Going further with FlightSense™
Agenda

1. Introduction
2. FlightSense™ ToF mass market roadmap
3. Highlights on new products features
4. ToF sensors KPIs comparison
5. New FlightSense™ ToF sensors – Focus
6. Tools ordering codes
7. FlightSense™ vs. other proximity sensing technologies
ST pioneer and leader in Time-of-Flight (ToF)

ST is #1 Worldwide ToF sensor supplier

**4 Generations**
of all-in-one ToF solution deployed since 5 years

**>155 phones with FlightSense™**
Above 15 smartphone OEMs

**Hundreds other customers**
Hundreds non wireless end-products in the market

**>40,000**
Evaluation kits deployed

**>1Bu**
ToF units shipped. Mastering end-to-end supply chain
**FlightSense™**

... making light work

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**Time-of-Flight Principle**

![Diagram of Time-of-Flight Principle]

**Measured distance** = \( \text{Photon travel time} / 2 \times \text{Speed of light} \)

1 cm round-trip takes 67 ps

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**ST proprietary FlightSense™ technology**

**True distance measurement**

Independent of target size, color & reflectance

**Fast and low power**

**Truly invisible 940 nm illumination**
FlightSense™
Typical module overview

All-in-One (illumination & sensor) Time of Flight system
→ Optimized size / performance / cost mix

- Advanced optics with integrated IR filter
- State-of-art assembly & testing manufacturing ST line in SHZ
- Monolithic ToF SoC, SPAD Array, RAM/ROM & powerful Class1 VCSEL driver
- High power VCSEL Full Class 1 safety
FlightSense™ product longevity
7-year commitment

FlightSense™ benefits from ST Longevity Program
7-year longevity from Product Introduction Date

• VL6180X since January 2015
• VL6180V1 since January 2019
• VL53L0CX since January 2019
• VL53L3CX since January 2019
• VL53L1CX since January 2019
Camera Assistance
- Laser autofocus
- Touch-to-Focus
- Scene understanding
- AWB assist based on 940nm content

Ranging & Proximity
- True ToF distance
- High accuracy
- Up-to 4 meters

Multispectral & Flicker
- True tone color display & ALS
- Camera AWB
- Light flicker measurement and correction

Face Identification
- Face anti-spoofing
- Cost, power, size optimized
- All-in-one depth sensing

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

Depth Map & AR/VR
- All-in-one Module
- High resolution receiver
- Gesture
- Consumer LiDAR

Smart optical sensing & FlightSense™
… making light work
FlightSense™ ST ToF ranging sensors
Mass-market roadmap
FlightSense™ mass-market roadmap

XX° FoV
Programmable FoV
XX° Max
Up to 4 zones sequentially
Histogram
MultiObject detection
Perf. Under Ambient
Smudge correction
Close distance
Linearity

Max. Distance measurement in cm (in the dark)

Overall performance

VL6180V1 (Gen1)
VL53L0CX (Gen2)
VL53L3CX (Gen2)
VL53L1CB (Gen2)
VL53L1CX (Gen2)

