NI600B12E6K4_D2

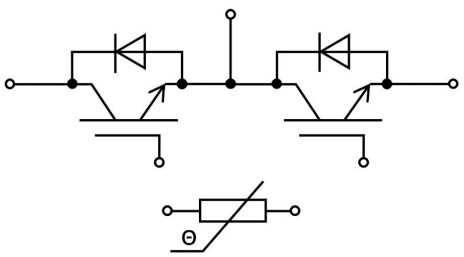
1200V 600A IGBT 模块, E6封装, 内置续流二极管
1200V 600A IGBT Module, E6 Package, with FWD

特点 Features

- 1200V 沟槽栅及场截止结构
  1200V Trench Gate & Field Stop Structure
- 高短路耐量
  High Short Circuit Capability
- 低开关损耗
  Low Switching Loss
- 高可靠性
  High Reliability
- 正温度系数
  Positive Temperature Coefficient

应用 Applications

- 光伏逆变器
  Solar Inverter
- 不间断电源UPS
  Uninterrupted Power Supply
- 伺服驱动
  Servo Driver
- 电机驱动
  Motor Driver



最大额定值 Maximum Rated Values

参数 Parameter	符号 Symbol	条件 Condition	数值 Value	单位 Unit
集电极-发射极电压 Collector-Emitter Voltage	V_{CES}	V_{GE}=0V,T_{vj}=25°C	1200	V
集电极电流 DC Collector Current	I_C	T_c=100°C, $T_{vj,max}$=175°C	600	A
集电极峰值电流 Peak Collector Current	I_{CM}	t_p=1ms	1200	A
栅极-发射极电压 Gate-Emitter Voltage	V_{GES}		±20	V
IGBT最大功耗 IGBT Maximum Power Dissipation	P_D	T_c=25°C, $T_{vj,max}$=175°C	3950	W
反向重复峰值电压 Repetitive peak reverse voltage	V_{RRM}	T_{vj}=25°C	1200	V
连续正向直流电流 Continuous DC forward current	I_F		600	A
正向重复峰值电流 Repetitive peak forward current	I_{FRM}	t_p=1ms	1200	A
I^2t-值 I^2t-value	I^2t	V_R=0V,t_p=10ms,T_{vj}=125°C	51000	A^2s
IGBT短路耐量 IGBT Short Circuit Withstand Time	t_{psc}		10	µs
最高结温 Maximum Junction Temperature	$T_{vj,max}$		175	°C
工作结温 Operating Junction Temperature	$T_{vj,op}$		-40~150	°C
存储温度范围 Storage Temperature Range	T_{stg}		-40~125	°C

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

参数 Parameter	符号 Symbol	条件 Condition		数值 Value			单位 Unit
				Min.	Typ.	Max.	
集电极-发射极饱和电压 Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	I_C=600A, V_{GE}=15V	T_{vj}=25°C		1.75	2.15	V
			T_{vj}=125°C		2.20		
			T_{vj}=150°C		2.25		
栅极-发射极阈值电压 Gate-Emitter Threshold Voltage	$V_{GE(th)}$	I_C=23mA, V_{CE}=V_{GE}		5.20	5.80	6.40	V
集电极-发射极截止电流 Collector-Emitter Cut-off Current	I_{CES}	V_{CE}=1200V, V_{GE}=0V				1	mA
栅极-发射极漏电流 Gate-Emitter Leakage Current	I_{GES}	V_{CE}=0V, V_{GE}=±20V		-100		100	nA
内置栅极电阻 Internal Gate Resistance	R_{Gint}				1.2		Ω
栅极电荷 Gate Charge	Q_G	V_{GE}=-15V~+15V			7.4		μC
输入电容 Input Capacitance	C_{ies}	V_{CE}=25V,V_{GE}=0V, f=1MHz			128		nF
反向传输电容 Reverse Transfer Capacitance	C_{res}				1.47		nF
开通延迟时间 Turn-on Delay Time	$t_{d(on)}$	I_C=600A, V_{CE}=600V, V_{GE}=±15V, R_{Gon}=1.5Ω, R_{Goff}=1.5Ω, Inductive Load	T_{vj}=25°C		435		ns
			T_{vj}=125°C		450		
			T_{vj}=150°C		450		
上升时间 Rise Time	t_r		T_{vj}=25°C		115		ns
			T_{vj}=125°C		160		
			T_{vj}=150°C		170		
关断延迟时间 Turn-off Delay Time	$t_{d(off)}$		T_{vj}=25°C		625		ns
			T_{vj}=125°C		680		
			T_{vj}=150°C		700		
下降时间 Fall Time	t_f		T_{vj}=25°C		90		ns
			T_{vj}=125°C		200		
			T_{vj}=150°C		235		
开通损耗 Turn-on Energy Loss	E_{on}		T_{vj}=25°C		55		mJ
			T_{vj}=125°C		100		
			T_{vj}=150°C		110		
关断损耗 Turn-off Energy Loss	E_{off}		T_{vj}=25°C		35		mJ
			T_{vj}=125°C		50		
			T_{vj}=150°C		60		
短路电流 Short Circuit Current	I_{SC}	V_{GE}≤15V, t_{psc}≤10us, V_{CC}=800V, T_{vj}=150°C $V_{CE,max}$=V_{CES}-$L_{s(CE)}$ x di/dt			2650		A

