World’s Smallest Time-of-Flight Proximity/Ranging Sensor

ST Imaging
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Product Marketing Manager
FlightSense™ Breakthrough Technology

Measurement at the true speed of light!

**FlightSense™ Principle**

- **Emitter**
- **Sensor**
- **Photon**
- **Target**

**Formula:**

$$\text{Measured distance} = \frac{\text{Photon travel time}}{2} \times \text{Speed of light}$$

1 cm round-trip at 67 ps!

- **Fully Integrated Time of Flight Module**
  - ST #1 World Wide Supplier

- **Direct distance measurement**
  - Independent of target size, color & reflectance

- **Very fast (few ms)**

- **Low power**
FlightSense™

Optical Time-of-Flight Product Family

- **ST is WWide #1 ToF supplier**
- **Single Photon Avalanche Diode**
  - Ultra fast time resolution enabling Direct ToF processed in ST CMOS SPAD process
- **ST Proprietary Time-of-Flight IP**
  - Best compromise of cost, complexity & power vs performance
- **Compact integrated system**
  - Sensor, filters, optics, VCSEL and driver integrated
  - Fully calibrated system
- **Optimised and reliable supply chain**
  - High volume & low cost

- Proven track record in manufacturing
- >300Mu products shipped
- 300% AAGR
ST Time of Flight: FlightSense™

Technology advantages

- True Distance
- High Accuracy
- Color independent
- Texture independent
- Detect Glass/Transparent
- 940nm
- Eye Safe
- Fully integrated
- Low Power
FlightSense™
… making light work

Camera Assist
- Instant focus
- Scene understanding
- AWB & light flicker rejection

Ranging & Proximity
- True distance
- Up-to 4m

Presence, User Detect
- Security
- Power saving
- Eye protection

Gesture
- Power, size & performance
- New ways to interact

Depth Map & AR/VR
- All-in-one Module
- Up-to high resolution receiver
ToF Proximity Sensor: Measure true distance
Independent to colour/texture/reflectivity

ST ToF Proximity vs. PIR Proximity:
https://www.youtube.com/watch?v=2NHKga3V6xo
“Laser AutoFocus”, a Recognized Brand
Advanced User Detection
IoT, laptops/PCs & displays

**Security**
- Early detection of user approaching PC to trigger Hello log-in
- Fast screen lock when user leaves desk
- Prevent malicious use of laptop in busy office

**Power saving**
- Very fast screen power-on/off depending on user presence detection
- Autonomous interrupt driven operation
- 400µW typical power consumption when user not present

**User Health Care / Eye Protection**
- Warning when user is too close from screen
- Can log user time spent in front of PC (warning if too long)

**Audio / UI Enhanced Control**
- Audio: adjust mic/speaker mode
- UI: Change font/display size based on distance

**Gesture**
- Basic gesture recognition with single device
- 3D gesture recognition possible with 2 devices

ST Patent Pending
**Gesture Recognition**

*FlightSense™ benefits versus traditional IR*

*FlightSense™* allows to discriminate vertical gesture from horizontal gesture while traditional IR sensor cannot.

<table>
<thead>
<tr>
<th>Hand Movement</th>
<th>Classical IR sensor</th>
<th>FlightSense™</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Signal Amplitude = computed distance</td>
<td>Real measured Distance (ToF)</td>
</tr>
<tr>
<td></td>
<td>$T_0$</td>
<td>$T_0$</td>
</tr>
<tr>
<td></td>
<td>$S_{IR}$</td>
<td>$S_{IR}$</td>
</tr>
<tr>
<td><strong>Up / Down</strong></td>
<td><img src="image1.png" alt="Diagram" /></td>
<td><img src="image2.png" alt="Diagram" /></td>
</tr>
<tr>
<td><strong>Swipe</strong></td>
<td><img src="image3.png" alt="Diagram" /></td>
<td><img src="image4.png" alt="Diagram" /></td>
</tr>
<tr>
<td><strong>Sensor answer:</strong></td>
<td>1 output</td>
<td>2 outputs</td>
</tr>
</tbody>
</table>
FlightSense™ Unlocks Endless New Applications

- Smart home: user presence, eye protection
- Industrial: proxy/ranging, ceiling detect, landing assist
- PC/Tablet: user presence, eye protection
- Robot vacuum cleaner: cliff detect, wall following
- Drone: ceiling detect, landing assist
- Liquid/Food: volume detect
- IoT: gesture
- Wearable: gesture
- Robotics: cliff detect, wall following
- Enterprise: proximity, level detect
- Medical: proximity, gesture
- AR/VR: gesture
- Faucet/Toilet: proximity
VL6180X

Ambient Light Sensor (ALS) / Proximity Sensor

Highlights

- Small package
  - OLGA 4.8 x 2.8 x 1mm
- Robust and accurate proximity detection
- Highly efficient ALS embedded
- Fully integrated
  - Near-IR (850nm) VCSEL emitter
  - Filters
  - Receiver
  - Advanced µC
- Low power
- Field-of-View : 25°
- Laser Class1 device (eye safe)
- Independent of reflectance/color/texture
- Complete API package and Android driver

Applications

Reliable Proximity detection

- User detection to safely power off touch screen or control white goods
- Obstacle detection for robotics
- ...

