



# SPE06S60B-CH

## 主要参数 MAIN CHARACTERISTICS

600V/6A 半桥驱动	
$V_{CES}$	600V
$I_C$	6A
$I_{CP}$	12A

### 用途

- 空调室内风机
- 冰箱
- 水泵

### APPLICATIONS

- Air conditioner fan
- Refrigerator
- Pump

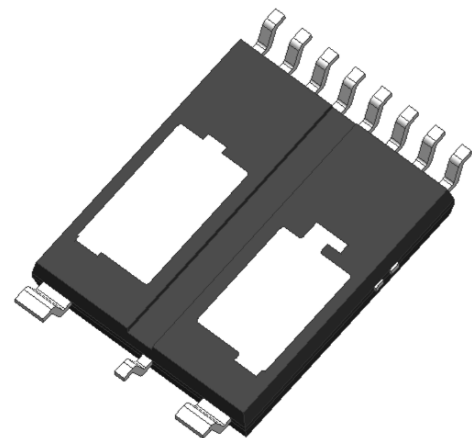
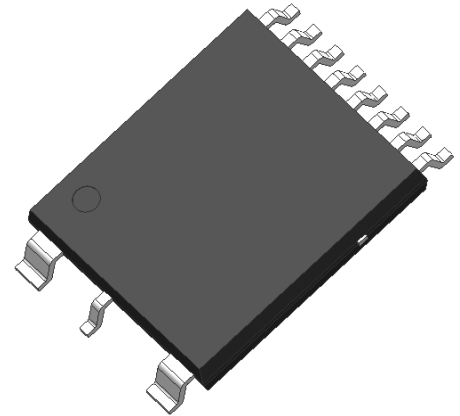
### 产品特性

- 信号高电平有效，兼容 3.3V 和 5V 的 MCU
- 下臂 IGBT 发射极输出
- 内置自举二极管
- 内置欠压保护
- 过流保护
- 使能关断功能
- 温度检测输出

### FEATURES

- Signal high level valid, compatible with 3.3v and 5V MCU
- Lower arm IGBT emitter electrode output
- Built-in bootstrap diode
- Built-in undervoltage protection
- Over temperature protection.
- Shut-Down Input
- Thermistor detection output.

### 封装 Package



SOP12B

## 订货信息 ORDER MESSAGE

订货料号 Order number	产品信息 Product information			
	无卤-条管 Halogen-Free-Tube	无卤-编带 Halogen-Free-Reel	印记 Marking	封装 Package
2A01-1157	SPE06S60B-CH	N/A	06S60B-CH	SOP12B



