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FAI AEROMODELLING COMMISSION (CIAM)
ELECTRONIC DEVICES IN COMPETITIONS WORKING GROUP (EDIC-WG)

References:
FAI web site: www.fai.org
CIAM website: www.fai.org/aeromodelling

To: CIAM web site under AMRT Approvals
CIAM Technical Secretary
F1 Sub Committee

Copy: Manufacturer Concerned

Date: 1 July 2023

CIAM APPROVAL FOR F1 ALTIMETER

Approval Reference:	**AMRT004**
Manufacturer:	**Flying Neurons**
Manufacturer Contact:	**Frederic Aberlenc, aberlenc@flyingneurons.com**
Device Name/s:	**Neurone, MiniNeurone and Flying Neurons app**

(i) This document gives formal approval from the above date for the AMRT equipment described below to be used for competitions under the Sporting Code Section 4: Aeromodelling – Class F1 – Free Flight.

(ii) This document is the initial approval for this type of AMRT and only applies to the functions relevant to the F competition class rules.

(iii) Tests undertaken by EDIC-WG (or such representative as it may appoint), are specifically concerned with the functions relevant to the F1 competition class rules.
Other functions of the equipment are not part of this approval and the relevance of this document does not extend beyond the specific validation and certification purposes mentioned above.

(iv) This document does not constitute a guarantee of compatibility of the device listed above with any associated devices with which it may be interconnected.

(v) This document does not constitute any guarantee and/or statement by EDIC-WG, CIAM and/or FAI as to the reliability of the device listed above.

(vi) This approval is not concerned with National and other regulations relating to electronic equipment and compliance with such regulations is not the responsibility of the FAI.

(vii) This approval is not concerned with, and the FAI has no responsibility for, matters related to:
(a) Intellectual property and intellectual property rights and/or,
(b) Relations of the manufacturer listed above with any other entities except with FAI and its agents or as they affect the FAI, its agents and this approval.

EQUIPMENT

1 HARDWARE

Left: *Neurone*
Right: *MiniNeurone*

1.1 Equipment Names

MiniNeurone (combined altimeter-GPS).
Neurone (communication interface between MiniNeurone and the Flying Neurons app).

1.1.1 Hardware Version

There is no hardware version number printed in silkscreen on the Neurone and MiniNeurone circuit board. Instead, the hardware version is identified by the physical appearance of the miniNeurone and Neurone. For this a color coding is used. Currently the MiniNeurone uses a red antenna grommet while the Neurone is a black polymer enclosure with a blue globe image and red SOS button on its front.

1.1.2 Interface

The flight data are sent from the MiniNeurone via a radio link to the Neurone unit. The Neurone sends these data via Bluetooth to the Flying Neuron app.

1.1.3 External Features

None

1.1.3 Unique identifier

Each MiniNeurone is assigned a unique identification number both in hardware (a sticker on the MiniNeurone with the number for the time keeper to verify) as well as being sent together with the flight data and visualized in the Flying Neuron App. Additionally, each flight is displayed in the app together with the UTC time (taken from the GPS signal) of the flight adding additional anti-tampering functionality.

1.2 Pressure height sensor

The sensor is the LPS22HH by STMicroelectronics with a resolution of 10 cm, absolute pressure accuracy of 0.5 hPa, low noise (0.65 Pa), embedded calibration and temperature compensation. The sensor is covered by a plastic housing to limit air turbulence over the sensor and avoid light induced height fluctuations caused by the pressure sensor light sensitivity.

1.3 Flight time accuracy

The time base is a quartz-crystal with 10 ppm accuracy.

1.4 Pre-flight check by timekeeper

The timekeeper can check the unique ID number printed on a label on the top of the MiniNeurone module and can check if the recording memory has been cleared from previously recorded data (led blinks green). If height data are still present, the green led will not blink and the user must clear the memory by using the Android or iOS “Flying Neurons” app to do so. The unique ID number and memory status can be marked on the scorecard prior to flight.

1.5 ANDROID and, iOS APP / SOFTWARE

The app allows full graphing possibilities to evaluate the time versus height data. The app connects to the MiniNeurone module via the Neurone unit using a Bluetooth connection. Upon connection, the unique ID number and firmware number are being shown. Buttons provide connection to Neurone and MiniNeurone module, download of height and UTC time data, clearing of memory and starting the graphing functionality. All downloaded data are stored on the Android / iOS device for further graphing analysis such as: preset max time for altimeter fly off purposes, set of zero-time, set of zero height, independent X and Y zooming, estimated flight to ground using average global sink rate, local sink rate (time window definable).

