APPLICATION NOTE

Analog ambient light sensor application note

1. Introduction：

Ambient light sensor (ALS) can sense light source similar to the human eye. ALS application product on, off or automatically are determined by light source information to reach the goal of power saving and safety.

Analog ALS basic component can divide into four different groups:

1. Photo Transistor
2. Photo Diode
3. Photo Darlington Transistor
4. PDIC (Integration of Photo Diode plus amplifying circuit)

2. Basic application circuit – choosing resistor and capacitor:

Analog ALS output is photo current that is depend on illuminance change. The simplest way to change from photo current to ambient light illuminance value is using figure 1 circuit to let photo current change to output voltage Vout and convert into ambient light illuminance (Lux). The load resistor R_L from Figure 1 can affect the usage of maximum ambient light range, with R_L plus C_L form integrator can decrease ambient light ripple (flicker).

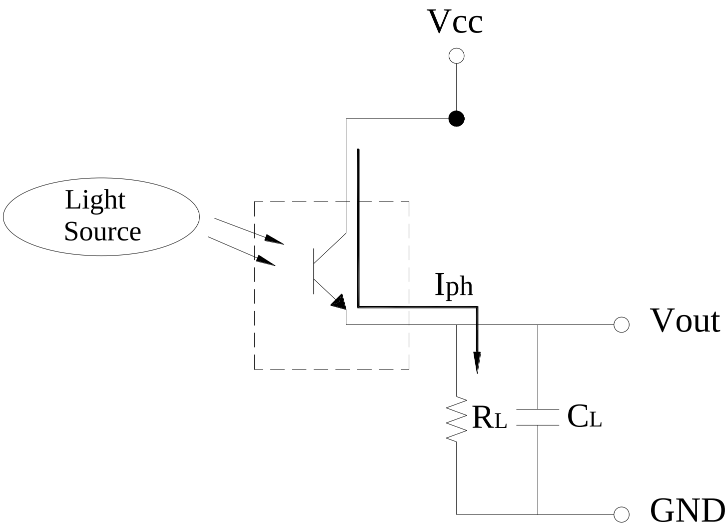

Figure 1 photo current covert into output voltage circuit

In figure 2, due to PDIC has operational amplifier that is recommend put R_L in Vout region. If R_L is between VDD and Vcc, when photo current change that voltage drop from R_L will cause amplifier voltage instability from IC.

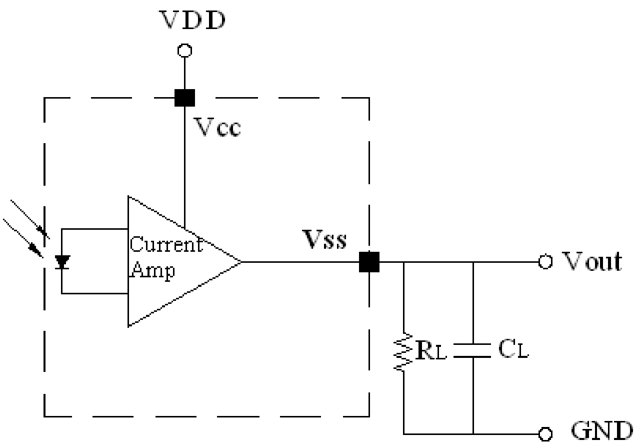

Figure 2 PDIC block diagram and recommend circuit

Recommend R_L choosing as follow:

- Prepare ALS sample (note 1) close to specification typical photo current, illuminometer and maximum light source Lmax.
- Use 150% Lmax light source to irradiate ALS (note 2).
- Change R_L value (note 3) to find saturated output voltage Vo(sat) (note 4).

- Gradually decrease light source to 0 Lux and record Vout change.
- Draw similar to figure 3 Vout V.S. Lux graph, so easier to find output voltage to correspond illuminance value.
- Let ALS operate in linear region(before close to saturated output voltage, there will be a small region of output voltage become non-linear)

Note 1: Even same illuminance value that every ALS have different photo current, this variation range can be reference to light current sections of specification.

Note 2: If cover lens is in front of ALS, that illuminance value ALS receive will depend on cover lens transmittance decay, when measure please put ALS into mechanism to test.

Note 3: If R_L is larger than 500kΩ and not saturated, is recommend change to larger output photo current ALS model.

Note 4: ALS maximum saturated output voltage Vo(sat) value can be reference to saturation output voltage in specification.

Let R_L = 7.5kΩ line from figure 3 as example, under 1100 lux is best to operate maximum ambient light. Please note that 0 Lux will have small output dark current to make minimum output voltage not equal to 0 volt, this dark current will increase as temperature increase, so illuminance is bit different when under 10 Lux (note5) and over 60℃ verse when is 25℃. ALS saturation output voltage smaller than supply voltage Vcc.

Note 5: Dark current change is fixed, when low illuminance occur and output photo current is small, dark current will have large effect. If output photo current is higher, dark current will have less effect.