*1 IGBT特征值遵从IEC 60747-9。

二极管特征值 Diode Characteristics Values*2

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=600A	T_{vj}=25°C		1.75	2.15	V
			T_{vj}=125°C		1.90		
			T_{vj}=150°C		1.90		
反向恢复峰值电流 Peak reverse recovery current	I_{RM}	I_F=600A, V_R=600V, V_{GE}=-15V $-di_F/dt$=2700A/µs (T_{vj}=150°C)	T_{vj}=25°C		460		A
			T_{vj}=125°C		450		
			T_{vj}=150°C		445		
反向恢复电荷 Reverse recovery charge	Q_{rr}		T_{vj}=25°C		50		uC
			T_{vj}=125°C		95		
			T_{vj}=150°C		105		
反向恢复损耗 Reverse recovery energy loss	E_{rec}		T_{vj}=25°C		12		mJ
			T_{vj}=125°C		25		
			T_{vj}=150°C		30		

*2 二极管特征值遵从IEC 60747-2。

负温度系数热敏电阻 NTC-Thermistor

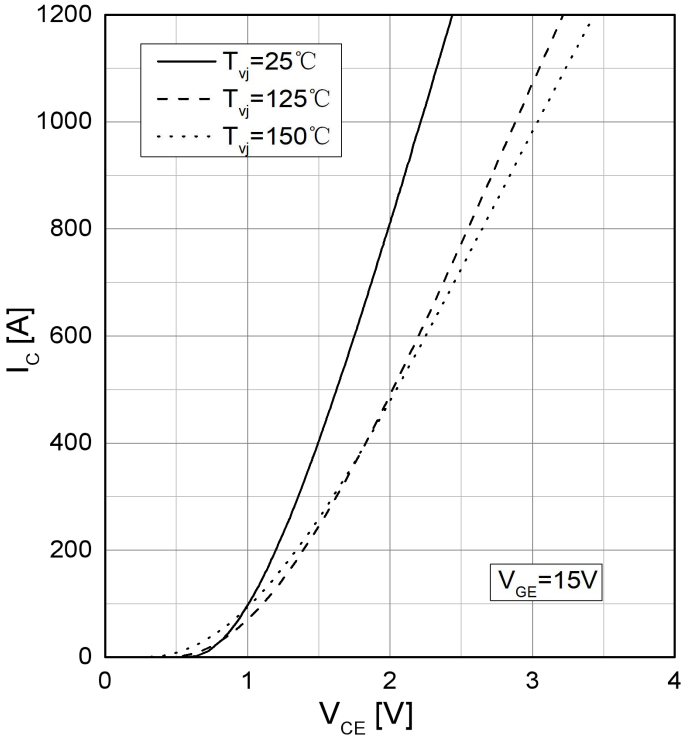
参数 Parameter	符号 Symbol	条件 Condition	数值 Value			单位 Unit
			Min.	Typ.	Max.	
额定电阻 Rated resistance	R_{25}	T_{NTC}=25°C		5.00		kΩ
功耗 Power dissipation	P_{25}	T_{NTC}=25°C			10	mW
B-值 B-value	$B_{25/50}$	$R_2=R_{25}\exp[B_{25/50}(1/T_2-1/(298,15K))]$		3375		K

