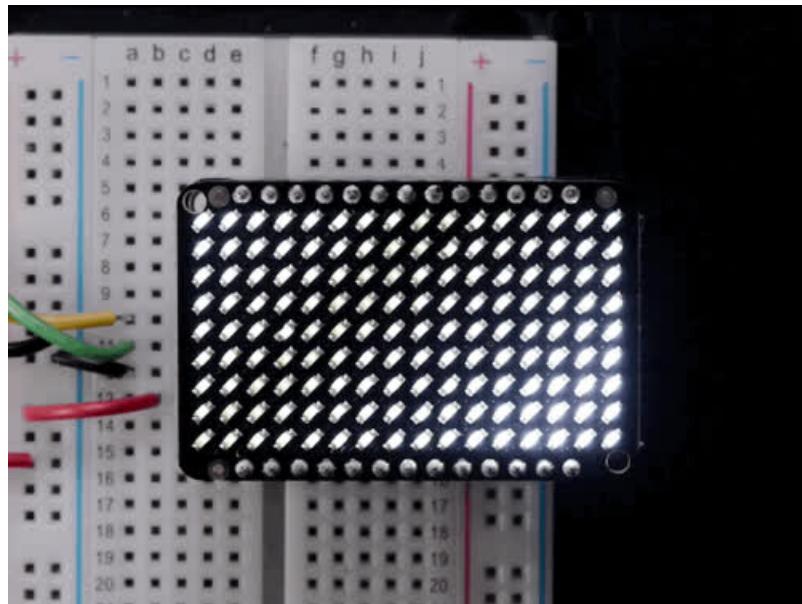




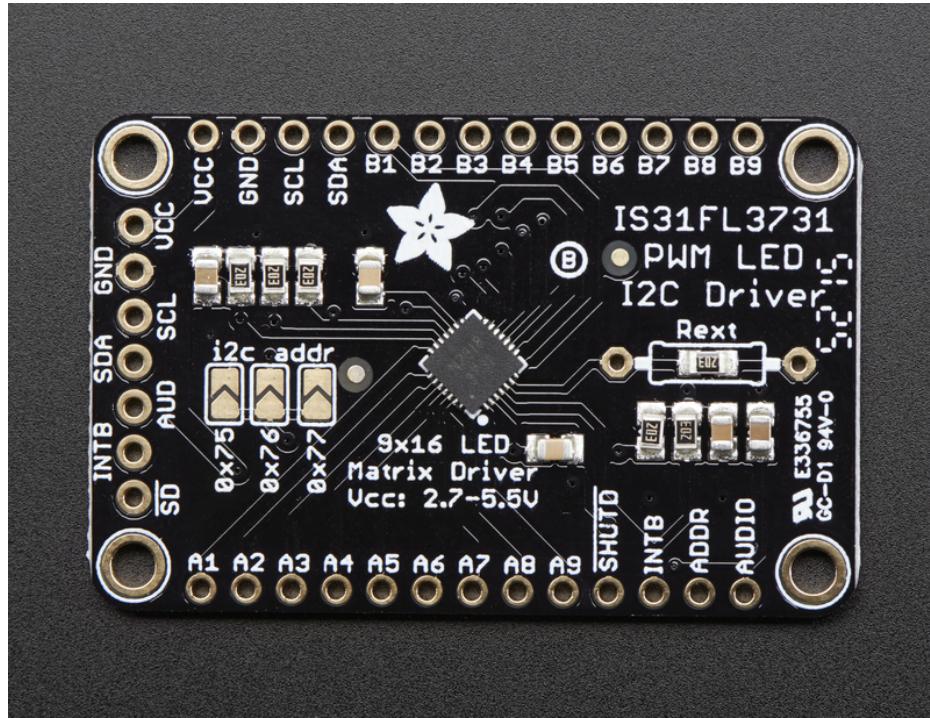
IS31FL3731 16x9 Charlieplexed PWM LED Driver

Created by lady ada

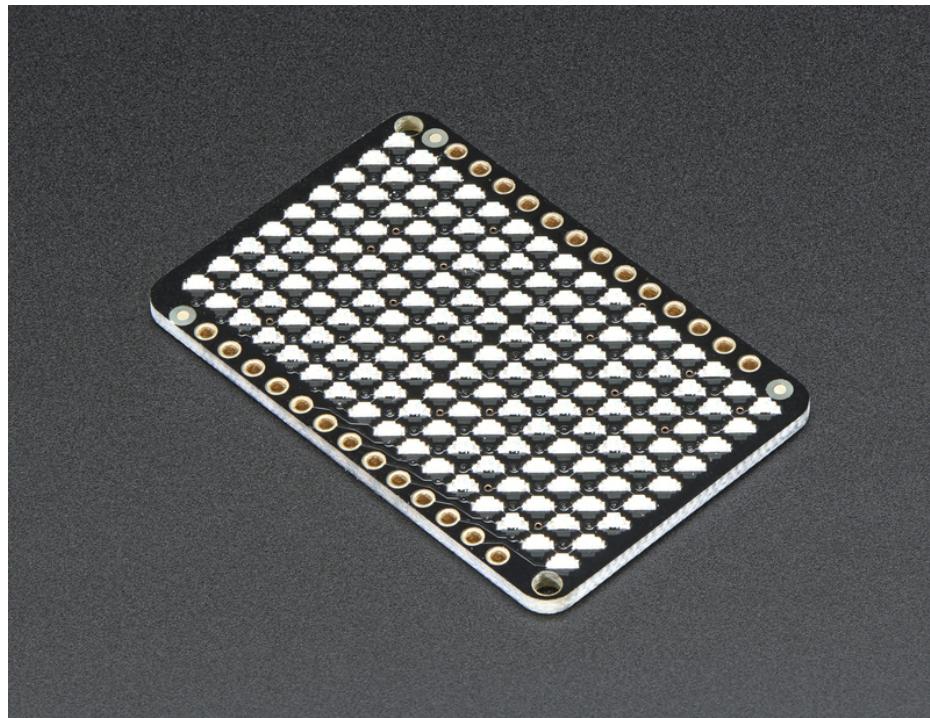


Last updated on 2019-05-12 07:13:28 PM UTC

Overview

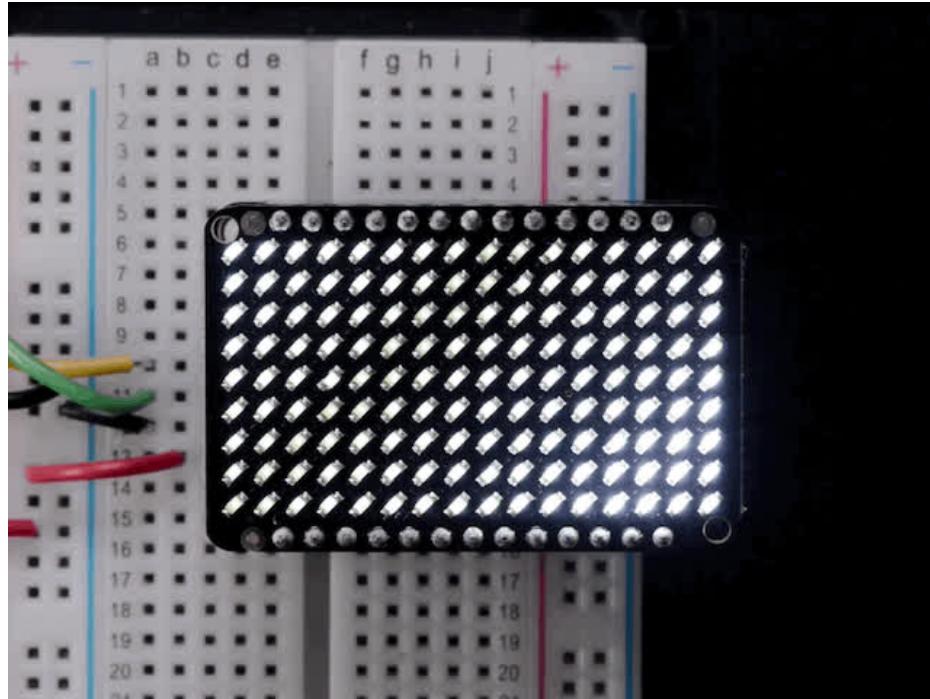


The IS31FL3731 will let you get back to that classic LED matrix look, with a nice upgrade! **This I2C LED driver chip has the ability to PWM each individual LED in a 16x9 grid so you can have beautiful LED lighting effects, without a lot of pin twiddling.** Simply tell the chip which LED on the grid you want lit, and what brightness and it's all taken care of for you.

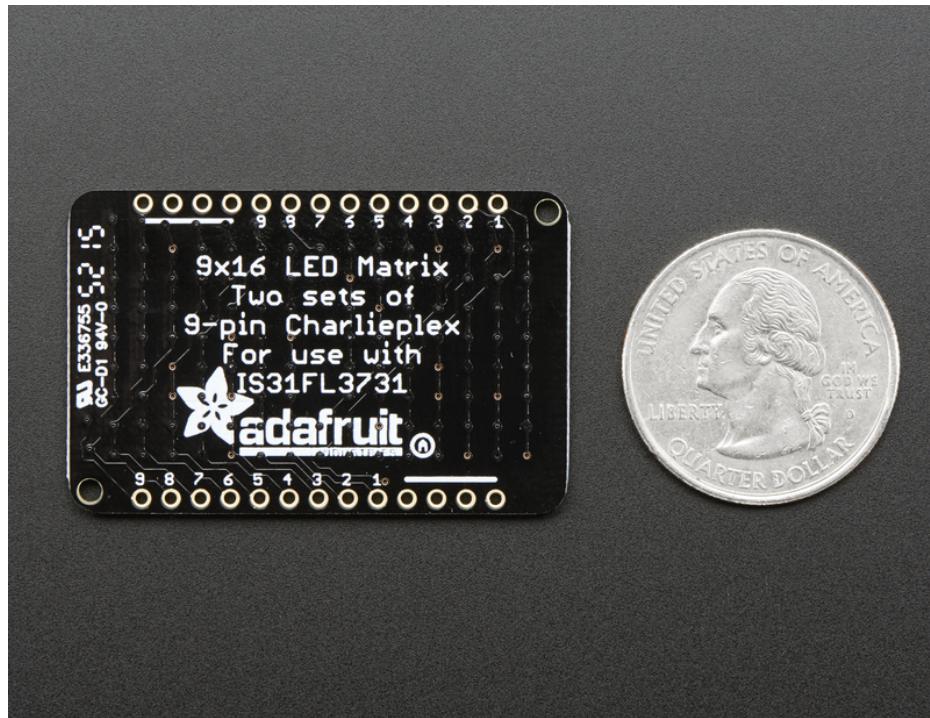


The IS31FL3731 is a nice little chip - it can use 2.7-5.5V power and logic so its flexible for use with any microcontroller.

You can set the address so up to 4 matrices can share an I2C bus. Inside is enough RAM for 8 separate frames of display memory so you can set up multiple frames of an animation and flip them to be displayed with a single command.



