Instruction manual

Medusa N-160K Vulkan

-KEROSENE START-

Serial number: _____

Version 03/09
(Draft)

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THE INSTALLATION AND OPERATION OF THE MODEL AND THE TURBINE IS SOLELY AT THE RISK OF OPERATOR.

You confirm by buying a Medusa Jet Engine (turbine) that Medusa Power Minature Jet Engines (Medusa Power can not be control and observe the instructions in this guide - regarding the installation, operation, use of aircraft, turbine and using the r/c remote control. Medusa Power not promise contractual agreements, guarantees or other agreements to persons or companies on the functionality and operation of the model and the turbine. As an operator you have leave on your own skills and your own discernment.

The implied warranty includes no rotating components, the turbine shaft, ball bearings, compressor, turbine wheel, electric motors and combustion chamber! In addition, there is no warranty for used electronics, sensors and the associated accessories and fuel pumps. Any changes between the series state of the turbine or electronic components will void the warranty!

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I. INTRODUCTION

SAFETY PRECAUTIONS

If other persons or animals are present while operating the Medusa engine, ALWAYS ENFORCE THE PROPER MINIMUM SAFETY DISTANCES FROM THE TURBINE!

The recommended minimum safety distances are:

In front of the turbine	15 meter
On the side of the turbine	25 meter
Behind the turbine	15 meter

In case of a mishap, fire extinguishers should be on hand at all times. Medusa Power (Miniature Jet Engines) recommends the CO/2 variety. Powdered extinguishers will contaminate the precision components, upsetting the integrity of the turbine.

Picture 1

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 50 cm 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 450-600°C while the exhaust gas may exceed 880 °C.

Assure that the fuel is mixed with approximately 5% synthetic oil (only BP 2380). Use only synthetic turbine oil (only BP 2380) available at local airport fuel suppliers.
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 fo-

rested tracts or areas experiencing drought or dryness. Obey all forest fire regulations and warnings by refraining from operating the Medusa 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 Medusa Power, unless you are willing to risk destroying your turbine! Medusa parts are designed and engineered specifically for the Medusa N-16, N-80, N-160, N-180, TP-80. Accept no substitutes, unless you are prepared to sacrifice your aircraft.

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 350 km/h, you can quickly run out of the 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.

EXCLUSION OF LIABILITY / PROPERTY / COPYRIGHT

Compliance with the installation and operating instructions in connection with the model and the turbine and the installation, operation, use and maintenance of the model-related components of Medusa Power-Miniature Jet Engines (Medusa Power) can not be monitored.

Buyer purchases from Medusa Power, or from one of Medusa Power - Miniature Jet Engines authorized dealers, a MINIATURE TURBOJET ENGINE for model aircraft for the invoice price, accompanying this sale, and buyer and Medusa Power agree to all of the following terms and conditions:

I. 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.

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.

Due to modification or replacement of components, components or accessories to the standard series extinguishes any warranty, damages, liability.

II. 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 **III. Full assumption of liability** below, Buyer accepts full responsibility for all of these risks and waives all liability as against Medusa Power.

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. 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.

III. Full assumption of liability
Waiver and Release of Medusa Power – Miniature Jet Engines. 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.

Where the legislature is not mandatory, it is the obligation to pay damages, for whatever reason excluded. (including damage to buildings, personal injury, death, damage due to business loss, or other consequences). The total liability under all circumstances and in any case limited to the amount you actually paid for the turbine have.

The recycling/publication of the texts and images, even in part on the Internet, chat, etc., without our consent in violation of copyright and liable to prosecution. A guarantee for completeness and accuracy of text, images, etc. are excluded.

Technical changes are reserved.

II. FUEL

FUEL MIXING

As fuel, use only Kerosene (Jet-A1) /Petroleum. Add 5 % turbine oil. As a rule of thumb applies:

1 Liter oil on 20 Liter fuel

Picture 2

As lubricating oil you **musst use** not carbonising turbine oil. Has proved the turbine oil **BP Turbo Oil 2380** (available at all airports, they handle with kerosene). When you use other oils, the warrenty deleted.

Picture 3

An Excel table of the correct mix ratio can be download here:
http://www.plastikturbine.de/MedusaPowerFlash/MedusaPowerintern/medusa.xls

Do scrupulously accurate that the fuel is clean (free of algae, dirt).

FILTER THE FUEL BEFORE YOU USE IT FOR THE TURBINE!

MOUNTING THE TURBINE

To mount the turbine, a two-piece, mounting bracket is included with the turbine. The clamp should be positioned so that the kerosene burner is centered in the hole of the clamp. This will help stabilize the engine along the thrust axis. The turbine can slide axially out.

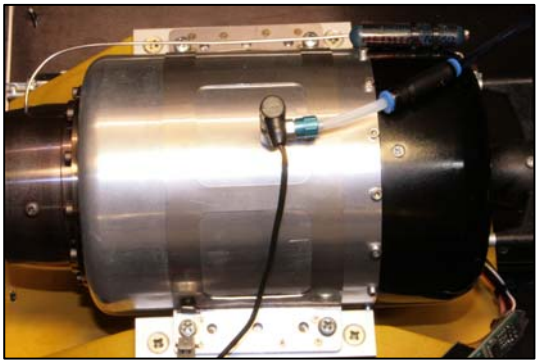
The glow plug must be in the vertical position, when mounted in your model (+/- 45° of engine rotation, from the glow plug at top dead center, is the allowable deviation). Secure the engine, using four metric mounting screws and lock washers that are provided with brackets.

The kerosene burner should always face upwards, so that the lubricating oil supply is ensured.

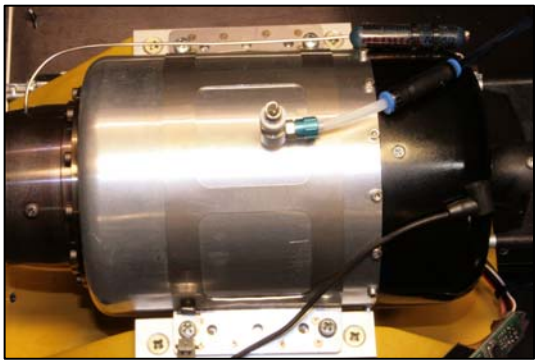
The turbine with the kerosene burner in no way fitted to the bottom!

When the turbine is mounted in models with the air intake at the bottom, 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.

Please always ensure that the glow plug has solid contact with the kerosene burner and cannot be sucked in! The glow plug must be fixed so with a wire cable that it cannot reach in the inlet of the turbine.



Picture 4

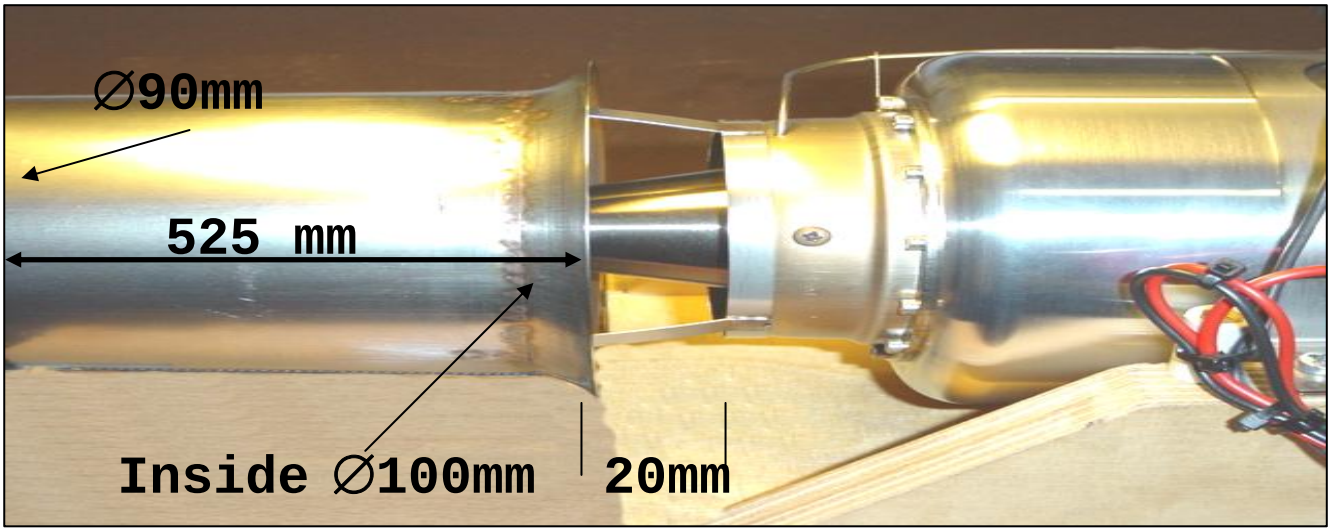


Picture 5

Note:
Kerosene burner tightened by hand-screwing! Do not use any tooling for doing this, otherwise you risk damaging the thin tread of the kerosene burner due to excessive torque being applied!

Proceed very carefully with the kerosene burner. The ceramic heating element can be very easily broken.

EXHAUST PIPE



Picture 6

When installing a thrust pipe make sure that the exhaust temperature of the turbine does not increase. When the temperature increases, the pipe must have a larger outlet diameter.

