Oxford Instruments STM32F103C8T6 Assembly Instructions

Tools required

- A temperature-controlled soldering iron with a fine chisel or bevelled conical tip, such as the TS100
- A method of cleaning the tip of the soldering iron such as brass wool or a damp sponge
- A pair of fine tip metal tweezers
- A small stiff bristled brush such as a tooth brush
- A stand mounted magnifying glass or microscope (optional)
- An ESD ground strap (optional, but recommended)

Consumables

- Approx. 50cm of fine solder wire, 0.5mm works well. 60/40 tin lead solder will give the best results, especially for a novice. The PCB and components are all lead free and ROHS compliant. If lead free status is required, a ROHS solder with 5% silver content will yield better results than standard 100% tin solder.
- A synthetic (not rosin based) “no clean” tacky flux such as ChipQuik SMD291. Cheaper alternatives can be found by searching for “tacky flux” and looking for a flux aimed at BGA reflow/reball. Rosin based fluxes give off harmful fumes during soldering and should be avoided unless working with good fume extraction.
- De-soldering wick such as Chemtronics soder-wik or Edsyn soldasip
- Acetone or isopropyl alcohol (IPA) for washing
- Latex or nitrile gloves to be worn during wash operations
- Double sided tape to mount the display
- ChipQuik de-soldering alloy (optional, needed for rework in case of mistakes)

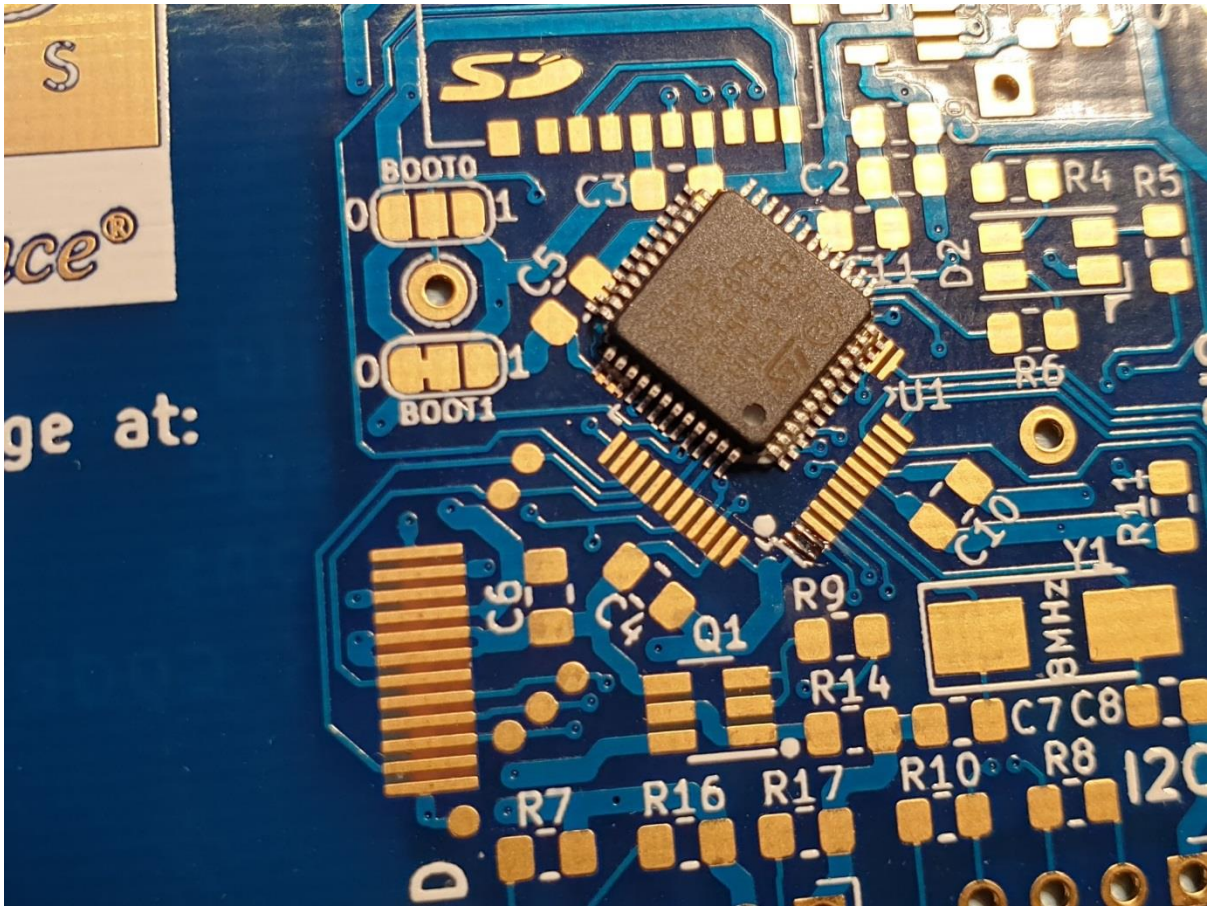
Step 1 – The Processor

Start with the processor as it is the hardest component to get right. Several attempts may be required to successfully solder the device, and other parts on the PCB may be damaged by the re-work process.

Note that the processor is mildly static sensitive. It does have ESD protection diodes built into the package on all its IO pins, however work should still be conducted wearing an ESD ground strap.

Set the soldering iron for an appropriate temperature for the solder in use. For tin/lead solder, 330°C is appropriate. For lead free solder, 370°C or higher is required. Thoroughly clean the tip of the soldering iron by applying some solder and wiping it off, several times if needed. There should be a shiny spot on the tip of the iron which readily accepts solder. It is important that the soldering iron tip has a small flat which will hold a small puddle of solder in a controlled location. Conical tips are not well suited to this task. Chisel tips or conical tips with a bevelled flat on the end are best.

Tin some solder onto 1 or two pins in one corner of the PCB footprint.

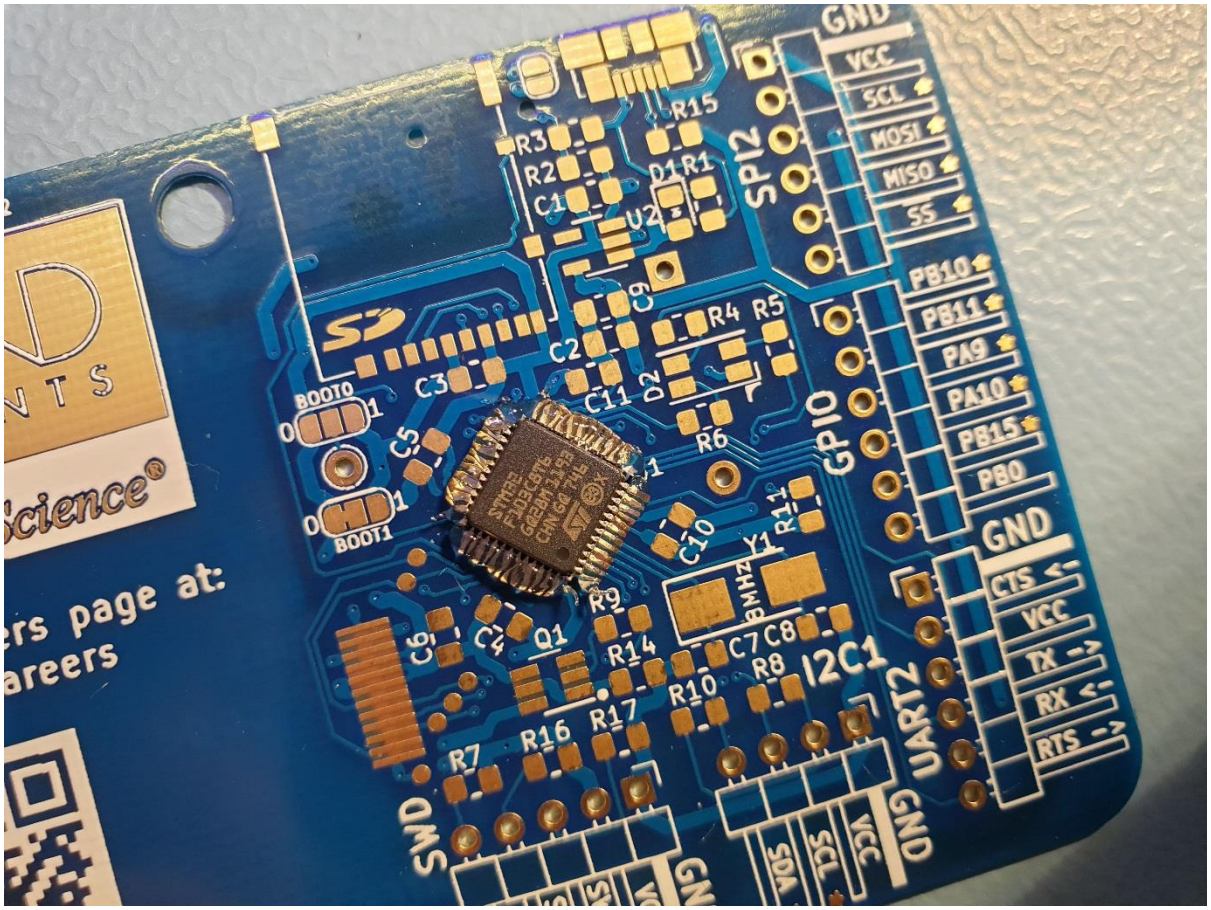


Place the processor over its correct location on the PCB, making sure to get the orientation and alignment exactly correct. The pin 1 indicator on the package should be at the bottom, matching the white dot on the PCB.

With a clean soldering iron tip, bond the pins of the package to the previously tinned pads, ensuring the processor is flat and correctly aligned. These pins will hold the processor in place for the next operation. Note that it does not matter at this stage if excess solder bridges 2 or 3 pins together as this will be corrected later.

Solder down a pin on the opposite side of the processor, ensuring the alignment is exactly correct. This will hold the processor in place for the following operations. Press down on the top of the processor with the tweezers and touch each of the soldered pins again, ensuring the processor is sitting flat on the PCB and all its pins are in contact with their pads.

Apply a bead of flux all around the processor, ensuring all the pins are entirely covered. Note that flux is single use. Once it has been heated it no longer works and more must be applied for the next soldering operation, even if there is flux residue present.

