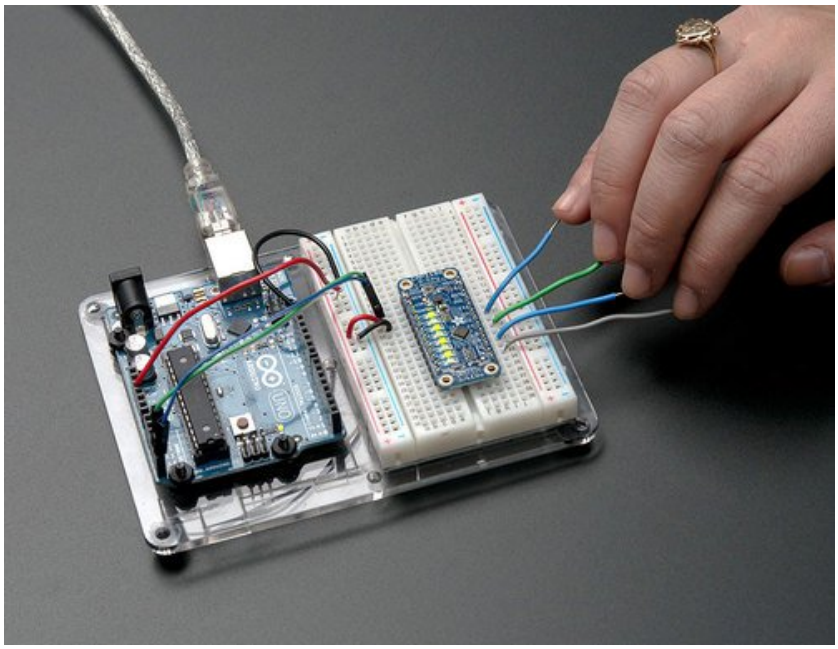
Adafruit CAP1188 Breakout

Created by lady ada



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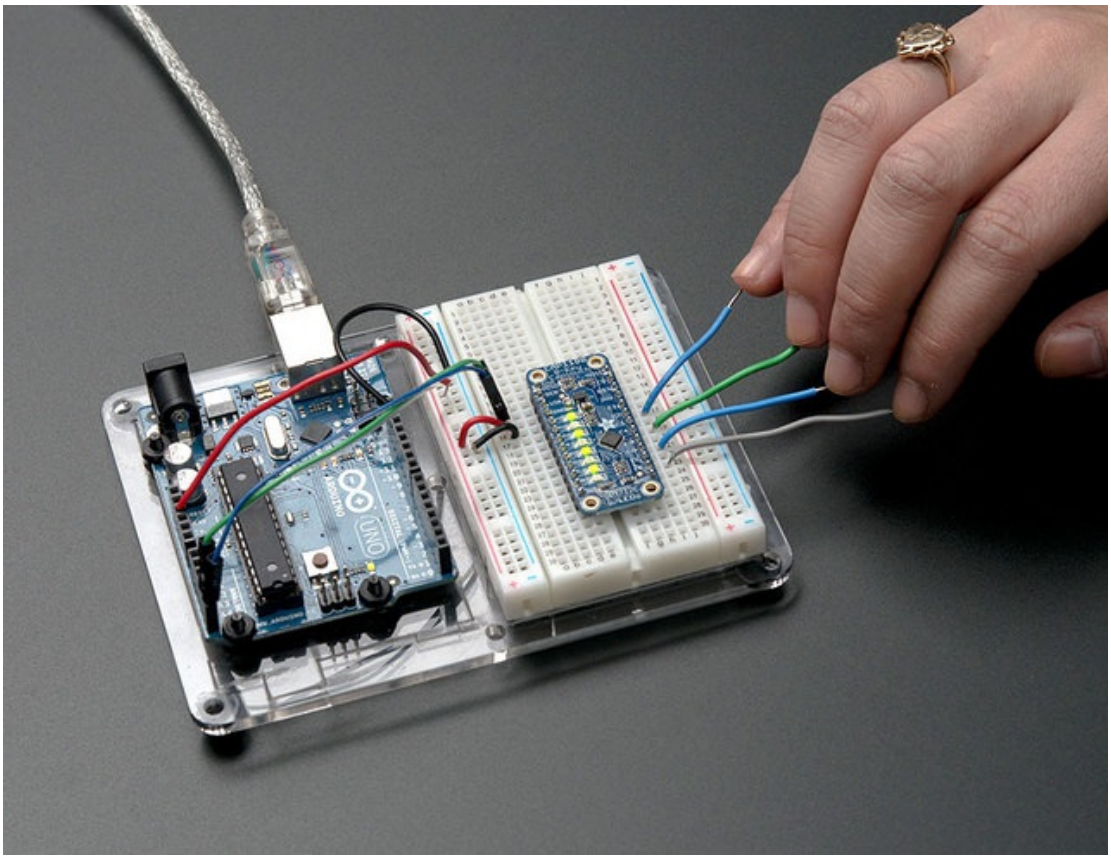
Guide Contents

Overview



Add lots of touch sensors to your next microcontroller project with this easy-to-use 8-channel capacitive touch sensor breakout board, starring the CAP1188. This chip can handle up to 8 individual touch pads, and has a very nice feature that makes it stand out for us: it will light up the 8 onboard LEDs when the matching touch sensor fires to help you debug your sensor setup.

