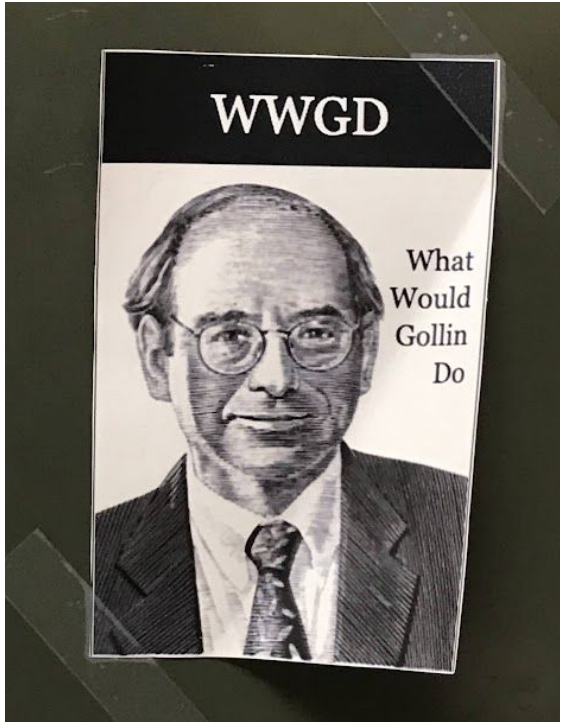


LSM9DS1 “9 Axis” Accelerometer

Group 1: The Sound Blasters

The LSM9DS1 "9 axis" Accelerometer

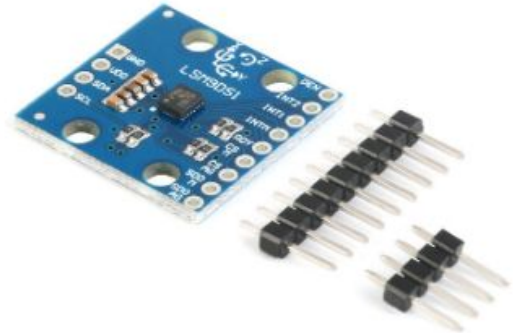
LSM9DS1 9-axis IMU Module

SKU 28065

~~$39.95~~ **$19.98**

Out of stock

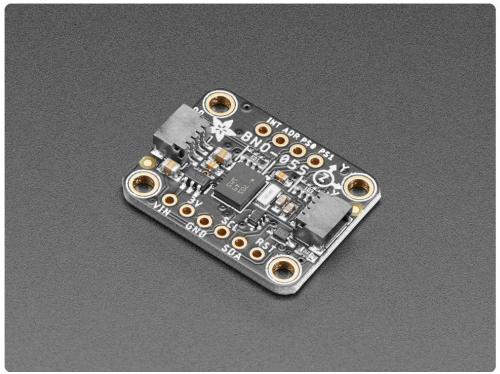
UNIT PRICE
$14.95000



Market Price: ~~USD $25.00~~

Price: USD $14.99

Save $10.01 (40% Off)



Adafruit 9-DOF Absolute Orientation IMU Fusion Breakout - BNO055 - STEMMA QT / Qwiic

Product ID: 4646

$29.95

In stock

1 Add to Cart

Also include 1 x STEMMA QT / Qwiic JST SH 4-pin to Premium Male Headers Cable ($0.95)

Also include 1 x STEMMA QT / Qwiic JST SH 4-pin Cable - 100mm Long ($0.95)

