INSTRUCTION MANUAL

On-board computer

for PPG/PPGG

Smart PG

Contents

1. General information

This manual is intended to familiarize the user with the operation and installation of Smart PG. Smart PG is a measuring device for paramotor. The task of Smart PG is to help pilots in piloting by controlling the parameters of the engine and the environment. The device consists of sensors and a module communicating in Bluetooth LE technology with a smartphone equipped with the "FFES Smart PG" application available at the "Google Play" or „App store", free of charge.

> **Attention!**
> *Use common sense when using the device. All measurement values due to technical problems of device or smartphone may not be compatible with the real.*

1.1 Technical data

Power	Battery Li-ion 18650 2200mAh
Work time / Battery charging time	~210h/~3,5h
Temperature CHT/CT	$0\,^{o}C$ - $1024\,^{o}C$
Temperature EGT	$0\,^{o}C$ - $1024\,^{o}C$
Fuel level	Display:0-6 Sensor Length: 250;275;300;350mm
Module dimensions	120x80x31mm
Ingress Protection Rating	IP65
Operating temperature	$-10\,^{o}C$ - $60\,^{o}C$
Minimum hardware / software requirements for a smartphone	Bluetooth 4.1, Android 5.0.2
Optimal hardware / software requirements for a smartphone	Bluetooth 4.1, Android 5.0.2, Barometer, Accelerometer, Gyroscope,GPS, LTE

2. Installation and description of the module

The installation of the module should be done with particular care, as it has a big impact on the correct operation of the device. Avoid unnecessary cable extensions (cables provided in the set are sufficient). In the case of too long cables, it is worth shortening them. Cable connections in connector should be soldered and insulated. When laying cables, consider the vibrations occurring in paramotor engines. Wires can not be too loose, it should be carried out in tunnels assembly (if the paramotor is so equipped), or use cable ties. A silicone hose should be placed on the cables from the set.

All materials supplied by the producer should be used for installation, this will allow for a solid and aesthetic finish of the product.

The first step in installation is to choose location for device. Placing the module is a very important element of the installation. Due to the fact that the ignition system of the internal combustion engine can generate large interferences, it is recommended to maintain a safe distance (at least 50cm) from the elements, ie ignition coil, HV cable, spark plug.
It is also worth equipping of spark plug with an additional resistor of minimum value. 4.7KOhm.
Connector cables should be directed toward the ground.

Good to know
Sample photos from the installation of the module and sensors can be found on the producer website.

2.1 Tachometer

The basic parameter measured by the module is the engine revs. The measurement takes place via a spring-shaped cable applied to the HV cable. This type of measurement method is safe due to galvanic isolation. With the ability to log settings RPM, the engine revs can be measured for different types of construction of combustion engines.

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Installation of the engine revs sensor:
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1. Wind the spring-shaped end on the HV cable.
2. Secure the cable against slipping.
3. Leading the ground cable from the motor to the module.
4. Connecting the wires according to the diagram.
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2.2 CHT/CT temperature

Each version of the Smart PG is equipped with a CHT or CT sensor. The CHT sensor is mounted as the spark plug primer and measures the temperature of the engine head, while the CT sensor is mounted in the connector of radiator with a sealing sleeve.

The type of sensor is a type K thermocouple with two wires, green "+", white "-"

2.3 EGT temperature

The extended version of the module allows the EGT to be measured, i.e. engine exhaust temperature. The capillary-shaped sensor is screwed together with the sealing sleeve into a stub pipe at the distance determined by the engine manufacturer, usually to 10cm from the cylinder.

The type of sensor is a type K thermocouple with two wires, green "+", white "-"

2.4 Ambient temperature

The module is equipped with a digital temperature sensor placed inside the device. Temperature range -55 ^{o}C to 125 ^{o}C. In order to read the relative ambient temperature, the module should be placed at a large distance from the engine.

2.5 Fuel level

The fuel level sensor is mounted inside the tank, it is made of contractors and a movable magnet. The fuel level indication is divided into 6 levels and reserve. Due to the diversity of tanks, the volume in liters should be examined individually. The fuel level indication is obtained through series of repeated measurements in specific time cycles. So that the application can get the real status of the fuel level, should fly straight without tilt on for about 10 seconds.

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Installing the fuel level sensor:

   1. Drill a hole with a diameter of 16 mm in the upper part of the
tank, preferably in the middle of the tank plane (the smallest are at
this point of fuel level fluctuation).

   2. Insert the sensor through the fuel cap, pull the wire through the
previously drilled hole.

   3. Fit the nut and tighten the sensor using a wrench.

   4. When connecting wires, polarity is irrelevant.
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Attention!
If there are other metal elements in the tank inside the tank within a radius of 5cm from the sensor, they should be connected to the ground of the engine together with the sensor housing.

2.6 Flight time

Measurement of the flight time is counted from starting the engine until it turns off.

The engine revs sensors are necessary for this purpose. The user can view two time counters, the current flight and the sum of all flights (They are permanently saved in the device).

2.7 Work time

The module is equipped with a lithium-ion battery that allows operation of the device for 210 hours. This time can be extended by switching off the power supply for the time when the module is not used, using the switch in the module.

The battery is charged using a charger with a USB connector, minimum power of charger must be 1A . The charging process is automatic. Set switch to „1" while charging.

