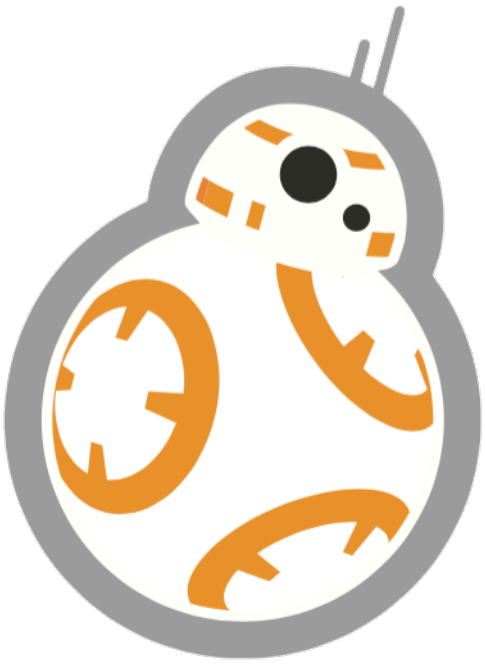

BB8

BUILDERS

T&M BB8 Part Files:
Instructions Guide to 3D Printing, Assembling & Finishing

T&M BB8 Part Files: Instructions Guide to 3D Printing, Assembling & Finishing (CC 4.0)

beta v029 – 9-Dec-2015

— Revision History —
beta v029 – Dome assembly cross section detail added, clarified Lens & LED install instructions, added Adhesives (Glue), CA joint smoothing, Hamster, Hamster Plate & Electronic Configuration: Simple sections.
beta v028 – Updated Body Triangle piece details with list and quantities of each. 70/80mm lens info.
beta v027 – Grammatical adjustments, Updated BOM for Hamster Hardware, BMM Control Arm & Drive
beta v026 – Corrected QTY on PTFE Bearings
beta v025 – Updated DMM, Dome Plate & Dome Hardware BOM
beta v024 – Revised Hamster Hardware BOM
beta v023 – NEW: Updated BMM Parts, BOM & Assembly. Initial Hamster Hardware BOM.
beta v022 – NEW: DMM Caster BOM, Information & Assembly, PSI Rear Cover.
beta v021 – Clarifications to instructions, typo in BOM PN, Deprecated Stud Load Transfer Caster & 5/16" Nut. NOTE: A new DMM part for a custom caster is being worked on. This will increase performance, save weight and cost.
beta v020 – New Sections: Body Stage Files: Hamster Battery Boxes, Orange Rings, Panels, Triangles
beta v019 – Additional Filament notes, Added Simplify3d Skirt/Brim section
beta v018 – Fixed McMaster-Carr Part number TYPO in Dome BOM: 92095A183
beta v017 – Adding detail to Body Stage build, created Body Panel Painting & Orientation section
beta v016 – Minor Changes, started adding detail to Body Stage section
beta v015 – Added Page Numbering
beta v014 – Minor changes
beta v013 – Started Body HW BOM
beta v012 – Updated Dome HW Magnet BOM
beta v011 – Minor changes
beta v010 – Minor clarifications, Minimum Print Area Required, Updated DOME HW BOM
beta v009 – Initial Public Release
beta v008 – Ordering of sections, Updated Finishing, Added additional pictures for clarification
beta v007 – Dome Assembly Instruction, Renamed Document, File URL Locations, CC4 Full Text, Using Helper Disks
beta v006 - Updated Introduction, Printing Parts for Others : The Economic Realities
beta v005 - Body Sections
beta v004 - Creative Commons License 4.0, Scale, Discussion about PIE top magnet mounts & Optional Parts, Painting, Weathering
beta v003 - Hardware Parts List, McMaster Part #s.
beta v002 - Initial beta Release

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— Introduction —

We have worked hard to make these parts as close as we can until we get our hands on more accurate information. We've also spent numerous hours doing various iterations to make sure the parts print well and work as expected. Our goal is to make a repeatable, printable solution to building this new droid. Please keep in mind we're currently only releasing the Dome as interpreted by us, and we're working on two versions ("Stage" & "Static") of the body. We'll release them as we can get them through the process.

Please don't think of this as a plastic model kit. While the pieces are wonderful, if we do say ourselves, the model files are only as accurate as they can be until we get actual measurements from the screen used droid.

All part model files are in mm and as such should not need re-scaling. The files are designed to print at 100% scale with every 3D slicer and printer we've tried to date. If you change the scale of a part, it's going to cause you issues with fitment and/or look.

All of the printed parts will require some minor level of custom fitment for your build. This is due to the fact that every printer is slightly different, even those that are the same make and model. So be prepared to invest a little time in properly fitting & finishing the parts. We are after all members of a builders club and not a for profit model kit manufacturer.

If you're new to 3D printing, we recommend you start with the smaller parts, like the HP, PSI, and Radar Eye. Then followed by the Dome Ring. If you have issues printing those parts, then don't attempt the larger Dome Panels or Dome Skirt. To us, the hardest part to print is the Radar Eye Internal, and we recommend you print it at least 0.2mm or better yet, 0.1 mm, if possible.

We'd also like to take this opportunity to thank all those beta testers and early adopters that spent numerous hours printing test pieces, and testing fitments from various printer manufactures, models, settings & trying different filament manufacture and types. Including several beta testers that bought new 3D printers (67 at current count). Honestly, without their rapid, candid, and direct feedback, along with their encouragement for this project, this would have been a much longer & harder project. We thank them for the filament they extruded for part testing. These same experienced builders are located around the globe and are willing to assist new droid builders. What an amazing, talented group of folks. Again we thank them for their efforts!

So now that you have obtained the current files, how do you make the droid parts? For most of them you print them on your 3D printer, ask another builder to print them for you, or have them printed by a commercial printer service provider.

— Printing Parts for Others: The Economic Realities —

We encourage everyone to print your own parts. That way it will ensure that you know exactly how all the parts work together, as well as to be able to make replacement parts when needed.

In all areas of the globe, there are also printer service providers that will manufacture or print these parts, and typically they charge based on the volume of material used or the amount of time of the print. Example of these are Shapeways.com & 3DHubs.com. 3DHubs.com lists locally available providers around the

globe. Both of which we have used in the past. Using either of those services is going to be a pricey option for printing these parts. An example, most 3Dhubs.com service providers charge an average $25 (US) per hour and more, depending on the filament being used. That would mean it would cost a builder about $1500 (US) for just the dome pieces from a basic FDM service operator. We have heard of a new service provider Voodoo at an unbelievable price of $3.00(US) per hour, plus various setup & shipping fees. We do not have any experience with them as of this writing. (9-Dec-15)

One affordable solution is renting a 3D printer. In the San Francisco Bay area, you can rent an Ultimaker2 for $350 per month. Several builders could go in together and make several sets of the parts, rather inexpensively within a month.

However we also recognize that many don't have access to a 3D Printer nor can they afford that cost, and as such those builders with access, may be asked or offer to print parts for those without access, and that is a reasonable/honorable request, and one we want to encourage the community to do.

That being said, a little financial analysis is in order. Currently, as of Aug-2015, a modern large format FDM PLA printer costs in a range from $1200 to $2900, and the cost of quality FDM material ranges from $29 (US) to $60 (US) per kg roll. Once we add in an average number of failed prints, electricity (~150 Wh), and maintenance, we currently estimate a cost of $4.00 to $5.80 per hour based on 500 hours of printing per year. This figure does not account for operator time, and that becomes a rather large variable.

It is reasonable to us that an average per hour printing, including the PLA filament, in the setting we used above, is costing the printer owner/operator around $5.00 (US) per hour or about $0.09 per minute.

This means that printing all of the parts of the BB8 dome files, using the resolutions and settings outlined in this guide, requires about 65 hours. Excluding any large failed prints that time of 65 hours equates to a cost around $325 to the printer owner. Our experience confirms that cost as well.

We are not accounting for any post processing of the parts in either scenario, simply the printer operator removes the printed file parts off the printer build plate and moves on to the next file in the queue.

It seems logical us, that if someone asked another builder to print out all the Dome files for them, it is reasonable that the printer operator be reimbursed for his or her time to some modest level. If the printer owner/operator is a FDM service provider, $1500 is currently reasonable to the industry right now.

So what are we saying? Well as of this writing December 2015, we feel that a builder should be able to acquire all of the BB8 Dome pieces for approximately $400, unfinished with no post processing. That works out to about $1.67 per hour for operator labor or $6.67 (US) per print hour all in ($0.11 per minute). If nothing else the little extra will help the printer operator take their significant other out for a dinner to get away from the printer running for 65 hours.

We encourage printer owners/operators to offer to print files for others builders without a 3D printer! We'd like for non printer owner builders to think about the unaccounted for time that a printer owner is spending in dealing with things in printing of the parts.

We have collected a list of Printer Service Providers List that is in the share with all the files. This is a list of fellow builders that are willing to print parts based on an hourly rate. They have all agreed to print the files at our recommended settings.

If a printer owner/operator can print out all of the parts for $100, and the parts are of an acceptable quality to the new builder, great. If the printer/operator is going to do some post processing, i.e. sanding & sub assembly, and asks for a little more than outlined above as a value added service, fantastic.

If a printer owner/operator makes a cast of a finished part, for reproduction via another means, we're OK with that, as long the maker of the part is not charging more than the reasonable cost per hour for the printed part. Not that we could actually enforce it if we wanted to, we're just asking for common courtesy. The Golden Rule applies: treat others like you would like to be treated.

If a printer owner/operator offers to get some number of makers on a specific print file, as part of a specific "run" that's also a great idea to lower costs.

However, here are some things we're not OK with and we simply don't support:
1) If you try to sell these files to others.
2) If you list individual parts, complete sets of parts, finished parts on eBay, Craig's List, etc, whether it's an auction or buy-it-now created by the files we made available.
3) If you imply these parts are "official" in any way.
4) If you commercially "market" parts produced by these files.
5) If a printer owner/operator prints out the parts and lists the parts for sale beyond the reasonable cost factors that could be seen as a commercial use.
6) If a printer owner/operator routinely makes a practice of finishing the dome, body, or sub assemblies, including stocking all parts in quantities. That seems to be commercial use in our opinion

These are not rules, just actions we don't endorse and will not support. The key here is if this looks or smells like a commercial use or false representation, we don't approve of it.

Our goal here is to make sure the builder has reasonable options, and in the meantime, we'll keep an eye on this to see where it goes.

Now on to the good stuff…

-Tiny Panganiban & Michael Erwin

— Parts File URL Location —

To download the current version of this guide, STereo Lithography (STL) files, along with an Instructions Guide and Build checklist. Visit:

http://tiny.cc/BB8Builders

For group discussions on printing and building various droid replicas from the SW universe visit:

BB8Builders.club – Redirects to the FaceBook Group
Astromech.net : Home of the R2 Builders Club – Free membership

— Printing the Part Files —

If you read nothing else about printing these files, please note, in general we recommend you use 5 or 6 shells or approximately 1.2 mm, and hexagonal infill of 10% to 15% for all parts and a 0.2 mm layer height.

For several parts, the shell is used as a load spreading device similar to a fender washer. If you assemble the Dome & Body Magnet Mounts as outlined here there will be 272 kg (600 lbs) of magnetic pull pressure on a few parts.

The second reason to use 5 or 6 shells, is that you will be sanding many of the part surfaces to get them smooth. You need enough material to sand and not go through the shell, into the infill. That would effectively ruin the part. In our testing doing 5 or 6 shells added very little time to the overall print time.

Most of the files will be printed at 0.2 mm as outlined in the Part File Checklist. A layer height of 0.2 mm is a good balance of speed, detail and strength.

The only one that we think should be printed at 0.1 mm is the Radar Eye Internal, even then that can be printed at 0.2 mm layer height if you so choose, and will not really be too noticeable.

For finest finish, slowing extruder movement to say 60 mm/s (MakerBot default 90 mm/s), gives a better finish. In beta testing these parts we have seen a few be able to do 0.08 mm. If you live on Hoth (Norway) apparently, the testers there were able to print layers at 0.06 mm. However that meant a single dome panel took 54 to 57 hours of machine time to print. While it looks amazing, once you sand it, you won't be able to tell, except in the circles or panel lines of the Dome Panels. As mentioned above, using the recommended settings, you should be able to print all the dome parts in approximately 60 hours.

— Choosing Third or Quarter Files —
During our initial beta release, we became aware that a few of the parts were too big for some of the builder's 3D printers. Tiny rose to the challenge and made a special set of the files to print in quarters. If the standard "third" files happen to be too big for your printer's build area, look in the quarter files section.

This will not increase the print time, as much as increase labor to fit and finish.

PLEASE NOTE: Not all 3D printers are going to be able to print some of these parts. Our minimum supported print area size is 9 in. x 6 in. x 6 in. (22.5 cm x 15.25 cm x 15.25 cm) and many of the smaller parts can print on much smaller printers. However, we have made the larger files such as the Dome Panel available in quarter cut for some of the smaller platform printers. We don't recommend slicing the files smaller, due to the fact these are designed as parts, not a simple 3D model.

It also doesn't make sense to keep dividing the parts into smaller printable sections beyond what we have provided.

Large single piece files are available for experimentation only.

— Printing Filament Observations & Settings —

In order of our filament preference:

PLA
Cubicity voltivo ExcelFil PLA 1.75mm, also available in 3mm (2.85mm): Very opaque, nice satin finish. Use 1.75 mm for Thickness of Filament, TEMP = 230°C .Cubicity provides Simplify3D profiles for their ExcelFil filament. This is now our favorite filament and gave the best results of any of our testing. Cubicity has also setup a special page just for BB-8 Builders Club: cubicity.com/BB8

Along with discounts for the BB-8 Builders Club coupons are:
1) BB8DOME for either of the dome packs
2) BB8BODY for the body pack
3) BB8S3D for Simplify3D for $130

DeltaMaker PLA 1.75 mm: Opaque: Use 1.75 mm for Thickness of Filament, TEMP = 230°C to 235°C: While this was previously our favorite, the packaging leaves a little to be desired.

3DSolutech PLA 1.75 mm: Slightly translucent: Use 1.75 mm for Thickness of Filament, TEMP = 230°C: Best Value, however supply comes and goes, even Amazon runs out of this often. Amazon currently lists White & Black as unavailable, and may not be restocked.

Makerbot PLA 1.75 mm: Very Opaque Light Ivory or Egg shell colored: Use 1.77 mm for Thickness of Filament, TEMP = 230°C

UltiMaker PLA 3.00 mm: Nicely Opaque – White: Use 2.85 mm for thickness, TEMP = 205°C: Most expensive per Kg

JustPLA.com PLA 1.75 mm & 3.00 mm: Good Color

Gizmo Dorks PLA 1.75 mm: Slightly translucent: Use 1.75 mm for Thickness of Filament, TEMP = 230°C: Close match to color of 3DSolutech, however it seems to clog nozzles much more than the above manufacturers.

Gizmo Dorks PLA 3.00 mm: Slightly translucent: Use 2.85 mm for Thickness of Filament, TEMP = 210°C: Reports of clogging much more than what is acceptable.

HatchBox PLA 1.75 mm: Nicely Opaque & White: NOT RECOMMENDED CURRENTLY – Higher tendancy to delaminate on part removal from build plate. Several indications from a few different printers that we know have also confirmed. We're not sure if it's just a bad batch, or a bad formulation indicative of HatchBox. While the parts were on the build plate, the Hatchbox White PLA was one of the nicest colors we've printed with. We'll continue to monitor quality.

SainSMART PLA 1.75 mm: NOT RECOMMENDED – Has a tendency to be very brittle, we have not used the heated in water solution. Several times, it breaks right as it goes past the extruding feed gear. Which eventually leads to a clog, due to the filament breakage. While you might be able to get print for small prints, we would not recommend you leave your printer unattended or overnight.

eSun PLA 1.75 mm: Very translucent: NOT RECOMMENDED – reports of trouble with clogging. Odor is

somewhat offensive. While researching this, found reports of the PLA sometimes being ABS or having ABS mixed into the PLA filament. Packaging makes this filament look much higher end than it really is. It appears that eSun is rebranded as “in house store” brand at many retailers.

ABS
Many ask why we don’t just recommend ABS? We understand the perceived PROs & CONs of the use of ABS, which we’ll not discuss here. We’ve tried ABS and a few of the BETA testers have successfully used ABS to print the files. We just find that the ABS CONs, currently outweigh the PROs, and a few of the CONs, like part shrinkage, are very hard to overcome when you’re making parts that need to fit together.

PETG
Experimental. This filament has really started becoming available at a reasonable price. PETG has the PROs of both PLA & ABS, and as such we are currently testing PETG. It does require a lot of setting tweaks, and high temperature settings. Feel free to test it and let us know your experiences.

— Adhesives (Glues) —

While we prefer Bob Smith Industries brand of adhesives, many times BSI is re-labeled with an in store branded logo. (i.e. Hobby Town) However we find that “store branded” keep the label colors the same as BSI, unless it is rebranded Great Planes, Zap! or Hot Stuff.

Bob Smith Industries Extra Thick (Maxi-Cure) Cyanoacrylate (Pink Label)
Bob Smith Industries Gap Filling (Insta-Cure+) Cyanoacrylate (Purple)
Bob Smith Industries Thin (Insta-Cure) Cyanoacrylate (Blue)
Bob Smith Industries Super Gold Thin Odorless (Super-Gold) Cyanoacrylate (Gold)
Bob Smith Industries Accelerator (Insta-Set) Cyanoacrylate Accelerator (Brown)

We have not tested Bob Smith Industries Brush On (Plastic-Cure) Cyanoacrylate (Black)

Great Planes Pro CA – Ultra Thick Slow Set Gel (Light Blue Label)
Great Planes Pro CA – Thick Slow Cure CA- (Dark Blue)
Great Planes Pro CA – Medium Gap Filling CA+ (Yellow)
Great Planes Pro CA – Thin Instant Set (Green)

Loctite GO2 Glue All Purpose Adhesive – Thick - (CA)

Gorilla Super Glue – Thin - (Blue Cap/Blue Label)

Please read Joint Smoothing (Method 3) below for using CA to do joint smoothing.

