DT0034
Design tip

VL6180X early convergence estimate implementation

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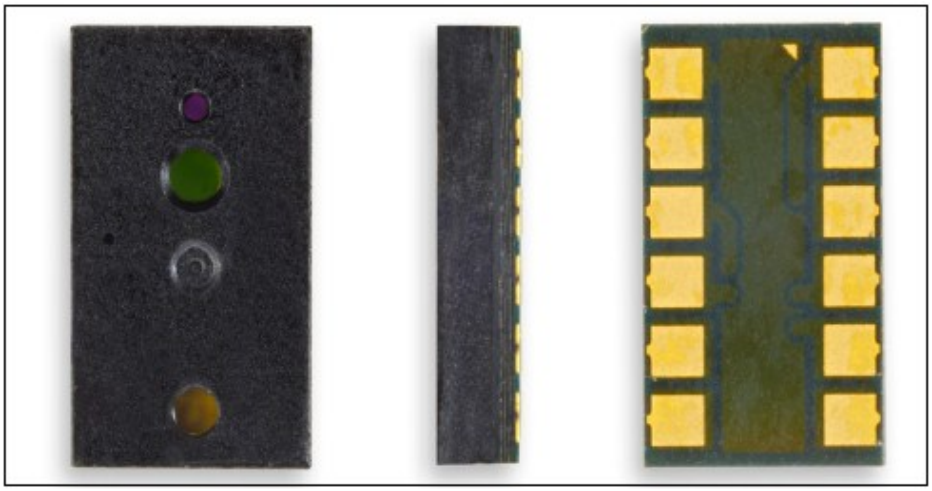
Main components	
VL6180X	Proximity and ambient light sensing (ALS) module

Purpose and benefits

This document explains how to implement the Early Convergence Estimate (ECE) feature of the VL6180X.

It is assumed that customers who use this document can communicate with the VL6180X through I^2C and are now looking for more information on how to implement the ECE feature in their application code.

Figure 1. VL6180X device



ECE Overview

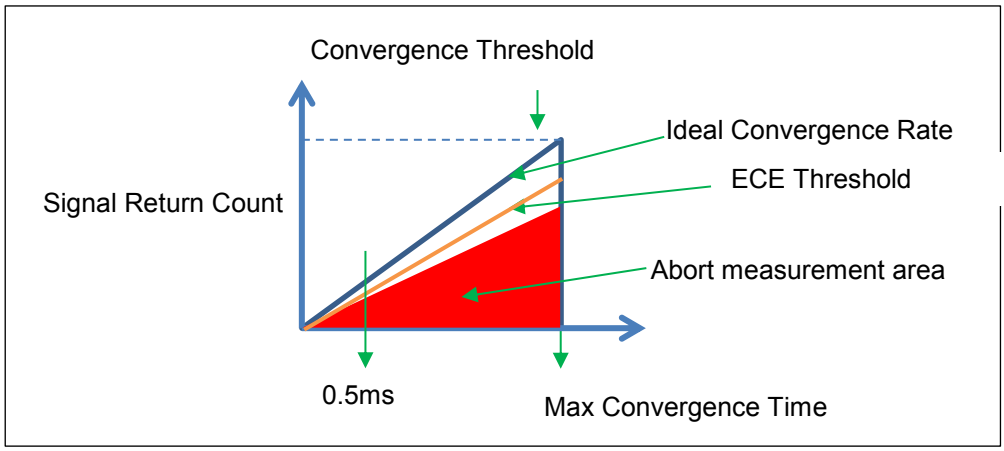
ECE refers to a feature within the VL6180X that allows for lower power consumption and will help in reducing the red glow that may be seen when the device is measuring the range without a target in the field of view. This feature works by calculating the rate of convergence 0.5 milliseconds after the measurement has been started. If the return count rate reported by the device is below the set ECE threshold, the measurement is aborted.

ECE Details and Description

The ECE threshold is a parameter set by the HOST system. This threshold is used by the internal ranging algorithms to decide to abort a measurement sooner if it seems there is no target in front of the sensor. To set the ECE threshold, an ECE factor which is decided by the user is chosen. In a normal use case, this would be an ECE factor of 80%, meaning if the counts received is 80% of the threshold, then the system will continue with measuring the distance and there is likely to be a measurement result.

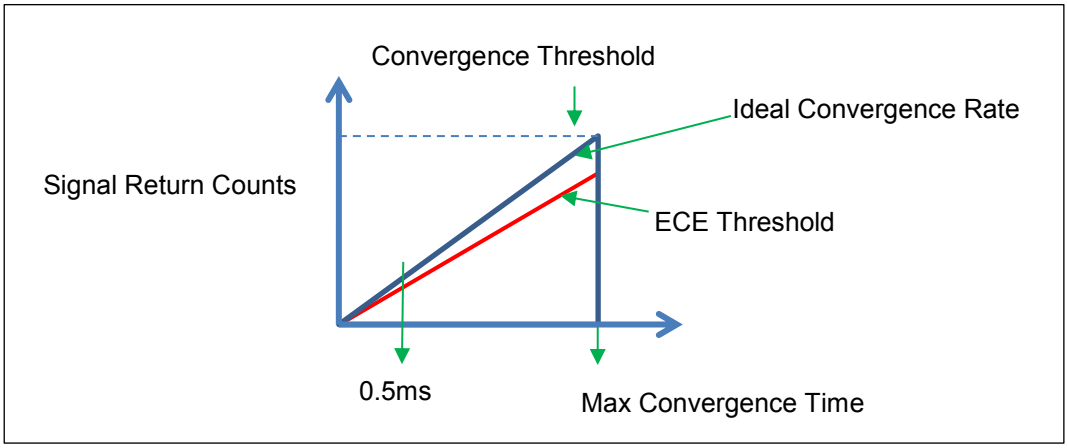
Figure 2 below gives an overview of some the key concepts with ECE.

