PIR Human body infrared sensing control chip

Descriptions of Product

- TTY5002 is the standard control solution specifically designed for PIR sensing the LED control with features such as detection of ambient brightness, optional delay of off time, and selection of 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 PIR pin of TTY5002 to detect the PIR sensing signal.

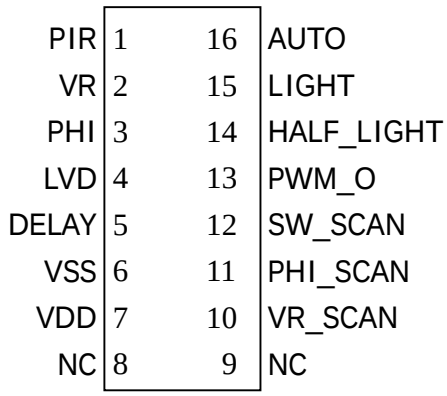
Features of the Product

- Operating Voltage：2.4V - 5.5V
- 9 delays of off time available for selection
- 3 work modes are available：Full Brightness, Half Brightness, and Auto Sensing
- Ambient brightness sensing is provided to identify the daytime and night time modes, with 9 adjustable levels of ambient brightness threshold
- Auto sensing mode and dimming on/dimming off brightness mode are available
- All parameters can be adjusted when the power is still on. No need to turn off the power for adjustment
- Capable of detection of low voltage/capacity

Product Applications

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

Pin diagram of packaging



SOP16-HOB

Pin Definition

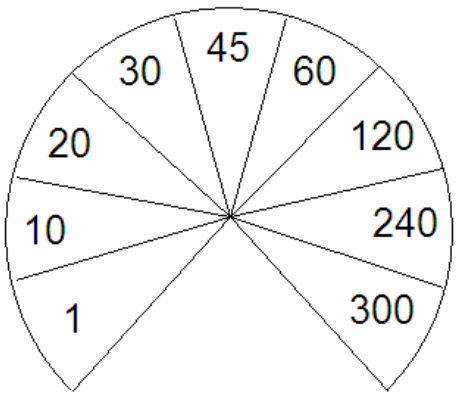
Pin	Pin Name	Type	Descriptions of Function
1	PIR	I	Input signal for PIR triggering, effective for low voltage level
2	VR	I	Adjustment of Ambient Brightness Threshold
3	PHI	I	Ambient brightness sensing is done by comparing to the electrical level of VR pin, where higher means the night time mode while lower means the daytime mode. The debounce time is 2 seconds
4	LVD	I	Electrical voltage/capacity detection. Capacity is low when the voltage is below 10/16VDD and the output is turned off immediately
5	DELAY	I	Adjustment of delayed off time, with 9 levels for selection
6	VSS	P	Negative terminal of power supply
7	VDD	P	Positive terminal of power supply
8	NC		
9	NC		
10	VR_SCAN	O	Scanning port of VR setting, read data at low voltage level
11	PHI_SCAN	O	Scanning port of CDS, read data at low voltage level
12	SW_SCAN	O	Scanning port of work mode, read data at low voltage level
13	PWM_O	O	Output control, effective at high voltage level
14	HALF_LIGHT	I	Manually set to half brightness mode, read is effective at low voltage level
15	LIGHT	I	Manually set to full brightness mode, read is effective at low voltage level
16	AUTO	I	Manually set to auto sensing mode, read is effective at low voltage level

Pin Type

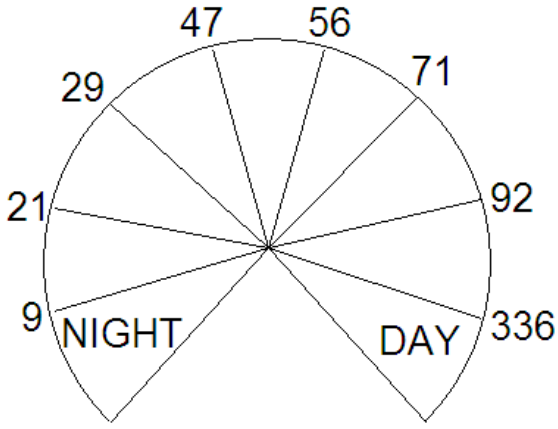
- I Input
- O Output
- P Power supply

Settings of VR and DELAY：

AD value	DELAY time（second）	VR brightness threshold（Lux）
0	1 second	NIGHT
1 or 2	10 seconds	9 - 21
3 or 4	20 seconds	21 - 29
5 or 6	30 seconds	29 - 47
7 or 8	45 seconds	47 - 56
9 or 10	60 seconds	56 - 71
11 or 12	120 seconds	71 - 92
13 or 14	240 seconds	92 - 336
15	300 seconds	DAY



