JetCat RX/RXi Turbines with V10 ECU

Ingenieurbüro CAT, M. Zipperer GmbH, Wettelbrunner Straße 6
79282 Ballrechten-Dottingen
Tel: + 49 (0) 7634 - 5056 - 800
Fax: + 49 (0) 7634 -5056 - 801
Internet: www.jetcat.de

V1.2

JetCat Three Year Limited Warranty.

Ingenieurbüro CAT, M.Zipperer GmbH, Wettelbrunner Straße6, 79282 Ballrechten-Dottingen, Germany hereafter called JetCat warrants that this MINATURE TURBOJET ENGINE for model aircraft, cars or boats ("Model Engine") enclosed with this warranty statement is free from defects in materials and workmanship during normal usage, according to the following terms and conditions.

1) The limited warranty extends to the original purchaser ("Buyer") of the Model Engine and is assignable or transferable to any subsequent purchaser /end-user.
2) Upon request from JetCat, the Buyer must prove the date of the original purchase of the Model Engine by a dated bill of sale or dated itemized receipt.
3) Warranty coverage begins the day you buy the Model Engine. For 3 (three) years all labor and parts except for the glow plug bearings and battery will be repaired or replaced free of charge. All parts, including repaired and replaced parts are covered for the original warranty period. When the warranty on the Model Engine expires, the warranty on all replaced and repaired parts also expires.
4) During the limited warranty period, JetCat will repair or replace, at JetCat's option, any defective parts with new or factory rebuilt replacement items if such repair or replacement is needed because of Model Engine malfunction or failure during normal usage. No charge will be made to the Buyer for any such parts. JetCat will also pay for the labor charges incurred by JetCat in repairing or replacing the defective parts. The limited warranty does not cover defects in appearance. JetCat shall not be liable for any other losses or damages.
5) The Buyer must operate and maintain the Model Engines in accordance to the Model Engine manual. The Model Engine must be returned to JetCat for maintenance on or before the TBO (Time Before Overhaul) interval of every 25 hours. lf Buyer fails to return the Model Engine within the. TBO interval, any damaged parts affected by this negligence will be subject to additional repair costs.
6) The Buyer shall have no coverage or benefits under this limited warranty if any of the following conditions are applicable
   a) The Model Engine has been subject to abnormal use, abnormal conditions, improper storage, unauthorized modifications, unauthorized repair, misuse, neglect, abuse, accident, alteration, improper installation or other acts which are not the fault of JetCat, including damage caused by shipping.
   b) The Model Engine has been damaged from external causes such as crash damage, foreign object damage, weather, Act of God, improper electrical connections, or connections to other products not recommend for interconnection by JetCat.
   c) The Model Engine is operated for commercial or institutional use.
   d) The Model Engine serial number has been deliberately removed, defaced or altered.
7) If a problem develops during the limited warranty period, the Buyer shall take the following step-by-step procedure:
   a) The Buyer shall ship the Model Engine prepaid and insured to JetCat.
   b) The Buyer shall include a return address, daytime phone number, complete description of the problem and proof of purchase.
   c) The Buyer will be billed for any parts or labor charges not covered by this limited warranty.
   d) If the Model Engine is returned to JetCat during the limited warranty period, but the problem with the Model Engine is not covered under the terms and conditions of this limited warranty, the Buyer will be notified and given an estimate of the charges the Buyer must pay to have the Model Engine repaired, with all shipping charges billed to the Buyer. If the estimate is refused, the Model Engine will be returned freight collect. If the Model Engine is returned to JetCat after the expiration of the limited warranty period, JetCat 's normal service policies shall apply and the Buyer will be responsible for all shipping charges.
8) The Buyer must bear the cost of shipping the Model Engine to JetCat, Germany. JetCat shall bear the cost of shipping the Model Engine back to the Buyer after the completion of service under this limited warranty. The Buyer must pay for any other shipping charges.
9) The Model Engine consists of newly assembled equipment that may contain used components that have been reprocessed to allow machine compliance with Model Engine performance and reliability specifications.
I0) JetCat shall not be liable for delay in rendering service under the limited warranty, or loss of use during the period that the Model Engine is being repaired.
11) JetCat neither assumes nor authorizes any other person or entity to assume for it any other obligation or liability beyond that is expressly provided for in this limited warranty.
I2) This is the entire warranty between JetCat and the Buyer, and supersedes all prior and contemporaneous agreements or understandings, oral or written, and all communications relating to the Model Engine, and no representation, promise or condition not contained herein shall modify these terms.
I3) Buyer must fully accept all conditions of the PURCHASE AGREEMENT, FULL ASSUMPTION OF LIABILITY AND INDEMNITY AGREEMENT
I4) lf the Buyer is not prepared to fully accept the liability associated with the use of this Model Engine, the Buyer is advised to return this Model Engine immediately in new and unused condition to the place of purchase.
I5) This limited warranty allocates the risk of failure of the Model Engine between the Buyer and JetCat. The allocation is recognized by the Buyer and is reflected in the purchase price of the Model Engine.
I6) Questions concerning the warranty may be directed to:

Ingenieurbüro CAT
M.Zipperer GmbH
Wettelbrunner Straße 6
79282 Ballrechten-Dottingen
Germany
Phone +49-7634-5056-800

Inhaltsverzeichnis

Introduction

Welcome to the Jet Age of model aircraft! ***JetCat*** is pleased to sell, support and service the ***JetCat*** turbine engine and greatly appreciates your purchase. We hope the ***JetCat turbine*** brings you many days of pleasurable flying.

Obviously, model turbine aviation - despite all the apparent fun involved - is serious business. The ***JetCat turbine*** has undergone extensive testing and redesign, in order to ensure it is a safe and reliable model turbine; however, it is **not** a recommended power source for the average model builder. It requires a good background in model flying and a working understanding of the principles of turbine engines, along with a disciplined commitment to correct and safe operation, in accordance with these instructions.
To begin, read this manual thoroughly. Develop an overall impression of the turbine and its operating procedures, measuring equipment and accessories. Study the material step-by-step and ascertain how to install, operate and maintain your turbine engine. If you are unsure about anything, re-read it again.

DO NOT OPERATE THE *JetCat turbine* BEFORE YOU HAVE READ THE MANUAL AND FULLY UNDERSTAND EVERY PROCEDURAL DETAIL

Should you still have doubts or questions, do not hesitate to contact ***JetCat*** for further assistance.

The ***JetCat*** model jet turbine closely functions like a full size jet turbine. A centrifugal compressor compresses the incoming air which is mixed in the combustion chamber with fuel (jet fuel / kerosene) and ignited. The result is a rapidly expanding volume of gas that drives an axial turbine wheel. The gas exiting the exhaust cone produces the required thrust for the jet model. To start the turbine, an electric motor is mounted on the front of the turbine. During startup to preheat the combustion chamber was formerly done with an auxiliary gas (propane / butane). However, the new ***JetCat*** RX series turbines utilize an internal kerosene start system using only a single fuel (kerosene) for starting and running. This single fuel operation is a more appropriate and simpler way of starting instead of the using a glow plug and an auxiliary fuel. RX turbines have the fuel control valves mounted internally for a very simple single fuel connection. The compressor is machined from high strength aluminum alloy using modern CNC technology. This guarantees even higher speed stability and an incredibly fast and precise acceleration.

The ***JetCat*** V10 ECU is a sophisticated on-board electronics that controls and monitors all the operating parameters. The parameters are displayed on the included hand held terminal (GSU) and several can be modified by the user for optimizing different installations. The power supply for all on board components, including the internal starting plug, is supplied via a 9.9V lithium iron phosphate battery.

The complete turbine kit contains all components required for operation and is a “plug and play” configuration.

Safety, meaning of symbols

	**Attention!** This symbol highlights the following points which must be strictly observed by the user! Any violation of the corresponding restrictions may impair the safe operation and the safety of the user.
	**Attention!** This symbol highlights restrictions which must be strictly observed by the user! Any violation of the corresponding restriction may impair the functional efficiency and severely compromise user safety.
	**Attention!** This symbol highlights information that should be heeded by the user to ensure safe operation of the device
	**Attention!** Fire or explosion hazard!
	**Attention!** This symbol warns of hot objects and surfaces. Any violation of the corresponding restriction may affect the health of the user.

Safety Precautions

	**Warning!** **Errors and/ or defects in the construction or operation of a jet model can lead to personal injury or even dead**
	**Attention!** **Before you put a model aircraft in operation, you must learn about the law. Legally, a model aircraft is a real aircraft and is subject to applicable laws which must be strictly adhered to. The rules of other countries are to be observed accordingly.**
	**Warning!** **It is your responsibility to protect others from injury. The minimum operation distance of residential areas to ensure the safety of people, animals and buildings must be at least 1 mile. Never operate model turbine jet aircraft in or around residential or heavily populated areas. Keep a safe distance away from power lines. Do not fly the model in bad weather with low clouds of fog. Never fly into direct sunlight, otherwise you might lose sight of model. To avoid collisions with manned or unmanned aircraft, land your plane immediately if a plane approaches. Persons or animals must comply with the following minimum safety distances form a turbine model:** **In front of the turbine =15 feet** **On the side of the turbine =25 feet** **Behind the turbine =15 feet**
	**Warning!** **The construction and operation of the model and / or turbine under the influence of alcohol, drugs, medicines, etc. are strictly forbidden. These activities must take place only in the best physical and mental health condition. This applies to both the operator and any assistants.**
	**Warning!** **The jetCat model turbines were designed exclusively for model aircraft and are NOT suitable for any other purpose. Never use for any other purpose except for the flight of the model. Any other types of uses may result in personal injury or death.**
	**Warning!** **Any deviations from these instructions or the instructions of the manufacturer, the use of other parts or materials or changes to the system may have an adverse effect on the functionally and reliability of the turbines and therefore must be avoided at all costs.**
	**Warning!** **The operation of a model jet turbine can only be done under strict accordance of the model, remote control and turbine operation manual. Before flying the model, all control functions and surfaces as well as the range of the remote control system must be checked in the accordance of the manufacture. The checking of these operations must be repeated with a running turbine engine including the remote control system range.**
	**Warning!** **In case of a mishap, fire extinguishers should be on hand at all times. JetCat recommends the CO/2 variety. Powered extinguishers will corrode the precision components inside the turbine and void your warranty.**

	**WARNING!** **When the turbine is running, never place your hands closer than six inches into the area of the intake. An extreme suction which can grasp a hand, fingers or other objects in an instant exists in this area. Always be aware of this source of danger!** **Prevent foreign materials from entering the intake or exhaust when working with the turbine. Before operation, make sure there are no lose parts or debris near the turbine. Objects being sucked in can cause severe damage. If your installation allows, we highly recommend using a "Jet Net" to protect the intake.**
	**WARNING!** **Never run the turbine in a closed room, or an area near any kind of flammable matter. Do not fly turbine-powered aircraft near flammable materials, nor in forested tracts or areas experiencing drought or dryness. Obey all forest fire regulations and warnings by refraining from operating the *JetCat* turbine in restricted fire zones.**
	**WARNING!** **The overflight of people, especially at low altitude, is strictly prohibited**
	**Attention!** **Always exercise caution around the hot parts of the turbine, to avoid burns. The outer case at the turbine stage and nozzle reaches 450-600° (Celsius), while the exhaust gas may exceed 800 °C.**
	**WARNING!** **Assure that the fuel is mixed with approximately 5% synthetic oil. Use only synthetic turbine oils available at local airport fuel suppliers. Synthetic turbine oils are dangerous and should only be handled as per the manufactures MDS sheets. *JetCat* has available a compatible oil that is less harmful that also contains an antistatic ingredient. Contact *JetCat* for more information.**
	**WARNING!** **To the avoid hearing damage, always use hearing protection when you are near a running turbine engine!**

Quick Start section for RX turbines with V10 ECU

This section covers just the very basics to get your ***JetCat*** turbine up and running. However, it is not a substitute for reading and understanding the manual in its entirety. There are many great features and options not cover in this section that are fully explained later.

- Identify components
- Mounting turbine support equipment
- Mounting turbine and fitting to tail pipe
- Fuel and electrical connections
- Battery power
- GSU and I/O board
- ECU power, setting failsafe and learn R/C
- Preparing fuel and fuel system
- Starting and stopping the turbine
- Running states
- Troubleshooting

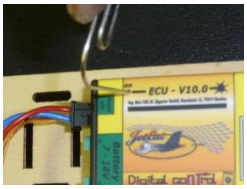
Identify components

1 – Turbine engine		1 – Pump Cable (only RX)	
1 – GSU, Ground Support Unit (Terminal)		1 – Fuel Line	
1 – ECU, Electronic Control Unit		1 – Fuel Filter (only RX)	
1 – Mini I/O board		1 – Turbine Mount	
1 – Pump (only RX)			
1 – Battery Pack			
1 – Turbine Power/Data Cable			
1 – I/O Board Flat Cable			
1 – GSU Data Cable			

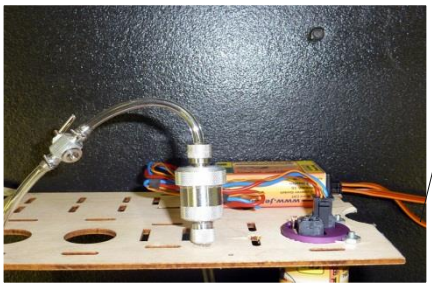
Mounting the turbine support equipment (RX)

There are just four main accessory components to decide where and how to mount in your model, (battery, ECU, I/O board and pump). Judge how to position these components within the cable lengths by laying them out in your model approximately where you would like to mount them. Since the components of the new RX series engines are so small, the default cables lengths should work for most installations. If longer cables are needed, consider a battery cable extension with heavy gauge wire as the simplest approach.

1. Battery. Usually the battery will mount in the nose area for balance requirements. When mounting, make sure it is secure but accessible since it is a component you will be removing regularly.
2. ECU should be mounted on a wood plate typically with Velcro. It should also be located in an easy location for removal. Consider applying the Velcro on the opposite side of the "**on**" switch access hole. See photo.
3. The I/O board should be mounted where the LED indicators will be visible and the data bus jack accessible for plugging in the GSU.
4. Ideally the pump should be mounted inverted using 4/40 screws and nuts through the flange holes (tubes mounted down and electrical connections on top. The pump requires a 1" diameter clearance hole. The pump can also me mounted horizontally with cable ties or clamp. Make sure that the fuel tubes will route so the fuel filter will be easy to access for cleaning. Favor the pump nearer to the UAT hopper tank keeping the inlet tube length as short as possible.



Underside view of equipment plate

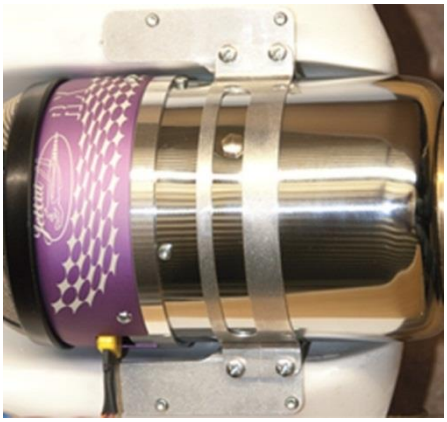


Topside view of equipment plate

In the above pictures is one example on how to mount the pump. In this case, there was plenty of room under the mounting plate to not pinch the tubes exiting the pump.

Mounting the turbine (RX/RXi)

A two-piece, aluminum mounting bracket is included with the turbine. Place the bracket around the turbine, with the center plug situated within the slot of the bracket or in the grooved portion of the turbine body depending on turbine type. This will help stabilize the turbine along the thrust axis. Secure the turbine, using four metric mounting screws and lock washers that are provided with brackets. The turbine can be set to any 360 degree rotational position.



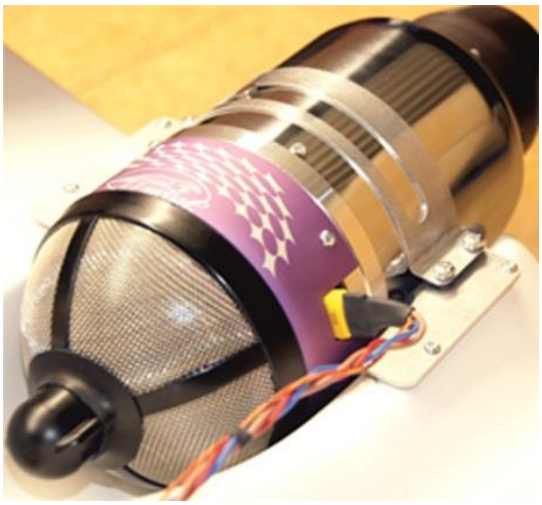
Turbine side view / thrust tube

For internally mounted turbines that do not utilize a bypass, set the ducting inlet ½ to ¾ of an inch after the end of the exhaust nozzle. For bypass installations, refer to the kit instructions for mounting the turbine. Use either reflective material or BVM heat shield paint to protect the fuselage near the hot section of the turbine. **Do not mount electrical components, fuel tubing or parts that could melt around the hot section of the turbine.**

Inlet Protection

Especially for models that have the air intake below the fuselage behind the nose wheel (F16 for example), there is the danger of small stones or dirt entering the turbine. In these cases you must incorporate intake protection (screen) in front of the turbine.

