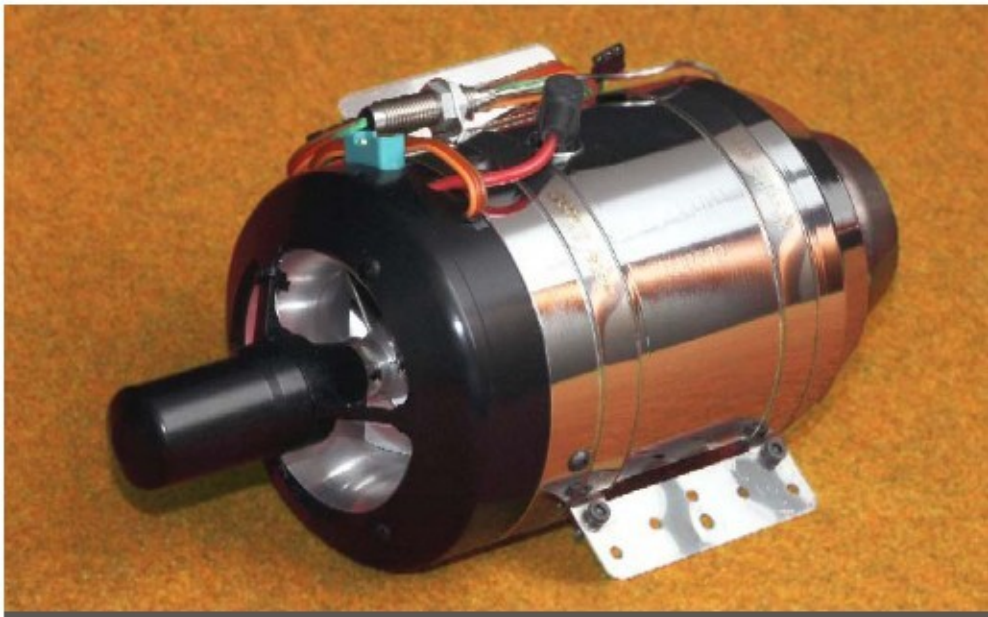

Merlin 90K

Instruction Manual

Version 1.0/2009

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Welcome!

Congratulations on the purchase of your new Jets Munt Merlin 90K gas turbine engine. Jets Munt are dedicated to the design and production of engines to the highest standards of quality and reliability to bring you the customer the very latest next generation engine designs.

The Merlin 90 is the result of an intensive effort of design and tests by the Jets-Munt staff. During the development period we made extensive use of the latest Computational Flow Dynamics programs allowing us to optimize the engine performance characteristics.

Please Read!

The Jets Munt SL responsibility is limited exclusively to the repair of the engine and accessories which are outlined in the conditions of warranty.
Before unpacking the engine please read the manual and agree to the conditions of warranty.

Customer satisfaction is important to Jets Munt SL. Technical support is available through your local dealer and trough email.

Jets Munt S.L
Torrent d'en Puig, 31
08358 Arenys de Munt
Barcelona. Spain
www.jets-munt.com
info@jets-munt.com
Fax: +34 93 7950113

Legal and Disclaimer

Disclaimer

The Merlin 90K engine is a sophisticated piece of machinery. Care should be taken at all times when using the engine. It should only be operated by those with the appropriate skills and knowledge to do so. This engine is not a toy. Incorrect operation or misuse can cause damage to property and bodily harm to operators, spectators and animals. Jets Munt SL accepts no liability for any kind of damage which may occur.
Jets Munt SL assumes no responsibility for any errors contained in this document and is not liable for any damages resulting from such errors.

It is forbidden the use of this engine outside Radio Control applications, specially those that power vehicles that carry people.

Warranty

The warranty period for the Merlin 90K is 2 years from the date of purchase, or 25 running hours, whichever comes first. Warranty is valid solely for the original owner and is non transferable upon resale.
Warranty includes parts and labour and is limited to manufacturing and material defects only.
Damage or defective operation covered under the warranty terms will be repaired and tested at no cost the original
owner (other than postage and packaging). Repairs not covered under the terms of warranty will be carried out by Jets Munt SL, or their appointed agents after agreement of costs.
Before returning the engine or ancillary equipment for service of repair, please contact first to your local dealer or Jets Munt central office to agree action and costs.

