**Dear user**

Thank you for purchasing and congratulations for choosing this advanced solution.

In order to take full advantage of the OSD, adapt to your individual preferences and maintain safety, please refer to the information contained in this manual.

OSD (On Screen Display) is designed for use in radio-controlled models that are equipped with a system for the transmission of video from the deck                                of                                the                                model.

**Introduction**

Our OSD is an instrument that provides the pilot with navigation information helping him to conduct a safe and conscious flight. Information are imposed on an image from on-board camera, giving more control over the model and facilitating safe return to base.



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> 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 that you have purchased contains a number of innovative solutions that have been created so that its operation is simple and intuitive, yet it offers maximum functionality and usability:

- **Clear form of visualization** - graphical presentation of navigation elements allows for clear display of flight data (e.g. location of the horizon, speed, geographic location) in an attractive and transparent manner, similar to the one presented in professional equipment of civil or military aviation.

- **4 screen compositions** - Two compositions are not modifiable by the user, and two are fully configurable by the user according to his preferences.

- **Standard of the image** - OSD supports PAL and NTSC standards. The system automatically detects transmission standard from on-board camera and adjusts the information system. In case of loss of the signal from the camera (due to disconnected or discharged battery), OSD continues to generate in the video standard in which the camera worked, allowing you to complete the flight according to the instruments.

- **Multilingual menu** - Built in OSD menu for configuration and settings of the OSD. OSD has a choice of one of the four main languages: Polish, German, English and French and the ability to upload your own language menu.

- **Help** - OSD menu has a unique possibility to turn on the system of prompts for the selected menu function, thus minimizing the possibility of incorrect selection of settings, and making the OSD operation simple and intuitive.
  **Menu control** – operation of the OSD menu is done using RC receiver channel (during the flight) or via 3-button keyboard.

- **Units of Measure** - Information on the screen can be presented in SI units (metric) as well as imperial (feet, yards, miles).

- **Telemetric data** - OSD transmits telemetric data encoded in the video signal, allowing monitoring of state of the basic elements of the FPV system on the ground, and controlling the directional receiving antenna (antenna tracker).

- **Configuration and update from the PC** - Configuring the system of screens and OSD software update can be done from a PC with Windows, via the USB port. The software does not require installation or special drivers.

- **DEMO** - The demonstration of the OSD features allows you to quickly check applied modifications and learn about the functionality of the system.

- **Open system** - UART communication port with OSD API for easy integration with third-party devices.

- **Autopilot** - OSD is designed to work with a dedicated autopilot (dedicated communication port), and includes built-in menu options, making it a uniform system of navigation.

- **MavLink** – OSD supports mavlink protocol and works natively with flight controllers based on ArduPilot code, e.g. APM or Pixhawk. OSD offers not only advanced presentation options, but also controls many aspects of RC behavior and acts in some way as GCS (ground control station)

- **BuddyFlight** – This additional radiomodem allows to track and display on screen position of other airplanes equipped with Pitlab system

## *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:

| | |
|---|---|
| **OSD** | A device processing telemetric information from sensors and inserting them in the real-time camera image. |
| **Video camera** | Color or black and white, in either PAL or NTSC (OSD does not support HD, and SECAM). Resolution of the camera sensor (TVL - number of lines of the image) is irrelevant to the work of the OSD itself, but it is recommended to use cameras with a resolution of 480 TV lines or more, with backlight compensation, to ensure proper image exposure when flying towards the sun. |
| **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 or 5Hz and baud rate of 4800, 9600, 19200 or 38400bps. 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** | OSD requires DC power supply with a value between 6.5 V and 15V. This voltage is distributed to the internal components OSD, video transmitter, camera and GPS (depending on configuration). It is |

| | |
|---|---|
| | recommended to have a separate power source than petrol engine package, because of a transfer of interference from the running motor on the video circuits. |
| **Current and voltage probe** | It can control the drive battery in electric models (voltage, discharge and current consumption). |
| **Autopilot** | Optional device for determining the position of the model in space (artificial horizon), stabilization of the model flight, autonomous flight following certain points along the route and model return to the starting point. |
| **Tracking antenna** | Optionally, the system may be equipped with the tracking antenna controller (directional antenna). The driver will be available in the offer soon. |

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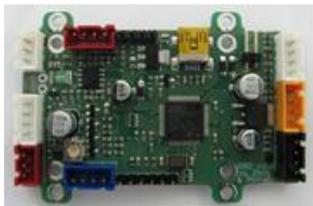
**Strictly follow the principle of limited trust. Prior to the flight control performance of all electronic and mechanical systems must be checked.**

