JETCENTRAL

MINIATURE JET ENGINES FOR THE SERIOUS FLYER

BEE II

KEROSTART

OPERATION AND MAINTENANCE MANUAL

INTRODUCTION

JET CENTRAL produces the most advanced micro turbines available today: smaller, more powerful, faster acceleration, less fuel burn, lower temperatures, higher quality, less maintenance and the best price. **JET CENTRAL,** an ISO 9000 Company is a full production engine manufacturer, producing high quality parts to be assembled into the newest line of micro turbines.

We are committed to our turbines in a way never seen before. You won't find a more knowledgeable company in micro turbines to turn than to **JET CENTRAL.**

TABLE OF CONTENTS

1 Safety Information

The **JET CENTRAL TURBINE ENGINES** are in its own right a single stage centrifugal flow gas turbine engine, configured to operate as a **TURBOJET ENGINE** for use mainly, but not exclusively, in remotely piloted fixed wing aircraft. Such aircraft and their control systems must be appropriately designed and constructed to be compatible with the performance of the **TURBOJET ENGINE.**

NOTE: *The airworthiness, structural design, integrity of the aircraft and its control systems* ***are the entire responsibility of the owner/builder/operator. JET CENTRAL*** *and its agents cannot accept responsibility for any failure, structural or otherwise, of the aircraft or its control systems.* ***JET CENTRAL*** *and its agents cannot accept responsibility for any inappropriate or unauthorized use of the* ***JET CENTRAL ENGINE.***

The **JET CENTRAL** gas turbine engine is a very safe, easy to operate unit. The **JET CENTRAL** is a state of the art gas turbine engine and all components are manufactured within the highest standards. If operated correctly it will provide years of reliable, trouble-free service, with low maintenance.

It cannot however, be stressed highly enough, that the operating instructions be fully understood before attempting to operate your engine. Any alterations to the engine whatsoever, without the written consent of JET CENTRAL, will render any warranty null and void and as a consequence the controlling body in your country may not grant approval for use.

The **JET CENTRAL** gas turbines are high performance **TURBOJET ENGINES** that need discipline, commitment to correct and safe operation. With other persons present while operation, the **TURBOJET ENGINE ALWAYS ENFORCE THE PROPER SAFE DISTANCES FROM THE TURBINE!**

The recommended minimum safe distances are:

In front of the turbine: 15 feet

Beside of the turbine: 25 feet

Behind the turbine: 25 feet

Fire extinguishers should be on hand at all times during operation, especially during the starting sequence, the recommend type is the CO2 variety. To avoid hearing damage, always use hearing protection when near a running turbine engine. When the turbine is running never place your hands closer than 6 inches into the area of the intake.

CAUTION: EXTREME SUCTION HAZARD, which can grasp a hand, fingers or other objects in a moment, prevails around the intake area. Always be aware of this danger!

Prevent foreign materials from entering the intake when working the turbine. Before operation, make sure there are no lose parts or debris near the turbine.

Objects being sucked in can cause severe damage. The use of the supplied FOD screen is highly recommended as FOD related damage is not covered by the Lifetime Warranty.

Always exercise caution around the hot parts of the turbine, to avoid burns. The outer case at the turbine stage and nozzle reaches 400 - 500ºC (750 - 950 ºF), while the exhaust gas may exceed 600º C (1290 ºF).

Make sure that the fuel is mixed with the correct amount of synthetic oil for the specific engine. **Use only 100% synthetic 2 strokes or turbine oils. (See section 2.4 for more details)**

Use common sense when operating model turbine jet aircraft. Never operate in or around heavily populated areas, and in or around areas experiencing drought or dryness.

1.1 Safety Rules

Rule 1 **Never run your engine indoors; always make sure you are in the open air.** Non-associated persons should be at least 9 meters (10 yards) away from the engine when running. Always have a fully operational CO_2 fire extinguisher available and ready for use when starting and running your engine.

Rule 2 When bench running or engine starting in an airframe; never allow yourself or another person to stand behind or in the rear quadrant of the engine. Always make sure the exhaust of the engine is directed away from persons and property as the heat of the engine exhaust can cause damage and injury.

Rule 3 Air will save the engine, in the event of a hot or failed start always isolate the fuel to the engine, but always keep the start air running to the engine, this will clear the engine of residual fuel and will keep the core of the engine cool. If you are using the Electric starter, isolate the fuel supply to the engine and keep the starter running. Do not be afraid to use your fire extinguisher, a CO_2 extinguisher will not harm the engine in any way. A hand held blower is another good safety item to have on hand during the start up and shut down of the turbine.

Rule 4 Never attempt to start a flooded or wet engine, this will result in a hot or wet start and you will have flames. To dry out or clear the engine, stand it tail pipe down and either run the starter motor or blow air through the engine until all residual fuel has been blown out of it.

Rule 5 Always start and shut down the engine with the nose of the plane pointed into the wind.

Rule 6 In the event of a hot start, or sever engine fire, close the throttle and the trim lever to the fully back position and turn off the fuel isolation valve, this will allow the engine to clear itself, be ready to use your fire extinguisher. A CO_2 type extinguisher will not harm the engine in any way; if a dry powder extinguisher is used and the powder is ingested into the engine then you must return the engine to our service department.

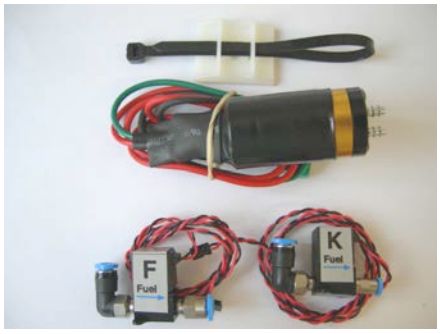
2 Turbine System Components Description

2.1 Parts List

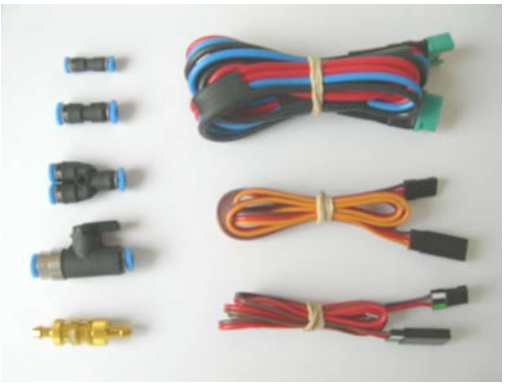
Before starting installation of the engine please check the contents against the parts list. If any part is missing or damaged please contact **JET CENTRAL** or their agent in your country for correction. **DO NOT** substitute missing or damaged parts as this will void your warranty and your country controlling body approval for use.

1 - Turbine Engine
1 - ECU Unit
1 - Clear Fuel Line 4mm.
1 - Clear Kerosene Line 3 mm.
1 - Battery
1 - Hand Data Terminal (HDT)
1 - Manual

Box #1 with:
1 - Fuel Pump
1 - Fuel Valve
1 - Kerosene Valve
1 - Nylon Strap
1 - Fuel Pump Mount



Box #2 with:
1 - Festo “Y” Connector (4mm.)
1 - On/Off Festo Valve (4mm.)
1 - Straight Festo Connector (4mm.)
1 - Straight Festo Connector (3mm.)
1 - Fuel Filter
1 - RPM Extension
1 - Temp. Extension
1 - Power Extension



2.2 Turbine

Jet Central Turbines utilize a design containing a single shaft turbojet with an annular combustor. The single stage axial flow turbine drives a single stage centrifugal compressor. The shaft is supported by 2 fuel/oil lubricated pre-loaded angular contact bearings. The turbine speed is controlled by the amount of fuel received from the fuel pump, which is controlled by the **ECU**

Turbine Specifications

	Bee II	Rabbit 100	Cheetah	Rhino	Mammoth
Thrust Class	7 Kg (15.5 Lbs) @185,000 RPM	10.2 Kg (22.48 Lbs) @152,000 RPM	14 Kg (31 Lbs) @ 130,000 RPM	16.3 Kg (36 Lbs) @ 117,000 RPM	21.5 Kg (48 Lbs) @ 104,000 RPM
Full Throttle Fuel Consumption	0.24 Lt/min (8.1 Oz/min)	0.36 Lt/min (12.2 Oz/min)	0.47 Lt/min (16 Oz/min)	0.52 Lt/min (17.5 Oz/min)	0.70 Lt/min (23 Oz/min)
R.P.M. range	55,000-185,000	42,000-152,000	35,000-130,000	32,000-117,000	28,000-104,000
E.G.T.	500°C - 700°C (932 -1292°F)	500°C - 700°C (932 -1292°F)	500°C - 700°C (932 -1292°F)	500°C - 700°C (932 -1292°F)	500°C - 700°C (932 -1292°F)
Weight	0.880 Kg (1.94 Lbs) with starter	1.0 Kg (2.2 Lbs) with starter	1.360 Kg (3 Lbs) with starter	1.700 Kg (3.75 Lbs) with starter	2.240 Kg (4.9 Lbs) With starter
Diameter	82 mm (3.228 inches)	91 mm (3.582 inches)	102 mm (4 inches)	111 mm (4.37 inches)	124 mm (4.881 inches)
Length	232 mm (9.13 inches)	245 mm (9.645 inches)	250 mm (9.842 inches)	300 mm (11.8 inches)	349 mm (13.74 inches)

2.3 ECU

The **ECU** (Electronic Control Unit) is a total system for the control of a model gas turbine engine. Its main function is to control and regulate the fuel pump, providing the turbine engine with the necessary amount of fuel for safe and controlled operation.

The **ECU** measures the exhaust gas temperature, the relative position of the throttle stick and the rotor speed. It monitors all of the controls necessary to guarantee that the engine stays between the user-defined parameters of operation, also providing fail-safe shutdown of the engine when it has detected any important anomaly. In order to make this assessment, the **ECU** has a RPM sensor, a thermocouple input, a throttle channel input, power connections for the fuel pump, starter, ceramic igniter, fuel and gas valves, battery and a digital (RS232) serial port to program and read the data in real-time to a PC or the (HDT) Hand Data Terminal.

