Artistic PCB Design for Terrified Beginners

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- I‘m Kliment
- I make electronics. I like cats. I occasionally teach people to build things.

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- I make electronics. I like cats. I occasionally teach people to build things.

Me

One of my boards

Our cat

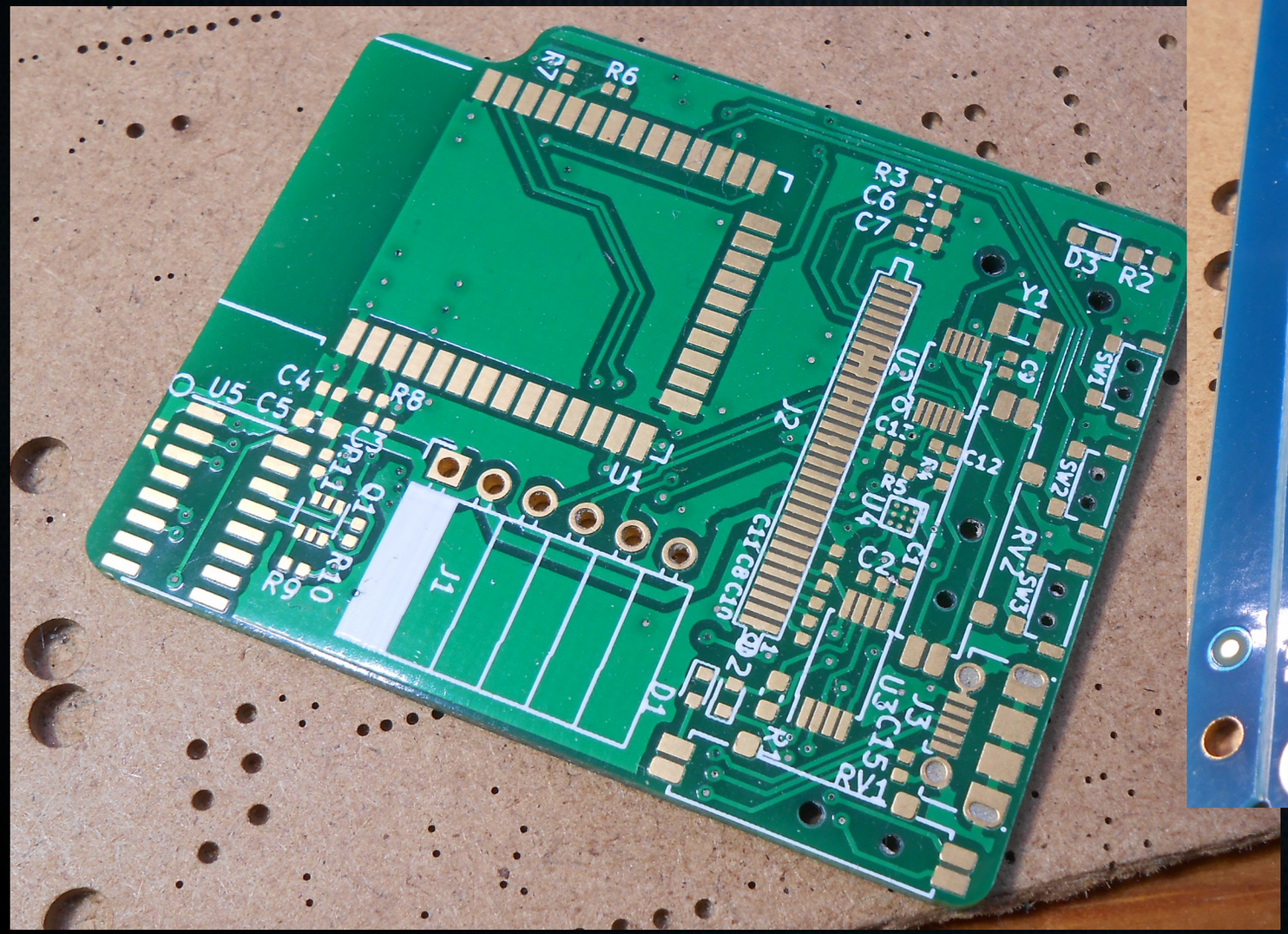
Who this is for

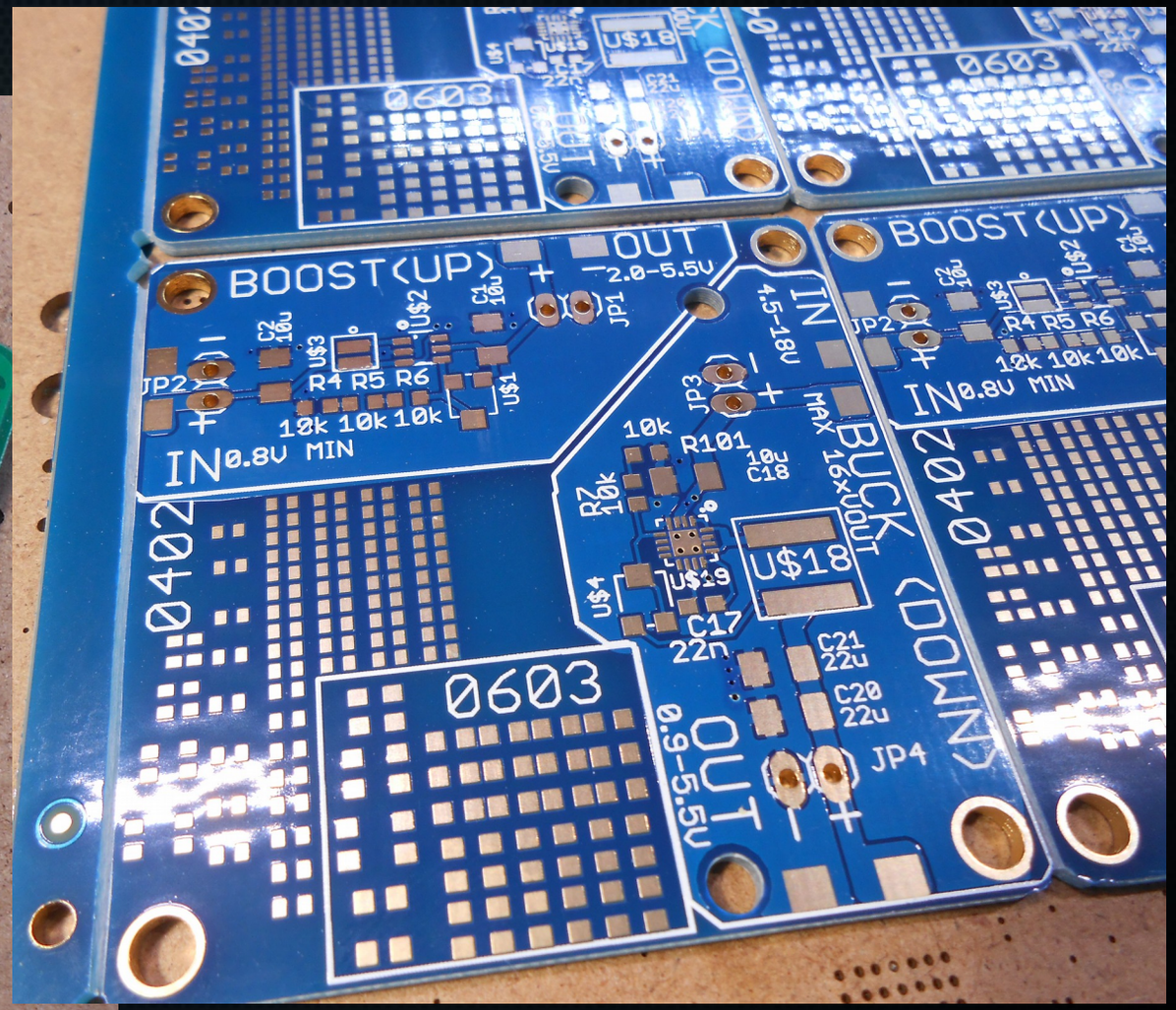
- Artists who want to use electronics as a medium
- PCB designers that want to make their PCBs pretty
- Artists who want to collaborate on PCB designs
- Electronics people who want to know how to handle input from designers and artists
- People who just want to have fun

What we will do

- Understand what PCBs are
- Find out what design elements we control
- Understand how to transform graphics into PCB elements
- See how we convert a very simple schematic into two very different artistic PCBs
- Have you try it for yourself and see what you come up with

