

# IoTSSC Hardware Overview

## nRF51 Dev Kit

The nRF51 Series is a family of multiprotocol, System on Chip (SoC) devices for ultra-low power wireless applications. The nRF51 Series SoCs support a range of protocol stacks including *Bluetooth*® Smart, ANT™, and proprietary 2.4 GHz protocols such as Gazell and are on-air-compatible with our existing nRF24L products. In addition, we offer our own protocol stack solutions in the form of SoftDevices, which are binary file downloads that you can upload onto nRF51 Series SoCs.

### [Compatibility matrix](#)

The nRF51 Series Compatibility Matrix shows the compatibility between the nRF51 Series IC revisions, SDKs, the relevant SoftDevices with corresponding SoftDevice Specifications, and development kits. This document will be updated for every new nRF51 IC revision release, and for every new release of the SDK or SoftDevice for the nRF51 Series IC.

### [Development](#)

Development on nRF51422 and nRF51822 is supported by the nRF51 Development Kit and the nRF51 Dongle. Both kits are compatible with Keil, IAR, GCC, and the ARM mbed toolchain. In addition, they can be used as a Bluetooth Smart packet sniffer to test the connection of your application.

### [Reference Manual](#)

The reference manual is a functional description of all the modules and peripherals supported by the nRF51 Series and subsequently, is a common document for all nRF51 System on Chip (SoC) devices.

Extensive details with manufacturer nRF51 documentation.<sup>1</sup> Reference guide is here.<sup>2</sup>

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<sup>1</sup>

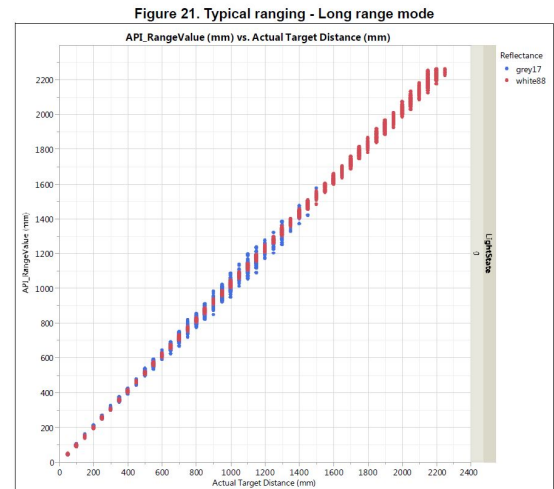
[http://infocenter.nordicsemi.com/index.jsp?topic=%2Fcom.nordic.infocenter.nrf51%2Fdita%2Fnrf51%2Fnrf51\\_series.html](http://infocenter.nordicsemi.com/index.jsp?topic=%2Fcom.nordic.infocenter.nrf51%2Fdita%2Fnrf51%2Fnrf51_series.html)

<sup>2</sup> [http://infocenter.nordicsemi.com/pdf/nRF51\\_RM\\_v3.0.1.pdf](http://infocenter.nordicsemi.com/pdf/nRF51_RM_v3.0.1.pdf)

# VL53L0X Distance Sensor

This sensor is a carrier/breakout board for ST's VL53L0X laser-ranging sensor, which measures the range to a target object **up to 2 m** away. The VL53L0X uses time-of-flight measurements of infrared pulses for ranging, allowing it to give accurate results independent of the target's color and surface. Distance measurements can be read through a digital I<sup>2</sup>C interface. The board has a 2.8 V linear regulator and integrated level-shifters that allow it to work over an input voltage range of 2.6 V to 5.5 V, and the 0.1" pin spacing makes it easy to use with standard solderless breadboards and 0.1" perfboards.

Uses a small laser to detect distance of object directly in front of the sensor. Good at determining distance of **only** the object directly in front of it, as it does not produce a sensing cone. Can sense from 50mm-1200mm in default mode. Can be extended to 2200mm with long-range mode (as shown below).



Further specification details can be found on the Pololu website.<sup>3</sup>

## Adafruit LSM9DS1 9-DOF

- 3-axis accelerometer, can determine direction sensor is facing with regards to ground.
- 3-axis magnetometer, can determine direction of Earth's magnetic field and nearby magnets.
- 3-axis gyroscope to orient direction in space.

