
OE8HSR rotor - Manual

3D-Printed Antenna Rotor for small
Antennas.



OE8HSR

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Disclaimer

If you are reading this Manual you are one of the first People that want to rebuild my AntennaRotor. This means that you know and understand that the Rotor is in Beta Status and is not guaranteed to work as imagined.

Please keep in mind that Computer controlled Machines (like this Rotor) can be dangerous. Keep your fingers away from moving and rotating Parts. You might think that the small Motors used in this project cant hurt you, but be warned.

Damages on:

- * Expensive Radio Hardware
- * Expensive Antenna Hardware
- * Expensive Rotor Hardware
- * Human Bodyparts
- * Your feelings

are not the My Fault.

Always use your Brain when making DIY Stuff and avoid hurting yourself!

Please.

Since this is said we can go further to the fun parts. =)

About Me:



Hello, My name is Hans, i am from Austria and my Callsign is OE8HSR.

I have got my AmateurRadio Licence in 2014.

I wanted to build an AntennaRotor to make my life easier when working with satellites.

There are several great designs about DIY Antennarotors, but i wanted to make it myself as easy as possible. And the easiest way in my Opinion is that i let the MACHINES do the work. =)

As you might have already noticed, My English is not the best. Since English is not my native Language please excuse wrong spelled words and my bad grammar.

As this is said lets go to the part you are reading this Document.

You can contact me at any time via mail at: oe8hsr@oe8hsr.at or hm@maschinensteiner.at

You can also visit my site at: www.oe8hsr.at

The Parts:

The most parts we will need are coming from the 3D-Printer. I will provide the STL files for printing. The files are named in german but every file has a number at the beginning. So this should help working with the files when you dont speak german.

There are also some parts that are not 3D-Printable

Mechanical PartsList:

4 x FastbuildScrew M6x60

4 x Spacer M6

1 x Nut ExtraLong M10

2 x Nut ExtraLong M8

1 x ThreadedRod M8x210

1 x Ball Bearing 6000

3 x Ball Bearing 6006

1 x Ball Bearing 51114

1 x Screw M10x50

1 x Nut M10

2 x Spacer M10

1 x Capping Nut M10

2 x StepperMotors Nema17

4 x Screw M3x20

4 x Screw M3x10

8 x Spacer M3

4 x Screw M6x50

8 x Spacer M6

4 x Nut M6

1 x Screw M10x30

2 x Spacer M10 (bigger outer Diameter)

2 x Screw M2.5x10

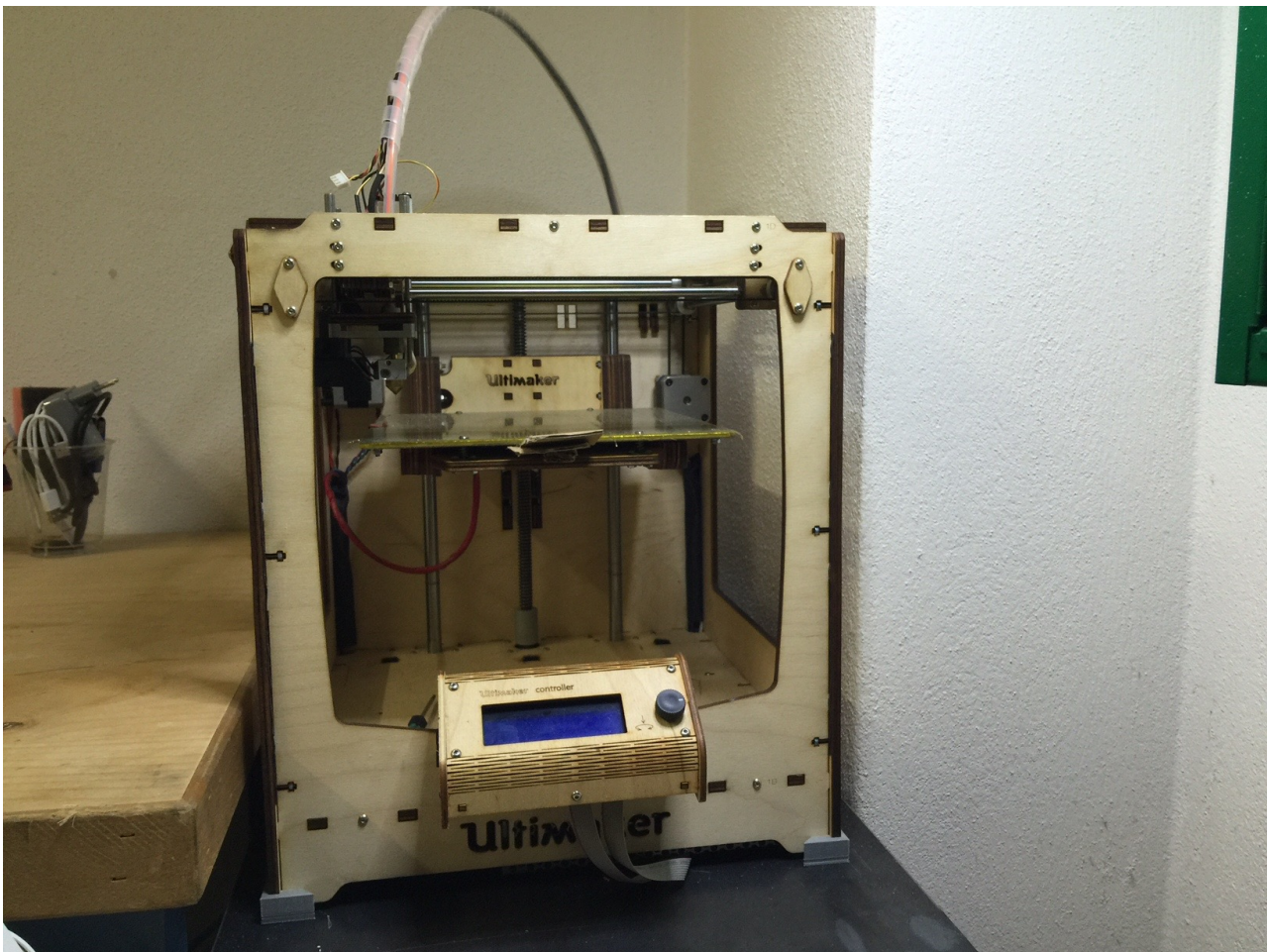
2 x Spacer M2.5

2 x Nut M2.5

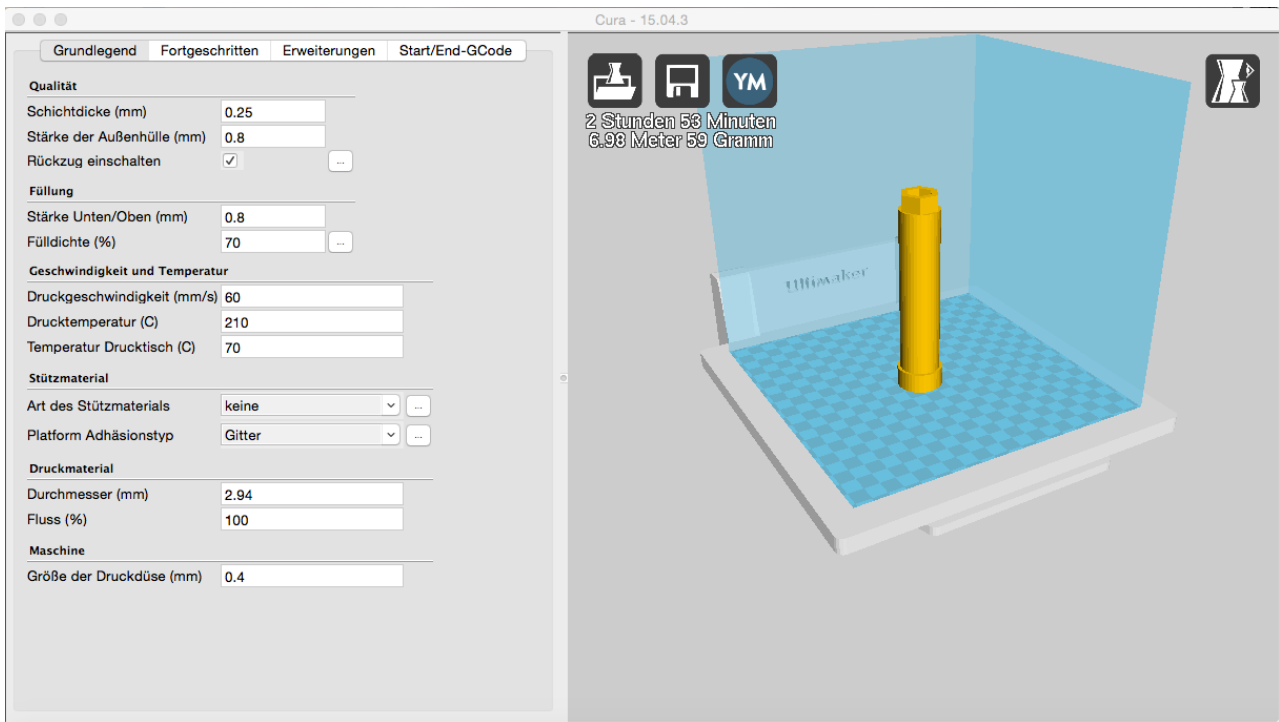
The 3D-Printing:

As i said before i am using the 3D-Printing technique because i wanted to make my Life as easy as possible. 3D-Printing is a great way to make komplex thins that work well and you dont need to search for the needed materials.

As a 3D-Printer i used the Ultimaker ONE:



The Material i am using is PLA. I use this material because it is easier to print and it doesnt shrink that much when cooling down to room temperature. You can use every 3D-Printer as long as it has at least **190 x 190 x h140mm** Build volume.



Because the prints are quite long for some parts and i have modded my Printer in some „questionable“ ways i have build a small safety feature. I habe build a small box that switches off the main Power for the Printer after the Printjob is done. That means in case something went horribly wrong and the nozzle or the bed is keeping heating up and wont stop there is at least one last feature that the Printer switches itself of after the job is finished.

