

HCG450FL120A3F5D1

1200V 450A IGBT 模块, A3 封装, 内置续流二极管及NTC
1200V 450A IGBT Module, A3 Package, with FWD and NTC

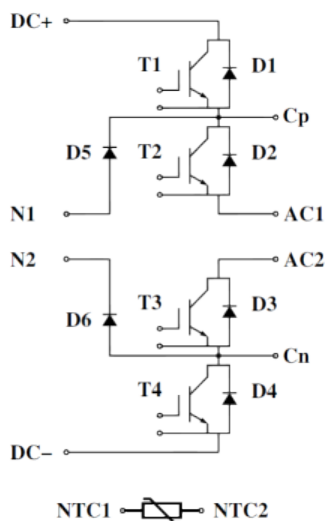
特点 Features

- 低开关损耗
Low switching losses
- 高功率密度
High power density
- 正温度系数
Positive temperature coefficient



应用 Applications

- 储能系统
Energy storage systems
- 太阳能应用
Solar applications
- 三电平应用
Three-level applications



最大额定值/ Maximum Rated Values ($T_{vj}=25^{\circ}\text{C}$ unless otherwise noted)

参数 Parameter	符号 Symbol	条件 Condition	数值 Value	单位 Unit
最高结温 Maximum junction temperature	$T_{vj\max}$		175	$^{\circ}\text{C}$
工作结温 Operating junction temperature	$T_{vj\text{op}}$		-40~150	$^{\circ}\text{C}$
存贮温度 Storage temperature	T_{stg}		-40~125	$^{\circ}\text{C}$

IGBT, T1/T4

参数 Parameter	符号 Symbol	条件 Condition	数值 Value	单位 Unit
集电极-射极电压 Collector-emitter voltage	V_{CES}	$V_{GE}=0V, T_{vj}=25^{\circ}C$	1200	V
集电极直流电流 DC collector current	I_C	$T_C=110^{\circ}C, T_{vj\ max}=175^{\circ}C$	450	A
集电极峰值电流 Peak collector current	I_{CM}	$t_p=1ms$	900	A
功率损耗 Total power dissipation	P_{tot}	$T_C=25^{\circ}C, T_{vj\ max}=175^{\circ}C$	3200	W
极-射极峰值电压 Gate-emitter peak voltage	V_{GES}		± 20	V

IGBT, T2/T3

参数 Parameter	符号 Symbol	条件 Condition	数值 Value	单位 Unit
集电极-射极电压 Collector-emitter voltage	V_{CES}	$V_{GE}=0V, T_{vj}=25^{\circ}C$	1200	V
集电极直流电流 DC collector current	I_C	$T_C=115^{\circ}C, T_{vj\ max}=175^{\circ}C$	450	A
集电极峰值电流 Peak collector current	I_{CM}	$t_p=1ms$	900	A
功率损耗 Total power dissipation	P_{tot}	$T_C=25^{\circ}C, T_{vj\ max}=175^{\circ}C$	3300	W
极-射极峰值电压 Gate-emitter peak voltage	V_{GES}		± 20	V

Diode, D1/D4

参数 Parameter	符号 Symbol	条件 Condition	数值 Value	单位 Unit
反向重复峰值电压 Repetitive peak reverse voltage	V_{RRM}	$T_{vj}=25^{\circ}C$	1200	V
正向直流电流 Continuous DC forward current	I_F		450	A
正向重复峰值电流 Repetitive peak forward current	I_{FRM}	$t_p=1ms$	900	A
I^2t - I^2t -value Diode, D2/D3	I^2t	$V_R=0V, t_p=10ms, T_{vj}=125^{\circ}C$	19000	A^2s

参数 Parameter	符号 Symbol	条件 Condition	数值 Value	单位 Unit
功率损耗 Total power dissipation	P_{tot}	$T_C=25^{\circ}C, T_{vj\ max}=175^{\circ}C$	1650	W
反向重复峰值电压 Repetitive peak reverse voltage	V_{RRM}	$T_{vj}=25^{\circ}C$	1200	V
正向直流电流 Continuous DC forward current	I_F		450	A
正向重复峰值电流 Repetitive peak forward current	I_{FRM}	$t_p=1ms$	900	A
I^2t - I^2t -value Diode, D5/D6	I^2t	$V_R=0V, t_p=10ms, T_{vj}=125^{\circ}C$	19000	A^2s

参数 Parameter	符号 Symbol	条件 Condition	数值 Value	单位 Unit
功率损耗 Total power dissipation	P_{tot}	$T_C=25^{\circ}C, T_{vj\ max}=175^{\circ}C$	1650	W
反向重复峰值电压 Repetitive peak reverse voltage	V_{RRM}	$T_{vj}=25^{\circ}C$	1200	V
正向直流电流 Continuous DC forward current	I_F		450	A
正向重复峰值电流 Repetitive peak forward current	I_{FRM}	$t_p=1ms$	900	A
I^2t - I^2t -value	I^2t	$V_R=0V, t_p=10ms, T_{vj}=125^{\circ}C$	19000	A^2s
功率损耗 Total power dissipation	P_{tot}	$T_C=25^{\circ}C, T_{vj\ max}=175^{\circ}C$	1650	W

IGBT特征值 IGBT Characteristics Values*¹ (T_{vj}=25°C unless otherwise noted)
IGBT, T1 / T4

参数 Parameter	符号 Symbol	条件 Condition		数□ Value			□位 Unit
				Min.	Typ.	Max.	
集□极-□射极□和□□ Collector-emitter saturation voltage	V _{CE sat}	I _C =450A, V _{GE} =15V	T _{vj} =25°C		1.90	2.40	V
			T _{vj} =125°C		2.35		
			T _{vj} =150°C		2.45		
□极-□射极□□□□ Gate-emitter threshold voltage	V _{GE th}	I _C =16mA, V _{CE} =V _{GE}		5.3	5.8	6.3	V
集□极-□射极截止□流 Collector-emitter cut-off current	I _{CES}	V _{CE} =1200V, V _{GE} =0V				1	mA
□极-□射极漏□流 Gate-emitter leakage current	I _{GES}	V _{CE} =0V, V _{GE} =±20V		-100		100	nA
开通延□□□ (□感□□) Turn-on delay time, inductive load	t _{d on}	I _C =450A, V _{CE} =600V, V _{GE} =-8/15V, R _{Gon} =1.65Ω, R _{Goff} =1.65Ω, 开通di/dt=8000A/μs (T _{vj} =150°C), 关断dv/dt=10500V/μs (T _{vj} =150°C), Inductive Load	T _{vj} =25°C		125		ns
			T _{vj} =125°C		128		
			T _{vj} =150°C		130		
上升□□ (□感□□) Rise time, inductive load	t _r		T _{vj} =25°C		35		ns
			T _{vj} =125°C		41		
			T _{vj} =150°C		42		
关断延□□□ (□感□□) Turn-off delay time, inductive load	t _{d off}		T _{vj} =25°C		215		ns
			T _{vj} =125°C		245		
			T _{vj} =150°C		253		
下降□□ (□感□□) Fall time, inductive load	t _f		T _{vj} =25°C		130		ns
			T _{vj} =125°C		142		
			T _{vj} =150°C		150		
开通□耗 (每脉冲) Turn-on energy loss per pulse	E _{on}		T _{vj} =25°C		16.0		mJ
			T _{vj} =125°C		23.0		
			T _{vj} =150°C		25.2		
关断□耗 (每脉冲) Turn-off energy loss per pulse	E _{off}		T _{vj} =25°C		19.0		mJ
			T _{vj} =125°C		24.3		
			T _{vj} =150°C		25.6		
内置□极□阻 Internal gate resistance	R _{G int}				1		Ω
□极□荷 Gate charge	Q _G	V _{GE} =-15V~+15V			1.9		μC
□入□容 Input capacitance	C _{ies}	f=1MHz, T _{vj} =25°C, V _{CE} =25V, V _{GE} =0V			68		nF
反向□□□容 Reverse transfer capacitance	C _{res}				1.1		nF

