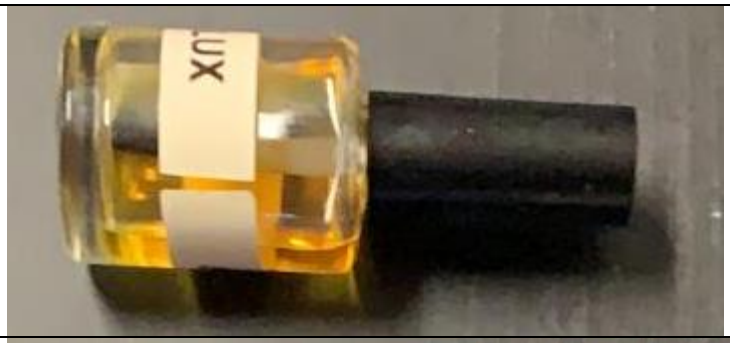
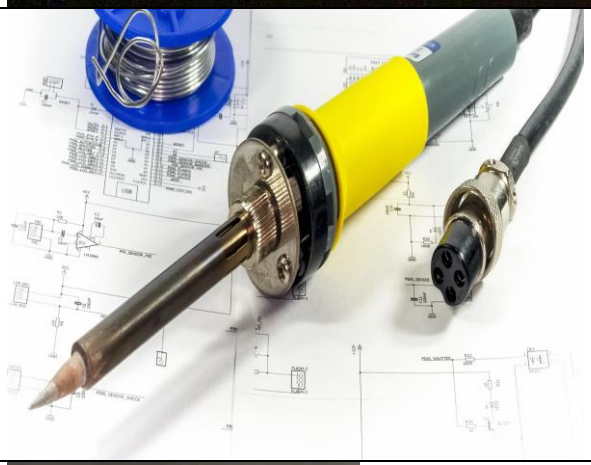
Building the FPGA Board V2 by D. Keekstra

Before starting soldering on the real board it's better to do some testing. For the testing there is an PCB attached to the board with all kinds of footprints. Don't hesitate to try some before starting. This tutorial is a guide for soldering the board but doesn't guaranty correctness.

1. Recommended tools

Before starting to solder be sure to have the correct tools with you. Beneath you will find a list with recommend tools for making the board.

Flux	
Solder pump	
Wire cutters	
Tweezers	
Old toothbrush	

Flux Remover	
Soldering iron with a medium or small tip Thin tin for a good dosage.	
Tip Cleaner	
Solder wick	
Third hand	

Magnifying glasses or a microscope	

2. ESD Safety

To prevent parts from breaking by electric shocks be sure to take ESD measures. Although the most parts are not extremely sensitive for ESD it is recommended to take ESD measures like a antistatic wristband or/and a grounded mat for soldering the board.

3. Soldering techniques

For soldering the footprints with a lot of pins (FPGA, microcontroller, etc.) it's recommended to use the following solder technique:

1. Start by placing the IC at the correct place.
2. Solder one or two next to each other easy to reach pins to the board.
3. Now watch carefully if all pins are correctly aligned.
4. If not, heat up the soldered pins and move the chip with tweezers or your fingers (don't heat up the pins to long or make them to hot!).
5. Check again if the chip is correctly aligned at all sides. In not repeat step 4 until it is.
6. When you are sure all pins are aligned solder one or two pins diagonal to the first soldered pin(s) so the chip is stuck to the board.
7. Now apply flux to a side of the chip where there are no soldered pins.
8. Apply a little solder tin to your iron and gently move over the pins. Don't stop or break when a few pins are connected to each other! This will be fixed in step 10

   The amount of tin applied is key for a good solder. Try not to use to much tin because this will short your pins to each other. If you use to less tin there will be bad connections. Try to get a feeling for it.

