



**Your guide to getting
started with Airineers**



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Introduction

What is it all about?

Airineers Micro class requires students to design and build their own Micro Drone to compete in several different challenges. The manufacturing techniques that students choose to use are completely up to them. It could be 3D printed, laser cut, handmade, or something else entirely.

The Challenges

The Micro Class includes two independent challenges:

Head to Head and **Capture the Flag**.

Head to Head is a race between two teams around a course marked out by a series of gates. The team who finishes the required number of laps first is the winner.

Capture The Flag is a team game where two teams work together to capture more flags than their opponent. The teams can also get bonus points for landing their drones on the landing pads before the match ends.

What do I need to get started?

- An Airineers Micro Drone Component Kit
- Batteries and chargers
- Transmitter

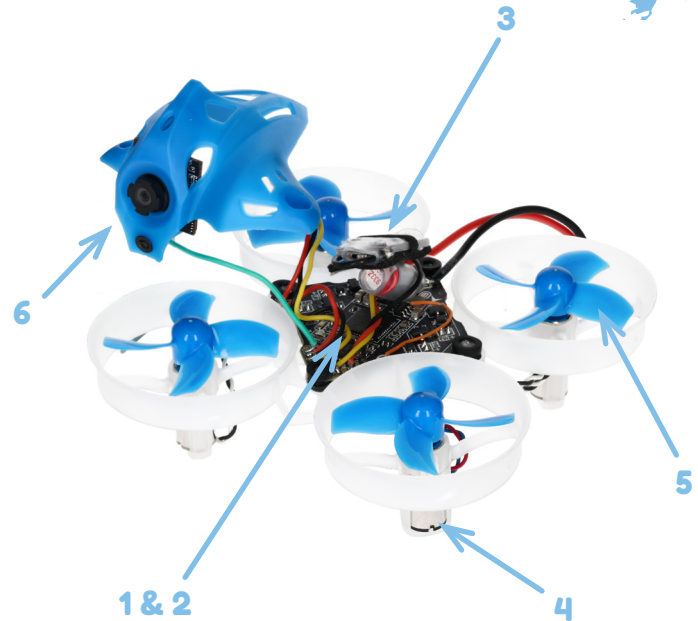
Airineers can supply everything that is required through Rapid Education. Several starter kits are available, plus any spare parts you could require if anything gets damaged.

Visit www.rapidonline.com/education to purchase.

What is a micro drone?

A Micro Drone is a small quad-copter designed for indoor use. A Micro Drone is made up of many key components:

- 1 An Electronic Speed Controller (ESC):** The ESC takes a signal from the Flight Controller and converts it to voltage to control the speed of the motors.
- 2 Flight Controller (FC):** The brain of the drone. It has accelerometer and gyroscope sensors that detect the movement of the drone. This data integrates the inputs from the pilot and the flight controller, which will work out the signals needed to be sent to each motor.
- 3 Receiver (RX):** Receives data from the pilot's transmitter using the 2.4GHz frequency. This data is passed to the flight controller for processing.
- 4 Motor:** Four motors are used and are connected directly to each of the propellers.
- 5 Propeller:** Four propellers are used to provide thrust which moves the drone.
- 6 Camera:** The camera is the eyes of the drone; this is what you see through when flying in FPV (first-person view). The camera transmits the image to the FPV goggles through a set radio frequency.



Components required to get started



Pre soldered
Boards

			BOARD ONLY	ASSEMBLED	COMPONENT	BRONZE	SILVER	GOLD	SQUADRON
Flight Controller (70-1422)	70-1421	70-1420	✓	✓	✓	✓	✓	✓	✓ (x4)
Receiver (70-1424)			✓	✓	✓	✓	✓	✓	✓ (x4)
Camera (70-1423)			✓	✓	✓		✓	✓	
Propellers (70-1426)				✓	✓	✓	✓	✓	✓ (x4)
Propeller tool (70-1431)						✓	✓	✓	
Motors (2x 70-1428 and 2x 70-1429)				✓	✓	✓	✓	✓	✓ (x4)
Fixing kit (70-1427)				✓		✓	✓	✓	
Frame (70-1425)				✓		✓	✓	✓	
Canopy (70-1434)				✓		✓	✓	✓	
Battery (70-1432)					✓	✓ (x3)	✓ (x3)	✓ (x3)	✓ (x4)
Battery charger (70-1433)					✓	✓	✓	✓	✓ (x4)
Transmitter (70-1158)						✓	✓	✓	✓ (x4)
FPV goggles (70-1157)								✓	
Replacement battery tails (70-1430)									
Order code			70-1420	70-1435	70-1445	70-1415	70-1416	70-1417	70-1418

