Instruction manual
V6.0 ECU

JetCat
P60SE / P70 / P80 / P120SE / P160SX / P180 / P200

JetCat USA, LLC
4250 Aerotech Center Way, Building G
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(805) 226-8700 Voice
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MADE IN GERMANY

JetCat USA, LLC Three Year Limited Warranty.

JetCat USA, LLC, a Limited Liability Company, ("JetCat USA") warrants that this MINIATURE 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 USA, 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 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) A one time reduced fixed cost service voucher is available from JetCat USA if purchased within 30 days after the original Model Engine purchase. Inquire with JetCat USA for service voucher purchase details.

5) During the limited warranty period, JetCat USA will repair or replace, at JetCat USA'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 USA will also pay for the labor charges incurred by JetCat USA in repairing or replacing the defective parts. The limited warranty does not cover defects in appearance. JetCat USA shall not be liable for any other losses or damages.

6) The Buyer must operate and maintain the Model Engines in accordance to the Model Engine manual. The Model Engine must be returned to JetCat USA for maintenance on or before the TBO (Time Before Overhaul) interval of every 25 hours. If 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.

7) 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 USA, 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 USA.

    c) **The Model Engine is operated for commercial or institutional use.**

    d) The Model Engine serial number has been deliberately removed, defaced or altered.

8) 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 USA.

    b) The Buyer shall include a return address, daytime phone number and / or FAX 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 USA 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 USA after the expiration of the limited warranty period, JetCat USA's normal service policies shall apply and the Buyer will be responsible for all shipping charges.

9) The Buyer must bear the cost of shipping the Model Engine to JetCat USA in Paso Robles, California. JetCat USA shall bear the cost of shipping the Model Engine back to the Buyer, within the continental United States, after the completion of service under this limited warranty. The Buyer must pay for any other shipping charges.

10) 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.

11) JetCat USA 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.

12) JetCat USA 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.

13) This is the entire warranty between JetCat USA 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.

14) **Buyer must fully accept all conditions of the PURCHASE AGREEMENT, FULL ASSUMPTION OF LIABILITY AND INDEMNITY AGREEMENT**

15) If 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.

16) This limited warranty allocates the risk of failure of the Model Engine between the Buyer and JetCat USA. The allocation is recognized by the Buyer and is reflected in the purchase price of the Model Engine.

17) Questions concerning the warranty may be directed to:

JetCat USA, LLC
4250 Aerotech Center Way, Building G
Paso Robles, CA 93446

805-226-8700 Voice
805-226-8742 FAX
www.jetcatusa.com

PURCHASE AGREEMENT, FULL ASSUMPTION OF LIABILITY AND INDEMNITY AGREEMENT

Buyer purchases from JetCat USA, a Limited Liability Company ("JetCat USA") or from one of JetCat USA's authorized dealers, a MINIATURE TURBOJET ENGINE for model aircraft, cars or boats ("Model Engine") for the invoice price, accompanying this sale, and Buyer and JetCat USA agree to all of the following terms and conditions:

1. Buyer's Representations. Buyer represents that he/she is very experienced in model airplane operation, and that all of the information set forth in the Purchase Application is true and correct. JetCat USA relies on such representations, and would not enter into this sale but for these representations.

2. Buyer's Acknowledgment of Risks and Dangers. Buyer recognizes that operation of the Model Engine may be dangerous, and that under certain circumstances, its handling will be dangerous. As set forth in Paragraph 3 below, Buyer accepts full responsibility for all of these risks and waives all liability as against JetCat USA.

(a) Buyer's Acknowledgment of Danger. Buyer expressly acknowledges that use of the Model Engine is dangerous if improperly handled, and could inflict injury if attempts are made to handle it properly, if the user does not fully acquaint himself/herself with the Model Engine's operation procedures. The Model Engine may cause burns to the user, or the user's assistant, particularly in the start-up procedure, and Buyer agrees to use extreme caution. The Model Engine exhaust is extremely hot, and will burn someone or something placed directly behind the exhaust tube. Highly flammable liquid is used to operate the Model Engine, and it or its fumes will ignite easily and flare up rapidly. The Model Engine itself remains extremely hot, after it is shut off, and requires a cooling down period. Improper use of the Model Engine, or failure to follow Academy of Model Aeronautics ("AMA") guidelines and rules will result in injury to the user, the user's assistant, or bystanders. Operation of the Model Engine in any location other than an approved location, and under safe circumstances could lead to injury to bystanders. A risk exists from explosion, in the event of tampering, modifications leading to over-speed or extreme metal fatigue.

(b) Buyer's Obligation to Become Fully Acquainted With Operation Procedure. Buyer acknowledges receipt of operating instructions for the Model Engine which depicts its handling and operation. Buyer agrees to thoroughly acquaint himself/herself with these materials, and to require his/her assistant to become equally familiar with them. Buyer expressly agrees not to allow any person to assist in the start-up procedure of the Model Engine, who has not become thoroughly familiar with these materials.

(c) Agreement to Use Qualified Assistant in Start-Up Procedure. Buyer acknowledges that the start-up procedure for the Model Engine cannot be safely done, without an assistant. Buyer expressly agrees to use an assistant, who is thoroughly familiar with the Model Engine and its operation as set forth above, on each occasion when the Model Engine is started up.

(d) Warning to Bystanders. Buyer acknowledges that injury or burns to bystanders could occur, during the start-up procedure or when operating the Model Engine. Buyer expressly agrees to take all steps necessary to assure that no bystander will be in a position to receive injuries during the start-up procedure, or while the Model Engine is running.

3. Full Assumption of Liability; Waiver and Release of JetCat USA. Buyer assumes all risk of injury, harm and damage, of every nature whatsoever, to himself/herself and his/her property. Buyer fully and completely waives and releases any and all claims which he/she might have at any time arising out of the purchase, handling, or operation of the Model Engine. This assumption, waiver and release is complete, full, and comprehensive.

(a) Release Even If JetCat USA Is Negligent. The waiver and release contained herein releases JetCat USA from all conduct, no matter how it could be characterized or alleged. JetCat USA shall not be liable for its own negligence, whether active, passive, primary, or secondary. JetCat USA shall not be liable for its sole negligence. JetCat USA shall not be liable for its willful misconduct. JetCat USA shall not be liable based on any theory in strict liability in tort. JetCat USA shall not be liable for any alleged breach of warranty, whether express or implied, of any nature whatsoever, whether a warranty of fitness for a particular use, merchantability, or otherwise. There is no warranty of merchantability; there is no warranty of fitness for a particular purpose; and there are no warranties which extend beyond the description on the face hereof or JetCat USA's One Year Limited Warranty.

(b) Waiver Effective for All Time. The waiver and release contained herein is effective, without regard to the passage of time. It is effective indefinitely. It will not be changed by any modification to the Model Engine, to any later sale, or other changes in circumstances.

(c) Release Extends to JetCat USA and All Its Associates. The waiver and release contained herein protects JetCat USA, and all of its employees, officers, principals, owners, designers, and agents ("Associates").

(d) Waiver of Civil Code Section 1542. Buyer acknowledges the existence of, and fully and completely waives the provisions of California Civil Code Section 1542, which provides:

"A general release does not extend to claims which the creditor does not know or suspect to exist in his favor at the time of executing the release, which if known by him must have materially affected his settlement with the debtor."

4. No Modifications to Model Engine. Buyer agrees to make no modifications of any kind to the Model Engine. This Agreement pertains to the entire life of the Model Engine.

5. Sale By Buyer to Other Party. Buyer agrees to fully inform any person to whom he/she sells or transfers the Model Engine, concerning the handling, use, and operation of the Model Engine, and agrees to give all operating instructions to such person, at or before the time of sale or transfer. The indemnity and hold harmless agreement contained in Paragraph 3 continues in effect, following such sale or transfer.

6. Severability. In the event any clause, provision, or term of this Agreement is held to be ineffective, void or otherwise unenforceable for any reason, that clause, provision, or term shall be severed from this Agreement, and the Agreement shall otherwise remain binding and effective. If any portion of Paragraph 3 is found to be unenforceable, then the parties agree that the fullest and most complete waiver and release which is permitted by law, shall be effective.

7. California Law Applicable. The law of the State of California shall apply to any and all controversies which may arise out of or relate to this Agreement, the sale of the Model Engine, or its ownership, use, or operation.

8. Arbitration. ANY CONTROVERSY OR CLAIM ARISING OUT OF OR RELATING TO THIS AGREEMENT, OR THE BREACH THEREOF, OR THE OWNERSHIP, USE, OR OPERATION OF THE MODEL ENGINE, SHALL BE SETTLED BY ARBITRATION ADMINISTERED BY THE JUDICIAL ARBITRATION AND MEDIATION SERVICE/ENDISPUTE, AT ITS LOS ANGELES OFFICE, UNDER ITS THEN APPLICABLE RULES AND PROCEDURES. THE ARBITRATION SHALL BE BINDING, AND JUDGMENT ON THE AWARD RENDERED BY THE ARBITRATOR MAY BE ENTERED IN ANY COURT HAVING JURISDICTION. BUYER EXPRESSLY ACKNOWLEDGES AND WAIVES THE RIGHT TO FILE A LAWSUIT IN A COURT OF LAW, TO HAVE THE MATTER DETERMINED BY A JURY, AND TO APPEAL. BUYER'S AGREEMENT TO THIS ARBITRATION PROVISION IS VOLUNTARY. THE PARTIES HAVE READ AND UNDERSTAND THE FOREGOING AND AGREE TO SUBMIT DISPUTES ARISING OUT OF ALL MATTERS TO NEUTRAL ARBITRATION.

9. This Document Is the Full Expression of Parties' Agreement. This Agreement contains the full and complete agreement of the parties. There is no representation, term, or provision which is outside this Agreement. Any and all discussions, oral agreements, and representations are merged into this single written Agreement. This Agreement cannot be modified or amended in any way, except by written Amendment, signed by the parties.

10. Paragraph Headings Not Controlling. The heading to any paragraph, or subparagraph of this Agreement, shall not be dispositive, but may be used to interpret the parties' intentions.

11. No Interpretation of Agreement Against Either Party. Buyer understands and expressly acknowledges that he/she has the right to have an attorney read and review this Agreement, before execution. This Agreement shall not be interpreted against either party, but shall be interpreted as if it was drafted mutually by the parties.

12) If the Buyer is not prepared to fully accept the PURCHASE AGREEMENT, FULL ASSUMPTION OF LIABILITY AND INDEMNITY AGREEMENT, the Buyer is advised to return this Model Engine immediately in new and unused condition to the place of purchase.

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Introduction

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

Obviously, model turbine aviation - despite all the apparent fun involved - is serious business. The *JetCat engine* has undergone extensive testing and redesign, in order to ensure it is a safe and reliable model engine; 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 engine 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 engine* **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 USA* for further assistance.

Once you are accustomed to handling the *JetCat engine*, you will observe that it is a very reliable engine. Some experienced operators have expressed their belief that it handles better than many piston engines. However, always remember this is a **REAL JET ENGINE**, requiring knowledge, discipline and maintenance.

In order to learn more about the development of the model turbine engine and understand its function, we highly recommend reading *Gas Turbine Engines for Model Aircraft* by Kurt Schreckling and *Model Jet Engines* by Thomas Kamps. These books are available through:

Traplet Publications	
Traplet House	
Severn Drive	
Upton upon Severn, Worcestershire	ISBN 0 9510589 1 6
United Kingdom WR8 0JL	ISBN 0 9510589 9 1

Safety Precautions

If other persons or animals are present while operating the *JetCat ENGINE*, **ALWAYS ENFORCE THE PROPER MINIMUM SAFE DISTANCES FROM THE TURBINE!**
The recommended minimum safe distances are:

In front of the turbine	**= 15 feet**
On the side of the turbine	**= 25 feet**
Behind the turbine	**= 15 feet**

In case of a mishap, fire extinguishers should be on hand at all times. *JETCAT USA* recommends the CO/2 variety. Powdered extinguishers will contaminate the precision components, upsetting the integrity of the turbine.

To the avoid hearing damage, always use hearing protection when you are near a running turbine engine!

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 a flash - prevails in this area. Be aware of this source of danger, always!

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.

Always exercise caution around the hot parts of the turbine, to avoid burns. The outer case at the turbine stage and nozzle reaches 450-500° (Celsius), while the exhaust gas may exceed 720 °C.

Assure that the fuel is mixed with approximately 5% synthetic oil. Use only synthetic turbine oils available at local airport fuel suppliers or from *JETCAT USA*. Synthetic turbine oils are dangerous and should only be handled per the manufactures MDS sheets

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 ENGINE* in restricted fire zones. Never operate model turbine jet aircraft in or around residential or heavily populated areas.

Installation of unauthorized parts from another manufacturing source may also result in engine failure. Do not introduce engine or electronic components other than those delivered by *JETCAT USA*, unless you are willing to risk destroying your turbine! *JETCAT USA's* parts are designed and engineered specifically for the *JetCat P80/ P120/P160*. Accept no substitutes, unless you are prepared to sacrifice your aircraft.

Warning:

A flying model with a turbine can reach higher flight speeds than ducted fan-powered models, because the turbine's thrust degrades less with higher flight speeds. With attainable flight speeds of over 250 MPH, you can quickly run out if flying room. There is also a danger of developing control surface flutter or mechanical overload, causing the model to fail in flight. When piloting a turbine powered aircraft, one must properly control the throttle. Full power should be used for takeoff or vertical maneuvers and a reduced setting for level or descending flight. To restrict the maximum flight speed, an optional airspeed sensor is available.

The Checklist

Before Running the Turbine

- Charge ECU Battery
- Prepare 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
- Be certain the starting gas release valve is closed, before filling the starting gas tank
- 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
- After the cooling process (approximately two minutes), turn off receiver switch
- After each flying session, open starting gas release valve, to empty the tank, before storing the model. This should be executed in a safe area

Fuel / Fuel Care

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 Aeroshell 500 turbine oil although any turbine oil that conforms to MS23699 standards will work.

