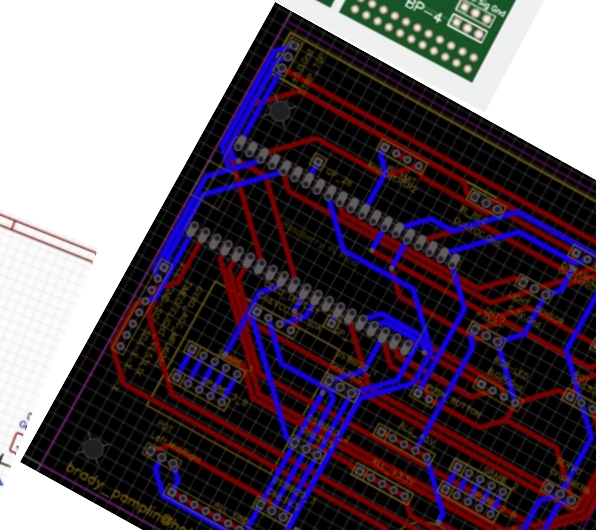
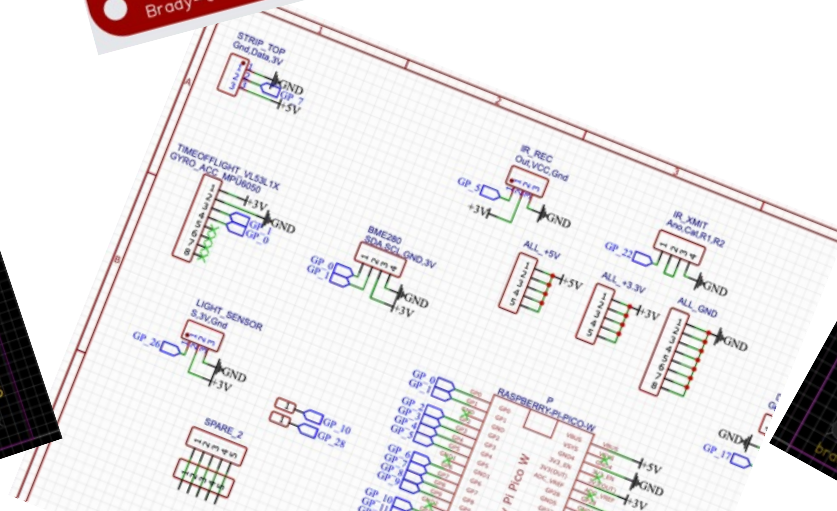
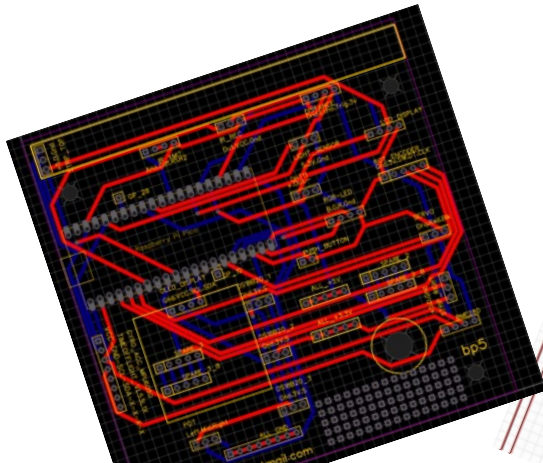
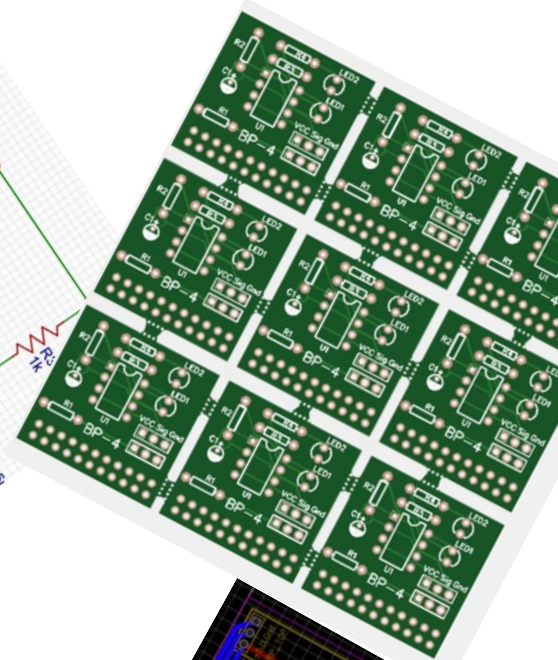
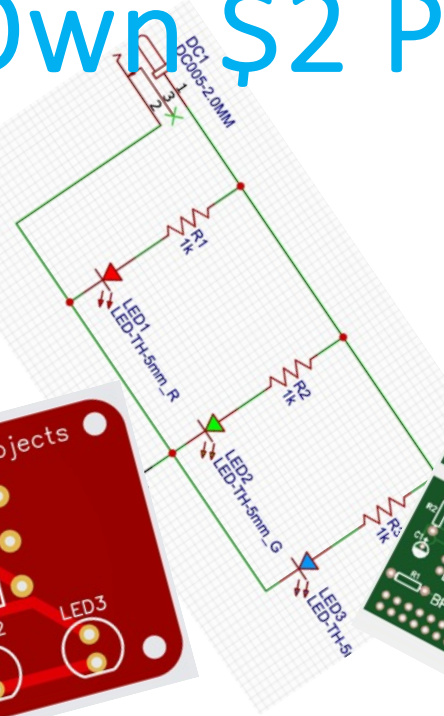
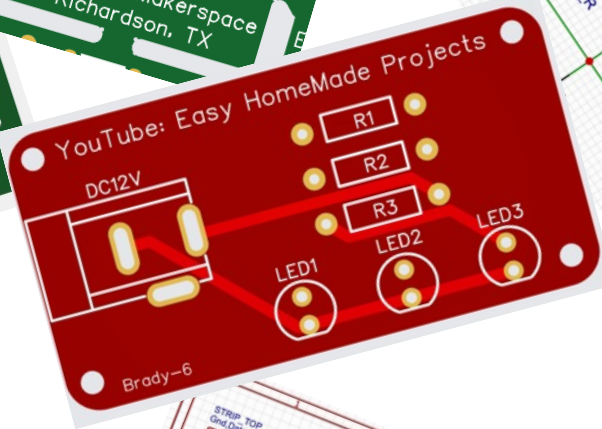
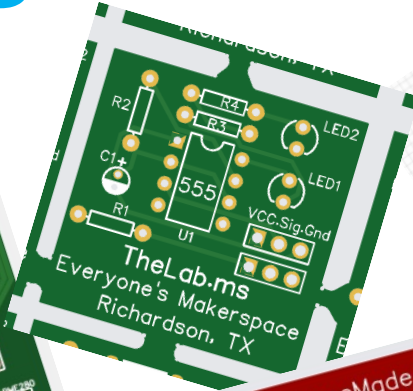
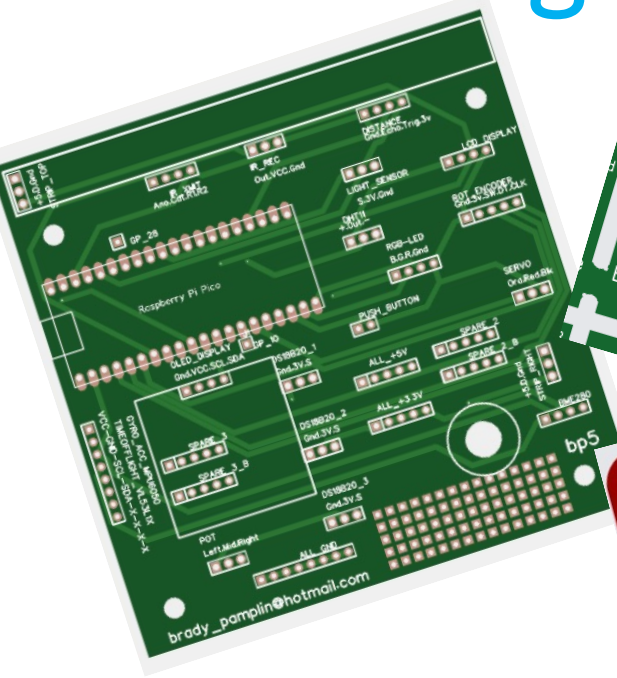
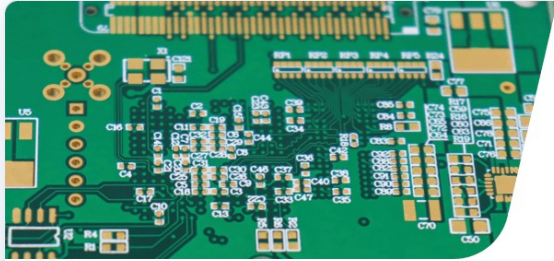


Design Your Own \$2 PCB



Is this for real?