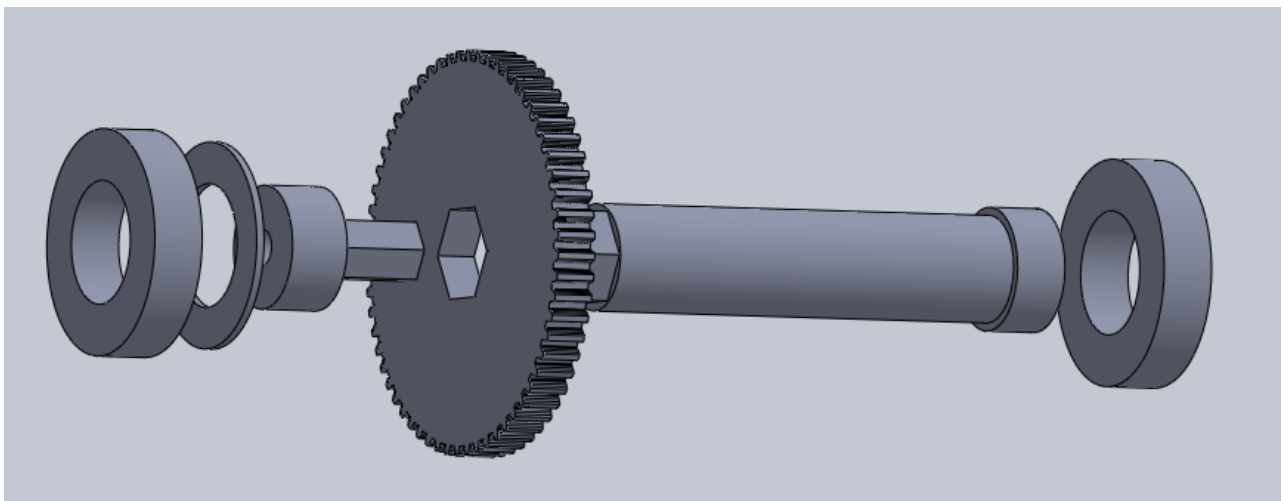
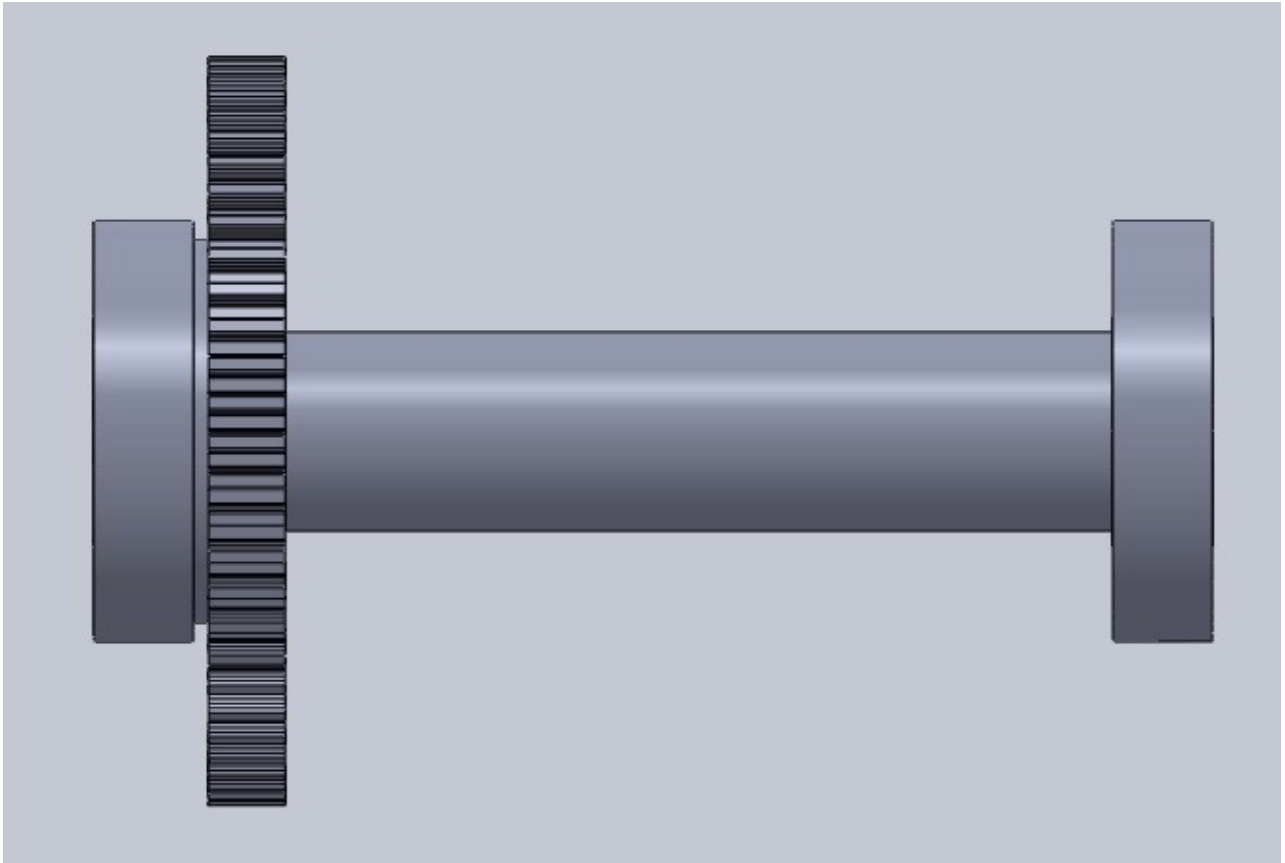


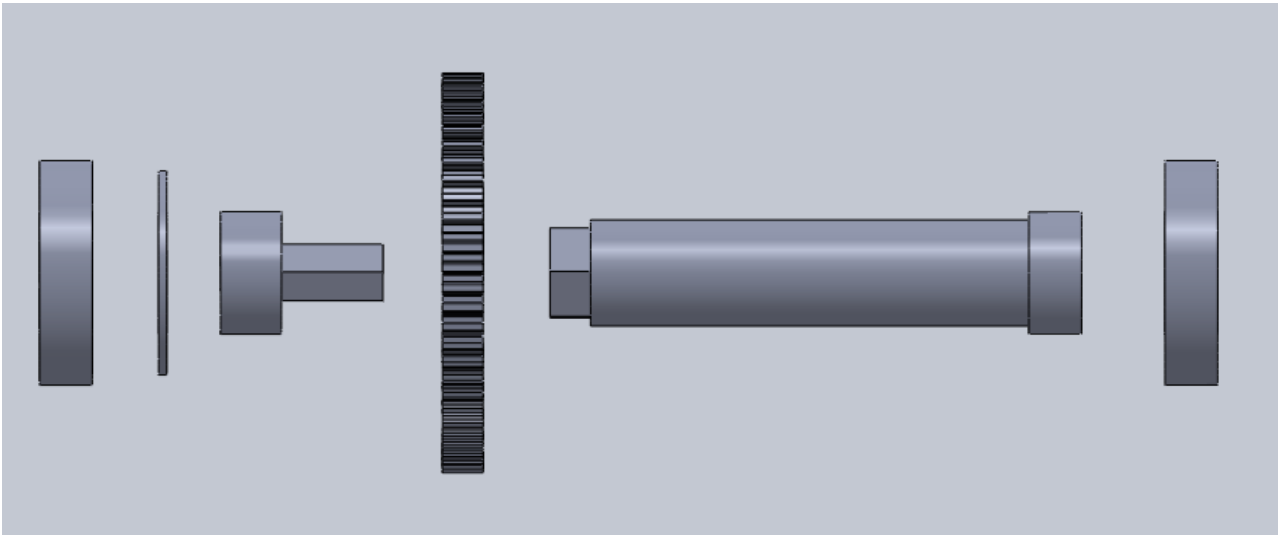
I strongly suggest that you only let your printer work when you are near the Printer!!

The most parts you will have to print in a 0.25mm layer hight and 20% filling. I will tell you when you should use other settings, when some parts have to be more strength or a better finish...

After Printing the parts make sure that they are smooth and printed right.

First Build Group - ElevationStage:





The first build group that we are going to build and print is the Elevation Stage.

You will need the following printed Parts:

1 x 9-AbtriebsWelleDistanz

1 x 1-AbtriebsWelleKurz

1 x 2-AbtriebsWelleLang

1 x 4-AbtriebsradZ60

You will also need some bought parts:

2 x Ballbearing 6006

some 5-Minute-Epoxy Glue

Putting it together:

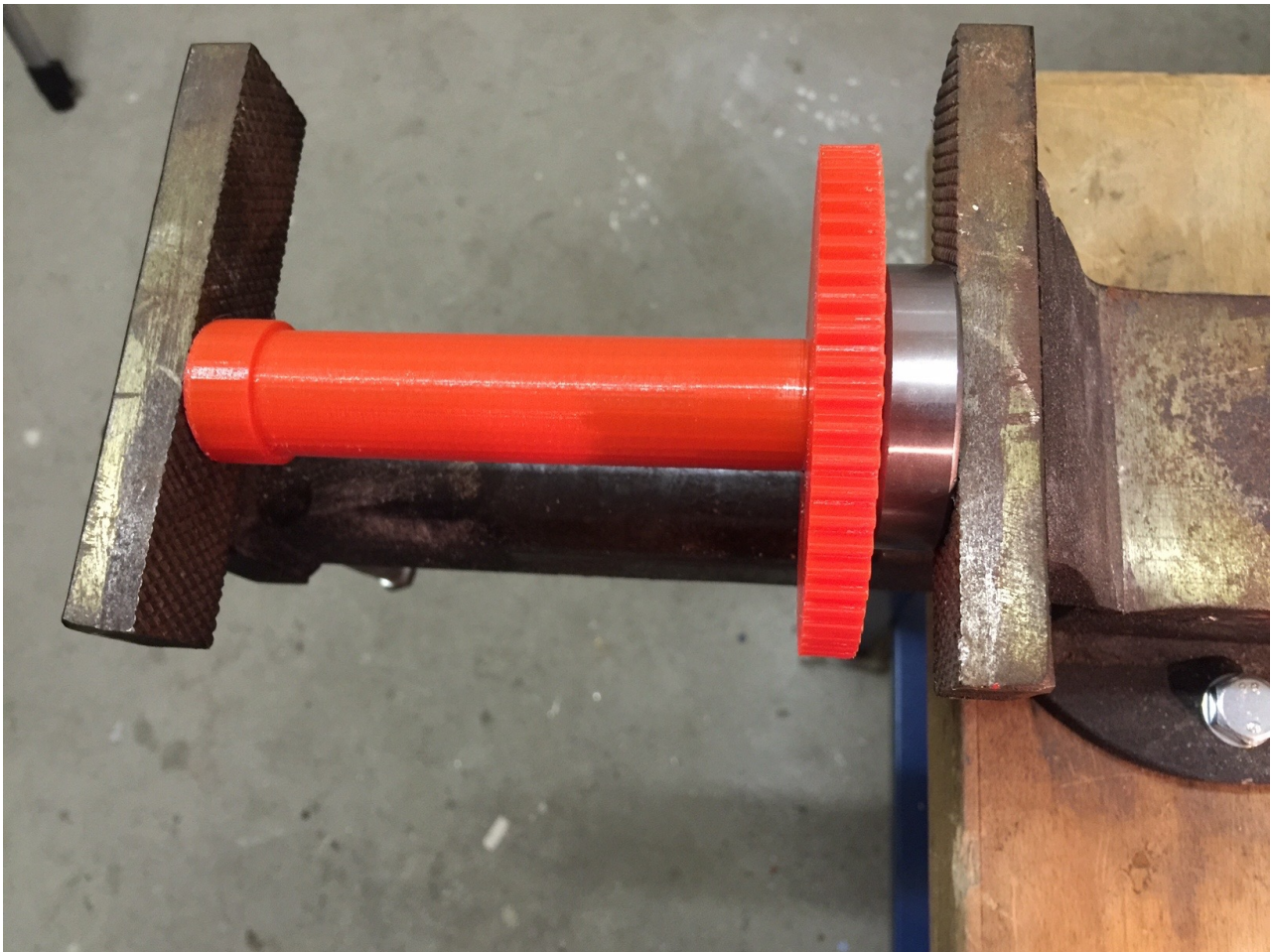
First you use part **2-AbtriebsWelleLang** and part **4-AbtriebsradZ60**. You can see that both parts have a hexagonal surface. The parts should fit nicely together. Test the fit of the two Parts before you put on glue.

Now after everything is ready, mix on some 5 Min Epoxy glue and put something on the hexagonal spot on part 2. now join the two parts like you have tested before. when some glue is coming out at the parts this is no problem, just wipe it of.

Now we need part **1-AbtriebswelleKurz**. Put also some Glue on part 1s hexagonal shape and stick it in in part 2s inner hexagonal shape and press it nicely together.

Now we will need part **9-AbtriebsWelleDistanz**. Put on some glue on Part 4, about as much as the outer diameter of Part 9 and slide part 9 over Part 1 so you can glue it on Part4.

I used a 6006 Ball bearing and put in on the Part 1 side and put in in a Vice so the parts are pushed nicely together.