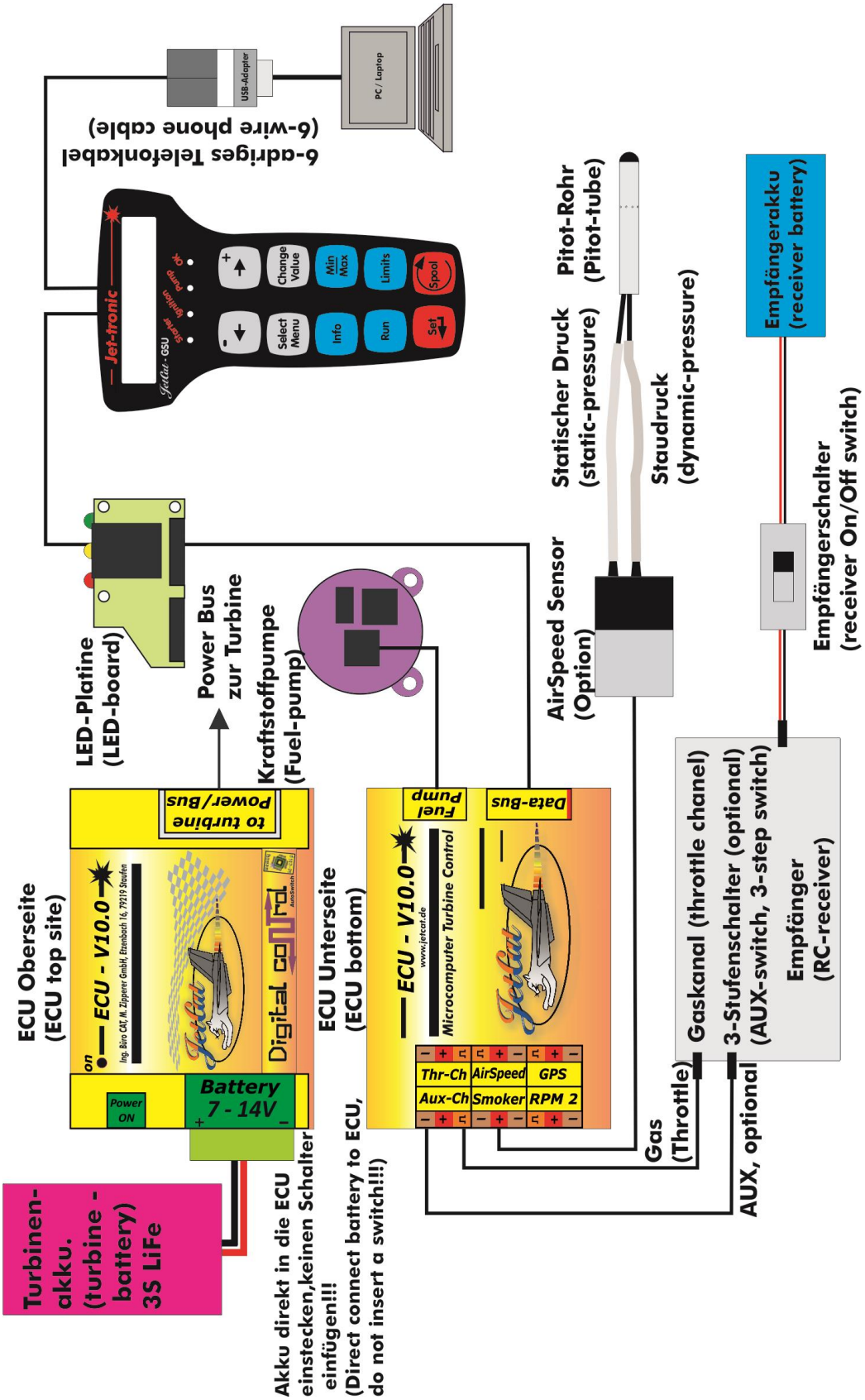
JetCat recommends a “Jet Net” to protect the turbine from debris. Available from ***JetCat!***



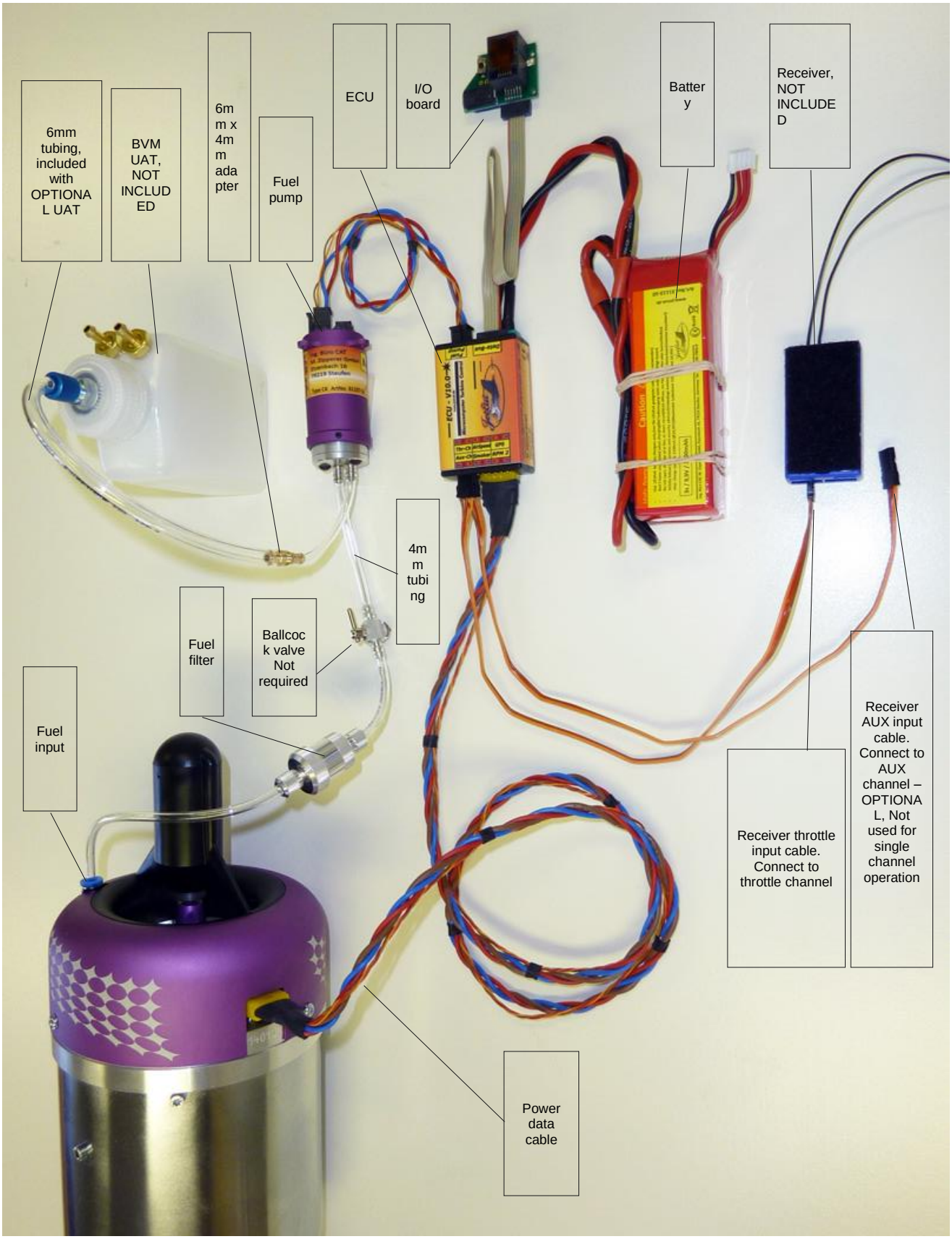
Connections

Once you have unpacked and identified all the components, follow the system diagram/photo for all connections.

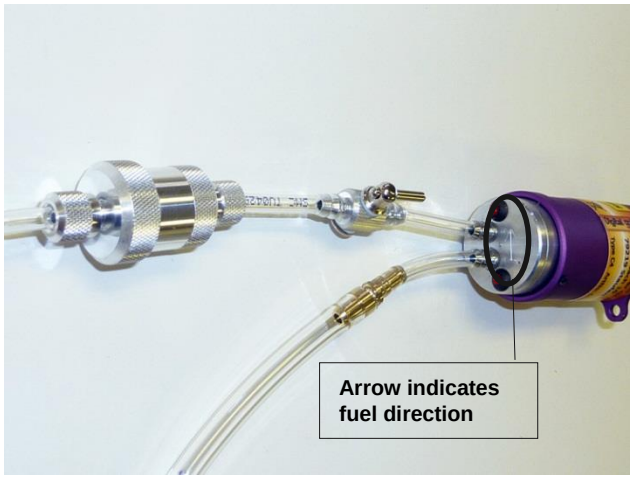
Complete System Connection Diagram RX



Complete System Connections RX Photo



Fuel connections RX

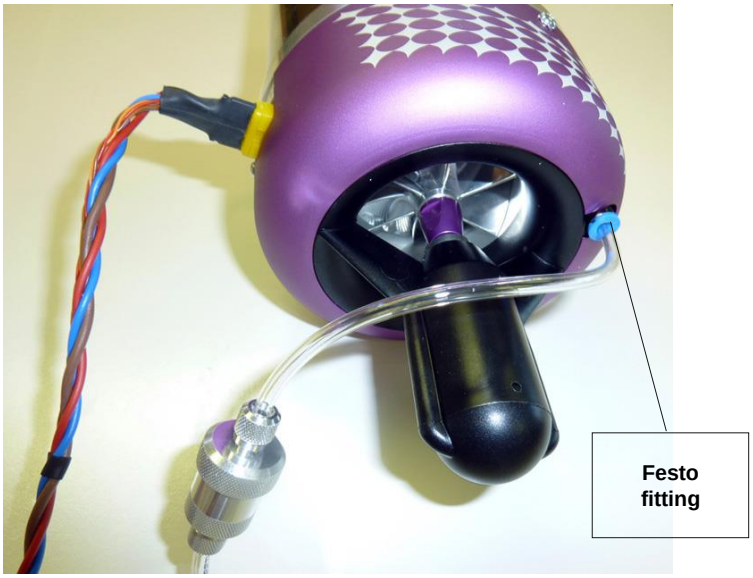


When installing tubing on a metal nipple fitting, secure the tubing by a double loop of safety wire around the connection. To remove tubing from the nipples, you must cut the tubing off. Be careful not to damage the nipple when cutting off the tubing. Warming the tubing can make it easier to slip over the nipple fitting. To insert tubing into Festo quick release fittings, use firm pressure until you feel the tube snap in. To release, press in on the blue plastic front ring, while pulling the tubing out.
The ballcock valve can be put on either side of the filter. When assembling the fuel filter, use caution not to pinch the O-ring when assembling. Clean off aluminum dust and **lubricate fine threads** before assembling**.**

We recommend mounting the fuel filter vertically. This will limit the possibility of air being trapped inside and then coming out at an inopportune time. It is also better not to affix it but to leave it free to slightly move.
ALWAYS use a gasoline-compatible stopper in your fuel tanks. **Silicon stoppers swell and leak**.

☞	The fuel demands are high, especially on larger engines, and require large tubing interconnecting the tanks. Use a 6 mm to 4 mm adapter to reduce the UAT 6 mm tubing to the 4 mm tubing connecting to the pump inlet.

☞	For safety reasons, ***JetCat*** recommends to replace the fuel pump after 25 hours of flight!

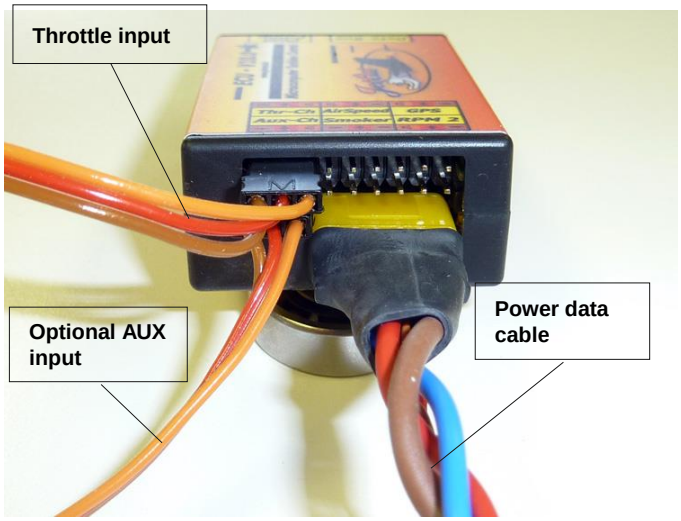


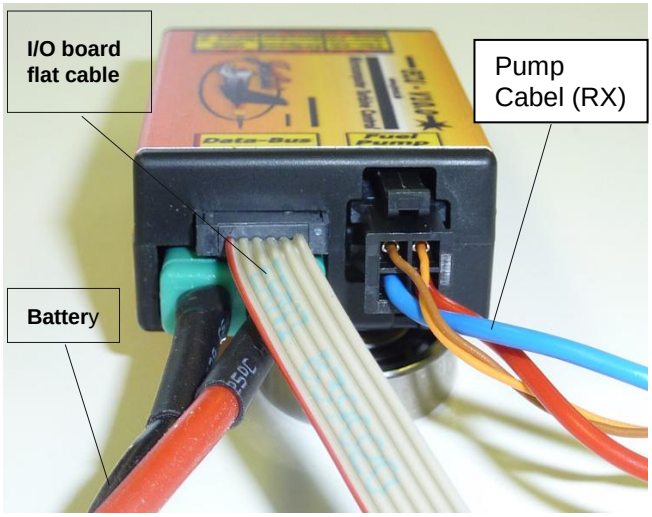
Hopper Tank - UAT

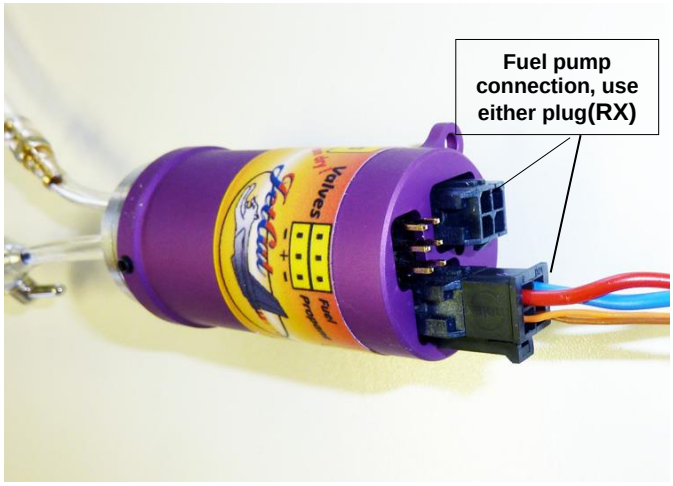
A hopper tank is recommended, between the main fuel tank and the turbine. ***JetCat*** highly recommends the **BVM** UAT for the hopper tank! The UAT is available as an option from ***JetCat.***

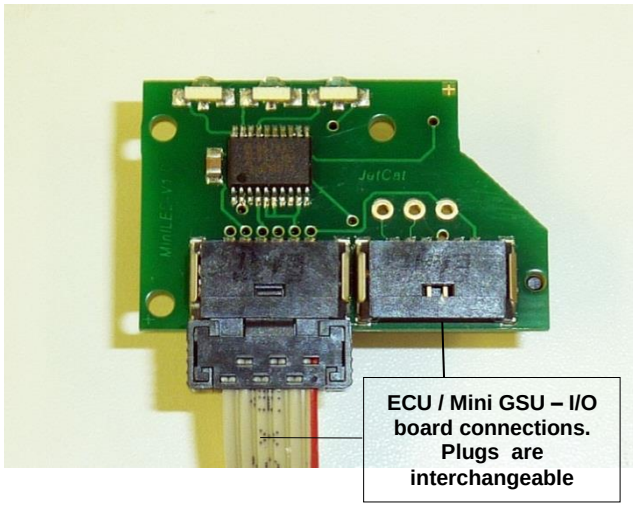
Always use the filter between the fuel pump and the turbine as shown in the diagram. This is true even when using the BVM UAT! The pump can emit small particles that can block the internal solenoid valves from completely closing!

