

Date:	29/05/21	Version:	1.0	By:	Matt Little
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This is an ESP8266 based Carbon Dioxide (CO<sub>2</sub>) level monitor, with small OLED display, a rotary encoder for user input and some RGB LEDs.

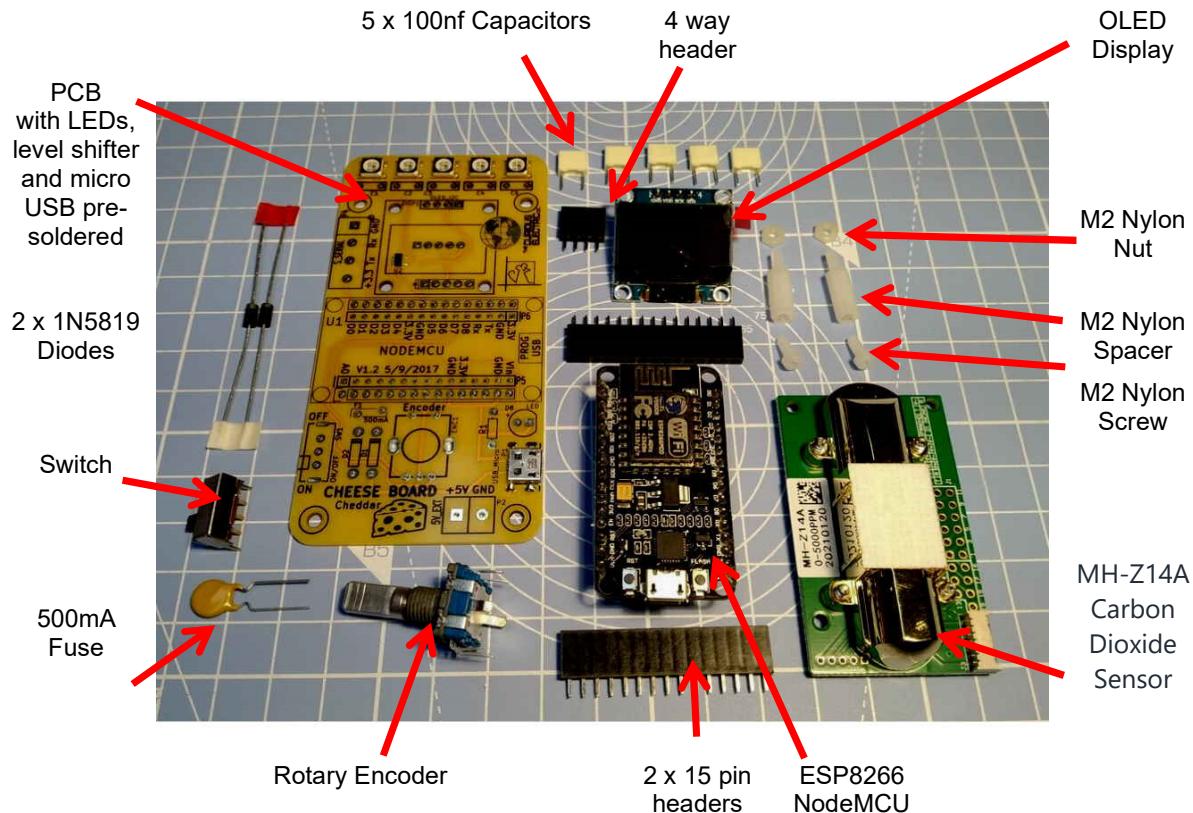
This uses a Winsen MH-Z14A carbon dioxide sensor.

It can connect to Wi-Fi and the firmware is designed to send your data to a feed on Adafruit IO. The code is open source. It also works stand-alone with no Wi-Fi connection

The main processor is based upon the [ESP8266 system-on-chip from Espressif Systems](#).

*This is a reasonably simple kit which requires some soldering & mechanical construction. This kit requires a micro-USB lead for programming and powering the unit. Not suitable for under 12 years old.*

