Raven

Onboard air-data measuring system for R/C aircraft with telemetry.

Manual version: 1.2

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Introduction

The “Raven” is one component of RC Electronics model aircraft telemetry system. The Raven is the “on-board” unit intended to be used with the “Snipe” “Ground station”. The Raven is designed to measure many parameters of an R/C model aircraft and transmit them to the Snipe ground station via the telemetry channel working on 433 MHz frequency. The unit is capable of measuring sink/climb rate (Vario), airspeed, altitude, orientation of the plane (pitch, roll and yaw), noise level, servo pulse on servo inputs, GPS data with 18Hz refresh rate and supply voltage. For storage it has internal 8Gb solid state storage which is presented as flash disk drive when unit is connected to PC via mini USB connection.

Key features of the Raven

- Various sensors all in one box
- Integrated 8 GB of solid state memory for virtual unlimited space for logging
- Indicated airspeed sensor
- Two pressure sensors for altitude and Vario measuring
- Latest MEAS technology sensors with high resolution and high sample rates.
- 9-DOF sensor (3 axes accelerometer, 3 axes gyroscope and 3 axes magnetometer)
- Electronic Total energy compensation for Vario as an option.
- Model polar measurement algorithms.
- **EnI - E**nvironment **n**oise **l**evel detection to detect working electric, impeller or jet motor.
- **FHSS - F**requency **H**opping **S**pread **S**ystem on 433MHz telemetry channel to eliminate frequency conflicts.
- 18 Hz GPS working with GNSS, Glonass and prepared for Galileo global positioning satellites.
- Various telemetry protocol supported over one of servo input (JetiEx, PowerBox System ...)

Specifications

Unit Dimensions	80 mm x 41 mm x 16 mm
Weight	57 grams (without GPS and RF antenna)
Temperature Range[1]	-10°C ~ +60°C
Input Voltage Range	4.0 – 18.0 volts DC
Input Current	80 milliamps
Measured Voltage	4.0 – 10.0 volts DC
Memory capacity	8 Gigabyte

[1] Specifications are taken from component ratings and system limits and may not have been tested to the full extent of the specified ranges.

Physical overview

Figure 1, Figure 2 and Figure 3 are showing the Raven module. It has two SMA connectors (one for RF and one for active GPS antenna), 3 pressure ports (Ptot – total pressure, Pst – static pressure, Pte – total energy compensated pressure from TEK probe) and a multi-color LED to show the status of the unit.

On the base there are 3 connectors. The micro USB is used for future updates and flight log download. The 4 pin connector is prepared for future use (CAN bus). The two 3-pin servo inputs are used to connect to selected channels on the model aircraft radio receiver for different logging and control options. Top servo input has additional option to serve as external telemetry channel, where 3rd party telemetry can be connected. Currently JetiEx protocol is supported so Jeti users can see all measured data also on their TX system The Raven is powered in flight by either one of the two servo inputs.

Important: Be careful on polarity when connecting power to the unit. Improper connection can damage unit!

Looking from front: left pin on servo connector is signal, middle is power and right is ground

Figure 1: The Raven module.

