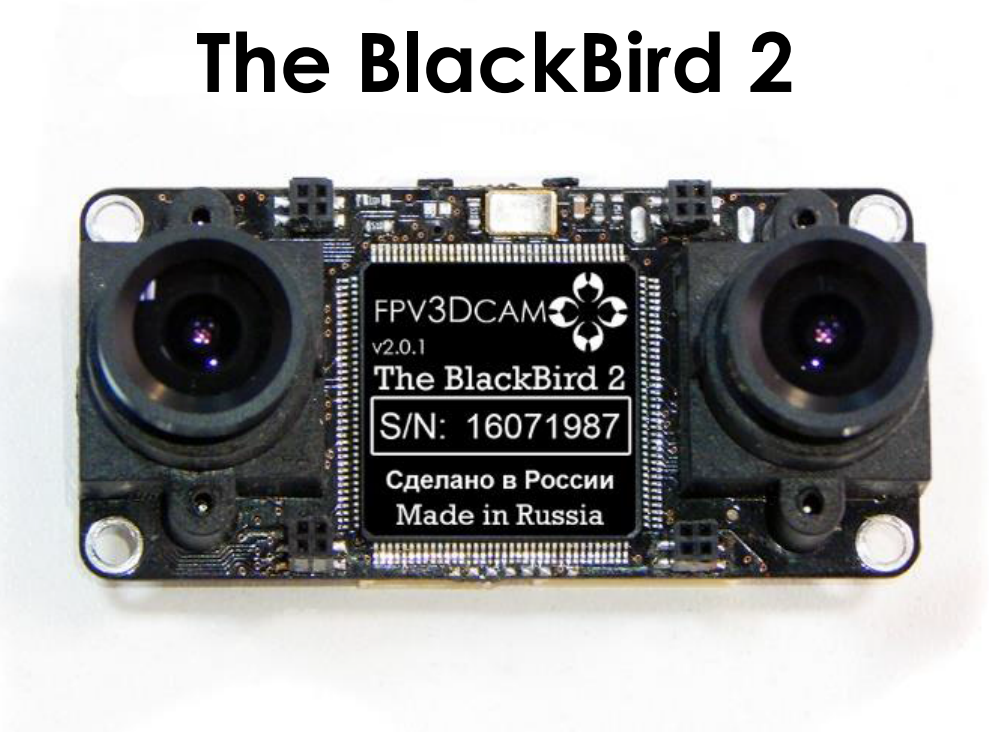
FPV3DCAM

3D FPV camera

The BlackBird 2



User manual

Table of contents

1. Description and Operation

1.1. Product description

The BlackBird camera 2 is designed to generate a video signal in a variety of formats:

- 3D SIDE BY SIDE video – stereo image pair
- INTERLACED 3D - interlaced stereo image
- 3D dual channel video – dual channel mode stereo image
- 2D video - single video image

Through the use of high-quality image sensors and a FPGA chip for video processing, the BlackBird 2 generates a stereoscopic analog video signal in real time (with a delay of less than 1 ms). The small size, support for input supply voltage in the range of 5 to 15V and a large choice of video outputs makes the camera versatile and easy to use.

For wireless transmission of stereo images from the video camera you can use an analog video transmitter[1] or an AV to Wi-Fi converter. Video recording is carried out using a video capture device or video recorder.

Areas of use of the BlackBird 2:

- FPV (first person view) - as a steering camera to a radio-controlled quadrocopter, model airplane or car.
- Video surveillance - as a stereo security video camera.
- A system of computer vision - for stereo image capture and its subsequent processing (i.e. VR).

Only the BlackBird 2 can be used in one of the many applications with a need for a true stereo video signal.

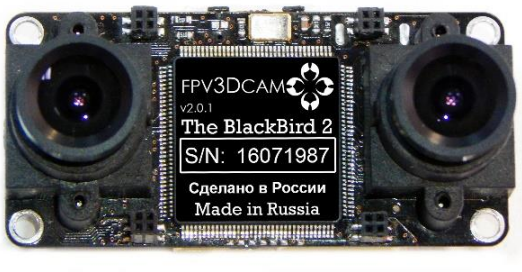
1 The BlackBird 2 can transmit stereo images using one or two analog video transmitters, depending on the size of the stereo image. Recommended frequencies for an analog video transmission are: 5.8GHz, 2.4 GHz, 1.2GHz or 900MHz.

