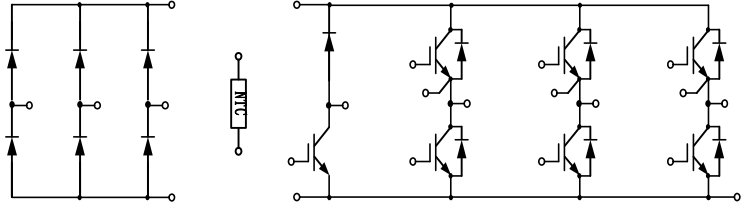


## PIM IGBT Module

### 电气特性:

- 1200V 沟槽栅/场终止工艺
- 低开关损耗
- 正温度系数



### 典型应用:

- 变频器
- 伺服
- 逆变器



$V_{CES} = 1200V$ ,  $I_{C\ nom} = 25A$  /  $I_{CRM} = 50A$

## IGBT, 逆变器 / IGBT, Inverter

### 最大额定值 / Maximum Ratings

Parameter	Conditions	Symbol	Value	Unit
集电极-发射极电压 Collector-Emitter voltage	$T_{vj} = 25^{\circ}C$	$V_{CES}$	1200	V
连续集电极直流电流 Continuous DC collector current	$T_C = 100^{\circ}C$ , $T_{vj\ max} = 175^{\circ}C$	$I_{C\ nom}$	25	A
集电极重复峰值电流 Repetitive peak collector current	$t_p = 1\ ms$	$I_{CRM}$	50	A
总功率损耗 Total power dissipation	$T_C = 25^{\circ}C$ , $T_{vj\ max} = 175^{\circ}C$	$P_{tot}$	187	W
栅极-发射极电压 Gate emitter voltage		$V_{GE}$	$\pm 20$	V

### 特征值 / Characteristic Values

Parameter	Conditions	Symbol	Value			Unit
			Min.	Typ.	Max.	
集电极-发射极饱和电压 Collector-Emitter saturation voltage	$V_{GE} = 15V$ , $I_C = 25A$ $T_{vj} = 25^{\circ}C$ $V_{GE} = 15V$ , $I_C = 25A$ $T_{vj} = 125^{\circ}C$ $V_{GE} = 15V$ , $I_C = 25A$ $T_{vj} = 150^{\circ}C$	$V_{CEsat}$		1.65 1.93 2.00	2.05	V