模块分布示意图 Module distribution diagram

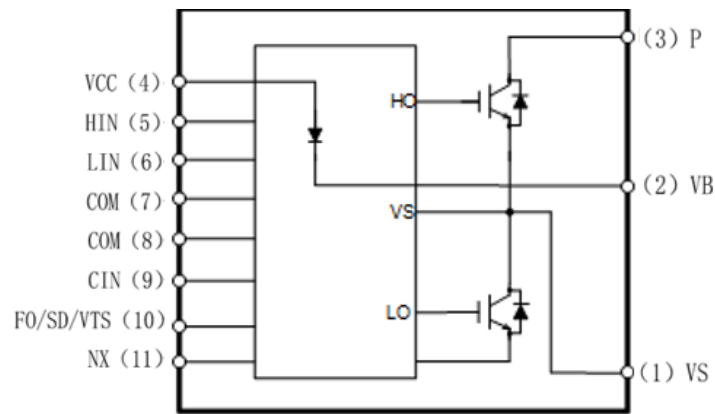


图 1: 模块内部电路示意图

Fig 1: Internal circuit

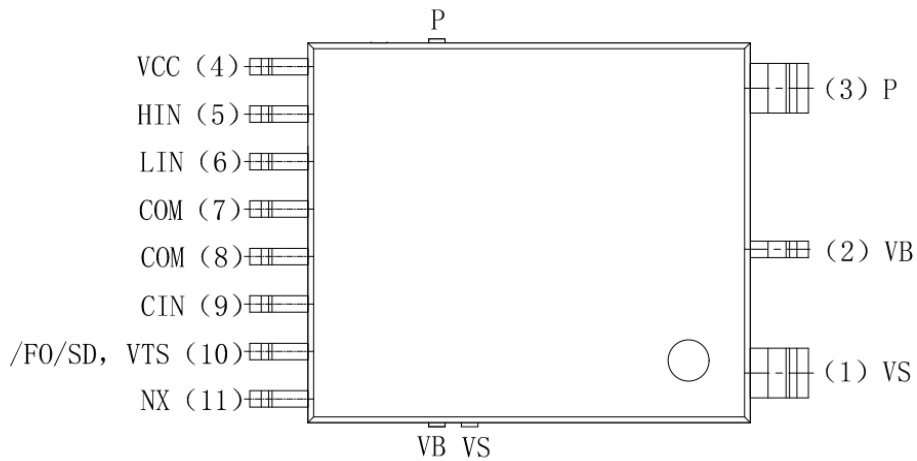


图 2.1: 模块正面引脚分布示意图

Fig 2.1: Distribution of pin

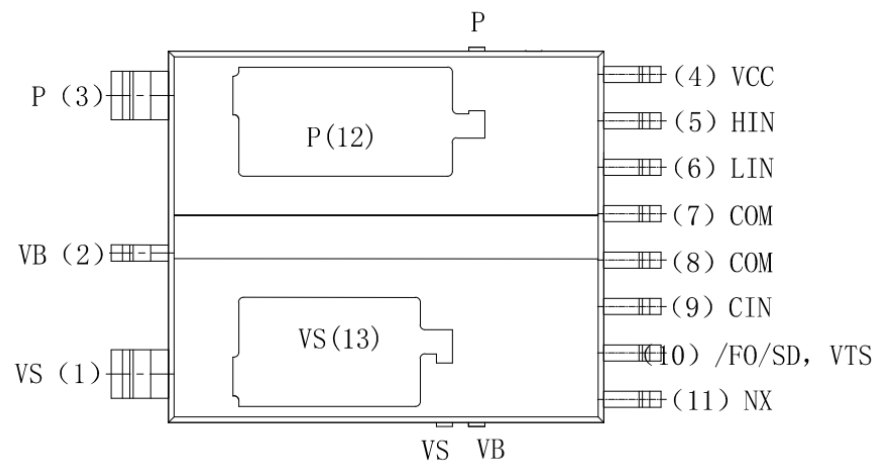


图 2.2: 模块背面引脚分布示意图

Fig 2.2: Distribution of pin



引脚编号 Number	引脚名称 Name	引脚描述 Description
1	VS	控制电源 GND 端子 IC Common Supply Ground
2	VB	上桥臂驱动电源端子 upper arm drive power terminal
3	P	逆变器直流输入端子 Positive DC-Link Input
4	VCC	控制电源端子 Power supply for low side and Low Side IGBT Driving
5	HIN	上臂控制信号输入端子 Signal Input for U-Phase High-Side
6	LIN	下臂控制信号输入端子 Signal Input for U-Phase Low-Side
7	COM	控制电源 GND 端子 IC Common Supply Ground
8	COM	控制电源 GND 端子 IC Common Supply Ground
9	CIN	短路保护触发电压检测端子 Short circuit protection trigger voltage detection
10	/FO, /SD, VTS	故障输出/输入关闭/温度输出端子 Fault output/input shutdown/temperature output
11	Nx	下臂 IGBT 发射极端子 lower arm IGBT emitter terminal
12	P	逆变器直流输入端子 Positive DC-Link Input
13	VS	控制电源 GND 端子 IC Common Supply Ground

图 3: 模块引脚功能定义表

Fig 3: Pin function

最大额定值 ( $T_j=25^\circ\text{C}$ , 除非特殊说明)Absolute Maximum Ratings ( $T_j=25^\circ\text{C}$ , Unless otherwise Specified)

## 逆变部分 Inverter Part

记号 Symbol	参数 Parameter	条件 Condition	额定值 Ratings	单位 Units
$V_{CES}$	集电极-发射极之间电压 Collector emitter Voltage of Each IGBT	备注 1	600	V
$I_C$	集电极电流 Each IGBT Current, Continuous	$T_c = 25^\circ\text{C}$ ( $T_c$ 测量参考图 5)	6	A
$I_{CP}$	集电极电流(峰值) Each IGBT Pulse Current, Peak	$T_c = 25^\circ\text{C}$ , 脉冲宽度小于 1ms $T_c = 25^\circ\text{C}$ , Less than 1mS	12	A
$P_C$	集电极功耗 Maximum Power Dissipation	$T_c = 25^\circ\text{C}$ , 单晶片 $T_c = 25^\circ\text{C}$ , Each IGBT	22	W
$T_j$	结温 Junction Temperature	见备注 2) Note1	-40~150	$^\circ\text{C}$

备注 1:  $V_{CES}$  是单个 IGBT C-E 间最大电压。VPN 应小于该值, 考虑到杂散电感, VCE 在任何情况下都不应超过  $V_{CES}$ ;

备注 2: IPM 功率晶片最大额定结温为  $150^\circ\text{C}$  (@表面温度  $T_c \leq 100^\circ\text{C}$ ), 为确保 IPM 的安全运行, 其均结温应限制在  $T_{j(ave)}=125^\circ\text{C}$  (@  $T_c=100^\circ\text{C}$ ) 以内。

## 控制部分 Control Part

记号 Symbol	参数 Parameter	条件 Condition	额定值 Ratings	单位 Units
$V_{CC}$	控制电源电压 Control Supply Voltage	$V_{CC}$ -COM 之间 Applied between VCC and COM	20	V
$V_{BS}$	高侧控制电压 High-side Bias Voltage	$V_B$ - $V_S$ 之间 Applied between VB and VS	20	V
$V_{IN}$	输入信号电压 Input Signal Voltage	$V_{IN}$ -COM 之间 Applied between VIN and COM	-0.3~ $V_{CC}+0.3$	V
$V_{FO}$	故障输出电压 Function Supply Voltage	$V_{FO}$ -COM 之间 Applied between VFO and COM	-0.3~ $V_{CC}+0.3$	V
$V_{SC}$	过流触发电压 Current Sensing Input Voltage	$V_{SC}$ -COM 之间 Applied between VSC and COM	-0.3~ $V_{CC}+0.3$	V



## 内部自举电路 Bootstrap Diode Part

记号 Symbol	参数 Parameter	条件 Condition	额定值 Ratings	单位 Units
VRRMB	反向耐压 Control Supply Voltage	/	600	V

## 整个系统 Total System

记号 Symbol	参数 Parameter	条件 Condition	额定值 Ratings	单位 Units
V <sub>PN(prot)</sub>	自我保护电源电压限制 Self-protecting power supply voltage limit	V <sub>CC</sub> =V <sub>BS</sub> =13.5V~16.5V, T <sub>J</sub> =125℃, 非重复性, <2us	400	V
T <sub>J</sub>	结温 Operating Junction Temperature	见备注 1	-40~150	℃
T <sub>C</sub>	模块壳体工作温度 Module shell temperature	-	-20~100	℃
T <sub>STG</sub>	贮存温度 Storage Temperature	TC=25℃	-40~125	℃
V <sub>ISO</sub>	绝缘耐压 Isolation Voltage	60Hz, 正弦, AC 1 分钟, 连接管脚到散热器 60Hz, Sinusoidal, AC 1 min, between pins and heat-sink plate	1500	V

备注 1: IPM 功率芯片最大额定结温为 150℃(@表面温度 TC≤100℃)。然而,为了确保 IPM 运行安全, 结温应限定于 T<sub>J(av)</sub>≤125℃(@表面温度 T<sub>c</sub>≤100℃)。

Note 1: The maximum rated junction temperature of the IPM power chip is 150℃ (@surface temperature TC≤100℃). However, to ensure safe operation of the IPM, the junction temperature should be limited to T<sub>J(av)</sub>≤125℃ (@surface temperature TC≤100℃)

