

# OPL Studio

## Kit Assembly Guide



# 1. Welcome!

Thank you for purchasing the OPL Studio kit!

This guide will take you step by step through the assembly process of the kit. You will need the following tools before we can begin:

- Soldering iron
- Solder
- Flush cutting pliers
- Philips head screwdriver
- Needle nose pliers (optional)
- Hobby knife (optional)

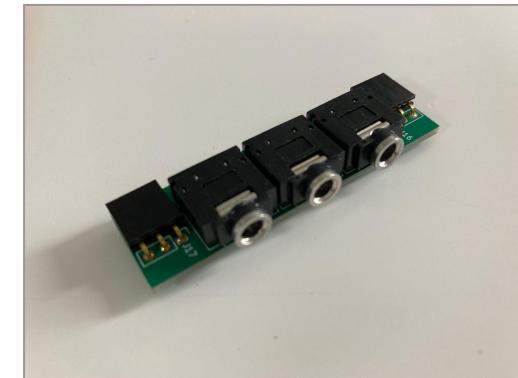
Grab your tools, grab a drink and let's get started!

## 1.1. Analog Plugin Boards

### Parts List

J16, J17	3 Pin female headers, right angled
J18, J19, J20	3.5 mm Jack sockets
Analog plug-in PCBs	

- Insert the two pin headers into the pads of the plugin board. Make sure that the headers are laying flat onto the surface of the PCB, flush with the edge and that they are facing toward the bottom of the board. The pin headers should **not** extend beyond the edge of the PCB
- Insert and solder the three jack sockets
- Repeat for the second plug-in board



## 1.2. Main Board - Diodes

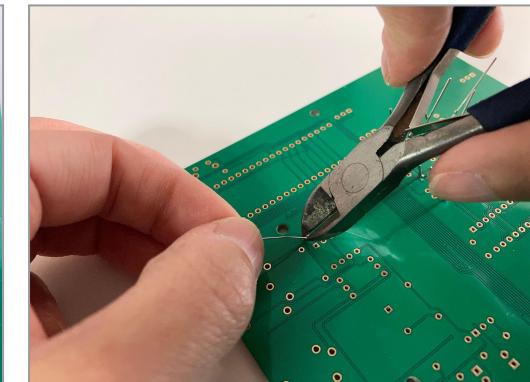
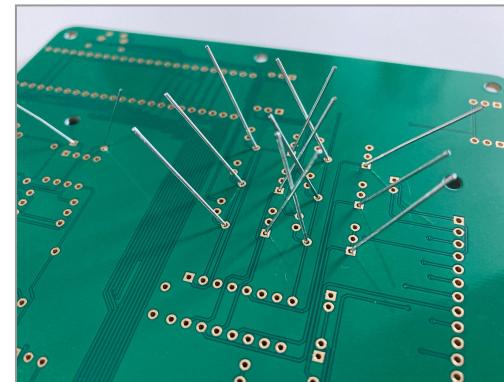
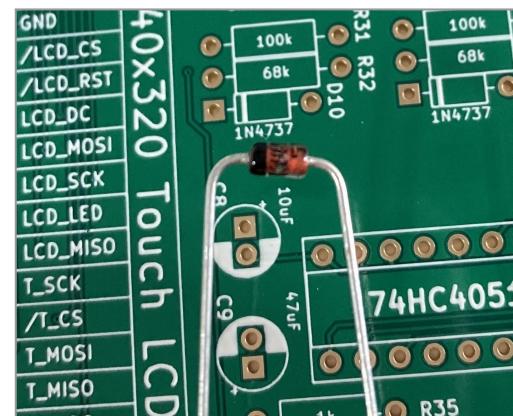
### Parts List

1N4148	D2
1N4737	D5, D6, D7, D8, D9, D10

- Bend the leads of the diodes so that they will fit through the holes in the PCB. When you insert the diodes make sure their orientation is correct. Each diode has a black band on its body which must be facing the same direction as the marking on the PCB.
- You can bend the leads of the diode slightly apart after inserting them to make sure they don't fall out when you turn the board over to solder them. Now solder the diodes and trim their leads flush to the solder joint.



When trimming the leads of components make sure you always hold the lead that you're trimming or put your finger on top of it to prevent it flying off and potentially hitting someone in the eye!