Fuel System

The input and output fuel tubing must be connected to the electronic shut-off valve as per the drawing. The tube from the pump, <u>fuel in,</u> is towards the heat shrink tubing covered coil. The tube to the engine, <u>fuel out,</u> is towards the edge of the valve. **It will not shut off if connected incorrectly!** If your engine was equipped with our new smaller valve (brass/plastic body), the input and output is indicated by an arrow on the side of the valve. The arrow indicates the flow direction.

When installing the fuel lines on components with nipples, slightly warm the tubing before connecting. This will soften the tube, making it easier to install. When installing tubing on a metal tube, secure the tubing by a safety wire loop around the connection. To remove tubing from nipples, you must cut the tubing off. Be careful not to damage the nipple when cutting off tubing. To insert tubing into Festo quick release fittings, use firm pressure until you feel the tube snap in. To release, press in on the front ring, while pulling the tubing out.

ALWAYS use a gasoline-compatible stopper. Silicon stoppers swell and leak.
Check your fuel filters every ten (10) flights. You may be surprised how rapidly they can clog up! The filter is installed with the **O-ring located toward the fuel pump**.

✋ **Extremely Important:**
Use caution not to pinch o-ring when assembling filters. **Clean any aluminum dust off and <u>lubricate threads</u> 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.

When running the engine at full power, check the fuel line from the pump to the engine. If there is a large quantity of air bubbles flowing with the fuel, there is probably a restriction in the fuel system or an air leak in a fitting.

Be careful not to over-pressurize the kerosene tanks and the kerosene shut off valve during refueling operations. You might pump a bit of raw fuel past the valve and into the turbine, and subsequently have a wet (hot!) start. We are now requiring a manual shutoff valve downstream of the automatic kerosene shutoff valve, as an additional precaution.

Hopper Tank

A hopper tank is recommended, between the main fuel tank and the engine. **JetCat USA highly recommends the BVM UAT for the hopper tank!**

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

NOTE: On P180/P200, use 6 mm tubing up to the fuel pump. The fuel demands are high on the P180/P200 and require larger tubing on the inlet side of the pump. The P180/P200 includes a 6 mm to 4 mm adapter.

Prime the pump and system.

To prime the fuel pump and fuel lines (or for fuel pump test purposes), it is necessary to open the fuel shutoff valve and run the fuel pump manually. For this purpose, use the **Test–Functions Menu** selection, **Pump TestVolt (Purge Fuel)**. This test opens the fuel valve and acts as a speed control for running the pump.

✋ **Extremely Important:**

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!
Before activating the pump test mode, ALWAYS remove the fuel feed line connected to the turbine.

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.

Fuel System Connection Diagram

Vent

Main Tank(s)

Kerosene Shut Off Valve

Brass clunk

To Turbine Fuel Connection

Neoprene Stopper !

Safety Petcock
!open before starting turbine!

Filter

BVM UAT supplied tubing

BVM UAT supplied plug

out

Fuel Pump

in

BVM UAT

Tank Fill (Kerosene)

1/4 inch section of 4 mm tubing acts as an adapter for large BVM UAT tubing
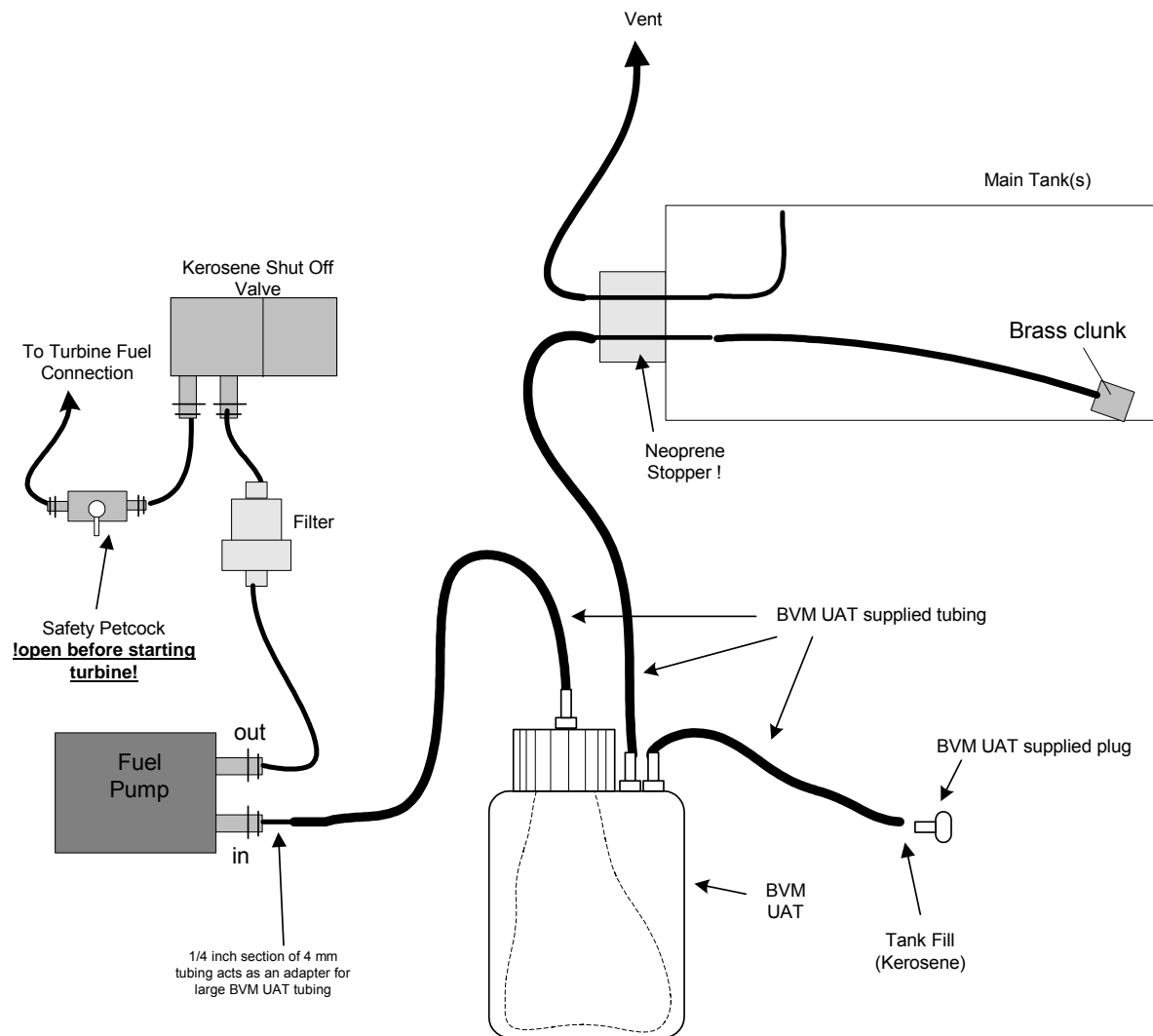
Note: All tubing 4mm(except as noted)

The UAT is available as an option from JetCat USA

Fuel pump adjustment

After the turbine has ignited on propane, the starter motor further accelerates the turbine. At approx. 5000 RPM, the fuel pump is automatically started at minimum power by the ECU. Beginning from this first pump start voltage, the fuel flow is then slowly increased by increasing the pump voltage.
The initial pump voltage that the pump is supplied immediately after ignition has been factory adjusted. If the fuel pump is changed or after several turbine runs the pump is braking in thus delivering too much fuel at start-up causing long flames behind the turbine exhaust, it might be necessary to readjust the pump start voltage.

For adjustment of the pump start voltage, the ECU incorporates a special adjustment function, which can be accessed as follows:

Interrupt fuel supply to the turbine. If the fuel supply to the turbine is not disconnected / interrupted the turbine can be "filled" with fuel during the following adjustment procedure!!! → Danger of a "Hot Start"

Pump setup menu for V5.0K and newer ECUs.
Press and hold the **Limits** key then press the ▶+ key. This will enter the new pump and NiCad battery cell count menu. To exit, press any blue key.

There are 3 selections available. 1 = U-accelr1, 2 = U-accelr2, 3 = number of NiCad cells (6-10 selectable).

On older ECUs, use the following to adjust the pump:

> Switch off ECU and plug in GSU (RC transmitter is not being used)
> Press <u>and</u> hold the key "Change Value/Item" on the GSU and switch on the ECU
>
> Release the "Change Value/Item" when the display of the GSU shows the following:
>
> | Pump start volt. |
> | --- |
> | Uaccelr1: |
>
> By pressing the "Run" key will run the pump at the current start voltage value.
> To increase the pump start voltage by one increment, press the ▶+ key.
> To decrease the pump start voltage by one increment, press the ◀ - key.
>
> The pump start voltage should now be adjusted in such a manner, that the pump just begins to steadily turn and that the fuel is delivered in a thin fuel stream (a little bit more than just dripping out of the tubing). To test this, press the "Run" key several times to check that the pump starts steadily running on different pump rotor positions.
>
> Normal values for the pump start voltage are between 0.100 and 0.325V.
>
> **Important:**
> At the end of the adjustment procedure press the "Manual" key to store the new setting and resume to normal operation.

Pump start voltage is adjusted too low:
If the pump start voltage is adjusted too low, the pump may not start to turn (→ the red "pump running" LED is illuminated, but the pump is not turning). This can result in the turbine, after ignition on propane, running an unusual long time and not picking up RPM. If this time is too long (>10sec.), the ECU will terminate the start and show an Error message "AccTimOut" or "Acc. Slow" (=acceleration too slow).

Pump start voltage is adjusted too high:
If the pump start voltage is adjusted too high, the turbine maybe supplied with too much fuel during start up. This could result in heavy flames behind the turbine (→ turbine RPM too low compared to fuel being supplied).

Starting Gas Diagram

3mm tubing to turbine

Starting Gas
Shutoff Valve

4mm tubing

4 -> 3mm tubing adapter

Filter

4mm tubing

4mm tubing

Petcock
(Starting Gas Vent)

On Board
Starting Gas
Tank

Keep Line Short !

One Way Festo
(Note markings!)

Plastic Barb
(To Offboard Gas Fill)

Coleman
Powermax
Starting Gas
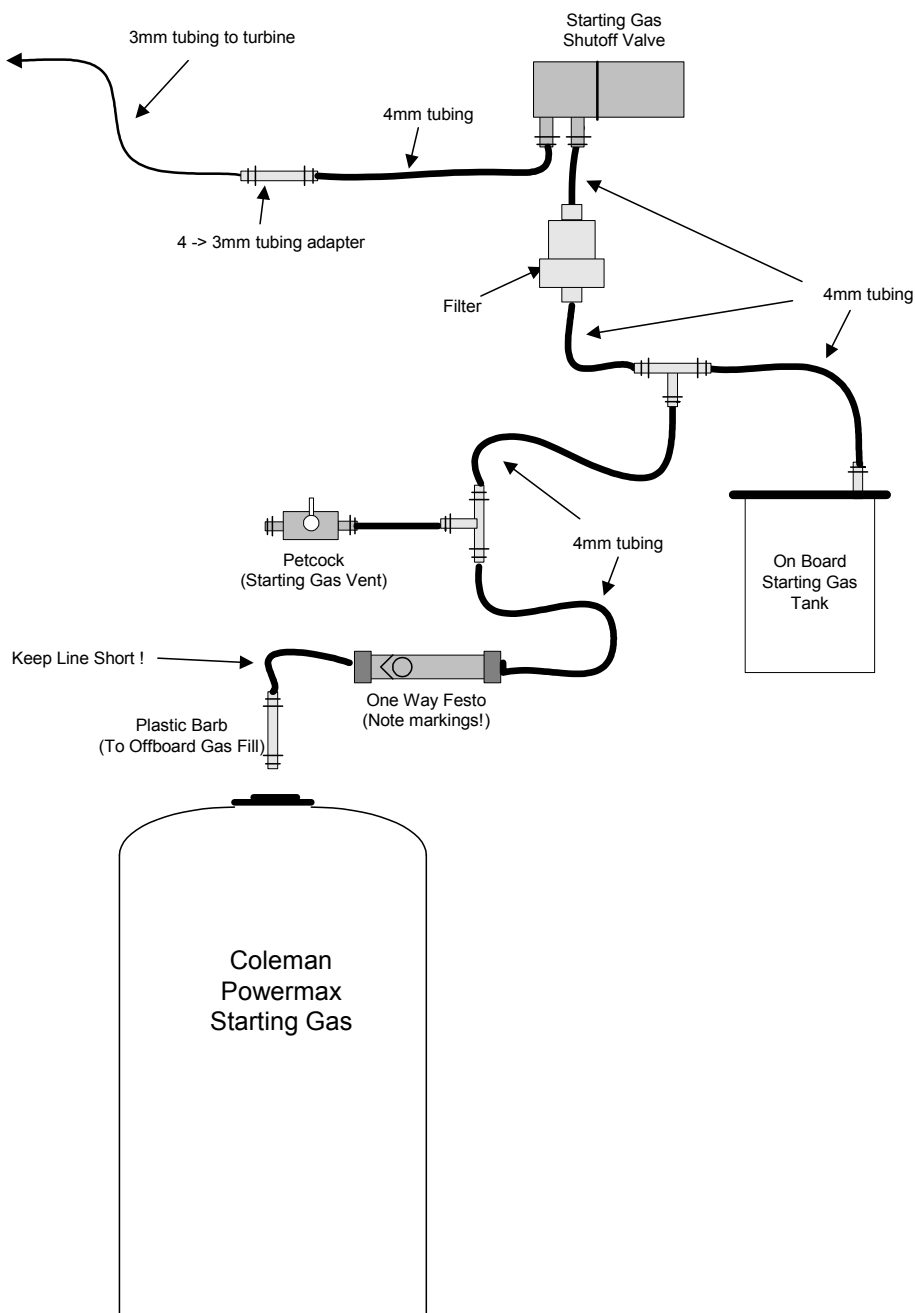
Important:

The input and output starting gas tubing must be connected to the electronic shut-off valve as per the drawing. The gas in is towards the heat shrink tubing covered coil. The gas out is towards the edge of the valve. **It will not shut off if connected incorrectly!** If your engine was equipped with our new smaller valve (brass/plastic body), the input and output is indicated by an arrow on the side of the valve. The arrow indicates the flow direction.

