



SPE05M50B-C

主要参数 MAIN CHARACTERISTICS

500V/5A 3 相全桥驱动	
V_{DSS}	500V
I_D	2.5A
I_{DM}	5A
V_{ISO}	1500V

用途

- 空调室内风机
- 风扇
- 高速吹风机
- 水泵

APPLICATIONS

- Air conditioner fan
- Electric fan
- High speed hair dryer
- Pump

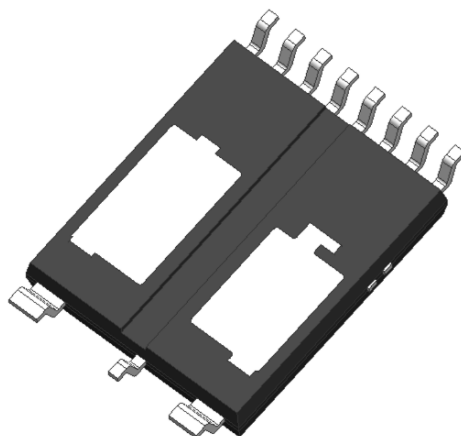
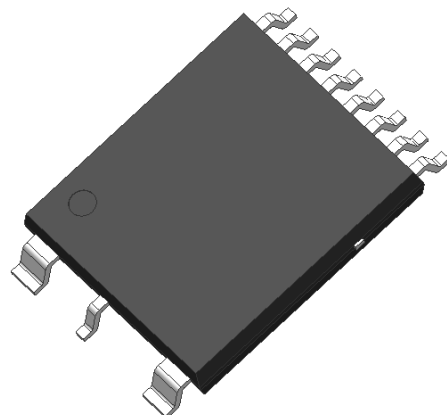
产品特性

- 信号高电平有效, 兼容 3.3V 和 5V 的 MCU
- 下臂 MOSFET 源极输出
- 内置自举二极管
- 内置防直通保护
- 内置欠压保护
- 内部集成温度检测输出
- 绝缘耐压 1500V

FEATURES

- Signal high level valid, compatible with 3.3v and 5V MCU
- Lower arm MOSFET source electrode output
- Built-in bootstrap diode
- Built-in straight through protection
- Built-in undervoltage protection
- Internal integrated temperature detection output
- Resistant to high voltage 1500V

封装 Package



SOP12B-FP

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
2A01-0841-16	SPE05M50B-C	N/A	SPE05M50B-C	SOP12B-FP



