

HOW TO GET STARTED WITH DRONE RACING AND MINI QUAD FPV



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So you are new to Drone Racing (aka FPV Mini Quad / Multirotor) and wondering where to start? I created this guide to help explain the basic process of buying, building and flying a drone. I will also recommend some other great resources related to FPV mini quad throughout this tutorial.

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What is Drone Racing?

Drone Racing is like racing roller-coasters, just without the tracks. The remote-piloted drones race together at high speed through a 3-dimensional course of obstacles and gates. It's one of the fastest growing sports in the world, attracting big corporate sponsorship deals, and with over 40 million online viewers in 2016 you can see why.

It doesn't matter if you are piloting or just watching a drone race, the true joy is in experiencing the neck breaking acceleration and agility from the aircraft's perspective through the immersive virtual reality style goggles.

We call this type of flying **FPV** (First Person View).



FPV Flying with Goggles – You can see what the drone sees

Flying a drone in FPV is the most surreal experience I personally have ever had. You can go anywhere in 3D space, what you can do is totally up to your imagination.

Flying FPV feels a bit like a video game, except it's real. There is no "reset button" and you could damage your drone in a crash, not to mention the damage or injury that could result in losing control at these speeds. It's the adrenaline rush that makes it such an exciting experience.



The Mini Quad FPV hobby is one of the most friendly communities I have ever experienced. Everybody helps each other out, and we regularly meet, fly and race together.

With the help of this guide, you will soon be building and repairing your own quadcopter, choosing parts and upgrades in order to fly faster and smoother. You will also learn to tune your drone to fly exactly the way you want it to. Everything in this hobby is highly customize-able and upgrade-able.



A group of friends racing together in a park

Drone Racing History

To get an idea of how drone racing started, we have to go back to the invention of the mini quad.

What is a Drone?

The word “drone” is being used a lot these days and has become synonymous with any unmanned aircraft with an onboard camera, and sometimes a camera is not even necessary for the title! Other than for military use, most “drones” were historically used for aerial photography (AP) and were large

What is a Multirotor?

The word Multirotor (or Multicopter) covers anything that is a “copter” with more than 1 main motor or propeller. For example, a “tricopter” has 3 motors / rotors, a “quadcopter” has 4, a “hexacopter” has 6 etc. So the term “multi-rotor” encompasses these types of drone.

Find out more about the [types of drones](#), and [different configurations of multirotors](#).

450 Quadcopter

Mini Quad



What is a Mini Quad?

A Mini Quad is basically a mini size quadcopter which is usually under 250mm. Mini quads are designed to be fast, nimble and resilient, so even when you crash you can usually just pick it up and take off again. This resilience gives pilots the confidence to fly faster, through smaller gaps, and continually push their limits to the next level.

Since this fantastic invention, we've seen huge progress in the power of these mini-quads, increasing propeller sizes, higher battery voltage, larger motors, all coming together to give insane power-to-weight ratios of over 14:1! Turning these little toys into insane rockets, the fastest racing drone in the world is capable of reaching 180mph (~290Kmh) in a matter of seconds

How much does it cost?

Building a drone can be expensive, but just like anything else it largely depends on your choice of components.

To give you a rough idea, an FPV racing drone (mini quad) can cost anywhere between \$150 to \$500 or even more. That is just the quadcopter itself. Other necessities like spare batteries, FPV Goggles, Radio Transmitter, building tools and other basic accessories can cost another \$150 to \$500.

With the growth of the hobby, there are cheaper options hitting the marketplace all the time, but you get what you pay for! Set aside \$300+ to get in the air with a quad that was worth the time, money and effort you are going to put in, then expect to quickly add to that figure along the road, if (WHEN) you get seriously hooked! :D

Speaking from experience, this hobby is much cheaper now than when I started back in 2013. Competition is driving the price down for every type of component, parts are better designed and more robust. A good example would be the durability of the propellers, now I don't have to change them for days, compared to the 10 props I used to break every session.

Should I Build My First Drone or Buy a Pre-built One?

