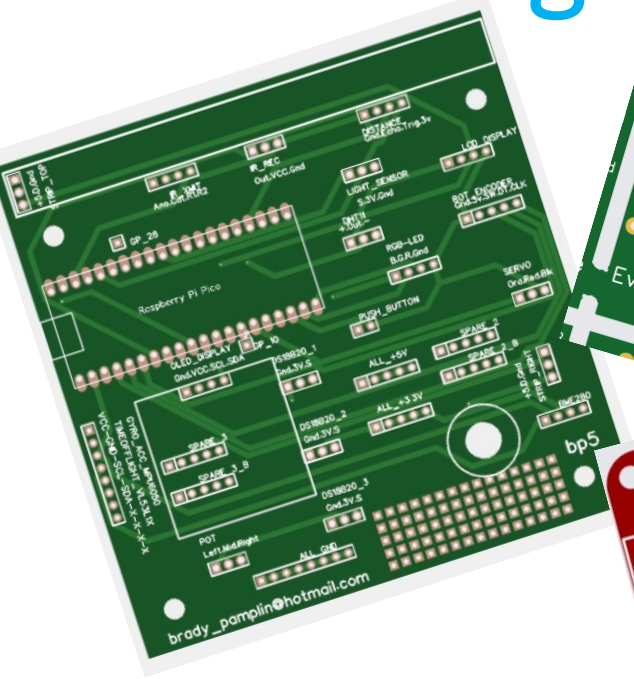
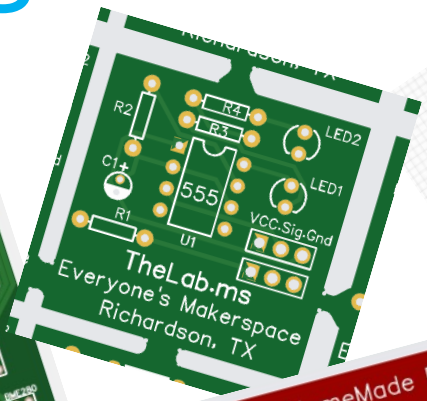
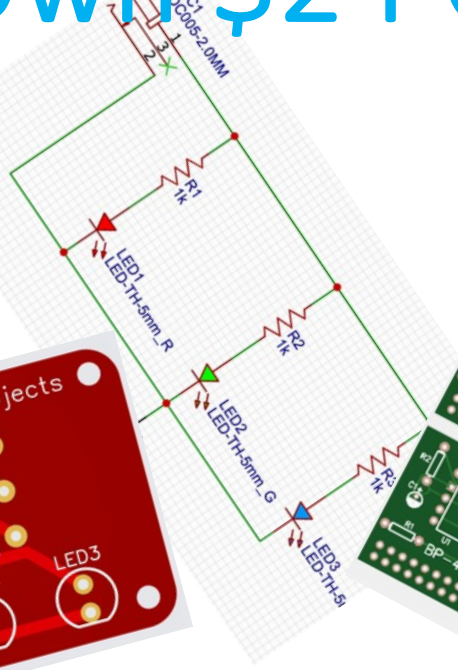
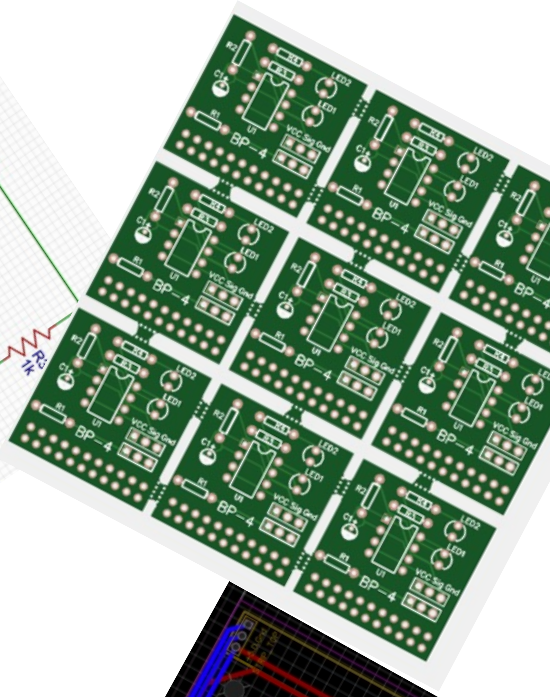
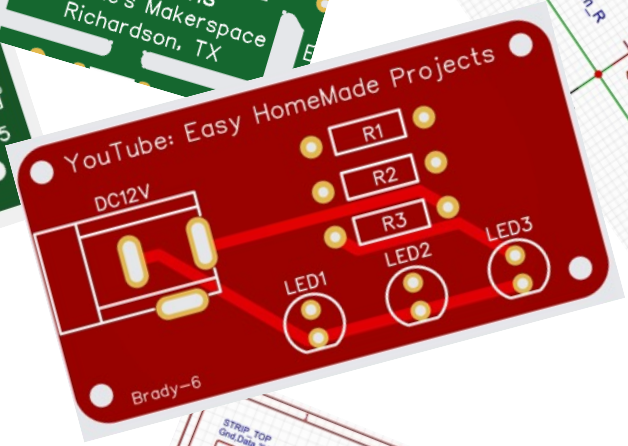
Design Your Own $2 PCB

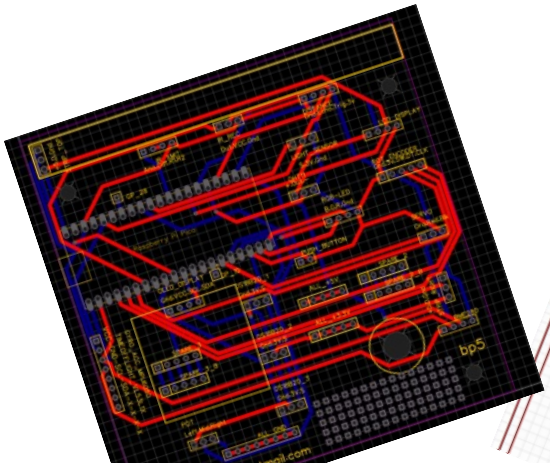


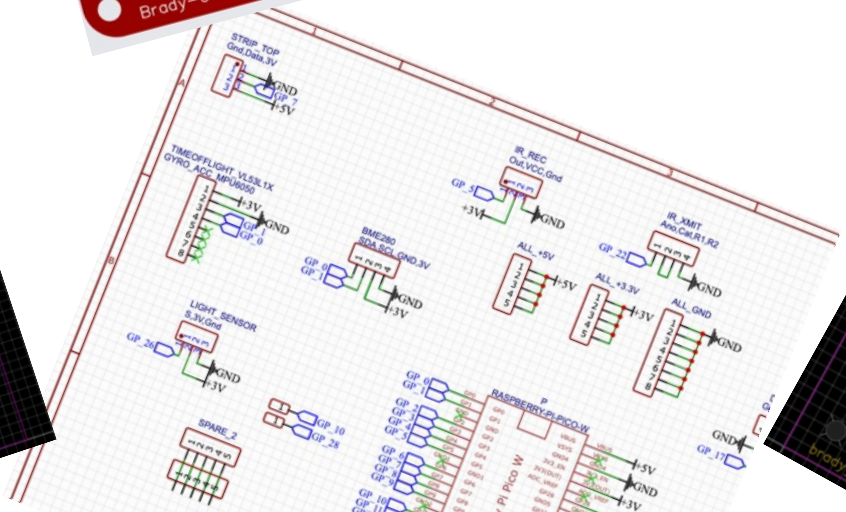


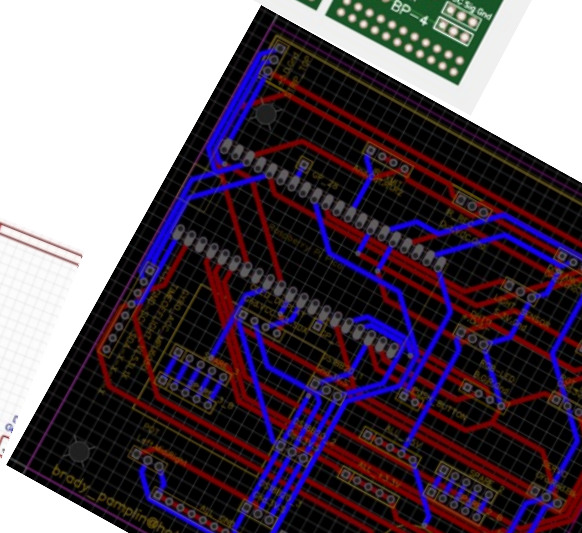




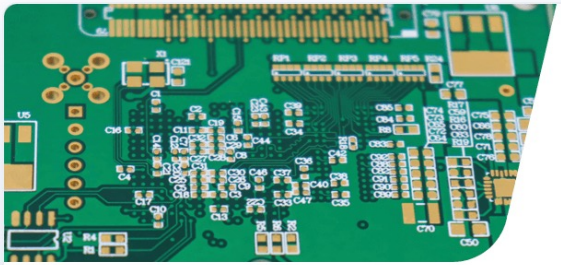


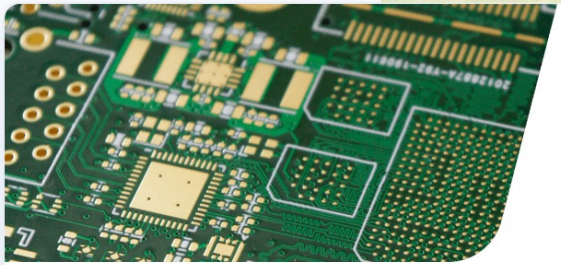


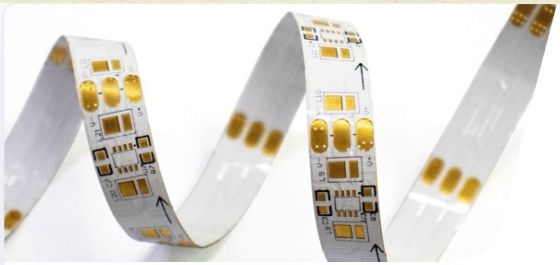




Is this for real?
Five 4”x4” two layer boards for two bucks?







