



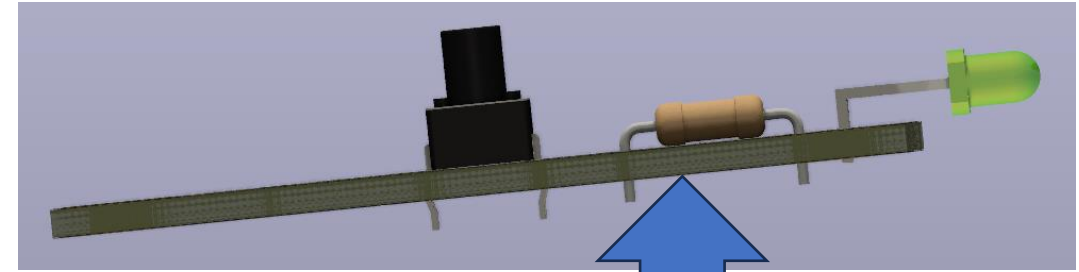
PCB Design with KiCad 10

Introduction and Production Guidance
with Hands-on

14th & 15th April 2026 – Peter-Bernd Otte - HI-Mainz



= PCB creation + SPICE simulation



Printed Circuit Board (PCB)
(1) holds components &
(2) electrical connections

- open source, actively developed since 1992, GPL
- widely used in physics community and beyond
- supported by CERN and many companies

KiCad Limits

- KiCAD **always** best tool for PCB design!
- **Limits:**
 - no properties of PCB itself are simulated
 - >5GHz range:
 - no integrated 3D EM field solver → CST Design Suite