Delay time VR
(Unit : sec)



Lux VR
(Unit : lux)

Descriptions of work mode：

- HALF_LIGHT：When the function switch selects this mode, the output of the LED is at 50% of the PWM signal.
- LIGHT：When the function switch selects this mode, the output of the LED is High.
- AUTO：PIR auto mode

  When the function switch selects this mode, the LED output is controlled by PIR and works as follows：

  1. Once PIR is triggered, the LED starts from OFF → brightness dimming on in 4 seconds → full brightness
  2. Once PIR is triggered, the LED starts from full brightness → brightness dimming off in 4 seconds → OFF
  3. Delay time for full brightness can be set by VR with 9 options：
     including 1 second、10 seconds、20 seconds、30 seconds、45 seconds、60 seconds、120 seconds、240 seconds、and 300 seconds
  4. In the process to full brightness, if the PIR remains triggered, the countdown of delay time will be reset
  5. In the 4 seconds of dimming off brightness, if PIR is triggered again, the LED become fully bright from dimming on bright
  6. During the detection of ambient brightness, if daytime is determined, PIR triggering is ineffective
  7. During detection of ambient brightness, the condition to determine
     Whether it is daytime or night time can be set by VR, with 9 Lux levels
     When VR is turned to “NIGHT” （V=VDD）, the system determines it is night time regardless of the lux reading of the ambient brightness
     When VR is turned to “DAY” （V=0V）, the system determines it is daytime regardless of the lux reading of the ambient brightness

