OPT101 Photodiode and CJMCU

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For the past few days, I've been searching for an easy-to-use photodiode module, and I found CJMCU's OPT101 Photodiode Module (CJMCU-101) this week. This is going to be a two-part article. In this post I will mainly give a quick review and in the next part I will share some do it yourself project ideas. First off, note that CJMCU-101 is just a compact breakout board for the far-famed OPT101 analog light sensor.

ANALOG LIGHT SENSOR OPT101

The OPT101 analog light sensor is a clever blend of a monolithic photodiode with an on-chip transimpedance amplifier. The integration of the photodiode and transimpedance amplifier on a single chip eliminates many issues commonly encountered in discrete designs, such as leakage current errors, noise pick-up, and gain peaking as a result of stray capacitance. The sensor is designed for single or dual power-supply operation and it can be operated from 2.7V to 36VDC. The output voltage increases linearly with light intensity!

KEY FEATURES

- SINGLE SUPPLY: +2.7 to +36V
- PHOTODIODE SIZE: 0.090 x 0.090 inch
- INTERNAL 1MΩ FEEDBACK RESISTOR
- HIGH RESPONSIVITY: 0.45A/W (650nm)
- BANDWIDTH: 14kHz at RF = 1MΩ
- LOW QUIESCENT CURRENT: 120mA

PIN FUNCTIONS

The OPT101 sensor is available in clear plastic 8-pin PDIP, and J-lead SOP. The 0.09 inch × 0.09 inch (2.29 mm × 2.29 mm) photodiode operates in the photoconductive mode for excellent linearity and low dark current.

CJMCU-101 QUICK LOOK

The CJMCU-101 is a simple breakout board for the OPT101 analog light sensor. Each unsoldered CJMCU-101 kit comes with the one sensor, a sensor board and a 6-pin header strip (I got a couple of them at a discount).

Sadly, CJMCU does not provide any useful technical leaflets but the schematic is simple and easily found online. Here is a copy from my lab diary.

Soldering the sensor on the sensor board obviously needs to be done with some care, that is to say, the index area of the sensor should be aligned to the marked area of the board (see below). You can also see a half-moon shape at the same end of the sensor if you've a good eyesight (ha ha)!

MYSTIC SMD SOLDER PADS

You have your module and you're ready to play with it. But what about the empty solder pads on the circuit board?

I'm almost sure CJMCU will not help you find it (there's unfortunately not much related tutorials on the web). Don't worry, see the below notes.

The C3 and C2 pads are for adding external power supply bypass capacitors

Excerpts from TI Datasheet: *The OPT101 is designed to operate from an input voltage supply range between 2.7V and 36V. Make sure the power supply input is well regulated. Place a 0.01-µF to 0.1-µF bypass capacitor with low-impedance, short connections between VS (pin 1) and –V (pin 3). If –V (pin 3) is not connected to Common (pin 8), place an additional bypass capacitor between VS (pin 1) and Common (pin 8).*

The CEXT and REXT pads are for adding an external

capacitor and resistor to change the responsivity

Excerpts from TI Datasheet: *To set a different voltage responsivity, connect an external resistor REXT. To increase the responsivity, place this resistor in series with the internal 1MΩ resistor (1) or replace the internal resistor with an external resistor (2) by not connecting pin 4. The second configuration also reduces the circuit gain below 106 V/A when using external resistors that are less than 1MΩ.*

You can tweak the responsivity by choosing one of the abovementioned configurations easily through the two-way solder pads (-IN C_R 1M) located at the bottom of the CJMCU-101 module.

In a nutshell:

- Changing responsivity with external and internal resistor

(1) = C_R + 1M Pads
- Changing responsivity with external resistor only (2) = -IN + C_R Pads

Note that -IN and 1M pads are wired to Pin2 and Pin4 of the OPT100 sensor respectively, and C_R is the “free” end of the CEXT-REXT feedback network. Below you can see the responsivity and bandwidth table. Now go to Page 9 of this BURR-BROWN datasheet (http://doc.chipfind.ru/pdf/burr-brown/opt101.pdf) to learn more about changing responsivity.

MY LITTLE TEST

When I started the quick test of my CJMCU-OPT101 module, I used a simple setup just for an approximate evaluation. The drawing below provides a better visual illustration of that bare minimum wiring scheme.

Below is a casual snap of my quick test setup wired on a mini breadboard.

Although the OPT101 sensor is capable of operating at a wide range of supply voltage, I decided to power my test setup through a well-regulated 5VDC power supply. This allows the output of the quick test setup to be directly connected to the I/O of any 5V MCU development boards such as Arduino Uno, as well.

The quick test was performed using a 1W Cool White LED Torch and a 100mW Green Laser Pointer as the light source. A digital multimeter then measured the output values (offset

neglected).

Here are the quick test results (hope my benchtop digital multimeter did not deceive me):

LIGHT SOURCE	OUTPUT VALUE
DARK OUTPUT	NEGLIGIBLE
ROOF LAMP (far-off)	~1.5V
WHITE LED TORCH & GREEN LASER (closer)	~ 4.25V

As observed, the output never goes above 4.25V. However, these are only approximate figures from my quick and dirty

experiments – you can proceed in your own way.

DOES IT WORKS WITH ARDUINO & RAPSBERRY Pi PICO?

Yes, it supports both Arduino and Raspberry Pi Pico. This is an analog light sensor and Raspberry Pi Pico does have ADC inputs, so it will work for Raspberry Pi Pico directly. I'm quite happy that this analog light sensor is capable of running at both 5V and 3.3V as it makes interfacing with today's 3.3V MCUs a lot easier. The broad scale of the default analog voltage output (from zero to slightly below the supply level) is another positive.

QUICK SUMMARY

Overall, I like the OPT101 analog light sensor (and the CJMCU-101 module) a lot. It meets most of what I was searching for. Many of those benefits come from the clever integration of the monolithic photodiode and on-chip transimpedance amplifier.

- Works with both 5V and 3.3 Microcontrollers
- Very low quiescent current consumption
- Reliable analog output
- Compact size
- Cost-effective

I look forward to testing it out for some hobby-grade light sensor projects. Stay tuned...