## 热阻 Thermal Resistance

记号	参数	条件	典型值	单位
Rth(j-c)	结到外壳的热阻	每个IGBT	6.0	℃/W

备注 2: 关于壳体温度 (T<sub>C</sub>) 的测量点, 参见图 5。

Note 2: For the measurement point of shell temperature (TC), see Figure 5

电气特性 (T<sub>J</sub>=25℃, 除非特别说明)

Electrical Characteristics (T<sub>J</sub>=25℃, Unless Otherwise Specified)

## 逆变部分 Inverter Part

记号	参数	条件	最小值	典型值	最大值	单位
V <sub>CE(SAT)</sub>	集电极-发射极间饱和电压 Collector - emitter saturation voltage	V <sub>CC</sub> =V <sub>BS</sub> =15V, V <sub>IN</sub> =5V I <sub>C</sub> =6A, T <sub>J</sub> =25℃, I <sub>C</sub> =6A, T <sub>J</sub> =125℃,	-	1.9	2.6	V
V <sub>F</sub>	FRD正向电压 FRD Forward voltage	V <sub>IN</sub> =0V, I <sub>C</sub> =-6A	-	2.0	2.6	V
I <sub>CES</sub>	集电极-发射极间漏电流 Collector emitter leakage current	V <sub>CE</sub> =V <sub>CES</sub> , V <sub>IN</sub> =0V	-	-	1	mA
t <sub>ON</sub>	开关时间	V <sub>PN</sub> = 300 V, V <sub>CC</sub> = V <sub>BS</sub> = 15 V, I <sub>C</sub> = 6 A	-	600	-	nS
t <sub>CON</sub>			-	270	-	nS
t <sub>OFF</sub>			-	500	-	nS
T <sub>COFF</sub>			-	90	-	nS



t <sub>rr</sub>		V <sub>IN</sub> = 0 ↔ 5 V, 感性负载 (备注3)		130		nS
E <sub>ON</sub>			-	350	-	uJ
E <sub>OFF</sub>			-	100	-	uJ

备注 3: t<sub>ON</sub> 和 t<sub>OFF</sub> 包含驱动 IC 传输延迟。列表值是在实验条件下测得，不同的 PCB 及连线会改变数值。请参考图 4 的开关时间定义。

NOTE 3: t<sub>ON</sub> and t<sub>OFF</sub> include the propagation delay time of the internal drive IC. Listed values are measured at the laboratory test condition, and they can be different according to the field applications due to the effect of different printed circuit boards and wirings. Please see Fig 4 for the switching time definition.

**控制部分 Control Part**

记号 Symbol	参数 Parameter	条件 Condition		最小值 Min.	典型值 Typ.	最大值 Max.	单位 Unit
I <sub>QCC</sub>	VCC 静态电流 Quiescent VCC Supply Current	VCC=15V VIN=5V	VCC-COM 之间 Applied between VCC and COM	-	-	1	mA
I <sub>QB</sub>	VBS 静态电流 Quiescent VBS Supply Current	VDB=15V VIN=5V	VB(U)-U, VB(V)-V, VB(W)-W 之间 Applied between VB(U)-U, VB(V)-V, VB(W)-W	-	-	500	uA
UV <sub>CCD</sub>	低侧欠压保护 Low-Side Under-Voltage Protection	检测电平 VCC Under-Voltage Protection Detection Level		7.2	8.2	9.2	V
UV <sub>CCR</sub>		复位电平 VCC Under-Voltage Protection Reset Level		8.0	9.2	10.2	V
UV <sub>BSD</sub>	高侧欠压保护 High-Side Under-Voltage Protection	检测电平 VBS Under-Voltage Protection Detection Level		7.0	8.0	9.0	V
UV <sub>BSR</sub>		复位电平 VBS Under-Voltage Protection Reset Level		7.5	8.5	9.5	V
V <sub>FOH</sub>	故障输出电压 Fault Out Voltage	VSC=0V, /FO Circuit: 10K to 5V pull-up		4.0	-	-	V
V <sub>FOL</sub>		VSC=1V, /FO Circuit: 10K to 5V pull-up		-	-	0.5	V
T <sub>FO</sub>	故障清除脉冲宽度 Fault output pulse width	-		20	-	-	us
V <sub>SC(ref)</sub>	短路跳闸阈值 Short-Circuit Trip Level	-		0.38	0.44	0.50	V
V <sub>IH</sub>	输入开启阈值电压 ON Threshold Voltage	逻辑高电平, 加在 VIN 与 COM 之间 Logic HIGH Level, Applied between VIN and COM		-	2.6	3.0	V
V <sub>IL</sub>	输入关闭阈值电压 OFF Threshold Voltage	逻辑低电平, 加在 VIN 与 COM 之间 Logic Low Level, Applied between VIN and COM		0.8	1.6	-	V
I <sub>FO_T</sub>	HVIC 温度检测输出电流 HVIC Temperature Sensing Current Output	VDD=VBS=15V,T=25°C		-	82.5	-	uA
		VDD=VBS=15V,T=75°C		-	207.5	-	
V <sub>FO_T</sub>	HVIC 温度检测输出电压 HVIC Temperature Sensing Voltage Output 备注 4 remark 4	温度 25°C, 通过 10K Ω 电阻下拉至 5V Tc=25°C, 10K to 5V Pull-up		-	4.18	-	V
		温度 25°C, 通过 10K Ω 电阻下拉至 5V Tc=75°C, 10K to 5V Pull-up		-	2.93	-	
V <sub>FSDR</sub>	使能关断复位电平 Shut-down Reset level	SDx-COM		-	-	2.6	V
V <sub>FSDD</sub>	使能关断阈值电压	SDx-COM		0.8	-	-	V



	Shut-down Detection level					
R <sub>BSD</sub>	自举二极管限流电阻 Bsd resistance		-	100	-	ohm

备注 4: VOT 输出特性曲线请参考图 6.1, 图 6.2 曲线是以 10KΩ 上拉电阻至 5V 和以 4.7 KΩ 上拉电阻至 3.3V 测试结果。

Note 4: Please refer to figure6.1 for the VOT output characteristic curve. The curve in Figure6.2 shows the test results of 10 KΩ pull-up resistance to 5V and 4.7 KΩ pull-up resistance to 3.3V.

