PIR / Microwave sensor control chip

Table of Contents

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Outline

SP012 is a dedicated integrated circuit designed for various sensors, manufactured in CMOS process. Pin design greatly reduces peripheral device, save space and cost and commissioning time, improve overall reliability. It can be widely used in lighting control, motor and solenoid valve control, anti-theft alarm and other fields.

Characteristic

- Voltage operating range 2.4V ~ 5.5V.
- Operating current Type, No load = 15uA @VDD=3.0V, 35uA@VDD=5.0V.
- CMOS digital-analog mixed dedicated integrated circuit.
- With independent high input impedance operational amplifier, it can be matched with multiple sensors for signal processing.
- Two-way amplitude discriminator, which can effectively suppress interference.
- Built-in delay timer (external RC adjustment) and block time timer $T_{I,}$ time is about 2.0 seconds.
- Built-in reference voltage for reference voltage of internal comparator and operational amplifier.
- 8 pin package and simple peripheral circuit and low cost.
- Low consumption, very suitable for battery-powered system application.
- The output will be delayed by about 1.0 second when power is turned on.
- Only need to configure the gain of the first stage op amp and RC device of the oscillator to work reliably.
- The signal debounce time about 12 milliseconds.

Applications

- Human infrared sensor LED lights
- Automatic energy-efficient lighting occasions like garden, garage, hallway, stairs
- Monitoring, alarm, doorbell system like home, shops, offices, factories
- Automatic switching system like exhaust fans, ceiling fans
- Saving products or control systems like electronic albums, monitors, digital cameras, hunting cameras
- Wisdom toys control, smart appliances

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Block Diagram

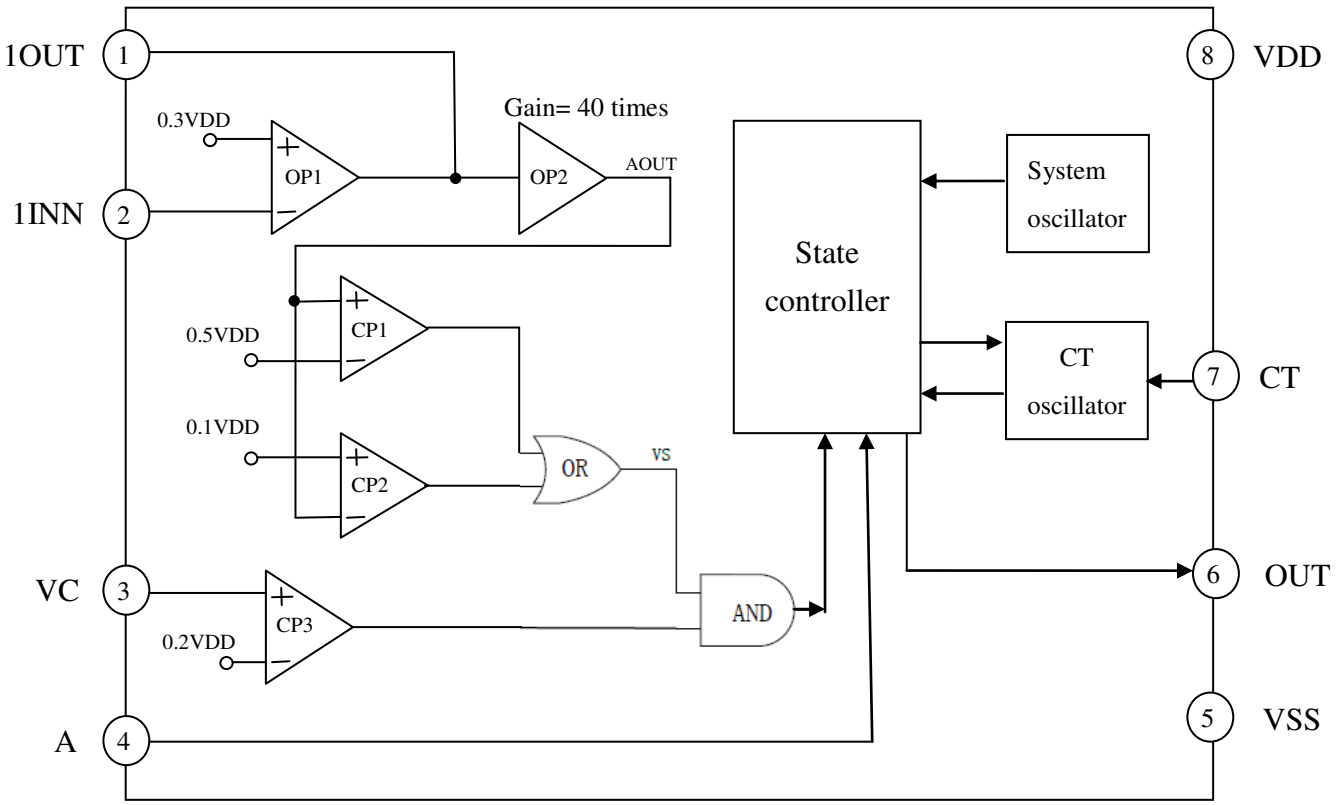

Fig.1

Pin Description

Pin NO	Pin Name	Type	Pin Description
1	1OUT	I/O	The first stage amplifier output and second amplifier stage input
2	1INN	I	The first stage amplifier negative input
3	VC	I	PIR trigger control VC voltage < 0.2VDD : Trigger is prohibited VC voltage > 0.2VDD : Trigger is enabled
4	A	I	PIR trigger mode Setting Options A=VDD : Repetitive trigger A=VSS: Non-repetitive trigger
5	VSS	P	Negative power supply
6	OUT	O	Control output
7	CT	I/O	Output delay time setting
8	VDD	P	Positive power supply