Five 4"x4" two layer boards for two bucks?



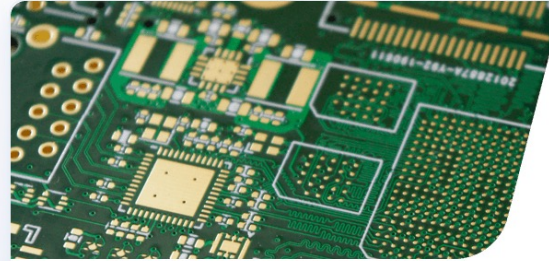
1 - 4 Layers

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

- 1-2L - \$2 for 100x100mm PCBs
- 4L - \$2 for 50x50mm PCBs
- FR4, Aluminum, Copper, Rogers, PTFE

[Quote Now](#)

[Learn More >](#)



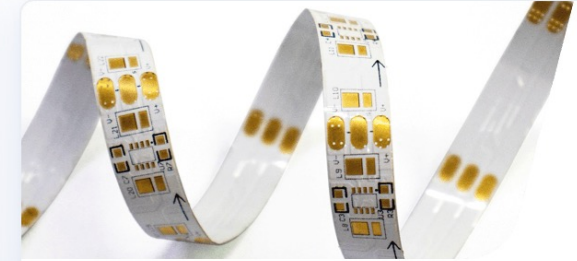
6 - 20 Layers

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

- 6-8L - \$2 for 50x50mm 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

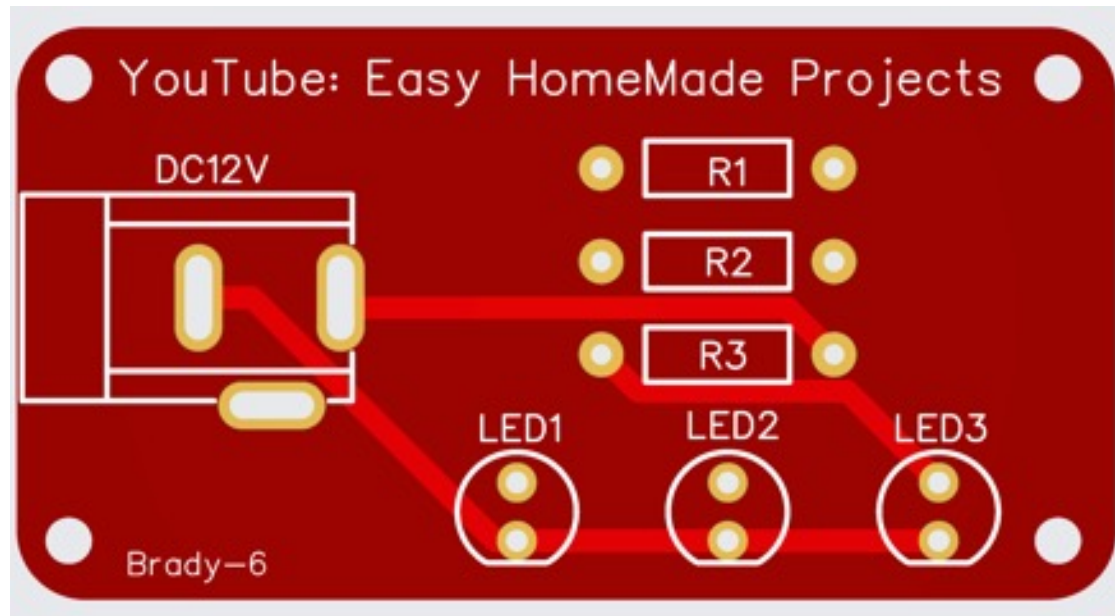
[Quote Now](#)

[Learn More >](#)

What's the catch?