**推荐工作条件 Recommended Operating Conditions**

记号 Symbol	参数 Parameter	记号 Symbol	最小值 Min.	典型值 Typ.	最大值 Max.	单位 Unit
V <sub>PN</sub>	电源电压 Supply Voltage	P-N 之间 Applied between P and N	-	300	400	V
V <sub>CC</sub>	控制电源电压 Control Supply Voltage	VCC-COM 之间 Applied between VCC and COM	13.5	15.0	16.5	V
V <sub>BS</sub>	高侧控制电源电压 High-Side Bias Voltage	V <sub>B</sub> -V <sub>S</sub> 之间 Applied between VB and VS	13.5	15.0	18.5	V
V <sub>IN(ON)</sub>	输入开启阈值电压 Input ON Threshold Voltage	V <sub>IN</sub> -COM 之间 Applied between VIN and COM	3.0	-	V <sub>CC</sub>	V
V <sub>IN(OFF)</sub>	输入关闭阈值电压 Input OFF Threshold Voltage		0	-	0.6	V
t <sub>dead</sub>	死区时间 Blanking Time for Preventing Arm-Shor	V <sub>CC</sub> =V <sub>BS</sub> =13.5~16.5V, T <sub>j</sub> <150°C	1.0	-	-	us
PWM	最小输入信号脉冲宽度 Minimum input signal pulse width	ON	0.7	-	-	us
		OFF	0.7	-	-	us
FPWM	PWM 开关频率 PWM Switching Frequency	T <sub>j</sub> <150°C	-	15	-	KHz