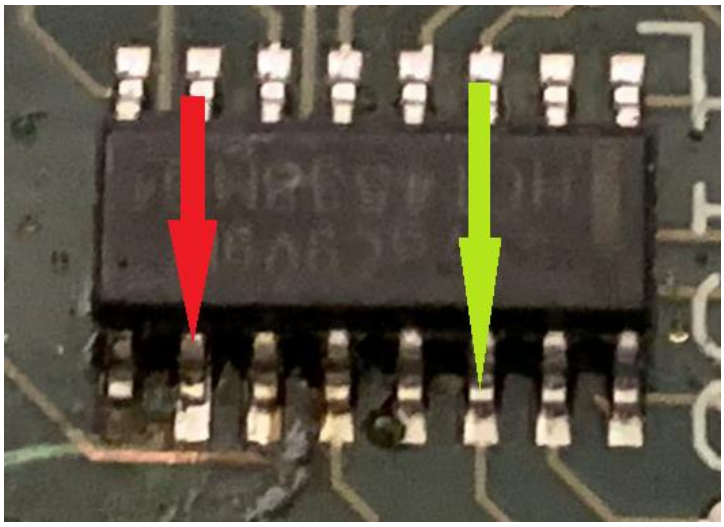


FIGURE 1: RED: TO LITTLE TIN, GEEN: GOOD AMOUNT

9. Repeat step 7 and 8 for the other sides. Be sure you take in to account that there is already tin applied to some pins for the alignment. You should apply less tin for these sides.
10. When there are a few pins are connected to each other you can first try to apply flux again and try to gently spread the tin to the other pins of the side.
11. If there is really to much tin try to move it to one side next you can lay solder wick on the pins and heat the solder wick with your iron. This will suck the tin away. Be careful when getting the wick of again. If its stuck first heat it again or you will break the pins!
12. When you used the solder wick be sure the pins have enough tin left. If not try to spread a little or apply a little again.
13. Always check you soldering's with a magnifying glass or microscope.

For a video you can watch this tutorial on SMD chip soldering by EEVblog.

https://www.youtube.com/watch?v=hoLf8gvvXXU

For soldering components with only a few pins (capacitors, transistors etc.) the technique is slightly different.

1. Try to find the easiest to reach pin on the board.
2. Apply a little tin to the pad.
3. Get the component with a tweezer in one hand and aligned it while holding the solder iron in the other hand.
4. Now heat the tinned pad and solder the pin of the component while holding it in place with your tweezer.
5. If it is correctly aligned move the iron and keep the component in place when the tin is cooling.
6. Now the other pins can be soldered one by one.
7. For some packages it can be handy to use flux when pins are connected to each other.

4. Components list

DO NOT solder the components in this order!

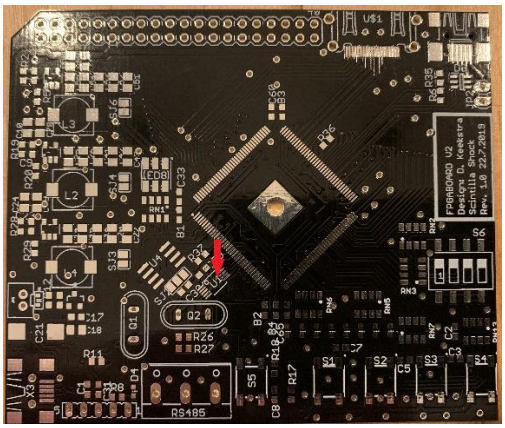
Type	Qty	Value	Package	Parts
Capacitor	33	100nF	C0603	C1, C2, C3, C5, C7, C8, C11, C13, C17, C27, C28, C29, C30, C31, C32, C33, C34, C35, C36, C37, C38, C39, C40, C44, C45, C46, C47, C58, C59, C60, C61, C64, C65
	4	16pF	C0603	C4, C6, C81, C82
	4	22pF	C0603	C9, C12, C23, C49
	22	10uF X5R	C0805K	C10, C14, C15, C16, C18, C20, C22, C24, C25, C26, C41, C42, C43, C50, C51, C52, C53, C54, C55, C78, C79, C80
Cap Pol	1	330uF	D/7343-31W	C21
Resistor	1	100R	R0603	R35
	2	10	R0603	R21, R22
	8	10k	R0603	R5, R11, R18, R24, R25, R33, R34, R36
	2	100k	R0603	R28, R29
	2	1k	R0603	R8, R17
	1	200R	R0603	R6
	1	150k	R0603	R19
	1	120R	R0603	R23
	1	32k	R0603	R2
	1	33k	R0603	R20
	2	2k2	R0603	R26, R27
	4	0	R0603	R1, R3, R4, R12
Res Array	5	1k	744-8NS	RN1, RN3, RN5, RN6, RN7
	2	10k	744-8NS	RN2, RN13
Ferrite Beads	6	B-EU	C0603	B1, B2, B3, B4, B5, B6
Coil	3	3.3uH 1.9A PWR	SLF7032T	L2, L3, L4
Xtal	1	12MHz	QS	Q1
	1	25MHz	QS	Q2
Mosfet	1	NTR2101P	SOT23-3	Q3
TVS	1	Bi TVS 5V	SOD-523	D1
	2	IP4234CZ6,125	SOT95-6N	D2, D3

Leds	1	OVSTRGBBCR8	150505M173300	LED9
	9	Any color	CHIP-LED0805	LED0, LED1, LED2, LED3, LED4, LED5, LED6, LED7, USB_BLASTER
Headers	1		1X02	JP2
	1	GPIO Header	MA20-2	SV1
	1	Pickit2	MA06-1	SV3
	1	VIN	JST-2-PTH-VERT	JP1
Switches	5	DTSM-6	DTSM-6	RESET, S1, S2, S3, S4
	1	SWS004	SMS-004	S6
Connectors	1	Screw terminal 3p	W237-3E	RS485
	2	MINI-USB	32005-201	X2, X3
	1	HDMI	HDMI_A	U$9
IC's	1	OSCILLATOR 5X3	5X3	U2
	1	SI5351A	MSOP-10	U1
	1	10CL016YE144C8G	QFP144	IC1
	3	AP3429	TSOT-25	U$3, U$7, U$11
	1	IS25LQ040B-JNLE	SOIC8	U4
	1	Any 3.3v rs485	SO-08	IC2
	1	PIC18F14K50-I/SS	SOP20	U3
Misc	1	PCB		
	1	USB Cable		
	5	Bumper		

