

Team Board Design 2024 Testing and Demonstrating

Board Completion

- While the boards are in production, you have the opportunity (read assignment) to plan for assembly, testing and demonstrating your board.
- First step is assembly.
- Once the board is assembled, you can divide the testing process into two stages:
 - Verifying that the processor is functioning as expected.
 - Verifying and demonstrating each interface/ device is functional.

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Board Assembly

- Before assembling the board, use a meter to verify that power and ground aren't connected.
 - If they are, you messed up and have to figure out how/where to separate them. This is easier on the bare board.
 - If they aren't, and find out after assembly that they are shorted, you know the cause is related to the assembly.

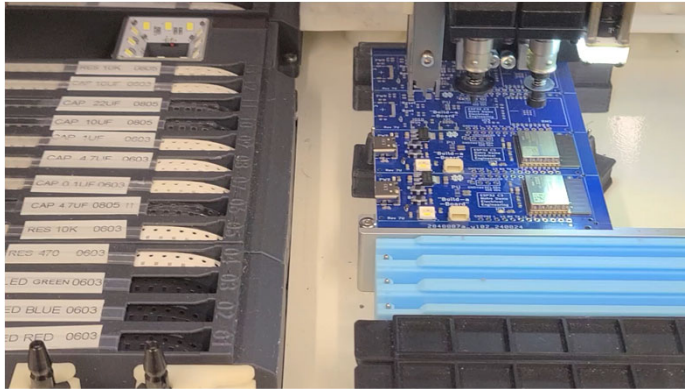
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Pick and Place

- We will assembly our boards using the automatic pick and place machine in the EIH (Neoden YY1).
 - Apply solder paste
 - Place parts
 - Inspect
 - Cook (reflow)
 - Inspect

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Pick and Place



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Preparation for Pick and Place

- Process:
 - KiCad has a board file with parts.
 - Part is specified by a designator, value, and footprint and has a location and orientation.
 - YY1 has feeder locations (mostly tape, but selected parts will be picked from a tray). Each feeder location has a particular part.
 - YY1 needs a .csv file that combines the part information from KiCad matched to a feeder.

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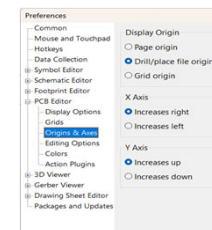
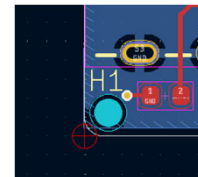
Preparation for Pick and Place

- Script:
 - I have written a python script which runs as a plug-in in KiCad. (Will not run on a mac.)
 - Script runs in the board view, reads the board file and a “feeder” file, and produces a .csv that can be placed on an SD card to run the YY1.
 - The difficulty in the process comes from the matching.

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Preparation for Pick and Place

- Script:
 - Note that the script uses the KiCad drill/place origin as its (0,0) reference.
 - The drill/place origin should be at the bottom left of the board.



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Feeder file

- The feeder file is a .csv with a list of parts and the assigned feeder.
- The entries here need to be matched to the part in the KiCad board file.

#Desig	Value	Footprint	Feeder Assigned	Mount Speed(%)	Pick Height	Place height	Camera Mode	Size
C	4.7uf	805	6	90	0	1	3	2
C	.1uf	603	7	90	0	0	3	1
C	100nf	603	7	90	0	0	3	1
C	4.7uf	603	8	90	0	0	3	1

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Feeder file

- For passives, it looks for C or R in the designator, looks to match the value, and for the Footprint to be a substring in the KiCad footprint.
- Note that there can be multiply entries for a single part.

#Desig	Value	Footprint	Feeder Assigned	Mount Speed(%)	Pick Height	Place height	Camera Mode	Size
C	4.7uf	805	6	90	0	1	3	2
C	.1uf	603	7	90	0	0	3	1
C	100nf	603	7	90	0	0	3	1
C	4.7uf	603	8	90	0	0	3	1

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Feeder file

- For LED's, it looks for LED as the designator and the color as the value.
- Transistors are listed as shown.

