PIR Human body infrared sensing control chip

Descriptions of Product

- TTY5001 is the standard control solution specifically designed for PIR sensing LED control with features such as detection of ambient brightness, optional delay of off time, and selection output modes. The chip does not include the amplification circuit used for PIR sensing and needs to work with TTY020 to provide the input for the SIN pin of TTY5001 to detect the PIR sensing signal.

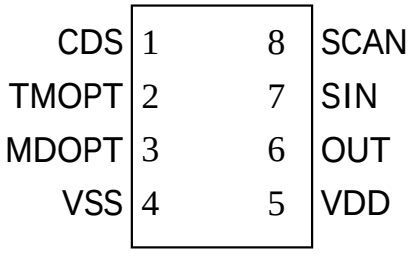
Features of the Product

- Operating Voltage：2.4V - 5.5V
- 9 delays of off time available for selection
- 9 work modes available for selection
- Daytime and nighttime modes in the provided ambient brightness detection
- Provide Bright/Low mode and Dim mode
- Passes the +- 4KV test required by the safety regulation IEC/EN 61000-4-4 of EFT

Product Applications

- Lighting equipment for home, bathroom, hallway, office, and security system Auto calibration for life.

Pin diagram of packaging



SOP8-FO8

Pin Definition

Pin	Pin Name	Type	Descriptions of Function
1	CDS	I	0 stands for the daytime mode and 1 is for the nighttime mode, with 2 seconds of anti-vibration time
2	TMOPT	I	Selection of delay time to turn off the LED once the PIR is activated. There are 9 settings available for selection by connecting with various combinations of resistors
3	MDOPT	I	Selection of work mode. There are 9 work modes available for selection by connecting with various combinations of resistors
4	VSS	P	Negative terminal of power supply
5	VDD	P	Positive terminal of power supply
6	OUT	0	Low voltage level in regular output, at 1KHz for PWM output, CMOS type output
7	SIN	I	Input signal for PIR triggering, effective for low voltage level
8	SCAN	0	High voltage level in regular output and low voltage level of output in the case of reading the input signal

Pin Type

- I Input
- O Output
- P Power supply

Selections of delay time to turn off and voltage divider resistor after TMOPT is triggered：

Pull-up resistor	Pull-down resistor	Delay time
Floating	100K	1 second
100K	10K	10 seconds
100K	27K	20 seconds
100K	51K	30 seconds
91K	82K	45 seconds
68K	100K	60 seconds
39K	100K	120 seconds
18K	100K	240 seconds
100K	Floating	360 seconds

Note：Please refer to the applied circuit diagram for details of the pull-up resistor （R5） and the pull-down resistor（R9）

Selections of MDOPT work mode and voltage divider resistor

Work mode	Pull-up Resistor	Pull-down Resistor	Descriptions of work mode
Mode 1	Floating	100K	ON/OFF function；off in Daytime mode；In Nighttime mode, output is at high level when triggered and at low level with no triggering；when the light is on, CDS testing is prohibited
Mode 2	100K	10K	ON/OFF function；off in Daytime mode；in Nighttime mode, output is at high level when triggered and at low level with no triggering；when the light is on, CDS testing is continued；light is automatically turned off in daytime mode
Mode 3	100K	27K	Function of Bright/Low light 1；light is off in Daytime mode；in Nighttime mode, the output is at high level when triggered and at 5% PWM without triggering；when low light is on, CDS is tested；light is automatically turned off in daytime mode
Mode 4	100K	51K	Function of Bright/Low light 2；light is off in Daytime mode；in Nighttime mode, the output is at high level when triggered and at 10% PWM without triggering；when low light is on, CDS is tested；light is automatically turned off in daytime mode
Mode 5	91K	82K	Function of Bright/Low light 3；light is off in Daytime mode；in Nighttime mode, the output is at high level when triggered and at 20% PWM without triggering；when low light is on, CDS is tested；light is automatically turned off in daytime mode
Mode 6	68K	100K	Function of dimming full brightness/dimming full darkness in 4 seconds；light is off in Daytime mode；in Nighttime mode, the brightness reaches 100% from OFF when triggered and diminishes to OFF from 100% brightness with no triggering；the transition completes in 4 seconds
Mode 7	39K	100K	Function of dimming full brightness/dimming full darkness in 8 seconds；light is off in Daytime mode；in Nighttime mode, the brightness reaches 100% from OFF when triggered and diminishes to OFF from 100% brightness with no triggering；the transition completes in 8 seconds
Mode 8	18K	100K	Function of dimming full brightness in 4 seconds +diminishing to 30% brightness with 10 seconds of warning+ dimming full darkness；light is off in Daytime mode；in Nighttime mode, the brightness dimming reaches 100% from OFF when triggered and diminishes to 30% brightness from 100%, ontinuing to diminish to OFF in case of no triggering in 10 seconds
Mode 9	100K	Floating	Function of dimming full brightness in 4 seconds +diminishing to 30% brightness with 30 seconds of warning+full darkness；light is off in Daytime mode；in Nighttime mode, the brightness dimming reaches 100% from OFF when triggered and diminishes to 30% brightness from 100%, continuing to diminish to OFF in case of no triggering in 30 seconds