Please do not disassemble this engine. You will breach your warranty agreement and you will find it is a precision assembly which you will be unlikely to re-assemble without considerable difficulty and specialist equipment. Simply slackening the spinner nut of the rotor will immediately lose the delicate balance condition, without which the engine may not run without damage to its rotating assembly.

This warranty is void if any one or more of the following conditions applies. In such a case Jets Munt will accept no responsibility for any damage or any other consequence caused by the Merlin 90 operation.

1. The engine is dissassembled.
2. The product has been subject to any form of operation whilst containing incorrect fuel, oil, or fuel/oil mix.
3. The product is crash damaged
4. Unauthorised maintenance or modifications have been made to any part of the product
5. Parts have been damaged by ingestion of foreign objects (e.g. wires, sand, water etc).
6. The engine has been operated incorrectly.
7. The product has been misused, neglected or inadequately maintained.
8. Damage to the engine where blockages in the fuel system have occurred by unfiltered or contaminated fuel.

Jets Munt Representatives

Check the current dealer list on our web page, www.jets-munt.com

Safety Notes

Please remember the engine is not a toy and has the potential to cause bodily harm to you and others if misused. The Merlin 90K is a sophisticated piece of machinery and should be treated with a high level of safety when it is in operation.

The following guidelines should be read carefully and adhered to.

1. Always keep a CO2 or similar fire extinguisher of at least 2Kg of CO2 contents close when starting and operating the engine

2. Always protect eyes and ears during the starting procedure.

3. Be aware of the extreme intake suction hazard, we advise the use of a suitable commercial wire mesh Foreign Object Damage guard to protect the engine intake. Ensure you have no loose items of clothing (ties, etc.) or equipment which can readily be sucked into the engine intake, even from adjacent to the engine.

4. Always operate your engine in open air away from confined spaces as the engine exhaust contains gases which can cause asphyxiation and nuisance smells.

5. Do not touch the engine whilst it is running. Turbines rotate at a very high rpm and the engine casing and exhaust can reach very high temperatures. Ensure anything affected by heat is kept well clear of the engine and exhaust during operation.

6. Never use the engine near to sources of flammable gases, liquids or materials.

7. Keep unauthorized persons, spectators, children and animals well away from the starting area (at least 30 ft or 10 meters away).

8. Always handle turbine fuel and oil with care as they are highly flammable. Store them in appropriate labeled containers. Never dispose inappropriately. We recommend the use of suitable disposable protective gloves for the mixing of turbine oil/fuel.

Merlin 90 Mk2 Specifications

Dimensions:	Outer Diameter 90 mm; Length: 230 mm
Weight:	1.010 grams (engine only including starter). 1250 gr including pump, ecu and fuel valves
Nominal thrust @ 15C and sea level:	Guaranteed 90N (9,18Kg-20.2lbf), typical 95N (21,2lbf) @ 152,000 rpm
Idle RPM:	40,000
Idle thrust @ 40,000:	4N (0.8lbf)
EGT @ max rpm:	550-650 ºC
Fuel consumption:	0.33 l/min at 90N
Mass flow:	180g/sec
Pressure ratio:	3.2 to 1
Fuel/oil:	Kerosene + 4% oil (3%-5% is OK) . Synthetic 2T motorcycle oil or turbine oil

Engine Description

The engine is a turbojet of a single shaft design specifically designed to power RC aircraft.
The engine starts automatically thanks to an installed electric starter situated in the front.
The starting sequence is controlled by an electronic unit that initiates the starting sequence and controls the parameters of the engine within the design limits.

The engine uses a system of direct liquid preheating, ignited by a long life ceramic glow plug situated inside the engine. After the initial preheat the liquid fuel is gradually introduced. The fuel should contain a small percentage (4%) of oil and uses part of this fuel to lubricate its two ceramic high speed bearings.
The fuel for the engine is provided from a fuel tank through a small electrical pump. The engine speed between idle and maximum are controlled by varying the speed of the fuel pump through an electronic controller called an ECU (electronic control unit).