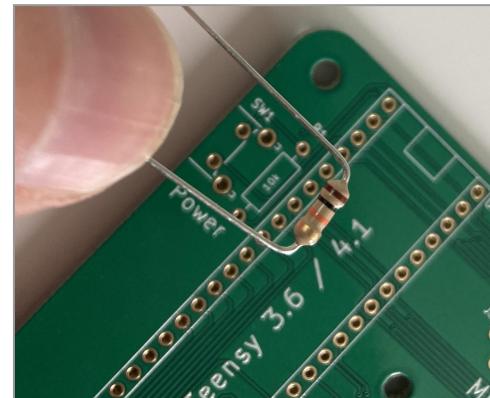
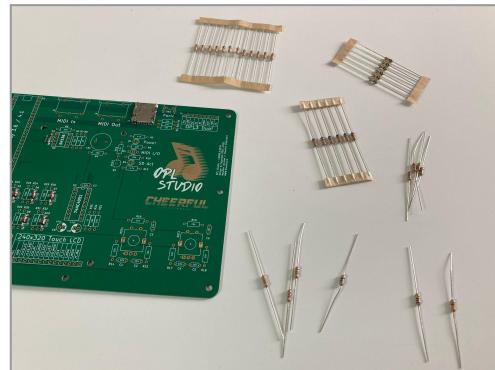


# 1.3. Resistors

## Parts List

R1, R2, R11, R14, R15, R16, R17, R18, R19, R20, R33, R34	10kΩ	Br	Bl	Or
R3, R12, R13	4.7kΩ	Ye	Vi	Re
R4	100Ω	Br	Bl	Br
R5, R6, R9, R10	220Ω	Re	Re	Br
R7	10Ω	Br	Bl	Bl
R8	33Ω	Or	Or	Bl
R21, R23, R25, R27, R29, R31	100kΩ	Br	Bl	Ye
R22, R24, R26, R28, R30, R32	68kΩ	Bl	Gy	Or
R35	1kΩ	Br	Bl	Re

- Bend the leads of the resistors so that they will fit through the holes in the PCB.
- Insert the resistors and make sure that each resistor matches with the value or part marking on the board.
- The orientation of the resistors does not matter, they are not polarized, but to get a neat looking endresult make sure that the gold bands of the resistors are facing the same direction.
- You can bend the leads of the resistors slightly apart after inserting them to make sure they don't fall out when you turn the board over to solder them. After soldering, trim the leads.

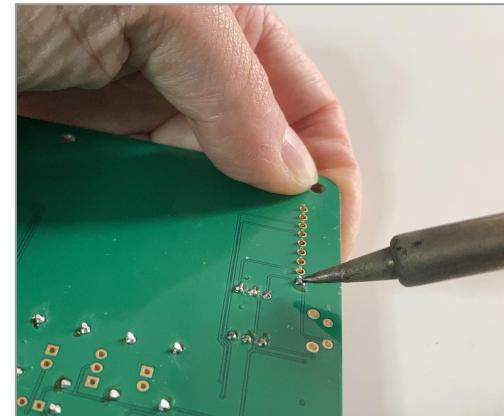
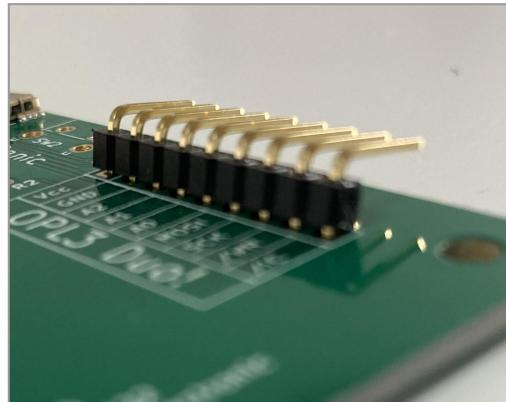
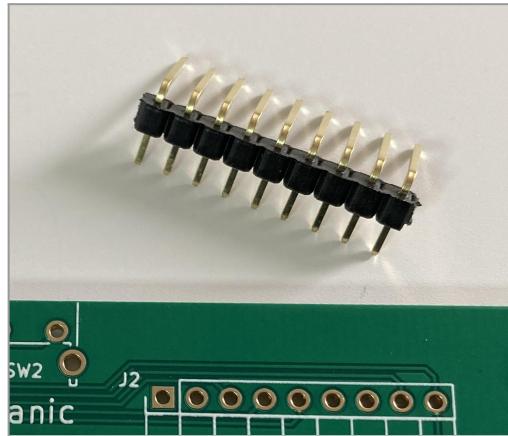


## 1.4. OPL3 Duo Connector

### Parts List

J2	9 Pin header, right-angle
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- Insert the 9 pin header and solder only the first pin.
- Inspect your work to make sure that the pin header sits flat on the board.
- If the pin header is not sitting flat, like you can see in the second picture, then reheat the solder joint while you hold your finger on the opposite end of the pin header. Be careful not to burn yourself and slightly push on the header until it sits flat onto the PCB.
- Now solder the remaining pins.

