

Radio Controlled Aircraft

by Rick Nungester WA6NDR & Jeff Banke NZ2S, 9/10/20

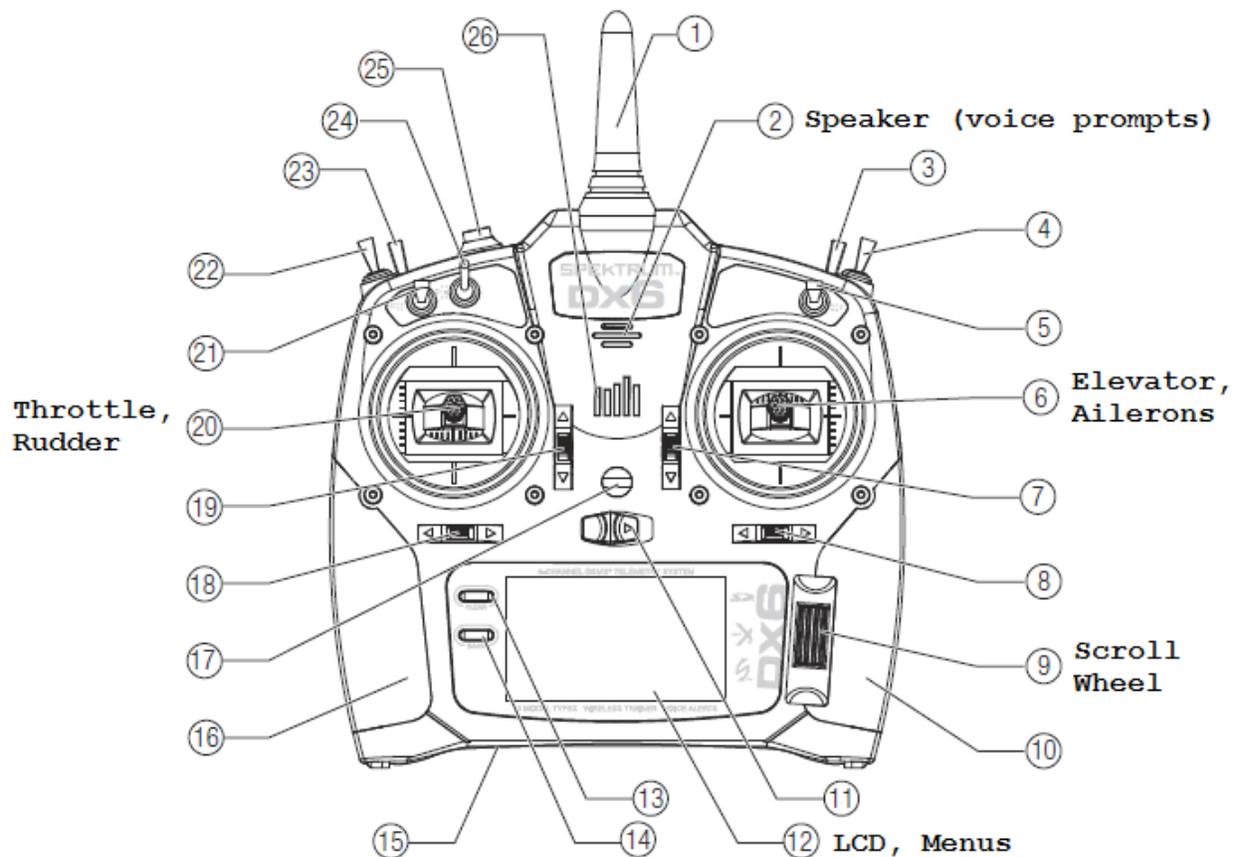
Ham Radio	RC Aircraft
Inland Empire VHF Radio Amateurs	Inland Empire Quiet Flyers
American Radio Relay League (ARRL)	Academy of Model Aeronautics (AMA)
QST magazine	Model Aviation magazine
Federal Communications Commission (FCC)	Federal Aviation Administration (FAA)
HT, Mobile, Base, Antennas, CW, AM, FM, SSB, Fusion, D-STAR, DMR, FT8...	Planes, Gliders, Helis, Drones, Gas, Electric, Jets, Video, Smoke, Brakes, Gear...
Contests, DX, Awards, Tech, Circuits, Service, Friendships...	Contests, Aerobatics, Awards, Tech, Modeling, Friendships...

