Orjowane

PCB

Anonymous Poll

56% Un

10% Une

34% Ryan c un dictateur

50 votes

Reply

Orjowane

PCB

Poll

72% Un

11% Une

43% Robin le dictateur ?

VIEW RESULTS

Reply

un ou une PCB ?

On dit "**un PCB**", car **PCB** est l'abréviation de "**Printed Circuit Board**", traduit en français par "**circuit imprimé**", et le mot "**circuit**" est masculin.

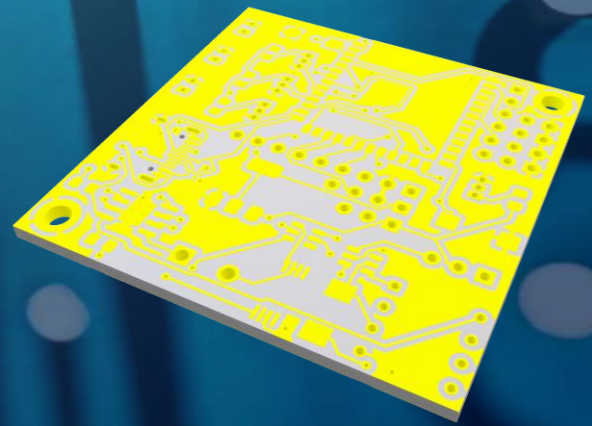
Donc même en parlant en français, on garde le genre masculin :

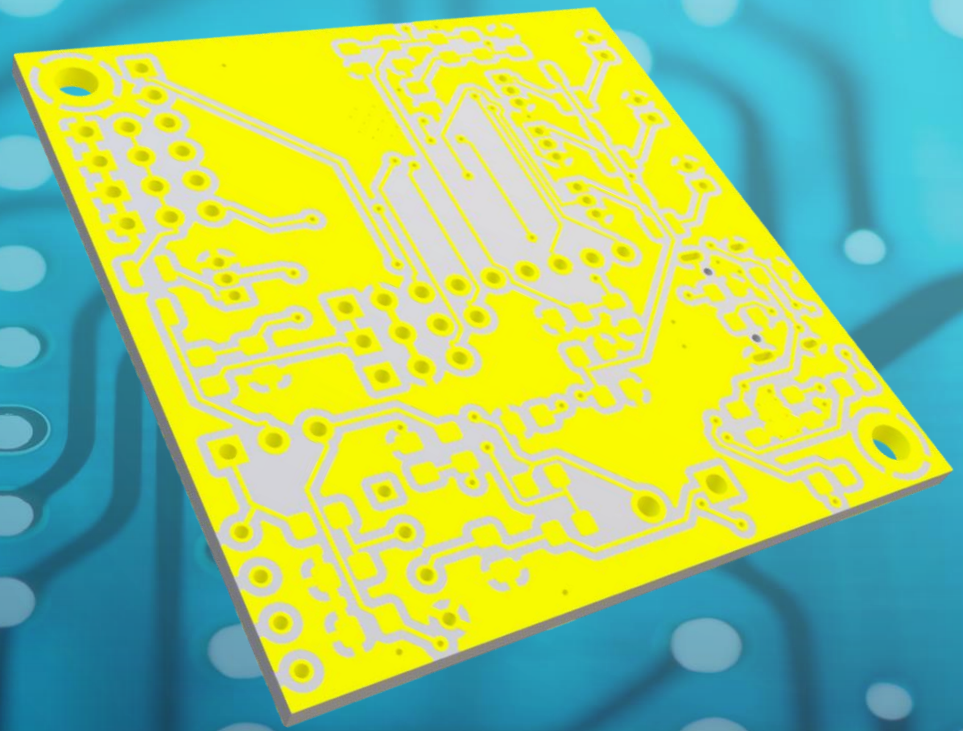
✅ *Un PCB*

❌ *Une PCB*

PCB DESIGN

BASSO SONNY, **KLEIN FLORIAN,** RHEINBOLDT-TRÂN EILEEN,
GUILLAUME-GENTIL ROBIN



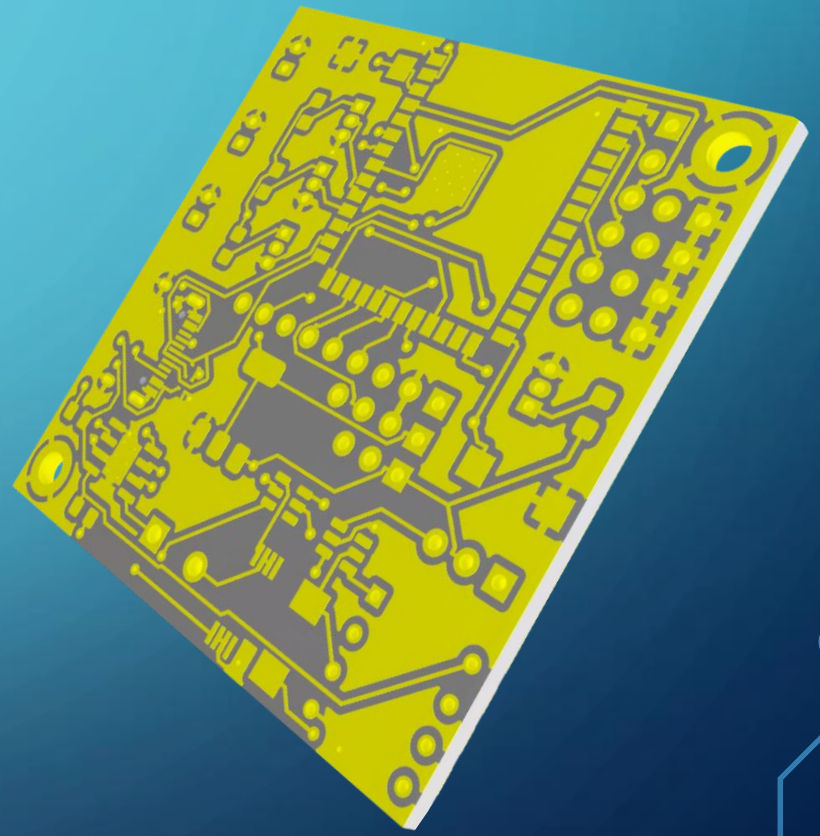


PLAN

1. Introduction au PCB Design
2. Types de PCB et Matériaux
3. Processus de Conception d’un PCB
4. Tendances et Innovations

INTRODUCTION

- **P**rinted **C**ircuit **B**oard
- Maintenir et relier électriquement un ensemble de composants électroniques
- Circuit électronique complexe
- Miniaturisation



INTRODUCTION

Méthode point à point

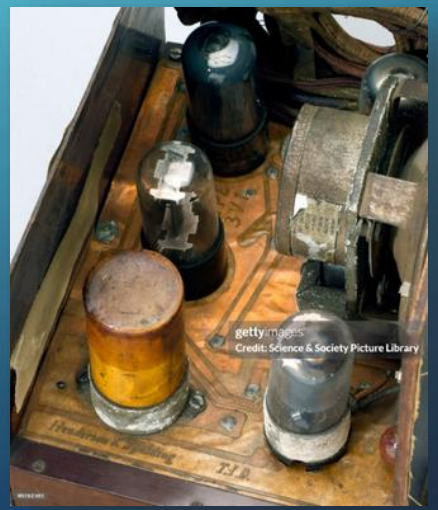
- Nombreux fils
- Encombrant
- Débogage complexe et peu fiable

Paul Eisler

INTRODUCTION

Paul Eisler

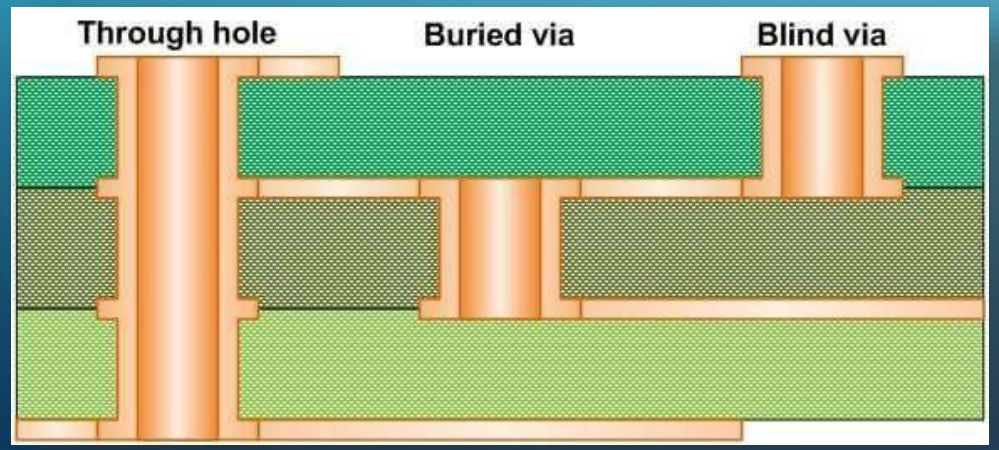
- 2nde guerre mondiale: développement rapide, miniaturiser les radios militaires
- 1950-1960: circuits imprimés en série
- 1970-1980: grand public, début des SMD

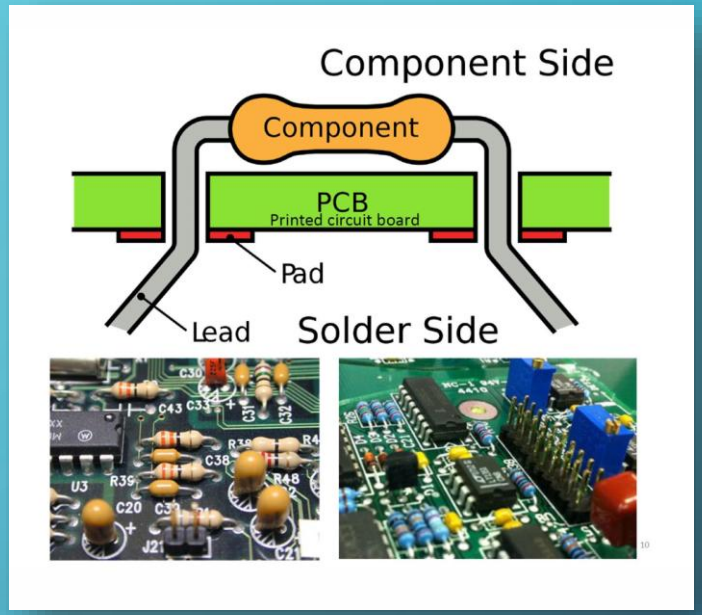


1er « PCB » en 1925

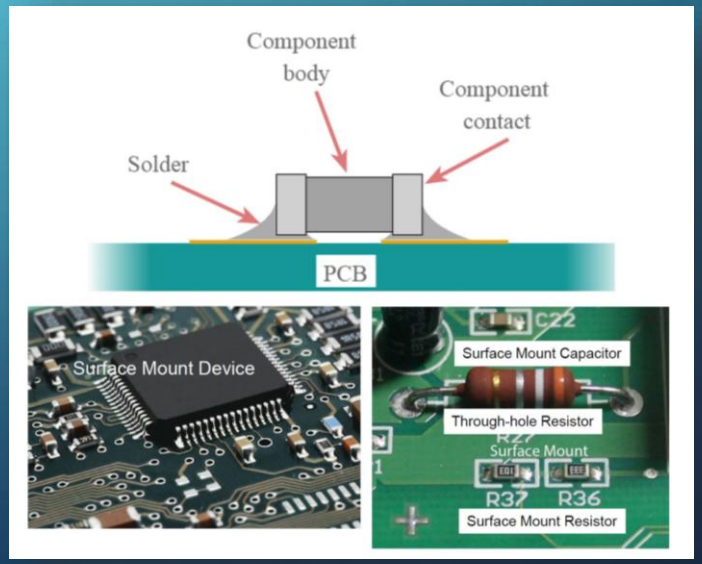
TYPE DE PCB ET MATÉRIAUX

- Matériau isolant + couche de cuivre
- Piste
- Via : connexion entre différentes couches de cuivre