Note：Please refer to the applied circuit diagram for details of the pull-up resistor（R6） and the pull-down resistor（R8）

AC／DC Characteristics

- **Absolute maximum ratings**

Item	Symbol	Rating
Operating Temperature	Top	-20℃ ~ +70℃
Storage Temperature	Tst	-50℃ ~ +125℃
Supply Voltate	VDD	VSS-0.3V ~ VSS+6.0V
Input Voltage	Vin	VSS-0.3V ~ VDD+0.3V
ESD（Human Body Mode）	ESD	> 5kV
Note：VSS symbolizes for system ground		

- **D.C. Characteristics**

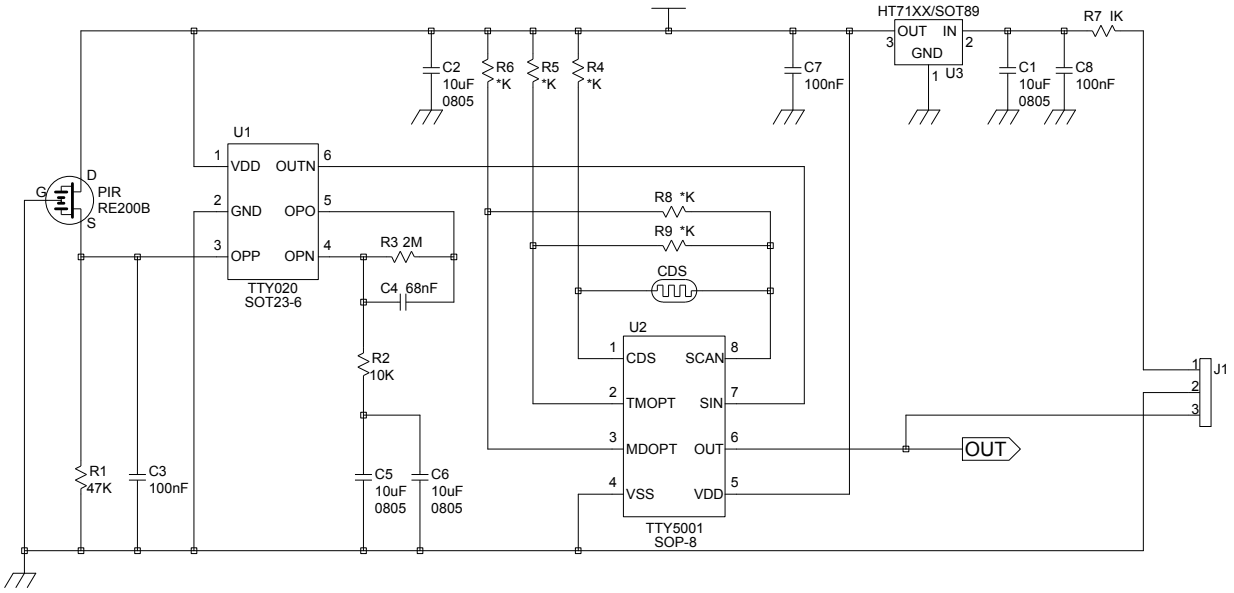
Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Operating Voltage	VDD	OSCH generated by on-chip 910kHZ oscillator	2.4	-	5.5	V
Operating Current	I_{nd3}	Normal mode, no load VDD=3.0V, SCH=910kHz	-	0.4	0.7	mA
GREEN mode Current	Istbl	ADC OFF, OSCH stop, OSCL active, VDD=3.0V, no load	-	0.8	1.2	uA
	Istb2	ADC measurement cycle time=32ms, OSCH stop, OSCL active, Vdd=3.0V, no load	-	1.1	1.5	uA
Input low voltage	V_{IL}	Input Low voltage	0	-	0.2	VDD
Input high voltage	V_{IH}	Input High voltage	0.8	-	1.0	VDD
Sink Current of output	I_{OL}	Vdd=3.0V, V_{OL}=0.6V	2	4	-	mA
Source Current of output	I_{OH}	Vdd=3.0V, V_{OH}=2.4V	-	-4	-2	mA
Pull-high Resistor of PB and PC	R_{PH}	Vdd=3.0V	50	100	150	KΩ
（ambient temperature is 25℃）						