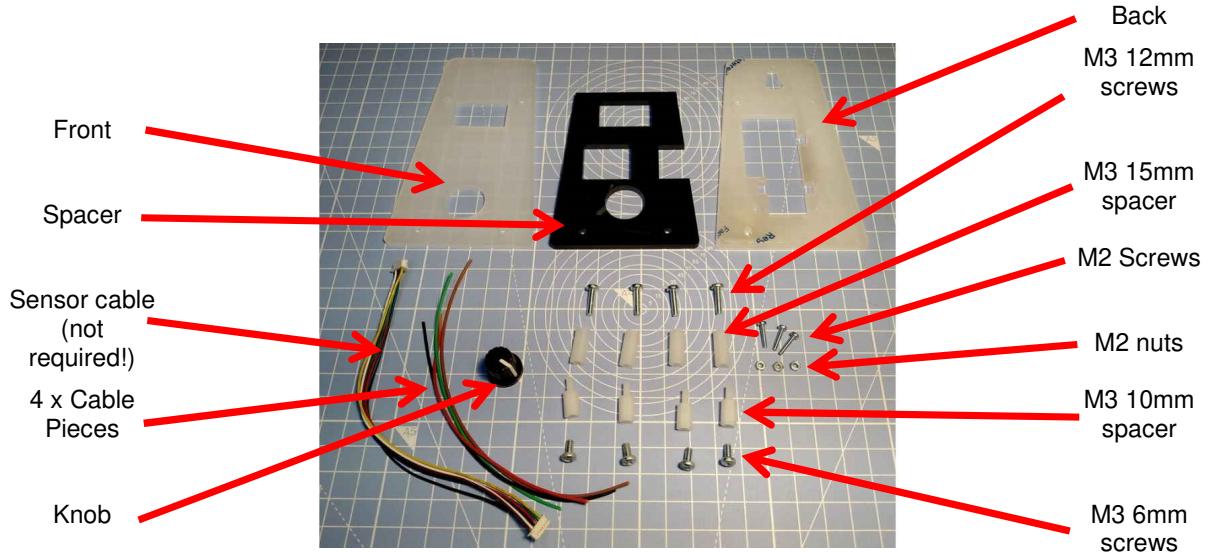
## Parts included:



## Parts list:

Item	Ref	Quantity
Capacitors. 100nf	C1-5	5
Diode. 1N5819	D1, D2	2
LED. WS2812 (pre soldered)	D3-7	5
LED. Red. NOT included	B8	Not Included
Display. OLED. 0.96" With 4-way header	DISP1	1
Encoder	ENC1	1
Fuse. 500MA	F1	1
USB micro Socket (pre-soldered)	P1	1
2 way screw terminal. 5V. Not Included	P2	Not Included
HC-11 Serial. Optional	P3	Not Included
Software Serial. Optional	P4	Not Included
Node MCU header. 15 way.	P5, P6	2
PCB – with SMD parts soldered		1
330ohm Resistor. Not Included	R1	Not Included
Switch	SW1	1
NodeMCU with 2 x 15 way headers	U1	2
74LVC1G17 Level shifter (pre-soldered)	U2	1
M2 Machine screws. Plastic. 6mm long		2
M2 Nuts. Plastic		2
M2 Spacers. Plastic. 12mm long		2
MH-Z14A Winsen CO2 Sensor Unit		1

## Enclosure Parts:



## Hardware

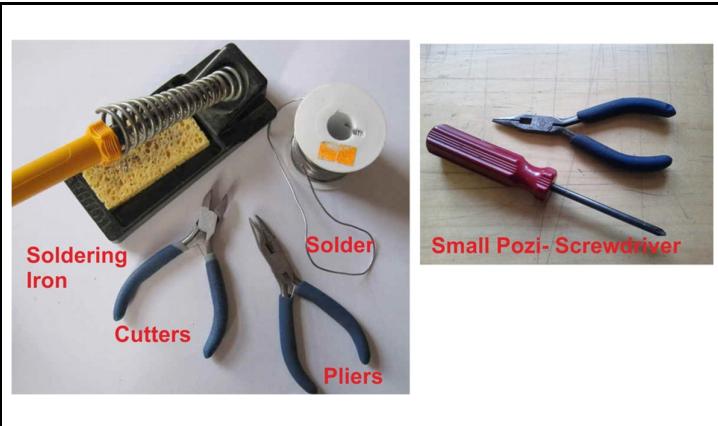
Item	Ref	Quantity
M2 Machine screws. 12mm long		3
M2 Nuts		3
M3 Machine screws. 6mm long		4
M3 Machine screws 12mm long		4
M3 Threaded Hex spacers. 10mm long		4
M3 Threaded Hex spacers. 15mm long		4
Front. Laser cut 3mm Frosted Acrylic		1
Spacer. Laser cut 3mm Black. Acrylic		1
Back. Laser cut 3mm Frosted Acrylic		1
Cable. Single Strand. For wiring sensor		4
Knob		1