Installation Notes

1. The engine should be mounted using the strap mount supplied or an approved equivalent.

2. The temperature probe should be firmly fixed to the engine as supplied and not allowed to rattle against metal parts as this could result in radio interference.

3. The signal cables from the engine must be carefully routed away from the engine intake so there is no possibility of accidental ingestion of the wire.

4. Fuel and starting pipes should be routed similarly clear of the intake. **The engine must not be run with the starting pipe open to the atmosphere.**

5. The fuel pump should be mounted at least 100 mm away from the front of the engine. The pump can emit magnetic pulses that cause the speed sensor to transmit incorrect rpm information to the ECU. The fuel pump should be preferably mounted with the spindle in the vertical position with the motor uppermost. In the event of any fuel seeping from the pump this will not pass through the electric motor. **Note the pump is supplied fitted with built in suppression to reduce radio frequency noise.**

6. The center of the fuel tank should be mounted laterally, as near to the center of gravity (CofG) of the model as possible. This will minimize the C of G shift as the fuel is used during flight.

7. Any air ducting to the inlet of the engine must have a minimum area of 40cm2 equivalent to a 65 mm (2-1/2") square.
8. If an extended exhaust duct is required, it should be approved by Jets-Munt SL. We have found that an exhaust of 65 mm diameter gives optimum engine performance.

9. Extreme care should be exercised to ensure that no foreign object, loose parts of the model, or debris are allowed to enter the compartment where the engine is installed.
   We recommend testing the engine on a test stand prior airframe installation.
   You should have a clear idea of how to arrange the components needed to run the engine inside the model. The main issue is the fuel tank, you will need to arrange the C of G in the centre of the tank and adjust the receiver and ECU batteries to achieve the correct location.
   Do not be tempted to move the fuel pump into the area between the tank and the engine as this can cause interference with the rpm pickup and presents a potential hazard in event of fuel leaking from the pump.
   In the event of the temperature probe wire being too short, it is correct to extend this with a good quality servo extension lead – use a gold plated connector version. With this arrangement a error of around 10°C is sometimes seen on the temperature display but this is of no consequence in normal starting and running.

Electronic Control Unit (ECU)

The Fadec ECU supplied with the engine is custom designed for the Merlin90K engine and must not be changed for any other, as this may result in improper control of the engine. Your engine has been set up and run with this ECU at the factory and the settings should be left as default. The ECU plugs into your receiver throttle channel and is powered from the receiver rechargeable battery. The ECU is pre-programmed and only requires simply setting to your radio. All ecu connections are color coded and easily identified.

ECU Data Terminal

The data terminal plugs into the ECU via the lead supplied. The display should be used only for starting and test running. This socket also doubles as the Computer connection socket.

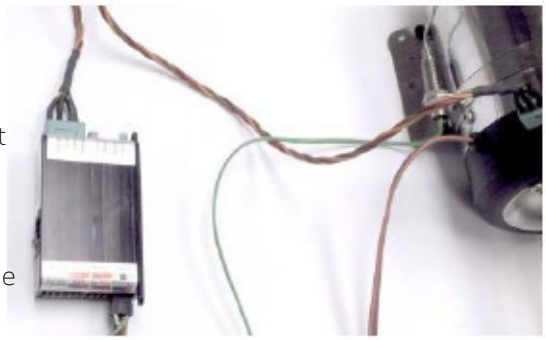
Do not fly the plane with the display connected as there is a potential for interference. The function of the buttons is described later in the "ECU setup".

Engine installation: Electrical connections

Temperature Probe (thermocouple)

The engine mounting provides an attachment for the temperature probe using the two nuts provided. The temperature probe has been carefully shaped and installed at the factory to align with the small hole in the exhaust cone.

When connecting the temperature probe plug, be sure to get the plug in the correct orientation- one wire has a white sleeve and this should be positioned as indicated on the ECU.



