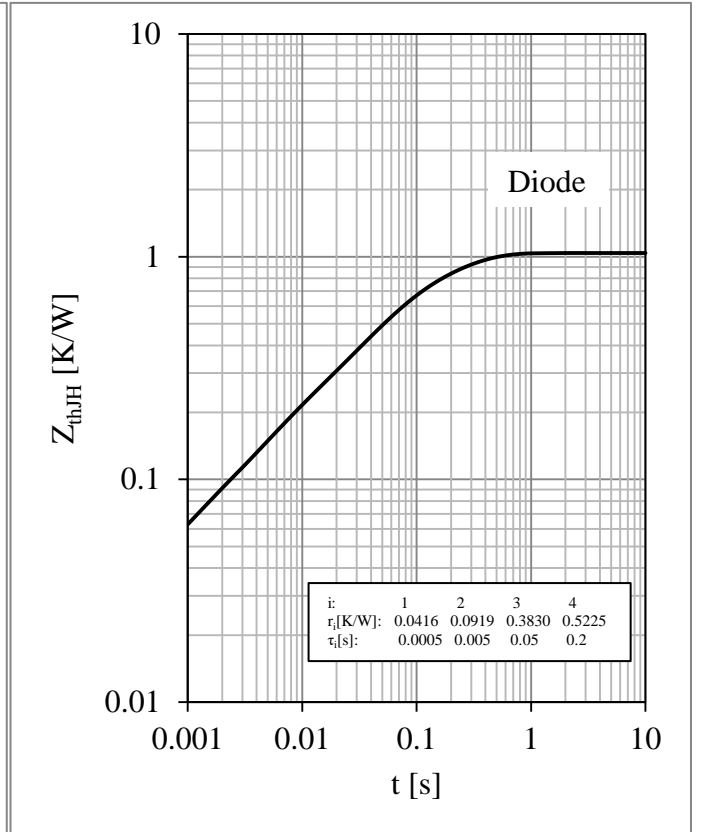


Fig 10. D1,D4 Diode Transient Thermal Impedance

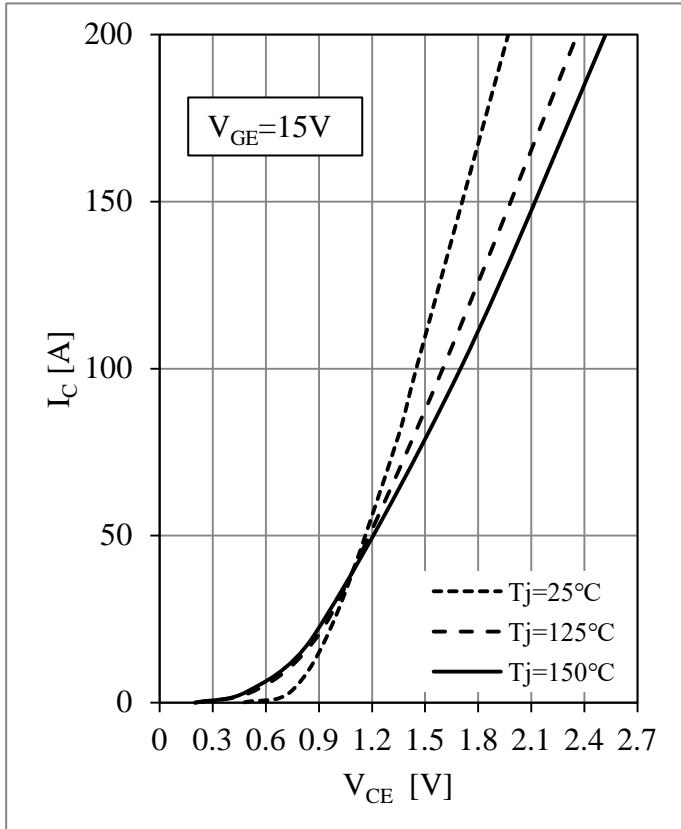


Fig 11. T2,T3 IGBT Output Characteristics

