



# 3D Design and Printing for Drones Pre-Flight Checklists

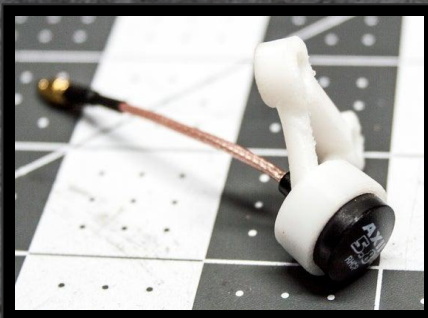
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# 3D Design for Drones

Pick your project!

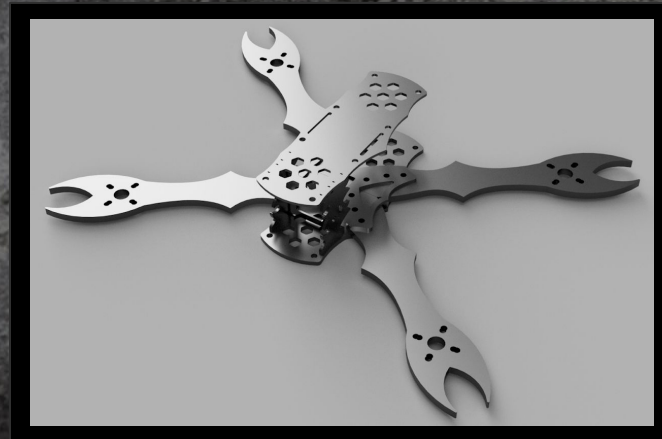
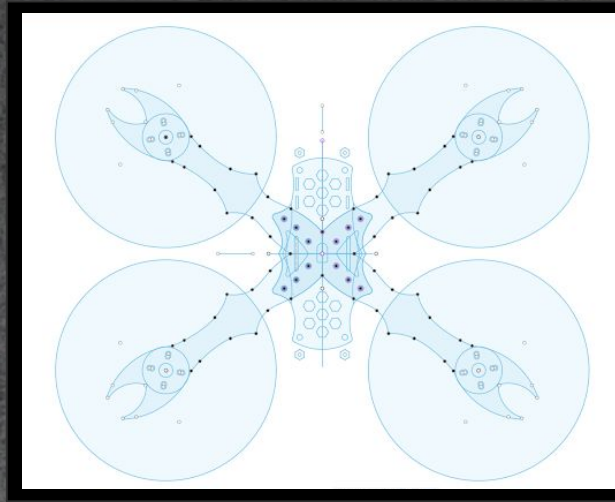
- Design a part for a drone
  - Quality of life improvement
    - Custom part holder
    - Prop guards
    - Turtle Mode Fin
  - Necessary parts
    - FPV Camera Mount
    - Antenna Mount
  - Accessories
    - HD Camera Mount
    - LED Holders
    - Skid Pads



# 3D Design for Drones

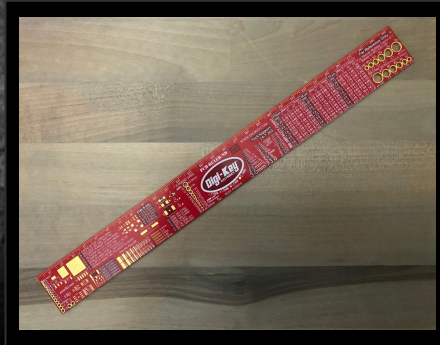
## Pick Your Project!

- Design a complete drone
  - Design for complete 3D Print
    - Will not be as durable.
    - Easier to prototype
    - Faster to make adjustments
  - Design for CNC cutting
    - Usually carbon fiber
    - Can be a variety of materials
      - Wood
      - Polycarbonate
      - Metal



# 3D Design for Drones - Tools Needed

- Paper and Pencil
  - Get your ideas down on paper
    - This can be design thoughts, pictures, solutions to problems with existing frames and accessories, anything to get you started
  - Does NOT need to be perfect, just a rough idea
- Ruler with Metric markings
  - Most engineering design software defaults to the metric system
  - Drones and drone parts are also on the metric system
- Digital Calipers
  - Useful for precise measurements
  - Multiple Measurement options including:
    - Outside Measurements
    - Inside Measurements
    - Depth Measurements



# 3D Design For Drones - Software

3D Software will be how you get your ideas from the page to the printer.

- Each software package will have it's own methods for creating your 3D objects
- Find one that works for you (watch some training videos on the respective websites or on YouTube).

There are several **FREE** software packages that will allow you to get started.