Electrical connection





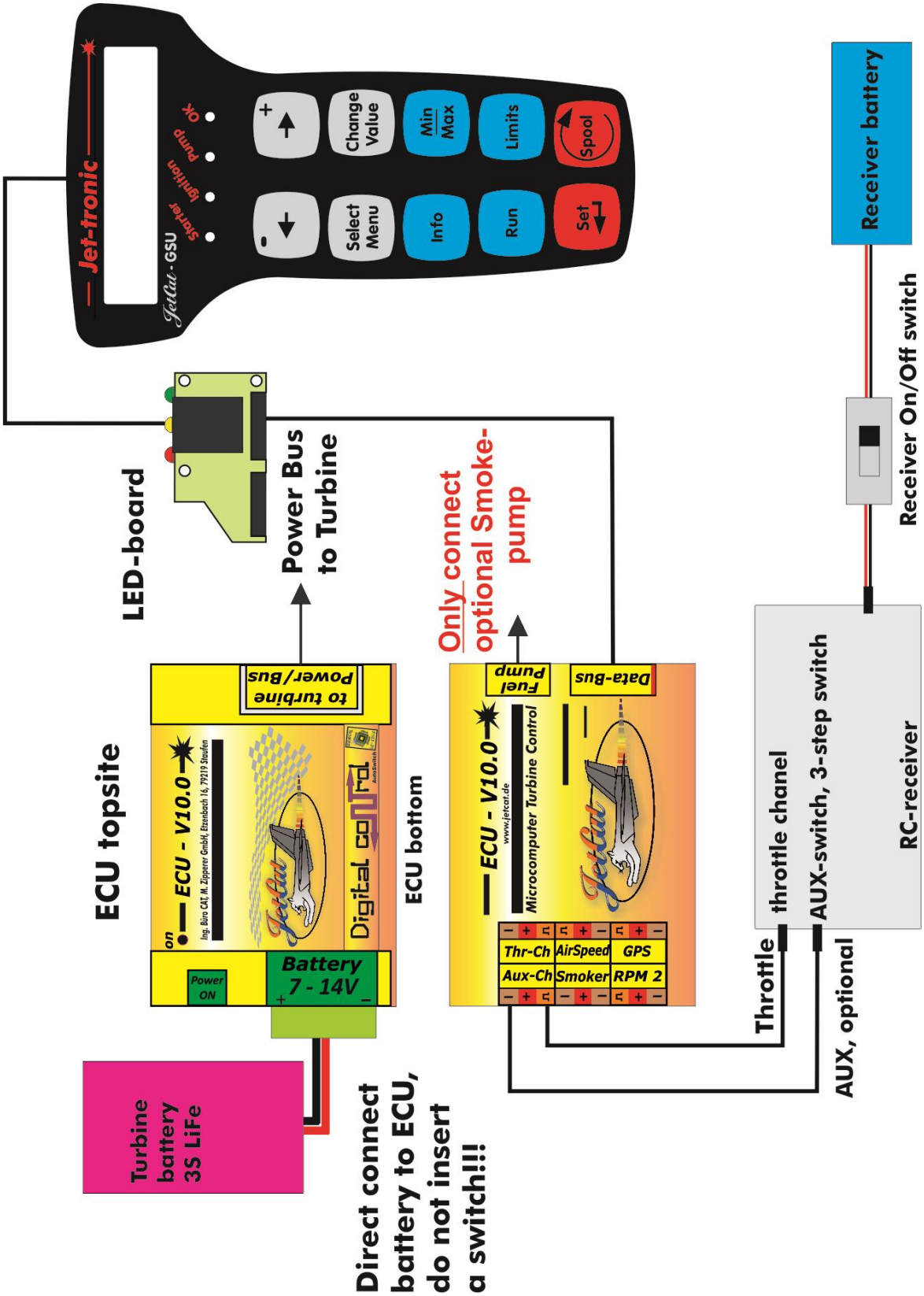




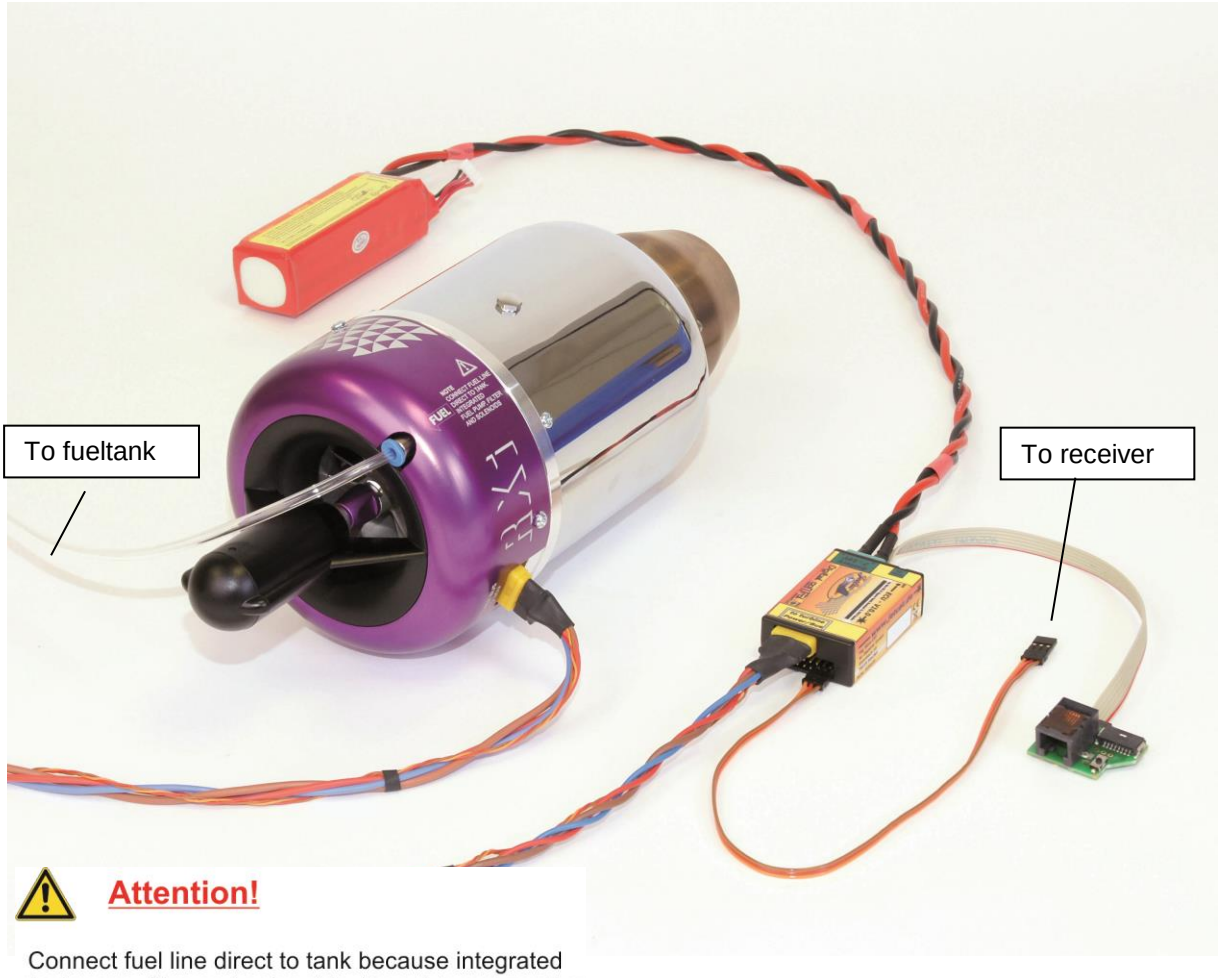
Interconnections

- Connect the fuel pump cable to either connector on the fuel pump and the ECU.
- Connect the Power/Data cable to the turbine and ECU.
- Connect the Flat cable to the LED I/O board and ECU.
- Connect a fully charged battery to the ECU. To charge the battery, refer to the **Power** section of this manual.

Complete System Connection Diagram RXi



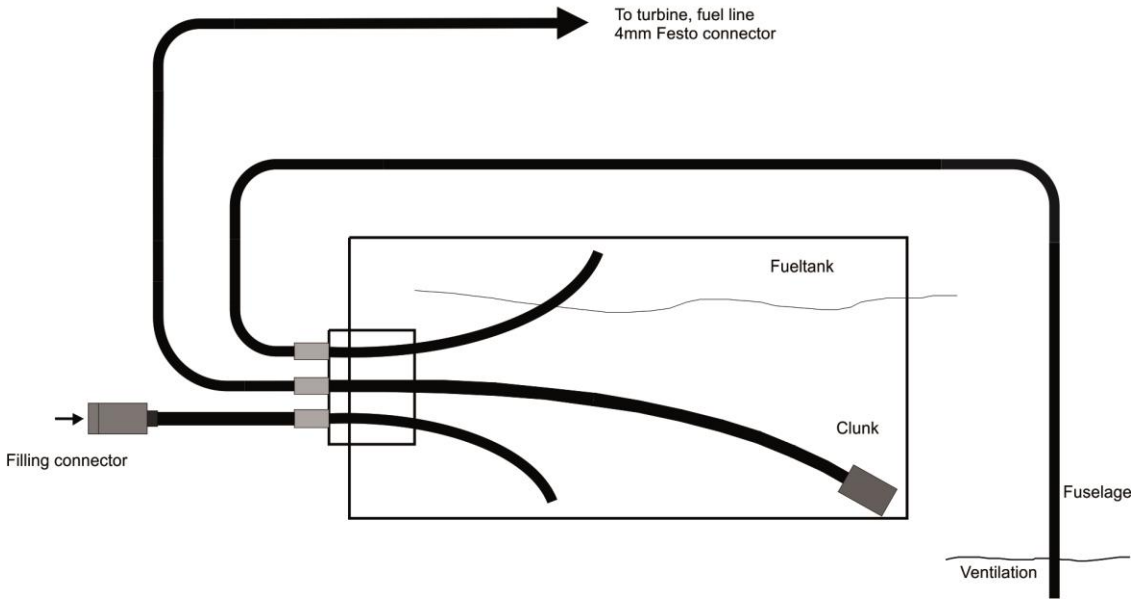
System Connection RXi Photo



Attention!

Connect fuel line direct to tank because integrated fuel pump, filter and solenoids. Do not insert another filter between tank and engine!
The connector „Fuel Pump“ on the ECU is only for smoke pump use.

Fuelsystem (Connection Diagramm)



Power

The operating power for all components of the turbine (starter / glow plug / ECU / fuel pump / valves ...) is from a **3-cell 9.9V 2200 mah LiFePo** battery. Alternatively, a 2(3) cell 25C or better LiPoly battery can be used, refer to battery types later in the manual in the **Limits Menu** options. The battery plugs directly into the ECU and the ECU powers on automatically when the receiver is switched on. If you plan to store the model for more than a few weeks, the battery should be disconnected.

Attention!

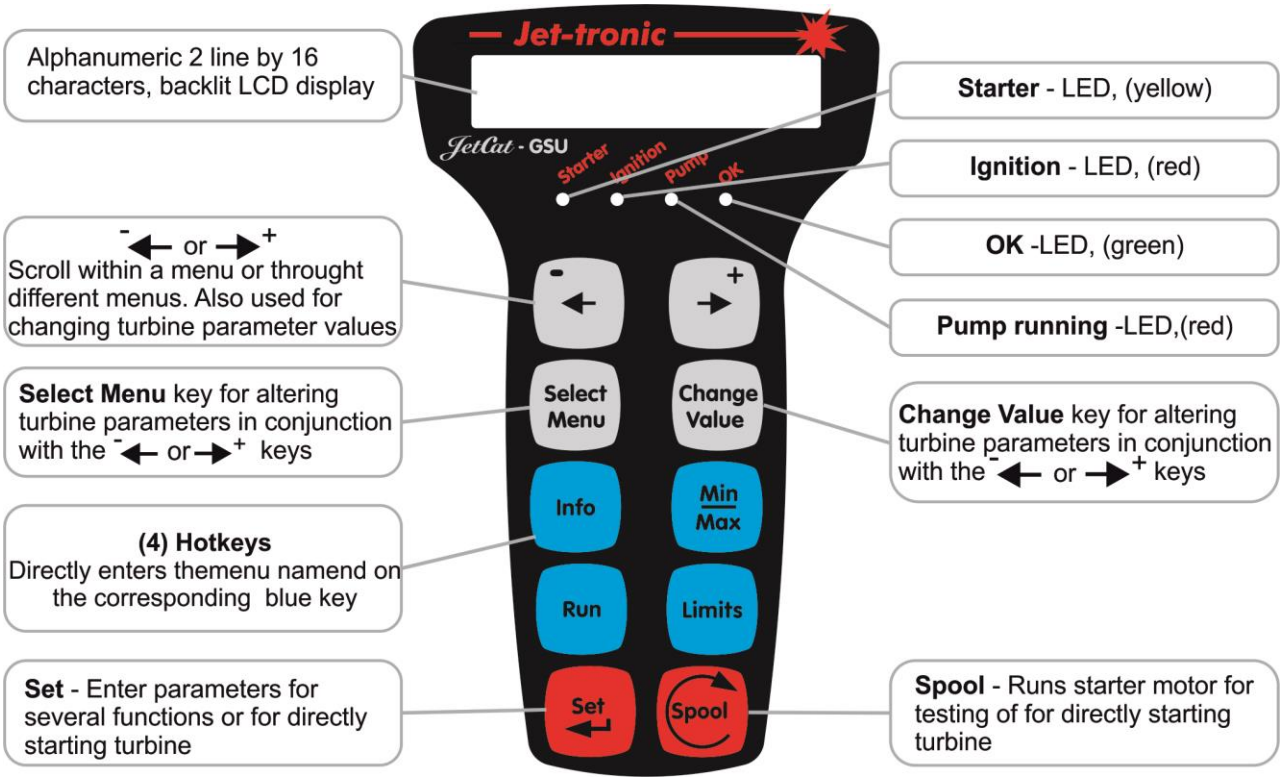
Fire! A LiPo/LiFePo battery can explode if incorrect charge parameters are used. You should therefore always refer to the manufacturer's charger instructions. **NEVER** charge the batteries unattended. **Do not exceed the batteries maximum allowed charging current. READ AND OBEY WARNINGS ON BATTERY BEFORE CHARGING!**

Always ensure the batteries are at their optimal charge state before use. The battery is heavily loaded because of the kerosene start. Please also note that at very low ambient temperatures, LiPo/LiFePo batteries have lower capacities.
IMPORTANT: DO NOT INSERT A SWITCH BETWEEN THE BATTERY AND ECU.

Ground Support Unit (GSU)

The GSU serves as a terminal for displaying and programming turbine parameters. It may be connected or disconnected at any time. The real time nature of the ECU allows the operator to adjust the turbine's parameters, even when the turbine is running.

GSU Control Panel Descriptions



OPTIONAL: Mini GSU, Part# 61161-00
With all the functionality of the larger version and, because of its small size and weight, it can be mounted in the model providing direct access to all information and functions.

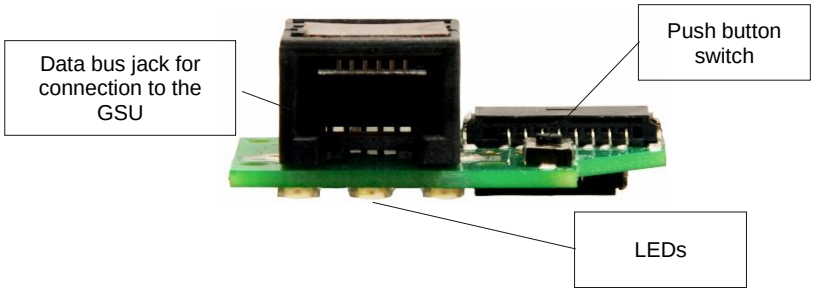
GSU Switch Descriptions

Key	Explanation
Info	Directly displays the **Info** menu (Hotkey).
Run	Directly displays the **Run** menu (Hotkey).
Limits	Directly displays the **Limits** menu (Hotkey).
Min/Max	Directly displays the **Min/Max** menu (Hotkey).
Select Menu	When the **Select Menu** key is pressed and held, the ◄ - / ►+ keys are used to select another menu. When a desired menu is reached, release the **Select Menu** key, and your selection becomes the currently displayed menu.
Change Value/Item	When the **Change Value/Item** key is pressed and held, the ◄ - / ►+ keys are used to change the indicated value. If the value is admissible to change, a small arrow appears in the display before the value. If the indicated value cannot be changed (e.g.: current RPM or temperature), the display will indicate that the "Value/Item cannot be changed".

☞	Please take the time to understand the table above especially the descriptions for the **Select Menu** and **Change Value/Item keys**. These are often used for viewing additional menus other than the Hotkey menus and for changing ECU settings.

The LED I/O Board

The LED I/O (**I**nput/**O**utput) board is a connection point for the data bus and a display for the current status of the ECU. The LED I/O board also features a pushbutton switch function to learn your R/C system, calibrate EGT probe or reset all parameters back to default (when powered up). These procedures are described later.



Description of LEDs on the GSU and LED board

Color	Designation	LED is on	LED flashes
Yellow	**Standby / start**	Starter Motor engaged	---
Red	**Pump running**	Fuel pump is on	Kerosene glow plug defective or turbine power / data cable is disconnected
Green	**OK**	Turbine running: throttle control active	If the turbine is running, the EGT is exceeding the maximum temperature. If the turbine is off, **Slow Down** mode is active

☞	If the yellow **Standby** and green **OK** LED's blink simultaneously, the battery is low and must be recharged.

OPTION: Part# 61168-00
The I/O board is enclosed within a housing and includes a connector for charging the battery.

	WARNING! When you charge a LiPo/LiFePo battery, the battery must be removed from the plane and never left unattended. **READ AND OBEY WARNINGS ON BATTERY BEFORE CHARGING!**

Jetcat V10 ECU

Switching on the ECU

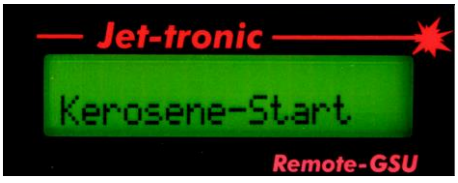
The battery is directly plugged into the ECU connector or via the optional Charge Plate I/O board (part #**61168-00). NEVER use a switch between the battery and ECU!!!.**

The ECU turns on automatically when power is applied to one of the two receiver connections, (THR and / or AUX channel). If the ECU was powered on with the transmitter off (no servo pulse), then there is a 60 second delay if the ECU is immediately powered off. To force the ECU to power off, simultaneously press the "Manual" and "Run" switches on the GSU.

