Electronic Devices in Competition

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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 4 - F5B OEM and REAL-TECT System

Section 4 – Performance Requirements Definition for FAI-F5B

Real Time Energy Consumption Telemetry (REAL-TECT) System Compatible with Existing GASSENSOR" Equipment and Onboard Energy Monito(OEM)

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) and Onboard Energy Monitoring systems (OEM) 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 and OEMsystems.

2.0 Onboard Energy Monitor (OEM)

The OEM consists of a processing/logging unit registering current, voltage and time (and thus Wmin), and a shunt mounted in the positive lead between battery and controller. A separate lead shall connect to the negative lead of the battery. The OEM stores the energy related information on a memory card, at a frequency of minimum 20Hz.

The electronic determination of whether or not a contestant’s motor is running, is based on signals coming from an extra ground based R/C receiver connected to a monitor known as a “GASSENSOR”.

This secondary receiver's 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.

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.

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.

2.1 Objectives OEM

The OEM System shall achieve the following objectives:

a) To accurately measure, tally and store in the memory of the device, the consumed energy used by the model as required for the competition flight.

c) The Motor-On event shall be detected by an additional ground based parallel R/C receiver a and presented to the GASSENSOR in real via a R/C Throttle Pulse High signal

d) To accurately store in memory and present the Wmin tally either via the telemetry system of the competitors transmitter or by connecting a display to the OEM after landing (choice at the discretion of the competition director)

e) To ensure that the OEM 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 the competitor with a system which can be used to analyse relevant data after the competition flight.

g) to store data on the memory of the OEM, which can easily be analysed by the jury in case of any dispute

h) relieve financial pressure on the organisation of competitions, while providing the competitor the chance to use the OEM both during and outside competition
i) a simple and robust system which can be permanently mounted in the competitors model, without the need for continuous removal and mounting, removing the risk of damages to and failures of the OEM.

j) simple to operate system for competition director, where only the GASSENSOR needs to be calibrated to the pilot's receiver.

K) a system not relying on RF transmissions, allowing the OEM system to be used worldwide irrespective of local RF-regulations

2.3 Verification of OEM

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

2.3.1 Purpose of Verification

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

2.3.2 OEM Wmin Calibration Testing

Testing will be done via a procedure that approaches actual power levels (Watts) in competition as close as possible.

The OEM shall be supplied a constant voltage of 37V.

Current should rise similar to the ramping used in competition up to 180A, then sharply reduce to 0. The verification shall include at least 10 cycles of rising current.

Alternatively a test may be performed at a constant current of 100A.

The testing device shall monitor energy consumption. When 1750Wmin (+/-0.2%) has been supplied, the device shall stop the testing cycle.

The OEM shall then be read out, either by a separate display or data as presented by the testing device.

2.3.3 Test Pass/Fail limits

OEM systems shall be considered to have passed if the device displays Energy between 1715Wmin and 1785 Wmin. <this is ± 2%> .

3 - REAL-TECT

3.1 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.

3.2 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.

4.0 Information for Manufacturers

4.1 F5B REAL-TECT Technical Specification

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

4.1.1 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:

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

4.1.2 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 pilot’s 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.

4.1.3 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.

Figure 2 REAL-TECT TRANSMITTER/PROCESSOR

4.1.4 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.

4.1.5 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.

5.1.6 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.

5 Verification Testing REAL-TECT

5.1 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.

5.2 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 GASSENSENSOR 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

5.3 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

5.4 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.

6.0 Competition Information

6.1 Installation Environment

6.1.1 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.

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

6.1.3 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.

7.0 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.

7.1 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.

7.2 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.

7.3 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 “0000”.

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%> .

7.4 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.

7.5 Firmware Revision Level

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

7.5.2 All GDGTs will display firmware revision upon start up.

8.0 Submission of REAL-TECT or OEM 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.

8.1 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 or OEMIf, 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 or OEM on the Approved List will be subject to review.