

HCG450FL120A3F5

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

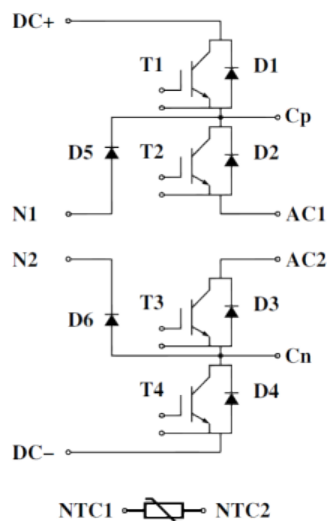
特点 Features

- 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	$T_C=95^{\circ}C, T_{vj\ max}=175^{\circ}C$	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}	$T_C=25^{\circ}C, T_{vj\ max}=175^{\circ}C$	2500	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	$T_C=100^{\circ}C, T_{vj\ max}=175^{\circ}C$	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}	$T_C=25^{\circ}C, T_{vj\ max}=175^{\circ}C$	2750	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}	$T_C=25^{\circ}C, T_{vj\ max}=175^{\circ}C$	1750	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}	$T_C=25^{\circ}C, T_{vj\ max}=175^{\circ}C$	1300	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}	$T_C=25^{\circ}C, T_{vj\ max}=175^{\circ}C$	1300	W

IGBT特征值 IGBT Characteristics Values*¹ ($T_{vj}=25^{\circ}\text{C}$ 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	$V_{CE\ sat}$	$I_C=450\text{A}$, $V_{GE}=15\text{V}$	$T_{vj}=25^{\circ}\text{C}$		1.90	2.40	V
			$T_{vj}=125^{\circ}\text{C}$		2.35		
			$T_{vj}=150^{\circ}\text{C}$		2.45		
□极-□射极□□□□ Gate-emitter threshold voltage	$V_{GE\ th}$	$I_C=16\text{mA}$, $V_{CE}=V_{GE}$		5.3	5.8	6.3	V
集□极-□射极截止□流 Collector-emitter cut-off current	I_{CES}	$V_{CE}=1200\text{V}$, $V_{GE}=0\text{V}$				1	mA
□极-□射极漏□流 Gate-emitter leakage current	I_{GES}	$V_{CE}=0\text{V}$, $V_{GE}=\pm 20\text{V}$		-100		100	nA
开通延□□□ (□感□□) Turn-on delay time, inductive load	$t_{d\ on}$	$I_C=450\text{A}$, $V_{CE}=600\text{V}$, $V_{GE}=-8/15\text{V}$, $R_{Gon}=1.65\Omega$, $R_{Goff}=1.65\Omega$, 开通 $di/dt=8000\text{A}/\mu\text{s}$ ($T_{vj}=150^{\circ}\text{C}$), 关断 $dv/dt=10500\text{V}/\mu\text{s}$ ($T_{vj}=150^{\circ}\text{C}$), Inductive Load	$T_{vj}=25^{\circ}\text{C}$		125		ns
			$T_{vj}=125^{\circ}\text{C}$		128		
			$T_{vj}=150^{\circ}\text{C}$		130		
上升□□ (□感□□) Rise time, inductive load	t_r		$T_{vj}=25^{\circ}\text{C}$		35		ns
			$T_{vj}=125^{\circ}\text{C}$		41		
			$T_{vj}=150^{\circ}\text{C}$		42		
关断延□□□ (□感□□) Turn-off delay time, inductive load	$t_{d\ off}$		$T_{vj}=25^{\circ}\text{C}$		215		ns
			$T_{vj}=125^{\circ}\text{C}$		245		
			$T_{vj}=150^{\circ}\text{C}$		253		
下降□□ (□感□□) Fall time, inductive load	t_f		$T_{vj}=25^{\circ}\text{C}$		130		ns
			$T_{vj}=125^{\circ}\text{C}$		142		
			$T_{vj}=150^{\circ}\text{C}$		150		
开通□耗 (每脉冲) Turn-on energy loss per pulse	E_{on}		$T_{vj}=25^{\circ}\text{C}$		16.0		mJ
			$T_{vj}=125^{\circ}\text{C}$		23.0		
			$T_{vj}=150^{\circ}\text{C}$		25.2		
关断□耗 (每脉冲) Turn-off energy loss per pulse	E_{off}		$T_{vj}=25^{\circ}\text{C}$		19.0		mJ
			$T_{vj}=125^{\circ}\text{C}$		24.3		
			$T_{vj}=150^{\circ}\text{C}$		25.6		
内置□极□阻 Internal gate resistance	$R_{G\ int}$				1		Ω
□极□荷 Gate charge	Q_G	$V_{GE}=-15\text{V}\sim+15\text{V}$			1.9		μC
□入□容 Input capacitance	C_{ies}	$f=1\text{MHz}$, $T_{vj}=25^{\circ}\text{C}$, $V_{CE}=25\text{V}$, $V_{GE}=0\text{V}$			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 值 Value			位 位 Unit
				Min.	Typ.	Max.	
集电极-射极饱和电压 Collector-emitter saturation voltage	$V_{CE\ sat}$	$I_C=450A, V_{GE}=15V$	$T_{vj}=25^{\circ}C$		1.90	2.40	V
			$T_{vj}=125^{\circ}C$		2.35		
			$T_{vj}=150^{\circ}C$		2.45		
射极-射极阈值电压 Gate-emitter threshold voltage	$V_{GE\ th}$	$I_C=16mA, V_{CE}=V_{GE}$		5.3	5.8	6.3	V
集电极-射极截止电流 Collector-emitter cut-off current	I_{CES}	$V_{CE}=1200V, V_{GE}=0V$				1	mA
射极-射极漏电流 Gate-emitter leakage current	I_{GES}	$V_{CE}=0V, V_{GE}=\pm 20V$		-100		100	nA
开通延迟时间 (感性负载) Turn-on delay time, inductive load	$t_{d\ on}$	$I_C=450A, V_{CE}=600V, V_{GE}=-8/15V, R_{Gon}=1.65\Omega, R_{Goff}=1.65\Omega, \text{开通} di/dt=7800A/\mu s (T_{vj}=150^{\circ}C), \text{关断} dv/dt=10500V/\mu s (T_{vj}=150^{\circ}C), \text{Inductive Load}$	$T_{vj}=25^{\circ}C$		117		ns
			$T_{vj}=125^{\circ}C$		120		
			$T_{vj}=150^{\circ}C$		122		
上升时间 (感性负载) Rise time, inductive load	t_r		$T_{vj}=25^{\circ}C$		41		ns
			$T_{vj}=125^{\circ}C$		45		
			$T_{vj}=150^{\circ}C$		46		
关断延迟时间 (感性负载) Turn-off delay time, inductive load	$t_{d\ off}$		$T_{vj}=25^{\circ}C$		211		ns
			$T_{vj}=125^{\circ}C$		250		
			$T_{vj}=150^{\circ}C$		256		
下降时间 (感性负载) Fall time, inductive load	t_f		$T_{vj}=25^{\circ}C$		207		ns
			$T_{vj}=125^{\circ}C$		185		
			$T_{vj}=150^{\circ}C$		188		
开通损耗 (每脉冲) Turn-on energy loss per pulse	E_{on}		$T_{vj}=25^{\circ}C$		8.8		mJ
			$T_{vj}=125^{\circ}C$		13.1		
			$T_{vj}=150^{\circ}C$		13.8		
关断损耗 (每脉冲) Turn-off energy loss per pulse	E_{off}		$T_{vj}=25^{\circ}C$		34.2		mJ
			$T_{vj}=125^{\circ}C$		34.5		
			$T_{vj}=150^{\circ}C$		35.1		
内置射极电阻 Internal gate resistance	$R_{G\ int}$				1		Ω
射极电荷 Gate charge	Q_G	$V_{GE}=-8V\sim 15V$			1.9		μC
输入电容 Input capacitance	C_{ies}	$f=1MHz, T_{vj}=25^{\circ}C, V_{CE}=25V, V_{GE}=0V$			68		nF
反向传输电容 Reverse transfer capacitance	C_{res}				1.1		nF