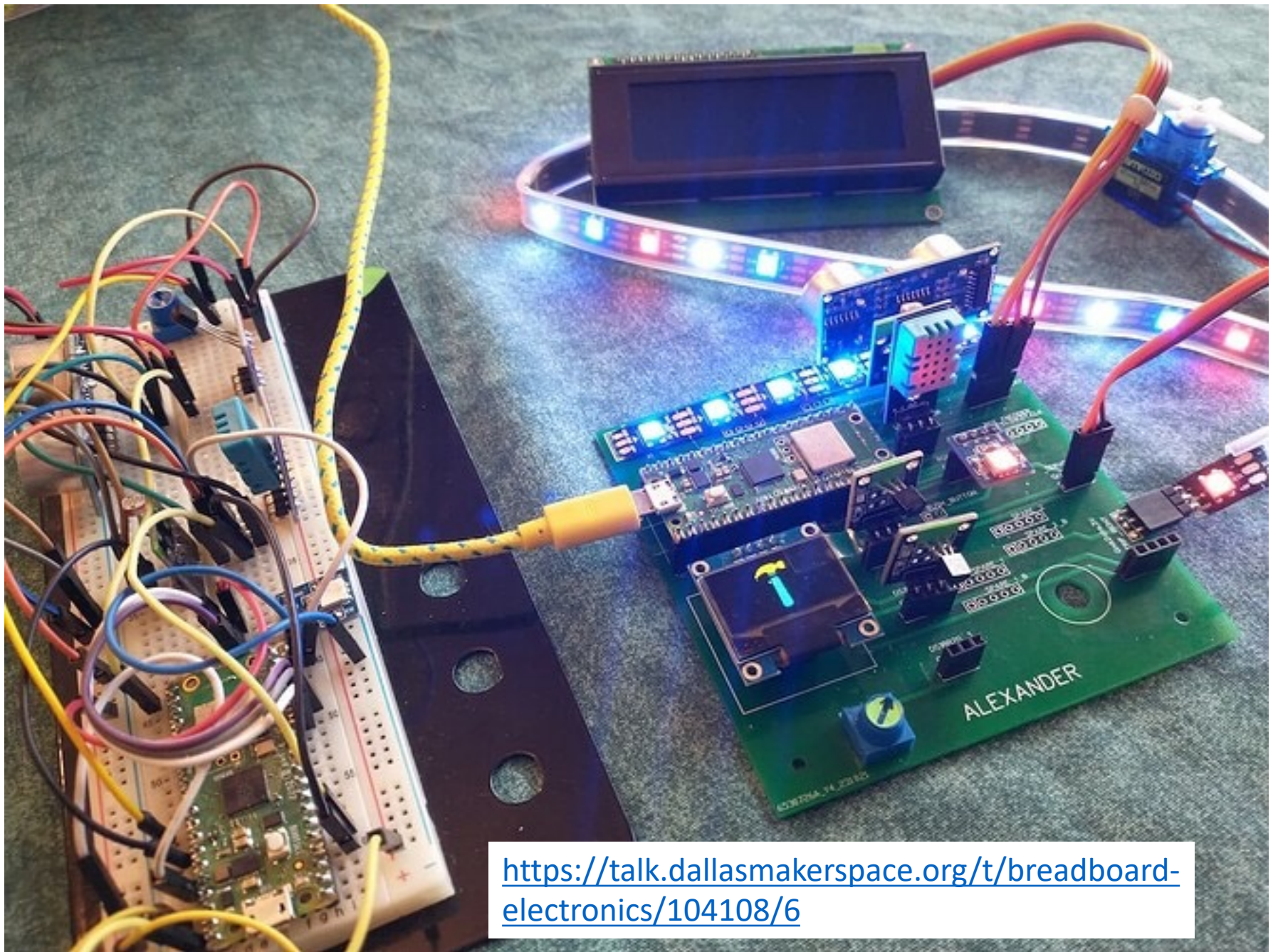
Goal

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

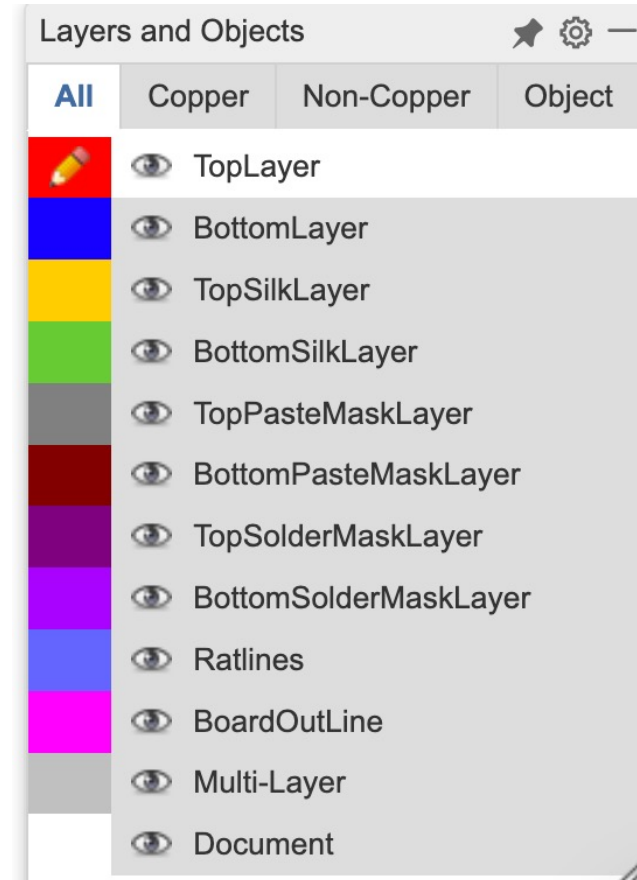
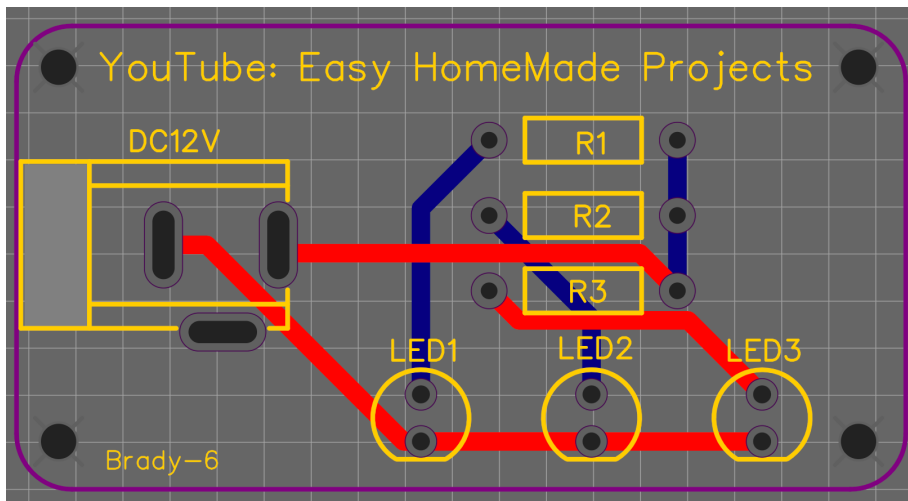
- Schematic diagram image
- Footprint for PCB
 - Through hole or surface mount
- 2D View
- 3D View
- Simulation

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

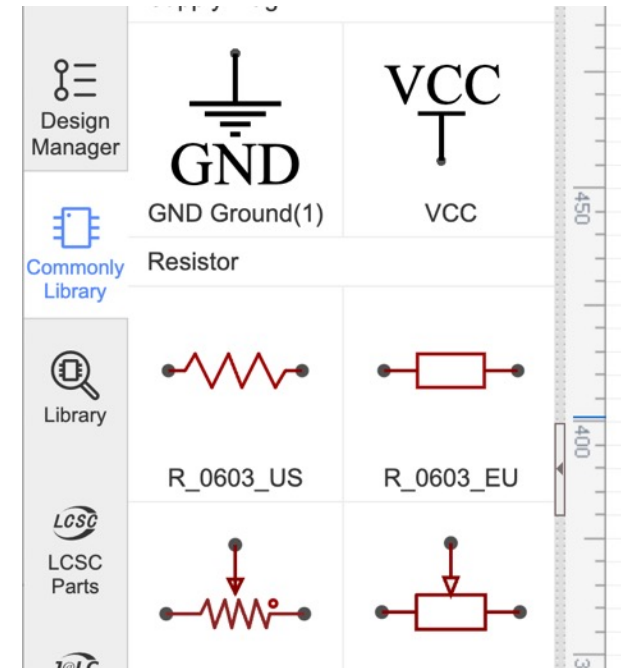
Left click a part – do not drag. Left click to place.
Right click to end placing the part.