 - not possible: waveguides, antenna design, millimeter-wave layouts
 - >16 layers? → Altium Designer
 - no native team support
 - no Industry Certification Tools

Personal limits

If you strive for ...

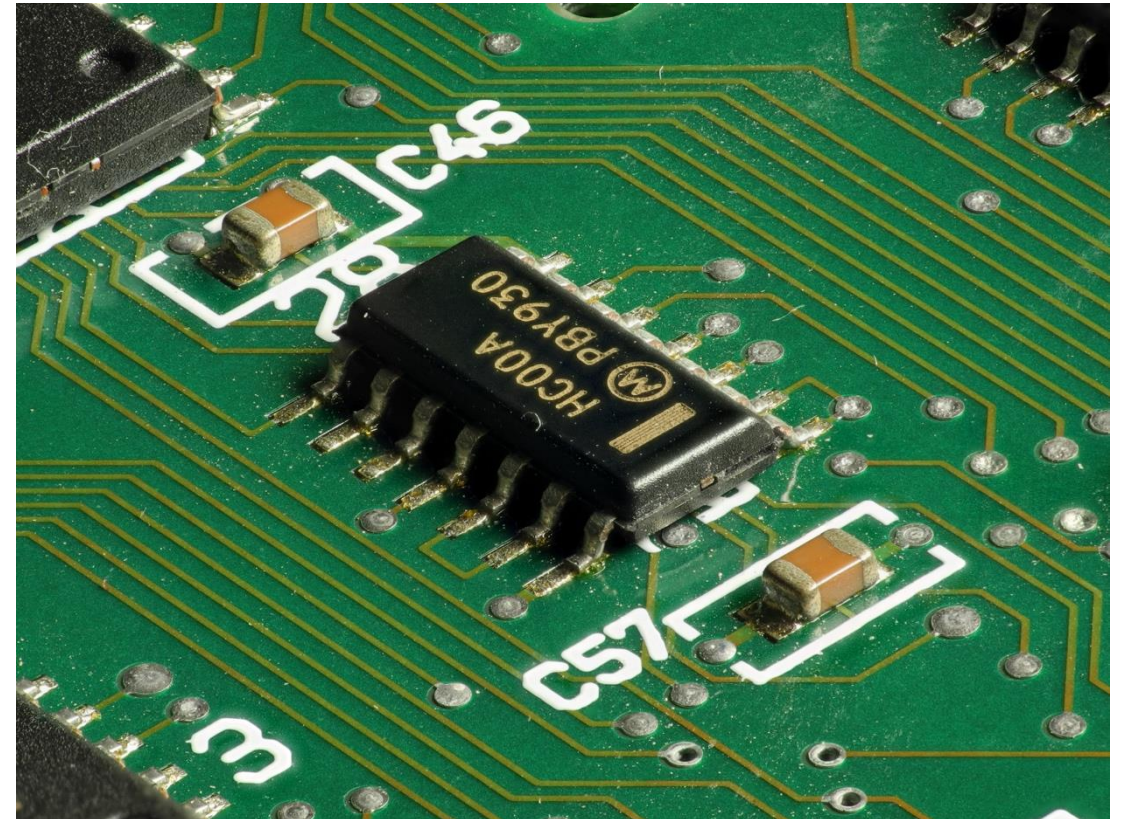
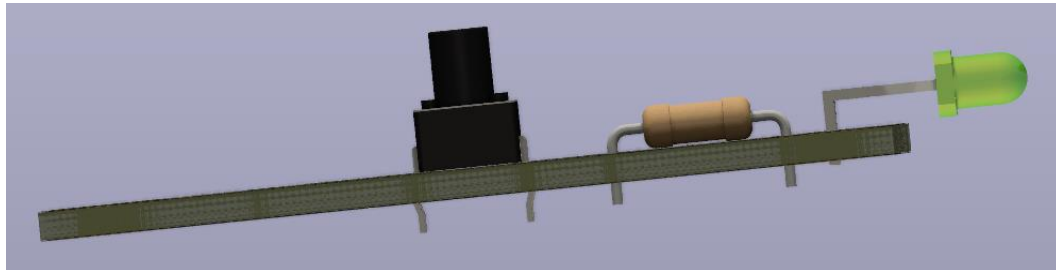
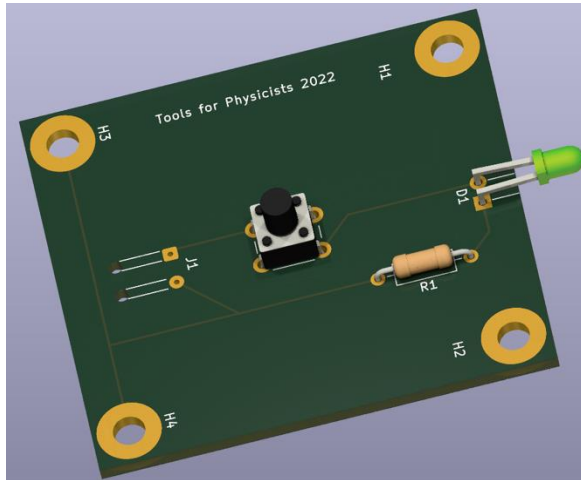
- high currents >1A → hot traces or contacts
- high voltages >42V → induce ventricular fibrillation
- high frequencies >20 MHz → impedance becomes important
- multi layer PCB >4 layers → complicated
- small / complicated parts → hard to solder / moisture controlled?
- large number of boards → usage of panels