*1 IGBT特征值遵从IEC 60747-9。

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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

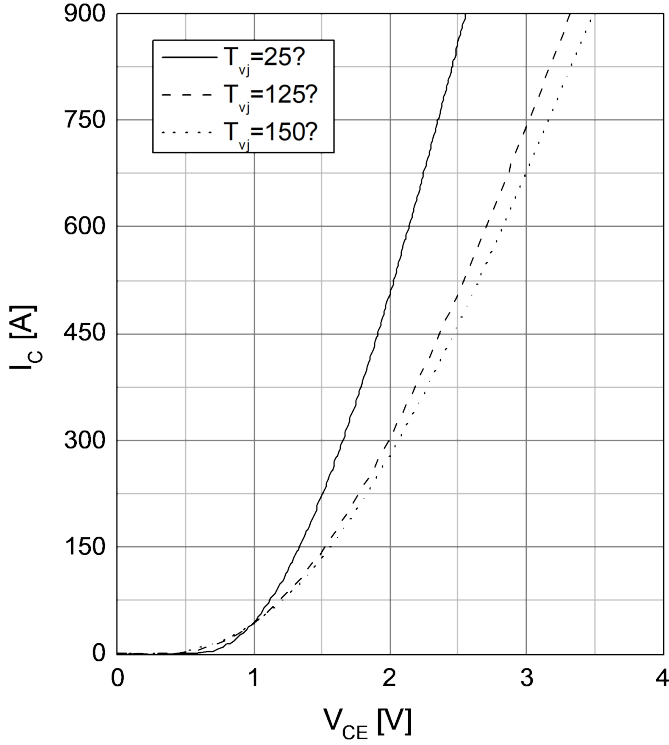
参数 Parameter	符号 Symbol	条件 Condition	数值 Value			单位 Unit
			Min.	Typ.	Max.	
IGBT 壳阻, T1/T4 IGBT thermal resistance: junction to case, T1/T4	$R_{th JC}$	每个IGBT/per IGBT		0.061		K/W
IGBT 壳阻, T2/T3 IGBT thermal resistance: junction to case, T2/T3	$R_{th JC}$	每个IGBT/per IGBT		0.055		K/W
二极管 壳阻, D1/D4 Diode thermal resistance: junction to case, D1/D4	$R_{th JC}$	每个二极管/per Diode		0.085		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		0.090		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		0.117		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