- Autodesk Fusion360
  - <https://www.autodesk.com/products/fusion-360/personal>
- Autodesk TinkerCAD
  - <https://www.tinkercad.com/>
- Trimble SketchUp
  - <https://www.sketchup.com/plans-and-pricing/sketchup-free>
- Blender
  - <https://www.blender.org/>



# 3D Design Software Practical Example - Fusion360



# 3D Design for Drones - Key Notes

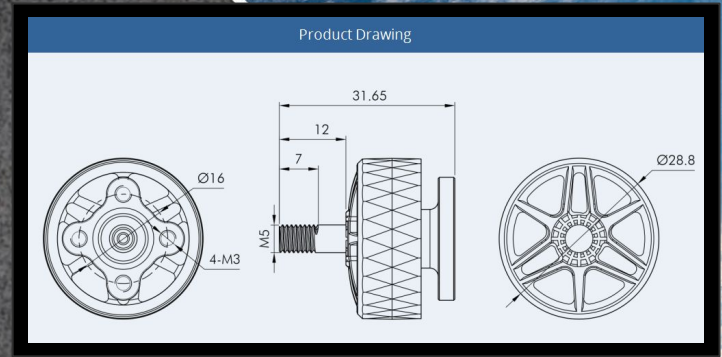
Know your key MEASUREMENTS!!!

- FPV / DIY Drone Parts

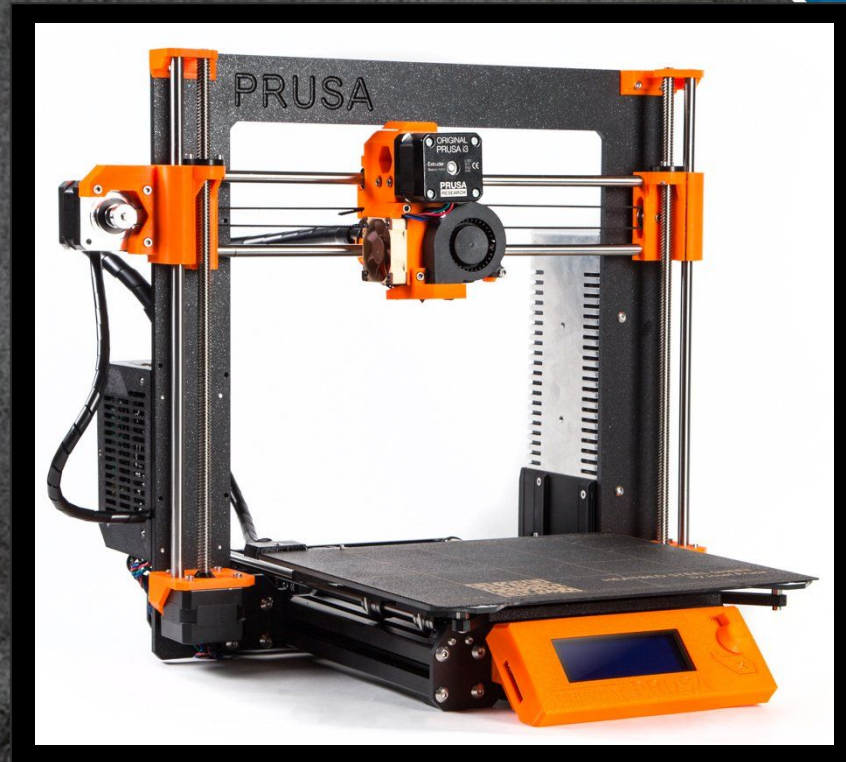
- Flight Controllers
  - 30.5mm x 30.5mm OC (On Center)
- Micro Flight Controllers
  - 20mm x 20mm OC
- 4-in-1 ESC's
  - Will mimic the FC depending on the size you choose.
- **NOTE:** Some designs might be appropriate to have both sizes of flight stack accommodated within the frame. This makes them more versatile.

- FPV Cameras

- Mini - 28mm x 26mm
- Micro - 19mm x 19mm
- Nano - 14mm x 14mm
  - **NOTE:** These can vary, this is just the most common sizes.
  - When in doubt, check the store pages or manufacturer website for size information.
  - Many offer detailed specs that you can then use to design your part / drone correctly!



# 3D Printing





# 3D Printing - How Does it Work?

3D printers come in several different varieties, but the most common is **FDM** or **Fused Deposition Modeling**

- Uses a thermoplastic filament that is melted and then **deposited** on the bed of the 3D printer
- Once a layer has been completed, the printhead then moves up slightly, then **fuses** to the previous layer
- This continues little by little until the model is complete!