#Desig	Value	Footprint	Feeder Assigned	Mount Speed(%)	Pick Height	Place height	Camera Mode	Size
LED	Blue	603	2	90	0	0	3	1
LED	Green	603	3	90	0	0	3	1
LED	Green	805	48	90	0	0	3	1
LED	Red	805	50	90	0	0	3	1
Q	PNP	SOT23	33	90	0	0.5	3	2
Q	NPN	SOT23	34	90	0	0.5	3	2
Q	PMOS	SOT23	35	90	0	0.5	3	2
Q	NMOS	SOT23	36	90	0	0.5	3	2
Q	PNP2	SOT363	37	90	0	1	3	2
Q	NPN2	SC70-6	38	90	0	1	3	2

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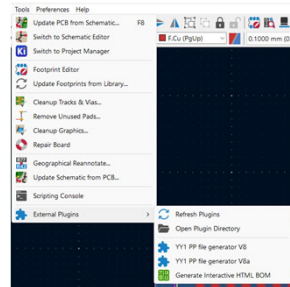
Feeder file

- For the larger parts, you need to be able to match parts on the board to the feeder file entries.
 - You can modify the information in the KiCad board.
 - You can modify the feeder file.
- If doing the latter, it is probably best to duplicate a line and change the entries to match your board.

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Adding the Script

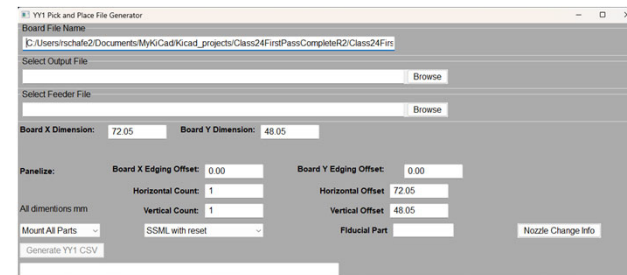
- Open plug in directory.
- Put the files from the zip folder into a folder in the directory.
- Refresh plugins.
- Name should appear in the list.



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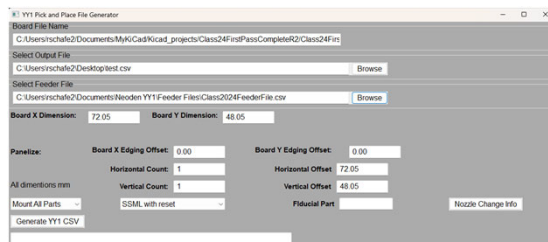
Running the Script

- When you run the script:
 - The board name is at the top
 - Board dimensions are read from the board file.



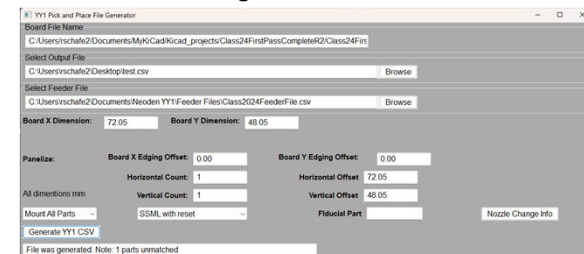
Running the Script

- Enter a name for the output file
- Enter the name of the feeder file.
- Leaving the rest of the settings at the default, you click the Generate button.



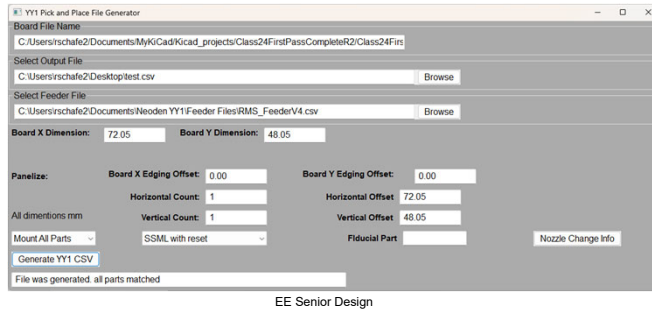
Running the Script

- Results show unmatched part which will show up at the end of the YY1 .csv file.
- Unmatched parts are a problem because of the nozzle change.



Running the Script

- Using a different feeder file resulted in all parts being matched.



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Script Results

- Nozzle change information is first.

NEODEN	YY1	P&P FILE					
PanelizedPCB	UnitLength	UnitWidth	48.05 Rows	1 Columns	1		
Fiducial	1-X	01-Y	OverallOffset 0 X	OverallOffset 0 Y	0		
NozzleChange	ON	BeforeComponent	1 Head2	Drop	Station3	PickUp	Station1
NozzleChange	ON	BeforeComponent	26 Head2	Drop	Station1	PickUp	Station2
NozzleChange	ON	BeforeComponent	30 Head2	Drop	Station2	PickUp	Station3
NozzleChange	OFF	BeforeComponent	0 Head2	Drop	Station3	PickUp	Station0

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Script Results

- Then there is a list that is the sequence of picks and places.

