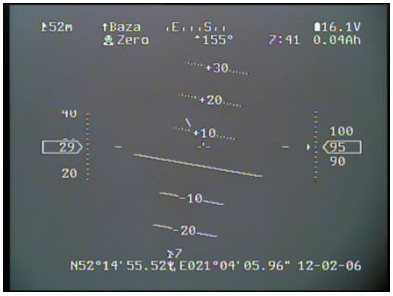
Introduction

The integrated FPV system combines the functionality of an autopilot supporting manual and autonomous piloting of an unmanned aerial vehicle, and OSD (HUD) sending the image from the camera to the ground with navigation information superimposed on the image. Advanced system software ensures high safety and comfort of flights, as well as adaptation to the specificity of the model and user preferences.

NOTE: The FPV system version 4.x is designed for fixed wing aircrafts only and does not support multi-rotor vehicles









NOTE:
For the latest information, software updates, new languages please refer to the website shown in the footer of this manual.

Features of the OSD

The device you have purchased contains many innovative solutions that we have created to make its operation as simple and intuitive as possible, and at the same time it offers maximum functionality and usability:

- **Integrated autopilot and OSD** – Simplifies and accelerates installation and commissioning of the system, guarantees trouble-free configuration and operation of the system in all conditions, and increases its reliability. The integrated on-screen menu allows you to fully configure the entire system and change its parameters also during the flight.
- **Control of aircraft models** - the system enables the control of aircraft models in various configurations, including flying wings, and aircraft with a V-tail, and twin-engine aircraft with differential gas. The built-in setup wizard allows you to quickly and conveniently copy the existing model settings from the RC transmitter to the system.
- **Three flight modes** - three flight modes selected with a switch on the apparatus allow for fully manual flight, stabilized flight, and fully autonomous flight that can perform:
    - return to the starting point,
    - continuation of the flight in the selected direction and altitude
    - circling over the GPS point
    - flight to a specific GPS point
    - flight on one of the 9 predefined routes
    - automatic landing

- **Two cameras** - the system supports up to two cameras, the signal from which can be switched during the flight by a switch on the RC apparatus. Both cameras must work in the same vision system (PAL or NTSC)
- **Clear form of visualization** - fully graphic presentation of navigation elements allows for unambiguous visualization of flight parameters (e.g. horizon position, speed, geographical location) in an attractive and clear way, similar to that presented in professional civil or military aviation devices.
- **4 screen compositions** - fully configurable by the user according to his preferences, with the option of hiding/presenting some information during the flight. Each element can present data using two font sizes.
- **Picture standards** - OSD supports PAL and NTSC standards. After the loss of the signal from the camera (disconnection or discharge of the battery), the OSD continues to generate the video image, allowing you to complete the instrument flight.
- **Integration with HD video systems** - The system supports the MSP Displayport protocol, allowing integration with compatible HD video systems, such as Walksnail Avatar, HDzero or DJI, copying navigation information from the built-in OSD to the HD system screen, and presenting a full on-screen menu and thus thus allowing full system configuration without the need for an additional low-resolution video transmission system (PAL/NTSC).
- **Multilingual menu** - Built-in on-screen menu for configuration and OSD settings. OSD has been equipped with the ability to choose one of the 4 basic languages: Polish, German, English and French, as well as the ability to upload your own, any language version of the menu.
- **Help** - The on-screen menu has a unique ability to activate the hint system for the function selected in the menu, minimizing the

possibility of incorrect selection of settings, and making the system operation simple and intuitive.

- **Remote Menu control** - OSD menu options are operated using the RC receiver channel (on the ground and in autonomous flight mode also using the elevator stick and ailerons).
- **Measurement Units** - Information on the screen can be presented in both SI (metric) and imperial (feet, yards, miles) units.

- **Telemetry data** - the system transmits telemetry data encoded in the video signal, enabling monitoring on the ground of the status of the basic elements of the FPV system, and controlling the directional receiving antenna (tracking antenna).
- **Configuration and update from PC** - Configuration of screen layouts and software update is done from a PC with Windows system, via the USB port. The software does not require installation or special drivers.
- **System Flexibility** - Configurable UART communication port allows you to generate telemetry data in various formats (including mavlink and MSP), enabling easy integration with third-party devices.
- **Additional devices** - The system is equipped with a set of additional connectors that allow you to connect and configure additional sensors, such as temperature and air velocity.
- **BuddyFlight** – an additional radio modem connected to the OSD allows you to monitor the position of other flying models equipped with the Pitlab system. Thanks to this, it is possible to avoid collisions, as well as to perform joint flights and video recordings of synchronous flights.

Complete set of FPV according to your needs

Complete installation for live model image monitoring requires the presence of the elements making up the system of transmission and reception of video from on-board cameras, and additional measuring devices. The complete set includes:

Video camera	Color or black and white, in either PAL or NTSC (System does not support HD, and SECAM). System supports two cameras (e.g. front and rear) and allows switching between them during flight
AV transmitter	For transmiting video and audio. The market offers transmitters for the frequency of 1.2 GHz, 2.4 GHz and 5.8 GHz. The higher the frequency, the smaller the antenna, however, the channel is less resistant to the phenomenon of radio transmission interference. The 2.4 GHz band is often used to control models and there may be a conflict between the video transmitter and RC receiver, resulting in a small range of control and interference in the video system.
TX AV antenna	Supplied with the transmitter rod omnidirectional antenna. It is sufficient for not too distant flight, however, it is often heavy. "inverted V" or "ground plane" are alternative types of antennas, they are possible for making on your own.
AV receiver	It is usually included with the AV transmitter and antennas. Multi-channel AV kit allows you to choose the best channel in the given conditions and when there are several flights at once.

Rx AV antenna	Supplied with AV receiver as omnidirectional rod antenna. In order to increase the range of the video link, directional panel antennas or "biquad" with a much bigger gain are used. The advantage of the directional antenna over omnidirectional is reflected in a much greater sensitivity. This antenna has to aim at a model and the higher the accuracy the greater the gain.
Displaying device	Monitor screen or goggles with built-in displays. The larger the field of view and resolution of the display the better the image quality. Aspects such as visibility in strong sunlight, power consumption, resistance to poor signal quality (blue screen with a weak signal) are also important.
GPS receiver	With a refresh rate of 1Hz, 5Hz or 10Hz and baud rate of 9600, 19200, 38400 or 57600bps. FPV System supports natively MTK and UBLOX GPS modules. The GPS receiver provides model position data. Courses, altitude and speed of the model are calculated on their basis. Without the GPS receiver that information will not be displayed on the OSD.
Supply battery	System requires DC power supply from UBEC with a value between 5 V and 7V. Separate 12V will supply video transmitter and camera.
Current and voltage probe	It can control the drive battery in electric models (voltage, discharge and current consumption).
Ground station	Including telemetry signal receiver, tracking antenna controller, video diversity selecting the best signal from one of the two video inputs, video output signal splitter and flight telemetry data logger.