IGBT, T2 / T3

参数 Parameter	符号 Symbol	条件 Condition		数口 Value			口位 Unit
				Min.	Typ.	Max.	
集口极-口射极口和口口 Collector-emitter saturation voltage	V _{CE sat}	I _C =450A, V _{GE} =15V	T _{vj} =25°C		1.90	2.40	V
			T _{vj} =125°C		2.35		
			T _{vj} =150°C		2.45		
口极-口射极口口口口 Gate-emitter threshold voltage	V _{GE th}	I _C =16mA, V _{CE} =V _{GE}		5.3	5.8	6.3	V
集口极-口射极截止口流 Collector-emitter cut-off current	I _{CES}	V _{CE} =1200V, V _{GE} =0V				1	mA
口极-口射极漏口流 Gate-emitter leakage current	I _{GES}	V _{CE} =0V, V _{GE} =±20V		-100		100	nA
开通延口口口（口感口口） Turn-on delay time, inductive load	t _{d on}	I _C =450A, V _{CE} =600V, V _{GE} =-8/15V, R _{Gon} =1.65Ω, R _{Goff} =1.65Ω, 开通di/dt=7800A/μs (T _{vj} =150°C), 关断dv/dt=10500V/μs (T _{vj} =150°C), Inductive Load	T _{vj} =25°C		117		ns
			T _{vj} =125°C		120		
			T _{vj} =150°C		122		
上升口口（口感口口） Rise time, inductive load	t _r		T _{vj} =25°C		41		ns
			T _{vj} =125°C		45		
			T _{vj} =150°C		46		
关断延口口口（口感口口） Turn-off delay time, inductive load	t _{d off}		T _{vj} =25°C		211		ns
			T _{vj} =125°C		250		
			T _{vj} =150°C		256		
下降口口（口感口口） Fall time, inductive load	t _f		T _{vj} =25°C		207		ns
			T _{vj} =125°C		185		
			T _{vj} =150°C		188		
开通口耗（每脉冲） Turn-on energy loss per pulse	E _{on}	T _{vj} =25°C		8.8		mJ	
		T _{vj} =125°C		13.1			
		T _{vj} =150°C		13.8			
关断口耗（每脉冲） Turn-off energy loss per pulse	E _{off}	T _{vj} =25°C		34.2		mJ	
		T _{vj} =125°C		34.5			
		T _{vj} =150°C		35.1			
内置口极口阻 Internal gate resistance	R _{G int}				1		Ω
口极口荷 Gate charge	Q _G	V _{GE} =-8V~+15V			1.9		μC
口入口容 Input capacitance	C _{ies}	f=1MHz, T _{vj} =25°C, V _{CE} =25V, V _{GE} =0V			68		nF
反向口口口容 Reverse transfer capacitance	C _{res}				1.1		nF

*1 IGBT特征值遵从IEC 60747-9。

*1 IGBT特征值遵从IEC 60747-9。

二极管特征值 Diode Characteristics Values*2
Diode, D1 / D4

参数 Parameter	符号 Symbol	条件 Condition		数□ Value			□位 Unit
				Min.	Typ.	Max.	
正向□□ Forward voltage	V _F	I _F =450A	T _{vj} =25°C		2.40	2.90	V
			T _{vj} =125°C		2.55		
			T _{vj} =150°C		2.55		
反向恢复峰□□流 Peak reverse recovery current	I _{RM}	I _F =450A, V _R =600V, V _{GE} =-8V, di _F /dt=-9150A/μs (T _{vj} =150°C)	T _{vj} =25°C		425		A
			T _{vj} =125°C		440		
			T _{vj} =150°C		475		
反向□荷 Reverse charge	Q _{rr}		T _{vj} =25°C		24.5		uC
			T _{vj} =125°C		33.8		
			T _{vj} =150°C		42.8		
反向恢复□耗 Reverse recovery energy loss	E _{rec}	T _{vj} =25°C		10.8		mJ	
		T _{vj} =125°C		13.6			
		T _{vj} =150°C		17.5			

Diode, D2 / D3

参数 Parameter	符号 Symbol	条件 Condition		数值 Value			单位 Unit
				Min.	Typ.	Max.	
正向电压 Forward voltage	V_F	$I_F=450A$	$T_{vj}=25^{\circ}C$		1.60	2.10	V
			$T_{vj}=125^{\circ}C$		1.65		
			$T_{vj}=150^{\circ}C$		1.70		

Diode, D5 / D6

参数 Parameter	符号 Symbol	条件 Condition		数□ Value			□ 位 Unit
				Min.	Typ.	Max.	
正向□□ Forward voltage	V _F	I _F =450A	T _{vj} =25°C		2.40	2.90	V
			T _{vj} =125°C		2.55		
			T _{vj} =150°C		2.55		
反向恢复峰□□ 流 Peak reverse recovery current	I _{RM}	I _F =450A, V _R =600V, V _{GE} =-8V, di _F /dt=-11600A/μs (T _{vj} =150°C)	T _{vj} =25°C		390		A
			T _{vj} =125°C		420		
			T _{vj} =150°C		450		
反向□ 荷 Reverse charge	Q _{rr}		T _{vj} =25°C		20.0		uC
			T _{vj} =125°C		32.3		
			T _{vj} =150°C		40.0		
反向恢复□ 耗 Reverse recovery energy loss	E _{rec}		T _{vj} =25°C		6.8		mJ
			T _{vj} =125°C		12.9		
			T _{vj} =150°C		16.0		

*2 二极管特征值遵从IEC 60747-2。

负温度系数热敏电阻 NTC-Thermistor

参数 Parameter	符号 Symbol	条件 Condition	数 值 Value			单 位 Unit
			Min.	Typ.	Max.	
额定阻值 Rated Resistance	R ₂₅	T _C =25°C		22		kΩ
B-值 B-Value	B _{25/50}	$R_2=R_{25}\exp[B_{25/50}(1/T_2-1/(298,15K))]$		3950		K

封装特性 Package Properties*3

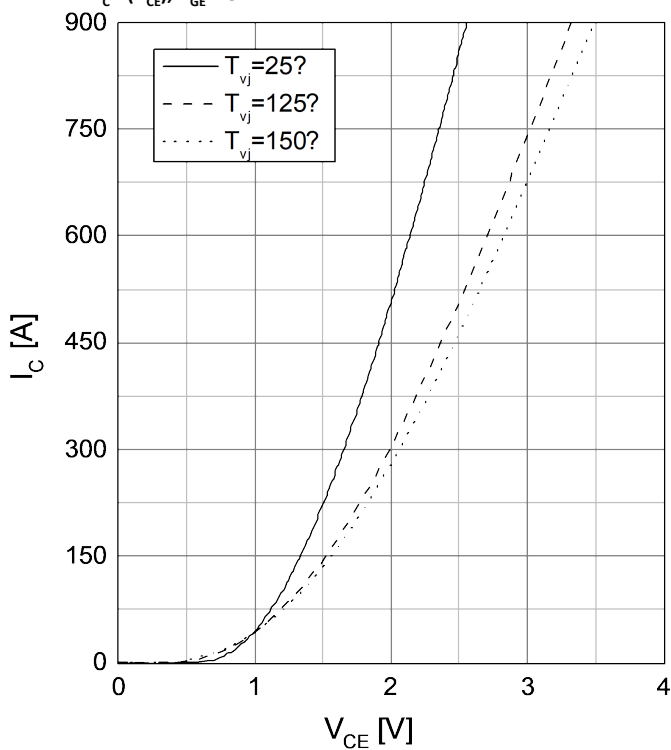
参数 Parameter	符号 Symbol	条件 Condition	数值 Value			单位 Unit
			Min.	Typ.	Max.	
IGBT 壳阻, T1/T4 IGBT thermal resistance: junction to case, T1/T4	$R_{th JC}$	每个IGBT/per IGBT		0.047		K/W
IGBT 壳阻, T2/T3 IGBT thermal resistance: junction to case, T2/T3	$R_{th JC}$	每个IGBT/per IGBT		0.045		K/W
二极管 壳阻, D1/D4 Diode thermal resistance: junction to case, D1/D4	$R_{th JC}$	每个二极管/per Diode		0.080		K/W
二极管 壳阻, D2/D3 Diode thermal resistance: junction to case, D2/D3	$R_{th JC}$	每个二极管/per Diode		0.079		K/W
二极管 壳阻, D5/D6 Diode thermal resistance: junction to case, D5/D6	$R_{th JC}$	每个二极管/per Diode		0.091		K/W
耐压 Isolation voltage	V_{isol}	RMS, f=50Hz, t=60s	4.0			kV
爬电距离 Creepage distance	d_{cr}	端子到散热器 Terminal to heatsink	18			mm
		端子到端子 Terminal to terminal	11.4			mm
气隙 Clearance distance	d_{cl}	端子到散热器 Terminal to heatsink	15			mm
		端子到端子 Terminal to terminal	9.8			mm
相漏起痕指数 Comparative tracking index	CTI		600			
安装扭矩 Mounting torques	M	基板至散热器, Baseplate to heatsink, M5	3.0		6.0	Nm
模块重量 Module weight	G			290		g