Desig	Comment	Footprint	Mid X(mm)	Mid Y(mm)	Rotation	Head	FeederNo	Mount Speed(% m)	Pick Height(m)	Place Height(m)	Mode	Skip	Index
R10	470	R0603	22.6	4.8	90	0	4	90	0	0	3	0	1
R2	10k	R0603	33.1	28.55	180	0	5	90	0	0	3	0	2
R1	10k	R0603	29.2	40.9	90	0	5	90	0	0	3	0	3
R8	10k	R0603	68.3	23.9	0	0	5	90	0	0	3	0	4
C9	.1uf	STA_0603	24.5	8.4	90	0	7	90	0	0	3	0	5
C8	.1uf	STA_0603	29.8	8.4	90	0	7	90	0	0	3	0	6
C7	.1uf	STA_0603	70.38	6.1	-90	0	7	90	0	0	3	0	7
C5	.1uf	STA_0603	47.4	5.53	-90	0	7	90	0	0	3	0	8
C4	.1uf	STA_0603	31.6	41	90	0	7	90	0	0	3	0	9

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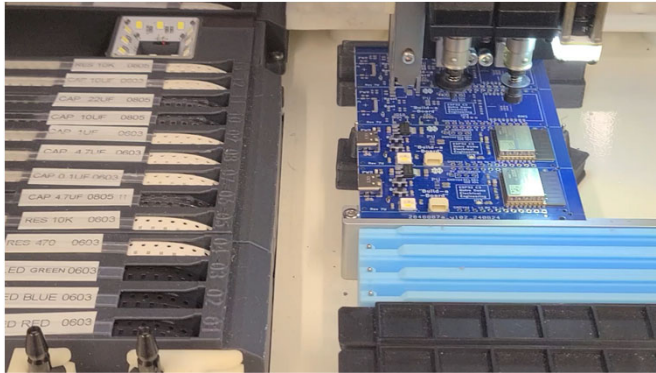
Script Results

- Here is the end of the list.
- Note there is a nozzle change before 26 and before 30

C3	22uf	STA_0805	33.9	40.9	90	0	11	90	0	1	3	0	20
C2	22uf	STA_0805	23.4	14.8	-90	0	11	90	0	1	3	0	21
SW2	PB5x5	PTS526	37.6	5.4	0	0	20	75	0	1.5	3	0	22
SW1	PB5x5	PTS526	51.68	5.4	0	0	20	75	0	1.5	3	0	23
U4	5	WS0N8_NXP	66.33	7.25	0	0	63	75	0	0	3	0	24
U5	BVR	SOT236	27	5.2	0	0	70	90	0	0.5	3	0	25
U3	LED	LED5x5mm	17.55	4.8	180	2	18	80	0	1.5	3	0	26
U2	AZ1117	SOT223	17.1	16.95	0	2	21	80	0	1.25	3	0	27
J2	I2C	JST04_1MM_RA	69.04	19.16	90	2	45	80	0	3	4	0	28
J3	_8	S8B-PH-SM4-TB	12.95	42.61	180	2	59	50	4.5	5	2	0	29
J1	USBC	GCT4105	3.95	8.7	0	2	44	80	0	3	4	0	30
U1	ESP32-C6	ESP32-C6-WROOM	45.3	31.74	0	2	60	50	0.5	3	2	0	31

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Pick and Place



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The Build Process

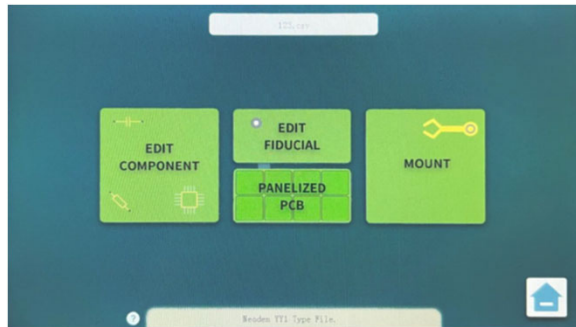
- YY1 Setup:
 - Align Feeders
 - Each time the machine starts, it homes.
 - Home in a \$5000 machine is a relative concept.
 - Thus, the feeders have to be aligned setting the needle position and pick position for each feeder.



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The Build Process

- YY1 Setup:



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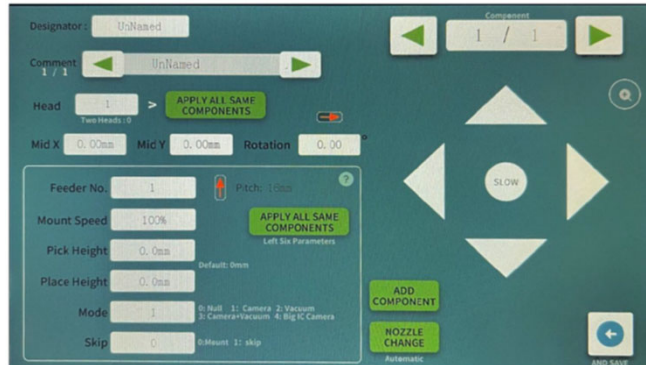
The Build Process

- YY1 Setup:
 - Board
 - Set fiducial part and fiducial.
 - Align each part: You will want to center the cursor for each of the parts. Note that the changes are stored in the file. Note also you can zoom the camera view.