The measurements made by the ECU are:

- Temperature of the exhaust gas
- Pump battery voltage
- Width of the throttle pulses from the radio transmitter
- Engine rotor RPM
- Engine run time
- External analog signal (Air Speed if optional sensor is being used)

All of these measurements can be read into and displayed on the Hand Data terminal (HDT) that is connected to the **ECU** by the integrated cable or into a personal computer through the optional RS232 adapter. The configuration/setup parameters are stored in the **ECU** memory, the parameter changes are supplied by the user utilizing the HDT or the PC program.

Features:

- RPM input: Magnetic sensor up to 250,000 R.P.M.
- Temperature range up to 1000ºC using a "K" type thermocouple
- PWM (Pulse Width Modulation) control of 8192 steps for pump
- Build-in electronic brake for the starter motor to help the clutch to disengage
- Open glow-plug / ceramic igniter detector
- Adjustable glow-plug / ceramic igniter power
- Start Type selection (Auto-Gas or Auto-Kero)
- Adjustable gas flow
- Battery Type Selection (LiPo 2s) or (A123 3s)
- Adjustable Kero Start parameter
- Elapsed engine run timers
- Status LED on **ECU**

- Status LED on electronic valves
- RS232 interface for communication with a PC or the HDT
- Black box function, records engine sensor measurements every 0.5 sec for up to 51 minutes
- Resettable total current used counter displayed in (mAh) milliamp hours
- Lost signal (glitch) counter
- Air Speed Sensor Input, used for limiting turbine output (Sensor Optional)
- Aux Output – Not supported at this time
- Aux Rx Input – Not supported at this time

2.4 Fuel / Oil System

The fuel supply for all Jet Central Turbines requires that the user to pre mixed fuel and oil together.

Internal lubrication is achieved by routing fuel oil mix to an internal T-fitting which sends some of the Fuel/Oil mix to the bearings and the rest is sent to the fuel nozzles in the combustion chamber. It is important to filter the fuel and use proper types of fuel and oil in the turbine engine. Without proper filtering one or more of the injector needles could become clogged, thus affecting the proper running of the engine.

Use the supplied hangar 9 fuel filter between the fuel pump and the turbine; this will help insure that the oil flow reducer will not be clogged. Failure to use this filter can damage the turbine by reducing the flow of fuel/oil to the rear bearing!

See section 8 for fuel and oil recommendations.

2.5 Starting Gas System (Optional)

Note: the supplied Kerosene Valve will need to be replaced with a Propane Valve if this option is desired; additionally the gas filter / restrictor assembly and one way valve will be required. Please contact Jet Central or one of its distributors / representatives to obtain the required components for the gas starting system.

If the “AUTO – GAS” option is selected in the Start Menu, the initial start sequence of the turbine utilizes propane or a propane/butane mixture. This system uses an onboard gas tank and a solenoid valve to deliver the gas to the combustion chamber, the internal ceramic igniter is powered momentary to cause ignition. When the required parameters are met the fuel solenoid valve is opened by the ECU and then fuel is used to bring the engine to the proper idle RPM during the remaining starting ramps. The gas valve is automatically closed when the predetermined RPM is reached during the fuel ramp.

2.6 Kerostart System (Standard)

With the “Auto-Kero” start type selected in the Start Menu the starting sequence is as follows:

The initial start sequence of the turbine utilizes the main fuel source (Kerosene / Jet A / Diesel). This system uses a Y-Festo connector from the outlet of the fuel pump connected through a solenoid valve (identified with a “K”) to deliver the fuel to the combustion chamber, the internal ceramic igniter is powered momentary to cause ignition.

When the start command is received by the ECU there will be a preheat time delay, then the starter must turn the turbine to preset RPM before the Kero Start solenoid valve will modulate, at this time the start fuel will ignite in the combustion chamber.

If the temperature rise and RPM’s are within the pre-programmed values, “Switchover point”, then the main fuel solenoid valve will modulate to deliver fuel to the main burner to bring the engine to the proper idle RPM during the remaining starting ramp. The Kero solenoid valve is automatically closed when the predetermined RPM is reached during the “Fuel Ramp” stage taking the turbine to the “Running” mode, where Turbine control is handed back to the transmitter control.

Note: If the temperature rise is not sufficient during the initial start phase the “IGN. Fail” error message will be displayed and the “Pump Pw. Ignt. K” parameter will need to be adjusted to a higher value.

If excessive flames are present during the initial startup verify that the cause was not a flooded combustion chamber due to fuel line/ priming. If flooding was not the cause of excessive flames, then the “Pump Pw. Ignt. K” parameter will need to be adjusted to a lower value.

If excessive flames are present during the “SWITCHOVER” point, then the ECU will need to have the parameter unlocked and the xxx adjusted, please contact your Jet Central Rep for instructions.

If there is an excessive amount of time to get from “SWITCHOVER” to “FUEL RAMP” then the ECU will need to have the parameters unlocked and the xxx adjusted, please contact your Jet Central Rep for instructions.

Caution:

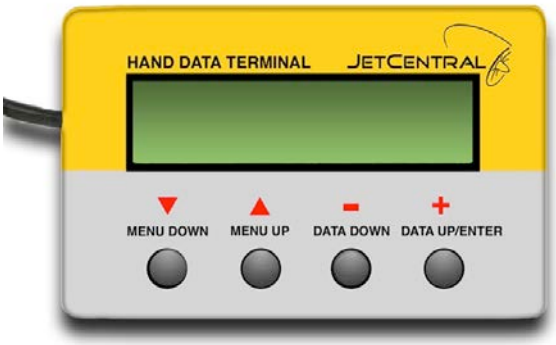
The main difference between gas and kerosene start systems is in the case of a failed ignition; the gas dissipates quickly into the air and is not retained inside the turbine. Kerosene is liquid and, if unburned, will pool inside the turbine and stay there. The turbine can hold a large quantity of kerosene internally and this excess kerosene will be ignited on next successful startup and will be pushed to the exhaust as soon as the airflow inside the turbine is sufficient. The exhaust will be ignited causing a hot start (in extreme cases a large fireball) that will not hurt the turbine, but can destroy the model.

2.7 Hand data Terminal (HDT)

The Hand Data Terminal is simple and easy to operate. The HDT is used to read the different information and to program certain parameters in the **ECU;** this is a link between the user and the **ECU.** Take the necessary time to learn the operation, as this is the only way the operator can monitor and check that the turbine is running properly. The unit is small and compact but it should always be removed before flying.

Note: *If you leave the HDT connected it uses power from your RX battery.*

HDT



3 Turbine System Installation Instructions

3.1 ECU

Connections:

- Throttle input to the receiver: JR type servo cable (Throttle RX)
- Kerosene valve / (Gas Valve): two pin connector receptacle
- Fuel valve: two pin connector receptacle.
- RPM sensor: JR type connector receptacle (RPM Sensor)
- Thermocouple: two pin connector receptacle (ThermoC)
- Multiplex connector 1
- Battery input: Red/black cable
- Fuel pump: Red/Green cable
- Multiplex connector 2
- Internal ceramic igniter: Red/Black cable
- Starter: Red/Blue cable

Note: In all power cables the black is the common and negative. This means that all the black cables are connected internally together and to the negative of the pump/starter battery.

Connect the cables to their assigned places, Note that some of the JR type connectors used can be connected in the wrong location or inverted.

Use the colored labels on the **ECU** body to connect the connectors ~~in~~ to their assigned place. The input / output connectors have been designed to prevent damage to the internal circuitry in the case of an incorrect connection.

Please note that:

- If the thermocouple connector is connected inverted, the temperature will decrease when heated and the **ECU** will fail to recognize the ignition.
- If the RPM sensor is connected inverted no RPM will be read.
- **IMPORTANT!** Use only 5 cell 6V packs on your receiver; this will insure proper operation of the ECU electronics. You can use a regulator if wished but we find 6V packs work just fine with today's radio equipment. Tests have shown that turbine electronics may be affected from glitches by using lower 4.8 Volt packs powering the radio system.
- Use the recommended (supplied) starter motor battery type, the two supported battery types are LiPo 2s or A123 3s.

ECU Main Unit

Because the **ECU** is an electronic piece of equipment, the installation in the model aircraft is similar to that of the radio receiver. It has to be in an accessible location within the airframe, with limited vibration and far from the heat of the engine. Also because the pump motor produces electrical noise when operating, it is highly recommended that the installation of the pump and all electrical equipment be done as far as possible from the R/C receiver. Keep the power cables at the minimum possible length and avoid installing the antenna(s) near them.

3.2 Pump/Starter Battery

The **ECU** needs for its operation two different power supplies. The first is taken from the radio receiver through the throttle servo connection and the second is the **(ECU)** battery that supplies power to the pump, starter and ceramic igniter.

Reversing the polarity of the ECU battery will cause the destruction of the ECU semiconductors.

The **ECU** battery does not need an on/off switch in the airframe since the **ECU** has an internal electronic switch, which disconnects it when the power to the receiver is switched off.

Note: Charge your batteries properly and make sure your packs are no less than 3 flights low. You can go more if you wish, but it's a good habit to re-charge after every third flight. Remember you can check the current consumption of the **ECU** pack using the HDT and reset your usage indicator after charging the **ECU** battery pack see section 4.7 "Info Submenu" for resetting instructions.

3.3 Radio Receiver

The **ECU** is connected to the radio receiver like a standard throttle servo, inserted in the channel for the throttle, receiving the information of the throttle control pulses and the receiver battery supply.

