

Introduction to Soft Robotics

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Part 1: Arduino 101

Arduino Uno and Serial communication



Arduino IDE 1.8.19

The open-source Arduino Software (IDE) makes it easy to write code and upload it to the board. This software can be used with any Arduino board.

Refer to the [Getting Started](#) page for Installation instructions.

SOURCE CODE

Active development of the Arduino software is [hosted by GitHub](#). See the instructions for [building the code](#). Latest release source code archives are available [here](#). The archives are PGP-signed so they can be verified using [this](#) gpg key.

DOWNLOAD OPTIONS

Windows Win 7 and newer
Windows ZIP file

Windows app Win 8.1 or 10 [Get](#)

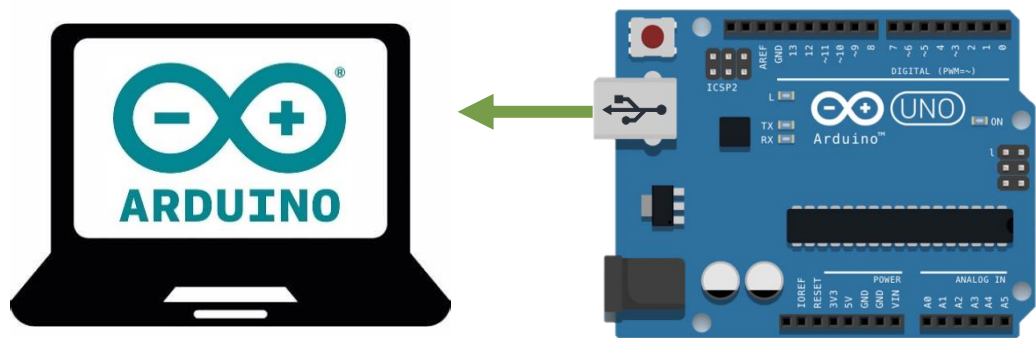
Linux 32 bits
Linux 64 bits
Linux ARM 32 bits
Linux ARM 64 bits

Mac OS X 10.10 or newer

Release Notes

Checksums (sha512)

[Download Link](#)



Soro_101 | Arduino 1.8.15

File Edit Sketch Tools Help

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Soro_101

```
previousMilliseconds = milliseconds;
angle = previousAngle + deltaRadians(elapsed, radiansPerMillisecond);
previousAngle = angle;

Serial.print(sin(angle));
Serial.print(', ');
Serial.println(2*sin(2*angle));
delay(10);

}

// functions
```

avrduide done. Thank you.

COM5

Arduino Uno on COM5

Signal1 Signal2



115200 baud | Send Newline

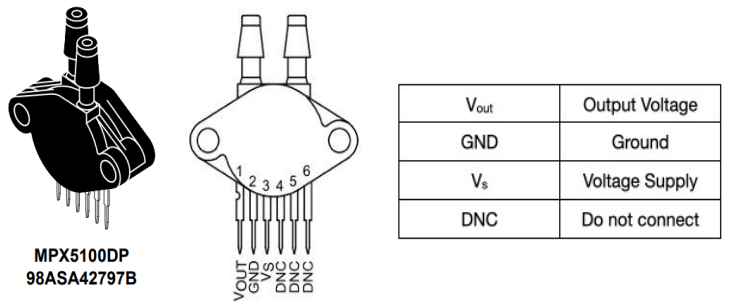


SoRo_101 QR code

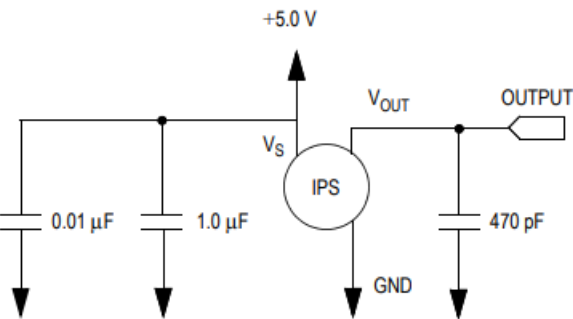
[GitHub Link](#)

