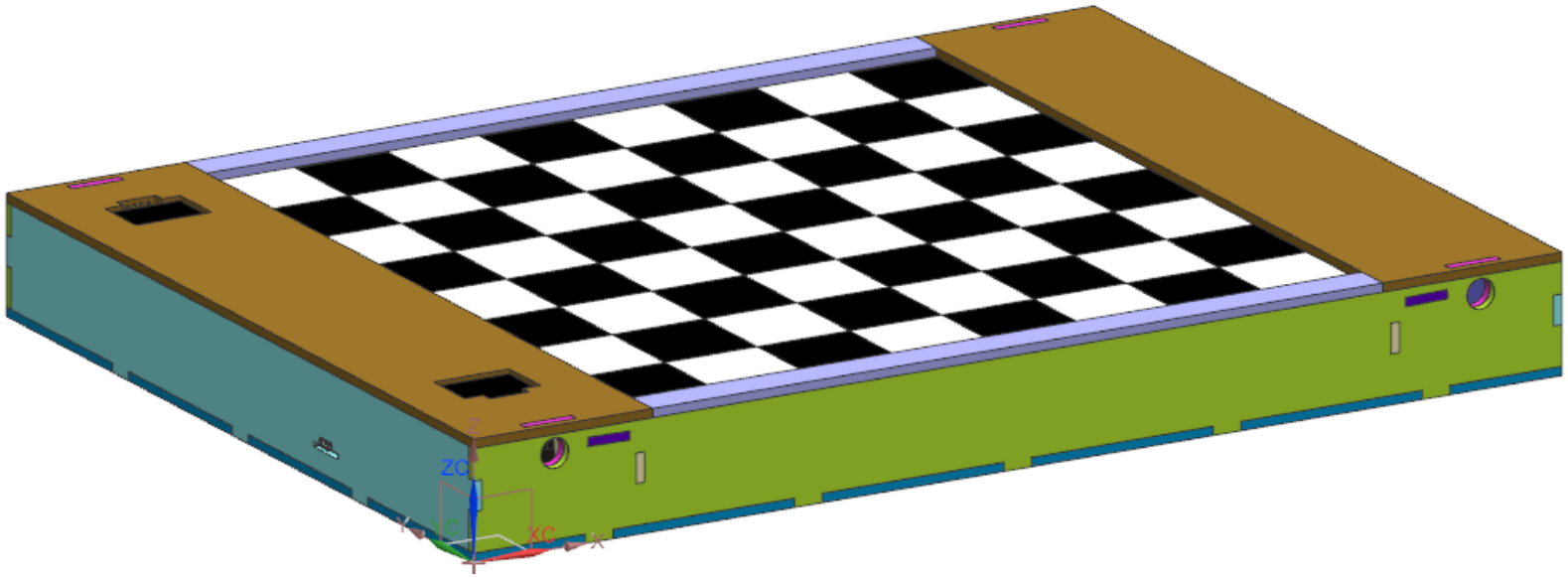
ESP Chess

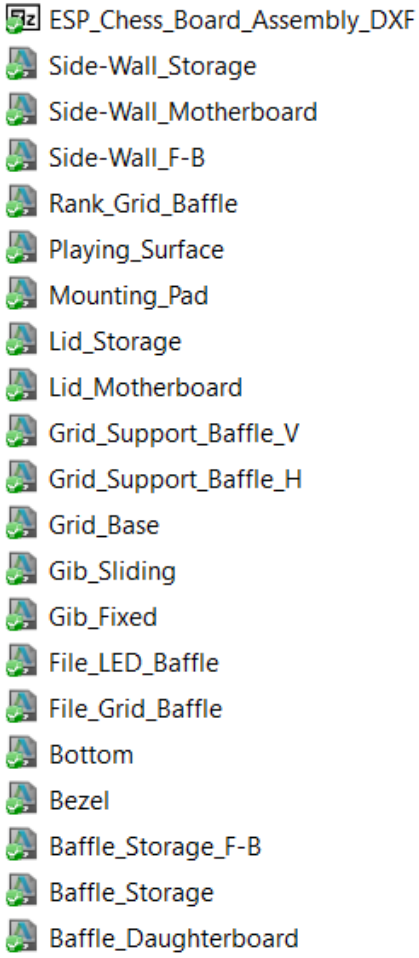


Program
https://github.com/scottyob/esp-chess

Board design
https://github.com/Tayherb/ESP-Chess-Board

Contents of
ESP_Chess_Board_Assembly_DXF.zip

These file names are referenced
throughout the document



Design philosophy; avoid the need for elaborate or expensive manufacturing processes to make and assemble the board enclosure.

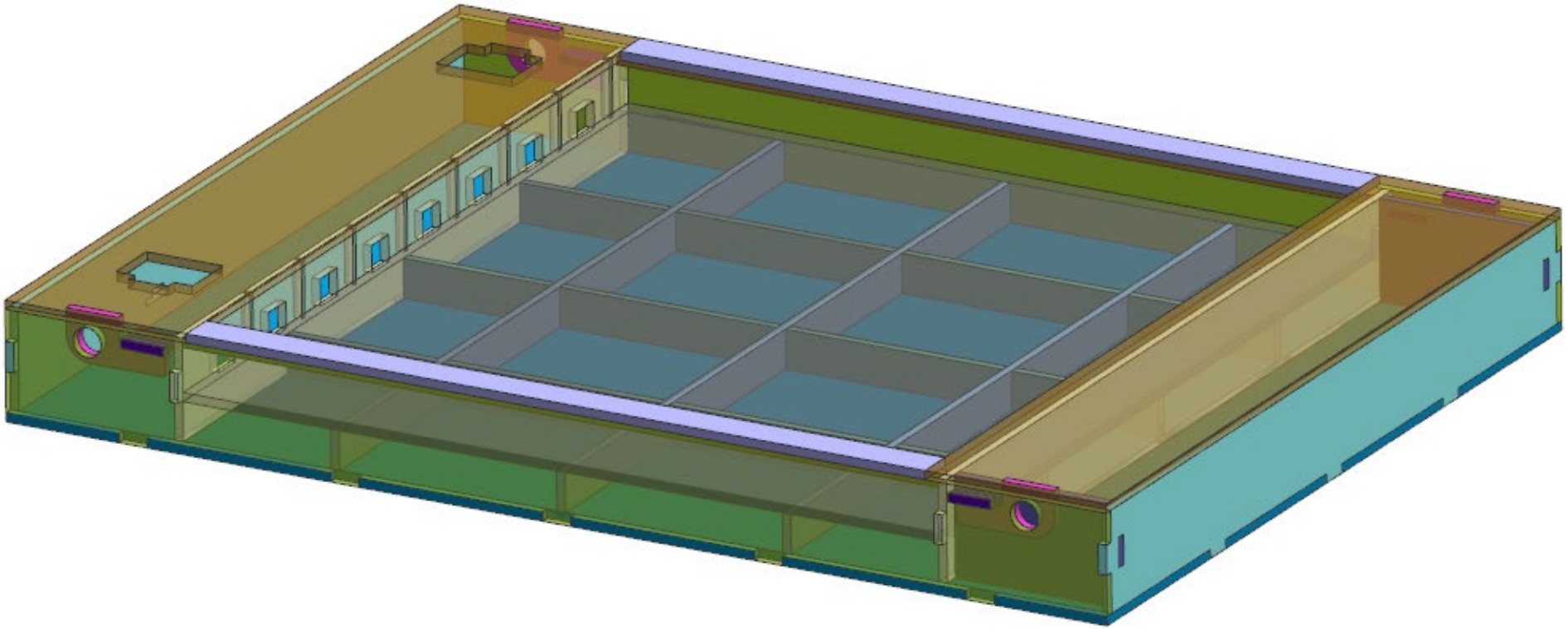
All the enclosure components are 3mm thick (wood or acrylic with one exception) and can be made by hand with utility knives, saws, drills, etc. as desired. (perhaps with some generous tuning using files or sandpaper.)

The exception is the playing surface. This must be translucent acrylic to allow illumination of the squares from the LED source below. (20% sign white recommended)

The DXF files can be printed 1:1 to use as layout templates or imported for machine cutting.

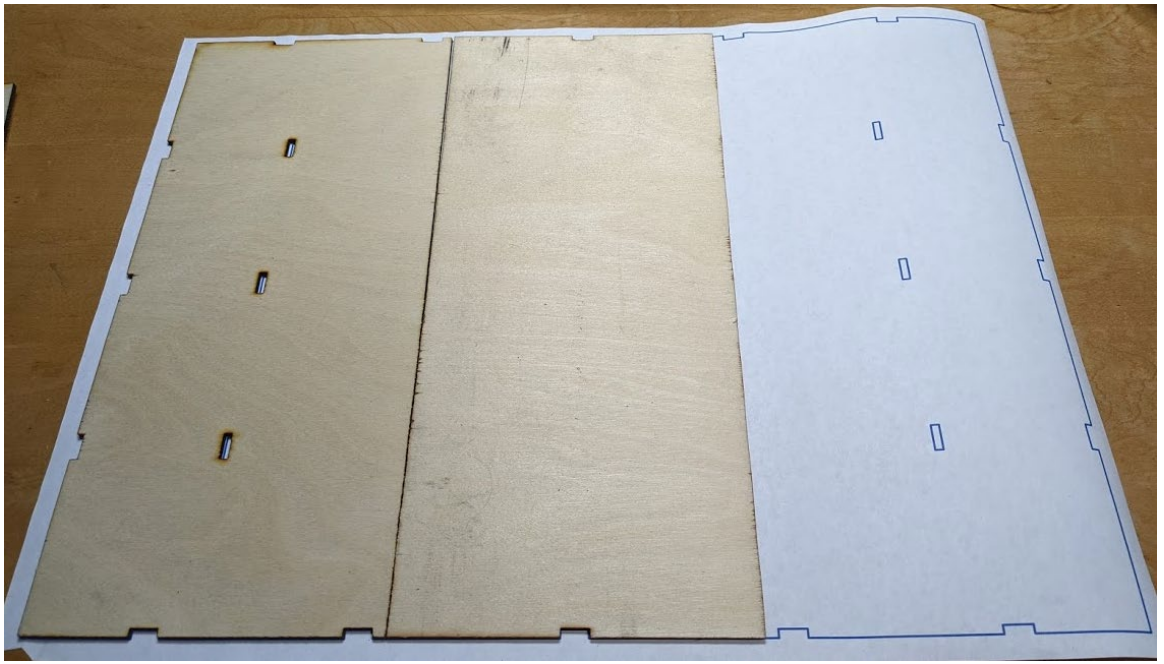
The build process for the first board

Assembling the board enclosure

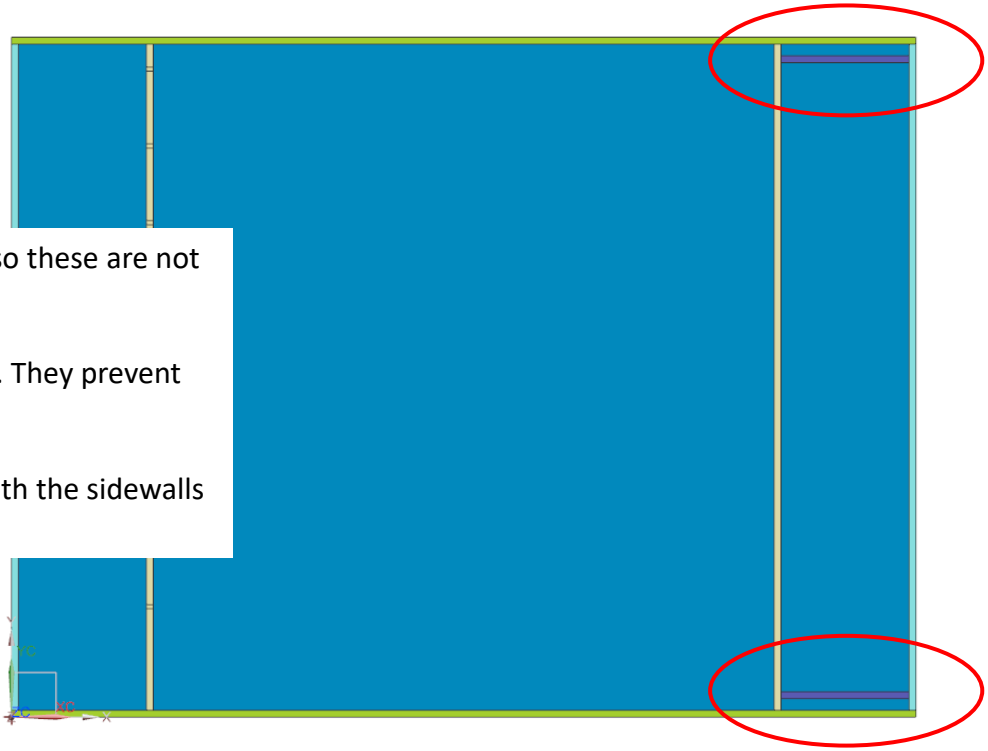


Part
Bottom.dxf

The laser bed size available for this build required making the larger pieces in multiple cuts. I printed a 1:1 of the bottom as a visual aid as this first build is also design validation.



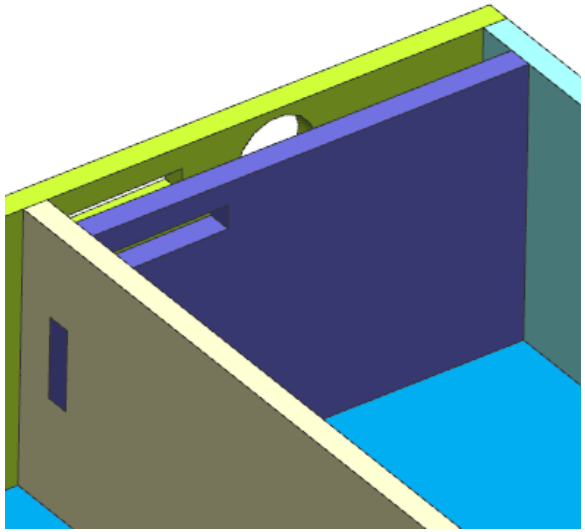
Notes concerning design addition:
Baffle_Storage_F-B.dxf



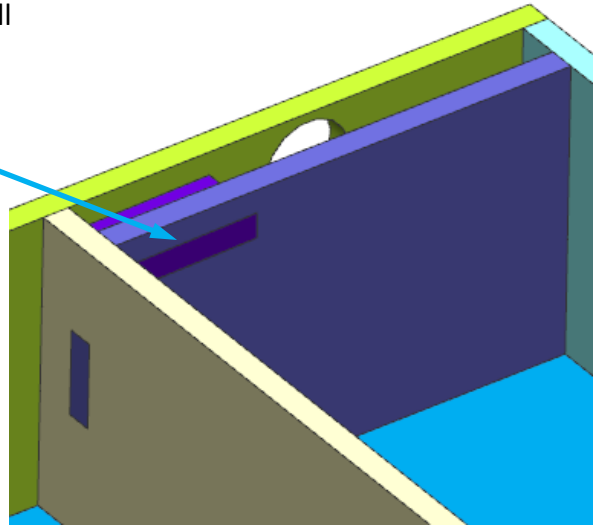
*Note; This page shows a design change I made after my build, so these are not present in my build pictures.

The design has two small baffles added in the storage enclosure. They prevent game pieces in storage from interfering with the lid.

If you include these in your build they must be installed along with the sidewalls and baffles on the next page.



Note; Gib_Fixed.dxf (added later) will fit into these storage baffles.



Parts attached to the bottom in this step;

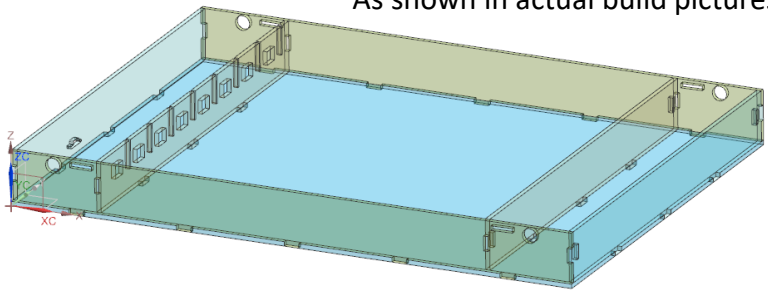
Baffle_Storage.dxf
*Baffle_Storage_F-B.dxf
Baffle_Daughterboard.dxf
Side-Wall_F-B.dxf
Side-Wall_Motherboard.dxf
Side-Wall_Storage.dxf

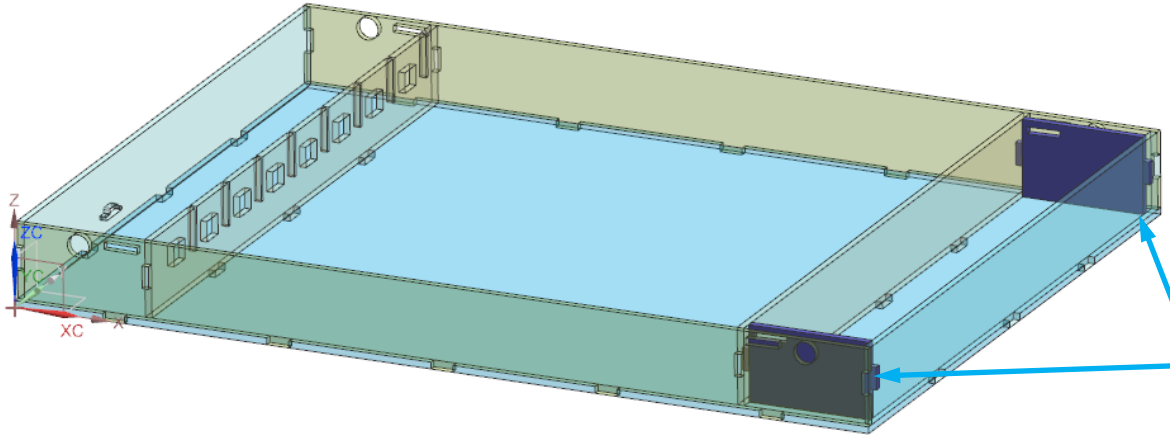
*Not shown in top right build picture.

Set the side walls, side enclosure baffles, and F-B baffles in place for assembly with a glue gun. Tape can be used to hold pieces in place until glued.