3.4 Thermocouple

The **ECU** uses a thermocouple of type "K". The provided thermocouple consists of a 1.5 mm diameter Inconel wire, finished with a connector that fits the supplied extension cable which connects to the **ECU.** The factory installation consists of inserting the end of the thermocouple so that it is 2 mm, 1/16 inch, within the flow of exhausts gases. Note that the wire coming from the thermo coupler has a solid green wire and a white wire. The two conductor extension lead is also color coded with white and green marks. The input of the **ECU** is color-coded; make sure to line up the correct colors when plugging in all of leads.

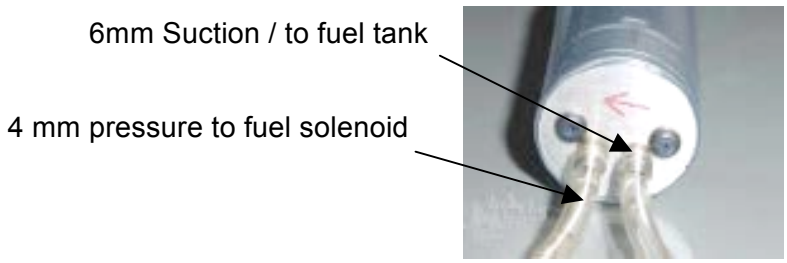
Never bend or cut the probe or probe wires. If you need to extend the wire, use the supplied thermo couple extension.

3.5 Fuel Pump Line out

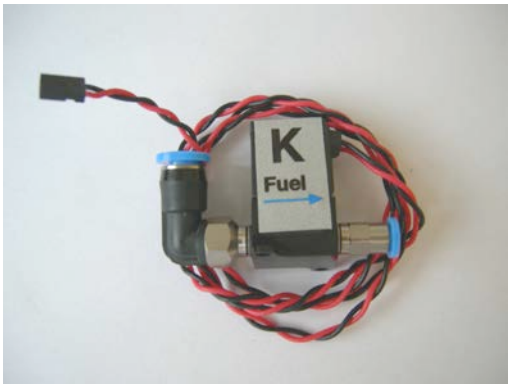
Note: the arrow on the pump shows the direction of the fuel flow.

The next generation fuel pumps supplied have an improved input (suction line) design utilizing a 6mm barbed fitting. Connect necessary length of 6mm tube in the suction side of the pump from the fuel supply, and the 4mm output line to the fuel solenoid valve. Place the manual on/off valve between the solenoid valve and the Turbine. We recommend placing the MANUAL valve where it can be closed easily in case of an emergency.

NOTE: It is recommended to safety tie all barbed fittings with 0.5 mm (.020") safety wire.



3.6 Fuel and Kero Valve



The Fuel valve supplied has a 4mm Festo inlet and outlet connector; the Kero Start valve has a 4mm input and a 3mm outlet connector.

Both valves also feature an integral status LED which illuminates while power is being applied. The valves have two pin connectors that plug directly into the **ECU**, if the valve connectors are plugged in backwards the valve will function however the internal LED may not illuminate.

Caution: Check the tightness of the threaded Festo connectors, if loose, a dangerous fuel leak may occur. Also make certain that the tubing is inserted completely against the internal stops.

3.7 RPM Sensor

Connect the JR type cable coming from the turbine to the RPM input on the **ECU,** use supplied extension if required.

3.8 Kerostart fuel system installation

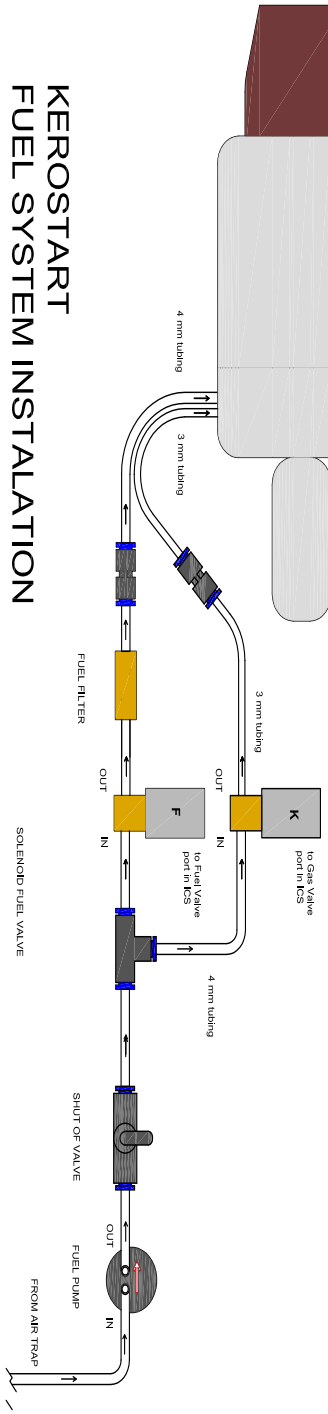
Make sure all plastic tubing is square and completely inside the Festo connectors.A slight twist while pushing in helps to make sure you are all the way in

Make sure all of the "end" cuts of the plastic tubing are clean, square and free of burrs before you connect.

Connect all the components as shown in the diagram bellow. This is important to the successful operation of your Jet Central Turbine.

Instal the fuel tank(s), and air buble trap system according to the manufactures intructions. This is also important to a successful experience.

Please double check the position of the fittings and valves as shown in the diagram below. Failure to properly install these components could lead to leaks or operation issues. Any leaks must be corrected prior to the operation of your Jet Central Turbine. Failure to do so could cause a fire, loss of aircraft and possible injury



3.9 Gas system installation

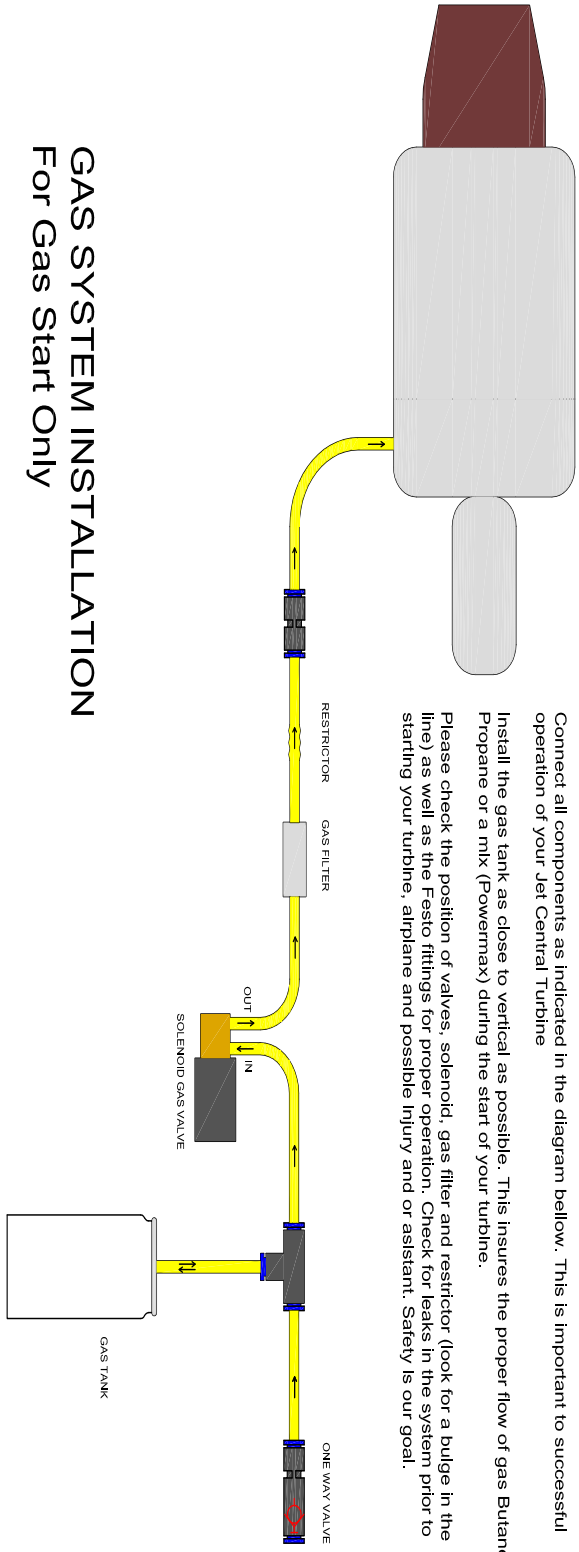
Make sure all plastic tubing´s are completely inside the Festo connectors. Some times a slight twist while pushing in helps to make sure they seat properly

Make sure all of the end cuts of the plastic tubing are clean, square and free of burrs prior to connecting

Connect all components as indicated in the diagram bellow. This is important to successful operation of your Jet Central Turbine

Install the gas tank as close to vertical as possible. This insures the proper flow of gas Butane, Propane or a mix (Powermax) during the start of your turbine.

Please check the position of valves, solenoid, gas filter and restrictor (look for a bulge in the line) as well as the Festo fittings for proper operation. Check for leaks in the system prior to starting your turbine, airplane and possible injury and or asistant. Safety is our goal.



GAS SYSTEM INSTALLATION
For Gas Start Only

3.10 Fuel system installation

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Instal the fuel tank(s), and air buble trap system according to the manufactures Intructions. This is also important to a successful experience.