Part 2: MPX5100 Integrated Silicon Pressure Sensor

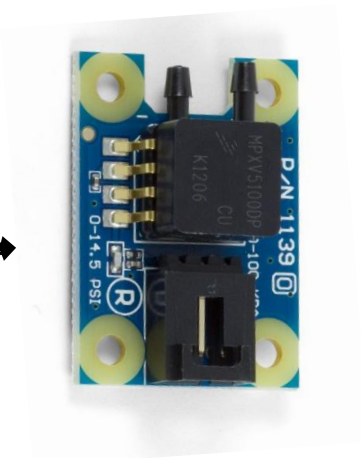
MPX5100, 0 to 100 kPa Pressure Transducer



Characteristic	Symbol	Min	Typ	Max	Unit
Pressure range ⁽¹⁾	P_{OP}				kPa
Gauge, differential: MPX5100G/MPXV5100G		0	—	100	
Absolute: MPX5100AP		15	—	115	
Supply voltage ⁽²⁾	V_S	4.75	5.0	5.25	V_{DC}
Supply current	I_O	—	7.0	10	mAdc



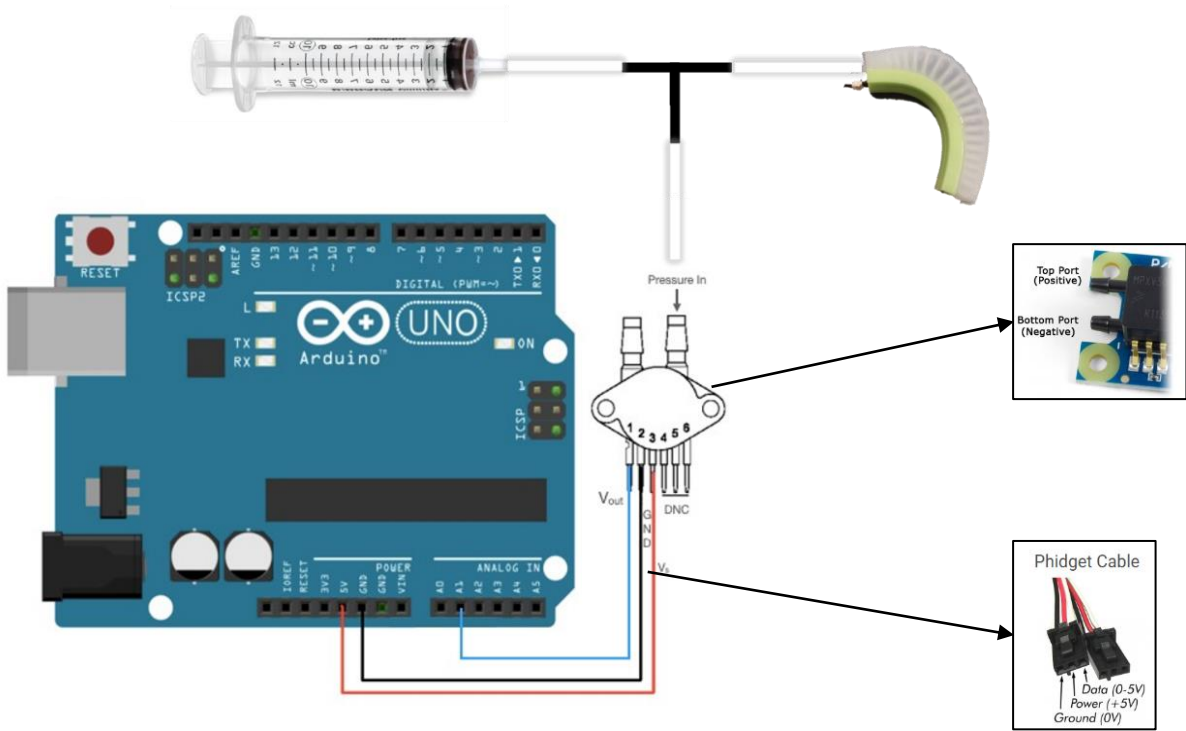
[Full data sheet of the pressure sensor](#)