Qty	Discount
1-9	$29.95
10-99	$26.96
100+	$23.96

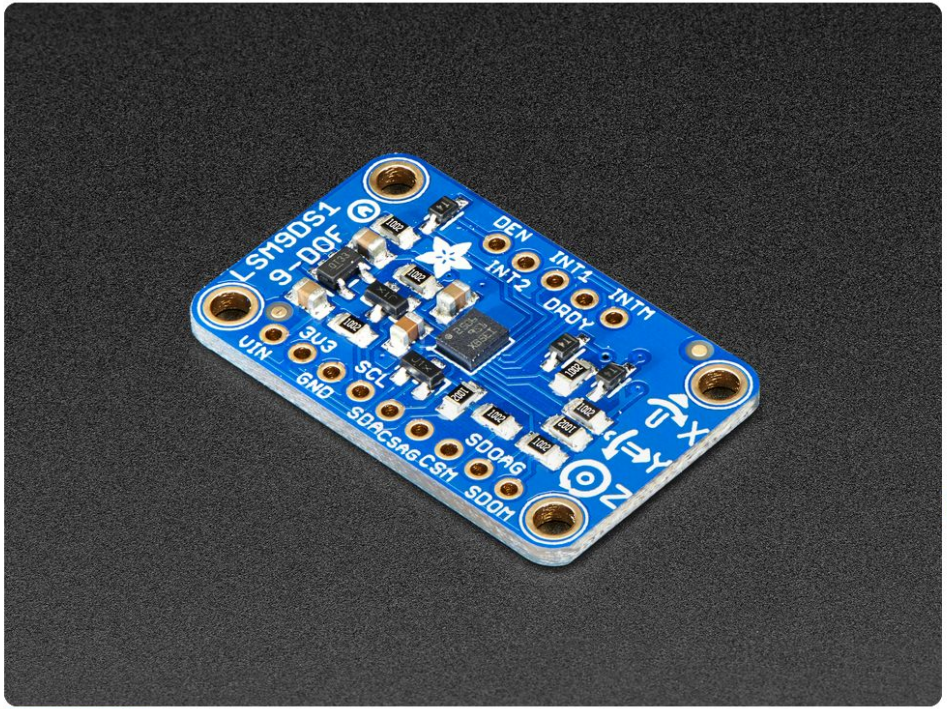
Add to Wishlist

Description

Technical Details

The LSM9DS1 "9 axis" Accelerometer

There are many variations of this device available, all of which use a mixture of Accelerometer, Gyro, and Magnetometer components to catalogue the position and motion of the device.



Adafruit 9-DOF Accel/Mag/Gyro+Temp Breakout Board - LSM9DS1

Product ID: 3387

$39.95

In stock

1 | Add to Cart

Qty	Discount
1-9	$39.95
10-99	$35.96
100+	$31.96

Add to Wishlist

Description

Technical Details

For the purpose of this presentation, all specs used will be referencing the adafruit variant that is found in our lab kits.

Back to basics ~ *accelerometer*

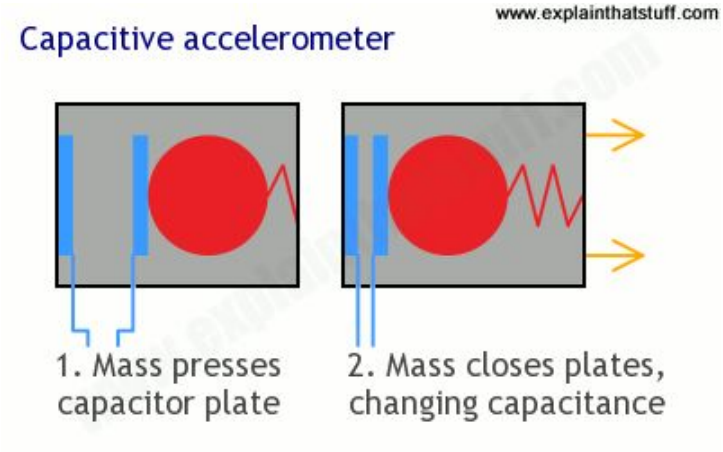
An accelerometer is a tool designed to measure ***proper*** acceleration, i.e. the acceleration of a body in its own instantaneous rest frame. We note this because it is important to know that an accelerometer does NOT measure coordinate acceleration, i.e. the acceleration in a fixed coordinate system.

This is a distinction you may recall from relativity, but why does it matter? Because of this, an accelerometer at rest on the surface of the Earth will measure an acceleration due to Earth's gravity, while accelerometers in free fall will measure zero.

Surprise! You're already familiar with this technology!

So how does it work?

