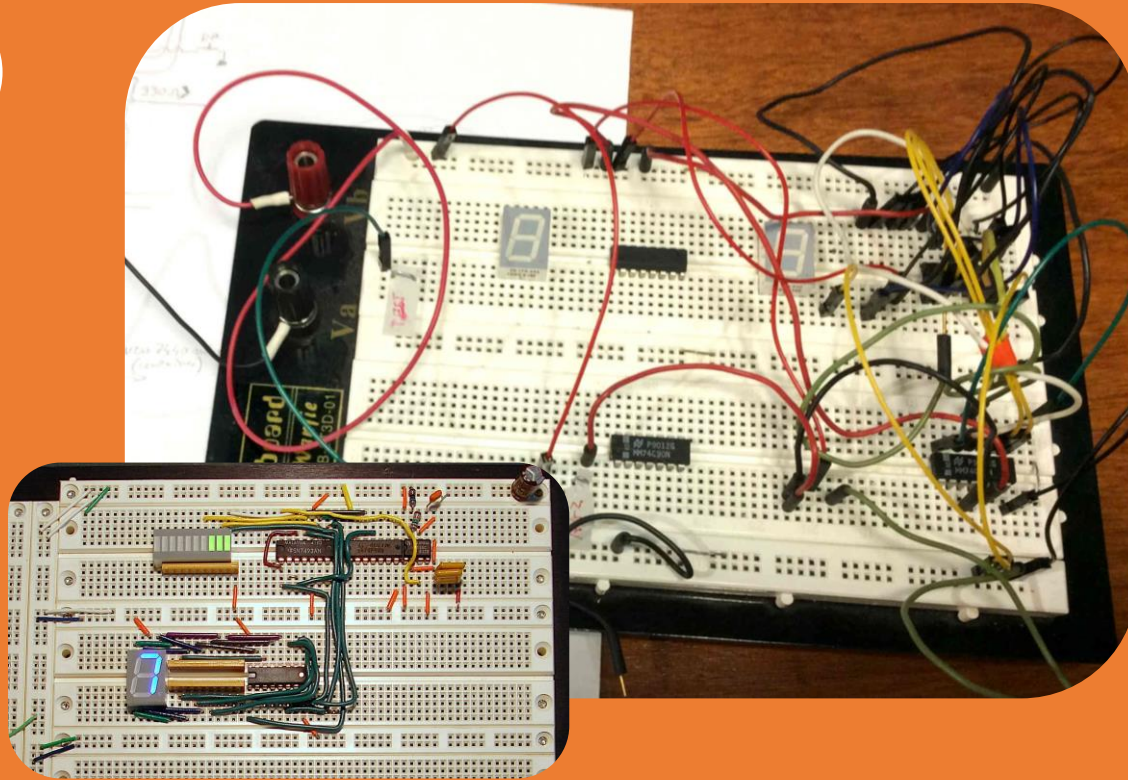


Comment réaliser des circuits imprimés (PCB)

Pourquoi l'utilisation de circuits imprimés est-elle primordial dans une fusée (ou d'un cansat) ?

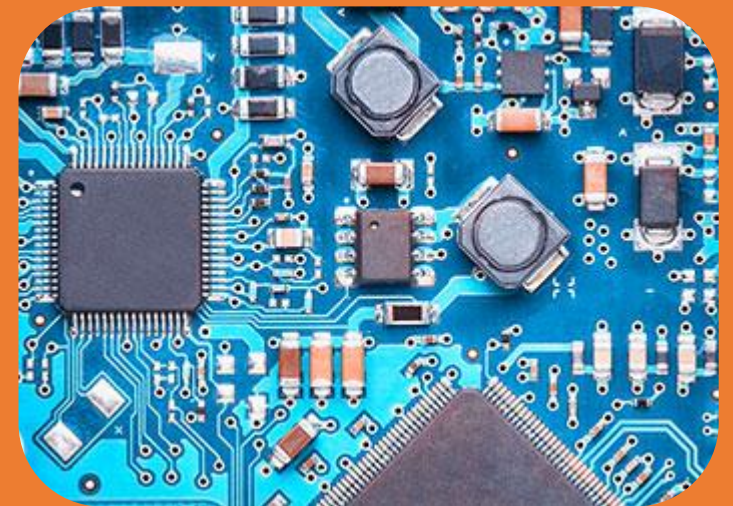


Deux mots d'ordre : **fiabilité** et **gain de place**



Breadboard : optimal pour la phase de test, modifications possibles à l'infini

PCB : optimal pour l'intégration finale, modifications impossibles, forme optimisable

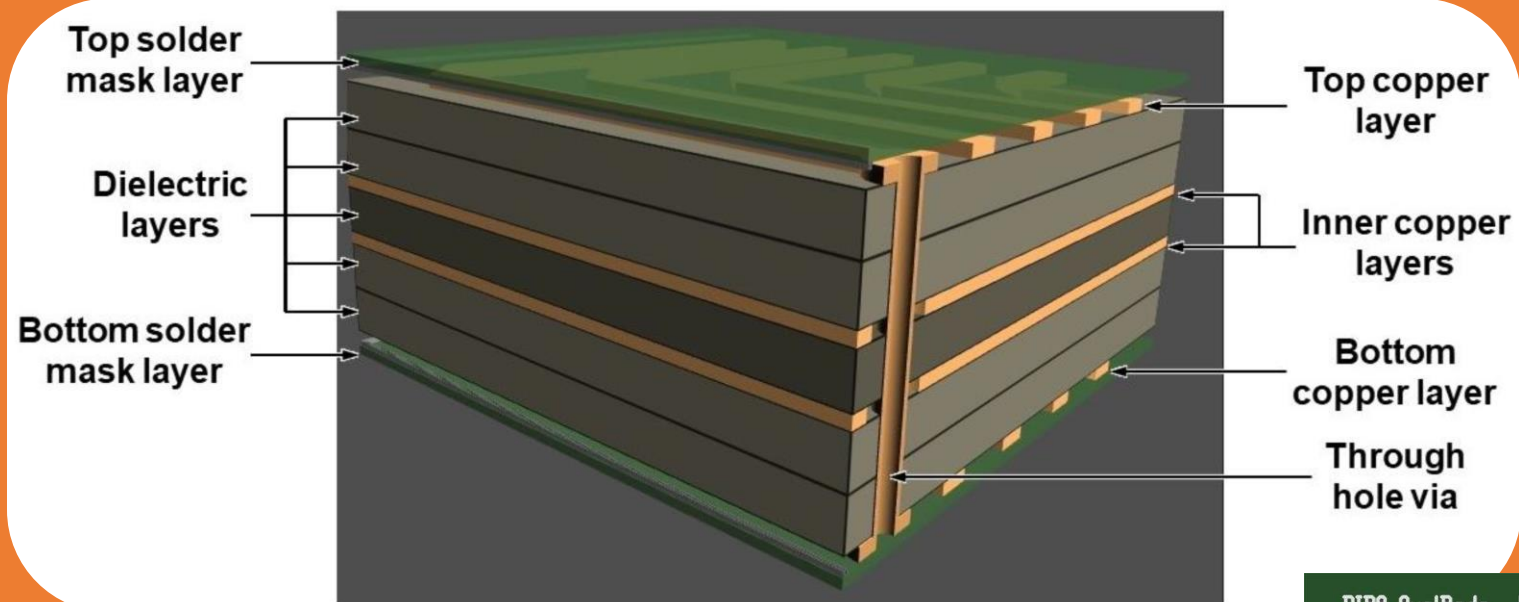


PCB : Printed circuit board

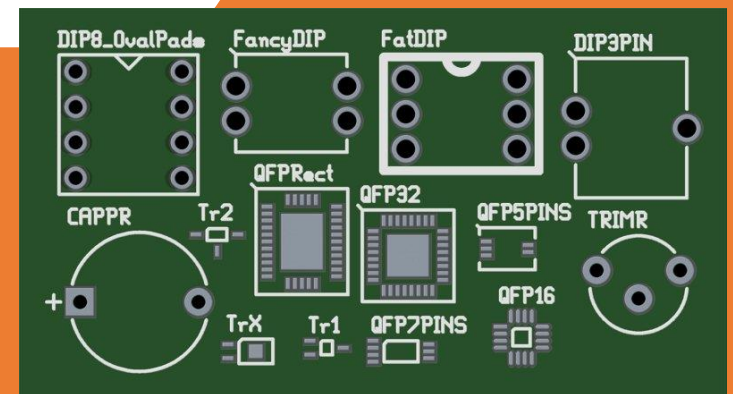
Composition d'une PCB



Couches et routes



Footprint



PREMIERE ETAPE :



La schématique : la « théorie » derrière votre PCB

Deux grandes étapes :

- Recherche des composants
- Réalisation du schéma du circuit

Création d'un projet



Démarrage rapide



Nouveau Projet

Create New Project

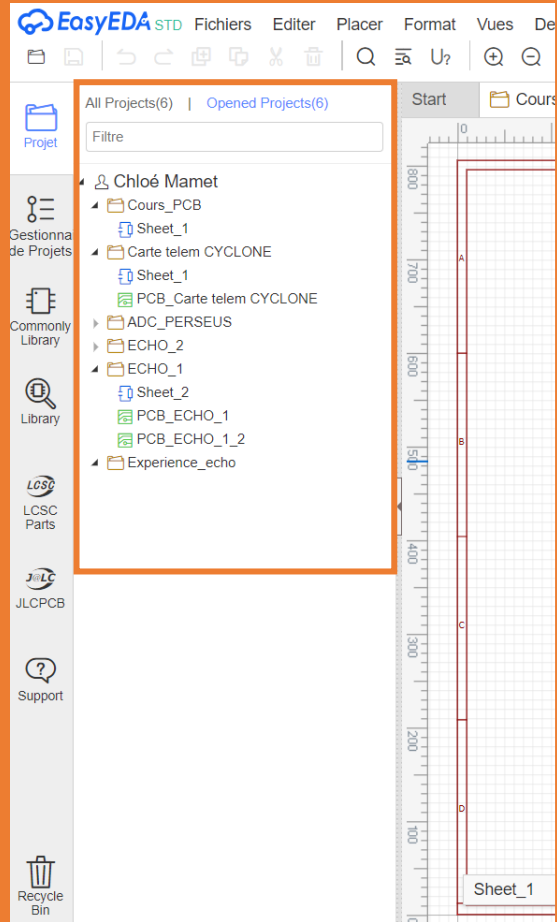
Folder:

Title:

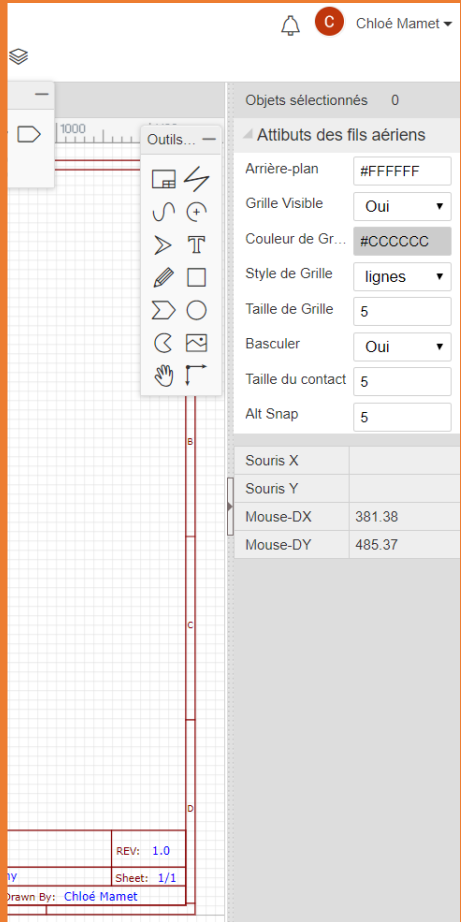
Chemin:

Description:

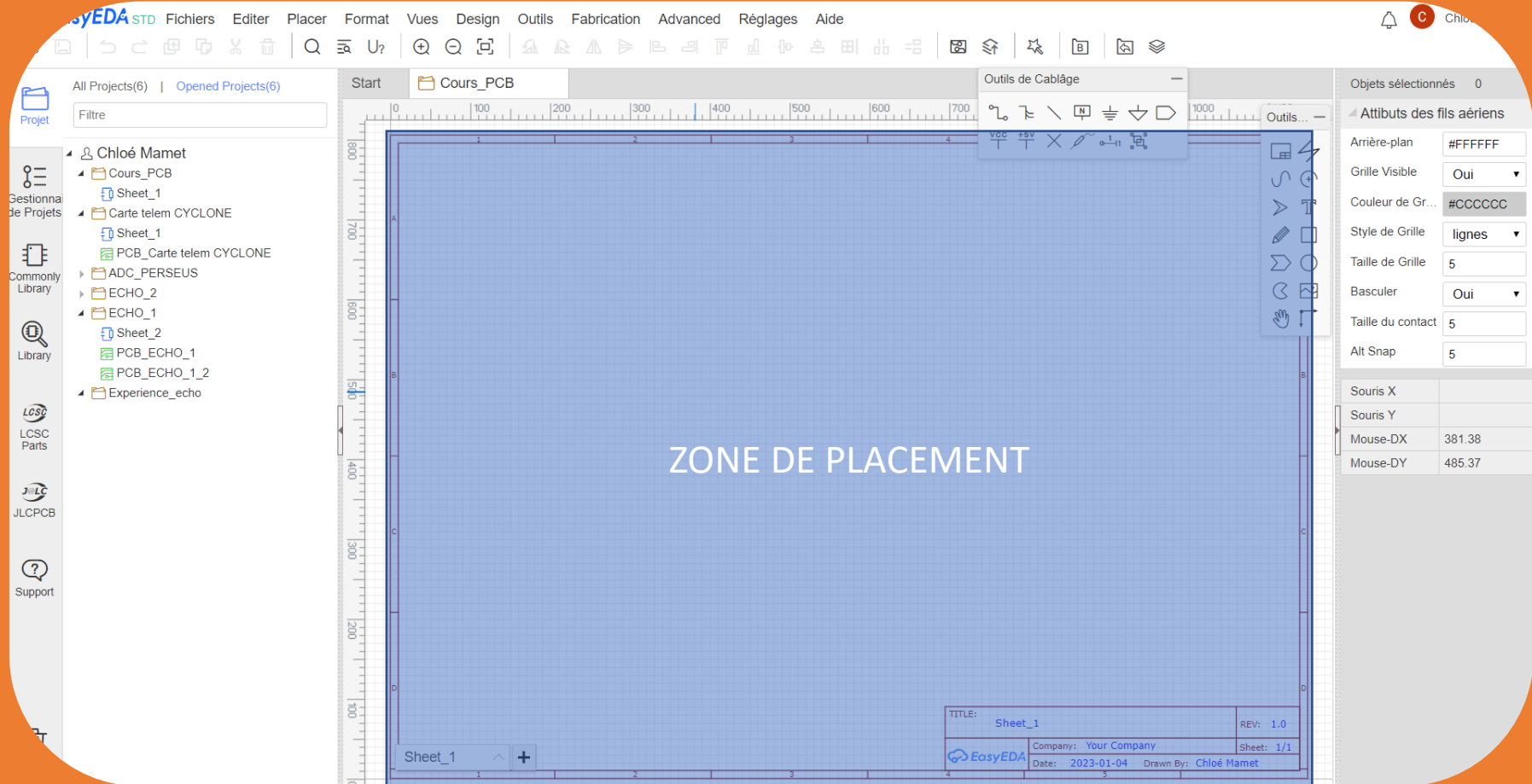
Création d'un projet



- Chloé Mamet
 - Cours_PCB
 - Sheet_1 ← **Projet**
 - Carte telem CYCLONE
 - Sheet_1 ← **Schématique**
 - PCB_Carte telem CYCLONE
 - ADC_PERSEUS
 - ECHO_2
 - ECHO_1
 - Sheet_2
 - PCB_ECHO_1
 - PCB_ECHO_1_2
 - Experience_echo



Zone de travail et outils



Zone de travail et outils



Wire : relier les pins (ou bornes) des composants



VCC : alimentation (dénomination peut être modifiée)



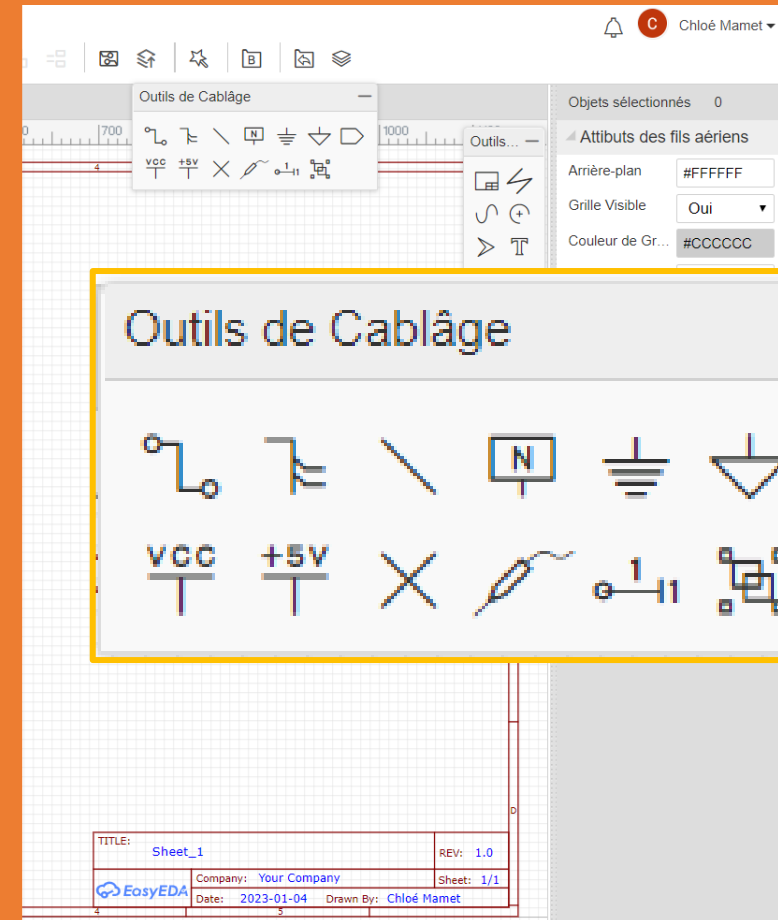
Balise sans connexion (pour éviter les erreurs/oublis)



GND

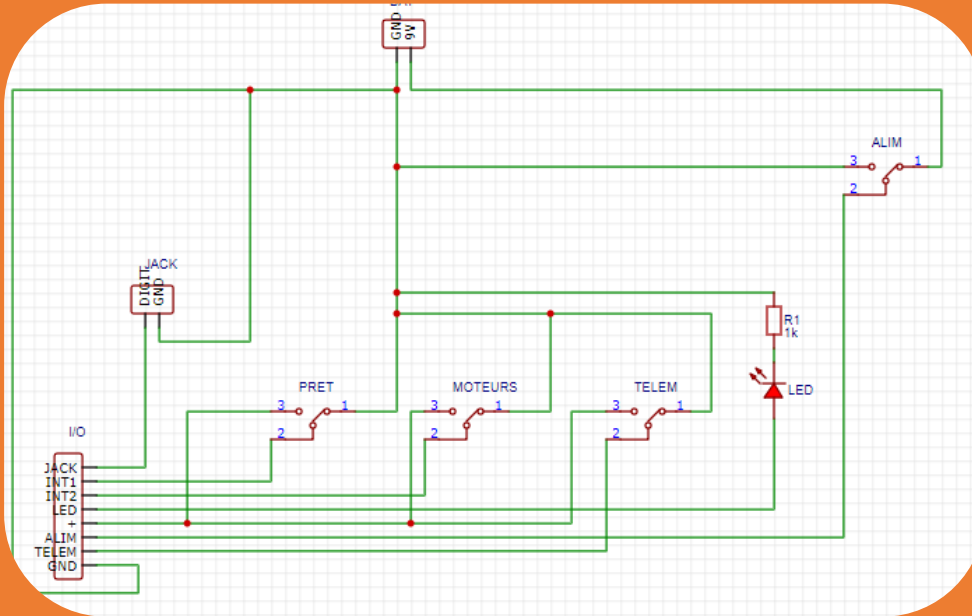


Port de liaison : permet de ne pas utiliser les « wire »

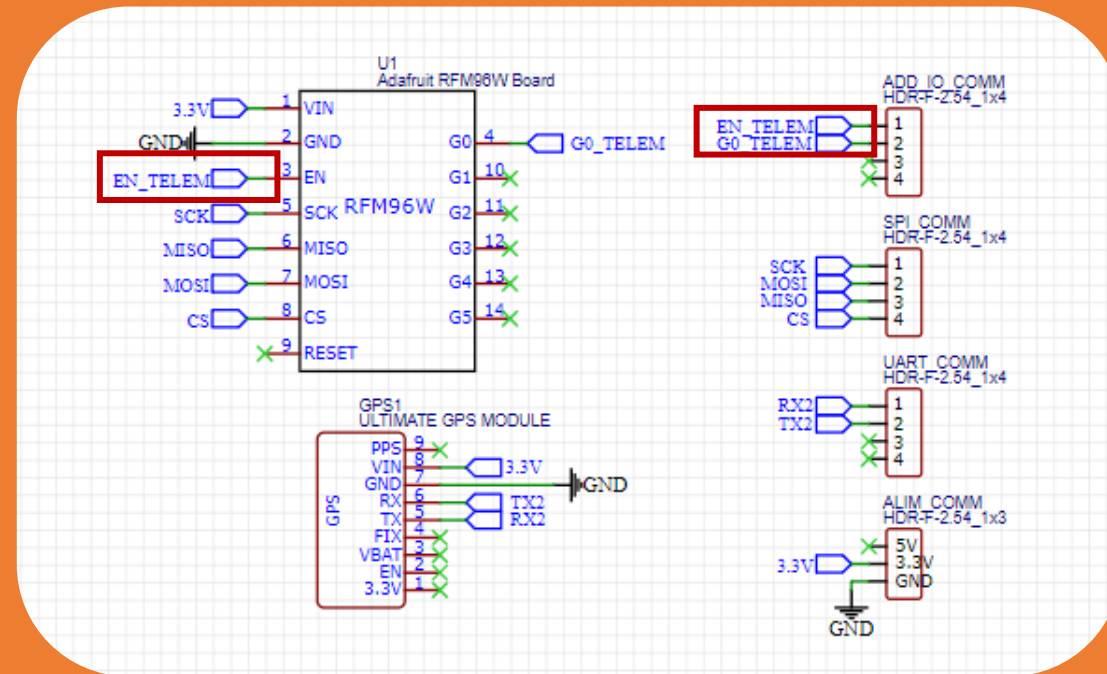


Zone de travail et outils

Circuit sans ports : liaison par « fil »

