Application Note

AN001020

Proximity Calibration Using POFFSET

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Content Guide

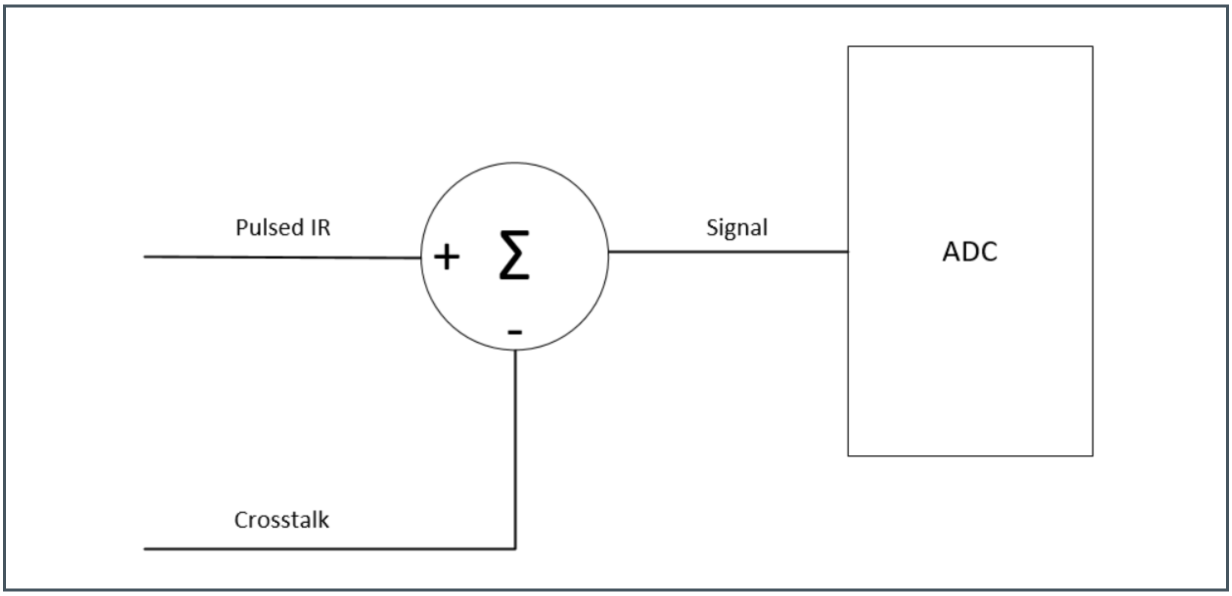
1 Introduction

A device with the proximity function measures the amount of reflected IR light at the IR photodiode detector.

This IR light is a combination of ambient IR energy and reflected IR energy from a pulsed emitter. The reflected IR energy is made up of IR energy reflected from a target plus unintended IR reflections from the optical stack and from within the device itself. These unintentional IR reflections are referred to as crosstalk. The amount of optical crosstalk is determined by measuring the reflected IR pulse energy without a target being present (i.e. open-air crosstalk).

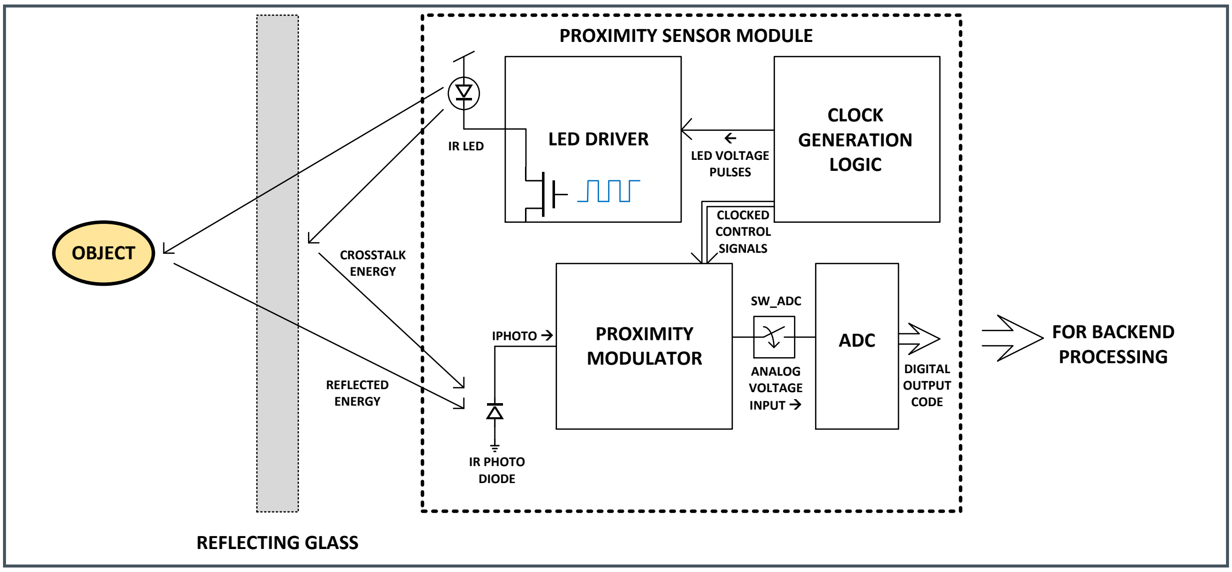
The crosstalk can be subtracted from the pulsed IR energy to leave behind the signal reflected from the target. A simple illustration of this is shown in Figure 1.