PCBs


R6
R3
C6
C7
D3
R2
Y1
U5
C4
C5
R8
U1
J2
J1
D1
R9
SW1
SW2
SW3
RV2
RV1
U3
U4
C12
C2

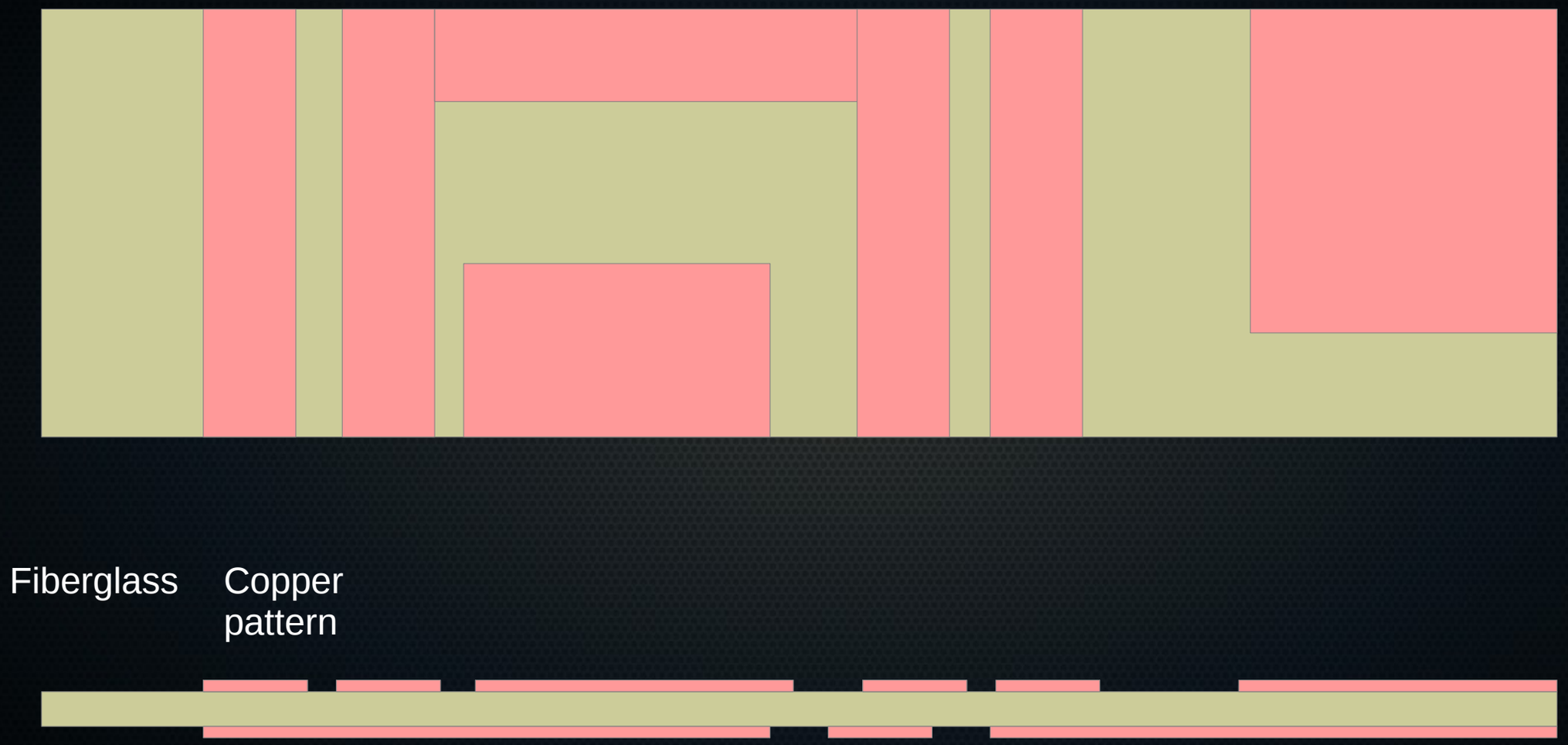

BOOST(UP)
OUT
2.0-5.5V
JP1
IN
4.5-18V
JP2
R4 R5 R6
10k 10k 10k
IN 0.8V MIN
JP3
R101
10k
R7
10k
C18
10u
BUCK
16xVOUT
MAX
U$18
U$19
C17
22n
C21
22u
C20
22u
JP4
OUT
0.9-5.5V
0603
0402
(INVOUT)

PCB parts

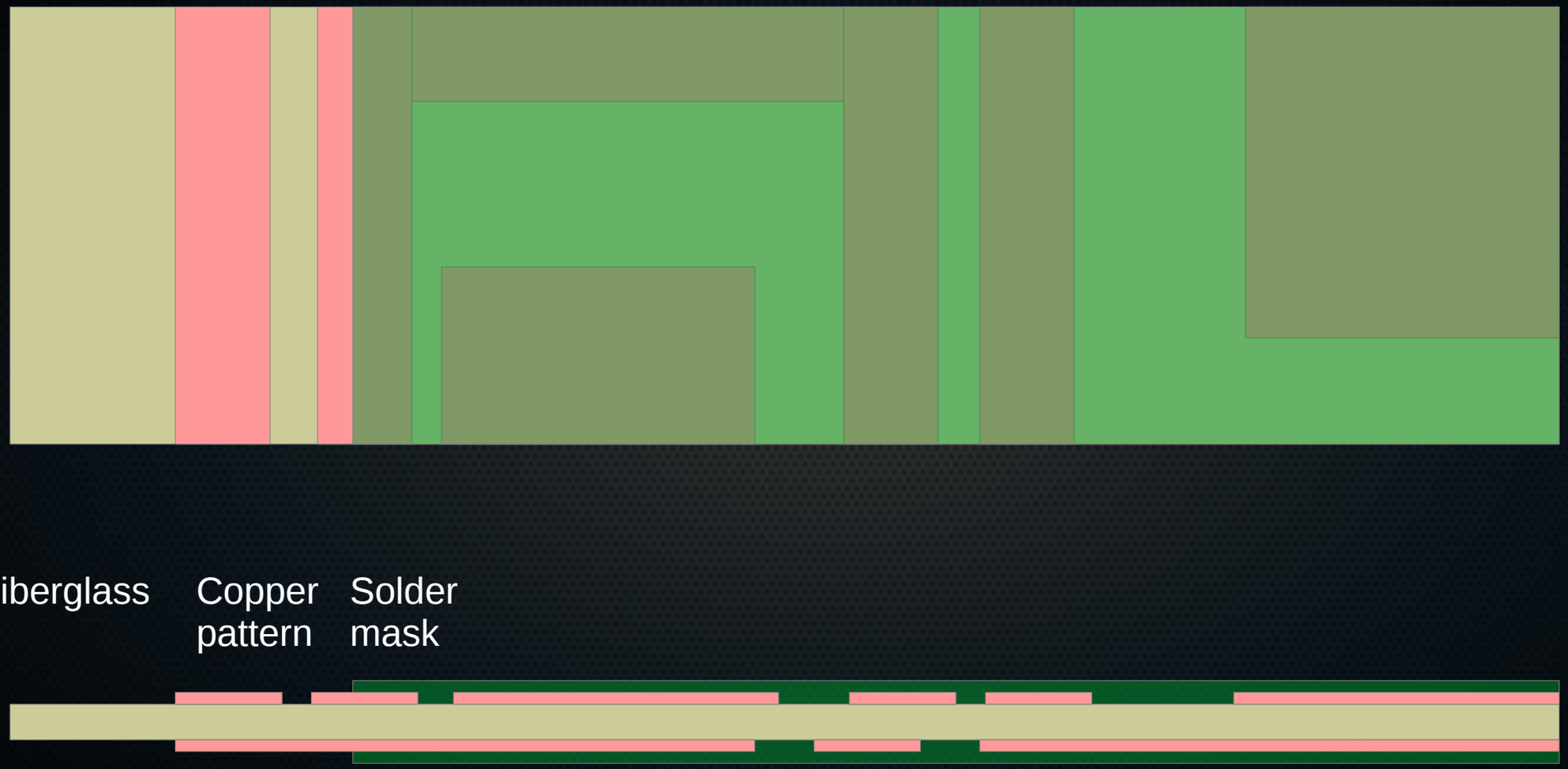
Fiberglass

PCB parts

PCB parts



PCB parts



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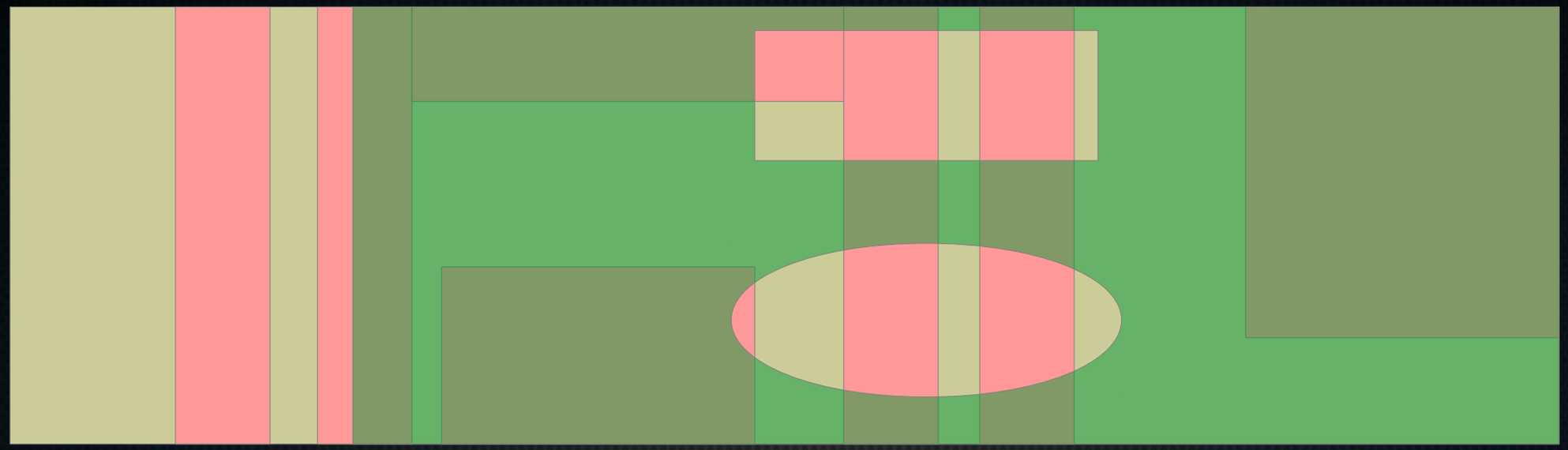