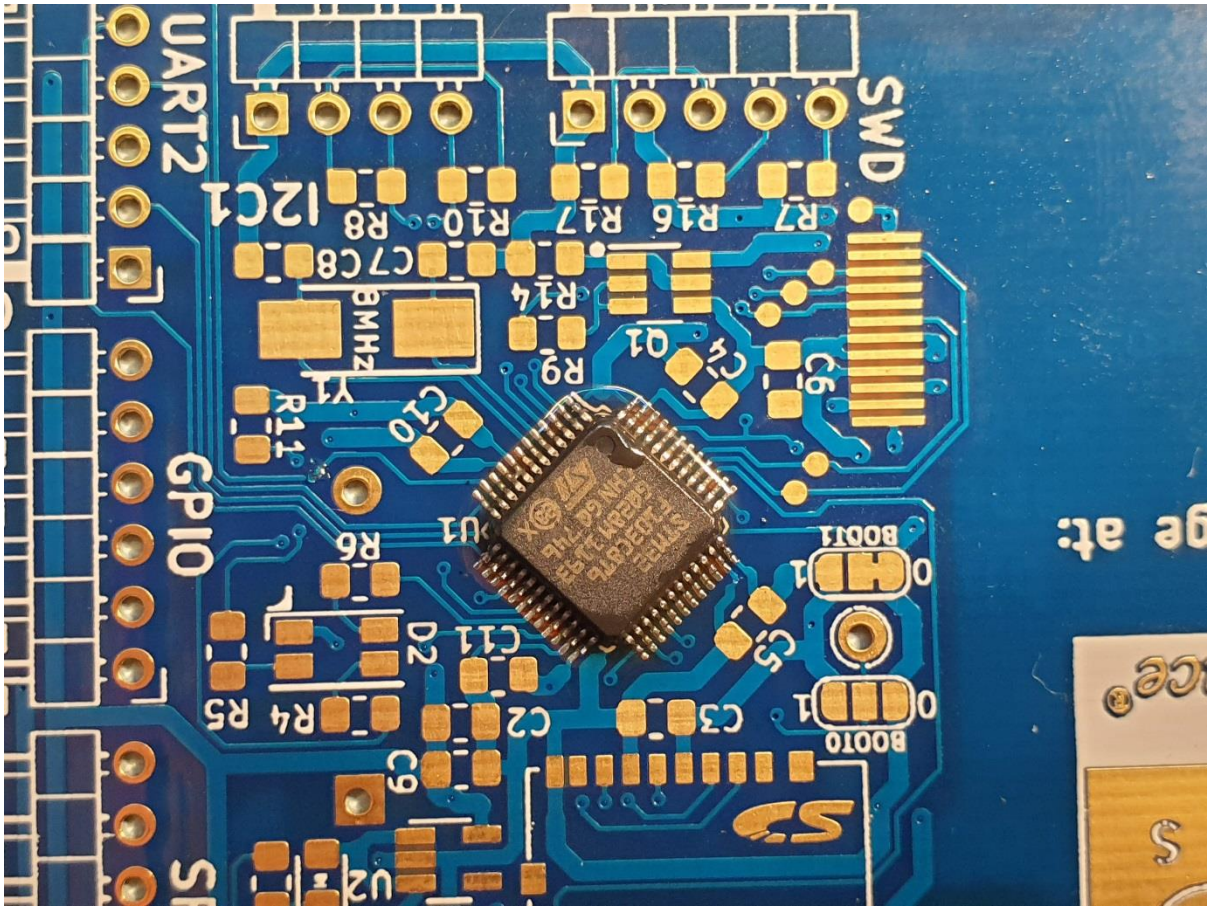


Thoroughly clean the tip of the soldering iron by applying some solder and wiping it off, several times if needed. Put a small amount of solder on the flat tip of the iron, around 1mm of solder wire. Place this puddle of solder onto one end of one row of pins of the processor and gently wipe it along the row. It should leave each pin properly soldered with no excess or solder bridges between pins.

If this does not happen cleanly, there are a number of possible causes:

- There was not enough flux - apply more flux, clean the iron and try running it along the pins again
- The solder on the tip of the iron became oxidised - clean the iron, re-apply solder and work quickly to avoid oxidisation
- The soldering iron temperature was wrong - too hot will cause excess oxidisation of the solder, too cool will prevent the solder flowing properly
- There was either not enough or too much solder on the tip of the iron - if lots of pins became bridged together, try less solder; if pins remain dry and do not solder well, try more solder

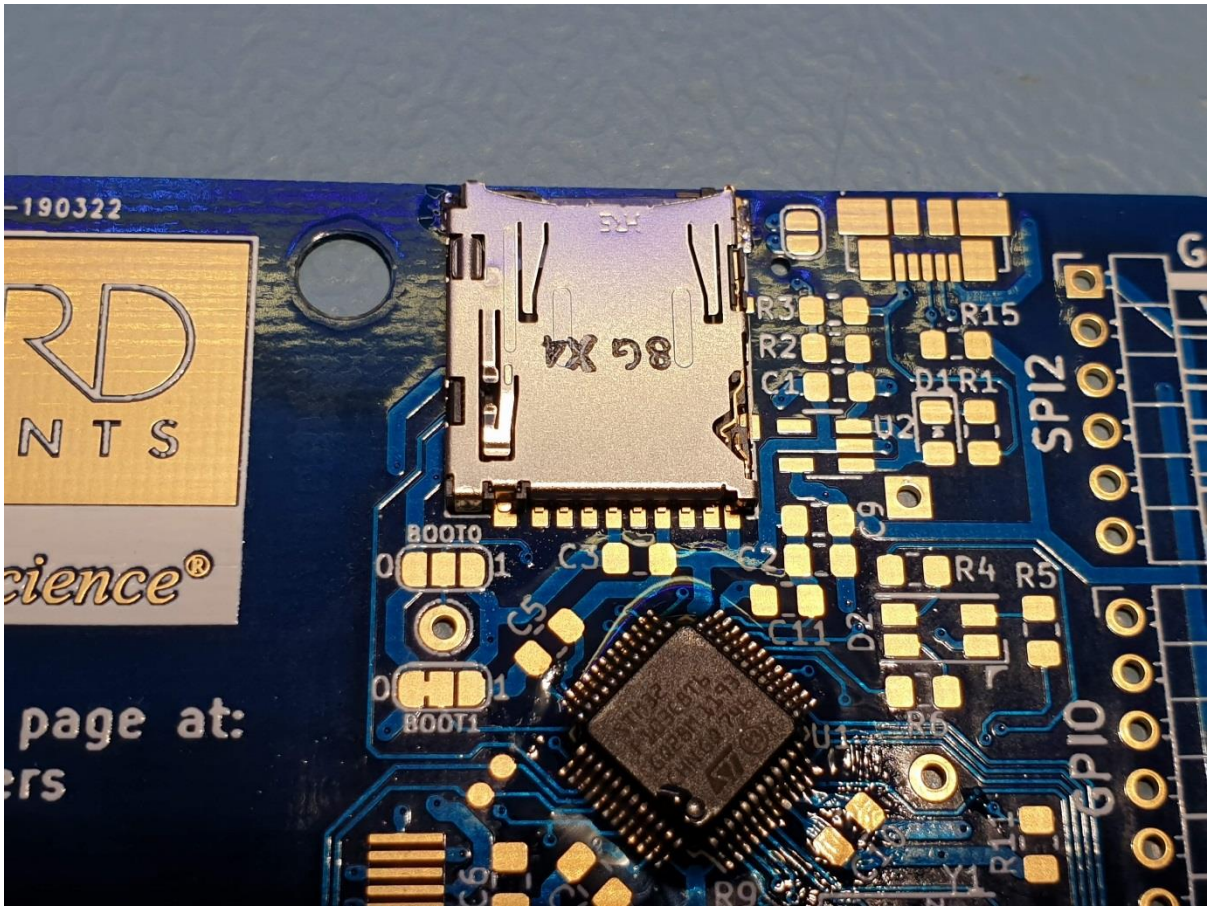
Solder wick can be used to remove excess solder. If lots of pins are bridged together after the above operation, try applying more flux and using the solder wick to remove excess solder.



Repeat this process for all 4 sides of the processor, ensuring there are no bridged pins. While wearing gloves, use acetone or IPA and a brush to remove all flux residue from the PCB. Note that the solvent dissolves the flux, however the solvent must then be removed from the PCB using paper towels, otherwise when the solvent flashes off the flux will remain on the PCB.

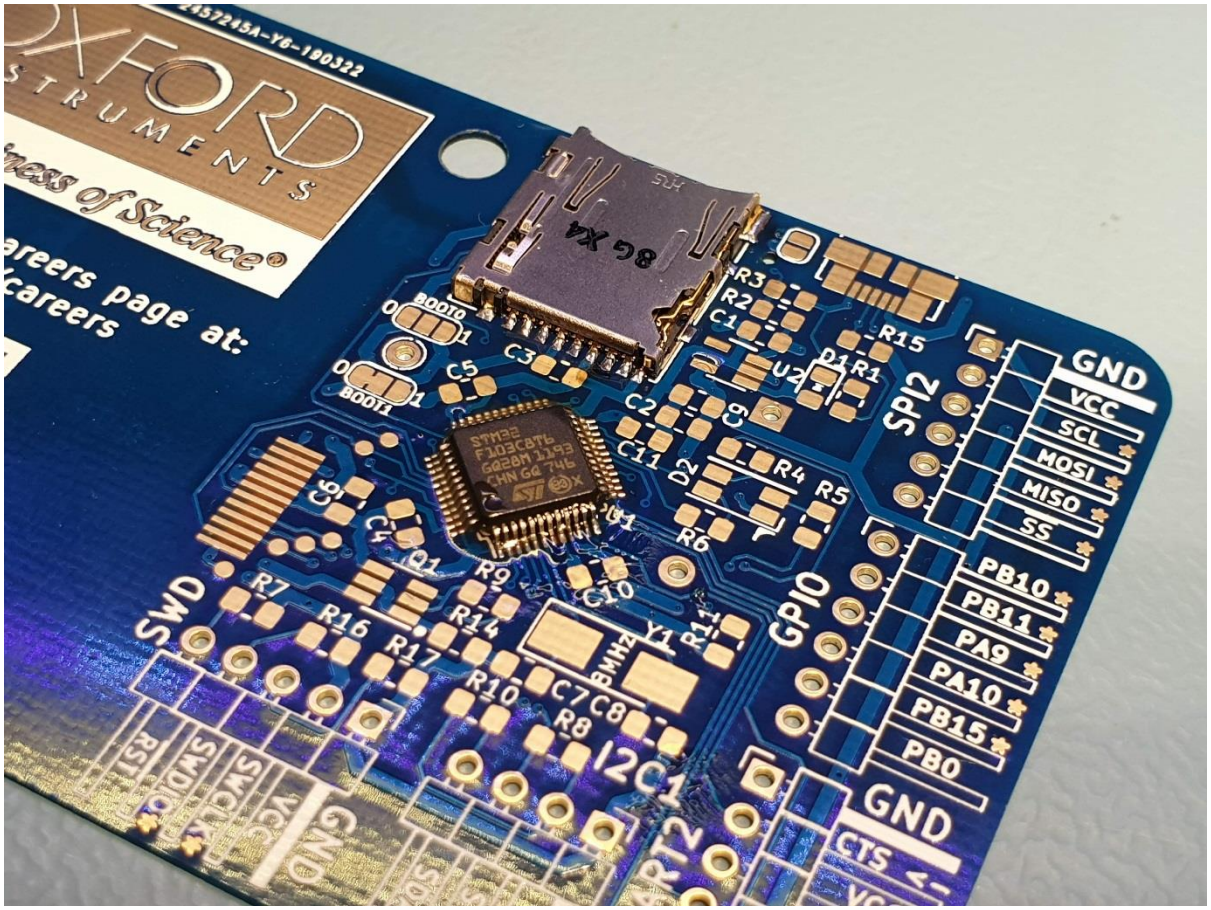
Step 2 – The SD card socket

The SD card socket is the next hardest component to solder and so should be tackled next. First tin the pad in the top right corner of the PCB footprint and position the part correctly on the PCB. Use the soldering iron to stick the part to the tinned pad, ensuring the alignment of all other pins is exactly correct. Particular care should be paid to the position of the data pins along the bottom of the package.