封装特性 Package Properties*3

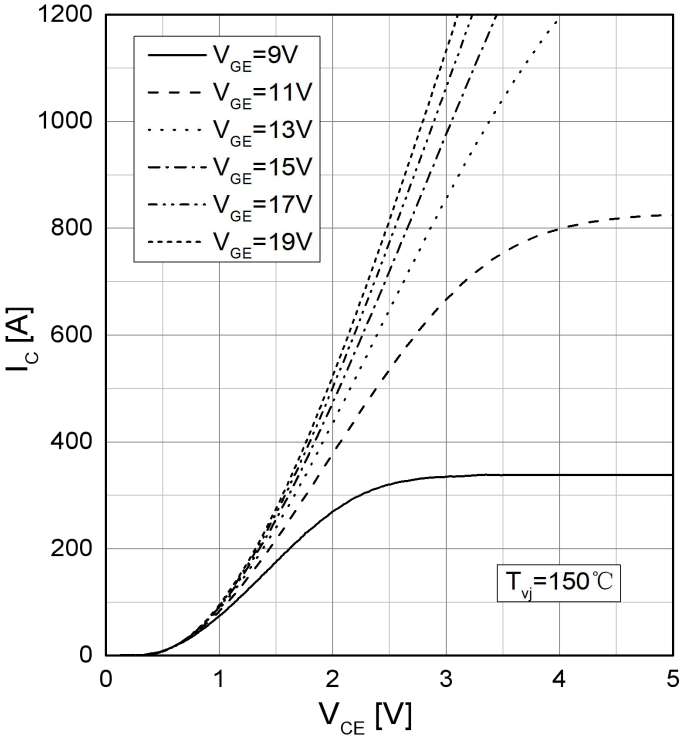
参数 Parameter	符号 Symbol	条件 Condition	数值 Value			单位 Unit
			Min.	Typ.	Max.	
IGBT 结-壳热阻 IGBT Thermal Resistance: Junction to Case	$R_{th(J-C)}$	每个IGBT/per IGBT			0.038	K/W
二极管 结-壳热阻 Diode Thermal Resistance: Junction to Case	$R_{th(J-C)}$	每个二极管/per Diode			0.063	K/W
IGBT接触热阻 IGBT Thermal Resistance: Case to Heatsink	$R_{th(C-H)}$	每个IGBT/per IGBT 硅脂导热系数λ_{grease}=1W/(m•K)		0.029		K/W
二极管接触热阻 Diode Thermal Resistance: Case to Heatsink	$R_{th(C-H)}$	每个二极管/per Diode 硅脂导热系数λ_{grease}=1W/(m•K)		0.048		K/W
绝缘耐压 Isolation Voltage	V_{isol}	RMS, f=50Hz, t=60s		3.4		kV
爬电距离 Creepage Distance	d_{cr}	端子到散热器 Terminal to Heatsink		14		mm
		端子到端子 Terminal to Terminal		13.5		mm
电气间隙 Clearance Distance	d_{cl}	端子到散热器 Terminal to Heatsink		12.5		mm
		端子到端子 Terminal to Terminal		10		mm
相对漏电起痕指数 Comparative Tracking Index	CTI			>200		
模块寄生电感 Module Stray Inductance	$L_{s,\ CE}$	每个桥臂/per Switch		20		nH
模块引线内阻 Module lead Resistance, Terminal to Chip	$R_{CC`+EE`}$	每个桥臂/per Switch, T_C=25°C		1.1		mΩ
安装扭矩 Mounting Torques	M	基板至散热器, Baseplate to Heatsink, M5	3.0		6.0	Nm
		功率端子安装, Power Terminal, M6	3.0		6.0	Nm
模块重量 Module Weight	G			350		g

