RPM flap controller

User manual

Revision 10

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1 Important Notices

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A Yellow triangle is shown for parts of the manual which should be read very carefully and are important for operating the FlapRPM.

Notes with a red triangle describe procedures which are critical and may result in loss of data or any other critical situation.

A bulb icon is shown when a useful hint is provided to the reader.

1.1 Limited Warranty

This RPM flap product is warranted to be free from defects in materials or workmanship for two years from the date of purchase. Within this period, LXNAV will, at its sole option, repair or replace any components that fail in normal use. Such repairs or replacement will be made at no charge to the customer for parts and labour, provided that the customer pays for shipping costs. This warranty does not cover failures due to abuse, misuse, accident, or unauthorized alterations or repairs.

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To obtain warranty service, contacts your local LXNAV dealer or contact LXNAV directly.

2 Revision History

Date	Revision	Revised	Description
May 2017	1		Initial release
May 2019	2		Updated manual
September 2019	3		Updated passwords, corrected wiring
December 2019	4		Modified, added chapters
August 2020	5		Added Ch.8 Updated Ch.3
September 2020	6		Updated Ch. 5.3.4.1 (Corrected Kd), added ch.5.1.1
February 2021	7		Updated Ch 5.3.4.1,5.3.1
April 2022	8		Updated Ch 5.3.4.1
September 2022	9		Updated tech. spec. Ch 3.1
April 2024	10	UK	Added Chapters 4.1, 2, 9, 9.1

Packing Lists

- RPM Flap control unit
- 10 pin Connector and pins
- 33kΩ, 68kΩ, and 100kΩ resistors for adjusting RPM signal level.

33kΩ	68kΩ	100kΩ
		

3 Technical Data

3.1 Power and Consumption

Table 1: Absolute maximum ratings

Parameter	Symbol	Rating	Units
Power Supply	Power	28.0	V
Maximum Power Consumption (without sensors connected to Ebox)	I_1	100	mA
Power Consumption (at full load)	I_2	560	mA
RPM pulse max voltage	V_{pmax}	100.0	V

Table 2: Electrical characteristics

Parameter	Symbol	Min	Typ	Max	Units
Power Supply	V_{in}	9.0	12.0	28.0	V
RPM Triggering Voltage	RPM	2.5	-	-	V
RPM minimum pulse width at 2.5V	$T_{min2.5V}$	100	-	-	ns
RPM minimum pulse width at 5V	T_{min5V}	50	-	-	ns
Motor current (Prop and Flap)	I_h			6	A
Flap potentiometer reference voltage	V_{fr}		3		V

3.2 Size and Weight

Size: 57 mm cut-out, 61x61x48mm
Weight: 300g

4 System description

4.1 Part numbers

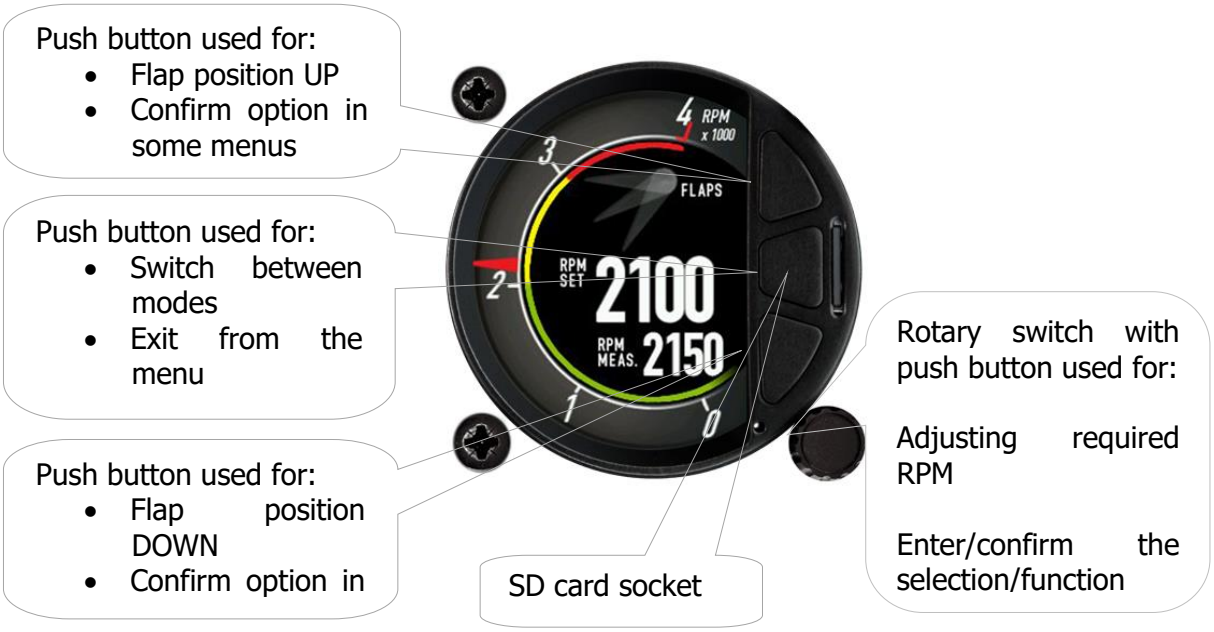
Model	Part number	Description
Flap selector	FLAP-SELECTOR	External Flap selector connected via CAN bus to the RPM-FLAP controller
Flap controller	FLAP-CONTROLLER	Controller for driving flap actuator with resistive input feedback