Right port: GND
Middle Port: 5V
Left Port: Signal

[Phidget website](#)

Wiring to Arduino



Please before connection to Arduino double check with TA for the wire connections

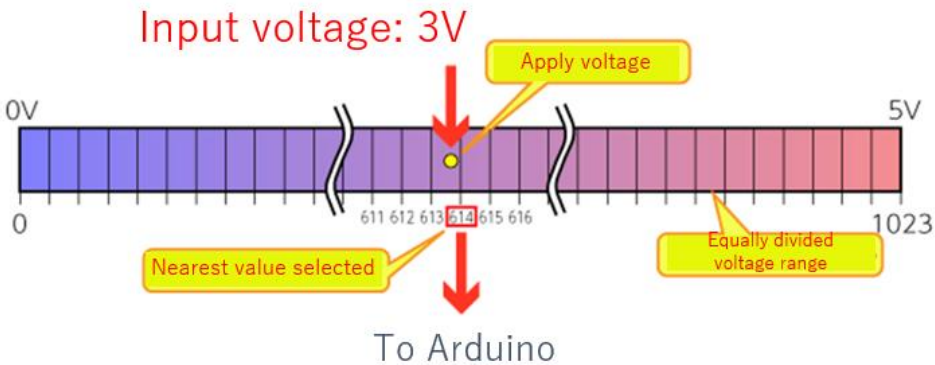
Voltage to Pressure Conversion

Nominal Transfer Value:

$$V_{OUT} = V_S (P \times 0.009 + 0.04) \pm (\text{Pressure Error} \times \text{Temp. Mult.} \times 0.009 \times V_S)$$