- **A.C. Characteristics**

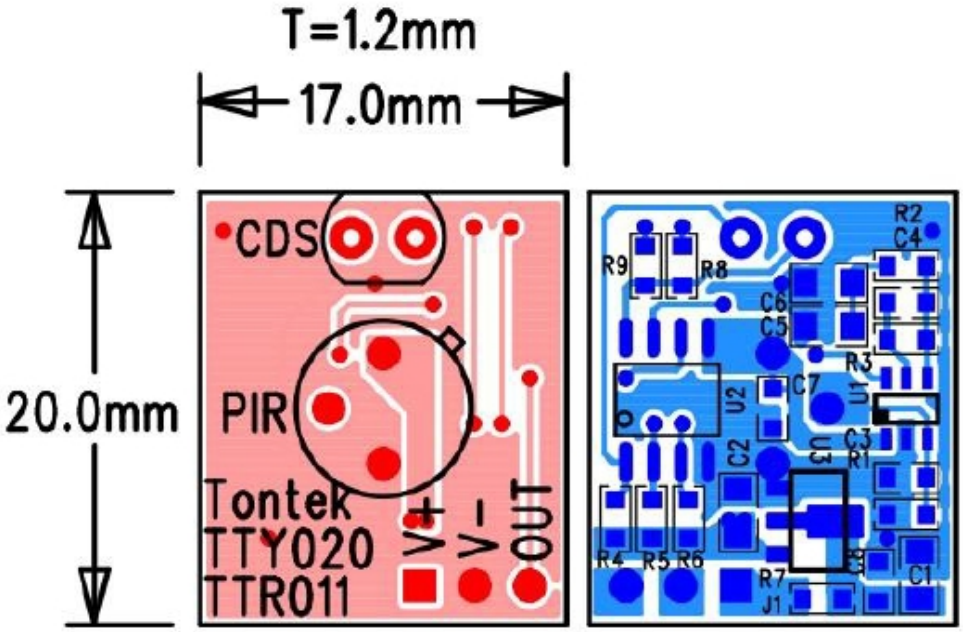
Parameter	Test Conditions	Min	Typ	Max	Unit
High-speed clock OSCH Frequency	On-chip 910kHz oscillator	882k	910K	937k	Hz
System stable time after power up	Stable time =（OSCL startupTime）+（1/OSCL）X256	-	17	-	ms
Wake up time	Wake up time to low power mode =（OSCL startup time）+（1/OSCL）X4	-	1	-	ms
	Wake up time to normal mode =（OSCH startup time）+（1/OSCH）X4	-	1	-	ms
（VDD=3V, ambient temperature is 25℃）					