- [Overview](#)
 - History, types, First Person View (FPV), modeling, gas/electric, radio.
- [Vocabulary](#)
 - Pitch (Elevator), Roll (Ailerons), Yaw (Rudder), Throttle.
 - RTF = Ready To Fly (plane, transmitter, everything).
 - BNF = Bind 'N Fly (plane only, no transmitter).
 - SAFE = Sensor Assisted Flight Envelope (limits max pitch and roll in 3 modes; "Panic" auto-recover in bad situations).
- Rick's progress and purchases
 - 06/19/13 \$180 [RealFlight R/C Flight Simulator](#) (Now v9 + Spektrum InterLink DX controller; 160 planes, helis, drones; 40 sites; training videos; camera fixed / nose / chase; wind; multiplayer; controller. Then v6.5.)
 - 09/06/18 \$30 [Syma Sky Phantom FPV Drone](#), Costco, controller + drone with low-res camera, WiFi to smartphone with free [Syma Fly](#) app.
 - 10/02/18 \$240 [Apprentice S 15e with SAFE 1.5m RTF with DXe Transmitter](#), a common student trainer, 6-channel (rudder, elevator, ailerons, throttle, SAFE, Panic), discontinued, see newer models.
 - 10/10/18 \$75 Academy of Model Aeronautics (AMA), yearly membership (with Model Aviation magazine) + insurance.
 - 10/10/18 \$50 Inland Empire Quiet Flyers (IEQF), yearly membership.
 - 12/16/18 \$34 each [Admiral 11.1V 3300 mAh LiPo batteries](#) for Apprentice.
 - 12/20/18 \$100 [Champ RTF 515 mm](#), small light starter plane for indoor (2 basketball courts) or park flying, 3-channel (throttle, elevator, rudder).
 - 04/19/19 \$64 [Tenergy TB6-G battery charger](#), for many types and sizes.
 - 04/19/19 \$250 [Spektrum DX6 6-Channel Gen 3 Transmitter](#), configurable for many types and models of air vehicles, nested menu system. Features:

assignable switches; interface changes for airplane / helicopter / sailplane / quadcopter; voice interface; timers; telemetry from plane; mixing; programmable stick motion curves; buddy box; more (see below).

- 06/19/19 \$50 Apprentice repair after crash. (Plan on it.)
- 06/25/19 \$10 [Ares Gamma 370 V2](#) won in a raffle, \$15 RX replacement so it worked with my TX, \$12 each battery.
- 09/15/19 \$218 [Night Radian FT 2.0m BNF Basic with AS3X and SAFE Select](#), power-assisted glider, 6.6' wingspan, LED lights for night flying, 4-channel (throttle, elevator, rudder, SAFE).
- 07/30/20 \$22 [Liftoff First Person View \(FPV\) Drone Racing](#) simulation software.

- Spektrum DX6 6-Channel 2.4 GHz DSMX Aircraft System (46-page manual)



FAA - Federal Aviation Administration requirements

Before you take your drone or small unmanned aircraft system (sUAS) out for your first flight, there are crucial safety and privacy considerations to consider. The most important safety guidelines are in the infographic below but ultimately you are responsible for checking with the FAA, nearby airports and control towers, and local authorities to determine where you can and cannot fly your drone. To help you understand where it is safe to fly your drone, use one of the recommended apps.

Know Your Surroundings

Some municipalities prohibit the operation of remote controlled aircraft within public spaces such as parks and school grounds. There are rules of the air you need to know. Always check with local authorities before you fly your drone.

- If you own a drone, register it
- Fly below 400 feet (for reference, an American football field is 360 feet long including the end zones)
- Avoid flying over groups of people and stadiums
- Never fly near other aircraft or airports
- Keep well away from emergency response efforts such as fires
- Fly within visual line of sight, meaning you as the drone operator use your own eyes and needed contacts or glasses (without binoculars), to ensure you can see your drone at all times
- Be aware of FAA airspace requirements
- Do not fly under the influence

Recreational or commercial use (part 107)?

Using a drone in connection with a business is considered to be commercial use by the FAA. This includes but is not limited to:

- Real estate, wedding or other photography
- Inspection - Antennas for ice or land survey services, such as farming studies for distribution of fertilisers, etc.
- Film or television Production
- Wire antenna erection

Recreational flyers and modeler

Following these rules will keep you and your drone safe and will help keep the airspace available to everyone.