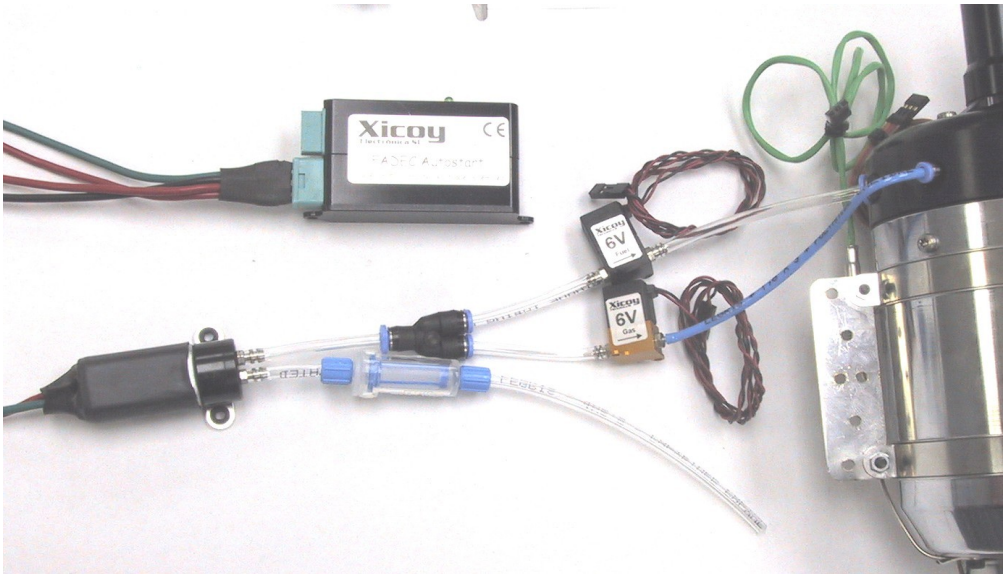
RPM Sensor

The RPM sensor used by the ECU to read the engine RPM is mounted in the front of the engine, this is underneath the black cover.
Because it receives the magnetic impulses of the rotor, it is important to assure that other electrical devices that can generate magnetic fields (e.g. servo, battery cables, pump etc), mount at least 100 mm away from the engine.
Both the RPM pickup and thermocouple may need extending to reach the ECU. A standard good-quality servo extension can be used there- those for JR radios have the same colour code and this helps avoid any errors when plugging in.

Power cord

The power for the starter and Glow plug is supplied through a 3 wire twisted lead with MPX connectors. Supplied length is of 50 cm, if it is necessary to extend it, use 1mm² copper section lead.

Engine installation: Fuel system



Install the fuel system components
as seen in the picture.

Start/Gas valve

The starting fuel valve is of gold color and must be connected to the "Gas valve" ecu socket in any orientation, polarity will always be correct. Respect the direction of flow as marked in the valve body.

Fuel valve

The main fuel valve is of black color and must be connected to the "fuel valve" ecu socket in any orientation, polarity will always be correct. Respect the direction of flow as marked in the valve body.

Fuel filter

The fuel filter must be installed close to the input port on the pump to prevent any particle to enter in the pump and to damage it. Use a suitable length of the4 mm clear tubing supplied and keep the tubing on the suction side as short as possible. Direction of flow inside the filter is not important, but should be always the same after first use. Do not run the engine without the fuel filter.

Finally connect the fuel pump, the valves and the battery to the ecu as shown. It is strongly recommended that, after a new installation or modification on the fuel system, to disconnect the fuel hose from the engine, routing it to a appropriate container, and run the pump few seconds using the "pump test function" on the ecu so that some fuel clean all the possible dirt particles that could have entered in the system.

ECU (Engine Control Unit) Set Up

The ECU supplied is a special software version of the FADEC Autostart made by Xicoy Electronica SL. It is a reliable unit and is supplied programmed for the Merlin 90. The engine has already been set up and tested using the ECU and pump supplied so there is very little to adjust in order to get the engine running. Confirm you have connected the ECU input to the throttle channel of your receiver, the ecu battery is fully charged and connected and the Data Terminal is plugged into the ECU. Remove all rates, mixes and throttle travel settings in the transmitter. The setup assumes the use of a transmitter with manual trims.

If you use a TX with digital trims, is essential to use the switch in the TX programmed for the function "Throttle cut", or "engine cut" which normally has the effect of producing the "trim-down" function. Check your radio manual for this before you start. DO NOT use the digital trim in any case.