Components required to get started

Transmitter (TX)

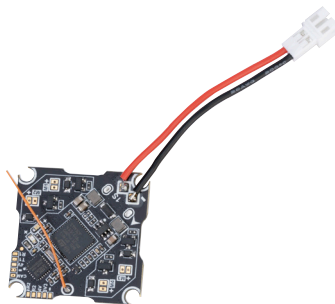
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- 2.4GHz controller for your Airginners drones
- Can be paired with up to 5 drones/ RC devices
- Can be used with other receivers that support FLYSKY
- FLYSKY receiver (RX) included for use on bigger drones and robotics etc.
- Requires 4x AA batteries

Flight Controller (FC)

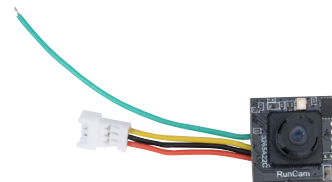
Order code 70-1422



- The "brain" of your drone
- It has a built-in Gyro and accelerometer
- FC can be brought pre-soldered with an external receiver (70-1421) or a receiver and a nano camera (70-1423), qualifying use with FPV goggles

Nano Camera

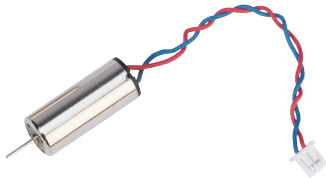
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- This camera mounts to your drone for first-person view (FPV) using any FPV goggles
- Features on-screen display (OSD) so that while you fly, you can check your flight time, battery life and flight mode, etc.
- Can be used with any FPV drone goggles

Components required to get started

Motors



- 2x Clockwise (CW) - red/blue wires (70-1428)
- 2x Counter-clockwise (CCW) - white/black (70-1429)
- 716-size microdrone motor
- 66880 RPM

NOTE: *The faster the RPM, the faster the drone goes. However, it will be less controllable, and the flight time will be reduced.*

Propeller Tool

Order code 70-1431



- Removes propellers without damaging them
- Reverse side of the tool is used to push the motors safely into the frame

Drone Battery

Order code 70-1432



- Generic PH2.0 micro drone connection
- 250mAh, roughly about 3.5 minute flight time
- Lightweight for agile flying

How the drone works

Motors and Propellers

The drone has counter-rotating propellers, two go clockwise, and two go counterclockwise

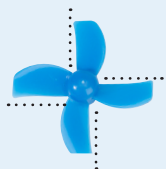
The clockwise and counterclockwise motors and propellers are different:

Motors

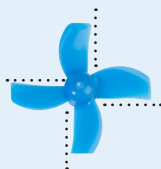
Clockwise (CW) - wire colour is red and blue

