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# PixelPi Library

Aug 20, 2020



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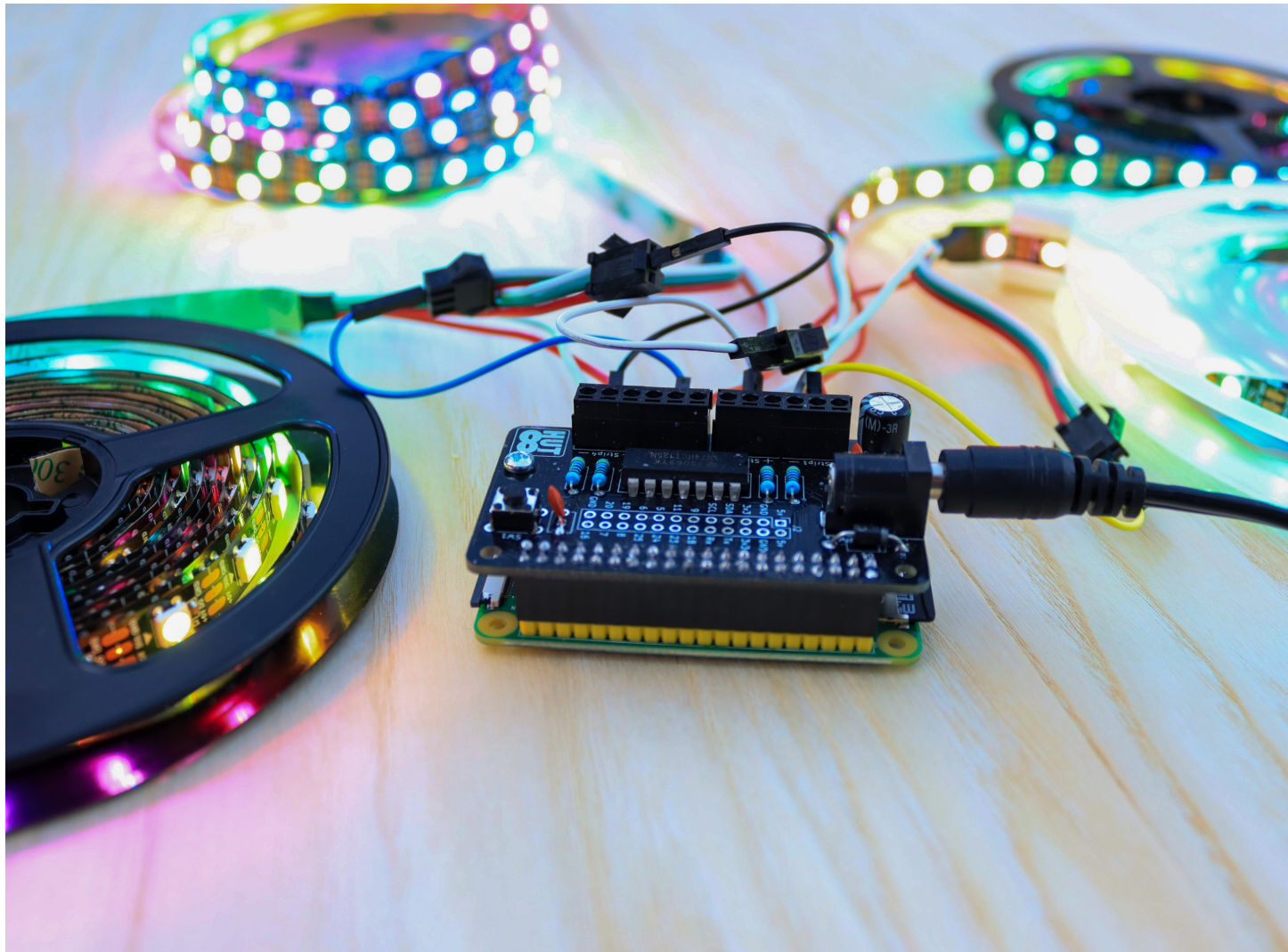
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The PixelPi Library is intended to be used with the PixelPi PCB from Hut 8 Designs.

The PixelPi is a HAT-like add on board from Hut 8 Designs for the Raspberry Pi computer (40-pin versions) and enables you to control up to four (4) WS281x type RGB LED strips or matrices independently with one Raspberry Pi.



*The PixelPi in action!*



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## Building the PixelPi Board

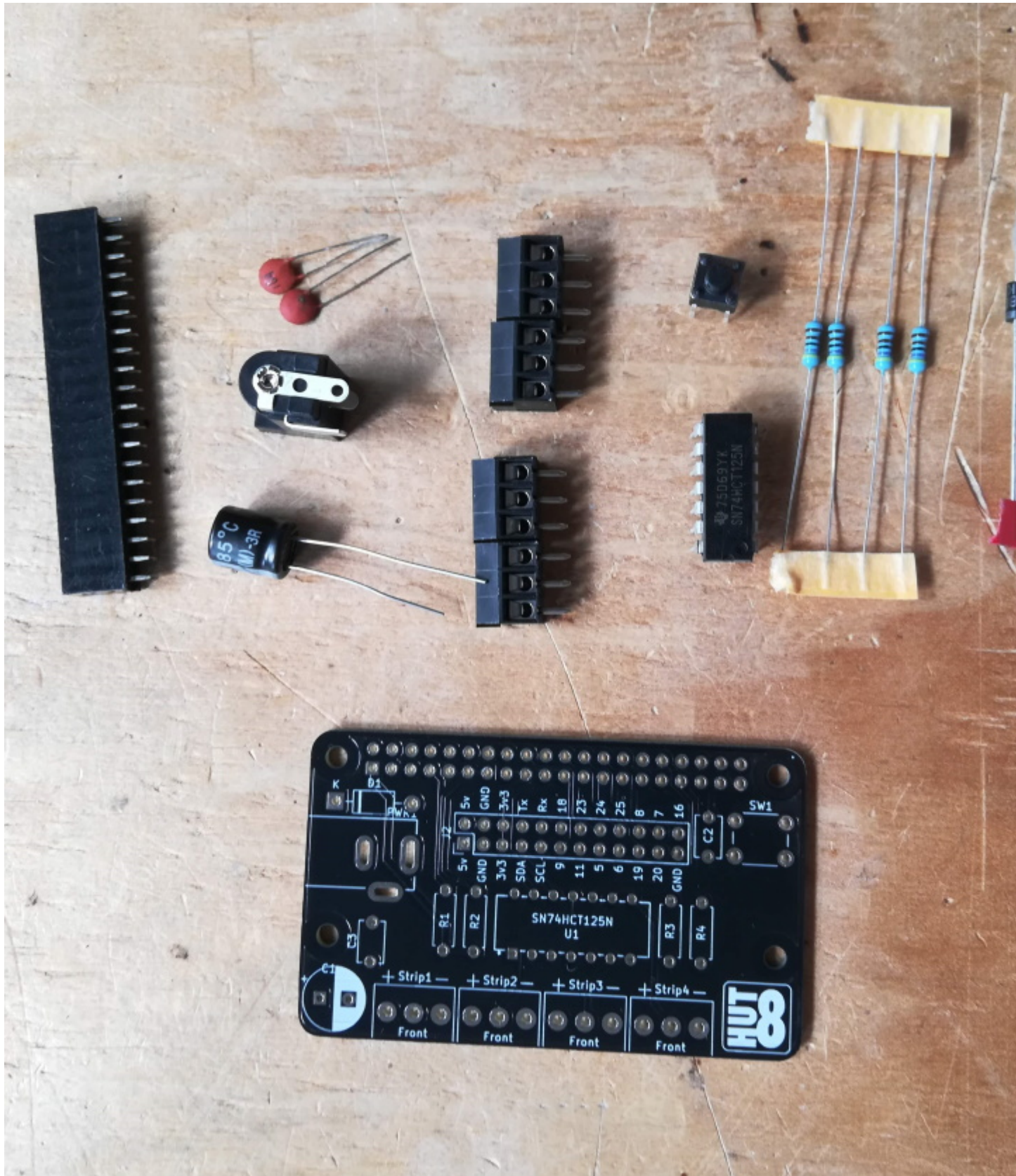
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### 1.1 Components

The PixelPi consists of the following components:

- Four 4.7k Resistors (R1, R2, R3, R4)
- Four screw terminal blocks (Strip1, Strip2, Strip3, Strip4)
- One 1N5817 Schottky Rectifier (D1)
- One 2.1mm barrel jack (PWR1)
- Two 1pF capacitors (C2, C3)
- One 470uF capacitor (C1)
- One button (SW1)
- One 2x40 pin header (J1)
- Optional GPIO Pin breakout pins (J2)
- One PixelPi PCB





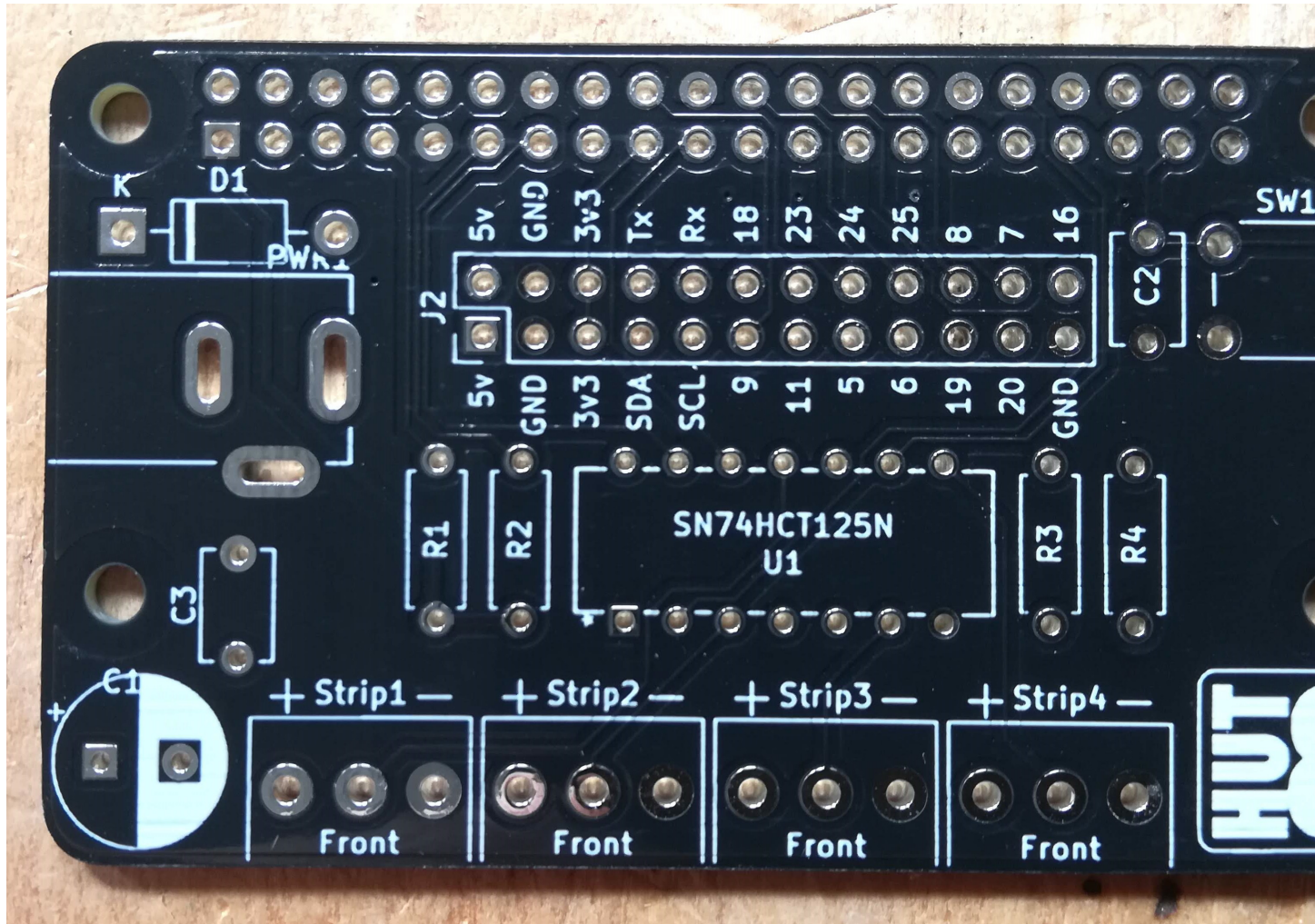


## 1.2 Soldering Order

The order you solder the board together does not matter, but doing it in the following order will make it easier.

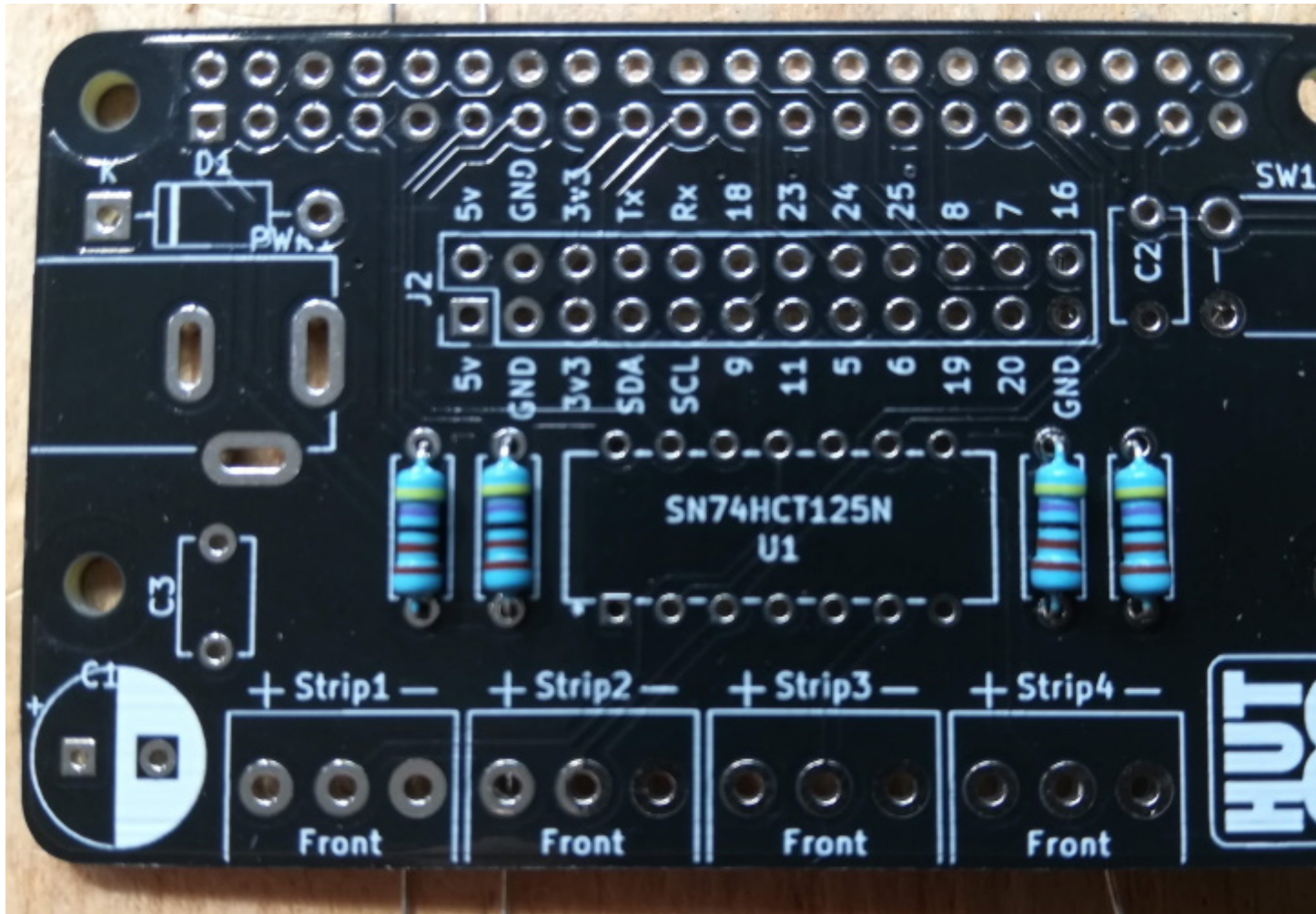
### 1.2.1 The PCB

View the PCB from the top and locate the positions of each component.