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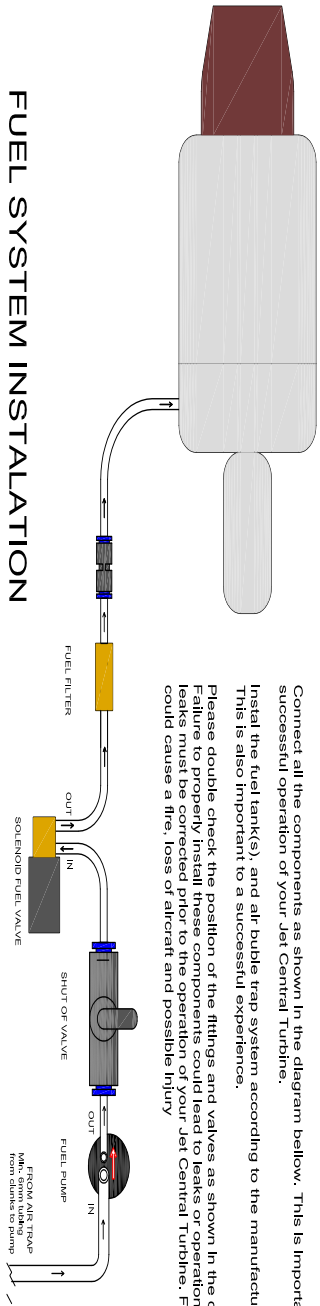
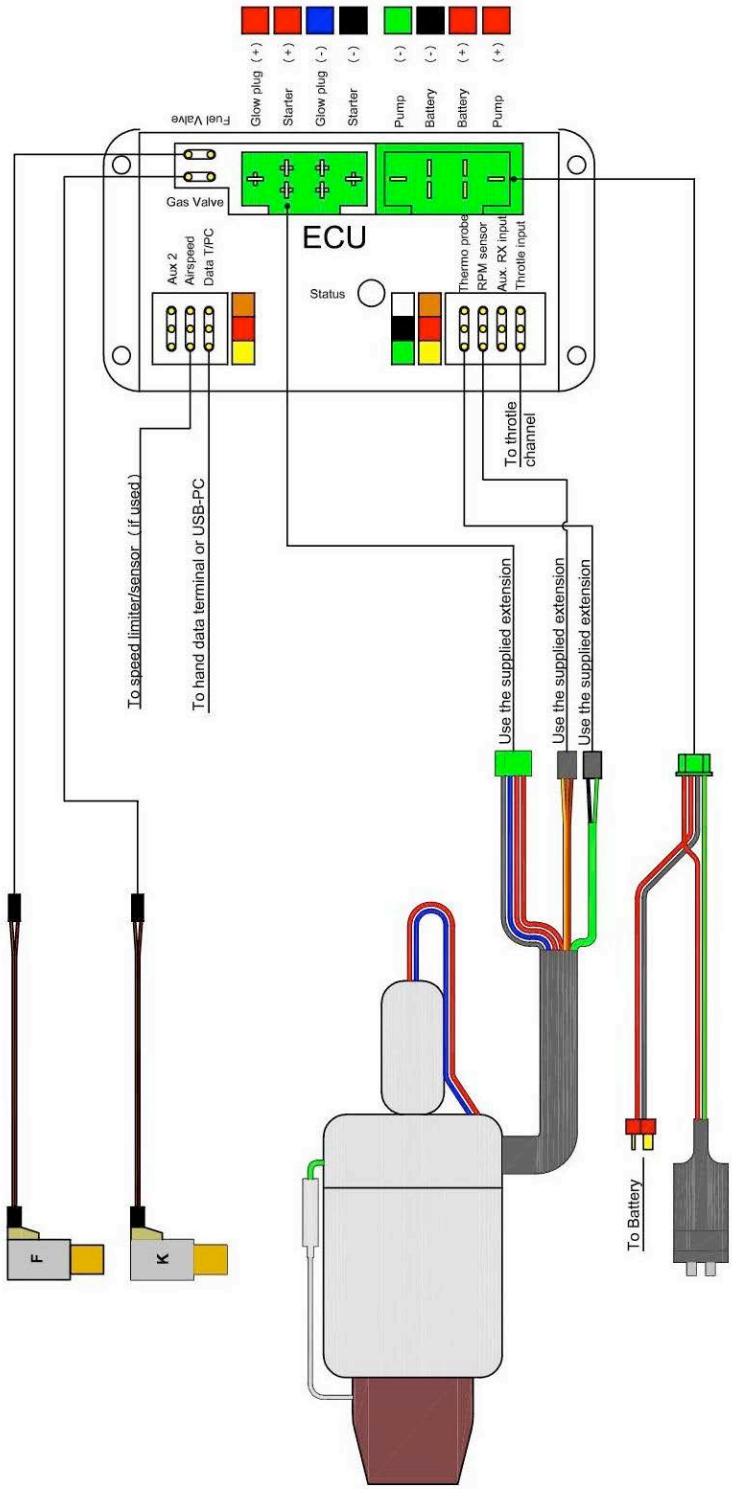
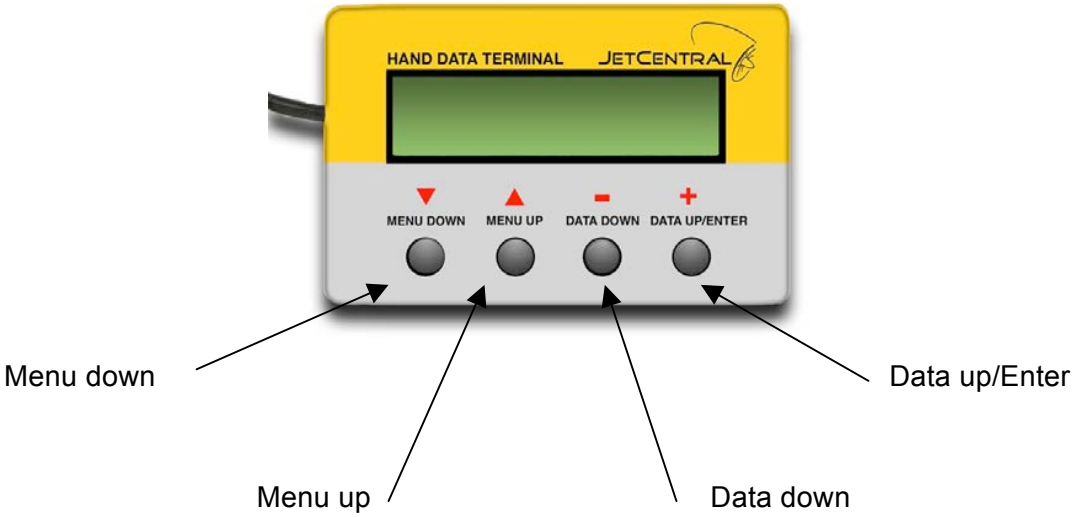


3.11 Electrical installation



4 Programming the ECU

The HDT has a LCD with 16 characters, 2 rows and four buttons which allow you to move through the various menus and to change the data settings in each menu page. The presentation of data has been organized in screens. The first two, displays the engine status readings in real time and the following screens allow you to modify the operating parameters. All of the parameters can be modified while the engine is running, so it is easy to tune the engine without having to start it again to test the new settings. Both left buttons allow you to move through the different screens in an ascending mode (Menu Up) or descending mode (Menu Down). Both right buttons allow you to change the data in increasing value (Up Data) or decreasing value (Down Data).



4.1 First Screen

When you have connected the ECU and you turn on the RX, appears briefly the presentation screen with the Serial Number of your engine.

4.2 Main Screen

This screen displays the status of the turbine temperature (in degrees Centigrade), RPM and the power supplied to the fuel pump (PW). This goes from 0 to 999. **Note:** Numbers exceeding PW values of 600 may indicate restritctions in the fuel system or a faulty fuel pump.

4.3 Secondary Screen

When the Menu Up button is selected the secondary screen is displayed.

Displayed are the pulse width from your transmitter, the % of the accelerator (throttle) stick, the voltage of the ECU battery and the software version.

4.4 Menu Screen

By pressing the Menu Up button the menu screen will be displayed.

Displayed are the fourmenus to choose from:

Start

Info

Radio

Run

To acess each menu, simply push the corresponding button.

Start – menu down (↓)

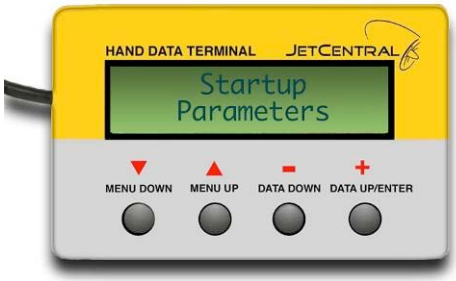
Info – menu up (↑)

Radio – data down (-)

Run – data up (+)

All the parameters in the submenus are factory preadjusted and are a good starting point to fine tunning your engine. **Note:** Only make small changes at one time when adjusting the turbine parameters.

4.5 Start Submenu for Gas Start



When selecting the “Start” submenu the Startup Parameters screen is displayed.

When selecting the menu up button the “Glow plug power” screen is displayed

With the Data up and Data down buttons you can change this value. The value is programed as a voltage. The idea is to have the lowest possible value, that will ignite the gas to conserve battery power. Default value is 8.0V, values can be changed in 0.5 volt increments.

The next screen is “Start gas adjust”

The amount of the gas that is supplied to the turbine during the start sequence. Again, the goal is to have the lowest possible gas input but enough to have a reliable start all the time.

The next menu screen is Battery Type:

The two avaliable selections are:

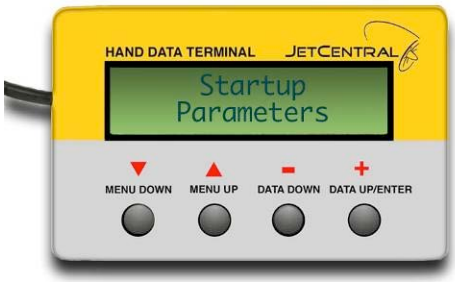
- LiPoi 2s(7,4V)
- A123 3s (9,9V)

The last menu screen in the “Start Mode Auto-Gas” menu is the Start Mode Type Selection

The three available selections include:

- AUTO-GAS
- AUTO-KERO
- MANUAL

4.6 Start Submenu for Kerostart.



When selecting the “Start” submenu the Startup Parameters screen is displayed.

When selecting the menu up button the “Glow plug power” screen is displayed.

With the Data up and Data down buttons you can change this value. The value is programmed as a voltage. The idea is to have the lowest possible value that will ignite the gas to conserve battery power. Default value is 8.0V; values can be changed in 0.5 volt increments.