User should manually assemble a radio link for transmitting audio and video. He also has to combine all elements of the OSD system model. OSD board is connected between the camera and the video transmitter.

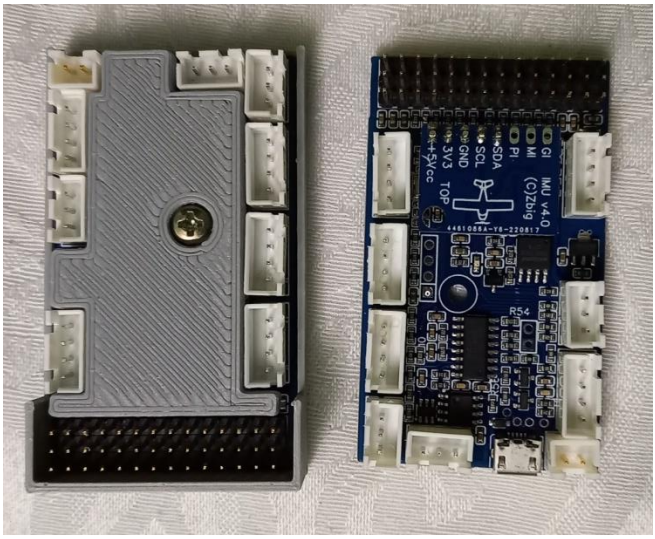
Safety

FPV flight safety depends largely on the reliability of the equipment used and the quality and reliability of the connections between them. Follow the following rules when electrically combining elements of your FPV set:
• Where possible, use solder connections rather than connectors.
• Use high quality connectors to ensure good contact and ones that are difficult to accidental disconnection.
• Use flexible cables with a suitable reserve of length so that they do not disconnect under the influence of stress or vibration during flight.
• Do not use worn or corroded connectors.
• Do not use wires with broken insulation or wires connected to each other by twisting the wires.
• Use colored wires, using the uniform color code (e.g. ground. – black, + supply - red, etc.), use a connector to prevent reverse connection of wires.
• Provide cooling of elements dissipating large amounts of heat (motor controller, video transmitter). Use the elements of a larger load capacity than the expected value during the flight (regulators, BEC stabilizers, servos).

Strictly follow the principle of limited trust. Prior to the flight control performance of all electronic and mechanical systems must be checked.

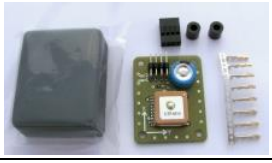
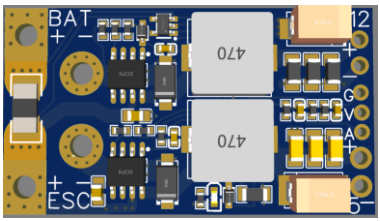
NOTE: *Remember that the reverse connection of power wiring or connecting devices can cause irreversible damage to these items, which are not the basis for the complaint and exchange to new.*

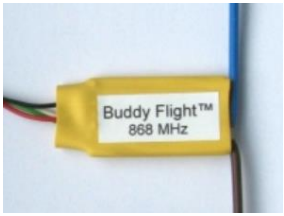
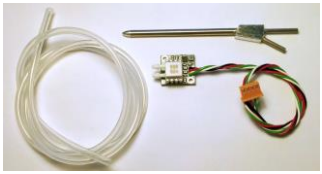
FPV System set content



	Cable to connect the OSD with RC receiver (length 20cm)
	15 cm cable to connect the camera
	Cable to connect the OSD with AV transmitter (length 20cm)
	45 cm cable to connect te OSD to GPS module.

Optional equipment

	GPS receiver module
	OSD current sensor with 20 cm wire. Available sensors: • 26,6A • 33A • 50A
	Power manager with two inverters and a voltage and current sensor: • UBEC 5.3V/4A power supply for the system, RC receiver and servo • 12V/2A converter powering the camera and video transmitter • • 66A current sensor
	Ground station with telemetry receiver, diversity system with AV signal splitter and tracking antenna controller.

	BuddyFlight radiomodel to track other airplanes with FPV System.
	Airspeed sensor with pitot tube and wires.

Navigation information

OSD is a modern navigation device, supporting the pilot during the FPV flight. The imposition of the information on the image of the camera, allows for quick and clear orientation in space, and to define the basic parameters of the flight and on-board equipment. It provides a comfortable flight, improves its safety, facilitates return to the starting point and helps to find a lost model (e.g. in case of loss of control or failure during the flight).

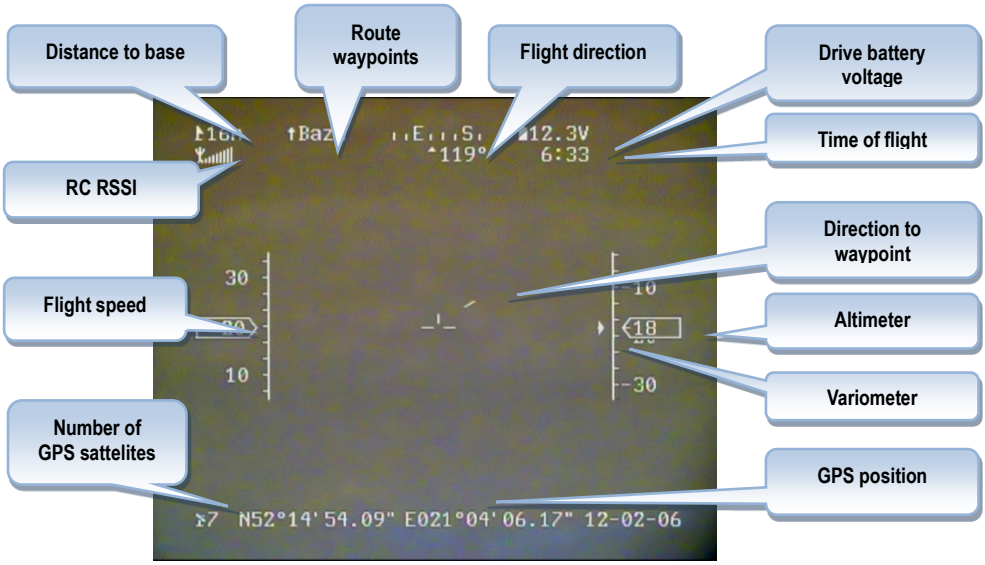


Fig 2: Location on screen and meaning of navigation information.