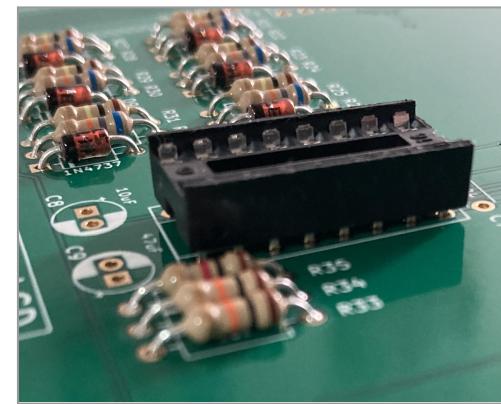
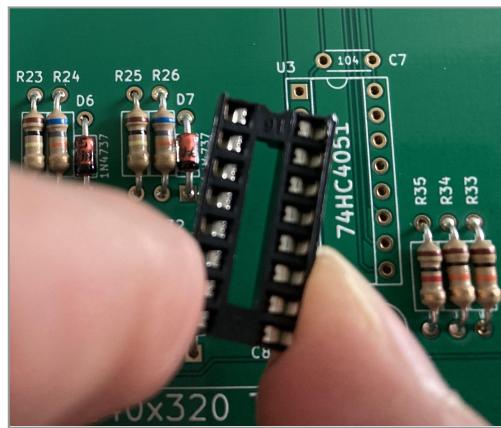
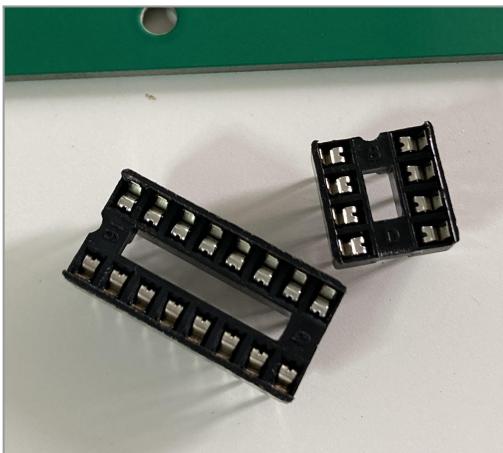


# 1.5. IC Sockets

## Parts List

U2	8 Pin DIP socket
U3	16 Pin DIP socket

- Insert the IC sockets at their designated locations on the board.
- When you insert the sockets notice that there is a small notch cut out of the top edge of each socket. This notch shows the orientation of the chips that we will insert later. Make sure that the notch of the socket matches with the marking on the PCB.
- To make sure that the sockets are sitting flat on the board, first solder a single pin. Then inspect your work. If the socket is not sitting flat on the PCB, as you can see in the third picture below, then reheat the solder joint while applying some pressure to the socket from the top with your finger. Be careful not to touch the end that you're heating! The socket should now move into place and you can solder the remaining pins.



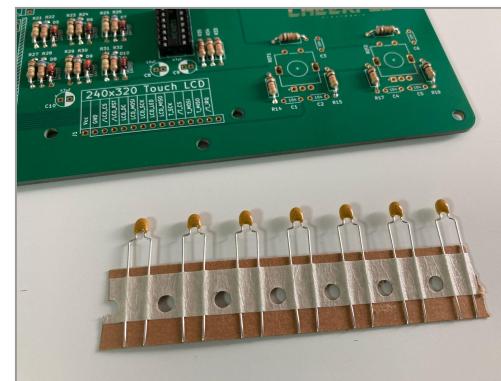
# 1.6. Ceramic Capacitors

## Parts List

C1, C2, C3, C4, C5, C6,  
C7

0.1 $\mu$ F Ceramic  
capacitor

- Insert the seven ceramic capacitors into the board at their marked locations. These capacitors are not polarized, so their orientation doesn't matter.
- If needed, slightly bend the leads to prevent them from falling out when you turn the board over.
- Now solder the capacitors. After soldering, trim the leads flush to the solder joints. Be sure to hold the leads as you trim them.

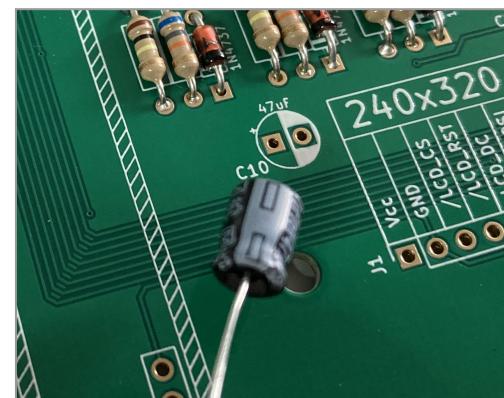
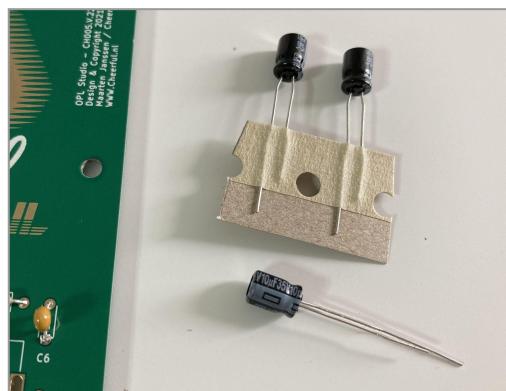