1 - 4 Layers

From **$2** /5pcs | Build Time: 24 hours

- 1-2L - $2 for 100×100mm PCBs
- 4L - $2 for 50×50mm PCBs
- FR4, Aluminum, Copper, Rogers, PTFE

Quote Now Learn More >

6 - 20 Layers

From **$2** /5pcs | Build Time: 4 days

- 6-8L - $2 for 50×50mm PCBs
- 6-20L - Free via-in-pad with POFV
- Controlled impedance PCB

Quote Now Learn More >

Flex PCBs

From **$15** /5pcs | Build Time: 4 days

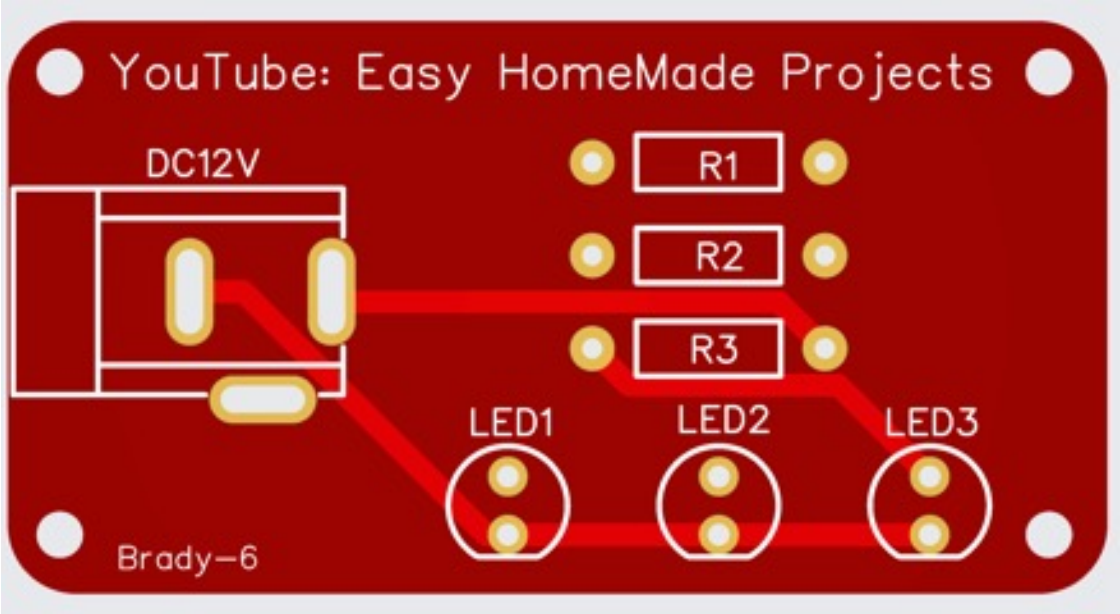
- Electro-Deposited (ED) copper
- Support PI, FR4, 3M tape stiffeners
- Support PCB Assembly

Quote Now Learn More >

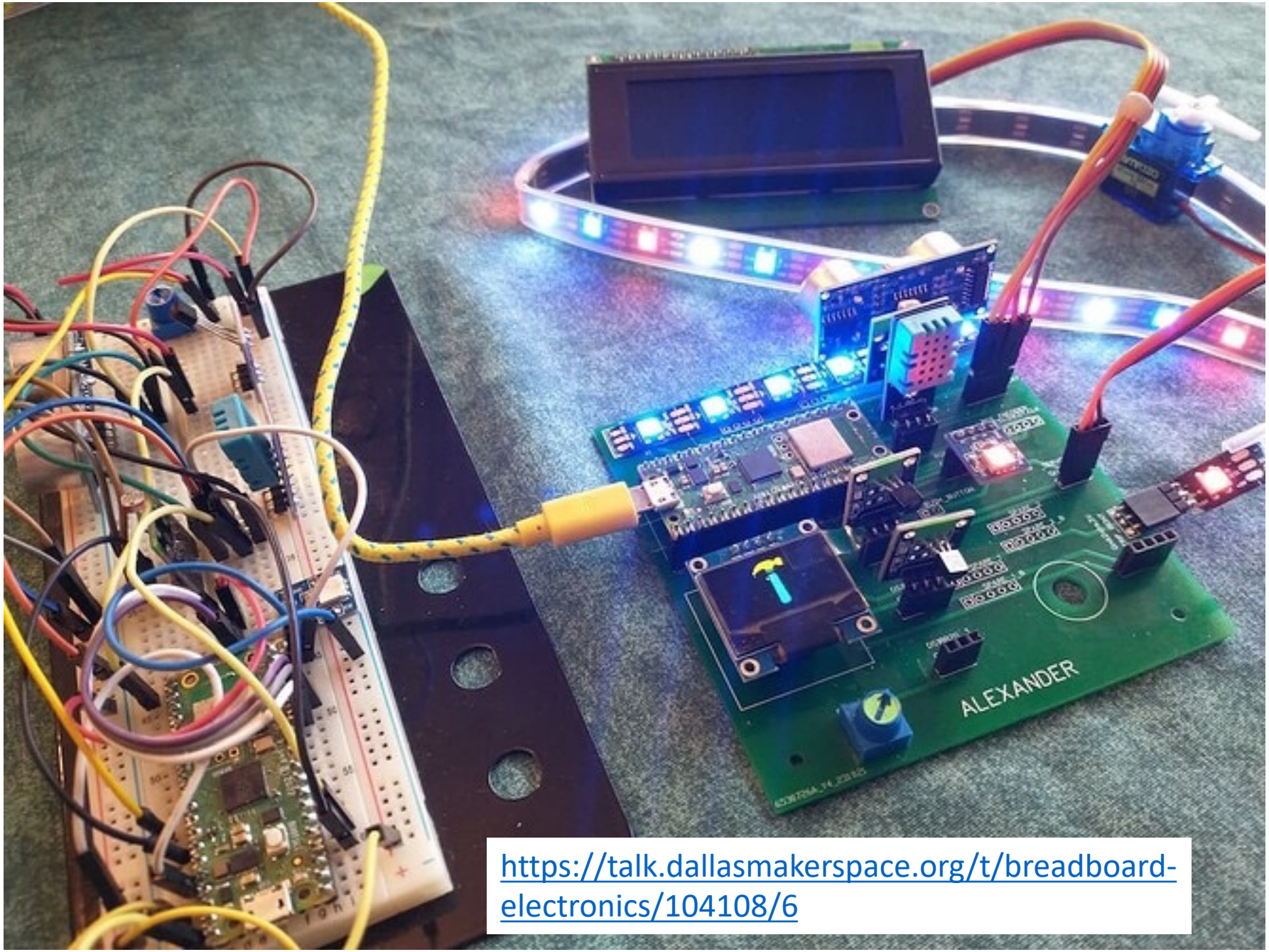
What’s the catch?

Goal

The main goal of the class is to show that anyone can take a little time, design a board and order it.



Brady Pamplin brady_pamplin@hotmail.com



https://talk.dallasmakerspace.org/t/breadboard-electronics/104108/6

High-Level Tasks

1. Design schematic
2. Convert to PCB
3. Arrange components
4. Route signals
5. Design rule check, look at 2D & 3D renders
6. Order PCBs

Exercises

Create an account at EasyEDA

Exercise 1: Place and connect a few random parts

Exercise 2: Download schematic parts not placed
Place and connect schematic parts

Exercise 3: Continue or download schematic complete
Run Design Rule Checker
Convert schematic to PCB
Place PCB parts
Try manual routing
Unroute All and run Auto Route

Exercise 4: Continue or download PCB complete
Fabrication / PCB Fabrication – No Generate Gerber
One Click order

Getting Started

EasyEDA documentation
https://docs.easyeda.com/en/Schematic/Canvas-Settings/index.html

Class is based around this YouTube:
https://www.youtube.com/watch?v=gCwibH1YeiY

Chrome browser is recommended

Create an account at https://easyeda.com/

For class, choose EasyEDA Designer / STD Edition

File / New Project
- Click frame to set paper size
- 600x500 is good for small diagrams

Links

Exercise 2: class_sch_parts_not_placed

https://u.easyeda.com/join?type=project&key=71c6ec33d120dc9745af5f42da2f26a6&inviter=e7e846ad3f354077ad8104a09db976dd

Exercise 3: class_sch_complete

https://u.easyeda.com/join?type=project&key=498ae6466712a53f6416b54ff4ac099d&inviter=e7e846ad3f354077ad8104a09db976dd

Exercise 4: class_final

https://u.easyeda.com/join?type=project&key=32c762f5c18bbefb5ebe82147a485470&inviter=e7e846ad3f354077ad8104a09db976dd

Links

555 simulation

https://u.easyeda.com/join?type=project&key=17bb2d917e8a067d7e9efd856bf73a60&inviter=e7e846ad3f354077ad8104a09db976dd

555 ordered bp4

https://u.easyeda.com/join?type=project&key=3509ccaefa7686eab2e3c00743bcceb9&inviter=e7e846ad3f354077ad8104a09db976dd

Component Modules

One or more of the following

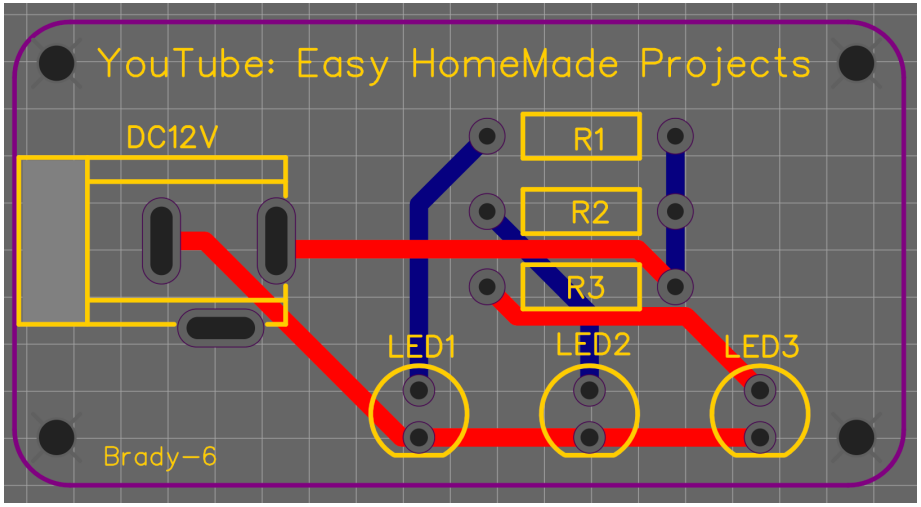
- Schematic diagram image
- Footprint for PCB
  - Through hole or surface mount
- 2D View
- 3D View
- Simulation