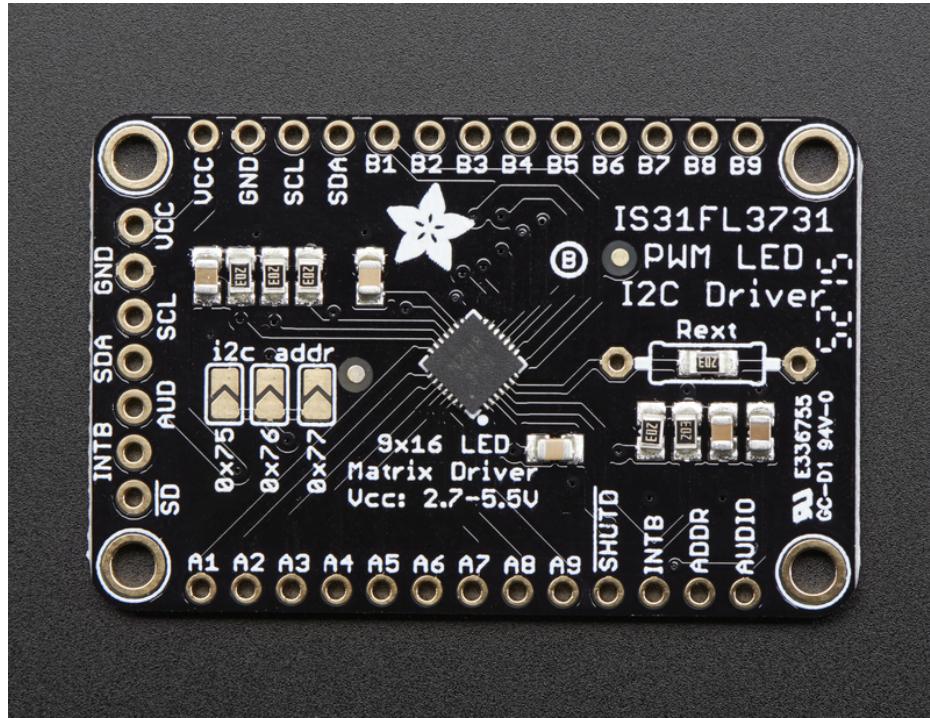
This chip is great for making small LED displays, and we even designed the breakout to match up with our ready-to-go LED grids in red, yellow, green, blue and white. Sandwich the driver and matrix breakout, solder together for a compact setup. Or you can DIY your own setup, just follow the LED grid schematic in the IS31FL3731 datasheet.



Pick up a driver board and your favorite color LEDs to match. You'll need to do some basic soldering to attach the

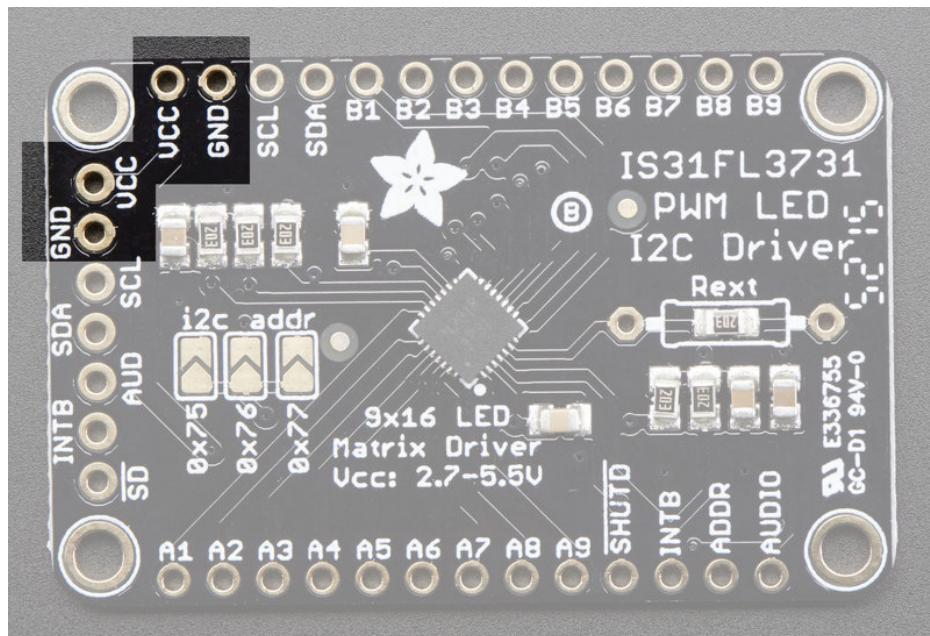
driver backpack and matrix together, and run wires to your microcontroller, but its not too hard. Then install our Arduino code to get some LEDs blinking immediately. Our library is Adafruit_GFX compatible so you can draw lines, circles, text, and small bitmaps if you want more graphics control

Pinouts



The IS31FL3731 has a lot of pins, and we wanted to make it easy to use with a breadboard while sandwiched with an LED matrix. The easiest way we could figure out to do this is make the board as large as our 0603-LED 16x9 matrix grids and have a control header on one edge. That way you can solder the two long headers directly to the matrix and still have access to pins for power and data.

Power Pins

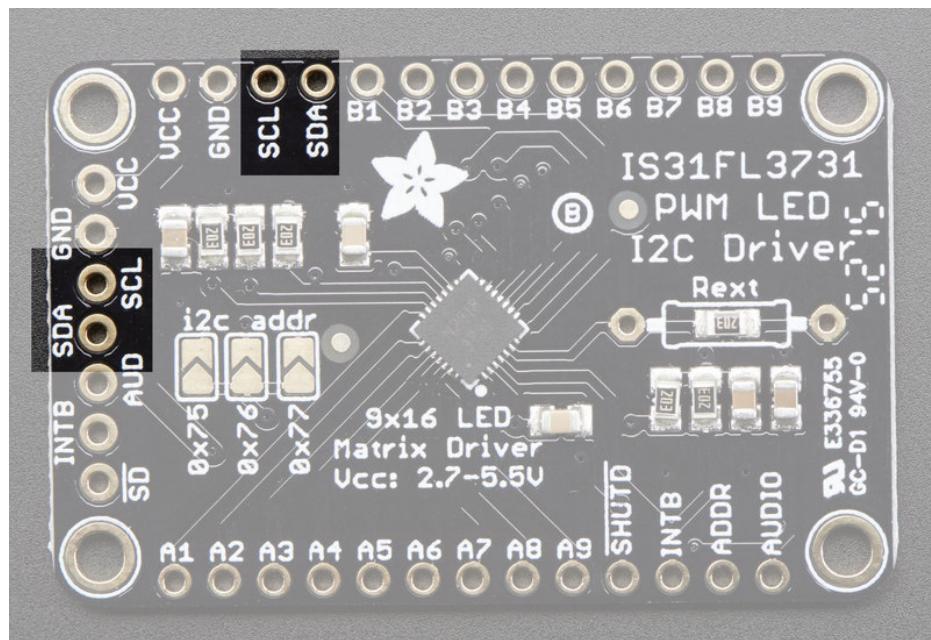


You can power the IS31 from 2.7-5.5VDC, but note that the same voltage is used for both power and logic.

If you are using a **5V** logic device, just connect **VCC** to 5V.

If you are using a **3.3V** logic, you can either power with 3.3V, which will work fine for red, yellow or light green LEDs *or* you can power from 5V and then use ~2.2K resistors from SDA and SCL to 3.3V to 'overpower' the built in 20K pullup resistors.

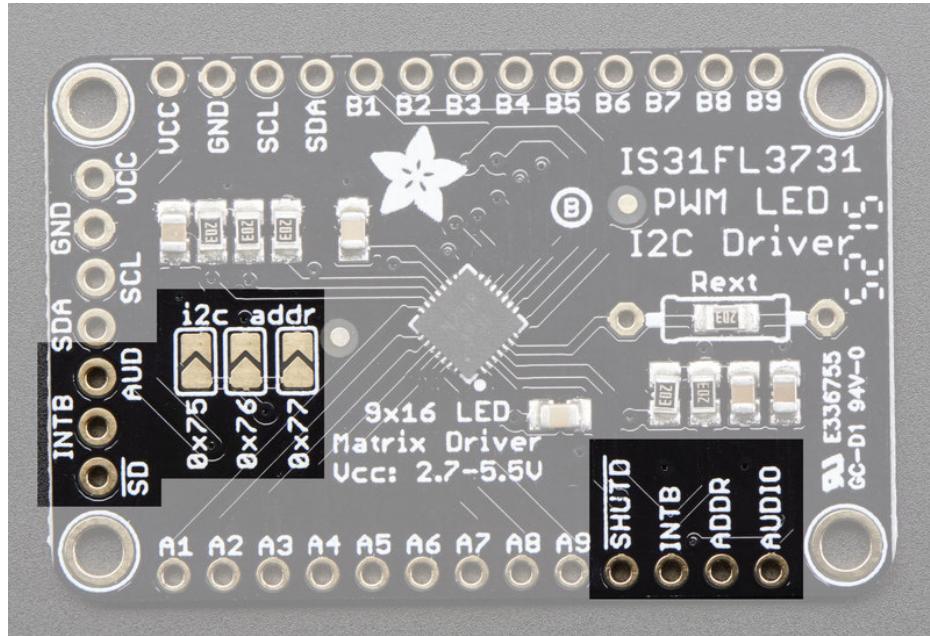
I2C Data Pins



This chip uses I2C for control, it does not use clock stretching or repeated start. There are built in 20K pullups to VCC. You can run it as fast as 400KHz clock speed, but you may need to add additional 2K pullups from SDA and SCL up to VCC for higher speeds

- **SDA** - I2C data line, connect to your microcontroller's I2C SDA pin
- **SCL** - I2C clock line, connect to your microcontroller's I2C SCL pin

