STARPOWER

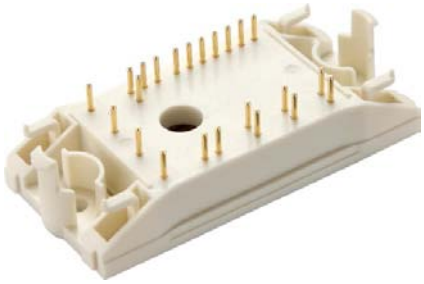
SEMICONDUCTOR **IGBT**

GD40TLT120F1S

1200V/40A 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-applications.



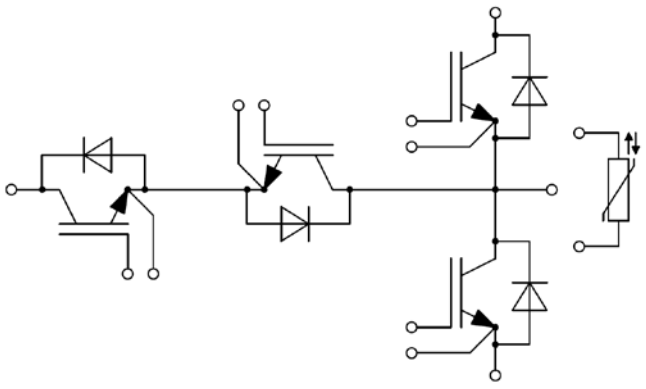
Features

- Low $V_{CE(sat)}$ Trench IGBT technology
- Low switching loss
- $V_{CE(sat)}$ with positive temperature coefficient
- High short circuit capability
- Maximum junction temperature 175℃
- Fast & soft reverse recovery anti-parallel FWD

Typical Applications

- Solar power
- UPS
- 3-level-applications.

Equivalent Circuit Schematic



Absolute Maximum Ratings T_C=25℃ unless otherwise noted

T1,T2 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℃ @ T_C=100℃	60 40	A
I_{CM}	Pulsed Collector Current t_p=1ms	80	A
P_D	Maximum Power Dissipation @ T_j=175℃	256	W

D1,D2 Diode

Symbol	Description	Values	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	1200	V
I_F	Diode Continuous Forward Current	40	A
I_{FM}	Diode Maximum Forward Current t_p=1ms	80	A

T3,T4 IGBT

Symbol	Description	Values	Unit
V_{CES}	Collector-Emitter Voltage	600	V
V_{GES}	Gate-Emitter Voltage	±20	V
I_C	Collector Current @ T_C=25℃ @ T_C=70℃	67 50	A
I_{CM}	Pulsed Collector Current t_p=1ms	100	A
P_D	Maximum Power Dissipation @ T_j=175℃	186	W

D3,D4 Diode

Symbol	Description	Values	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	600	V
I_F	Diode Continuous Forward Current	30	A
I_{FM}	Diode Maximum Forward Current t_p=1ms	60	A

Module

Symbol	Description	Values	Unit
T_{jmax}	Maximum Junction Temperature	175	℃
T_{jop}	Operating Junction Temperature	-40 to +150	℃
T_{STG}	Storage Temperature Range	-40 to +125	℃
V_{ISO}	Isolation Voltage RMS,f=50Hz,t=1min	4000	V

T1,T2 IGBT Characteristics T_C=25℃ unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	I_C=40A,V_{GE}=15V, T_j=25℃		2.05	2.50	V
		I_C=40A,V_{GE}=15V, T_j=125℃		2.50		
		I_C=40A,V_{GE}=15V, T_j=150℃		2.60		
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	I_C=1.5mA,V_{CE}=V_{GE}, T_j=25℃	5.3	5.8	6.3	V
I_{CES}	Collector Cut-Off Current	V_{CE}=V_{CES},V_{GE}=0V, T_j=25℃			1.0	mA
I_{GES}	Gate-Emitter Leakage Current	V_{GE}=V_{GES},V_{CE}=0V, T_j=25℃			400	nA
R_{Gint}	Internal Gate Resistance			/		Ω
C_{ies}	Input Capacitance	V_{CE}=25V,f=1MHz, V_{GE}=0V		2.33		nF
C_{res}	Reverse Transfer Capacitance			0.13		nF
Q_G	Gate Charge	V_{GE}=15V		0.19		μC
$t_{d(on)}$	Turn-On Delay Time	V_{CC}=600V,I_C=40A, R_G=15Ω,V_{GE}=±15V, T_j=25℃		170		ns
t_r	Rise Time			51		ns
$t_{d(off)}$	Turn-Off Delay Time			210		ns
t_f	Fall Time			135		ns
E_{on}	Turn-On Switching Loss			2.00		mJ
E_{off}	Turn-Off Switching Loss			1.35		mJ
$t_{d(on)}$	Turn-On Delay Time	V_{CC}=600V,I_C=40A, R_G=15Ω,V_{GE}=±15V, T_j=125℃		173		ns
t_r	Rise Time			53		ns
$t_{d(off)}$	Turn-Off Delay Time			235		ns
t_f	Fall Time			190		ns
E_{on}	Turn-On Switching Loss			2.68		mJ
E_{off}	Turn-Off Switching Loss			2.30		mJ
$t_{d(on)}$	Turn-On Delay Time	V_{CC}=600V,I_C=40A, R_G=15Ω,V_{GE}=±15V, T_j=150℃		175		ns
t_r	Rise Time			54		ns
$t_{d(off)}$	Turn-Off Delay Time			240		ns
t_f	Fall Time			200		ns
E_{on}	Turn-On Switching Loss			2.70		mJ
E_{off}	Turn-Off Switching Loss			2.35		mJ
I_{SC}	SC Data	t_P≤10μs,V_{GE}=15V, T_j=150℃,V_{CC}=900V, V_{CEM}≤1200V		160		A

D1,D2 Diode Characteristics T_C=25℃ unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
V_F	Diode Forward Voltage	I_F=40A,V_{GE}=0V,T_j=25℃		2.10	2.50	V
		I_F=40A,V_{GE}=0V,T_j=125℃		2.00		
		I_F=40A,V_{GE}=0V,T_j=150℃		1.97		
Q_r	Recovered Charge	V_R=600V,I_F=40A, -di/dt=550A/μs,V_{GE}=-15V T_j=25℃		2.6		μC
I_{RM}	Peak Reverse Recovery Current			23		A
E_{rec}	Reverse Recovery Energy			1.32		mJ
Q_r	Recovered Charge	V_R=600V,I_F=40A, -di/dt=550A/μs,V_{GE}=-15V T_j=125℃		4.9		μC
I_{RM}	Peak Reverse Recovery Current			27		A
E_{rec}	Reverse Recovery Energy			2.47		mJ
Q_r	Recovered Charge	V_R=600V,I_F=40A, -di/dt=550A/μs,V_{GE}=-15V T_j=150℃		5.1		μC
I_{RM}	Peak Reverse Recovery Current			29		A
E_{rec}	Reverse Recovery Energy			2.57		mJ