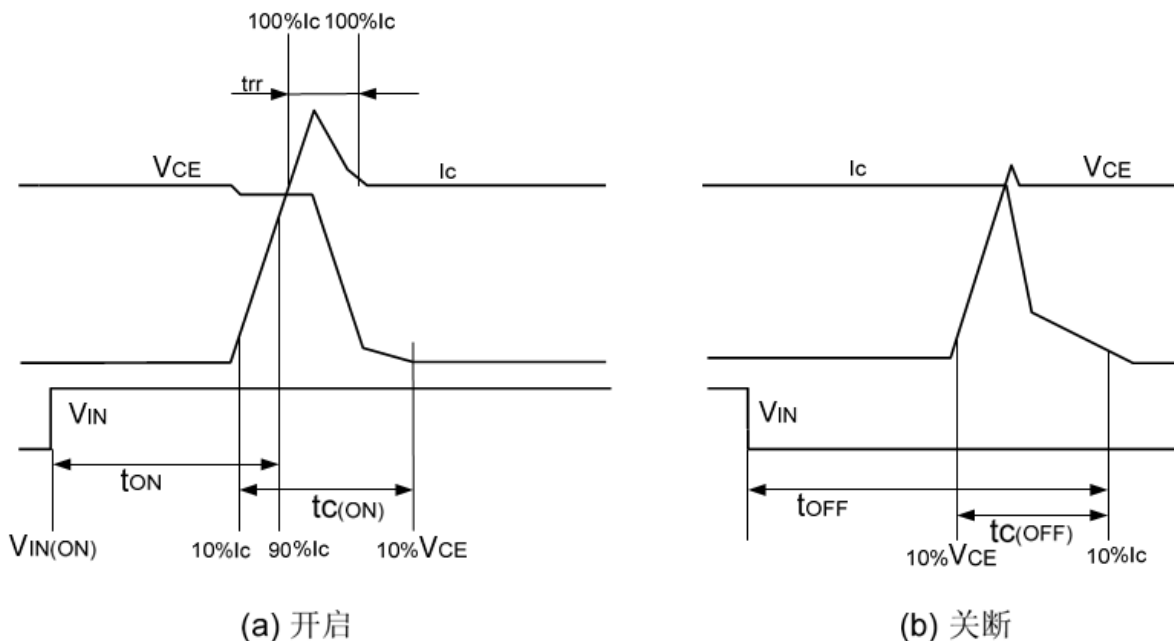


图 4: 开关时间定义  
Fig 4: Switching Time Definition

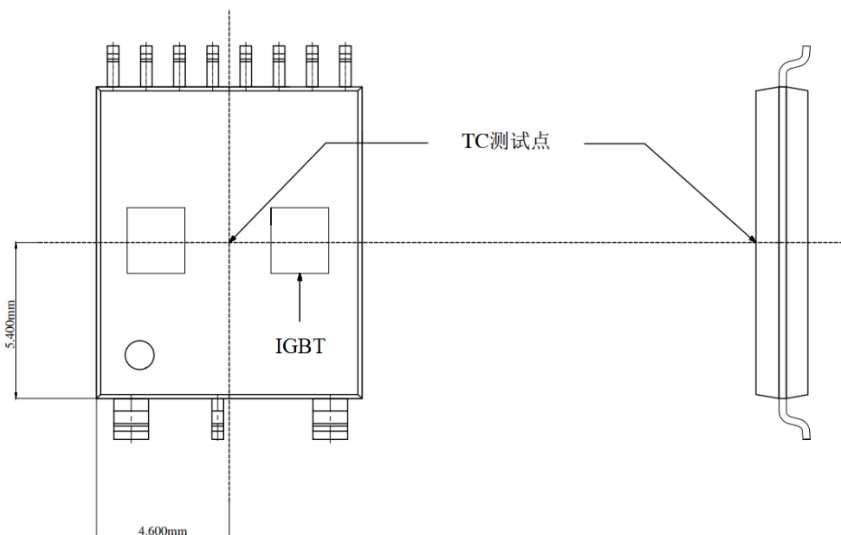


图 5: 壳温 Tc 测试点

Fig 5: Case Temperature Measurement

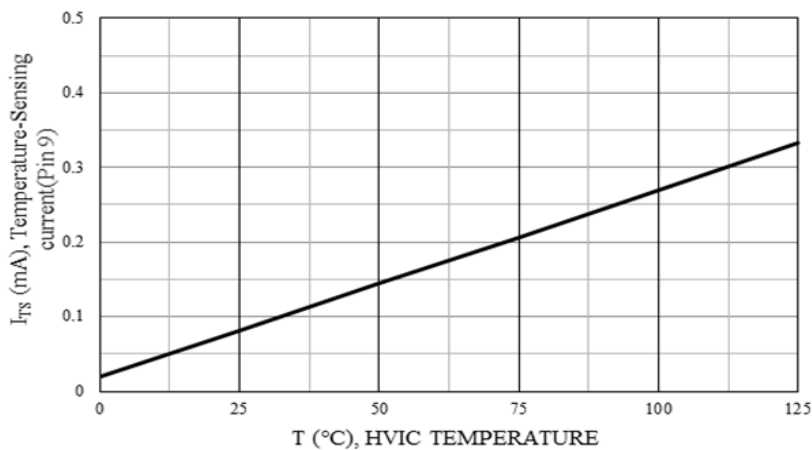


图 6.1: HVIC 温度检测输出温度—电流曲线

Fig 6.1: Curves of HVIC Temperature-Current Output

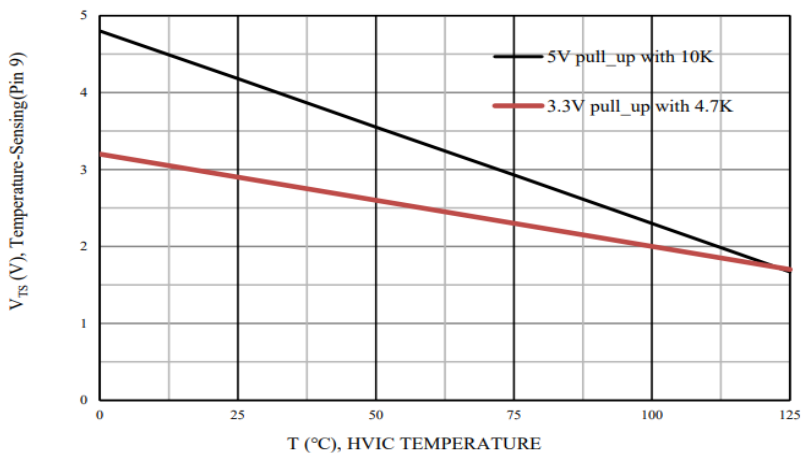


图 6.2: HVIC 温度检测输出温度—电压曲线

Fig 6.2: Curves of HVIC Temperature Detection-voltage Output

## 保护功能时序图 Time Charts of Protective Function

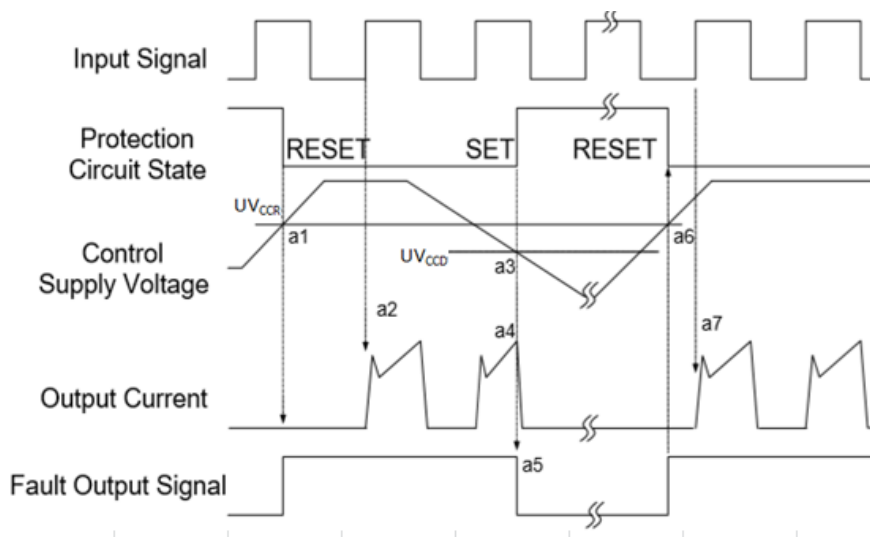


图 7: 欠压保护时序图(低侧)

Fig 7: Undervoltage protection sequence diagram (low side)

- a1 :电源电压上升: 电压上升至  $UV_{CCR}$ ,当下一个输入信号到来时电路开始工作;  
a1 : Control supply voltage rises: after the voltage rises  $UV_{CCR}$ , the circuits start to operate when next input is applied.
- a2: 正常运行: IGBT 开启并加载电流。  
a2: Normal operation: IGBT turns on and loads current.
- a3: 欠压检测点( $UV_{CCD}$ )。  
a3: Undervoltage detection point ( $UV_{CCD}$ ).
- a4: 不管输入是什么信号, IGBT 都是关闭状态。  
a4: No matter what signal is input, the IGBT is off.
- a5: 故障输出开启。  
a5: Fault output is on.
- a6: 欠压恢复( $UV_{CCR}$ )。  
a6: Undervoltage recovery ( $UV_{CCR}$ ).
- a7: 正常运行: IGBT 导通并加载负载电流。  
a7: Normal operation: IGBT is turned on and load current is loaded.