The ECU can also be turned on without the receiver being powered on. To do this, there is a switch on the ECU labeled "on" and with a ballpoint pen or similar device, press the switch for 5 seconds. Settings can now be made or the turbine can be started via the GSU. After 60 seconds of inactivity, the ECU will shut off automatically. By simultaneously pressing the "Manual" and "Run" switches on the GSU, the ECU can be turned off immediately.

If the GSU is connected to the ECU then immediately after switching on the ECU, the GSU will briefly display the software version number, starting fuel type and turbine type.

ECU version, V10.1G in this example



Starting fuel type, kerosene in this example

Turbine type, P100-RX in this example

Single or two channel operation?

The turbine may be operated with either one or two channels from your receiver (throttle only or throttle and an auxiliary channel). If single channel is selected, starting, stopping and controlling the power is all accomplished with just the throttle channel. If two channel operation is selected, an auxiliary channel can be used to start, stop or optionally control other special features of the ECU like the smoke pump and airspeed control explained later in the manual. Most commonly, one channel is used.

How to set your ECU for single channel operation

Single channel operation can be selected automatically by not connecting the auxiliary channel cable to the receiver. When you are in the **learn R/C** mode, it will detect the auxiliary channel is not plugged in and will automatically change to single channel operation (auxiliary channel = **Not Used**).

To manually select one or two channel operation, follow the instructions below. This is required for changing from single to two channel operation.

- Plug in the GSU and power up the system.
- Press the **Limits** key.
- Using the ►+ key, scroll through the selections until **AUX-channel func** is displayed.
- There are three selections in the **AUX-channel func menu**. While pressing the **Change Value** key, use the ◄ - or ►+ key to scroll through these selections.

:ON Turb Ctrl ON	Aux channel enabled for turbine control enabled.
:ON Turb Ctrl OFF	Aux channel enabled for speed limiter functions and/or Smoker. Turbine control disabled. You still need to use the AUX channel for speed limiter and/or smoker functions but the turbine control will be in Single Channel Mode.
:Not Used	Single Channel Mode. Totally disable the AUX channel input for turbine control, speed sensor and smoker functions. AUX channel wire does not need to be connected to the receiver in this mode. If Not Used is selected and you have a speed sensor, the Maximum Limit Speed is still active, limiting the maximum speed your plane will fly. You cannot disable this safety function.

Setup failsafe mode

The ECU has the unique ability to shut-off your turbine if you have a radio failure. This is accomplished by detecting that the signal from the receiver's throttle output is either missing or outside the values that were learned during setup.

YOU ARE REQUIRED TO USE THE FAILSAFE!

This will not instantly shut off the turbine. A timer is started when the failsafe condition occurs and the turbine will immediately go to idle. After 2 seconds (AMA requirements as of March 1, 2004) the turbine will then shut off. This 2 second timer is reset back to zero anytime a non-failsafe condition is met. Your R/C signal must be broken for at least 2 continuous seconds before the turbine is shut off.

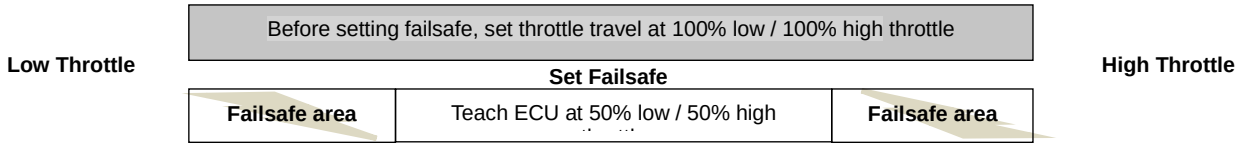
The following failsafe instructions are for PCM or Spread Spectrum receivers only. (PPM Receivers are not allowed under AMA rules.)

Setting the failsafe

The following procedures are for most radios like JR, Futaba or Airtronics/Sanwa →

If you look at the following servo travel graph below, you can see how the ECU detects a failsafe condition. The gray bar is the transmitters throttle channel end points set for +/- 100% travel. This is the travel range when setting the transmitter's failsafe. The white bar is a reduced end point travel set for +/- 50% travel. This is the value that will be taught into the ECU. If the throttle input to the ECU is between 50% for low throttle, low throttle trim and 50% for high throttle, then this would be within the ECU's taught range and will operate normally. If a failsafe condition exists, the transmitter's pre-programmed 100% low throttle, low throttle trim will be outputted by the receiver and this value would be outside of the ECU's taught in range.

The ECU will now automatically set the turbine to idle (after a default 0.1 second **FailSafe delay**) and start a programmable timer. The timer is set to 2 seconds by default. If the timer times out, the ECU will shut-off the turbine. If at any time during this countdown the receivers signal is reacquired, the ECU timer will be reset and the turbine will go back to the speed the throttle stick is currently at.
Setting the travel range to +/- 50% does not affect the RPM range of the turbine.



☞	If you change your transmitter's failsafe after these steps are completed, you must redo the following instructions again**.**

FOR TWO CHANNEL OPERATION: Do not enable the auxiliary channel in your transmitter for failsafe. Keep it in **hold mode** only. The auxiliary channel is always designed to stop the turbine instantly if commanded to do so.

For spread spectrum radios, there are two different ways to set the failsafe. It is either accomplished by the transmitter's failsafe menu or by binding the receiver to the transmitter. Refer to your transmitter's manual on how to set the failsafe.

To set the failsafe, you must execute the following steps. It is **VITAL** that these steps be performed in this order for the failsafe feature to operate properly. **YOU MUST PERFORM THESE STEPS!**

- Inspect the transmitter programming to ensure that dual rates and exponential functions are disabled and sub trim is set at zero for both throttle and, if two channel operation, the auxiliary channel. Some transmitters have a travel limit menu in addition to travel end points menu. If so, set the limits to its maximum amount >= 100%
- Set your transmitters end point travel parameter to +/- 100% for low and high throttle.
- If you are using two channel operation, position the auxiliary channel to the center position.
- Set your transmitters throttle stick to low throttle and low throttle trim. Depending on the radio system you are using, either set the throttle channel for failsafe and store/memorize this minimum position or bind your receiver to the transmitter.
- Return to the travel end point menu and now set the low and high throttle end point to +/- 50%.
- Now you must teach in these values into the ECU. Refer to **Learn R/C** section next in this manual.

Additional Failsafe menus are explained in the manual's advanced section.

“Learn R/C”. Teach the ECU to the R/C System

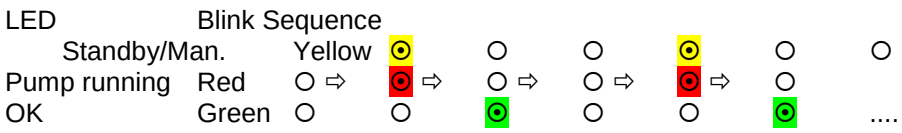
Before the ECU can be used for the first time you must program the failsafe and learn the throttle stick and optionally the auxiliary control positions of your R/C system.

To accomplish this, complete the following steps:

1. Connect one or both ECU servo cables to the receiver depending on either using single or two channel operation. The “**THR**” cable connects to the throttle channel and if used, the “**AUX**” cable must be connected to a channel capable of three (3) positions or a variable control. Make certain that all other connections are made in accordance with the **Electrical Connection Diagram**.
   Note: Even if you do not use the auxiliary channel for control, you can still plug the **“AUX”** cable into an unused receiver channel for a redundant power signal connection. However, if this is done, you must manually disable the auxiliary channel in the limits menu.

2. While pressing the **Select Menu** key on the GSU, switch on the receiver.
   Note: Instead of the **Select Menu** key on the GSU, the small button switch on the LED I/O board may be pressed instead. This key can also be used to advance through the **learn R/C** sequence (described below). This feature is useful when the GSU is not available. Keep in mind that the LED’s on the I/O board are the same as the GSU for **Standby**, **Pump running** and **OK**.

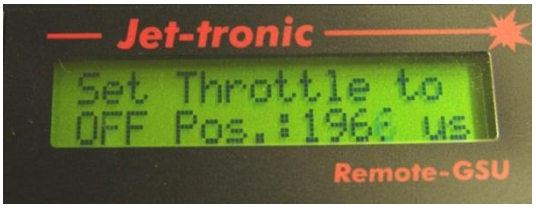
   Release Select Menu only after the three LED’s display the following blink sequence:



The GSU screen will display:

3. This procedure enables a system mode, whereby the stick positions can be learned by the ECU. When **Select Menu** is released, only the green **OK** LED should illuminate. If the pulse width number is “:0 us” and the green **OK** LED is flashing rapidly, then there is a problem with the receiver output. Test with a servo and ensure the transmitter / receiver are working correctly. To test the connection, move the throttle stick and the pulse width number should change. If not, the **THR** cable is not connected to the correct channel.

   The GSU screen will display:
   → Throttle channel “**Off**” position

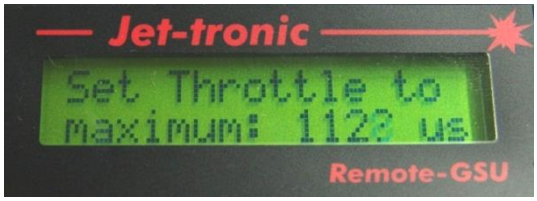


4. Now the ECU can memorize the positions of the throttle and AUX channels. First, place the throttle stick and throttle trim to minimum. Next, press **Select Menu** or the LED I/O board button switch again. This will store the R/C system’s pulse width for immediate shutdown of the turbine. The green **OK** LED will turn off and the red **Pump running** LED will illuminate.

The GSU screen will display:
→ Throttle channel "**Idle**" position

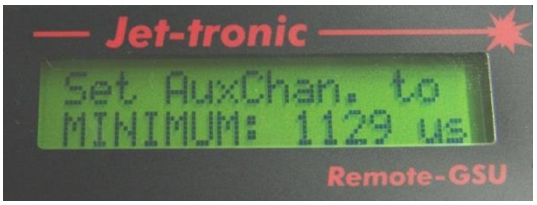
5. Advance the throttle trim lever to maximum. Press **Select Menu** or the LED I/O board button switch again to store the R/C system's pulse width for the turbine idle position. The red **Pump running** LED will turn off and the yellow **Standby** LED will illuminate.

The GSU screen will display:
→ Throttle channel "**Full Power**" position



6. Advance the throttle stick to maximum. Press **Select Menu** or the LED I/O board button switch again to store the R/C system's pulse width for the turbine full power position. The yellow **Standby** LED will turn off. If your ECU is set up for single channel operation skip to instruction number **11**.

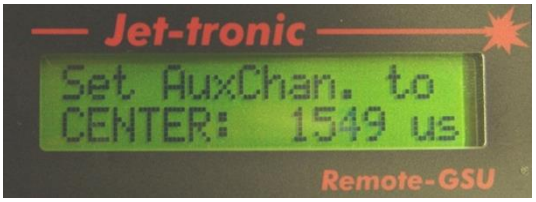
The GSU screen will display:
→ AUX channel minimum "**Off**" position.



7. If the ECU is set for two channel operation, continue to program the auxiliary channel. The green **OK** LED will illuminate again and initiates the learn mode for the three-position auxiliary channel.

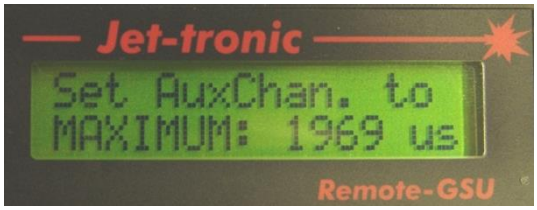
8. Move the auxiliary channel to the minimum position for **Off** and press **Select Menu** or the LED I/O board button switch again to store the R/C system's pulse width for immediate shutdown of the turbine. The green **OK** LED will turn off and the red **Pump running** LED will illuminate.

The GSU screen will display:
→ AUX channel center "**Start/Standby**" position



9. Set the auxiliary channel to the middle position for **Start/Standby** and press **Select Menu** or the LED I/O board button switch again to store the R/C system's pulse width for the turbine to start and run. The red **Pump running** LED will turn off and the yellow **Standby** LED will illuminate.

The GSU screen will display:
→ AUX channel maximum "**Auto-Off**" position



10. Set the auxiliary channel to the maximum position for **Auto-Off** and press **Select Menu** or the LED I/O board button switch again to store the R/C system's pulse width for a normal auto shut-off of the engine. The yellow **Standby** LED will turn off.

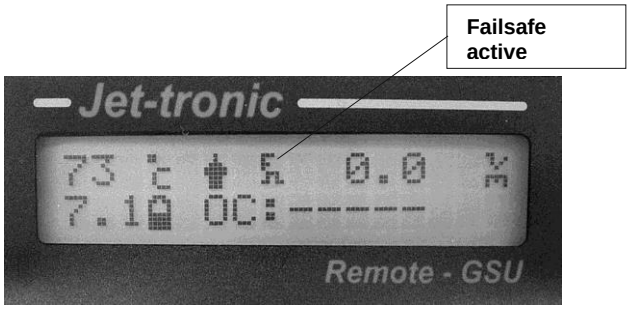
11. The green **OK** LED will flash and the display will briefly show “SAVING SETUP DAT“ and then return to the normal default **RUN** screen. Return the throttle stick and trim to the minimum position and the auxiliary channel (if used) to **Off** and the green **OK** LED will turn off. This completes the programming. The ECU will now permanently store the data. Repeating this procedure is only necessary when the R/C system is changed or adjusted.

    Note: This data is permanently stored in the turbine. If you change ECUs, the turbine data will be copied into the new ECU and the “**learn R/C**” will not need to be redone

.

Verify failsafe programing

You can verify the failsafe function in the default **RUN** screen with the GSU. With your receiver and ECU on, turn off the transmitter. After about two seconds a F should display on the screen.



Turn your transmitter back on and the F should clear from the screen. **The failsafe must function to operate the turbine in a safe manner.**

Preparing fuel and fuel system

	**Warning!** Obey local laws for the transportation and storage of fuels. **Fire warning!** When mixing the fuel with oil or when operating (fueling, defueling, etc.), never handle near an open flame. Please do not spill or empty fuel to the ground.

The ***JetCat*** engine can use deodorized kerosene, 1-K kerosene or Jet-A1 for fuel. Fuel must be mixed with 5% synthetic turbine oil.
Example formula: 1 quart of oil in 5 gallons of fuel.
JetCat recommends low toxicity ***JetCat*** oil with anti-static additive or Aeroshell 500 turbine oil although any turbine oil that conforms to MS23699 standards will work.

To reduce static charges from the fuel system, we recommend adding our anti-static additive (Part# 61198-00) or ***JetCat*** Turbine Oil (Part# 61197-00) with anti-static additive already blended in.

	**Please note:** Fully synthetic **2-stroke oils or Mobil DTE** are not suitable and should not be used.

Fueling on board tanks

	Do not fill the on board tanks too quickly. There is capillary resistance in a series tank system, possibly causing a high pressure rupturing of a tank.

Fill the on board tanks through the **UAT** tank filling tube. Make sure the “fuel dot” is fitted after refueling. It is important to check the “fuel dot” for a secure fit. If it leaks, the UAT can fill with air, causing the turbine to shut down.

Prime the pump and system (Not needed for the RXi)

To prime the fuel pump and fuel lines (or for fuel pump test purposes), it is necessary to open the fuel solenoid shutoff valve and run the fuel pump manually. For this purpose, use the **Test–Functions Menu** selection, **Fuel Pump Test (Purge Fuel)**. This test opens the fuel valve and acts as a speed control for running the pump. **Note:** RX engines have internal solenoids so the valve function is irrelevant.

	**Before activating the purge pump mode, ALWAYS remove the fuel feed line connected to the turbine.** Pump Test / Purge Fuel allows the fuel pump to operate without the turbine running. However, if the fuel feed line is not removed from the turbine during this procedure; it will become flooded with fuel. When this occurs, the next turbine start can become highly combustible!

Use the select menu key and select the **Test-Functions** menu.

	**Remember** when the **Select Menu** key is pressed and held, the ◄ - / ►+ keys are used to select another menu. When a desired menu is reached, release the **Select Menu** key, and your selection becomes the currently displayed menu.

Press the Change Value/Item key to run the pump. If you want to change the voltage the pump runs at, press either the ◄ - or ►+ while pressing the Change Value/Item key. It is best to lower the pump voltage back down to the 0.5V default amount when finished.

Running the turbine for the first time

The Checklist

Before Running the Turbine

- Charge ECU Battery. **You must read and obey warnings on the LiPo/LiFePo battery pack.**
- Prepare CO2 fire extinguisher
- Check fuel lines and filter. Make sure they are clean with no restrictions
- Check that the fuel tank vent is unobstructed
- Mix 5 % oil in fuel (i.e.: 1 quart per 5 gallons of kerosene)
- Fill fuel tank(s). Make sure the main and header tanks are full
- Turn on receiver switch
- Place the model with nose into the wind
- Activate brakes and start turbine

After Stopping the Turbine

- Turn model into the wind. Activate brakes and stop turbine
- During the cooling process the receiver switch can be shut off at any time. When the cooling process is complete, the ECU will automatically shut off
- After each flying session, defuel the tanks before storing.

