

PIM IGBT Power Module

初步规格书/Preliminary Datasheet

产品特性 / Product Features

- Low switching losses
低开关损耗
- Low $V_{CE(sat)}$ losses
低 $V_{CE(sat)}$
- Low stray inductance design
低电感设计
- Maximum junction temperature 175°C
最大结温 175°C
- RoHS compliant
符合 RoHS 标准

HP25R12W2



产品应用 / Product Applications

- Industrial application
工业应用

典型参数 / Typical Performance Parameters

Type	V_{CE}	I_C	I_F	T_{vjmax}	Marking	Package
HP25R12W2	1200V	25A	25A	175°C	HP25R12W2AWBE	W2

IGBT(T1-T6)最大额定值 / IGBT (T1-T6) Maximum Rated Values

参数 Parameters	符号 Symbol	工作条件 Test Conditions	额定值 Ratings	Unit
集电极-发射极电压 Collector-emitter voltage	V_{CES}	$T_{vj} = 25^{\circ}\text{C}$	1200	V
连续集电极直流电流 Continuous DC collector current	$I_{C\text{ nom}}$	$T_C = 100^{\circ}\text{C}, T_{vj\text{ max}} = 175^{\circ}\text{C}$	25	A
	I_C	$T_C = 25^{\circ}\text{C}, T_{vj\text{ max}} = 175^{\circ}\text{C}$	40	A
集电极脉冲电流 Pulsed Collector Current	I_{CRM}	$t_p = 1\text{ ms}$	50	A
功率损耗 Power dissipation	P_{tot}	$T_C = 25^{\circ}\text{C}, T_{vj\text{ max}} = 175^{\circ}\text{C}$	250	W
栅极-发射极峰值电压 Gate-emitter peak voltage	V_{GES}		± 20	V

IGBT(T1-T6)特征值 / IGBT (T1-T6) Characteristic Values

($T_{vj} = 25^{\circ}\text{C}$, unless otherwise specified)

参数 Parameters	符号 Symbol	工作条件 Test Conditions	最小值 Min.	典型值 Typ.	最大值 Max.	单位 Unit
集电极-发射极饱和电压 Collector-emitter saturation voltage	$V_{CE(\text{sat})}$	$I_C=25\text{A}, V_{GE} = 15\text{V}, T_{vj}=25^{\circ}\text{C}$ $T_{vj}=125^{\circ}\text{C}$ $T_{vj}=150^{\circ}\text{C}$		1.7 1.94 2.1	2.2	V
栅极阈值电压 Gate Threshold Voltage	$V_{GE\text{th}}$	$V_{GE}=V_{CE}, I_C=0.625\text{mA}$	5.2	5.9	6.5	V
栅极电荷 Gate-charge	Q_G	$V_{GE}=-15\text{V}\dots+15\text{V}$		0.31		μC
内部栅极电阻 Internal gate resistor	$R_{G\text{int}}$			0.7		Ω
输入电容 Input capacitance	C_{ies}	$f = 1\text{ MHz}, V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}$		5.3		nF
反向传输电容 Reverse transfer capacitance	C_{res}	$f = 1\text{ MHz}, V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}$		0.45		nF
集电极-发射极截止电流 Collector-emitter cut-off current	I_{CES}	$V_{CE}=1200, V_{GE}=0\text{V}$			1.0	mA
栅极-发射极漏电流 Gate-emitter leakage current	I_{GES}	$V_{GE}=V_{CE}, V_{GE}=20\text{V}$			500	nA

参数 Parameters	符号 Symbol	工作条件 Test Conditions	最小值 Min.	典型值 Typ.	最大值 Max.	单位 Unit
开通损耗能量 Turn-On Switching Energy	E_{on}	$V_{CE} = 600V, I_C = 25A$ $R_g = 18\Omega, V_{GE} = \pm 15V$ $T_{vj} = 25^\circ C$ $T_{vj} = 125^\circ C$ $T_{vj} = 150^\circ C$		1.61 2.6 2.98		mJ
关断损耗能量 Turn Off Switching Energy	E_{off}	$V_{CE} = 600V, I_C = 25A$ $R_g = 18\Omega, V_{GE} = \pm 15V$ $T_{vj} = 25^\circ C$ $T_{vj} = 125^\circ C$ $T_{vj} = 150^\circ C$		2.15 2.9 3.1		
开通延迟时间 Turn-On Delay Time	$t_{d(on)}$	$V_{CE} = 600V, I_C = 25A$ $R_g = 18\Omega, V_{GE} = \pm 15V$ $T_{vj} = 25^\circ C$ $T_{vj} = 125^\circ C$ $T_{vj} = 150^\circ C$		145 134 144		ns
上升时间 Rise Time	t_r	$V_{CE} = 600V, I_C = 25A$ $R_g = 18\Omega, V_{GE} = \pm 15V$ $T_{vj} = 25^\circ C$ $T_{vj} = 125^\circ C$ $T_{vj} = 150^\circ C$		31 36 39		
关断延迟时间 Turn-Off Delay Time	$t_{d(off)}$	$V_{CE} = 600V, I_C = 25A$ $R_g = 18\Omega, V_{GE} = \pm 15V$ $T_{vj} = 25^\circ C$ $T_{vj} = 125^\circ C$ $T_{vj} = 150^\circ C$		142 170 175		
下降时间 Fall Time	t_f	$V_{CE} = 600V, I_C = 25A$ $R_g = 18\Omega, V_{GE} = \pm 15V$ $T_{vj} = 25^\circ C$ $T_{vj} = 125^\circ C$ $T_{vj} = 150^\circ C$		321 411 480		
结-壳热阻 Thermal Resistance from Junction to Case	$R_{th(j-c)}$	Per IGBT		0.52	0.6	$^\circ C/W$
在开关状态下温度 Temperature under switching conditions	$T_{vj,op}$		-40		150	$^\circ C$