栅极-发射极阈值电压 Gate-Emitter threshold voltage	$I_C=1\text{mA}, V_{GE}=V_{CE}$	$T_{vj}=25^\circ\text{C}$	$V_{GE(th)}$	5.0	5.6	6.20	
内部栅极电阻 Internal gate resistor			$R_{Gint}$		None		$\Omega$
输入电容 Input capacitance	$f=1\text{MHz}, V_{CE}=25\text{V}, V_{GE}=0\text{V}$	$T_{vj}=25^\circ\text{C}$	$C_{ies}$		1.66		nF
反向传输电容 Reverse transfer capacitance			$C_{res}$		0.08		
集电极-发射极截止电流 Collector-emitter cut-off current	$V_{CE}=1200\text{V}, V_{GE}=0\text{V}$	$T_{vj}=25^\circ\text{C}$	$I_{CES}$			1	mA
栅极-发射极漏电流 Gate-emitter leakage current	$V_{CE}=0\text{V}, V_{GE}=20\text{V}$	$T_{vj}=25^\circ\text{C}$	$I_{GES}$			100	nA
开通延迟时间 Turn-on delay time	$I_C=25\text{A}, V_{CE}=600\text{V}$ $V_{GE}=\pm 15\text{V}, R_G=40\Omega$ (电感负载) / (inductive load)	$T_{vj}=25^\circ\text{C}$	$t_{don}$		67		ns
		$T_{vj}=125^\circ\text{C}$			58		
		$T_{vj}=150^\circ\text{C}$			60		
上升时间 Rise time	$I_C=25\text{A}, V_{CE}=600\text{V}$ $V_{GE}=\pm 15\text{V}, R_G=40\Omega$ (电感负载) / (inductive load)	$T_{vj}=25^\circ\text{C}$	$t_r$		46		ns
		$T_{vj}=125^\circ\text{C}$			56		
		$T_{vj}=150^\circ\text{C}$			55		
关断延迟时间 Turn-off delay time	$I_C=25\text{A}, V_{CE}=600\text{V}$ $V_{GE}=\pm 15\text{V}, R_G=40\Omega$ (电感负载) / (inductive load)	$T_{vj}=25^\circ\text{C}$	$t_{doff}$		311		ns
		$T_{vj}=125^\circ\text{C}$			347		
		$T_{vj}=150^\circ\text{C}$			360		
下降时间 Fall time	$I_C=25\text{A}, V_{CE}=600\text{V}$ $V_{GE}=\pm 15\text{V}, R_G=40\Omega$ (电感负载) / (inductive load)	$T_{vj}=25^\circ\text{C}$	$t_f$		202		ns
		$T_{vj}=125^\circ\text{C}$			274		
		$T_{vj}=150^\circ\text{C}$			288		
开通损耗能量 (每脉冲) Turn-on energy loss per pulse	$I_C=25\text{A}, V_{CE}=600\text{V}$ $V_{GE}=\pm 15\text{V}, R_G=40\Omega$ (电感负载) / (inductive load)	$T_{vj}=25^\circ\text{C}$	$E_{on}$		2.74		mJ
		$T_{vj}=125^\circ\text{C}$			3.95		
		$T_{vj}=150^\circ\text{C}$			4.46		
关断损耗能量 (每脉冲) Turn-off energy loss per pulse	$I_C=25\text{A}, V_{CE}=600\text{V}$ $V_{GE}=\pm 15\text{V}, R_G=40\Omega$ (电感负载) / (inductive load)	$T_{vj}=25^\circ\text{C}$	$E_{off}$		1.71		mJ
		$T_{vj}=125^\circ\text{C}$			2.15		
		$T_{vj}=150^\circ\text{C}$			2.36		
短路数据 SC data	$V_{GE}\leq 15\text{V}, V_{CC}=800\text{V}$		$I_{SC}$		125		A
	$V_{CEmax}=V_{CES}-L_{SCE}\cdot di/dt$	$t_p\leq 8\mu\text{s}, T_{vj}=150^\circ\text{C}$					
结-外壳热阻 Thermal resistance, junction to case	每个 IGBT / per IGBT		$R_{thJC}$			0.80	K/W
在开关状态下温度 Temperature under switching conditions			$T_{vj op}$	-40		150	$^\circ\text{C}$

## 二极管，逆变器 / Diode, Inverter

### 最大额定值 / Maximum Ratings

Parameter	Conditions	Symbol	Value	Unit
反向重复峰值电压 Repetitive peak reverse voltage	$T_{vj}=25^\circ\text{C}$	$V_{RRM}$	1200	V
连续正向直流电流 Continuous DC forward current		$I_F$	25	A
正向重复峰值电流 Repetitive peak forward current	$t_p=1\text{ms}$	$I_{FRM}$	50	A

I <sup>2</sup> t 值 I <sup>2</sup> t-value	t <sub>p</sub> =10ms, sin180°, T <sub>j</sub> =125°C	I <sup>2</sup> t	200	A <sup>2</sup> s
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## 特征值 / Characteristic Values

Parameter	Conditions	Symbol	Value			Unit
			Min.	Typ.	Max.	
正向电压 Forward voltage	I <sub>F</sub> =25A, V <sub>GE</sub> =0V I <sub>F</sub> =25A, V <sub>GE</sub> =0V I <sub>F</sub> =25A, V <sub>GE</sub> =0V	T <sub>vj</sub> =25°C T <sub>vj</sub> =125°C T <sub>vj</sub> =150°C	V <sub>F</sub>	1.85 1.54 1.46	2.40	V
反向恢复峰值电流 Peak reverse recovery current	I <sub>F</sub> =25A, -di <sub>F</sub> /dt=464A/μs(T <sub>vj</sub> =150°C) V <sub>R</sub> =600V, V <sub>GE</sub> =-15V	T <sub>vj</sub> =25°C T <sub>vj</sub> =125°C T <sub>vj</sub> =150°C	I <sub>RM</sub>	19 25 28		A
恢复电荷 Recovered charge	I <sub>F</sub> =25A, -di <sub>F</sub> /dt=464A/μs(T <sub>vj</sub> =150°C) V <sub>R</sub> =600V, V <sub>GE</sub> =-15V	T <sub>vj</sub> =25°C T <sub>vj</sub> =125°C T <sub>vj</sub> =150°C	Q <sub>r</sub>	1.93 4.83 5.79		μC
反向恢复损耗（每脉冲） Reverse recovered energy	I <sub>F</sub> =25A, -di <sub>F</sub> /dt=464A/μs(T <sub>vj</sub> =150°C) V <sub>R</sub> =600V, V <sub>GE</sub> =-15V	T <sub>vj</sub> =25°C T <sub>vj</sub> =125°C T <sub>vj</sub> =150°C	E <sub>rec</sub>	0.63 1.57 1.90		mJ
结-外壳热阻 Thermal resistance, junction to case	每个 Diode / per diode	R <sub>thJC</sub>			1.35	K/W
在开关状态下温度 Temperature under switching conditions		T <sub>vj op</sub>	-40		150	°C