*3 封装特性遵从IEC 60747-15

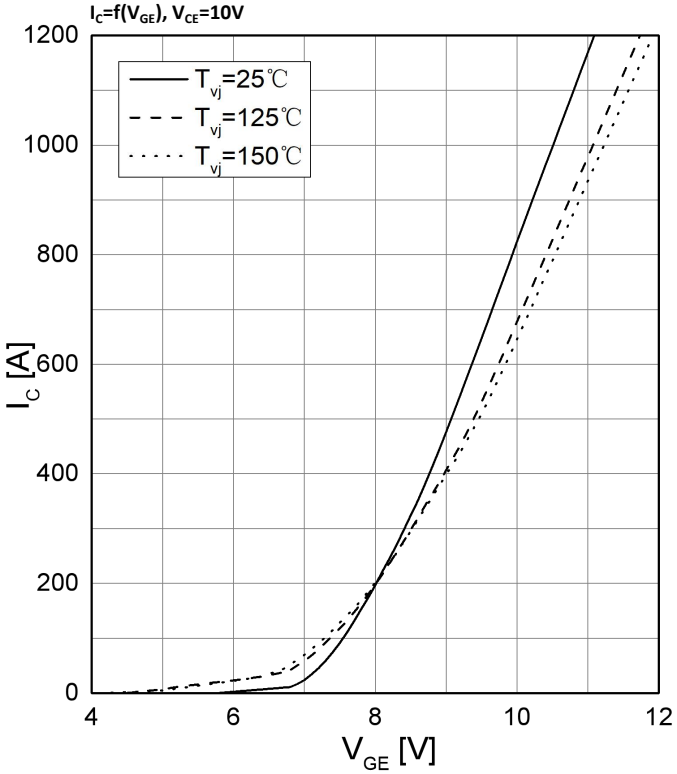
输出特性IGBT
Output characteristic IGBT
$I_C=f(V_{CE}),V_{GE}=15V$



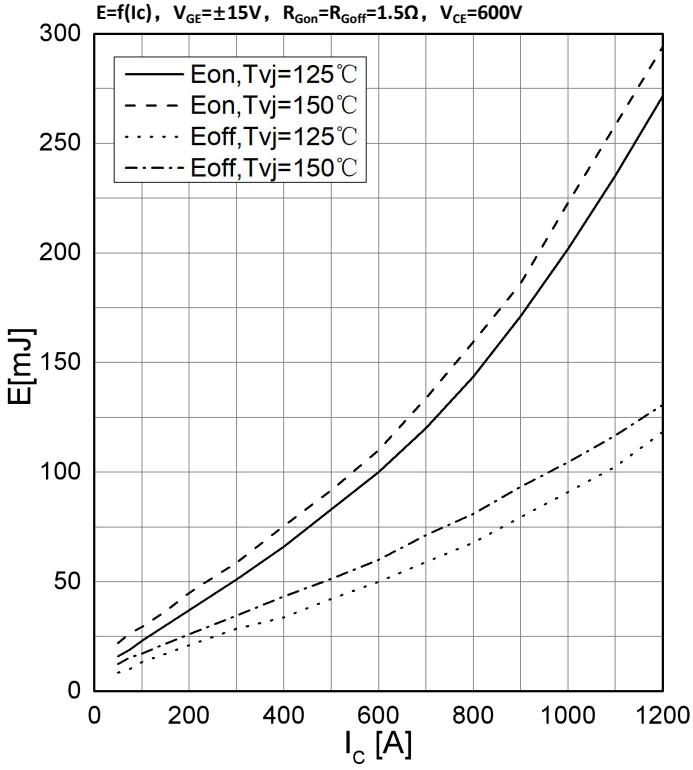
输出特性IGBT
Output characteristic IGBT
$I_C=f(V_{CE})$, T_{vj}=150°C



