

How to Select an Ambient Light Sensor for Your End Equipment



Introduction

Generally, when someone thinks of trying to design a system with an ambient light sensor there are four main concerns or problems that need to be addressed. The most important features of an ambient light sensor are spectral response, power, size, and range of lux measurement.

Selection

In many applications, ambient light sensors are used to set the display brightness based on the surrounding light conditions or variables. These use cases need light measurement at specific wavelengths such as spectroscopy and ultra-violet (UV) measurement. The ambient light sensor is used to measure optical energy at a specific wavelength or specific bands of wavelengths of light spectrum. The goal is to improve the visual experience to make it the most comfortable. It is important to regulate lighting based on surrounding variables to improve user experience (mobile displays, thermostats, and more). This is also critical to ensure safety in applications such as automobile center stack and heads up displays (HUD), where too bright is distracting and too dim is dangerous.

In some applications the spectral response of the sensor must tightly match the photopic response of the human eye and include significant infrared rejection. Applications that need human eye response are things such as IP cameras, tablets, thermostats, and wearables. Some applications do not need human eye response, but instead can use a wide spectral bandwidth. For example, applications like video doorbells (Figure 1) or indoor lighting sometimes use a wide spectral bandwidth. The [OPT3002](#) has a wide spectral bandwidth, ranging from 300 nm to 1000 nm. The [OPT3001](#), [OPT3006](#), and [OPT3007](#) have human eye response.

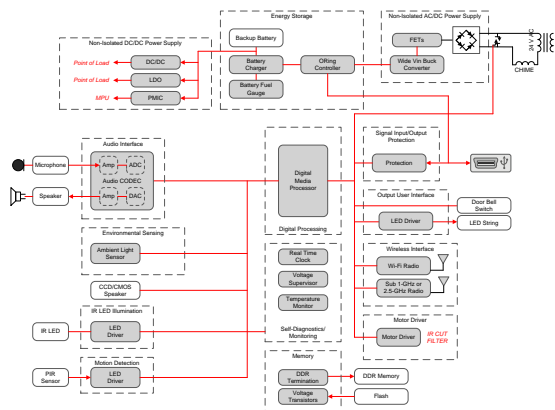


Figure 1. Video Doorbell Block Diagram Example

Regardless of the environment an ambient light sensor is designed to be used in, a goal will always be to extend battery life. Displays consume approximately 30 to 40% of the power budget in most equipment, which is critical in wearables, mobile units, tablets, other devices because these applications run on battery 90% of the time. Controlling display intensity based on ambient conditions can help conserve power. The lifetime of the display can also increase by running at lower power. One feature of the [OPT3002](#) is the ultra-low power at approximately 2 μA . Power consumption is very low, allowing the [OPT3002](#) to be used as a low-power, battery-operated, wake-up sensor when an enclosed system is opened.

The next important consideration when designing an ambient light sensor into a system is size. For personal electronics industry (smart phones, notebook PCs, tablets, etc.) small form factor is extremely important since the applications are generally in a small enclosure. The [OPT3007](#) has a nominal body size of 0.856 mm \times 0.946 mm \times 0.226 mm and comes in a picostar package. The four pin (six pins total, but four active) package enables the PCB designer to create a bigger opening to the active sensor area. The next device TI offers the [OPT3006](#), which is differentiated from the [OPT3007](#) by adding two more pins of functionality. The [OPT3007](#) has a fixed addressing scheme and the [OPT3006](#) has an ADDR pin that sets the LSBs of the I2C address. The [OPT3006](#) also has an interrupt pin and the [OPT3007](#) does not. Both parts are the same size and come in the picostar package.

The final consideration needed for designing an ambient light sensor is the range of lux measurement that can be measured. The [OPT3002](#) has a wide spectral bandwidth, ranging from 300 nm to 1000 nm. Measurements can be made from 1.2 nW/cm² up to 10 mW/cm² without the need to manually select the full-scale ranges by using the built-in, full-scale setting feature. This capability allows light measurement over a 23-bit effective dynamic range. The results are compensated for dark-current effects, as well as other temperature variations. For the [OPT3006](#), [OPT3007](#), and [OPT3001](#) measurements can be made from 0.01 lux up to 83k lux without manually selecting full-scale ranges by using the built-in, full-scale setting feature. This capability allows light measurement over a 23-bit effective dynamic range.

Conclusion

In summary, the main considerations for designing an ambient light sensor into a system are spectral response, power, size, and measurement range. The OPT300x devices are sensors that measure the intensity of visible light and are suitable for display applications. The spectral response of the sensor tightly matches the response of the human eye, includes significant infrared rejection, has ultra-low power, and small size options. The [OPT3002](#) differs by having an optical range of 300 nm to 1000 nm and no human eye response. The [OPT3001](#), [OPT3001-Q1](#), [OPT3006](#), and [OPT3007](#) are single-chip lux meters, measuring the intensity of light as visible by the human eye. The precision of the spectral response and strong IR rejection of the device enables the devices to accurately meter the intensity of light as seen by the

human eye, regardless of light source. The strong IR rejection also aids in maintaining high accuracy when industrial design calls for mounting the sensor under dark glass for aesthetics. These parts are designed for systems that create light-based experiences for humans, and an ideal preferred replacement for photodiodes, photoresistors, or other ambient light sensors with less human eye matching and IR rejection.

To summarize the parts, please refer to the following table.

	OPT3002	OPT3007	OPT3006	OPT3001	OPT3001-Q1
Optical Range/Filter	300 nm to 1000 nm	Human Eye	Human Eye	Human Eye	Human Eye
ADC	23-Bit Effective Dynamic Range	23-Bit Effective Dynamic Range	23-Bit Effective Dynamic Range	23-Bit Effective Dynamic Range	23-Bit Effective Dynamic Range
Current Consumption	1.8 μ A	1.8 μ A	1.8 μ A	1.8 μ A	1.8 μ A
Supply Range	1.6 V to 3.6 V	1.6 V to 3.6 V	1.6 V to 3.6 V	1.6 V to 3.6 V	1.6 V to 3.6 V
Package	USON6 (2 mm x 2 mm)	PICOST AR(6) (YMF): 4 Active	PICOST AR(6) (YMF)	USON6 (2 mm x 2 mm)	USON6 (2 mm x 2mm)

Related Documentation

- Order the [OPT3001 evaluation module \(EVM\)](#)
- Order the [OPT3002 evaluation module \(EVM\)](#)

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