The list and description of presentation of telemetric data are listed in the table below:

GPS signal	During startup and initialization of the GPS (so-called "catch-and FIX", which usually takes about one minute number and signal strength of individual GPS satellites are presented on the screen. This feature also allows you to diagnose any problems with the GPS signal interference, e.g. by running video or camera transmitter board.
GPS position	Current model GPS position (coordinates) can be displayed on the screen in one of the three commonly used formats, that are selected from a menu. This allows both for the location of the lost model and the identification of points of interest along the route of flight, as the device is capable of storing in-flight up to 9 GPS positions.
Height and variometer	Flight altitude information is necessary for the fundamental security of the flight. FPV pilots should refer to areas of controlled aviation maps and follow the permissible limits of flight in each zone. For gliders models altitude control allows for effective use of thermal currents, resulting in long flights. OSD also supports the use of thermal currents through the presentation of the current rate of ascent or descent of the model, indicated by the generated sound. OSD supports two types of altitude measurement: ➢ altitude based on GPS data, whose accuracy strongly depends on the number of satellites in view and the weather conditions. It can range from a few to up to tens of meters in adverse conditions, but that provides stability of indications with changes in atmospheric pressure and high accuracy at high altitudes (a small percentage of error responses). ***NOTE:*** *GPS as a source of information has too small accuracy compared to variometer.* ➢ altitude based on pressure measurement provides high

	measurement accuracy and resolution, ideally suited to fly at low altitudes, and flight in thermal condition using variometer. Because of the type of measurement, altitude indication changes with a change in atmospheric pressure or temperature, and can be subject to relatively high error at high altitudes. An error of several meters during or after the ended flight is a natural phenomenon. ***NOTE:*** *The OSD does not have a built-in pressure sensor, therefore, indications of the variometer are only possible in conjunction with the autopilot, or other external device, equipped with such a sensor.*
Speed	Current model speed related to the Earth's surface. Along with other information such as distance, height, and battery power, you can make the right decisions on the continuation of the flight or emergency landing.
Distance	The device shows on screen the current model distance from the starting point, calculated on the surface of the earth (not including the model altitude). Distance control allows you to accurately plan and conduct the flight, and maintain a stable control range. The distance is given in meters (or yards), to a maximum value of 60 km. Accuracy is directly dependent on the GPS readings and the average is about 5-10 meters.
Indicatior of received RSSI signal	When using the remote control receivers equipped with an analog output for level of the received signal (RSSI), OSD can present on the screen a graphic display of the received signal. This is a very useful information, to evaluate the quality of the RC link and to estimate the maximum safe distance of flight control without interruptions. Keep in mind that the quality of the RC link depends not only on distance but also on the relative positions of the transmitting and

	receiving antennas, as well as weather conditions and local interference. The received signal strength can change rapidly after a turn or tilt of the model
Time of flight	The passage of time is measured from the time of switching on the power OSD. In addition, an indication of the passage of time is reset when you select the menu command: "save the position of the base." Keep in mind that if the OSD is switched on long time before the start and then we force it to save the position of the base - OSD battery allows for a shorter flight time than it would result from the timer display.
Direction of flight	Direction of flight, or otherwise the course of the model can be based on GPS indications, or when using the autopilot it can be a magnetic heading. Each has its own characteristics: ➢ GPS Course, also known as CMG (Course Made Good) is the real model course calculated on the basis of actual distance traveled by the model, including for example, pushing the model of the course by a strong side wind. CMG is an indication of something totally different than the direction in which the model nose is turned to and while maneuvering the CMG course is delayed in relation to the model turns, and with side wind the CMG course is tilted in relation to the direction indicated by the nose of the model (opposite to the direction of the wind). In extreme conditions (the wind ahead is stronger than the model speed - model backs up into the wind) CMG may show the opposite direction than the nose of the model. Keep this in mind when flying in strong winds, so as not to lose the correct orientation. This course type allows for maintaining the real course in a strong wind and for reaching the target via the shortest possible route.

	➢ Magnetic course is available only in cooperation with the autopilot or other equipment with a magnetic field sensor. It always shows the direction in which the model nose is turned to, regardless of the wind and the model speed. Flight towards the magnetic direction for long ranges may cause significant model drift by the side wind.
Information about performed flight	After the end of the flight information on main parameters of completed flight is presented on-screen. L = (track lenght) - distance traveled during the flight. This length is calculated based on the actual speed given by the GPS and has a measurement error and rounding that speed. H = (maximum height) - Maximum height (altitude) achieved by the model. D = (maximum distance) - the maximum distance of the model from the starting point, measured on the ground (not including the height). V = (maximum velocity) - the maximum speed of the model relative to the ground, reached during the flight.
Battery conditions	The device monitors the voltage and current consumption from the drive battery (after connecting an additional current sensor). The screen presents the current battery voltage with an accuracy of 0.1V, as well as the current consumption and the amount of energy drawn from the battery - in ampere-hours, with an accuracy of 0.01Ah. This allows you to precisely control the state of the drive battery and return to the starting point without the risk of losing the drive of the model. This also allows for experiments with the selection of the optimal drive (engine, propeller) and, for example, optimal power consumption, ensuring the longest flight. After

	setting the alarm voltage and battery capacity in the menu, the battery discharge status is also displayed graphically. After the battery reaches the alarm voltage, the voltage indicator will show the symbol of an empty battery and additionally the inscription will start flashing, signaling the discharge of the battery.
Waypoint	Displays the number of waypoint in relation to which the direction of "the point" is determined (the return, or the direction of where the autopilot will fly in the "auto" mode). The default is "Base" - the reference is the base (starting point), but when you set 'waypoint' in the menu flight following the waypoints, waypoint on the route is the next point of reference (marked with N being shown as "Wp N"). If "Base" is shown, it means that the direction of flight and the distance is determined in reference to the base, and an automatic flight will be just going back to the base, If "WP 1" to "WP 9" is shown, it means that the direction of flight and the distance is determined relative to that waypoint and the automatic flight will be just to the waypoint (and then the next waypoint). After approaching the waypoint at a distance less than 50m, and when we start to move away from it (or we will be flying around it for a minute in the area of ~ 100m), the waypoint will be included and the next waypoint is shown in the field of radar or waypoint. Waypoints do not have to be defined as subsequent numbers, blank entries are ignored. ***NOTE:*** *After the last waypoint the base* ***is not*** *indicated as a target, so if the mission would include a return to the base, set the coordinates of the base as the last waypoint.*
Direction to	Indication of the direction (to the point) allows a flight that