1.2. Specifications

Table 1

Video sensor	
model	Aptina MT9V136
size and type of the matrix	1/4" CMOS
size of the array of pixels	680 x 512
sensitivity	11.9V / Lux- sec @ 550nm
signal / noise ratio	45 dB
Optics	
focal length of the lens	2.5 mm
angle of view (full frame)	80°
thread type	M12 x 1
IR filter on the lens	680 nm (day lens for color cameras)
focus operation	by hand
Video output	
video format	NTSC 525/60
horizontal resolution	550 TVL
video output	75 ohm, scope 1B
Stereo	
stereo base	42 mm
3D formats	•side by side 16:9 clipped •side by side 4:3 clipped • side by side 4:3 • side by side horizontally scaleable •interlaced (Field Sequential 3D 4 : 3)
frame rate for each eye	60 HZ
adjusting the convergence	•by hand, shifting the lens holder •digitally, in the clipped SBS modes
Electrical specifications	
supply voltage	5 V - 15 V
current consumption at 12V	150 mA
power consumption at 5 V	2.2 W
power consumption at 12 V	1.8 W
Type of connectors	
DF13-10P-1.25H	1 piece
10 pin mini USB	1 piece
HsuanMao C4828-04BDGDN0R	4 pieces
Mechanical and performance	
camera weight	23 g
dimensions (LxWxH)	59 x 28 x 27 mm
operating temperature	from -30° C to + 70° C

1.3. Equipment



3D FPV camera BlackBird 2 — 1 part

The lens covers - used to protect the lens from dirt and damage during storage or carrying theBlackBird 2. — 2 parts

Interface cable - connects the BlackBird 2 output to a playback device or to a video transmitter, connection to a power source. — 1 part

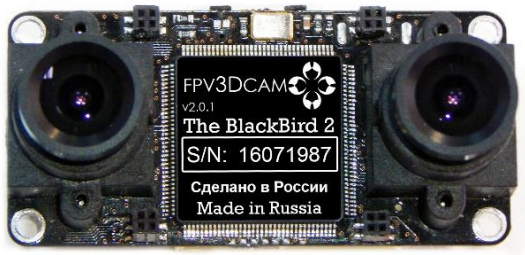
Full cable - allows you to use all the contacts of the connector of the BlackBird 2. — 1 part

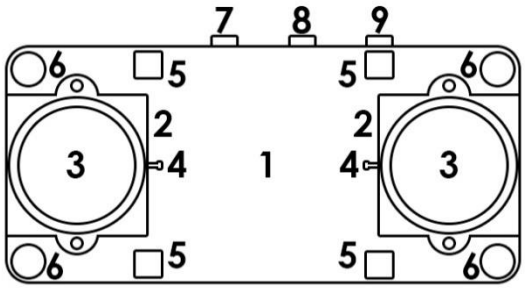
Power Divider - is a branching JST connector to the Li-Po battery. It allows you to connect the BlackBird 2 and a video transmitter to the same power source. — 1 part

1.4. Construction of The BlackBird 2

Design description:

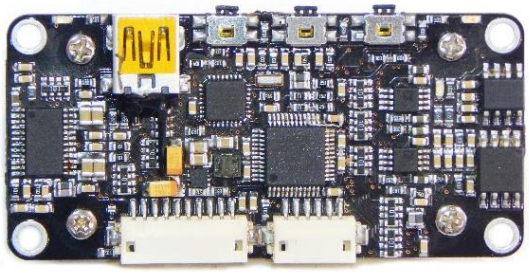
front view

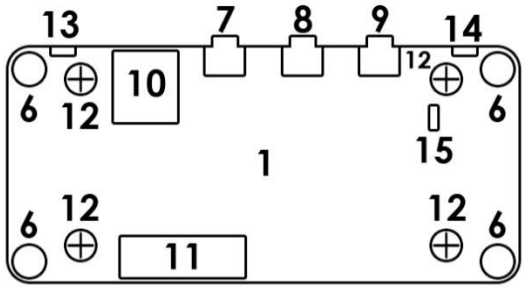




picture 1

back view





picture 2

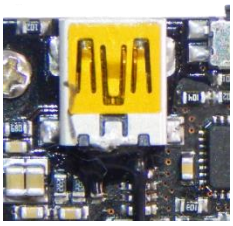
part no.	name	quantity
1	printed circuit board	1 part
2	lens mount	2 parts
3	lens	2 parts
4	lens fixing screw	2 parts
5	modular connector	4 parts
6	mounting hole	4 parts
7	" BACK " button	1 part
8	"MENU" button	1 part
9	" NEXT " button	1 part
10	10 pin miniUSB connector	1 part
11	DF13-10P-1.25H interface	1 part
12	screw fixing the lens holder	4 parts
13	Green LED	1 part
14	Red LED	1 part
15	Green LED	1 part