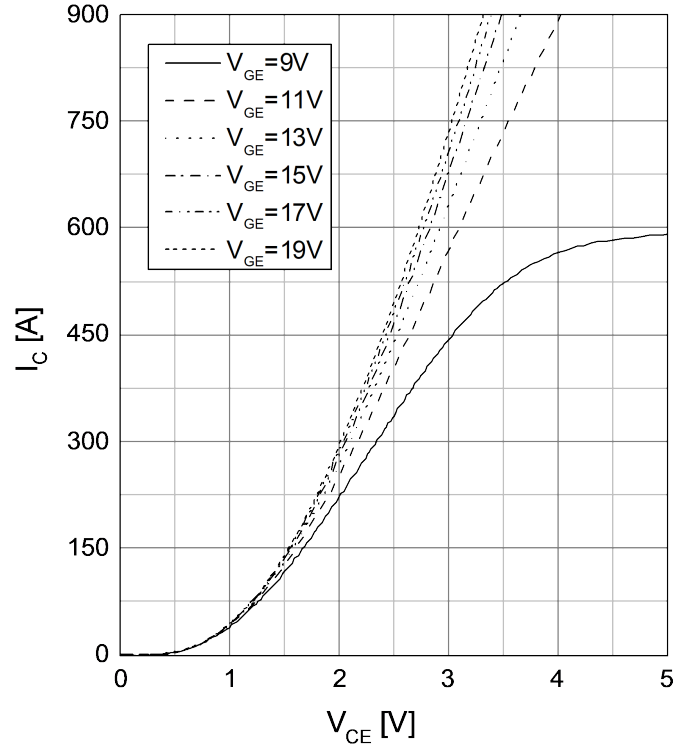
$I_C = f(V_{CE}), V_{GE} = 15V$



输出特性 IGBT, T1/T4

Output Characteristic IGBT, T1/T4

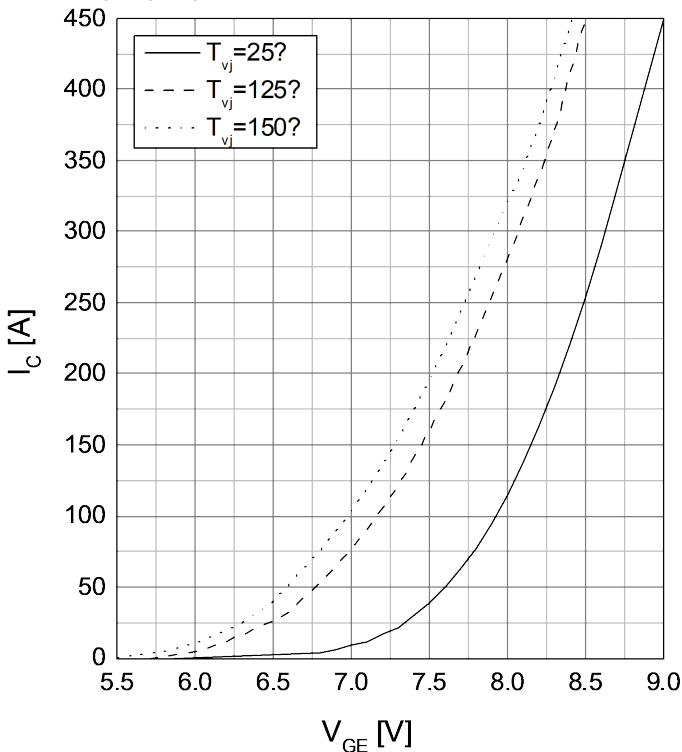
$I_C = f(V_{CE}), T_{vj} = 150^\circ C$



传输特性 IGBT, T1/T4

Transfer Characteristic IGBT, T1/T4

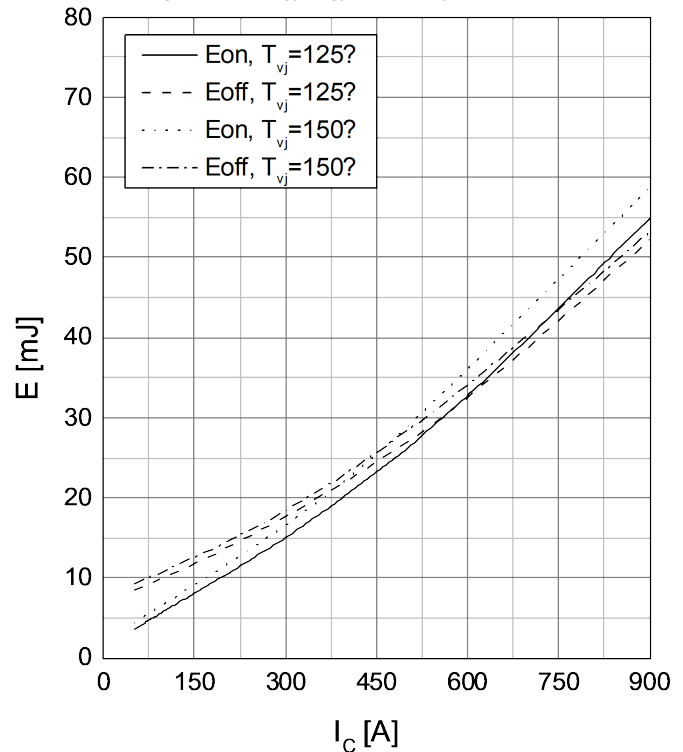
$I_C = f(V_{GE}), V_{CE} = 10V$



开关损耗 IGBT, T1/T4

Switching Losses IGBT, T1/T4

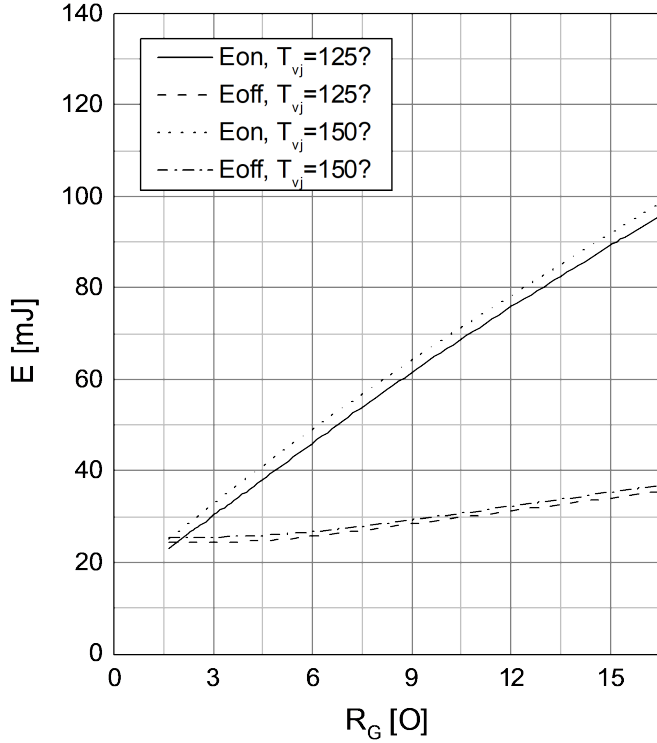
$E = f(I_C), V_{GE} = -8/+15V, R_{Gon} = R_{Goff} = 1.65\Omega, V_{CE} = 600V$



开关损耗 IGBT, T1/T4

Switching Losses IGBT, T1/T4

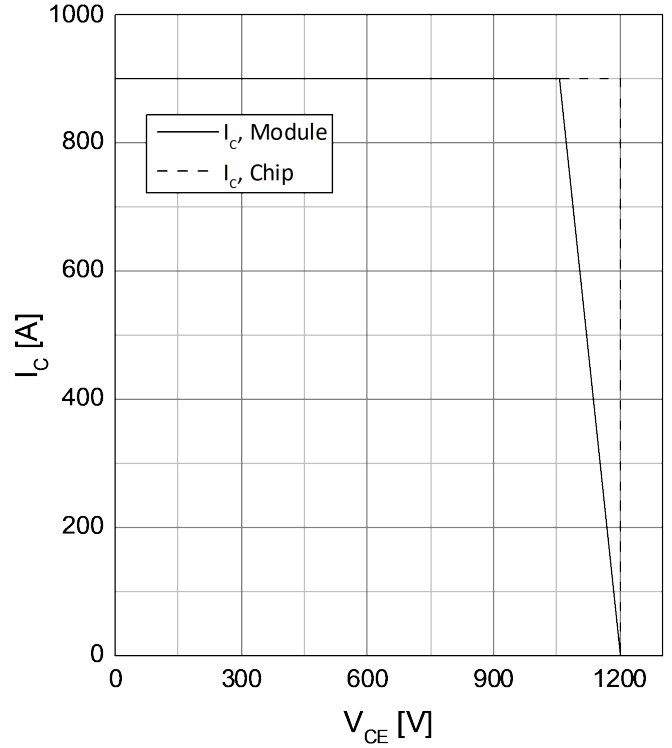
$E=f(R_G), V_{GE}=-8/+15V, I_C=450A, V_{CE}=600V$



反偏安全工作区 IGBT, T1/T4

Reverse Bias Safe Operating Area IGBT, T1/T4

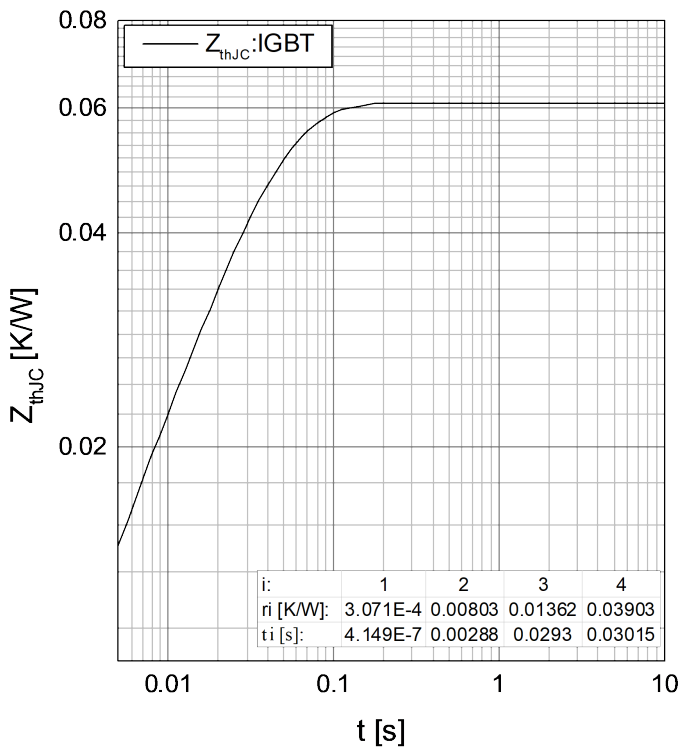
$V_{GE}=-8/+15V, R_{Goff}=1.65\Omega, T_{vj}=150^\circ C$