二极管，整流器 / Diode, Rectifier

## 最大额定值 / Maximum Ratings

Parameter	Conditions	Symbol	Value	Unit
反向重复峰值电压 Repetitive peak reverse voltage	T <sub>vj</sub> =25°C	V <sub>RRM</sub>	1600	V
反向不重复峰值电压 Non-Repetitive peak reverse voltage	T <sub>vj</sub> =25°C	V <sub>RSM</sub>	1800	V
最大正向平均电流 Maximum Average Forward Current		I <sub>F(AV)</sub>	25	A
正向浪涌电流 Surge forward current	t <sub>p</sub> =10ms, sin180°, T <sub>vj</sub> =25°C	I <sub>FSM</sub>	320	A
I <sup>2</sup> t 值 I <sup>2</sup> t-value	t <sub>p</sub> =10ms, sin180°, T <sub>vj</sub> =25°C	I <sup>2</sup> t	512	A <sup>2</sup> s

## 特征值 / Characteristic Values

Parameter	Conditions	Symbol	Value			Unit
			Min.	Typ.	Max.	
正向电压 Forward voltage	I <sub>F</sub> =25A, T <sub>vj</sub> =25°C	V <sub>F</sub>			1.1	V

反向电流 Reverse current	$V_R=V_{RRM}$	$T_{vj}=25^{\circ}\text{C}$	$I_R$			5	$\mu\text{A}$
在开关状态下温度 Temperature under switching conditions			$T_{vj\text{ op}}$	-40		150	$^{\circ}\text{C}$

## IGBT，制动-斩波器 / IGBT, Brake-Chopper

### 最大额定值 / Maximum Ratings

Parameter	Conditions	Symbol	Value	Unit
集电极-发射极电压 Collector-Emitter voltage	$T_{vj}=25^{\circ}\text{C}$	$V_{CES}$	1200	V
连续集电极直流电流 Continuous DC collector current	$T_C=100^{\circ}\text{C}, T_{vj\text{ max}}=175^{\circ}\text{C}$	$I_{C\text{ nom}}$	25	A
集电极重复峰值电流 Repetitive peak collector current	$t_p=1\text{ ms}$	$I_{CRM}$	50	A
总功率损耗 Total power dissipation	$T_C=25^{\circ}\text{C}, T_{vj\text{ max}}=175^{\circ}\text{C}$	$P_{\text{tot}}$	125	W
栅极-发射极电压 Gate emitter voltage		$V_{GE}$	$\pm 20$	V