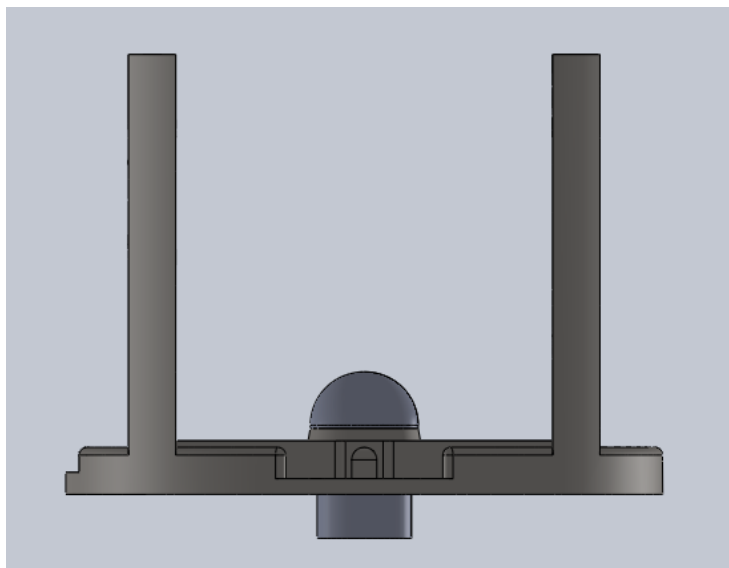
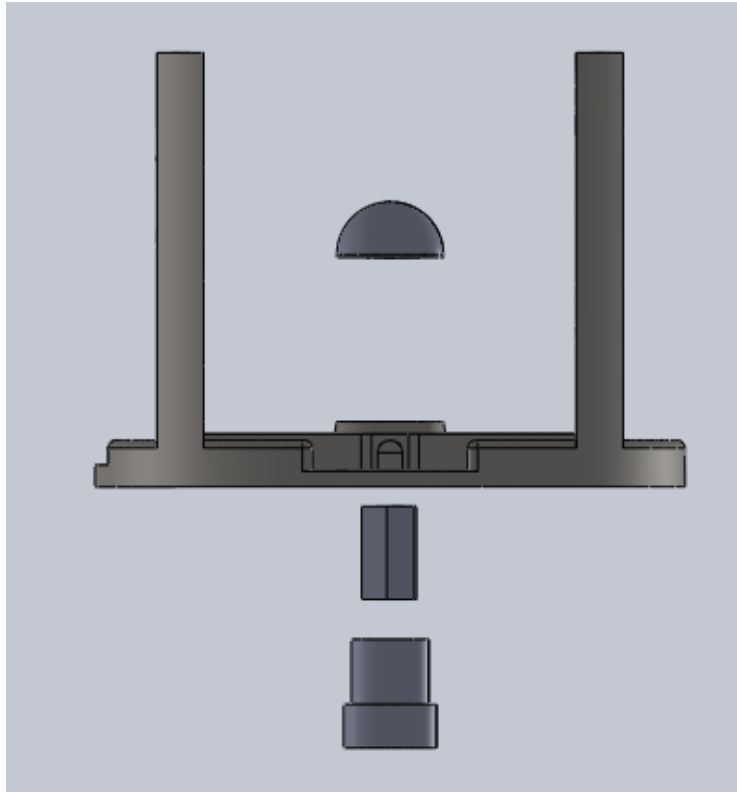


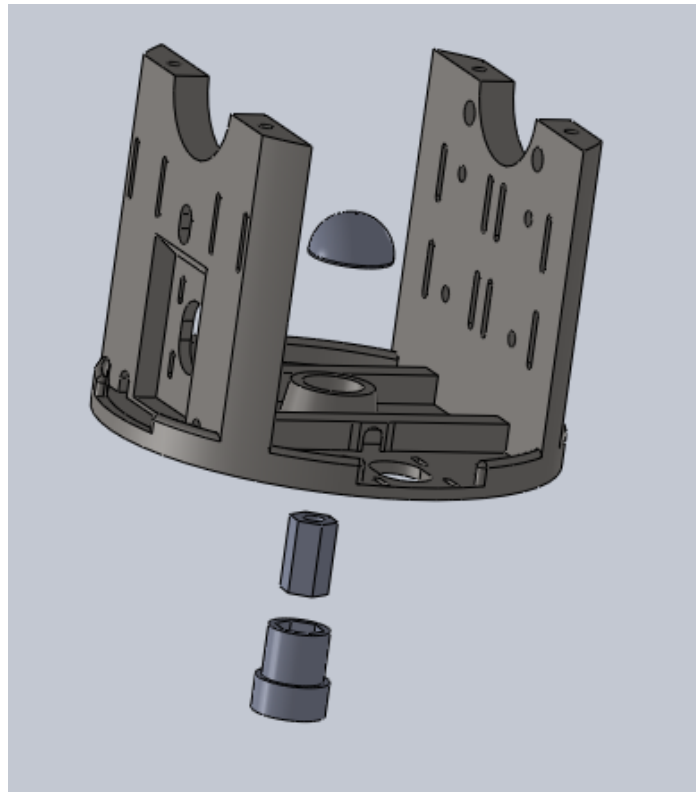
The last step in this Build group is to glue the 2 6006 Bearings on the outer sides of the Build group. just put a litte bit of glue on the outer sides of the Build group. You just have

to make sure that the Bearins go on the Buildgroup so that they are as wide on the „Rod“ so that the Rod doesnt stick out. (see pictures)

This was all the work for the first Build group.

Second BuildGroup - AzimuthStage:





You will need the following printed Parts:

1 x 5-Drehteil

1 x 7-Verbindungsbolzen

1 x 17-DrehteilAbdeckung

You will also need some bought parts:

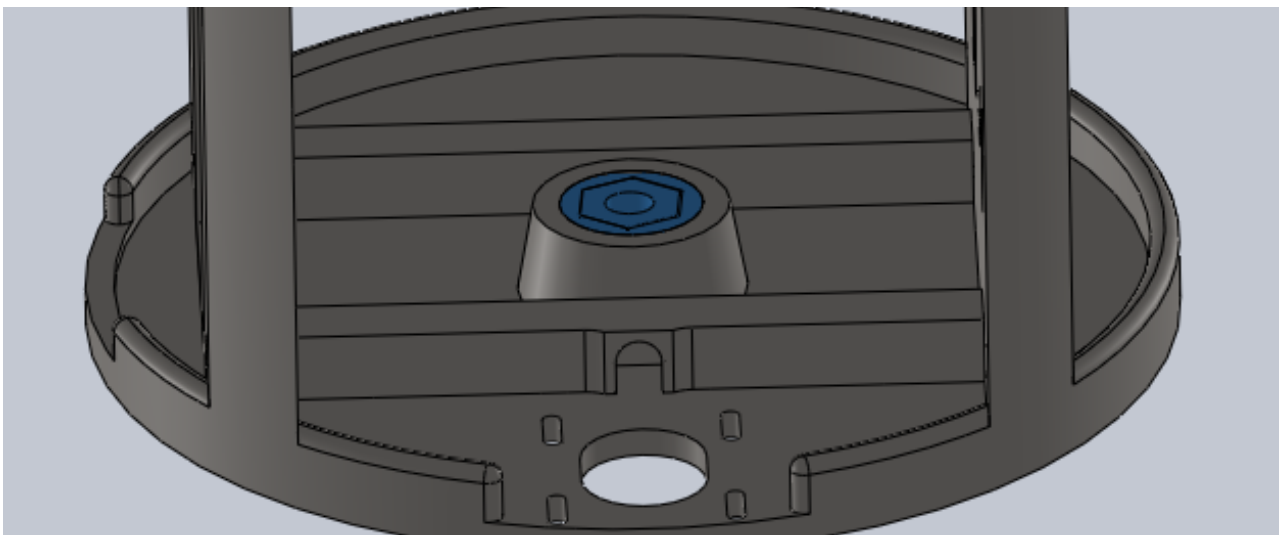
1 x M10 Nut (Extra Long [30mm long])

some 5-Minute-Epoxy Glue

Putting it together:

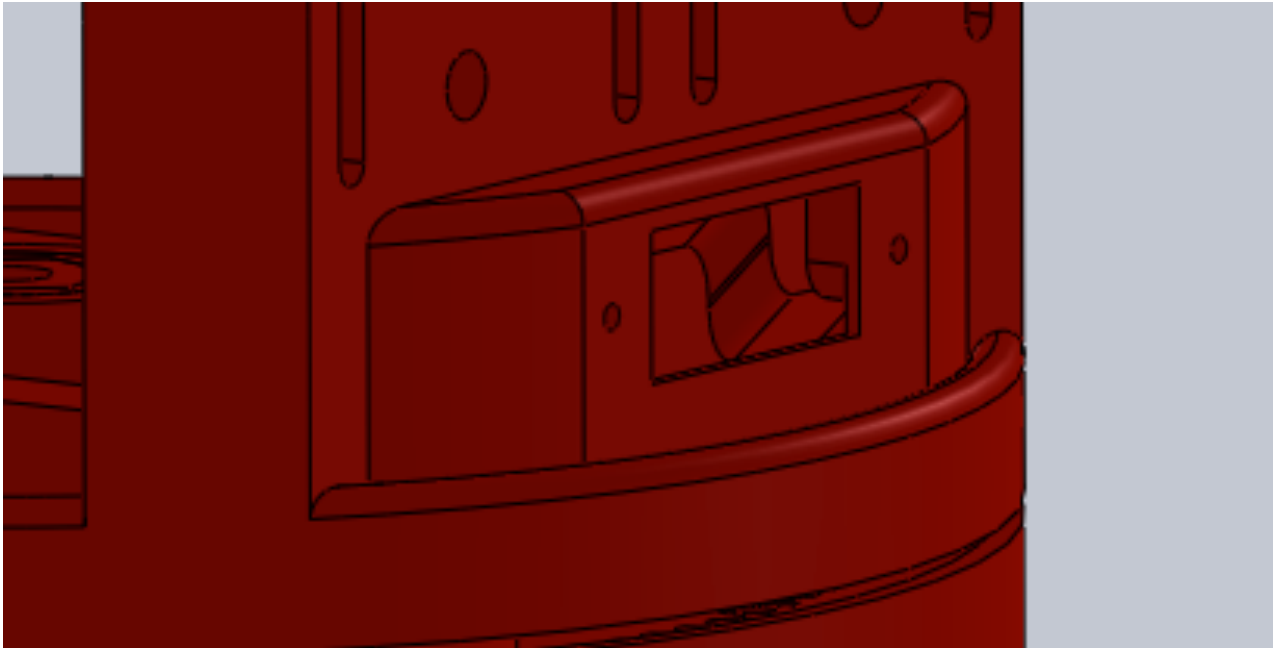
The first thing we have to do is take **Part 7** and the **Extra Long M10 Nut**. The Nut should **fit tight into the hexagonal Shape** of Part 7. You should **use a littel bit of Epoxy glue** on the **Sides of the Nut** to secure it into the Part7.

Now take again **some Epoxy Glue** and glue the „tuned“ **Part 7 into Part 5** so that the **thicker Side** comes **out of the Bottom of Part 5** (as seen on the first Picture). Please make sure that the **Glue is not already half hardened**. **Make sure** that Part 7 is in Part 5 securely and as **wide as it goes**. When you look at Part 5 from above now you should see that all **3 Parts (7, 5 and the Nut) are even**.