*3 封装特性遵从IEC 60747-15

输出特性 IGBT, T1/T4

Output Characteristic IGBT, T1/T4

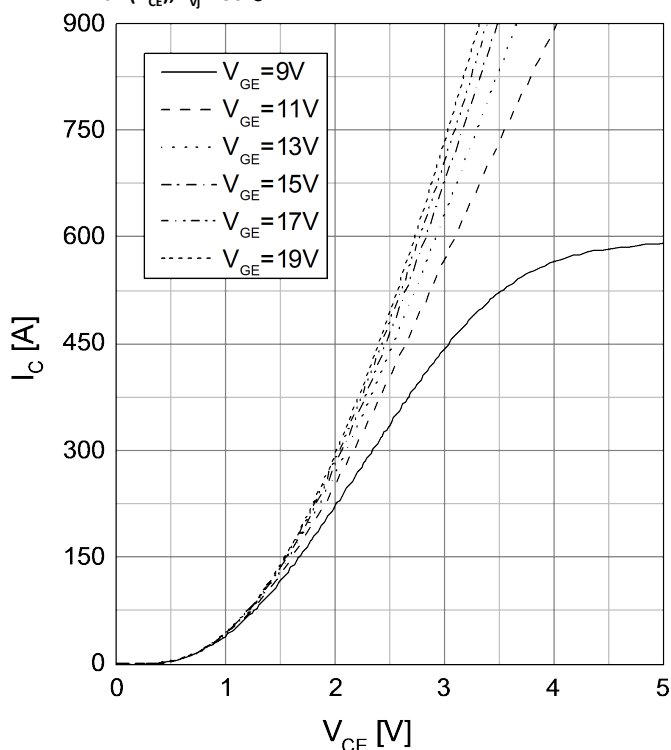
$I_C = f(V_{CE}), V_{GE} = 15V$



输出特性 IGBT, T1/T4

Output Characteristic IGBT, T1/T4

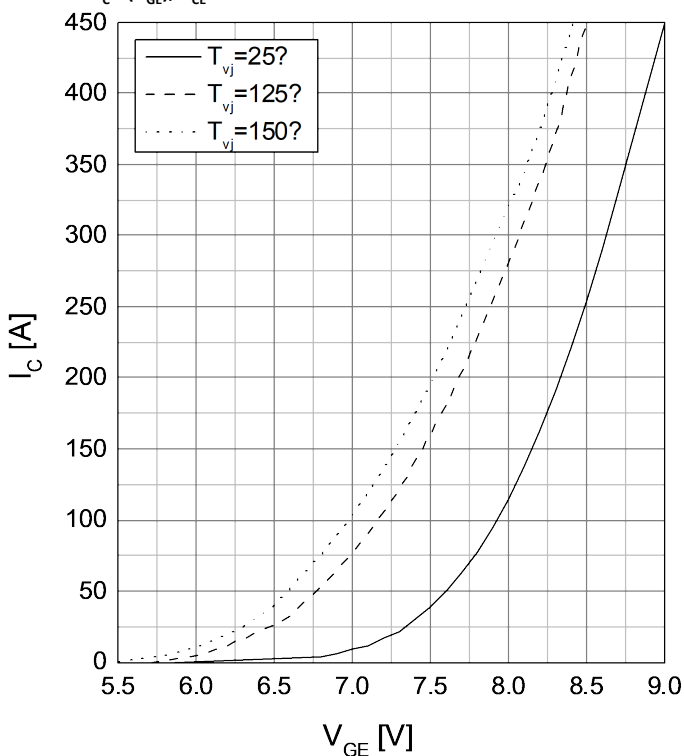
$I_C = f(V_{CE}), T_{vj} = 150^\circ C$



传输特性 IGBT, T1/T4

Transfer Characteristic IGBT, T1/T4

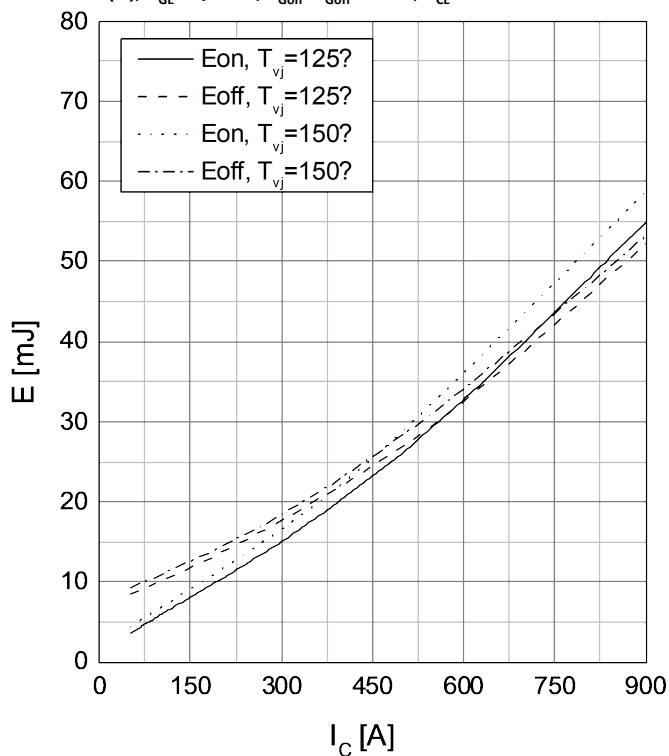
$I_C = f(V_{GE}), V_{CE} = 10V$



开关损耗 IGBT, T1/T4

Switching Losses IGBT, T1/T4

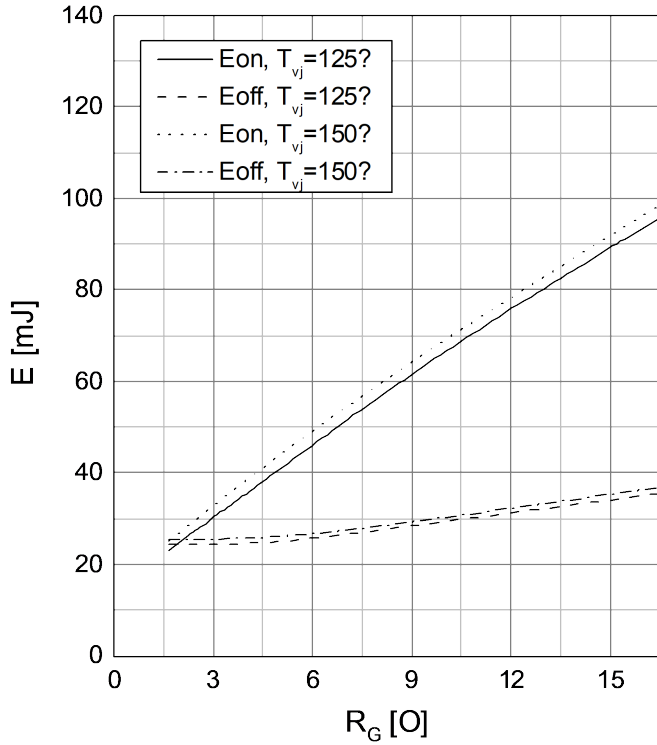
$E = f(I_C), V_{GE} = -8/+15V, R_{Gon} = R_{Goff} = 1.65\Omega, V_{CE} = 600V$



