

3D dToF all-in-one lidar module



Product status link

[VL53L9CA](#)

Features

- Fast and accurate 3D direct Time-of-Flight (dToF) camera module
 - Multizone ranging output with up to 54 x 42 separate zones and binning options
 - On-chip processing streaming 2D IR image, depth and ambient maps
 - Confidence level and reflectance maps generated in postprocessing
 - Ranging from <5 cm up to 10 m
 - Up to 60 Hz frame rate capability
 - On-chip histogram processing and algorithmic compensation minimize or remove the impact of cover glass crosstalk and veiling glare
- Fully integrated miniature module with wide field of view (FoV)
 - Scan by two vertical-cavity surface-emitting lasers (VCSEL) flood illumination
 - 940 nm invisible light and integrated analog driver
 - 71° diagonal FoV using metasurface optical elements (MOE) on both transmitter and receiver
 - Receiving array of single photon avalanche diodes (SPADs)
 - Size: 12.8 x 6.1 x 4.6 mm
- Easy integration
 - True all-in-one module with integrated SPAD sensor and VCSEL PMIC
 - Single reflowable component
 - Flexible power supply options:
 - Supports dual power supply operation: 1.2 V & 3.3 V
 - Compatible with a wide range of cover glass materials

Applications

- Robotics
 - SLAM
 - Obstacle avoidance
 - Small object identification
- Augmented reality/virtual reality (AR/VR) enhancement.
 - Dual camera stereoscopy assistance thanks to 2D and depth multizone distance measurement at 60 fps
 - 3D room mapping (multizone and multiobject detection)
 - Gesture recognition and skeletal tracking
- Industrial applications
 - Content management thanks to wide FoV and multizone scanning (liquid level control, load in trucks, tanks, waste bins)
 - People mapping
- Smart homes
 - Smart buildings and smart lighting (user detection to wake up devices)
- IoT
 - User and object detection

- Mobile devices
 - Telephoto zoom camera assist. High resolution and long range allow image crop to align with telephoto camera.
 - Laser-assisted autofocus (LAF). Enhances the camera AF system speed and robustness, especially in difficult low-light or low-contrast scenes.
 - Video focus tracking. 60 Hz ranging allows optimization of continuous focus algorithm.
- Projectors
 - Keystone correction for video projectors

Description

The VL53L9CA is a state of the art, dToF 3D lidar (light detection and ranging) module with market leading resolution of up to 2.3k zones enhancing the ST FlightSense product family. Housed in a miniature reflowable package, it integrates all necessary components to make it a true all-in-one and easy to integrate module. The VL53L9CA includes a SPAD array, postprocessing SoC, two VCSELs powered by a dedicated BCD VCSEL driver providing a flood illumination, physical infrared filters, metasurface optical elements (MOE), and an embedded PMIC. The module is Class 1 laser safe, offering skin protection in addition.

The use of a MOE above the VCSELs allows to project an optimized rectangular FoV onto the scene. The receiver lens focuses the reflection of this light onto the SPAD array.

Unlike conventional IR sensors, the VL53L9CA uses ST's latest generation BSI stacked direct ToF technology, which allows absolute distance measurement whatever the target color and reflectance. It provides accurate ranging from below 5 cm up to 10 m. The VL53L9CA can stream processed data at maximum frame rate (60Hz), which makes it the fastest, truly integrated 3D lidar camera module on the market. Available output data: depth, 2D IR with active illumination, 2D IR without active illumination, reflectance, and confidence.

The VL53L9CA achieves the best ranging performance, including under strong ambient light conditions, with a range of cover glass materials. Multizone distance measurements are possible up to 54 x 42 zones with a wide 54°x42° FoV, which can be reduced by software.

1 Application schematic

Figure 1. Example application schematic

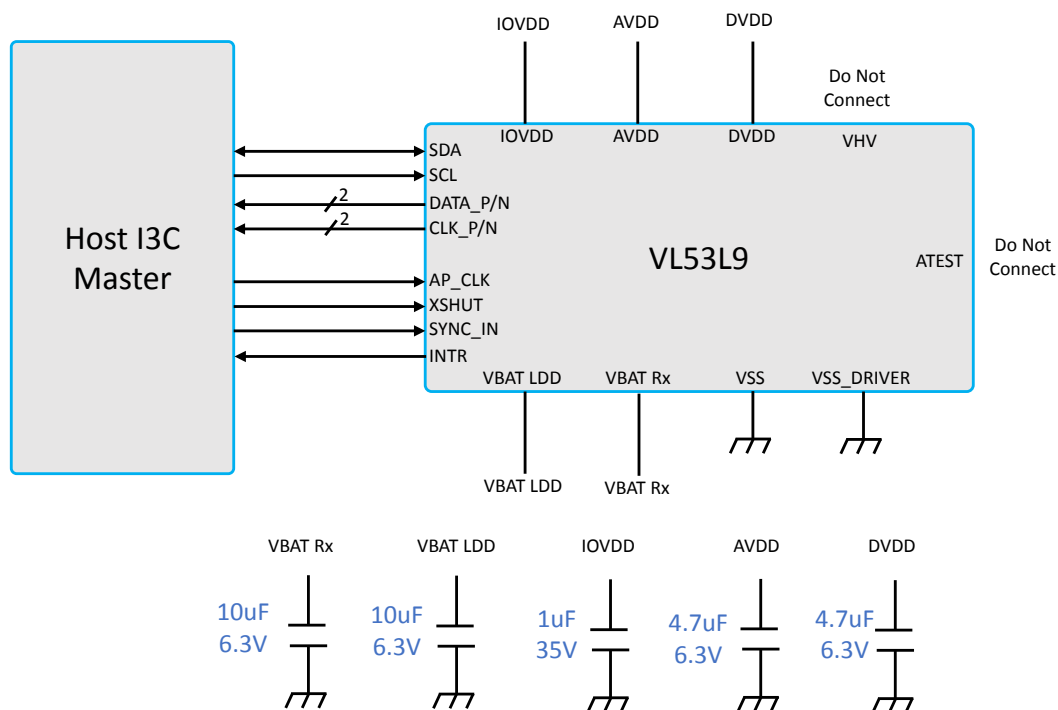


Table 1. Power supply details

Voltage rail	Range
VBAT	2.8 V to 4.8 V
AVDD	2.8 V or 3.3 V
DVDD	1.2 V
IOVDD	1.2 V or 1.8V

Revision history

Table 2. Document revision history

Date	Version	Changes
20-Feb-2024	1	Initial release
25-Feb-2025	2	Added ST Confidential watermark. Updated Section Features . Updated Section Applications . Updated Section Description .
03-Mar-2025	3	Updated classification.

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