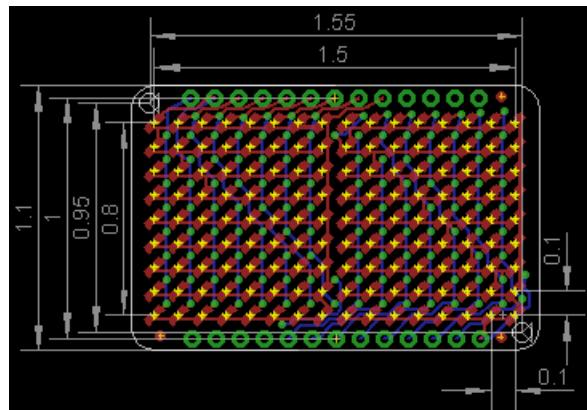
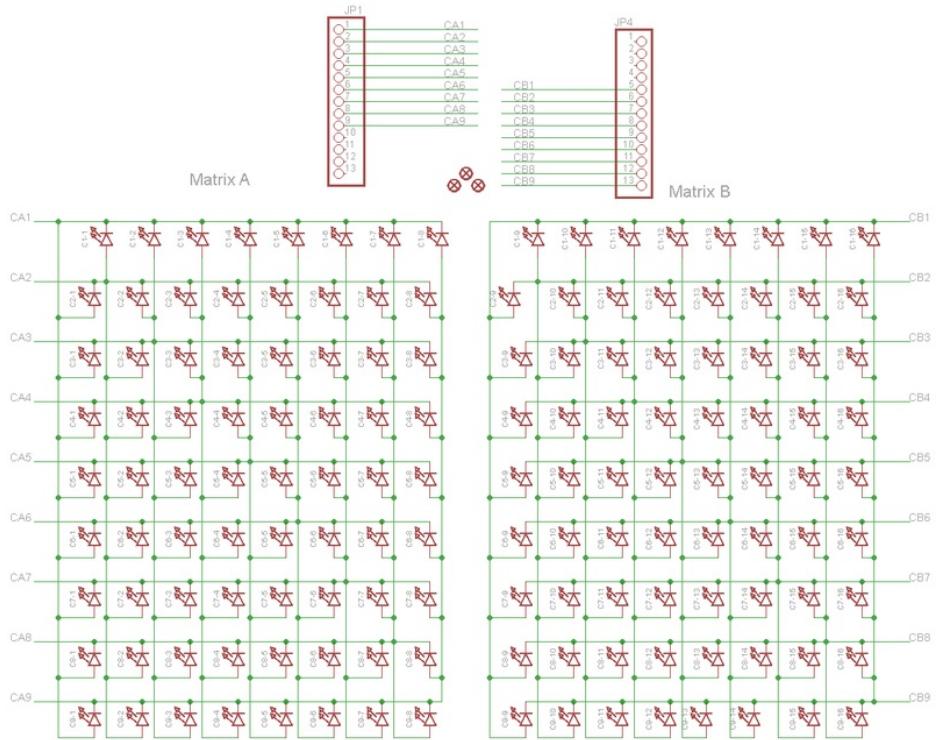
Other Control Pins



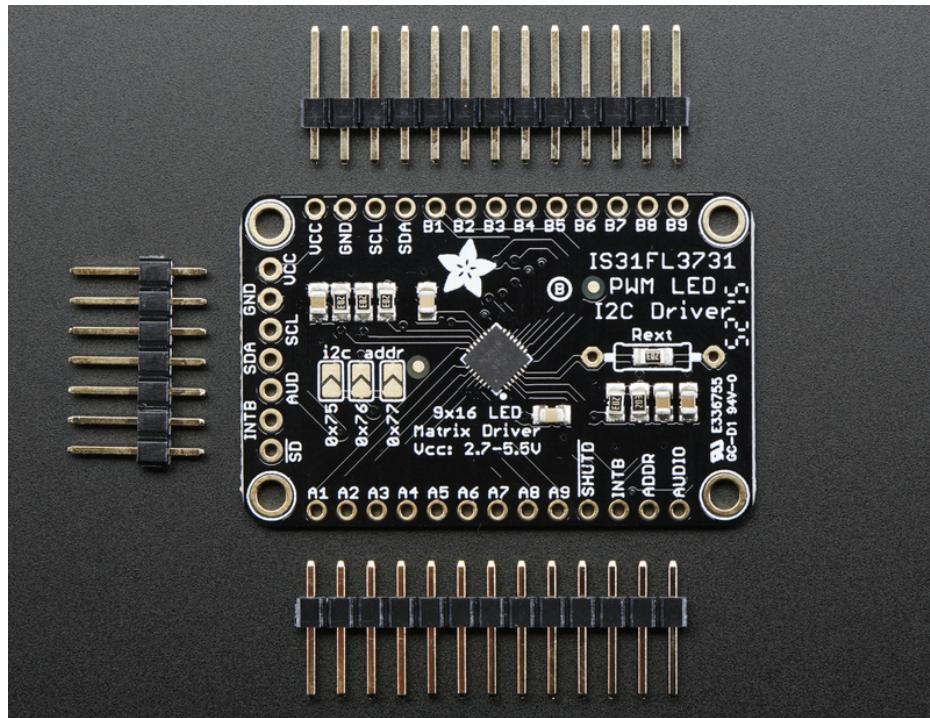
- **SD** - Shutdown pin, default pulled up to VCC. Connect to ground to put the chip in shutdown mode
- **AUD** - Audio input, can be used to modulate the entire display with the amplitude of a line level audio signal, has a series capacitor installed.
- **ADDR and jumpers** - By default the address is **0x74** but you can close **one** of the jumpers to change the address for up to 4 devices with varying addresses
- **INTB** - Output interrupt from chip when using the built in animation modes

LED Grid

The LED Grid is much simpler, it just has 2 charlieplex grids, 16x9 total 0603 LEDs, with the two grids broken out to side pins that line up with the driver

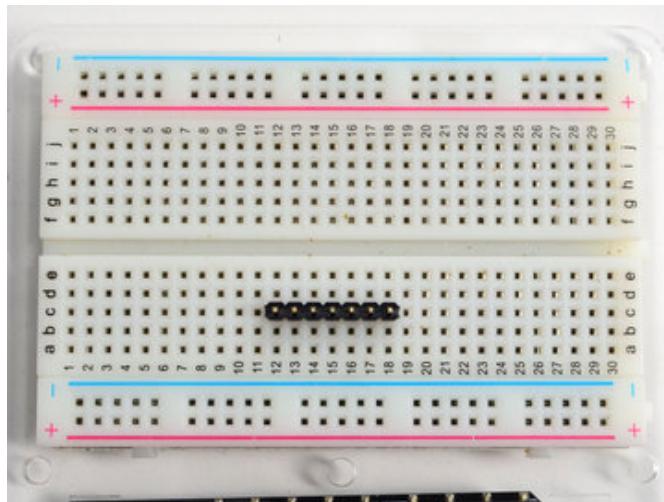


Assembly



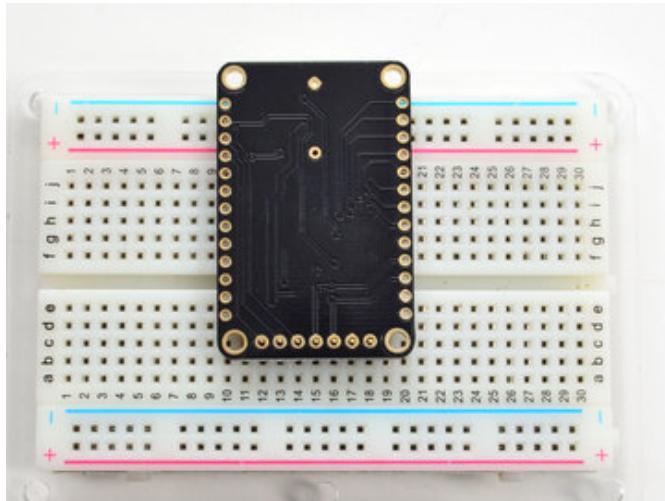
Assemble the IS31 Driver Board

We'll start by soldering in the 7-pin 'control' header. Break the headers you received so that you have a 7-pin piece and follow these steps.



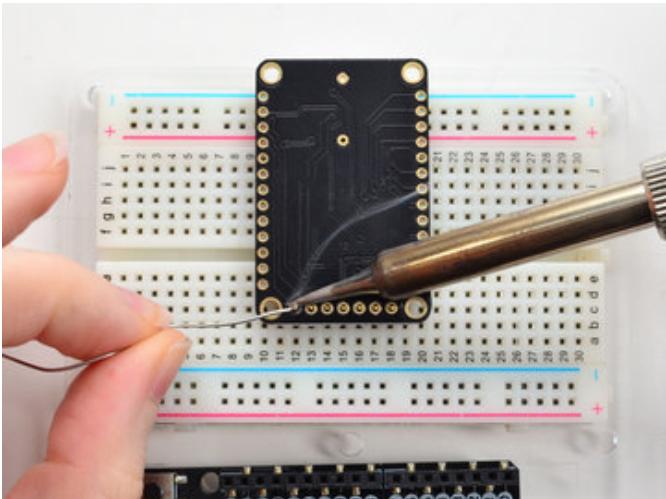
Prepare the header strip:

Cut the strip to length if necessary. It will be easier to solder if you insert it into a breadboard - **long pins down**



Add the breakout board:

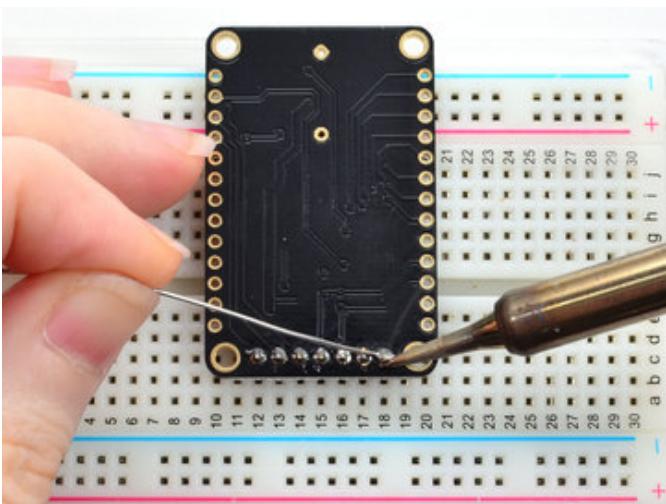
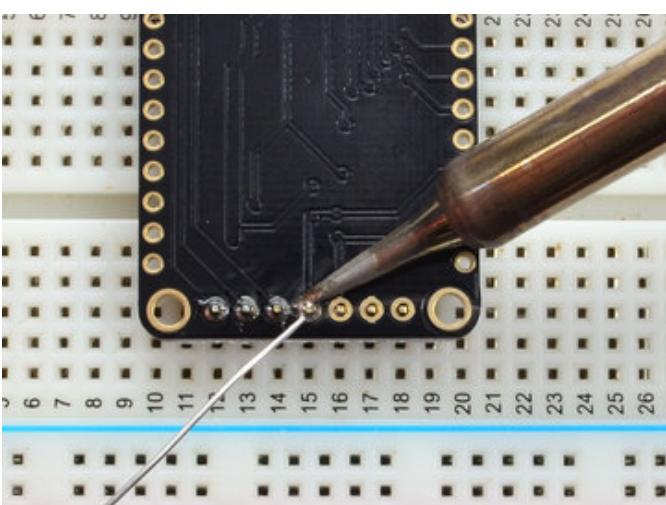
Place the breakout board over the pins so that the short pins poke through the breakout pads

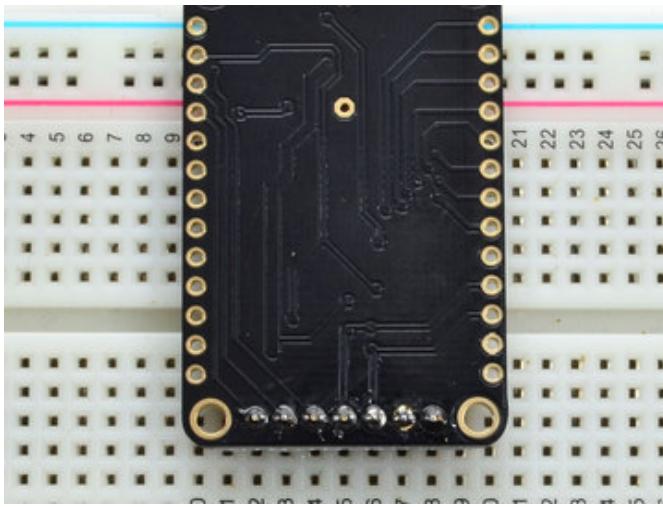


And Solder!

