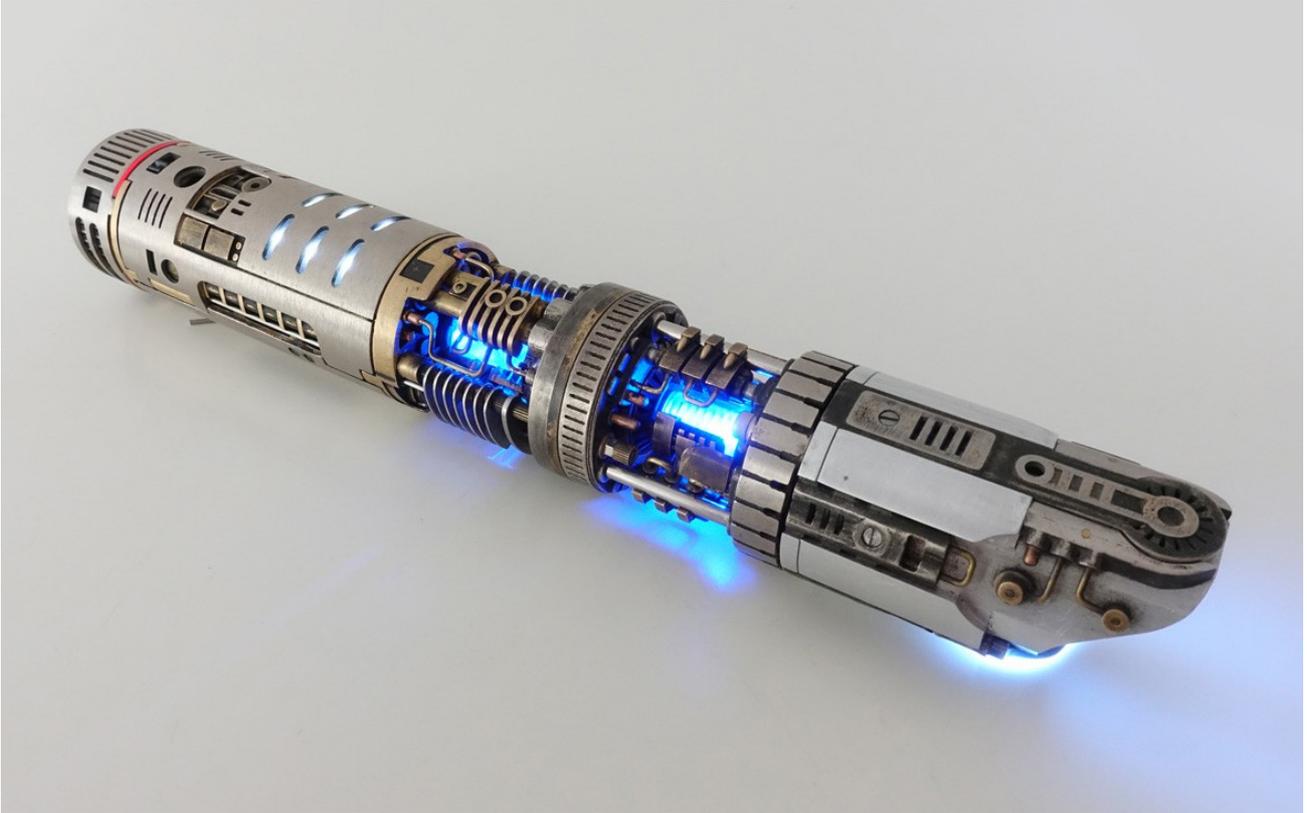


METAL MASTER CHASSIS SYSTEM 3.0

INSTRUCTION MANUAL



This is the manual for the Saber-chassis only.
It shows how to install the electronics and put together all chassis parts. This manual does not show how to convert a Graflex Flashgun or setup a soundboard.

This manual contains the instructions for Metal Master chassis version
3.0

Metal Master Lightsaber chassis is only recommended for experienced model builders

Manual Version 02.08.2022

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1. Foreword

Thank you for choosing my Graflex Lightsaber Chassis for your own Graflex based Lightsaber project.

The mb-sabers Graflex chassis design has been continuously developed and improved for over 3 years. MB-sabers focused on this one chassis design to create the best possible chassis for Graflex based Lightsaber.

A lot of experience and passion has gone into this design. And of course mb-sabers will continue to work on improving this chassis and adapting it to customer needs in the future.

The Metal Master chassis design allows individual parts to be simply exchanged for the old version after further development. This often allows a complete chassis to be updated without having to re-buy all parts.

For creative design

The metal Master chassis gives a lot room for individual custom designs.

Use the basic chassis parts and add self designed parts and elements to it. Especially the crystal chamber and the plasma gate can easily be modified.

For experienced hobbyists

Editing and assembling the individual parts is not easy. 3D printed parts are not that accurate as CNC machined parts. Adjustments always have to be made. A proper workspace and professional tools are absolutely necessary. I only recommend building one of my chassis for experienced hobbyists.

Responsibility

3D printed metal is conductive. The installation of all electronic parts must be done with care! MB-Sabers cannot be held responsible for improper use or assembly of the Metal Master Saber Chassis.

Print materials

The Metal Master chassis is specially developed for metal 3D printing. Most parts are available as 3D prints. These parts are designed for precious metal materials. These materials have the best accuracy and usability. They can be drilled, cut and tapped very easy.

However, most parts are also available in steel or nylon plastic.

2. Tools

For assembling the printed chassis parts and installing the electronic parts you need different tools...

- sandpaper (240 grain and 600 grain)
- drill heads 1mm, 2mm, 3mm, 4mm
- small slot screwdriver
- double-sided adhesive tape (thin and foam)
- scalpel / small cutter
- tap M1.2 and M1.4
- glue (Pattex repair EXTREME and Epoxy)
- Loctite 648
- files with diamond grid (small and medium)
- soldering-iron and solder
- tweezers
- liquid rubber
- insulating tape
- shrink tubing
- belt sanders small (for example Proxxon)
- power tool (Dremel or Proxxon)

3. Additional parts

Basic Chassis parts

- 3x M2 threaded steel rods
- 1x M1.2 brass rod
- 2x 40mm steel rods (1mm diameter)
- 4x 95mm steel rods (1mm diameter)
- 2x brass tubes 40mm x 4mm diameter
- 3x M1.2 countersunk screws
- 6x M2 nuts DIN934
- 4x M1.2 nut
- power switch (**TS01CQE 3A 120V**)
- micro USB-B or USB-C port (female)
- 1x AAA battery spring contacts
- 1x AAA battery contacts
- 3x M2 washer
- speaker cover ring
- speaker chamber accent LED spacer
- Emitter blade holder

<https://www.mb-sabers.com/shop>

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[DigiKey](https://www.digikey.com)

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Plasma Gate Parts

- 3x screws 4-40 UNC 3/4"
- 3x M2 nuts
- 1x poly carbonate tube (10mm diameter)
- 3x steel tubes (3mm diameter)
- 3mm ultra bright LED or pixel LED

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Electronic parts

- 18650 3.7V Li-Ion Battery (**protected only!**)
Keppower 3,7V 18650 Lithium-Ion 3500 mAh
- 1x 28mm speaker (max 12mm high)
- 0.02 mm² (AWG 34) wire
- 0.05 mm² (AWG 30) wire
- 0.09 mm² (AWG 28) **PTFE** wire
- 0.14 mm² (AWG 26) **PTFE** wire
- 0.21 mm² (AWG 24) **PTFE** wire
- 0.32 mm² (AWG 22) **PTFE** wire
- 3mm accent LEDs
- SMD LEDs 0805
- single pixel LED
- Soundboard
- USB charging PCB
- Oled display 0,91" (128 x 32)
- electric motor with gear box 1:136 (6mm)
- NeoPixel connector (blade and hilt)
- High brightness LED
- Blade parts

<https://thesaberarmory.com/>

<https://thesaberarmory.com/>

<https://thesaberarmory.com/>

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<https://www.mb-sabers.com/shop>

<https://thesaberarmory.com/>

<https://thesaberarmory.com/>

<https://thesaberarmory.com/>

<https://www.thecustomsabershop.com/>

GRAFLEX parts

- GRAFLEX flash gun
- GRAFLEX add on parts

<https://thesaberarmory.com/>

<https://graflexshop.com/>

<http://romanprops.com/>

<https://www.thecustomsabershop.com/>

<https://thesaberarmory.com/>

Bladeholder

<https://www.mb-sabers.com/shop>

4. 3D print parts overview

Part Variations

Some parts have variations!

Depending on technical aspects like:

Blade style:	NeoPixel or High Brightness LED
Plasma Gate:	Standard or spinning
Oled display:	YES or NO
USB:	USB-B or USB-C

Or design aspects:

Crystal Chamber:	number of Fins
Main Section:	number of accent LED on Part06

Print Materials

3D printed precious Metal:

The **metal parts** are designed **for precious metal material printing (Silver, Brass, Bronze)**.

These materials have the best accuracy and usability. They can be drilled, cut and tapped very easy. However, most metal parts are also available in steel or nylon plastic.

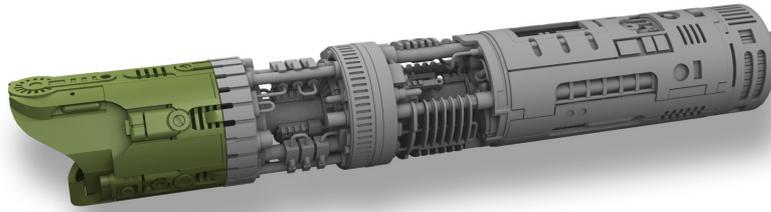
3D printed Steel:

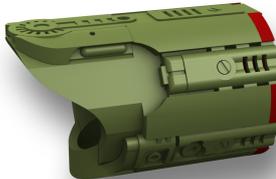
Steel material prints are not recommended for inexperienced hobbyist. But it is absolutely possible to work with printed steel parts. It takes some time to prepare the parts to make them fit. The standard SW steel material is brittle and cannot be drilled, cut or tapped! All steel material prints have an accuracy of +/- 5%!

Anyway, the lower cost of steel prints are of course a good way to save money.

Info: Each steel materials look the same after sanding!

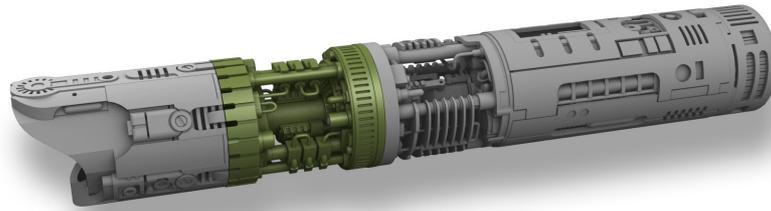
Emitter Section

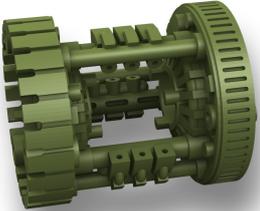
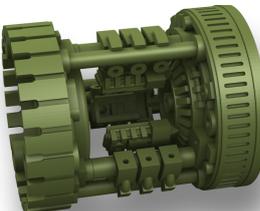
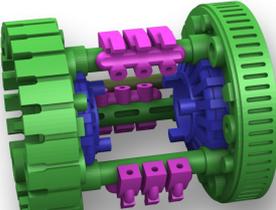
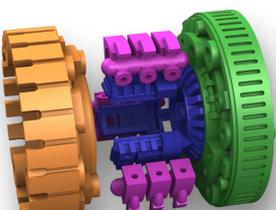


Variation A (short) thin back plate for Neo Pixel	Variation B (long) thick back plate for high brightness LED
	
Parts	Parts
<u>Emitter glass-eye adapter</u>	<u>Emitter glass-eye adapter</u>
<u>Emitter add-on A short</u>	<u>Emitter add-on A long</u>
<u>Emitter add-on B</u>	<u>Emitter add-on B</u>
<u>Emitter add-on C short</u>	<u>Emitter add-on C long</u>
<u>Emitter add-on D short</u>	<u>Emitter add-on D long</u>
<u>Emitter add-on E</u>	<u>Emitter add-on E</u>
<u>Emitter 2.0 NeoPixel Connector holder</u>	

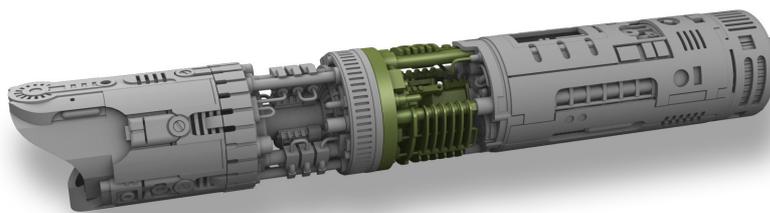


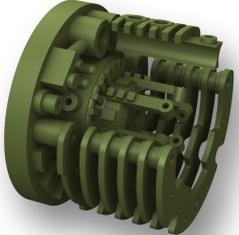
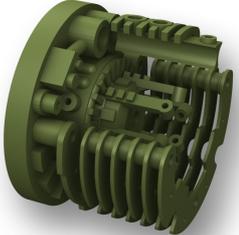
Plasma Gate Section (Part 01)

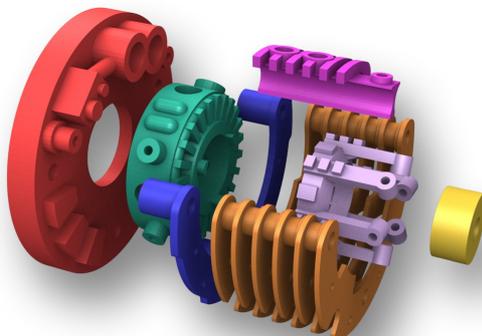


Standard Plasma Gate	Spinning Plasma Gate (SPG)	
		
precious metal or steel	precious metal	steel
parts	parts	parts
Part 01 Plasma Gate 2.0 A	Part 01 SPG front cast metal	Part 01 SPG front steel
Part 01 plasma gate 2.0 B	Part 01 SPG back cast metal	Part 01 SPG back steel
Part 01 Plasma Gate 2.0 C		Part 01 SPG tube holder
		Part 01 SPG ring
	Part 01 SPG spacer	Part 01 SPG spacer
	Part 01 SPG magnet	Part 01 SPG magnet
	Part 01 SPG details	Part 01 SPG details
	Part 01 SPG motor holder	Part 01 SPG motor holder
		

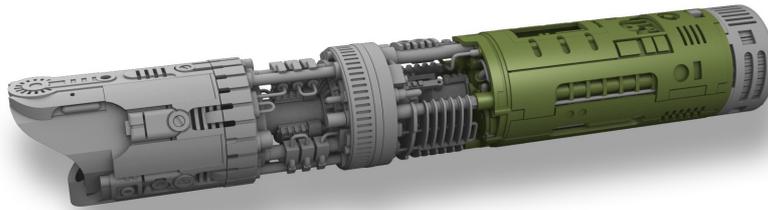
Crystal Chamber Section (Part 02, Part 03 Part 04)



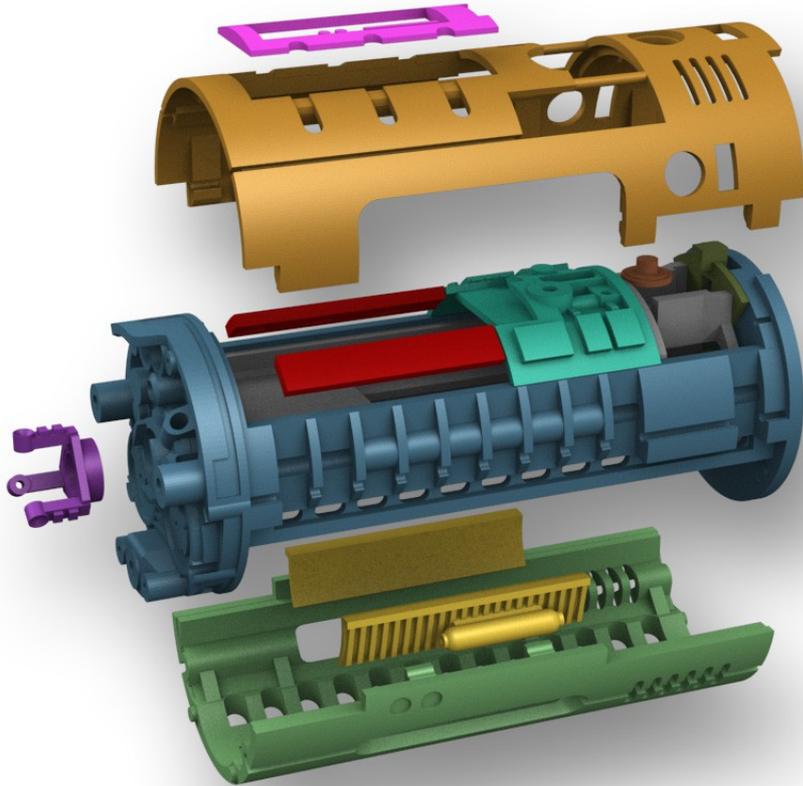
Crystal Chamber with 5 fins	Crystal Chamber with 6 fins
	
Parts	Parts
Part 02 A	Part 02 A
Part 02 B	Part 02 B
Part 02 C (crystal holder)	Part 02 C (crystal holder)
Part 02 D (led holder)	Part 02 D (led holder)
Part 03	Part 03
Part 04 (5 fins)	Part 04 (6 fins)
Pipes Add On	Pipes Add On



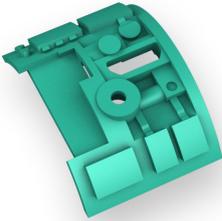
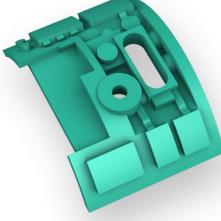
Main Section (Part 05, Part 06, Part 07)



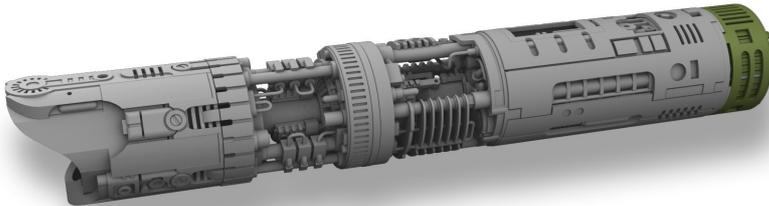
V1	V2	Oled
		
Parts	Parts	Parts
<u>Metal Master 3.0 part 05</u>	<u>Metal Master 3.0 part 05</u>	<u>Metal Master 3.0 part 05</u>
<u>Metal Master 2.0/3.0 Crystal holder</u>	<u>Metal Master 2.0/3.0 Crystal holder</u>	<u>Metal Master 2.0/3.0 Crystal holder</u>
<u>Metal Master 3.0 part05 slider</u>	<u>Metal Master 3.0 part05 slider</u>	<u>Metal Master 3.0 part05 slider</u>
<u>Metal Master 3.0 plate and spacer</u>	<u>Metal Master 3.0 plate and spacer</u>	<u>Metal Master 3.0 plate and spacer</u>
<u>Metal Master 2.0/3.0 Insulation</u>	<u>Metal Master 2.0/3.0 Insulation</u>	<u>Metal Master 2.0/3.0 Insulation</u>
<u>Metal Master 07</u>	<u>Metal Master 07</u>	<u>Metal Master 07</u>
<u>Metal Master Battery cover</u>	<u>Metal Master Battery cover</u>	<u>Metal Master Battery cover</u>
<u>Metal Master 3.0 part06 V1</u>	<u>Metal Master 3.0 part06 V2</u>	<u>Metal Master 3.0 part06 Oled</u>
<u>Metal Master six-pack smd LED Holder</u>	<u>Metal Master double smd LED holder</u>	<u>Metal Master LED Holder Oled</u>
		<u>Metal Master Oled cover SET</u>

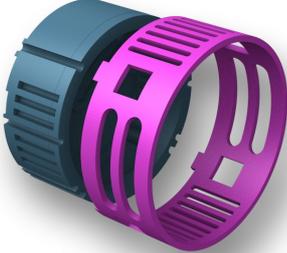


Main Section (USB)

USB-B	USB-C
	
<p><u>Metal Master 06 Tech USB-B</u></p>	<p><u>Metal Master 06 Tech USB-C</u></p>

Speaker Section (Part 08)



	<p><u>Metal Master Speaker Chamber</u></p>
	<p><u>Metal Master 08 (speaker cover)</u></p>

5. Check the metal printed parts (especially standard steel)

After the printed parts arrive, they must first be inspected.