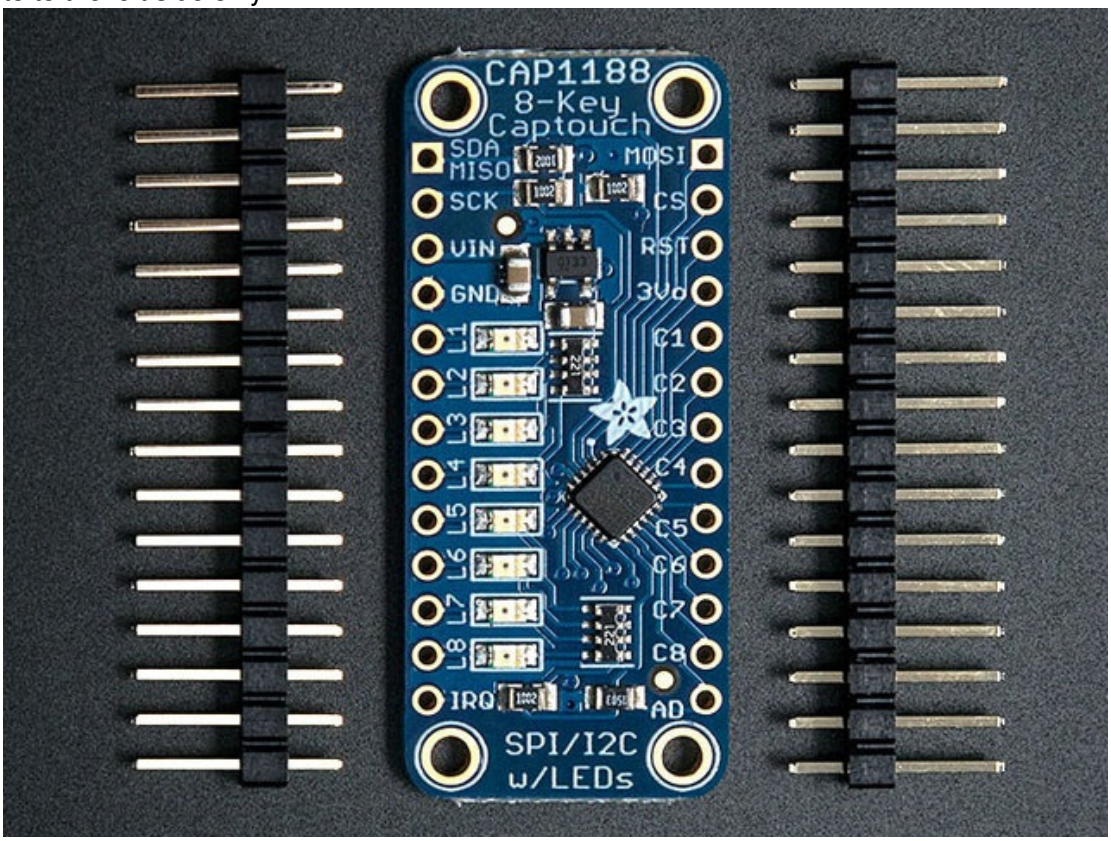
The CAP1188 has support for both I2C and SPI, so it easy to use with any microcontroller. If you are using I2C, you can select one of 5 addresses, for a total of 40 capacitive touch pads on one I2C 2-wire bus. Using this chip is a lot easier than doing the capacitive sensing with analog inputs: it handles all the filtering for you and can be configured for more/less sensitivity.

Comes with a fully assembled board, and a stick of 0.1" header so you can plug it into a breadboard. For contacts, we suggest using copper foil, then solder a wire that connects from the foil pad to the breakout.

Getting started is a breeze with our Arduino library and tutorial. You'll be up and running in a few minutes, and if you are using another microcontroller, its easy to port our code.

Pinouts

The CAP1188 has a lot going on, so much so that we had to make the breakout double-sided! It fits nicely into a breadboard and has the sensors all in a row on one side and if you're using plain i2c you can connect to to the left side only



Here's all the pins and what they do!

Power pins

VIN and **GND** are power in pins, you can use 3-5VDC so its great for any kind of microcontrollers. There's an on-board 3V regulator as well, the output is available on the **3Vo** pin (you can snag up to 150mA)

I2C interface pins

For I2C, connect to the **SCK** (i2c clock a.k.a SCL) and **SDA** (i2c data) pins. These are 5V safe so you can use them with 3V or 5V logic

SPI inteface pins

If you want to use SPI instead, you'll be using the SCK, MOSI, MISO and CS pins

Other interfacing pins

The **AD** pin is used to select SPI or I2C interface, and if I2C what address to use. See the wiring page for more details
The **IRQ** pin goes *low* when a pin is touched. We don't use it on our code examples, but if you want to have an interrupt pin used, connect it to this IRQ pin and use active-low triggering.
The **RST** pin is used to reset the chip, either in I2C or SPI mode. It's optional but using it will make the system more reliable so we suggest it.

Sensor input pins

This is the part you touch - there are 8 individual capacitive sensor pins, called **C1** thru **C8**. On restart the system recalibrates them so don't touch these when powering up!

Sensor output pins

The **L1** thru **L8** pins are the LED driver/sensor output pins. The indicators are really useful for debugging your touch sensor system, but you can also use the indicator output pins for triggering some other electronics. Each **L** pin corresponds to the matching **C** sensor input. These pins are 3V normally, and drop to 0V when triggered.