Keep the tubing length short from the one/way valve to the black nylon starting gas probe. This will minimize the amount of excess gas released when the probe is removed from the **POWERMAX** can. Be careful to identify the proper end of the starting gas probe. The probe has a barbed nipple on one end and a smooth nipple on the other. The smooth end is inserted into the **POWERMAX can.**

The starting gas tank can be mounted vertically or slightly horizontally. Whether the tank is mounted upright or slightly on its side, the nipple must always be towards the top. This will limit the amount of liquid propane entering the turbine during startup. After every flying session, open the release valve to empty the tank, before storing the model. Perform this procedure in a safe area.

The propane filter is installed just before the starting gas valve.

If you are using the engine in a bypass, and it produces a bang when the starting gas ignites, or if it is too rich and not igniting immediately, you must limit the amount of starting gas flowing to the turbine. This is accomplished by changing the **Gas Flow** percentage to a lower value in the **Limits** menu. Start by lowering it in 10% increments until it smoothly ignites. This should be adjusted with a full tank of gas each time. Watch the exhaust gas temperature each time you make an adjustment. The turbine will over heat if the amount of starting gas is too low. When a good adjustment is achieved, it should work unless there is a broad change in outside temperature.

Filling the Starting Gas Tank:

Only use a propane/butane mix for starting gas. *JETCAT USA* recommends **Coleman POWERMAX** fuel (or a mix of propane butane 60/40%). **POWERMAX** is available at sporting goods stores or from *JETCAT USA*. Use the 10.6-ounce size.
Do not use 100% propane from torch refill bottles. The pressure is too high and will cause the tubing to rupture.
To fill the tank, insert the starting gas fill probe into the valve on the **POWERMAX** can. Make sure the can is vertical since it has a clunk at the bottom. Verify that the fluid is flowing into the tubing. Continue filling, until the fluid slows. Just before the liquid stops flowing, remove the probe from the **POWERMAX** can. Although several starts are attainable with a full tank, *JETCAT USA* recommends refilling before every flight, establishing a routine that is not overlooked.

Do not over fill the on-board starting gas tank. When you notice the liquid flow into the tank start to slow down, stop filling. You will prevent any tendency to "pop" on start up, while still having enough gas for 2 to 3 auto starts.

Mounting the Turbine

A two-piece, aluminum mounting bracket is included with the turbine. Place the bracket around the turbine, with the glow plug situated within the slot of the smaller bracket piece. This will help stabilize the engine along the thrust axis. The glow plug must be in the vertical position, when mounted in your model (+/- 75° of engine rotation, from the glow plug at top dead center, is the allowable deviation). Secure the engine, using four metric mounting screws and lock washers that are provided with brackets.
For models that require an exterior turbine mount (such as the Kangaroo) or for bypass tube mounting, optional brackets are available from *JETCAT USA*.

Suggested turbine installation

Turbine side view / thrust tube

When the turbine is mounted in models with the air intake at the bottom, for example F-16, care should be taken to prevent foreign object damage of the compressor stage. This can be accomplished by using a strainer screen at the inlet. The screen mesh should be about 0.06 inches in width.

Außenabmessungen JetCat P80

Connections at the Turbine

Fuel Connector,
4mm tubing from
the fuel pump

From ECU,
EGT & RPM
sensor cable

Starting Gas
Connector,
(Propane/ Butane)
3mm tubing from the
starting gas tank

From ECU
(Glow-plug /
Starter device)
3-lead cable

Electrical connection diagram (1/2)

Connection - diagramm (Verbindungsschema)

The sequence of these connections can be changed as required (parallel bus system)
(Die Reihenfolge der Verbindungen spielt keine Rolle -> paralleles Bussystem)

"phone"- cable ("Telefonkabel")

(optional)

RS232 Adapter

PC

GSU =ground support unit (Programmier- und Anzeigegerät)

Remote - GSU

— Jet-tronic —

+ ·

● Standby / Man.
● Ignition on
● Pump running
● OK / Reset...

Info   MinMax   Change Value from

Run   Limits   Select Menu

Manual   Ignition

"phone"- cable ("Telefonkabel")

static pressure (statischer Druck)

air pressure (Staudruck)

pitot-tube (Staurohr)

Airspeed Sensor

(optional)

6-wire phone cable to turbine
6-adriges Telefonkabel, zur Turbine

NiCad battery (6 cells)

LED I/O-board

ECU top-view (von oben)

Airspeed   Temp&Rpm Sensor (Connect to turbine)   Propane

Battery 7,2V 6 cells   +   −

— ECU - V5.0 — ☀

Microcomputer Turbine Control

CE

Data-Bus   Smoker   Fuel   + ·

6-wire phone cable
6-adriges Telefonkabel

Receiver-battery (Empfängerakku)

Receiver-ON/OFF switch (Empfängerschalter)

The ECU is automatically powered up whenever the receiver is switched on
(Die Elektronik schaltet sich automatisch EIN sobald der Empfänger eingeschaltet wird)

RC receiver (Empfänger)

AUX
linked to a 3 position switch on the RC-transmitter (3-Stufenschalter)

THR
Throttle stick (Gaskanal)

Shut-off valve propane

Shut-off valve fuel

Electrical connection diagram (2/2)

Connection - diagramm (2/2)
(Verbindungsschema)

ECU bottom-view
(von unten)

Fuelpump
(Kraftstoffpumpe)

Fuel Pump
(max. 12A)

GPS
Exp.

P60 P70 P80 P120 P160 P200 PHT3 PHT4 SP15
Type:

Glow-plug
Starter
(Connect to turbine)

ECU - V5.0

To turbine (3 wire cable)
(Zur Turbine 3-adriges Kabel)

Electrical connection pictures

Fuel valve

Propane valve

2x to receiver
(THR/AUX)

Fuel valve to be
connected on
lower output

Propane valve
(below Air Speed input.)

Power Supply

Power for all electrical components of the turbine (starter / glow plug / ECU / fuel pump / fuel and gas valves) are supplied by the six-cell, 1250 mah (2400 mah with P180/P200) ECU battery. Engines supplied with V6.0I or newer ECU may include a 2 cell 7.4V 2500 mah LiPoly battery. **Note: V6.0I or newer ECUs default to LiPoly battery type.** The amount of battery capacity used per flight is approximately 300-400 mah (500-800 mah with the P180/P200). This includes starting and cool down. The NiCad battery **must** be recharged after two (2) fl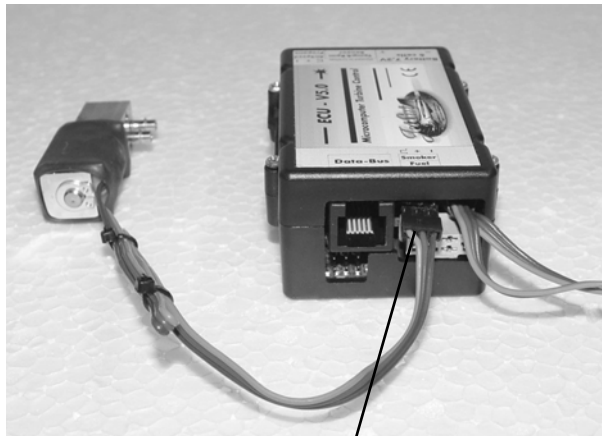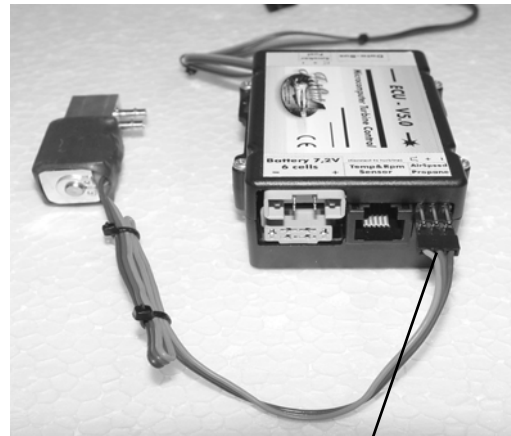ights! *JETCAT USA* recommends recharging after every flight, making it a routine that is not overlooked. The battery should be cycled periodically, to prevent NiCad memory problems that lower the battery's capacity. If you use Lithium batteries, we suggest unplugging the ECU at the end of the day to prevent over discharging. We do not recommend Lithium Ion cells. **IMPORTANT: DO NOT USE THE 3 CELL LiPo OPTION.** Although this selection is available in the Limits Menu, it will over power the ECU and damage it.

Charging the Battery

Do not charge the battery, with a quick charger using negative discharge pulses, when connected to the ECU. This will destroy the electronics of the ECU. The only recommended method is to disconnect the battery from the ECU and charge it directly. This type of negative pulse chargers is only applicable to NiCads. If you are absolutely sure that this is not the case with your charger, the battery can be charged using a Y cable.

Glow Plug

A modified, (non-idle bar) glow plug (Rossi 8) is appropriate. The glow plug is installed on the turbine with the washer. Do not over-tighten or you may damage the threaded bushing. Light torque is fine; there is no vibration to loosen it. The glow plug is modified, so that two turns of the element extend beyond the bottom of the plug. With a pin, pull out two turns of the element. Make sure the plug glows brightly red. The limits menu features an adjustment for glow plug voltage. If high voltage plugs are used (Rossi R8), a value of 2.6-2.7 V will be required. This adjustment is described later.
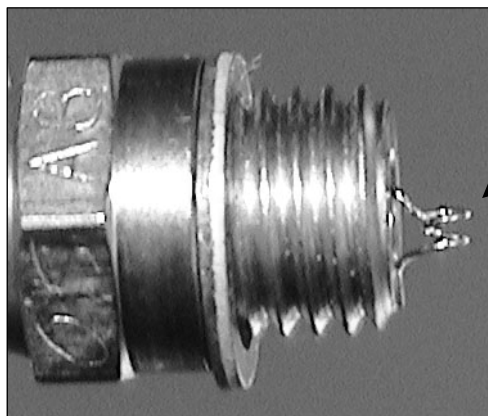
Note: 2 coils pulled out 90° from the body

If you have been enjoying good auto starts, and suddenly you notice that your turbine does not start immediately on the first starting gas cycle, check the glow plug. The plugs last so long that we sometimes forget that they can finally wear out!

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

Alphanumeric, 2 line by 16 character, backlit LCD Display.

◀ - or ▶ + Keys scroll within a menu or through different menus. Keys also work for changing turbine parameter

Hotkeys
Directly enters the menu named on the corresponding key.

Manual - Direct starting turbine or to enter parameters for several functions.

— **Jet-tronic** —

Remote - GSU

● Standby / Man.

● Ignition on

● Pump running

● OK / Reset...

Info   Min/Max

Run   Limits

Manual Ignition

Change Value Item

Select Menu

Standby - LED (yellow)

Ignition - LED (red)

Pump running - LED (red)

OK - LED (green)

Change Value key for altering turbine parameters in conjunction with the ◀ - / ▶ + keys

Select Menu key for selecting different menus in conjunction with the ◀ - / ▶ + keys

Ignition - runs starter for testing or for directly starting turbine.

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".

GSU LED Descriptions

Color	Name	LED On	LED Blinks
Yellow	**Standby/Man.**	Starter Motor engaged	
Red	**Ignition On**	Glow Plug is on	---
Red	**Pump Running**	Fuel pump is on	Glow Plug is defective
Green	**OK / Reset…**	Turbine running: throttle control active	1. If the turbine is running, the EGT is exceeding the maximum temperature. 2. If the turbine is off, **SlowDown** mode active

Special function:

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

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 board should be mounted with the LED's visible and the data bus connector accessible for plugging in the GSU. The connector facing opposite of the LED's is attached to 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.

Illustration 1:

Explanation of the Lights on the LED I/O board. These LED indicators are identical to the **GSU** LED's (excluding the red "ignition on").

Color	Name	LED On	LED Blinks
Yellow	**Standby**	Starter Motor engaged	
Red	**Pump Running**	Fuel pump is on	Glow Plug is defective
Green	**OK / Reset…**	Turbine running: throttle control active	1. If the turbine is running, the EGT is exceeding the maximum temperature. 2. If the turbine is off, **SlowDown** mode active

JetCat ECU version 4.0 – 6.0 introduction

This is the most significant update for the American market since our introduction of the JetCat engine, December 1998. This update replaces the processor board in the ECU with a new, totally redesigned board, utilizing the Hitachi H8 16 bit micro-controller. This very fast and powerful micro-controller allowed us to expand our already rich set of features and has a much larger capacity to expand in the future. Further updates will only require a new program to be "Flashed" in through the serial port without opening the ECU and reprogramming the chip as its predecessor required.

This update includes many new operating and safety features but still retains the basic menu structure and operation similar to the previous ECU. The most significant new features include
- Programmable failsafe time out.
- Starting gas purge.
- Optional Global Position System interface.
- Optional Windows™ compatible computer interface.
- Expanded set of test functions.
- Expanded set of diagnostic functions.
- Ability to start the engine directly from the GSU without the transmitter.

The Hitachi H8 micro-controller is the latest technology in its class and features very quiet operation. By utilizing this micro-controller, our updated ECU has very low Radio Frequency and Electro Magnetic Interference yet is much more powerful than **any** other ECU on the market today. The low emissions from this new ECU allows for much easier installation in your aircraft and has very little to no effect on the receiver's range operating on the American frequencies (50, 53 and 72 MHz).

Setting up the ECU

These are the first steps you need to complete before operating the ECU. Make sure your batteries are charged, the ECU is off and the GSU is connected.

To power the ECU without using a receiver, plug either the ECU throttle (T) or auxiliary (A) input cable into the ECU airspeed input. The ECU will then power on when the ECU battery is plugged in. For GSU operation (no radio) only!

Do not perform the calibration of the temperature probe if this is a new engine. Temperature probe calibration is for ECU updates only.

Calibrate the temperature probe.

To compensate the differences from engine to engine there is an offset number that is used to correct the temperature displayed. This offset is derived by sampling the actual temperature read from the engine compared to the ambient room temperature.

Your engine should be at approximately room temperature, 21 °C.

Press and hold the **Select Menu** key on the GSU, then switch on the power.