*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.*

# OSD set content

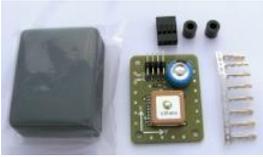| | |
|---|---|
|  | OSD board |
|  | Keyboard for control of OSD |
|  | Cable to connect the OSD with RC receiver (length 20cm) |
|  | 15 cm cable to connect the camera |
|  | Cable to connect the OSD with AV transmitter (length 20cm) |
|  | 45 cm cable to connect te OSD to GPS module. |

## *Optional equipment*

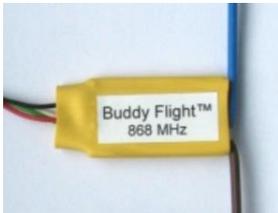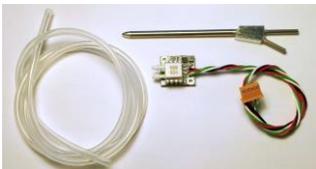| | |
|---|---|
|  | GPS receiver module |
|  | OSD current sensor with 20 cm wire. Available sensors: <br> • 26,6A <br> • 33A <br> • 50A |
|  | Set of JST plugs for manual preparation |
|  | Autopilot |

Tracking antenna controller



BuddyFlight radiomodel to track other airplanes with Pitlab 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).
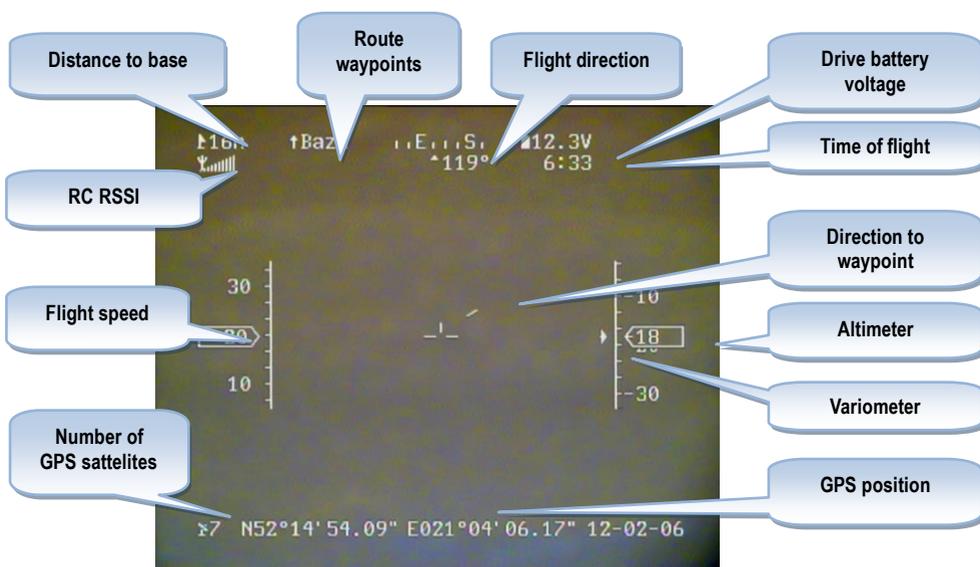


*Fig 2: Location on screen and meaning of navigation information.*

**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.

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**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 OSD battery voltage and when additional current sensor is connected, also the battery of the model driven by electric drive.

- OSD Battery - current battery voltage with 0.1V accuracy is presented on screen. After setting the alarm voltage in the menu also a graphical battery charge is displayed, which should be treated with caution, because the battery voltage does not vary linearly with the state of the discharge. Once the battery reaches alarm voltage, voltage indicator will show the empty battery symbol and the inscription also flashes to indicate low battery. Always set the alarm threshold so that the rest of the energy is sufficient to complete the flight safely.
- Drive Battery (PWR) - the screen displays the battery voltage with 0.1 V accuracy and the current power consumption and the amount of energy taken from the battery - in ampere-hours, with an accuracy of 0.01 Ah. This allows for precise control of the drive battery status and coming back to the starting point without losing the model drive. It also allows for experimentation with the selection of

the optimum propulsion (engine, propeller) and optimized power consumption, e.g., ensuring the longest flight.

| | |
|---|---|
| **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. <br><br> *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 waypoint** | Indication of the direction (to the point) allows a flight that 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. |

## Functions available only with autopilot

Connecting the autopilot or other device equipped with an additional IMU (inertial unit) allows for the presentation of information about the flight on the screen, and for obtaining additional features supporting the pilot during the FPV flight.

**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:
• Off - Autopilot Off
• STAB - flight in stabilization mode
• AUTO - the flight in autonomous mode. Flight destination point is described by the "Waypoint"
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.