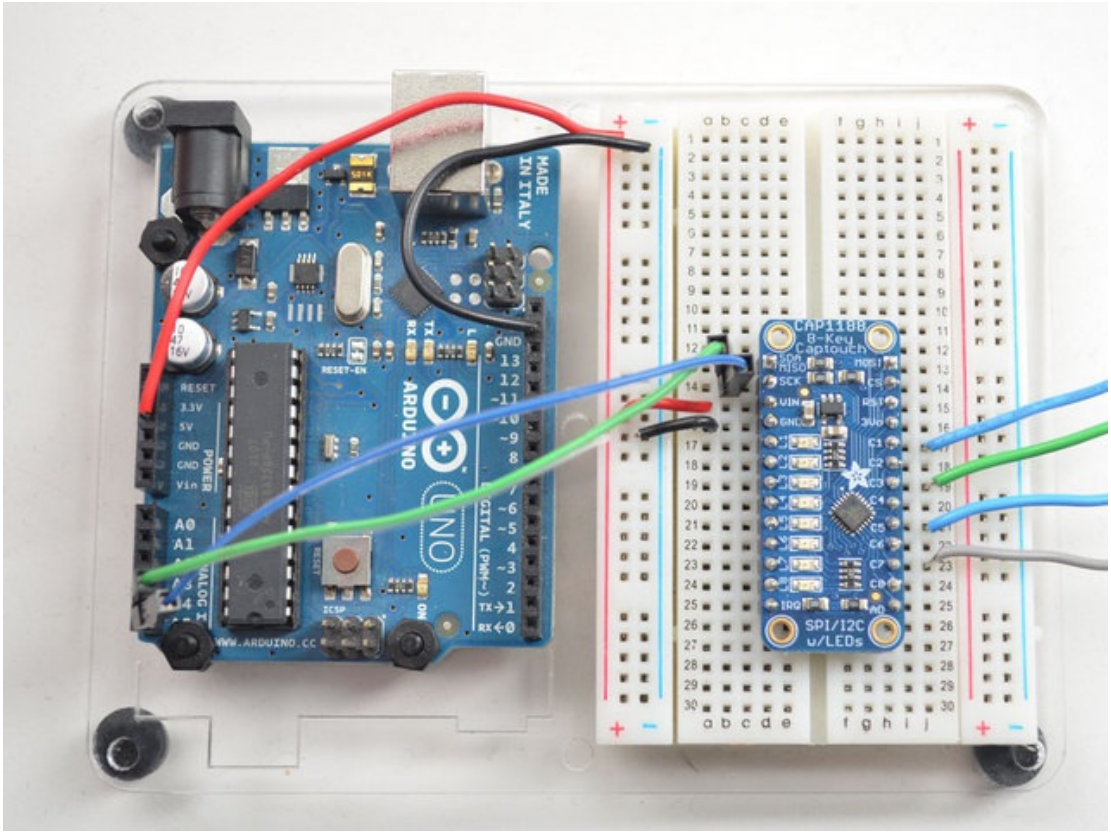
Wiring

Wiring for use with I2C

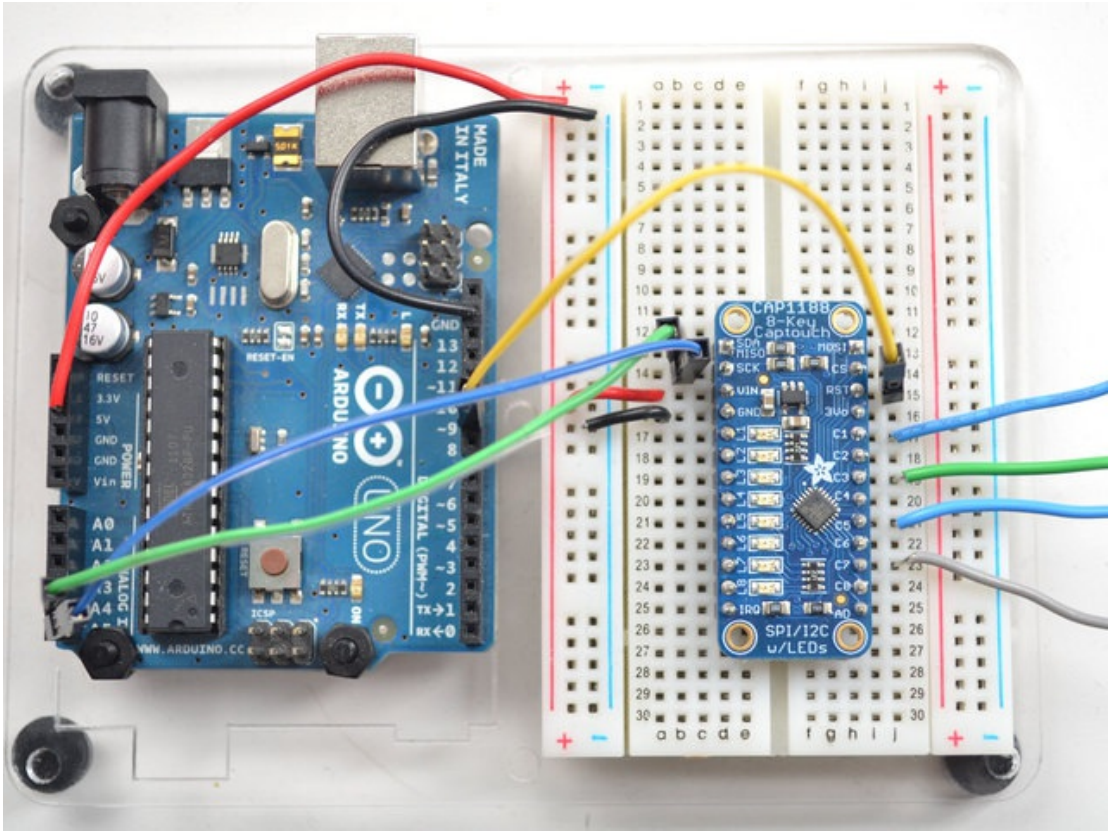
Chances are you'll use this board with the I2C interface pins. I2C is handy because you can have multiple sensors all connected on two I2C pins and share them nicely as long as each one has a unique address. I2C isn't particularly fast but that's fine for a sensor like this one (it's not good for video or audio type data)

I2C is really fast to get started, so we suggest that. Connect the**VIN** pin to 5V and **GND** pin to ground. Then connect the **SDA** pin to your I2C SDA/data line and**SCL** pin to your I2C SCL/clock line.

- On UNO/Duemilanove/etc, SDA == Analog 4, SCL == Analog 5
- On Leonardo/Micro, SDA == Digital 2, SCL == Digital 3
- On Mega/ADK/Due, SDA == Digital 20, SCL == Digital 21