## Tools required:

Soldering Iron

Solder

Side cutters



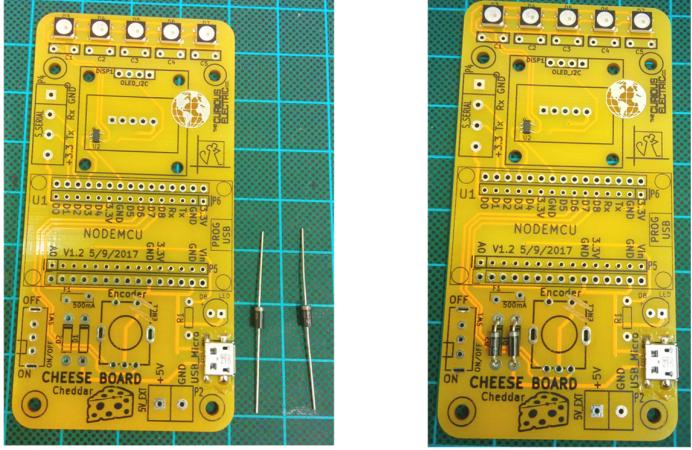
Long-nosed  
Pliers

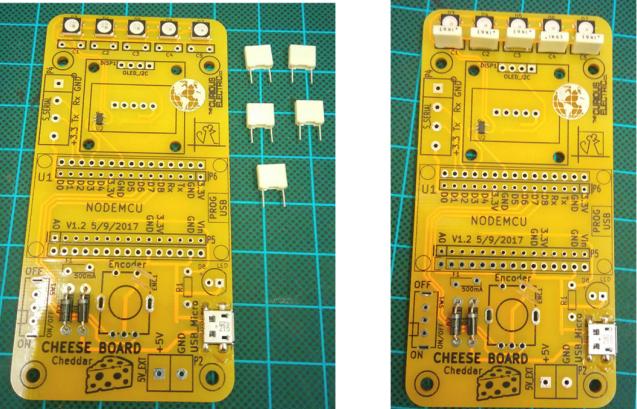
Posi-drive  
Screwdriver

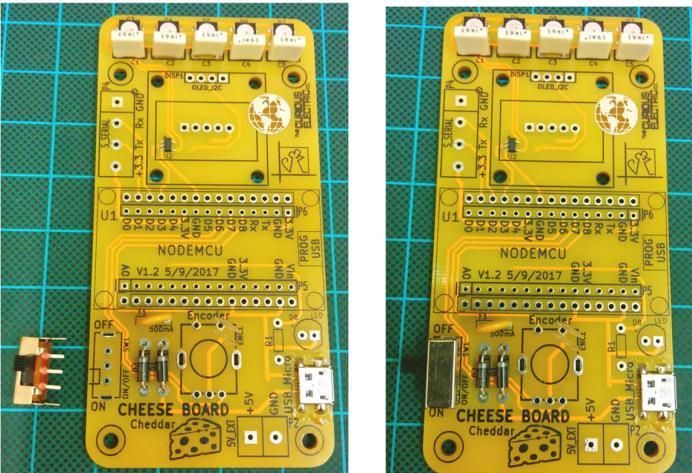
## Additional Items Required

- 1 x Micro-USB lead (for powering and for programming)
- 1 x 5V USB power supply (might be required for powering stand-alone unit)
- To update/change code: Computer with Arduino IDE and additional libraries installed. (see software section for more details)

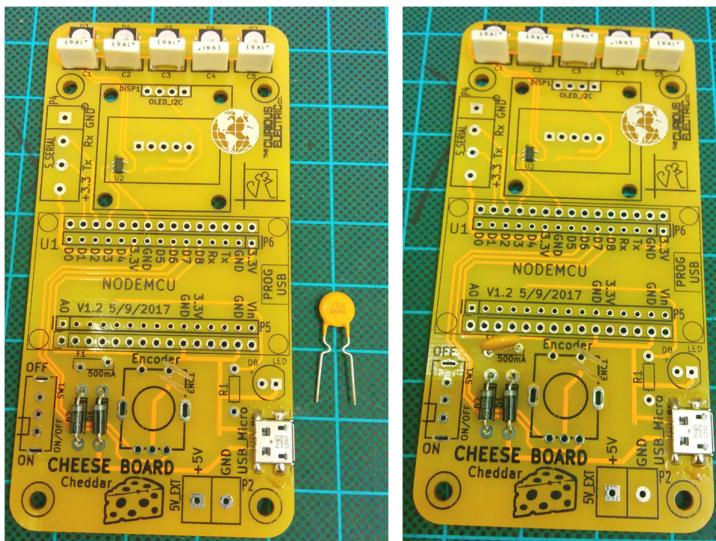
## Instructions:

Step: 1	Solder diodes
<p>There are two diodes to solder in to the two components marked D1 and D2.</p> <p>Ensure correct polarity! The white band on the diode should align with the black band on the PCB silkscreen.</p>	

Step: 2	Solder capacitors
	

Step: 3	Solder switch
<p>The right-angled switch should be soldered into SW1.</p>	

## Step: 4 Solder fuse



The 500mA resettable fuse should be soldered into the hole marked F1.

