ECU-V12

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Inhalt

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Introduction

The ECU V12.0 is the latest development of the ECU V10.0.
So the basic installation and the connection diagrams to the turbine etc. have not changed and can be adopted from the operating instructions for the turbines with V10 ECU.

EXCLUSION OF LIABILITY AND DAMAGES

Compliance with the installation and operating instructions in connection with the model and the model jet turbine as well as the installation, operation, use and maintenance of the components associated with the model cannot be monitored by CAT. Therefore, CAT or its employees shall not be liable for any loss, damage or expense arising out of or in any way connected with the improper operation, misconduct or use of the model. Except to the extent required by law, CAT's liability to pay damages for any cause whatsoever (including personal injury, death, damage to property, loss of revenue or business, business interruption or other indirect or direct consequential loss) arising out of the use of the model shall be excluded. Liability is governed in all circumstances and in all cases by the statutory provisions of the contract for work.

THE INSTALLATION AND OPERATION OF THE MODEL AND/OR AN ENGINE IS CARRIED OUT AT THE RISK OF THE OPERATOR ONLY.

You acknowledge that CAT cannot supervise or control the observance of the instructions regarding the assembly, operation, use of the model aircraft, model jet engine and use of the remote control. There have been no promises, contractual arrangements, warranties or other agreements made by CAT to any person or company regarding the functionality and operation of the model aircraft and the model jet engines. You, the operator, have relied on your own expertise and judgment in acquiring the model or model jet engine.

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Features of the JetCat ECU V12

- Powerful 132-bit microcontroller of the latest generation, with large programming and data memory.
- The ECU can be switched on without receiver power supply to read out data or configure settings.
- The receiver can be switched off immediately after the turbine is switched off. The ECU monitors the cooling process and will only shut down automatically after it has been completed.
- The cooling sequence runs the starter motor permanently at one speed during the cooling process.
- The adjustment of the pump voltage is no longer necessary.
- The fuel pump is automatically detected and displayed.
- Integrated Fail Safe Counter with evaluation and display of the number and duration of errors. This can be used to assess the quality of the radio connection after landing.
- Thanks to the integrated flash program memory, software updates can be easily carried out online.
- Programmable fail safe behavior. The hold and fail safe times and the failsafe RPM can be programmed.
- Computer connection via RS232 interface.
- Engine control optionally via single or two transmitter channels.
- Direct start and control of the engine from the GSU, even without the remote control transmitter.
- Functions for easy starting of several engines connected in parallel on the receiver side (e.g. for multi-engine models).
- Activable warning functions via the smoker valve, generates warning signals in case of low battery voltage, empty tank or fail safe.
- Integrated data logger function. The data of the last 17 minutes of operation are stored with a resolution of one second and can be read out using the PC software. The data remain stored even after a power supply failure. In addition, the last 8 operating seconds before the turbine is switched off are stored with a resolution of 0.2 seconds. This allows precise fault diagnosis.
- Airspeed sensor input for measuring/controlling/limiting the model's airspeed.
- Advanced test and diagnostic functions for pump, valves and sensors.
- Substantially expanded Info- and Min/Max Menu.
- Tolerant error detection of the connected sensors. In case of a defective sensor, the turbine is no longer rigorously switched off, but an emergency mode is activated, which enables the safe completion of the flight. After landing, a restart is only possible after the error has been resolved.
- Integrated telemetry for e.g. Jeti, Futaba, Graupner, Multiplex and Core

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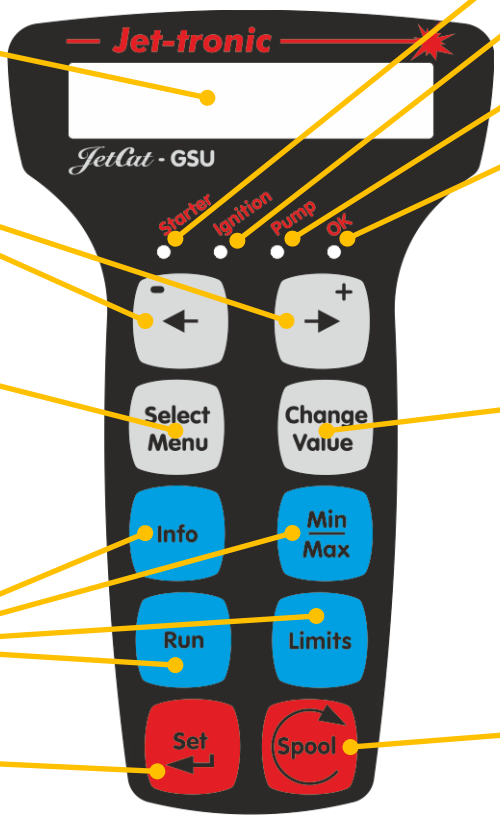
Ground Support Unit (GSU)

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

GSU Control Panel Description



Alphanumeric, 2 line by 16 characters, backlit LCD display

-◄or ►+
Scroll within a menu or through different menus. Also used for changing parameter values

Select Menu key for selecting different menus in conjunction with the **-◄or ►+** keys

(4) Hotkeys
Directly enters the menu named on the corresponding blue key

SET – Enter parameters for several functions or together with "Set" key to direct start/stop engine from GSU

Starter - LED, (yellow)

Ignition - LED, (red)

Pump running - LED, (red)

OK - LED, (green)

Change value key for altering engine parameters in conjunction with the **-◄or ►+** keys

Spool – Runs starter motor for testing or together with "Set" key to direct start/stop engine from GSU

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GSU Button Descriptions

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

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

Description of LEDs on the GSU

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

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

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Engine control

Control Options

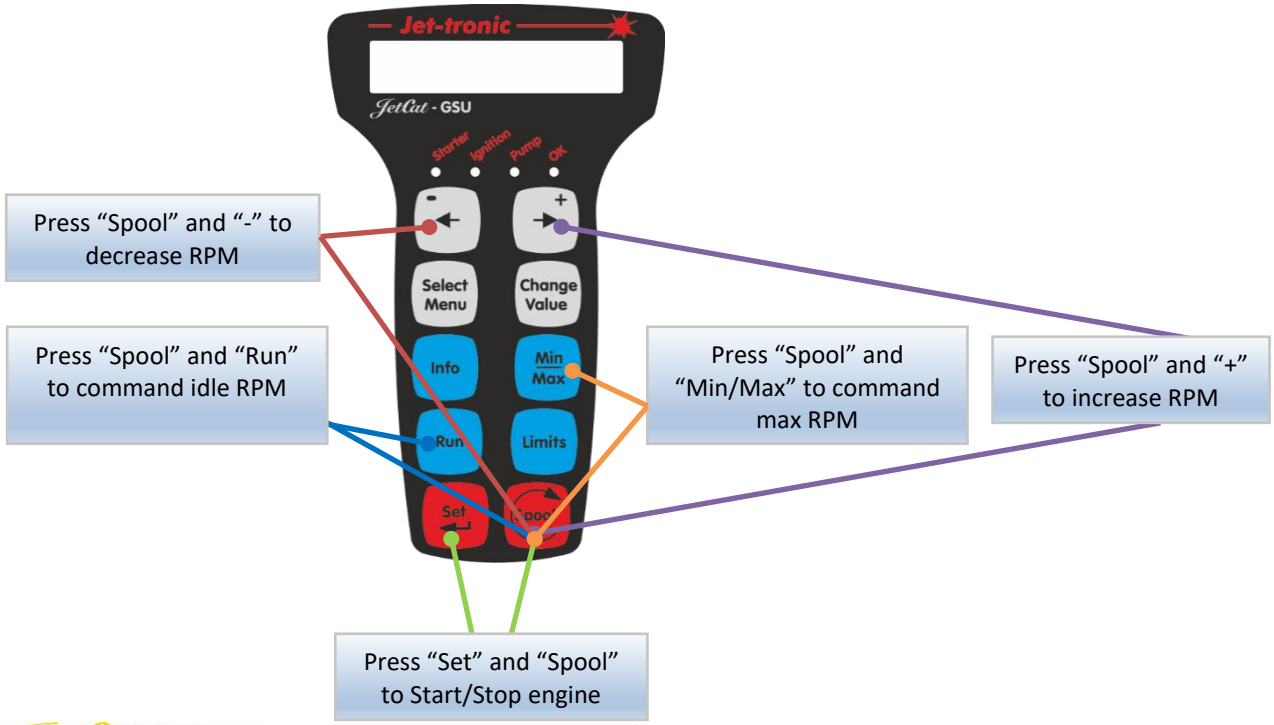
Engine control (on/off/throttle commanding) can be done in various ways:

- Control via GSU (manual)
- Control via Servo-PWM signal(s)
- Control via analog Signal (0-2,5V) fed into Airspeed input
- Control via serial communication protocol (COM1)
- Control via CAN-Bus (PRO Engines only)
- Control via Switches/Potentiometer connected to PRO-Interface (Pro Engines only)

Control via GSU

With the GSU connected, the engine can be controlled with the following keys:

Action	Buttons to be pressed	Comment
Engine Start/Stop	Press and hold Set and additionally press Spool	If engine is Off, engine will be started If engine is running, engine will be shut off
Increase Rpm	Press and hold Spool and additionally press +	Only if engine is running and green “OK” LED is on
Decrease Rpm	Press and hold Spool and additionally press -	Only if engine is running and green “OK” LED is on
Go to idle Rpm	Press and hold Spool and additionally press Run	Only if engine is running and green “OK” LED is on
Go to full Rpm	Press and hold Spool and additionally press Min Max	Only if engine is running and green “OK” LED is on



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Control via Servo-PWM Signals

Single or two channel Operation?

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

How to set your ECU for single channel operation

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

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

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

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

Setup failsafe mode

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

YOU ARE REQUIRED TO USE THE FAILSAFE!