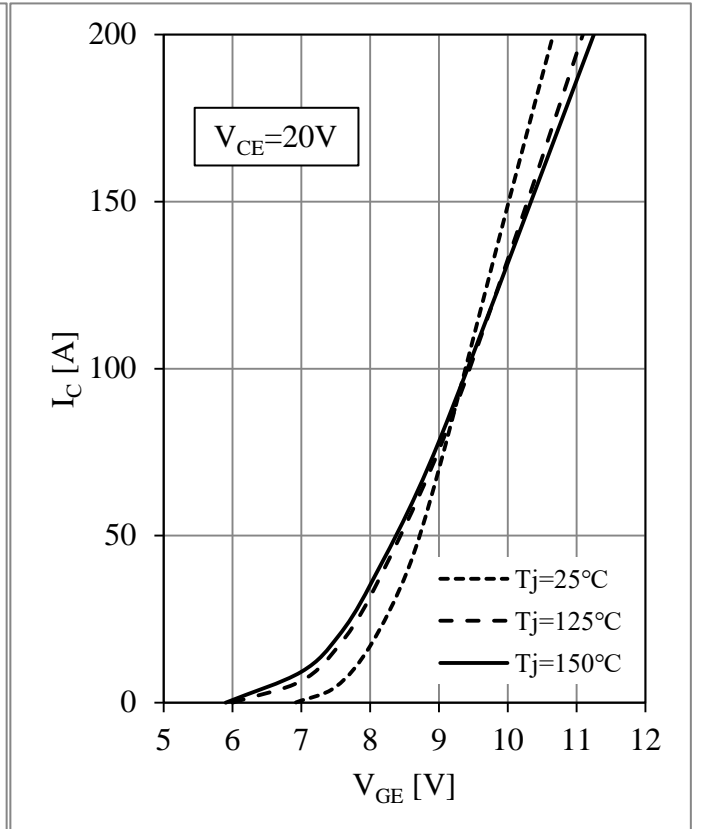


Fig 12. T2,T3 IGBT Transfer Characteristics

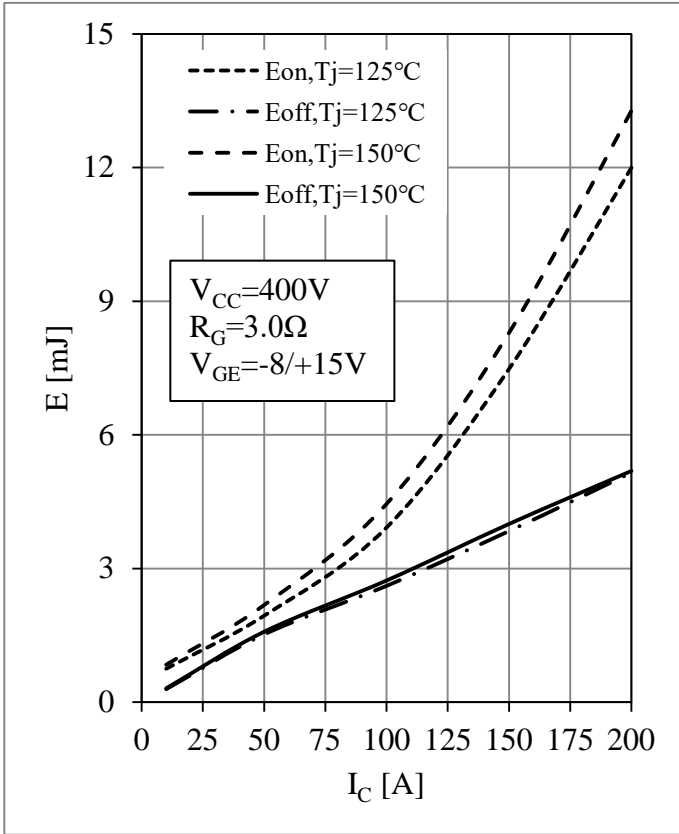


Fig 13. T2,T3 IGBT Switching Loss vs.  $I_C$