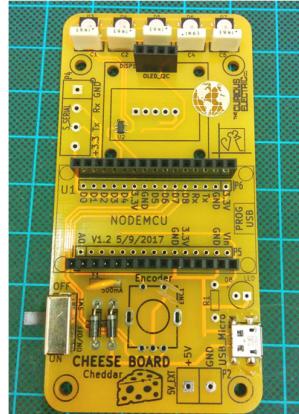
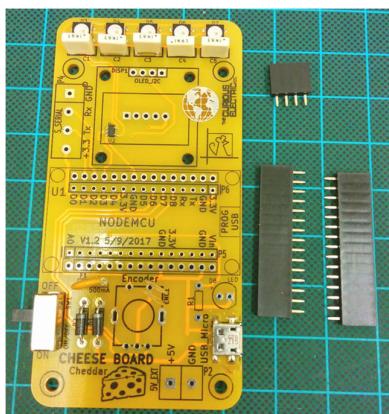
The fuse does not have any polarity.

## Step: 5 Solder header pins

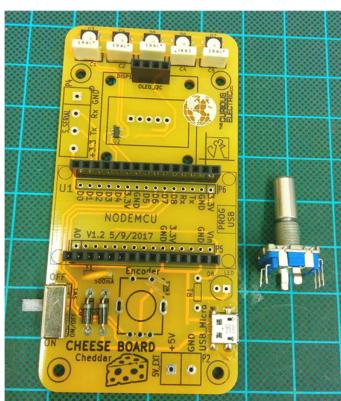
Solder the 4 way header block into the holes marked DISP1.

The 15 way headers are soldered into the NodeMCU area marked U1.

Do not solder anything into the holes marked P5 and P6 – these are connections for any external circuits you might want to add.



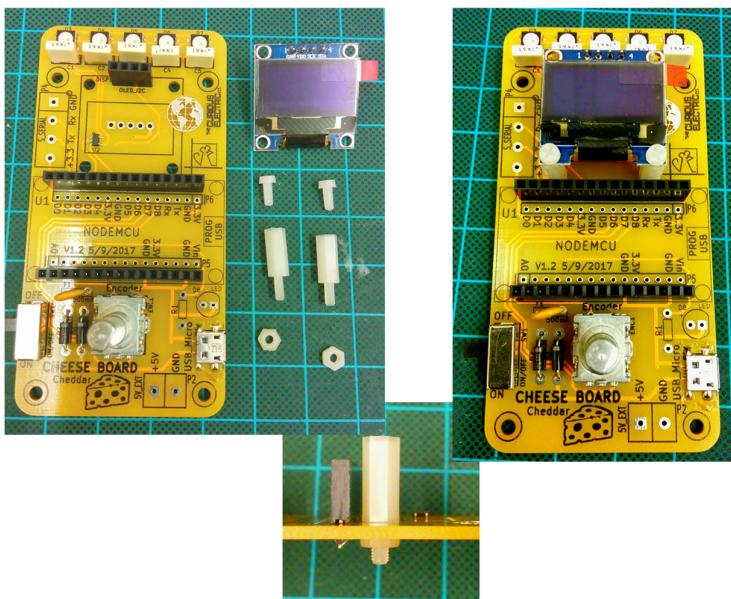
## Step: 6 Solder encoder



The encoder is soldered into the area marked ENC1.

Solder the two larger pads first to hold the encoder in place. Ensure the encoder is straight when soldered, as this goes through the front of the case, with the plastic knob added at the end.

## Step: 7 Fit OLED module



The OLED unit pushes into the 4 way header pins soldered in step 6.

There are two 2.5mm spacers. The long plastic spacer is placed with the threaded male section through the holes and the nuts added to hold them in place.

Then put in the OLED module and fit the two 2.5mm machine screws from the top of the OLED module, as shown in the picture.