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

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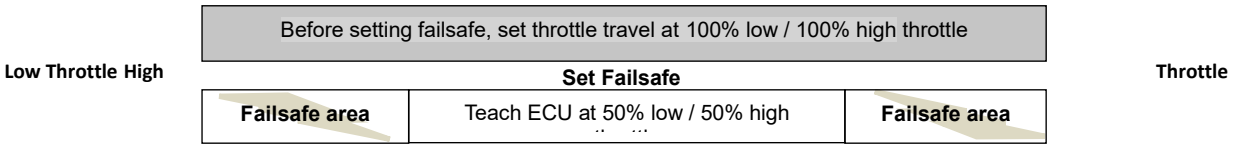
☞	The following failsafe instructions are for PCM or Spread Spectrum receivers only. (PPM Receivers are not allowed under AMA rules.)

Setting the failsafe

The following procedures are for most radios like JR, Futaba, or Airtronics/Sanwa.
If you look at the following servo travel graph below, you can see how the ECU detects a failsafe condition. The gray bar is the transmitters throttle channel end points set for +/- 100% travel. This is the travel range when setting the transmitter's failsafe. The white bar is a reduced end point travel set for +/- 50% travel. This is the value that will be taught into the ECU. If the throttle input to the ECU is between 50% for low throttle, low throttle trim and 50% for high throttle, then this would be within the ECU's taught range and will operate normally. If a failsafe condition exists, the transmitter's pre-programmed 100% low throttle, low throttle trim will be outputted by the receiver and this value would be outside of the ECU's taught in range. The ECU will now automatically set the engine to idle (after a default 0.1 second **Failsafe delay**) and start a programmable timer. The timer is set to 2 seconds by default. If the timer times out, the ECU will shut-off the engine. If at any time during this countdown the receivers signal is reacquired, the ECU timer will be reset and the engine will go back to the speed the throttle stick is currently at.
Setting the travel range to +/- 50% does not affect the RPM range of the engine.



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

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

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

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

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

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

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Teach the ECU to the R/C System

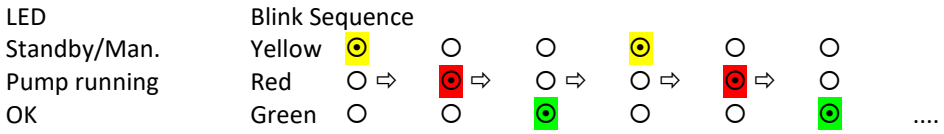
Aircraft

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

To accomplish this, complete the following steps:

1. Connect one or both ECU servo cables to the receiver depending on either using single or two channel operation. The "**THR**" cable connects to the throttle channel and if used, the "**AUX**" cable must be connected to a channel capable of three (3) positions or a variable control. Make certain that all other connections are made in accordance with the **Electrical Connection Diagram**.
   Note: Even if you do not use the auxiliary channel for control, you can still plug the **"AUX"** cable into an unused receiver channel for a redundant power signal connection. However, if this is done, you must manually disable the auxiliary channel in the limits menu.
2. While pressing the Select Menu key on the GSU, switch on the receiver/engine.
   Note: Instead of the **Select Menu** key on the GSU, the small button switch on the LED I/O board may be pressed instead. This key can also be used to advance through the **learn R/C** sequence (described below). This feature is useful when the GSU is not available. Keep in mind that the LED's on the I/O board are the same as the GSU for **Standby**, **Pump running** and **OK**.

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

   The GSU screen will display:

   Release button to memorize/teach the positions of the throttle and AUX channels…

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

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The GSU screen will display:
➔ Move throttle stick to idle position and throttle trim to minimum/off position!

Next, press Select Menu or the LED I/O board button switch. This will store the R/C system's pulse width for immediate shutdown of the engine. The green **OK** LED will turn off and the red **Pump running** LED will illuminate for the next step.

4. Next step: Teach in of the throttle stick idle position

The GSU screen will display:
→ Move the throttle trim up to the idle position (keep throttle stick at idle)

Next, press Select Menu or the LED I/O board button switch. This will store the R/C system's pulse width for engine idle. The yellow **Starter** LED will turn will illuminate for the next step.

5. Next step: Teach in of the throttle stick max position

The GSU screen will display:
➔ Advance the throttle trim lever to maximum (keep throttle trim at idle).
(Throttle channel "**Full Power**" position)

Press Select Menu or the LED I/O board button switch again to store the R/C system's pulse width for the engine full throttle position.

Depending if the parameter "AUX-channel func" (Limits menu) is not set to "disabled", the teach-in procedure for the AUX channel would follow in the next step. In case the "AUX-cannel function" should be set to "Disabled", the teach in process will end here / continued with step 12, as with this setting the ECU is setup for single channel operation.
In case there would be no PWM signal detected on the AUX input, the parameter "AUX-channel func" would be automatically set to disabled and process would terminate/skipped to step 11.

6. Next step: Teach in of the AUX-channel position „0/OFF":

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

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7. Move the auxiliary channel to the minimum position for **Off** and press Select Menu or the LED I/O board button switch again to store the R/C system's AUX pulse width for AUX position "0/Off". The green **OK** LED will turn off and the red **Pump running** LED will illuminate.

8. Next step: Teach in of the AUX-channel position „1/Center":

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

   Next, press Select Menu or the LED I/O board button switch. This will store the R/C system's AUX pulse width for AUX switch position 1/Center. The red **Pump running** LED will turn off and the yellow **Standby** LED will illuminate.

9. Next step: Teach in of the AUX-channel position „2/Maximum":

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

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

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

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

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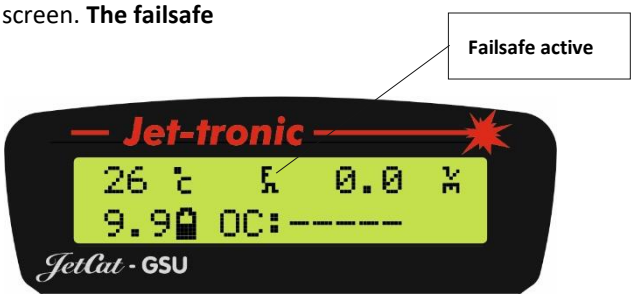
Verify failsafe programing

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

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

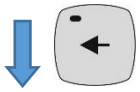


Optional skipping of teach position

For applications which, for technical reasons, only provide 2 positions for teaching in the throttle or AUX channel, the following procedure can be applied:

After the instruction to teach the first value (Set Thr &Trim to min/OFF) press the key, the message " Teach-Point is skipped by user!" appears briefly and the teach-in process starts with the IDLE position.

For the AUX channel, the minimum or maximum teach point can be skipped. If the corresponding instruction appears in the display, the key can be pressed and the message "Teach-Point is skipped by user" appears here as well.



The flow chart below illustrates the different possibilities for teaching.

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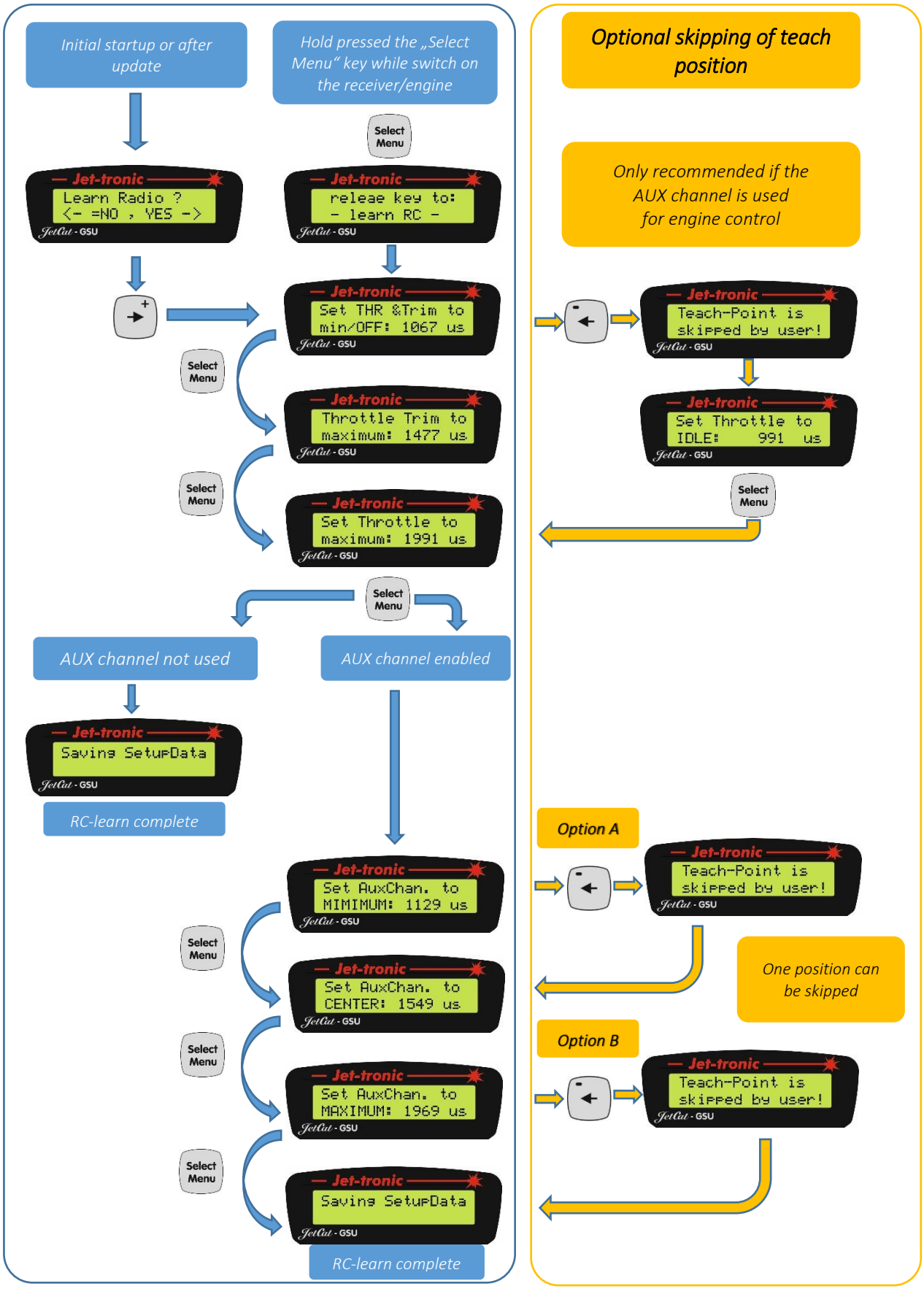

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Helicopter

Before the ECU can be used for the first time you must program the failsafe and learn the throttle and optionally the auxiliary positions of your R/C system. The AUX channel should only be used for the RPM switch function! (See page 29, LIMITS menu/ Aux-channel func/ OnRPMSwitch)
Note: Modifying the learned pulse at a later time is not allowed!