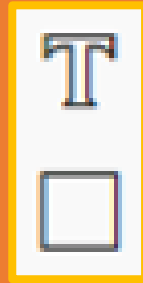


Circuit avec ports

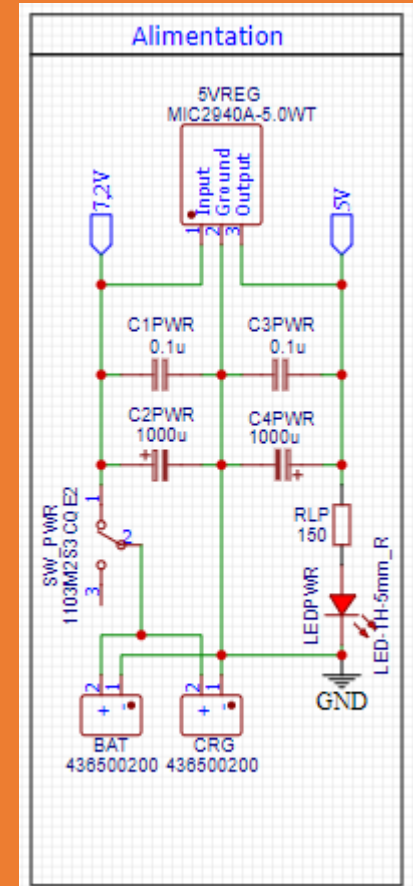
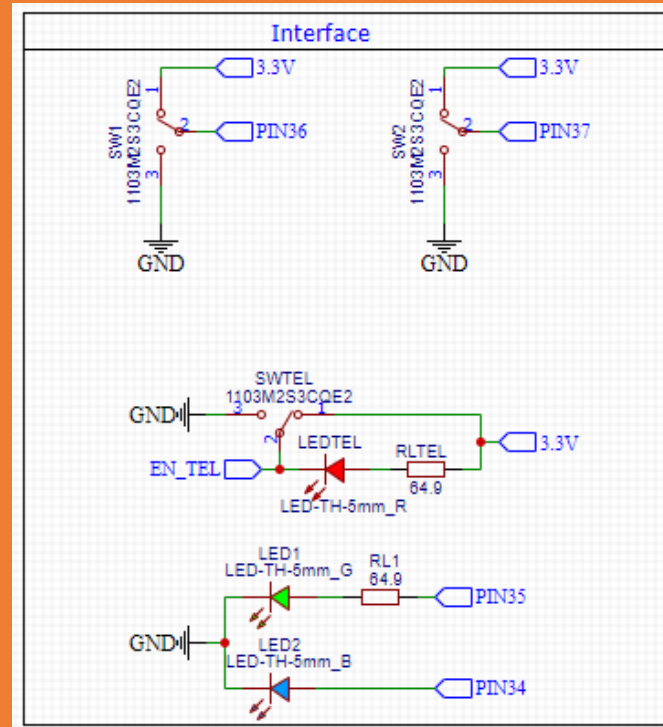


Toujours donner le même nom aux E/S

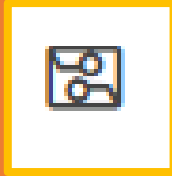
Zone de travail et outils



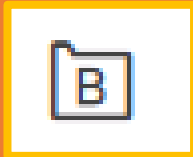
**Clarifier le schéma,
ajouter des annotations**



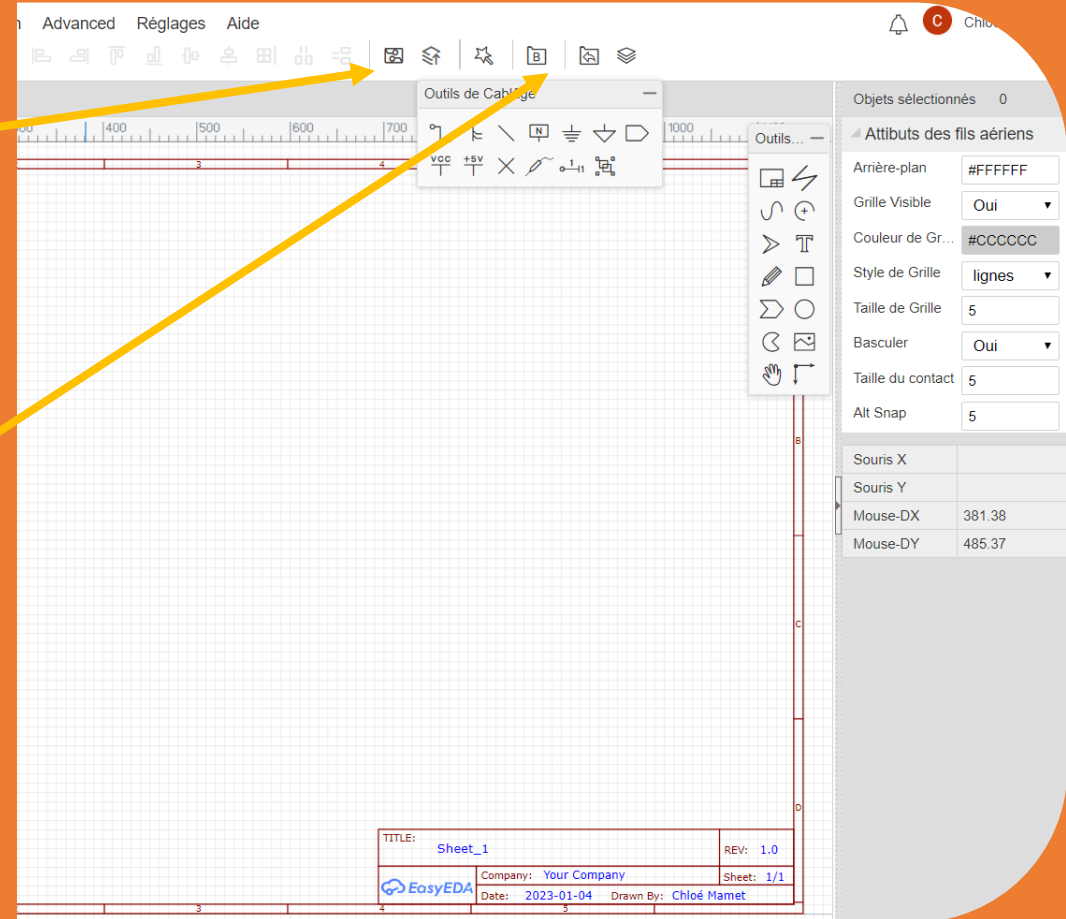
Autres icônes utiles



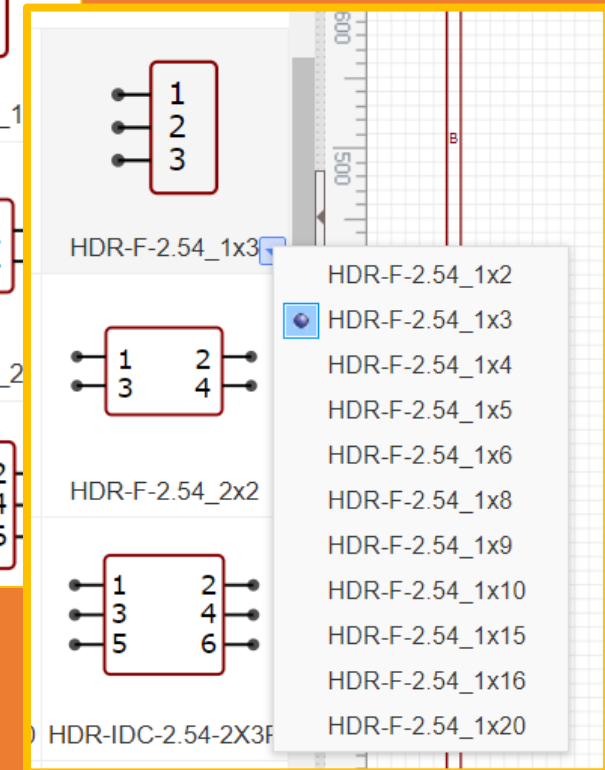
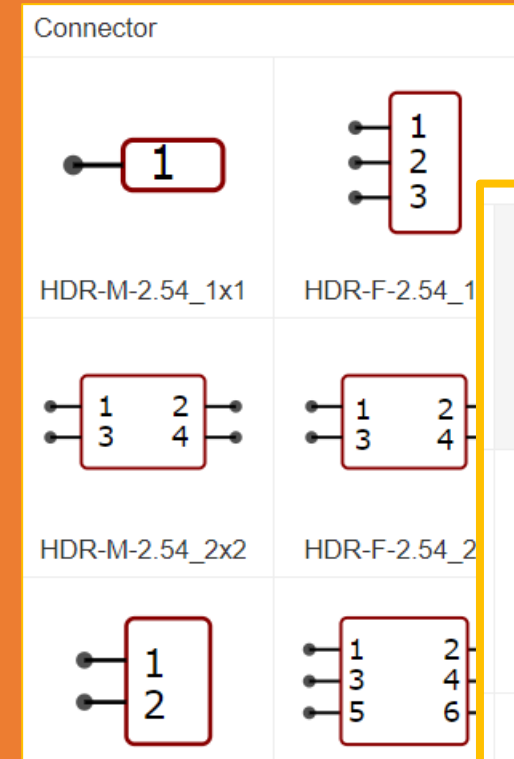
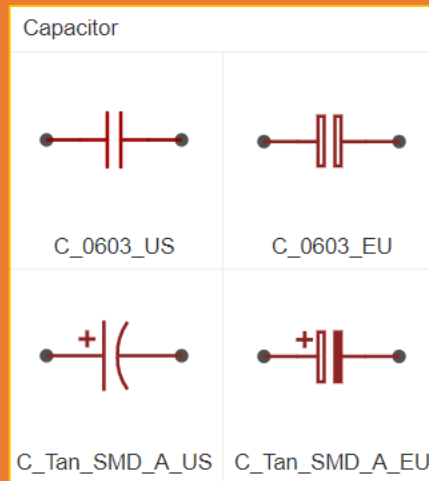
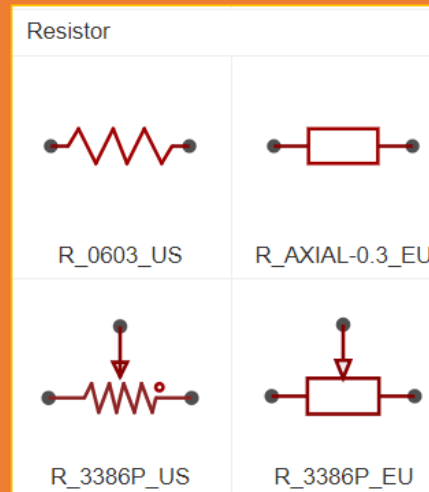
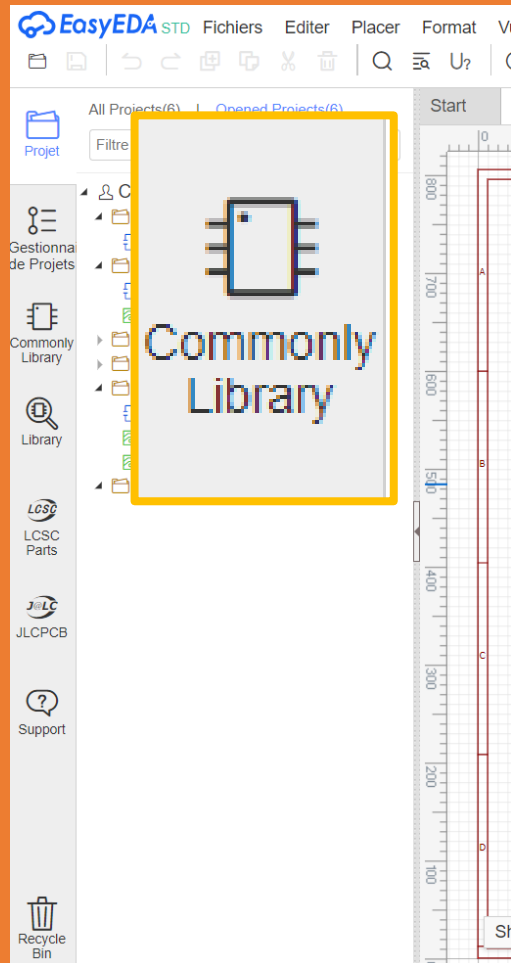
Convertir en PCB