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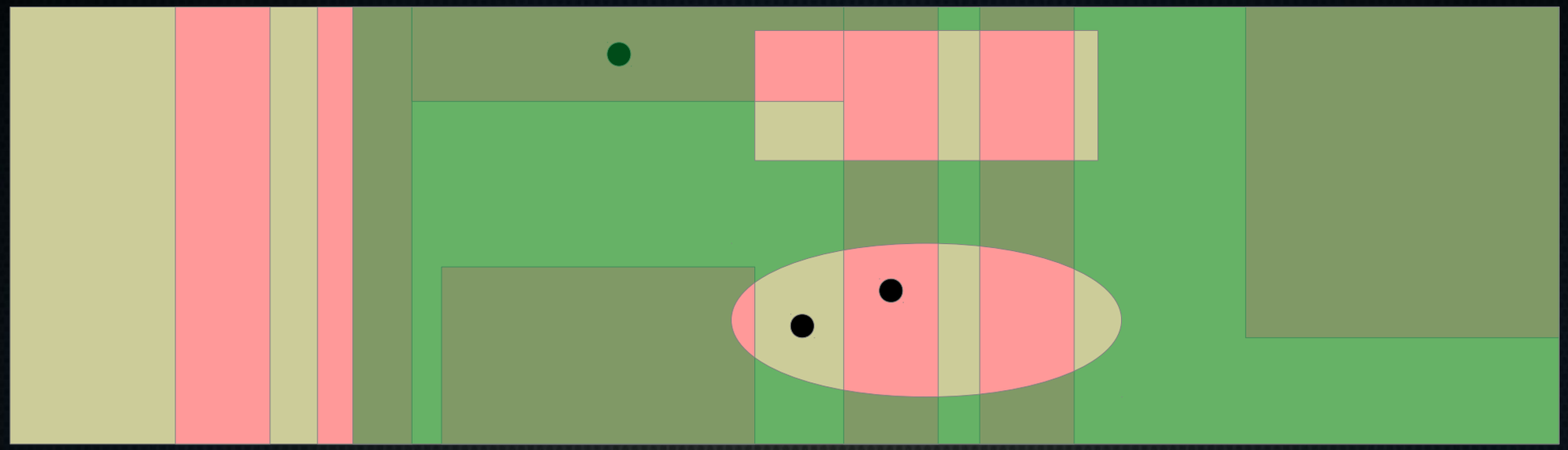
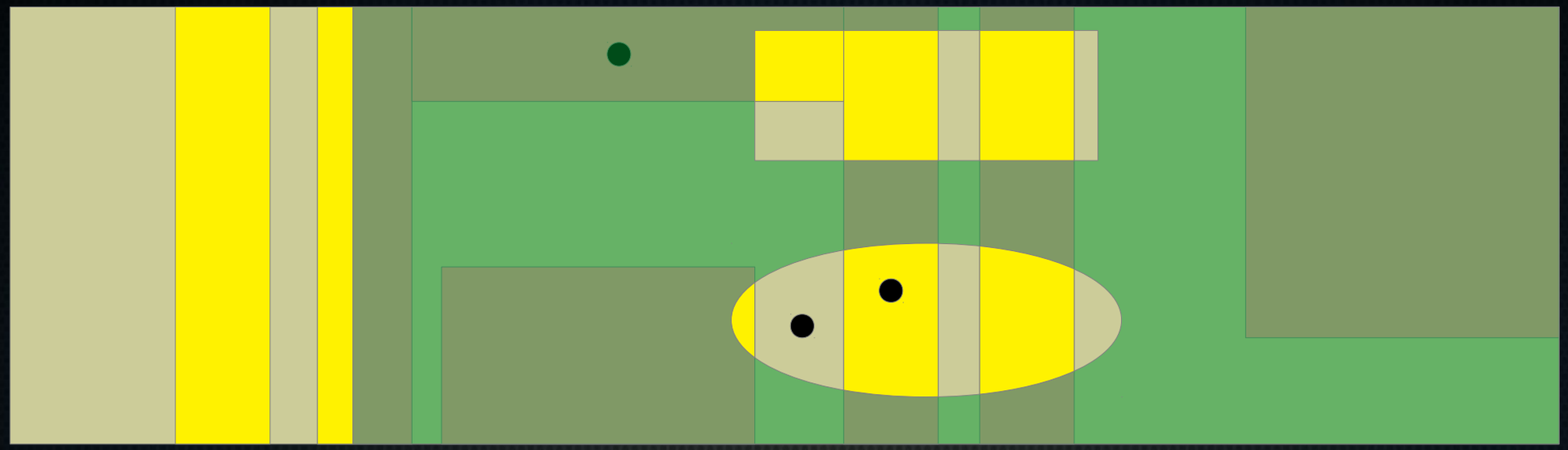


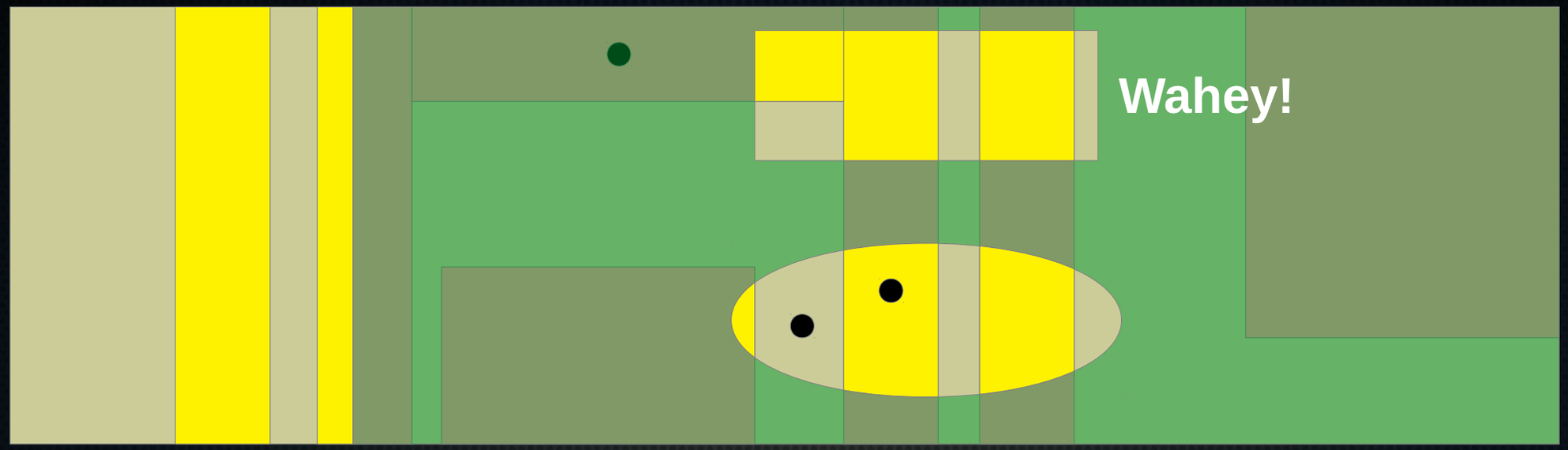
Fiberglass
Copper pattern
Solder mask
Mask pattern
Holes Vias