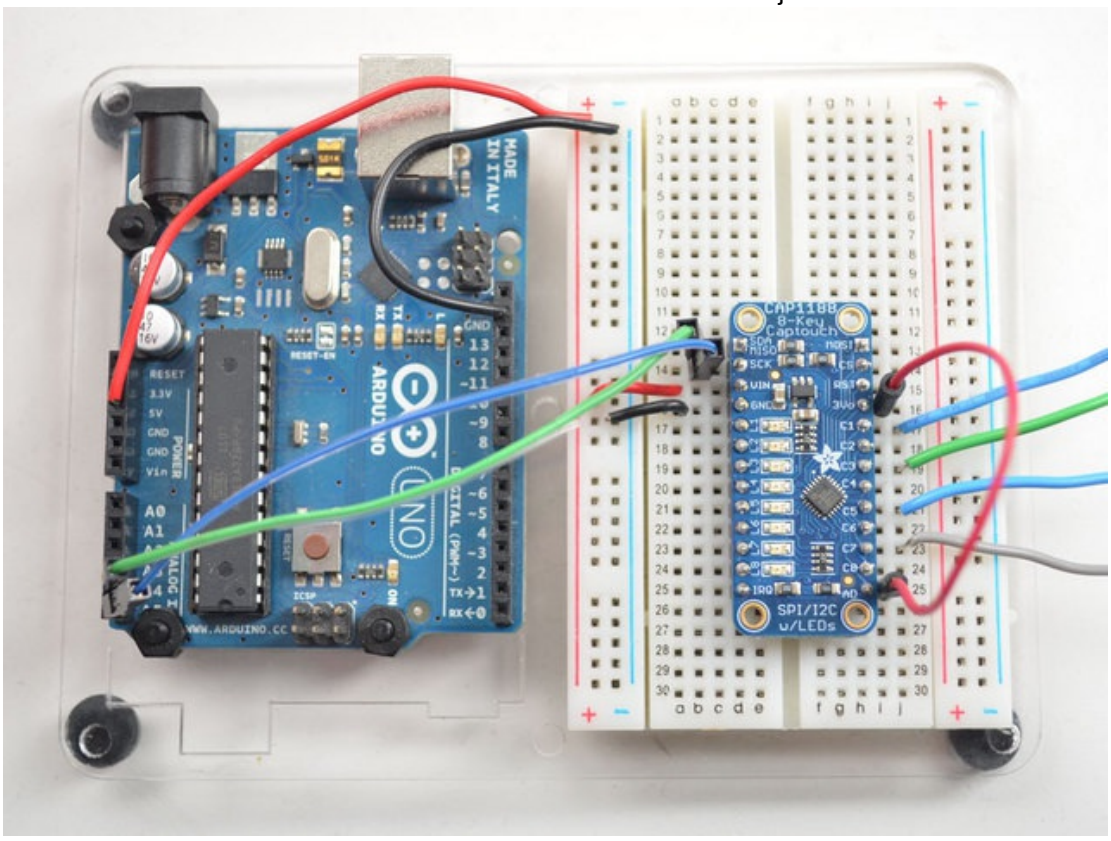


The reset pin is not required for use, but if you can spare a pin, it will make the system a little more rugged - the Arduino will do a hard reset of the CAP1188 on startup, connect **RST** to any digital I/O pin. In the library example code you can set up that pin in the CAP1188 object creation.



If you're using multiple sensors, or you just want to change the I2C address to something else, you can choose from 5 different options - **0x28**, **0x29** (default), **0x2A**, **0x2B**, **0x2C** and **0x2D**

The I2C address are selected by connecting a resistor to the**AD** pin in the lower right: different resistors set a different address. The easiest address to set is 0x28 which is just a wire from **AD** to the **3Vo** pin.



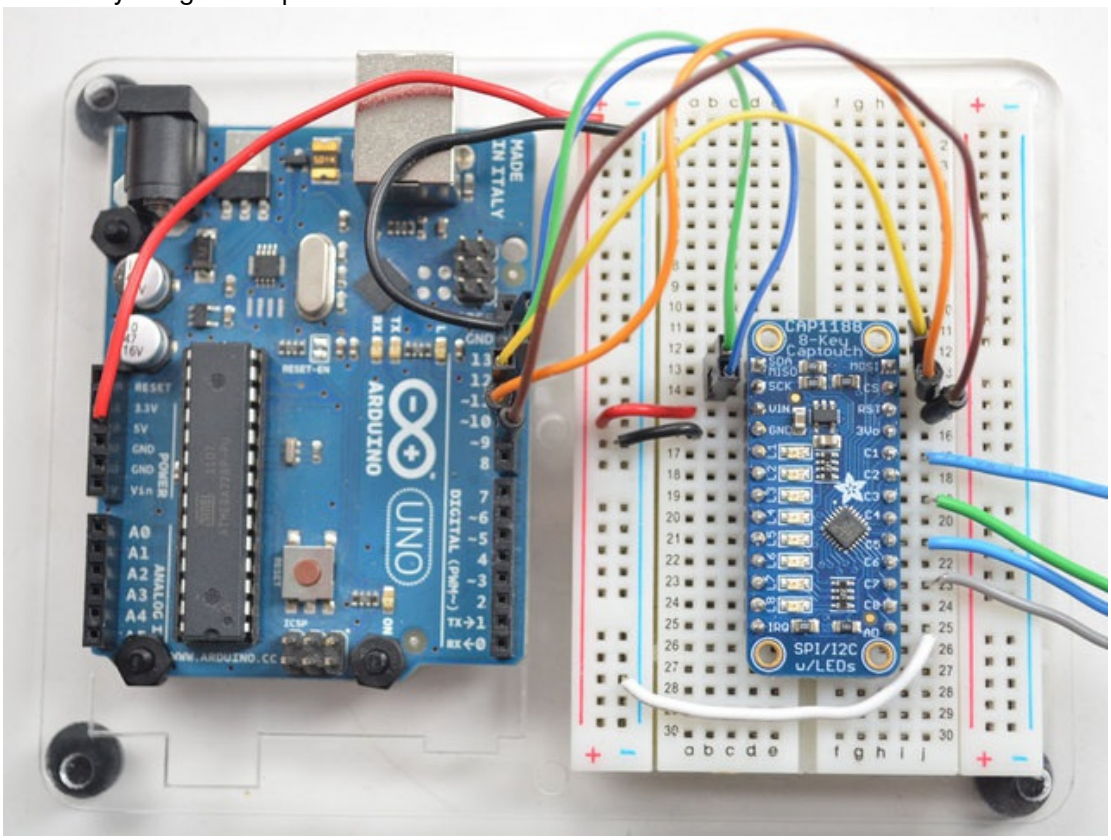
If you want to set the I2C address to a different value you'll need to connect a resistor from **AD** to ground instead of a wire to 3V. The datasheet talks about different resistor values in table 3.1 - but since the breakout board already has a 150K resistor on it, you'll need to use different values so that the parallel resistance comes out right. Here's the values you should use:

- Wire connecting **AD** to **3V** -> I2C address **0x28**
- No resistor or wire attached to **AD** -> I2C address **0x29**
- 600K resistor from **AD** to ground -> I2C address **0x2A**
- 300K resistor from **AD** to ground -> I2C address **0x2B**
- 180K resistor from **AD** to ground -> I2C address **0x2C**

Wiring for use with SPI

You can put the CAP1188 in SPI mode by powering it up with **AD** connected to ground. Then the 4 SPI pins are used to communicate instead of I2C. SPI may be preferrable for your project if you have an I2C address collision (which is unlikely given you can choose 5 addresses!) or say if you have an UNO and you want to use the I2C pins for analog input instead of I2C, or if you are porting to a microcontroller that does not have hardware I2C.

Either way, SPI is there for you. Connect **Vin** to 5V and **GND** to ground, then tie a wire from **AD** to ground as well. Now connect the **SCK**, **MISO**, **MOSI, CS** and **RST** pins to your microcontroller. If using an Arduino you can use either the hardware SPI pins which are fixed for each Arduino, or go with software SPI where you select any 5 digital I/O pins



Using with Arduino

Its super easy to use this sensor board with an Arduino thanks to the great Adafruit library. Once you've installed the library you can connect the sensor board via I2C or SPI to your Arduino, it will work with any kind or flavor. If you're using a different kind of microcontroller, the library is a good reference to help you port the code over.

