

FPV

ESSENTIALS

EXPERT ADVICE FOR VIRTUAL FLIGHT

BY MICHAEL YORK PHOTOS BY JOHN REID

I'm sure that most of us have wished that there was a way to shrink ourselves down so that we could just hop on our multirotor and go fly it around. Unfortunately, that technology isn't quite here yet, but luckily there is something that's almost as good: first-person-view (FPV) flight. Within the last couple of years, the explosion of the drone market has spurred an FPV boom, and it's amazing how quickly equipment has advanced in just a short time. As with anything, innovation and reduction in cost are directly related to popularity, which is great news for us. Whether you're into aerial video/photography, fast-paced drone racing, or just want to fly around "in" your aircraft, you have your choice of complete ready-to-fly FPV drones, ready-to-go standalone FPV systems, or kits for assembling one yourself from individual parts. While Wi-Fi-based systems are easy to use and fine for things like aerial photography, if you plan on doing some fast-paced flying around objects, you need the near-zero latency that dedicated FPV systems provide. Here are some basic insights to get you going.



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Equipment and compatibility

There are several all-inclusive FPV systems out there that are basically ready to go out of the box. These easily mount onto your model and have been tested to make sure that everything works when turned on. If you decide to assemble your own, you will need at the very least a camera, a video transmitter, and a ground station, which consists of a video receiver and some sort of display monitor.

Power can come from either a dedicated battery, or you can use the flight battery. Be sure to use the correct voltage for your gear. If you need to, there are several step-down regulators available that will allow the use of higher-voltage flight batteries. Some are even included on the flight boards.

Many of us already have an action camera, such as a GoPro or a Mobius, which can easily be used for FPV, but cameras designed for FPV are much smaller, lighter, and less expensive to replace should you have a close encounter of the tree kind.

The video link is most commonly transmitted over 5.8GHz. This allows you to use a standard 2.4GHz radio system without interference, and though high frequency has the most limited range, it allows the use of much smaller antennae on both the drone and ground station (circular polarized omnidirectional being the most popular). You always want to use a longer-range frequency for control, because it's better to start losing video at the fringes than having a clear image of what happens when you go beyond RC range. As you get more advanced in FPV, you can look into higher-power



ALTHOUGH MORE MANUFACTURERS ARE MAKING THEIR VIDEO-LINK GEAR BAND SWITCHABLE, CHECK THAT THE NEW PAIR OF HEAD-TRACKING GOGGLES THAT YOU WANT TO GET ARE COMPATIBLE WITH THE DRONE'S TRANSMITTER.

Here are a selection of different-size video transmitters. The large Connex is for cinematic production work. You can see the difference between regular omni-directional antenna (left) and a circular polarized cloverleaf antenna (right, with and without cover).

and/or lower-frequency systems to increase your range, but these will require a license from the Federal Communications Commission (FCC).

Make sure that the video transmitters and receivers are frequency-compatible. Although more manufacturers are making their video-link gear band switchable, check that the new pair of head-tracking goggles that you want to get are compatible with the drone's transmitter.

Options like an on-screen display and GPS modules that overlay telemetry (like heading, altitude, speed, and even an artificial horizon) are not only cool but also will prevent getting disoriented while zipping around. Many ready-to-fly drones have these functions already built in.

Monitors versus goggles

Choosing whether to use a monitor or a pair of goggles comes down to personal preference.

Monitors come in various sizes and options. They can be small units that can clip onto a mount on your RC transmitter, or much larger units, mounted on a stand, allowing spectators to partake in the fun. More are becoming self-contained units, having a video receiver/antenna, SD recorder, and power-supply battery built right in. They have the benefit of making the transition of going from FPV flight to line of sight quick and easy, in case you get disoriented. If you use monitors in bright conditions, the use of a sunshade is imperative to prevent glare.

Although you might look a little odd to passersby, goggles are the most immersive way to fly FPV. Like everything in the drone world, they have improved



Goggles or monitor? It really comes down to personal choice. There's no denying that goggles make you feel most connected to the action, but they can be a bit disorienting to some. Monitors are less claustrophobic but don't fully immerse you. Ideally, try out both to see which one is best for you.





DO I NEED A LICENSE?

Anything not displaying the FCC Part 15 certification requires at least a Technician Class Ham license. It's not too difficult to acquire, and allows you to boost your FPV range by using higher-power transmitters. Although most think that more power will automatically equal greater distance, the correct antenna and equipment setup can make a huge difference in range. Think of what would happen if you tried running a MotoGP bike on bicycle tires in the snow: Power does nothing without a proper way to transmit it. Also, as you go up in power, you go up in power consumption and heat buildup, requiring a larger battery and making setup more complex. You'd be surprised how much range you can get from even a 250mW system.

greatly in just a short time. Screen resolutions are becoming better, making it easier to see finer details, such as branches or race-course markers, and most are self-contained, having the receiver/antenna and power supply mounted on the unit, which make them very portable. Some even feature head tracking, allowing gimbal-mounted cameras to mimic your head movement. They can also be wired into a ground-station system, if you want to share your view on a monitor, or you plan to go to a long-range system, which requires more



SOME GOGGLES EVEN FEATURE HEAD TRACKING, ALLOWING GIMBAL-MOUNTED CAMERAS TO MIMIC YOUR HEAD MOVEMENT.