瞬态热阻抗 IGBT, T1/T4

Transient Thermal Impedance IGBT, T1/T4

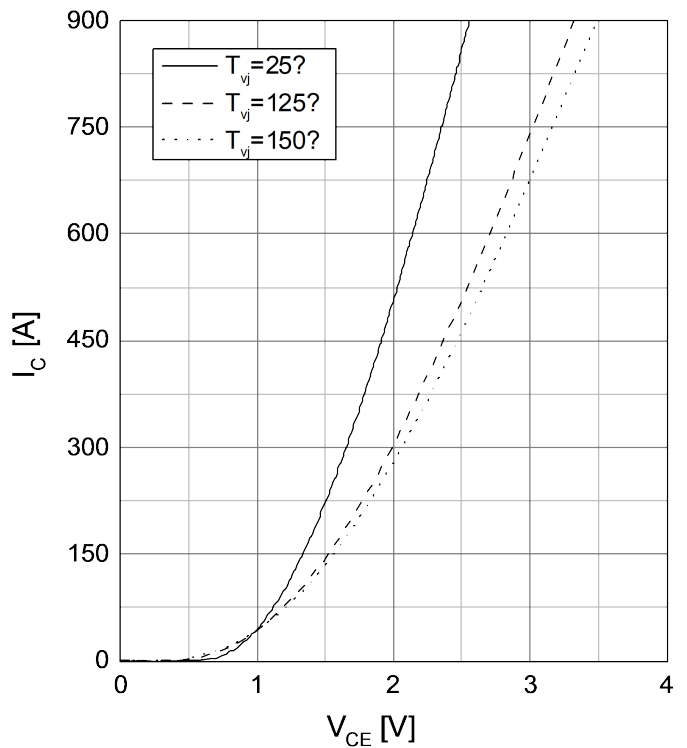
$Z_{thJC}=f(t)$



输出特性 IGBT, T2/T3

Output Characteristic IGBT, T2/T3

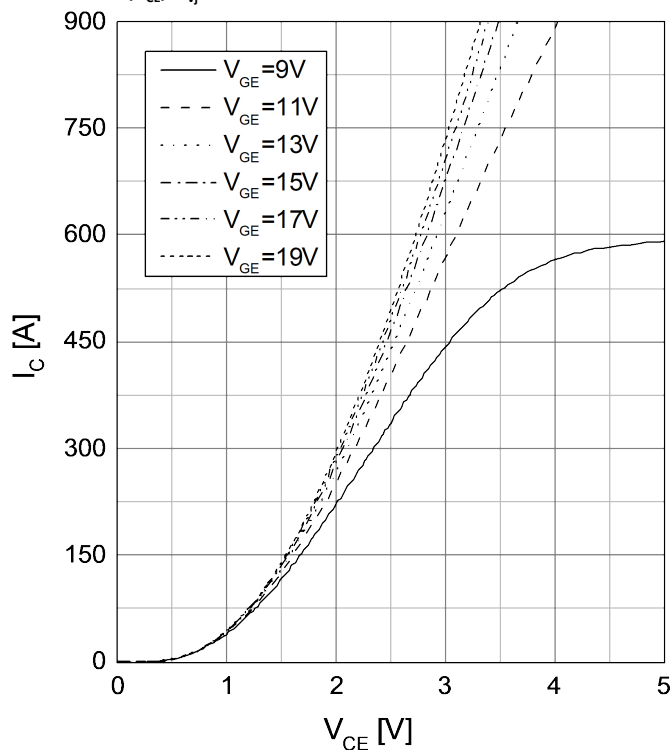
$I_C=f(V_{CE}), V_{GE}=15V$



输出特性 IGBT, T2/T3

Output Characteristic IGBT, T2/T3

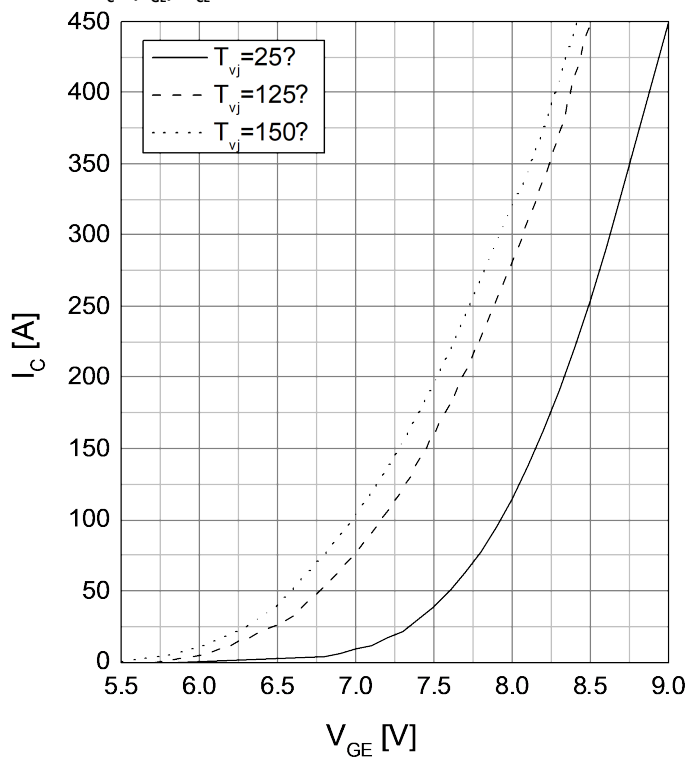
$I_c = f(V_{CE})$, $T_{vj} = 150^\circ\text{C}$



传输特性 IGBT, T2/T3

Transfer Characteristic IGBT, T2/T3

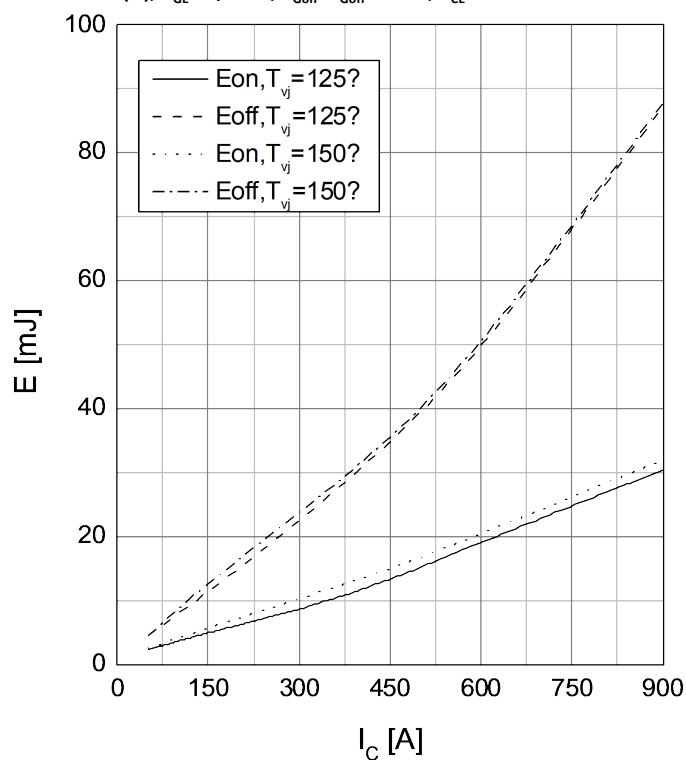
$I_c = f(V_{GE})$, $V_{CE} = 10\text{V}$



