概述/General Description

BG35G12N10S4 是一款由比亚迪半导体设计开发的 Mini 封装的 PIM 工业模块（Power Integrated Module）。该产品具有封装小、集成度高等优点；实现了三相变频电路、二极管桥接电路制动电路的高度集成，能够紧凑地设计主电路。模块集成温度检测，可快速响应及温度实时输出。

BG35G12N10S4 is a cabinet and high integrated power module encapsulated by Mini Pack that BYD has newly developed and designed. It highly combines convert circuit, breakdown circuit and invert circuit to make application circuit outside compact. It includes temperature detection function which can feedback quickly and output the analog temperature signal in real time.

产品特性/Features

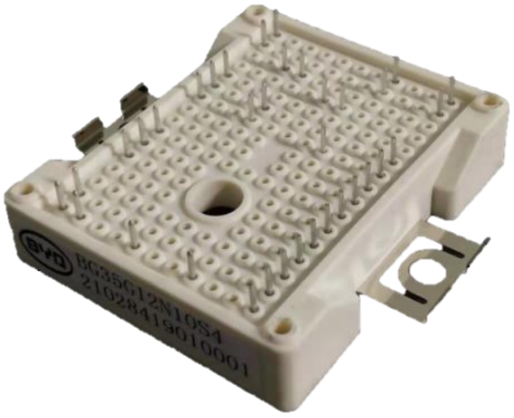
- 1200V/35A，V_{CEsat}=2.0V@I_C=35A，25℃
- 采用陶瓷覆铜板（DBC），低热阻设计
  Very low thermal resistance due to using DBC
- BYD四代IGBT芯片技术，低导通和开关损耗
  The 4th technology of BYD IGBT chip, low conduction and switching losses
- 饱和电压正温度系数
  Positive temperature coefficient
- 10μs短路耐受能力
  Short Circuit withstand time-10μs

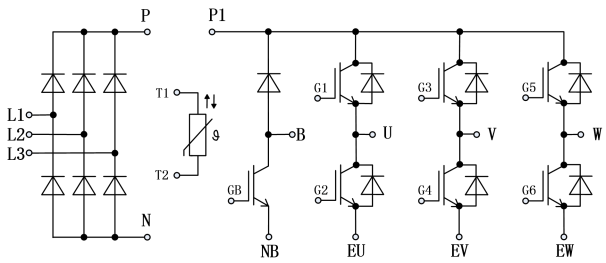
典型应用/Typical Applications

- 空调等变频家电
  Home appliances applications like air condition
- 变频、伺服控制器
  Convert and servo controller
- 三相电机逆变器
  Three-phase inverter for ac motor

封装/Package

miniPIM2





IGBT,逆变器 / IGBT, Inverter

初步数据
Preliminary Data

最大额定值 / Maximum Rated Values

(T_J=25°C,除非另外注明/unless otherwise noted)

参数 Parameter	符号 Symbol	工作条件 Conditions	额定值 Ratings	单位 Units
集电极-发射极电压 Collector-emitter voltage	V_{CES}	T_{vj} = 25°C	1200	V
连续集电极直流电流 Continuous DC collector current	I_C nom I_C	T_C = 100°C, T_{vj} max = 175°C T_C = 25°C, T_{vj} max = 175°C	35 70	A
集电极重复峰值电流 Repetitive peak collector current	I_{CRM}	t_p = 1 ms	70	A
集电极功耗 Collector power dissipation	P_{tot}	T_C= 50°C,$T_{vj\ max}$= 175°C	208	W
栅极-发射极电压 Gate-emitter voltage	V_{GES}		±20	V

电气特性 / Electrical Characteristics

参数 Parameter	符号 Symbol	工作条件 Conditions		最小值 Min.	典型值 Typ.	最大值 Max.	单位 Units
集电极-发射极饱和电压 Collector-emitter saturation voltage	V_{CEsat}	V_{GE}=15V,I_C=35A, T_{vj} = 25°C		1.7	2.0	2.3	V
		V_{GE}=15V,I_C=35A, T_{vj} = 150°C		-	2.5	-	V
栅极-发射极阈值电压 Gate-emitter threshold voltage	V_{GEth}	I_C=1.6mA,V_{GE}=V_{CE},T_{vj}= 25°C		5.0	5.8	7.0	V
栅极电荷 Gate charge	Q_G	V_{GE} = -15 V ... +15 V			0.25		µC
内部栅极电阻 Internal gate resistor	R_{Gint}	T_{vj} = 25°C			0.0		R
输入电容 Input capacitance	C_{ies}	f = 1 MHz, T_{vj} = 25°C, V_{CE} = 25 V, V_{GE} = 0 V			2		nF
反向传输电容 Reverse transfer capacitance	C_{res}	f = 1 MHz, T_{vj} = 25°C, V_{CE} = 25 V, V_{GE} = 0 V			0.08		nF
集电极-发射极截止电流 Collector-emitter cut-off current	I_{CES}	V_{CE}=1200V,V_{GE}=0V, T_{vj}= 25°C		-	-	0.1	mA
栅极发射极漏电流 Gate leakage curren	I_{GES}	V_{CE}=0V,V_{GE}=±20V, T_{vj}= 25°C		-	-	200	nA
开通延迟时间 Turn-on delay time	$T_{d\ on}$	V_{CC}=600V, I_C=35A, V_{GE}=±15V, R_G=10Ω	T_{vj} =25°C	-	49	-	ns
			T_{vj} =150°C	-	50	-	
上升时间 Rise time	t_r		T_{vj} =25°C	-	19	-	
			T_{vj} =150°C	-	22	-	
开通损耗 Turn-on energy loss	E_{on}		T_{vj} =25°C	-	1.85	-	mJ
			T_{vj} =150°C	-	3.22	-	