### 1.2.2 Resistors (R1, R2, R3, R4)

The resistors can be soldered either way round, but they look better if they are all the same way round.



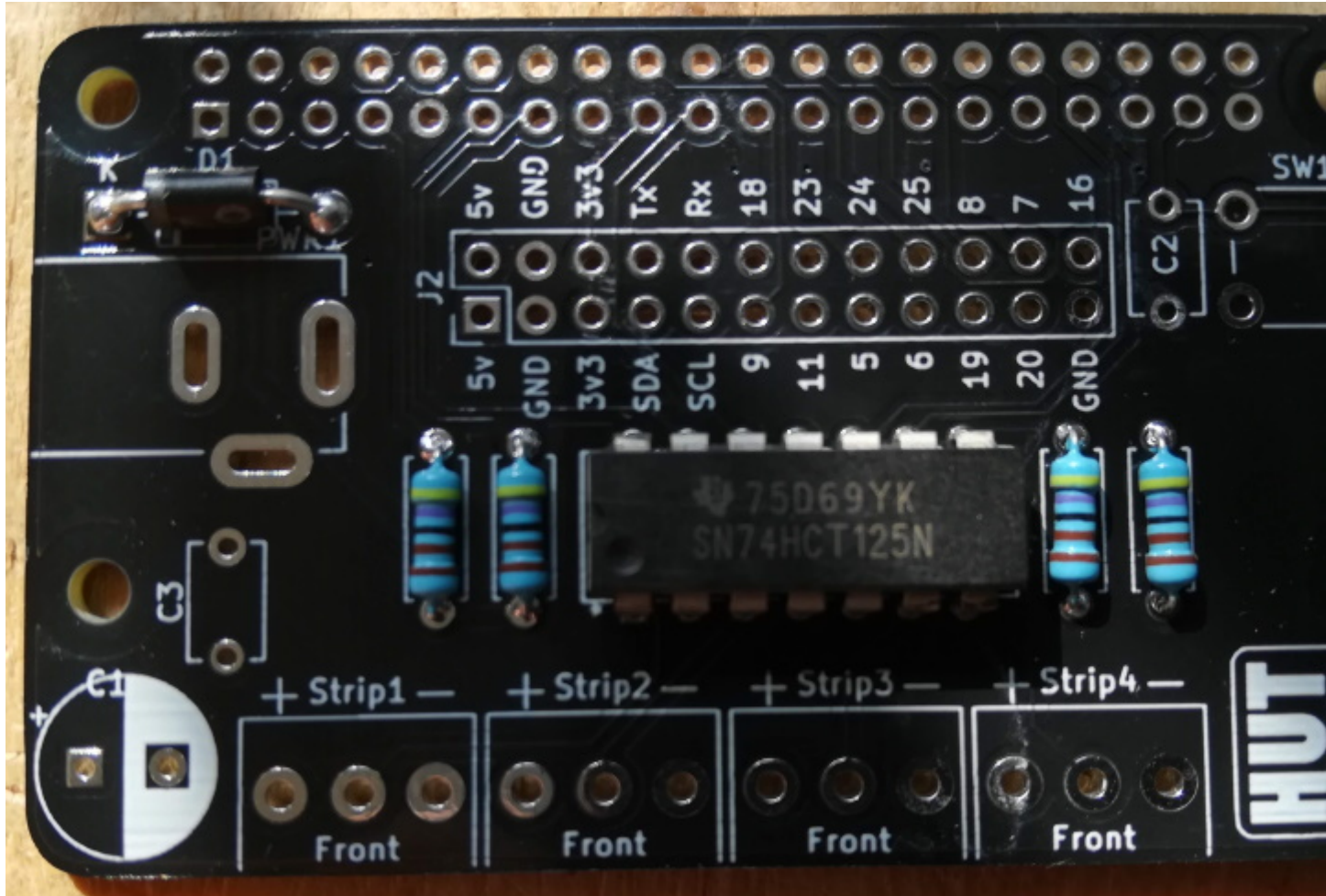
### 1.2.3 Schottky Rectifier

The rectifier (diode) has to be soldered the correct way around. Locate the white band on one end of the diode and line it up with the white line on the location D1.