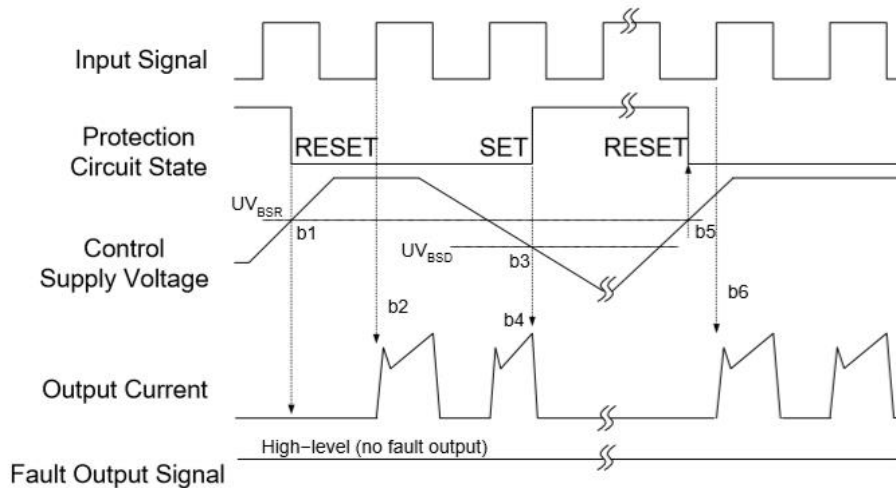


图 8：欠压保护时序图(高侧)

Fig 8: Undervoltage protection sequence diagram (High side)

b1 : 电源电压上升: 当该电压上升到欠压恢复点, 在下一个欠压信号被执行前该线路将启动运行。

b1: Power supply voltage rise: When the voltage rises to the undervoltage recovery point, the line will start running before the next undervoltage signal is executed.

b2 : 正常运行: IGBT 导通并加载负载电流。

b2: Normal operation: IGBT is turned on and load current is applied.

b3 : 欠压检测 ( $UV_{BSD}$ )。

b3: Undervoltage detection ( $UV_{BSD}$ ).

b4 : 不管输入是什么信号, IGBT 都是关闭状态。

b4: No matter what signal is input, IGBT is off.

b5 : 欠压恢复( $UV_{BSR}$ )。

b5: Undervoltage recovery ( $UV_{BSR}$ )。 .

b6 : 正常运行: IGBT 导通并加载负载电流。

b6: Normal operation: IGBT is turned on and load current is applied.

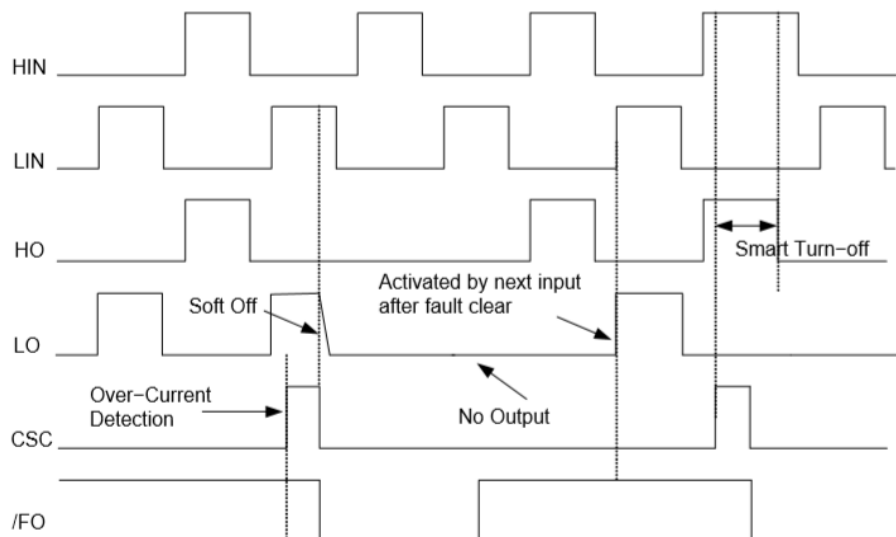


图 9：过流保护时序

Fig 9: Fault-Out Function by Over Current Protection

HIN :高侧输入信号;  
HIN : High-side Input Signal  
LIN : 低侧输入信号;  
LIN : Low-side Input Signal  
HO : 高侧输出信号;  
HO : High-Side Output Signal  
LO : 低侧输出信号;  
LO : Low-Side Output Signal  
CSC :过流侦测信号;  
CSC : Over Current Detection Input  
/FO:故障输出信号  
/FO : Fault Out Function

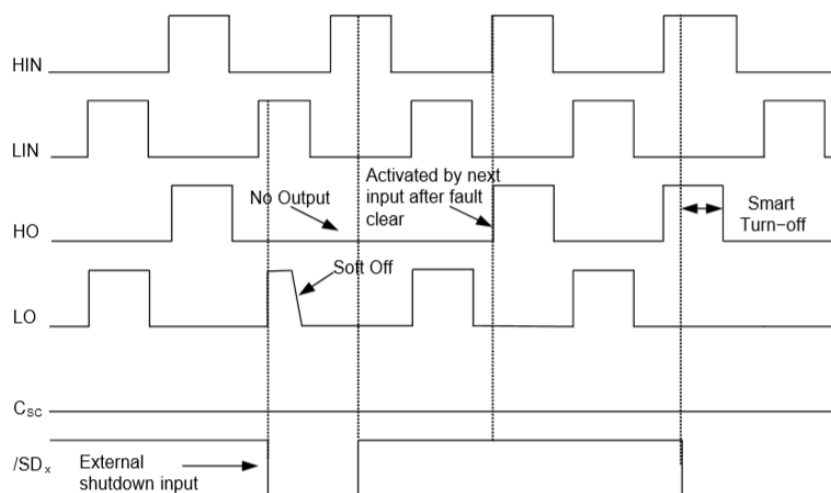


图 10. 外部关断功能时序

Figur10. Shutdown Input Function by External Command

HIN :高侧输入信号;  
HIN : High-side Input Signal  
LIN : 低侧输入信号;  
LIN : Low-side Input Signal  
HO : 高侧输出信号;  
HO : High-Side Output Signal  
LO : 低侧输出信号;  
LO : Low-Side Output Signal  
CSC :过流侦测信号;  
CSC : Over Current Detection Input  
/SDx:外部关断输入信号  
/SDx : Shutdown Input Function