New
Already In MP
In MP
In MP
In MP

Close distance
Programmable FoV
XX° Max
### FlightSense™ mass-market roadmap

<table>
<thead>
<tr>
<th>Sensor</th>
<th>Proximity</th>
<th>Ranging</th>
<th>Proximity + Ranging</th>
<th>Long Ranging</th>
<th>3.2 meters (Histogram)</th>
</tr>
</thead>
<tbody>
<tr>
<td>VL6180V1</td>
<td>up to 62cm</td>
<td>up to 2 meters</td>
<td>up to 3 meters</td>
<td>up to 4 meters</td>
<td>up to 4 meters (Lite ranging)</td>
</tr>
<tr>
<td>VL53L0CX</td>
<td>Proximity sensor</td>
<td>Ranging sensor</td>
<td>Proxy + Multi target sensor</td>
<td>Long Distance sensor</td>
<td>Long Distance + Multi target sensor</td>
</tr>
<tr>
<td>VL53L0CX</td>
<td>Proximity sensor</td>
<td>Ranging sensor</td>
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<td>Long Distance + Multi target sensor</td>
</tr>
<tr>
<td>VL53L1CB</td>
<td>Proximity sensor</td>
<td>Ranging sensor</td>
<td>Proxy + Multi target sensor</td>
<td>Long Distance sensor</td>
<td>Long Distance + Multi target sensor</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Distance measurement</th>
<th>Proximity up to 62cm</th>
<th>Ranging up to 2 meters</th>
<th>Proximity + Ranging up to 3 meters</th>
<th>Long Ranging up to 4 meters</th>
<th>3.2 meters (Histogram) up to 4 meters (Lite ranging)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Close distance linearity</td>
<td>++ (&gt;2.5cm)</td>
<td>++ (&gt;2.5cm)</td>
<td>+ (&gt;4cm)</td>
<td>+ (&gt;4cm)</td>
<td></td>
</tr>
<tr>
<td>Performance under ambient light (along windows with strong outside light)</td>
<td>+ (80cm)</td>
<td>++ (100cm)</td>
<td>+++ (135cm)</td>
<td>+ (90cm)</td>
<td></td>
</tr>
<tr>
<td>Resolution</td>
<td>1 zone</td>
<td>1 zone</td>
<td>1 zone</td>
<td>1 zone</td>
<td>1 zone or sequential MultiZone</td>
</tr>
<tr>
<td>FoV</td>
<td>25° No Lens</td>
<td>25° No Lens</td>
<td>25° No Lens</td>
<td>27° (SW config) Lens on Rx</td>
<td>27° (SW config) Lens on Rx</td>
</tr>
<tr>
<td>Multi-target detection (Histogram)</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>X-talk / Smudge immunity</td>
<td>X-talk compensation</td>
<td>X-talk compensation</td>
<td>Immunity &gt;80cm</td>
<td>X-talk compensation</td>
<td>Immunity &gt;80cm</td>
</tr>
<tr>
<td>X-talk / Smudge immunity</td>
<td></td>
<td></td>
<td>&lt;80cm: Smudge compensation</td>
<td></td>
<td>&lt;80cm: Smudge compensation</td>
</tr>
<tr>
<td>Power Consumption</td>
<td>1.7mA (low power mode available)</td>
<td>19mA</td>
<td>16mA (low power mode available)</td>
<td>16mA</td>
<td></td>
</tr>
<tr>
<td>Driver size</td>
<td>ROM 3.9kB to 4.5kB</td>
<td>ROM 13.5kB to 23.4kB</td>
<td>ROM 28.5kB to 36kB</td>
<td>ROM 9.8kB to 14.6kB</td>
<td>ROM 31kB to 47.6kB</td>
</tr>
<tr>
<td>RAM 0.14kB</td>
<td>RAM 0.78kB</td>
<td>RAM 0.31kB</td>
<td>RAM 0.30kB (ultra lite driver available)</td>
<td>RAM 0.31kB</td>
<td></td>
</tr>
<tr>
<td>Small all-in-one modules</td>
<td>4.8 x 2.8 x 1.0 mm</td>
<td>4.4 x 2.4 x 1.0 mm</td>
<td>4.4 x 2.4 x 1.0 mm</td>
<td>4.9 x 2.5 x 1.56 mm</td>
<td>4.9 x 2.5 x 1.56 mm</td>
</tr>
</tbody>
</table>
FlightSense™ ST ToF ranging sensors
Highlights on new product features
Programmable Field of View
VL53L1CX & VL53L1CB

Flexible FOV selections => Regions of Interest (RoI)

<table>
<thead>
<tr>
<th>ROI zone size (in SPADs)</th>
<th>Diagonal FOV covered by the zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>4x4</td>
<td>15° (smallest)</td>
</tr>
<tr>
<td>8x8</td>
<td>20°</td>
</tr>
<tr>
<td>16x16</td>
<td>27° (largest, full FoV)</td>
</tr>
</tbody>
</table>

VL53L1CX - ROI application note
Multi-object detection
VL53L3CX & VL53L1CB

• Output ranging distance for each object (60~70cm granularity)
• Only direct ToF can do it. Indirect ToF cannot output multi bins and extract distance with correct resolution
• Allow first object detection
• Allow background removal

158cm
26cm
92cm

Histogram based
The histogram is based on 24 bins. Each bin is a "time window" representing the amount of photons back on the sensor during a certain period of time.

A detected object will cover ~3 bins. This means 3 bins per object, equivalent to ~80cm. The typical depth separation between objects has to be at least 80 cm to detect 2 different objects.