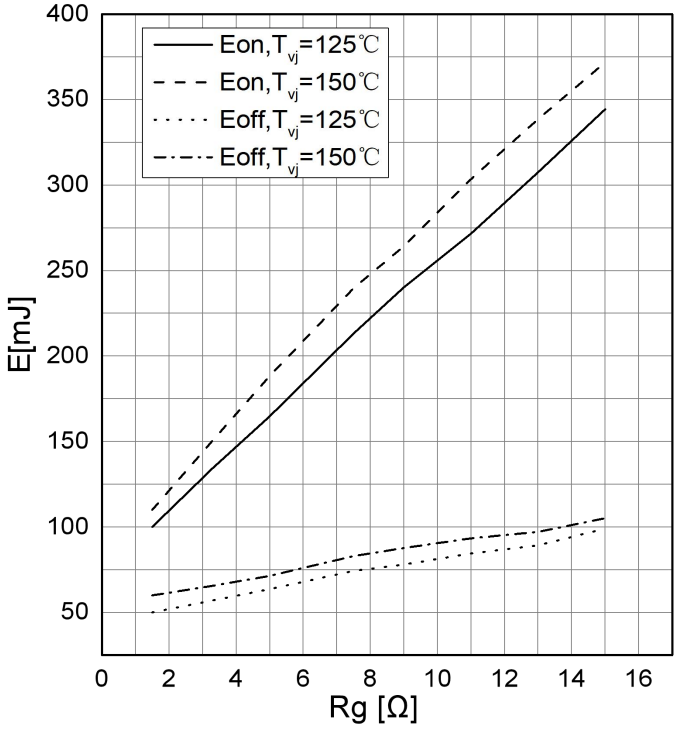
传输特性 IGBT
Transfer characteristic IGBT
$I_C=f(V_{GE})$, V_{CE}=10V



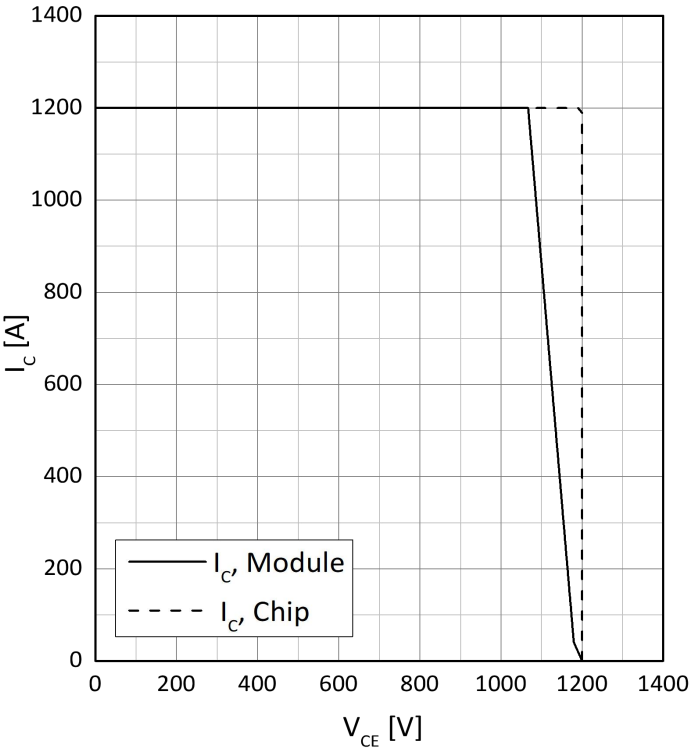
开关损耗 IGBT
Switching losses IGBT
$E=f(Ic)$，$V_{GE}=\pm15V$，$R_{Gon}=R_{Goff}=1.5\Omega$，$V_{CE}=600V$



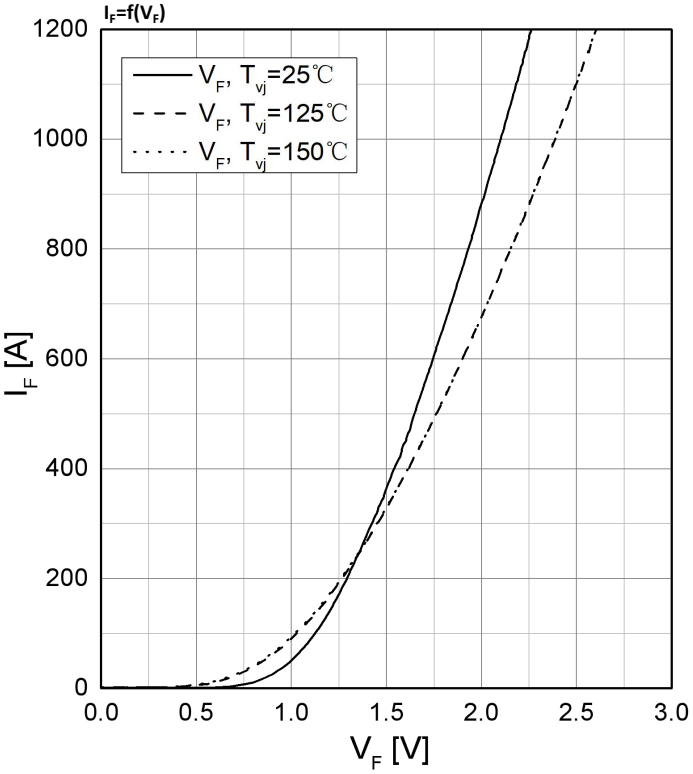
开关损耗IGBT
Switching losses IGBT
V_{GE}=±15V, I_C=600A,V_{CE}=600V