## How to proceed

Starting the OSD installation and commissioning in the model, please read the user manual in the first place. In case of doubts that cannot be answered by this documentation, please contact the manufacturer. Forums on topics such as FPV flight: http://rc-cam.pl/ or http://rc-fpv.pl/, gathering persons with extensive experience in this field are an invaluable source of information exchange.

After the installation of the video system in the model it is necessary to conduct ground testing of proper operation of all system components and testing the range coverage. This is especially important because with a broken link with the model during the flight means the loss of the model.

When performing the first flight you should have an attendant, preferably with experience with model, which maintains eye contact with the model, and who in case of problems with the video link can help in the model recovery.

Check for how long the power source used lasts during the flight, and to what voltage drop the camera and video transmitter work. Set the alarm voltage value in the OSD and estimate safe flight time.

Starting the flight, specify its plan taking into account the wind direction and speed, the potential places of an emergency landing, and the approximate distance that can be flown in the current weather conditions.

## How to start the OSD

We suggest to perform the proper start-up of the OSD in the following order:

1. Power supply configuration

2. Connecting external devices: camera, video transmitter, sensors

3. Adjusting the blackness level

4. Configuration of screens layout

5. Calibration of current and voltage sensors

6. Fitting into the model

**Each point is described in the following sections.**

# Power supply configuration

**NOTE:** Factory power setting fulfill most common configuration:

- Camera, video transmitter and OSD are powered from 3S liPo battery (11.1V) or switched power supply (12V)

- GPS powered by +5V (Pitlab GPS or compatible)

OSD allows you to adjust the voltage of external components, such as camera, video transmitter, GPS receiver and internal circuits. For this purpose the underside of the plate provides the following jumpers:

- ➢ "**POW 12V" Jumper** - allows you to power the OSD from one power source - the video package. When the jumper is shorted (by a drop of tin), other components are powered by 12V power source.

- ➢ To the open jumper, remove a drop of solder. By default, the jumper is shorted.

- ➢ "**CAM" Jumper** - allows you to power the camera with the input voltage of the video package. By default it is shorted by a drop of tin. If cameras are powered from 5V voltage the

jumper must be disconnected and the unit must be powered from an external 5V power source. Power cable for the camera can be soldered to the underside of the joint, or soldered to the jumper connected to power supply pin in camera socket. Alternatively, you can unclip the red wire from the plug and connect it to an external source of 5V. *NOTE: The internal 5V stabilizer has insufficient current rating to power the camera.*

➢ **"GPS" Jumper** - allows you to select the GPS receiver module power supply. You can select the power supply between 3.3 V or 5V. The receiver modules available in Pit.Lab.Shop have input voltage of 5V (with internal stabilizer to 3.3 V), so by default the jumper sets the voltage to 5V. Some GPS receivers do not have a stabilizer and require 3.3 V power supply. In this case, using a soldering iron move a drop of tin connecting the upper and middle pad of the jumper labeled "5V" to the lower and middle pad labeled "3.3 V"."
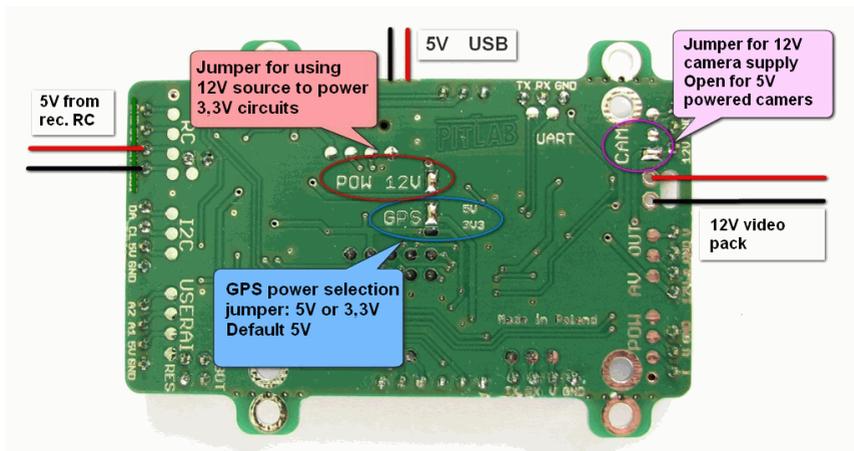
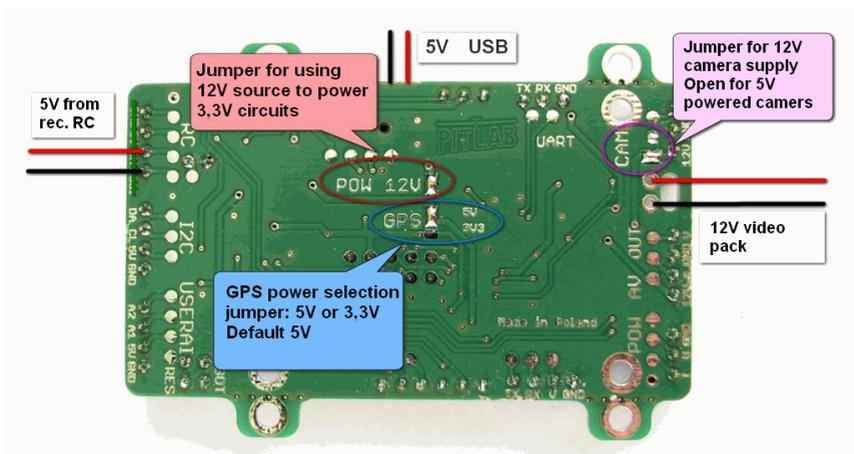Figure 3: Layout of jumpers that configure the OSD power supply.