→ contact your electronics workshop

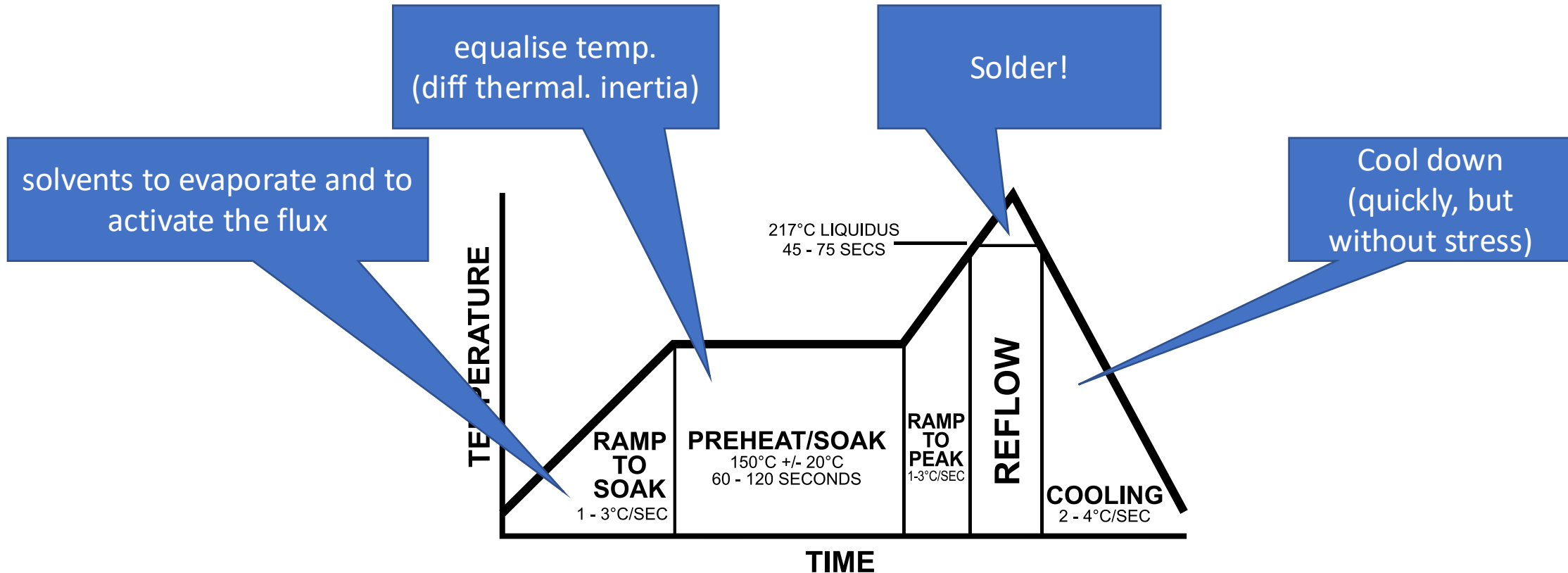
Focus today: slow control

PCB: THT and SMD

- Through hole technology (THT) and Surface Mount Device (SMD)