二极管(D1-D6)最大额定值 / Diode(D1-D6) Maximum Rated Values

参数 Parameters	符号 Symbol	工作条件 Test Conditions	额定值 Ratings	Unit
反向重复峰值电压 Repetitive peak reverse voltage	VRRM	$T_{vj} = 25^\circ C$	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	I_{FRM}	$t_P = 1\text{ ms}$	50	A
I ² t-值 I ² t-value	I ² t	$V_R = 0\text{ V}, t_P = 10\text{ ms}, T_{vj} = 125^\circ C$ $V_R = 0\text{ V}, t_P = 10\text{ ms}, T_{vj} = 150^\circ C$	208 200	A ² s

二极管(D1-D6)特征值 / Diode(D1-D6) Characteristic Values

参数 Parameters	符号 Symbol	工作条件 Test Conditions	最小值 Min.	典型值 Typ.	最大值 Max.	单位 Unit
正向电压 Forward voltage	V_F	$I_F = 25A, V_{GE} = 0V, T_{vj} = 25^\circ C$ $I_F = 25A, V_{GE} = 0V, T_{vj} = 125^\circ C$ $I_F = 25A, V_{GE} = 0V, T_{vj} = 150^\circ C$		2.24 1.86 1.81	2.5	V
反向恢复峰值电流 Peak reverse recovery current	I_{RM}	$V_R = 600V, I_F = 25A, T_{vj} = 25^\circ C$ $V_{GE} = -15V, T_{vj} = 125^\circ C$ $-di_F/dt = 650A/\mu s (T_{vj} = 150^\circ C), T_{vj} = 150^\circ C$		18 21 22		A
恢复电荷 Reverse Recovery Charge	Q_{rr}	$V_R = 600V, I_F = 25A, T_{vj} = 25^\circ C$ $V_{GE} = -15V, T_{vj} = 125^\circ C$ $-di_F/dt = 650A/\mu s (T_{vj} = 150^\circ C), T_{vj} = 150^\circ C$		1.47 3.25 3.82		μC
反向恢复损耗 Reverse recovery energy	E_{rec}	$V_R = 600V, I_F = 25A, T_{vj} = 25^\circ C$ $V_{GE} = -15V, T_{vj} = 125^\circ C$ $-di_F/dt = 650A/\mu s (T_{vj} = 150^\circ C), T_{vj} = 150^\circ C$		0.52 1.19 1.4		mJ
结-壳热阻 Thermal Resistance from Junction to Case	$R_{th(j-c)}$	per diode		0.9	1.04	$^\circ C/W$
在开关状态下温度 Temperature under switching condition	$T_{vj,op}$		-40		150	$^\circ C$

IGBT(T7)最大额定值 / IGBT (T7) Maximum Rated Values

参数 Parameters	符号 Symbol	工作条件 Test Conditions	额定值 Ratings	Unit
集电极-发射极电压 Collector-emitter voltage	V_{CES}	$T_{vj} = 25^\circ C$	1200	V
连续集电极直流电流 Continuous DC collector current	$I_{C\ nom}$	$T_C = 100^\circ C, T_{vj\ max} = 175^\circ C$	25	A
	I_C	$T_C = 25^\circ C, T_{vj\ max} = 175^\circ C$	40	A
集电极脉冲电流 Pulsed Collector Current	I_{CRM}	$t_p = 1\ ms$	50	A
功率损耗 Power dissipation	P_{tot}	$T_C = 25^\circ C, T_{vj\ max} = 175^\circ C$	250	W
栅极-发射极峰值电压 Gate-emitter peak voltage	V_{GES}		± 20	V

IGBT(T7)特征值 / IGBT (T7) Characteristic Values

($T_{vj} = 25^{\circ}\text{C}$, unless otherwise specified)

