eBook – Buying and Flying DJI Phantom 3 and 4 Quadcopters – Chapter 1

SEPTEMBER 9, 2016 BY CRAIGI

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Dear Friends,

We are now publishing our best-selling Phantom eBook here on the Droneflyers.com site – and removing it from sale on Amazon. The book will be published in sections, each of which can be read online or downloaded as a PDF (see button at bottom of article). Note – all material is copyrighted, so please do not redistribute online or in bulk (lending and passing on is OK).

Although the book will be 100% free you can still help the site and author by using one of our affiliate links (ads in the articles and at the bottom) to make purchases. In that case we receive a small commission – but you don't pay any more!

The entire book will be published – along with updates – by September 15 – so please start your reading now and watch for new chapters!

Chapter 1 – Introduction to Author, DJI and the Phantom Camera Drones

About the Author

By any method necessary, Craig has been attempting to leave the confines of Mother Earth since childhood. From Model Rocketry to Balsa Scale Models, his early attempts succeeded in sending large payloads, including live mice, into near space. In his adult life, he first tried CB Radio with pirate channels, then Ham Radio with vast antenna arrays on his rooftop. Finally he found the promised land of Compuserve (1986), AOL (1988) and the Internet (1994 on).

Along the way, he developed and sold various alternative energy products, wrote technical manuals, obtained two patents, founded major web sites and, along with his spouse of 40+ years, raised three children. Craig founded the popular Droneflyers.com web site and regularly tests and reviews quadcopters, cameras and other related accessories. His first book, Getting Started with Hobby Quadcopters and Drones, quickly became a best-seller and garnered rave reviews.

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Phantom 3 Pro
Here's what readers are saying about this book

"This is a well-written introduction to the Phantom Quadcopters. The author has obviously spent a lot of time with this product, and a lot of time sharing his experiences. The author writes well, and has done a good job editing this book and making it readable and fun"

"If you plan on buying a Phantom, this is a must read"

"Very good basic info that dji should have provided in the first place. Thanks!"

"This guide does exactly what it says it does: gives readers enough information to get started with DJI Phantom Quadcopters, in a short, clear, concise, and well-organized way"

If you or your friends are just getting started in this thrilling hobby, be sure to check out our beginner's book Getting Started with Hobby Quadcopters and Drones – available on Amazon in ebook or paperback form.

Introduction

The DJI Phantom 3 & Phantom 4 Quadcopters represent a major milestone in the adoption of consumer level drones. This is a Photography and Video platform that, just a few short years ago, would have been impossible to build for even 10x the current price.

The DJI Phantoms are sold Ready to Fly (RTF) complete with transmitter (also called the Remote), camera w/stabilizing gimbal and advanced navigation and software control. This book will introduce the reader to DJI, the history of the Phantom quadcopters and the newer Phantom models. Features, operation and safety will also be discussed.

Who is this book written for?

This book is designed as an educational resource and a *guide to help beginning flyers and those new to aerial robots make an intelligent purchasing decision*. Those just entering the pursuit or ready to step up from toy grade models will learn all the basics – and more. If you are already experienced with R/C flying and/or quadcopters then you may be able to skip this book. Hopefully you are familiar enough with the DJI products to research them online and make an informed choice on your own.

If you have never flown a quadcopter or other R/C craft, it may help to start with our other book Getting Started with Hobby Quadcopters and Drones, available on Amazon in ebook and paperback form. Practice makes Perfect and better to crash and lose a couple $40 quadcopters during your learning experience then to lose your precious DJI Phantom.

Note: This book is not written as a replacement for the DJI manuals or guides, rather it is a Cliffs Notes and overview of the Phantom 3 and 4.

Who should consider a DJI Phantom Quadcopter?

DJI markets the Phantoms as flying cameras. This is an accurate description as Phantoms are not designed for racing, training or hacking and modification. A list of current and potential uses:

1. Video – creative uses as well as inspection of structures
2. Still photography – creative uses as well as inspection
3. Aerial Mapping – stitching photos and/or using other sensors
4. Small agricultural inspection/sensing
5. Technology Demo, Education and Experiments
6. Aerial piloting education in GPS, Orientation and more
7. "Gotta Have it" Gadget – add to your tech collection

See the world from a new perspective

Use of Terms and Basic Definitions

aerial-360-panoramas

We will use the terms drone, quad and quadcopter interchangeably, drone being the common use in the news media while quadcopter is more descriptive of the Phantom models. Not all drones are quadcopters – quadcopters have 4 propellers, while some drones have 6 or 8. There are also winged drones with one or more propellers or jet engines. Future drones may have flapping wings and other propulsion methods.

A more accurate name might be UAVs, which stands for unmanned aerial vehicles. Some use the term aerial robots or autonomous in their descriptions, indicating the drone may have more advanced capabilities, such as flying a pre-programmed flight path (called waypoints) without operator input or control.

We will start with only a few definitions – a more complete glossary is at the end of the book.

Autonomous – not subject to control from outside, often used to describe a drone which follows a preset path using GPS or other means, as opposed to being actively steered by the operator.

DJI – DJI Innovations, manufacturer of the Phantom models.

Drone – A newer, perhaps slang, definition for any unmanned powered aerial vehicle.

F/C or Flight Controller – the brain of a quadcopter which performs the many functions that keep the Phantom flying.

FPV – First Person View – often used to describe cameras mounted on aerial (or any unmanned) vehicles which let the operator see what the aircraft camera sees in real time.

Gimbal – Mount for Camera which uses electronics to keep the camera level as your drone flies.

GPS – Global Positioning System used to track movement or hold position on DJI quadcopters.

LiPo – This describes the type of battery (internal chemistry) that most electric drones currently use.

R/C – Another way of writing RC – Radio Controlled or Remote Controlled.

Remote – is used by DJI to refer to the Remote Controller (formerly called a Transmitter or TX) which is used to control the Phantom.

RTF – Ready to Fly – this means that the unit is sold complete – little or no assembly or programming is needed to take to the skies.

Telemetry – Refers to a back and forth connection between an aerial vehicle and your controller/transmitter/screens. This would allow, as an example, the display of the battery power remaining on the drone to be displayed to you at your ground station.

TX – Short for Transmitter – this is the radio controller you hold while flying your Phantom – also called a Remote or Remote Control.

The book may also use shorthand for the various Phantom Models – as follows:
P3 – Phantom 3 (general)
P3S – Phantom 3 Standard Model
P3 4K – Phantom 3 4K Model
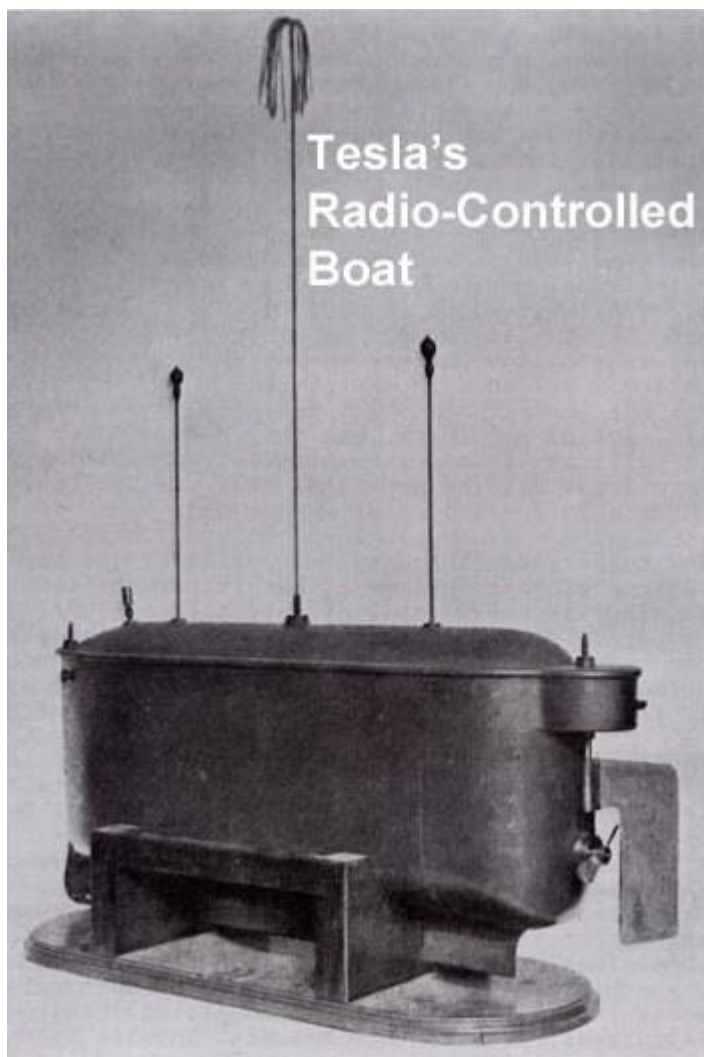P3 Advanced (or P3A) – Phantom 3 Advanced model (HD)
P3 Pro (or P3P) – Phantom 3 Professional model (4K)
P4 – Phantom 4
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A Short History of R/C, Quadcopters and DJI

The first demo of a Radio Controlled vehicle was in 1898, when Nikola Tesla showed a working R/C boat at an electrical expo at Madison Square Garden.

He claimed the boat had a "borrowed mind" and obtained U.S. patent number 613,809 for various R/C schemes.

The First Quadcopter

The de Bothezat helicopter, also known as the Jerome-de Bothezat Flying Octopus, was an experimental quadrotor helicopter built for the United States Army Air Service by George de Bothezat in the early 1920s, and was said at the time to be the first successful helicopter. Although its four massive six-bladed rotors allowed the craft to successfully fly, it suffered from complexity, control difficulties, and high pilot workload, and was reportedly only capable of forwards flight in a favorable wind. The Army canceled the program in 1924, and the aircraft was scrapped.
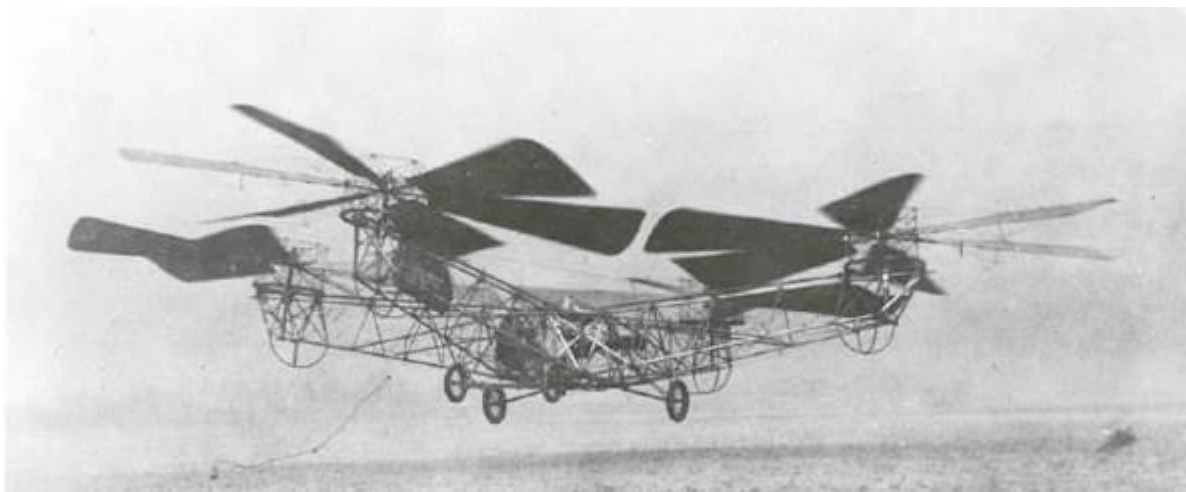
d
e bothezat quadrotor
First Hobbyist Quadcopters

Modern Quadcopters started as an offshoot of the model Helicopter and Airplane hobby. Early models became available in 2007-2008 and by 2009 a number of Chinese toy helicopter companies were adding inexpensive quadcopters to their product lines. At the same time, a few new companies (MikroKopter, Draganflyer, etc.) started to address the photography market with more sophisticated models costing many thousands of dollars. As with similar technological products, hobbyists and hackers advanced the technology by programming and building their own custom quadcopters.

2012-2014 The Rise of the Drones

2012 saw explosive growth in the market and technology, as costs went down and capabilities up. Much of this was driven by lower prices for the important electronic components – which was driven by the rise of hundreds of millions of smartphones and game machines.

Accelerometers, gyroscopes, electronic barometers, compasses and GPS – the same instruments in your smartphone – help keep a drone flying. Cameras are also getting smaller – again driven by the market for millions of them inside smartphones and consumer digital

cameras.All these factors combined to make the DJI Phantom and similar quadcopters a reality.

The first DJI Phantom model, the Phantom 1, was introduced in November of 2012 for a price of approx. $700 US. In the same way that the Apple II computer started the mass market for personal computers, the Phantom 1 brought in legions of new users. It has been followed quickly by more advanced Phantom models. (link here to ID every Phantom made!).

DJI Innovations

Started by a student of Hong Kong's University of Science and Technology, DJI is now the world leader in consumer-level quadcopters. Often described as "The up and coming Apple of China", DJI started in an 80 sq. ft. office by Frank Wang Tao and has already grown to over 6,000 employees. As to why Frank started the company – "I was a model enthusiast, but my aircraft often crashed," he says. "So it was my dream to develop this technology."

Frank Wang Tao – DJI Founder
DJI became a billion dollar (total sales) company in 2015 and sales are still accelerating. A recent outside investment in DJI set the market value of the company at approx.12 billion dollars!

DJI grows by staying one step ahead of the competition and delivering as much technology as possible at the lowest possible price. This often leaves their competitors scrambling as they find themselves unable to achieve the benefits of scale (mass production, engineering) that DJI uses to drive the market.

According to Frank, just the parts for the modern Phantom would have cost tens of thousands of dollars a few years ago. Today's Phantom models are one example of Clarkes Law which states:

"Any sufficiently advanced technology is indistinguishable from magic."

What makes a Phantom Different?

Most other quadcopter companies decided to appeal to the impulse buyer by producing $20-$150 models with limited features. These models are considered toy grade. Although fun platforms for learning, they are somewhat disposable and not capable of heavy payloads and long distance flight.

DJI decided to build a better quadcopter with higher grade parts and features. This means a Phantom will last much longer than the toy machines. Built-in intelligence makes it easier to fly and less likely that the operator will lose it. DJI includes a high quality camera in the P3 and P4 line – giving the operator an "eye in the sky". As technology has advanced, DJI has built in more and more features. Although competition is a good thing, there are currently no other companies offering the same level of sophistication and reliability in a RTF (ready to fly) consumer (<$1300) quadcopter.

In addition to reliability and relative ease of use, the Phantom is of a size and weight which represents the sweet spot for many uses. Larger models are available, but the costs spiral – somewhat similar to boats, where a larger model costs much more than a mid-sized one. The newer Phantom 3 models are truly mass-produced, giving the consumer an amazing amount of technology at a unheard of price point.

Should You Buy a DJI Phantom Quadcopter?

Phantoms contain impressive technology, however skills are still required to fly – and most importantly keep – your Phantom. The internet is full of stories about new pilots crashing and losing their Phantoms. There is a good chance this will happen to you if you do not spend the time to properly understand the Phantom. We have written a few articles on avoiding such problems.

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To summarize the article:

These are very delicate machines and should not be used as your sole flying machine – that is, don't practice with it, demo it and fly it around for your regular hobby. Rather, these are flying cameras which should only be used when you intend to actual take footage and still photos. Flying them for other reasons will likely cost you time and money.

1. If this is your first quadcopter – don't fly it! Buy a couple toy quadcopters and then perhaps a low priced (w/o camera) Phantom 1 or older Blade 350QX and get a number of hours of flight time.

2. Please don't experiment with your Phantom – it seems that many who take up this hobby like to push things to the limits…and then far beyond. If you want to keep your Phantom, think and act very conservatively. Treat it like you would a very fine and delicate flying camera – because that's exactly what it is!

3. If you regularly fly long missions over large bodies of water, in urban areas or or out of your line-of-sight (LOS) you are very likely to lose your Phantom prematurely.

Crashing or losing your expensive aircraft is not covered under the DJI warranty…this is true of any and all hobby quadcopters. There is additional insurance available from both DJI (DJI Care) and some 3rd parties (Neary Aerial) which will cover your Phantom for most crashes.

Chapter 2 link here!

If you would like to help support our publishing and educational efforts, purchase your Phantom (or accessories – or anything at Amazon, etc. for that matter) using the links below or on one of our sister sites of Dronesavings.com (best deals updated regularly) or Phantominfo.com (most everything you need for a Phantom).

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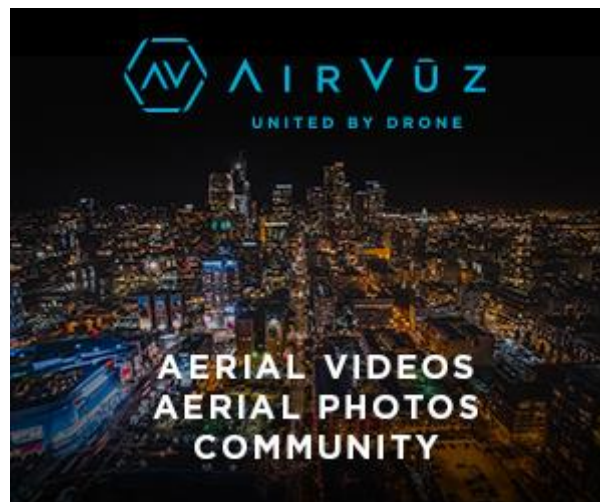
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Chapter 2 – Guide to Current DJI Phantom 3 and 4 Models

The P3 and P4 build upon the platform and successes of earlier models. The price/performance (value) has increased – DJI is now building in more goodies for less money!

Phantom 4
$1199 (approx.)

DJI Phantom 4

The Phantom 4 comes in a single model easily recognizable by the lack of decals and colors – it is bright white.

Phantom 3 – 4 models as of Fall, 2016
DJI Phantom 3 Standard -$499
DJI Phantom 3 4K -$599
DJI Phantom 3 Advanced -$799
DJI Phantom 3 Professional – $999

The Phantom 3 is not available "bare" – it comes complete with the camera and transmitter (remote). All that is needed to fly is your phone or tablet (IOS or Android).

DJI Phantom 3
Pro Model has Gold Stripes, Advanced Blue Stripes and Standard Red Stripes
P3 4K model has Gold Stripes and "Phantom 3 4K" Name

The two more expensive models, Advanced and Pro, are identical except for the capabilities of the camera. The Phantom 3 Standard has a different camera and remote controller as well as some different specs in terms of range. The Phantom 3 4K is essentially an upgraded P3S. Let's discuss the two top-end models first and then delve into the differences in the less expensive Phantom 3 Standard and Phantom 3 4k.

The Phantom 4 is essentially a perfected Phantom 3 Professional with one major new feature – Computer Vision (Obstacle Avoidance, etc.). We will introduce that feature at the end of this section and expand upon it later in the book. Those interested in the Phantom 4 should read all the Phantom 3 material since it also applies fully to the Phantom 4.

Phantom 3 Advanced and Professional

The main difference between these two models is in the camera – the Pro model is capable of 4K video (4096 x 2160 pixels), while the Advanced is HD (1920 x 1080 pixels). A major advantage of the new camera is that the lens is rectilinear, which means it lacks the fish-eye or bending of the picture and video so common to earlier models and sports cameras.

For many users, 4K is not important. Most computers don't have the capability of easily editing or watching 4K and most screens where it is viewed don't take advantage of the large number of pixels. The exceptions would be:
1. You are a professional doing Indie or other films – and/or commercial and industrial video where 4K is called for.
2. You own a 60″ or larger 4K TV and desire to watch your own videos in the fullest resolution possible on this large screen.
3. You like to take video and then use screen and frame grabs for still pictures. The 4K will get you a slightly better frame grab.
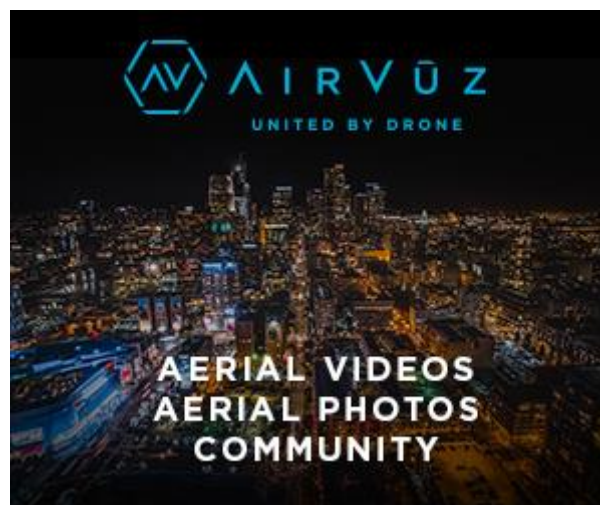
The FPV (camera view beamed back to you) is much improved, so monitoring of the flight on larger tablets will look better. This is made possible by a patented DJI system called "lightbridge" which is standard in the P3A, P3P and P4. It is essentially a custom radio system for the broadcast and receiving of high quality digital images and other data.