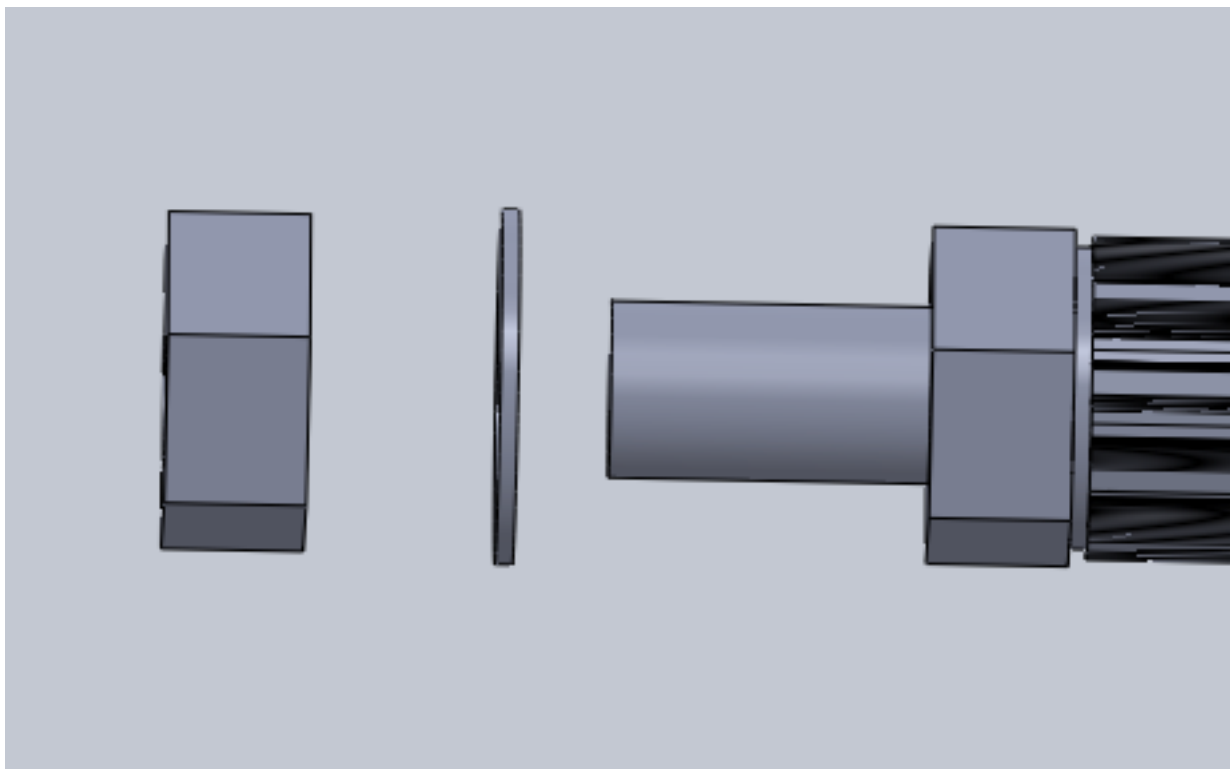
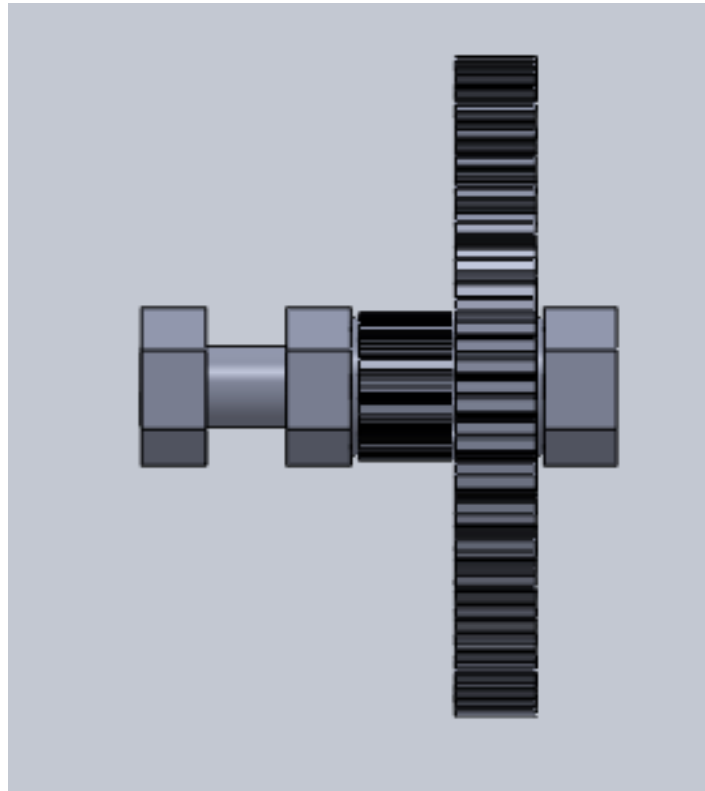


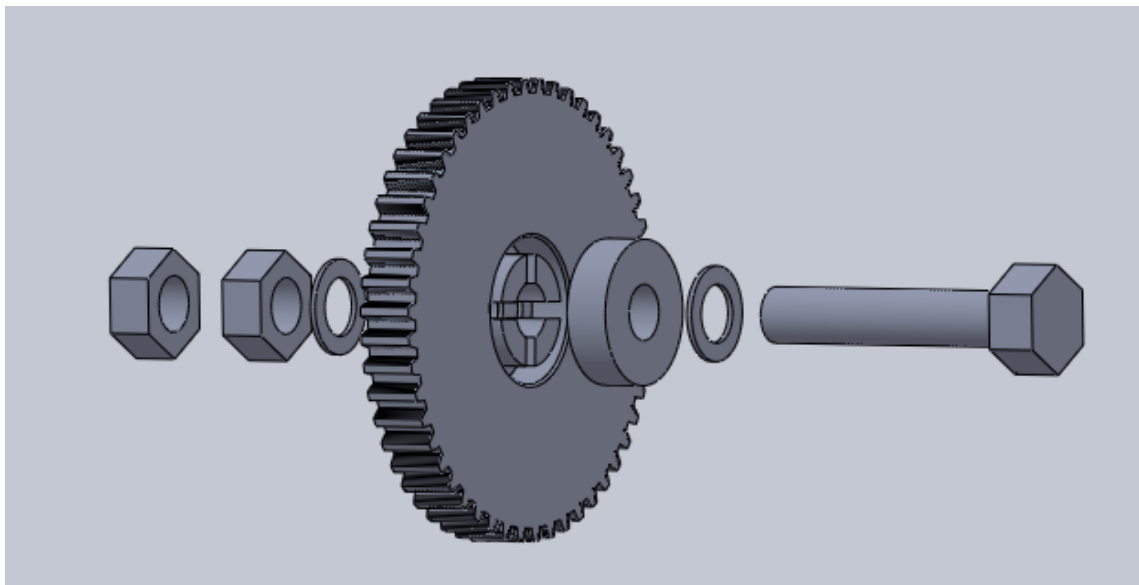
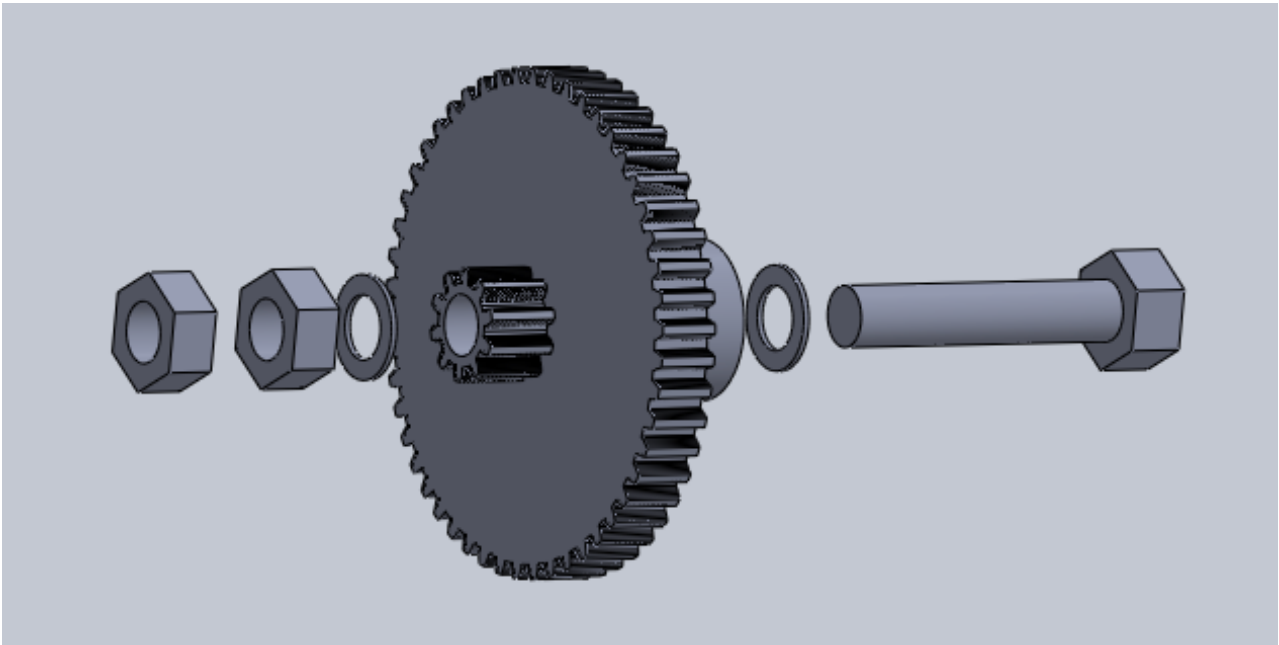
Now, finally, take again a **little bit of Epoxy** and glue **Part 17 on Top of Part 5** so that you **cover the Nut**. This Stepp is **not nececery** but it looks a little bit nicer.

I have **not added** the **Part 21 in this BuildGroup** because it is **only pressed** in the Side and exceptionally doesnt need to be glued somewhere.(implied that it holds in place nicely. =))



Third BuildGroup - RedirectingStage





You will need the following printed Parts:

1 x 6-UmlenkradZ60

You will also need some bought parts:

1 x Ballbearing 6000

1 x Screw M10 x 50

2 x Spacer for M10

1 x Spacer for M10 Big

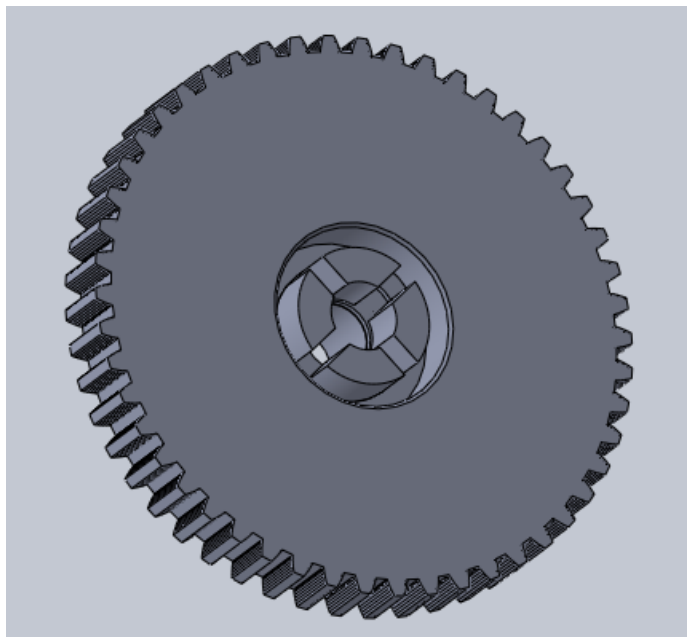
1 x Nut M10

1 x Capping Nut M10 (in the Drawing it is a normal Nut...)

some **5-Minute-Epoxy Glue** and some **Grease**

Putting it together:

You will have noticed that **Part 6** has some **strange stuff in the bigger hole**. That Stuff is a **Support for the upper Wall** of the bigger Diameter. Just **take some Pliers** and **break the 4 Support Parts of**. Now **grind** the existing Material away that there is a **nice flat area inside** where the Bearing can go.



Now take the **6000 Ball Bearing** and put it in the **hole** but **BE AWARE not to break the Part 6** while inserting the Bearing. (**I broke 3...**) The Bearing **should go „hard“** inside Part 6 **but not too hard**. When it goes **light** inside Part 6 just use a **bit of glue** on the **walls of the Bearing**. When it goes **too hard grind a little bit away** from the **inner Diameter** of part 6. (Dremel). Normally it should fit inside nicely.

Protip: When installing the Bearing dont just use a Hammer and hammer inside. Use a bigger bearing (like one from BG1 [you should still have one laying around for later]) and put it over the smaller Gear of Part 6. Now put the 6000 Bearing on the inner Diameter and put that „packet“ in a Vice and press it in slowly. With that method the Part 6 doesnt break (that easily...)

Now **check** if the **Screw** goes **inside** the **Bearing** and the **remaining Part** nicely and **without friction**. When it goes **hard** use some **grinding Paper or a file** and make it go **nicely**. Make sure it goes **frictionless**.

Use **some Grease or some DryLube** and put in on the **inside** of the **Bearing** and the **smaller Hole** of Part 6.

Take the **screw** and **put a spacer** on it. Now put the **assambled Part 6** on the screw so that the **bearing is facing the hexagonal shape** (the End?) of the screw. Put **another spacer** on the Screw (like a Spacer - Gear - Spacer Sandwich =)). Now **take a nut** and put it on the thread of the screw so that is **almost touches Part 6**. Put the **big spacer** on the screw **next**. The last Step is to **put the Capping nut on** the end of the screw.

At this moment you **dont** have to **mind** how wide you put the **nuts on the screw**. Will **finetune** that **later**. Put the Buildgroup on the Side for later.