4.2 Push Button – Rotary Switches

The two Rotary switches also have a push button function. The LXNAV RPM & Flap controller detects short or long presses of the push button. A short press means just a click, a long press means pushing the button for more than one second.

4.2.1 Rotary Switches

The upper rotary knob is momentary without function



The lower rotary knob is used to adjust required RPM or settings within menus. With the lower rotary push button is possible to adjust setting values and editing texts.

4.2.2 Buttons (Three)

The three buttons between the two rotary knobs have fixed functions. The top button gives command to flap, to move one position up, lower button gives command to flaps, to move down.
The middle button will switch page, on ground (when engine is not running), to page with flight and total time.
Long press of middle button will bring you to the setup menu.

4.3 Switching on the Unit

The unit powers up immediately, when it gets power supply.

4.4 SD card

Primary function of SD card is to make firmware update of the system.

4.5 User Input

The LXNAV RPM & Flap controller user interface consists of dialogues which have various input controls. They are designed to make the input of names, parameters, etc., as easy as possible. Input controls can be summarized as:

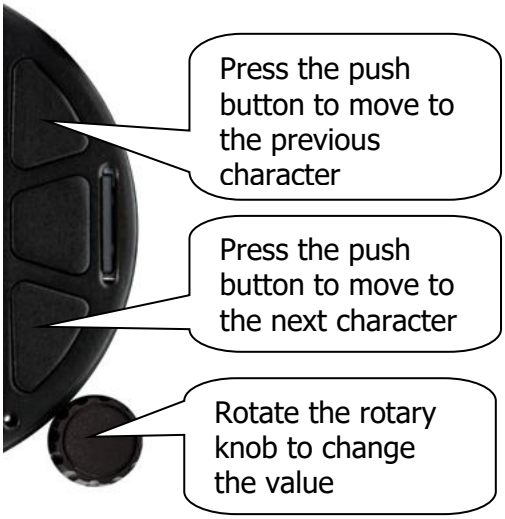
- Text editor
- Spin controls (Selection control)
- Checkboxes
- Slider control

To move the function from one control to another, rotate the lower rotary knob as follows:

- Clockwise rotation will select the next control.
- Counter clockwise rotation will select the previous control. The lower PUSH button enters the selected feature.
- Faster rotation of the rotary knob will increase the rate at which the value changes i.e. bigger steps in value.

4.5.1 Text Edit Control

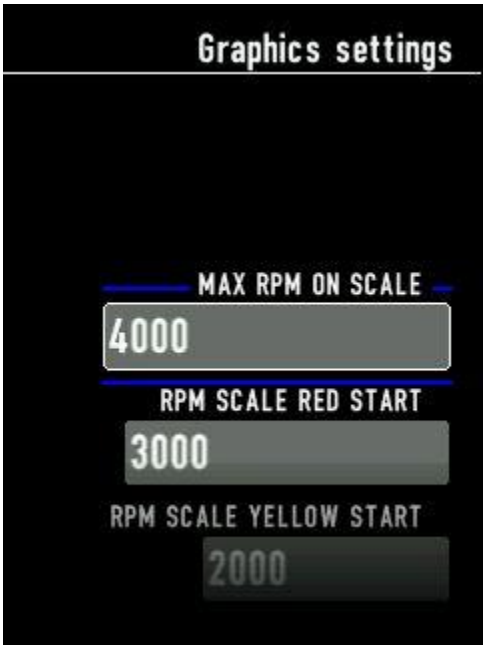
The Text Editor is used to input an alphanumeric string; the picture below shows typical options when editing text/numbers. Use the lower rotary knob to change the value at the current cursor position.