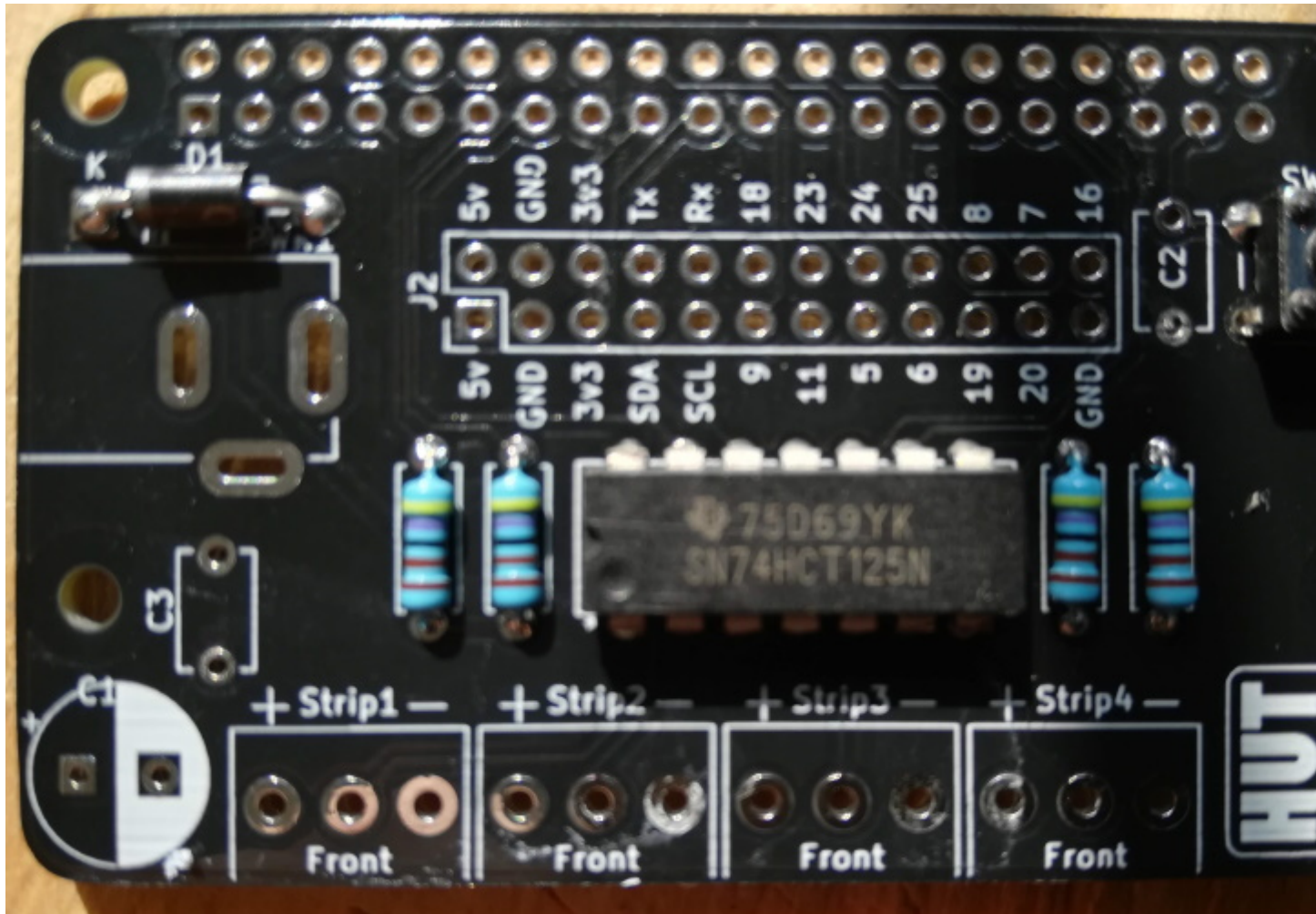


### 1.2.4 The IC Chip



### 1.2.5 Button

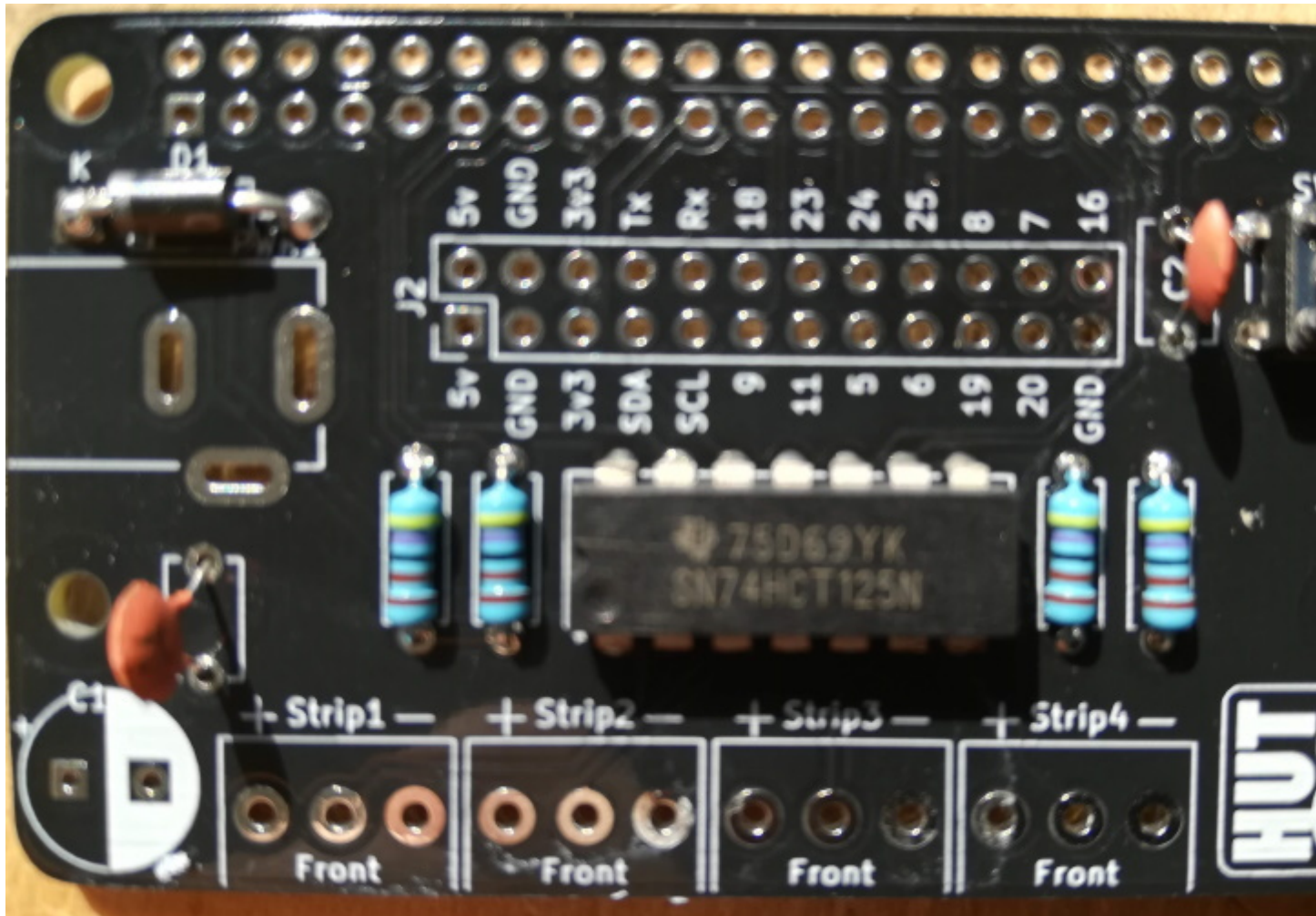
The button will only fit one way around at location SW1.



### 1.2.6 1pF Capacitors (optional, but recommended)

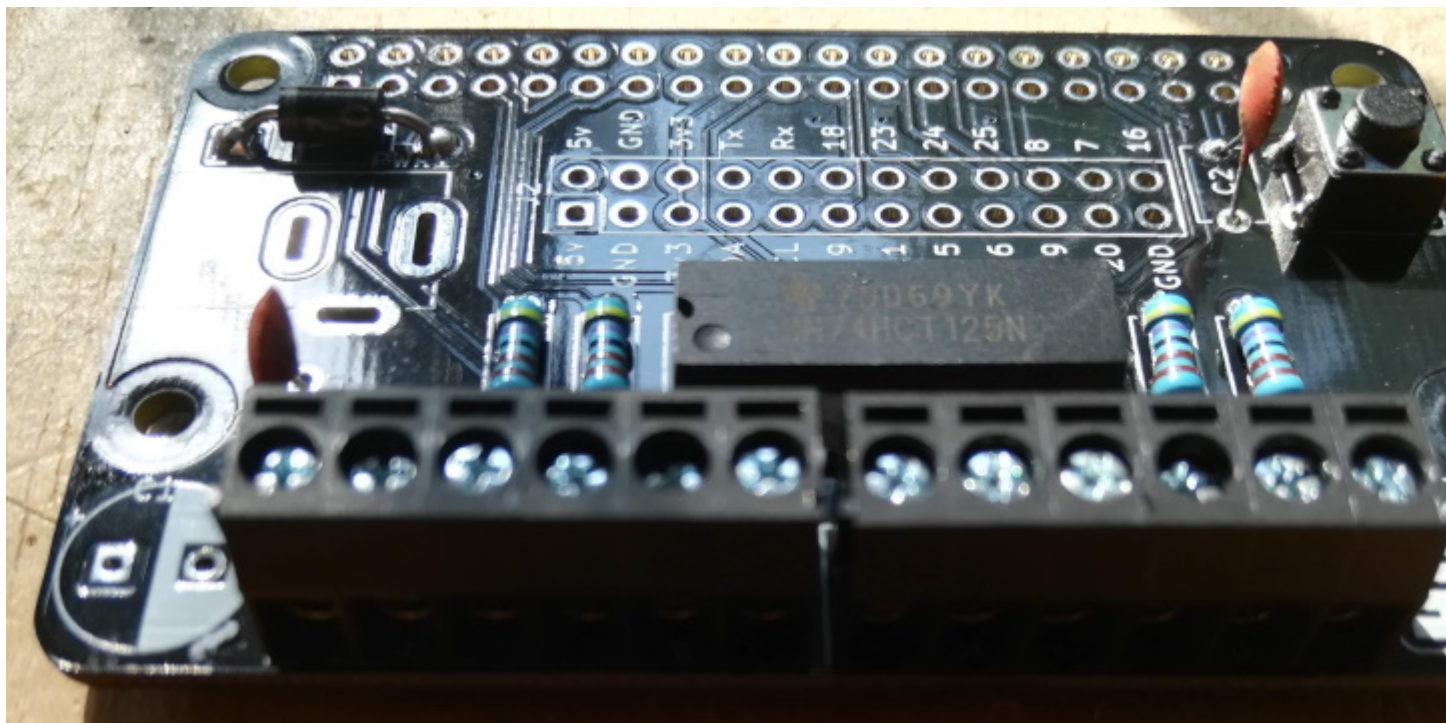
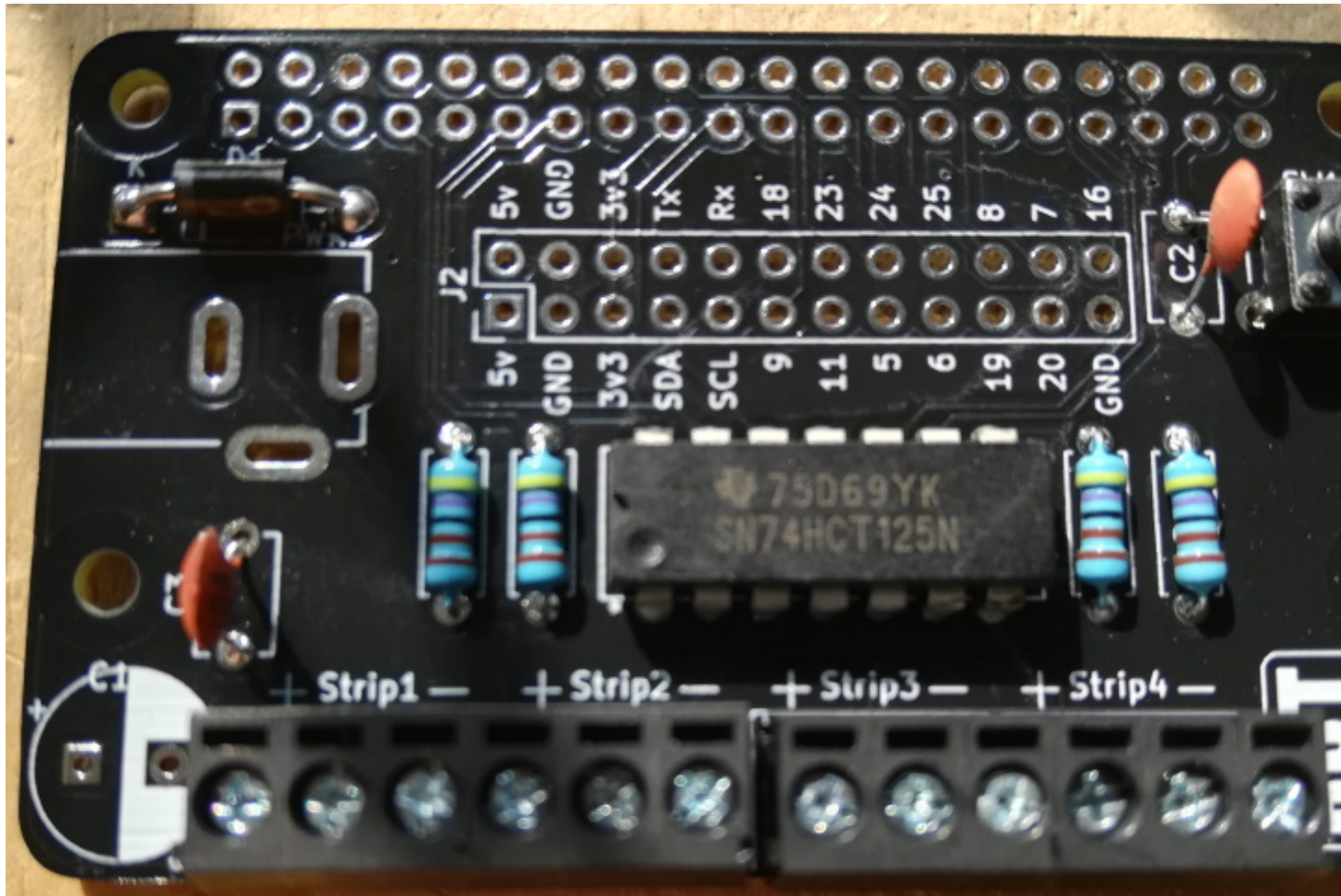
The two 1pF capacitors, locations C2 and C3, can be soldered either way around.