The histogram allows cover glass crosstalk immunity beyond 80 cm, and dynamic smudge compensation.

Note: The "threshold" is a minimal signal threshold for valid target detection.
X-Talk immunity principle
Accurate distance whatever the smudge or X-Talk

Beyond 80cm: Immune to X-Talk

Beyond 80cm: Immune to X-Talk

Below 80cm: X-Talk compensation

* Need a X-Talk calibration
Smudge detection
VL53L3CX & VL53L1CB

Below 80cm: X-Talk compensation

Beyond 80cm, the smudge has no impact on the distance measurement thanks to the histogram.

Smudge correction

XX° FoV
Programmable FoV
XX° Max
Up to 4 zones sequentially
Histogram
MultiObject detection
Perf. Under Ambient
Close distance
Linearity (+: Excellent)

Cover-window crosstalk + **Smudge**, dust, or fingerprint crosstalk

Smudge

Coverglass

Airgap

Module

X-Talk calibration data without smudge

X-talk increase due to smudge

New X-Talk calibration data for smudge compensation
ToF sensors KPIs comparisons
FlightSense™ mass-market roadmap
VL53L0CX vs VL53L3CX

**VL53L0CX**
- Cheaper
- Low Power Mode
- Small size API

**VL53L3CX**
- Histogram:
  - Multi target distance measurement
  - Immune to X-talk above 80cm
- Dynamic Smudge correction
- Short distance linearity (>2.5cm)
- Ranging up to 3m
- Longer ranging under ambient light

XX° FoV
Programmable FoV
XX° Max
Up to 4 zones sequentially
Histogram
MultiObject detection
Perf. Under Ambient
Smudge correction
Close distance Linearity

Max. Distance measurement in cm (in the dark)
FlightSense™ mass-market roadmap
VL53L3CX vs VL53L1CB

Overall performance

VL53L1CB
- Multi-zone (up to 4 sequentially)
- Programmable FoV
- Longer ranging under ambient light

New
In MP

VL53L3CX
- Short distance linearity
- Smaller
- Cheaper

New
In MP

XX° FoV
Programmable FoV
XX° Max
Up to 4 zones sequentially
Histogram
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Max. Distance measurement in cm (in the dark)
FlightSense™ mass-market roadmap
VL53L1CB vs VL53L1CX

**VL53L1CB**

- **Histogram:**
  - Multi target distance measurement
  - Immune to X-talk above 80cm
  - Longer max distance with low reflectance target (Histo Merge)
- **Dynamic Smudge correction**

**VL53L1CX**

- **Ranging up to 4m**
- **ULD API** (Ultra Light Driver)
- **Documentation** (People counting, smart shelves, Linux example code, Videos...)
- **Low power mode**
- **Cheaper**

- **Up to 4 zones sequentially**
- **Programmable FoV XX° Max**
- **Perf. Under Ambient**
- **Smudge correction**
- **Close distance Linearity**

Max. Distance measurement in cm (in the dark)
New ToF sensors – Focus
Proximity sensor

**Highlights**

- Proven technology.
- Robust and accurate proximity detection
- Measures actual distance in cm **up to 60cm**
- Independent of target reflectance / color
- Fully integrated (near IR 850nm VCSEL emitter, filters, SPAD receiving array, advanced µC)
- Low power (stdby 1µA, active 5mW at 10Hz)
- Complete API package and **Android driver**
- Laser Class1 device (eye safe)

**Uses-cases**

- Reliable Proximity detection
- User detection to safely power off touch screen or control white goods
- Obstacle detection
- Wall tracking
- Basic gesture