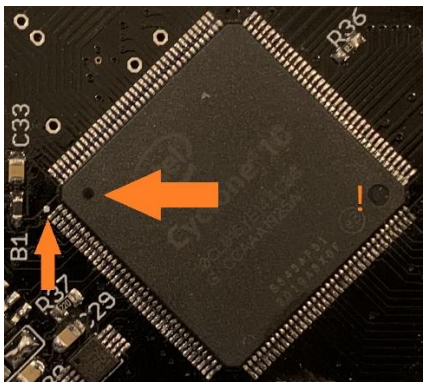
5. Soldering the actual board

When soldering the board be sure to check your soldering's. Especially the big chips with small outlines. Its recommended to check all connections of these chips under the microscope or magnifying glasses.

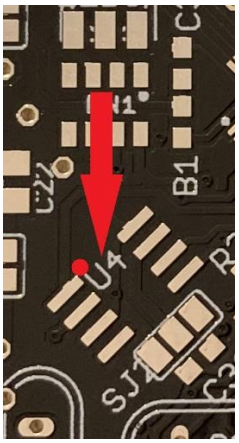
1. Solder the SI5351A Clock chip



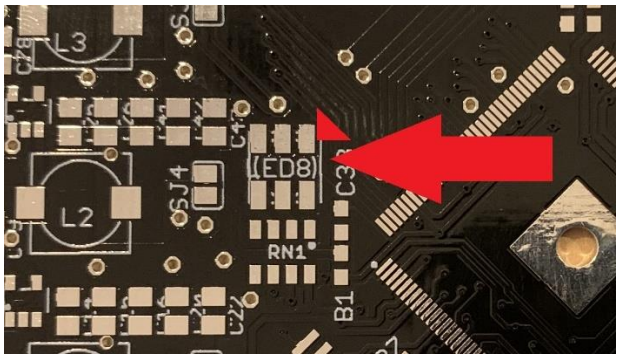
2. Solder the FPGA (be aware of the marking)



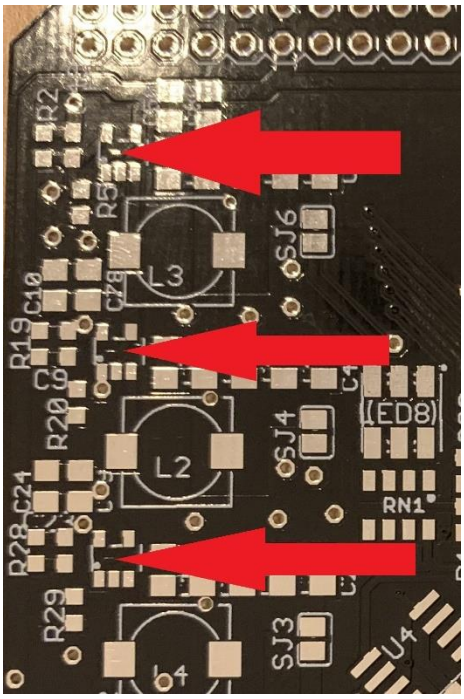
3. Solder the memory chip IS25LQ040B-JNLE



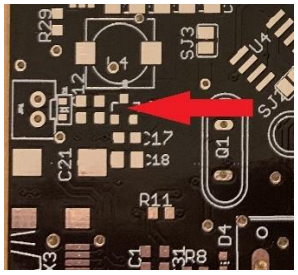
4. Solder the RGB led. Place the led with the corner to the dot on the PCB