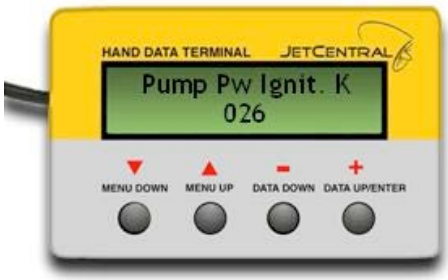
The next menu screen is Battery Type:

The two available selections are:

- LiPo 2s(7,4V)
- A123 3s (9,9V)

The next screen is activated by pressing the “menu up” button will display “Pump Pw. Ignt. K”. Entries are numeric values between 000 and 255

This is the only fuel adjustment you have in Kerostart mode but it is most critical.



A value that is too low will probably get the fuel ignited but it will not raise the temperature enough to trigger the preheat mode, so if you hear or see flames inside the turbine but you still get **“Ignition fail”** alarm, increase this value one point at a time until it creates a sufficient temperature change to pass to next step.

The last menu screen menu is the Start Mode Type Selection.
The three available selections include:

- AUTO-GAS
- AUTO-KERO
- MANUAL

4.7 Info Submenu

When this option is selected, the first screen will show the avaliable timers.

“Tot:” – The total time in minutes that your turbine has run

“Last:”- The time in seconds of your last run

“Cy:” – The number of cycles (start, run, off) your turbine has

The second menu option is “Battery used”

The display counts the total current in mAh used from the battery. User can set to zero at first flight of the day, and check after each fligth to know approximately the remaining power of the battery.

NOTE: The circuit that measures the amperage in the ECU is not a precision circuit, it was added to protect the ECU from overloads. Measured values can have an error of 10%.

The last screen lists dropped pulses and the total time duration of the lost signal.

The next five options are test options. For access to these options you must have the trim down on your transmitter. They all have an ON (-) / OFF (+) button and you can test them individually: the Starter, Glow Plug, Fuel Pump, Gas Valve and Fuel Valve.

Starter

Glow Plug

Test/Prime Fuel Pump

Gas Valve

Fuel Valve

Test Prime Kerosene Burner

The priming procedure is by turning on the fuel pump until the fuel lines are full.

CAUTION: When you test the Fuel Pump you may flood the turbine.

4.8 Radio Submenu

IMPORTANT – Please Read

Before programming the **ECU** to learn your transmitter throttle settings, it is important that you clear your transmitter of all and any **MIX** or **FAILSAFE** program you might have programmed connected to the throttle channel, since this can interfere with the operation of the **ECU**

Program your failsafe after you have programmed the **ECU** to learn your transmitter throttle settings.

Here are some key items not to forget to check:

- Your transmitters throttle channel ATV, end points or travel adjustments should be at 100% with no reductions or mixes to it
- When your trim is down, HDT should read “Trim Low” and 0%
- When trim is up, HDT should read “Ready” and about 25%
- When you raise throttle to maximum, HDT should read 100%
- Always program your failsafe after you program your ECU and set it to “ENGINE CUT” Throttle down and Trim Down
- Check that your failsafe is working properly

4.8.1 Transmitter Preparation and Verification.

First unplug the fuel pump/starter battery to prevent accidental starting of the engine.

The transmitter must not have programmed any reduction of throw, trim, slow movement, the center value or the linearity modified. In case of doubt it is recommended to connect a servo to verify that the movement is correct from end to end and fast. Once the transmitter has been verified, connect the **ECU** and by means of the key “Menu Up” change to screen 2. With the trim and stick of the transmitter raised (Full power) the reading of “Pulse = xxxx” must be between 1900-2200. With the stick and the trim lowered, the reading must be between 800 and 1200. In the case where readings are inverted, when using Futaba transmitter for example, it is necessary to utilize the servo reverse function. If the readings do not arrive at the described values it means that the transmitter may have some function of limitation of throw applied. Once the transmitter is verified, the **ECU** can be programmed.

To program the throttle stick position select the menu screen, and then press the “radio” submenu to get to the adjust screen.

This first menu is only informative and it warns you of the entrance into the screens of programming ~~of~~ the throttle control. Press the button 'Data Up' to enter in the programming menus. Next the screen of programming the full throttle position is displayed.

In order to program these parameters locate the trim and stick in the maximum position. Once located in this position, push the button "Data Up". At this moment the **ECU** will record this as the position of full power.

The following screen allows programming the lower limit (Stop). In order to do this, locate the trim and stick to the minimum position and push the button "Data Up”.

The last screen is the position of the trim that will correspond to the idle of the turbine. To make this adjustment locate the stick to the minimum position and the trim to the maximum position then ~~and~~ push the button “Data Up”.

Note: When in the transmitter adjustment menu and changes to transmitter adjustment are not required pushing the “Menu up” button will cause the screen to change without varying the previous adjustment.

Once the programming of the transmitter is finished it can be verified by means of the secondary screen of the HDT.

To the right of the value of the transmitter's received pulse width values are displayed from 0 to 100%. This value must correspond to the relative position of the throttle stick, matching 0% to the lowest stick and trim position and, 100% to the stick and trim maximum position. If these values were not reached, or the limits of the 0 or 100% were reached before pushing the stick to the end of its travel, the calibration process must be repeated.

When the maximum and minimum limits are verified, the adjustment of the trim can be verified with the ECU blue status LED.

With the **ECU** in start mode and locating the trim and the throttle stick to its lowest setting the LED must be off. When raising the trim slowly, the LED must light approximately at half of the throw of the trim. From this point the **ECU** considers that the turbine must be in its running mode and below this, it is in the stop mode.

Note: When programming the transmitter when the HDT displays stick up and trim up, place the trim all the way to the top; then when the HDT displays stick low trim at idle place the trim only to the center during this learn feature.

By following the above steps if needed after the turbine is running you can use the seconded half of your trim movement to idle up your turbine to create some residual thrust to help in taxing and for landing if wished.

4.8.2 Throttle Curves

By default the ECU controls the RPM in linear way i.e., at the half stick position the engine turns at half of the rotor RPM range. Jet engines develop the thrust in exponential mode, thus half RPM means approximately 1/4 of thrust. On small engines with a high idle to full power RPM ratio, or in a high drag/low power planes, often only the last 1/3 of the throttle stick produces significant thrust, with the low half stick travel being not used. Although that with current digital TX the pilot can modify the throttle curve to suit its needs, from version 5.48 three throttle curves have been added to simplify the setup for most of the installations:

FULL EXPO: Means linear RPM, it is the default setting and the mode used for all previous software versions. Thrust develops exponentially, and it is the recommended curve for big engines and/or high thrust/weight ratio planes, as it eases the control in low power used during taxi.

LINEAR: Means that the thrust develops linearly with the throttle settings. It could cause difficult taxi, as it would be difficult to fine adjust the power at low settings.

HALF EXPO: An intermediate setting between the other two modes.

	STICK POSITION					
MODE	0% (idle)	25%	50%	75%	100%	
FULL EXPO	Idle thrust	6%	25%	56%	100%	% of total thrust
HALF EXPO	Idle thrust	16%	38%	66%	100%	
LINEAR	Idle thrust	25%	50%	75%	100%	

4.9 Run Submenu

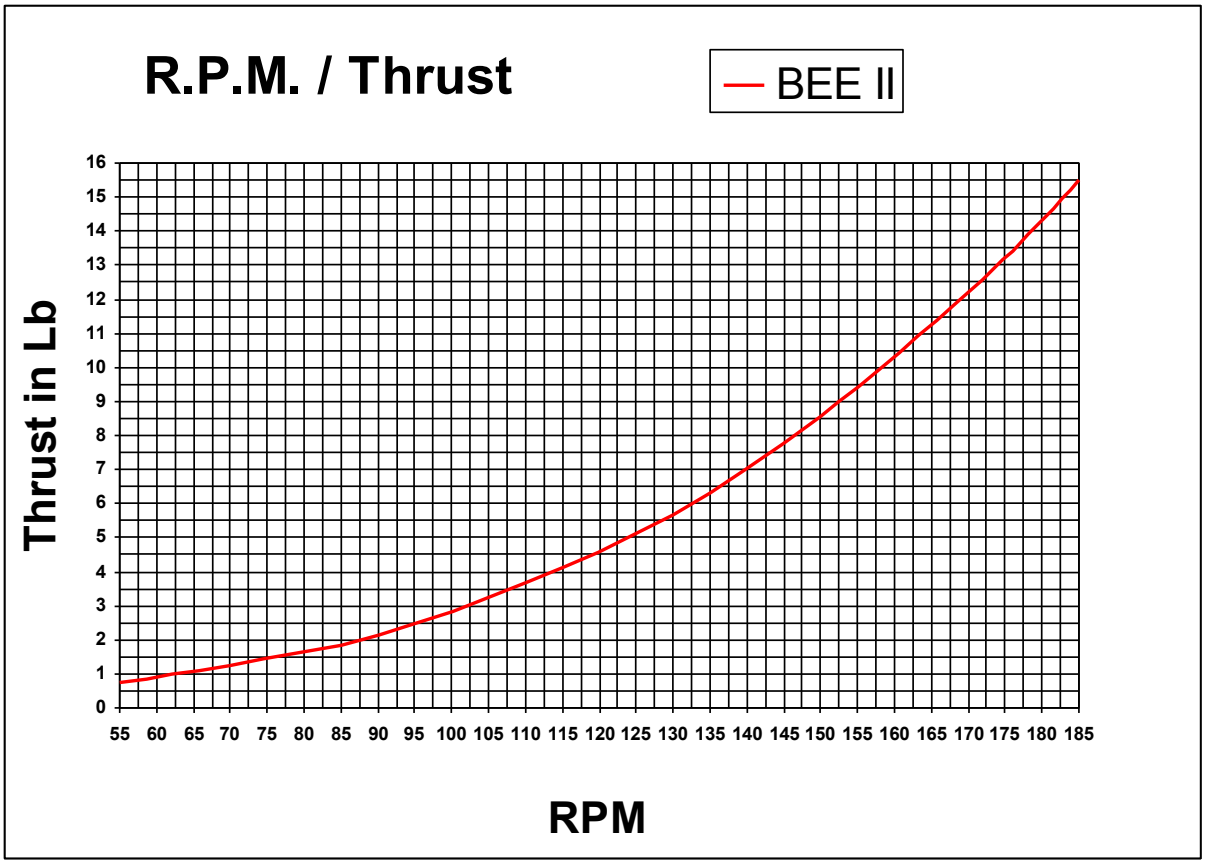
When you select this option you will enter the normal run parameter.