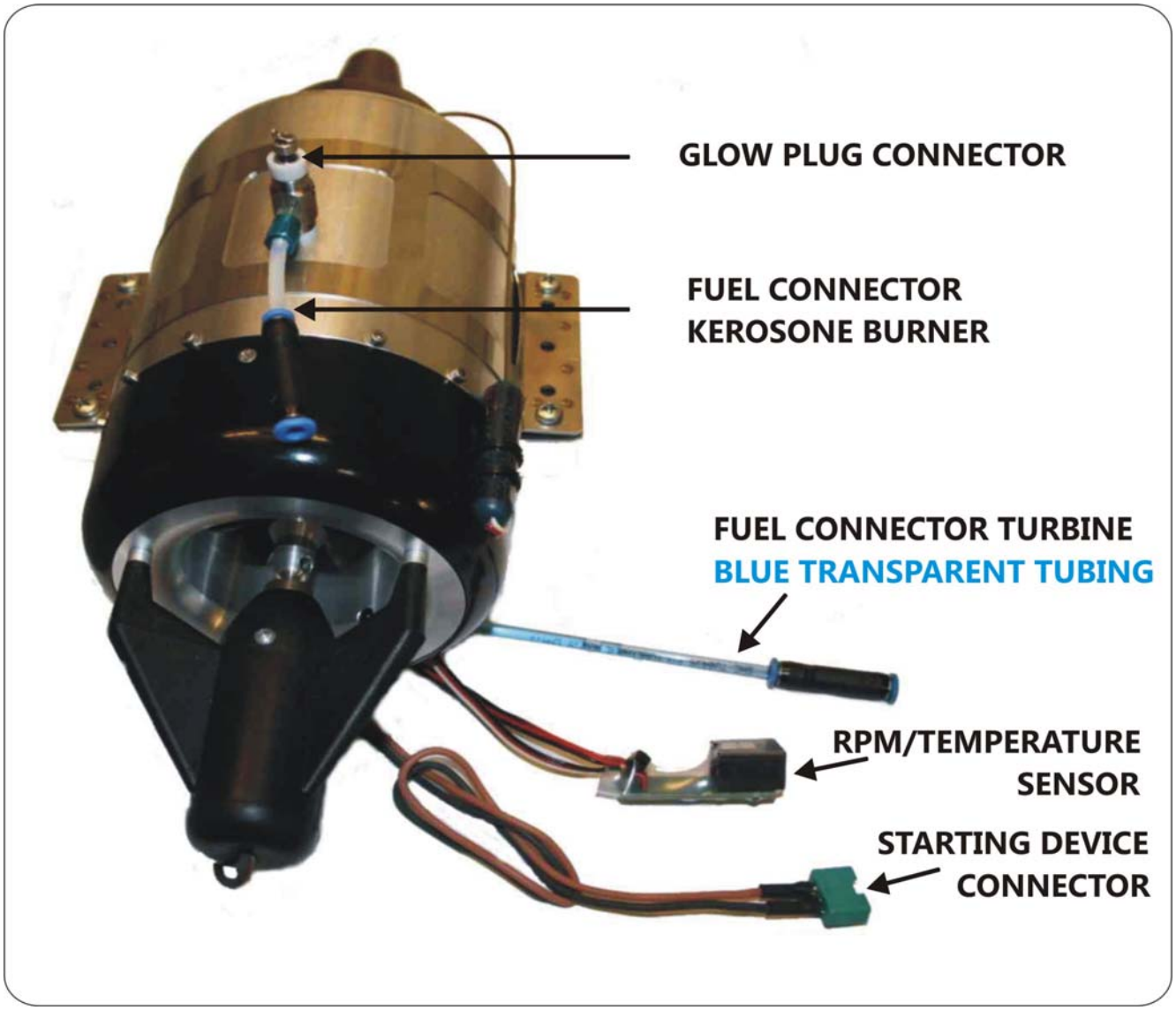
However the result of an increase in exhaust temperature can be a too small air inlet or too small sized screen.

Make sure while mounting the turbine there is a sufficiently rotating air gap . A minimum of 4 cm air from the turbine to the body of the flight model should be given.

If this is not adhered, firstly, the model could catch fire due to radiating heat of the turbine. Moreover, the engine overheats. And could be damage.

IV. CONNECTION THE TURBINE

CONNECTION DIAGRAM: MEDUSA N-160 VULKAN

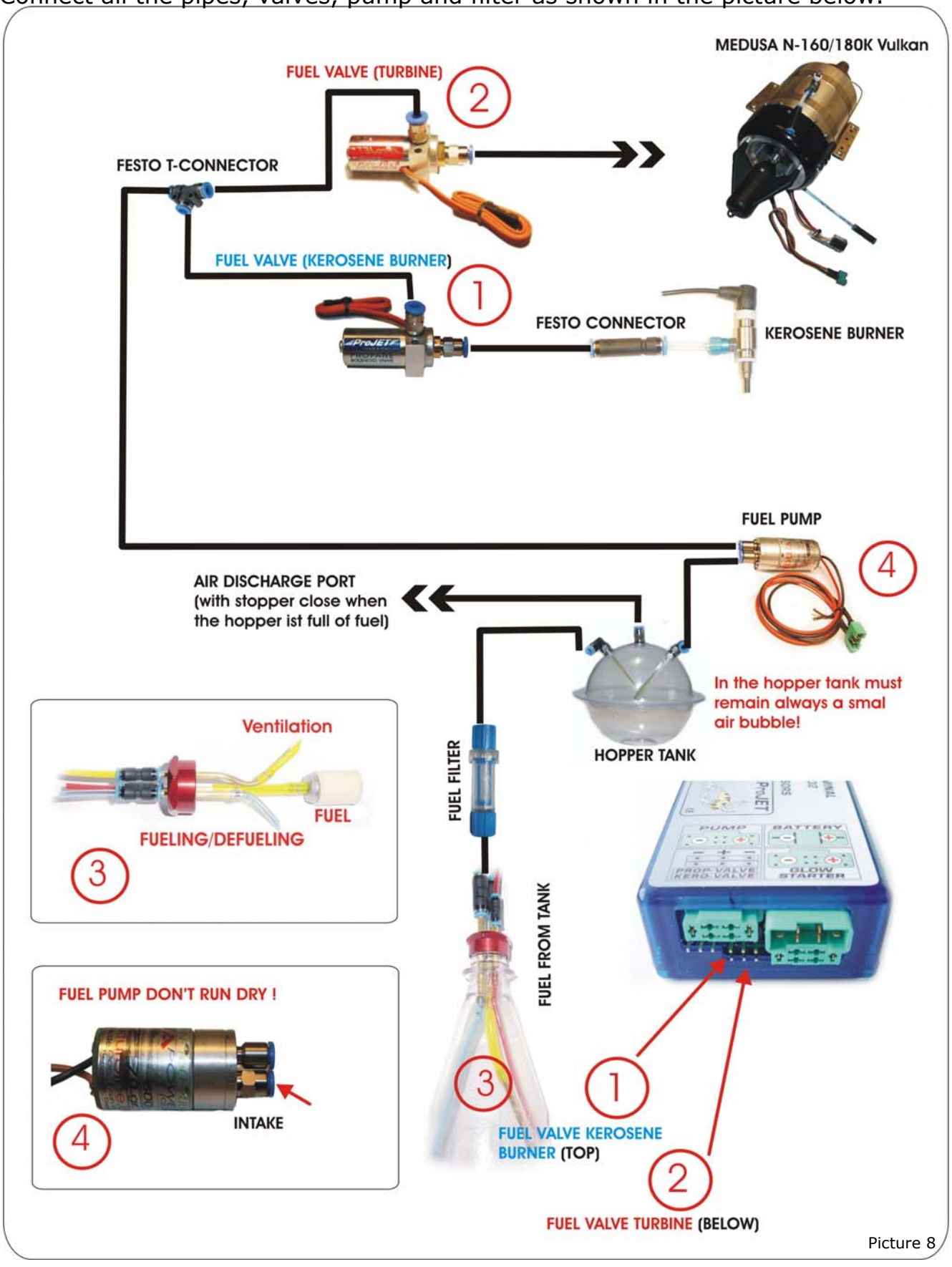


Picture 7

Always make sure that the tubes in the self-locking plug connectors (Festo) are properly locked. The tubes locked right, if a "clack" by coupeling sounds.

CONNECTION DIAGRAM: FUEL

Connect all the pipes, valves, pump and filter as shown in the picture below.



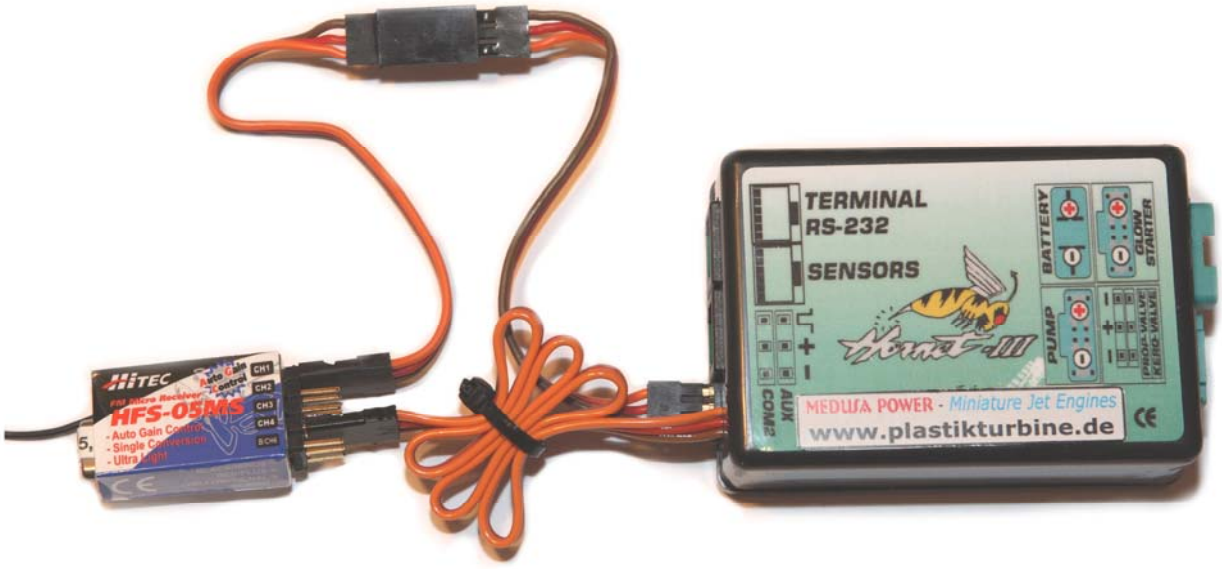
Picture 8

CONNECTING DIAGRAM: TURBINE ELECTRONICS TO RECEIVER

To control the turbine electronics only one channel is needed. Most modern jets require a lot of receiver channels. The turbine electronic (ECU) "Projet Hornet III" only requires one channel (the throttle in combination with the trim).