> ✍ Remark:
> Instead of pressing the **Select Menu** key on the GSU, the little key on the LED board can be use instead.

The three LED´s first show the following blinking sequence:

LED		*Blink Sequence*						
Standby/Man.	**Yellow**	◉	○	○	◉	○	○	
Pump running	**Red**	○ ⇨	◉ ⇨	○ ⇨	○ ⇨	◉ ⇨	○	
OK	**Green**	○	○	◉	○	○	◉	....

The Display of the GSU will also show the message:

```
Release key to:
- learn RC -
```

Keep the Select Menu key pressed during this blinking sequence. It takes up to 10 seconds!

Only release the key when the 3 LED´s are showing the following sequence:

LED	*Blinking sequence*					
Standby	**Yellow** ⊙	○	⊙	○	⊙	○
Pump running	**Red** ○ ⇨	⊙ ⇨	○ ⇨	⊙ ⇨	○ ⇨	⊙ ⇨
OK	**Green** ⊙	○	⊙	○	⊙	○ ....

The Display of the GSU will change to the message:

```
Release key to:
Calibrate Temp
```

→ now release the key

- The display should return to the default showing RPM and temperature. The temperature should be 21 °C.

Setup failsafe mode and "Learn RC".

The updated ECU has the unique ability to shut-off your engine 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 engine. A timer is started when the failsafe condition occurs and the engine will immediately go to idle. After 3 seconds (2 seconds after V5.0A for AMA requirements as of March 1, 2004) the engine 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 engine is shut off.

The following is for PCM receivers only. Users of FM (PPM) receivers bypass the failsafe instructions and go to the **"Learn R/C"** section in the manual. (FM Receivers are not allowed under AMA rules.)

Setting the failsafe for JR PCM receivers

The following procedures are for most radios like JR and Futaba. Call JetCat USA for failsafe setup procedures for Futaba 8U radios or other radio brands.

If you look at the following servo travel graph, you can see how the ECU detects a failsafe condition. The dark gray bar is the transmitters throttle channel for low throttle, low throttle trim and full throttle set to 100% travel. This is the value that is set into the transmitter's failsafe. The light gray bar is a reduced low throttle, low throttle trim travel and full throttle set to 75%. This is the value that will be taught into the ECU. If the throttle input to the ECU is between 75% for low throttle, low throttle trim and 75% for full throttle, then this would be within the normal range taught into the ECU 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 engine to idle (after the **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 engine. If at anytime during this countdown the receivers signal is reacquired, the ECU timer will be reset and the engine will go back to the speed the throttle stick is currently at.

Low throttle

| Failsafe 100% low / 100% high throttle travel. | High throttle |
| ECU 75% low / 75% high throttle travel. | |
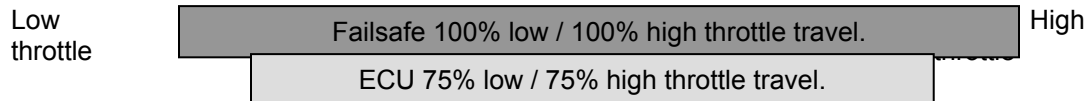
To accomplish this, you must execute the following steps. It is VITAL that these steps be preformed in this order for the failsafe feature to operate properly! Review your transmitter's manual on how to set the failsafe. Examples are given for the JR 10X with S style receivers. **YOU MUST PERFORM THESE STEPS!**

IMPORTANT: IF YOU CHANGE YOUR TRANSMITTERS FAILSAFE AGAIN IN THE FUTURE, YOU MUST REDUE THE FOLLOWING INSTRUCTIONS AGAIN**.**
FOR TWO CHANNEL OPERATION: DO NOT SET THE AUX CHANNEL IN YOUR TRANSMITTER FOR FAILSAFE. KEEP IT IN **HOLD MODE** ONLY. THE AUX CHANNEL IS ALWAYS DESIGNED TO STOP THE ENGINE INSTANTLY IF COMMANDED TO DO SO.

- First, set your transmitters travel parameter to 100% for low throttle and 100% for high throttle. On the JR 10X transmitter, use function 12 to access the throttle travel.
- Set your transmitters failsafe for low throttle, low throttle trim. On the JR 10X transmitter use function 77 to access the failsafe. Enable the throttle channel for a failsafe (select **1** so the bar is in the top position ▀) and then set the throttle stick and throttle trim to their minimum positions. Save this minimum position by pressing STORE.
- Return to the travel menu and now set the minimum and maximum throttle travel to 75%.
- Now you must teach in these values into the ECU. Refer to **"Learn R/C"** section in this manual for this procedure.

You can verify the failsafe function in the default GSU screen.

Default Display   This symbol will appear when in failsafe.

```
 21  ↑  ⌐0.0
6.9   OC:----
```
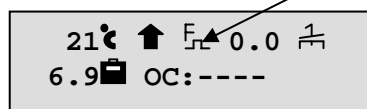
If you turn-off your transmitter, the default display will indicate a failsafe by displaying an ⌐. If you turn the transmitter back on, the ⌐ will disappear. If the ⌐ does not appear when you turn-off your transmitter, the fail-safe is not programmed properly!

You can verify the failsafe parameters by accessing the **RC Check Menu**. Press and hold the **Select Menu** key on the GSU and by pressing the ▶ + key until the **RC-Check Menu is displayed**. Now release the **Select Menu** key.

Time in Failsafe (seconds)
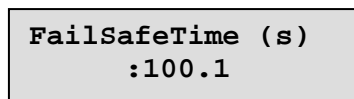
```
FailSafeTime (s)
     :100.1
```

If you press the ◀ - in the RC-Check Menu until you see FailSafeTime: the display will indicate the number of seconds the reciever was in failsafe. This is a total time for all the failsafe counts. If you turn-off your transmitter, it will increase every second. This is a great tool for diagnosing the quality of the RC systems RF link by checking this after each flight.

Number of Failsafes

```
FailSafe Count ⌐
      :1
```
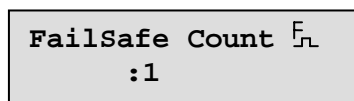
If you press the ◀ - again you see Failsafe count: the display will indicate the number of times the receiver went into failsafe. If you turn-off and turn-on your transmitter, it will increase this count by one. This is a great tool

for diagnosing the quality of the RC systems RF link by checking this after each flight.

Refer to the Limits menu for the following parameters.

Failsafe delay

> ```
> Failsafe Delay
> :0.1
> ```

Setting for the period before the ECU will go into the Failsafe mode and reduce the throttle to the preset **FailSafeRPM**. After the **FailSafeTimeOut** below, the engine would then shut off. This maybe programmed from 0.1 to 20 seconds (Default = 0.1 seconds).

Failsafe timeout

> ```
> FailSafeTimeOut
> :2.0
> ```

Setting for how long the turbine will run in a failsafe condition before the engine shuts off. This may be programmed from 0.1 to 20 seconds (Default = 2 seconds).

Failsafe RPM

> ```
> FailSafeRPM
> :33000
> ```

Setting for the RPM the engine will run at durring the **FailSafeTimeOut**. This maybe programmed from Minimum RPM to Maximum RPM (Default = Minimum RPM).

If the engine is shutdown because of a failsafe, in the **Info Menu** the **LAST-OffCond :FailSafe** will be displayed. The **Info Menu** has selections for **LastFailsafeCnt:0** and **Last FailSafeTim:0.0.** This is the number of times the ECU went into failsafe and the actual time period it was in failsafe during the last flight.

How to set your ECU for single channel operation

NEW FOR ECU V4.9R and later!
Single channel operation can be done automatically by not connecting the auxiliary channel 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.

One or two receiver channels may be used to control the JetCat ECU. If single channel is desired, follow these steps.
- 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 speed limiter functions and/or Smoker. 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 engine 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.

Single Channel Mode start/stop procedure.
- To start the turbine, place the throttle stick and trim to there minimum positions. Next, move the trim to its maximum position. This will initiate the LED chase. Finally, move the throttle stick to its maximum position and the engine will start. To stop the startup, move the throttle stick and trim to their minimum positions.
- To stop the engine 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 there minimum position. The auto-cool down mode will start when the engine has nearly stopped rotating.

"Learn R/C". Teach the ECU to the R/C System

Before the Jet-Tronic 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 the two ECU servo cables to the receiver. The "**THR**" cable connects to the throttle channel and the "**AUX**" cable must be connected to a channel capable of three (3) positions. Make certain that all other connections are made in accordance with the **Electrical Connection Diagram**.

2. Inspect the transmitter programming, to ensure that dual rates and exponential functions are disabled, travel is set at 100% (75% if failsafe is active) and sub trim is set at zero for both channels.

3. While pressing the "**Select Menu**" key on the GSU, switch on the receiver.

   Helpful hint:
   Instead of the **Select Menu** key on the GSU, the small 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:

LED		*Blink Sequence*						
Standby/Man.	**Yellow**	◉	○	○	◉	○	○	
Pump running	**Red**	○ ⇨	◉ ⇨	○ ⇨	○ ⇨	◉ ⇨	○	
OK	**Green**	○	○	◉	○	○	◉	....

   The GSU display will simultaneously read:

   ```
   Release key to:
   - learn RC -
   ```

4.
5. 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.

   The GSU display will read:

   ```
   Set Throttle to
   minimum:
   ```
   → Alternate "**Off**" position

6. Now the ECU can memorize the positions of the throttle and AUX channels. First, place the throttle stick and throttle trim to low. Next, press **Select Menu** or the LED I/O board 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. This indicates that the shutdown data has been set correctly.

The GSU display will read:

Throttle Trim to maximum:

→ Throttle channel "**Idle**" position

7. Advance the throttle trim lever to maximum. Press **Select Menu** or the LED I/O board 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. This indicates that the turbine idle data has been set correctly.

The GSU display will read:

Set Throttle to maximum:

→ Throttle channel "**Full Power**" position

8. Advance the throttle stick to maximum. Press **Select Menu** or the LED I/O board switch again, to store the R/C system's pulse width for the turbine full power position. The yellow **Standby** LED will turn off and the green **OK** LED will illuminate again, indicating that the turbine full power data has been set correctly. This completes the learn mode for throttle and initiates the learn mode for the three-position AUX channel.

The GSU display will now read:

Set AuxChan. to minimum:

→ AUX channel minimum "**Off**" position.

9. Move the AUX channel to the minimum position for **Off** and press **Select Menu** or the LED I/O board 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. This indicates that turbine shutdown data has been set correctly.

The GSU display will read:

Set AuxChan. to center:

→ AUX channel middle "**Start/Standby**" position

10. Set the AUX channel to the middle position for **Start/Standby** and press **Select Menu** or the LED I/O board 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. This indicates that the turbine start/standby data has been set correctly.

The GSU display will read:

Set AuxChan. to maximum:

→ AUX channel maximum "**Auto-Off**" position

11. Place the AUX channel on the maximum position for **Auto-Off** and press **Select Menu** or the LED I/O board switch, to store the R/C system's pulse width for a normal shut-off of the engine. The yellow **Standby** LED will turn off and the ECU will now permanently store the data. This indicates that the

"**learn R/C**" procedure is completed and the ECU now retains the pre-set stick position values. Repeating this procedure is only necessary when the R/C system is changed or adjusted.

Test Functions

The new Test Function Menu

For owners of our previous ECU, the Manual mode is no longer implemented. Instead, a new expanded set of test functions are available from the **Test–Functions Menu**. This menu is selected while pressing the **Select Menu** key, press the ◄ - or ► + key until the menu is displayed. To test the selected component, press the **Change Value/Item** key. To change the fuel pump or glow plug voltage when testing, while pressing the **Change Value/Item** key, press the ◄ - or ► + key. The following functions are available ->

- Purge fuel system with a programmable voltage. This is principally used to prime the fuel system.
- Test the glow plug and/or set the voltage.
- Test the starting gas valve.
- Test the smoker valve.
- Test the fuel valve.
- EGT offset information.

Turbine Starting / Running

1. Prepare to start by completing the startup checklist (previously described on **page 10**).
2. Briefly hold the model upward, to ensure there is no residual fuel in the turbine.
3. Set the AUX switch to the **Off** position. All LED's will be off.
4. Move the throttle trim lever to idle (maximum) position.
5. Set the AUX switch to the **Start/Standby** (middle) position.
6. If the throttle stick is not at the idle position, the LED's will blink in a continuous sequence of yellow to red to green. Bring the throttle stick to the idle position, changing the LED blink sequence to green to red to yellow, continuously. The turbine is now ready to start!
7. Advance the throttle stick to its maximum setting and the turbine will start.
8. Once the turbine begins to accelerate, the throttle stick can be returned to idle position. 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 the throttle stick is set to the maximum position (Step 7 above), the ECU will begin a fully automatic starting sequence. This starting sequence can be immediately stopped at anytime by moving the AUX switch to the **Off** position and/or reducing the throttle stick and trim to the minimum positions.

After the start process is initiated, the following occurs:

1. The starting motor spins the turbine rotor up to approximately 2,500-3,500 RPM -then the starting motor is stopped.
2. Next, the glow plug is switched on and the starting gas valve opened.
3. The speed of the turbine begins to fall slowly, while ignition normally occurs during this period. Should ignition not occur, the starter will automatically make two more attempts. If the turbine does not ignite, during a 30-second period of attempts, the process is aborted and the green **OK** LED will blink.
4. As soon as ignition occurs, the yellow **Standby** LED will illuminate and the starting motor is re-engaged to accelerate the turbine. At approximately 5000 RPM, the fuel pump switches on and the red **Pump running** LED illuminates.
5. Turbine speed 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.
6. As the turbine approaches approximately 55,000 RPM, it will briefly stabilize, before automatically decelerating to idle RPM.
7. 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.

Manual startup without using the transmitter directly from the GSU

The former **Manual Mode** has been removed in the v4.0-6.0 ECU. Therefore, a new **Manual Control Mode** with the following features are included:

- The turbine can be started directly from the GSU. While pressing down the **Manual** key, press the **Ignition** key to start.
- While pressing down the **Ignition** key, press the ▶+ or ◀ - key to incrementally increase or decrease the turbine's RPM.
- While pressing down the **Ignition** key, press the **Run** key to set the RPM directly to idle.
- While pressing down the **Ignition** key, press the **Min/Max** key to set the RPM directly to maximum.
- While pressing down the **Manual** key, press the **Ignition** key to stop the engine.