Pin Type

- I CMOS INPUT
- I/O CMOS INPUT/OUTPUT
- O CMOS OUTPUT
- P POWER SUPPLY/VSS

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Electrical Characteristics

- **Absolute maximum ratings**

Parameter	Symbol	Condition	Rating	Unit
Operating Temperature	T_{OP}	—	-40～+85	℃
Storage Temperature	T_{STG}	—	-50～+125	℃
Supply Voltage	VDD	Ta=25°C	VSS-0.3～VSS+5.5	V
Input Voltage	V_I	Ta=25°C	VSS-0.3～VDD+0.3	V
Human Body Mode HBM	ESD	—	5	KV
Note：VSS symbolizes for system ground				

- DC / AC Characteristics：（Test conditions at room temperature = 25 ℃）

Parameter	Symbol	Test condition	Min.	Typ.	Max.	Unit
Operating voltage	VDD		2.4	5.0	5.5	V
Operating current (No load)	I_{OP}	VDD=5.0V	-	35	45	uA
	I_{OFF}	VDD=3.0V	-	15	25	uA
System oscillator	F_{OSC}	VDD=5.0V,K=1024	-	16K	-	Hz
OP offset voltage	V_{OS}	VDD=5.0V	-	2	5	mV
OP offset current	I_{OS}	VDD=5.0V	-	-	50	nA
OP open loop gain	A_{VO}	VDD=5.0V	60	-	-	db
OP output high level	V_{OPOH}	VDD=5.0V, I_{LOAD}= 5.0uA	4.5	4.85	-	V
OP output low level	V_{OPOL}	VDD=5.0V, I_{LOAD} = 5.0uA	-	-	0.1	V
VC pin input high level	V_{VCIH}	VDD=5.0V	1.1	-	-	V
		VDD=3.0V	0.7	-	-	V
VC pin input low level	V_{VCIL}	VDD=5.0V	-	-	0.4	V
		VDD=3.0V	-	-	0.3	V
OUT pin output high level	V_{OH}	VDD=5.0V, I_{LOAD} = 10mA	4.5	4.6	-	V
		VDD=3.0V, I_{LOAD} = 5mA	2.5	2.6	-	V
OUT pin output low level	V_{OL}	VDD=5.0V, I_{LOAD} = -10mA	-	0.3	0.5	V
		VDD=3.0V, I_{LOAD} = -5mA	-	0.3	0.5	V
A pin input high level	V_{AIH}	VDD=5.0V	3.5	5.0	-	V
		VDD=3.0V	2.0	3.0	-	V
A pin input low level	V_{AIL}	VDD=5.0V		0.0	1.0	V
		VDD=3.0V		0. 0	0. 7	V

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Function Description

Ⅰ. T_X oscillator operation frequency description

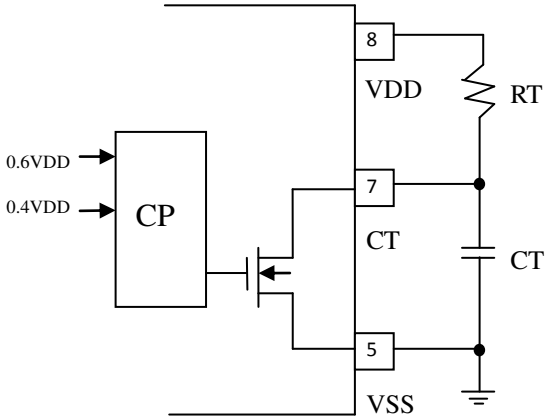

Fig.2

System charge CT capacitor through a Pull-up resistor RT. The built-in comparator turns on to discharge CT capacitor when the voltage on the capacitor is charged to 0.6VDD. Built-in comparator turns on to charge CT capacitor when the voltage on the capacitor is discharged to 0.4VDD. The CT capacitor is charged again to 0.6VDD through RT resistor. In this way the periodic capacitor is charged and discharged to obtain a stable operating oscillation frequency.