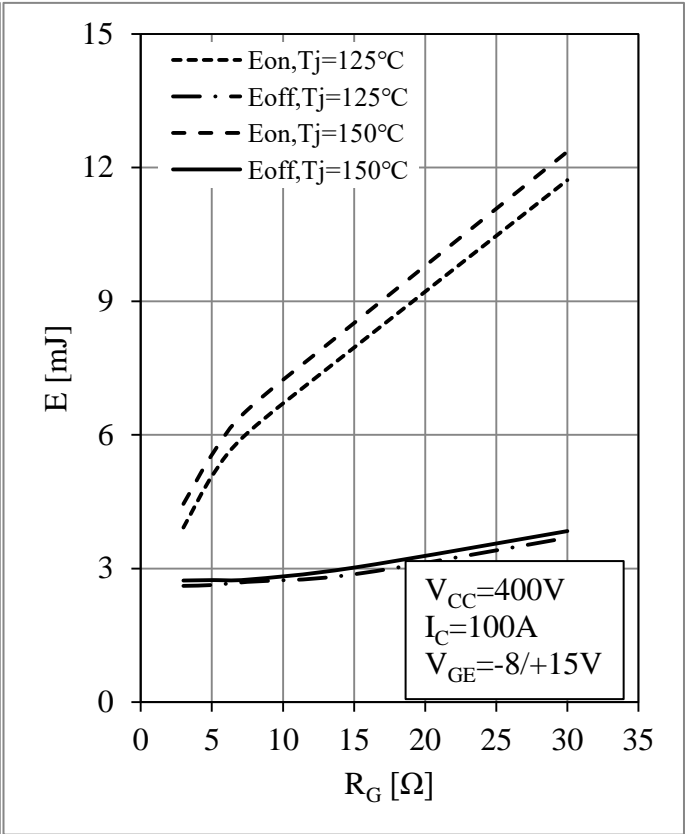


Fig 14. T2,T3 IGBT Switching Loss vs.  $R_G$

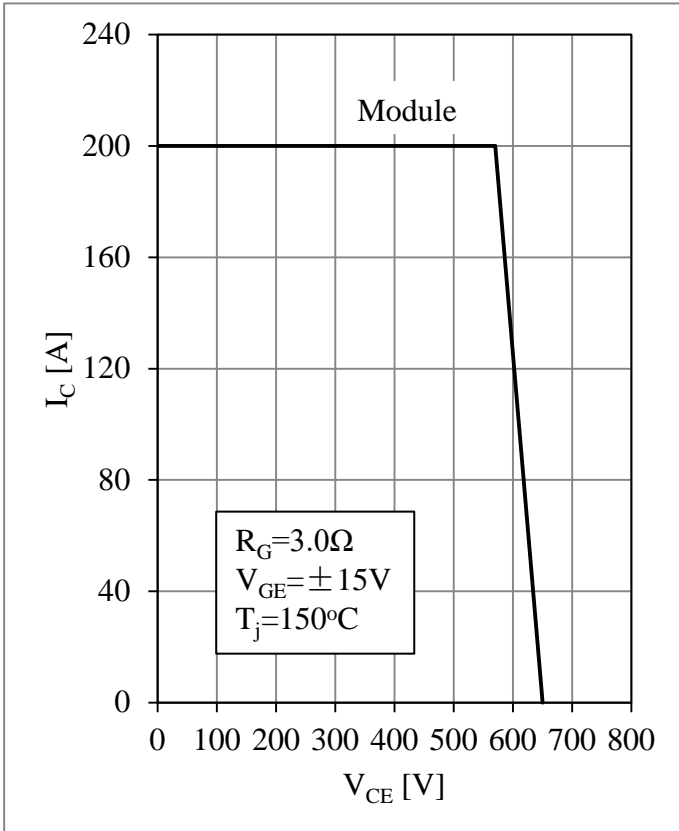


Fig 15. T2,T3 RBSOA