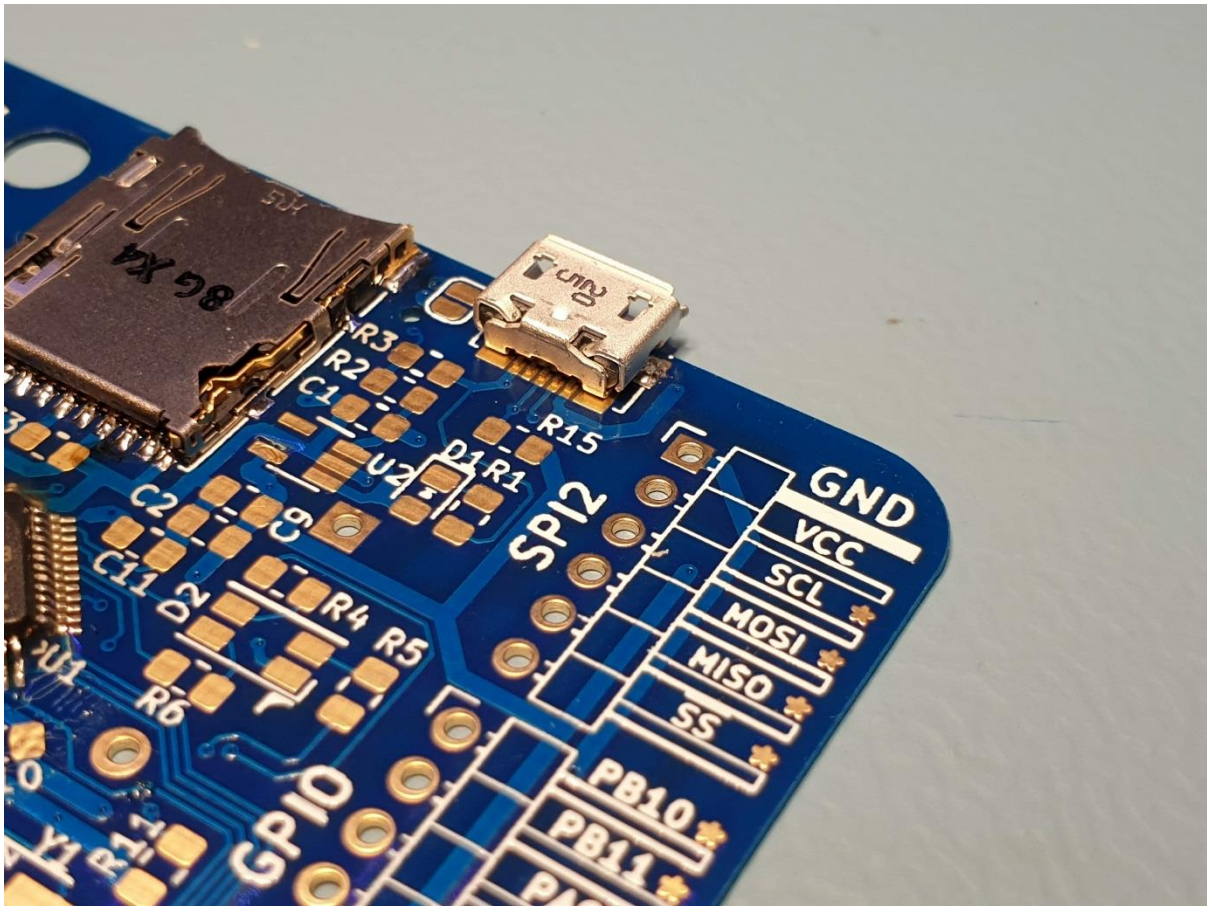
Solder down the tab on the top left of the package to ensure it is firmly held in place. Apply flux to the data pins at the base of the package and then apply the soldering iron and a small amount of solder to each pin one at a time. Ensure there are no shorts between pins, or between any of the pins and the metal body of the SD card socket. Use extra flux and solder wick to remove any excess solder from any bridged pins.

Solder the remaining pins on the right hand side of the package and then, while wearing gloves, repeat the cleaning process described in step 1.

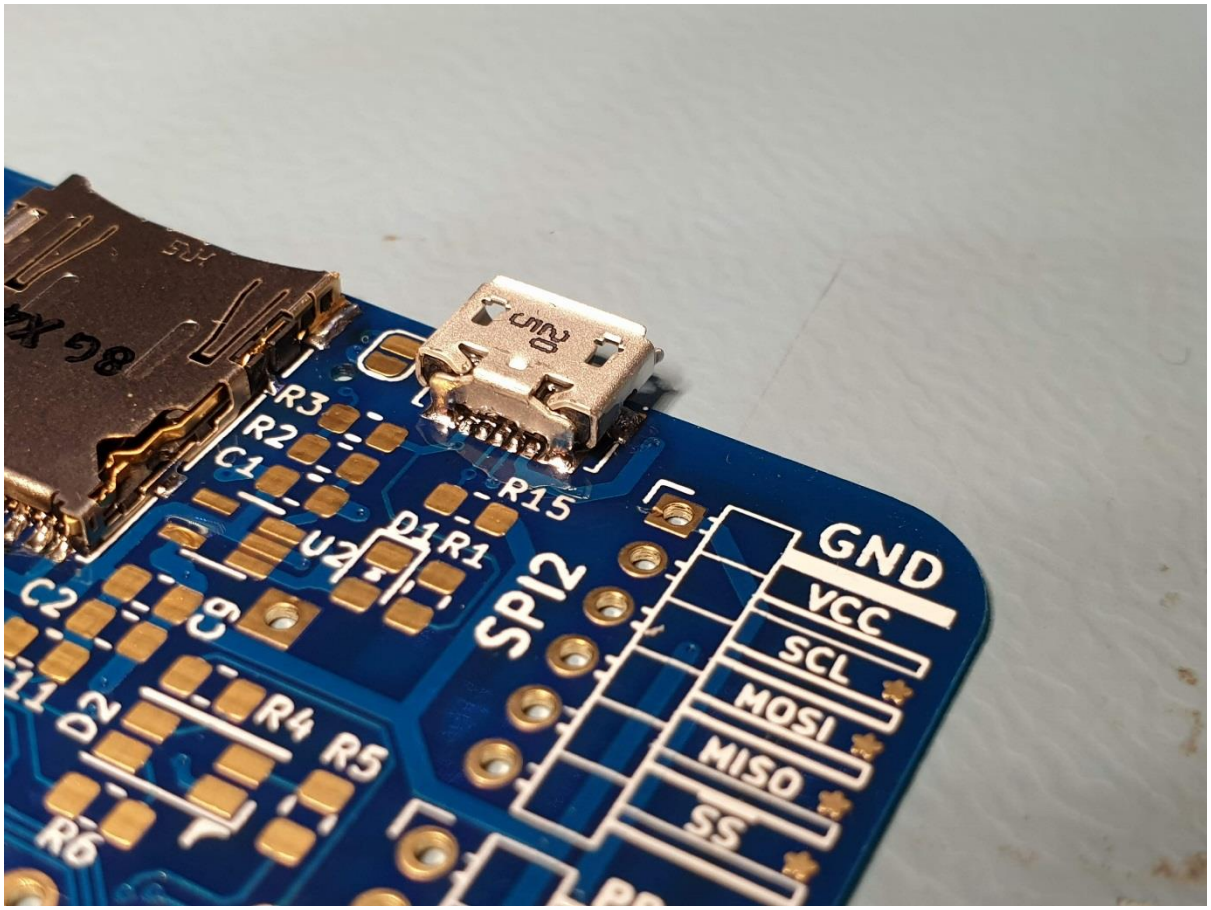


Step 3 – The USB Socket

Tin the top right pad of the USB socket PCB footprint and position the USB socket correctly over its footprint. Use the soldering iron to stick the USB socket to the tinned pad.



Solder the top left pad of the USB socket to ensure it is secure. Apply flux to the data pins at the bottom of the package, then apply a small amount of solder to each pin one at a time and then, while wearing gloves, repeat the cleaning process from steps 1 and 2. Ensure there are no shorts between pins, or between any of the pins and the metal body of the USB socket. Use extra flux and solder wick to remove any excess solder from any bridged pins.



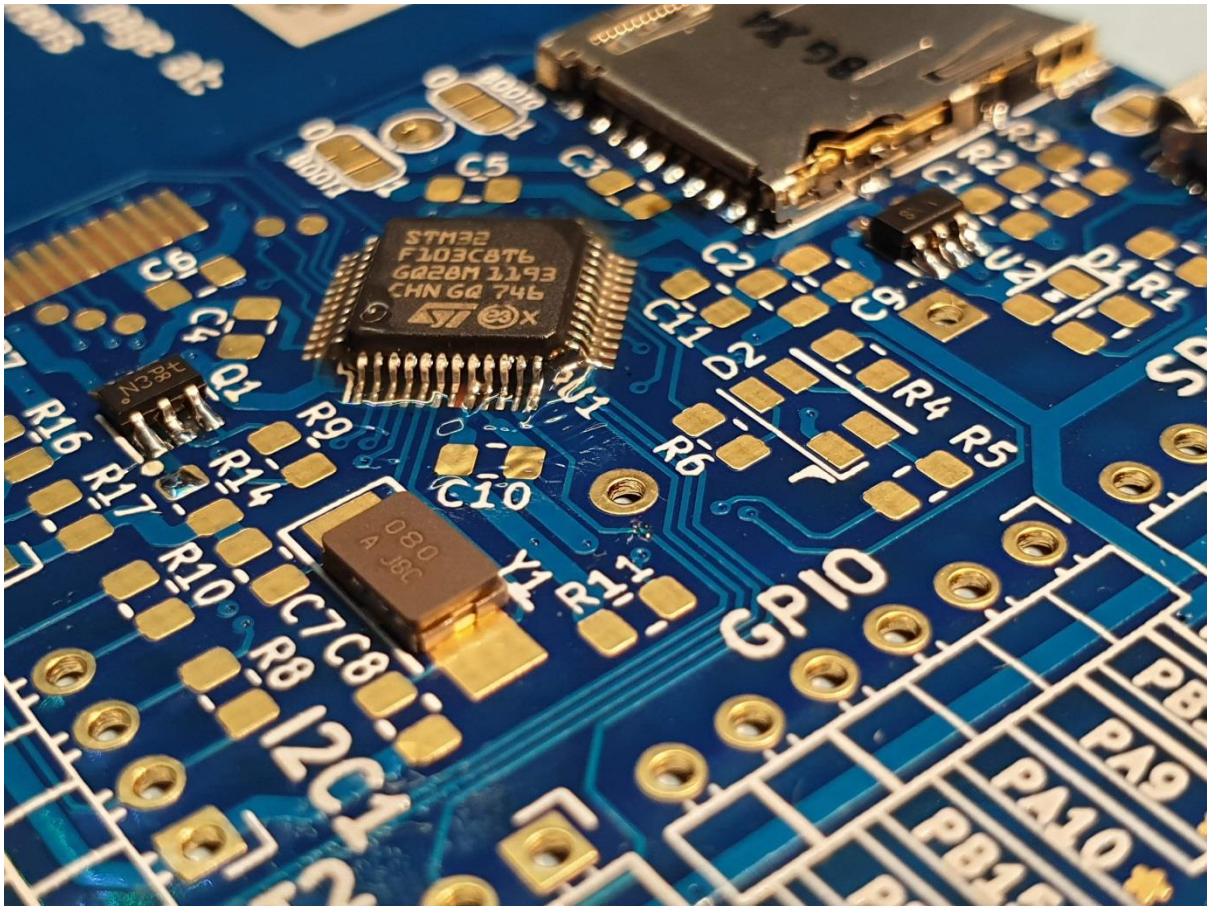
Step 4 – The Linear Regulator & Dual NPN Transistor

The Linear regulator (U2) and dual NPN transistor (Q1) are both SOT23 packages and are both soldered in the same way. Tin 1 pad on the PCB footprint of each device, ideally one corner of the package.