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

Space bar to rotate

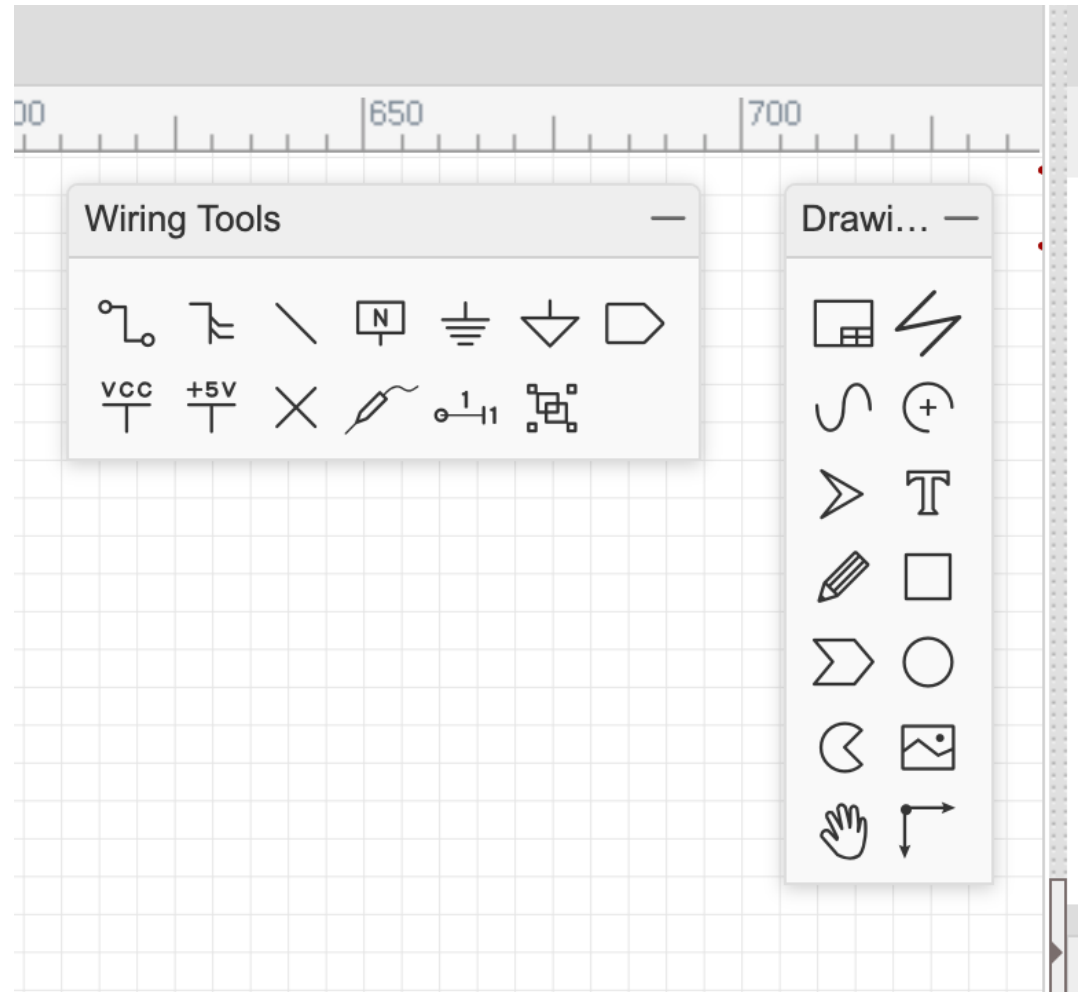
X to reverse horizontal

Y to reverse vertical



Exercise 1: Wiring and Drawing Tools

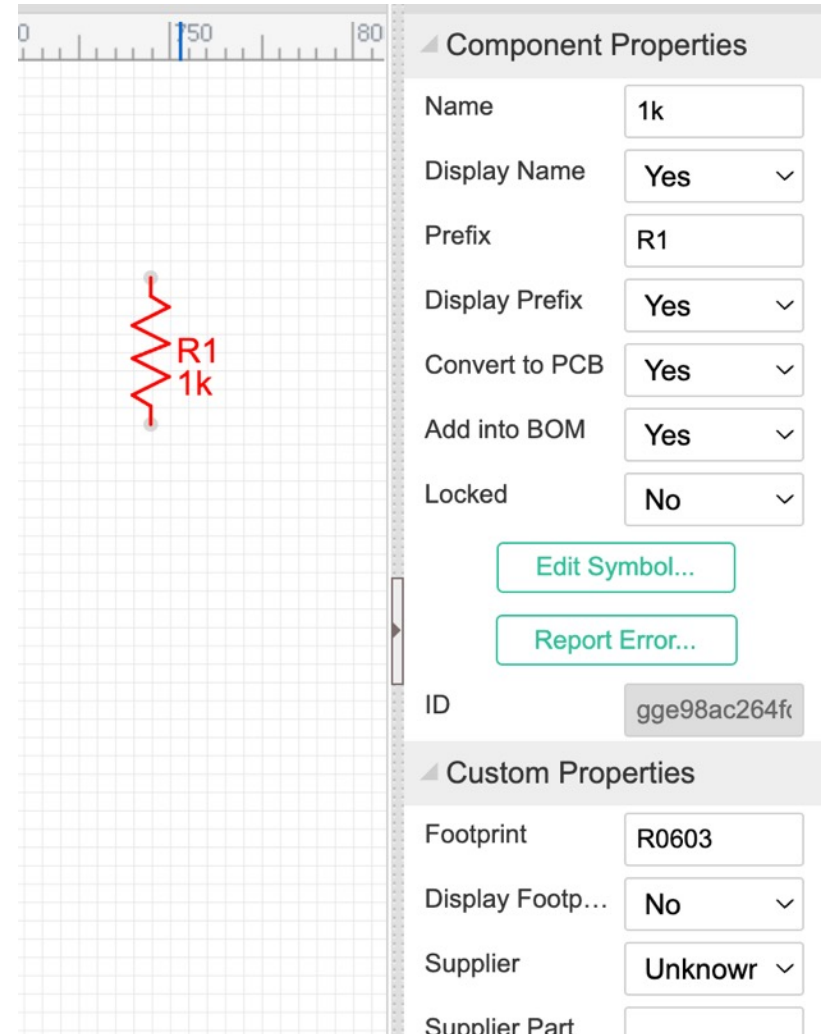
File / New Project



Exercise 1:

Component Properties Table

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



The screenshot shows a PCB design software interface. On the left, a grid displays a red resistor symbol with the text "R1" and "1k" next to it. On the right, a "Component Properties" panel is visible, containing a table of properties and two buttons: "Edit Symbol..." and "Report Error...". Below the main properties table is a section for "Custom Properties".

Component Properties	
Name	1k
Display Name	Yes
Prefix	R1
Display Prefix	Yes
Convert to PCB	Yes
Add into BOM	Yes
Locked	No
Edit Symbol...	
Report Error...	
ID	gge98ac264fc
Custom Properties	
Footprint	R0603
Display Footp...	No
Supplier	Unknowr
Supplier Part	

Exercise 2: Prepare the Schematic

The screenshot displays the EasyEDA software interface. The main workspace shows a schematic diagram of a parallel LED circuit. A DC source labeled "DC1 DC005-2.0MM" is connected to a network of three parallel branches. Each branch contains a 1k resistor (R1, R2, R3) in series with an LED (LED1, LED2, LED3). The LEDs are labeled "LED1 LED-TH-5mm_R", "LED2 LED-TH-5mm_G", and "LED3 LED-TH-5mm_B". The circuit is connected to ground (GND). The interface includes a top menu bar, a toolbar, a left sidebar with project and design tools, and a right sidebar with component properties and custom properties. A title block is visible at the bottom of the schematic area.

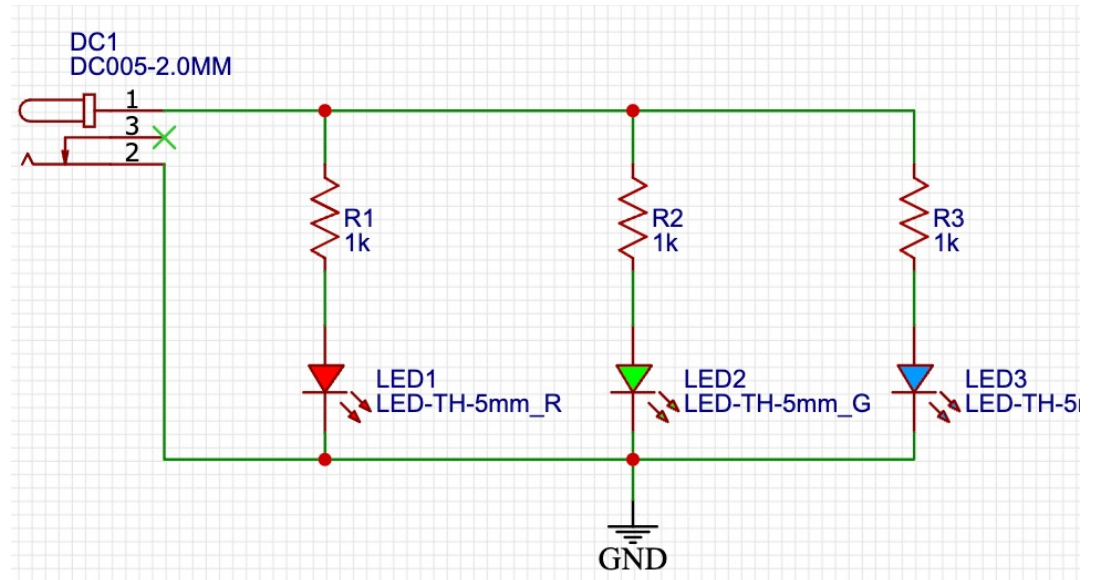
TITLE: Sheet_1		REV: 1.0
Company: Your Company		Sheet: 1/1
Date: 2023-12-14		Drawn By: brady_pamplin

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

The screenshot displays the EasyEDA software interface for PCB design. The main workspace shows a PCB layout with a purple rounded rectangle containing the following components and text:

- Text: "YouTube: Easy HomeMade Projects" (top center)
- Text: "Brady-6" (bottom center)
- Component: "DC12V" (top left)
- Resistors: "R1", "R2", "R3" (top right)
- LEDs: "LED1", "LED2", "LED3" (bottom right)

The layout features red and blue traces connecting these components. A "PCB Tools" panel is visible on the left, and a "Layers and Objects" panel is at the bottom left. The right sidebar shows "Canvas Properties" and "Grid" settings.