— Using Helper Disks —

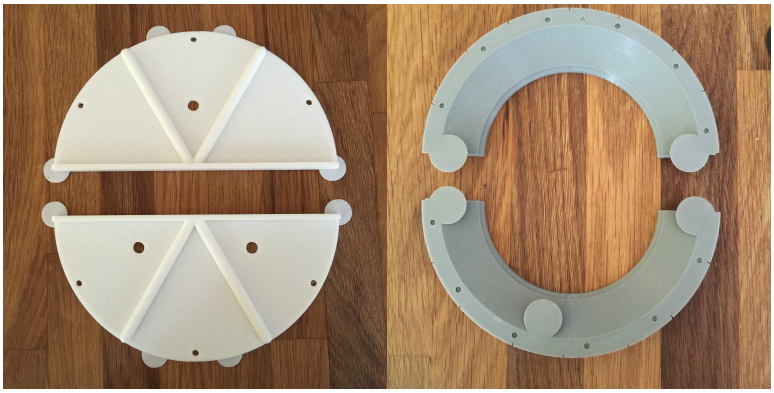
You will see references to “Helper Disks” throughout this guide. If you are new or maybe not to 3D printing, you might not realize what these are and how they are used.

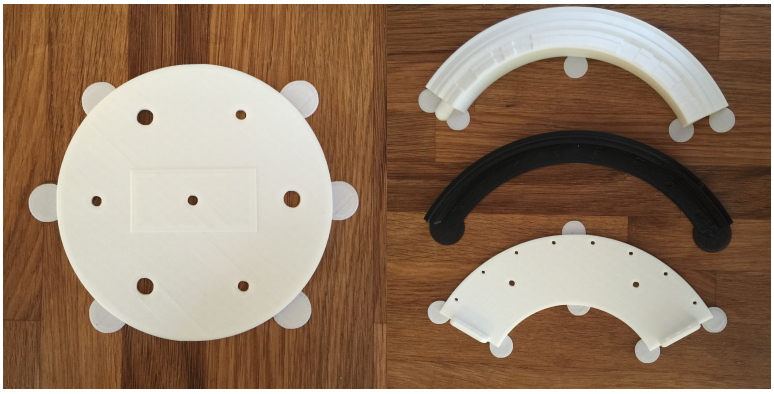
When PLA cools after being extruded on long straight, sometimes even large curved, parts, the PLA wants to contract as part of thermal contraction. The heated PLA begins contracting ever so slightly as soon as it begins cooling. This normally isn’t a problem for printing small parts, however on long straight run sections it can cause the part to pull away from the build plate.

Nothing is more of a time waste, as much as printing overnight, only to wake up and see the part is basically unusable.

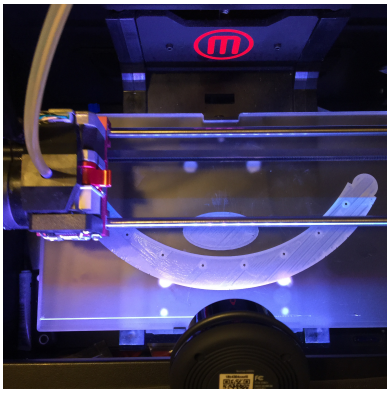
To help alleviate that issue, we place 1 mm thick round or oblong disks, onto the slicer software’s build platform prior to slicing. Most slicer software has a feature to add these helper disks. If not, just download some basic helper disks from Thingiverse.com, and add them prior to slicing the files for printing. We typically locate the disks where we think there might be a problem. For example, below left shows two Dome Plate sections. The top part has helper disks on the end, the bottom does not. Notice the distortion of the lower part. While the lower part may be fundamentally usable, it’s going to require a lot of work to get it presentable.

Here are the recommended placement of helper disks for various parts.





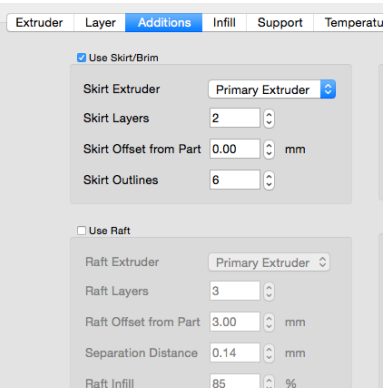
On Dome Panel 1, we typically make an elongated helper disk to place slightly behind the Radar Eye. This gives the support structure a nice PLA base for the printer to print the supports on as shown below.



— Simplify3D Skirt/Brim —

We highly recommend everyone consider Simplify3d.com Printing & Slicing software, regardless of the make and model of the printer used. As of this writing the cost is $149, and they do not offer a trial version. Having said that, this is an essential upgrade in our opinion. The quality of the prints, supports, simple and advanced features are well worth the investment. Changing the slicer many times dramatically improves the quality of the print.

Instead of using helper disks, Simplify3D allows you to add a skirt or brim to the part. By default, Simplify3d prints a 2 outline brim around the part offset 4 mm as a boundary. However, if you adjust the offset to 0 mm, and increase the outlines to 6 this will suffice as one huge helper disk around the part. To use, edit the Process you're going to use, for this example Process1 (FFF). Move to the Additions section, select Use Skirt/Brim, set Skirt Layers 2, Skirt Offset from Part 0.00 mm, Skirt Outlines 6



— Non-Manifold Models —

Repetier software may occasionally report that a few of the models may be non-manifold, meaning holes in the model. We have tested all of the model files with various other manifold checkers and we are not finding the issue. We also do not use Repetier software. However we have had no reported model printing issues with the files as of 24-Sep-2015. We'll continue to monitor to determine if there is a real concern or not.

— DROP of Canola Oil Magic —

If you are having missing layers and general issues with your PLA, we recommend using a very small amount or a small drop of Canola oil on the filament.

For all the PLA parts shown on FB & Astromech, we started each print by putting either a drop of Canola (ONLY USE CANOLA) on the filament end when changing filament, or using a paper towel soaked in CANOLA, to wipe down the first 2 - 3 inches (50 - 75 mm) of filament before inserting into the extruder, especially Delta Maker & 3D Solutech PLA filaments. The Canola oil has a very high smoke temp, so it will not smoke under normal temperatures of < 280°C.

Some of the new printers have smoother (lubricity) extruder filament tubes, and this shouldn't be needed, but just remember, it only costs a few dollars for a HUGE bottle that you're never going to use all of anyway.

— Surface Smoothing —

After gluing the parts together, you will want to smooth the outside surfaces.

We've tried 3 methods for smoothing the parts.

1. Vapor Smoothing: We **cannot** recommend or endorse the use of either "vapor" smoothing by using Acetone for ABS or THF for PLA. This "Breaking Bad" technique smooths by melting the plastic. If you have not heard of "Vapor Smoothing" it requires you to boil a chemical and then place the part in the "vapors" of the boiling chemical. Simply put, this isn't safe, good for your health or the environment, and it smells terrible. Since it melts the PLA or ABS, long term no one really knows for sure what's going to happen to the PLA or ABS. It about killed us; so please don't do this if you care about yourself, your family, your home or the environment.
2. Smooth-On XTC-3D (epoxy coating): This is an interesting epoxy based product. However, its use changes the dimensions of the parts WAY too much to compensate. It's good for single stand alone parts when you don't care about exact dimensions.
3. Sanding: Our preferred and best results come from using a simple Filing and Sanding.

First use a mill file to rapidly remove rough edges from parts.

Second, invest in a 5inch Random Orbital Sander. An example is the Rigid 5 inch Random Orbital Sander available at Home Depot: https://www.ridgid.com/us/en/five-inch-random-orbit-sander. It really works great. Some of the newer sanders have a fine dust collection filtration system.

Start with 100-120 grit pads, (btw I liked Norton vs. Diablo pads. Norton also leaves a very light yellow sand color in the finish (Jakku dust?), Diablo pads give the surface a RED tint). Sand until the surface is smooth to the touch, erasing all layer lines, ringing effects and any filament zippers.

Finish with a 220 grit paper and this leaves the parts with a great finish for paint adhesion, and in general it makes the part feel cast rather than FDM printed.

Plus, this works great to remove the bad Rustoleum White Satin when the "new and improved Nozzle"

sputters and ruins your parts.

NOTE: We've tried using as low as 60 grit paper. **DON'T DO IT!** While it is much faster, it is so fast that it will eat right through your parts. I have also tried higher grit, as much as 1500 grit. It seems to be a waste of time, but it's your time and your droid, it won't hurt. It just makes the finish feel like cheaper plastic injection molding.

— Joint Smoothing —

We recommend two methods that work very well for us during prototyping.

Method 1: PLA Welding
To completely make the seams disappear, use 1 inch of PLA inserted half way into your favorite rotary tool around 4000 to 5000 RPM. If you take your time, you can use that rotating piece of filament as a welder, Heat is produced from the spinning friction between the rotating filament and the seam, the PLA will melt and make a perfect weld, just like metal. After letting the weld cool and set, use a fine file to clean up the bead. It's kind of fun doing this method, plus it sounds cool that you welded with PLA.

Method 2: Tamiya Plastic Model Putty in White. Apply with X-ACTO blade, makes a smooth seam. With a little practice this is the fastest, safest, and easiest method with very smooth results and less post work.

Method 3: Gel CA & Accelerator. Apply thick gel CA to the joint as smoothly as possible. Spray joint with CA accelerator or kicker. Easy to sand, provides rock hard joint and provides for very fast build.

— BB8 Dome —

The dome is designed to work with both our “Stage” and “Static” body designs. (Yet to be released)

NOTE: If you are going to use the “Plan B” Body decals, we recommend you not paint orange sections of the dome until you can color match the orange ring color on the decals. Decal and sign printers do vary in color.

We have spent untold hours with our interpretation of the designs. We have noticed several things on the stage & static droids that honestly bug us (we might be a little OCD). However, we have duplicated those “features” in our interpretation to the best of our ability. We simply do not have the massive data points that currently exist with R2 or the other droids. We might be off by a mm here or there. We can guarantee it’s not perfect since we are human after all.

— Printing FDM PLA & Parts Print Order —

Based on our experience and those of some of the beta testers, we are providing a recommended printing ORDER to reduce changing the filaments. We have broken the part print order into 2 colors of PLA – Black & White - and provide an indication of those you might want to print in Gray (or Grey as JoyMonkey would say).

We have listed what we feel are the easier to print parts first, to allow those new to 3D printing to gain some experience before getting to the larger, time consuming pieces. Simply put, if you are having a hard time printing the HP, you’ll be really frustrated by starting with the large Dome Panels. Get your printer settings for the HP correct, and the larger pieces will be much easier.

- Black PLA Parts -

BB8 HP - print at .1 mm - No Helper Disks are needed, carefully make sure the CROWN details are clean and strand free. However, some printers or slicers don’t quite finish the crown details. In those cases, you can use a small jewelers sharp edged file or better yet, use luthiery gauged nut slotting files or Mitchell abrasive cord. These are available from Stewart-MacDonald @ stewmac.com part numbers #0821, #0823 and #6125.

PSI - .2 mm - Print with Support. No helper disks are needed.
There are 2 pieces, print the larger housing piece at .2 mm. There is an inner white ring printed at .1 mm OR optionally fill the PSI ring cavity with paint for a smoother look. We find that filling the PSI ring cavity is easier and provides superior results. For that reason, we consider the printed white inner ring as optional.

BB8 PSI Rear Cover – New part as of v22. print at .2 mm - No Helper Disks are needed.

Dome Pie Panels - print at 0.1 mm or 0.2 mm - Black, White or Gray. Use Helper Disks on the ends and use a 10 mm x 10 mm x 4.5 mm helper disk in the Antenna hole area for additional strength. Gray or Black PLA will help the piece look like metal if chipped. You will notice 2 holes in each end, to insert & glue 1.75 mm filament to help strengthen. Test fit before gluing and use a drill bit to enlarge the holes slightly. Make

sure to sand the outer surface smooth before painting. We recommend Hot Rod Gray primer to paint first followed by rub-n-buff Silver. Simply rub a very small amount on with your finger, and keep rubbing, it will turn metallic. You will also notice small 3.3 mm x 1.1 mm holes in the bottom of the pie panel ring. Those are for you to insert & glue magnets to allow you easy access by removing the pie panel & top of the dome to work on electronics or make changes. It will require you to also install magnets into the top of the dome panels.

Antenna 2 (Lower whip antenna) - print at .1 mm - actually 3 parts, but 4 pieces are needed, the top piece should be printed twice. Helper Disk are required on the ends of the bottom halves. Don't remove the helper disks from the part until after gluing the halves together. You will need to use a 1/16 inch (1.5 mm) drill bit to ensure a clean opening on the top end of the assembled bottom half, as well as the top wire protector. We recommend a 5 7/8 inch (150 mm) length of 1/16 inch (1.5 mm) spring steel for the wire section of the antenna. Once inserted into the base and top, it will be the correct height.

BB8 Radar Eye Surround - print at .1 mm - (Gray PLA) - No Helper Disks are needed. There are several optional files for this part, some may wish to do the surround in 2 pieces - the outside surround, and the internal base. This allows for ease of painting, if you choose to do the base flat black. The outer surround needs to be Hot Rod Gray Primer, then when dry, lightly buff with a dry paper towel or cloth, which gives it a machined look.

BB8 Radar Eye Internal - print at .1 mm - No Helper Disks are needed. To clean up any little filament whiskers in the internal details use a file card or a small wire brush. Paint Internals with a flat black. Once paint is cured, glue to finished internals. I prefer Hybrid GO2 or a GEL CA glue for this connection. Then install 6 x 3 mm LEDs, with or without flanges. Hold LEDs in place by a touch of hot glue into the holes.

OPTIONAL LARGER RADAR Internals, to some, the internals look larger, so we have made an optional larger version that works with the same 75 mm Eye surround. Follow the same instructions as above.

Dome Ring - print at .2 mm, 0.1 mm resolution is a waste of time in our opinion. Black PLA will help the two painted silver rings look like metal. Helper Disks may be required on the ends, depending on the adhesion of the PLA to your build plate. Make sure to sand the outer surface smooth before painting or using rub-n-buff Silver (our preferred)

- White PLA -

Antenna 1 (Top Rubber Duck antenna, looks like 2.4 GHz Antenna) print at .1 mm - WHITE PLA - Use helper disk on the very ends. Don't remove helper disks until after gluing the halves together.

Dome Top - print at .1 mm - WHITE PLA - The reason to print this in finer resolution is that it will be the dome top. At lower resolutions you will distort the top trying to sand smooth. Use support and place 8 small helper disks around the perimeter. I also like to place a larger 30 mm helper disk directly in the center, this helps with removal from the build plate as well as being used to hot glue the part on a flat wooden stick to help paint. No need to remove the supports; just cut the helper disks that go beyond the normal edge away. A future version of this part will not need support or the helper disks.

Dome Panels - sectioned into 3 pieces - print at .2 mm - White PLA, 6 shells - it's a 3 part collection that

will need to be assembled and glued to make the majority of the dome. Print with Support and Bridging. On my MakerBot Replicator 2, I set the slicer to only add support over 80 deg angle. This will allow bridging support. I used helper disks on each end and the inside middle. Careful placement will allow for easy removal. Also recommend a 100 mm x 30 mm helper oval, placed about 2 cm behind the inside ring mounts. This will provide a base for the bridging supports. Print times, range from approximately 10.5 hours for Panel 1, to 12.75 hours for Panels 2 & 3.

You will also notice small 3.3 mm x 1.1 mm holes in the top of the dome panels. Those are for you to insert & glue in magnets to allow you easy access by removing the pie panel & top of the dome to work on electronics or make changes. It will require you to also install magnets into the bottom of the pie ring.

Dome Skirt pieces - print at .2 mm, Ditto - White PLA - 3 or 4 large sections, that once assembled makes a rather large part. Larger helper disk may be required on the outside ends.

Dome Magnetic Mount (aka DMM) System, with integrated custom Caster parts - .2 mm - no helper disks are required. Do not paint. Interestingly if you don't weather the bottom or the large magnetic mount, it seems to disappear under the dome. Weathering makes it show up more, just like it does with the dome panels.

Dome Plate - .2 mm - no helper disks are required. Do not paint, again like the DMM, if you don't weather the bottom of the dome plate it seems to disappear under the dome.

- Radar Eye Lens -
Cut an 80 mm clear "ornament" Sphere (available on Amazon 12 @ $9) at 68 mm for the Radar Eye lens. It is a tight fit, so make sure the paint on the surround is well cured. Be patient. Install a single 3mm red LED in the Radar Internal before installing the lens. Make sure the inside of the lens is TOTALLY clean before mounting.

If you like a fatter lens look and you believe the 80mm is too flat of a profile, use a 70mm lens cut at 68mm same as above.

In some photos, BB-8's radar eye lens appears very clear. If you prefer smoked lens like R2's Radar Lens, there are several solutions to do that such as Testor's Smoked Window Tint aerosol spray.

- HP Cobalt Blue/Purple/Black Lens -
Congratulations you actually read this guide! GET A FREE BB-8 HP LENS. Once you have the BB8 HP printed, post an image on Facebook BB8 Builders Club and/or send Tiny or Mike an image of your BB8 HP along with your shipping address via FB messenger or PM on Astromech.net and Mike will send you a custom translucent Cobalt Blue resin 20 mm lenses for your HP for free. Supplies are limited.