If building a quadcopter from scratch sounds too challenging, you can consider a pre-built model either **RTF** (ready to fly) which usually includes a radio transmitter, a **BNF** (bind and fly) or **ARF** (almost ready to fly) which may require your own radio transmitter and receiver. I strongly recommend you to take the time, do the research and buy a radio transmitter you like. It might cost more but it will be more future-proof and you wouldn't need to upgrade it anytime soon.

Cheaper ARF and RTF quads such as [Eachine Wizard](#) and [Diatone GT2](#) normally cost less than \$300, while at the high end the [ImmersionRC Vortex](#) and [TBS Vendetta](#) can cost in excess of \$500 each.

RTF drones get you in the air much quicker, learning how to set it up via computer software, assigning the "Arm" switch and such, is quite a steep learning curve, but is well worth the effort. It often costs more to buy a ready made quad than building your own, spare parts can be more costly and stock can be harder to find.

We strongly recommend to build your own drone

Building is a big part of the fun and the skills and knowledge you learn along the way will enable you to diagnose, repair and upgrade the quad later on.

Whether you are buying a pre-built drone or building it yourself, you should make a shopping list, and have it checked by someone with experience. If you want to find someone to provide advice before you decide, or help you select components for you to build your own, the 3000+ members at our [IntoFPV forum](#) have a wealth of experience and are always ready to welcome new members and answer questions.

Get a TX and start practicing in simulators

“I don’t even have a drone yet, how can I learn to fly?”

You don’t need a drone to learn to fly these days, there are many FPV simulators available for practice and to learn with. Simulators can teach you the basic controls of a drone, and the muscle memory your hands require. You will be able to use the same radio transmitter to fly the simulator, as well as your drone so there is no need to adjust between different controllers.

It’s not a very wise idea to learn to fly on a full size mini quad. It’s dangerous and expensive if you crash and damage the parts. You are most likely going to crash, a lot, in the first few flights with a real quad. Gradually your muscle memory takes over and you will crash less. Practicing in a sim in advance can accelerate that process and prepare you for it.

Here is a list of [FPV flight simulators for Drone](#).



FPV sims are probably the cheapest way to get into quadcopter flying. You can practice anytime of the day regardless the weather. It's not exactly like flying in real life, but they are good enough to give you some basic training. Spending 5 to 10 hours practising with a simulator will help you tremendously as a complete beginner.

The radio you buy should work with simulators and yet allow you to control your mini quad later on. Try not to use an XBox console or keyboard to practice with simulators, using a proper transmitter will provide the full benefit of improving your muscle memory before you risk your expensive new drone.

Here are my personal recommendation, these are probably the most popular TX in the community and you won't go wrong with them.

- [Taranis Q X7](#) (\$110)
- [Taranis X9D](#) (\$220)

If you want to dig deeper into what makes a good TX for mini quad, here is a guide [how to select radio transmitters](#).

How to practice flying without simulator?

If you find flying with simulators a little boring or don't have a high enough spec computer to run them, you could consider learning on smaller models like a **tiny whoop**, or micro drone (aka micro quad).

Check out this guide to learn about **how to pick your first toy drone and start flying**.



Starting out with a micro quad is not my first recommendation though since simulators are getting quite good these days. Not to mention micro quads fly quite differently than something larger (such as a 5") due to the much higher power levels. The power of brushless micro's are starting to rival those of their bigger brothers now, and they are getting cheaper these days. However, shelling out for spare parts, extra batteries and accessories for one drone is enough of an investment in the early days.

Don't fly in auto-level mode

If all you want to fly is a DJI drone, or other GPS assisted multirotors, auto level is perfect and it's fine to just fly like that. But if you want to get into racing and freestyle flying, you have to learn to fly in acro mode.

This article explains the differences between **acro mode (rate mode)** and **self-level mode**.

using them while running a 100m sprint! Once you have learned acro mode, auto level will feel like a hindrance, it can also teach bad habits which can be difficult to shake.