Approximate charge and discharge time:

$Tosc1=0.8R_TC_T \rightarrow F=1/Tosc1$

Example: RT=100KΩ，CT=1nF

Tosc1 ≒ 0.8x100Kx1n = 80uS → F≒12.5KHz

T_X≒100000x80us= 8 seconds

Test parameter : VDD=5.0V, @25℃		
CT	RT	TX delay time
1.0nF	47KΩ	3.8 second
	100KΩ	8.0 second
	200KΩ	15.9 second
	300KΩ	24.6 second
	1000KΩ	79.2 second

Ⅱ. Pin A allow repetitive trigger and non-repetitive trigger explanation

1. When A = VSS, operating mode is set to non-repetitive trigger, any changes in VS are ignored during T_X time until the end of the T_X time. Explanation is following by fig.3.

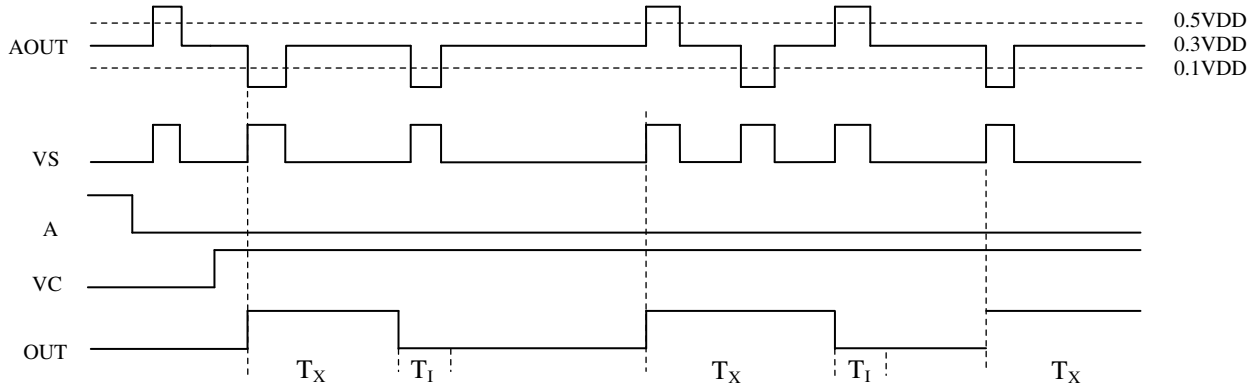

Fig3. Non-repetitive trigger

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2. When A = VDD, operating mode is set to repetitive trigger, any changes in VS during the T_X time allows the T_X time to be recounted. Explanation is following by fig.4.

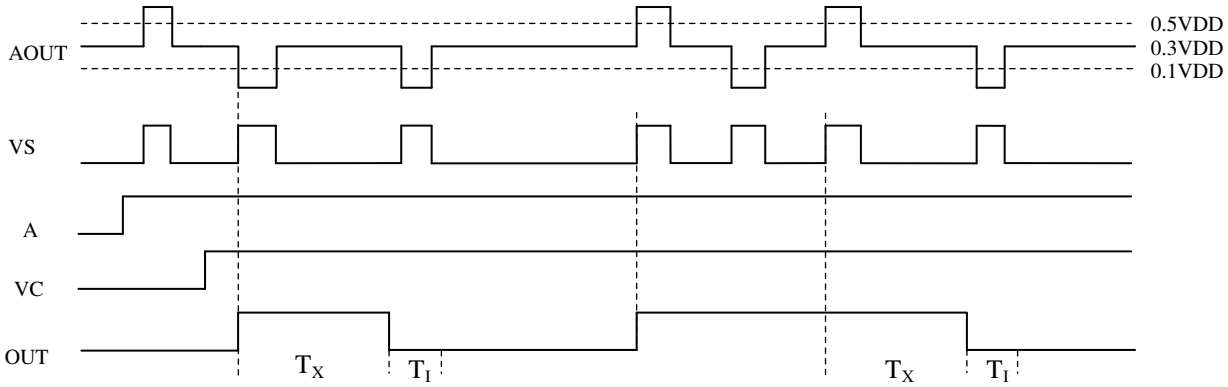

Fig4. Repetitive trigger

Ⅲ. Pin VC for PIR trigger control explanation

VC input voltage	comments
VC voltage < 0.2VDD	Trigger is prohibited. The internal VC comparator is blocked, so that the input VS trigger signal is invalid, and the OUT terminal is always at a low level output.
VC voltage > 0.2VDD	Trigger is enabled. The internal VC comparator is turned on to enable the input VS trigger signal. When the VS jump source comes, the chip enters the trigger delay timing T_X, and the OUT terminal outputs a high level until the T_X timing ends, and the OUT terminal returns to a low level output.

Ⅳ. Operation amplifier gain setting

The gain configuration of the first-stage OP amp is shown in fig.5. The input signal needs to be connected to the reverse input of the op amp. Make the first-stage op amp work in the state of proportional amplification of response. The first stage gain parameter is set by R2 and R3, the absolute gain is A1=R3/R2. As shown in the Fig.5 parameters op amp gain A1=R3/R2=3,000,000/10,000=300, A2 gain is fixed 40 times. The overall gain is A=A1*A2=300*40=12,000. The user can adjust the gain of A1 appropriately according to the characteristics of the infrared pyroelectric probe to change the detection distance.
C2 is DC blocking capacitor, C3 is high frequency anti-interference capacitor.