PCB Tools Panel:

- Place
- Move
- Copy
- Paste
- Delete
- Undo
- Redo
- Zoom In
- Zoom Out
- Fit
- Grid
- Grid Color
- Grid Style
- Snap
- Grid Size
- Snap Size
- Alt Snap

Layers and Objects Panel:

Layer	Object
All	Copper
All	Non-Copper
All	Object
TopLayer	
BottomLayer	
TopSilkLayer	

Canvas Properties Panel:

Property	Value
Units	mm
Background	#999999
Visible Grid	Yes
Grid Color	#FFFFFF
Grid Style	line
Snap	Yes
Grid Size	2.540mm
Snap Size	0.127mm
Alt Snap	0.127mm
Routing Width	1.000mm
Routing Angle	Line 45°
Routing Conflict	Block
Remove Loop	Yes
Copper Zone	Visible

Other Panel:

Property	Value
Mouse-X	9.398mm
Mouse-Y	57.785mm
Mouse-DX	-22.642mm

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

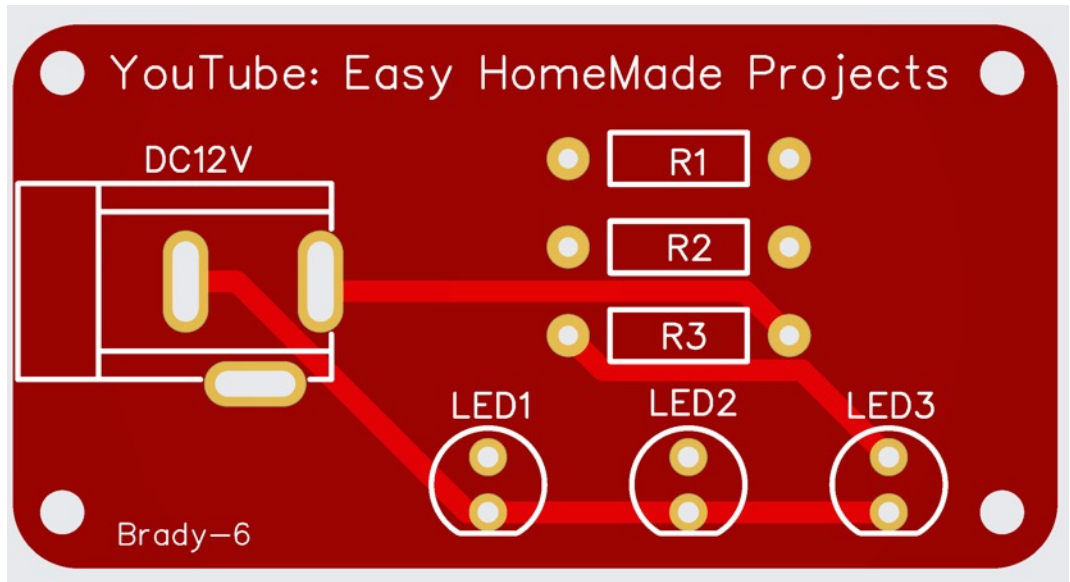
Place PCB parts

Text on top silkscreen

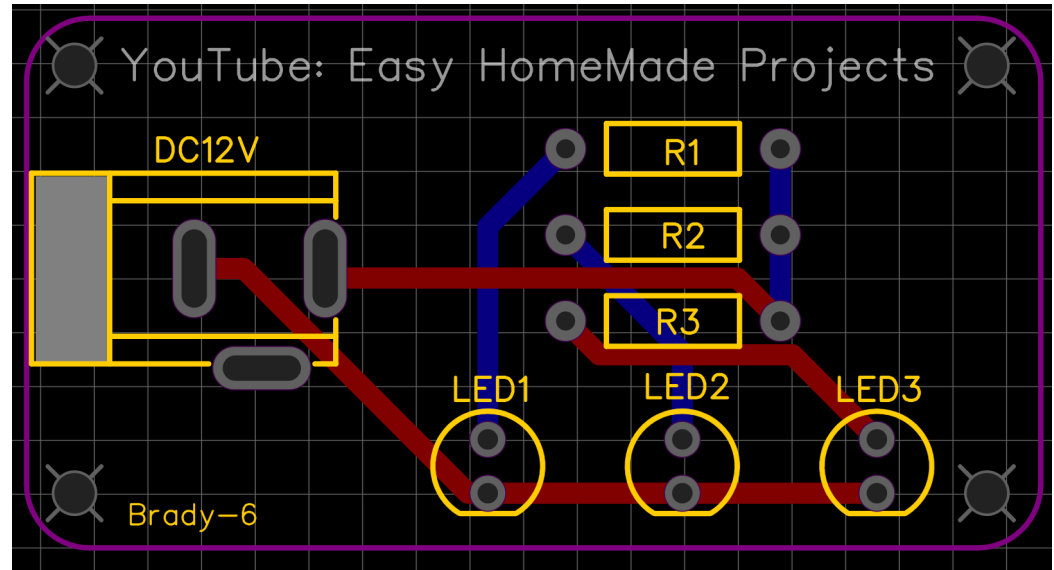
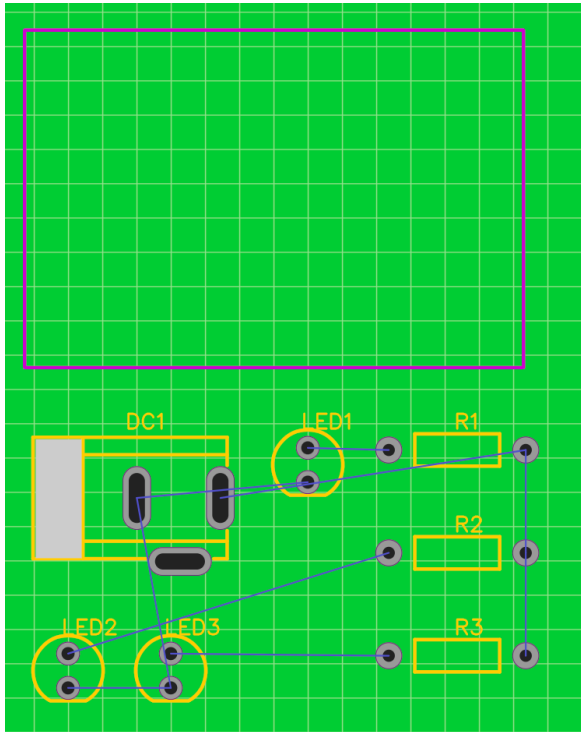
Try manual routing