开关损耗 IGBT, T2/T3

Switching Losses IGBT, T2/T3

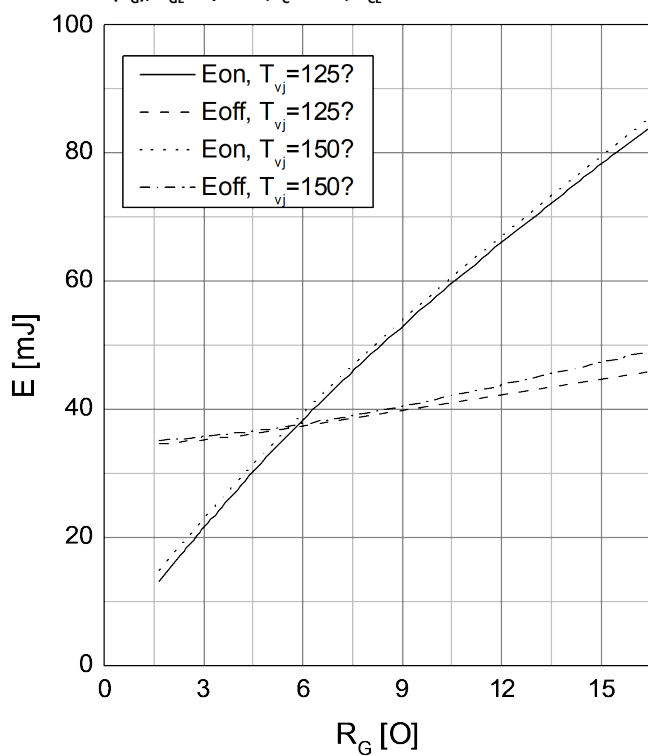
$E = f(I_c)$, $V_{GE} = -8/+15\text{V}$, $R_{Gon} = R_{Goff} = 1.65\Omega$, $V_{CE} = 600\text{V}$



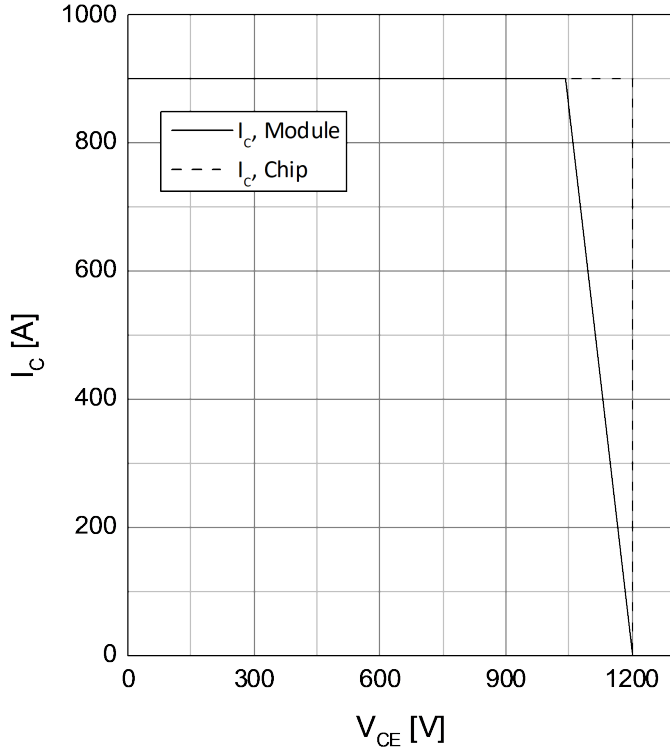
开关损耗 IGBT, T2/T3

Switching losses IGBT, T2/T3

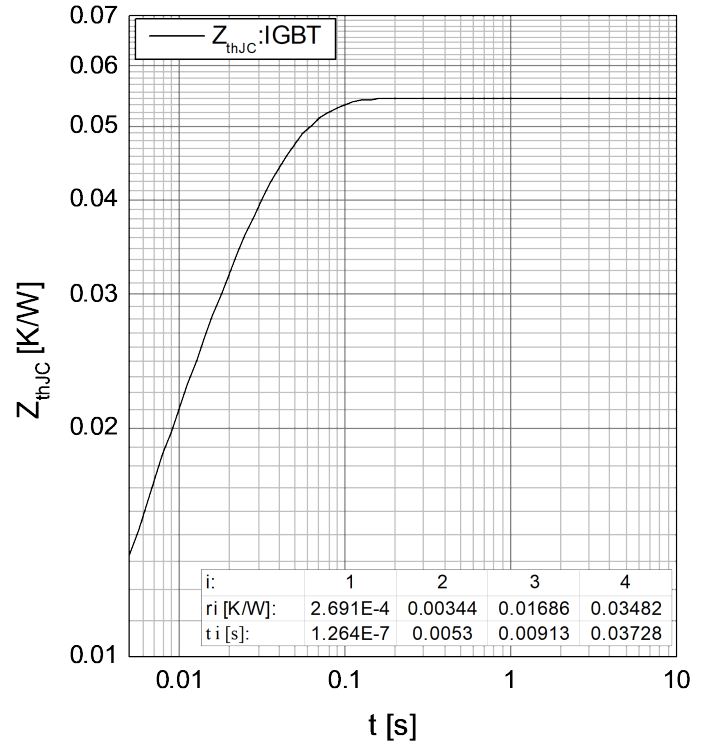
$E = f(R_G)$, $V_{GE} = -8/+15\text{V}$, $I_c = 450\text{A}$, $V_{CE} = 600\text{V}$



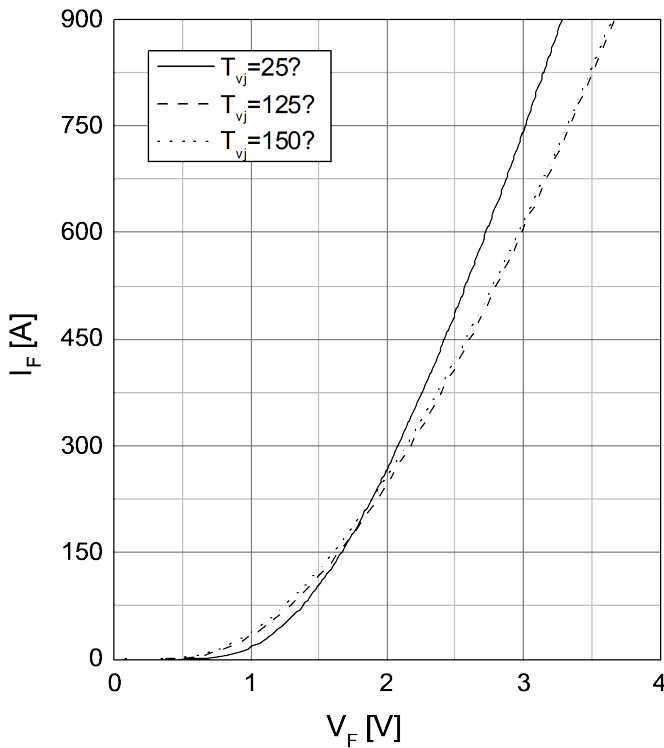
反偏安全工作区 IGBT, T2/T3
Reverse Bias Safe Operating Area IGBT
 $V_{GE}=-8/+15V, R_{Goff}=1.65\Omega, T_{vj}=150^{\circ}C$