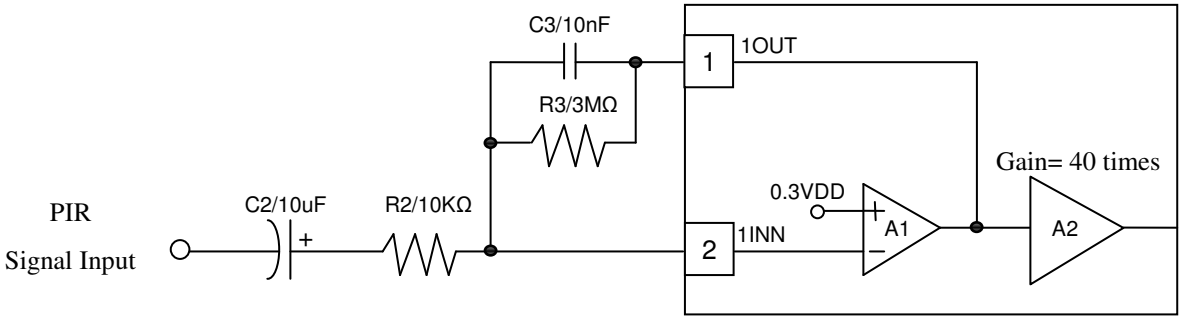

Fig.5 Internal OP amp block diagram

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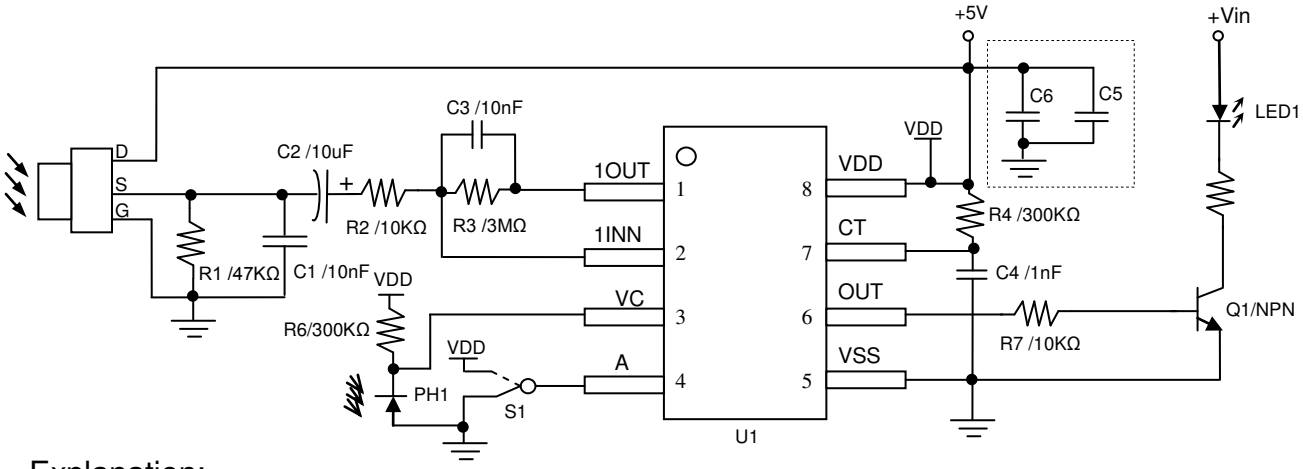
Application circuit

1. PIR sensor LED light application(1)

Reference only



Explanation:

(1) PH1 is a photo resistor and is used to detect the environmental luminance. When used as a lighting control, if the environment is brighter, the resistance value of PH1 will decrease. The trigger signal cannot effectively enable the delay time T_X and save lighting power.

(2) PIR and IC leads should be as short as possible to avoid noise interference.

(3) PIR cable should be as far away as possible from interference sources such as switching power supplies to avoid introducing noise interference

BOM Table.

	Device						
No.	Mark	Name	Parameter	No.	Mark	Name	Parameter
1	C1	Ceramic capacitors	10nF	11	R5	Carbon resistance	1KΩ
2	C2	Electrolytic capacitor	10uF/25V	12	R6	Carbon resistance	300KΩ
3	C3	Ceramic capacitors	10nF	13	R7	Carbon resistance	10KΩ
4	C4	Ceramic capacitors	1nF	14	PH1	Photodiode	
5	C5	Electrolytic capacitor	*10uF/25V	15	Q1	NPN transistor	8050S
6	C6	Ceramic capacitors	*0.1uF	16	S1	Switch	Signal pole
7	R1	Carbon resistance	47KΩ	17	LED1	LED	
8	R2	Carbon resistance	10KΩ				
9	R3	Carbon resistance	3MΩ				
10	R4	Carbon resistance	300KΩ				

Note: * Power filter components are installed as appropriate.