— Hardware Parts Needed: DOME —

We used McMaster-Carr to order here in the US.
You could simplify this somewhat and possibly save a little money, however I liked the look of the brass and white PLA for the Dome Magnet Mount.

McMaster-Carr
1x 92095A183 18-8 Stainless Steel Button-Head Socket Cap Screw, M3 Size, 12 mm Length, .5 mm Pitch, packs of 100
1x 93625A100 18-8 Stainless Steel Nylon Lock Nut M3 Size packs of 100

NEW DMM Integrated Caster Parts
1 x 9660K37 Extreme-Temperature Slippery PTFE Ball (Pack of 50)
3 x 9660K33 Extreme-Temperature Slippery PTFE Ball

Magnet4less.com
6x ND060-TH 1in x 1/2in Disk Counter-Sunk (3 for Dome, 3 for Body)
2x ND073-T 2in x 1/2in Disk Counter-Sunk (1 for Dome, 1 for Body)

For the Dome Panel to Pie Panel Ring magnets we have tried:

Magcraft – Available at many U.S. HobbyTown hobby stores
Model NSN0592 Rare Earth (N40) 1/8 in. x 1/32 in. (3.2 mm x 0.8 mm) Disc Magnets (150 Pack).

K&J Magnetics
3x D201-N52 1/8in. x 1/32in. (3.2 mm x 0.8 mm) N52 Disc Magnets (10 Pack) – Stronger than Magcraft!

Regarding the magnets, always attempt to get the strongest N rating you can. The higher the number the better, N52 is much stronger than N40.

— Paints Needed —

NOTE: If you are going to use the “Plan B” Body decals, we recommend you not paint orange sections of the dome until you can color match the orange ring color on the decals. Decal and sign printers do vary in color.

- White -
For those white parts that are seen, we’ve come to like Krylon Satin White. While we’ve tried Rustoleum satin white (most builders use on R2-D2 for his white paint), however it has a new nozzle, and the new nozzle on the Rustoleum can spatters the paint after a few moments of painting. We have tried hot & warm water baths for the can, 10 minutes in a shaker, spray 30 second, shake for 2 minutes. It should not be this hard to use a can of spray paint. That’s the point of buying a can of spray paint. Just buy the Krylon Satin White or similar, and you will be in good shape.

- Black -
Used to seal the Dome Ring prior to applying silver rub-n-buff or silver paint. We also like Brian Munger’s use of black paint on the inside of the dome panels to prevent any LED illumination from showing through the dome panel.

- Orange -
We’ve tried all the canned spray oranges available here in the US and none of them look right to our eyes. We’ve tested various available off the shelf Oranges here in the US as well. It seems we don’t have an exact purchased paint, available in the US. If you order custom mixed spay paint cans, Pantone 715C, seems to be a very close match.

Thanks to Francis Assis, what we have come to love is using Tamiya’s Acrylic X-6 Orange 10ml bottle & adding ~0.5ml to 1ml of Tamiya’s Acrylic XF-49 Khaki or XF-59 Light Khaki. This de-saturates the Orange to be more representative of a desert lighting condition. To be fair, Francis actually recommended MR Hobby Paints H14 with a small amount of H404 for the de-saturate, however we’ve had an impossible time acquiring these MR Hobby paint colors here in the U.S.

The Orange will still be a little light or bright to the eye, however once you start weathering it looks great.

The Tamiya Orange paint is super easy to airbrush, just thin about 2:1 with Tamiya thinner. If you needed a reason to get a decent airbrush, well this is one that is a great start for it.

- Silver -

We preferred the appearance of Silver Rub-N-Buff. It has carnauba and silver paint, and is best applied with a very thin film on your finger or hand.

- Acrylic Clear Coat -

While technically not needed, we really like applying a nice acrylic clear coat before applying weathering. It gives it a nice shine under the weathering, making it look more realistic. Just be aware that clear coats seem to make all Chrome paint surfaces turn gray. So please test before using.

- Weathering -

There are scenes of R2 weathered, even dented, as well as him looking shiny and new. BB-8 just doesn't look right looking pristine. The weathering really brings out his character. Until the weather is on, many features of the dome panels just don't appear. That absence really affects the overall look of BB-8.

Examine and study the images from SWCA of the stage and static versions. You will notice the weather is slightly different on each. Also there are a few shots in the trailers, that weathering doesn't match either the stage or static. We expect that it is either a puppet droid, like they did with R2, or a CGI version.

We started out with numerous layers of simple washes, followed by slightly heavier weathering including fluid drips and runs. Then the really heavy stuff and wipes in between.

For washes we used very thinned (5+ thinner :1 paint) acrylics Raw Umber, Raw Sienna, Burnt Umber and Burnt Sienna. DO NOT USE BLACK, it's just too much. Do multiple layers of wash, make sure to get into those panel lines, then use a paper towel to wipe off.

Apply Wash
Wipe off runs
Let dry
Repeat

The more and lighter layers you can do, the more realistic it seems to look.

Use thicker amounts of paint, in the corners, think how you would wipe down if there were an oil leak.

If you can find a copy of Cory Pacione's Droid Weathering video from DroidCON 1, or Dan Baker's video from R2-Atl MegaBuild 2015, both are a great help.

Don't forget to do the dome skirt!

Use a Tamiya XF-59 Light Khaki (sandy color) wash to give it some sand blown look, especially on the front, in the crevices.

NOTE from Mike: It seems to me, when I was testing weathering on the magnet mount housing or the bottom dome plate, it made the dome NOT appear to be "magically floating". So on the prototype finished dome, I did NOT weather or paint the Lower Dome Plate or the Dome Magnet Mount, other wise I did rather heavy weathering everywhere else.

— Dome Assembly —

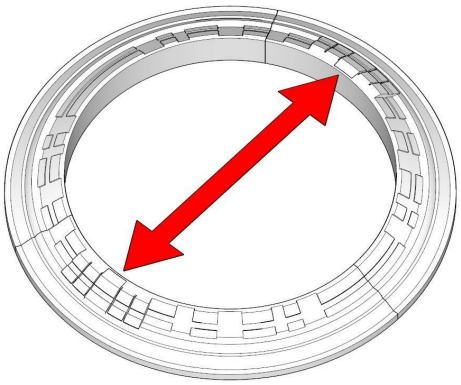
Verify that you have all of the printed parts and hardware needed. Use the above hardware list and the current checklist file on the share.

Estimated build time for the dome is 6 hours, excluding painting and weathering.

We're going to assemble from the outside, bottom up to top, then go inside.

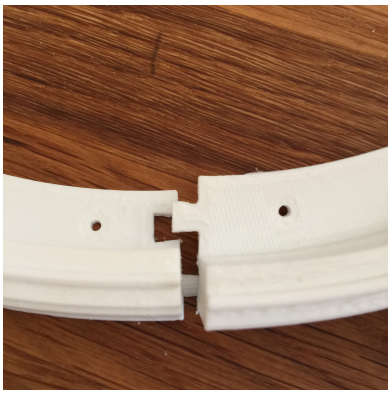
Dome Skirt (3 pieces) - This completed piece will look like it's floating above the body sphere, because it is.

There is an order to this, arrange the 3 pieces so it looks like the following. You may have to sand the key & slot areas to get a nice tight fit. Notice the top & bottom of this picture, there are extra little raised areas on the front and back which should be assembled opposite each other. Make sure when you glue this together with thick GEL CA that you place it on a flat surface covered in wax or parchment paper. The joint should be very clean, and almost disappear if done correctly. Leave this sub-assembly to cure, and you will glue this to the Dome Ring, much later.



— Dome Ring —

The Dome Ring (BLACK PLA) is composed of 3 identical parts. You will notice these are a little trickier to join together due to the key on each end. Flush cutters are a great help in removing helper disks, however just remove a little at a time, or use the flush cutters to score the helper disks first before cutting all the way through the part. Take your time and file the key & slots to get a perfect fit.


Do not glue until all the pieces fit nicely and lay flat. Glue and allow curing on parchment paper. It's critical this piece be as flat as possible, with holes down. You will notice a raised ring that will fit down into the Dome Skirt, and the holes face up and will align with the mounting holes on the bottom of the Dome Panels. If you notice pictures from SWCA, there are slots cut in the dome ring under the Radar Eye or the HP. You can either fill in the large joint seams with Tamiya model putty, or PLA weld. Sand the outside surfaces now if you wish.

Using either a 1/8 inch or 3 mm drill bit mounted to a drill, ensure all of the outer ring holes are at least 1/8 inch or 3 mm in diameter.

— Dome Panels —

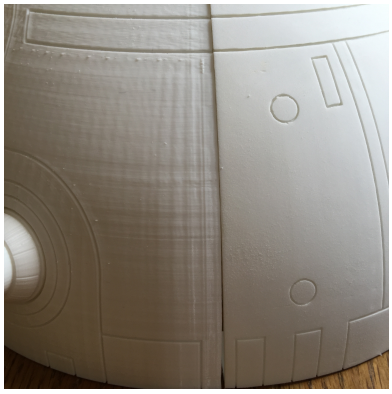
The Dome Panels are composed of 3 different panels or possibly 4 if you have a smaller volume printer. We recommend you sand the outside of the Dome Panels using the orbital sander technique with 120 grit (approximately 10 minutes) followed by 220 grit (approximately 5 minutes). Dome Panel 1 is the one with the Radar Eye, from above going clockwise, joined to Dome Panel 2, joined to Dome Panel 3 (which has the mounting hole Antenna 2 Black whip).
Here in the first photo you see Dome Panel 1 (left), being shown with Dome Panel 3 (right). Dome Panel 3 has been sanded.

Use a small stiff bristle brush or carefully with a hobby knife, remove any filament that clogs the panel lines after sanding. You may wish to use a hobby knife #11 blade to carefully clean up any circles or line imperfections.

In the second picture you will notice there are small holes molded into the edges of the dome panels. These holes allow you to insert and glue 1.75 mm filament into them, strengthening the joint. Prep & clean the hole by using a 2 mm drill bit, test fit filament into the holes, leaving about 4 mm exposed. Place the

Dome Panels on parchment or wax paper. Test fit the dome panels together, WITHOUT gluing. Adjust the filament length until the panels fit flush as shown in the first picture. Once you're satisfied with all three panels fitment, glue the filament into one panel side only.

Using thick GEL CA, insert glue into the hole of the other panel, and all along the seam edge, including the internal mounting ring. With CA on both panel edges, press and hold until the CA cures. Continue to work around the dome, using the same process until all panels are glued together.

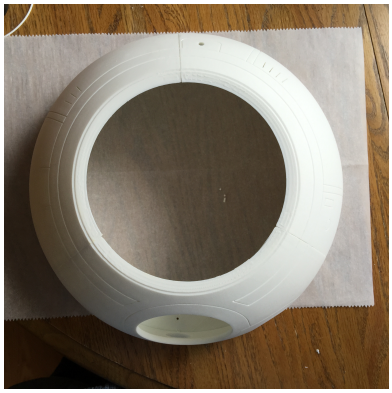



Ensure the glued panels cure on a flat surface.

Fill in the 3 dome panel seams, with either Tamiya White model plastic putty or with a combination of filament welding. Make sure you use the same make and color of filament you used to print the Dome Panels. This technique of spinning PLA or ABS in a rotary tool is quite effective. Both surfaces along with the PLA weld are melted together, forming a very solid bond, reinforcing the CA glue.

Sand the outside seam smooth with the random orbital sander technique introduced earlier. You can use the Tamiya white model putty on the inside seam.





Make sure the top of the dome panels are smooth, however there should be an approximate 1 mm raised surface above the top of the Dome Panel top plane. This will be used to put a 1 mm gap in between the Dome Panel and the Pie Panel ring. Carefully, hand sand the top of that raised surface smooth, with 320 or 400 grit. This will be the raised surface that the Pie Panel Ring will be affixed via the 1/8 inch x 1/32 inch (3.2 mm x 0.8 mm) disk magnets.

You may glue in and install the magnets now or after painting.

Remove the bridging support in the LED "logics?" windows, and clean up any rough angles or edges with a

small flat hobby file. The picture below shows the support bridging still in the “logic” windows.

Using either a 1/8 inch or 3 mm drill bit mounted to a drill, ensure all of the bottom outer ring holes are at least 1/8 inch or 3 mm in diameter.

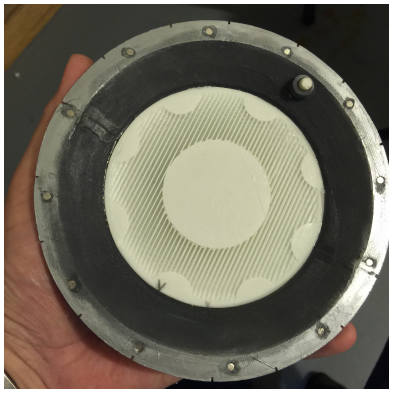
— Pie Panel Ring —

Typically these are either Black or Gray filament. These are two pieces that form a key visual element on the dome. The front ring panel and has a small arrow indicator on the middle bottom. This arrow will point to the Radar Eye opening. The rear ring panel has the Antenna 1 (White Stubby) mounting hole as well as the parallel circle feature.

Sand, via the Orbital sander method, the panel halves to remove all circular filament printer marks. The better you remove these marks, the more metallic these will look when finished. **Be careful** handling as you sand since the panel lower outside edge tends to get sharper as you sand, the extruded filament holds an edge quite nicely.

Like the dome panels, you will notice there are two holes molded into the adjoining edges. These holes allow you to insert and glue 1.75 mm filament into them, strengthening the joint. Prep & clean the hole by using a 2 mm drill bit, test fit filament into the holes, leaving about 4 mm exposed. Place the Dome Pie Ring panels on parchment or wax paper. Test fit the two pieces together, WITHOUT gluing. Adjust the filament length until the panels fit flush. Once you’re satisfied with both ring panels fitment, glue the filament into one panel side only. Then using thick GEL CA, insert glue into the hole of the other panel, and all along the seam edge. With CA on both panel edges, press and hold until the CA cures. It’s critical to keep this piece as flat as possible until fully cured.

You may install and glue the 1/8 x 1/32 inch (3.2 mm x 0.8 mm) magnets into the bottom recesses of the Pie Panel ring now or wait until finished. Ensure the magnetic poles are aligned to attract the magnets in the Dome Panel.

Set aside to allow the CA to cure.

— Dome Top —

Remove any helper disks on the outside edge.

Since it's only one piece, just sand smooth using the Orbital Sanding technique used before. Clean the panel outline with either a stiff bristle brush or a hobby knife edge.

If you haven't noticed before, the Dome Top has protrusions on the inside front (wide) and rear (thin), and fits SNUGLY into the Pie Ring, in one way. You will now notice there are indentions on the inside top of the Pie Panel ring that aligns the dome top.



You will need to use a half round file to remove material slowly from the inside of the Pie Panel ring, slowly working your way around the inside groove on the Pie Panel ring. You may also need to file the lower outside edge of the Dome Top. Be careful not to hit the finished surfaces. Do this until the Dome Top fits firmly and snugly into the Pie Panel ring.

Do **NOT** glue the Dome Top into the Pie Panel ring.

— Dome General —

If you installed the magnets into the Dome Panel and Pie Panel ring, this is a good time to test fit. Make sure all magnetic poles are oriented as to attract each other.

You should notice an approximate 1 mm gap between the bottom outside edge of the Pie Ring and the upper outside edge of the Dome Panel. We want that gap.

With the Dome Panels and Pie Panels, use the orbital sander technique, with a 220 grit pad installed, to sand the edges of the Pie Panel to make a smooth transition to the Dome Panel.

Now that the upper parts are fitted, time to paint.

—Dome Panel Assembly Painting—

Apply a few light coats of the white of your choice as discussed in the prior section on Paints Needed.

Mask the panel lines, referring to reference pictures from SWCA.

An easy and accurate way to mask the panel lines is to use 2 inch blue 3M painter's tape over the entire panel. Firmly seal the tape onto the dome and use your fingernail to outline the panel through the tape. Carefully, using a hobby knife with a new #11 blade, trace the panel to be painted orange with the blade. Remove excess blue tape.

Cover all remaining surface area with either paper or a Press & Seal plastic wrap.

Use your airbrush to paint the orange panels.

Let the paint cure for about 10-15 minutes, remove the wrap & blue masking tape.

Set aside to cure for a few hours.

Then do the same masking technique for the outer ring around the HP opening, using the Hot Rod Gray primer.

Set aside to allow the paint to cure.

— Painting Pie Panel Ring —

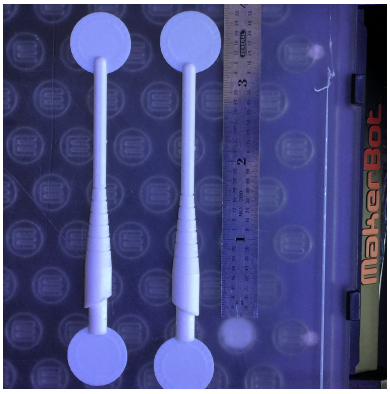
Paint the Pie Panel Ring either flat black or, to our eye, the preferred Hot Rod Gray Primer.

To make the Pie Panel Ring look metal, we've found the best results by using Silver Rub-N-Buff. The best application technique we've found is to place a dollop of the Rub-N-Buff on a paper plate. Using your index finger, smear a small section of the Rub-N-Buff dollop, across the plate. This will leave a small film on your index finger tip. Then begin lightly rubbing your finger in the section of the ring.