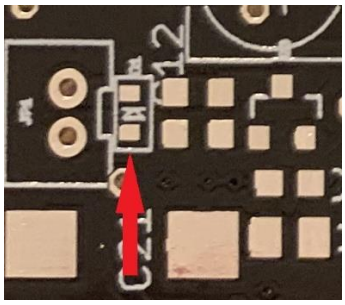
5. Place 3x buck converter AP3429



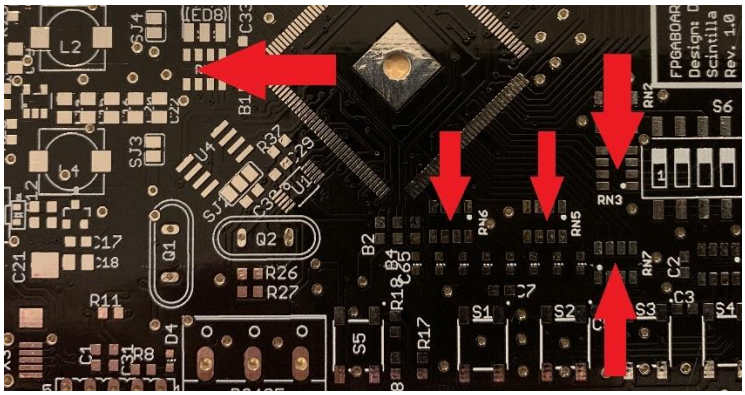
6. Place the mosfet NTR2101P



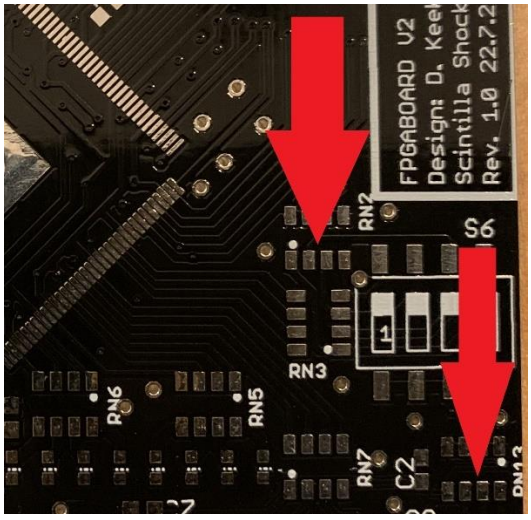
7. Place diode D1 Bi TVS 5V (polarity doesn’t matter)



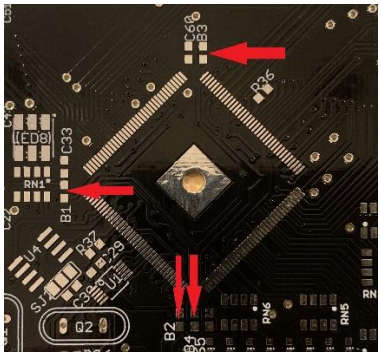
8. Place the 1K resistor arrays



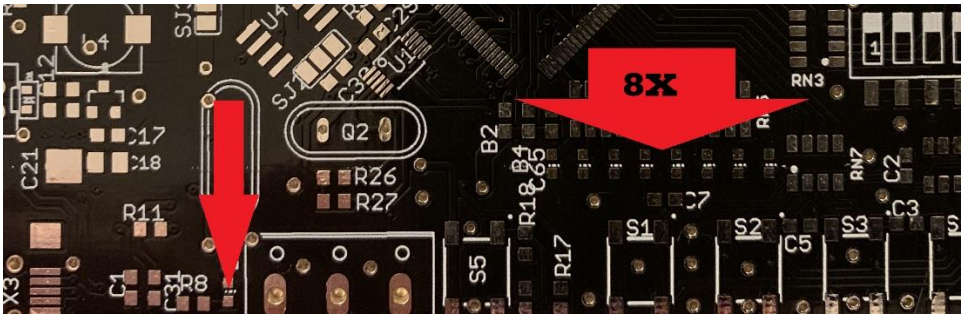
9. Place the 10K resistor arrays



10. Place 4x Ferrite beads (only on top)



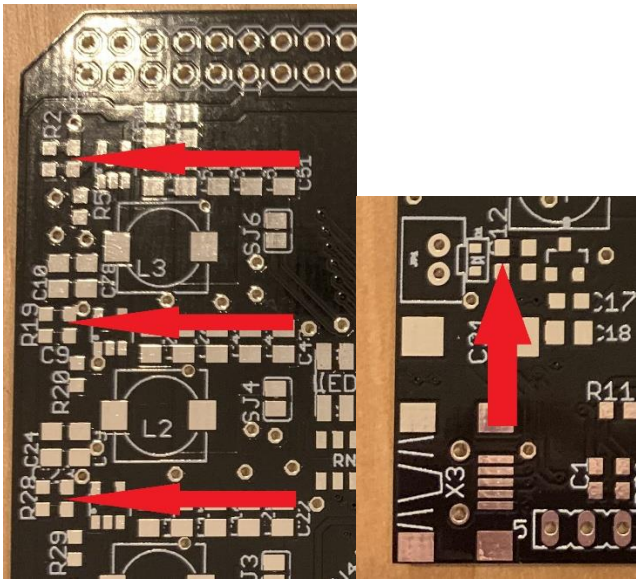
11. Place 9x leds



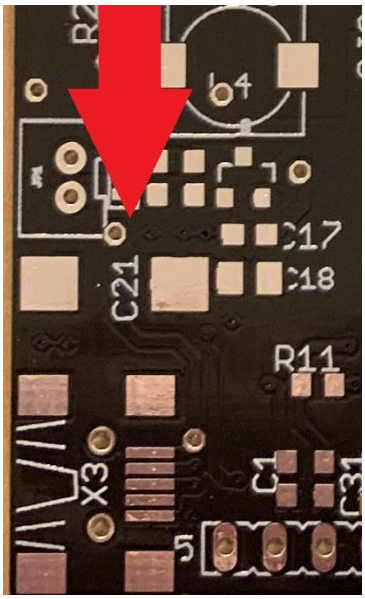
12. Place all the resistors at top level (marked on the PCB)