Aligning transmitter with ecu

As the display does not photograph well we have reproduced the display readings as a green box. Turn on the transmitter and receiver. The opening screen should show as below: (If the temp'' probe is not connected it will show as 0ºC). "T" = ambient temp'.

```
Trim Low          T=020°C
RPM 00000         PW 000
```

Note there are four buttons on the display, two on the left and two on the right hand side. The left buttons move to the different screens and the right buttons are used to change the values stored. Press the second, left button and scroll through the menus until you find the one showing:

```
     Info              Run
Start       Radio
```

Press the (-) button and the ecu will show the "Radio" parameters menus.

```
Transmitter           yes
adjust
```

Press the (right hand button (+) to confirm that you really want to program the radio.
The screen will change to:

```
Stick Up Trim Up
     (Full power)
```

On your transmitter, raise the throttle stick and trim to full.
Ensure stick is firmly against the stop.
Now holding the stick against the stop, press the right button (+) to store the signal from your TX into the ECU.
The screen will now change to:

```
Stick Down
Trim Down      (Stop)
```

Move the trim (or switch the “engine cut” switch to on) and throttle
stick back to zero and again press the right hand button (+).
The display will now change to:

```
Stick Down
Trim Up          (Idle)
```

Leaving the throttle stick in the minimum position, raise the throttle trim to the full up position or switch “Engine Cut” switch to off, and again press the “+” button to store the value into the ecu.

If you have done all steps correctly the green LED located directly
above the data terminal socket in the ecu will light up in the ECU when the “Idle” command is received, meaning that trim and throttle stick are set to idle position on the transmitter.

Lower your throttle trim and the green LED will go out indicating correct reading of the transmitter engine shut off signal by the Fadec ecu.

When using a Futaba transmitter, the throttle channel sense of movement may require reversing (Servo reverse) and if so reverse and repeat the transmitter alignment. Correct reading of throttle % by the ecu can be verified in the second screen of the HDT, percentage of the throttle position is shown on, 0% in the position of engine stop (trim and stick down), 100% with stick/trim full up and between 10% and 30% at idle.

```
Pulse=1000uS 0%
Battery: 7,2V
```

This now completes your radio setup and should only need doing again if the radio settings are changed significantly.
There are many more parameters that can be modified in the ECU, but we have specifically programmed your Merlin 90 ecu with the optimum settings, further adjustment should not be required and can only be carried out by Jets Munt SL or your authorized dealer.

Preparing the engine for running

Always test the engine in a test bench before installing it into the plane, this will confirm that all system work as they should, and you will be able to learn its operation and the emergency procedures. A suitable platform/table/workbench is now required to clamp the test stand onto. Make sure this can be easily transported outside and weight 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 secured.

Important notes for kerostart engines. PLEASE READ

The kerostart system used on this is a reliable and well tested that produce very smooth and trouble free starts.

However, extra care and attention must be paid when starting a kerostart engine.

The main difference between gas and kerosene is that in the case of a failed ignition, the gas dissipates quickly on the air and don't keep inside the engine. Kerosene is liquid and, if unburned, will pool inside the engine and stay there forever. The engine can hold a big 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 engine, but can destroy the model.

To prevent this:

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

-Double check that solenoid valves are installed in the correct sense. A 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 that 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 trough intake. Do not tilt upwards, due at the internal engine construction, the fuel cannot exit trough 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 happen during a aborted start, the start-up sequence is aborted by the user or automatically before the engine arrive to idle. This can cause that the kerosene inside the engine 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. A white smoke from the engine is a good indication here, mean that there is no fire inside.

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. 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 metre radius 180° arc from engine centre 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.

Priming the fuel system

Both main fuel and starting fuel lines need purging of all air after initial installation. Take extra care when priming the lines, ensure that NO fuel is pumped inside the engine. To do so, disconnect the fuel lines from the engine wile priming.

Priming is achieved by a special menu on the ecu. 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.

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 at next startup.

Starting the engine

Set the throttle stick down and the trim up. "Idle" - Confirm that the green 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 glow plug will be energized. 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. 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 receive fuel only trough its normal fuel input, and internal glow plug iwill 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.**

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 stabilise for around 5 seconds before carrying out the shutdown procedure.

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.