Counterclockwise (CCW) - wire colour is black and white

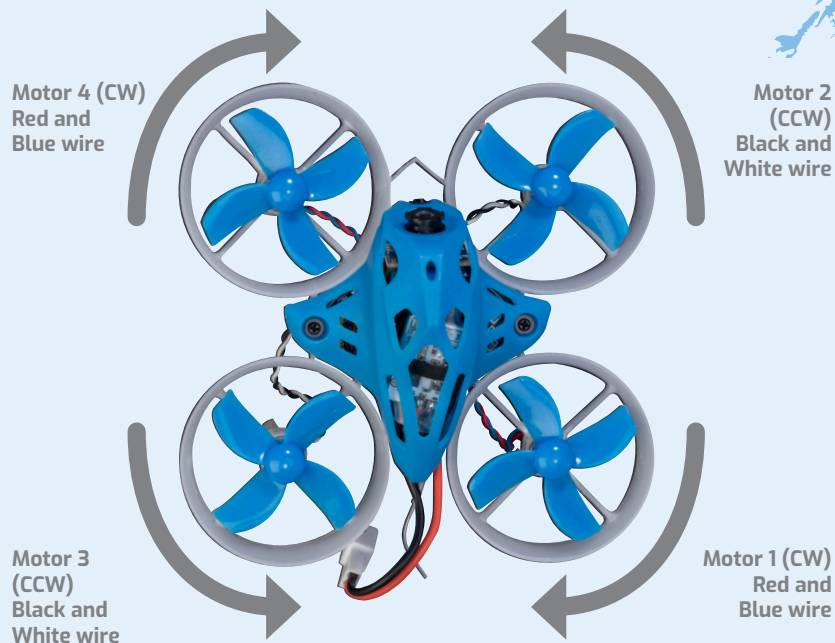
Propellers



Clockwise (CW)



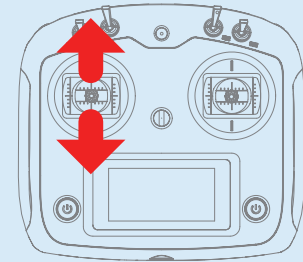
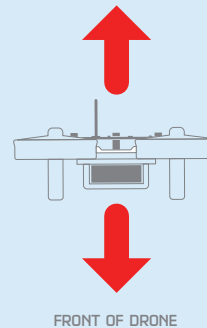
Counterclockwise (CCW)



How the drone works

Movement - Throttle

To go straight up, all 4 propellers must provide the same amount of thrust



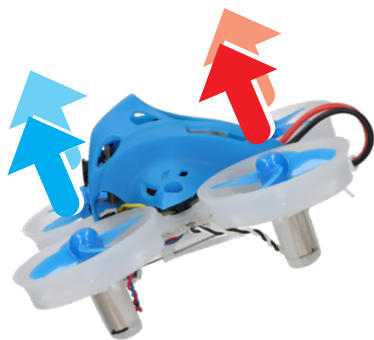
THROTTLE

The left stick on your transmitter is also the throttle. The throttle gives the propellers on your drone enough power to get airborne. When flying, you will have the throttle engaged constantly.

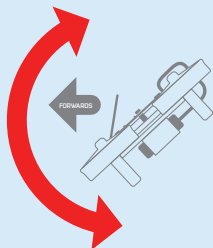
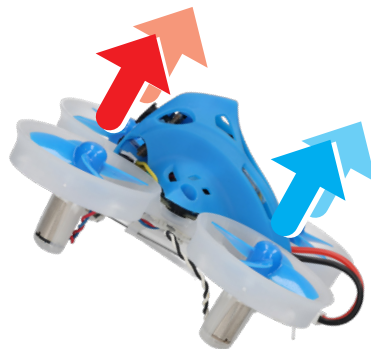
How the drone works

Movement - Pitch

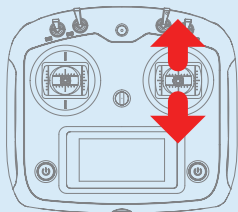
To travel forwards (pitch forwards), the rear propellers need to provide more thrust than the front ones



To travel backwards (pitch backwards), the front propellers need to provide more thrust than the rear ones



SIDE OF DRONE



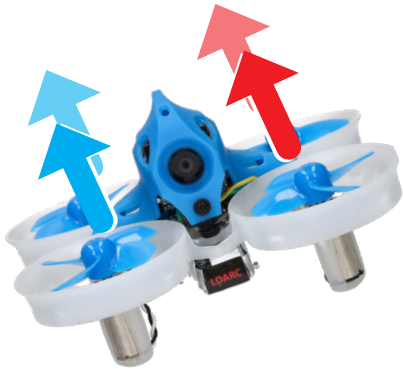
PITCH

You can tilt your drone forwards or backwards by pushing the right stick on the transmitter ... yes, you guessed it, forwards or backwards.