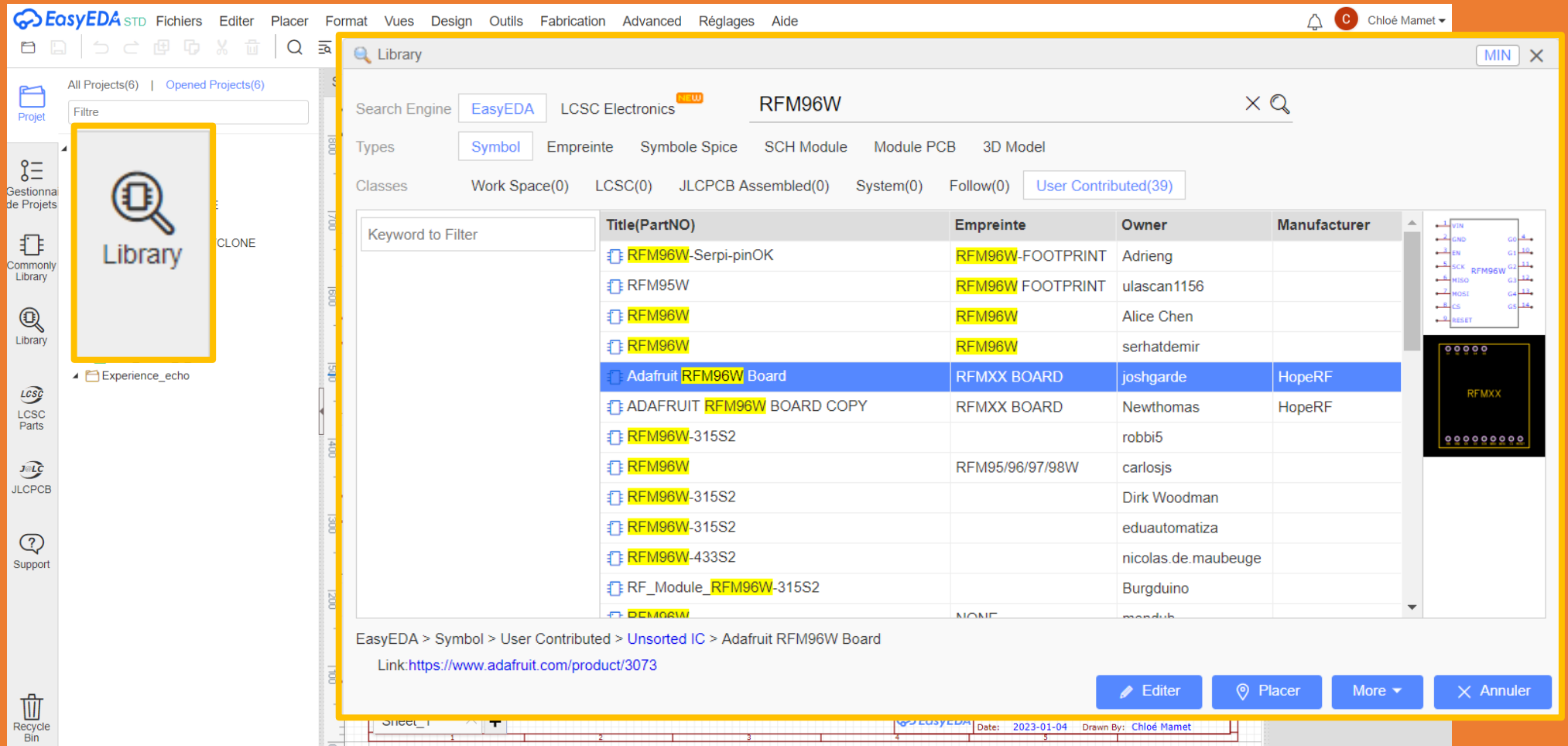
Bill of materials



Recherche des composants : les composants « **basiques** »



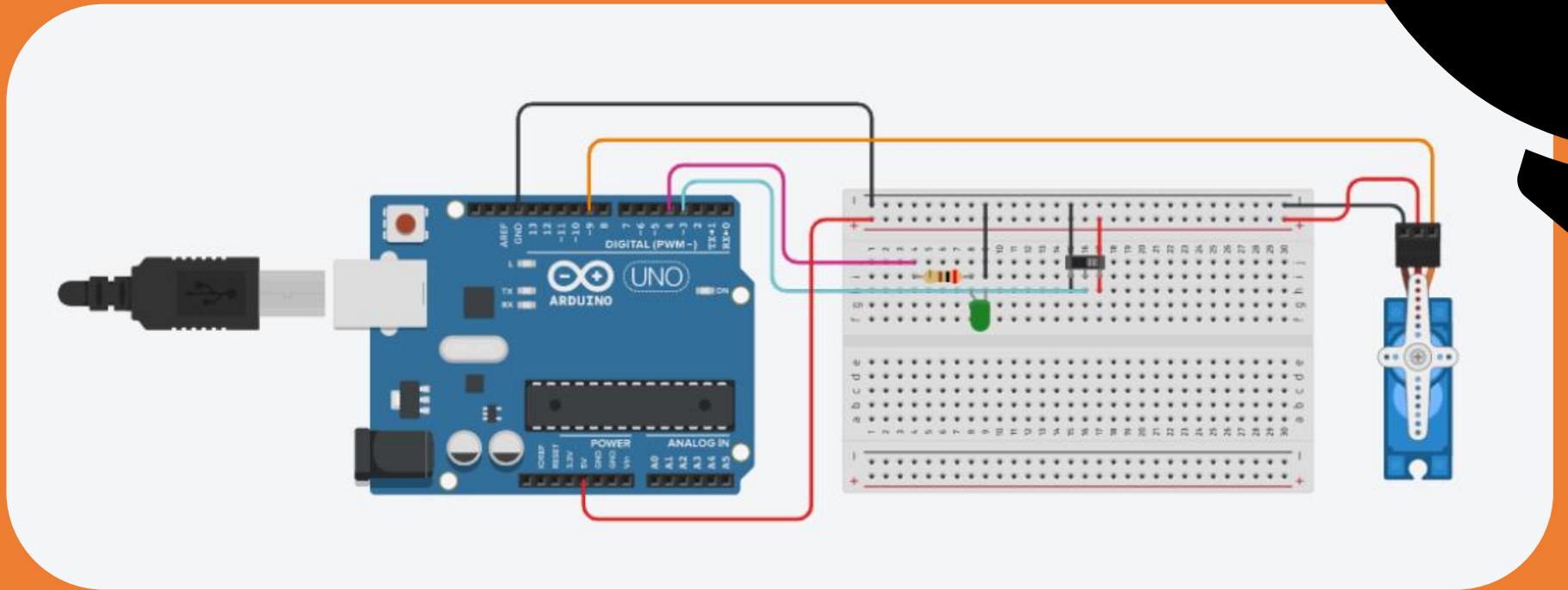
Recherche des composants : composants « complexes »



The screenshot shows the EasyEDA software interface with the Library search window open. The search engine is set to 'EasyEDA' and the search term is 'RFM96W'. The search results are displayed in a table with columns for Title (PartNO), Empreinte, Owner, and Manufacturer. The 'Adafruit RFM96W Board' is highlighted in blue. The breadcrumb path at the bottom of the window is 'EasyEDA > Symbol > User Contributed > Unsorted IC > Adafruit RFM96W Board', and a link to the product page is provided: <https://www.adafruit.com/product/3073>. The interface also shows a sidebar with navigation options like 'Projets', 'Gestionnaire de Projets', 'Commonly Library', 'Library', 'LCSC Parts', 'JLCPCB', 'Support', and 'Recycle Bin'. A pencil icon is visible in the top left corner of the overall image.

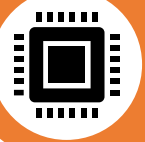
Keyword to Filter	Title(PartNO)	Empreinte	Owner	Manufacturer
	RFM96W-Serpi-pinOK	RFM96W-FOOTPRINT	Adrieng	
	RFM95W	RFM96W FOOTPRINT	ulascan1156	
	RFM96W	RFM96W	Alice Chen	
	RFM96W	RFM96W	serhatdemir	
	Adafruit RFM96W Board	RFMXX BOARD	joshgarde	HopeRF
	ADAFRUIT RFM96W BOARD COPY	RFMXX BOARD	Newthomas	HopeRF
	RFM96W-315S2		robbi5	
	RFM96W	RFM95/96/97/98W	carlosjs	
	RFM96W-315S2		Dirk Woodman	
	RFM96W-315S2		eduaumatiza	
	RFM96W-433S2		nicolas.de.maubeuge	
	RF_Module_RF96W-315S2		Burgduino	
	RFM96W	NONE	moduh	

C'est parti pour les travaux pratiques !