! Ensure your glue locations will not interfere with the grid support baffles to be added in the next step.
(see next page)

As shown in actual build pictures





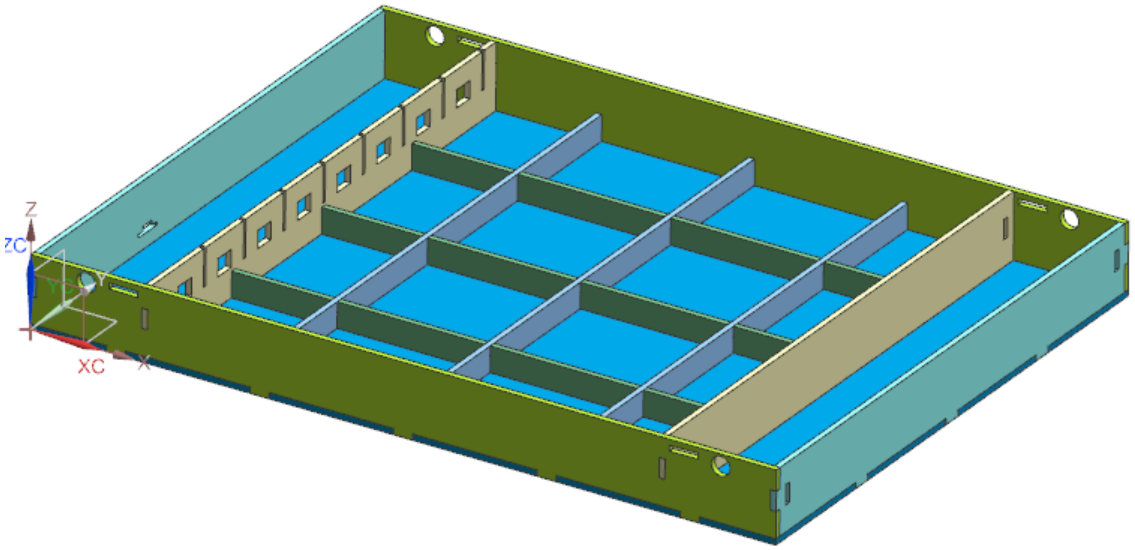
Shown with the Baffle_Storage_F-B described on the previous page. Ensure these are installed when gluing the side-walls and baffles. They cannot be added later.

Choosing glue locations

Quick and easy to fix with a belt sander. Still better to avoid the interference in the first place.

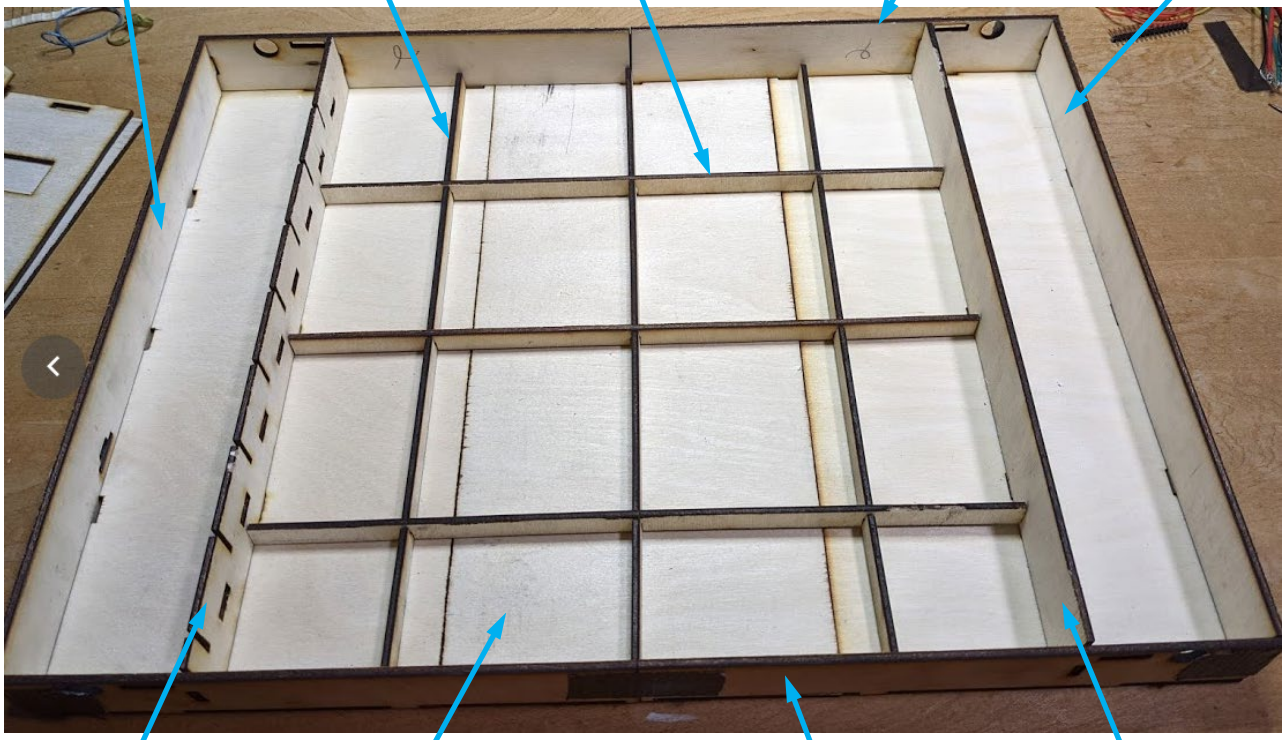
Parts added in this step;

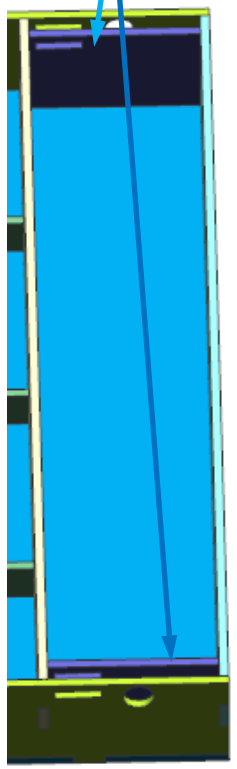
Grid_Support_Baffle_H.dxf
Grid_Support_Baffle_V.dxf



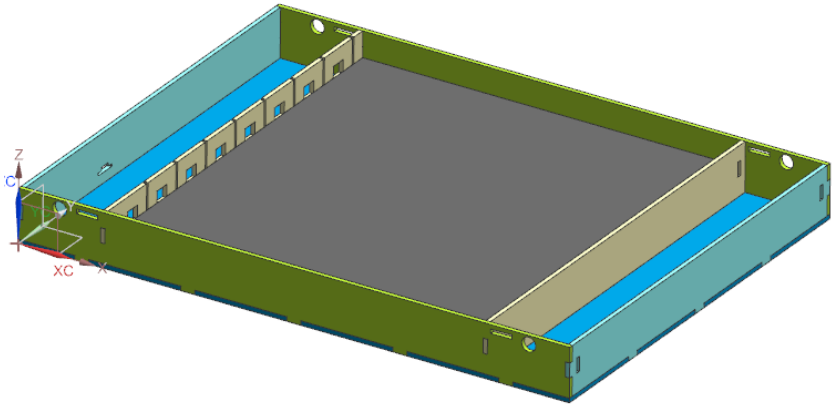
Set the grid support baffles in place and glue.

Enclosure assembly summary





Part added in this step:
Grid_Base.dxf

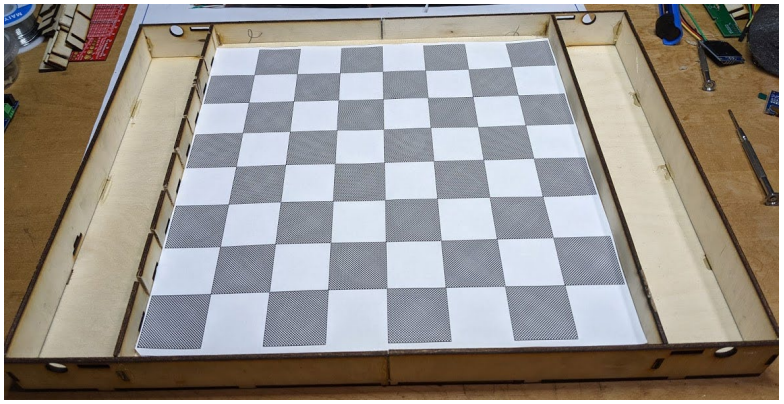


Set the grid base in place. This is the surface on which the NeoPixel strips are mounted.

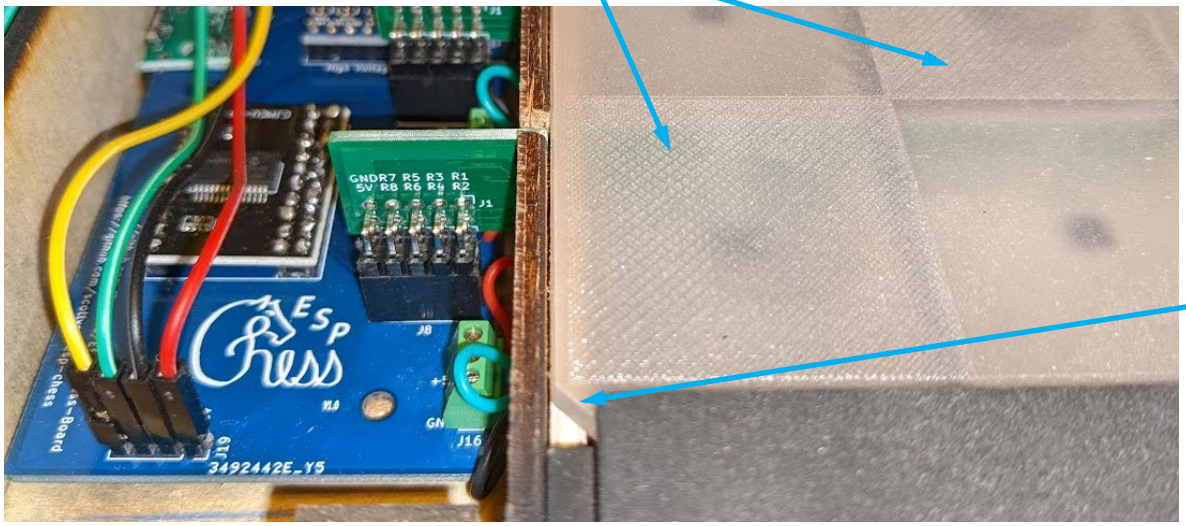
! Ensure your glue locations will not interfere with the baffles that comprise the actual board grid to be added later.

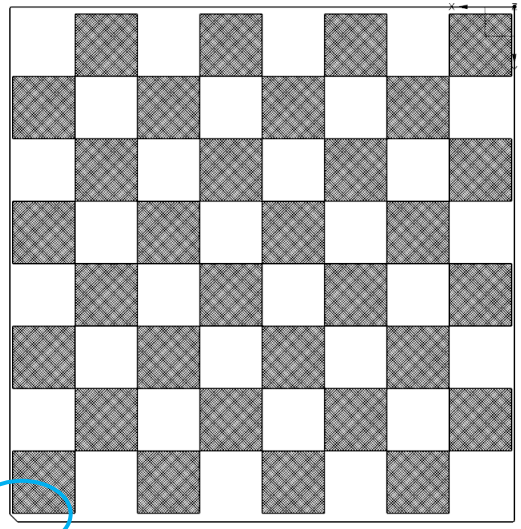
Optional; I added a printed board grid for visual contrast through the translucent playing surface to the black/white squares.

File Playing_Surface.dxf contains cross-hatching as shown and can be printed 1:1 scale to make this sheet.



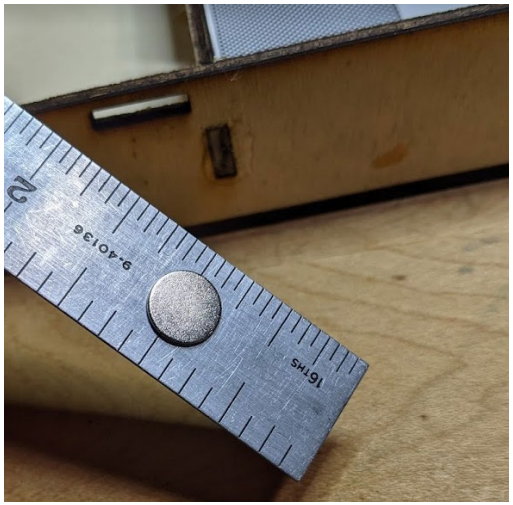
The cross hatching can also be used to etch a texture on the playing surface if a laser is available.





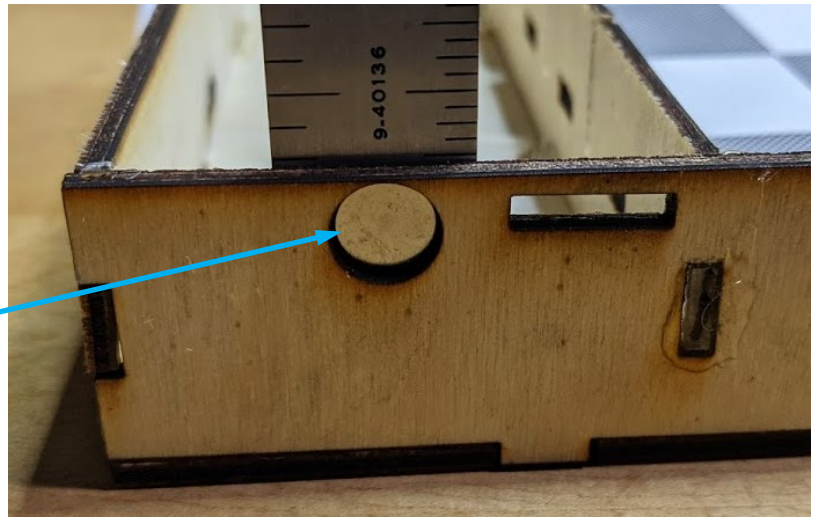
When the playing surface is set in place ensure the corner chamfer is adjacent to the logo on the motherboard

Parts added in this step:
Ø10mm x 1 magnets in the front and back walls. (4 required)

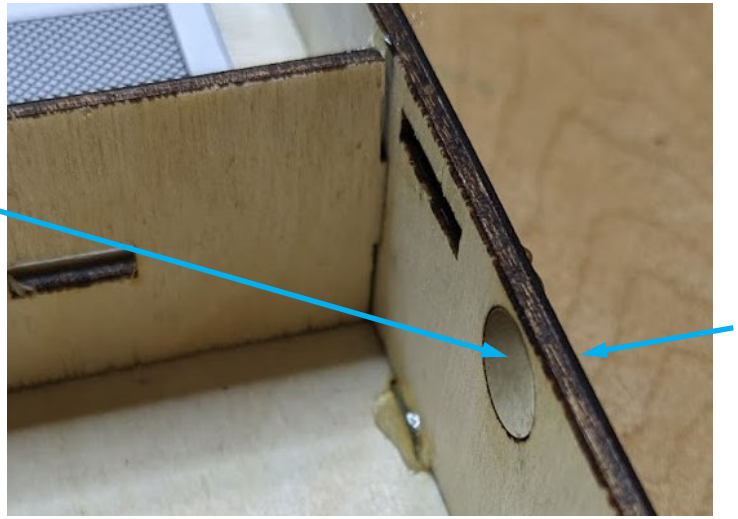


The magnets should be mounted flush with the inside surface of the front and back walls.

A flat piece of steel is a convenient way to hold the magnet in place & flush while applying glue to the outside.



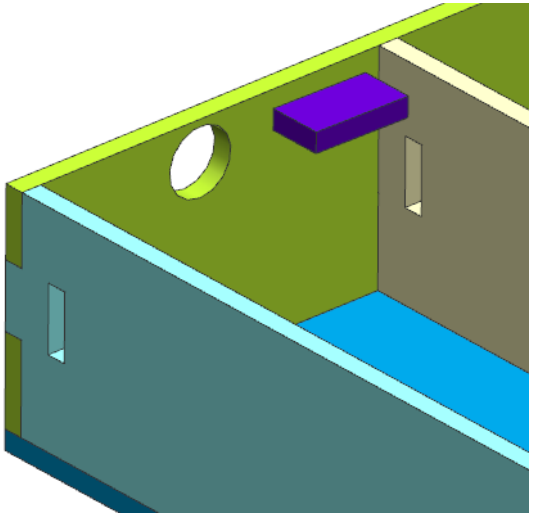
Inside flush



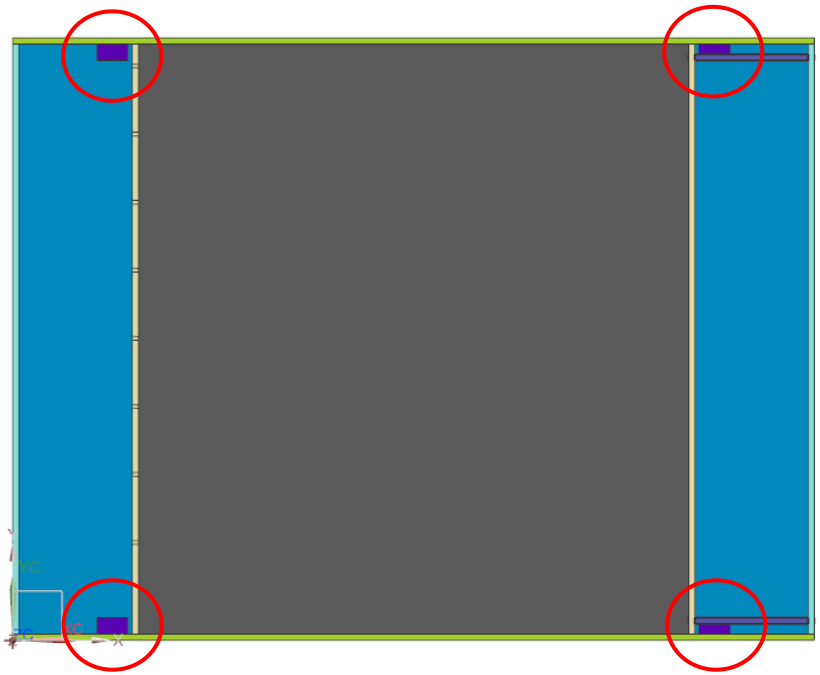
Glue outside

Parts added in this step:
Gib_Fixed.dxf

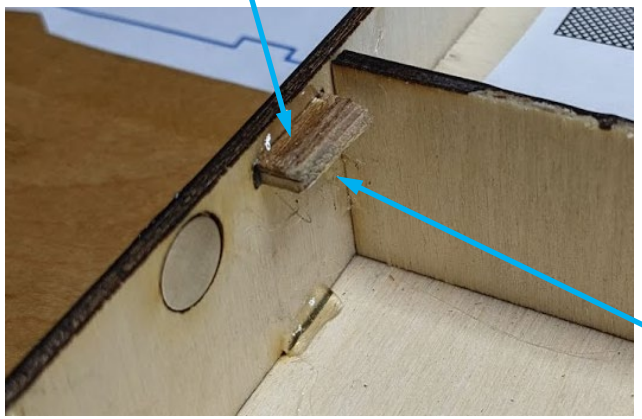
Installed in four locations; two in each side enclosure



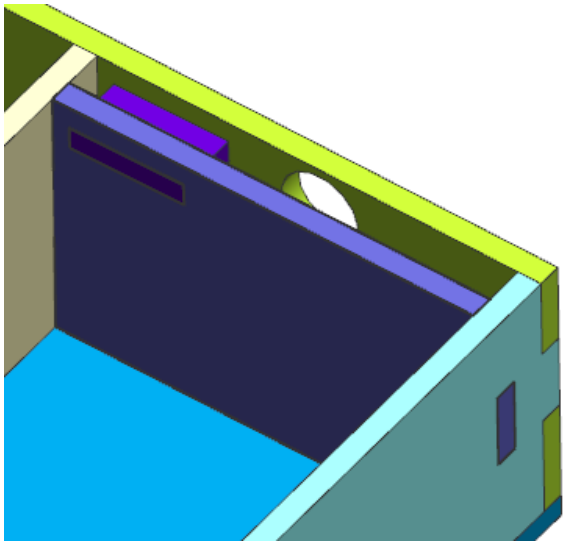
These work with Gib_Sliding attached to the lids. Together with the bezels these hold the playing surface in place in the final assembly. (see following two pages)



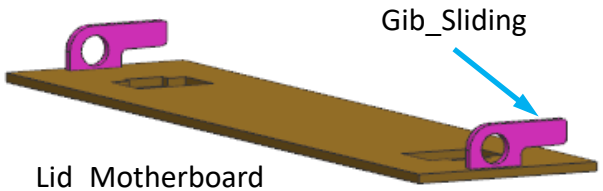
Glue on the top or outside.