While learning how to fly in a simulator, you should also start doing research on quadcopter parts, and plan your build. Move on to the next section to learn more about parts and equipment.

Parts and Equipment You will need

As your first build, I strongly recommend building a 5" mini quad because it's the most versatile platform you can get for flying acro as well as racing. It's efficient yet powerful enough to carry a HD camera, much easier to fit all the parts than a smaller model, and it's the most well documented size for build logs and obtaining advice.

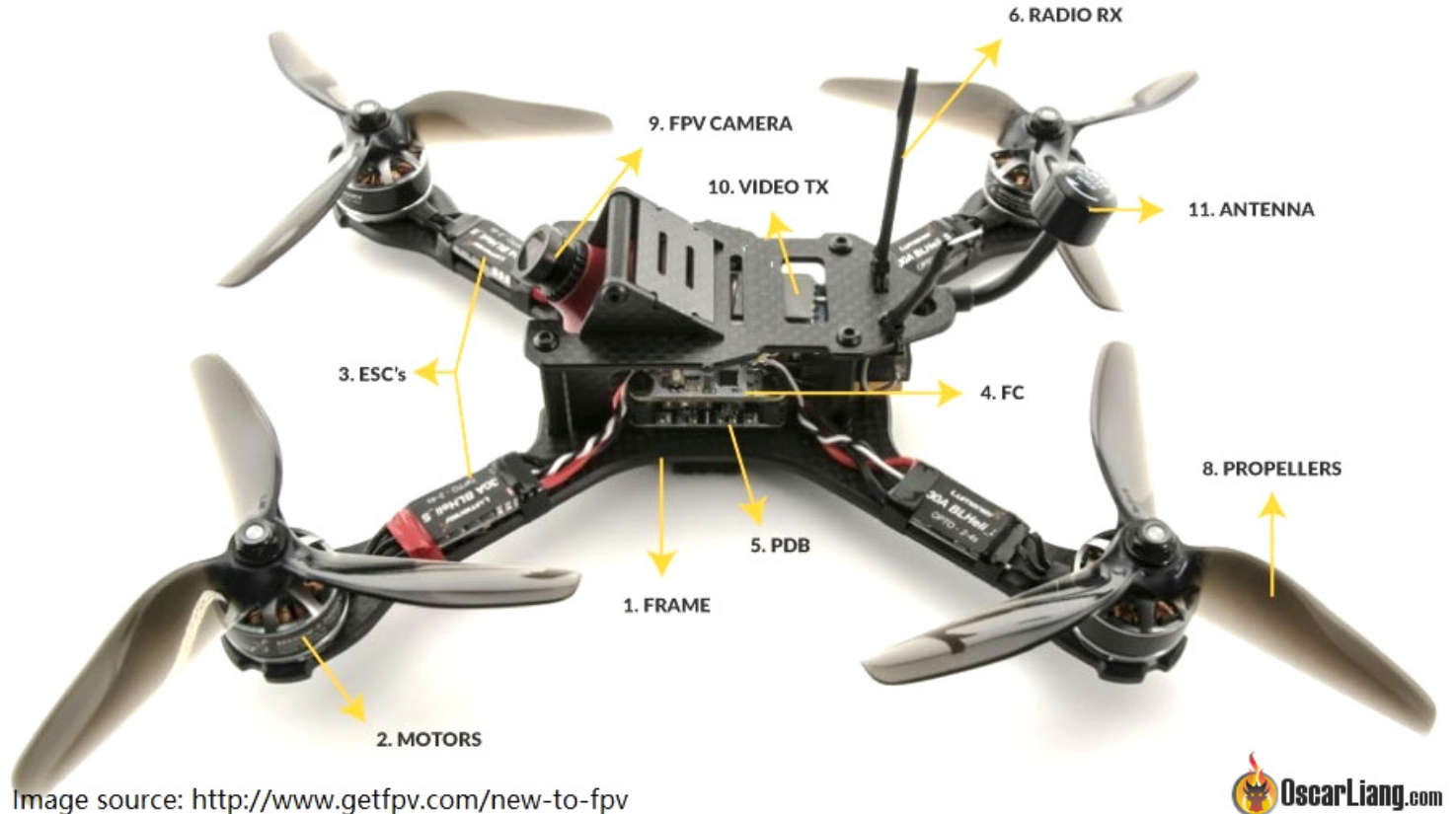
250mm? 5"? What do these numbers mean?