开关损耗 IGBT, T1/T4

Switching Losses IGBT, T1/T4

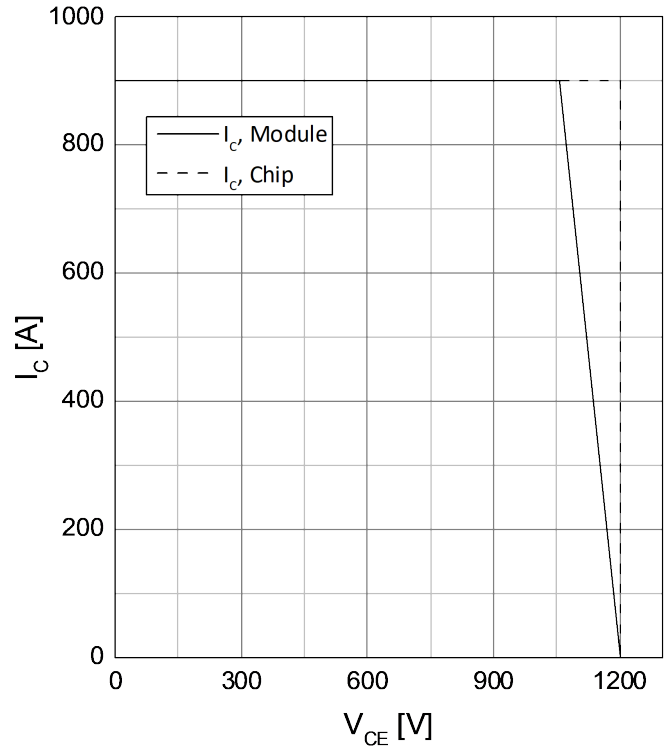
$E=f(R_G)$, $V_{GE}=-8/+15V$, $I_C=450A$, $V_{CE}=600V$



反偏安全工作区 IGBT, T1/T4

Reverse Bias Safe Operating Area IGBT, T1/T4

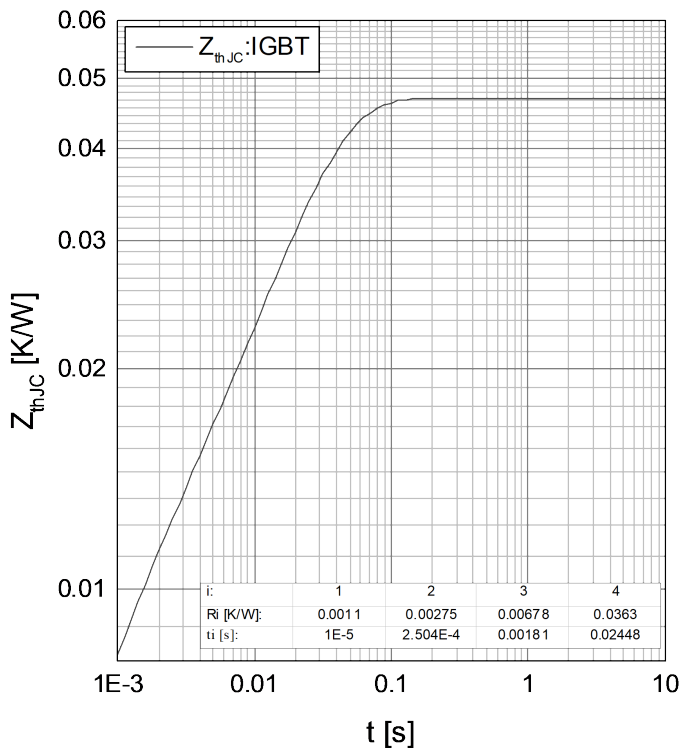
$V_{GE}=-8/+15V$, $R_{Goff}=1.65\Omega$, $T_{vj}=150^\circ C$



