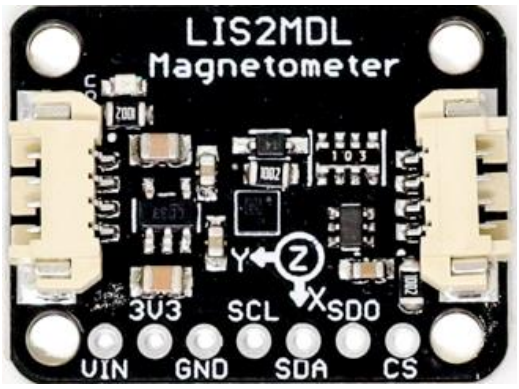
SmartElex Triple-axis Magnetometer - LIS2MDL



Sense the magnetic fields that surround us with this handy triple-axis magnetometer (compass) module. Magnetometers can sense where the strongest magnetic force is coming from, generally used to detect magnetic north, but can also be used for measuring magnetic fields. This sensor tends to be paired with a 6-DoF (degree of freedom) accelerometer/gyroscope to create a 9-DoF inertial measurement unit that can detect its orientation in real-space, thanks to Earth's stable magnetic field. It's a great match for any of our 6-DoF IMU sensors such as the LSM6DSOX or LSM6DS33.

We based this breakout on ST's LIS2MDL, a great general purpose magnetometer. This compact sensor uses I2C to communicate and its very easy to use. Simply download our library and connect the SCL pin to your I2C clock pin, and SDA pin to your I2C data pin and upload our test program to read out magnetic field data. If you'd like, you can also use SPI to receive data (we just happen to prefer I2C here) This sensor can measure up to nearly **+-50 gauss** (49.152 gauss to be specific**,** +-4952 uTesla) which is quite a bit! It also has an adjustable data rate and can take measurements as slowly as 10Hz and as fast as 100Hz.

This adorable little magnetometer is quite capable but it is near-microscopic at 2mm square. To make things easier, we've put it on a breakout PCB along with

support circuitry to let you use this little wonder with 3.3V (Feather/Raspberry Pi) or 5V (Arduino/ Metro328) logic levels.

Power Pins

- **Vin** - this is the power pin. Since the sensor chip uses 3 VDC, we have included a voltage regulator on board that will take 3-5VDC and safely convert it down. To power the board, give it the same power as the logic level of your microcontroller - e.g. for a 5V microcontroller like Arduino, use 5V
- **3Vo** - this is the 3.3V output from the voltage regulator, you can grab up to 100mA from this if you like
- **GND** - common ground for power and logic

I2C Logic Pins

- **SCL** - I2C clock pin, connect to your microcontroller's I2C clock line. This pin is level shifted so you can use 3-5V logic, and there's a **10K pullup** on this pin.
- **SDA** - I2C data pin, connect to your microcontroller's I2C data line. This pin is level shifted so you can use 3-5V logic, and there's a 1**0K pullup** on this pin.

SPI Logic pins:

All pins going into the breakout have level shifting circuitry to make them 3-5V logic level safe. Use whatever logic level is on **Vin!**