	**WARNING!** **In case of a mishap, fire extinguishers should be on hand at all times. *JetCat* recommends the CO/2 variety. Powdered extinguishers will corrode the precision components inside the turbine and void your warranty.**

Starting and stopping the turbine

1. Prepare to start by completing the startup checklist.
2. Single Channel Mode start/stop procedure.
    a. To start the turbine, place the throttle stick and trim to their minimum positions. Next, move the trim to its maximum position. Finally, move the throttle stick to its maximum position.
    b. When the throttle stick is set to the maximum position, the ECU will begin a fully automatic starting sequence. This starting sequence can be immediately stopped at any time by moving the throttle stick and trim to the minimum positions.
    c. To stop the turbine after it is running, throttle up just above idle and let it stabilize for a couple of seconds, then move the throttle stick and throttle trim to their minimum positions. The auto-cool down mode will start when the turbine has nearly stopped rotating.
3. Two Channel Mode start/stop procedure.
    a. Set the throttle stick and trim to their minimum positions and the AUX switch to the **Off** position.
    b. Move the throttle trim lever to its maximum position.
    c. Set the AUX switch to the middle **Start/Standby** position. The turbine is now ready to start!
    d. Advance the throttle stick to its maximum position and the turbine will start.
    e. Once the turbine begins to accelerate, the throttle stick can be returned to idle position.
    f. When the throttle stick is set to the maximum position, the ECU will begin a fully automatic starting sequence. This starting sequence can be immediately stopped at any time by moving the AUX switch to the **Off** position and/or reducing the throttle stick and trim to the minimum positions
    g. To stop the turbine after it is running, set the AUX switch to the **Auto-Off** position. The turbine will increase RPM above idle, stabilize and then shut off. The auto-cool down mode will start when the turbine has nearly stopped rotating.
4. As soon as the turbine stabilizes at idle speed, the green **OK** LED will illuminate, indicating that thrust control is now handed over to the pilot. The throttle stick must be in the idle position for the green **OK** LED to illuminate.

☞	When initiating a start, the LED's will blink in a continuous sequence of green to red to yellow. If the throttle stick is above minimum position when initiating a start sequence, the LED's will blink in a continuous sequence yellow to red to green indicating an error. Bring the trim to the maximum position and the throttle stick to the minimum position and this will correct the error condition.

After the start process is initiated, the following occurs:

1. After the start signal has been received, the starter motor is shortly activated to give an "acoustical signal" that the start sequence has been initiated.
2. Now the Kerosene-Igniter is pre-heated for approximately 5 seconds (the starter motor is not running).
3. Next, the starter motor spools up the turbine to a constant speed and then starting fuel pulses into the turbine until the combustion chamber rises above 120 degrees C. The yellow **Standby** LED will illuminate when the starting motor engages. Should ignition not occur, after a 30-second period of time, the process is aborted and the green **OK** LED will blink.
4. Turbine RPM will progressively increase until achieving stable speed. When the turbine speed surpasses the idle RPM value, the starter motor disengages and the yellow **Standby** LED goes out.
5. As the turbine approaches its stabilize RPM, it will briefly dwell, before automatically decelerating to idle RPM.
6. When the turbine attains idle speed and the throttle stick is placed at idle position, the green **OK** LED will illuminate, indicating that thrust control is now handed over to the pilot.

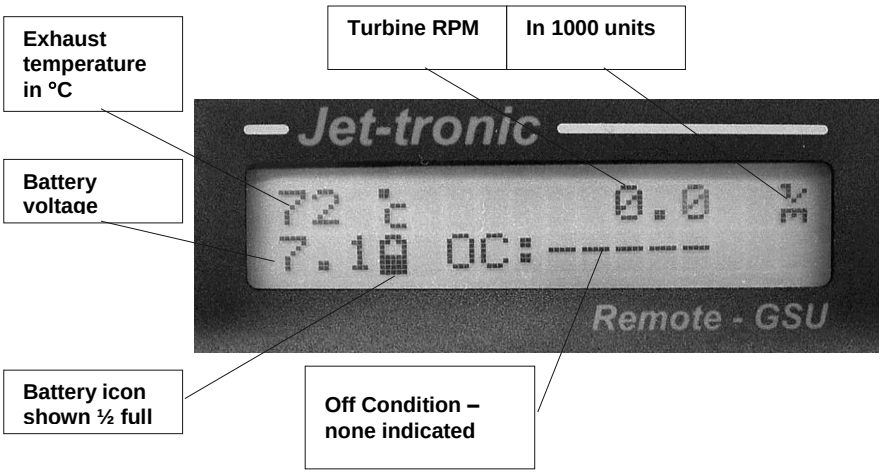
Automatic Cooling Process

After the turbine spins down from **Auto Off** or **Manual Off**, the starter motor will spin the turbine rotor at a slow constant speed until the **E**xhaust **G**as **T**emperature is below 100° C.

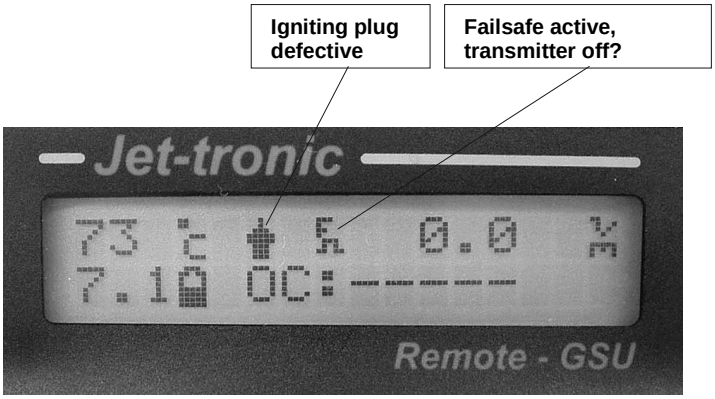
	**ATTENTION!** **Two channel control only:** In unsafe situations (e.g.: a model fire), the automatic cooling process may contribute additional oxygen. To immediately discontinue the cooling process, bring the throttle stick to idle, throttle trim to the minimum position and the AUX switch to **Off**.

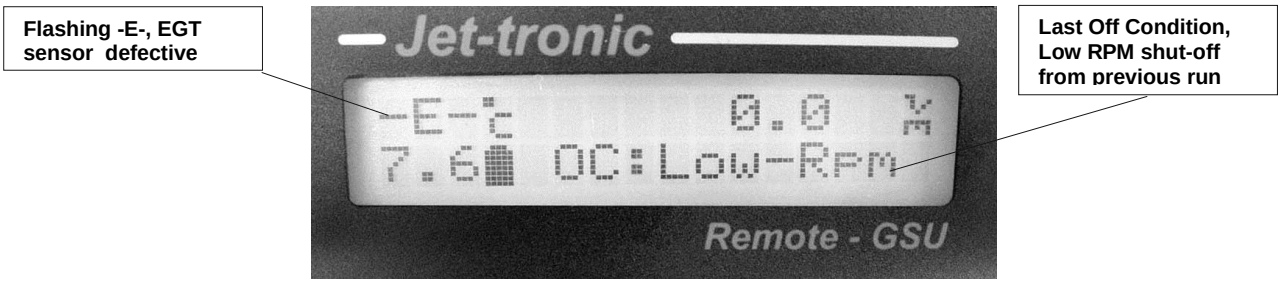
GSU (Run menu default) display symbols

Initial default display screen after power up

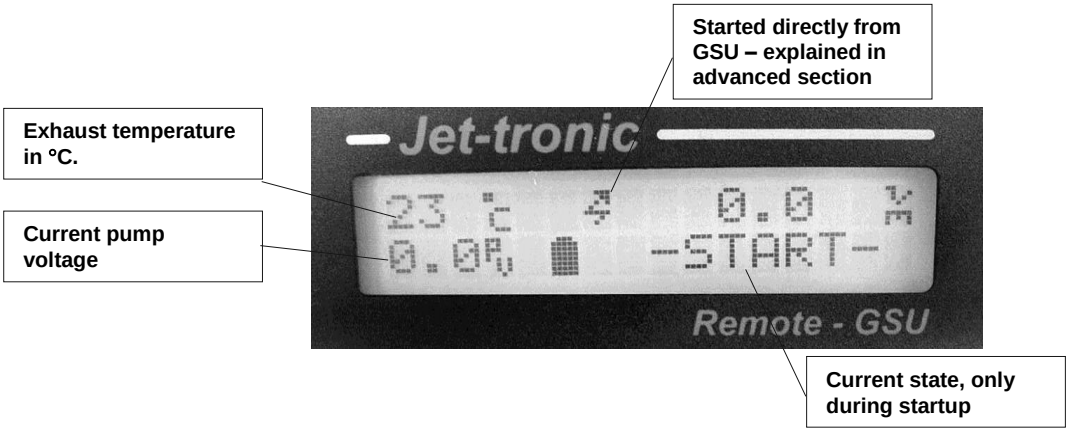


After power up – "error condition" display screen

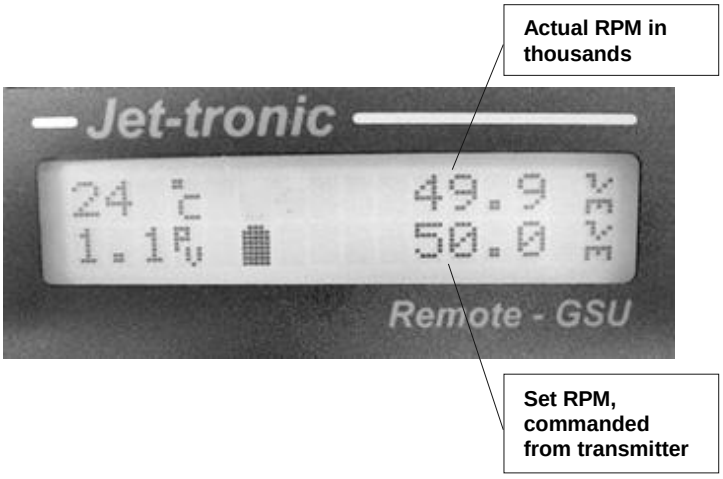



Flashing -E-, EGT sensor defective
Jet-tronic
-E-
0.0
%
7.6
OC:Low-RPM
Remote - GSU
Last Off Condition, Low RPM shut-off from previous run

Turbine starting display screen



Turbine running display screen



Turbine Running States

The ***JetCat turbine*** progresses through several operating states, from ignition to the cool down process. The transitions of these states are automatically controlled by the ECU and by user commands. The current value is always displayed on the GSU screen in the **STATE** selection in the **RUN** menu. When the turbine is starting, the GSU will also display the current state on the bottom line of the display. Whenever the engine is in cooling mode or the starter is tested with the **Ignition** key, the top line of the GSU display will flash "! – Cooling - !".

Explanation of the Turbine States

Table 1

Value	Explanation
-OFF-	AUX switch in the **Off** position and/or the throttle trim in the **Off** position. All LEDs are off. Turbine is off (preventing starting).
Standby / START	AUX switch positioned to the **Start / Standby** position, throttle trim at maximum and throttle stick at idle. The LED chase sequence is started from green to red to yellow, continuously. When throttle stick is advanced to the maximum position, the starter motor engages to spin the rotor. When RPM reaches a pre-programmed value, the starter motor's voltage is removed and the turbine is ready to **ignite**.
Pre Heat 1	The burner is pre-heated for 3-7 seconds (the starter motor is not running)
Pre Heat 2	The starter motor spools up the engine to it's ignition. After another few seconds the ignition of the engine is engaged by injecting kerosene into the Kerosene-Igniter. The pump and the internal starting fuel solenoid will begin pulsing.
MainF-On	Main fuel solenoid opens and kerosene is modulated into the engine.
AccelDly	Delay while combustion chamber is preheating. Waiting for a rise in EGT.
Ker.Full	Starting fuel solenoid closes and all the fuel is now directed to the main injectors. The red **Pump running** LED turns on and will stay illuminated as long as the pump operates.
Stabil.	Turbine successfully accelerates to the idle RPM, then automatically increases speed to about 30% higher RPM. When this speed is maintained consistently for at least one second, the turbine will proceed to the next state (**Learn LO)**.
Learn LO	In this state, the turbine automatically decreases RPM to the idle speed. As soon as idle speed is attained, with the throttle stick in the idle position, the turbine will proceed to the next state (**RUN (reg.)**).
Run (reg.)	Turbine in the normal running state; the throttle stick will regulate turbine thrust. During this operant condition, the green **OK** LED will illuminate, indicating that pilot has control. (red LED is already illuminated) **RUN (regulated)** continues, until the turbine is switched off.
Auto Off	The AUX switch placed in the **Auto Off** position. Turbine automatically increases RPM if at idle and remains at that RPM for a few seconds, before transition to the next state (**Slow Down)**.
Slow Down	During this state, the fuel shut-off valve is closed and the fuel pump is stopped. The green **OK** LED blinks and the GSU displays !-Cooling-!, indicating **Slow Down** This condition will continue, until all of the following parameters are met: • Turbine speed less than 800 RPM • EGT is less that 100 degrees C. • The AUX switch is moved to the **Off** position and throttle trim is moved to the minimum position Once these conditions are met, turbine proceeds to **Off**.
Speed Control	Speed Control mode -- only active when the air speed sensor is connected. Regulates model flight speed.

Table 2

Code	Value	Explanation
1	**R/C Off**	AUX switched to **Off** position or throttle stick and throttle trim moved to the minimum position.
2	**OverTemp**	Turbine running over temperature. Exceeded high temperature parameter and time out.
3	**IgnTimOut**	Turbine did not ignite within programmed time interval.
4	**AccTimOut**	Turbine achieved ignition, but did not accelerate within programmed time interval.
5	**Acc.Slow**	Turbine achieved ignition, but acceleration was less than the programmed value, during startup.
6	**Over-RPM**	Turbine exceeded the maximum RPM, by 5% and a delay of 0.5 seconds.
7	**Low-RPM**	Turbine running under the minimum RPM, by 10% and a delay of 3 seconds. Usually triggered by a flame out.
8	**BattryLow**	Battery pack is dead. Cell voltage is < 1.0V.
9	**Auto-Off**	Turbine shut down via the **AutoOff** sequence, using the AUX channel.
10	**LowTemp**	EGT dropped below the minimum value. A dislodged EGT sensor can trigger this shut down.
11	**HiTempOff**	EGT exceeded the maximum range (~950 °C).
12	**GlowPlug!**	Defective kero/glow plug.
13	**WatchDog**	ECU processor was locked out usually from static discharge or voltage spike in power supply.
14	**FailSafe**	Turbine was shut down from a failsafe timeout condition.
15	**ManualOff**	Turbine was shut off by using the GSU.
16	**PowerFail**	The power failed to the ECU when the turbine was running. This will occur if the power was lost because of a defective battery, connection or if the switch is turned off before the engine is shut-down. **Note: If this state is displayed the Info, Min/Max and Statistics menus retain information from the previous run.**
17	**TempSensor Fail**	EGT sensor failed. **Note: This could happen only during startup.**
18	**Wrong Pmp**	Wrong pump type, see pump configuration in the advanced section of the manual.
19	**No Pump**	There is either no pump connected or the pump cable is defective.
20	**Over Curr**	The electrical current to the engine is too high. • Starter may be jammed • Kero/glow plug is short circuited

Troubleshooting

Most frequent errors. Cause and remedy:

Problem	Cause	Remedy
Turbine doesn't ignite	Fuel supply lines are empty or not purged	Purge fuel system. Use the Test Functions Menu, Purge Pump
	ECU battery weak or empty	Charge ECU battery
	The kero start igniter failed. The automatic glow plug test may not detect a failed igniter!	This is an extremely rare event but the turbine must be returned to ***JetCat***. It may be possible on some engine types to use a temporary external plug. Call ***JetCat*** for information.
Starting process fails	Turbine is still too warm; Cool Down not yet completed.	Wait until **SlowDown** sequence is finished. The green OK LED will stop blinking.
	Low battery or faulty connection.	Charge battery. Check ECU's battery connection.
	Glow plug defective (red **Pump running** LED blinks).	Replace defective glow plug.
	Three-conductor cable for starter motor and glow plug disconnected.	Check cable. Check for proper connection from ECU to the turbine.
ECU doesn't follow full commands from the throttle stick	Programming alteration in R/C transmitter	Check alignment with RC-Check menu. Re-align ECU to the R/C system.
Turbine ignites, but the start process is discontinued.	Air in fuel feed lines.	Air leaks in fuel system. Examine all Festo fittings, nipples, clunk, filter, etc. Check for fuel filter clogs.
	Fuel pump not running.	Test the pump in Test Functions menu, (as soon as the red **Pump running** LED illuminates, the fuel pump must run!).
Starter unit slips, makes noise.	Dust and oil sediment on the compressor nut and O-ring.	Clean O-ring and compressor nut periodically, with cotton swab and solvent.
EGT giving erratic temperature or RPM readings.	Transmitter antenna too close to the model.	Keep the antenna away from the model. It may cause false readings.
Turbine quits with Watchdog Failure	Static discharge reset the ECU.	Do not mount ECU directly to the fiberglass body of the plane. Use a plywood mount with a layer of foam tape and Velcro between the body and the ECU. If the plane has a glossy finish and the failure happened directly after the wheels left the ground, spray the tires with an anti-static spray available from electronic or hardware supply stores.

Reason for an unexpected Shut-Down

There are three ways to diagnose why the engine flamed out.