瞬态热阻抗 IGBT, T1/T4

Transient Thermal Impedance IGBT, T1/T4

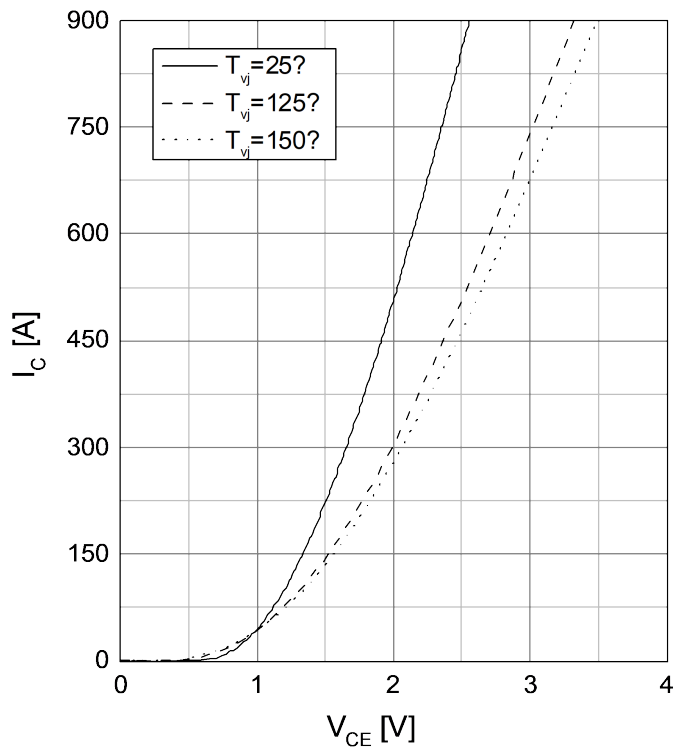
$Z_{thJC}=f(t)$



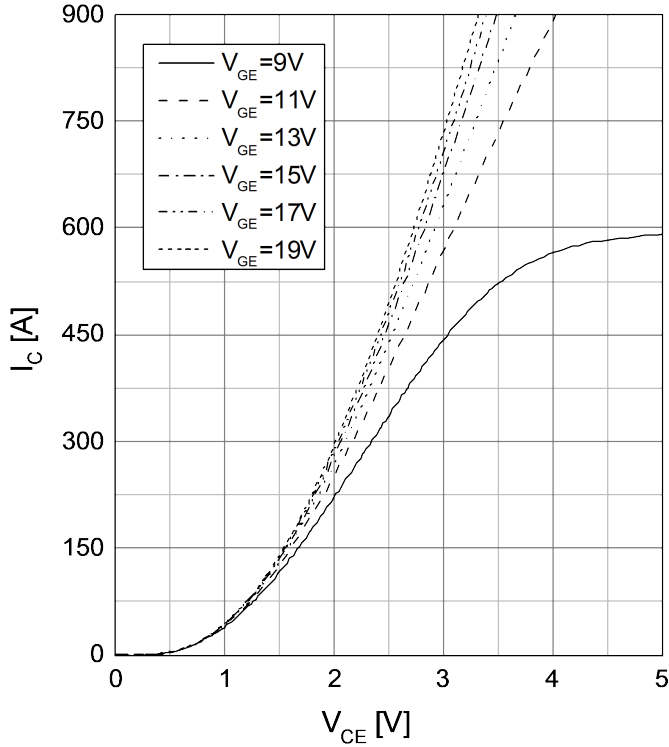
输出特性 IGBT, T2/T3

Output Characteristic IGBT, T2/T3

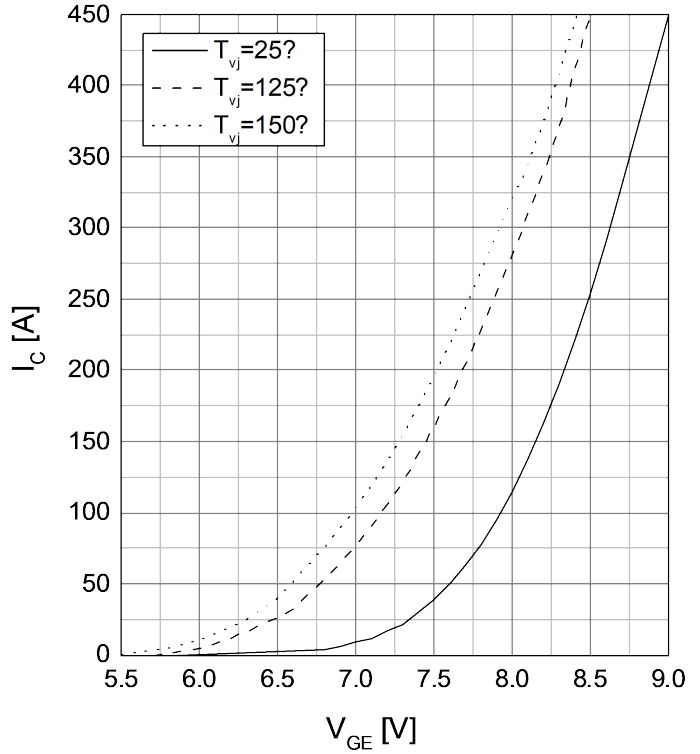
$I_C=f(V_{CE})$, $V_{GE}=15V$



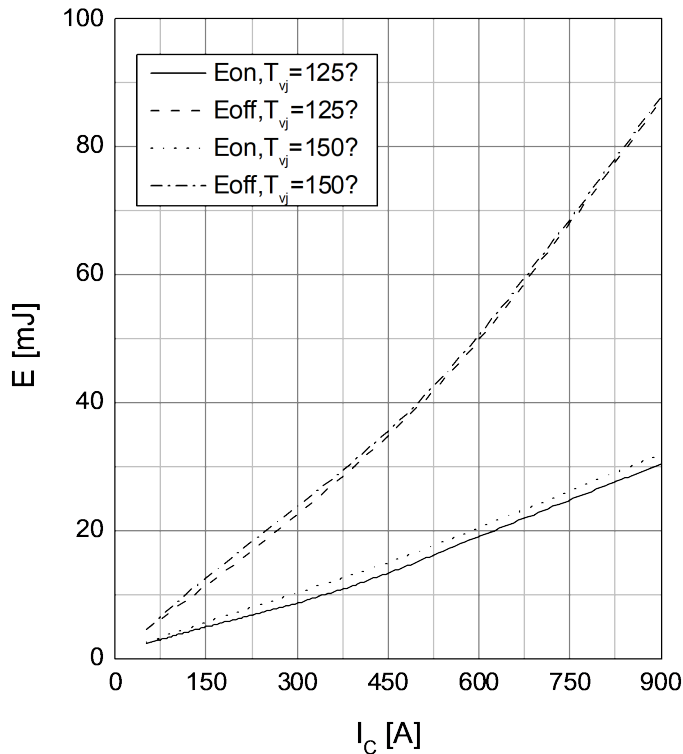
输出特性 IGBT, T2/T3
Output Characteristic IGBT, T2/T3
 $I_c = f(V_{CE})$, $T_{vj} = 150^\circ\text{C}$



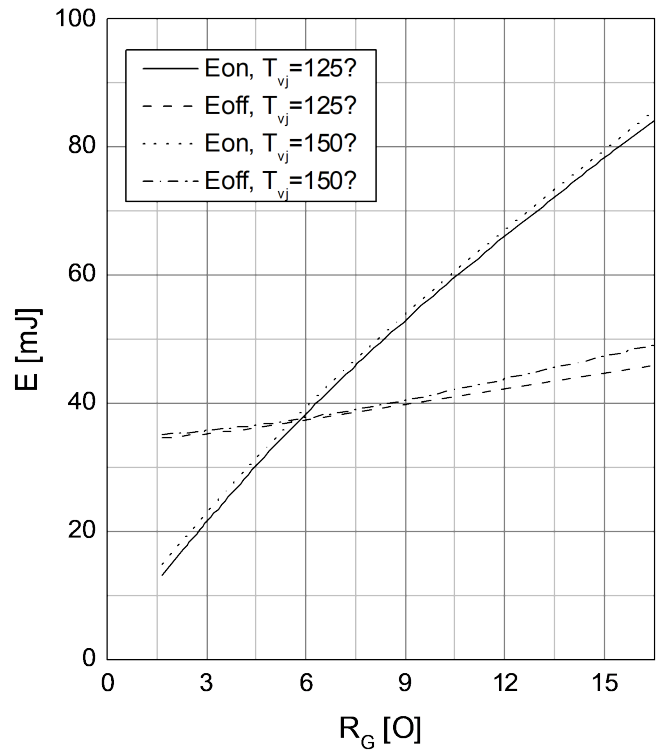
传输特性 IGBT, T2/T3
Transfer Characteristic IGBT, T2/T3
 $I_c = f(V_{GE})$, $V_{CE} = 10\text{V}$



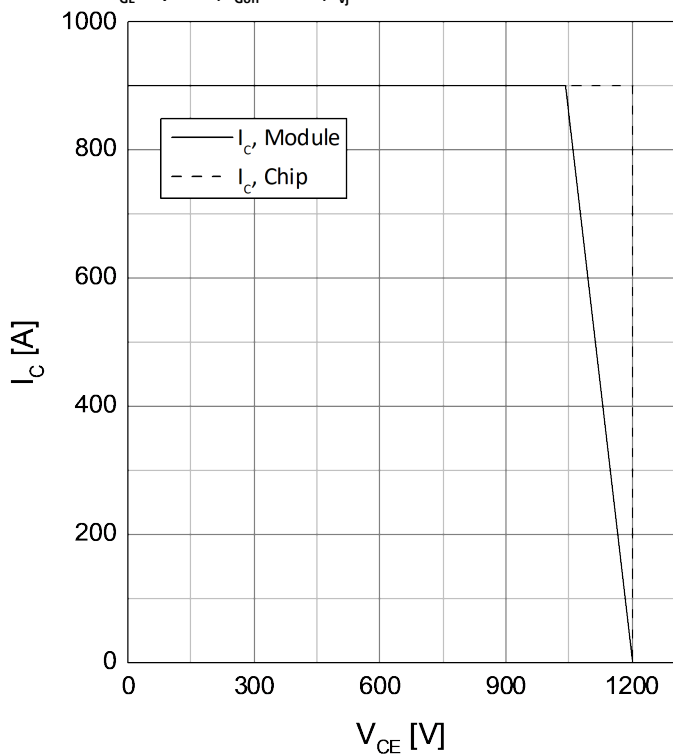
开关损耗 IGBT, T2/T3
Switching Losses IGBT, T2/T3
 $E = f(I_c)$, $V_{GE} = -8/+15\text{V}$, $R_{Gon} = R_{Goff} = 1.65\Omega$, $V_{CE} = 600\text{V}$



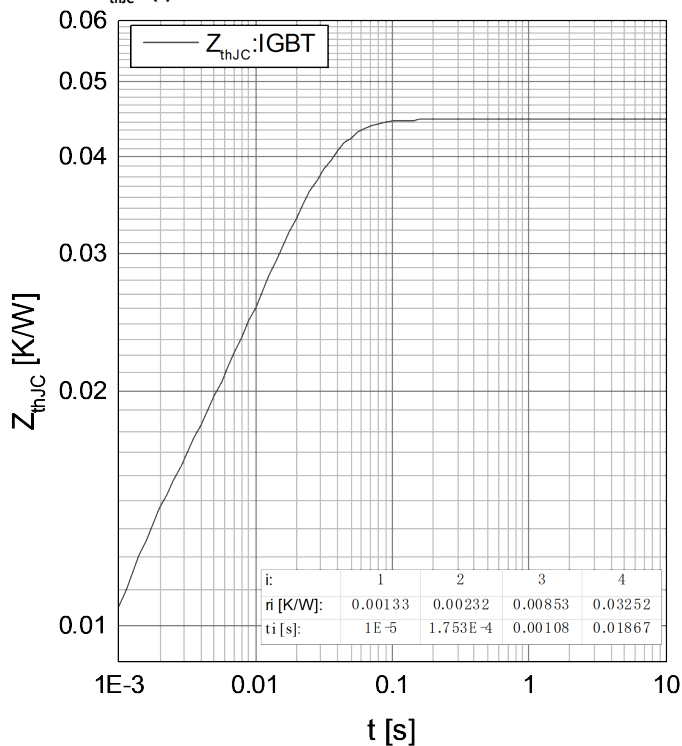
开关损耗 IGBT, T2/T3
Switching losses IGBT, T2/T3
 $E = f(R_G)$, $V_{GE} = -8/+15\text{V}$, $I_c = 450\text{A}$, $V_{CE} = 600\text{V}$



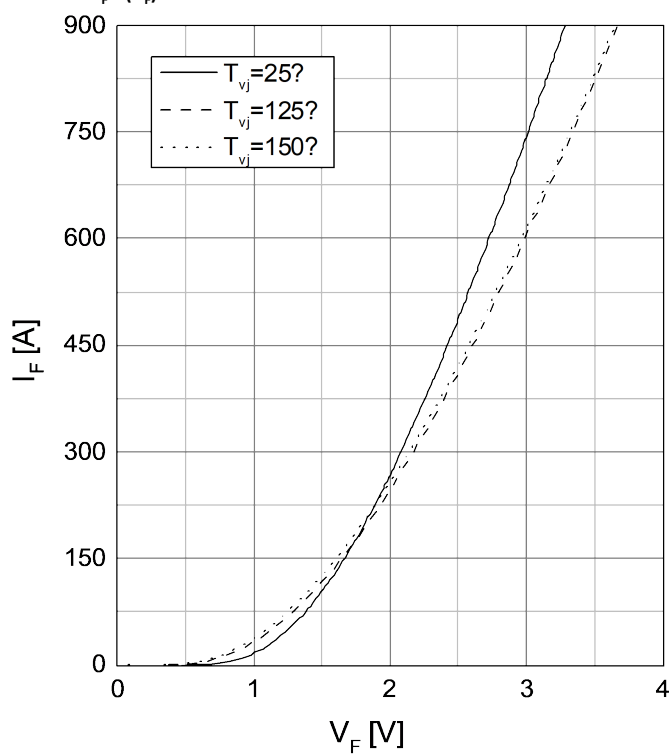
反偏安全工作区 IGBT, T2/T3
Reverse Bias Safe Operating Area IGBT
 $V_{GE}=-8/+15V, R_{Goff}=1.65\Omega, T_{vj}=150^{\circ}C$