waypoint	follows points along the route, regardless of visibility conditions (fog, problems with the camera) or loss of orientation in the field. When the line of the return direction is vertical at the top, the model goes exactly in the direction of a point. For example, the deviation of a line, in the right means that you should turn right to get back the course to the point . Course to the point is determined by the position of the model in relation to the waypoint and the current course of the model, so all the comments in relation to the direction of flight, are also applicable for the return direction.
Radar	Once you have defined the waypoints you can switch OSD to radar mode, in which the position of all points of the route is displayed on the screen at the same time, like on the radar screen, maintaining their relative positions, and according to the current course of the model. The location of the starting point is marked with the "H" letter and the next waypoints by numbers from "1" to "9". Distance of the point from the marker in center of the screen is dependent on the actual distance of the model from this point, however it is not linear, but logarithmic, so that it is possible to show on the screen larger range of distances and better visualization of both smaller and larger distances. This corresponds to a more natural perception of distance. Radar area also shows routes and runway with approach path during landing.
ILS	This control, similar to ILS in regular airplanes provides landing support and helps maintaining proper approach path during landing. This feature do not require any special equipment on runway.
RC monitor	Displays information of selected radio control channels. Up to 5 channels may be monitored, with 11 different visualizations (numerical and graphical). Useful for

	monitoring landing gears or flaps.
Artificial horizon	Presentation of the artificial horizon makes the screen similar to those which are used in professional HUD equipment, such as F16 fighter. Besides the aesthetic features, artificial horizon allows safe flight in poor visibility (fog, low clouds, twilight), and in case of failure of the camera - it is possible to control the position of the model using instruments.
Autopilot status	Presentation of information about the autopilot mode: • MANU – Manual flight (Autopilot Off) • STAB - flight in stabilization mode • AUTO - the flight in autonomous mode. Autopilot mode change is made by RC channel signal level (three-position switch).
Flight stabilization	Autopilot is equipped with flight stability system limiting an unexpected model tilting for example due to wind, turbulence, thermal currents, etc. Flight stabilization helps in flight learning and improves model control comfort in all weather conditions. In many cases, it also helps to overcome difficult situations, and to some extent, eliminates the shortcomings of the model (e.g. incorrect balance or trim). It is also very useful when recording videos and taking pictures from the deck of the model.
Return to base and autonomous flight	Autopilot is equipped with the function of self-control of the model without the remote control. After proper programming of the "fail safe" in the receiver, it enables automatic and safe return to the starting point in the case of loss of RC

control, such as in the case of interference, low battery in transmitter or exceeded range of equipment. Enabling this feature by switch in the remote control also allows for the safe return in case of problems with a set of video transceiver. This function can also be used for solo flight (autonomous flight) after pre-defined waypoints along the route.

External devices connectors

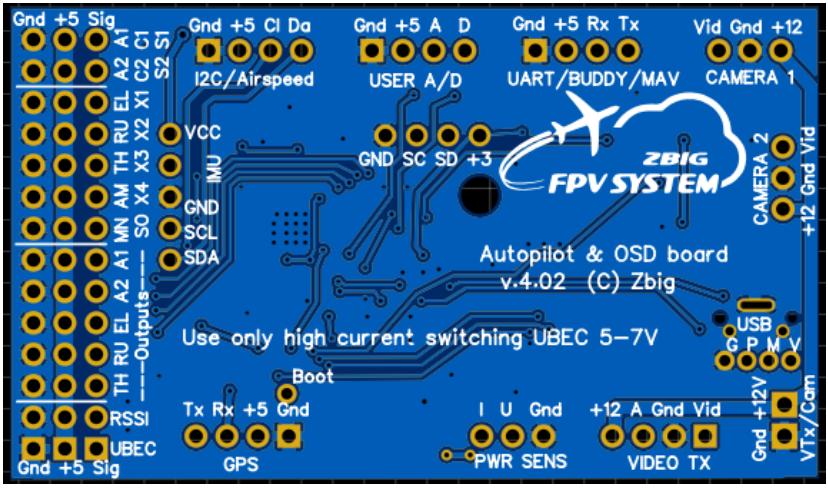


Figure 4: Bottom side of the board.

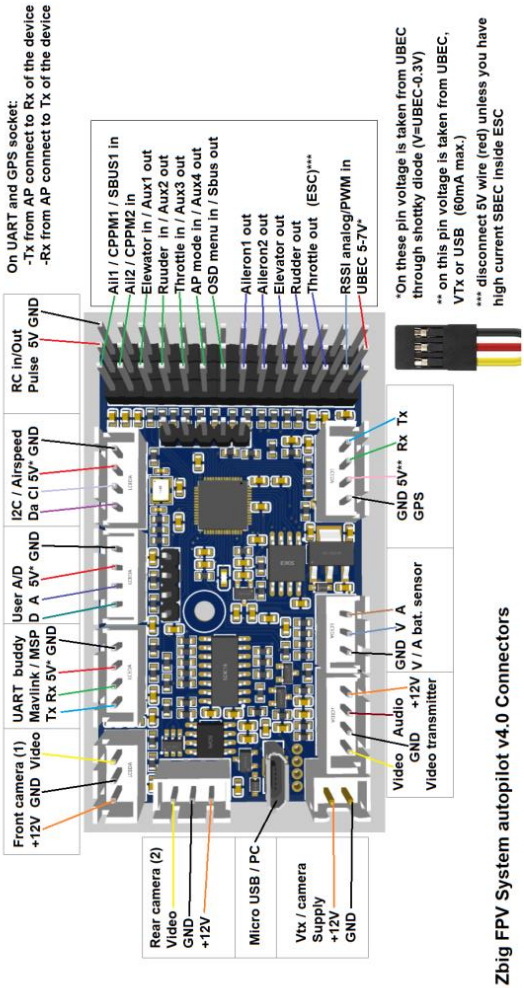


Figure :5 OSD board connectors

On the bottom side of the PCB there is a description of the sockets and the individual signals in the sockets.

JST sockets are polarized and cannot be connected incorrectly. Be especially careful when connecting the servos and UBEC power connectors, as there is a risk of reverse connection, which may damage the RC receiver, servos or autopilot.

Video camera

The camera is connected to a white, 3-pin socket on the OSD board labeled "CAM". The cable going to the camera is terminated on one side by a white plug. On the other side it has loose wires to be connected with a cable provided by the camera manufacturer. Camera operating at a voltage other than 12V must have their own power supplies.

Nr	Name	Color	Purpose
1	+12V	red	12V camera Power supply
2	GND	black	GND for camera Signal and Power supply
3	V	yellow	Video input from camera

Video transmitter

Video transmitter is connected to white, 4 – pin socket labeled "AV OUT". Like the cable to the camera on the other side it has loose wires to be connected with a wire coming out of the transmitter. Video transmitter is powered from 12V supply voltage for OSD.