To accomplish this, complete the following steps:

1. Connect one or both ECU servo cables to the receiver depending on either using single or two channel operation. The "**THR**" cable connects to the throttle channel, which is preferably operated with a 3-step switch, and if used, the "**AUX**" cable must be connected to a channel capable of three (3) positions or a variable control. Make certain that all other connections are made in accordance with the **Electrical Connection Diagram**.
   Note: Even if you do not use the auxiliary channel for control, you can still plug the **"AUX"** cable into an unused receiver channel for a redundant power signal connection. However, if this is done, you must manually disable the auxiliary channel in the limits menu.
2. While pressing the Select Menu key on the GSU, switch on the receiver/engine.
   Note: Instead of the **Select Menu** key on the GSU, the small button switch on the LED I/O board may be pressed. This key can also be used to advance through the **learn R/C** sequence (described below). This feature is useful when the GSU is not available. Keep in mind that the LED's on the I/O board are the same as the GSU for **Standby**, **Pump running** and **OK**.

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

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

   The GSU screen will display:

   Release button to memorize/teach the positions of the throttle and AUX channels…

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

   The GSU screen will display:
   ➔ Move throttle switch to off position
   Note: The off position of the 3-step switch is also the trim off position!

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Next, press Select Menu or the LED I/O board button switch. This will store the R/C system's pulse width for immediate shutdown of the engine. The green **OK** LED will turn off and the red **Pump running** LED will illuminate for the next step.

4. Next step: Teach in of the switch idle position

The GSU screen will display:
→ Move the 3-position switch to the middle position.

Next, press Select Menu or the LED I/O board button switch. This will store the R/C system's pulse width for engine idle. The yellow **Starter** LED will turn will illuminate for the next step.

5. Next step: Teach in of the throttle switch max position

The GSU screen will display:
➔ Advance the throttle switch to maximum .

Press Select Menu or the LED I/O board button switch again to store the R/C system's pulse width for the engine full throttle position.

Depending if the parameter "AUX-channel func" (Limits menu) is not set to "disabled", the teach-in procedure for the AUX channel would follow in the next step. In case the "AUX-cannel function" should be set to "Disabled", the teach in process will end here / continued with step 11, as with this setting the ECU is setup for single channel operation.
In case there would be no PWM signal detected on the AUX input, the parameter "AUX-channel func" would be automatically set to disabled and process would terminate/skipped to step 11.

6. Next step: Teach in of the AUX-channel position „0/OFF":

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

7. Move the auxiliary channel to the minimum position for **Off** and press Select Menu **,**or the LED I/O board button switch, to store the R/C system's AUX pulse width for AUX position "0/Off". The green **OK** LED will turn off and the red **Pump running** LED will illuminate.

8. Next step: Teach in of the AUX-channel position „1/Center":

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

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Next, press Select Menu or the LED I/O board button switch. This will store the R/C system's AUX pulse width for AUX switch position 1/Center. The red **Pump running** LED will turn off and the yellow **Standby** LED will illuminate.

9. Next step: Teach in of the AUX-channel position „2/Maximum“:

The GSU screen will display:
→ AUX channel maximum “**Maximum** ” position

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

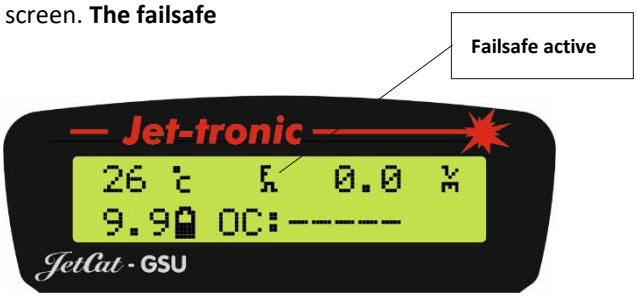
11. The green **OK** LED will flash and the display will briefly show “SAVING SETUP DAT“ and then return to the normal default **RUN** screen. Return the throttle stick and trim to the minimum position and the auxiliary channel (if used) to **Off** and the green **OK** LED will turn off. This completes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

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

Verify failsafe programing

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

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



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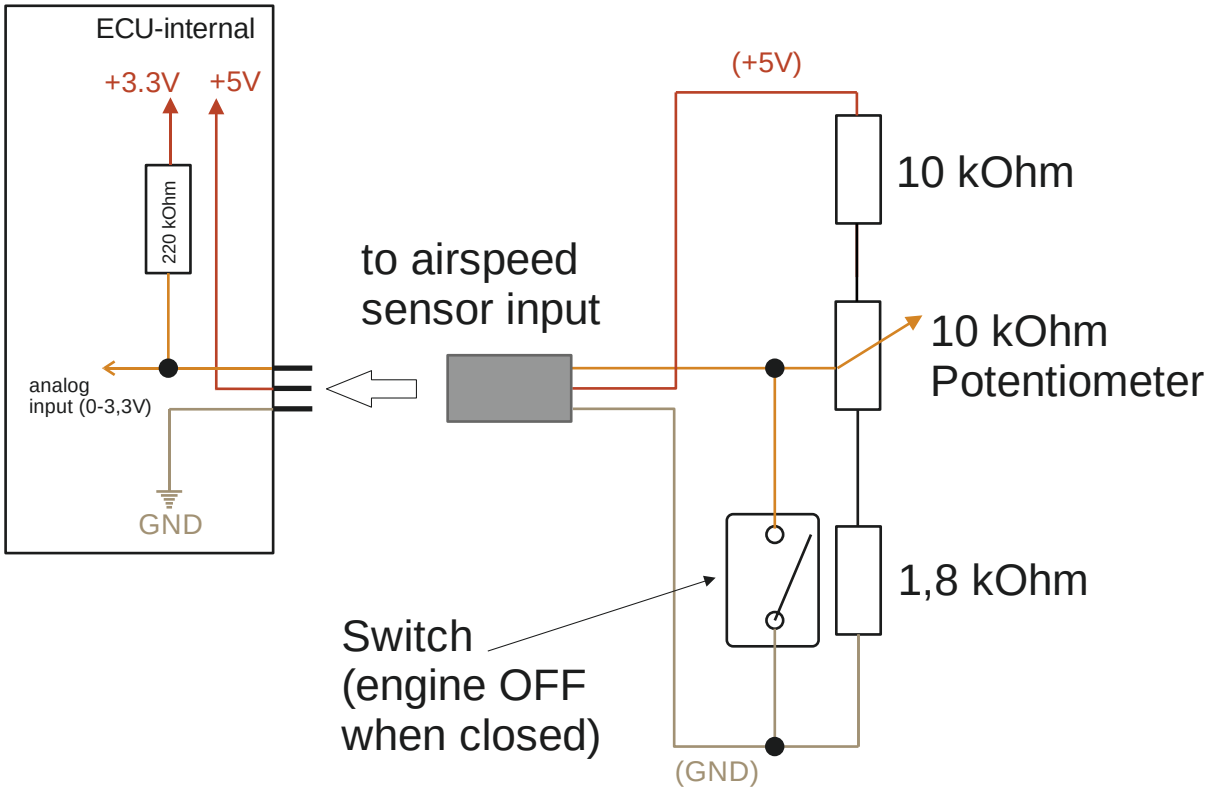
Control via analog signal (0-3,3V) fed into Airspeed input

The ECU allows to use the analogue input, normally used for the airspeed sensor, to be used for the throttle control signal.
For this special mode, the engines "Operation mode" needs to be set to one of the "Industrial" modes and the parameter "THR-Ctrl Input" needs to be set to "Airspeed Signal". Both settings can be found in the Limits menu. If set like this, obviously the airspeed signal is no longer available.

A suggested typical wiring of e.g. a potentiometer for engine thrust control to this input would then look like this:



Potentiometer Position	**Switch Position**	**Action**	**Resulting approx.. control voltage**
Left (min) position	Closed	Engine OFF	0V
Right (max) position	Closed	Engine OFF	0V
Left (min) position	Open	Engine idle	0,41V
Right (max) position	Open	Engine full power	2,7V
Potentiometer/switch circuitry disconnected	---	Error → Off	>3.13V treated as error/failure

If the potentiometer circuitry should accidentally be disconnected to the analog input, the signal would internally be pulled high (3,3V), allowing the ECU to detect this as a failure and shutting down the engine.

For the system to work correctly, the input needs to be "teached in" one time prior to be used . For "teach in" please follow the instructions given in chapter "*Teach the ECU to the R/C System*" (page 10 step 2).

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Control via serial Bus (COM1)

Please refer to our separate available documentation on the serial control interface.

Control via CAN-Bus

(Pro Engines only)
Please refer to our separate available documentation on the CAN-bus protocol.

Throttle Curve

(This function has no effect with helicopter engines)

The translation function from “throttle command” to effective engine rpm can be defined via the parameter “Throttle curve” in the Limits Menu (page: 27).