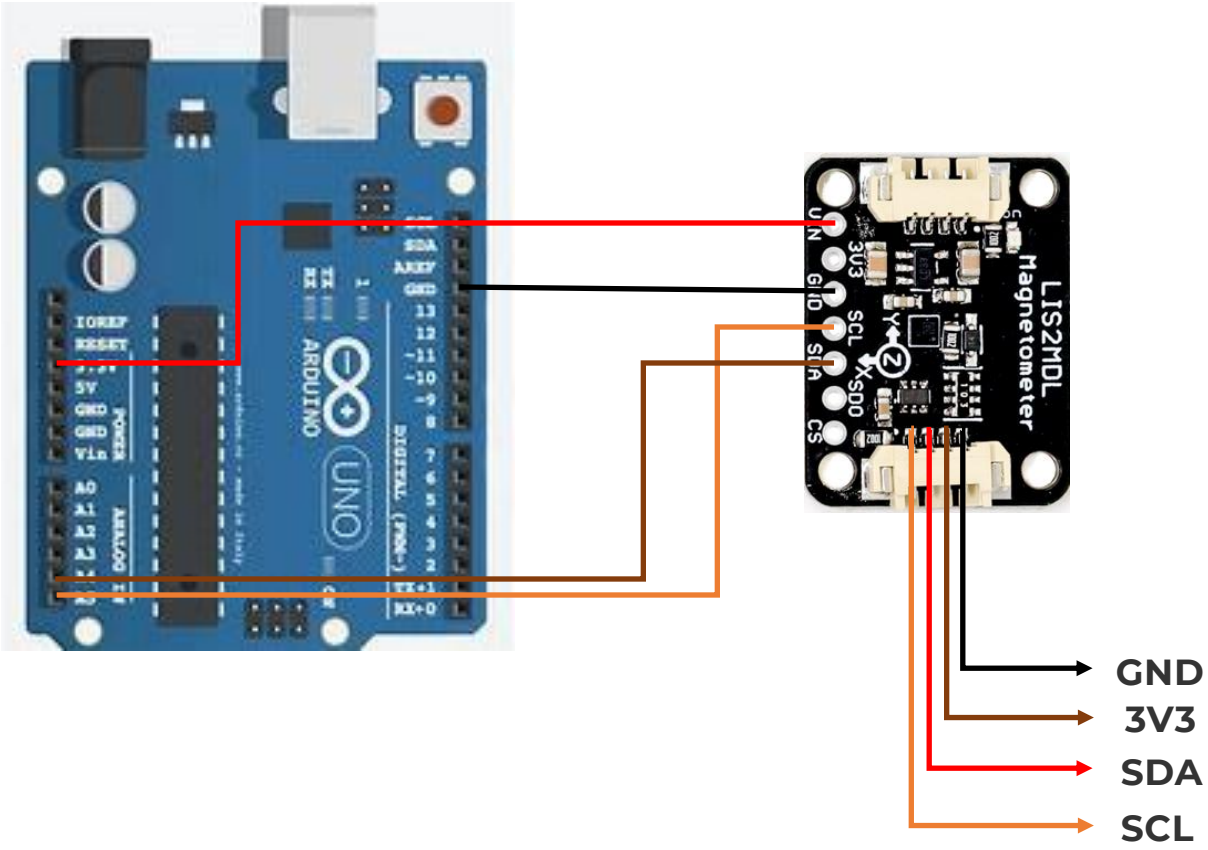
- **SCL** - This is *also* the **S**PI **C**loc**k** pin, it's an input to the chip
- **SDA** - this is *also* the **S**erial **D**ata **I**n / **M**icrocontroller **O**ut **S**ensor **I**n pin, for data sent from your processor to the LIS2MDL
- **SDO** - this is the **S**erial **D**ata **O**ut / **M**icrocontroller **I**n **S**ensor **O**ut pin, for data sent from the LIS2MDL to your processor.
- **CS** - this is the **C**hip **S**elect pin, drop it low to start an SPI transaction. Its an input to the chip

If you want to connect multiple LIS2MDLs to one microcontroller, have them share the **SDA**, **SDO** and **SCL** pins. Then assign each one a unique **CS** pin.