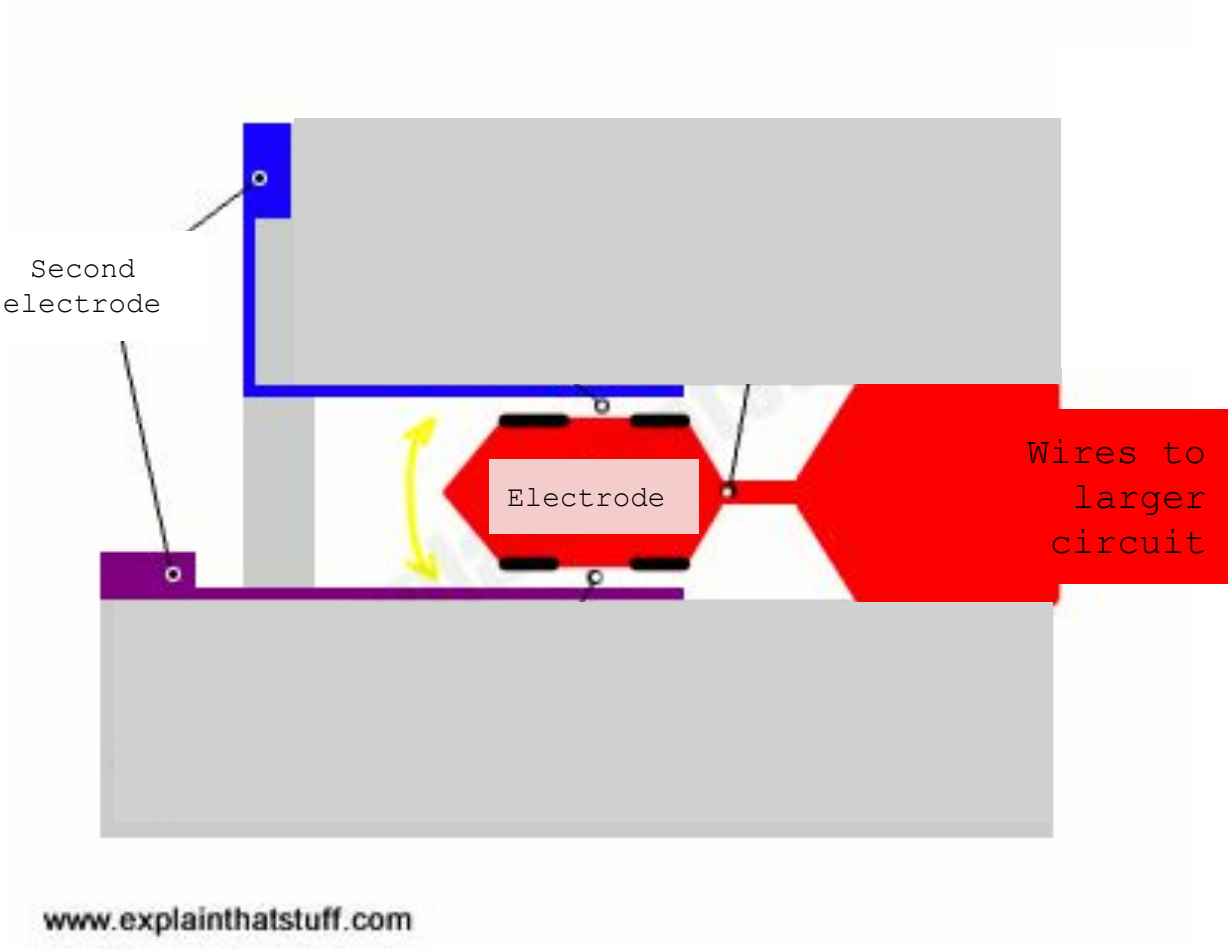
The accelerometer found in a device like this is a tiny microelectromechanical system (MEMS), kind of like a microscopic mass on a spring connected to a capacitor. The spring compression/extension lead to tiny changes in electrical output that can be amplified and measured.



MEMS

The two electrodes work together to form a capacitor.

This system can take precise measurements in a very small space (needing only movements as small as microns).



Wait…“9 axis”?

An accelerometer has 3 axes, x,y, and z.

So what about the other 6?

Two more motion detecting sensors — the gyroscope and the magnetometer — work to aid in positioning efforts.

Gyroscope

How does it work (to provide position)

A device with a disc or some mass mounted to it. The disc will rotate around an axis. The orientation is not affected by tilting the gyroscope. We can use this feature to measure rotation and angular velocities

Gyroscope continued

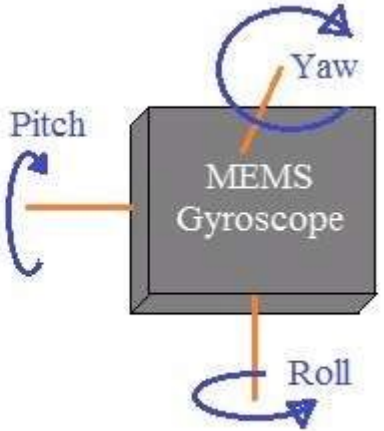
-Mechanical and electrical gyroscope

Mechanical: It uses spinning mass mounted on gimbals to detect rotation.

Electrical: It uses alternating current to

induce rotations of a mass.