Hold the part in a pair of tweezers and position it in the correct orientation and alignment above its PCB footprint. The Linear regulator (U2) is easy to orient as it has a missing pin on one side. The Transistor (Q1) must be oriented by matching the pin 1 indicator on top of the package with the marking on the PCB.

Use the soldering iron to stick the part to the tinned pad. Once the part is soldered in place, press on the top of the package with the tweezers and then touch the soldering iron to the tinned pad a second time. This will ensure that the part is flat and that all its legs are making contact with their pads on the PCB.

Apply the soldering iron and a small amount of solder to each of the remaining pins one at a time. Extra flux should not be needed for these parts as the solder has some flux in its core. If the part is not soldering cleanly, extra flux may be applied to help the process.

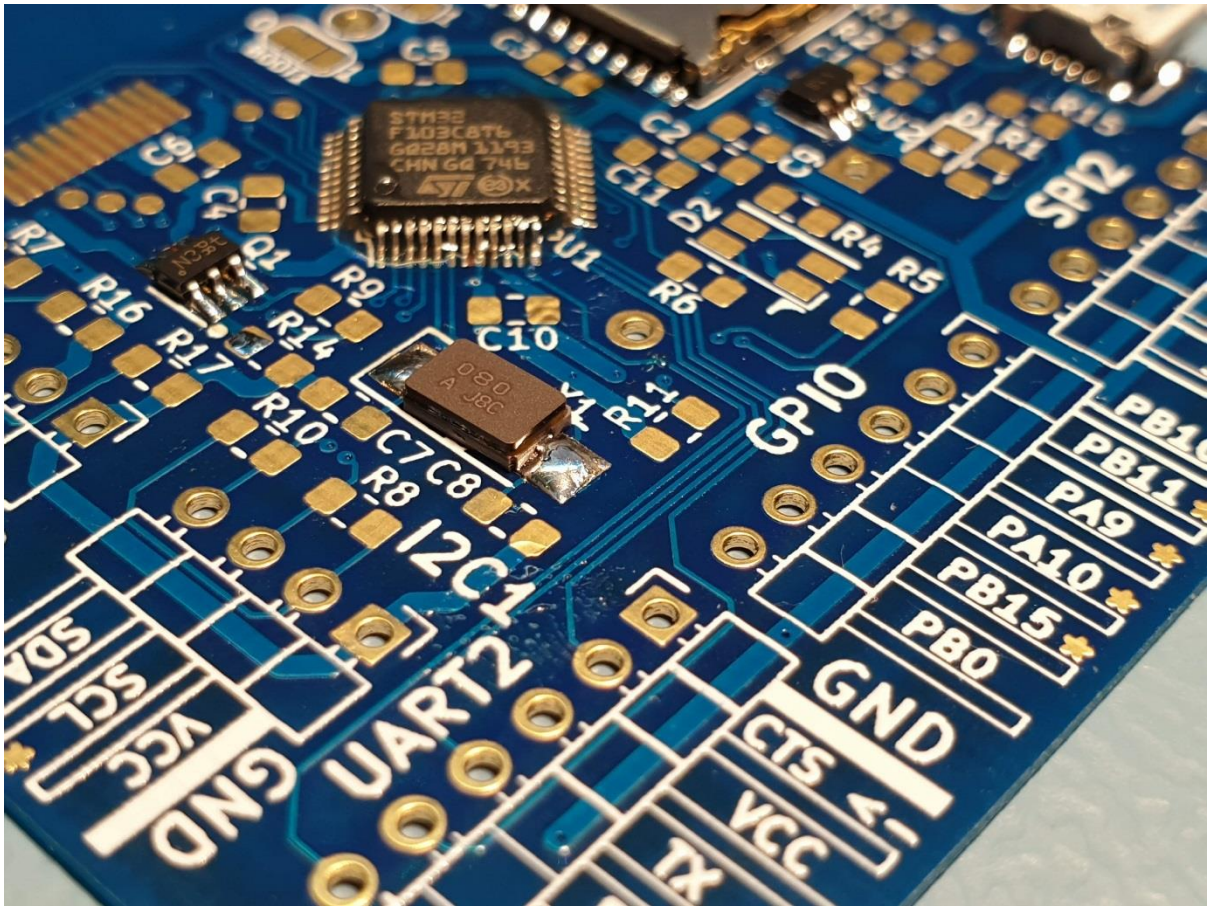


Step 5 – The 8MHz Crystal

The crystal (Y1) is non-polarised and may be soldered down in either orientation. The PCB footprint has been designed to make hand soldering easier, however despite this the SMD crystal package can be tricky to solder.

The best way to solder this component is to place it onto the untinned pads as shown in the image above. Apply the soldering iron to the exposed section of one of the pads and apply solder. The solder will wick under the crystal and bond to the pad on the underside.

Remove the soldering iron and allow the solder to solidify. Verify that the crystal is stuck to the PCB by the pad you just soldered. Once this is done, apply the soldering iron to the other pad to repeat the same process.