Once the required value is selected press the lower push button to move to the next character selection. To move back to the previous character, press the upper push button. When you have finished editing, press the Enter key – the lower rotary button. A short press of the middle push button exits from the edited field ("control").

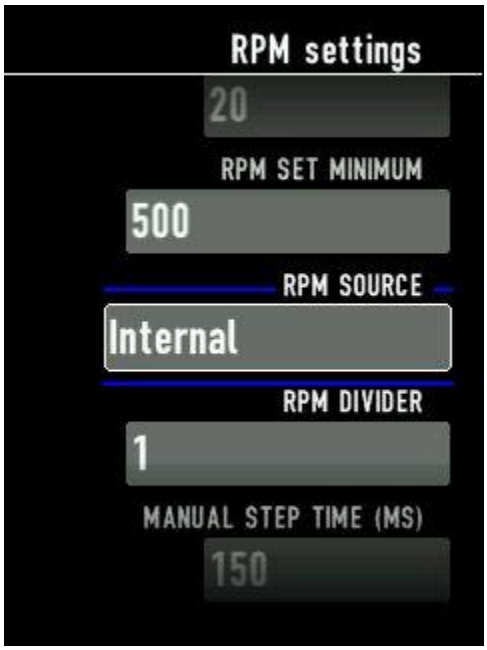
4.5.2 "Spin" Control

"Spin" controls are designed for numeric parameters. Rotate the knob to increase/decrease the selected value. To increase a value in larger steps, spin the lower rotary knob faster.



4.5.3 Selection Control

Selection boxes, also known as combo boxes, are used to select a value from a list of predefined values. Use the lower rotary knob to scroll through the list.



4.6 Switching Off

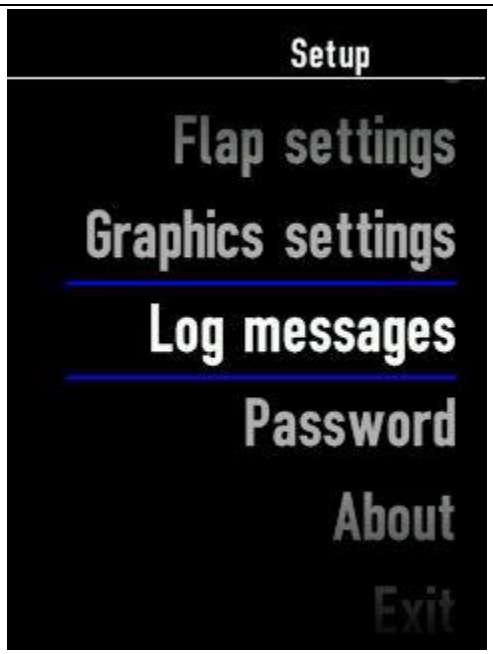
Unit switches down, when power goes down.

5 Operating Modes

The LXNAV RPM & Flap controller has three operating modes. Push to lower rotary knob will toggle between Manual and automatic mode of RPM setting.

With Short press to middle button we enter to info page with flight time and total engine running time.

With long press to middle button user can enter in setup menu.



5.1 Automatic and manual mode.

In **automatic** mode RPM is regulated all the time to required (SET) RPM.
In **manual** mode we are adjusting pitch of propeller manually. The RPM may vary.

5.1.1 MIN/MAX pitch position detection

When propeller reaches maximum or minimum position, the position of the prop will be indicated as MIN PITCH or MAX PITCH.
MIN PITCH is the position of propeller for takeoff and landing
MAX PITCH can be used only in cruise.

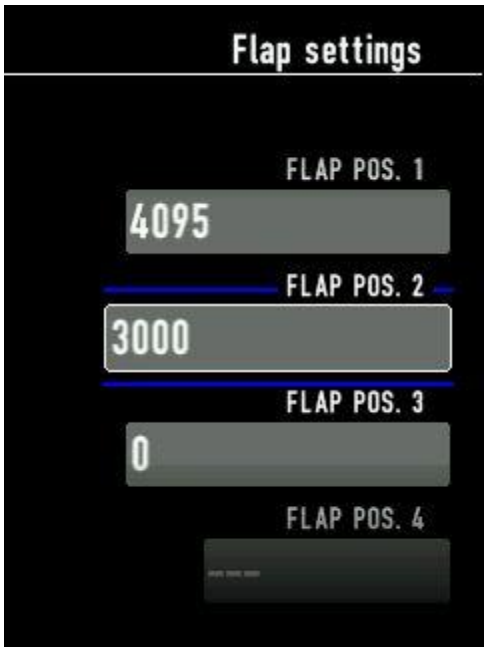
This function is supported with firmware 1.03(Display) and 1.03(Regulator) or higher

5.2 Flap position selection

With pressing upper① or lower② button, pilot can choose between flap presets. Requested flap position will start blinking, flap will move until will not reach requested flap position (pre programmed value). When requested position is reached, flap will stop blinking.
In case that movement of the flap is not detected, unit will display an error.