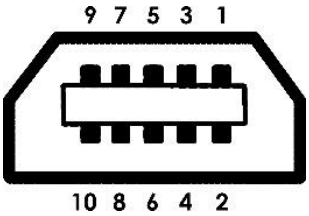
Connector pinout:

DF13-10P-1.25 H

1 pin: --3.3V output for external devices. Current less than 100mA
2 pin: GND
3 pin: MAVLINK RX(UART 3.3V)
4 pin: MAVLINK TX(UART 3.3V)
5 pin: GND
6 pin: +5V...+12V
7 pin: GND
8 pin: 2D video output (right video sensor) CVBS
9 pin: 2D\3D video output CVBS
10 pin: 2D video output (left video sensor) CVBS

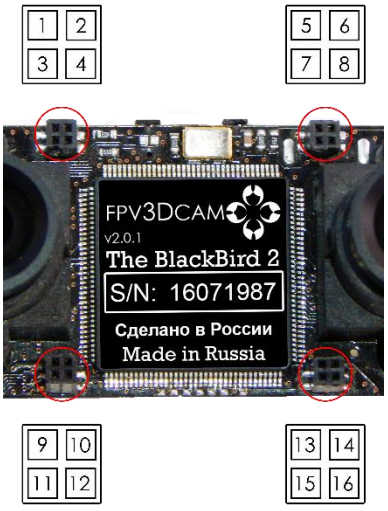
10 pin miniUSB





1 pin:
2 pin: +5V
3 pin:
4 pin: D-
5 pin: video GND
6 pin: D+
7 pin: 2D\3D video output CVBS
8 pin:
9 pin:
10 pin: GND

modular connector



1 pin:
2 pin:
3 pin:
4 pin:
5 pin: GND
6 pin: GND
7 pin: +VIN
8 pin: GND
9 pin: GND
10 pin: +VIN
11 pin: GND
12 pin: GND
13 pin: 2D video output (right video sensor) CVBS
14 pin: 2D\3D video output CVBS
15 pin: GND
16 pin: 2D video output (left video sensor) CVBS

1.5. Design and operation

The BlackBird 2 core consists of two image sensor and an optical system. Low level with image sensors is processed in the FPGA chip, where a signal is required in 3D. Further there is a digital-to-analog conversion and the signal is transmitted to the interface, the modular connector and a mini USB port of your camera.

1.6. Adjustment instruments, tools and accessories

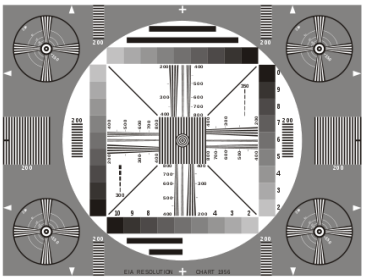
The main tool that is required for camera maintenance - Phillips screwdriver. It is used when setting the vertical displacement and focusing the lenses. You can use it to loosen the screws that hold the lenses and their holders.
Optional accessories:

- Pencil for cleaning lenses. It is used to clean the lenses from contamination (see Figure 3). The flat side of the stick used for cleaning the lens from dirt.
  A brush is used to clean the dust from the lenses.

- A special table is used for measuring the resolution of the instrument. For example, EIA1956 or others authorised for at least 600 TVL (see Figure 4).

Figure 3

Figure 4



2. Intended use

2.1. Operating limitations

- The camera operating temperature ranges from - 30 to +70 degrees Celsius. If the use at different temperatures is planned, it is necessary to arrange extra cooling or heating to provide the allowed temperature.

- The BlackBird 2 comes in a frameless design and is not protected against moisture. Protection class IP50 sensors, protection class IP00 for the other components. For use in a moist environment it must be protected from moisture;
- The BlackBird 2 is not protected against static electricity. When working with the BlackBird 2 it is neccessary to take measures to protect your camera from static electricity;
- When operating the BlackBird 2 it is possible that the camera heats up to a temperature of about 50 degrees Celsius.

2.2. Preparing for use

Connect video and power

Before you begin, you need to connect the 2 BlackBird output to a video playback device or a video transmitter[2] and also to a power source. To do this, connect the interface cable or a preconfigured full cable to the interface connector of the BlackBird 2. The yellow RCA connector of the interface cable is connected to the playback device or a video transmitter. The red JST connector of the interface cable is to be connected to the 2S or 3S Li-Po battery or another power source. If everything is connected correctly, the camera should light up the LEDs and the video monitor / stereo eyepieces connected to the camera should display the live video of the BlackBird 2.