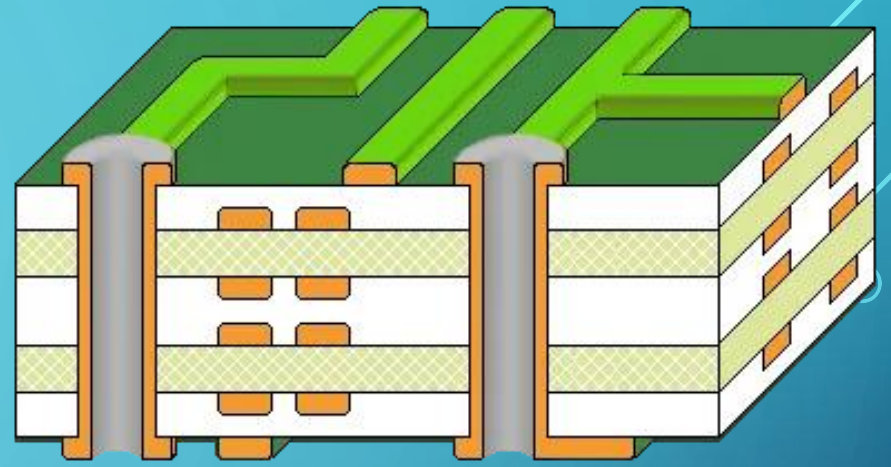
THT

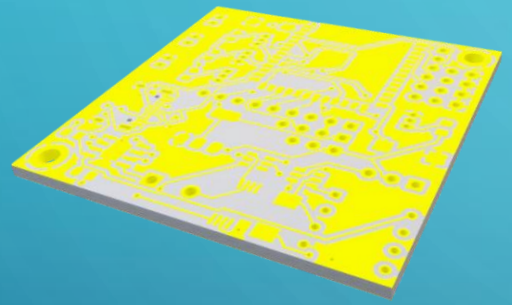


SMT

TYPE DE PCB ET MATÉRIAUX

- Plusieurs couches, souvent pair
- Alimentation et masse



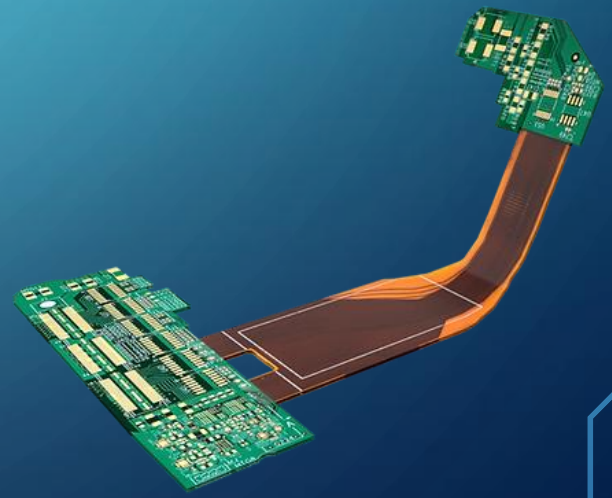


Rigide

- Résine époxyde + fibres de verre/papier
- Grande solidité

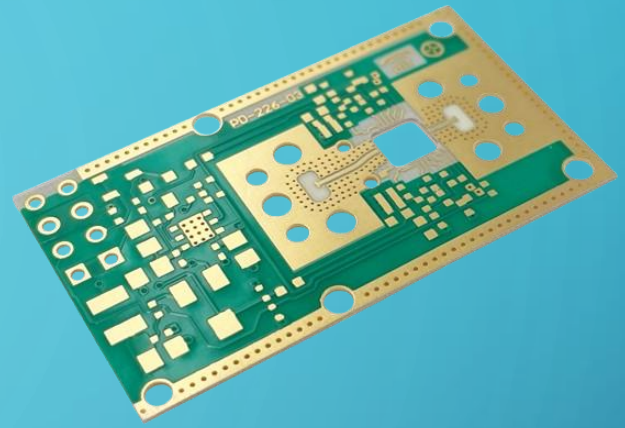
Souple / Flexible

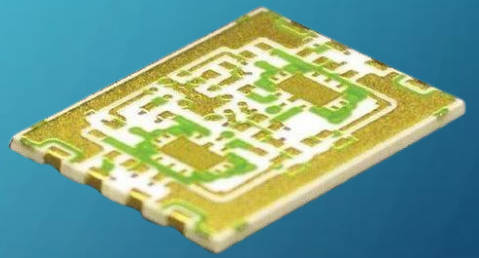
- Polyimide
- Liaison: câble etc
- Caméras, écrans pliables etc

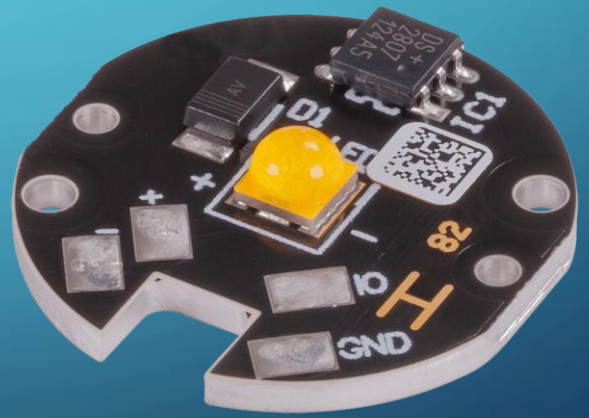


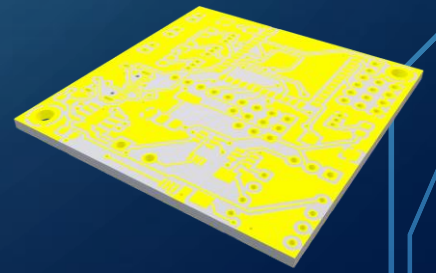
TYPE DE PCB ET MATÉRIAUX

- **FR4**
  - le plus utilisé (fibre de verre + résine époxy)
  - Bon rapport qualité/prix
- **CEM-1/CEM-3**
  - Moins cher
  - Électroménager, PCB simples
- **Rogers**
  - Haut de gamme
  - Hautes fréquences (RF, 5G…)
- **Aluminium/Metal Core PCB (MCPCB)**
  - Dissipation thermique
  - Power élec, LEDs puissantes…
- **Céramique (AIN, alumine)**
  - Excellente conduction thermique, isolation électrique
  - Aérospatial et médical

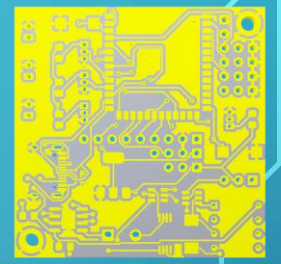








PROCESSUS DE CONCEPTION D'UN PCB



Cahier des charges

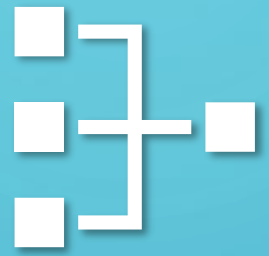
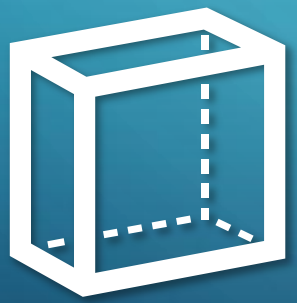


Schéma électronique

Création du PCB

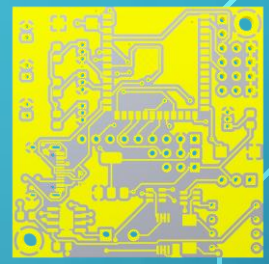


3D

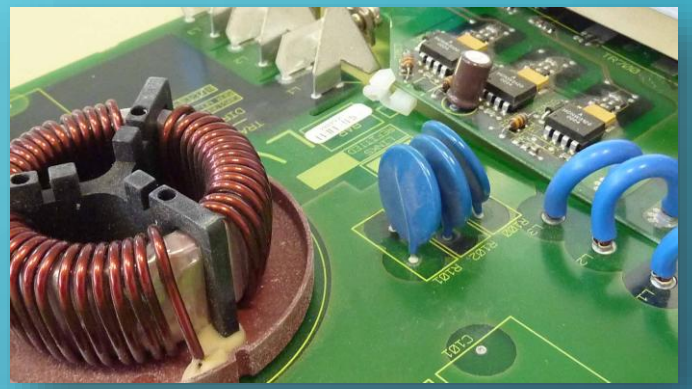
Fichiers de fabrication

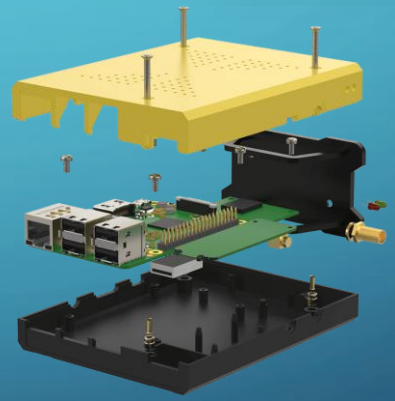
Fabrication

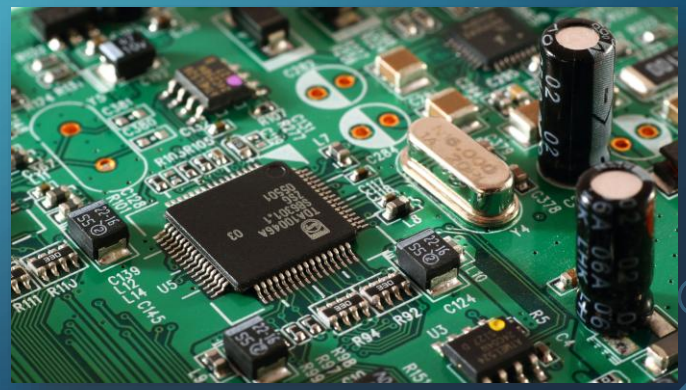
PROCESSUS DE CONCEPTION D'UN PCB



- Objectif du circuit
- Dimensions, format, nombres de couches
- Contraintes électriques et thermiques
- Budget







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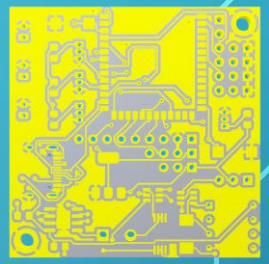
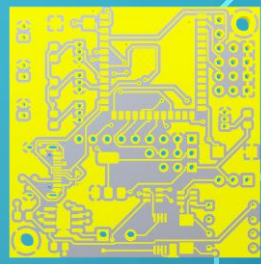


- Logiciel (Kicad, EasyEDA, Altium…)
- Schematics & Footprints
- Vérifications : ERC (Electrical Rules Check)