Figure 3: Layout of jumpers that configure the OSD power supply.

OSD supply from one 12V set is convenient but uneconomical because most current is consumed by the 3.3 V circuit and the power is dissipated in the form of heat. A more efficient solution is additional OSD power supply by 5V - 6V from RC receiver powered external switch-mode stabilizer. In this case the jumper "POW 12V" should be removed

The diagram below shows the possibilities of power supply configuration:
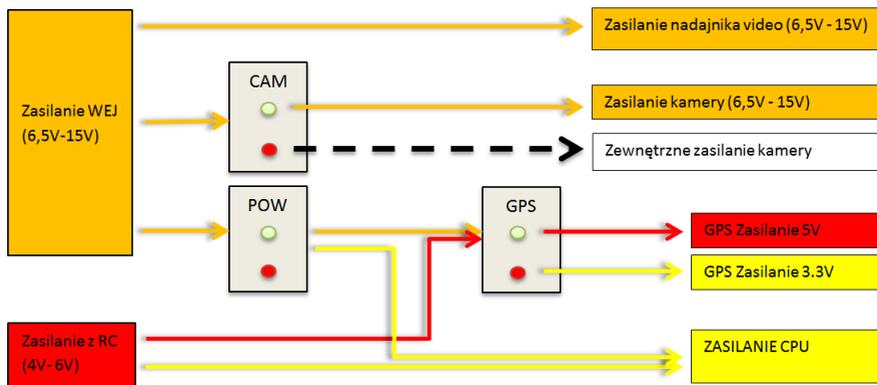


The diagram shows the OSD power supplies: INPUT (6.6 V-15V) power from RC connector (4V-6V) and CAM, POW, GPS jumpers, together with an indication of the current flow to the connectors of the external devices. Jumper status is marked by:

• a green dot means shorted jumper or selected option 1 (for GPS)
• a red dot opened jumper or Option 2 (for GPS))