Most materials do not pose a major problem. However, parts printed from standard steel materials may have imperfections. **Nylon or precious metal parts shouldn't cause any problems.**

Check all parts for:

- closed / blocked holes (try to push rods through each hole)

If there is a blocked hole make a picture (for Shapeways) before you do anything else.

If it is not possible to resolve this issue by drilling or other techniques please contact Shapeways and reclaim the part. They will reprint the part for you.



Use this text:

I know the printing process. I know it is possible to get a perfect print result with this model.

It looks like the print was not checked and cleaned properly after the first step before the part goes through the infusion process.

- bent geometry

If the object does not fit because of bent geometry try to reshape it. Steel material is brittle. So you have to be careful.

First take pictures of the non-fitting part (for Shapeways). Then try to reshape it.

In most cases it is possible to make it fit again. If it is not possible then please contact Shapeways and reclaim this part. Send them the picture of the issue and ask for a reprint. They will reprint this part!

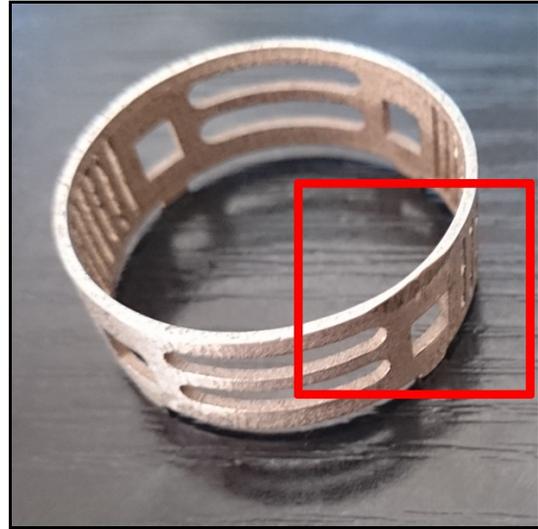
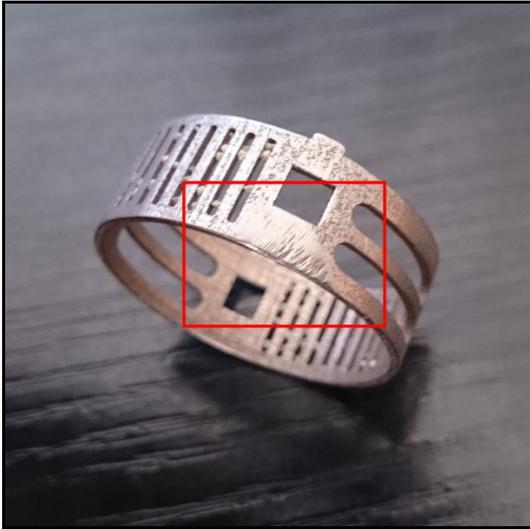


- **damaged surface** caused by removing sprue marks.

During the printing process sprues are added to the geometry. These sprues will be removed after the printing process. Sometimes Shapeways damages the part. Please contact Shapeways and reclaim the bad print. Send them the picture of the issue. They will reprint this part!

Use this text:

*I know the production process. These damages are caused by removing sprue marks careless.
Please reprint this part.*

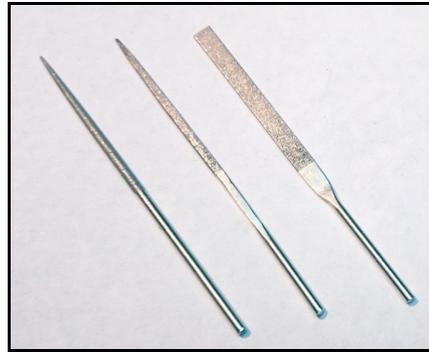


6. Preparing the surface

3D printed metal parts are never perfect! They all need post processing to make them fit and look good. Depending on the material, the parts require more or less work. Precious metals require the least amount of work. Standard steel needs the most amount of work.

Tools

- power tool and grinding heads
- diamond files (small)
- sandpaper (240 grit, 600 grit)
- belt sander (80 grit and 180 grit)



Precious Metal parts (Brass, Bronze, Silver) in general:

Precious metal material can be ordered as polished or raw.

I recommend to order the raw version. It is a lot cheaper. It is easy to sand or polish by yourself. Also polished precious metal print lose detail and edges are rounded.

For preparing precious metal parts, belt sander, sandpaper and small files are needed.

Steel parts in general:

Steel parts do not fit without sanding.

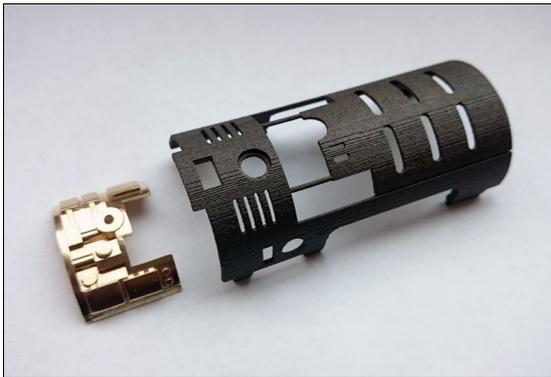
Each part has to be sanded. Take your time. For steel parts use your Dremel or Proxxon power tool with a grinding head.

For the finish use a belt sander (**80 grit and 180 grit**).

There are several areas which have to be sanded to make sure all parts fit together.

For the holes use small (2mm) grinding heads with your Dremel and small round hand files.

Standard Steel material cannot be drilled. Always use grinding heads, sand-paper or a diamond file.

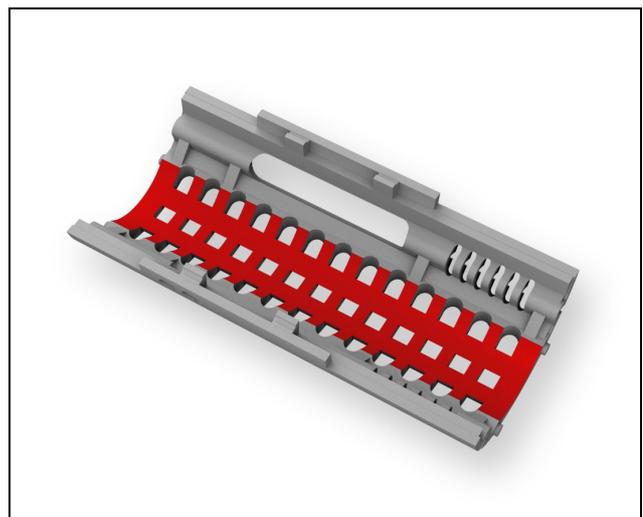


Steel parts which need more attention:

Battery cover Metal Master 07 (steel)

It is also necessary to sand down well the rough surface inside the battery section from part 07 (battery cover).

The battery has to have enough space to lay in the battery cover loosely. **The battery cover must fit easily! This is very important.**



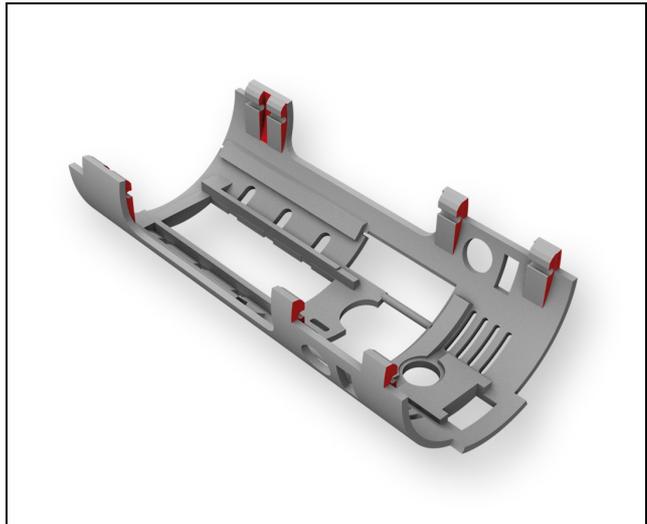
Soundboard cover Metal Master 06 (steel)

Some areas of the soundboard cover **Metal Master 06** need special attention.

The area around the “light holes” inside the cover need to be sanded carefully to make sure the LED holder fits. This area has to be nice and smooth.

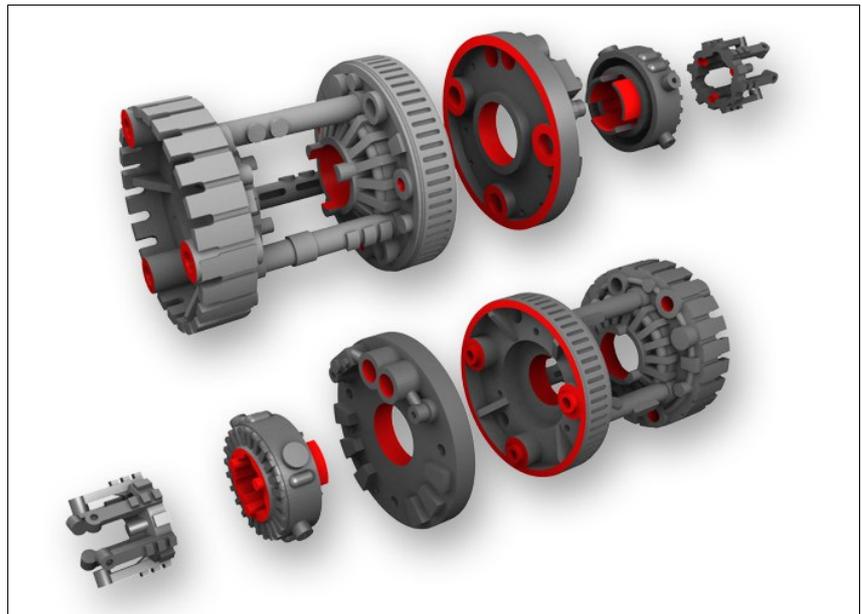
Other areas at the holders must be sanded to make the cover fit on the main part **Metal Master 05**.

Check the fitting first. Then decide where and how much material has to be removed. Each steel print is different.

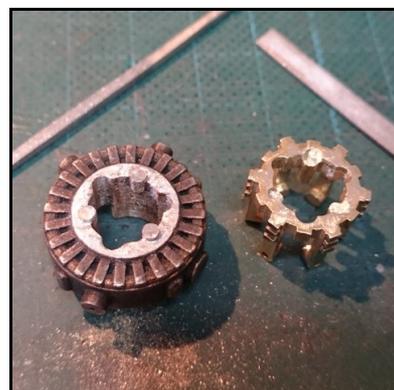


Plasma Gate Part 01 and Part 02

All areas marked in **red** have to be sanded to make the steel parts fit.



Take your time to make everything fit together...



7. Installation

! Safety first !

Please remember that metal materials are conductive! You have to make sure that the battery contacts are well insulated as well as all other electronic parts.

Do not mix up the electronic poles. Install the contacts like shown on the pictures.

Electronic wire

Use PTFE wire. PTFE has the smallest profile.

function	AWG	mm ²
speaker	26	0.14
single Pixel	30	0.05
Pixel data	30	0.05
+ battery to + Soundboard	24	0.21
- battery to - Soundboard	22	0.32
+ battery to + pixel blade	22	0.32
- pixel blade to Soundboard	22	0.32
motor	28	0.09
Plasma Gate Pixel PCB	26	0.14
USB port D+/D- to Soundboard	34	0.02
USB port <> charge PCB	28	0.09
Battery <> charge PCB	28	0.09
AUX/ACT switch	34	0.02
Accent smd LEDs	34	0.02

Speaker chamber

M2 threaded rods preparation

Install one M2 nut on each M2 threaded rod **end** (2x).
You need two 135mm long M2 rods.
The third one is shorter and will be installed later!

Use **Loctite 648** to glue them in position. Let it dry over night.
These three rods have to be installed before the speaker chamber is screwed on...

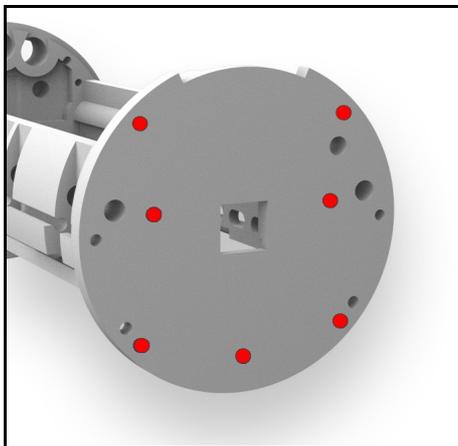


Speaker-Chamber mounting hole tapping

Seven holes in the back of Part 05 need 1.2M threads.
Use a M1.2 tap set of three.
Drill the holes to 1mm and cut the threads.

Use the tap guide! [Link: Part 05 tap guide](#)

If you have problems to get a M1.2 tap like this: info@mb-sabers.com



Polishing the back of part 05

Polish the back of Part 05 to a mirror finish. This effects the brightness of the speaker chamber accent LED.

Preparing the speaker chamber LED-SPACER

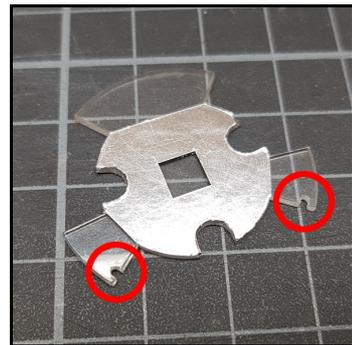
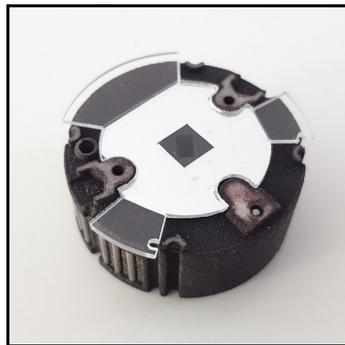
The spacer guides the speaker chamber's accent LED light.

Remove the blue foil from the **LED spacer**.

This part does not have to be glued. Just place it between part 05 and the speaker chamber.

Attach a thin self-adhesive mirror film to the side facing the chamber. Cut out a 5mm x 5mm area in the center.

Cut two notches into the LED spacer like shown on the picture. Use the rod guides on the chamber to find the correct position! **Make sure 1mm rods fit and slide easy through the guides, notches and holes!**



Preparing the speaker chamber frame rods

The speaker chamber is framed by four 1.2mm rods.

Use four 1.2mm rods and cut M1.2 threads to each end.

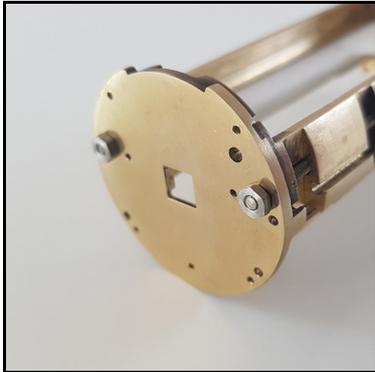
(Or use 1.2mm pre threaded rods [LINK](#))

1. Cut four 1.2mm rods to 2.5cm length.
2. Tap a thread on one end of each rod.
3. Screw them onto Part05, add the speaker chamber and speaker ring. Adjust the length of both ends of each rod.
4. Tap the other end of each rod.



Assembling the speaker chamber

1. Install the two M2 rods into Part05 first!
2. Add the four prepared 1.2 mm rods to Part05
3. Add the LED spacer and the chamber to Part05 and mount it with three M1.2 screws
4. Glue (12x) 8mm long 1mm rods into the indentations on the chamber side. Use **Loctite 648!**



Preparing the Speaker rim cover

The speaker ring covers the speaker rim. It also holds the speaker and the Part08 in place. It consists of two metal rings. The first one is smaller. It is placed inside the Part08. It has to be adapted to the inner diameter of Part08. Sand the outside of the ring evenly till it fits into the cover.

Slide the Part08 over the chamber. Add the first ring and push it in the cover onto the chamber. **Ring and Part08 should now have the same level!**

Make sure Part08 and the ring are rotated correctly. All holes line up.

Place the second ring onto the first. Make sure it is rotated correctly too.

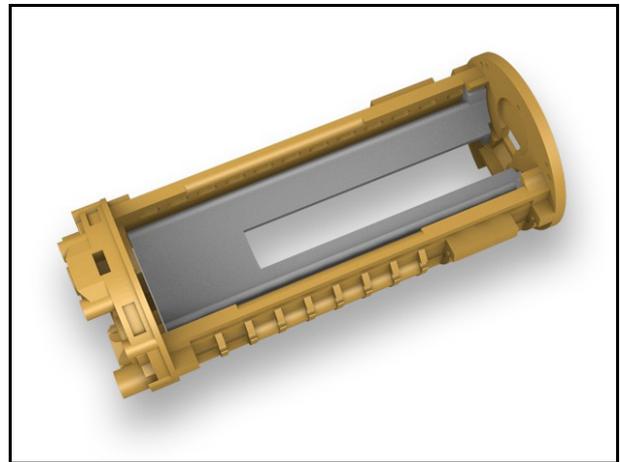
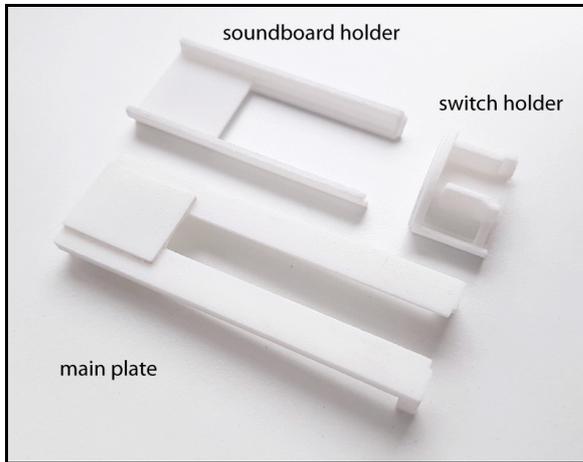
Add 4x M1.2 nuts to each chamber frame rod and screw them down.

Now match the outer edge of the ring to the radius of Part08. Use a rotary tool with grinding head and sandpaper.

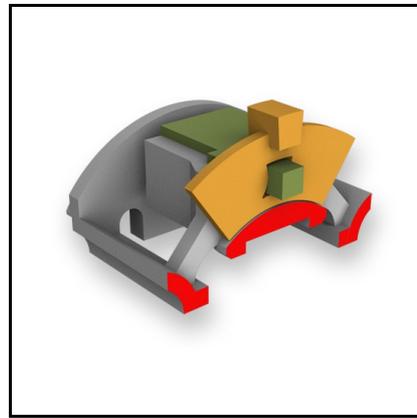
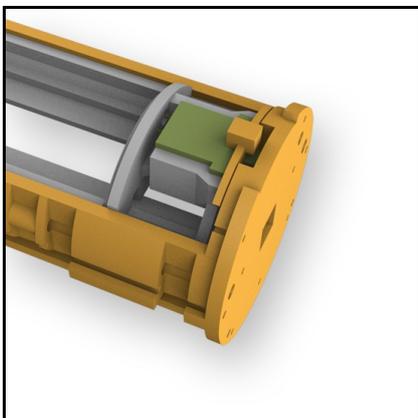


Preparing plate and spacer (main plate, board holder, switch holder)

1. Separate all three parts and sand down the grainy surface.
2. Install the **main plate** into Part05. **NO glue needed!**

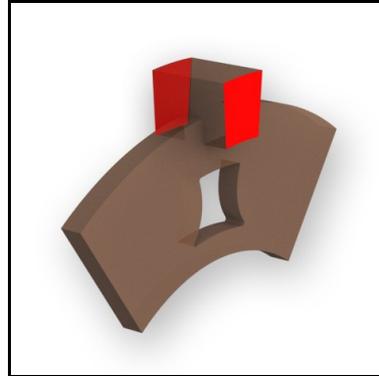
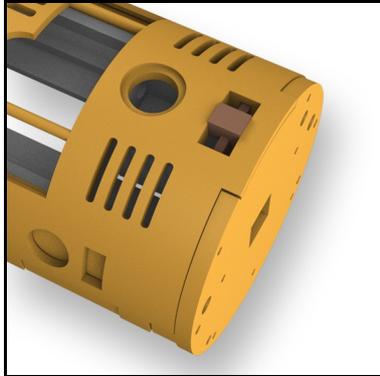


3. Add the **power switch TS01CQE** and the **slider** to the switch holder
4. Install the **soundboard holder** and the **switch holder** into Part05.
5. Test the **slider function**. It should fit nice and tight.
If it is too loose, sand down the **red marked areas** on the switch holder and test again.



