FAI Sporting Code

Section 4 Ë Aeromodelling

Volume EDIC
Electronic Devices in Competition

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SECTION 1   -   F5J ALTIMETER/MOTOR RUN TIMERS (AMRT)

SECTION 2   -   TECHNICAL GUIDANCE NOTES AND TECHNICAL SPECIFICATION
FOR ALTIMETERS USED IN SPACE MODELLING COMPETITION

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SECTION 4   -   F5B REAL-TECT SYSTEM

ADDENDUM   -   EDIC WORKING GROUP TERMS OF REFERENCE

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1   FAI Statutes, ... Chapter 1, ...para. 1.6
2   FAI Sporting Code, Gen. Section, ... Chapter 4, ...para 4.1.2
3   FAI Statutes, ... Chapter 1, ...para 1.8.1
4   FAI Statutes, ... Chapter 2, ...para 2.1.1; 2.4.2; 2.5.2 and 2.7.2
5   FAI By-Laws, ... Chapter 1, ...para 1.2.1
6   FAI Statutes, ... Chapter 2, ...para 2.4.2.2.5
7   FAI By-Laws, ... Chapter 1, ...paras 1.2.2 to 1.2.5
8   FAI Statutes, ... Chapter 5, ...paras 5.1.1, 5.2, 5.2.3 and 5..2.3.3
9   FAI Sporting Code, Gen. Section, ... Chapter 4, ...para 4.1.5
10 FAI Sporting Code, Gen. Section, ... Chapter 2, ...para 2.2.
11 FAI Statutes, ... Chapter 5, ...para 5.2.3.3.7
12 FAI Statutes, ... Chapter 6, ...para 6.1.2.1.3

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VOLUME EDIC

ELECTRONIC DEVICES IN COMPETITION

This volume, instituted in January 2014, will contain various special technical specifications, guidance and approval procedures relating to specific electronic devices regardless of the class in which those devices may be utilised.

Section 1   -   F5J Altimeter/Motor Run Timers V 1.0

Section 2   -   Technical Guidance Notes and Technical Specification for Altimeters Used in Space Modelling Competition V 1.0

Section 3   -   F5D Energy Limiter V 1.0

Section 4   -   F5B REAL-TECT System

Addendum   -   EDIC Working Group Terms of Reference

The use of "shall" and "must" implies that the aspect concerned is mandatory. The use of "should" implies a non-mandatory recommendation; "may" indicates what is permitted, and "will" indicates what is going to happen. Words of masculine gender shall be taken as including the feminine gender unless the context indicates otherwise. Words expressing the singular will be taken to include the plural and vice versa. Italics are used for explanatory notes.

THIS 2016 (REV 1) EDITION INCLUDES THE FOLLOWING AMENDMENTS MADE TO THE 2016 CODE

These amendments are marked by a double line in the right margin of this edition

Paragraph	Date of Publication	Brief description of change	Change incorporated by
Section 3	July 1 2016	Added Section 3: F5D Energy Limiter V 1.0	Kevin Dodd Technical Secretary
Section 4	July 1 2016	Added Section 4: Performance Requirements Definition for FAI-F5B . Real Time Energy Consumption Telementry (REAL-TECT) System . compatible with existing ɢASSENORq equipment.	
Page 5	2016	Consequential changes for Volume ABR, due to the release of Edition 2016 of FAI General Section.	Kevin Dodd Technical Secretary
Section 2	2016	Added Section 2: Technical guidance and specification for altimeters used in Space Modelling competition.	
Appendix A	n/a	Deleted, since the list of Approved AMRTs/Firmware is updated as necessary, and is available in the Documents section of the CIAM website under the heading EDIC WG & Electronic Device Approvals	

Four-year Rolling Amendments for Reference			
Paragraph	Date of Publication	Brief description of change	Change incorporated by
There were no changes or additions made at the 2014 Plenary meeting.			

Four-Year Rolling Amendments for Reference			
Paragraph	Date of Publication	Brief description of change	Change incorporated by
Section 1	2014	Added the first section: technical specification and guidance for F5J altimeter/motor run timer (AMRT).	Jo Halman Technical Secretary
Addendum		Added the EDIC Working Group Terms of Reference	

RULE FREEZE FOR THIS VOLUME

This content of this volume is not subject to Plenary meeting approval, nor is it restricted by any rule freeze regulation. It is under the direct control of CIAM Bureau on recommendation from the EDIC Working Group and may be updated at any time during the year.

Section 1 - F5J Altimeter/Motor Run Timers V 1.0

Initial Publication: 01 January 2014

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Appendix A has been deleted (2015)

The List of Approved AMRT Firmware is available in the Documents section of the CIAM website under the heading EDIC WG & Electronic Device Approvals.

Addendum

EDIC Working Group Terms of Reference

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1.0   INTRODUCTION

1.1   Purpose of this Document

The FAI CIAM rule making/amendment process is geared to maintain competition rule stability and as such presents some difficulties in areas subjected to rapidly changing technologies. To overcome this problem, CIAM Bureau instituted an "Electronic Devices in Competition (EDIC)" Working Group which will provide a system of "technical considerations" outside the rule making process that will enhance a class but not impinge on the class rules.

As part of that system, this document provides technical guidance on the specification, testing and application of Altimeter/Motor Run Timers (AMRTs) for use in F5J competitions. The information contained herein is relevant to AMRT manufacturers, competition organisers, competitors and persons involved in the evaluation of AMRTs.

1.2   Philosophy behind the AMRT Specification

International competitions attract large numbers of competitors, each of whom is entitled to three models. Consequently competition organisers could expect to be presented with a significant number of AMRTs from a number of different manufacturers for scrutineering and verification purposes.

It is against this background that the AMRT Specification has been formulated with the following objectives:

a)   To accurately determine the "Start Height" as required for the competition.

b)   To minimise any ambiguity in reading the "Start Height" from the AMRT.

c)   To provide a safe working environment for official timekeepers when reading the AMRT.

d)   To ensure that the AMRT can only function as required by the rules of the competition and cannot be operated, unintentionally or otherwise, in any other manner.

e)   To retain "Start Height" information for subsequent resolution of any disputed reading.

f)   To provide a standard method of operation so that, irrespective of AMRT manufacture, verification testing can be performed easily with a defined test procedure.

g)   To define standard connectors for compatibility with test facilities and to reduce the risk of accidental damage during handling by competition officials.

h)   To provide a standard method of determining that the AMRT is of the type for which an approval has been granted.

2.0   INFORMATION FOR MANUFACTURERS

2.1   AMRT Technical Specification

This section is the formal specification for AMRTs intended for use in the F5J competition environment.

2.2   An electronic AMRT carried in an F5J model shall fulfil the following technical specifications:

a)   It must use the barometric pressure measurement technique.

b)   Altitude indication must be based on the International Standard Atmosphere, as defined in ICAO Document 7488/2.

c)   The method of converting pressure measurements to height information must be such that the specified accuracy is maintained across the full working range of the AMRT.

d)   It must record the maximum difference in pressure altitude ("Start Height") in accordance with the following definition:

"Start Height" is defined as the recorded maximum difference in pressure altitude, measured in metres, from initialisation until 10 seconds after the motor is stopped manually by the competitor or automatically by the Motor Run Timer, whichever occurs first.

e)   The Motor Run Timer must stop the motor 30 seconds after it is started at launch, if it has not already been stopped by the competitor within this time limit.

f)   The AMRT must not allow any restart of the motor at any time during the flight.

g)   The AMRT must have compatibility with ESCs using the nominal 1 to 2 milliseconds control signal from the receiver such that no low speed motor drive occurs when "motor stop" is instituted either by the competitor or the AMRT.

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h) The supply of power to the AMRT shall be that available from the receiver output to the ESC at the receiver motor command connector. If the power source to the receiver is supplied via the ESC motor command connector, it is permissible for this to be supplied to the receiver via the AMRT.

i) The connectors of the AMRT shall be of a universal type compatible with JR/Futaba and must be proof against any misalignment that could result in electrical damage to the AMRT or connected equipment. Where an extension lead is used to satisfy this requirement it must be secured to the AMRT in such a manner that it cannot be unintentionally removed.

j) The AMRT shall be provided with a digital display. The display may be an integral part of the AMRT, or a separate module that is either carried within the model or is detachable.

A detachable AMRT display may be used to service any number of AMRTs of the same approved type.

2.3   Characteristics of the AMRT

2.3.1   The accuracy of the determined 'Start Height' shall be within the range plus or minus 2.5 metres. This accuracy must be achieved across an ambient ground level pressure range of 750 to 1050 hPa and across an ambient temperature range of 0 to +50 degrees centigrade.

2.3.2   The calculation of 'Start Height' shall incorporate any calibration parameters provided by the pressure sensor manufacturer.

2.3.3   The sampling rate of the pressure measurement used for 'Start Height' determination shall be a minimum of 10 samples per second.

2.3.4   Any firmware processing of pressure measurements (or height information derived from such measurements) used for 'Start Height' determination, must not result in a modification of the maximum height as would be detected by the single measurement sample representing the peak value.

2.3.5   The timing accuracy used for the Motor Stop function and 'Start Height' determination shall be equal to or better than 0.1 seconds.

2.3.6   There must be no configurable settings or adjustments that allow the user to modify the operation of the AMRT such that it will operate outside the requirements of the competition rules.

2.3.7   Any additional features incorporated into the AMRT by the manufacturer, must not cause any variation in the sampling rate or timing functions, nor affect the ability of the AMRT to satisfy the requirements of the competition rules.

2.3.8   The resolution of the display when showing the calculated 'Start Height' shall be 0.1 metre, this to be displayed with the format 'xxx.x'. Leading zero characters may be blanked. (When using the final calculated 'Start Height' for scoring purposes, the reading shall be rounded down to the nearest full metre.)

2.3.9   On completion of the period ending 10 seconds after 'motor stop', the recorded 'Start Height' shall be continuously transferred to the display with a minimum repetition rate of once per two seconds. This function shall commence automatically when the recording of the 'Start Height' has been completed.

2.3.10   The display shall show the firmware revision level of the AMRT, in the format 'Fx.x' with any leading zero characters blanked.

2.3.11   Display of the firmware revision level shall occur for the first 3 seconds following the application of power to the AMRT. On completion of the 3 seconds period, the display shall continue to show any previously recorded 'Start Height' or cleared status indication, until such time as a Motor Start signal is detected. This sequence shall occur irrespective of whether an input command signal is being applied to the AMRT.

2.3.12   If the display is not an integral part of the AMRT, the method of transferring the information to the display shall be immune to any form of corruption or modification from external sources.

2.4   Recording the 'Start Height'

The AMRT shall record the 'Start Height' in accordance with the following procedure:

(a) Immediately on application of power to the AMRT it must determine a zero height reference level from which any subsequent 'Start Height' will be determined. Any previously recorded 'Start Height' must NOT be erased at this point.

(b) This function shall be carried out with the model at ground level at the location specified within the competition rules.