Nr	Name	Color	Purpose
1	+12V	red	12V Power supply for transmitter
2	A	white	Audio output from OSD
3	GND	black	GND for camera Signal and Power supply
4	V	yellow	Video output from OSD

Current sensor

It is connected to the red, 3-pin socket. Sensors are available for a number of current ranges. Because of that, each of them needs to be calibrated.

Nr	Name	Color	Purpose
1	I	yellow	Current input of current sensor
2	U	white	Voltage input of current sensor
3	GND	black	Signal GND

UART

It has a white, 4-pin socket. It is used for connecting BuddyFlight modem, Bluetooth, communication with external devices using proprietary API, or for additional MavLink telemetry output for LRS or other transmitter. UART mode and speed selection is set via the OSD menu. **NOTE:** *Boards 2.2 and 2.3 have different socket type (horizontal vs. vertical). Connector has this same pin layout, but pin order on PCB is in opposite order (see bottom side of PCB for pin descriptions).*

Nr	Name	Color	Purpose
1	TX	white	Data transmission from OSD
2	RX	green	Data Deception by OSD
3	+5V	Red	+5V power supply for external device
4	GND	black	Signal GND

GPS receiver

The GPS receiver is connected to the blue, 4-pin socket. OSD requires a receiver with 3.3V or 5V TTL output, sending NMEA messages with the speed of 4800, 9600, 19200 or 38400 bps. You can use the GPS refresh rate of 1Hz or 5Hz.

A dedicated receiver is fed by 5V. You can switch the power value to 3.3 V by the jumper described "GPS",

Nr	Name	Color	Purpose
1	TX	white	Data sending from OSD, GPS RXD input
2	RX	green	Data reception by OSD, GPS TXD output
3	V	red	+5V or 3,3V power supply for GPS
4	GND	black	Signal and power supply GND for GPS

PC USB

Micro USB connector is used for configuration and software updates. It also transmits power to the processor unit. Other power sources can be connected regardless of the power from USB.

RC receiver

RC Receiver is connected by a cable with 4-pin plug. The other end of the cable has a standard servo plug. Additional fourth white cable is used to measure the RSSI output voltage in the receiver. OSD supports analog RSSI signal of any polarity (either increasing or decreasing voltage with the increase of the signal) and with the voltage range from 0 to 3.3 V. If the RSSI voltage range of the receiver is greater than 3.3 V, use an appropriate voltage divider.

Nr	Name	color	Purpose
1	RSSI	white	RSSI voltage input from receiver
2	RC	yellow	RC signal for OSD menu control from devices
3	+5V	red	+5V power supply from RC receiver
4	GND	black	Signal and power supply GND of OSD

I2C connector

The connector has 4-pin socket that allows you to extend the capabilities of the device so it could communicate with additional airspeed sensors.

Nr	Name	color	Purpose
1	GND	black	Signal and power supply GND of sensors
2	V	red	+3,3V power supply for external sensors
3	CL	green	Clock line for I^2C bus
4	DA	white	Data line SDA of I^2C bus

Analog/Digital inputs

4-pin connector allows connection of one analog/digital input and one digital-only input

Nr	Name	color	Purpose
1	GND	black	Signal and power supply GND of sensors
2	V	red	+5V power supply for external sensors
3	A	green	Analog input or digital input/output 1
4	D	white	Digital input/output 2

Mechanical fixing

The device has one mounting hole that can be used to attach the device to the model. You can also fix the plate with a self-adhesive "Velcro", or use a plastic casing (3D print) to attach the device to the model. The autopilot board must be placed horizontally in the model with the RC connectors facing the rear of the model.
It is recommended to perform the assembly in a flexible way, eliminating vibrations from the propulsion system.

OSD Menu

The device is equipped with a full-screen configuration menu, controlled by the keyboard or by using the selected channel of the RC receiver. Control via the RC channel allows you to change the settings during the flight of your model.

In AUTO flight mode or on the ground before arming the engines, menu navigation can also be done using the aileron and elevator sticks.

Please refer to the menu structure and learn about the possible configuration options.

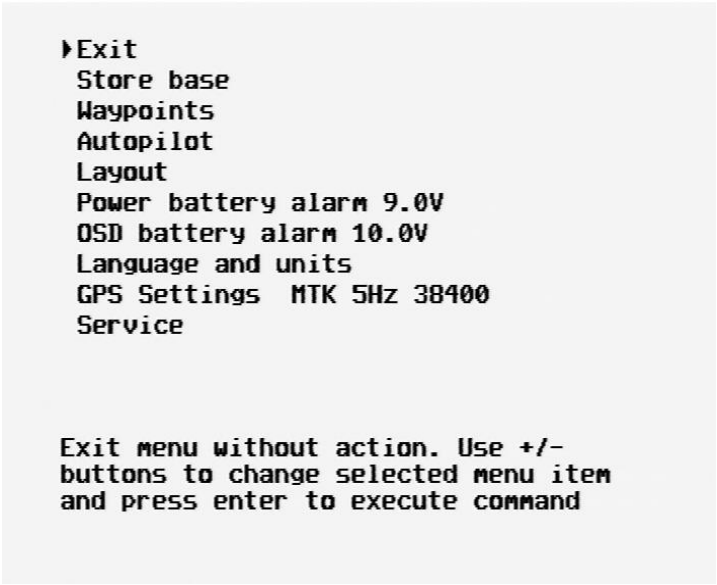


Figure 5: Main OSD menu.

Current menu item is indicated by a pointer on the left side o the item. "Exit" is always the first item of each menu allowing or leaving the selected menu without changing the parameters.

Depending on the type of menu item, after the execution, sub-menu can be opened, or the action associated with the menu can be executed (e.g. change of on-off type, or setting the selected parameter). After execution the menu is automatically closed.

At the bottom of the screen (below the menu) the help text explaining the meaning of the current menu item is presented.

Menu operation via RC equipment

The menu can be controlled by 3-position switch in RC device:

- *The "*minimum" position - *PPM pulse duration less than 1250 ms*
- *The "*neutral" position- *PPM pulse duration between 1250-1750 ms*
- *The "*maximum" position - *PPM pulse time above 1750 ms*

Calling the menu - *the switch is in "minimum" position*
Changing the menu item – to *the next occurs after the withdrawal of the switch to the "*neutral" *and its re-*adjustment *to the "*minimum" position.
Select / execute the command *- when the selector switch is in the "*maximum" *or the switch* is left *in the "*minimum" *for 5 seconds.*
Closing the menu *– occurs automatically if no menu operation is executed when you leave the switch in the "*neutral" *for about 5 seconds, or* when you *select a menu command*.