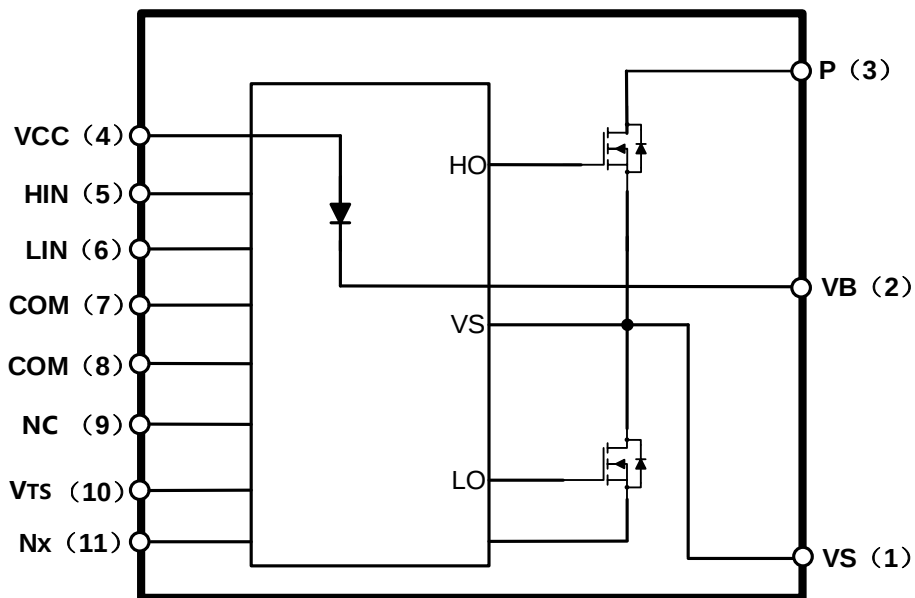


图 1: 模块内部电路示意图

Fig 1: Internal circuit

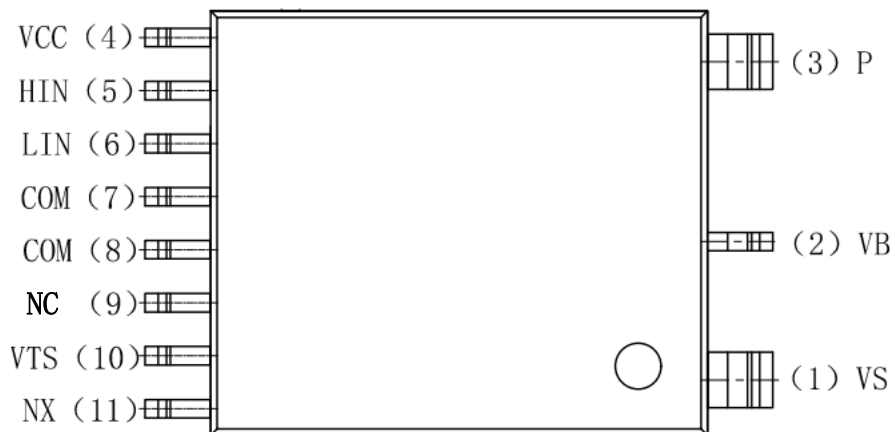


图 2.1: 模块正面引脚分布示意图

Fig 2.1: Distribution of pin



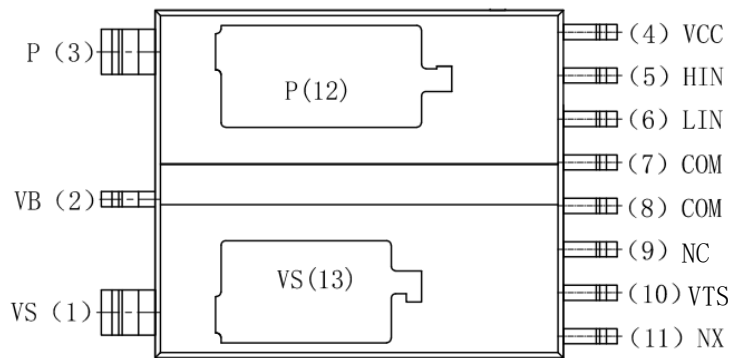


图 2.2: 模块背面引脚分布示意图

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	U 相上臂驱动电源端子 Bias Voltage for U-Phase High-Side MOSFET Driving
3	P	逆变器直流输入端子 Positive DC-Link Input
4	VCC	控制电源端子 Bias Voltage for V-Phase IC and Low Side MOSFET 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	NC	无连接 Not Connection
10	VTS	温度输出端子 Temperature output
11	Nx	下臂 MOSFET 源极端子 Negative DC-Link
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_{DSS}	漏-源电压		500	V
I_{D}	漏极连续电流	$T_c = 25^\circ\text{C}$ (T_c 测量参考图 6)	2.5	A
I_{DM}	漏极电流 (峰值)	$T_c = 25^\circ\text{C}$, 脉冲宽度小于 100us	5	A
I_{rms}	漏极电流 (有效值)	$T_c = 25^\circ\text{C}$, FPWM<20KHz (注)	1.8	Arms

注: 内部的功率硅片的最大结温定额是 150°C ($@ T_c=100^\circ\text{C}$), 但是为确保 IPM 的安全运行, 其平均结温应限制在 $T_{j(\text{ave})}=125^\circ\text{C}$ ($@ T_c=100^\circ\text{C}$) 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 V _{CC} and COM	20	V
V _{BS}	高侧控制电压 High-side Bias Voltage	VB-VS 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 V _{IN} 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
V _{RRMB}	反向耐压 Control Supply Voltage	/	500	V

整个系统 Total System

记号 Symbol	参数 Parameter	条件 Condition	额定值 Ratings	单位 Units
T _j	结温 Operating Junction Temperature	/	-40~150	℃
T _{STG}	贮存温度 Storage Temperature	T _C =25℃	-40~125	℃
V _{ISO}	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: 为了确保 IPM 正常工作, 模块的结温应该小于 150℃ (@T_C ≤ 100° C)。

NOTE 1: To insure safe operation of the IPM, the average junction temperature should be limited to T_J ≤ 150° C (@T_C ≤ 100° C).