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2. PIR sensor Relay application(2)

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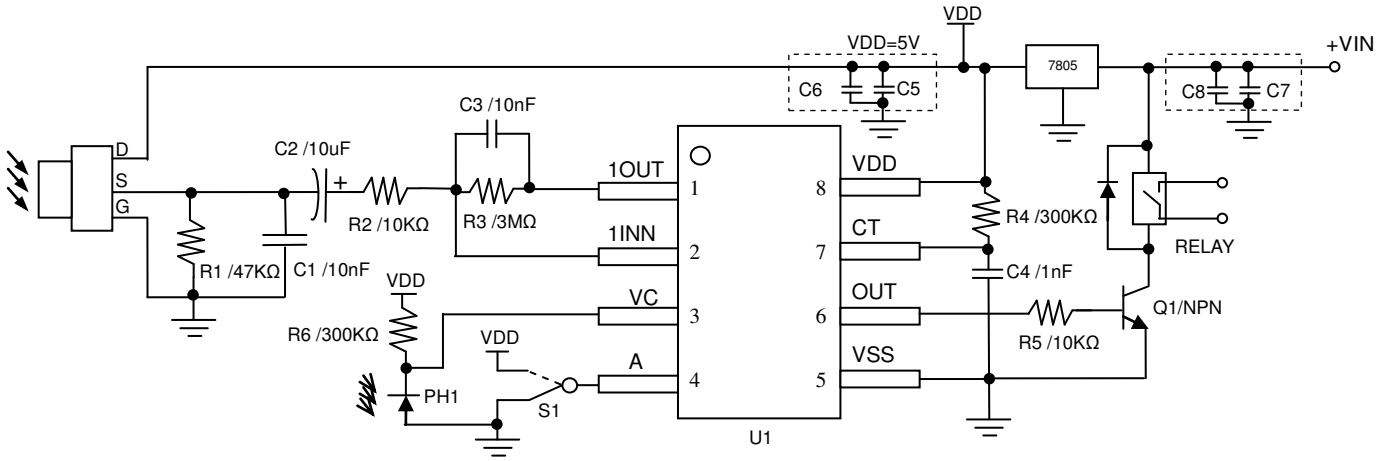
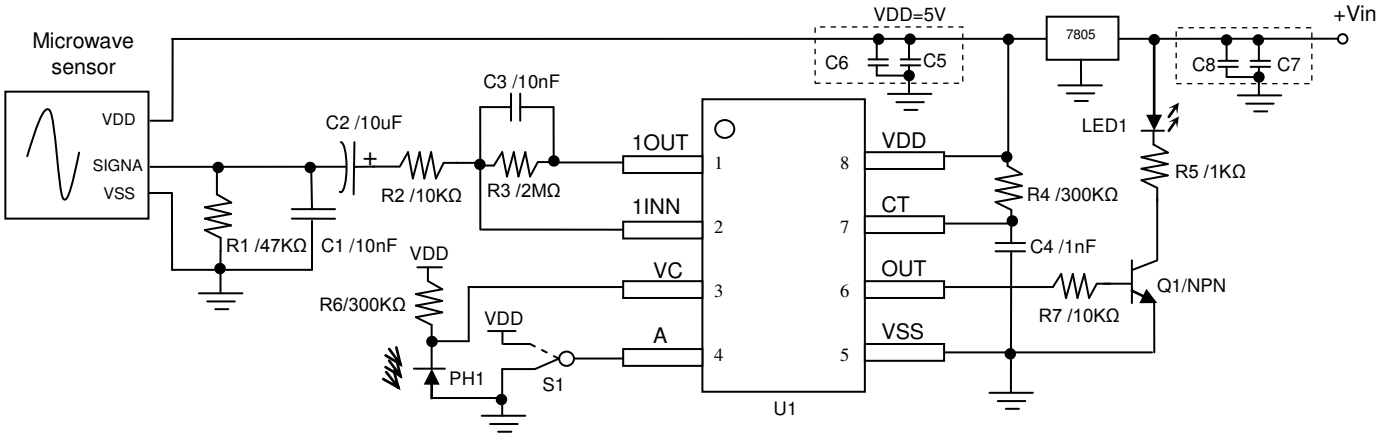


Note: The dotted lines C5, C6, C7, C8 can adjusted according to the needs of the power supply.

3. Microwave LED light application(3)

Reference only



Note: The dotted lines C5, C6, C7, C8 can adjusted according to the needs of the power supply.