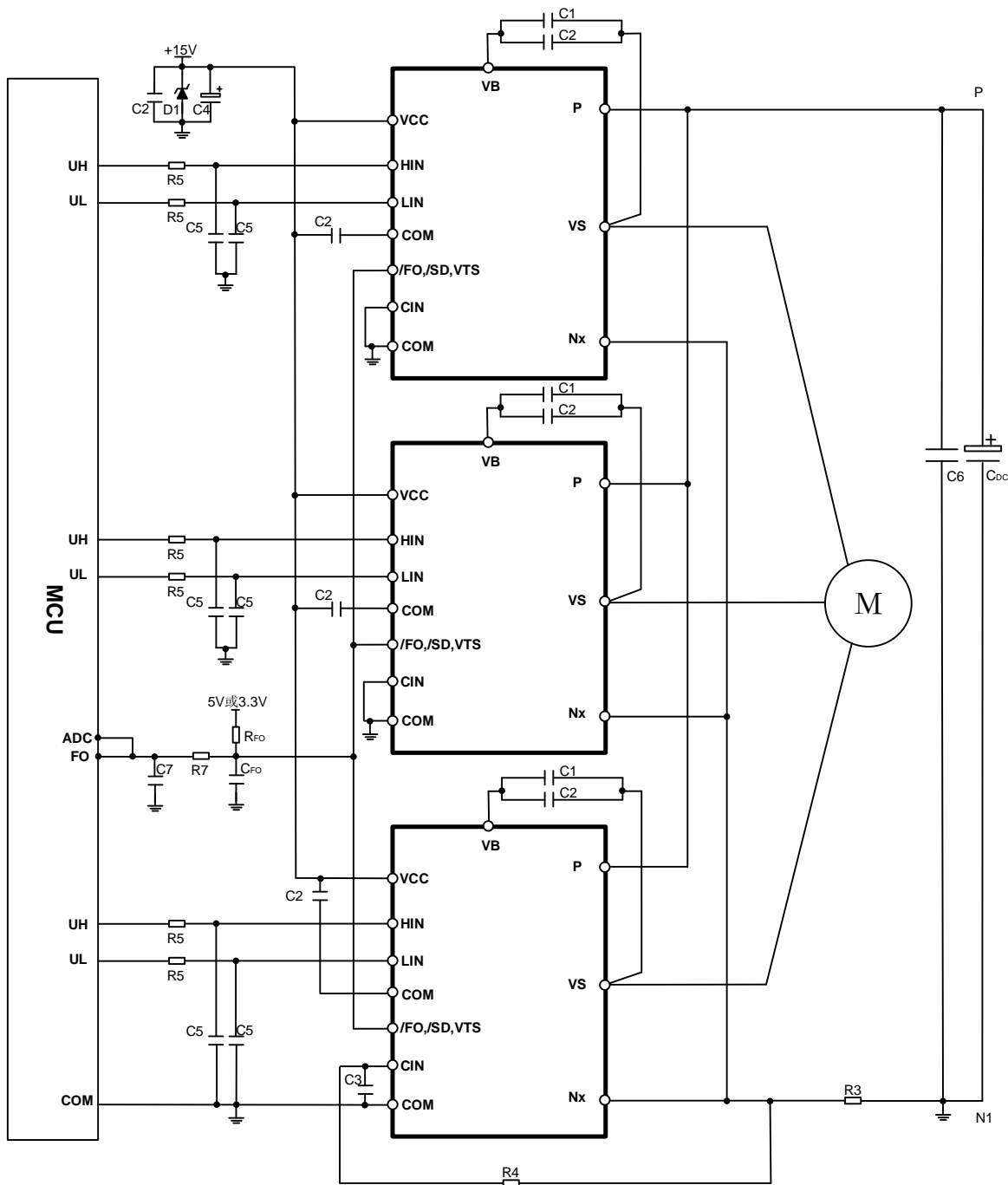


图 11: 典型应用电路图

Fig 11: Example of Application Circuit

备注 4: 自举电路的元器件参数要根据 PWM 周期而定, 以 15kHz 开关频率为例:  $C1=4.7\mu\text{F}$ ,  $C2=0.1\mu\text{F}$ 。

NOTE 4: Parameters for bootstrap circuit elements are dependent on PWM algorithm. For 15 kHz of switching frequency, typical example of parameters is an example of:  $C1=4.7\mu\text{F}$ ,  $C2=0.1\mu\text{F}$ 。

备注 5: 在模块每个输入端和 MCU 输出端之间加入 RC 去耦电路, 如  $R5$ 、 $C5$ , 防止干扰噪声引起的信号失真。

NOTE 5: RC coupling ( $R5$  and  $C5$ ) input of IPM and MCU may be used to prevent improper signal due to surge noise. Signal input of IPM is compatible with standard CMOS or LSTTL outputs.



备注 6: 输入驱动高有效; IC 内部集成有一个 500K (典型值)下拉电阻; 为防止发生误动作, 输入布线应尽可能短; 当用 RC 去耦线路时, 须确保输入信号达到开启和关断阈值电压范围。

NOTE 6: Input drive is High-Active type. There is a 500k $\Omega$ (typ.) pull-down resistor integrated in the IC input circuit. To prevent malfunction, the wiring of each input should be as short as possible. When using RC coupling circuit, make sure the input signal level meet the turn-on and turn-off threshold voltage.

备注 7: 由于模块内置专用 HVIC, 其控制端子可与 CPU 端子直接相连, 不需要任何光耦或变压器等隔离电路。

NOTE 7: Thanks for HVIC inside modules, direct coupling to MCU without any opto-coupler or transformer isolation is possible.

备注 8: 自举电路负极应直接连接到 VS 端。

NOTE 8: Bootstrap negative electrodes should be connected to VS terminals directly and separated from the main output wires.

备注 9: 保护线路 R4、C3 的时间常数建议选取在 1~2 $\mu$ S。关断时间可能随着布线的不同而多少有些变化。建议 R4、C3 选择小容差, 温度补偿类型。

NOTE 9: The time constant R4、C3 of the protection circuit should be selected in the range of 1.0-2 $\mu$ s. SC interrupting time might vary with the wiring pattern. Tight tolerance, temp-compensated type is recommended for R4, C3.