1	100R	R0603	R35
4	10k	R0603	R5, R11, R18, R36
2	100k	R0603	R28, R29
2	1k	R0603	R8, R17
1	200R	R0603	R6
1	150k	R0603	R19
1	32k	R0603	R2
1	33k	R0603	R20
2	2k2	R0603	R26, R27

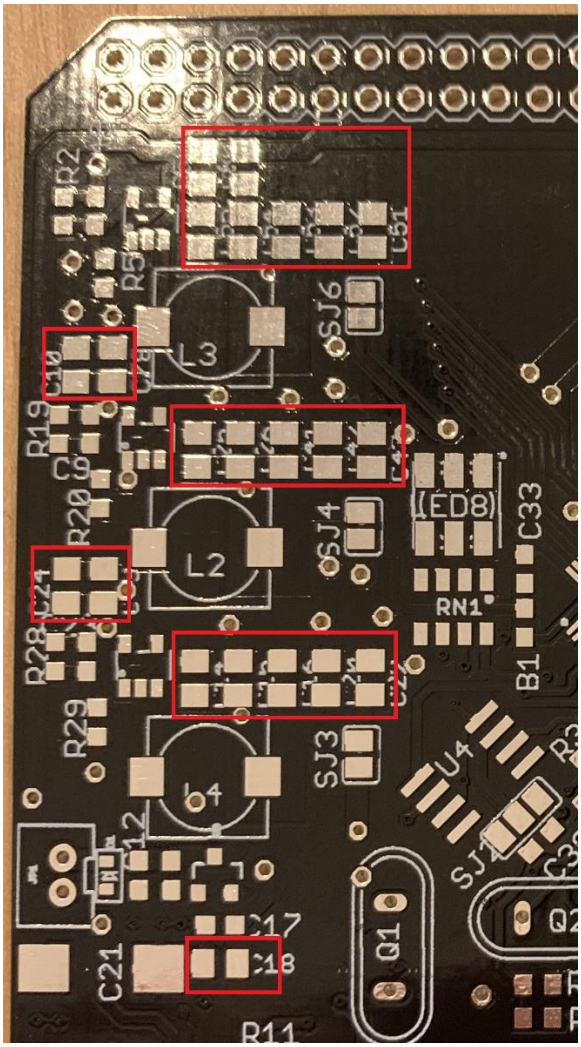
13. Place 4x 22pF’s



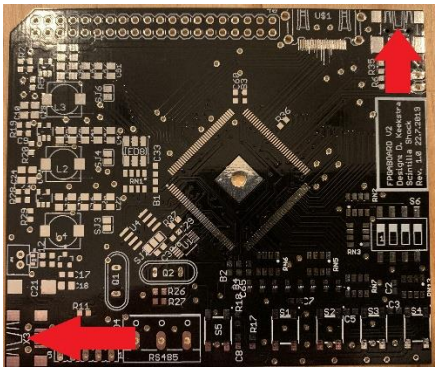
14. Place the polarized capacitor



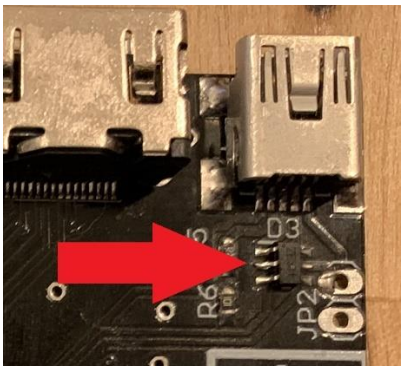
15. Place 22x 10uF’s



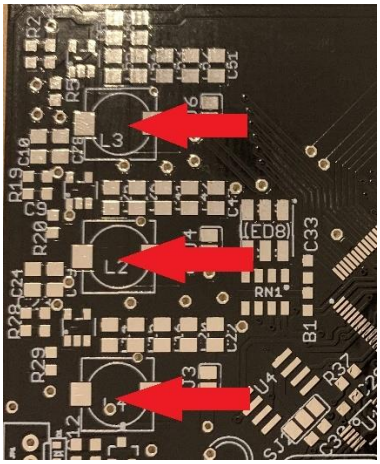
16. Place the 100nF's only at top level (All 0603 footprints that aren't soldered yet)
17. Place the two USB connectors



