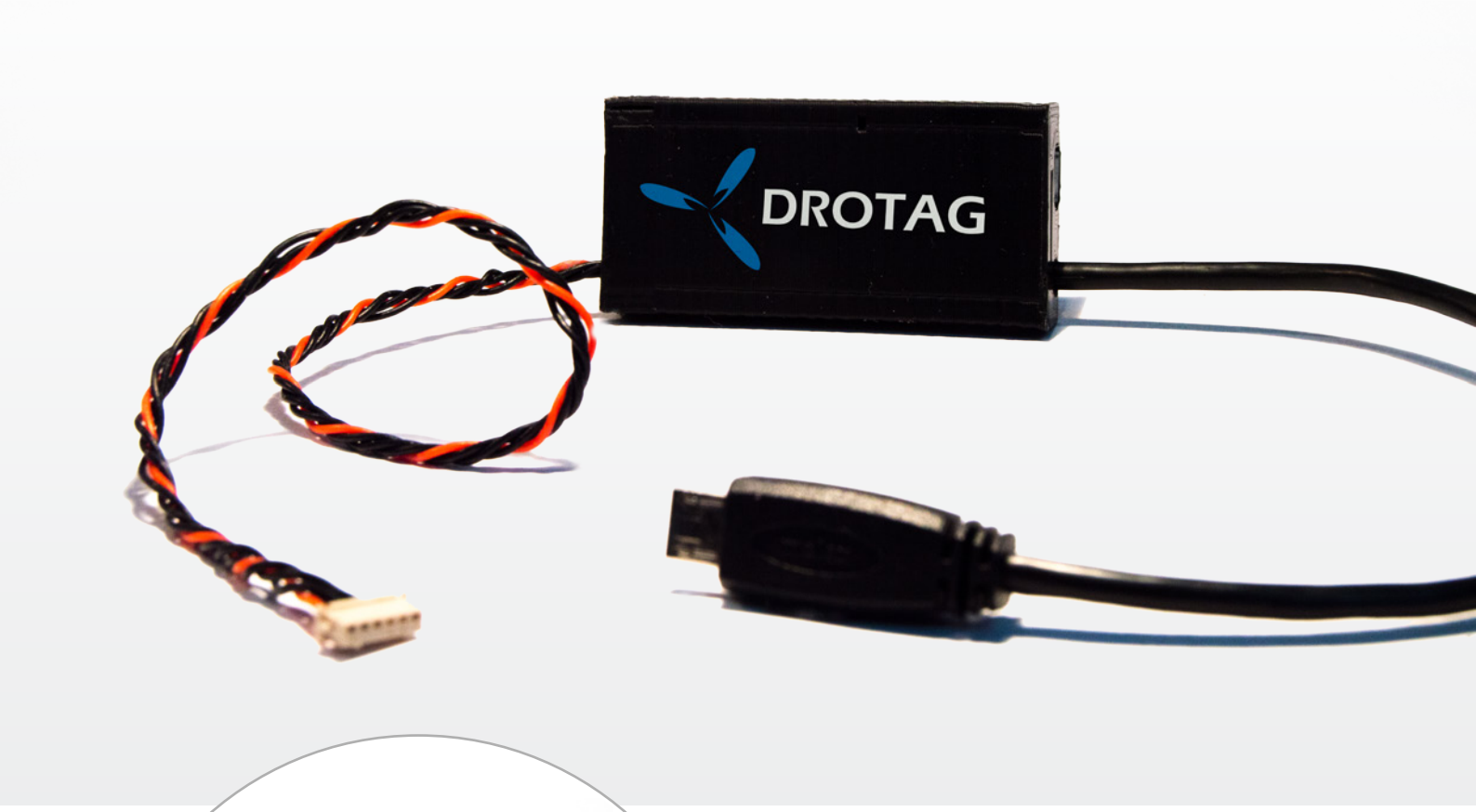
AIRBORNE PROJECTS

Airborne Projects specializes in building drone solutions with emphasis on telemetry gathering and integration with avionics and automatic flight systems.

DROTAG - Sony Alpha Series Image Tagging

Quick Start Guide



DroTag is a small board that simply sits between your **Sony Alpha** Series camera and your **Pixhawk**, allowing you to plan the camera trigger events and have the **pictures taken automatically geo-tagged on the fly**.

Upon landing you only need to take out the card from the DroTag board and the images are immediately available and ready to be visualized/used by your mapping software.