With menu up you get in the “Full power speed”

The maximum RPM limit is set to get the desired thrust accordingnto the attached chart. The Factory set default value is 185,000 RPM

With menu up you get in the “Idle speed”

The idle RPM is set with this value, default value is 55,000 RPM



4.10 Last Run Reason

To get to this screen the Rx power must cycled off and then on, then press the “Menu Down” button it will then display for a couple of seconds the last shutdown reason, last temperature, RPM’s and the PW (pulse width value) of the fuel pump.

User Off –	Means that was shutdown from the transmiter by a trim down or throtle cut
Speed Low –	Means that the ECU registered a lower RPM than the minimum factory programmed value
Hi Temp –	Means that the ECU registered a temperature higher than the maximum factory programmed value
Low Temp –	Means that the ECU registered a temperature lower than the minimum factory programmed value
Ign Fail -	Means that the ECU did not see the proper rise in temperature in the alotted time. Typical cause may include: air in the 3 mm kero burner line, a restriction in the kero burner line, the value of Pump Pw. Ignt. K set too low.

All this data is very important to determinate the cause of the last shutdown or flame out.

In case this information is not enough to determinate the causes, the ECU stores the last 51 minutes of use, and can be downloaded to a computer through the optional data link.

Please contact your dealer for advise.

5 Radio Link Failsafe

The **ECU** has a failsafe feature that stops the engine in the case of the radio link failure, but prevents to stop it in the case of short glitches. This system works in PCM/PPM/IPD systems.

5.1 PPM systems

In the case of radio failure (erratic movement of the servos or pulses out of the programmed values window), the **ECU** sets the power to idle during approximately 1 sec. If the radio link is regained in this time, the power goes back to normal, if not; the system will kill the engine.

5.2 PCM /IPD systems

The user should program the failsafe of these systems to cut the engine (trim low-stick low). In the case that the receiver has a radio link failure, it will output the failsafe settings. The **ECU** will set the power at idle during 1 second after receiving the stop command, and if during this time the receiver exits from failsafe the engine will go back to the throttle set power. If not, it will be cut-off. This system allows flying through small glitches while retaining the ability to kill the engine in the case of radio failure.

ALWAYS PROGRAM THE FAILSAFE TO KILL THE ENGINE. NEVER FLY A TURBINE PLANE WITH THE FAILSAFE SET TO “HOLD”.

5.3 Programming the fail Safe for JR 12X

The following procedure describes how to properly set-up the "failsafe" feature on a JR 12X transmitter:

STEP ACTIVITY

1. Gear lever in the down position

2. Using code 12, set the throttle travel to 100% "high" and 100% "low."

3. Bind the system per JR manual instructions. Note: Throttle stick and trim must be at a minimum before you bind it.

4. "Teach RC" to the ECU in this manual page 44.

STEP TESTING AND VERIFYING THE FAILSAFE

1. 1 Start the engine. Set the power to any setting above idle.

2. 2 Turn off the transmitter but leave the receiver on and engine running.

Verify that the engine power goes to idle after 0.5s and shutdown after 2s. If signal from TX is regained during these 2s, power will return to normal

5.4 Programming the Fail Safe for Futaba 12FG

The following procedure describes how to set-up the "Fail Safe" feature on a Futaba 12FG transmitter:

1. In the “Linkage Menu”, sub menu “End Point” Set the throttle travel to 100% "High" and 100% "Low", “Limit” setting may be higher than 100%.

2. In the “Linkage Menu”, sub menu “Fail Safe” there are three columns for each channel, the first column is “F/S”, selections include “Hold” or “F/S”. The second column is “Bat. F/S”, selections are either “OFF” or “Bat. F/S”. The third column is “F/S-POS”; the entry for this parameter is the servo position that will be used if the Fail Safe is active.

3. Select the throttle channel and the select “F/S” under the F/S column, next select the second column, this is a user choice of either “Off” or “Bat. F/S”. Next select the third column and set the position of the throttle during Fail Safe, it should be a minimum of -100%.

4. Make sure that the "Transmitter Adjust" procedure has been completed in section 4.8 of this manual

Testing and verifying the failsafe, verification can be performed either by starting the turbine or using the HDT display.

Verification by Starting the Turbine

1. Start the engine. Set the power to any setting above idle.

2. Turn off the transmitter but leave the receiver on and engine running.

Verify that the engine power goes to idle after 0.5s and shutdown after 2 s. If signal from Tx is re-gained during these 2s, power will return to normal.

Note: this is only valid when using non 2.4 GHz equipment, with 2.4 GHz equipment the Turbine will shut down immediately with the powering down of the transmitter, the reboot time of the power up sequence is longer than two seconds therefore signal cannot be regained in the time allotted.

Verification by the use of the HDT and Status LED

1. Turn on transmitter and receiver, make sure trim lever and throttle stick are at their lowest setting, the HDT should display “TRIM LOW”,

2. Move only the trim lever to highest position, the HDT should display “Ready” and the Blue Status LED should illuminate.

3. Shit off the transmitter power, the HDT should display “TRIM LOW”, and the Blue Status LED should be extinguished. Fail safe confirmed.

HINT: With the fail safe properly programmed, the transmitter may be shut down during the cooling cycle to conserve its batteries.

Special features

Last power-down cause

The ECU stores in its internal memory the measurements taken from the turbine for each 0.5s up to 52 minutes. These measurements are RPM, temperature, throttle position and pump power. This data can only be downloaded through a PC and a RS232 cable, but the user can check through the HDT the cause of the last power down and the measures of the engine at the moment when the ECU cut the engine. This feature is useful to track the cause of a flame out in flight. After power up, set the trim low and press the “Menu Down” button. The HDT will show the cause of the last shut down, and the EGT, RPM and pump power at this moment during 2 sec.

6 Starting the engine

6.1 With Gas

Before Start Checklist

- Charge Receiver Battery
- Charge **ECU** Battery
- Prepare Fire Extinguisher
- Check Fuel Tank Vent Unobstructed
- Mix oil 2.5% Ratio
- Fill Tanks Check For Leaks
- Open Manual Shutoff Valve
- Fill Start Gas Tank
- Turn On Receiver Switch
- Place Model With Nose In Wind
- Activate Brakes
- Start

Shutdown Check List

- Turn Model Into Wind
- Activate Brakes and Stop Turbine
- Close Manual Fuel Shut Off Valve
- After Cool down (2 minutes) Turn Off Receiver Switch

Starting the engine

Keep the magnetic RPM pickup clear of stray magnetic sources such as fuel pump, solenoid valves, glow plug wire, or servos, as the magnetic field generated can upset the rpm reading.

Gas supplied must be liquid gas; dip-tube liquid feed types are suitable, if your system doesn't have one, just hold the gas bottle upside down. Propane and Propane/Butane mixtures work well in temperate climates.

Always set-up and confirm the operation of your Auto-start installation on the test stand, before installing into your model. Always use a pre start checklist.

The present version of Auto Start uses only one channel to all of the engine functions: To trigger the auto start cycle, the process is as follows: TEMPERATURE MUST BE BELOW 100ºC TO START

The user raises the trim. "Ready" will appear on the HDT (Hand Data Terminal) screen when the engine is supposedly to be to idle. If the trim is on "stop" position, "Trim low" will be read on the HDT. If higher than idle, "Stick Lo!" will be read.

When "Ready" is displayed, the user raises the stick to half power and back to idle again, the start sequence begins.

GLOW ON - If the glow test fails a "Glow Bad" message is displayed and the blue LED will blink.

- WAIT EIGHT SECONDS TO ALLOW THE IGNITER TO WARM UP
- GAS ON AND STARTER ON AT LOW POWER
- GAS IGNITES
- GAS IGNITION DETECTED PREHEATING AND FUEL RAMP

When the max ignition RPM is reached and the ignition isn't detected the starter is switched off and the RPM decays repeating the cycle. Usually the lack of ignition is caused by insufficient glow power, (i.e. battery requires charging) or too much or too little gas.

"Weak Gas" message on the HDT means not enough gas has entered the combustion chamber to support ignition.

When the thermocouple registers an increase of 50ºC in temperature or it is higher than the "start/minimum temperature", it means that the ignition have occurred, the starter is switched on immediately at reduced power, increasing its power accordingly to the real rotor RPM.

At the same time the engine begins to accelerate at the "fuel ramp" values, depending on the real RPM. Once the engine reaches the factory preprogrammed RPM's the gas valve is closed, and when the RPM arrive at the predefined "starter off" value, the starter is switched off and the brake applied to it. The engine continues accelerating alone until the idle RPM are reached.

Note: If it's cold outside, 8°C (45°F) or below, and a time out message is displayed it may be due to an insufficient start gas flow, one remedy may be to leave the fill supply hooked up and open as you cycle the throttle to start. Once the pre-heat message or Ramp message is displayed, disconnect the fill bottle and let the engine finish the ramping from the onboard gas tank.

SHUT DOWN

To shut down the turbine at any time, close the throttle trim and the turbine will stop and go into auto-cool until 100°C are reached. The turbine will only go into auto-cool if the trim is lowered.

START RECAP

1. Fill the gas tank.
2. Open the manual fuel valve.
3. Check the voltage on your ECU battery.
4. Raise the trim the HDT will read “Ready”
5. Raise the throttle to full and back to idle engine starts… “If not it will go into auto-restart mode”
6. Shut down... lower the trim
7. If you wish not to start the turbine, lower the trim FIRST, then the throttle.