List of ECU message codes:

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

TrimLow: 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, (green LED lit).
StickLo!: 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 glow plug and heating up.
StartOn: 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.
FuelRamp: Phase of acceleration until idle speed
Running: Engine working correctly, pilot have full control of engine power.
Stop: Engine off.
Cooling: Starter operating to cool the engine.
GlowBad: Defective or disconnected glow plug.
StartBad: Defective starter, insufficient RPM reached during start.
Low RPM: Engine speed below the minimum.
HighTemp: Excessive temperature.
FlameOut: Exhaust GAS Temperature below the minimum.

Diagnoses

During engine operation the Ecu measures and stores all the engine operating parameters recorded during the last the 51 minutes of operation. These measures can be downloaded later to a PC to study the behaviour of the engine in flight and to diagnose any possible problems.

Also, after each cycle of operation, the Ecu stores the last cause of shut down and the values of RPM, temperature and pump power. In order to access these measures, it is necessary to shut down and power-up the Ecu. Set the trim down (trim Low) and push the left button on the display. The Ecu will show the cause of shutdown and the parameter values at the moment of shut down. These are as follows:

Diagnosis messages

UserOff:	The engine has been shut down because it has received the shut down command from the transmitter.
FailSafe:	The engine has been shut down because of loss of the control signal from the transmitter. After 0,5sof detecting a loss or invalid RC signal, the ecu sets engine power to idle, and if after another 1,5 seconds a valid signal is still not received the engine is shut down.
LowRPM:	The engine has been shut down because the RPM has dropped below a minimum. Cause could be lack of fuel, air bubbles, problem with the batteries, or defective RPM sensor.
FlameOut:	The engine has been shutdown because the temperature has dropped below the minimum of (100ºC).(Usually a thermocouple failure).
RCPwFail:	Lack of power from the radio receiver.

Other useful information and installation tips

Fuel System

Always use appropriate containers to store fuel.
It is advisable to install an antibubble system to the fuel supply circuit.
The simplest one is a felt filter clunk installed into the fuel tank. This helps maintain consistent fuel flow and greatly reduces the possibility of air getting into the suction side of the pump circuit, which could cause stoppages.

To prevent the felt element sliding out of position a washer is fitted between it and the feed tube – as seen.

A BVM UAT is another contemporary method of reducing the possibility of air bubbles in the engine fuel line. This is a very important aspect of the operation of any turbine engine.

Use a appropriate adapter for the 6 mm tube output of the UAT to the 4 mm in the inlet side of the fuel pump, direction of fuel flow is clearly shown at the top of the pump. The clear 4 mm tubing is used on the pressure side of the pump. Clear tubing helps identify and locate any potential future problems with air leaks.

The fuel pump and ECU can be mounted simply with a pair of tie wraps and/or Velcro. The best orientation for the fuel pump is vertical. It is important to ensure any fuel seepage does not reach the motor brushes. The fuel feed from the pump to the engine should have sufficient length of the clear tubing fitted to allow the fitment of the electronic fuel shutoff valve and the valve should always go on the pressure side.

When making any fuel line cuts use a sharp blade to make and cut squarely. The fuel filter provided should be installed in an accessible place for regular inspection, in line between the tank and the pump.

Fuel and Oil

1. Use **CLEAN** well filtered Jet A1 or kerosene fuel which is available from most airports, or paraffin (K1) used for greenhouses available from most hardware stores.

2. Ensure the fuel is clean and filtered at each stage of mixing and transfer to the model fuel tank.
   Please note the importance of using clean fuel. Failure to do so will result in blockages of the fine fuel injectors in the engine or blockage of the engine lubrication system and subsequent bearing damage.

3. Ensure the fuel is free from moisture (water is heavier than fuel and will settle at the bottom of the container).
4. Use good quality aircraft turbine oils e.g. Aeroshell 500, Exxon 2380, Mobil JetOil II, Mobil DTE Light turbine oil or 2T synthetic oil with a specification JASO FC or better.

5. The fuel must be mixed with turbo oil in the ratio of 4% oil to 96% fuel (ratio 1:24). Too little oil will shorten the bearings life. You can use higher content of oil (5-6%) without any problem for the engine to share the same fuel with other engines.
   Please remember to always handle fuel and oils with care! Avoid all direct contact with skin - in case of contact wash all affected areas with soap and warm water immediately.