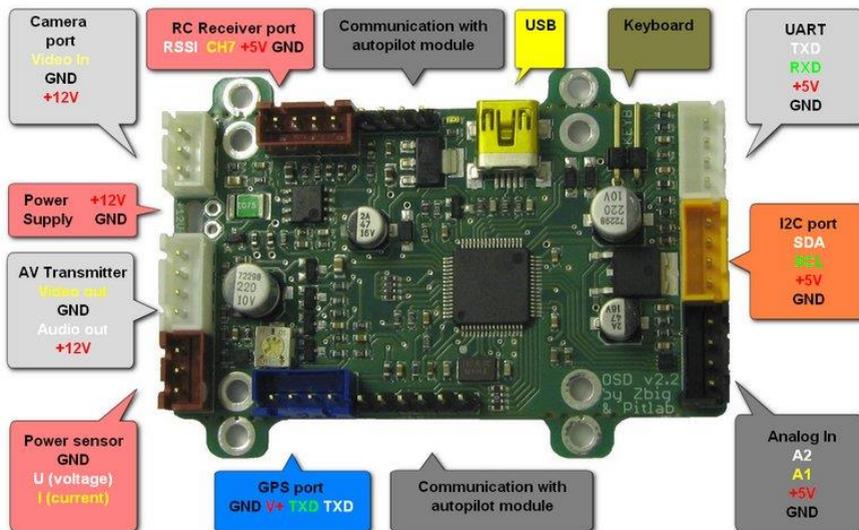# External devices connectors



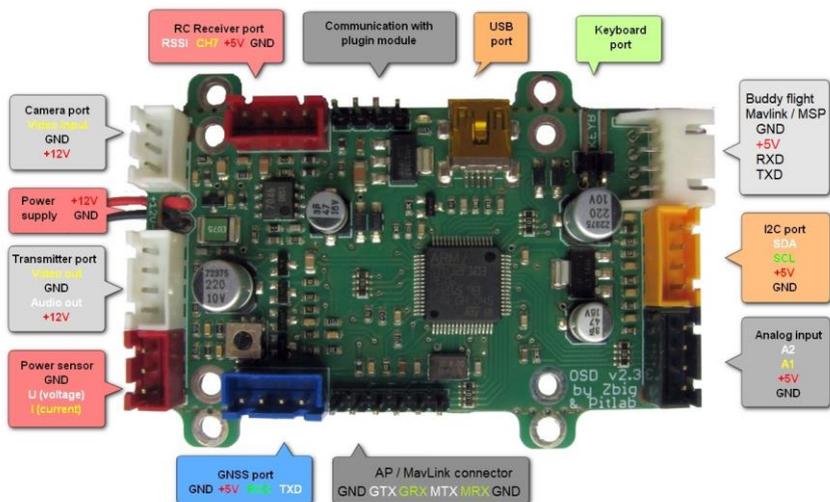*Figure 4: OSD board 2.2 connectors.*

*Figure :5  OSD board 2.3 connectors*

On the underside of the circuit board you can find a description of sockets and the individual signals in them.

Each socket is marked with a different color or has a different number of pins. The connectors are coded and there is no possibility of misuse of their connections. In each connector pin No. 1 is marked with an arrow.

### 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 |

## Autopilot and IMU

The two pin connectors are used to connect the autopilot module, which will soon be available as an expansion module of the OSD. The connector can be used to connect an autopilot module dedicated to M644 OSD. For operation this autopilot requires additional IMU module, connected to the I2C interface.

The top 3-pin autopilot connector sends the RC signal from autopilot to the OSD.
The lower 6-pin autopilot connector provides communication with GPS and internal communication between OSD and autopilot.

| Nr | Name | Purpose |
|----|------|---------|
| 1 | RC | RC signal for OSD menu control from devices |
| 2 | +5V | +5V power supply from autopilot |
| 3 | GND | GND |

| Nr | Name | Purpose |
|----|------|---------|
| 1 | GND | GND |
| 2 | GPS_TX | Data sending to GPS |
| 3 | GPS_RX | Data reception from GPS |
| 4 | RXAP_TXOSD | Data reception by autopilot, sending by OSD |
| 5 | TXAP_RXOSD | Data sending by autopilot, reception by OSD |
| 6 | GND | GND |

## PC USB

Mini USB connector is used for configuration and software updates. It also transmits power to the processor unit. The USB is not used for supplying the video section. Other power sources can be connected regardless of the power from USB.

## Keyboard

The keyboard is the only element having a non-coded connector, but in this case, the coding is not important. The keyboard is usually connected on the ground only for the purpose of OSD configuration, although it can be permanently mounted in the model.

## RC receiver

RC Receiver is connected by a cable with 4-pin, red 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 |

**Note!** Labels printed on the bottom PCB layer in 2.1 version are incorrect for this connector

### I2C connector

The connector has orange, 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 I2C bus |
| 4 | DA | white | Data line SDA of I2C bus |

### Analog inputs

Black, 4-pin connector allows connection of two analog inputs, or PWM input on A2 pin

| Nr | Name | color | Purpose |
|---|---|---|---|
| 1 | GND | black | Signal and power supply GND of sensors |
| 2 | V | red | +5V power supply for external sensors |
| 3 | A1 | green | Analog input 1 |
| 4 | A2 | white | Analog input 2 or PWM input |

## Adjusting the level of blackness

After the camera connection and the OSD launch, you can adjust the visibility of the black borders around the characters generated by the OSD, according to your needs ensuring comfortable information perception.

To set the blackness level of borders, use the potentiometer located near the GPS connector. The adjustment should be performed on the source image with contrast as high as possible, so that the characters are visible on a dark or light background.

NOTE: in the low-resolution displays and with generally poor video signal (e.g., noisy at long flights) consider using a dark background in various fields (available in the M644 system, and two own screen configurations). This provides greater clarity of the subtitles on a light background than tinted rim of the characters.

## Mechanical fixing

The device has two sets of fixing holes:

> ➢ Internal with the size of 44,5x33mm

> ➢ External with the size of 44,5x44,5mm compliant to the size of holes of numerous flight controllers of multi-propeller airplanes.

Internal holes are used for mounting the autopilot module via the distance pins. The PCB can be attached to the base by these pins. External holes are made in the form of lifting eyes protruding outside the PCB. In case of installation in a classic plane the lifting eyes can be cut off along the perforated line.