KiCad EasyEDA Altium

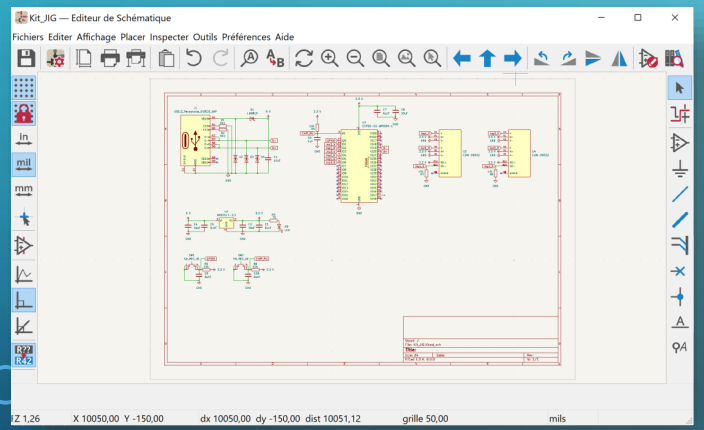
PROCESSUS DE CONCEPTION D'UN PCB

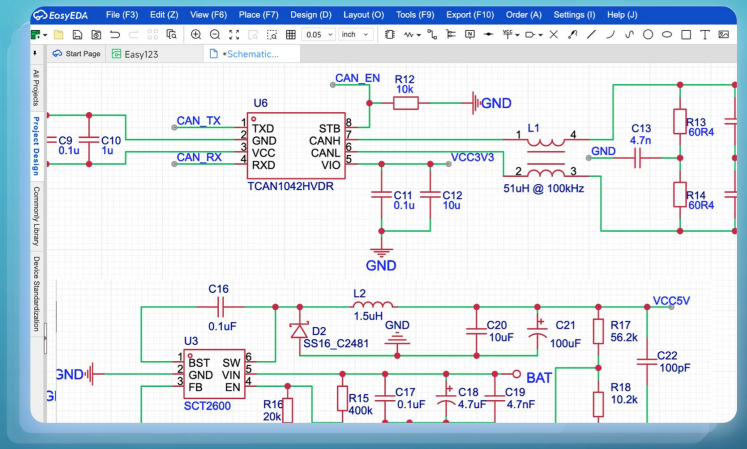


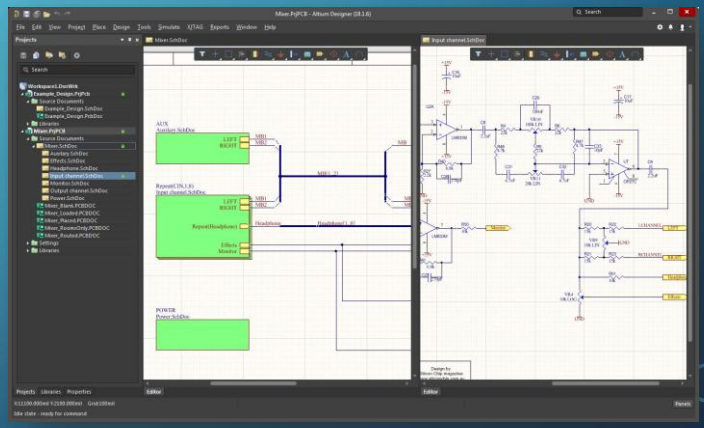
KiCad

EasyEDA

Altium



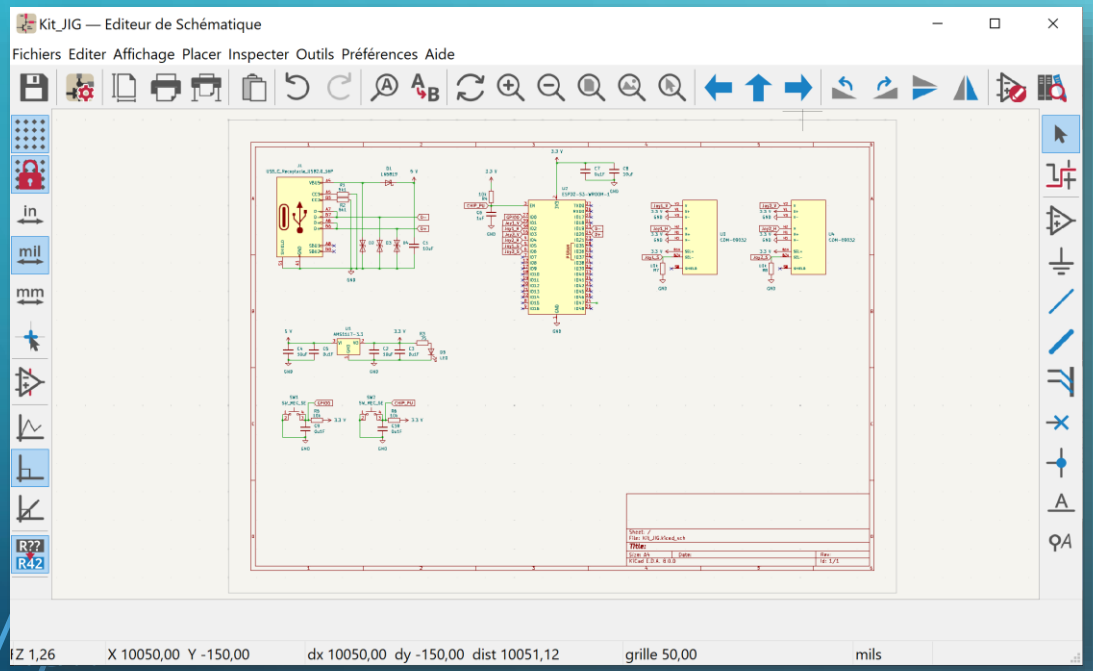


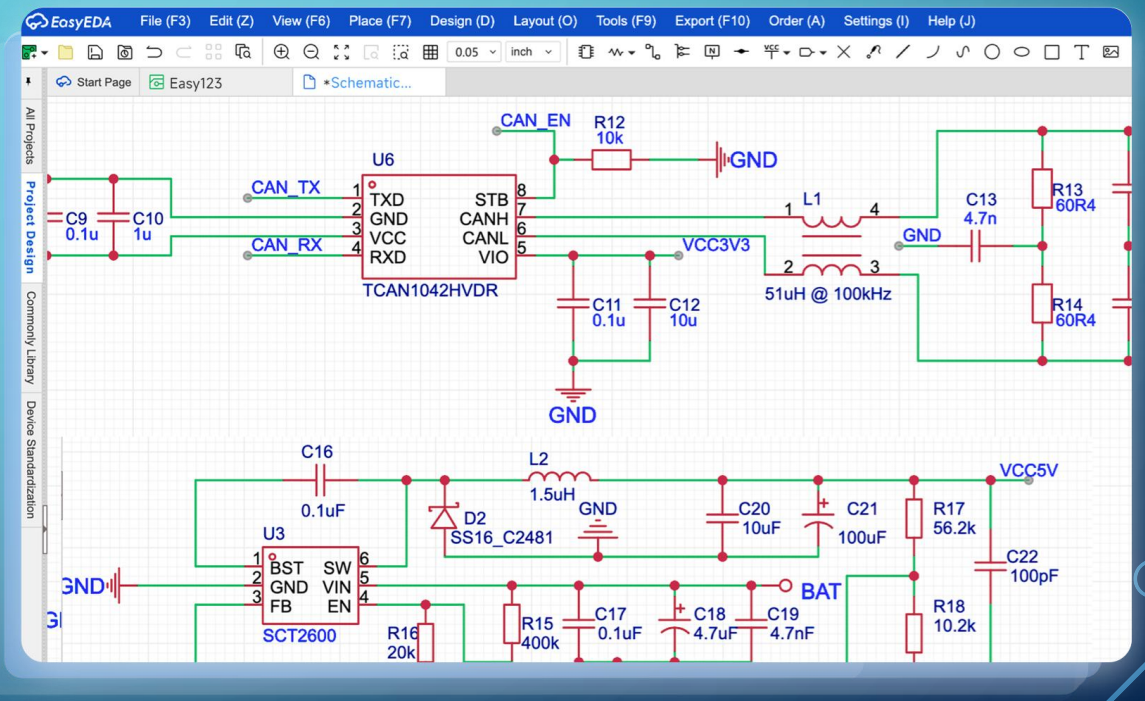


PROCESSUS DE CONCEPTION D'UN PCB

KiCad

EasyEDA





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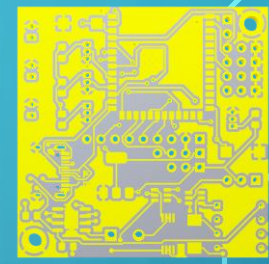
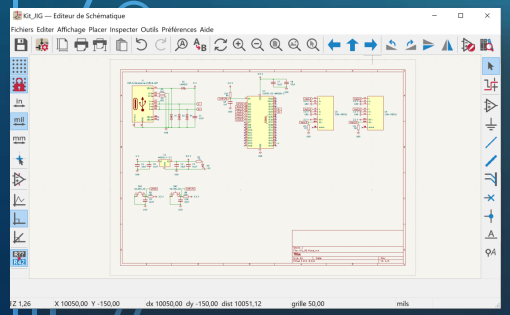


EasyEDA

- Cloud
- Fast prototyping
- Compatible avec fabrication JLCPCB
  - Liste des composants

KiCad



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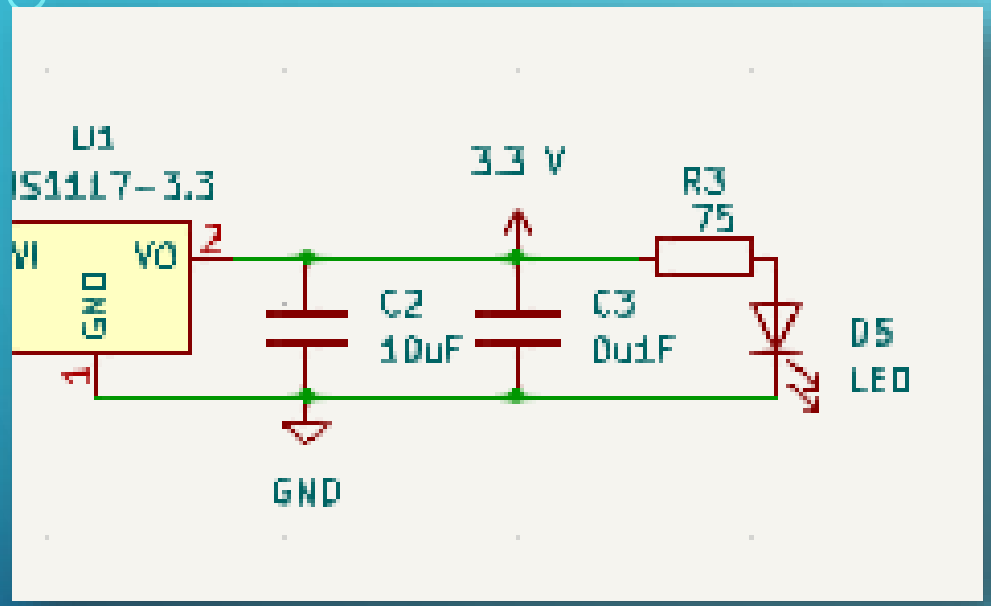

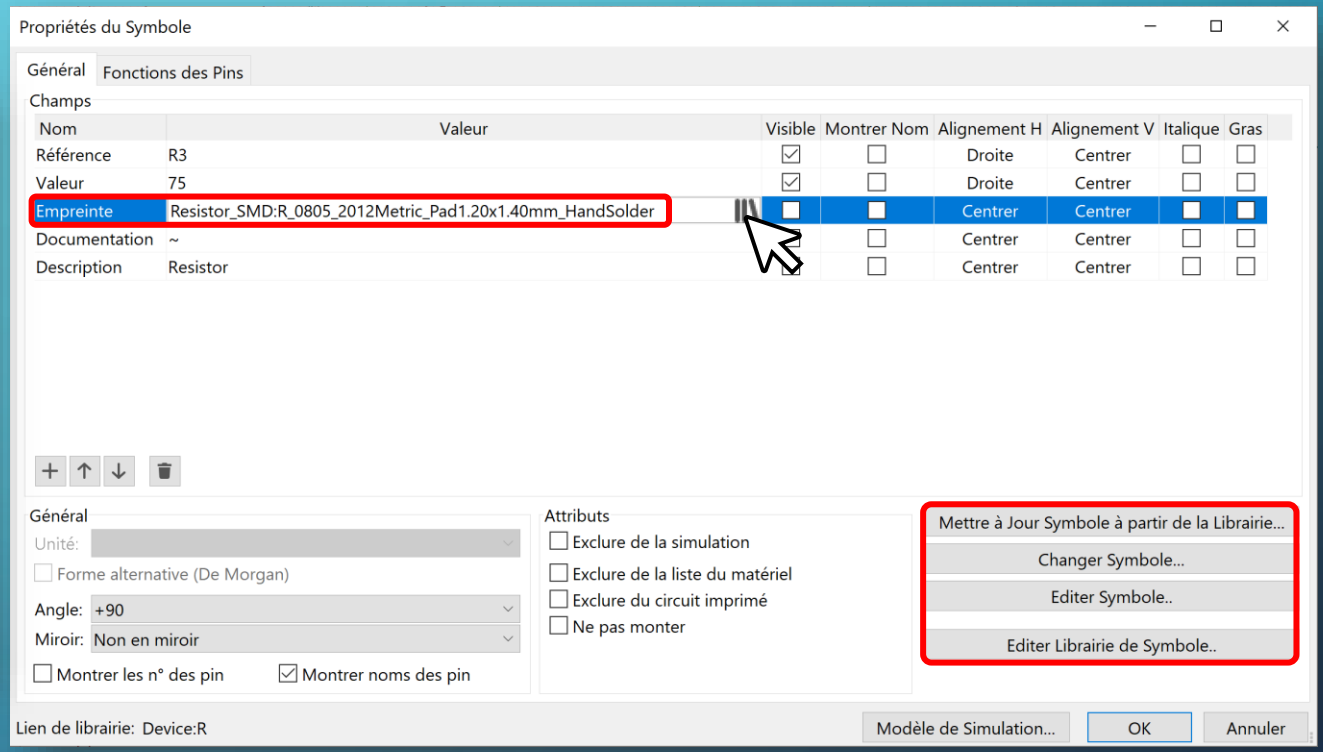

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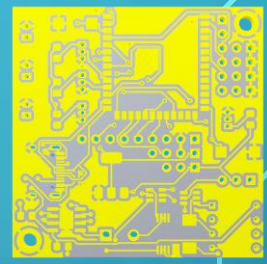