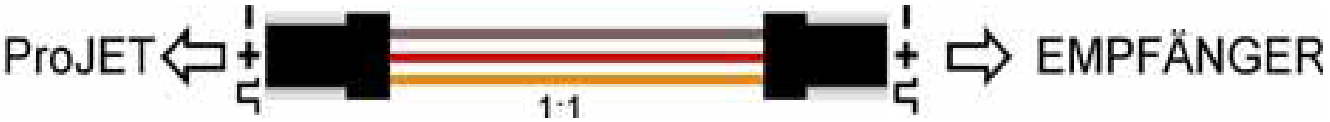
Picture 9

An additional switched channel (ON/OFF switch) can be used for shut down of the turbine or as switch connected to a smoker valve. If you are using a modern remote (radio control system) with digital trims, you will need to set the rate at which the trim moves to the highest setting on your transmitter, or use a separate channel with the auxiliary (AUX) on the ECU.



Picture 10

The cable has to be connected to the AUX channel on the ECU and a switched channel on the Receiver. The polarity is **- + -** (see drawing).



Picture 11

As with the throttle channel, the switch channel must not have any Expo, or Dual Rate functions programmed in. The AUX channel does not need any calibration.

NOTE: The only difference to the single channel version is that the trim is always in the UP position when using the ECU.

The GSU will monitor the engine status -depending on throttle and trim position- after you have switched it **ON.**

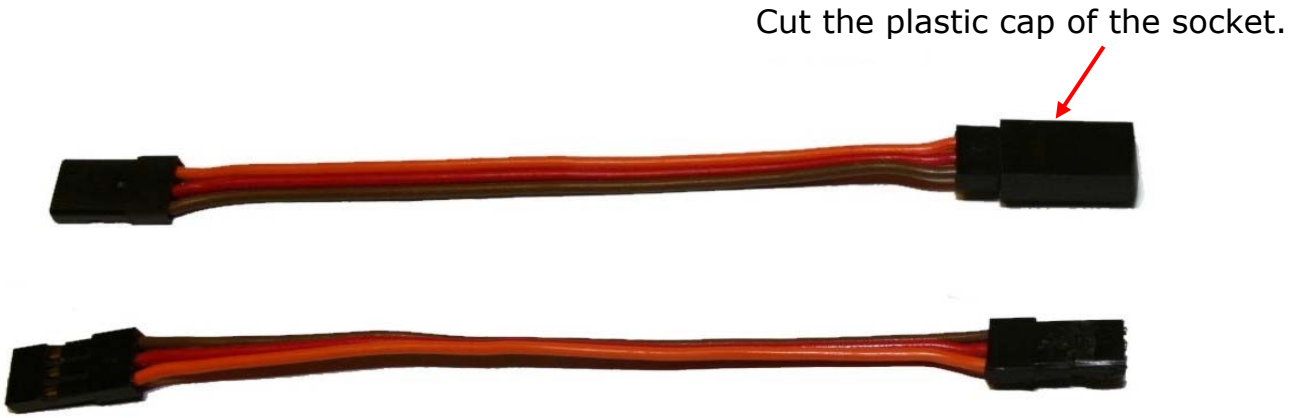
Ready for use cables can be purchased from "Projet electronics components GmbH" or you can make your own with JR servo connectors. Simply use two graupner servo extension cables and connect them 1:1 (see picture 11).

INSTRUCTIONS TO SWITCH CABLE MODIFICATION

1. Requires two Graupner servo extension leads

Picture 12

2. One of the servo extension leads needed to rework.

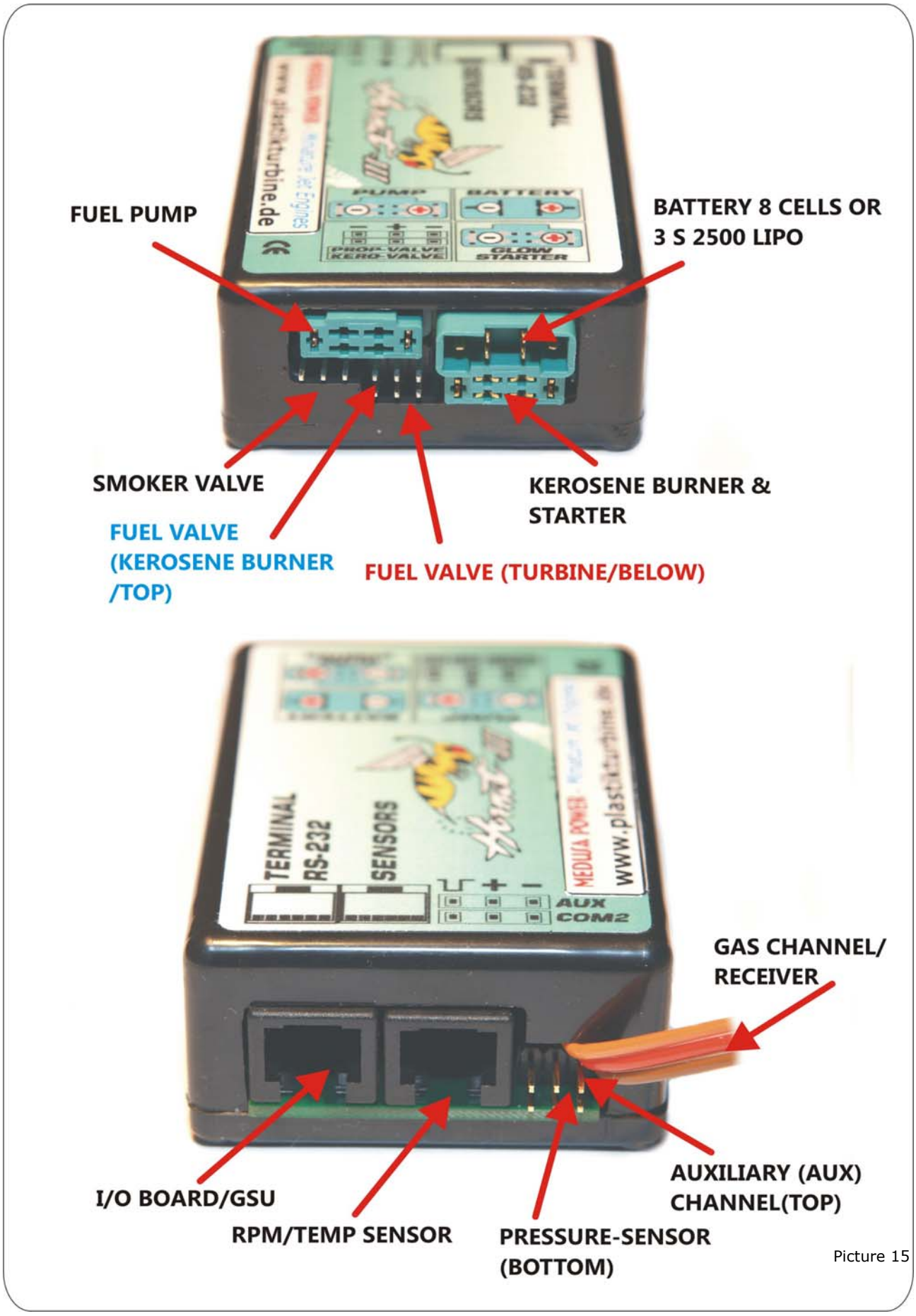


Picture 13

3. Stick the two calbes together

Picture 14

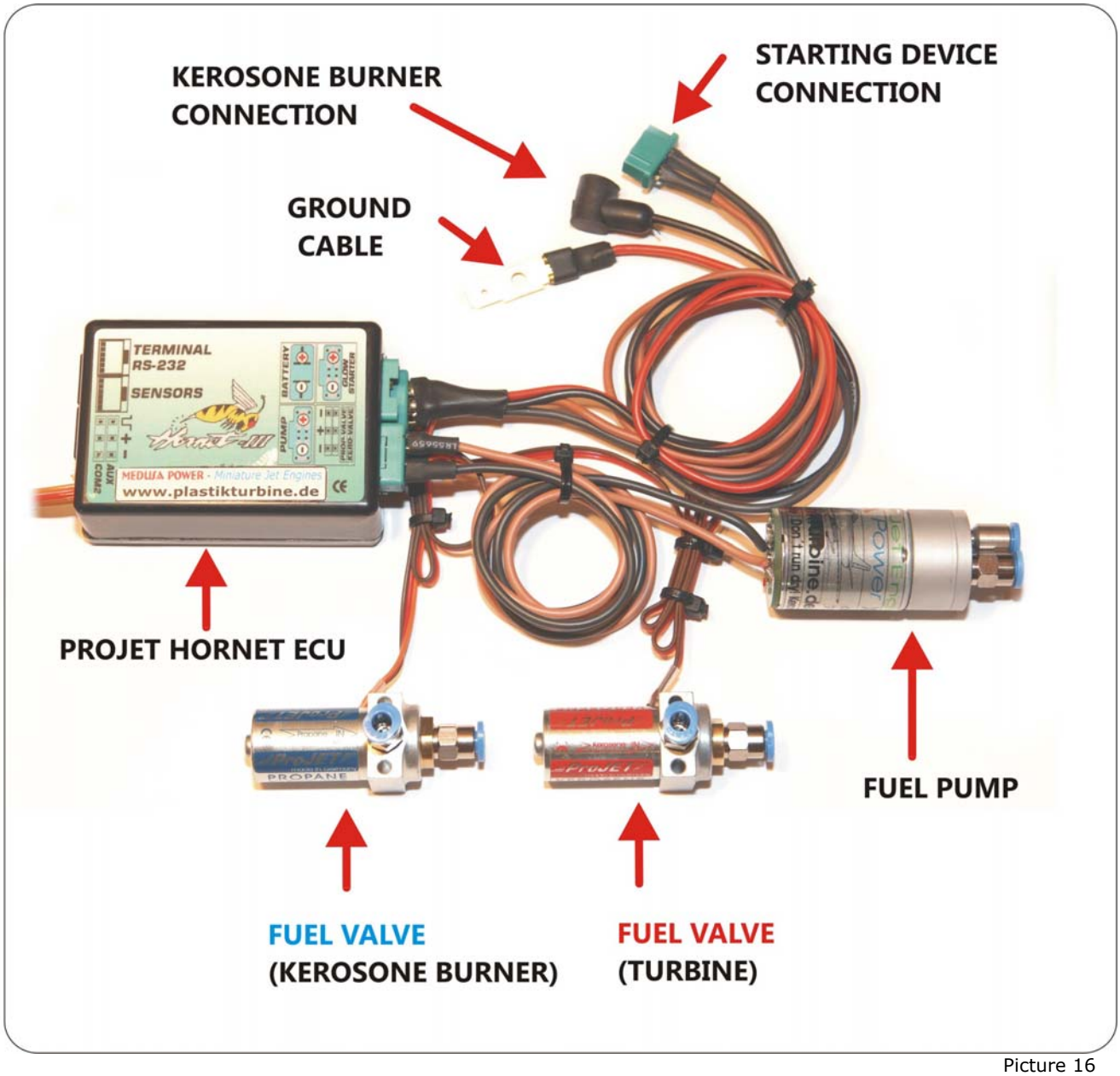
PIN ASSIGNMENT: TURBINE ELECTRONIC (ECU)