# 1.7. Electrolytic Capacitors

## Parts List

C8	10µF Electrolytic capacitor
C9, C10	47µF Electrolytic capacitor

- Next take the electrolytic capacitors and look for the white stripe that runs vertical over the capacitor's body. This stripe marks the lead on the negative side of the capacitor. The label will also show you the value of the capacitor. When inserting the capacitors make sure that you match the negative side with the filled half of the circular marking on the PCB.
- After inserting the capacitors you can bend their leads slightly if needed, solder them and trim their leads.



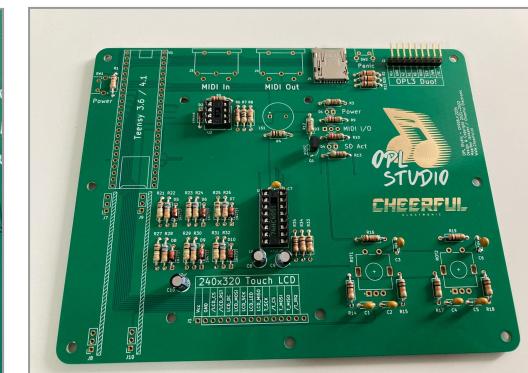
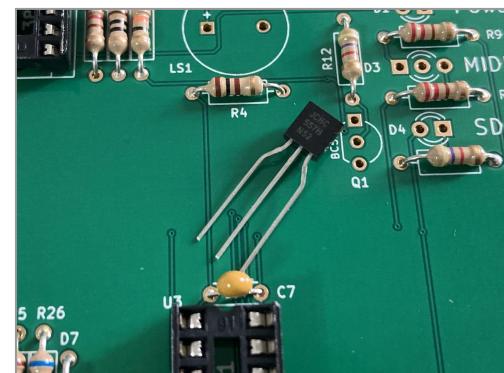
## 1.8. Transistor

### Parts List

Q1

BC557

- Take the transistor and insert it into the board.
- Make sure that the flat side of the transistor matches with the flat side marked on the PCB.
- You can bend the two outer leads of the transistor slightly to prevent it from falling out before you solder it.
- After soldering, trim the leads of the transistor and be careful to hold the lead while you trim it, otherwise the small cuttings will fly everywhere.



# 1.9. Push Buttons

## Parts List

SW1, SW2

Tactile push buttons

- Take the two push buttons and push them into the pads on the PCS.
- The switches should lock into place making it easy to solder them.



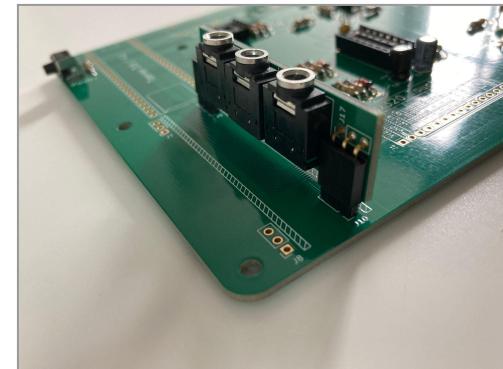
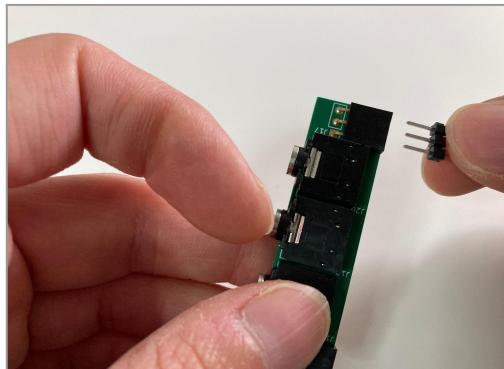
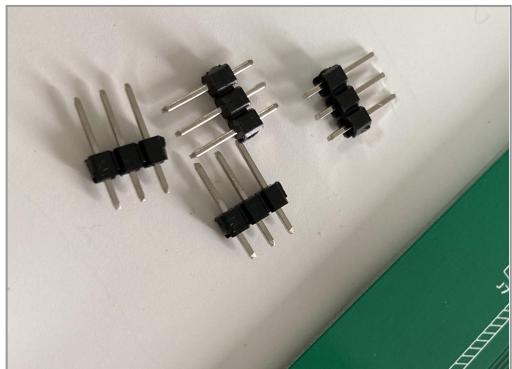
## 1.10. Plug-in Board Headers

### Parts List

J7, J8, J9, J10

3 Pin male headers

- Take two of the headers and insert the long ends into the sockets of one of the analog plugin boards that you assembled earlier.
- Now insert the short pins of the headers through the holes in the PCB. Using the same trick as before, solder one of the pins, then inspect your work to make sure the header is sitting flat on the board. If not then reheat the pin and gently move the plugin until the header is positioned correctly. Solder the remaining pins of the first header and repeat for the second one.
- Remove the plugin board and repeat with the second set of headers.