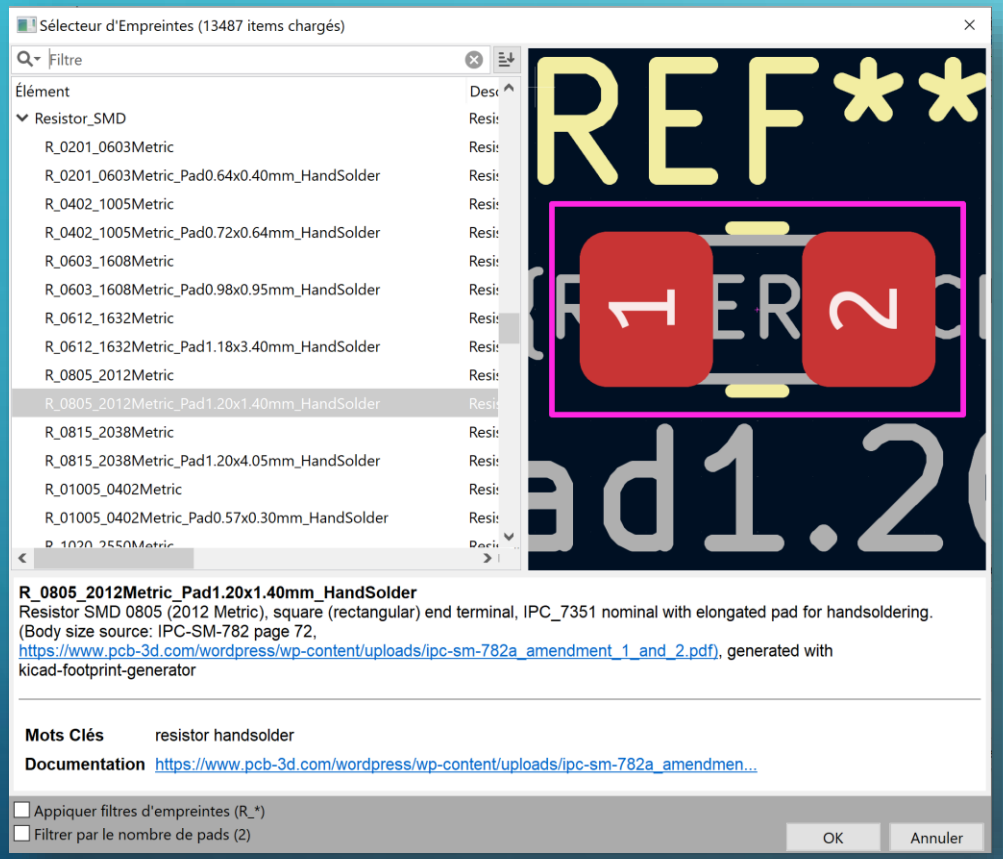

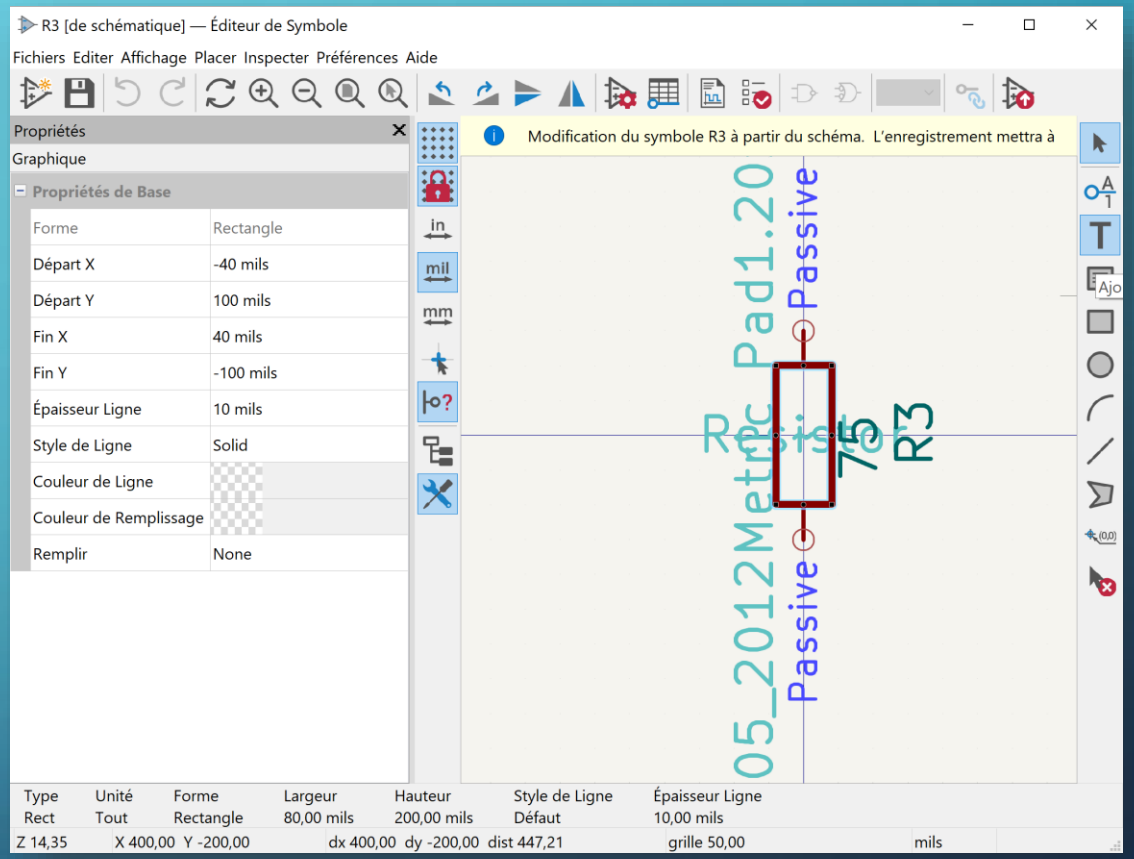

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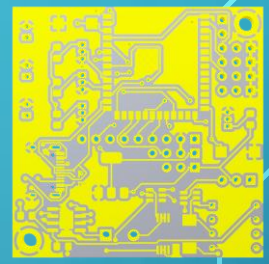
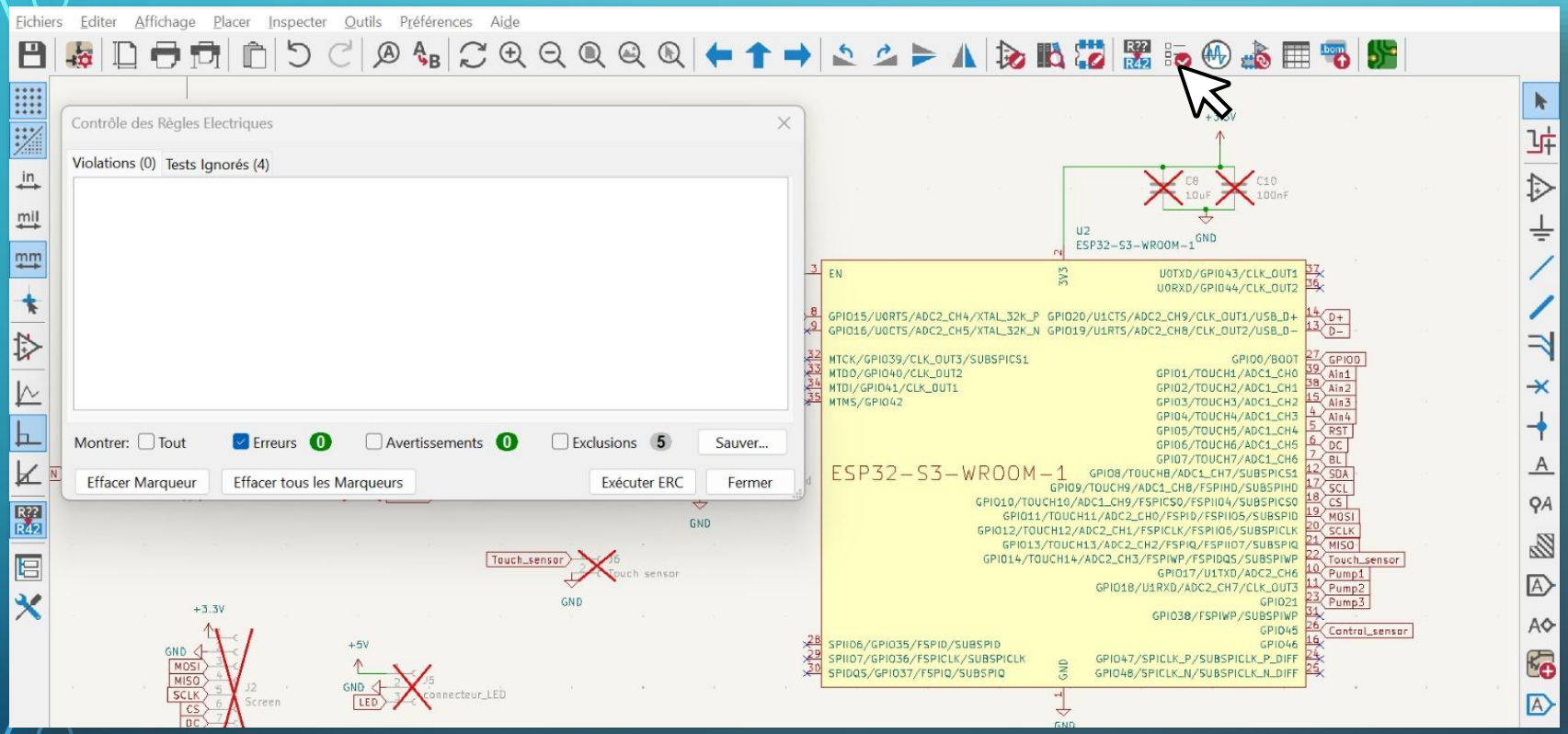
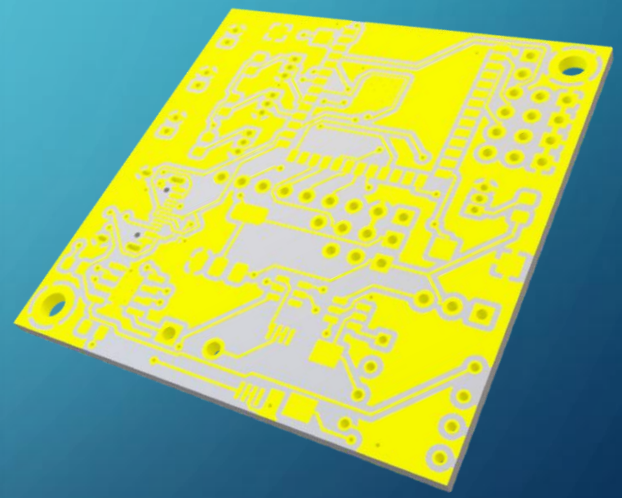


Erreurs types

- Mauvais footprint
- Pad trop petit ou trop grand
- Ex: kit botanique avec les trous trop près les uns des autres
- Antenne à côté d'une source de tension → bruit
- Absence de test point (circuits complexes)
- Pads thermiques, vias thermiques, zones de dissipation autour des composants chauffants