Attention!
Do not charge more than 3.5 hours. If the device does not work after charging, they should be removed. Use chargers from reputable producer.
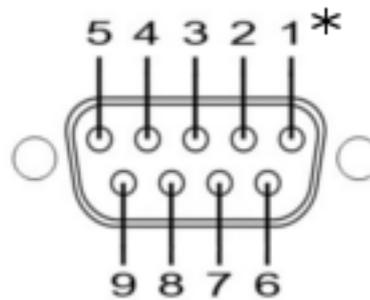
2.8 Schematic

R P M   S E N S O R   9

F U E L   S E N S O R   2 6 G

C T H   S E N S O R   8 4

E G T   S E N S O R   7 3

5 4 3 2 1 *

9 8 7 6

Smart PG

* The numbering is on each connector and according to it you should connect the sensors.

5- Connect to the engine ground.

G- Connect to the engine ground and the housing of the fuel sensor, if it necessary.

3. Application

The FFES Smart PG application is an integral part of the device, it aims to convert and display flight parameters downloaded from the module and smartphone.

For installation, run the Play Store app, search for "FFES Smart PG" and download, the application is free. The application uses network connections, GPS, Bluetooth, barometer and accelerometer, in order to fully use the capabilities of the application, you must agree to access to the above. options. Each time you start the user will be asked to start the Bluetooth transmitter, GPS and network connections. The necessary for using the application is establishing communication via Bluetooth with the Smart PG module, the remaining functionality depends on the user. The communication with the module is established by going to the "Scan" tab and selecting its module named "Smart PG". Each module has an individual MAC address, which makes it easier to find your device among others. The application also has the option of automatically connecting to the selected module, the option is available in the "Scan" tab. By using of Bluetooth LE it is possible to work with a smartphone and other devices, i.e. Headsets without breaking the connection.

3.1 Operation and user interface

The main graphic user interface is based on one activity, containing all current measurements and navigation. In addition to measurements taken from the module, the application presents parameters such as wind speed and direction, altitude above ground, ascent / descent speed, ground speed, and overload value acting on the pilot. Set/ Distance traveled, direction of flight.

Properties of individual fields:

WIND - Wind speed and direction. Data is collected from the weather service. Lack of interactivity.

ALTITUDE - Height above the ground expressed in meters, the accuracy depends on the pressure sensor in the phone. It is possible to set the zero point at any time by holding it longer. The value is stored for the next application start.

SPEED - Ground speed expressed in Km / h, the result is taken from the GPS. Lack of interactivity.

UP/DOWN - Speed rise / fall, the value calculated on the basis of measurements from the pressure sensor, expressed in m / s. Lack of interactivity.

G-FORCE - Actual / minimum / maximum overload value, expressed in "G". The result of overloading depends on the accelerometer built into the smartphone. With a longer hold it is possible to reset the minimum and maximum values.

Fuel level/battery level - It presents the current status of the battery installed in the module and the fuel level. Lack of interactivity.

CTH/EGT - Displays the current exhaust and head / radiator temperatures. With a long hold it is possible to set critical values, after crossing them the font will change to red and will start flashing.

OUT - Ambient temperature. Lack of interactivity.

RPM - Engine revs. Lack of interactivity.

SUMMARY - It presents the current flight time, measured from the last start of the engine and the total condition of the flight. Lack of interactivity.

POINTS - It presents the direction and distance to the designated destination. With a longer hold it is possible to edit travel points.

BRG - Direction of the flight.

In case of sensor failure or lack thereof, the values take the form "-".

3.2 Navigation

Navigation in Smart PG is based on Google maps. It is equipped with a compass, taking values from 0^0 to 360^0 with the marker (arrow) of the north or a set direction and the current direction of flight. The map uses GPS and Internet access, after activating them, it takes us to the current location. With a longer hold on any point of the map, we can unlock it and add travel points. Unlocking the map will allow you to move freely around the entire area. Travel points are added by placing your finger on the selected place or by entering geographic coordinates. Editing points is done by holding down the "POINTS" window for a longer time. Values, i.e. the direction and length of the road are generated based on the shortest distance in a straight line.

Good know

Calibration of the compass is carried out by making a phone "eight", once or several times.

3.3 Settings

Due to the diversity of engines and user preferences, the application has been equipped with the "Settings" tab. The configuration consists of the following parameters.

a) Engine revolution log, that is the declaration the number of sparks for one revolution. The default value of "1" and is used for single cylinder two-stroke engines.
b) Alarm for CTH and EGT temperatures.
c) Initial altitude, eg the introduction of altitude to the sea level.
d) Barometer sensitivity. The default value is 25, the higher the value, the more stable and delayed the measurement will be.
e) Accelerometer sensitivity. The default value is 60, the higher the value, the more stable and delayed the measurement will be.

4. Warranty conditions

1. Guarantee for the correct operation of "Smart PG" confirmed by the stamp and signature of the seller is granted for a period of 24 months from the date of purchase.

2. The guarantee ceases to apply if:
   a) Breaking the warranty seals
   b) Incorrect connection of the module or sensors
   c) Using sensors other than those recommended by the producer
   d) Incorrect assembly of the module or sensors
   e) Unsuitable operating conditions of the module or sensors.

3. A prerequisite for considering the warranty is a purchase document and a supplemented warranty card (placed on the next page).

4. The scope and method of warranty repair is determined by the guarantor.

5. After the third repair, the module is replaced with a new one.

6. In order to process the complaint, the product and description of the defect should be delivered to the producer or seller.

7. The repair time can not last longer than 7 days from the date of delivery of the product.

8. Complaints should be submitted to the distributor or directly to the producer.

Warranty Card

Date	Description	Stamp and signature of the seller	User signature
	Purchase		

Smart PG is an electronic device. According to the directives obliging in the European Union, it cannot be disposed of with other household waste. Such a product should be returned to a special WEEE facility