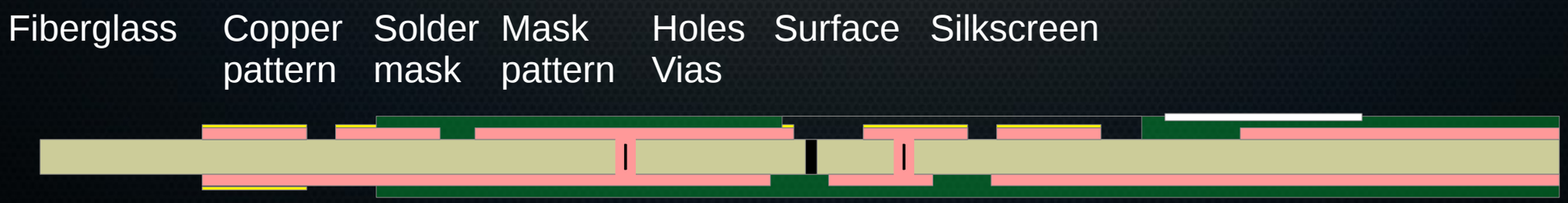
PCB parts



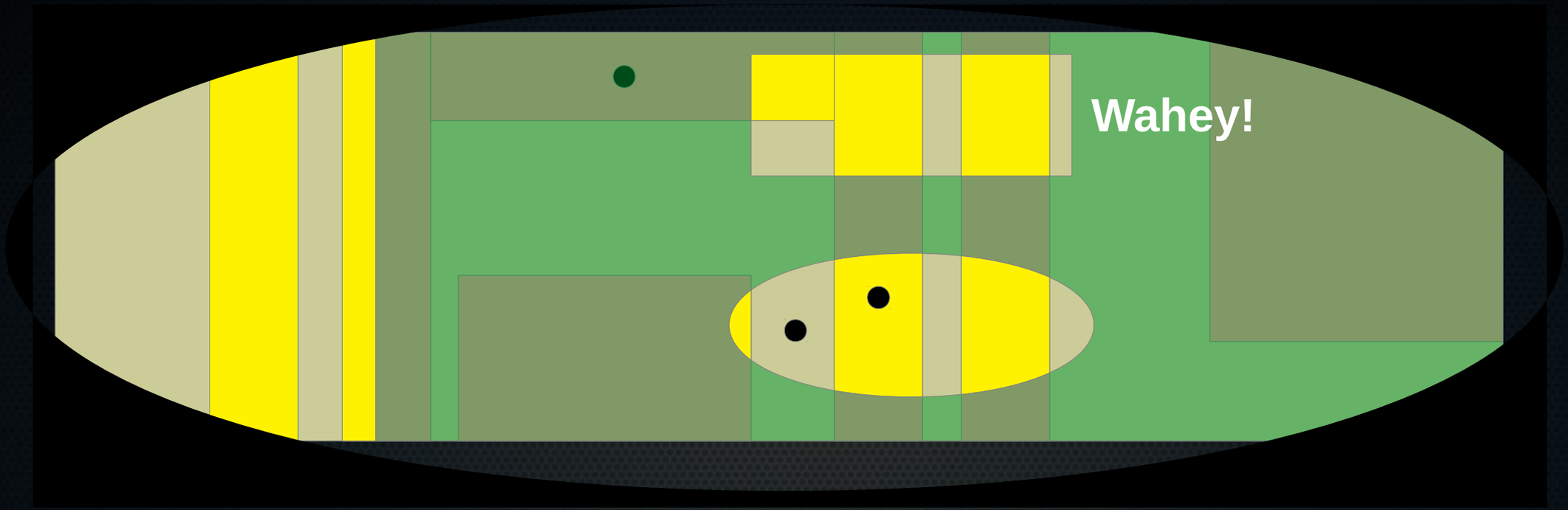
Fiberglass Copper pattern Solder mask Mask pattern Holes Vias Surface

PCB parts


Wahey!

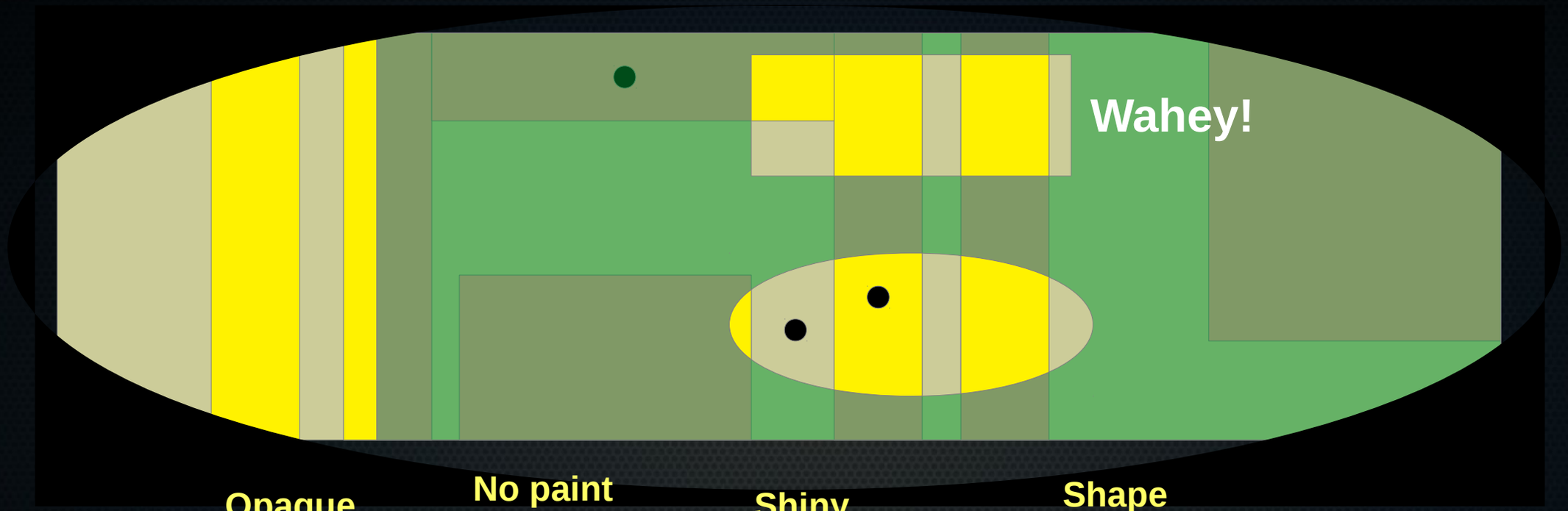

Fiberglass
Copper pattern
Solder mask
Mask pattern
Holes Vias
Surface
Silkscreen

PCB parts



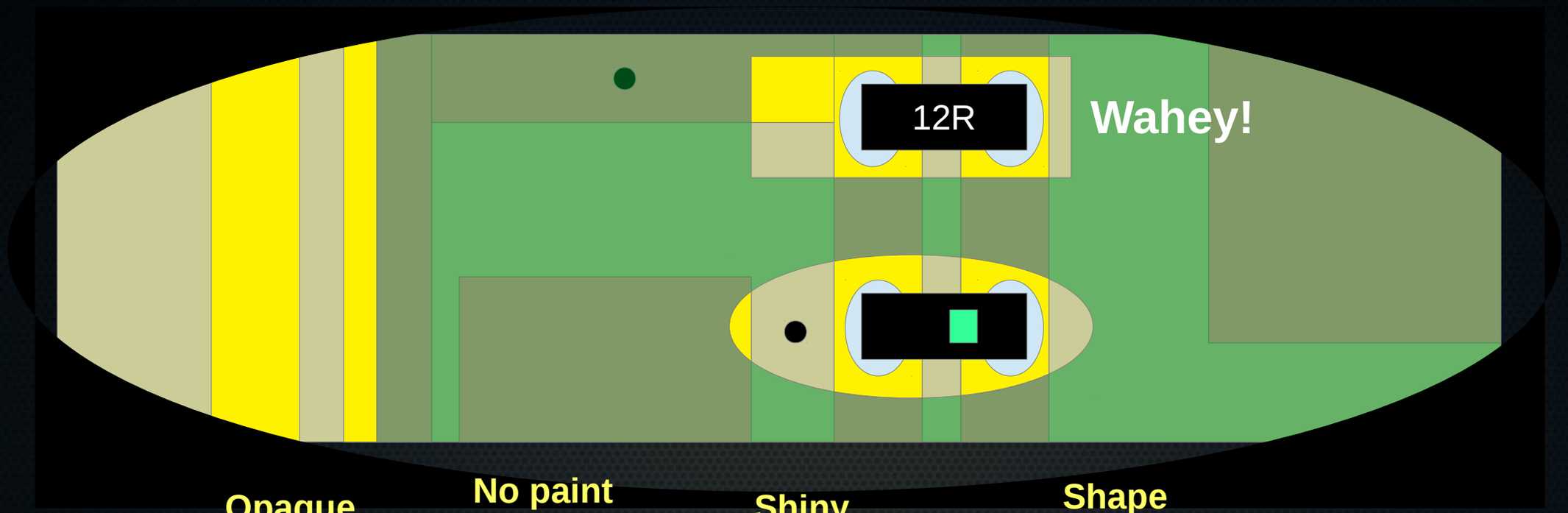
Fiberglass | Copper pattern | Solder mask | Mask pattern | Holes Vias | Surface | Silkscreen | Milling

PCB parts – for Humans



Translucent	Opaque	Paint (color)		No paint	Holes	Shiny	Paint (white)	Shape
Fiberglass	Copper pattern	Solder mask	Mask pattern		Holes Vias	Surface	Silkscreen	Milling