Be sure to solder all pins for reliable electrical contact.

(For tips on soldering, be sure to check out our [Guide to Excellent Soldering](#) (<https://adafru.it/aTk>)).



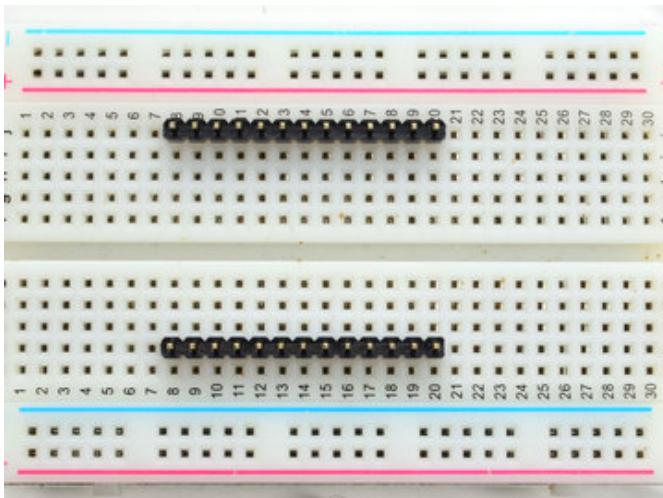


OK the control port header is done.

Check your solder joints visually and continue onto the next steps

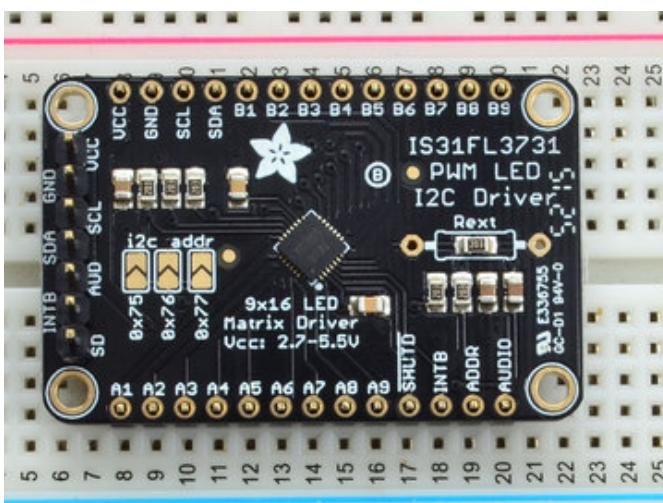
Solder Driver Headers for LEDs

The two side strips are what are used to control the charlie-plexed LEDs



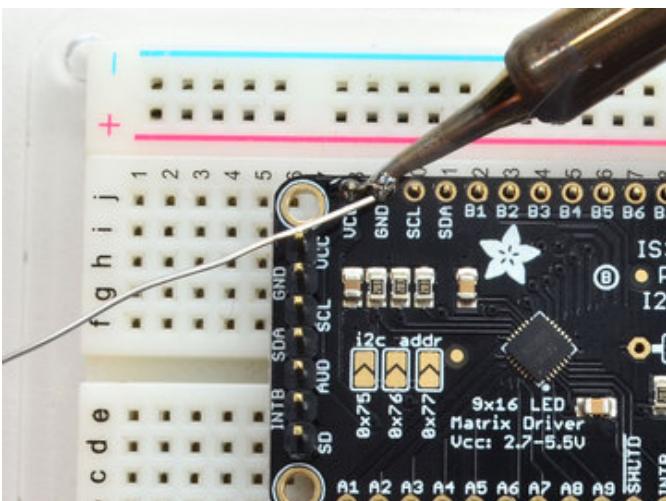
Prepare the header strip:

Cut the strip to length if necessary. It will be easier to solder if you insert it into a breadboard - **long pins down**



Add the breakout board face up:

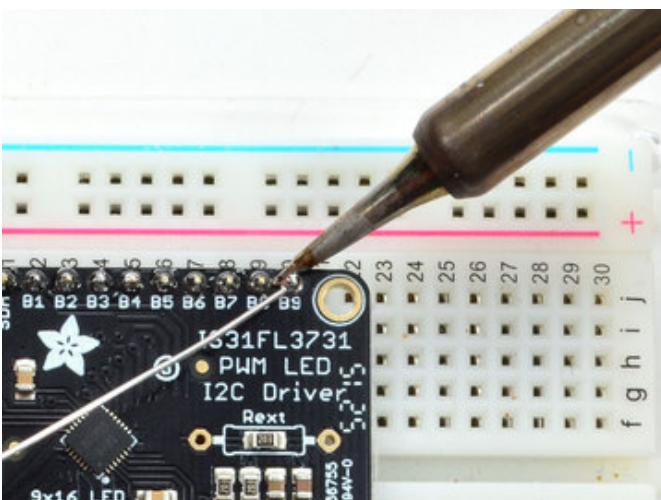
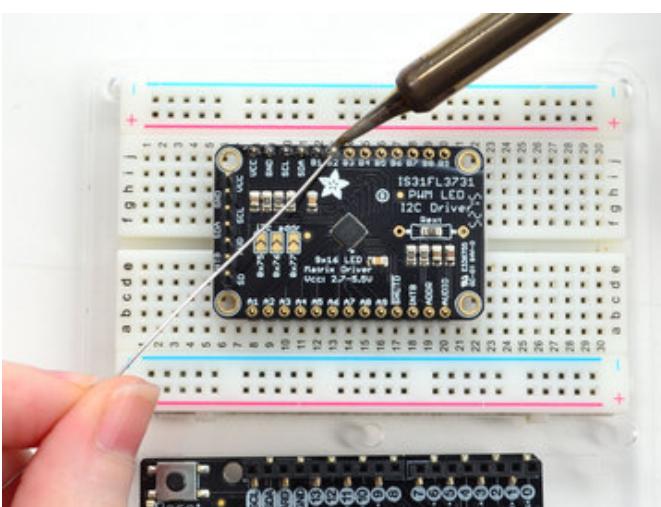
Place the breakout board over the pins so that the short pins poke through the breakout pads

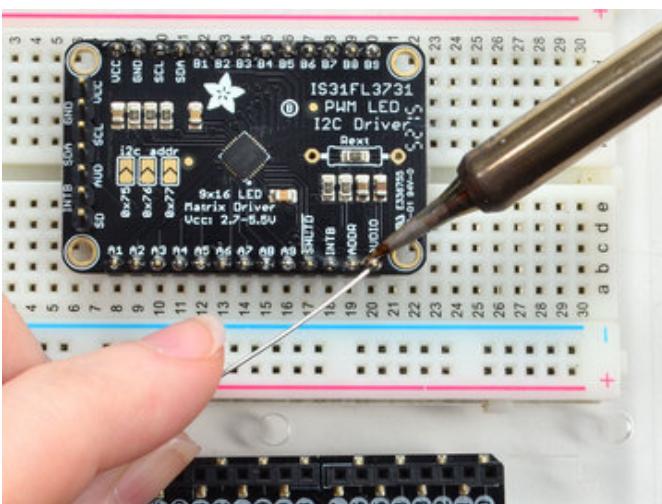
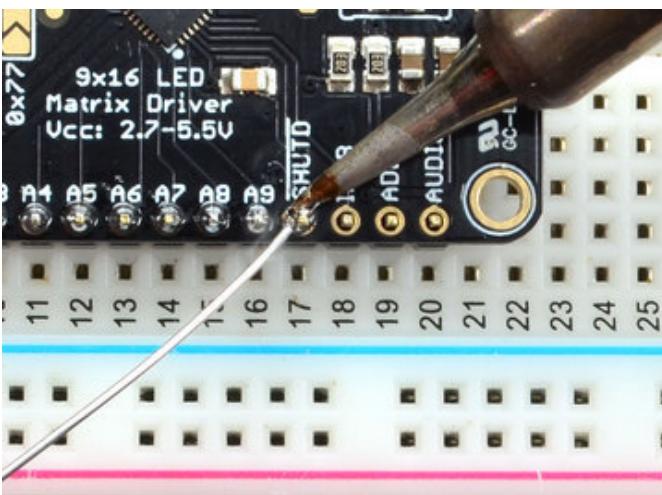
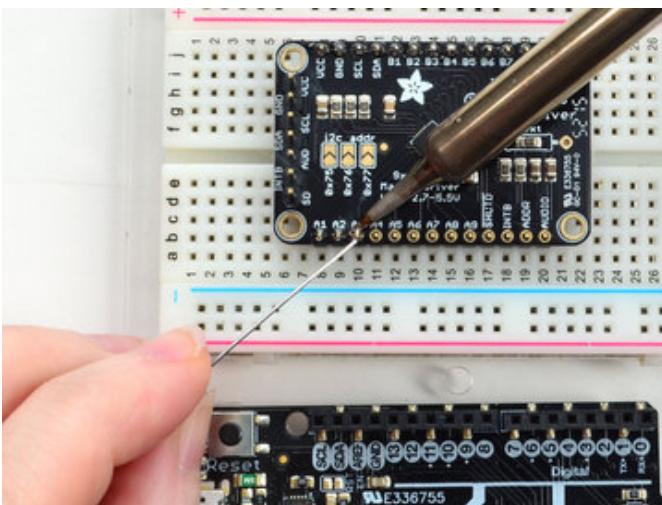


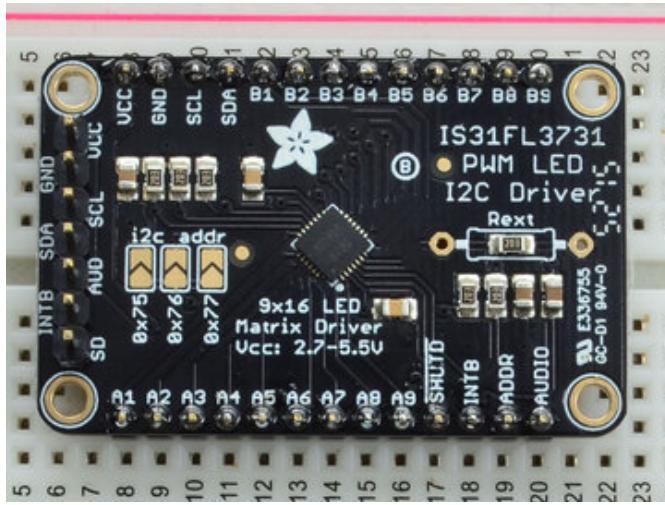
And Solder!

Be sure to solder all pins for reliable electrical contact.