6.2 With Kerostart.

For Kerostart turbines please read

6.2.1 Preparing the turbine for running

Always test the turbine on a test bench before installing it into the plane, this will confirm that all systems work as they should, and you will be able to learn its operation and the emergency procedures. A suitable platform/table/workbench is required to clamp the test stand onto. Make sure this can be easily transported outside and weighs enough to ensure it cannot be blown over by the thrust of the engine.

Select a clear area for running – keep clear of areas with loose leaves, sand or other debris that could be picked up or drawn towards the intake. Ensure the fuel tank is position well clear of the exhaust area and is secured.

6.2.2 Important notes for kerostart turbines

The kerostart system used on all Jet Central turbines is reliable and well tested system that produces very smooth and trouble free starts. However, extra care and attention must be paid when starting a kerostart turbine.

The main difference between gas and kerosene starting is that in the case of a failed ignition, with gas starting the gas dissipates quickly in the air and isn’t kept inside the engine Kerosene is liquid and, if unburned, will pool inside the engine and stay there. The engine can hold a large quantity of kerosene inside. This kerosene will be ignited on next successful start up and will be pushed to the exhaust as soon as the airflow inside the engine is sufficient, and will be ignited in the exhaust, causing a hot start (in extreme cases a big fireball) that will not hurt the turbine, but can destroy the model.

To prevent this:

- During the start-up listen to the turbine sound to check for positive sound of ignition, check looking from the exhaust that the kero is burning, or check for an increase in exhaust temperature in the data terminal.

If you see a small plume of white smoke from the exhaust mean that the kero is not burning, so the kero is pooling inside the engine. Abort the start immediately.

- Double-check that solenoid valves are installed in the correct sense. An extra security measure is to place a manual valve between the last fuel tank and the pump intake line, to prevent that during the process of filling the tanks or during storage, some fuel can arrive to the engine.

- After a failed start, or whatever condition could cause that fuel be collected inside the engine (i.e. extra priming), ALWAYS empty the engine of fuel by tilting the engine nose down. Fuel will exit through the intake. Do not tilt upwards, due at the internal engine construction; the fuel cannot exit through exhaust.

Another big difference between gas start and kero start is that the kerosene can keep burning during long time inside the engine. This situation usually happens during an aborted start. The start-up sequence is aborted by the user or automatically before the engine arrives to idle. This can cause that the kerosene inside the engine to keep burning for long time, and could destroy the engine or the model. IF A STARTUP SEQUENCE IS NOT COMPLETED, ALWAYS CHECK FOR FLAME INSIDE THE ENGINE. If there is flame, then set full throttle to engage the starter and blow out the flame. USE SHORT BURSTS OF STARTER. Using the starter for long time can destroy the starter motor. In the case that the start-up procedure has been aborted due at starter failure, then it will be necessary to apply the CO2 fire extinguisher. White smoke from the engine is a good indication here; mean that there is no fire inside.

6.2.3 First engine runs

- Confirm your test stand is securely fixed to a bench or heavy table. Keep your ear defenders within easy reach and a CO2 fire extinguisher handy. THIS IS VERY IMPORTANT ON KEROSTART ENGINES.
- Fill the fuel tank. Do not forget to filter the fuel, and to mix the oil.
- Confirm all batteries are freshly charged and connected up. USE ONLY 7.4V Batteries.
- Check there is a temperature reading on the data terminal.
- Ensure the running area is clear of onlookers – especially the prohibited zone of a 10 meter radius 180° arc from engine center around the rear.
- Verify that the fuel tubes are full of fuel and purged of all air, if not; carry out the fuel prime sequence as described here.

6.2.4. Priming the fuel system

Both main fuel and starting fuel lines require the purging of all air after initial installation. Take extra care when priming the lines; ensure that excess fuel is not pumped into the turbine.

A special menu on the ECU facilitates priming. Set the trim to low and go to “Info” menus and next to “Pump test”. Click on “on” / ”off” to start/stop the pump manually. Please observe fuel line to engine very carefully and push the off button to shutoff as soon as fuel reaches engine. Repeat the same operation on the burner line by the appropriate menu entry (Prime Burner), except that after stopping the fuel when it reaches the turbine case restart the prime for and additional three seconds to get the start fuel down to the igniter’ If this step is not completed a series of “start bad” errors may occur until the fuel reaches the igniter.

IMPORTANT:

The prime procedure should be done only to fill the fuel tubes and filters in the case of a first installation or in case of disassembling of the tubes. Do not run the prime function so that the engine becomes flooded by fuel, as this will cause an uncontrolled fire (Hot Start) at next startup.

6.2.5 Starting the engine

Set the throttle stick down and the trim up. “Idle” - Confirm that the Blue LED in the ECU is illuminated and the screen shows “Ready” - **Ready to start!**

Move the stick to 50% and then back to idle again. The ECU will begin the startup sequence as described below:

First the internal ceramic igniter will be energized and after 6-10 seconds, depending on the engine temperature and battery charge, the starter will be powered up to have the rotor turning at 3000 RPM.

Once the rotor is at speed, the pump and solenoid valves will be energized in pulsating mode, the LED indicators on the valves will illuminate to provide a visual feedback of the valve operation. A few seconds later the kerosene will ignite and the exhaust temperature will begin to increase. The rpm and pump power will increase automatically. During this phase the data terminal will display “IGNITION”.

When the exhaust temperature is of around 70ºC, the data terminal reading will change to “SWITCHOVER”, during this phase the fuel will be routed to main injectors and the speed of the rotor will be progressively increased to 10,000 RPM.

Once this phase is finished, the reading will be “FUEL RAMP”. In this phase the engine receives fuel only through its normal fuel input, and battery power to the internal ceramic igniter will be disconnected. The fuel flow and starter power will be increased automatically to increase the RPM up to idle RPM. When 25.000 RPM is reached the ECU will automatically disconnect power to the starter.

When the rotor speed reaches idle, the screen will change to “running” and the engine speed is stabilized.

The engine is running!

Control of engine power/rpm is now handed back to the transmitter and controlled by the position of the throttle stick.

Increase/decrease the throttle slowly, verifying that the engine accelerates/decelerates. **Take special care around the engine intake; keep your hands at a safe distance along with any other objects as they can be easily ingested.**

6.2.6 Engine shut down procedure

To shut down the engine lower the trim and the stick. Is recommendable that before shutting down the engine please restrain the model then raise the throttle stick to approximately 25%, allowing temperatures to stabilize for around 5 seconds before carrying out the shutdown procedure.

Note: Trim must be in the lowest position in order for the Auto Cool down to work.

WHAT TO DO IN THE CASE OF AN EMERGENCY

During the start sequence the ECU will be in charge of everything, controlling temperature and RPM. The only thing the user can do is to abort the sequence by lowering the trim in the case that something abnormal (excessive flames in the exhaust, etc).

If a problem is detected, first:

MOVE THE TRIM TO THE LOW POSITION TO ABORT THE SEQUENCE.

If there is a fire in the engine and the problem is because the starter has failed or the engine is seized (not turning),

IMMEDIATELY APPLY THE FIRE EXTINGUISHER through the intake side of the engine, never trough the exhaust.

If there is a fire, but the rotor remains free to spin and the starter is OK, raise the trim and stick to the full power position this will connect the starter manually to ventilate the engine and extinguish the fire. The throttle channel acts as a starter switch if the temperature is over 100ºC after an aborted start.

USE SHORT BURSTS OF STARTER. Using the starter for long time can destroy the starter motor.

6.3 List of ECU message codes

Here is a list of possible messages shown on the data terminal screen and their meaning.

Message	Means
Trim Low	Indicates that the signal received from the transmitter corresponds to the lowered trim, that is to say, engine OFF.
Ready	Indicates that the engine is ready for starting, and that the transmitter signal corresponds to IDLE, (Blue LED lit).
Stick Low	This indicates that the throttle stick is in a position above IDLE, the engine will not start with the stick in this position, so the stick must set Low.
Glow Test	Verification of igniter and preheat cycle.
Start On	Test of the starter.
Ignition	Kerosene ignition phase and heating of the combustion chamber.
Switchover	Phase of switching the kerosene feed from igniter to normal injectors.
Fuel Ramp	Phase of acceleration until idle speed is reached
Running	Engine working correctly, full control of turbine power reverted back to transmitter.
Stop	Turbine off.
Cooling	The starter is operating to cool the engine.
Glow Bad	Defective or disconnected igniter
Start Bad	Defective starter, insufficient RPM reached during start.
Low RPM	Engine speed below the minimum.
High Temp	Excessive temperature.
Flame Out	Exhaust GAS Temperature below the minimum.
IGN. Fail	Insufficient Temper rise for the preset time duration

7 Range Checking

Range checking is recommended for every new installation or if changes are made:

- Place model perpendicular.
- Program up-elevator Fail Safe.
- Remove antenna or (place transmitter into low power output mode*)
- Hold transmitter arm's length.
- Walk backwards until elevator deflects **STOP** and mark position and measure, carefully count how many paces out you went.
- Re-program Fail Safe for engine to idle.
- Perform exact same test with turbine running at 1/2 throttle. When engine goes to idle **STOP** and mark position, and carefully count how many paces you went.
- If you lost more than 20% with the turbine running investigate and retest**.** Suggested minimums are:
    - Engine off 175 Feet, 60 paces, 55 m.
    - Engine running 150 feet, 50 paces, 50 m.

***** This option is located under the "System Menu" sub menu "Range Check" on Futaba 12 FG.

NOTE: DON'T FORGET AFTER THE ABOVE RANGE CHECK TO RESET YOUR FAILSAFE TO "ENGINE OFF" (THROTTLE DOWN AND TRIM DOWN)!