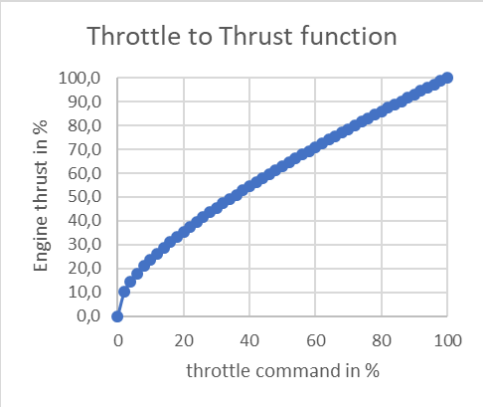
The throttle command input (from 0-100%) is derived from one of the following inputs/sources:

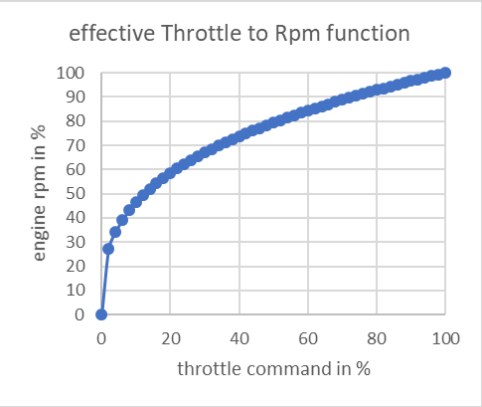
- Servo-PWM
- Analogue input
- Any commands coming in via RS232 or CAN-Bus which are commanding throttle percent values.

Per default the parameter “Throttle curve” is set to a value of **3.0** which in result gives a slight logarithmic relation between throttle command and effective engine thrust. For most applications this gives a good handling of the engines response versus throttle command. In case a perfect linear relation between throttle position and engine thrust is desired, the “Throttle curve” parameter can be set to a value of 2.0 (see example 2 below).

Examples:
In the following examples the transfer functions from throttle command to thrust and engine SetRpm are shown for different settings of the “Throttle curve” parameter. The 0% thrust point is referring to the engines thrust at idle; 0% Rpm point is referring to the idle Rpm of the engine.

Example 1; Parameter „throttle curve“ set to **3.0** (default) gives the following relation:





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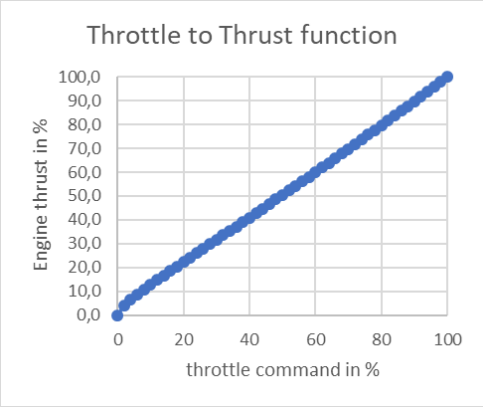
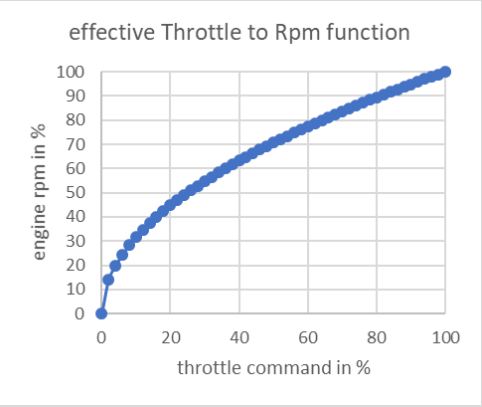
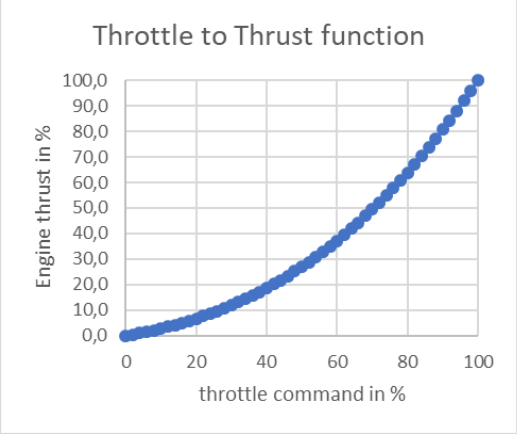
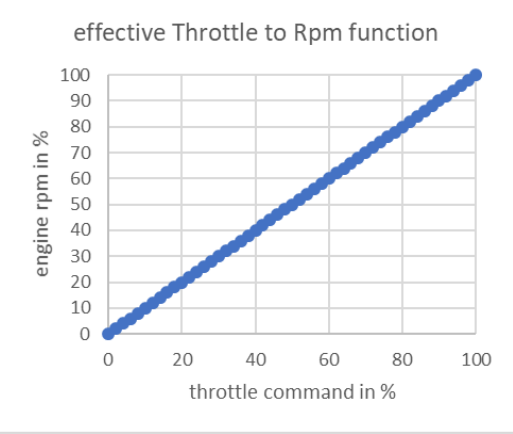
Example 2; Parameter „throttle curve“ set to **2.0** gives the following relation (→ linear throttle to thrust curve):



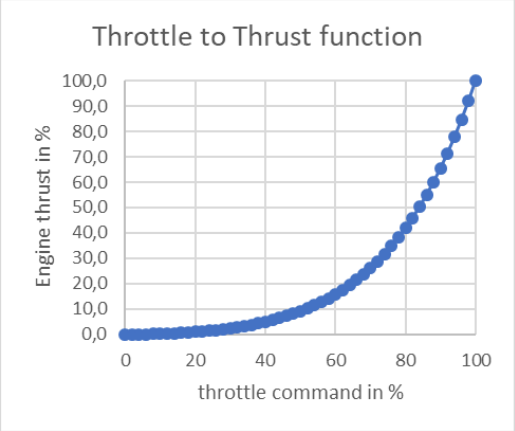


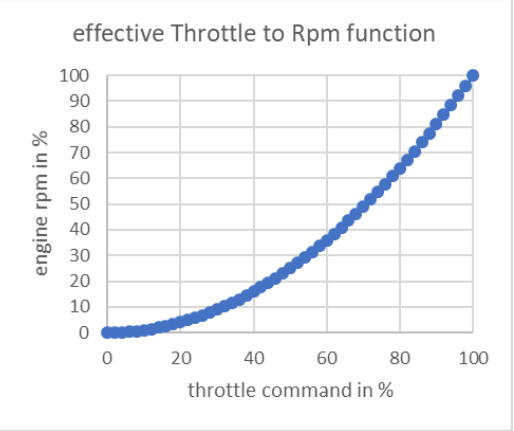
Example 3; Parameter „throttle curve“ set to **1.0** gives the following relation (→ linear throttle to rpm curve):





Example 4; Parameter „throttle curve“ set to **0.50** gives the following relation (exponential throttle to thrust curve):





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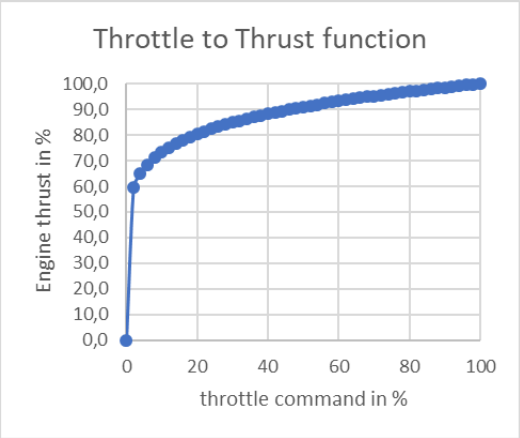
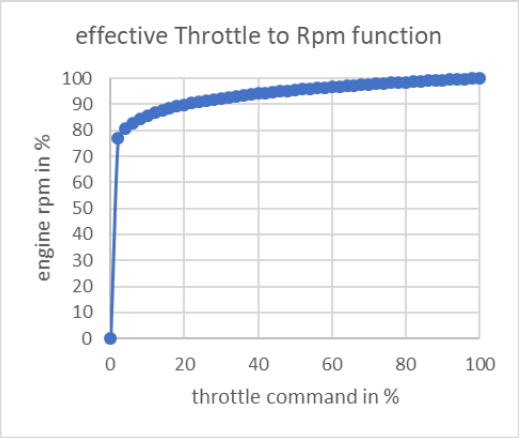
Example 5; Parameter „throttle curve“ set to **15.0** gives the following relation:





Operation modes

The JetCat-PRO engine allows for different modes of operation:

- Operation mode for propulsion of RC-models (typically radio-controlled models)
- Extended operation mode of RC-models. (extensions are the simulate mode and Throttle input signal)
- Industrial operation mode, normal altitudes
- Industrial operation mode A, for high altitude operation of the jet engine, without altitude controlled low rpm governing.
- Industrial operation mode B, for high altitude operation of the jet engine, with altitude controlled low rpm governing.

Industrial operation mode, normal altitude

This mode allows for engine operation over a normal altitude range (0-2000m).
If selected, there are further options to “simulate” (dry run) the engine. This allows e.g. to test the serial communication without hot running the engine.

Industrial operation mode, High altitude-A, without altitude controlled low rpm governing.

This mode allows for engine operation over a wide altitude range (0-10000m). If selected the engine response will be more relaxed/slower to ensure safe engine operation in a very high-altitude band.
If selected, there are further options to “simulate” (dry run) the engine. This allows e.g. to test the serial communication without hot running the engine.

Industrial operation mode, High altitude-B, with altitude controlled low rpm governing.

Same as previous mode, in addition this mode will engage a governor system which will make sure that the commanded engine rpm is verified/limited not being possibly commanded too low for the actual flight altitude! When flying in higher altitudes, the user otherwise needs to assure that the engine is operated/commanded above a certain minimum required rpm (otherwise too low mass flows can lead to an engine flameout, especially in altitudes above 4000m). The ECU will automatically increase idle rpm to a safe value for the actual flight altitude.
This mode is only available in firmware releases equal or higher to V12.01Q.