Both models have added a sonar (sound wave) sensor for better manners when flying indoors or close to the earth. This helps determine the position of the Phantom in relation to the floor or ground when GPS is not present or is not as accurate. The sonar is augmented by a small downward facing camera – this uses a picture of the floor to help stabilize the Phantom. These sensors help keep the Phantom stable during indoor flight (GPS does not work indoors) and when it is relatively close to the ground.

Range has been increased in both models – up to a mile or more is now possible. A new TX (the Remote Control) has been introduced…which contains the hardware and software for these new features.

The P3A and P3P also contain a dual GPS system which uses both Russian and American satellites to achieve more accurate positioning. The P3S and P3 4K contain only American GPS positioning.

Phantom 3 Standard

The Phantom 3 Standard was introduced a few months after the Advanced and Professional models. It was designed to appeal to beginners and budget buyers but still sports amazing technology at a price less than 1/2 of former models (introduced at $799, now $499). The following are the main differences between the Standard and the other P3P and P3A models.

Shorter range – the Standard has a maximum range of approx. 3200 feet in the USA (1/2 that in Europe). This is about 1/3 the distance the P3A and P3P can travel. Note that these are maximums so your normal working range will generally be less. In either case, this is plenty of range for most pilots as the Phantom becomes a dot in the sky at even 1000 feet distance.

Phantom 3 Standard with Remote

Lower quality video monitoring – the Phantom Standard uses a different protocol to send the camera feed back to your smart phone or tablet. The quality is not quite as good as the lightbridge technology used on the two more expensive models.

No VPS (downward sonar) – the Standard lacks the VPS system so it will not fly as reliably indoors.

Different Camera Specifications – although the camera lens and resolution (Megapixels) are similar, the Standard lacks some of the video settings of the Advanced and Pro models. For example, at full HD (1080), the Standard shots conventional 20 fps (frames per second) while the P3A and P3P can shoot at 1080/60.

The Remote (TX) is more basic and designed for use with smaller mobile devices.

While the Standard does not measure up to its big brothers, it is still one of the most advanced machines of its type – and superior to the Phantom 2 Vision+ which sold for $1369 1 1/2 years ago.
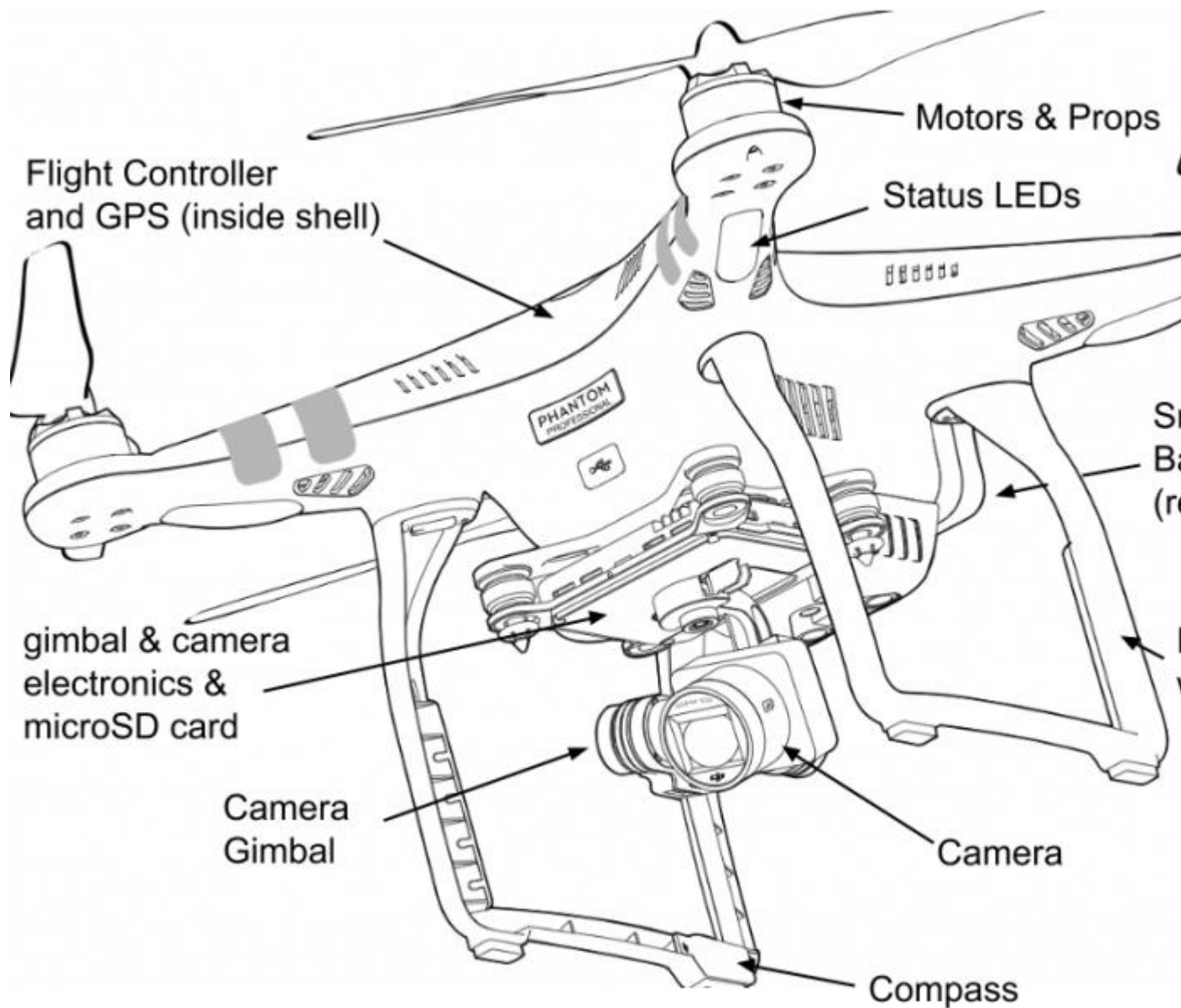
All Phantom 3 models use a new battery (4 cells, 15.2 volts) so you cannot reuse any extras you are using with the older Phantom models. An active braking system allows for more precise control in the air.

The Phantom 3 models feature an updated DJI App (DJI Go) that runs on your IOS or Android smart device. This advanced app allows access to various features, settings and controls. Long term experts claim, and we agree, that IOS devices generally work better for use with the DJI Phantoms and Go App. However, many pilots use Android with little problem – just get the most powerful device you can afford from the suggested list DJI provides in their specs.
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Anatomy of the DJI Phantom

The Phantom is a highly technical product. Unlike your computer, cell phone and other examples of modern technology, users of flying machines with sophisticated cameras and controls MUST familiarize themselves with both the fundamentals of flight and the operation of their specific drone. Here are the very basics on the parts of the Phantom 3 as well as a description of the internal flight control system and its functions

Flight Controller
and GPS (inside shell)

Motors & Props

Status LEDs

PHANTOM
PROFESSIONAL

S...
B...
(r...

gimbal & camera
electronics &
microSD card

Camera
Gimbal

Camera

Compass

Phantom 3 Basic Parts

Phantom 3 Basic Parts

In addition to the parts shown above, all P3 models other than the P3S have bottom facing sonar and camera (VPS) as shown in the picture below.
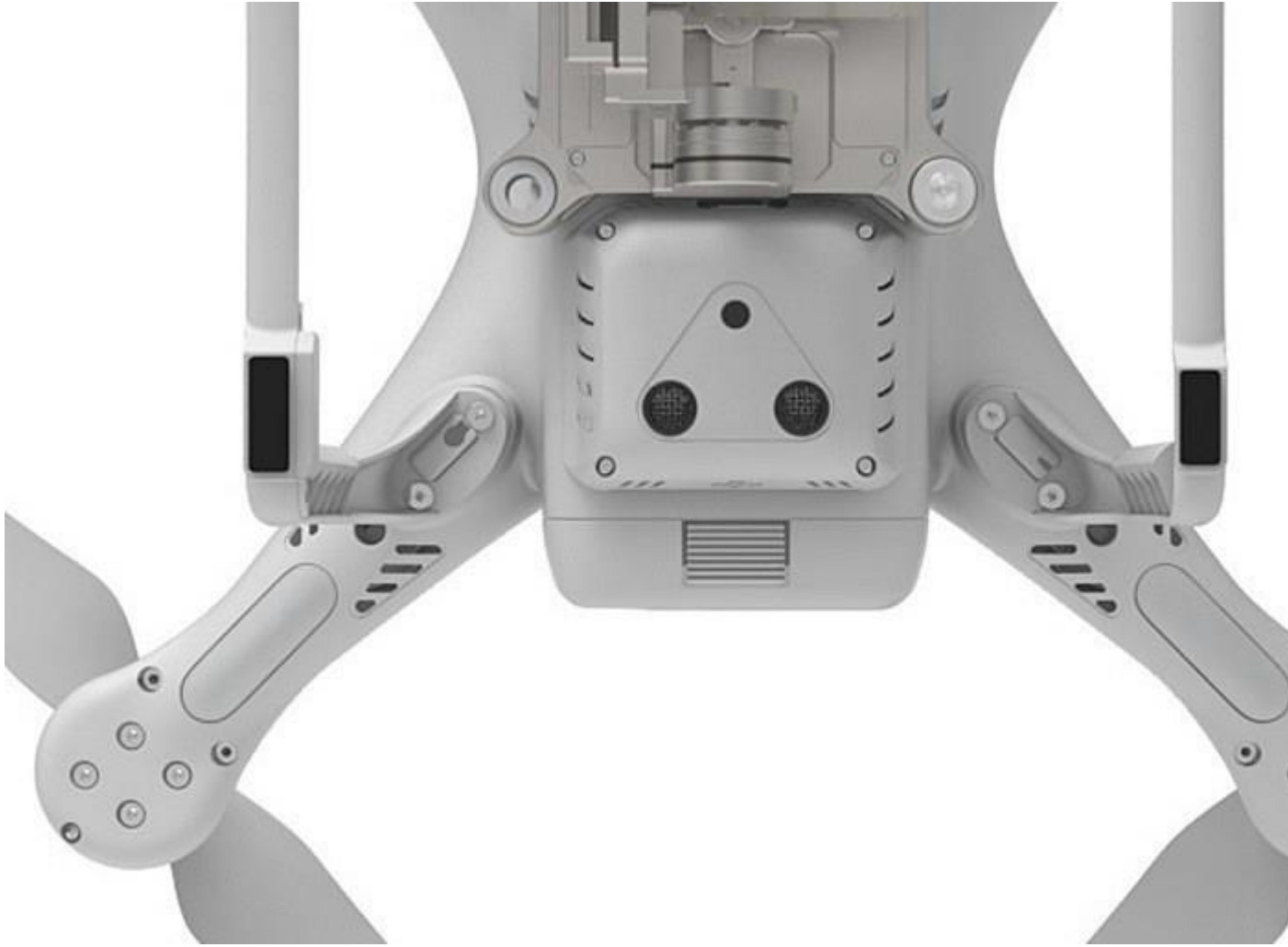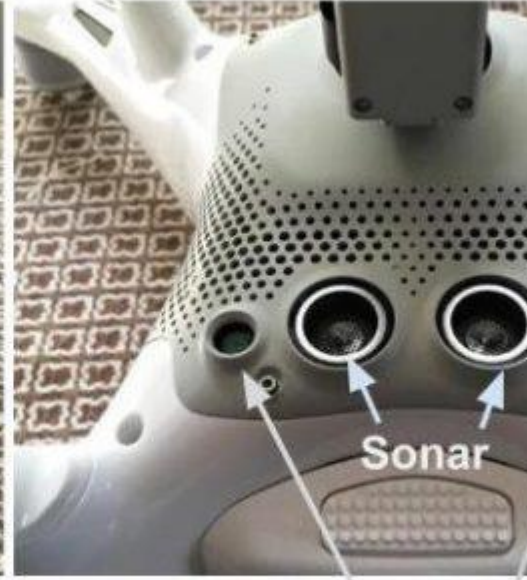
Phantom 3 VPS

The Phantom 4 has the bottom facing Sonar and Camera (2) and, in addition, two front facing cameras located in the legs. These provide Computer Vision and Obstacle Avoidance.
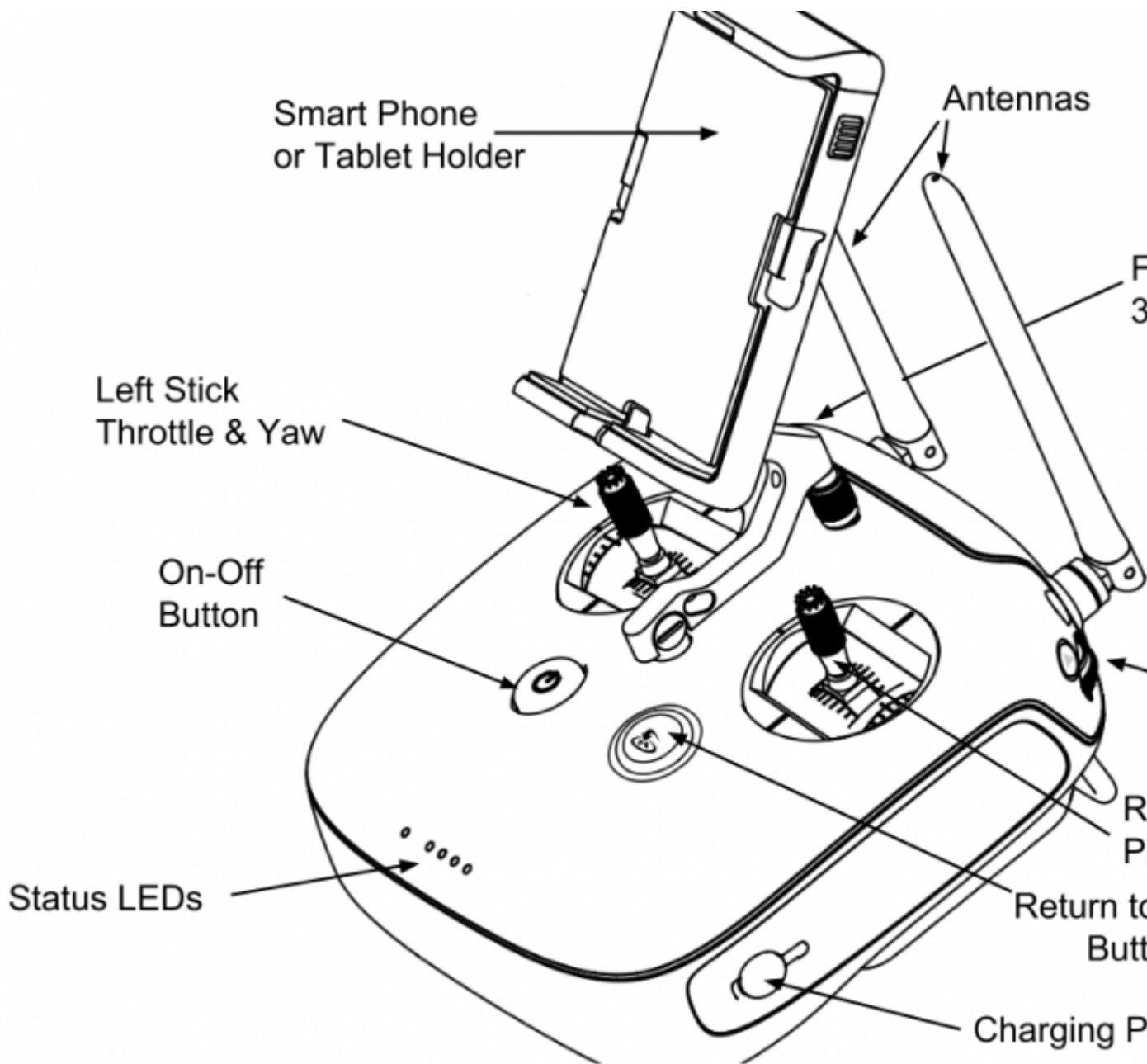
Front Facing Cameras

Sonar

Bottom Facing Cam

Phantom 4 VPS and Computer Vision Cameras

The Phantom Controller (P4, P3P, P3A and P3 4K) Controller (also called Remote or TX) provides the interface between your Phantom, your smart device (tablet or phone) and you – the pilot. In addition to the parts shown above there are some additional buttons for activating the camera as well as other such tasks. Some buttons and switches can be programmed by the user for quicker access to various functions.

Phantom 3 Controller (TX) Basic

Labels on the diagram:
- Smart Phone or Tablet Holder
- Antennas
- Left Stick Throttle & Yaw
- On-Off Button
- Status LEDs
- Return to... Butt...
- Charging P...
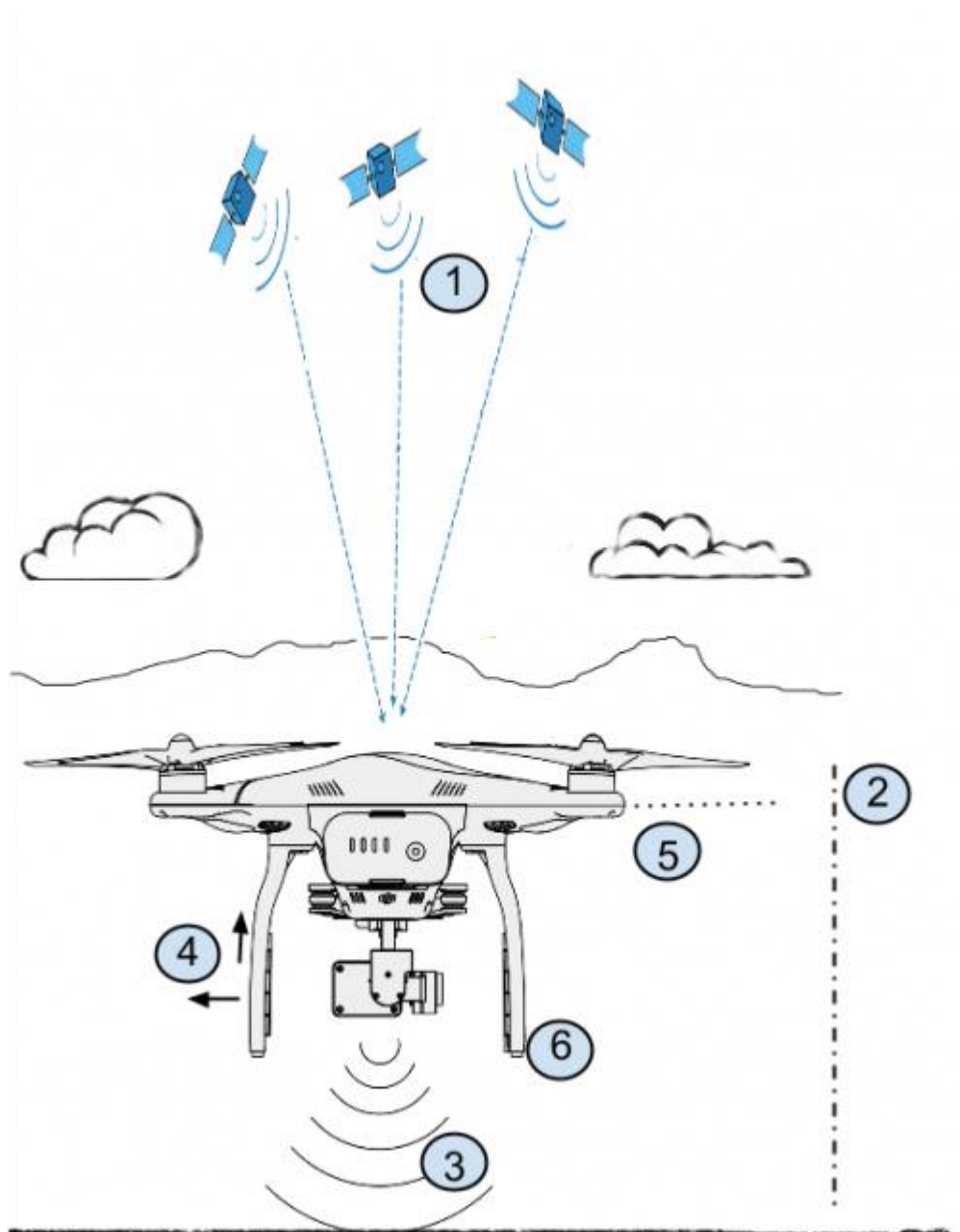
Remote – For P3 and P4 (except Standard)

The real magic happens on the inside of your Phantom. This is the location of a powerful computer along with numerous instruments that help your Phantom fly.

Phantom Flight Control Systems

What makers the Phantom tick?