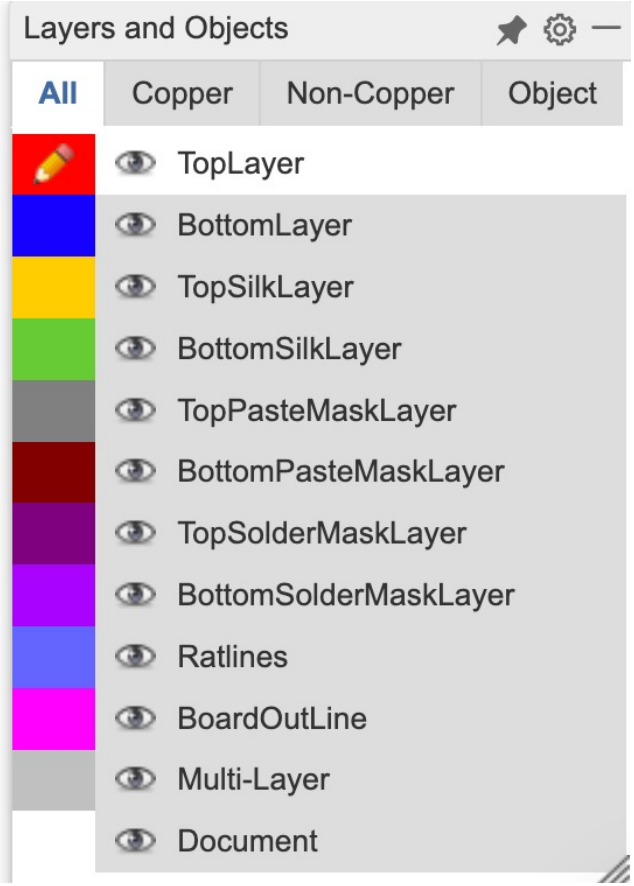
Main Layers of a PCB

Top Silkscreen – Text
Top Solder Mask

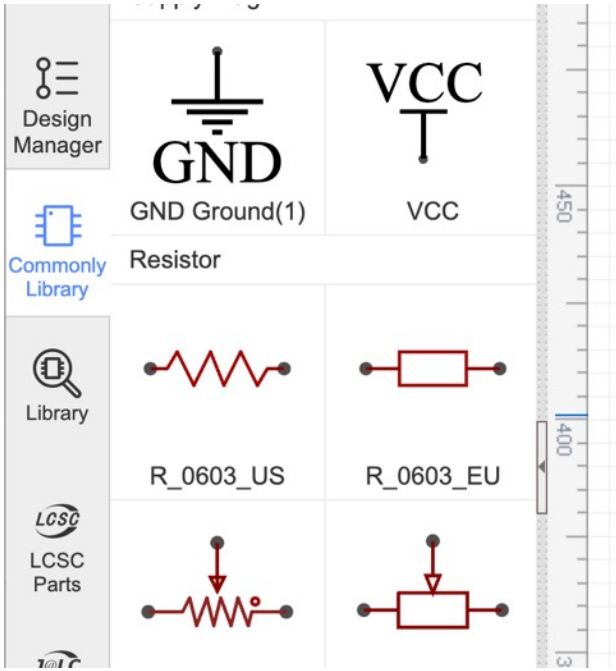
Top Copper – Red
Board – Fiberglass – 1.6mm
Bottom Copper – Blue

Bottom Solder Mask
Bottom Silkscreen - Printing





Exercise 1:
Place and connect a few random parts on the schematic screen



File / New Project

Select Commonly Library on left toolbar

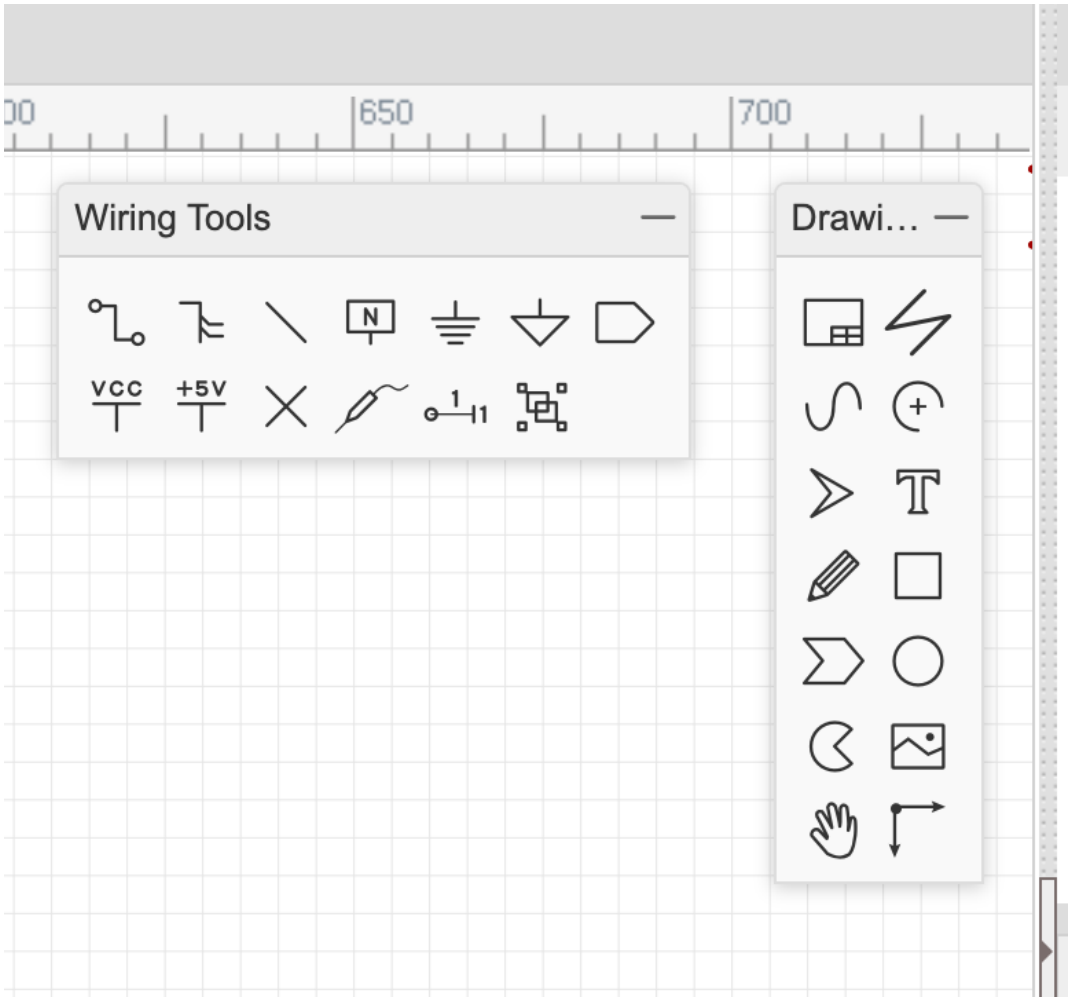
Left click a part – do not drag. Left click to place.
Right click to end placing the part.

Escape key may not work as expected but Ctrl-Z to Undo works great.