参数 Parameters	符号 Symbol	工作条件 Test Conditions	最小值 Min.	典型值 Typ.	最大值 Max.	单位 Unit
集电极-发射极饱和电压 Collector-emitter saturation voltage	$V_{CE(sat)}$	$I_C=25\text{A}$, $V_{GE} = 15\text{V}$ $T_{vj}=25^{\circ}\text{C}$ $T_{vj}=125^{\circ}\text{C}$ $T_{vj}=150^{\circ}\text{C}$		1.7 1.94 2.1	2.2	V
栅极阈值电压 Gate Threshold Voltage	V_{GEth}	$V_{GE}=V_{CE}$, $I_C=0.625\text{mA}$	5.2	5.9	6.5	V
栅极电荷 Gate-charge	Q_G	$V_{GE}=-15\text{V}\dots+15\text{V}$		0.31		μC
内部栅极电阻 Internal gate resistor	R_{Gint}			0.7		Ω
输入电容 Input capacitance	C_{ies}	$f = 1 \text{ MHz}$, $V_{CE} = 25 \text{ V}$, $V_{GE} = 0 \text{ V}$		5.3		nF
反向传输电容 Reverse transfer capacitance	C_{res}	$f = 1 \text{ MHz}$, $V_{CE} = 25 \text{ V}$, $V_{GE} = 0 \text{ V}$		0.45		nF
集电极-发射极截止电流 Collector-emitter cut-off current	I_{CES}	$V_{CE}=1200$, $V_{GE}=0\text{V}$			1.0	mA
栅极-发射极漏电流 Gate-emitter leakage current	I_{GES}	$V_{GE}=V_{CE}$, $V_{GE} = 20\text{V}$			500	nA

参数 Parameters	符号 Symbol	工作条件 Test Conditions	最小值 Min.	典型值 Typ.	最大值 Max.	单位 Unit
开通损耗能量 Turn-On Switching Energy	E_{on}	$V_{CE} = 600\text{V}$, $I_C = 25\text{A}$ $R_g=18\Omega$, $V_{GE} = \pm 15\text{V}$ $T_{vj}=25^{\circ}\text{C}$ $T_{vj}=125^{\circ}\text{C}$ $T_{vj}=150^{\circ}\text{C}$		1.97 2.82 3.1		mJ
关断损耗能量 Turn Off Switching Energy	E_{off}	$V_{CE} = 600\text{V}$, $I_C = 25\text{A}$ $R_g=18\Omega$, $V_{GE} = \pm 15\text{V}$ $T_{vj}=25^{\circ}\text{C}$ $T_{vj}=125^{\circ}\text{C}$ $T_{vj}=150^{\circ}\text{C}$		2.22 2.97 3.24		
开通延迟时间 Turn-On Delay Time	$t_{d(on)}$	$V_{CE} = 600\text{V}$, $I_C = 25\text{A}$ $R_g=18\Omega$, $V_{GE} = \pm 15\text{V}$ $T_{vj}=25^{\circ}\text{C}$ $T_{vj}=125^{\circ}\text{C}$ $T_{vj}=150^{\circ}\text{C}$		145 143 142		ns
上升时间 Rise Time	t_r	$V_{CE} = 600\text{V}$, $I_C = 25\text{A}$ $R_g=18\Omega$, $V_{GE} = \pm 15\text{V}$ $T_{vj}=25^{\circ}\text{C}$ $T_{vj}=125^{\circ}\text{C}$ $T_{vj}=150^{\circ}\text{C}$		59 65 67		

关断延迟时间 Turn-Off Delay Time	$t_{d(off)}$	$V_{CE} = 600V, I_C = 25A$ $R_g = 18\Omega, V_{GE} = \pm 15V$	$T_{vj} = 25^\circ C$ $T_{vj} = 125^\circ C$ $T_{vj} = 150^\circ C$	149 176 179		
下降时间 Fall Time	t_f	$V_{CE} = 600V, I_C = 25A$ $R_g = 18\Omega, V_{GE} = \pm 15V$	$T_{vj} = 25^\circ C$ $T_{vj} = 125^\circ C$ $T_{vj} = 150^\circ C$	319 419 436		
结-壳热阻 Thermal Resistance from Junction to Case	$R_{th(j-c)}$	Per IGBT		0.52	0.6	$^\circ C/W$
在开关状态下温度 Temperature under switching conditions	$T_{vj,op}$			-40	150	$^\circ C$

二极管(D7)最大额定值 / Diode (D7) Maximum Rated Values

参数 Parameters	符号 Symbol	工作条件 Test Conditions	额定值 Ratings	Unit
反向重复峰值电压 Repetitive peak reverse voltage	V_{RRM}	$T_{vj} = 25^\circ C$	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	I_{FRM}	$t_p = 1 \text{ ms}$	30	A
I^2t -值 I^2t -value	I^2t	$V_R = 0 \text{ V}, t_p = 10 \text{ ms}, T_{vj} = 125^\circ C$ $V_R = 0 \text{ V}, t_p = 10 \text{ ms}, T_{vj} = 150^\circ C$	91 85	A^2s