The Rub-N-Buff, will initially feel like paint, then turn slightly gummy or tacky. Continue rubbing, in the same direction, it will become like a metallic shiny surface. Keep doing this until the entire Pie Ring surface is covered, including the underside edges. By using your finger it appears the heat from your finger melts the carnauba wax in the silver and aids in the appearance.

Set aside to allow the paint to cure.

— Antenna 1 —
Antenna 1, the upper white stubby one, is composed of two pieces. While this is most likely a found piece, there are some unique grooves on the antenna, that makes perfect piece alignment easy.



Lightly hand sand with 400 grit, the wide flat side of the two (2) antenna pieces. You may wish to leave the helper disks on the antenna pieces until finished gluing.

Carefully & neatly apply a thin coat of GEL CA to the internal wide areas of the two antenna pieces. As you move the pieces together, align the grooves and edges as closely as you can. Press & hold for 30 seconds along the length of the piece. Remove with a paper towel any CA that has been forced out from the two halves.

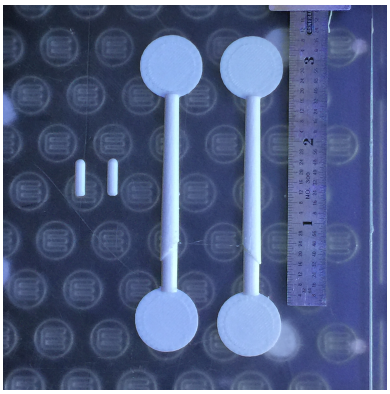
Sand the entire antenna to give the antenna a uniform look and fit.

Test fit Antenna 1 into the hole of the Pie Panel ring. The hole may have a small helper disk at the bottom. That will require you to drill through from the top. Start with a 2 mm or 1/8 inch drill to make the initial hole. Enlarge by increasing the drill bit size until the hole is open to match the inner dimension of the upper hole. Sand the lower mounting section of the antenna until it fits and seats into the Antenna 1 hole in the Pie Panel ring.

Do NOT glue antenna into the mounting hole, until finished painting.

— Antenna 2 —

Antenna 2, the lower multi-piece whip antenna, typically made of black filament, is composed of 4 extruded pieces and a single 150 mm x 1.5 mm (1/16 inch) spring steel or music wire, if this is a static dome that will be a collector piece, replace the music wire with aluminum tube for a more accurate look. Shown below in white for clarity.



Do not remove the helper disk yet.

You will notice there is a groove on the inside of in the bottom and tip pieces that will be used for the spring steel.

Lightly hand sand with 400 grit the wide flat side of the two (2) bottom antenna pieces and the two (2) antenna tip pieces.

Carefully & neatly apply a thin coat of GEL CA to the wide areas edge of the two antenna pieces. Avoid getting GEL CA into the wire groove. As you move the pieces together, align the grooves and edges as closely as you can. Press & hold for 30 seconds along the length of the piece. Remove with a paper towel any CA that has been forced out from the two halves.

If you have not yet, remove the helper disks from the part.

Repeat for the two antenna tips.

Sand both entire antenna pieces to give the antenna a uniform look and fit.

Using a 2 mm or 1/16 inch drill bit ensure the hole for the wire whip is clear in both the bottom and tip. If you fail to do this, when you insert the wire whip into the section, the wire may not seat correctly or it may break the cured CA joint.

Test fit Antenna 2 into the hole of the Dome Panel assembly. Sand the lower mounting section of the antenna until it fits and seats into the lower Antenna 2 hole in the Dome Panel assembly.

If you wish to paint the antenna BLACK, mask off the mounting area of the antenna. Lightly spray a gloss or semi gloss black that is safe for plastics.

TIP: Use some scrap 2 mm wire to hold & turn the pieces when you paint.

Paint the Antenna tip piece the same color as the antenna base.

Once the paint has dried, insert the 150 mm x 1.5 mm spring steel wire into the pieces. If it's not fitting correctly, use the 2 mm (1/16 inch) drill bit to clear any obstruction. Once satisfied that the wire fits correctly, carefully insert GEL CA into the base hole, and place a thin film of CA on the end of the wire approximately 2 cm long (1 inch).

On the tip end of the wire, test fit the antenna tip,

Glue the antenna tip onto the wire. Set the piece aside to cure.

Do NOT glue antenna into the mounting hole, until finished painting.

— Radar Eye —

The Radar Eye assembly is constructed from 2 or 3 printed parts along with a purchased 70/80 mm lens. The Radar Eye Lens is either 70mm or 80mm plastic 2-part ornament. These are available from Hobby Lobby for $1.79 (US) or Amazon in a box of 12, which will give you 24 lenses.

In the simple configuration, shown above, the Radar Eye Surround has an integrated base for Internals mechanism. In the optional 3-piece configuration, it is comprised of separate Surround, internal Base and the Internal mechanism. This allows for an easier way to paint base separate from the Surround and Internals.

For the Internal mechanism, you have the option of either a smaller or larger size. Both sizes will fit either Surround design and currently it's our feeling that larger might be more accurate. However it is your droid.

For either Surround configuration, use the Orbital sander technique to sand the entire outside smooth, with special attention to the visor top. Do not worry about the back of the simple surround or the back of the base; those surfaces will be inside of the dome when finished. The smoother you can get the outside, the better. To get the prongs smooth, use a medium foam-sanding block. Depending on the printer and filament, these may be a little brittle. It typically takes us as much time sanding the Radar Eye Surround as it does the entire dome.

For the internal mechanism piece, use a file card or soft wire brush to remove any filament whiskers from the details. This piece will be painted flat black later.

If you are building the 3 piece Radar Eye, sand the inside floor of the base smooth. This will also be painted flat black later.

Make sure the base fits snuggly into the surround. File or sand to ensure a proper fit.

You'll be assembling and gluing the parts later.

You will be required to cut the radar lens so that it fits into the 68 mm space inside of the prongs. At 67 or 68 mm, the plastic lens will fit into the prongs.

To cut you can use a compass and draw a 68.5 mm circle, and cut a ring with a plastic cutter bit in your rotary tool. Then using a flat file, carefully remove excess from the lens, until it has a diameter of 68 mm.

You may also print the lens cutting helper tool or print out a helper disk 68 mm in diameter, 4 mm in height. Insert this into the lens hemisphere and mark the outside of the lens where the disk touches the hemisphere. Once marked, use a plastic cutting blade in your rotary tool to cut away the excess. Take your time, and go slowly and carefully. Let the tool do the work.

File the lens flat, by either using 600 grit sand paper on a flat surface, and sliding the lens cut edge across that, or by using a flat file. The flat file, gives better results but takes a little practice.

As you clean and flatten the lens edge, test fit the lens into the Surround.

To insert the lens, start by pushing the lens into the top of the Surround under the visor, the carefully apply pressure the to the lens until it gets past the prongs, and fits inside of the prongs and rests on a ledge on the inside of the prongs.

Test fit a single flanged red 3 mm LED, either red or water clear plastic. Insert into into the mechanism from the rear. There is a small lip inside the mechanism that should keep the flange of the LED from going too far. We want the LED to just extend into the first left opening, no more than 1 mm.

Do not glue lens at this time.

Test fit the Surround into the Radar Eye opening of the Dome Panel 1. You might need to remove a little material from the opening with a half round file. Go slowly, you don't want to remove too much. The Surround should fit very snugly, and be flush on the inside of the dome when properly seated.

Do NOT glue the Surround into the opening until after painting.

— Holo-Projector —

This is most likely the first part you printed, and a great part to start with. We recommend that you sand the raised panel surfaces smooth.

The crown might need a little sharp edged hobby or jewelers file, to clean up the points. Do not use a hobby knife to cut away the filament, it is too wide and will break off the crown prongs.

We suggest that you paint this with a dark flat gray. We prefer Dupli-color Hot Rod Gray Primer. Like we did on the Radar Eye Surround, once the paint has cured for a few hours, we found that if we take a dry paper towel and rub the primer gently, it gives the HP a nice worn machined patina.

You will need a 20 mm hemisphere for the lens. We have made a limited number of the lenses, in three shades of cobalt blue. We have a limited number of them and will have them at gatherings or if you check with us, we might be able to send you a set of three, so you can choose which one you want to use.

The outer diameter of the HP lens needs to be ~17.8 mm. Use a flat file to remove material from the back of the lens, and test fit into the HP as you go. Be careful not to hit the round outward section of the lens, the file will scratch it easily.

Glue the HP Lens in with thick GEL CA.

Test fit the HP into the opening of the Dome Panel 1. You might need to remove a little material from the HP opening with a half round file. Go slowly, you don't want to remove too much. The HP should fit very snugly, and be flush on the inside of the dome when properly seated.

Remove the HP and set to the side.

Do NOT glue the HP into dome HP opening.

— PSI —

Whether this is a PSI or not, we don't know, but that's what we're calling it until we figure out what it really is.

This is made of two parts, the black PSI housing, and an optional small white ring, PSI Ring, to inlay into the housing.

The PSI housing actually has an internal ledge, you will notice the opening on the front of the PSI housing is smaller than the rear. This allows you to place a white frosted lens in the PSI housing. If support was used when printing the PSI housing, you will need to remove the support material from inside of the rear of the PSI housing.

Sand the outside of the PSI surface fairly smooth.

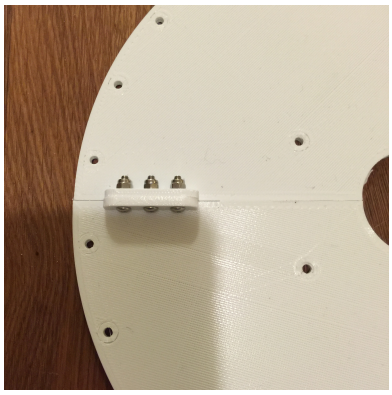
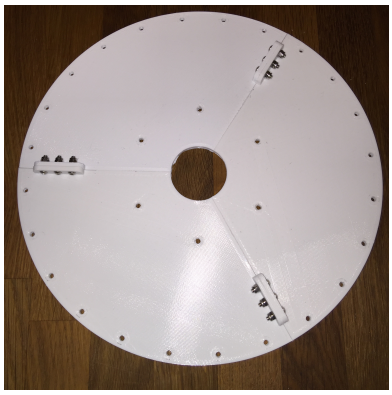
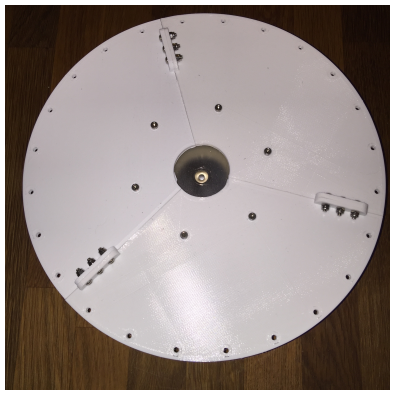
Sand flat & sand edge of PSI Ring to fit into the PSI housing. We did this for completeness, however you may wish to just inlay white paint into the recess in the PSI housing.

Test fit the PSI into the opening of the Dome Panel 1. You might need to remove a little material from the PSI opening with a half round file. Go slowly, you don't want to remove too much. The PSI should fit very snugly, and it will be flush with the outside of the dome. The PSI will extend inside of the dome when properly seated.

To make a PSI frosted lens, we recommend using semi translucent white plastic, such as a plastic milk container or similar. Cut the lens to fit into the PSI.

—Dome Plate —

This plate is made of 3 pieces. It is bolted together with 9 M3 12 mm Button Heads and M3 Nylon Lock Nuts. Recommend that you sand the bottom smooth with the orbital sander. We recommend that you DO NOT paint it. The outside holes will be used to mount the Lower Dome Plate to the Dome Ring and Dome Panels.

The 6 smaller holes will be used for the DMM Lite.

Using either a 1/8 inch or 3 mm drill bit mounted to a drill, ensure all of the outer ring holes are at least 1/8 inch or 3 mm.

Take the Dome Lower Plate and place the Dome Ring that you assembled earlier on top of the Dome Lower Plate. The Dome Ring should hang down below the Dome Plate.

Align the holes on the bottom of the Dome Plate with the holes in the Dome Ring. Using four 3 mm x 12 mm stainless button head machine screws, place the screw up from the bottom, through holes on the Dome Lower Plate into the Dome Ring holes, up through the bottom of the Dome Panel assembly.

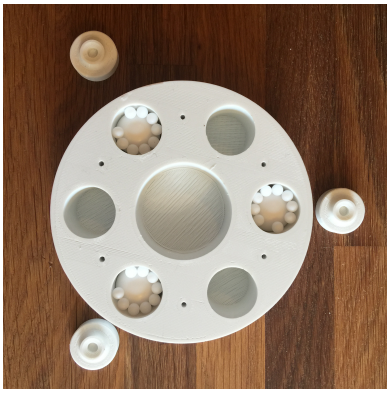
If the holes don't align all the way around, try to get them to align the best you can, then use the 1/8 inch or 3 mm drill bit, to ensure an open hole and that the Dome Ring, Dome Panels are as even as possible around the dome.

Take this assembly a part after making sure all the holes align or drilled to align.

— Dome Magnet Mount —

WARNING: The magnets we need to use are very powerful, and as such they will hurt you if you lose control of them. If you ordered the magnets from Magnets4Less.com, they no doubt came with a warning on the shipping box. Take that warning seriously. We recommend that you clear at least a 1 meter (39 inch) area away from ALL metal objects and wear leather gloves when handling. If you lose control of the magnets, you will want to have some way to remove them if they begin to crush your hand or fingers. PLEASE DO NOT LET YOUR KIDS PLAY WITH THEM, if you do you're a freaking moron, and we do not want you around others.

The Dome Magnet Mount Lite (DMM) is designed to provide integrated casters, keep the magnets aligned with the casters, and to be as light as reasonably possible.



Using the Orbital sander technique, sand the outside & bottom of the DMM smooth.

PLEASE READ THIS SECTION CAREFULLY AND FULLY BEFORE ASSEMBLY. Consider yourself warned.

The parts that make up the integrated DMM are the 1 inch (~27 mm) PTFE main ball, 9 x 0.25 inch (6.35 mm) PTFE ball bearings, and a printed DMM Caster Race. All shown in the picture above.

Place the 1 inch PTFE ball into the housing and place 9 x .25 inch (6.35 mm) PTFE ball bearings onto the main ball in the DMM housing, as shown above.

Place the DMM Caster Race so that it is smooth side up, and the center race is inside of the caster opening.

Push the caster race into the opening so that is flush with the top.

You do not need to glue the race into the DMM, since it will be held into place by the Dome Plate.

Additional thick GEL CA can be used to seal the top of the caster around the joint between the cap and housing. A small amount of CA accelerator can be applied to the cap/housing joint.

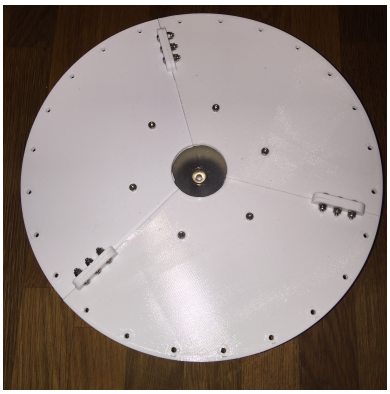
Repeat for the 2 remaining casters.

Document & mark the pole orientation of all the magnets. This will ensure that all magnets pull towards one another when you assemble the Body Magnet Mount system. We recommend that magnet poles be

oriented the same way in this updated design.

Cautiously place all the magnets into the respective holes in the magnet openings in the DMM. We recommend that you insert 2 of the smaller magnets, then use the dome plate to hold them in place, and insert the large center magnet, then slide the dome plate so as to retain the 2 small and 1 large center, then insert the 3 small outside magnets.

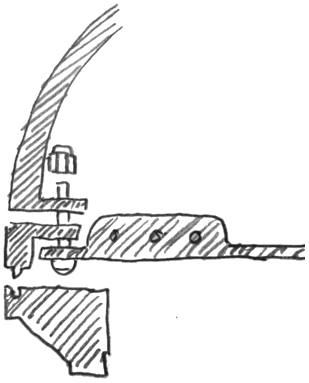
Use 6 x M3 12 mm Button Cap stainless screws or 6x M3 12 mm Socket Cap stainless steel screws, to bolt the DMM to the Dome Plate as shown below.



— Dome Plate —

We like the current height on the prototype, this gives the Dome Skirt a clearance right at 0.5 inch, and looks the best to our eye. However as always, it's your droid. If you find it low or high later on, you can add additional printed pieces to the top of the DMM to increase or decrease the height.

Take the Dome Plate assembly and place the Dome Ring that you assembled earlier, on top of the Dome Plate. The Dome Ring should hang down below the Dome Plate.



Align the holes on the bottom of the Dome Lower Plate with the holes in the Dome Ring. Using four 3 mm x 12 mm stainless button head machine screws, place the screw up from the bottom, through holes on the Dome Lower Plate into the Dome Ring holes, up through the bottom of the Dome Panel assembly. Repeat this for the other three machine screws approximately spaced ¼ a way around the dome.

Place a 3 mm nylon lock onto the 3 mm screw on the inside of Dome, in between the Dome Plate and the Dome Panel wall. Be patient with yourself, once you get the hang of this, it is actually faster than doing the "ship in the bottle" assembly. We've tried several assembly techniques, and this is still our favorite.

— Dome Final Assembly —

— Dome Skirt —

Install and glue with either thick GEL CA or an epoxy the Dome Skirt to the bottom of the Dome Ring.

— HP —

Install and glue with thick GEL CA the HP, making sure the rear of the HP part is flush with the inside dome wall. You may wish to match the panel orientation of the HP with photos from SWCA.