### 1.2.7 Screw Terminals

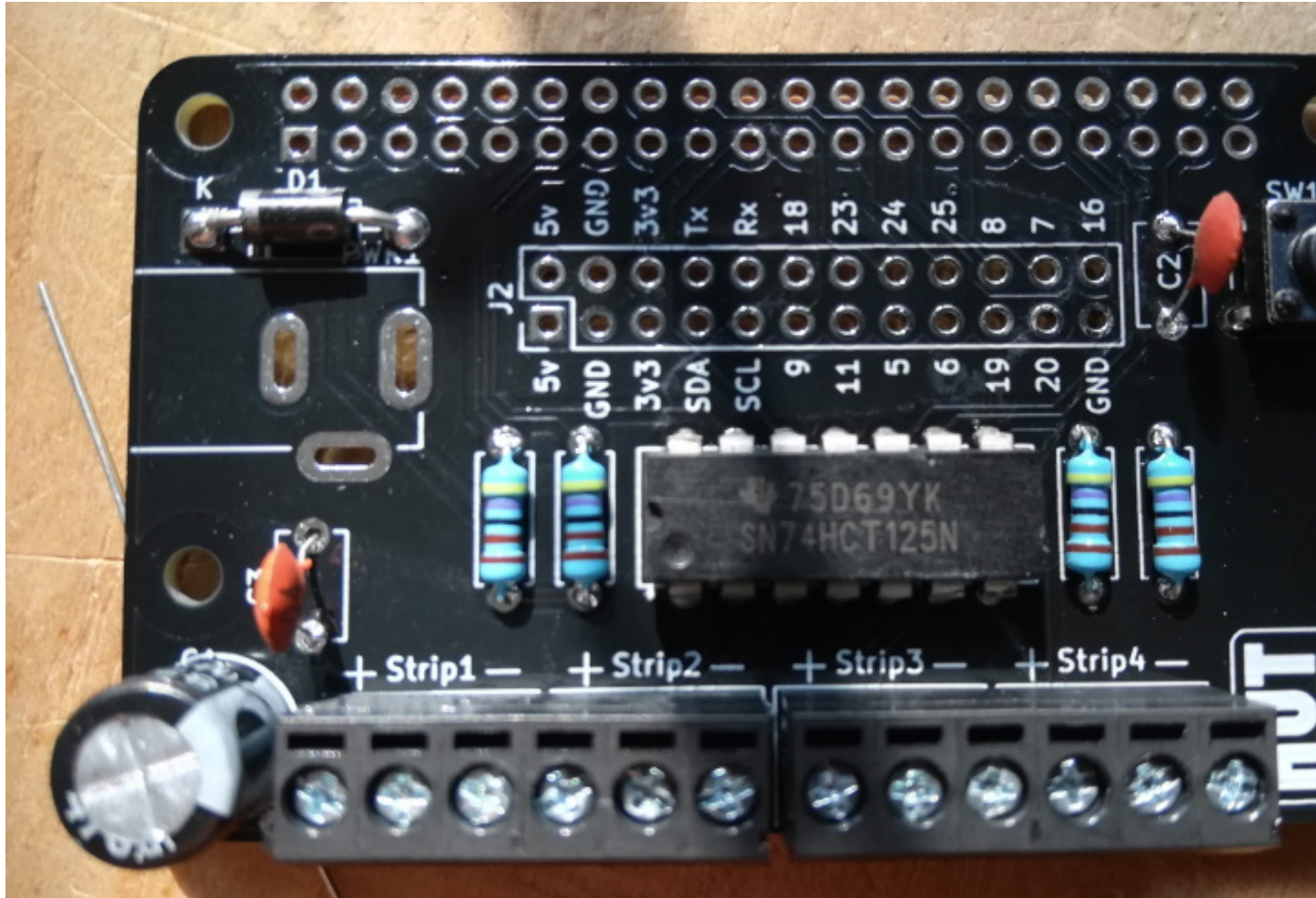
Connect two pairs of terminals together by sliding the edges together, then solder them onto the board with screw terminal access holes towards the front of the board.