Diagram of Application Circuits

Ⅰ. Demo board circuit



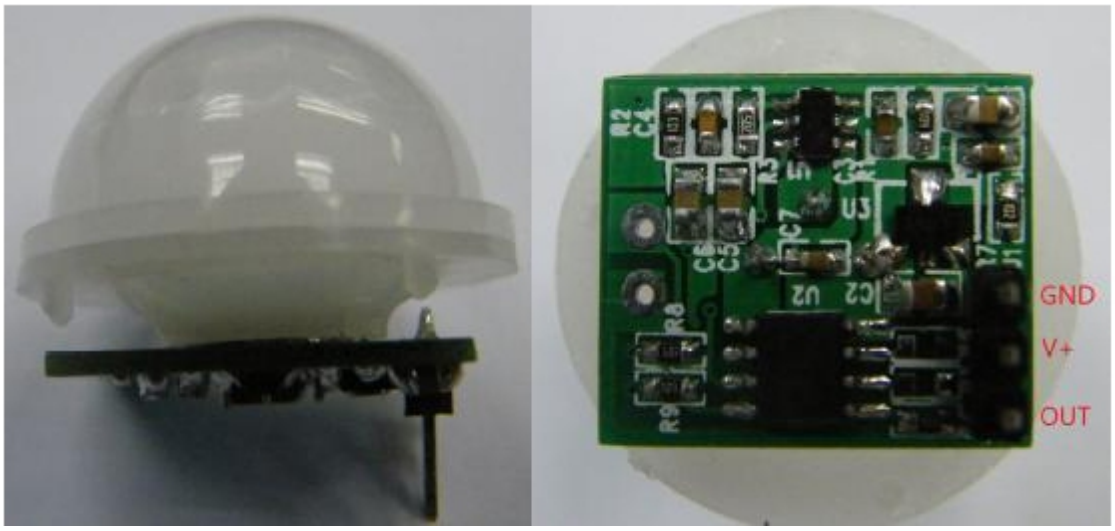
- **Demo PCB**



- **BOM list**

Serial	Specifications	Quantity	Position
1	TTY020 SOT23-6	1	U1
2	TTY5001	1	U2
3	HT7550A-1 SOT89	1	U3
4	RE200B PIT Sensor	1	PIR
5	CDS	1	CDS
6	100nF/25V X7R 0603	3	C1、C7、C8
7	68nF/50V X7R 0603	1	C4
8	10uF/10V Y5V 0805	4	C1、C2、C5、C6
9	10K 5% 0603	1	R2
10	47K 5% 0603	1	R1
11	2M 5% 0603	1	R3
12	Adjust by desired functions	5	R4、R5、R6、R8、R9
13	1K 5% 0603 （adjust according to input voltage）	1	R7

- **Photo of actual object**



Module input voltage：3.3~7V

Standby Current：< 50uA

Sensing Distance：>10m

（Lateral sensing distance in the front along the horizontal direction of window）

For easy testing, DEMO is set to work mode 1 with 1 seconds of delay time and no CDS forced night time mode；customers can modify the setting according to their needs.