DEUXIEME ETAPE :

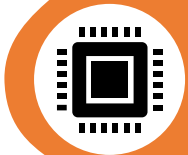
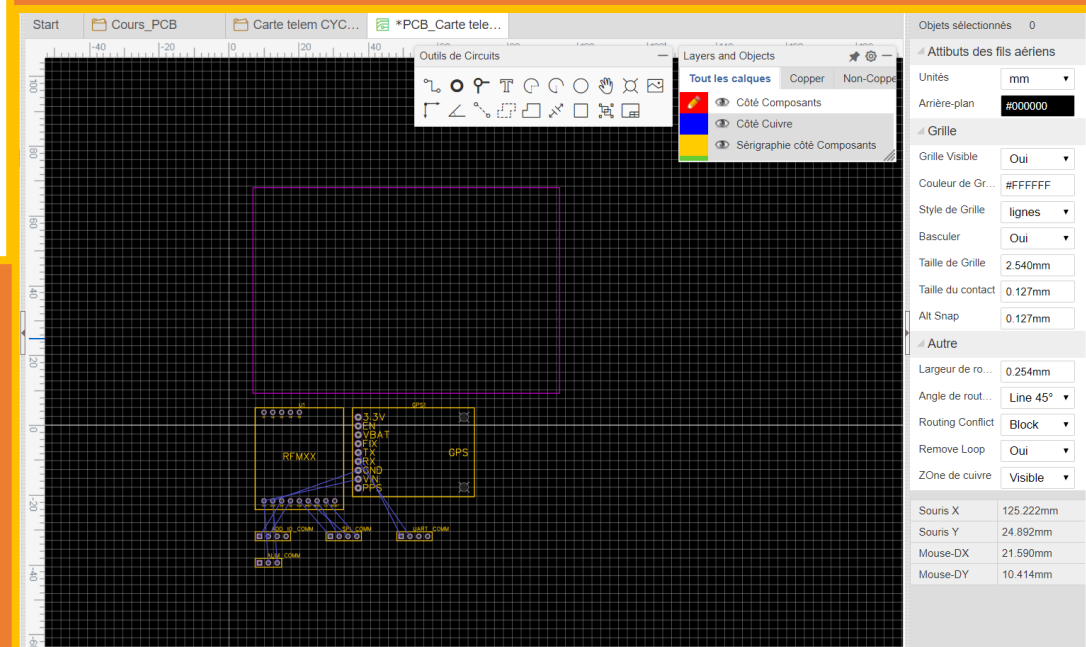
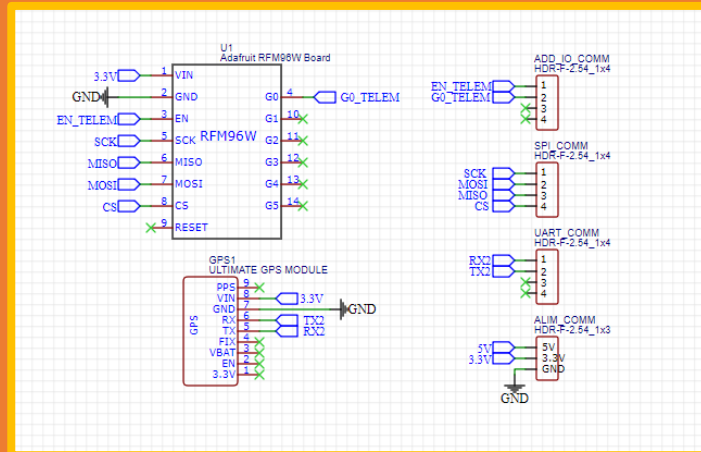
Le PCB design : la couche « physique » de votre carte



Plusieurs grandes étapes :

- Le routage
- L'ajout des sérigraphie
- La forme de la carte
- Visualisation et vérification

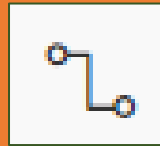
Nouvelle zone de travail :



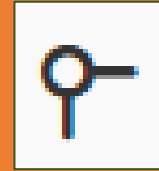
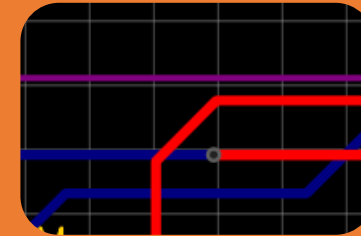
Outils : tracer les routes



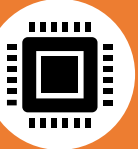
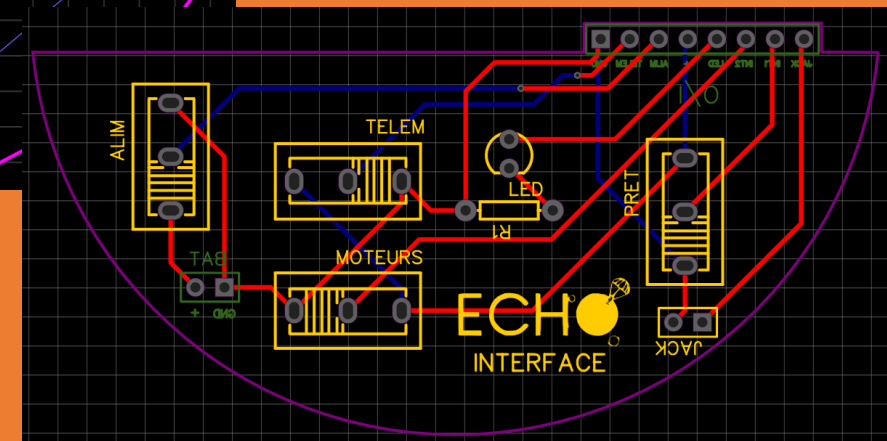
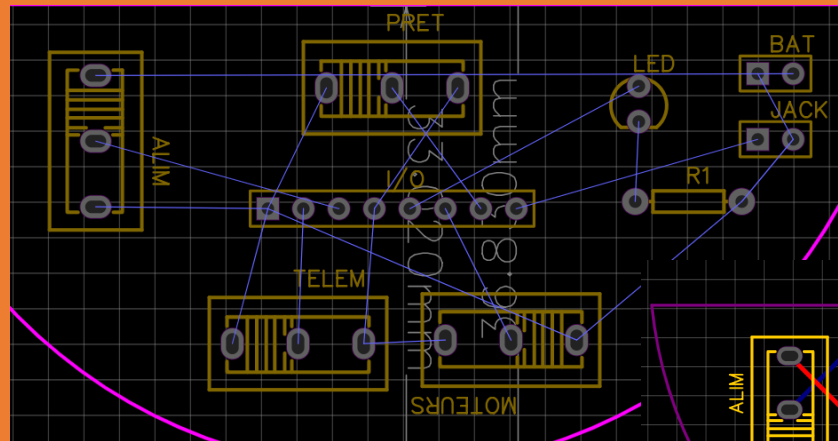
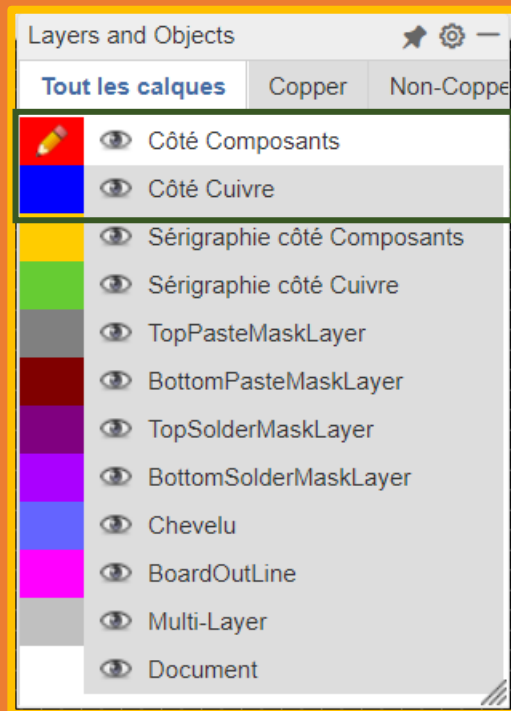
Routes



Vias

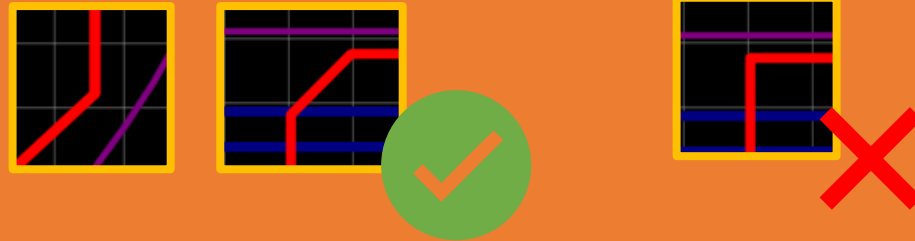


Placement des composants puis routage

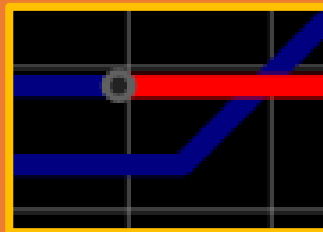


Les règles d'or du routage !

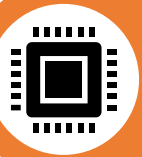
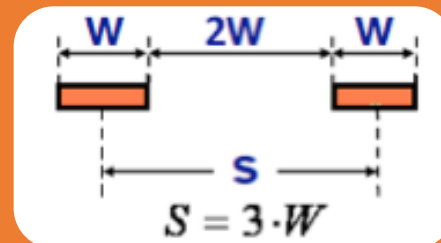
- **Jamais d'angle droit**