二极管(刹车)特征值 / Diode (Brake) Characteristic Values

参数 Parameters	符号 Symbol	工作条件 Test Conditions	最小值 Min.	典型值 Typ.	最大值 Max.	单位 Unit
正向电压 Forward voltage	V_F	$I_F = 15A, V_{GE} = 0V, T_{vj} = 25^\circ C$ $I_F = 15A, V_{GE} = 0V, T_{vj} = 125^\circ C$ $I_F = 15A, V_{GE} = 0V, T_{vj} = 150^\circ C$		1.84 1.62 1.55	2.25	V
反向恢复峰值电流 Peak reverse recovery current	I_{RM}	$V_R = 300V, I_F = 25A, T_{vj} = 25^\circ C$ $V_{GE} = -15V, T_{vj} = 125^\circ C$ $-di_F/dt = 3600A/\mu s (T_{vj} = 150^\circ C), T_{vj} = 150^\circ C$		8.9 12.7 13.4		A
恢复电荷 Reverse Recovery Charge	Q_{rr}	$V_R = 300V, I_F = 25A, T_{vj} = 25^\circ C$ $V_{GE} = -15V, T_{vj} = 125^\circ C$ $-di_F/dt = 3600A/\mu s (T_{vj} = 150^\circ C), T_{vj} = 150^\circ C$		1.16 2.6 2.9		μC

反向恢复损耗 Reverse recovery energy	E_{rec}	$V_R = 300V, I_F = 25A,$ $V_{GE} = -15V,$ $-di_F/dt = 3600A/us (T_{vj} = 150^\circ C), T_{vj} = 150^\circ C$	$T_{vj} = 25^\circ C$ $T_{vj} = 125^\circ C$ $T_{vj} = 150^\circ C$	0.5 1.14 1.26		mJ
结-壳热阻 Thermal Resistance from Junction to Case	$R_{th(j-c)}$	每个二极管/per diode		1.41	1.62	$^\circ C/W$
在开关状态下温度 Temperature under switching condition	$T_{vj,op}$			-40	150	$^\circ C$

二极管(整流)最大额定值 / Diode (Rectifier) Maximum Rated Values

参数 Parameters	符号 Symbol	工作条件 Test Conditions	额定值 Ratings	Unit
反向重复峰值电压 Repetitive peak reverse voltage	V_{RRM}	$T_{vj} = 25^\circ C$	1600	V
最大正向均方根电流(每芯片) Max. R.M.S forward current per diode	I_{RMSM}	$T_C = 100^\circ C$	60	A
最大整流器输出均方根电流 Max. R.M.S current at rectifier output	I_{FSM}	$T_C = 100^\circ C$	60	A
正向浪涌电流 Surge forward current	I_{FRM}	$t_p = 10\text{ ms}, T_{vj} = 125^\circ C$	300	A
I^2t -值 I^2t -value	I^2t	$V_R = 0\text{ V}, t_P = 10\text{ ms}, T_{vj} = 125^\circ C$ $V_R = 0\text{ V}, t_P = 10\text{ ms}, T_{vj} = 150^\circ C$	722 684	A^2s

二极管(整流)特征值 / Diode (Rectifier) Characteristic Values

参数 Parameters	符号 Symbol	工作条件 Test Conditions	最小值 Min.	典型值 Typ.	最大值 Max.	单位 Unit
正向电压 Forward voltage	V_F	$I_F = 25A,$ $T_{vj} = 25^\circ C$ $T_{vj} = 125^\circ C$ $T_{vj} = 150^\circ C$		1.15 1.07 1.04	1.8	V
反向电流 Reverse leakage current	I_R	$V_R = 1600V,$ $T_{vj} = 25^\circ C$ $T_{vj} = 125^\circ C$ $T_{vj} = 150^\circ C$			1	mA
结-壳热阻 Thermal Resistance from Junction to Case	$R_{th(j-c)}$	per diode		0.59	0.68	$^\circ C/W$

负温度系数热敏电阻 / NTC-Thermistor Characteristic Values

参数 Parameters	符号 Symbol	工作条件 Test Conditions	最小值 Min.	典型值 Typ.	最大值 Max.	单位 Unit
额定电阻值 Rated resistance	R ₂₅	T _c =25°C		5		kΩ
R100 偏差 Deviation of R100	R/R	T _c = 100°C, R100 = 493	-5		5	%
耗散功率 Power Dissipation	P ₂₅	T _c =25°C			20	mW
B-值 B-value	B _{25/50}	$R_2 = R_{25} \exp [B_{25/50}(1/T_2 - 1/(298,15 \text{ K}))]$		3375		K
B-值 B-value	B _{25/80}	$R_2 = R_{25} \exp [B_{25/80}(1/T_2 - 1/(298,15 \text{ K}))]$		3411		K
B-值 B-value	B _{25/100}	$R_2 = R_{25} \exp [B_{25/100}(1/T_2 - 1/(298,15 \text{ K}))]$		3433		K

模块 / Module

参数 Parameters	符号 Symbol	工作条件 Test Conditions	典型值 Typ.	Unit
Isolation test voltage	V _{ISOL}	RMS, f = 50 Hz, t = 1 min.	2.5	kV
Internal isolation		Basic insulation (class 1, IEC 61140)	Al ₂ O ₃	
Creepage distance		terminal to heatsink	11.5	mm
		terminal to terminal	6.3	
Clearance		terminal to heatsink	10.0	mm
		terminal to terminal	5.0	
Comperative tracking index	CTI		>200	