T3,T4 IGBT Characteristics T_C=25℃ unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	I_C=50A,V_{GE}=15V, T_j=25℃		1.65	2.15	V
		I_C=50A,V_{GE}=15V, T_j=125℃		1.95		
		I_C=50A,V_{GE}=15V, T_j=150℃		2.00		
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	I_C=1.4mA,V_{CE}=V_{GE}, T_j=25℃	4.0	4.9	6.5	V
I_{CES}	Collector Cut-Off Current	V_{CE}=V_{CES},V_{GE}=0V, T_j=25℃			1.0	mA
I_{GES}	Gate-Emitter Leakage Current	V_{GE}=V_{GES},V_{CE}=0V, T_j=25℃			400	nA
R_{Gint}	Internal Gate Resistance			/		Ω
C_{ies}	Input Capacitance	V_{CE}=30V,f=1MHz, V_{GE}=0V		3.03		nF
C_{res}	Reverse Transfer Capacitance			0.09		nF
Q_G	Gate Charge	V_{GE}=15V		0.10		μC
$t_{d(on)}$	Turn-On Delay Time	V_{CC}=300V,I_C=50A, R_G=3.3Ω,V_{GE}=±15V, T_j=25℃		58		ns
t_r	Rise Time			31		ns
$t_{d(off)}$	Turn-Off Delay Time			80		ns
t_f	Fall Time			100		ns
E_{on}	Turn-On Switching Loss			0.41		mJ
E_{off}	Turn-Off Switching Loss			0.42		mJ
$t_{d(on)}$	Turn-On Delay Time	V_{CC}=300V,I_C=50A, R_G=3.3Ω,V_{GE}=±15V, T_j=125℃		64		ns
t_r	Rise Time			37		ns
$t_{d(off)}$	Turn-Off Delay Time			90		ns
t_f	Fall Time			117		ns
E_{on}	Turn-On Switching Loss			0.69		mJ
E_{off}	Turn-Off Switching Loss			0.69		mJ
$t_{d(on)}$	Turn-On Delay Time	V_{CC}=300V,I_C=50A, R_G=3.3Ω,V_{GE}=±15V, T_j=150℃		66		ns
t_r	Rise Time			38		ns
$t_{d(off)}$	Turn-Off Delay Time			92		ns
t_f	Fall Time			120		ns
E_{on}	Turn-On Switching Loss			0.90		mJ
E_{off}	Turn-Off Switching Loss			0.90		mJ
I_{SC}	SC Data	t_P≤5μs,V_{GE}=15V, T_j=150℃,V_{CC}=360V, V_{CEM}≤600V		450		A

D3,D4 Diode Characteristics T_C=25℃ unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
V_F	Diode Forward Voltage	I_F=30A,V_{GE}=0V,T_j=25℃		1.45	1.90	V
		I_F=30A,V_{GE}=0V,T_j=125℃		1.43		
		I_F=30A,V_{GE}=0V,T_j=150℃		1.41		
Q_r	Recovered Charge	V_R=300V,I_F=30A, -di/dt=1250A/μs,V_{GE}=-15V T_j=25℃		1.9		μC
I_{RM}	Peak Reverse Recovery Current			35		A
E_{rec}	Reverse Recovery Energy			0.40		mJ
Q_r	Recovered Charge	V_R=300V,I_F=30A, -di/dt=1250A/μs,V_{GE}=-15V T_j=125℃		2.8		μC
I_{RM}	Peak Reverse Recovery Current			36		A
E_{rec}	Reverse Recovery Energy			0.48		mJ
Q_r	Recovered Charge	V_R=300V,I_F=30A, -di/dt=1250A/μs,V_{GE}=-15V T_j=150℃		3.0		μC
I_{RM}	Peak Reverse Recovery Current			41		A
E_{rec}	Reverse Recovery Energy			0.65		mJ

NTC Characteristics T_C=25℃ unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
R_{25}	Rated Resistance			22.0		kΩ
ΔR/R	Deviation of R_{100}	T_C=100℃,R_{100}=1486.1Ω	-5		5	%
P_{25}	Power Dissipation				200	mW
$B_{25/50}$	B-value	$R_2=R_{25}\exp[B_{25/50}(1/T_2-1/(298.15K))]$		4000		K

Module Characteristics T_C=25℃ unless otherwise noted

Symbol	Parameter	Min.	Typ.	Max.	Unit
$R_{\theta JC}$	Junction-to-Case (per T1,T2 IGBT) Junction-to-Case (per D1,D2 Diode) Junction-to-Case (per T3,T4 IGBT) Junction-to-Case (per D3,D4 Diode)			0.585 1.133 0.806 1.584	K/W
$R_{\theta CS}$	Case-to-Sink (per T1,T2 IGBT) Case-to-Sink (per D1,D2 Diode) Case-to-Sink (per T3,T4 IGBT) Case-to-Sink (per D3,D4 Diode)		0.183 0.354 0.252 0.495		K/W
$R_{\theta CS}$	Case-to-Sink		0.035		K/W