1. The GPS gathers satellite data in order to determine the position of the Phantom 3 – this data is also fed into the main flight controller. The Phantom 3 reads both USA (GPS) and Russian (GLONASS) satellites, resulting in much more accurate positioning than previous models.

2. A Barometer measures the pressure in the air, which help the Phantom know its altitude above the ground.

3. Sonar sensors and a bottom facing camera combine to help the Phantom (all models except Standard) know where the ground or floor is when it is within 9 feet of the ground. This system is helpful for indoor flight when no GPS is available.

4. Accelerometers (IMU) inside the Phantom sense whether it is moving through the air and/or the effects of G forces and gravity against it.

5. A gyroscope helps keep the Phantom body level during flight.

6. A compass keeps basic track of which direction the Phantom is pointing.

It is the combination of all of these sensors and inputs that results in a flight system which is extremely robust and reliable.

The Phantom 4 actually contains dual compasses and IMUs (accelerometer) to provide an even more reliable and failsafe drone.

However, the instruments by themselves are of little good without programming and computing power – that's where the flight controller (F/C) comes in. This is the central computer of your Phantom and it performs many thousands of calculations per second.

The Flight Controller and Power System

If you were able to look from above down into your Phantom, you'd first see the GPS system which is located in the top center hump of your quadcopter. Underneath that is the flight computer along with the main IMU (Inertial measurement unit) which contains some of the instruments mentioned previously (#2,#4 and #5 in the list). This board also contains the radio receiver and transmitter which help your Phantom communicate with the transmitter and smart device back on the ground. Other parts of the main system board contain the "ESCs" (Electronic Speed Controllers) which provide power to the Phantom motors.

The Phantom Smart Battery takes up much of the center of the Phantom shell and provides the energy to power all the electronics and motors of your Phantom.
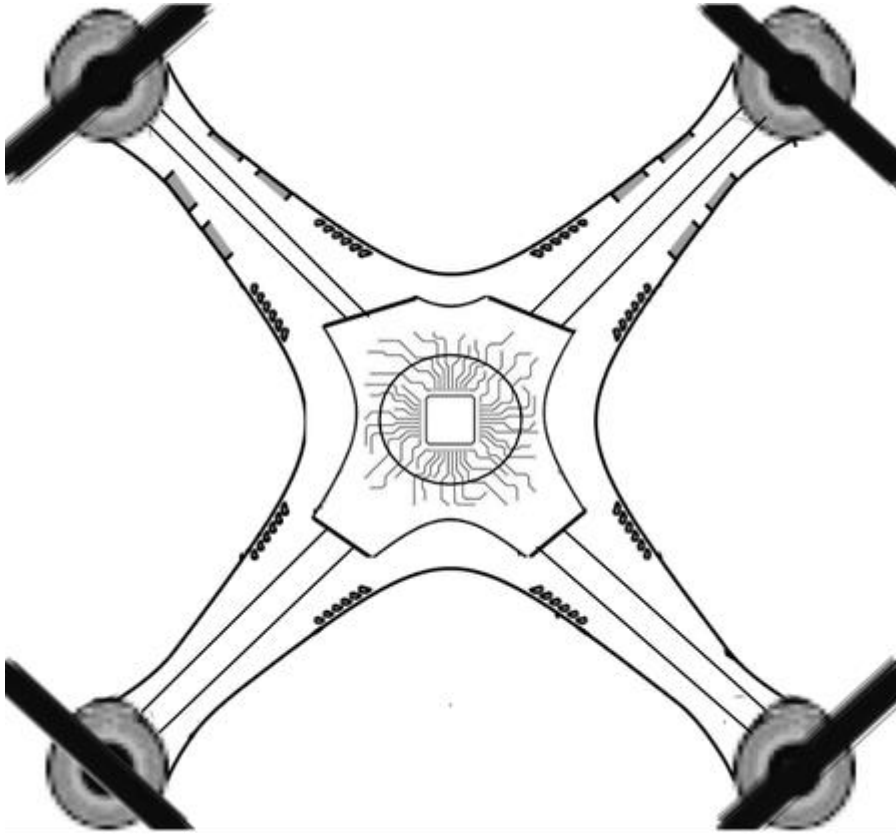
Central Controller

The DJI Go App

The DJI Go App, which runs on certain models of smartphones or tablet computers, provides the last piece of a Phantom complete system. This app is very advanced and provides literally hundreds of features and options.

DJI GO Screen

These three basic assemblies – the Quadcopter, Transmitter (TX, Remote) and a smart device (IOS or Android – see DJI.COM for an approved list) make up a complete and ready-to-fly system.

The preceding is just an introduction – the later sections on Flying your Phantom and Camera Tips and Hints will delve deeper into some of the specifics of operation and control. A separate chapter on the new features of the Phantom 4 will also explain the details of the

Obstacle Avoidance and Computer vision included in this top-of-the-line model. Here is one of our posts here on Droneflyers.com which explains the system in detail.

Chapter 3 coming soon.
If you would like to help support our publishing and educational efforts, purchase your Phantom (or accessories – or anything at Amazon, etc. for that matter) using the links below or on one of our sister sites of Dronesavings.com (best deals updated regularly) or Phantominfo.com (most everything you need for a Phantom).

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Part 1 – Part 2 – Part 3 (this page) – Part 4

Buying your DJI Phantom

DJI Sales Outlets

DJI sells through various outlets – from online giants such as amazon.com to many local hobby shops. In between these two are many online shops – from one-person operations to more sophisticated outlets. In the USA, the vast majority of Phantoms are sold online through one of these outlets. DJI even offers their own online store – linked directly from most pages of their web site at dji.com.

The best advice we can give is to consider what the support will be after the sale.
Ask some questions – such as:
What if the unit arrives and is defective?
What if I ordered the wrong model – can I return it while brand new?
If I crash it and break something – or if it needs warranty work, who do I call first and how do I obtain such service?

DJI has been in a state of rapid growth and their customer service has been improving as they get a handle on it and hire additional staff. They have been trying to address earlier concerns and recently started turning things around. Still, customers who are familiar with the generous customer service policies of Amazon, Walmart and other large modern companies are likely to be frustrated when contacting DJI support for questions, concerns and repairs. General questions and concerns are best answered by visiting the many online forums which have ongoing conversations about the Phantom. DJI also runs their own forums at dji.com.

Certain privately owned vendors may offer more responsive advice and repair and/or warranty service. DJI has recently posted an explanation of their warranty service at http://www.dji.com/service .

DJI and third parties also offer extra-cost "crash insurance". DJI calls their offering DJI Care. Another popular option is a company called Neary Aerial which offers insurance on DJI and other popular drone models.

Which Model to Buy?

DJI produces four models of the Phantom 3 – the Standard, 4K, Advanced and Professional. The Phantom 4 is produced as a single model.
The Phantom 3 machines look identical at first glance except for the color of the decals and trim.

Note – the designation "Professional" does not make the Phantom a piece of truly professional-level equipment, which would cost 20 to 40x as much.

The Phantom 3 Standard was introduced a few months after the Advanced and Pro models. It was designed to appeal to the budget buyer and beginner. While it is a great value at the $499 price point, it is our opinion that most buyers would be better to step up to the 4K or Advanced model given the small price difference. The additional range and the more refined Remote are, by themselves, enough reason to consider the Advanced, Pro or Phantom 4. However, if money is tight you will be very pleased with what $499 buys you in the Standard model. The 4K model is currently approx. $599 and provides a better camera (4K), the upgraded remote and the downward facing sonar and positioning camera (VPS).
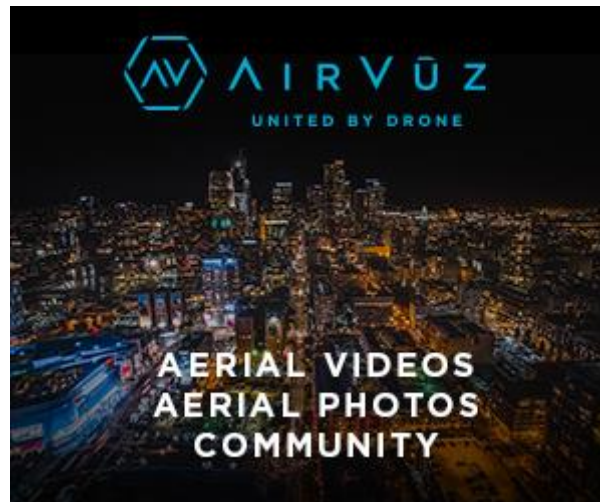
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Phantom 3 Professional or Advanced – Which to Buy?

The main difference between the two is the 4K video option on the Professional. The Professional model also includes a more powerful battery charger for slightly quicker charging times.

But is the difference worth spending?

In our opinion most buyers would be fine choosing the Advanced model. Those who want or need 4K understand the technology so they don't have to take buying advice from this book.

Please see the following chart to compare some of the features of the current Phantom Product line.

Model Name ->	P3S	P34K	P3A	P3P
GPS (US or US&Russian)	Single	Single	Dual	Dual
VPS (Sonar for indoor use)	No	Yes	Yes	Yes
Upgraded Remote	No	Yes	Yes	Yes
4K Camera	No	Yes	No	Yes
Longer Range (LightBridge)	No	No	Yes	Yes
Flying time (approx.)	20 minutes	20 minutes	20 minutes	20 minut
Dual IMU and Compass	No	No	No	No
True Computer Vision	No	No	No	No
Foam Carrying Case Included	No	No	No	No
Street Price (Oct, 2016)	$470	$599	$685	$

Feature Comparison Phantom 3 and Phantom 4

4K- Not ready for Prime Time?

4K video refers to video which is approx. 4,000 pixels (screen dots or elements) wide. This is twice the width and 4X the picture area of HD video. In many ways it's a solution to a problem that doesn't exist – that is, HD video on our computers, tablets and phones is more than good enough. In fact, HD video looks great even on large TVs.
The vast majority of computers, tablets and phones cannot even play 4K video and won't be able to do so for years. This is due to the following factors:
Screens – the screens on most computers and tablets (and even TV's) are generally 2,000 pixels or less wide (HD or less). A study of the devices which accessed our (droneflyers.com) web site in the last month showed almost none that supported 4K video. It will take years for this to change substantially.
Computing Power – even if a user had a 4K screen, most computers are unable to process the video. This results in choppy playback and/or poor quality images.
Bandwidth (Internet or network connections) – 4K video cannot be sent easily over most internet connections.

Keep in mind that you need all three of the above in place to properly view 4K video. The listed shortfalls apply to viewing of 4K video – but as a pilot and flying camera operator, you have to create and edit the video, which requires large amounts of storage and a very fast computer.

Some buyers claim they buy a 4K model to make certain their purchase is "future proof" when 4K becomes even more commonplace. This logic has very little merit for the following reasons:

The cycle of computer and tablet replacement takes years – an educated guess would be 3-4+ years before a large part of the market (your online video viewers) would have upgraded 4K capable machines.

The life of a Phantom quadcopter is limited. Your Phantom is not a long term investment and chances are you will be buying a Phantom 5 or 6 by the time 4K video is commonplace over the internet and easily able to be viewed and edited on most machines.

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Lastly, all 4K video is not created equal. There is only so much quality which can be pulled out from a small and lightweight flying camera. This is due to technical reasons such as the small size of the sensor and lens.

4K Advantages?

There are valid reasons why a Phantom buyer may choose a 4K model. Advanced photographers and videographers may already own equipment capable of processing the 4K video streams and their knowledge and experience can pull a slightly higher finished product out of the 4K video. Here are the 4K advantages:

1. Better still photos from video screen frame grabs – 4K video takes very high resolution pictures at 30 frames (pictures) per second. Still photos can be made from certain of these frames – these photos will be more detailed than frame grabs from HD video (but not better than still photos from either the Pro or Advanced).

2. *Better HD Video* – Video professionals claim they may get a better quality HD video by starting with original 4K footage and then processing and compressing it down to HD for the final cut. This requires serious computing power as well as knowledge of all the advanced editing software and techniques.

The choice is fairly easy – if you are not a professional, consider purchasing the Advanced model if you want the most technology for the lowest investment. Even if you spring for a 4K model, chances are you will use it on a lower setting (1080/60) for most video due to the smaller file sizes and easier editing and uploading.

Note that the still picture capability is identical for all the models – 12 MP – or 4000 pixels wide by 3000 high. However, the P3S camera is slightly inferior (lens, processor, etc.) to the other Phantom 3 models – and the Phantom 4 camera is slightly better than even the better Phantom 3 models.

A Note about Battery Purchases

The DJI Smart batteries can usually be purchased for less when initially bought with the Phantom itself. Packages are available at dealers, on Amazon and on the DJI site. Some packages also included extras like a backpack or SD card.

The casual user can probably get by with a total of 2 batteries, especially on the Phantom 4 which has a longer flight time. If you are a more serious photographer you'll want to have 3 or more.

DO NOT BUY THIRD PARTY BATTERIES – USE DJI BRANDED SMART BATTERIES ONLY.

Link to Chapter 4

If you would like to help support our publishing and educational efforts, purchase your Phantom (or accessories – or anything at Amazon, etc. for that matter) using the links below or on one of our sister sites of Dronesavings.com (best deals updated regularly) or Phantominfo.com (most everything you need for a Phantom).

FB Comments

eBook – Buying and Flying DJI Phantom 3 and 4 Quadcopters – Chapter 4

SEPTEMBER 10, 2016 BY CRAIGI

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Part 1 – Part 2 – Part 3 – Part 4 (this page)

Preparing to Fly

NOTE: This book is not intended to replace or supplement the DJI quick start guide or manual, rather it is to familiarize the reader with the basics of the aircraft before a potential purchase. After you have finished this book and decided on a model, please download and

read the manual and watch the official DJI videos. Continuing education is needed to get the most out of your Phantom – and also to avoid mishaps!

Safety Warnings and Topics

Please become familiar with the many safety issues which apply to this hobby. An outline of some major safety points is below:

Spinning Propellers can injure humans and animals – Phantom propellers could cause deep wounds or worse. Be cautious – do not fly near or over people, moving vehicles or animals. Make certain you are familiar with the startup process (arming) of your quadcopters. Newer pilots may want to consider propeller guards which are sold by DJI.

LiPo Batteries can ignite as well as cause shocks. Do not charge batteries near combustible materials and do not charge unattended. Use specially made LiPo battery charging sacks or charge in a metal or ceramic container. Make certain there are smoke and CO detectors in the areas where you charge and store your batteries. Make certain that water and other fluids do not come into contact with your LiPo batteries. A guide to traveling (flying) with your DJI Phantom is covered later in this book.

Falling or Crashing quadcopters can injure or kill. As stated before, do not fly over or near people, animals or moving vehicles. Use common sense in planning your flight path. Do not fly out of your line of sight (LOS).

FAA Registration and Use of your Phantom

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Starting in 2016 the FAA requires registration of all drones weighing more than 250 grams. Registration is easy and costs only $5 for 3 years. Here is a link to the FAA registration. Once you have obtained a registration number, mark or label your Phantom with this information and carry a printed card with your FAA information.

FAA Registration entitles you to hobby and recreational use of your Phantom. If you intend to provide commercial services (house inspection, realty photography, etc.), then you need to take a test to qualify and obtain a UAS (unmanned aerial systems) license. Anyone of reasonable intelligence can study and learn the subjects needed to pass this test. However, since this book is an introduction we will not delve into the specifics. Here is an FAA link to the general information on Part 107 for commercial uses.

Your Flying Grounds

Avoid the temptation to walk out onto your small backyard or the street in front of your home for your first Phantom flights. Crashing your valuable bird before you even paid the credit card bill can easily ruin your day – or week!

Instead, seek out a large open area with few obstacles (trees, people, buildings) – an acre (200 x 200 feet) is a good minimum size to shoot for although larger is better. Good candidates include local conservation land, unused town and high school sports fields and/or R/C club flying grounds (contact a local R/C club). Pick an area away from highways, large power lines and dense housing to avoid radio frequency interference.

Place the Phantom well away from trees, buildings or other obstacles. This will allow it a clear landing space if it goes into Return to Home (RTH) mode either automatically or on your command. Become familiar with the RTH settings and functions (covered later in this book) so that you can anticipate how it will react in situations such as low battery or loss of Remote signal.

The Phantom models have programming which limit the use of the aircraft near major airports. Responsible pilots should stay a distance from ANY airport and also limit the height of their flights when close to such facilities. If you are very near (

Even experienced pilots should only fly in open areas. It would be wise to consider your anticipated flying ground(s) before you make your purchase as flying over people, dense urban areas, buildings, roads, etc. is a safety hazard and could also result in premature loss of your valuable Phantom.

Extras

You'll want at least 2 batteries to get the most out of your Phantom. Make certain to bring an extra set of props to the field. If you are a first time flyer you may want to install the optional prop guards before attempting your first flights. A small bag with various tools, rubber bands, electrical tape and glue can be handy for various in-the-field small modifications and/or repairs.

Only DJI brand batteries should be used for the P3 and P4 series. Clones (copies) may eventually hit the market, but it's not worth your valuable quadcopter to take a chance.

Understanding how your Aircraft Moves

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The various directions in which an aircraft moves have names – as do the usual flight controls which make the vehicle take these actions. Once in flight and hovering, your Phantom can move up-down, left-right, forward-backwards and also spin on its axis.

The following definitions will apply – we are using aircraft terms although quadcopters do not have the actual mechanical parts such as moving flaps and rudders.
Elevator – this is the flight control used to make the quad angle up or down when facing forward. *Pitch* is the term used to describe the effect of the elevator on the nose of the aerial vehicle. The Phantom will fly forward when the nose is pitched down and backwards when pitched up.
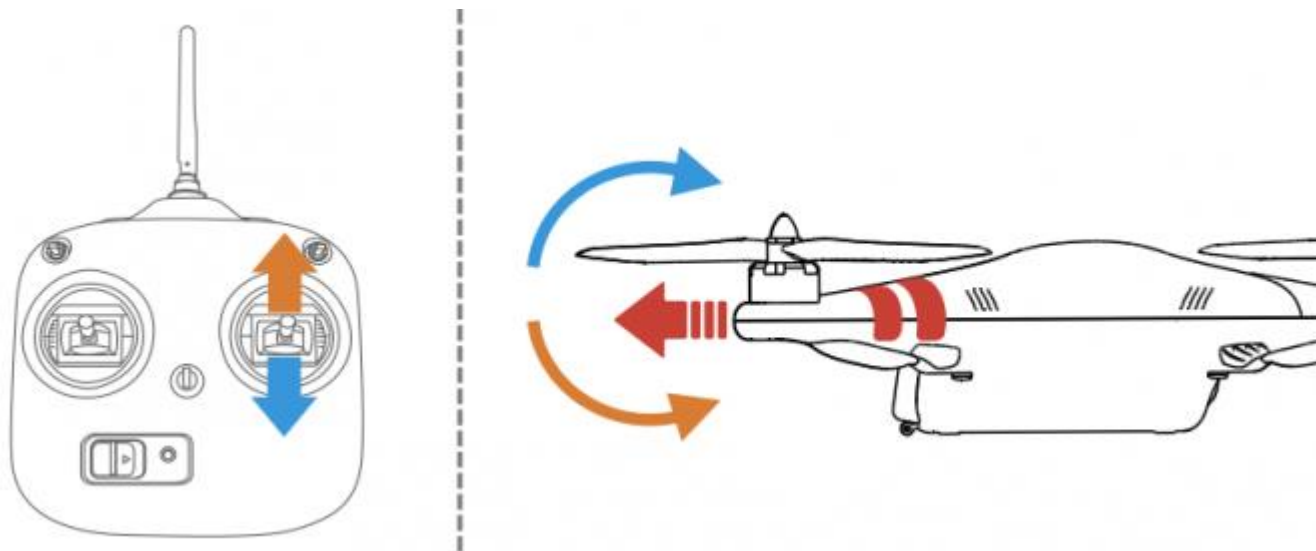

Elevator Causes Pitch Forward or Backward

Aileron – this is the flight control used to make the quadcopter lean left or right – the actual movement is called a *roll or banking* and the aircraft will move left or right when this stick movement is applied.
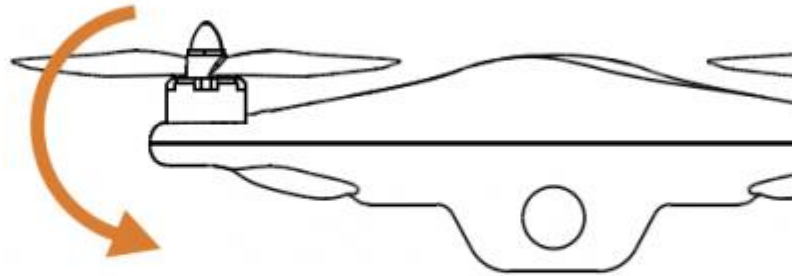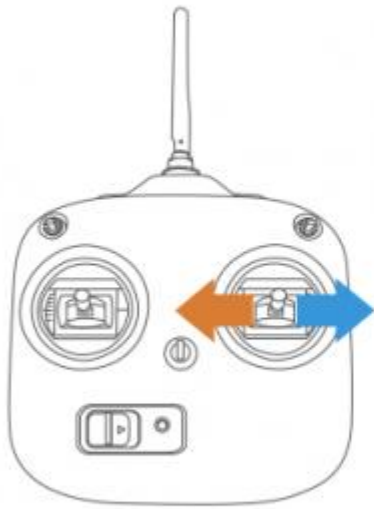
Roll or Banking (sideways) – Aileron

Rudder – This describes the flight control which makes the quad rotate on its center axis – called *YAW*. It will stay level and spin (as in dance pirouettes!) so that the nose faces various directions.