Figure 2. ALS and Ranging Timeline



To expand on the ECE factor, if the user chooses an 80% ECE factor, the resulting ECE threshold result is shown in Figure 3 below. What this means is that the system will gather the return signal count and if these are above 80% of the ideal convergence rate after 0.5ms of the measurement starting then the system will allow the measurement to continue.

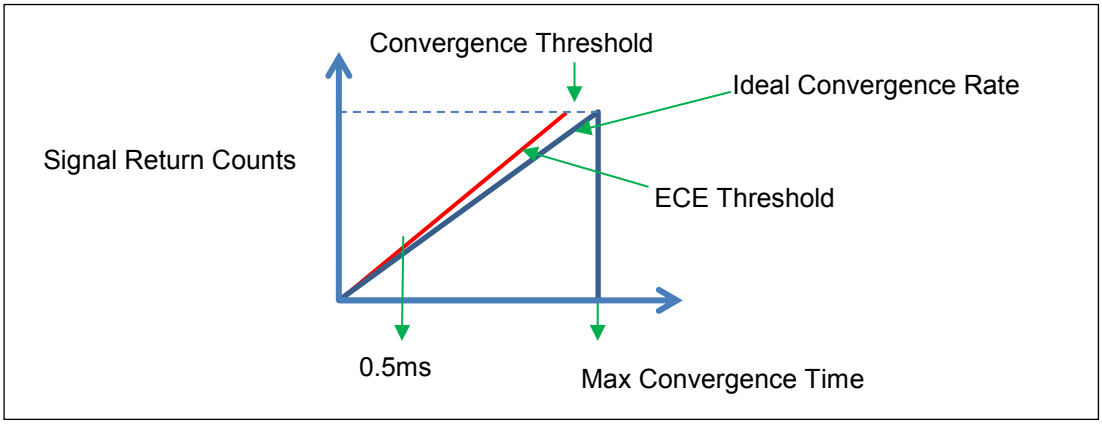
Figure 3. 80% ECE Factor



To give another ECE factor example, if the user chooses a 110% factor, the resulting ECE threshold result is shown in Figure 4 below. What this means is that the system will gather the return signal count and if these are above 110% of the ideal convergence rate after 0.5ms of the measurement start, then the system will allow the measurement to continue.

This is beneficial if the user wants to have much better power savings as it will only allow a measurement when there is a material or object in front of the sensor.

Figure 4. 110% ECE Factor



ECE Registers:

The following registers in Table 1 are used in the ECE operation.

Table 1. Overview of registers used in ECE feature

Register Name	Register Address	Description
SYSRANGE__RANGE_CHECK_ENABLES	0x02D	This register is used to enable the ECE feature of the VL6180X.
SYSRANGE__EARLY_CONVERGENCE_ESTIMATE	0x022	Early convergence estimate register. Value in this register defines the threshold that is used by the ECE algorithm. This is a two-byte value.
SYSRANGE_MAX_ CONVERGENCE_TIME	0x01C	This will define the maximum time allowed for a range measurement to complete. Note: The maximum time set cannot be more than the ALS inter-measurement period.
READOUT__AVERAGING_SAMPLE_PERIOD	0x10A	This register is used to specify the averaging sampling period that the VL6180X performs during each range measurement. This metric is required for the ECE threshold calculation.
SAMPLE_COLLECTED	0x109	This register dictates how many samples are collected for every range measurement average.

The registers shown in Table 1 are a subset of what is used in normal operation of the VL6180X. The user is advised to refer to the datasheet for further information on how to set up GPIO modes, interrupt conditions, and other functions of the VL6180X.

ECE Threshold Example

This example below gives an overview of how the ECE threshold is calculated and what is required to use the ECE threshold feature in the VL6180X.

To enable the ECE feature of the VL6180X, the ECE function needs to be enabled through the range check enable register. To do this, set bit[0] of SYSRANGE__RANGE_CHECK_ENABLES Reg 0x02D to '1'.

The next step is to calculate the ECE threshold and then store this value in the SYSRANGE__EARLY_CONVERGENCE_ESTIMATE Reg 0x022. In this example the variables are stated below and are unsigned integers.

ECE_THRES = ECE threshold that will be written to Reg 0x022.

CONV_THRES = 15360

ECE_FACTOR = 1.05, we chose a 95% ECE factor for this example.

MAX_CONV = Maximum convergence time value read from Reg 0x01C.

PERIOD = This is the averaging sample period read from Reg 0x10A.

SAMPLE = This is the amount of samples read for each averaging period, read from Reg 0x109.

TIME = This is an intermediate variable that is used to calculate the convergence time in the equation below.

*TIME = (SAMPLE + 1) * (24 + 70 + (PERIOD*10)) + 200*

*CONV_TIME = MAX_CONV * 1000 - TIME*

*ECE_THRES = ([CONV_THRES] * 500 * ([ECE_FACTOR]*100)) / ([CONV_TIME]*100)*

The ECE_THRES value is then written to Reg 0x022. The high byte is written to 0x022 and the low byte to 0x023.

The example shown above can be applied to the VL6180X after the device has completed boot up and is waiting for commands. The ECE threshold can be used in single shot or continuous ranging mode which can be decided by the user.

Support material

Related design support material
MOB-EK2-180-03 Product/ system evaluation board
Documentation
Datasheet: VL6180X - Proximity and ambient light sensing (ALS) module

Revision history

Date	Version	Changes
16-June-2014	1	Initial release

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