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(c) A maximum of 5 seconds is permitted for the zero height reference level to be determined, during which period the AMRT shall not respond to any Motor Start signal instituted by the competitor or resulting from receiver start up procedures.

Note: A Motor Start command is defined as any control signal exceeding 1.2 milliseconds.

(d) After power has been applied to the AMRT, the ±Start Heightq determination and the start of the Motor Run Timer will be initiated by the Motor Start signal instituted by the competitor. Such initialisation must clear any previously recorded ±Start Heightq

(e) The cleared status of any previously recorded value shall be indicated on the display as a sequence of dashes (- - - . -). This shall be carried out in such a manner that if a detachable display were to be connected it would show the cleared status.

(f) When the Motor Start signal has been instituted by the competitor, the AMRT will determine, and record, a new ±Start Heightq replacing the previously cleared status.

(g) When power is removed from the AMRT, the ±Start Heightq or cleared status indication must be retained by the AMRT. The application of power to the AMRT must never erase either the recorded ±Start Heightq or the cleared status indication. Only the Motor Start signal instituted by the competitor may do this.

3.0   TECHNICAL CONSIDERATIONS

This section is provided as design guidance on AMRTs intended for use in the F5J competition environment.

3.1   Restriction on User Configuration Options

Whilst for commercial considerations manufacturers may wish to produce AMRTs adaptable for differing applications, when used in the F5J competitive environment, the installed firmware shall have dedicated F5J functionality with no user configurable options. The purpose of this is to eliminate any possibility of errors in operation due to incorrect configuration settings.

3.2   ISA Calculation

Pressure at a given location is caused by the weight of the atmosphere above. This varies with air density, humidity, gravity and temperature. In addition, temperature itself reduces as height increases. Consequently height is not directly related to pressure and some form of standardised definition is required to enable instrumentation based on barometric pressure to be used to determine height.

The International Standard Atmosphere (ISA) assumes a mean sea level pressure of 1013.25 hPa at a temperature of 15 degrees C, a specified temperature lapse rate with height, a specified gravitational force and a given molecular density of air.

Conditions on any day are unlikely to correspond exactly with the ISA model; a typical spread of 50hPa can occur at a given location due to normal meteorological conditions. Consequently significant variations will occur from true geographic height. However for aviation applications, including F5J, all instruments calibrated and operating in accordance with the ISA standard, will produce the same result.

3.2.1   In the lower atmosphere (up to 12kM), the ISA relationship for a pressure P, can be described by the following formula:

$$\text{Altitude} = K1 \times \{1 . (P/Po)^{K2}\} \text{ metres}$$

where $K1 = 44330.76923$ metres
$K2 = 0.190266669$
$Po = 1013.25$ hPa (ISA sea level pressure)

K2 is derived from the universal gas constant, temperature lapse rate, gravitational force, molecular mass of dry air and temperature with respect to absolute zero.

This formula results in a relationship between pressure and height that is represented by a curve that is steeper at high pressure/low altitude and less steep at low pressure/high altitude. Over the range of site elevations that might be encountered for F5J competitions, the nature of the ISA relationship is significantly non-linear. There is approximately 14% difference in the pressure reduction of a 200 metre launch commencing at sea level compared with one starting at 1500 metres.

3.2.2   The calculation of F5J ±Start Heightq requires a precise measurement of the difference between two ISA pressure altitudes. The first is the zero reference value at ground level for the local site elevation. The second is the maximum altitude that occurs during the launch phase of the aircraft.

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3.2.3   In order to achieve sufficient accuracy for F5J, the method of firmware processing of pressure data is important. Whilst ideally the ISA computation should be performed by an arithmetic calculation with maximum precision, processing constraints may make this impractical. It is permitted to use an algorithm approach to emulate the computation provided it can be demonstrated that an appropriate accuracy is maintained and no discontinuities are introduced in the ISA curve.

3.2.4   In order to maintain overall AMRT accuracy within the specified tolerance, the accuracy of the firmware ISA computation should be within the range plus or minus 0.5 metres.

3.2.5   AMRT manufacturers may wish to adopt pressure sensor modules that have an inbuilt pressure-to-height conversion. In such a case, it must be demonstrated that the computation complies with the accuracy requirements over the specified working range of the F5J application.

Note: In this context, results from calculations using the formula of the 1976 US Standard Atmosphere, agree closely with those of the ISA formula in the lower atmosphere and are considered acceptable over the F5J working range.

3.2.6   Pressure sensor offset errors will influence the 'Start Height' calculation. However, since 'Start Height' is the difference between two readings, much of any offset error is removed from the result.

3.3   'Start Height' Determination

3.3.1   'Start Height' determination requires the AMRT to perform a peak (height) detection function for the time duration commencing at switch-on initialisation, until 10 seconds after the motor has been stopped.

3.3.2   The F5J competition application requires the 'Start Height' to be determined with the best possible accuracy and all manufacturers' AMRTs should exhibit similar characteristics.

3.3.3   Initialisation following power-up, and the acquisition of the ground level (zero height reference) reading should be accomplished with due allowance for any time required for the pressure sensor device to stabilise.

3.3.4   During the launch phase, the dynamics of the flight envelope are subject to rapid change and the transition through the peak can occur within a short time period. Item 2.3.3 defines the minimum acceptable sampling rate for detecting the peak. It is not permissible for additional filtering or smoothing to be incorporated in the firmware as this can result in a downgrading of the ability to accurately detect the peak value.

3.3.5   Oversampling functions incorporated within the pressure sensor device may be used subject to being configured in a manner that maintains the integrity of readings taken at the specified sampling rate.

3.3.6   Pressure sensor devices:

(a)   Are subject to variation due to temperature. Many sensor manufacturers specify the inclusion of temperature data in the processing of the pressure data. Manufacturers' recommended firmware procedures must be incorporated into the AMRT firmware.

(b)   Can be affected by strong light falling on the sensitive area, therefore they must be mounted within the AMRT n such a manner that the sensitive area is shielded from strong light levels.

3.3.8   The accuracy tolerance stated in item 2.3.1 is the maximum permitted when all possible variations are at worst case conditions. No individual factor should contribute a significant proportion of the total permitted variation.

3.4   Motor Run Timer

3.4.1   The Motor Run Timer function must operate with the accuracy specified in item 2.3.5.

3.4.2   On initial power-up of the AMRT, the Motor Run Timer must be protected from false triggering during the period defined in Item 2.4 (c). After this period, the Motor Run Timer shall commence operation and 'Start Height' determination shall be initiated on the first occasion that the command signal exceeds 1.2 milliseconds.

3.4.3   After the Motor Run Timer has been triggered, the timing of the motor run ceases when either the command signal reduces below 1.2 milliseconds, or the elapsed time reaches 30 seconds and a definite stop command must be applied to the ESC by the AMRT.

3.4.4   The 'Start Height' determination process shall continue for a further 10 seconds after the instant of "motor stop".

3.4.5   Once the definite stop command has been applied to the ESC, the system must not respond to any further changes in the motor command signal.

3.4.6.   A small amount of hysteresis is permitted in the sensing of the 1.2 milliseconds motor command signal to eliminate malfunction with jittering command signals.

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3.4.7 Monitoring of the timing functions is achieved with the aid of the displayed information as detailed in Items 2.4 (a) . (g).

3.5 Retention of 'Start Height' Reading

3.5.1 In the normal competition environment the Start Height reading is obtained immediately following the landing of the aircraft, without power removal from the system.

3.5.2 There is a requirement for the AMRT to retain the Start Height reading when power is removed. The primary reason for this is for purposes of reading dispute resolution and possible AMRT investigation away from the aircraft installation.

3.5.3 Erasure of the stored Start Height reading shall only occur in accordance with the sequence detailed in Items 2.4 (a) . (g).

3.6 Display Considerations

3.6.1 The display readout should employ characters that are easily legible in normal outdoor ambient light levels. It is not acceptable to require adjustment of contrast levels to suit ambient conditions.

3.6.2 Character height should be such that no optical aids other than normal spectacles are required in order to observe the readings.

3.6.3 The formation of the numeric font must be unambiguous. With some font formats it may be necessary for manufacturers to substitute a capital letter 'O' character to replace a slashed through zero numeral in order to avoid confusion with the numeral 8.

3.7 ESC Compatibility

There is no defined standard for the manner in which ESCs (electronic speed controllers) initialise to the range of motor command signals. In addition, programmable transmitters allow the user to set the motor command signals to any value within the programmable range.

3.7.1 Commercial pressures will encourage AMRT manufacturers to configure their products to operate with the majority of available ESC devices.

3.7.2 The F5J specification of motor on threshold at 1.2 milliseconds has been selected as being compatible with most known equipment but cannot be a guarantee of correct operation for every combination of transmitter, receiver and ESC.

3.8 Connector Compatibility

3.8.1 AMRTs exist that do not fully satisfy the shrouded connector requirement. Whilst a bare pin arrangement may be acceptable for many other applications, the F5J competition environment requires event officials to handle competitors' equipment for verification purposes. There is, therefore, the potential to cause accidental damage. For this reason, the use of shrouded connectors has been specified. It is permissible to supply an extension cable to meet the shrouded connector requirement provided that it is mechanically restrained at the connection to the AMRT in such a manner that it cannot be unintentionally removed.

3.8.2 Where the readout display is detachable, the AMRT manufacturer must ensure that where a non polarised connector is used, incorrect insertion cannot cause damage to the AMRT or display.

4.0 COMPETITION INFORMATION

4.1 Installation Environment

4.1.1 The installation and functioning of the AMRT, the transmitter and its programming, receiver and ESC, is the sole responsibility of the competitor, who must ensure that they operate together in the correct manner as required for the rules of the competition.

4.1.2 The AMRT must be installed in such a way that it is protected from pressure fluctuations other than changes in atmospheric pressure which result from the height of the model above ground level.

4.1.3 The AMRT must be placed inside the model in the state as supplied by the manufacturer. The use of any method that modifies the true barometric pressure at any time is prohibited.

4.1.4 Adequate venting shall be provided to minimise any uneven pressure distribution within the model in the region where the AMRT is installed.

4.1.5 The ESC must always operate via its series connection to the AMRT and not with a direct connection to the receiver.

4.1.6 Where the readout display is an integral part of the AMRT the AMRT shall be installed in such a manner that it is readily accessible for viewing the readings.

4.1.7 Where the readout display is not an integral part of the AMRT, the connection facility for the display unit shall be readily accessible for the purpose of connecting the display unit to view the readings.

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4.1.8   The competitorș AMRT shall be installed in such a manner that it can be easily removed from the model for verification purposes at any stage during the period of the contest.

4.1.9   The connectors linking the AMRT to the receiver shall be readily accessible so that a monitoring AMRT with appropriate interconnection can be fitted on demand by the Contest Director. Such monitoring AMRTs will serve to verify ŞStart Heightq whilst maintaining the normal operation of the competitorș own installation.