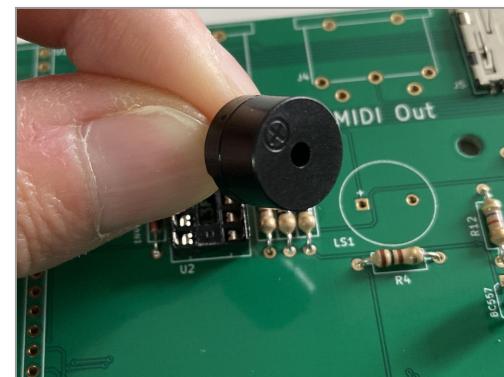
## 1.11. Buzzer

### Parts List

LS1

Piezo Buzzer

- Take the piezo buzzer and notice the little '+' mark on the top. The pin with the + sign must be inserted in the hole with the + marking on the PCB.
- Solder the buzzer and trim the pins.

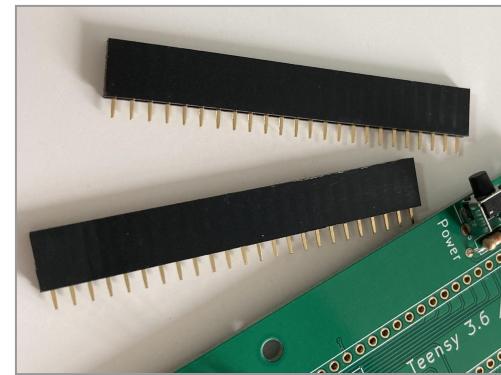


## 1.12. Teensy Socket

### Parts List

U1	2x 24 Pin female header
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- Take the two 24 pin headers and insert the first one into its footprint. Solder the first pin and if necessary reheat the pin and move the header until it sits perfectly upright on the board.
- These headers are quite long, so to prevent them from sitting at a vertical angle we will now solder the pin at the opposite end. Make sure that the header sits flush onto the board.
- Now solder the remaining pins and repeat for the second header.

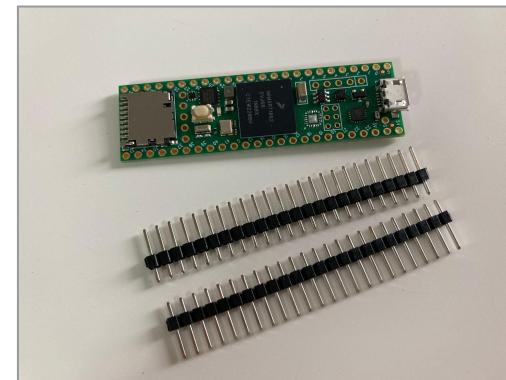


## 1.13. Teensy

### Parts List

	2x 24 Pin male pin headers
U1	Teensy 4.1

- If you are using your own Teensy for OPL Studio then you can skip this step.
- Insert the long ends of the 24 pin male headers into the sockets that you just installed for the Teensy.
- Take the Teensy board and push it onto the headers. Solder the headers to the teensy. After soldering the pins you can remove the Teensy from the socket for now, we will install it later.



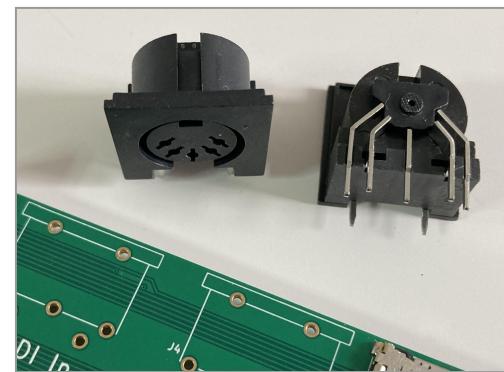
## 1.14. MIDI Connectors

### Parts List

J3, J4

5 Pin DIN connector

- Insert the two DIN connectors into the board. This will be a tight fit, but make sure the connectors are pushed all the way in before soldering them.