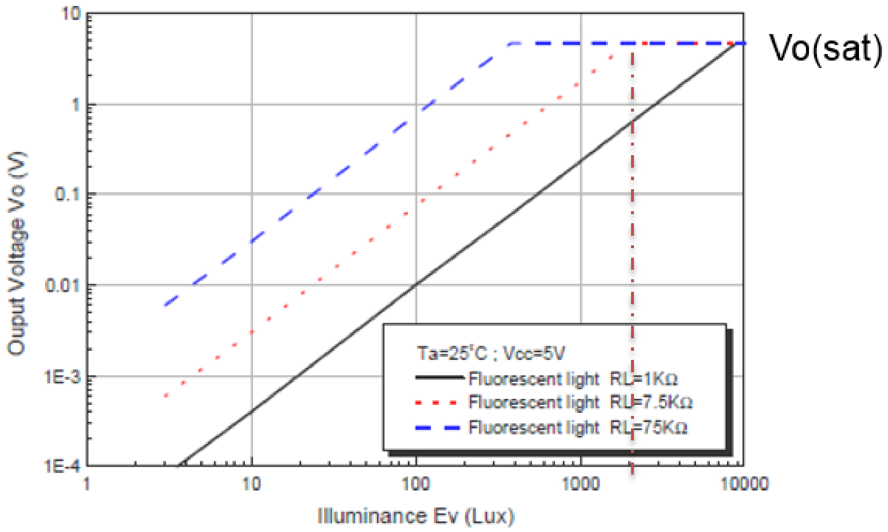

Figure 3 Light to electric convert graph

When R_L is set than choose capacitor C_L. Normal fluorescent lamp usually operate frequency is two times of power supply frequency which is 100Hz or 120 Hz (period time is 10ms or 8.33ms). To reduce ripple effect, RC circuit discharge time should be larger than period time, the recommend discharge time should be larger than 200ms and maximum value is depend on customer require speed. C_L is recommend to be ≧ 200m / R_L.

3. Other application

Figure 4 is three common process of light convert to electric, the easiest circuit application is mention pervious chapter. This circuit can be easily design, but every ALS has variation in light convert to electric, so this is only for low accuracy light control circuit application.

To improve accuracy ALS Vout is connect to analog to digital convert (ADC) pin, so voltage signal is show by digital data.

If ADC is 10 bits, than every step of change is output ADC saturation voltage correspond to illuminance value dived 1023.

If need for higher accuracy, is suggest to use digital ALS (16 bits resolution), digital ALS can utilize register and algorithm to do gain, integrate time, light calibration, multi-point control and discontinuity etc. application.

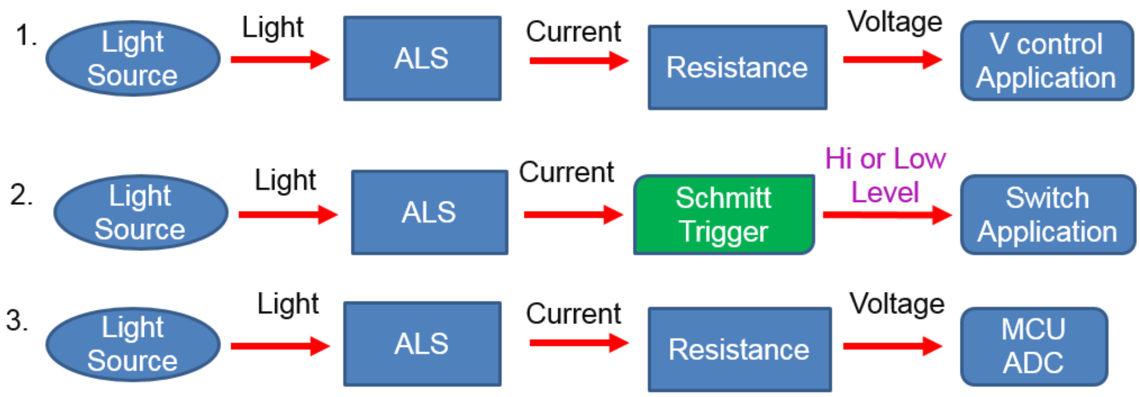

Figure 4 Light covert to electric application process

For switch application is recommend connect non- symmetrical schmitt trigger (figure 5) after ALS Vout, this circuit output only have high or low level and with resistor tuning to trigger level.

Below are some design examples:

If R1=R2=R3=10kΩ and Vref = 5V

When design high level switching voltage

Let V_{out}=0V => $V_A = \frac{R_2//R_3}{R_1+R_2//R_3} V_{ref} = 1.66V$

When design low level switching voltage

Let V_{out}=5V =>$V_A = \frac{R_3}{R_3+R_1//R_2} V_{ref} = 3.33V$

Vout respond as follow

When Vin <= 1.66V, Vout = V_H = 5V
When Vin >= 3.33V, Vout = V_L = 0V
When 1.66V < Vin <3.33V, Vout stay the same

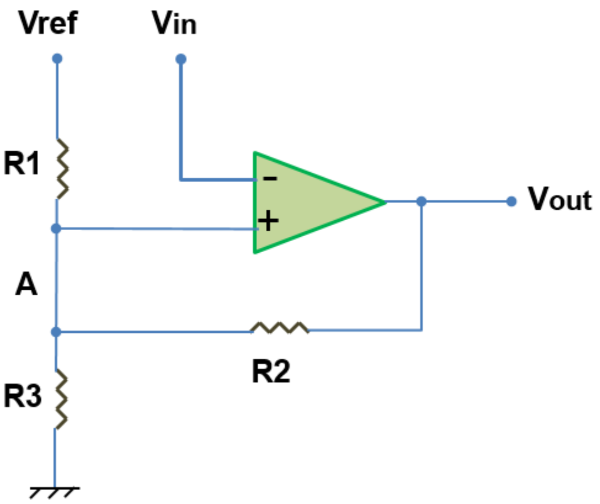

Figure 5 Non-Symmetrical Schmitt Trigger

The information in this application manual is only for customers' design reference. Please verify when actually use it. If have any other questions, please contact Everlight for further technical support.