YAW
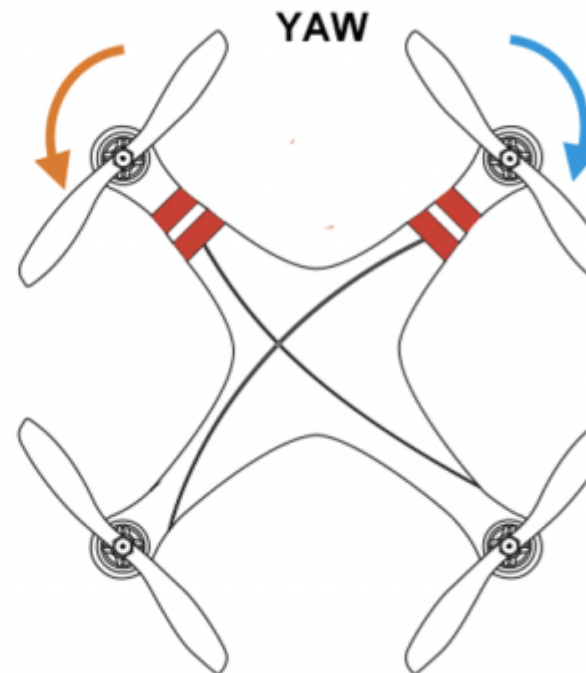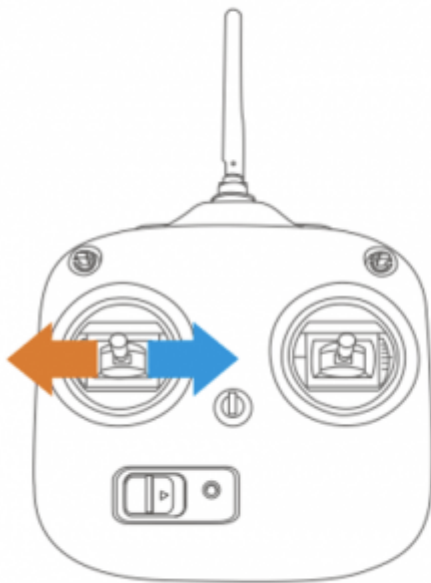
Phantom spins as if rotating on a pole

Yaw – Spin on the Center Axis

Throttle – The left stick, when moved in an up or down direction, puts more or less power to the propellers. In a quadcopter, throttle is used both for up-down movement of the machine and for movement in other directions when combined with other stick commands. Beginners would do well to notice how helicopters fly – they "lean" forward (pitch) and then apply throttle. This is the same way that a Phantom moves through the air.

Since a quadcopter is computer controlled, they don't have the actual flaps as with a fixed wing aircraft – but if they did, the Elevators would be the tail flaps and the ailerons the wing control surfaces. Instead, control is achieved by the Flight Controller varying the exact amount of electrical power delivered to each of the rotors, making the craft lean in the direction the pilot desires to fly.

Phantom 3 and 4 initial Setup

The owners manual and quick start guide are quite complete and can be used to properly set up your Phantom. An overview of the steps required are listed here:
Note: if your smart device does not have cellular service it would be best to first setup your Phantom in a location (back yard, etc.) where there is a wireless network – the DJI Go App requires you to login with DJI and also may require some software and firmware updates. After setup, you can then take the Phantom to a larger field for your actual first flights.

1. Unpack Phantom and install props – no tools needed, but make certain to snug the new plastic hub propellers on by hand (P3). Remove small foam piece from behind gimbal(P3).

2. Using the included battery charger, charge up the Remote Controller- when the Remote is fully charged, hook the battery charger to the included Phantom smart battery and charge fully. DO NOT CHARGE BOTH AT THE SAME TIME.

3. Download and Install the DJI Go App on your phone or tablet.

4. Mount your smart device in the included holder on the TX and connect it to the TX using either the supplied USB cord (android) or your own lightning connector (IOS). (P3S and P3 4K are wireless so do not connect via USA) Make sure the 3 position switch on the top left of the TX is in the rightmost position (P-GPS)

5. Remove plastic gimbal lock and lens cap (if included) – check that the micro SD card is in the CD camera slot on the side of the gimbal holder.

6. Turn on the Remote (first) then the Phantom – both are turned on by pressing the respective power buttons once for 2 seconds, then leaving go, then pressing again.

7. Open the DJI Go App (with a working cellular or wireless connection)- this should guide you through the steps required to register and update your Phantom.

Note -there are multiple ways to upgrade the firmware on your Phantom – through the app though the SD card and/or through a computer program for Mac and PC called DJI Assistant

2. This can be downloaded from the DJI site. On occasion firmware updates will not take or throw off errors. If this occurs, try to reinstall again – perhaps using another method. In some cases it helps to replace the MicroSD card with a newly formatted card.

8. Activate the Camera screen in the DJI Go App. A banner across the top center should inform you of the status of the aircraft – Safe to Fly-GPS means the aircraft is ready. Check the map on your smart device to assure that the home point is where you are currently located.

9. Calibrate compass on the Phantom (the DJI Go App should guide you through this step). If not prompted to calibrate the compass, touch the status banner on the center-top of the screen to navigate to the settings where you can select "calibrate compass".

Note: If you did the above at home in a wireless access point – you can shut everything down and move out to the field where you intend to fly. If you have a cellular connection to the net and are already at the flying field you can just go ahead to #10 below.

10. Arm props using the CSC (Combined Stick Command) as with other Phantoms – propellers should start spinning slowly, indicating that the quadcopter is ready for take off.

11. After landing, power off the devices in the opposite manner – that is, turn off the quadcopter battery first and then power off the transmitter.
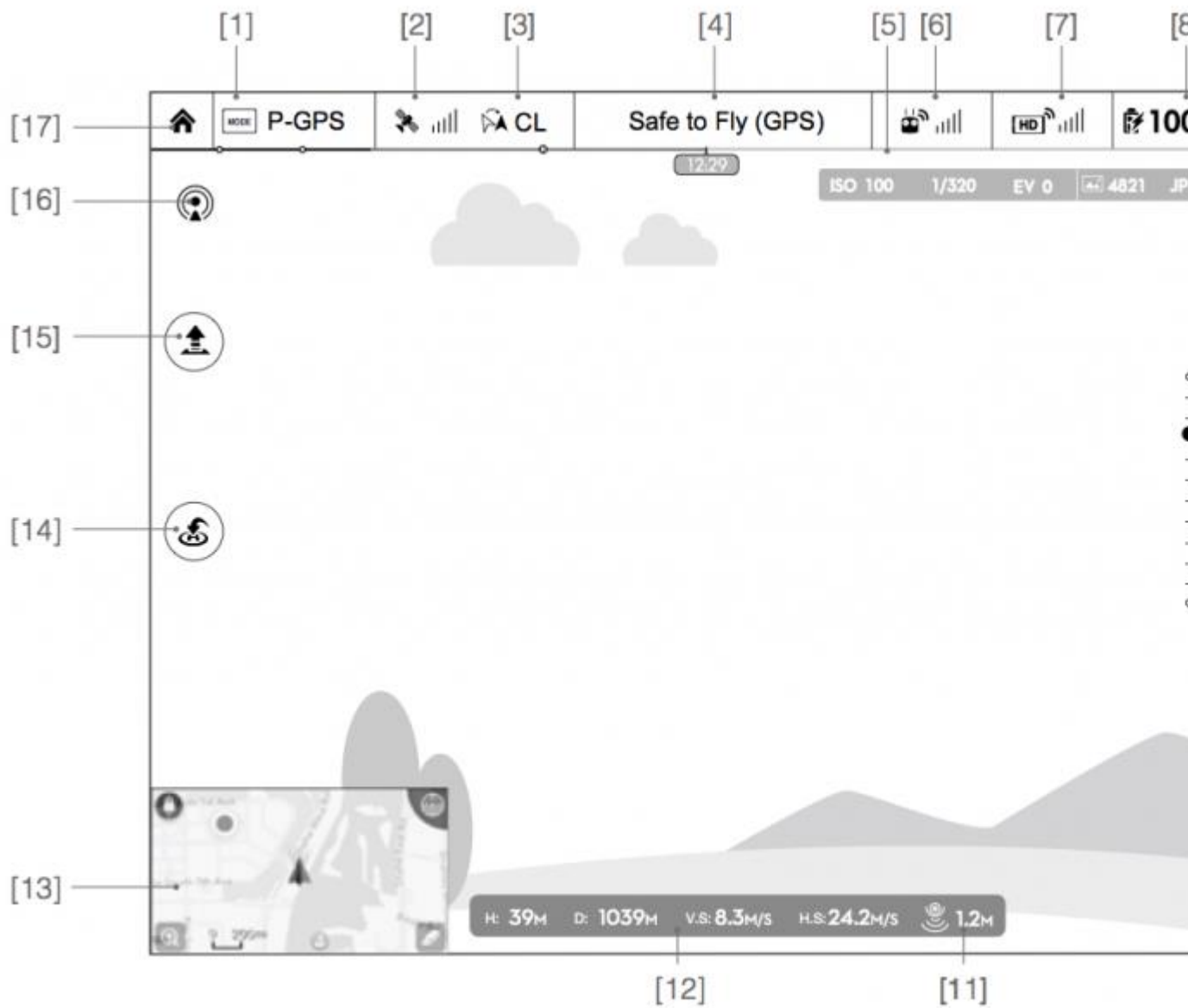
The DJI Go App

Note: The Camera and DJI Go App on the Phantoms are nearly identical to that on the DJI Inspire 1. When searching online for videos and guides to camera and Go App functions, you may find those about the Inspire helpful.

Note 2: The DJI Go App puts a very heavy load on the smart device – so faster and newer models will work best. IOS (Apple) devices tend to work better as they have fewer background applications (so-called bloatware) running.

The DJI Go App, which runs on certain IOS and Android smartphones and tablets, functions as your monitor as well as an interface to many of the functions and settings of the Phantom. The Go App is not fully documented in the current DJI manual (it is quite complex and capable), so you will have to learn many of the functions and settings by other means. You can explore the App without turning your Phantom on, which will give you some ideas of the main menus. There are also some useful videos online. A simulator is included with the Go App, allowing you to practice most all functions of the Phantom from the comfort of your home.

The main screen of the DJI Go App is the Camera view and contains a number of status indicators and menus as well as a view of what your Phantom Camera is seeing. A second picture in picture can be tapped to fill up the entire screen shows a map which indicates your

Home Point (where your Phantom was started) as well as your flight path and current location of the Phantom.

DJI Go App Illustration

#1 – shows the mode your Remote is switched to
#2 -the GPS status and will show the number of satellites as well as the overall signal strength.
#3 shows if IOC is turned on and exactly which mode of IOC is active.
#4 -status banner which will display messages such as warming up or ready to fly (GPS)). Tapping the status banner will bring up a screen with options to calibrate the compass and other options.
#5 -colored line which is the battery status and level indicator
#6 -strength of the Remote Control Signal (your sticks, etc.)
#7 – he strength of the HD video signal from the Phantom 3 Camera.

#8 – Battery percentage remaining
#9 – Tap this to access to the settings and calibration menus
#10 – Camera controls and settings panel
#11 – VPS (close to ground sensors) status and measurement.
#12 – Altitude and distance to your Phantom from the Home Point
#13 – Map screen – tap to have it switch places with the Camera view.
#14 – Return to Home icon – tap to have the Phantom return to the Home Point.
#15 – Auto-takeoff – tap to have the Phantom take off or land automatically.
#16 – Live streaming indicator when sending directly to youtube.
#17 – Go to Home Screen of DJI Go App

The secret to learning the DJI Go App is to take some time at home and poke around to find all the various menus and settings. To do this effectively, follow these steps:
Remove the propellers, gimbal lock and lens cap from your Phantom 3 and set it near you on the floor or a desk, etc. – if you are on an exterior wall with windows you may even get a GPS lock.
Turn on your Remote – have your smart device mounted and connected to it as usual. Then turn on the Phantom.
Open the DJI Go App and chose Camera from the main App screen. You should then be seeing what the camera is pointed toward. In the settings menu (top right) is a sub-menu called Other which has a setting (near the bottom of that screen) for Tutorial. Slide this switch to the right so that it is green.
Tips and Hints "Bubbles" will then show up in the Go App as per the example which follows. They will go away after you make a few selections on the touch screen – go back to the Other screen and slide the switch to the right again if you want to activate it again (repeat as needed).

DJI has included a Simulator program with the Go App. This will give you a chance to practice use of the app as well as virtual piloting of your Phantom.
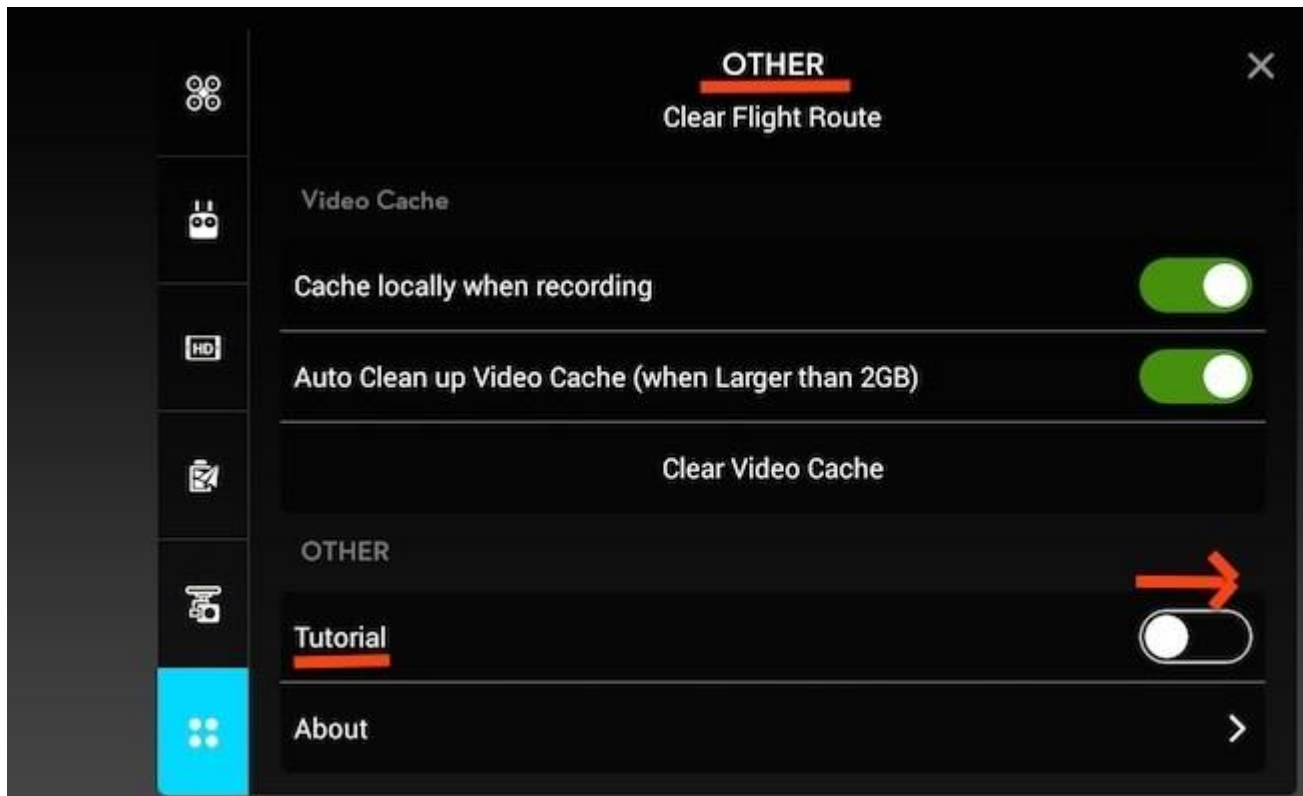
Other
Settings
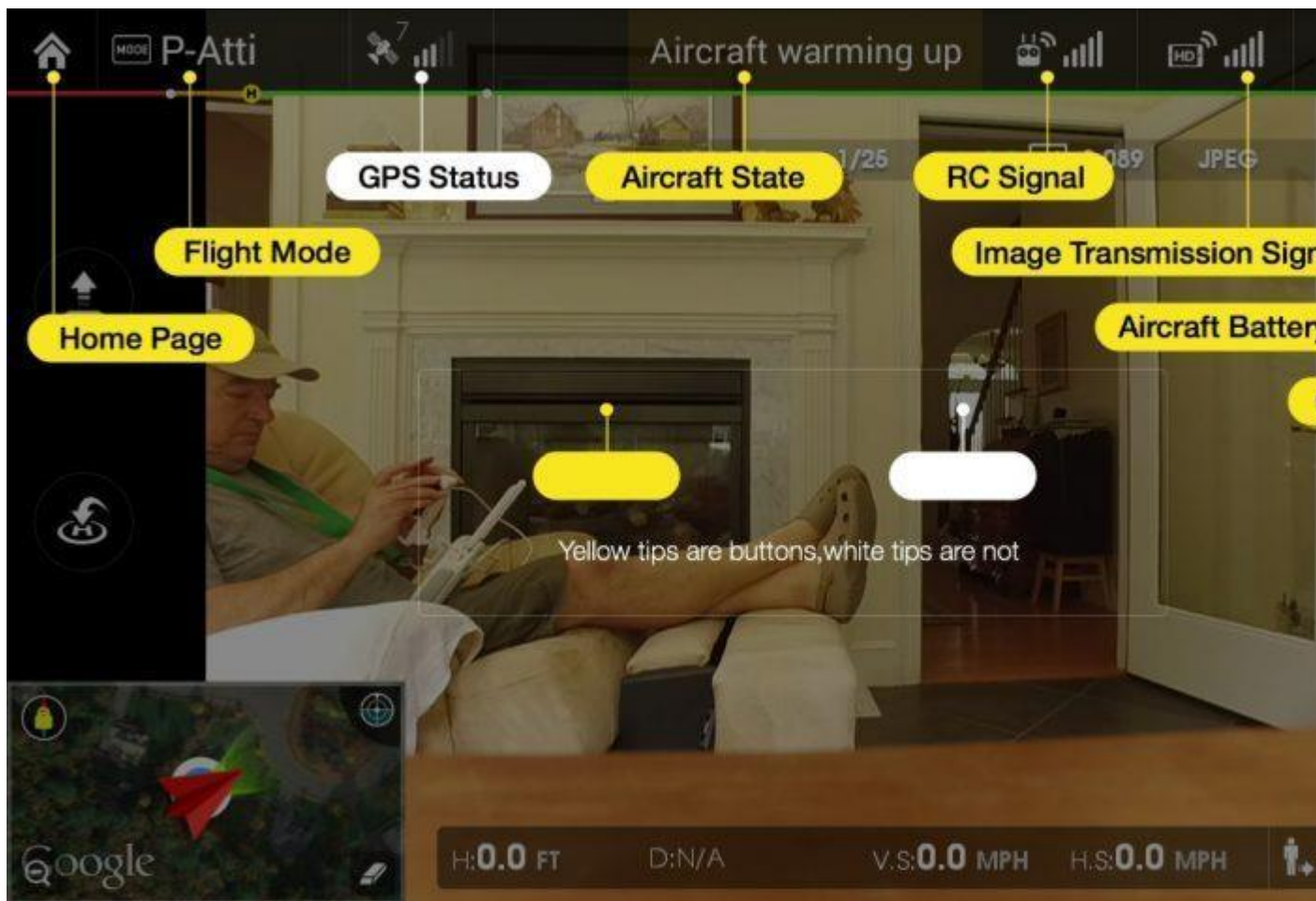
Hints and Tip Bubbles Activated using Tutorial switch.

Preloading Maps

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If you are using a tablet computer or other device without a cellular connection, you'll want to preload (cache) the maps of your intended flying area into your device before heading out to the field. You can download maps for a large area, so your flying grounds will be available to you on your device even when not in a wifi or cellular networks. *If you have cellular service (using a smartphone or cellular enabled tablet), disregard this step.*

Map preloading is done by opening the DJI GO app while still in a wireless access point and then scrolling the map screen to the area where you intend to fly. Make sure "cache maps" is enabled in the general settings of the DJI GO App. On Android devices it may also work to open Google Maps and scroll the flying area.

