



NEED TO KNOW

MANUFACTURER:

DJI-Innovations

TYPE: Quadcopter

FOR: Beginner to intermediate

MINIMUM FLYING AREA:

Large park

PRICE: \$679.00

DJI-INNOVATIONS

Phantom

Although the multi-rotor revolution is barely five years old, the popularity of quadcopters, hexacopters and octocopters has quickly become the hottest niche in the RC field. Initially, those interested in climbing aboard the bandwagon had to take on a do-it-yourself project that required choosing an airframe, flight controller, motors, ESCs, transmitter/receiver and other components, in addition to having the skills necessary to make sure everything played nicely together.



Author's Opinion

The DJI PHANTOM represents a watershed in the world of multi-rotor flying. To date, no other manufacturer has achieved a true "soup-to-nuts" ready-to-fly package that includes a full-performance GPS flight controller along with a transmitter/receiver bound and set up at the factory. The heart of the system is the respected DJI-Innovations NAZA-M-GPS multi-axis controller that is well known to the multi-rotor community for its stability and ease of configuration using a PC with a USB connector. Many seasoned multi-rotor pilots are buying a PHANTOM to use as a training tool or simply for noodling around given that it can fit inside an airline carryon or a small briefcase. Furthermore, the inclusion of a mount for a GoPro camera opens up the PHANTOM to a broad spectrum of users with interests that range from whimsical to truly utilitarian.

DJI's one-stop-solution to join the multi-rotor revolution!

In time, a number of dealers and online RC shops began offering ARF (almost-ready-to-fly) and RTF (ready-to-fly) multi-rotor solutions. In truth, these offerings simply allowed you to pay for someone to do the work of assembling the DIY project for you. Not surprisingly, this was not a cheap alternative and it often required waiting a month or more for the multi-rotor to be assembled and shipped to the customer.

While many flyers will argue that building your own is the best way to save money and to truly learn how to operate and repair your aircraft, DJI-Innovations recognized that there is a huge market of those who want a turnkey system that flies out of the box at a reasonable price. Some people will simply never have the inclination or time to solder their own components and the DJI PHANTOM was unapologetically made for them. Using the marketing tagline "The Spirit of Flight," the company promoted the PHANTOM as being "fun and easy" and to say it has been a success would be quite an understatement.

The truly intriguing aspect of the DJI Phantom is the number of features and the level of performance the package delivers for the price. At a retail price of \$697, the Phantom isn't going to be a casual birthday gift you'll buy for your nephew or niece. On the other hand, if you are looking for a small multi-rotor with the same flight controller

that operates full-scale craft and has the ability to carry a GoPro camera, the Phantom is worth considering.

Unlike other alternatives, the DJI Phantom is truly ready-to-fly as soon as its new owner charges batteries, puts the four props on and attaches the landing gear. The brain of the little bird turns out to be a fully-fledged DJI NAZA-M flight controller with a GPS sensor that occupies a slot in the lower landing gear. The NAZA-M is what makes this package particularly attractive for experienced RC pilots who want to move into multi-rotors as efficiently as possible. Flight behavior, control and calibration will transfer over to a larger multi-rotor and the robust construction of the Phantom is surprisingly forgiving of the hard knocks that accompany the learning curve for new pilots (or more experienced ones who deliberately choose to push the envelope).

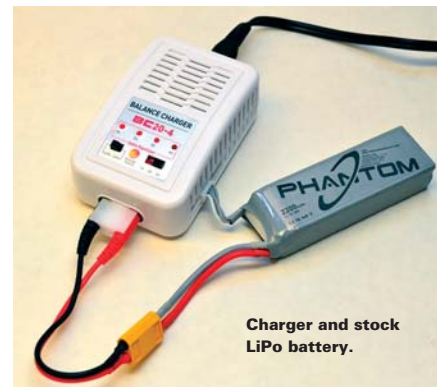
The Phantom's receiver is bound to the supplied transmitter at the factory so that it is effectively operational out of the box. Nevertheless, it is recommended that new owners perform a compass calibration to assure proper GPS response as explained in the manual available online from the DJI-Innovations website. Additionally, the NAZA Assistant software is downloadable from the site and a supplied USB cable allows the Phantom to be configured per the user's preferences.