关断延迟时间 Turn-off delay time	$T_{d\ off}$		T_{vj} =25℃	-	242	-	ns
			T_{vj} =150℃	-	337	-	
下降时间 Fall time	t_f		T_{vj} =25℃	-	22	-	
			T_{vj} =150℃	-	173	-	
关断损耗 Turn-off energy loss	E_{off}		T_{vj} =25℃	-	2.21	-	mJ
			T_{vj} =150℃	-	3.95	-	
短路耐受时间 Short-circuited withstand time	t_{SC}	V_{CC} = 800V, V_{CE} ≤ 1200V, V_{GE} ≤ 15V, Tj ≤ 150℃		10	-	-	μs
反偏安全工作区 Reverse biased safe operating area	RBSOA	V_{CC} = 800V, V_{CE} ≤ 1200V, V_{GE} = 20V, T_j ≤ 150℃		70	-	-	A
结－外壳热阻 Thermal resistance, junction to case	R_{thJC}	每个 IGBT / per IGBT		-	0.6	-	K/W
外壳－散热器热阻 Thermal resistance, case to heatsink	R_{thCH}	每个 IGBT / per IGBT λ_{Paste} = 1 W/(m•K) / λ_{grease} = 1 W/(m•K)		-	0.6	-	K/W
在开关状态下温度 Temperature under switching conditions	$T_{vj\ op}$			-40	-	150	°C

二极管,逆变器 / Diode, Inverter

最大额定值 / Maximum Rated Values

(T_J=25°C,除非另外注明/unless otherwise noted)

参数 Parameter	符号 Symbol	工作条件 Conditions	额定值 Ratings	单位 Units
反向重复峰值电压 Repetitive peak reverse voltage	V_{RRM}	V_{GE}=0V, I_C=25A	1200	V
连续正向直流电流 Continuous Forward current	I_F		35	A
正向重复峰值电流 Repetitive peak forward current	I_{FRM}	持续 1ms 的脉冲宽度 less than 1ms	50	A
I2t-值 I^2t - value	I^2t	V_R = 0 V, t_P = 10 ms, T_{vj} = 150° C	244	A^2S

电气特性 / Electrical Characteristics

参数 Parameter	符号 Symbol	工作条件 Conditions		最小值 Min.	典型值 Typ.	最大值 Max.	单位 Units
正向压降 Forward voltage	V_F	I_F=25A	T_{vj} =25℃	-	1.9	2.3	V
			T_{vj} =150℃	-	1.87	-	V
反向恢复峰值电流 Peak reverse recovery current	I_{RM}	T_{vj} =25℃		-	16.2	-	A
		T_{vj} =150℃		-	20.9	-	A
反向恢复电荷 Recovered charge	Q_r	T_{vj} =25℃		-	2.1	-	μC
		T_{vj} =150℃		-	4.3	-	μC
反向恢复损耗 Reverse recovery energy	E_{rec}	T_{vj} =25℃		-	0.7	-	mJ
		T_{vj} =150℃		-	1.5	-	mJ
结－外壳热阻 Thermal resistance, junction to case	R_{thJC}	每个二极管 / per diode		-	0.38	-	K/W
外壳－散热器热阻 Thermal resistance, case to heatsink	R_{thCH}	每个二极管 / per diode λ_{Paste} = 1 W/(m•K) / λ_{grease} = 1 W/(m•K)		-	0.89	-	K/W
在开关状态下温度 Temperature under switching conditions	$T_{vj\ op}$			-40	-	150	℃

二极管,整流器 / Diode, Rectifier

最大额定值 / Maximum Rated Values

参数 Parameter	符号 Symbol	工作条件 Conditions	额定值 Ratings	单位 Units
反向重复峰值电压 Repetitive peak reverse voltage	V_{RRM}	T_{vj} = 25°C	1600	V
最大正向均方根电流(每芯片) Maximum RMS forward current per chip	I_{FRMSM}	T_C = 85°C	35	A
最大整流器输出均方根电流 Maximum RMS current at rectifier output	I_{RMSM}	T_C = 85°C	30	A
正向浪涌电流 Surge forward current	I_{FSM}	t_p = 10 ms, T_{vj} = 25°C	450	A
		t_p = 10 ms, T_{vj} = 150°C	370	A
I2t-值 I^2t - value	I^2t	t_p = 10 ms, T_{vj} = 25°C	1000	A^2S
		t_p = 10 ms, T_{vj} = 150°C	685	A^2S

电气特性 / Electrical Characteristics

参数 Parameter	符号 Symbol	工作条件 Conditions		最小值 Min.	典型值 Typ.	最大值 Max.	单位 Units
正向电压 Forward voltage	V_F	I_F = 30 A	T_{vj} =25°C	-	1	1.2	V
反向电流 Reverse current	I_R	V_R = 1800 V	T_{vj}= 25°C	-	-	5	uA
			T_{vj}= 150°C	-	1	1	mA
结－外壳热阻 Thermal resistance, junction to case	R_{thJC}	每个二极管 / per diode				0.83	K/W
外壳－散热器热阻 Thermal resistance, case to heatsink	R_{thCH}	每个二极管 / per diode λ_{Paste} = 1 W/(m•K) / λ_{grease} = 1 W/(m•K)		-	0.41	-	K/W
在开关状态下温度 Temperature under switching conditions	$T_{vj\,op}$			-40	-	150	℃