This should automatically cache (save) the maps and they should be still available when you go out to the field. Another option if you have both a phone and a tablet is to setup the phone as a hotspot when you are out at the field and connect the tablet to it with WiFi. This will allow the DJI Go App to continuously download and update the maps.

Note – the Phantom still knows where it is even if you have no maps displaying on your smart device.

Chapter 5 coming soon.
If you would like to help support our publishing and educational efforts, purchase your Phantom (or accessories – or anything at Amazon, etc. for that matter) using the links below or on one of our sister sites of Dronesavings.com (best deals updated regularly) or Phantominfo.com (most everything you need for a Phantom).

FB Comments

Your First Flights- Orientation and Startup

New pilots will find it easier to learn by facing in the same direction as the Phantom while standing behind it. Using this orientation, the controls on the transmitter will feel more natural – that is, if you move the right stick forward, the Phantom will travel forward, etc. If you have no familiarity at all with Quadcopters it is usually suggested that you fly some of the toy models first…just to get the basic idea of how things work. You can find more information in our beginners section.

Assuming you have calibrated the compass earlier, place the Phantom 3 on the ground in front of you with the nose facing away and go through the startup process of turning on the transmitter FIRST and then turning on the smart battery. The Phantom will sing a startup tune. Make certain the 3-way mode switch on your Transmitter is set to the right (P mode).
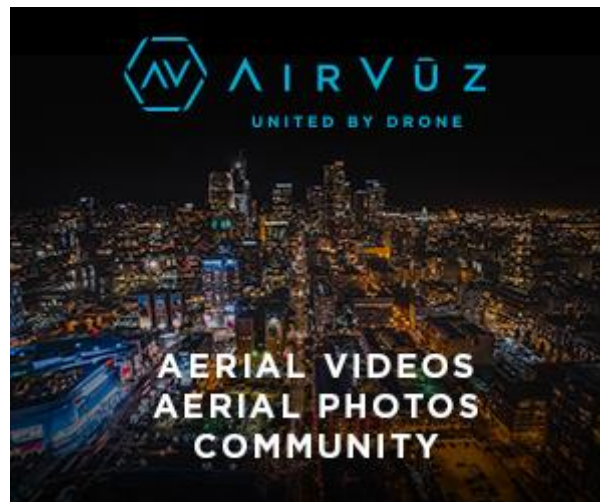
Open the DJI Go App (see: DJI Go App info for more) on your smart device (it should already be connected via USB to your Remote) and hit the Camera icon. This screen should display a yellow banner on the top which says Aircraft Warming Up. Within about 2 minutes it should turn green and display Ready to Fly (GPS). Check the map screen to make certain that your Phantom knows where it is – the triangle representing the aircraft should be at your current location. This is often referred to as the Home Point since it's where your Phantom will fly back to if the RTH function becomes activated.

Starting and Stopping the Motors – IMPORTANT

Note – it it the author's opinion that budding pilots should learn how to take off and land manually rather than using the automatic features. This will allow you to become a safer and more capable operator.

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CSC – Combined Stick Commands – are used to start (and one way to stop) the Phantom motors. A CSC requires the movement of both sticks into a certain position…such a move generally eliminates the possibility of accidentally starting or stopping the motors.

In most normal operation, a CSC is used to start the motors before flight – and a simple "throttle down" command is used to stop them. The "throttle down" motor stop only works when the Phantom has already landed (or been hand caught) and is activated by holding the left stick against the bottom (6 o'clock position) for a few seconds. Don't be concerned about accidentally shutting the motors off this way in flight by holding the throttle down – they will only turn off if the Phantom is stationary.
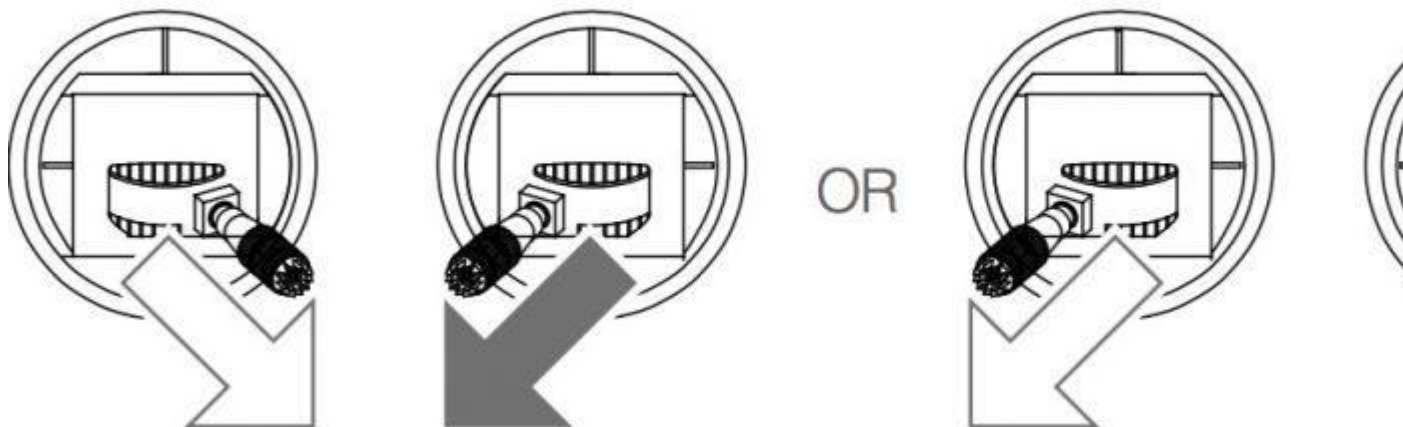

CSC – Start – Stop Motors

Please check a *current copy* of your owner's manual for the most current CSC setup and practice both the CSC as well as normal "throttle down" motor stop. At the time of this writing, the setup of the Phantom 3 and Phantom 4 are slightly different. A CSC on a Phantom 3 will turn off (or on) the motors whether the Phantom is flying or not! This is a feature which exists for emergency use – for example, if you see your Phantom drifting toward a large highway and you want to make it drop out of the air (with the possible crash/loss), you'd execute this command.

On the Phantom 4, the CSC only works when the Phantom is stationary. There is a different sequence which makes it "drop out of the sky" described as follows and pictured below. Hold the right stick (throttle) at the bottom right and press the "H" hardware button on the Remote (the rightmost round button below the sticks).

HEISHA
Drone Charging Pad

Business Partners
Wanted
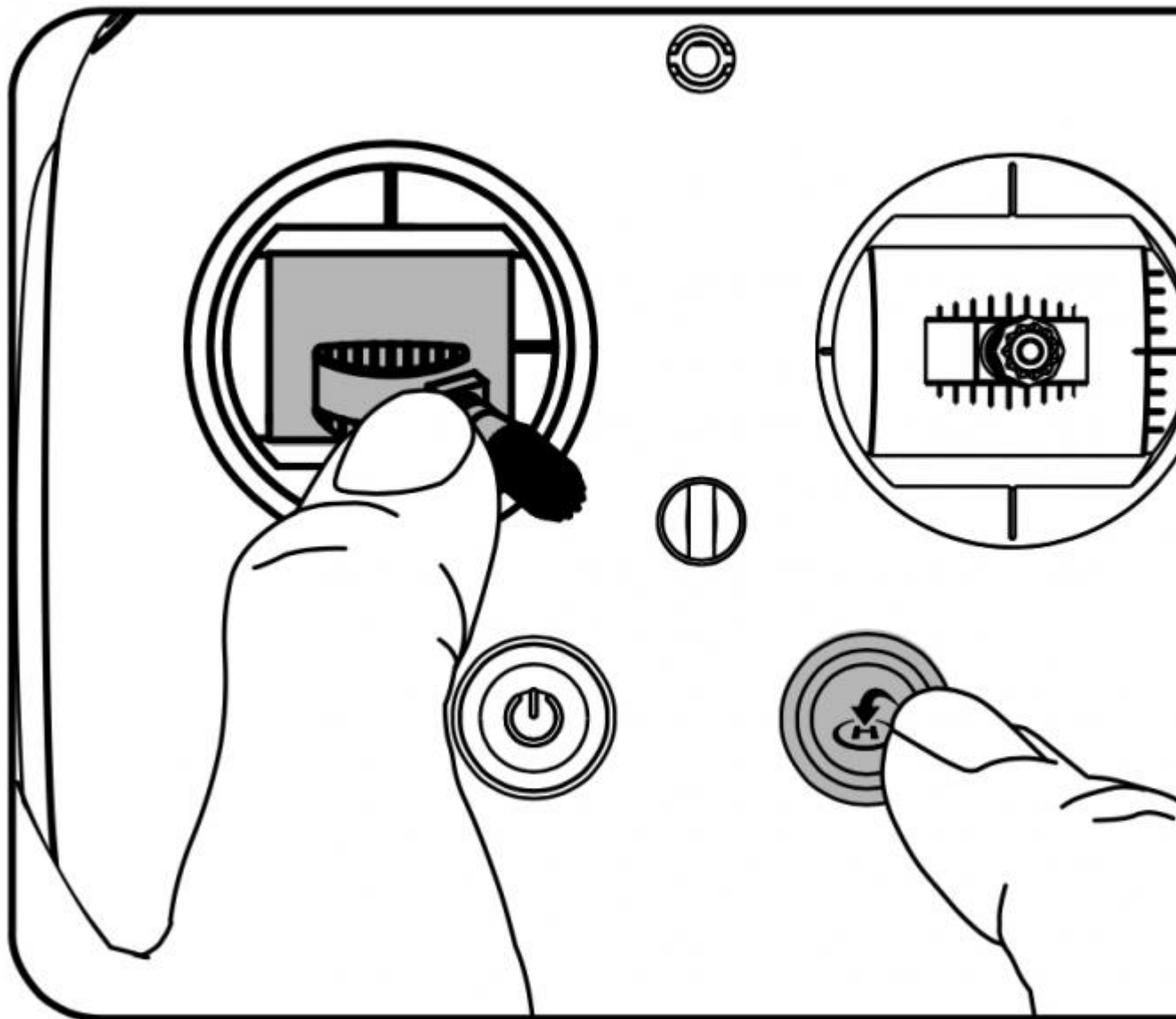
Phantom 4 Emergency Motor Stop

Once you have confirmed all systems are go, arm the motors by pulling both control sticks in and toward the bottom (as per diagrams, any of these sequences will work) – let go as soon as the motors start. The motors will execute a few short bursts of speed – not enough to lift the aircraft, but it is likely to startle you if you are not prepared. These are startup bursts and designed both to inform you that all systems are go – and also to help tighten the propellers in case they were installed loosely.
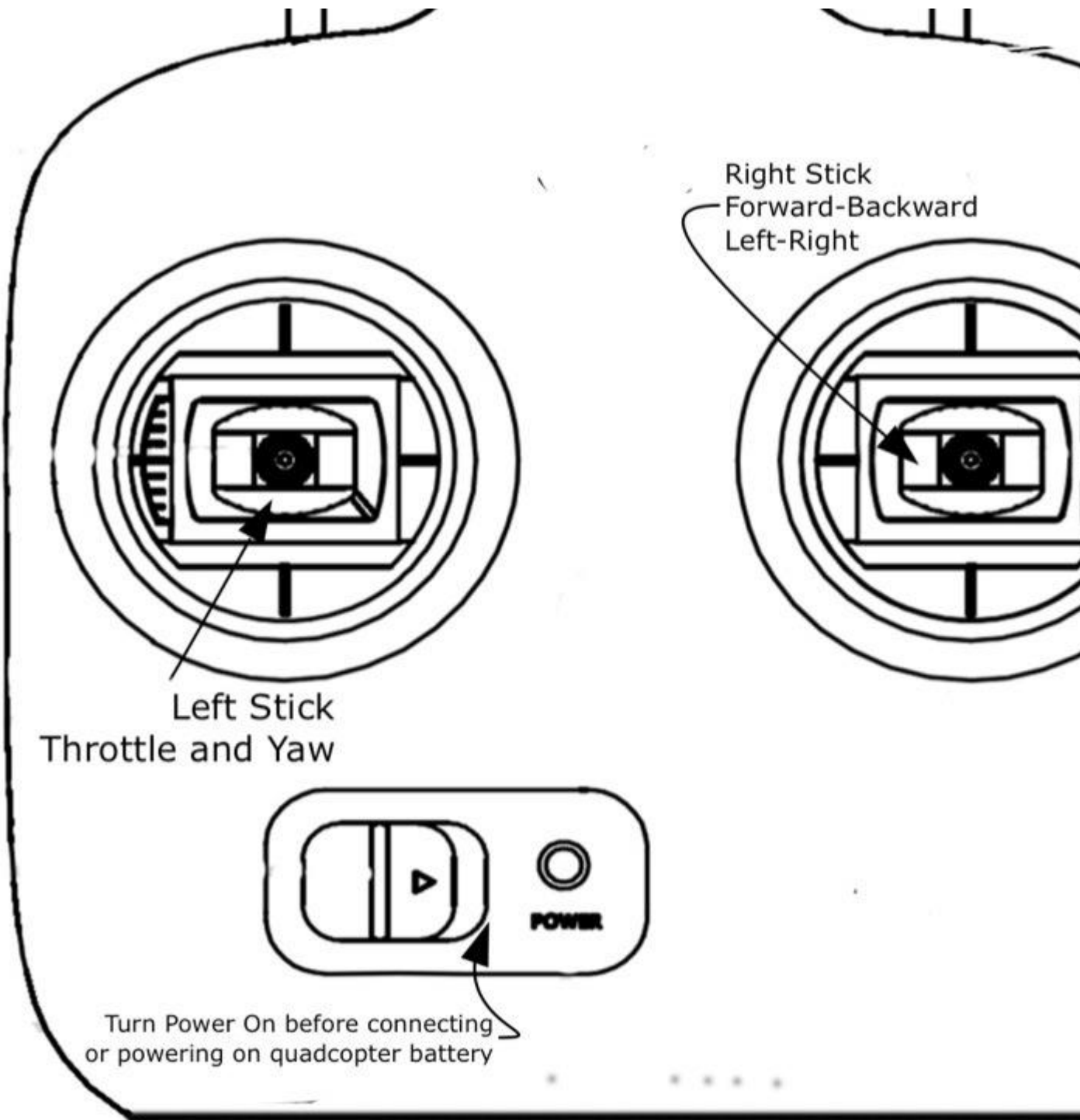
If you get nervous and don't move the sticks after this sequence, the motors may turn off again. Don't fret – simply go through the motions again and this time apply a bit of throttle (left stick up) after the motors have started.

NOTE: If status LEDs are doing something other than what is expected (green), do not fly your Phantom! Try re-calibrating the compass and then a new startup to fix the problem. If they do not correct the LED error, consult your owners manual and/or dealer. Phantoms are very reliable aircraft, but as with any complicated technology, things can and do go wrong.

The Basics of the Sticks (Transmitter Layout)

You may remember what each of the remote "stick" controls from the previous descriptions, but here is a refresher so that you know your basics before you take off.

The DJI Transmitter has two sticks – a left and a right. Both sticks use springs to hold the sticks in the center.

Right Stick
Forward-Backward
Left-Right

Left Stick
Throttle and Yaw

POWER

Turn Power On before connecting
or powering on quadcopter battery

Remote Stick Layout (P3 Standard shown – others differ in style, but sticks work the same)

The left stick serves two functions – it's the throttle to lift the craft higher (spin props faster) by pushing forwards, and conversely you can make the craft descend by pushing down on the stick. The same stick when pushed left or right provides yaw, which in the case of a quadcopter means spinning it on its axis – that is, pointing the nose in a different direction.

The right stick is more natural – pushing it forwards makes the Phantom lean and then move forwards – pulling it back makes the quad come back. Left and right make the quadcopter lean in those directions and therefore also move left-right.

Liftoff

Start all your flights with a fully charged battery. If your Phantom is new it will automatically be in beginner mode which will limit how high and how far you can fly. You can turn this off later and set your own maximums.

Your Remote3-way mode switch should be in P (positioning) mode – this is all the way to the right on all models except the P3S, where it is the right switch in the upper position.

Your initial flights will go better if the wind is relatively calm – anything under 10 MPH should be fine, especially if you keep the Phantom relatively close to the ground.

Perform the CSC to start the motors. The Phantom 3 will execute a small burst of power which is designed to make sure the propellers are on tightly.

Advance the throttle forward and the propellers will slowly build up speed – don't be shy because the Flight Controller (F/C) moderates the initial takeoff acceleration. You can give it quite a bit of throttle and then, when it's a few feet off the ground, let the throttle spring back to center. A good height for your initial test is about eye level, so try to hover at about five feet off the ground. If you are in GPS mode (and you should be!), the Phantom will stay fairly stable and only drift a few feet in any direction. Once you are satisfied that the quad is stable, get the feel of the throttle by raising the aircraft up a couple more feet – and then back down. Now it's time to actually fly.

Push forward slowly on the right stick and the Phantom should start moving away from you in the direction the nose was pointed. Pull back on the same stick and it will return toward you. Move the same stick a little to the right – and then to the left – and you will see your Phantom slowly roll in those directions. Each time you let go of the control sticks, the Phantom will self-level. This is called 6 axis stabilization and makes both flying and photography much easier.

Once you have the basic feel of controlling the craft, lift up to 15-20 feet high – high enough that the LEDs on the Phantom's arms become clearly visible. This will help you with orientation as you learn. Remember, the solid red LEDs are the front of the quadcopter while the green are in the rear.

During your first flights, try to keep the Phantom no further than 50 feet from you and no higher than 20-25 feet. This will assure that you don't get into trouble or chance losing it in a tree or over some nearby houses. The idea now is to build stick time and muscle memory so that the feel of the controls comes natural.

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Beginning Pilot Hints

The Phantom works differently than most quadcopters in that it features a centered throttle. Once your Phantom is in the air, let go of the throttle and the stick will spring to the center – while the Phantom hovers at the height you left it at. The ability to go hands off and have the Phantom maintain its position makes it much easier to fly and to concentrate on other actions such as photography. Note in the picture below, the Phantom took a picture of our drone camp – but I have no hands on the transmitter sticks.

No Hands! Phantom will hover when the sticks are released.

Your first 1/2 hour or so of flight should consist of simply moving the Phantom forward, backwards, left and right – with you standing behind the craft. This is a simpler orientation which feels natural to most flyers. Your stick movements during this practice will be mostly with the right stick – forward, backwards, left and right. You may have to give it some small bursts of throttle (left stick upwards) just to make sure it stays far enough in the air. Once you feel that you have some control, you can try using the yaw (spin) control, which is moving

the throttle stick (left stick) left or right. This motion will make the Phantom spin in place on its center axis – in other words, it will point the quadcopter in a different direction.

Timing the Flight

Your Phantom has some intelligence built into the flight controller so it will not simply run low on battery and fall out the sky. The P3 models have multiple warnings including the flashing of the status LED's under the rear arms and warnings on the app.

During your first 10 flights you'll want to condition the battery by only discharging to 45-50%. This will assure a longer life and more power from your Phantom smart battery. It will also assure you that your Phantom will not automatically enter into an emergency mode and RTH (Return to Home) on its own. Low battery warnings and actions can be changed in the "Battery" settings screen of the DJI Go App.

If the Phantom goes into RTH mode and you want to regain manual control, hit the RTH button on your Remote once – that should then disable the current Return to Home activity. There is much more information of the RTH (Return to Home – Failsafe) in the following pages and in the owners manual on your particular model.

Landing

Landing is best accomplished by hovering a few feet high over level and soft ground and then slowly lowering the throttle until the legs touch down. Holding the throttle down for a few more seconds should stop the motors – or, if you wish to stop them quicker, perform the same dual stick sequence as you did to arm the motors on startup.

The new Phantoms features automatic landing and takeoff with the press of a button on the app- however, it's best to learn how the Phantom operates by actually flying it.

IMPORTANT: Turn off the Phantom smart battery before turning off your Remote. Failure to do so may cause the Phantom to go into RTH (Return to Home) mode and take off without your consent!

Next Steps in Flying

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Once you are confident in the basics, it's time to start practicing other moves. Successful piloting of any aircraft or motor vehicle requires the ability to do a number of things at the same time. This will eventually come naturally, but you have to train your brain and your muscles first. Here are some of your first challenges:

Orientation – it's easy to fly the Phantom when it faces the same direction as you do – but when it's facing you or another direction, the sticks will work differently – often in the

opposite way as previously! Practice these moves so that you become more confident in your ability to control the craft no matter what the direction of flight.

Banking – many pilots find that learning how to fly loops or figure 8's is very instructive, as you can practice using both sticks at once.

Spacial awareness – it's important to get a grasp on distances, directions, compass headings as well as wind and weather. Just as sailors and pilots know these things, so should anyone piloting a Phantom. The Phantom models will display altitude as well as the distance from you on the DJI GO App.