Well done! Allow your self a little brake and take some Time to relax, drink a coffee and hear some calm music because its going to get serious. =)

Fourth BuildGroup - Preparing the Motors:



You will need

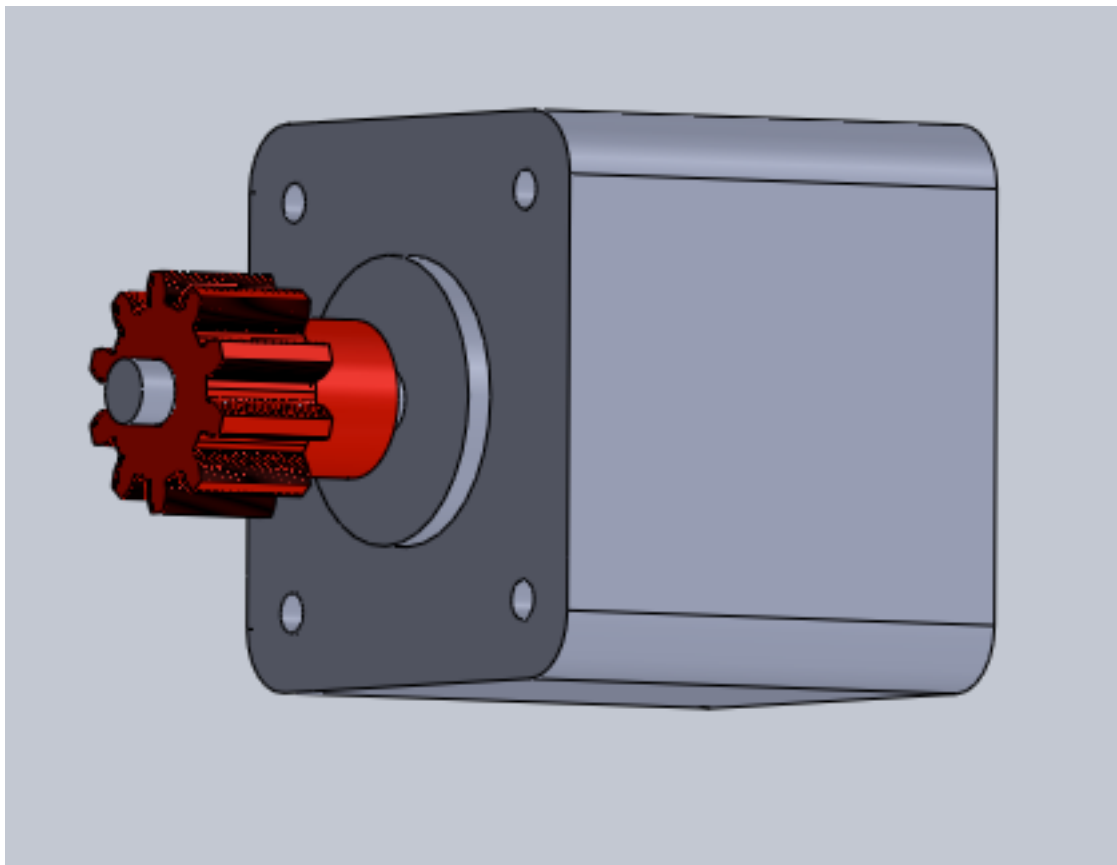
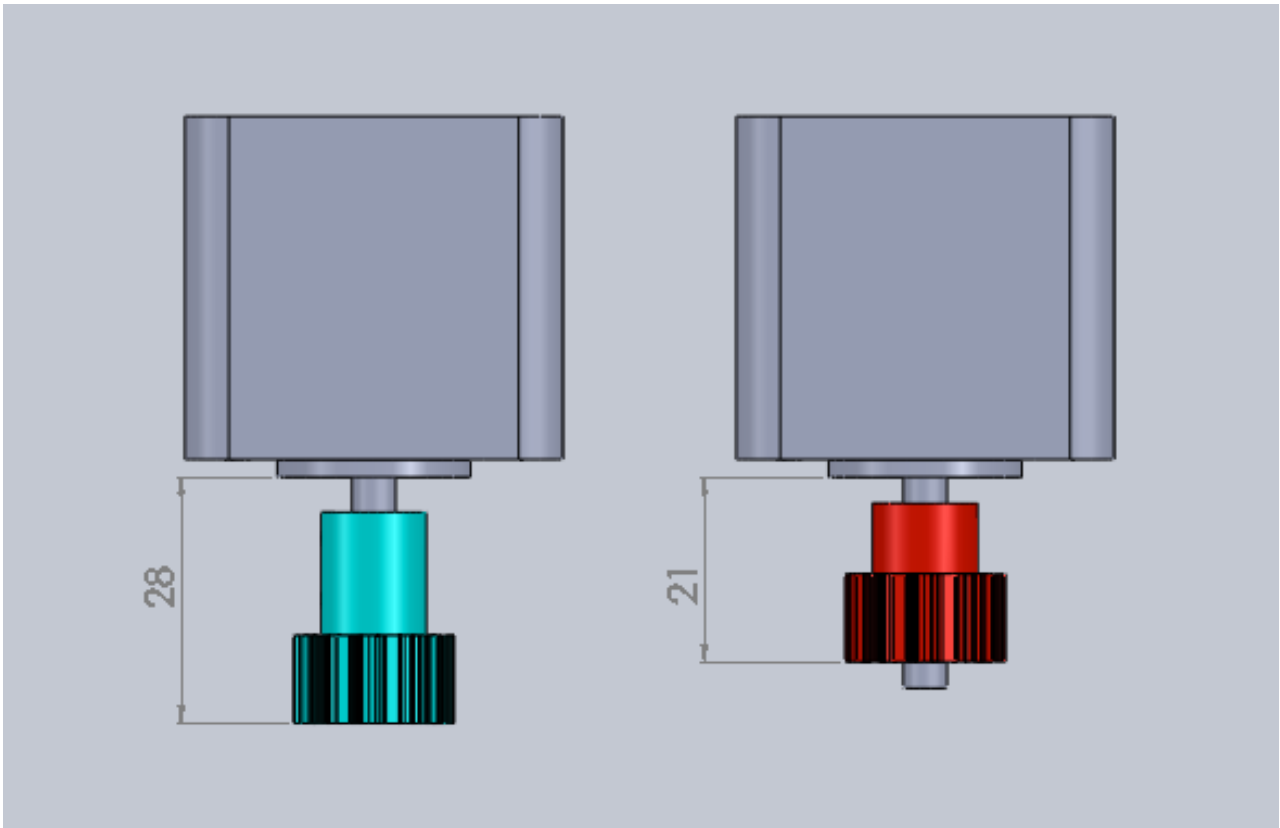
2 x Nema 17 Motors

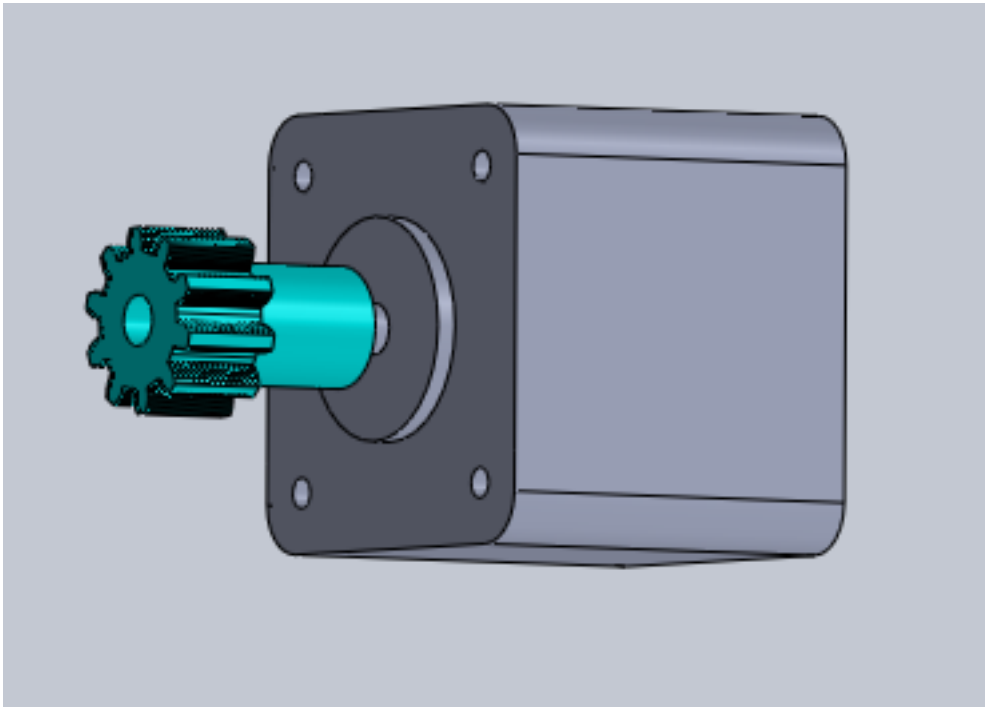
some Aluminium / Copper / Conductive Tape

As you might know i have had Troubles with QRM from my own Electronics for the Rotor. As a Solution i shielded everything as much a i could. Since the Motors are very near the Antenna i also decided to shield the Motors. If this makes Sense or not is in your Opinion. I have done it (together with much other Shielding) and it worked for me...

Put the conductive Tape nicely around the **Motors and the cable** so that the Shield is **connected to the Housing** (the outer Part) of the Motors. Be very **carefull** with that because the **conductive Tape is very fragile**. Use a Multimeter and measure the resistance between the Shielding (from the Tape around the Motor to the Tape on the cable.). Make sure you cut out the part where the Motor shaft comes out of the Motor. =)

Fifth BuildGroup - Assambling the Motors:





You will need the following printed Parts:

1 x 8-MotorElZ10

1 x 15-MotorAzZ10

You will also need some bought parts:

2 x Nema17 Stepper Motors (With our special Shielding.)

some **5-Minute-Epoxy Glue**

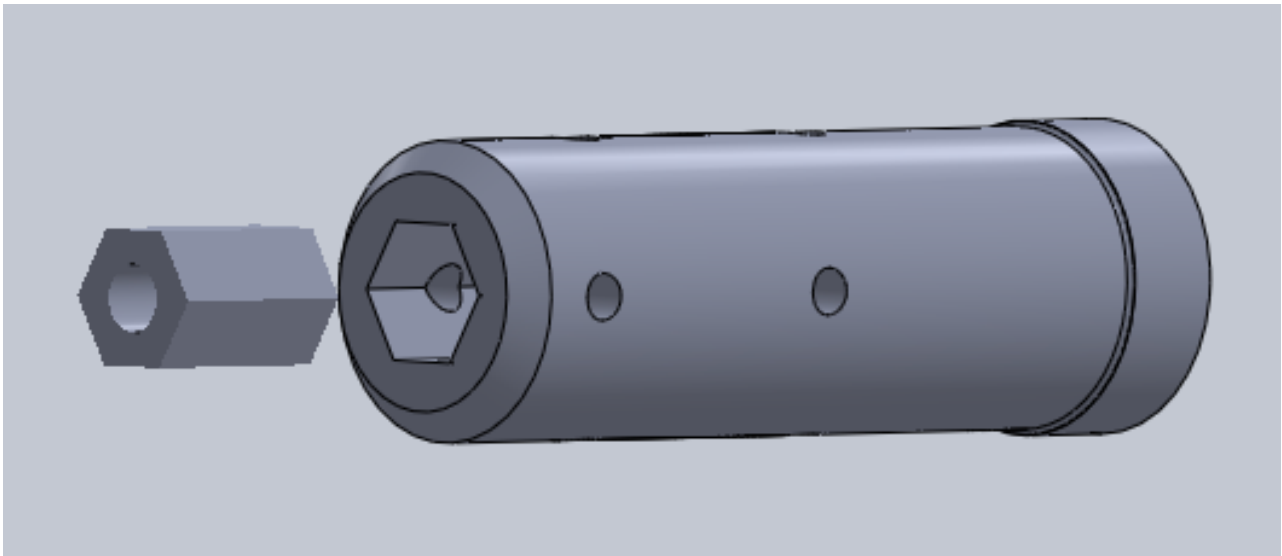
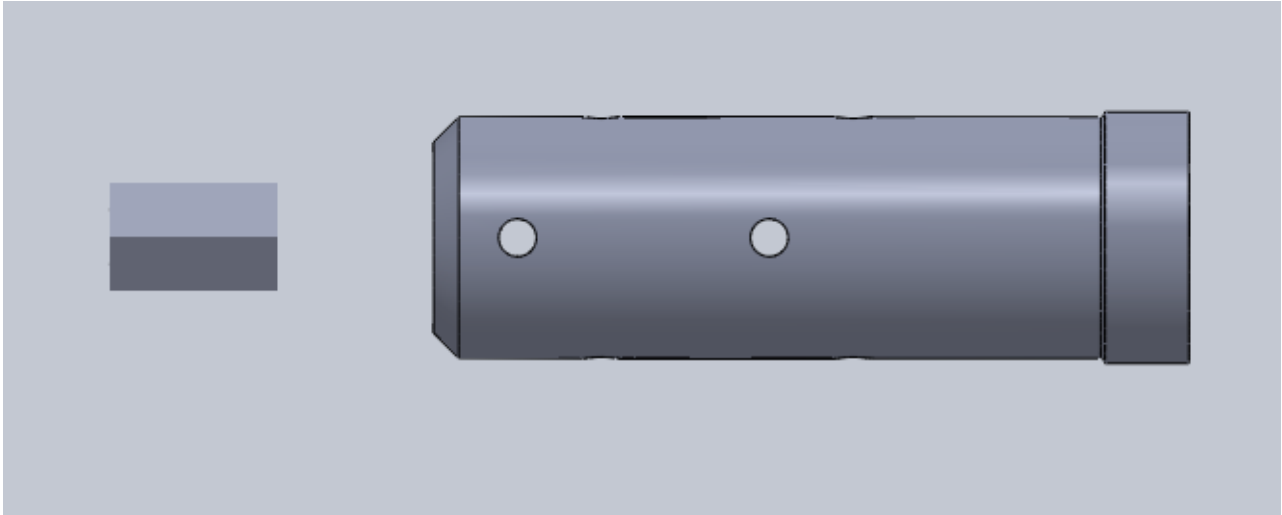
Putting it together:

First take the **Azimuth Motor** and **cut** the **shaft** so that the shaft **length is 21mm** (see pictures) **grind** a **camper** on the side where you cut the shaft. Now take the **Part 15** and put it on the **Shaft** like you see at the Pictures. The outer Side from the printed part should be **21mm** away from the round part of the motor (Picture).