IGBT,制动-斩波器 / IGBT, Brake-Chopper

最大额定值 / Maximum Rated Values

(T_J=25°C,除非另外注明/unless otherwise noted)

参数 Parameter	符号 Symbol	工作条件 Conditions	额定值 Ratings	单位 Units
集电极-发射极电压 Collector-emitter voltage	V_{CES}	V_{GE}=0V, I_C=1mA, T_{vj} = 25°C	1200	V
连续集电极直流电流 Continuous DC collector current	$I_{C\,nom}$ I_C	T_C = 100°C, $T_{vj\,max}$ = 175°C T_C = 25°C, $T_{vj\,max}$ = 175°C	25 50	A
集电极重复峰值电流 Repetitive peak collector current	I_{CRM}	t_P = 1 ms	50	A
集电极功耗 Collector dissipation	P_{tot}	T_C= 50°C,$T_{vj\,max}$= 175°C	192	W
栅极-发射极电压 Gate-emitter voltage	V_{GES}		±20	V

电气特性 / Electrical Characteristics

参数 Parameter	符号 Symbol	工作条件 Conditions	最小值 Min.	典型值 Typ.	最大值 Max.	单位 Units
集电极-发射极饱和电压 Collector-emitter saturation voltage	V_{CEsat}	V_{GE}=15V, I_C=25A, T_{vj} = 25°C	-	2.1	2.3	V
		V_{GE}=15V,I_C=25A,T_{vj} = 150°C	-	2.6	-	V
栅极-发射极阈值电压 Gate-emitter threshold voltage	V_{GEth}	I_C=1.6mA,V_{GE}=V_{CE},T_{vj}= 25°C	5.0	5.8	7.0	V

栅极电荷 Gate charge	Q_G	V_{GE} = -15 V ... +15 V			0.16		µC
内部栅极电阻 Internal gate resistor	R_{Gint}	T_{vj} = 25°C			12		R
输入电容 Input capacitance	C_{ies}	f = 1 MHz, T_{vj} = 25°C, V_{CE} = 25 V, V_{GE} = 0 V			0.65		nF
反向传输电容 Reverse transfer capacitance	C_{res}	f = 1 MHz, T_{vj} = 25°C, V_{CE} = 25 V, V_{GE} = 0 V			0.04		nF
集电极-发射极截止电流 Collector-emitter cut-off current	I_{CES}	V_{CE}=1200V, V_{GE}=0V		-	-	0.1	mA
栅极发射极漏电流 Gate leakage curren	I_{GES}	V_{CE}=0V, V_{GE}=±20V		-	-	200	nA
开通延迟时间 Turn-on delay time	$T_{d\ on}$	V_{CC}=600V, I_C=25A, V_{GE}=±15V, R_G=10Ω	T_{vj}=25℃	-	37	-	ns
			T_{vj} =150℃	-	38	-	
上升时间 Rise time	t_r		T_{vj}=25℃	-	15	-	
			T_{vj} =150℃	-	17	-	
开通损耗 Turn-on energy loss	E_{on}		Tj=25℃	-	1.67	-	mJ
			T_{vj} =150℃	-	4.06	-	
关断延迟时间 Turn-off delay time	$T_{d\ off}$		T_{vj} =25℃	-	220	-	ns
			T_{vj} =150℃	-	305	-	
下降时间 Fall time	t_f		T_{vj} =25℃	-	19	-	
			T_{vj} j=150℃	-	117	-	
关断损耗 Turn-off energy loss	E_{off}		T_{vj} =25℃	-	1.41	-	mJ
			T_{vj} j=150℃	-	2.54	-	
短路耐受时间 Short-circuited withstand time	t_{SC}	V_{CC} = 800V,V_{CE} ≤ 1200V, V_{GE} ≤ 15V, T_{vj} ≤ 150℃		10	-	-	µs
反偏安全工作区 Reverse biased safe operating area	RBSOA	V_{CC} = 800V, V_{CE} ≤ 1200V, V_{GE} = 20V, T_{vj} ≤ 150℃		50	-	-	A
结－外壳热阻 Thermal resistance, junction to case	R_{thJC}	每个 IGBT / per IGBT		-	0.65	-	K/W
外壳－散热器热阻 Thermal resistance, case to heatsink	R_{thCH}	每个 IGBT / per IGBT λ_{Paste} = 1 W/(m•K) / λ_{grease} = 1 W/(m•K)		-	TBD	-	K/W
在开关状态下温度 Temperature under switching conditions	$T_{vj\ op}$			-40	-	150	°C

二极管,制动-斩波器/Diode, Brake-Chopper

最大额定值 / Maximum Rated Values

参数 Parameter	符号 Symbol	工作条件 Conditions	额定值 Ratings	单位 Units
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		25	A
正向重复峰值电流 Repetitive peak forward current	I_{FRM}	T_C = 25°C，持续 1ms 的脉冲宽度 T_C = 25°C , less than 1ms	50	A
I2t-值 I^2t - value	I^2t	t_p = 10 ms, T_{vj} = 150°C	244	A^2S