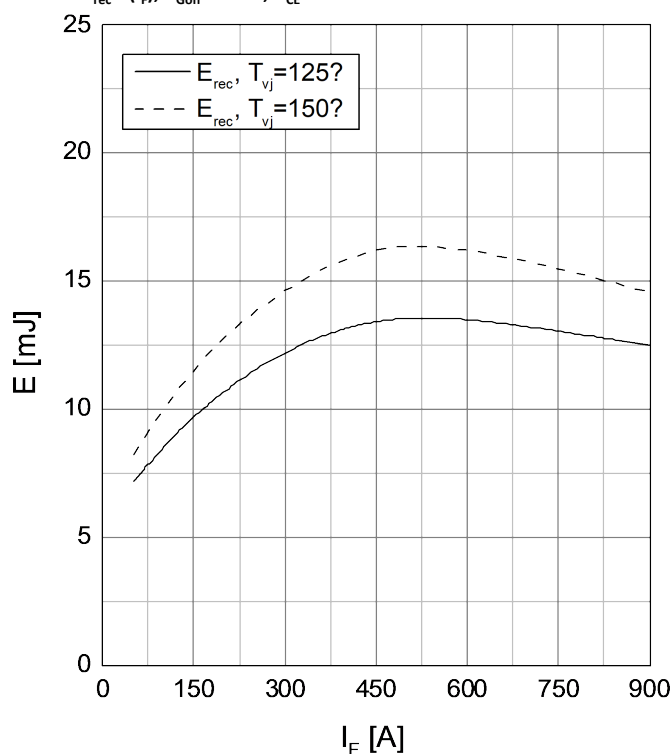
瞬态热阻抗 IGBT, T2/T3
Transient thermal impedance IGBT, T2/T3
 $Z_{thJC}=f(t)$



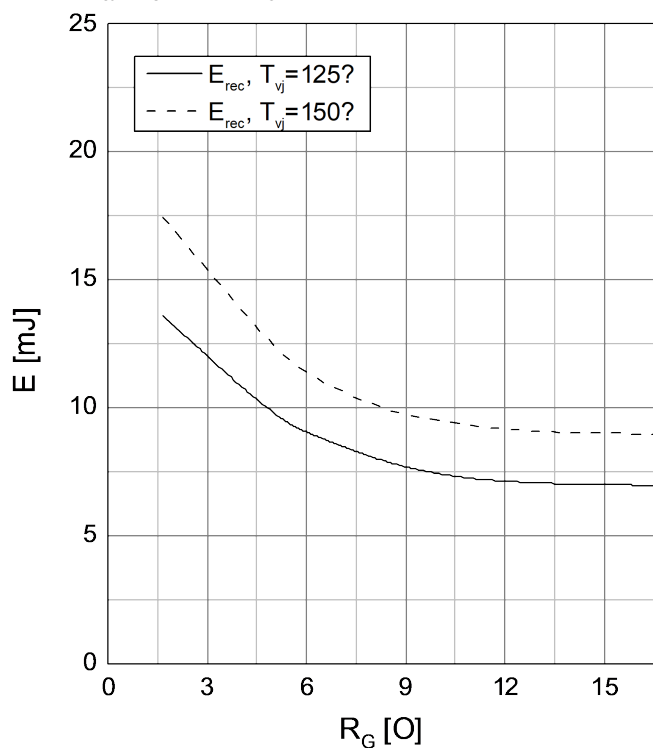
正向特性 Diode, D1/D4
Forward Characteristic Diode, D1/D4
 $I_F=f(V_F)$



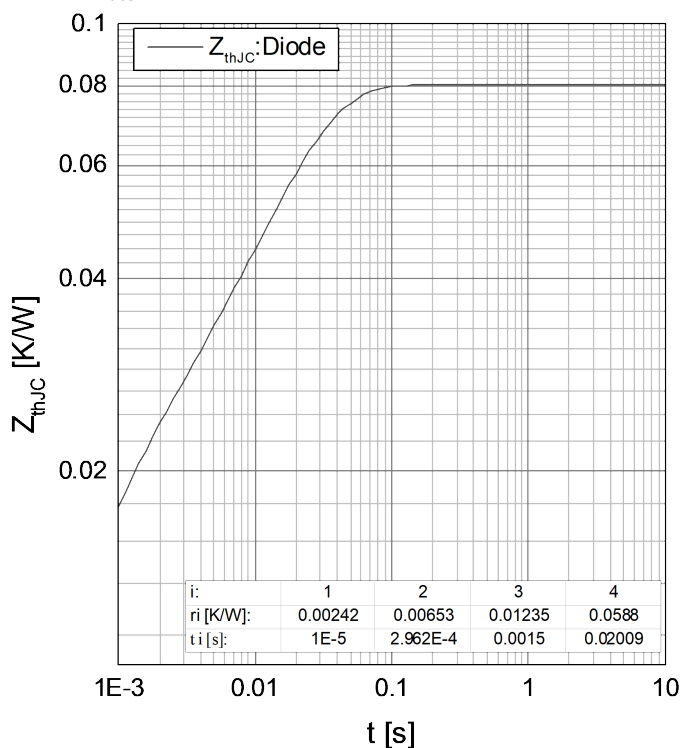
开关损耗 Diode, D1/D4
Switching Losses Diode, D1/D4
 $E_{rec}=f(I_F), R_{Gon}=1.65\Omega, V_{CE}=600V$



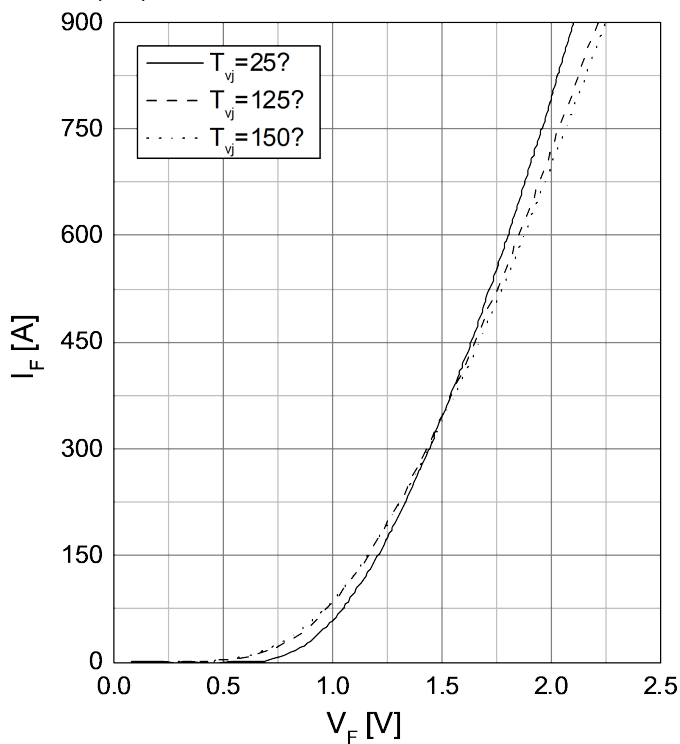
开关损耗 Diode, D1/D4
Switching Losses Diode, D1/D4
 $E_{rec}=f(R_G)$, $I_F=450A$, $V_{CE}=600V$