5.3 Setup Menu

5.3.1 Flap settings



Number of flap positions and their positions are also programmed in factory. Set focus to flap, that you want program, then with long press to upper or lower button adjust flap angle for each flap position. Flaps can be displayed graphically or as number/name.
Reverse flap order will invert the entered table. You can use that, in case you have start to program flap positions from the wrong side.

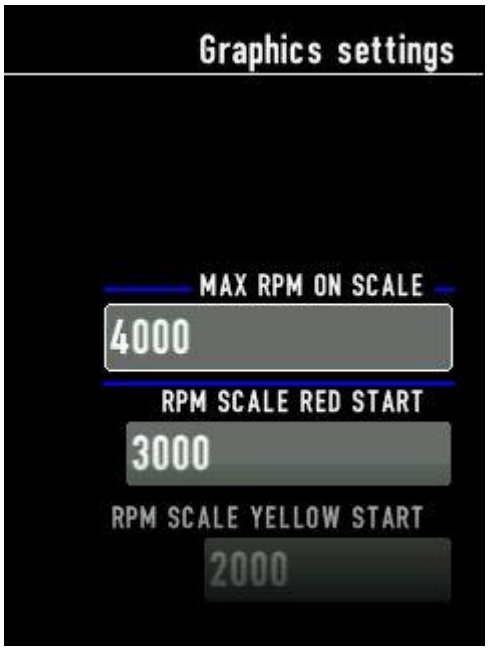
Automatic RPM setting after flap change is possible, if that feature is **enabled**. You must set **required RPM** and **time** after flap command, the RPM will change to requested value. The unit has two settings, one is for flap going from 0 position and another for flap is going to zero position.

Please use this function with caution, if you don't understand this feature, please leave it disabled.

5.3.1.1 Programming flap positions

- Set focus to flap position and push to edit flap position ①
- Manually drive flap to the right position using up②/down③ flap button
- Confirm flap position ①

5.3.2 Graphics settings



In this menu user can set colors of RPM scale.
Max RPM on scale is the maximum position of the RPM needle that can indicate.
RPM scale red start is RPM value, where needle will come to the red area.
RPM scale yellow start is RPM value, where needle will come to the yellow area.
Initially **Engine hours and minutes** can be set, then the engine hours will increase automatically when RPM is present.
Red engine hours is a setting, when pilot will get announcement that is time for next check of the engine. After service, you can set this to a hours, when next service interval is required.

5.3.3 Log messages

In this page are displayed last error messages with time stamp.

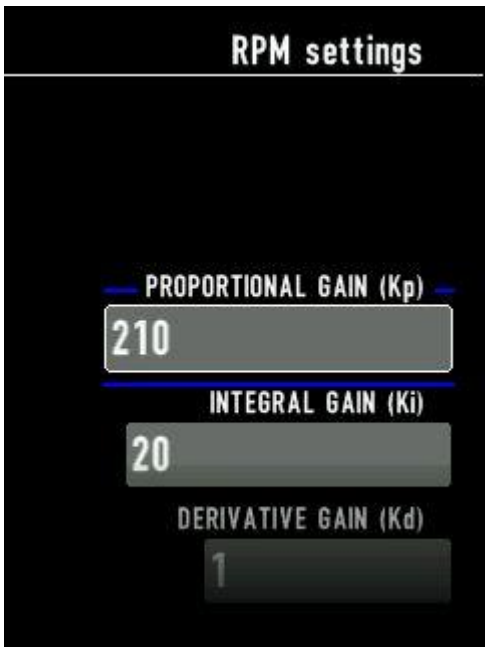
5.3.4 Password

Password 89891 can be used for firmware update.
Password 44444 can be used to enter into RPM setup
Password 00666 will reset unit to factory default. All settings will be lost
Password 90000 and 91000 are debug information passwords
Password 43001 is toggle function to log can data on SD card

5.3.4.1 RPM setup

This menu is not recommended for users to do any changes. Most of data is set in factory.

Changing data in this menu may affect to wrong operation of the RPM regulation. RPM can oscillate or not reach requested RPM setting.