Picture 15

CABLE CONNECTION DIAGRAM: TURBINE ELECTRONIC (ECU) PART I

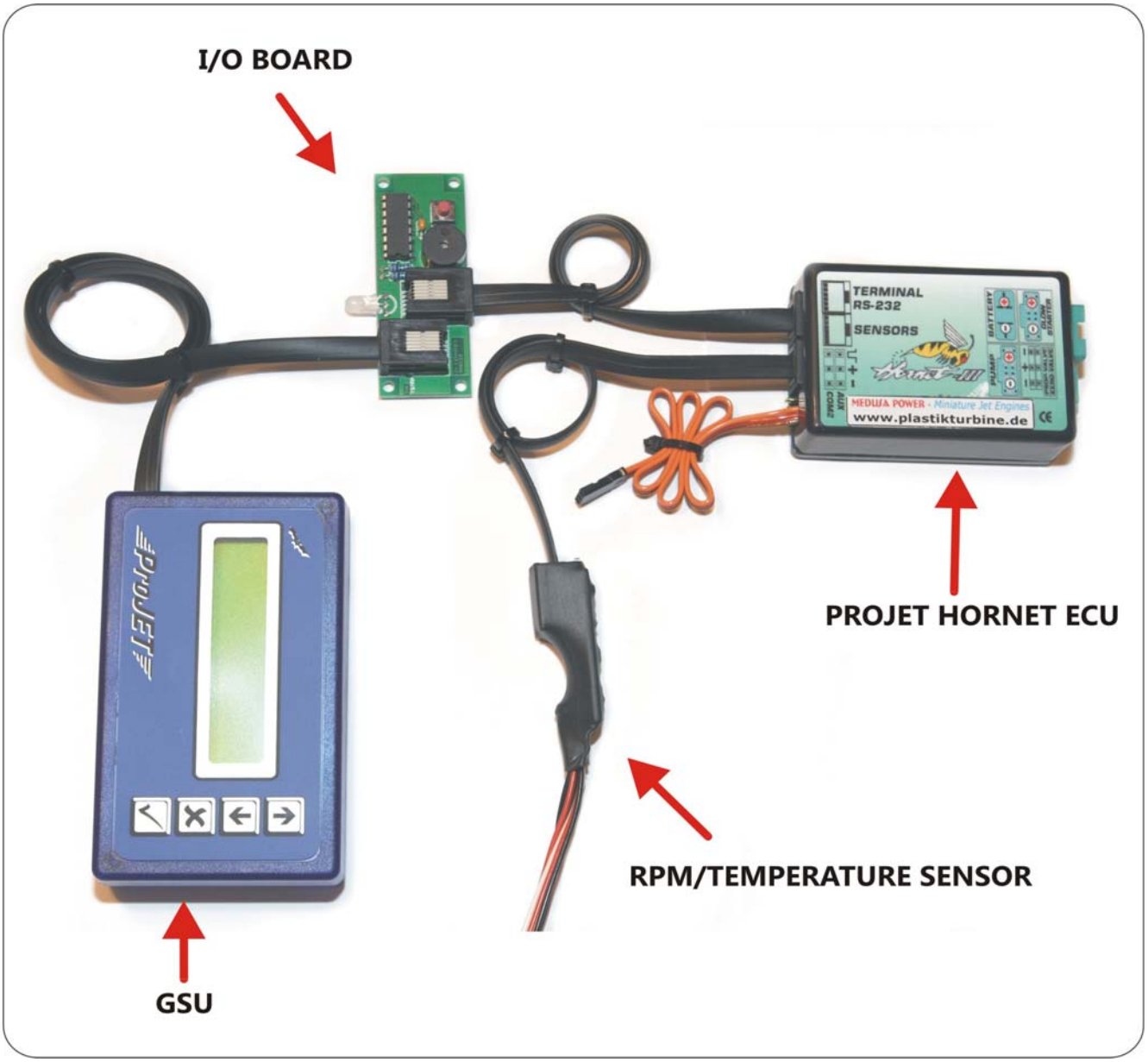
Connect all cables as shown in the picture below.



Picture 16

CABLE CONNECTION DIAGRAM: TURBINE ELECTRONIC (ECU) PART II

Connect all cables as shown in the picture below.



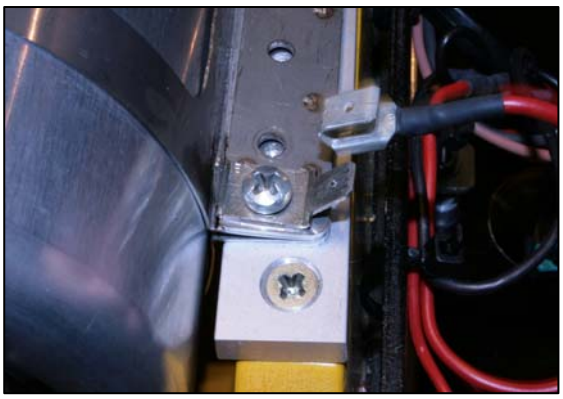
Picture 17

KEROSENE START SYSTEM - TO COMPLETE THE CIRCUIT

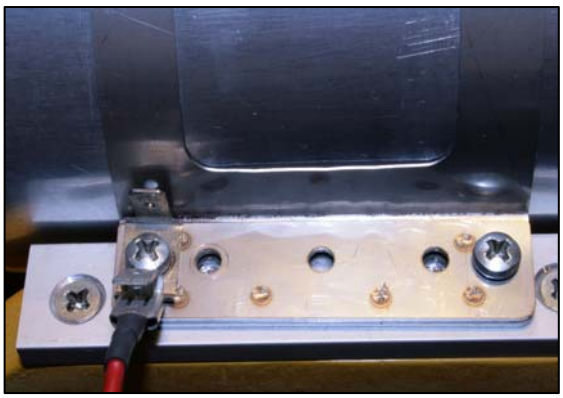
The kerosene burner works only if the ground cable is connected with the mounting clamp, as shown in the picture 17 and 18.

The mounting clamp must have conductive contact with the turbine body. Now connect the plug connector with the kerosene burner.

Through the ground cable the kerosene burner gets power and thus forms the circuit.



Picture 17



Picture 18

ECU SOFTWARE MENUS - DETAIL OVERVIEW

Some settings of the turbine control system (ECU) must be set or may be different than the factory settings. What you can change and what will be observed, is explained in this section:

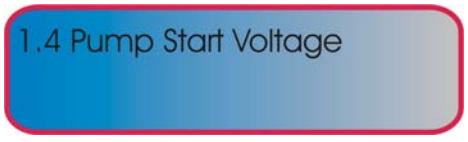
1- SETUP-MENU to open the menu press the (√) button

Each turbine has completed a test run with a set of factory-provided parameters. These parameters are still set. These include, for example the RPM, pump voltage and more. If another full-speed (= less thrust) is required, you should change the following values:

In menu [1.1 MAX-RPM] you can enter the maximum acceptable turbine RPM (full throttle). More than 120,000 RPM can not be set for security reasons. See the performance curve in attachment 2.

In menu [1.2 MIN-RPM] you can enter the minimal turbine RPM (idle). A lower value of 33.000 RPM can not be set!

In menu [1.3 ACC/DEC TIMING], you can set the turbine acceleration and deceleration **fast - medium - slow**, depending on weather or altitude difference, the acceleration or deceleration of the turbine must to be adjusted.



In menu [1.4 PUMP START VOLTAGE], you can set the start voltage of the fuel pump. This is the minimum voltage to start the pump. Too low values can cause malfunction in the start-up procedure.

You can check the voltage by pressing the push button on the i/o board. Increase or decrease the value to obtain the ideal voltage. Confirm the procedure by pressing the [ENTER] button. Quit the procedure by pressing the [X] button.

When replacing the fuel pump, turbine control or changing the the fuel lines, it may be necessary to adjust the pump start voltage.