PROCESSUS DE CONCEPTION D'UN PCB





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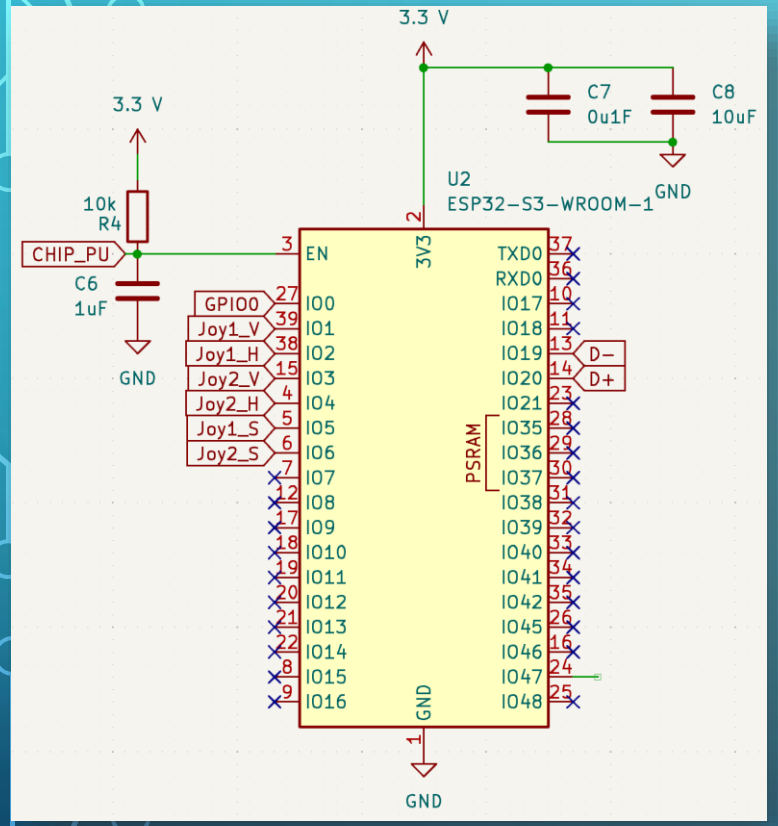
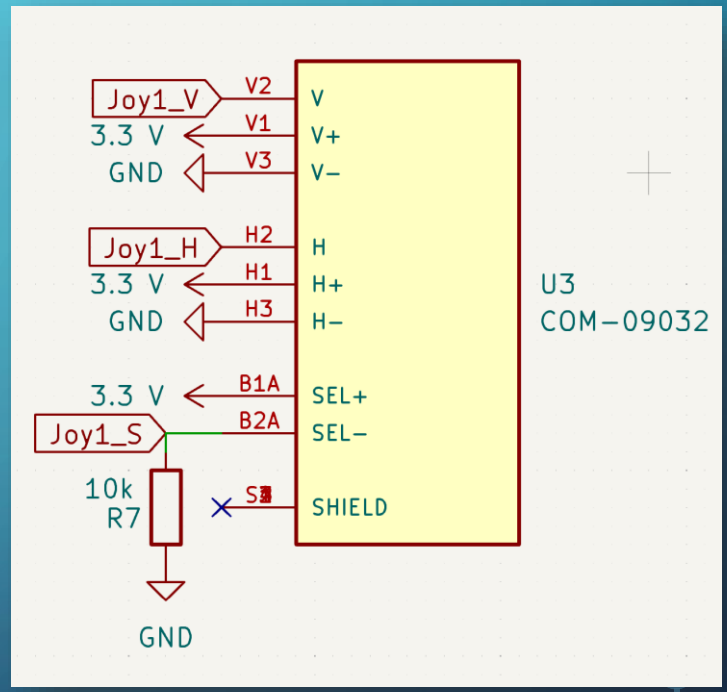
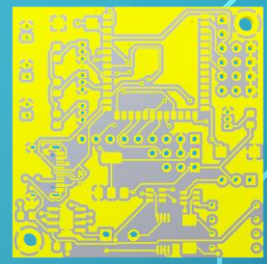


IMPORTANT

! LABELS !





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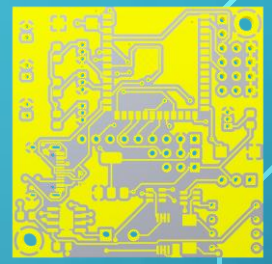
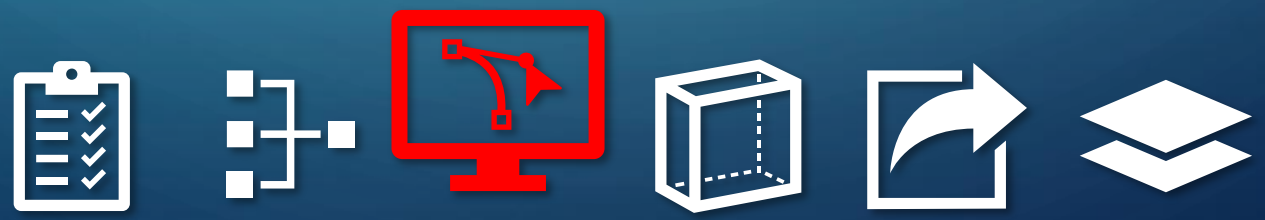


- Importation du schéma
- Placement des composants
- Routage
  - Largeur de pistes
  - Distance d'isolation
- Vérifications : DRC (Design Rules Check)



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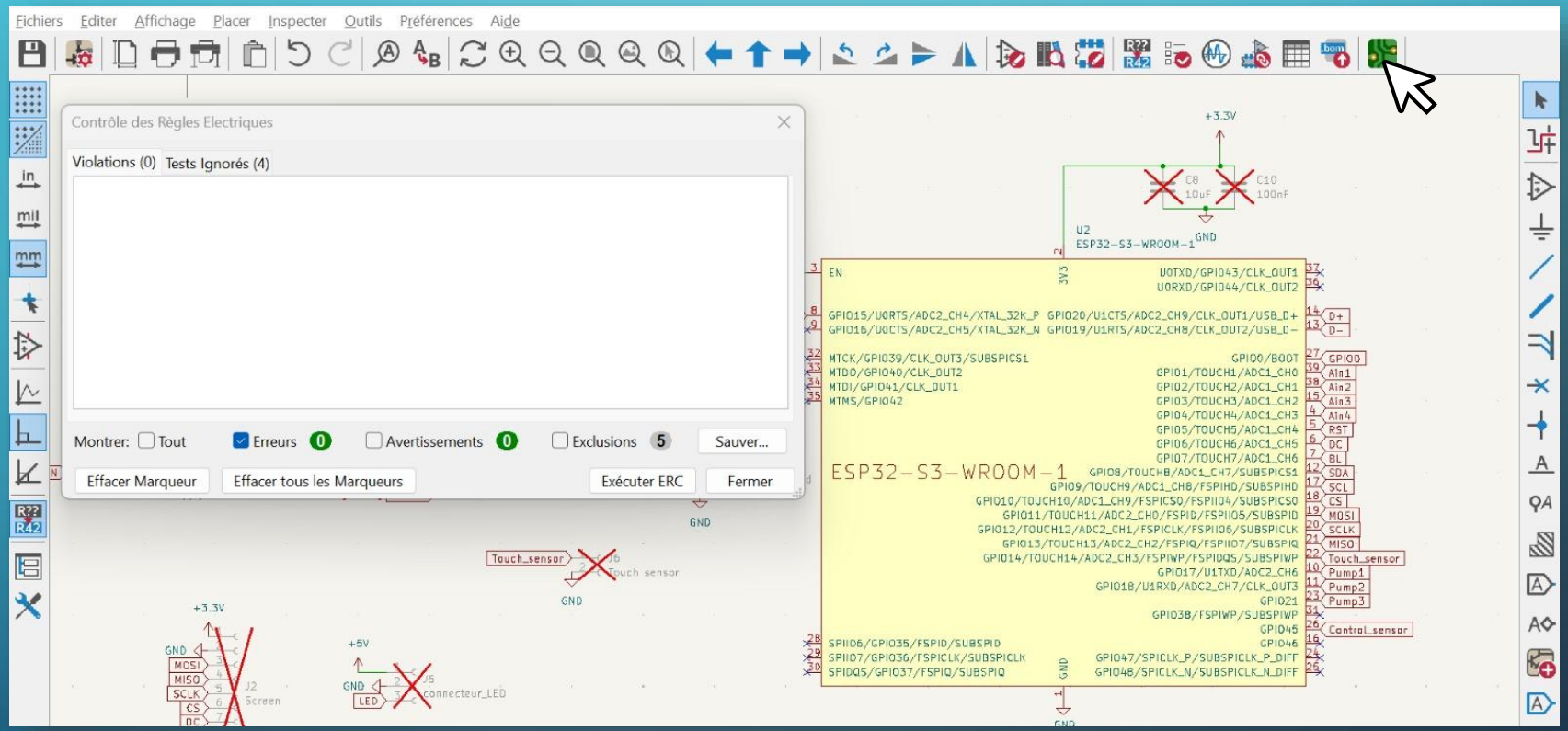