Unroute All

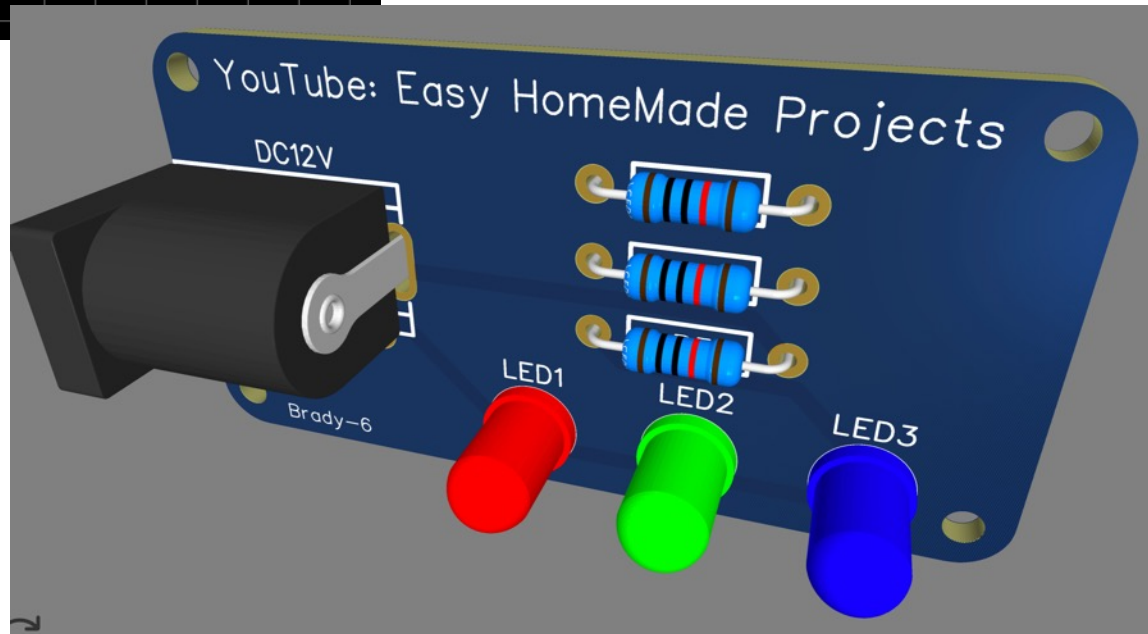
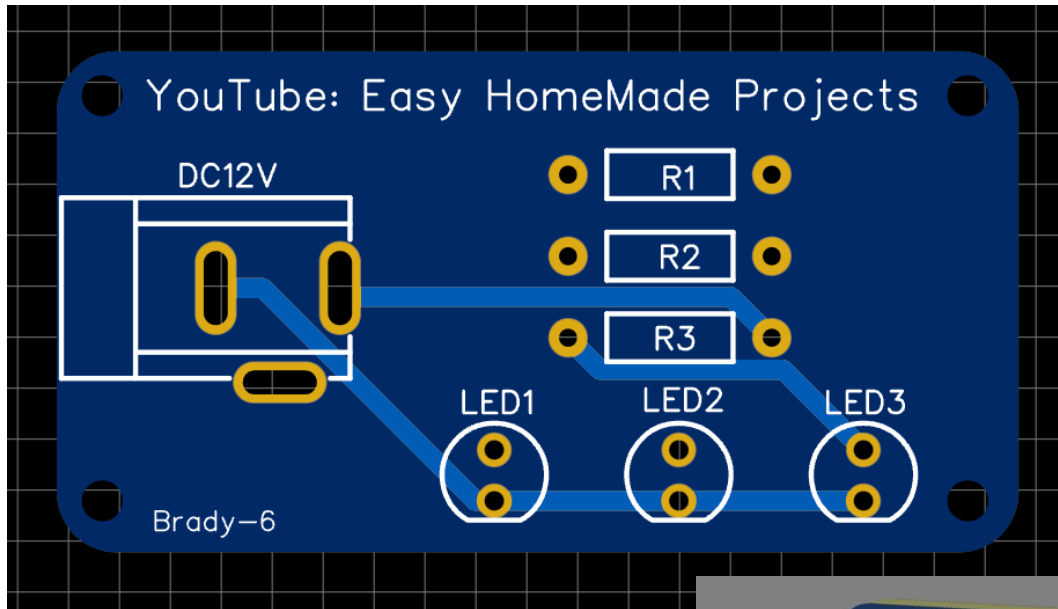
Auto Router



Exercise 3:



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

Standard PCB/PCBA | Advanced PCB/PCBA | SMT-Stencil | 3D/CNC

YouTube: Easy HomeMade Projects

DC12V, R1, R2, R3, LED1, LED2, LED3, Brady-6

Detected 2 layer board of 25x48mm(0.98x1.89 inches) .

Back to Upload File | Gerber Viewer

Base Material: FR-4, Flex, Aluminum, Copper Core, Rogers, PTFE Teflon

Layers: 1, 2, 4

Dimensions: 48 * 25 mm

PCB Qty: 5

Charge Details

Special Offer	\$2.00
Via Covering	\$0.00
Surface Finish	\$0.00

Build Time

PCB: 3-4 days \$0.00
 2 days \$0.00
 24 hours \$7.20
 24 hours PCBA Only \$0.00

Calculated Price ~~\$4.00~~ **\$2.00**
Additional charges may apply for [special cases](#)

SAVE TO CART

Shipping Estimate \$1.50
Global Standard Direct Line 9-15 business days
Weight 0.14kg

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

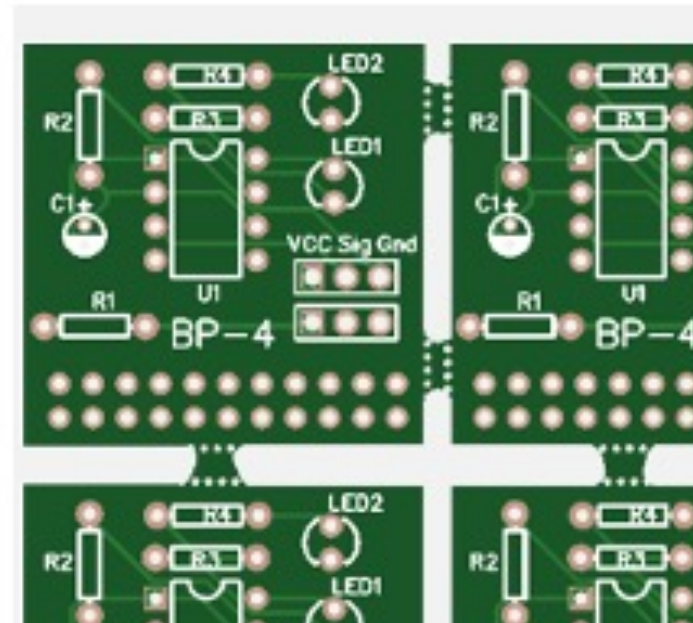
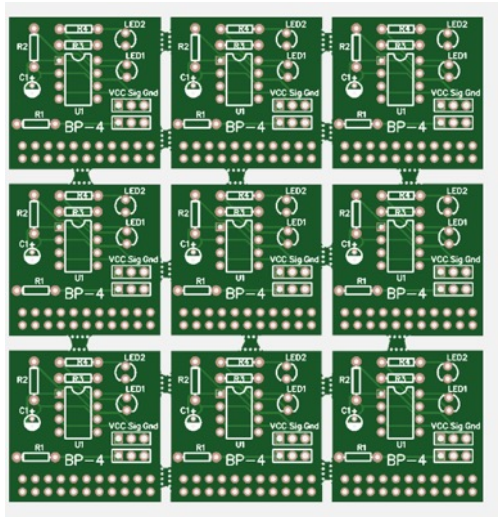
ThisIsNotRocketScience panelizer – rough but cheap

JLCPCB panelizing – rows and columns on last page

ThisIsNotRocketScience Panelizer

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

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



JCLPCB Panelize 2x4

Different Design 1 2 3 4

Delivery Format Single PCB Panel by Customer Panel by JLCPCB

Panel Format Column: 48mm Row: 25mm

Edge Rails No On 2 Sides On 4 Sides

Panel size X : (48 x 2) = 96.000 mm Y : (25 x 4) = 100.000 mm

PCB Thickness 0.4 0.6 0.8 1.0 1.2 1.6 2.0

PCB Color Green Purple Red Yellow Blue White

PCB Color Black

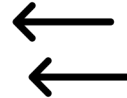
Silkscreen White

Surface Finish HASL(with lead) LeadFree HASL ENIG

High-spec Options

Outer Copper Weight 1 oz 2 oz

Tented Untented Pluqaed Epoxy Filled & Capped



Charge Details

Engineering fee	\$4.00
Via Covering	\$0.00
Surface Finish	\$0.00
Board	\$3.70

Build Time

PCB:	<input checked="" type="radio"/> 3-4 days	\$0.00
	<input type="radio"/> 2 days	\$0.00
	<input type="radio"/> 24 hours	\$7.20
	<input type="radio"/> 24 hours PCBA Only	\$0.00