It is recommended to install the OSD in a flexible manner, eliminating vibration 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.

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

```
▸Exit
 Store base
 Waypoints
 Autopilot
 Layout
 Power battery alarm 9.0V
 OSD battery alarm 10.0V
 Language and units
 GPS Settings  MTK 5Hz 38400
 Service




Exit menu without action. Use +/-
buttons to change selected menu item
and press enter to execute command
```

*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.

*NOTE:* For safety reasons, during the menu control via RC equipment, some service settings are not available (they are available via the keyboard or by an emergency method).

## Operation of the menu using the keyboard

The keyboard is equipped with 3 buttons: "up", "down" and "Enter".

**Calling the menu** - *by pressing any key.*
**Changing the menu item -** *is done by using the "up" or "down" buttons.*
**Select / execute the command -** *after pressing "Enter".*
**Closing the menu –** after *the menu item is selected.*

## 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.*

### Emergency menu operation

OSD has the function of emergency menu operation without using the 3-button keyboard or RC apparatus.

Its concept lays in a direct short-circuit of pin in keyboard connector. Each subsequent pins shorting will switch to the next menu item. Implementation of the selected menu item is done automatically after about 3 seconds after the last position change.

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

### OSD voltage calibration

We can calibrate OSD display voltage in the similar way to " Calibration of drive package voltage". In the menu, choose "Service settings-> OSD voltage calibration" but the voltage should be measured at the power source of the OSD.

## OSD Configurator

OSD can be set up 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:
• Configure the appearance of two layouts of user displays (Custom 1 and Custom 2);
• OSD software update (firmware);
• Loading additional language menus and messages;

## Application Requirements

Configuration application (executable file FPV_manager.exe) requires:
• PC running MS Windows family (XP, Vista, Win7, Win8)
• 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 OSD via the USB port on the PC and via a typical mini-USB cable.

## Connecting the OSD to PC

After connection of the device to computer, Windows OS automatically recognizes the OSD. OSD is seen in Windows as **Pitlab&Zbig OSD device**.
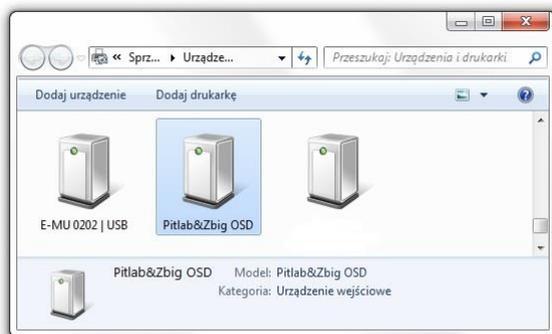
*Figure 6: OSD as recognized by Windows OS.*

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

OSD 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 without the ability to preview OSD operation at video output.

- USB port and 12V OSD power supply - in this configuration, you can additionally view the OSD operation at video output - the system automatically generates an image in PAL system (white characters on black background).

- USB port and 12V OSD 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.
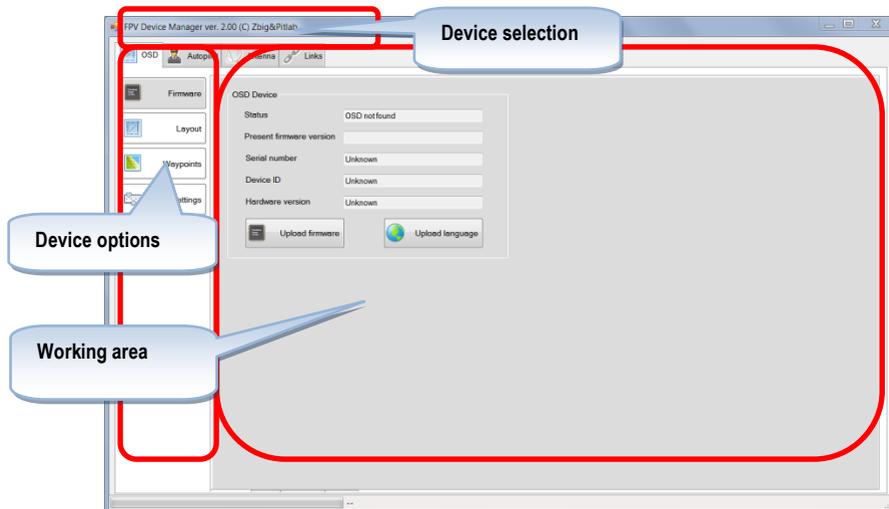
Device selection - a dedicated tab to operate the devices:
- OSD - OSD support function selection
- Autopilot - selection of Autopilot Function
- Antenna – selection od antenna tracking device
-Links - useful links, including materials for devices

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, OSD and OSD device is selected in the Firmware options, information about the device will be presented:

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

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

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 OSD settings.