### 1.2.8 470uF Capacitor (optional, but recommended)

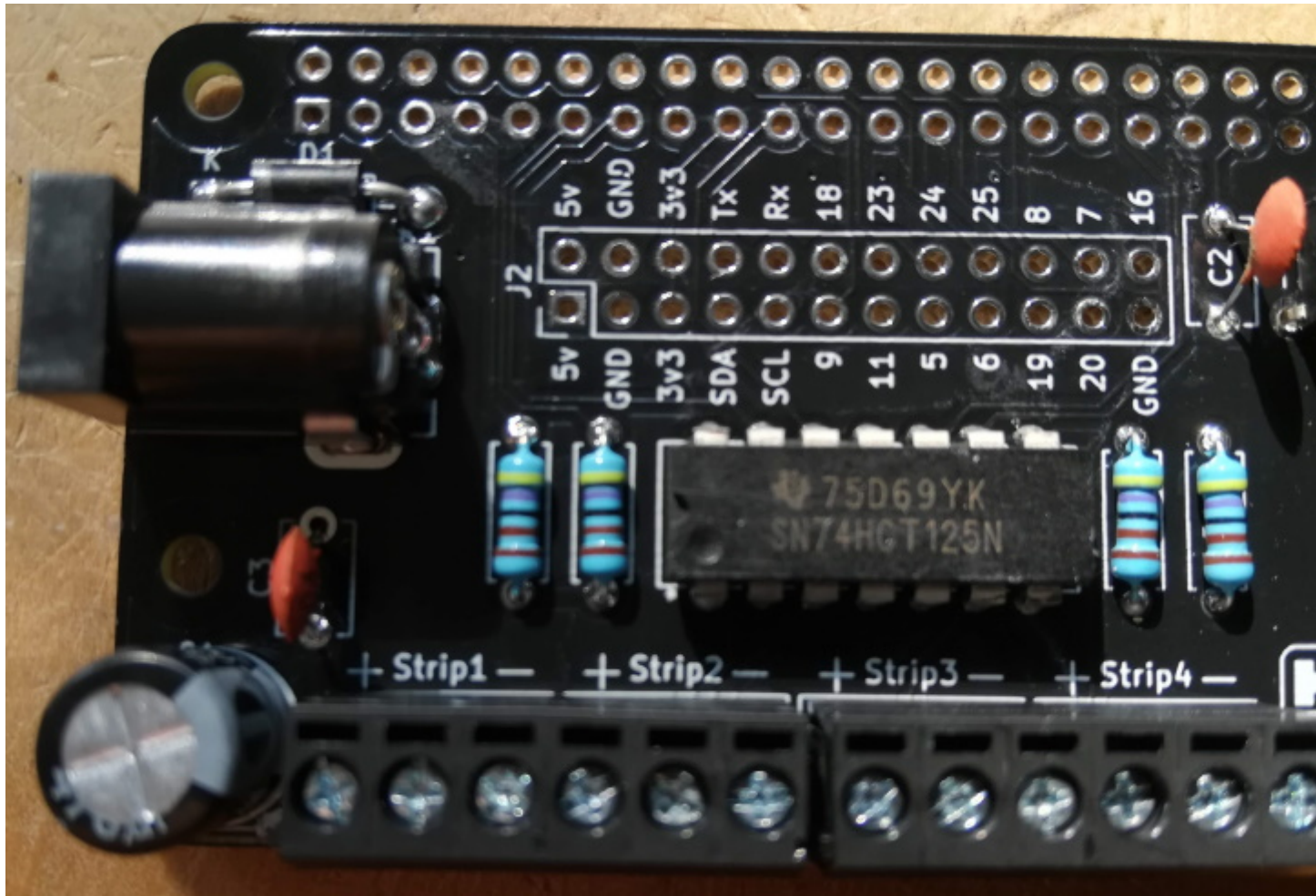
This capacitor has polarity, and therefore has to be soldered the correct way around. The white area of C1 indicates the -ve leg. The -ve leg is marked with a white line and - symbol.



### 1.2.9 The Barrel Jack

The last component on the top of the PCB is the barrel jack. This can only fit in one way, with the hole of the barrel pointing away from the board.

**note** Only use a 5v power supply with the PixelPi board. Anything higher will kill your Raspberry Pi as well as your LEDs.



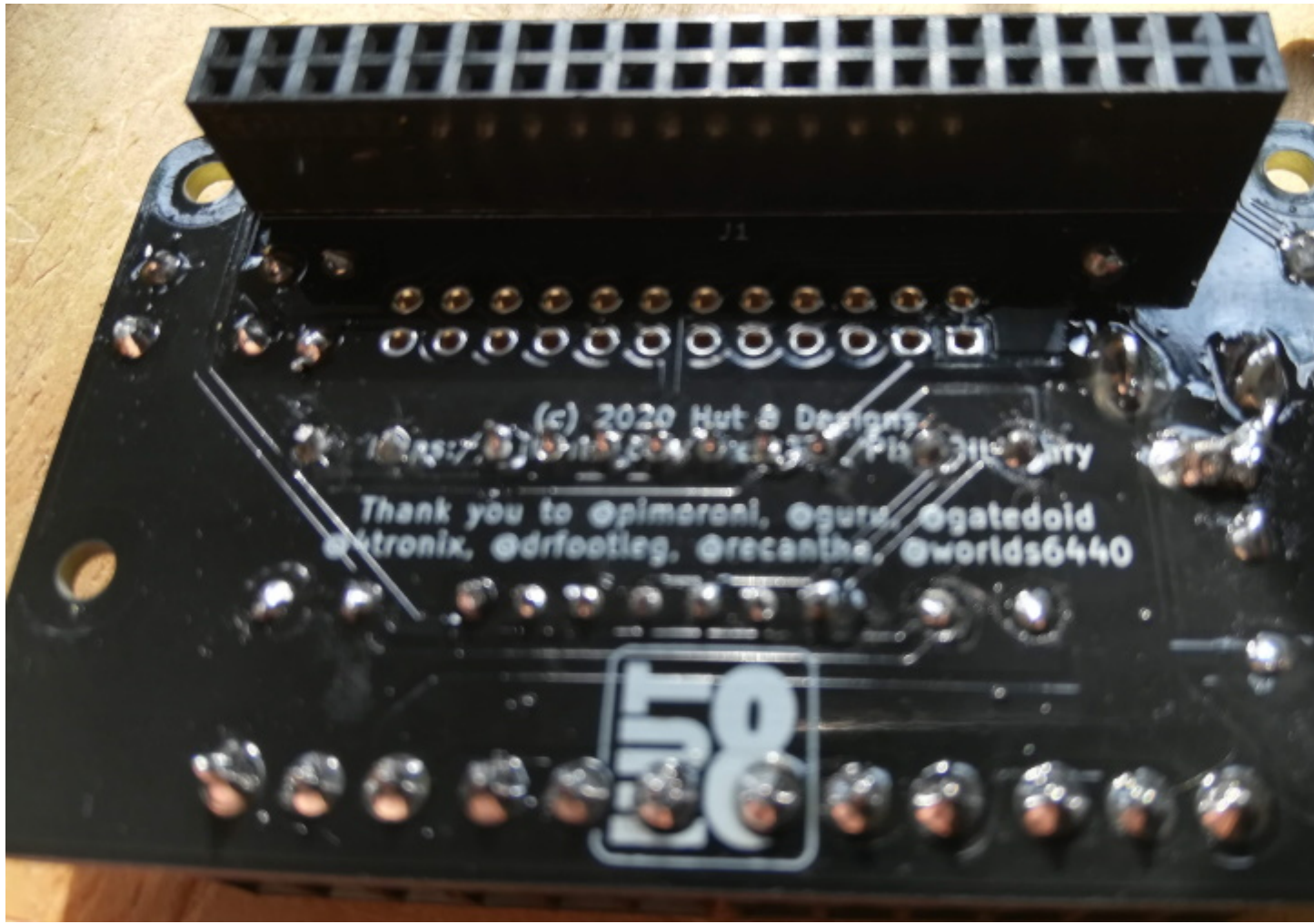
**Note** If you have one of the alpha boards, you will need to solder two pins together due to a small design issue.





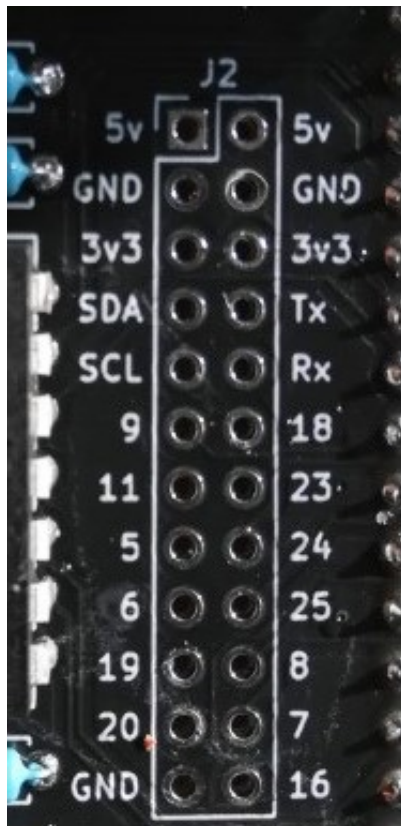
### 1.2.10 Raspberry Pi Header

The Raspberry Pi header should be mounted on the underside of the PCB, soldered from the top.



### 1.2.11 (Optional) Breakout Headers

If you plan to use any of the breakout pins, you may solder header pins in place.





## CHAPTER 2

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### Installing the Python Library

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This PixelPi Library is a fork of the Pimoroni (<http://pimoroni.com>) Plasma code (<https://github.com/pimoroni/plasma>), massively simplified and extensively modified to be used with the PixelPi Raspberry Pi ‘small’ HAT from Hut 8 Designs.

**Note** The library has been designed to only work with Python 3.

Before installing the library, you need to prepare you Raspberry Pi OS. These instructions assume you are starting with the latest version of the Raspberry Pi OS Lite.

