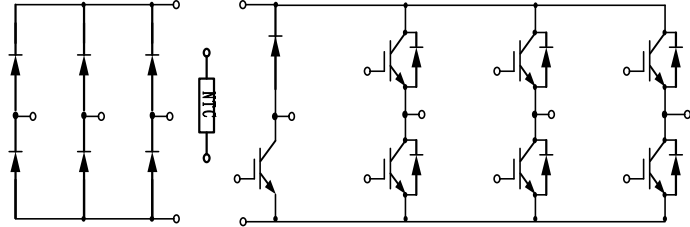


PIM IGBT Module

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



$V_{CES} = 1200V, I_{C\ nom} = 50A / I_{CRM} = 100A$

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	$T_C = 100^{\circ}C, T_{vj\ max} = 175^{\circ}C$	$I_{C\ nom}$	50	A
集电极重复峰值电流 Repetitive peak collector current	$t_p = 1\ ms$	I_{CRM}	100	A
总功率损耗 Total power dissipation	$T_C = 25^{\circ}C, T_{vj\ max} = 175^{\circ}C$	P_{tot}	280	W
栅极-发射极电压 Gate emitter voltage		V_{GE}	± 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	$V_{GE} = 15V, I_C = 50A$ $V_{GE} = 15V, I_C = 50A$ $V_{GE} = 15V, I_C = 50A$	$T_{vj} = 25^{\circ}C$ $T_{vj} = 125^{\circ}C$ $T_{vj} = 150^{\circ}C$	V_{CESat}	2.14 2.73 2.89	2.65	V
栅极-发射极阈值电压 Gate-Emitter threshold voltage	$I_C = 1.7mA, V_{GE} = V_{CE}$	$T_{vj} = 25^{\circ}C$	$V_{GE(th)}$	5.10 5.70	6.30	

内部栅极电阻 Internal gate resistor		R_{Gint}		None		Ω
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}		3.63		nF
反向传输电容 Reverse transfer capacitance		C_{res}		0.12		
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	$I_C=50\text{A}, V_{CE}=600\text{V}$ $V_{GE}=\pm 15\text{V}, R_G=15\Omega$ (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_{don}		62	ns
上升时间 Rise time				$T_{vj}=125^\circ\text{C}$	62	
				$T_{vj}=150^\circ\text{C}$	56	
关断延迟时间 Turn-off delay time	$I_C=50\text{A}, V_{CE}=600\text{V}$ $V_{GE}=\pm 15\text{V}, R_G=15\Omega$ (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_{doff}		204	
				$T_{vj}=125^\circ\text{C}$	243	
				$T_{vj}=150^\circ\text{C}$	251	
下降时间 Fall time	$I_C=50\text{A}, V_{CE}=600\text{V}$ $V_{GE}=\pm 15\text{V}, R_G=15\Omega$ (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_f		164	
				$T_{vj}=125^\circ\text{C}$	216	
				$T_{vj}=150^\circ\text{C}$	256	
开通损耗能量 (每脉冲) Turn-on energy loss per pulse	$I_C=50\text{A}, V_{CE}=600\text{V}$ $V_{GE}=\pm 15\text{V}, R_G=15\Omega$ (电感负载) / (inductive load)	$T_{vj}=25^\circ\text{C}$ $T_{vj}=125^\circ\text{C}$ $T_{vj}=150^\circ\text{C}$	E_{on}		3.38	mJ
$T_{vj}=125^\circ\text{C}$				6.91		
$T_{vj}=150^\circ\text{C}$				8.03		
关断损耗能量 (每脉冲) Turn-off energy loss per pulse	$I_C=50\text{A}, V_{CE}=600\text{V}$ $V_{GE}=\pm 15\text{V}, R_G=15\Omega$ (电感负载) / (inductive load)	$T_{vj}=25^\circ\text{C}$ $T_{vj}=125^\circ\text{C}$ $T_{vj}=150^\circ\text{C}$	E_{off}		3.14	
$T_{vj}=125^\circ\text{C}$				3.88		
$T_{vj}=150^\circ\text{C}$				4.07		
短路数据 SC data	$V_{GE}\leq 15\text{V}, V_{CC}=800\text{V}$ $V_{CEmax}=V_{CES}-L_{sCE}\cdot di/dt$ $t_p\leq 10\mu\text{s}, T_{vj}=150^\circ\text{C}$	I_{SC}		155		A
结-外壳热阻 Thermal resistance, junction to case	每个 IGBT / per IGBT	R_{thJC}			0.54	K/W
在开关状态下温度 Temperature under switching conditions		T_{vjop}	-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	50	A
正向重复峰值电流 Repetitive peak forward current	$t_p=1\text{ms}$	I_{FRM}	100	A
I^2t 值 I^2t -value	$t_p=10\text{ms}, \sin 180^\circ, T_{vj}=125^\circ\text{C}$	I^2t	570	A^2s

特征值 / Characteristic Values

Parameter	Conditions	Symbol	Value			Unit
			Min.	Typ.	Max.	
正向电压 Forward voltage	$I_F=50A, V_{GE}=0V$ $I_F=50A, V_{GE}=0V$ $I_F=50A, V_{GE}=0V$	$T_{vj}=25^{\circ}C$ $T_{vj}=125^{\circ}C$ $T_{vj}=150^{\circ}C$	V_F	2.45 2.10 1.75	2.95	V
反向恢复峰值电流 Peak reverse recovery current	$I_F=50A,$ $-di_F/dt=1210A/\mu s(T_{vj}=150^{\circ}C)$ $V_R=600V, V_{GE}=-15V$	$T_{vj}=25^{\circ}C$ $T_{vj}=125^{\circ}C$ $T_{vj}=150^{\circ}C$	I_{RM}	35 60 75		A
恢复电荷 Recovered charge	$I_F=50A,$ $-di_F/dt=1210A/\mu s(T_{vj}=150^{\circ}C)$ $V_R=600V, V_{GE}=-15V$	$T_{vj}=25^{\circ}C$ $T_{vj}=125^{\circ}C$ $T_{vj}=150^{\circ}C$	Q_f	4.45 7.88 12.89		μC
反向恢复损耗（每脉冲） Reverse recovered energy	$I_F=50A,$ $-di_F/dt=1210A/\mu s(T_{vj}=150^{\circ}C)$ $V_R=600V, V_{GE}=-15V$	$T_{vj}=25^{\circ}C$ $T_{vj}=125^{\circ}C$ $T_{vj}=150^{\circ}C$	E_{rec}	1.57 2.29 4.04		mJ
结-外壳热阻 Thermal resistance, junction to case	每个二极管 / per diode		R_{thJC}		0.81	K/W
在开关状态下温度 Temperature under switching conditions			$T_{vj op}$	-40	150	$^{\circ}C$

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	$T_{vj}=25^{\circ}C, I_{RRM}=0.05mA$	V_{RRM}	1600	V
反向不重复峰值电压 Non-Repetitive peak reverse voltage	$T_{vj}=25^{\circ}C, I_{RRM}=0.05mA$	V_{RSM}	1800	V
最大正向平均电流 Maximum Average Forward Current	$T_S=80^{\circ}C, T_{vj}=25^{\circ}C$	$I_{F(AV)}$	35	A
正向浪涌电流 Surge forward current	$t_p=10ms, \sin 180^{\circ}, T_{vj}=25^{\circ}C$	I_{FSM}	420	A
I^2t 值 I^2t -value	$t_p=10ms, \sin 180^{\circ}, T_{vj}=25^{\circ}C$	I^2t	880	A^2s

特征值 / Characteristic Values

Parameter	Conditions	Symbol	Value			Unit
			Min.	Typ.	Max.	
正向电压 Forward voltage	$I_F=5A, T_{vj}=25^{\circ}C$	V_F		0.9	1.0	V
反向电流 Reverse current	$V_R=1600V$ $T_{vj}=25^{\circ}C$	I_R			50	μA

在开关状态下温度 Temperature under switching conditions		$T_{vj\ op}$	-40		150	°C
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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	$T_C=100^{\circ}\text{C}, T_{vj\ max}=175^{\circ}\text{C}$	$I_{C\ nom}$	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	$T_C = 25^{\circ}\text{C}, T_{vj\ max} = 175^{\circ}\text{C}$	P_{tot}	160	W
栅极-发射极电压 Gate emitter voltage		V_{GE}	± 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_{CESat}	2.03 2.55 2.62	2.55	V
栅极-发射极阈值电压 Gate-Emitter threshold voltage	$I_C=0.85\text{mA}, V_{GE}=V_{CE}$	$T_{vj}=25^{\circ}\text{C}$	$V_{GE(th)}$	5.20	5.70	6.40
内部栅极电阻 Internal gate resistor			R_{Gint}	None		Ω
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}	1.42		nF
反向传输电容 Reverse transfer capacitance				C_{res}	0.06	
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)	$T_{vj}=25^{\circ}\text{C}$ $T_{vj}=125^{\circ}\text{C}$ $T_{vj}=150^{\circ}\text{C}$	$t_{d\ on}$	63 60 59		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	51 59 59		
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)	$T_{vj}=25^{\circ}\text{C}$ $T_{vj}=125^{\circ}\text{C}$ $T_{vj}=150^{\circ}\text{C}$	$t_{d\ off}$	203 243 252		
下降时间 Fall time	$I_C=25\text{A}, V_{CE}=600\text{V}$ $V_{GE}=\pm 15\text{V}, R_G=40\Omega$	$T_{vj}=25^{\circ}\text{C}$ $T_{vj}=125^{\circ}\text{C}$	t_f	173 167		

	(电感负载) / (inductive load)	$T_{vj}=150^{\circ}\text{C}$			214		
开通损耗能量 (每脉冲) Turn-on energy loss per pulse	$I_C=25\text{A}, V_{CE}=600\text{V}$	$T_{vj}=25^{\circ}\text{C}$	E_{on}		1.67		mJ
	$V_{GE}=\pm 15\text{V}, R_G=40\Omega$	$T_{vj}=125^{\circ}\text{C}$			2.48		
	(电感负载) / (inductive load)	$T_{vj}=150^{\circ}\text{C}$			2.80		
关断损耗能量 (每脉冲) Turn-off energy loss per pulse	$I_C=25\text{A}, V_{CE}=600\text{V}$	$T_{vj}=25^{\circ}\text{C}$	E_{off}		1.54		
	$V_{GE}=\pm 15\text{V}, R_G=40\Omega$	$T_{vj}=125^{\circ}\text{C}$			1.99		
	(电感负载) / (inductive load)	$T_{vj}=150^{\circ}\text{C}$			2.14		
短路数据 SC data	$V_{GE}\leq 15\text{V}, V_{CC}=800\text{V}$		I_{SC}		82		A
	$V_{CEmax}=V_{CES}-L_{sCE}\cdot di/dt$ $t_p\leq 10\mu\text{s}, T_{vj}=150^{\circ}\text{C}$						
结-外壳热阻 Thermal resistance, junction to case	每个 IGBT / per IGBT		R_{thJC}			0.95	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, 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	$T_{vj}=25^{\circ}\text{C}$	V_{RRM}	1200	V
连续正向直流电流 Continuous DC forward current		I_F	15	A
正向重复峰值电流 Repetitive peak forward current	$t_p=1\text{ms}$	I_{FRM}	30	A
I^2t 值 I^2t -value	$t_p=10\text{ms}, \sin 180^{\circ}, T_{vj}=125^{\circ}\text{C}$	I^2t	50	A^2s

特征值 / Characteristic Values

Parameter	Conditions	Symbol	Value			Unit
			Min.	Typ.	Max.	
正向电压 Forward voltage	$I_F=15\text{A}, V_{GE}=0\text{V}$ $I_F=15\text{A}, V_{GE}=0\text{V}$ $I_F=15\text{A}, V_{GE}=0\text{V}$	V_F		2.19	2.70	V
	$T_{vj}=25^{\circ}\text{C}$			1.87		
	$T_{vj}=125^{\circ}\text{C}$			1.75		
反向恢复峰值电流 Peak reverse recovery current	$I_F=15\text{A},$ $-di_F/dt=364\text{A}/\mu\text{s}(T_{vj}=150^{\circ}\text{C})$ $V_R=600\text{V}, V_{GE}=-15\text{V}$	I_{RM}		4		A
	$T_{vj}=25^{\circ}\text{C}$			10		
	$T_{vj}=125^{\circ}\text{C}$			13		
恢复电荷 Recovered charge	$I_F=15\text{A},$ $-di_F/dt=364\text{A}/\mu\text{s}(T_{vj}=150^{\circ}\text{C})$ $V_R=600\text{V}, V_{GE}=-15\text{V}$	Q_r		0.26		μC
	$T_{vj}=25^{\circ}\text{C}$			1.02		
	$T_{vj}=125^{\circ}\text{C}$			1.31		
反向恢复损耗 (每脉冲) Reverse recovered energy	$I_F=15\text{A},$ $-di_F/dt=364\text{A}/\mu\text{s}(T_{vj}=150^{\circ}\text{C})$ $V_R=600\text{V}, V_{GE}=-15\text{V}$	E_{rec}		0.05		mJ
	$T_{vj}=25^{\circ}\text{C}$			0.25		
	$T_{vj}=125^{\circ}\text{C}$			0.35		
结-外壳热阻 Thermal resistance, junction to case	每个二极管 / per diode	R_{thJC}			1.50	K/W
在开关状态下温度 Temperature under switching		$T_{vj op}$	-40		150	$^{\circ}\text{C}$

conditions

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		$\text{K}\Omega$
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			Al_2O_3			
储存温度 Storage temperature		T_{stg}	-40		125	$^{\circ}\text{C}$
模块安装的扭矩 Mounting torque for modul mounting		M	3.0		6.0	Nm
重量 Weight		W		170		g

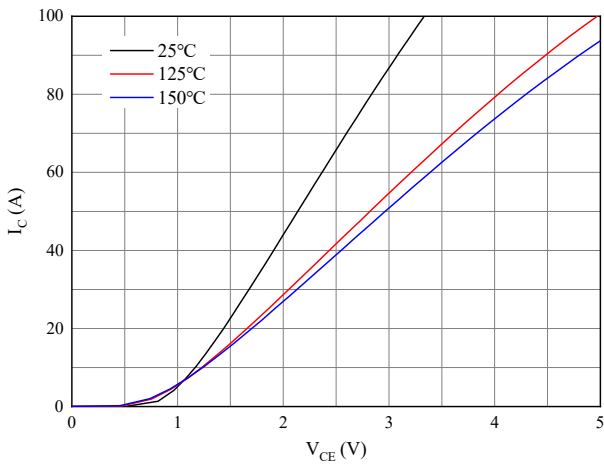


图 1. 输出特性 逆变器 ($V_{GE}=15V$)

Figure 1. Output characteristics IGBT, Inverter

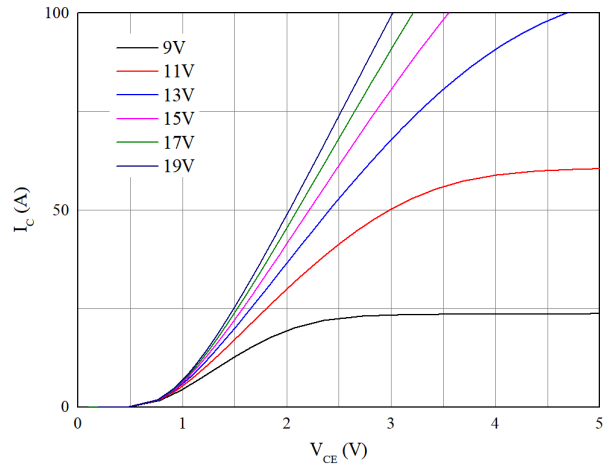


图 2. 输出特性 逆变器 ($T_{vj}=150^{\circ}C$)

Figure 2. Output characteristics IGBT, Inverter

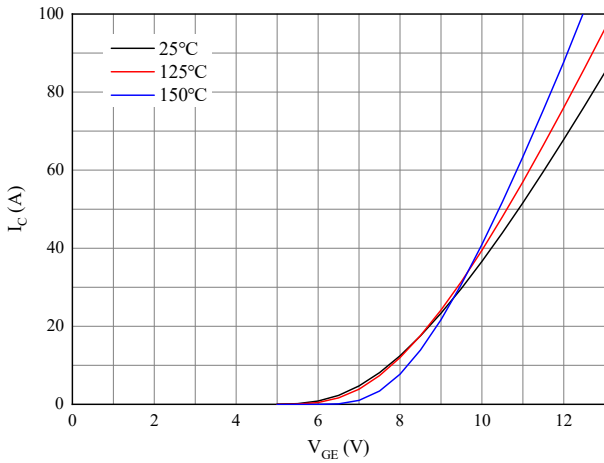


图 3. 输出特性 逆变器 ($V_{CE}=15V$)

Figure 3. Output characteristics IGBT, Inverter

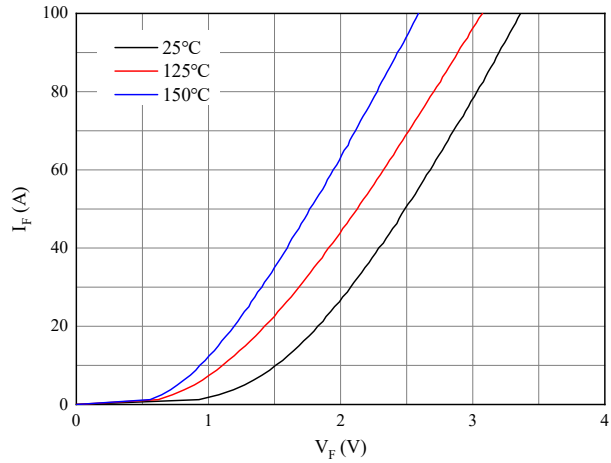


图 4. 正向偏压特性 二极管

Figure 4. Forward characteristic of Diode

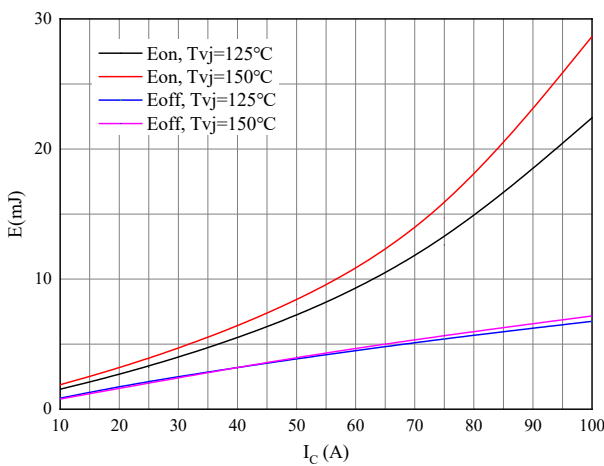


图 5. 开关损耗 逆变器

Figure 5. Switching losses of IGBT

$V_{GE}=\pm 15V, R_{Gon}=15\Omega, R_{Goff}=15\Omega, V_{CE}=600V$

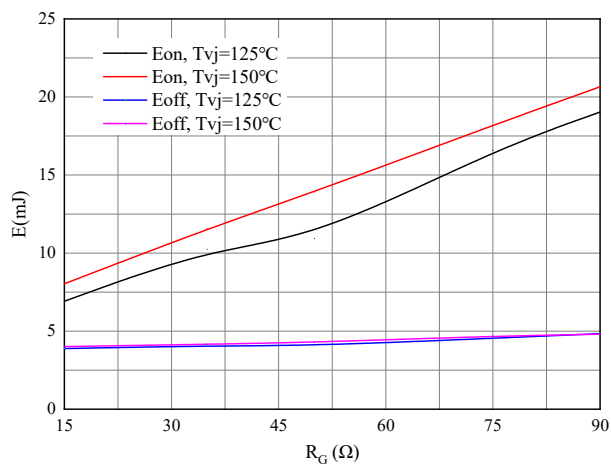


图 6. 开关损耗 逆变器

Figure 6. Switching losses of IGBT

$V_{GE}=\pm 15V, I_C=50A, V_{CE}=600V$

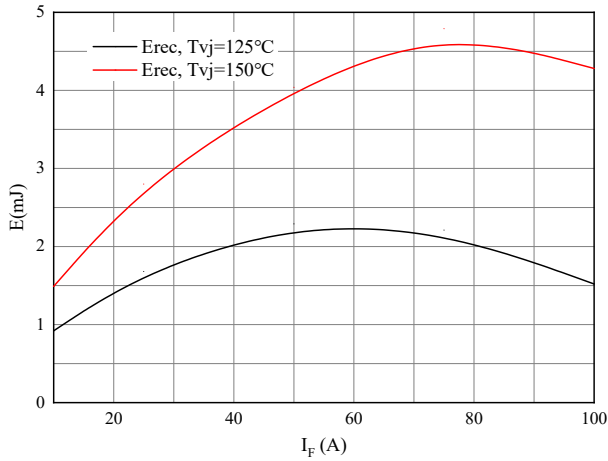


图 7. 开关损耗 二极管

Figure 7. Switching losses of Diode

$R_{Gon}=15\ \Omega, V_{CE}=600\text{V}$

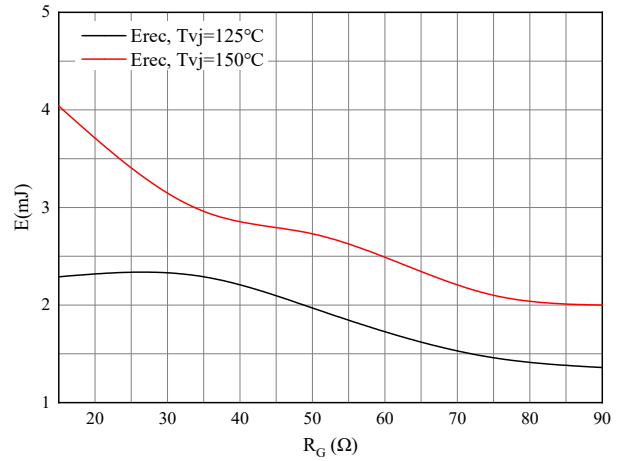


图 8. 开关损耗 二极管

Figure 8. Switching losses of Diode

$I_F=50\text{A}, V_{CE}=600\text{V}$

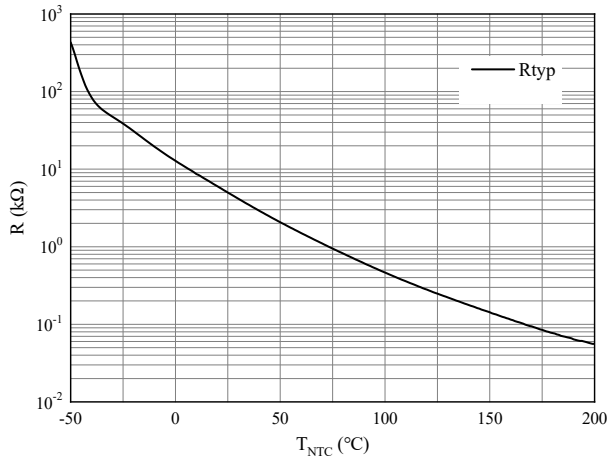
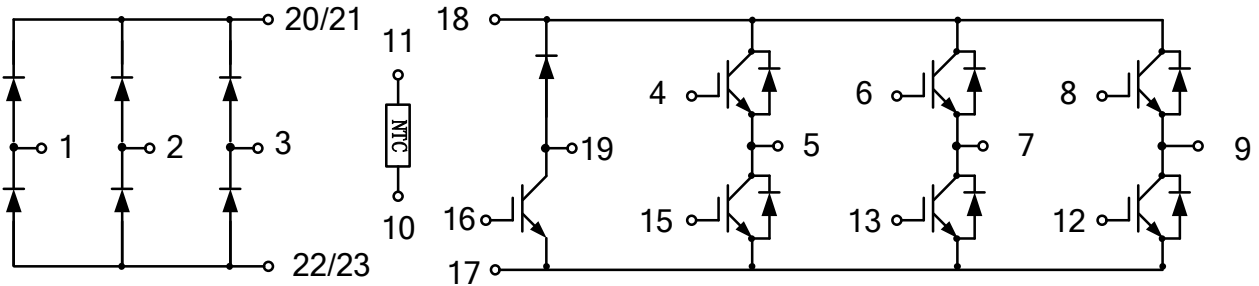


图 9. 负温系数热敏电阻 温度特性

Figure 9. NTC-Themistor-temperature characteristic

接线图 / Circuit diagram



封装尺寸 / Package outlines