Download the library

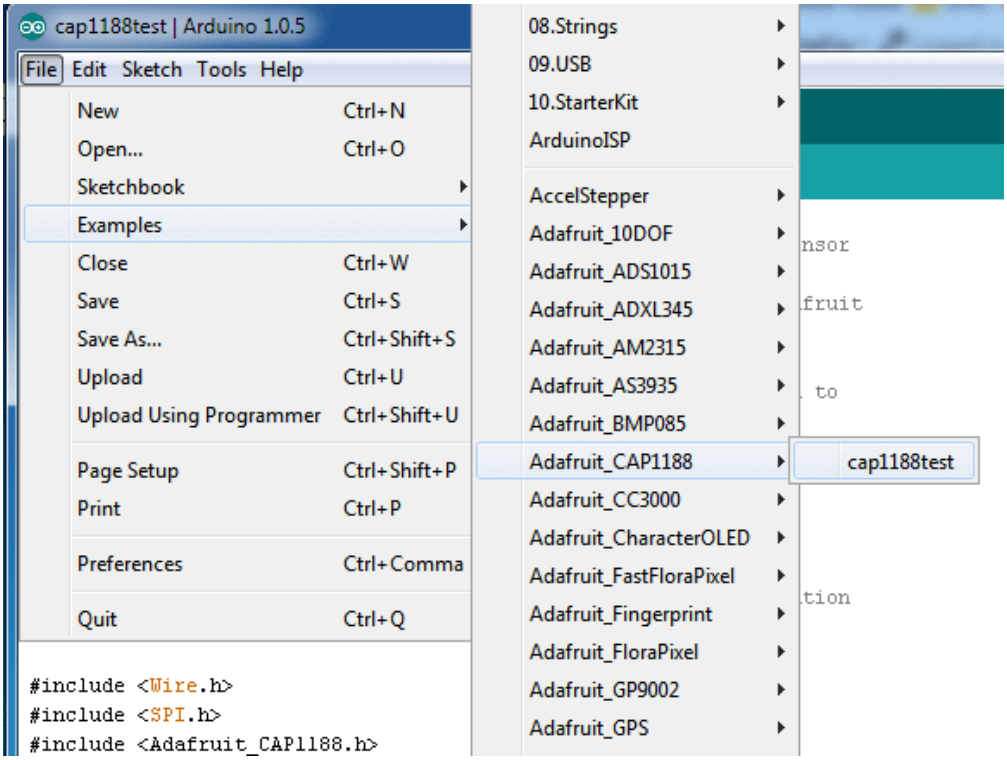
First up, we'll download the Arduino library from github. The source code is in a repository there, but to make it easy, we suggest just clicking the button below to get the latest version in a Zip file.
Download CAP1188 Library
http://adafru.it/d5g
Rename the uncompressed folder **Adafruit_CAP1188** and check that the **Adafruit_CAP1188** folder contains **Adafruit_CAP1188.cpp** and **Adafruit_CAP1188.h**

Place the **Adafruit_CAP1188** library folder your **arduinosketchfolder/libraries/** folder.
You may need to create the**libraries** subfolder if its your first library. Restart the IDE.

We also have a great tutorial on Arduino library installation at:
http://learn.adafruit.com/adafruit-all-about-arduino-libraries-install-use (http://adafru.it/aYM)

Run Test Sketch

After you've restarted, you should be able to load up the**File->Examples->Adafruit_CAP1188->cap1188test** sketch



Wire up the sensor as shown in the Wiring section, for I2C. Connect the **GND** pin to ground, **VIN** pin to 5V and connect **SDA** to your Arduino's **SDA** pin, **SCL** to **SCL** pin