1. In the info menu the "LAST OFF-COND" variable will tell you why. For example, low RPM, high temp, fail-safe etc. **This parameter is non-volatile and will be available until the engine is run again.**
2. You can view the last 8 seconds of the flight before it shut-down. This data is updated every 0.2 seconds. This allows you to see the trend leading up to the shut-down. This mode is entered by pressing the "+" key of the GSU while powering up the ECU. You can scroll through the data using the (+ or -) keys and scroll forward and backward through time using the (info or min/max) keys. **This parameter is non-volatile and will be available until the engine is run again.**
3. You can download and view the entire flight using the optional serial adapter Part# A1028-USB and a PC.

If the off condition is "POWER-FAIL" then the data is not valid. This occurs if the ECU or receiver battery was disconnected or was intermittent or if the receiver power goes lower than 3 volts. In this case, the data in the system would be for the previous run.

Sample of displayed values

Tim:	**R:**	**S:**	**EGT:**	**Pmp:**	**Sta:**	**Th:**	**Au:**	**Bat:**	**AirS:**	**SetS:**
Time	RPM	Set-RPM	Temp	Pump V	State	Thr. pulse	Aux. pulse	Batt volts	Air Speed	Set Air speed
-4.0	0	0	0	0.0	0	0	0	0	0	0

See the **Explanation for Turbine Shut Down** for a description of each state code.

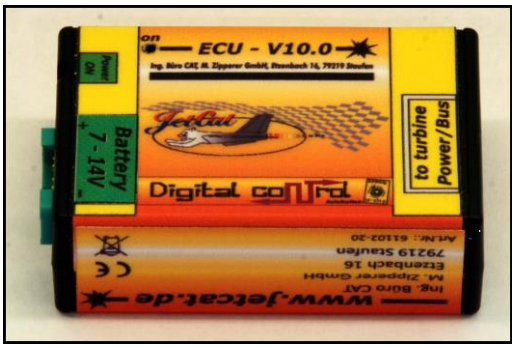
How to diagnose a shut-down from the saved data

Symptom	Engine shut-off state	Possible Reason
Engine quits with a trail of white smoke.	Low RPM or Fuel Fail	This is normally caused by air in the fuel system. Make sure there is no leaks in the fuel system and most importantly, get all the air out of the fuel filter. The fuel filter should not be hard fixed to the plane but allowed to hang free. It is best mounted vertically. When you purge the fuel system, tap the filters while the pump is running to get all the air out them. **USE A BVM Ultimate Air Trap!**

	If the engine fails to ignite, you **CAN** get excess kerosene in the engine. **YOU CANNOT REMOVE EXCESS KEROSENE BY TILTING THE PLANE WITH THE NOSE UP IN THE AIR**. The kerosene will be captured by the exhaust guide vanes and will not run out of the engine. The nose must be tilted down towards the ground. The excess kerosene will then run out the intake. You may need a towel around the intake to absorb the kerosene. Clean off the starter o-ring afterwards since it may get kerosene on it as well.

Manual advanced section

JetCat ECU features Version 10.00



- Powerful 16/32-bit latest generation microcontroller with substantial program and data memory.
- The ECU can be turned on without powering up the receiver to read data or make adjustments.
- When the turbine is stopped the ECU enters a cooling process. During that time, the receiver can be immediately powered off. The ECU remains on monitoring the cooling process and will switch itself off after it is complete.
- The starter motor is run at a constant speed during the turbine cooling process. This reduces the wear of the starter coupling.
- The settings for the startup pump voltage are eliminated.
- The fuel pump type is automatically detected and displayed.
- Integrated R/C system fail-safe analysis and display of the number and duration of any faults. After landing, the R/C system communication quality can be assessed.
- Programmable fail-safe behavior. The hold times and failsafe reaction time can be programmed.
- RS232 interface for PC connectivity
- Turbine control using either one or two transmitter channels
- Direct start and control of the turbine from the GSU terminal without the R/C transmitter.
- Support for parallel connected turbines (multi engine models)
- With an optional smoke system, the ECU can be programmed to generate warnings for low battery voltage, low fuel or Fail Safe.
- Built-in data logger functions. The data for the last 17 minutes of operation will be stored at a resolution of one sample per second and can be read by the optional PC software. The data remains stored even after a power failure. In addition, the last 8 seconds of operation before shutdown of the turbine is stored with a resolution of 0.2 seconds. This allows for accurate fault diagnosis.
- Input for an optional airspeed sensor for measurement, control and limiting of the model's airspeed.
- Global Position System (GPS) interface for the optional ***JetCat*** GPS receiver. A highly accurate measurement and display of maximum ground speed, route distance, maximum altitude, maximum flight radius and maximum G-force of the model, etc.
- Advanced test and diagnostic functions for pump, valves and sensors.
- Significantly expanded Information and Min / Max menus.
- Tolerant error detection for the turbine sensors. If a sensor fails the turbine does not immediately shut off but activates an emergency operation mode that may enable a safe landing. After landing, a restart is only possible after troubleshooting the error.

Smoker valve

The ECU can directly control a smoker valve for injection of smoke fluid (e.g. diesel oil) in the exhaust blast. The smoker valve is of the same type as used for the fuel shut off .(Order No.:61106-00).

The function of the smoker valve can be defined in the “Limits menu”
(Parameter: „SmokerValve Ctrl“)

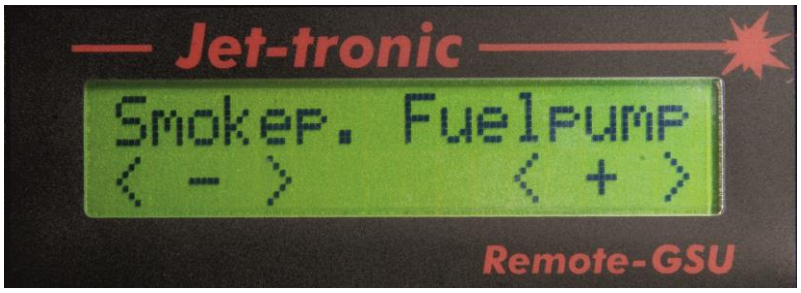
The possible option for the parameter „SmokerValve Ctr” are:

Option	***Description***
DISABLED	The smoker valve is not used, → valve is always closed !
Open if AuxSw=0	Smoker-valve is opened if the AUX-Switch (3-Pos. switch) is brought into the **lower** position (“OFF”-Position) and the turbine is running. To be able to use this function it is necessary, that the AUX-channel is activated, this is the parameter „AUX-channel func“ (see below) must not be adjusted to „NOT USED“.
Open if AuxSw=2	Smoker-valve is opened if the AUX-Switch (3-Pos. switch) is brought into the **upper** position (“AUTO-OFF”-Position) and the turbine is running. To be able to use this function it is necessary, that the AUX-channel is activated, this is the parameter „AUX-channel func“ (see below) must not be adjusted to „NOT USED“.

Smoke

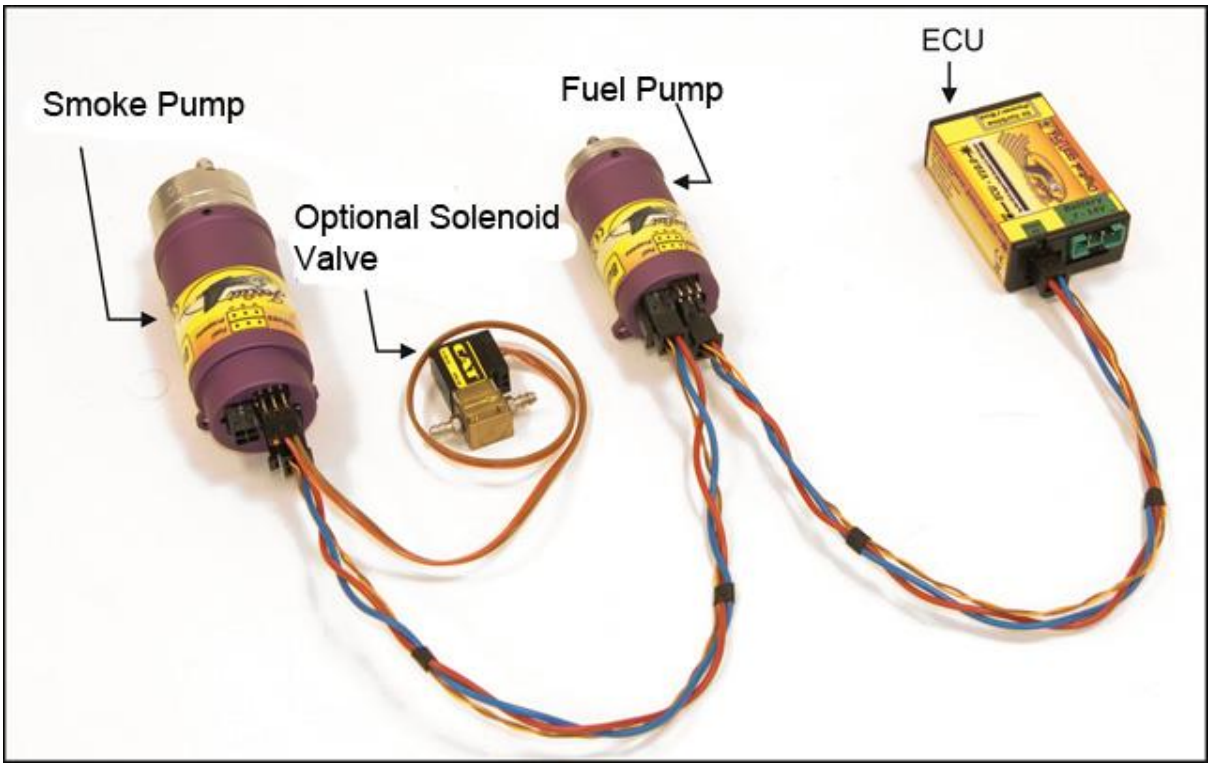
Attention!
Injekt the smokefluid rear the thrust tube to avoid flash fire of unburned fuel.

Each JetCat Bus-pump can be switched between fuel – and smoke pump, factory setting is fuel pump. To change the setting switch off receiver, connect **only** the pump you want to adjust (**RXi,** disconnect the Power-Bus cable during this procedure) press the key **Change Value** and switch on the RC. Release the key **Change Value** once in the display appears:



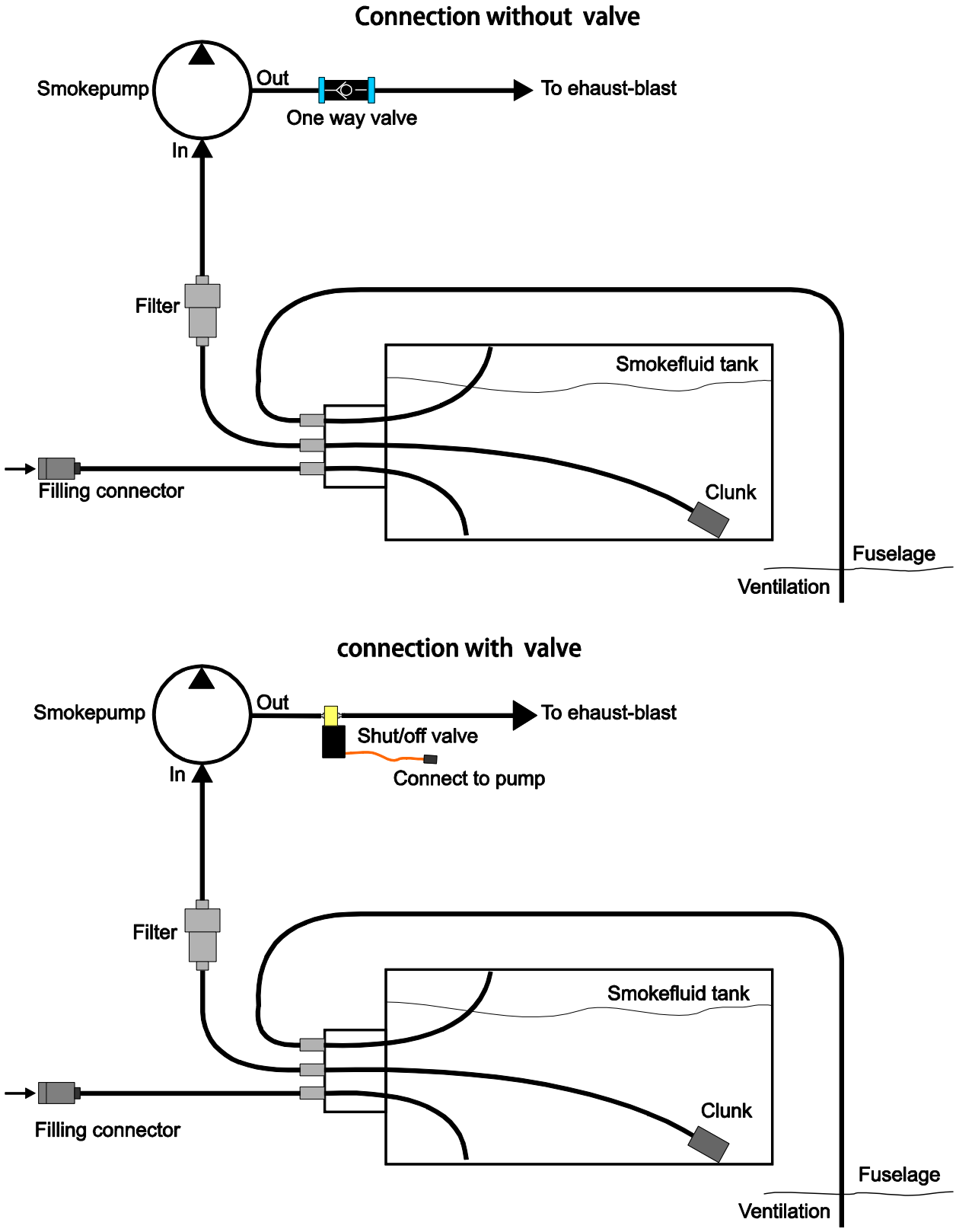
By pressing the” – “key the connected pump is set to smoke pump and will be detected by the system as such. Now connect both pumps and ECU as shown in the next picture. During the next power up either pump will be detected and logged by the system.
It’s recommended to connect the fuel pump first to the ECU and the smoke pump in series to the fuel pump.

Certainly the pump can be reversed to fuel pump by running this procedure again but press the “+” key

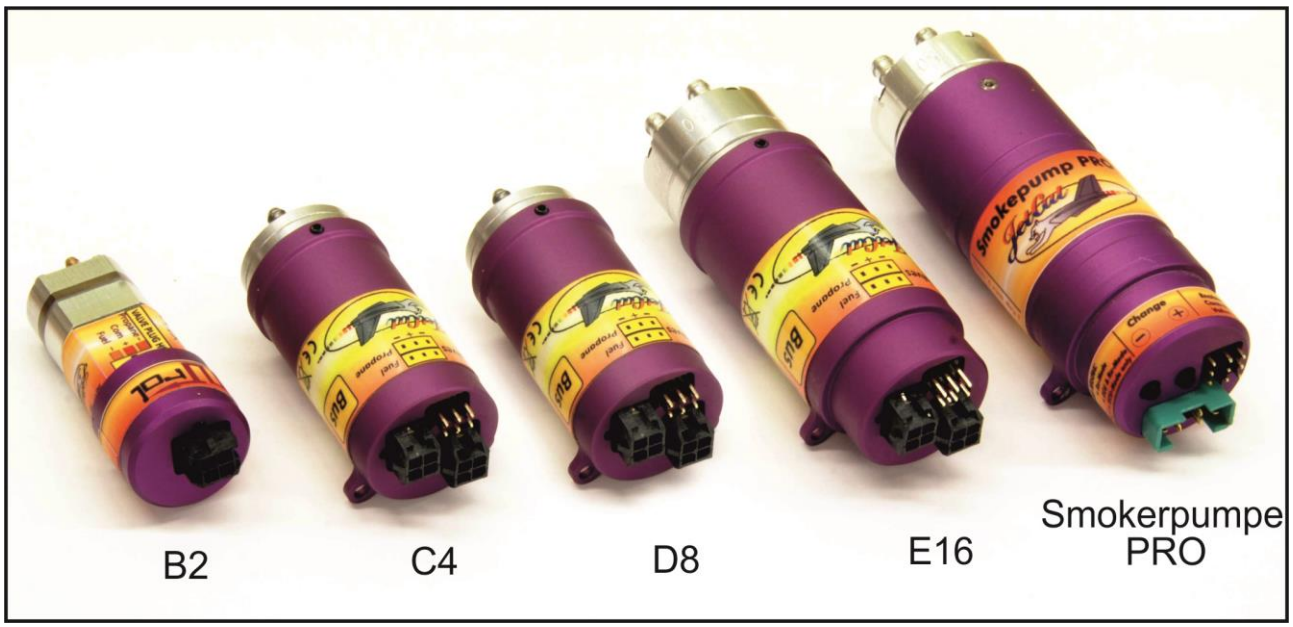


The smoke flow can be set up by the **Limits Menu** – **Smoke Flow.**
Press the **Change Value** key and change the value by pressing the "**-**" and "**+**" key

Connection Diagram of the Smoke System



Overview of Pumps



Pumpe, Type	Engine	
B2	**P20 SE/SX**	
C4	**P140RX/P180RX/P200RX**	
D8	**-**	
E16	**P300RX/P400RX**	
Smokerpumpe PRO	**-**	

The Smokerpumpe PRO can't be switched because it's no Bus-Pump, further it is impossible to set up the flow by GSU. Proceed according the Smokepump PRO manual.