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Operation mode for propulsion of RC-models

This mode ensures optimum throttle response times as well as safe operation of the jet engine for the use in radio-controlled models/applications. Expected altitude changes on a flight are expected to be less than 1000m.

Extended operation mode for propulsion of RC-modles

This mode ensures optimum throttle response times as well as safe operation of the jet engine for the use in radio-controlled models/applications. Expected altitude changes on a flight are expected to be less than 1000m.
The simulation mode can be activated and the control signal can be fed in as an analog signal via the airspeed sensor input.

Setup/adjustment of the operation mode

The operation mode can be changed with the GSU as follows:

1) Connect the GSU to the system and power up.
2) Once ECU has booted press the Limits key on the GSU (this calls the “Limits” menu)
3) Scroll through the Limits menu using the - or + keys until the parameter “Op-Mode” is displayed.
4) Now press and hold the Change Value key and select the desired Op-Mode with the - or + keys.

Menu Structure

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

Menu Selections

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

Selecting a Menu

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

Change Values

To change an indicated value, press and hold the Change Value key while using the - or + keys to alter its value. An arrow (→) will appear in front of the value, if it can be changed.

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The RUN Menu

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

Value	Explanation
Sx Px **Rx St**	Values of the second engine in cross check operation Sx: set point external. Px: Power external Rx: actual value St: engine state external
RPM P **Set I**	Current speed. Current Power Set speed Current Flow
r2 r1 **s2 s1**	r2: actual value second stage r1: actual value. s2: set point second stage s1: set point
Temp.	Current EGT (**E**xhaust **G**as **T**emperature). The units, °C or °F can be selected in the LIMITs menu.
State **RPM F**	Current engine state. Current RPM Current thrust
U-Pump	Current pump voltage.
Airspeed	Current Air speed (km/h) this readout is usual for function check of the speed sensor. Note: This readout is only supported by connected airspeed sensor.
Set Speed	Target state-air speed (km/h). This readout is for checking at the “speed control” mode the set target state-airspeed of throttle stick. Note: This readout is only supported by connected airspeed sensor.
Gen: A xxx **Bat: A xxx V**	Generator current (A) Capacity withdraw or loaded (mAh) Charging current (A) Voltage of engine battery (V)
FuelQuality **--BUBBLES--**	Present fuel quality in % Present air bubbles

The Min/Max Menu

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

Value	Explanation
MaxPmp **MinPump**	Maximum pump voltage. Minimum pump voltage.
MaxTemp **MinTemp**	Maximum EGT. Minimum EGT.
MaxRpm **MinRpm**	Maximum engine RPM. Minimum engine RPM.
MaxAirSpd	Maximum Airspeed (*)

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AvgAirSpd	Average Airspeed (*)
Flight Distance	Flight distance in km (*)
AvgRpm **MaxRTmp**	Average-RPM Average temperature at full throttle
AvgPump **AvgTemp**	Average pump voltage Average temperature
Max Altitude (m)	Maximum altitude reached
BubbleCount **BubbleTime**	Number of detected air bubbles Total time of air bubbles decsted
LowestFuel Quality	Worst fuel quality
MaxProp **MinProp**	Maximum Propeller RPM Minimum Propeller RPM

(*) Only by connected air speed sensor!

The Min/Max values can be reset by pressing "Change Value „key.
The values are only valid during and after the actual run. By switching on the ECU they are reset

The R/C Check Menu

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

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

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

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The INFO Menu

Info menu displays the following information:

Value	Explanation
Rest Fuel	Remaining fuel in tank. Tank size can be entered using the **LIMITs** menu. Value is reset every time the ECU is switched on (or can be reset manually by pressing the **Change Value/Item** button on the GSU).
ml/min gr/N/h	Actual fuel consumption in ml/min. Also specific fuel consumption is displayed in gr/N/h
BattCnd **Ubattery**	The condition of the battery is indicated in the upper line: 1. **--OK--** 2. **!WEAK!** 3. **--EMPTY--** 1. If the battery voltage is 1.1V/Cell or higher "**—OK--**" will be displayed. 2. If the battery voltage drops under 1.1V/Cell, the display will read "**!WEAK!"**. Red **Standby/Manual** and green **OK** LED's will blink simultaneously (at a rate of twice per second). Starting the engine is not possible, until the battery is recharged. If the engine is already running and the battery warning function is enabled, the warning function will be activated. 3. If the battery voltage drops under 1.0V/Cell "—**EMPTY--**" is displayed. Starting the engine is not possible until the battery is recharged. If the engine is running, it will be immediately shut off, to avoid a malfunction of the ECU. Current voltage of the battery. Displayed on bottom line.
Battery capacity	Capacity of the engine battery in mAh
Baro **Temp**	Indicate the current barometric pressure. Temperature indicator (C°) in range of ECU : Adjustable temp for compensate the ECU heating.
PressureAltit(m) **Thrust, PF**	Current altitude based on air pressure in meters Calculated Thrust in N in the current environmental conditions. The power factor defines the multiplier for calculating the thrust.
LastAltitude(m)	Highest altitude reached during last flight (referenced to the altitude were the engine has been powered on)
Inlet Temp.T0 °C	Air Temperature at compressor inlet. Only on engines with T0 sensor.
Last Run Time	Last engine run time.
Last Fuel Count	Quantity of fuel consumed, during the last engine run.
Last-Off PmpVolt	Volts applied to the pump when it was switched off.
Last Off RPM	RPM of the engine, when it was switched off.
LAST-OFF TEMP	Temperature of the engine when it was switched off.
Last-OffCond	Last stored Off condition.
Last MaxTemp	Maximum temperature during the last engine run
Last MinTemp	Minimum temperature during the last engine run
Last AvgTemp	Average temperature during the last engine run
Last MaxR AvgTmp	Average full throttle temperature during the last engine run
Last StartTemp	maximum EGT during last engine start

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Last MaxRPM	Highest rpm during the last engine run
Last MinRPM	Lowest rpm during the last engine run
Last AvgRPM	Average rpm during the last engine run
Last Max Pump	Maximum pump voltage during the last engine run
Last Min Pump	Minimum pump voltage during the last engine run
Last Avg Pump	Average pump voltage during the last engine run
Last FailSafeCnt	Number of Fail Safe during the last engine run
Last FailSafeTim	Fail Safe Time in seconds during last run
Last-Max AirSpd	Maximum reached flight speed during the last flight (Only with connected Airspeed sensor!)
Last AvgAirSpd	Average flight speed during the last flight (Only with connected Airspeed sensor!)
Last Distance	Flight distance traveled during the last flight (Only with connected Airspeed sensor!)
Last MaxProp	Highest Rpm of second shaft (only on 2-shaft engines) during last run
Last MinProp	Lowest Rpm of second shaft (only on 2-shaft engines) during last run
L-MinFuelQ **L-OffFuelQ**	Value of the last minimum fuel quality during the last run Value of the fuel quality in the moment the engine is switched off.
L-BubblCnt **L-Bubble time**	Number of the bubbles during last engine run Total time in which air bubbles occurred during the last run
SFB-Ver. 0010 **:301020 0305 8.1**	Front board version : Date ([D]D/MM/YY) hardware version firmware
Pump Ver. 0012 **:211020 0305 7.7**	Pump version : Date ([D]D/MM/YY) hardware version firmware
Ign.Ver 0011 **120921 0303 7.9**	Igniter version : Date ([D]D/MM/YY) hardware version firmware
S/Gen Vers. 0012 **91020 0303 7.9**	Starter / generator version : Date ([D]D/MM/YY) hardware version firmware

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

The Statistic-Menu

Value	Explanation
Total Run-Time	Total engine running time.
TimeSinceService	Total engine running time since last service.
Runs-OK	Number of successful engine runs, without errors.
Runs aborted	Number of engine shut downs, caused by the ECU’s safety system.
Ignitions OK	Number of successful ignitions.
Ignitions FAILED	Number of failed ignitions.

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Starts FAILED	Number of failed starts.
Total fuel count	Total fuel consumption of engine
LoBatt Cut-Outs	Number of cut off due weak battery voltage
Serial No	ECU serial no

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

The LIMITs Menu

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

Value	Explanation
Minimum RPM	Turbine idle speed (If **IdleRPM-SET** or **Idle&Ramp-Set** is enabled by **Barom.Auto Tune** it will further appear **(Auto)** in the display and the RPM is set by ECU).
Maximum RPM F	Turbine maximum speed Indicate the thrust at full throttle. By varying the RPM this value calls the related thrust of the engine. This provides a save and easy way to limit the maximum thrust.
ShaftHiR1 Shft	Maximum speed of the second stage. Corresponding max. propeller RPM
ShaftHiR 0,1,2 Shft	Three adjustable maximum speeds of the second stage. Corresponding max. propeller speed.
ShaftHiR1 SHFT= T=	Constant speed (controlled). Corresponding speed of main and tail rotor.
ShaftHiR 0,1,2 SHFT= T=	Three adjustable constant speeds (controlled). Corresponding speed of main and tail rotor.
MaxRPM1 Rot= T=	Maximum engine speed. Corresponding speed of main and tail rotor
MaxRPM 0, 1, 2 **Rot= T=**	three maximum speeds of the AUX switch position 0, 1, 2 can be edited here when the AUX channel function **ON, Rpm-Switch** is active. Indicate the corresponding speeds of the main and tail rotor.
LowIdle RPM	Reduced idle speed. This function is activated if the throttle stick is in idle and the throttle trim is set to half. The Idle speed will be decreased to the programmed value. The acceleration time to get back to the common idle speed can take 2-5 seconds according the used engine type.
Ignition-Mode	Version of ignition type: Kerosene-N JetCat kerosene start. This parameter is for informational purposes only and can't be changed
Battery Type	Kind of connected Battery**: LiPo / LiFe / NiCd / Pb / LiIon**
Cells	Number of battery cells
BatterySize(mAh)	Capacity of the connected supply battery. This option is only present on engines with integrated charging system/alternator.