1.5 Pump Idle Voltage

1.6 Pump Output Maximum

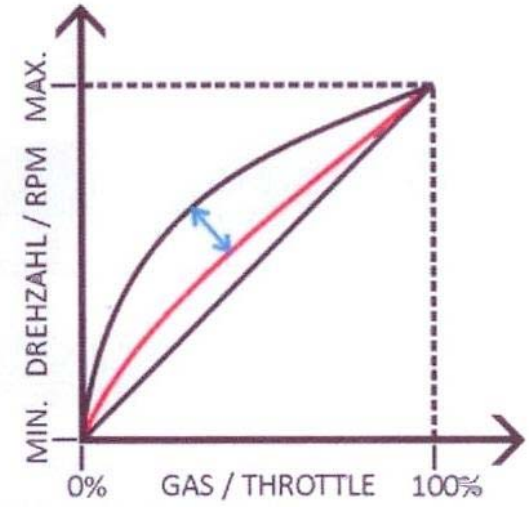
Menu 1.5 to 1.6 shows you the pump voltages at idle and maximum speed (RPM). If you exceed the maximum pump output voltage, the turbine stops immediately.

1.7 Propane Modulation

The amount of kerosene fuel for the burner can be adjusted. This can be necessary under changing weather conditions. 100 % means that the valve is permanently opened. Anything less than 100% will cause the valve to pulse (frequency 20 Hz.). 55% open will be sufficient. A more open burner valve means more start temperature. (The ECU will switch to RAMP-UP Sequence after the temperature of 200 °C has been reached.)

1.9 Throttle Expo

Setting the gas stick speed curve.
0% = Linear (no EXPO)
100% = Maximum EXPO

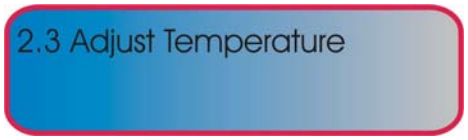


Picture 19

2-ADJUSTMENTS-MENU to open the menu press the (√) button

To put the turbine into operation, you must teach (learn) the ECU to the remote. For more information, see page 26.

After Menu 2.2 has been activated the glow plug will be switched on (powered with the adjusted voltage). Increase or decrease the voltage with ↓↑ buttons.
Note: Set no more than 9,50 volt!

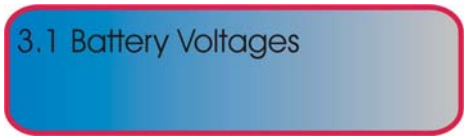


It is important to calibrate the temperature sensor, when the ECU is used for the first time. Or if the sensor element has been replaced.

Enter the ambient temperature and press the [ENTER] button.

The ECU can monitor the actual fuel consumption. To use this function, you need to programme – fuel consumption at idle, fuel consumption at maximum power and tank size. 1,0 volt = 140 ml, 2.0 volt = 305 ml.

3-SYSTEM-MENU to open the menu press the (√) button



Give the minimum and maximum battery voltage, this is important as it activates the "low battery and full battery" display.

Select the menu language.

Menu [3.3 OPERATING TIMES], shows the total running time of your turbine. This is not a default that you can reset.

The ECU checkes permanently if the remote pulse arrives. A faulty remote pulse activates the **FAILSAFE** function.

FAILSAFE DELAY:
Delay time between fail pulse and lowering to fail safe RPM (menu FAILSAFE THRUST).

FAILSAFE TIMEOUT:
The turbine shuts down after expiration of the entered time, if no valid remote pulse is detected.

FAILSAFE THRUST:
After expiration of the **FAILSAFE DELAY** the turbine reduces the entered value.

Disable FAILSAFE-function
You can disable the **FAILSAFE** – function by setting the value 0.0 sec. (in the **FAILSAFE** menu)

PCM remote / receiver

To recognize a **FAILSAFE** signal with a PCM receiver, programme fail safe on the remote. The remote control system must send impulses that lie outside of the throttle way.

Example:

If the remote control system was adjusted (calibrated) with -100%/+100% throttle way, then the signal must be either <-110% or >+110% in case of **FAILSAFE**.

For more programming information check your rc-remote manual.

3.5 RC-Switch Functions

If you use a channel-switch (AUXILIARY), here you can enter the function.

Possible choices:

WITHOUT FUNCTION : The channel function is not used

ON/OFF SWITCH : The channel-switch replaces the trim

SMOKER VALVE : A SMOKER VALVE can be switched ON/OFF. Only works at a exhaust temperature of > 300 °C.

Note: The channel-switch cable must be connected to the ECU before the rc-switch-functions can be use.

3.6 Wireless Telemetrie

Activate the telemetrie sender (TRX-2400). For more information, see the tele-metrie manual (optional).

3.9 Reset - Defaults - DON´t USE!!!!!!!!!

Do not reset the ECU - NEVER!

The turbine may be destroyed, if you reset the ecu, because that will change values in menü 9(EXPERT/MASTER).

4-GPS + AIRSPEED LIMITS-MENU to open the menu press the (√) button

In menu 4 can be displayed the current as well as the recorded AIRSPEED and GPS data of the GAS-module. For more information, see GPS/AIRSPEED (GAS) manual.

5-TEST FUNCTIONS-MENU to open the menu press the (√) button

The ECU has special electronics extensive test and diagnostic menus. All electronics connected components to the turbine as the fuel pump, solenoid valves, temperature sensor, rpm sensor and more can be tested.

The tests may not be with connected fuel system, because of accidental switched on the pump can be filled the engine with fuel. DANGER OF FIRE!

Before each test remove all connection fuel lines/tubes from the turbine!

1. Pump
The pump voltage can be adjusted with the up and down arrow buttons, the enter button starts the pump, the (X) button is used to stop the pump.

2. Kerosene burner
With ↓↑ the voltage be changed. With (√) button the burner switches on.

3. Kerosene burner/propane valve (blue valve)
The up and down arrow buttons adjust the pulse width, the enter button switches the valve on and the button switches off (valve closed)

4. Fuel valve
(√) button switches **ON** (Valve opened)
(X) button switches **OFF** (valve closed)

5. Smoke valve
(√) button switches **ON** (Valve opened)
(X) button switches **OFF** (valve closed)

6. Rc-timing
The rc-signal for the gas and switching channel is displayed.

7. Speed sensor
The speed signal is displayed.

8. Temperature sensor
TMP : detected ambient temperature
AMB : Compensated ambient temperature

TEACH THE ECU TO THE R/C SYSTEM (REMOTE)

To put the turbine into operation, you must teach (learn) the ECU to the remote. Go for this in the menu [2.1 LEARN RC TIMING].

The left number shows the transmitter pulse width, the right one represents the throttle position 0% = idle, 100% = full throttle = maximum RPM.) The words "**ON**" or "**OFF**" show the trim position.

Start the signal calibration by pressing the [ENTER] button.

1. Teach idle

Bring the throttle and trim to the idle position and press the [ENTER] button.

2. Teach condition of trim (ON / OFF status)

Bring the trim to the maximum position, press the [ENTER] button.

3. Teach full power

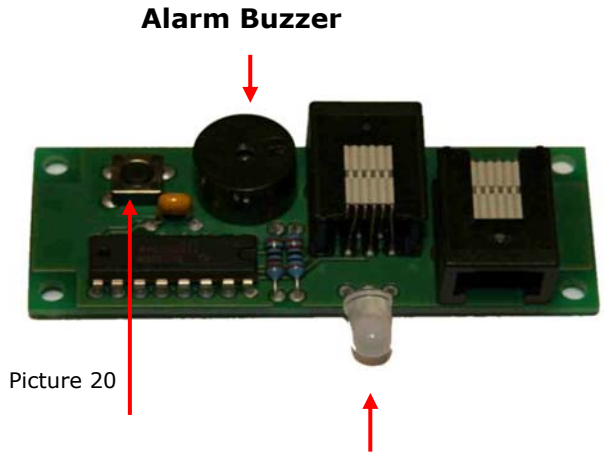
Now move the throttle to maximum and press the [ENTER] button again.

If an error message occurs, reverse the throttle channel in your transmitter. Leave the menu with the [X] button. The settings of the remote control are now saved.

VI. INPUT/OUTPUT BOARD

I/O-BOARD

The input/output electronic board is connected to the "**TERMINAL**" ECU port and should be placed in your model at a position where you have good visual access. The board gives acoustic and visual information about the engine status. This makes the permanent use of the GSU during starting unnecessary.



Picture 20

Alarm buzzer:

Short beep	: ECU is switched on.
Long beep	: Auto start sequence begins (kerosene burner heats).
Short interval	: Battery low, temperature sensor defect, glow plug defect. (see additional error messages on GSU)

Status-LED:

GREEN	: OFF status
ORANGE	: Ready
RED	: Turbine in automatic controlled operation

Button:

You can press the push button on the i/o board to manually pump kerosene. The kerosene valve opens and the pump is powered by the programmed voltage menu [1.4 PUMP START VOLTAGE] as long as the button is pressed.

VII. GROUND SUPPORT UNIT

HANDLING THE GROUND SUPPORT UNIT (GSU)

Picture 21

The GSU (see picture 21) is used to programm the Hornet turbine electronic (ECU) and to show all the important turbine parameters. Programming is done with the four push buttons on the GSU.

↑	**Up arrow** - used to increase values or move menu Upwards.
↓	**Down arrow** - Used to decrease values or move menu downwards.
X-Button	**Escape button**, if you want to escape from an unwanted value change. The (X) button will make the change ineffective. Example: You changed the maximum RPM from 100.000 to 105.000 RPM. After pressing the [X] button, you leave the new setting and the old value will be effective (100.000 RPM)
ENTER – Button or YES-Button (√)	A value change will only be accepted (stored), after the [ENTER] button has been pressed.

Additional terminal function – starting the engine:

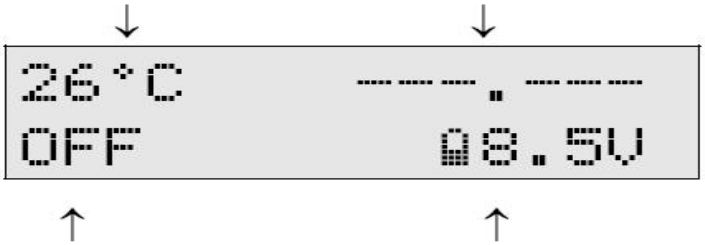
An engine can be started by the GSU simultaneously pressing the UP (↑) and ENTER (√) buttons. **The throttle and trim have to be in the max. position (= ready).** This function is necessary to operate two or more engines if connected to the same receiver channel.

