FÉDÉRATION AÉRONAUTIQUE INTERNATIONALE
Maison du Sport International Avenue de Rhodanie 54 CH-1007 Lausanne Switzerland
Tel: +41(0)21/345.10.70; Fax: +41(0)21/345.10.77; sec@fai.org

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 EDIC Approvals
CIAM Technical Secretary
F1 Sub Committee

Copy: Manufacturer Concerned

Date: **7** July 2025

CIAM APPROVAL FOR F1Q Energy Limiter

Approval Reference: **F1QEL005**
Manufacturer: **AJK electronics**
Manufacturer Contact: **elf1q@AJKelectronics.pl**
Device Name/s: **ELF1q-AJK**

(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.

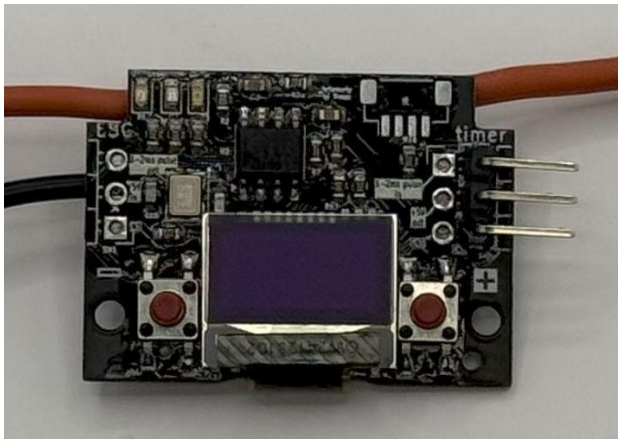
(iii) Tests undertaken by EDIC-WG (or such representative as it may appoint), are specifically concerned with the functions relevant to the F1 competition class rules.
Other functions of the equipment are not part of this approval and the relevance of this document does not extend beyond the specific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

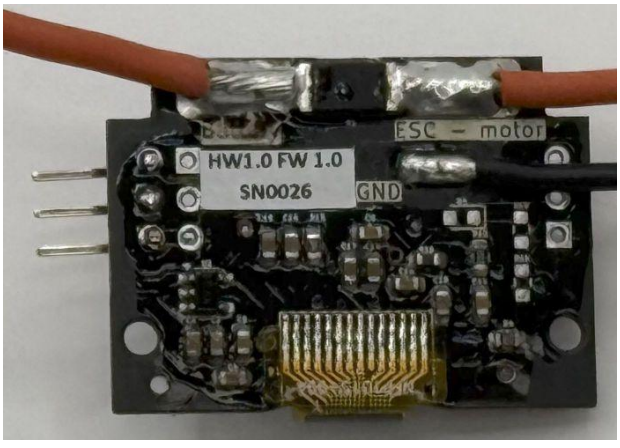
(iv) This document does not constitute a guarantee of compatibility of the device listed above with any associated devices with which it may be interconnected.

(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 PRINCIPLE OF OPERATION

The ELF1q-AJK is an F1Q limiter designed for the F1Q class It monitors elapsed time and energy consumption, as well as ESC pulses from the timer, supply voltage, and motor current. Once the predefined energy limit is reached, it stops the motor by overriding the ESC pulse and sends a stop signal to the timer.

2 HARDWARE

2.1 Equipment Name

"ELF1q-AJK".

2.2 Hardware Version

The HW version is 1.0. While the version is not printed in the PCB, it is showed on the device screen after power-up for 5 seconds.

2.3 External Features

The **ELF1q-AJK** energy limiter is built on a single electronic board and includes an integrated OLED display. It comes with short cables for the ESC and battery, a ground cable, several pin headers for digital I/O signals, two tactile switches for setting the power limit, three status LEDs, and a telemetry connector.

2.4 Current/Voltage sensing

The voltage is measured with a resistor divider and the current is sensed through a shunt resistor. Both voltage and current are digitized through the internal microcontroller's analog-to-digital (A/D) converter.

3 FIRMWARE

The firmware of the ELF1Q-AJK, along with its version number, is stored in the microcontroller´s flash memory. It is read-protected and cannot be modified or accessed by the user in any way.

3.1 Firmware version

The currently supported firmware version for the **ELF1q-AJK** is **FW 1.0** and is displayed on the device screen after power-up for 5 seconds.

3.2 Sampling rate

Current and Voltage sample rate is 50 samples per second.

3.3 Minimum current threshold

The minimum current threshold is 0.2A .

3.4 Calibration

Each device is individually calibrated with the calibration parameters stored in the microcontroller´s non-volatile memory. These parameters are protected and cannot be modified by the user.