These quadcopters are not toys. Rather they are small aircraft and piloting them requires a skill set. The good news is that most anyone can learn these basics and, added to common sense, they will provide a good introduction to flying your Phantom.

Next Chapter (6) Link
If you would like to help support our publishing and educational efforts, purchase your Phantom (or accessories – or anything at Amazon, etc. for that matter) using the links below or on one of our sister sites of Dronesavings.com (best deals updated regularly) or Phantominfo.com (most everything you need for a Phantom).

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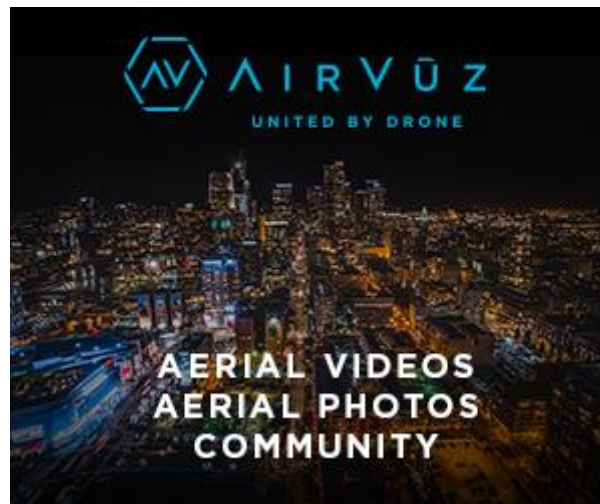
Related

Advanced Flight Modes and Features

Return to Home (RTH) and failsafe – are functions built into all Phantom models. These functions work in various ways to assure recovery of your drone w

hen it has low battery or lost connection between your Phantom and the Remote.

RTH is an emergency function – it can save your machine however it can also kick into gear when you least expect it and could cause your Phantom to fly into a tree or other obstacle. The best advice I can give is:

1. Take some time to fully understand the failsafe and RTH functions. Read the manual section and try some of the RTH modes in a large open field.

2. ALWAYS start up your Phantom in an open area and not underneath or near trees or buildings. This will assure a safe return to home (RTH) if the mode is triggered.

3. Don't take your Phantom to the limit – use LOS (line of sight) flying and your own piloting skills to bring your craft home with some juice left in the battery whenever possible.

There are various types of failsafes – out of range and low battery as well as user-initiated (smart).

1. Out of Range failsafe will automatically kick in the return to home….or land- depending on YOUR setting in the MC Settings –> Advanced Settings

2. Low Battery failsafes – this works differently and depends on user adjusted settings in the Aircraft Battery Screen of the DJI Go App settings.

There are two settings – Low Battery Warning and Critical Battery Warning. At the low battery warning the DJI Go App will give you a warning and the option to cancel out the RTH – but if you do not cancel it, it will initiate.

At the Critical battery warning level the Phantom will not RTH – but just descend and land immediately. With either you can still control the Phantom to a degree with the sticks in order to avoid obstacles.

3. Pressing the RTH button (a switch on P3 Standard Model) on the Remote and in the DJI Go App will always initiate RTH – hitting it again should turn RTH off again.

If you are an experienced pilot and flying mostly over open land and close-in, you can probably set the low battery at 20% and critical at 10%.

The *Phantom 4* will attempt to avoid obstacles on its RTH path if the OA system is turned on. However, the best course of action is to set your RTH altitude high enough to avoid any trees, buildings, power lines or other obstructions in your flying area.

NOTE: Check and adjust these settings only when the Aircraft is powered on and connected to the Remote and DJI App. Check them before every flight as they may change with a battery change, firmware updates, etc.

Other Flight Modes

Note: Due to the OA (Obstacle Avoidance – Computer Vision) system included, the Phantom 4 has additional flight modes and capabilities. You can read about them and see a video demo in our article here.

Intelligent Flight Modes are accessed in various methods depending on the exact model. Please consult your manual and the DJI Go App for the exact setup of your model.
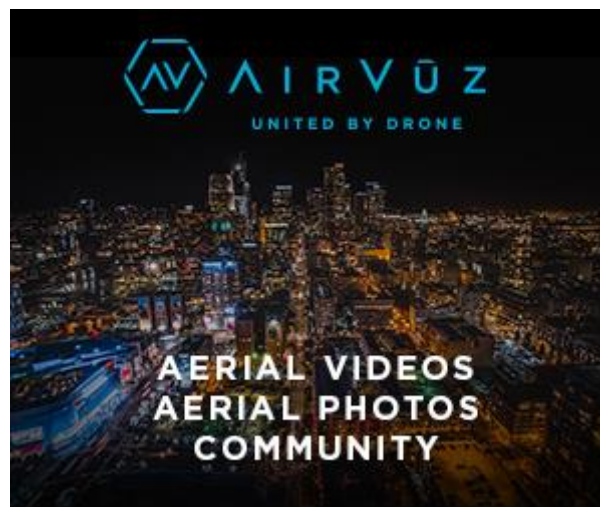
Phantom 3 models (except P3S) have a 3 position switch on the Remove as shown below. This switch allows the following modes:

3-Way Switch Phantom 3 (except Standard)

GPS (P) – (Positioning) mode attempts to use as many of the Phantoms sensors to keep the aircraft stable. The P system will use GPS as well as the Barometer (altitude) and, if closer to the ground, the VPS sonar and camera ground sensors (P3S has no VPS).

ATTI (A) – is a mode available on all Phantoms. This turns off the GPS system but maintains altitude (barometer). In this mode the Phantom will drift with the wind and so must be actively piloted. One use of ATTI is for the pilot to regain manual control if he or she suspects the GPS system has gone awry.

FUNCTION (F) are set by the 3 position with in the upper left of the Phantom 3 and activates other intelligent modes.

Most flights will be in P mode which will keep the aircraft as stable as possible. The additional modes can be used once the operator has familiarized themselves with the pros and cons of these options. As an example if a GPS error occurs and the Phantom starts flying away or acting erratically, an experienced pilot will switch into ATTI mode and regain control.

Note: The mode switch does not change modes in the stock (default) setup of the DJI Go App – you must first choose *Multiple Flight Modes* in the MC Setting -> Advanced Settings menu screen.

Intelligent Flight Modes (F Mode or Icon on DJI Go App)

Note: Check your manual to confirm how to enter these modes on your particular model.

Point of Interest is an advanced feature which allows you to select an object (example – a church steeple) and have the Phantom 3 circle the object while keeping the camera pointed toward it.

Follow Me – allows the Phantom to follow a target – for instance you on your bike, at a set distance and height. You must have a GPS enabled device (iphone, etc.) running the DJI Go App for this to work. Note that this should only be used in large open (and treeless) areas due to the lack of accuracy of GPS positioning. The Phantom 4 has a more advanced follow which uses the built-in computer vision.

Waypoint Flying – These terms describe the ability of a Phantom to fly a preset course. You can set a course by flying it once and then saving it. The built-in waypoint program has some limits in terms of range and capabilities however it should be fine for most common uses. See the following section on Litchi and other 3rd party apps for more advanced waypoint and autonomous flying hints.

Home Lock should be thought of as a way to save your quadcopter when it's fairly far away and you have lost orientation. In these cases, you may become unsure of which way your right stick movements are sending your Phantom – so you may be flying it even further away when your intention is to bring it back. When you switch to Home Lock, your Transmitter

will operate just as if you were standing behind your quadcopter with it facing away from you! If you pull back on the right stick, it will fly directly back toward you, no matter which way it may have been facing. It can undoubtedly save your Phantom without you having to fall back on Return to Home (RTH) or other measures.

Course Lock allows your Phantom to fly along a straight path while allowing you to still rotate the aircraft and camera. As an example, you could use Course mode on the football field sideline and set it such that forward moves the aircraft along the length of the football field. But as you fly the aircraft down the field, you can pivot the aircraft and camera to the subject you are recording. Think of it as a cable-cam or camera on rails.
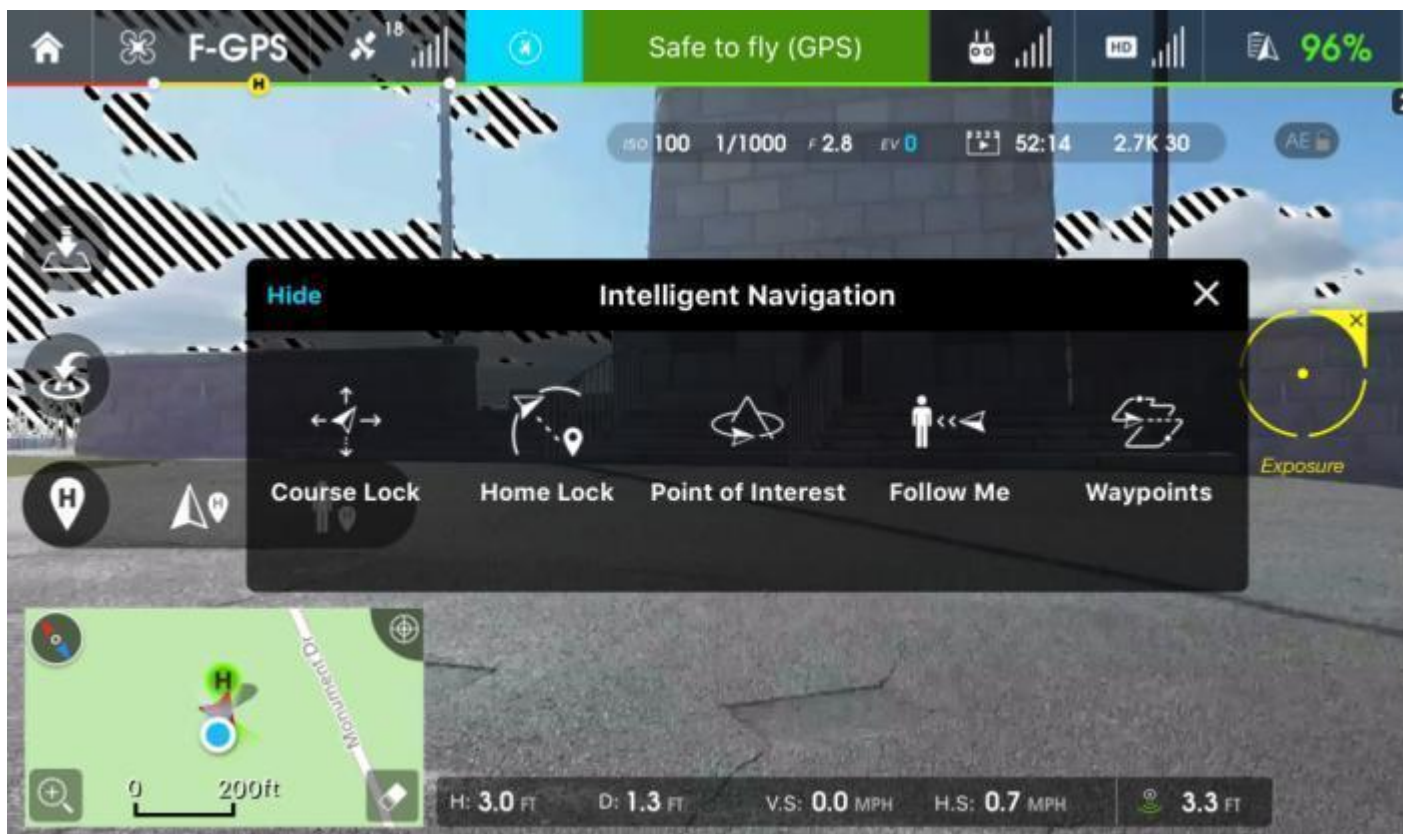
Phantom 3 Advanced Flight Mode Selection

Keep in mind that these modes of flight requires some experience and a good understanding of maps, distances, altitudes and compass directions. It's probably wise to become very familiar with your Phantom before trying the Intelligent Flight Modes. Experiment in a large open area and become familiar with the instructions on how to terminate autonomous flight. This way, if things go wrong, you can regain control or possession of your valuable quadcopter.

You can also use the built-in flight simulator to practice these advanced flight modes – this will definitely help with your preparedness once you are ready to deploy them in the field.

Other Advanced Modes and Abilities

The Phantoms are not limited to the features which DJI provides. They have released an SDK (Solutions or Software Development Kit) which allows for 3rd party access to many of the instruments and capabilities inside this machine. One example is Litchi (see our introductory article) which allows you to plan waypoint missions perfectly – even before you head out to the flying grounds. Another popular app is Autopilot – which features various flight modes including the ability to photography a panorama. Mapping is available for your Phantom including the popular Dronedeploy application. These three apps are just a sample of what is available to extend the capabilities of the Phantom.

Example Litchi Waypoint Mission

The use of these apps allows the Phantom to be used in various agricultural, construction and inspection pursuits.

Repair of your DJI Phantom

The vast majority of Phantom problems can be solved by patience and asking your fellow pilots on one of the many internet forums or social media groups that cover the Phantom. Often the solutions involve reinstalling of software and firmware, rebooting of the Phantom and/or the smart devices. In some cases, the use of a newly formatted SD card will allow for reinstallation of the firmware – and solve some nagging problems.

If all else has failed and you suspect an actual factory hardware defect, you should contact either DJI or your dealer. The Phantoms have proven a very reliable machine so these occurrences are quite rare.

In terms of customer support, you will get good answers and helpful advice from many of the R/C forums around the net. DJI has some employees who frequent these forums and help with some support. DJI even maintains their own forums on DJI.com – so you can check for answers on the corporate site.

Although the Phantom quadcopters are reliable, sooner or later many owners are going to need repair services. In most cases, this is due to operator error such as hard landings, collisions with trees and buildings and landing in water. Very simple repairs and replacements can be DIY (do it yourself) – examples including propeller and landing gear replacement. Other systems, such as the Camera/Gimbal assembly, can be replaced with a new part. Be aware that the camera and gimbal alone cost about 1/2 the total price of a Phantom.

DJI and/or 3rd parties will also do repairs on your machine outside of warranty. Two well known repair shops are Neary Aerial and USDronerepair.

The best way to keep costs down is to avoid crashing your Phantom. Fly conservatively and use your common sense to plan your missions, set home points and keep your equipment clean and functional.

Chapter 7 coming soon!

If you would like to help support our publishing and educational efforts, purchase your Phantom (or accessories – or anything at Amazon, etc. for that matter) using the links below or on one of our sister sites of Dronesavings.com (best deals updated regularly) or Phantominfo.com (most everything you need for a Phantom).

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Phantom Modifications and Additions

There are many useful and decorative modifications you can make to your Phantom. A large aftermarket has sprung up online to satisfy the demand for various accessories.

Note: We advise using only DJI brand OEM propellers for your Phantom. These are specially designed and DJI has developed very high standards for both the shape and the materials used.

Here are some popular add-ons for the Phantom:
Backpacks and cases – these are available in hard or soft shell designs. DJI offers their own and other brands such as Thinktank, Mofrotto and GPC offers others.
Cases are available from as low as $40 to $400+
ND and Polarizing Lens Filters (DJI, PolarPro, Taco, Snake River, etc.)
Lens Caps and Lens Hoods (petals)
Car charger (DJI) and Multiple Battery Chargers
Sunshades (hoods) for your smartphone or tablet
HDMI out module (sold by DJI for the Pro and Advanced) allows the video output of

the Phantom to be shown on large screens (monitors, TV, etc.) and also on certain headset [goggles](#).

Links to popular Phantom accessories and add-ons can be found on the popular site Phantominfo.com

Some Phantom add-ons are 3D printed and available from the popular site [Shapeways](#).

Be sure to consider the added weight when adding accessories to your Phantom. A digital postal scale is part of the quadcopter pilot's toolbox.

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Payload Capacities

The Phantoms are sold RTF (Ready to Fly) complete with a camera and gimbal. This means that no additional payloads are needed for full function – however, there are various add-ons and accessories which many pilots install on their quadcopters.

The propulsion system on the Phantom models is quite robust and easily capable of lifting many of these small add-ons. Examples include propeller guards, lens attachments (ND filters, etc.), gimbal and camera protectors and add-on GPS locators. DJI does not publish a maximum payload specification, but our experience is that adding up to 5 oz. (140 grams) should not present a problem. Take care to balance any payloads and not to interfere with the VPS system (or turn VPS off). As an example, here are the weights of some common accessories:
Propeller Guards -78 grams (4)
Trackimo Locator GPS – 34 grams
ND Lens Filter – 6 grams

Traveling with – or shipping – your Phantom

Note- We will reference USA laws and policies here. However, since the USA sets a lot of the highest standards for airline safety, Phantom owners would be wise to follow them.

DO NOT CHECK YOUR PHANTOM w/BATTERIES AS LUGGAGE!

The Phantoms use powerful batteries which contain massive amounts of energy – enough to easily start a fire if mishandled or short circuited. Phantoms with batteries should not be checked as luggage (not gate or counter checked), but rather carried inside of the airliner as carry-on and stored in the overhead compartments or under the seat. The Batteries should be carefully packed to avoid the possibility of other metal objects contacting them and creating a short circuit. The best way to do this is to pack each of the Smart Batteries in its own LiPo bag. LiPo bags are inexpensive fireproof sacks designed to store LiPo batteries. The Phantom, along with a couple of these batteries in sacks, should fit into many of the specially designed Phantom carrying backpacks. We use one made by Think Tank and it easily survives being slung around the airport and pushed into the overhead bins.

PLEASE do not gate check or otherwise check your Phantom batteries. This is a very serious matter – as they could cause a fire which could damage or destroy an airliner.
Another alternative is to ship your Phantom to your destination using a package service such as UPS or Fedex. The original box works well for this application, especially if you pack the original box inside another – slightly larger – box. Be sure to declare the contents as LiPo batteries and specify ground shipping when possible.

Phantom Maintenance – Preventing Crashes and Loss

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The Phantoms are very reliable quadcopters – especially when compared to earlier models. The GPS system as well as improvements in the accessibility of the Failsafe system help increase the chances of your Phantoms survival.

Operator Error is responsible for many crashes, "flyaways" and other losses. Here is a list of the major items to confirm before you take flight.
Make sure your battery is fully charged and give the pins and spade connectors on the Phantom a visual inspection for corrosion. Clean if needed and apply conductive grease or gold contact cleaner (De-Oxit is one well known brand).
Make certain that your flying area is not near power lines or dense housing where the radio frequencies may cause the Phantom to become confused. Flying in urban areas, caves or deep canyons may be problematic is you desire to use the GPS mode.
Make certain that your compass was recently calibrated – it's a good idea to redo this every couple of weeks or if you are flying the Phantom more than a few miles from where you did the last calibration.
Make certain the mode switch is set all the way to the right (P) for most flights. Take

a test flight or two to check the function of Home Lock, so when you get in real trouble you will already be familiar with it.

Make certain your firmware and Go App is up to date.

If possible, take off and land from a grassy or soft area and one without a lot of dust – this will avoid damage on small crashes – the cameras and gimbals are especially fragile.

The above tips and hints should help avoid 3/4 or more of the potential problems – however, like any mechanical product (especially those which fly) the Phantom needs occasional inspection of its flight systems. Here's a basic list.

Battery – the battery section in the Appendix as well as your manual will inform how to properly care for your LiPo batteries.

Propellers – DJI has upgraded their propellers to "screw-on" or twist-on models which do not have a separate locking nut. These props should be checked, wiped off clean and replaced when they are badly nicked, bent or cut.

Motors – The DJI Motors use sealed bearings – do not oil them. Blowing them out with a straw or air-can (computer type aerosol) will help keep dust from getting too thick inside them.

Landing gear and body – vibration can loosen the screws which hold the landing gear, the motors and the body together. Check them every few months (or after each 25-30 flights) and retighten if needed.

The overriding theme above is that becoming familiar with your aircraft will pay dividends in terms of keeping it flying…and, in your possession.

Droneflyers.com has additional articles regarding the best ways to make certain you don't crash or lose your drone. Here are the links:

DJI Phantom 3 how to avoid Flyaways and Crashes

Did your Drone Crash? Maybe it’s not your Fault!

Fear of Flying 2016 – The Last Word on Drone Flyaways!

Chapter 8 coming soon!

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rone Detection & Defense Systems

DeTect has developed a unique drone/small UAV detection and defense solution, DroneWatcher, consisting of three technologies that can operate independently or together to provide complete, multi-layer security:

DroneWatcherAPP uses advanced signals intelligence technology to turn an Android smartphone or tablet into a drone and small UAV finder that detects, tracks and records information on ~95% of consumer and prosumer drones with a range of up to 1/4 – 1/2 mile. The APP also records data including the drone type, ID and other information that can be used to document incursions and support apprehension and prosecution by local law enforcement. Multiple devices using the APP can create a crowd sourced network for wide area coverage and detection with real-time web based situational awareness displays and automatic warning of drone incursions via visual and audible alerts and text messaging. The free APP is available on Google Play. **View the privacy policy**.