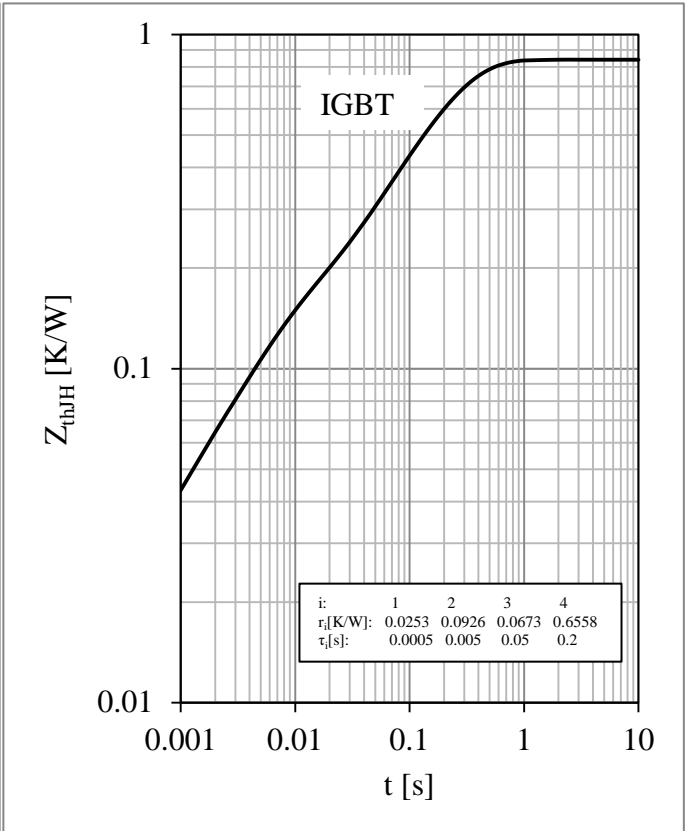


Fig 16. T2,T3 IGBT Transient Thermal Impedance

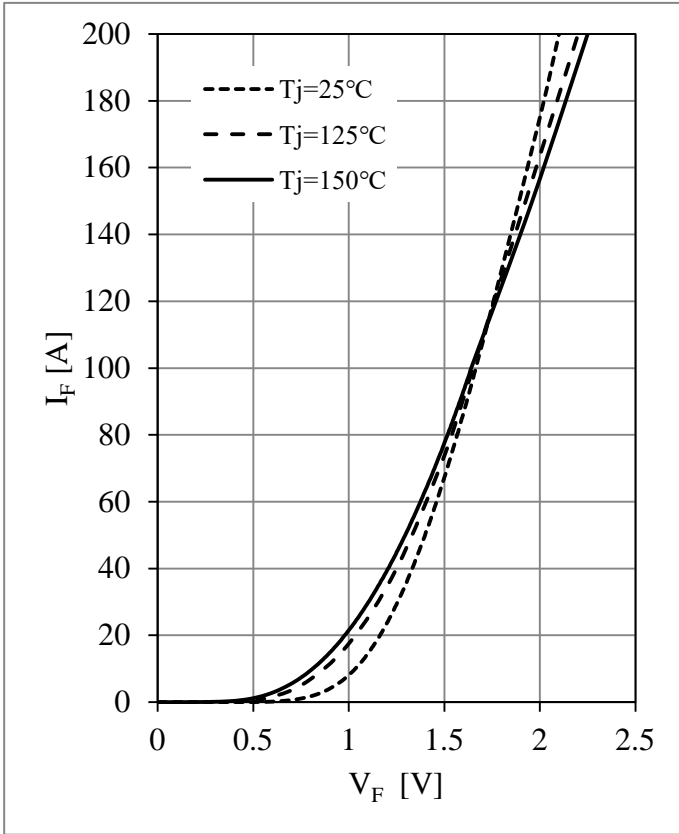


Fig 17. D2,D3 Diode Forward Characteristics