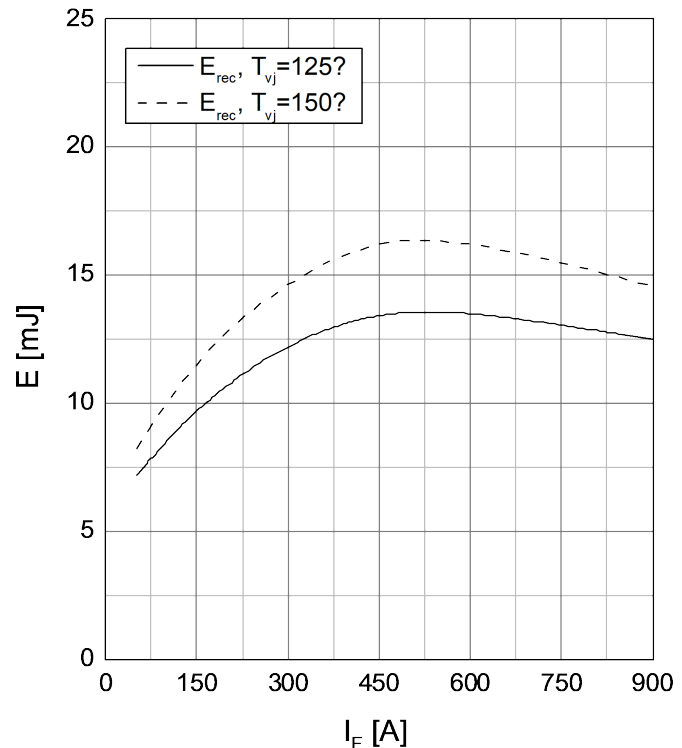
瞬态热阻抗 IGBT, T2/T3
Transient thermal impedance IGBT, T2/T3
 $Z_{thJC}=f(t)$



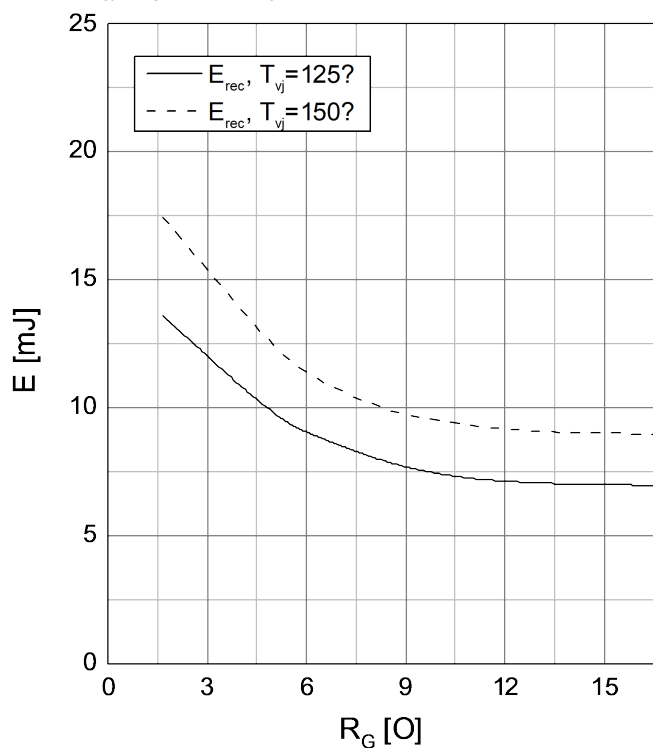
正向特性 Diode, D1/D4
Forward Characteristic Diode, D1/D4
 $I_F=f(V_F)$



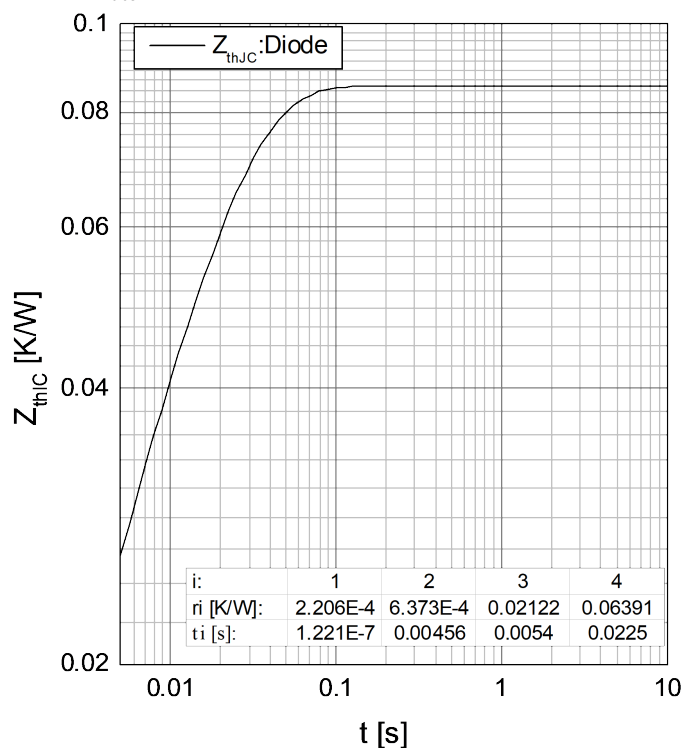
开关损耗 Diode, D1/D4
Switching Losses Diode, D1/D4
 $E_{rec}=f(I_F, R_{Gon}=1.65\Omega, V_{CE}=600V)$



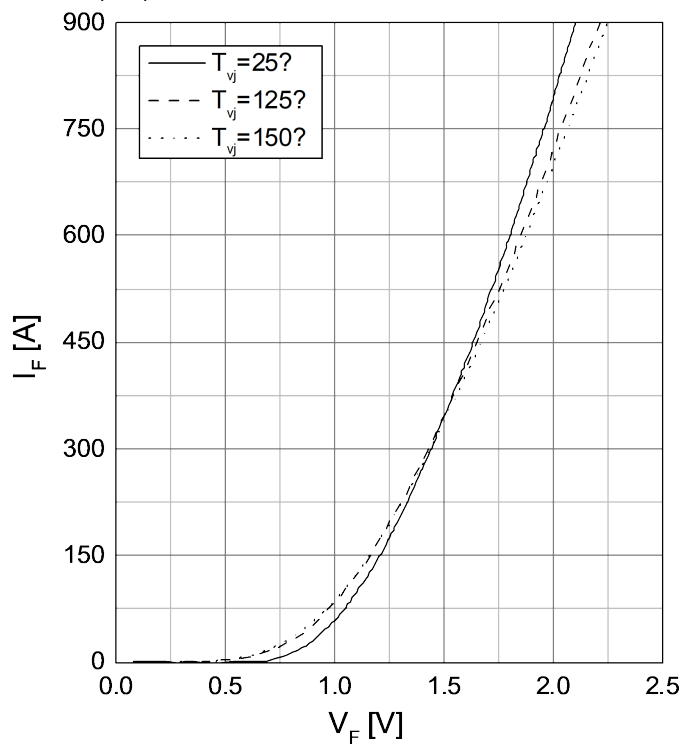
开关损耗 Diode, D1/D4
Switching Losses Diode, D1/D4
 $E_{rec}=f(R_G)$, $I_F=450A$, $V_{CE}=600V$