Space bar to rotate
X to reverse horizontal
Y to reverse vertical

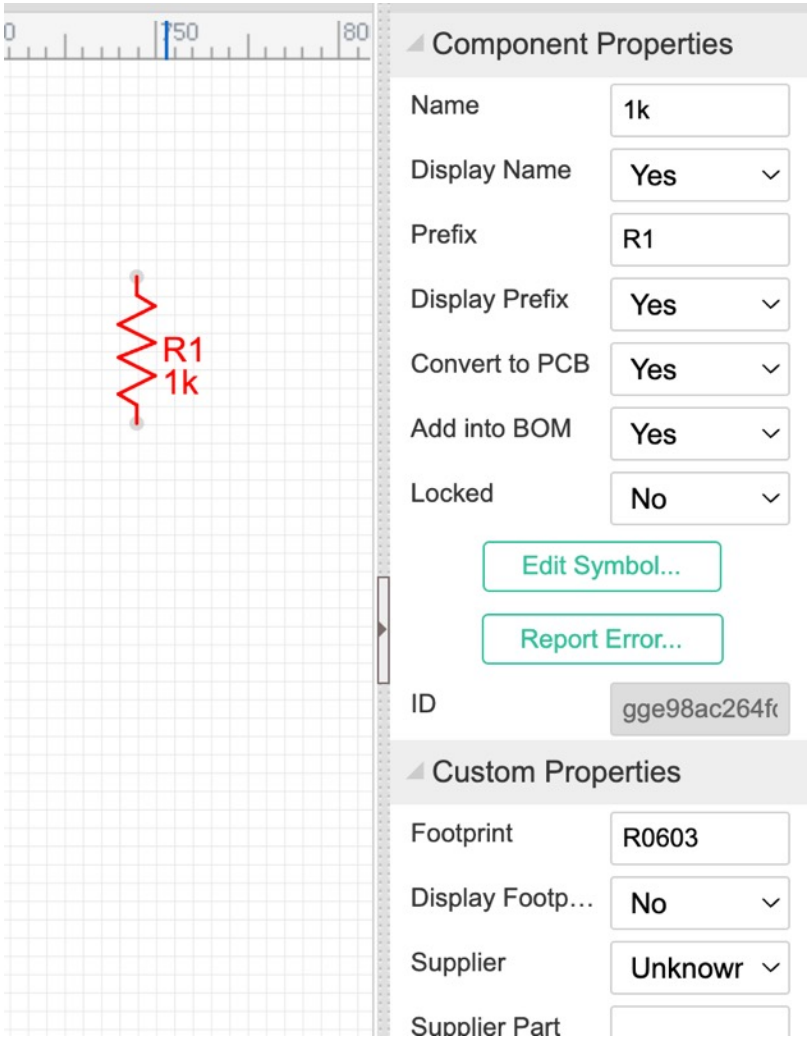
Exercise 1: Wiring and Drawing Tools

File / New Project

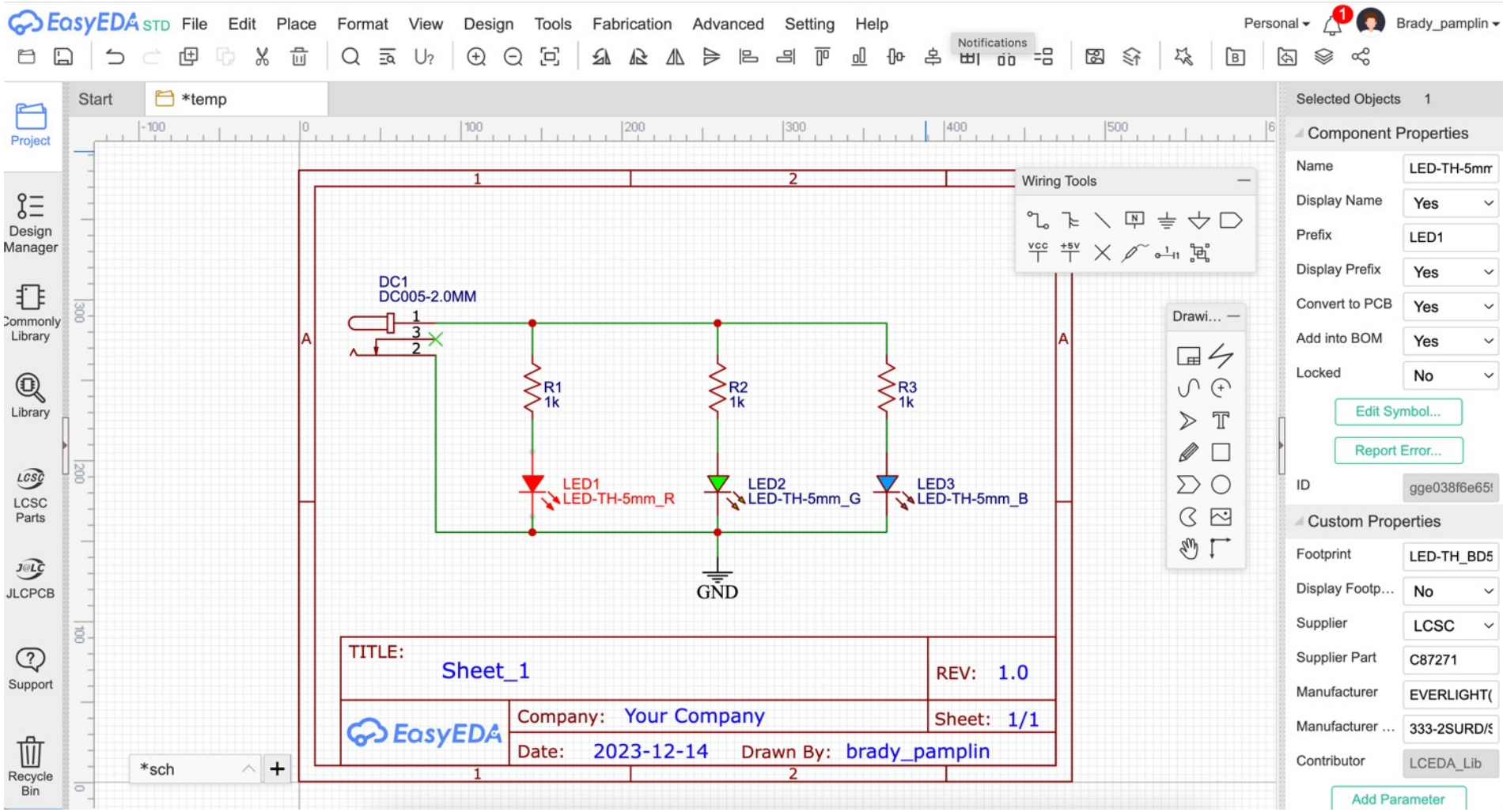


Exercise 1:
Component Properties Table

Display Name and Prefix can be modified by clicking the text or by changing the table entry,



Exercise 2: Prepare the Schematic

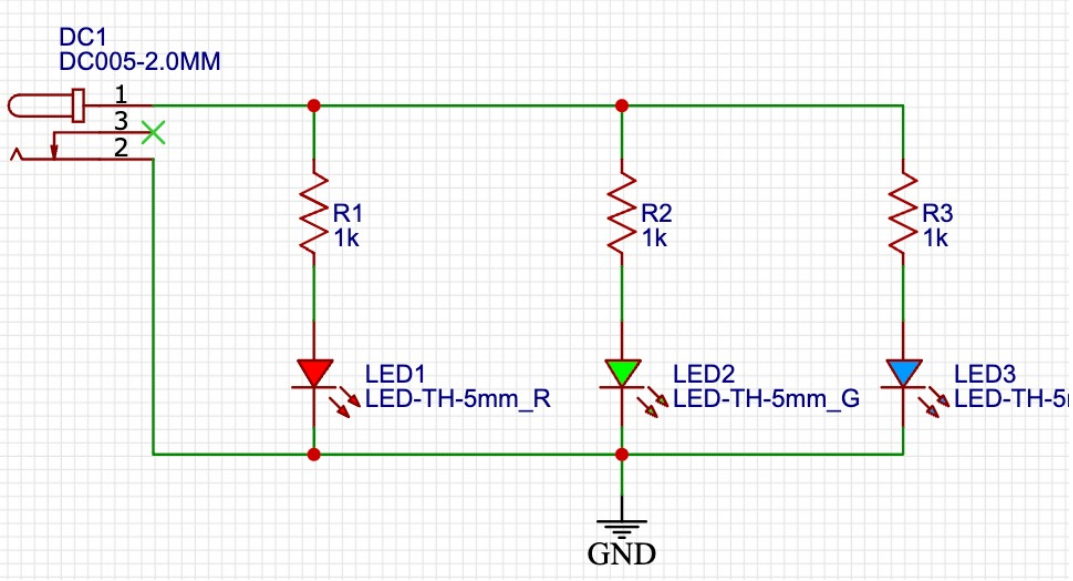


Exercise 2:

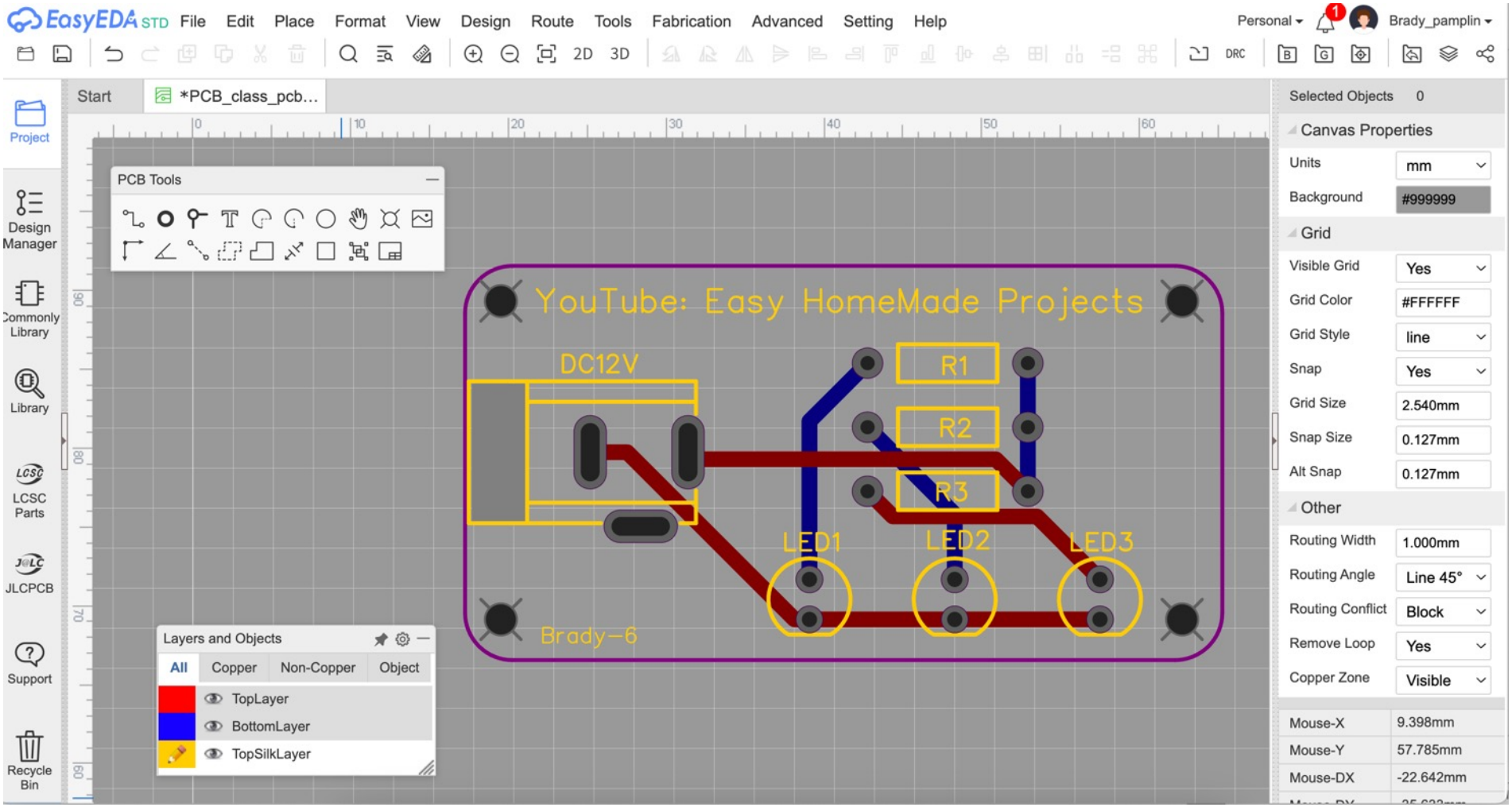
Move parts into position

Rotate as required

Change text and values in schematic and table on right

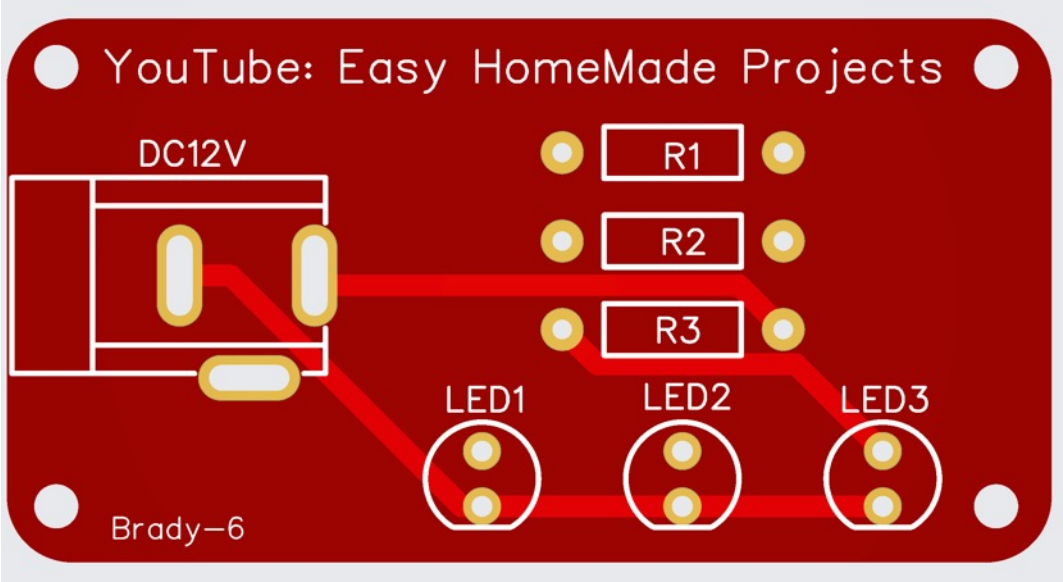


Exercise 3: Place parts and Route

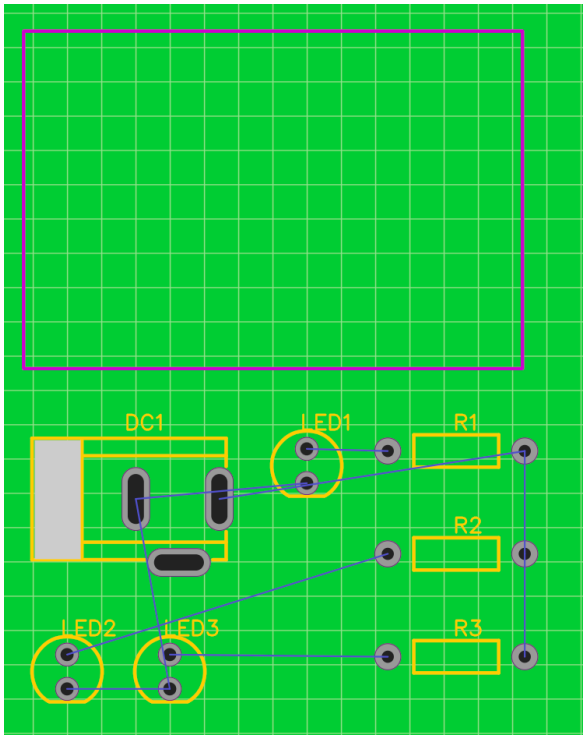


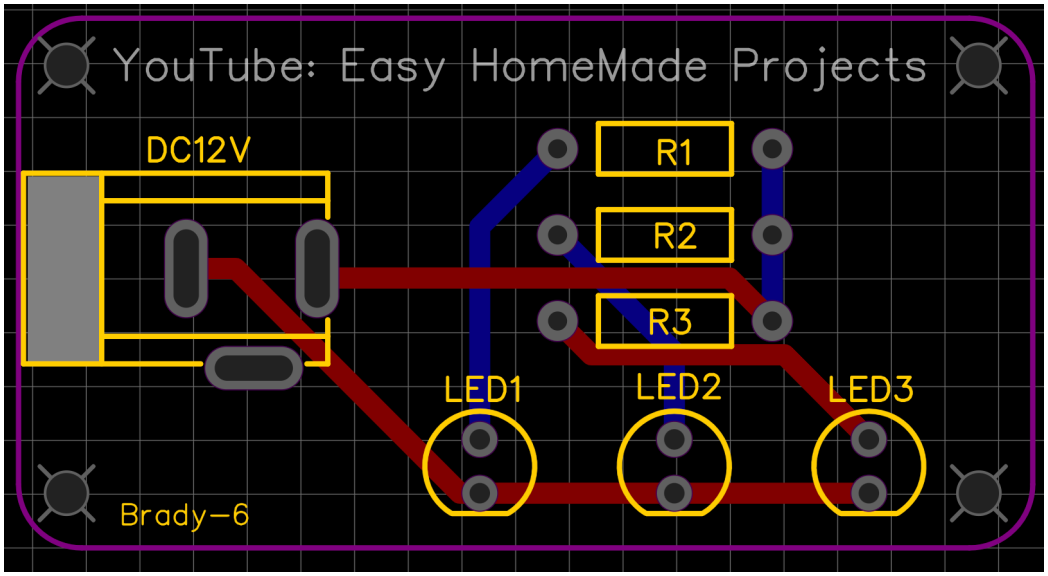
Exercise 3:

Use your schematic file or download schematic complete file
Run Design Rule Checker
Convert schematic to PCB with Design/ConvertSchematic to PCB – only once
    If you move back to schematic, move forward with Design/Update PCB
Place PCB parts
Text on top silkscreen
Try manual routing
Unroute All
Auto Router

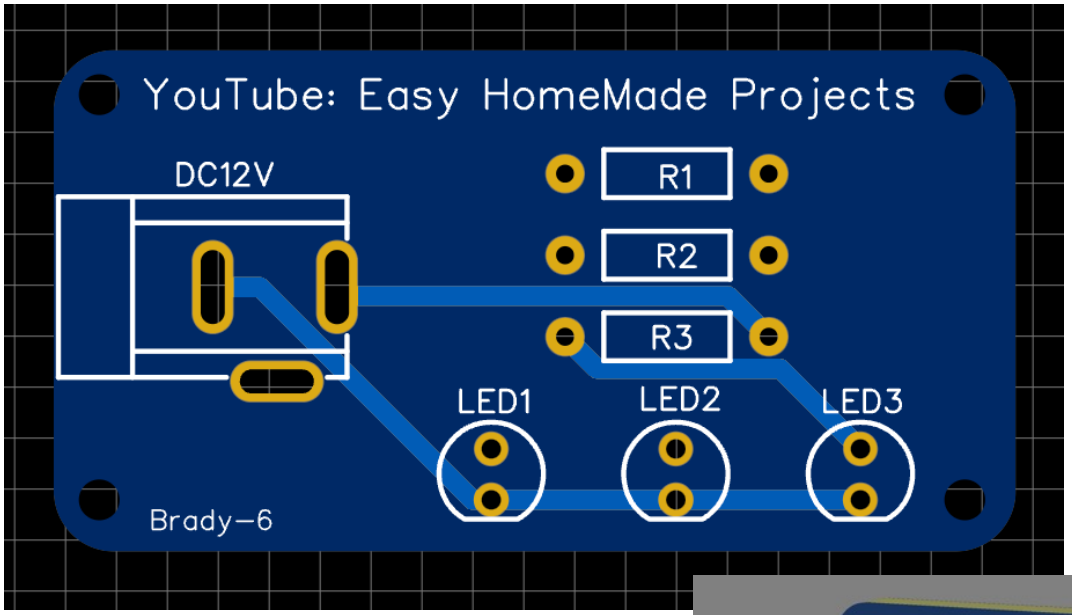


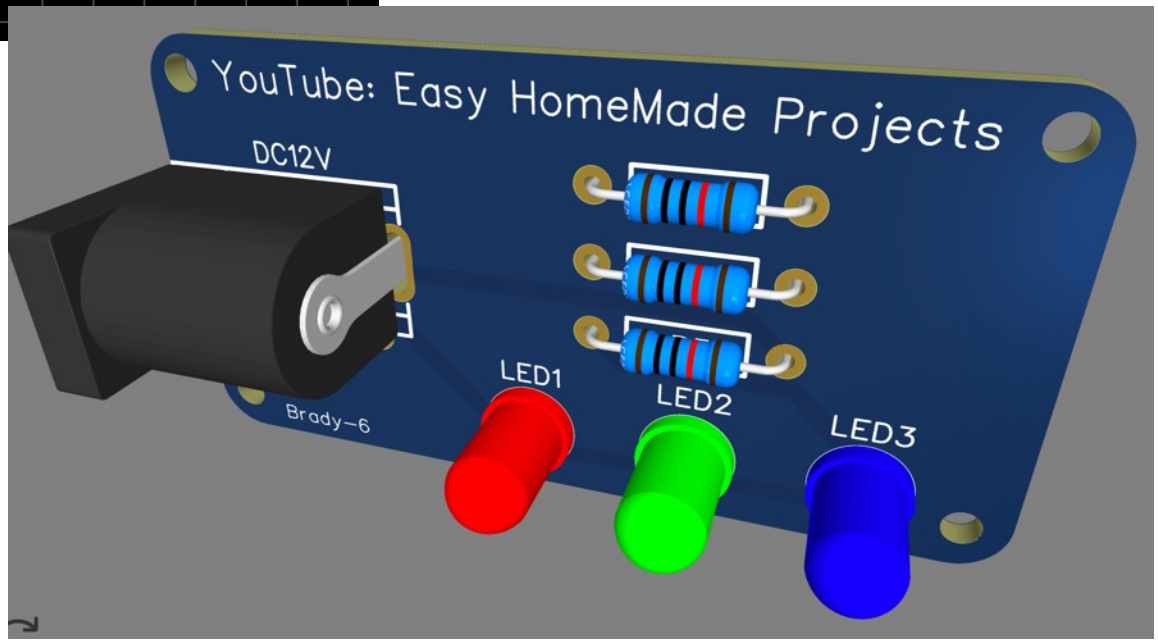
Exercise 3:


DC1
LED1
R1
R2
LED2
LED3
R3


YouTube: Easy HomeMade Projects
DC12V
R1
R2
R3
LED1
LED2
LED3
Brady-6

Exercise 3: View / 2D & 3D





Exercise 4:
It’s ready…
Prepare and optionally order

Download PCB complete or keep your own

Fabrication / PCB Fabrication – No Generate Gerber

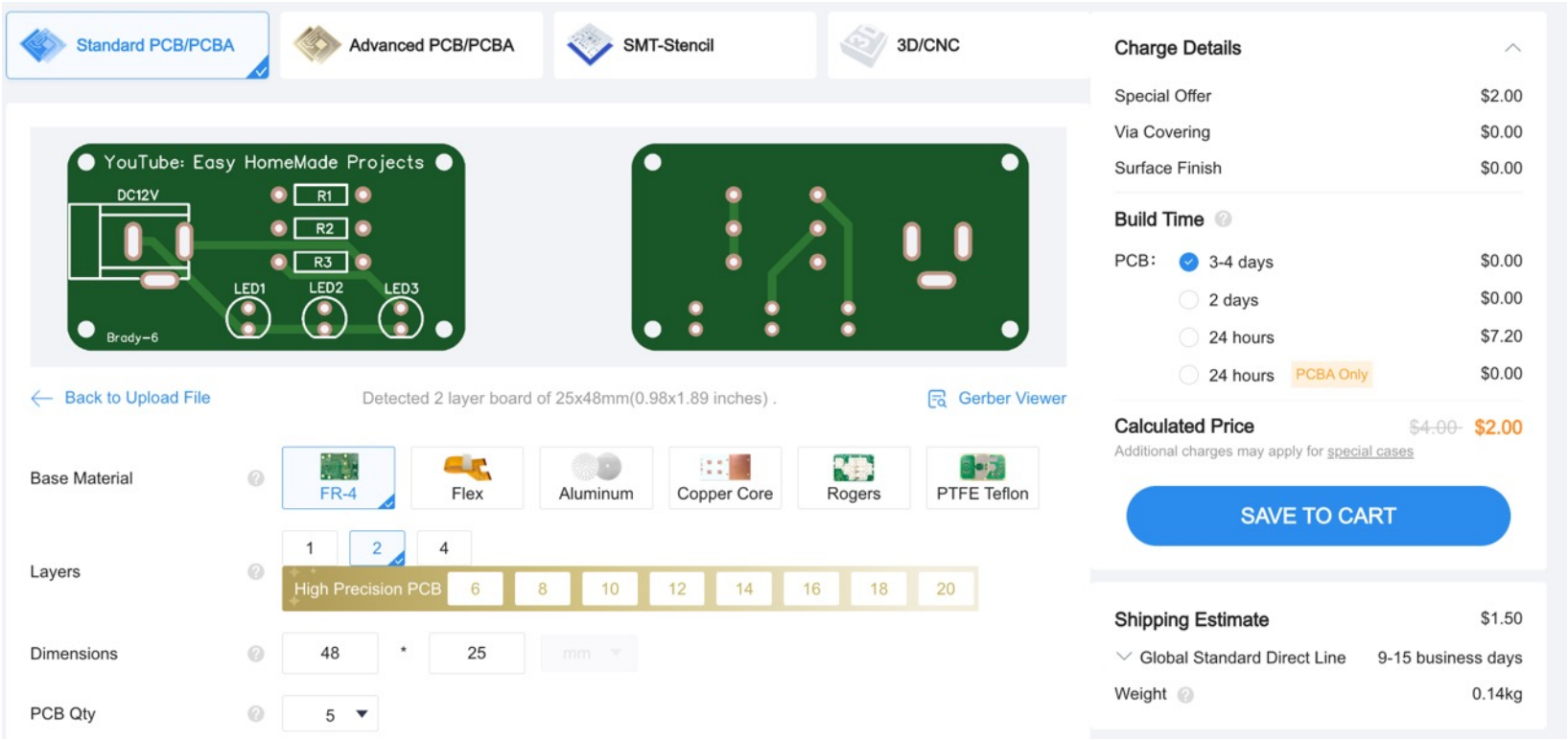
One Click order

Note the price

Colors are neat but add two days

Check out JLCPCB panelize

Default order



Five boards for $3.50 plus tax!

Not bad but you can get more for your money

Panelizing Methods

Order many small size boards – best edges

Panelize in EasyEDA

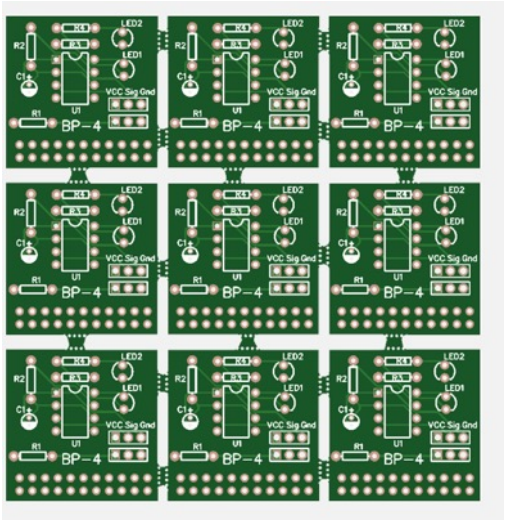
ThisIsNotRocketScience panelizer – rough but cheap

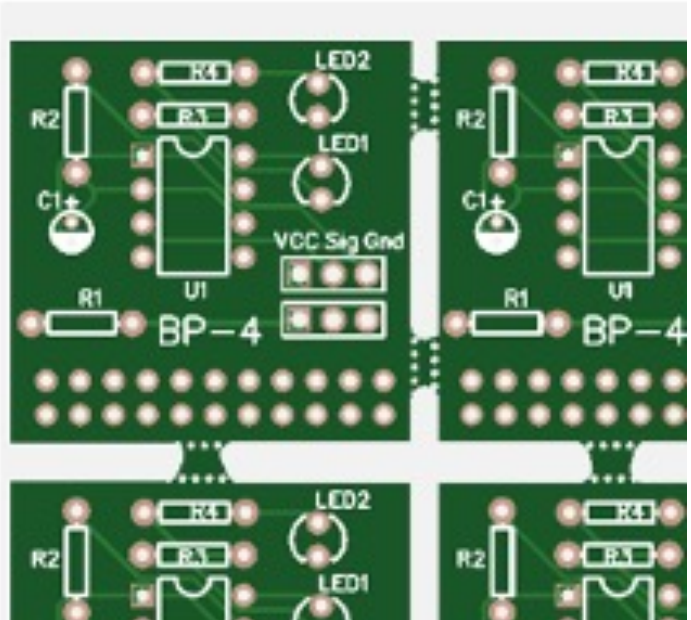
JLCPCB panelizing – rows and columns on last page

ThisIsNotRocketScience Panelizer

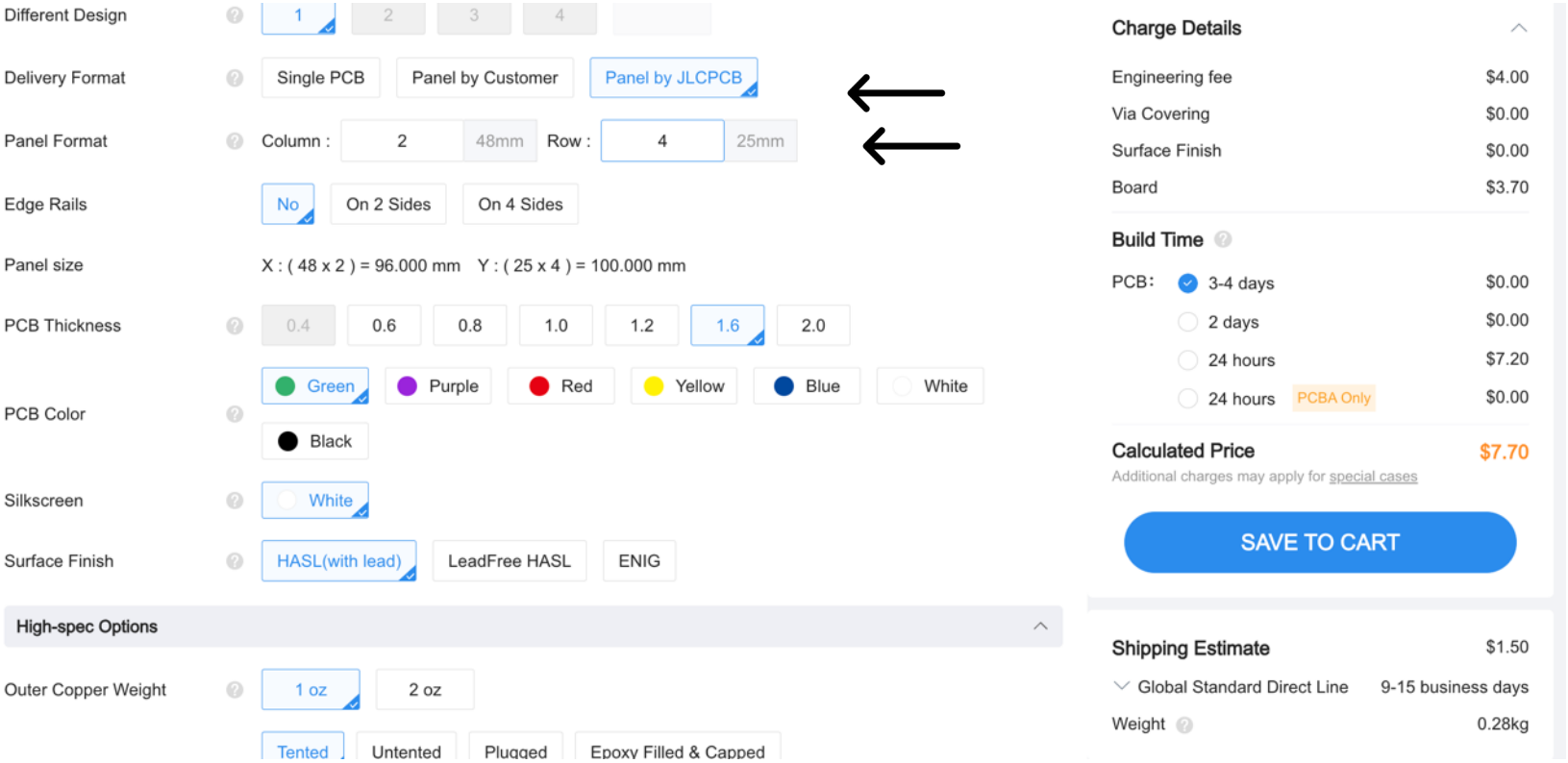
Not well documented but there are a number of YouTubes.
There is no extra charge for fabricating such boards.

https://www2.thisisnotrocketscience.nl/software/pcb-panelizer/





JCLPCB Panelize 2x4



Forty boards for $9.20 plus tax

Three Recent Orders

PCB Prototype

Order #: Y18-6530726A

Build Time: 3-4 days

5 pcs $7.70

Product Details

class_pcb_PCB_class_pcb__...