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		

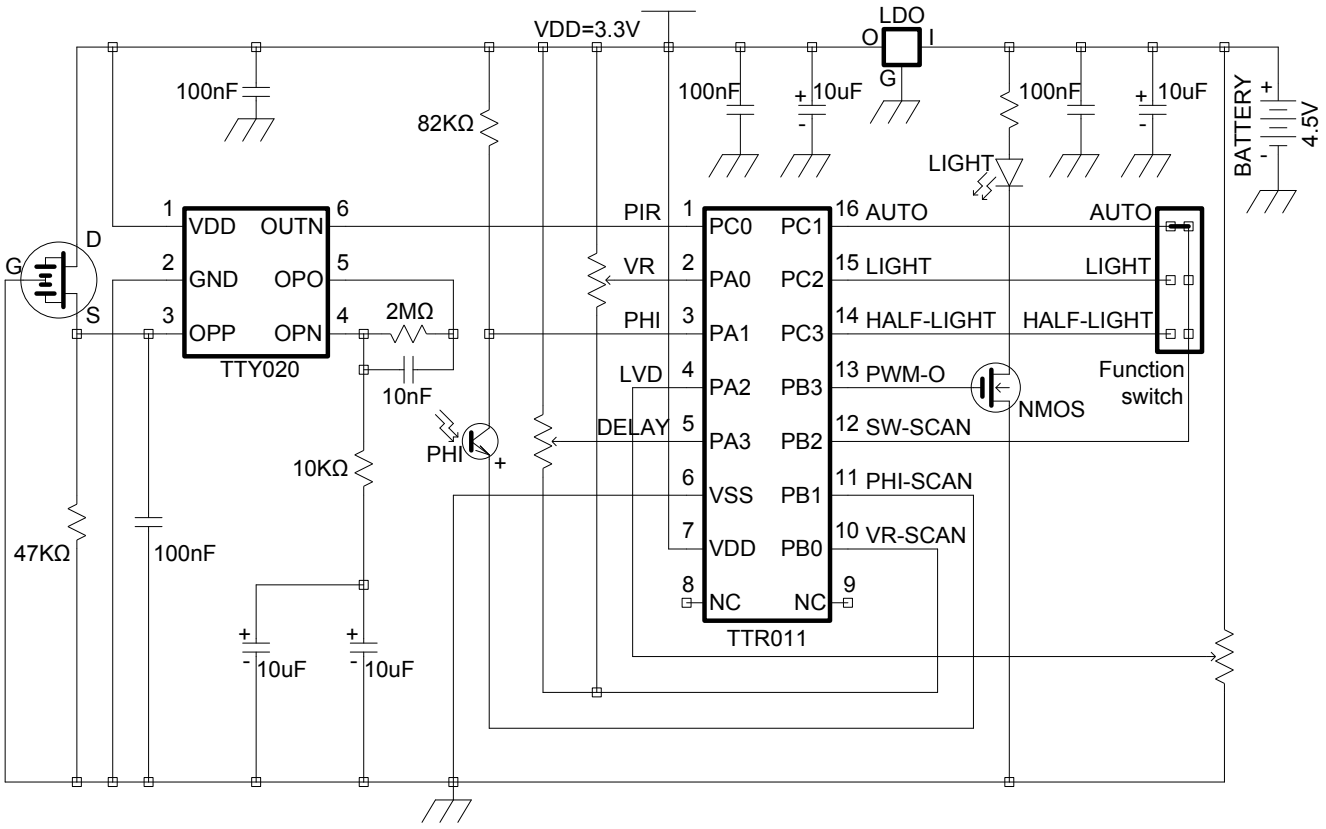
- **D.C. Characteristics**

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）X 256	-	17	-	ms
Wake up time	Wake up time to low power mode =（OSCL startup time）+（1/OSCL）X 4	-	1	-	ms
	Wake up time to normal mode =（OSCH startup time）+（1/OSCH）X 4	-	1	-	ms
（VDD=3V, ambient temperature is 25℃）					

Diagram of Application Circuits



TTY5002 + TTY020 Application Circuit

Standby Current：< 50uA / VDD=3.3V

Sensing Distance：>10m

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

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 ensuing 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 the 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：

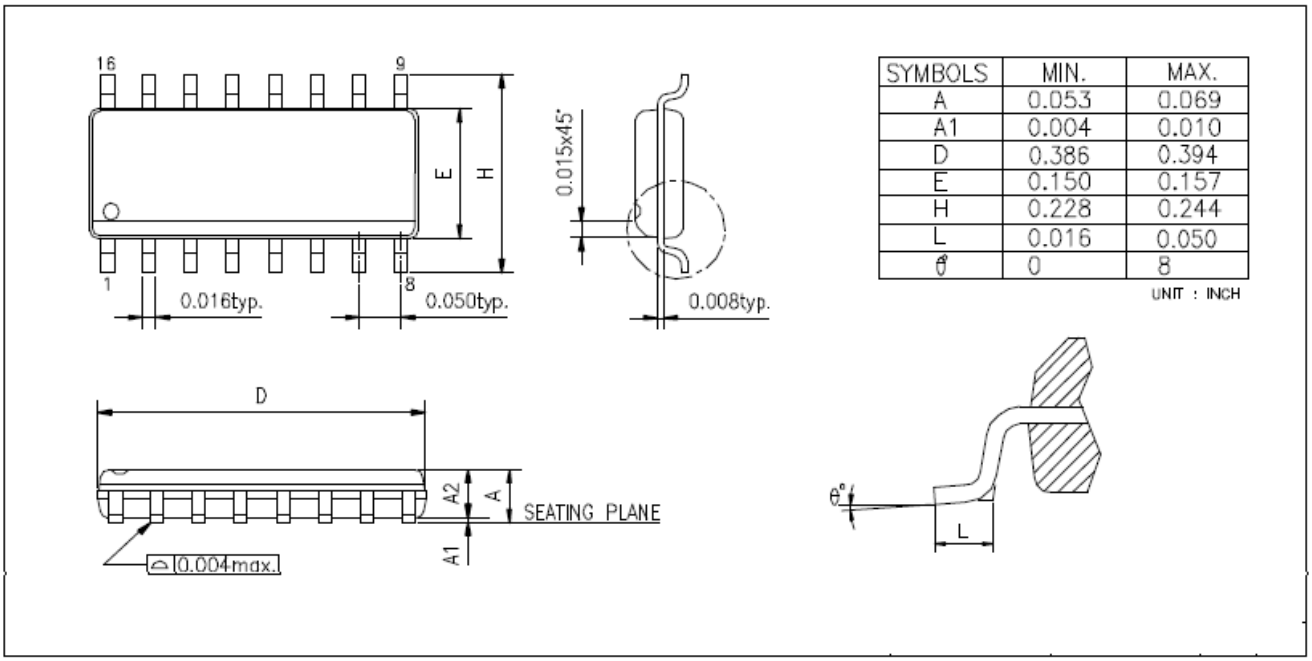
   The Fresnel Lens also has significant effect on the circuit gain. Use of a lens with incorrect specifications may cause errors in the sensing distance up to 100%. The focal distances of various Fresneal lenses are different. The sensing window of PIR SENSOR is preferred to be centered on the focal point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

4. Requirement of Circuit Gain：

   The OPP, OPN, and OPO of TTY020 can be treated as an independent operational amplifier. Since it operates in 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.

Descriptions of Packaging

- **SOP 16 pins**



SYMBOLS	MIN.	MAX.
A	0.053	0.069
A1	0.004	0.010
D	0.386	0.394
E	0.150	0.157
H	0.228	0.244
L	0.016	0.050
θ	0	8

UNIT : INCH

Ordering Information

TTY5002

Package Type	Chip Type	Wafer Type
TTY020-CA6 (SOT23-6)	—	—