PCB parts – for Humans



Translucent
Fiberglass

Opaque
Copper pattern

Paint (color)
Solder mask

No paint
Mask pattern

Holes
Holes
Vias

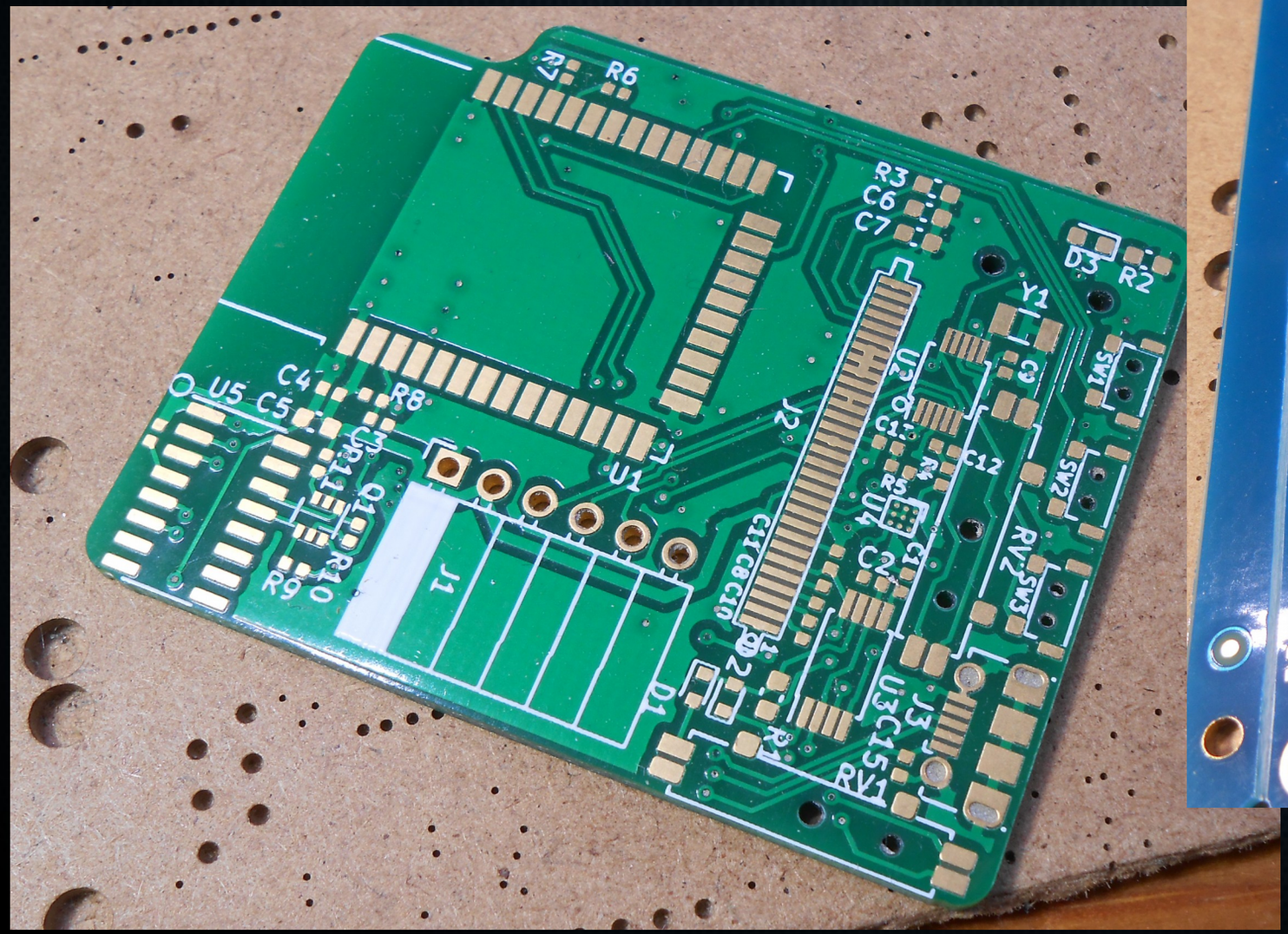
Shiny
Surface

Paint (white)
Silkscreen

Shape
Milling

Parts

PCBs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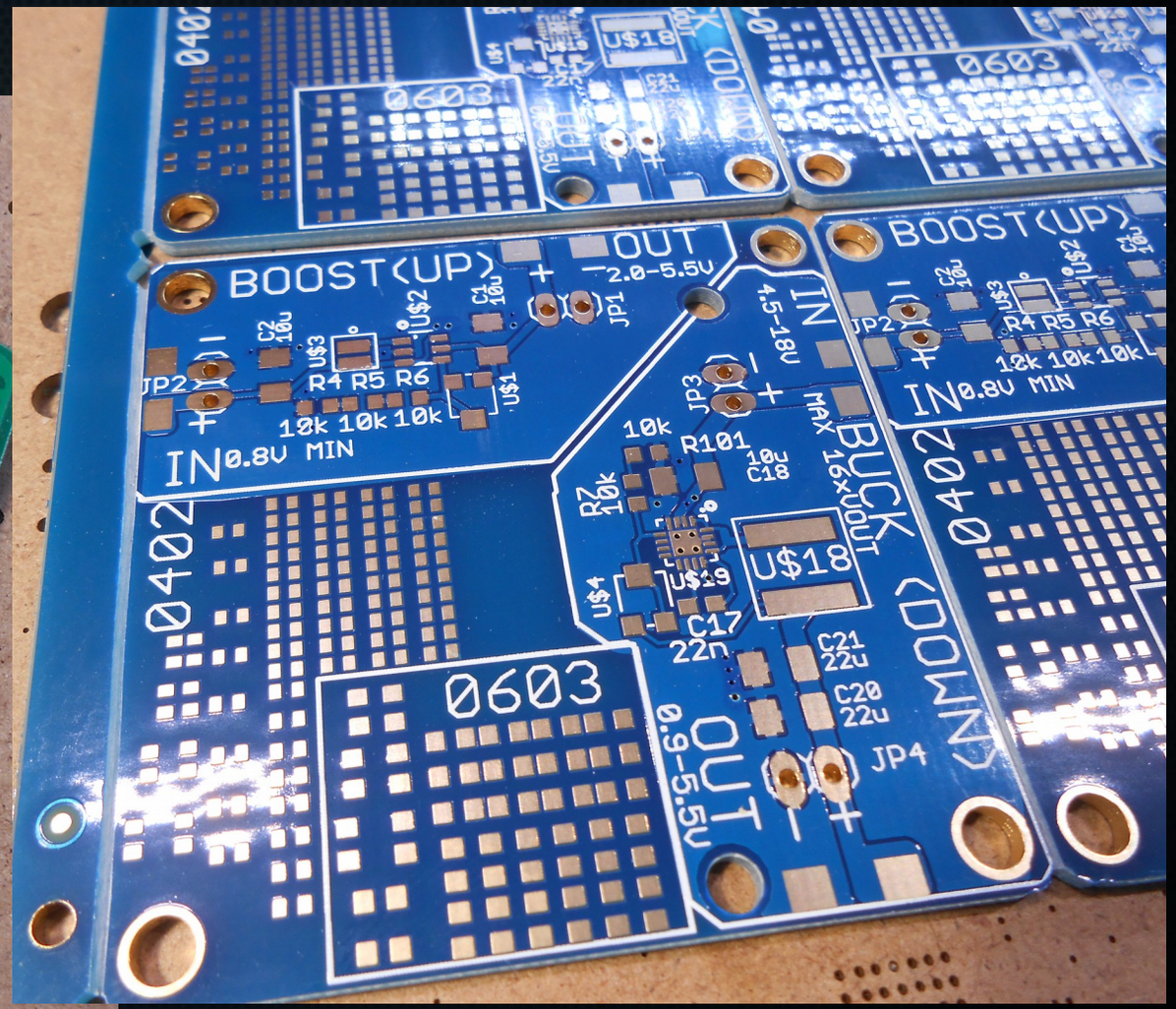
R9
R10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4.5-18V
0.8V MIN
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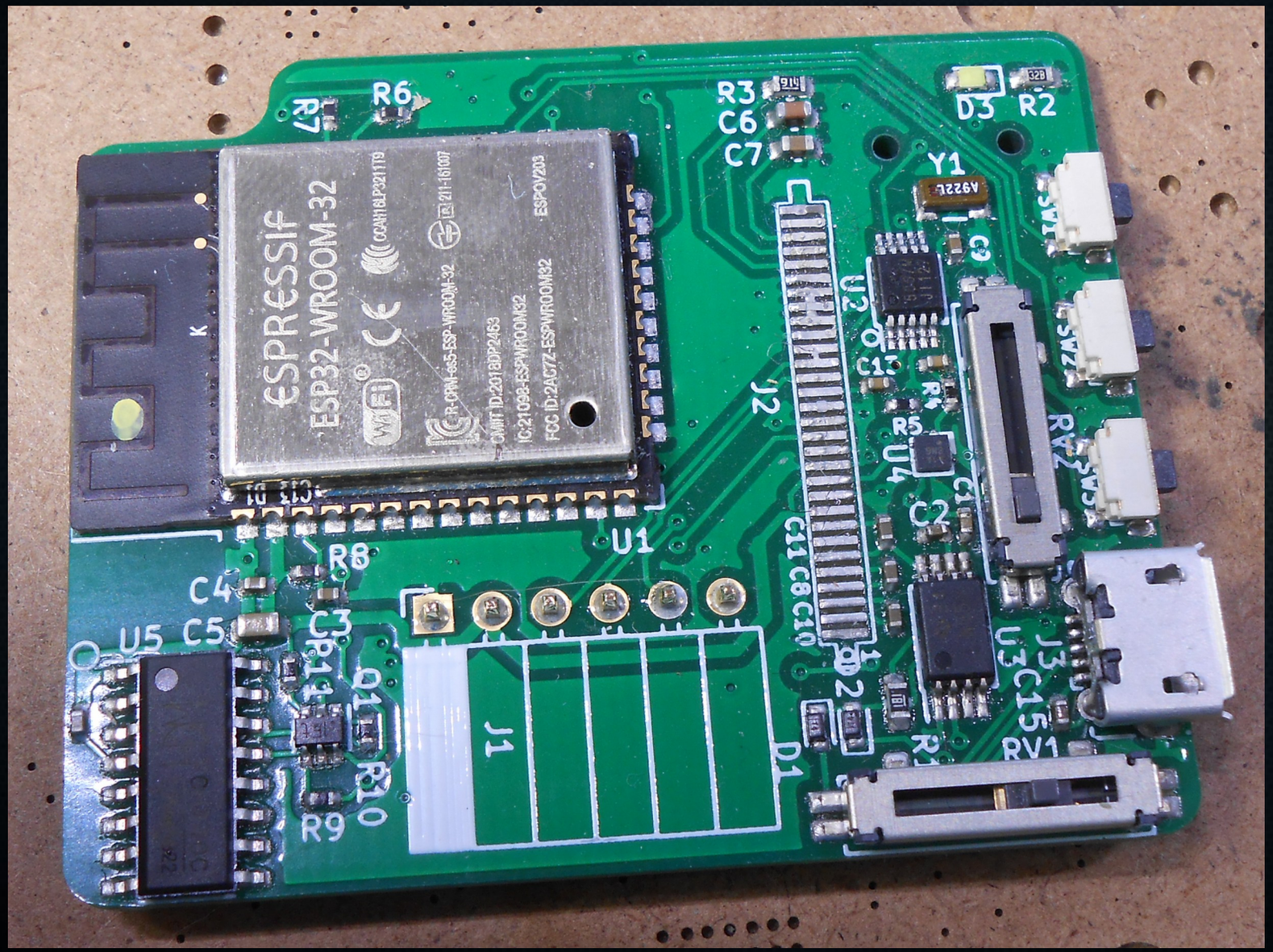
R7
10k
C18
10u
C17
22n
C21
22u
C20
22u
U$18
U$19
U$4
BUCK
16xVOUT
MAX
OUT
0.9-5.5V
0603
0402
0204
(INVOUT)