Contents

1 Context

This User Guide's goal is to get **DROTAG** working with your tethering camera and your **APM based Flight Controller** module.

DROTAG is a small board that simply sits between your camera and your Flight Controller (like Pixhawk), allowing you to remote trigger the camera (manual or automatically) and have the taken pictures automatically geo-tagged. Upon landing you only need to take out the microSD card from the DROTAG board and the images are immediately available and ready to be visualized/used by your preferred stitching software.

Currently just the main Sony Alpha Series cameras were tested (A5000, A5100 & A6000), although it is likely that many more tethering capable cameras are supported. Our product is based on *libgphoto2* and it's camera compatibility list can be found in *this link*;

This manual also features an appendix with the cameras tested and any relevant comments.

2 Assumptions

1. The **DROTAG** module is connected to one of the available telemetry output found on your flight controller (Pixhawk/APM/NAVIO/etc);
2. The power to the **DROTAG** is supplied by the autopilot's telemetry port;
3. The **microSD card** that came with your package is inserted in the DROTAG board. Another card with the image supplied by Airborne Projects can also be used;
4. To get the pictures geo-tagged **you need a GPS fix** on your Autopilot. Without it, the camera triggers manually and saves the picture but no additional tags are written;
5. The microSD card image you receive is bound to your **DROTAG** serial number. That means you can use any microSD card you wish but you can only run it on your board. If you would like to run **DROTAG** in another board contact us at *our email*;

3 Package Contents

1. DROTAG board;
2. 16GB Class 10 microSD card loaded with DROTAG software;
3. USB 3.0 microSD card Reader;
4. microSD to SD card Adapter;
5. DROTAG User Guide;
6. An Operation Checklist;

4 Hardware installation

Below you can find a picture illustrating the installation. We point out that good practices are advised regarding fixation of the board. **Boards and Cables should be stowed clear of propellers in a vibration resistant manner.**

4.1 Sony Alpha 5000 Specifics

There are 2 camera settings **DROTAG** can't change automatically, which are important for aerial photography. The tethering setting and the focus mode. In the following instructions you will learn how to make these one-time configurations to your Sony Alpha 5000 Series camera. The procedure for other Sony Alphas are analogous although albeit with slightly different steps than the exemplified below.

4.1.1 Tethering setting

- Turn On the camera;
- Press the **Menu** button;
- Navigate to the **Setup** tile;
- Navigate-right, to page **2**;
- On the **USB Connection** select **PC Remote**;

4.1.2 Focus Mode setting

- Turn On the camera;
- Press the **Menu** button;
- Select **Camera Settings**;
- Go to Page **3** by navigating-right;
- Navigate and select **Focus Mode**;
- Navigate the options available until you find and select one saying **MF**;
- Rotate the lens ring until your camera says it is on ∞.

4.2 Setup your TELEM Port Parameters

This step is required to configure the TELEMETRY Port that you are willing to use your DROTAG board. It only needs to be done once or any time you reset/refactor your parameters.

In the following instructions SERIAL1 prefix corresponds to TELEM1. If you would like to use TELEM2 the applicable parameters are prefixed by SERIAL2. Accordingly, prefix SERIAL4 corresponds to physical port TELEM4/5.

1. Connect your Flight Controller to Mission Planner (or equivalent);
2. Select the **Config/Tuning** tab;
3. Select **Full Parameter Tree**;
4. Find the command node **SERIAL1** and set:
   (a) SERIAL1_BAUD 57
   (b) SERIAL1_PROTOCOL 1
5. Click **Write Params**
6. **Power Cycle your Flight Controller** boar in order to the changes take effect.

5 Preflight Mission Planning

DROTAG relies on APM messages to trigger the camera and add tags to it, so it is worth taking the time to learn how to efficient mission planning. At Airborne Projects we do the planning of the mission and waypoint upload through Mission Planner.

Although planning a mission in Mission Planner or others is outside the scope of this manual there are some details that need to be taken into account. Specifically the **"Photo every (est)"** and the **"Trigger Method"**.

Other parameters and tutorials on Mission Planner can be found on this link. We seriously advise our customers to get comfortable with tutorials as this part of the flight is the only one which is not automated.

5.1 Time Between Pictures or "Photo every (est)"

With the Sony Alpha Series, a full resolution JPEG picture with the advised settings never exceeds the 10 MBytes size. As the **DROTAG** needs to download the picture to process it, the "**Photo every (est)**" parameter **should not be less than 3 seconds**. If the time between triggers in your mission plan is less than 3 seconds some pictures may be missed or triggered out of turn, producing undesirable results. To achieve always the best results, play with your mission parameters in order to achieve more than 3 seconds between photographs.