Default settings are:
Kp:**1670**
Ki:**0**
Kd:**5**
Deadband:**50**

Initial RPM setting is the value that will be set after power on.
Maximum RPM setting is a max. value, that user can set for the RPM.
Minimum RPM setting is a min. value, that user can set for the RPM.
RPM step is the step for setting RPM.
RPM source can be internal or external. Internal is analogue input on RPMFLAP controller. External can be used in case that RPM data is received via CAN bus. For Rotax 912IS, is necessary CAN2CAN adapter, which convert RotaxCAN to LXNAV CAN. eCopilot can be connected directly to the CAN bus of the RPMFLAP controller.
RPM divider is a values to set correct RPM indication in case of internal measurement of the pulses.
Manual step time is a time in ms, for manual setting of the pitch. One click on rotary knob, will give a xxx milliseconds long pulse to change pitch of the propeller.
Engine hours and **minutes** is the HOBBS time.
With Enabling **RPM presets for buttons**, you can program the function of all three buttons to have quick RPM setting for each button (**Top Button Preset**, **Middle Button Preset** and **Lower Button Preset**).

Enabling RPM preset buttons, flap control with those buttons will not work. Remains only external flap selector.

5.3.5 About

Under setup-About is the information about unit. Its serial numbers and running firmware versions.

6 Firmware Update

Firmware updates for the main display indicator and regulator can be easily carried out using the micro SD Card. Please visit our webpage www.lxnav.com and download the firmware update.
You can also subscribe to a newsletter to automatically receive news about the system.

6.1 Updating LXNAV RpmFlap unit Firmware Using a Micro SD Card

Copy the firmware **LXFW** file type to the SD card. The unit will ask you to update.
After confirmation the firmware update will be performed automatically.

7 Backup - manual/automatic - switch flip over (optional)

Along RPM flap controller unit can be used panel mounted switches with whom user can select between manual or automatic control of propeller and flaps pitch. For each function has to be used one switch unit, one for propeller control and one for flaps. Each unit has two switches. With left toggle switch user can choose between manual or automatic control of function for the switch is used. When lever is switched up, automatic function is enabled (motors are driven by RPM flaps unit) and when the lever is down, manual control is enabled. In this option user can override pitch with right momentary toggle switch. When pushing lever up, flaps go up (negative movement) or pitch of propeller increases and vice versa, when pushing switch down, flaps go down (positive movement) or propeller pitch decreases. In following chapters, 10.2 and 10.3, is described, how switch unit must be wired together with electric motor and RPM flap controller.

Figure 1: Panel mounted switch unit

8 RPM – installing and tuning

RPM flap indicator has one dedicated port for RPM readings.

Input has an internal resistance of 100kΩ. It is designed for passive P-lead sensing, but with some external components, it can be used in other situations also.
RPM sensing is done in various way:

- Direct P-lead sensing from magnetos (Lycoming, Continental) – Figure 2
- Active P-lead sensing from magnetos (JPI 420815) - Figure 3
- Passive P-lead sensing from magnetos (inductive pickup) - Figure 4

8.1 Direct P-lead

Direct P-lead sensing from magnetos is the least preferable way of measuring RPM (wiring shown on Figure 2). Because of high voltage spikes on magnetos, user must include a series resistor that has a value of 33kΩ. If the readings are unstable, the user must increase the value of the resistor (100kΩ or more) until the issue is resolved. Be sure to mount the resistors near the ignition switch, since magnetos are high voltage spikes that cause a lot of EM interference. This is the least preferable way of measuring RPM, because it does not isolate RPMFlapBox from the damaging high voltage spikes generated on the magnetos.

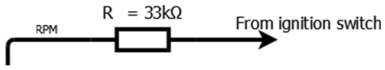


Figure 2: eBox - Direct P-lead sensing

8.2 Active P-lead

Active P-lead sensing from magnetos is a preferred method of measuring RPM. Sensors like the JPI 420815 have a open-collector digital output (no high voltage spikes) and isolates the eBox from the magnetos. Figure 3 shows connection for such a sensor. Since RPM inputs on the eBox have no internal pullup, user must include a pullup 2.2kΩ to +12V.

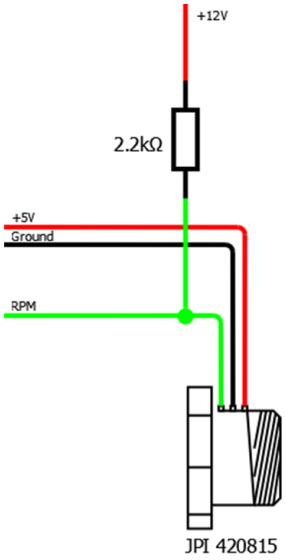


Figure 3: Active P-lead sensing from magnetos

8.3 Passive P-lead

Passive P-lead sensing is also a option for measuring RPM with eBox. A good example is the Rotax 912 which has a passive inductive pickup. Figure 4 shows the connections for this kind of sensing.