PCBs - assembled



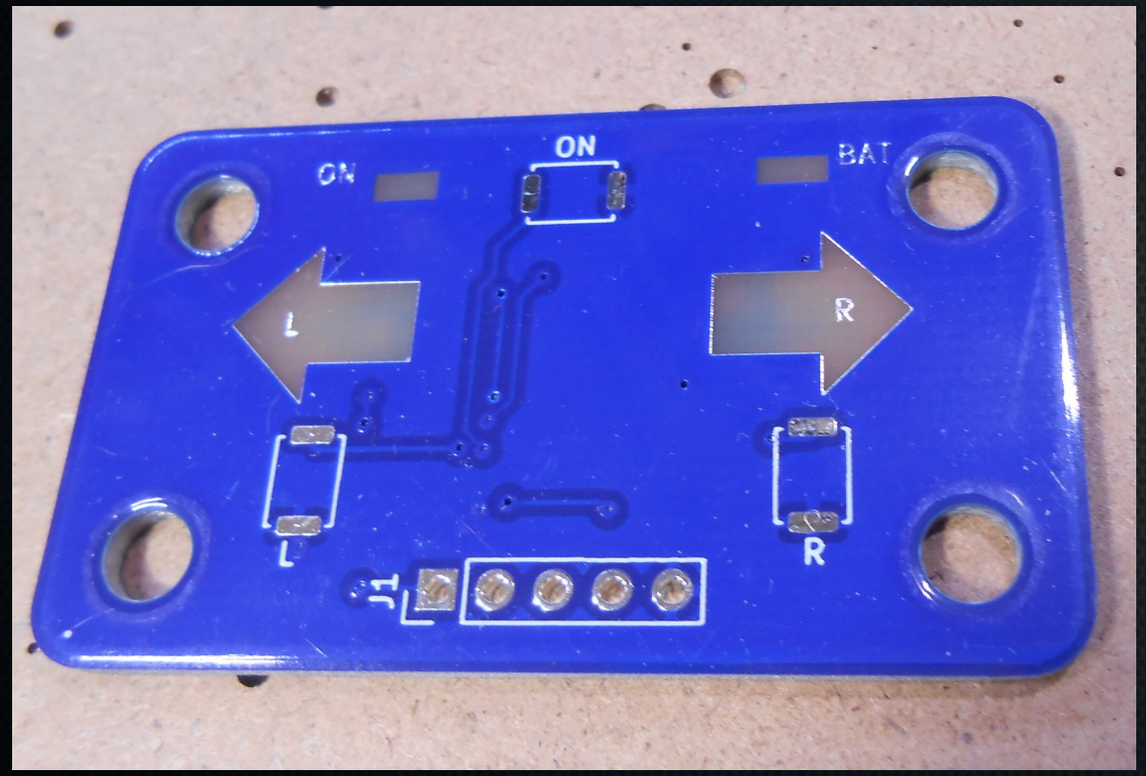
What we control

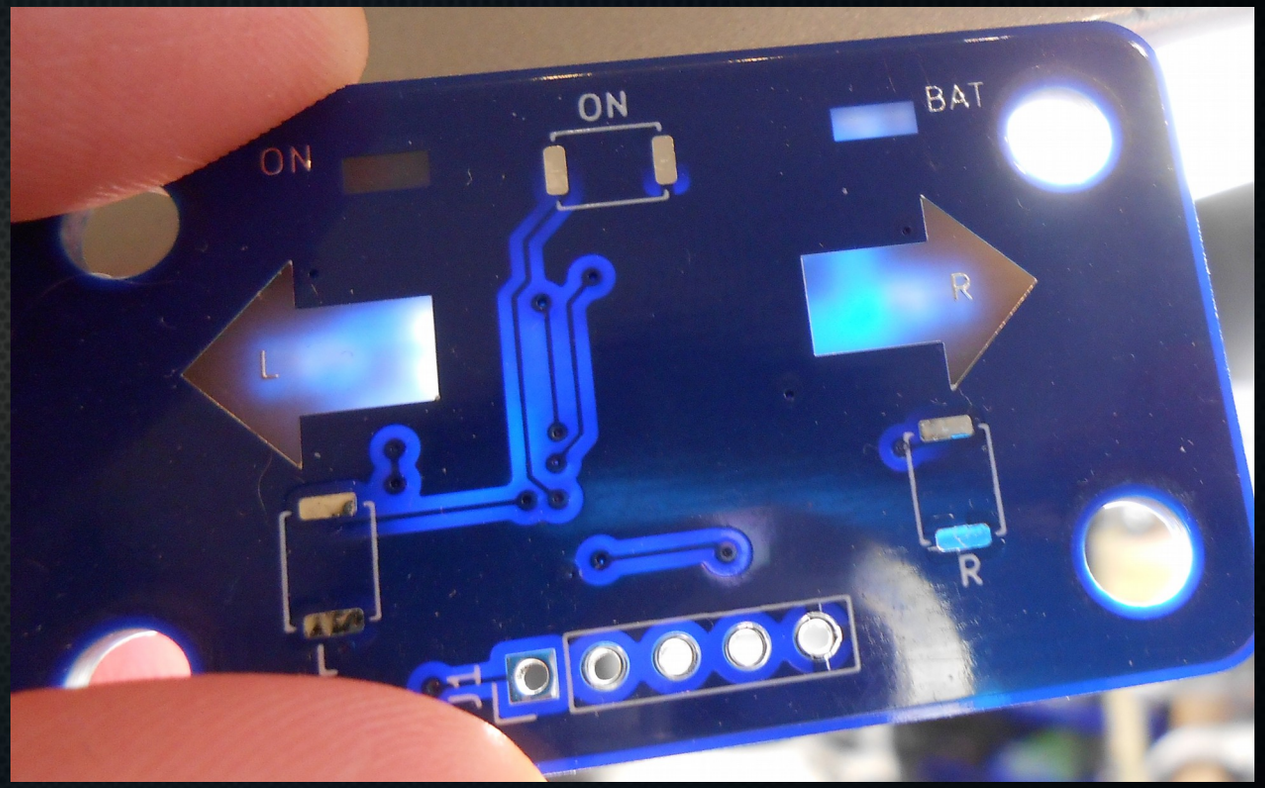
- Board shape
- Copper pattern (both sides)
- Component placement (both sides)
- Mask pattern (both sides)
- Silkscreen pattern (both sides)
- Holes
- Color (sorta) – ENIG vs HASL, mask color

What we can make

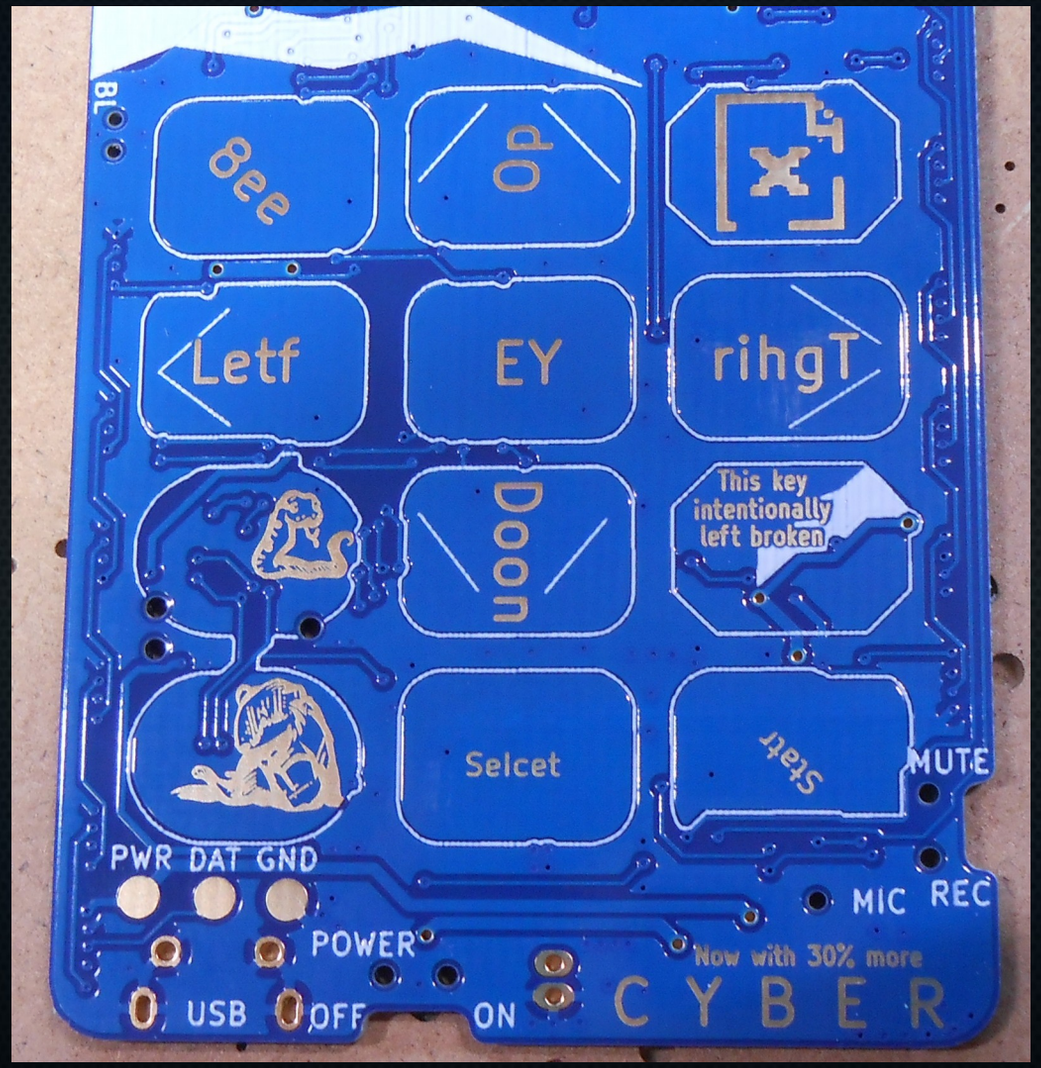
- Translucent areas with shadows (copper on back only)
- Metallic shapes (mask pattern over copper, super precise)
- Painted shapes (one color only, usually low precision)
- Shaped holes (made with milling bit)
- Subtle shapes (copper pattern under mask)
- Shapes made of components
- Shape made of the whole board (made with milling bit)