(For tips on soldering, be sure to check out our [Guide to Excellent Soldering](#) (<https://adafru.it/aTk>)).





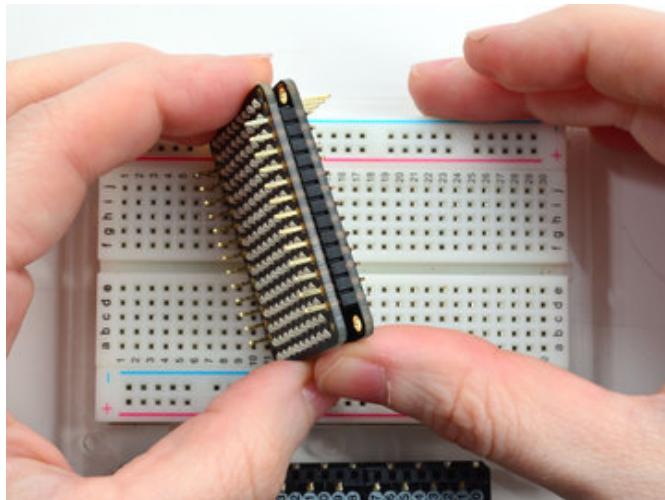


OK now you have the control *and* LED pads with headers.

Check your solder joints visually and continue onto the next steps

Attach LED panel

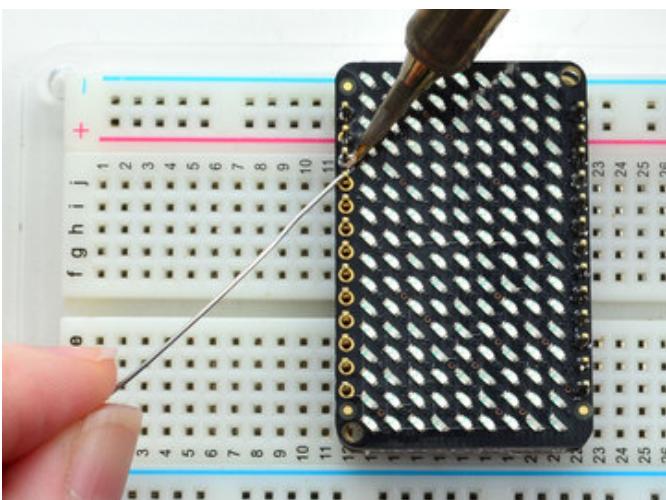
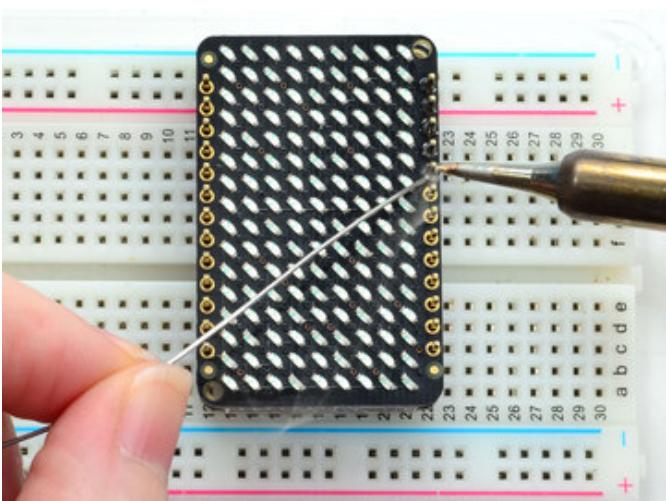
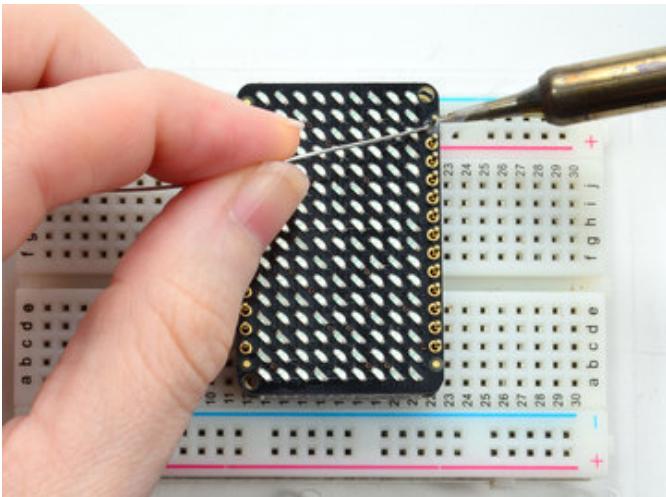
Now we'll sandwich on the charlieplexed LED panel

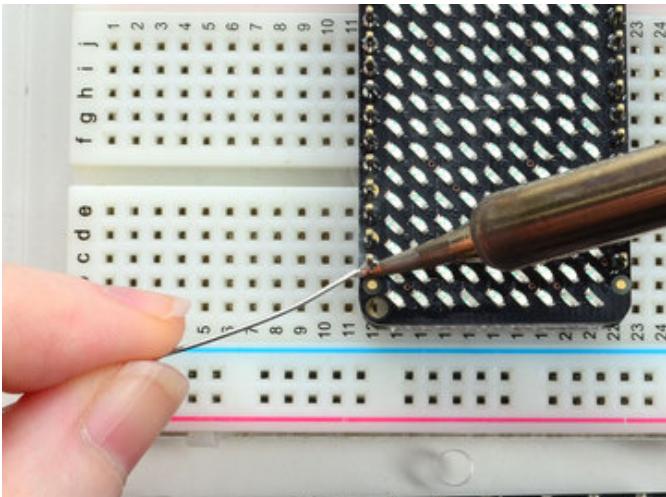


The LEDs face out and connect to the two side header strips.

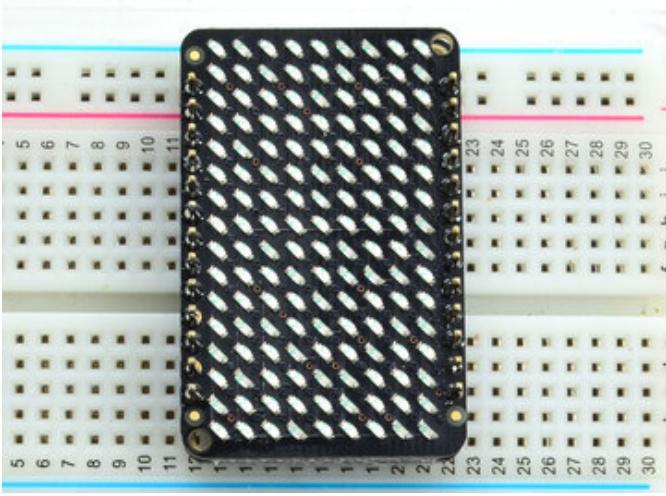
The panel is **symmetric** - you can flip it around either way and it will work fine

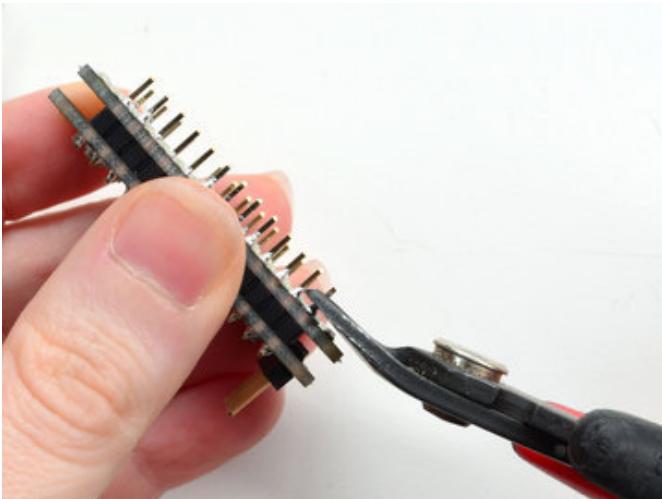
Solder in the two long header strips. Not all are connected on the LED matrix but it makes the connections mechanically stable.





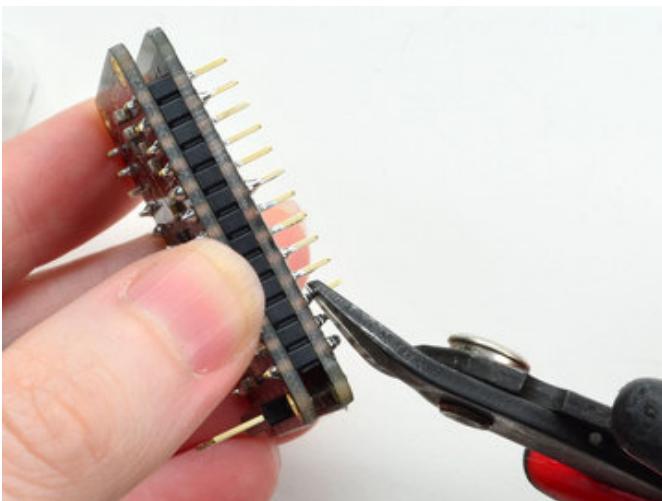
Check your solder joints visually and continue onto the next steps

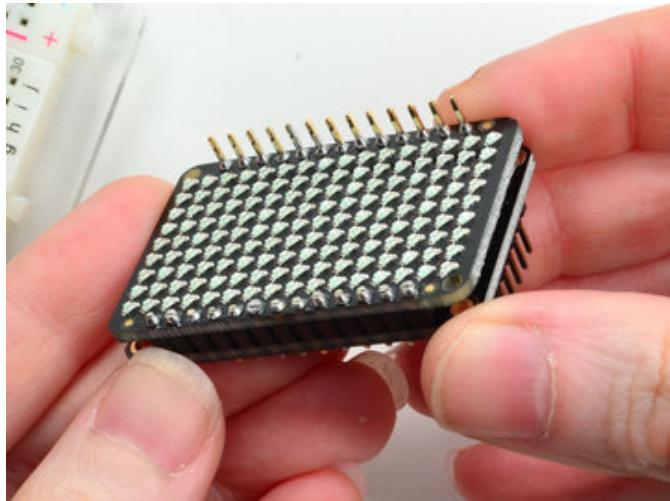




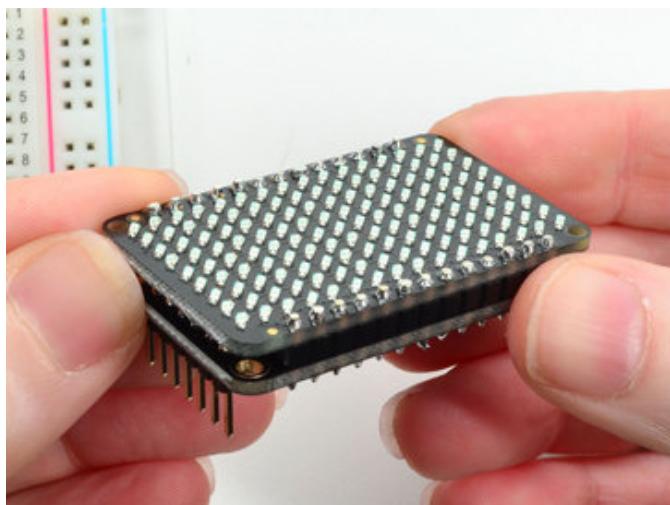
Now you can trim the long header with diagonal cutters.
Cut one or two pins at a time