3.5 Energy calculation.

The duration of each measurement and calculation cycle is recorded, and the energy consumed during that cycle is calculated using the formula: *Energy (J) = Voltage (V) × Current (A) × Time (s)*.

3.6 Displayed information

Upon startup, the **ELF1q-AJK** limiter sequentially displays its firmware version, serial number, data from the previous flight (including consumed energy and motor run time), and the currently set energy limit.

3.7 Displayed resolution

The resolution for the displayed energy is 1 Joule.
The resolution for the displayed motor time is 1/10 of a second.

3.8 Programmability of the target energy limit

The target energy limit is programmable in 1-Joule increments using 2 small tactile switches located next to the display.

3.9 Recording capabilities

The **ELF1q-AJK** limiter retains the programmed target energy limit and records the energy consumed during the last cycle. This data is stored in the microcontroller's non-volatile memory and is displayed at the next power-up. All stored values are read-protected and cannot be modified by the user.

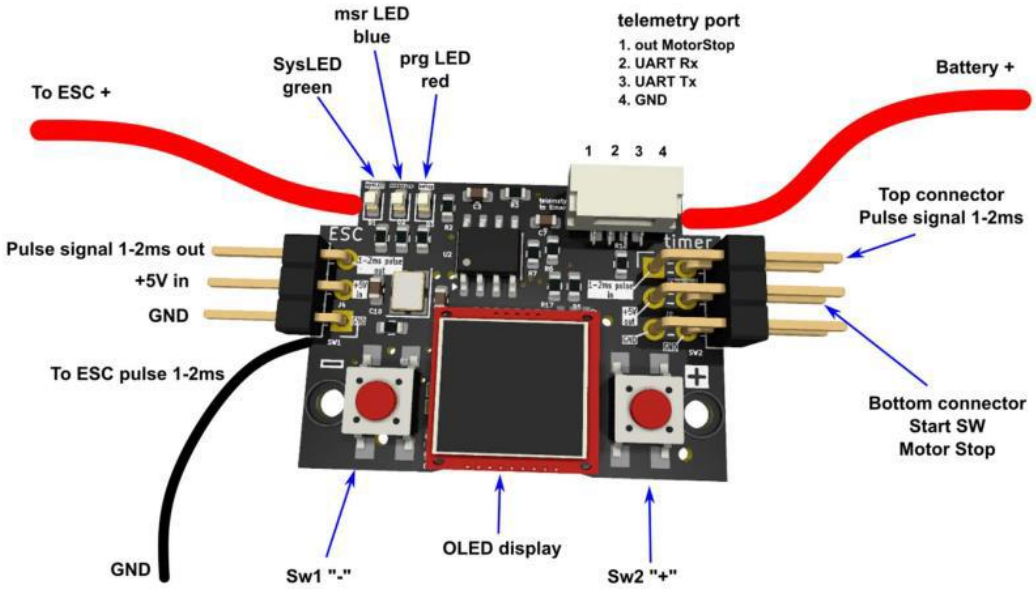
4 Digital I/O

4.1 Start switch

The **ELF1q-AJK** limiter is armed when the switch is pressed (falling edge, contact closed) and begins energy measurement when the switch is released (rising edge, contact open).

4.1.2 Input/output signals

BATTERY+	Red cable terminated with a 3.5 mm **female** bullet connector	- battery plus
ESC+	Red cable terminated with a 3.5 mm **male** bullet connector	- ESC plus connector
GND	Black cable terminated with a 2.0 mm **male** bullet connector	- battery minus
ESC i/o	single row 2.54mm male 3 pin header	- to the ESC
TIMER i/o	double row 2.54mm male 2x 3 pin header	- to timer, start switch etc.
Tel. port	4 pin jst connector	- telemetry, motor stop



5 TECHNICAL DATA

Dimensions:	32 x 23.5 x 8 mm (without wires)
Weight:	10 g (without wires)
Current measurement method:	voltage developed on a shunt resistor
Shunt resistance:	0.002 ohm
Voltage range:	3.7 - 25 Volt
Current range:	0.5 - 20 Ampere
Accuracy of energy measurement:	< ± 2 %, resolution 1 Joule
Energy setup range:	100 - 1650 Joule
Operating conditions:	-10 ... +50 ºC