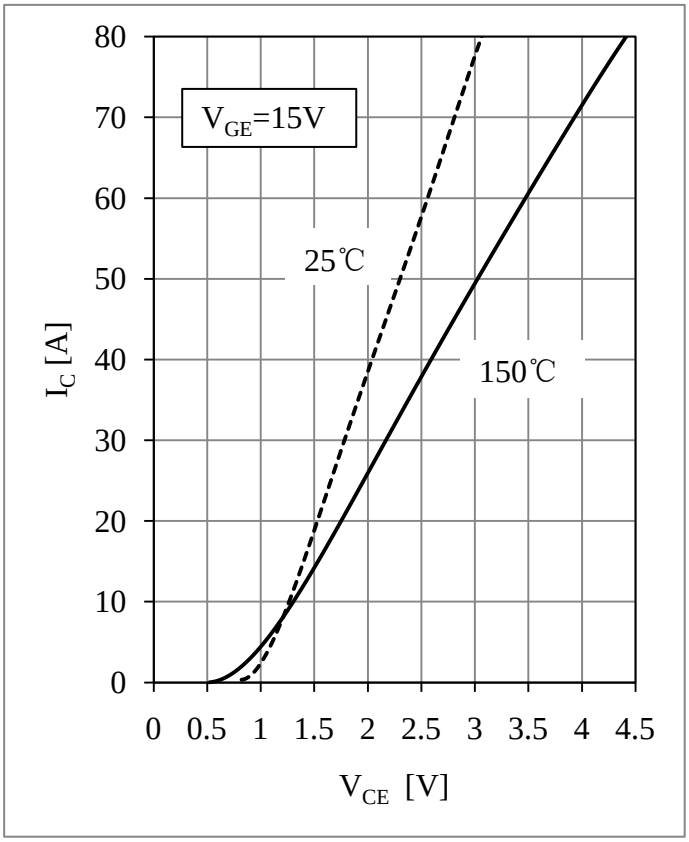


Fig 1. T1,T2 IGBT Output Characteristics

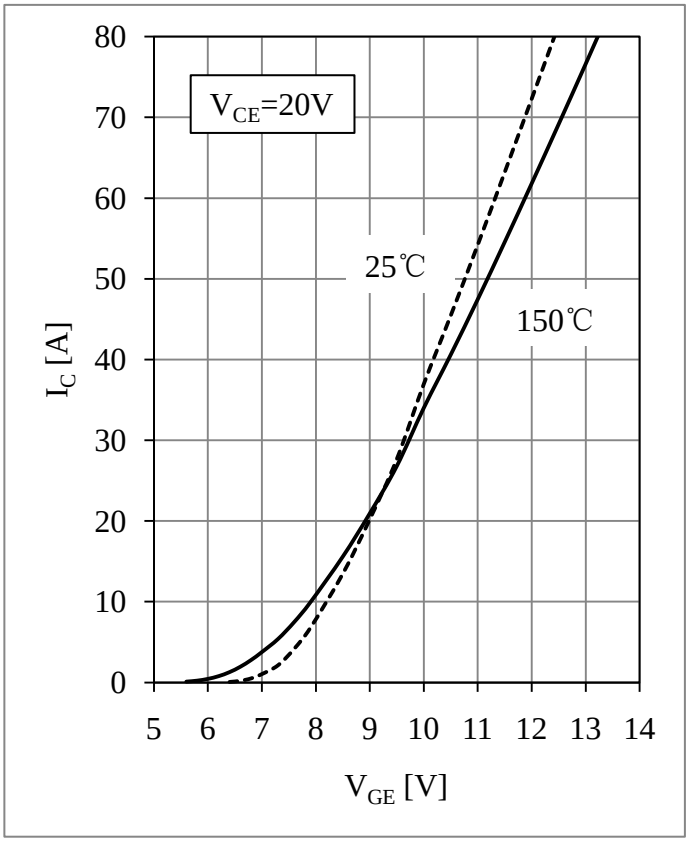


Fig 2. T1,T2 IGBT Transfer Characteristics

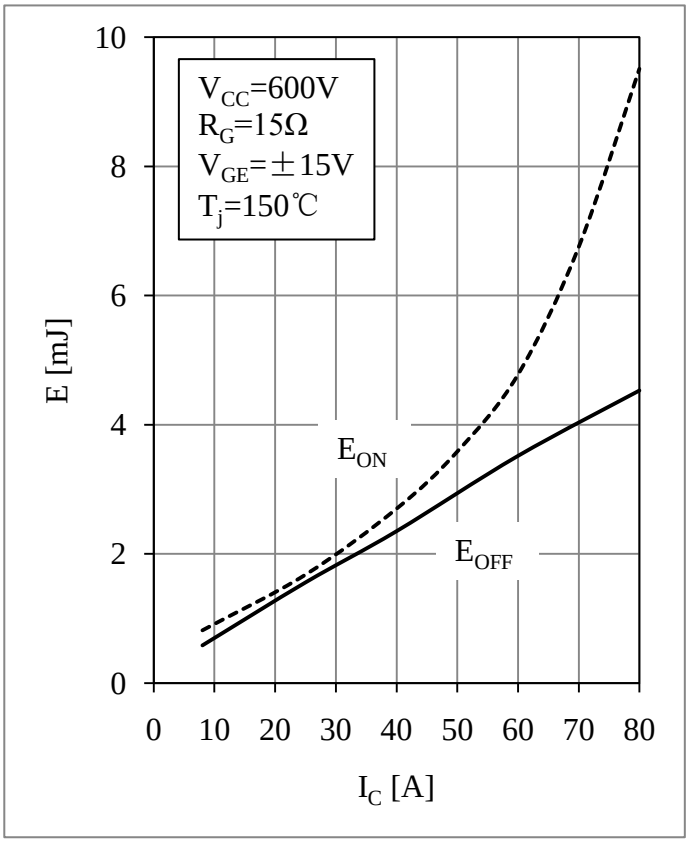


Fig 3. T1,T2 IGBT Switching Loss vs. I_C

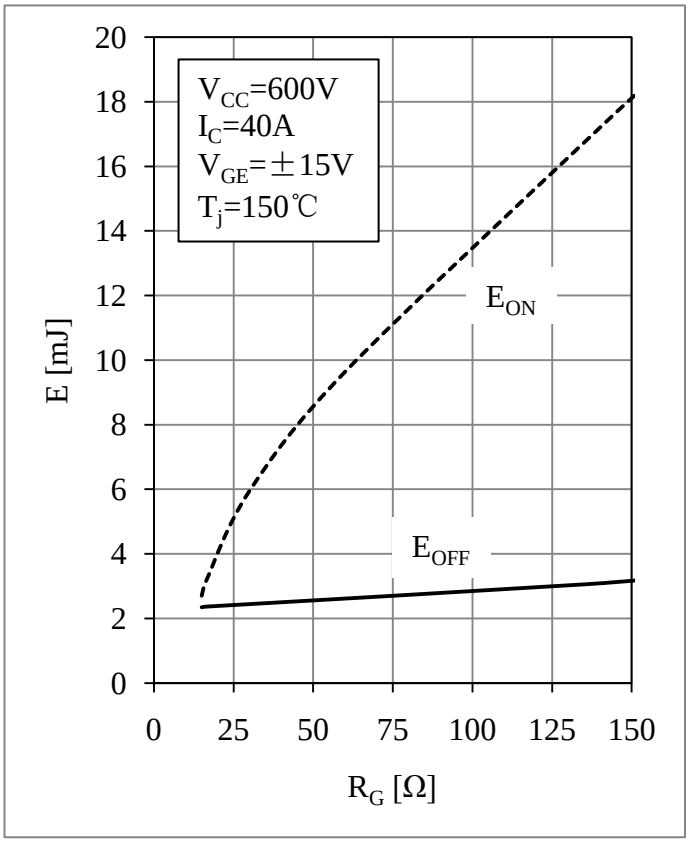


Fig 4. T1,T2 IGBT Switching Loss vs. R_G