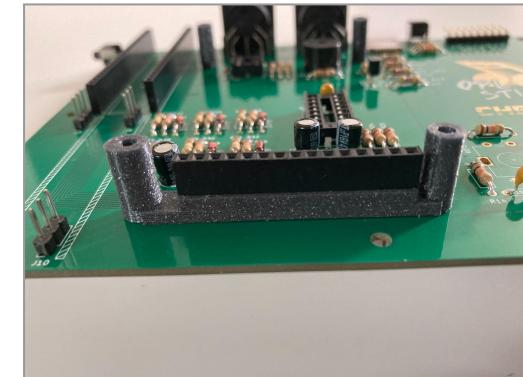
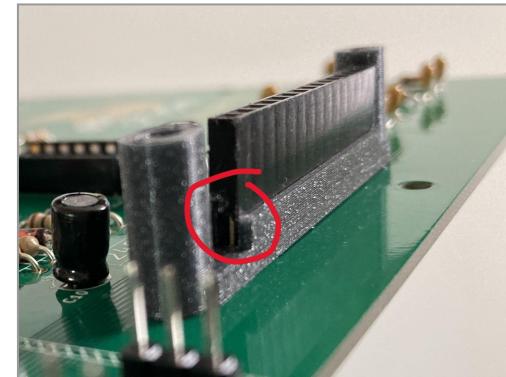


## 1.15. LCD Connector

### Parts List

J1	15 Pin female connector with long pins
LCD pin header mount	
2x 13 mm Spacer	
4x M3x5mm screw	

- First examine the 3D printed parts. There may be some support material left that you can carefully scrape or cut away with a hobby knife. Test fit the pin header by inserting it into the mount to make sure all the holes for the pins are open.
- Put the LCD mount on the board and notice the orientation in the pictures. Screw it down from the bottom side. Be careful not to overtighten the screws as this may damage the part.
- Now take the two spacers and screw them from the bottom into the two holes located under the MIDI in and out connectors. Do not overtighten the screws.
- Take the 15 pin header and push it into the mount. The pin header must be pushed **all the way into** the mount so it sits flat onto the mount between the two lips. This might be a tight fit. Before soldering you can test fit the LCD to make sure it rests flat onto the four screw posts. Solder the header and trim the pins.

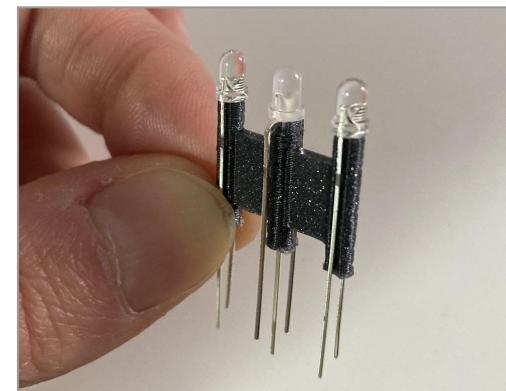


## 1.16. Status LEDs

### Parts List

D1, D4	LED, green, 3mm
D3	LED, bicolor 3mm
LED mount	

- Examine the LED mount. There may be some left over support material from 3D printing that you can cut away with a hobby knife.
- Insert the LEDs into the mount. The two green leds go on the top and bottom of the mount with their pins resting in the grooves on the side of the part. The short pins of the LEDs must be facing **right**. The 3 pin bicolor led goes in the middle. The middle pin will stick through the hole in the center of the mount and the shortest lead of the LED must be facing **left**.
- Insert the LED assembly into the PCB and make sure that the short pins of the green LEDs are inserted into the holes with the square pads on the board. Carefully solder the LED assembly and make sure the mount sits flat on the board and all LEDs are resting on it to make their tops line up. Use the same trick as before where you solder one pin first and align the part before soldering the remaining pins.



## 1.17. Rotary Encoders

### Parts List

ROT1, ROT2

Rotary encoders

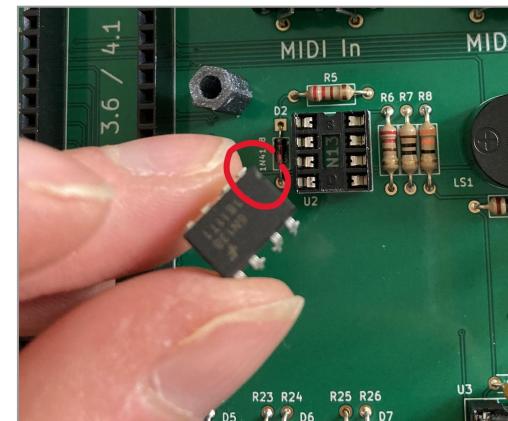
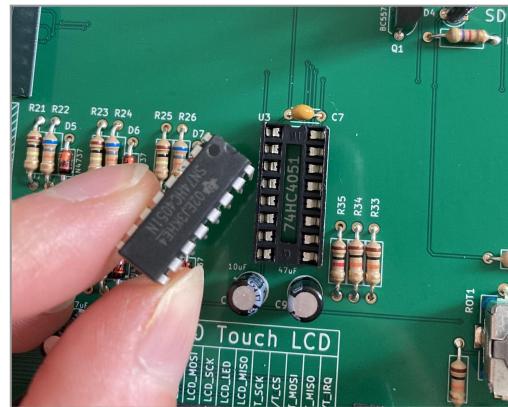
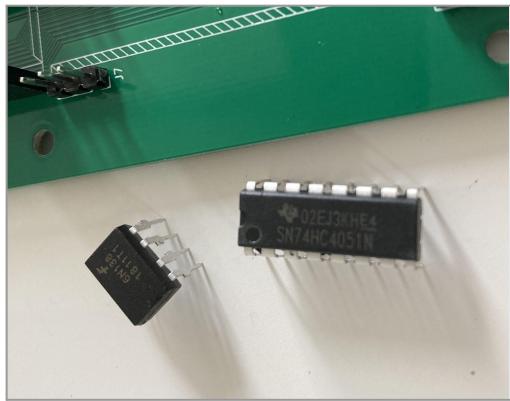
- Insert the two rotary encoders ROT1 and ROT2 and solder them in place.