## Step: 8 Solder wires to CO2 sensor

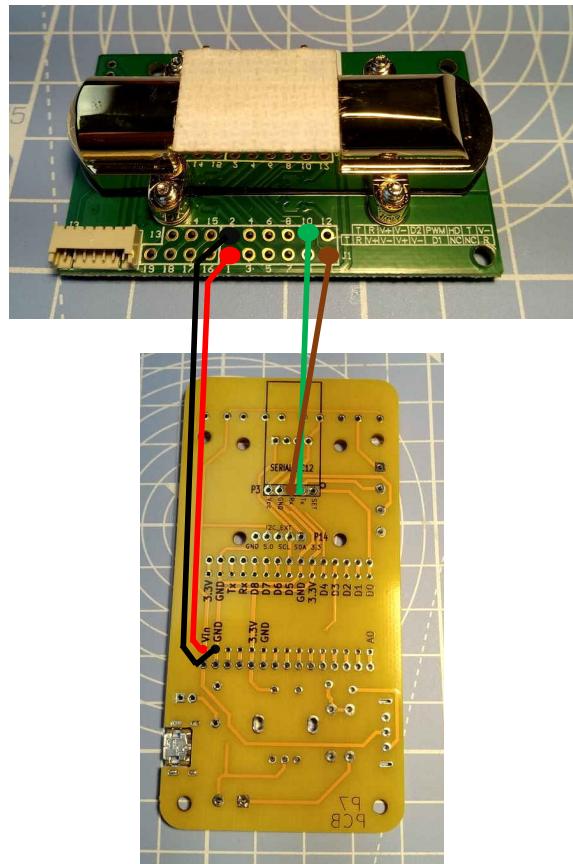
You now need to wire the CO<sub>2</sub> sensor to the yellow main PCB.

Use the 4 pieces of wire. Strip 5mm of the end of the wire from each end of all 4 pieces of wire. Solder from the back of both PCBs (the opposite side to the CO<sub>2</sub> sensor image shown here). Use the following connections and solder the cable to the following points on the CO<sub>2</sub> sensor:

- Black -> Pin 2
- Red -> Pin 1
- Green -> Pin 10
- Brown -> Pin 11

Use the following connections and solder the cable to the following points on the yellow PCB:

- Black -> GND
- Red -> Vin
- Green -> Tx
- Brown -> Rx



<b>Step: 9</b>	Fit Node MCU
<p>The NodeMCU unit pushes into the two 15 way header strips.</p> <p>Ensure that the USB socket is above the 'PROG USB' area. Double check this before powering on!</p> <p>The NodeMCU has been pre-programmed with a test code. This should run when powered.</p>	

<b>Step: 10</b>	PCB is finished!
<p>Have a nice cup of tea.</p> 	<p>Test with micro-USB cable. The USB power cable can either be plugged into the NodeMCU (used for programming the unit) or it can be plugged in to the USB_Micro socket (only used to power the unit – there is no communication through this socket).</p> <p>Switch on and check:</p> <ul style="list-style-type: none"> <li>• LEDs light</li> <li>• OLED screen shows data</li> <li>• Rotary Encoder changes data on OLED</li> </ul> <p>This should prove that the functions of the PCB and the NodeMCU are working OK.</p>

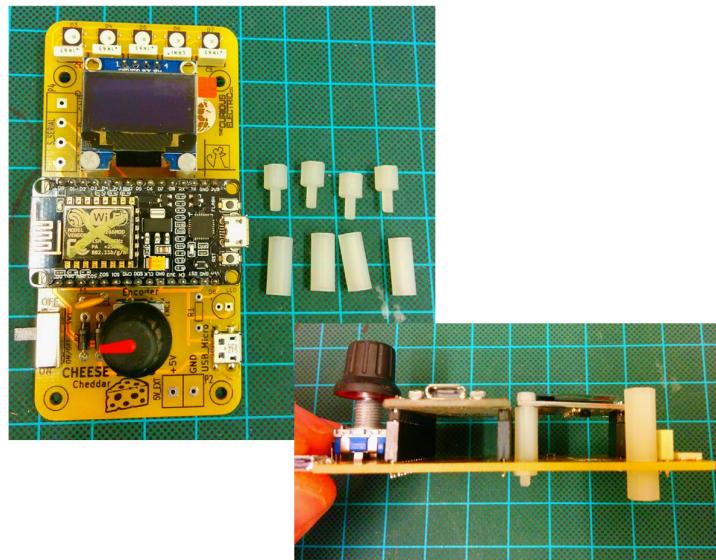
## Enclosure

<b>Step: 11</b>	Remove protective plastic film
	

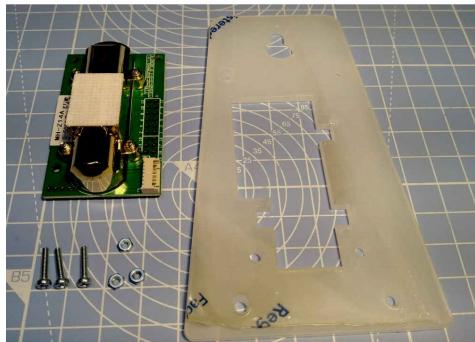
### Step: 12 Add spacer

There are four spacers to add, each one is comprised on a short spacer with male and female ends and a female-female longer spacer.