- On UNO/Duemilanove/etc, SDA == Analog 4, SCL == Analog 5
- On Leonardo/Micro, SDA == Digital 2, SCL == Digital 3
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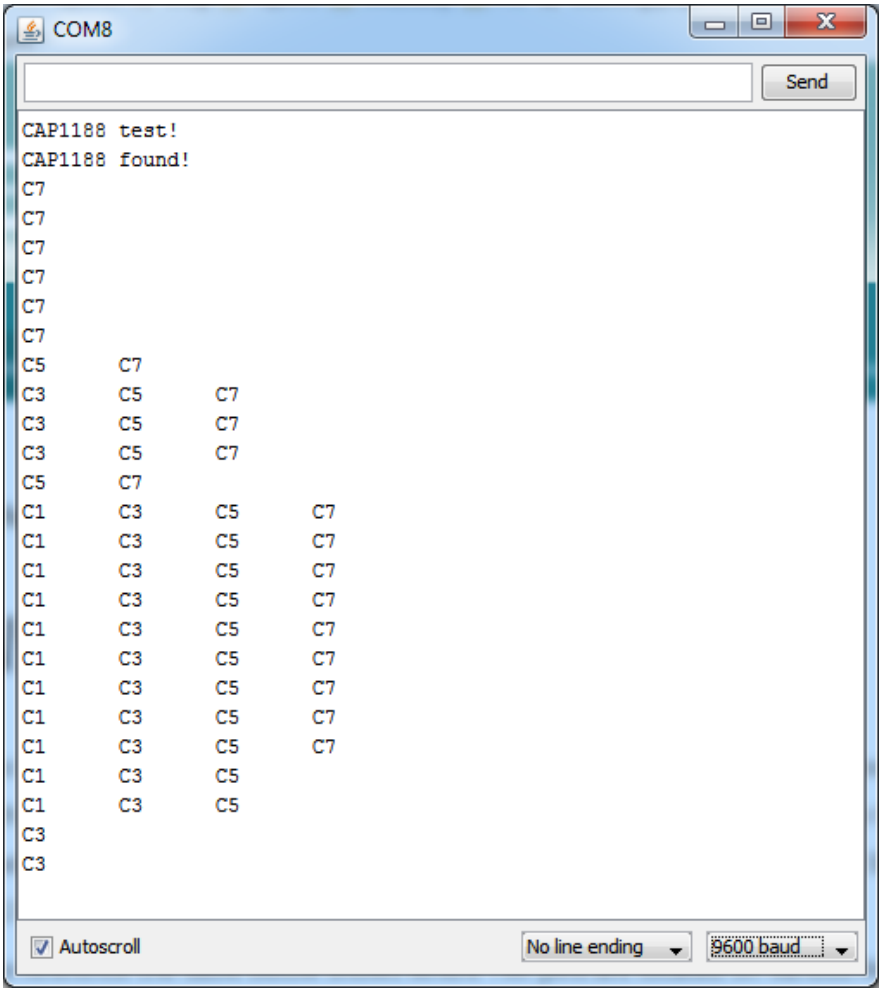
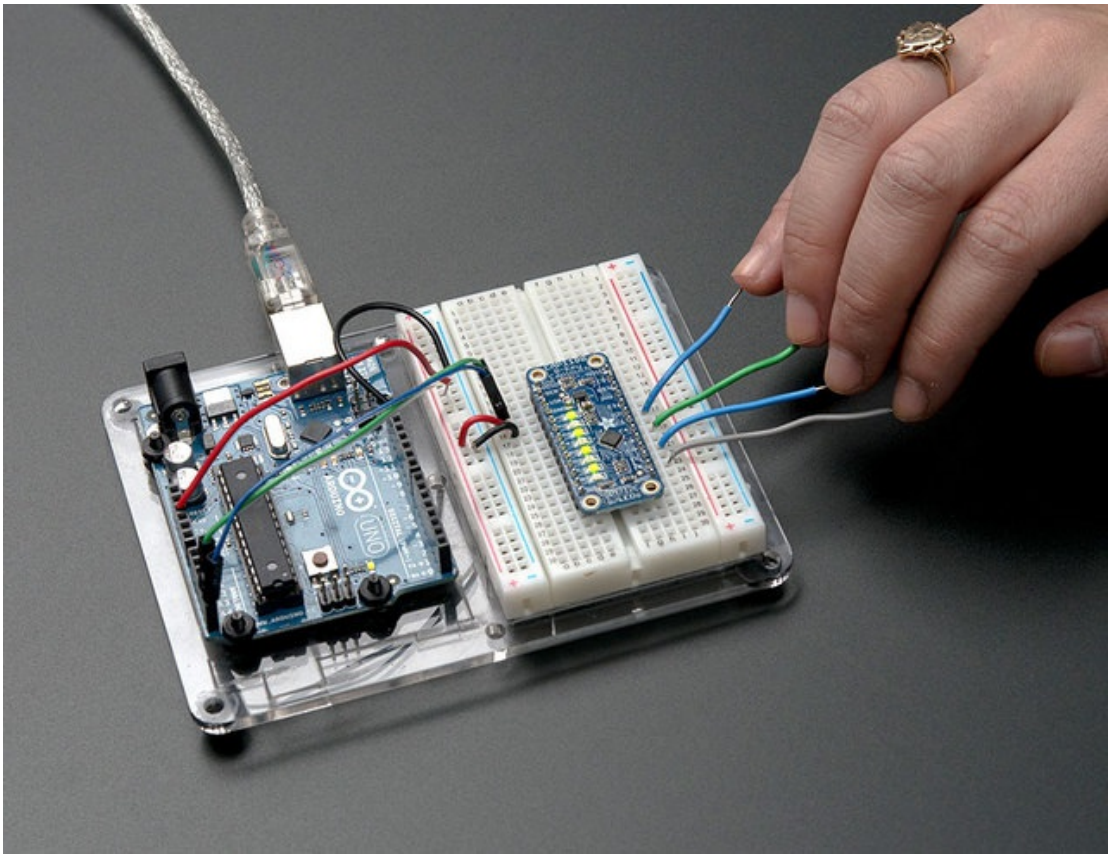
Upload the sketch and open up the serial console at 9600 baud. You should see that the CAP1188 is found (good!) and then you can touch the C1 thru C8 pads with your fingers to see the touch sensor go off. When you touch a pin, you'll also see the matching LED light up.


COM8
Send
CAP1188 test!
CAP1188 found!
C7
C7
C7
C7
C7
C7
C5 C7
C3 C5 C7
C3 C5 C7
C3 C5 C7
C5 C7
C1 C3 C5 C7
C1 C3 C5 C7
C1 C3 C5 C7
C1 C3 C5 C7
C1 C3 C5 C7
C1 C3 C5 C7
C1 C3 C5 C7
C1 C3 C5 C7
C1 C3 C5 C7
C1 C3 C5
C1 C3 C5
C3
C3
Autoscroll
No line ending
9600 baud



I2C with a different address

If you're using multiple sensors, or you just want to change the I2C address to something else, you can choose from 5 different options - **0x28**, **0x29** (default), **0x2A**, **0x2B**, **0x2C** and **0x2D**
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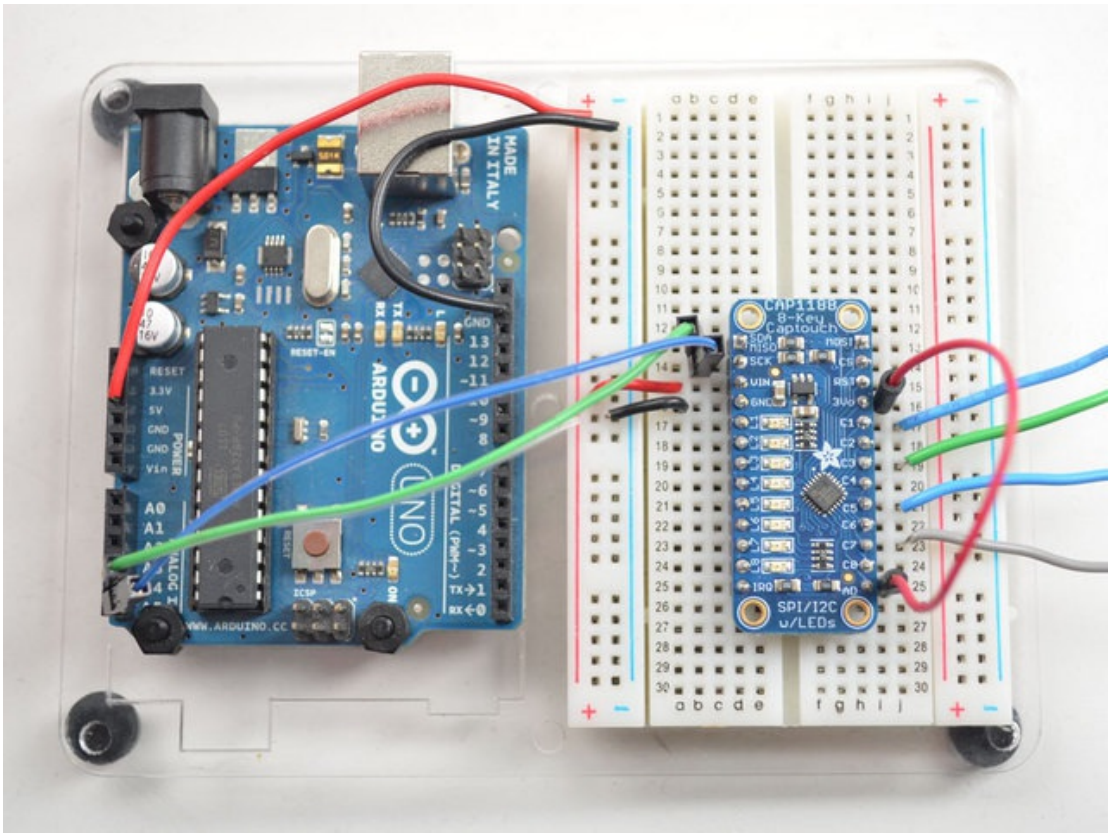