## 1.18. ICs

Parts List	
U2	6N138
U3	74HC4051

- Insert the two ICs into their sockets. Make sure that the side with the notch in the body of the IC matches with the notch in the socket. If your chip does not have a notch but a dot, then the side with the dot must match the side with the notch in the socket.
  - For the 8-pin chip U2 the notch may be less noticeable as it may be very tiny! If it looks like the package is damaged on one of its short edges, then that's the notch you're looking for.



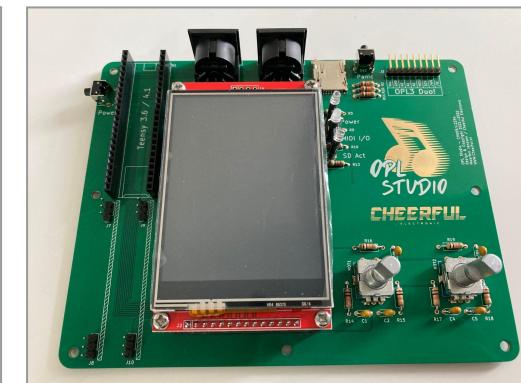
# 1.19. LCD Screen

## Parts List

240x320 LCD touch screen

4x M3x5mm screw

- Plug the LCD screen into the pin header. The right most pin of the LCD header is not used. Secure it in place with four screws, but don't tighten the screws too much as it may damage the 3D printed parts.



## 1.20. Enclosure I

### Parts List

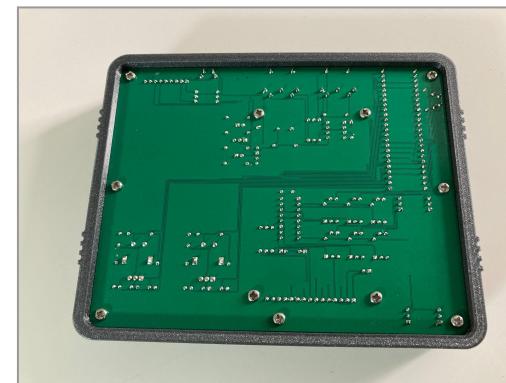
Enclosure

7x x M3x5mm screw

Teensy

2x Plug-in boards

- Take the 3D printed enclosure. There may still be some support material left on the bottom edge and some of the screw posts that you can remove with some pliers and a hobby knife.
- Insert the PCB. The best way to do this is by starting with the power button on the side and rotating the PCB into the enclosure toward the pin header for the OPL3 Duo.
- Secure the PCB in the enclosure with 7 screws from the bottom.
- Insert the Teensy and the two plugin boards. The PCBs of the plugins should be on the side with the marked line on the OPL Studio PCB.



## 1.21. Enclosure II

### Parts List

Front panel

7x x M3x5mm round head screw

- Align the front panel, push it into the enclosure. This will be a tight fit! A good way to do this is to start with one edge of the front panel, push it all the way to the edge of the enclosure and push it down. You may need to maneuver the plugin boards a little to make the sockets stick through the holes in the front panel. Secure the front panel with the 7 remaining screws.
- Remove the protective film from the LCD screen



## 1.22. Enclosure III

### Parts List

2x Rotary encoder knobs

2x Push button caps

LCD bezel

- Take the knobs for the rotary encoders and the push button caps and push them onto the stems. Don't push them down too far, you should still be able to make the encoders click if you press the knobs.
- Push the two button caps onto the stems of the power and panic buttons.
- To finish the build take the 3D printed LCD bezel and push it around the LCD screen. There is an opening in the ridge that goes around the screen that should face toward the bottom.