The engine control can be switched from **Manual Control Mode** over to **RC control** and back while the engine is running. While pressing down the **Ignition** key, press the **Select Menu** key to switch control.

Note: Switching from **Manual Control Mode** to **RC control** is only possible if the throttle stick is in the idle position and, if the AUX channel is used, it must be in the center position. When switching from **RC control** to **Manual Control Mode**, the engine will be set initially to idle.

Turbine Stopping / Cool Down

To shut off the turbine, there are two methods:

Manual Off
Turbine immediately turns off!
At anytime, the turbine can immediately be switched off manually by:
- setting the three-position AUX switch to **Off**
OR
- bringing the throttle stick and trim to there minimum positions

Auto Off
Turbine automatically turns off!
This is the normal way of shutting down the turbine:
When the three-position AUX switch is moved to the **Auto-Off** position, the following happens:

> The turbine automatically stabilizes at around 55,000 RPM, for approximately six (6) seconds, before shutting down. This allows the turbine to run at an optimal temperature, drawing in a large quantity of cool air through the turbine, as it shuts off. This automatic off function can be discontinued at any time, by returning the AUX switch back to the **Start/Standby** position, before the turbine shuts down.

Automatic Cooling Process
After the turbine spins down from **Auto Off** or **Manual Off,** the starter motor will periodically spin the turbine rotor, if the **E**xhaust **G**as **T**emperature is above 100° C. This happens at regular intervals, for about one minute or longer.

✋ **Extremely Important:**

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**.

Battery / Fuel Warning Function

These functions are DISSABLED by default.
The ECU has an optional function for low battery and fuel warning. This function is activated by the following conditions:

>   1. ECU battery is dangerously low (less than 1.1V/cell).
>   2. Calculated remaining fuel in tank is below a pre-programmed limit.

When the corresponding warning functions have been enabled in the Limits menu (see page 39), the following occurs:

If the throttle stick is set above 50% thrust, the turbine will idle for five (5) seconds, then return to the actual throttle stick position power for ten (10) seconds. Thereafter, the sequence is repeated.

This warning function can be interrupted for a 25-second period, by briefly bringing the throttle stick to idle and then back to the previous position. As long as the stick is below the 50% throttle level, the warning function will be interrupted. When the throttle stick is set above the 50% level, it returns to the warning function sequence.

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, under the **STATE** selection in the **RUN** menu.

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**.
Ignite...	Glow plug is switched on and the starting gas valve is opened. The GSU's red **Ignition** LED is illuminated when the glow plug switches on. The ECU now pauses until ignition occurs and will remain in this condition until at least one of the following criteria is met: • The measured EGT exceeds a pre-programmed value • The measured EGT rises faster than a pre-programmed time If one of these conditions exists, turbine proceeds to the next operant condition (**Acceleration Delay**). If the turbine doesn't ignite after several attempts (within the pre-programmed time), the ignition state is discontinued and the turbine will shift to the **Slow Down** state.

Acceleration Delay	Voltage for the starter motor is re-engaged. Fuel valve opens and the fuel pump will run at a steady minimum voltage (a level where the pump just begins to operate), for approximately two (2) seconds. During this state, the turbine operating system purges air from the pump and fuel lines, while warming the combustion chamber in preparation for acceleration. Glow plug turns off. The red **Pump running** LED turns on and will stay illuminated as long as the pump operates.
Accelerate	In this condition, the fuel pump and starter motor voltages ramp up to accelerate the turbine to idle. The yellow **Standby** LED will illuminate during this period. Starting gas is shut off. Under normal circumstances, the turbine will ascend to idle RPM. The starter motor then disengages and the yellow **Standby** LED turns off. Here, the turbine progresses to the next state (**Stabilize**). During the following error conditions, the acceleration is discontinued and a jump to the **Slow Down** state occurs: • Turbine does not reach idle RPM after a pre-programmed period of time • The change in turbine speed is less than a pre-programmed amount, during a 0.1 second interval
Stabilize	Turbine successfully accelerates to the idle RPM, then automatically increases speed to about 55,000 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.)**).
Slow Down	During this state, the fuel shut-off valve is closed and the fuel pump is stopped. The green **OK** LED blinks, 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**.
Auto Off	The AUX switch placed in the **Auto Off** position. Turbine automatically adjusts to 55,000 RPM and remains at that RPM for approximately six (6) seconds, before transition to the next state (**Slow Down)**.
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. **RUN (regulated)** continues, until the turbine is switched off.
Speed Control	Speed Control mode -- only active when the air speed sensor is connected. Regulates model flight speed.

Explanation for Turbine Shut Down

In the run menu, state selection, are the following explanations for the last shut down condition of the turbine.

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 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.**

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
- Test Functions
- Limits menu

Selecting a Menu

The corresponding keys (hot keys) can directly select the "Run", "Info", "MIN/MAX", or "Limits" menus. An alternate method is to press and hold the **Select Menu** key and use the ◄ - / ► + keys 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** key while using the ◄ - / ► + keys to alter its value. An arrow (→) will appear in front of the value, if it can be changed.

Important Note for **Min/Max** and **Info** values->

1. After the turbine has started and stabilized, the Min/Max values are reset. This makes the Min/Max values correct for the actual run time of the turbine not including the startup values.
2. When the turbine stops, the Min/Max values are copied to the Info menu's "Last values".

The RUN Menu

As soon as the ECU is switched on, the default run menu is displayed.

Before starting the engine, the default display appears like this. The first line displays the temperature in degrees Celsius, glow plug bad icon (flashing), remote mode icon, failsafe icon and RPM in thousands. The second line displays battery voltage, remaining battery voltage icon and the "**OC:**" Off Condition.

Defective Glow plug icon (flashing) **Not displayed if Plug is OK**	Remote mode icon / GSU. **Not displayed if currently operated from the transmitter.**
Current Temp.	Failsafe icon **Not displayed if signal is OK**
Battery voltage	RPM in thousands. **1/M**
Remaining battery voltage icon.	Off Condition / Current State.

```
21°C  ↑∕ ⌐ 0.0 ⊥
6.9🔋 OC:----
```
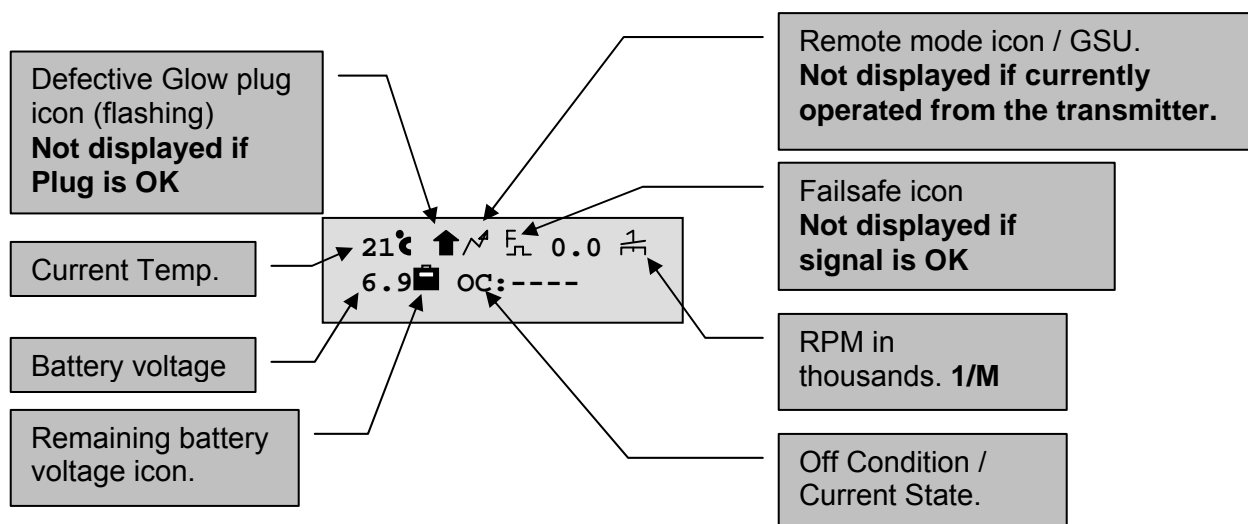
During the start sequence of the engine, the "**OC:**" will be over written with all the different states during the start process until the engine is at idle (green LED is on). The battery voltage will change to pump voltage as well.

When the engine is in the RUN State, the display will be as follows ->

Current Temp.	RPM in thousands. **1/M**
Pump voltage	Set RPM. This is the RPM equivalent to where the throttle stick is currently positioned
Remaining battery voltage icon.	

```
610°C      0.0 ⊥
0.6 ⟲ 🔋   0.0 ⊥
```
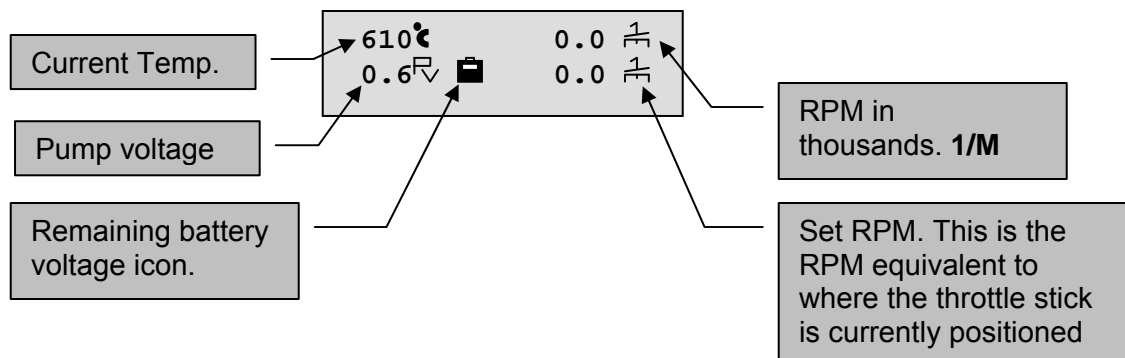
The pump voltage display is useful to monitor the voltage under full power. If this value begins to increase over time, it may be an indication that the fuel filter is clogging. Make note of the maximum voltage at full power for future reference.

When the engine is shut-off, the display changes back to the pre-start version. The Off Condition can then be check for why the engine was shut-off. **R/C Off** is the normal state when the user stops the engine.

In addition to the default display, the following selections can be monitored on the upper display line. Use the ◄ - / ► + keys alone for selecting the different parameters.

Value	Explanation
Default Display	See above for description.
U-Pump / **RPM**	Current pump voltage. Current RPM.
Temp. / **RPM**	Current EGT (**E**xhaust **G**as **T**emperature). Current RPM.
OffCnd **SetRpm /** **Set RPM**	Last Off command (reason for shut down). See table on page 35. Commanded RPM.
State / **RPM**	Current turbine state. Current RPM.
AirSpd / **SetAir**	Current air speed. Displayed only if the air speed sensor is connected. Commanded air speed.

The Min/Max Menu

The Min/Max menu is used primarily for diagnostics purposes. All of the following variables may be reset manually by pressing the **Change Value/Item** key on the GSU. Although the display will indicate that the values cannot be changed, it will reset the Min/Max values.

Value	Explanation
MaxPump **MinPump**	Maximum pump voltage. Minimum pump voltage.
MaxTemp **MinTemp**	Maximum EGT. Minimum EGT.
AvgPump **AvgTemp**	Average pump voltage Average temperature
MaxRpm **MinRpm**	Maximum turbine RPM. Minimum turbine RPM.
AvgRpm **MaxRTmp**	Average RPM Average temperature at maximum RPM during the last run.

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
StickPuls ⎍	Position of the throttle stick (by percentage, 0-100%). An 'F' signals a failsafe condition.
Throttle%	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**).

Value	Explanation
FailSafe Count ⎍	Displays the number of times the receiver went into failsafe during the flight.
FailSafeTime In seconds	Displays the time the receiver was in failsafe.

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** key 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** 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.

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 MaxTemp	Maximum temperature during the last run.
Last MinTemp	Minimum temperature during the last run.
Last AvgTemp	Average temperature during the last run.
Last MaxR AvgTmp	Average temperature during the last run at maximum RPM.
Last StartTemp	Maximum temperature during startup during the last run.
Last MaxRPM	Maximum RPM during the last run.
Last MinRPM	Minimum RPM during the last run.
Last AvgRPM	Average RPM during the last run.
Last MaxPump	Maximum pump voltage during the last run.
Last MinPump	Minimum pump voltage during the last run.
Last AvgPump	Average pump voltage during the last run.
Last FailSafeCnt	Number of failsafe conditions during the last flight.
Last FailSafeTim	Time in a failsafe condition.

The Statistic-Menu

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

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 used.
LoBatt Cut-Outs	The number of low battery shutoffs.

The Test Functions Menu

The Manual mode is no longer implemented. Instead, a new expanded set of test functions are available from the **Test–Functions Menu**. To test the selected component, press the **Change Value/Item** key. To change the fuel pump or glow plug voltage when testing, while pressing the **Change Value/Item** key, press the ◄ - or ►+ key. The following functions are available ->

Value	Explanation
Pump TestVolt or Purge FuelSystem	Opens fuel valve and runs the pump. Default = 0.500 volts. **Note:** Can be used to prime the pump and fuel system. Make sure the fuel line is disconnected from the turbine.
GlowPlug Power	Test and / or change glow plug voltage. Default = 2.100 volts.
GasValve Test	Test starting gas valve.
SmokerValve Test	Test smoker valve.
FuelValve Test	Test fuel valve.
Temp **AD**	Temperature value and offset. Analog Converter value and offset

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
Maximum RPM	Turbine maximum speed
LowIdle RPM	Allows for a lower RPM at idle than the minimum RPM. This feature is enabled by moving the trim control to its center position when idling. The engine takes longer to throttle up from the low idle to normal idle when accelerating.
Ignition-Mode	Select between Propane or Kerosene start. To toggle between modes, while powering on the system hold the **Ignition** key plus the ◄ - key for propane or ►+ key for kerosene. Default = Propane

BatteryType	Select between 6 cell (7.2v) NiCd or 2 cell (7.4v) LiPo **IMPORTANT: DO NOT USE THE 3 CELL LiPo OPTION** Default = NiCd 6 cell ---- V6.0I or newer default = LiPo
LowBat Warning	Battery warning function, Enabled/Disabled Default = Disabled (OFF)
Fueltank size	Actual capacity of the fuel tank in ml
LowFuel Limit	Remaining fuel in the tank when the fuel warning function activates
LowFuel Warning	Fuel warning function, Enabled/Disabled Default = Disabled (OFF)
GlowPlug Power	Glow plug voltage, The glow plug will glow with the selected voltage when the **Change Value/Item** key is pressed. Default = 2.250V
Gas Flow	Sets the amount of starting gas that will flow when the turbine is started. The range is from 10 to 100% adjustable in 10% increments.