**Watch out for flying header bits. Wear eye protection
and be careful!**





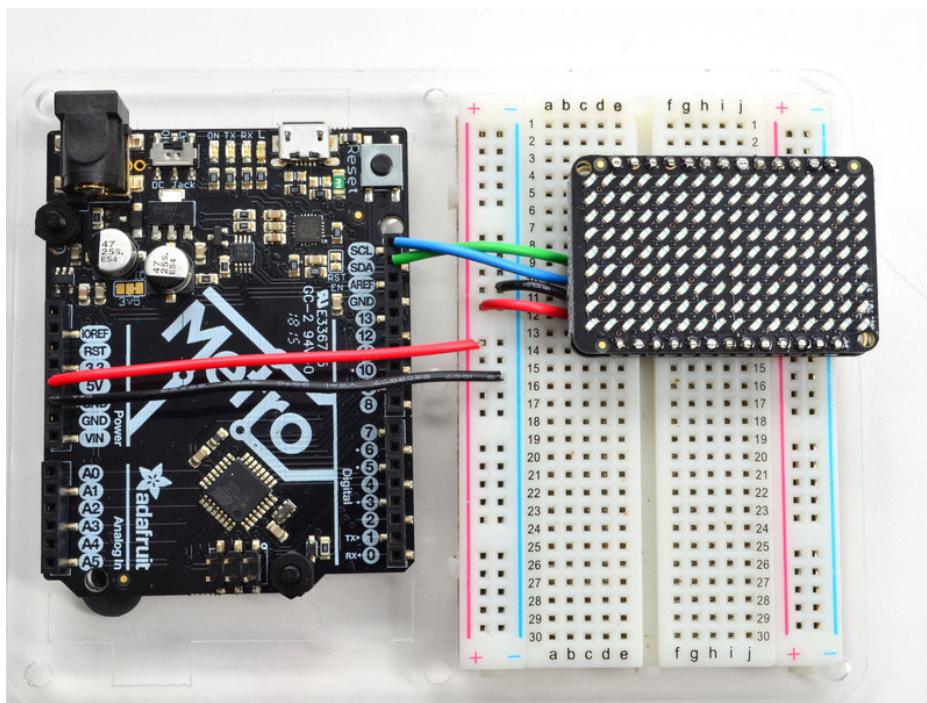
Cut both sides down for the best look





You're done! Check your solder joints visually and continue onto the next steps

Arduino Wiring & Test



You can easily wire this breakout to any microcontroller, we'll be using an Arduino. For another kind of microcontroller, as long as you have I2C pins available, just check out the library, then port the code.

Wiring

Use this wiring if you want to connect via I2C interface

- Connect **Vin** to the power supply, 3-5V is fine. Use the same voltage that the microcontroller logic is based off of. For most Arduinos, that is 5V
- Connect **GND** to common power/data ground
- Connect the **SCL** pin to the I2C clock **SCL** pin on your Arduino. On an UNO & '328 based Arduino, this is also known as **A5**, on a Mega it is also known as **digital 21** and on a Leonardo/Micro, **digital 3**
- Connect the **SDA** pin to the I2C data **SDA** pin on your Arduino. On an UNO & '328 based Arduino, this is also known as **A4**, on a Mega it is also known as **digital 20** and on a Leonardo/Micro, **digital 2**

Download Adafruit_IS31FL3731 library

To begin reading sensor data, you will need to [download Adafruit_IS31FL3731 from our github repository \(<https://adafru.it/IWA>\)](https://github.com/adafruit/Adafruit_IS31FL3731). You can do that by visiting the github repo and manually downloading or, easier, just click this button to download the zip

<https://adafru.it/IWB>

<https://adafru.it/IWB>

Rename the uncompressed folder **Adafruit_IS31FL3731** and check that the **Adafruit_IS31FL3731** folder contains **Adafruit_IS31FL3731.cpp** and **Adafruit_IS31FL3731.h**

Place the **Adafruit_IS31FL3731** 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 \(https://adafru.it/aYM\)](http://learn.adafruit.com/adafruit-all-about-arduino-libraries-install-use)

Install Adafruit GFX

You will need to do the same for the **Adafruit_GFX** library available here (<https://adafru.it/aJa>)

<https://adafru.it/cBB>

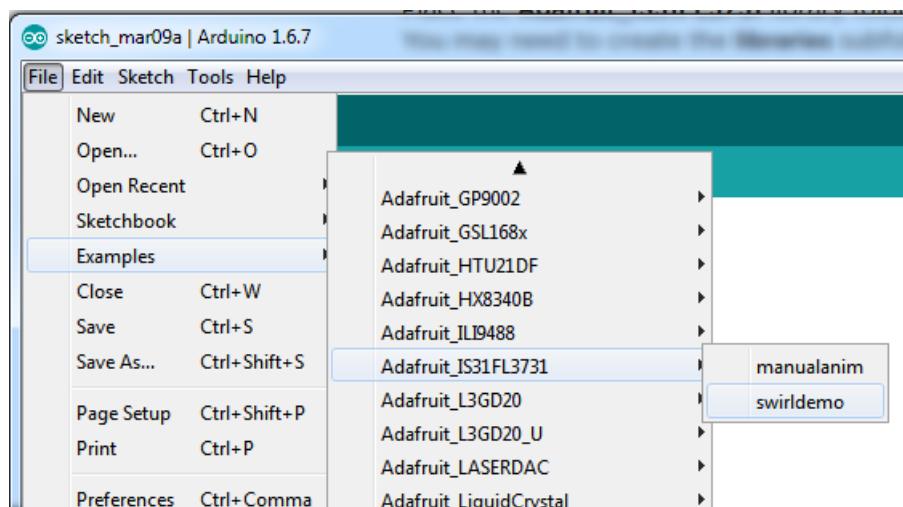
<https://adafru.it/cBB>

Rename the uncompressed folder **Adafruit_GFX** and check that the **Adafruit_GFX** folder contains **Adafruit_GFX.cpp** and **Adafruit_GFX.h**

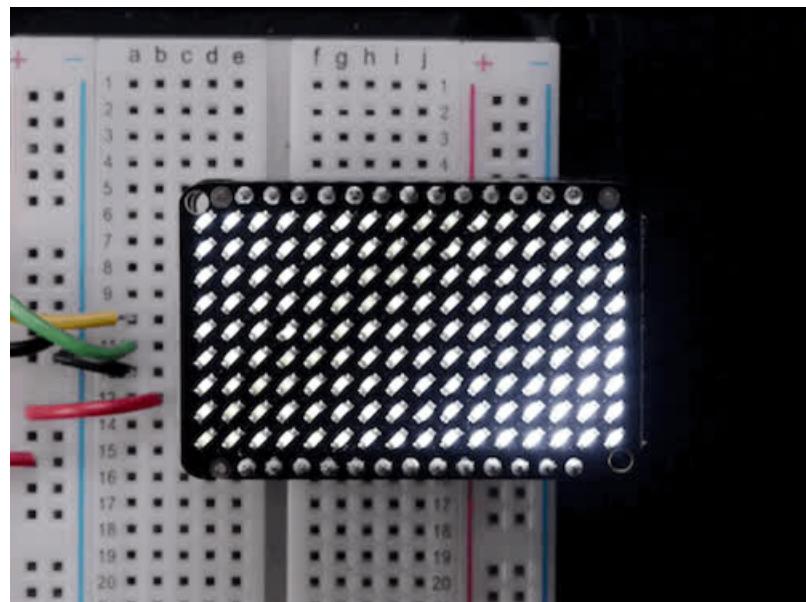
Place the **Adafruit_GFX** library folder your **arduinosketchfolder/libraries/** folder like you did with the IS31FL library

Load Demo

Open up **File->Examples->Adafruit_IS31FL3731>swirldemo** and upload to your Arduino wired up to the driver & matrix



Upload to your Arduino, you'll see the LED display swirl different brightnesses!



Library Reference

Now that you have the demo working, you can control the matrix directly.

Initialize

Start by creating a new matrix object with something like:

```
Adafruit_IS31FL3731 ledmatrix = Adafruit_IS31FL3731();
```

There's no arguments to the constructor

Then in your setup, call **begin(*address*)** to initialize the driver. Begin() will return false if the matrix was not found, and true if initialization worked out

```
if (! ledmatrix.begin()) {
    Serial.println("IS31 not found");
    while (1);
}
Serial.println("IS31 found!");
```

Drawing

You can then draw to the display. Note that since we write directly to the driver RAM, any pixels 'drawn' will appear immediately.

You can start with **drawPixel(*x*, *y*, *brightness*)** where *x* ranges between 0 and 15 inclusive, and *y* ranges between 0 and 8 inclusive. **Brightness** is the PWM of the LED, 0 is off, and 255 is all the way on.

This loop will light up every LED in increasing brightness:

```
int i = 0;
for (uint8_t x=0; x<16; x++) {
    for (uint8_t y=0; y<9; y++) {
        ledmatrix.drawPixel(x, y, i++);
    }
}
```

Adafruit GFX

Once you get pixels drawing, you can use Adafruit GFX to draw lines, rectangles, circles, text, etc.

The Adafruit_GFX library for Arduino provides a common syntax and set of graphics functions for all of our LED, TFT, LCD and OLED displays. This allows Arduino sketches to easily be adapted between display types with minimal fuss... and any new features, performance improvements and bug fixes will immediately apply across our complete offering of color displays.

Check out our detailed tutorial here <http://learn.adafruit.com/adafruit-gfx-graphics-library> (<https://adafru.it/aPx>) It covers the latest and greatest of the GFX library!

Multiple Buffers

The IS31 has 8 full display frame buffers available. By default you draw and display to frame buffer #0

But! If you want to flip thru different images quickly, you can double buffer by writing to one buffer and then telling the IS31 to switch which one is visible.

To set which frame we are **drawing** to, use **setFrame(*n*)**

where *n* ranges from 0 to 7 inclusive

```
ledmatrix.setFrame(frame);
```

Then when you are ready to display it, to set which frame we are **displaying** to, use **displayFrame(*n*)**

where *n* ranges from 0 to 7 inclusive

```
ledmatrix.displayFrame(frame);
```

Python & CircuitPython

It's easy to use the IS31FL3731 Charlieplex breakout, the Charlieplex FeatherWing, and the CharliePlex Bonnet with Python or CircuitPython and the [Adafruit CircuitPython IS31FL3731](https://adafru.it/zIE) (<https://adafru.it/zIE>) module. This module allows you to easily write Python code that does all sorts of fun things with the LED matrix.