1. [Register](#) your drone, [mark](#) (PDF) it on the outside with the registration number and carry proof of registration with you.
2. Fly only for recreational purposes.
3. Fly your drone at or below 400 feet above the ground when in uncontrolled (Class G) airspace.
4. Obtain authorization before flying in controlled airspace ([Class B, C, D, and E](#)). You can obtain authorization in three ways:
 1. [LAANC](#)
 2. [DroneZone](#)
 3. A written agreement with the FAA for fixed flying sites. For more information about fixed flying sites, contact us at UAShelp@faa.gov.

NOTE: Flying drones in certain airspace is not allowed. Classes of airspace and flying restrictions can be found on our [B4UFLY](#) app.

5. Keep your drone within your visual line of sight, or within the visual line-of-sight of a visual observer who is co-located (physically next to) and in direct communication with you.
6. Do not fly at night unless your drone has lighting that allows you to know its location and orientation at all times.
7. Give way to and do not interfere with manned aircraft.
8. Never fly over any person or moving vehicle.
9. Never interfere with emergency response activities such as disaster relief, any type of accident response, law enforcement activities, firefighting, or hurricane recovery efforts.
10. Never fly under the influence of drugs or alcohol. Many over-the-counter medications have side effects that could impact your ability to safely operate your drone.
11. Do not operate your drone in a careless or reckless manner.

Recreational flyers should know that if they intentionally violate any of these safety requirements, and/or operate in a careless or reckless manner, they could be liable for criminal and/or civil penalties.

Changes Coming in the Future

The law also requires:

1. Drone operators to pass an online aeronautical knowledge and safety test and carry proof of test passage.
2. The FAA to issue guidance for how it will recognize community based organizations.

The FAA is incrementally rolling out these features and requirements.

Recreational users who only fly their drone/unmanned aircraft for fun, now have an improved app—B4UFLY—to help show where they can and cannot fly with interactive maps.

The FAA has partnered with Kittyhawk to redevelop the FAA's first mobile application, to improve the user experience so that recreational flyers know whether it is safe to fly their drone/unmanned aircraft. The app provides situational awareness to recreational flyers and other drone users. It does not allow users to obtain airspace authorizations to fly in controlled airspace, which are only available through the FAA's Low Altitude Authorization and Notification Capability (LAANC).

The new B4UFLY app is now available to download for free at the [App Store for iOS](#) and [Google Play store](#) for Android.

Part 107 Eligibility Requirements

In order to fly your drone under the FAA's Small UAS Rule (Part 107), you must obtain a Remote Pilot Certificate from the FAA. This certificate demonstrates that you understand the regulations, operating requirements, and procedures for safely flying drones.

To become a pilot you must:

- Be at least 16 years old
- Be able to read, speak, write, and understand English
- Be in a physical and mental condition to safely fly a drone
- Pass the initial aeronautical knowledge exam

Requirements for Remote Pilot Certificate:

- Must be easily accessible by the remote pilot during all UAS operations
- Valid for 2 years. Certificate holders must pass a recurrent knowledge test every two years

Step 1: Obtain an FAA Tracking Number (FTN) by creating an [Integrated Airman Certification and Rating Application](#) (IACRA) profile prior to registering for a knowledge test.

Step 2: Schedule an appointment with a [Knowledge Testing Center](#) which administer initial and recurrent FAA knowledge exams. Be sure to bring a government-issued photo ID to your test.

Step 3: Pass the initial aeronautical knowledge test. Knowledge test topic areas include:

- Applicable regulations relating to small unmanned aircraft system rating privileges, limitations, and flight operation
- Airspace classification and operating requirements, and flight restrictions affecting small unmanned aircraft operation
- Aviation weather sources and effects of weather on small unmanned aircraft performance
- Small unmanned aircraft loading and performance
- Emergency procedures
- Crew resource management
- Radio communication procedures
- Determining the performance of small unmanned aircraft
- Physiological effects of drugs and alcohol
- Aeronautical decision-making and judgment
- Airport operations
- Maintenance and preflight inspection procedures

Step 4: Complete FAA Form 8710-13 for a remote pilot certificate (FAA Airman Certificate and/or Rating Application) using the electronic FAA Integrated Airman

The following are examples of the regulations

Operating Limitations

The sUAS must be operated in accordance with the following limitations:

- Cannot be flown faster than a groundspeed of 87 knots (100 miles per hour);
- Cannot be flown higher than 400 feet AGL, unless flown within a 400-foot radius of a structure and does not fly higher than 400 feet above the structure's immediate uppermost limit;
- Minimum visibility, as observed from the location of the control system, may not be less than 3 SM; and
- Minimum distance from clouds being no less than 500 feet below a cloud and no less than 2000 feet horizontally from the cloud.