I2C Wiring

Use this wiring if you want to connect via I2C interface:

The I2C address is **0x1E.**

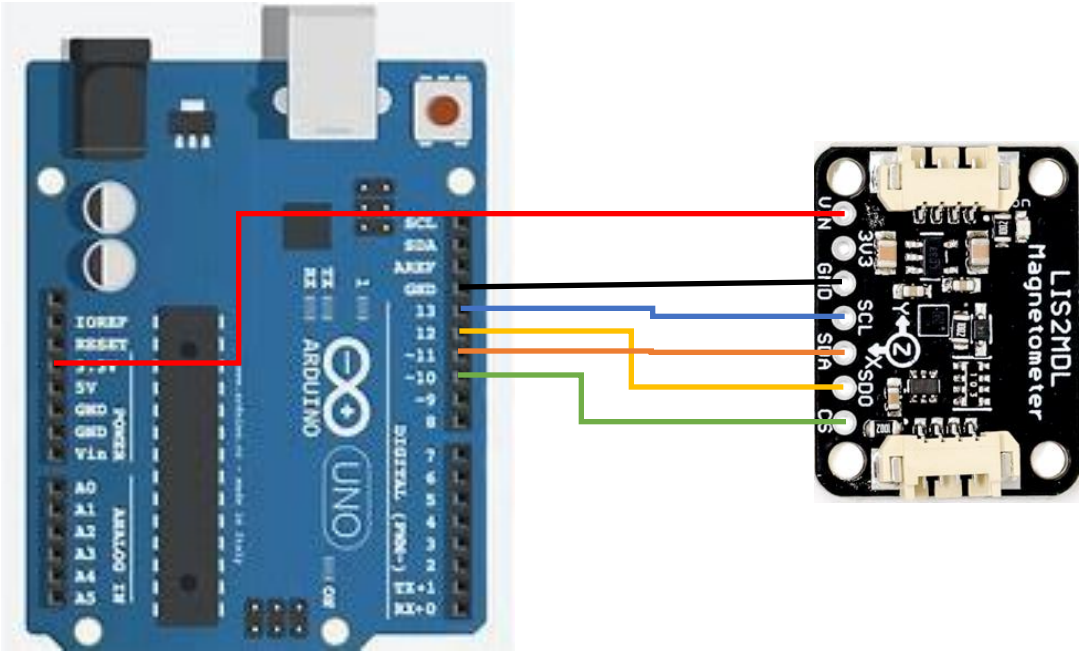


Arduino	LIS2MDL
SCL(A5)	SCL
SDA(A4)	SDA
5v OR 3.3v	VIN
GND	GND

- Connect **board VIN** to **Arduino 5V** if you are running a **5V** board Arduino (Uno, etc.). If your board is **3V,** connect to that instead.
- Connect **board GND** to **Arduino GND**
- Connect **board SCL** to **Arduino SCL**
- Connect **board SDA** to **Arduino SDA**

SPI Wiring

Since this is a SPI-capable sensor, we can use hardware or 'software' SPI. To make wiring identical on all microcontrollers, we'll begin with 'software' SPI. The following pins should be used:



Arduino	LIS2MDL
D13(SCK)	SCL
D12(MISO)	SDO
D11(MOSI)	SDA
D10(SS)	CS
5v OR 3.3v	VIN
GND	GND

- Connect **Vin** to the power supply, 3V or 5V is fine. Use the same voltage that the microcontroller logic is based off of.
- Connect **GND** to common power/data ground
- Connect the **SCL** pin to **Digital #13** but any pin can be used later
- Connect the **DO** pin to **Digital #12** but any pin can be used later
- Connect the **SDA** pin to **Digital #11** but any pin can be used later
- Connect the **CS** pin **Digital #10** but any pin can be used later

Later on, once we get it working, we can adjust the library to use hardware SPI if you desire, or change the pins to others.

Library Installation

You can install the **Adafruit LIS2MDL Library** for Arduino using the Library Manager in the Arduino IDE.

Click the **Manage Libraries ...** menu item, search for **Adafruit LIS2MDL**, and select the **Adafruit LIS2MDL** library:

Load Example

Open up **File -> Examples -> Adafruit LIS2MDL -> magsensor** and upload to your Arduino which has been wired up to the sensor.