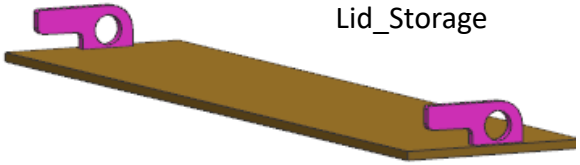


! Do not glue on the bottom side as this will interfere with lid function

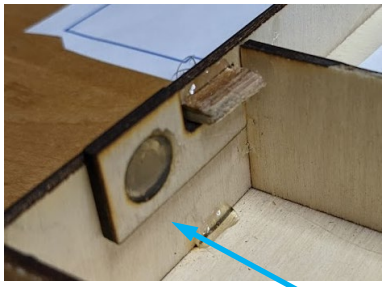


Parts added in this step:
Gib_Sliding.dxf (4 pieces required)
Lid_Motherboard.dxf
Lid_Storage.dxf
Ø10mm x 1mm magnets (4 pieces)

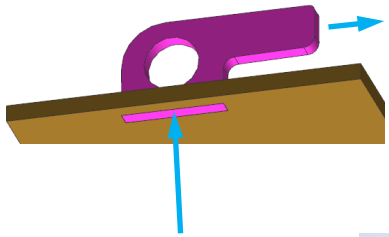




1. The magnets are already glued to the front & back side walls. Check the magnet polarity before gluing them in Gib_Sliding.
2. Flat steel is convenient for holding the magnets while gluing to ensure they are flush on the side of the gib closer to the front & back sidewall magnets
3. Double check that the magnets are oriented correctly and that each Gib_Sliding faces the correct direction.
4. Glue Gib_Sliding to Lid_Motherboard and Lid_Storage.

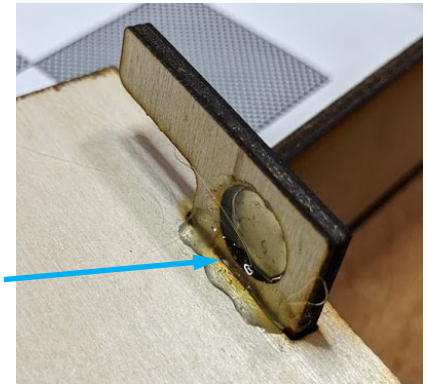


Checking magnet polarity and correct orientation of all four Gib_Sliding with front & back sidewall.

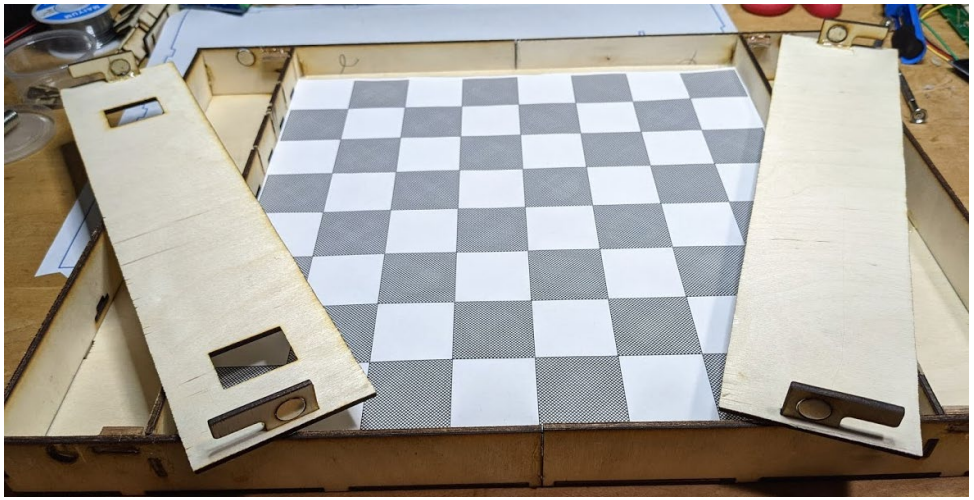


All four Gib_Sliding pieces should point towards the playing surface

Glue Gib_Sliding flush with the top of the lids

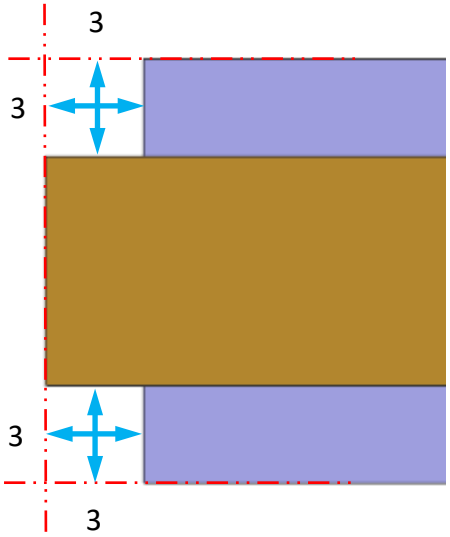


! Ensure glue is on the inside of all four Gib_Sliding pieces. Glue on the outside will interfere with lid seating.



Parts added in this step:
Bezel.dxf
2 required

1. The bezels trap the playing surface and together with the lids provide an overlap to hold the playing surface in place along all four edges.
2. The purpose for this is to have a uniform appearance around the playing surface while providing quick access to the board electronics with the 3mm thick build philosophy.



Glue the upper and lower bezel rails as shown. Ensure the over-hang is a uniform 3mm on each side

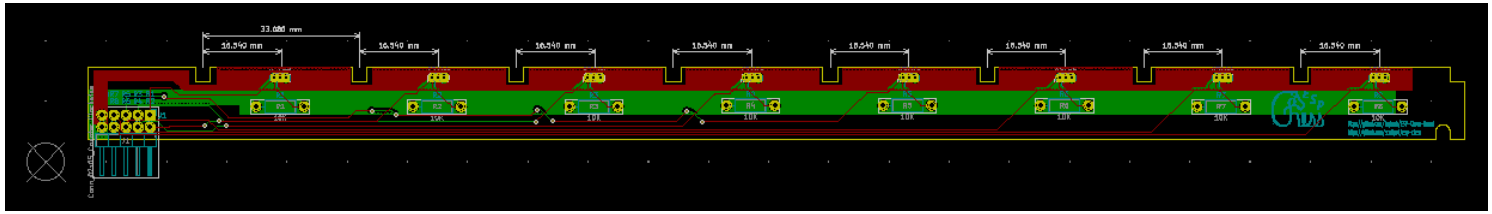
File Bezel.dxf includes an optional guide piece to help with aligning the top and bottom plates for gluing. This is not part of the final assembly.

Assembling the PCBs

PCBs are designed in KiCad.
https://www.kicad.org/

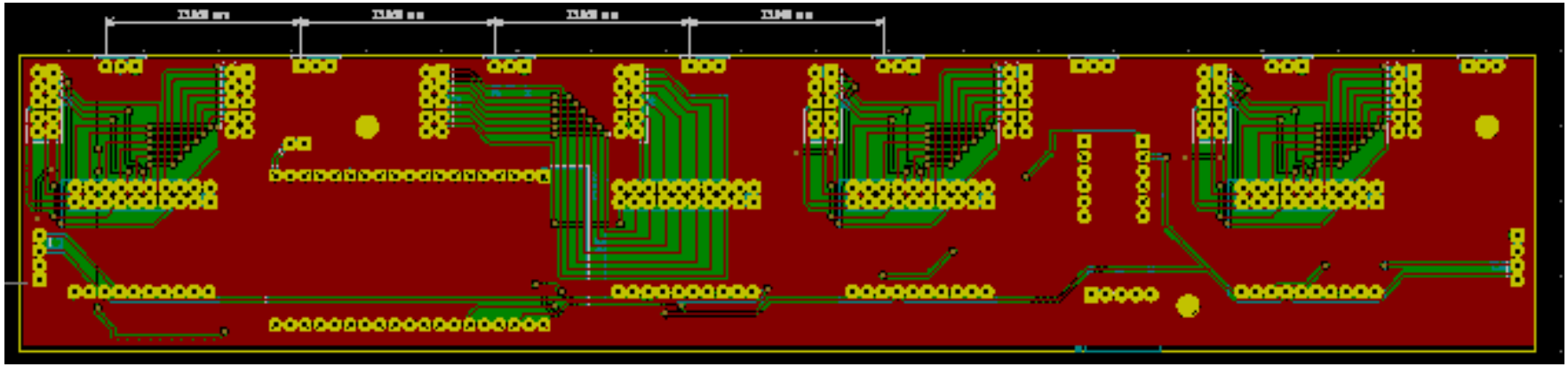
Column_daughterboard (8 required)

See file:
column_daughterboard _KiCad.zip (KiCad design)
Includes folder containing gerber files for PCB manufacturer

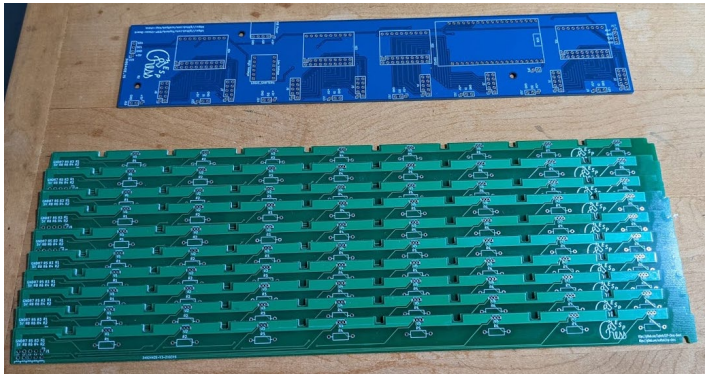


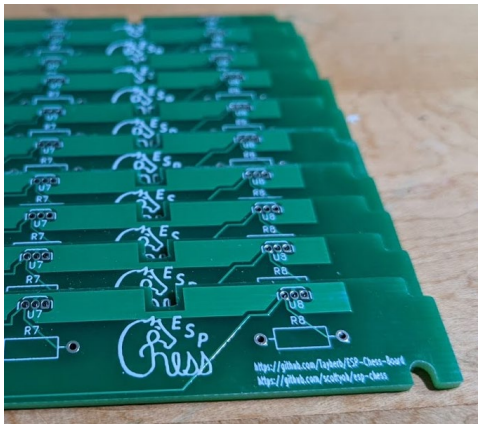
Motherboard

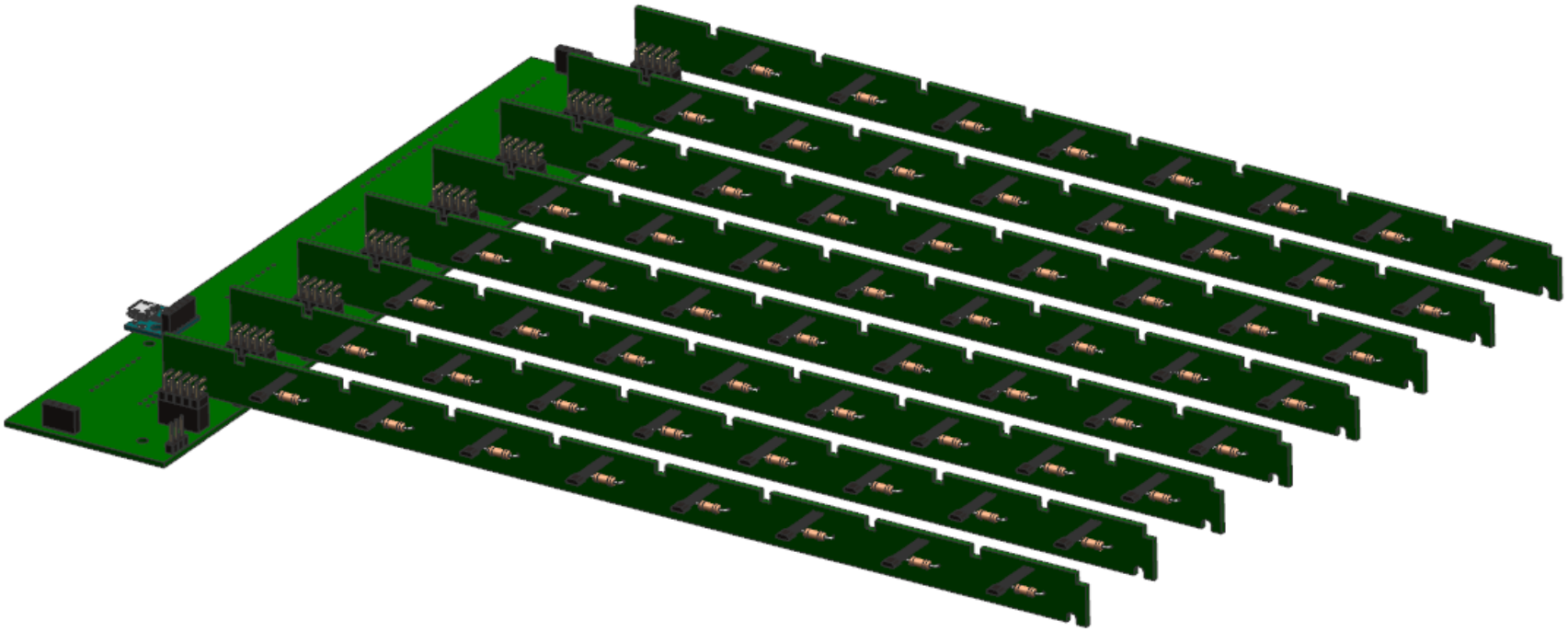
See file:
motherboard_KiCad.zip (KiCad design)
Includes folder containing gerber files for PCB manufacturer



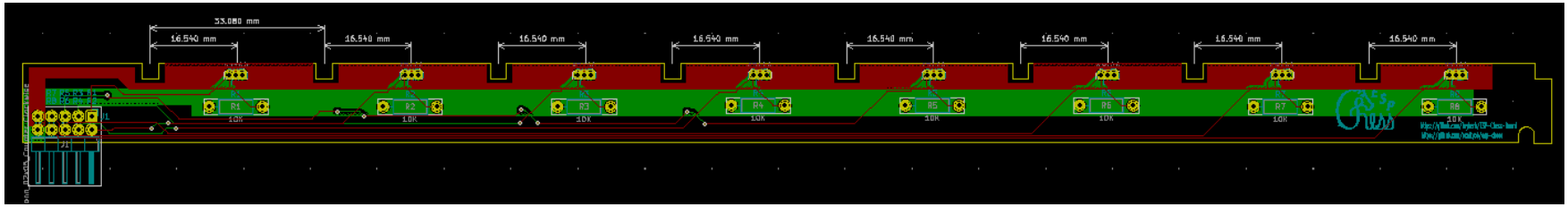

https://github.com/Tayherb/ESP-Chess-Board
https://github.com/scottyob/esp-chess
+5V
J15
ESP
Chess
J8
+5V
GND
J16
V1.0
SDA
SCL
GND
+5V
J19
3492442E_Y5

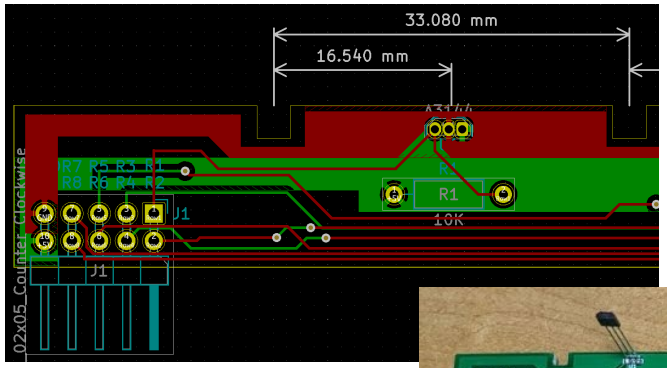



ESP
Chess



Daughterboard Assembly

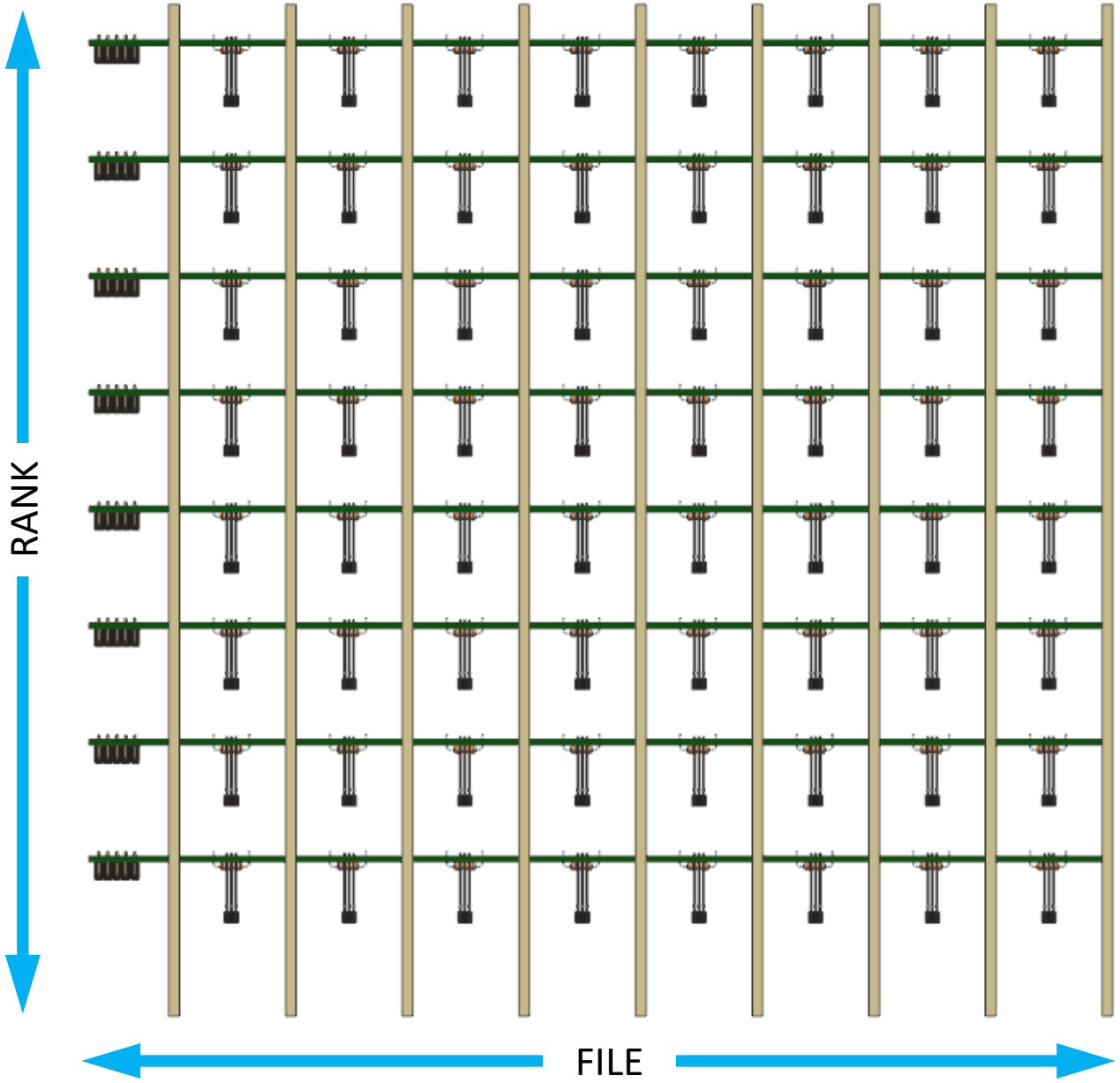




These boards are designed to function as the horizontal (rank) square dividers.