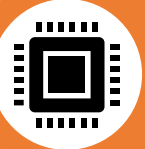
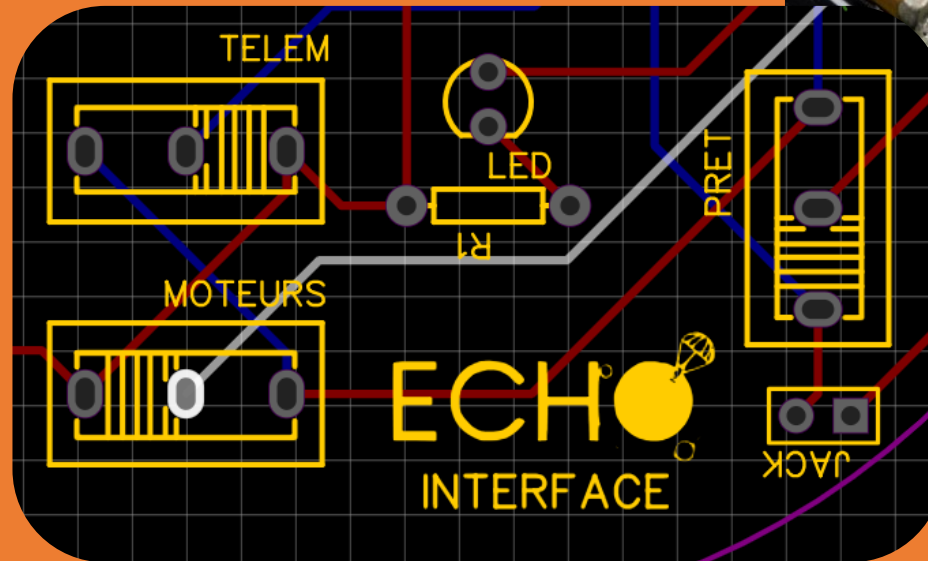
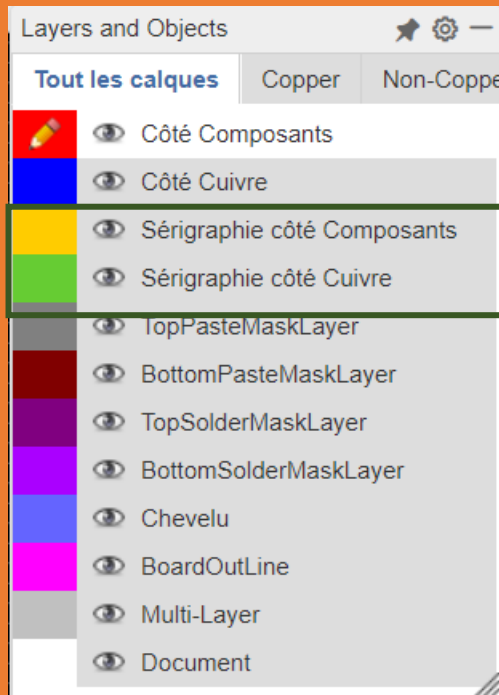
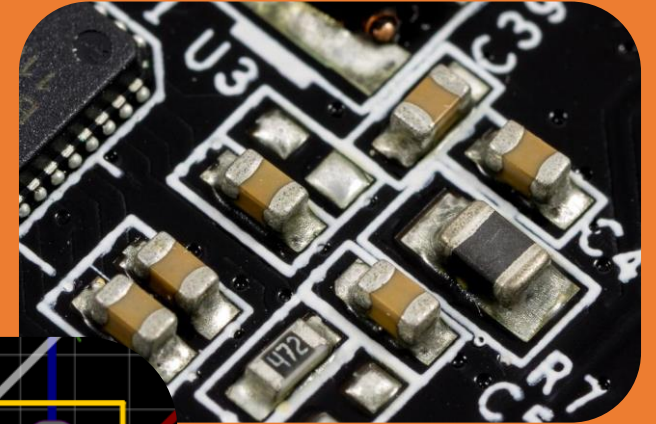
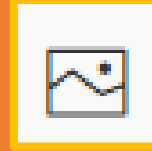
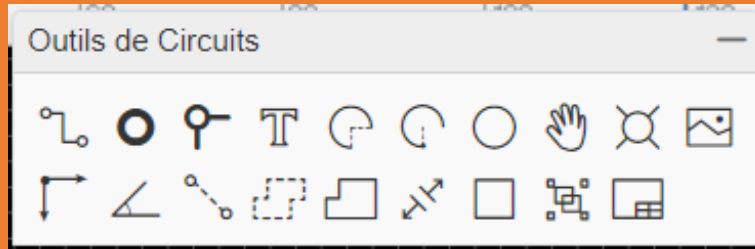
- **Deux routes sur la même couche ne peuvent se croiser (utiliser des vias !)**



- **Pour optimiser les contraintes EM -> règle des 3W**

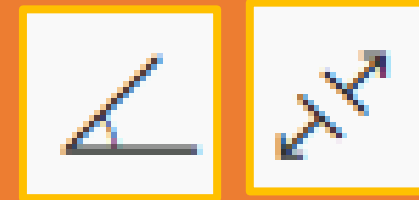
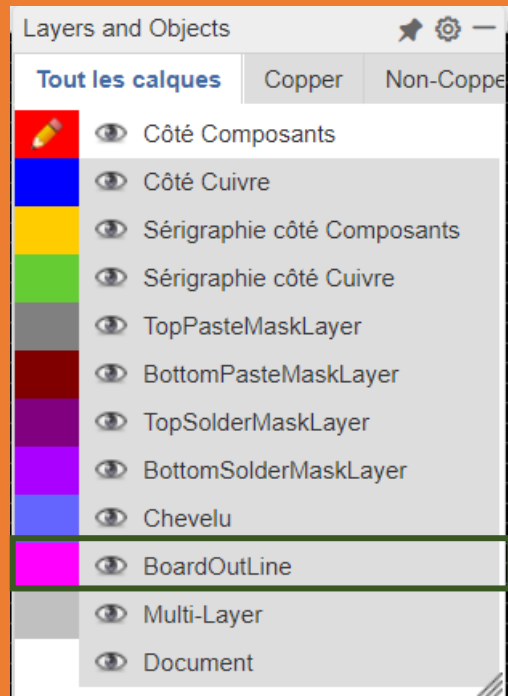
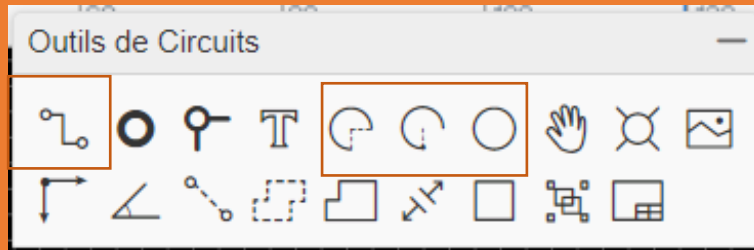


Outils : ajouter des sérigraphies

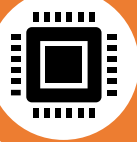
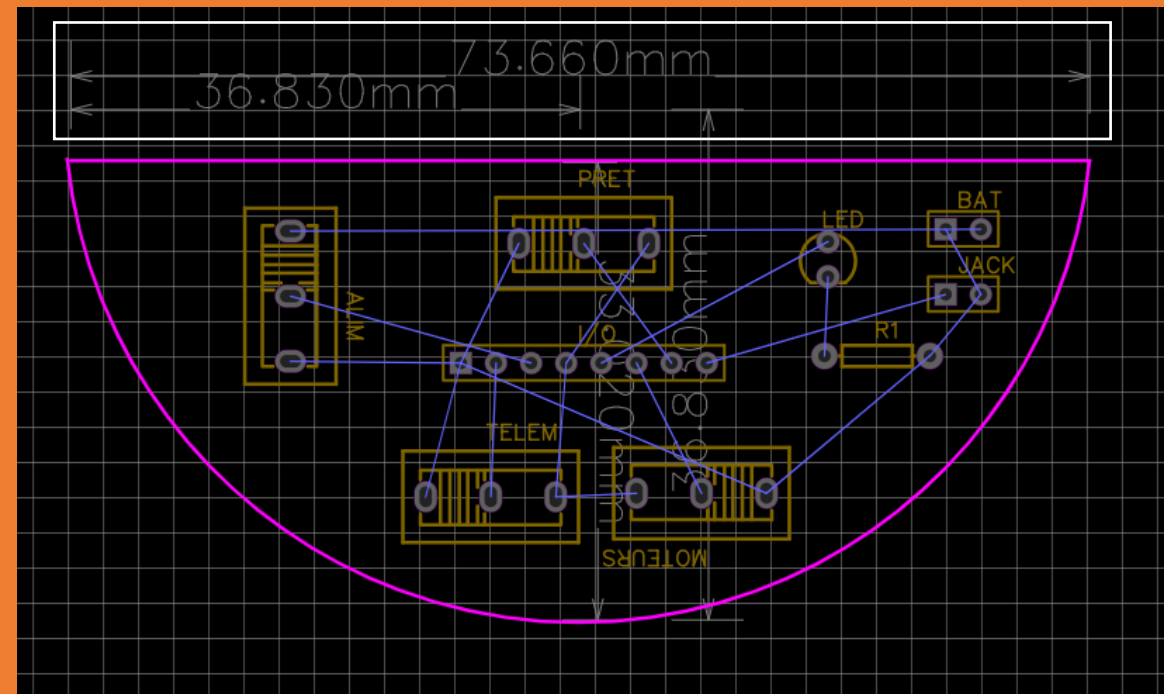


Outils : dimensionner la carte

Tracer (trait droit, cercle,...)