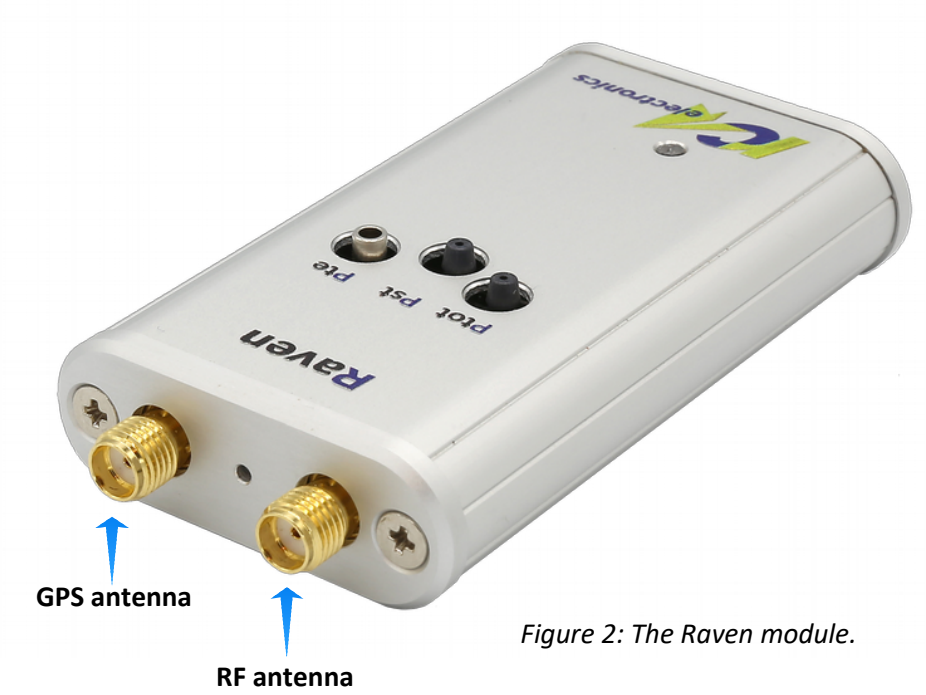


Figure 2: The Raven module.

Connect IAS probe to Ptot. IAS probe can be mounted in nose or on tail where air is laminar. When using V tail model, special IAS probe for V tail can be mounted on top of fuselage

Static pressure is connected to Pst port. Static can be taken from sides of fusalage using special IAS tubbing set.

Multi color LED

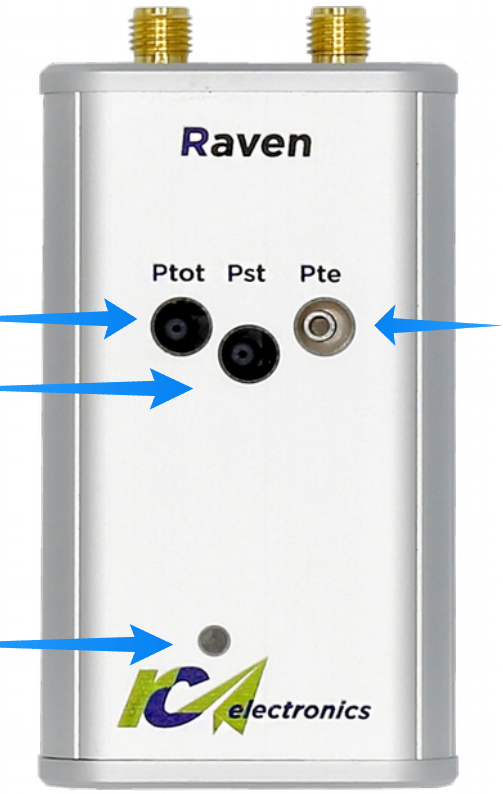


Figure 3: The Raven module.

There are 2 ways of connection Pte port:

1: When using normal TEK probe, connect it to Pte port and vario willl be calculated from measuring compensated pressure at TEK probe.

2: When using electronic compensation connect Pte port to Pst port. There is a T-joint in IAS tubbing set for that. Vario is based on measuring static pressure and then using mathematical equation of TEK probe to compensate it for changes in altitude due to elevator control. In order to enable electronic compensation, user must set TE level to around 90% and then fine tune it to get the best result by changing this TE level parameter.
Refer to special chapter for electronics compensation and TE level.

Using the Raven module

Powering the module

To power the Raven module plug the 3 pin female connector cable into one of servo channel inputs and the other end to the R/C aircraft receiver. **Be sure to observe proper polarity when plugging the connector into the module and receiver**. You can also power it directly from a battery. Please respect max voltage input of 18V and correct polarity.

When power on the LEDs will flash red, green, blue and white to confirm its operation. During operation LED status is:

red – module is waiting for GPS signal

green – module is ready for flight

blue – onboard logger is running

white – not yet implemented.

Mounting the module

The Raven module and the gps antenna can be mounted using double-sided tape, cable ties or Velcro. Velcro is recommended, so that the module can be easily removed and interfaced with the PC for downloading flight data. Mount Raven as horizontal as possible due to internal 9-DOF sensor to detect correct orientation.

Be sure that the module is not touching any metal surfaces. Although unlikely, there is a possibility of shorting the metal contacts on the module, which could result in a radio system failure. The Raven antenna should be located so there is no carbon or large metal items blocking its line of sight to the Snipe ground station. For example the Raven should be located in an area of the fuselage that is free of carbon or antenna extend cable should be used to mount antenna to non carbon area.

Do not mount the module on top of power batteries when using electric motors, because they get hot and this can affect the altitude readings by up to 30m.

