

Ambient Light Sensor

More light, higher voltage. A phototransistor, not an LDR.



VCC sets the ceiling

In bright light SIGNAL climbs to about $V_{CC} - 0.4$ V. On an ESP32, ESP32-S3 or Pico, feed VCC from 3V3, never 5V: 5 V would put up to about 4.6 V on a 3.3 V analog pin.

Pins, and which to wire

Parts up, header at the bottom. Wire GND, VCC and SIGNAL; NC is connected to nothing on the board.

Phototransistor

Most sensitive to near infrared, 850 nm.

4.7 kΩ to GND

Turns the light's current into the voltage you read.

GND is the square pad

Count from it. The back prints no pin names.

Printed sun

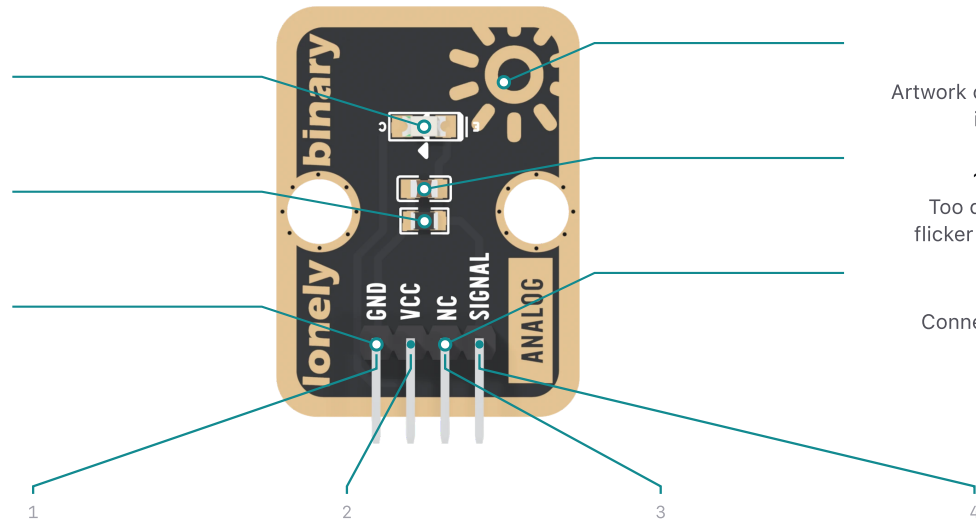
Artwork only. The sensor is the clear part.

100 nF, 0.47 ms

Too quick to hide the flicker of mains lamps.

NC

Connected to nothing on the board.



Front	GND	VCC	NC	SIGNAL
Read it	GND	VCC	•	SIGNAL

Not an LDR

Light makes a current, about $0.5 \mu\text{A}$ per lux, and the $4.7 \text{ k}\Omega$ turns it into a voltage. VCC does not change the reading; it only sets how high it can go.

What a room reads

Dim room, 10 lux

24 mV on
SIGNAL

About 5 on an Uno. An ESP32 may read 0: its ADC sees little below about 0.1 V.

Lit room, 300 lux

0.7 V on
SIGNAL

About 140 on an Uno: well under half, not the middle.

Daylight, bright

2.9 V, flat,
from 3.3 V

Stops rising near 1230 lux from 3.3 V, near 1960 lux from 5 V.

The numbers are not lux you can trust: one part can read 30 % above or below another, and sunlight or a filament bulb reads brighter than LED light that looks the same. Measure your own dark and lit, and set the threshold between them.

From the datasheet's typical photocurrent at 5 V, $5 \mu\text{A}$ at 10 lux to $50 \mu\text{A}$ at 100 lux; above 100 lux the line is extended, not measured. About 2 lux per count on an Uno. The ESP32 floor, about 43 lux, is illustrative.

A night light, set by your room

Arduino IDE · Board: your board · ESP32-S3: USB CDC On Boot: Enabled

```
// SIGNAL: Uno A0. ESP32 34. S3 4. Pico 26.
// TK01 LED: Uno 9. ESP32 4. S3 5. Pico 15.
const int LIGHT_PIN = A0, LED_PIN = 9;
float onBelow, offAbove;
bool lampOn = false;

float steady() { // average 50 ms: whole lamp cycles
  float sum = 0; long n = 0;
  unsigned long t = millis();
  while (millis() - t < 50) { sum += analogRead(LIGHT_PIN); n++; }
  return sum / n;
}

void setup() {
  Serial.begin(115200);
  pinMode(LED_PIN, OUTPUT);
  Serial.println("Leave the room lit..."); delay(3000);
  float lit = steady();
  Serial.println("Cover the sensor..."); delay(4000);
  float dark = steady();
  onBelow = dark + 0.4 * (lit - dark);
  offAbove = dark + 0.6 * (lit - dark);
}

void loop() {
  float r = steady();
  if (!lampOn && r < onBelow) lampOn = true;
  if (lampOn && r > offAbove) lampOn = false;
  digitalWrite(LED_PIN, lampOn ? HIGH : LOW);
  Serial.println(r, 0);
  delay(200);
}
```

143
141
4
Serial Monitor at 115200: the averaged reading. Cover the sensor and the LED lights; uncover it and it goes out.

Mains lamps flicker

The sensor answers in about 15 μ s, so under many LED and fluorescent lamps the reading ripples at 100 Hz (50 Hz mains) or 120 Hz (60 Hz). The 100 nF barely dents it. Average over 50 ms, which is 5 whole cycles of one and 6 of the other, and the ripple cancels. On an ESP32, read `analogReadMilliVolts()` instead of the raw count.

When it does not work

Reads 0 in a dim room

On an ESP32 that is its ADC's floor, not a dead sensor. Try more light, or an Uno or Pico.

The number jumps about

Lamp flicker. Average over 50 ms instead of reading once.

Sunlight reads far too bright

It sees near infrared best, 850 nm. Compare readings under the same kind of light.

Specifications

Sensor	XYC-PT21C-L1 phototransistor, 1206	Output	About 0.5 μ A per lux into 4.7 k Ω
At 100 lux	About 0.24 V, typical	Ceiling	About VCC – 0.4 V
Peak	850 nm, near infrared	Response	15 μ s; 0.47 ms filter
Supply	3.3 V or 5 V, the same as your board	Current	Under 1 mA at most

Wiring

	FRONT	UNO	ESP32	S3	PICO
1	GND	GND	GND	GND	GND
2	VCC	5V	3V3	3V3	3V3
3	NC				
4	SIGNAL	A0	GPIO 34	GPIO 4	GP26

Hole 1 is the square pad. The night light's LED goes on a second pin: D9 (Uno), GPIO 4 (ESP32), GPIO 5 (S3), GP15 (Pico). Keep its light off the sensor.