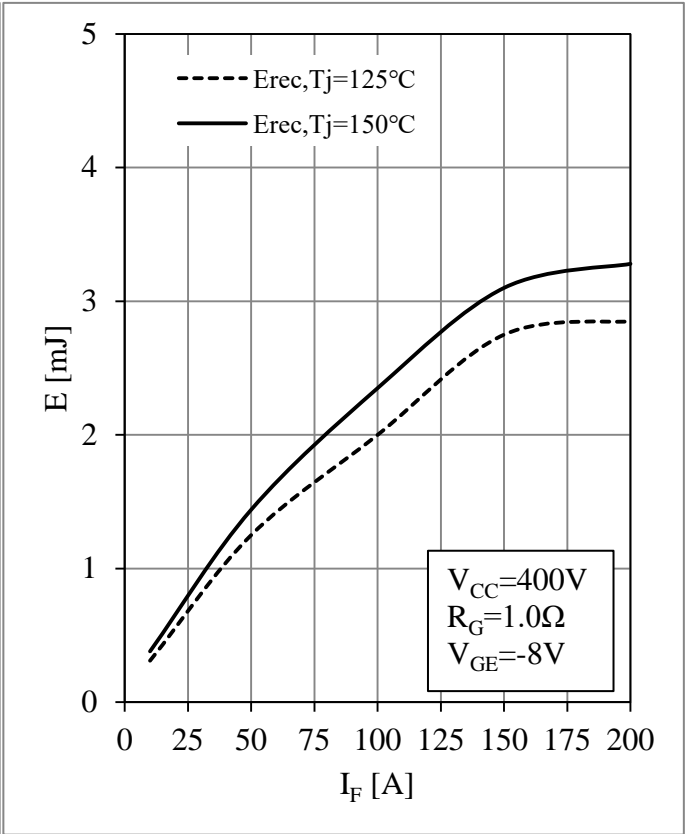


Fig 18. D2,D3 Diode Switching Loss vs.  $I_F$

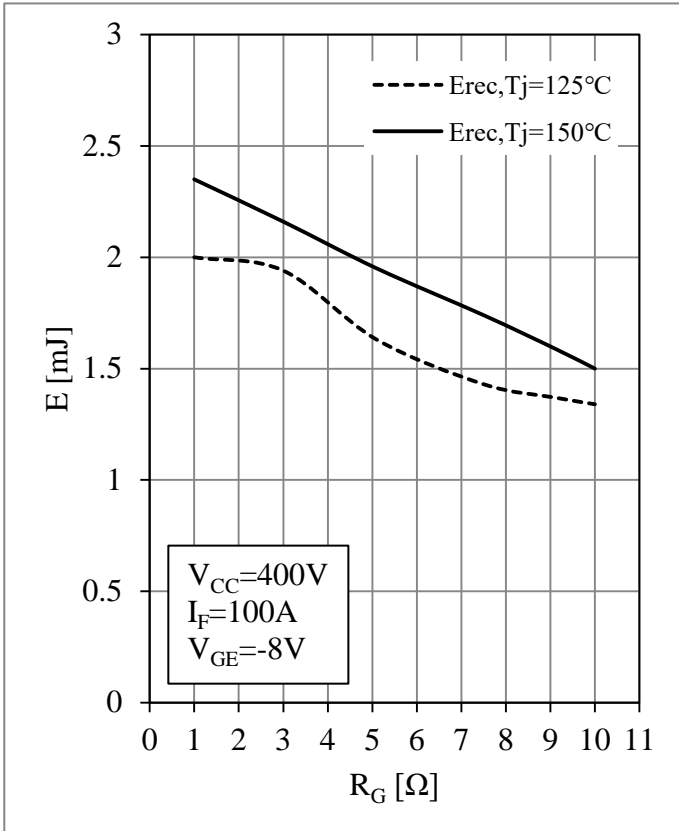


Fig 19. D2,D3 Diode Switching Loss vs.  $R_G$