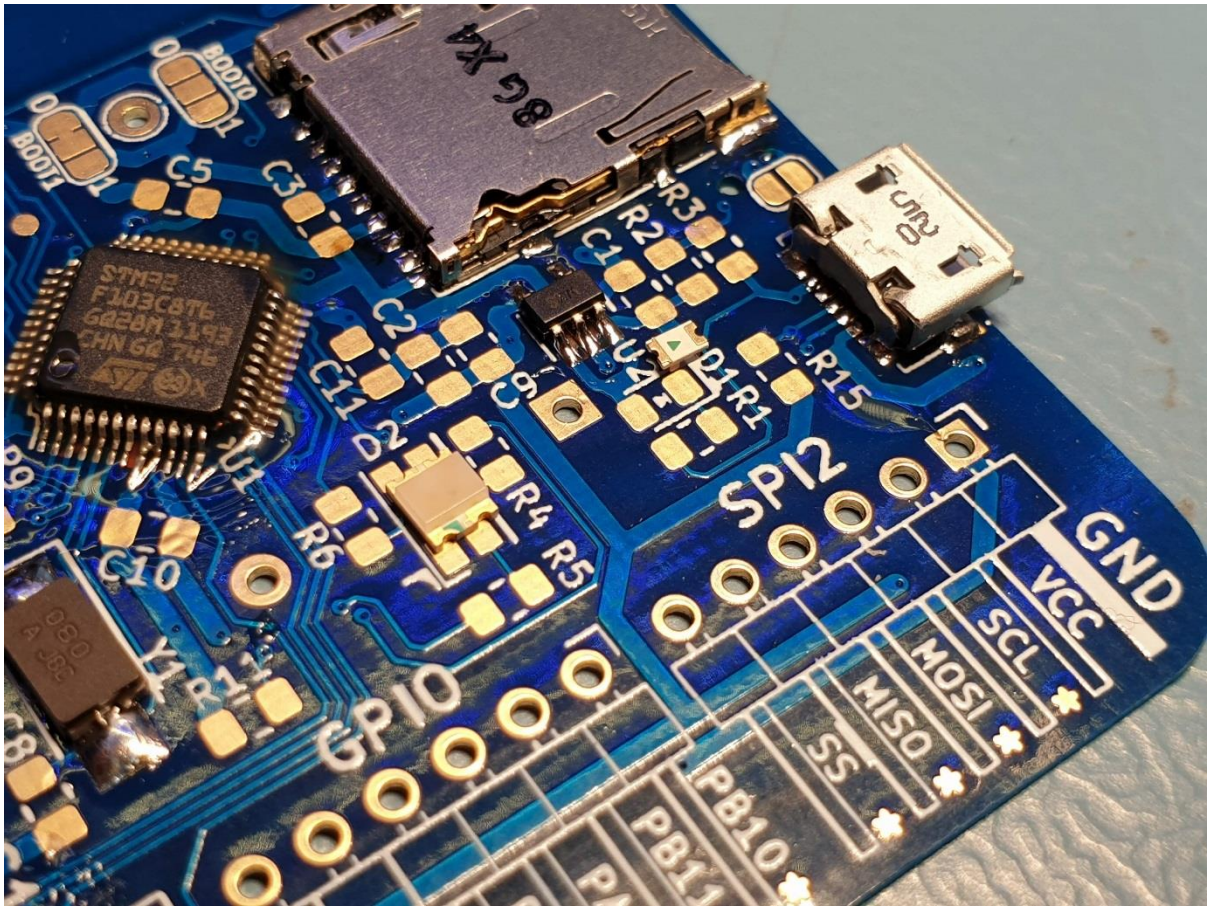


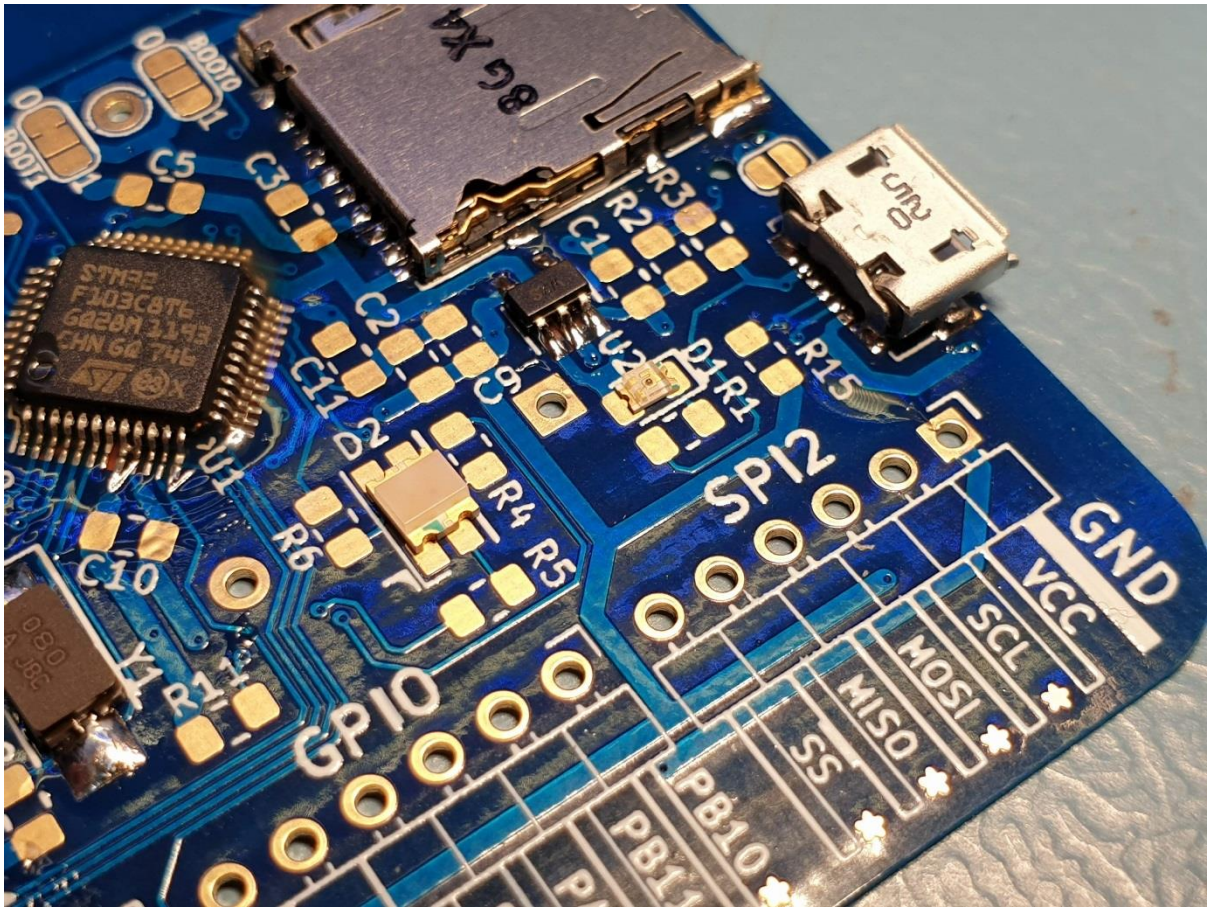
Step 6 – The LEDs

There are two LEDs on the PCB: the power indicator and the RGB LED controlled by the processor. The same technique as with all other components is followed: tin one pad and stick the component down, then apply the soldering iron and a small amount of solder to each of the remaining pins one at a time.

The power LED PCB footprint has an arrow showing the proper orientation of the component. The LED has an arrow on the under side of the component which should be aligned with the arrow printed on the PCB.

The RGB LED has the common anode marked with a green spot. This must be aligned with the white spot on the PCB, in the bottom right corner of the package.


BOOT0
BOOT1
C5
C3
R3
R2
C1
C2
C11
C9
U4
D1
R1
R15
D2
R4
R5
R6
U1
C10
Y1
R11
SPI2
GND
VCC
SCL
MOSI
MISO
SS
GPIO
PB10
PB11


BOOT0
BOOT1
C5
C3
R3
R2
C1
C2
C11
C9
U2
D1
R1
R15
D2
R4
R5
R6
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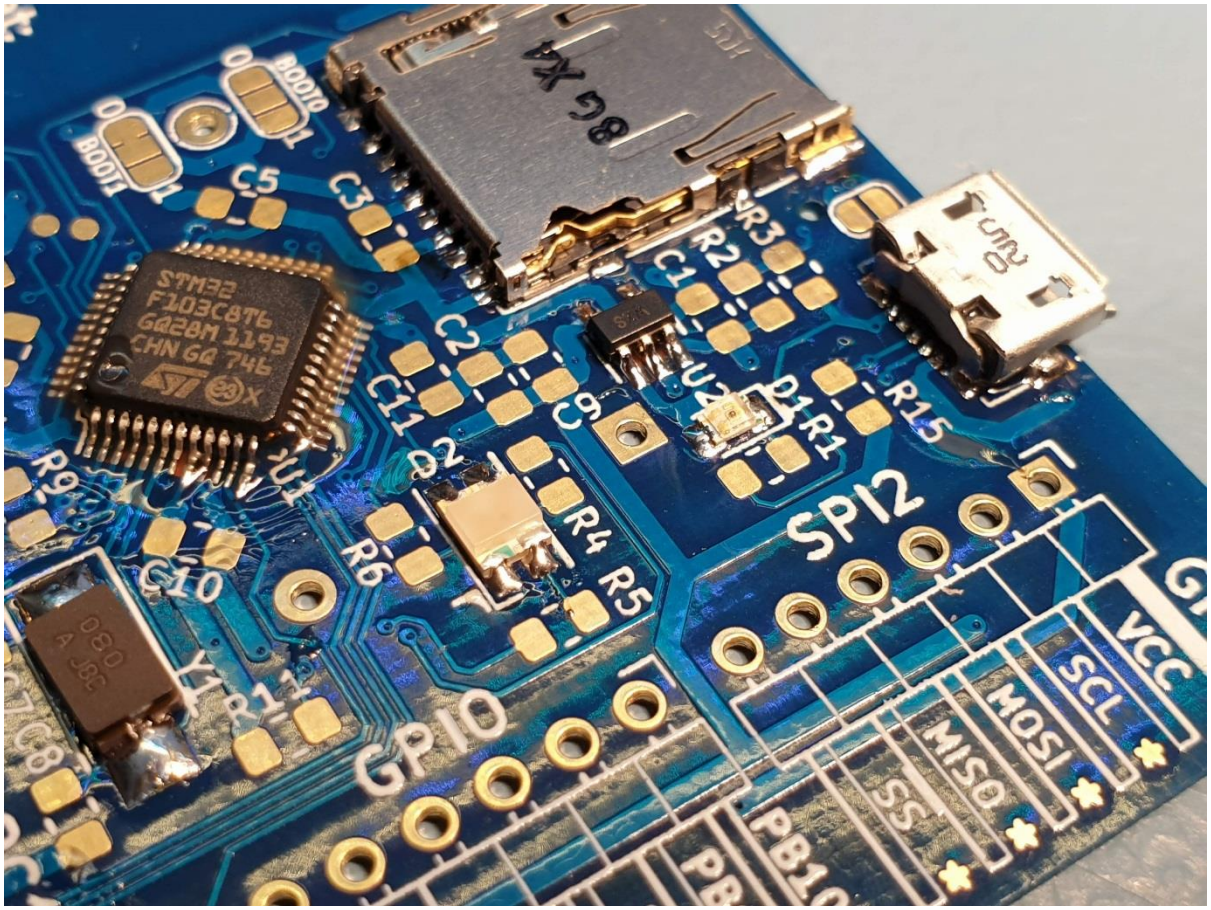
C10
Y1
R11
SPI2
GND
VCC
SCL
MOSI
MISO
SS
GPIO
PB10
PB11