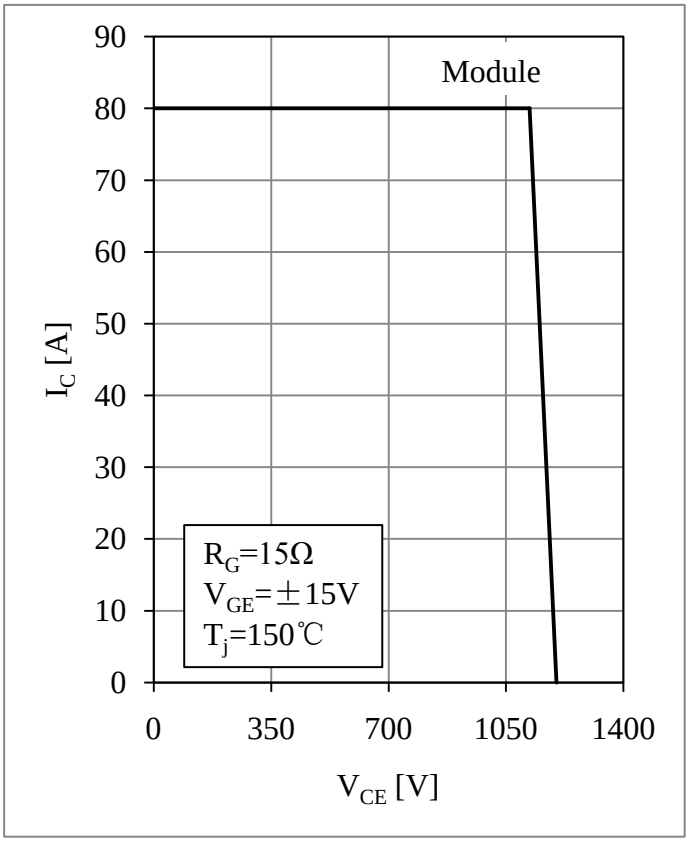


Fig 5. T1,T2 RBSOA

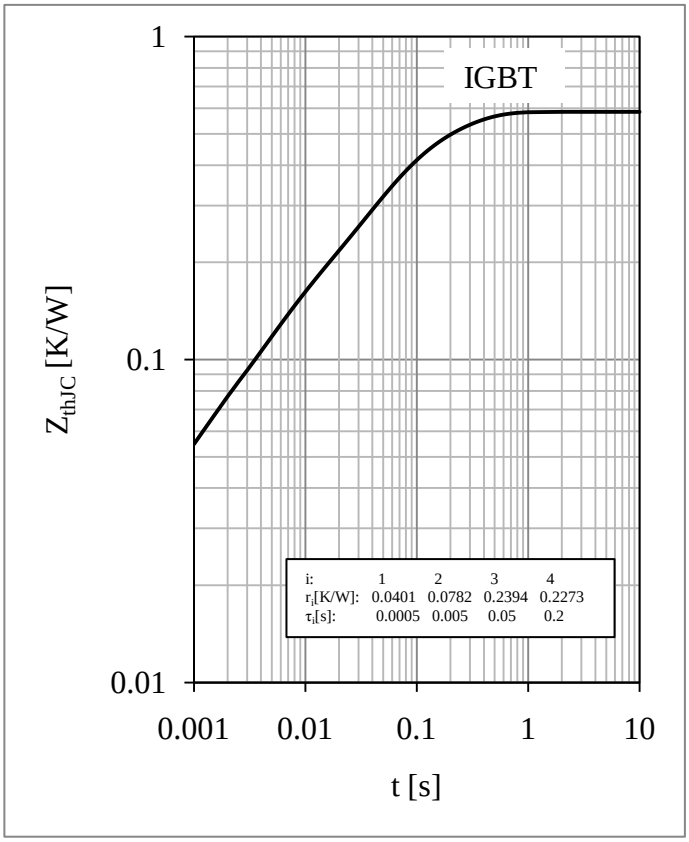


Fig 6. T1,T2 IGBT Transient Thermal Impedance

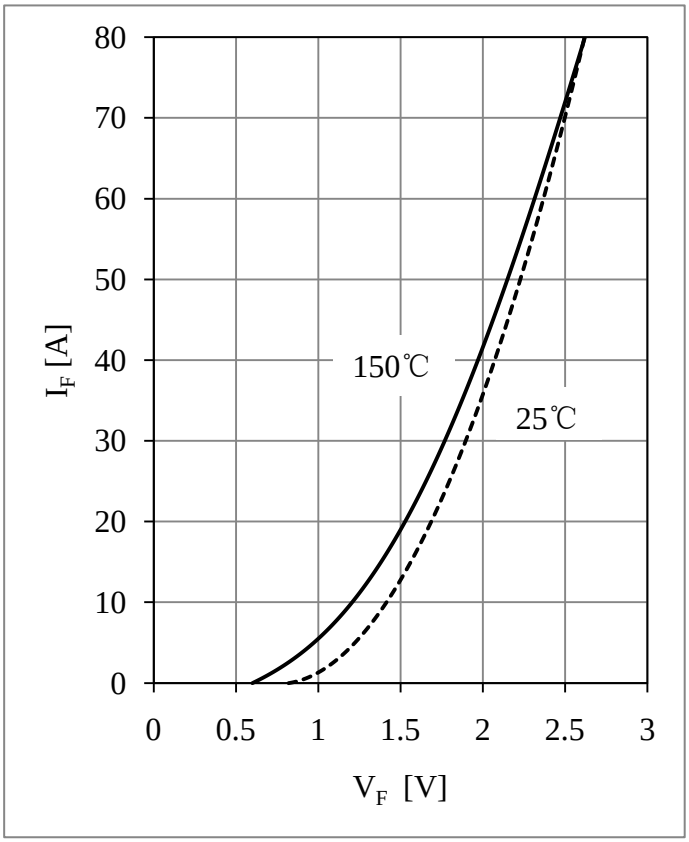


Fig 7. D1,D2 Diode Forward Characteristics

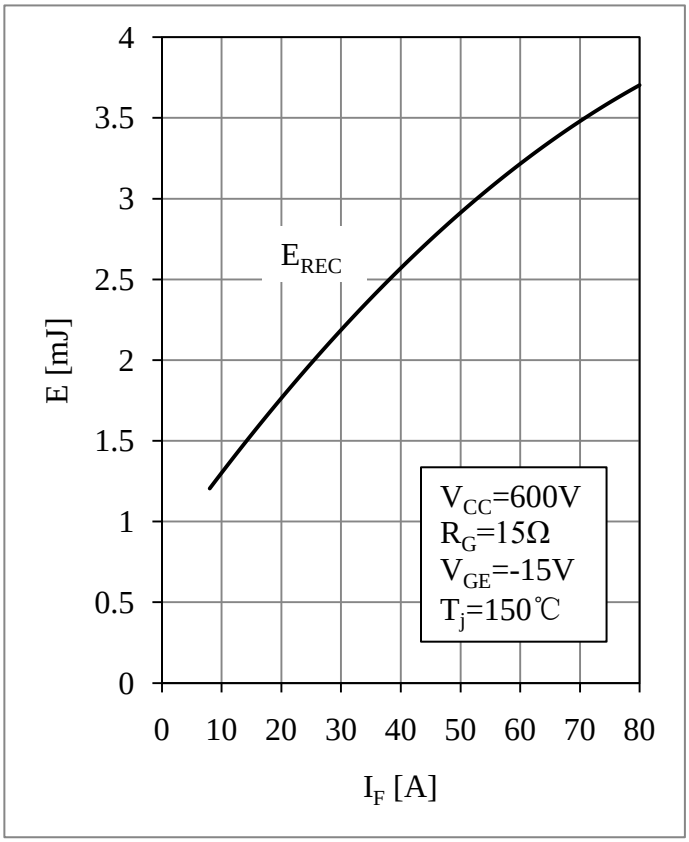


Fig 8. D1,D2 Diode Switching Loss vs. I_F