These operating limitations are intended, among other things, to support the remote pilot's ability to identify hazardous conditions relating to encroaching aircraft or persons on the ground, and to take the appropriate actions to maintain safety.

Determining Groundspeed

There are many different types of sUAS and different ways to determine groundspeed. Therefore, this guidance will only touch on some of the possible ways for the remote PIC to ensure that the sUAS does not exceed a groundspeed of 87 knots during flight operations. Some of the possible ways to ensure that 87 knots is not exceeded are as follows:

- Installing a GPS device on the sUAS that reports groundspeed information to the remote pilot, wherein the remote pilot takes into account the wind direction and speed and calculates the sUAS airspeed for a given direction of flight, or
- Timing the groundspeed of the sUAS when it is flown between two or more fixed points, taking into account wind speed and direction between each point, then noting the power settings of the sUAS to operate at or less than 87 knots groundspeed, or
- Using the sUAS manufacturer design limitations (e.g., installed groundspeed limiters).

Determining Altitude

In order to comply with the maximum altitude requirements of part 107, as with determining groundspeed, there are multiple ways to determine a sUAS's altitude above the ground or structure. Some possible ways for a remote pilot to determine altitude are as follows:

- Installing a calibrated altitude reporting device on the sUAS that reports the sUAS altitude above MSL to the remote pilot, wherein the remote pilot subtracts the MSL elevation of the CS from the sUAS reported MSL altitude to determine the sUAS AGL altitude above the terrain or structure;
- Installing a GPS device on the sUAS that also has the capability of reporting MSL altitude to the remote pilot;
- With the sUAS on the ground, have the remote pilot and VO pace off 400 feet from the sUAS to get a visual perspective of the sUAS at that distance, wherein the remote pilot and VO maintain that visual perspective or closer while the sUAS is in flight; or
- Using the known height of local rising terrain and/or structures as a reference.

Visibility and Distance from Clouds

Once the remote PIC and VO have been able to reliably establish the sUAS AGL altitude, it is incumbent on the remote PIC to determine that visibility from the CS is at least 3 SM and that the sUAS is kept at least 500 feet below a cloud and at least 2,000 feet horizontally from a cloud.

One of the ways to ensure adherence to the minimum visibility and cloud clearance requirements is to obtain local aviation weather reports that include current and forecast weather conditions. If there is more than one local aviation reporting station near the operating area, the remote PIC should choose the closest one that is also the most representative of the terrain surrounding the operating area. If local aviation weather reports are not available, then the remote PIC may not operate the sUAS if he or she is not able to determine the required visibility and cloud clearances by other reliable means. It is imperative that the sUAS not be operated above any cloud, and that there are no obstructions to visibility, such as smoke or a cloud, between the sUAS and the remote PIC.

Can I fly my drone near stadiums & sporting events?

Flying drones in and around stadiums is prohibited starting one hour before and ending one hour after the scheduled time of any of the following events:

- Major League Baseball
- National Football League
- NCAA Division One Football
- NASCAR Sprint Cup, Indy Car, and Champ Series races

Specifically, UAS operations are prohibited within a radius of three nautical miles of the stadium or venue. In addition, other flight restrictions may exist. It always best to consult the B4UFLY mobile app before flying your drone/unmanned aircraft.

Register your Drone with the FAA

- Registration costs \$5 and is valid for 3 years. You'll need a credit or debit card and the make and model of your drone handy in order to register.
- Visit dronezone.faa.gov and select "Fly sUAS under Part 107" to create an account and register your drone.
- Once you've registered, [mark your drone](#) (PDF) with your registration number in case it gets lost or stolen.

Drone Labeling Instructions

Remember to label your drone with your FAA certificate number before heading out to fly. The certificate number must be on the exterior of your drone. You can make your own label.

FLYING SAFELY



Recreational or commercial use?

Using a drone in connection with a business is considered to be commercial use by the FAA. This includes but is not limited to:

- Real estate, wedding or other photography
- Inspection or survey services
- Film or television production

Go to b4youfly.org to stay up to date on how and when you can fly your drone.

Know your surroundings

Some municipalities prohibit the operation of remote controlled aircraft within public spaces such as parks and school grounds. There are rules of the air you need to know. Always check with local authorities before you fly your drone.