电气特性 / Electrical Characteristics

参数 Parameter	符号 Symbol	工作条件 Conditions	最小值 Min.	典型值 Typ.	最大值 Max.	单位 Units
正向压降 Forward voltage	V_F	T_{vj}=25°C	-	1.9	2.3	V
		T_{vj}=150°C	-	1.87	-	V
反向恢复峰值电流 Peak reverse recovery current	I_{RM}	T_{vj}=25°C	-	16.2	-	A
		T_{vj}=150°C	-	20.9	-	A
反向恢复电荷 Recovered charge	Q_r	T_{vj}=25°C	-	0.7	-	μC
		T_{vj}=150°C	-	1.5	-	μC
反向恢复损耗 Reverse recovery energy	E_{rec}	T_{vj}=25°C	-	311	-	mJ
		T_{vj}=150°C	-	487	-	mJ
结－外壳热阻 Thermal resistance, junction to case	R_{thJC}	每个二极管 / per diode	-	0.7	-	K/W
外壳－散热器热阻 Thermal resistance, case to heatsink	R_{thCH}	每个二极管 / per diode λ_{Paste} = 1 W/(m•K) / λ_{grease} = 1 W/(m•K)	-	0.89	-	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

电气特性 / Electrical Characteristics

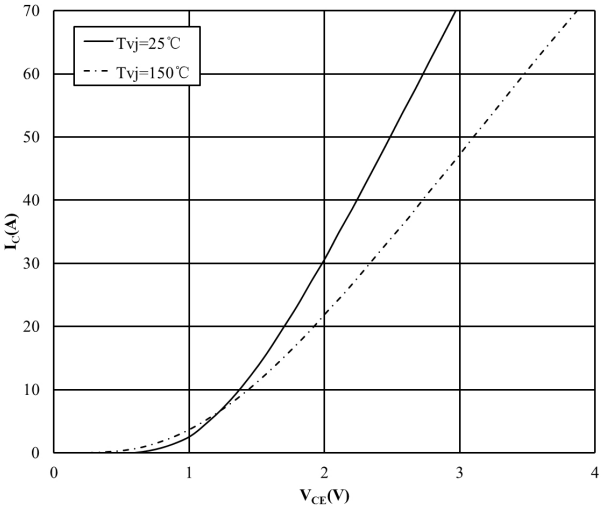
参数 Parameter	符号 Symbol	工作条件 Conditions	最小值 Min.	典型值 Typ.	最大值 Max.	单位 Units
额定电阻值 Rated resistance	R_{25}	T_{vj} = 25°C	-	5	-	kΩ
R100 偏差 Deviation of R100	ΔR/R	T_{vj} = 100°C, R100 = 465Ω	-7.2	-	7.5	%
耗散功率 Power dissipation	P_{25}	T_{vj} = 25°C	2	-	-	mW
B-值 B-value	$B_{25/50}$	$R_2 = R_{25} \exp [B_{25/50}(1/T2 - 1/(298,15\ K))]$	-	3380	-	K

模块 / Module

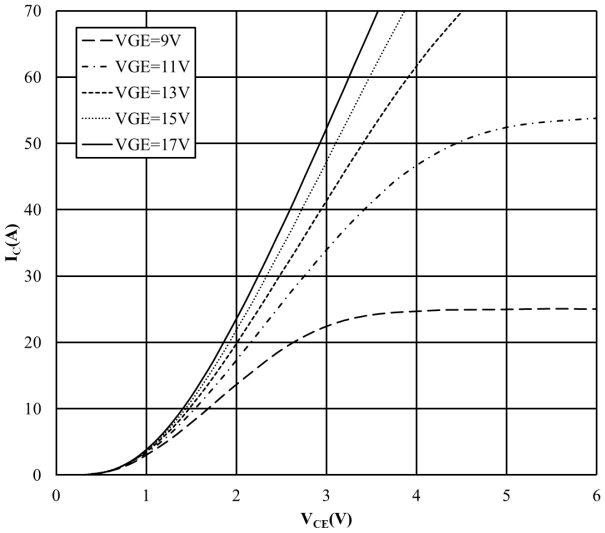
参数 Parameter	符号 Symbol	工作条件 Conditions	典型值 Typ.	单位 Units
绝缘耐压 Isolation test voltage	V_{ISOL}	RMS, f = 50 Hz, t = 1 min.	2.5	kV
内部绝缘介质 Internal isolation		基本绝缘 (class 1, IEC 61140) basic insulation (class 1, IEC 61140)	Al_2O_3	
爬电距离 Creepage distance		端子 - 散热片 /Terminal to heatsink	11.5	mm
		端子 - 端子 /Terminal to terminal	6.3	mm
电气间隙 Clearance		端子 - 散热片 /Terminal to heatsink	10	mm
		端子 - 端子 /Terminal to terminal	5	mm

参数 Parameter	符号 Symbol	工作条件 Conditions		最小值 Min.	典型值 Typ.	最大值 Max.	单位 Units
杂散电感 Stray inductance	L_{sCE}			-	37	-	nH
模块引线电阻,端子-芯片 Module lead resistance, terminals - chip	T_{jop}	T_C = 25°C, 每个开关 /per switch	$R_{CC'+EE'}$	-	5.0	-	mΩ
			$R_{AA'+CC'}$	-	6.0	-	mΩ
储存温度 Storage temperature	T_{stg}			-40	-	125	℃
Anpresskraft für mech. Bef. pro Feder mountig force per clamp	F			40	-	80	N
重量 Weight	G			-	39	-	g