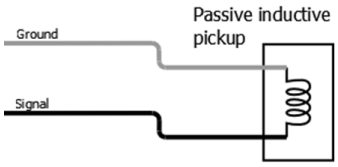


Figure 4: Passive P-lead sensing from magnetos

8.4 Kelly dual magnetos and Slick 4347

We tested Kelly dual magnetos and Slick 4347. With Kelly was the best resistor value 29.2 kΩ. With Slick single magneto this value was for R1 = 38.3 kΩ. Those values can also vary, even if the model type is the same.

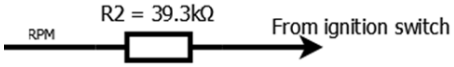


Figure 5: eBox - Direct P-lead sensing (Kelly magneto)

Figure 6: eBox - Direct P-lead sensing (Slick magneto)

8.5 Rotax 912

Test on Rotax912 has given results that the resistor should be arround 100kΩ. It may work with 30kΩ, but some wrong reading are expected at higher RPM.

8.6 Rotax 914

Test on Rotax914 has given results that the resistor should be arround 100kΩ. It may work with 30kΩ, but some wrong reading are expected at higher RPM. RPM signal has been taken from TCU (Turbine control unit).

8.7 RPM input via CAN bus

In case that ECU can provide RPM information via CAN bus it can be used as RPM source. ROTAX 912 IS provides RPM information via CAN BUS. For connection is necessary CAN2CAN converster, which converts Rotax CAN data to readable format for RPM controller.