Rank dividers are made by the daughterboard PCBs

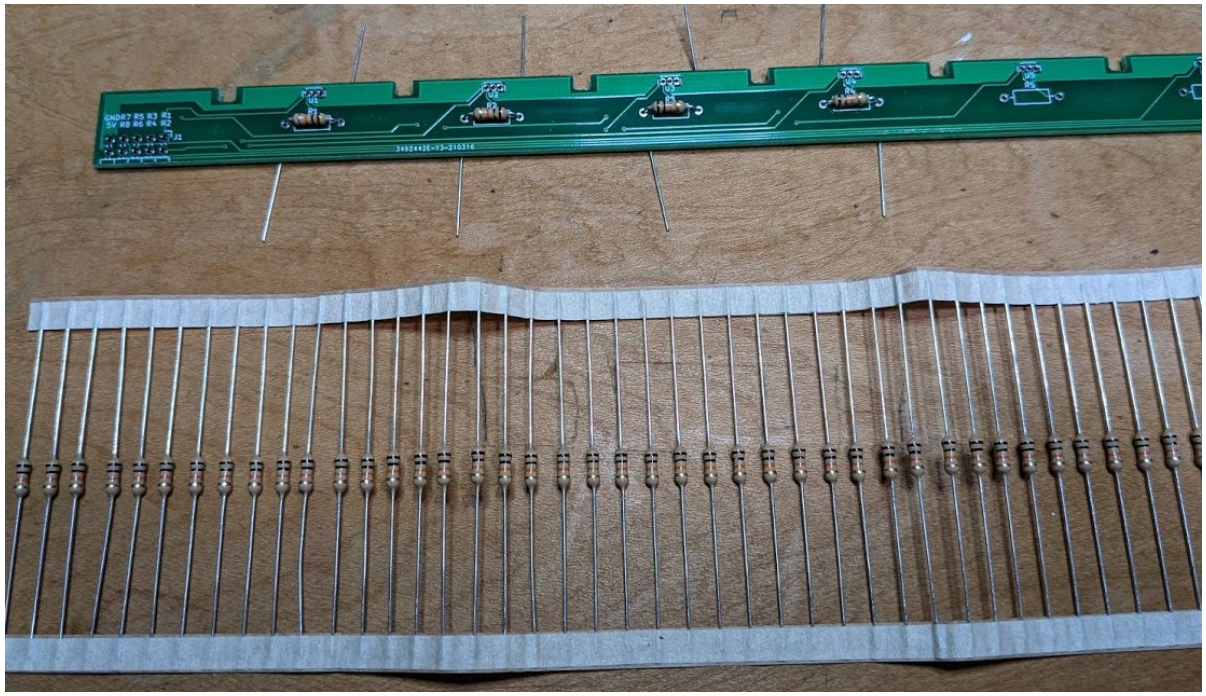
- ESP_Chess_Board_Assembly_DXF
- Side-Wall_Storage
- Side-Wall_Motherboard
- Side-Wall_F-B
- Rank_Grid_Baffle
- Playing_Surface
- Mounting_Pad
- Lid_Storage
- Lid_Motherboard
- Grid_Support_Baffle_V
- Grid_Support_Baffle_H
- Grid_Base
- Gib_Sliding
- Gib_Fixed
- File_LED_Baffle
- File_Grid_Baffle
- Bottom
- Bezel
- Baffle_Storage_F-B
- Baffle_Storage
- Baffle_Daughterboard

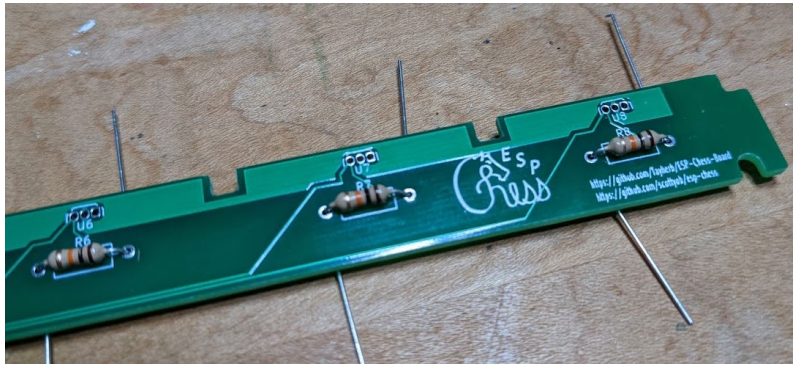


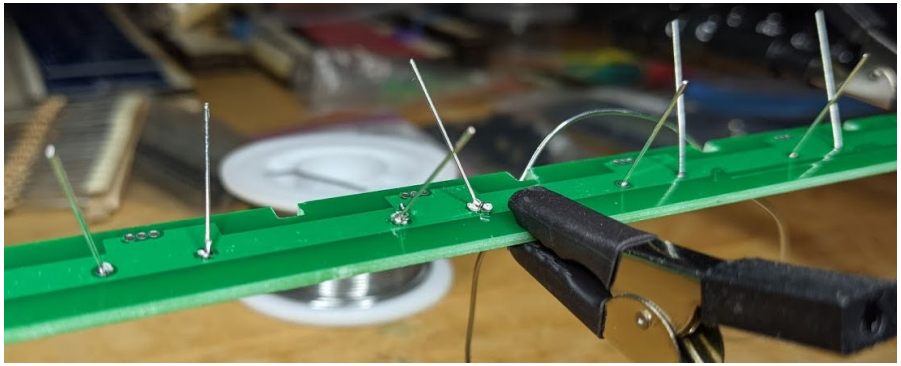
File dividers are made with the board enclosure material. (wood, acrylic, etc)

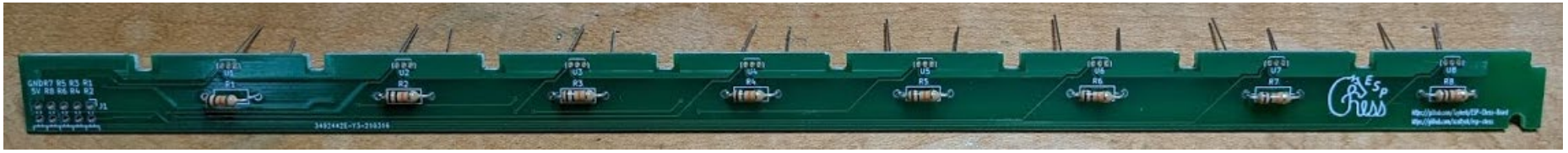
Daughterboard Assembly

Solder the resistors to the daughterboards
8 daughterboards
8 resistors per board
64 resistors
2 solder points per resistor
128 solder points







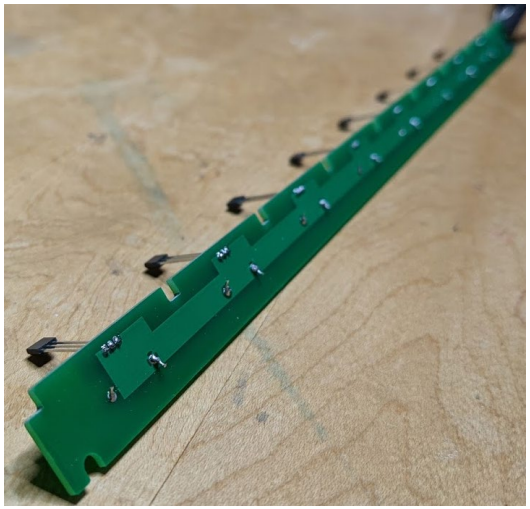


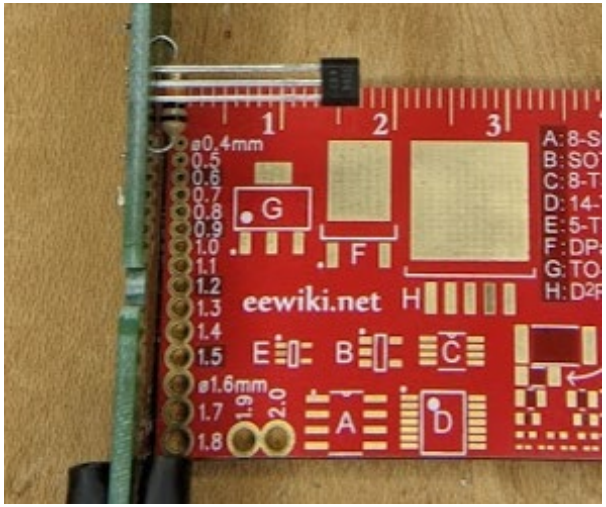
Daughterboard Assembly

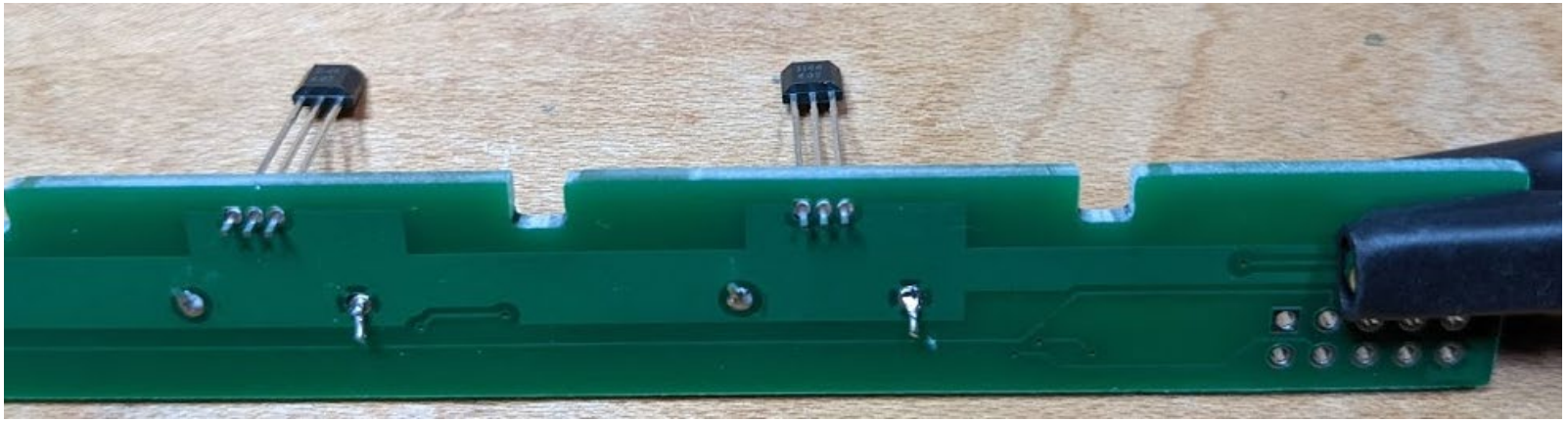
Solder the Hall effect sensors to the daughterboards
8 daughterboards
8 Hall effect sensors per board
64 Hall effect sensors
3 solder points per sensor
192 solder points

Position the sensors so they are close to the center of the square in the board assembly.

The board square size is 33.08mm so the Hall effect sensors should extend approximately 16.5mm from the daughterboard.

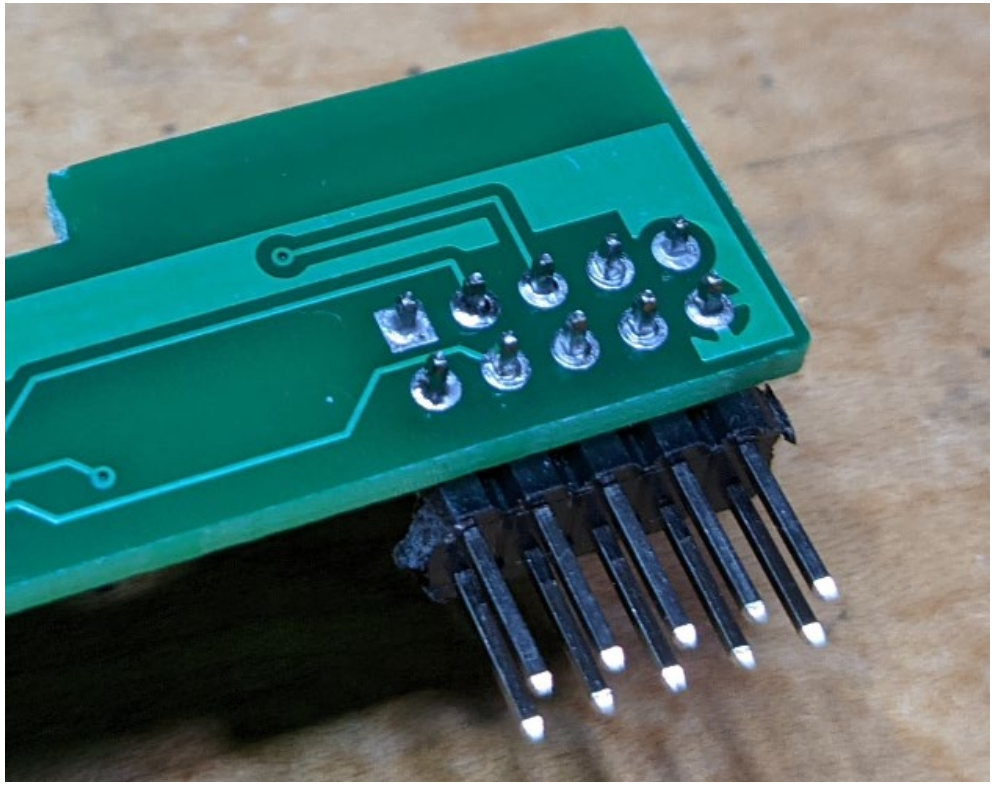


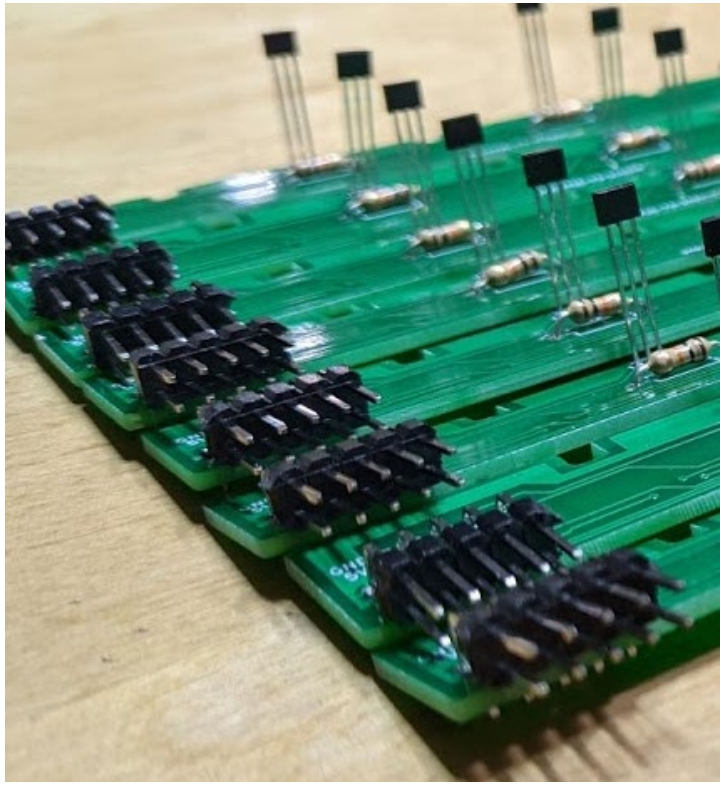




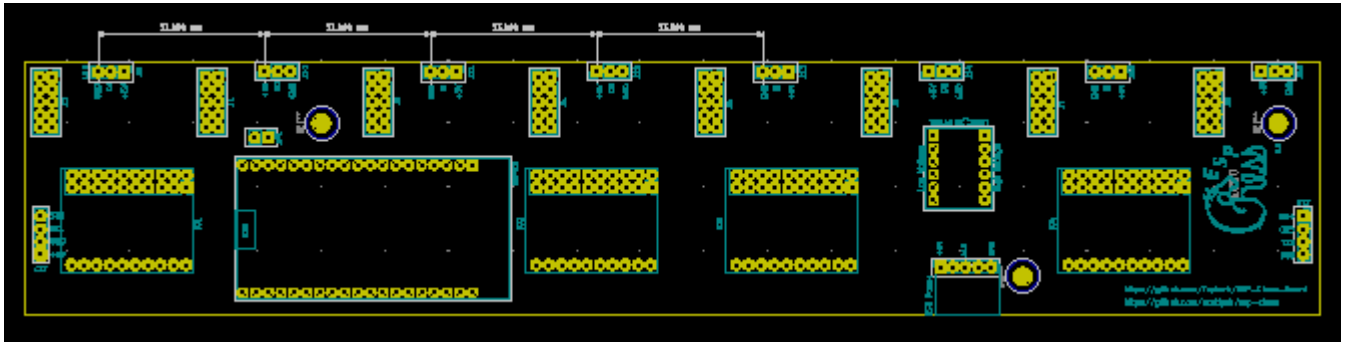
Daughterboard Assembly

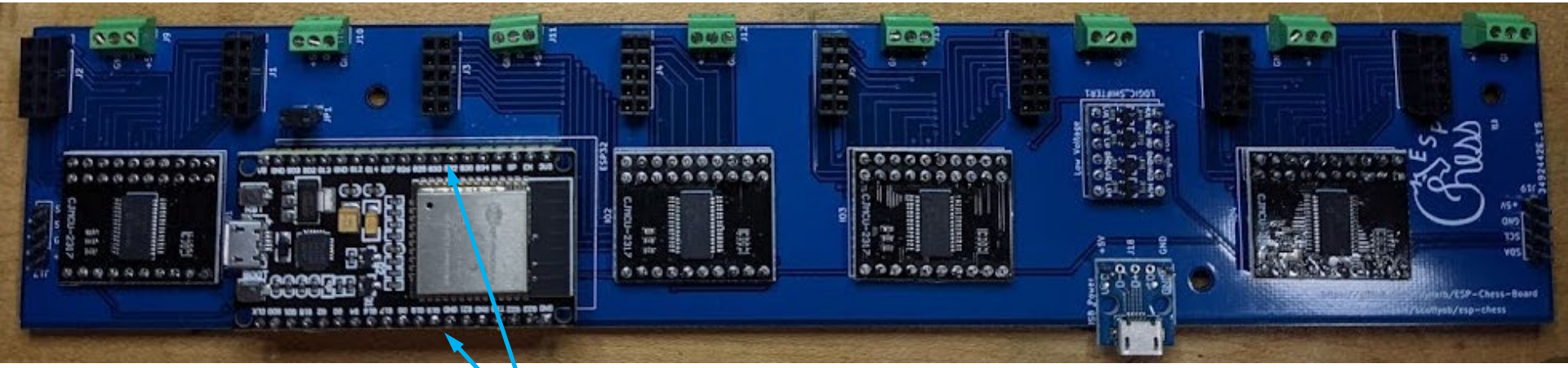
Solder the 10 pin sockets to the daughterboards
8 daughterboards
1 socket per board
10 pins per socket
10 solder points per socket
80 solder points





Motherboard Assembly



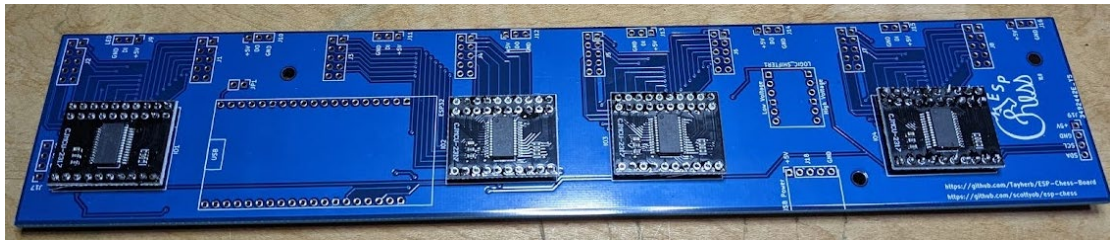


For removability of the ESP32 and to raise the USB port away from interference;
two 19P 2.54mm Single Row Female Headers are soldered to the motherboard.