- ✓ If you own a drone, register your drone droneregistration.com
- ✓ Fly below 400 feet
- ✓ Avoid flying over groups of people and stadium events
- ✓ Never fly near other aircraft or airports
- ✓ Keep well away from emergency response efforts such as fires
- ✓ Fly within visual line of sight
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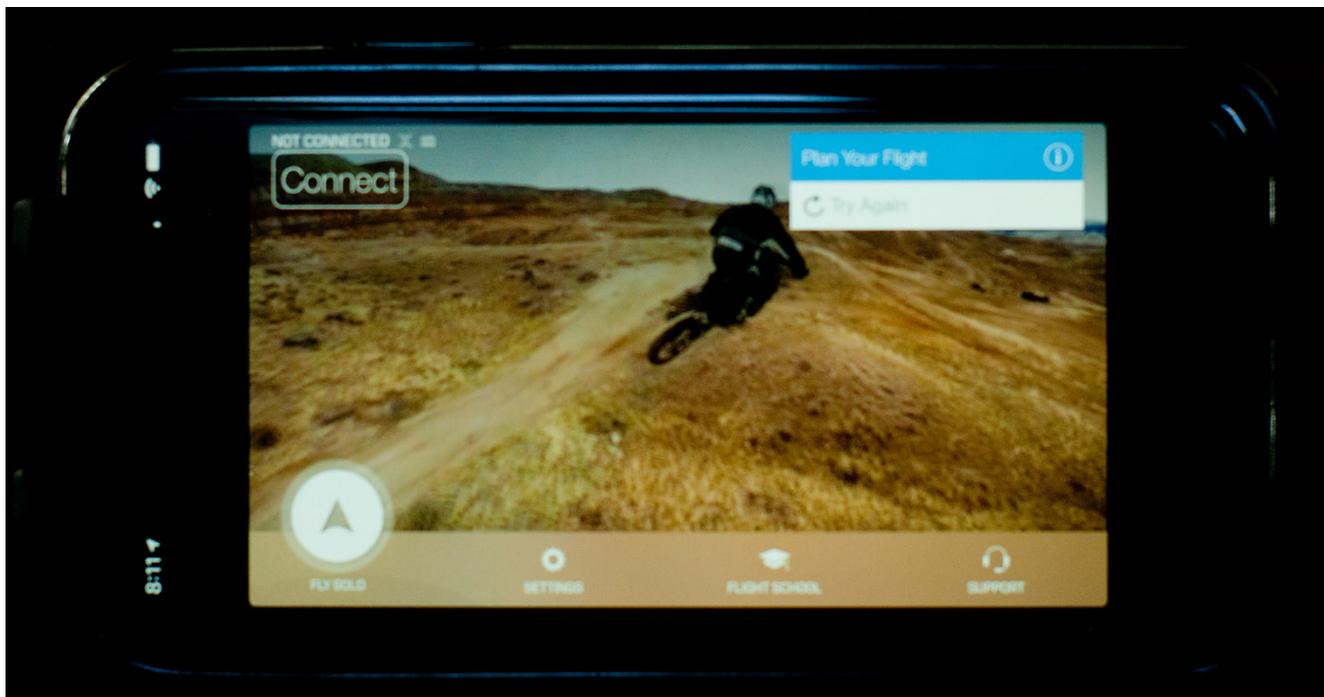
The most practical use of a larger drone for an amateur radio station is the ability to use it to erect wire antennas. This is achieved by using a drone clip or release as will be seen below, in conjunction with a fishing weight of one or two ounces. The drone clip/release, has its own radio link and therefore is independent of the drone, which is why it is useful to have two operators, one to fly the drone and one to drop the weight. The weight obviously has fishing line attached to it, and dacron cord attached to the fishing line. Once the drone is flown over the selected tree, the operators drops the weight, it in turn pulls the fishing line off the spool as it drops and once the weight has landed on the ground, you tie the dacron onto the fishing line. Then the line is pulled over the tree from where the weight landed and with it the dacron line, once the dacron is at the base of the tree, then the antenna wire is attached and hauled into position by pulling the dacron. The dacron is then tied off at the base of the tree. This means there will be a fair number of feet of dacron tied off, but this will allow the lowering of the antenna at any future date if needed.

Here is a shot of a typical drone, this a 3DR drone, equipped with a GoPro Hero 4 camera on a gimbal.



A shot of the controller, which as you can see also resembles the controllers on the model aircraft, with the addition of an iPhone, which connects to the GoPro camera, such that one can see what the SOLO drone is doing., from the drones perspective.





Above the GoPro Hero 4 camera, and below the iphone screen linked to the GoPro.

What makes it useful to the radio amateur is this little device, the drone clip which straps onto the drone and is controlled by the little push button controller to the right.