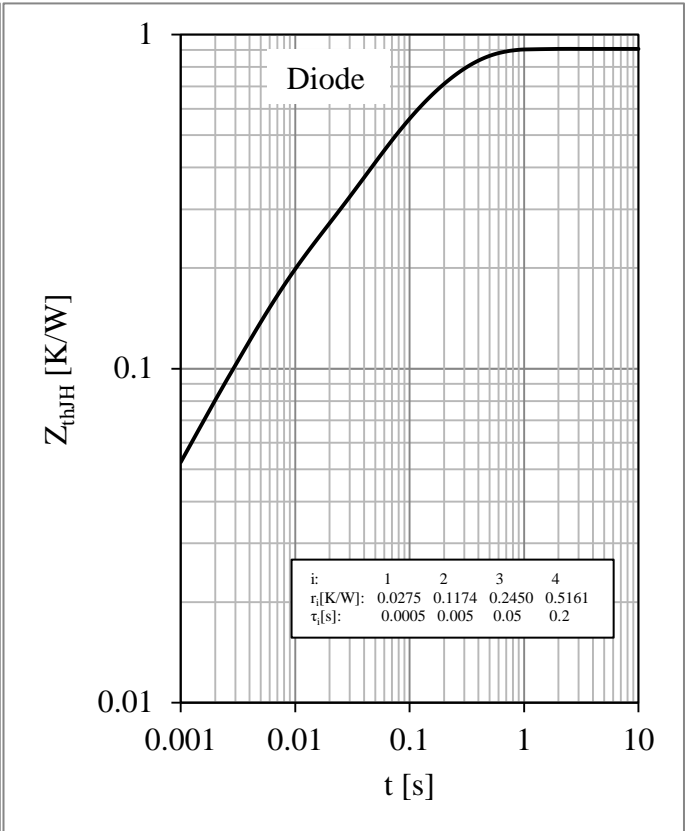


Fig 20. D2,D3 Diode Transient Thermal Impedance

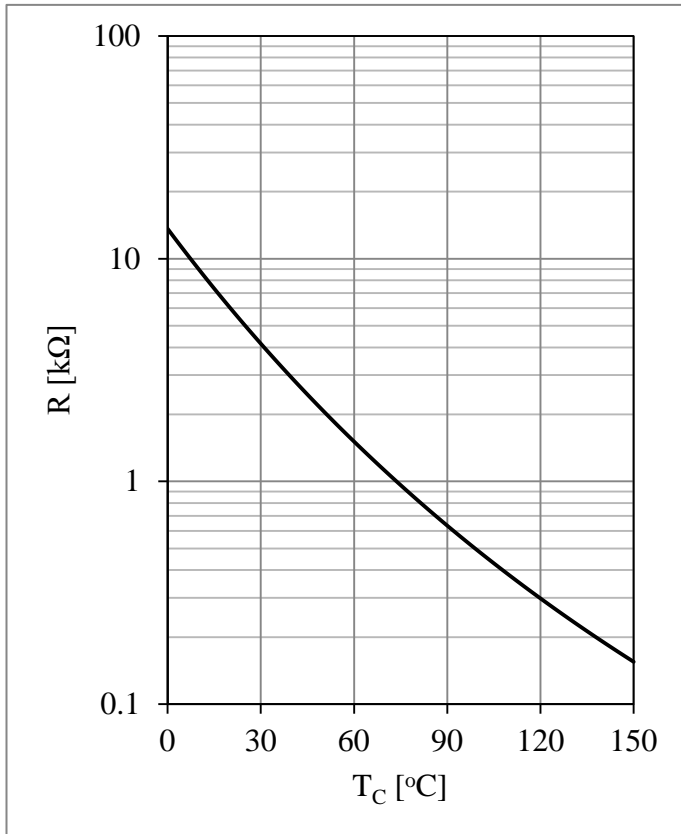
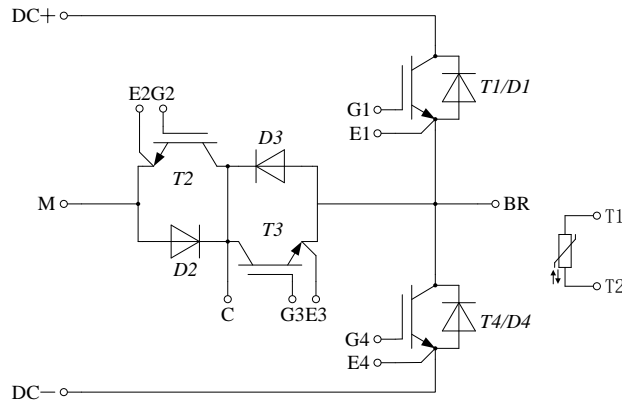