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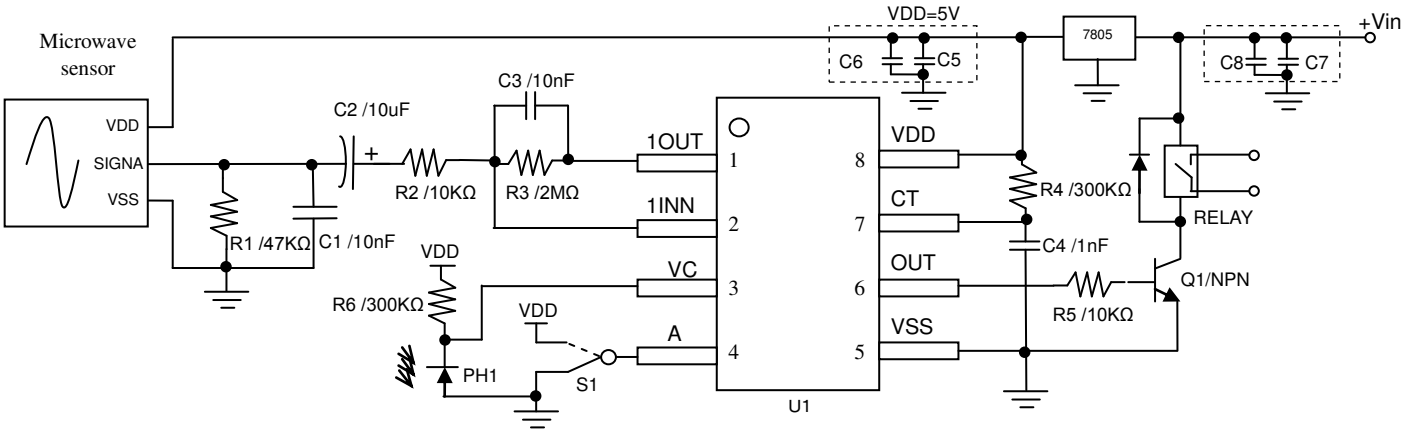
4. Microwave Relay application(4)

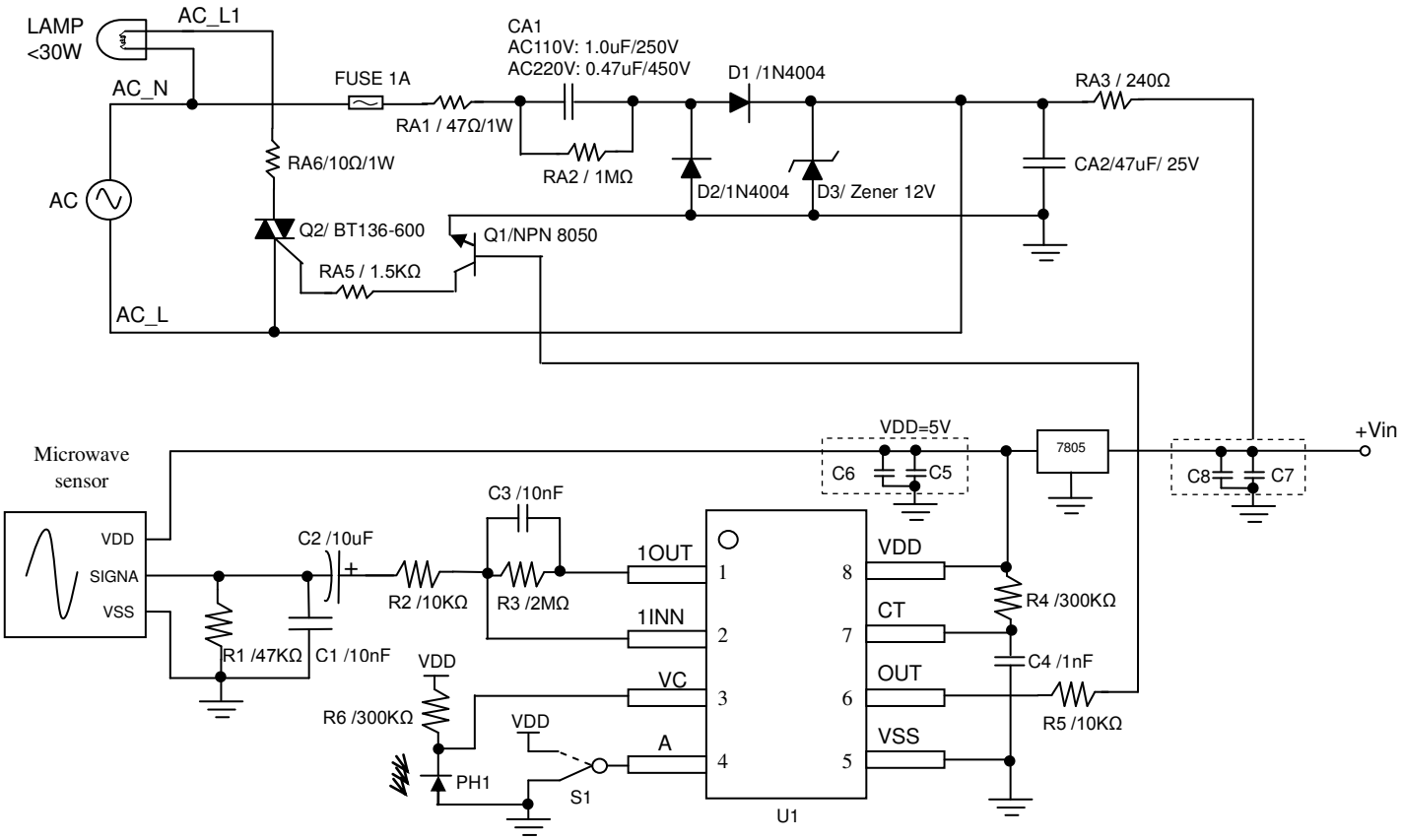
Reference only



Note: The dotted lines C5, C6, C7, C8 can adjusted according to the needs of the power supply.