Preparing the power switch slider

Install the slider (together with the power switch and the switch holder) into Part05. Attach Part06 to Part05. Check how the slider knob fits into the **cut out** of Part06. **Adapt the knob** by sanding the two **red marked faces** till it fits into the cut out perfectly.



Battery contacts

Do not remove the shrinking foil/insulation from the Battery!
Everything must be insulated well!

Battery

The Metal Master chassis is designed for **protected 18650 Lithium-Ion Batteries with raised top (plus pole)...**



I recommend to use this battery brand:

**protected 18650 Keppower 3.7V 3500 mAh / discharge rate 10A
- NCR18650GA-**

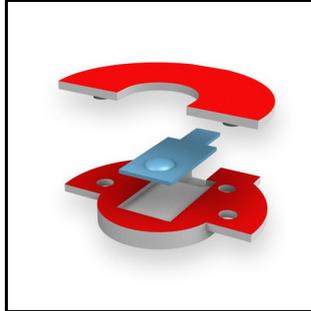
Preparing nylon insulation parts

Separate all three nylon insulation parts and sand down the grainy surface.

The insulation parts for the positive pole contact needs special attention!

First sand down the red marked face of the bottom part till it lines up with the contact plate surface!

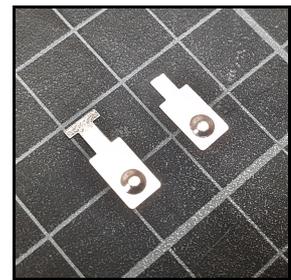
Then sand down the red marked face of the top part. Make it nice and thin.



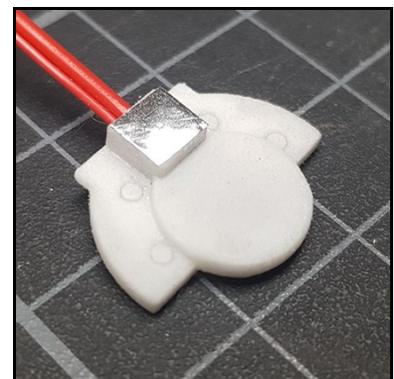
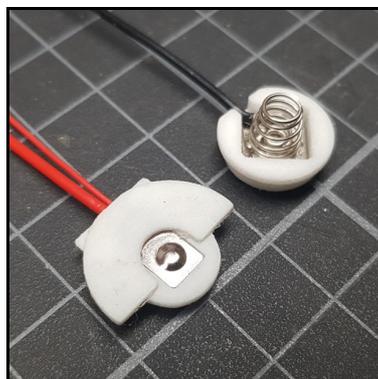
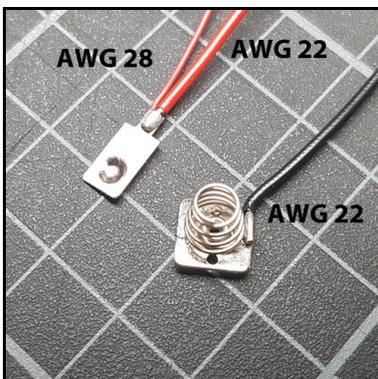
Preparing and wiring the battery contacts

Both contacts are available at www.mb-sabers.com

1. Flatten the hooks of the **spring-contact** with pliers.
2. Remove the T-bar of the **flat-contact**



3. Solder **PTFE wires** (AWG 28 and AWG22) to the contacts as shown on the picture below. Solder the wires to the **bottom** of the **flat-contact** and to the **top** of the **spring-contact**.
4. Glue the contacts onto the nylon parts. Also glue on the flat contact cover. Use Pattex EXTREM or Epoxy
5. Attach a thin self-adhesive mirror film to the back of the flat-contact.

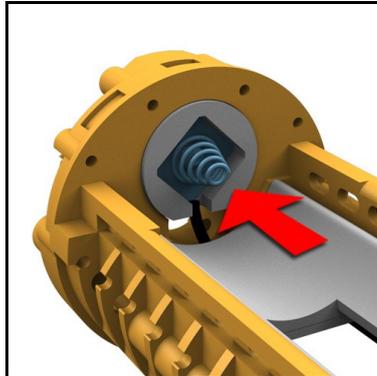


Battery-contacts installation

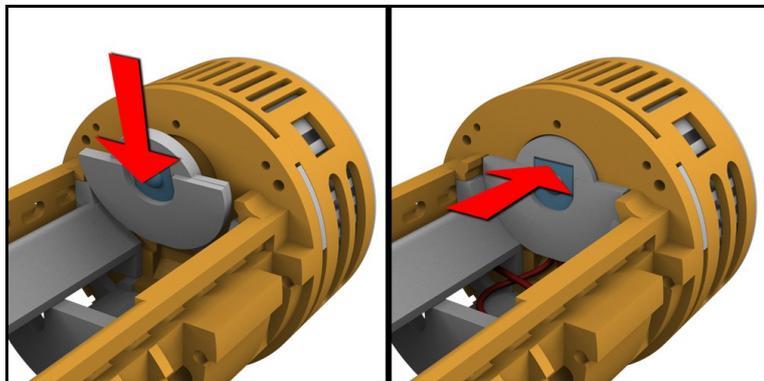
Important: The battery-contacts will be installed after the main plate!

The **spring-contact** just has to be pushed into the slot.

No glue needed!



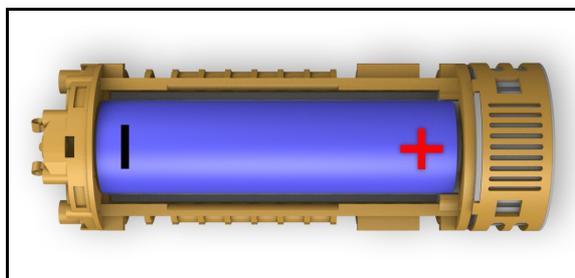
The **flat-contact** must be inserted at an angle of 40°. Then push it down to the final position. **No glue needed!**



Electric pole orientation

Front (**spring-contact**): negative (-)

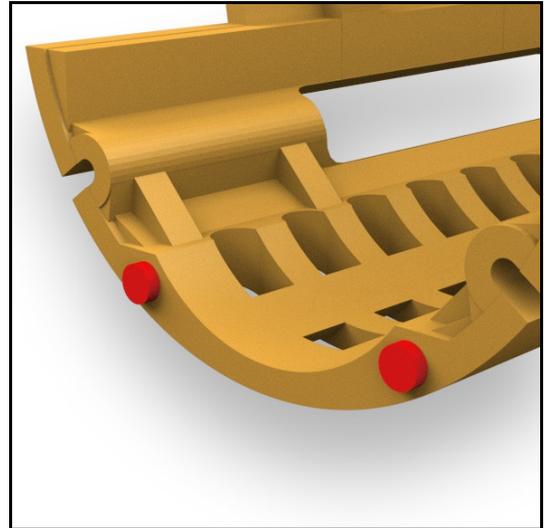
Back (**flat-contact**): positive (+)



Battery cover part07

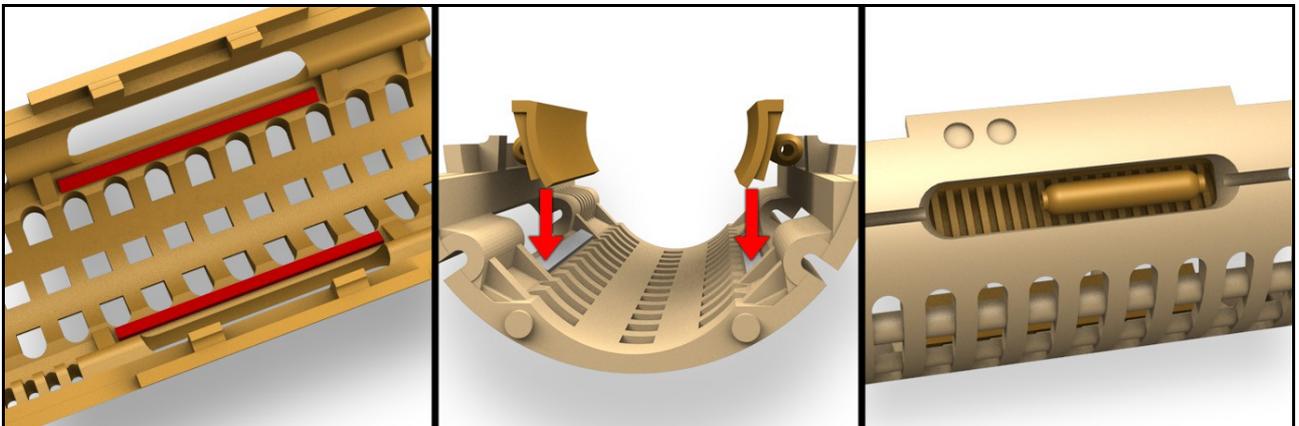
Battery cover adjustments

Metal Master 08 has got four spacers to make sure the cover has a nice fit. Steel material has +/- 5% tolerance in any dimension. The four spacers must be adjusted in length.



Battery cover add-on installation

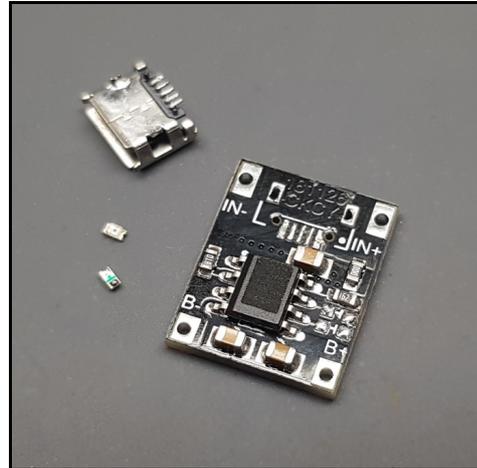
- Add two stripes of **double-sided adhesive foam tape** as shown in the picture in red.
- Place the two **add-on parts** onto the foam tape as shown in the picture.



Charge PCB

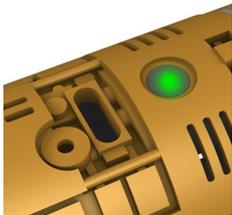
Preparing the Charge board PCB

1. Remove the USB port
2. Solder a 4cm AWG 28 wire to the **B-** pad
3. If you like to have the two **indicator LEDs** on a different position, remove them.



External charging indicator LED position

You can add charging indicator LEDs to the chassis cover Part06.
There are **two different positions** possible:

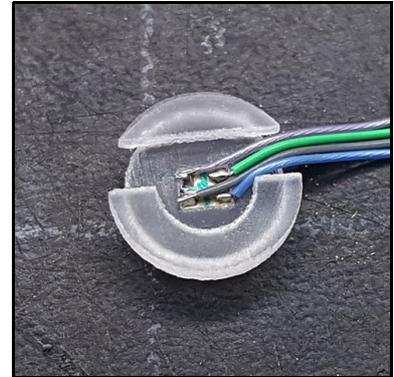
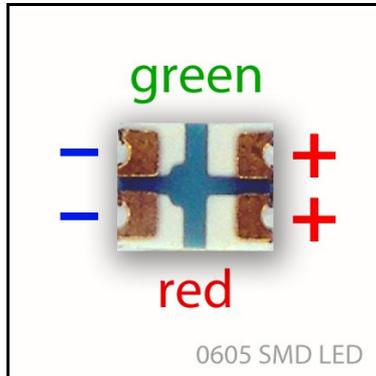
	LED position	Part needed	Link to print part
1			Metal Master 3.0 part 06 LED holder
2			Metal Master 3.0 part 06 detail

Preparing the SMD charge LED

You need a **0605 Bi-color SMD LED** (usually green/red).

Add 5cm **AWG 34 wires** to the four solder pads.

Depending on where the LED will be placed, glue it into the **Part 06 LED holder** or not.

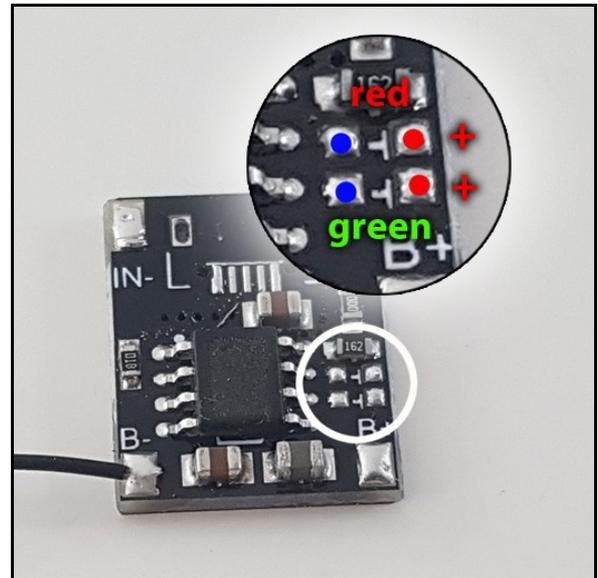


Wiring the indicator LED to the charge PCB

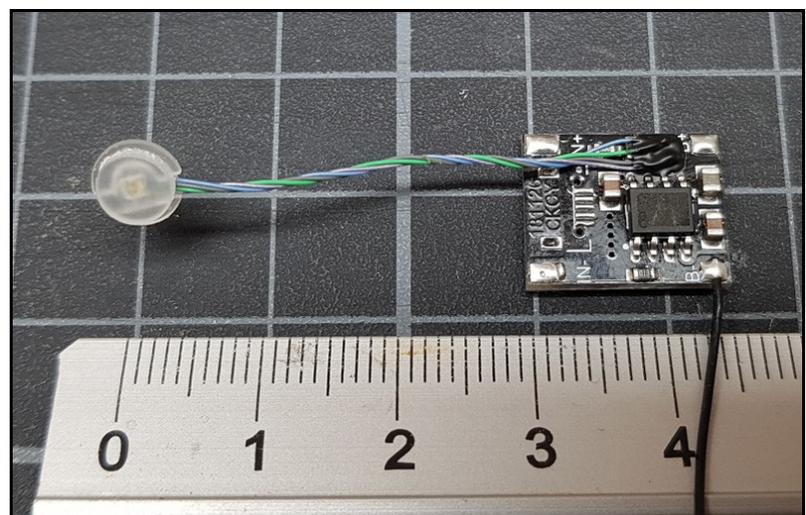
Solder the four AWG 34 LED wires to the pads on the charge-PCB as shown on the picture.

The wires should be twisted and be at least 4cm long!

Apply liquid rubber to the solder joints on the LED and PCB for more stabilization.

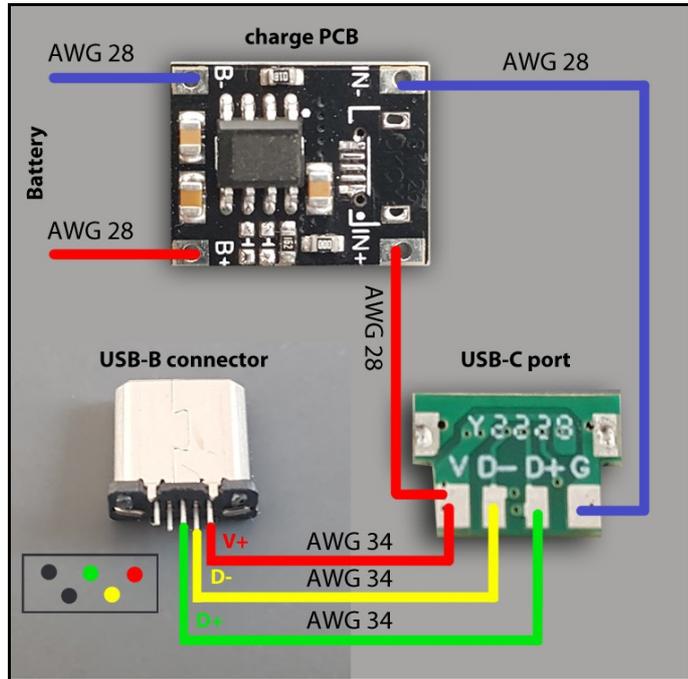
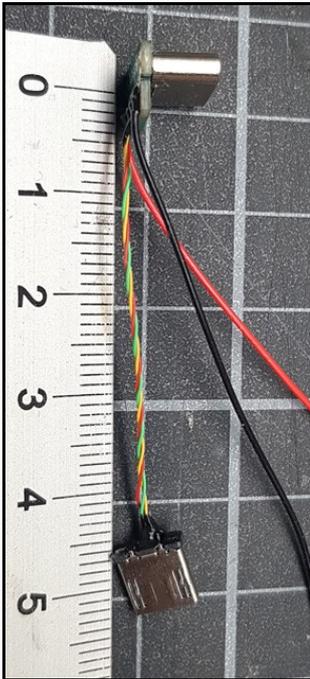


The PCB should now look like this:



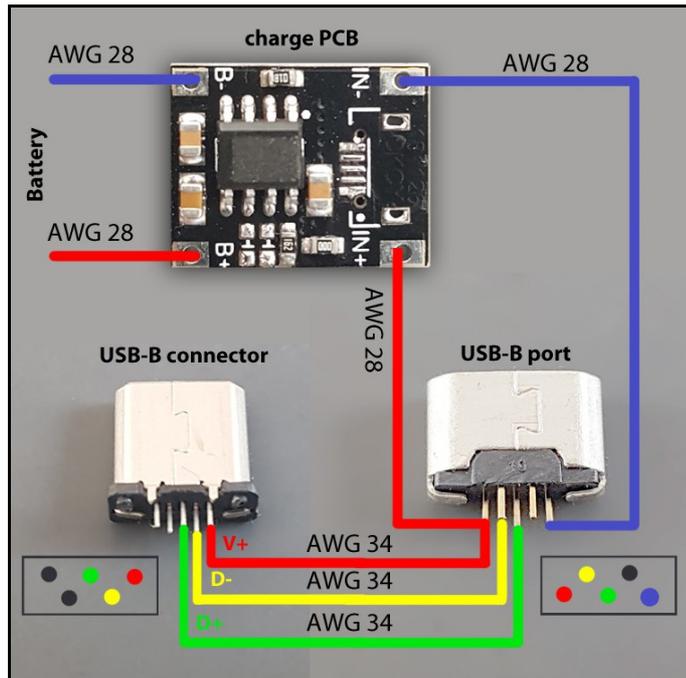
Wiring the USB-C port

The AWG 34 wires should be twisted. For the USB-C port the wire bridge should be at least 4cm long. Add liquid rubber to the solder joints for protection.



Wiring the USB-B port

The AWG 34 wires should be twisted. For the USB-B port the wire bridge should be at least 3cm long. Add liquid rubber to the solder joints for protection.



Attaching the USB port to the chassis Part06 tech

Solder the AWG 28 wires to the charge PCB (IN-/IN+).