**Application examples**

- Vacuum cleaners
- Service Robots
- Wearable & IoT
- White Goods
- Faucets
<table>
<thead>
<tr>
<th>Feature</th>
<th>Detail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Package</td>
<td>Optical LGA12</td>
</tr>
<tr>
<td>Size</td>
<td>4.8 x 2.8 x 1 mm</td>
</tr>
<tr>
<td>Ranging</td>
<td>Ranging up to 62 cm maximum (dependent on target reflectance and external conditions)</td>
</tr>
<tr>
<td>Field of View</td>
<td>25°</td>
</tr>
<tr>
<td>Operating voltage (AVDD)</td>
<td>2.6 V to 3 V</td>
</tr>
<tr>
<td>Typical power consumption</td>
<td>Hardware Standby (GPIO0 = 0): &lt; 1 µA</td>
</tr>
<tr>
<td></td>
<td>SW Standby: &lt; 1 µA</td>
</tr>
<tr>
<td></td>
<td>Active ranging average consumption (including VCSEL): 1.7 mA (typical)</td>
</tr>
<tr>
<td>Function temperature range</td>
<td>-20 to 70°C</td>
</tr>
<tr>
<td>IR emitter</td>
<td>850 nm</td>
</tr>
<tr>
<td>I²C (Clock / Data)</td>
<td>Up to 400 kHz serial bus</td>
</tr>
<tr>
<td>XSHUT (GPIO0)</td>
<td>XSHUT (in): HW power down when put at zero</td>
</tr>
<tr>
<td>GPIO1</td>
<td>Information pin: Thresholds or sample ready interrupts</td>
</tr>
</tbody>
</table>

(1) 10 Hz sampling rate, 17% reflective target at 50 mm
VL6180V1 support on st.com

Videos
- All-in-one proximity and ambient light sensing module

Documentation

<table>
<thead>
<tr>
<th>Description</th>
<th>Version</th>
<th>Size</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>DG8818 Proximity sensing module</td>
<td>1.2</td>
<td>1.38 MB</td>
<td>IDE</td>
</tr>
<tr>
<td>DB1904 Time-of-Flight proximity sensor and IR emitter two-in-one module</td>
<td>5.0</td>
<td>771.4 KB</td>
<td>IDE</td>
</tr>
</tbody>
</table>

User Manuals
- X-CUBE UM
- X-NUCLEO UM

Software
- API (driver)
- GUI for X-NUCLEO
- X-CUBE example
High-performance proximity sensor, combining short distance linearity & ranging performance

Highlights
- Full FoV ranging: 300cm+ (white target, no IR)
- High-performance proximity sensor
- Excellent short distance linearity
- Multi-target distance measurement based on ST Histogram patented algorithms
- Immunity to cover glass cross-talk beyond 80cm
- Automatic fingerprint smudge compensation
- Miniature ToF product

OLGA: 4.4 x 2.4 x 1 mm
FoV: 25° diagonal
Single zone

Uses-cases
- Presence user detection
- Obstacle detection
- Accurate distance scanning

Application examples
- AR/VR
- Tablets
- Service Robots
- Trucks
- Industrial
- Warehouse
<table>
<thead>
<tr>
<th>Feature</th>
<th>Detail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Package</td>
<td>Miniature Optical LGA12</td>
</tr>
<tr>
<td>Size</td>
<td>4.4 x 2.4 x 1 mm - Compatible with VL53L0X</td>
</tr>
<tr>
<td>Ranging</td>
<td>Ranging up to 310 cm (Indoor, under 88% white target reflectance). Up to 290 cm (Indoor, under 54% light grey target reflectance)</td>
</tr>
<tr>
<td>Field of View</td>
<td>25°</td>
</tr>
<tr>
<td>Operating voltage (AVDD)</td>
<td>2.6 V to 3.5 V</td>
</tr>
<tr>
<td>Typical power consumption</td>
<td>Hardware Standby (GPIO0 = 0): &lt; 5 µA  SW Standby: &lt; 6 µA  Active ranging average consumption (including VCSEL): 16 mA (typical)^(1)</td>
</tr>
<tr>
<td>Function temperature range</td>
<td>-20 to 85°C</td>
</tr>
<tr>
<td>IR emitter</td>
<td>940 nm</td>
</tr>
<tr>
<td>I²C (Clock / Data)</td>
<td>Up to 1 MHz serial bus</td>
</tr>
<tr>
<td>XSHUT (GPIO0)</td>
<td>XSHUT (in): HW power down when put at zero</td>
</tr>
<tr>
<td>GPIO1</td>
<td>Information pin: Thresholds or sample ready interrupts</td>
</tr>
</tbody>
</table>

^(1) 30 Hz sampling rate, 33msec ranging budget
## VL53L3CX – Ranging performance