参数 Parameters	符号 Symbol	工作条件 Test Conditions	最小值 Min.	典型值 Typ.	最大值 Max.	单位 Unit
杂散电感, 模块 Stray inductance module	L _{sCE}			15		nH
模块引线电阻, 端子-芯片 Module lead resistance, terminals - chip	R _{CC'+EE'}			2.00		mΩ

存储温度 Storage temperature	Tstg		-40		125	°C
每个夹具的安装力 Mounting force per clamp	F		40		80	N
重量 Weight	G			40		g

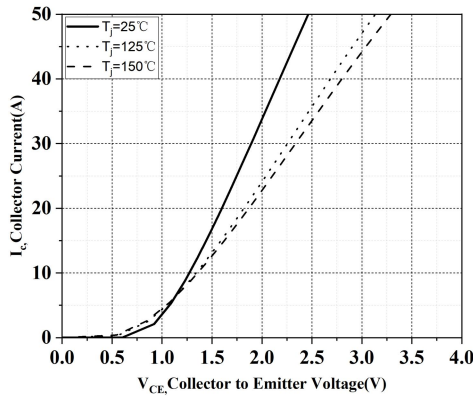


Fig.1. output characteristic IGBT, Inverter (typical)
 $I_C = f(V_{CE}), V_{GE} = 15V$

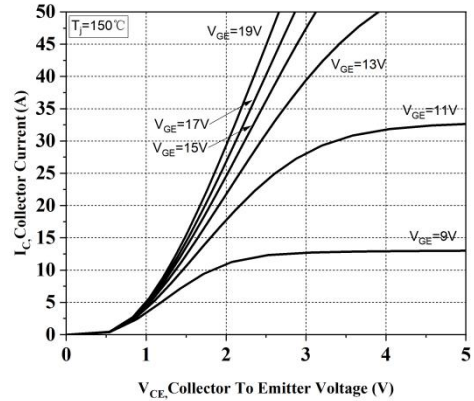


Fig.2. output characteristic IGBT, Inverter (typical)
 $I_C = f(V_{CE}), T_{vj} = 150^\circ C$

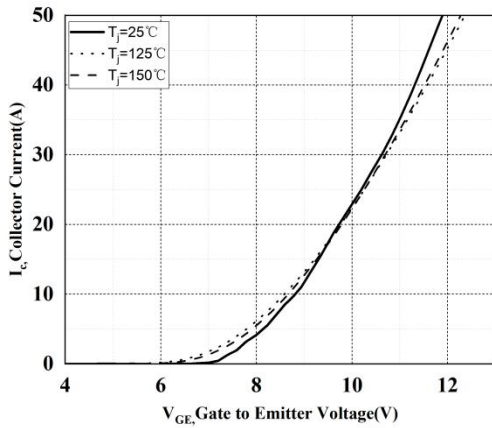


Fig.3. transfer characteristic IGBT, Inverter (typical)
 $I_C = f(V_{GE}), V_{CE} = 20V$

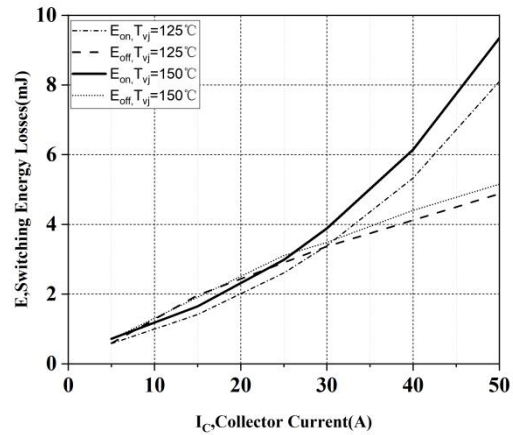


Fig.4. switching losses IGBT, Inverter (typical)
 $E_{on} = f(I_C), E_{off} = f(I_C), V_{GE} = \pm 15V,$
 $R_{Gon} = 18 \Omega, R_{Goff} = 18 \Omega, V_{CE} = 600V$

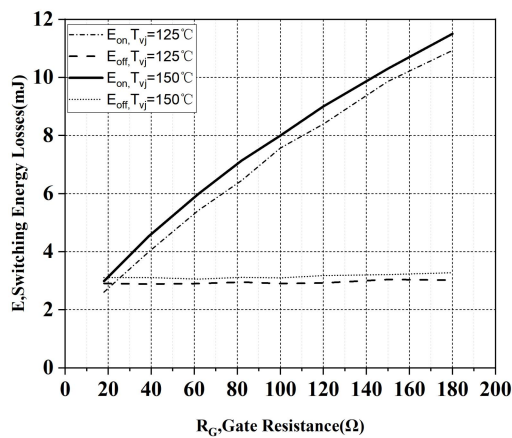


Fig.5. switching losses IGBT, Inverter (typical)
 $E_{on} = f(R_G), E_{off} = f(R_G), V_{GE} = \pm 15V, I_C = 25A, V_{CE} = 600V$