There are many ways around the **"Photo every (est)"** parameter, each with their own drawbacks. Below, you can find the available approaches in order of best to worse:

1. **Slightly Slower Flight -** Your mission will take longer to fly but all your pictures will be with the desired Ground Resolution (pixel/cm) which is the normal requirement parameter when doing aerial photography.
2. **Higher Altitude -** When flying higher you can sacrifice Ground Resolution to obtain pictures with bigger area covered. With bigger area covered in each picture, the more time you have to take next one. You may hit a hard limit on both the altitude as well as on the Ground Resolution requirements.
3. **Overlap or Sidelap reduction -** It may be possible, due to end use of the collected pictures to reduce the sidelap or overlap of the pictures so that they are less frequent. This increases the time between pictures.

4. **2 passes -** You can program the mission to perform the same flight path twice with a slight offset to get the same overlap at the cost of extended mission time. This option is not available automatically by Mission Planner and needs manually creating the mission waypoints.

5.2 Trigger Method

DROTAG requires the **DO_DIGICAM_CONTROL** Trigger Method in order to trigger the camera shutter. This command should be executed every time a camera trigger is required. When drawing your grid in Mission Planner you should define this command as default and all the trigger messages will be automatically created according to your Survey Grid configuration.

As the actual trigger does not have any mechanical or analog component, there is no need to configure any Servos or Relay pins. It is just simple as that.

If you want to know more about the Trigger Methods you should read this page.

6 Flight Checklist

Included in the **DROTAG** package is a checklist to perform before the flight. This checklist is not mandatory but is a good practice to guarantee that your field work will be flawlessly done.

1. Verify camera and **cables** are secure and **away form the propeller's path**.
2. Verify the **DROTAG** has its microSD card inserted.
3. **Power On the camera** and check battery.
4. (Optional) Make shure that the camera settings are correct.
5. Power On the UAV general power.
6. Wait for GPS Lock.
7. Listen for 2 consecutive camera triggers.
8. The **DROTAG** system is **ready-to-go**! Have a nice flight!

6.1 Flight checklist - Detailed Explanation

1. **Verify camera and cables are secure -** This item is responsible for no damage or loss of equipment. Not getting pictures is bad, destroying your hardware is worse.
2. **Verify the DROTAG has its microSD card inserted -** Without the microSD card inserted the problem is 2-fold. The DROTAG software cannot run and it has no place to store your pictures. End result is: your camera will do nothing.
3. **Power on the camera and check battery -** The camera should be powered before the DROTAG board because the software running will not see any camera available. If the DROTAG board is powered before camera it can be reset and it will try to check the camera again. Powering on the camera is useful to check if there is any error in the camera. The battery check serves as a situational awareness reminder. It is up to the operator to ensure the camera has enough battery to perform the flight.

4. **(Optional) Verify camera settings are correct -** This is optional because the camera settings should not change between flights. You should observer this item if the camera settings were previously changed. Incorrect picture settings can make DROTAG under-perform severely because some settings can cause the camera to have big delays between trigger and picture shooting, blocking DROTAG while flight is carried on normally. Incorrect picture settings can also lead to blurry, dark or white pictures. Standard guidelines to camera settings are given in the appendix.
5. **Power On the UAV general power -** This will power all the system as well as the DROTAG board allowing it to take control of the camera.
6. **Wait for GPS Lock -** The APM needs to acquire a 3D Fix to have a position estimate. The position estimate of APM is what enables coordinates tagging into the picture. The way you check for this event is not the same in all the APM/GPS receivers. On the Pixhawk when the **LED is green** the GPS is locked and this item is passed.
7. **Listen for 2 consecutive camera triggers -** The 2 camera triggers are a way for you to know that DROTAG was able to take control of the camera, trigger it, download the image and write it in the memory card. You can also manually trigger the camera if you have any channel in your Radio bound to the camera action. This manual trigger will also record pictures.
8. **DROTAG System is Ready-to-Go! -** The operator can take-off and start the mission knowing the camera system is working.