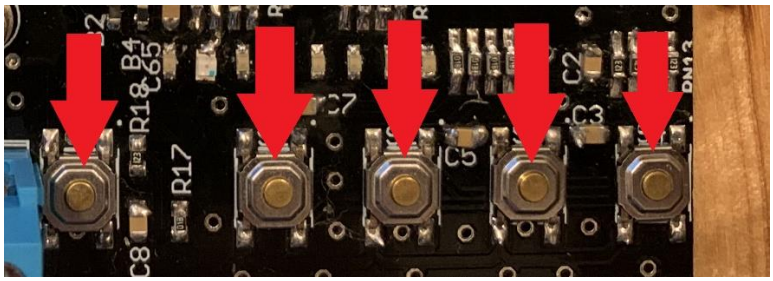
18. Place TVS Diode D3 IP4234CZ6,125



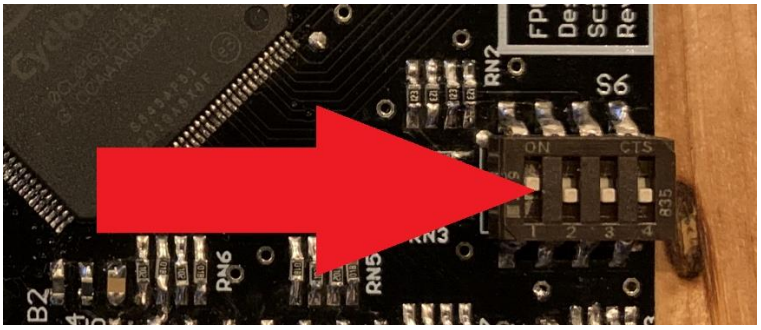
19. Place 3x Coils SLF7032T



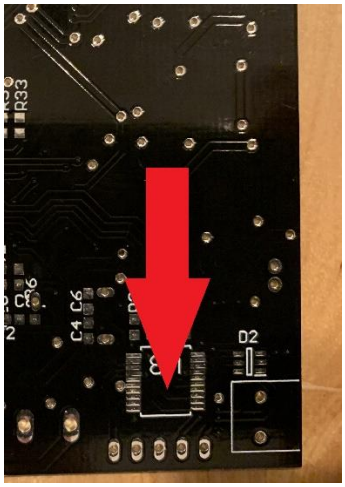
20. Place 5x button



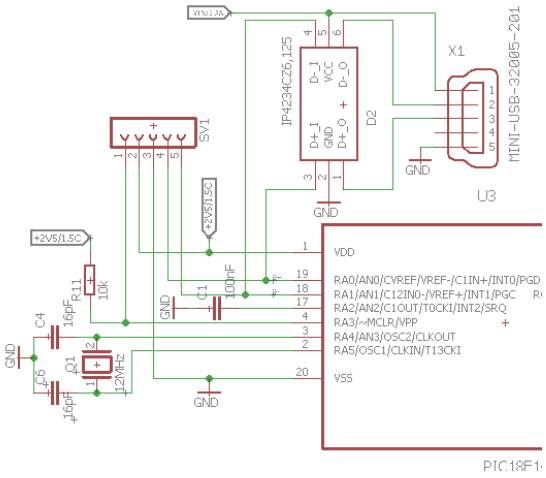
21. Place the dipswitch



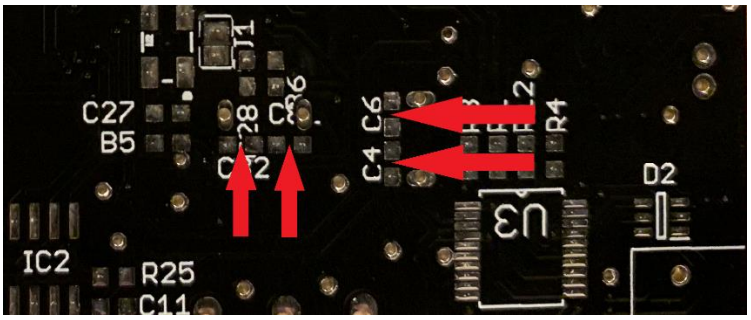
22. Now turn the PCB upside down
23. Solder the Microcontroller PIC18F14K50-I/SS



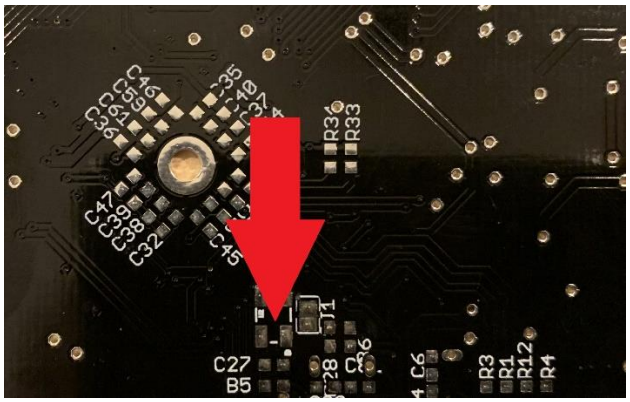
24. Program the microcontroller (Don't skip this step when d2 is soldered you can't program it anymore!) The programming can be done by a pickit 2 or different programmer on SV1