You can think of 3D printing like building a Lego model

- Often, you start out with a base for things to build on.
- Each stage of the instructions, you add a new blocks
- Page by page, you continue to add new blocks, connecting them to the blocks that are already built, until your model is complete!

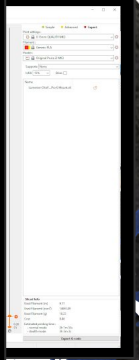
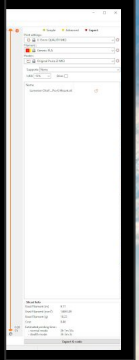


# 3D Printing - How Does it Work?

Like the Lego, a 3D printer needs instructions!

- The 3D printer gets the instructions from a program called a “**Slicer**”
- The slicing program takes the 3D model and cuts it many, many times into several layers.
- Each layer can be as small as 1/10 of a millimeter (and even smaller sometimes!)
- Then the slicer determines how the printhead needs to move on each layer as well as how much material to extrude, what the temperature, fan speeds, and several other parameters should be.
- The instructions are then saved in a “**gCode**” file that the printer can read and understand

```
14780 G1 F11200.0
14781 G1 X127.892 Y388.388 E0.00579
14782 G1 X128.804 Y388.388 E0.00785
14783 G1 X129.716 Y388.388 E0.00991
14784 G1 X129.929 Y388.049 E0.03085
14785 G1 X130.387 Y387.871 E0.00618
14786 G1 X130.617 Y387.847 E0.00615
14787 G1 X130.983 Y387.878 E0.00619
14788 G1 X131.399 Y388.064 E0.00619
14789 G1 X132.893 Y388.677 E0.03042
14790 G1 X133.387 Y388.648 E0.00492
14791 G1 X134.838 Y388.882 E0.01051
14792 G1 X139.830 Y112.485 E0.11892
14793 M204 S1000
14794 G1 F8040
14795 G1 X131.944 Y138.157 E-0.76000
14796 G1 E-0.88800 F2100.00000
14797 G1 Z2.000 F10000.000
14798 G1 X138.893 Y134.313
14799 G1 Z3.400
14800 G1 E0.00000 F2100.00000
14801 M204 S1500
14802 G1 F5000.7
14803 G1 X131.834 Y113.855 E0.01582
14804 G1 X132.322 Y114.015 E0.00918
14805 G1 X131.840 Y113.883 E0.02736
14806 G1 X131.898 Y113.215 E0.01179
14807 G1 X132.578 Y114.782 E0.02079
14808 G1 X133.083 Y114.612 E0.00838
14809 G1 X133.313 Y114.681 E0.00297
14810 G1 X131.352 Y112.929 E0.04526
14811 G1 X131.891 Y112.648 E0.00798
14812 G1 X151.849 Y112.788 E0.51882
14813 M204 S1000
```



# 3D Printing Software Practical Example - Prusa Slicer





PRINT SPEED  
**50mm/s**

FILL  
**20%**

TRAVEL SPEED  
**150mm/s**

PRINT TEMP  
**230°C**

BED TEMP  
**60°C**

LAYER HEIGHT  
**60 micron**



# Pre-Flight Checklists



# Pre-Flight Checklists - Why Do We Need Them?

Pre-Flight Checklists are extremely useful tools for both the beginner and the professional drone pilot!

Airplane pilots, fighter pilots, helicopter pilots, and even hot air balloon pilots all use pre-flight checklists to help them make sure everything is in working order, and that they have everything they need for a safe, and amazing flight!

They work exactly the same for drone pilots. They keep us safe, those around us safe, and our drone from doing something we aren't expecting.

When flying a drone, the safety of yourself and everyone around you is the first and most important factor.

To ensure that our aircraft is in working order, we need to visually inspect it, ensure each system is working, and that all mechanical parts work as they should.

Let's take a look at a pre-flight checklist for an FPV Multicopter!



This area provides us with a step by step visual check of the multirotor, to ensure nothing is damaged. Here, we can make the and that everything is in working order and we see during many people pre-flight, as well as how long we flew. Also notice the incidents that happens during the flight that you can't need to be addressed of the workbench else!