— PSI —

Install and glue with thick GEL CA the PSI, making sure the front of the PSI part is flush with the front surface of the dome panel.

Do not glue the PSI Rear Cover into place.

— Radar Eye —

Install and glue with thick GEL CA the Radar Eye, making sure the rear of the Radar Eye is flush with the inside dome wall. You may wish to match the orientation of the Radar Eye with photos from SWCA.

— Antenna Installation —

We mounted the Antennas before weathering. However you may choose to do this afterwards, just keep in mind where the antennas go, and the weathering around the antennas. Use thick GEL CA to install the Antenna 1 (White) into the Pie Panel Ring, and Antenna 2 (Black whip) into the Dome Panel assembly (Dome Panel 3 specifically).

— Weathering —

It would seem that weathering would be impossible to do incorrectly. Try to keep it natural. Make sure you layer the washes and thinned paints numerous times. Do not use oversaturated colors such as black. Think about what you would wipe off if this was your droid and it was dirty, had a leak, carbon scoring from being blasted or rolled through Bantha poodoo for that matter.

— Electronics —
TBD

— BB8 Body Stage Edition—

This section is under construction. Parts and options are being currently tested, so please check back regularly for updates.

The “Stage” version of the droid body appears to be a few machine panel details and cutouts, while the details were mostly painted on to a white painted 506mm sphere. This approach makes finishing the body very quickly. This is what we call “Plan B”. Plan B requires the builder to spray paint the hemispheres white, and apply the high quality decals and then apply weather effects. This made a smooth surface for the Dome to ride on and looks great on the stage or in photos.

The “Plan B” decals have been completed. The documentation and files are now available for download. However it requires some patience to apply the decals. If you are in a hurry, we recommend you use the “Plan B” body decals.

As we gain experience with the operation of the droid in crowd settings, we may make “Plan B” the recommended “Stage” edition.

NOTE: If you are going to use the “Plan B” Body decals, we recommend you not paint orange sections of the dome until you can color match the orange ring color on the decals. Decal and sign printers do vary in color.

The “Static” edition looks much more detailed, since this version of the droid had deep recesses, and most likely was used to build various “puppet” versions of the droid. We know from photos released by the studio, that several panels open and arms come out of these panels. This will most likely be what we’ll see in the movie close ups.

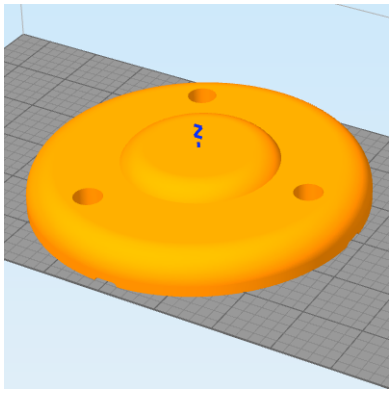
We decided that we’d make our “Stage” version using semi detailed panels, to achieve the look of the “Static” with the functionality of the “Stage”. This should facilitate a nice blend of detail with the ability to operate much like the stage version.

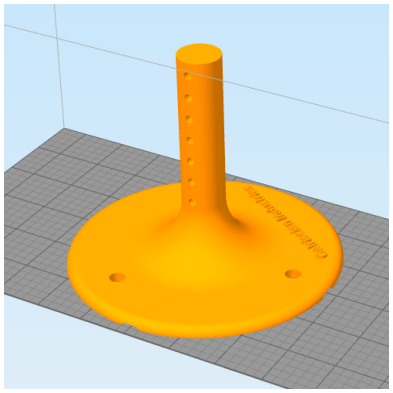
As such, all of our Stage Edition Parts are designed like the static body with the exception that the details are not quite as deep to help facilitate the Dome Magnetic Mount system to roll smoothly over the surface. Please Note that all of the stage body parts are designed to fit onto a 506 mm OD sphere. While we know this makes the overall OD slightly larger than what we saw at SWCA and in the trailers to date, we feel that this compromise to screen accuracy is required to achieve proper function with an acceptable level of detail.

- Printing FDM PLA & Parts Print Order -

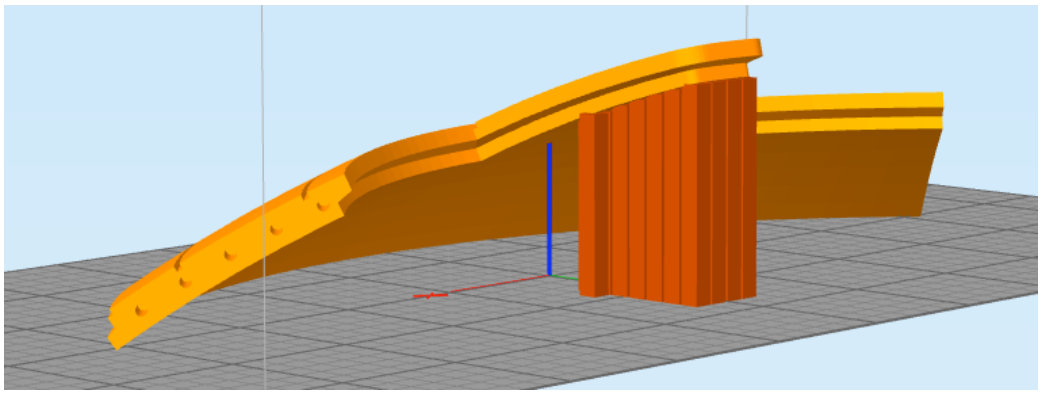
Based on our experience and those of some of the beta testers, we are providing a recommended printing ORDER to reduce changing the filaments. Unlike the dome, we recommend all outside body parts be white and a combination of Orange, White or Silver for the internal parts.

Body Magnetic Mount & Arm - 0.2 mm - 8 shells or more – 30% Infill, Orange/White/Grey. No helper disks are required, however we use support on the BMM. You will notice small what we call James' notches, located around the perimeter to assist those with glass build plates in removing these parts. You should lightly sand the BMM top, however not the BMM Arm. Do not paint these parts. Do not reduce the shells on the Arm, if anything increase the shell counts.

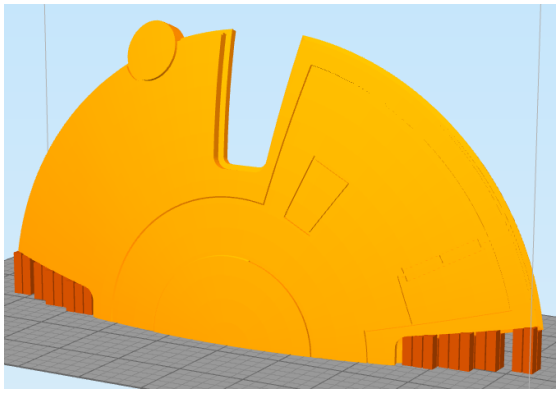




Orange Rings - 0.2 mm - 6 shells or more – Orange/Grey. We have tried numerous part printing orientations, and we get repeatable great results by orienting like the following, you will need to use either helper disks or use the brim/skirt feature of Simplify3D.

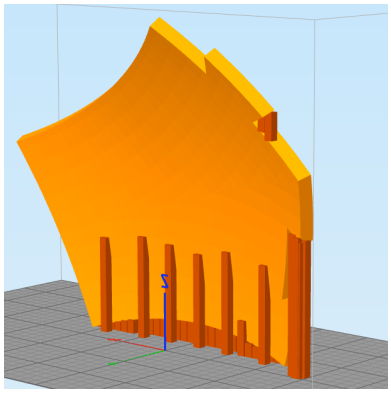


Body Center Panels – 0.2 mm – 6 shells – White - Print vertically, this will reduce lines and reduce print time. You will need to add support under the edges. If using Simplify3D, increase the density of the support 3 layers before part. This will make it easier to smooth later.

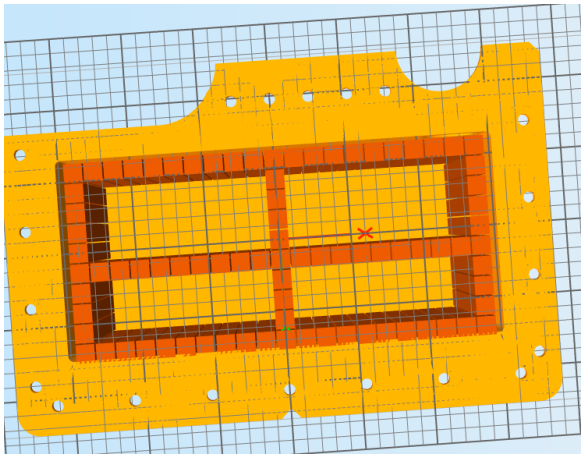


Triangle - 0.2 mm – 6 shells – White - Print these vertically and make sure to add support. You will need 8 Triangles, 6 x Triangle 1 and 2 x Triangle 2. However each corner edge is unique in that it can have an overlap or under. You will need the following 24 pieces to assemble the 8 Triangles

Triangle1 Piece 1/3 Overlap	Qty 3
Triangle1 Piece 2/3 Overlap	Qty 5
Triangle1 Piece 3/3 Overlap	Qty 3
Triangle1 Piece 1/3 Under	Qty 5
Triangle1 Piece 2/3 Under	Qty 3
Triangle1 Piece 3/3 Under	Qty 3
Triangle2 Piece 3/3 Overlap	Qty 1
Triangle2 Piece 3/3 Under	Qty 1



Hamster Battery Box – 0.2 or 0.3 mm – 6+ Shells – Infill 20% - White/Grey/Any – Print these with the top flat down on the build plate. Make sure to add just enough support to the inside of the battery box area to support the top, which is actually the bottom of the battery box. We recommend that you start the print of the battery box with a new 2 kg spool of filament. If you print this at 0.2 mm layer, it will require 32 hours to print each battery box. If you default and add full support, it will require 54 hours. Be judicial on how much support you add. We get good results with the following support configuration:



— Hardware Parts Needed: Body —

We used McMaster-Carr to order here in the US. Many of these parts are available from many world-wide shipping sources.

<PLACE HOLDER>

—Body Panel Assembly —

— Body Center Panels —

There are 6 unique round Center Panels, and the center panels are made up of 2 half pieces each. Then surround the center panels with Orange Rings.

We recommend that you use the same technique of gluing small filament pieces into the alignment holes with thick GEL CA glue. When fitting the pieces together, while holding the pieces spray a CA accelerator onto the joint, then wipe the part with a paper towel to remove the excess accelerant.

Once the Center panels are glued, test fit unassembled Orange Ring parts, and sand until a very tight fit is achieved.

— Orange Rings —

The Orange Rings are divided into quarters. You will need to print 3 x Orange Ring 1, 2 x Orange Ring 2, and only 1 x Orange Ring 3 parts. Then surround the center panels with Orange Rings.

Like the Center Panels and various Dome parts, we use the same technique of gluing small filament pieces into the alignment holes with thick GEL CA glue. Ensure that the overall ring is in alignment and flat. We recommend you cover a table with parchment paper when assembling. When fitting the pieces together, while holding the pieces in place, spray a CA accelerator onto the glued joint then wipe the part joint with a paper towel to remove the excess accelerant.

Once the Orange Ring is assembled, sand to fit into the Center correct Center Panel & orientation as outlined in the Body Panel Painting & Orientation section of this guide.

Sand smooth the outer surface, and to a lesser degree, the inner sphere facing side.

— Triangles —

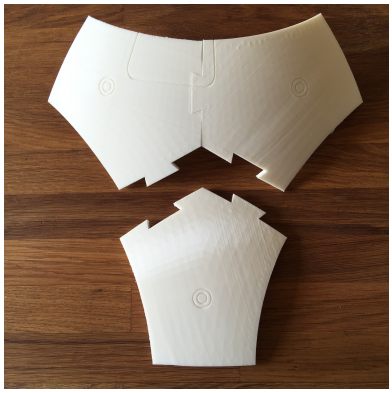
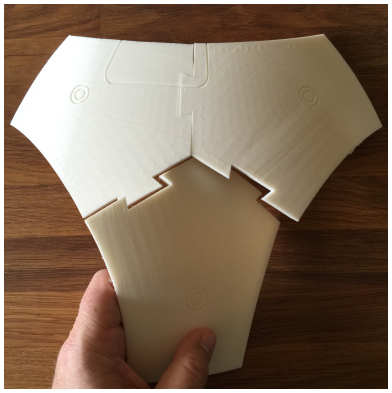
The Triangles are divided into three pieces. You will need to print 6 x Triangle 1, 2 x Triangle 2. These are designed to fit on to a 506 mm OD sphere. You will also notice that pieces each piece of the triangle has either an overlap or an underlap indication on the file as well. You should have the following 24 pieces

Triangle1 Piece 1/3 Overlap	Qty 3
Triangle1 Piece 2/3 Overlap	Qty 5
Triangle1 Piece 3/3 Overlap	Qty 3
Triangle1 Piece 1/3 Under	Qty 5
Triangle1 Piece 2/3 Under	Qty 3
Triangle1 Piece 3/3 Under	Qty 3
Triangle2 Piece 3/3 Overlap	Qty 1
Triangle2 Piece 3/3 Under	Qty 1

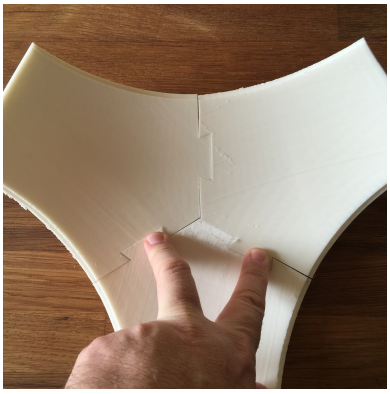
Unlike the Center Panels and various Dome parts, we used a puzzle piece technique to ensure the proper curvature of these parts. You will need to file or sand lightly to assemble. We recommend first assembling the pieces 1 of 3 to 2 of 3, which will be used make 8 triangles.

Inserting the third piece into the triangle assembly is a little tricky the first time.

We recommend you file the right inside blank of piece 2 of 3 at a 45 degree angle, and the left inside blank piece 3 of 3 at a 45 degree angle. This will allow you to twist counter clockwise, the 3 of 3 piece into position as shown in this sequence of images.


Then you will need to place the triangle assembly, face down on a firm surface. At the joint of piece 3 of 3 to the rest of the triangle assembly, firmly apply pressure to the two points shown here:



The 3 of 3 piece will slide into place, do not heavily force. If it does not go together easily, the pieces require more sanding to fit the joint. If you force it, or use a hammer, you might fracture one of the pieces.

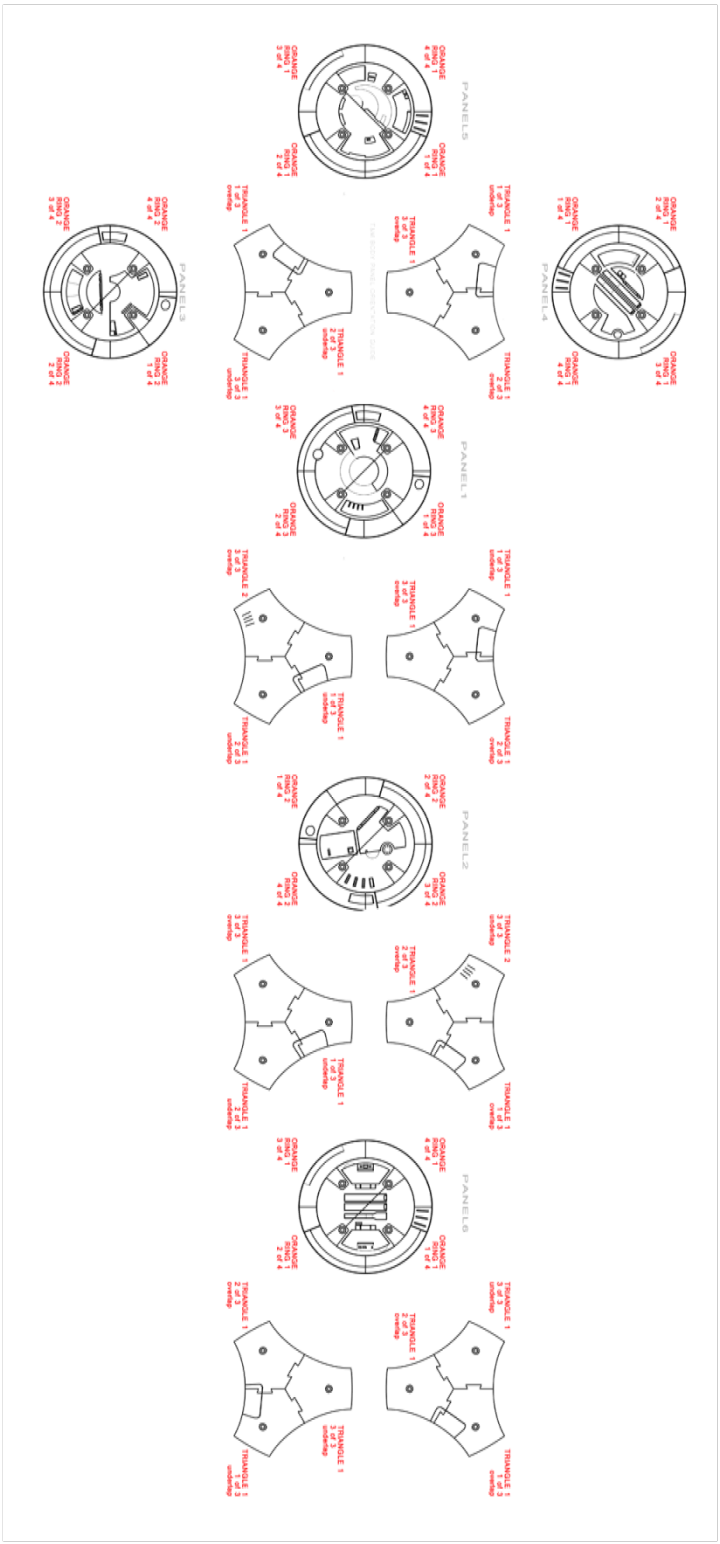
Then use a THIN CA glue applied to the combined joint seam. The CA will be pulled into the inner joint. Quickly, lightly spray CA accelerator to both sides of the joint.