Both numbers are size indicators of a quadcopter. The numbers in "mm" are known as the "wheelbase" of the chassis / frame and it is the distance between two diagonal motors. The 5" I mentioned is referring to the max propeller size that can be used with the frame.

The most common combination is 5" propellers on a 210mm frame. There are some smaller and larger frames that can take this size prop too.

Here are a few posts I strongly recommend reading first.

- [How to build a quadcopter](#) – It explains the construction of a quadcopter in general
- [250 Mini quad parts list](#) – It goes into extreme detail in each component of a mini quad, and what the latest products are
- [Multirotor Glossary](#) – You can look up acronyms in this table
- [How to solder for beginners](#) – choosing the right tools, how to solder wires, header pins, solder pads, XT60 connectors etc



An FPV racing quadcopter consists of the following parts:

- Quadcopter Frame – [how to choose a mini quad frame](#)
- 4 x Motors – [how to choose mini quad motors](#)
- 4 x Props (Propellers) – 2x CCW and 2x CW rotations – [how to choose propellers](#)
- 4 x ESC's – Electronics Speed Controller – [how to choose ESC's](#)
- FC – Flight Controller – [how to choose a flight controller](#)
- LiPo Battery – [how to choose a LiPo battery](#)
- FPV Camera – [how to choose an FPV camera](#)
- FPV OSD – [how to choose an OSD](#)

Additionally you will also need the following equipment to fly your quadcopter in FPV:

- Radio transmitter (TX) and receiver (RX) – [how to choose a radio transmitters](#)
- Video Transmitter (VTX) and Receiver (VRX) – [how to choose a VTX](#)
- FPV antennas – [how to choose an FPV antenna](#)
- FPV Goggles or Monitor – [how to choose FPV goggles](#)
- LiPo Charger – [how to choose LiPo charger](#)
- Optional: HD Camera for recording flight footage – [how to choose HD Action camera for racing drones](#)

And you will need tools: [Multirotor Building Tools](#)

This can be tough for your first build. If you are not sure what to get, it's a good idea to get something popular so if you run into problems, there are more people who might have the answer to your questions.

I personally wouldn't put too much trust in local hobby shops, or anyone trying to sell you stuff, you might end up spending 2 or 3 times more than you should, for some crappy/outdated gear. Do your own research and if in doubt, ask at the forum!



Very Important Advice

BUY SPARES! Especially props (propellers). Crashing is inevitable so you will break lots of props. It also doesn't hurt to have spare batteries, motors and ESCs if you want to avoid waiting around for replacement parts. (it could take days even weeks for international shipping)

FC Firmware

There are quite a few different **flight controller firmwares** available for a mini quad. My personal favorites are **Betaflight**, **KISS** and **Raceflight**, they all perform really well, being frequently updated and have a large user community for supports. Choose one of the three to begin with, you can't go wrong with any of these FC firmware.



Every ESC has its own processor and there is “ESC firmware” running on it. Flight controllers communicate with ESC’s using “ESC Protocol”.

Check out this post to learn more about [ESC firmware and protocols](#).