### Upload firmware

New versions of OSD 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 OSD 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.
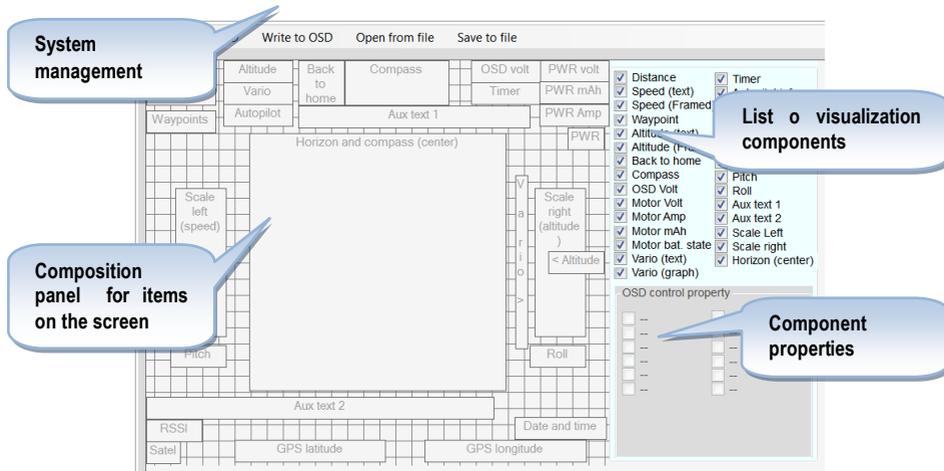
**System management** – contains the following commands

> ➢ 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 catalog 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

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-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.
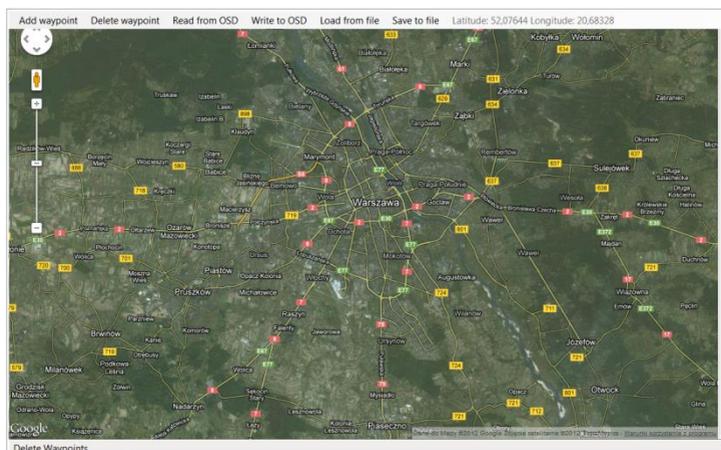


OSD functionality enables you to:

• 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.. OSD 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
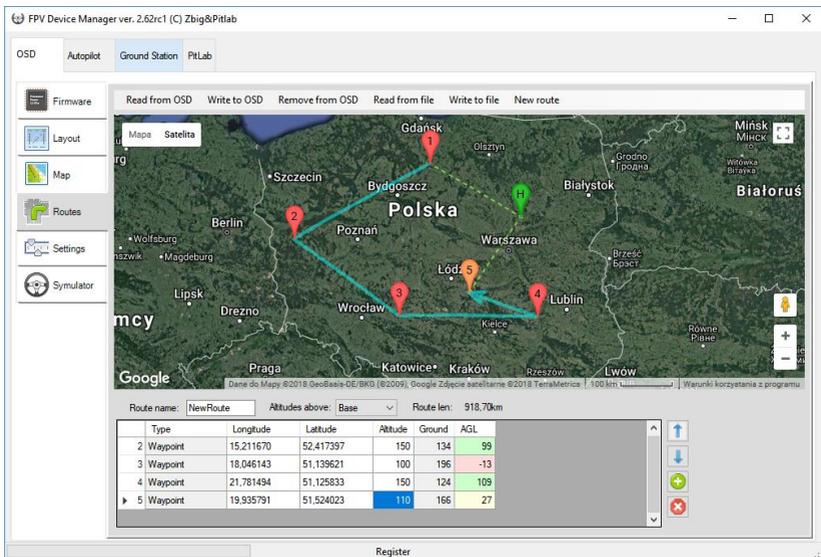


Each route's vertex has individual altitude. There are 3 possible ways of defining altitudes (selectable from drop down list):

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 sae level – In this mode altitude is set above sea level (AMSL).