4.1.10   If a competitor incorporates an additional lead extension for use with a detachable display, it is the competitorș responsibility to ensure compliance with section 3.8.2.

5.0   VERIFICATION OF AMRTs

This section details procedures for verifying the operation of Approved AMRTs for use in the F5J competition environment. It is provided as a guide for both competitors and competition organisers.

5.1   Purpose of Verification

All AMRTs used in an F5J competition are required to be of an Approved Type. The verification process serves to ensure that no individual AMRT operates in a manner different from others in use at the competition. As such, comparison methods are employed for ŞStart Heightq verification, in place of a requirement to undertake absolute accuracy measurements.

5.2   Verification Procedures

5.2.1   Firmware Revision Level

An AMRT with connected display, will show the firmware revision level for three seconds immediately after the application of power.

5.2.2   Operational Sequence

For this procedure, the AMRT has to be supplied with power, a command signal input and a means of monitoring the ‰motor runÿ+stop+ signal that is supplied to the ESC. A display module must be connected.

Whilst this procedure is applicable to a complete aircraft installation, for reasons of safety and when verifying an AMRT, it should be removed from the aircraft and tested independently.

The procedure is as follows:

(a) With the command signal at Motor Off, apply power to the AMRT. After the initial display of the firmware revision level, the display will show either a previously recorded ŞStart Heightq or a sequence of dashes. The ESC signal will be in the ‰motor stop+ state.

(b) If a sequence of dashes is shown the first time power is applied, it will be necessary to perform steps (c) and (d) to establish a ŞStart Heightq

(c) Apply a Motor On command and raise the AMRT to a low height. After a short time period, apply a Motor Off command. The display will show a sequence of dashes from the time of the Motor On command to 10 seconds after the Motor Off command. During this sequence the ESC signal follows the command signal.

(d) After the 10 seconds has elapsed, the display will show a low value height reading.

Note: The value displayed may be influenced by local air movement.

(e) Remove power. Wait for approximately 30 seconds and then, with the Motor Off Command, selected, re-apply power. After the display of the firmware revision level, the same low level height reading as recorded in (d) will be displayed.

(f) Apply and maintain a Motor On command. Immediately the display will show a sequence of dashes and the ESC signal becomes ‰motor run+.

(g) 30 seconds after the Motor On command, the ESC signal will change to ‰motor stop+. Immediately raise the AMRT to a low height for approximately two seconds to simulate a peak height.

(h) 10 seconds after the ESC signal became ‰motor stop+, the display will show a low height value.

(i) Apply a Motor Off command.

(j)   Whilst maintaining power, apply a further Motor On command. The ESC signal will remain in the ‰motor stop+ condition and the AMRT will remain in the same state.

(k) Repeat steps (e) to (h), but instead of waiting for 30 seconds at step (g), apply a Motor

Off command after about 10 seconds which will cause the ESC signal to become ‰motor stop+. The result of the ‰motor stop+ should be as (h) and (j).

5.2.3   ‰Start Height+ Detection

Verification of the measured ‰Start Height+ value requires the use of a ‰vacuum+ chamber. Such a chamber comprises an airtight container from which air can be extracted to create a pressure reduction. Air equivalent to approximately 3% of the chamber capacity has to be extracted in 15 to 20 seconds in order to simulate a typical model climb. On completion of the climb simulation, a slight increase in pressure is required in order to emulate the transition to gliding flight.

For verification purposes it is only necessary to perform tests starting at local ambient pressure. Slight air leakage of the chamber is acceptable and aids the gliding flight simulation.

Within the chamber, facilities are required to provide power and simultaneous command signals to a number of AMRTs.

A known, good AMRT (preferably with a certificated calibration) is used as the reference standard against which other AMRTs are compared.

The procedure is as follows.

(a) Place the device(s) to be tested in the chamber together with the reference device.

(b) Readout display(s) may be attached either before or after the pressure change has been applied.

(c) Close the chamber and allow a short period for the pressure to stabilise. (Some variation may occur due to temperature differences introduced by handling).

(d) With the Motor Command set to ‰motor off+, apply power to the AMRTs. This causes the zero height reference to be detected by the AMRT(s).

(e) Apply a Motor Run command.

(f) Reduce the chamber pressure at an appropriate rate to simulate a climb to approximately 150 metres.

(g) Apply a Motor Stop command and immediately allow the pressure to begin increasing to simulate a descent of gliding flight.

(h) Wait for a minimum of 10 seconds.

(i) Observe ‰Start Height+ readings for all AMRTs.

(j) Analyse the results by comparison with the known, good AMRT.

Any AMRT that deviates by more than plus or minus 1.25 metre from the monitoring AMRT should be subject to further investigation.

Note: The overall tolerance for absolute accuracy specified in Section 2 is the worst case figure when all possible discrepancies are taken into consideration.

(The 1.25 metre figure may be subject to revision when more experience has been gained in the competition environment).

Repeat the procedure simulating other climb heights as considered necessary.

6.0   GUIDANCE FOR COMPETITION ORGANISERS ON THE USE OF MONITORING AMRTS

Competition rules allow competition organisers to carry out random checks on competitors+ equipment at any time during a competition. One aspect of this could be the use of a monitoring AMRT to be fitted in a competitor+s aircraft for a competition flight. Item 4.1.9 defines that the appropriate connectors in an aircraft must be accessible.

6.1   Use of Monitoring AMRT in Competitors+ Aircraft

6.1.1   A monitoring AMRT may be fitted at the command signal input of an AMRT by means of a Y connection lead. This permits the monitoring AMRT to respond to the motor command signals and take its own ‰Start Height+ measurement of a flight.

The rating and quality of the Y lead must be such that it does not degrade the performance of the competitor+s own installation.

6.1.2   The ‰Start Height+ as determined by the monitoring AMRT should be in close agreement with the reading taken by the competitor+s own AMRT.

Allowing for variations in pressure distribution within the aircraft, agreement within plus or minus 2.0 metre is considered acceptable.

Note: The 2.0 metre figure may be subject to revision when more experience has been gained in the competition environment.

cont/ō

7.0   APPROVAL PROCEDURES

7.1   Check list of features to be verified when evaluating compliance

(a) Display of firmware revision level.

(b) Operational sequence (as in 5.2.2).

(c) Retention of Start Height reading when power removed.

(d) Accuracy of Motor On pulse sensing.

(e) Accuracy of timing of motor run.

(f) Accuracy of 10 second period after motor cut.

(g) Accuracy of ISA calculation across full ambient pressure range.

(h) Accuracy of Start Height determination across range of Start Heights.

(i) Dynamic response of Start Height determination.

(j) Affect of temperature variations on Start Height accuracy.

(k) Prevention of motor restart.

(l) Clarity and legibility of readout.

(m) Verification that any additional features not required by the specification (eg buttons on the display, flight logging) do not affect the essential operation of the device.

7.2   Submission of AMRTs for Approval

The CIAM is establishing a Working Group to assume responsibility for the approval process. The services of a technical expert may be used to undertake the practical testing on behalf of the Working Group.

Further details will be advised in due course, together with the specific requirements concerning the presentation of devices for approval.

Devices submitted for approval must be to normal production standard and must incorporate firmware at the revision level that is to be evaluated.

Supporting documentation shall include the sensor manufacturerŏs data sheet on the pressure sensor device with particular reference to long term drift and temperature variation characteristics.

Additional supporting information may be required at the request of the technical expert undertaking the evaluation on behalf of the CIAM Working Group.

Approval, when granted, will relate to a specific hardware/firmware combination. Any subsequent modification to hardware or firmware must be notified to the CIAM committee and advice will be provided concerning any requirements for upgrading the previously granted approval.

7.3   Withdrawal of Approved Status

7.3.1 An approved AMRT may have its Approved Status withdrawn if inconsistencies of performance are found in further examples of the AMRT.

7.3.2 If, subsequent to the granting of an approval status, the rules of the competition are amended in a manner that affects the technical specification of the AMRT, the validity of all AMRTs on the Approved List will be subject to review.

Section 2 - Technical Guidance Notes and Technical Specification for Altimeters Used in Space Modelling Competition V 1.0

Initial Publication: 01 January, 2016

CONTENTS

1.0   INTRODUCTION

1.1   Purpose of this Document

The FAI CIAM rule making/amendment process is geared to maintain competition rule stability and as such presents some difficulties in areas subjected to rapidly changing technologies. To overcome this problem, the CIAM Bureau instituted an %Electronic Devices in Competition (EDIC)+working group which will provide a system of %technical considerations+outside the rule making process that will enhance a class but not impinge on the class rules.

As part of that potential system, this document provides technical guidance on the specification, testing and application of altimeters for use in Space Model contests, where places in several events are determined based on the maximum flight altitude achieved by models. The information contained is relevant to altimeter manufacturers, competition organisers, competitors and persons involved in the evaluation of Space Model altimeters.

1.2   Philosophy behind the Altimeter Specification

Certain classes within the FAI structure of Space Model contests require the measurement of flight altitude. Such events attract large numbers of competitors each of whom is entitled to multiple flights. Consequently competition procedures require organisers to deal with a significant number of altimeters for operation and verification purposes.

a) To accurately determine the ±maximum altitude achievedqas required for the competition.

b) To ensure that the altimeter can only function as required by the rules of the competition and cannot be operated, unintentionally or otherwise, in any other manner.

c) To provide a standard method of operation for use of altimeters in a competition

2.0 MANUFACTURING SPECIFICATIONS

This section is the formal specification for altimeters intended for use in the space modelling competition environment.

2.1 Altimeter Technical Specification

The essential requirements of an electronic altimeter carried in a space model are that it must:

a) Use a barometric pressure measurement technique.

b) For a single flight, measure and record the difference between the altitude achieved at each moment of sampling after launch and the altitude of the pad from which it was launched.

c) Retain the flight data, even with power removed.

d) Be equipped with a data communication interface to be used for accessing data and managing the altimeter as described in Section 2.1.3.2. .

e) Provide an audible and/or visual indication of its operating status. For the purposes of this document ±lashesqshall mean audible beeps and/or visual flashes.

f) Have no configurable settings or adjustments that allow the user to modify its operation such that it will operate outside the requirements of the competition rules.

g) Be powered by a flight battery, either rechargeable or non-rechargeable, having sufficient capacity to operate the altimeter for a minimum of five hours before requiring recharging or replacement.

h) Have dimensions that permit the altimeter, together with its flight battery, to fit in a cylindrical section of a space model airframe that is no greater than 17.5 millimetres in diameter and 30 millimetres in length.

i) Not exceed 2.5 grams in weight, with flight battery.