### 特征值 / Characteristic Values

Parameter	Conditions	Symbol	Value			Unit
			Min.	Typ.	Max.	
集电极-发射极饱和电压 Collector-Emitter saturation voltage	$V_{GE}=15\text{V}, I_C=25\text{A}$ $V_{GE}=15\text{V}, I_C=25\text{A}$ $V_{GE}=15\text{V}, I_C=25\text{A}$	$T_{vj}=25^{\circ}\text{C}$ $T_{vj}=125^{\circ}\text{C}$ $T_{vj}=150^{\circ}\text{C}$	$V_{CE\text{ sat}}$	1.81 2.17 2.24	2.20	V
栅极-发射极阈值电压 Gate-Emitter threshold voltage	$I_C=1\text{mA}, V_{GE}=V_{CE}$	$T_{vj}=25^{\circ}\text{C}$	$V_{GE(\text{th})}$	5.10	5.68 6.30	
内部栅极电阻 Internal gate resistor			$R_{G\text{int}}$		None	$\Omega$
输入电容 Input capacitance	$f=1\text{MHz}, V_{CE}=25\text{V}, V_{GE}=0\text{V}$	$T_{vj}=25^{\circ}\text{C}$	$C_{\text{ies}}$	1.66		nF
反向传输电容 Reverse transfer capacitance			$C_{\text{res}}$	0.08		
集电极-发射极截止电流 Collector-emitter cut-off current	$V_{CE}=1200\text{V}, V_{GE}=0\text{V}$	$T_{vj}=25^{\circ}\text{C}$	$I_{CES}$		1	mA
栅极-发射极漏电流 Gate-emitter leakage current	$V_{CE}=0\text{V}, V_{GE}=20\text{V}$	$T_{vj}=25^{\circ}\text{C}$	$I_{GES}$		100	nA
开通延迟时间 Turn-on delay time	$I_C=25\text{A}, V_{CE}=600\text{V}$ $V_{GE}=\pm 15\text{V}, R_G=40\Omega$ (电感负载) / (inductive load)	$T_{vj}=25^{\circ}\text{C}$ $T_{vj}=125^{\circ}\text{C}$ $T_{vj}=150^{\circ}\text{C}$	$t_{d\text{ on}}$		69 58 60	ns
上升时间 Rise time	$I_C=25\text{A}, V_{CE}=600\text{V}$ $V_{GE}=\pm 15\text{V}, R_G=40\Omega$ (电感负载) / (inductive load)	$T_{vj}=25^{\circ}\text{C}$ $T_{vj}=125^{\circ}\text{C}$ $T_{vj}=150^{\circ}\text{C}$	$t_r$		69 60 59	

关断延迟时间 Turn-off delay time	$I_C=25A, V_{CE}=600V$ $V_{GE}=\pm 15V, R_G=40\Omega$ (电感负载) / (inductive load)	$T_{vj}=25^\circ C$ $T_{vj}=125^\circ C$ $T_{vj}=150^\circ C$	$t_{d\ off}$		299 351 361		
下降时间 Fall time	$I_C=25A, V_{CE}=600V$ $V_{GE}=\pm 15V, R_G=40\Omega$ (电感负载) / (inductive load)	$T_{vj}=25^\circ C$ $T_{vj}=125^\circ C$ $T_{vj}=150^\circ C$	$t_f$		224 299 309		
开通损耗能量 (每脉冲) Turn-on energy loss per pulse	$I_C=25A, V_{CE}=600V$ $V_{GE}=\pm 15V, R_G=40\Omega$ (电感负载) / (inductive load)	$T_{vj}=25^\circ C$ $T_{vj}=125^\circ C$ $T_{vj}=150^\circ C$	$E_{on}$		2.01 2.48 2.68		mJ
关断损耗能量 (每脉冲) Turn-off energy loss per pulse	$I_C=25A, V_{CE}=600V$ $V_{GE}=\pm 15V, R_G=40\Omega$ (电感负载) / (inductive load)	$T_{vj}=25^\circ C$ $T_{vj}=125^\circ C$ $T_{vj}=150^\circ C$	$E_{off}$		1.59 2.14 2.26		
结-外壳热阻 Thermal resistance, junction to case	每个 IGBT / per IGBT		$R_{thJC}$			1.2	K/W
在开关状态下温度 Temperature under switching conditions			$T_{vj\ op}$	-40		150	$^\circ C$

## 二极管, 制动-斩波器 / Diode, Brake-Chopper

### 最大额定值 / Maximum Ratings

Parameter	Conditions	Symbol	Value	Unit
反向重复峰值电压 Repetitive peak reverse voltage	$T_{vj}=25^\circ C$	$V_{RRM}$	1200	V
连续正向直流电流 Continuous DC forward current		$I_F$	8	A
正向重复峰值电流 Repetitive peak forward current	$t_p=1ms$	$I_{FRM}$	16	A
$I^2t$ 值 $I^2t$ -value	$V_R=0V, t_p=10ms, T_{vj}=125^\circ C$	$I^2t$	24	$A^2s$