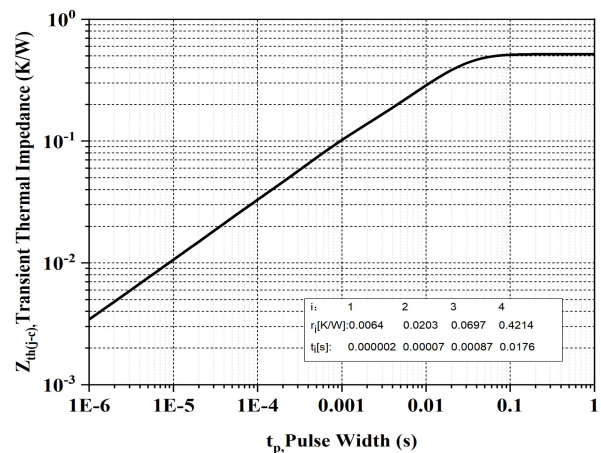


Fig.6. transient thermal impedance IGBT, Inverter (typical)
 $Z_{th(j-c)} = f(t)$

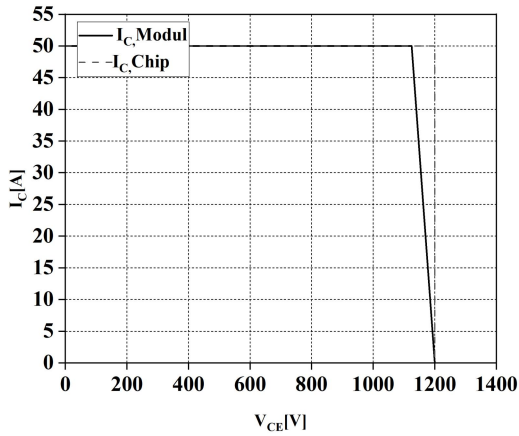


Fig.7. reverse bias safe operating area IGBT, Inverter(RBSOA)

$$I_C = f(V_{CE}), V_{GE} = \pm 15V, R_{Goff} = 18 \Omega, T_{vj} = 150^\circ C$$

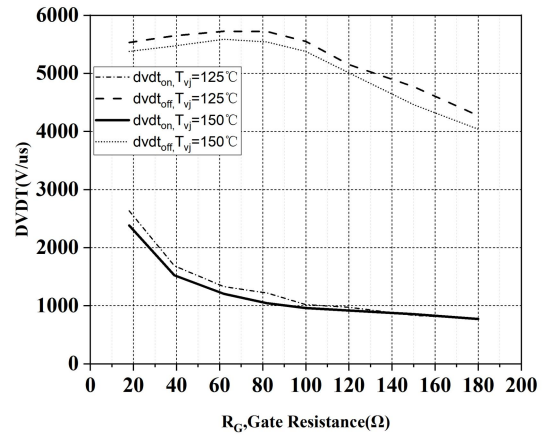


Fig.8. DVDT vs. R_g

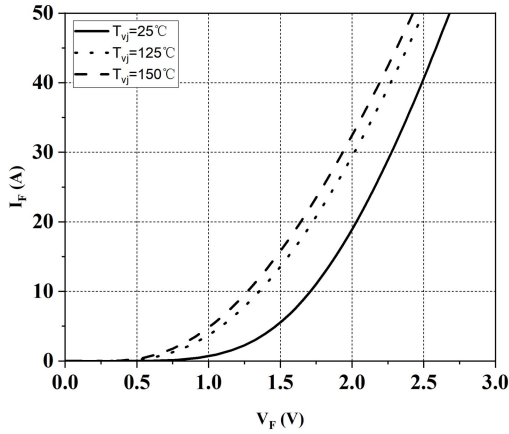


Fig.9. forward characteristic of Diode, Inverter (typical) $I_F = f(V_F)$

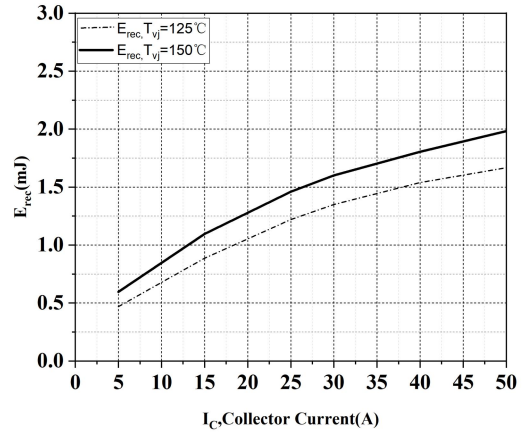


Fig.10. switching losses Diode, Inverter (typical)