Reflow profile characteristics



Reflow Ovens

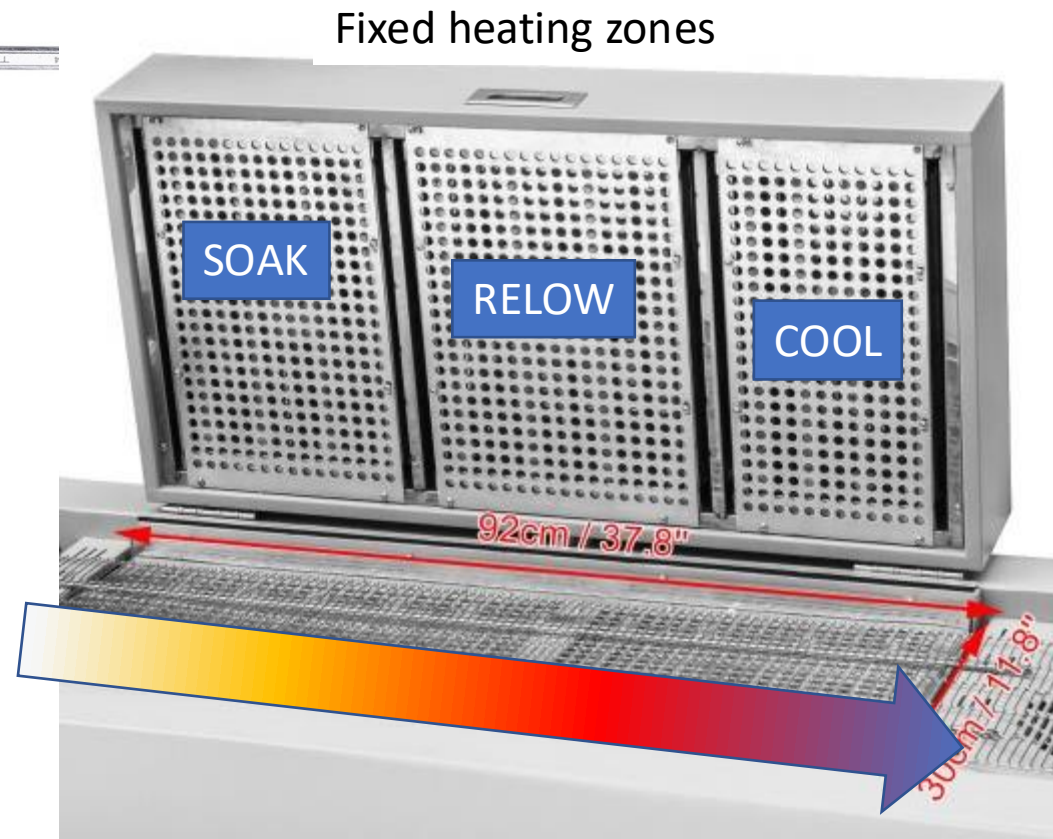


eC-reflow-mate V4 from eurocircuits

time dependent temperature



Conveyor belt



Fixed heating zones

SOAK

RELOW

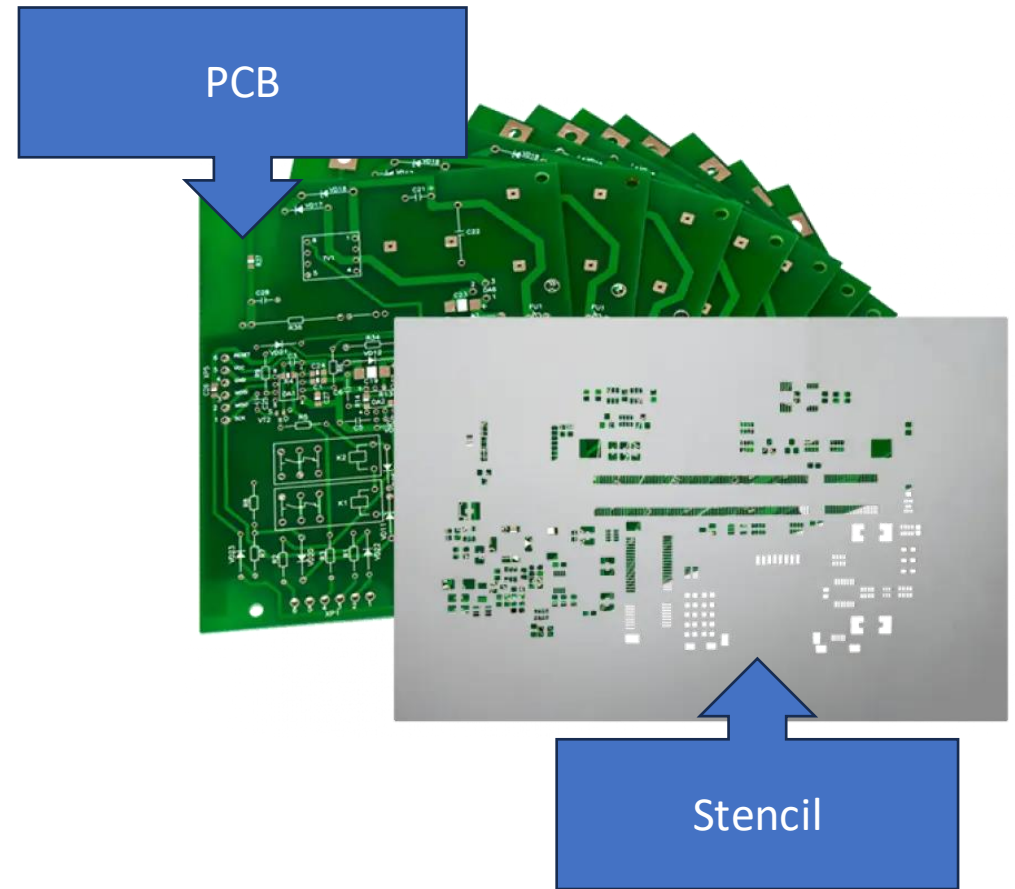
COOL

92cm / 37.8"

30cm / 11.8"