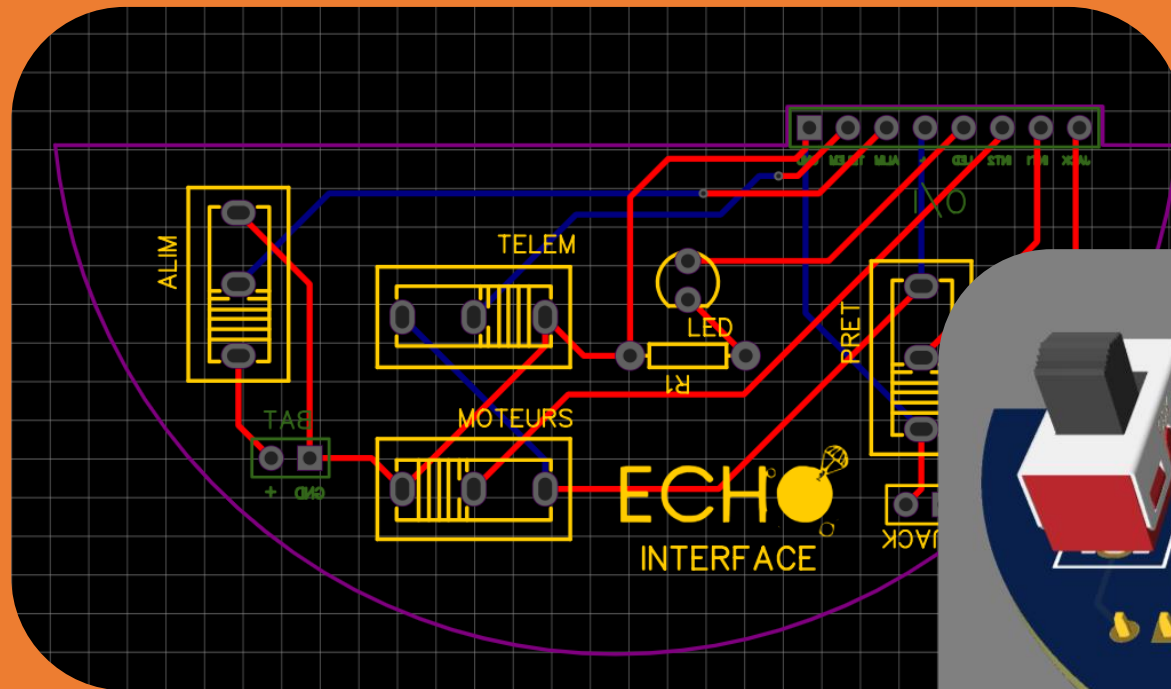


Mesures

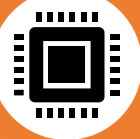


Visualisation

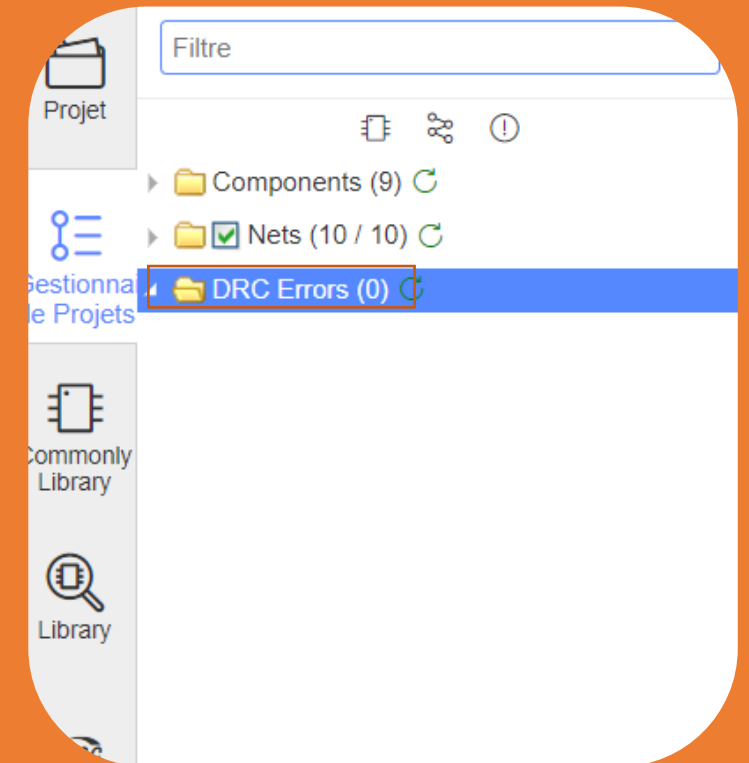
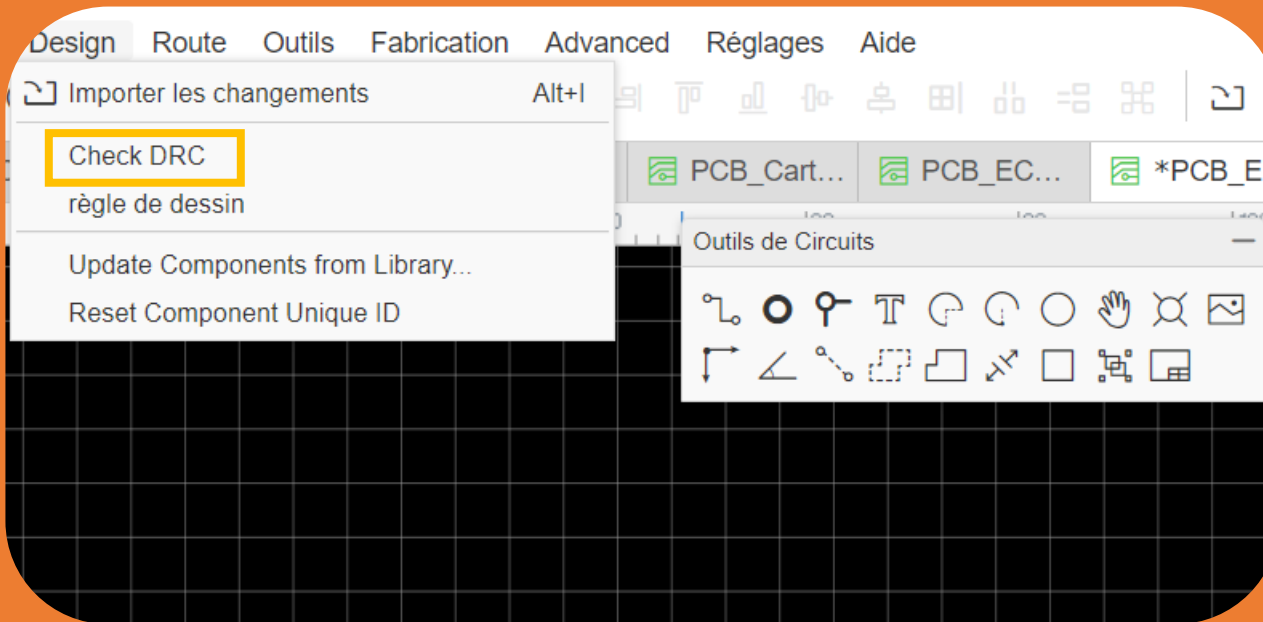
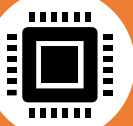
Vue 2D



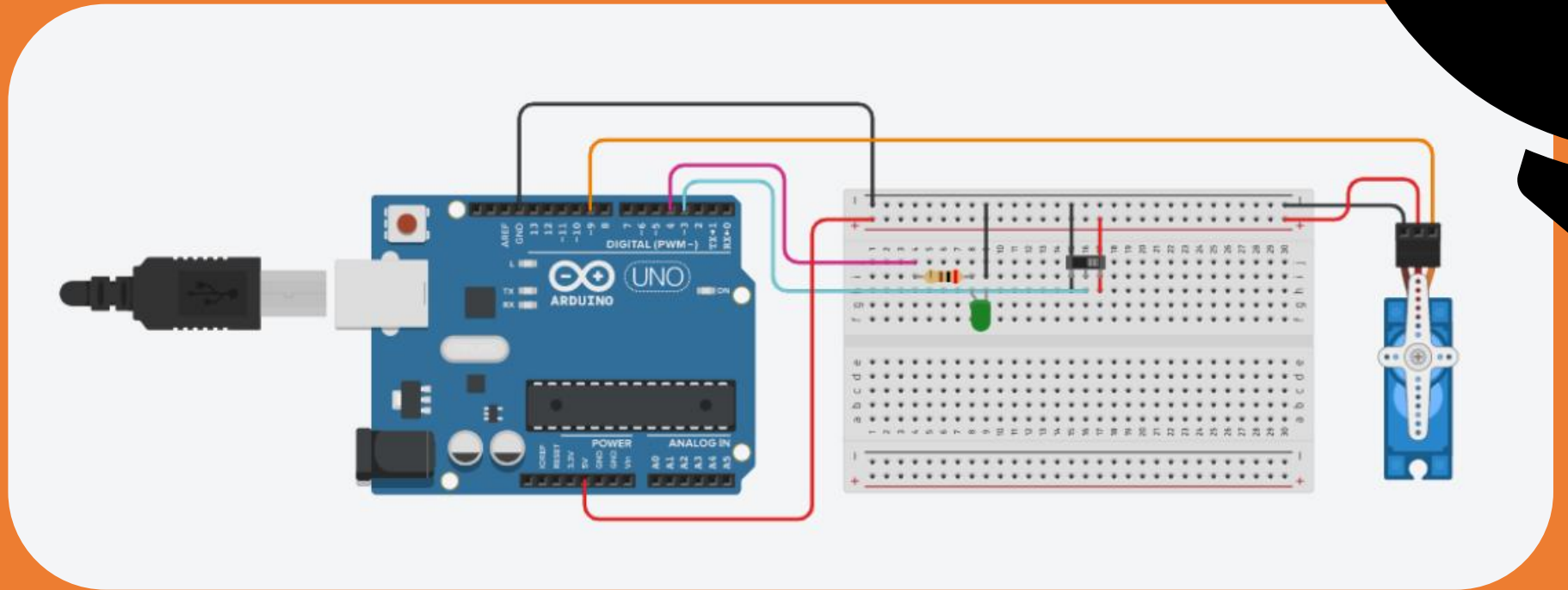
Vue 3D



Vérifications : design rules check



C'est parti pour les travaux pratiques !



TIPS POUR DES PCB DE PROS :

- Bien choisir le montage des composants
- Copper Area



Bien choisir le **montage** de ses composants

L 'exemple de la résistance

Through hole



- Démontage possible via des barrette
- Dessoudage possible
- Soudage au fer ou avec de la pâte à souder



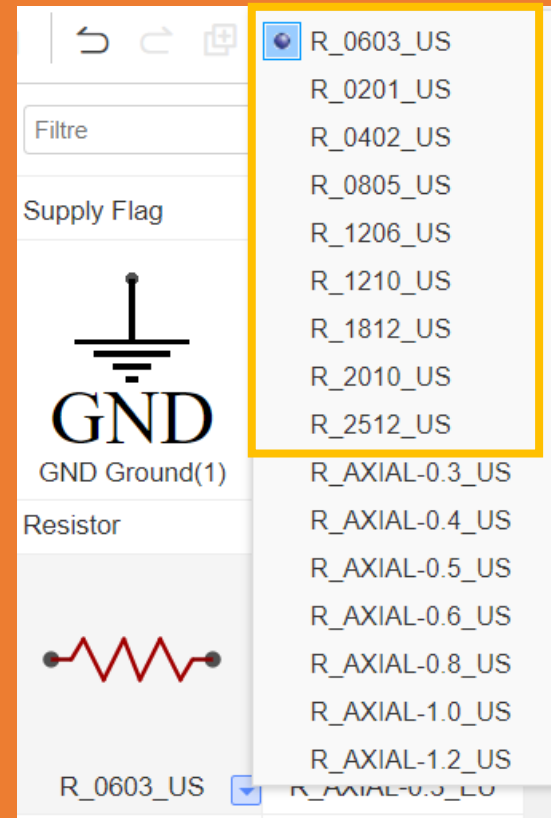
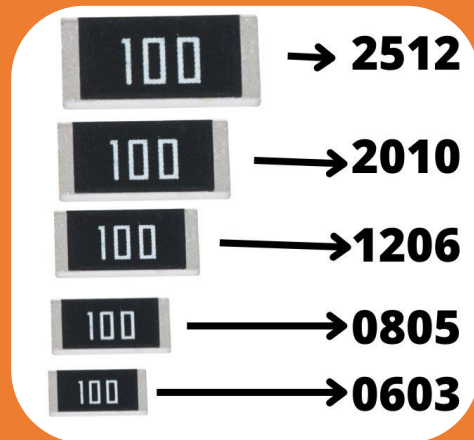
SMD



- Format très petit
- Plus fiable
- Soudage au fer impossible
- Soudage avec pâte à souder et « stencil »

Bien choisir le **montage** de ses composants

L'exemple de la résistance



SMD

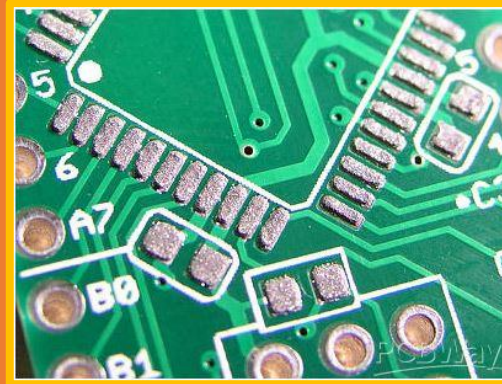
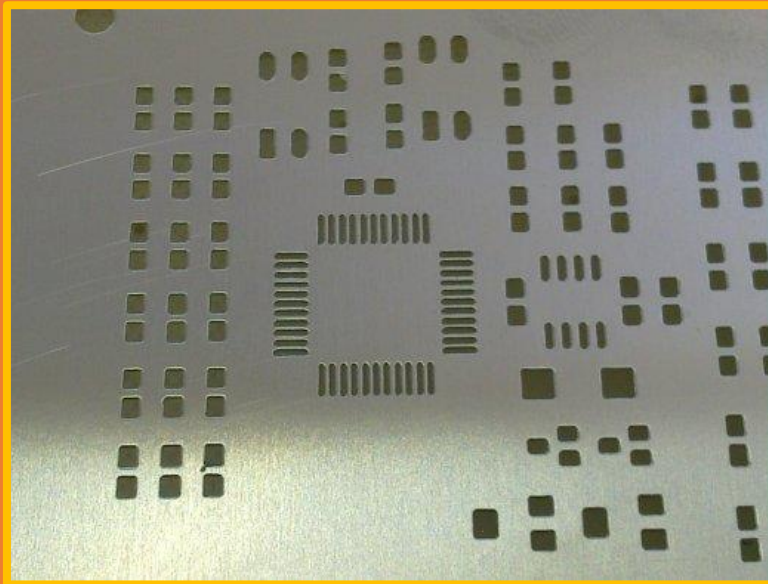