Wire length:

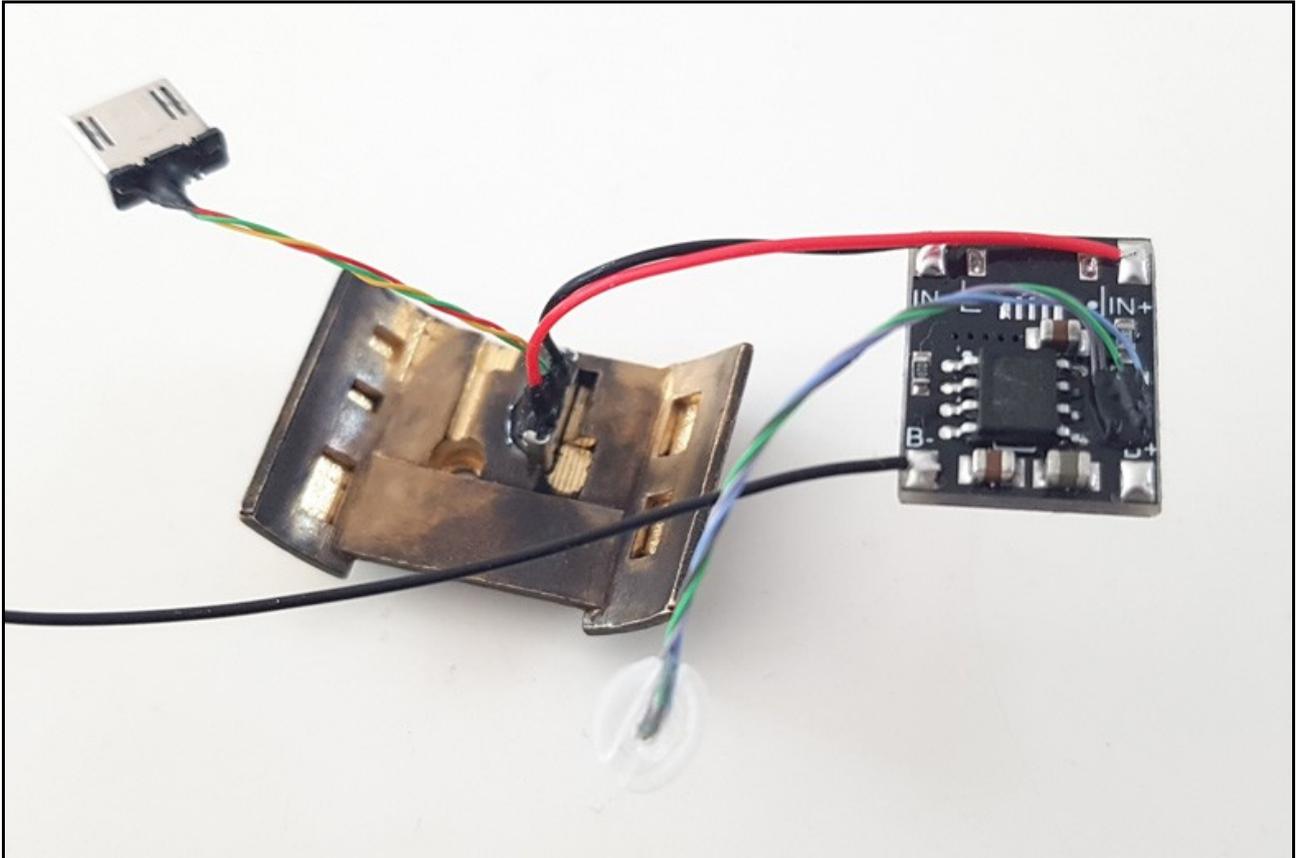
USB-B: red 4.5cm / black 3.5cm

USB-C: red 5.5cm / black 4.5cm

Install the USB port into **Part06 TECH**. Make it fit first. Maybe some sanding is needed.

Then place it into the slot.

Add some (a needle tip) **Loctite 648**. Let it flow between the port and slot. **Do not let it drip into the port!**

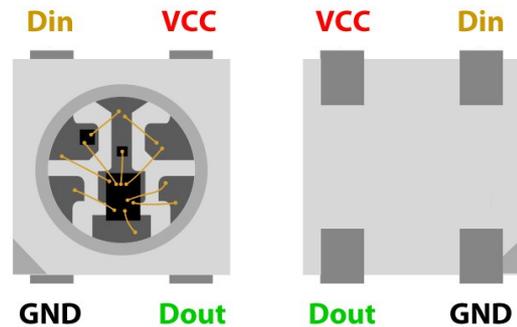


Accent LED/Pixel

Preparing 5050 RGB Pixel LED

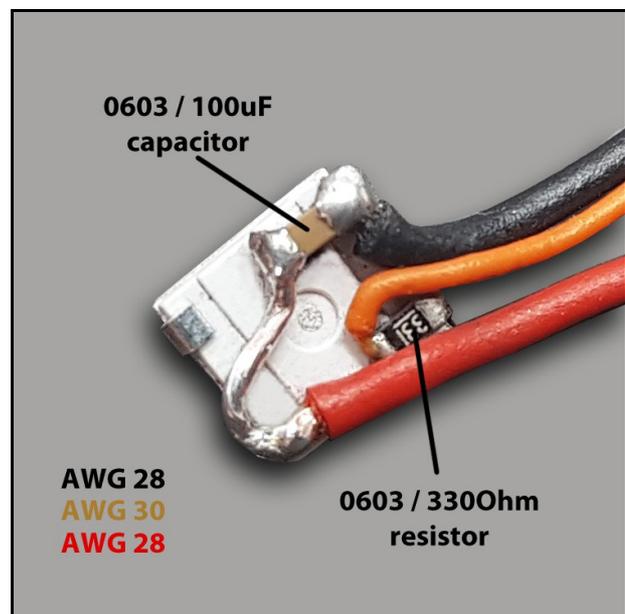
Because there is not much space for accent LED/Pixel, **single pixel without PCB** have to be used.

In this case a common **LED SMD 5050 RGB WS2812B** is used.



Solder the wires as shown in the picture

Din: AWG 30
VCC: AWG 28 – AWG 30
GND: AWG 28 – AWG 30
capacitor: 100uF
resistor: 330 Ohm



Crystal chamber 5050 RGB Pixel installation

Add the wired pixel to both crystal holder.

The picture shows the position of the 5050 pixels...

Glue them in.

The wires pointing up! (Not shown in the pictures)

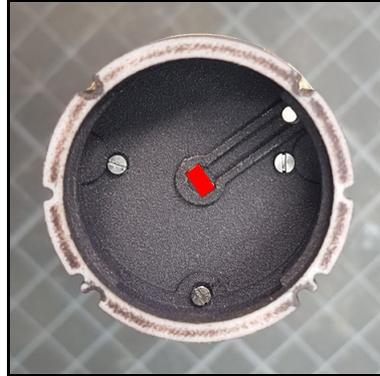
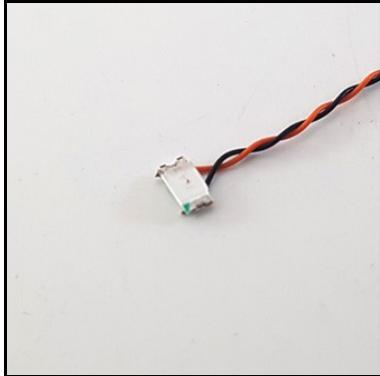
Make sure the solder pads do not touch the metal parts!
Insulate them with liquid rubber!

You can glue a 10mm washer onto Part02D for a nicer look.



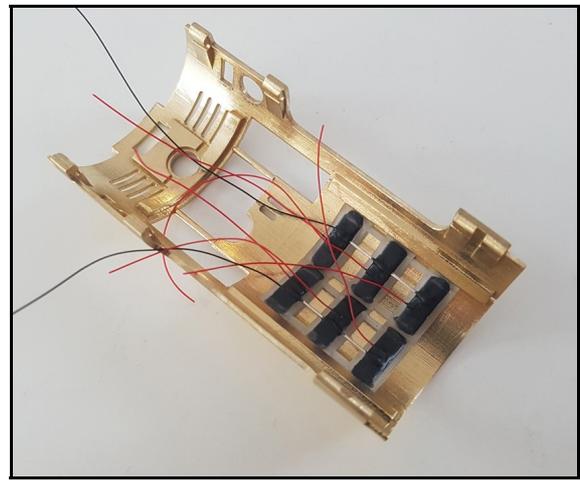
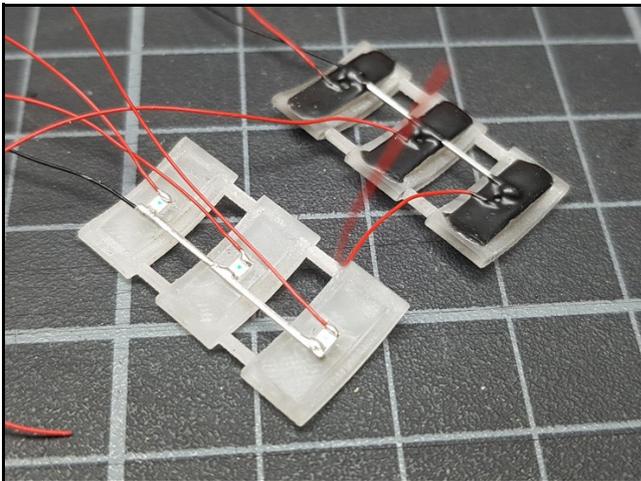
Speaker chamber accent LED installation

The speaker chamber has got a slot for one **1206 smd LED**.
Glue the smd LED into this slot directly onto the spacer. Cover the LED-back with black liquid rubber. Lead the wires to and through the through hole.



Top cover (Part 06) accent LED installation

Most Part06 LED holder are designed for **0805 SMD LEDs**.
Glue the LEDs into the indentations and solder AWE 34 wires to the solder pads. Insulate everything with liquid rubber. Then push the holder into the guide rail. (Maybe some tape or glue is necessary to hold it in position).
It can also look good to add translucent white adhesive film onto the holder.

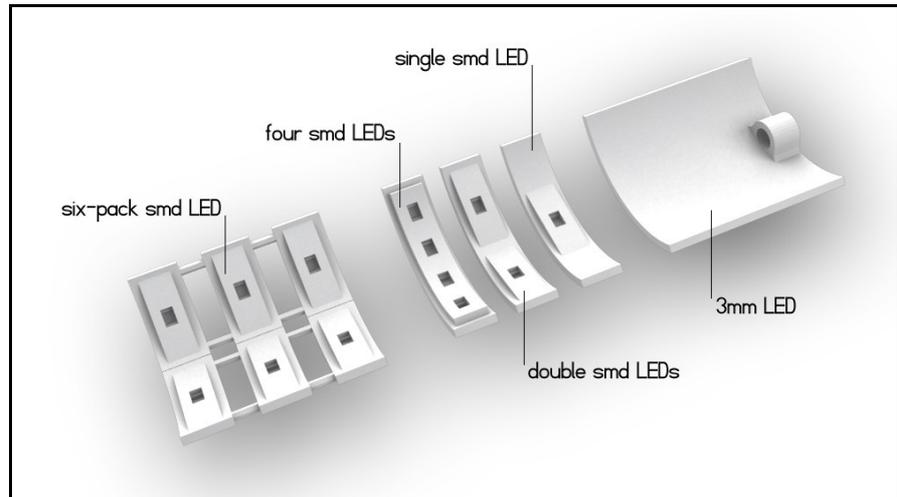


There are different smd LED holder available...

The six-pack is designed for the top cover with six light holes V1. All other smd LED holder can be used with all Metal Master top covers.

One version is for one 3mm LED.

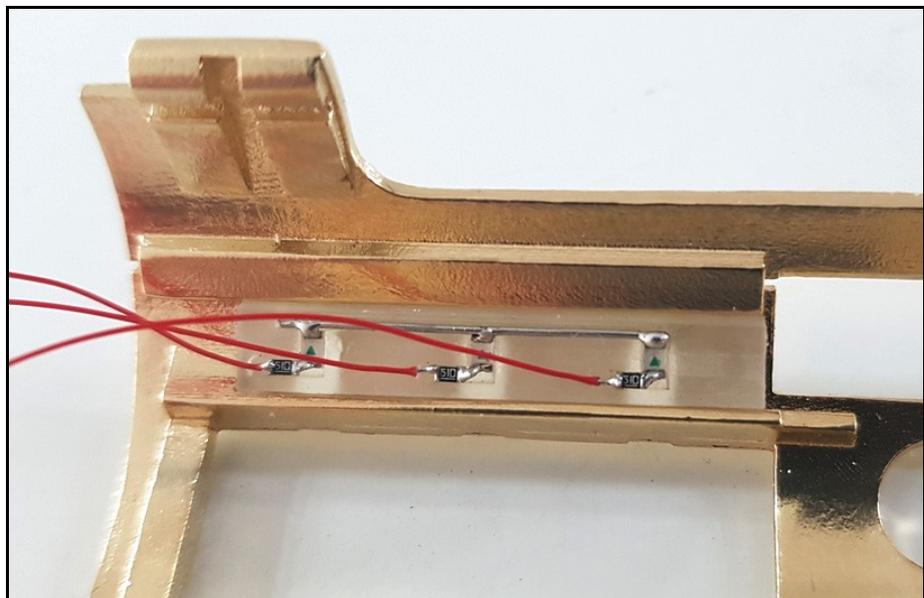
The single holder are available for **one, two or four smd LEDs**. You can also combine them.



Oled accent LEDs

The **Part06 Oled** has his own accent LED holder design. It's designed for **0805 SMD** LEDs. It also has slots for 0603 smd resistors for each LED.

1. Glue the smd LEDs into the slots. Pay attention to the orientation.
2. Add the resistors and solder them to the LEDs.
3. Add a long pin to connect all negative poles. Solder it to each LED.
4. Solder AWG 34 wires to each resistor and one to the pin.
5. Cover everything with liquid rubber.



Oled display

The top cover **Metal Master 06 Oled** is designed to integrate an standard Oled display with **128x32 pixel resolution**.



Oled display modifications

Before the Oled display can be installed into the chassis cover, it has to be modified. Otherwise it would not fit. The modification is simple...

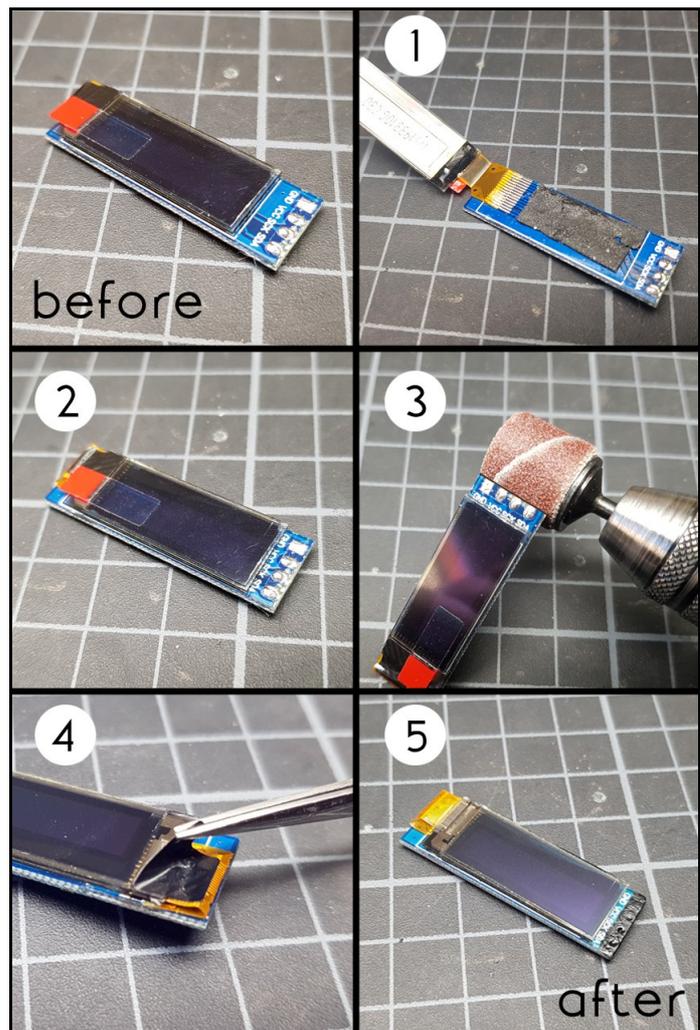
1. Remove the display carefully from the board. It is held by an double-sided adhesive film. Remove this film and replace it with a thin double-sided adhesive film.
Be careful with the flat flexible wire.

2. Place the display back onto the board. But change the position 2mm to the front.

3. Reduce the length of the board. Remove 1-2mm material up to the solder joints.

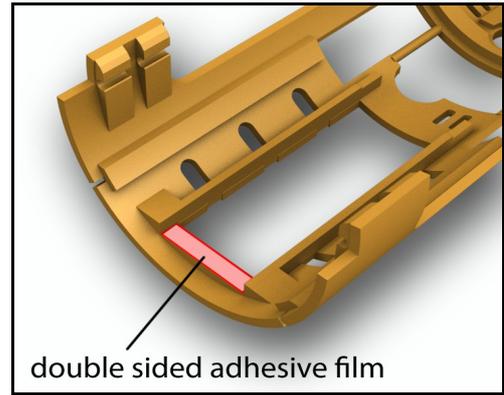
4. Remove the black protection foil from the flat wire behind the display.

5. Cover and insulate the solder joints with liquid rubber and tape.

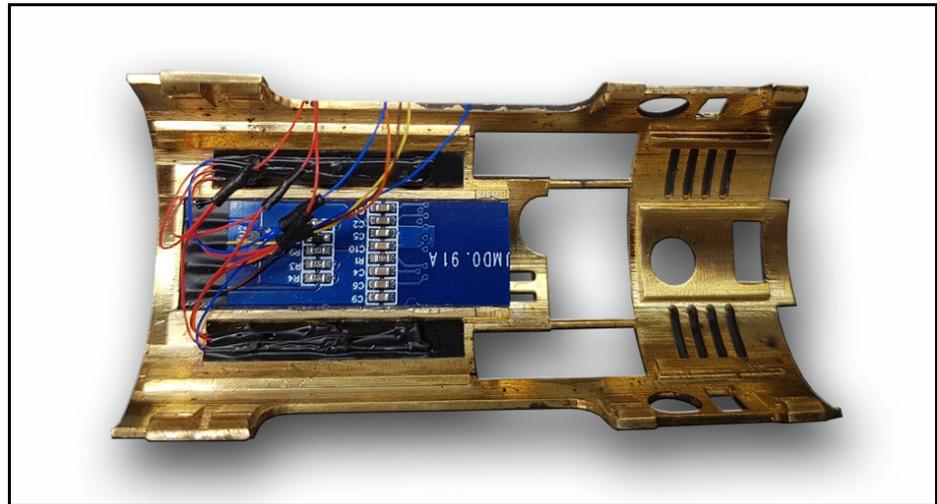


Oled display installation

1. Solder AWG 34 wires to the four pads in **PCB direction**.
2. Insulate the solder pads with liquid rubber and adhesive film.
3. Apply thin **double sided adhesive film** to the top end of the Oled window as marked in the picture in red.
4. Apply Pattex extreme repair glue (or similar) to the **long sides** of the Oled PCB.
5. Push the Oled display into the frame



This is how the attached Oled display and accent LEDs should look like...



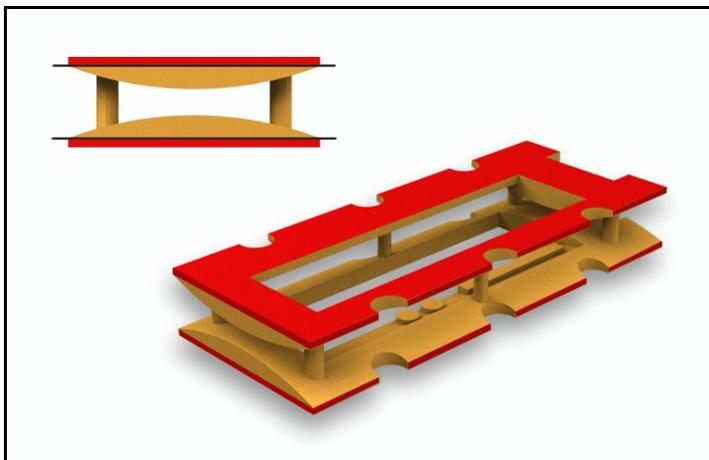
Oled display cover

Do not separate the two Oled cover! Use one as grip while sanding down the other one.

The red marked faces (Oled cover underside) must be sanded down to the edge.

After that the two parts can be separated.

Adapt the size to the Oled frame. Then lay it onto the display. Add some (a needle tip) **Loctite 648**. Let it flow between the Oled cover and Part06.