The display

After switching the ECU on, the display first shows the software version.

TERMINAL (GSU) SYMBOLS AND IT'S MEANINGS

Actual temperature **Actual RPM**



Actual engine status **Battery voltage/condition** Picture 22

Temperature : Actual temperature of turbine
RPM : Actual RPM of turbine x 1.000
Engine status : Actual engine status (OFF, READY, AUTOMATIC)

OFF:	Turbine in OFF-modus
READY:	Turbine READY to start
AUTOMATIC:	Turbine can be controlled through the remote control (throttle stick)

Battery voltage : At first the display shows the battery voltage. After the start sequence is activated the display shows the pump voltage.

Display symbols:

- Battery full
- Battery in normal condition
- Battery empty
  Note: The battery condition monitoring can only work perfectly if the minimum and maximum voltage is programmed [3.1 BATTERY VOLTAGE].
- Kerosene burner damaged or disconnected
- Temperature sensor damaged or disconnected
- Pump running – symbol changes in actual pump voltage
- Switch mode (only if separate switch channel is used to operate the ECU - digital trim)

The above mentioned error messages are accompanied by acoustic signals from the i/o board.

STATUS MESSAGE 1 – TURBINE STATUS

OFF : Turbine off, waiting for standby.

STANDBY : Ready - waiting for boot sequence (throttle stick at 0% then to 100%).

BURNER ON : Fuel ignition - kerosene burner on.

FUELIGNIT : Ignite fuel.

FUELHEAT : Preheat - the turbine preheated at a constant starter speed and pump voltage.

RAMP DELAY : Ramp delay - the starter accelerates slowly without increasing the pump voltage.

RAMP UP : Ramp up turbine on idle speed.

WAIT ACC : Waiting for acceleration halt.

STEADY : Waiting for RPM stabilization.

CAL IDLE : Adjust the idle RPM.

CALIBRATE : Adjust calibration RPM.

GO IDLE : Stabilize the idle RPM.

AUTO : Turbine in automatic controlled operation.

AUTO-HC : Turbine in automatic controlled operation - the full RPM has been adjusted - requirement to execute the contingency plan for sensor failure.

EMERGENCY : Contingency plan - the turbine is regulated exclusively on the pump voltage.

SLOW DOWN : Turbine off - waiting for stop.

COOL DOWN : The turbine cooled at constant starter speed.

DEV DELAY : The turbine speed could not follow the increase in pump performance - to rapid acceleration of the turbine – slower throttle response.

STATUS MESSAGE 2 – FUEL

The status display 2 provides information on current fuel consumption and remaining quantity. The display is used as a bar as well as plain text.

STATUS MESSAGE 3 – ELECTRIC POWER SUPPLY

The status display 3 provides information about current battery status. The display is used as a bar as well as plain text.

STATUS MESSAGE 4 – MIN/MAX VALUES

Information of the min/max values of the last turbine run. The values are cleared after ECU is turned off. To display the different values use the [ENTER] button **(√)**.

STATUS MESSAGE 5 – ERROR INDICATOR

The status display 5 provides information on the matter of the shutdown. To pinpoint a source of a problem, the following details will help you:

I. ERROR MESSAGES – STARTUP PHASE

RPM <2.000 PROPANE HEAT	:	Starter was unable to accelerate the turbine.
OVERTEMPERATURE	:	Temperature during start up higher than 1100 °C.
FLAME-OUT HEAT	:	Temperature during preheat is too low.
FLAME OUT FUEL	:	Temperature during kerosene ignition is too low.
NO PROPANE IGNIT	:	No propane ignition detected. Glow plug ok? Battery charged? Starter speed too high?
RPM <5.000 PROPANE HEAT	:	Starter was unable to accelerate the turbine during preheat (RPM lower than 5.000).
BATTERY LOW	:	Battery less than 1 volt / cell. (charge the battery)
USERBREAK	:	Start up interrupted by the operator.
RPM < 12.000 DURING START UP	:	RPM during acceleration (kerosene) was less than 12.000.
NO ACCELERATION	:	Turbine did not accelerate during start up.

II. ERROR MESSAGES – AUTO-CALIBRATION PHASE

FLAMEOUT UNDER CALIBRATION : The temperature during the calibration phase fell under 250°C. Restart. Perhaps prime something more fuel into the turbine (press button on i/o board).

MIN. CALIBRATION RPM UNDERRUN : The minimum required RPM to accelerate the turbine has underrun. Reason**:** Air bubbles in tank.

ERROR DURING CALIBRATION : The calibration speed was not stabilized. Reason**:** Air bubbles in tank.

CALIBRATION VOLTAGE OVERRUN : The set of calibration voltage has been exceeded.

END-PUMP VOLTAGE TO HIGH : Pump voltage menu 1.6 to low.

III. ERROR MESSAGES – TURBINE RUNNING

UNDERRUN RPM MIN: If the RPM falls below the preset idle RPM by 10%.

OVERRUN RPM MAX : The RPM has exceeded by more than 5% the programmed maximum RPM.

OVERTEMPERATURE : The permitted maximum temperature has been exceeded.

FLAME-OUT : The turbine temperature dropped below the programmed minimum temperature.

FAIL SAFE : Caused by the loss of the radio transmitter signal.

RPM-SENSOR FAIL : Loss of the RPM sensor signal.

IV. ERROR MESSAGES – GENERAL

BATTERY LOW : The battery voltage fell below specified minimum voltage in the menu 3.1.

MALFUNCTION OF THE PUMP AMPLIFIER : The maximum pump load (menu 1.6) was exceeded.

VIII. STARTING TURBINE

FIRST START OF THE TURBINE

In the following part of the commissioning of the turbine, the turbine battery must be fully charged. The battery should be loaded before each start, otherwise it can happen a start break-off and the turbine set on fire!

STEP 1 - Connection of the components

The following components have to connected to the ECU:

1. The sensor amplifier
2. Input/output board (I.O.board)
3 Starter motor
4. Kerosene pump
5. Propane valve(for kerosene burner)
6. Kerosene valve
7. Battery

Note: The ECU switches automatically with the receiver, it does not require a separate switch. The ECU has a small power consumption in the **OFF** switched mode. Therefore disconnect the battery from the ECU when not being used for a while.

STEP 2 - Necessary adjustments

The following values have to be programmed before the first operation of the turbine:

- Calibration of transmitter signal (menu 2.1 – see page 26)
- Minimum/maximum RPM (menu 1.1 and 1.2)
  Factory presetting: 33.000/120.000 RPM
- Pump start voltage – if the pump do not run – (menu 1.6)
  Factory presetting: 0,32 volt
- Calibration of temperature sensor (menu 2.3)
- Calibration of battery voltage (menu 3.1)

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

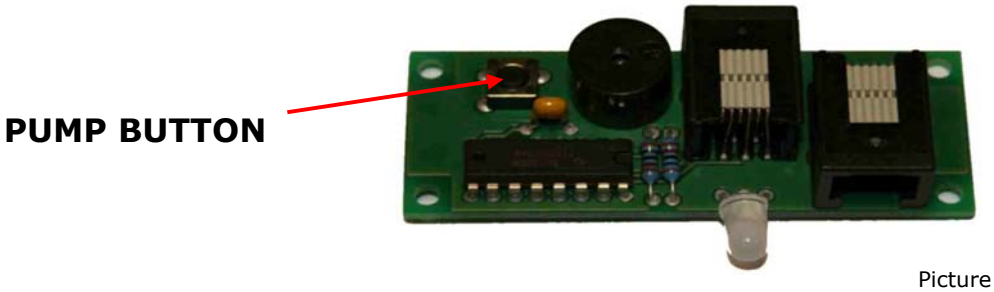
The burner must immediately get fuel! Otherwise burnt up the ceramic element. Risk of destruction!

Purge the air out the kerosene supply line to the engine. Carry out the following points:

1. First remove the 4 mm kerosene fuel feed line from the engine and the fuel feed line from the kerosene burner. Now put the end of the tubes 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. Now press the pump button on the LED i/o board to start the fuel pump (ECU must be switched ON). Continue pumping fuel until all air bubbles are removed.



Picture 23

4. Re-connect the fuel supply and kerosene burner tubing to the engine.

5. Pump a little bit of fuel into the teflon (white) tube. Stop when it just reaches the kerosene burner.

TIP:

Pump before even start for a one second a little bit of fuel into the turbine. The turbine starts so better.

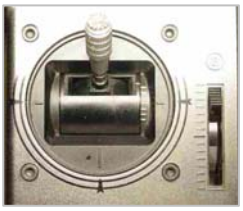
I. START-UP THE ENGINE

Every time the turbine starts it will do a calibration run to accommodate all the characteristic parameters, such as compressors performance, pump flow rate - to measure and save them.

Turbine start - what should i do?

A. Starting without switch

1. Switch, trim, throttle



Bring the throttle and trim to the maximum position.

When using a switch, set the two-position AUX switch to **ON**

2. LED i/o board

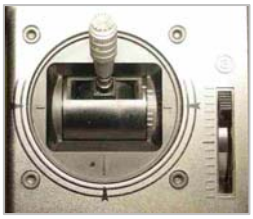
Status LED on the i/o board goes into **READY MODE** (**ORANGE** color)

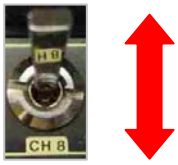
3. Throttle, switch

Now move the throttle stick forward and back (within 2 seconds) – After that, you will hear a long beep on the alarm buzzer.