### Ranging capabilities with a 30 ms ranging operation (Fast mode)

<table>
<thead>
<tr>
<th>Target Type</th>
<th>Indoor (no IR)</th>
<th>Outdoor</th>
</tr>
</thead>
<tbody>
<tr>
<td>White Target 88%</td>
<td>310cm</td>
<td>100cm</td>
</tr>
<tr>
<td>Light Grey Target 54%</td>
<td>290cm</td>
<td>70cm</td>
</tr>
<tr>
<td>Grey Target 17%</td>
<td>170cm</td>
<td>70cm</td>
</tr>
</tbody>
</table>

**Measurement conditions without Cover glass:**
- Typical value with a detection rate at 94%
- Targets reflectance used: Grey 17%, Light grey 54%, White (88%)
- Indoor: no Infrared / Outdoor: eq. 5kLux equivalent sunlight (10kcps/SPAD)
- Nominal Voltage (2.8V) and Temperature (23°C)
- All distances are for a complete Field of View covered (FOV = 25deg)
ToF sensor with lens, for long distance ranging and FoV programing

**Highlights**
- Full FoV ranging: 320cm+ (white target, no IR)
- SPAD array zone selection (from 4x4 SPADs up to 16x16 SPADs full screen), for FoV control
- SPAD array with Multi-object distance measurement within each zone
- Integrated lens for enhanced return signal, multi-zone detection and better immunity to IR ambient
- Multi-pass temporal filtering
  - Immunity to cover glass crosstalk beyond 80cm
  - Automatic fingerprint smudge compensation
  - Advanced histogram and object detection

**OLGA**: 4.9 x 2.5 x 1.56 mm
**FoV**: 27° diagonal max – Programmable FoV
Single zone or Multi-zone.

**Uses-cases**
- Presence user detection
- Obstacle detection
- Accurate objects distance scanning

**Applications**
- Laptops
- White Goods
- Smart home
- Logistic
- Service Robots
- Vacuum cleaners
### VL53L1CB ranging sensor technical specification

<table>
<thead>
<tr>
<th>Feature</th>
<th>Detail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Package</td>
<td>Miniature Optical LGA12</td>
</tr>
<tr>
<td>Size</td>
<td>4.9 x 2.5 x 1.56 mm - Compatible with VL53L1X</td>
</tr>
<tr>
<td>Ranging</td>
<td>Up to 320 cm (Indoor, under 88% white target reflectance) with full FoV @60 Hz&lt;br&gt;Up to 250 cm (Indoor, 88% white target reflectance) with 8x8 SPADs ROI @60 Hz</td>
</tr>
<tr>
<td>Field of View</td>
<td>Programmable FoV 27° max</td>
</tr>
<tr>
<td>Operating voltage (AVDD)</td>
<td>2.6V to 3.5V (typ. 2.8V)</td>
</tr>
<tr>
<td>Typical power consumption</td>
<td>Hardware Standby (GPIO0 = 0): &lt; 5 µA&lt;br&gt;SW Standby: &lt; 6 µA&lt;br&gt;Active ranging average consumption (including VCSEL): 16 mA (typical)&lt;sup&gt;(1)&lt;/sup&gt;</td>
</tr>
<tr>
<td>Function temperature range</td>
<td>- 20 to 85°C</td>
</tr>
<tr>
<td>IR emitter</td>
<td>940 nm</td>
</tr>
<tr>
<td>I²C (Clock / Data)</td>
<td>Up to 1 MHz serial bus</td>
</tr>
<tr>
<td>XSHUT (GPIO0)</td>
<td>XSHUT (in): HW power down when put at zero</td>
</tr>
<tr>
<td>GPIO1</td>
<td>Information pin: Thresholds or sample ready interrupts</td>
</tr>
</tbody>
</table>

<sup>(1)</sup> Ranging mode with 16msec timing budget
**Ranging capabilities with a 16 ms ranging operation, under histogram mode**

<table>
<thead>
<tr>
<th></th>
<th>Indoor (no IR)</th>
<th>Outdoor</th>
</tr>
</thead>
<tbody>
<tr>
<td>White Target 88%</td>
<td>320cm</td>
<td>90cm</td>
</tr>
<tr>
<td>Grey Target 17%</td>
<td>230cm</td>
<td>90cm</td>
</tr>
</tbody>
</table>