What we can make





What we can make



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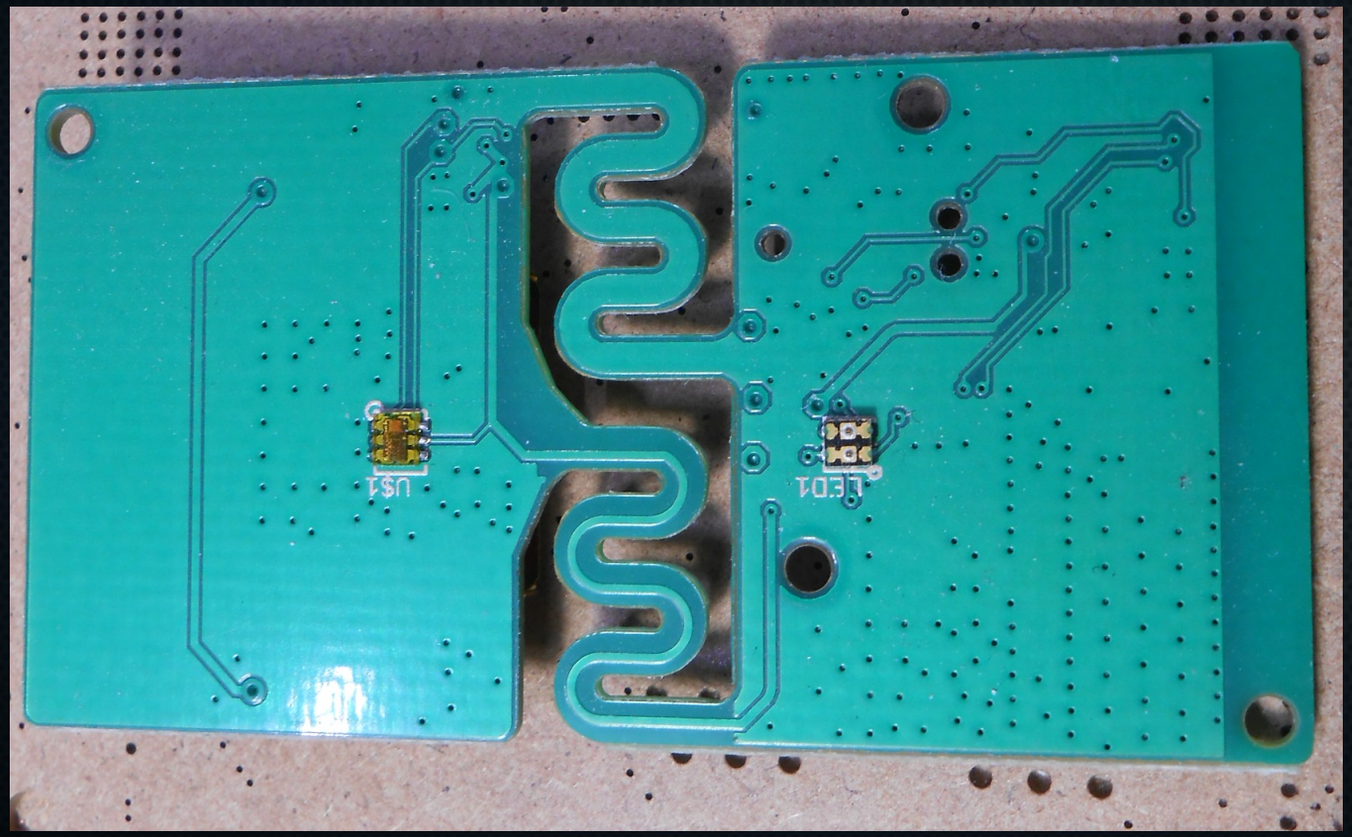

What we can make

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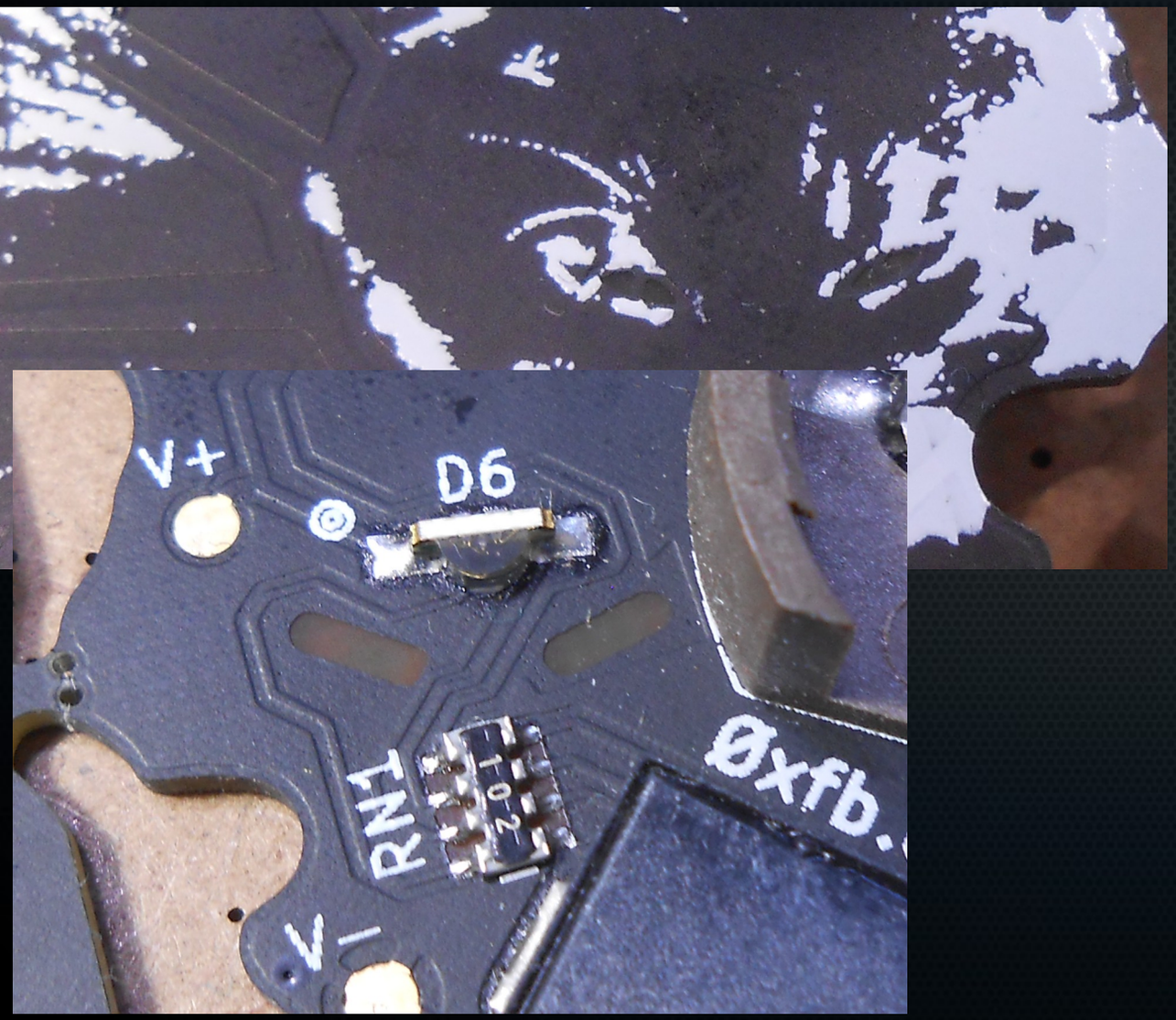