Menu Structure

All similar data and running parameters are grouped in separate menus. Menus can be displayed and their values modified (where accessible), by using the GSU.

Menu Selections

- RUN menu
- MIN/MAX menu
- RC-Check menu
- INFO menu
- STATISTICS menu
- LIMITS menu
- TEST menu

Selecting a Menu

The corresponding buttons (hot keys) can directly select the “Run”, “Info”, “MIN/MAX”, or “Limits” menus. An alternate method is to press and hold the **Select Menu** button and use the **+ / -** buttons for selecting.
Note: this method is the only access to all menus.

Change Values / Items

In order to change an indicated value, press and hold the **Change Value/Item** button while using the **+ / -** buttons to alter its value. An arrow (→) will appear in front of the value, if it can be changed.

The RUN Menu

As soon as the ECU is switched on, the **Run** menu is displayed.
In the lower display line, the actual turbine RPM is indicated.
In the upper display line, the following selections can be monitored. Use the **+ / -** buttons alone for selecting the different parameters.

Value	Explanation
Temp.	Current EGT (**E**xhaust **G**as **T**emperature). The units, °C or °F can be selected in the LIMITs menu.
OffCnd **SetRpm**	Last Off command (reason for shut down). See table on page 28
State	Current turbine state.
U-Pump	Current pump voltage.
AirSpeed	Current Air speed (km/h) this readout is usual for function check of the speed sensor. Note : This readout is only supported by connected airspeed sensor.
SetSpeed	Target state-air speed (km/h). This readout is for checking at the “speed control” mode the set target state-airspeed of throttle stick. Note: This readout is only supported by connected airspeed sensor.

The Min/Max Menu

The Min/Max menu is used primarily for diagnostics purposes. All of the following variables may be sampled manually by pressing the **Change Value/Item** button on the GSU.

Value	Explanation
Upump-Max **Upump-Min**	Maximum pump voltage. Minimum pump voltage.
MaxTemp **MinTemp**	Maximum EGT. Minimum EGT.
MaxRpm **MinRpm**	Maximum turbine RPM. Minimum turbine RPM.
MaxAirSpd **AvgAirSpd**	Maximum Airspeed (*) Average Airspeed (*)
Flight Distance	Flight distance in km (*)
AvgRpm **MaxRTmp**	Average-RPM Average temperature at full throttle
AvgPump **AvgTemp**	Average pump voltage Average temperature

(*) Only by connected air speed sensor!

The Min/Max values can be reset by pressing “Change Value”key.

The values are only valid during and after the actual run. By switching on the ECU they are reset

The R/C Check Menu

All parameters in this menu are for informational purposes only and will vary in accordance with R/C input.

Value	Explanation
Throttle% **StickPulse**	Position of the throttle stick (by percentage, 0-100%). Position units of the throttle stick.
AuxInp% **AuxPulse**	Position of the 3-position AUX channel (by percentage, 0-100%). Position units of the AUX channel.
Aux.Position	Position of the AUX channel control (0=**Off**; 1=**Start/Standby;** 2= **AutoOff**).
Fail Safe Count F	Indicate the numbers of Fail Safes since the ECU is active
Fail Safe Time In seconds	Indicate Fail Safe-time (sec.) the ECU recognized since it is active

Menu parameters are for informational purposes only and cannot be changed.

The INFO Menu

Info menu displays the following information:

Value	Explanation
Rest Fuel	Remaining fuel in tank. Tank size can be entered using the **LIMITs** menu. Value is reset every time the ECU is switched on (or can be reset manually by pressing the **Change Value/Item** button on the GSU).
Fuel Flow ml/min	Actual fuel consumption in ml/min.
BattCnd **Ubattery**	The condition of the battery is indicated in the upper line: **1. --OK--** **2. !WEAK!** **3. --EMPTY--** 1. If the battery voltage is 1.1V/Cell or higher "**—OK--**" will be displayed. 2. If the battery voltage drops under 1.1V/Cell, the display will read "**!WEAK!"**. Red **Standby/Manual** and green **OK** LED's will blink simultaneously (at a rate of twice per second). Starting the turbine is not possible, until the battery is recharged. If the turbine is already running and the battery warning function is enabled, the warning function will be activated. 3. If the battery voltage drops under 1.0V/Cell "—**EMPTY--**" is displayed. Starting the turbine is not possible until the battery is recharged. If the turbine is running, it will be immediately shut off, to avoid a malfunction of the ECU. Current voltage of the battery. Displayed on bottom line.
Baro **Temp**	Indicate the current barometric pressure. Temperature indicator (C°) in range of ECU
L-MinFuelQ **L-OffFuelQ**	Minimum fuel quality during the last turbine run Fuel quality by shut off at the last turbine run
L-BubblCnt **L-Bubble Tim**	Number of bubbles counted during the last turbine run Timefram in seconds of the bubble count during the last turbine run
Last Run Time	Last turbine run time.
Last Fuel Count	Quantity of fuel consumed, during the last turbine run.
Last-Off PmpVolt	Volts applied to the pump when it was switched off.
Last Off RPM	RPM of the turbine, when it was switched off.
Last Off TEMP	Temperature of the turbine, when it was switched off.
Last Off Cond	Last stored Off condition.
Last Max Temp	Maximum temperature during the last turbine run
Last Min Temp	Minimum temperature during the last turbine run
Last AVG Temp	Average temperature during the last turbine run
Last MaxR AVGTmp	Average full throttle temperature during the last turbine run
Last Max Pump	Maximum pump voltage during the last turbine run
Last Min Pump	Minimum pump voltage during the last turbine run
Last Avg Pump	Average pump voltage during the last turbine run
Last Fail Safe Cnt	Number of Fail Safe during the last turbine run
Last Fail Safe Time	Fail Safe Time in seconds
Last-Max AirSpd	Maximum reached flight speed during the last flight (Only by connected Airspeed sensor!)
Last AvgAirSpd	Average flight speed during the last flight (Only by connected Airspeed sensor!)
Last Distance	Flight distance traveled during the last flight (Only by connected Airspeed sensor!)

Menu parameters are for informational purposes only and cannot be changed.
All “LAST” values show the results of the last flight, even if the ECU is switched off in the meantime. These results kept stored up to the next run of turbine.

The Statistic-Menu

Value	Explanation
Totl Run-Time	Total turbine running time (excluding startups).
Runs-OK	Number of successful turbine runs, without errors.
Runs aborted	Number of turbine shut downs, caused by the ECU’s safety system.
Ignitions OK	Number of successful ignitions.
Ignitions failed	Number of failed ignitions.
Starts failed	Number of failed starts.
Total fuel count	Total fuel consumption of turbine
LoBatt Cut-Outs	Number of cut off due weak battery voltage

Menu parameters are for informational purposes only and cannot be changed.

The LIMITs Menu

The LIMITs menu allows the operator to adjust the following parameters of the turbine, within the allowable values, according to the performance requirements of a particular model.

Value	Explanation
Minimum RPM	Turbine idle speed (If **IdleRPM-SET** or **Idle&Ramp-Set** is enabled by **Barom.Auto Tune** it will further appear **(Auto)** in the display and the RPM is set by ECU)
Maximum RPM **F**	Turbine maximum speed Indicate the thrust at full throttle. By varying the RPM this value call the related thrust of the turbine. This provides a save and easy way to limit the maximum thrust.
Lowidle RPM	Reduced idle speed. This function is activated if the throttle stick is in idle and the throttle trim is set to half. The Idle speed will be decreased to the programmed value. The acceleration time to get back to the common idle speed can take 2-5 seconds according the used turbine type.
Ignition-Mode	Version of ignition type: Kerosene-N JetCat kerosene start. This parameter is for informational purposes only and can’t be changed
Battery Type	Kind of connected Battery: **NiCd** **LiPo 2Cell/7.4V** **LiPo 3Cell/11.1V** **LiFePo 3Cell/9,9V** (recommend by JetCat)
Barom.Auto Tune	Enables the ECU to align the control system according the barometric pressure. The possible settings are: **Disabled:** No auto tuning by ECU **IdleRPM-Set:** Optimize of idle RPM only **Ramp-Set:** Optimize of acceleration only **Idle&Ramp-Set:** IdleRPM and acceleration are optimized

Smoker Flow	Only available by connected **Bus-pump**. The smoke flow can be adjusted in a range of 0-100%. Additional is shown the quantity of flow in milliliters (ml).
LowBat Warning	Battery warning function, Enabled/Disabled Default = Disabled
Fueltank size	Actual capacity of the fuel tank in ml
LowFuel Limit	Fuel level (ml) to activate the fuel warning function.
LowFuel Warning	Fuel warning function, Enabled/Disabled Default = Disabled (OFF)
AUX-channel func	The AUX-channel (3-step switch) can be used for optionally special features or disabled even for single-channel operation. **ON,TrbCtrl ON**: Aux channel enabled for turbine control **ON.TrbCtrl OFF**: Aux channel enabled for speed limiter functions and/or Smoker. Turbine control disabled. The Aux channel is used only for speed limiter and/or smoker functions. The turbine control takes place by Single Channel Mode **NOT USED**: Single Channel Mode. Totally disabled AUX channel input for turbine control, speed sensor and smoker functions. AUX channel wire must not be connected to the receiver in this mode. In case of a connected a air-speed sensor the Maximum Limit Speed is still active and limits the maximum speed of the plane. This safety function can't be disabled.
Fail Safe delay	Delay in seconds before Fail-Safe function will be activated. While this time the turbine speed run on the last valid stick pulse **(→HOLD**) adjustable range = 0.1 -20.0 seconds. After expiration of this term the Fail Safe Time Out starts. (see next point)
Fail Safe Time Out	Delay in front of Fail Save cut off. While this time the turbine speed is set to the Fail Save RPM (next point) Is there no valid pulse after the expiration of this term the turbine will be cut off by the ECU. Range 0.1-20 seconds.
Fail Safe RPM	Programmable turbine speed for the Fail Safe Time Out procedure. Range from minimum RPM to maximum RPM.
Aux-ch Smoker Ctrl	The ECU can directly control a smoke valve or a Smoke pump for injection of smoke fluid into the exhaust blast to generate smoke. You can use the shut off valve (Part# 61106-00) as smoke valve. For smoke pump you can use any Jetcat Smokerpump AUX-channel programming for smoke function (3-step switch) Settings: **DISABLED** Smoke solenoid is not used → valve is constantly closed **Open if AuxSw=0** Smoker-valve is open if: Turbine is running and the AUX switch (3-Pos. switch) is brought to lower position ("off" position) To be able to use this function its necessary that the ***AUX-channel func*** is activated by ***ON,TrbCtrl Off*** (see above). That is to say the Aux switch is enabled for smoke function but not for turbine control. **Open if AuxSw=2** Smoker -valve is open if:

	Turbine is running and the Aux switch (3-Pos.switch) is brought to upper position ("AUTO-OFF" position) To be able to use this function its necessary, that the ***AUX-channel func*** is activated by ***ON,TrbCtrl Off*** (see above). That is to say the Aux switch is enabled for smoke function but not for turbine control.
Smoker Warn Func	If this function is activated, the smoke-valve will pulse in a sequence of 0,2 sec on and 0,4 sec off –time if following conditions are complete: **BATTERY LOW:** The valve will pulse if the ECU battery is weak/empty. **FUEL LOW:** The valve will pulse if the fuel level is low the programmed ***LowFuel Limit*** **BATT orFUEL LOW:** The valve will pulse in any of this conditions **FAIL- SAVE**: The valve will pulse if the ECU detect a fail safe **BATT,FUEL,FAILS:** The valve will pulse in any of this conditions **ENABLESmokePmp:** Enables signal for smoke pump only if turbine is running. That is to say the pump can't run without a running turbine (only useful by operate a JetCat Smoke pump) **High-Temp.** The valve will be pulse in case of excessive exhaust temperature. **MaxRPM-reached:** The valve will be pulsed if the turbine has reached its maximum RPM. **Disabled:** No function, off. **Note:** The smoke warn function is switched off while the throttle stick is in idle position.
IdleThrResponse	Adjustment of the throttle response (acceleration) by idle (up to average speed) **Fast** default setting **Normal** average acceleration **Slow** slow acceleration for excessive warm weather or for operate more than 1000m sea level
FullThr Response	Adjustment of the throttle response by full throttle (from average speed to full) **Fast** default setting **Normal** normal acceleration (for operation above 1000m)
AirSpeed units	Displayed flight speed unit in ***km/h*** or ***mph***
ThrStick Curve	Throttle stick curve, factory setting is 3.0 herewith the thrust and the throttle stick position proceed proportional. At the value 1.0 the RPM proceed proportional to the throttle stick position.
StartUp Mode	This function allows to select different start procedures. You can decide between following settings: **SEQUENCE:** Default setting: Throttle trim to maximum, throttle stick to idle, AUX switch to center and now move the throttle stick to maximum to start the turbine. By using the Single Channel Mode (devoid of the AUX switch) start the turbine by set the throttle trim to maximum and then move the throttle stick to maximum.

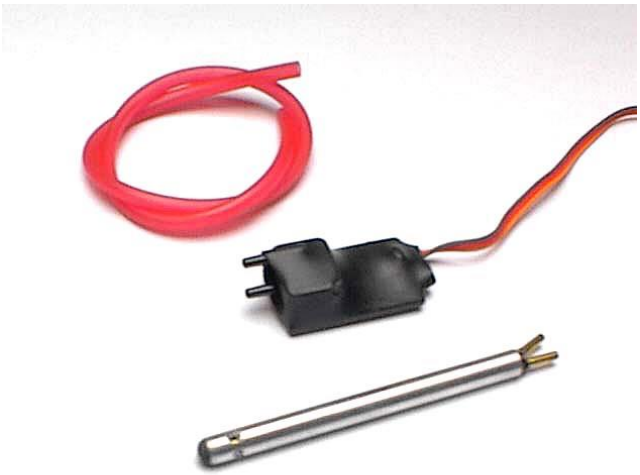
	THROTTLE MAX: Throttle trim and throttle stick to maximum. Turbine starts if the AUX-switch is set to center. By Single Channel Mode (devoid of AUX switch) the turbine starts by move the throttle more than 95% of maximum **IMMEDIATE:** The turbine starts direct by move the throttle stick to maximum and set the AUX-switch to center. By Single Channel Mode on move the throttle trim to maximum for start. **Suggestion to start a multi-engine model** **Two channel mode:** Program one ECU to **THROTTLE MAX** mode but the second to **SEQUENCE** mode. The "Throttle Max turbine" starts by move the throttle trim and throttle stick to maximum and set the AUX switch to center. To start the "Sequence turbine" you now have to move the throttle stick first to minimum and back to maximum. **Single channel mode:** Program on turbine to **IMMEDIATE** the other to **SEQUENCE** mode. Throttle trim and throttle stick must be set to minimum. To start the "immediate turbine" just move the throttle trim to maximum. The "sequence turbine" starts by move the throttle stick to maximum.
SpdCtrl SW0 Act.	See chapter "Air Speed Control" of the manual
SpdCtrl SW2 ACT.	See chapter "Air Speed Control" of the manual
Max LimitAirSpd	See chapter "Air Speed Control" of the manual
Max.AirSpeed	See chapter "Air Speed Control" of the manual
Min.AirSpeed	See chapter "Air Speed Control" of the manual
SpeedRegVal-P	See chapter "Air Speed Control" of the manual
SpeedRegVal-I	See chapter "Air Speed Control" of the manual
SpeedRegVal-D	See chapter "Air Speed Control" of the manual
MinRPM SpdCtrl	See chapter "Air Speed Control" of the manual

TEST Menu

	**<u>Before activating the purge pump mode, ALWAYS remove the fuel feed line connected to the turbine.</u>** Pump Test / Purge Fuel allows the fuel pump to operate without the turbine running. However, if the fuel feed line is not removed from the turbine during this procedure; it will become flooded with fuel. When this occurs, the next turbine start can become highly combustible!

Value	Explanation
PurgeFuel	Enable to prime the fuel pump and lines. By pressing the "Change Value" key the fuel valve opens and the fuel pump starts to run. To change the voltage the pump runs at, press either the "+" or "-" key while the "Change Value " key is pressed.
BurnerTest (Volt)	By pressing the"Change Value" key the Burner glow with the appointed voltage. The left number displays the burner voltage the right show the current battery voltage. The burner voltage can't be changed.
BurnerValve Test	Pressing the "Change Value" key opens the burner valve
SmokerValve Test	Pressing the "Change Value" key opens the smoke valve
FuelValve Test	Pressing the "Change Value" key opens the fuel valve
Temp. **AD**	Displays the data of the temperature sensor. The upper left value indicate the exhaust gas temperature, the right value call the measured value of environment. These values are the according internal values of the AD-converter. If appears a "F" in the upper right edge the temperature-sensor is faulty or the data cable in not connected or faulty,too.

Airspeed Sensor



The optional *Airspeed Sensor* consists of a pitot tube and a precision, differential pressure sensor. By sampling the ambient air temperature, the current flight speed of the model is calculated by the ECU, from the measured difference in static versus dynamic pressure.