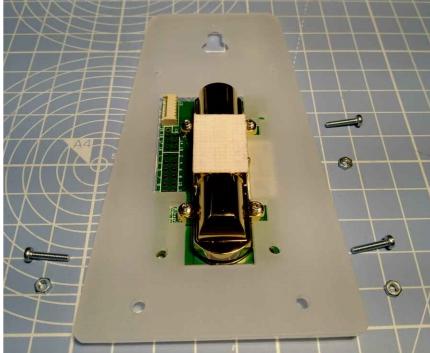
The shorted spacer should go through from the bottom of the PCB, with the longer spacer screwed on top, as shown in the picture.



### Step: 13 Add CO2 sensor to back



Parts required  
(Your unit will have wires to the CO2 sensor)



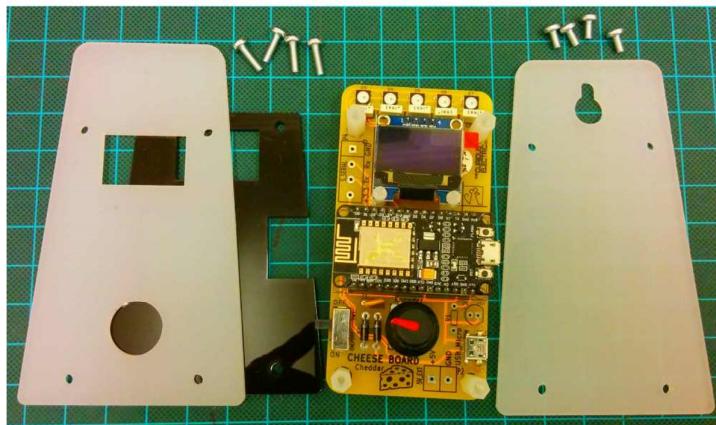
Place CO2 sensor as shown here. The white section contains the sensor.



Use the 3 x M2 metal screws and nuts to hold in place.



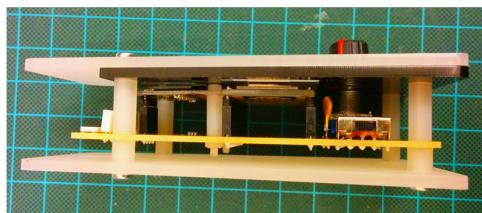
## Step: 14 | Add enclosure and knob



The shorter M3 screws are used to hold the back enclosure plate in place. The back enclosure plate has a hook hole and the cut-out for the CO<sub>2</sub> sensor (not shown here).

The front should have the black cover placed on first, then the front enclosure plate added. The 15mm M3 screws then hold this in place on the front of the unit into the spacers added in step 12.

The knob for the rotary encoder can also be pushed on. This is sometimes a little difficult and may require some force – it is a push fit.



## Step: 15 | Finished build!

Now the unit can be plugged in using a micro-USB lead. It should power on and start to show information on the OLED screen.

If not, then please check:

- Is the ESP8266 unit correctly installed and LED lights ON?
- Check soldering and connections.

The unit can also be programmed to show data from the internet, or to upload data from the internet. It can also be used as a stand-alone unit.