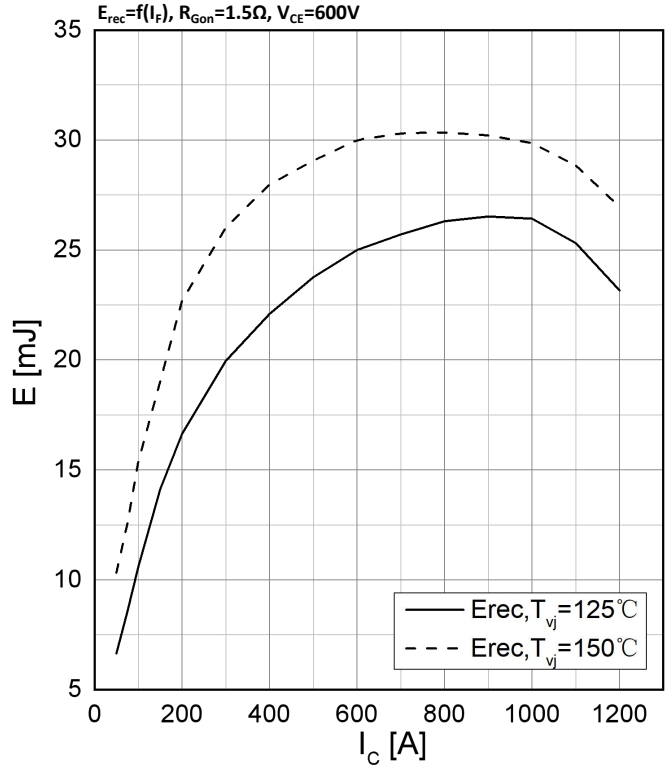
反偏安全工作区 IGBT
Reverse bia safe operating area IGBT
V_{GE}=±15V,R_{Goff}=1.5Ω,T_{vj}=150°C



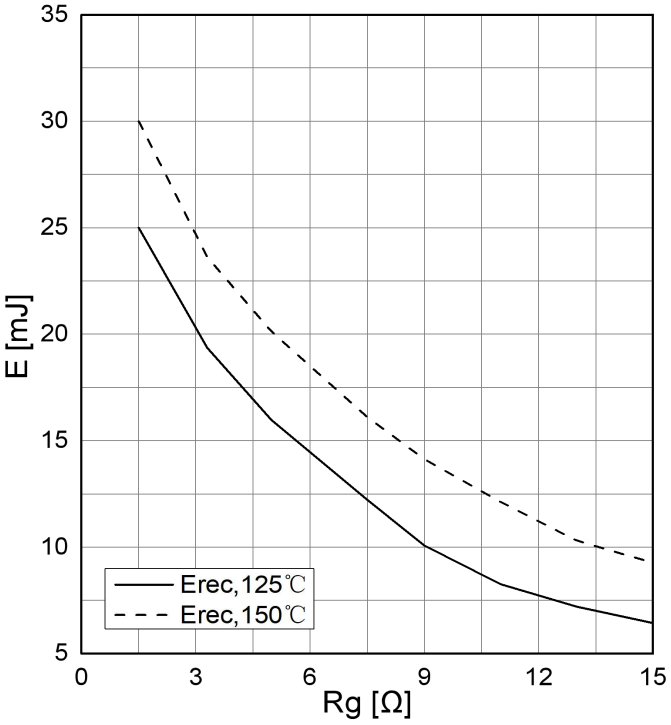
正向特性Diode
Forward characteristic Diode
I_F=f(V_F)