$V_S = 5.0 \text{ V} \pm 0.25 \text{ V}$

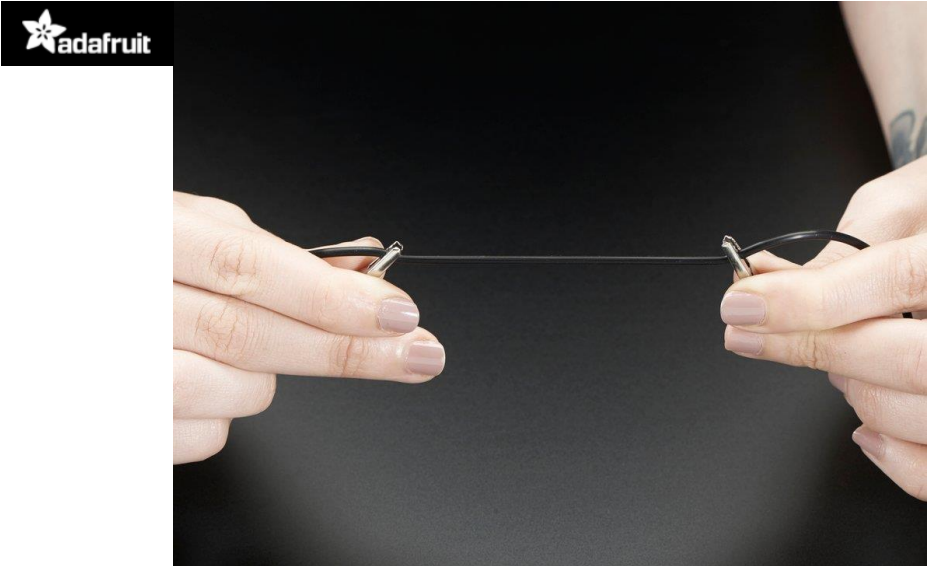
Arduino Bit conversion



$$Voltage = \frac{5}{1023} * analogread$$

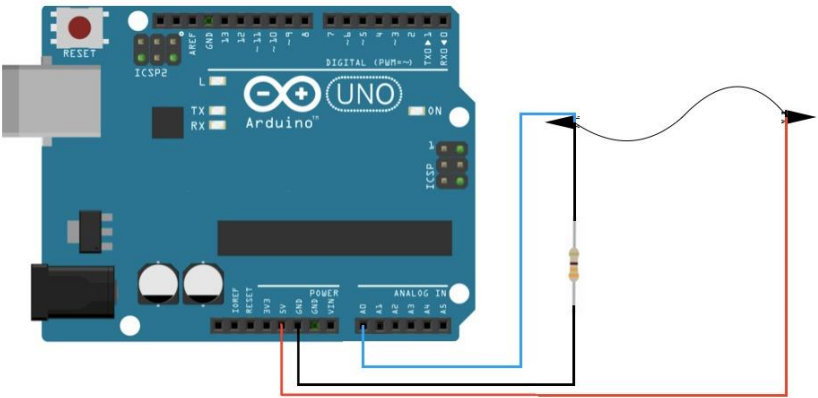
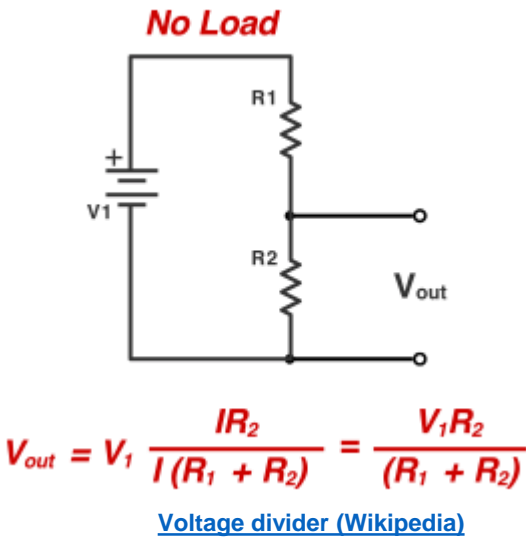
Part 3: Conductive Rubber Cord Sensor

Voltage divider

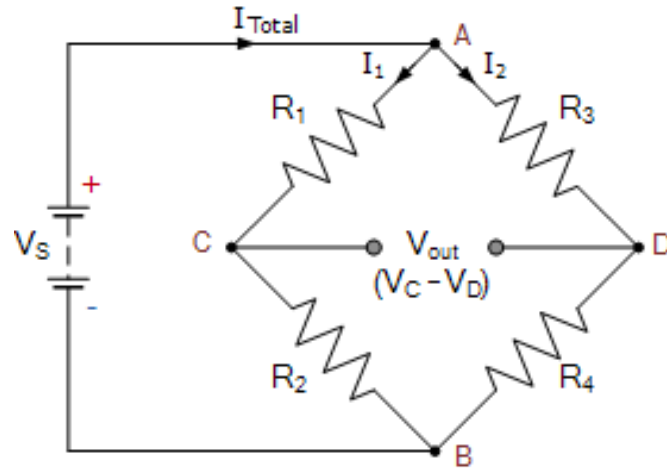


TECHNICAL DETAILS

Length: approximately 1 meter = 39 inches
Diameter: 2mm
Resistance: 350-400 ohms per inch / 140 - 160 ohms per centimeter