Add motion, direction and orientation sensing to your Arduino project with this all-in-one 9-DOF sensor. Inside the chip are three sensors, one is a classic

<sup>3</sup> <https://www.pololu.com/product/2490>

3-axis accelerometer, which can tell you which direction is down towards the Earth (by measuring gravity) or how fast the board is accelerating in 3D space. The other is a 3-axis magnetometer that can sense where the strongest magnetic force is coming from, generally used to detect magnetic north. The third is a 3-axis gyroscope that can measure spin and twist. By combining this data you can REALLY orient yourself.<sup>4</sup>

## Component breakdown

A **magnetometer** or magnetic [sensor](#) is an instrument that measures [magnetism](#)—either the [magnetization](#) of a magnetic material like a [ferromagnet](#), or the direction, strength, or relative change of a [magnetic field](#) at a particular location. A [compass](#) is a simple type of magnetometer, one that measures the direction of an ambient magnetic field.<sup>5</sup>

An **accelerometer** is a device that measures [proper acceleration](#).<sup>[1]</sup> Proper acceleration, being the [acceleration](#) (or [rate of change](#) of [velocity](#)) of a body in its own instantaneous [rest frame](#),<sup>[2]</sup> is not the same as coordinate acceleration, being the acceleration in a fixed [coordinate system](#).<sup>6</sup>

A **gyroscope** (from [Ancient Greek](#) γῦρος *gûros*, "circle" and σκοπέω *skopéō*, "to look") is a device used for measuring or maintaining [orientation](#) and [angular velocity](#).<sup>[1][2]</sup> It is a spinning wheel or disc in which the axis of rotation is free to assume any orientation by itself. When rotating, the orientation of this axis is unaffected by tilting or rotation of the mounting, according to the [conservation of angular momentum](#).<sup>7</sup>

## PIR Sensor

The PIR Sensor detects motion by measuring changes in the infrared (heat) levels emitted by surrounding objects. When motion is detected a LED lights up the lens dome as a visual signal, and the module also outputs a high signal on its output pin.

## Tech Details

- Longer detection range, selectable by onboard jumper
- Wider supply voltage, from 3 to 6 VDC

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<sup>4</sup>

<https://learn.adafruit.com/adafruit-lsm9ds1-accelerometer-plus-gyro-plus-magnetometer-9-dof-breakout/overview>

<sup>5</sup> <https://en.wikipedia.org/wiki/Magnetometer>

<sup>6</sup> <https://en.wikipedia.org/wiki/Accelerometer>

<sup>7</sup> <https://en.wikipedia.org/wiki/Gyroscope>

- Higher output current provides for direct control of an external load
- Mounting holes included for permanent projects
- All parts SMT

### Key Features:

- Typically detects a person up to approximately 30 ft (9.14m) away, or up to 15 ft (4.57m) away in reduced sensitivity mode
- Jumper selects normal operation or reduced sensitivity
- Approximately 90 degree field of view
- LEDs light up the dome for visual signal of sensor activation
- Mounting holes for 2-56 sized screws provide easy integration in permanent applications
- 3-pin SIP package perfect for breadboard-friendly projects
- Easy communication with any microcontroller
- Small size makes it easy to conceal

Alternate specification of module can be found on the Digi-Key website.<sup>9</sup> Pin and further specifications can also be found within this Parallax documentation.<sup>10</sup>

## IR Sensor Technology

The IR sensor itself is housed in a hermetically sealed metal can to improve noise/temperature/humidity immunity. There is a window made of IR-transmissive material (typically coated silicon since that is very easy to come by) that protects the sensing element. Behind the window are the two balanced sensors.

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<sup>8</sup> <https://www.parallax.com/product/555-28027>

<sup>9</sup> <https://www.digikey.co.uk/product-detail/en/parallax-inc/555-28027/555-28027-ND/1774435>

<sup>10</sup> <https://www.ladyada.net/media/sensors/PIRSensor-V1.2.pdf>

The PIR sensor detects changes in infrared energy, in other words it is a motion detector. The PIR can be aimed at a target area where it is expected that trickier treaters will walk past. As the trickier treaters walk in the path of the PIRs detection area, the PIR will detect the change in IR energy and will output a signal to the microcontroller. The PIR then hands off responsibility to the microcontroller and the microcontroller will do whatever task it is programmed to do, such as turn on LEDs, play a wav file containing spooky music or an evil laugh recording. This is a common application for PIR sensors. You could also use the PIR combined with a microcontroller (such as Basic Stamp) to drop props such as a ghost or bats from a porch or tree. Visit the Parallax website or [learn.parallax](http://learn.parallax.com) for more ideas and tutorials<sup>11</sup>

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<sup>11</sup> <https://www.amazon.com/Parallax-555-28027-Sensor-Passive-1-41/dp/B00B8867V4>