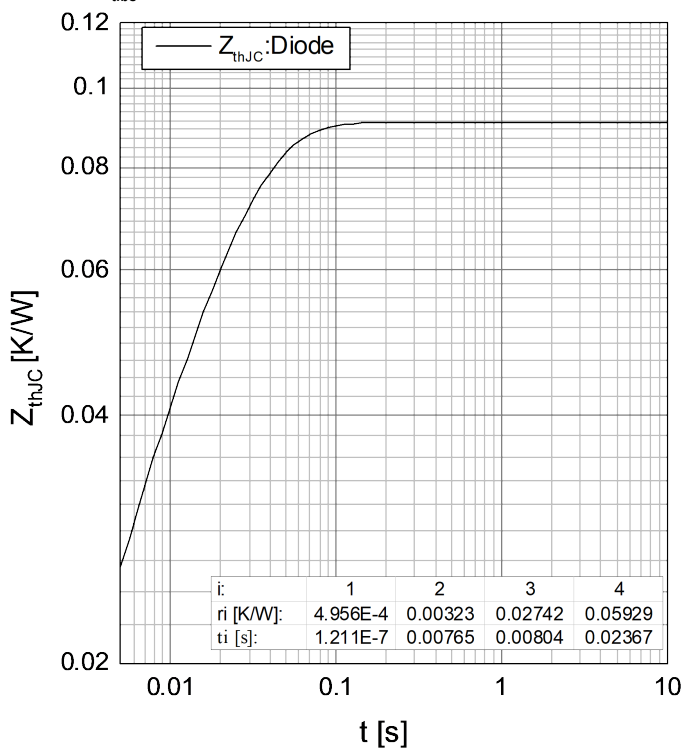
瞬态热阻抗 Diode, D1/D4
Transient Thermal Impedance Diode, D1/D4
 $Z_{thJC}=f(t)$



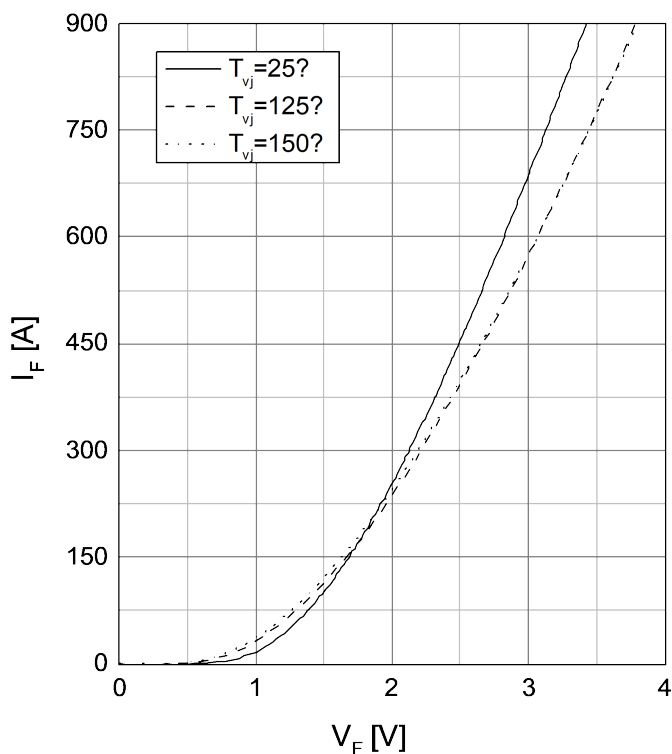
正向特性 Diode, D2/D3
Forward Characteristic Diode, D2/D3
 $I_F=f(V_F)$



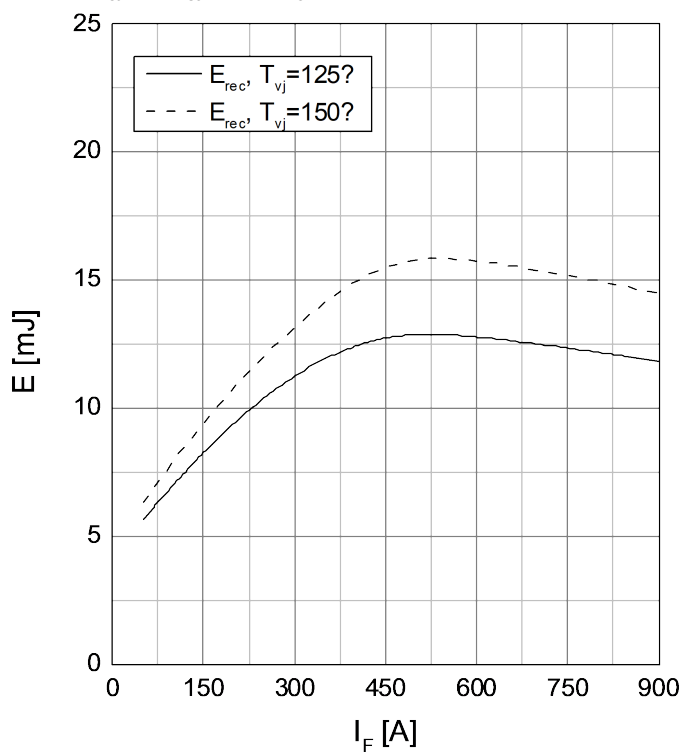
瞬态热阻抗 Diode, D2/D3
Transient Thermal Impedance Diode, D2/D3
 $Z_{thJC}=f(t)$



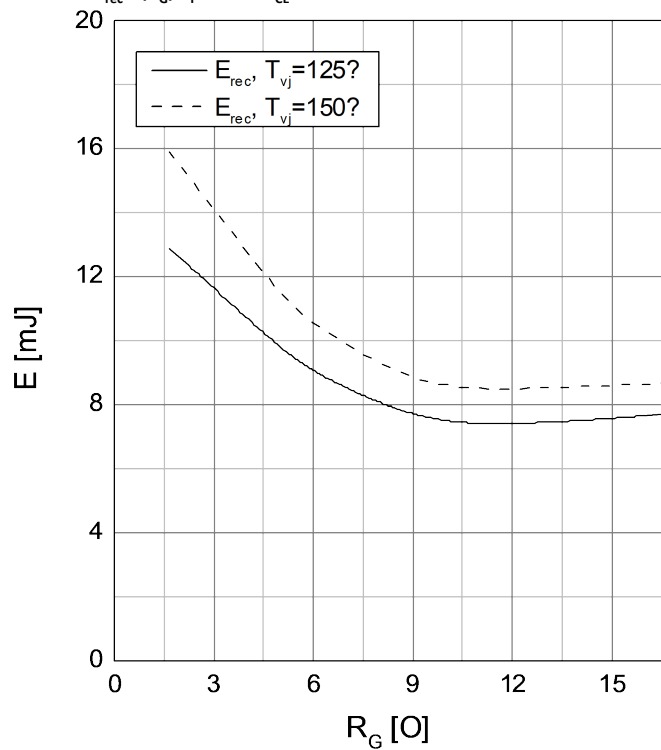
正向特性 Diode, D5/D6
Forward Characteristic Diode, D5/D6
 $I_F = f(V_F)$



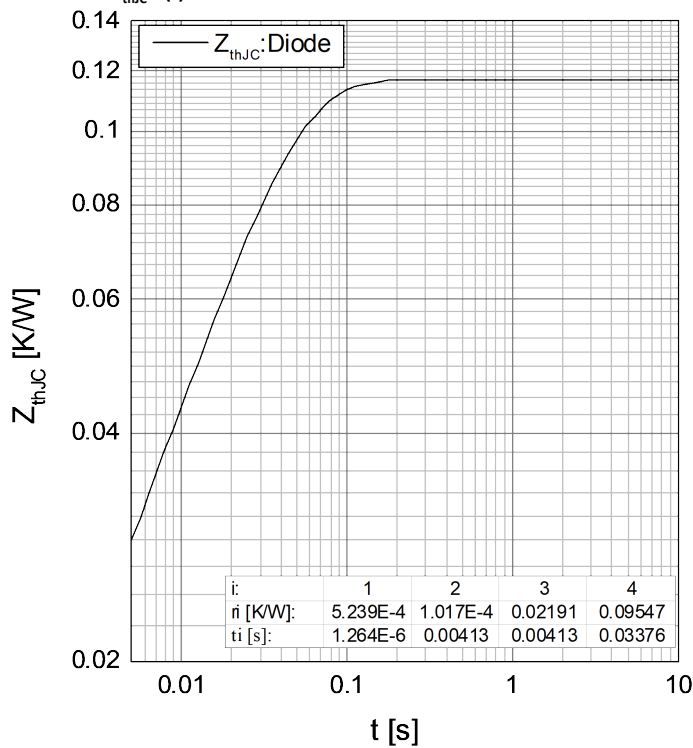
开关损耗 Diode, D5/D6
Switching Losses Diode, D5/D6
 $E_{rec} = f(I_F, R_{Gon} = 1.65\Omega, V_{CE} = 600V)$