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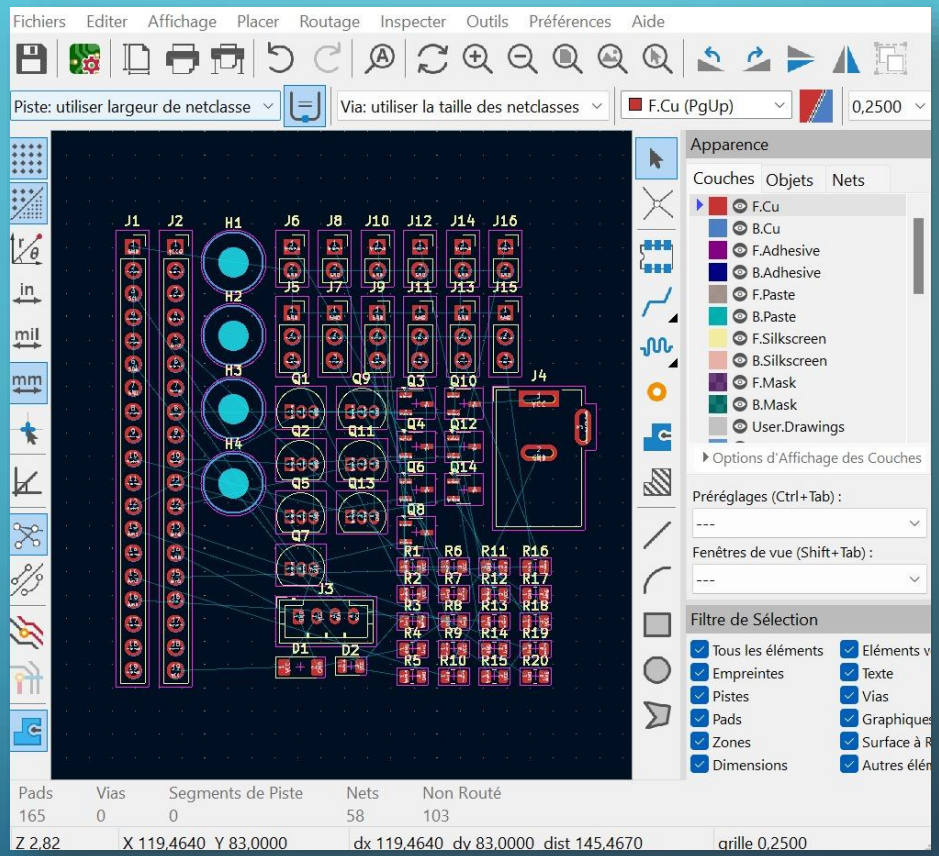
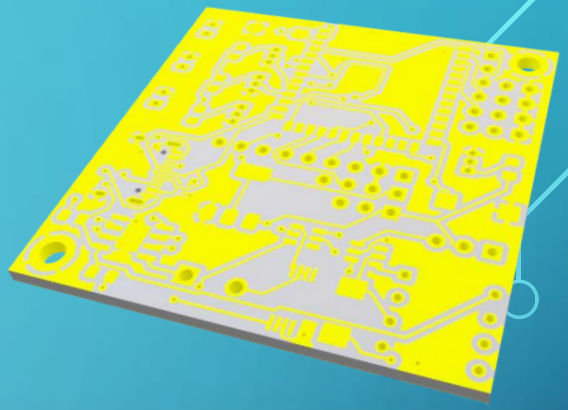
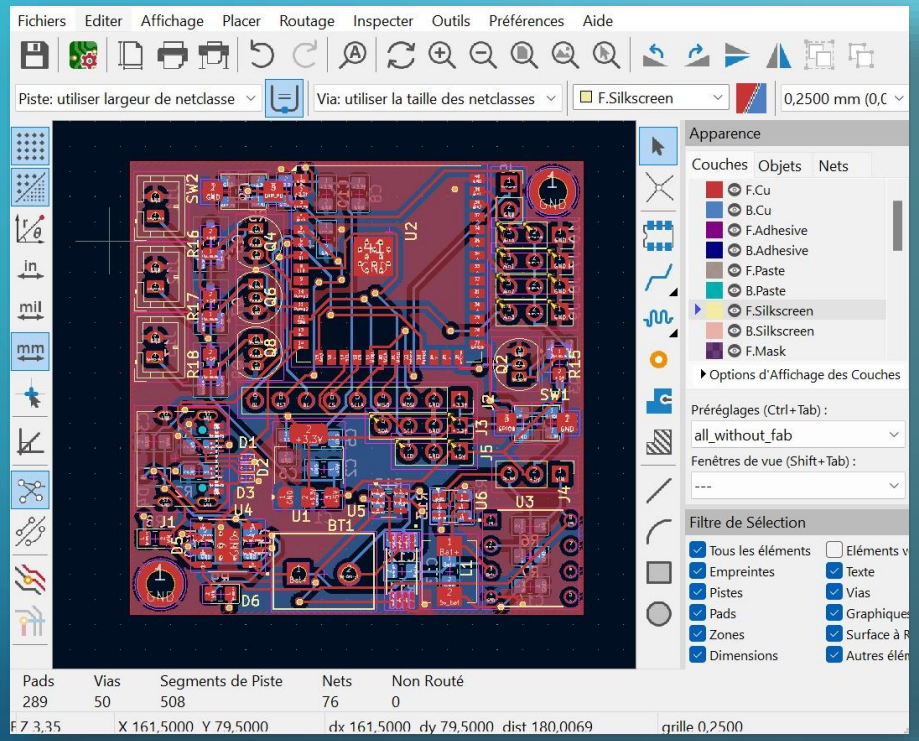
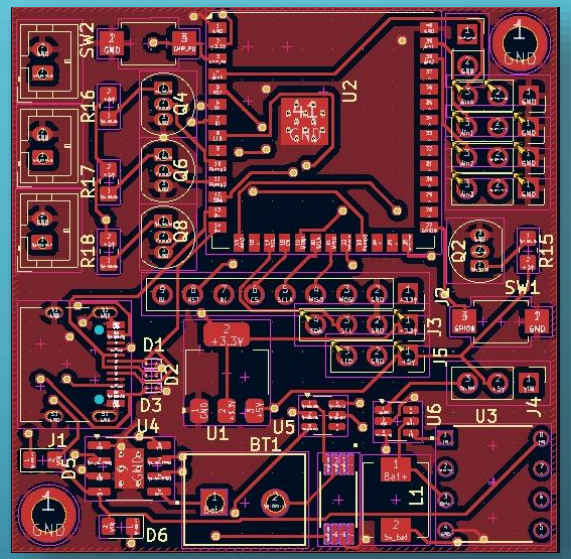
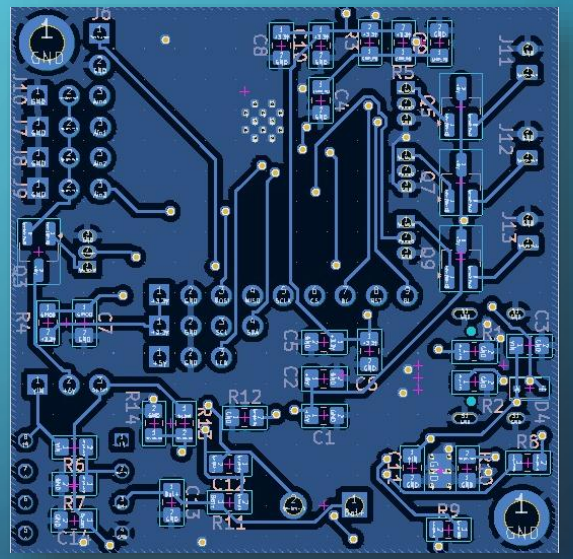


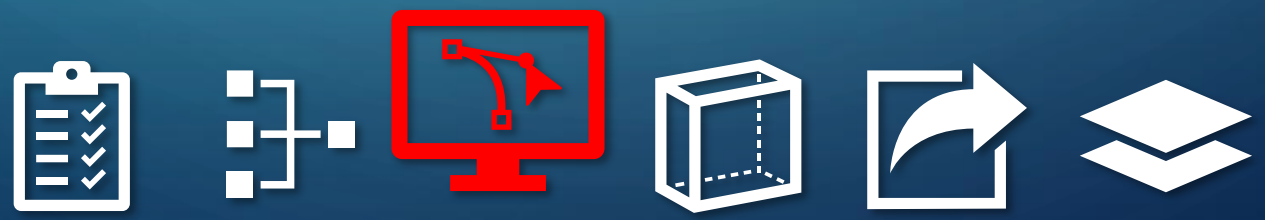
PROCESSUS DE CONCEPTION D'UN PCB











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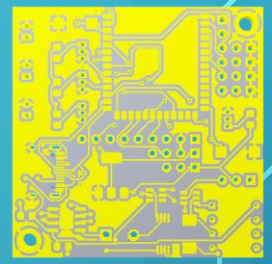
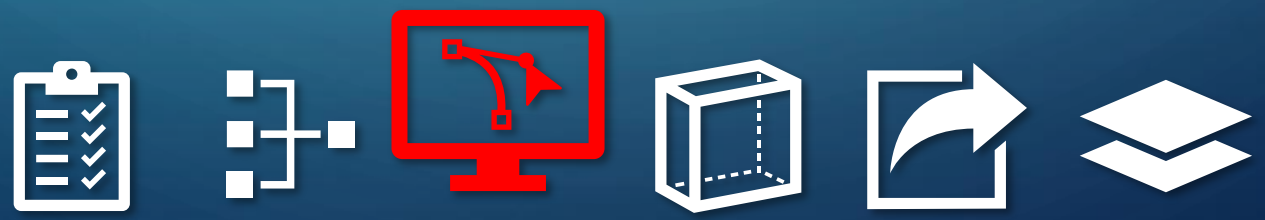
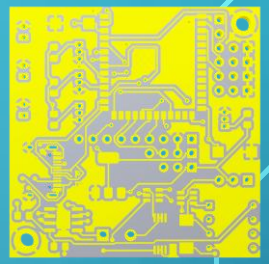


Calculateur de taille de piste :
https://www.digikey.ch/fr/resources/conversion-calculators/conversion-calculator-pcb-trace-width?srsltid=AfmBOootKMAOzO2b-yWKOCkZYZ9wTSyUfLAIaWEUNjkVc43FHaXj-TZc

Type de signal / usage	Largeur de piste typique	Espacement entre pistes
Signaux logiques (faible courant)	0.25 – 0.3 mm	0.2 – 0.25 mm
Alimentation basse puissance (jusqu'à 1 A)	0.5 – 0.8 mm	≥ 0.3 mm
Alimentation moyenne (jusqu'à 3 A)	1.0 – 1.5 mm	≥ 0.4 mm
Courant élevé (>3 A)	2 mm et + (selon le cuivre)	≥ 0.5 mm



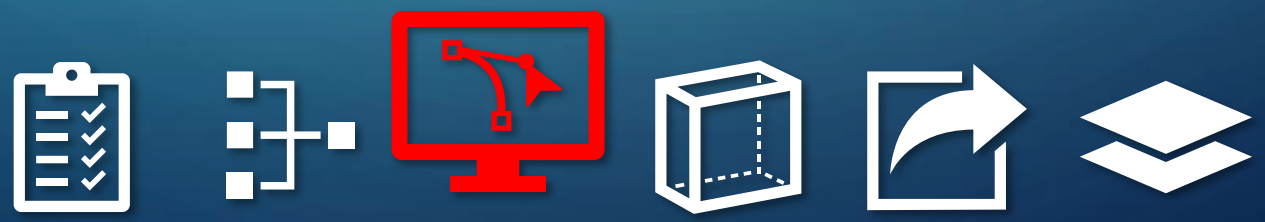
PROCESSUS DE CONCEPTION D'UN PCB



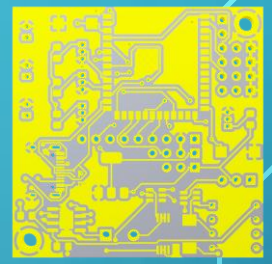
- PCB thickness: 0.4mm à 2mm
  - 1.6mm standard (trop épais ou trop fin→ très cher)
- Epaisseur de la couche de cuivre: 1oz/ft² (standard) ou 2 oz/ft²
- Min via hole diameter: 0.3mm (standard) à 0.15mm

1 mil = 0.001 pouce = 0.0254 mm

Élément	Valeur minimale typique	Remarques
Largeur de piste	0.15 mm (6 mil)	Souvent gratuit jusqu'à 6 mil chez JLCPCB
Espacement entre pistes	0.15 mm (6 mil)	Attention à ne pas trop compacter
Taille via (trou)	Ø 0.3 mm	Percage minimum standard
Pad de via	Ø 0.6 mm	Annulaire typique
Taille de texte	1 mm hauteur / 0.15 mm trait	En sérigraphie, pour rester lisible
Diamètre de perçage	0.3 mm (non via-plated)	Certaines usines peuvent aller à 0.2 mm

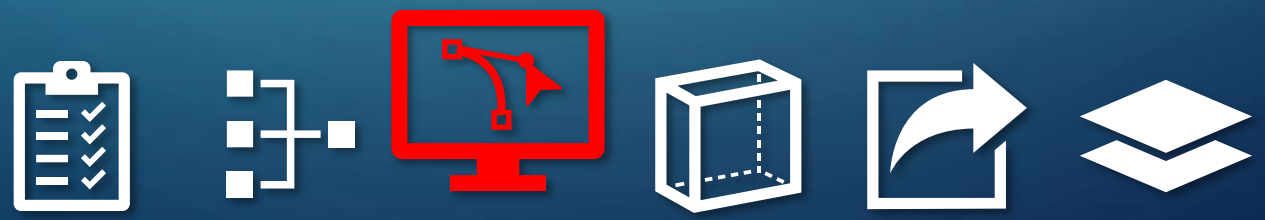


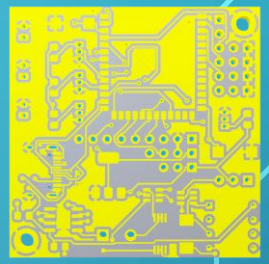
PROCESSUS DE CONCEPTION D'UN PCB



Erreurs types

- Angles de 90° au lieu de 45°
  - 90°: plus facilement de défauts de fabrication, courant circule moins bien, agit comme une mini antenne pour des signaux rapides
- Routes trop près des composants
- Largeur de route
- Détours trop longs, boucles, croisements → bruit
- Oublier la sérigraphie utile





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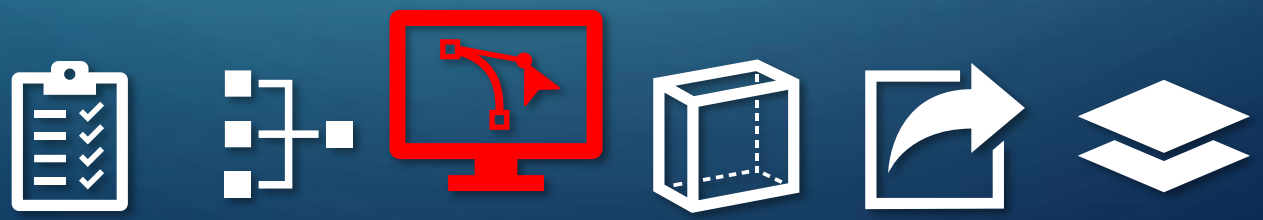

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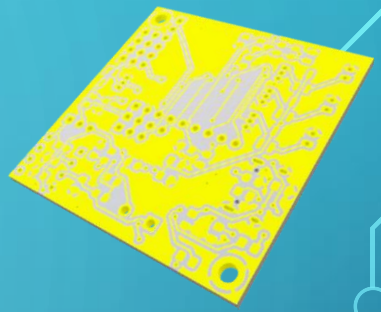