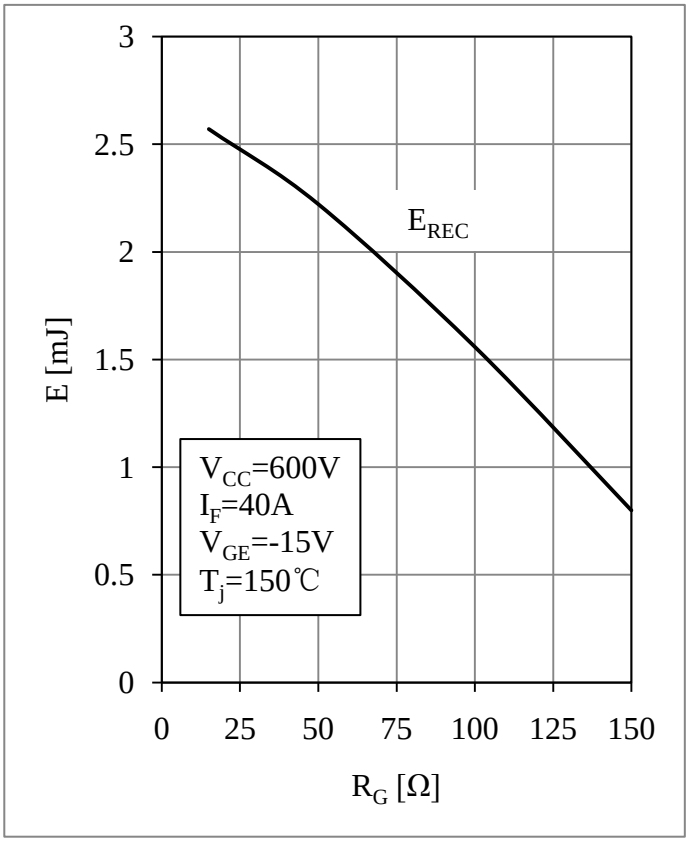


Fig 9. D1,D2 Diode Switching Loss vs. R_G

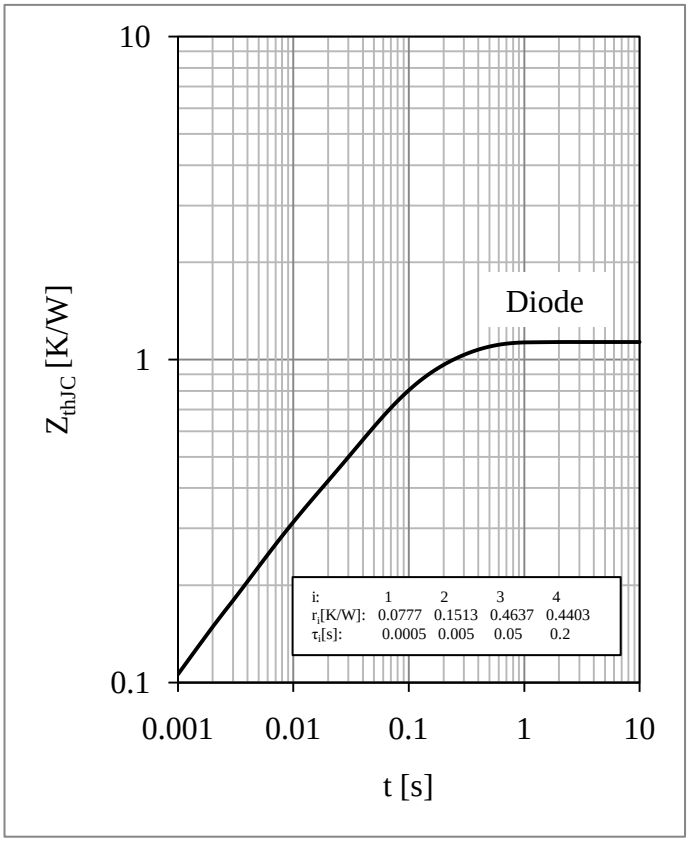


Fig 10. D1,D2 Diode Transient Thermal Impedance

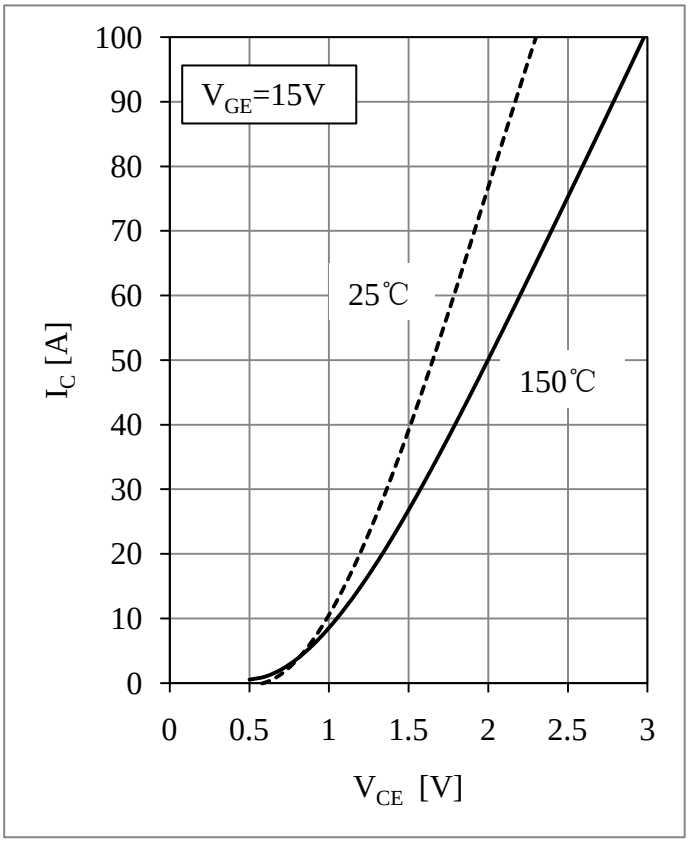


Fig 11. T3,T4 IGBT Output Characteristics

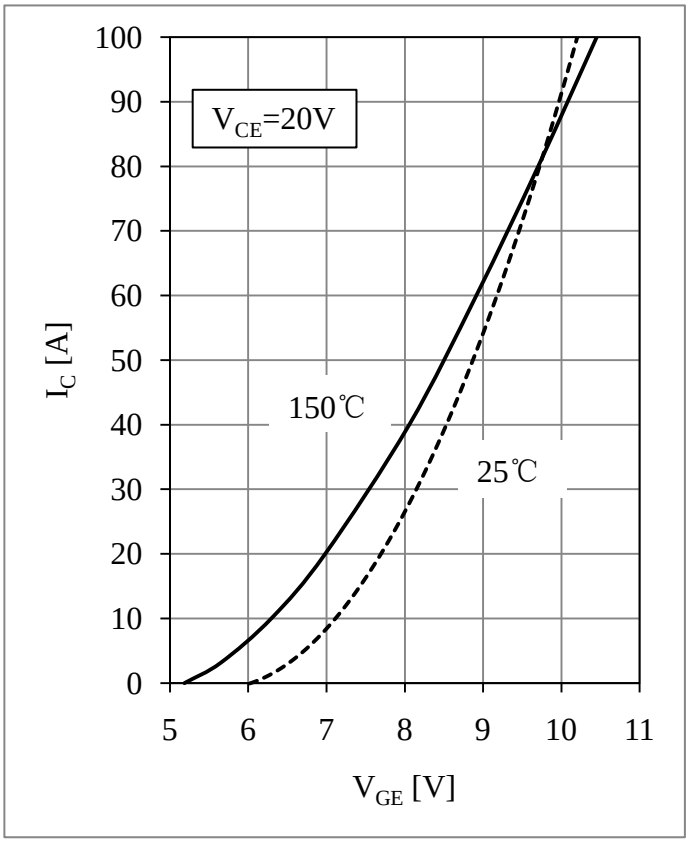