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Value	Explanation
	On engines with alternator function, this information will also be used to limit the max. charging current to the supply battery (also depending on the selected battery chemistry).
Barom.Auto Tune	Enables the ECU to align the control system according the barometric pressure. The possible settings are: **Disabled:** No auto tuning by ECU **IdleRPM-Set:** Optimize of idle RPM only **Ramp-Set:** Optimize of acceleration only **Idle&Ramp-Set:** IdleRPM and acceleration are optimized
Smoker Flow	Only available when a bus-smoke pump is connected. The smoke flow can be adjusted in a range of 0-100%. Additional is shown the quantity of flow in milliliters (ml).
Bleed fuel lines	This function allows to automatically aspirate fuel up to the engine. The system automatically stops the pump as soon as fuel has reached the engine sided fuel pump. One of the following options can be selected: **DISABLED**: Turns function off **Always**: Before every start, it is checked if fuel is present at the pump. **Automatic**: Only after a prior false start or a failed engine run, the bleeding function will be executed upon the next engine start. **Manual:** If this option is selected the bleeding function is executed once as soon as the "Change value" button is released.
Fueltank size	Actual capacity of the fuel tank in ml
LowFuel Limit	Fuel level (ml) to activate the fuel warning function.
TelemAdap.	Port of the adapter used • **NOT USED** = Disabled *PRO Engines* *Hobby* • **Intern, A1** Telemetry on front board Telemetry on ECU • **Extern, A1** Telemetry on Pro-Interface Extern JetCat Telemetry Adapter • **Extern, A2** Not in use yet , for future extern purposes
Telemetry	Select type of telemetry protocol, only applicable in conjunction with PRO-Interface Options are (see also instruction manual of "JetCat telemetry adapter"): • Futaba SBUS-2 • Graupner HOTT • MPX M-Link1 • Jeti • MPX M-Link2 • Jeti-NoAlarms • Mikado Vbar (Telem V8.7 of higher only) • PowerBox (Telem V8.8 or higher only) • Spektrum (Telem V8.9 or higher only) Depending on actual telemetry system present, only some of the above options might be available!
AUX-channel func	The AUX-channel (3-step switch) can be used for optionally special features or disabled even for single-channel operation.

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Value	Explanation
	ON,TrbCtrl ON: Aux channel enabled for engine control **ON.TrbCtrl OFF**: Aux channel enabled for additional functions like speed limiter functions, Smoker control etc. Turbine control disabled. The Aux channel is used only for additional control functions. The engine control is only via the throttle channel (Single Channel Mode) **ON, Rpm-Switch** (only Helicopter/two shaft engines) Allows presetting of three maximum speeds (**MaxRPM 0, 1, 2)** **NOT USED**: Single Channel Mode. Totally disabled AUX channel input for engine control, speed sensor and smoker functions. AUX channel wire must not be connected to the receiver in this mode. In case of a connected air-speed sensor the Maximum Limit Speed is still active and limits the maximum speed of the plane. This safety function can't be disabled.
AUX-SW0 Action	Only if the parameter "AUX-channel func" (see above) has been set to "ON, TrbCtrl OFF" this option is visible. In this case, the AUX-channel (3-step switch) can be used for optional controls or can be disabled. This option defines the action taken if the 3-step switch is be set to the "SW0" position (backwards position) **DISABLED/NONE** No Action **LowIdle active** Idle rpm will be reduced to the value set by the "LowIdleRpm" parameter **Turbine-OFF** The following options are only present with an airspeed sensor connected: **LrnSpeed Lo/Hi** **LrnSpeed Lo** **LrnSpeed Hi** **Hold-Speed**
AUX-SW2 Action	Only if the parameter "AUX-channel func" has been set to "ON, TrbCtrl OFF" this option is visible. In this case, the AUX-channel (3-step switch) can be used for optional special controls or be disabled. This option defines the action taken if the 3-step switch is be set to the "SW2" position (forward position) **DISABLED/NONE** No Action **LowIdle active** Idle rpm will be reduced to the value set with the "LowIdleRpm" parameter

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Value	Explanation
	The following options are only present with an airspeed sensor connected: **LIN-SpeedCtrl** **3-StepSpdCtrl** **Hold-Speed** **SwitchSpeedLim**
FailSafe delay	Delay in seconds before Fail-Safe function will be activated. While this time the engine speed run on the last valid stick pulse **(→HOLD**) adjustable range = 0.1 -20.0 seconds. After expiration of this term the Fail-Safe Time Out starts. (see next point)
FailSafeTimeOut	Delay in front of Fail Save cut off. While this time the engine speed is set to the Fail Save RPM (next point) Is there no valid pulse after the expiration of this term the engine will be cut off by the ECU. Range 0.1-20 seconds.
FailSafeRPM	Programmable engine speed for the Fail-Safe Time Out procedure. Range from minimum RPM to maximum RPM.
SpoolUp Time	Time from idle to max rpm. Only available for helicopter engines!
Operation mode	See page: 21
THR-Ctrl Input	The following options are available: **ServoPWM direct**: Engine control via Servo PWM Signal **AirSpeed Signal**: Engine control via analogue Signal on “AirSpeed” input
IdleThrResponse	Adjustment of the throttle response (acceleration) by idle (up to average speed) **Fast** default setting **Normal** average acceleration **Slow** slow acceleration for warm weather or for operate more than 1000m sea level **very slow** slow acceleration for excessive warm weather or for operate more than 1000m sea level **very fast**
FullThr Response	Adjustment of the throttle response by full throttle (from average speed to full) **Fast** default setting **Normal** normal acceleration (for operation above 1000m)
StartUp Mode	This function allows to select different start procedures for the THR-input (PWM or analogue signal) You can select between following settings: **[SEQUENCE]:** Default setting: Throttle trim to maximum, throttle stick to idle, AUX switch to center and now move the throttle stick to maximum to start the engine. By using the Single Channel Mode (devoid of the AUX switch) start the engine by set the throttle trim to maximum and then move the throttle stick to maximum. **THROTTLE MAX:** Throttle trim and throttle stick to maximum. Turbine starts if the AUX-switch is set to center. By Single Channel Mode (devoid of AUX switch) the engine starts by move the throttle stick more than 95% of maximum.

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Value	Explanation
	THROTTLE MIN: Throttle trim to maximum and throttle stick to minimum. Turbine starts if the AUX-switch is set to center. By Single Channel Mode (devoid of AUX switch) the engine starts by move the throttle stick more than 95% of maximum. **IMMEDIATE:** The engine starts direct by move the throttle trim to maximum and set the AUX-switch to center. By Single Channel Mode only move the throttle trim to maximum for start. **Suggestions to start a multi-engine model** **Two channel Mode:** Program one ECU to **THROTTLE MAX** mode but the second to **SEQUENCE** mode. The "Throttle max engine" starts by move the throttle trim and throttle stick to maximum and set the Aux switch to center. To start the "Sequence engine" you now must move the throttle stick first to minimum and back to maximum. **Single channel mode:** Program one engine to **IMMEDIATE** mode, the other to **SEQUENCE** mode. Throttle trim and throttle stick must be set to minimum. To start the "immediate engine" just move the throttle trim to maximum. The "sequence engine" starts by move the throttle stick to maximum.
THR-Transfer (%)	After the engine has been started up, the system will stay in the "LearnLo" state until the throttle stick is brought to idle/backwards. This parameter defines the threshold to which the throttle stick at least must be lowered to transfer throttle control to the user and switch to "Run" mode. A value of 100% means that the engine will directly go to the commanded throttle setting after it has been started up, no matter where the throttle stick is set at. Default setting: 5%; range 0-100%
Throttle Curve	Throttle stick curve, factory setting is 3.0. Herewith the thrust and the throttle stick position proceed slightly logarithmic (higher response at the idle range compared to the full throttle range of the throttle stick/commanding). At the value of 2.0 the thrust will proceed exactly proportional to the throttle stick position. This parameter can be used to tune the throttle command to thrust curve in a very wide range. See also page: 17
Auto-Restart	In case the engine would flame out during normal run, the system can be programmed to automatically try a restart of the engine and resume operation. Per default the Auto restart feature is disabled for safety reasons. A restart always can be interrupted via the normal controls which stop the engine. The following options are selectable: **Disabled/Off** (Default, recommended) **Allways** (engine will be restarted in case of flame out)

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Value	Explanation
	ThrottleMax (engine will be restarted instantly, but operator must bring throttle stick to full throttle position within 6 seconds (after the flameout happened) in order not to interrupt/stop the restart attempt.
AUX-ch SmokeCtrl	To be able to use this function its necessary that the ***AUX-channel func*** is activated by ***ON,TrbCtrl Off*** (see above). This option defines the smoke pump control option for the 3-step switch. The ECU can directly control a smoke valve or a Smoke pump for injection of smoke fluid into the exhaust blast to generate smoke. You can use the shut off valve (Part# 61106-00) as smoke valve. For smoke pump, you can use any Jetcat Smoker pump AUX-channel programming for smoke function (3-step switch) Settings: **DISABLED** Smoke solenoid is not used → valve is constantly closed **Open if AuxSw=0** Smoker-valve is open if: Turbine is running and the AUX switch (3-Pos. switch) is brought to lower position (“off” position) That is to say the Aux switch is enabled for smoke function but not for engine control. **Open if AuxSw=2** Smoker -valve is open if: Turbine is running and the Aux switch (3-Pos.switch) is brought to upper position (“AUTO-OFF” position) To be able to use this function its necessary, that the ***AUX-channel func*** is activated by ***ON,TrbCtrl Off*** (see above). The Aux switch is enabled for smoke function but not for engine control.
Smoker WarnFunct	If this function is activated, the smoke-valve will pulse in a sequence of 0,2 secs on and 0,4 sec off –time if following conditions are complete: **BATTERY LOW:** The valve will pulse if the ECU battery is weak/empty. **FUEL LOW:** The valve will pulse if the fuel level is low the programmed ***LowFuel Limit*** **BATT or FUEL LOW:** The valve will pulse in any of these conditions **FAIL- SAVE**: The valve will pulse if the ECU detect a fail safe **BATT,FUEL,FAILS:** The valve will pulse in any of these conditions **ENABLESmokePmp:** Enables signal for smoke pump only if engine is running. The pump can’t run without a running engine (only useful by operate a JetCat Smoke pump)