备注 10: 所有电容的位置尽可能的靠近 IPM。

NOTE 10: All capacitors should be mounted as close to the terminals of the IPM as possible.

备注 11: 为了防止噪声干扰, 储能电容与 P&N1 之间的引线应尽可能的短, 推荐在 P&N1 端子之间加约 0.1~0.22 $\mu$ F 的 MLCC 低频滤波电容。

NOTE 11: To prevent surge destruction, the wiring between the smoothing capacitor and the P, N1 terminals should be as short as possible. Generally, a 0.1-0.22 $\mu$ F snubber between the P-N1 terminals is recommended.

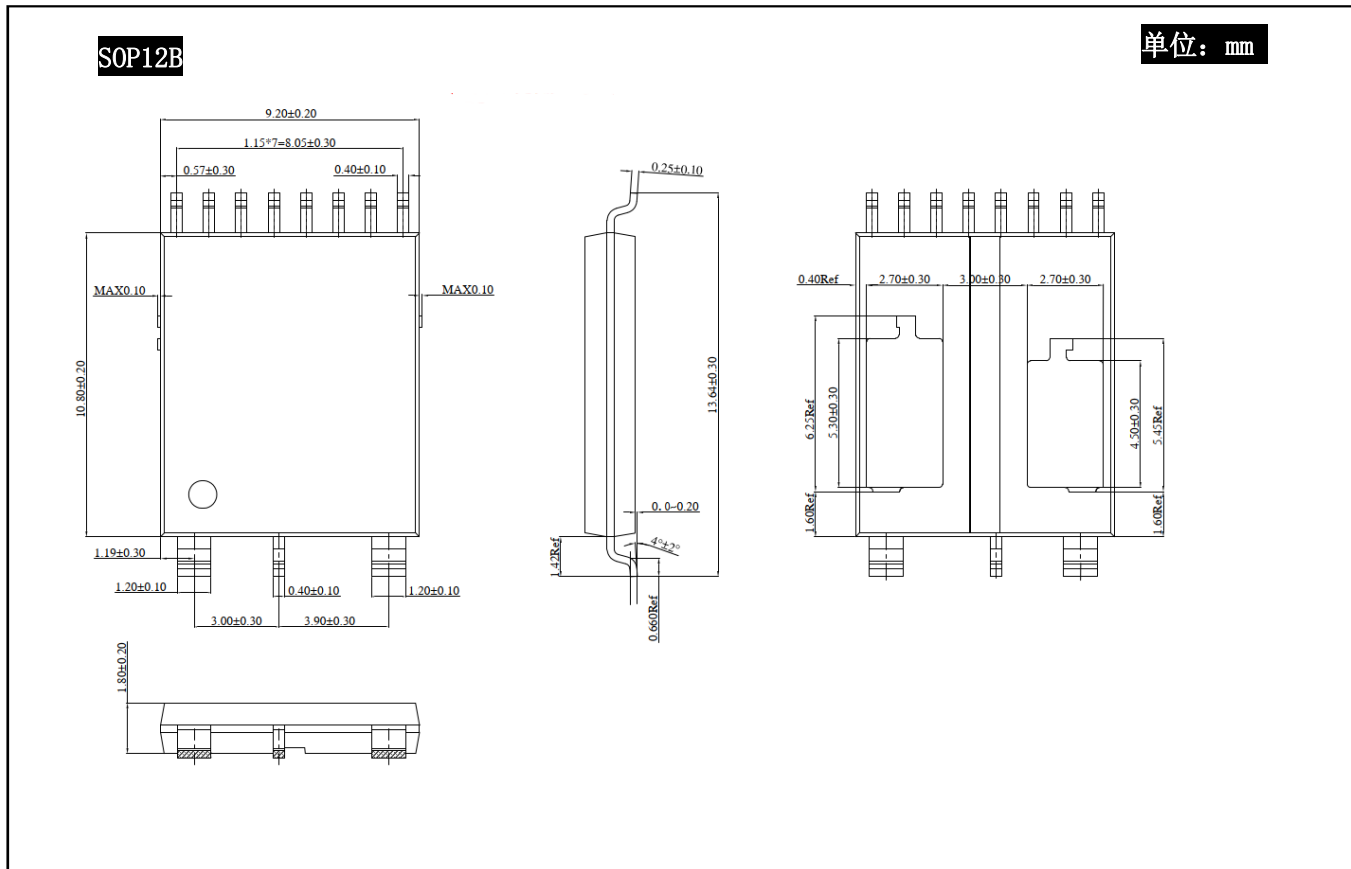


图 12: SPE06S60B-CH 封装外形图  
Fig12: SPE06S60B-CH Package Outline Drawings



### 注意事项

1. 吉林华微电子股份有限公司的产品销售分为直销和销售代理，无论哪种方式，订货时请与公司核实。
2. 购买时请认清公司商标，如有疑问请与公司本部联系。
3. 在电路设计时请不要超过器件的绝对最大额定值，否则会影响整机的可靠性。
4. 本说明书如有版本变更不另外告知。

### NOTE

1. Jilin Sino-microelectronics co., Ltd sales its product either through direct sales or sales agent , thus, for customers, when ordering , please check with our company.
2. We strongly recommend customers check carefully on the trademark when buying our product, if there is any question, please don't be hesitate to contact us.
3. Please do not exceed the absolute maximum ratings of the device when circuit designing.
4. Jilin Sino-microelectronics co., Ltd reserves the right to make changes in this. specification sheet and is subject to change without prior notice.

### 联系方式

#### 吉林华微电子股份有限公司

公司地址：吉林省吉林市深圳街 99 号

邮编：132013

总机：86-432-64678411

传真：86-432-64665812

网址：[www.hwdz.com.cn](http://www.hwdz.com.cn)

### CONTACT

#### JILIN SINO-MICROELECTRONICS CO., LTD.

ADD: No.99 Shenzhen Street, Jilin City, Jilin Province, China.

Post Code: 132013

Tel: 86-432-64678411

Fax: 86-432-64665812

Web Site: [www.hwdz.com.cn](http://www.hwdz.com.cn)