The transmitter is powered by four standard "AA" batteries.



PHOTOS BY CHRIS MULCAHY



The Phantom itself comes very nicely packaged in a box with carrying handle. Inside, in addition to the multi-rotor, you'll find the 2200mAh LiPo battery, transmitter, propellers (including two spares), the GoPro camera mount, landing struts, a wall charger and the necessary screws and a small wrench to tighten the prop holders. You'll find some decals if you wish to add some red striping to help you identify which arms represent the nose of the craft. Setup takes less than a half hour even if you move slowly.

It's difficult to put the kit together improperly. You do need to carefully feed the GPS compass cable through holes in the landing gear so it can be connected to the compass installed in the bottom of one of the landing struts.

All multi-rotors use opposing props and the PHANTOM is no exception. Molded into each arm is an arrow showing which prop goes where and the props themselves have matching arrows molded into their surfaces so that the process is almost fool-proof. The props themselves lock onto the

SPECS

- FLYING WEIGHT:** 1000g
- LENGTH:** 15.3 in. (390mm)
- WIDTH:** 15.3 in. (390mm)
- MAIN BLADES:** Four 8x4.5
- RADIO:** Includes a DJI six-channel 2.4GHz ISM transmitter. The receiver is an integrated DJI system.
- POWER SYSTEM:** Four 920Kv DJI brushless motors
- BATTERY:** 11.1V 2,200mAh LiPo
- NEEDED TO COMPLETE:**
This is a complete ready-to-fly quadcopter system with all components required to fly included in the box.

PROS

- ◆ Sets the standard for true “ready-to-fly” capability
- ◆ Molded plastic shell protects electronics and is surprisingly robust
- ◆ Full GPS capability, including return-to-home failsafe/auto land feature

CONS

- ◆ Takeoff weight is limited to 000g maximum
- ◆ Transmitter range is limited to 300 meters (984 feet)



motors with plastic nacelles that tighten easily with the supplied wrench.

The built-in wall charger operates fine, but anyone with a decent LiPo charger will find charging much quicker and the wall charger will generally be relegated to a travel bag for road trips or emergency charging. The Phantom battery is equipped with an XT60 connector and the stock battery is rated at 20C. Replacement batteries at higher charge rates are available from many sources.

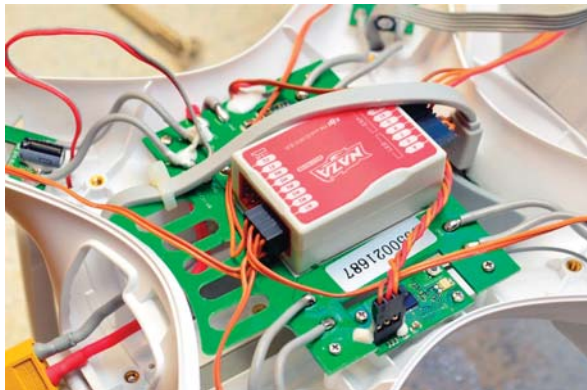
The included transmitter can be opened up to switch operation between mode 1 and mode 2 and to allow adjustment of stick tension. The transmitter itself seems to run forever on the required four “AA” batteries. Having some spares is probably a good idea, of course.

MODIFICATIONS

The Phantom comes with a simple attachment for a GoPro camera that is suspended below the main body between the two plastic landing struts. This “out-of-the-box” capability for AP (aerial photography) will no doubt cause many people to get their checkbooks out, given the penchant for sharing videos online and the natural desire to get a bird’s eye view of one’s surroundings.

Nevertheless, it is important to understand that the stock GoPro mount will transmit every bit of vibration to the camera since there is no vibration dampening in the mount. The GoPro is notoriously susceptible to a phenomenon commonly called “Jello” due to the camera’s use of what is known as a “rolling shutter.” People expecting sweeping majestic aerials from their Phantoms will likely be disappointed to see subtle wavering of the video frames caused by vibration during flight.