2.1.1 Barometric Pressure Measurement

a) The conversion of pressure measurements to height information must be based on the International Standard Atmosphere, as defined in ICAO Document 7488/2. The detailed requirements are specified in Section 2.2 of this document.

b) The method of converting pressure measurements to height information performed by the altimeter firmware must be such that the specified accuracy is maintained up to a height of 4000 metres above sea level.

c) Within the altimeter firmware, it must have a smoothing or filtering technique that enables it to recognize and reject by averaging across any abrupt pressure transients in one, or in two adjacent, sampling intervals that are the result of flight dynamic events such as staging, activation of a rocket motor ejection charge, or wind gusts.

d) It must have a measurement accuracy of no less than 1% of the recorded altitude or 2 metres, whichever is greater

   1) This accuracy must be achieved across an ambient ground level pressure range of 750 to 1050 hPa and across an ambient ground level temperature range of 0 to +50 degrees centigrade.

   2) This accuracy shall include the effects of the manufacturer-specified accuracy of the pressure sensor. Such effects include:

      - The resolution of the analogue to digital conversion
      - Signal noise
      - Thermal drift across a period of two hours of operation when operated at 15 degrees Celsius
      - Hysteresis effects over the specified working range of the altimeter

e) The calculation of pressure shall incorporate any calibration parameters provided by the pressure sensor manufacturer.

f) Temperature measurements made by the pressure sensor device must not be used in the calculation of pressure to altitude, except in accordance with the sensor manufacturer's recommendations for sensor device compensation purposes.

2.1.2 Operating Parameters

a) Height data shall be recorded and indicated in metres with a precision of one decimal place.

b) The working range shall be no less than 2000 metres when operated at launch site altitudes up to 2000 metres above sea level.

c) The data sampling rate shall be not less than ten samples per second.

2.1.3 Sequence of Operation

Following the application of power, the altimeter shall determine whether it is in a Flight Recording Mode or connected to a readout device in Data Communication Mode.

2.1.3.1 Flight Recording Mode

a) On application of power, the status of the altimeter shall be indicated as follows.

1) A correctly reset device ready to accept new flight data shall be indicated by single flashes with a repetition rate of once every four seconds.

2) An altimeter that contains flight data and has not been reset, shall be indicated by a group of three single flashes repeating once every four seconds. The altimeter must not be used for flight until a reset has been applied.

b) Immediately following the application of power, a correctly reset device shall

1) Start timing a 180 seconds period allocated for the purpose of installing the altimeter in a space model.

2) Begin sampling air pressure at a rate of not less than once each minute until prior to launch. This pressure shall be used to determine launch pad altitude for purposes of calculating flight altitudes above the launch pad.

c) On completion of the 180 seconds period the altimeter shall become ready for collection of flight data and become ready to detect a launch.

The sampling of air pressure as defined in 2.1.3.1.b) 2) above, shall continue until immediately prior to launch.

In order to be able to determine a flight as having commenced, the altimeter shall calculate and record flight altitude at the sampling rate defined in 2.1.2.c).

The altimeter status indication shall continue as single flashes but at an increased repetition rate of once every two seconds.

d) Lift off and commencement of a flight is considered as having been detected when a flight altitude of 30 metres has been achieved.

Calculated flight altitude data must continue to be recorded for each sampling point until at least 45 seconds after lift off.

e) When a flight has commenced, the altimeter shall

1) Use the calculated flight altitude data to determine the peak altitude above the launch pad achieved during the flight. This value must be recorded and retained for subsequent retrieval.

2) Retain recorded Flight Data for the period commencing at least 5 seconds before lift off, until at least 45 seconds after lift off.

3) Change the status indication to a repeating series of three single flashes with a repetition rate of once per four seconds

f) The altimeter shall remain in this state until power is removed.

2.1.3.2 Data Communication Mode

Data Communication Mode is required for retrieval of flight data and resetting of the altimeter.

The use of Data Communication Mode is the only permitted method of resetting the altimeter.

In Data Communication Mode the audible/visual indicator will indicate in accordance with the current operational state of the altimeter as defined in Section 2.1.3.1.

The altimeter must connect with a digital device such as a computer equipped with a software package that will

a) Display the firmware revision level of the processing firmware loaded onto the altimeter.

b) Display a unique serial number allocated to the altimeter by the manufacturer.

c) Display the peak altitude above the launch pad achieved during the flight, as determined by the altimeter.

d) Display the full digital output of the altimeters altitude versus time data in graphical or tabular format.

e) Permit resetting the altimeter so that:

   1) Any previously recorded flight data is deleted and can no longer be retrieved from the altimeter.

   2) The altimeter becomes initialised so that when subsequently powered up in Flight Recording Mode, it will initiate a new flight data collection sequence.

   3) Following application of the reset, the audible/visual status indication of the altimeter shall be as defined in 2.1.3.1.a 1).

2.1.3.3 Additional Features

In addition to being stored internally within the firmware, the serial number shall be shown by means of an indelible marking on the altimeter.

2.2 Altitude Calculation

Pressure at a given location is caused by the weight of the atmosphere above. This varies with air density, humidity, gravity and temperature. In addition, temperature itself reduces as height increases. Consequently some form of standardised definition is required to enable instrumentation based on barometric pressure to be used to determine height accurately.

The International Standard Atmosphere (ISA) assumes a mean sea level pressure of 1013.25 hPa at a temperature of 15 degrees Celsius, a specified temperature lapse rate with height, a specified gravitational force and a given molecular density of air. Conditions on any day are unlikely to correspond exactly with the ISA model; a typical spread of 50hPa can occur at a given location due to normal meteorological conditions.

Because records for altitude may be set in space modelling competitions, it is necessary to apply an adjustment for launch site ambient temperature to the standard ISA calculated value in order to achieve greater absolute accuracy of the calculated altitude.

2.2.1 In the lower atmosphere (up to 12km), the 15 degree Celsius ISA relationship for a pressure P, can be described by the following formula:

$$\text{ISA Altitude} = K1 \times \{1 \,.\, (P/Po)^{K2}\} \text{ metres}$$

where K1 = 44330.76923 metres

K2 = 0.190266669

Po = 1013.25 hPa (15 degree Celsius ISA sea level pressure)

K1 is derived from the formula:

$$K1 = T/L$$

where T = temperature in degrees Kelvin

(15 degrees C is equivalent to 288.15 degrees Kelvin)

L = Lapse Rate 0.0065 degrees K per metre.

K2 is derived from the universal gas constant, temperature lapse rate, gravitational force, molecular mass of dry air and temperature with respect to absolute zero.

This formula results in a relationship between pressure and height that is represented by a curve that is steeper at high pressure/low altitude and less steep at low pressure/high altitude.

Note: In this context, results from calculations using the formula of the 1976 US Standard Atmosphere, agree closely with those of the ISA formula in the lower atmosphere and are considered acceptable over the space modelling working range.

2.2.2   The calculation of the altitude achieved by a space model requires a precise measurement of the difference between two ISA-derived pressure altitudes. The first is the zero reference value at launching pad level. The second is the altitude that is measured during each moment of the model's flight.

2.2.3   In order to achieve sufficient accuracy for space modelling competition, the method of firmware processing of pressure data is important. Whilst ideally the ISA computation should be performed by an arithmetic calculation with maximum precision, processing constraints may make this impractical. It is permitted to use an algorithm approach to emulate the computation provided it can be demonstrated that an appropriate accuracy is maintained and no discontinuities are introduced in the ISA curve.

2.2.4   Altimeter manufacturers may wish to adopt pressure sensor modules that have an inbuilt pressure-to-height conversion. In such a case, it must be demonstrated that the computation complies with the accuracy requirements over the specified working range of the space modelling application.

2.2.5   In order to compensate for the effect of launch site ambient temperature on the conversion of pressure to ISA altitude, a factor K3 must be applied to the 15 degree Centigrade ISA value. This correction is to be applied post-flight using the temperature recorded by the competition organiser for the round in which the flight occurred.

Temperature Corrected Altitude = K3 x ISA Altitude

where K3 = (273.15 + Ta)/ 288.15

Ta = ambient temperature in degrees Celsius

3.0 COMPETITION PROCEDURES

This section provides procedures for the competitor and for the competition organiser for employment of altimeters in competition.

3.1 Competitor Installation of Altimeters

3.1.1 The installation of the altimeter in the space model is the sole responsibility of the competitor, who must ensure that it is not subjected to conditions that might cause it to fail or to operate in a manner different from that required for the rules of the competition.

3.1.2 Pressure sensor devices can be affected by strong light or heat falling on the sensitive area, therefore the altimeter must be installed in the space model within the required three minute period before the altimeter has initiated its collection of pressure data, and should be installed in such a manner that the sensitive area is shielded from strong light levels or heat.

3.1.3 The altimeter must be placed inside the space model in the state as supplied by the contest officials. The use of any method that modifies the true barometric pressure at any time is prohibited.

3.1.4 The altimeter should be shielded from direct exposure to the hot and corrosive gases of any rocket motor or its ejection charge.

3.1.5 The compartment in the space model that houses the altimeter must fully enclose it through apogee of the flight; must permit its removal after flight but not permit its separation from the space model during flight; and must be provided with a vent hole or holes of a size sufficient to rapidly equalize its internal pressure with the ambient pressure at the altitude of the model throughout its flight.
   a) The vent holes must be located on a straight surface, not the curved portion of the model's surface at the nose, and must be burr-free and not located behind any protrusions from the surface.
   b) If multiple holes are used there should be three or more, equally spaced around the space model's circumference.
   c) The combined area of the vent holes in square centimetres should be in the range of 0.0002 to 0.0003 times the volume in cubic centimetres of the compartment holding the altimeter

3.2 Organiser Management of Altimeters

3.2.1 All altimeters used in an altitude competition shall be of the same type and shall be provided by the competition organiser.
   a) It is recommended that the competition organiser tender offers from more than one producer whose devices are approved as fully meeting the technical standards of this code and announce to all competitors the type that has been selected for use at least 60 days in advance of the competition.
   b) The competition organiser shall provide a number of altimeters at least equal to 1.2 times the number of registered competitors in the altitude classes for that contest.
   c) The producer shall provide written instructions in English along with appropriate digital device connectors and software for the organiser's pre-flight set up and post-flight readout of the altimeters and for the competitors' use of the altimeters.
   d) The producer shall calibrate all altimeters at his premises and shall provide the organiser with calibration certificates for each altimeter, by serial number

e) The producer shall, if required, provide an altimeter test apparatus for the organiser, and the organiser shall use such an apparatus to conduct a verification that the accuracy of the altimeters is in compliance with 2.1.j before the beginning of the competition.

1) The apparatus shall allow verification of all altimeters simultaneously, and shall be used for all altimeters at three test altitudes: 300 metres, 600 metres, and 1000 metres

3.2.2 The competition organiser shall collect a deposit for each altimeter that is issued during the competition, sufficient to cover the cost of the altimeter and its battery, and shall return this deposit if the altimeter is returned in working order but shall keep the deposit for altimeters not returned or returned with damage that prevents their continued use.

3.2.3 The competition organiser shall maintain a log and record the serial number of each altimeter issued to a competitor during the competition and the start number of that competitor; shall record the time of issue and of return of each altimeter; and shall collect initials from both the organiser's representative and the competitor for each issue and each return of that altimeter during the competition.