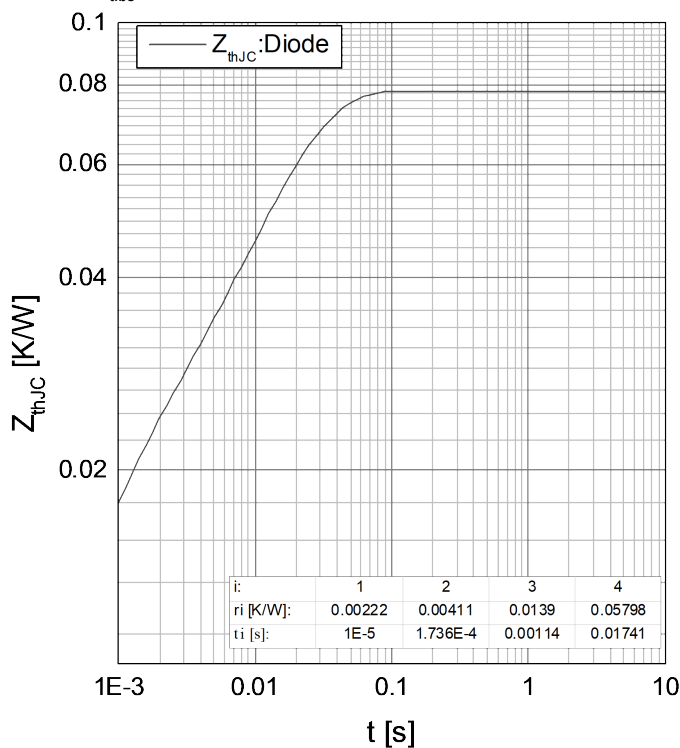
瞬态热阻抗 Diode, D1/D4
Transient Thermal Impedance Diode, D1/D4
 $Z_{thJC}=f(t)$



正向特性 Diode, D2/D3
Forward Characteristic Diode, D2/D3
 $I_F=f(V_F)$



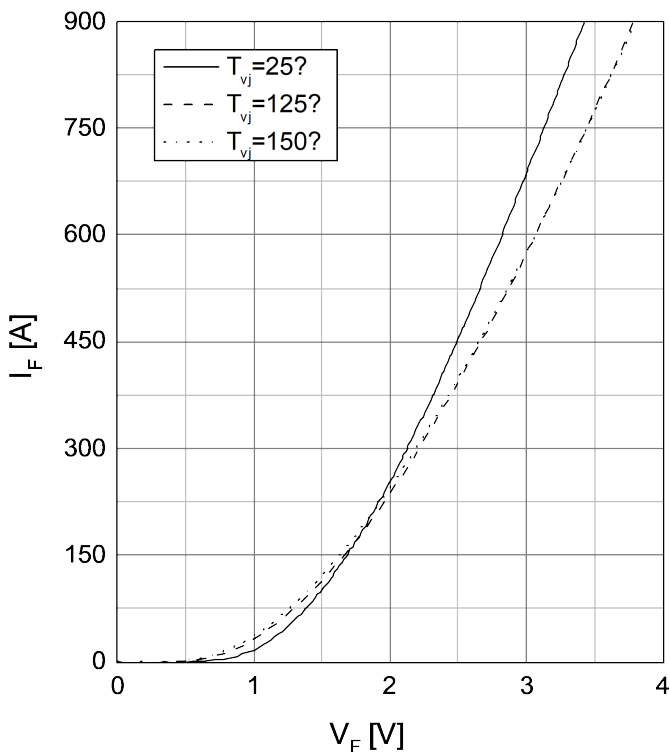
瞬态热阻抗 Diode, D2/D3
Transient Thermal Impedance Diode, D2/D3
 $Z_{thJC}=f(t)$



正向特性 Diode, D5/D6

Forward Characteristic Diode, D5/D6

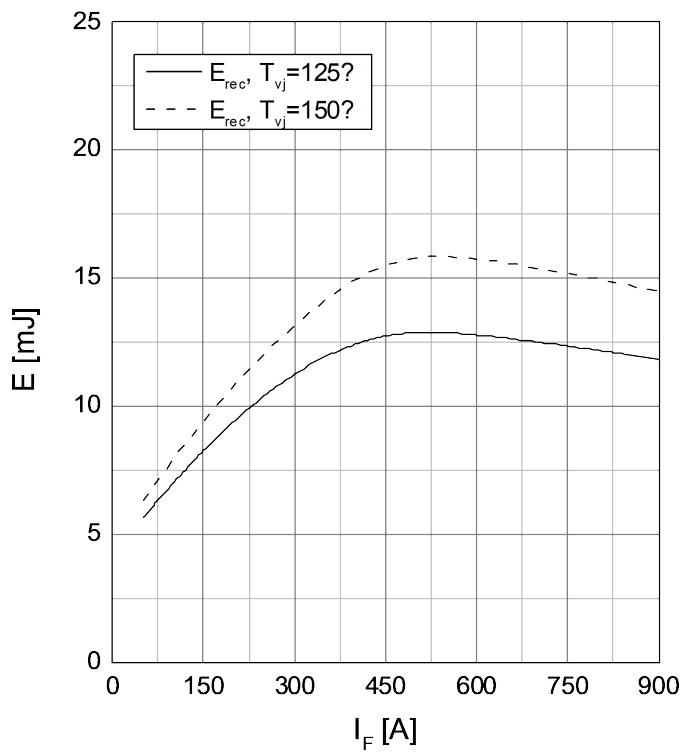
$$I_F = f(V_F)$$



开关损耗 Diode, D5/D6

Switching Losses Diode, D5/D6

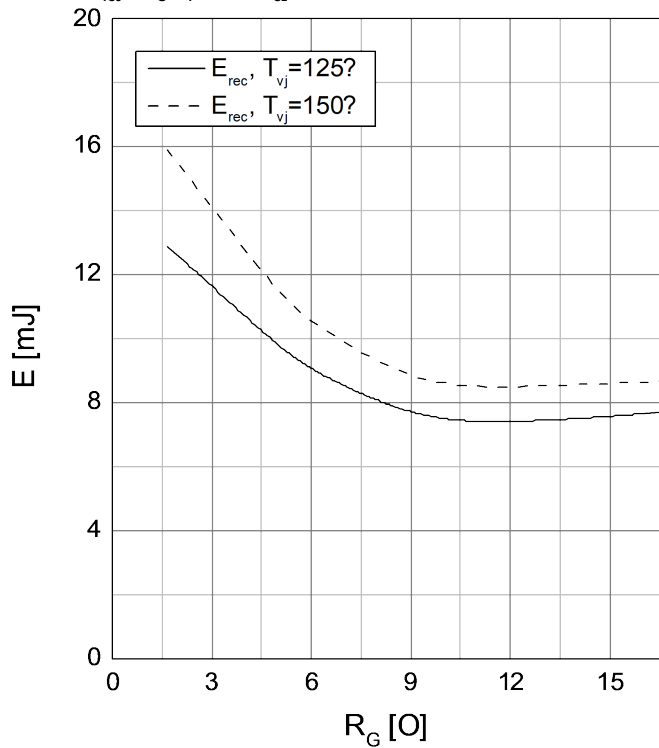
$$E_{rec} = f(I_F, R_{Gon} = 1.65\Omega, V_{CE} = 600V)$$



开关损耗 Diode, D5/D6

Switching Losses Diode, D5/D6

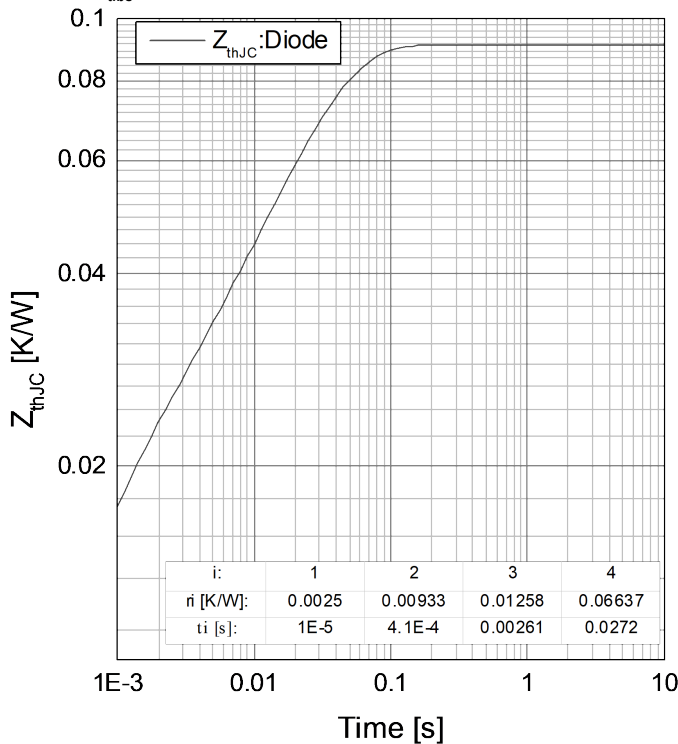
$$E_{rec} = f(R_G), I_F = 450A, V_{CE} = 600V$$