B. Starting with switch

Switch, Trim, Throttle

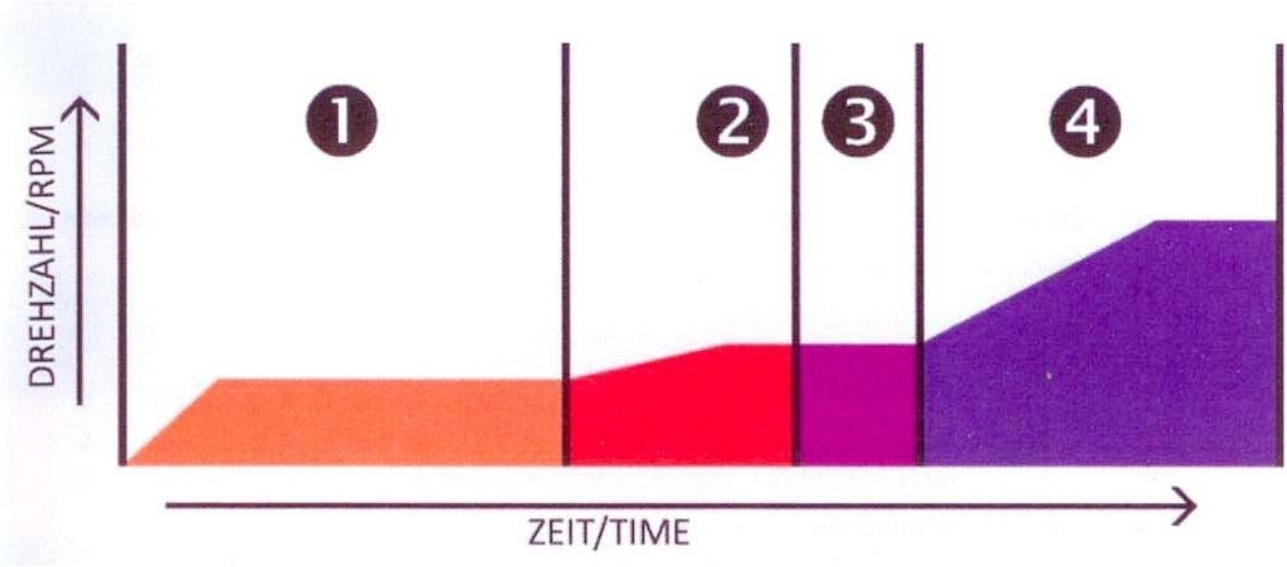




The throttle stick and trim stand forward and only the **ON** / **OFF** switch will be move within 3 seconds forward and back.

After the start signal has been received, the LED i/o board will sound an "acoustical signal" that the start sequence has been activated.

Characteristic start sequence:



Picture 24

1. BURNER ON
Now the burner is pre-heating for 3 seconds (the starter motor is not running)

2. FUEL IGNIT / FUELHEAT
The starter motor accelerates the rotor to its ignition RPM (around 5.000 RPM). After another 4 seconds the ignition of the engine is engaged by injecting kerosene into the kerosene burner and heats the combustion chamber.

3. RAMP DELAY
After the engine has ignited, the starter motor ramps up to maximum voltage.

4. RAMP UP
The turbine rotor accelerates to idle RPM as usually. The exhaust temperature must reach 200 °C. Otherwise the ECU abort the engine start.

5. THROTTLE CONTROL BY PILOT

Once the turbine begins to accelerate, the throttle stick can be returned to idle position. As soon as the turbine stabilizes at idle RPM, the red LED will illuminate, indicating that thrust control is now handed over to the pilot. The throttle stick must be in the idle position.

TROUBLESHOOTING: KEROSENE START

Turbine is not igniting: The reason for this is normally that no fuel is delivered to the kerosene burner or the ceramic heating element is not glowing.

Possible reasons for this:

1. Pump start voltage is too low (adjust pump start voltage in menu 1.6).

2. Fuel supply lines are empty or not purged.

3. The shut-off valve (**blue colored valve**) for the kerosene burner or the shut-off fuel valve (**red colored valve**) is not opening (control if the valve is plugged in the right slot of the ECU. Reverse the valves. 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 turbine.

If the turbine 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 turbine. 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.

II. TURBINE STOPPING /COOL DOWN

Turbine immediately turns off!

A. Stopping with throttle and trim:

Throttle, trim, switch set to OFF

Bring the throttle stick to idle position, while bringing the throttle trim to its minimum position.

B. Stopping with switch:

Set the two-position auxiliary (AUX) switch to **OFF.**

Automatic cooling process

After the turbine spins down from manual OFF, the starter motor will permanently spin the turbine rotor, if the exhaust gas temperature is above 79°C. This happens for about one minute.

IX. TROUBLESHOOTING

REASONS FOR SHUT DOWN

PROBLEM	CAUSE	REMEDY
TURBINE DO NOT IGNITE	Kerosene burner ceramic element is not bright enough. Ceramic element defective	Adjust kerosene burner voltage. Not more than 9,6 volt. Replace defective kerosene burner
STARTING PROCESS FAILS	Turbine is still too warm. The cool down sequence is not yet completed	Wait until cool down sequence is finished. Charge battery. Check cables.
TURBINE IGNITES, BUT THE START PROCESS IS DISCONTINUED	Air in the fuel lines/tubes.	Air lakes in the fuel system.
STARTER UNIT SLIPS OR MAKE NOISE	Dust and oil on the compressor nut an o-ring.	Examine all (Festo) connectors, filter.
TURBINE QUITS WITH A TRAIL OR WHITE SMOKE	Low RPM of fuel fail	Is caused by air in the fuel system. Make sure there is no air in the fuel system and in the fuel filter.

CONTACT PERSONS

I. ECU, GSU, I/O board, cables

All the cables of the turbine or turbine controller or peripheral components (valves, pumps, etc.) including the data cable may not be extended, shortened, or other connectors may be. Disregard any voids the warranty! Other cable lengths are available here:

ProJET Electronic Components GmbH
Buchäckerweg 27
95689 Fuchsmühl
Germany
Tel: 0049(0)9634-1517
Email: Info@projet-ecu.de
Website: www.projet-ecu.de

Picture 25

II. Magnet valves (PV70 K+G)

Projet Valves
Reiner Eckstein
Sonnenstraße 11
95643 Tirschenreuth
Germany
Tel: 0049(0)96314396
Email: info@projet-valves.de
Website: www.projet-valves.de

Picture 26

III. Gas cap - System "Richter"

The illustrated gas cap is available at Markus Richter and is very well suited for the hopper tank system.

Website: http://www.richter-lackierung.de/aktualisierung_2006/modellflug.htm

X. PART LIST

SPARE PARTS / ACCESSORIES

Illustration	Description	ArticleNr	Price in EUR
	Kerosone burner 9,6 V Set	M018	117,00
	Teflon tubing 4 mm, 5 cm long	M021	2,50
	Fuel tubing 4 mm Blue transparent Per meter	M023	1,90
	Fuel pump XP 450 (450ml)	M012	75,00
	Fuel pump XP 650 (600ml)	M011	94,00
	Hopper tank Weight: ~ 55 gr Fuel content: 300 ml	M128	45,00
	ECU Set for N-160/N-180 Includes: I/O board, cables, ECU	M025	229,00
	GSU	M026	56,50

	GPS / Airspeed modul GAS	M160	110,00
	Telemetrie Set 2.4 GHZ	M161	305,00

XI. TECHNICAL DATA

TECHNICAL DATA MEDUSA N-160 VULKAN

Thrust at 120.000 RPM in Newton (N)[1] ..... ~160

Idle speed in revolutions per minute (RPM) 33.000

Full speed in revolutions per minute (RPM) 120.000

Fuel consumption in ml ..... ~110 - 580

Temperature at full power in °C [2] ..... ~695

Length with starter in mm 330

Diameter in mm 112

Weight of the engine with starter in gram .....~1780

Systemweight in gram. 2450

Fuel (**use only!)** ..... Kerosone, Jet-A1, Petroleum

Oil (**use only!**) .....BP Turbo Oil 2380

[1] at ISO Atmosphäre: 15 °C, 1.013,25 hPA
[2] the thrust of the series may vary due to spread for std. factory models and depending on the weather ± 5 %.

TEST RUN CERTIFICATE

Thrust at 120.000 RPM in Newton (N) _____

Idle speed in RPM: _____

Idle temperature in °C: _____

Maximum allowed full speed in RPM: _____

Used fuel in test run: ☐ JET A 1 / Kerosene

Temperature at full power in °C: _____

Outside temperature in °C: _____

Atmospheric pressure in hPa: _____

Atmospheric humidity in %: _____

Serial number: _____

Place, Date: Lemgo, _____

THRUST CALCULATION

The thrust of a gas turbine model is influenced by various factors:

- Outdoor temperature
- Atmospheric pressure
- Elevation
- Number of revolutions (RPM) of the turbine rotor

The following calculation can be used to calculated the thrust of the gas turbine at ISO atmosphere.

Given:

- The level at which we measure the performance: 360 meters
- The thrust that we measured in 360 meters height: 145 Newton (~ 14,50 Kg)
- The air pressure: 990 hPa
- The outdoor temperature: 29 ° C

1. Calculation (absolute pressure):

990 hPa -(**360 meters**/8) = 990 hPA-45 = **945hPa**

(945hPa = **94500 Pa**)

2. Calculation (absolute temperature in Kelvin):

29 °C + 273 = **302 K (Kelvin)**

3. Calculation:

$$\frac{\textbf{94500 Pa}}{\textbf{302 K} \times 287} = \textbf{1,0903}$$

4. Calculation:

145N x 1,226 / **1,0903** = **163,04 Newton thrust at ISO-Atmospheric**

In fact the engine produces nearly 165 Newtons (16.5 KG) thrust at 15 ° C outdoor temperature and 1013.25 hPa barometric pressure.

The formula is available for download (Excel Table) here: **http://www.plastikturbine.de/MedusaPowerFlash/MedusaPowerintern/iso.xls**. You need a password, which is noted on your invoice to this product.