Stereoscopic cameras allow for a true 3D experience with compatible goggles—talk about full-immersion flying!

powerful receivers. Switching to line of sight is a hair more cumbersome, and doing so, some people have had issues with vertigo, although this usually goes away with time (note: sitting while flying really helps).

Setup and troubleshooting the video link

When flying via FPV, radio-frequency interference can wreak havoc on your signal, so it's important to minimize it as much as possible. Separate all of your electrical components from each other as much as you can, especially the RC and video transmitters. On very small drones, this might be impossible, but do the best you can. It's also good to keep the wiring to a minimum and nicely organized, reducing interference.

The 5.8GHz frequency does not like to pass through solid surfaces, even your drone's chassis, so orient the antenna so that it's in the clear during normal flight. Being outside with a clear line of sight to your drone will give you the best signal and farthest range, so keep clear of objects that can block or disperse the signal. If you fly near or around solid objects, you might encounter a momentary drop in signal, so it's a good idea to have a viewing system that doesn't revert to a default screen with signal loss; it's better to have an intermittent garbled view of your surroundings than a solid blue screen. It goes without

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saying that you should always have a spotter and be prepared to switch to line-of-sight flying.

Choosing the right channel is a matter of trial and error. It depends on where you fly and what types of rogue signals are out there. Switching to a frequency in either direction from the one you're having issues with can make all the difference. This, of course, gets a bit trickier if you're flying with other people, such as at drone races. Race bands allow up to eight people to fly without experiencing signal interference, and just like the equipment on the drone, distance from each other helps.

Best flight mode for FPV

Even basic drones will have several flight modes to choose from. Manufacturers might call them by different names, but their functions are pretty much the same. There isn't a perfect all-around flight mode, so the one that you choose depends on what you plan to do.

For beginners, stability mode is the way to go. The gyro will do its best to maintain a steady attitude and altitude (if equipped with a barometric sensor). If there is a breeze, however, the drone will constantly be making little corrections to stay in place, which can make the image you see appear twitchy.

At the other extreme, manual or acro mode is the least intrusive mode. This is best left to more advanced pilots because you need to be on the sticks at all times, but it will give you the most flowing feel when flying.

Some models have attitude modes that will let you program tilt limits, allowing you to have some freedom of movement without letting things get too out of hand.

VIDEO FREQUENCIES

There are four FPV video frequencies to choose from:

5.8GHz: This is the most common FPV frequency. If the gear is FCC Part 15 certified, it does not require any licensing (most small ready-to-fly drones at your local hobby shop fall into this category). This frequency has the most choice in channels and uses the smallest antenna. It does, however, have the poorest signal penetration and range.

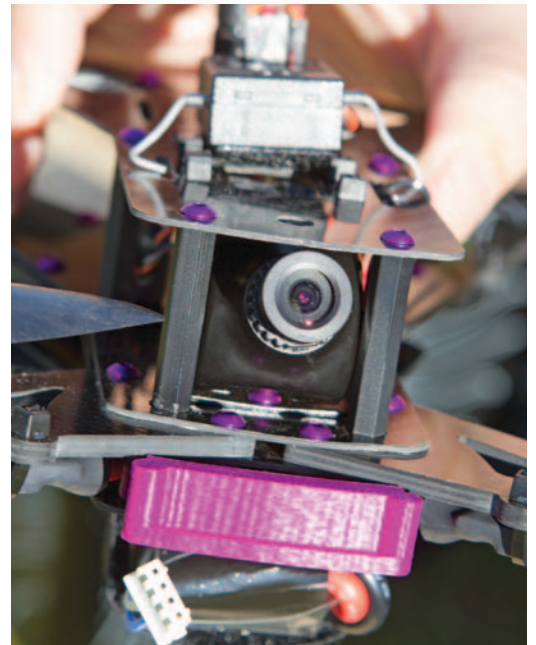
2.3GHz/2.4GHz: This is a popular frequency for intermediate to long-range setups. It does much better in passing through solid objects, but it prevents the use of a 2.4GHz radio system, so many use the classic 72MHz radios.

1.3GHz: This frequency is very popular when paired with long-range-system radios. Antenna size limits its use on smaller models.

900MHz: Although this frequency seems as if it would be the best choice for those wanting to expand their horizons, it is very close to cell-phone frequencies, so it has a good chance of interference.



Right, top to bottom: Companies like DJI and Yuneec use their own gimbaled HD cameras that allow you to pan and tilt as you fly, giving you ultimate flexibility in viewing your surroundings. Race drones have fixed cameras that are tilted at an angle, which give you a forward view when the chassis is tilted during forward flight. You can also add pan/tilt capability to almost any drone using an action camera and one of the many gimbal units now available.