8 Fuel and Fuel System Care

Your JET CENTRAL micro turbine can burn deodorized kerosene-k, kerosene Jet-A or Diesel for fuel; the fuel must be mixed with oil as follows:

Jet Central recommends using 2 strokes 100% synthetic oil mixed in 2% (50-1) to 2.5% (40-1) ratios. Any recognized brand that meets the norm "JASO FC" will work. Another alternative is 100% synthetic turbine oil mixed in ratios from 2.5% (40-1) to 5% (20-1); however this type of oil is not recommended from a health and safety aspect because it's been proven to be toxic. The last alternative is Mobil DTE light in with a mixing ratio of 5% (20-1).

You may use an additional onboard filter beyond what is shown in the diagrams if you wish. We use an automotive type filter and filter the fuel before it goes into the tank.

Header Tank

Jet Central recommends a header tank with some type of bubble eliminator or an Orbit clunk. This is a requirement if you want to take every possible measure to insure against flame outs.

Fuel Line

Jet Central recommends to safety tie all barbed fittings with 0.5 mm (.020") safety wire. Unless they are a Festo type of connection.

Tanks

Always use a gasoline compatible stopper; as for fuel tanks, Dubro style and Kevlar tanks work fine and seem to have the best impact resistance; but always use a 5/32 size brass tubing for pick up and vents, this ensures your fuel flow is always flowing without resistance.

9 Multiengine Installation

For multiengine installation, first set up each turbine as per manual, start and run each engine separately. Then, when the Turbines are starting and running smooth, plug the throttle leads from each of the **ECU's** into a "Y" connector and plug the central lead into your throttle channel. Now both turbines will start at the same time and shut down at the same time. This is preferred over individual starting and is a simple way of assuring you're taking off on both turbines!

Helpful Tips

- If one turbine starts and the other doesn't for any reason, just cycle the throttle again; the one not running will enter the re-start sequence.
- In multiengine installations always have each turbine with its own complete fuel system.
- As the ECU has auto restart feature, if it is required to shut down after the turbines are running and need to restart quickly, just raise the trim to the ready position and cycle the throttle, when the auto cool down cycle gets the turbine to a safe temperature the ECU will restart the turbines automatically.
- Place on/off switches on the throttle lead before the "Y" connector that plugs the ECU's throttle channel into the receiver, this way you can shut off one turbine or the other on the ground or start one at a time by turning off the engine desired, it is also helpful if you have a "BAD START" on one turbine to reset the ECU.

10 Maintenance

Due to being an advanced design over other popular turbines you will find that your **JET CENTRAL** turbine needs less maintenance and your turbine will only need to be properly cared for to get hours of enjoyment. We have new state of the art bearing systems, precision made combustion chambers and high efficiency turbine wheels that take heat and load of the main components thus greatly extending service requirements. If you find yourself needing service just call! We have a special system in place to give you quick turn around and for all major repairs your **JET CENTRAL** Turbine goes back to its ISO 9000 factory, were it was built to be repaired; this ensures a quick turn around with quality workmanship and keeps major repairs to the least cost.

Warranty - in order to maintain the lifetime warranty the turbine must be returned to the factory for inspection and service at 25 hour intervals, the cost of this service is published on the Jet Central web site.

11 Troubleshooting

PROBLEM	CAUSE	SOLUTION
When raising the trim of the radio, the LED does not illuminate	**ECU** in stop mode after running. Bad adjustment of radio transmitter. Battery supply failure.	Switch off and on the **ECU** (RX) again. Program the parameters of the radio. Verify battery power, check connectors.
After cycling the throttle stick (initiate start sequence) "Glow Bad" message appears	Blown glow plug or disconnected.	Check wiring and battery connections.
After cycling the throttle stick the starter motor does not spin and later the "Start Bad" message appears.	Start motor bad/disconnected.	Check starter. Check connectors
After cycling the throttle stick the starter motor turns but later the "Start Bad" message appears.	Starter battery power to low. RPM sensor failure.	Check starter battery. Check that the starter runs freely. Check RPM sensor connections, check for reverse connection.
Gas Start: The RPM cycles but the gas doesn't ignite.	Gas empty or gas solenoid valve disconnected or bad. Filter / restrictor plugged. Igniter power to low. Too much gas.	Check the Gas supply. Check Filter and restrictor Check/adjust Igniter voltage Check gas valve adjustment value
When the gas is ignited the "Start Bad" Message appears.	The starter failed to reach the minimum RPM to continue the sequence.	Check the starter Battery. Check the starter. Check Starter O-ring for slippage

When the start gas is ignited the **ECU** does not begin to pump fuel and "Time Out" message appears	The Temperature rise isn't sufficient to start the fuel ramp. There is not enough gas flow. Gas does not ignite.	Check the temperature probe that it's inserted in the tail pipe 1/16". Check restrictor and filter for clog. Check glow plug voltage.
When the fuel ramp starts and the "Weak Gas" message appears	The fuel is not reaching the engine.	Check fuel lines. Check manual valve is open. Prime an try again
Kero Start The RPM cycles but the kerosene doesn't ignite.	Kerosene solenoid valve disconnected or bad. Igniter voltage to low. Kero start tubing not purged of air Not enough fuel being supplied to burner	Check the valve. Check/adjust Igniter voltage value Purge tubing using "Prime Burner" function. "Pump Pw. Ignt. K" parameter will need to be adjusted to a higher value.

Ignition	Kerosene ignition phase and heating of the combustion chamber.
Switchover	Phase of switching the kerosene feed from igniter to normal injectors.
Fuel Ramp	Phase of acceleration until idle speed
Running	Engine working correctly, pilot have full control of engine power.
Stop	Engine off.
Flame out	Exhaust GAS Temperature below the minimum.
IGN. Fail	Insufficient Temper rise for the preset time duration

ECU SHUTDOWN CODES

The ECU will always display the reason for the last shut down. It will also display the error code and the engine parameters. The following are the error codes and what they infer. It is important that in the event of an unwanted shut down that the given parameters and codes are noted to determine what has happened before restarting the turbine. The error codes will be reset upon the next successful start of the turbine.

USER OFF	The ECU has received the shutdown command from the receiver
RX PWR	The ECU lost power from the receiver
FAILSAFE	The ECU received the failsafe command from the receiver
FLAME OUT	The ECU lost the temperature reading from the thermocouple
SPEEDLOW	The ECU has shut the turbine down due to the fact the RPM has fallen below a certain RPM
AUTOMODE	The ECU has received a start command after initiated an auto start

IMPORTANT PARAMETERS - In each of the above codes also these important parameters will be displayed:

- **TEMPERATURE**
- **RPM**
- **PUMP POWER**

The ECU stores at last 10 min run time parameters to help in diagnosing any issues.

12 Safety Tips

- Remember to always have a fire extinguisher present during operations
- Caution a flooded turbine will lead to a hot start
- Inspect all turbine fuel connections and wiring periodically
- Safety wire all fuel connections
- Follow all instructions contained in this manual; learn all operations of the ECU
- Under no circumstances charge your LiPo battery while installed in your aircraft
- Never operate the turbine indoors

Enjoy your new Jet Central Turbine. Your Jet Central Team welcomes you aboard and thanks you for selecting our product for your new turbine.

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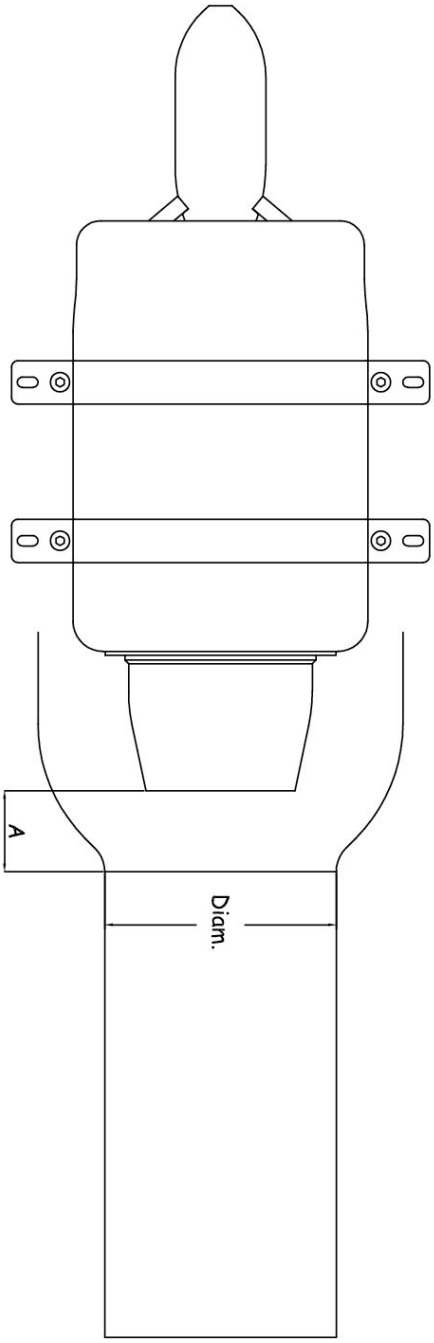
Please take note of different time zones, as **JET CENTRAL** is a worldwide company.

Appendix A: Bee II Mounting Dimensions[1]

[1] This drawing is not fit to scale. Please check the website for a PDF that prints at scale.

Appendix B: Pipe Gaps

There are many factors affecting the best distance between the pipe and the turbine, like inlets and bypassesetc. so please refer to the airplane manufacturer and use this table just as reference



Turbine	A max.	A min.	Diam. max.	Diam min.
Bee	22 mm	12 mm	70 mm	55 mm
Rabbit	25 mm	15 mm	75 mm	60 mm
Cheetah	30 mm	20 mm	80 mm	70 mm
Rhino	32 mm	22 mm	90 mm	80 mm
Mammoth	40 mm	30 mm	120 mm	100 mm

Some Notes:

The bigger the diameter of the pipe, the smaller the distance "A" you have to set

It is worse to be to close to the pipe than to far away

You can use bigger pipe diameter than recomended but never smaller

Mantain the turbine and pipe always alligned and centered