Reflow by hand

- PCB + stencil + electronic parts +
- DIY: toaster / pizza oven / hot plate



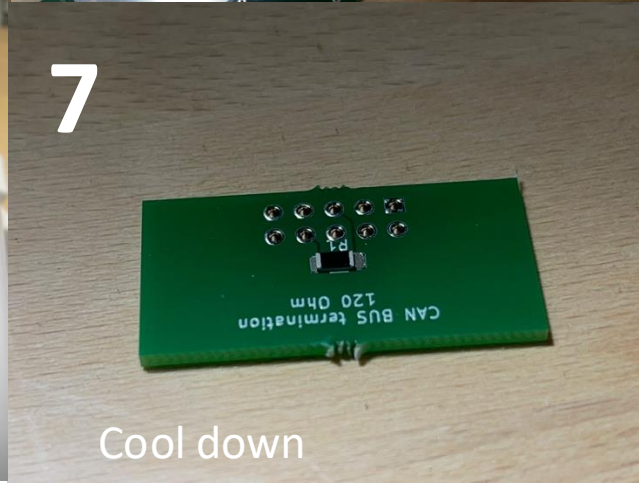
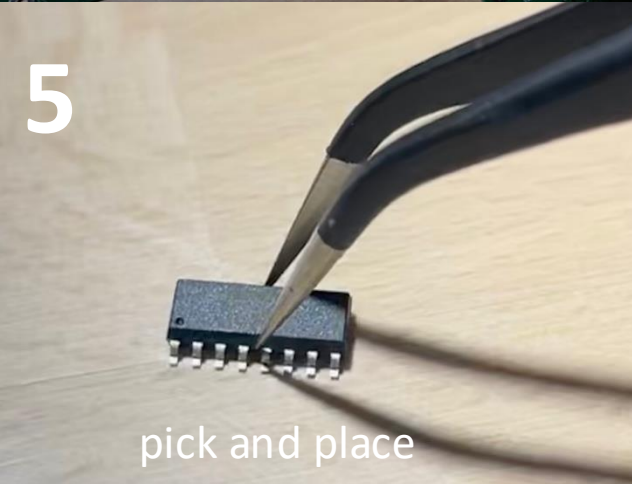
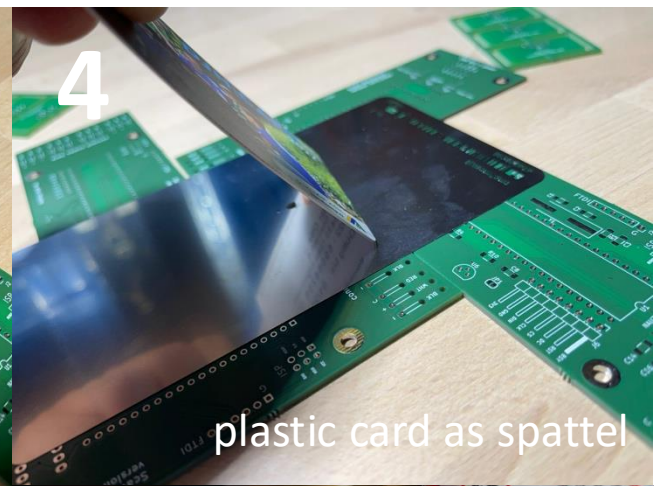
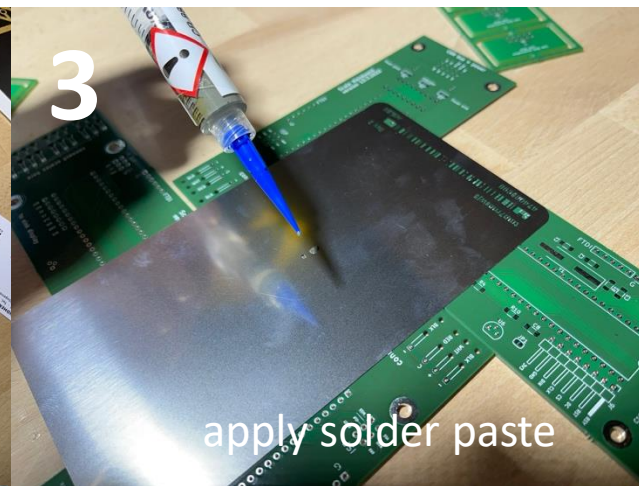
CAN BUS termination
120 Ohm

100Ω

R1



Reflow step by step



Think beyond: arbitrary shapes, holes and thickness

Think 3D!

https://electronoobs.com/PCB_prototype17.php



PCB as holder

ARDUBEE, <http://luminousbe.es/ardubee/>



Flexible

Image from multi-circuit-boards.eu



PCB properties

- Material: FR-4 (standard), aluminium, copper base, etc.
- Flexible, High frequency, high thermal loads, etc.
- Layer buildup for PCBs



multi-circuit-boards.eu

- (companies also offer assembly)

Only nominal values

| |
|-------------------------|
| Solder-Stop |
| Cu 18 μ m + plating |
| 2x Prepreg 1080 |
| Cu |
| Core 1200 μ m |
| Cu |
| 2x Prepreg 1080 |
| Cu 18 μ m + plating |
| Solder-Stop |

| | | |
|---------|--------------|---------------------|
| - TOP - | 35 μ m | |
| | 140 μ m | ϵ_r : 4,00 |
| - IN2 - | 35 μ m | |
| | 1200 μ m | ϵ_r : 4,60 |
| - IN3 - | 35 μ m | |
| | 140 μ m | ϵ_r : 4,00 |
| - BOT - | 35 μ m | |

Board Setup

PCB Editor: File > Board Setup ← match it with PCB manufacturer

Board Stackup

- Board Editor Layers
- Physical Stackup
- Board Finish
- Solder Mask/Paste
- Text & Graphics
 - Defaults
 - Text Variables
- Design Rules
 - Constraints
 - Pre-defined Sizes
 - Net Classes
 - Custom Rules
 - Violation Severity