1.5.1 App SW Version

Android Flying Neurons app:	1.1
iOS Flying Neurons app	1.1

2 TESTS PERFORMED

2.1 Time accuracy

Two MiniNeurones were exposed to a sharp pressure drop twice with an exact 10 minute interval. The time produced in the Flying Neuron app was verified to be 600 seconds.
Result: PASS

2.2 Height accuracy

2.2.1 Height by lifting

Two MiniNeurones were taken up 26 stairs in parallel with a certified altimeter (the All-Tee) and the height graphs were compared. Mutual difference was only 10 centimeters.
Result: PASS

2.2.2 Height by pressure

Two MiniNeurones were positioned in a vacuum excicator together with a certified altimeter (the All-Tee). The pressure was lowered to and equivalent of 3000 meters and the differences between the units compared. Relative difference 0,1%.
Result: PASS

The MiniNeurones were tested if they could also measure negative height data (if the model lands below the flight start ground level).
Result: PASS

2.3 Start up behavior

The MiniNeurones were switched on and the height recording started immediately. A certified altimeter (All-Tee) was positioned next to the MiniNeurones to give an ambient pressure reference. The height graph was analyzed if it would drift with time since the moment of switch on. There was no noticeable drift detected.
Result: PASS

2.4 Data resolution (time and height)

The height graphs produced in the Flying Neuron app were analyzed if the data frequency was 5 Hz or faster. The height resolution is 0.1 meter.
Result: PASS (data recorded at 5 Hz, height resolution 0.1m).

2.5 Recording capacity

More than the required 40 minutes of flight data can be stored.
Result: PASS (2 hours can be stored).

2.6 Memory cleared indicator

Once the command is given in the Flying Neuron app to clear the existing data inside the MiniNeurone, the MiniNeurone shows a green blinking led at 1 Hz.
Result: PASS

2.7 Flight data stored independent from data recording unit (MiniNeurone)

All downloaded flight data are permanently stored in the Flying Neuron app.
Result: PASS

2.8 Temperature sensitivity

The MiniNeurone was exposed to a temperature range of -10 to +50C. Height deviation over this range was -2.0 m (negative temperature coefficient).
Result: PASS

3 FIRMWARE.

3.1 Firmware Version

MiniNeurone 1.2

Neurone: 3.3

Firmware version of both the connected MiniNeurone as well as the Neurone are visualized in the Flying Neuron app.

3.1.1 SW Changes

Reduction in consumption of up to 50% compared to version 1.1 for MiniNeurone.
Barometric height display during flight.
Display of the strength of the radio signal allowing a very precise search in dense vegetation.
40% reduction in altimeter reading time.
Addition of “end of battery” mode. The GPS is switched off, but the MiniNeurone periodically sends the last position calculated before switching off.
Various minor fixes.

3.2 Pressure to ISA Height Conversion

The firmware uses a high precision computation to perform the pressure to ISA height calculation. Calibration factors provided by the pressure sensor manufacturer are incorporated in the calculation. The calibration values are factory stored in the sensor and used by firmware.

3.3 Recording Frequency and Capacity

Five measurements per second (fixed). Up to 2 hours of recording capacity.

3.4 Temperature Compensation

The firmware incorporates temperature compensation processing in accordance with the pressure sensor manufacturer’s recommendations.

3.5 Dynamic Response

Oversampling of pressure sensor data and subsequent processing does not contribute any significant degradation of dynamic response in the context of the F1 competition application. The oversampling guarantees low noise levels of +/- 10cm still in air.

4 CONDITIONS OF APPROVAL

4.1.1 This Approval is only applicable to devices of the type described and manufactured to the same production standards as the example evaluated.

4.1.2 This Approval is not applicable to any device which has been subject to repair or modification by person(s) other than the original manufacturer or his authorised agent.

4.2 Withdrawal of Approval

If after this Approval has been issued, inconsistencies of performance are found in further examples of the device(s), Approval may be withdrawn upon notice to the manufacturer.

4.3 Changes to F1 Class Rules

If the F1 class rules are amended in any manner that affects the technical specification of the altimeter, the validity of this Approval will be subject to review.

4.4 Expiry of Approval

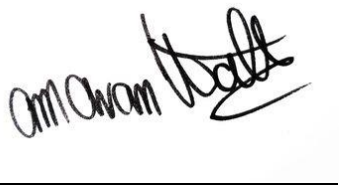
This Approval remains active until it is either superseded or withdrawn. A list of all currently active Approvals can be obtained from the FAI CIAM website.

5 PRODUCTION STATUS

At the date issue of this Approval, the Neurone and MiniNeurone together with the Android / iOS app are in current production.

6 MANUFACTURER'S CHANGES

The manufacturer must make notification of any changes to hardware and/or firmware to the Chairman of EDIC-WG so that a decision can be made on any further testing that might be required to maintain CIAM Approval of the altimeter. This includes changes that are applicable to any additional functions of the device that do not necessarily form part of the F1 requirements.



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