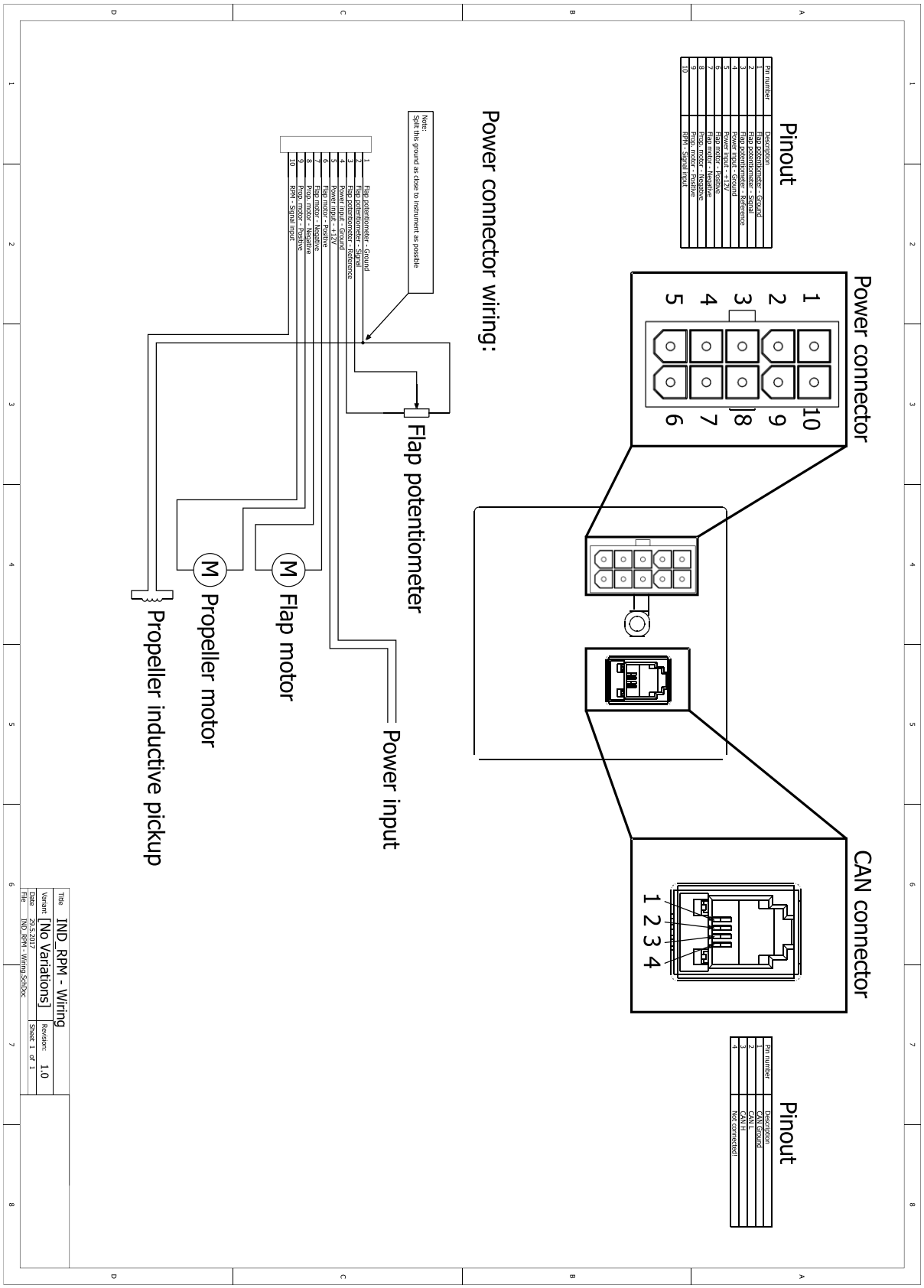
9 Options

9.1 Flap Selector

With flap selector, you can control flaps more intuitive. Please refer to the flap selector for more details.