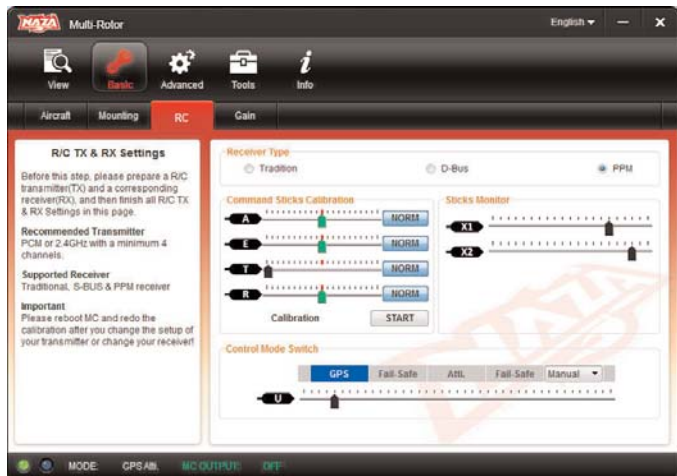
The good news is that legions of RC fanatics have been obsessed with eliminating “Jello” from their GoPro footage and it is probably the single most popular topic of



Left: The NAZA-M flight controller exposed by removing the top of the body shell.



NAZA Assistant: Basic mounting and gain adjustment.



NAZA Assistant: Transmitter settings.

IN THE AIR

I have flown many multi-rotors that have ranged from quadcopters, hexacopters (in both standard and Y6 configurations) and several large Cinestar octocopters. Flying the Phantom is both radically different and surprisingly similar to these larger cousins. Its small size and ability to overcome inertia makes it seem ridiculously "zippy" in comparison to the heavy lifters. At the same time, though, I was struck by how much it required the same skill set necessary for competent flying of larger multi-rotors. This shouldn't be surprising given that the flight controller is identical to the NAZA-M that many larger craft are equipped with. The NAZA itself can be considered a little brother of the pro-oriented WOOKONG-M controller that DJI-Innovations won awards for. Thus, the Phantom is a legitimate training tool for anyone who intends to move into higher weight classes.

Flight control is switchable among three modes: GPS, ATTI and manual (the manual mode is not recommended for novices so it is necessary to use the NAZA Assistant software in order to make it available as an option from the transmitter). While takeoff can be done from any mode, pilots will want to verify GPS lock at the outset so that in the event of loss of signal, the Phantom will be able to go into a 'failsafe' mode that will bring it back and land automatically at the takeoff location where GPS lock occurred. For optimum results, users are advised to acquire at least six satellites for at least eight seconds before takeoff.

The 'failsafe' mode will activate no matter which flight mode is being used and if the Phantom cannot get a satellite lock, it will descend slowly and attempt to land wherever it is. I tested the 'failsafe' mode on two different Phantoms and found both to operate as advertised. (I will admit to a couple of nervous moments when one Phantom began making several large sweeping circles before finally settling down into a return-to-home flight path. Nevertheless, both times the PHANTOM landed within a few feet of the takeoff location.)



In GPS mode, the Phantom will "park" itself wherever it is in the sky when the user releases the control sticks. Obviously, this feature requires a good GPS lock and proper compass calibration. The number of satellites locked at any given time is indicated by a flashing LED on the PHANTOM body. At this point I have flown five different Phantoms in a variety of geographic locations with exceptional stability in every instance. Of course, your mileage may vary, depending on a number of factors that include the presence of large metal structures, mountainous terrain and other interference that can degrade GPS reception.

The 'ATTI' mode eliminates the GPS lock, but does keep the Phantom's altitude constant provided it isn't overridden by the control stick. This will cause the Phantom to drift if there is wind, but it also provides the smoothest flight performance because the autopilot isn't constantly trying to correct its position per GPS coordinates. Those interested in shooting video with a GoPro are recommended to use 'ATTI' mode during filming.

In 'manual' mode, the pilot has the same control as when flying a flybarless helicopter with a standard 3-axis gyro. Without the automation, 'manual' mode is more difficult to master, but it allows an experienced RC pilot to achieve more aggressive

and extreme maneuvers. You can find some impressive videos of users who have tuned their Phantoms in order to do amazing flight tricks.