5. AC 3-wire Microwave TRIAC application(5)

Reference only



Note: The dotted lines C5, C6, C7, C8 can adjusted according to the needs of the power supply.

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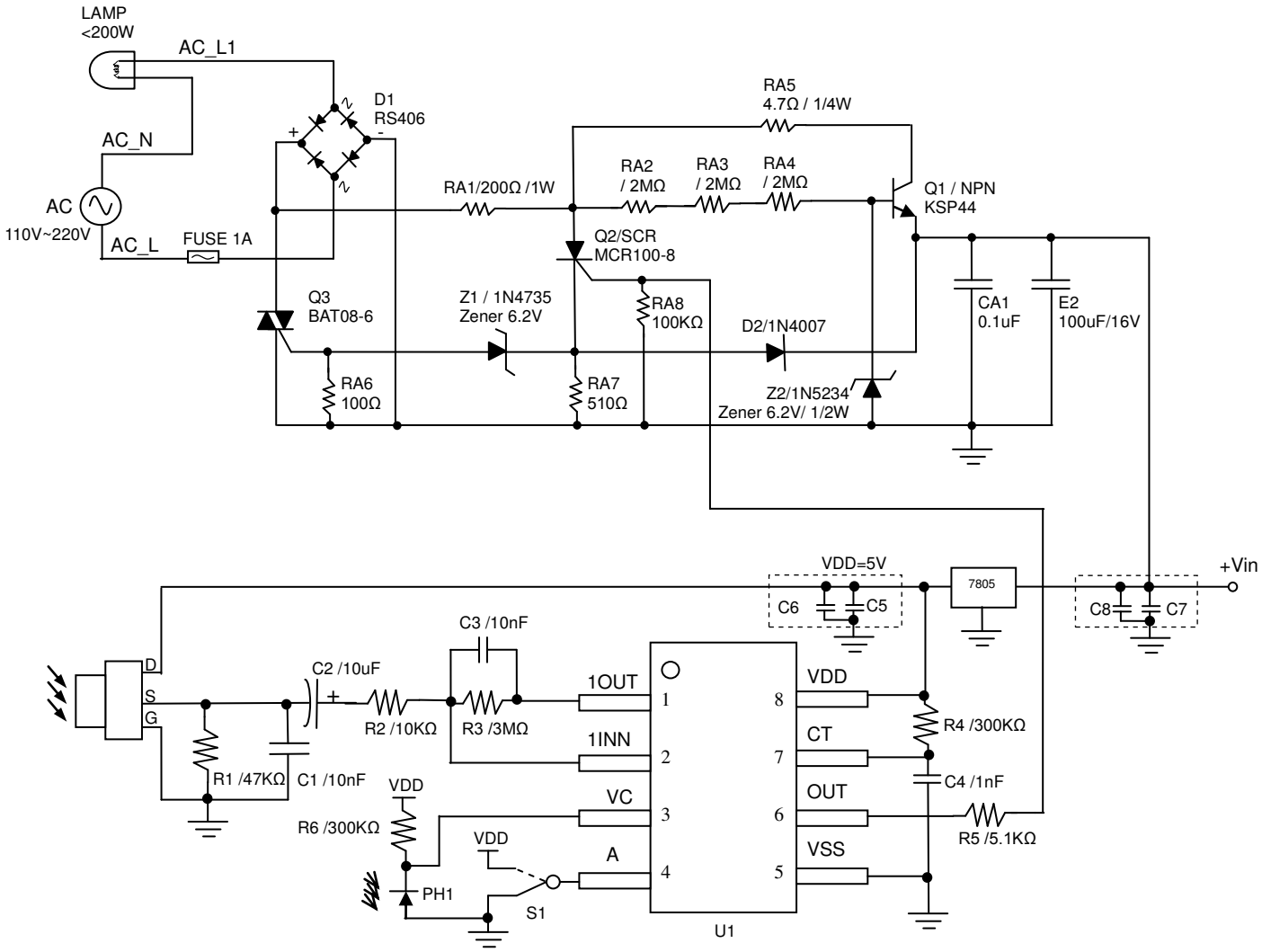
6. AC 2-wire PIR sensor TRIAC application(6)

Reference only



Note: The dotted lines C5, C6, C7, C8 can adjusted according to the needs of the power supply.