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Value	Explanation
	High-Temp. The valve will be pulse in case of excessive exhaust temperature. **MaxRPM-reached:** The valve will be pulsed if the engine has reached its maximum RPM. **Disabled:** No function, off. **Note:** The smoke warn function is switched off while the throttle stick is in idle position.
AirSpeed units	Displayed flight speed unit in ***km/h*** or ***mph***
ThrustReduFactor	This parameter allows to automatically reduce the engines thrust in relation to the weight of fuel burned. At a programmed value of 1.0 the engines thrust would be reduced such that it exactly compensates for the weight (force) of the amount of fuel burned up to this moment. For hovering applications, this function can help to automatically reduce thrust and compensate for the weight loss of the system by fuel burned/consumed. Per default this value is set to 0, which effectively disables this function (recommended setting!). The lower the value is set the lower the effective thrust reduction will be computed. Values higher than 1.0 will result in an overcompensation.
Simulate engine	•**Enable** or **disable** Simulation mode. If set to "enabled" engine will not be run in real, Rpms / EGT etc. is internally simulated. Pump/Starter/valves are disabled in this mode. This allows e.g. to test the serial communication without hot running the engine. Only available if operation mode is not set to "RC-model"! • **Altitude.** For future purposes.
Engine CrossChk	This function allows to interchain two engines with each other via the secondary serial interface (→Tx2/Rx2, null modem cross over connection). In this configuration every engine then "knows" the operation state/rpm/thrust etc. of its "partner engine" and vice versa. Typically, this is used to synchronize two engines and/or to keep their thrust differentials within a preset safe margin. For this option to work correctly it must be ensured that the "Slave-address" value (see below) is set to different values on the two engines communicating with each other (e.g. engine #1 Slave-address set to 1, engine #2 Slave-address set to 2) Also, it will be ensured that the control would only be handed over to the pilot if both engines are started up and running at idle. **"DISABLED":** This disables the cross-checking function, default **"ON; OFFOnFail ":** This enables the crosschecking function, if the other engine should turn off by any reason, the "partner engine" would also be switch off. Also, if the communication cable should be interrupted, this would result in an engine shut down. **"ON; ContOnFail":** This enables the crosschecking function, if the partner engine should turn off by any reason, the engine would not be turn off, but would be auto limited on thrust according to below setting of the "**Max-ThrustDiff"** value. **"Heli-Syncronis":** This option is used to synchronize a pair of two-shaft engines which are connected/driving to the same output shaft and have the shaft regulator function activated (typical twin-engine helicopter configuration). This option will avoid that one of

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Value	Explanation
	the two engines, over time might take a larger portion of the load, whilst the other one is getting lazy (=applying less power). Only applicable for two-shaft engines!
Max-ThrustDiff	Desired maximum thrust differential value in Newtons for the cross-check function The engine which produces more thrust than its linked partner engines thrust plus the differential value would be de-rated such in rpm to match the condition. Only available if "Engine CrossChk" is not set to "Disabled"
ThrustDiffOffDly	Allowed time in multiples of 0,1s where the thrust differential compared to other engine in Newtons is allowed to be higher than the programmed window. A setting of 0 disables the shut down due too high differential thrust, the limiter function stays active though. Only available if "Engine CrossChk" is not set to "Disabled"
Generator-Charge	Generator function Enabled or Disabled; only on engines with generator functionality This effectively will turn on/off the internal AC/DC converter and charging circuitry.
SelfPower funct.	Normally the engine is powered on/off via the control input on pin 9 of the 15pin Sub-D connector. This option allows to optionally keep the ECU powered on under certain conditions, even if this control signal should be removed. This option is only available if the operation mode is not set to "RC-model" • OFF • run & cooling • cooling
CAN-Ctrl-Address	CAN control offset address. See CAN-bus documentation
CAN-Report-Adr	CAN report offset address. See CAN-bus documentation.
CAN-Bus Mode	"CAN 2.0A, 11Bit" or "CAN 2.0B, 29Bit"
CAN-Bus Speed	"125kHz", "250kHz", "500kHz","1 MBit/s",
CAN-Timeout	Option to check if CAN communication link is working/present. If a value unequal to zero is set, and the engine has been started via a command sent through the CAN interface, the ECU will expect commands to come in via the CAN interface within the set timeout interval. Timeout value is in multiples of 0,1 seconds. In case communication is lost, engine will be shut down.
RS-232 Baudrate	"2400", "4800", "9600", "19200", "38400", "57600", "115200"
Slave-Address **:1 B: C:**	Address to be used for serial communication addressing (RS232 interface) Address number (even for cross check) B: byte received C: command connection
COMM-Timeout	Option to check if serial communication link is working/present. If a value unequal to zero is set, and the engine has been started via a command sent through the serial interface, the ECU will expect commands to come in via the serial interface within the set timeout interval. Timeout value is in multiples of 0,1 seconds. In case communication is lost, engine will be shut down.
Serial Protocol	ASCII (standard) or Binary serial control protocol (not available on all engines)
AirSpeedSensor	This option allows to disable or enable the optional Airspeed Sensor input •Disabled •Analogue For use of the analogue Airspeed Sensor type •Digital-1 For use of the digital Airspeed Senor type.
SpdCtrl SW0 Act.	See chapter "Air Speed Control" of the manual
SpdCtrl SW2 ACT.	See chapter "Air Speed Control" of the manual
MAX LimitAirSpd	See chapter "Air Speed Control" of the manual
Max.AirSpeed	See chapter "Air Speed Control" of the manual

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Value	Explanation
Min.Air Speed	See chapter “Air Speed Control” of the manual
SpeedRegVal-P	See chapter “Air Speed Control” of the manual
SpeedRegVal-I	See chapter “Air Speed Control” of the manual
SpeedRegVal-D	See chapter “Air Speed Control” of the manual
MinRPM SpdCtrl	See chapter “Air Speed Control” of the manual

Possibly not all of the above options are displayed in your effective engine system. Some of the above given parameters might be omitted depending on your specific engine configuration!

TEST Menu

	**Before activating the purge pump mode, understand that fuel will/might be pumped into the engine if the user is not stopping the pump when fuel has arrived at the engines fuel inlet.** Pump Test / Purge Fuel allows the fuel pump to operate without the engine running. However, if the fuel feeding is not stopped once fuel arrives at the engine, the engine will become flooded with fuel. When this occurs, the next engine start can become highly combustible!

Value	Explanation
Purge FuelSystem	Enable to prime the fuel pump and lines. By pressing the “Change Value” key the fuel valve opens, and the fuel pump starts to run. To change the voltage the pump runs at, press either the “+” or “-“ key while the “Change Value “ key is pressed. Depending on engine type, the fuel pump can also be run reverse. Negative values for the pump voltage then result in reverse operation of the pump.
Purge FueR	Same function as Purge FuelSystem, additionally the RPM is displayed for brushless pumps.
BurnerTest ***External ECU***	By pressing the “Change Value” key the Burner is powered with the appointed voltage from the top line of the GSU. In the lower line the left number displays the burner voltage, the middle value indicates the present power and the right shows the current. The burner voltage can’t be changed.
Burner Test ***PRO***	The value in the upper line shows the power applied to the burner when the CHANGE VALUE button is pressed. The bottom line shows the current power on the left, the letter next to it indicates the status of the burner. C means cold, h means hot, b means broken and s means short circuit. The value on the right shows the current
Burner Test ***PRO-S***	The function is active as long as the CHANGE VALUE key is pressed. The value in the upper line of the display is for internal purposes only. The lower line on the left shows if the ignition is active (ON) or inactive (OFF). The following letter indicates the ignition status. G for good, B for broken and S for a short circuit.
BurnerValve Test	Pressing the “Change Value” key opens the burner valve
Smoker Test	Pressing the “Change Value” key opens the smoke valve

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FuelValve Test	Pressing the “Change Value” key opens the fuel valve
PurgeValve Test	Pressing the “Change Value” key opens the purge valve. This function is not available on all engines!
OilPump Test	Pressing the “Change Value” key will start the oil pump. This function is not available on all engines!
LCU-Test	This allows to test the LCU. Only available if LCU is connected/present.
Temp. **AD**	Displays the data of the temperature sensor. The upper left value indicates the exhaust gas temperature, the right value call the measured value of environment. These values are the according internal values of the AD-converter. If appears a “F” in the upper right edge the temperature-sensor is faulty or the data cable in not connected or faulty, too.
RPM **Sig** **Err**	Current RPM Signal in % signal error level

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Engine Running States

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

Explanation of the engine States

Table 1

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

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Speed Control	Speed Control mode -- only active when the air speed sensor is connected. Regulates model flight speed.