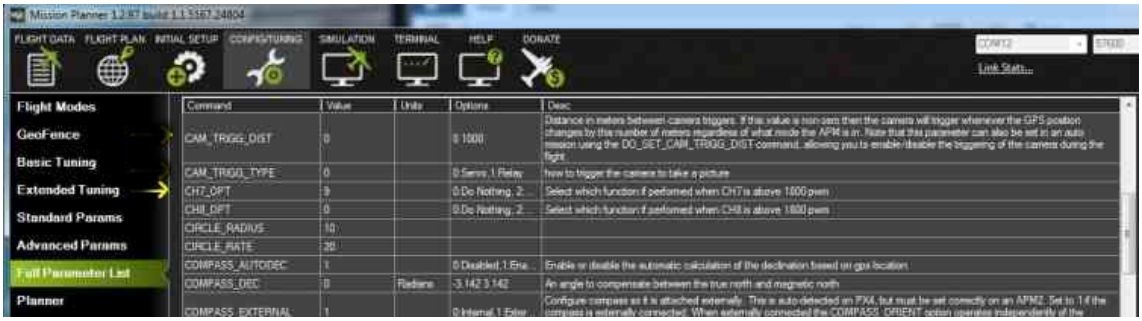
7 In Flight Capabilities

You can only interact with DROTAG in flight by associating an RC channel to Camera trigger. All other interactions are automatically triggered by APM.

7.1 Manual triggering from RC

If you want to manually trigger DROTAG you can configure an RC channel to do it. For this follow the instruction taken from Ardupilot documentation page for example for channel 7:

- Open Mission Planner and then click on CONFIG/TUNING | Full Parameters List;
- Set the value of **CH_OPT** to 9
- Write Parameters and reboot.



The camera should now trigger on channel 7 toggle.

8 After Flight Capabilities

8.1 microSD card care

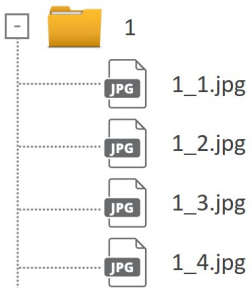
The partition that is visible under Windows and that contains the tagged pictures, also contains hidden boot files necessary for **DROTAG** to boot and start. If you blindly format the card you will also erase this boot files needing to re-image the card, which is a time wasting effort. Reiterating **DO NOT FORMAT THE CARD IN WINDOWS**. If you delete your pictures just delete the directories with single numbers on it's name, although any other files should be hidden. You can find out more in section 8.2.

8.2 File structure

When the Drone has landed the pictures are ready to be used and tagged with the geographical coordinates. The structure of the card is organized by **X/X_Y.jpg**.

- **X** is the directory name. It is a sequential number that increases each power-cycle of DROTAG. DROTAG sequentially checks if the X directory already exists in the root of the microSD card. If it does not exist a new directory is created and pictures will written to it. The prefix of X in the file name also makes the image have a unique file name, making it useful to track the same mission waypoint over different flights.
- **Y** is a sequential number reflecting the number of the picture in a given **DROTAG** power-cycle.

To finalize with an example, take the following scenario: The SD card doesn't have any directory and is connected to the power once, executes a flight of 4 points and returns to base. When the operator takes the card off the **DROTAG** board and inserts it into a card reader, the file structure should be the following:



9 Troubleshooting

9.1 Significant delay in pictures

This happens if the camera was not configured with manual settings. The automatic modes of the cameras always take a certain amount of time find the correct settings. Not only can it take long for the automatic focus to settle but it can also find that long exposure times are adequate. Possible actions are:

1. Follow the recommended setting provided in the appendix.
2. Abnormal behavior. Contact us.

9.2 Display is stuck "Camera USB Connecting"

When this happens it means the DROTAG is correctly booting but not taking over the camera. This may mean that the main program is not running. Possible actions are:

1. View hidden files in the microSD card and try to check if the executable ./telepresence_gstreamer is there. If it is not, you may have inadvertently deleted it. Please contact us.
2. Power cycle the **DROTAG** board and wait 30 seconds. The screen should disappear.

9.3 Display is stuck on "Check Connect Device"

This means the DROTAG did not boot at all even though the USB has power.

1. Verify the card is correctly seated in the DROTAG board.
2. Verify that all the hidden files are present: acme-arietta.dtb, boot.bin, full_gpio.dtb, OPERATION.LOG, wpa_supplicant, zImage. If any of these are not present contact us so we can provide you with the files.

10 Further Information

DROTAG relies on several open source projects. Airborne Projects takes open source licenses very seriously and we have a public repository for the modifications made to the open source projects it relies on, fulfilling the clauses of GNU Public License and Lesser GNU Public License where applicable. We are not a company of lawyers so if we made any licensing mistake let us know so we can correct it as soon as possible.