热阻 Thermal Resistance

记号	参数	条件	典型值	单位
R _{th(j-c)}	结到外壳的热阻	每个MOSFET	6.8	°C/W

电气特性 (T_J=25℃, 除非特殊说明)Electrical Characteristics (T_J=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
BV _{DSS}	漏-源击穿电压	V _{IN} = 0 V, I _D = 1 mA (备注2)	500	-	-	V
I _{DSS}	零栅极电压漏极电流	V _{IN} = 0 V, V _{DS} = 600 V	-	-	1	mA
V _{SD}	源-漏二极管正向电压	V _{CC} = V _{BS} = 15V, V _{IN} = 0 V, I _D = -1.2A	-	0.9	-	V
R _{DS(on)}	漏-源导通电阻	V _{CC} = V _{BS} = 15 V, V _{IN} = 5 V, I _D = 1.2 A	-	-	1.5	ohm
t _{ON}	开关时间	V _{PN} = 300 V, V _{CC} = V _{BS} = 15 V, I _D = 2.5 A V _{IN} = 0/5 V, 感性负载	-	790	-	nS
t _{OFF}			-	550	-	nS
t _{rr}			-	170	-	nS
E _{ON}			-	160	-	uJ



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E_{OFF}		(备注3)	-	40	-	μJ
R_{BSOA}	反向偏置安全工作区	$V_{PN} = 400 V, V_{CC} = V_{BS} = 15 V, I_D = I_{DP}, V_{DS} =$ $BV_{DSS}, T = 150^\circ C$	全直角			

备注 2: BV_{DSS} 是单个 MOSFET 漏源最大电压。 V_{PN} 应小于该值, 考虑到杂散电感, V_{DS} 在任何情况下都不应超过 BV_{DSS} 。

NOTE 2: BV_{DSS} is the absolute maximum voltage rating between drain and source terminal of each FRFET inside SPM®. V_{PN} should be sufficiently less than this value considering the effect of the stray inductance so that V_{DS} should not exceed BV_{DSS} in any case.

备注 3: t_{ON} 和 t_{OFF} 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_{ON} and t_{OFF} 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_{QCC}	VCC 静态电流 Quiescent VCC Supply Current	$V_{CC}=15V$ $V_{IN}=5V$	VCC-COM 之间 Applied between VCC and COM	-	-	600	μA
I_{QB}	VBS 静态电流 Quiescent VBS Supply Current	$V_{DB}=15V$ $V_{IN}=5V$	VB(U)-U, VB(V)-V, VB(W)-W 之间 Applied between VB(U)-U, VB(V)-V, VB(W)-W	-	-	210	μA
UV_{CCD}	低侧欠压保护 Low-Side Under-Voltage Protection	检测电平 VCC Under-Voltage Protection Detection Level		7.4	8.2	9.4	V
UV_{CCR}		复位电平 VCC Under-Voltage Protection Reset Level		8.0	8.9	9.8	V
UV_{BSD}	高侧欠压保护 High-Side Under-Voltage Protection	检测电平 VBS Under-Voltage Protection Detection Level		7.4	8.2	9.4	V
UV_{BSR}		复位电平 VBS Under-Voltage Protection Reset Level		8.0	8.9	9.8	V
V_{TS}	HVIC 温度检测输出 HVIC Temperature Sensing Voltage Output	$V_{CC}=15V, T_{HVIC}=25^\circ C$ (图 5) (Fig5)		0.6	0.79	1.3	V
V_{IH}	输入开启阈值电压 ON Threshold Voltage	逻辑高电平, 加在 V_{IN} 与 COM 之间 Logic HIGH Level, Applied between V_{IN} and COM		-	-	2.6	V
V_{IL}	输入关闭阈值电压 OFF Threshold Voltage	逻辑低电平, 加在 V_{IN} 与 COM 之间 Logic Low Level, Applied between V_{IN} and COM		0.8	-	-	V
$V_F(BSD)$	自举二极管导通压降 BSD Forward voltage	$I_F=10mA, T_C=25^\circ C$		-	3.5	7	V
R_{BSD}	BSD 限流电阻 Built-in limiting resistance			240	300	360	ohm