$$E_{rec} = f(I_F), R_{Gon} = 18 \Omega, V_{CE} = 600V$$

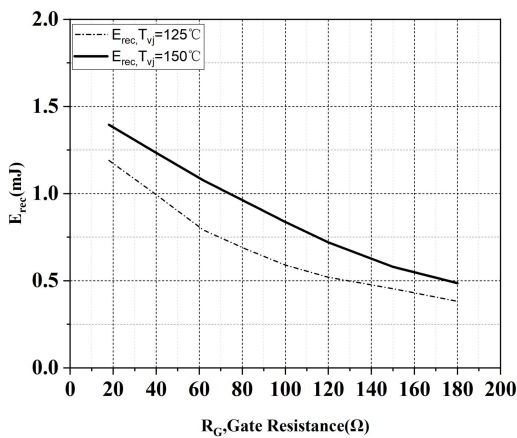


Fig.11. switching losses Diode, Inverter (typical)

$$E_{rec} = f(R_G), I_F = 25A, V_{CE} = 600V$$

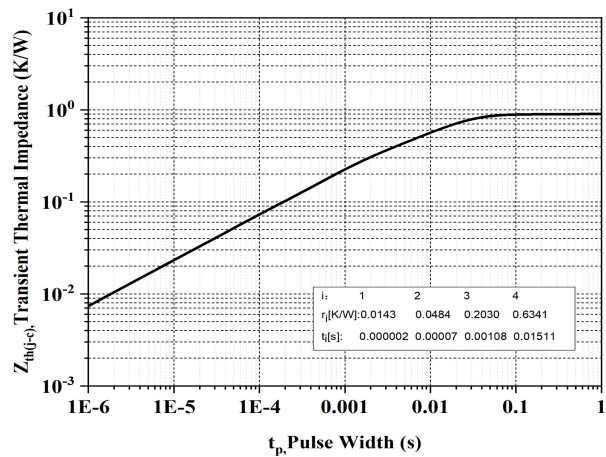


Fig.12. transient thermal impedance Diode, Inverter (typical) $Z_{thJH} = f(t)$

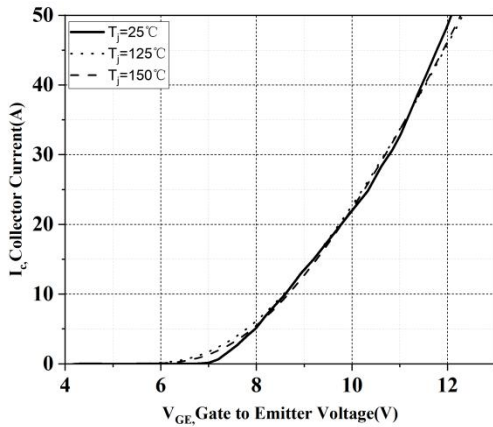


Fig.13. transfer characteristic IGBT, Brake (typical)

$$I_C = f(V_{GE}), V_{CE} = 20V$$

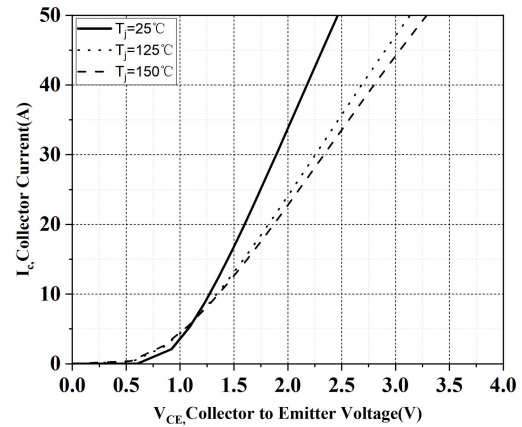


Fig.14. output characteristic IGBT, Brake (typical)

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

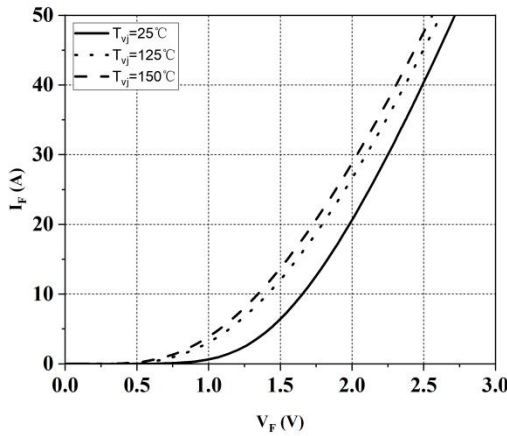


Fig.15. forward characteristic of Diode, D7 (typical)

$$I_F = f(V_F)$$

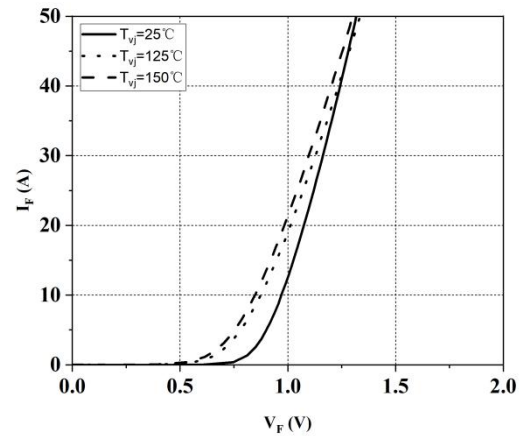


Fig.16. forward characteristic of Diode, D5-D6 (typical)