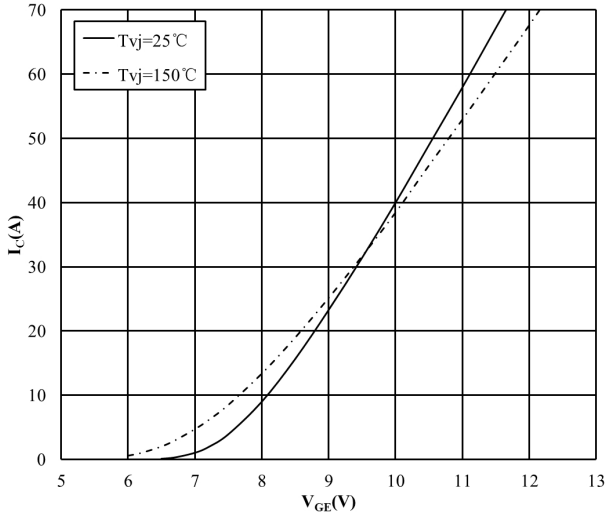
输出特性 IGBT，逆变器（典型）
output characteristic IGBT, Inverter (typical)
$I_C = f(V_{CE})$
V_{GE} =15V



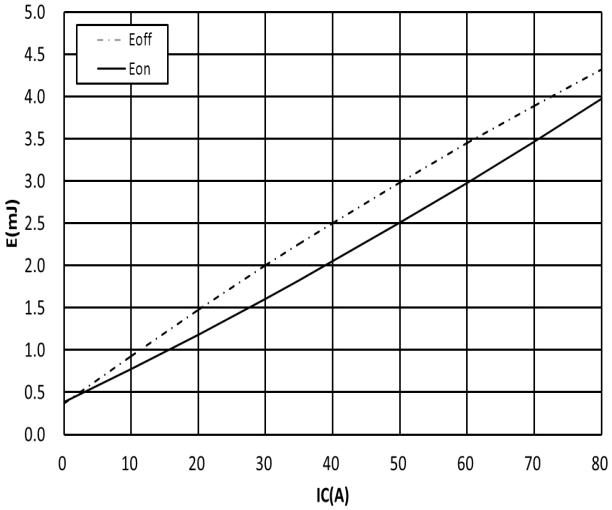
输出特性 IGBT，逆变器（典型）
output characteristic IGBT, Inverter (typical)
$I_C = f(V_{CE})$
T_{vj} = 150°C



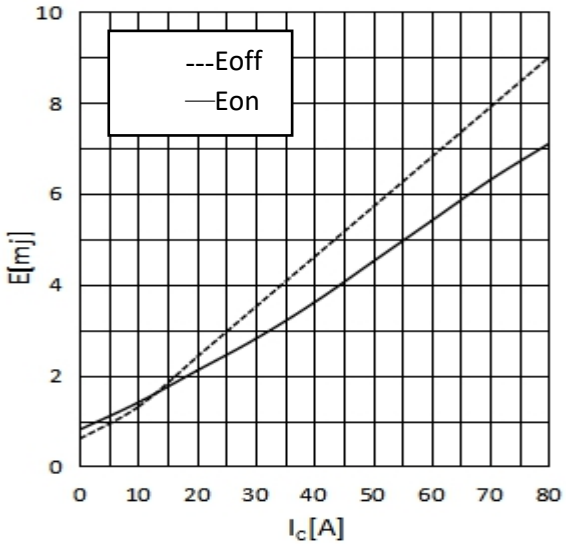
传输特性 IGBT, 逆变器（典型）
transfer characteristic IGBT, Inverter (typical)
$I_C = f(V_{GE})$
V_{CE} = 20V



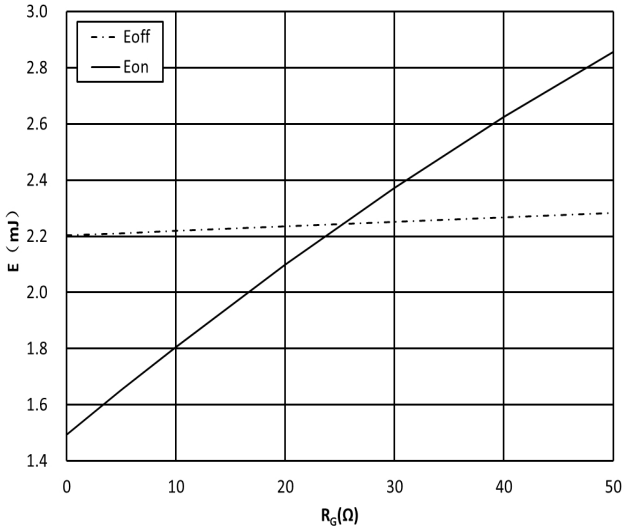
开关损耗 IGBT, 逆变器（典型）
switching losses IGBT, Inverter (typical)
$E_{on} = f(I_C)$, $E_{off} = f(I_C)$
V_{GE} =±15V, R_{Gon} = 10Ω, R_{Goff} = 10Ω,
V_{CE} = 600V, T_{vj} = 25°C