Limits Menu, continued

AUX Channel Function	Remark	AUX-Learn R/C Active?	Airspeed Control
NOT USED	AUX has no function at all	No	Limiter function remains active
ON, TrbCtrl ON	AUX switch controls-> - Turbine (OFF/RUN/AutoOff) - Airspeed control	Yes	Normal function
ON, TrbCtrl OFF	AUX switch only controls-> - Airspeed control - Smoker valve (if enabled)	Yes	Normal function

Limits Menu, continued

Value	Explanation
FailSafe delay	Delay before the failsafe function is activated. Range = 0.1 to 20.0 seconds.
FailSafeTimeOut	Delay before turbine shuts off because of a failsafe. Range = 0.1 to 20.0 seconds
FailSafeRPM	RPM the turbine will throttle to during a failsafe time out period. Range = Minimum RPM to Maximum RPM
Drain GasTank	If enabled, after turbine is started and throttled up, the starting gas valve will open, draining the tank. Default – Disabled (Off)

Limits Menu, continued

Aux-ch Smoker Ctrl	Remark	Function	Test Function
DISABLED	Smoker Valve not used, always closed		---
Open if AuxSw=0	Smoker Valve is opened if: (Turbine is running)	Valve opens if AUX is set to the OFF position AUX-Channel Option must be set to Enabled, Turbine control off.	The function of smoker valve can be tested with the smoker valve selection in the Test Function menu.
Open if AuxSw=2	Smoker Valve is opened if: (Turbine is running)	Valve opens is AUX is set to Auto-Off position	The function of smoker valve can be tested with the smoker valve

| | | AUX-Channel Option must be set to Enabled, Turbine control off | selection in the Test Function menu. |

Limits Menu, continued

Value	Explanation
Smoker WarnFunct	When this function is assigned a condition value and the suggested smoke system in the manual is implemented, the smoke valve is pulsed on for 0.2 seconds and off for 0.4 seconds if that condition occurs. This function can be very useful in determining several dangerous situations and giving the pilot a visual warning. This function is especially useful for the helicopter pilot that cannot have the throttle change automatically for these warnings. These are the possible settings for this function: **DISABLE,** no function **BATTERY LOW,** if the ECU battery is getting weak. **FUEL LOW,** if the fuel level reaches the pre-programmed **LowFuel Limit**. **BATTor FUEL LOW,** if any of these conditions exist. **BATT, FUEL, FAILS,** if any of these conditions exist. **FAIL-SAFE,** if the ECU is detecting a failsafe condition. **Note:** If the throttle is at idle, the smoke warning is temporarily disabled.
IdleThrResponse	This function allows you to change the throttle response from idle to mid range. Use this feature to compensate for different atmospheric conditions. If the engine is hesitating while accelerating, then try **Slow** or **Normal**. Default = **Normal or Fast**
FullThrResponce	This function enables or disables the boost mode. Boost mode accelerates the engine very quickly from @ 70% to full power. For high altitudes or in hot humid climates use **Normal**. Default = **Fast -- Not Available on all engines.**
GPS-Receiver	Enables or disables the GPS menu for the optional GPS receiver. Disabled, Enabled COM1 or Enabled COM2 Default = Disabled
AirSpeed units	Set airspeed and distance display in km/h or mph.
StartUp Mode	This function allows for different engine start procedures for multi engine models. The possible methods are: • **SEQUENCE,** default, with the throttle trim at maximum, start the engine by switching the AUX control to the center **START/RUN** position and then moving the throttle stick to maximum. If in single channel mode, start the engine by moving the throttle trim to maximum and then moving the throttle stick to maximum. • **THROTTLE MAX,** with the throttle trim at maximum and the throttle stick at maximum, start the engine by switching the AUX control to the center **START/RUN** position. If in single channel mode, the turbine will be started as soon as the throttle stick is set higher than 95% of maximum. • **IMMEDIATE,** with the throttle trim at maximum, start the engine by switching the AUX control to the center **START/RUN** position. If in single channel mode, start the engine by moving the throttle trim to maximum.

Suggestions for starting a multi-engine plane using StartUp Mode

In two channel mode->
Place one ECU in **SEQUENCE** mode and the other in **THROTTLE MAX** mode. By moving the throttle trim to maximum and the throttle stick to maximum, start the engine in **THROTTLE MAX** mode by

switching the AUX control to the center **START/RUN** position. The engine in **SEQUENCE** mode is then started by moving the throttle stick to the minimum position and then back to the maximum position.

In single channel mode->
Place one ECU in **SEQUENCE** mode and the other in **IMMEDIATE** mode. First have both the throttle trim and stick at their minimum positions. Then by moving the throttle trim to the maximum position will start the engine in **IMMEDIATE** mode. The engine in **SEQUENCE** mode is then started by moving the throttle stick to the maximum position.

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.

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 func** is **ON**, **TrbCtrl** is **OFF** and the smoker **AUX-ch SmokeCtrl** is not set to **DISABLED**.
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 func** is **ON**, **TrbCtrl** is **OFF** and the smoker **AUX-ch SmokeCtrl** is not set to **DISABLED**.

*** JetCat USA suggests using our Smoke Pump System for a better smoke solution then the pressurized system.

Typical smoke system connections
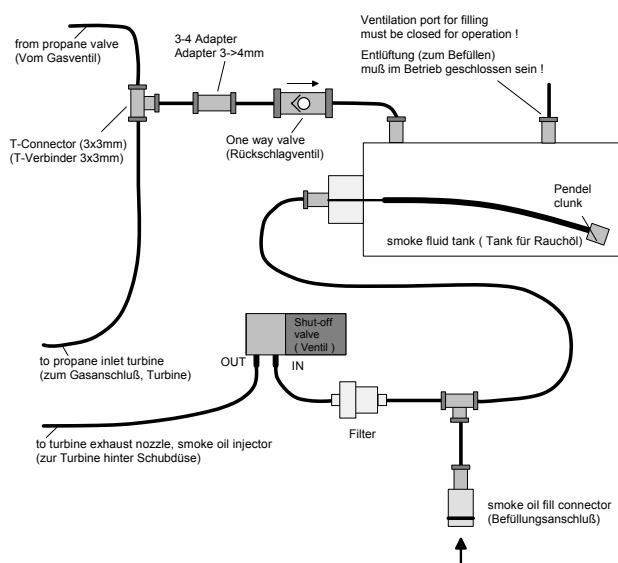
Troubleshooting

Most frequent errors. Cause and remedy:

Problem	Cause	Remedy
Turbine doesn't ignite	Starting gas system has a leak or bad connection.	Check starting gas system for leaks and poor connections.
	Starting gas pressure is low. May be caused by insufficient quantity of gas or low outside temperatures.	Fill starting gas tank; fly in warmer conditions (e.g. Southern California)
	Glow plug is not glowing bright enough.	Adjust glow plug voltage. Glow plug must be bright red!
	Glow plug defective or glow plug element not sufficiently extracted.	Replace defective glow plug. Glow plug element must be extracted by at least 1/8 inch (two coils)! See page 21.
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. See page 27.
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 manual mode (as soon as the red **Pump running** LED illuminates, the fuel pump must run!). See page 30.
	Starting gas tank nearly empty.	Fill starting gas tank.
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 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. With V4.0g and later ECU you can view the last 4 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. As long as you do not power-down the system, you can down view the entire flight using the RS-232 adapter 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: Time	R: RPM	S: Set-RPM	EGT: Temp	Pmp: Pump V	Sta: State	Th: Thr. pulse	Au: Aux. pulse	Bat: Batt volts	AirS: Air Speed	SetS: 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 Code 7	99 times out of 100 times this is 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. You will see the pump voltage rising rapidly before it shuts off because the ECU is trying to maintain the RPM. The temperature and RPM will be decreasing. The ECU will turn off the pump when the RPM is approximately less than 24,000 RPM.

|		**USE A BVM Ultimate Air Trap!!!!!!!!!!!**

Maintenance

Occasionally, the starting unit clutch may slip or not grip properly, the result of dust and oil sediment on the compressor nut. The O-ring and compressor nut should be cleaned periodically, with a cotton swap and solvent. When the turbine is not running, the starter may be tested by pressing the **IGNITION** key on the GSU.

Check your fuel filters every ten (10) flights.

Each *JetCat* has a prescribed maintenance interval. After approximately 25 hours, the engine should be returned to *JETCAT USA* (along with the ECU and fuel pump), for service. The total running time of the turbine can be accessed and monitored through the **STATISTIC** menu.

Reset the ECU to the factory default values.

NEW FOR ECU V4.9R and later!
After resetting, the display will prompt you if you want to "**learn R/C**". Press the ◄ - key for NO or the ► + key for YES. After teaching the R/C system, the ECU will automatically calibrate the EGT sensor.

To reset all the user parameters back to the factory default, perform the following steps.

This will put the ECU back to the "before delivery state". You will need to recalibrate the EGT probe, re-Learn R/C and set the fuel pump voltage for startup.

Press and hold the **Select Menu** key on the GSU, then switch on the power.
 ☞ Remark:
Instead of pressing the **Select Menu** key on the GSU, the little key on the LED board can be use instead.

The three LED´s first show the following blinking sequence:
LED		*Blink Sequence*							
Standby/Man.	**Yellow**	☉	○	○	☉	○	○		
Pump running	**Red**	○ ⇨	☉ ⇨	○ ⇨	○ ⇨	☉ ⇨	○		
OK	**Green**	○	○	☉	○	○	☉		....

The Display of the GSU will also show the message:

```
Release key to:
- learn RC -
```

Keep the Select Menu key pressed during this blinking sequence. It takes up to 10 seconds!

Next the 3 LED´s are showing the following sequence:
LED		*Blinking sequence*						
Standby	**Yellow**	☉	○	☉	○	☉	○	
Pump running	**Red**	○ ⇨	☉ ⇨	○ ⇨	☉ ⇨	○ ⇨	☉ ⇨	
OK	**Green**	☉	○	☉	○	☉	○	....

The Display of the GSU will change to the message:

```
Release key to:
Calibrate Temp
```

Keep the Select Menu key pressed during this blinking sequence. It takes up to another 10 seconds!

Next the 3 LED´s are showing the following sequence:

LED	Blinking sequence					
Standby	**Yellow** ⊙	○	⊙	○	⊙	○
Pump running **Red**	⊙ ⇨	○ ⇨	⊙ ⇨	○ ⇨	⊙ ⇨	○ ⇨
OK	**Green** ⊙	○	⊙	○	⊙	○ ....

The Display of the GSU will change to the message:

```
Release key to:
Reset system !!!
```

→ now release the key

The display will indicate that it is saving system data and then will return to the default showing RPM and temperature.

Parts List

1 – Turbine engine
1 – ECU
1 – GSU
1 – PUMP
1 – Battery Pack
2 – Fuel / Starting Gas Solenoid
1 – Cable Set
1 – Fuel Line Set
1 – Starting Gas Tank
2 – Fuel / Starting Gas Filters
2 – Ball Cock Valves
2 – "T" Nipple Connectors, (White Nylon)
1 – 4 to 3mm Nipple, (Brass)
1 – (P180/P200) 6 to 4mm Nipple, (Brass)
1 – Starting Gas Probe, (Black Nylon)
1 – Charge Connector
1 – Standard Engine Mount
1 – Manual

Optional Accessories

A1030   -- Air Speed Sensor
A1030a -- Air Speed Sensor housing
A1029   -- RS-232 Adapter with Windows™ software
A1042   -- GPS receiver and antenna
A1045   -- FOD Screen / static shield
A3011   -- BVM UAT Header tank
A1019   -- Engine Mount, Kangaroo Style
A1020   -- Engine Mount, BVM Bypass Style