Fig 12. T3,T4 IGBT Transfer Characteristics

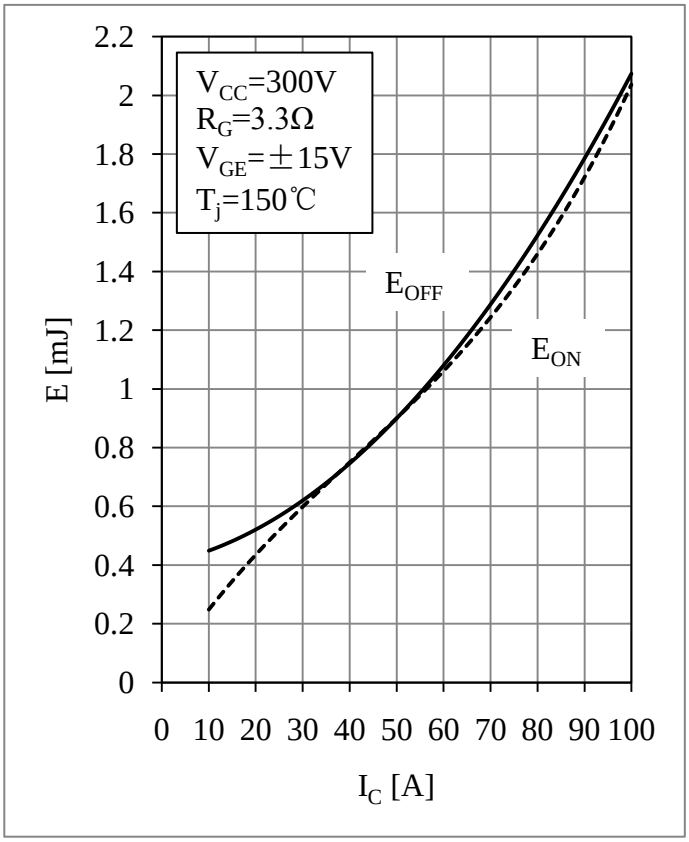


Fig 13. T3,T4 IGBT Switching Loss vs. I_C

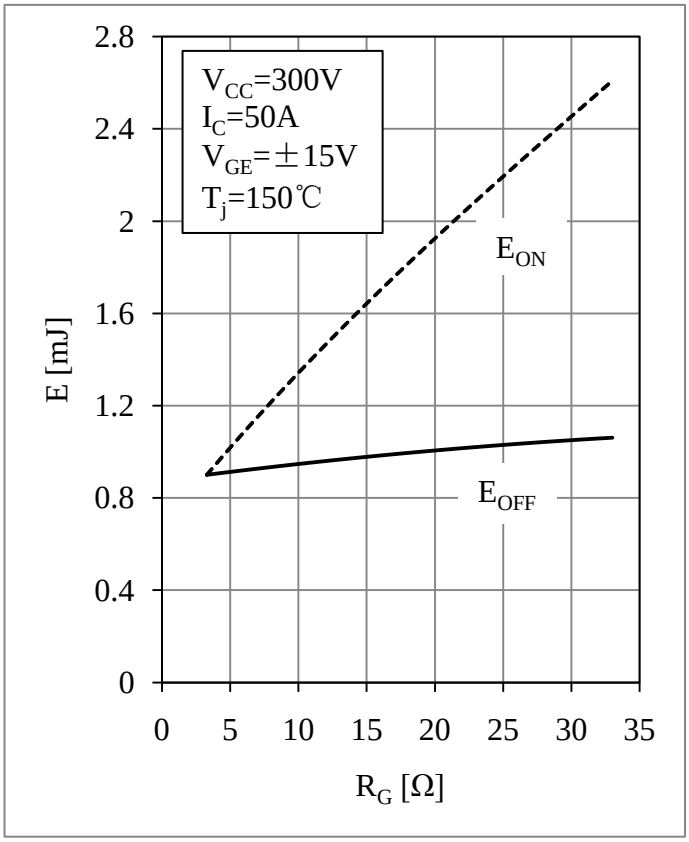


Fig 14. T3,T4 IGBT Switching Loss vs. R_G

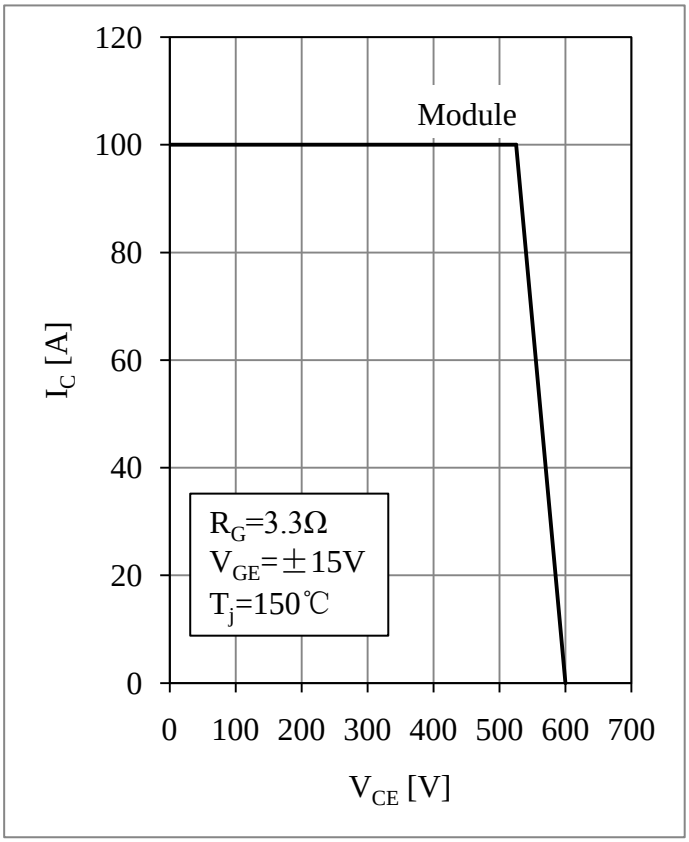


Fig 15. T3,T4 RBSOA

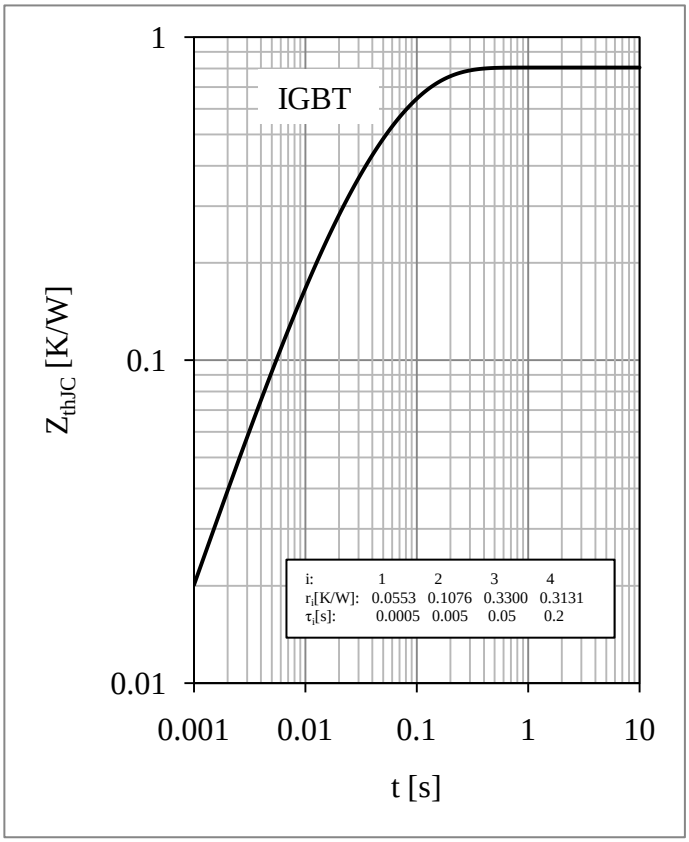


Fig 16. T3,T4 IGBT Transient Thermal Impedance

