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Temperature and Ambient Light Data Collection

Abstract

The ISL29501 has the ability to do real time correction of distance measurements due to changing temperature and ambient light conditions. To best serve our initial customers Intersil will create correction coefficients based on collected data taken in the end application. To make this process efficient the data will need to be delivered in a standardized format, which is described in this document.

Advanced Calibration Process

These are the required steps in the advanced calibration process.

1. Data is collected for phase while a single independent variable is changed. At this time, supported variable types are die temperature and ambient light. The ISL29501 has separate 8-bit registers for each of these. Phase is collected along with the ISL29501 measured temperature or ambient light data.
2. At Intersil, a graph is made of phase vs the independent variable. A least squares curve fit to a 2nd order polynomial is generated from the data. The process involves creating an Excel trendline. The resultant curve has the form of Ax2 + Bx + C. From the Excel curve the A and B coefficients are calculated and converted into the correct hexadecimal format.
3. The values for A, B and an exponent are emailed back to the customer who programs them into the correct registers. These values need to be programmed into the ISL29501 each time the chip is power cycled. They can be left at the default (0x00), which does no correction.
4. The final constant C will come from the standard distance calibration. Distance calibration is the reference point where all errors should be nulled. At the time of distance calibration a reference temperature needs to be written into the chip. The user reads register 0xE2 and needs to write this result into 0x31. For high integration time settings the temperature will change while running the distance calibration routine. The best way to compensate for this is to average the temperature value in the distance calibration routine and write the average into 0x31 at the end. For many circuit board designs it is acceptable to read only a single temperature during the last measurement in distance calibration.

Collecting Data

Temperature and ambient light are two independent sweeps, these cannot be done at the same time. The user should start from “power on” conditions and then program the emitter current and integration time. Before collecting data all 3 standard calibrations should be performed or values loaded from a previous calibration. All registers from 0x31 to 0x52 should be at the default (power-up) state of 0x00. Temperature should be varied in an oven so the emitter and photodiode change along with the ISL29501 chip. A heat gun should not be used as it is unlikely to produce a representative temperature gradient. A good technique is to ramp the temperature from the minimum to the maximum over ~5 minutes recording 1 - 5 distance measurements per second. About 80% of temperature drift in caused by the photodiode. In an oven it is best to use a black target, ~10% to minimize the amount of reflections inside the oven. The target should be sized and the board aligned so that beam completely strikes the target.

CSV is the required data format. The application software needs to output 3 registers separated by a comma. The order is not important. The required registers are listed below:

1. Temperature - registers 0xE2, 0xD8, 0xD9
2. Ambient Light - registers 0xE3, 0xD8, 0xD9

In all cases, the independent variable (temperature or ambient light) should be swept across the anticipated range of the application. A good target is a minimum of 10 measurement steps and at least 100 measurements made at each step. More data points are better so that noise is averaged out.

In ambient light data sweeps it is important that the temperature remains constant. If that cannot be guaranteed, the temperature coefficients should be generated and programmed into the chip prior to collecting data in the ambient sweep. To avoid self-heating of the board use low integration times (reg0x10 ≤ 0x02) to avoid raising the die temperature. The emitter (reg90 and reg91) should be programmed to the application condition. Both calibrations are independent and have separate coefficients. The user can choose to do either one or both or do one now and the other later. There is a single exponent that is shared by both sets of coefficients, which will also be provided.

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