Pxxx - SX engine supplement

SX engines are kerosene start only engines utilizing an internal igniter. The following diagram shows the proper hookup. Please note, the SX engines do not include the starting gas probe, one way connector or propane tank.
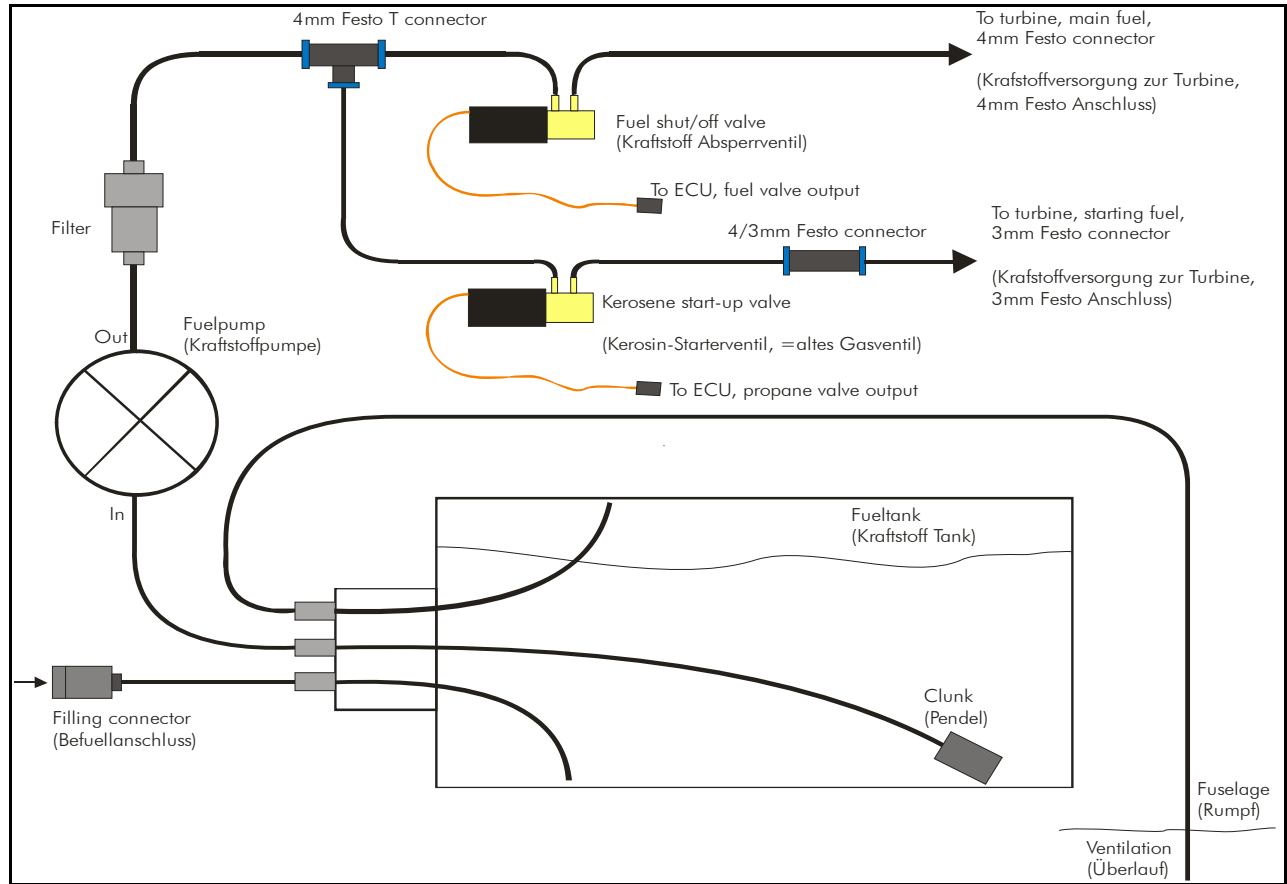
The V6.0I or newer ECUs included with the SX engine has an auto-off feature. After shutting off the engine the receiver power can be shut off however the engine will continue to cool until it is less than 100 degrees C. Then the ECU will automatically power off.

The default battery type for V6.0I or newer ECUs is LiPoly.

Ducting

Außenabmessungen JetCat P80

	Abt.	Name		Ingenieurbüro CAT			
erstellt				M. Zipperer GmbH, 79219 Staufen	Projekt		
geprüft							
freigegeben			Rev.Nr. 1.0			Blätter	Blatt
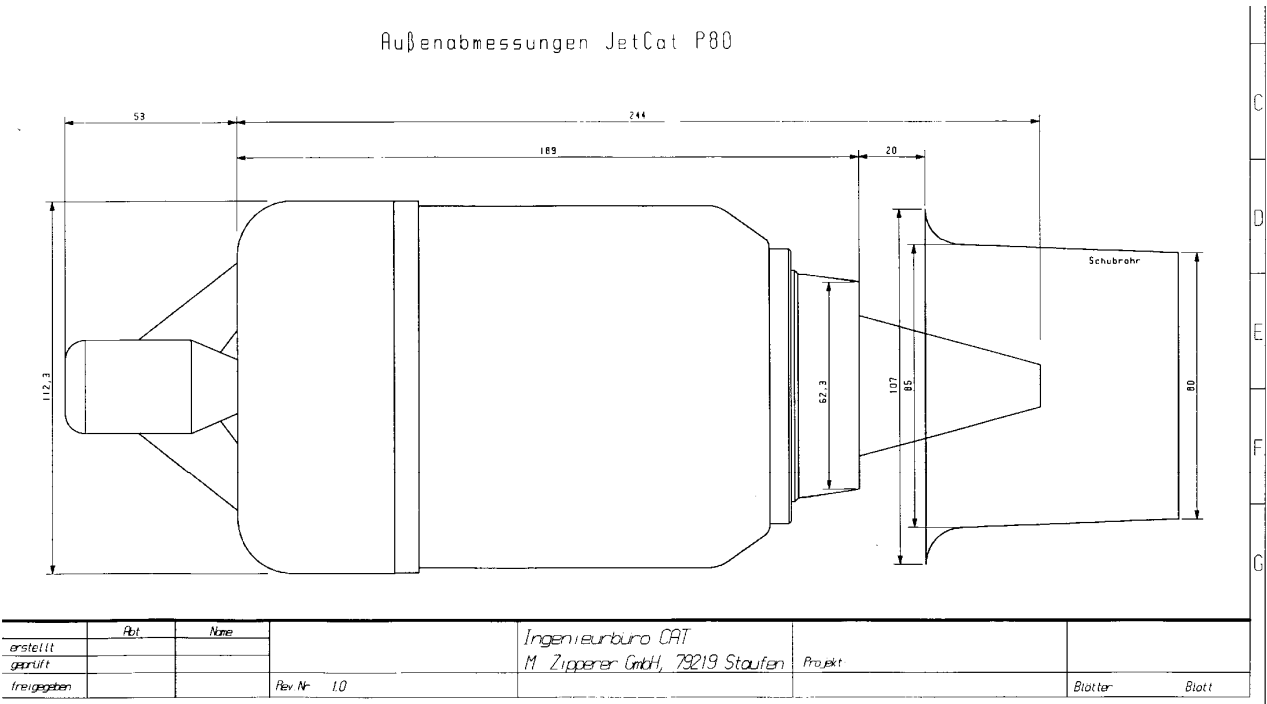
P60 P120, P180, P200 or Titan: Set the ducting inlet ½ to ¾ of an inch after the end of the exhaust nozzle.

6V Kerosene Start System V2
(Part Number A1051-2)

Package content

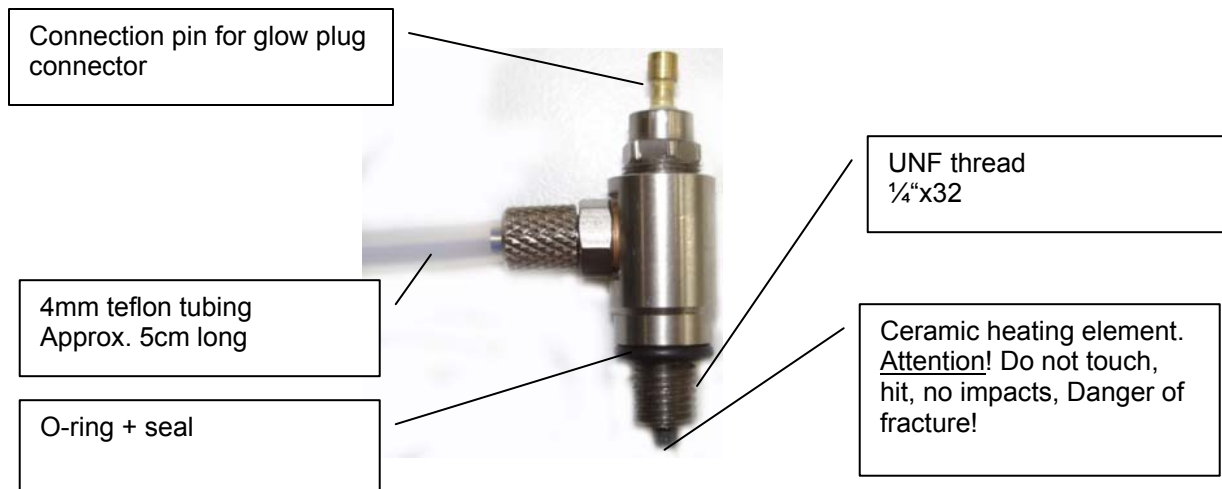> 1x Kerosene-Igniter incl. seal ring
> 1x Teflon tubing (5 cm)
> 1x Festo 3/4 Adaptor (use 3/4 or 4/4 Adapter)
> 1x Festo 4/4 Adaptor
> 1x T-connector (4 mm)
> 1x Kerosene tubing (2 m)
> 1x Gas plug (3 mm)
> 1x Gas plug (4mm) (for helicopter engine)
> 1x Instruction manual

System requirements

For operation of the Kerosene startup system an ECU software version 5.00Q or higher is needed.
ECU´s from V4.00 or higher can be software updated to operate with the kerosene ignition system.
Therefore the ECU needs to be sent in to a JetCat service point.

Installation

Connections

Connection pin for glow plug connector

UNF thread
¼"x32

4mm teflon tubing
Approx. 5cm long

Ceramic heating element.
Attention! Do not touch, hit, no impacts, Danger of fracture!

O-ring + seal

:NOTE - Not pictured is a steel and Teflon washer. These washers go between the engine and the o-ring on the kerosene igniter. The Teflon washer seats against the engine. The steel washer has a radius side that seats against the kerosene igniters o-ring.

Kerosene-Igniter installation

1. Remove "old" glow plug.
2. Before you screw in the Kerosene-Igniter into the turbine engine, please check with a caliper or similar tool that the glow plug hole has a minimum clear depth of
    at least 9.5mm or 3/8" measured from the turbine housing into the hole. If it is less than this dimension, you may be able to press on the vaporizer stick with a screwdriver or drift and bend it in for the proper clearance. If you are uncomfortable doing this, call JetCat USA for assistance.

3. Is the measured distance large enough? The Kerosene-Igniter can now be screwed in and tightened **by hand!** Do not use any tooling for doing this, otherwise you risk damaging the thin tread of the Kerosene-Igniter due to excessive torque being applied! The threads of the engine may need to be chased with a ¼ x 32 tap if the Kerosene-Igniter doesn't thread in easily. If this is the case, we recommend sending the engine to us to install the Kerosene-Igniter.
4. The P60 glow plug boss may have damaged threads near the combustion chamber. DO NOT FORCE THE KEROSENE START UNIT IN AS IT WILL SURELY BE DAMAGED. This is due to the fact the P60 glow plug boss is tig welded on instead of being brazed. In some cases the weld penetration distorted the threads deeper then what would affect the glow plug but would damage the longer kerosene start unit. We would suggest that you return the engine to JetCat USA if this is the case.
5. Remove the "old" 3mm propane tubing from the engine and then close the propane supply connector on the engine with the supplied 3mm plug.
6. Install the fuel supply connection according to the connection diagram on the next page.
   Important: Between the Kerosene-Igniter and the normal fuel tubing is a short piece of Teflon tubing that must be installed (The Kerosene-Igniter gets very hot!)

Connection diagram
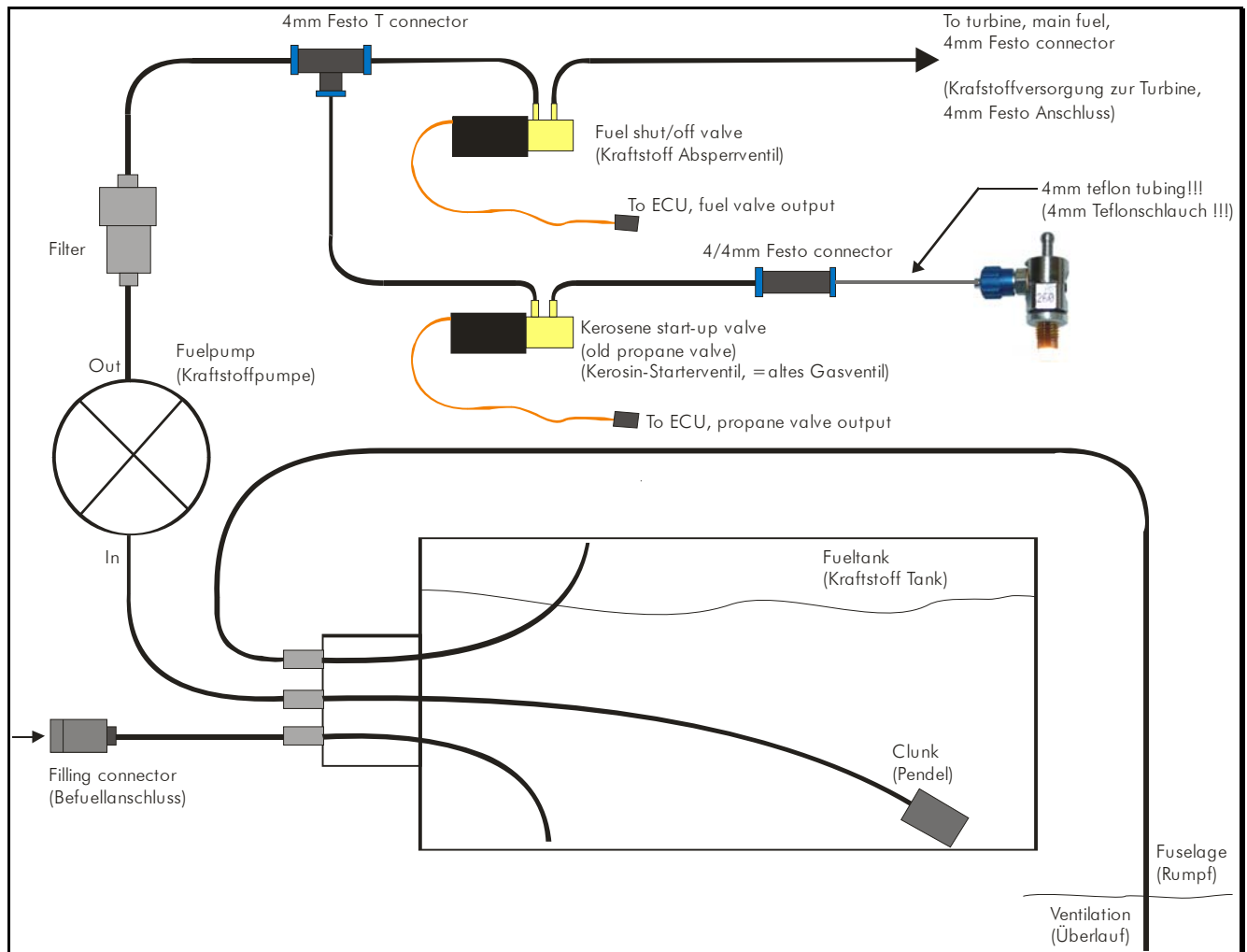
Setup the start-up mode of the ECU (Propane/Kerosene)

Set ECU V6.0F or newer to 6V Kerosene start mode

- Switch off RC-receiver
- Connect the GSU to ECU
- Simultaneously press and hold the buttons "Ignition" and "Min/Max"
- Switch on the RC receiver (keep the buttons pressed)
- After a few seconds the display of the GSU shows:
  ```
  KEROSENE (6V N)
  Start activated!
  ```
- Release all buttons, the ECU is now configured for Kerosene start-up

Set ECU V6.0E or older to 6V Kerosene start mode

- Switch off RC-receiver
- Connect the GSU to ECU
- Simultaneously press and hold the buttons "Ignition" and "**+**"
- Switch on the RC receiver (keep the buttons pressed)
- After a few seconds the display of the GSU shows:
  ```
  KEROSENE (6V)
  Start activated!
  ```
- Release all buttons, the ECU is now configured for Kerosene start-up

Set ECU to Propane start mode

- Switch off RC-receiver
- Connect the GSU to ECU
- Simultaneously press and hold the buttons "Ignition" and "**-**"
- Switch on the RC receiver (keep the buttons pressed)
- After a few seconds the display of the GSU shows:
  ```
  PROPANE
  Startup activated!
  ```
- Release all buttons, the ECU is now configured for Propane start-up

Before the first start-up

Prior to the first start-up, or if the fuel lines should be empty or contain air bubbles, the system needs to be primed.