DroneWatcherRF is able to detect over 95% of the commercially-available, consumer and prosumer drones on the market out to 1-2 miles providing detailed information including drone type, ID and other data. The DroneWatcher RF is a compact, unobtrusive electric box that is installed around the perimeter of a facility with only nominal power and network requirements (self-contained solar and cellular versions are available). New drone signatures are continually being added to DeTect's DroneWatcherRF identification database. DroneWatcher RF also includes DeTect's proprietary drone interdiction and inception functionality.
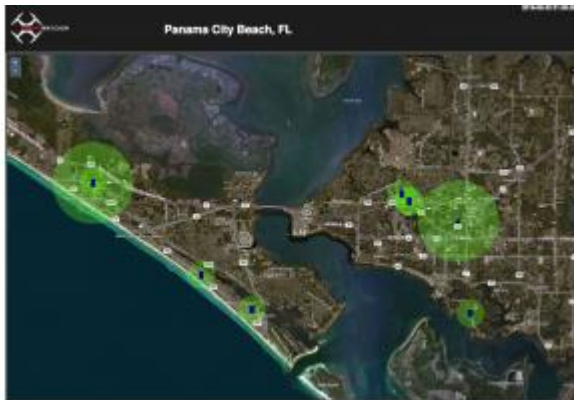

HARRIER DSR (drone surveillance radar) is primary surveillance radar designed specifically for detection and tracking of small, low flying, non-cooperative targets in high clutter environments. DSR is able to detect and track small consumer, prosumer and military cooperative and non-cooperative drones within line of sight and at longer ranges out to 2+ miles with a longer range for larger UAVs. The HARRIER DSR detects and tracks uncontrolled, programmed drones flying on autopilot that are not detectable by DroneWatcher APP and RF and interfaces with a wide range of ancillary sensors including video and DeTect third party interception technologies.

DroneWatcher Layered Drone Surveillance & Interdiction
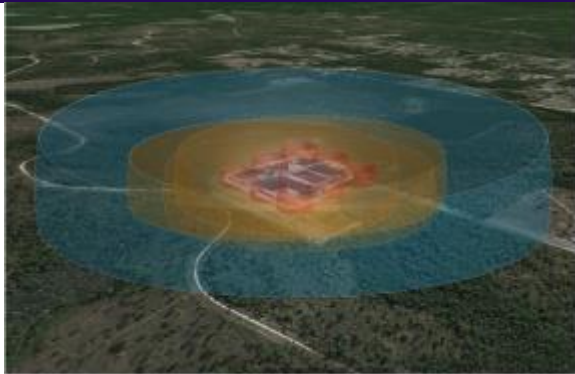
DeTect's DroneWatcher system delivers a flexible, highly customizable multi-layered solution for finding, tracking, alerting and interdiction of drones/sUAVs and includes signals intelligence (SIGINT) and radar technologies. Each DeTect technology can be used as a stand alone sensor or can be combined to provide the level of security specific to each user's requirements. Additionally, the technology is upgradable to meet the security challenges presented by continually evolving drone capabilities, features and threats. The DroneWatcher APP, available through Google Play is free. Pro and Pro Premium versions provide a low cost effective technology for protecting personal privacy and for small business security. For large area coverage, multiple DroneWatcher APP enabled devices using DeTect's optional DroneWatcherWEB service can be crowdsourced to provide wide-area drone control and interdiction at public events (such as indoor and outdoor concerts, fairs, and rallies), sporting events (such as NASCAR, stadium sports, golf tournaments, marathons, tennis and other outdoor competitions), airports, prisons, power plants, government facilities, industrial sites and for general law enforcement.

For higher level security requirements, the APP can be integrated with the DroneWatcher RF and/or HARRIER Drone Surveillance Radar to provide 100% security for covered airspace with the APP and RF sensors detecting, tracking and identifying RF controlled drones and the HARRIER DSR providing detection and tracking of non-cooperative, non-RF controlled, or auto programmed drones and UAVs. Both DroneWatcher and the HARRIER DSR also can include DeTect's proprietary drone interdiction and inception functionality.

The DroneWatcherWEB is DeTect's Web service that provides a real-time consolidated, custom situational awareness web display for each user site, including wide area views for large complexes, cities and counties. DroneWatcherWEB is highly flexible and includes custom visual, audible and text message alerting options. The web service additionally logs all sensor

detections including drone ID signatures, location, flight path and other parameters that can be used to support law enforcement prosecutions for illegal intrusions.

HARRIER Drone Surveillance Radar

The HARRIER DSR uses advanced, military grad, solid-state Doppler radar for small RCS targets in complex clutter environment and provides reliable detection of non-RF and GPS programmed flown drones to 2+ miles. DeTect's solid-state radar technology offers significant increased performance, longer useful life and lower maintenance costs over conventional magnetron-based systems. HARRIER also includes an advanced SQL datasystem that provides real-time drone target classification and rejection of false positive targets from birds. The system interfaces with third party video, acoustic and other technologies and includes a consolidated Web Service for real-time user situational awareness displays for specific sites and regions. HARRIER has a tested record of exceptional performance with the following general detection ranges for drone size ranges:

- Large (Global Hawk class) to 14+ nm
- Medium (Raven class) to 4-6+ nm
- Micro UAVs (DJ Phantom class) to 2+ nm
- DeTect's HARRIER system also includes DeTect's proprietary drone interdiction technology and the system can be integrated with and control third-party interdiction technologies.

Interoperable Integrated Technology

DroneWatcher and HARRIER systems can operate as a stand alone facility and force protection systems detecting and alerting perimeter intrusions by air, water and land. The systems are also multifunctional and can be programmed to detect multiple intruder types including simultaneous locating, tracking and alerting of sUAVs, aircraft, ultralights, ships and boats crossing pre-set site perimeters or entering restricted zones. It

provides automated visual and audible notifications through DeTect's web service to security and law enforcement by text message, pager or cellular phone and direct read-out at remote monitoring stations.

Automatic detection and tracking capabilities includes user defined monitoring and alarm zones. Systems are offered in fixed skid and mobile configurations and can be linearly networked to cover large areas and lines such as border crossings, coastlines and large facilities. DeTect's technology is highly customizable providing radar, video, and thermal detection and acoustic deterrent through a single user interface display with advanced alerting and response features all viewable and controllable remotely in real-time. HARRIER features include:

- Microsoft Windows-based operating software
- User displays & interfaces developed for non-technical user
- Integrated radar, thermal, video, acoustic & sonar deterrents
- Intelligent Radar feature provides real-time target identification
- Automatic false positive (birds) rejection
- Display activated "point-and-click" video zoom & deterrent activation
- Compatible with other security & display systems
- Site-specific underlay maps
- Mobile mapping technology
- Identifies & tracks each target by size, position, speed & heading
- Audible & visual intrusion alarms
- Optional notification by email & radio pager
- Automated data recording, archiving & reporting

HOW TO BUILD A DRONE: CONSTRUCT YOUR DRONE FROM SCRATCH

41 Comments

17 min read

Written by Jack Brown

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Unmanned aerial vehicles have been around for decades, but they have achieved the greatest popularity in recent years with small commercial drones. The new so-called FPV (first person view) technology gave us a unique experience of flying and the advancement of GPS systems in drones opened a whole new world for passionate individuals.

Of course, drones are not the only RC flying devices on the market, but their agile multi-rotors and their capability to take amazing photos and record stunning videos during flight made them the most popular. That's why commercial drones are in great

demand nowadays, but have you ever wondered how to build a DIY drone from scratch?
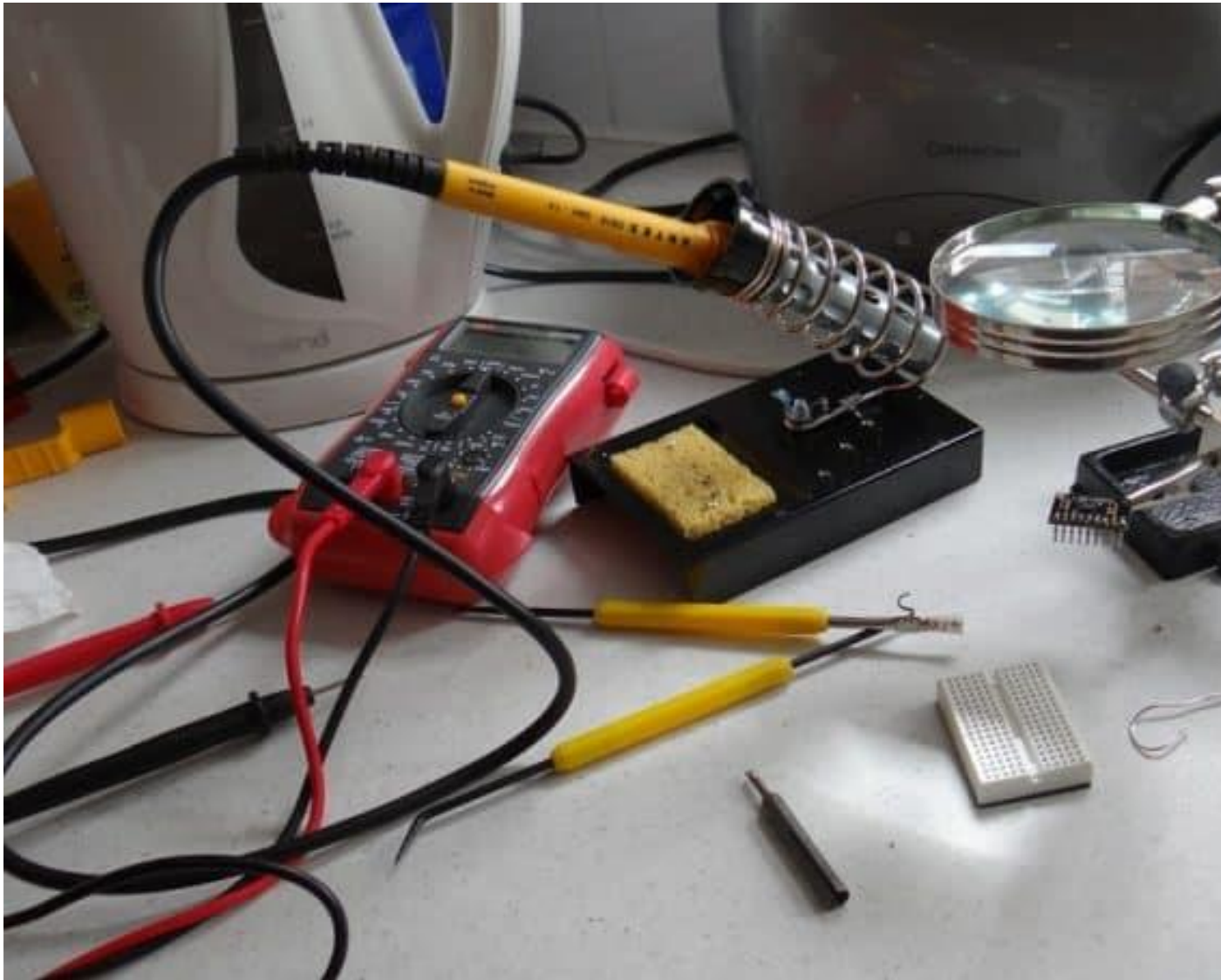
Today, there is a wide range of drones on the market, and they differ in size, design, and properties. You just need to visit some popular online stores where the drones are being sold and find some ready to use a model that best suits you, according to its features and price.

Most people will simply buy a drone. On the other side, people who like do it yourself projects may enjoy building these devices from scratch. If you also like this craft, you can buy drone kits and enjoy piecing them together like a Lego puzzle.

The real challenge is to construct a drone from scratch without using a special kit. This is a complicated project, as you would have to find the necessary pieces and imagine the drone structure yourself. So what do you say? Are you up for this task?

This article will take you through the basic steps of building a drone from scratch. As expected, this can be an extremely complicated project, depending on the type of drone you want to build, and the materials necessary. This article will take you through a general outline of what it looks like to make a DIY quadcopter drone, and hopefully this will help you to understand whether you truly want to take on this project. No one is saying it is going to be easy, but some people find that the end satisfaction is more than worth it!

BASIC PARTS YOU'D NEED

Before you start to make this DIY drone, you need to know which components are needed to build it; if you want it to fly, of course.
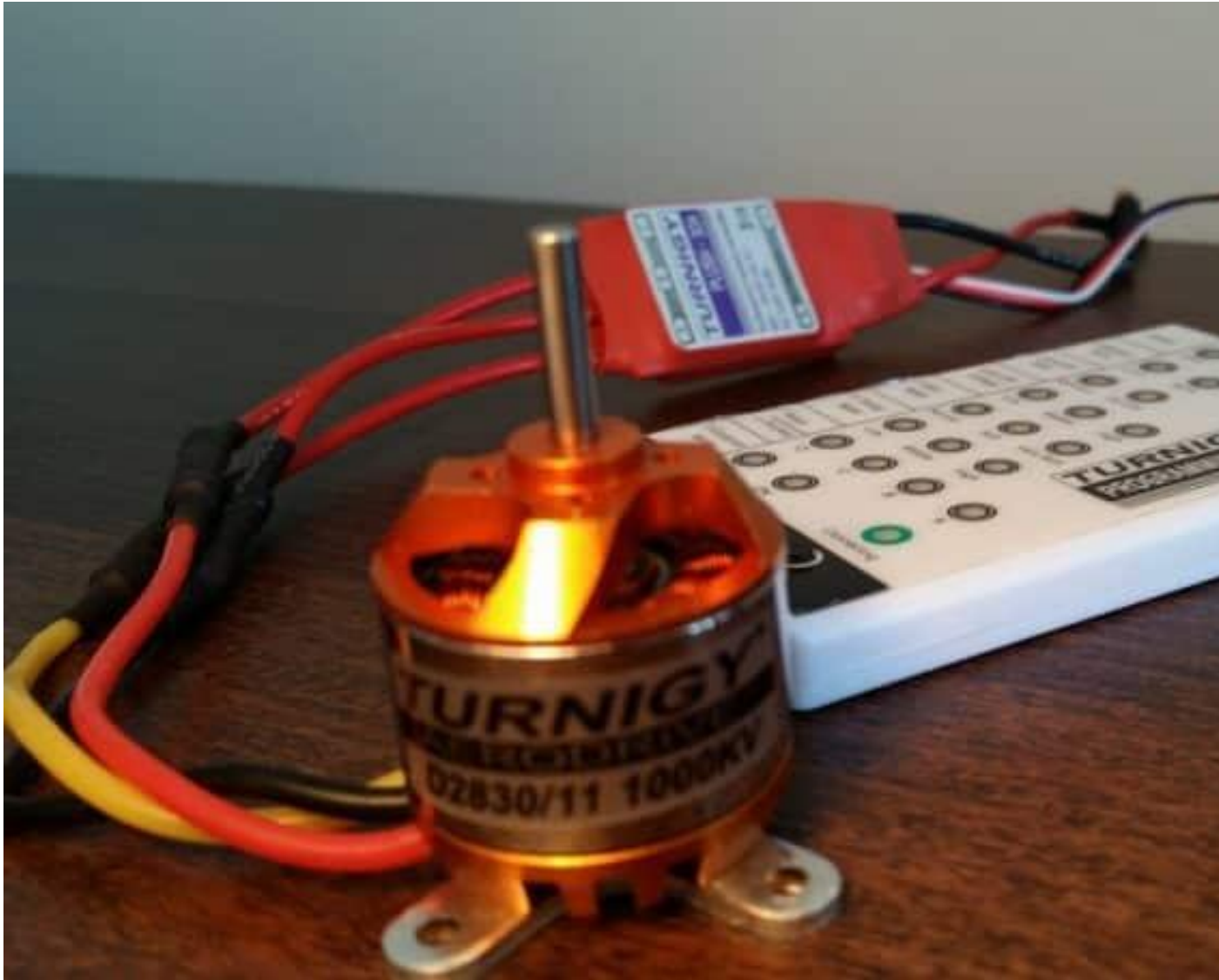
Here is a basic list of the components you'll need in order to build yourself a drone:

- **Frame:** there are two possibilities when it comes to a frame for your drone. You can make it yourself or buy it in an online store, and for a wide choice of high-quality frames, we suggest checking out **our article about best drone frames**. If you decide to build it yourself, the project is not that difficult, but you'll need some engineering knowledge and knowledge of the materials you are going to use. For instance, you can use metal (something light), plastic, or even wood slats. If you opt for a wooden frame, you'll need a wood board which is about 2.5 cm thick.

- **Motors:** For an ordinary quad, you will need 4 motors in total, but an octocopter requires eight motors to fly. The recommendation is to use brushless

motors – they are lighter on the battery and, unless you are an engineer who completely understands how a motor works, these pieces should be bought from a store. You can also get more familiar with them by reading **our article about drone motors**.

- **ESCs or electronic speed control:** these are also essential pieces of your drone as they are in charge of delivering power to the motors. Again, their number depends on the number of arms your drone is going to have.

- **Propellers:** When looking for the propellers, you must find the ones that match the frame of your drone. Pay attention to materials – you won't find wooden propellers, but you must make sure the ones you choose are a good fit.

- **Connectors:** You will need 3.5 mm connectors to weld the motors and ESCs, as well as 4.5 mm connectors for the power distribution board.

- **The power distribution board** – this board connects the electronic speed controls to the battery.

- **Batteries:** When purchasing the batteries for your drone, you need to consider the capacity of a battery and its type. The most used batteries for this purpose are Li-Po batteries and their power differs. To have a much better insight on this topic, we strongly suggest checking out **our article about drone batteries**.

- **Battery monitor:** This is not an elementary item, but the monitor is quite useful in warning you when the batteries are close to finishing. This way you don't risk having the drone remain out of juice in the air, over a pond. A battery monitor ensures that your aerial vehicle won't die in the most inopportune place.

- **Mounting pad:** It reduces the vibrations, and thus improves the flight. This one is very useful especially if you are trying to take pictures or videos with your DIY drone.

- **Controller:** This device shares the power and commands the motors at the same time.

- **RC receiver:** Of course, if you have a transmitter (which is usually with you), you'll also have a receiver mounted on the drone.

- **Camera:** If you want to take aerial photos and record the surroundings while flying your drone, you will need a camera. The best cameras are those that can take the quality 4K videos, but everyone will find one according to their needs.

For high-quality aerial photography and videography, you might also need a gimbal for the camera.

- **USB key:** This is necessary to save the photos and videos.

Aside from the above-mentioned parts, you will also need AWG silicone wires, a battery charger, Servo lead wire cables, zip ties, 3M command strips, thread locking compounds, etc. In addition to these components, you can also embed other accessories to your drone and make it more advanced.

In other words, there are many, many ways to build a drone, and depending how much of it you truly want to make DIY, these steps will vary and the necessary components will change. The guide below will provide you with insight into the DIY process for a quadcopter.

STEP-BY-STEP INSTRUCTIONS

There are different types of drones, but people find quadcopters to be more efficient, as they are easy to fly.

So for this step-by-step guide, we have focused on showing you how to build a quadcopter with pieces that you can buy separately:

STEP 1: MAKING THE FRAME

No matter what your drone is going to be, it must have a frame. So, the first task is to make a frame. For this purpose, you can use different materials, such as metal, plastic, or wood. These materials will differ based on how sturdy you intend the drone to be.

If you select wood for the frame, find a wood board that is longer than 60 cm and about 25-30 mm thick. Cut up this board in such a way to get two laths which are 60cm long and 30mm wide. These two lengths are required to make the structure of your future quad.

Crossing these two laths you'll make the X frame. Also, you will need a wooden sheet in order to make and add a rectangular piece in the central part of this frame. Its size should be 6×15 cm, and about 2mm thick.

Of course, you can use other dimensions if you like, but these will get you a pretty nice quad. To connect these parts, you will need nails and glue. In case you decide to go with metal or plastic, the dimensions are similar but the way you connect the laths together is going to be different.

Check out our suggestions for the best-premade frames which you can use as a base for your project:

- **LHI 220-RX FPV Quadcopter Frame (Carbon Fiber)**
- **Readytosky FPV Drone Frame (Carbon Fiber)**

- [iFlight XL5 V3 240mm FPV Frame Carbon Fiber](#)
- [Mallofusa 4-Axis HJ450 F450 RC QuadCopter Multirotor Airframe](#)
- [Usmile X style Carbon Fiber Drone Frame](#)
- [Readytosky S500 Quadcopter Frame with Carbon Fiber Landing Gear](#)

STEP 2: PROPELLERS, ELECTRONIC SPEED CONTROLLERS, AND MOTORS

The ESCs (Electronic Speed Controllers), the motors, and the propellers are among the most important elements of a functional drone. So, you should get these components from an authorized store to ensure quality and reliability. They must be in accordance with the size of your drone, so bare this in mind when buying them. Do not be afraid to ask for assistance from someone at the store.