3.3 Employment of Altimeters in the Competition

3.3.1 All altimeters that will be used in a competition shall be kept in the secure custody of the competition organiser in a locked box out of direct sunlight once they have been accepted following verification of calibration, except when issued individually to competitors during the competition.

3.3.2 Altimeters shall be issued during the competition from a single Altimeter Control Station with two Altimeter Controllers: one to set and issue the altimeters and one to maintain the log required in 3.2.3 and collect the deposit required in 3.2.2.

3.3.3 Altimeters shall be issued to and used by competitors once a flying round has begun in accordance with the following procedure:
a) The Altimeter Controller will observe and record the ambient temperature of the launch area at the beginning of each flight round and will write that observed value on the flight cards for all altimeters that are issued during that round.
b) The competitor will insert the rocket motor(s) in his space model and otherwise prepare it for flight
c) The competitor will proceed to the Altimeter Control Station with his model and flight card, in company with a launch site monitor who has a stopwatch
d) The Altimeter Controllers will issue an altimeter selected at random from a common pool, with a charged battery, after verifying that the altimeter has been reset for a new flight, and will write the serial number of this altimeter on the flight card
e) The launch site monitor will start his stopwatch when the Altimeter Controller connects the altimeter to its battery and will observe the competitor insert the altimeter into his model within the 180 seconds before the altimeter goes into its data collection mode, and will then accompany the competitor back to the launch lane
f) The competitor will fly and recover the model and will present it to the launch site monitor upon recovery
g) The competitor will return to the Altimeter Control Station with the model and flight card in company with the launch site monitor and will remove the altimeter in the presence of the Altimeter Controller
h) The Altimeter Controller will take the altimeter, read and save its full recorded flight data including serial number on a computer, apply the ambient temperature correction required in 2.2.5, and write the resulting score on the flight card after verifying that the altimeter serial number matches the serial number issued before the flight, present a score report showing the altitude recorded by the altimeter to

the competitor for his signature and provide a second copy of that report to the competitor, then reset the altimeter following that signature and return it to the common pool for future issue

i) If the competitor disputes the score and declines to sign the score report the altimeter will be kept separately from all others and its data will not be reset until directed by the FAI Jury

3.3.4 If the altimeter experiences an anomaly in use that puts the accuracy of its data in doubt or causes it to provide no data, then the flight shall be scored at a %Track Lost+(TL) and the competitor may re-fly if there is enough time to perform another flight in the same round

a) Such anomalies include evidence that the altimeter may have been tampered with or removed during the recovery process prior to presentation to the launch site monitor, or failure of the altimeter to initiate a data-collection sequence during flight

b) Loss or damage of the altimeter during flight shall be a TL but shall not be the basis for another flight attempt in the same round.

c) Failure to return the model with altimeter to the launch site monitor within 30 minutes after the end of the final round of the event shall be a TL

4.0   APPROVAL OF ALTIMETERS

The CIAM is establishing a committee to assume responsibility for the approval process for altimeters that are designed in accordance with the requirements of Section 2 of this document and may be eligible to be used in spacemodelling competition. The services of a technical expert may be used to undertake the practical testing on behalf of the committee.

Further details will be advised in due course, together with the specific requirements concerning the presentation of devices for approval.

Devices submitted for approval must be manufactured to normal production standards and must incorporate altimeter firmware and supporting digital device software at the revision level that is to be evaluated.

Supporting documentation shall include the sensor manufacturer's data sheet on the pressure sensor device with particular reference to long term drift, hysteresis, and temperature variation characteristics.

Additional supporting information may be required at the request of the technical expert undertaking the evaluation on behalf of the CIAM committee.

A list of Approved altimeters, together with copies of approval documents, is published in the documents on the CIAM website under the section 'EDIC WG & Electronic Device Approvals'. Updates are made immediately any new approval is issued. Competitors and Contest Organisers are advised to regularly check for updates to the list.

Approval, when granted, will relate to a specific hardware/firmware combination. Any subsequent modification to hardware or firmware must be notified to the CIAM committee and advice will be provided concerning any requirements for upgrading the previously granted approval.

An approved altimeter may have its Approved Status withdrawn if inconsistencies of performance are found in further examples of the altimeter.

If, subsequent to the granting of an approval status, the rules of the competition are amended in a manner that affects the technical specification of the altimeter, the validity of all altimeters on the Approved List will be subject to review.

Section 3 Ë F5D Energy Limiter V 1.0

Initial Publication: 01 July, 2016

Contents

1.0   Introduction

1.1   Purpose of this Document

The FAI CIAM rule making/amendment process is geared to maintain competition rule stability and as such presents some difficulties in areas subjected to rapidly changing technologies. To overcome this problem, CIAM Bureau instituted an %Electronic Devices in Competition (EDIC)+Working Group which will provide a system of %technical considerations+outside the rule making process that will enhance a class but not impinge on the class rules.

As part of that system, this document provides technical guidance on the specification, testing and application of F5D Energy Limiters (F5DELs) for use in F5D competitions. The information contained herein is relevant to F5DELs manufacturers, competition organisers, competitors and persons involved in the evaluation of F5DELs.

1.2   Philosophy behind the F5DEL Specification

International competitions attract large numbers of competitors, each of whom is entitled to three models. Consequently, competition organisers could expect to be presented with a significant number of F5DELs from a number of different manufacturers for scrutinizing and verification purposes.

It is against this background that the F5DELs Specification has been formulated with the following objectives:

a) To accurately determine the consumed energy as required for the competition.

b) To ensure that the F5DEL can only function as required by the rules of the competition and cannot be operated, unintentionally or otherwise, in any other manner.

c) To provide a standard method of operation so that, irrespective of F5DEL manufacture, verification testing can be performed easily with a defined test procedure.

d) To define standard connectors for compatibility with test facilities and to reduce the risk of accidental damage during handling by competition officials.

e) To provide a standard method of determining that the F5DEL is of the type for which an approval has been granted.

f) To guarantee the particular version for which the device was approved.

2.0   INFORMATION FOR MANUFACTURERS

2.1   F5DEL Technical Specification

This section is the formal specification for F5DELs intended for use in the F5D competition environment.

2.2   Technical Specifications

An electronic F5DEL carried in an F5D model shall fulfill the following technical specifications:

a) Current measurement will be by use of resistive shunt resistor or current sensing Hall sensor type device installed in the positive side of the power lead between the battery and the motor controller.

b) Voltage measurement will be made between the positive and negative leads of the battery that supplies power for the motor. The battery voltage measurement is to be taken on the battery side of the measurement device if a resistive shunt is used.

c) The method of converting current and voltage to energy units (WM), must be such that the specified accuracy is ensured over the operating range. The calculation will be watts (volts x amps) x minutes motor run.

d) The motor will be stopped once the accumulated total energy limit of 1000 WM has been reached. The motor cutoff will continue for 10 seconds after which additional motor run time will be allowed until the additional 10% energy limit is reached at which point another 10 second motor cutoff will occur. This sequence shall repeat until the model lands.

e) The F5DEL must have compatibility with ESCs using the nominal 1 to 2 milliseconds (mS) control signal from the receiver such that no low speed motor drive occurs when %motor stop+is instituted either by the competitor or the F5DEL.

f) The supply of power to the F5DEL shall be that available from the receiver output to the ESC at the receiver motor command connector. If the power source to the receiver is supplied via the ESC motor command connector, it is permissible for this to be supplied to the receiver via the F5DEL.

g) The connectors of the F5DEL shall be of a universal type compatible with JR/Futaba and must be proof against any misalignment that could result in electrical damage to the F5DEL or connected equipment. Where an extension lead is used to satisfy this requirement it must be secured to the F5DEL in such a manner that it cannot be unintentionally removed.

2.3   Characteristics of the F5DEL

2.3.1   The accuracy of the determined energy (WM), shall be within the range +/- 2%. This accuracy must be achieved across input voltage between 10 and 25 volts and across 25 to 100 amps and ambient temperature range of 0 to +50 degrees centigrade.

2.3.2   The calculation of the energy shall incorporate any calibration parameters provided by the current sensor manufacturer.

2.3.3   The sampling rate of the power measurement used for energy usage determination shall be a minimum of 10 samples per second.

2.3.4 There must be no configurable settings or adjustments that allow the user to modify the operation of the F5DEL such that it will operate outside the requirements of the competition rules.

2.4   Starting condition

The F5DEL shall initialize using the following procedure:

(a) Immediately on application of power to the F5DEL it will zero out the energy accumulator.

(b) The motor command will initialize to the "off state" and will remain there until the radio control command commands otherwise.

(c) When the motor start command exceeds 1.2 mS the F5DEL will start to accumulate WM.

Note: 1) A Motor Start command is defined as any control signal exceeding 1.2 milliseconds.

Note: 2) When the limit is reached refer to 2.2 d) for information on operation.

3.0   TECHNICAL CONSIDERATIONS

This section is provided as design guidance on F5DELs intended for use in the F5D competition environment.

3.1   Restriction on User Configuration Options

Whilst for commercial considerations manufacturers may wish to produce F5DELs adaptable for differing applications, when used in the F5D competitive environment, the installed firmware shall have dedicated F5D functionality with no user configurable options. The purpose of this is to eliminate any possibility of errors in operation due to incorrect configuration settings.

3.2   Connector Compatibility

The F5DEL shall use standard JR/Futaba type connectors for both the signal in and outputs.

The power connectors will be 6mm connectors with a female on the positive lead from the battery and a male on the negative lead from the battery. The F5EDL will be fitted 6mm connectors so as to plug in between the positive ESC lead and the positive battery lead. Negative ESC plug will be plugged into the negative battery plug. The ground reference for the F5EDL is through the ESC ground shared with the RC signal.

3.3   ESC Compatibility

There is no defined standard for the manner in which ESCs (electronic speed controllers) initialize to the range of motor command signals. In addition, programmable transmitters allow the user to set the motor command signals to any value within the programmable range.

3.3.1 The F5DEL specification of motor on threshold at 1.2 milliseconds (mS) has been selected as being compatible with most known equipment but cannot be a guarantee of correct operation for every combination of transmitter, receiver and ESC.

4.0   COMPETITION INFORMATION

4.1   Installation Environment

4.1.1   The installation and functioning of the F5DEL, the transmitter and its programming, receiver and ESC, is the sole responsibility of the competitor, who must ensure that they operate together in the correct manner as required for the rules of the competition.

4.1.2   The F5DEL must be installed in such a way that it is protected from mechanical damage.

4.1.3   The F5DEL must be placed inside the model in the state as supplied by the manufacturer. The use of any method that modifies the current or voltage sensing at any time is prohibited.

4.1.4   The ESC must always operate via its series connection to the F5DEL and not with a direct connection to the receiver.

5.0   VERIFICATION OF F5DELs

This section details procedures for verifying the operation of Approved F5DELs for use in the F5D competition environment. It is provided as a guide for competition organisers.