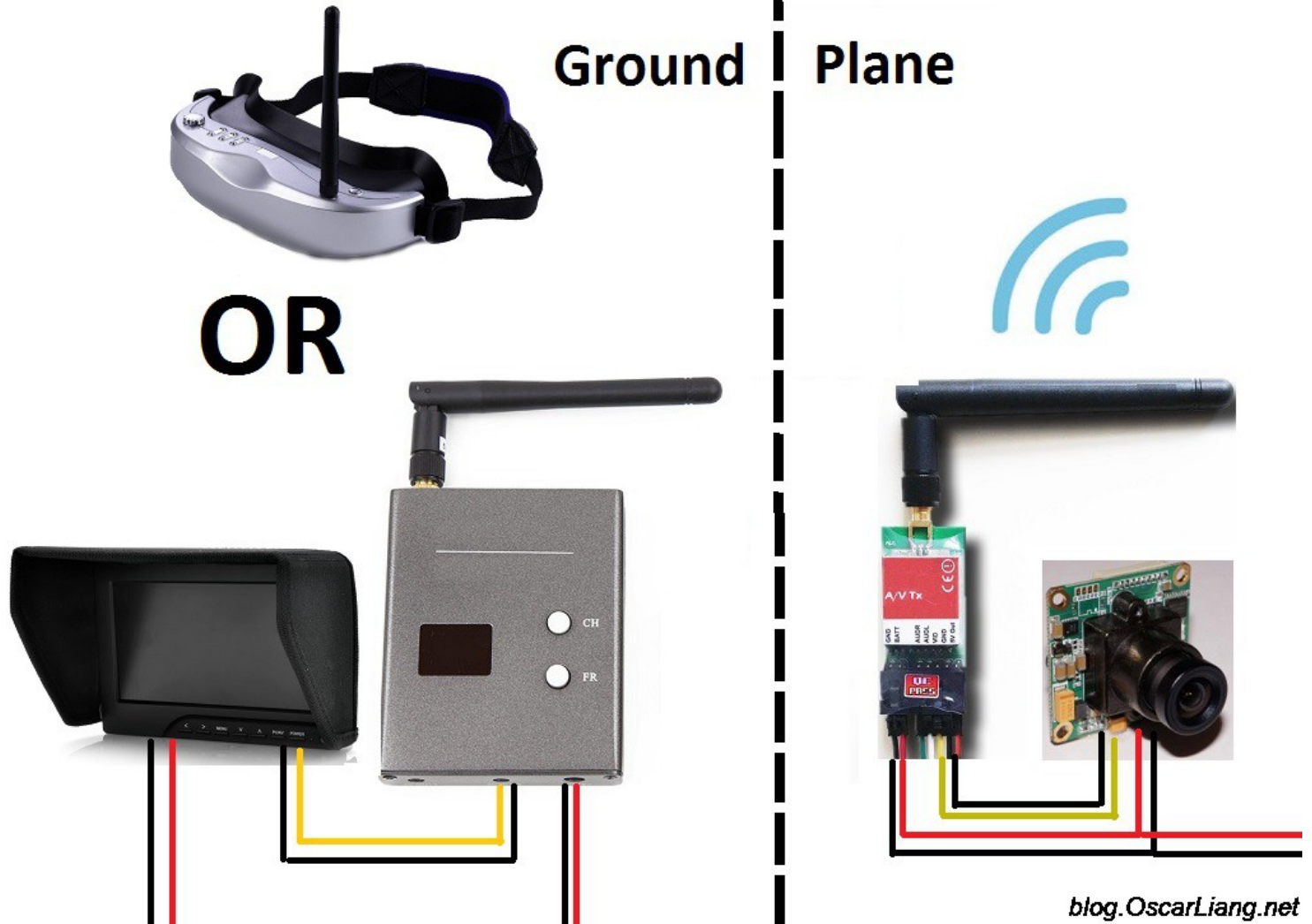


The Basics of the FPV System

An FPV System on a mini quad is actually quite simple:

- There is a camera connected to a video transmitter (VTX)
- The video is streamed onto a monitor which is connected to a video receiver (VRX), or FPV Goggles which has a integrated VRX

Read this [FPV guide](#) to learn more about FPV systems.



FPV Frequencies

5.8Ghz is the frequency that we use for FPV equipment. Most video transmitters and receivers these days support more than 40 channels and more recently up to 80, allowing more people to fly together at the same time. The frequency we use on our radio transmitter is 2.4Ghz, so there is very little interference.



Use a low power VTX!

Some countries (e.g. UK) have a transmission power legal limit of 25mW for 5.8Ghz frequency, using higher power than this requires a HAM radio license.