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_{PN}	电源电压	P-N 之间	-	300	400	V



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	Supply Voltage	Applied between P and N				
VCC	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
VBS	高侧控制电源电压 High-Side Bias Voltage	VB-VS 之间 Applied between VB and VS	13.5	15.0	16.5	V
VIN(ON)	输入开启阈值电压 Input ON Threshold Voltage	VIN-COM 之间 Applied between VIN and COM	2.5	-	VCC	V
VIN(OFF)	输入关闭阈值电压 Input OFF Threshold Voltage		0	-	0.6	V
t _{dead}	死区时间 Blanking Time for Preventing Arm-Shor	VCC=VBS=13.5~16.5V, T _j <150℃	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
F _{PWM}	PWM 开关频率 PWM Switching Frequency	T _j <150℃	-	15	-	KHz

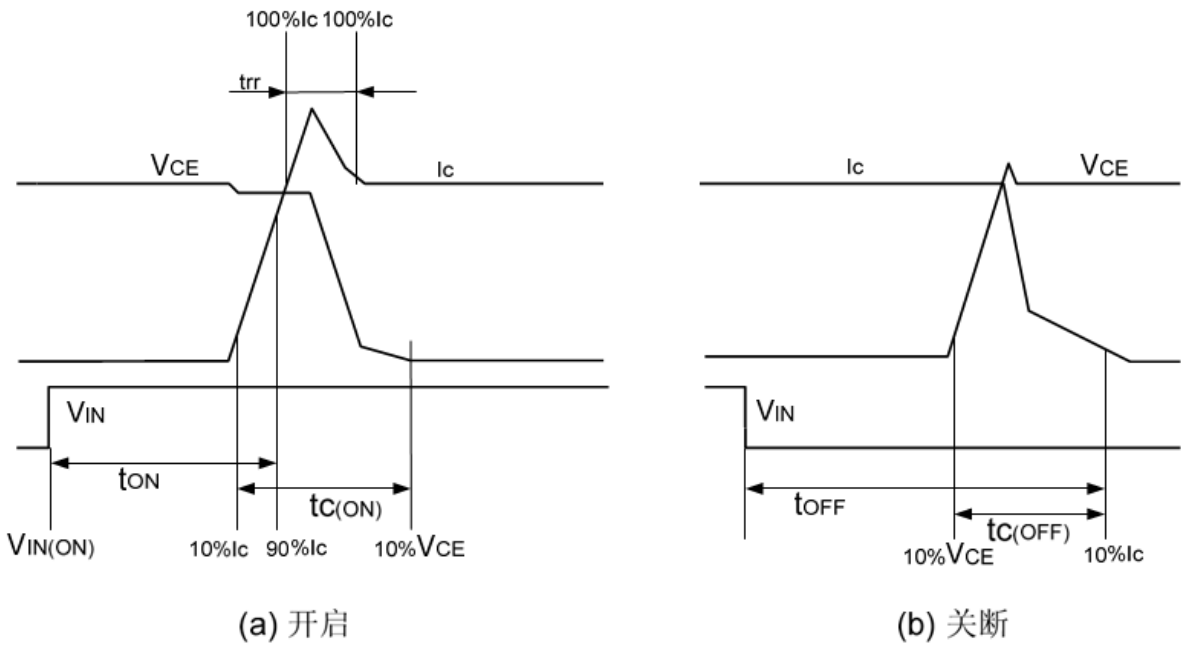


图 4：开关时间定义
Fig 4: Switching Time Definition

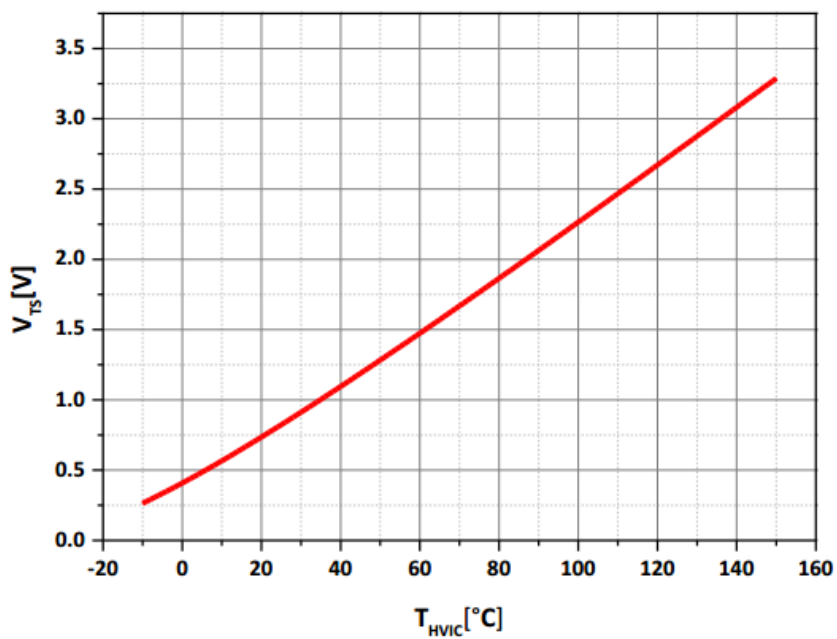