5.1   Purpose of Verification

All F5DELs used in an F5D competition are required to be of an Approved Type. The verification process serves to ensure that no individual F5DEL operates in a manner different from others in use at the competition.

5.2   Verification Testing of 1000 WM F5DEL

5.2.1   Equipment required for testing.

1) A regulated power supply capable of 0 to 25 volts output.

2) A current source capable of up to 100 amps.

3) A constant current electronic load capable of up to 100 amps.

4) Suitable meters and shunts for reading current and voltage with 1% or better accuracy.

5) Stopwatch capable of at least .1 second resolution.

6) A %servo simulator+ to generate a motor command pulse.

7) Suitable meter or oscilloscope to monitor motor command output of F5DEL.

5.2.2   Verification testing will be carried out at a nominal 1000 watts. The voltage for testing will be 20 volts and the current will be 50 amps.

5.3   Test sequence for checking WM accuracy.

1) A 1000 watt simulated load will be applied to the F5DEL using the above test equipment.

2) The stopwatch will be started when the motor command pulse is changed to above 1.5 mS.

3) The motor control pulse out of the F5DEL will be monitored and when it changes to below 1.2 mS the stopwatch will be stopped and the 1000 watt load terminated. The time will be recorded.

5.4 Firmware Revision Level

All F5DELs will have a label on the exterior surface. The label information will include the name of the manufacturer, model number and firmware version.

5.5 Test Pass/Fail limits

5.5.1 An F5DEL is considered to have passed if it reduces the motor command to below 1.2 mS when the 1000 watt load has been applied for 1 minute +/-2% (58.8 to 61.2 seconds).

5.5.2 An F5DEL is considered to have passed if all the test requirements outlined in this document are satisfied.

6 Submission of F5DEL Devices for Approval

The CIAM is establishing a Working Group to assume responsibility for the approval process. The services of a technical expert may be used to undertake the practical testing on behalf of the Working Group. Further details will be advised in due course, together with the specific requirements concerning the presentation of devices for approval.

Devices submitted for approval must be to normal production standard and must incorporate firmware at the revision level that is to be evaluated.

Supporting documentation shall include the sensor manufacturers data sheet on the pressure sensor device with particular reference to long term drift and temperature variation characteristics. Additional supporting information may be required at the request of the technical expert undertaking the evaluation on behalf of the CIAM Working Group.

Approval, when granted, will relate to a specific hardware/firmware combination. Any subsequent modification to hardware or firmware must be notified to the CIAM committee and advice will be provided concerning any requirements for upgrading the previously granted approval.

6.1 Withdrawal of Approved Status

An approved F5DEL may have its Approved Status withdrawn if inconsistencies of performance are found in further examples of the F5DEL.

If, subsequent to the granting of an approval status, the rules of the competition are amended in a manner that affects the technical specification of the F5DEL, the validity of all F5DEL devices on the Approved List will be subject to review.

Section 4 Ë Performance Requirements Definition
for FAI-F5B
Real Time Energy Consumption Telemetry (REAL-TECT) System
Compatible with Existing Í GASSENSORÎ Equipment

Initial Publication: 01 July, 2016

Contents

1.0   Purpose of this Document

The FAI CIAM rule making/amendment process is devised to maintain competition rule stability and as such presents some difficulties in areas subjected to rapidly changing technologies. To overcome this problem, CIAM Bureau instituted an %Electronic Devices in Competition (EDIC)+Working Group which will provide a system of %technical considerations+outside the rule making process that will enhance a class but not impinge on the class rules.

As part of that system, this document provides technical guidance on the specification, testing and application of Real Time Energy Consumption Telemetry Systems (REAL-TECT) for use in F5B competitions. The information contained herein is applicable to F5B electronics equipment manufacturers, competition organisers, competitors and persons involved in the evaluation of REAL-TECT systems.

1.1   Previous Equipment used in F5B Competitions

Before the introduction of the telemetry equipment described in this document, the electronic determination of whether or not a contestants motor is running, is based exclusively on signals coming from an extra ground based R/C receiver connected to a monitor known as a %GASSENSOR+.

This secondary receivers throttle channel is connected to the GASSENSOR and the GASSENSOR infers the motor is running when the pulse width of that channel rises to a threshold 100 μS above that recorded when the throttle is low. The converse is also true as the motor is expected to be off when the throttle pulse width decays to below the threshold.

The GASSENSOR system was designed before the introduction of computer/microprocessor based Radio Transmitters and software programmable speed controllers. With these modern radio control systems and speed controllers there is no guarantee that the output of the secondary receiver truly reflects the operation of the motor in contestantsqmodels.

During the F5B Distance Task, the GASSENSOR communicates the detected Motor-ON/Motor-OFF events to the base station via wired RS-232. At the conclusion of the Distance task, the GASSENSOR automatically commences to measure duration time, continuing the timing operation until duration ends.

The GASSENSOR is disconnected from the base station (and transported by an official) in order to stop duration time at the landing circle.

The length of the Motor runs during duration is also accumulated using this inferred Motor-ON logic.

1.2   Philosophy of the F5B REAL-TECT System

The REAL-TECT system shall use motor current obtained as the primary mechanism to infer the motor is running and provide that information to the GASSENSOR via telemetry.

The REAL-TECT ground station shall connect between the extra receiver and the GASSENSOR, maintaining all functionality of the GASSENSOR.

1.3   F5B REAL-TECT System Functionality

The REAL-TECT system shall directly read the motor current as a measure of whether the motor is running and transmit that information via RF to the Ground Station and Contest Organisers in real time. There shall also be a mechanism for a second R/C receiver bound to a contestant's transmitter to be used only as backup in case of RF system failure or RF out of range condition.

The REAL-TECT ground station shall constantly evaluate the condition of the RC based motor signal and the RF based motor signal in order provide the most conservative input to the GASSENSOR; any ambiguities will be construed as motor not running.

There shall be two connections to the contestant's airborne equipment: one in series with battery positive lead to supply power to the airborne device and to monitor motor current; the second to the battery negative connection to supply ground.

The GASSENSOR will receive the adjudicated Motor Status signal via the REAL-TECT ground station as if it were an R/C throttle pulse high or low so that any Course motoring foul may be applied in real time. The pilot may then adjust his flight strategy in accordance with the Class rules.

Near real time WM telemetry information replacing an absolute 1750 WM Limiter will allow pilots to better apportion their energy use between Distance and Duration and to know that a penalty is being incurred once 1750 WM is attained. A known and calculable penalty after 1750 WM should be preferable to the possibility of a lost model due to unforeseen cessation of power while being in a precarious or unsafe flight condition and having no ability to apply power to correct the condition and/or return to the field.

International competitions attract large numbers of competitors, each of whom is entitled to two models thus a significant amount of REAL-TECT qualified equipment is necessary and must be seamlessly integrated with organiser owned "GASSENSOR" equipment. Consequently competition organisers may be offered REAL-TECT systems from a number of different manufacturers for qualification, verification and/or revenue purposes. It is against this background that the REAL-TECT Specification has been formulated with the following objectives:

a)   To accurately measure, tally and broadcast via RF, the consumed energy used by the model as required for the competition.

b)   To accurately detect presence of current flowing from the model's motor battery to the speed control and broadcast the event via RF.

c)   To accurately decode the Motor-On RF event and adjudicate it with the Motor-On RC event and provide the net result to the GASSENSOR in real time as equivalent to only an R/C Throttle Pulse High signal received from a parallel R/C receiver.

d)   To accurately receive and decode the RF WM tally and a mechanism to convey it to the pilot's helper on a demand basis.

e)   To ensure that the REAL-TECT system can only function as required by the rules of the competition and cannot be operated, unintentionally or otherwise, in any other manner.

f)   To provide a sufficiently standard method of operation so that, irrespective of REAL-TECT manufacturer, verification testing can be performed easily with a defined test procedure.

g) To define standard connectors for compatibility with test facilities and to reduce the risk of accidental damage during handling by competition officials.

h) To provide a standard method of determining that the offered REAL-TECT system is of the type for which an approval has been granted.

i) To guarantee the particular hardware and software version for which the devices are approved.

2.0 Information for Manufacturers

2.1 F5B REAL-TECT Technical Specification

This section is the formal specification for REAL-TECT equipment intended for use in the F5B competition environment.

2.1.1 REAL-TECT System General Description

A manufacturer supplied REAL-TECT system shall consist of two major Components: Airborne Telemetry Transceiver (ATT) and Ground Display GASSENSOR Transceiver (GDGT).

A World Championship capable system will consist of as many GDGTs as GASSENORS as required for use in the competition and two ATTs per pilot. Sufficient spares will be required of each device.

There must be no configurable settings or adjustments that allow the user to modify the operation of the REAL-TECT system components such that a system can be operated outside the requirements of the competition rules.

The highest priority of the system is to detect motor current (in excess of a nuisance threshold) equating to Motor-ON from the telemetry system, adjudicate that with information from the second R/C receiver bound to a contestant's transmitter (referred to as "RC System") and communicate the motor status as quickly as possible to the GASSENSOR.

The lower priority system function, whilst the motor is stopped for greater than 1.5 seconds, is to convey to the pilot accumulated WM, alternately with Motor-OFF.

The transmissions taken in total shall constitute a "heart beat" message to the GDGT so it may constantly validate the RF condition and properly and seamlessly use it in conjunction with the Receiver R/C pulse value, to derive the proper GASSENSOR input.

Table 1 on the following page defines the required logic, 1 being Motor ON, 0 being Motor OFF and N being NULL or invalid signal:

cont/ō

RC-MOT-STATUS	RF-MOT-STATUS	GASSENSOR output pulse Width
N	N	1 mS <Motor OFF>
N	0	1 mS <Motor OFF>
0	N	1 mS <Motor OFF>
0	0	1 mS <Motor OFF>
1	0	1 mS <Motor OFF>
1	N	2 mS <Motor ON>
0	1	2 mS <Motor ON>
1	1	2 mS <Motor ON>
N	1	2 mS <Motor ON>

TABLE 1: R/C AND RF MOTOR STATUS LOGIC

2.1.2 REAL-TECT System RF Power and Frequency Band

The ATT shall have adequate RF power to have Line-of-Sight minimum nominal range of 500 metres. The GDGT is not required to transmit and if there is a facility for transmission, any adjustable RF power level should be set to minimum.

The RF frequency shall be within an ISM band allowed in each country, selected for adequate RF power. A typical ISM transmission allowed at +20 dBm in most Western European Countries is 433 to 438 MHz.

Use of 2.4 GHz equipment is strongly discouraged to prevent interference with the pilots control of the model.

The RF modulation method, RF data rate and Communication Baud rate shall be at the discretion of the system designer subject to system performance requirements being met.

Each ATT shall be inalterably programmed with a unique serial number address, known as NODE_ID;

A block of serial numbers shall be reserved exclusively for contest use and a block for individual user experimentation.

REAL-TECT manufacturers offering equipment for competitions shall provide a list of NODE IDs offered for public sale/sold and those offered for unique use by competition organisers.