10 Wiring

10.1 RPM flap controller pinout and wiring diagram



10.2 Flap motor control switch

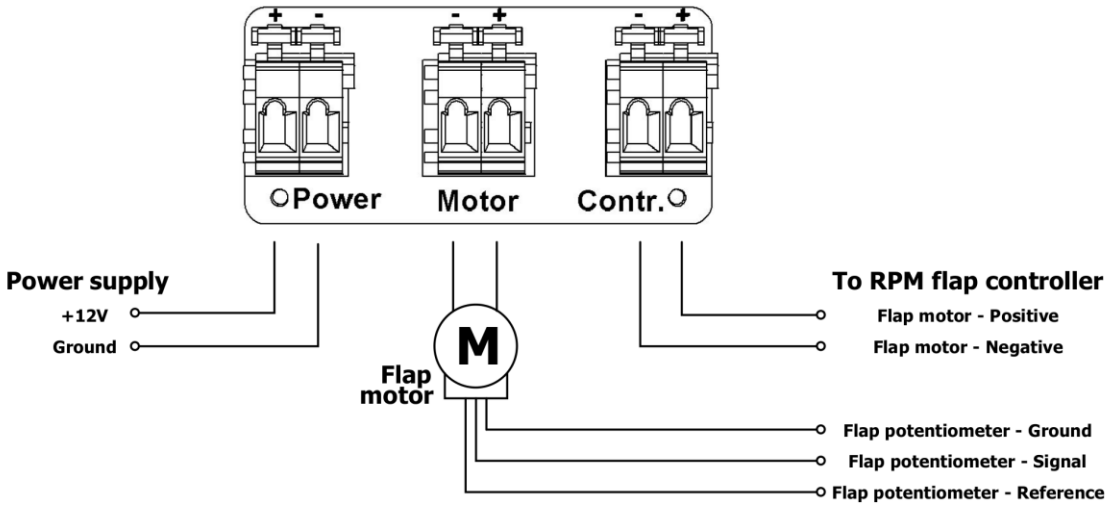


Figure 7: Backup switch connections for flap motor controller

10.3 Propeller motor control switch

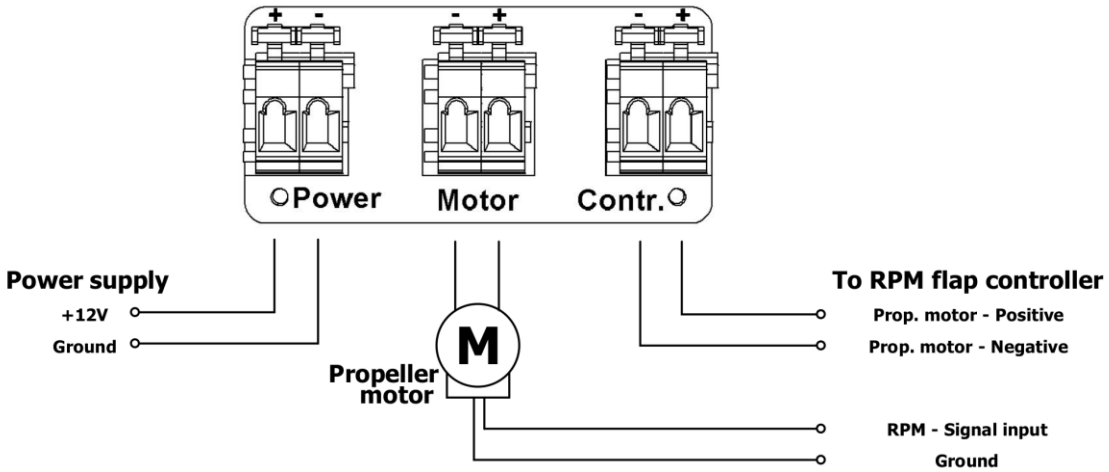


Figure 8: Backup switch connections for propeller pitch motor controller

11 Dimensions

11.1 RPM flap controller

11.2 Backup switch

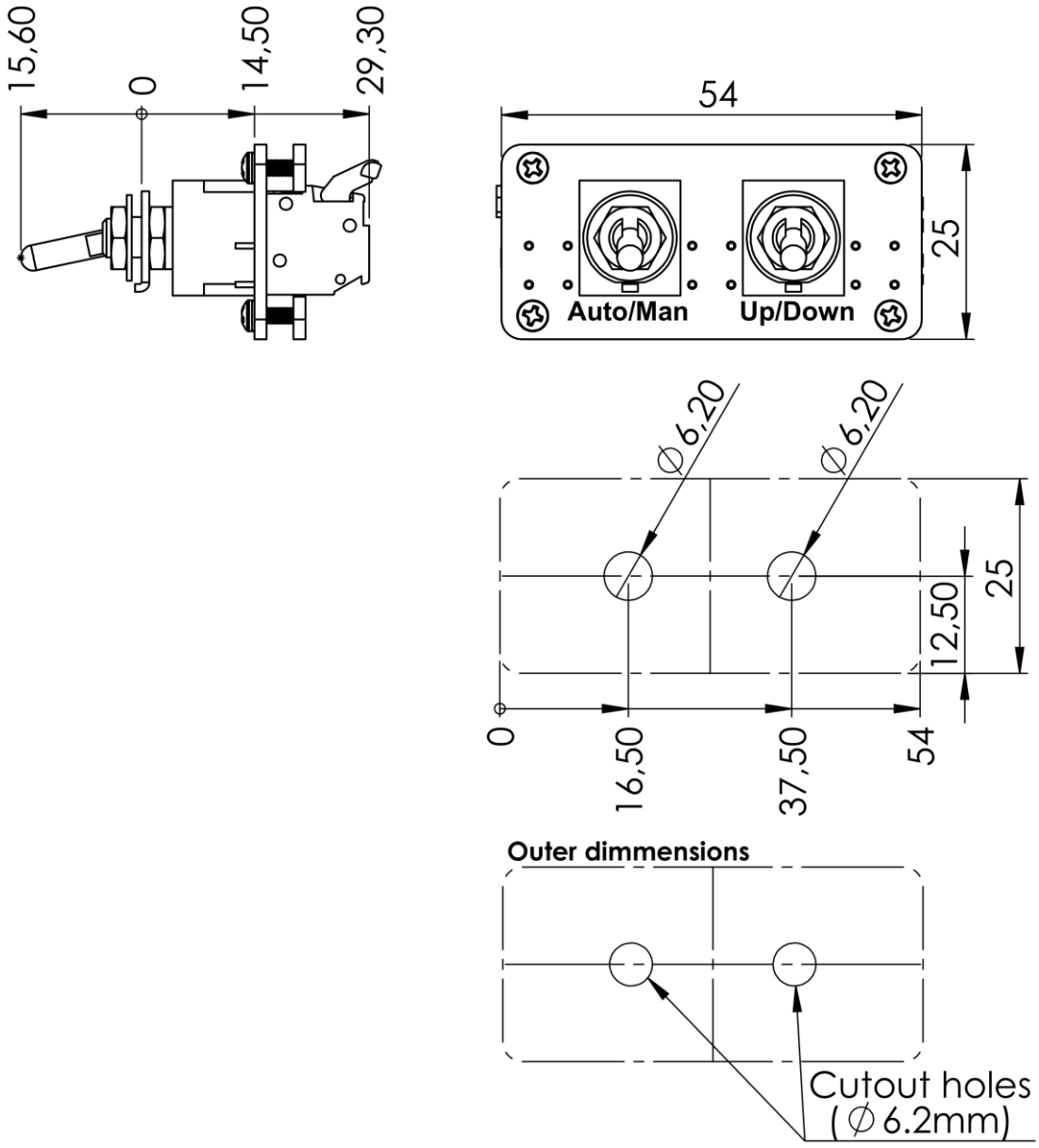


Figure 9: Dimensions and panel cutout holes (not to scale)