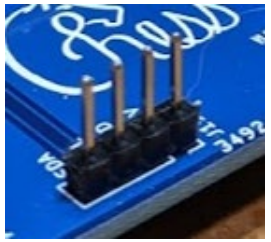
Motherboard Assembly

284 solder points

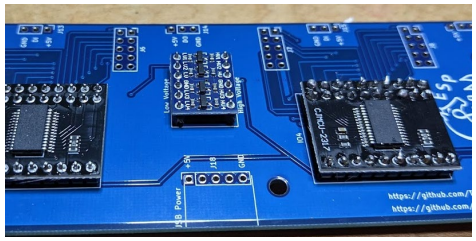
IO Expanders
4 chips
30 pins per chip
120 solder points



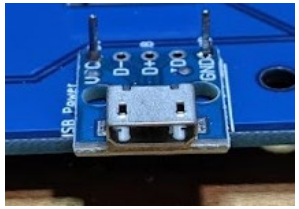
LCD terminals
2 terminals
4 pins per terminal
8 solder points



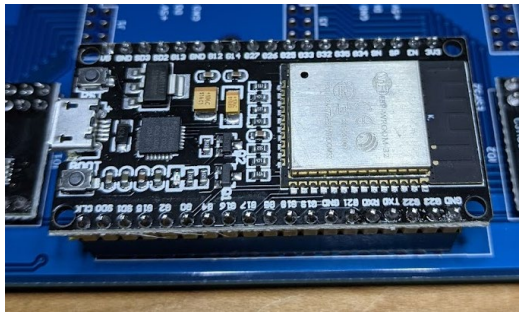
Logic Level Shifter
1 chip
12 pins/solder points



USB chip
1 chip
2 pins/solder points

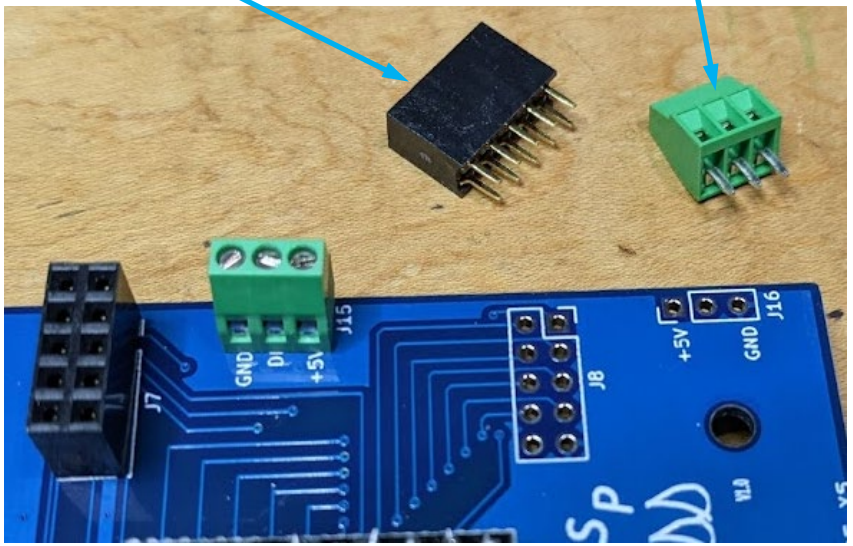


Headers for ESP32
2 headers
19 pins her header
38 solder points



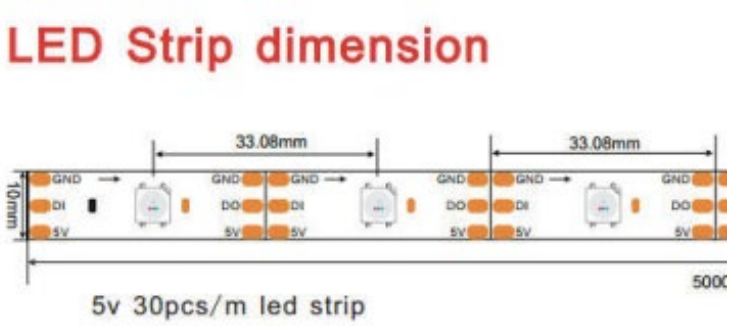
Daughterboard Connectors
8 sockets
10 pins per socket
80 solder points

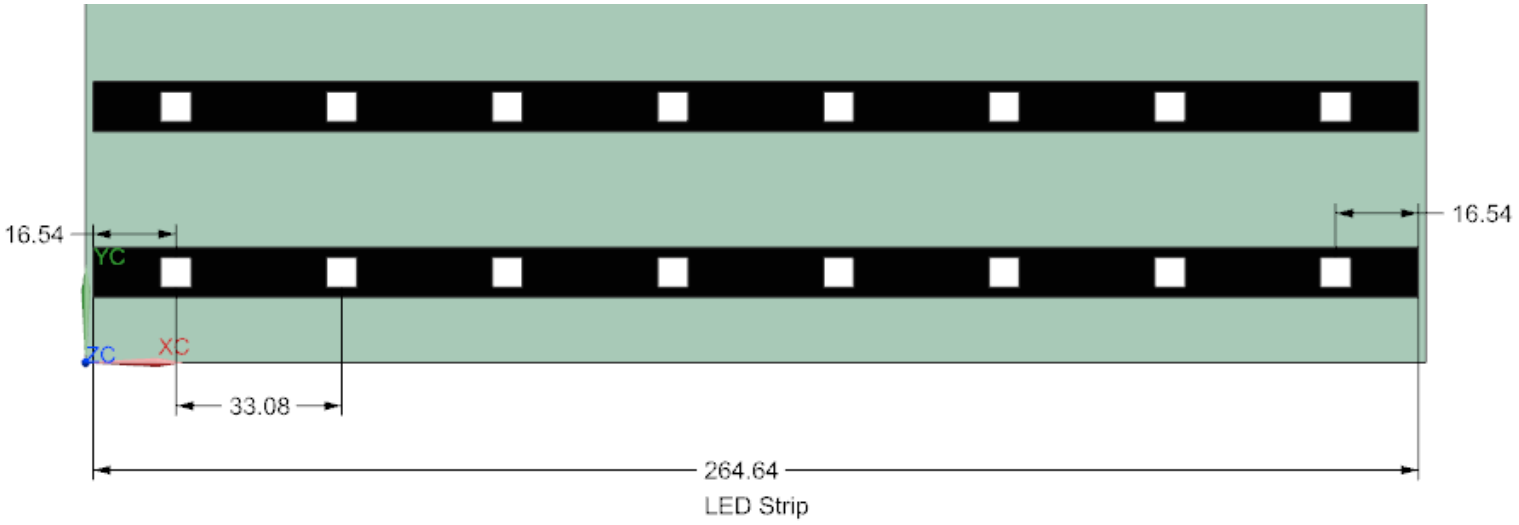
LED terminals
8 terminals
3 pins per terminal
24 solder points



LED Strip Assemby

The length of the daughterboards and therefore the entire board assembly is driven by the LED distance of the Neopixels strip.



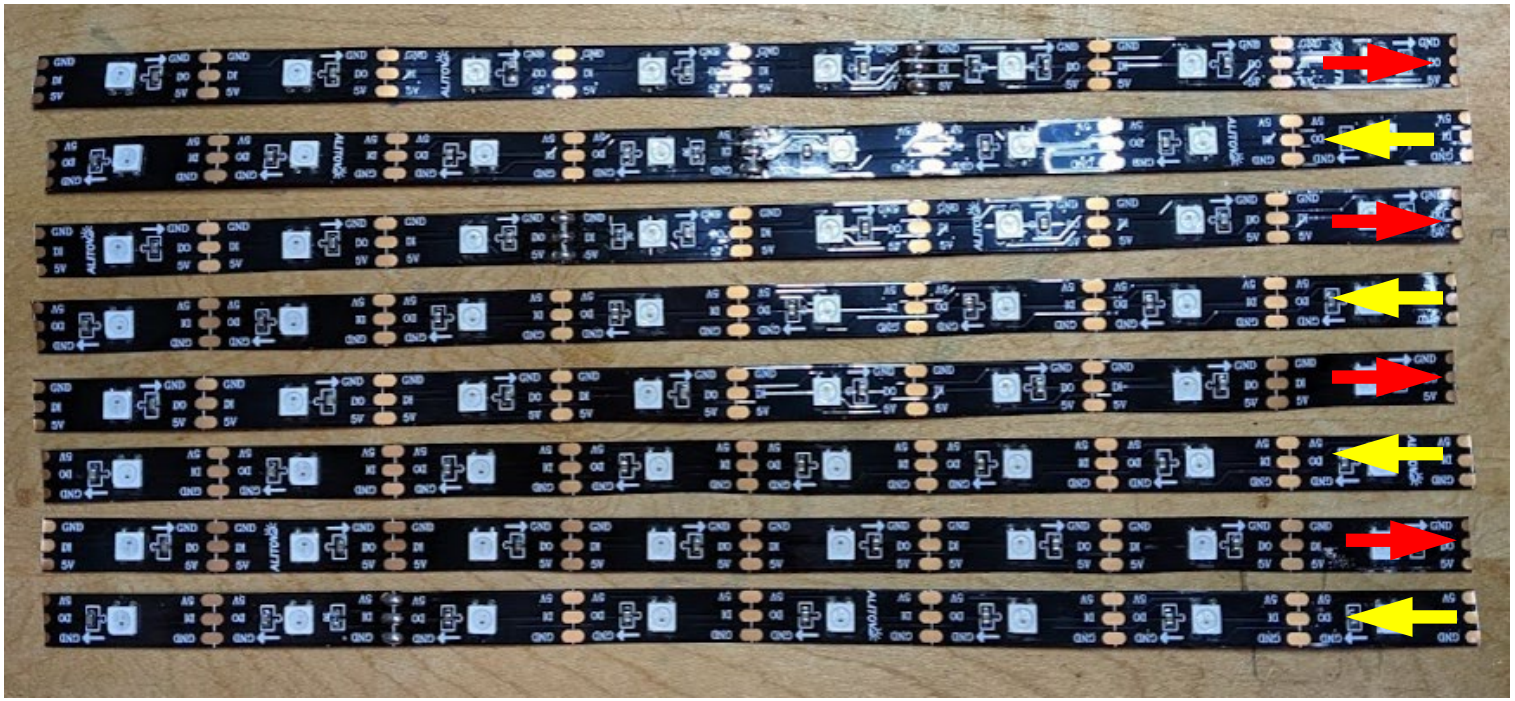


Cut 8 strips from the Neopixels coil and remove the casing as shown below
Strip must contain 8 LEDs with the power pads on each end cut through the middle.
Wires will be soldered to these.

Cut short wires to connect the LED strips to the motherboard. I used approx. 40mm. Specific length is not important and needs to be sufficient to reach the connection points while avoiding the need to keep excess wire under control.

Wire quantities:
Red (5V) 8
Black (GND) 8
Green (DI/DO) 12

From rank 1 to rank 8 the LED strip direction must alternate. This aligns the physical board with the programming to keep track of the chess piece locations



Solder the wires to the LED strips.

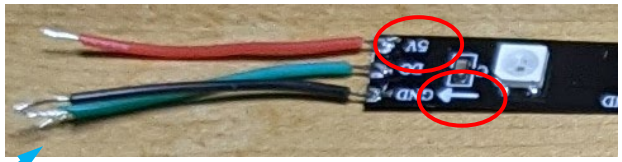
They must be assembled in relation to the motherboard as shown below.

Observe the arrow direction on the LED strips.

Solder the wires accordingly.

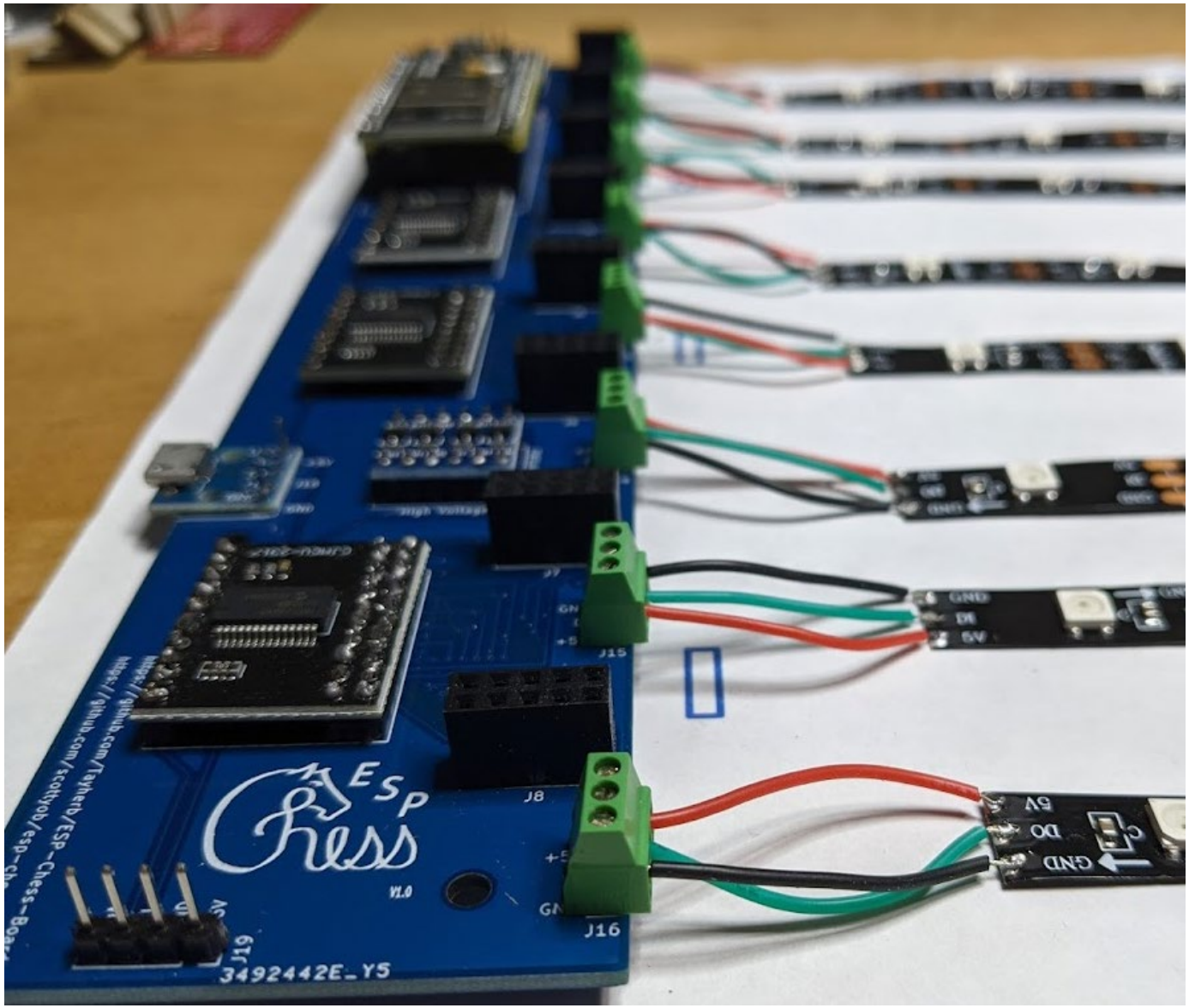
*Note the 5V and GND wires alternating on the left (motherboard) side of the strips

*The green wires at the far end from the motherboard do not have to be soldered at this stage as this build picture shows.