The Phantom also has two choices for operating with IOC (Intelligent Orientation Control). When 'course lock' IOC is activated, the Phantom records the orientation of the nose at the time of activation and uses it to lock the relative position accordingly. Thus, pushing the stick forward and backward remains aligned with the locked vector and right/left move relative to that heading.

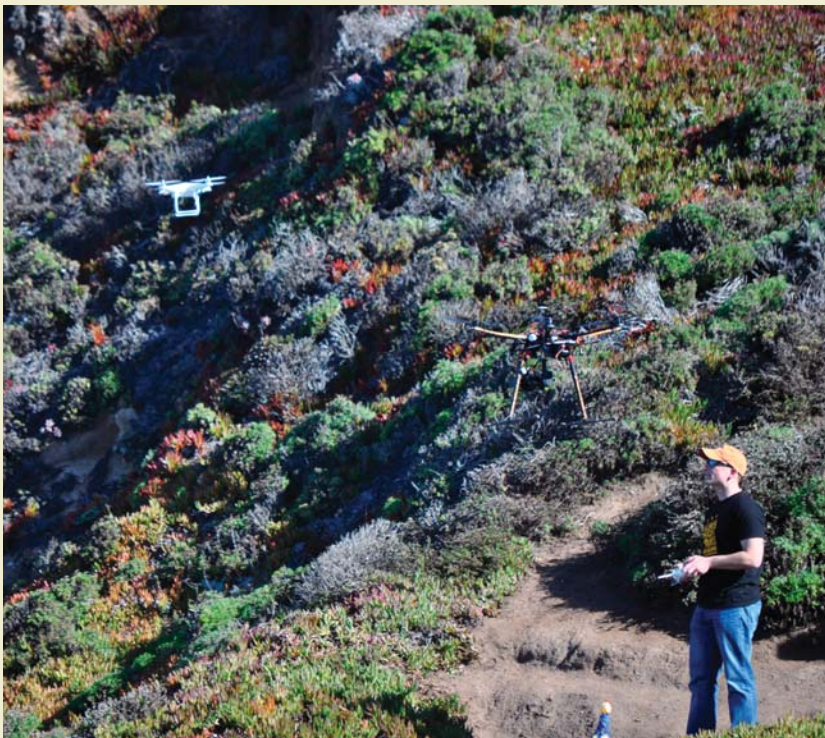
The 'home lock' IOC uses an imaginary line from the pilot to the Phantom for orientation. Thus, no matter which direction the nose is pointed, pushing the stick causes the Phantom to move away from or toward the pilot and the left/right movement is similarly constrained so that it will orbit around you. This feature is a boon for inexperienced

pilots, or even more experienced ones who temporarily lose orientation visually. By activating 'home lock' IOC, pulling the stick back will always return the Phantom toward you regardless of the direction it is pointing.

With regard to orientation, the Phantom does have bright LEDs in orange and green on the arms that are useful for keeping track of the direction the nose is pointing. Furthermore, when the craft is pointed nose-away, a large flashing status LED provides a visual status of flight mode, GPS lock and also low voltage warnings.

The default settings for the Phantom provide two levels of voltage protection. When the LiPo drains to about 45-percent a red flash appears. If you continue flying until the second level is reached, the Phantom will begin descending and attempt to land wherever it is. Needless to say, pilots are advised to pay attention to the first warning and, in fact, you can set your own specific voltage parameters for this feature by using the NAZA Assistant software.

Perhaps the biggest accolade the Phantom commonly gets is its stability in flight while using the GPS and ATTI modes. Indeed, I am always impressed with how well the Phantom holds position in GPS mode even with moderate wind gusts present. Most owners of heavy lift multi-rotors find that considerable tuning of the gains is necessary to achieve GPS hold comparable to what most Phantoms exhibit using the factory settings.





NAZA Assistant: Fail-Safe settings.



NAZA Assistant: Intelligent Orientation Control.

discussion in the Phantom community. Perusing the online communities such as RCGroups.com will give you a wide range of possible ways to improve AP footage from the Phantom and you can find innumerable YouTube videos that show the results people have achieved.

Some of the anti-vibration techniques are as simple as rubber dampers or prop/motor balancing, while others are as complex as two and three axis motorized camera gimbals for the Phantom. Indeed, a whole community has arisen devoted to the joys of improving, modifying and tuning the DJI Phantom.