Figure 1:
Crosstalk Subtraction Block Diagram



The process of subtracting the estimated crosstalk offset voltage at the ADC input is called proximity offset calibration.

Figure 2:
Proximity Sensor Architecture



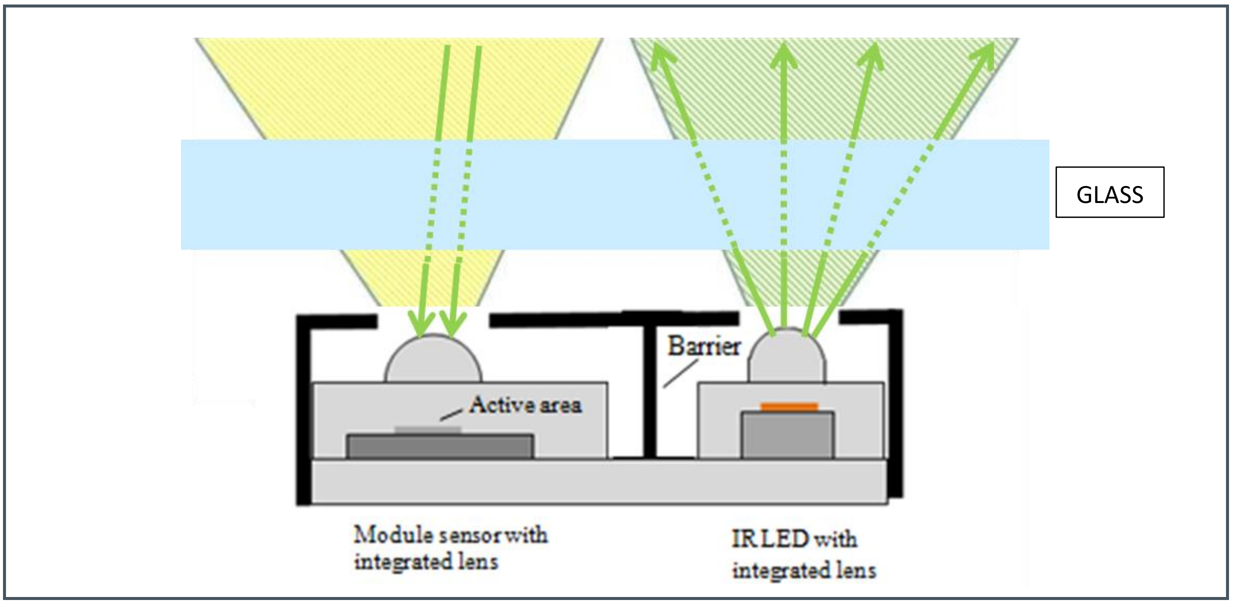
The purpose of this application note is to explain the process of proximity offset calibration within the system.

2 Proximity Response

2.1 Reflective Light

In an ideal world 100% of the pulsed IR energy would pass through the glass, 100% would reflect off the target (with no absorption) and 100% would return to the sensor no amount of propagation loss. There would be zero offset in the device and no optical crosstalk. However, it is a non-ideal world.

Figure 3:
Ideal System



Due to mechanical alignment, air gap, glass thickness, glass physical characteristics (reflection, scattering, absorption, etc.) and other phenomena, the pulsed IR energy does not behave in an ideal manner.