Ambient Light Sensing

Adjust the brightness of the display subject to the ambient light level detected
World’s Smallest ToF Sensor

**Highlights**
- **World’s smallest ToF sensor**
  - OLGA 4.4 x 2.4 x 1mm
- Range up to **2 meters in less than 30ms**
- **High accuracy** (up to +/- 3%)
- **Fast ranging** time (up to 50Hz)
- **Fully integrated**
  - Near-IR (940nm) VCSEL emitter
  - Filters
  - Receiver
  - Advanced µC
- **Low power**
- Field-of-View : **25°**
- Laser Class1 device (eye safe)
- Independent of reflectance/color/texture
- Complete API package and **Android driver**

**Applications**

**Laser AF**
WW #1 supplier, with Focus in 1 frame

**Drones/Robotics**
Obstacle/ceiling detection; landing assistance.

**User Detection & Smart Interaction**
Power saving, zoom, user detection and counting, …
Which Time-of-Flight to Use?

VL6180X or VL53L0X?

- Max Ranging Distance
- Short Distance Performance
- Detection rate
- Measurement rate
- Sunlight Performance
- Price
- Size
- Accuracy
- Ambient Light Sensor (ALS)
VL53L1

First product with Multi-zone and Multi-object detection

• More info at st.com:
  • Datasheet: available under NDA.

STMicroelectronics’ Latest Time-of-Flight Ranging Sensor Brings Multi-Object Detection and Multi-Array Scanning to Mobile Applications

• Widely used FlightSense™ low-power sensors are ideal for autofocus, presence-detection, and power-saving functions
• The VL53L1 offers best-ever Time-of-Flight sensor performance, unlocking exciting new applications and user experiences
• Demonstrations at Mobile World Congress (Barcelona, Feb 27 - Mar 2)
  Hall 7A61 will highlight key features

Geneva / 20 Feb 2017

STMicroelectronics (NYSE: STM), a global semiconductor leader serving customers across the spectrum of electronics applications, has released its third-generation laser-ranging sensor based on its industry-leading FlightSense™ technology. The VL53L1 sensor benefits from new patented silicon- and module-level architectures, adding for the first time, optical lenses to the module. This combination boosts core performance while introducing many new features including multi-target detection, cover-glass crosstalk immunity at long distance, and programmable multi-zone scanning. These advances deliver new levels of sensor performance to robotics, user detection, drones, IoT, and wearable applications.

With a form factor of 4.9 x 2.5 x 1.56mm, the sensor module integrates a new lens system, a 940nm VCSEL[1] invisible-light source, a processing core, and a SPAD[2] photon detector. The addition of the optical lens system increases the photon detection rate to boost the module’s ranging performance. The embedded microcontroller manages the complete ranging function and runs the innovative digital algorithms to minimize host-processing overhead and system power consumption, maximizing battery life for mobile applications.
VL53L0X NUCLEO expansion board

- Arduino Connectors
- 4-digit display
- PC GUI interface
- VL53L0X Ranging sensor
- 2x VL53L0X satellites (plugged or hardwired)
- Cover Glass sample (PMMA material. Low XTalk)
- Cover Glass holder (Can hold Cover Glass and spacers)
- Spacers 3 spacers 0.25/0.5/1mm to create various air gaps below CG
## VL6180X: Module & Development Tools

Go to [www.st.com/VL6180X](http://www.st.com/VL6180X) or contact your usual distributor

<table>
<thead>
<tr>
<th>Product</th>
<th>Picture</th>
<th>Order code</th>
</tr>
</thead>
<tbody>
<tr>
<td>VL6180X proximity sensor</td>
<td><img src="image1.png" alt="Image" /></td>
<td>VL6180XV0NR/1</td>
</tr>
<tr>
<td>Nucleo VL6180X Expansion board (Gen2)</td>
<td><img src="image2.png" alt="Image" /></td>
<td>X-NUCLEO6180XA1/1</td>
</tr>
<tr>
<td>Nucleo Pack: VL6180X expansion board + STM32F410 “Full features” Nucleo board</td>
<td><img src="image3.png" alt="Image" /></td>
<td>P-NUCLEO-6180X1/</td>
</tr>
<tr>
<td>VL6180X Satellites (2 units per delivery)</td>
<td><img src="image4.png" alt="Image" /></td>
<td>VL6180X-SATEL/1</td>
</tr>
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# VL53L0X: Module & Development Tools

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<tr>
<td>VL53L0X module</td>
<td><img src="image1.png" alt="Image" /> Delivered with a protective liner</td>
<td>VL53L0CXV0DH/1</td>
</tr>
<tr>
<td>VL53L0X Nucleo™ Expansion board</td>
<td><img src="image2.png" alt="Image" /></td>
<td>X-NUCLEO-53L0A1/</td>
</tr>
<tr>
<td>Pack: VL53L0X Nucleo™ Expansion board + STM32F401 NUCLEO board</td>
<td><img src="image3.png" alt="Image" /></td>
<td>P-NUCLEO-53L0A1/</td>
</tr>
<tr>
<td>VL53L0X Satellite boards to be hard-wired to customers PCBs</td>
<td><img src="image4.png" alt="Image" /></td>
<td>53L0-SATEL- I1/1</td>
</tr>
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FlightSense™ Technology Summary

Eye Safe
Thank You!