Using the orbital sander technique used on the dome, sand smooth the outer surface and to a lesser degree, the inner sphere facing side.

You may want to use plastic model putty to fill any gaps and then sand to get the seam totally smooth. Once painted Satin White you will not be able to tell this is three pieces if done correctly.

— Body Panel Painting & Orientation —

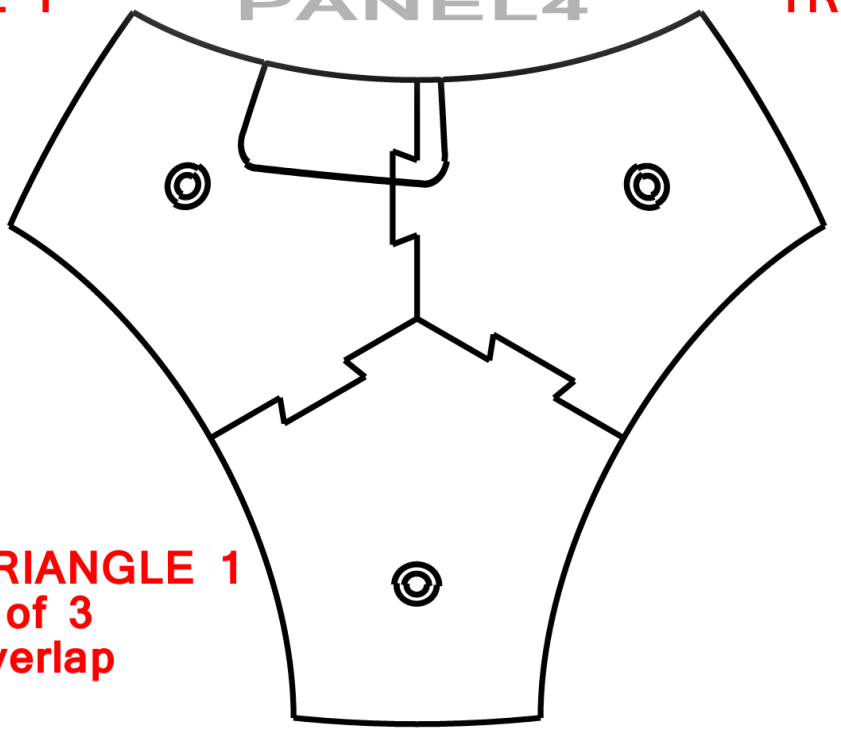
Here a picture is worth a lot more than a thousand words:


PANEL5
PANEL4
PANEL3
PANEL1
PANEL2
PANEL6

PANEL4

TRIANGLE 1
1 of 3
underlap

TRIANGLE 1
2 of 3
overlap



TRIANGLE 1
3 of 3
overlap

PANEL5

PANEL1

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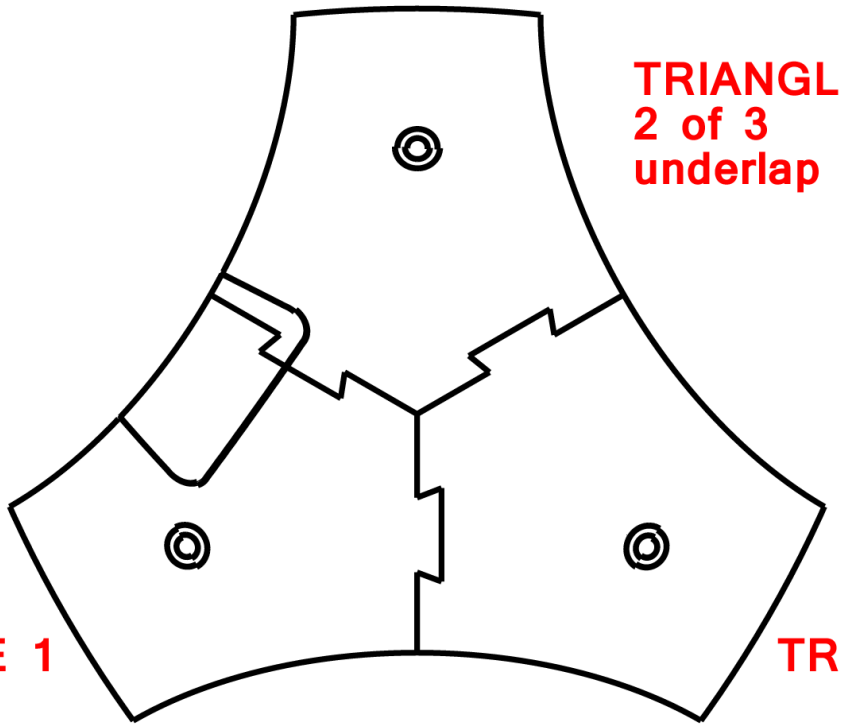
TRIANGLE 1
2 of 3
underlap

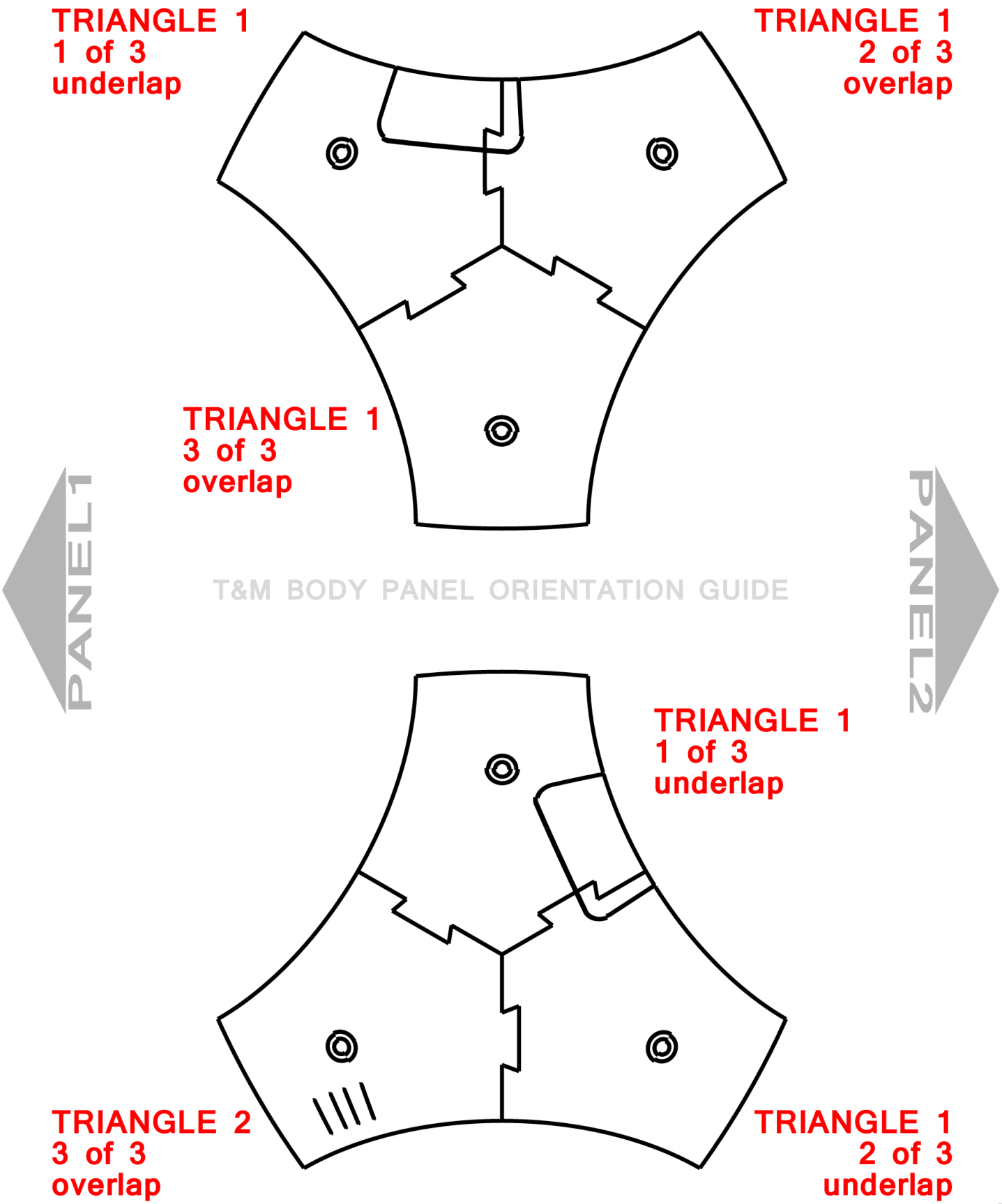


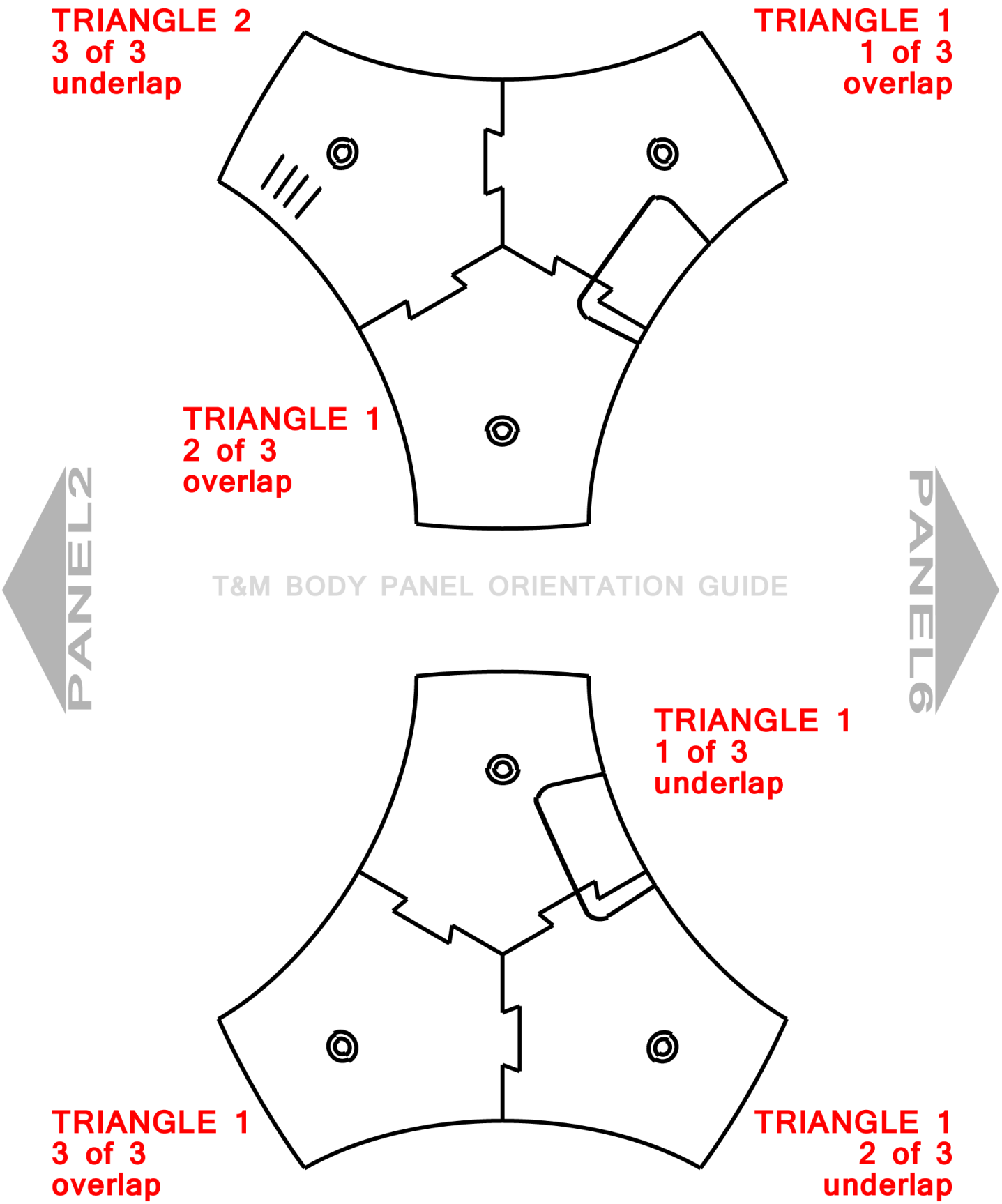
TRIANGLE 1
1 of 3
overlap

TRIANGLE 1
3 of 3
underlap

PANEL3

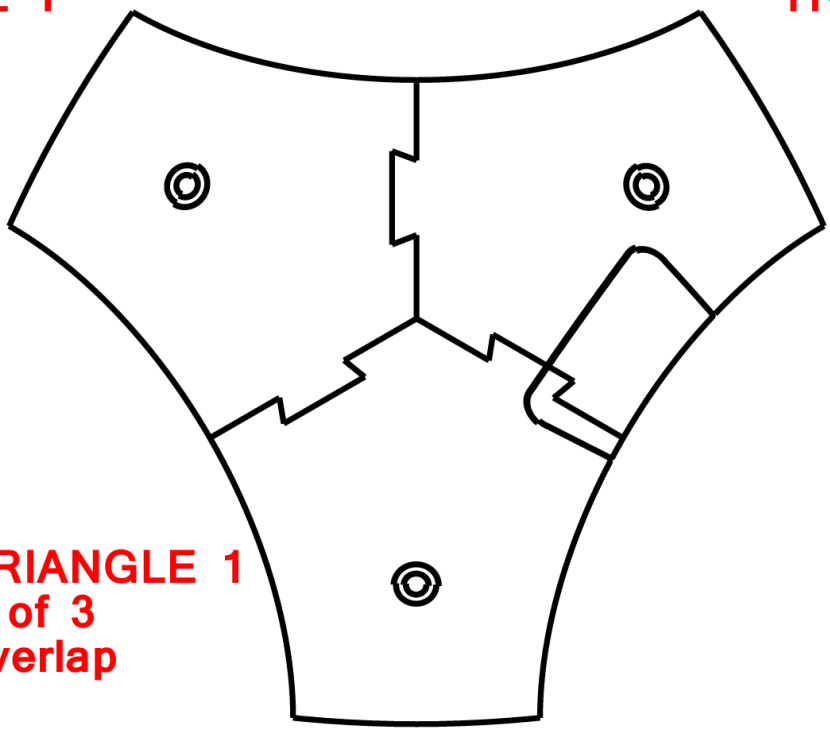
1


TRIANGLE 1
1 of 3
underlap
TRIANGLE 1
2 of 3
overlap
TRIANGLE 1
3 of 3
overlap
PANEL1
T&M BODY PANEL ORIENTATION GUIDE
PANEL2
TRIANGLE 1
1 of 3
underlap
TRIANGLE 2
3 of 3
overlap
TRIANGLE 1
2 of 3
underlap


TRIANGLE 2
3 of 3
underlap
TRIANGLE 1
1 of 3
overlap
TRIANGLE 1
2 of 3
overlap
PANEL2
T&M BODY PANEL ORIENTATION GUIDE
PANEL6
TRIANGLE 1
1 of 3
underlap
TRIANGLE 1
3 of 3
overlap
TRIANGLE 1
2 of 3
underlap