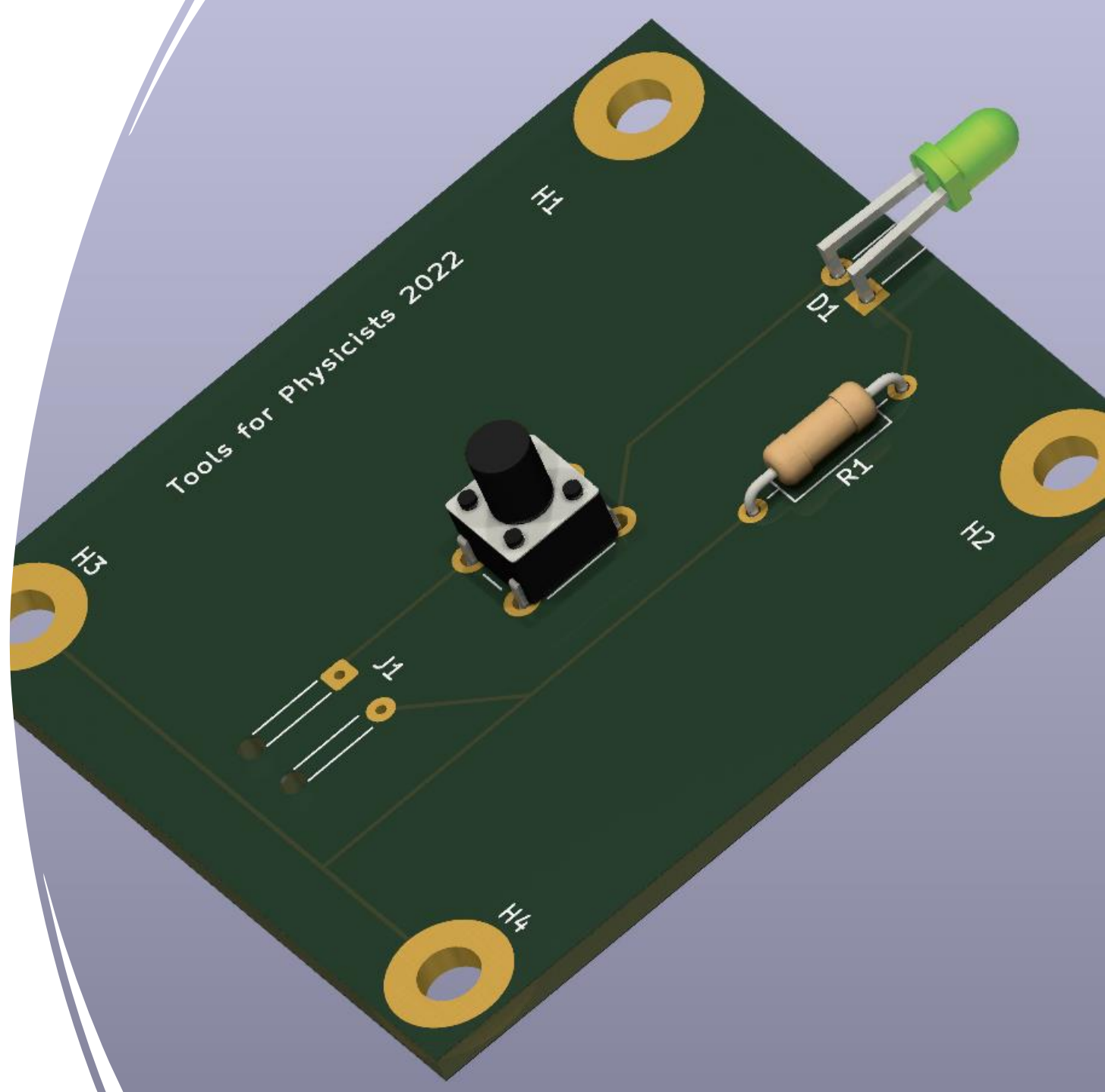
Copper layers: 2

Impedance controlled

| Layer | Id | Type | Material | Thickness | | Color | Epsilon R | Loss Tan |
|-------|--------------|---------------------------------------|-------------------|-----------|--------------------------|---------------|-----------|----------|
| | F.Silkscreen | Top Silk Screen | Not specified ... | | | Not specified | | |
| | F.Paste | Top Solder Paste | | | | | | |
| | F.Mask | Top Solder Mask | Not specified ... | 0.01 mm | | Not specified | 3.3 | 0 |
| | F.Cu | Copper | | 0.035 mm | | | | |
| | Dielectric 1 | Core <input type="button" value="↕"/> | FR4 ... | 1.51 mm | <input type="checkbox"/> | | 4.5 | 0.02 |
| | B.Cu | Copper | | 0.035 mm | | | | |
| | B.Mask | Bottom Solder Mask | Not specified ... | 0.01 mm | | Not specified | 3.3 | 0 |
| | B.Paste | Bottom Solder Paste | | | | | | |
| | B.Silkscreen | Bottom Silk Screen | Not specified ... | | | Not specified | | |