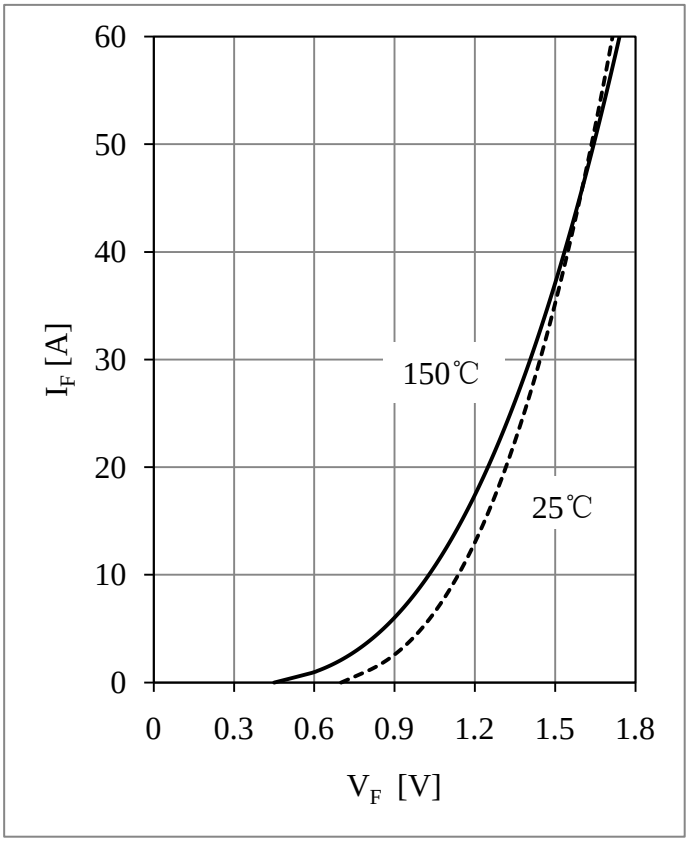


Fig 17. D3,D4 Diode Forward Characteristics

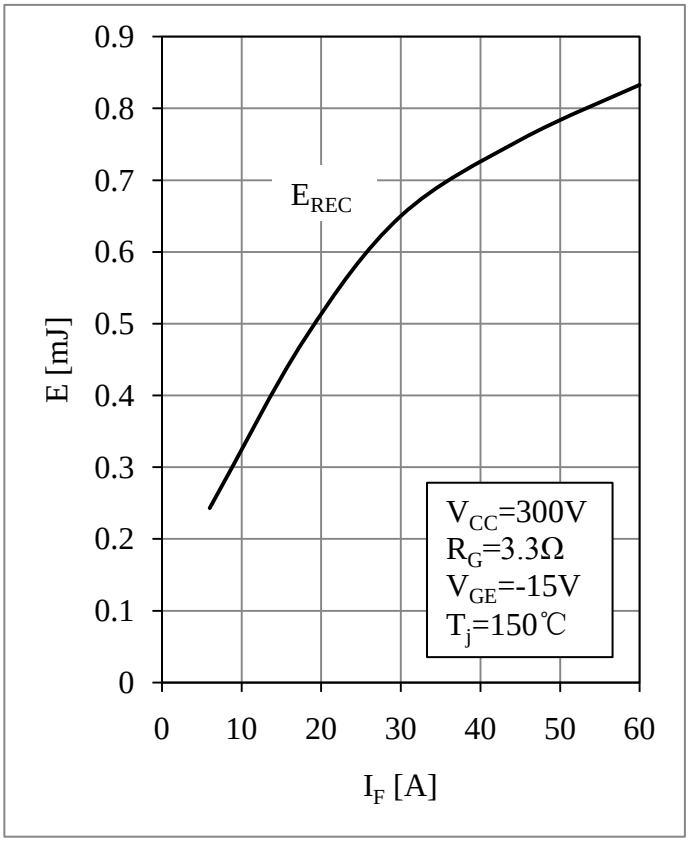


Fig 18. D3,D4 Diode Switching Loss vs. I_F

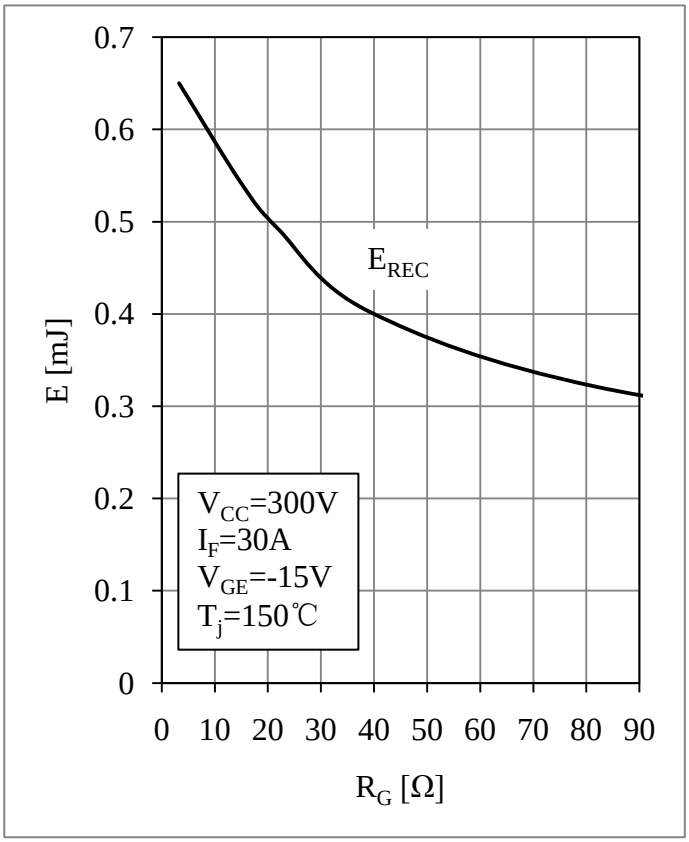


Fig 19. D3,D4 Diode Switching Loss vs. R_G

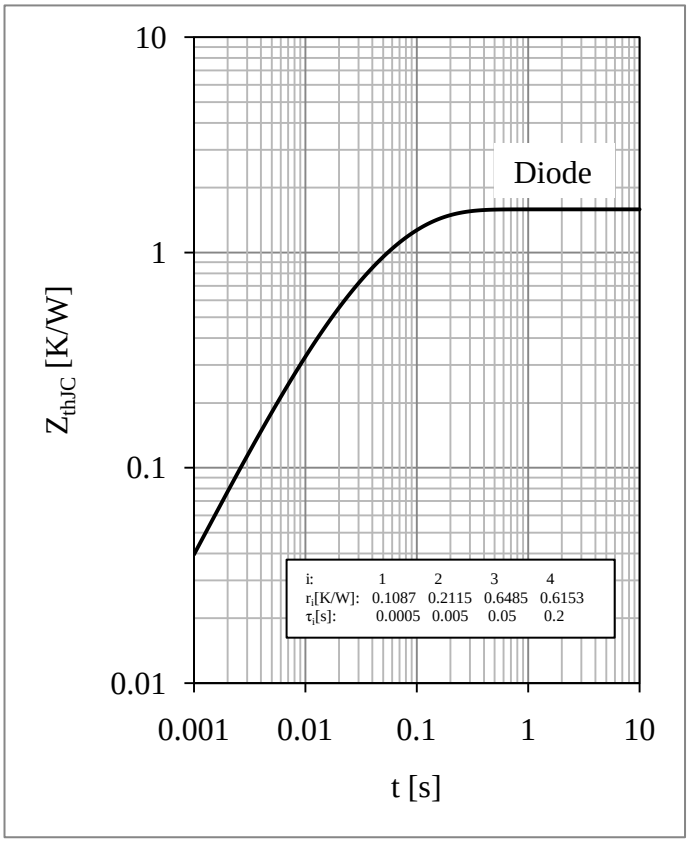