### 特征值 / Characteristic Values

Parameter	Conditions	Symbol	Value			Unit
			Min.	Typ.	Max.	
正向电压 Forward voltage	$I_F=8A, V_{GE}=0V$ $I_F=8A, V_{GE}=0V$ $I_F=8A, V_{GE}=0V$	$T_{vj}=25^\circ C$ $T_{vj}=125^\circ C$ $T_{vj}=150^\circ C$	$V_F$	2.03 1.71 1.64	2.50	V
反向恢复峰值电流 Peak reverse recovery current	$I_F=8A,$ $-di_F/dt=254A/\mu s(T_{vj}=150^\circ C)$ $V_R=600V, V_{GE}=-15V$	$T_{vj}=25^\circ C$ $T_{vj}=125^\circ C$ $T_{vj}=150^\circ C$	$I_{RM}$	8 12 13		A
恢复电荷 Recovered charge	$I_F=8A,$ $-di_F/dt=254A/\mu s(T_{vj}=150^\circ C)$ $V_R=600V, V_{GE}=-15V$	$T_{vj}=25^\circ C$ $T_{vj}=125^\circ C$ $T_{vj}=150^\circ C$	$Q_r$	0.23 1.16 1.30		$\mu C$
反向恢复损耗 (每脉冲) Reverse recovered energy	$I_F=8A,$ $-di_F/dt=254A/\mu s(T_{vj}=150^\circ C)$ $V_R=600V, V_{GE}=-15V$	$T_{vj}=25^\circ C$ $T_{vj}=125^\circ C$ $T_{vj}=150^\circ C$	$E_{rec}$	0.03 0.36 0.40		mJ

结-外壳热阻 Thermal resistance, junction to case	每个 Diode / per diode	$R_{thJC}$			2.30	K/W
在开关状态下温度 Temperature under switching conditions		$T_{vj\ op}$	-40		150	°C

## 负温度系数热敏电阻 / NTC-Thermistor

### 特征值 / Characteristic Values

Parameter	Conditions	Symbol	Value			Unit
			Min.	Typ.	Max.	
额定电阻值 Rated resistances	$T_c=25^\circ\text{C}$ , $\pm 5\%$	$R_{25}$		5.0		K $\Omega$
B-值 B-value	$\pm 1\%$	$B_{25/50}$		3380		K

## 模块 / Module

Parameter	Conditions	Symbol	Value			Unit
绝缘测试电压 Isolation test voltage	RMS, $f=50\text{Hz}$ , $t=1\text{min}$	$V_{ISOL}$		2500		V
内部绝缘 Internal isolation				$\text{Al}_2\text{O}_3$		
储存温度 Storage temperature		$T_{stg}$	-40		125	°C
模块安装的扭矩 Mounting torque for modul mounting		M	3.0		6.0	Nm
重量 Weight		W		170		g

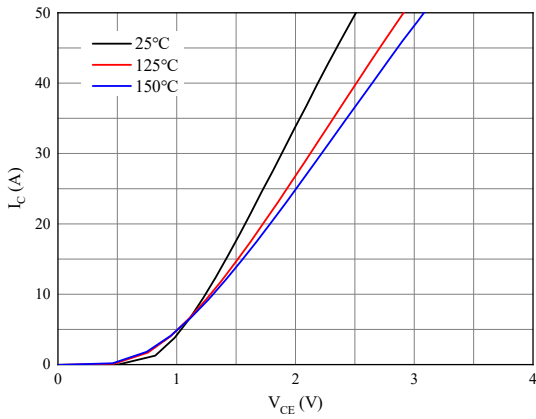


图 1. 典型输出特性 ( $V_{GE}=15V$ )

Figure 1. Typical output characteristics ( $V_{GE}=15V$ )

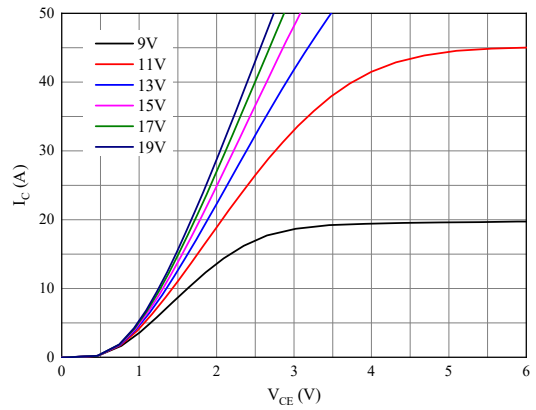
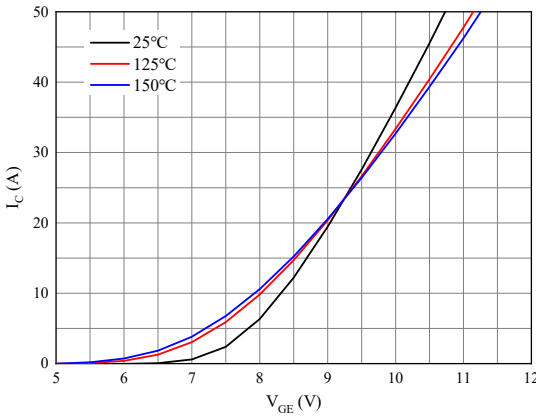