Feed Pipes

All the pipes must be Polyurethane or nylon as provided by Jets Munt or Tygon (like the ones used by gasoline engines). Do not use Tygon on the pressure side of the fuel pump.

Silicone tubing must not be used anywhere in the installation as it is dissolved by fuel and oil. If in doubt, take a small piece of tube and submerge it in kerosene for a few days and verify that it's characteristics have not changed.

Maintenance

1. Always keep the engine and its accessories clean and dry.
2. Regularly check wires for chafing or insulation breakdown, etc.
3. Regularly check fuel and gas pipelines for chafing and /or leaks at joints.
4. Check the temperature probe is correctly positioned.
5. Check the engine and mounting for loose fittings and secure if required.
6. Ensure the fuel system is kept free from dust and dirt inclusion and that fuel is carefully filtered.

Battery charging and care:

The engine come with a LiPo (2 cell) batteries. You can use any type and capacity of battery, but only of 7,2 - 7,4V nominal voltage, minimum recommended capacity is 2000mAh 20C type. Never use a 3s (11,1V) battery. Special care should be taken with LiPo technology and they should be charged with a LiPo charger, using a regular NiCad charger could cause the battery exploding or taking fire. Always follow the charger manufacturer recommendations.
The ecu will not start the engine if the batteries show low voltage, but once the engine is running, the ecu will keep it running until the batteries are completely empty, so this can cause the battery to discharge below it's safe voltage.

Always disconnect the batteries from the ecu after a flying session. Always there is a small amount of current drawn from the ecu that can cause that a fully charged battery of 2000mAh be empty after 2 month.

Running Time Counter

Using the second left hand button, scroll through the menu's to the INFO menu.
This screen contains a timer which shows:

The total running time of the engine in minutes (Tot).
The time in seconds of the last engine run (Last).
The total number of starts (cycles - CY) .
Use this screen to keep track of your total running time and starts.

Extra ECU functions

The ecu provide several menus that allow to do some tests and personalize some settings, like:

- Adjust the thrust/throttle curve (Linear, Expo,Intermediate). Usual seting is EXPO that provides linear RPM
- Check the capacity of battery used.
- Test the starter, Glow Plug, valves and Pump.
- Check the failsafe counter (time and pulses of wrong RC signal).
- Check and set the maximum airspeed (if pitot tube and sensor installed).
- Adjust maximum engine power.

Please refer to the FADEC manual (http://www.espiell.com/FAD06.pdf) for further information.

Merlin 90 Trouble Shooting

PROBLEMS	SOLUTIONS
There is no reading on the screen	1. Disconnected receiver or the ecu/receiver batteries are empty 2. The display is badly connected 3. Problem in the ecu or display
The kerosene does not ignite	1. The Battery is weak. 2. The start solenoid valve is not connected properly or fuel line not primed. 3. Too long and thin leads from the battery to the fadec or from the fadec to the engine
There is little increase of RPM when the fuel ignites	1. The manual fuel valve is partially open 2. There is air in the line of fuel 3. The filters are blocked
The engine reduces the power of it is stopped during starting	1. The ecu has detected temperatures over 800ºC due to too slow starting 2. There is low battery or air in the tubes- Therefore let it cool and retry
Engine does not accelerate to maximum set rpm	1. There is insufficient fuel or air bubble entering the engine during the initial start up. 2. Low battery capacity
The engine loses power in flight	1. The ECU battery is empty: recharge 2. The filters are dirty
The engine stops in flight	1. The fuel level is low and/or there is air in the pipes 2. There is a poor connection between the battery and pump 3. Interference 4. Check the "last power down" cause on the ecu
There is excessive vibration and unusual noise	1. The engine is unbalanced by the ingestion of a foreign object. Do not use the engine and send it in for service.

Merlin 90 Log

Owner ..... Serial Number ..... Purchase Date .....

Start

No. Date Model Place Engine

Time

Flight

Time

Remarks

Jets Munt SL

Torrent d'en Puig, 31

08358 Arenys de Munt

Barcelona (Spain)

Tel/Fax: +34 93 7950113

www.jets-munt.com

info@jets-munt.com