Figure 4:
Simplified Optical Reflected Light

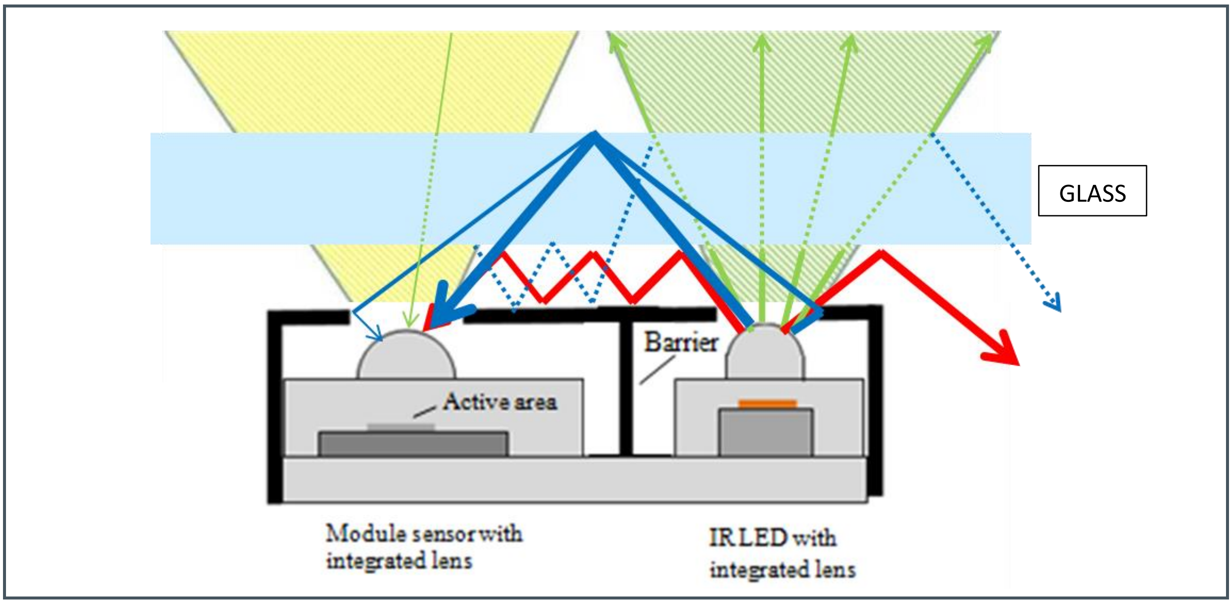


Figure 4 is a highly simplified diagram of reflective light in a real-world system. Fresnel reflection and refraction occurs whenever light enters or exits the glass, but is not shown in this picture. Attenuation happens with every reflection. Due to the small distance between the sensor and IR LED/VCSEL this induces crosstalk.

3 Proximity Calibration

3.1 Offset Calibration

A calibration starts with user settings for gain, pulse length, number of pulses, drive current. Then the resulting no-target ADC value is used to determine the amount of crosstalk. Upon completion of the offset calibration process, the resulting offset value is stored in the **POFFSETx** registers.

Before starting, the flags in **CALIBSTAT** get cleared automatically by clearing the cien interrupt by writing '1' to **STATUS.cint**.

1. Remove the target from above the device.
2. User sets the **CALIBCFG2.binsrch_target**.

   The target value is configurable in **CALIBCFG2.binsrch_target** – on one hand one would like a value that is close to zero, on the other hand one would like to prevent measuring too many zeroes (PDATA=0) during regular run time (as PDATA=0 cannot distinguish whether it's 'just' zero, or whether it's actually quite negative).

   NOTE: The CALIBCFG2.binsrch_target value sets the PDATA value that the calibration attempts to achieve.

3. User sets the **CALIB.start_offset_calib** bit to start calibration.
4. When cien is asserted, **CALIBSTAT** will show the result details.

   The calib_finished bit must be asserted, otherwise there was an error.

4 Summary

The calibration process includes optimizing the proximity configuration parameters, determining acceptable detect and release thresholds while balancing the tradeoffs between power consumption, noise, and performance. This is an iterative process.

5 Glossary

IR – Infrared

CIEN – Calibration Interrupt Enable

LED – Light Emitting Diode

VCSEL - Vertical-cavity surface-emitting laser

6 Reference Documents

For further information, please refer to the following documents:

- AN000556: Proximity Detection: Optimizing Proximity Parameters

7 Revision Information

Changes from previous version to current revision v1-00	Page
Initial production version	

- Page and figure numbers for the previous version may differ from page and figure numbers in the current revision.
- Correction of typographical errors is not explicitly mentioned.

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