Menu structure

- **Set the base** - setting a GPS base is necessary for the proper determination of the return direction and distance from the base. Position of the base is stored automatically after 6 seconds from the start of the GPS navigation (after the fix), but during the first few minutes the navigation position can be displayed at a reduced accuracy and then the operator should manually re-call base position storing.
- **Waypoints** - is a set of sublevel menus and commands for defining points on the route, saving points on the route of flight

and navigation (or automatic flight with the autopilot) to defined points along the route.

- **Autopilot** - is a set of sublevel menus and commands controlling the operation of an additional autopilot. It allows configuration of the autopilot parameters such as control surfaces settings (mixers, reverses), the parameters of stability and control parameters for autonomous flight.
- **The screen layout** - allows you to select one of four screen layouts, as well as disabling OSD video overlay while keeping all the features of the device working in the background.
- **Battery alarm** - features allow you to set voltage alarm of the drive battery and OSD battery. When the voltage is below a specified value, the OSD shows the battery symbol. OSD allows you to set the alarm with an accuracy of 1V.
- **Language and units** - Menu and OSD information may be presented in one of the built-in languages: Polish, English, German, French. Whatever your language choice, you can select the units in which figures are presented. You can choose metric or imperial system (feet, yards, miles).
- **GPS settings** – Menu includes choice of type of GPS (transmission bit rate, information refresh rate), and a choice of three ways to present GPS position on the screen.
- **Horizon tilt** - it is a set of commands that allow to compensate for inaccurate attachment of the autopilot (or IMU sensor) in the model. It is recommended to mount the device horizontally, but the OSD allows you to compensate for the fixing imperfections to + / -10 ° for pitch and roll axes. The yaw axis compensation is not provided.
- **Service settings** - it is a set of commands for calibration and configuration of both OSD, as well as of the autopilot. The commands of this menu should not be performed during the flight,

if they are executed other functions of the device can be locked. This menu contains also a demonstration of the device command, which emulates the data from the GPS and autopilot.

Calibration of voltage and current sensors

When equipped with the additional current sensor, OSD can present on the screen additional information for electric models, such as the current drawn, voltage, and capacity of the package used hitherto. Since the sensors have different versions with different limit parameters, it is necessary to correctly calibrate the OSD display (range calibration).

Calibration of drive package power consumption

When you select the "service settings-> current calibration" menu command, the screen will be present the current value of the current flowing through the sensor and calibration factor as an information. For optimum calibration , the sensor should be loaded by a constant current within range from 1/3 to 1/2 of the maximum range of the sensor. At the same time you should measure the current drawn with a multimeter (ammeter). Pressing the "up" and "down" we change the calibration factor so that OSD display is in accordance with the meter indication.

Calibration of drive package voltage

When you select the "service settings-> motor voltage calibration" menu command the screen will be present current drive package voltage, and the calibration factor as information.

At the same time you should measure the package voltage with a

voltmeter. Pressing the "up" and "down" we change the calibration factor so that OSD display is in accordance with the meter indication.

FPV_manager PC application

System can be configured and updated by the software that runs on a computer with running Windows in both 32 and 64 bit versions.

The application allows you to:

- Fully configure the FPV system;
- Update device software (firmware);
- Install additional language menus and messages;
- Make settings backup and restore settings
- Perform sensors calibration

Application Requirements

Configuration application (executable file FPV_manager.exe) requires:
• PC running MS Windows family (Win7, Win8, 10)
• Installed runtime. NET Framework version 3.5.

. NET Framework comes with new versions of Windows and does not require any additional installation.
In older versions of Windows such as XP .NET Framework should be downloaded from Microsoft (http://www.microsoft.com/downloads) and

installed in your system, if it has not already been installed.

The current version of the application configuration can always be found at the manufacturer's website: .http://www.pitlab.com/osd.html

Configuration application is ready for use immediately after downloading to a local or removable drive. The application can be run from any media, including the removable media (pen drive).
The application does not require installation in Windows, and does not require any additional drivers.
NOTE: The application communicates with the device via the USB port on the PC and via a typical micro-USB cable.

Connecting the OSD to PC

After connection of the device to computer, Windows OS automatically recognizes it as new COM port.

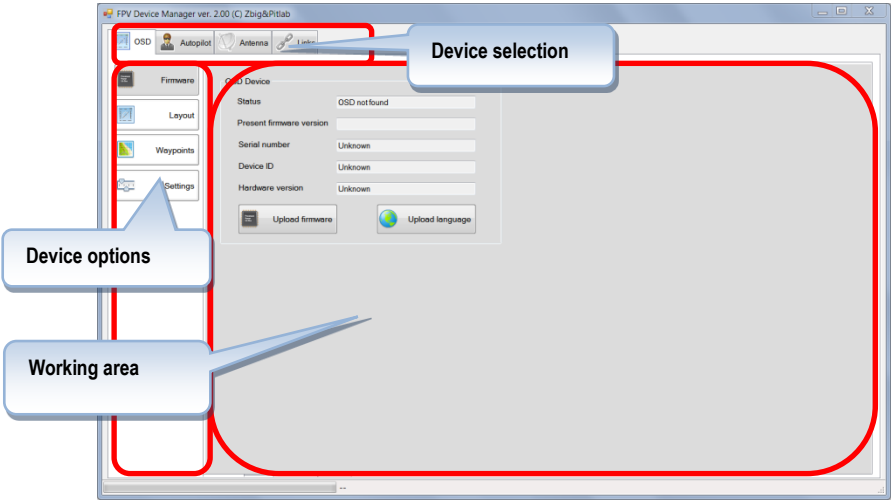
When you connect the device to your computer and run the setup application, everything is ready to use.

Device can be connected to a computer in the following configurations:

- Only USB port - only unit processor is supplied, providing access to the full configuration, but with the ability to preview OSD operation without signal from camera (black background).
- USB port and 12V power supply and camera - in this configuration OSD operation can be viewed at the video output with OSD information superimposed on the image transferred from the camera.

Configuration program

The following figure presents the working screen of the configurator.



Device selection - a dedicated tab to operate the devices:
- OSD - OSD support function selection
- Autopilot - selection of Autopilot Function
- Antenna – selection of antenna tracking device
-Links - useful links, including materials for devices

Device options - options to operate the selected device. For the OSD they are the following:
• Firmware - information about the device, software update and downloading the additional language
• Layout - Configuration of screen layouts
• Waypoints - service of flight waypoints

Firmware option

When connected to a PC, and OSD/Firmware option is selected, information about the device will be presented:



- Status - The status of the connection between the device and PC
- Present firmware version - version of the device firmware
- Serial Number - The serial number of the device
- Device ID - the unique device ID
- Hardware Version - Hardware version of the device

This information enables the identification of the device when communicating with the manufacturer and inform about the software version..