Do not connect the video output jack to the audio input. Usually this RCA red or white jacks. It does not cause damage, but the image on the monitor / stereo eyepieces will not show.

As power for the camera it is permissible to use an external DC power source with a voltage of 5 to 15V. The sources to be used can be:

- From 4 to 9 batteries with a voltage (1.5V) connected in series;
- From 5 to 9 batteries NiMH, NiCd (1.2V) connected in series;
- From 2 to 3 batteries LiIon, LiPo (3.6V) connected in series;
- 1 lead battery with a voltage of 6 to 12V;
- A stabilized DC power supply with a voltage of 5 to 15 V and a current of 150 mA.

Additionally, the power supply is connected to the **red** wire of the interface cable and to the negative **black** wire of the interface cable.

Attention! Observe that the polarity to the power supply connections are correct. Connection of the power supply to the video output, or failure to comply with the polarity will damage the camera!

[2] Under playback device or a video transmitter are understood: video eyepieces, monitors, video transmitters, video capture devices, etc.

Before starting

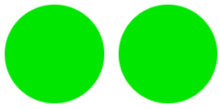
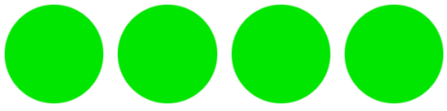
Before using the BlackBird 2 it is recommended:

- check the lens focus settings ..... (item 3.1)
- ensure there is no vertical image shift..... ..... (item 3.2)
- select the outgoing video format..... (item 3.3)
- check the orientation of the image of each eye ..... (item 3.4)
- set the desired metering mode ..... (item 3.5)

2.3. Use of the menue

Adjusted and correctly connected the camera starts to operate immediately after power-up. A lit up green LED 13 (see Figure 2) indicates the power supply is on.

Table 2: Menu

count of fast flashing green LED	name and description of the menu item
	**Selecting video mode** – allows you to select an outgoing video format 1. Side by side 3D crop 16x9 2. Side by side 3D crop 4x3 3. Side by side 3D full frame 4. Side by side 3D manual cropping 5. Interlaced 3D 6. 2D
	**change of right for left** – for swapping the right and left images (switch images).
	**image shift** – this menu item lets you adjust the convergence in SBS crop modes
	**stretch / zoom images horizontally -** serves to adjust the cropping of SBS in manual mode
	**selecting the exposure** – allows you to select one of four modes of light metering 1. Across the frame 2. At the center of the frame 3. In the bottom half of the frame 4. In the upper half of the frame

To change a menu item, use the **«MENU»** button, to change the settings of the menu item use the **«NEXT»** and **«BACK»** buttons.

3. Maintenance and calibration

3.1. Lens focus adjustment

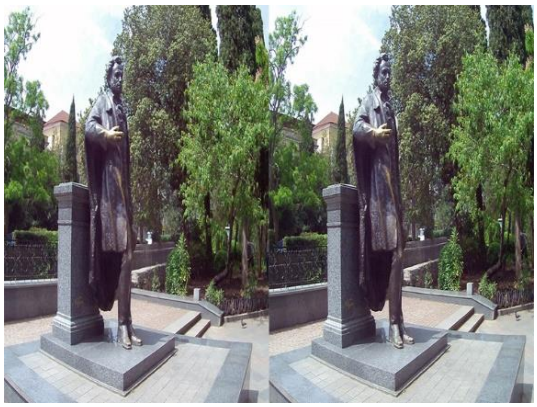
If an image displayed by the BlackBird 2 is blurred, the lenses should be focused

Table 3 Examples of possible lens focus options. Format 3D SIDE BY SIDE.

A blurred image (focusing required)

on the left lens	on the right lens	on both lenses
		

A sharp image on both lenses (focusing not required)



In order to adjust the focus, go through the following steps:

- Connect the BlackBird 2 to a monitor or video eyepieces, connect the BlackBird 2 to a power source;
- Turn off the 3D mode at the monitor / video eyepieces and switch the BlackBird 2 in 3D SIDE BY SIDE mode;
- In the image on the monitor / video eyepieces identify objects in need to be in focus;
- Loosen the screw fixing the lens;
- Turn the lens left or right to obtain a sharp image of the desired range;
- Tighten the lens screw;
- Repeat these steps for the second lens, if necessary.