Now look in the test sketch for the lines

```
if (!cap.begin()) {
Serial.println("CAP1188 not found");
while (1);
}
```

And change the **cap.begin()** statement to **cap.begin(0x28)** to initialize it to use the **0x28** address. Don't forget to do a full power off of the Arduino & sensor, the sensor only detects the i2c address on power up so you can't change it on the fly!

Using with SPI

You can also use SPI if you wish. The library supports both hardware SPI (using the 'hardware SPI' port on your arduino) or software/bit-bang SPI, where you can define the pins. In general, these sensors are not very fast so I2C is a good way to interface them but if you wish, SPI is there for you too! For example, if you want to have more than 5 of these connected to one board, that is possible to do with SPI, but the I2C interface on this chip doesn't support that many shared I2C addresses.

To enable SPI, be sure to wire for SPI as shown in the Wiring section, and do a power reset of your board so that the chip 'wakes up' in SPI mode

If you're using hardware SPI, check the SPI page for what pins you need to use, sometimes they are only on the ICSP header which makes them trickier to use. (http://adafru.it/d5h)

To enable the hardware SPI interface, create the Adafruit_CAP1188 object with

```
Adafruit_CAP1188 cap = Adafruit_CAP1188(CAP1188_CS, CAP1188_RESET);
```

If you are using software SPI, you can use*any* pins that are not already used for some purpose. In that case, create the object with

```
Adafruit_CAP1188 cap = Adafruit_CAP1188(CAP1188_CLK, CAP1188_MISO, CAP1188_MOSI,
CAP1188_CS, CAP1188_RESET);
```

Using the external IRQ Interrupt

Arduino has some basic ability to attach to pin interrupts, here's an example from Nobody123 of connecting the IRQ pin from the CAP1188 to digital pin #3 on an Uno (Interrupt #1) for tracking touches asynchronously

```
/*************************************************
  This is a library for the CAP1188 I2C/SPI 8-chan Capacitive Sensor

  Designed specifically to work with the CAP1188 sensor from Adafruit
  ----> https://www.adafruit.com/products/1602

  These sensors use I2C/SPI to communicate, 2+ pins are required to
  interface
  Adafruit invests time and resources providing this open source code,
  please support Adafruit and open-source hardware by purchasing
  products from Adafruit!

  Written by Limor Fried/Ladyada for Adafruit Industries.
  BSD license, all text above must be included in any redistribution
 *************************************************/

#include <Wire.h>
#include <SPI.h>
#include <Adafruit_CAP1188.h>

// Reset Pin is used for I2C or SPI
#define CAP1188_RESET  4

// CS pin is used for software or hardware SPI
#define CAP1188_CS  10

// These are defined for software SPI, for hardware SPI, check your
// board's SPI pins in the Arduino documentation
#define CAP1188_MOSI  11
#define CAP1188_MISO  12
#define CAP1188_CLK  13

volatile byte interrupt = 0;

// For I2C, connect SDA to your Arduino's SDA pin, SCL to SCL pin
// On UNO/Duemilanove/etc, SDA == Analog 4, SCL == Analog 5
// On Leonardo/Micro, SDA == Digital 2, SCL == Digital 3
// On Mega/ADK/Due, SDA == Digital 20, SCL == Digital 21

// Use I2C, no reset pin!
// Adafruit_CAP1188 cap = Adafruit_CAP1188();

// Or...Use I2C, with reset pin
```