At the Firmware option level it is also possible to update the software version, upload additional OSD language of the OSD menu, and save or restore settings.

Upload firmware

New versions of software and patches are published on the manufacturer's website. New versions can eliminate the problems reported by users, or contain new features and additional functions. It is recommended to update software of the device to the latest version. Thanks to the latest technology, software update is very simple. Just download the latest update file to disk, and then click "Firmware" and indicate the downloaded file in the standard file search window. The update takes several seconds, during which the process progress bar is shown. In the process of updating the OSD does not display any information in the video, and after the update is complete the unit will automatically restart.

After updating the software all previous settings and OSD screen layouts are retained**.**

Upload language

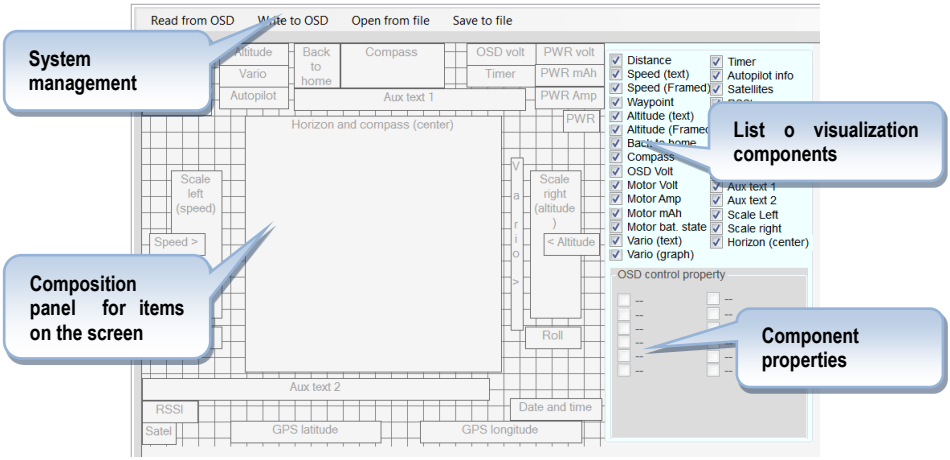
Files with additional language versions of the menu are published on the manufacturer's website.

The configurator allows you to upload one additional version, prepared by the manufacturer or by the user. Uploading additional language requires downloading the language version of the file to disk, and then selecting the command "Language" and indicating files downloaded files in the standard search box. The update takes several seconds, during which the process progress bar is shown. In the process of updating the OSD does not display any information in the video, and after the update is complete the unit will automatically restart.

People interested in creating their own language, should contact the manufacturer.

Layout option

Functions for modifications and design of own screen layouts.



System management – contains the following commands

- Read from OSD – read the layout of OSD objects to composition panel
- Write to OSD – save the layout of OSD objects
- Open from file – opens the objects layout to composition panel from file
- Save to file – saves the objects layout to file

Panel of objects composition - the area of visualization and adjustment of the position of objects on the screen.

List of visualization components - a list of components / objects visualized by the OSD

Component Properties - detailed properties of the selected component. Common options are:

-back background – field contents is presented on black background

-Inverted – field foreground and background intensity are inverted

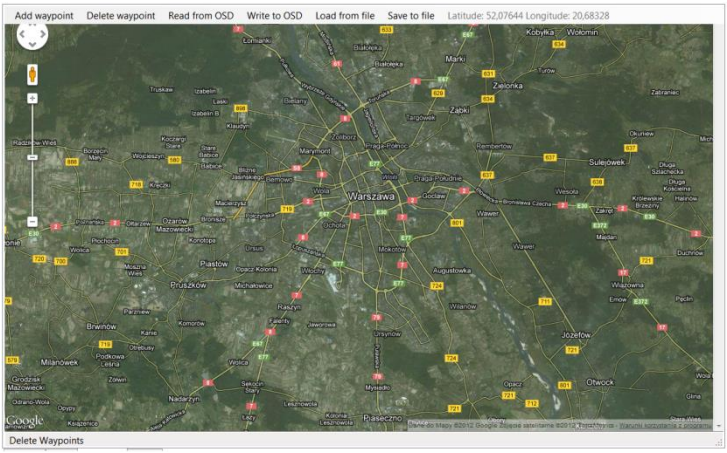
-Small font – field is presented using smaller font

-Hide min – option to hide field in "Minimum display" mode

Other field properties may be present depending on field selected.

Waypoints option

Function of waypoints management and visualization.



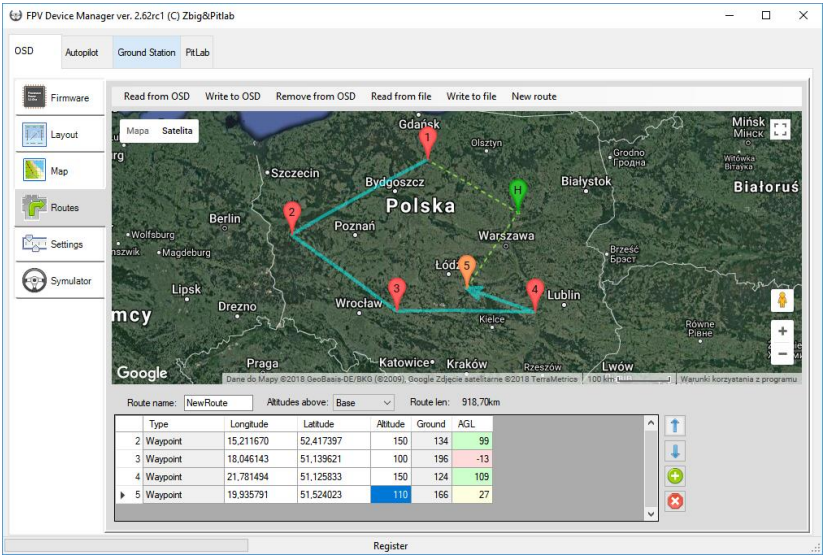
OSD functionality enables you to:

- navigate to the pre-defined waypoint
- store model positions during the flight and subsequent visualization of the accomplished route

In order to visualize and identify specific points google maps service was used, which requires access to the Internet.