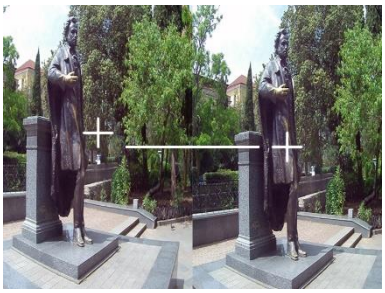
3.2. Adjusting the vertical image shift

A vertical shift of the images will be perceived by the viewer as disconcerting. The presence of vertical displacement can quickly tire the eyes, lead to an incorrect perception of distance and possibly headache.

Table 4: Examples of possible vertical image shift. Format 3D SIDE BY SIDE.

There is vertical shift (requires adjustment)

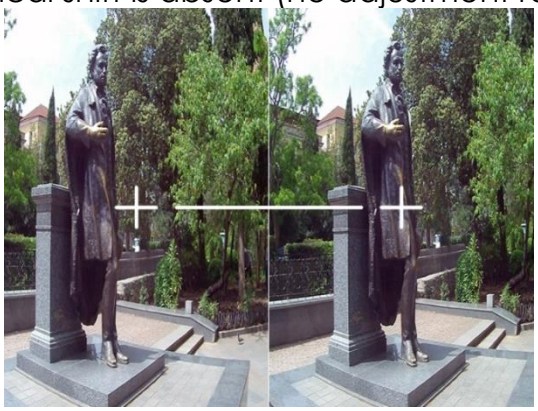
on the left lens



on the right lens

on both lenses

The vertical shift is absent (no adjustment required)



To eliminate the vertical shift, go through the following steps:

- Connect the BlackBird 2 to a monitor or video eyepieces, connect the BlackBird 2 to a power source;
- Turn off the 3D mode at the monitor / video eyepieces and switch the BlackBird 2 in 3D SIDE BY SIDE mode;
- In the image on the monitor / video eyepieces identify objects where adjustment of the vertical shift is neccessary;
- Loosen the screws fixing the lens holder;
- Move the lens holder up or down until the vertical shift is eliminated;
- Secure the lens mount screws;
- After fixing the screws, make sure that there is no more vertical image shift. If necessary, repeat the steps above to resolve the vertical shift.

3.3. Selecting the video format

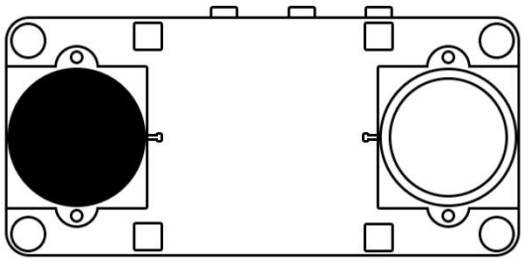
To change the stereo image format, choose the menu item **«**Selecting the video mode**«**[3] and **«**N**EXT»** button or **«BA**CK« to select the desired stereo image format. After selecting wait until the red LED goes out - it will mean that the camera has stored your settings and is ready for use.

3.4. Switch the left and right image from side to side

In order to understand the need to switch the images from side to side or not conduct a little test:

- Close the right lens cover of the 2 BlackBird. Connect the camera to the monitor / video eyepieces, connect the power supply;
- change the video format of the BlackBird 2 to 3D SIDE BY SIDE. Switch the monitor / video eyepieces to 2D mode;
- look at the monitor or video eyepieces - one of the pictures should be dark. If the dark image is on the right side of the screen, ie, indoor lens meets the eye - everything is fine, there is no need to switch images. If the dark picture is on the left side of the screen, it is necessary to switch the images from side to side.

Right lens cover (front view)



we need to switch the images from side to side

do not need to switch the images from side to side

In order to switch the left and right image from side to side press the **«MENU«**[3] button, go to the menu item **«Exchange of right-left«**4 . Click on the button once.

[3] Green LED does one flash
[4] Green LED does two quick flashes

«NEXT« or **«BACK«**. After a wait until the red LED goes out - this means that the camera remembers the settings you made - they are stored in memory for use and after Power Off or a power failure you will not have to adjust them again.

3.5. Selecting the exposure mode

The BlackBird 2 allows you to do ‹in picture› light metering in one of four options:

- The entire frame
- Frame center
- The bottom half of the frame
- The top half of the frame

In order to set the desired setting of light metering with the button **«Menu»** you need to navigate to the menu **«Selecting the exposure»**. Use the **«NEXT«** and **«BACK«** buttons to set the desired metering parameter.

Note: when using the BlackBird 2 in a FPV system, the light metering must be set to **«The bottom half of the frame»** in order to eliminate the ‹black land› phenomenon.

3.6. Possible errors and methods of their elimination