Table 2

Code	Value	Explanation
1	RcThrOff	throttle stick and throttle trim moved to the minimum/OFF position.
2	OverTemp	Turbine running over temperature. Exceeded high temperature parameter and time out.
3	IgnTimOut	Turbine did not ignite within programmed time interval.
4	AccTimOut	Turbine achieved ignition but did not accelerate within programmed time interval.
5	Acc.Slow	Turbine achieved ignition, but acceleration was less than the programmed value, during startup.
6	Over-RPM	Turbine exceeded the maximum RPM, by 5% and a delay of 0.5 seconds.
7	Low-RPM	Turbine running under the minimum RPM, by 10% and a delay of 3 seconds. Usually triggered by a flame out.
8	BattryLow	Battery pack is dead. Cell voltage is < 1.0V.
9	Auto-Off	Turbine shut down via the AutoOff sequence, using the AUX channel.
10	Low-EGT	EGT dropped below the minimum value. A dislodged EGT sensor can trigger this shut down.
11	HiTempOff	EGT exceeded the maximum range (~950 °C).
12	GlowPlug!	Defective kero/glow plug.
13	WatchDog	ECU processor was locked out usually from static discharge or voltage spike in power supply.
14	FailSafe	Turbine was shut down from a failsafe timeout condition.
15	ManualOff	Turbine was shut off by using the GSU.
16	PowerFail	The power failed to the ECU when the engine was running. This will occur if the power was lost because of a defective battery, connection or if the switch is turned off before the engine is shut-down. Note: If this state is displayed the Info, Min/Max and Statistics menus retain information from the previous run.
17	TempSensor Fail	EGT sensor failed. Note: This could happen only during startup.
18	FuelFail	
19	Rpm2Fail	Second rpm sensor defective, only for 2-shaft engines
20	2nd EngF	Cross check enabled, and shut down was forced due to 2nd engine shut down
21	2nd Diff	Cross check enabled, and shut down was forced due to thrust differential
22	2nd Comm	Cross check enabled, communication error to 2nd engine.
23	No-OIL	Not applicable for PRO engines

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24	OverCurr	The electrical current to the engine is too high. Starter may be jammed Kero/glow plug is short circuited
25	No Pump!	There is either no pump connected, or the pump cable is defective.
26	Wrong Pmp	Wrong pump type, see pump configuration in the advanced section of the manual.
27	Pump Err	Communication to pump driver disturbed.
28	No Fuel!	Not applicable for PRO engines
29	LoRpmPmp	Pump driver problem
30	LowRpmFB	Rpm measurement subsystem error
31	!Clutch	Clutch of Starter motor does not disengage
32	EngMatch	Not applicable for PRO engines
33	CAN-Error	Engine has been started up via CAN-Bus, but then the CAN Bus has been disconnected (no commands received)
34	NoRcPuls	Engine has been started up via THR channel, but then the THR signal has been disconnected.
35	RotorBlck	Rotor of engine is blocked
36	Kill Sig	The “Kill signal” was activated, which will turn off the power to the fuel solenoids as well as disable power to the pump(s) via an independent secondary hardware circuit. (See also: pinout of 15pin SUB-D connector)
37	ReStartX	AutoRestart was triggered and AutoRestart option is set to “MaxThrottle”. However throttle stick was not set to max throttle position by user within 6sec timeout periode → Restart aborted
38	RcAuxOff	Engine off commanded via AUX channel.
39	RS232Off	Engine off commanded via command received through serial interface.
40	CAN-Off	Engine off commanded via command received through CAN interface.
41	Test-Off	Engine off commanded via internal test cycle termination.
42	RS232-TO	Engine off commanded, as no serial communication was received within timeout periode.
43	PrHeatTO	Timeout during Preheat phase

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Firmware Update *(non Pro Engine)*

The update of the Pro Engines is documented in the PRO Engines manual.

JetCat ECU V12.0 allow for online firmware update.

The ECU update can be done by using the integrated USB port of the ECU or via the LED board.

In the case of the variant via the integrated USB port, the ECU and PC are connected directly via the supplied connection cable.

The other option requires the JetCat USB adapter (USB to Serial) which makes a connection to the PC via the RJ12 connector of the LED board and the GSU. Alternatively, the USB adapter can be connected directly to the LED board without the GSU.

For to update via the LED-board a JetCat USB-adapter (USB to serial) is required.

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First you need to install the “JetCat ECU-V12 Updater” program (for Windows PC)

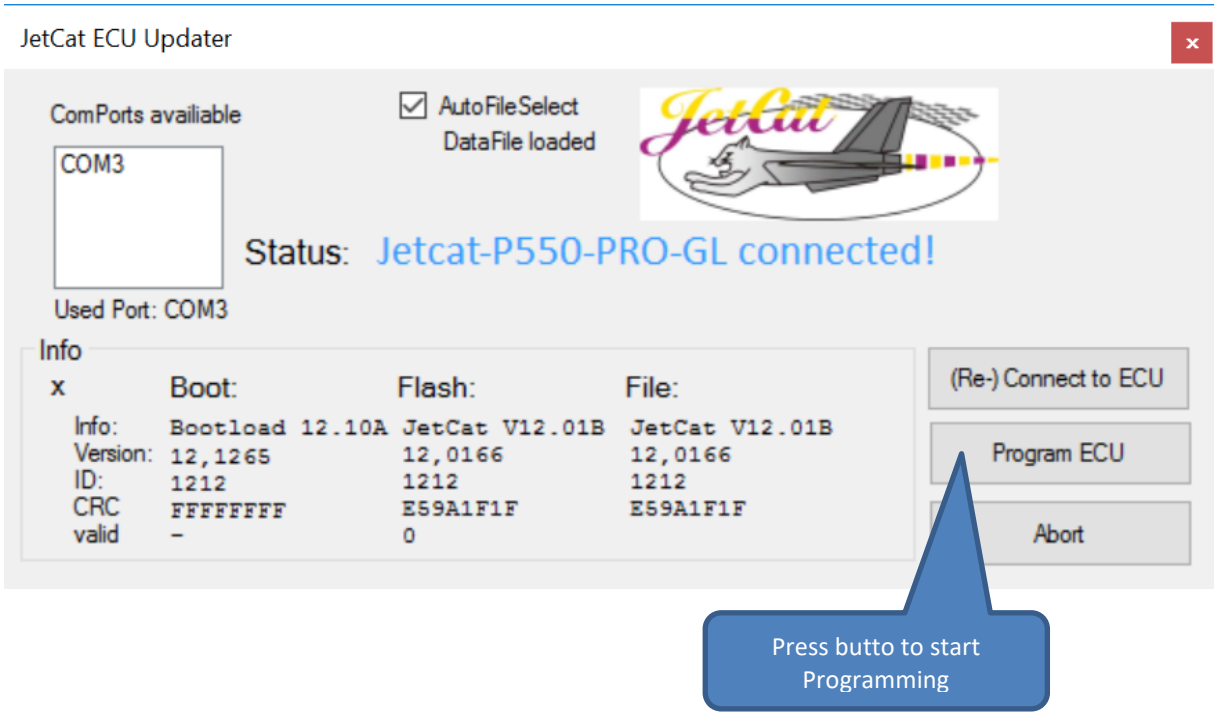
To install the software, type the following in the address line of your Internet browser:

http://www.cat-ing.de/jetcat-hexfiles/JetCatUpdaterV12.htm

After the utility program has installed you are ready to run the update.
Independent of the chosen option, the procedure is the same. The engine must be connected during the update.

1) Connect the ECU to the PC
2) Switch on the electronics
3) Start the "JetCat Updater-V12" (make sure that the PC has access to the internet).

After some seconds the following Screen should come up:



Click on „Program ECU".

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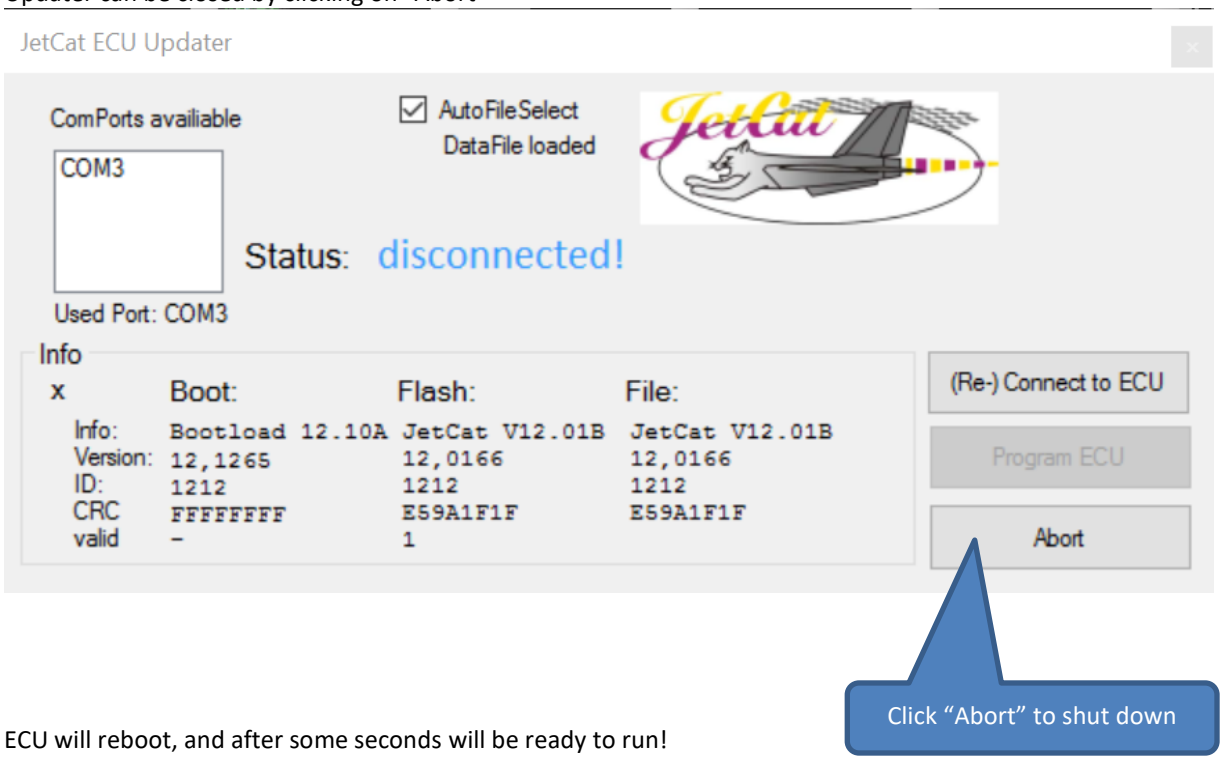
The programming is finished when the status "Device programmed, data restored!" appears, now the JetCat ECU Updater can be closed by clicking on "Abort"



ECU will reboot, and after some seconds will be ready to run!

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