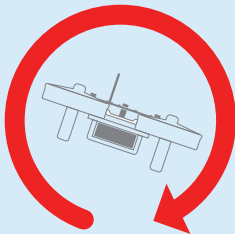
How the drone works

Movement - Roll

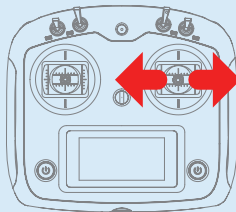
To travel right (bank right), the left propellers need to provide more thrust than the right ones



To travel left (bank left), the right propellers need to provide more thrust than the left ones



FRONT OF DRONE



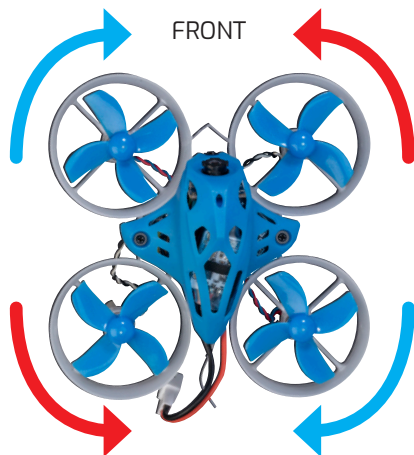
ROLL

Pushing the right stick on your transmitter from side to side moves the drone right and left on its horizontal axis, causing it to "roll." However, it does not cause the drone to change its altitude position.

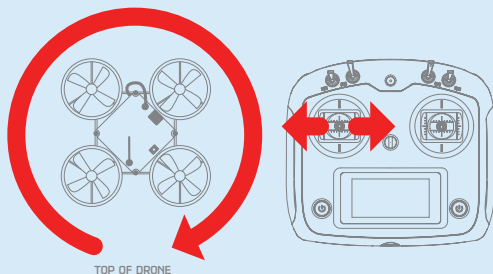
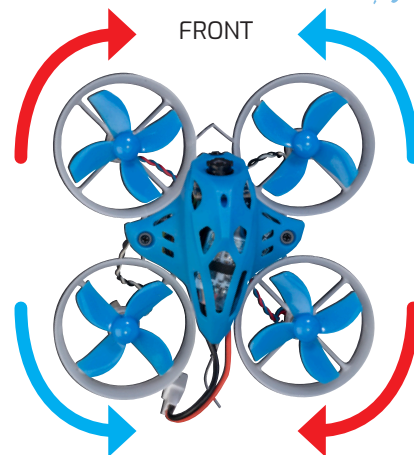
How the drone works

Movement - Yaw

To rotate left (yaw left), the counter-clockwise propellers need to spin faster than the clockwise ones



To rotate right (yaw right), the clockwise propellers need to spin faster than the counter-clockwise ones



YAW

Yaw rotates the drone clockwise (to the right) or anticlockwise (to the left). You achieve this by moving the left hand stick of your transmitter from side to side.

Health & safety

Drone Safety

Flying drones is a perfectly safe hobby but it is important to adhere to a few rules to ensure that you not only stay safe, but you also stay legal.

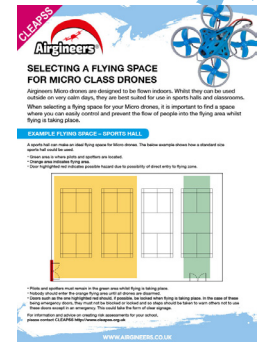
In recent times, there has been a significant amount of bad press surrounding drone usage and these cases always come down to pilots doing things that they shouldn't. At Airgineers, we are advocates of safe and legal drone usage. It is your responsibility to ensure that you are operating your drone in a safe and legal manner so take the time to familiarise yourself with the basic rules.

We have produced a number of documents to help teams taking part in the Airgameers competition to understand the safe use of drones.

Selecting a Flying Space

Micro Class drones can be flown in almost any indoor space. Following the steps in this guide will help you choose a safe area.

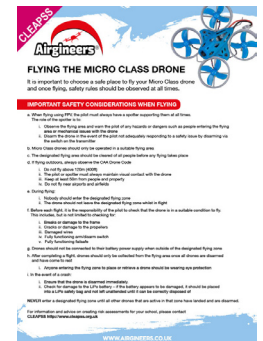
Download your Selecting a Flying Space data sheet **here**.



Flying the Micro Class Drone

Once you have a suitable space for flying, this document has advice for staying safe.

Download your Flying the Micro Class Drone data sheet **here**.