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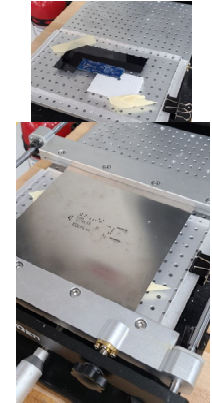
The Build Process

- Edit part view



The Build Process

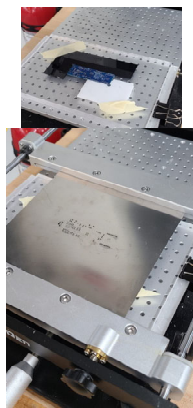
- Apply solder paste:
 - Load screen. Note it is made taught using knobs.
 - Position board so holes are correct. Fine adjustments can be made with silver knobs.
 - Squirt a dab of solder paste on the screen and use a wiper to force it through the holes onto the board.



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The Build Process

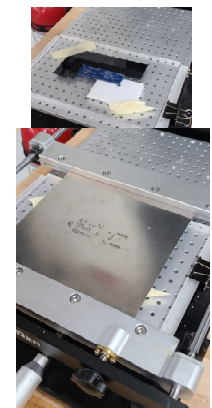
- Apply solder paste:
 - Be frugal with the paste. It does not go back into the syringe.
 - Ensure that all the pads get paste, but avoid forcing too much paste through the holes.



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The Build Process

- Apply solder paste:
 - Clean up your mess. Put the cap back on the solder paste syringe as soon as you have applied it to the screen.
 - Use the alcohol (by the sink) to clean up all solder paste mess, and clean the screen for subsequent use.
 - Paper towels go in the hazardous waste white bucket by the sink.



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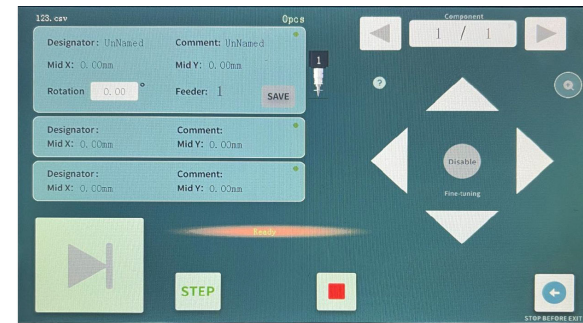
The Build Process

- Running the YY1 job:
 - Put the pasted board back in the YY1, being careful not to smudge the paste.
 - Ensure the initial state of the nozzles matched your job. (You should not try and drop a nozzle in a place that already has a nozzle.)
 - Hit the mount button.

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The Build Process

- Mounting presents this screen:



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The Build Process

- Mounting presents this screen:
 - Hitting the play button with start the job running.
 - You can also single step and preview.

The Build Process

- After running the job, if all parts have been placed, carefully move the board to the stereo microscope.
- If there are additional parts that need placing, you can move the board to the manual pick and place.

The Build Process

- The stereo microscope focuses by setting the height of the head above the table.
 - Adjust for focus.
 - Adjust the height of the chair for comfort.
 - Note that the lenses rotate to give you either a 4x or 8x view.
- Verify that parts are placed appropriately and nudge parts if necessary.

The Build Process

- Run the board through the reflow oven.
 - Green light on the belt entrance lights when the oven is at temperature.
 - It takes about 30 minutes to heat us, so turn on the oven and hit the OK button before you do the earlier steps.
- Re-inspect and repair after reflow.

Testing your board

- Basic Test
 - Power
 - Program
- Interface testing

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Demonstrating

- Board should:
 - Program
 - SPI: Show SPI interface driving a display
 - A number of different displays will be available.
 - Library to use is based on the display controller.
 - All the displays I have worked on my version of this board using Adafruit libraries.
 - I2C:
 - Temp sensor demo.
 - OLED demo
 - External I2C demo.

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Driving a Display

- Find the Adafruit library. Note that the library should be chosen based on the controller used in the display.
 - Most displays have this information on the back.
 - Simple search will find the needed info if it is not on the back.
- The GitHub site for the library will have example programs. All that I have seen have an example called graphicstest.

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Driving a Display

- You will need to set the pins appropriately for your choice of GPIO pins.
- You will need to set the display size (in pixels).
- You will need to connect the display using the cable with the Dupont connector on one end. (The JST connector will be installing in the display.)
- Thus, you will be connecting to the header pins, not to the JST.

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