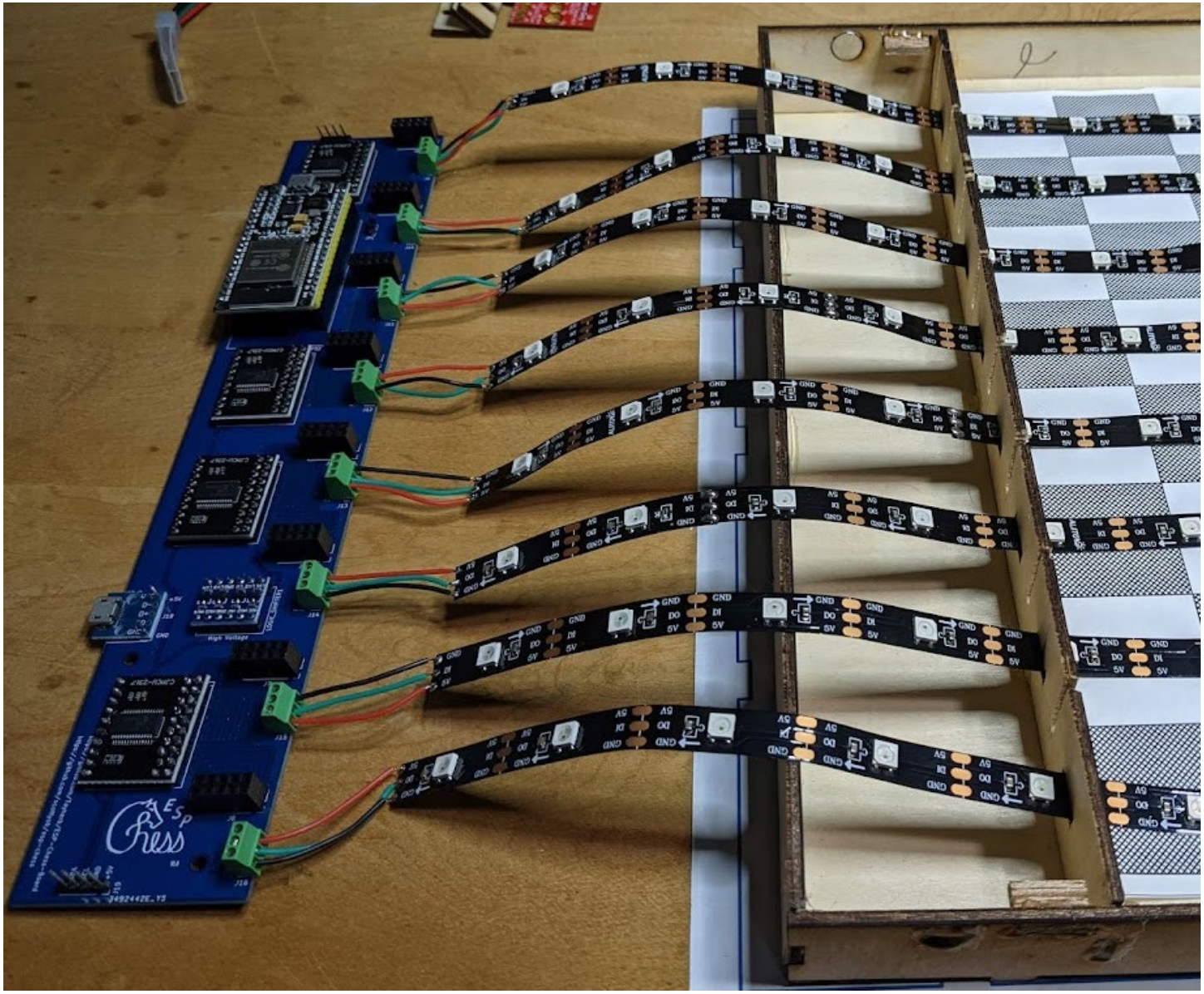


Attach LED strips to motherboard terminals.

***Ensure the strips are attached in the correct order as shown on previous page**



Feed the loose ends of the LED strips through rectangular holes in baffle-daughterboard



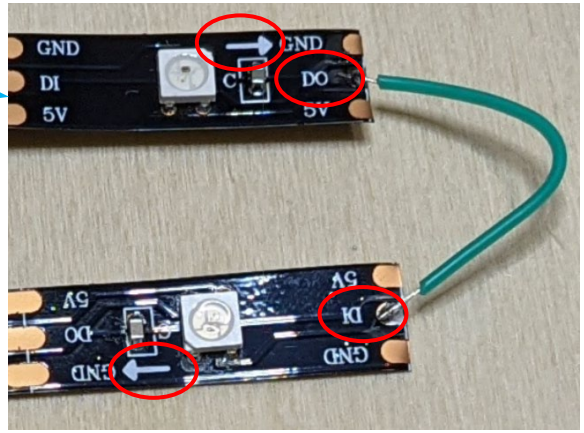
Solder the green data wires to the middle electrical pad to close the loop on the loose ends.

On this end of the LED strips:

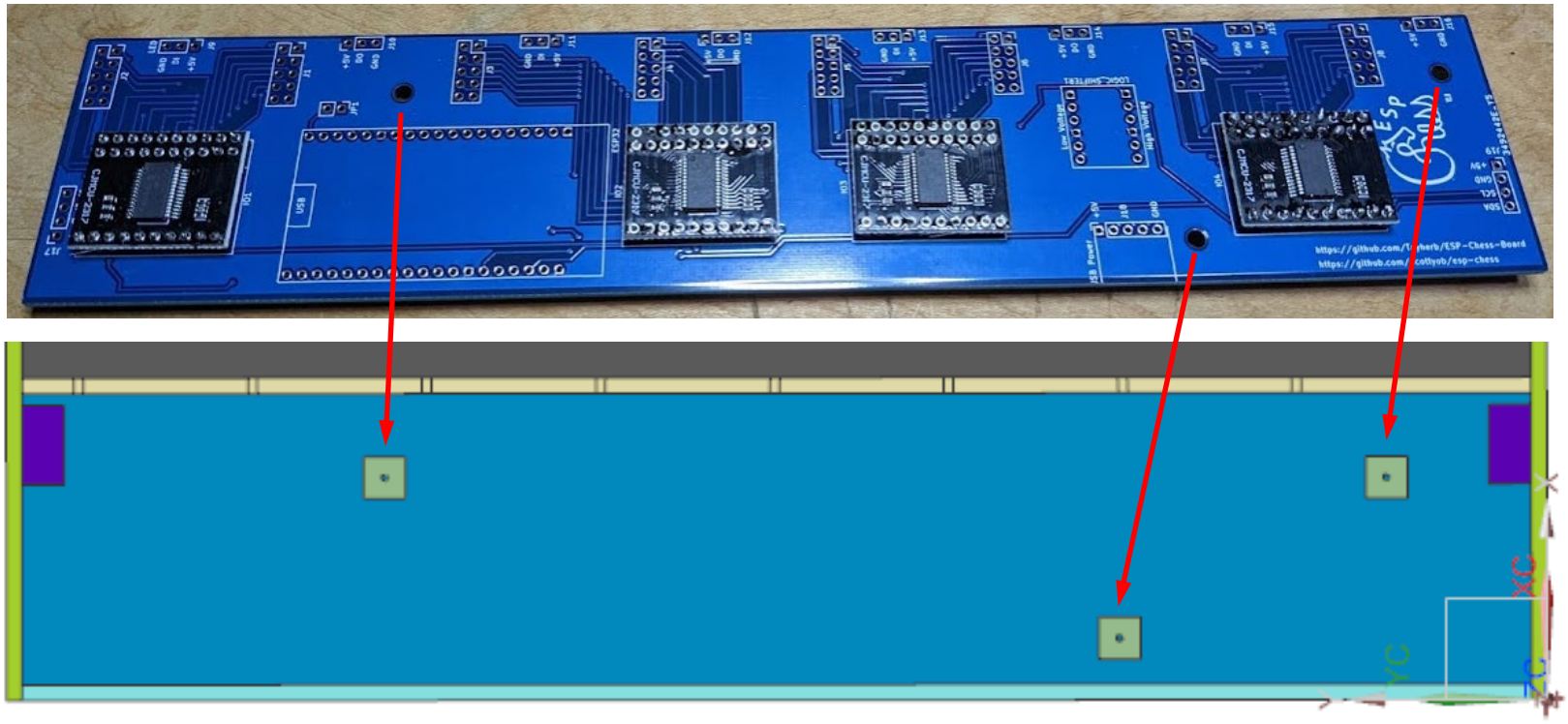
Odd number ranks must be DI

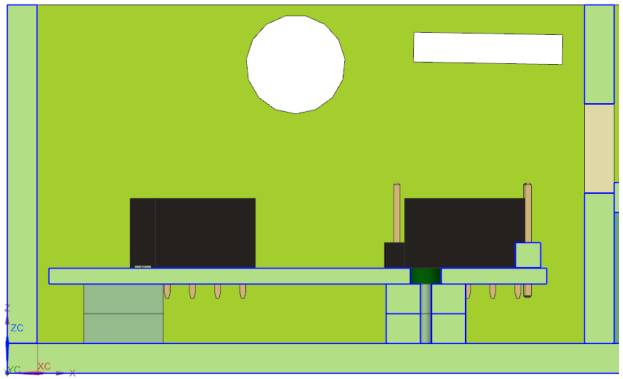
Even number ranks must be DO

Ensure each of the four wires closes the DI/DO loop



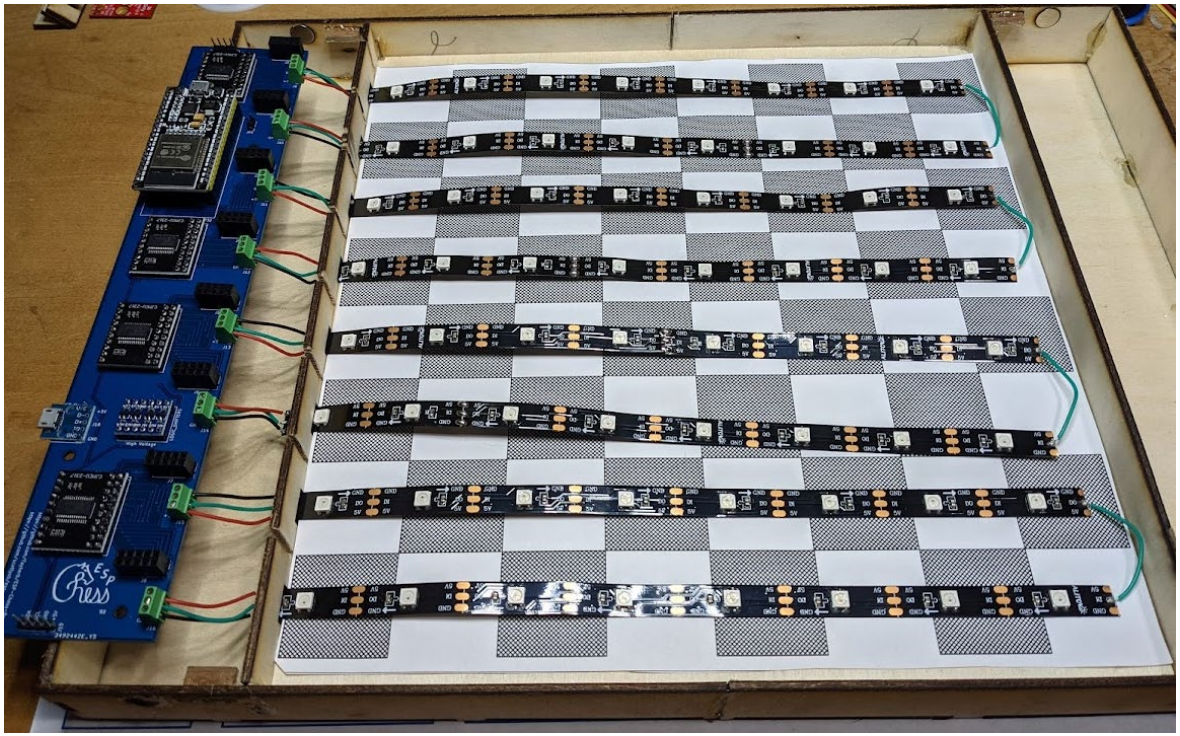
Optional step;
Before final insertion of the motherboard; align and glue the mounting pads in place.
The mounting pads secure the motherboard from movement while installing the daughterboards and using the USB port.
Take care while positioning the motherboard to ensure the holes are close enough to insert the screws after the daughterboards are installed.

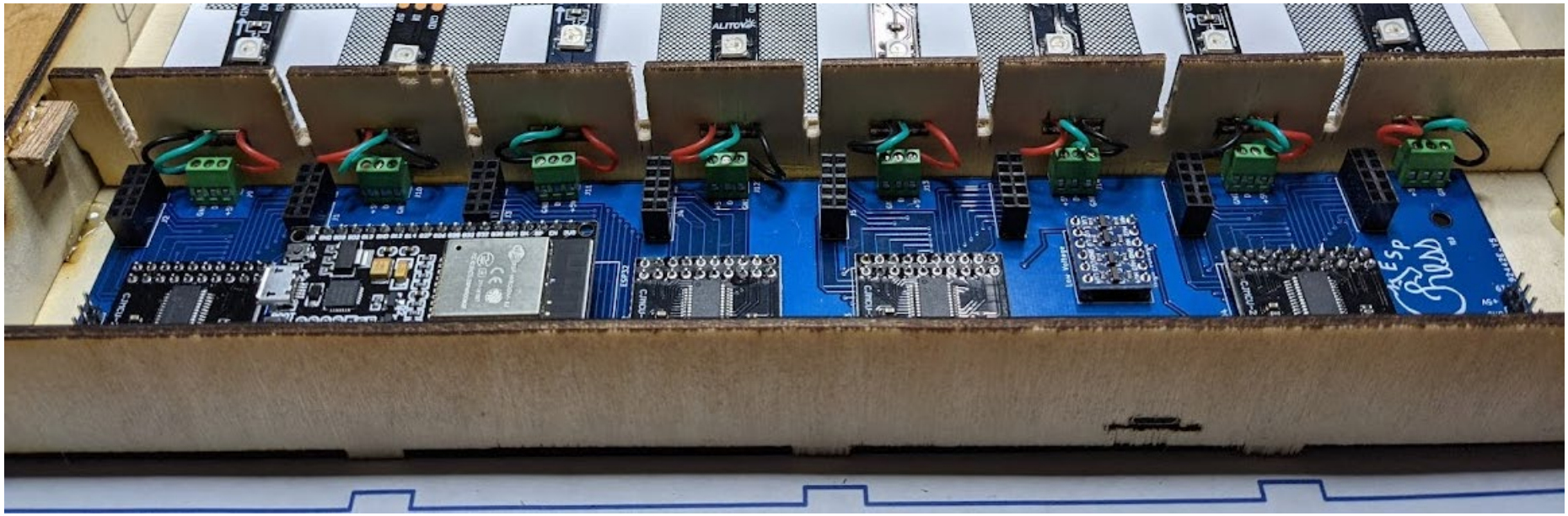




Two pads stack up to 6mm to provide seating for the motherboard

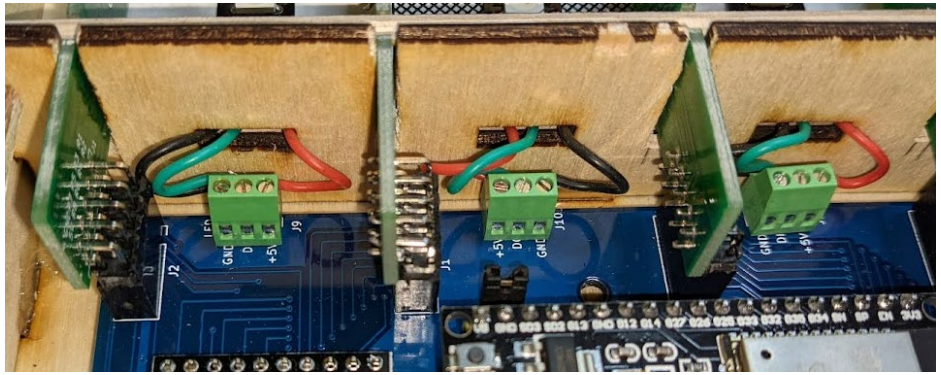
Continue feeding the LED strips until the motherboard can be seated in its compartment

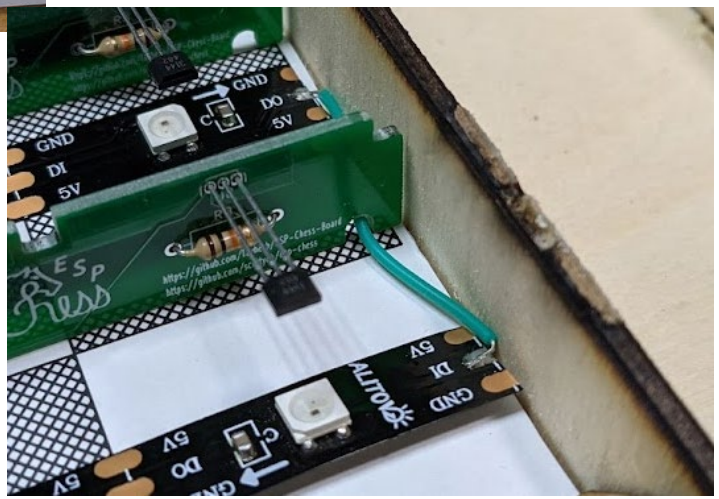




Finishing the grid Assembly

Install the PCB daughterboards



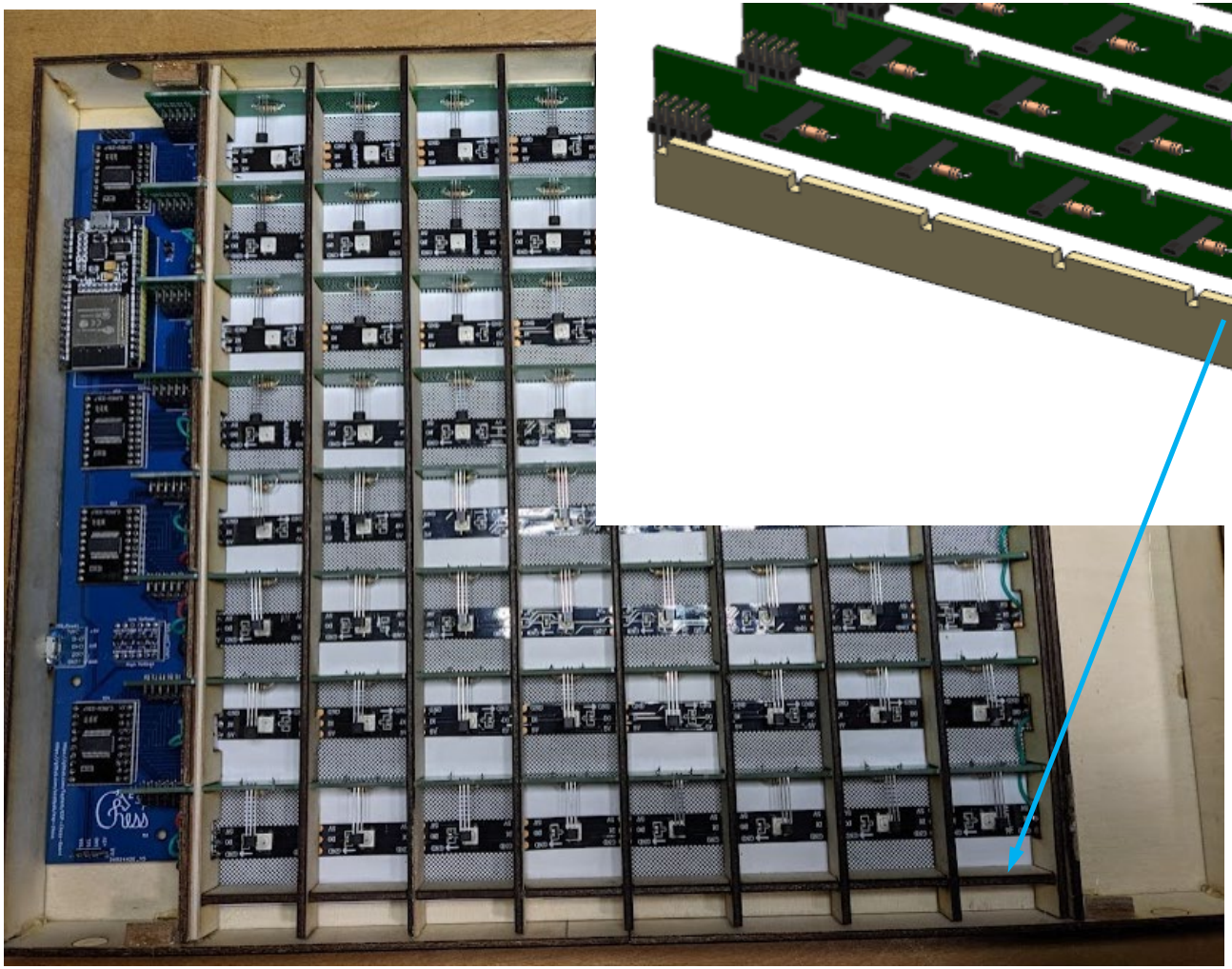


Ranks

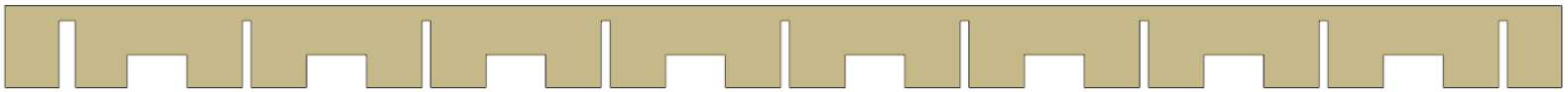
8	a8	b8	c8	d8	e8	f8	g8	h8
7	a7	b7	c7	d7	e7	f7	g7	h7
6	a6	b6	c6	d6	e6	f6	g6	h6
5	a5	b5	c5	d5	e5	f5	g5	h5
4	a4	b4	c4	d4	e4	f4	g4	h4
3	a3	b3	c3	d3	e3	f3	g3	h3
2	a2	b2	c2	d2	e2	f2	g2	h2
1	a1	b1	c1	d1	e1	f1	g1	h1
	a	b	c	d	e	f	g	h