Calculated Price

\$7.70

Additional charges may apply for [special cases](#)

SAVE TO CART

Shipping Estimate

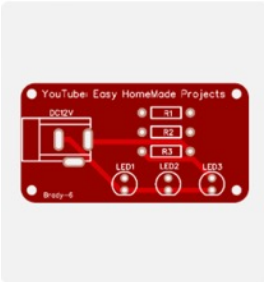
\$1.50

Global Standard Direct Line 9-15 business days

Weight 0.28kg

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

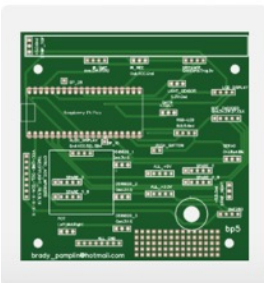
Merchandise Total: \$3.20

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

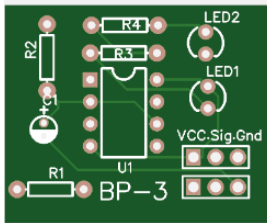
Shipping Charge: \$1.50

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___... Merchandise Total: \$5.70

✓ Production Completed

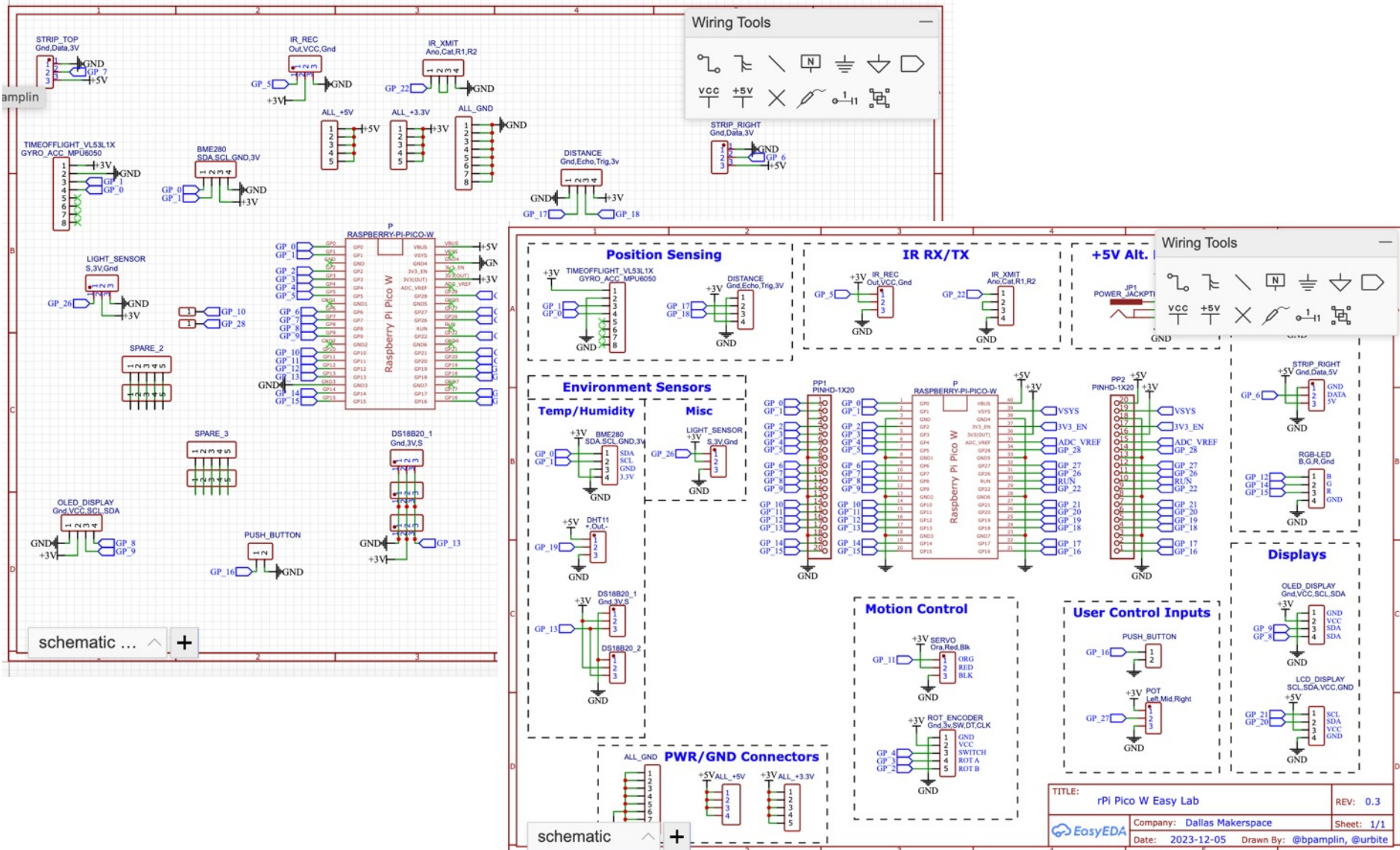
Shipping Charge: \$1.44

Quality Complaint

