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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: 05 March 2024

CIAM APPROVAL FOR F1Q Energy Limiter

Approval Reference:	**F1QEL004**
Manufacturer:	**SM Elektronik**
Manufacturer Contact:	**info@sm-modellbau.de**
Device Name/s:	**UNILOG2**

(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.

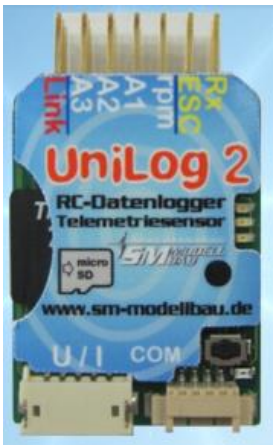
(iii) Tests undertaken by EDIC-WG (or such representative as it may appoint), are specifically concerned with the functions relevant to the F1 competition class rules.
Other functions of the equipment are not part of this approval and the relevance of this document does not extend beyond the specific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

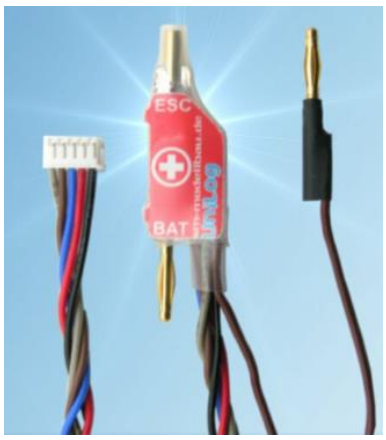
(iv) This document does not constitute a guarantee of compatibility of the device listed above with any associated devices with which it may be interconnected.

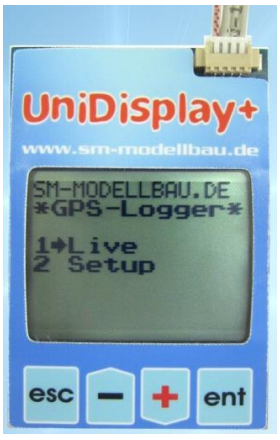
(v) This document does not constitute any guarantee and/or statement by EDIC-WG, CIAM and/or FAI as to the reliability of the device listed above.

(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 Unilog2 configured as F1Q limiter measures time and energy consumed and monitors ESC pulses from the timer, supply voltage and current. During the measurement, which begins when the start button connected to digital input A2 is released, the ESC pulses from the timer are transparently forwarded to the ESC. When the set energy limit is reached, the motor is stopped by setting the pulse width to the ESC below 1ms, and a negative pulse is provided on digital output A3.

2 HARDWARE

2.1 Equipment Name

“Unilog2” + “Unidisplay+” + “Unilog current sensor 20A or 40A”.

2.2 Hardware Version

The equipment name defines the hardware version for the complete system. All parts have a label inside of clear shrink tube that covers the components.

2.3 External Features

The Unilog2 consists of the following devices: “Unilog2” + “Unidisplay+” + “Unilog current sensor 20A or 40A”.

2.4 Current/Voltage sensing

The voltage is sensed through an A/D converter of the internal microcontroller.
The current sensing is based on shunt resistor.

3 FIRMWARE

The firmware of the Unilog2, as well as its version number, reside in the flash memory of the microcontroller. They are read-protected and cannot be altered in any way by the user.

3.1 Firmware version

3.1.1 Unilog2

The currently supported firmware version for the Unilog2 is **FW 1.16**. The firmware version is displayed from the setup menu of the Unidisplay+.

3.1.2 Unidisplay+

The currently supported firmware version for the Unidisplay+ is FW 1.27. The firmware version is displayed when the Unidisplay+ is turned on.

3.2 Sampling rate

Current and Voltage sample rate is 20 samples/s

3.3 Minimum current threshold

The minimum current threshold is 1A

3.4 Calibration

Each device is individually calibrated. Calibrating parameters are stored in the program memory of the sensor microcontroller. User manipulation of the calibration parameters is not possible.

3.5 Energy calculation.

The time period of the measurement/calculation cycle is measured and the energy consumed during the measurement/calculation cycle is counted with the formula: voltage x current x time (s)

3.6 Displayed information

All related information will be displayed by the plugged in Unidisplay+ by scrolling through the setting menu.

3.7 Displayed resolution

The resolution for the displayed energy is 1 Joule.

3.8 Programmability of the target energy limit

The value of the target energy limit is programmable with the resolution of 1 Joule by using the UniDisplay+ setting menu.

3.9 Recording capabilities

The Unilog2 holds the programmed target energy limit and records the value of the energy consumed in the last cycle. This value is also stored in the non-volatile memory of the microcontroller to be shown at the next power up of the Unilog2. These values are read-protected, have a unique time stamp and cannot be altered in any way by the user

3.10 Digital I/O

3.10.1 Start switch

The Unilog2 is armed when the switch (A2) is pressed (negative edge, contact closed) and starts counting the energy when the switch is released (positive edge, contact open).