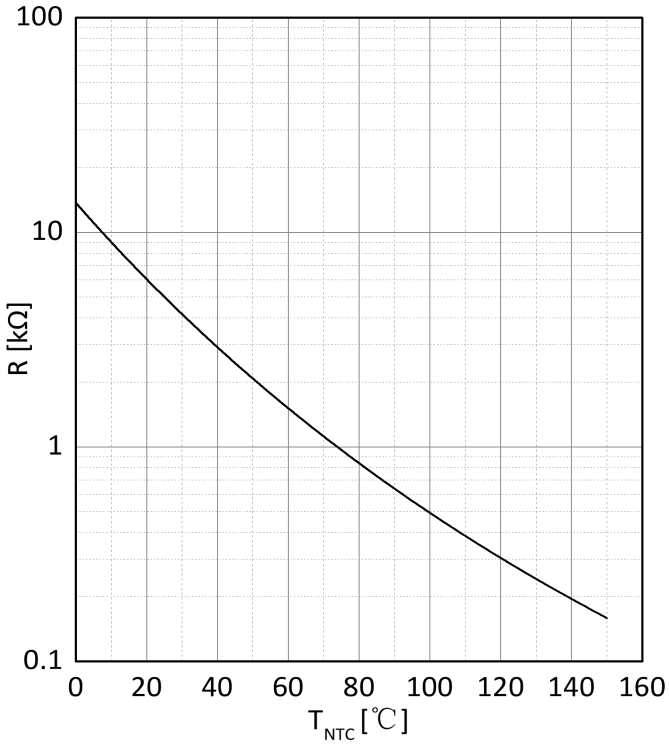
开关损耗 Diode
Switching losses Diode
E_{rec}=f(I_F), R_{Gon}=1.5Ω, V_{CE}=600V



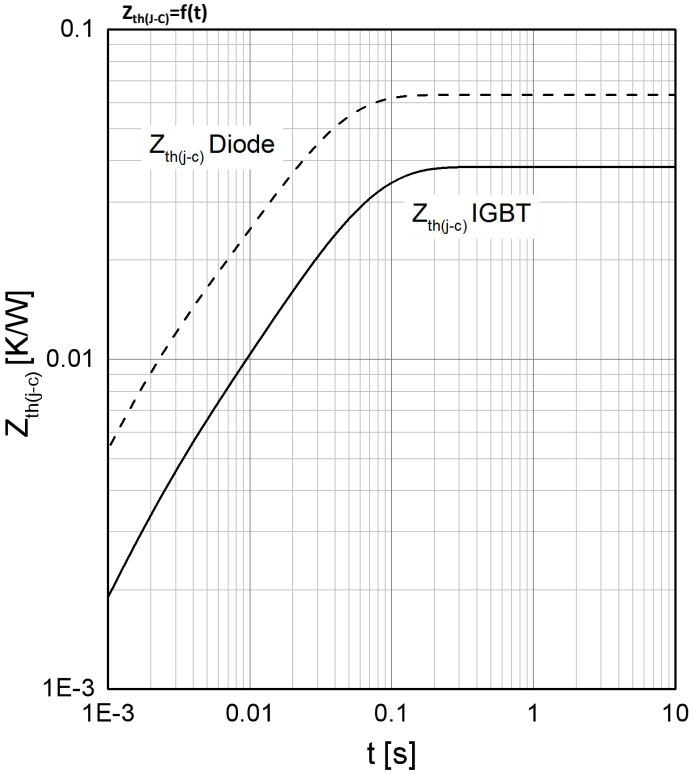
开关损耗Diode
Switching losses Diode
$E_{rec}=f(R_G),V_{CE}=900V$



热敏电阻温度特性曲线
NTC temperature characteristic (typical)
$R = f(T_{NTC})$



瞬态热阻抗 IGBT&Diode
Transient thermal impedance IGBT&Diode
$Z_{th(j-C)}=f(t)$



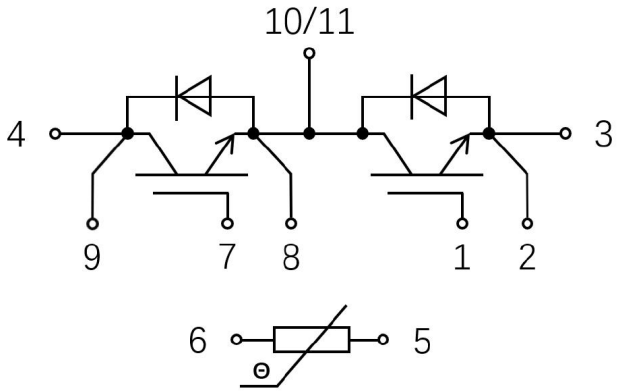
Analytical function for transient thermal impedance:

$$Z_{th(j-c)}(t) = \sum_{i=1}^{n} R_i\left(1 - e^{-t/\tau_i}\right)$$

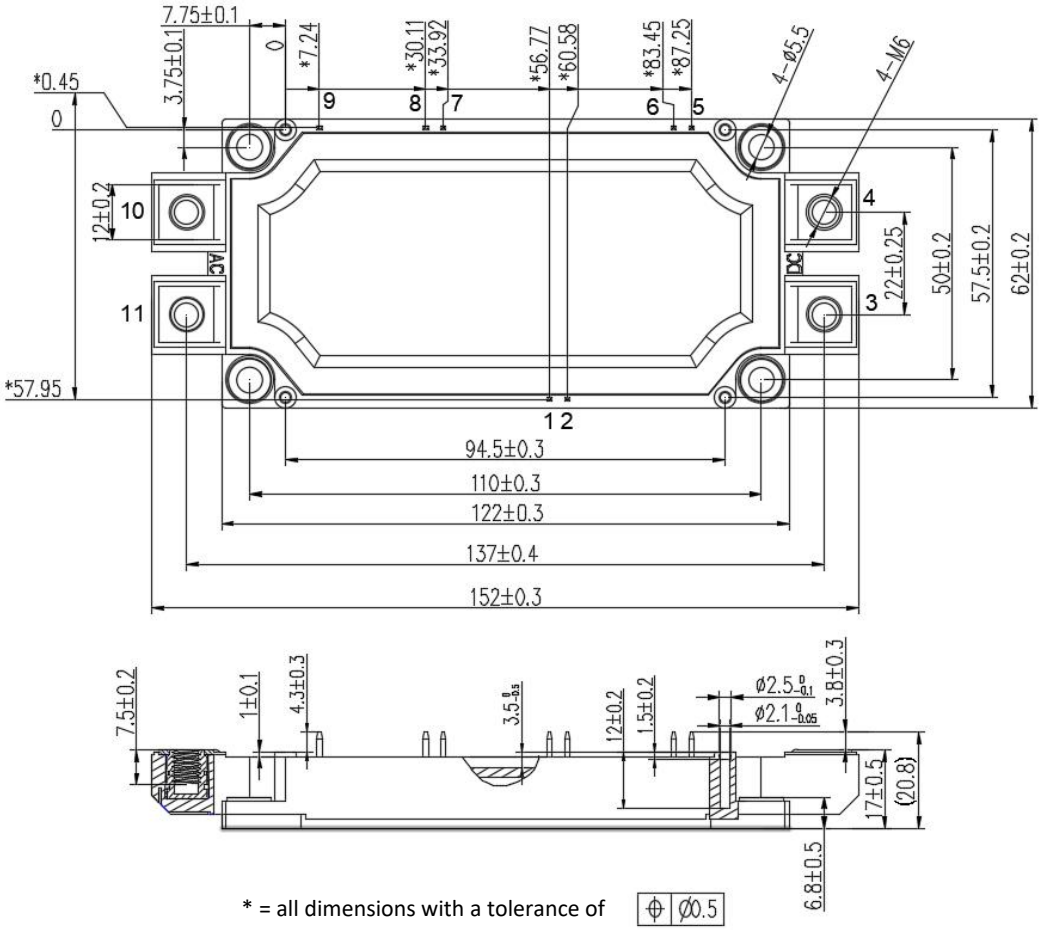
	i	1	2	3	4
IGBT	Ri（K/kW）	2.07	33.85	0.045	2.34
	τi（ms）	8.07	46.79	0.011	2.06

DIODE	Ri（K/kW）	18.21	7.41	16.16	21.58
	τi（ms）	28.29	1.7	24.03	28.28

电路图 Circuit Diagram



外形尺寸 Outline Drawing



* = all dimensions with a tolerance of ⌖ Ø0.5

修订记录 Revision History

版本 Version	日期 Date	描述 Description
A0	2022-12-07	Preliminary 初版
A1	2023-06-01	正式版