**Done!**

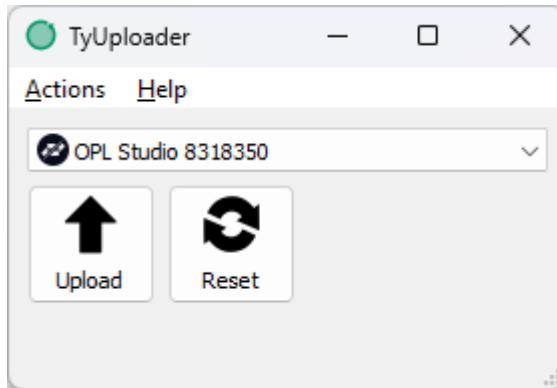


## 2. Installing the Software

If you are using your own Teensy then you need to install the OPL Studio software onto it. If your kit came with a Teensy then it will already have the latest software installed. The latest version of the OPL Studio software can be downloaded from <http://www.cheerful.nl/oplstudio>.

The zip that contains the software also contains the TyUploader program that is used to upload the OPL Studio software to the Teensy. When you open TyUploader and you have your OPL Studio connected you should see your Teensy in the drop down list. Click the Upload button and select the .hex file that is appropriate for your Teensy: the '\_T36' file for a Teensy 3.6 or the '\_T41' file for a Teensy 4.1. After selecting the file that upload will begin,

During software update the power LED of OPL Studio will faintly glow. After updating the software, OPL Studio will reboot. The new software version will be shown in the bottom left corner of the boot screen or you can find it in the about screen in the OPL Studio settings. If this is the first time the OPL Studio software is installed on your Teensy then OPL Studio will boot into the pointer calibration, otherwise it will boot directly to the home screen. You may want to do a factory reset on OPL Studio in case you used your Teensy for another project before.



The OPL Studio manual contains more info on how to update the software from other platforms such as Linux or Mac OS and what to do in case an update fails and you need to recover the Teensy.

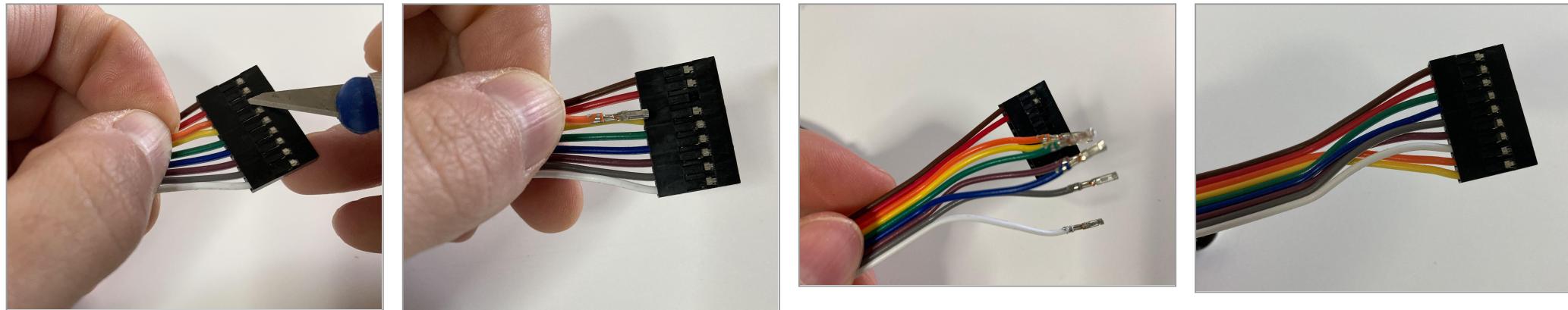
### 3. OPL2 Audio Board Crossover Cable

If you're using OPL Studio with an OPL2 Audio Board instead of an OPL3 Duo! then you need to swap some of the pins in the connector that connects to the OPL2 board. This section will show you how you can make a crossover cable that allows you to use the OPL2 Audio Board.

The pin mapping that we need to make is the following:

1	2	3	4	5	6	7	8	9
VCC	GND	A2	A1	A0	MOSI	SCK	/WR	/IC
VCC	GND	-	-	A0	DATA	SHIFT	LATCH	RESET

On the end of the ribbon cable that you are going to connect to the OPL2 Audio Board remove pins 3 through 9 from the connector. To remove a wire from the connector, carefully lift the little lip that holds the metal connector at the end of the wire. The lip only needs to be bent up a little to loosen the wire so you can pull it out. Now we will re-insert the wires into the connector in the order as shown in the table below. Push the connectors all the way into the socket so they latch behind each of the lips with a click. The wires should not come out when you gently pull on them.



Wire Number	Connector Pin
3 (A2)	8 (No longer used)
4 (A1)	9 (No longer used)
5 (A0)	3 (A0)
6 (MOSI)	4 (DATA)
7 (SCK)	6 (SHIFT)
8 (/WR)	5 (LATCH)
9 (/IC)	7 (RESET)

In order to use an OPL2 Audio Board you must also change the OPL Type to 'Single OPL2' in OPL Studio settings. See the 'Settings' section of the OPL Studio manual for more info.