3.10.2 Input/output signals

RX	linked to the motor controller output of the timer
ESC	linked to the ESC
5-pin connector	linked to the U/I sensor; only the 20A (No.:2523) and 40 A (No.: 2510 / 2530) type specified for Unilog2 must be used It is preferred to solder the U/I sensor in the wire between battery positive connector and the positive Power solder pad of ESC
A2 (signal pin only)	linked to the positive contact of timer's start button connector (or the associated contact of the start button) These connection controls begin of energy counting as follow: By pressing the start button the level on this pin moves to "low" (ground), by releasing the start button to "high", the energy counter starts
A3 (signal pin only)	linked to the timer input used to receive the "end of energy" signal (not mandatory, only to inform the timer at the instant in which the limiter switches off the motor via the ESC generating the appropriate PWM stop signal)

4 TECHNICAL DATA

- Dimensions: 42x 25 x 10 mm
- Weight: Unilog2 device: 9 g
  sensor: 7 g (with wires and connectors)
- Current sense method: shunt
- Shunt resistance: 20 A sensor: 0,004 ohm - 40 A sensor: 0,001 ohm
- Voltage range: 20 A sensor: 0-10 V - 40 A sensor: 0-60 V
- Current range: 20 A sensor: -5 A – 20 A - 40 A sensor: -10 A – 40 A
- Accuracy of energy measurement: < ± 2 %, resolution 1 J
- Energy setup range: 1– 2750 J
- Operating conditions: -20 … +50 ºC

5 VERIFICATION OF THE UNILOG2

5.1 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
- automatic digital stopwatch with 1/100 second resolution started by the start switch and stopped by the Unilog2 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**)

5.2 Test sequence

Two identical tests are performed in which the power load and the energy limit are changed. Two identical tests are performed in which the power load and the energy limit are changed. In both tests the nominal stop time is 20s

5.2.1 TEST #1 - 800 Joules / 40 Watts

- properly connect the Unilog2 to the Unidisplay+ and current sensor
- set the energy limit to 800 joules in the device
- connect the start button to A2 pin ‘Start input’. Connect also the scope to A2 pin
- connect the automatic stopwatch to A3 pin ‘Stop signal to the timer’ to trigger on the first negative edge. Connect also the scope to A3 pin
- connect the servo tester to the RX input of the Unilog2. Set the pulse length to 1750uS
- connect the scope to the ESC output of the Unilog2 ‘Control signal pin to the ESC’
- set the power supply for a voltage of 10 volts
- properly connect the electronic load
- set the electronic load to 40 Watts and apply the load. Resulting current will be 4 Amps
- press and hold the start switch for 2 seconds, then release it: the Unilog2 starts to count and displays the energy consumed, the stopwatch starts, the scope monitors the PWM pulses to the ESC and the stop signal to the timer
- monitor the pulse duration of the signal to the ESC. During the test the pulse duration must be 1750uS. When the energy limit is reached the pulse duration must instantly turn to less than 1000uS and a 30mS negative pulse must be issued on A3 pin (motor stop signal)

- make sure the automatic stopwatch has stopped and verify that it displays a time of 20 seconds (20s ± 2% = 19.6s to 20.4s). This value must be congruent with the test duration measured with the scope

5.2.2 TEST #2 - 1600 Joules / 80 Watts

Same as TEST #1 except that the energy limit and load are set to 1600 Joules 80 Watts respectively. In the last step of the test verify that the stopwatch displays a time of 20 seconds ± 2% (20s ± 2% = 19.6s to 20.4s)

5.2.3 TEST RESULTS

Several iterations were carried out with the above procedures on the device supplied by the manufacturer (only one unit supplied) pre-calibrated as per paragraph 3.4.

Tests were performed with both resistive and real loads, the latter consisting of a Sunnysky X2212-12 brushless motor and a Castle Creations Talon 15 ESC.

An average deviation of +1.05% and +1.78% of the limiter tripping time from the expected value respectilvely for resistive and real motor load was recorded over the entire specified temperature range (-10 to +50 °C).

F1QEL test	temp	max dev %	set voltage (Vdc)				EDIC workgroup
	-10°C +50°C	2,0	10				
				Unilog2 - V1.6			
set energy (J)	power (W)	current (A)	exp. cutoff time (s)	actual cutoff time (s)	Δtcut (s)	Δtcut %	
800	40	4,00	20,00	20,25	0,25	1,25	**RESISTIVE LOAD**
1600	80	8,00	20,00	20,17	0,17	0,85	DC precision electronic load
					Avg	1,05	
				TALON 15 ESC			
800	40	4,00	20,00	20,35	0,35	1,75	**REAL LOAD**
1600	80	8,00	20,00	20,36	0,36	1,80	300W DC brushless motor prop 9" x 4.5" - 20 Amp ESC
					Avg	1,78	

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

6 CONDITIONS OF APPROVAL

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

6.2 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.

6.3 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.

6.4 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.

6.5 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.

7 PRODUCTION STATUS

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

8 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.

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