## FPV Pre-Flight Checklist

### Charge Batteries

- Model Batteries
- Goggles Batteries
- Transmitter Batteries

### Model Check

- Propellers are removed
- Inspect for damage
- Frame damage
- Standoff damage
- Wire wear
- Broken zip ties
- Battery strap wear
- Check all screws and nuts
- Model power up initialization
- Motor test
- Motors spin freely
- Motor direction check

### Transmitter Communication

- Transmitter power check
- Range check
- Telemetry check (if applicable)
- Check receiver antennas
- Check switches for functions

### FPV System Functionality

- Goggles power up and function
- Channel check
- Power check
- Camera focus
- Transmit check
- Check antennas on goggles and model

### Propellers

- Install propellers
- Tighten propeller nuts

### Pre-flight Notes:

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### Post-flight Notes:

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### Flight Log Data:

- Flight Class (Micro, Mini): \_\_\_\_\_
- Number in Attendance: \_\_\_\_\_
- Number of Pilots: \_\_\_\_\_
- Duration of Event: \_\_\_\_\_
- Number of Incidents: \_\_\_\_\_
- Nature of Incidents: \_\_\_\_\_
- Other Information: \_\_\_\_\_



This checklist is for FPV Racing! The top section is more of a “Make sure you bring these things!” so you can be prepared for the event. It also gives you an area to note your assigned video channel (SUPER IMPORTANT!), as well as your practice and race time slots.



## FPV Racing Checklist

### Basics

- FPV Model
- Backup Models
- Transmitter
- Goggles w/ Accessories
- Model Batteries
- Extra Propellers
- Charger

### Crash Kits (for each Model):

- Camera and Lenses
- Extra Multivolt Ams
- VTC's
- Receivers
- Flight Controllers
- ESC's
- Motors
- Spare VTX Antennas
- Zip Ties
- Electrical Tape
- Heat Shrink
- Portable Soldering Iron
- Battery Straps

### Essentials

- Camera and Lenses
- Extra Multivolt Ams
- VTC's
- Receivers
- Flight Controllers

### Tools

- Side Cutters
- Nut Drivers
- Hex Drivers
- Pcap Tool

### Hardware

- Prep Mats
- M3 screws
- Standoffs
- Nylon Standoffs

### Extras

- Action Camera (GoPro)
- Laptop, Tablet, Phone
- Spare Clothing
- Chair
- Table
- Tent or Canopy
- Food and Drink

### Knowledge

- Rules
- Assigned Video Channel

Practice Times: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
 Race Seats: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

### Flight Log Data:

- Event Type (Multi-CP, Local Event): \_\_\_\_\_
- Flight Class (Micro, Mini): \_\_\_\_\_
- Number in Attendance: \_\_\_\_\_
- Number of Pilots: \_\_\_\_\_
- Duration of Event: \_\_\_\_\_
- Number of Incidents: \_\_\_\_\_
- Nature of Incidents: \_\_\_\_\_
- Other Information: \_\_\_\_\_





This checklist is for flying with your friends! Here, you and your friends can write down this one again! who is on what channel, and who can fly with who. This gear. These should be used in conjunction with the first someone powering up a pre-flight. Safety is the top priority! channel that someone in the air is using!



## FPV Group Session Checklist

**Basics**

- FPV Model (or multiple)
- Transmitter
- Doggles w/ Accessories
- Model Batteries
- Extra Scopelens

**Essentials**

- Extra Multicopter Arms
- Spare VTX Antennas
- Spare Camera Lenses
- Zip Ties
- Electrical Tape
- Portable Soldering Iron
- Battery Straps

**Tools**

- Side Cutters
- Nut Drivers
- Hex Drivers
- Prop Tool

**Hardware**

- Prop Nuts
- M3 Screws (at least 2 of every size)
- Standoffs
- Nylon standoffs

**Extras**

- Action Camera (GoPro)
- Laptop, Tablet, or Phone for Tuning

**Optional Items**

- Chair
- Tent or Canopy
- Battery Charger
- Snacks and Beverages

**Group Items**

- Video Channel Assignments
- Dates
- Flags

**Video Channel Assignments**

Channels	Pilot Assignments				

**Flight Log Data:**

- Flight Class (Micro, Mini): \_\_\_\_\_
- Number in Attendance: \_\_\_\_\_
- Number of Pilots: \_\_\_\_\_
- Duration of Event: \_\_\_\_\_
- Number of Incidents: \_\_\_\_\_
- Nature of Incidents: \_\_\_\_\_
- Other Information: \_\_\_\_\_



# Pre-Flight Checklists - Wrap Up

Pre-Flight Checklists are important to ensure that you have safety as your top priority.

- They give you the instructions to check over your aircraft, before putting it in the air.
- It helps you check your systems to ensure that everything is functioning just the way it should.
- Look for damage.... If something breaks mid-flight, you could crash, damaging your aircraft, hurting a person, or someone's property, like a car.
- **SAFETY FIRST, USE A CHECKLIST!**

You can find these checklists, and more for free at [www.fpvfc.org](http://www.fpvfc.org), the home of the FPV Freedom Coalition!