图 2. 典型输出特性 ( $T_{vj}=150^{\circ}C$ )

Figure 2. Typical output characteristics ( $T_{vj}=150^{\circ}C$ )



3. 典型传输特性 ( $V_{CE}=20V$ )

Figure 3. Typical transfer characteristic ( $V_{CE}=20V$ )

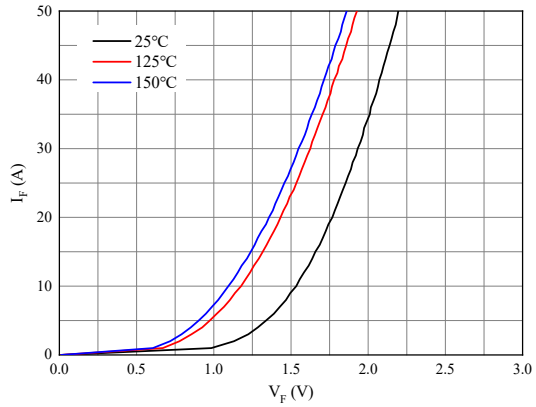


图 4. 正向偏压特性 二极管

Figure 4. Forward characteristic of Diode

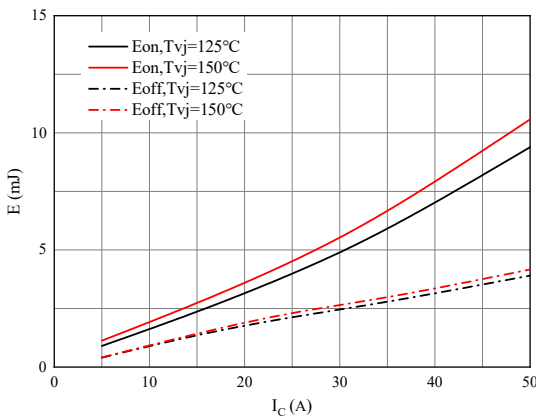


图 5. 开关损耗 逆变器

Figure 5. Switching losses of IGBT  
 $V_{GE}=\pm 15V, R_{Gon}=40\Omega, R_{Goff}=40\Omega, V_{CE}=600V$