图 5: HVIC 温度检测输出温度—电压曲线

Fig 5: Curves of HVIC Temperature detection-voltage curve

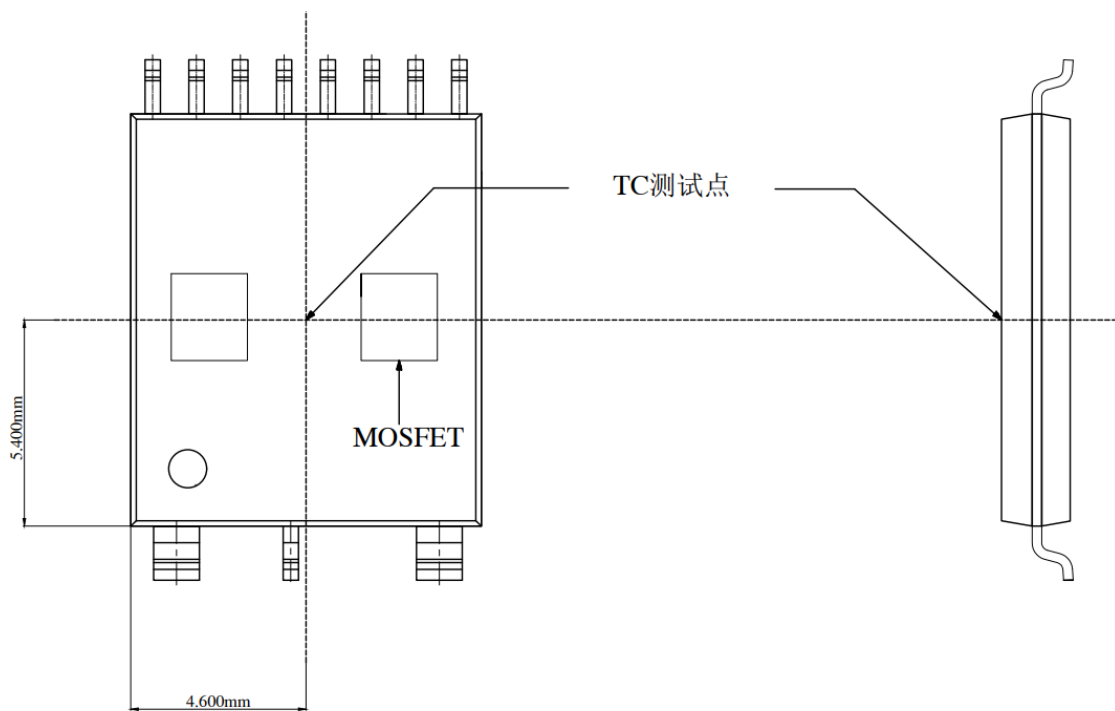


图 6: 壳温 Tc 测试点

Fig 6: Case Temperature Measurement

保护功能时序图 Time Charts of Protective Function

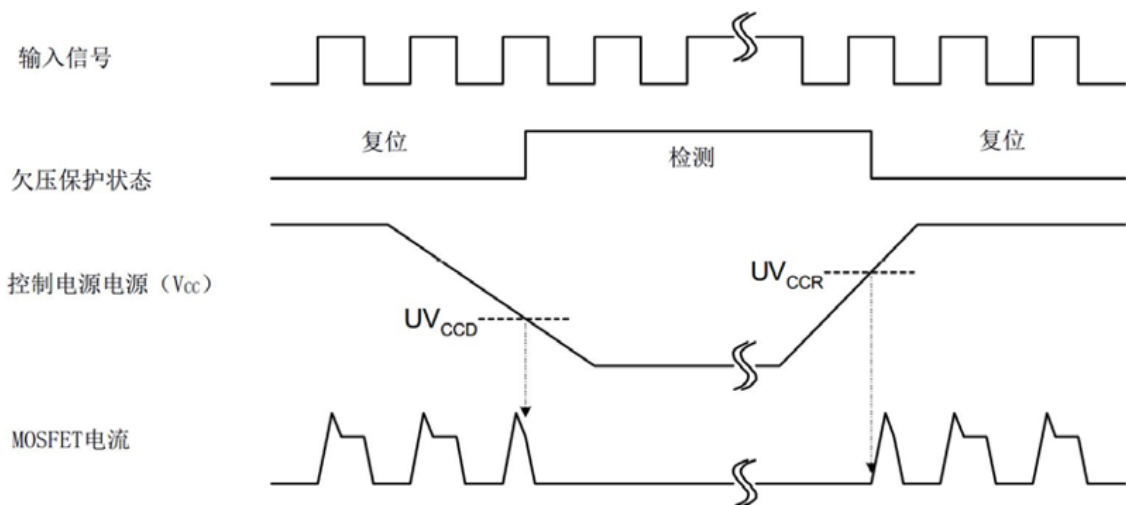


图 7：欠压保护时序图(低侧)

Fig 7: Undervoltage protection sequence diagram (low side)

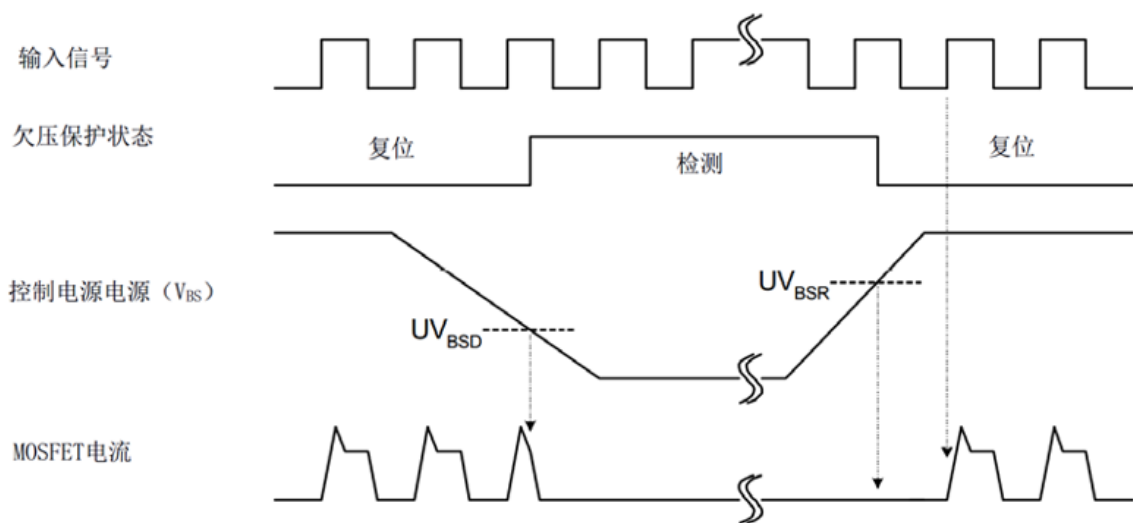


图 8：欠压保护时序图(高侧)