Production Completed

Quality Complaint

Merchandise Total: $7.70

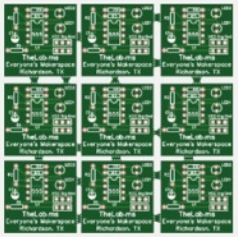
Shipping Charge: $1.50

Sales Tax: $0.76

Order Total: $9.96

Panelized by JLCPCB – 2 columns – 4 rows
Break apart – 40 small boards for under $10.00

2023-11-16 | W202311160456384



PCB Prototype

Order #: Y16-6530726A

Build Time: 2 days

5 pcs $3.20

Product Details

555_panels_Y16

Production Completed

Quality Complaint

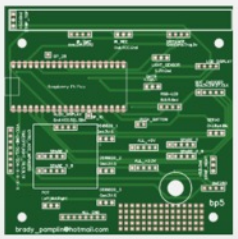
Merchandise Total: $3.20

Shipping Charge: $1.50

Order Total: $4.70

Panelized by Brady with NotRocketScience Panelizer. A little rough but no extra charge.

2023-11-05 | W202311050238404



PCB Prototype

Order #: Y14-6530726A

Build Time: 2 days

5 pcs $2.00

Product Details

pcb_4_PCB_pcb_4__202311...

Production Completed

Quality Complaint

Merchandise Total: $2.00

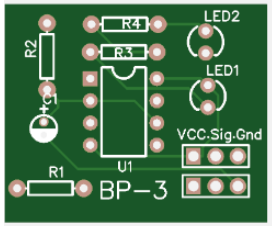
Shipping Charge: $1.50

Order Total: $3.50

A basic 100mmx100mm – 4”x4” board
Awesome deal!