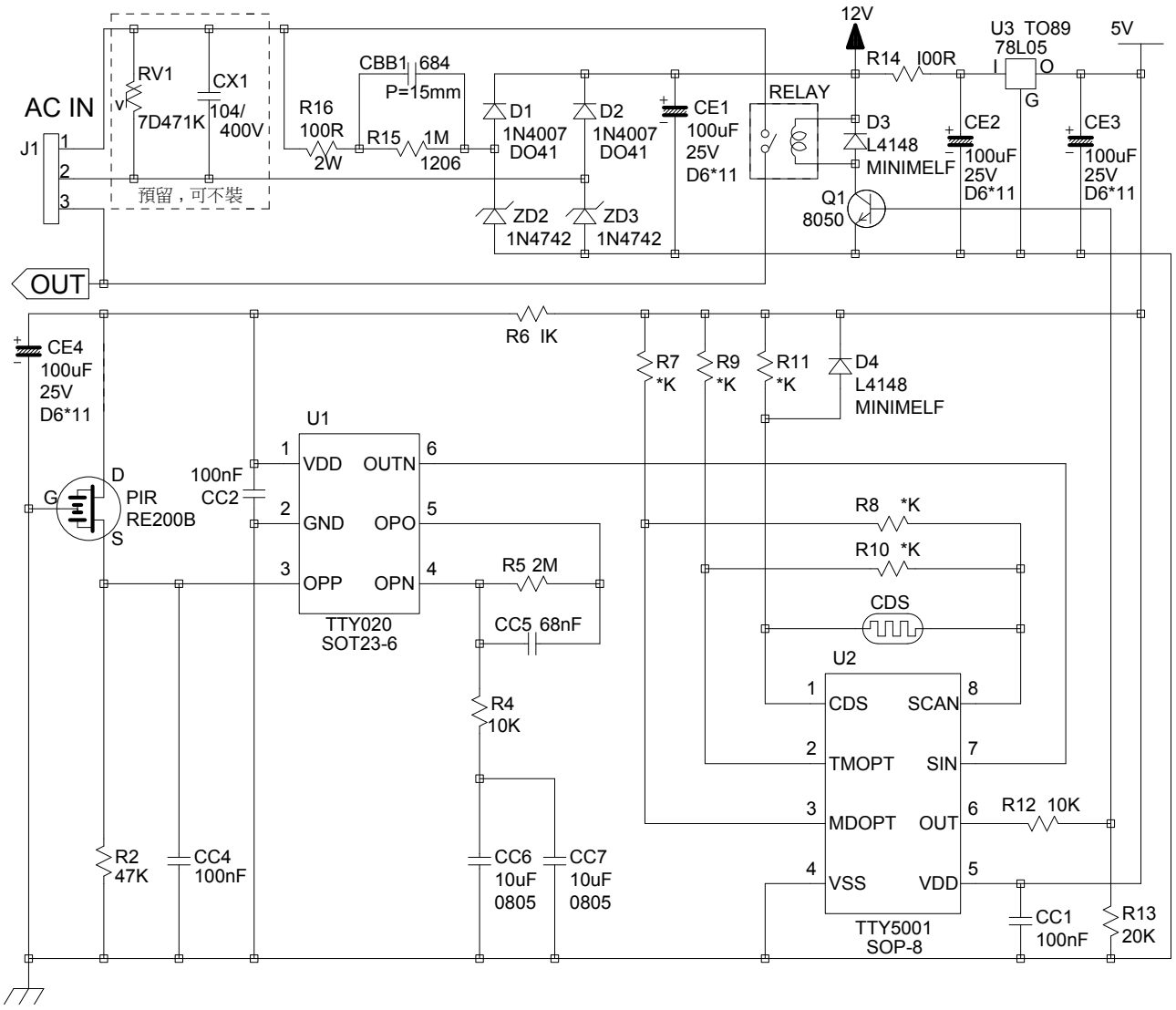
- **Requirement of Circuit Gain：**

The OPP, OPN, and OPO of TTY020 can be treated as an independent operational amplifier. Since it operates in the AC mode single phase amplification, one needs to consider how the capacitive imdedance of C4, C5, and C6 affects the gain when calculating the total circuit gain.

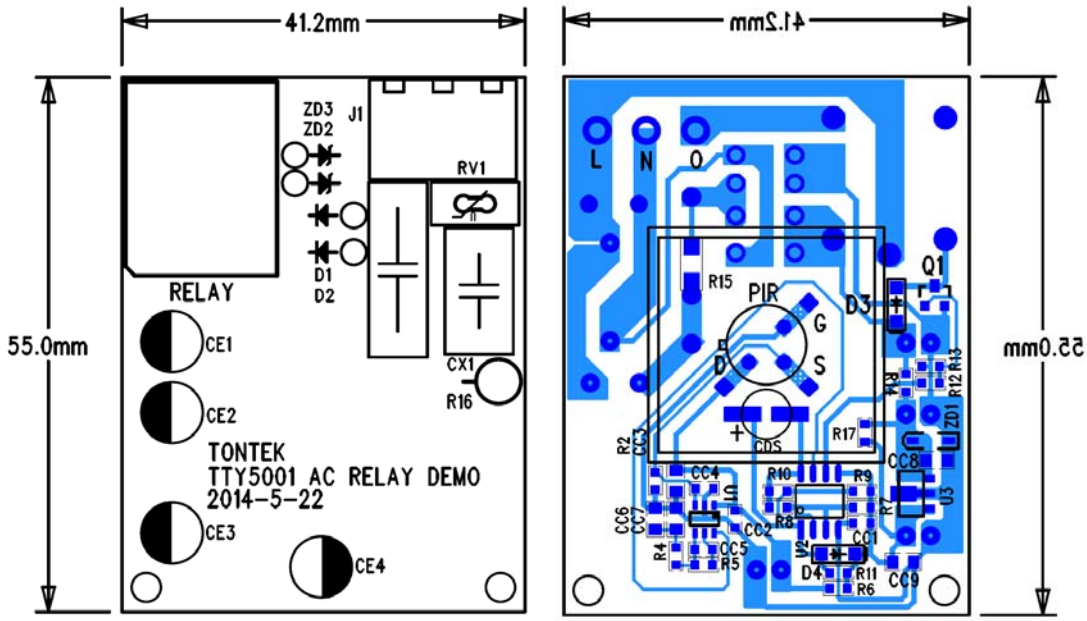
When the sensing distance it too short, the order of gain adjustment is：

increase R3=Max3M >>> decrease R2=Min2K >>> increase C5+C6=Max22uF >>> Select Fresnel lens with higher gain >>>Select PIR SENSOR with higher gain

Ⅱ. AC relay application circuit



- **Layout Reference**



Module input voltage：AC

Sensing Distance：>10m

（Lateral sensing distance in the front along the horizontal direction of window）

- **Requirement of Circuit Gain：**

The OPP, OPN, and OPO of TTY020 can be treated as an independent operational amplifier. Since it operates in the AC mode single phase amplification, one needs to consider how the capacitive imdedance of CC5, CC6, and CC7 affects the gain when calculating the total circuit gain.