TRIANGLE 1
3 of 3
underlap

TRIANGLE 1
1 of 3
overlap

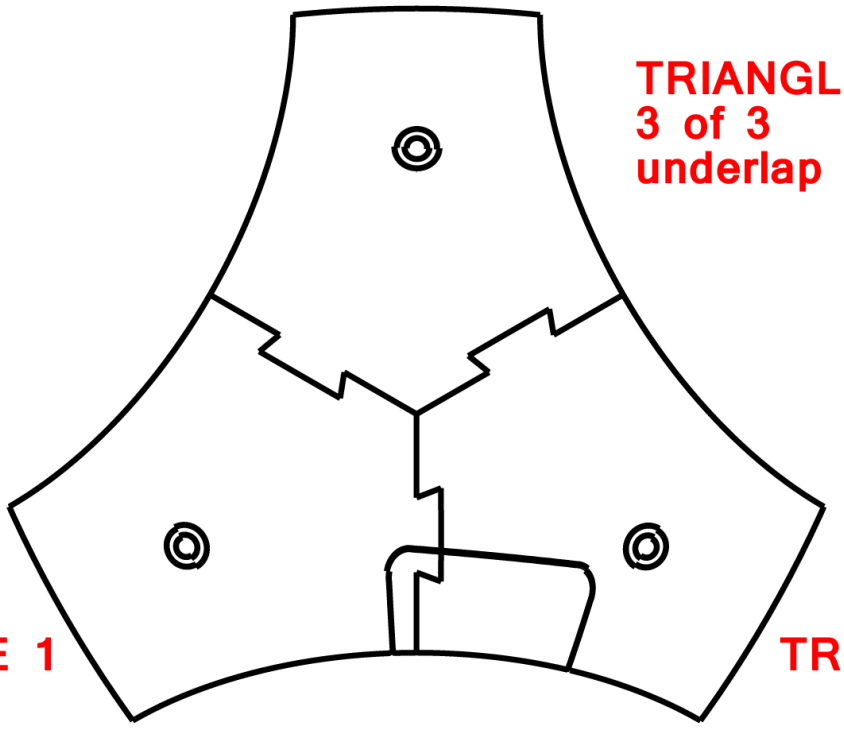


TRIANGLE 1
2 of 3
overlap

PANEL6

T&M BODY PANEL ORIENTATION GUIDE

TRIANGLE 1
3 of 3
underlap

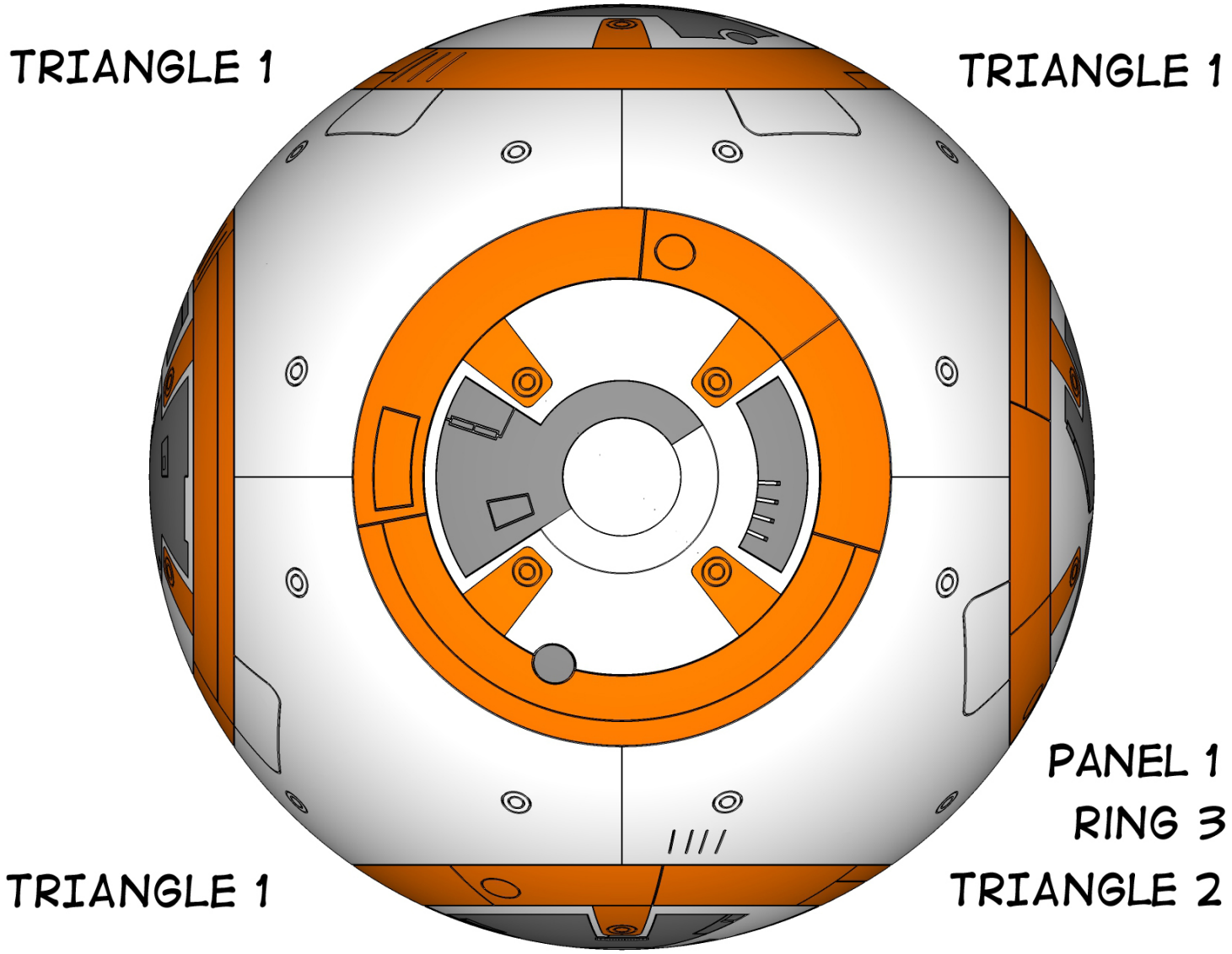


TRIANGLE 1
2 of 3
overlap

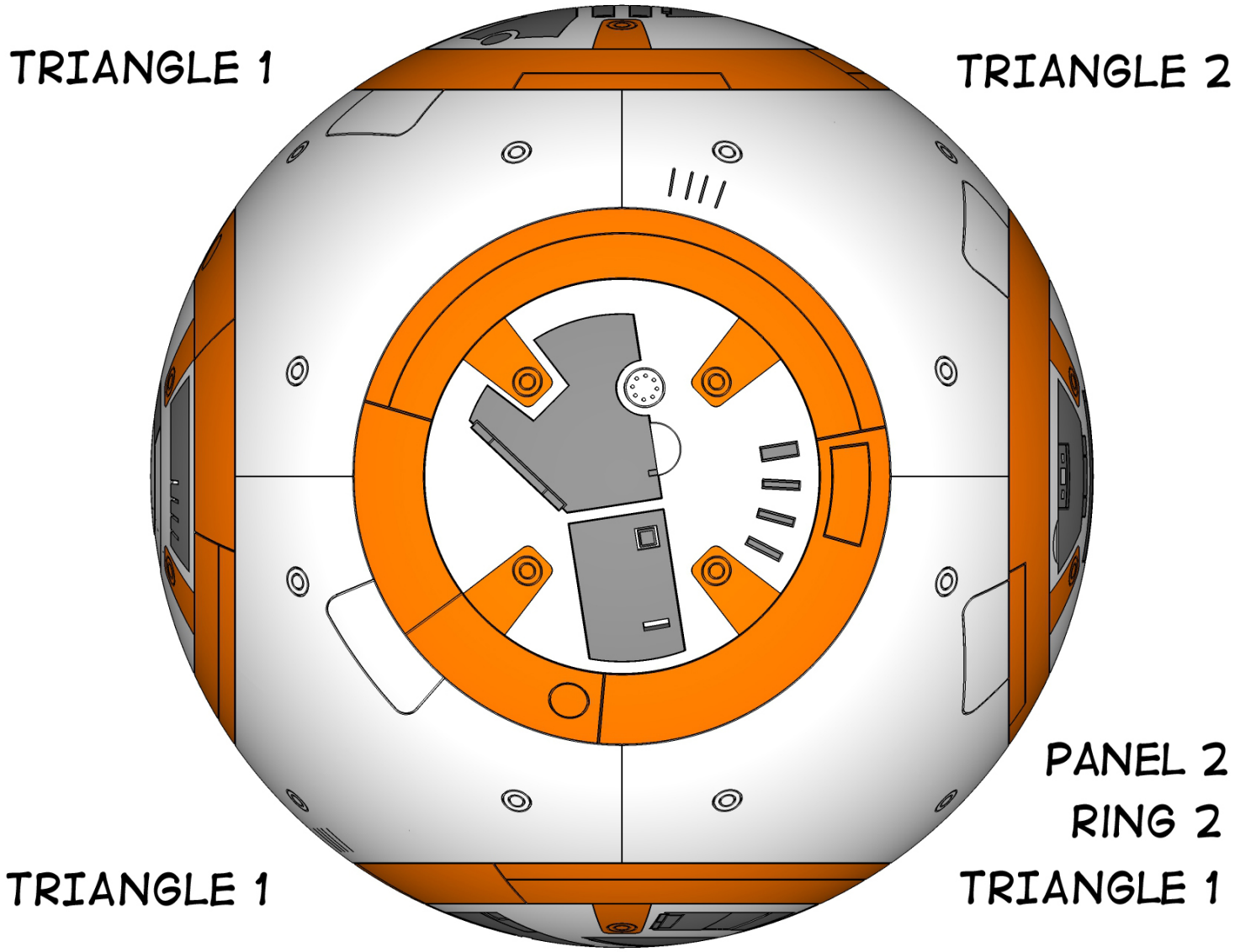
TRIANGLE 1
1 of 3
underlap

4

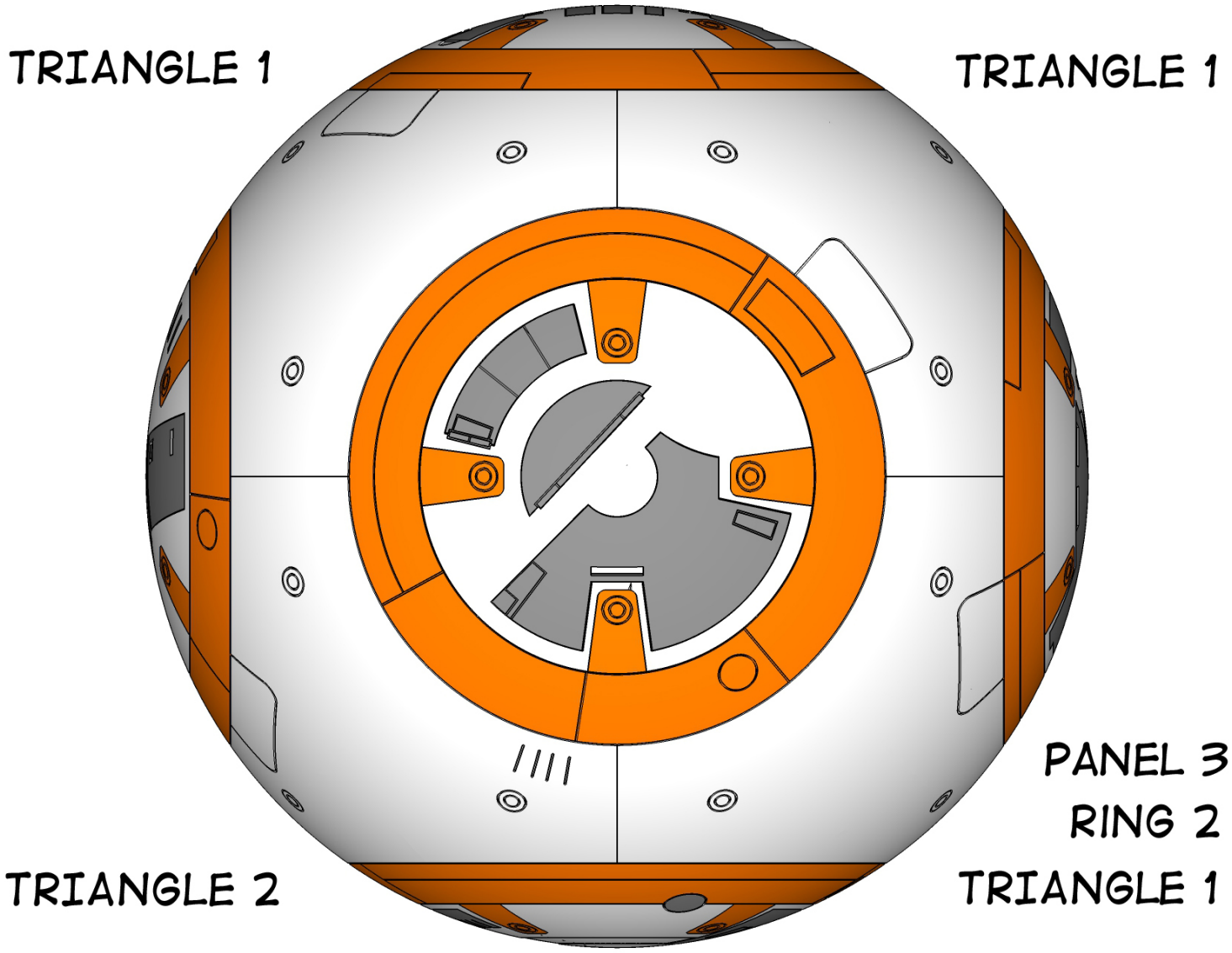
Panel 1 – Front



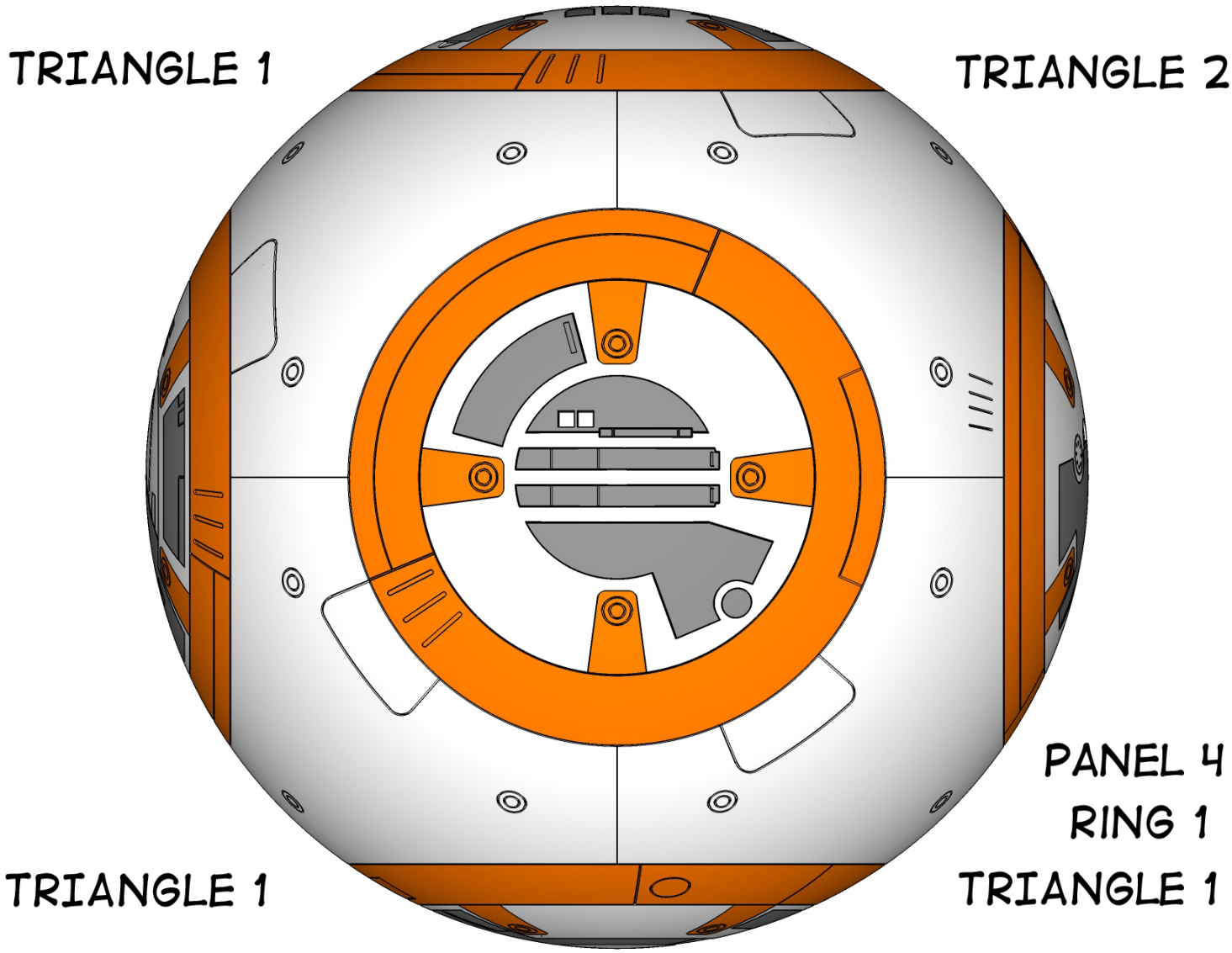
Panel 2 – RIGHT Side



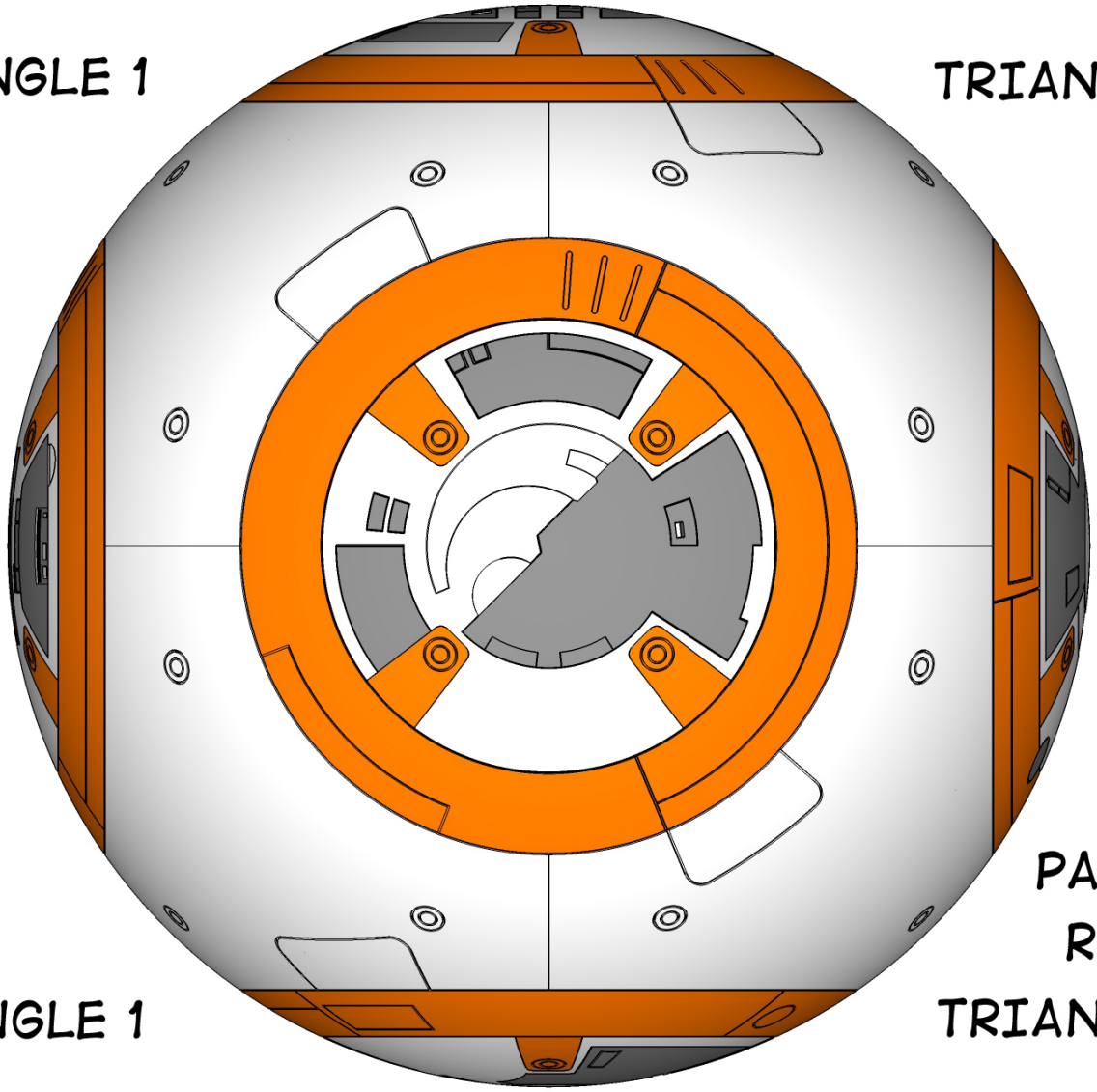
Panel 3 – BOTTOM Side



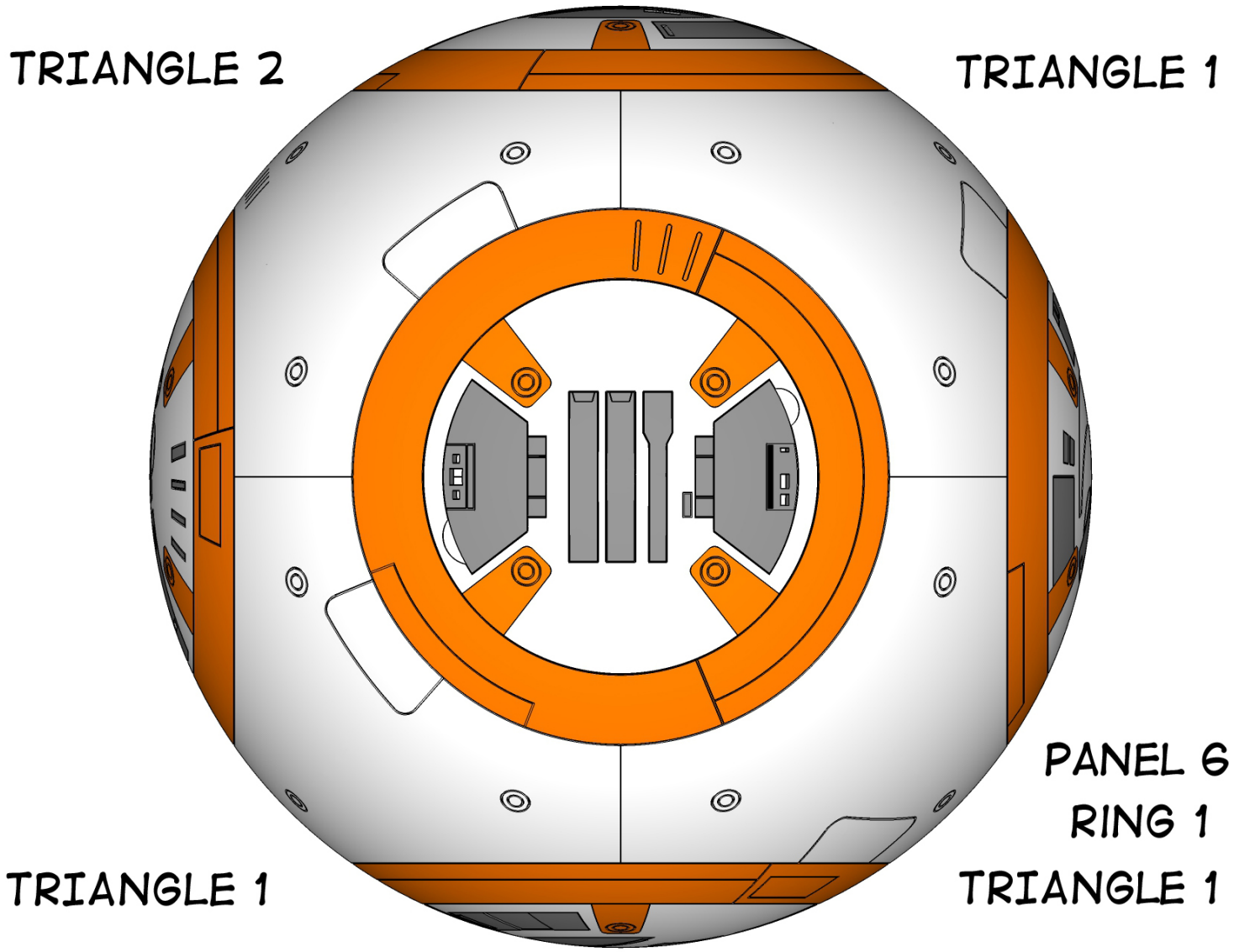
Panel 4 – TOP Side



Panel 5 – LEFT Side



Panel 6 – BACK Side



— Body Hemispheres —

Since we believe the body sphere is 503 mm or so, we are recommending the use of California Quality Plastics molded & matched 20 inch hemispheres for the body either 1/2 (0.5) inch thick or 3/4 (0.75) inch thick. Interestingly of the 20 inch molded hemispheres we have measured, they have all had an outside diameter of 503 to 508 mm at the equatorial circumference.

NOTICE: We are in the process of developing a full builder club inner sphere to be used in replacement of the CQP hemispheres.

We are using the 1/2 (0.5) inch thick version CQP Stock Number 02-PD500CA-921 (yeah we think its interesting that it has 500CA in the part number as well) Ask for Mario @ extension 126, tell him the BB8 Builders Group sent you, and there is special pricing available for both Acrylic and Polycarbonate versions.

Acrylic Hemispheres: measure ~506mm equatorially, while the Polycarbonate hemispheres: measure ~504mm equatorially, and due to being Polycarbonate, they are much harder drill.

Regardless of which you purchase, you will need to ensure that the hemispheres are equatorially and polar circumferences are the same. These hemispheres due to the material molding, shrink slightly different based on several factors. To date all hemispheres are larger in polar circumference, and will require sanding to ensure roundness.

To assist with drilling holes into the edge of the hemispheres and keeping alignment. Steele Smith worked with us on what we call the 506mm & 504mm Sphere Drill Jigs. They are available for download, and designed to be cut out via CNC machine. It uses ratcheting straps to hold the hemispheres in place while drilling. The jig files also include an simple hamster plate design that is removed from the middle.

NOTE: We have indications that the stage used BB8 was a 3/4 (0.75) inch molded & matched hemisphere from California Quality Plastics.

— Hardware Parts Needed: STAGE —

- California Quality Plastics -

You have options here, however we're using the following from CQP.

02-PD500CA-921 20" outside diameter hemisphere with no flange. Material starting thickness will be 1/2" clear acrylic. Tell them to make hemispheres in mold, they will be used as a matched set.

If you really wanted to replicate the stage droid, order 3/4" thickness.

We used McMaster-Carr to order here in the US. Many of these parts are available from many world-wide shipping sources.

Hamster Hardware
1x 92196A144 Stainless Steel Socket Head Cap Screw, 6-32 Thread, 1/4" Length (Qty 100)
1x 92196A151 Stainless Steel Socket Head Cap Screw, 6-32 Thread, 3/4" Length (Qty 100)
1x 92196A165 Stainless Steel Socket Head Cap Screw, 6-32 Thread, 1" Long, Fully Threaded (Qty 100)
1x 92196A157 Stainless Steel Socket Head Cap Screw, 6-32 Thread, 1-1/2" Length (Qty 100)
1x 92196A237 Stainless Steel Socket Head Cap Screw, 6-32 Thread, 1-5/8" Long (Qty 25)
1x 91831A007 Stainless Steel Nylon-Insert Locknut, 6-32 Thread Size, 5/16" Wide, 11/64" High (Qty 100)
1x 92196A580 Stainless Steel Socket Head Cap Screw, 5/16"-18 Thread, 5/8" Length (Qty 25)
1x 91855A370 Stainless Steel 5/16-18 Cap Nuts (Pack of 10)