XII. MAINTENANCE

INSTRUCTIONS FOR MAINTENANCE

If the electric starter slips through or does not function properly, clean the compressor nut with a alcohol soaked cloth.

Occasional turning of the rotor is used to detect abnormal noise, which may suggest damage to a ball bearing. This also includes whistle noises. A quiet click of the rotor turning is normal, since the ceramic balls come together. Due to hot starts the ball bearing can reduce maintenance intervals!

The maintenance of the turbine is exclusively carried out by ourselves. Never attempt to repair or change your turbine yourself. This could be the loss or even damage to persons and property happen. For example, self-repairs or Use other than specified in this manual fuels / oils, immediately deleted the warranty claim. We therefore offer the following services for you:

Turbine Check after each season (Flight-Check):

With the flight check we offer to ensure smooth operation of the turbine. Often there is a little damage from rough landing, or by debris such as grass or dust. To avoid a failure in the next season it is better, when the turbine will be submitted to us.

Turbine Check after 20 hours:

The turbine must be sent to the service after 20 hours to be able to guarantee smooth functions. The period of 20 hours should not be exceeded!

XIII. ATTACHMENTS

DEFAULT (Factory) – PRESETTINGS *ATTACHMENT 1*

PROJET Hornet ECU - Version Medusa 2.0C III

1 SETUP Menü	**Einstellparameter für MEDUSA N-160K Vulkan**
1.1 MAX-RPM	120000 U/min
1.2 MIN-RPM	33000 U/min
1.3 ACC/DEC TIMING	**FAST** - MEDIUM - SLOW
1.4 PUMP START VOLTAGE	0,30-0,35 VOLT
1.5 PUMP IDLE VOLTAGE	0,60 VOLT
1.6 PUMP OUTPUT MAX	6,50 VOLT
1.7 PROPANE MODULATION	55 %
1.8 KEROSONE MODULATION	72 %
1.9 THROTTLE EXPO	0 %
1.10 GLOW PLUG CHECKING	ON
1.11 COLDOWN TEMPERATURE	79 °C

2 ADJUST	
2.1 LEARN R/C TIMING	LEARN YOUR RC REMOTE TO THE ECU
2.2 ADJUST GLOW	9,5 VOLT
2.3 ADJUST TEMP	LEARN THE ACTUAL AMBIENT TEMPERATURE TO THE ECU
2.4 FUEL CONSUMTION	1.0 VOLT = 140 2,0 VOLT = 305

3 SYSTEM	
3.1 BATTERY VOLTAGES	**8 CELLS NICAD BATTERY** (MIN: 7,00 Volt MAX: 9,00 Volt) 3 S LIPO BATTERY (MIN: 9,20Volt MAX: 11,10 Volt)
3.2 LANGUAGE – SPRACHE	ENGLISH
3.3 OPERATING TIMES	0,15
3.4 FAILSAFE FUNCTIONS	DISABLED
3.5 RC-SWITCH FUNCTIONS	**WITHOUT FUNCTION** - ON/OFF SWITCH - SMOKER VALVE
3.6 WIRELESS TELEMETRIE	SEE OPTIONAL MANUAL FOR WIRELESS TELEMETRIE
3.9 RESET -DEFAULTS-	DO NOT USE – NEVER!!!

4 GPS + AIRSPEED LIMITS

SEE OPTIONAL MANUAL FOR GPS + AIRSPEED

5 TEST FUCTIONS

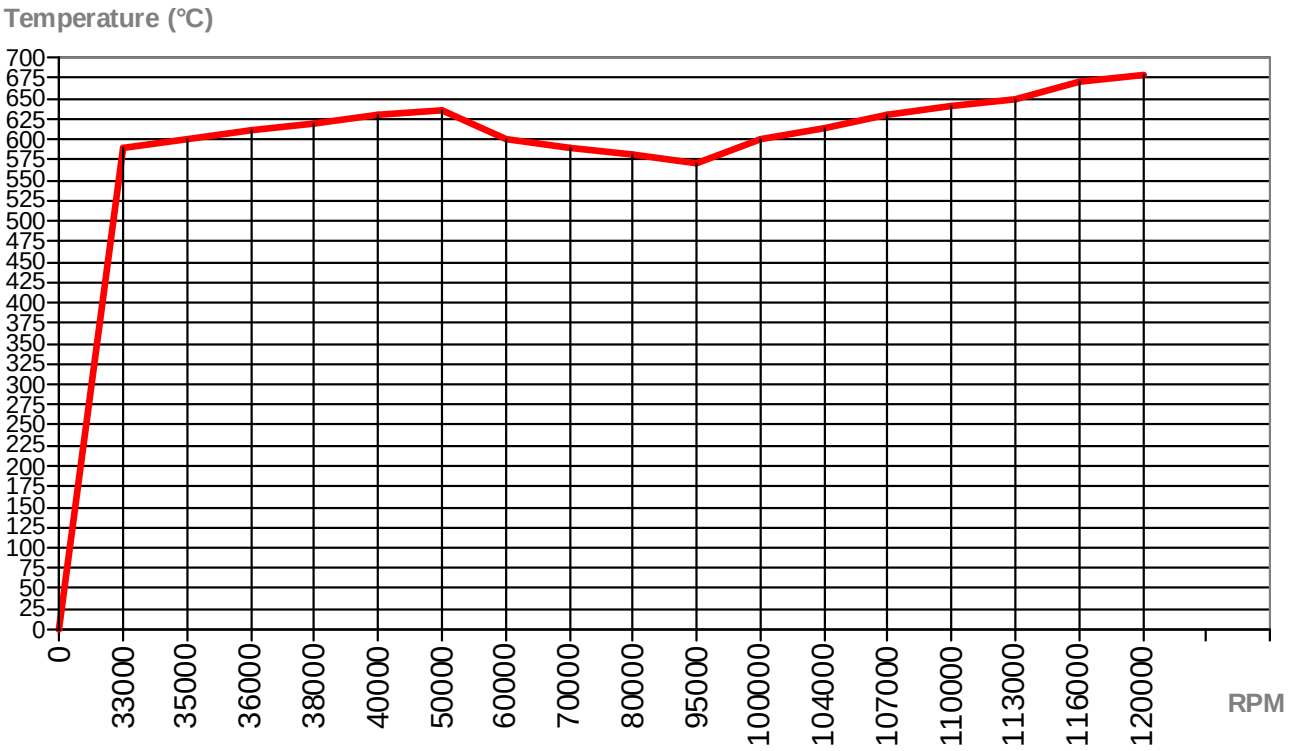
NO SETTING VALUES

9 EXPERT MASTER MODE

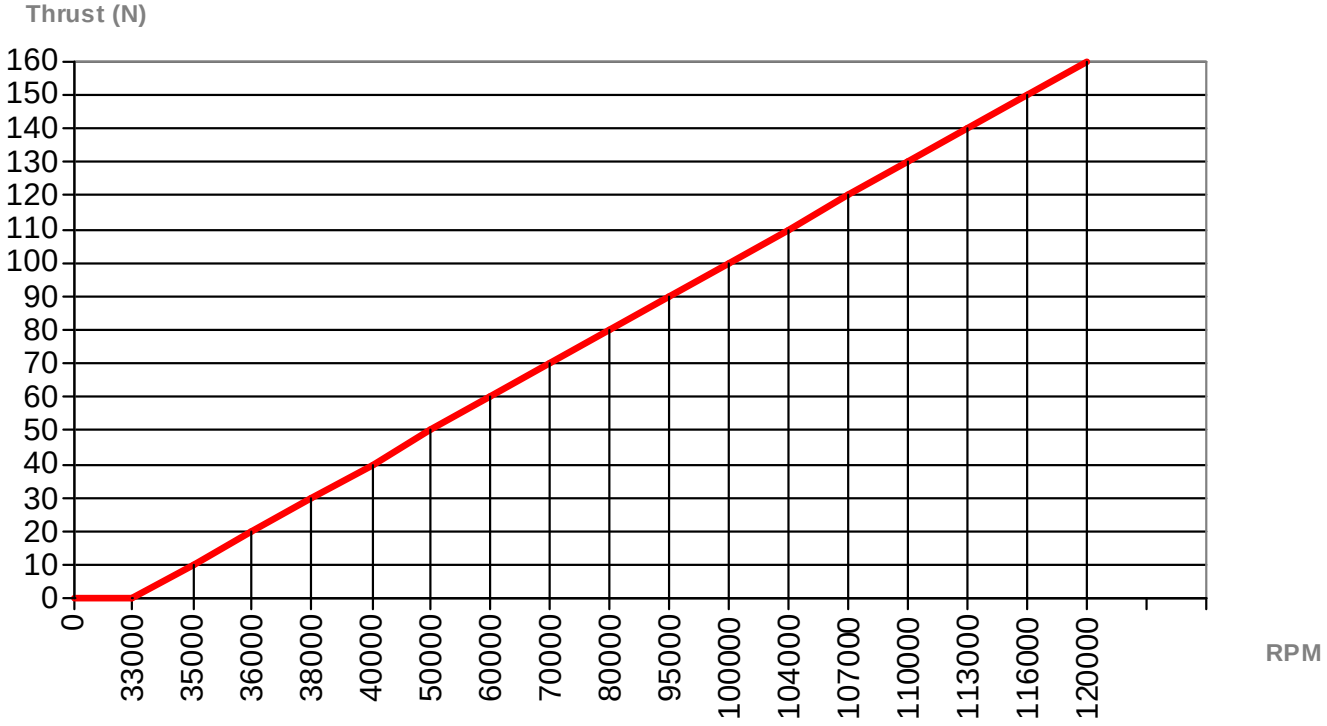
MENU LOCKED

ATTACHMENT 2

Temperature curve Medusa N-160 Vulkan



Performance curve Medusa N-160 Vulkan



Information at ISO-atmospheric pressure/temperature

Data without guarantee!
Technical modification reserved.