Now take the **Elevation Motor** and Put the **Part 8** on the Motorshaft. The **Distance** between the outhter Side of Part 8 and the round Plane of the Motor should be **28mm**. (Picture)

The printed **Parts** should **go hard** on the Shaft. You can **use a Vice** to press the Gears on the Motors. **If** they **dont go hard** use **Epoxy** to fix the Gears on the Shaft.

Sixth BuildGroup - SideExtensions:



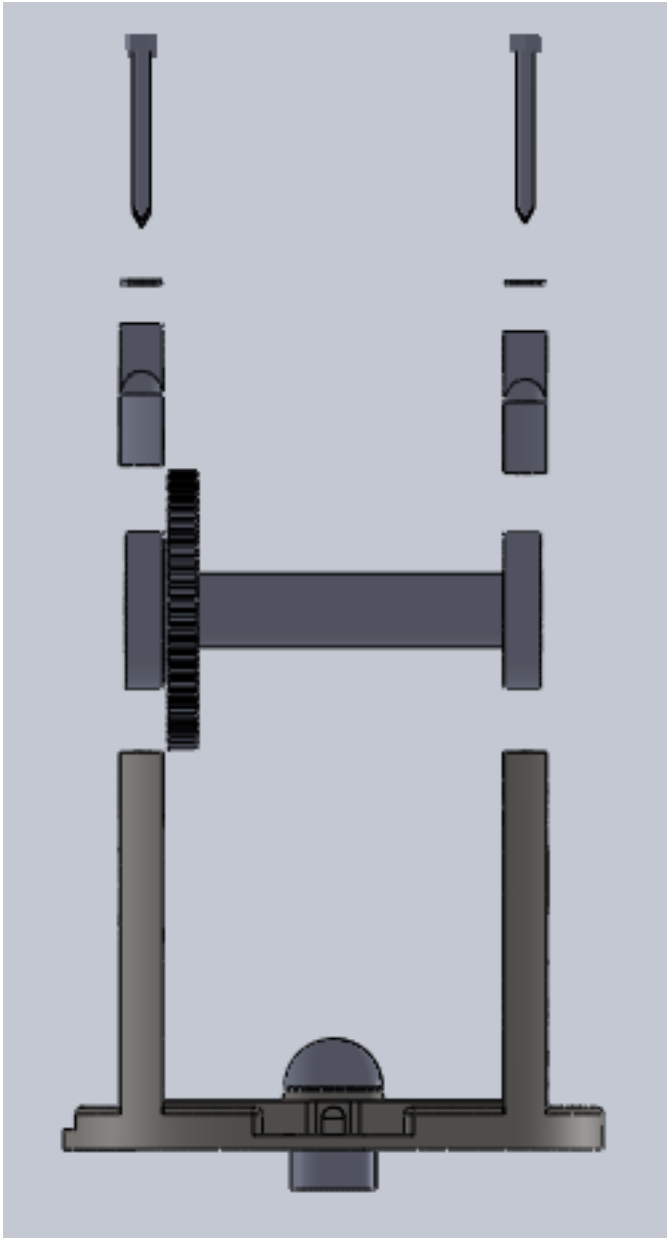
You will need the following printed Parts:

2 x 3-Seitenverlängerung

You will also need some bought parts:

2 x Nut M8 Extralong

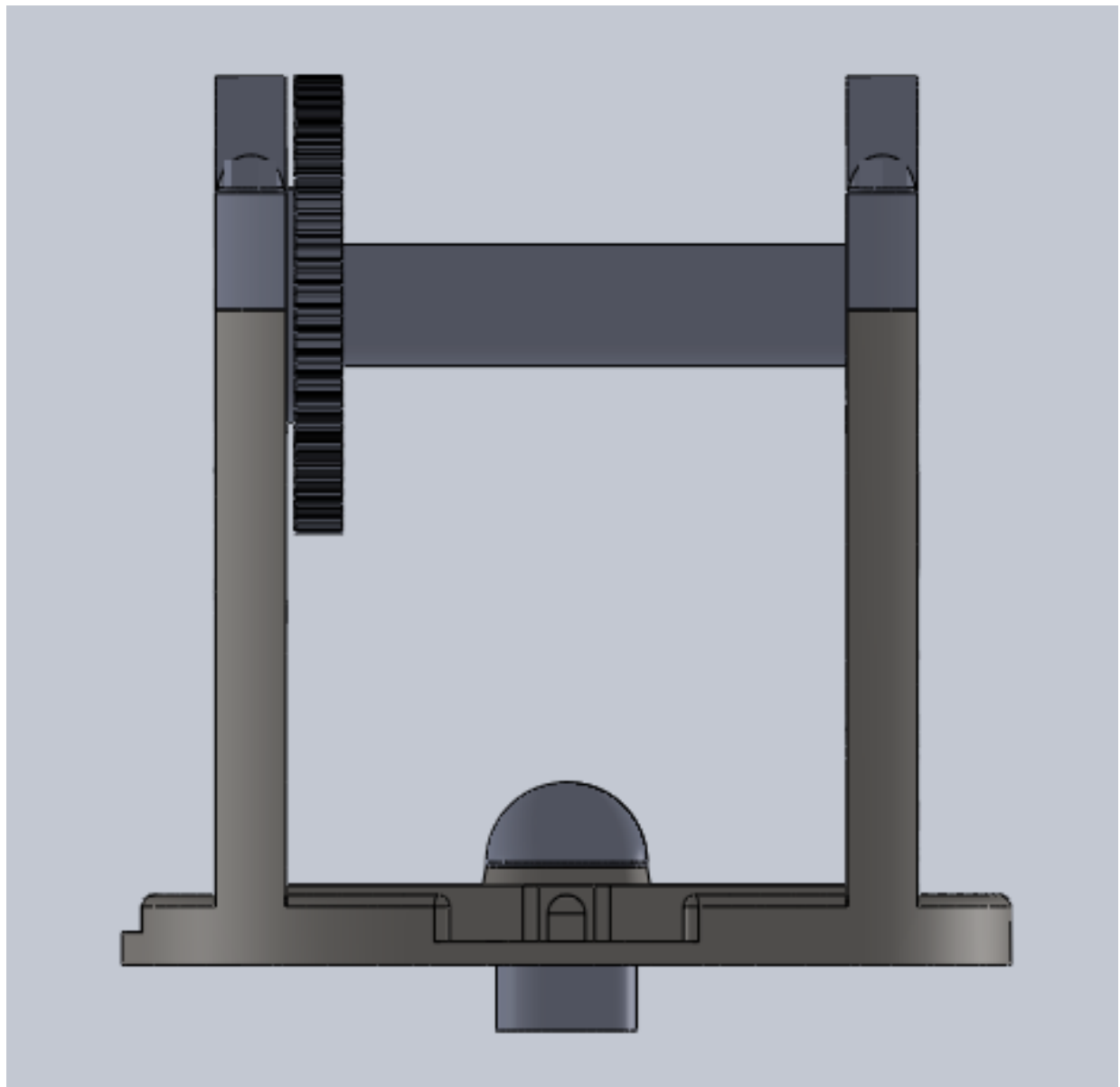
1 x Threaded Rod M8 x 210

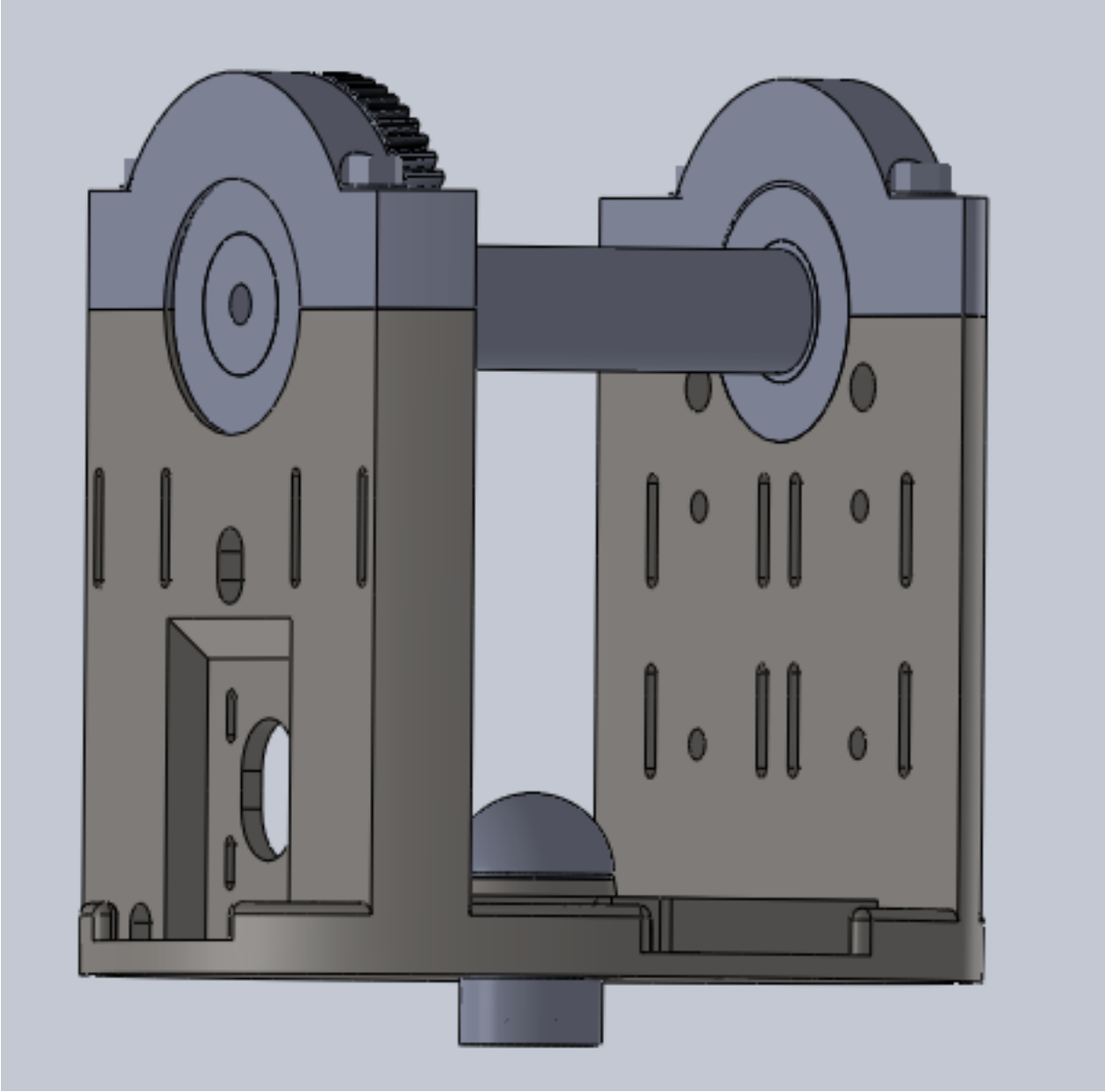


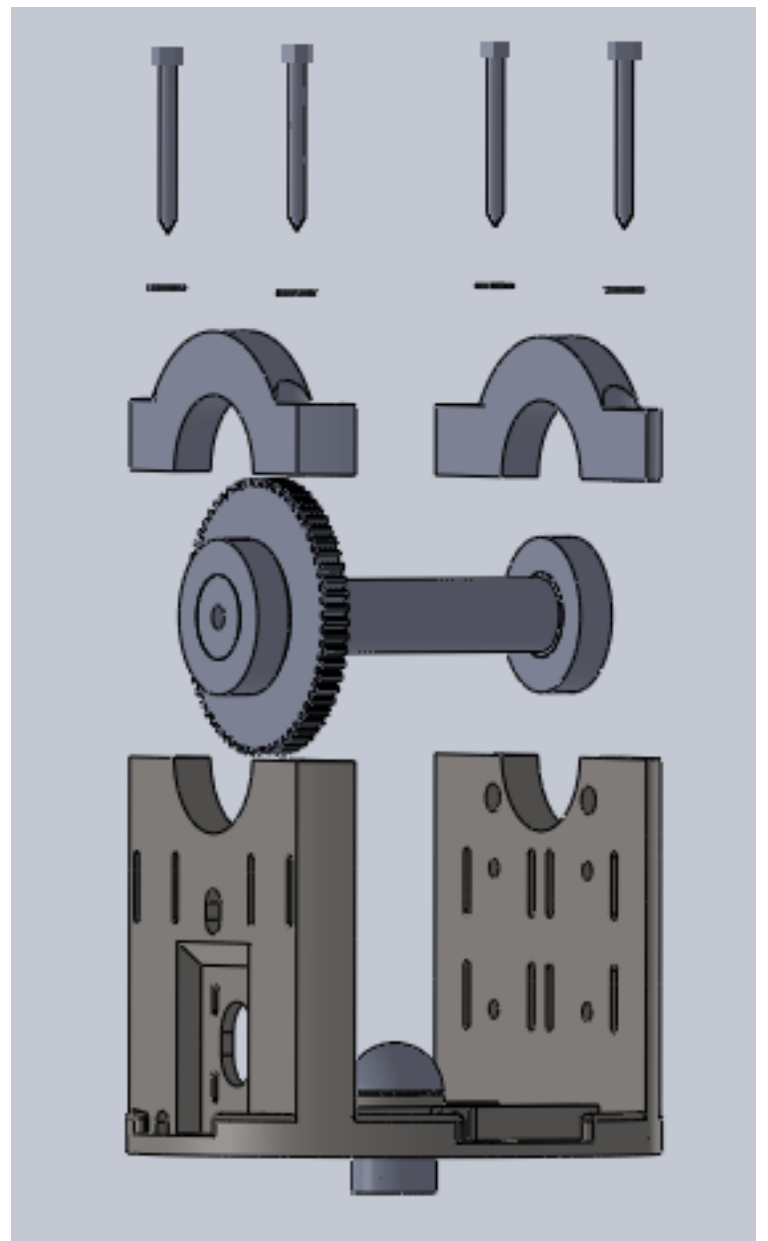
Putting it together:

The **long M8 nut** should go nicely in the **Hexagonal shape** of Part 3. If it goes a little **harder** use the **Threaded Rod** and **Screw on the Nut about half** of the way (Half way of the Nut not the Rod). Now you can **use a Plastic hammer** on the Rod and Put so the Nut into the printed Part.

Seventh BuildGroup - Prefinish AzimuthStage:







You will need the following printed Parts:

2 x 14-LagerhalterungOben

You will also need some bought parts:

4 x „FastbuildScrews“ M6 x 60

4 x Spacers M6



We also need the prepared BuildGroup:

1 x BG1 ElevationStage

1 x BG2 AzimuthStage

Putting it together:

Take **BG2** and put it in **front of you**. Make sure that the Place for the **Azimuth Motor** (in the Bottom) **faces you** and the Place for the **Elevation Motor** is on your **Left Side**.

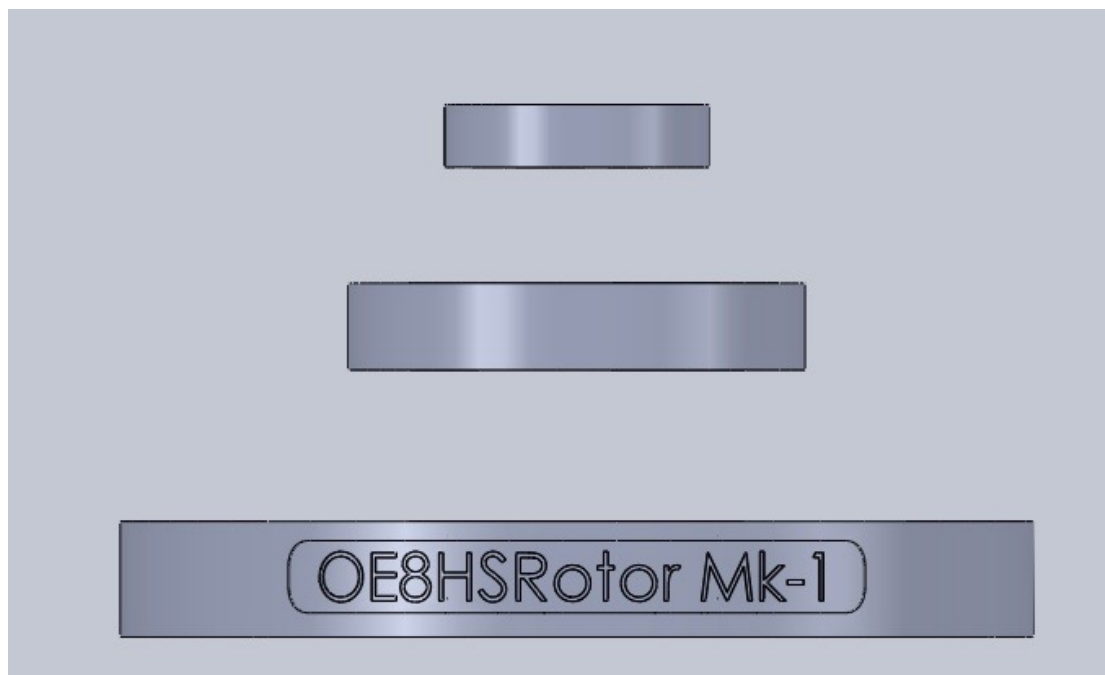
Now take **BG1** and place it on **top of BG2**. The **big Gear** on BG1 should look to the **left side** (Where the Elevation Motor will be.)

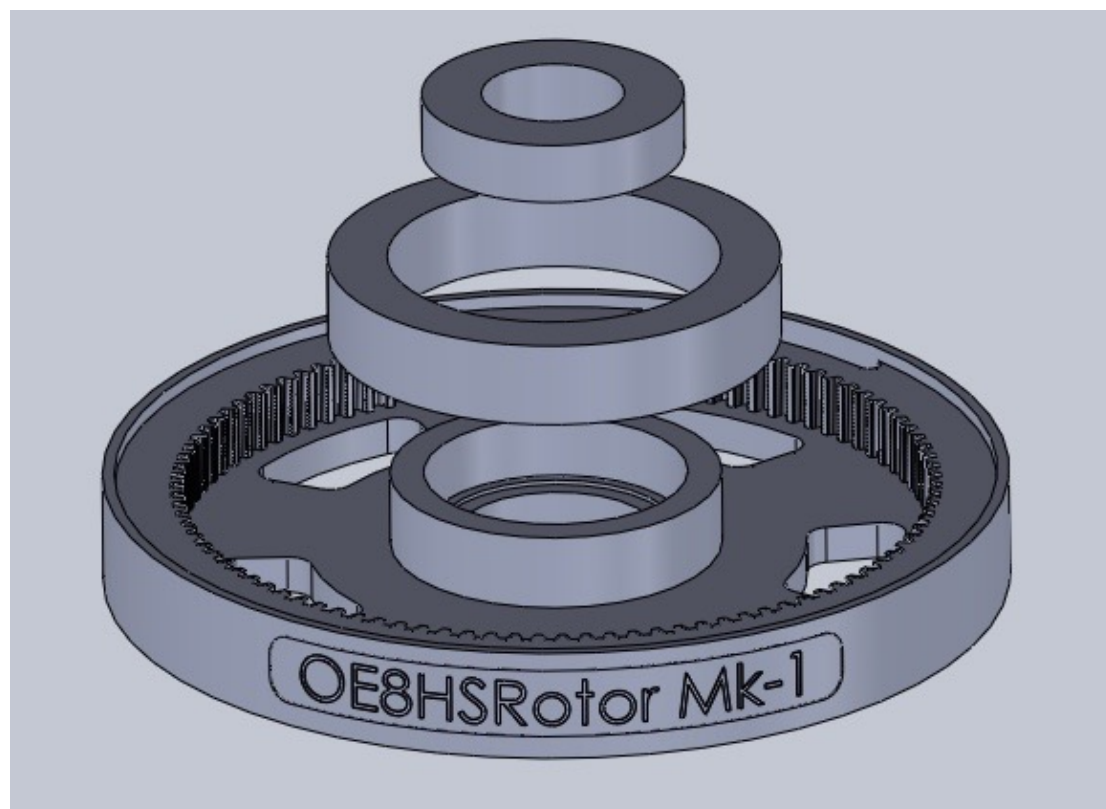
When everything is assembled correctly the **inner sides of the bearings** (BG1) should be **plane with the inner side of BG2**.

Take the **Part 14** and **Put on the BG2**. Use **2 x „FastbuildScrews“ M6 x 60 with spacers** to **screw Part14 in Place**. **Do not screw the Parts too hard**. I have made 2 Rotors that way and it worked well but when you use **too much Force** on the screws the layers of **BG2 will break**.

Do the **same** on the **second side** of BG2. **If the Sidewalls** of BG2 are **not 100% straight** you can **press them in place** before fixating the Screws.

8th BuildGroup - BottomPart:





You will need the following printed Parts:

1 x 13-Innenverzahnung100

You will also need some bought parts:

1 x BallBearing 6006

1 x BallBearing 51114

some **5-Minute-Epoxy Glue**

Putting it together:

We take **Part 13** and **dryfit** the Bearing **6006** **inside** the **middle Hole**. It should **go tightly** in. **If** it goes in **very hard**, **grind** some **Material from the wall** of the **inner diameter** away. **DO NOT USE FORCE!** The Plastic will break if you use too much force and the part is broken. It is **better** that it fits in **light than too tight!**

Now take some **Epoxy glue** and put in on the **side Area** of the Bearing. Glue in the Bearing and **make sure** that is **all** the way **in** until it **touches the bottom** of the Hole. Make also sure that the Bearing is **not tilted** inside the Hole.

Make sure that there is **only glue** on the **sidewall** of the **bearing** and **not on** the **surface area** (inner ring and plastic cover).

You can now **take** some **extra epoxy** and put it on the **outer ring and the sidewall** of the printed part (but **not** on the **cover or the inner ring** of the bearing). It is

mandatory that the bearing is **secured in the printed part** because this will hold the **Rotor together**.

The **51114** Bearing goes **over** the part where the inner bearing is glued. We **dont need** to **glue** this bearing inside. When you take a **look** at the **51114** bearing you will **notice** that **one „Plate“** of the baring has a **slightly tinier inner diameter** than the other. Make sure that the **tinier Ring** goes to the **Bottom** of the Printed Part.