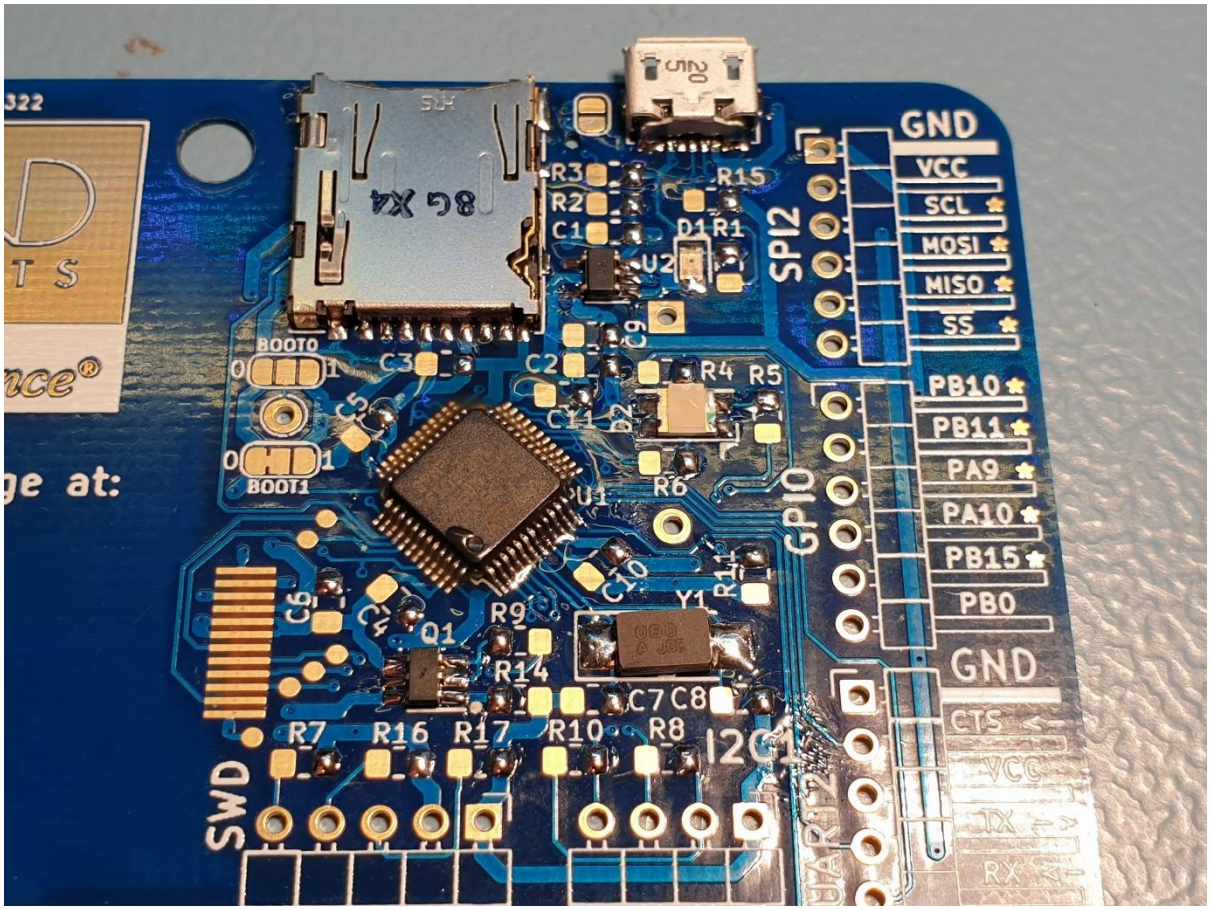
Step 7 – Capacitors & Resistors

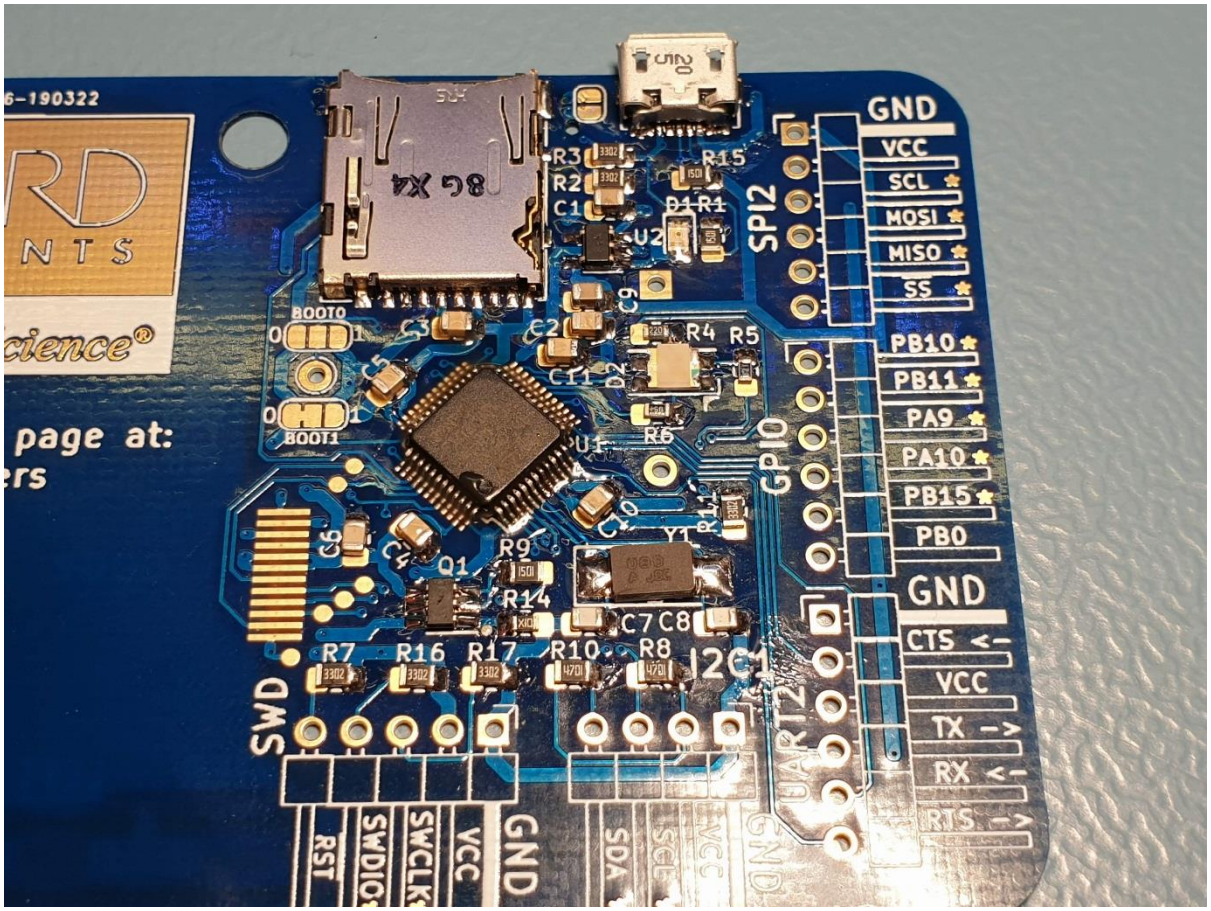
All the capacitors and resistors on the PCB are 0805 SMD packages and are all marked with their reference designators. None of them are polarised, so the orientation is non-critical.

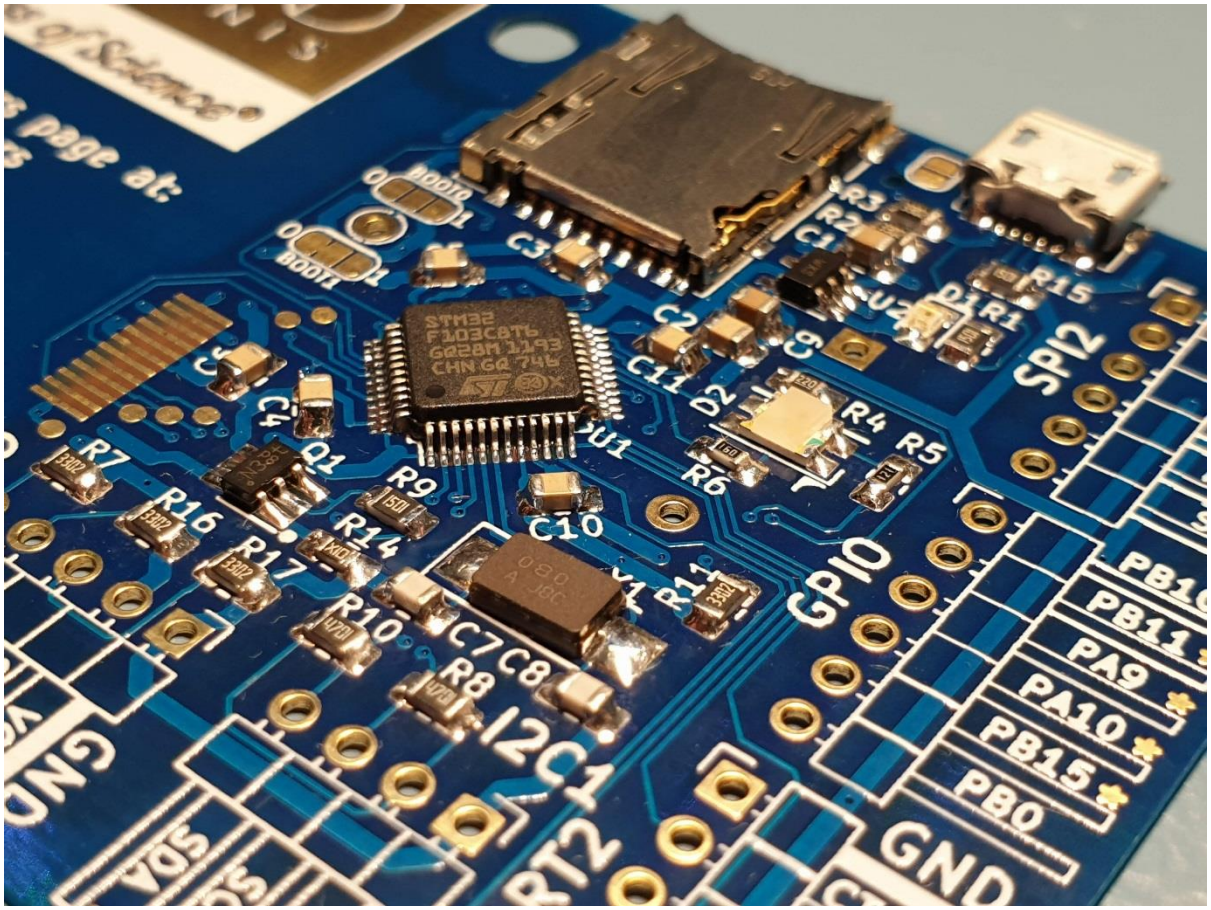
The same soldering procedure is followed as will all other parts: tin one pad and stick the component down, then apply the soldering iron and a small amount of solder to the remaining pad. To save time, tin one pad of all the 0805 footprints at the same time on the PCB.

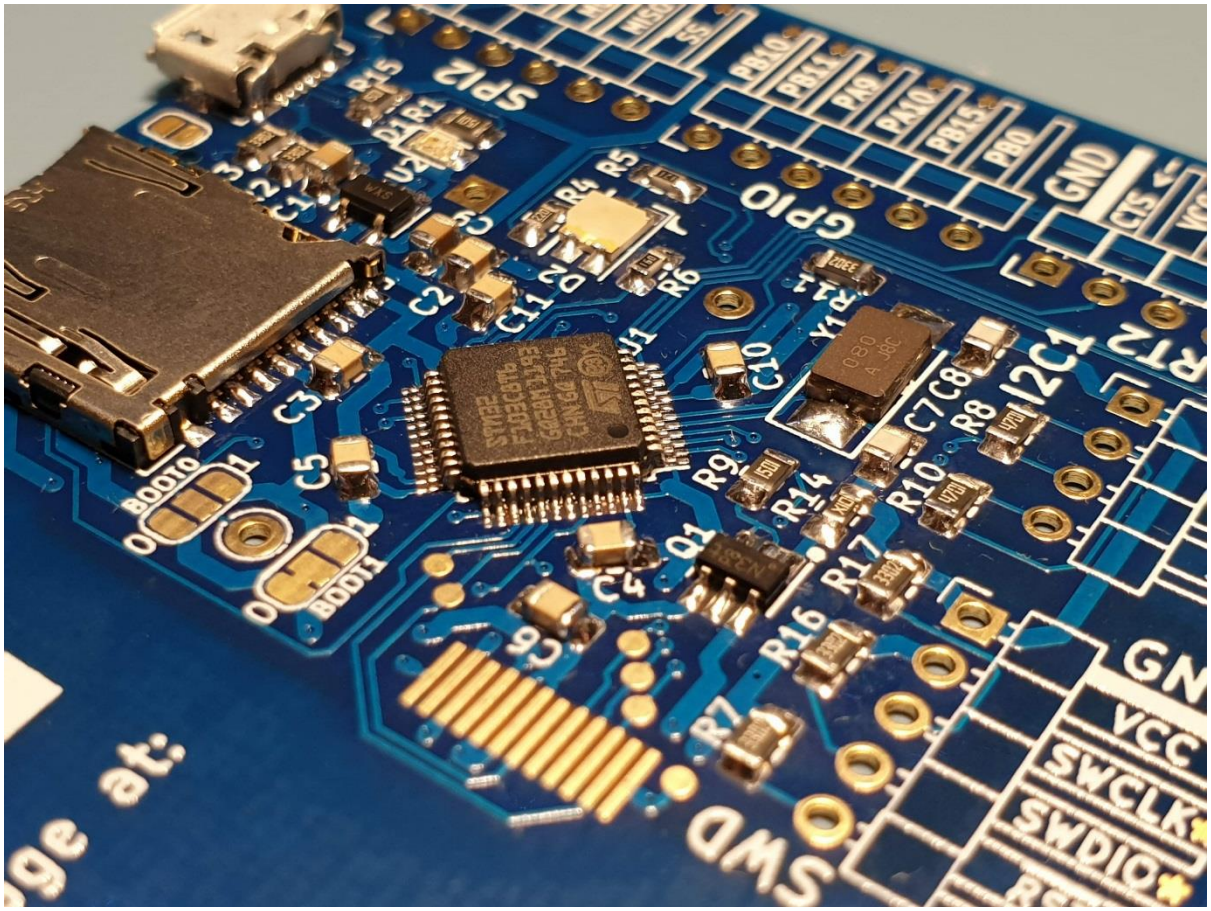
Refer to the bill of materials to determine which values of resistor and capacitor should be fitted where. Each component is marked with a reference designator, for example R4, R5 & R6 are visible in the above image. Each reference designator is associated with a component value in the bill of materials.

It will save confusion if all components of a particular value are done at the same time. For example, solder all the 33K resistors first, then the 4K7 resistors etc. Once all the parts are held in place with a single pin, go around and solder all the other pins at the same time.