1x 95412A602 Stainless Steel Fully Threaded Stud, 5/16”-18 Thread, 10" Long
1x 91831A030 Stainless Steel Nylon-Insert Locknut, 5/16”-18 Thread Size, 1/2” Wide, 11/32” High (Qty 25)
1x 90313A321 Stainless Steel Oversized Flat Washer, 5/16” Screw Size, 0.344” ID, 2.500” OD (Qty 5)

BOM continues on next page

We've included ServoCity Part Numbers and description of the hardware we used for each area of the body internals. We've broken them out between the BMM Control Arm and the Hamster Drive. This list DOES NOT include wiring, fuses and power switches

BMM Control Arm
2x 535150 1/4 inch Bore Pillow Block
2x 535178 1 inch Bore Square Pillow Block
1x 545352 1 inch Bore Clamping Hub A
1x 555176 32mm Aluminum Clamping Motor Mount
1x 585446 6.00 inch Aluminum Channel
1x 605061 Pololu Simple Motor Controller 18v15
1x 615226 84T, 32 Pitch, 1.00" Bore, .250" Face Aluminum Hub Gear (7075) <NEED VERIFICATION>
1x 615262 20 Tooth, 32 Pitch, 6mm Bore Pinion Gear
2x 632106 .250 in L x 6-32 Zinc-Plated Alloy Steel Socket Head Cap Screw (25 Pack)
2x 632110 .375 in L x 6-32 Zinc-Plated Alloy Steel Socket Head Cap Screw (25 Pack)
1x 633116 1 inch Shafting & Tubing Spacers (12 Pack)
1x 633136 .2497 D x 1.32 L 6-32 Tapped Aluminum Standoff (4 Pack)
1x 635180 1 inch OD x 4.725 inch L Hollow Aluminum Tubing with Flange1x 638278 165 RPM Heavy Duty Precision Planetary Gear Motor
1x 57185A11 3/32" Hex Extra Long L-Key
1x 57185A44 7/64 Hex Key
1x HDLS-4-2-12V 4 inch Stroke, 2.00 inch/sec., 12V Linear Servo

Hamster Drive
4x 555176 32mm Aluminum Clamping Motor Mount
2x 595626 4.90 inch Robot Wheel (Orange)
2x 595640 Drive Wheel Adapter D
1x 605098 RoboClaw 2x30 Motor Controller
2x 638270 45 RPM Heavy Duty Precision Planetary Gear Motor

— Hamster —

The internal operational mechanism is affectionately referred to as the “Hamster”, e.g. Hamster in a Ball.

This mechanism provides for dome movement, as well as body sphere movement. This can be as simple or as complex as you the builder wish.

— Hamster Plate —

If you use our hemisphere jigs, more details on that in the next section, you will notice that it uses that inner wasted area to actually make a simple platform for the BMM, arm, motors, motor controllers, batteries, linear servo, switches, wiring, and of course radio control receivers. We call that the Hamster Plate.

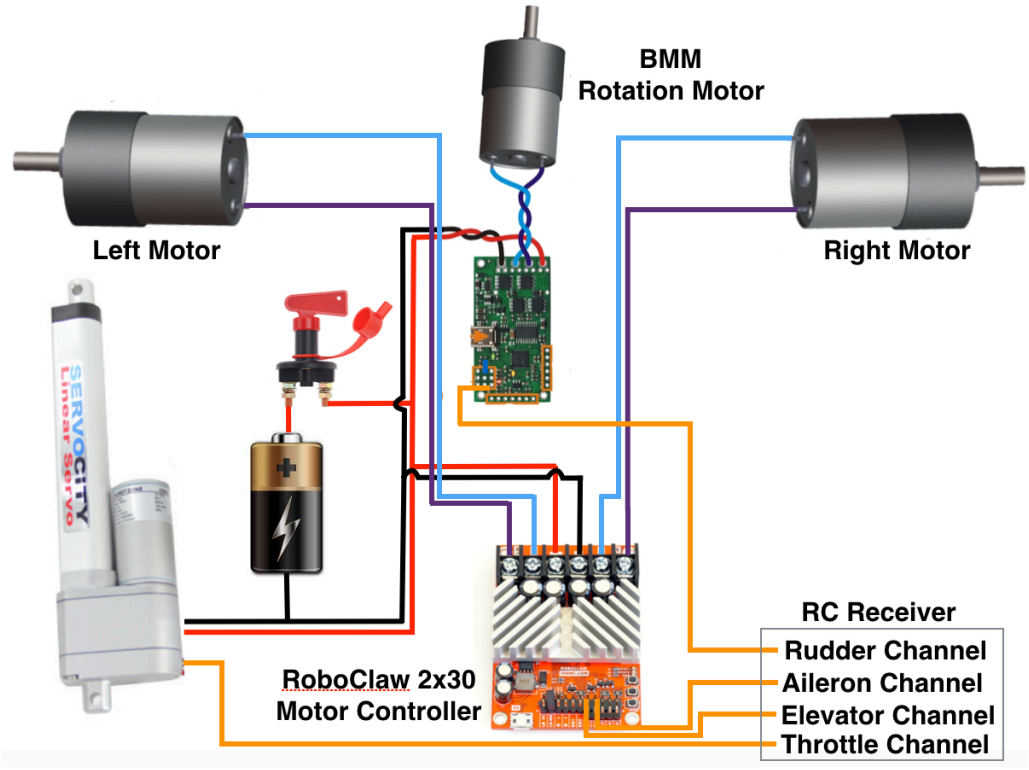
Basically a piece of plywood or plastic material can be used for the hamster plate to your style and liking.

<MORE DETAIL WILL BE ADDED>

— Hamster Electronics: Simple —

ServoCity Linear Servo: HDLS-6-2-12V
Pololu Simple Motor Controller: SMC 18v15
Pololu RoboClaw: 2x30A
4 Channel RC Receiver

The following is a functional wiring diagram of a simple hamster control configuration, with a 4 channel RC receiver. This is as simple as we can do and make a fully operational droid currently. For safety, you should use adequate wire gauges along with short circuit and current protect.



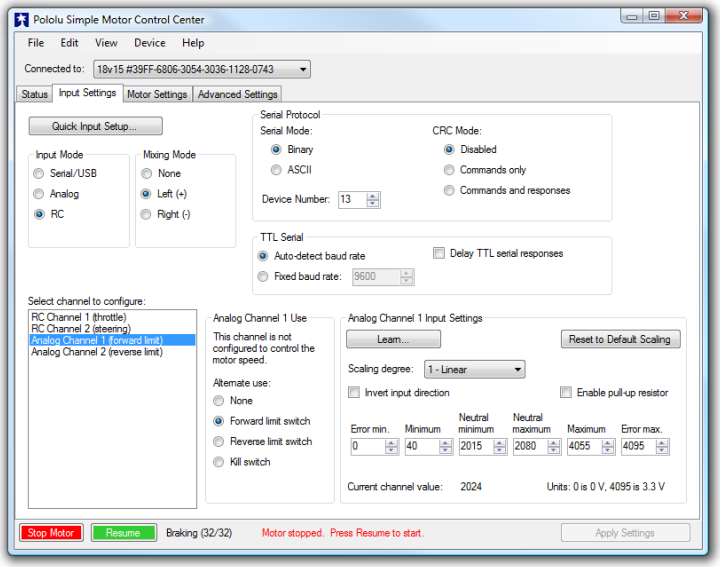
— Pololu Simple Motor Controller 18v15 Setup —

NOTE: This is NOT a replacement for completely reading and understanding the motor controlled documentation.

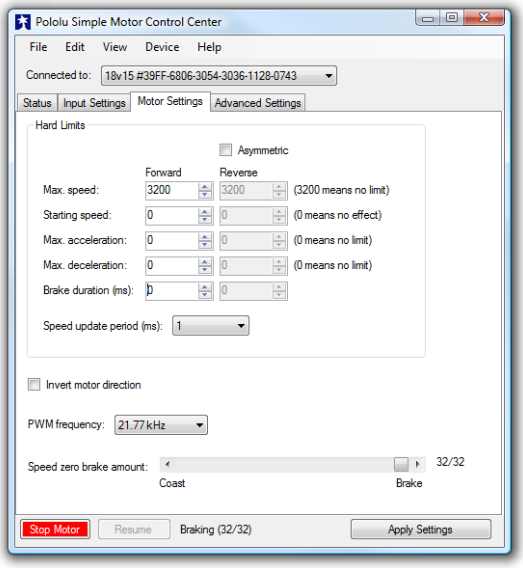
Disable the Battery Elimination Circuit, by removing the jumper.

Use the Pololu Simple Motor Control Center software, available from Pololu.com to make the following changes.

Input Settings tab
Set Input Mode: RC



Motor Settings tab
Max. speed = 2000
Max. acceleration = 2
Max. deceleration = 3



— Hamster Electronics: Complex —

<TO BE ADDED>

— BB8 Body Static Edition—

This requires some slight of hand to protect the magic from the guests.

- Printing FDM PLA & Parts Print Order -

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