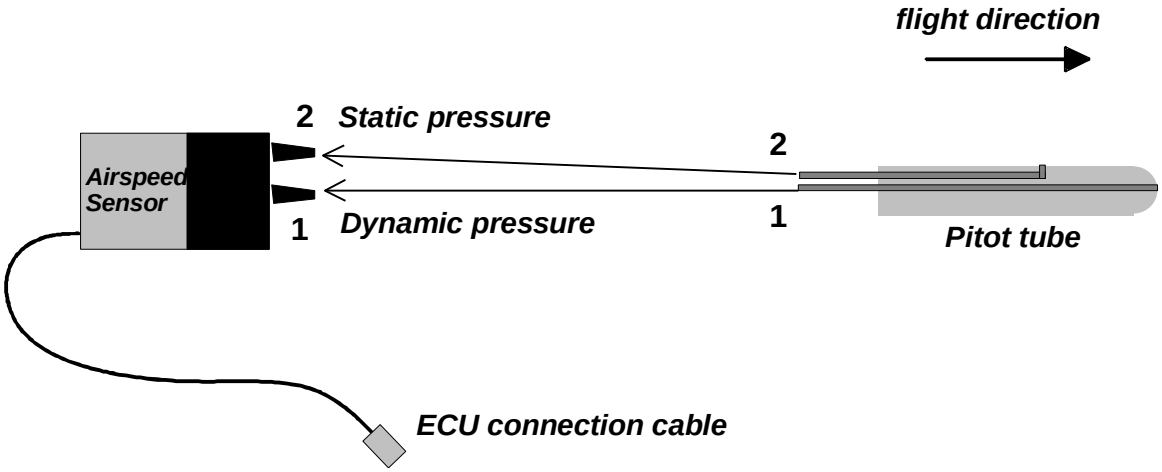
When the ECU is used without the *Airspeed Sensor*, it is set in **thrust control** (normal) mode. In this mode, the throttle stick directly alters turbine thrust.

When the *Airspeed Sensor* is plugged into the ECU, it automatically establishes **speed control** mode. In **speed control** mode, the turbine thrust is automatically controlled – to keep the model at a predetermined speed and/or to limit the model's maximum speed.

Speed control mode features several functions:

- measurement and storage of maximum and average flight speeds
- measurement of the flight distance.
- automatic restriction of maximum flight speed
- maintenance of current flight speed ("**Hold-speed**"-mode)
- regulation of flight speed, analogous to throttle stick position (adjustable "**Cruise Control**")

Connection diagram for the Airspeed Sensor:



Connect the air lines from the pitot tube to the airspeed sensor, using the 1/16th inch ID vinyl tubing provided.

1 = Dynamic pressure input
2 = Static pressure input

Note: Tubing length and/or cross sectional area has no influence on measurement precision

Connect the *Airspeed Sensor* cable to the appropriate socket, where indicated on the ECU. The orange wire is aligned to the pulse symbol. Once the *Airspeed Sensor* is connected, the ECU controls additional functions:

- under the **Run** menu**,** measurement of current air speed ("**Airspeed**") and desired flight speed ("**SetSpeed**"), can be displayed
- under the **Min/Max** menu, the measured maximum speed ("**MaxAirSpd**") and the average flight speed ("**AvgAirSpd**"), can be displayed
- under the **Limits** menu, speed limits and the parameters of speed regulation can be predetermined

Limits menu parameters assigned to the *Airspeed Sensor*:

Parameter	***Explanation***
MAX LIMITAIRSPD	Maximum allowed flight speed of the model, in km/h. If this speed is achieved, turbine thrust is automatically reduced – to keep the model from exceeding the maximum limit. This safety option is always active, despite the position of the **AUX** switch.
Max.AirSpeed	Maximum flight speed value, in km/h, for the **Speed Control** mode. This value corresponds to the speed at the maximum throttle stick position.
Min.AirSpeed	Minimum flight speed value, in km/h, for the **Speed Control** mode. This value corresponds to the speed at the minimum throttle stick position.
SpeedRegVal-I	Regulator speed, which sets the reaction time of the PID servo loop – much like a sensitivity control in a gyroscope system. **Default value = 18** Increase this value, to increase reaction sensitivity.

SpeedRegVal-P	Regulator coefficient (proportional) **Default ≥ 500** Under normal circumstances, does not require alteration.
SpeedRegVal-D	Regulator coefficient (differential) **Default = 50** Under normal circumstances, does not require alteration.
SPDCTRL SW0 ACT	With the *Airspeed Sensor* connected to the ECU – by moving the **AUX** switch to the **Off** (**SW0**) position, while maintaining a model air speed **>** 40km/h, the following options are available: **Hold-Speed** = momentarily sustains the current flight speed **DISABLED/NONE** = no function, **thrust control** remains active **Turbine OFF** = turbine will immediately shut off **LrnSpeed Lo/Hi** = learn minimum or maximum flight speeds **Lrn Speed Lo** = learn minimum flight speed **Lrn Speed Hi** = learn maximum flight speed
SPDCTRL SW2 ACT	With the *Airspeed Sensor* connected to the ECU – by moving the **AUX** switch to the **AutoOff** (**SW2**) position, while maintaining a model air speed **>** 40km/h, the following options are available: **Hold-Speed** = momentarily sustains the current flight speed **DISABLED/NONE** = no function, **thrust control** remains active **LIN-Speed Ctrl** = linear **Cruise Control** **3-StepSpdCtrl** = three speed **Cruise Control**

Explanation of the speed regulator options:

If the *Airspeed Sensor* is NOT connected – the standard functions of the **AUX** switch are assigned as follows:

Standard assignments of the **AUX** switch:

* **Position SW0** = **Off**, turns the turbine off, immediately
* **Position SW1** = **Start/Standby,** normal **thrust control**
* **Position SW2** = **AutoOff,** normal shutdown method

With the *Airspeed Sensor* connected to the ECU, the **AUX** switch positions **SW0** and **SW2** include the expanded functions that are covered in the above parameters table. These expanded assignments are only valid when the model is airborne (with a flight speed **>** 40 km/h), otherwise the standard functions remain active.
As long as the **AUX** switch is maintained in the center position, the ECU continues functioning in **thrust control** mode and turbine thrust can only be determined by the throttle stick position.

Available options:

Option	***Description***
Hold-Speed	Maintains the current flight speed. Flight speed is measured at the time the **AUX** switch is placed in the **SW0** position. This action establishes the ECU in **speed control** mode (i.e.: the model maintains the flight speed measured at the time the mode is activated, despite the throttle stick position). This mode remains active until the **AUX** switch is returned to the **SW1** position. **WARNING:** When the **AUX** switch is set in the **SW0** position, the model must be flying faster than 40 km/h, otherwise the turbine will shut off.
DISABLED/NONE	No function. **Thrust control** mode remains active.
Turbine OFF	Immediately shuts down turbine. Normal **thrust control** mode remains active.
LrnSpeed Lo/Hi	Learns the current flight speed.

	If the throttle stick is set at less than half throttle and the **AUX** switch is momentarily placed in the **SW0** position, the current flight speed is assigned and recorded as the Min.AirSpeed parameter. If the throttle stick is set at greater than half throttle and the **AUX** switch is momentarily placed in the **SW0** position, the current flight speed is assigned and recorded as the Max.AirSpeed parameter. By momentarily activating the **AUX** switch, this option makes it possible to store a particular slow or fast model speed, while in flight. These values then become the parameters for the **Cruise Control** mode, plus the operator can also display the values in the **limits** menu, after landing. **WARNING:** When the **AUX** switch is set in the **SW0** position, the model must be flying faster than 40 km/h, otherwise the turbine will shut off.

Lrn Speed Lo	Learns the slow flight speed. If the **AUX** switch is momentarily placed in the **SW0** position, the current flight speed is assigned and recorded as the Min.AirSpeed parameter. **WARNING:** When the **AUX** switch is set in the **SW0** position, the model must be flying faster than 40 km/h, otherwise the turbine will shut off.
Lrn Speed Hi	Learn the fast flight speed. If the **AUX** switch is momentarily placed in the **SW0** position, the current flight speed is assigned and recorded as the Max.AirSpeed parameter. **WARNING:** When the **AUX** switch is set in the **SW0** position, the model must be flying faster than 40 km/h, otherwise the turbine will shut off.
LIN-Speed Ctrl	**Cruise Control** mode, with linear speed regulation to the throttle stick position. Flight speed is controlled between the values of the “Min AirSpeed” (throttle stick in the minimum position) and “Max AirSpeed” (throttle stick in the maximum position).
3-StepSpdCtrl	**Cruise Control** mode, featuring three different speeds. Flight speed can be set to three predetermined speeds, between the values of “Min AirSpeed“ (throttle stick in the minimum position) and “Max AirSpeed” (throttle stick in the maximum position). Speed 1: “Min AirSpeed” → throttle stick in the minimum to 1/3 position Speed 2: (“Min AirSpeed” + “Max AirSpeed”) / 2 → throttle stick in the 1/3 to 2/3 position Speed 3: “Max AirSpeed” → throttle stick in the 2/3 to maximum position

Reminder:

The turbine can be immediately switched off, any time the throttle stick and the throttle trim are brought to their minimum positions.

If **Hold-Speed** or **Cruise Control** modes are activated, while the model is flying over 40 km/h -- and should the model then slow down, to a speed less than 40 km/h -- **Hold-Speed** or **Cruise Control** *will remain active*. The turbine will NOT shut off, unless the **AUX** switch is moved back to the **SW1** position and then returned to **Hold-Speed** or **Cruise Control** position.

WARNING:

Make sure the *Airspeed Sensor* is working, before using features that require a minimum flight speed to operate. If the system is not operating properly, you may inadvertently shut off your engine, in flight. To verify that the *Airspeed Sensor* is functioning, apply a little air pressure and note the change in "**Airspeed**" on the **run** menu display.

Two examples:

Example 1 – **Hold-Speed** function
SpdCtrl SW0 Act assigned to "**Hold-Speed**" and **AUX** switch set in the **SW0** position:

a) Flight speed is measured and stored, when the **AUX** switch is moved to the **SW0** position. Thrust is then regulated automatically, to maintain this memorized speed, despite the throttle stick position. This regulator function is turned off immediately, by returning the **AUX** switch to the **SW1** position (normal **thrust control**).

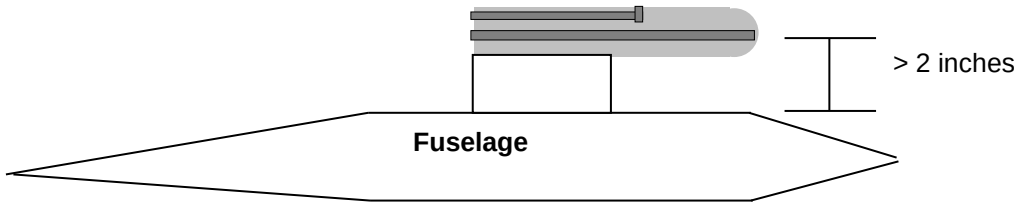
b) If this function is activated while flight speed < 40 km/h, turbine will shut off, immediately (normal **Off** function).

Example 2 – **Linear speed** regulation
SpdCtrl SW2 Act assigned to "**Lin-SpeedCtrl**" and **AUX** switch set in the **SW2** position:
Cruise Control mode becomes active, featuring linear speed regulation to the throttle stick position.

a) The minimum throttle stick position corresponds to the parameter "Min AirSpeed" and the maximum throttle stick position corresponds to the parameter "Max AirSpeed".
b) If flight speed < 40 km/h when this function is activated, the turbine will shut off (normal **AutoOff** function).

***Airspeed Sensor* Mounting:**

Experiments indicate that the *Airspeed Sensor* is more accurate when the pitot tube is side-mounted on the widest part of the fuselage. In this configuration, the pitot tube should stand off from the fuselage, by at least two (2) inches. Because each model installation is different, JetCAT will have additional mounting information for review, as auxiliary data becomes available.



Hold Speed and Cruise Control limitations:

Under normal circumstances, the *Airspeed Sensor* is primarily used for limiting the maximum flight speed and/or recording the maximum and average speeds of the model. Nonetheless, **Hold Speed** and **Cruise Control** modes are clever additions. These modes require evaluating and adjusting the PID parameters in the **limits** menu, while flying the model with a different technique. The slower reaction time of the throttle response necessitates executing smoother patterns, with limited pitch changes. Experimenting will identify how the turbine will react and help ascertain how to compensate for its limitations.

Calibration of the Air Speed Sensor

The characteristic curves of the differential pressure sensor can be calibrated to obtain a maximum of measuring accuracy.

Additional necessary facility for calibration:

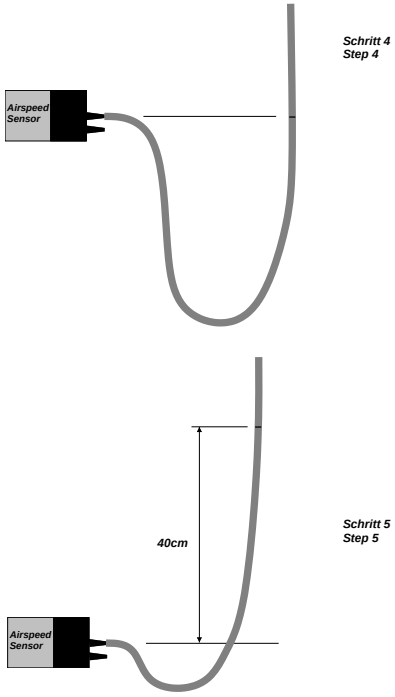
- 50 – 60cm silicone tube
- a plenty of water
- Ruler or folding meter stick

How to proceed:

1. Fill water into the silicon tube (minimum 50cm water column)
2. Fit the silicon tube to the Pitot tube or directly to the differential pressure sensor.
3. Keep pressed the key “RUN” on GSU and switch on the electronic. Release the key “RUN” if following appears on GSU:

   CAL. AirSpeedSns
   Set 40cm water

4. Adjust the end of water column to the altitude of the differential pressure sensor (or Pitot tube, if used). Press the key”INFO” on the GSU to define the zero point.
5. Raise the end of water column to a level of 40cm above the defined zero point now press the “MIN/MAX” key to store this value. You should read in the right upper edge of display **h=40.0**
   You can check the calibration by moving the water column up and down, The value in the display should be correspond to the value of the ruler. The step 4/5 can be arbitrary repeated. In the right edge below the value should be in a range between 6000 and 10000. (Default = 8560)
6. To store this determined calibration data press the “MANUAL” key on GSU at last. After the ECU stored this data it transfer back to the general duty.



Special Function

Temperatur adjustment

After a replace of a temperature sensor it need be necessary to run a temperature calibration

How to manage:

The turbine must be at ambient temperature (ca. 21°C) !!!

Press and hold the „Select Menu“ key on GSU, then **swictch on ECU** (receiver). Instead of „Select Menu“ key of GSU, it’s possible to press the little key on the LED-board.

The LED´s indicate the following blink sequence :

LED	**Blink Sequenz**	
Standby	⊙ ○ ○ ⊙ ○ ○	(yellow)
Pump running	○ ⇨ ⊙ ⇨ ○ ⇨ ○ ⇨ ⊙ ⇨ ○	(red)
OK	○ ○ ⊙ ○ ○ ⊙	(green)

The dispaly of GSU indicate simultanously :

Release Key to „Learn RC“

While this sequence hold the key „SelectMenu“<u>don’t</u> realease it !!!!

Release the key if the three LED´s indicate this blink sequence:

LED	**Blink Sequenz**	
Standby	⊙ ○ ⊙ ○ ⊙ ○	(yellow)
Pump running	○ ⇨ ⊙ ⇨ ○ ⇨ ⊙ ⇨ ○ ⇨ ⊙	(red)
OK	⊙ ○ ⊙ ○ ⊙ ○	(green)

The Display of the GSU indicate simultanously:

“Release Key to Calibrate Temp“

after releasing the key on the GSU the temperature calibration runs.

Reset to Default Value

The Ecu can be reseted to default values by following descrption:

Press and keep presses the „Select Menu“ key on the GSU, switch ond the **ECU** (receiver). Insted of „Select Menu“ Taste auf der GSU, its also possible to press the little key of the LED-board.

The LED’s indicate the following blink sequence :

LED	**Blink Sequenz**	
Standby	⊙ ○ ○ ⊙ ○ ○	(yellow)
Pump running	○ ⇨ ⊙ ⇨ ○ ⇨ ○ ⇨ ⊙ ⇨ ○	(red)
OK	○ ○ ⊙ ○ ○ ⊙	(green)

The dispaly of GSU indicate simultanously :

Release Key to „Learn RC“

While this sequence hold the key „SelectMenu“<u>don’t</u> realease it !!!!

After awhile of ca. 15 seconds the LED’s indicat the folowing blink sequence:

LED	**Blink Sequenz**	
Standby	⊙ ○ ⊙ ○ ⊙ ○	(yellow)
Pump running	○ ⇨ ⊙ ⇨ ○ ⇨ ⊙ ⇨ ○ ⇨ ⊙	(red)
OK	⊙ ○ ⊙ ○ ⊙ ○	(green)

While this sequence hold the key „SelectMenu“<u>don’t</u> realease it !!!!
Releas the key not before the LED’s indicate following sequnce:

LED	**Blink Sequenz**	
Standby	⊙ ○ ⊙ ○ ⊙ ○	(gelb)
Pump running	⊙ ⇨ ○ ⇨ ⊙ ⇨ ○ ⇨ ⊙ ⇨ ○	(rot)
OK	⊙ ○ ⊙ ○ ⊙ ○	(grün)

Simultanously the Display of GSU indicate:

“Release key to Reset System”

Now release the key to run the reset.

After a reset ist neccessary to:

- **Learn in RC**
- **Run the Temperature calibration**