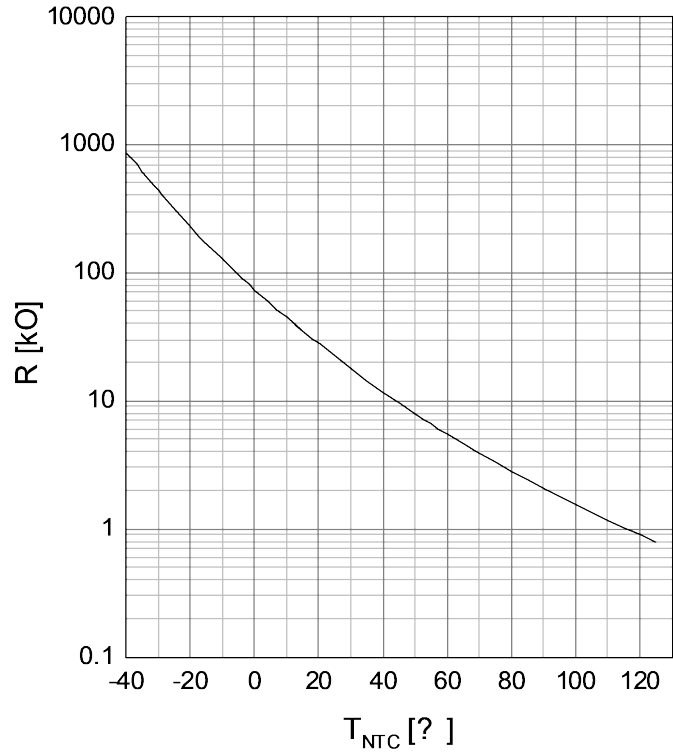
瞬态热阻抗 Diode, D5/D6

Transient Thermal Impedance Diode, D5/D6

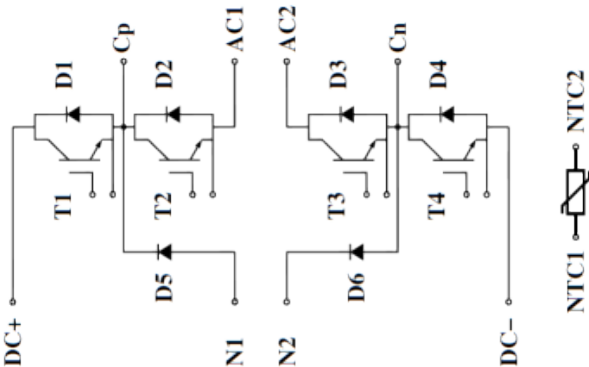
$$Z_{thJC} = f(t)$$



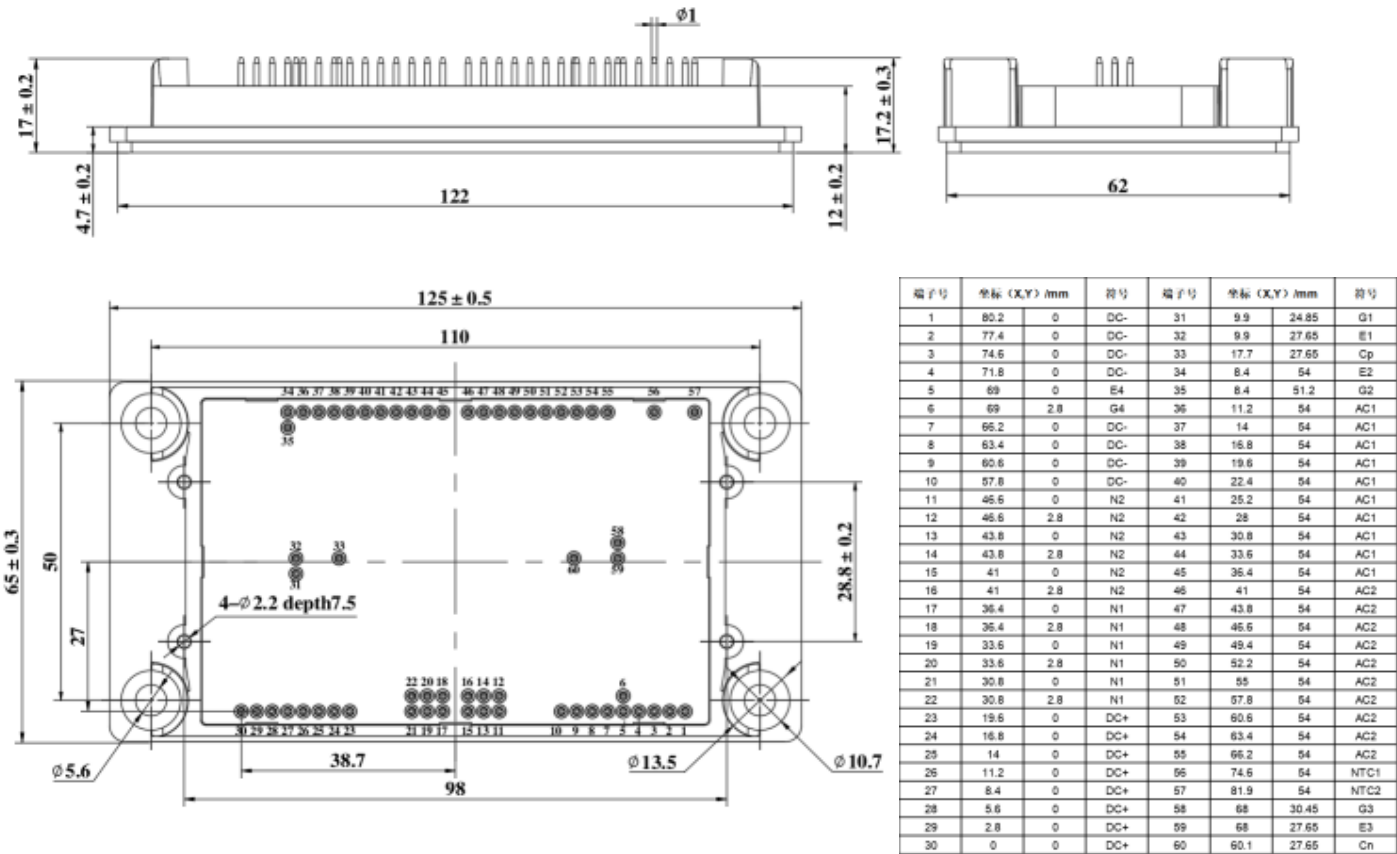
热敏电阻温度特性曲线
NTC Temperature Characteristic



电路图 Circuit Diagram



外形尺寸 Outline Drawing



修订记录 Revision History

日期 Date	描述 Description
2024-12-17	正式版

声明与使用条件/ Notices and conditions of use

1. HIITIO 保留手册的更改权；

HIITIO reserves the right to change the manual;

2. 本手册中提供的数据一部分为产品的典型值，实际出厂测试的数据与典型值略有差异，但我司保证这些差异不会影响产品的正常使用，如果产品信息发生变更，我司会及时更新手册，请随时关注；

Part of the data provided in this manual is the typical value of the product, the actual factory test data and the typical value are slightly different, but our company guarantees that these differences will not affect the normal use of the product, if the product information changes, our company will update the manual in time, please pay attention at any time;

3. 在应用我司产品时请不要超过产品的最大额定值，否则我司无法保证产品应用的可靠性；

When applying our products, please do not exceed the maximum rating of the product, otherwise our company can not guarantee the reliability of the product application;

4. 产品在使用时，严禁触碰，断电后确认无残余电荷且产品已完全冷却后，才可以在有静电防护措施下触碰产品；

When the product is in use, it is strictly forbidden to touch the product. After power off, it is confirmed that there is no residual charge and the product has been completely cooled, and it can only be touched under electrostatic protection measures;

5. 购买产品时请认准我司商标，如有疑问请与本司联系。

Please look for our trademark when purchasing products. If you have any questions, please contact us.