SEVEN FPV FLIGHT RULES

1 All FPV pilots must fly with a spotter who will watch the aircraft throughout its flight as well as let the FPV pilot know of any incoming aircraft or other issues.

2 If FPV pilots experience a safety issue that's more than a brief glitch, they must abandon FPV and fly visual line of sight.

3 Before flying any aircraft for the first time with FPV or after any changes or repairs, you must perform a safety flight via visual line of sight.

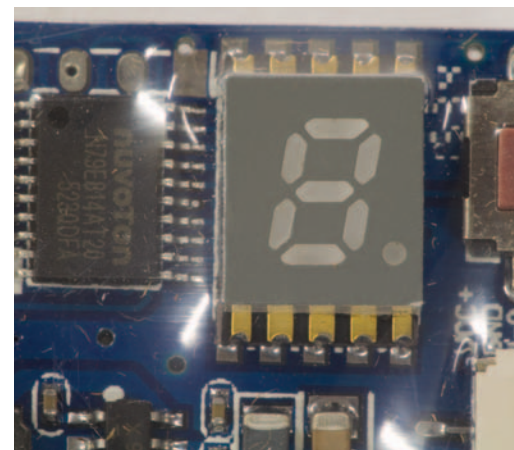
4 FPV model aircraft must use frequencies approved by the FCC for both the radio-control system and the wireless video system.

5 FPV pilots must be capable of flying their model aircraft via visual line of sight before they try FPV flight.

6 To be excluded from Federal Aviation Administration (FAA) regulations, model aircraft must be flown within visual line of sight of the operator at all times and at or below a 400-foot altitude.

7 FPV model aircraft are limited to a total ready-to-fly weight of 15 pounds and a speed of 70mph.

This list of FPV rules is based on Document #550, "Utilizing 'First Person View' Systems," published by the Academy of Model Aeronautics (AMA), the world's largest model aviation organization and the official national body for model aviation in the United States. AMA leaders work with the FAA as well as state and local governments to promote the interests of RC pilots. To view the entire document, go to modelaircraft.org/files/550.pdf.



Some transmitter/receiver units feature an LED display that indicates which frequency and channel is being selected via a push-button selector.

Depending on the controller, you can also set it up to level off as soon as you neutralize the controls—great if you get disoriented.

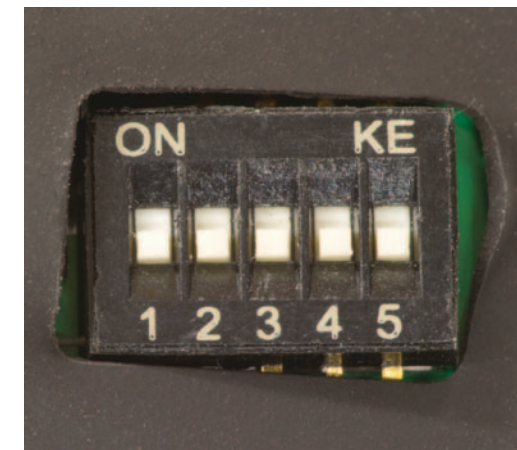
If equipped with GPS, you get options like course lock, home lock, and return to home. Think of course lock as flying on a grid. The drone moves fore/aft and sideways based on your stick input, no matter which way the nose is pointing. Home lock makes you the hub of a wheel, and you control how far away from you the drone rotates. Again, this is independent of camera direction. Return to home is a great safety feature if you lose video or control signal. It can also be manually selected if you get lost.

Bottom line

When getting into FPV, being humble about your ability goes a long way toward success. Just because you can fly line of sight like a pro doesn't mean that you'll be a pro flying while looking at a screen. Having an easy-to-fly platform is key because this will allow you to gauge things like distance and altitude/attitude without having to worry about the drone getting away from you. Safety is obviously of utmost importance. This is where the monitor has a slight advantage over



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Many transmitters/receivers use dip switches that are toggled into a combination that correspond to a particular band and frequency.

goggles as you can quickly look at the model if you get disoriented via the camera.

Don't be afraid to start out with a small drone as it will allow you to practice in more places than you could with a bigger one. Micro drone FPVs, for example, can easily be flown indoors, so you can maximize your time behind the screen. Once you get comfortable with how things look through a camera and feel proficient in controlling basic flight, you can engage more agile flight modes and start having some real fun. Obviously, it is imperative that you know your surroundings and maintain situational awareness; otherwise, you might end up with a brick wall surprise.

Finally, don't be too proud to ask for help. Most of us have experienced similar issues when getting started and are more than willing to assist you. Send your questions to RotorDrone@airage.com, and stay tuned to *RotorDrone* magazine for more FPV news and how-tos. Enjoy your virtual flights! ✈️

Though many systems allow you to record the FPV video feed you see, most of us use a dedicated camera to capture flight video. The image quality is much better, and you don't record any of the static that can be associated with video transmission.