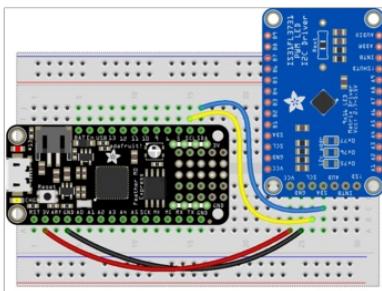
You can use CharliePlex LED matrices with any CircuitPython microcontroller board or with a computer that has GPIO and Python [thanks to Adafruit_Blinka, our CircuitPython-for-Python compatibility library](https://adafru.it/BSN) (<https://adafru.it/BSN>).

CircuitPython Microcontroller Wiring

First wire up a IS31FL3731 breakout to your board exactly as shown on the previous pages for Arduino.

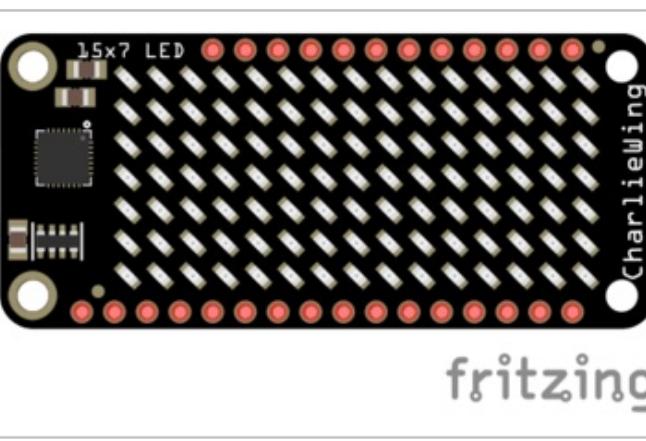
For the FeatherWing, solder on the headers, and attach to the Feather.

Here's an example of wiring a Feather M0 to the breakout with I2C:



- **Board 3V to sensor VCC**
- **Board GND to sensor GND**
- **Board SCL to sensor SCL**
- **Board SDA to sensor SDA**

And here is the CharlieWing on a Feather M4:



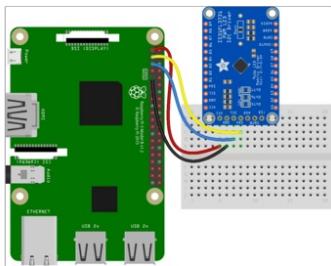
- Assemble the CharlieWing by soldering headers onto the board.
- Once assembled, plug it into a Feather!

Python Computer Wiring

Since there's *dozens* of Linux computers/boards you can use we will show wiring for Raspberry Pi. For other platforms, [please visit the guide for CircuitPython on Linux to see whether your platform is supported](https://adafru.it/BSN) (<https://adafru.it/BSN>).

For the Bonnet, simply attach the Bonnet to your Raspberry Pi header.

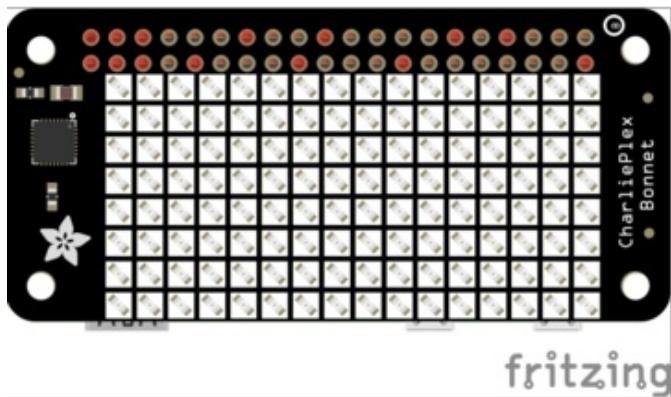
Here's the Raspberry Pi wired to the breakout with I2C:



- Pi 3V3 to sensor VIN
- Pi GND to sensor GND
- Pi SCL to sensor SCL
- Pi SDA to sensor SDA

Here is the CharliePlex Bonnet on a Raspberry Pi Zero:

The CharliePlex Bonnet comes fully assembled. Simply plug it into your Raspberry Pi!



CircuitPython Installation of IS31FL3731 Library

You'll need to install the [Adafruit CircuitPython IS31FL3731](https://adafru.it/zIE) (<https://adafru.it/zIE>) library on your CircuitPython board.

First make sure you are running the [latest version of Adafruit CircuitPython](https://adafru.it/Amd) (<https://adafru.it/Amd>) for your board.

Next you'll need to install the necessary libraries to use the hardware--carefully follow the steps to find and install these libraries from [Adafruit's CircuitPython library bundle](https://adafru.it/uap) (<https://adafru.it/uap>). Our CircuitPython starter guide has a [great page on how to install the library bundle](https://adafru.it/ABU) (<https://adafru.it/ABU>).

For non-express boards like the Trinket M0 or Gemma M0, you'll need to manually install the necessary libraries from the bundle:

- `adafruit_is31fl3731.mpy`
- `adafruit_bus_device`

Before continuing make sure your board's lib folder or root filesystem has the `adafruit_is31fl3731.mpy`, and `adafruit_bus_device` files and folders copied over.

Next [connect to the board's serial REPL](https://adafru.it/Awz) (<https://adafru.it/Awz>) so you are at the CircuitPython >>> prompt.

Python Installation of IS31FL3731 Library

You'll need to install the Adafruit_Blinka library that provides the CircuitPython support in Python. This may also require enabling I²C on your platform and verifying you are running Python 3. [Since each platform is a little different, and Linux changes often, please visit the CircuitPython on Linux guide to get your computer ready \(<https://adafru.it/BSN>\)!](#)

Once that's done, from your command line run the following command:

- `sudo pip3 install adafruit-circuitpython-is31fl3731 adafruit-circuitpython-framebuf`

If your default Python is version 3 you may need to run 'pip' instead. Just make sure you aren't trying to use CircuitPython on Python 2.x, it isn't supported!

CircuitPython & Python Usage

To demonstrate the usage of the sensor we'll initialize it and manipulate the LED matrix from the board's Python REPL.

NOTE: Due to size and design of each CharliePlex matrix form-factor, import and initialisation is different for each. Make sure you're running the correct code for your matrix!

First, run the following code to import the necessary modules and create the I²C object:

```
import board
import busio
import adafruit_is31fl3731
i2c = busio.I2C(board.SCL, board.SDA)
```

If you're using the CharliePlex breakout, initialise it by running the following code:

```
display = adafruit_is31fl3731.Matrix(i2c)
```

If you're using the CharliePlex FeatherWing, run the following code:

```
display = adafruit_is31fl3731.CharlieWing(i2c)
```

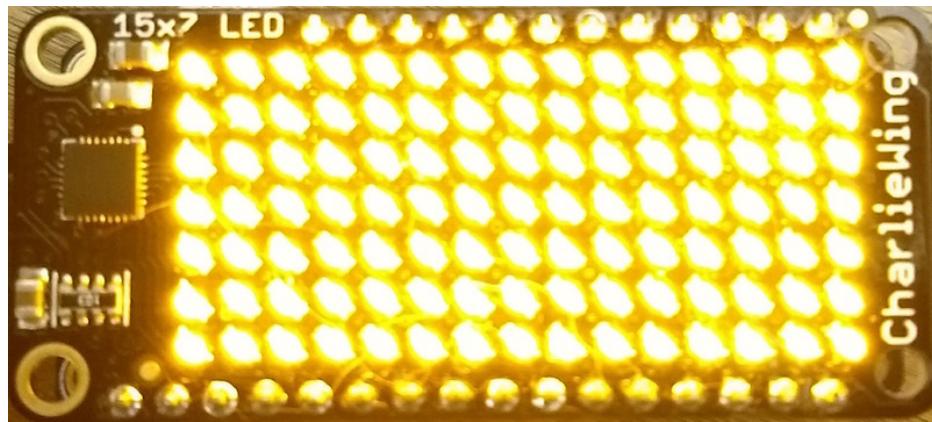
If you're using the CharliePlex Bonnet, run the following code:

```
display = adafruit_is31fl3731.CharlieBonnet(i2c)
```

When the display initializes it will go through and clear each frame (there are 8 frames total) of the display. You might see the display momentarily flash and then turn off to a clear no pixel lit image.

You can control all of the board's pixels using the `fill` function. Send to this function a value from `0` to `255` where `0` is every LED pixel turned off and `255` is every LED pixel turned on to maximum brightness. For example to set all the pixels to half their brightness run:

```
display.fill(127)
```

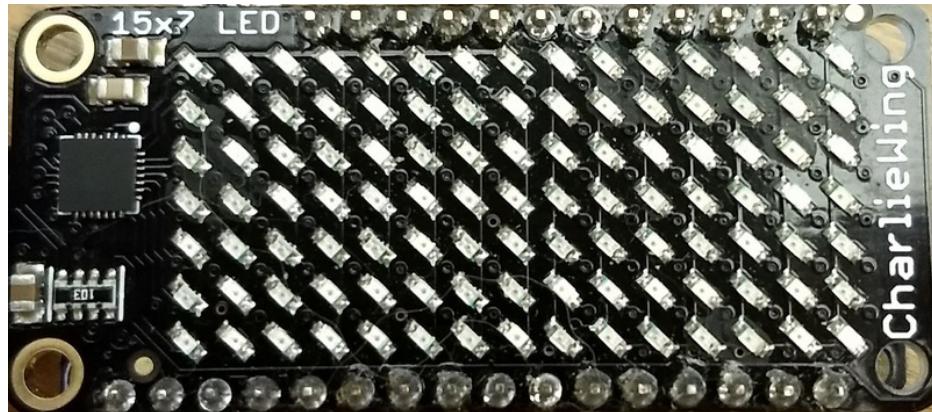


You might notice some buzzing or ringing sounds from the display when all pixels are lit, this is normal as the Charlieplex driver quickly switches LEDs on and off.

If you've used other displays like LED matrices you might notice the Charlieplex module doesn't need to have a show function called to make the changes visible. As soon as you call fill or other display functions the display will update!

You can turn all the pixels off with `fill` set to `0`:

```
display.fill(0)
```



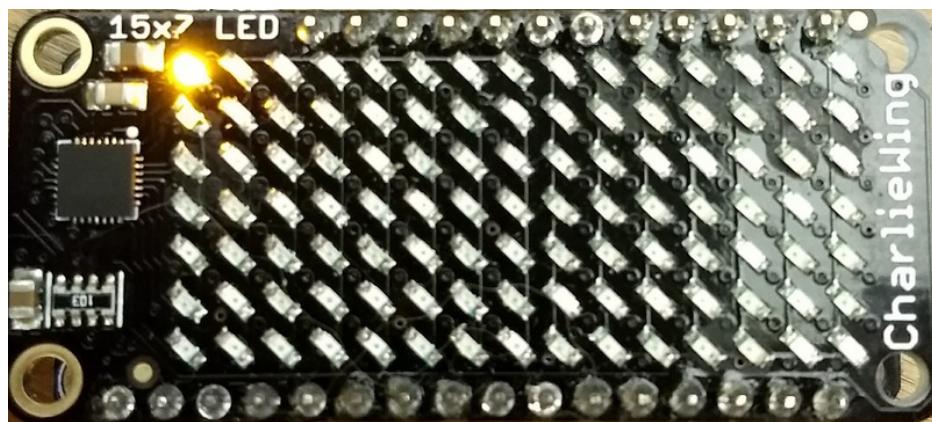
█ Be careful setting all pixels to 255 maximum brightness! This might pull more power than your computer's USB port can provide if you are powering your board over USB. Use an external powers supply or battery when lighting lots of LEDs to max brightness.