Hands on

- Design and produce a printed circuit board (PCB)!
- Torch



KiCAD 10 Tutorials

Peter-Bernd Otte ✉

HI-Mainz

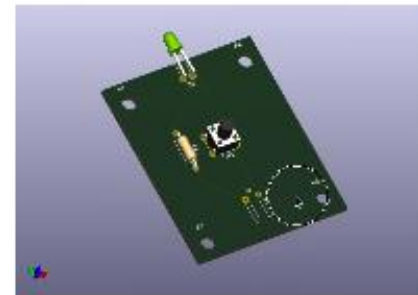
Hands on session

- <https://tutorials-a7c08d.pages.gitlab.rlp.net/>
- Objective today:
→ get *something* working,
fast + order it.
- 2nd step, later:
Do it again with precise
dimensions, etc. for your very
use case.

0. Setup steps



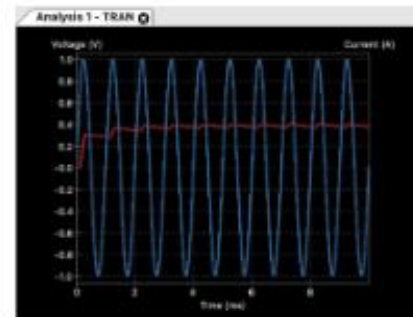
1. Start with the Intro



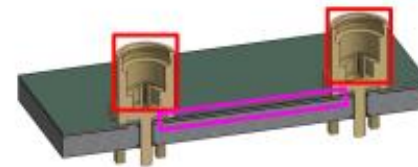
2. Order at fab



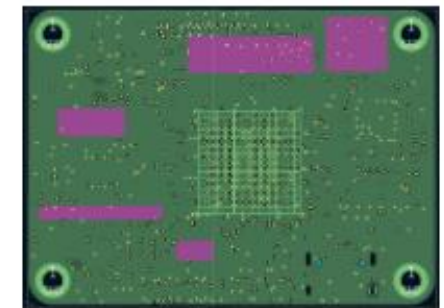
3. Simulation



4. Match impedance

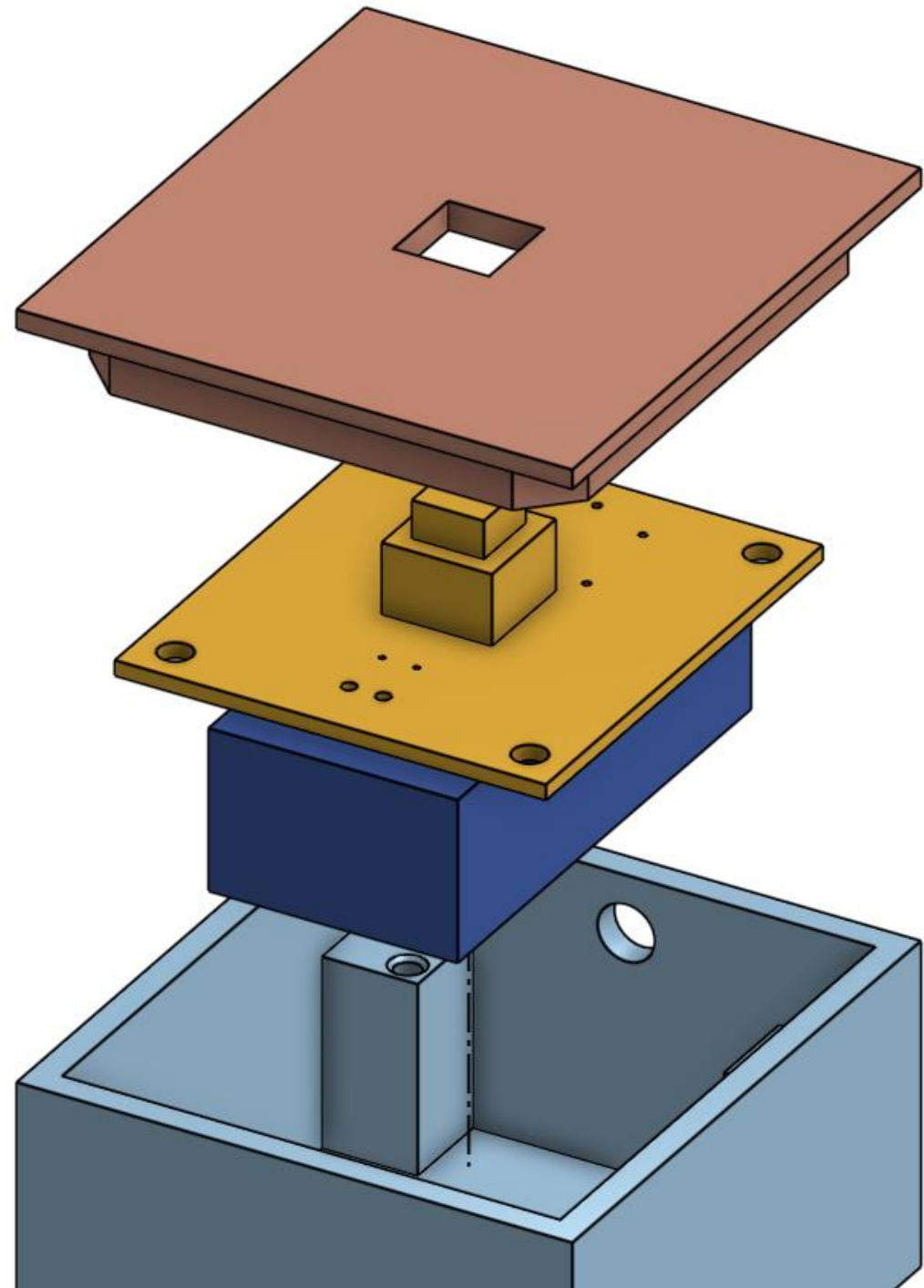


General design hints



Your 1st project: Flash light

- Think of an amplifier in a box, but for today's problem class a bit simpler
- <https://cad.onshape.com/documents/f3df22f41f5956c250e92d72/w/e39ec1ee5ab3727597d41460/e/9d99f21896da01cb25f775fc?renderMode=0&uiState=62a8a9478ac6385651dec014>



| Item | Sourced | Placed | Quantity | Value | References |
|------|-------------------------------------|-------------------------------------|----------|---------------------|-------------------------------------|
| 1 | <input checked="" type="checkbox"/> | <input type="checkbox"/> | 8 | 100n | C3, C4, C8, C11, C12, C15, C16, C17 |
| 2 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | 5 | 1μ | C6, C7, C14, C19, C20 |
| 3 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | 4 | 22pF | C1, C2, C9, C10 |
| 4 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | 2 | 10μ | C5, C18 |
| 5 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | 1 | 330p | C13 |
| 6 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | 3 | 120 | R2, R5, R11 |