All ATT data transmissions shall include the unique NODE ID for positive source identification and a checksum for the GDGT to validate the data packet. In addition, if a fixed frequency, limited band, or software configurable frequency hopping mechanism is available, the unique NODE IDs should be spread over the available RF Channels.

An example of an eight Channel System using an 8 bit NODE ID is shown on the following page:

NODE ID 000-029   : RF CHANNEL 0

NODE ID 030-059   : RF CHANNEL 1

NODE ID 060-089   : RF CHANNEL 2

NODE ID 090-119   : RF CHANNEL 3

NODE ID 120-149   : RF CHANNEL 4

NODE ID 150-179   : RF CHANNEL 5

NODE ID 180-209   : RF CHANNEL 6

NODE ID 210-239   : RF CHANNEL 7

NODE ID 240-255   : <Undefined>

TABLE 2: NODE ID and RF Channel

The GDGT must be configurable to accept RF signals from two ATT NODE IDs corresponding to a competitor's Primary model and to his Back Up model. These two NODE IDs must be on the same RF CHANNEL as detailed in Table 2.

The GDGT shall reject the Back Up NODE ID selection if it doesn't correspond to the same RF CHANNEL as the Primary NODE_ID.

Once either accepted ATT NODE ID transmits more than 50 WM, RF signals from the other NODE ID shall be ignored while the GDGT remains powered by the GASSENSOR.

2.1.3 Physical Arrangement: ATT

The ATT shall consist of a bi-directional current/voltage sensor and a processor-transmitter connected by a 40 ± 5 cm flat ribbon cable. The sensor may be either hall-effect, torroidal or shunt type and normally resides in the nose of the model convenient to the connection of the motor battery to the speed controller. The processor-transmitter resides in the fuselage immediately behind the wing.

The current/voltage sensor shall be connected in series with the positive battery connection and shall have a one 6 mm male barrel type connector and one female 6 mm barrel connector. The current/voltage sensor shall also provide system power ground via an additional 10 ± 1 cm lead terminated in 2 mm male barrel connecter.

See Figure 1 on the following page for maximum allowed dimensions of the current sensor.
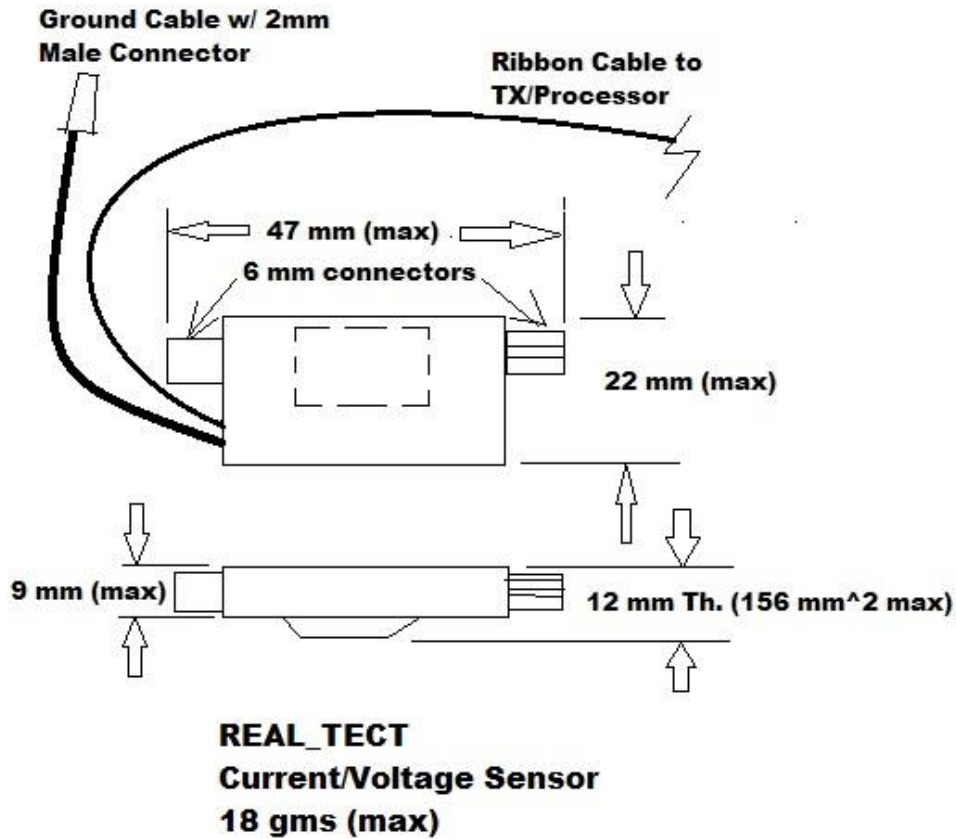
Figure 1: REAL-TECT CURRENT/VOLTAGE SENSOR

The processor-transmitter shall contain a microprocessor based circuit card assembly (CCA) that accumulates and stores the WM, an RF module having Country Approved frequency band/RF power and a suitable antenna.

The antenna may be integral to the module, directly connected to the module or connected to the module via micro-coax type cable of between 6 and 8 cm. It is permissible to specify that the cable exit the fuselage via a small hole or adjoining the wing opening in the fuselage.

The aerial configuration must be such that when the processor-transmitter is installed in a full carbon fibre model, the specified operating range requirements are satisfied.

See Figure 2 on the following page for maximum allowed dimensions of the processor-transmitter.
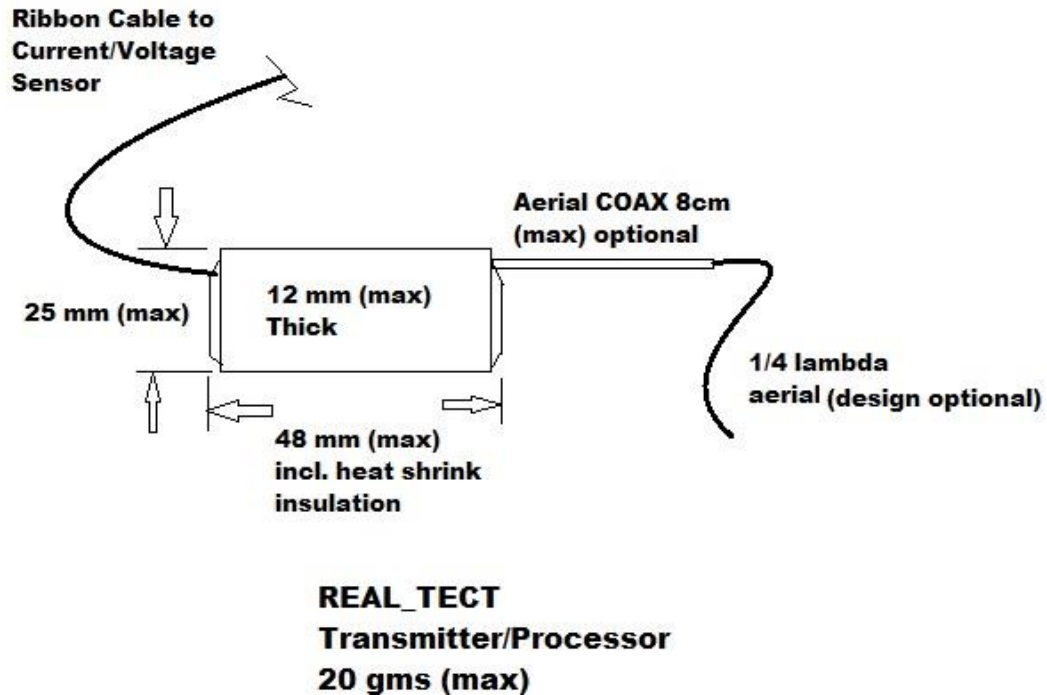
Ribbon Cable to Current/Voltage Sensor

Aerial COAX 8cm (max) optional

25 mm (max)

12 mm (max) Thick

1/4 lambda aerial (design optional)

48 mm (max) incl. heat shrink insulation

REAL_TECT Transmitter/Processor 20 gms (max)

Figure 2 REAL-TECT TRANSMITTER/PROCESSOR

2.1.4 Physical Arrangement: GDGT

The GDGT shall have the following physical features:

a) An enclosure containing all the equipment described below having maximum dimensions 15 cm X 10 cm X 5cm.

b) A daylight readable alpha-numeric character display having a minimum of 32 characters.

c) A set of buttons, momentary switches or other human input mechanism that configures the GDGT to the applicable NODE IDs.

d) An ISM band Commercial-Off-The-Shelf (COTS) RF receiver configurable with any ATT and applicable Receiver Antenna.

e) JR 3-pin female connectors to provide Motor Status to the GASSENSOR.

f) JR 3-pin female connector to accept the motor signal from the Pilot's ground based receiver.

g) The GDGT shall be powered by the GASSENSOR (4.6 V dc nominal) which will also power the contestant's receiver.

cont/ō

2.1.5 Functional Description: GDGT Preparation for Flight

The GDGT shall be connected to the GASSENSOR via the GASSENSOR receiver port.

The pilot will provide his second Receiver to the operator who will connect the throttle pulse output to the GDGT Rx input port.

After powering on the GASSENSOR/GDGT/RC Receiver, the 32 character display (the DISPLAY) may show an opening message and must show its software version-number for 2 +/- 1 seconds, prior to presenting a message requesting entry of the two NODE IDs corresponding to the ATTs of the Pilot's primary model and of the backup model. Without a backup model, the Primary NODE ID should also be stored as the Backup NODE ID.

After Node ID entry, the GDGT will continuously read and display the R/C throttle pulse value. The operator shall request the Pilot toggle his transmitter to RC throttle LOW if not already LOW. The GDGT will request operator make an input (e.g. press a button) to store the LOW pulse width.

The GDGT shall then show a message on the Display that the operator command the pilot to toggle his RC throttle to HIGH. The GDGT will request operator make an input (e.g. press a button) to store the HIGH pulse width. The operator shall ensure that the pulse value is stable before making the entry.

Once ENTER is pressed, the program will store the Backup NODE ID to volatile memory and if necessary change the RF channel of the RF Module.

While the Channel is being changed, or for 3 seconds, whichever is longer, the LCD will clear and then very briefly display "ADJUSTING RF CHANNEL TO <RF CHANNEL>.

The GDGT shall verify that

<Throttle High Pulse Width> - <Throttle Low Pulse Width> = 600μS or greater

and determine a value for motor on threshold (RC_MOT_ON_PULSE_WIDTH as

RC_MOT_ON_PULSE_WIDTH = Throttle Low Pulse Width + 100μS

If the difference between Throttle High Pulse Width and Throttle Low Pulse Width (pulse delta) is less than 600 μS, the 100 μS threshold is reduced proportional to the difference in the pulse delta when the pulse delta is between 600 μS and 200 μS. For example, if the pulse delta is 400 μS, the RC_MOT_ON_PULSE WIDTH shall be Throttle Low Pulse Width + 50μS. If the pulse delta is below 200 μS, the GASSENSOR rejects the input, thus any REAL-TECT system must also reject that input.