Another Deal

2023-10-26 | W202310260739638



PCB Prototype

Order #: Y10-6530726A

Build Time: 2 days

30 pcs $5.70

Product Details

555 Timer_PCB_555 Timer__...

Production Completed

Quality Complaint

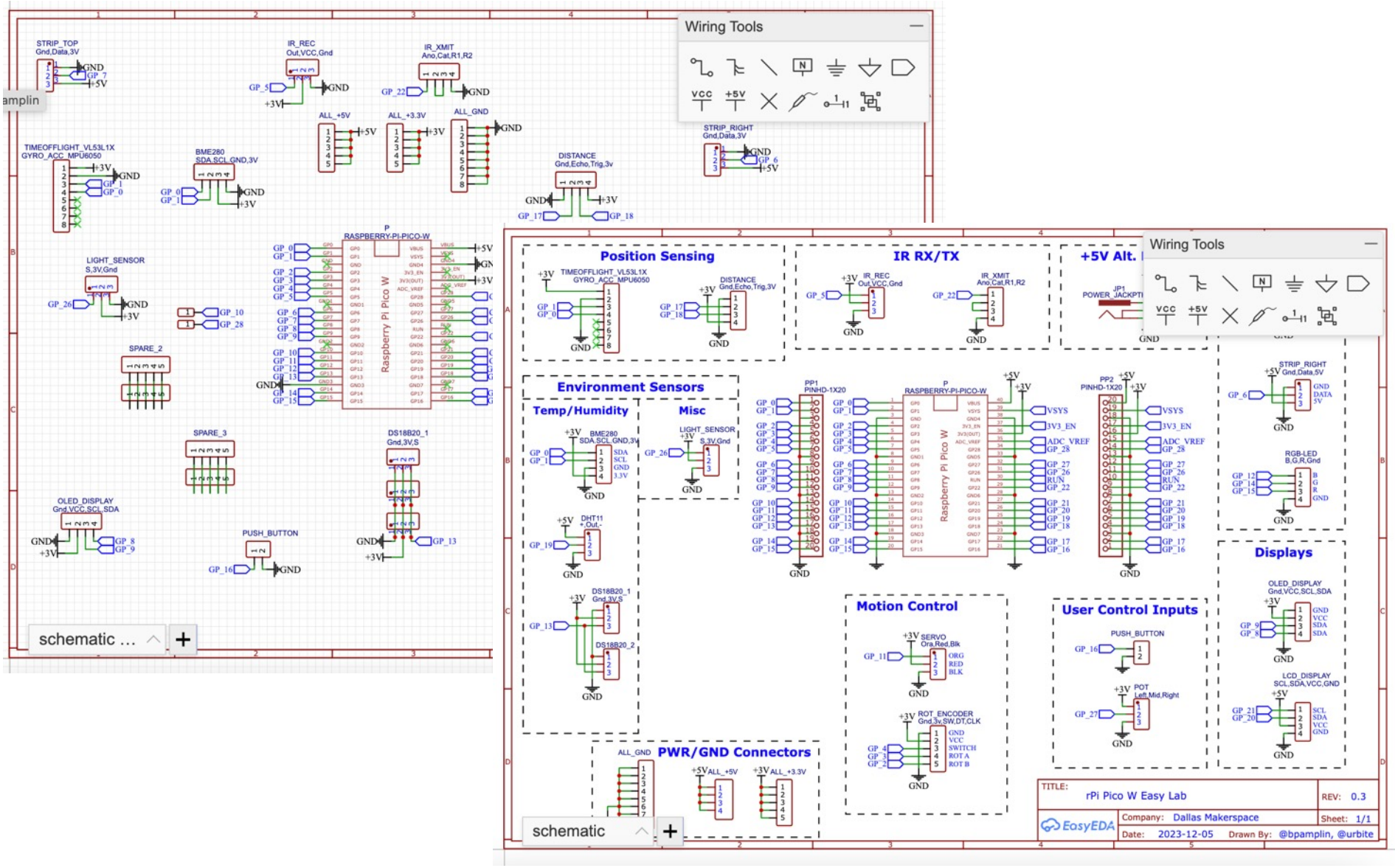
Merchandise Total: $5.70

Shipping Charge: $1.44

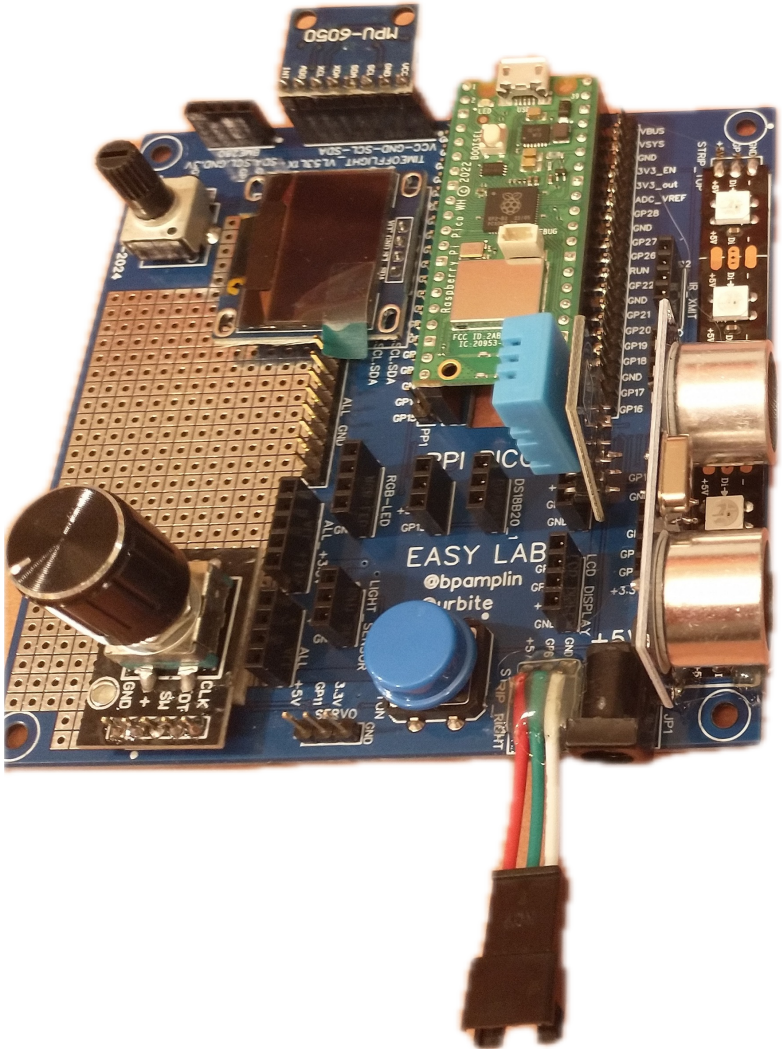
Order Total: $7.14

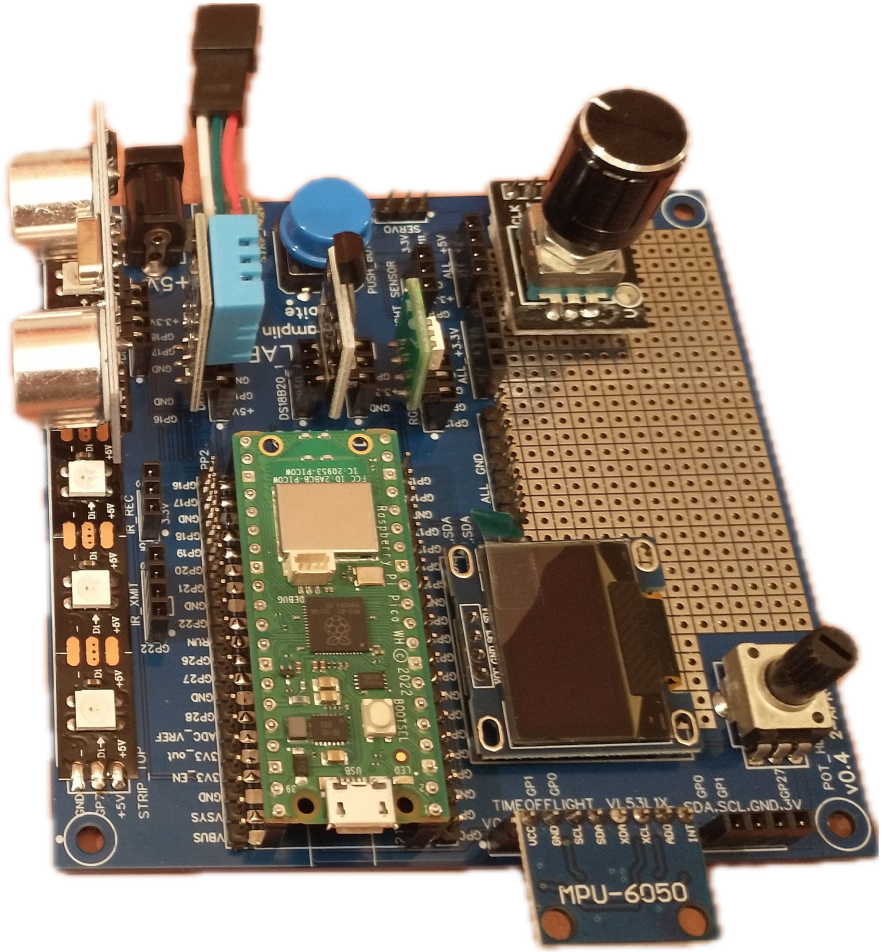
30 separate 30mmx25mm boards
Nice but should have specified rounded the corners

Brady's Novice Schematic Perfected by a Real Professional

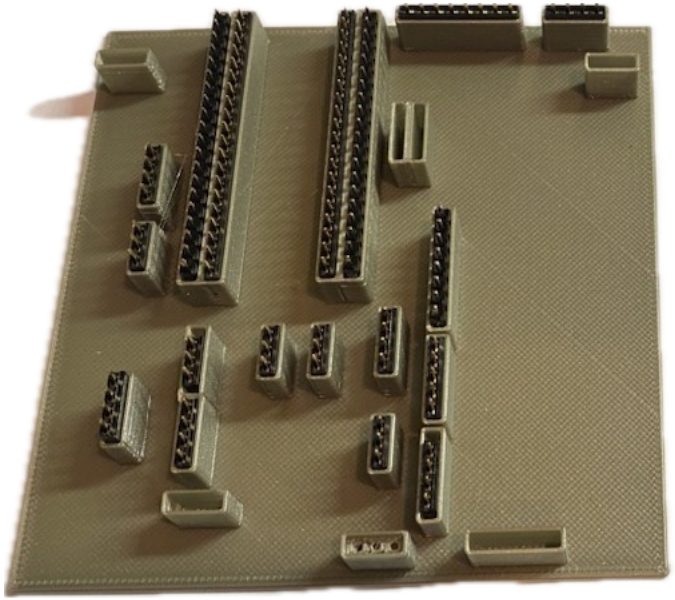


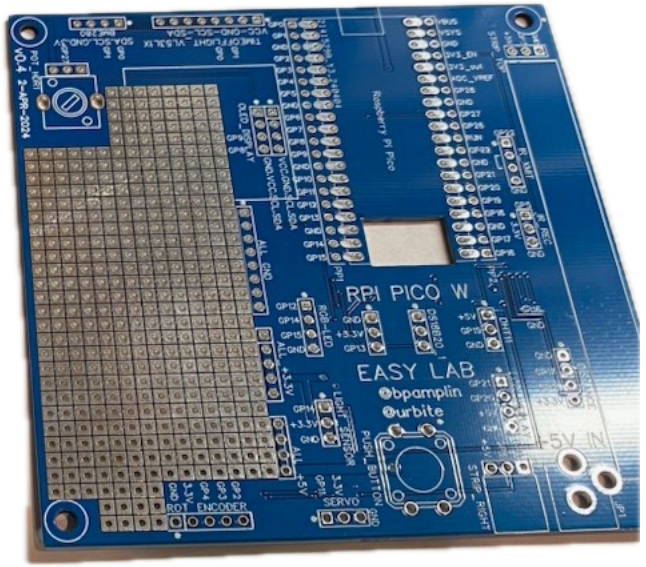
Paul Urbanus - Easy Lab Board





Paul Urbanus
Assembly Jig and Board



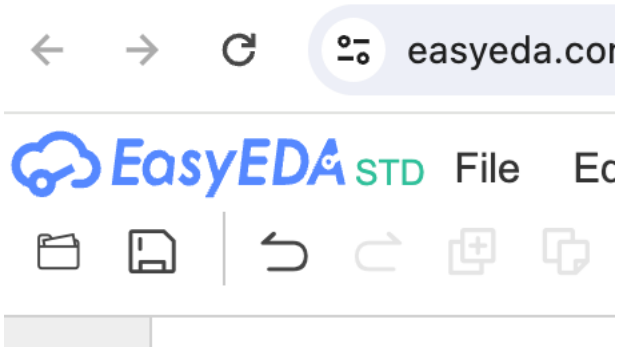


Zip file contains plans for board, jig and sample Python programs.

https://1drv.ms/u/s!AtRNaDxYyK1fjK4JcoU-YKcEoKxLsw?e=A1hvNm

LT Spice Simulation

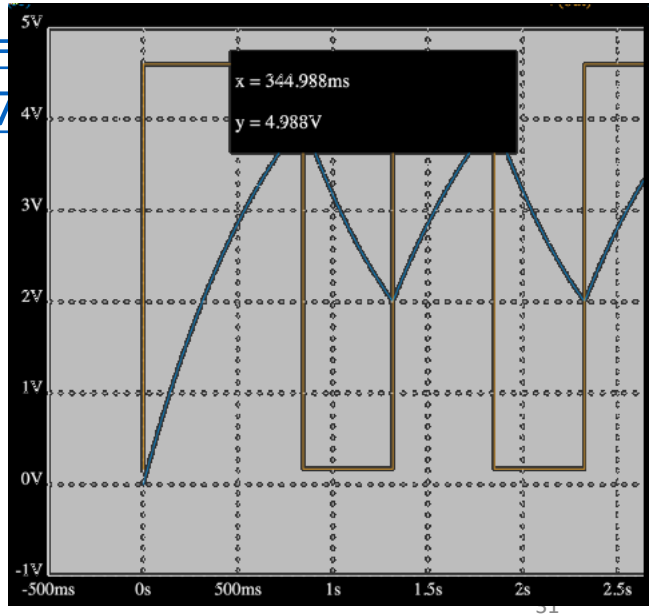
Change STD to SIM after upper left logo



Simulation/Simulation Setting
  10m = 10 milliseconds
  4s = 4 seconds

Simulation/RunYourSimulation

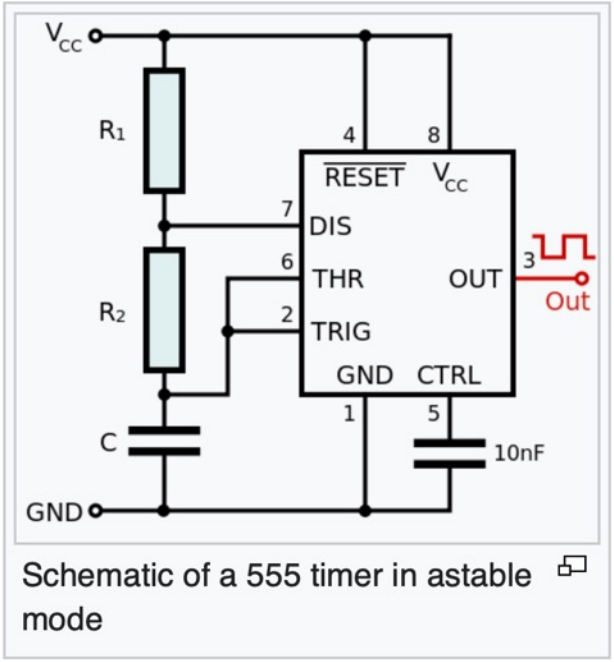
https://u.easyeda.com/join?type=project&key=d7e9efd856bf73a60&inviter=e7e846ad3f35407dd



555 Timer Chip – Astable Circuit

Wikipedia: In 2017, it was said that over a billion 555 timers are produced annually by some estimates, and that the design was "probably the most popular integrated circuit ever made".

https://en.wikipedia.org/wiki/555_timer_IC



Schematic of a 555 timer in astable mode

Astable mode examples with common values

Frequency	C	R_1	R_2	Duty cycle
0.1 Hz (+0.048%)	100 µF	8.2 kΩ	68 kΩ	52.8%
1 Hz (+0.048%)	10 µF	8.2 kΩ	68 kΩ	52.8%
10 Hz (+0.048%)	1 µF	8.2 kΩ	68 kΩ	52.8%
100 Hz (+0.048%)	100 nF	8.2 kΩ	68 kΩ	52.8%
1 kHz (+0.048%)	10 nF	8.2 kΩ	68 kΩ	52.8%
10 kHz (+0.048%)	1 nF	8.2 kΩ	68 kΩ	52.8%
100 kHz (+0.048%)	100 pF	8.2 kΩ	68 kΩ	52.8%