Probably the most popular area of interest for Phantom owners involves converting the little quad for use as an FPV (First



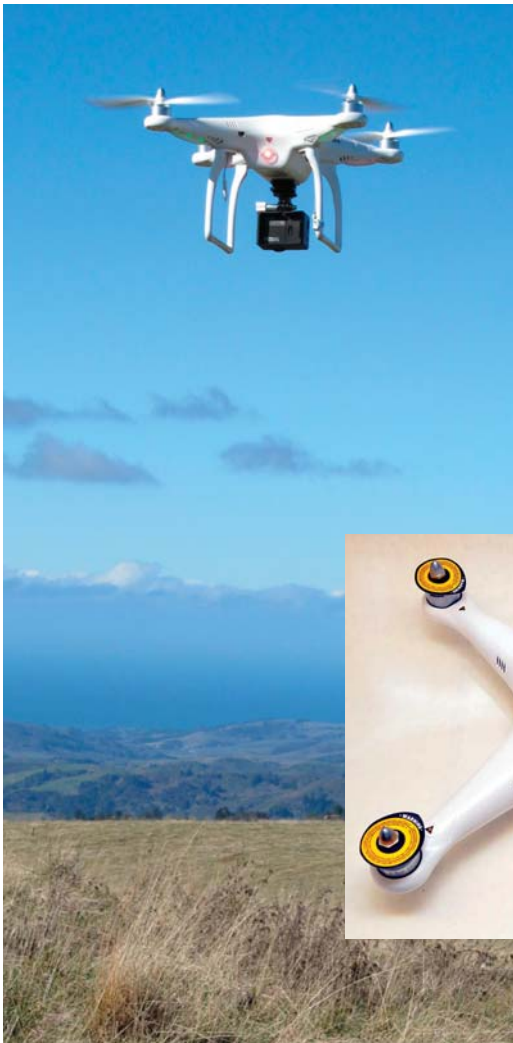
Person View) platform. DJI-Innovations apparently anticipated that owners might be interested in these types of modifications since they included a set of auxiliary power leads inside the body of the Phantom for users to be able to easily add additional components. A miniature video transmitter is easily fitted inside the body shell and, since GoPro cameras have a live-video feed option, adding the transmitter is all that is needed to have an FPV-ready multi-rotor. I've set up several FPV PHANTOMS using both the GoPro as camera source and also using the miniature pinhole cameras that have long been the staple of the FPV community. So far I've found the small 5.8GHz STINGER transmitters built by Iftron Technologies (www.IftronTech.com) to work best inside the Phantom.

THE LAST WORD

I predict the DJI Phantom is going to be responsible for more people entering the



Body shell and landing gear.



PRO TIPS

- Performance of the PHANTOM is all about weight. Published specs call for a maximum takeoff weight of 1000 grams. The more weight you can shave off of that total will result in much more responsive flight performance.

- he first and usually most effective reduction of vibration in the PHANTOM can be achieved by balancing the motors/props. This will make a huge difference in eliminating "Jello" in your GoPro footage.

- You can add a bigger battery to achieve longer flight times. However, you'll have to mount the battery under the body since the battery compartment will only accept 2200mAh LiPos. Be aware that more weight will make your PHANTOM sluggish! I was able to get almost 22 minutes of flight time using a 5000mAh LiPo but it put my weight 55 grams over the takeoff limit. Not surprisingly, the PHANTOM was much more sluggish to fly at that weight, but it does show how you can extend flight times.

multi-rotor field than any other factor over the course of the next twelve months. In that sense, it is a true game-changer for the RC community because of the number of new pilots it introduces to the hobby.

Of course, like all things, there are positives and negatives to contend with. We already face restrictive legislation and administrative rules due to public concern over privacy and safety related to the dreaded "drone" invasion the press loves to discuss. More inexperienced pilots will risk more boneheaded actions that can damage the public perception of RC operations.

Nevertheless, the Phantom represents a huge opportunity to acquaint more people with the wonderful potential of RC flying. Moreover, it provides a cost-effective and very efficient means for experienced RC pilots to dip their toes into the multi-rotor universe. ☺

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For more information, please see our source guide on page XX.