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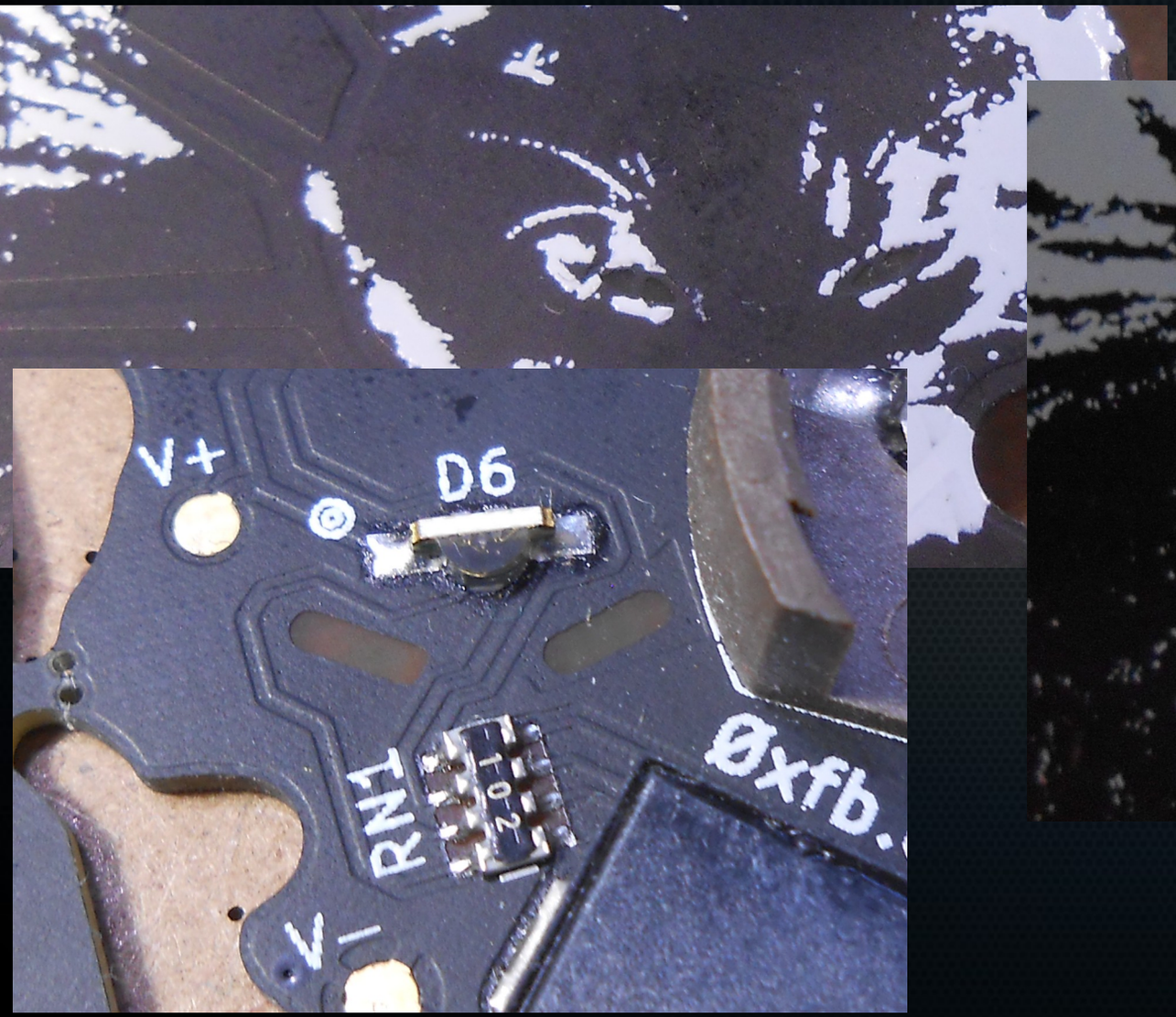

Graphics elements

- Board outline (vector)
- Negative mask (export as b/w raster)
  shows up as surface (gold/silver) or as fiberglass depending on if there is copper underneath
- Positive silkscreen (export as b/w raster)
- Copper fill zones (polygon)
- Copper exclusion zones (polygon)

Processing graphics

- Vector graphics can be directly exported
- Photos need some more complex processing to be mapped onto layers:
  1. Each layer must be a binary image – no transparency, no antialiasing, just flood fill
  2. Separate out fiberglass areas, and board surface areas into own layers. Export separately or together.
  3. Same for silkscreen. Use halftone or threshold or both.
  4. Excessive halftone may crash your PCB manufacturer :)

Design process

- Decide board size
- Draw outline and export
- Create graphical elements and export
- Import outline and graphics into board
- Place components on board
- Route traces
- Decorate as needed and export for manufacture

(E)CAD Sotfware

- Schematic
- Layout
- Gerbers

(E)CAD Sotfware

- Schematic
  What the board does – components and connection
- Layout
- Gerbers

(E)CAD Sotfware

- Schematic
  What the board does – components and connection
- Layout
  What the board looks like – traces, footprints
- Gerbers

(E)CAD Sotfware

- Schematic
  What the board does – components and connection
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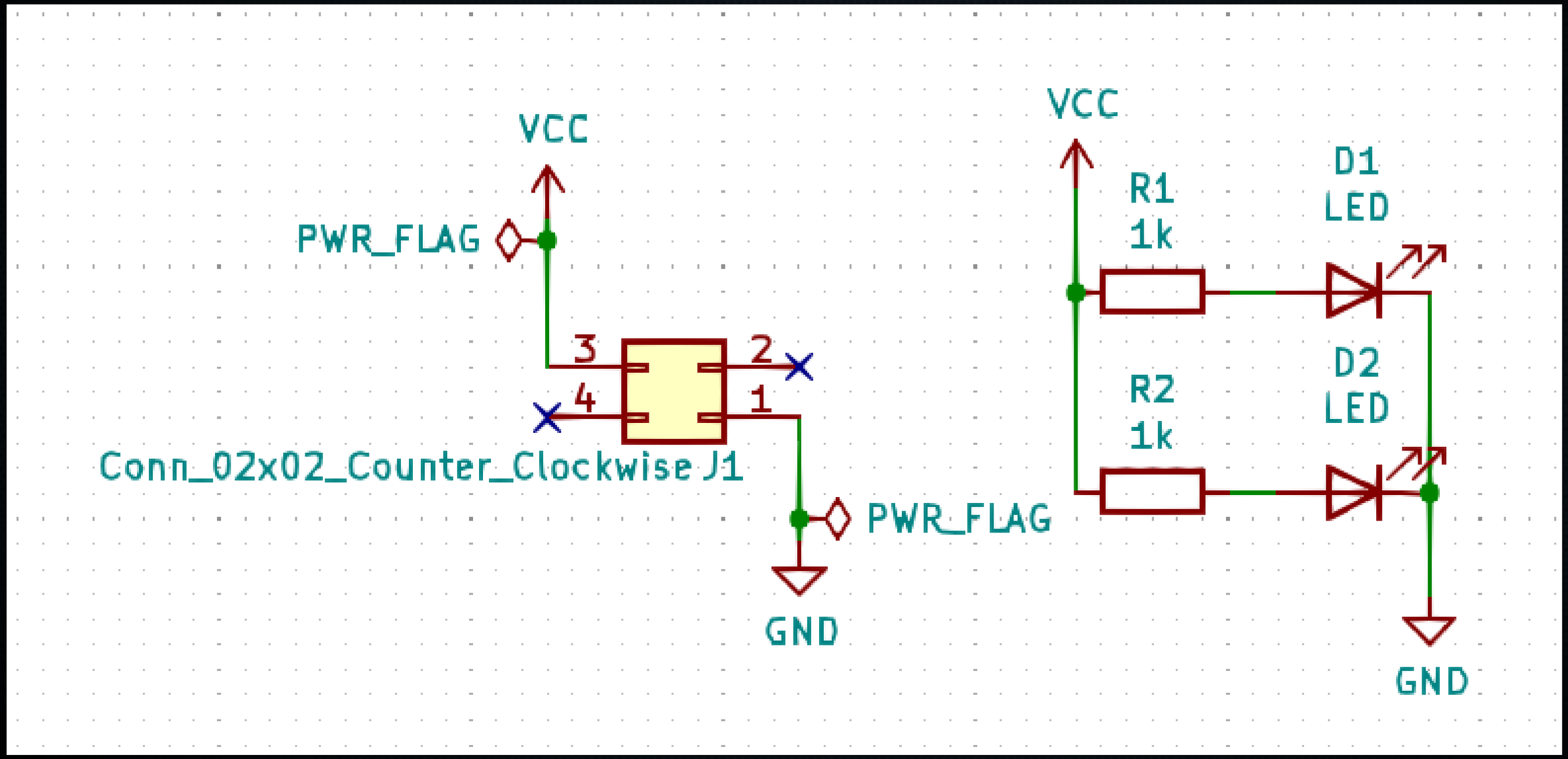
  What the manufacturer needs to know to make it

Tools we will use

- Inkscape
  vector graphics, conversions
- Krita
  raster and vector graphics
  halftone
  color separation
- Kicad
  schematic+layout

Schematic


VCC
PWR_FLAG
3
2
4
1
Conn_02x02_Counter_Clockwise J1
PWR_FLAG
GND
VCC
R1
1k
D1
LED
R2
1k
D2
LED
GND

Demo

Ordering boards

- NextPCB
- PcbWay
- Aisler
- OSHPark
- JLC

Ordering boards

- NextPCB (Shenzhen, China)– best mask/silk precision, no purple
- PcbWay (Shenzhen, China) – most options
- Aisler (US and Germany manufacturing/shipping) - only green, 1.6mm and silkscreen gets cut off near edges, takes KiCad files
- OSHPark (US) – purple boards, takes KiCad files
- JLC (Shenzhen, China) – cheapest, okay boards

Ordering boards - process

- Measure your PCB size
- Decide thickness, color
- Decide if ENIG or HASL
- Remove order number from board (option or note)
- For nextpcb and pcbway add a note to use machine printed silkscreen

Demo

Now you try it

- Workshop materials are at:

https://github.com/kliment/artpcb