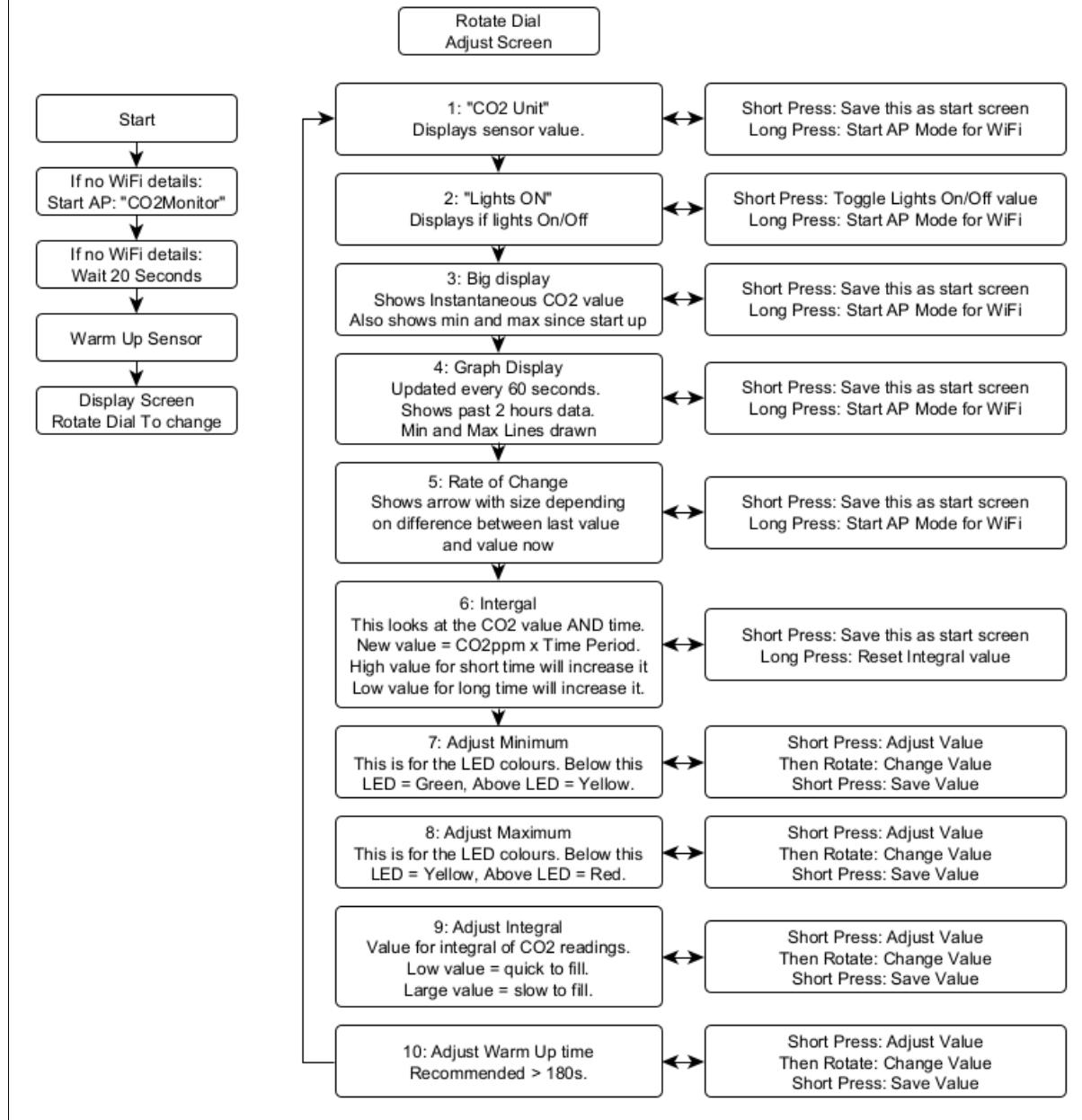
The limit to this unit is only your imagination and coding skills!



# Software

## Software Overview

The unit has the following flow diagram of the various functions:



## Upload software

This is not needed for standard use of the unit.

This can be where the fun begins! You can alter the code and improve it.

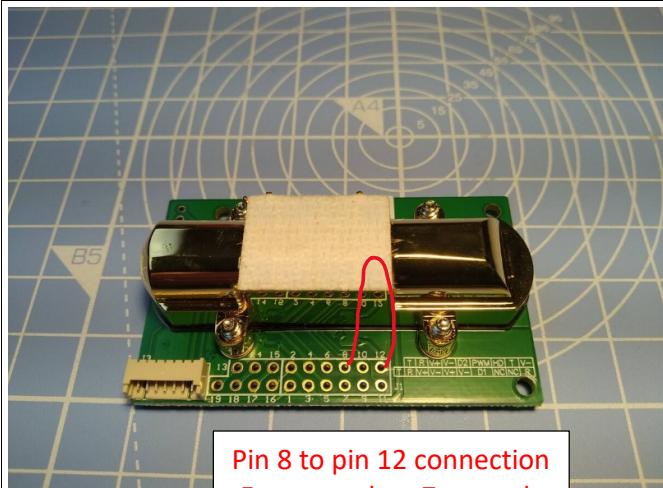
This project has software stored on GITHUB software repository here:

**<https://github.com/curioselectric/CO2Monitor>**

Please follow the readme in this file for the most up to date instructions for uploading code using the Arduino IDE (or any other IDE of your choice).

This GITHUB contains all the design files as well as the software code. Move to the "FIRMWARE" folder for the software example.

## Calibrating CO2 sensor



To calibrate the CO2 sensor for more accurate readings please follow these instructions:

Take the unit outdoors to an area away from roads/CO2 sources.

It is assumed that outside there will be a relatively constant 400ppm value.

You will need to power the unit, so either use a USB power pack or plug into a laptop computer with a battery.

Switch on the unit. Leave running for at least 20 mins for stabilisation of readings.

Use a short jumper wire to connect pin 8 (HD) of the CO2 sensor with pin 12 (GND) of the CO2 sensor. Keep this connection for at least 7 seconds or a bit more.

(See sensor datasheet for more info if needed)

The reading should now show 400 ppm. This calibration will be stored.

The unit can then be placed inside to measure CO2 levels.