9th BuildGroup - Elevation Motor and RedirectionGear:

We need the prepared BuildGroup:

1 x BG7 UpperStage

1 x BG3 RedirectingGear

1 x Prepared Elevation Stepper Motor

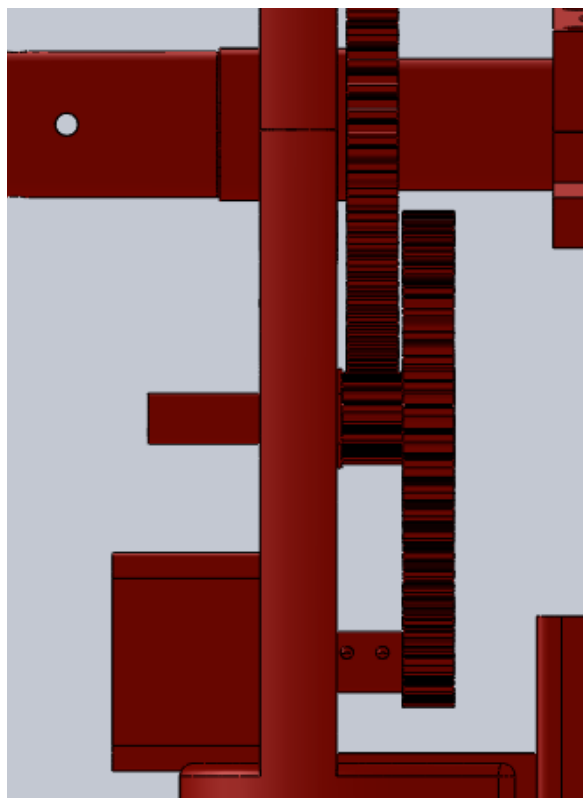
You will also need some bought parts:

4 x Screw M3 x 20

4 x Spacer M3

Putting it together:

Since i dont have drawings of the assambly of this part we will do this blind... But trust me. it is not that hard. ;)



First **take** the **Elevation stepper** and mount it on the **BG7**. Stick it **through** the left **wall** from the **left** side and make sure the **cable goes downward**. **Stick** the **Cable** of the Motor **through** the **Cablecanal** on the **Front** of the BG7. Secure it with the 4 **M3 x 20 Screws** with the **spacers** attached. You **dont** have to **tighten** the screws yet. Make sure that the Motor can be **slided up and down**.

Take **BG3** and **screw off** the **CapingNut** and **also** put off the **big Spacer**. Now put the part **through** the „longhole“ on the left side of BG7. You will **notice** that the the **Nut** on the **BG3** will fit in the **hexagonal „longhole“**. Now take the **big Spacer** and Put it on the **standing out Screw** from **BG3** and **also** put on the **CappingNut**. **Do not tighten** the nut **yet**.

Adjusting the Gear Backlash:

We should now have the Parts be in place quite loosly. Now we will adjust the gears. Take your time for this step because it has to be done right to get good function of the rotor.

The Thing is that we have to Put the BG3 in place that it has a **good gear backlash**. If it is **too loose** there is **unwanted movement** in the Elevation stage. If it is **too tight** the **motor wont be able to move** the Elevation Stage properly.

To setup the BG3 right **make sure** that the **Nut** is in the **hexagonal „longhole“**. Now **tighten the Head of the Screw** (on the right side of the gear) **until** the gear **dont move** on the screw. When the **Gear cant move** anymore **turn the Head** of the screw a **little bit loose again**. The gear **should go nicely**. Now **push** the **BG3** up to the **upper Gear** and **simultaneously tighten** the **CappingNut** a little bit. Now **check** if the gear **backlash** is **not too much** and the gear upper „ElevationRod“ **turns freely** all the way around.

When the Gear **Backlash** is **too high**, **unscrew** the capping **nut** a little bit and **push** BG3 **further up against the gear**. If the „ElevationRod“ **doesnt turn freely** or **hooks** somewhere on the way, **lighten** the Capping **Nut** and let BG3 a littlebit **down again**.

Take your time in adjusting the Gears. It makes no sense to make this part sloppy and the Rotor doesnt work properly.

When we have done this **push the motor up against BG3** and **tighten** the Screws on the motor. I know that the upper 2 Screws are not good to tighten because the BG3 gear is in the way.

You may want to take some **Pliers** on the **upper screws**. I will change that flaw in the next version. When the Motor is mounted check again if the upper Stage can turn all the way and doesn't hook.

DO NOT TURN ON THE UPPER ELEVATION ROD!! The Elevation stage has a high Gear ratio. When you turn the upper Rod there might be some damage on the Stage. When you want to turn the Elevation Stage from hand Please turn the motor on the gear or the Middle Reduction gear.

10th BuildGroup - The Rest:

You will need the following printed Part:

1 x 16_Stativhalterung

1 x 21_Steckerhalterung

We need the prepared BuildGroup:

1 x BG9 UpperStage

1 x BG8 BottomStage

1 x Prepared Azimuth Stepper Motor

You will also need some bought parts:

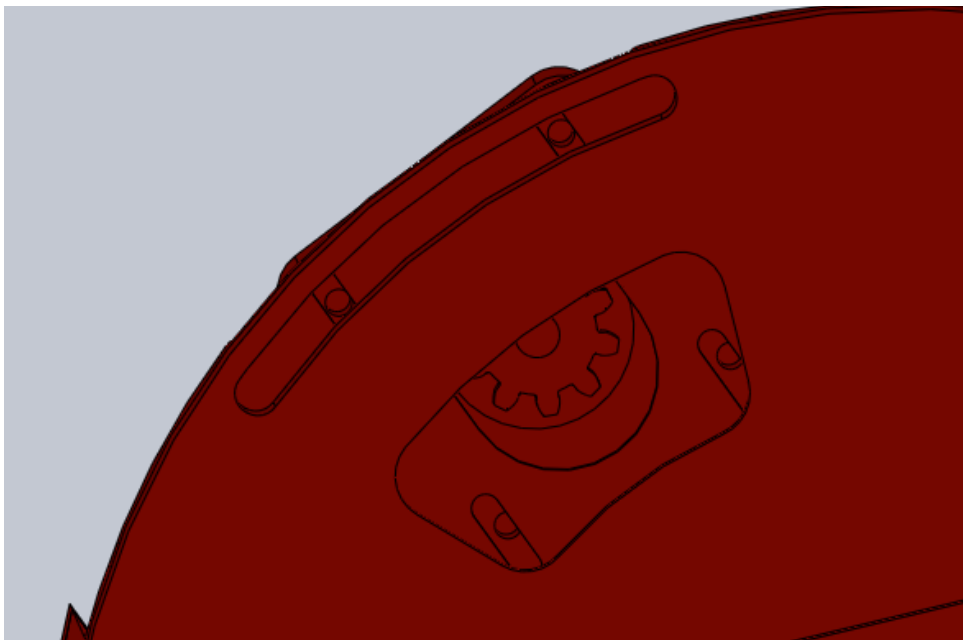
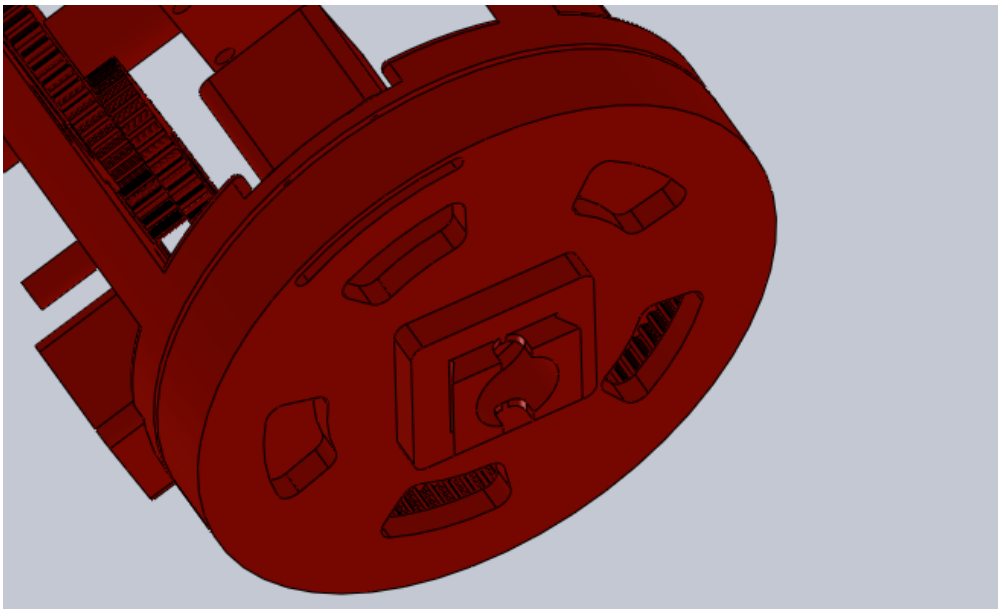
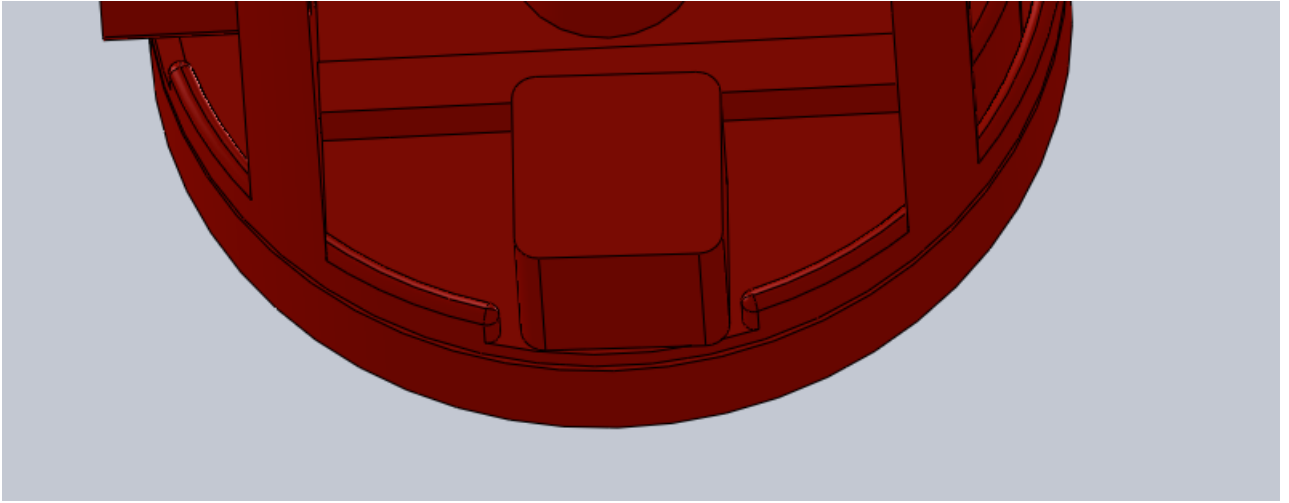
4 x Screw M3 x 10

4 x Spacer M3

1 x M10 x 30

1 x Spacer Big (outer diameter 27mm)

some 5-Minute-Epoxy Glue



Putting it together:

Take **BG9** and the **AzimuthStepper**. Put the **Cables** of the Motor **through** the **Rear CableCanal** (This will maybe be some fiddeling but make sure you **dont break** the **shielding** on the cable!). Now put the **Motor in Place** and **secure** it **loosely** with the 4 **M3 x 10** Screws and the M3 **spacers**. Make sure the motor **slides nicely** in the **longhole**. Put the Motor as far to the middle of BG9 as Possible.

Now put **BG9** on **BG8** with the **Rod** on the **bottom** of **BG9** through the **inner bearing** of **BG8**. Remember this Moment because since this exact moment we hold a Antenna Rotor in our Hands. =)

Put the **Big Spacer** on the **M10x30** screw and **Screw** the **Screw** through the **big hole** in **BG8**. **Tighten** the Screw „**normally**“ but **not too much**. Try again to turn the upper Part. It should again go nicely.

Now we have to **adjust** the **Gear Backlash** of the Azimuth Motor. Put the Rotor upside down and Turn the BG8 as wide so you can see the Screws through the Holes in the BG8. Push the Motor to the outer side of the Rotor and make sure the gearteeth go in each other. Tighten the screws through the Holes in the BG8 and make sure the Rotor turns nicely. When he Gear Backlash is too high... You should know until now what to do. =)

Congratulations!!! You have Finished the Mechanical part of the Rotor.

The **Part 16** can be **glued** on the **bottom** of the **Rotor now or later**. I would **suggest** you do it **later** so you can put the Rotor **on** a **table** while **testing**. Make sure you Glue the Part 16 in the **middle** of the **BG8**. You can use the **screwhead** of the screw as a **point of reference**. **Glue** the part 16 in place **very good**. This part is the **weakest point** of the Rotor that gets the **most force** on it!!

The Part 21 will only be slided on the right side of the Rotor. But we will do that later when we connect the Motorcables to the Connector.

If you have any question that is not answered in this guide (wich there will be plenty =))
write me an email to: **oe8hsr@oe8hsr.at** or **hm@maschinen-steiner.at** or post your
problem in the forum at: **forum.oe8hsr.at**

Best wishes Hans