GND
VCC
SCL
MOSI
MISO
SS
SPI2
PB10
PB11
PA9
PA10
PB15
PB0
GPIO
GND
CTS
VCC
TX
RX
UART2
I2C1
SWD
BOOT0
BOOT1
R3
R2
C1
R15
D1
R1
U2
C3
C2
R4
R5
C11
U1
R6
C10
Y1
R11
C6
C4
R9
Q1
R14
C7
C8
R7
R16
R17
R10
R8


GND
VCC
SCL
MOSI
MISO
SS
SPI2
PB10
PB11
PA9
PA10
PB15
PB0
GPIO
GND
CTS
VCC
TX
RX
RTS
UART2
I2C1
SWD
BOOT0
BOOT1
R3
R2
C1
R15
D1
R1
U2
C3
C2
R4
R5
C11
U1
R6
C10
Y1
R11
C6
C4
R9
Q1
R14
C7
C8
R7
R16
R17
R10
R8
RST
SWDIO
SWCLK
VCC
GND
SDA
SCL


STM32
F103C8T6
GPIO
SPI2
I2C1
PB10
PB11
PA9
PA10
PB15
PB0
GND
VCC
BOOT0
BOOT1
U1
U2
Y1
Q1
D1
D2
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
R12
R14
R15
R16
R17
C1
C2
C3
C4
C5
C7
C8
C9
C10
C11

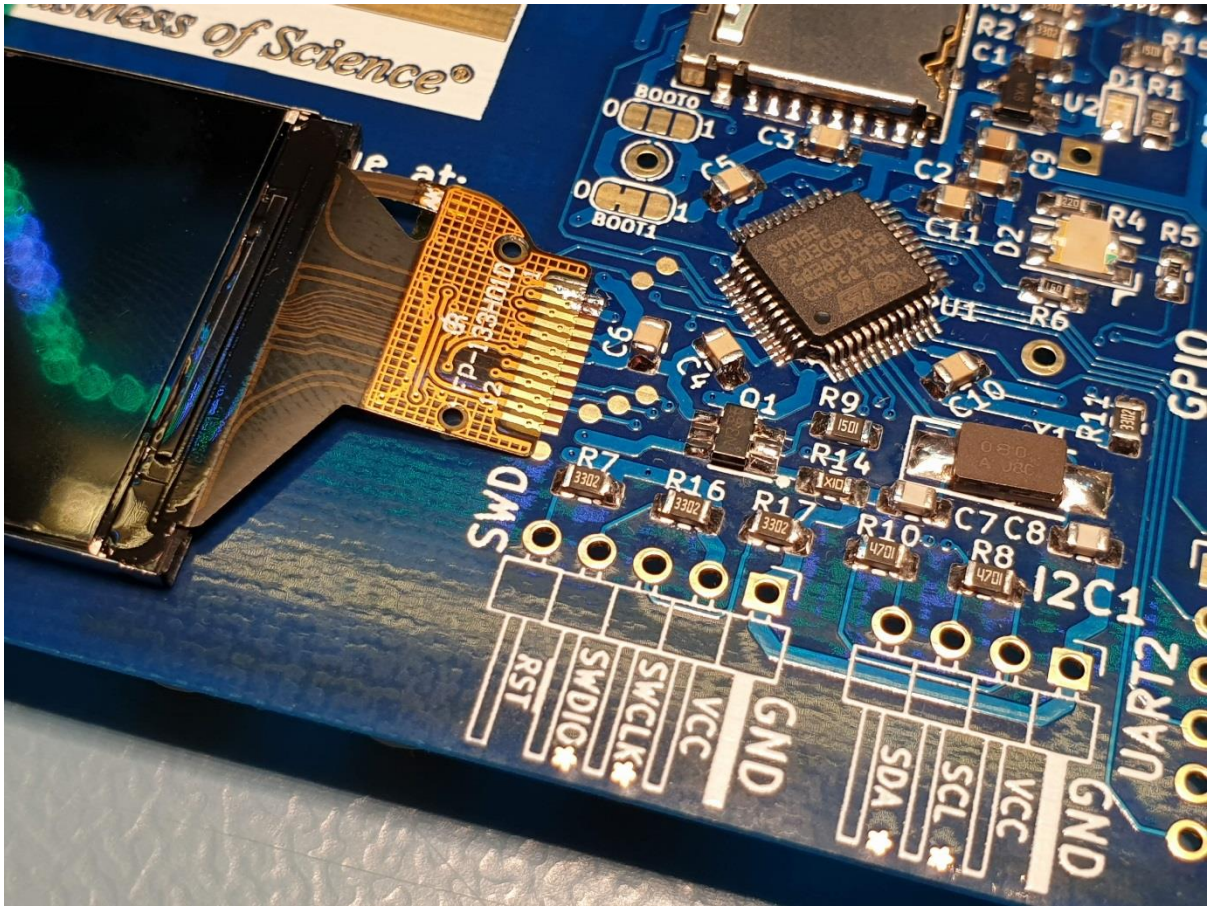

SPI2
GPIO
I2C1
SWD
VCC
SWCLK
SWDIO
GND
BOOT0
BOOT1
U1
Y1
Q1
R1
R4
R5
R6
R7
R8
R9
R10
R14
R16
R17
C2
C3
C4
C5
C7
C8
C10
C11

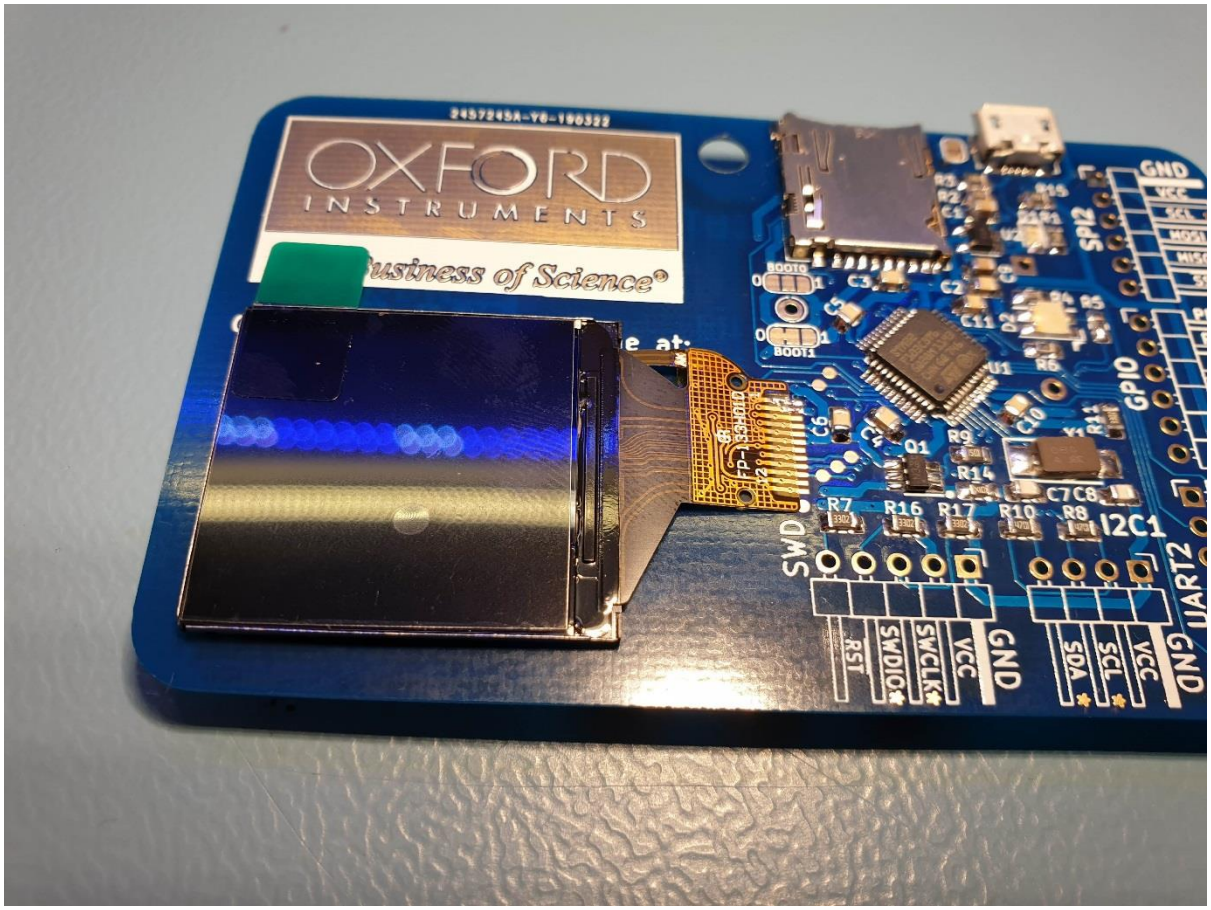
The display is sensitive to solvents and therefore should not be washed. Before fitting the display, give the PCB a thorough clean. While wearing gloves, apply a generous amount of acetone or IPA to the PCB and scrub thoroughly with a stiff brush, paying particular attention to the edges of the SD card socket and USB socket. This process is best conducted in a small tray to contain the solvent. Dry the PCB with paper towels and repeat the cleaning process again with fresh solvent. It is important to dry the PCB with paper towel rather than just letting the solvent evaporate. If the solvent is just allowed to dry, any dissolved flux residue will remain on the PCB after the solvent is gone.

Step 8 – Display

The display solders directly to the PCB. The flexible PCB tail on the display has exposed pads on both sides with plated through holes in the pads allowing solder to flow from one side of the contacts to the other.

Position the display on the PCB so that the contacts line up with the pads and covering roughly half of each pad. This will allow the soldering iron access to both the PCB footprint and the contacts on the display.



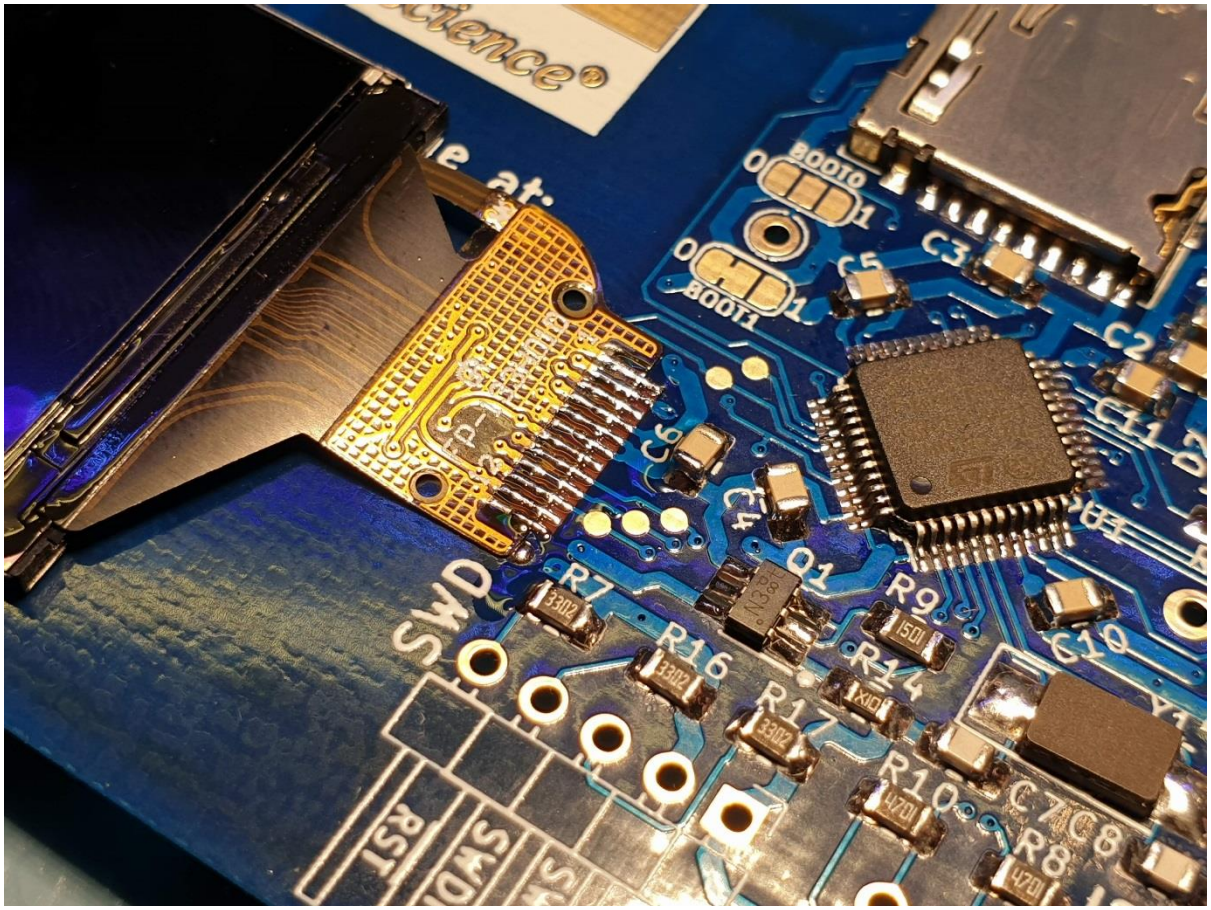


Apply some solder to one of the pads and then while holding the display in the correct position, solder one pad down. Once one pad is in place, apply a small amount of flux and then apply the soldering iron and a small amount of solder to the remaining pads.