**Measurement conditions without Cover glass:**

- Typical values
- Targets reflectance used: Grey 17%, White (88%)
- Indoor: no Infrared / Outdoor: eq. 5kLux equivalent sunlight (10kcps/SPAD)
- Nominal Voltage (2v8) and Temperature (23°C)
- All distances are for a complete Field of View covered (FOV = 27deg)
- Detection rate is considered at 94% minimum
Multi-object detection within the FoV Foreground and background separation

VL53L3CX & VL53L1CB perform advanced ranging with direct ToF temporal filter:

- **Only possible with direct ToF**
- **Multiple object detection** within the same FoV, up to 60 Hz
  - Ideal for complex scenes management (foreground / background)
  - Distance (in mm) also provided, for single or multi objects
- **Immune to cover glass crosstalk beyond 80 cm**, and compensation capability below 80 cm
- **Real time** smudge detection and compensation (On the fly = at each run)
VL53L1CB allows custom FoV selection
Region of interest (ROI) selection by the user

<table>
<thead>
<tr>
<th>ROI zone size</th>
<th>Diagonal FOV covered by the zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>4x4 spads</td>
<td>15° (smallest)</td>
</tr>
<tr>
<td>8x8 spads</td>
<td>20°</td>
</tr>
<tr>
<td>16x16 spads</td>
<td>27.0 (largest, full FoV)</td>
</tr>
</tbody>
</table>

- No fixed pre-defined size for the sensing array (Region of Interest) Unlike other sensors on the market or VL53L0CX
- Sensing array is composed by 16x16 SPADs (Single Photon Avalanche Diodes) that can be selected by customer
- VL53L1 returns the distance to object covered by the ROI FoV
- User defines the 2 corners of the array, through SW driver (API) or the Eval Kit GUI. It could even be rectangular. Only condition is to have a minimum of 4x4 SPADs array.
- The change of ROI can be done “on the fly” by the host
Tools ordering codes
**Ecosystem and tools**

**Imaging products supported by ST ecosystem & and expanding optical partnership network**

**Complete package**
- X-NUCLEO expansion board
- P-NUCLEO packs with STM32 NUCLEO
- Stand-alone Breakout boards

**STM32 ODE**
- FlightSense™ fully integrated in STM32 Ecosystem
- Compatible with NUCLEO-F401RE and NUCLEO-L476RG
- Referenced on mbed & Arduino platforms

**Cover glasses**

**Oval Cover Glass:**
- Reference cover glass proposed in NUCLEO development boards

**Square Cover Glass:**
- 3 spacers 0.25/0.5/1mm to create various air gaps
- Cover glass holder
### VL6180V1 ordering codes

Go to [www.st.com/VL6180](http://www.st.com/VL6180) or contact your usual distributor.

<table>
<thead>
<tr>
<th>Item</th>
<th>Picture</th>
<th>Commercial Product (= Order Code)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>VL6180V1 sensor</td>
<td><img src="image1" alt="Image" /></td>
<td>VL6180V1NR/1</td>
<td>Delivery in T&amp;R MOQ: 5Ku LT = 16 weeks</td>
</tr>
<tr>
<td>VL6180V1 Nucleo™ Expansion board</td>
<td><img src="image2" alt="Image" /></td>
<td>X-NUCLEO-6180A1/</td>
<td>To go along with STM32F401 Nucleo board. Comes with 2x 2v8 Breakout boards</td>
</tr>
<tr>
<td>Pack: VL6180V1 Nucleo™ Expansion board + STM32F401 NUCLEO</td>
<td><img src="image3" alt="Image" /></td>
<td>P-NUCLEO-6180A1/</td>
<td>X-NUCLEO-6180A1 expansion board delivered together with STM32F401 NUCLEO board</td>
</tr>
<tr>
<td>VL6180V1 Breakout boards</td>
<td><img src="image4" alt="Image" /></td>
<td>VL6180-SATEL</td>
<td>2x Breakout boards delivered</td>
</tr>
<tr>
<td>Item</td>
<td>Picture</td>
<td>Commercial Product (= Order Code)</td>
<td>Comments</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>---------</td>
<td>-----------------------------------</td>
<td>--------------------------------------------------------------------------</td>
</tr>
<tr>
<td>VL53L0CX sensor</td>
<td><img src="image1.png" alt="Image" /></td>
<td>VL53L0CXV0DH1</td>
<td>Delivery in T&amp;R</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>MOQ: 5Ku</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>With protective liner</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>LT = 16 weeks</td>
</tr>
<tr>
<td>VL53L0CX Nucleo™ Expansion board</td>
<td><img src="image2.png" alt="Image" /></td>
<td>X-NUCLEO-53L0A1/</td>
<td>To go along with STM32F401</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Nucleo board.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Comes with cover-glass holder,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>cover-window, 3x spacers, 2x 2v8</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Breakout boards</td>
</tr>
<tr>
<td>Pack: VL53L0CX Nucleo™ Expansion board +</td>
<td><img src="image3.png" alt="Image" /></td>
<td>P-NUCLEO-53L0A1/</td>
<td>X-NUCLEO-53L0A1 expansion</td>
</tr>
<tr>
<td>STM32F401 NUCLEO</td>
<td></td>
<td></td>
<td>board delivered together with</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>STM32F401 NUCLEO board</td>
</tr>
<tr>
<td>VL53L0CX Breakout boards</td>
<td><img src="image4.png" alt="Image" /></td>
<td>53L0-SATEL-I1</td>
<td>2x Breakout boards delivered</td>
</tr>
</tbody>
</table>

Go to [www.st.com/VL53L0X](http://www.st.com/VL53L0X) or contact your usual distributor.
<table>
<thead>
<tr>
<th>Item</th>
<th>Picture</th>
<th>Commercial Product (= Order Code)</th>
<th>Comments</th>
</tr>
</thead>
</table>
| VL53L3CX sensor | ![VL53L3CX sensor](image1.png) | VL53L3CXV0DH/1 | Delivery in T&R  
MOQ: 4.5Ku  
With protective liner  
LT = 16 weeks |
| VL53L3CX Nucleo™ Expansion board | ![VL53L3CX Nucleo™ Expansion board](image2.png) | X-NUCLEO-53L3A2/ | To go along with STM32F401 Nucleo board.  
Comes with cover-glass holder, 2x cover-window samples, 3x spacers, 2x 2v8 Breakout boards |
| VL53L3CX Breakout boards | ![VL53L3CX Breakout boards](image4.png) | VL53L3CX-SATEL | 2x Breakout boards delivered |

Go to [www.st.com/VL53L3CX](http://www.st.com/VL53L3CX) or contact your usual distributor.
<table>
<thead>
<tr>
<th>Item</th>
<th>Picture</th>
<th>Commercial Product (= Order Code)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>VL53L1CX sensor</td>
<td><img src="image" alt="VL53L1CX sensor" /></td>
<td>VL53L1CXV0FY/1</td>
<td>Delivery in T&amp;R MOQ: 3.6Ku With protective liner LT = 16 weeks</td>
</tr>
<tr>
<td>VL53L1CX Nucleo™ Expansion board</td>
<td><img src="image" alt="VL53L1CX Nucleo™ Expansion board" /></td>
<td>X-NUCLEO-53L1A1/</td>
<td>To go along with STM32F401 Nucleo board. Comes with cover-glass holder, 2x cover-window samples, 3x spacers, 2x 2v8 Breakout boards</td>
</tr>
<tr>
<td>Pack: VL53L1CX Nucleo™ Expansion board + STM32F401 NUCLEO</td>
<td><img src="image" alt="Pack: VL53L1CX Nucleo™ Expansion board + STM32F401 NUCLEO" /></td>
<td>P-NUCLEO-53L1A1/</td>
<td>X-NUCLEO-53L1A1 expansion board delivered together with STM32F401 NUCLEO board</td>
</tr>
<tr>
<td>VL53L1CX Breakout boards</td>
<td><img src="image" alt="VL53L1CX Breakout boards" /></td>
<td>VL53L1X-SATEL</td>
<td>2x Breakout boards delivered</td>
</tr>
</tbody>
</table>