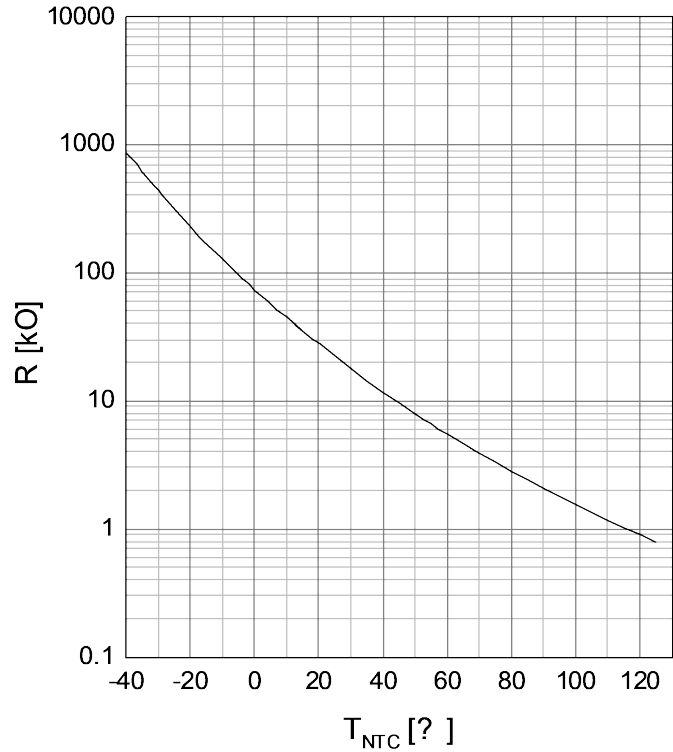
开关损耗 Diode, D5/D6
Switching Losses Diode, D5/D6
 $E_{rec} = f(R_G), I_F = 450A, V_{CE} = 600V$



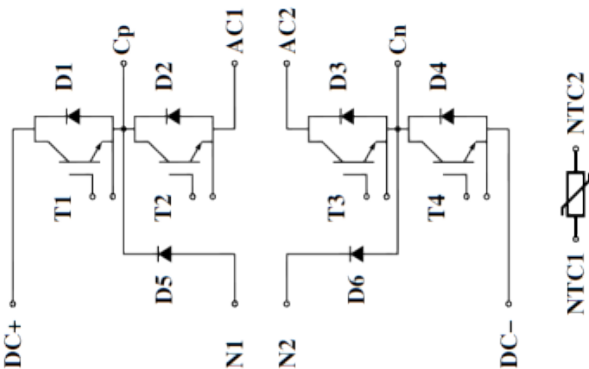
瞬态热阻抗 Diode, D5/D6
Transient Thermal Impedance Diode, D5/D6
 $Z_{thJC} = f(t)$



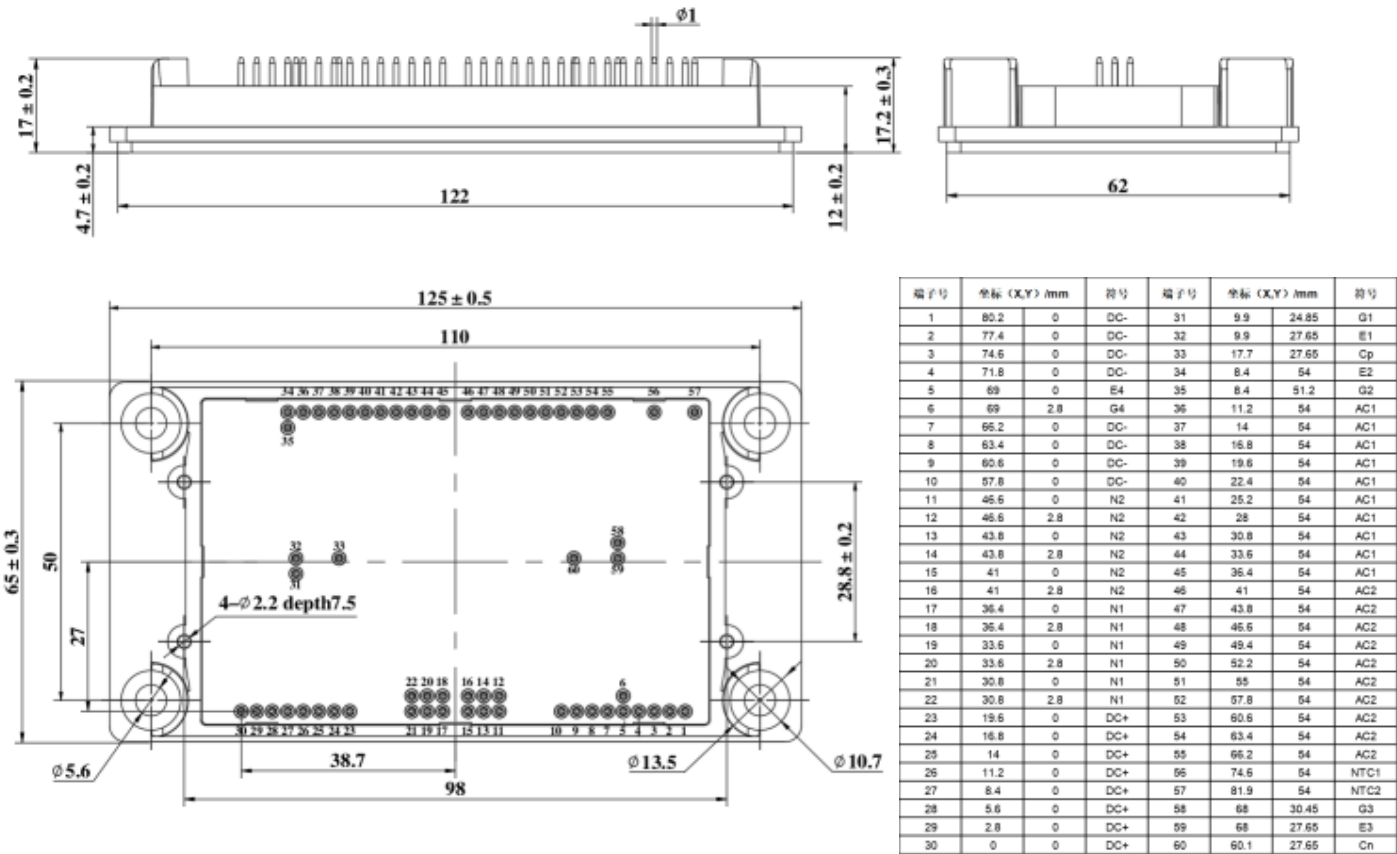
热敏电阻温度特性曲线
NTC Temperature Characteristic



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

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