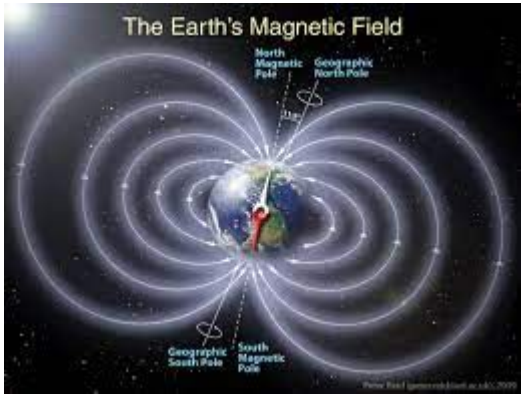
-In LSM9DS1 “9 Axis”, a MEMS gyroscope is used. I rotation in xyz axes(Pitch, Yaw, Roll).



Magnetometer

How does it work (to provide orientation data)

- Earth’s Magnetic Field
  - Magnetometer measures the orientation of the sensor with respect to the Earth’s magnetic field
- The “Northern” Direction
  - Does not align with the geographic location of the North Pole (albeit kind of close)
- Can measure the magnitude of a magnetic field

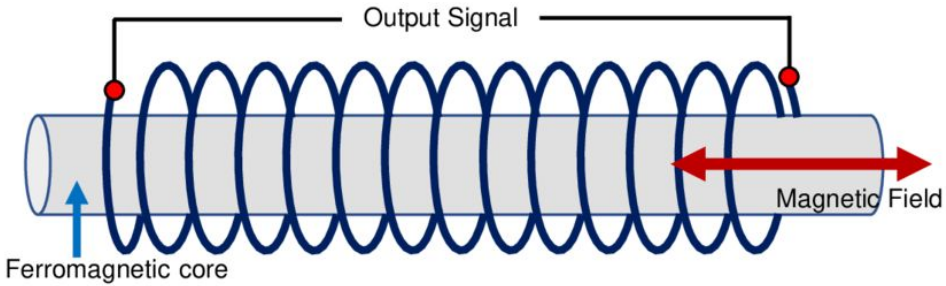


Types of Magnetometer

Scalar Magnetometer:Only captures the magnitude of the magnetic field

Vector Magnetometer: Captures both the magnitude and direction of the magnetic field

- We probably use a “Search Coil Magnetometer”. The other kinds of vector magnetometers use superconductors.



And everyone is friends?

The three sensors work together to provide a detailed orientation. In summary,

- The 3-axis accelerometer can tell you which direction is down towards the Earth (by measuring gravity) or how fast the board is accelerating in 3D space.
- The 3-axis magnetometer can sense where the strongest magnetic force is coming from, generally used to detect magnetic north.
- The 3-axis gyroscope that can measure spin and twist.

“By combining this data you can REALLY orient yourself!”

- Adafruit Overview

Device to controller interface

- I2C

  -0x6A or 0x6B are the addresses for the accelerometer and the gyroscope.

  -0x1C or 0x1E are the addresses for the magnetometer.

- SPI

  -SCL - this is also the SPI clock pin, it's level shifted so you can use 3-5V logic input

  -SDA - this is also the SPI MOSI pin, it's level shifted so you can use 3-5V logic input

  -CSAG - this is the Accelerometer+Gyro subchip Chip Select, it's level shifted so you can use 3-5V logic input

  -CSM - this is the Magnetometer subchip Select, it's level shifted so you can use 3-5V logic input

  -SDOAG - this is the Accelerometer+Gyro subchip MISO pin - it's 3V logic out, but can be read properly by 5V logic chips.

  -SDOM/DOM- this is the Magnetometer subchip MISO pin - it's 3V logic out, but can be read properly by 5V logic chips.

What can be done with a device such as this?

-smartphones- orientation of screen

-rockets- lets crew know when they reach orbit

-clothes washing machines- prevent unstable spins tearing machine apart

-heaters- turn off if not upright, prevent fires

Citations

Adafruit LSM9DS1 Accelerometer + Gyro + Magnetometer 9-DOF Breakout

Adafruit LSM9DS1 Accelerometer + Gyro + Magnetometer 9-DOF Breakout

Adafruit 9-DOF Absolute Orientation IMU Fusion Breakout - BNO055 [STEMMA QT / Qwiic] : ID 4646 : $29.95

Accel/mag/gyro+temp Breakout Lsm9ds1 - 3387

Digikey | MOD ADXL335 5V READY 3AXIS +-3G

LSM9DS1 9-axis IMU Module - Parallax

Accelerometer - Wikipedia

The Accelerometer in Smartphones and the IOlab

Connect to LSM9DS1 sensor on Arduino hardware I2C bus - MATLAB (mathworks.com)

https://www.explainthatstuff.com/accelerometers.html

https://www.youngwonks.com/blog/What-is-a-Magnetometer-and-How-Does-It-Work#:~:text=Based%20on%20the%20principle%20of,the%20flow%20of%20electrical%20currents.