| 7 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | 2 | 10k | R1, R7 |
| 8 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | 2 | 2.2k | R3, R4 |
| 9 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | 2 | 47 | R8, R9 |
| 10 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | 1 | 1k | R6 |
| 11 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | 1 | 4.7k | R10 |
| 12 | <input type="checkbox"/> | <input type="checkbox"/> | 3 | LED | D1, D2, D3 |
| 13 | <input type="checkbox"/> | <input type="checkbox"/> | 2 | MCP1700-3302E_T092 | U2, U7 |
| 14 | <input type="checkbox"/> | <input type="checkbox"/> | 1 | ATmega1284P-P | U1 |
| 15 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | 1 | SN65HVD230 | U3 |
| 16 | <input type="checkbox"/> | <input type="checkbox"/> | 1 | MCP2515 | U4 |
| 17 | <input checked="" type="checkbox"/> | <input type="checkbox"/> | 1 | NAU7802SGI | U5 |
| 18 | <input type="checkbox"/> | <input type="checkbox"/> | 1 | DS18B20 | U6 |
| 19 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | 1 | 12MHz | Y1 |
| 20 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | 1 | 8MHz | Y2 |
| 21 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | 1 | Fuse/Polyfuse 500mA | F1 |
| 22 | <input type="checkbox"/> | <input type="checkbox"/> | 1 | SolderJumper_2_Open | JP1 |
| 23 | <input type="checkbox"/> | <input type="checkbox"/> | 4 | Conn_01x03_Male | J4, J5, J7, J8 |
| 24 | <input type="checkbox"/> | <input type="checkbox"/> | 1 | AVR-ISP-6 | J1 |
| 25 | <input type="checkbox"/> | <input type="checkbox"/> | 1 | Conn_01x06 | J2 |
| 26 | <input type="checkbox"/> | <input type="checkbox"/> | 1 | Conn_02x05_Odd_Even | J3 |
| 27 | <input type="checkbox"/> | <input type="checkbox"/> | 1 | Conn_01x08 | J6 |