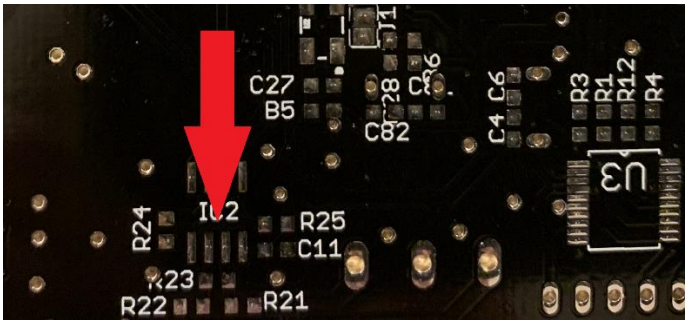
25. Place 4x 16pF



26. Place the oscillator



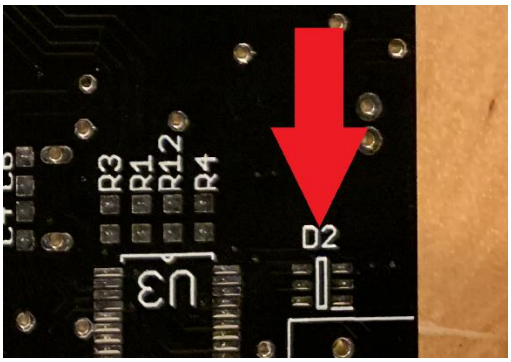
27. Place the differential bus converter



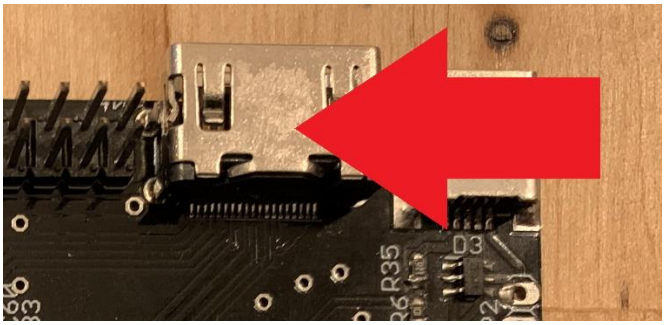
28. Place the resistors on bottom level

2	10	R0603	R21, R22
4	10k	R0603	R24, R25, R33, R34
1	120R	R0603	R23
4	0	R0603	R1, R3, R4, R12

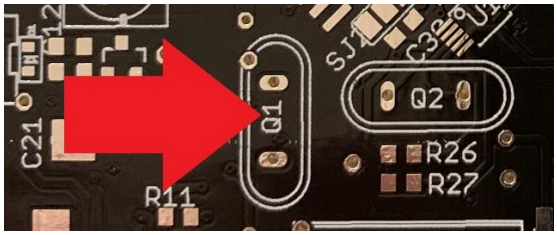
29. Place D2 IP4234CZ6,125



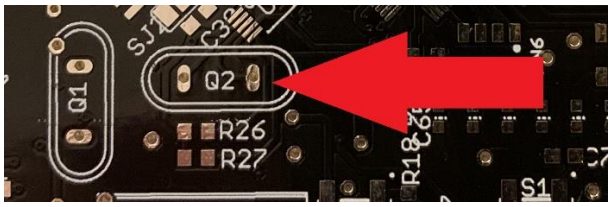
30. Place all the 100nf at the bottom (the only 0603 packages left)
31. Place the HDMI connector