Fig 8: Undervoltage protection sequence diagram (High side)



应用电路 Application Circuit

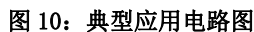


Fig 10: Example of Application Circuit

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= 4.7uF, C2=0.1uF.

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: $C1 = 4.7\mu F$, $C2 = 0.1\mu F$.

备注 5: 在模块的每个输入端和 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 Ω (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 R3 位于 MOSFET 源极与 COM 之间, R3 的压降会影响到下侧 MOSFET 的开关特性以及自举电路的特性因此 R3 的稳态压降应小于 1V。

NOTE 7: The voltage drop across R3 affects the low side switching performance and the bootstrap characteristics since it is placed between COM and the source terminal of the low side MOSFET. For this reason, the voltage drop across R3 should be less than 1V in the steady-state.

备注 8: 由于模块内置了专用 HVIC, 其控制端子可与 CPU 端子直接相连, 而不需要任何光耦或变压器等隔离电路。

NOTE 8: Thanks for HVIC inside modules, direct coupling to MCU without any opto-coupler or transformer isolation is possible.

备注 9: 自举电路负极应直接连接到 VS 端。

NOTE 9: Bootstrap negative electrodes should be connected to VS terminals directly and separated from the main output wires.

备注 10: 保护线路 R4、C3 的时间常数建议选取在 1~2 μ 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 10: The time constant R4、C3 of the protection circuit should be selected in the range of 1.0-2 μ s. SC interrupting time might vary with the wiring pattern. Tight tolerance, temp-compensated type is recommended for R4, C3.

备注 11: 所有电容的位置尽可能的靠近 IPM。

NOTE 11: All capacitors should be mounted as close to the terminals of the IPM as possible.

备注 12: 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 μ F 的 MLCC 低频滤波电容。

NOTE 12: 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 μ F snubber between the P-N1 terminals is recommended.





Technical drawings of a building component, showing three views: a front elevation, a side elevation, and a top plan view.

Front Elevation (Left):

- Overall width: 9.200 ± 0.200
- Overall height: 10.800 ± 0.200
- Top section width: $1.15 \times 7 = 8.050 \pm 0.100$
- Top section height: 0.575
- Right side offset: 0.400 ± 0.050
- Bottom section width: 1.190
- Bottom section height: 1.200 ± 0.050
- Internal width: 2.200
- Internal height: 3.100
- Internal offset: 0.400 ± 0.050
- Bottom section width: 3.000 ± 0.100
- Bottom section height: 3.900 ± 0.100
- Bottom section width: 1.200 ± 0.050
- MAX 0.100

Side Elevation (Middle):

- Overall height: 13.640 ± 0.200
- Top section width: 0.250 ± 0.050
- Top section height: 0.760
- Bottom section width: 1.420
- Bottom section height: 0.660
- Internal width: 0.075 ± 0.050
- Internal height: 0.660
- Internal offset: 4°

Top Plan View (Right):

- Overall width: 9.200 ± 0.200
- Overall height: 10.800 ± 0.200
- Top section width: 0.800
- Top section height: 0.673
- Internal width: 3.000
- Internal height: 0.823
- Bottom section width: 2.700
- Bottom section height: 2.700
- Bottom section width: 0.400
- Bottom section height: 0.400
- Internal width: 2.200
- Internal height: 3.100
- Internal offset: 0.400 ± 0.050
- Bottom section width: 3.000 ± 0.100
- Bottom section height: 3.900 ± 0.100
- Bottom section width: 1.200 ± 0.050

Fig11: SPE03M60B-CH Package Outline Drawings



注意事项

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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。
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