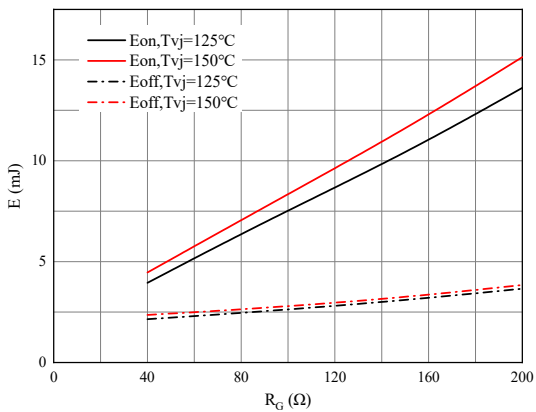


图 6. 开关损耗 逆变器

Figure 6. Switching losses of IGBT  
 $V_{GE}=\pm 15V, I_C=25A, V_{CE}=600V$

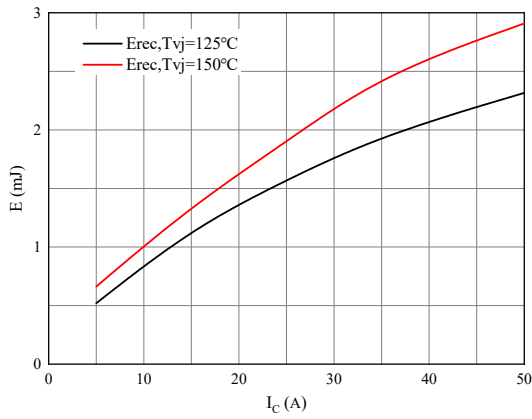


图 7. 开关损耗 二极管

Figure 7. Switching losses of Diode  
 $R_{Gon}=40\Omega, V_{CE}=600V$

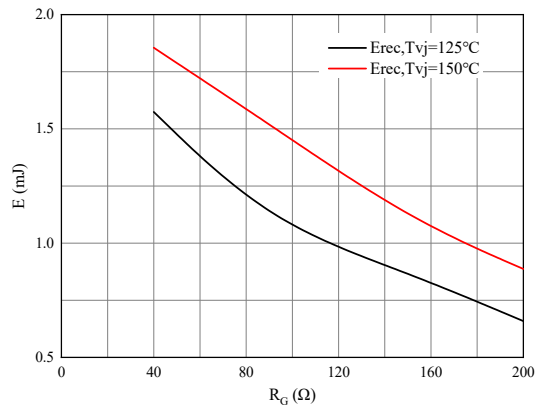


图 8. 开关损耗 二极管

Figure 8. Switching losses of Diode  
 $I_F=25A, V_{CE}=600V$

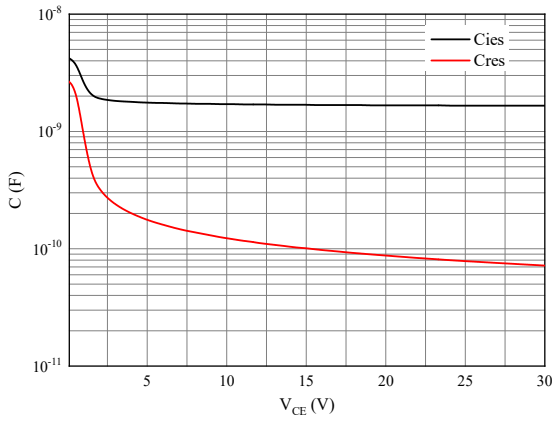


图 9. 电容特性

Figure 9. Capacitance characteristic

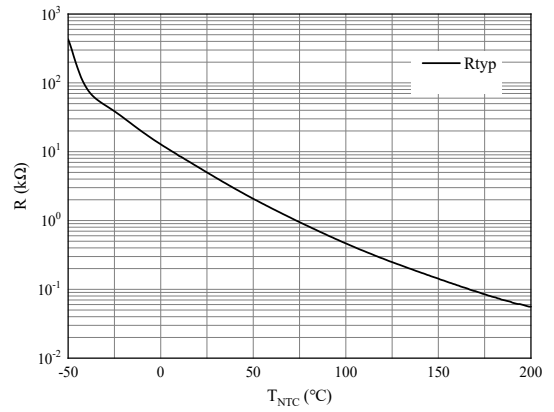
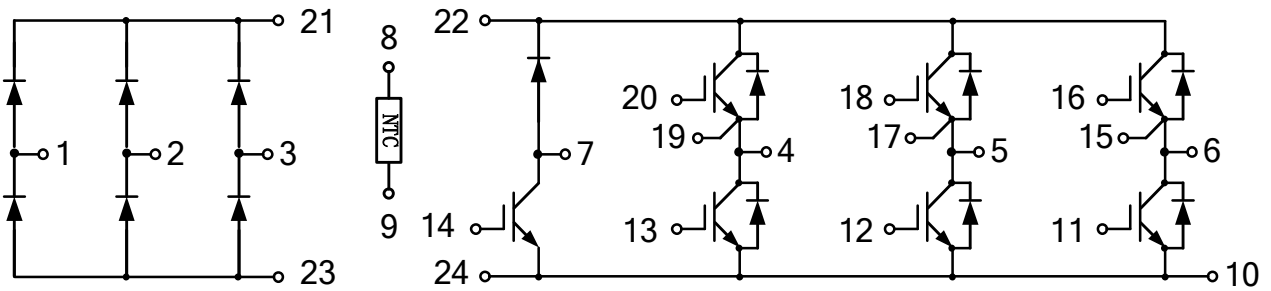


图 10. 负温系数热敏电阻 温度特性

Figure 10. NTC-Themistor-temperature characteristic



接线图 / Circuit diagram



封装尺寸 / Package outlines