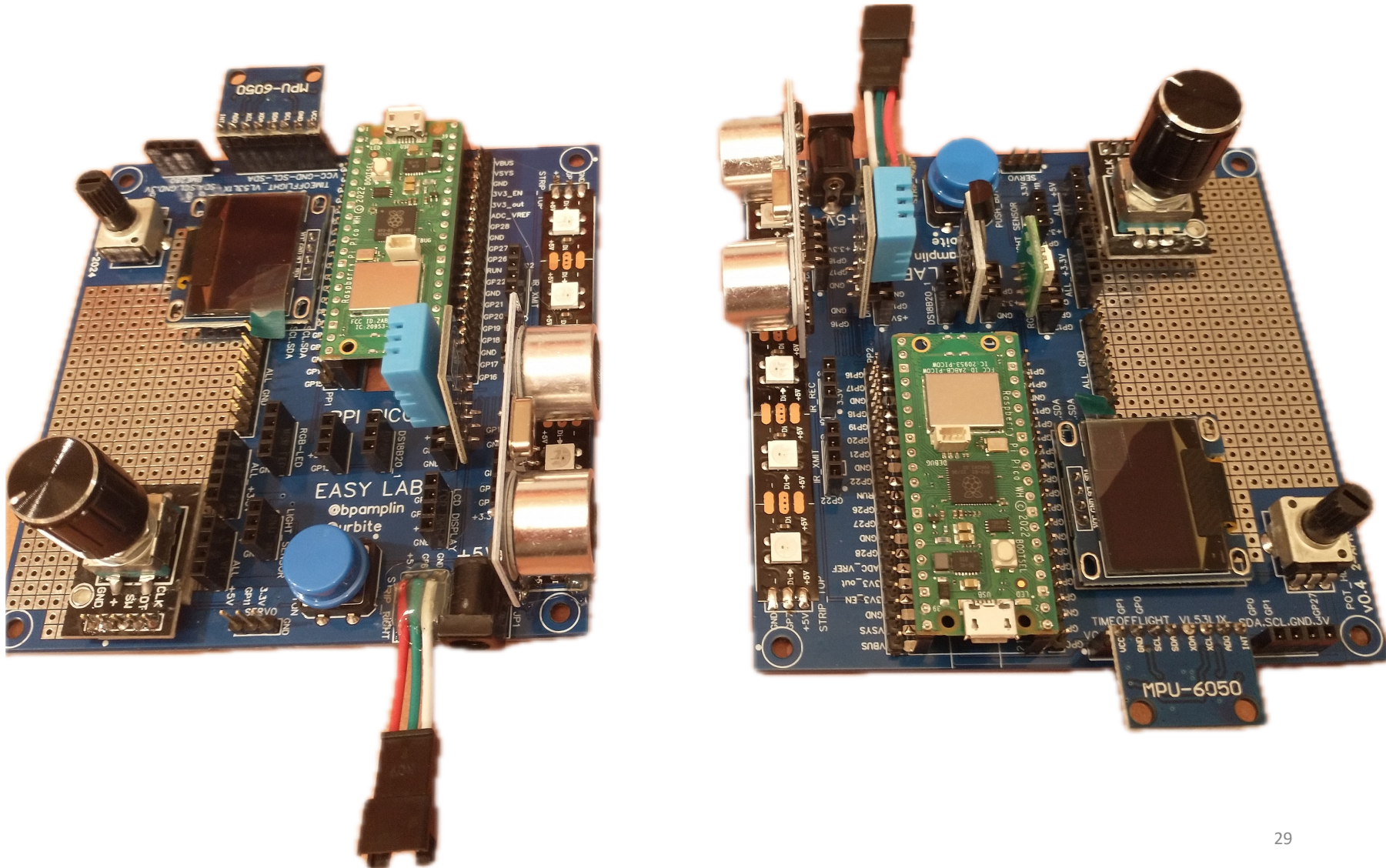
Order Total: \$7.14

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

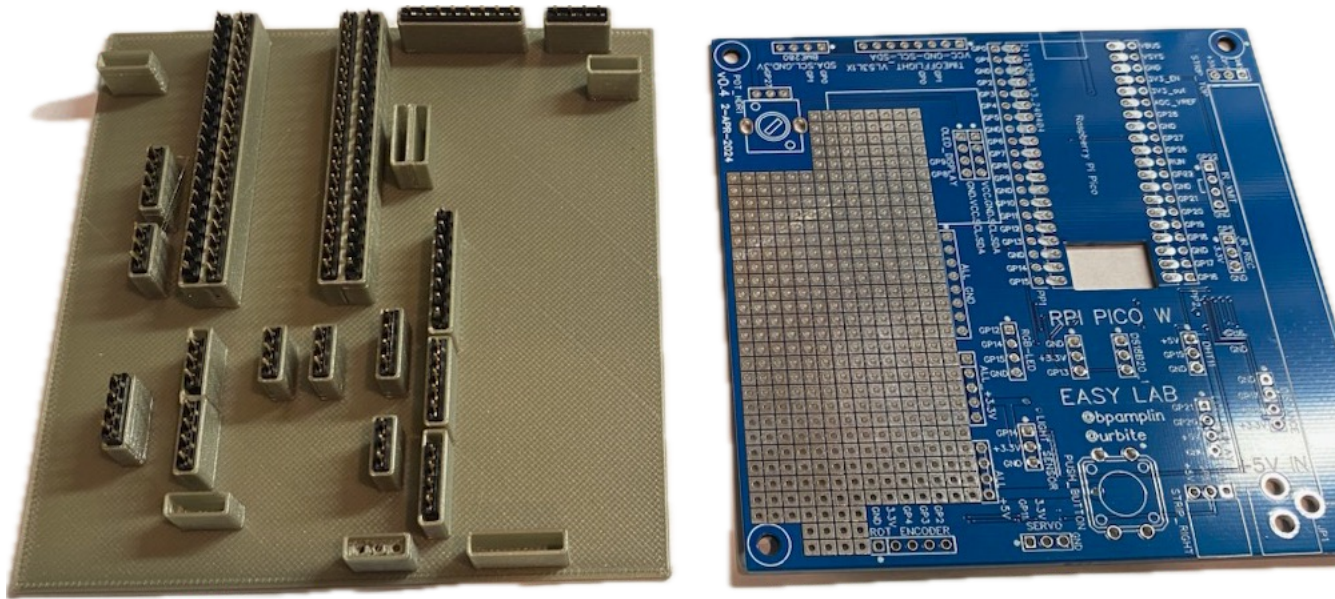
Brady's Novice Schematic Perfected by a Real Professional



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

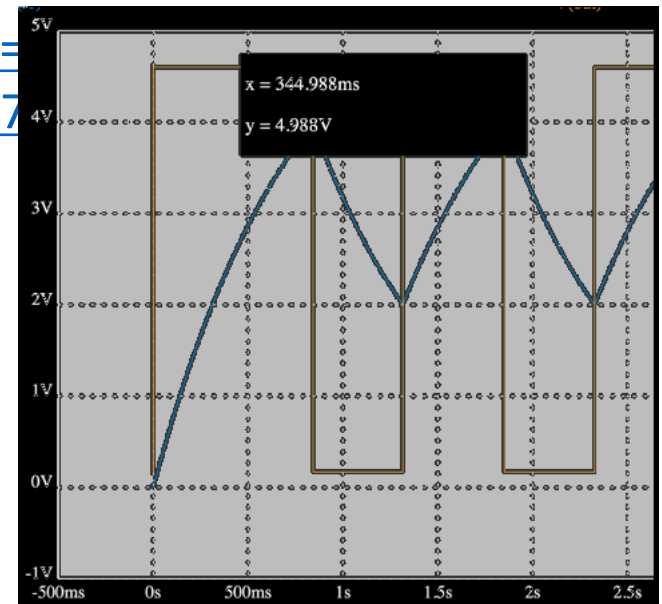
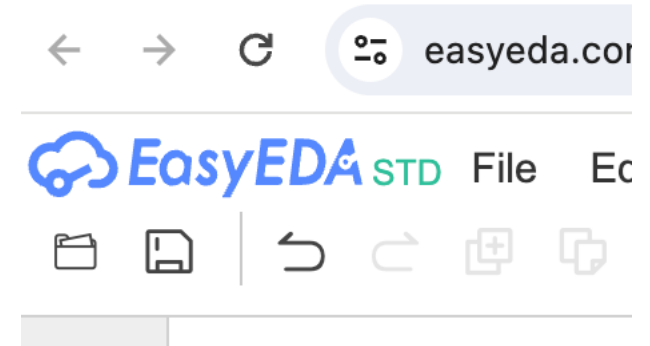
Simulation/Simulation Setting

10m = 10 milliseconds

4s = 4 seconds

Simulation/RunYourSimulation

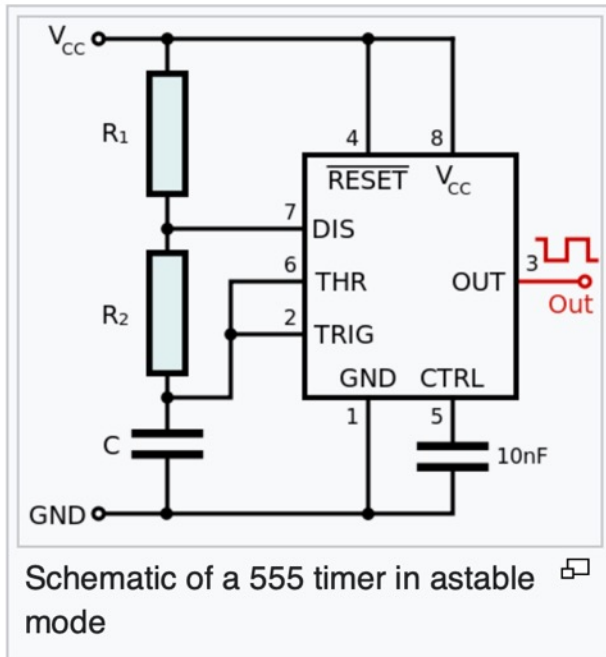
<https://u.easyeda.com/join?type=project&key=d7e9efd856bf73a60&inviter=e7e846ad3f35407dd>



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



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%