6 VERIFICATIONS of the ELF1q-AJK Limiter

6.1 Testing equipment

- regulated DC power supply capable of 0 to 24 volts, 30 Amps output (**Telcom AV-8-30NF**)
- precision constant current electronic load capable of 20 Amps (**Atorch CDL-24P**)
- digital electronic multimeter (**Peaktech 3360 DMM** - 60.000 counts)
- digital electronic multimeter (**Aneng AN8008** - 10.000 counts)
- 2-channel digital storage oscilloscope (**Tektronics TDS220**) for accurately measuring the PWM pulse width change when the energy limit is reached
- Dual input automatic digital stopwatch with 1/100 second resolution started by the start switch and stopped by the limiter (‘motor Stop’ signal) when the energy limit is reached. No manual intervention is required
- start switch connected to the EL to start energy accumulation
- r/c servo tester (**Hitec**)

6.2 Test sequence

Two identical tests are conducted, each with different power loads and energy limits.

6.2.1 TEST #1 - 800 Joules / 40 Watts

- set the energy limit on the device to 800 joules
- Connect the start button to the appropriate input
- Connect a servo tester to the "Pulse signal 1–2 ms input" and set the pulse length to 1.75 ms
- Connect oscilloscope channel 1 to the "Motor Stop" pin and set the trigger to the first falling edge
- Connect the automatic stopwatch inputs to the "Start SW" and "Motor Stop" pins
- Connect oscilloscope channel 2 to the "Pulse signal 1–2 ms output"
- Set the power supply to 10 volts
- Configure the electronic load to 40 watts and apply the load. The expected current should be 4 amps
- Press and hold the start switch for 2 seconds, then release it:
  - The stopwatch should start
  - The limiter should begin measuring and displaying the consumed energy
- Monitor the PWM signal to the ESC:
  - The pulse duration must remain at 1.75 ms during the test
  - When the energy limit is reached, the pulse must immediately drop to less than 1.0 ms
  - A 30 ms negative pulse must also be generated on the "Motor Stop" output
- Verify stopwatch behavior:

- Ensure it stops automatically
- Confirm it displays 20 seconds ± 2%, i.e., between 19.6 s and 20.4 s

- Check oscilloscope data to confirm the expected transition in the PWM pulse duration from 1.75 ms to <1.0 ms at the correct time

6.2.2 TEST #2 - 1600 Joules / 80 Watts

This test is identical to Test #1, except for the following changes:

- Set the energy limit to 1600 joules
- Set the electronic load to 80 watts, resulting in a current of 8 amps at 10 volts

6.2.3 TEST RESULTS

Multiple iterations were conducted using the procedures described above on two pre-calibrated units provided by the manufacturer, in accordance with section 3.4. Tests were performed with both resistive loads and real loads, the latter consisting of a **Sunnysky X2212-12** brushless motor paired with a **Castle Creations Talon 15** ESC.

Across the full specified temperature range (**–10°C to +50°C**), the limiter tripping time showed an average deviation of **-0.77%** for resistive loads and **+1.10%** for real motor loads compared to the expected values.

F1QEL test	temp	max dev %	set voltage (Vdc)				EDIC workgroup
	-10°C +50°C	2,0	10				
				ELF1q-AJK - V1.0			
set energy (J)	power (W)	current (A)	exp. cutoff time (s)	actual cutoff time (s)	Δtcut (s)	Δtcut %	
800	40	4,00	20,00	19,87	-0,13	-0,65	**RESISTIVE LOAD**
1600	80	8,00	20,00	19,82	-0,18	-0,90	DC precision electronic load
					Avg	-0,77	
				TALON 15 ESC			
800	40	4,00	20,00	20,21	0,21	1,05	**REAL LOAD**
1600	80	8,00	20,00	20,23	0,23	1,15	300W DC brushless motor prop 9" x 4.5" - 20 Amp ESC
					Avg	1,10	

800 Joule / 40 Watt and 1600 Joule / 80 Watt - Actual vs Expected limiter tripping time (20s)

7 CONDITIONS OF APPROVAL

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

7.2 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.

7.3 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.

7.4 Changes to F1Q Class Rules

If the F1Q class rules are amended in any manner that affects the technical specification of the F1QEL, the validity of this Approval will be subject to review.

7.5 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.

8 PRODUCTION STATUS

At the date issue of this Approval, the device is current production.

9 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 F1QEL. This includes changes that are applicable to any additional functions of the device that do not necessarily form part of the F1 requirements.

Massimo Ursicino FAI-CIAM EDIC Working Group F1Q email: info@ffelectronics.com	Ing Manfred Lex Chairman FAI-CIAM EDIC Working Group Address any queries to: Chairman, FAI-CIAM EDIC Working Group email: ciam-edic@fai.org