It is always good to start from an updated OS, so log in and run the following commands:

```
sudo apt update && sudo apt upgrade
```

### 2.1 config.txt

The PixelPi board needs some of the Raspberry Pi interfaces turned on, and one turned off. The Raspberry Pi audio and the PWM channels used by the PixelPi cannot be used at the same time, so if you are using strip outputs 2 and 4 you need to disable audio on the Pi. Do the following to ensure the audio is completely turned off by editing the boot config file with:

```
sudo nano /boot/config.txt
```

The uncomment this lines, and add the second:

```
hdmi_force_hotplug=1
hdmi_force_edid_audio=1
```

Ensure the following line is commented by placing a # at the start:

```
#dtparam=audio=on
```

Uncomment or add the following to in the optional hardware interfaces:

```
dtparam=spi=on
```

Add the following line to the end of the file to set memory frequency:

```
core_freq=250
```

## 2.2 Disable Sound in the Kernel

You will also need to edit the kernel module blacklist:

```
sudo nano /etc/modprobe.d/snd-blacklist.conf
```

Add the following line:

```
blacklist snd_bcm2835
```

## 2.3 Using strip4

Strip 4 uses SPI. You should increase the buffer size to handle most eventualities of LED strip length. Edit the boot cmdline file:

```
sudo nano /boot/cmdline.txt
```

Add the following to the end of the only line to increase the SPI buffer size:

```
spidev.bufsiz=32768
```

## 2.4 Reboot

You need to reboot your Raspberry Pi for the above changes to take effect:

```
sudo reboot
```

## 2.5 Installing the PixelPi Library

The PixelPi library is available on GitHub. to retrieve it you need to install git:

```
sudo apt install git -y
```

The library can be downloaded then installed (with all prerequisites) with the following commands:

```
cd ~  
git clone http://github.com/geekytim/PixelPiLibrary  
cd ~/PixelPiLibrary  
sudo bash install.sh
```



---

### Identifying LED Types

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When you attach your LEDs you may not know the exact LED type they, and if it is a matrix, you may not know the order of the LEDs. Sample code has been given to help you identify both LED type and matrix shape.

### 3.1 Connecting the LEDs to the PixelPi board

WS281x LEDs have three wires which are usually red, green and white. The red wire should be connected to + on a terminal, the white to - and the green to the centre.

Strings and matrices that use the same LED type may be connected together to form longer strings or larger matrices but you should note that LED brightness will diminish the further away from the start they are.

**Note** Only ever connect a 5v power supply to the PixelPi board. Higher voltage will destroy the board, the Raspberry Pi, the LEDs or all three.

### 3.2 Strings and Matrices

An LED strip, or string, is a set of LEDs on a long, flexible PCB. They come in many different lengths and LED spacing.



LED matrices are a 2D array of LEDs:



### 3.3 Finding LED Types

Once connected to the board, use the following code (in `/PixelPiLibrary/examples/string_test.py` or `/PixelPiLibrary/examples/matrix_test.py` if you are using a matrix):

```

1  #!/usr/bin/env python3
2
3  import time
4
5  from pixelpi import Strip
6
7  """
8  Change the parameters below until you see the colours indicated on the screen:
9
10     terminal = The screw terminal your LEDs are connected to
11
12     size = The number of LEDs in your terminal (can be (x, y) for a matrix)
13
14     shape = The 'shape' of the terminal.
15         * `straight` - A led string (default)
16         * `reverse` - A led string which starts at the opposite end
17         * `matrix` - a normal matrix where the led order goes left to right. i.e:
18             1 2 3 4
19             5 6 7 8
20             9 . . .
21         * `zmatrix` - A matrix where the shift in the first row go left to right,
the next one

```

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```

22         right to left. i.e:
23         1 2 3 4
24         8 7 6 5
25         9 . . .
26
27         ledtype = One of the supported terminal types:
28         WS2812, SK6812, SK6812W, SK6812_RGBW, SK6812_RBGW, SK6812_GRBW, SK6812_GBRW,
↪ SK6812_BRGW,
29         SK6812_BGRW, WS2811_RGB, WS2811_RBG, WS2811_GRB, WS2811_GBR, WS2811_BRG, ↪
↪ WS2811_BGR
30
31         brightness = The default brightness for all LEDs (0-255).
32     """
33
34     strip = Strip(terminal=1, size=256, shape='straight', ledtype='WS2812', brightness=40)
35
36     try:
37         while True:
38             print("Red")
39             strip.setLEDs(rgb=(255, 0, 0))
40             strip.showLEDs()
41             time.sleep(1)
42
43             print("Green")
44             strip.setLEDs(rgb=(0, 255, 0))
45             strip.showLEDs()
46             time.sleep(1)
47
48             print("Blue")
49             strip.setLEDs(rgb=(0, 0, 255))
50             strip.showLEDs()
51             time.sleep(1)
52
53             strip.clearLEDs()
54             strip.showLEDs()
55
56             for led in range(strip.getLength()):
57                 print("White: ", led)
58                 strip.setLEDs(rgb=(255, 255, 255), led=led)
59                 strip.showLEDs()
60                 time.sleep(0.25)
61                 strip.setLEDs(rgb=(0, 0, 0), led=led)
62
63     except KeyboardInterrupt:
64         strip.clearLEDs()
65         strip.showLEDs()
66     del strip

```

Edit line 34 to set:

- Which terminal your LEDs are connected to.
- The number of LEDs in the string (or matrix size, in (width, height) format))
- The LED type.
- If you are using a matrix, the shape must also be set to either `matrix` or `zmatrix`.

To run the code, use the following:

```
sudo python3 string_test.py
```

or:

```
sudo python3 matrix_test.py
```

**Note** `sudo` is currently required.

If the LEDs do not display colours in the order RED, GREEN, BLUE followed by a white moving LED you should change the LED type to one of the following:

WS2812, SK6812, SK6812W, SK6812\_RGBW, SK6812\_RBGW, SK6812\_GRBW, SK6812\_GBRW,  
SK6812\_BRGW, SK6812\_BGRW, WS2811\_RGB, WS2811\_RBG, WS2811\_GRB, WS2811\_GBR,  
WS2811\_BRG, WS2811\_BGR

For example, your LEDs may display BLUE, GREEN then all go white. This will not damage them, but indicates you are using the incorrect type. Change the type until the colors are displayed in the right order.

For a matrix, the white LED should move in the same direction for each row. If it does not, swap the `shape` between `zmatrix` and `matrix`.



## CHAPTER 4

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### Example Code

---

Example code has been supplied to illustrate the methods available.

---

**Note:** Remember to change the Strip definition to suit the LEDs connected. Each of the four terminals may use a different LED type and shape.

---

Run the code using:

```
sudo python3 example.py
```

### 4.1 Rainbow

Displays a moving rainbow on your LEDs.

```
#!/usr/bin/env python3

import colorsys
import time

from pixelpi import Strip

# Change the terminal type to the type you have
strip1 = Strip(1, 256, ledtype='WS2811-GRB', brightness=30)
strip2 = Strip(2, 256, ledtype='WS2811-GRB', brightness=30)
strip3 = Strip(3, 256, ledtype='WS2811-GRB', brightness=30)
strip4 = Strip(4, 256, ledtype='WS2811-GRB', brightness=30)

spacing = 360.0 / 16.0
hue = 0

try:
```

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```
while True:
    hue = int(time.time() * 100) % 360
    for x in range(256):
        offset = x * spacing
        h = ((hue + offset) % 360) / 360.0
        r, g, b = [int(c * 255) for c in colorsys.hsv_to_rgb(h, 1.0, 1.0)]

        for strip in [strip1, strip2, strip3, strip4]:
            strip.setLEDs(rgb=(r, g, b), led=x)

        for strip in [strip1, strip2, strip3, strip4]:
            strip.showLEDs()

        time.sleep(0.001)

except KeyboardInterrupt:
    for strip in [strip1, strip2, strip3, strip4]:
        strip.clearLEDs()
        strip.showLEDs()
    del strip
```

## 4.2 Shifting LEDs

The LED colours can be shifted by a number of LEDs and direction:

### 4.2.1 Shifting LED Strings

```
#!/usr/bin/env python3

from pixelpi import Strip

strip = Strip(1, 256, ledtype='WS2812', brightness=40)

strip.clearLEDs()
pattern = strip.getLEDs()

for pixel in range(len(pattern)):
    pattern[pixel] = [0, pixel, 0, pattern[pixel][3]]

strip.setLEDs(pattern=pattern)

try:
    while True:
        strip.showLEDs()
        strip.shift("down", 2)

except KeyboardInterrupt:
    strip.clearLEDs()
    strip.showLEDs()
    del strip
```

## 4.2.2 Shifting LED Matrices

```
#!/usr/bin/env python3

from pixelpi import Strip
import time

strip = Strip(4, (8, 32), shape="zmatrix", ledtype='WS2812', brightness=30)

for x in range(strip.getWidth()):
    strip.setLEDs(led=(x, 0), rgb=(128, 0, 0))

strip.showLEDs()

try:
    while True:
        strip.shift("up", 2)
        strip.showLEDs()
        time.sleep(0.2)
except KeyboardInterrupt:
    strip.clearLEDs()
    strip.showLEDs()
    del strip
```

## 4.3 Mirroring in an Axis

### 4.3.1 Mirroring LED Strings

```
#!/usr/bin/env python3

import time

from pixelpi import Strip

strip = Strip(1, 264, ledtype='WS2812', brightness=40)

strip.clearLEDs()
pattern = strip.getLEDs()

for pixel in range(int(len(pattern) / 2)):
    pattern[pixel] = [255, 0, 0, pattern[pixel][3]]
    pattern[strip.getLength - pixel - 1] = [0, 0, 255, pattern[strip.getLength - pixel -
↵1][3]]

strip.setLEDs(pattern=pattern)

try:
    while True:
        strip.mirror()
        strip.showLEDs()
        time.sleep(1)
except KeyboardInterrupt:
```

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```
strip.clearLEDs()
strip.showLEDs()
del strip
```

## 4.3.2 Mirroring LED Matrices

```
#!/usr/bin/env python3

import time

from pixelpi import Strip

strip = Strip(4, (8, 32), shape="zmatrix", ledtype='WS2812', brightness=30)

for x in range(int(strip.getWidth / 2)):
    for y in range(strip.getHeight):
        strip.setLEDs(led=(x, y), rgb=(128, 0, 0))
        strip.setLEDs(led=(strip.getWidth - 1 - x, y), rgb=(0, 0, 128))

strip.showLEDs()

try:
    while True:
        strip.mirror("horizontal")
        strip.showLEDs()
        time.sleep(0.2)

except KeyboardInterrupt:
    strip.clearLEDs()
    strip.showLEDs()
    del strip
```

## 4.4 Displaying an Image

### 4.4.1 Displaying Images of LED Matrices

```
from time import sleep

from PIL import Image
from pixelpi import Strip

im = Image.open("image.png").convert(mode='RGB', colors=256)

# strip1 = Strip(2, (8, 8), ledtype='SK6812-GRBW', shape="matrix", brightness=0.2)
strip = Strip(terminal=4, size=(8, 32), ledtype='WS2812', shape="zmatrix",
↳brightness=30)

try:
    i = 0
    while True:
        i = i + 1
```

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```
if i >= 32:
    i = 0

for r in range(4):
    im = im.transpose(Image.ROTATE_90)
    strip.setLEDs(led=(0, i), image=im)
    strip.showLEDs()
    sleep(0.5)

strip.clearLEDs()
strip.showLEDs()

except KeyboardInterrupt:
    strip.clearLEDs()
    strip.showLEDs()
del strip
```

**Note** You can of course display an image on an LED string by supplying a 1 by x image.



---

## Using the PixelPi Python Library

---

The PixelPi Library is intended to be used with the PixelPi PCB from Hut 8 Designs.

If you have not already installed the library, see [Installing the Python Library](#)

### 5.1 Creating a Strip Object

**class** `pixelpi.Strip` (*terminal*, *size*, *shape*='straight', *ledtype*='WS2812', *brightness*=255)

Creates an led Strip with the provided configuration.

#### Parameters

- **terminal** (*int*) – Which terminal the terminal is attached to (1-4).
- **size** (*int or tuple*) – The size of the LED string or matrix. Either the number of LEDs for a string, or (width, height) for a matrix.
- **shape** (*str, optional*) – The 'shape' of the LEDs attached:
  - `straight` - A LED string (default)
  - `reverse` - A LED string which starts at the opposite end.
  - `zmatrix` - A matrix where the LEDs in the first row go left to right, the next one right to left. i.e:

```
1 2 3 4
8 7 6 5
9 ...
```

- `matrix` - a normal matrix where the led order goes left to right. i.e:

```
1 2 3 4
5 6 7 8
9 ...
```

- **ledtype** (*str*) – One of the supported LED types:  
WS2812 (*default*), SK6812, SK6812W, SK6812\_RGBW, SK6812\_RBGW, SK6812\_GRBW, SK6812\_GBRW, SK6812\_BRGW, SK6812\_BGRW, WS2811\_RGB, WS2811\_RBG, WS2811\_GRB, WS2811\_GBR, WS2811\_BRG, WS2811\_BGR
- **brightness** (*int*) – The default brightness for all LEDs (0-255).

**getHeight**

Returns the height of the matrix (or length of an LED string).

**getLength**

Returns how many LEDs are in the strip/matrix.

**getStripNumber**

Returns the terminal the LEDs are attached to.

**getStripType**

Returns the set LED type.

**getWidth**

Returns the width of the matrix (1 if an LED string).

**updateStatus**

Returns or sets whether output is currently enabled for the LEDs.

When set to `False`, the current LED pattern will remain unchanged even if the pattern is changed and `showLEDs()` is called.

**Getter** Returns the status.

**Setter** Sets the status.

**Type** bool

## 5.2 Setting LED Colours and Brightness

`Strip.setLEDs(led=None, rgb=None, brightness=None, image=None, pattern=None)`

Sets the RGB value, and optionally brightness, of one or more LEDs.

If `led` is not supplied or set to `None`, all LEDs will be set to the defined colour and brightness.

If a matrix is being used, `led` can either be the LED count from the first LED, or the (x, y) location.

If a brightness value is not supplied, or set to `None`, the current LED brightness will be kept.

If an image is supplied, then it must be in RGB format (see [Pillow image file formats](#))

If a pattern is supplied, it must be a list consisting of a tuple with four elements, (red, green, blue, brightness).

**Parameters**

- **led** (*int, tuple or None*) – The LED location or `None` to set all LEDs to the desired colour.



- **rgb** (*tuple or None*) – A tuple consisting of 3 elements, (red, green, blue), with each value being between 0 and 255.
- **brightness** (*int or None*) – A value between 0 (dim) to 255 (very bright) or None to take the default.
- **image** (*image or None*) – An image object (see PIL or Pillow libraries) containing an RGB formatted image.
- **pattern** (*list or None*) – A list of the RGB and brightness values for each LED, in numerical order from the start of the strip/matrix.

`Strip.getLEDs (led=None)`

If `led` is supplied, returns the RGB and brightness values of a specific LED.

If `led` is not supplied or set to `None` a list of red, green, blue and brightness values for each LED is returned in a list.

**Parameters** `led` (*int, tuple or None*) – The led location, either the LED count from the start, or the x,y matrix location, or if `None`, a list of all LEDs will be returned

**Returns** (red, green, blue, brightness) or a list of (red, green, blue, brightness)

`Strip.clearLEDs ()`

Clears the LEDs (sets them to black), leaving the brightness as it is.

## 5.3 Manipulating LED Colours

`Strip.shift (direction='UP', shift=1)`

Shifts the LEDs on the matrix or string by *shift* LEDs in the direction specified.

**Parameters**

- **direction** (*str*) – The direction the LEDs should shift (LEFT, RIGHT, UP, DOWN)
- **shift** (*int*) – The number of LEDs the matrix/string should be moved in the specified direction.

`Strip.mirror (mirror='VERTICAL')`

Mirrors the matrix LEDs either in the VERTICAL or HORIZONTAL plane.

Reverses the LED colours on an LED string. The `mirror` parameter is not required for strings.

**Parameters** `mirror` (*str*) – VERTICAL (*default*) or HORIZONTAL

## 5.4 Updating LEDs

`Strip.showLEDs ()`

Once you have set the colours of the string/matrix LEDs, use *showLEDs* to update the LEDs.



## CHAPTER 6

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### Indices and tables

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