When the sensing distance it too short, the order of gain adjustment is：

increase R5=Max3M >>> decrease R4=Min2K >>> increase CC6+CC7=Max22uF >>> Select Fresnel lens with higher gain >>> Select PIR SENSOR with higher gain

Ⅲ. Note of Cautions for Design

1. Requirement for PIR SENSOR：

   The PIR SENSOR is the core component and is critical to the overall performance. It is recommended to use RE200B made by Nicera, which exhibits excellent performance after extensive production grade testing and matches well with TTY020. PIR SENSORs made by other manufacturers are not recommended due to concerns of compatibility issues. RE200B is two device infrared sensor, with the two sensing units arranged in tandem along the length direction of the rectangular mount. Only when the object is moving along the left/right direction can the PIR SENSOR have the best infrared reception and the best sensitivity. The difference in the ensued sensing distance with different probe head directions can be up to 2~3 times.

2. Requirement for Power Supply：

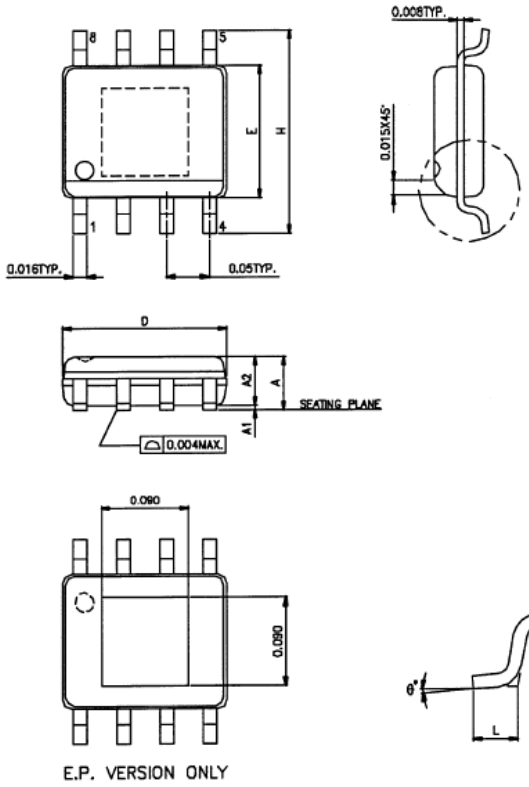
   Since the PIR amplifier is amplifying the analog signal, any interference can be amplified together with the normal signal, leading to false actions. Therefore, power supply with high stability is required. In the circuit design, it is demanded to include LDO for voltage stabilization. In addition, branching of node current must be strictly followed in the layout of copper circuit to avoid overlap of currents between the amplification circuit and other loads, which can cause repeated triiggering. Only LDO with output voltage of 2.4~5V can be used for TTY020 and please observe the voltage rating limit.

3. Requirement for the Fresnel Lens：

   The Fresnel Lens also has significant effect on the circuit gain. Use of lens with incorrect specifications may cause error in the sensing distance up to 100%. The focal distances of various Fresneal lenses are different. The sensing window of PIR SENSOR is preferred to be centered on the focal point to achieve the best sensing distance.The focal distance of Fresnel lens can be found the speficitaion book provided by the corresponding manufacturer.

Descriptions of packaging

- **SOP 8 pins**



SYMBOLS	MIN.	MAX.
A	0.053	0.069
A1	0.004	0.010
A2	–	0.059
D	0.189	0.196
E	0.150	0.157
H	0.228	0.244
L	0.016	0.050
θ°	0	8

UNIT : INCH

NOTES:
1. JEDEC OUTLINE : MS-012 AA / E.P. VERSION : N/A
2. DIMENSIONS "D" DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS.MOLD FLASH, PROTRUSIONS AND GATE BURRS SHALL NOT EXCEED .15mm (.006in) PER SIDE.
3. DIMENSIONS "E" DOES NOT INCLUDE INTER-LEAD FLASH, OR PROTRUSIONS. INTER-LEAD FLASH AND PROTRUSIONS SHALL NOT EXCEED .25mm (.010in) PER SIDE.

Ordering Information

TTY5001

Package Type	Chip Type	Wafer Type
TTR011(D)-FO8N-P002	–	–
TTY020-CA6（SOT23-6）	–	–