At the conclusion of the last ENTER button press, the LCD shall clear and display:

"GASSENSOR Cal LO <cr> (ENTER) to Cont+

and continuously output a 1.0 mS, 30 Hz pulse.

(This is a representative spare R/C receiver throttle low pulse and will be used by the GASSENSOR to determine its RC_MOT_ON_PULSE_WIDTH in order to output the net logical Motor state (per Table 1 above) to the Base Station).

This condition shall persist for approximately 3 seconds after which LO on the display will change to HI and the output pulse width will change to 2.0 mS at 30 Hz to simulate R/C receiver throttle high pulse width.

The operators are required to press appropriate buttons on the GASSENSOR while the GDGT output to the GASSENSOR toggles between 1 mS and 2 mS every 3 seconds.

Once the GASSENSOR has accepted both inputs via audible beeps, the Operator shall press ENT on the GDGT to denote completion of the calibration and ready the system for operation/flight.

After final user input, the LCD shall clear and display

%NODES< Primary NODE ID>,<BACKUP NODE ID>,CH<RF CHANNEL>+ on line 1 and

%RC:+<RC_MOT_STATUS>RF:+<RF_MOT_STATUS>WM:+<Watt Minutes> on line 2.

2.1.6 Functional Description: ATT

The ATT shall accumulate Watt-Minutes (WM) independently of any telemetry transmissions including during out-of-range conditions.

Power measurement shall be at a minimum rate of 10 Hz. The accuracy of the determined energy (WM) shall be within the range +/- 2%. This accuracy must be achieved across an input voltage range of 20 and 42 volts, a current range of 50 to 250 amps and an ambient temperature range of 0 to +50 degrees centigrade.

At Power On, the microprocessor shall read and store any current sensor tare value in flash memory and zero the Energy accumulation.

The first WM transmission is assumed to be a %Motor Test Blip+at less than 50 WM. After this Test Blip the ATT shall transmit %0000+for WM.

When the accumulation exceeds 50 WM the WM will accumulate and the value will be transmitted.

When Motor-On is detected, Motor-ON transmissions shall be nearly continuous at 30 Hz.

When the motor current subsequently decays below the threshold determined during calibration, the Motor-OFF event will be transmitted at 30 Hz.

When the Motor-OFF condition has persisted for 45 times at 30 Hz, the ATT shall transmit accumulated WM, alternating this with Motor-OFF at a repetition rate of 1 Hz until the next Motor-ON event is detected or power is interrupted.

The telemetry motor transmissions shall reset to Motor-OFF within 20 ms of motor power decaying to below 275 ± 50 watts.

cont/õ

3   Verification Testing

3.1   Equipment required for testing

a) Regulated power supply capable of 0-50 volts output.

b) Current source capable of up to 250 amps.

c) Constant current electronic load capable of up to 250 amps.

d) Suitable meters and shunts for reading current and voltage to 1% or better accuracy.

e) Stopwatch capable of at least .1 second resolution.

f)   %Servo tester+to generate a motor command pulse 900 to 2000 uS.

g) Oscilloscope.

h) Complete carbon fibre F-5B aircraft including motor, batteries, speed control, R/C receiver, etc. (e.g. Avionic B14 model or equivalent) for RF range testing.

i) 10 S LiPo Battery with 6 mm connectors.

3.2   Ground Display GASSENSOR Transceiver Tests

TEST 1.   GDGT POR and Version Display.

TEST 2.   GDGT Invalid NODE ID Rejection

TEST 3.   GDGT Primary NODE ID Input.

TEST 4.   GDGT Valid Backup NODE ID Input.

TEST 5.   GDGT Invalid Backup NODE ID Rejection

TEST 6.   GDGT RF Module Channel Adjustment

TEST 7.   GDGT R/C Throttle Hi Input

TEST 8   GDGT R/C Throttle Lo Input

TEST 9   GDGT GASSENSOR HI/LO Calibration

TEST 10   GDGT Flight Ready Display

TEST 11   GDGT R/C Motor Status Toggle : 1/0/N

TEST 12   GDGT RF Motor Status Toggle : 1/0/N

TEST 13   GDGT WM Accumulation Display

TEST 14   GDGT Wrong Node RF Message Reject

TEST 15   GDGT Wrong Checksum RF Message Reject

TEST 16   GDGT RC/RF Motor Status Logic (All Table 1 Conditions)

TEST 17   GDGT RF Dropout Persistence- Motor ON : < 37.5 mS

TEST 18   GDGT RF Dropout Persistence-Motor OFF : < 1.5 S

TEST 19   GDGT RC/RF Motor Status Change without GASSENSOR interruption

TEST 20   GDGT Heartbeat Message Persistence

TEST 21   GDGT RF Motor ON Time Delay : < 20 mS

TEST 22   GDGT RF Motor OFF Time Delay : <20 mS

TEST 23   GDGT RF Motor ON/OFF Transition Persistence : 1 ± .1 S

3.3   ATT Tests

TEST 24   ATT Message Content: NODE ID=Labeled ID

TEST 25   ATT Message Content: Checksum Accuracy

TEST 26   ATT Message Content: MOTOR-ON

TEST 27   ATT Message Content: Motor-Off

TEST 28   ATT Message Content: Watt-Minutes

TEST 29   ATT Message Content: 1st Motor ON < 50 WM=+0000+

TEST 30   ATT Motor ON/OFF Toggle Delay : < 20 mS

TEST 31   ATT Motor OFF/ON Toggle Delay : <20 mS

TEST 32   ATT WM Calibration Accuracy: ± 2% over Temp and Current Range

3.4   Systems Test

TEST 33   RF RANGE : >300 metres, over flat unobstructed ground, with the ATT in a complete epoxy-carbon fibre based Model (such as an Avionic B14) and with the GDGT maintained 1 metre AGL.

4.0   Competition Information

4.1   Installation Environment

4.1.1   The installation and functioning of the REAL-TECT ATT, in conjunction with the competitor's transmitter (including its programming), receiver and ESC, is the sole responsibility of the competitor, who must ensure that they operate together in the correct manner as required for the rules of the competition.

4.1.2   The REAL-TECT ATT must be installed in such a way that it is protected from mechanical damage.

4.1.3   The REAL-TECT ATT must be placed inside the model in the state as supplied by the manufacturer. The use of any method that modifies the current or voltage sensing at any time is prohibited.

5.0   Verification of REAL-TECT Components

This section details procedures for verifying the operation of Approved REAL-TECTs for use in the F5B competition environment. It is provided as a guide for competition organisers.

5.1   Purpose of Verification

All REAL-TECT Systems used in an F5B competition are required to be of an Approved Type. The verification process serves to ensure that no individual REAL-TECT system operates in a manner different from others in use at the competition.

5.2   ATT WM Calibration Testing

Testing will be done at a nominal 1500 watts. The voltage for testing will be 30 volts and the current will be 50 amps.

5.3   Test Sequence for Checking WM Calibration (TEST 32)

a) Connect a GDGT to a GASSENSOR and Servo Tester. Configure the NODE ID to match the ATT under test. Complete the GDGT setup sequence to the Operate Mode.

b) A 1500 watt simulated load will be connected to the ATT current sensor using the above test equipment. The ATT power supply shall be 42 vdc (equivalent to a 10 S LiPo).

c) A Test Current blip shall be applied to ensure the associated GDGT display reads %0.000+.

d) The 1500 Watt Load and the stopwatch will be started simultaneously.

e) After a period of 70 seconds, both the load and the stop watch will be stopped simultaneously. GDGT WM shall display between 1715 and 1785 WM. <this is ± 2%> .

5.4   Test Pass/Fail limits

REAL-TECT Systems and Systems components will considered to have passed if all the Test Requirement of Section 5.2 and 5.4 are met.

5.5   Firmware Revision Level

5.5.1   All REAL-TEST ATTs will have an anti-tamper sticker showing the version of firmware.

5.5.2   All GDGTs will display firmware revision upon start up.

6.0   Submission of REAL-TECT for Approval

The CIAM is establishing a Working Group to assume responsibility for the approval process. The services of a technical expert may be used to undertake the practical testing on behalf of the Working Group. Further details will be advised in due course, together with the specific requirements concerning the presentation of devices for approval.

Devices submitted for approval must be to normal production standard and must incorporate firmware at the revision level that is to be evaluated.

Additional supporting information may be required at the request of the technical expert undertaking the evaluation on behalf of the CIAM Working Group.

Approval, when granted, will relate to a specific hardware/firmware combination. Any subsequent modification to hardware or firmware must be notified to the CIAM committee and advice will be provided concerning any requirements for upgrading the previously granted approval.

6.1   Withdrawal of Approved Status

An approved F5BEL/F5BELo may have its Approved Status withdrawn if inconsistencies of performance are found in further examples of the REAL-TECT

If, subsequent to the granting of an approval status, the rules of the competition are amended in a manner that affects the technical specification of the REAL-TECT, the validity of all REAL-TECT on the Approved List will be subject to review.

EDIC WORKING GROUP TERMS OF REFERENCE

1.0   Background

(a) Electronic devices are already in use in aeromodelling or space modelling competitions for scoring purposes. Devices need to be manufactured under specific technical specifications and then need to be checked whether they meet those specifications and finally be approved for official use. During the December 2103 meeting, CIAM Bureau decided to form a Working Group which will be responsible for this task.

(b) All projects undertaken by the EDIC WG are at the request of CIAM Bureau or a CIAM Subcommittee Chairman.

2.0   Mission

The mission of this CIAM Working Group is:

(a) To issue technical specifications for all electronic devices used for CIAM competitions.

(b) To communicate with companies which are willing to manufacture such electronic devices.

(c) To define the approval procedure and the necessary steps in order to evaluate such devices.

(d) To test the devices according to the procedures defined.

(e) To issue and maintain an approval list of all such devices.

(f) To provide advice, to CIAM, on any matter relating to electronic devices that are used or can be used for aeromodelling or space modelling competitions.

3.0   Membership

The working group will comprise 3 (three) appointed members:

(a) One person who will be the Chairman and will be appointed by CIAM Bureau. He will be responsible for all CIAM running projects.

(b) Two persons per project who will be appointed by the relevant CIAM Subcommittee.

4.0   Term

The Working Group Chairman shall be appointed for a two-year term and may be re-appointed.

The two persons appointed by the relevant CIAM Subcommittee, will be members of this Working Group for the life of the specific project.

5.0   Transaction of business

(a) The Working Group may plan face-to-face meetings in conjunction with other CIAM activities at which all, or the majority of, Working Group members are present.

(b) The normal business of the Working Group is expected to be conducted through the mediums of email and VoIP (Voice over IP) services.

(c) Working Group members are not entitled to claim any casual expenses or travel costs from the CIAM unless these are expressly pre-approved by CIAM Bureau.

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