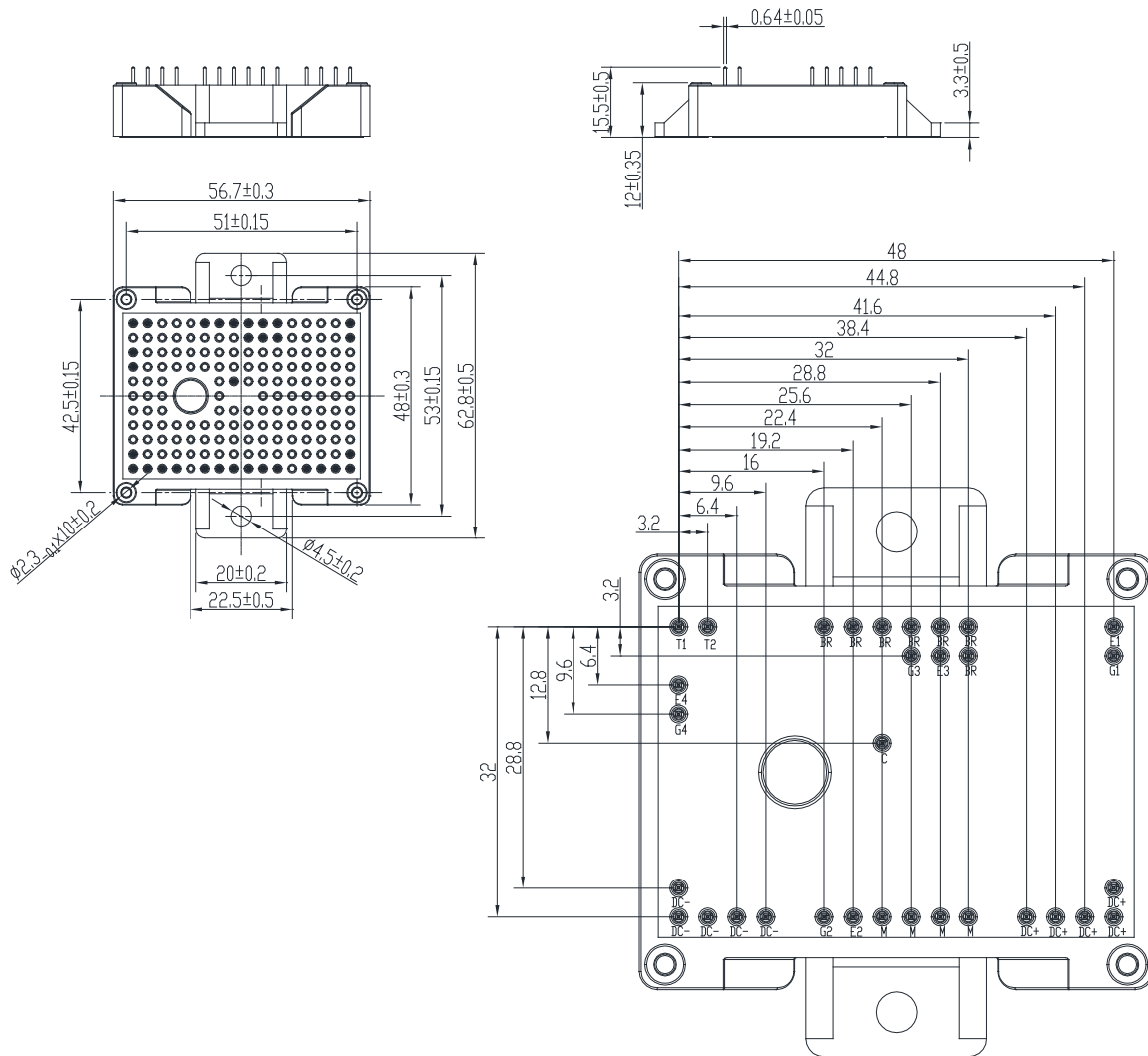
Fig 21. NTC Temperature Characteristic

**Circuit Schematic**



**Package Dimensions**

Dimensions in Millimeters



Pinpositions with tolerance  $\oplus \ominus$

## Terms and Conditions of Usage

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