## **Contact details:**

This kit has been designed and produced by:

The Curious Electric Company  
**[hello@curioouselectric.co.uk](mailto:hello@curioouselectric.co.uk)**  
**[www.curioouselectric.co.uk](http://www.curioouselectric.co.uk)**

Unit 23, Block D, Hartley Business Centre, Haydn Road, Nottingham, NG5 1DG

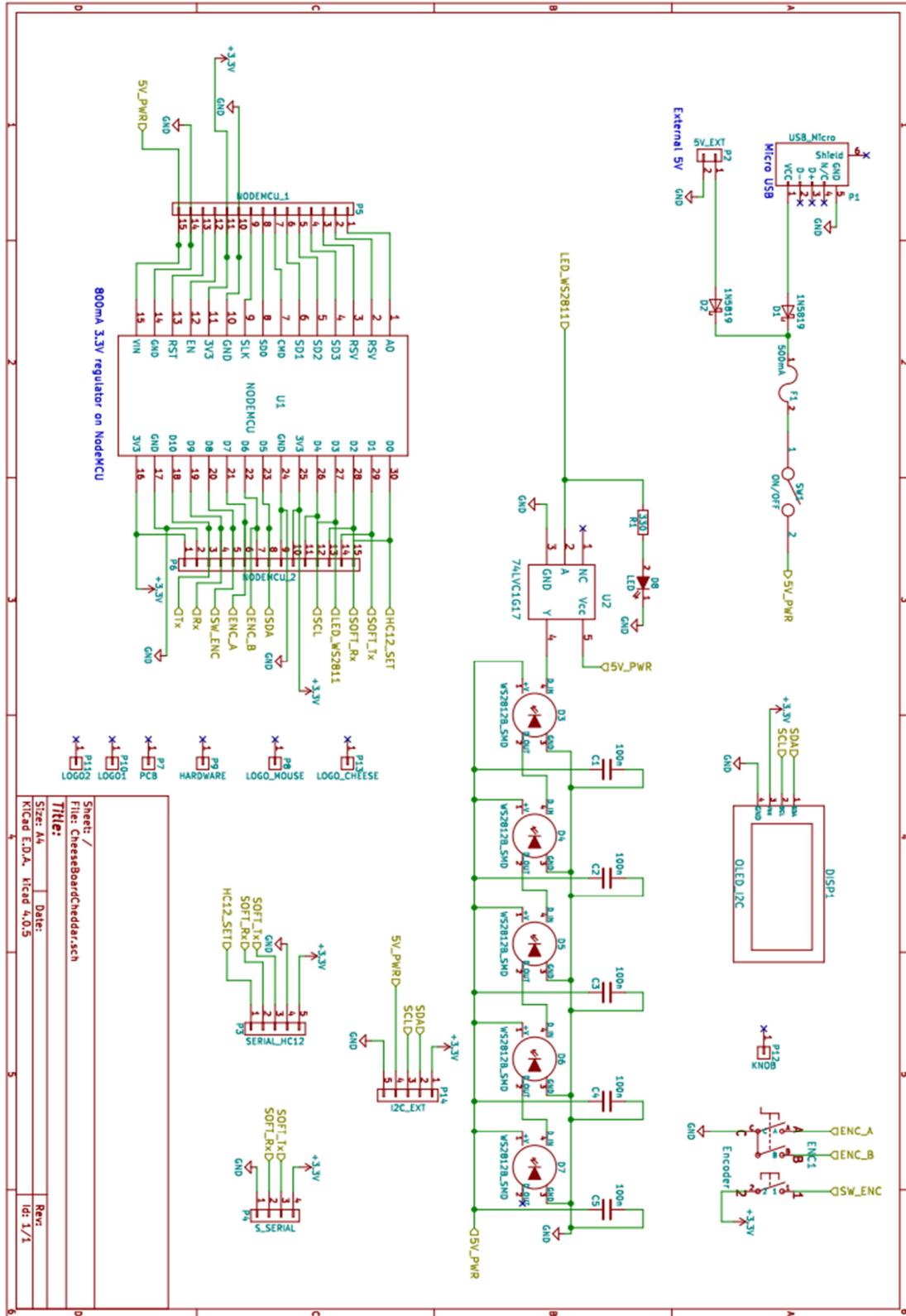
We would like you to be happy with this kit. If you are not happy for any reason, then please contact us and we will help to sort it out.

Please email **[hello@curioouselectric.co.uk](mailto:hello@curioouselectric.co.uk)** with any questions or comments.  
Please tweet us at **@curioouselectric**

If any parts are missing from your kit, then please email **[hello@curioouselectric.co.uk](mailto:hello@curioouselectric.co.uk)** with details, including when and where the kit was purchased.

More technical information can be found via **[www.curioouselectric.co.uk](http://www.curioouselectric.co.uk)**

## Circuit Schematic:



## PCB Design:

