Mini Custom Intelligent Propeller

Version for Rotax Engines

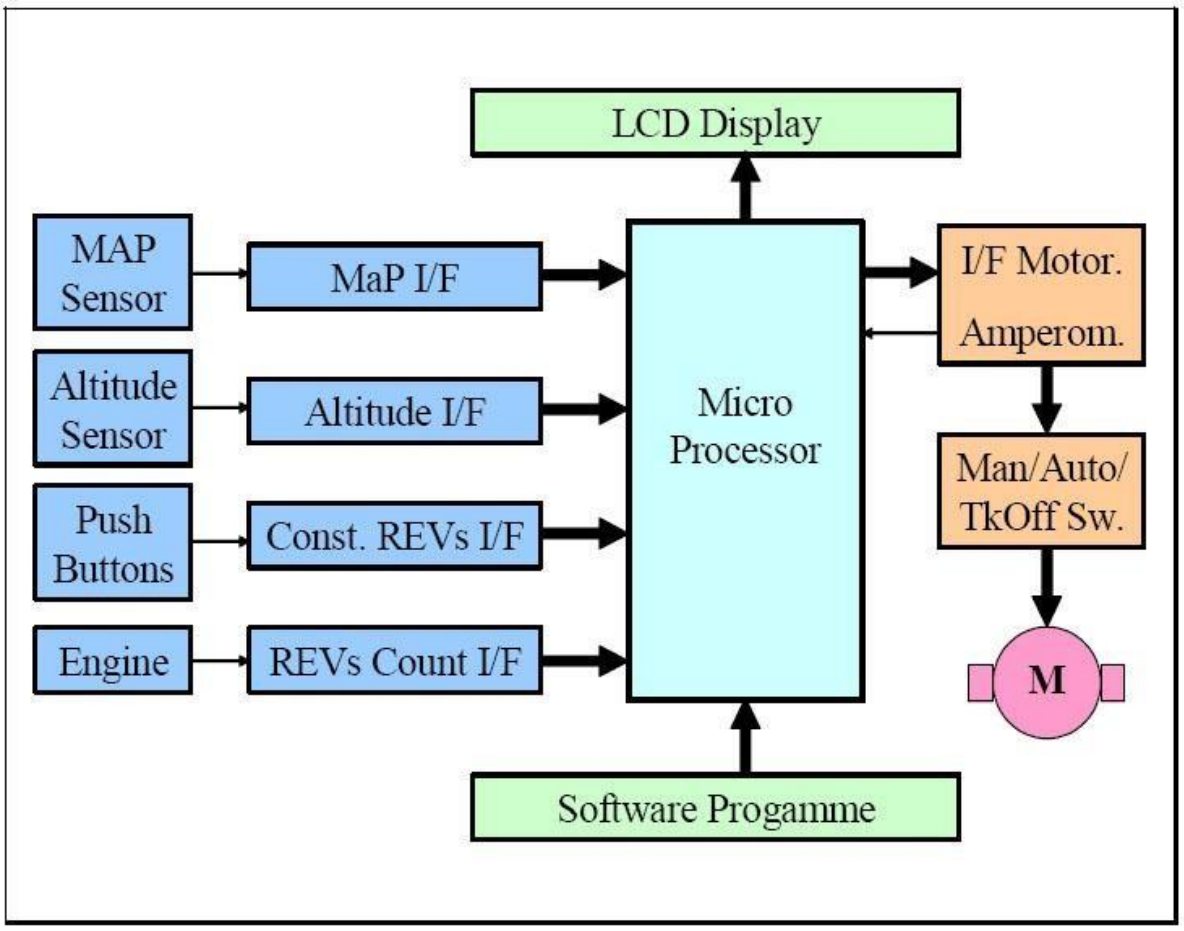
Mini Custom Intelligent Propeller

General Description.

Mini Custom Intelligent Propeller controls the pitch of your electric variable pitch propeller automatically and intelligently.

Mini Custom Intelligent Propeller is physically made up of a Main Unit and from a Display Unit integrated in a single assembly.

Schematic diagram of the Mini Cip (Mini Custom Intelligent Propeller)



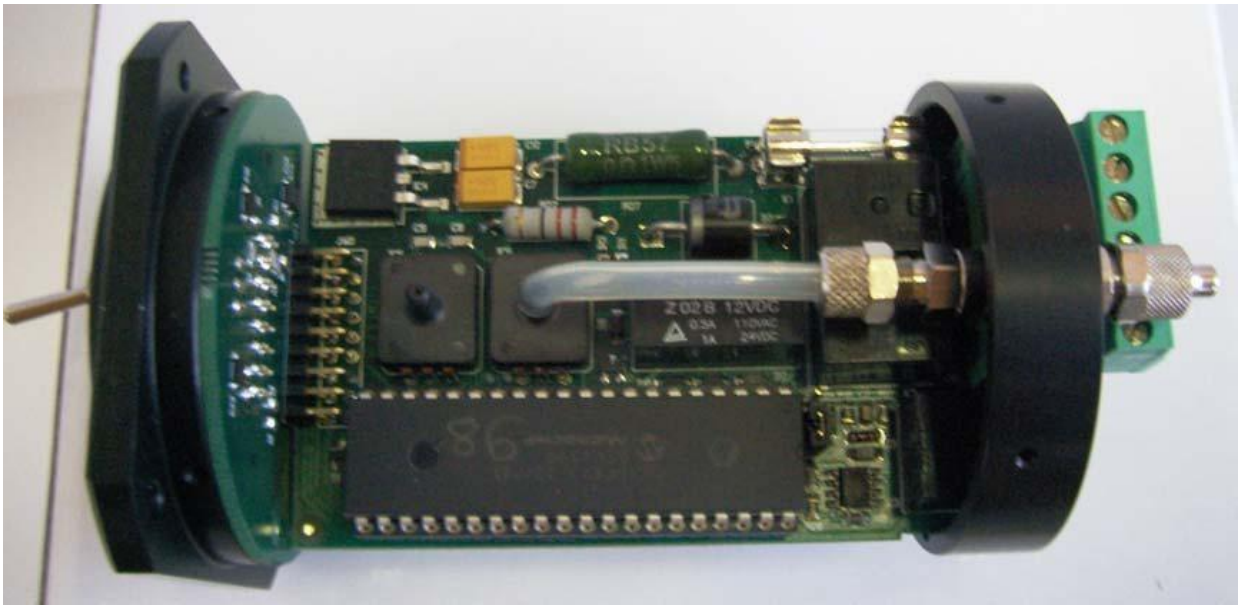
Legend:

LCD	liquid crystal display
I / F	Interface
REVs	Engine revs
MaP	Supply pressure
Sw	Push Button Switch + - Press Pressure

The main unit consists of a double-sided board in vetronite.

It contains:

- The Microcomputer to execute the program that controls the pitch of the propeller.
- An EEPROM to store the program,
- An EEPROM used as a non-volatile memory to store the customization parameters associated with the aircraft and the propeller used.
- An Analog-to-Digital Converter needed to digitize the input parameters to the microprocessor.
- A digital gauge of fuel supply pressure, MaP o Manifold Pressure.
- A digital pressure gauge. Atmospheric (Atm).
- A Digital Tachometer to measure engine revs.
- A digital ammeter to measure the current absorbed by the motor.
- A relay for manual / automatic switching.
- Two high current relays used as forward / backward actuators.



The Display Unit is made up of a black anodized aluminum cylindrical support (on the back of which the main unit is fitted) of standard size (57 mm), suitable to be installed on the dashboard like a normal aeronautical instrument .

It contains commands and indications.

CONTROLS:

1) A three-position switch to select mode operation to.
   a. Take Off / Landing,
   b. Manual,

c. Automatic / Constant revs.

2) A Set button to set the parameters.

3) Two + Buttons - for various adjustments depending on the context:

a. In Constant Speed mode, these buttons adjust target RPM (desired RPM) in the range from 4000 to 5500 RpM.

b. In Manual mode these pulses increase and decrease the pitch of the propeller

c. In Setup, these buttons increase or decrease the value of the selected parameter.

INDICATIONS:

4) A digital LCD display with 16 characters on two lines, with a large reading angle, backlit type.

5) One green LED for end of MINIMUM (fine pitch) and one Blue LED for end of MAXIMUM (course pitch).

How Mini CIP works, Mini Custom Intelligent Propeller

Manual mode.

The pilot can decide to adjust the pitch manually if he wishes or in the event of a malfunction. Place the switch “1” in Manual mode and press the + - buttons to increase or decrease the RPM. Obviously take-offs and landings must be carried out at a minimum (fine) pitch setting. To adjust to Minimum pitch, press and hold the –button until the Green LED lights up. In this phase, the value of the current absorbed by the motor, in the lower right corner, can also be observed.

Constant Speed mode (4500-5500 RPM)

The pilot moves the switch “1” to the Auto / Cnst position and presses button "2" to set “Cst” on the display. At this point set the target engine RPM reading on the lower right of the display unit, by using the + - buttons “3”.
Mini CIP will adjust the propeller pitch to obtain the set revolutions (Target Value +/- 100 RPM).

This mode of operation is the traditional one used in general aviation; it provides for a constant propeller RPM, independent of the aircraft speed and throttle position (MaP), but obviously within the possible physical limits imposed by the aircraft and flight conditions.

Automatic mode

The pilot moves switch "1" to the Auto / Cnst position and presses button “2” to set "A" on the lower left Display. In this mode the system determines the target revs based on the Manifold Pressure (MaP), according to the selected Rotax engine performance curve, and based on the Atmospheric Pressure at the altitude at which the aircraft is flying. The Max and Min rpm limits will still be those set in the system setup.

Takeoff / Landing mode

The pilot moves switch "1" to the Takeoff / Landing position. All takeoffs and landings should be carried out at this setting (selecting MIN ‘full fine’ pitch is ok but not preferred). In the Takeoff / Landing mode the value of the target revs will be the one set for this phase in the Setup (ie 5800 RPM in the Rotax), but if the time at full power extends beyond 2 ½ minutes the target revs would decrease to the set maximum continuous value (ie 5500 RPM for the Rotax).

LCD Display Description.

P29 / 5300
A29 / 5300

P29 / - Indicates the Manifold Pressure (MAP) in inches (29) and in quarters of an inch (\ ¼” , = ½” and / ¾”). In this example 29 ¾” of mercury.

5300 on the upper line indicates the engine RPM

5300 on the lower line indicates the “Target RPM” selected by the pilot (or the CIP computer in Auto Mode). When the engine RPM matches the Target RPM the propeller pitch has adjusted to the correct value.

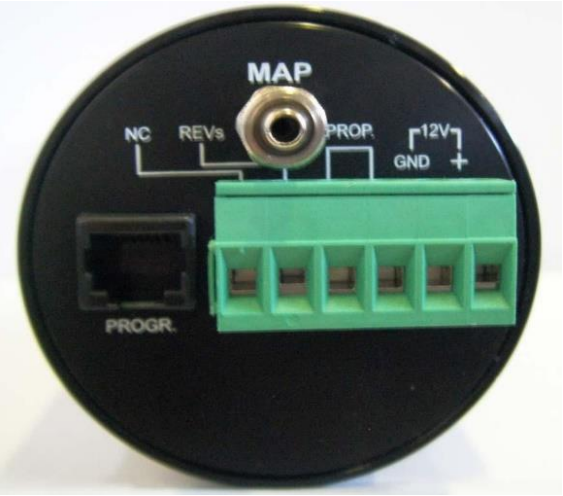
In Auto mode, the optimal "Target" number is processed by the computer according to an optimization algorithm that takes into account the phase and flight parameters. The actual revolutions and Target revolutions must coincide (with a tolerance of +/- 100 rpm), unless the propeller pitch has reached the Min or Max travel limits indicated by Green LED and Blue LED respectively.

Man Indicates that the system is set in Manual mode.

A29 \ - Indicates Atmospheric Pressure. In this example: 29 ¼" of mercury.

Atmospheric pressure varies with altitude. Typically the atmospheric pressure decreases by about 1" of Hg every 1000’ of altitude.

When the system is in Cruising mode, it determines the Target RPM based on the MaP; it essentially follows the torque curve of the selected motor. However, it always takes into account the Atmospheric Pressure, which varies with the altitude.



Installation

Electrical Installation

The MiniCIP Unit is equipped with a 6 pins connector. The pins are identified with the writings on the bottom of the unit. Proceeding from Right to Left we find the following connections:

a) Positive Pin. Primary power supply identified with the word 12V, +.

b) GND Pin Negative.

c) The two central pins identified with PROP are connected to the propeller motor. See „Test of Operation", more before, for the polarity.
d) Ilpin REVs must be connected to the lead wire of the RPM pickup e) The NC pin should not normally be connected.

Pneumatic installation
MAP
The socket for the **MaP** (**Manifold Pressure**), must be connected with a plastic tube of dimensions 4 mm internal diameter, and a "Y" or "T" branch on the socket of the engine **MaP** .

NB .: Push a cigarette paper filter into the tube before pressing connect it to the unit. The filter must be compressed and lubricated with talcum powder to be able to do so better to insert in the tube. Without the filter the reading of the MaP could oscillate and cause instability to the system.

Functional test
1) Switch on the master and the **Mini C** ustom **I** ntelligent **P** ropeller switch previously installed on the dashboard of the aircraft.

2) Look on the Display of the writings similar to the following:
P30 0000
Man 000A
If the writings do not appear, make sure that the 12V are present, in particular check the external fuse and the polarity. With reversed polarity the fuse blends and the unit can damage.

NB .: While moving the switch '1' out of the Manual position, you will notice that the unit does not switch. In fact it remains in manual, unless you start the aircraft engine.

3. Switch the unit in **Man** ual.

4. Press the **PITCH +** / **-** buttons and listen for the relays to be triggered on the main unit, in addition, the first and then the other **LEDs should be lit** , **Green** on the left and **Blue** to the right; the propeller will move towards the minimum or towards the maximum depending on whether
press the - or + respectively. Also make sure that the pitch of the propeller decreases (the **Green LED** should light up intermittently) or increases (the **Blue LED** should switch on intermittently). **If the lines are inverted, the wires are inverted that go to the propeller motor and try again.**

5. Make sure that the propeller stops at the end of travel (if it is equipped with a micro-switch of)

end of run). When the propeller is to limit **Min** imo it will turn on the **green LED .**
When the propeller is at the end of travel **Max** imo the **Blue LED** will light up **.**

6. When the propeller is operated manually you can read the current value absorbed, at the bottom right of the display. The intervention thresholds for excess of current absorbed by the propeller motor, are adjusted in the **setup** phase described further on. These thresholds act as both protection against malfunction and from electronic limit switches for the propeller.

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7. **Warning:** When you are in **Man** ual, with no propellers micro-limit switches **,** remove the contact as soon as you turn on the **LED** limit (**Green** for **Min** imo and **Blue** for **Max** imo), when you are not in Manual the contact is disconnected automatically from the **Mini CIP** computer and the problem does not arise.

7. Start the aircraft engine.

8. Turn on the **Mini CIP** .

9. Make sure the tachometer is working properly. If the tachometer does not work the **Mini**
CIP remains in **Manual** even if switched to **Automatic** .

10. Switch to **Auto / Cnst** and look at an **A29** sign at the bottom left, i
Target laps will change with the **MaP.**

11. Switch to **Constant Laps by** pressing the Set button and observe the word **Cst** below
on the left, the target laps will change from **4500** to **5500** using the **+** or **-** buttons .

12. If all the previous tests have given a positive result your **MiniCIP** stands working properly.

In case of failure or malfunction.
MAP sensor malfunction
The system works at constant rpm and in manual mode, it does not work in **Automatic** .
Atm sensor malfunction

The system works at constant rpm and in manual mode, it does not work in Automatic.

Tachometer malfunction
The system works in **Man** ual forced. This condition is highlighted:
From the target laps of **000A.**

From the **Man** indication even if the switch is in another position.

Computer malfunction
The system works in **Man** ual

Electrical protection for Mini CIP and Elica
To always fly with maximum safety we recommend protecting the circuit of power supply of the “Elica - **Mini CIP** ” group with a fuse or with a thermal breaker of suitable value.

NB: The Mini CIP contains a high current fuse (20 or 25 A) on the board printed. Each external fuse is expected to be of lower value and of faster intervention.

The protection trip current is generally obtained by doubling the operating current.

As an example, if the propeller requires a current of 7 Amps to work, the breaker on the dashboard should be 15 Amps.

Calibration of the maximum current that can be supplied to the propeller motor *.*
This value depends on the helix used. When you change the pace, every type of helix absorbs a specific current value.
Here are some absorption values as an example:
Elica Polato 2.5 A
Elica Porcelli 2.5 A
Elica IvoProp 8 A
When the propeller reaches a stroke end, both maximum and minimum, the current absorbed
it increases noticeably as the electric motor is under stress.
Some propellers never reach this condition thanks to micro-switches that they interrupt the electrical circuit before the blades reach the mechanical limit switch.
The **Mini CIP** is able to reveal the end-of-stroke both for excess and for lack of current absorbed, adapting to helices of both types, ie with or without micro-switches.
The tripping current of the **MiniCIP limit switch** must be calibrated case by case, generally the
Min imo (**Green**) threshold current is adjusted to 50% more than the current value absorbed during shoveling of the blades.
The threshold current of the **Max** imo (**Blue**) is adjusted to 50% more than the current value
absorbed during keying of the blades.
The calibrations are carried out by executing the **Setup** procedure proceeding as follows described.
The values of the absorbed currents can be read on the same display when in **Manual** bottom right

Setup
The procedure Setup is activated by turning on the Mini Custom Intelligent Propeller while press and hold the **Set** button on the display unit.

If the unit is in the " **Auto / Cnst** " position, the values of all the parameters previously set are stored and can be confirmed, increased or decreased.

If the unit is in the " **TakeOff / Landing** " position, the values of all parameters come reset to default values and can be confirmed, increased or decreased.

However, if the unit is in the **Manual** position , the **Setup** does not activate and the system turns on in normal operation. The parameters are highlighted one at a time to allow the user to accept them value or update it. The current value of the highlighted parameter is shown on the display and can be confirmed with the **Set** key , after confirming the unit goes to the next parameter. The value of the parameter in evidence can, on the other hand, be increased or decreased using the **PITCH** +/- keys until the desired value is obtained, after which it is confirmed as explained above and go to the next parameter. If you switch to **Manual** , the system exits the **Setup** and immediately switches to normal
operation.

1. **"Curr Adj. Grn"** Adjustment of the threshold for excess current absorbed by the propeller motor near the limit switch **Min** imo. Resolution in tenths of
Ampere.

2. **"Curr Adj. Blu"** Adjustment of the threshold for excess current absorbed by the propeller motor near the limit switch **Max** imo. Resolution in tenths of
Ampere.

3. **"User Corr"** Offset value of the revs (**Revs)** of the motor with respect to the **Map-Giri** curve
published in the manuals. Resolution in hundreds of turns.

4. **"Max Crus"** Maximum number of laps allowed during the cruise phase.

5. **"Min Revs"** Minimum number of laps allowed during the cruise phase.

6. **"Takeoff"** (**Take off**) Number of target revolutions for the Takeoff phase selected with lo switch "1". This value is maintained during the takeoff phase for the first two minutes and a half. If the take-off lasts more than two and a half minutes the system switches to the target rpm Mc (Maximum Continuous).

7. **"Max Cont"** Number of target revolutions **Max** imo Continuous adopted during the take-off phase
after the first 2.5 minutes.

8. **"Aspir0 Turbo1"** Select 0 for **Suction** motors and 1 for Turbo motors.

9. **Equalization MaP Atm.** The system shows both pressures: Manifold Pressure and Atmospheric Pressure. With the engine off, the two values must be the same. In If a difference, adjust the **Atm** because it equals the **MaP** .

Notes on the mechanical development of the propeller

It is advisable to adjust the minimum mechanical pitch of the propeller so as to have a fixed point e with the engine at maximum, a number of revs slightly lower than the maximum allowed by the engine manufacturer for the take-off phase. As an example, in the Rotax 912 and 914 laps at fixed point should be around 5600-5700, the maximum is in fact 5800 **RpM** . The maximum wheelbase must instead be adjusted to a slightly higher position step reached in cruising at high altitude and at maximum speed. Under normal conditions of flight the maximum step should never be reached.

Tests with propellers associated with Rotax engines:

Make sure the aircraft is braked so that it cannot move and the engine work at normal temperature. Set the **Mini CIP** in **Manual** mode . Adjust the propeller pitch to **Min** imo and set the engine revs to 5700 **RpM** . With the engine at maximum power, increase the propeller pitch and observe the **ReVs** to decrease; when the propeller pitch reaches its **Max** imo the **ReVs** should be equal to 4000 **Rpm**. Switch to **Constant Speed** and adjust the **Target RPM** , using the **Mini CIP** , to a value of 5500 and then to 4000. The engine revs should adapt and follow your value target.

Try in flight.

If all the tests listed have been successful, you can fly with your **Mini CIP** in Manual mode, setting your propeller to the pitch minimum (**Green LED** on). Obviously make sure you don't exceed the maximum laps of the your engine, keeping speed too high. If it happens, you will have to increase manually the pitch of your propeller up to the necessary.
Switch to **Automatic** mode only after reaching a safety altitude e only if the **Revs** , **Velocity** and **MaP values** are really at security levels.
Change the flight conditions to force the **Mini CIP** (**Mini Custom Intelligent Propeller**) to change the pitch of your propeller in every possible flight condition.
Take off and land in automatic mode only after you have gained more than enough confidence in the system and certainly not before having tested it thoroughly.

Responsibility

Having no control neither on the installation nor on the maintenance nor on the use of **Mini CIP** , we are relieved of any civil or criminal liability.
Consider that the take-off and reattached maneuvers, for safety reasons, go carried out with the **Mini CIP** in **Man** ual, after reducing the step at the suitable value (close to the minimum).