For racing, a higher power output such as 200mW is more favorable than 25mW as it will stream a more reliable FPV feed further and with less interference from obstacles. 200mW is also preferable to 600mW if you want to fly with other people. 600mW is too powerful and will cause lots of interference for other pilots.

If you crash, unplug your LiPo as soon as you pick it up. If you walk back to your seat with the quad powered on, it might affect your buddy's video signal if they are still flying (because your transmitter is now closer to your friend's receiver than their own quad is).

Use Circular Polarized Antenna

Although most VTX and VRX come with dipole antennas, we recommend getting some “circular polarized” antennas for your FPV gear instead. They provide better range, reliability and less interference (for you and others).

Find out more about the [benefits and negatives of circular polarized antennas](#).

Flying FPV with a Mini Quad

It takes time to relate what you learn on a simulator to a mini quad in real life. Don't worry it might take a few days, then it will just click and all of a sudden the sky becomes your oyster!

Here is an article about [learning FPV flying](#), and here are [some motivation and advice](#) for learning FPV. BigglesFPV also wrote a few excellent articles about getting into FPV on the IntoFPV forum, check it out:

- [Tips for new FPV pilots](#)
- [Words of encouragement](#)

And you also need to learn [how to tune PID](#) when learning how to fly.

Attending Meetup and Race Events

As you arrive at the FPV site, first thing you want to do is to work out who is using which video transmitter channel.

DO NOT power on your quad before you get your video channel confirmed, especially when

When 2 quads are on the same VTX channel, or when frequencies are too close to each other, one can disrupt the video feed of the other. Interference on 5.8GHz frequency can cause accidents because the image in the goggles can disappear entirely while flying, leaving a pilot “blind”.

Always warn other pilots before you power on your quad.

Even if you are not on the same channel, some low quality VTX can emit power through the whole spectrum on start-up and changing channels. This can cause a split second of interference to everyone else.

Alternatively you can always switch on your video receiver first, and check which channels are being used before you switch on your video transmitter.

With proper equipment and frequency management, normally up to 8 people can fly at the same time, but typically 4 pilots is more common for an interference free race.

Safety Rules

Safety should always come first.

Remember that these racing mini quads are really FAST and powerful! They can cause some nasty injuries to people and animals, and damage to property. We have zero tolerance for people ignoring safety rules, because it does not only affect the pilot and victim, but also the reputation of this hobby.

- Check your local rules and regulations regarding FPV, RC and Model Flying in general
- Buy Insurance!
- Get a spotter, or a fly buddy!
- Choose your flying location sensibly
- Never fly too close to or above people and animals
- Disconnect battery immediately after picking up the crashed quad
- Do not try to catch a multicopter in mid-air
- Never use damaged LiPo, and **dispose of LiPo battery properly**

Please also read about this [article that explains FPV safety](#) in a bit more detail.

FAQ

Best Configuration for Drone Racing – Quadcopter or Hexacopter or Tricopter?

Personally I prefer quadcopter especially mini quad.



Quads are easier to build and maintain, have many different options for frames and are most common when it comes to seeking advice. A quadcopter is also a great balance of power, weight and efficiency.

Although with the same motor/props/battery, hexacopter can give a higher top speed, but every time you crash you have more chance of damaging propellers, motors and arms.

Tricopter is pretty energy efficient, and has the best yaw authority of the three. But the yaw servo can get damaged easily in crashes, and i just don't think they are as fast as a quadcopter for a similar setup.

Tips about Mini Quad Racing

Winning a race, is not all about **speed**, **consistency** is king. But most importantly, **stay in the air!** Sometimes it's better to go slow and steady, rather than going too fast and getting out of control. So many times I have seen the fastest pilots get defeated by a crash in racing.

Make sure you bring spare propellers, crashes are inevitable no matter how much experience you have. Be prepared to crash, props and parts can get damaged, it happens to every pilot and it's completely normal. You will only start pushing your limits and improving your skills more quickly once you stop worrying!

Edit History

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