Fig 20. D3,D4 Diode Transient Thermal Impedance

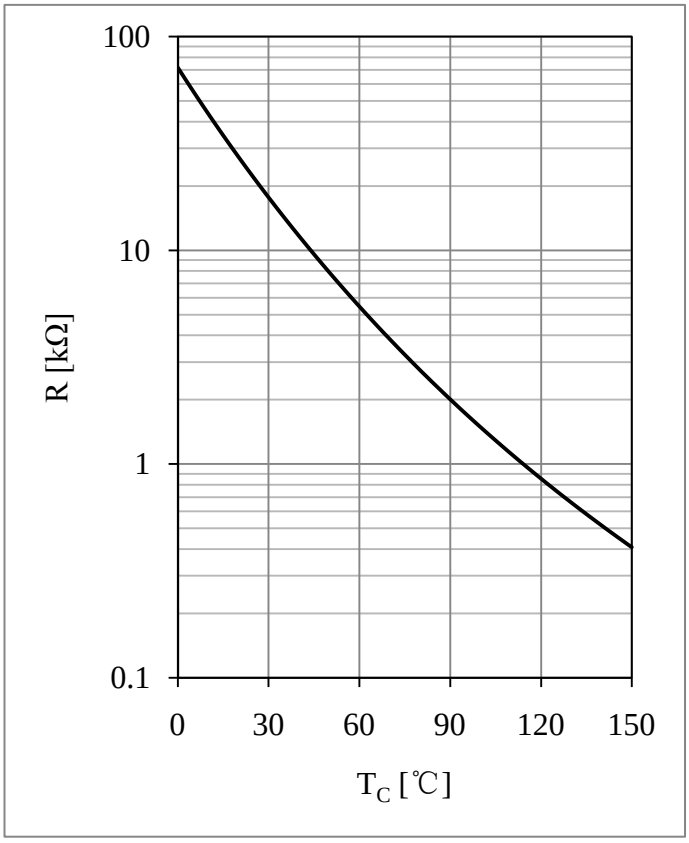
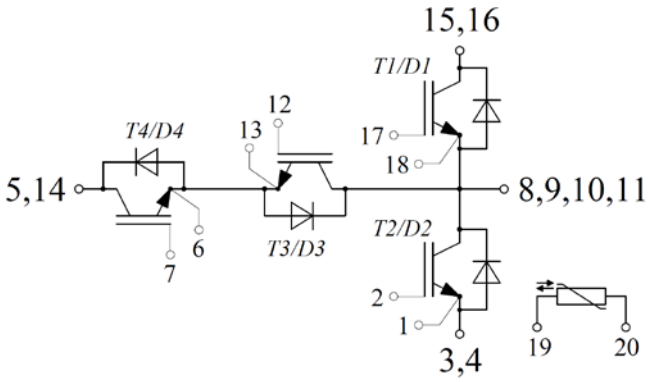


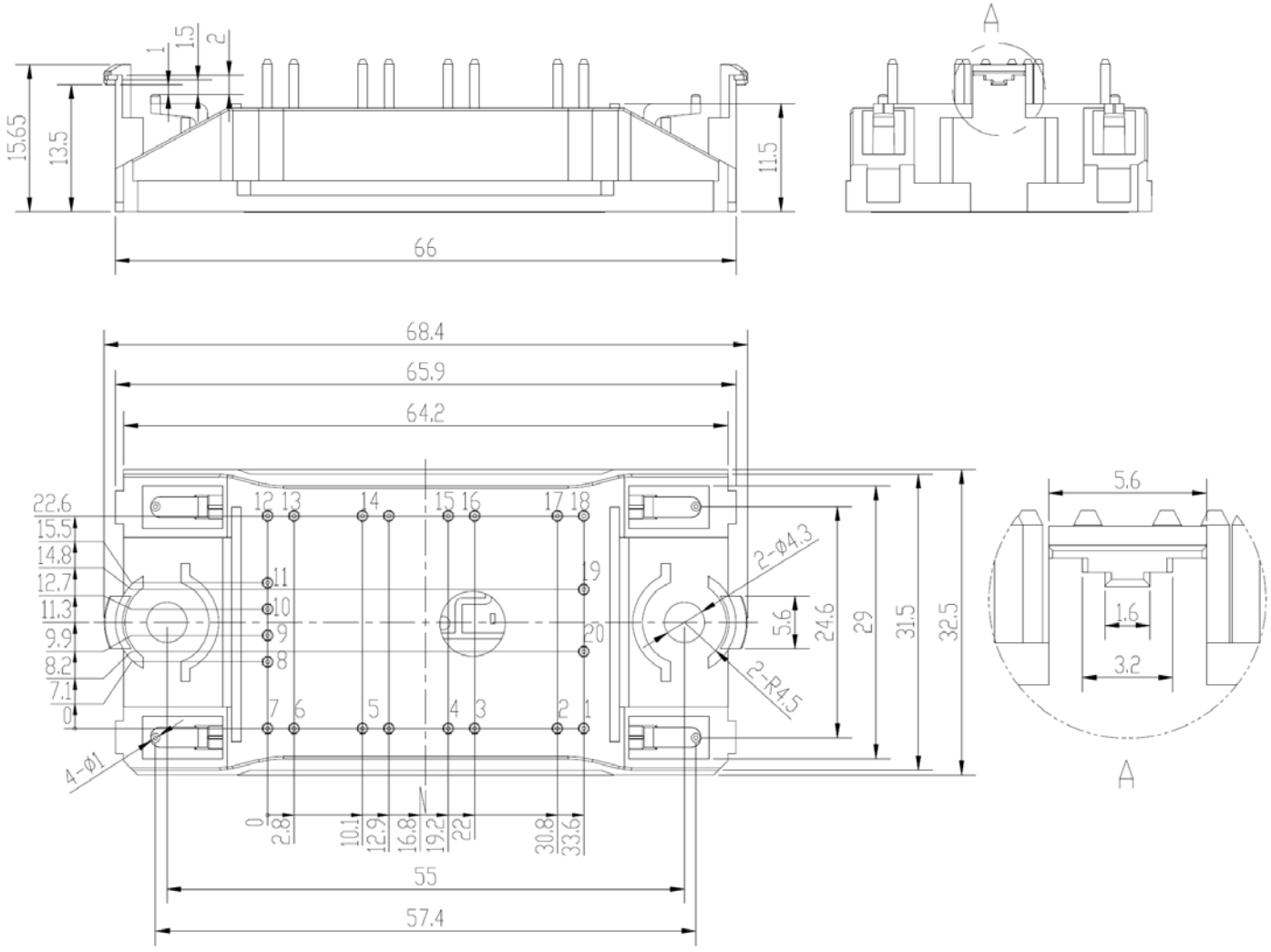
Fig 21. NTC Temperature Characteristic

Circuit Schematic



Package Dimensions

Dimensions in Millimeters



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