Depending on whether you are using I2C or SPI, change the pin names and comment or uncomment the following lines.

```
if (!lis2mdl.begin()) {  // I2C mode
  //if (! lis2mdl.begin_SPI(LIS2MDL_CS)) {  // hardware SPI mode
  //if (! lis2mdl.begin_SPI(LIS2MDL_CS, LIS2MDL_CLK, LIS2MDL_MISO,
LIS2MDL_MOSI)) { // soft SPI
```

Once you upload the code and open the Serial Monitor (**Tools->Serial Monitor**) at **115200** baud, you will see the current configuration printed, followed by magnetometer measurements, similar to this:

```
Magnetometer Test

------------------------------------
Sensor:       LIS2MDL
Driver Ver:   1
Unique ID:    12345
Max Value:    0.00 uT
Min Value:    0.00 uT
Resolution:   0.00 uT
------------------------------------

X: 17.40  Y: 65.55  Z: -29.40  uT
X: 16.35  Y: 65.25  Z: -30.00  uT
X: 16.65  Y: 65.85  Z: -29.40  uT
```

The sensor class in the magnetometer library reports X, Y and Z axis magnetometer readings directly in micro-Teslas. The **magsensor** example code reads from the sensor and prints the micro-Tesla readings to the Serial Monitor.

In the absence of any strong local magnetic fields, the sensor readings should reflect the magnetic field of the earth (between 20 and 60 micro-Teslas). When the sensor is held level, by calculating the angle of the magnetic filed with respect to the X and Y axis, the device can be used as a compass.

Example Code

```
#include <Adafruit_LIS2MDL.h>

#include <Adafruit_Sensor.h>

#include <Wire.h>
```

```
/* Assign a unique ID to this sensor at the same time */
Adafruit_LIS2MDL lis2mdl = Adafruit_LIS2MDL(12345);
#define LIS2MDL_CLK 13
#define LIS2MDL_MISO 12
#define LIS2MDL_MOSI 11
#define LIS2MDL_CS 10

void setup(void) {
 Serial.begin(115200);
 while (!Serial)
   delay(10); // will pause Zero, Leonardo, etc until serial console opens

 Serial.println("LIS2MDL Magnetometer Test");
 Serial.println("");

 /* Enable auto-gain */
 lis2mdl.enableAutoRange(true);

 /* Initialise the sensor */
 if (!lis2mdl.begin()) {  // I2C mode
 //if (! lis2mdl.begin_SPI(LIS2MDL_CS)) {  // hardware SPI mode
 //if (! lis2mdl.begin_SPI(LIS2MDL_CS, LIS2MDL_CLK, LIS2MDL_MISO, LIS2MDL_MOSI)) { // soft SPI
   /* There was a problem detecting the LIS2MDL ... check your connections */
   Serial.println("Ooops, no LIS2MDL detected ... Check your wiring!");
   while (1) delay(10);
 }

 /* Display some basic information on this sensor */
 lis2mdl.printSensorDetails();
```

```
}

void loop(void) {
 /* Get a new sensor event */
 sensors_event_t event;
 lis2mdl.getEvent(&event);

 /* Display the results (magnetic vector values are in micro-Tesla (uT)) */
 Serial.print("X: ");
 Serial.print(event.magnetic.x);
 Serial.print("  ");
 Serial.print("Y: ");
 Serial.print(event.magnetic.y);
 Serial.print("  ");
 Serial.print("Z: ");
 Serial.print(event.magnetic.z);
 Serial.print("  ");
 Serial.println("uT");

 /* Note: You can also get the raw (non unified values) for */
 /* the last data sample as follows. The .getEvent call populates */
 /* the raw values used below. */
 // Serial.print("X Raw: "); Serial.print(lis2mdl.raw.x); Serial.print("  ");
 // Serial.print("Y Raw: "); Serial.print(lis2mdl.raw.y); Serial.print("  ");
 // Serial.print("Z Raw: "); Serial.print(lis2mdl.raw.z); Serial.println("");

 /* Delay before the next sample */
 delay(100);
}
```