Appendix A How to update DROTAG's firmware

To update the firmware you just need to contact us through info@airborneprojects.com and request the new application binary. When you receive the application binary just copy it to the root of the microSD card and replace the previous one. Nothing else should be necessary, unless an amend is published in this manual.

Appendix B Camera compatibility

This is not an exhaustive list. It serves as a reference for the cameras we guarantee the DROTAG works with.

Camera Model	Minimum Time Between Pictures	Can Raw
Sony A5000	3 seconds	Yes
Sony A5100	3 seconds	Yes
Sony A6000	3 seconds	Yes

Appendix C DROTAG Camera Configuration

DROTAG has the capability of configuring the camera with specific settings when it starts. It is easy to configure this settings.

Insert the DROTAG microSD card in your computer and inspect it's contents. Look for a file called **AP1.conf** and open it with your favorite text editor. In this file use the search functionality of your editor to find the word called **camera_settings**.

In this file section you will find many common photography parameters. Below is an excerpt of the default settings pre-configured with **DROTAG**.

```
camera_settings:
            {
                iso_speed = "100";
                white_balance = "Automatic"
                exposure_program = "M"
                image_size = "Large"
                focus_mode = "Manual"
                shutter_speed = "1/800"
                flash_mode = "Flash off"
                f_number = 5.0
            }
```

As you can notice all the settings are enclosed with **""(double quotes)** except for the *f_number*. You should keep this formatting otherwise the settings will not work correctly. The possible values depend largely on which camera you are using. You can find how to get possible values for other cameras in the appendix **??**.

In the following section the possible values available for the **Sony Alpha Camera Series** are described.

- **iso_speed -** The sensitivity of the sensor to light. If the sensor is too sensitive to light it will capture noise, or in our case pixels which don't represent any scene data. A low value is desired so that the noise is minimized, but enough sensitivity must remain to ensure the picture does not get "dark". We recommend setting the *iso_speed="320"*.

  Possible values for the ISO Speed of the **Sony Alpha Series** are:

  - 25; 100; 125; 160; 200; 250; 320; 400; 500; 640; 800; 1000; 1250; 1600; 2000; 2500; 3200; 4000; 5000; 6400; 8000; 10000; 12800; 16000; 102400;

- **white_balance -** The white balance is setting that allows to relate how similarly white an object is both in reality and registered in the picture. Sometimes this setting needs to be corrected.

  We recommend setting *white_balance=Automatic*.

  Possible values for the White Balance of the **Sony Alpha Series** are:

  - Automatic; Daylight; Shade; Cloudy; Tungsten; Fluorescent: Warm White; Fluorescent: Cold White; Fluorescent: Day White; Fluorescent: Daylight;

- **exposure_program -** This setting is specific to the camera and is a set of options for exposure control.

  We recommend setting *exposure_program="M"*.

  Possible values for the Exposure Programs of the **Sony Alpha Series** are:

  - Intelligent Auto; Superior Auto; P; A; S; M; Movie; Unknown value 8051; Unknown value 8052; Unknown value 8053; Unknown value 8054; Sweep Panorama; Portrait; Sports Action; Macro; Landscape; Sunset; Night Scene; Hand-held Twilight; Night Portrait; Unknown value 8018;

- **image_size -** The size of the image. This a very general setting that may not be available in all cameras.

  We recommend setting *image_size="Large"*.

  Possible values for the Image Size of the **Sony Alpha Series** are:

  - Large; Medium; Small;

- **shutter_speed -** The time the shutter stays open for a given picture trigger and is measured in fractions of a second. Typically, the shutter speed for usage in drones should be very fast. This makes the pictures look crisp and without motion blur caused by motion of the drone.

  Depending on the lighting conditions we advise *shutter_speed=1/3000*.

  Possible values for the Shutter Speed of the **Sony Alpha Series** are:

  - You can choose any shutter speed provided it has a multiple of 10 in the denominator. A range of tried shutter speeds are *"1/20"* to *"1/3000"*, from slower to faster

- **flash_mode -** Self explanatory flash mode. There are several modes, but for flying purposes *flash_mode* should be "Flash off".

- **f_number -** The ratio of the camera's focal length and the diameter of the lens pupil. It mainly affects picture depth of field, and which objects are in focus. For aerial photography the value should be fixed, either at *5.6* or *8.0*. Note that you can't chose an arbitrary value. It depends on the lens you are using. For more information on available F-Stops consult with this wikipedia page.