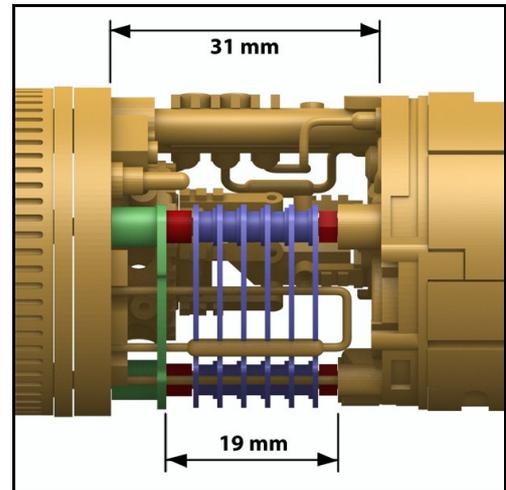


Fins installation (3D printed or laser cut)

Fin variations

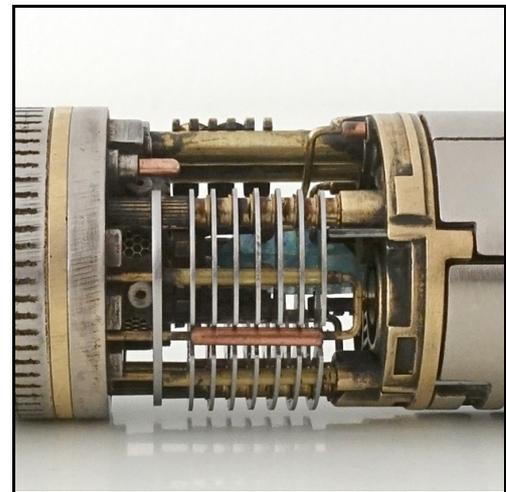
It is possible to use either 3D printed **Part04 fins** or **laser cut fins** (from www.mb-sabers.com) with M2 spacer. It doesn't matter what kind of spacer are used or how many fins. Important is only to keep the chamber length equal or smaller than 31mm.

So, if six **0.5mm laser cut fins** are used, **2.2mm spacer** are necessary to make sure the chamber is not longer than 31mm.



This is the steel **fin setup** with the laser cut fins from **mb-sabers.com**.

It contains seven 0.5mm brass fins, 6 threaded spacer and one 1mm steel fin (replacing Shapeways Part 02 C).



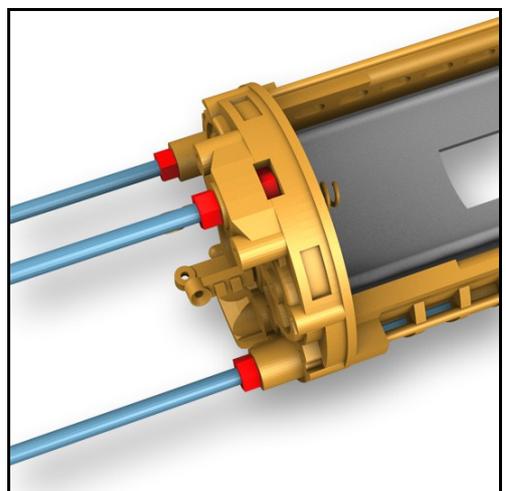
Adding the third M2 threaded rod

Now it's time to add **the third M2 threaded rod** to Part05. Use a **55mm long** threaded steel rod.

1. Insert a M2 nut into the designated slot on Part05.
2. Screw the threaded rod into the nut.
3. Add an other nut from the outside to each of the three threaded rods!

IMPORTANT:

**The nuts on the two long rods have to be hand tight!
But the nut on the short rod has to be nice and tight!**

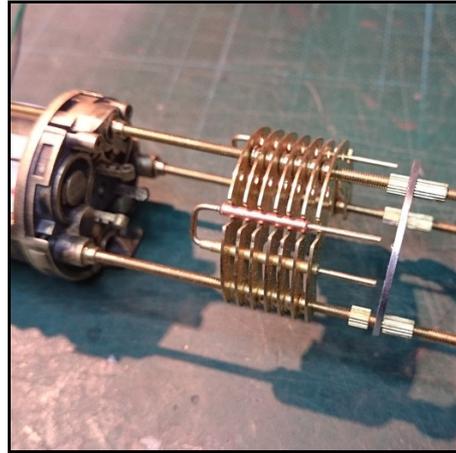


Preparing the U-rods

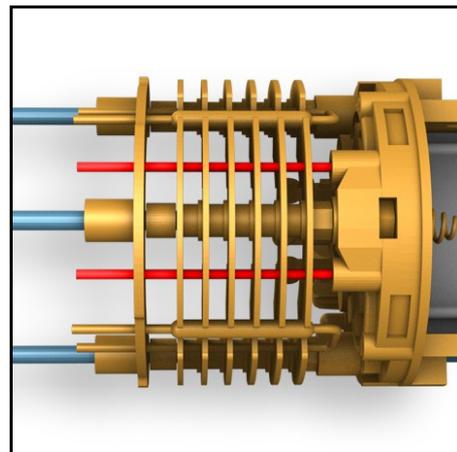
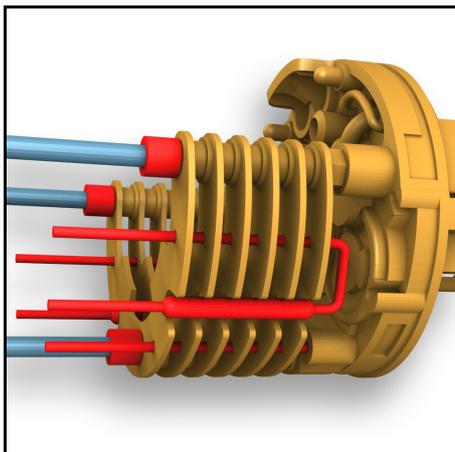
The **U-rods** for the fins are a design element, which can also be modified. You need at least two 70mm rods with 1mm diameter.

- Bend them with **round nose pliers** to the U-shape you can see on the pictures. The distance between both ends is 5.5mm.

The next pictures show **advanced U-rod designs**. Some 2mm diameter tubes were added. These U-rods can be combined with the **fins** from the mb-sabers.com shop.



1. Install the U-rods together with the fins.
2. Add a **M2 nut** or a 3mm long **threaded spacer** to each threaded rod to hold the fins in place. **Hand-tighten each nut.**
3. Install the **short rods** into the lower fin holes. The rods should be 35-37mm long.
4. Add the **3D printed Part03** or the 1mm steel fin with the 5mm threaded spacer.



Crystal chamber Part02

1. Stick two brass tubes (35mm long / 4mm diameter) into the two holes from Part02A.

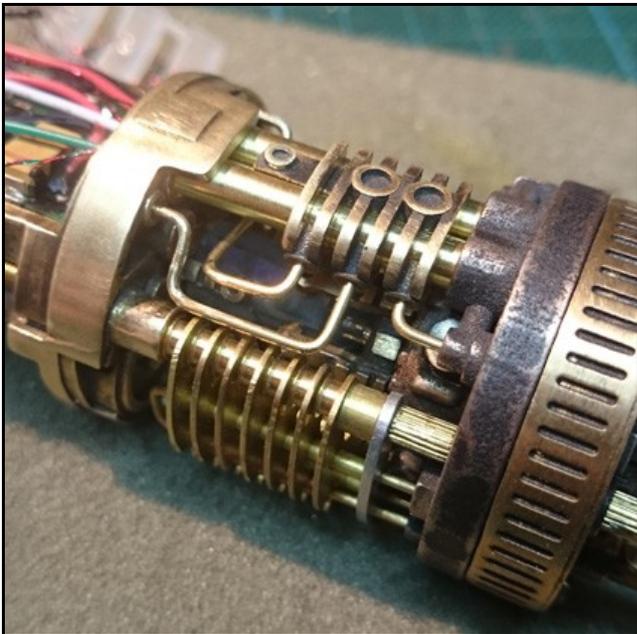
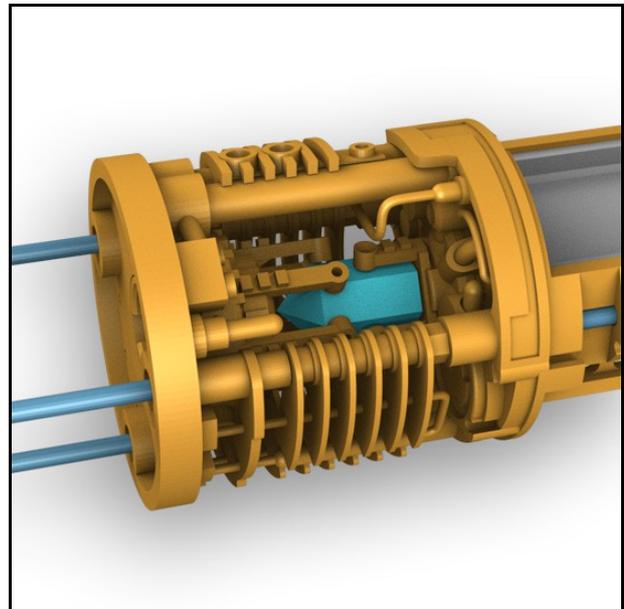
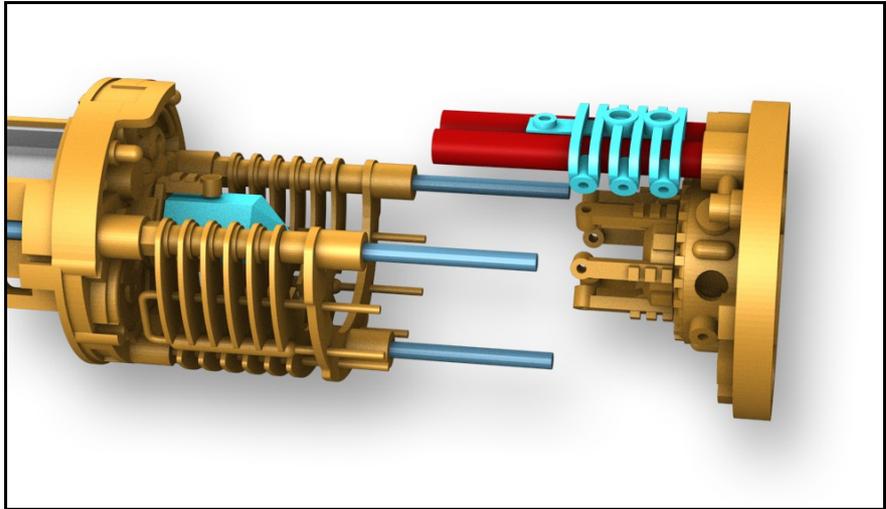
2. Slide the 3D printed tubes-add-on loose over the tubes. **Don't glue it on.**

3. Install the crystal

4. Place Part02 with installed brass tubes over the three threaded main threaded rods

5. Install crystal-chamber metal wire details. This step is up to you. You can add details to the crystal-chamber the way you like.

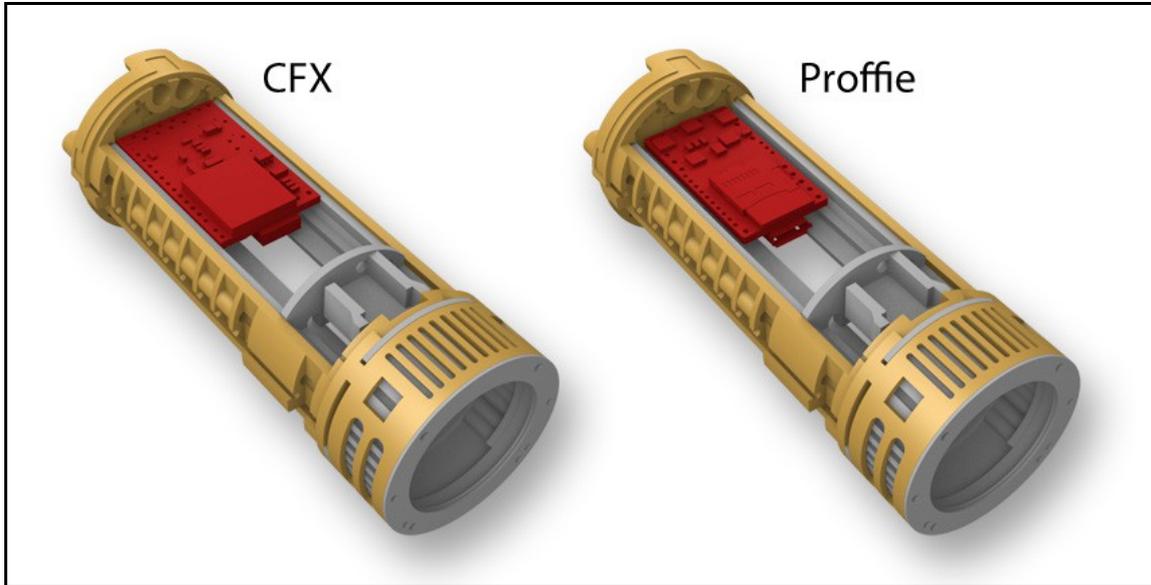
This is an example:



Installing the Electronic parts

Now it's time to install The Soundboard, Main Power-Switch and Speaker.

Soundboard position

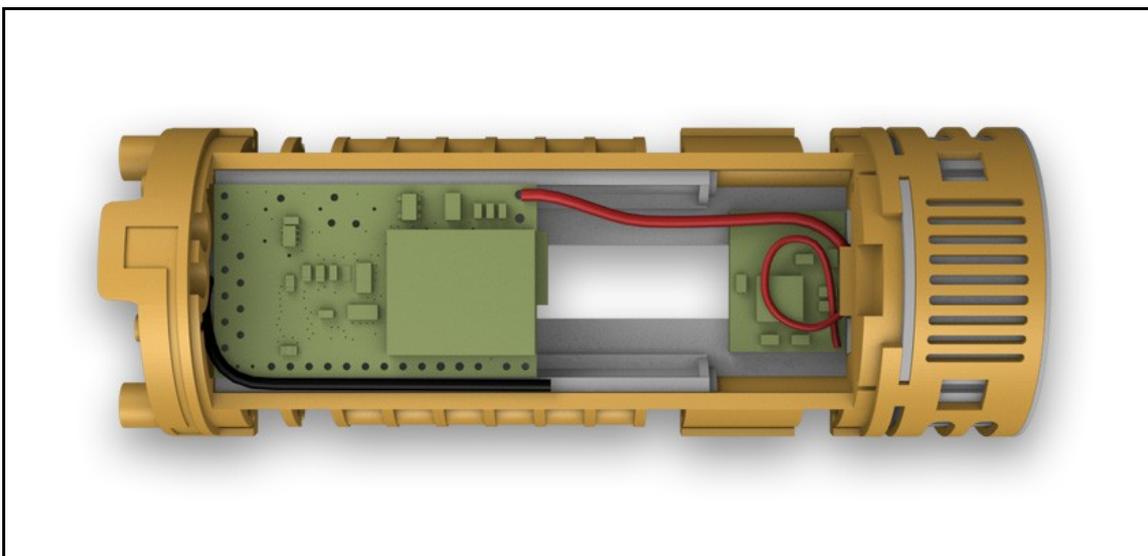


Attach the Soundboard.

The soundboard is clamped into the soundboard-holder. In addition, a double-sided adhesive tape should be attached under the soundboard.

Battery contact wire positions

This picture shows the position for the **Soundboard**, **charge-PCB** and the **wires** from both battery contacts.



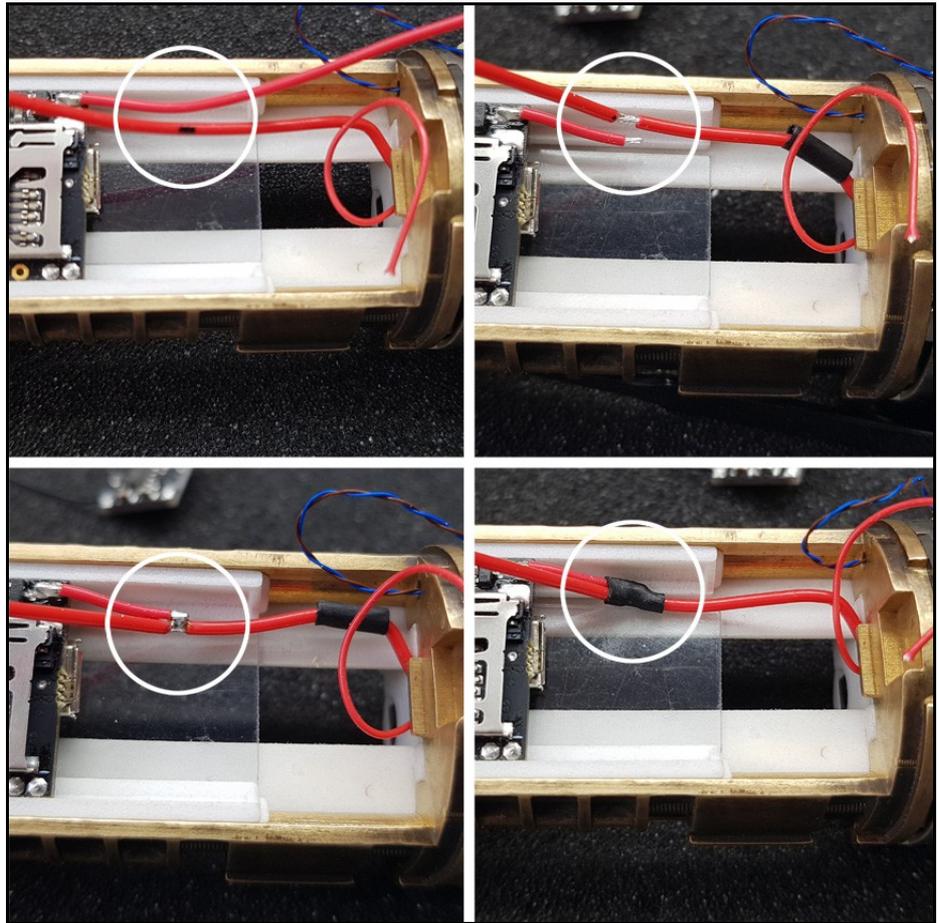
Soundboard - Blade power junction

The **NeoPixel blade** will be powered directly from battery +.

So, the wire from battery needs a junction as shown in the pictures.

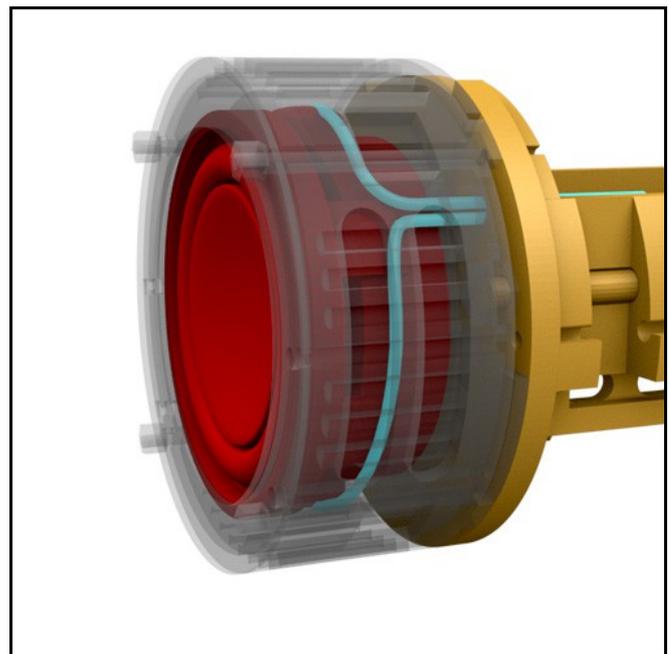
Other option:

Most Soundboards have two Vin(+) solder pads. One on each side. Use one for Vin(+). And the other one for the Pixel Blade power wire.



Speaker installation

1. Solder **AWG 26 wire** to a 28mm speaker.
2. Rout the wires through the hole inside the speaker chamber.
3. Push the speaker carefully into the chamber. Make sure it's rotated correctly! **Solder joints pointing up and down.** As shown in the picture.
4. Install the inner and outer speaker cover ring.