Be sure to keep the module away from water, fuel and other liquids. Always range check and test the aircraft's radio systems before flying with the Raven module installed, to verify that all connections have been made correctly and there is no system interference.

GPS antenna has to be mounted where there is no metal or carbon above it and must be turned in such direction that white arrow is pointing up towards the sky as in Figure 4.

Figure 4: Correct position of GPS antenna

Static tube installation

In order to utilize the full capability of the Raven an Indicated Airspeed (IAS) probe must be install in the aircraft. The IAS probe must have two components, Ptot (total air pressure) and Pst (Static Air pressure). Tubing from the Ptot probe and Pst probe needs to be connected to the Ptot and Pst ports on the Raven. Use only doft sillicon tubing to connect to ports of the RAven

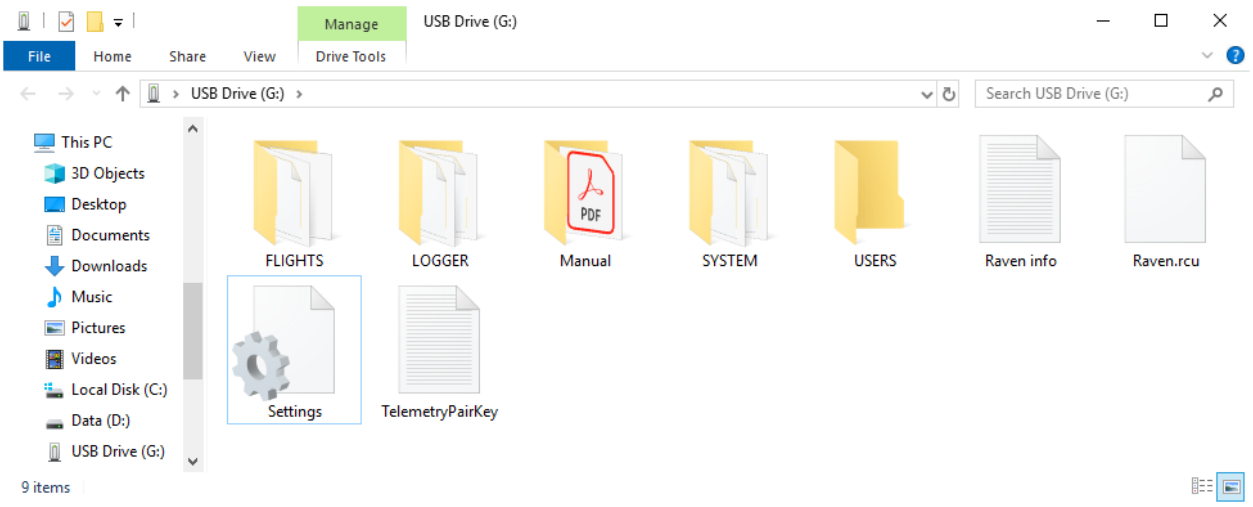
Inside IAS tubing set user can find one 3mm brass fitting where IAS probe can be connected. This fitting must be installed in nose or on tail as high as possible to get as laminar air flow as possible. It must point to the flight direction. Additionally, 2 x 2.5mm brass tubes for static intake on sides of fuselage are located in IAS tubing set. Those tubes must be located where airflow around fuselage is in non-turbulent area. We advise to install it in canopy area in front of wing on each side of fuselage. To connect all together a silicone tubes and 2 x plastic T-jonts are included. Figure 5 shows an example of how to connect all components and to use electronic compensation for vario (Pte is connected to Pst). When normal TEK probe is used then connect Pte to TEK probe and do not use 2nd T-joint.

Left side of fusalage Right side of fusalage

Figure 5: Example how to connect tubbing with electronic vario compensation

Connecting module to PC

Connect the Raven module to a PC using a cable with a micro USB connector inserted into the micro usb slot on the Raven. When connected to the PC the module will power up and will open a new flash disk on the computer screen. On that disk there are system folders and files which can checked for their contents. The “FLIGHTS” folder contains all flight data (IGC, DAT and POL files). The “Raven Info.txt” file is a file showing all the information about the module (Name, Serial Number- SN, HW version, Settings used, …etc.). **Inside TelemetryPairKey.txt user must enter valid and correct serial nr of Snipe unit.** Settings.ini file is a specific hardware settings



Raven info.txt example:

Device: Raven - device name
Serial No: 178001 - device serial no.
IGC Sn: 001 - device unique IGC number (for future use)
HW: 1.1 - Hardware version of device
Produced: 27.9.2018 - date of production
FW v: r.0.9.B100 - Firmware version installed
Telemetry Pair key: 168015 - Telemetry pair key (Snipe serial nr)
3rd party telemetry protocol in use: JetiEx Compressed data - Telemetry protocol on 3rd party connector
TE Level: 0 % - electronic compensation level set
Filter: 1.5 s - Vario filter set
Servo trigger level: 30 % - Servo level to arm / restart a task on Albatross
Servo control input: Bottom connector - Can be bottom connector or channel from JetiEX data

TelemetryPairKey.txt example:

Snipe serial nr: 168015 - **Enter here yours Snipe serial nr to have a valid RF link**

Settings.ini example:

//0: 3rd party telemetry disabled
//1: JetiEx
//2: PowerSystem
//3: JetiEx compressed data for GPS triangle racing
3rd party telemetry in use: **3**

Set a number which represents a system you are using for back channel telemetry. For Jeti we have 2 options. Compressed data is not presenting human readable data and is used for high rate data transfer needed for GPS triangle competitions. Normal JetiEx is sending human readable data which can be seen on transmitter

// Servo channle for servo control. If -1 is used then
// lower servo input on device is used, else servo channel from
// 3rd party telemetry data
Servo channel: -1

If there is no psychical connector on JetiCB to be used as servo control to start/restart task and switch pages on Albatross application then servo channel from JetiEX data can be taken. On JetiEx bus there is 24 channels! For example Jeti ESC are also using this option to be controlled over JetiEX connector, not requiring extra servo channel for throttle.

Modes of operations

Electronic compensation

Electronic compensation can work only when an IAS probe (Indicated Airspeed) is installed in aircraft and connected to Raven. It is used when the user wishes to fine tune the TEK probe (TEK probe can be over or under compensating dynamic change of plane). For fine tuning of TEK probe set TE level in range of -10% to +10%. When TEK probe is over compensating then reduce the value and if not compensating enough then increase the value.

It is also possible to use electronic Total Energy compensation exclusively with the Raven. In this case the TEK probe is not needed and can be removed. Pte static port on Raven must be then connected to Pst port measuring static pressure. When using only electronic compensation the user should set TE level somewhere between +70% to +110%.

Setting the right value takes some time, after a new value is set, a test flight should be made in still conditions. When properly adjusted, diving and pulling up should not produce any change in Vario tone. This goes to using fully electronic compensation or fine tuning TEK probe.

Each aircraft will have a different TE level settings, time spent adjusting and testing will be beneficial.

Polar measurements

To measure the "polar" of your aircraft you will need to make a flight or multiple flights in still air, early in the morning. The complete flight must be made on one flap setting and any snap flap disabled! Before measuring polar pilot must have correctly compensated vario (fine tuned TEK probe or correctly set TE level for electronic compensation)

The aircraft should be flown with different airspeeds ranging from minimum speed to maximum speed. Try to fly a large triangular course with very gentle turns and no abrupt maneuvers. There can be many flights made which can later be combined to get a good polar. Example: ASW17 6.6m wingspan with 0 flap setting at 17.5kg will fly from 55km/h to up to 200km/h! Try to fly with constant speed for at least 300m then increase speed for 2-5km/h. **The Polar will be measured from end of towing until 100m above takeoff position!**

After flight send the *.POL file with specification which glider you are flying, flap setting (0, thermal, speed, etc.) and weight of glider to: support@rc-electronics.eu

At this time "polar" measurements are used for obtaining "polar" info data, which will later be used in the Android app to alert the pilot how fast he should fly (Speed To Fly) and for MC dolphin flying. The "Polar" of the aircraft also helps user to get the info on "netto" air movement even when flying at high speeds.

Firmware update

1. Download latest firmware for Raven from our web site. Firmware should have name Raven.rcu
2. Connect Raven to PC via USB cable
3. Copy Raven.rcu to Raven flash disk and do a power reset.
4. Check in Raven info.txt file that new version is installed.

Revision history

20.11.2019	V1.2	- Added Settings.ini file description - Description of latest Raven info.txt file
05.04.2019	V1.1	- Added TelemetryPairKey.txt file description
23.01.2019	v1.0	- initial version