Overview

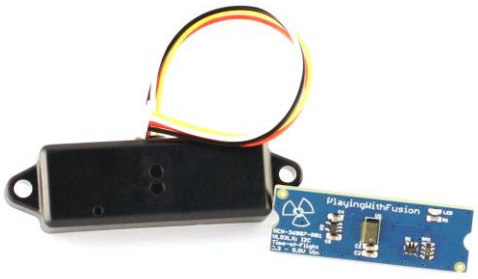
SEN-36007 is a 4-meter capable, maximum 50 Hz sample rate Time-of-Flight (ToF) sensor based on the ST Microelectronics VL53L1X. Unlike typical "breakout board" solutions, SEN-36007 is protected by a plastic enclosure, including special, split-view cover glass to prevent internal reflections from causing erroneous readings from the sensor. This package is not water-proof, but is capable of preventing direct mechanical access (rocks, dirt, metal shavings) and ingress of probing fingers from damaging the delicate VL53L1 IC. The sensor package includes a power LED indicator, level translation and power components to enable a 3.0 - 5.5V digital and supply range, and a Qwiic-compatible cable installed. SEN-36007-L1 represents a good balance between cost and performance of a ToF sensing solution. We also offer a SEN-36007-L3 version of this module if your application requires the VL53L3 solution.

Features

- Protected module for ST's VL53L1X
- Qwiic-compatible I2C interface included
- Absolute (mm) ranging, max 4 meters
- Adjustable sampling to 50Hz (or more, per ST's special appnote)
- Invisible 940nm Class 1 laser emitter
- Adjustable Field-of-View (15° - 27°) by programmable Region-of-Interest (RoI)
- 16x16 SPAD Array (full FoV), 4x4 (min) SPADs can be used for custom FoV
- Multi-zone sampling possible via software use of RoI
- 400kHz I2C clock frequency
- 3.0V - 5.5V I2C and supply voltage range

Includes

- SEN-36007-L1 4m ToF Module, fully assembled



Typical Applications

- Service robots and vacuum cleaners
- Drones
- Laser-assisted autofocus
- User detection
- Smart (shelves, vending, sanitary, lighting, building)
- 1-D gesture recognition
- Did we mention robots?!

Description

ST's FlightSense™ technology uses an invisible Class 1 VCSEL laser to measure absolute distance, regardless of color or reflectance. The VL53L1X has several user-adjustable parameters for end-use optimization. These include ranging (distance) modes, ranging (distance) timing and allowance, Field-of-View, SPAD Array Region-of-Interest, data validation thresholds, calibration functions, and more.

These adjustable parameters will be specific to application needs, so a user must understand operating conditions for their expected use case in order to properly design a robust calibration and implementation. Ultimately, most calibration functions support a handful of primary outputs from the VL53L1X:

- Ranging distance, in mm

- Return signal rate (signal integrity)
- Ambient signal rate (noise)
- Range status (confidence in result)

Perhaps the biggest impact on sensor performance is the "**Distance Mode**" chosen by the user. Short, Medium, and Long modes can be selected. Tuning this parameter for your application is an exercise in balancing maximum distance performance with ambient light (noise) immunity. Short mode, for example, provides nearly identical maximum ranging capability under dark (ideal) and strong ambient light conditions, at just over 1.3 meters. Medium distance mode gives a maximum range of ~2.9 m (290cm), but strong ambient light conditions cut this to 0.76 m, per ST testing. Long mode pushes the range over 3.5m, with strong ambient light pushing capability to 0.73 m. See VL53L1 datasheet, section 2.5.1 for test details.

Ranging timing (**timing budget**) not only impacts maximum ranging distance, but also the repeatability (statistical significance) of the output. Essentially, lowering the timing budget to increase sample frequency rate reduces the maximum distance that can be ranged for a given ambient lighting condition and target color, while simultaneously increasing the standard deviation of the measurement. See VL53L1 datasheet, section 2.5.2 for more details.

Region of Interest configuration allows a user to select which Single Photon Avalanche Diode (SPAD) pads are active during operation. VL53L1 contains a 16x16 SPAD array, which, in conjunction with the integrated optics, can sense objects in up to a 27° field-of-view. A user can, however, reduce the active SPADs to use as few as a 4x4 area of the array, and this area can be adjusted (doesn't have to be at the center of the array). This allows two functions. First, it can reduce the FoV from 27°to 15°, which can be used to avoid known obstacles near the sensor. Second, software can use this FoV knowledge and RoI placement to identify and range multiple objects in the full FoV of the sensor.

Application & Guide

SEN-36007-L1 is designed for rapid setup and integration. Zero soldering. Qwiic-compatible I2C interface. Just about as easy as you can get.

QuickStart

Start by plugging SEN-36007-L1 into a Qwiic-compatible port on either your Qwiic-enabled microcontroller board or something like a Qwiic Mux Breakout. Download the desired application code, flash the board, and start ranging! Please note: if you're using Arduino code examples, be sure to set your serial monitor baud rate to match the Serial.begin() statement in the setup() routine.

Advanced User

ST's VL53LXXX sensors are smart, and with those smarts comes LOTS of configurability. It is highly recommended to spend some time with the VL53L1X datasheet once you are up and running to ensure optimal performance in your application.