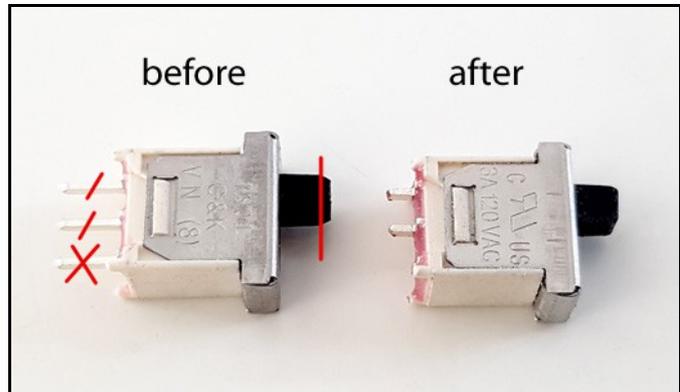
[Main Power-Switch TS01CQE](#)

Buy it at [DigiKey](#)

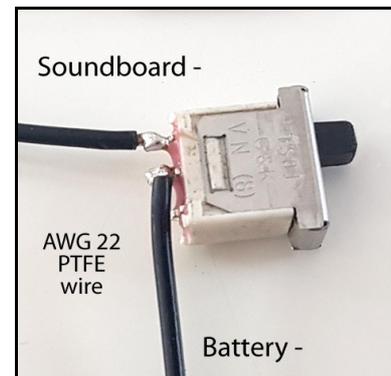
Metal Master 3.0 is designed for [TS01CQE 3A](#) switch. This switch can handle high current and is best for Pixel blade sabers.

The switch has to be modified first. As shown on the pictures.

1. Remove one pin.
2. Shorten the other two pins.
3. Shorten the slider.

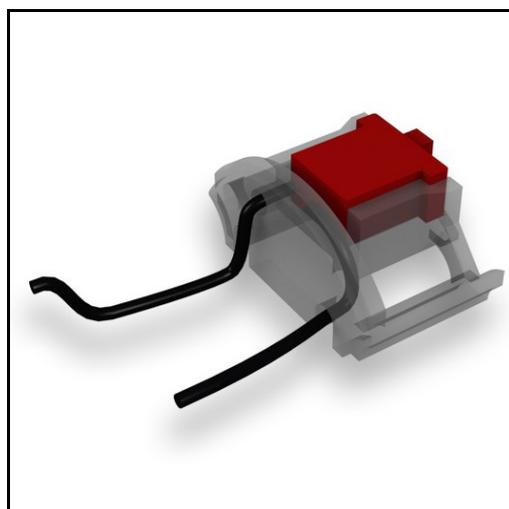


Add 5cm AWG 22 PFTP wire to the two pins as shown in the picture.



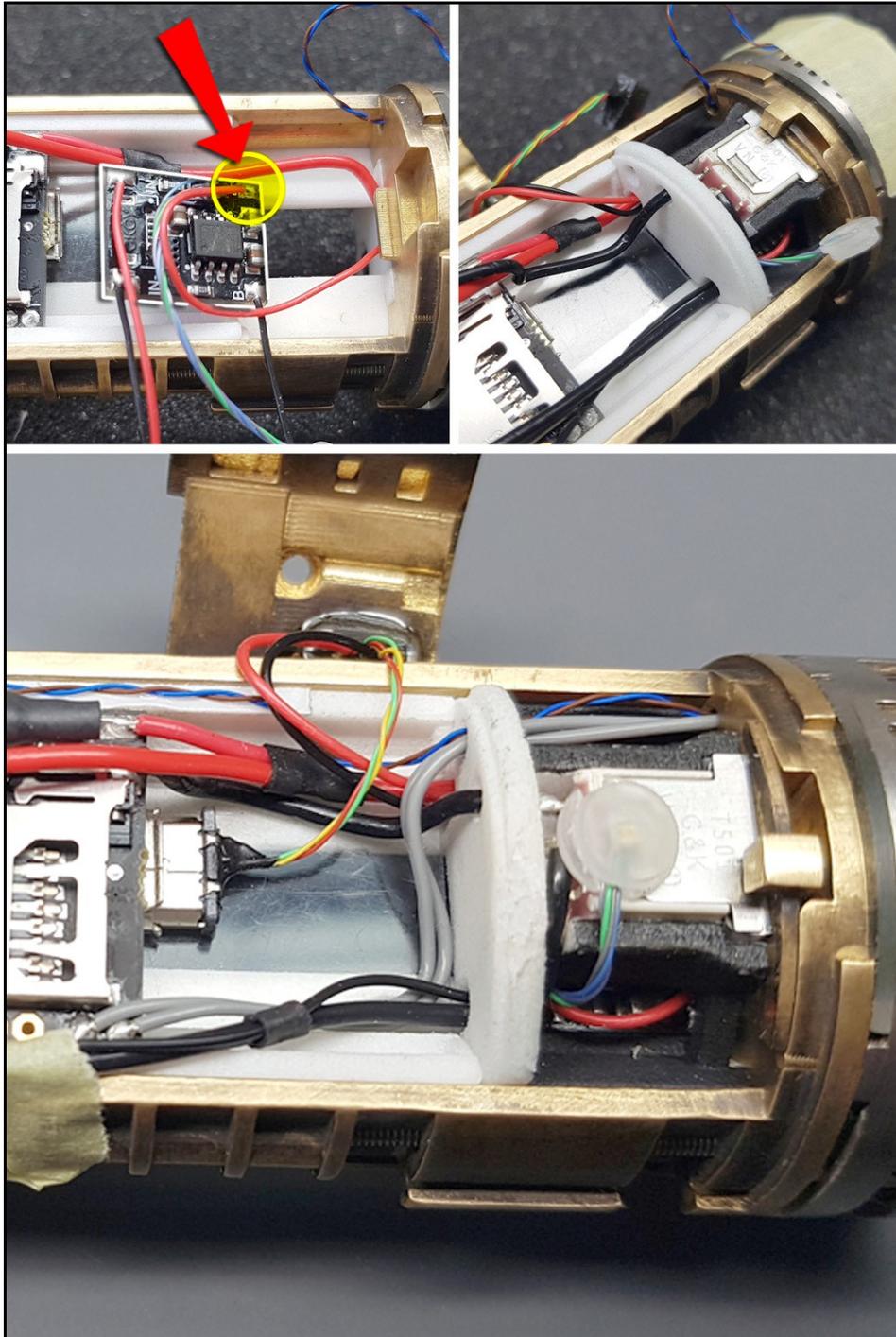
[Power-Switch holder wire routing](#)

Place the switch into the holder and rout the wires as shown in the picture. **No glue needed!**



Adding the Power-Switch and charge-PCB / USB port

1. Install the main power switch into the switch holder.
2. Solder the AWG 30 wire from battery positive to the prepared charge-PCB **B+ pad**.
3. Place the **charge PCB** in position **below the switch holder**. **No glue needed**.
4. Install the switch holder. Guide the wires as shown on the pictures.
5. Solder the wires coming from the switch to the Soundboard negative pad and to the wire which leads to the battery negative.
6. Solder the **speaker wires** (gray) to the Soundboard. Rout the wires as shown in the picture.
7. Place the **charge indicator LED** above the main power switch



Plasma Gate 2.0

The **plasma gate** is only available for **mb-Sabers' EMITTER Blade holder**.

Additional parts for the plasma gate 2.0

- 35mm poly-carbonate tube with 10mm outer diameter
- 3x 35mm aluminum, steel or brass tubes with 3mm outer diameter
- plastic wrap / clingfilm
- 3mm LED, 5mm LED or pixel LED / Pixel ring
- LED holder / Pixel ring holder

The **Part01 Plasma Gate 2.0** part has **supporting sprues**. These sprues have to be removed (picture on the right)!

The cast metal version does not have supporting sprues!

After removing the sprues, the **deluxe details** (tube holder) can **be installed**. Glue them into position.

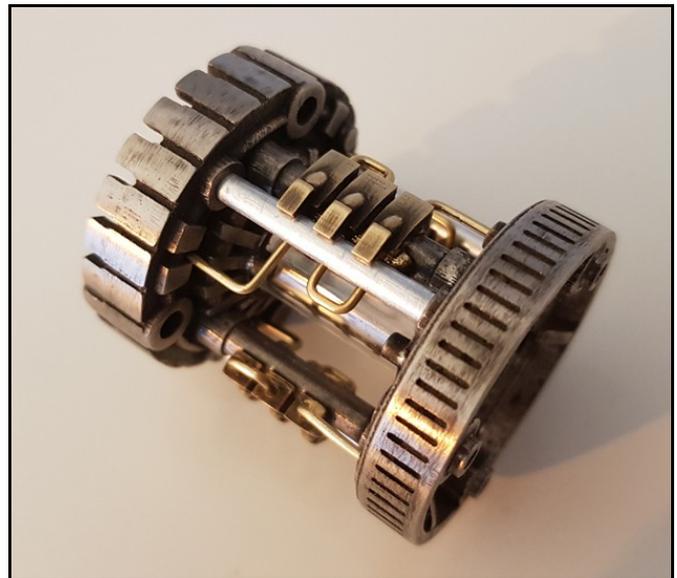
Also remove the sprues from the three Plasma Gate **tech-details** and put them in position.

After that install the **three 3mm wire guide tubes**. Glue them into position.



Additional brass wire details

The final step is to add metal wires as shown in the picture. There are holes in the **tech-details** part and the plasma gate main part. These holes can be used to install the **metal wires**. There is no general way to add them. The picture shows an example.



Spinning Plasma Gate (Part 01 SPG)

The **Spinning Plasma Gate (SPG)** is only available for **mb-Sabers' EMITTER Blade holder**. It is compatible with all mb-Sabers Graflex chassis. Old Part01 versions can easily be replaced. It includes a spinning object called the "magnet".

Required additional parts for the SPG

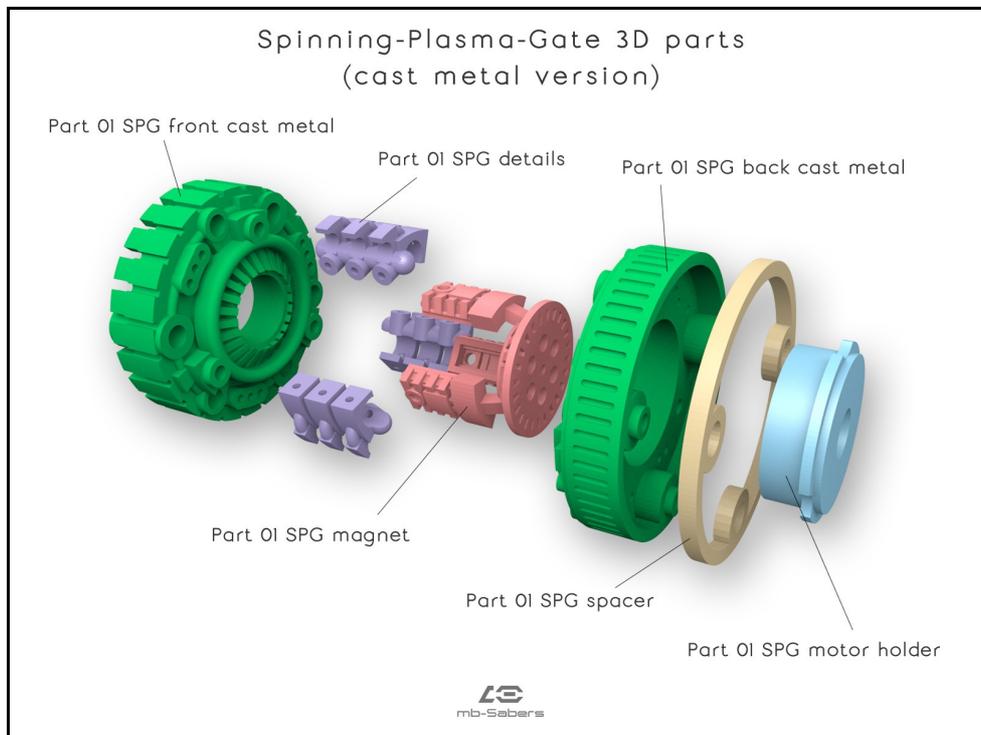
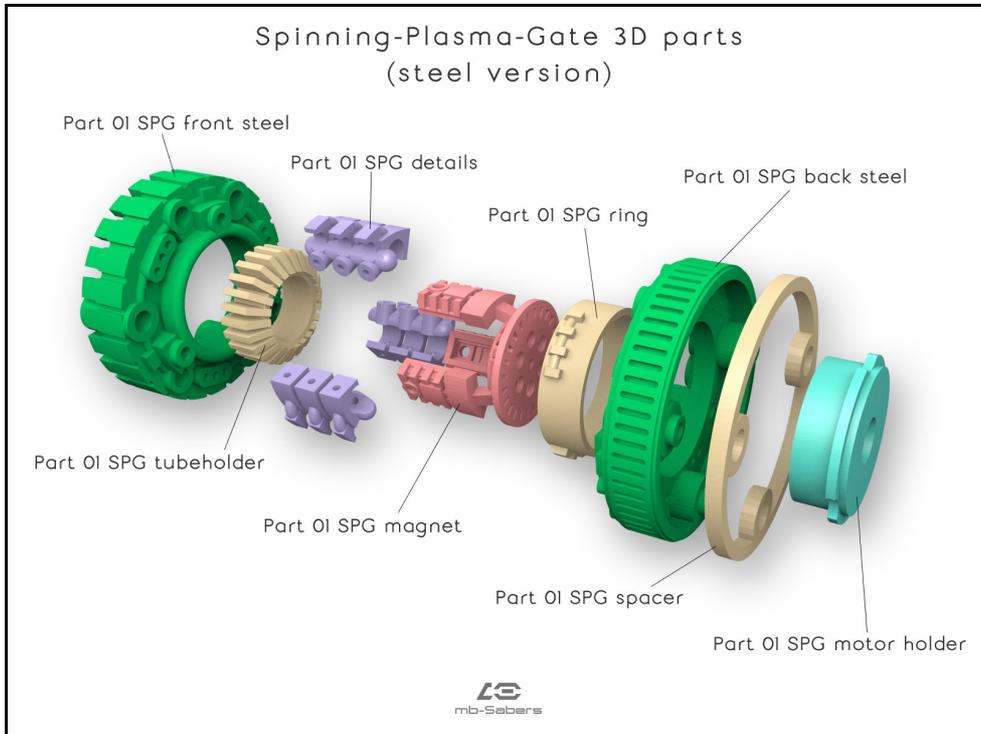
- 35mm **poly-carbonate tube** with 10mm outer and 7mm inner diameter
- 3x 35mm **steel tubes** with 3mm outer diameter and thin wall [Link to shop](#)
- 3x 15mm **brass tubes** with 4mm outer and 2mm inner diameter [Link to shop](#)
- 3x 40mm steel **threaded rods** M2 [Link to shop](#)
- 2x **bearing** (dimensions are listed in the description below) [Link to shop](#) [Link to shop](#)
- 12x M2 **model-nuts (steel)** [Link to shop](#)
- **plastic wrap** / clingfilm
- 3mm **LED**, 5mm LED or pixel LED [Link to shop](#)
- LED holder [Link to shop](#)
- electronic **motor with gear installed (200 rpm) 6mm diameter!** [Link to shop](#)



3D printed steel or cast metal material

The **Spinning Plasma Gate (SPG)** is available as **steel or cast/precious metal version**.
The steel version has two more 3D printed parts!
On the pictures below are all 3D printed parts listed for both variations.

I recommend testing and adjusting the fit of all parts first, before final installation



Steel part preparation

The **steel version parts have sprues** to avoid deformation.

These sprues **must be removed**. Use a rotating tool or a diamond saw.

Also important is to sand down the **surface and holes (!)** of all steel parts!



Tube-holder and SPG ring

The **steel version has two more parts**: The **tube holder** and the **SPG ring** (pictures below).

The insides of the holes provided must be sanded until the parts (tube-holder and ring) fit in.

The parts of the cast metal version have these design elements already integrated!

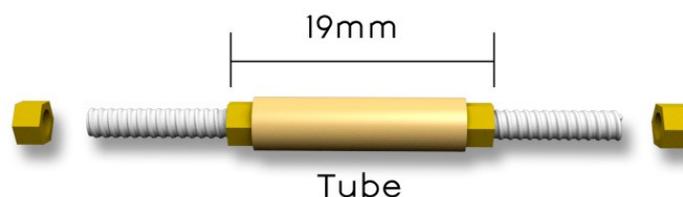


Threaded rod setup (very important step)

Part01-front and **Part01-back** are connected by three threaded **M2** steel rods.

Each rod gets a metal tube as spacer (4mm outside/2mm inside). These tubes **MUST** have the same **exact length (+/- 0.05mm)** AND both ends have to be **parallel**. Otherwise the whole construction does not work. A lathe is best for exact cutting the tubes. Together with **two M2 nuts**, holding the tube in position, the length should be around 19mm (+/- 0.5mm). **These additional nuts are absolutely necessary!**

After all three rods are prepared attach them to **Part01 SPG back**. Add a washer and a nut to each and fasten the nuts.



Tech-details

Remove the sprues from the **Part01 SPG tech-details**.

Put all three tech-details loose over the already attached spacer/steel rods.

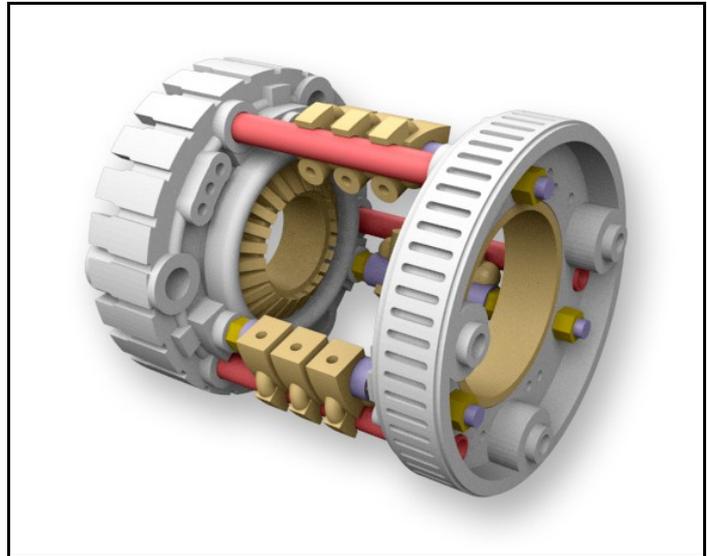
Electric wire guide tubes

- Add three **thin walled steel tubes** (3mm diameter) to **Part01 SPG back**.

Make sure the ends are smooth without sharp edges. Otherwise electric wires could get damaged!

Attach them with **screw-lock medium** to hold them in position.

- Add **Part01 SPG front** to the Plasma Gate. Add washers and nuts. Fasten the nuts. The **Plasma Gate should now look like that:**



Motor-holder

The motor-holder holds the small electric motor in position.

It also houses one of the two bearings. **This bearing is not absolutely necessary.** The SPG works also without it. **All parts will be assembled without glue!**

It is important to (carefully) sand off the grain on the printed Motor-holder surface!

Check the fitting of the motor and the motor-holder itself. **The motor should slip in with medium pressure as well as the holder. But do not make both parts fit loose!**

Magnet and motor installation

Use a small 6mm diameter electric motor with attached gear.

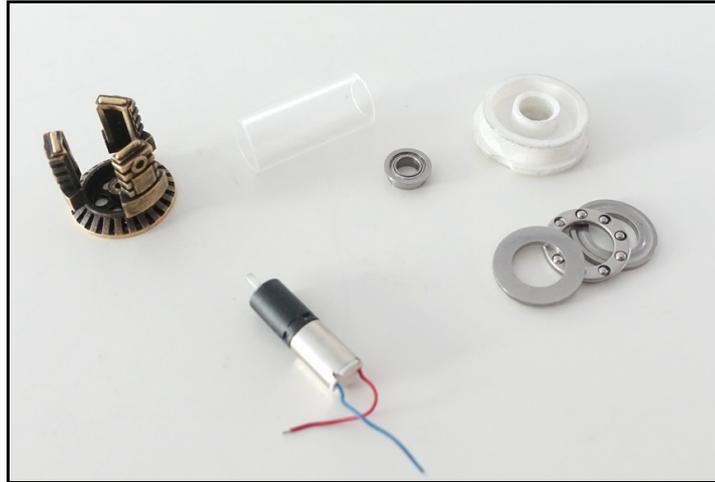
Depending on the manufacturer, the motors have different shaft diameter. Some have 2mm others have 1.5mm or less.