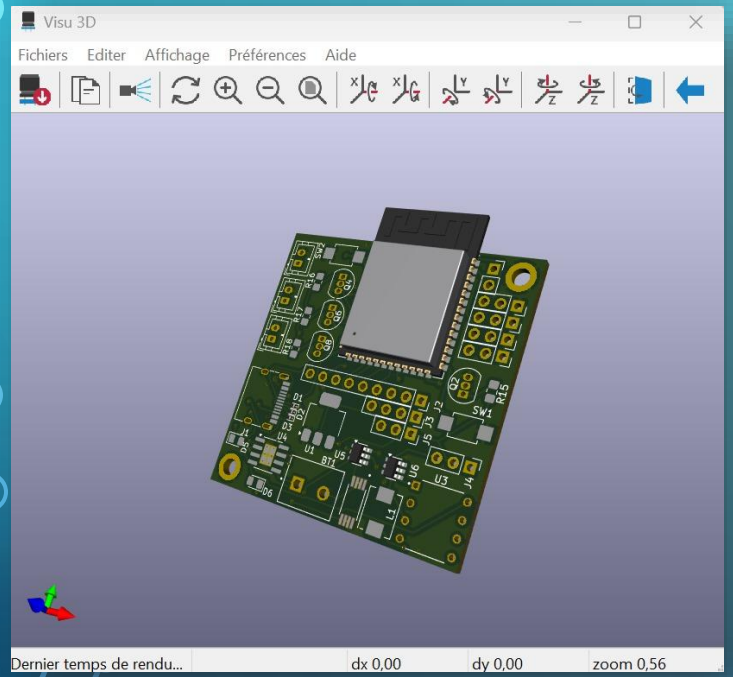

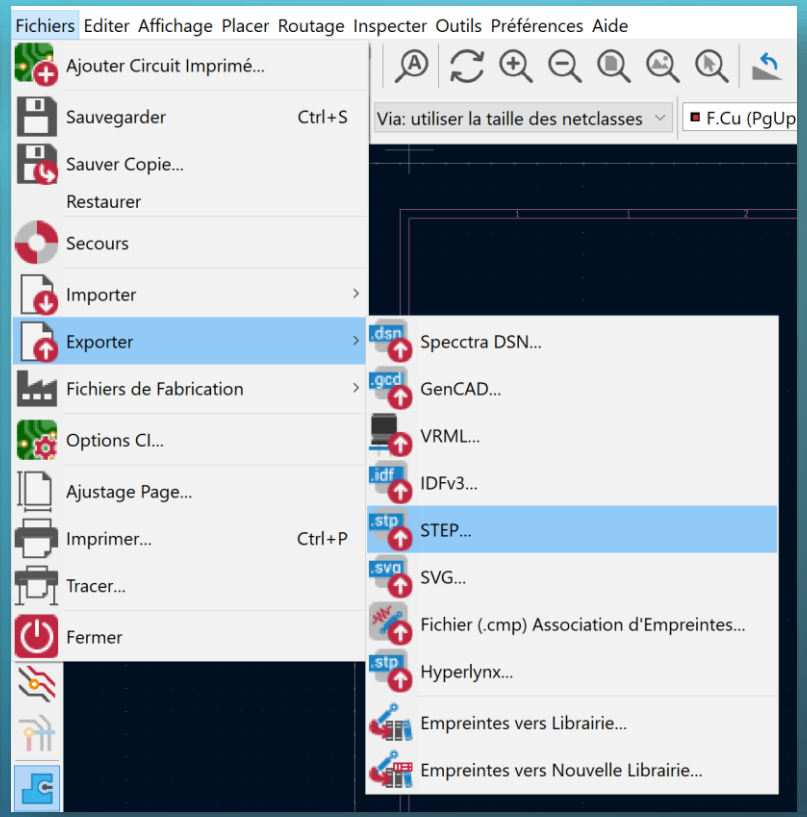

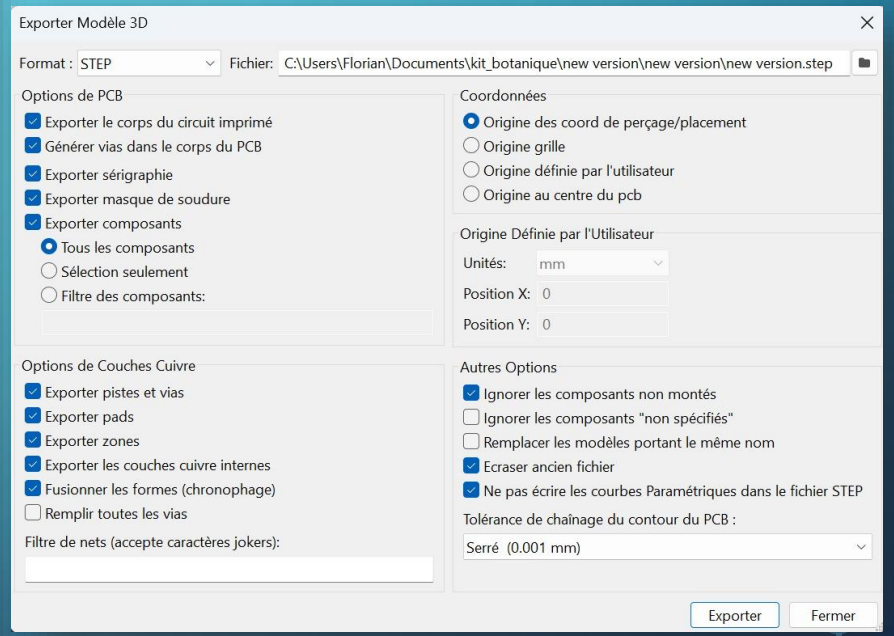

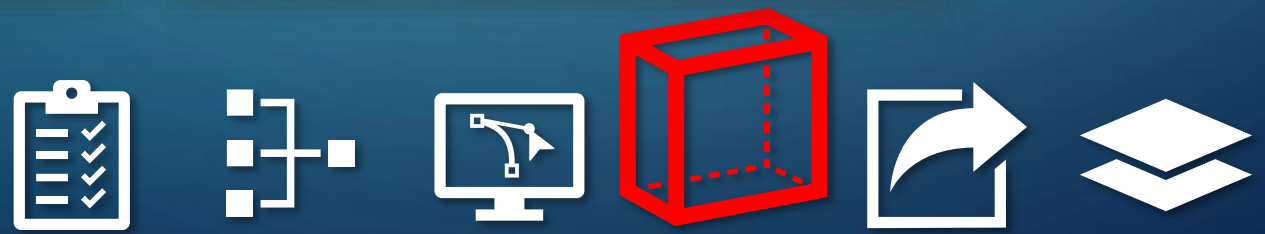

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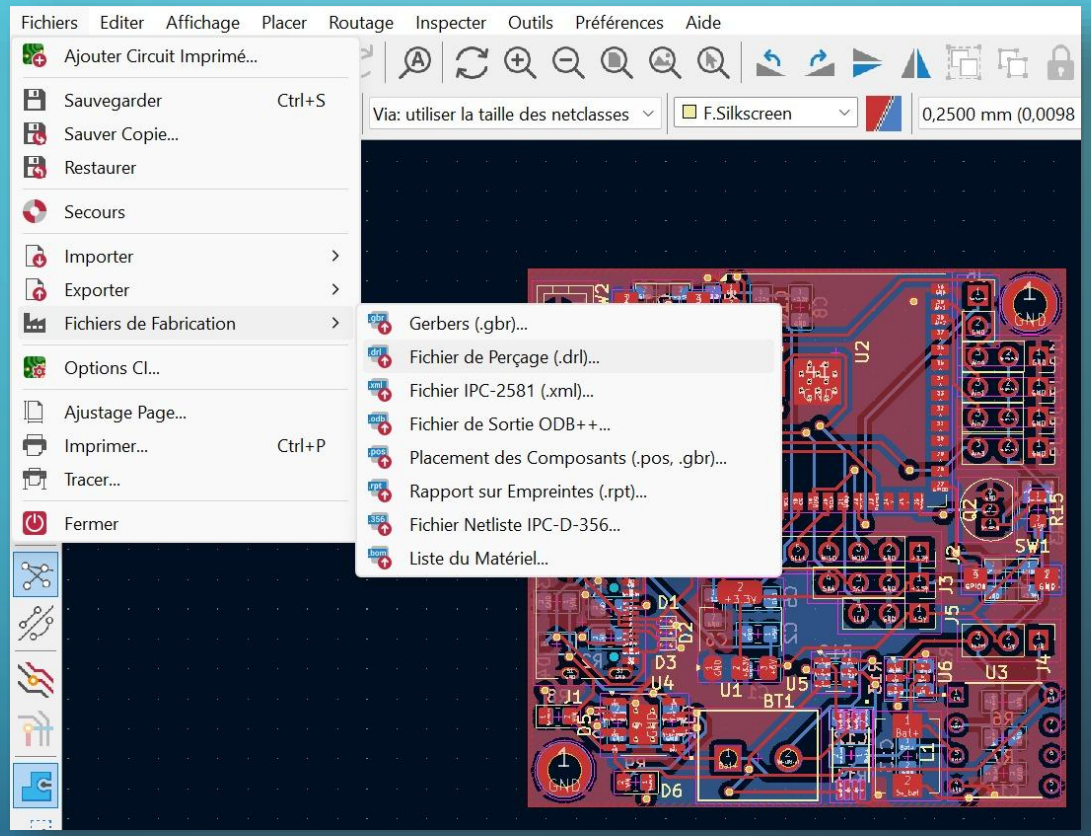

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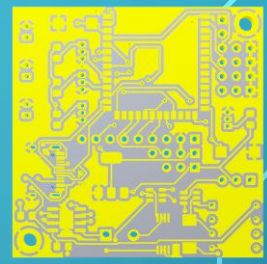