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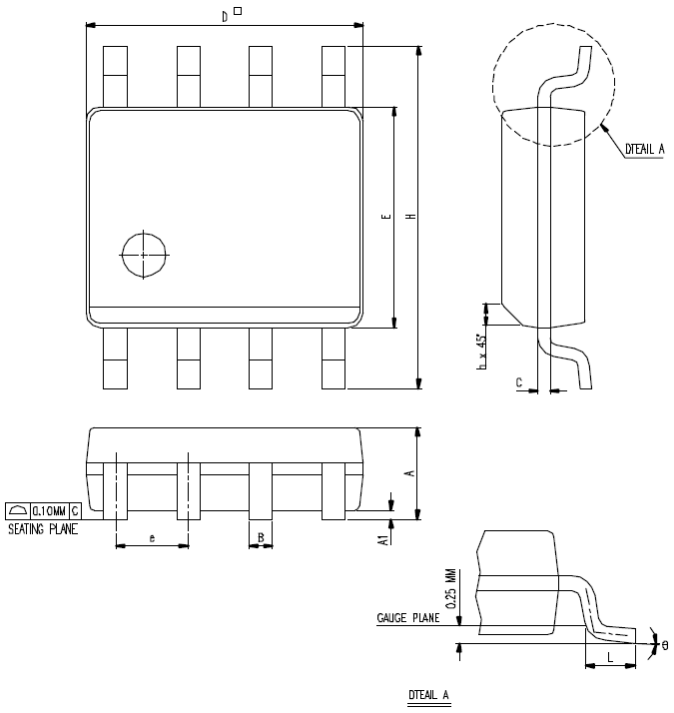
Package outline

Package type: SOP-8



Symbol Parameter (Unit : mm)														
A			A1			B			C			e		
Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max		Typ	
1.35		1.75	0.100		0.250	0.33		0.51	0.19		0.25		1.27	

Symbol Parameter (Unit : mm)																	
D			H			E			L			h			Θ		
Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
4.80		5.00	5.800		6.200	3.80		4.00	0.40		1.27	0.250		0.500	0		8

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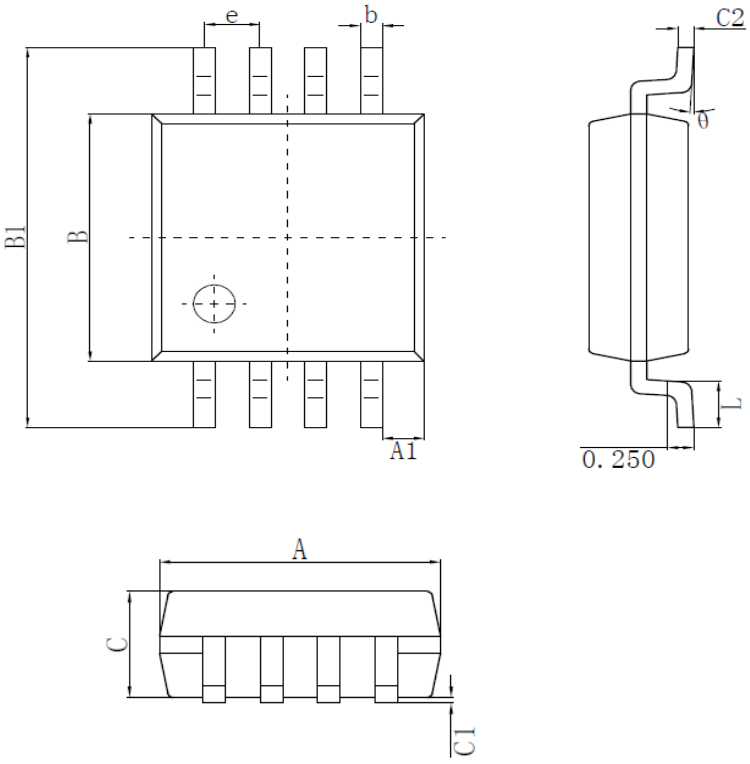
Package type: CPC-8



Symbol Parameter (Unit : mm)														
A			A1			e			B			B1		
Min	Nom	Max	Min	Nom	Max		Typ		Min	Nom	Max	Min	Nom	Max
2.50		2.70	0.350		0.450		0.53		2.50		2.70	3.85		4.15

Symbol Parameter (Unit : mm)																	
b			C			C1			C2			L			θ		
Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
0.16		0.26	0.85		1.05	0.00		0.15	0.15		0.18	0.400		0.600	0		8

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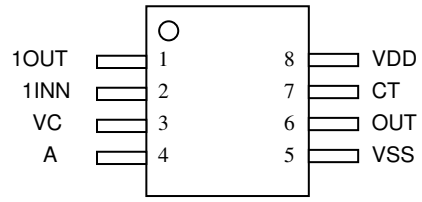
Package configuration

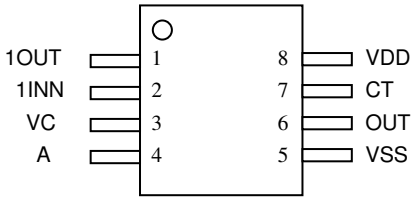
SP012-A

Package type SOP-8



SP012-C

Package type CPC-8



Ordering Information

SP012

Package Item	Package Type	Chip type	Wafer type
SP012-A	SOP-8	No support	No support
SP012-C	CPC-8	No support	No support

Revision History:

1. 2020/05/19：Version: 1.0
   Initial version.

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