The spinning “Magnet” has a 1mm hole. **Adjust the hole size to the shaft size.**

The shaft should slip in with medium pressure. But do not make it fit loose! The shaft will not be glued into the “magnet”!

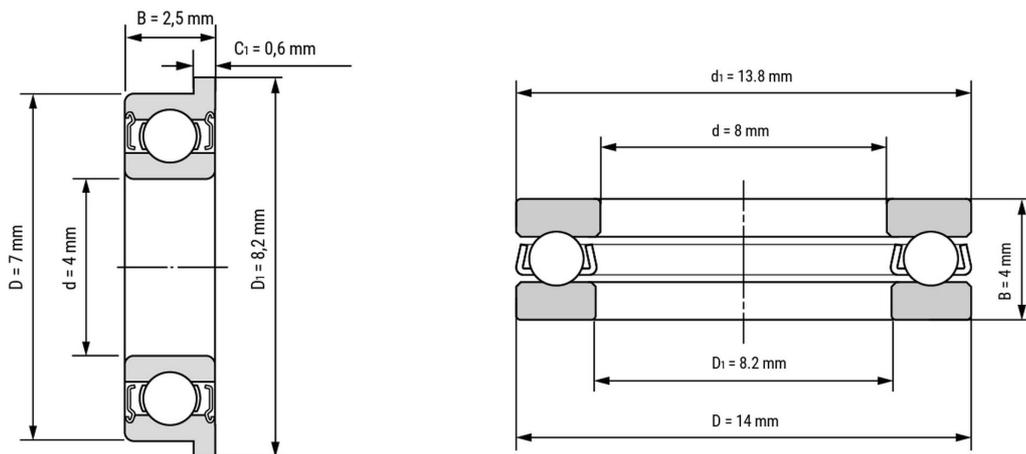
If the shaft fits loose, use small round pliers to press the Nylon-shaft slightly flat. This makes the shaft fit tighter.

Motor section parts



Bearings

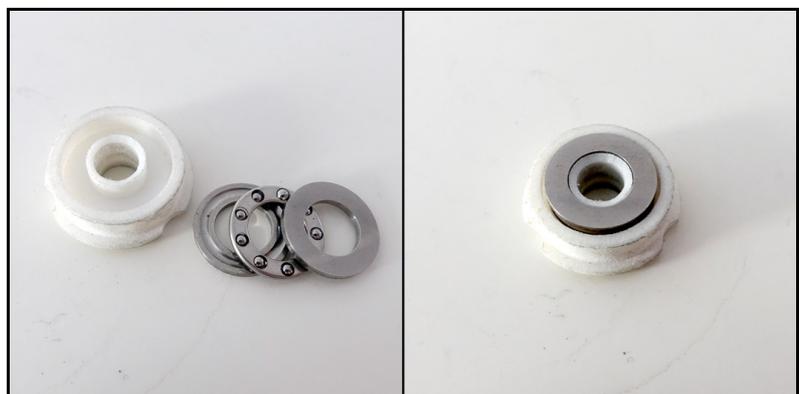
These are the two bearings for the SPG.



Assembling the motor section

1. Place the first bearing into the motor-holder.

Important: The motor-guide in the middle of the motor-holder must not protrude beyond the ball bearing! Cut it a little until it is slightly lower the bearing level (picture).



2. Push the “magnet” onto the motor shaft.
It should now look like this...

The motor wires can be protected by shrinking foil and liquid rubber.

Push the holder (with installed motor and “magnet”) into **Part01 SPG back.**



Install the poly-carbonate tube

The poly-carbonate tube is a very important part for the spinning function.
The tube holds one of the bearings (bearing 1).

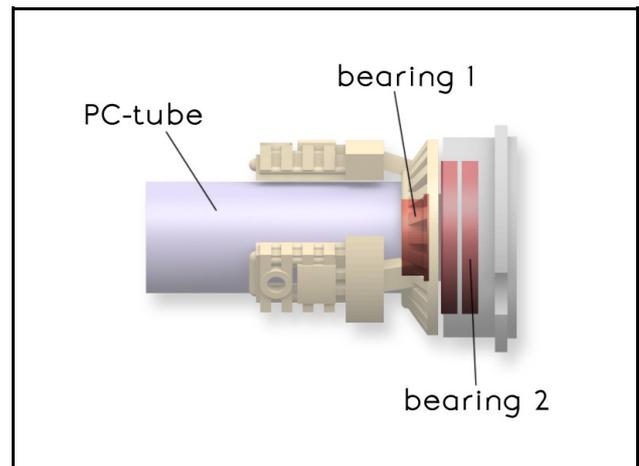
The tube needs a planar and smooth right-angled end to make sure the rotation axis is straight!

Install the bearing 1 and push the PC-tube through the tube-holder down to the bearing1.

Check the length of the tube and make adjustments if necessary.

The tube should touch the bearing without pressure!

Run the motor and make a test. When everything works and fits nicely, **remove motor-holder and PC-tube again (push out the motor-holder by pushing the PC-tube in motor direction).**



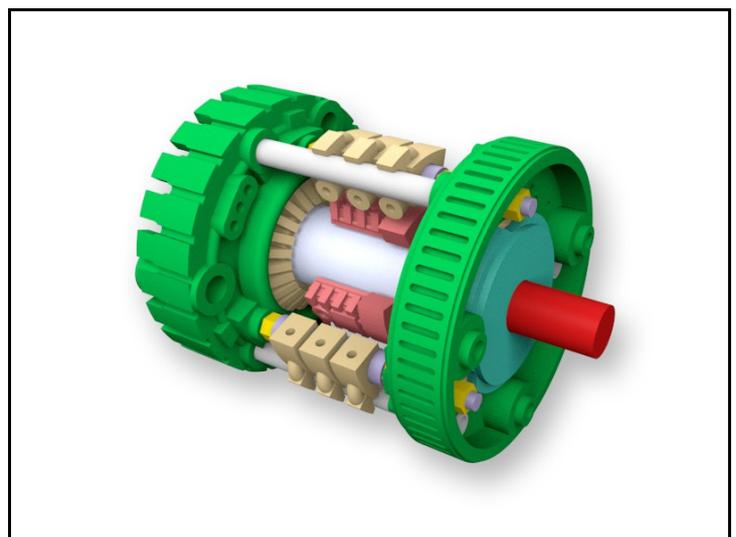
Attach PC-tube and motor

Install the motor-holder again and use 1-2 Epoxy drops to just fix the position.
Add some flexible glue to the PC-tube and push it into the tube holder down to the bearing1.

Again... **The tube should touch the bearing without pressure!**

Run the motor for a moment and let everything dry well!

Now the SPG should look like this...



Connecting SPG to Part02

To connect the SPG to Part02 a “**spacer-ring**” between Part01 and part02 is necessary. Otherwise the motor would not fit into the chassis. The spacer is called **Part01 SPG spacer**.

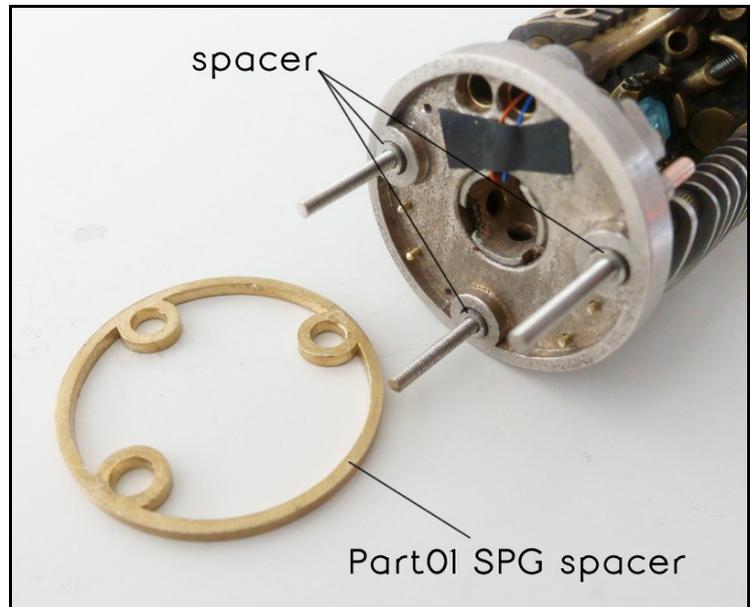
I recommend testing and adjusting the fit of all parts first, before all other work-steps.

For all following work-steps the crystal chamber must be completely attached!
Now each **main threaded chassis rods** get a **spacer**.

I recommend to use threaded spacer (rounded nuts). But this is not absolutely necessary!

It is just easier to attach the **spinning plasma gate** when the Part02 and the crystal chamber is safe attached to the main chassis.

These three spacer are also holding the **Part01 SPG spacer** (between **Part01 SPG** and **Part02**) in position.



Spacer size: 2.8mm diameter / 2.75mm height

Part02 spacer

The easiest way to get the right spacer is to use **three washer and one M2 nut** for each threaded rod.

Reduce the diameter of the washers and the nuts to make them fit into the deepenings.

1. Attach a M2 threaded rod (3cm length) to a rotating tool (Dremel).
2. Attach the washers and the nuts to the rod.
3. Turn on the rotating tool and hold the attached rotating washers and nuts against a file or sandpaper to **reduce the diameter to max 2.8mm**.



Plasma Gate accent 3mm/5mm LED

Prepare the **LED holder (example) for the PC-tube**. Cut down the LED holder. Glue it into the installed PC-tube.

(This is just a suggested solution. Actually you can do what you like. It is also possible to stick the LED into the tube... or more than one LED in row... or one from each side. It's up to you. Also the LED holder can be something different)



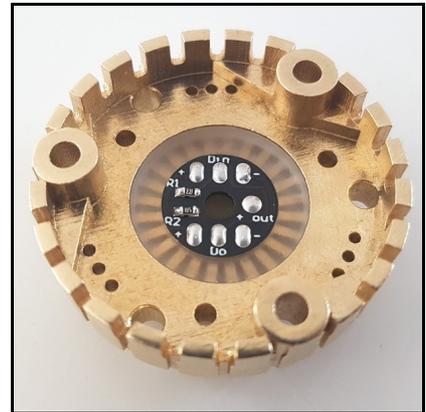
Plasma gate NeoPixel ring

The mb-sabers **NeoPixel ring** is specially designed to illuminate the plasma tube with 6 Pixel. It is very small. 11.7mm diameter. The **Pixel ring holder** is 3D printed.

Parts:

Pixel Ring shop: [LINK](#)

Pixel Ring holder shop: [LINK](#)



R1: 0603 resistor pad for data (usually 330 Ohm)

R2: 0603 resistor pad for + out

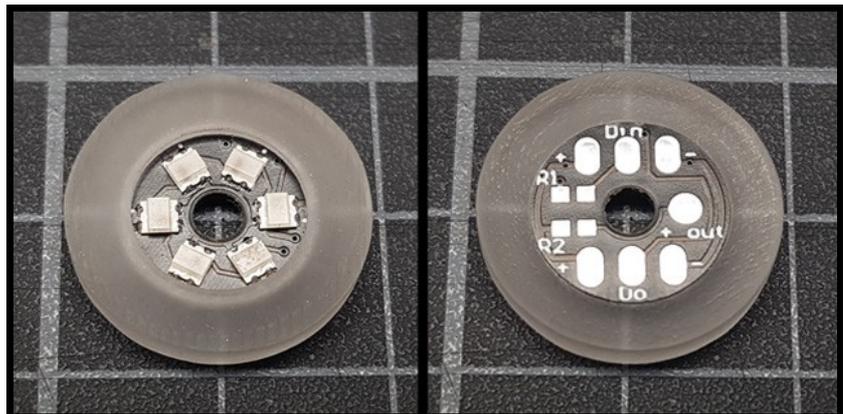
Din: Data in (AWG 32)

Do: Data out (AWG 32)

+: Vcc (AWG 26)

-: GND (AWG 26)

+ out: This pad is for additional electronics like extra LEDs or a motor which are placed inside the plasma tube. The **+ wire** can then be routed through the PCB hole into the tube. This pad also has an own resistor pad **R2**!

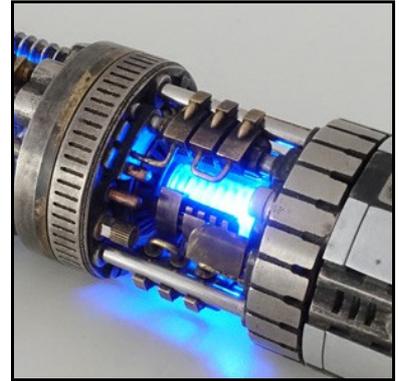


IMPORTANT!: Don't use it in series with the blade Pixel strip. The Pixel ring cannot handle much current!

Plasma gate tube

Next step is to fill the poly-carbonate tube with something to **scatter the light**. I would use some **plastic wrap**. But it is up to you. There are a lot solutions.

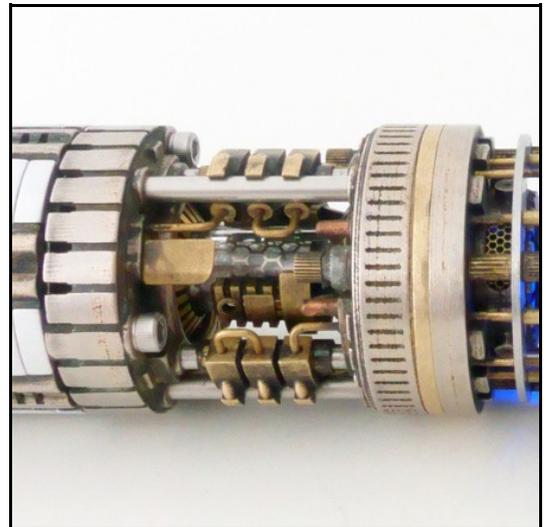
Do some light tests. If there is too much plastic wrap inside, the light will not shine through. You have to find the right setup.



Additional metal wire details

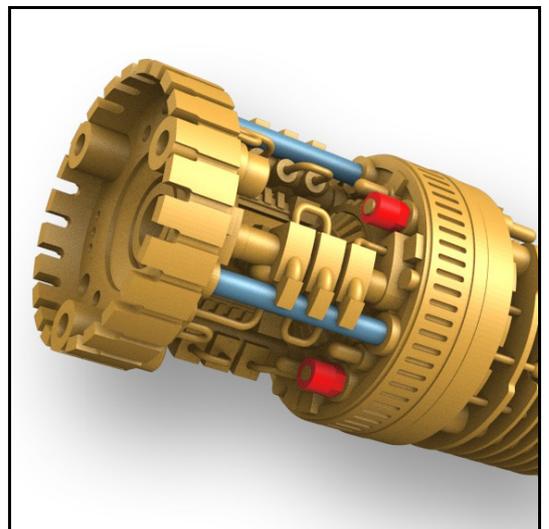
The final step is to add metal wires like shown on the picture below. There are holes in the **tech-details** part and the plasma-gate main part. These holes can be used to install the **metal wires**. There is no general way to add them. The picture shows an example.

IMPORTANT: First add the 3 Blade-holder 4/40 UNC mounting screws before adding the metal wires. There will be not enough space to add them later



Attaching the Plasma Gate (Part01) to the chassis (Part02)

1. Pull/push all wires through the **wire tubes (blue)** from Part01 to the front.
2. Push Part01 over the threaded rods and attach **M2 nuts (red)** to the rods. Use washer underneath the nuts. If you use the Plasma Gate **assembly kit**, add the three **threaded spacer (red)** to the end of the three main rods.



Blade holder - Emitter

Backplate

Two different **backplates** can be used. The thin one for NeoPixel setup and the thick version for high brightness LED setup. **The thick back plate works as heat sink.**

Blade stop

Two different blade stop rings can be used. A 3D printed nylon version. Or an aluminum version.
The high brightness LED setup works only with the aluminum blade stop!

The nylon version has a guiding groove and **slots for five accent NeoPixel LED**. They can illuminate the five Emitter vents.



High brightness LED setup

Mount the HB-LED directly onto the **thick backplate**. Lead the LED wires through the backplate hole.

IMPORTANT: Only use the aluminum blade stop ring with HB-LED. The nylon blade stop would melt!



NeoPixel setup

1. Prepare the NeoPixel connector PCB (hilt).

IMPORTANT: Only use NeoPixel connectors with low profile Pogo pins! I recommend to use the high quality PCBs from ShtokCustomWorx [Shop LINK](#)

2. **Tap the three holes** in the thin back plate. Use a M1.4 tap.
3. Install the **connector holder** onto the thin Back plate. Use three M1.4 screws.
4. Install the wired NeoPixel connector into the connector holder.



Switch PCBs

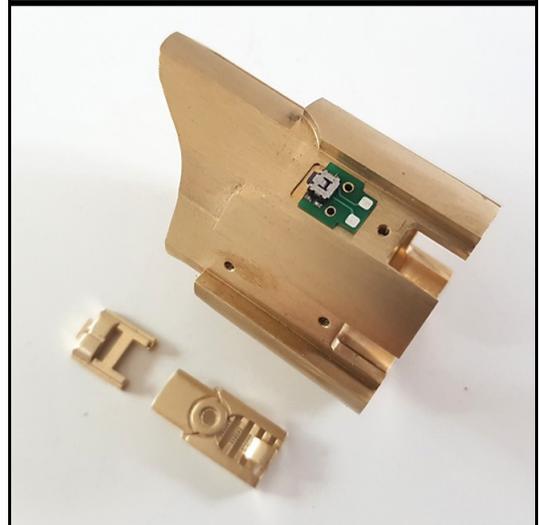
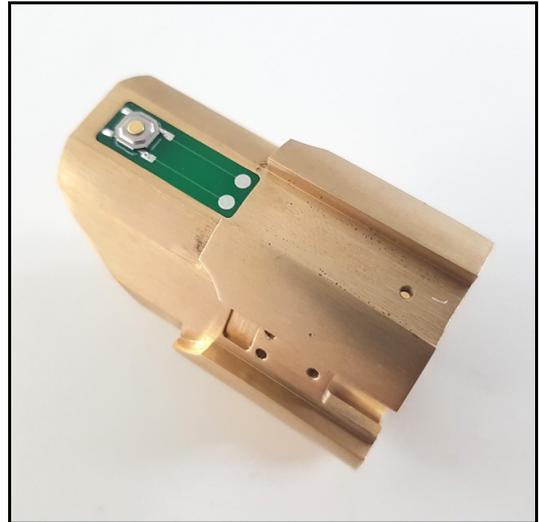
1. Solder the smd switches onto the two PCBs. Add **AWG 34 wires** later when the Emitter is done.

2. **Adjust the PCB thickness.** Sand down the PCB bottom a bit till the switch covers fit and work perfectly. Especially the **ACT switch PCB** should be reduced in height. So that there is more distance between the switch and the switch cover. Otherwise the switch could respond too easily.

3. **Install two 1.5mm brass rods** into the AUX switch **PCB mounting holes.** Adjust the height. They should line up with the switch PCB surface.

4. Place both PCBs into their position. **No glue needed!**

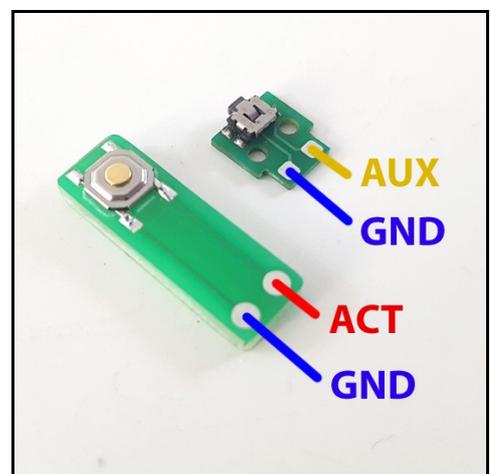
5. Mount the switch cover A and C over the switches and **test the function.** Does it work smoothly? Especially the AUX switch cover needs attention. It should move nice and easy. If not, more sanding is needed.