3. Alttudes 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 color for low altitude warning, and with red color for 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 OSD 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.
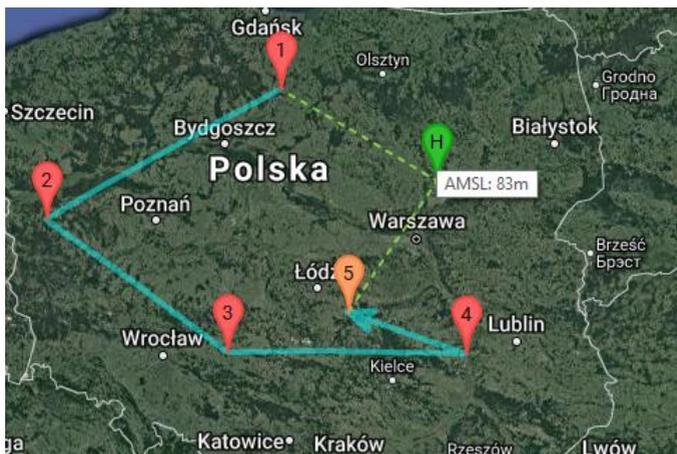


Altitude of route vertex may be changed individually or for selected group of vertices. To change group mark multiple altitude fields on list (use Ctrl

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 OSD to PC (USB cable)

4. Run OSD – preview of the changes requires powering the video circuit by 12V supply

5. Select Connect From the menu, - the program will display identification information of the OSD

6. Select a screen layout that you want to modify using one of the following ways:

    a. Read existing layout from OSD

    b. Use the Layout menu / Open from file

    c. Use predefined template to modify

7. Make changes to the screen layout.

8. 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 OSD.

9. After obtaining the desired effect disconnect the OSD 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 lines, compass), and the possibility to change their position is limited.

The currently selected screen layout of the OSD is always loaded and saved. "Custom 1" and "Custom 2" layouts are stored in non-volatile memory of the OSD and are retained even after power is turned off, while the changes in the "F16" and "M644" layout are only stored until the OSD power is off. This allows for safe, convenient and fast testing of appearance and behavior of the new layout, when the OSD is connected to the external power supply and OSD preview is generated on the TV screen for example. The composed screen layout can also be saved to a file on disk and read from the file.



_____
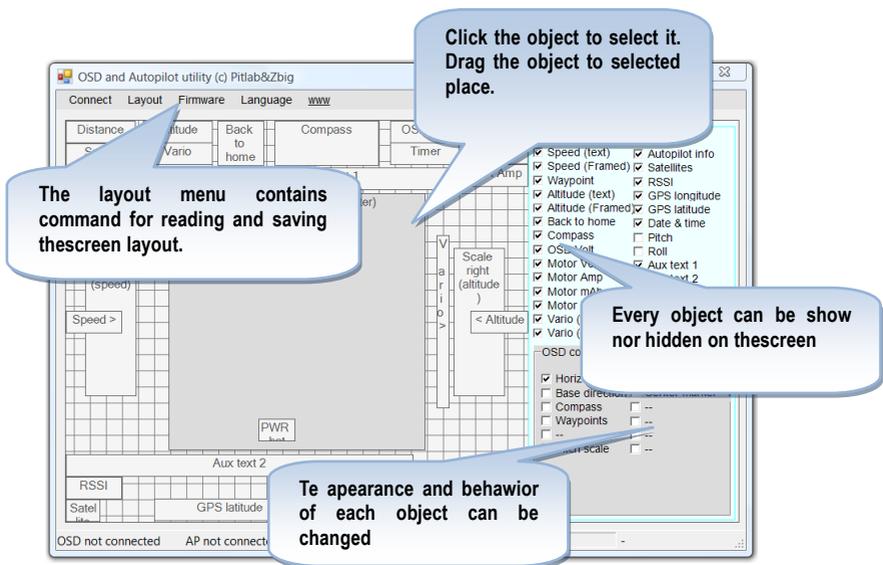
*Figure 7: OSD configurator main screen.*

# Important information

## *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 non professional 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** | 6,5 | 12 | 15 | V |
| **Input voltage from RC connector** | 4 | 5 | 6 | V |
| **Current consumption from 12V power source ("POW 12V" jumper opened)** | | 26,5 | | mA |
| **Current consumption from 12V power source ("POW 12V" jumper shorted, no 5V power supply)** | | 80 | | mA |
| **Current consumption by GPS module** | | 60 | | mA |
| | | | | |
| **OSD PCB weight** | | 18 | | g |
| **Weight of GPS module with cable** | | 20 | | g |
| **Weight of keyboard with cable** | | 8 | | g |
| **Weight of current sensor with cable** | | 3 | | g |
| **Weight of RC camera and transmitter cables** | | 7 | | g |