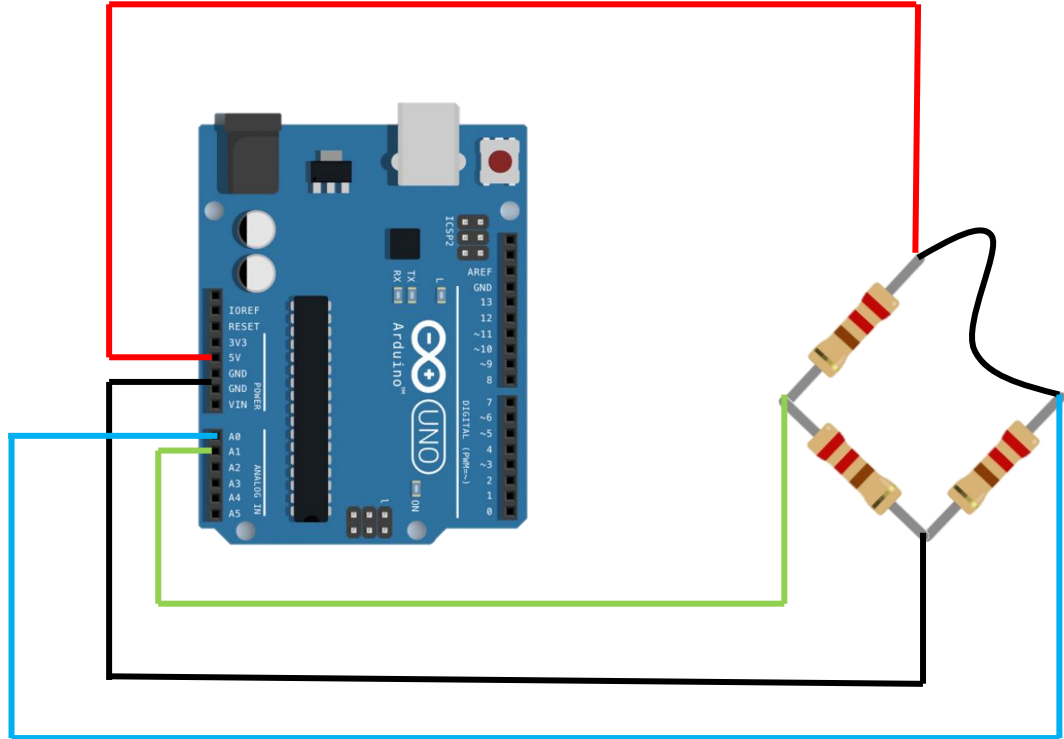


Wheatstone Bridge



[Wheatstone bridge instruction \(Youtube\)](#)

$$R_3 = R_4 * \left(\frac{1 - \left(\frac{R_2}{R_1 + R_2} - \frac{V_{out}}{V_s} \right)}{\frac{R_2}{R_1 + R_2} - \frac{V_{out}}{V_s}} \right)$$



Part 4:

Data Acquisition with

MATLAB and Python

Code Information

MATLAB

Setting up Arduino data collection in MATLAB

- Type: `a = arduino("com3","Uno")` in MATLAB command windows (the com is dependent on your computer COM)
- Install the required package if needed ([Link](#))
- When the package is installed, you can directly read the voltage of the analog pin of the Arduino via `readVoltage(a, 'analogpin')`
- An example code to measure the pressure in Part 2 can be accessed via [GitHub](#) and the next slide

Code Information

MATLAB

<pre>%% Setting up arduino a = arduino('com','Uno');</pre>	
<pre>%% Collecting voltage information from the arduino seconds =10; % Defining the required duration for the data collection elapsed_time = 0; tic % initiate time duration while elapsed_time<seconds v = readVoltage(a,'A0'); % collecting voltage data from Arduino. % Please mind that you have to adjust the pin based on the your input % pin in arduino elapsed_time = toc; %collecting time for each iteration end</pre>	
<pre>%% Applying sensor transfer function P = (v-0.2)/0.045; % calculating the pressure based on the read voltage</pre>	

Code Information

Python

Setting up Arduino data collection in Python

→ Type `$ pip install pyserial` in your Python console to install it.

→ If you are using Anaconda Prompt use the following code : `conda install pyserial`

→ Import **Serial**, **time**, **matplotlib.pyplot** for acquiring the data and plotting.

→ An example code to measure the pressure in Part 2 can be accessed via [GitHub](#) and the next slide

Code Information

Python

```
import serial

import time

import matplotlib.pyplot as plt

ser = serial.Serial('COM4', 9600)
time.sleep(2)

data = []

for i in range(50):
    line = ser.readline()
    if line:
        string = line.decode()
        num = float(string)
        print(num)
        data.append(num)

ser.close()

plt.plot(data)
plt.xlabel('Time')
plt.show()
```