When looking for **the motors (or rotors)**, you should know that multi-rotor drones produce greater speed and ensure a stable flight, as each rotor works with other's thrust points. **For example, check out these rotors:**

- [**Emax RS2205 2600KV Brushless Motors**](#)
- [**Readytosky GT2205 2205 2300KV Brushless Motor**](#)
- [**HOBBYMATE 2204 QuadCopter Rotors Combo**](#)
- [**AOKFLY 4PCS RV1104 4200KV FPV Brushless Motor**](#)

For the propellers, we suggest you buy the metal 9-inch props you can find at a very affordable price on the market. These are durable and won't bend so easily if the drone hits something during flight. However, if you want better performance, it would be better to get carbon props.If you want good performance we recommend you to get any of these:

- [**BTG Quick Release Carbon Fiber Reinforced Propellers**](#)
- [**Myshine 9450 Self-tightening Propeller Props**](#)
- [**Performance 1245 Black Propellers MR Series**](#)
- [**USAQ Carbon Fiber Propellers (2) Pair**](#)
- [**Helistar Propellers 6 Pairs 4730F Colored Quick Release Folding Blades**](#)

And finally, you need to pick up some **ESCs (Electronic Speed Controllers)**, if you don't want 4 of these (keep in mind we're talking about a quad here) you can buy the 4 in 1 controller. **We would suggest these models, which are great and stable:**

- [**AKK 30A 4 IN 1 2-6S Brushless ESC BLHeli_S Electronic Speed Controller DShot150/300/600 Capable for Micro Racing Drones**](#)
- [**Original Airbot Omnibus F4 Nano Flight Controller**](#)

STEP 3: ASSEMBLE THE MOTORS

The next thing you need to do is drill the holes in the frame for the motors, according to the distance between the screws holes on the motors. It would be good to make another hole that will allow the clip and shaft of the motor to move freely.

However, you may skip this action if the motors already came with mountings. Put the motor in the appropriate place and fix it to the frame using the screws and a screwdriver.

STEP 4: MOUNT THE ELECTRONIC SPEED CONTROLLERS

After mounting the motors, you also have to mount the speed controllers. How will you do this? It is recommended to connect the speed controllers on the bottom side of the frame due to several reasons which involve the functionality of the drone. These reasons, among others, include that it will "unload" the upper side of the drone where other components should be added.
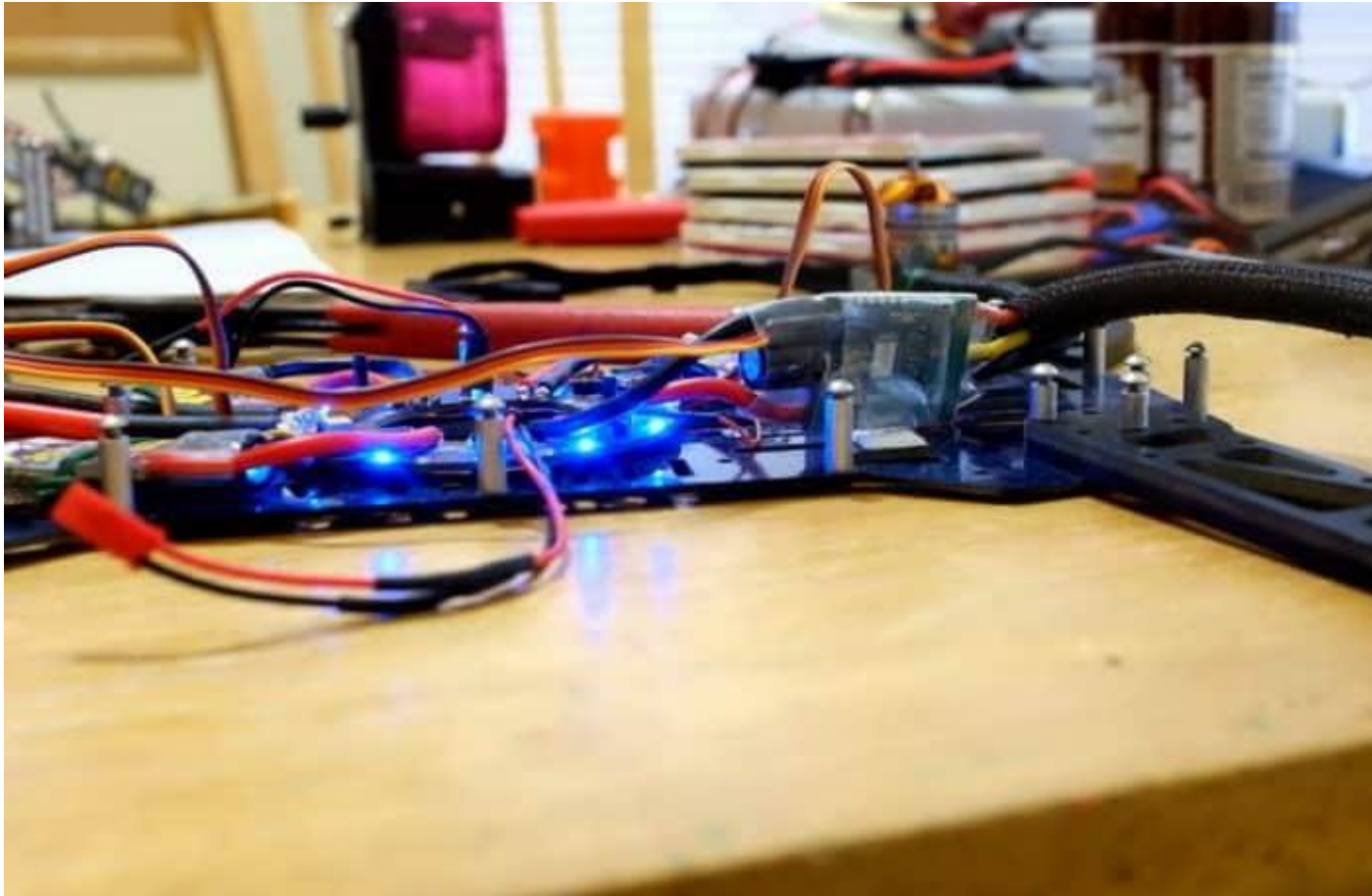
In order to fix the ESC very well to the frame, you need to use zip ties. This way, your ESCs are tied down and well secured while flying.

STEP 5: ADD THE LANDING GEAR

This gear is an important part when landing your UAV because it significantly reduces the shock when the drone lands on a solid ground. It can be made in different ways, but you should be creative and make it in your own, unique way.

Here's one idea: find a metal pipe (about 6 inches in diameter) and cut off (with the appropriate tools) 4 rings that will be 1-2 cm thick. Of course, the size of these rings should be in accordance with the general size of your drone. You can then use duct tape to fix these pieces to the frame.

If you don't like this metal pipe idea, you can also use other materials that are flexible but strong, such as some new plastics, or anything that will reduce shock.

STEP 6: FLIGHT CONTROLLER

Every flying drone must have a control system. This electronic system allows a drone to be stable in the air while flying and processes all the shifts and changes in direction and the wind.
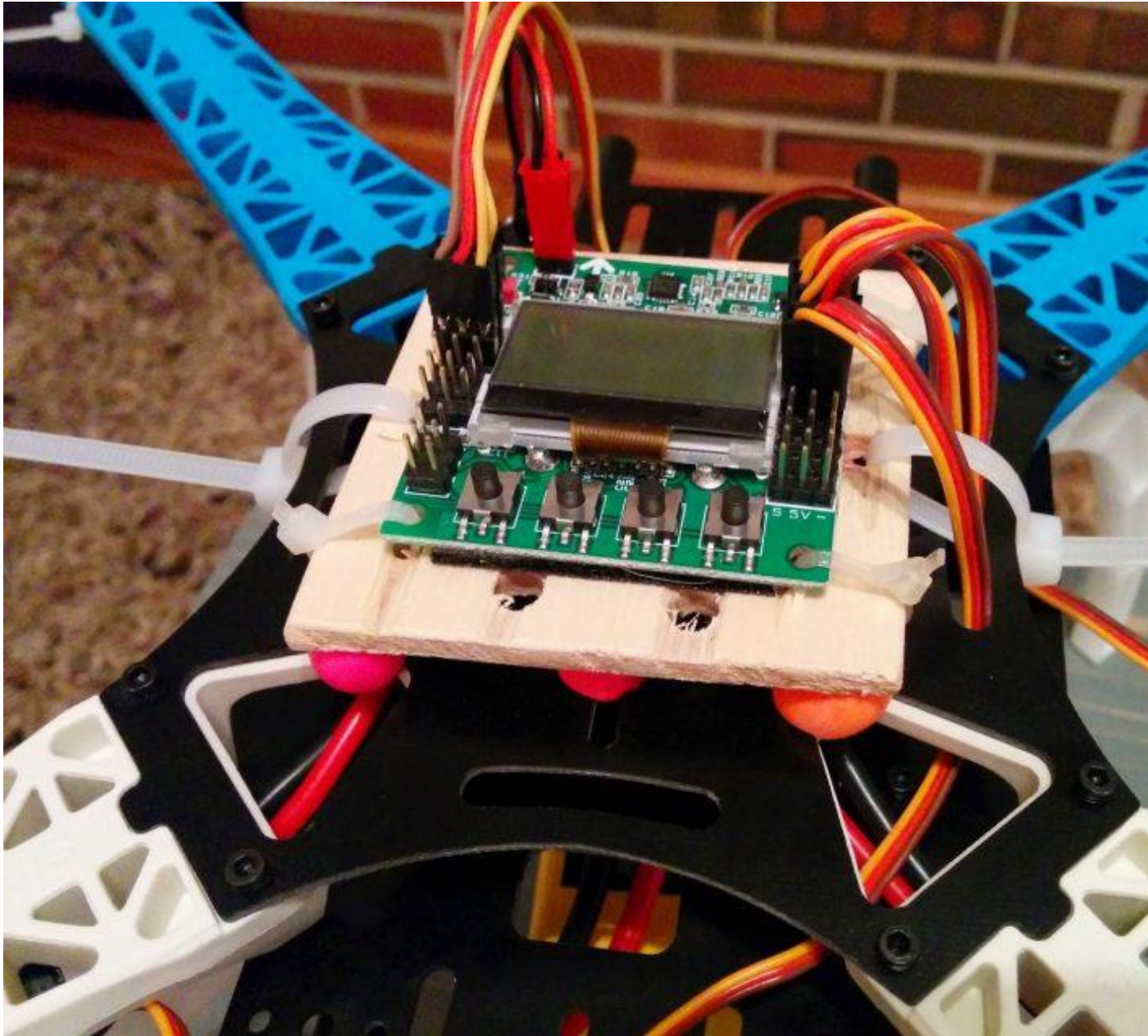
There are two options when it comes to this step:

First, and the easier option, is to buy a ready-to-use controller. With the second option being that you make it yourself.

For this work, you can use one of the following source **flight controller projects**:

- DJI NAZA: **DJI NAZA M V2**or **DJI Naza Lite** closed sources.
- **ArduPilot**: An expensive but a very good hardware for drone controllers with great performance. It features an automated flight mode.
- **OpenPilot CC3D**: This superb open-source flight project contains 6 channels and the **MPU-6000** It is very easy to set up and install, and there is a wizard guide that leads you through the installation. Even better, this open project is now available through different sources on the web.
- **NAZE32**: Very flexible but a bit complicated to set up. It has the advanced fliers which improve the control over your drone, but you must make sure you can actually set it up.
- **KK2**: This is one of the most used projects for this purpose since it is cheaper than most other sources of that ilk. It comes with LCD that is based on the advanced AVR controllers. Thus, you can set it up without using a computer. Also, it has the **MPU6050** has a sensor, which allows you to write your firmware. However, KK2 requires manual tuning and it is not convenient for RC beginners.

If you want to make a controller yourself, you should opt for one of these projects that best suits your needs. Follow the links above to do some more research, and examine the individuals features of each in more detail. It is very complicated to construct such a device and requires an expert drone technician. But if you are able, your drone will be the ultimate "**do-it-yourself**" aerial vehicle.

STEP 7: CHOOSING A RIGHT RC TX-RX (WIRELESS REMOTE CONTROL SYSTEM)

This is the remote control system that is needed to control a drone.

There are various available **RC control systems** nowadays, like **Futaba, Spektrum, Turnigy, FlySky**, and so on. You can find more details and do research on all of these systems here:

- [**Futaba 10JH 10-Channel Heli T-FHSS Computer Radio System**](#)
- [**Spektrum DX8 Radio Transmitter**](#)
- [**Turnigy 9X 9Ch Transmitter w/ Module**](#)
- [**Flysky FS-i6X 10CH 2.4GHz AFHDS RC Transmitter w/ FS-iA6B Receiver**](#)

In addition to this system, you'll also need a few channels for yaw, pitch, throttle, and roll, as well as the additional channels if you want to mount a camera control to your drone for some aerial photography.

STEP 8: MOUNT THE FLIGHT CONTROLLER

Once you choose the particular flight controller that is best for your needs, you need to mount it. There are several ways to mount it. For instance, you can place it on the top of the frame in a certain direction, but you need to make sure that all the components are fixed well before calibrating your drone. For this purpose, you can also use the zip ties which were mentioned above.
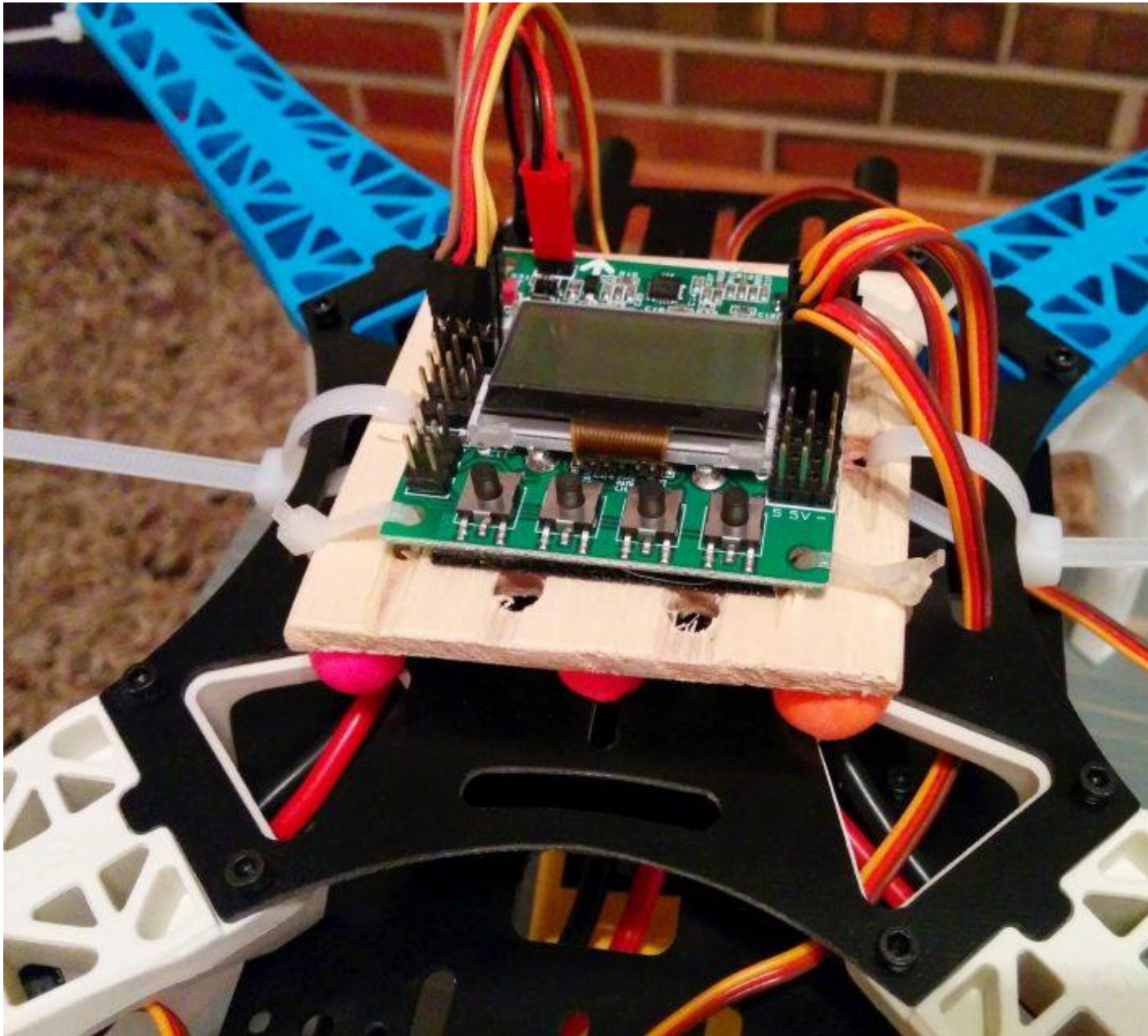
It is recommended to put a small piece of sponge on the underside of the flight controller because it absorbs and reduces the vibrations from the motors. Thus, your drone will be more stable while flying, and stability is key to fly a drone.

STEP 9: CONNECT THE OPEN PILOT TO YOUR DRONE

The next thing you have to do is to configure and connect the flight controller to the electronic speed controllers.

Also, you have to connect it to the remote control. In order to see how to do this step, you will need to find an appropriate tutorial video on the web for the particular flight controller you have previously mounted.

I wrote an ultimate guide on **how to build a quadcopter with the Arduino Uno Controller**. There is lots of info on assembling, wiring everything together, and the programming science involved.

STEP 10: CHECK OUT AND TEST YOUR DRONE

Before you finally use your drone, you must be sure that everything works well. Therefore, you have to check out all the functions before the first flight. You can test the sensors as well as other components of your drone using the special OpenPilot GCS.

To make sure that everything works well, you need to take off the props and make a small experiment with the remote control. This ensures that you can test the drone without risking the potential of breaking it.

For this test, you should find a suitable place and try to move your drone within its control distance. Pay attention to the zip ties and cables to make sure that they are connected well. When everything is okay, your drone is ready to fly!

Be sure not to cut any corners in this step, it is imperative to test everything in detail before actually flying the drone. You would not want your drone's first flight to be its last after all!

STEP 11: TAKEOFF

This is the last (and dare I say, most important) step. Before taking off, the battery must be well connected and all the components must be fixed in place. For the test flight, you need to choose a location carefully, since this aircraft can cause serious damages and can be damaged as well. It is best to choose an open, flat area, so that you do not run the risk of damaging anything with your drone, or vice versa. Also, you will ensure that you can see your drone at all times.

Place your quad on the ground, put it into operation, take the flight controller, and get started with your first flight. It's recommended that you slowly throttle up your drone, and fly it at low altitude for the very first time. Thus, if it starts coming down out of control, the damage won't be that significant.

If the drone starts drifting in one direction, you have to use the trims in order to make the necessary flight correction. Also, you should try out different PID values to see how your drone works in various inputs until you get exactly what you want.

WRAPPING UP

In this article, we managed to briefly cover the pieces and the steps to make in order to build a drone from scratch, but you should consider learning more. What's more, there are also many "intermediate steps" in addition to the basic steps we just described. It is simply the fact that due to the multitude of types of drones, component, programs, and accessories, that there are many ways to build a drone depending on the complexity of drone you are planning to make.

So, what will be the final conclusion when it comes to the do-it-yourself unmanned aircraft? In any case, they are not going to be serious competitors to the ready-to-use drones on the market, especially if they are made by the amateurs.

This general gap in quality **between DIY and ready-to-use drones** applies to both features and appearance. However, people who build the UAVs from scratch usually don't want to compete with the commercial drones, they simply do it for pleasure. It is indescribable joy when you take off your do-it-yourself aircraft in the air! People who want to build a drone likely just want to learn a new skill, and take pride in something that they have built themselves, regardless of how high-performance the end result may be.

Another big consideration is the total cost for such a drone. Because there are so many potential variables, components, and programs involved, the cost can really fluctuate. The cost will depend on the components you are going to use if you are considering additional accessories. However, as a general benchmark, the total costs for the entire project range from $200 to $300 for an ordinary quadcopter.

Aside from this amount, you also should consider the cost of the camera and if you are going to use a drone for aerial recording and taking high-quality photos as well.

If you check out the prices on the Amazon and other similar websites, you will see that you can buy an advanced drone that supports aerial photography for a similar

amount as a DIY drone. However, the satisfaction of having built your own drone does not have a price tag, and often you just want to have the experience of flying something that you have built!

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Jack is the Chief Pilot at MyDroneLab.com bringing experience, expertise and knowledge in this quite new industry. He is a graduate of the Drone/UAV Pilot Training Certificate program and member of the Association for Unmanned Vehicle Systems International. Besides having all the

necessary technical knowledge when it comes to drones, Jack and his team love to spend the time outside by the ocean, working on new features and teaching others how to pilot these amazing and exciting new robots.

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