It is advisable to check for short circuits between pins on the display connector after soldering. This can be done with a multi-meter in continuity mode. Note that pins 5 and 6 are intentionally connected together near C6.

Once all the pads are soldered down, apply some acetone or IPA to a paper towel and wipe away the flux residue. Ensure the display does not come into contact with the solvent as it may be damaged.

Apply a small piece of double sided tape to the bottom of the display and stick it in place on top of the PCB.


BOOT0
BOOT1
SWD
RST
R7
R16
R17
R14
R9
R10
C1
C2
C3
C5
C7
C8
Q1


OXFORD
INSTRUMENTS
The Business of Science®
Check out our careers page at
oxinst.com/careers
GND
VCC


OXFORD
INSTRUMENTS
The Business of Science®
Check out our careers page at:
oxinst.com/careers
GND
VCC
SCL
SDA
SWDIO
RST


2457245A-Y6-190322
OXFORD
INSTRUMENTS
The Business of Science®
SWD
RST
SWDIO
SWCLK
VCC
GND
I2C1
SDA
SCL
VCC
GND
UART2
CTS
VCC
TX
RX
RTS
SPI2
GND
VCC
SCL
MOSI
MISO
SS
GPIO
PB10
PB11
PA9
PA10
PB15
GND
BOOT0
BOOT1
U1
U2
Y1
Q1

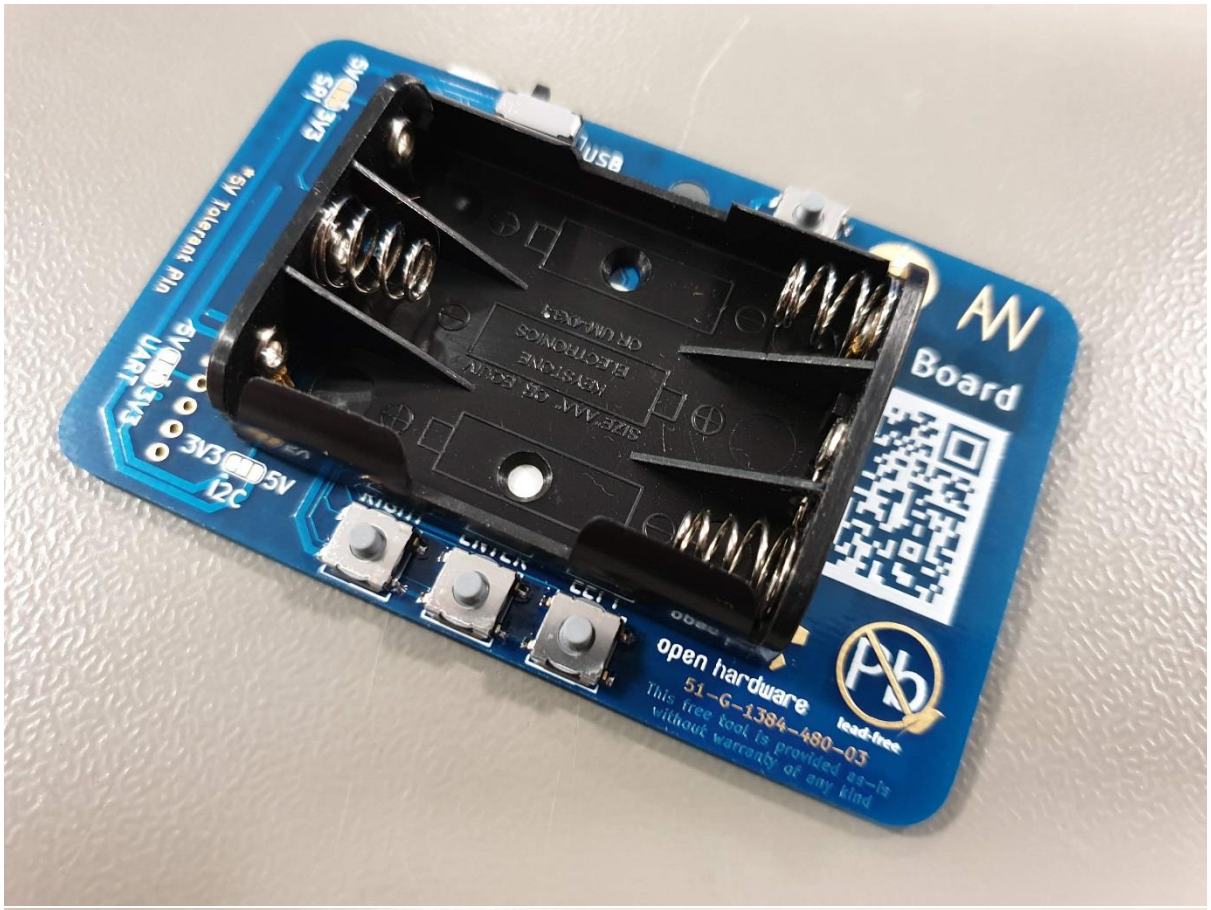
Step 9 – Optional Extras

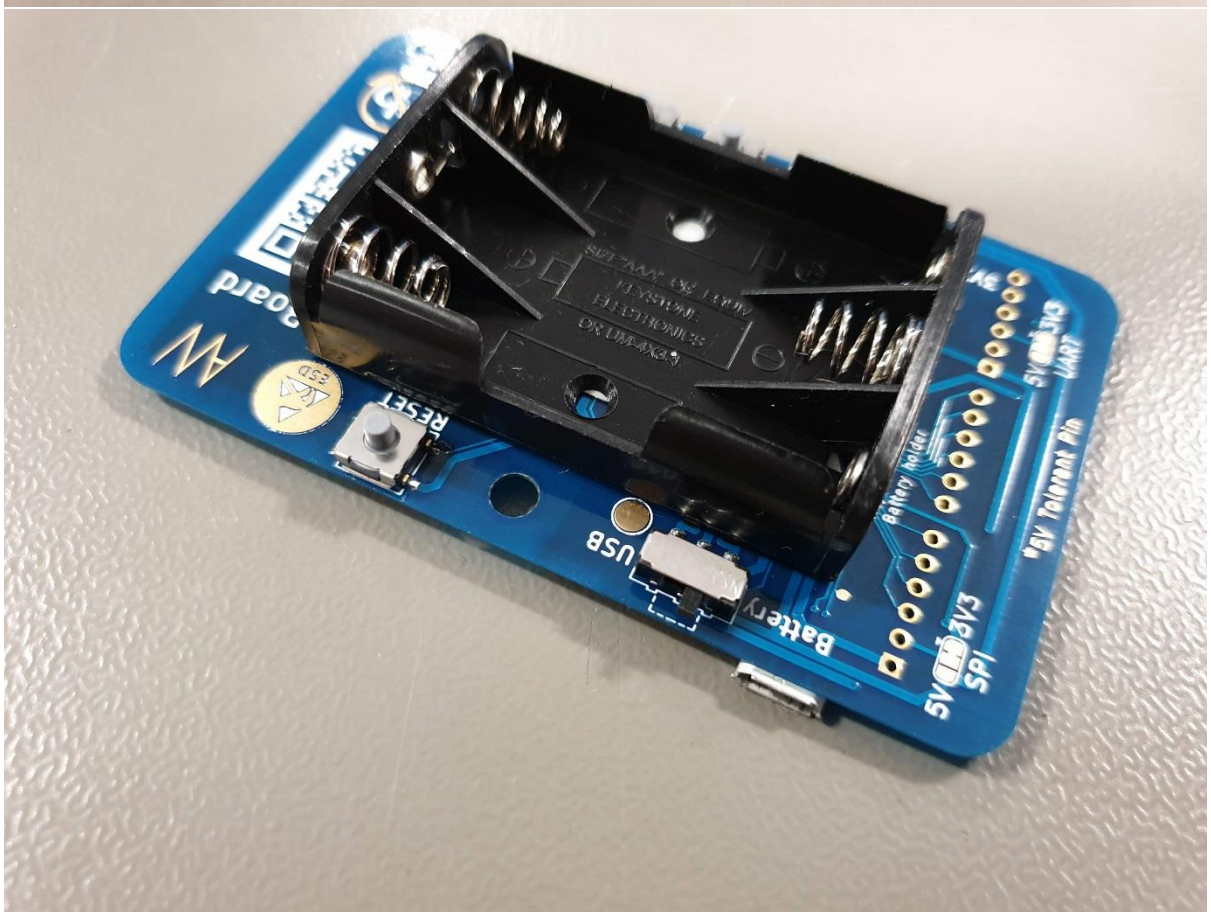
The PCB may be fitted with a power switch, 4 buttons and a battery holder on the reverse side if desired. Three of the buttons may form a user interface (left, right and enter), the 4th is a reset switch which is useful for programming via the USB bootloader.

Each of the switches is mounted in the same way as other components. Tin one pad in the footprint and attach the component in the correct orientation and alignment. Apply the soldering iron and a small amount of solder to all the remaining pins.

Note that behind the footprint of the power switch is a set of pads suitable for bypassing the switch to hard wire the PCB for USB or battery operation without fitting the switch. Pads are also available for this purpose on the top surface of the PCB between the USB and SD card sockets. The pads on the top bypass the switch in USB power mode, the pads on the bottom may be used to bypass the switch in either configuration. The pads on the top have been provided to allow the PCB to be hard wired in USB configuration using a single sided solder paste pick and place assembly process.

The battery holder should be held to the PCB using double sided tape before soldering the pins in place. It was not possible to use the mounting holes in the battery holder as they would have interfered with the display.


Board
open hardware
51-G-1384-480-03
lead-free
USB
RESET
Battery
SPI
UART
I2C
3V3
5V


RESET
USB
Battery
SPI
UART
Battery Holder
3V3
5V