$$I_F = f(V_F)$$

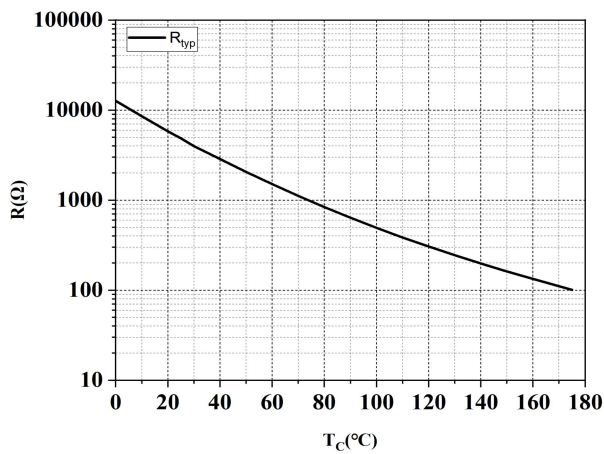
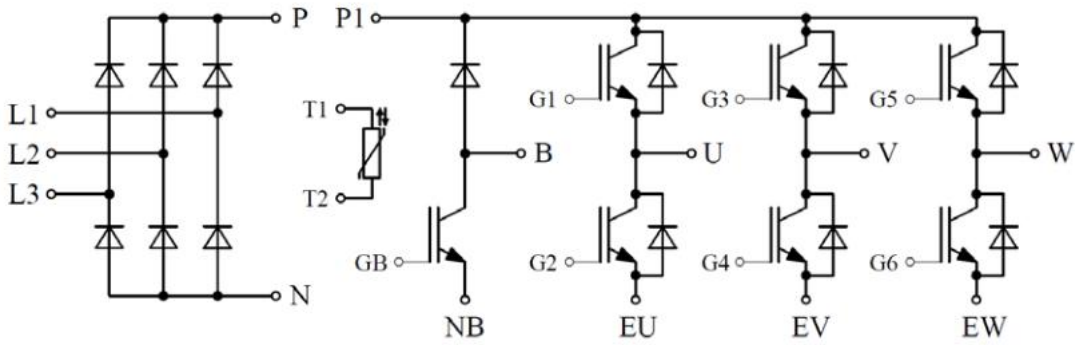
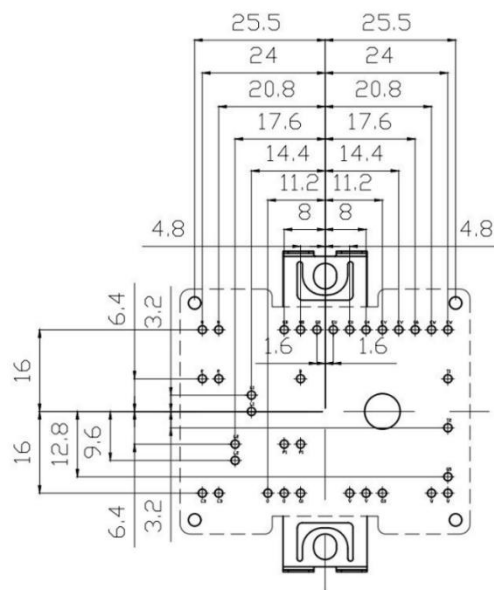
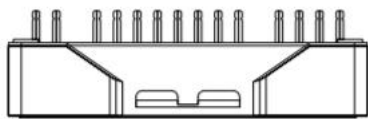
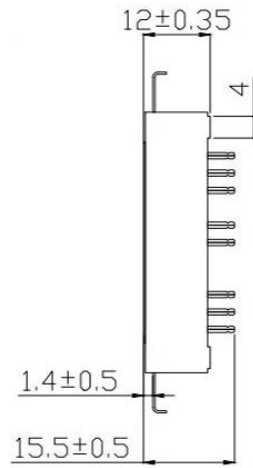
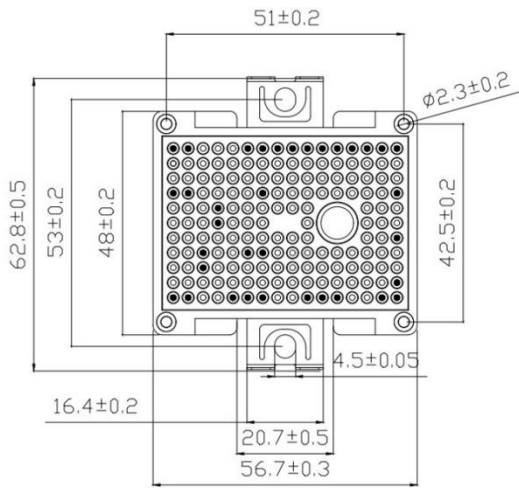


Fig.19. NTC-Thermistor-temperature characteristic (typical) $R = f(T)$

接线图 / Circuit Diagram



封装尺寸 / Product Outline



14. Version Information

Version No.	Status	Date changed	Version revision record
V1.0	Preliminary version	2024/03	