Routes option

Routes or missions have multiple points (or vertices) and straight lines between these points, forming path to follow during flight. System can handle up to 10 routes with up to 120 points each route. Routes are defined by clicking on map and thus adding new route vertices. Application draws straight lines between vertices, and automatically calculates total route length. Additionally each vertex is presented on list, which allows to individually modify vertex altitude or order and delete or add new point. The simplest way to change vertex location is to move it on the map with mouse



Each route's vertex has individual altitude. There are 3 possible ways of defining altitudes (selectable from drop down list):

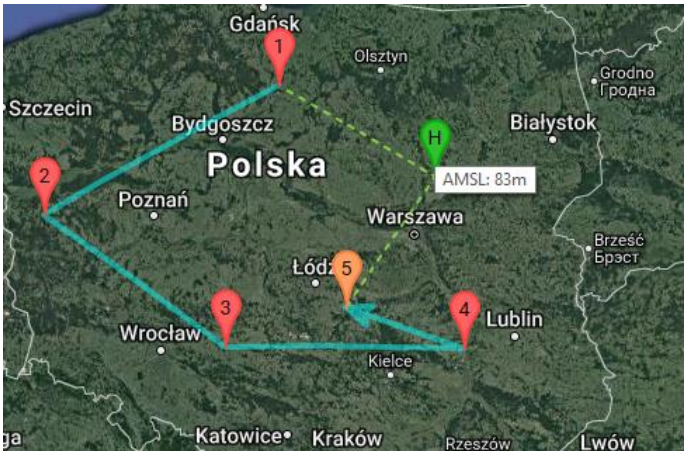
1. Altitudes above base – In this mode each vertex altitude is set relative to current base position (Base position is marked on map by green marker with "H" letter on it). This is simplest way, good for relatively flat area.
2. Altitudes above sea level – In this mode altitude is set above sea level (AMSL).
3. Altitudes above ground - in this mode altitudes are given above terrain level at particular point.

Vertex list also presents actual terrain (ground) and resulting altitudes above ground. This allows to check altitudes against possible collision in

uneven terrain. Altitudes close to the terrain level are marked with yellow for low altitude warning, and with red for possible collision condition.

NOTE: Application do not checks terrain level between vertices, and this is up to pilot to verify safe route altitudes between vertices.

When routes are stored into device all altitudes are recalculated to base-relative, regardless of initial settings. It is important to set properly and verify current base (home) location on map. Base altitude can be verified by hoovering mouse pointer over home Marker.



Altitude of route vertex may be changed individually or for selected group of vertices. To change group mark multiple altitude fields on list (use Ctrl or Shift key and left mouse click), type new altitude for this group and then press Enter key. New value will be inserted in all selected fields. By clicking on altitude header one may select all vertices on list.

In order to visualize and identify specific points google maps service was used, which requires access to the Internet.

Configuration of screen composition

1. Step by step:
2. Run the configuration program
3. Connect device to PC (USB cable)
4. Select a screen layout that you want to modify using one of the following ways:
    a. Read existing layout from OSD
    b. Open from file
    c. Use predefined template to modify
5. Make changes to the screen layout.
6. Store changes to the OSD - use the Layout / Write to OSD menu option - the changes are immediately visible in the image generated by the OSD without having to reboot the device.
7. After obtaining the desired effect disconnect the device from the PC.

Composing the screen layout

The idea of configuring the appearance of the screen is to click on the selected item, drag it to a new location, and set additional parameters that determine its appearance. In addition, each object can be shown or hidden on the screen.

Note: Some of the objects are automatically centered (e.g., horizon), and the possibility to change their position is limited.

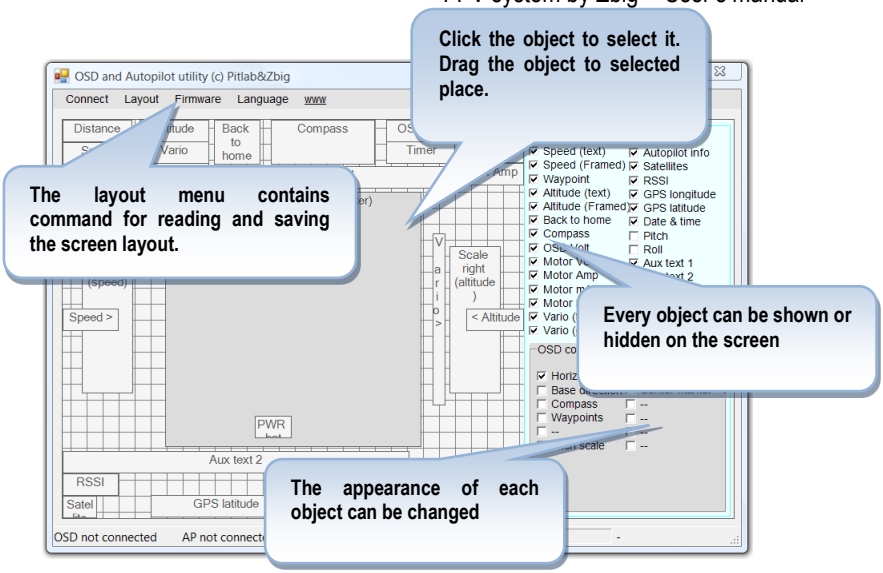


Figure 7: OSD configurator main screen.

Important information

Detailed descriptions

Many advanced system functions are described in detail in separate documents available at https://www.pitlab.pl/system-fpv.html

Warranty

The manufacturer makes every effort to make the operation of the OSD comfortable and that it works flawlessly. The manufacturer agrees to remove all eventual technical faults arising due to manufacturing errors or material defects within 14 working days from the date of delivery to service office, for a period of two years from the date of purchase. Please send the equipment for warranty and post-warranty repairs to the address of the manufacturer:

Pit Lab, Piotr Laskowski

ul. Jana Olbrachta 58a/164

01-111 Warszawa, Poland

Warranty does not cover mechanical damage and malfunction caused by operation not according to instructions. It is not allowed to carry out modifications to the device without the permission of the manufacturer. In case of doubt whether unusual use will cause damage, please use the technical support.

Limited use

OSD is designed exclusively for no commercial use. It cannot be used wherever the safety of people or animals depends on it.

The user of the model takes the sole responsibility for any damage caused while piloting. Flights must be designed in such a way that in the event of failure of any component in the chain of transmission of the image from the model, the resulting loss of control over the model does not pose a risk to the health and property of the public.

Disposal of waste equipment

In accordance with the EU Council Directive 2002/96/EC on waste electrical and electronic equipment (WEEE), this electrical product must not be disposed of as unsorted municipal waste. Please dispose of this product by returning it to the manufacturer, the dealer or to your local municipal collection point for recycling.

Technical parameters

Parameter	Value			Unit
	min.	typ.	max.	
Input voltage 12V	6	12	15	V
Input voltage from RC connector	4.5	5.3	7	V
Current consumption from UBEC (without		80		mA

external devices/sensors connected)				
Output signals (for servos etc)	3.3			V
Input signals (e.g from receiver)	2.5	3.3	5	V
Video system	PAL or NTSC			