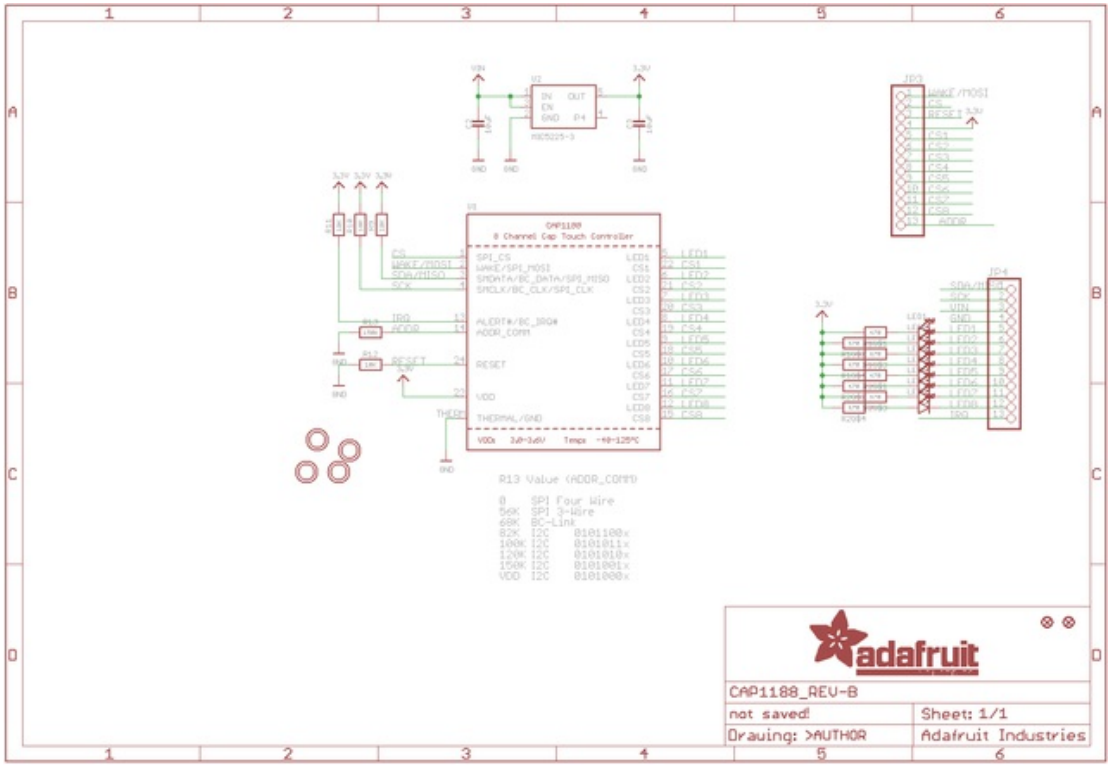
```
//Adafruit_CAP1188 cap = Adafruit_CAP1188(CAP1188_RESET);

// Or... Hardware SPI, CS pin & reset pin
Adafruit_CAP1188 cap = Adafruit_CAP1188(CAP1188_CS, CAP1188_RESET);

// Or.. Software SPI: clock, miso, mosi, cs, reset
//Adafruit_CAP1188 cap = Adafruit_CAP1188(CAP1188_CLK, CAP1188_MISO, CAP1188_MOSI, CAP1188_CS, CAP1188_RESET);

void setup() {
  Serial.begin(9600);
  Serial.println("CAP1188 test!");
  pinMode(3,INPUT);
  // Raise SPI slave select (SS) pins
  // Communication begins when you drop the individual select signals to LOW
  digitalWrite(10,HIGH);


  // Initialize the sensor, if using i2c you can pass in the i2c address
  // if (!cap.begin(0x28)) {
  if (!cap.begin()) {
    Serial.println("CAP1188 not found");
    while (1);
  }
  Serial.println("CAP1188 found!");
  pinMode(3, INPUT);
  // Turn off multitouch so only one button pressed at a time
  cap.writeRegister(0x2A, 0x80);  // 0x2A default 0x80 use 0x41  — Set multiple touches back to off
  cap.writeRegister(0x41, 0x39);  // 0x41 default 0x39 use 0x41  — Set "speed up" setting back to off
  cap.writeRegister(0x72, 0x00);  // 0x72 default 0x00  — Sets LED links back to off (default)
  cap.writeRegister(0x44, 0x41);  // 0x44 default 0x40 use 0x41  — Set interrupt on press but not release
  cap.writeRegister(0x28, 0x00);  // 0x28 default 0xFF use 0x00  — Turn off interrupt repeat on button hold
  EIFR = 1; // clear flag for interrupt 1
  attachInterrupt(1, routine_Interrupt_CAP1188, FALLING);
}

void loop() {

  // Serial.println(digitalRead(3));
  uint8_t touched = cap.touched();

  if (touched == 0) {
    // No touch detected
    // return;
  }

  for (uint8_t i=0; i<8; i++) {
    if (touched & (1 << i)) {
      Serial.print("C"); Serial.print(i+1); Serial.print("\t");
    }
  }
  Serial.println();
  delay(50);
  Serial.print("Interrupt: ");  Serial.println(interrupt);
}

void routine_Interrupt_CAP1188()  {
  ++interrupt;
}
```

Downloads

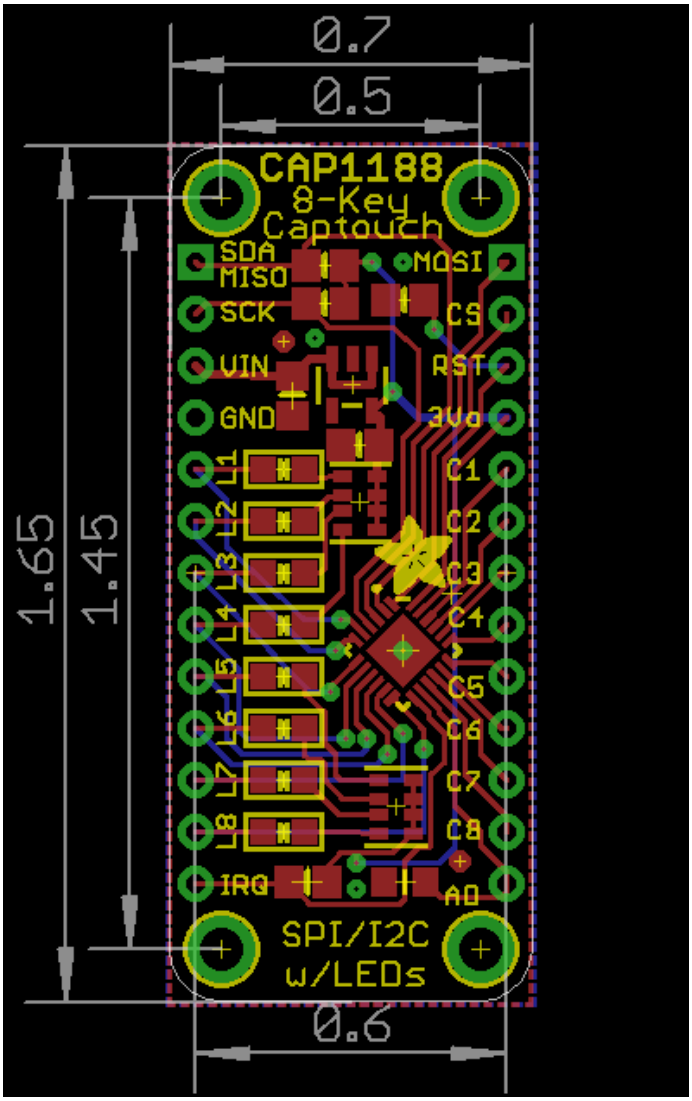
File

- The CAP1188 Datasheet has lots of details about this chip(http://adafru.it/d5i)
- EagleCAD PCB files on GitHub (http://adafru.it/ruE)
- Fritzing object in Adafruit Fritzing library (http://adafru.it/aP3)

Schematic



Fabrication Print


0.7
0.5
CAP1188
8-Key
Captouch
SDA
MISO
SCK
VIN
GND
MOSI
CS
RST
3Vo
C1
C2
C3
C4
C5
C6
C7
C8
AD
L1
L2
L3
L4
L5
L6
L7
L8
IRQ
SPI/I2C
w/LEDs
1.65
1.45
0.6