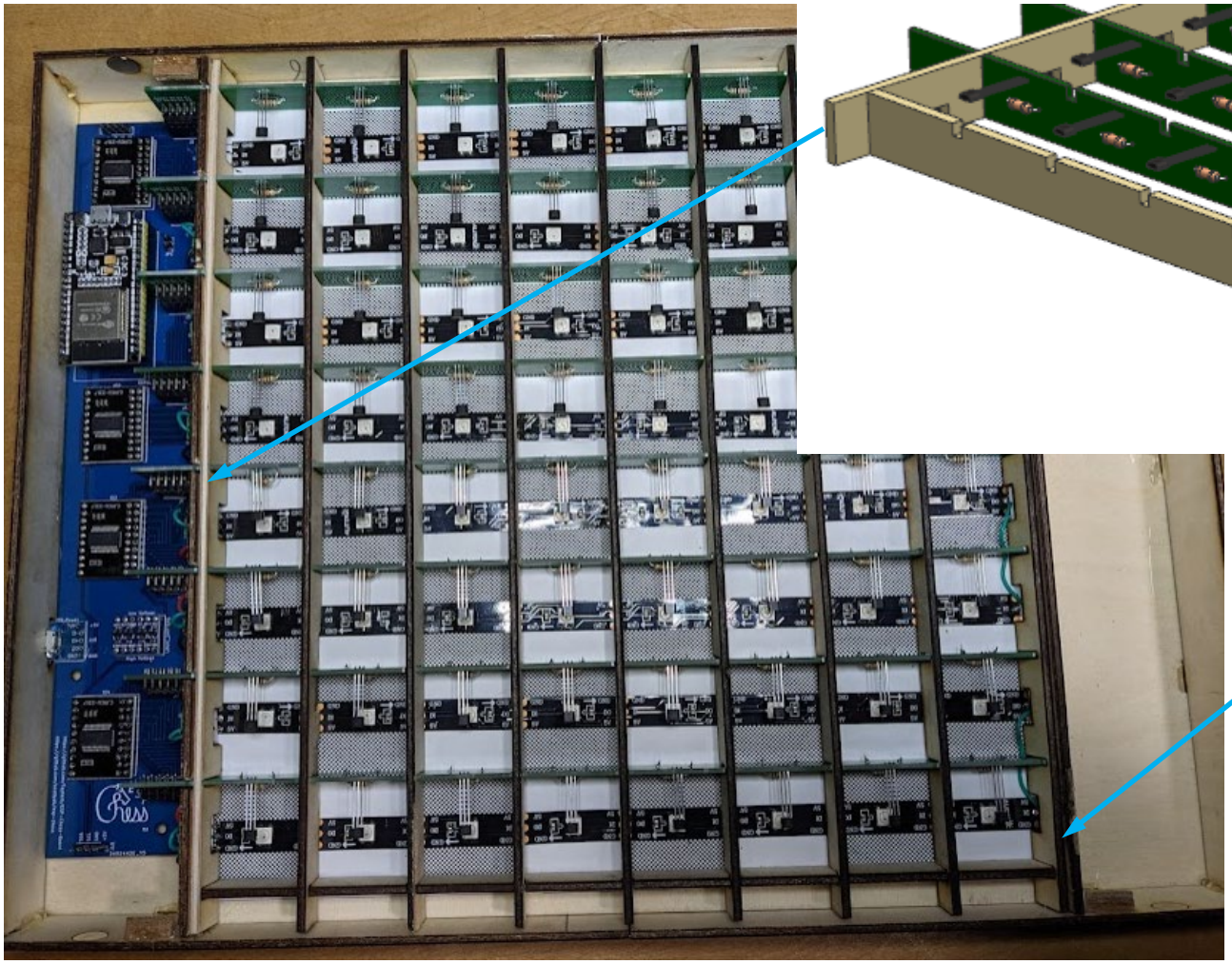
Files

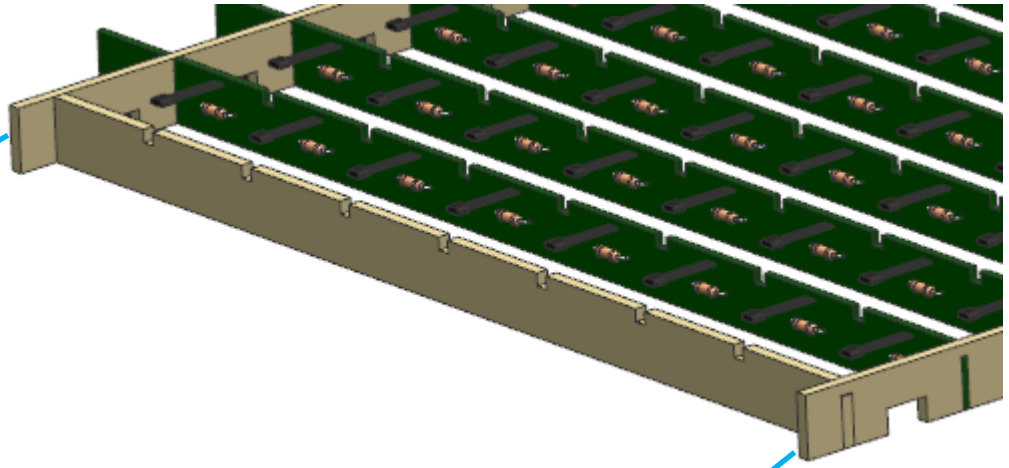
Rank_Grid_Baffle.dxf (1 piece)
Install in front of rank 1



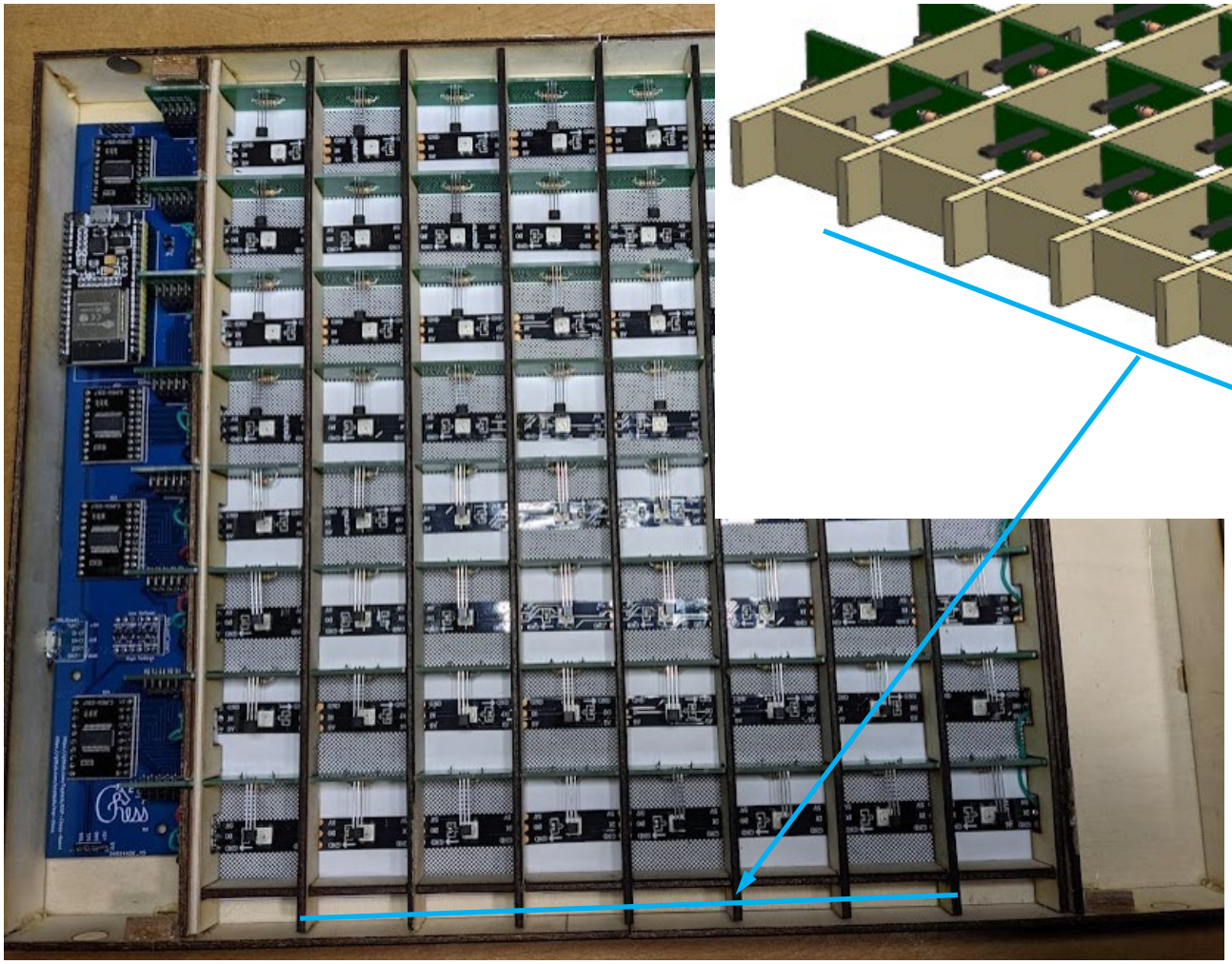
File_LED_Baffle.dxf (2 pieces)
Install left & right outside of files a and h

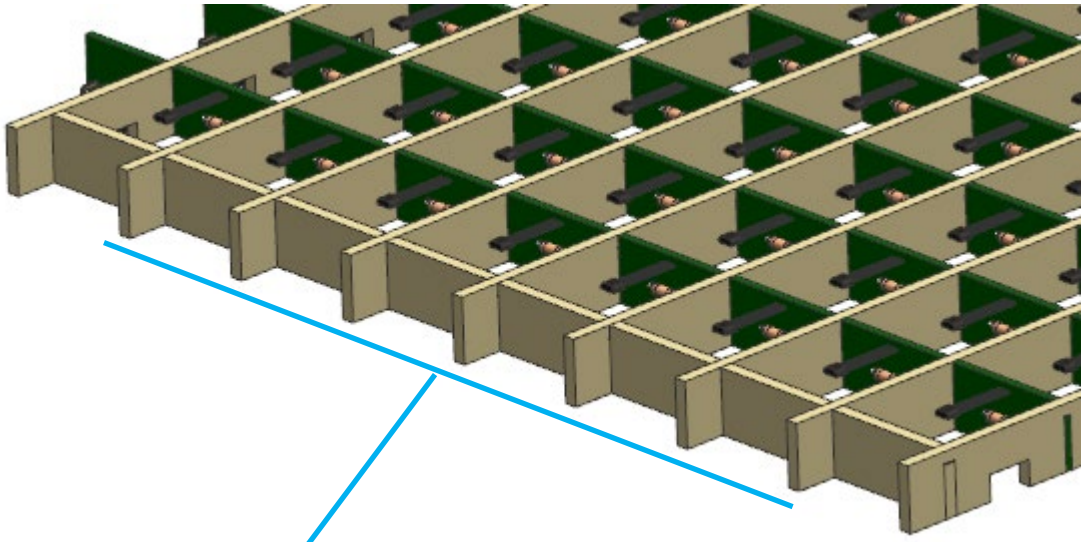






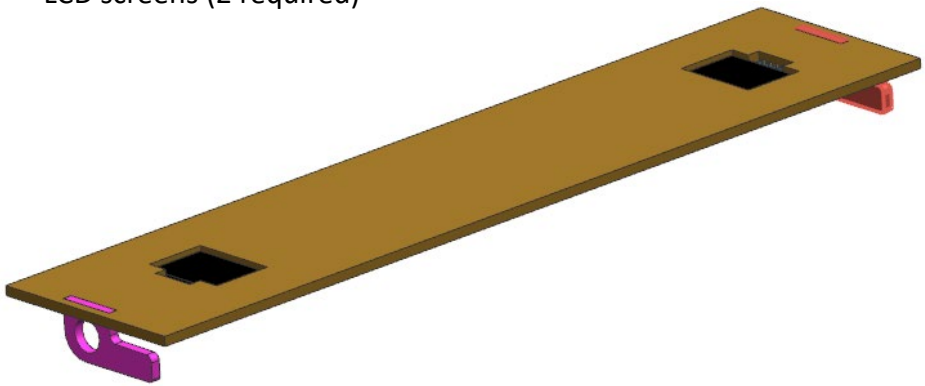
File_Grid_Baffle.dxf (7 pieces)
Install between each file

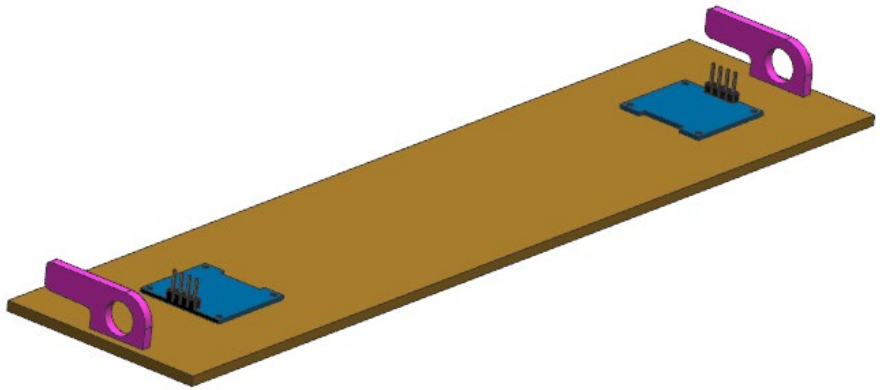




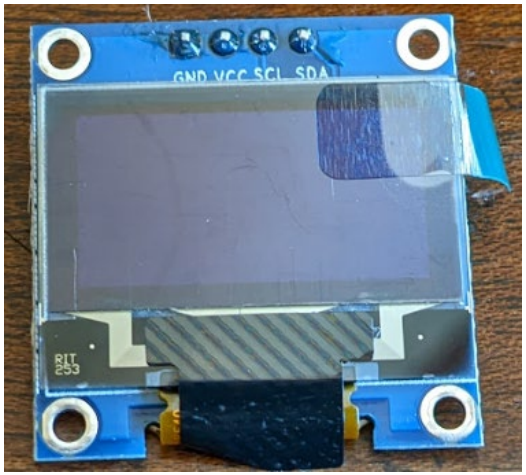
Installing the LCD screens

Lid_Motherboard.dxf
LCD screens (2 required)





Lay an LCD in each opening and use a marker to transfer the hole locations for drilling



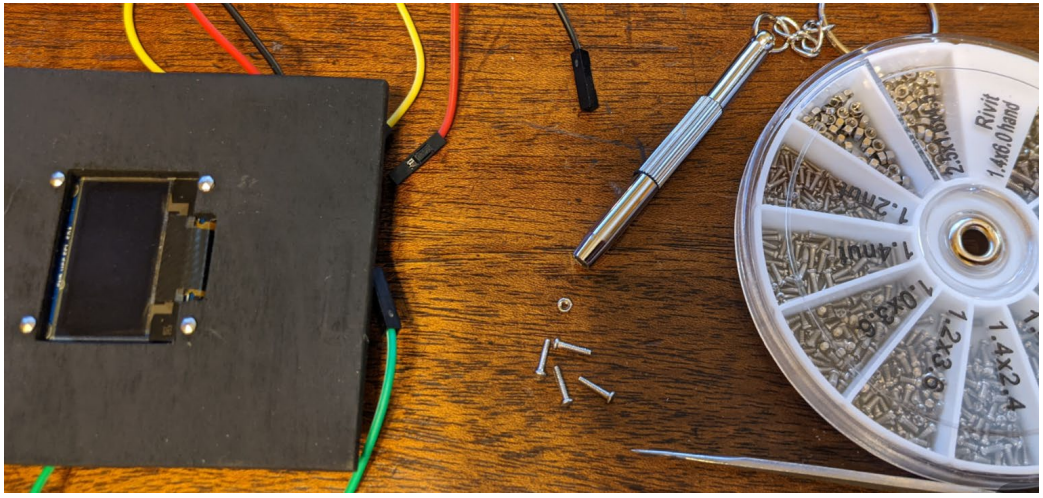
Assemble the LEDs

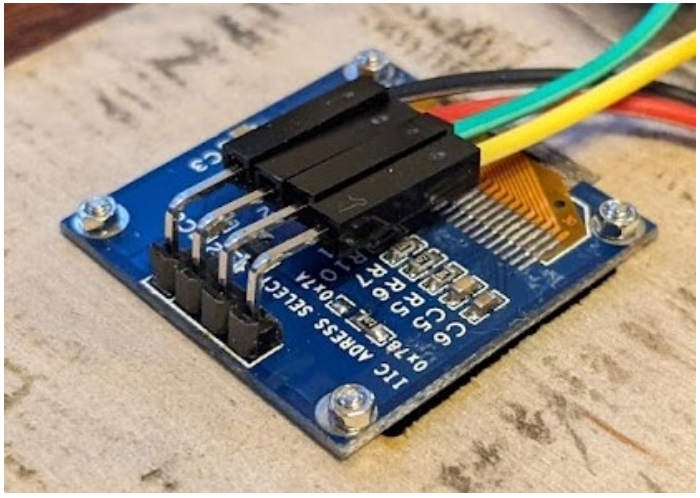
600pcs Mini Electronics Screws Nuts Assortment Tool Kit M1 M1.2 M1.4 M2.5
12 Kinds of Repair Hardware Tools Box with Screwdriver for Watches Glasses etc
Home Electronics