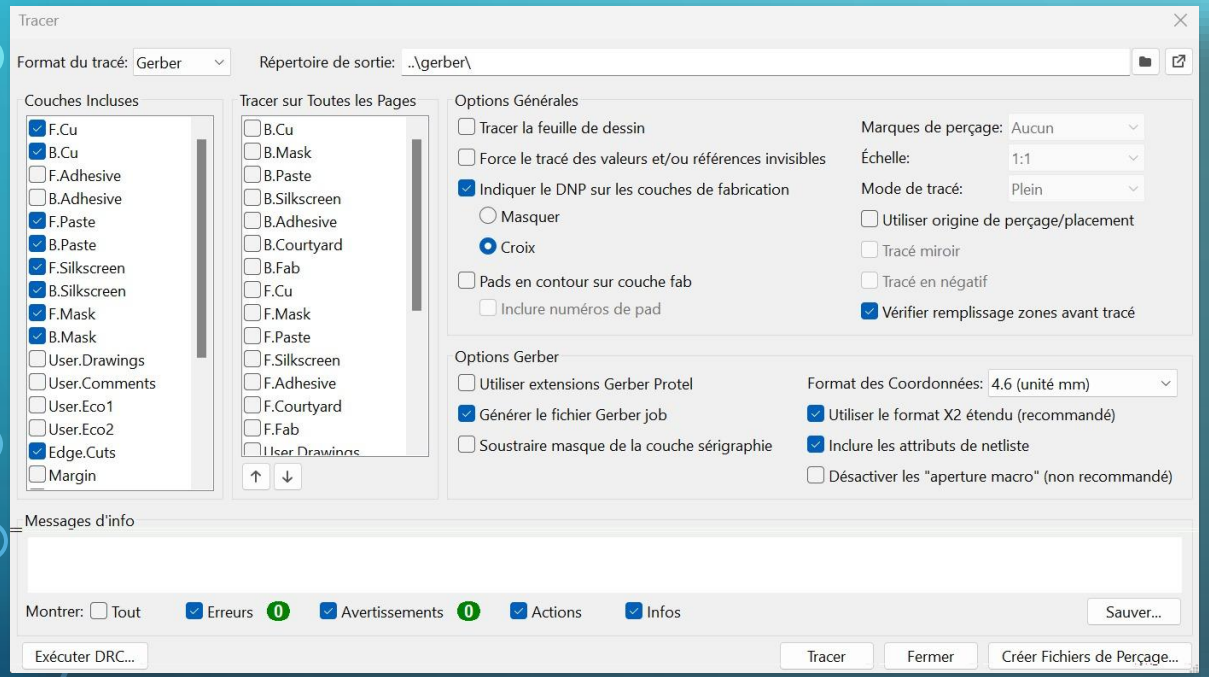

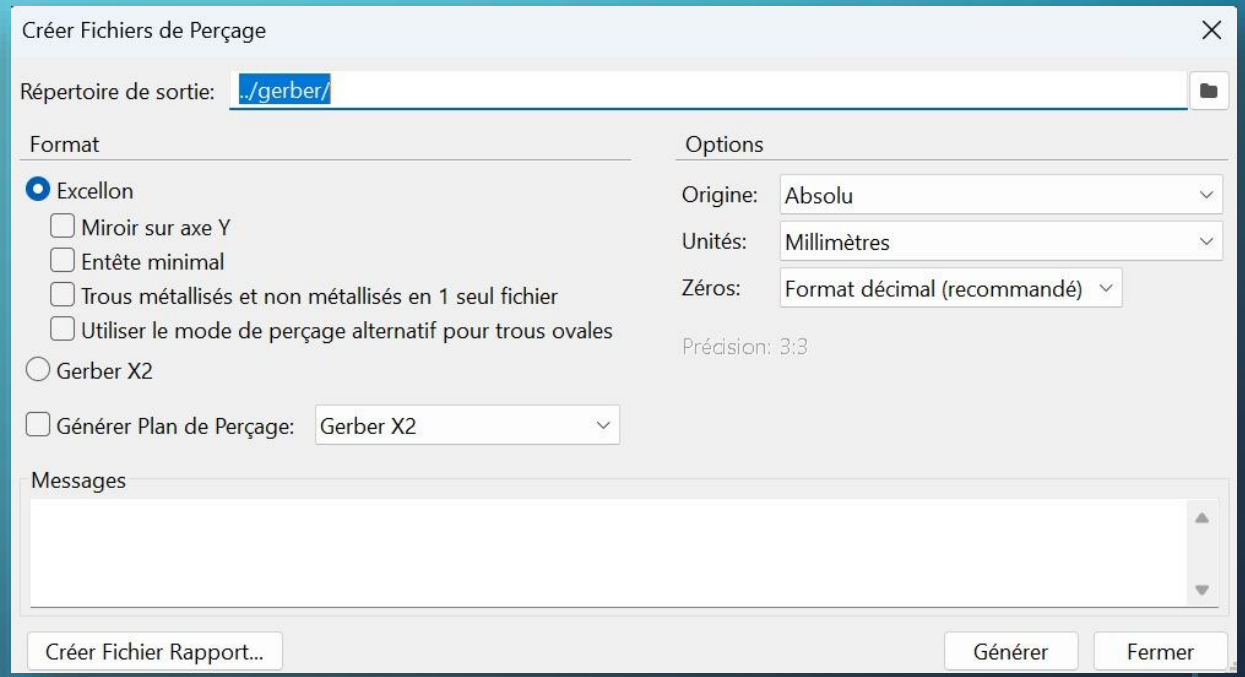

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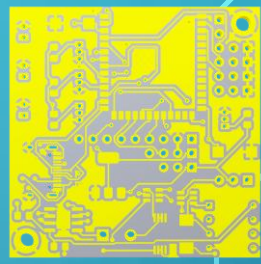

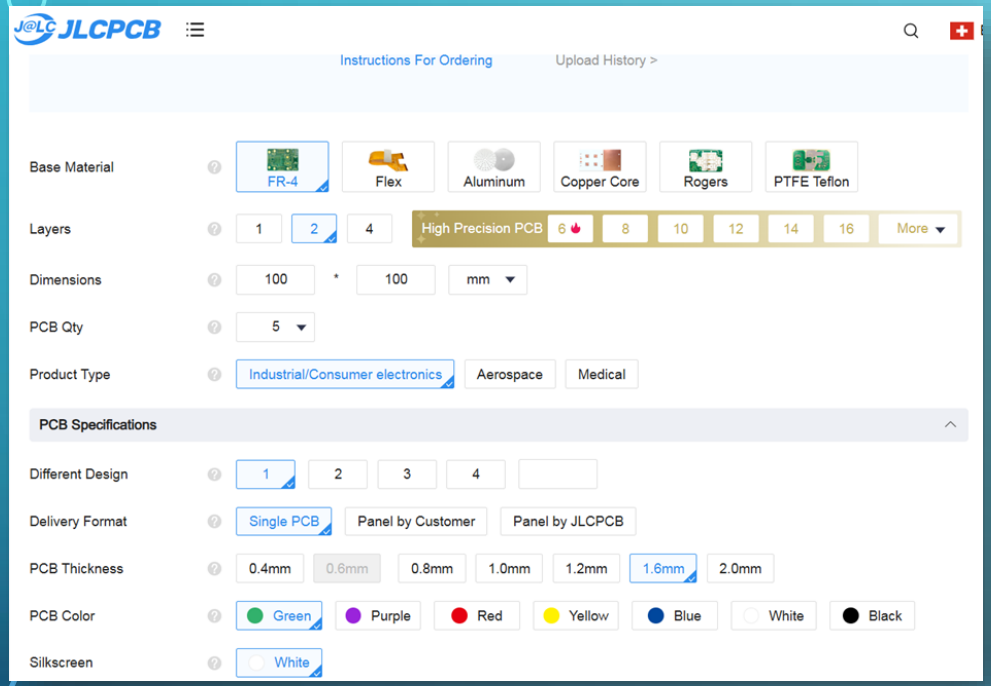

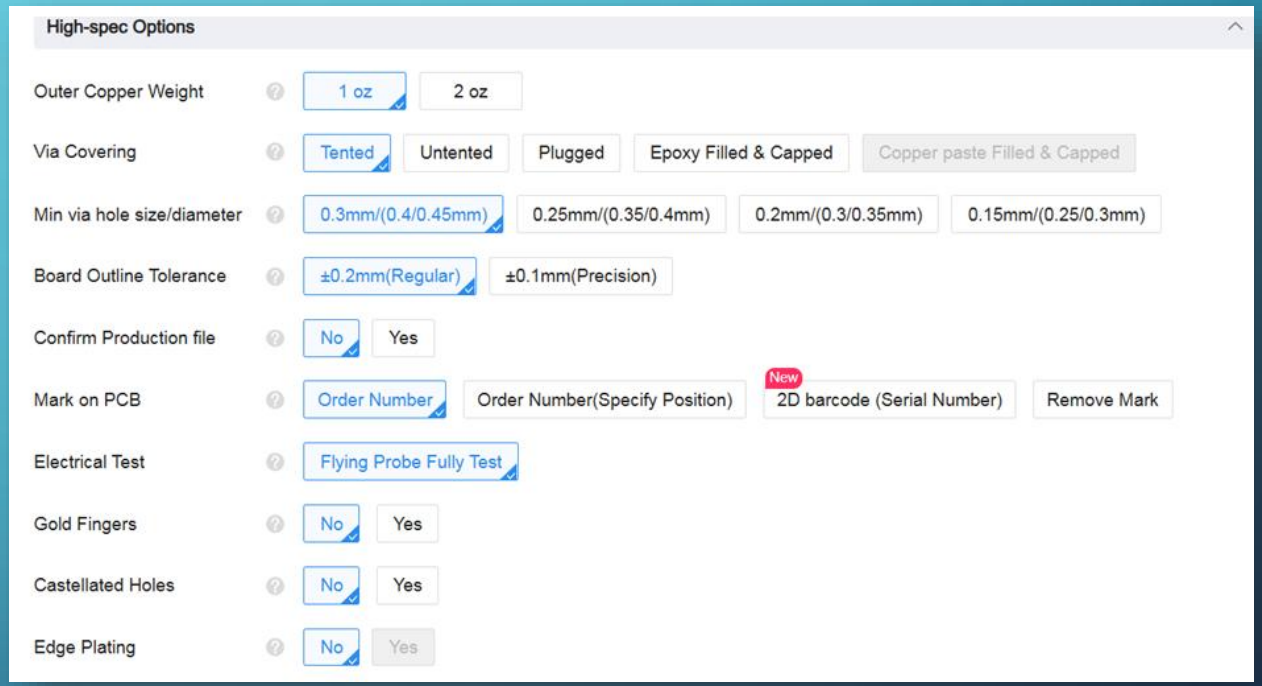

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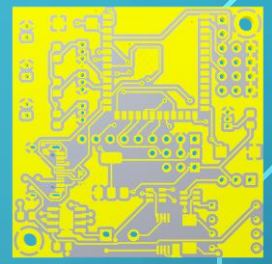
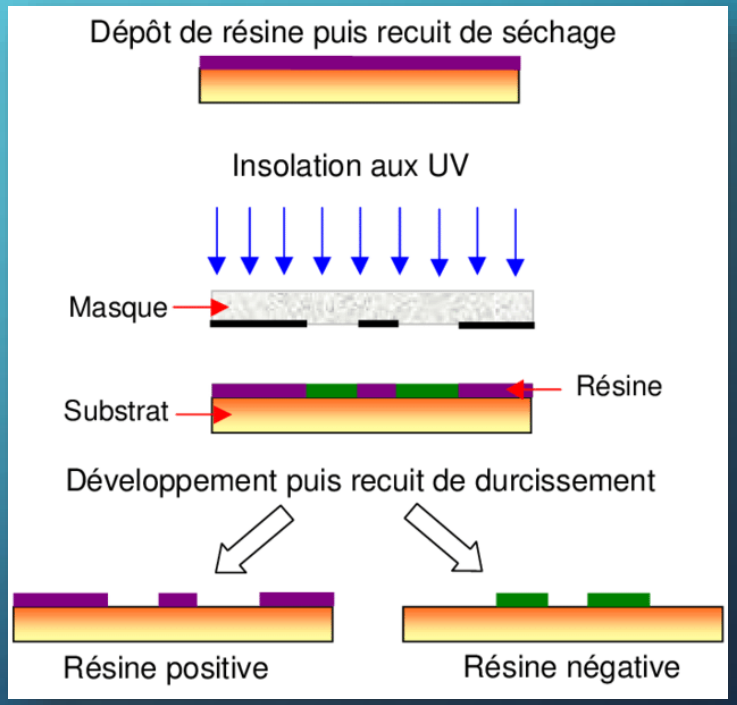
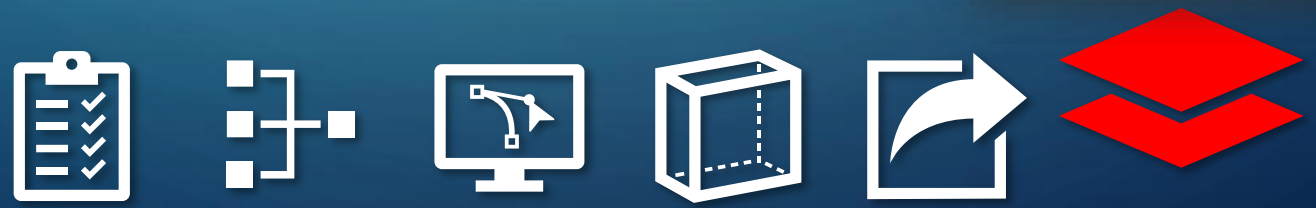


- Chimie, mécanique, électronique
- Fichiers Gerber traités via un logiciel CAM (Computer-Aided Manufacturing)
  - DRC
  - Couches intermédiaires
  - Données de perçage
- Plaque de base (FRA) recouverte d'une couche de cuivre
- Photolithographie: motif du circuit
  - Exposition aux UV
  - Développement
  - Bain chimique
- Perçage
  - Foreuses
  - Trous métallisés
- Masque de soudure
- Sérigraphie
- Tests





TENDANCES ET INNOVATIONS

Impression 3D de PCB

- Recherche de matériaux écolo ? (ex: fibres de celluloses)
- Composants introduits directement dans les couches du circuit imprimé (embedded components) → réduire encombrement + améliorer les performances
- Toujours plus petit

MERCI DE VOTRE ATTENTION

On dit "**un PCB**", car **PCB** est l'abréviation de "**Printed Circuit Board**", traduit en français par "**circuit imprimé**", et le mot "**circuit**" est masculin.

Donc même en parlant en français, on garde le genre masculin :

✅ *Un PCB*

❌ *Une PCB*