Switch wiring

Solder AWG 34 wires to the pads. Both GND wires can be combined!

TIP: Use a small (1mm grid) connector for the switch wires to connect with the wires coming from the chassis.



Emitter Add-On Parts variations

IMPORTANT: Depending on which back plate will be used (thick or thin) the appropriate Add-On parts must be used.

Add-On parts long for the thick plate

Add-On parts short for the thin plate

Activation switch “frame” (Emitter add-on B) installation

The ACT switch cover is framed by **Emitter Add-On B** which has to be installed first!
Take your time to get the parts in the perfect position.

1. Install the Emitter Add-On A (ACT switch cover) with a M1.6 screw.

2. Separate the switch frame parts (Add-On B) and place them into position.

3. Check the fit. Maybe some adjustment is required.

4. Temporarily replace Add-On A with a 10mm x 10mm square wooden stick. This is the best way to make sure the parts line up perfectly.

5. Clean the surface where the two frame parts will be placed and roughen it a bit.

6. Glue both parts in position.

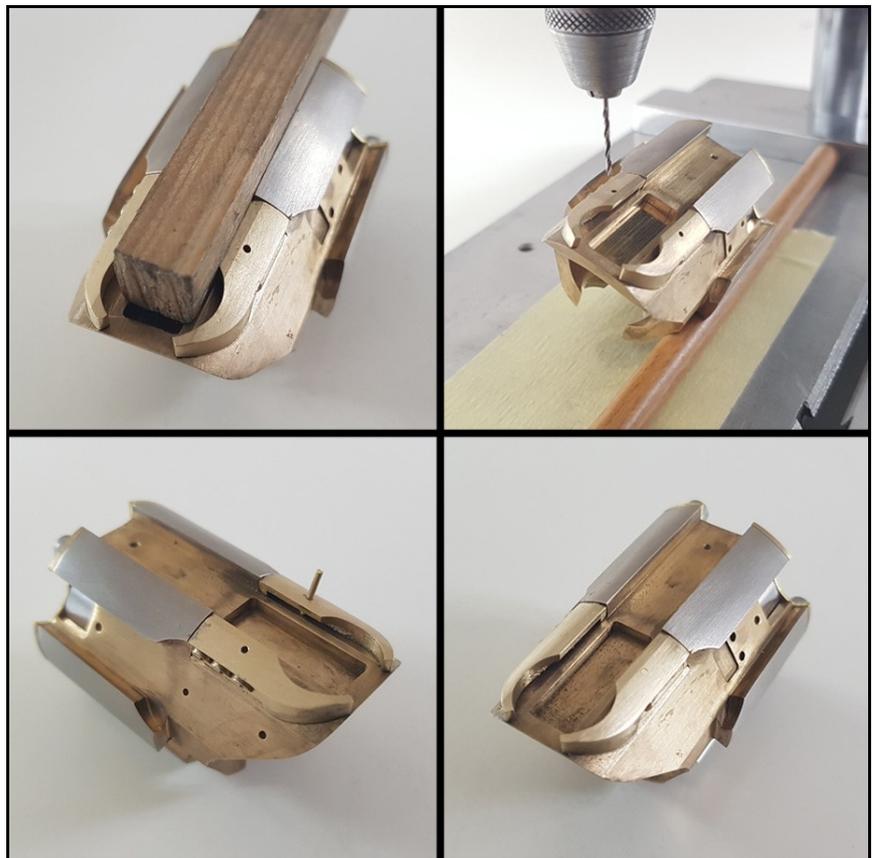
Use Loctite 648!

7. After the glue dried the mounting holes can be drilled.

Use a drill-stand to get a perfect result. Align the Emitter to the drill head so that the mounting holes in the frame parts can be continued into the Emitter body. Stick a short 1mm rod into the mounting holes temporarily for easy alignment!

9. Install 1mm rods into the mounting holes and add **Loctite 648.**

10. Cut the rod to length and sand the surface smooth.



Emitter Glass-Eye adapter

1. Push the Glass-Eye adapter into position.
2. Mount it with two **M1.6 cylinder head screws**.

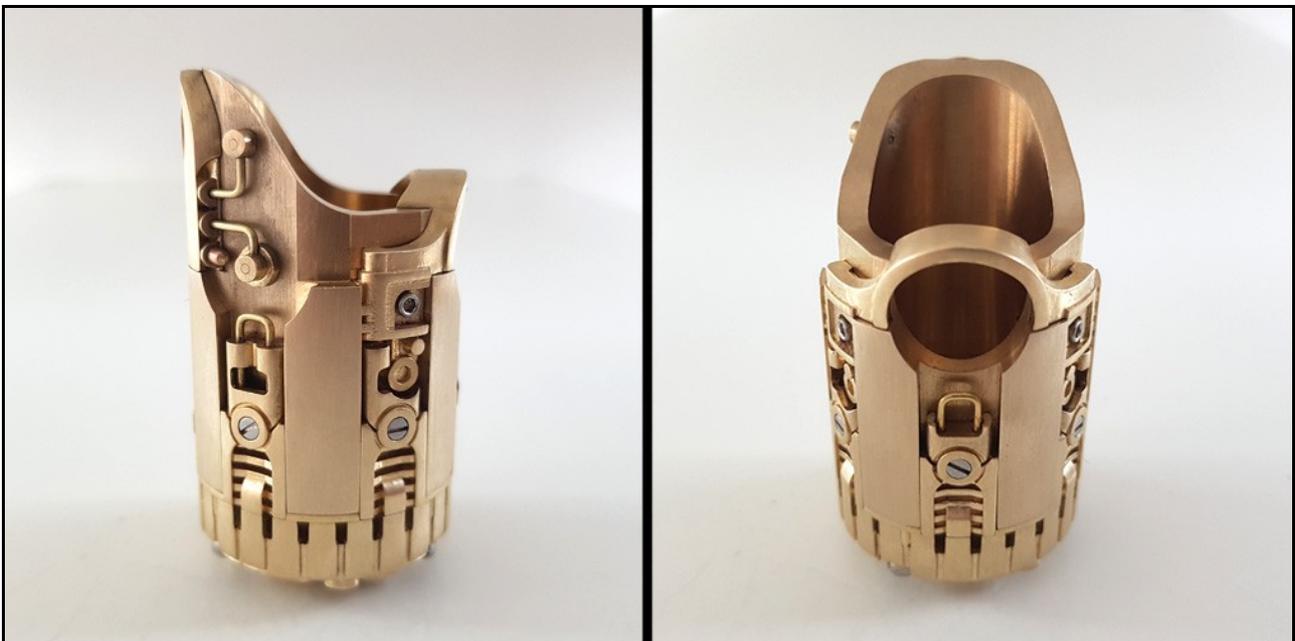
Emitter Add-On D

1. Separate all Add-On D parts and check for fit.
2. Add brass wire details and Install each part with a **M1.6 countersunk screw**.

Emitter Add-On E

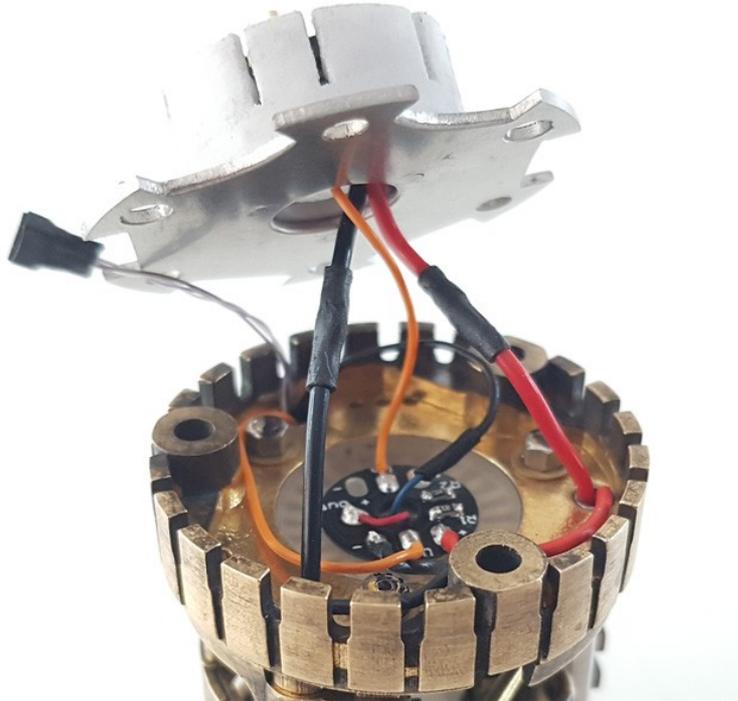
1. Separate both Add-On E parts.
- Tip: Insert two long 1mm rods into each piece first. So that they don't get lost.**
2. Glue two short (2cm) 1mm Brass rods into the designated mounting holes on the Emitter.
Use Loctite 648
3. Put the printed parts **loos** onto the installed rods.
4. Attach the brass wire details.
5. Adjust the position. When everything looks good add **Loctite 648**

The Emitter now should look like this:



Emitter installation

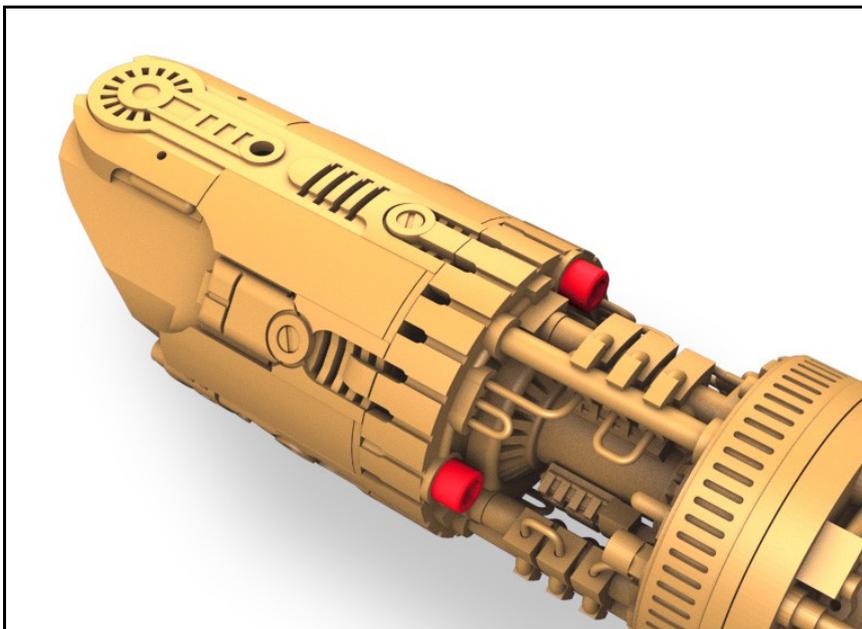
1. Connect all wires coming from the chassis to the wires from the blade holder back plate. **(High power LEDs or NeoPixel connector)**



2. Attach the back plate to the Emitter and connect the switch wires.

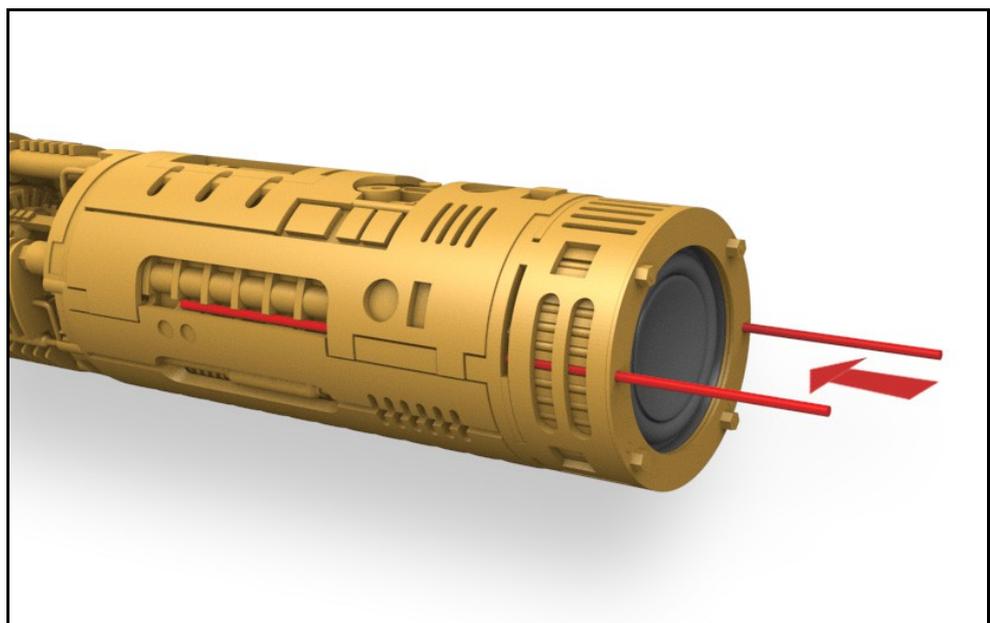
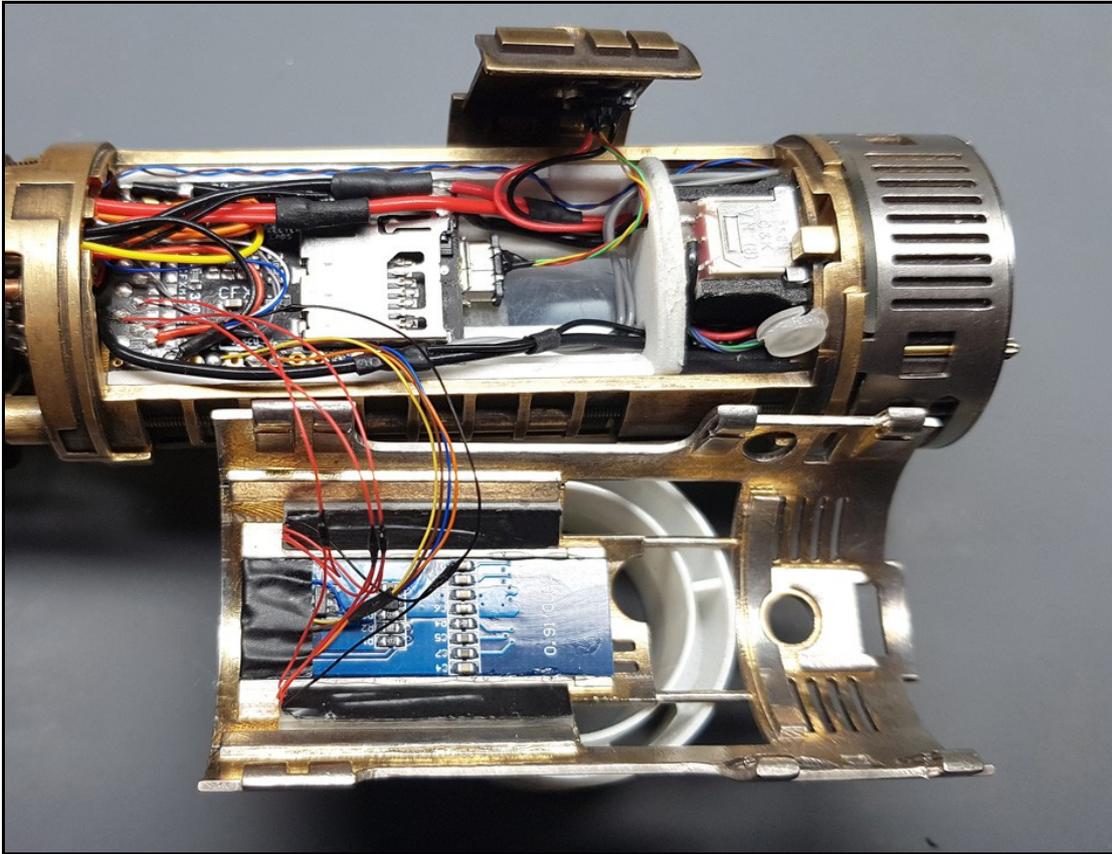
3. Install 3x 4-40 UNC 3/4" cylinder head screws into the Emitter mounting holes.

4. Screw on the Emitter. **No screw lock needed!**



Installing the top cover Part 06

1. Solder the wires coming from the top cover to the soundboard.
2. Place the tech-details loose onto Part 05.
3. Place the Metal Master Part 06 onto Part 05. Make sure the indicator LED is aligned.
4. Install two 1mm diameter rods from the back.



Installing the Battery

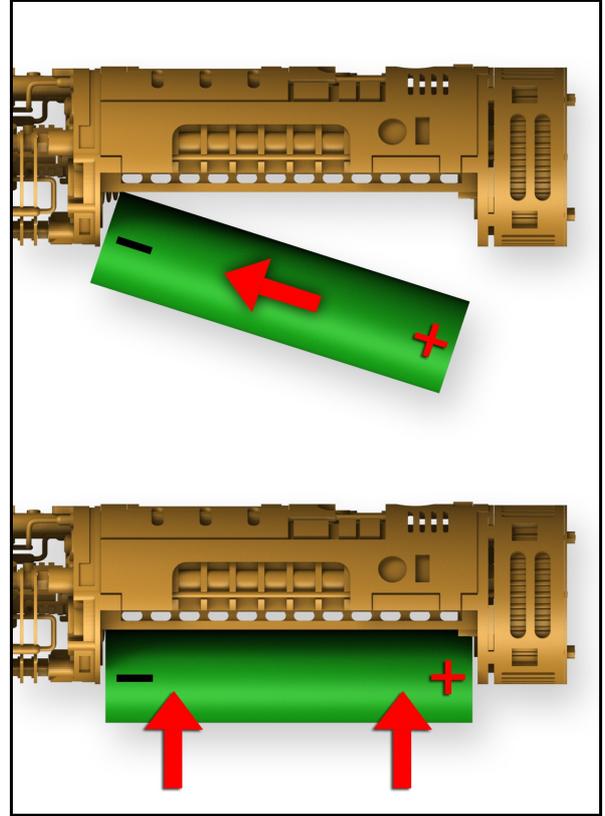
Battery installation

IMPORTANT: Don't mix up the poles!

1. Push the spring-contact with the **edge** of the Battery-end (negative pole) into the spring housing. **Do not try to push with the center of the Battery-end. It would not work that way.**

Then tilt the other end with the positive pole.

2. When the battery is horizontal, push it in to the final position.



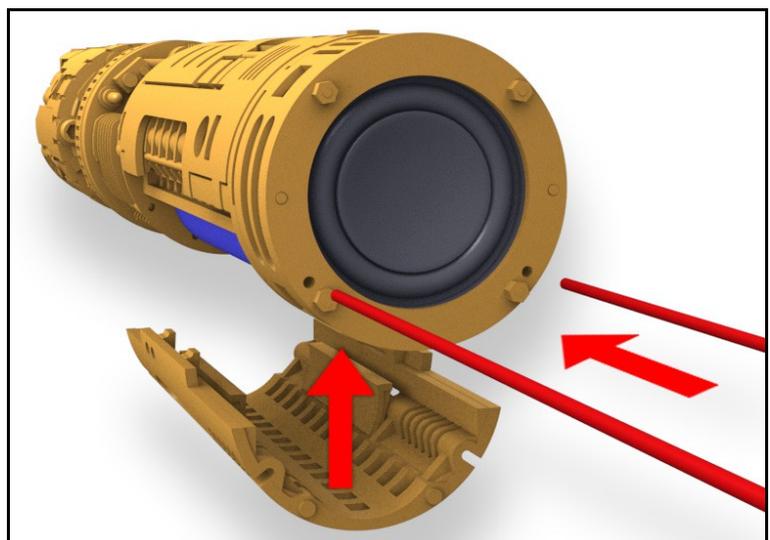
Installing the Battery cover Part 07

Place the **battery cover Part07** over the battery and install the two steel rods. Make sure the rods have the correct length.

For removing the battery you have to remove the two rods again.

Push the rods out. Use pliers. Then pull them from the back.

Remove the cover.



**If you have any questions, feel free to contact me:
info@mb-Sabers.com**