Now for some fun! You can set any of the LED pixels using the `pixel` function. This function takes the following parameters:

- **X position** - The location of the horizontal / X pixel position.
- **Y position** - The location of the vertical / Y pixel position.
- **Intensity** - This is a value from `0` to `255` which specifies how bright the pixel should be, 0 is off and 255 is maximum brightness. Use an in-between value to show a less bright pixel.

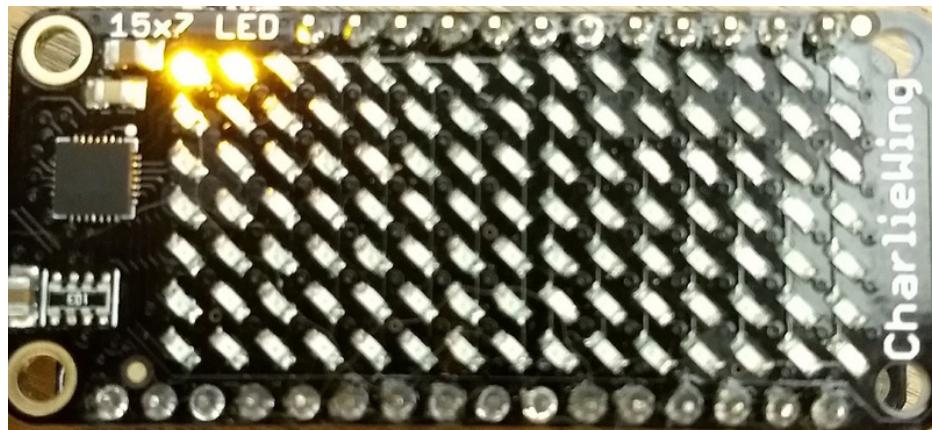
For example to set pixel 0, 0 to full brightness run:

```
display.pixel(0, 0, 255)
```



Or to set the pixel next to it horizontally to half brightness run:

```
display.pixel(1, 0, 127)
```



You can turn off individual pixels by setting them to an intensity of zero.

You can even make pixels blink! The board supports a fixed blink rate that you set using the `blink` function. This function takes in the number of milliseconds to use for the blink rate (but internally it can only blink in 270ms increments so you might not get an exact match). For example to blink pixels about once every half second call:

```
display.blink(500)
```

You'll notice nothing actually changes on the board. This is because in addition to intensity each LED pixel has a blink state which can be enabled and disabled. The `fill` command can actually set all pixels and turn them on to blink:

```
display.fill(127, blink=True)
```

You can turn off the blinking by setting `blink=False`.

The `pixel` command supports the blink parameter too! You can turn on and off blinking pixel by pixel as needed. For

example to turn on blinking for pixel `0, 0`:

```
display.pixel(0, 0, 127, blink=True)
```

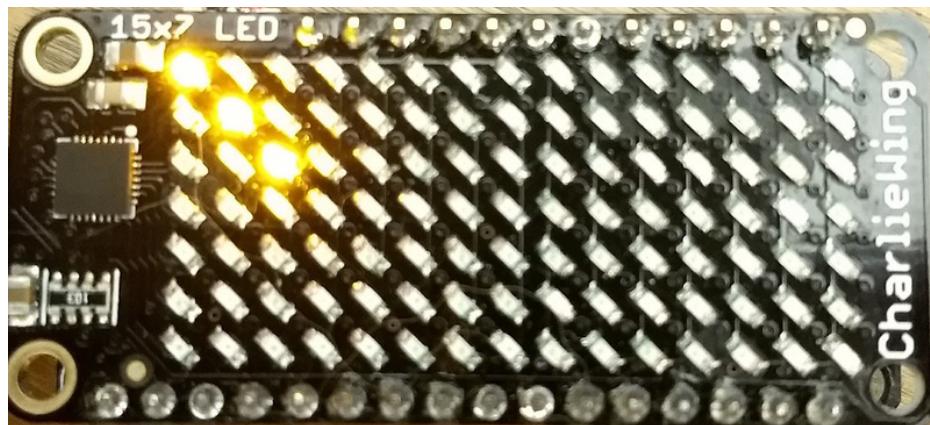
Currently the Charlieplex module is very simple and only exposes pixel set commands. In the future more advanced graphics commands like line drawing, text display, etc. might be implemented but for now you'll need to manipulate the pixels yourself.

Finally the display supports holding up to 8 frames of pixel data. Each frame contains an entire matrix of LED pixel state (intensity, blinking, etc.) and by default the module starts you on frame 0. You can change to start displaying and drawing on another frame by calling `frame` which takes these parameters:

- **Frame number** - This is the frame number to make the active frame for display or drawing. There are 8 frames total, `0` through `7`.
- `show` - An optional boolean that defaults to `True` and specifies if the frame should be immediately displayed (`True`) or just made active so that pixel and fill commands draw on it but it's not yet shown.

For example to clear frame `1` and draw a few pixels on it, then display it you can run:

```
display.frame(1, show=False)
display.fill(0)
display.pixel(0, 0, 255)
display.pixel(1, 1, 255)
display.pixel(2, 2, 255)
display.frame(1) # show=True is the default, the frame will be displayed!
```



Notice how the first call switches to make frame `1` the active frame but doesn't display it because `show` is set to false. Then the frame pixel data is changed with `fill` and `pixel` commands, and finally the frame is shown by calling `frame` again but letting the default `show = True` be used so the frame is displayed.

Using frames you can build simple animations by drawing each frame and swapping between them over time!

That's all there is to the basic Charlieplex driver module usage!

Full Example Code

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Text Scrolling Example

NOTE: When running this example on Raspberry Pi, you must have the font8x5.bin file found [here](https://adafru.it/Edh) (<https://adafru.it/Edh>) in the same directory as the program!

```
wget https://raw.githubusercontent.com/adafruit/Adafruit_CircuitPython_framebuf/master/examples/font5x8.bin
```

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Python Docs

[Python Docs \(https://adafru.it/C55\)](https://adafru.it/C55)

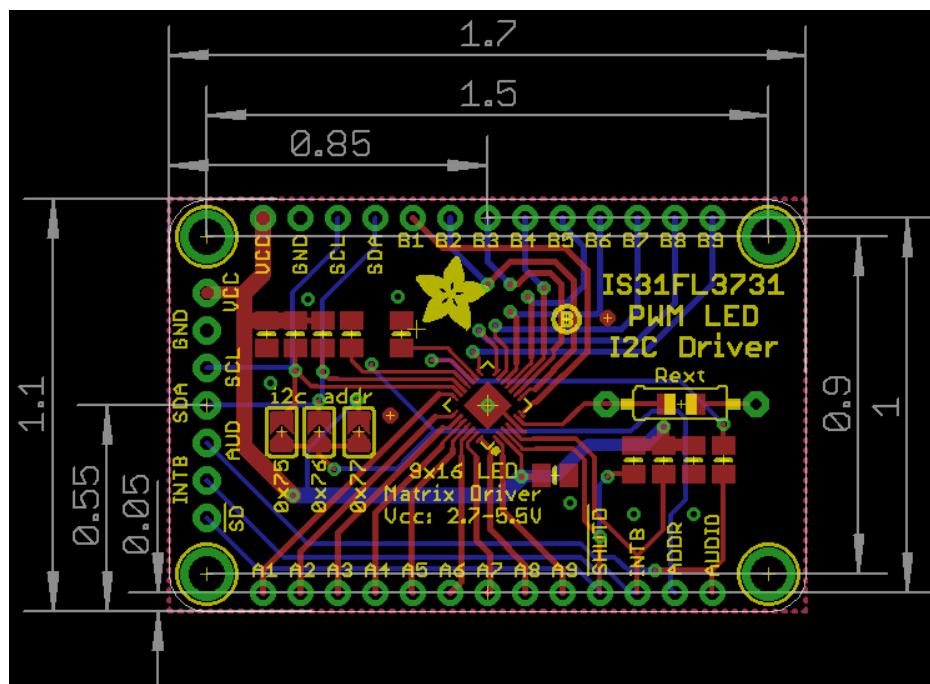
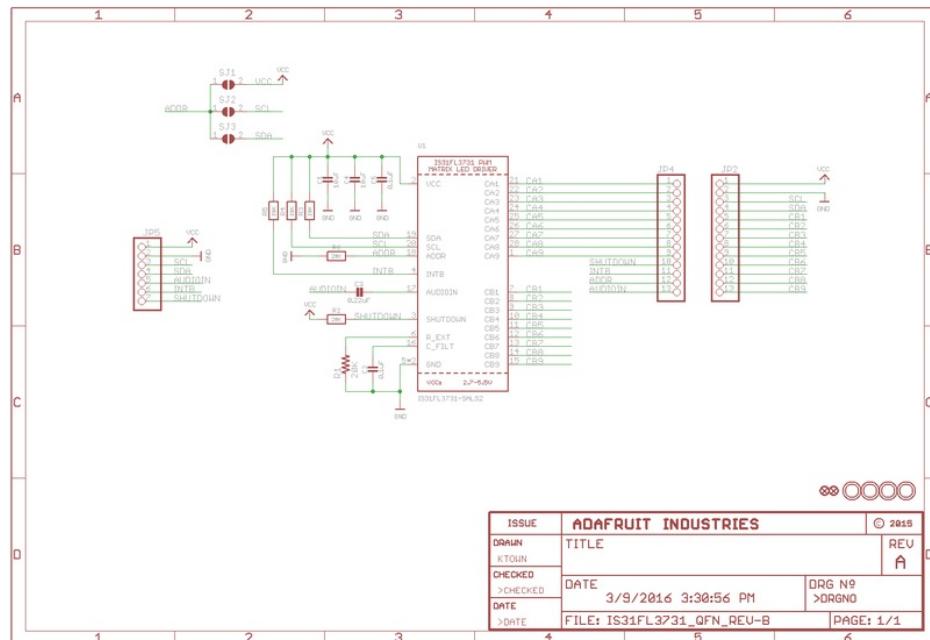
Downloads

Datasheets & Files

- EagleCAD PCB files on GitHub (<https://adafru.it/oja>)
- Fritzing objects in the Adafruit Fritzing library (<https://adafru.it/aP3>)
- IS31FL3731 Datasheet (<https://adafru.it/IWC>)

IS31FL3731 Breakout

Schematics & Fabrication Print (Dimensions in Inches)



16x9 0603 LED Grid

Schematics & Fabrication print (dimensions in inches)