Go to [www.st.com/VL53L1X](http://www.st.com/VL53L1X) or contact your usual distributor
<table>
<thead>
<tr>
<th>Item</th>
<th>Picture</th>
<th>Commercial Product (= Order Code)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>VL53L1CB sensor</td>
<td><img src="image" alt="VL53L1CB sensor" /></td>
<td>VL53L1CBV0FY/1</td>
<td>Delivery in T&amp;R MOQ: 3.6ku With protective liner LT = 16 weeks</td>
</tr>
<tr>
<td>VL53L1CB Nucleo™ Expansion board</td>
<td><img src="image" alt="VL53L1CB Nucleo™ Expansion board" /></td>
<td>X-NUCLEO-53L1A2/</td>
<td>To go along with STM32F401 Nucleo board. Comes with cover-glass holder, 3x cover-window samples, 3x spacers, 2x 2v8 Breakout boards</td>
</tr>
<tr>
<td>Pack: VL53L1CB Nucleo™ Expansion board + STM32F401 NUCLEO</td>
<td><img src="image" alt="Pack: VL53L1CB Nucleo™ Expansion board + STM32F401 NUCLEO" /></td>
<td>P-NUCLEO-53L1A2/</td>
<td>X-NUCLEO-53L1A2 expansion board delivered together with STM32F401 NUCLEO board</td>
</tr>
<tr>
<td>VL53L1CB Breakout boards</td>
<td><img src="image" alt="VL53L1CB Breakout boards" /></td>
<td>VL53L1-SATEL</td>
<td>2x Breakout boards delivered</td>
</tr>
</tbody>
</table>

Go to [www.st.com/VL53L1CB](http://www.st.com/VL53L1CB) or contact your usual distributor
Numerous on-line support tools & a growing set of use-cases webinars and videos

VL53L1X Calibration free dirty environment cover glass solution

Getting Started with VL53L1X ToF sensor

People Counting Using a Single ST Time-of-Flight Sensor (VL53L0CX)

VL53L1X - smart shelves demonstrating programmable region-of-interest (ROI)

New on YouTube...

Mini LIDAR (9x VL53L1CX)

Reflectometer (VL53L0CX)
FlightSense™ vs. Other proximity sensing technologies
### FlightSense™ vs. other proximity sensing technologies

<table>
<thead>
<tr>
<th></th>
<th>Radar</th>
<th>UltraSonic</th>
<th>Conventional IR</th>
<th>ST FlightSense™</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Size/Weight</strong></td>
<td>Large PCB NovaLED: 15 x 4 x 1.5mm with antenna</td>
<td>2xToF</td>
<td>Small/Light</td>
<td>Small</td>
</tr>
<tr>
<td><strong>Mechanical integration</strong></td>
<td>Complex (antenna) Works through cover if no impact on high freq.</td>
<td>Need hole (impact on ID)</td>
<td>Easy (if all-in-one)</td>
<td>Easy (all in one, reflowable) Need Cover window</td>
</tr>
<tr>
<td><strong>FoV</strong></td>
<td>~180deg. (@2m then lower)</td>
<td>~180deg tbc</td>
<td>~25deg</td>
<td>27 to 61deg diagonal</td>
</tr>
<tr>
<td><strong>Real distance output</strong></td>
<td>Yes (5.4cm intervals)</td>
<td>No</td>
<td>No</td>
<td>Real distance in mm</td>
</tr>
<tr>
<td><strong>Ranging distance</strong></td>
<td>40cm to 9m</td>
<td>20cm to few meters</td>
<td>0cm to 20/80cm (1)</td>
<td>0cm to 4m (1)</td>
</tr>
<tr>
<td><strong>Speed</strong></td>
<td>Slow Boot-up and user detection (tbc)</td>
<td>tbc</td>
<td>Boot-up: few ms</td>
<td>Boot-up: few ms</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>User detect.: Depends on target reflectance</td>
<td>User detect: 20ms @ 1Hz</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>User vs Chair: Not possible</td>
<td>(ranging freq. programmable)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>User vs Chair distinction: 30s Maxi</td>
</tr>
<tr>
<td><strong>Reliability of ranging data</strong></td>
<td>First target detected only May detect through wall Sensitive to object charge</td>
<td>Impacted by wide sound from environment</td>
<td>Impacted by target reflectivity and IR ambient light</td>
<td>Not impacted by target reflectivity Multi target detection Sensitive to IR ambient light</td>
</tr>
<tr>
<td><strong>Power consumption</strong></td>
<td>~2.5mW in Std.by @1m (higher for longer distance)</td>
<td>Very Low</td>
<td>Low (1 depending on model and conditions)</td>
<td>Low (0.9mW for User detection under autonomous mode)</td>
</tr>
</tbody>
</table>
Thank you