Common Issues

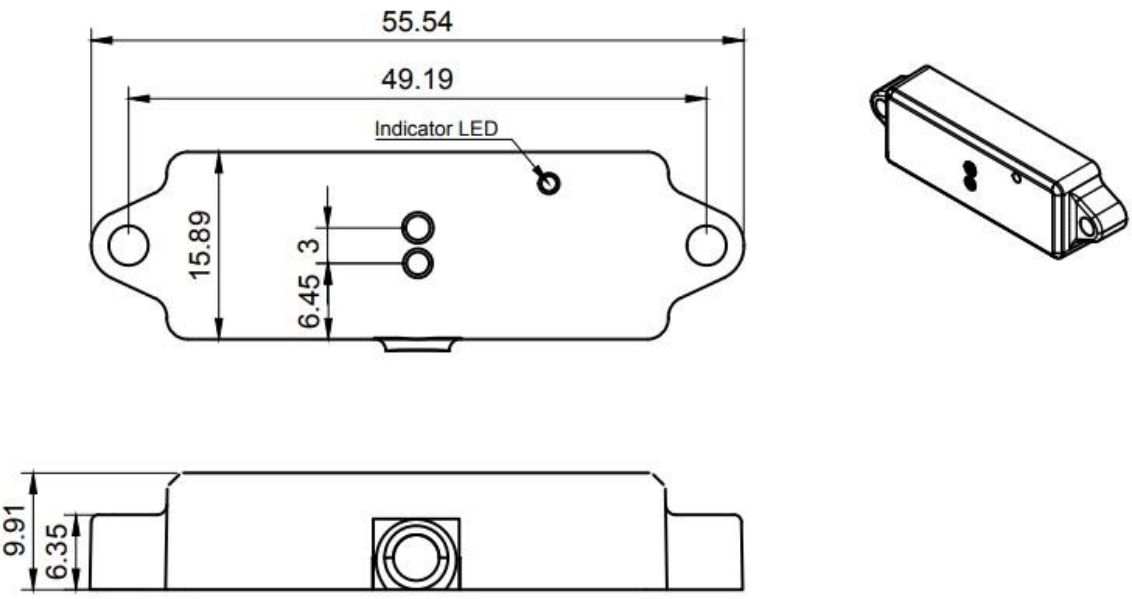
- Conflicting device addresses when using multiple SEN-36007-L1 modules
  - Use an I2C MUX to add additional SEN-36007s without any soldering!

- Inconsistent readings on a target
  - First, consider your ranging mode and expected target distance range (what is the maximum distance you need to sense)
  - Adjust the timing budget to allow the sensor time to acquire a statistically relevant result
  - Adjust Region-of-Interest if adjacent objects are being detected instead of your intended target
  - Consider applying retroreflective tape to your target for a higher return signal

Ordering Options & Related Parts

SEN-36007-L1: VL53L1X Qwiic 4m ToF Module
SEN-36007-L3: VL53L3 Qwiic 2m, multi-target ToF Module
IFB-10011: Qwiic-compatible I2C MUX based on TCA9548A
WIR-10001: 10cm Qwiic-compatible interconnect cable
SEN-36005: VL53L1-based, 5-16V, CAN interfaced ToF module

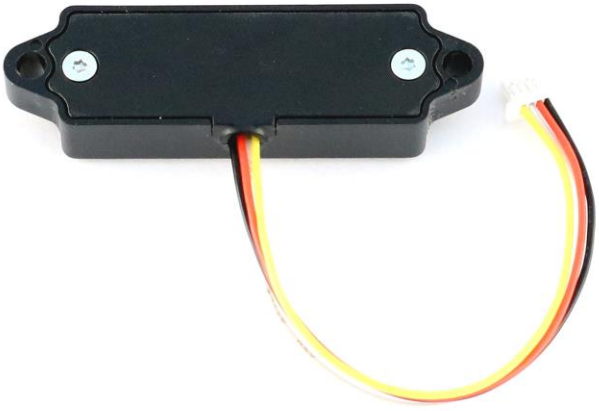
Appendix 1: Mech Drawing



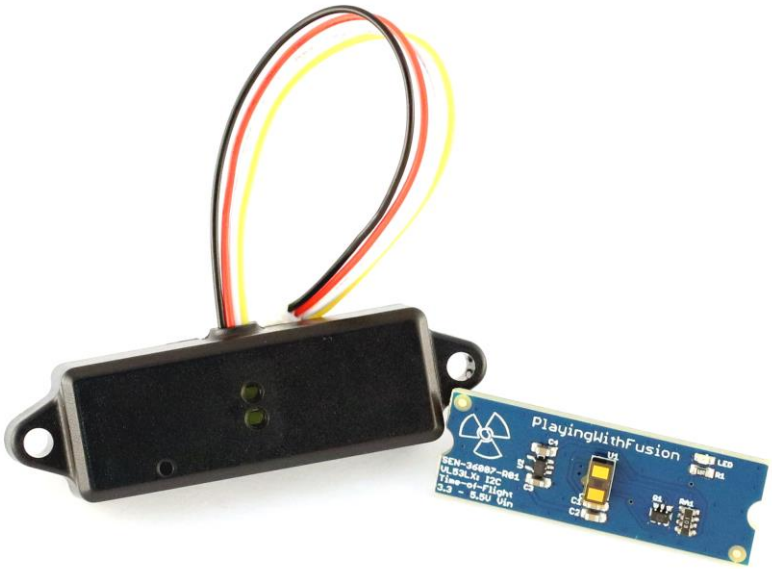
Notes:
1) All dimensions in mm

Appendix 2a: SEN-36007 Front View

Appendix 2b: SEN-36007 Back View



Appendix 2c: SEN-36007 Component View



Revision History

Date	Author	Notes
03/23/2021	J. Steinlage	First revision published