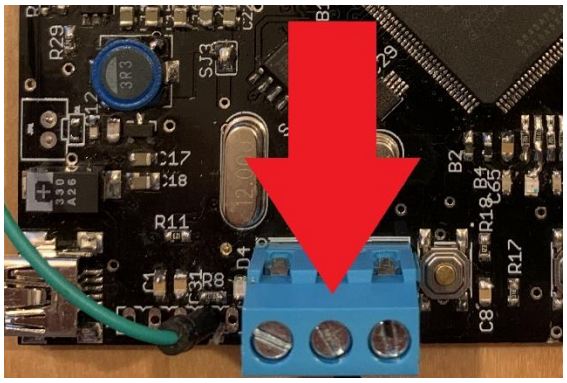
32. Place Xtal Q1 12Mhz



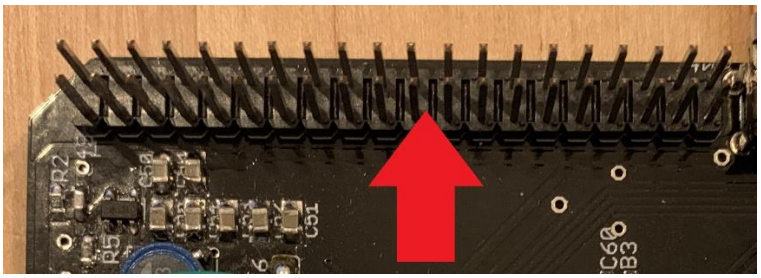
33. Place Xtal Q2 25Mhz



34. Place the screw terminal



35. Place the 40-pins terminal

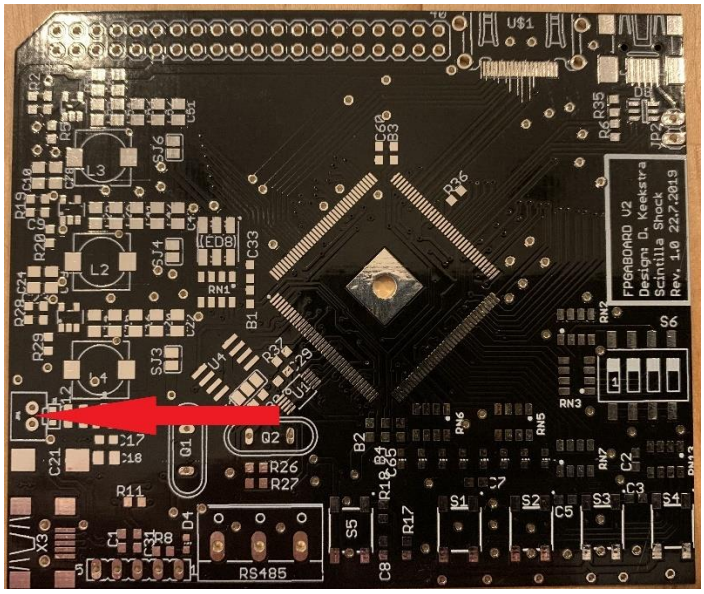


36. When you're done with chapter 6 you can glue the bumpers to the bottom of the board to protect the contacts from hitting the surface.

6. Checking/Measuring

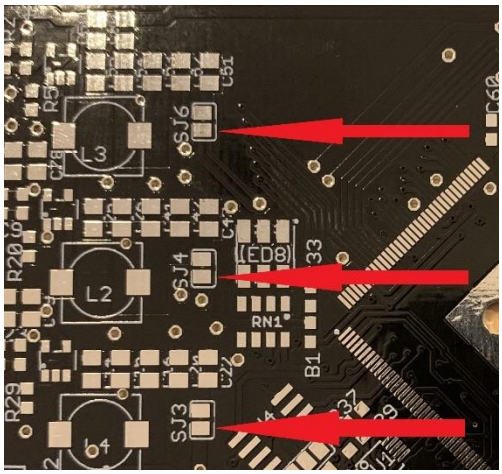
For the measuring you can use a simple multimeter.

1. Short test



Measure on JP1 if there exist any short. A normal value should be between 100k and 500k ohm.

Measure if there exist any shorts to ground from the bottom side of SJ6, SJ4 and SJ3 (see the picture). If there is a short remove the short before going any further!



2. Current

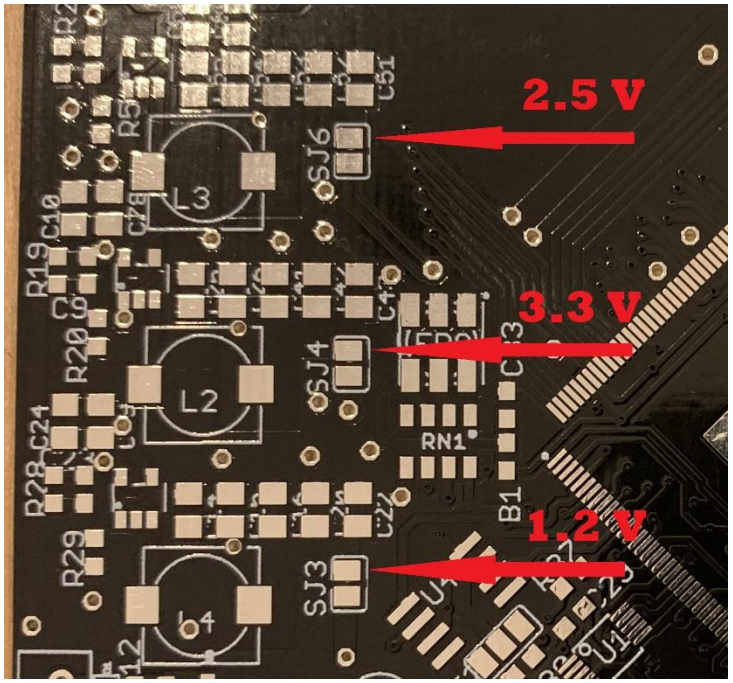
Connect the board to a proper lab power supply first (don't try it on your laptop you may have a chance to break it!). The board should take max 10mA.

3. Voltages

There are three power supplies on the boards. The voltages can be measured on the solder jumpers as shown on the picture. The voltages should be maximum 100mV off. When they all measure the correct values power off the board and make shorts on the three solder jumpers SJ6, SJ4 and SJ3.

Now power up the board again with the lab power supply and check step 2 again.

When this is done check the voltages again. When everything is correct you can try to program the demo software.




You did it!