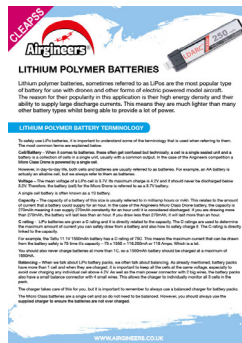
Health & safety

Lithium Polymer (LiPo) Battery Safety

LiPo batteries are used on racing drones because they are light and for their size and weight, they can store a large amount of energy. They can also be discharged very quickly which is important when powering lots of electric motors. This document has information on how LiPo battery terminology and how to use them safely.

- When charging or storing your LiPo batteries, make sure the battery pack is in a fireproof LiPo safety bag
- Only charge your batteries with a proper LiPo battery charger with a "balanced charging" facility
- Never leave batteries unattended whilst charging
- Set the low battery warning alarm on your drone as detailed in our instructional videos. Do not continue to fly longer than necessary once the alarm is sounding

Download your Lithium Polymer Battery (LiPo) Safety data sheet **here**.



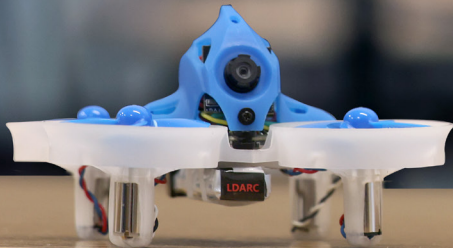
CLEAPSS

If you require any advice on any aspect of Health and Safety, contact CLEAPSS
www.cleapss.org.uk

CLEAPSS has been working with schools for over 50 years to help facilitate the safe use of practical activities. If you require any advice on the safe use of any aspect of the Airineers competition including 3D printing, soldering, use of hand tools or for advice on creating risk assessments, contact CLEAPSS.

VR02 FPV Goggles

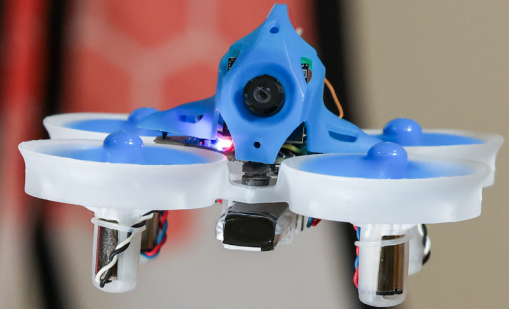
Order code 70-1157



Competition

Head to Head racing

- Race head to head against another pilot
- Follow a course made up of gates and flags
- The winner is the first pilot to complete the required number of laps
- Receive 10 points for winning the race
- Receive 2 points for setting the fastest lap in a race
- Courses fit into an area approximately the size of a badminton court
- Practice in almost any room – tables, chairs and boxes make excellent obstacles
- Laser cut your own gates using the files which can be downloaded from **www.airgineers.co.uk/micro-class**



Competition

Capture the Flag

- Played as either 1 vs. 1 or a 2 vs. 2 team game
 - Bump the flags to change the colour
 - 2 points for every large flag in your colour at the end of the match
 - 3 points for every small flag in your colour at the end of the match
 - 1 point for being landed on a pad of your colour when the match ends
 - Maximum of 26 points to be won in a match
 - Playing area is approximately the size of a badminton court
 - Practice in almost any room but halls are idea
 - Make your own flags using Arduino – bill of materials and plans will be available soon
- www.airineers.co.uk/micro-class**



Top Tips

- Practice, practice, practice! It takes time to get good at flying
- Spotters are vital in competition – practice with a spotter to optimise the language and communication used within the team
- Use the injection moulded Micro Drone frame to get practice whilst you are perfecting your 3D printed frame
- Find the optimum combination of lightweight and strong – use the weight tool in Fusion360 to see if you are making improvements before you print
- Find the limits of your 3D printer – how thin can it reliably print?
- Protect the motor wires - hot melt or epoxy as a strain relief
- Experiment with 2 and 4 blade propellers – modify the 4 blade versions
- Test drive the drones, learn from the mistakes & design flaws, practice flying
- Set up your own school competition!

If you have any questions please contact **education@rapidonline.com**