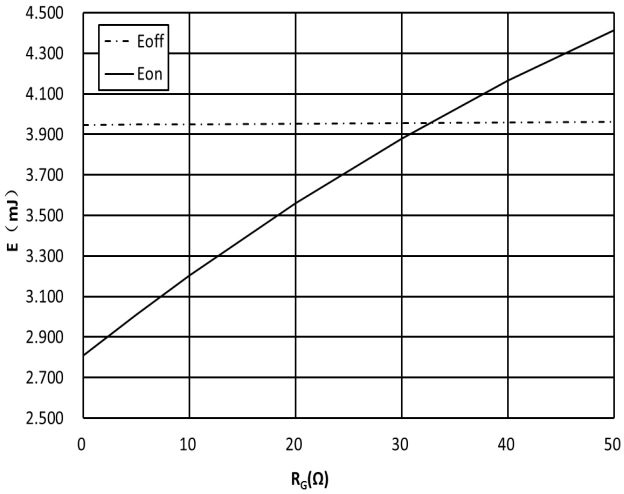
开关损耗 **IGBT, 逆变器（典型）**
switching losses IGBT, Inverter (typical)
E_{on} = f (I_C), E_{off} = f (I_C)
V_{GE} =±15 V, R_{Gon} =10Ω, R_{Goff} = 10Ω,
V_{CE} = 600V ,T_{vj} = 150°C



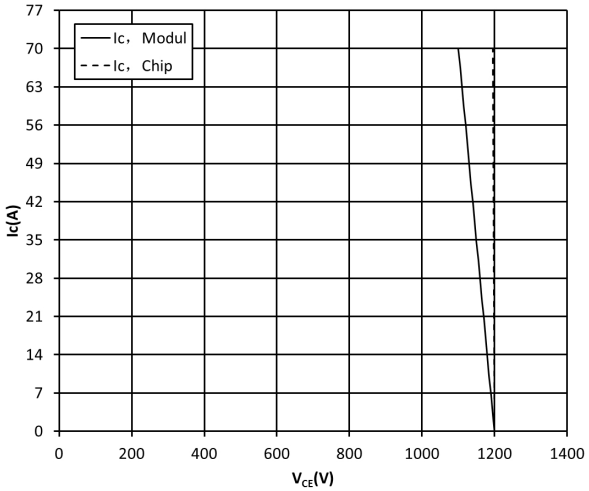
开关损耗 **IGBT, 逆变器（典型）**
switching losses IGBT, Inverter (typical)
E_{on} = f (R_G), E_{off} = f (R_G)
V_{GE} =±15 V, I_C = 35A, V_{CE} = 600V,
T_{vj} = 25°C



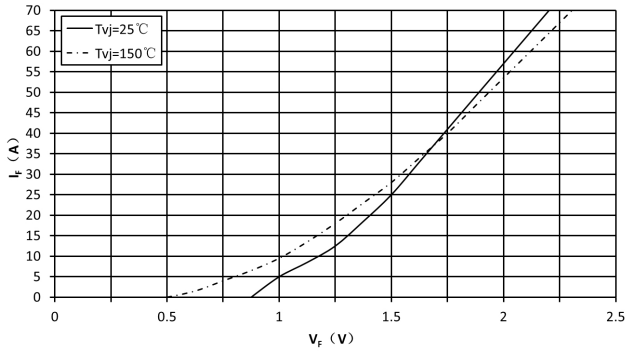
开关损耗 **IGBT, 逆变器（典型）**
switching losses IGBT, Inverter (typical)
E_{on} = f (R_G), E_{off} = f (R_G)
V_{GE} =±15V, I_C = 35A, V_{CE} = 600V,
T_{vj} = 150°C



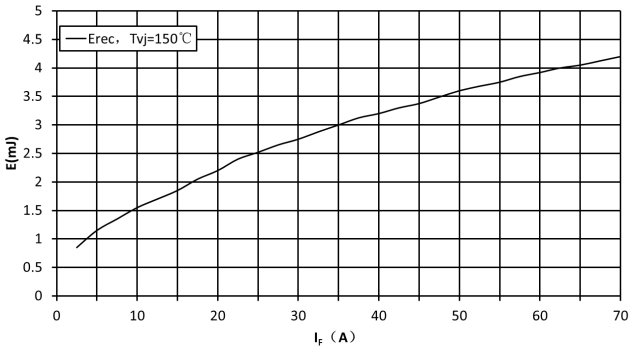
反偏安全工作区 **IGBT, 逆变器（RBSOA）**
reverse bias safe operating area IGBT, Inverter (RBSOA)
I_C = f (V_{CE})
V_{GE} = ±15 V, R_{Goff} = 12Ω, T_{vj} = 150°C



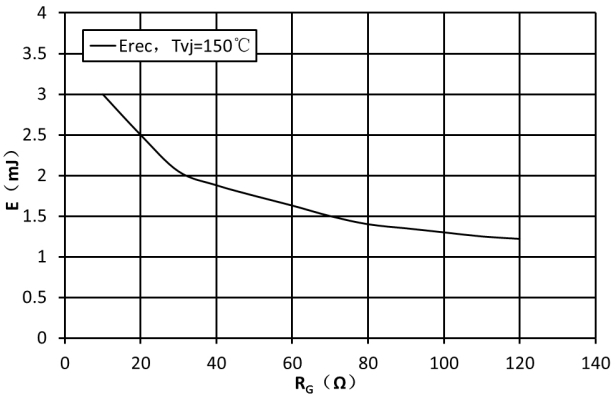
正向偏压特性 二极管,逆变器（典型）
forward characteristic of Diode, Inverter (typical)
$I_F = f(V_F)$