- **Format très petit**
- **Plus fiable**
- **Soudage au fer impossible**
- **Soudage avec pâte à souder et « stencil »**

Bien choisir le **montage** de ses composants

L 'exemple de la résistance

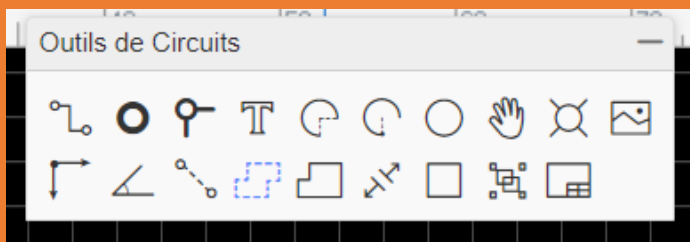
SMD



- **Format très petit**
- **Plus fiable**
- **Soudage au fer impossible**
- **Soudage avec pâte à souder et « stencil »**

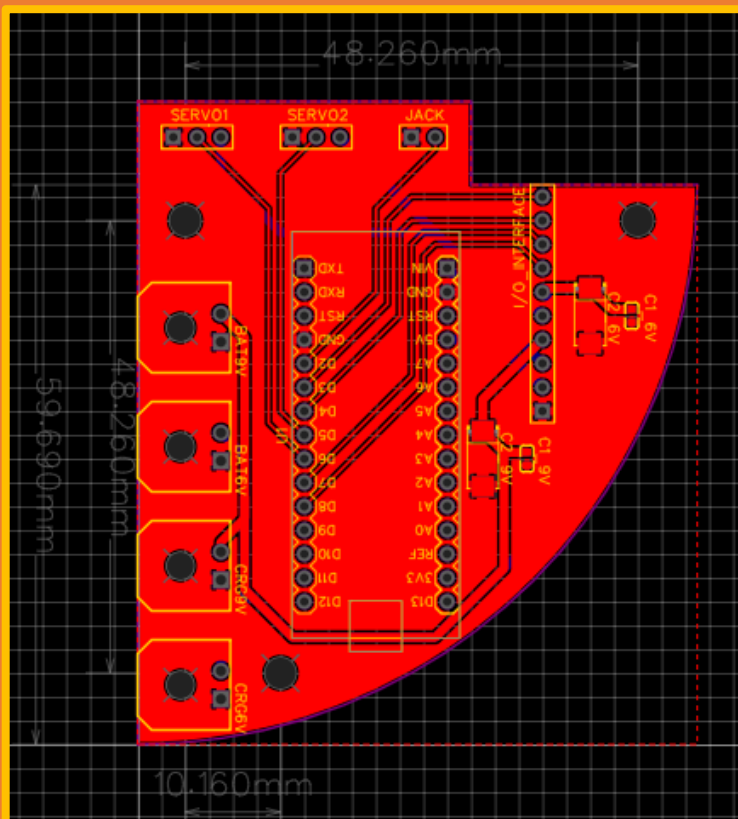


Copper Area



En mode PCB : outil « copper area»

Il faut penser à définir le nœud de connexion



Objets sélectionnés 1

▲ Solid Region

Couche

Connexion

Type

Bloqué

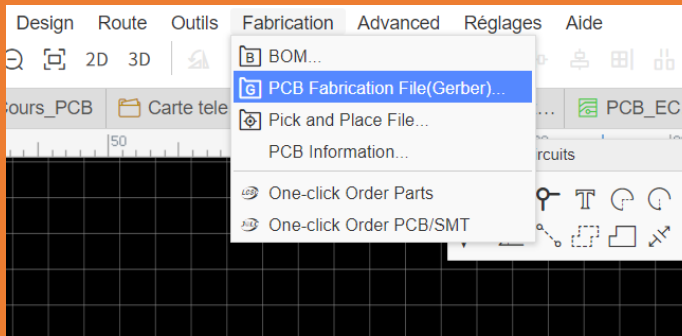
Repère

Souris X	114.681mm
Souris Y	39.116mm
Mouse-DX	3.575mm
Mouse-DY	-1.599mm

Il faut réactualiser à chaque modification apportée sur le copper area

Commander vos PCB

Etape 1 : Générer le Gerber

A screenshot of the 'Generate PCB Fabrication File(Gerber)' dialog box. The dialog shows a preview of a blue PCB with various components labeled: ALIM, TELEM, LED, R1, MOTEURS, ECHO INTERFACE, PRET, and JACK. On the right side, there are configuration options: Couches: 2, Dimensions(Estimated): 73.9mm x 36mm, PCB Qty: 5, Epaisseur du circuit: 1.6, Couleur du circuit: Vert, Finition: HASL(with lead), Copper Weight: 1oz, Manufacturer: JLCPCB, PCB Price: \$4, and Estimated Delivery Time: 3-7 days. At the bottom, there are three buttons: 'Gerber View', 'Generate Gerber', and 'One-click Order PCB/SMT' (highlighted with a yellow box).

Generate PCB Fabrication File(Gerber)

Couches: 2
Dimensions(Estimated): 73.9mm x 36mm

PCB Qty: 5

Epaisseur du circuit: 1.6

Couleur du circuit: Vert

Finition: HASL(with lead)

Copper Weight: 1oz

Manufacturer: JLCPCB

PCB Price: \$4

Estimated Delivery Time: 3-7 days

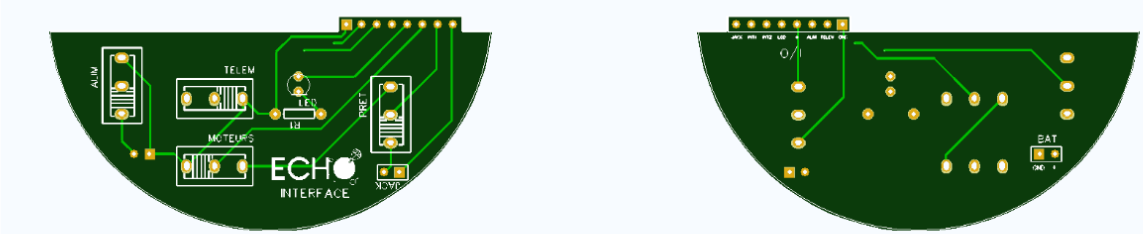
Gerber View Generate Gerber One-click Order PCB/SMT



Via JLCPCB

JLPCB

Etape 2 : Vérifier les spec, choisir qté, personnaliser



← Back to Upload File Detected 2 layer board of 36x73.9mm(1.42x2.91 inches) . [Gerber Viewer](#)

Base Material ? FR-4 Aluminum Copper Core

Layers ? 1 2 4 High Precision PCB 6 8 10 12 14 16 18 20

Dimensions ? 73.9 * 36 mm v

PCB Qty ? 5 v

Product Type ? Industrial/Consumer electronics Aerospace Medical

Charge Details ^

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

Build Time ?

PCB: <input checked="" type="radio"/> 3-4 days	\$0.00
<input type="radio"/> 2-3 days	\$0.00
<input type="radio"/> 1-2 days	\$0.00

Calculated Price ~~\$4.00~~ **\$2.00**
Additional charges may apply for special cases

SAVE TO CART

Shipping Estimate

Charge: [Choose destination country first](#)

Weight ? 0.15kg



Stencil Order together with PCB

PCB Specifications

Different Design ? 1 2 3 4 v

Delivery Format ? Single PCB Panel by Customer Panel by JLPCB

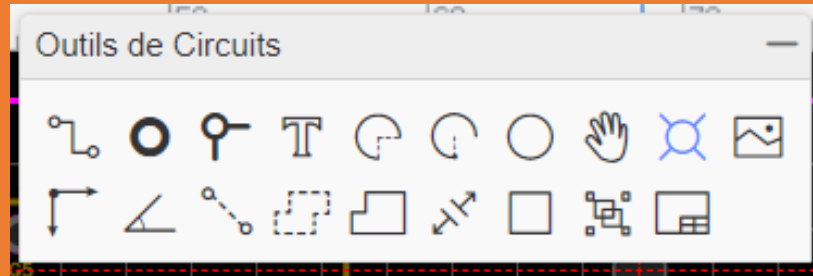
PCB Thickness ? 0.4 0.6 0.8 1.0 1.2 1.6 2.0

PCB Color ? Green Purple Red Yellow Blue White Black

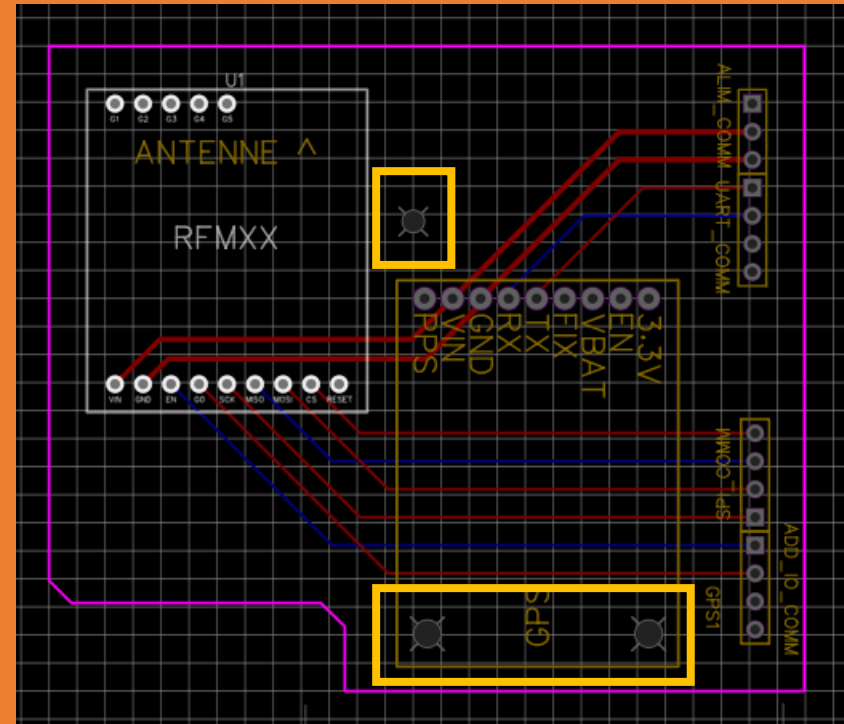
Silkscreen ? White

Surface Finish ? HASL(with lead) LeadFree HASL ENIG

Intégration elec



Utiliser des **trous** !!!



**Merci pour votre écoute !
Des questions ?**