Purge the air out the kerosene supply line to the engine

1. First remove the 4mm kerosene fuel feed line from the engine and put the end of the tube into a small container. This step is required because the turbine would become flooded with kerosene in the following steps!
2. Fill fuel tank.
3. Connect the GSU to the ECU and select the parameter "`Pump TestVolt`" or "`Purge FuelSystem`" in the "Test-Functions" menu. (→ press and hold the button "Menu Select" and use the +/- buttons to scroll until "`Test-Functions`" is displayed, now release the "menu select" button. Thereafter use the +/- buttons to scroll through the Test-Functions menu until "`Pump TestVolt`" or "`FuelSystem`" is displayed).
4. Now press the "Change Value" button to start the fuel pump (use the "Change value" button in connection with the +/- buttons to change the pump voltage/power). Continue pumping fuel until all air bubbles are removed.
5. Re-connect the fuel supply tubing to the engine.

Purge the kerosene supply tubing to the kerosene ignition system

1. First purge the kerosene main supply tubing (as described above). Fill the fuel tank.
2. Disconnect the 4mm kerosene fuel feed line to the Kerosene-Igniter (→ transition from fuel tubing to Teflon tubing, 4mm Festo connector) and put the end of the tube into a container. This step is required because the turbine would become flooded with kerosene in the following steps!
3. Connect the GSU to the ECU and select the parameter ″BurnerValve Test″ in the "Test-Functions" menu. (→ press and hold button "Menu Select" and use the +/- buttons to scroll until "Test-Functions" is displayed, now release the "menu select" button. Thereafter use the +/- buttons to scroll through the Test-Functions menu until ″BurnerValve Test″ is displayed).
4. Now press the "Change Value" button to start the fuel pump on a low power setting to pump kerosene through the kerosene-Igniter tubing (the pump runs on a low power setting, the valve for the Kerosene-Igniter is pulsed On/Off , the main fuel shut-off valve stays closed). Continue pumping fuel until all air bubbles are removed.
5. Re-connect the fuel supply tubing to the Kerosene-Igniter (4mm Festo connector). Then, once again pump a little bit of fuel until the Teflon tubing attached to the Kerosene-Igniter is filled with kerosene. Stop when it just reaches the Kerosene-Igniter.

Start-up the engine

The triggering of a turbine start is exactly the same as on the propane start-up (please refer to the instruction manual of the engine)

The difference on kerosene start-up is:
- After the start signal has been received, the starter motor is shortly activated to give an "acoustical signal" that the start sequence has been started.
- Now the burner is pre-heated for 5 seconds or less (the starter motor is not running)
- Thereafter the starter motor spools up the engine to it's ignition rpm (around 2000-6000 RPM, depending on engine type). After another 5 seconds the ignition of the engine is engaged by injecting kerosene into the Kerosene-Igniter.
- After the engine has ignited, the engine is spooled up to idle rpm as usual.

Troubleshooting

Turbine is not igniting:
The reason for this is normally that no fuel is delivered to the Kerosene-Igniter or the igniter is not glowing.

Possible reasons for his could be:
1. Pump start voltage is too low (adjust pump start voltage → see instruction manual)
2. Fuel supply lines are empty or not purged.
3. The shut-off valve for the Kerosene-Igniter is not opening (the valve cable is plugged in reverse into the ECU, or the valve is defective)
4. ECU battery weak or empty
5. Too long or too light gauge power connection wire from ECU to the engine (3-wire power cable)

For identifying the problem, it is recommended to temporarily disconnect the fuel supply tubing at the 4/4mm Festo connector on the transition from fuel to the Teflon tubing and perform an engine start-up. After the Pre-heat phases (approx. 10 seconds), as soon as the Run menu of the GSU shows "Ignite", one must see kerosene dripping out in pulses from the disconnected supply tubing.

Attention Kero Start Engines Users:

If the engine fails to start, 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. You may also need to clean off the starter o-ring afterwards since it may get kerosene on it.

Now why would the engine not start in the first place? -
- The kero start igniter failed. The automatic glow plug test may not detect a failed igniter! If you put your finger on it while the engine is starting and it feels cool, the igniter has failed. If you tried to start the engine with a failed igniter, it will get some kerosene inside the engine. **Do not immediately install a new igniter and try again without draining the engine.**
- The kero start feed line has not been primed. Please refer to the kero start instructions on how to prime the feed line. The fuel should be all the way up to the igniter. If you DID prime the feed line and it gets more than 3" of air after a flight, make sure the fitting is tight on the kero start fuel connection and the festo fitting is not leaking. Also make sure the solenoid is fully shutting off. If the fuel does not get to the kero igniter in a few seconds it may not start.
- The fuel system has a high capillary resistance or the pump is a little weak and the kerosene will not get to the igniter. The pump will need to be adjusted to a higher start voltage. This is adjusted by holding down the limits key on the GSU and then press the + key. A three item menu will appear. The first selection is for the number of cells in your battery pack. Use the + key alone to index to the next selection, UACCEL 1. This sets the minimum pump voltage to start moving fuel through your fuel system. To increase the voltage, press and hold the change value key and then each press of the + key will advance the UACCEL1 voltage by 0.025V. Try one or two increases at a time. To test the flow to the kero start igniter go to the test functions menu and select the kero start valve test. Press the change value key to flow fuel to the kero start igniter. MAKE SURE YOU DISCONNECT THE LINE TO THE KERO START IGNITER SO YOU DON'T GET FUEL IN THE ENGINE.....

Technical data

ECU power supply	: 6-8 cells (7,2-9,6V)
Kerosene-Igniter	: 5,9V / 37 Watts

Airspeed Sensor
(Part Number A1030)
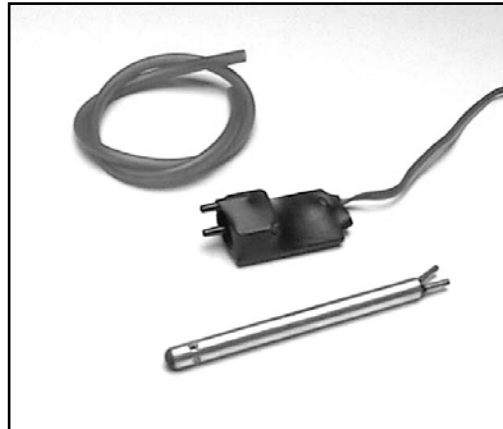
The optional *Airspeed Sensor* consists of a pitot tube and a precision, differential pressure sensor.   By sampling the ambient air temperature, the current flight speed of the model is calculated by the ECU, from the measured difference in static versus dynamic pressure.

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
- Automatic restriction of maximum flight speed
- Maintenance of current flight speed (fixed "**Cruise Control**")
- Regulation of flight speed, analogous to throttle stick position (adjustable "**Cruise Control**")

To display the maximum speed the user is allowed to set the speed control can be displayed on the GSU when powering up by holding down the Info key. This can be used to verify that the system cannot be set higher then the maximum AMA allowable speed.
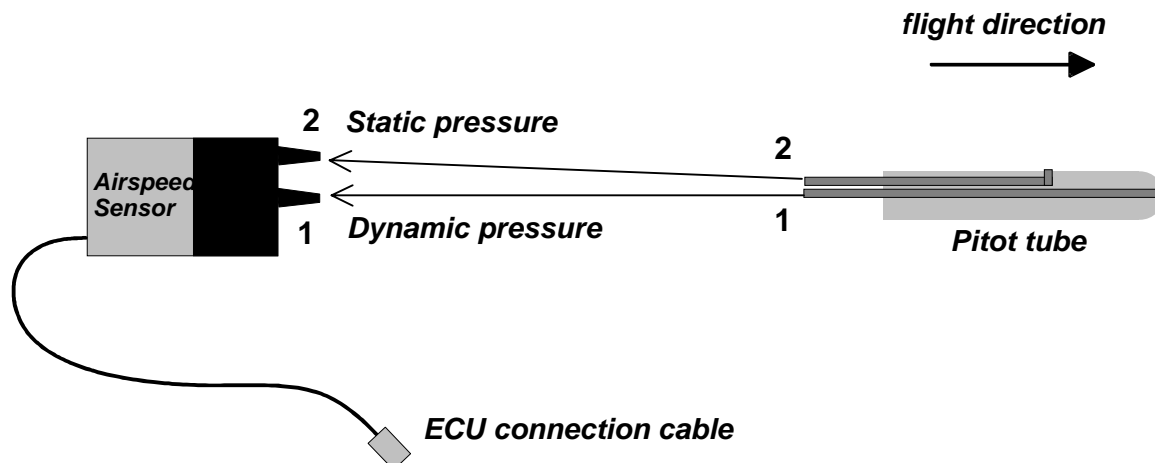
Connection diagram for the Airspeed Sensor:

Connect the air lines from the pitot tube to the airspeed sensor, using the 1/16th inch ID vinyl tubing.
       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 (see: engine diagram in the Operation Manual). 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* :

Value	Explanation
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**
MAX LimitAirSpd	Maximum allowed flight speed of the model, in km/h or mph. 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 or mph, for the **Cruise Control** mode. This value corresponds to the speed at the maximum throttle stick position.
Min.AirSpeed	Minimum flight speed value, in km/h or mph, for the **Cruise 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. Increase this value, to increase reaction sensitivity.
SpeedRegVal-P	Regulator coefficient (proportional) Under normal circumstances, does not require alteration.
SpeedRegVal-D	Regulator coefficient (differential) Under normal circumstances, does not require alteration.
MinRPM SpdCtrl	Turbine RPM low Limit value in cruise control mode. In airspeed control mode, the turbine RPM will not be set below this limit value. This allows a faster reaction time of the airspeed control loop, if this value is set higher than the idle RPM (@ 50000-60000 RPMs are reasonable values)

Explanation of the speed regulator options:

If the *Airspeed Sensor* is <u>NOT</u> 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:

Value	Explanation
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	Learn1s 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** modes 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 1/3rd position Speed 2: (**Min AirSpeed** + **Max AirSpeed**) / 2 → throttle stick in the 1/3rd to 2/3rd position Speed 3: **Max AirSpeed** → throttle stick in the 2/3rd 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:
1. 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**).
2. 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.
1. The minimum throttle stick position corresponds to the parameter "Min AirSpeed" and the maximum throttle stick position corresponds to the parameter "Max AirSpeed".
2. 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.

> 2 inches

Fuselage
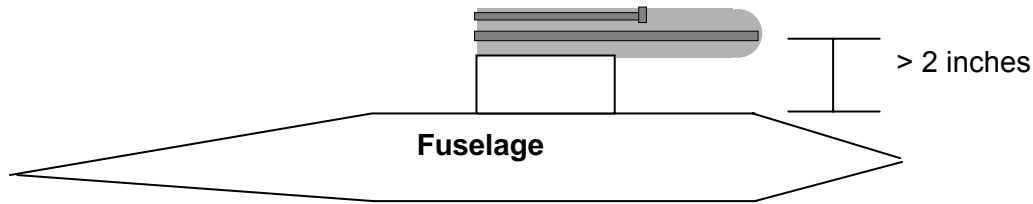
Hold Speed and Cruise Control limitations:

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 airspeed sensor

The ECU calibration data of the differential pressure sensor can be aligned with software version V2.0g or higher.

You will need the following items for this calibration:
1. 50-60cm of silicone tube or similar. The inside diameter is not important.
2. Water
3. Ruler, graduated in cm.

Proceed with the following instructions:

Fill the silicone tube with at least 50cm of water.
1. Place the silicone tube on the pitot tube just far enough to stay on but without covering the static port holes.
2. Press and hold the **RUN** key while switching on the electronics.
3. Release the **RUN** key when the message **"Cal. AirSpeedSns / Set 40cm waters"** appears in the GSU display.
4. Now set the water line at the same height as the pitot tube and then press the **INFO** key. This sets the zero-point.
5. Now with the ruler, move the tubing until the water line is 40 cm higher than the pitot tube and press the **MIN/MAX** key. The display should read **h=40.0**.You should be able to move the tube up and down observing the water line height measured by the ruler. This should approximately equal the displayed value on the GSU **h=?**. You may repeat steps 4/5 until 0 - 40cm is properly displayed when moving the tubing. The default coefficient **Cv=8560** and should be within 6000 to 10,000 after calibration.
6. To store in the new set values, you must press the **MANUAL** key. The message **"Saving SetupDat"** will appear and then return to normal run status. If the power is cycled before pressing the **MANUAL** key, the original values will be retained.

7.

Open

Open

Set water line
to 40cm.

40

30

20

10

Set water line
level with pitot

Pitot tube

Pitot tube