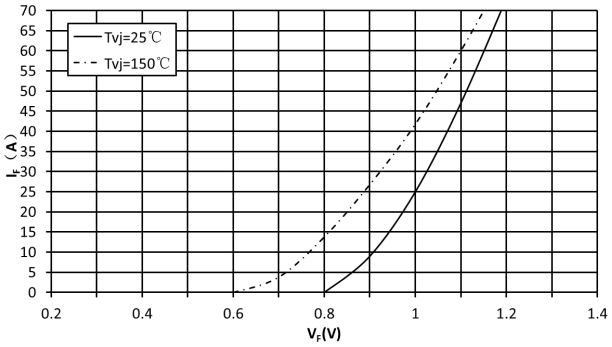
开关损耗 二极管,逆变器 （典型）
switching losses Diode, Inverter (typical)
$E_{rec} = f(I_F)$
$R_{Gon} = 12\Omega$, $V_{CE} = 600V$



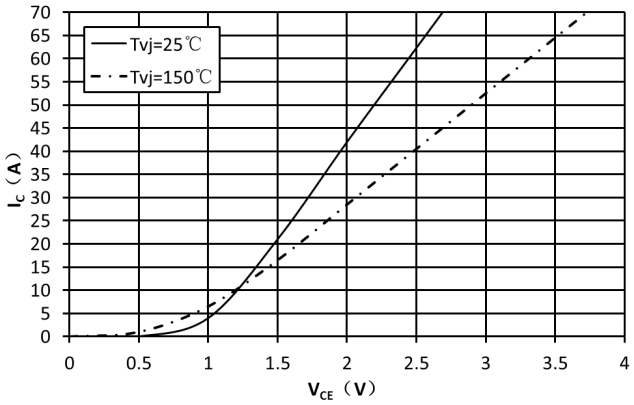
开关损耗 二极管,逆变器（典型）
switching losses Diode, Inverter (typical)
$E_{rec} = f(R_G)$
I_F= 25A, V_{CE}= 600V



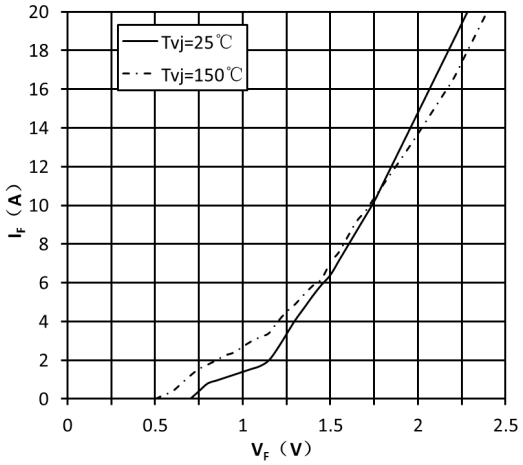
正向偏压特性 二极管,整流器（典型）
forward characteristic of Diode, Rectifier (typical)
$I_F = f(V_F)$



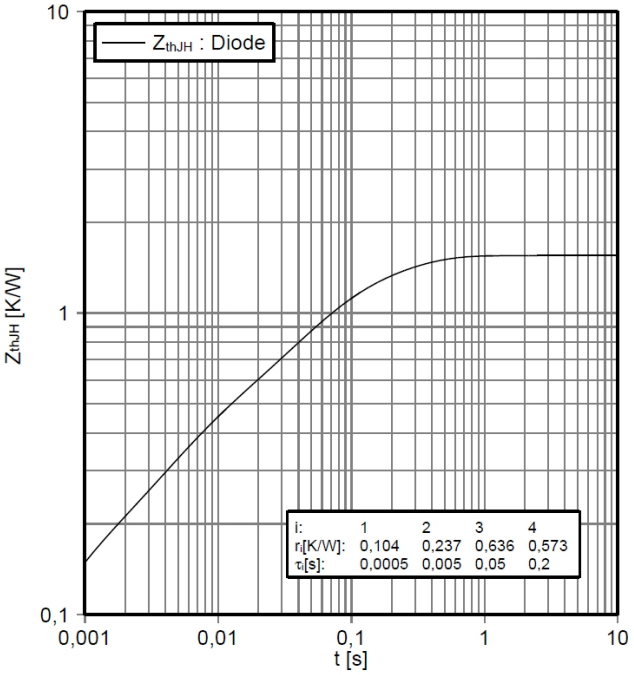
输出特性 IGBT, 制动-斩波器 （典型）
output characteristic IGBT, Brake-Chopper (typical)
$I_C = f(V_{CE})$
$V_{GE} = 15V$



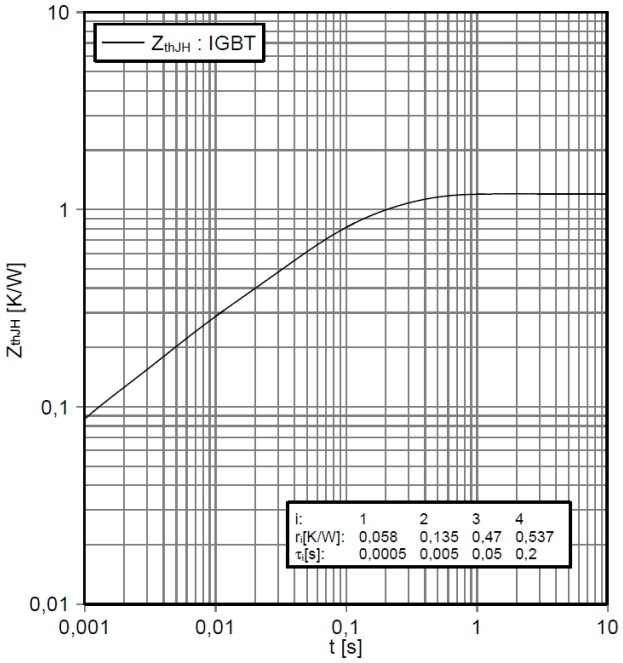
正向偏压特性 二极管，制动-斩波器（典型）
forward characteristic of Diode, Brake-Chopper (typical)
$I_F = f(V_F)$