Specifications for this item

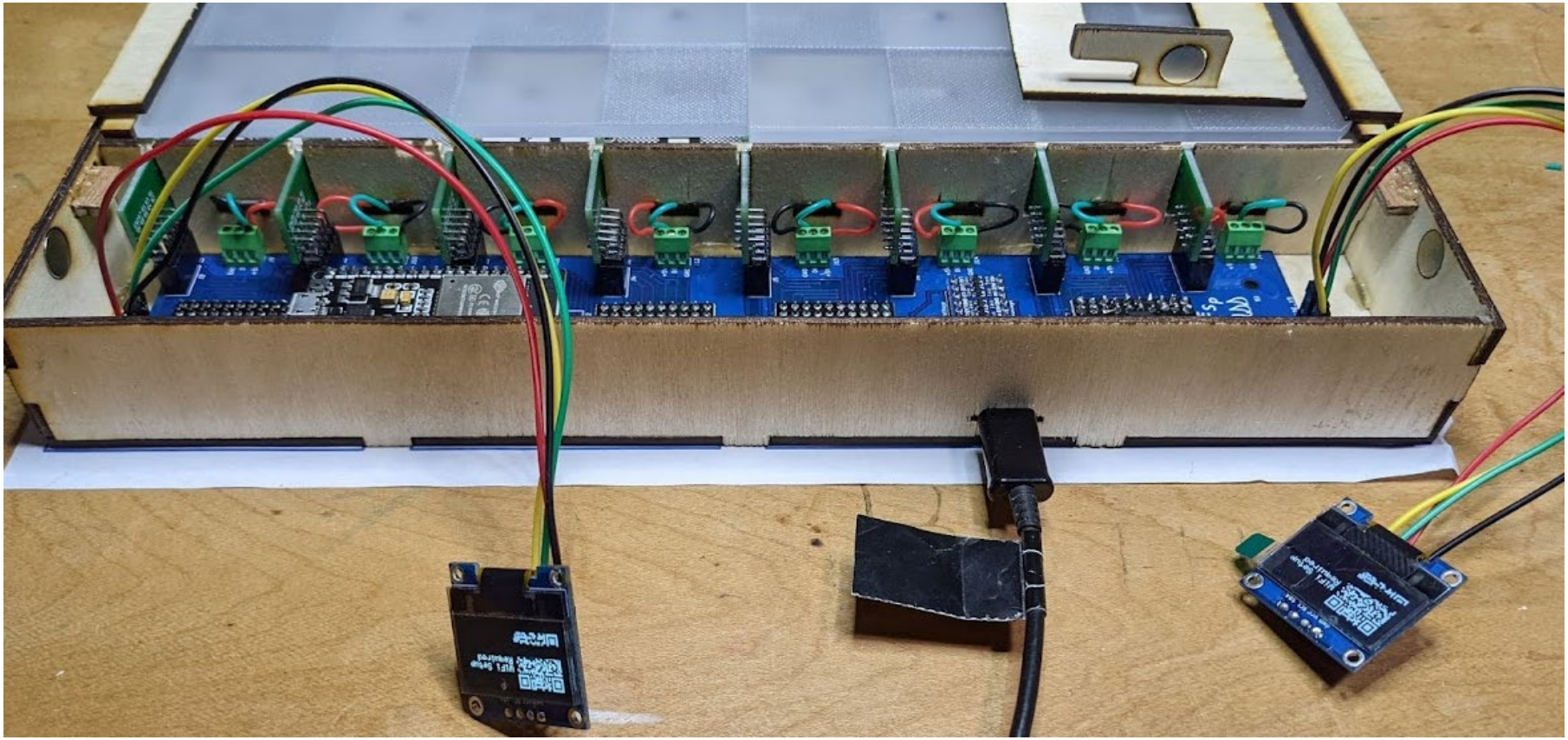
Brand Name	RuiLing
Ean	0713871355444
Head Style	Round
Part Number	MI-ESCREW-A600
UNSPSC Code	31161500
UPC	713871355444

I used 1.4 x 6 rivets along with 1.4 nuts from this kit





Connect LED to motherboard with 1 pin 20cm 2.54mm male – male bread board cables

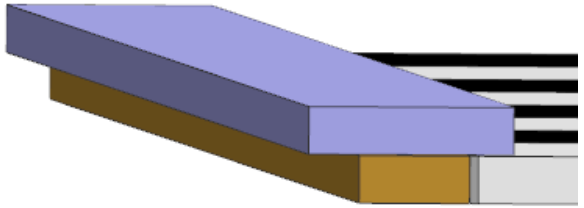


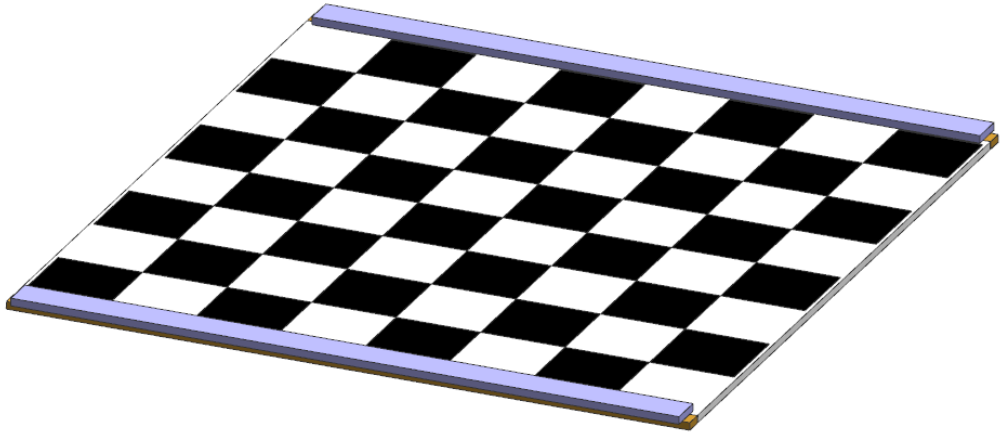
Playing surface Assembly

Playing_Surface.dxf

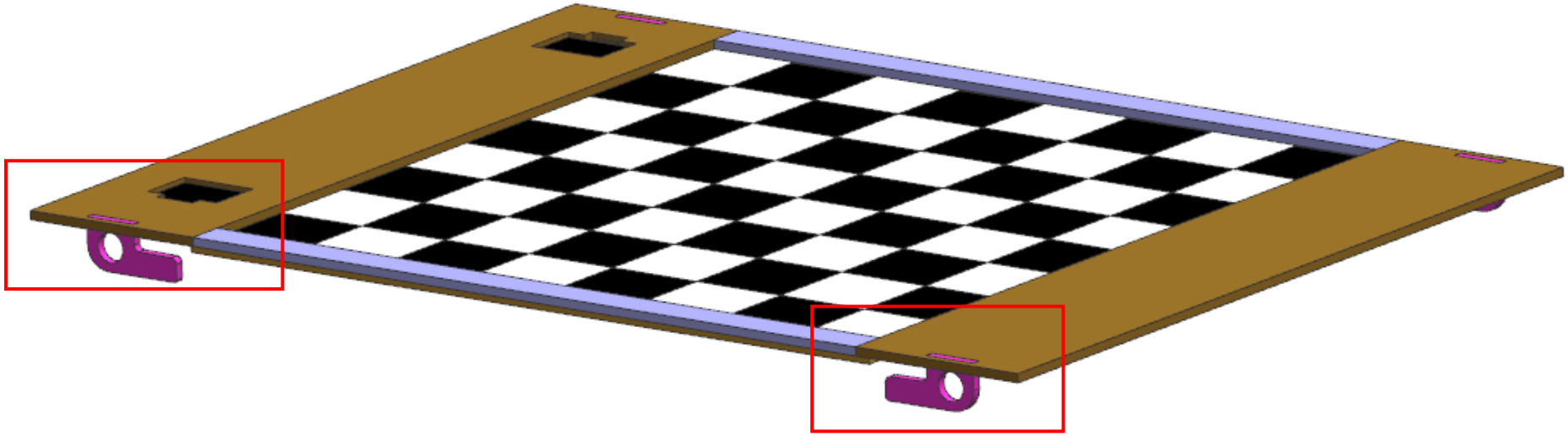
Once the main enclosure is finished the playing surface and lids can be installed and removed as needed.

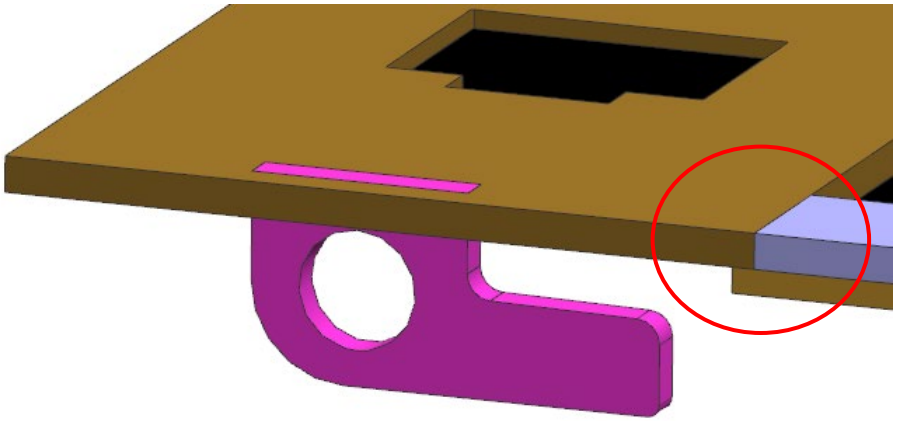
Playing surface and bezels are installed first

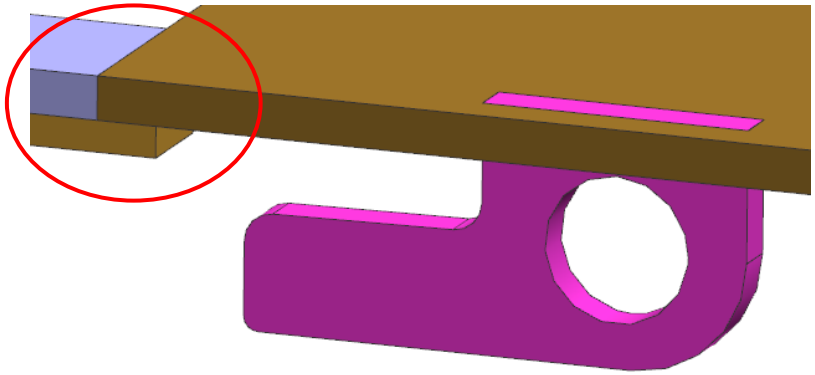


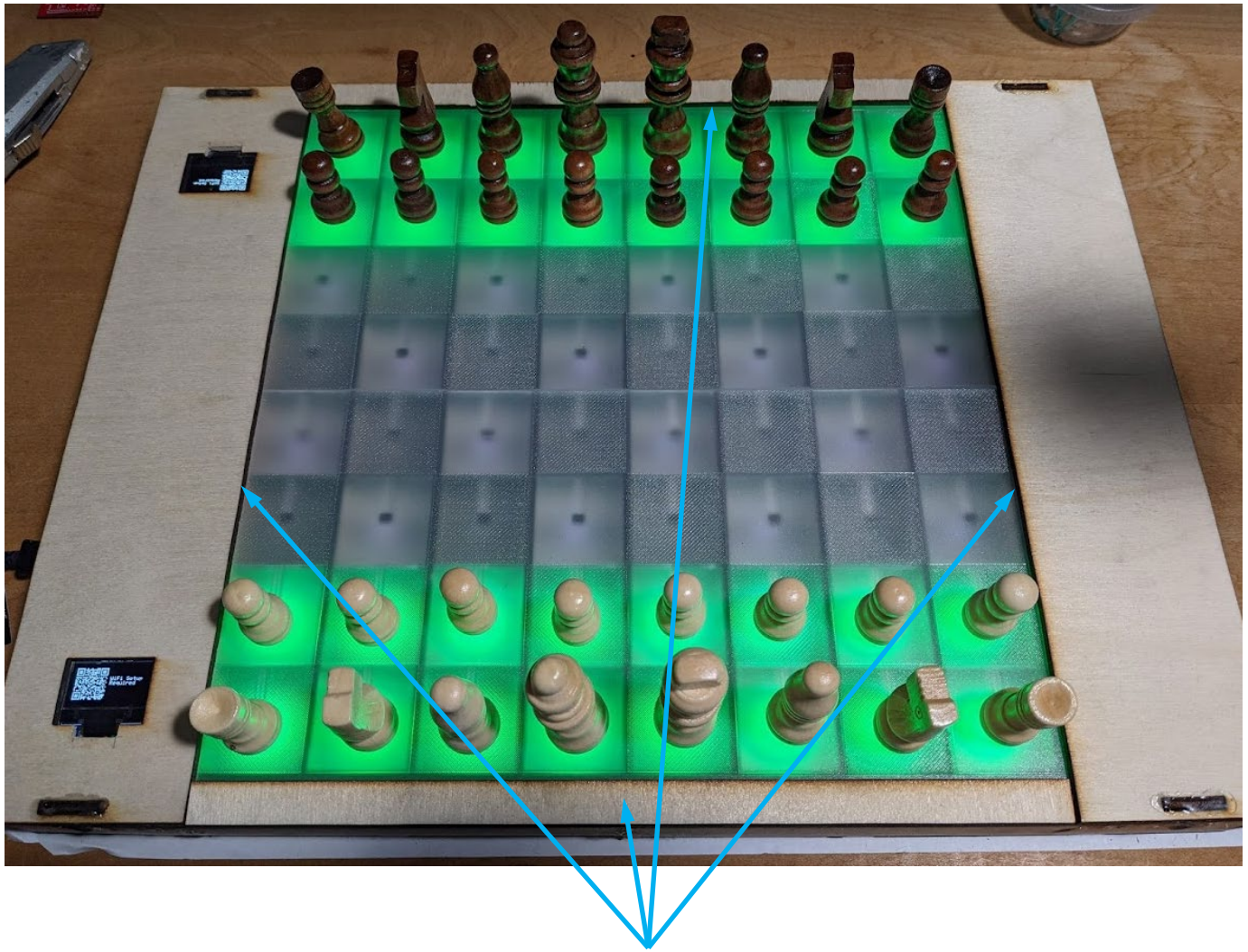


The lids overlap the bezel and playing surface to hold them in place.
These pieces are the removable portion of the assembly.









Bezels and lids trap the playing surface on all four sides
Gib_Sliding and Gib_Fixed work together to secure the lids to the base enclosure

Prepare the chess pieces

Ø 3/8"x1/24" - (10mmx1mm)

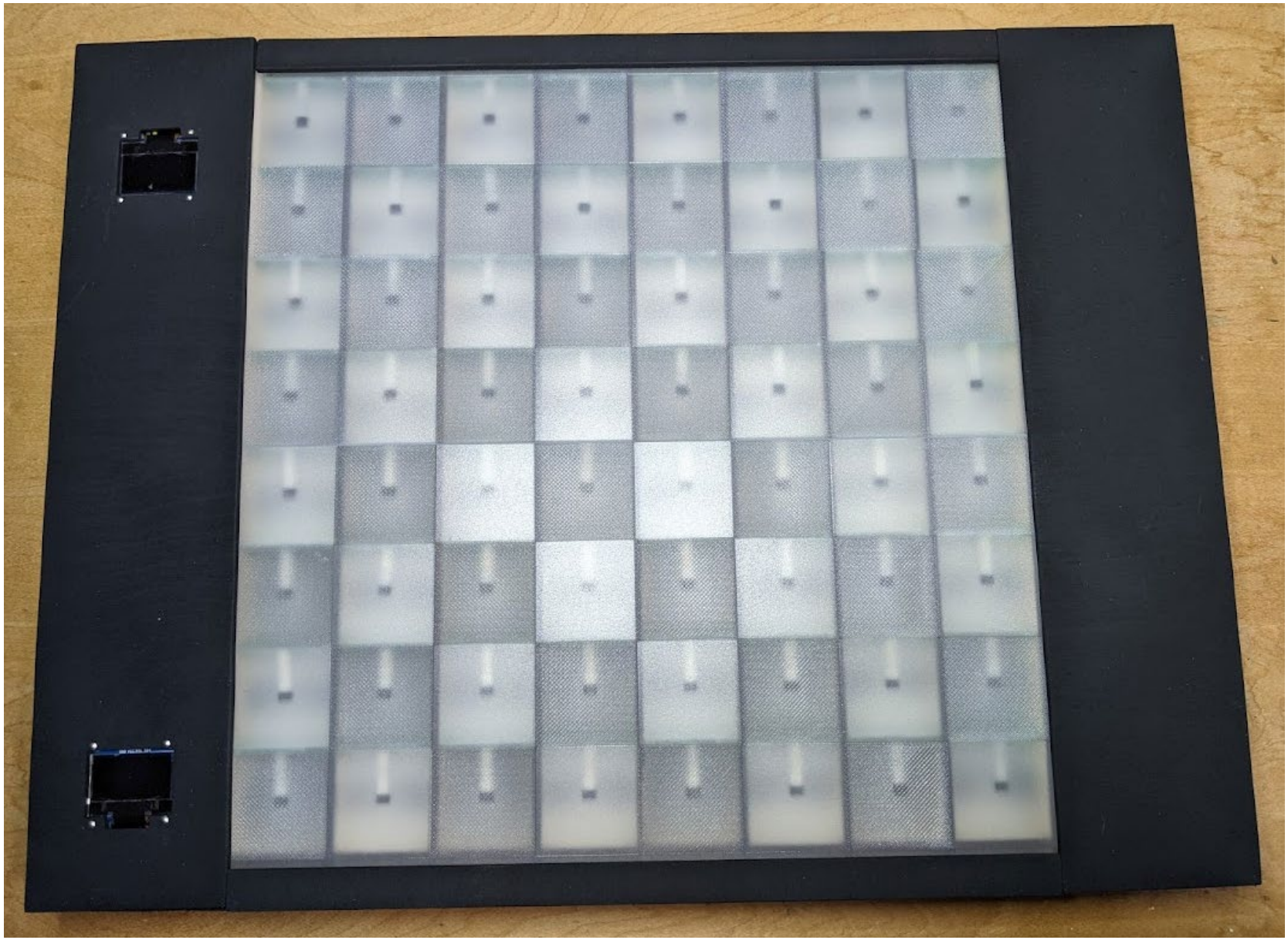
These are the chess pieces shown in this document:

Size	2 x 2 x 6.5cm
Brand	NUOBESTY
Material	Wood
Genre	Strategy
Item Dimensions LxWxH	0.79 x 0.79 x 2.56 inches

I used an endmill already in my possession to bore the bottom of the chess pieces for the magnet. Not recommended. If you don't print your own chess pieces, buy the appropriate size tool for a Ø10mm magnet.

Glue the magnets to the bottom of the chess pieces. (with or without the pocket)
Loctite Power Grab works well because it holds instantly and doesn't run.

Decorate exterior surfaces as desired
The visual black/white contrast of the translucent playing surface is provided by including the printed playing grid below the LED strips.



Game in progress.
The lights on my board show that my opponent moved the bishop from f8 (green) to d6 (white) on his board.
On my board I will move his bishop then make my move.