瞬态热阻抗 二极管,逆变器
transient thermal impedance Diode, Inverter
$Z_{thJH} = f(t)$



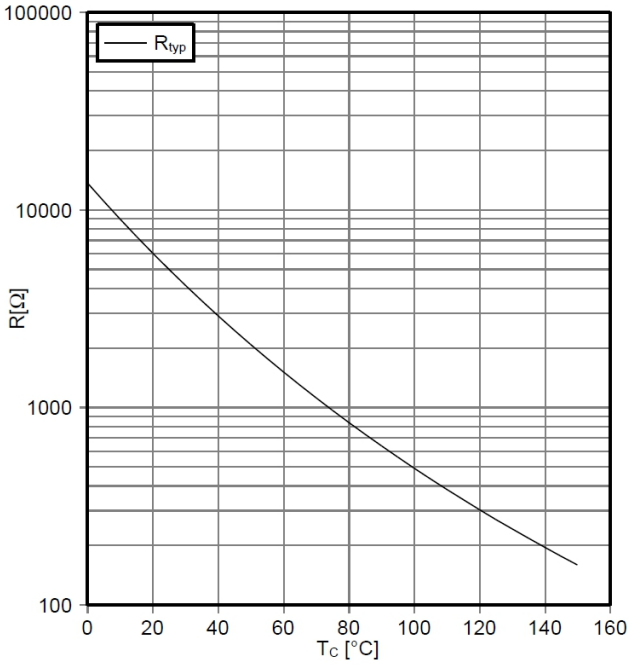
瞬态热阻抗 IGBT, 逆变器
transient thermal impedance IGBT,Inverter
$Z_{thJH} = f(t)$



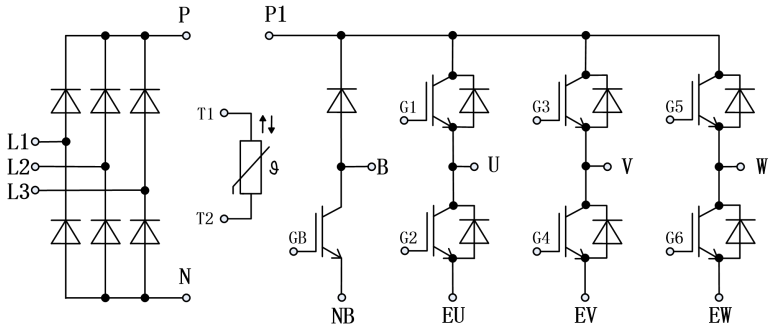
负温度系数热敏电阻 温度特性

NTC-Thermistor-temperature characteristic (typical)

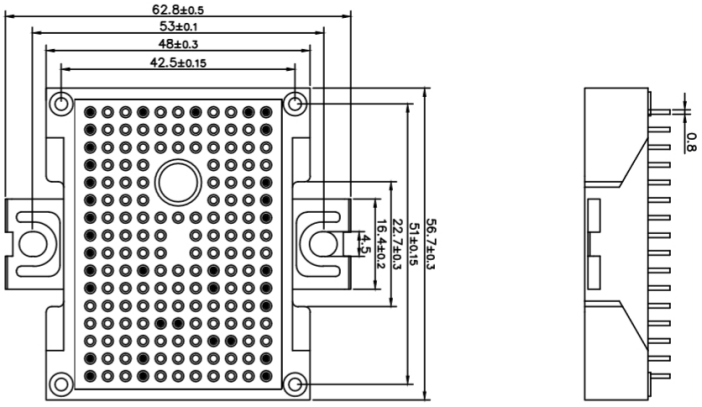
R = f (T)

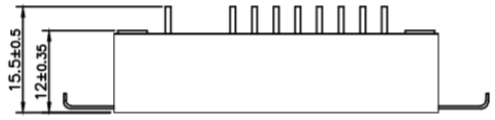


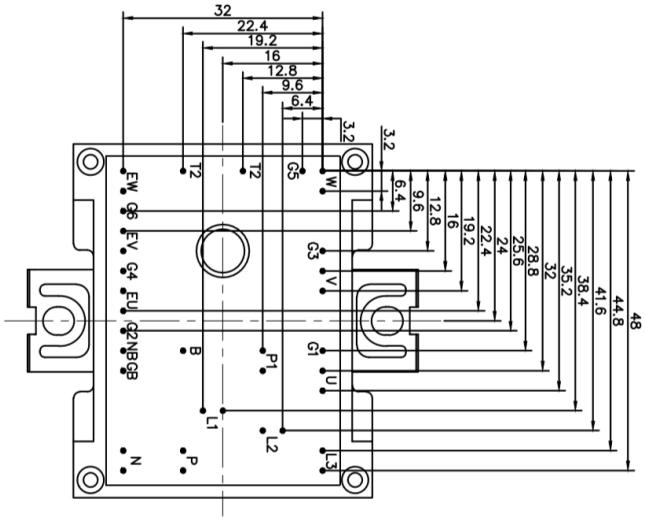
接线图 / circuit_diagram_headline



封装尺寸 / package outlines







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