European Aviation Safety Agency

Deviations requests for an ETSO approval for CS-ETSO applicable to a MMR (Multi Mode receiver (ETSO-2C104a/ETSO C129a)
Consultation Paper

1. Introductory note

The hereby presented deviation requests shall be subject to public consultation, in accordance with EASA Management Board Decision No 7-2004[1] products certification procedure dated 30 March 2004, Article 3 (2.) of which states:

"2. Deviations from the applicable airworthiness codes, environmental protection certification specifications and/or acceptable means of compliance with Part 21, as well as important special conditions and equivalent safety findings, shall be submitted to the panel of experts and be subject to a public consultation of at least 3 weeks, except if they have been previously agreed and published in the Official Publication of the Agency. The final decision shall be published in the Official Publication of the Agency."

2. ETSO-C129a#11 Airborne Supplemental Navigation Equipment using GPS

Deviate from ETSO-C129a paragraph 3.1.1 for the associated requirements in Eurocae ED-72A paragraphs 1.3.2, 2.9.1, 2.9.2, 3.1.3.1 & Table 3-4, 3.2.1 & Table 3-5, 3.2.2.3, 3.2.2.3b(2), 3.2.3.2b(2), 6.2.4a.

Industry:

When the GPS antenna is largely or totally masked, the GPS receiver may be either in Navigation mode with a very bad GDOP (Geometric Dilution of Precision) or may revert to degraded DIR/SPEED AIDED mode. When the GPS antenna is no more masked, the satellites become visible again. From the time satellites are masked to the time they can be re-acquired, the time search range is increased (proportionally to the GDOP value) and may exceed the code repetition period.

Operational effects:

In these conditions the GPS receiver may acquire one (or more) satellite on the wrong code and generate a great error on the position. At best, this error is indicated by the RAIM (Receiver Autonomous Integrity Monitoring) bit alarm.

When the GPS receiver is in DIR/SPEED AIDED mode, it uses either aiding data or the last calculated GPS speed to update the last calculated position during an unlimited time that can, after a long time, make the position to be erroneous with a SSM (Sign/Status Matrix from ARINC429) "No Computed Data".

In operation such behaviour may occur when the aircraft is successively powered and initialised in a clear area, and then located under a roof or a hangar in such a way that GPS antennas are partially or totally masked for a significant period of time (at least 1 hour) and finally positioned in a clear area back. To be noticed that probability of occurrence is directly linked to the masking duration.

Proposed operational limitation:

- To avoid such behaviour, do not to put the aircraft under a roof or a hangar when the MMR units are powered. If operations necessitate doing so, when the aircraft is put in a clear area back, flight crew or maintenance staff shall check the exactness of GPS position.

[1] Cf. EASA Web: http://www.easa.europa.eu/doc/About_EASA/Manag_Board/2004/mb_decision_0704.pdf

- Moreover, installation will be limited to aircraft family for which the manufacturer has assessed acceptability of those limitations on its design.

EASA:

This GPS engine has already been ETSO-authorised as part of a previous MMR approval (EASA.210.242). In order to comply with Part 21[2], this previous authorisation will have to be cancelled since the manufacturer wants to keep the same model name and part number while upgrading the functionality for the MLS part (see deviations below in sections 3 and 4). The proposed operational limitation provides a compensating operational procedure for integrity monitoring, failure warnings, acquisition time and failure protection by substituting operational checks to equipment automatic detection and annunciation. It provides an equivalent of safety while not compensating for performance characteristics. The Declaration of Design and Performance (DDP) which is referenced on the ETSO authorisation will have to clearly describe the issue and the operational effect while clearly stating the operational requirement to compensate those operational effects. Moreover, the DDP will actually limit the installation to the aircraft family for which the manufacturer has assessed acceptability of these operational effects and performance limitations on its design.

EASA has reviewed this requested deviation and agrees that the above arguments are acceptable compensating factors providing an equivalent level of safety for the intent of ETSO-C129a requirements.

Note 1: If this deviation is accepted, it would than be published in the Official Publication of the Agency. It would then be usable by other applicants, if they could substantiate their specific case with relevant data and when supported by the applicable aircraft manufacturer.

Note 2: there are previous deviations to TSO-C129a which have been approved. These deviations can be found on the EASA Web internet site at the following address: http://www.easa.europa.eu/doc/Certification/Design_Appro/ETSO.Dev.pdf).

3. ETSO-2C104a#2 MLS Airborne Receiving Equipment

Deviate from ETSO-2C104a paragraph 3.1.1 with the deviation to use Eurocae ED-36B instead of ED-36A for the associated requirement in paragraph 3.5.2c of draft 5 of ED-36B.

Note 3: deviation to use Eurocae ED-36B instead of ED-36A has already been published on EASA Web site. This deviation is written ahead the publication of ED-36B on the basis of draft 5 of ED-36B. If this deviation is approved, the applicant will have to demonstrate that it remains applicable to final ED-36B. It is published ahead in order to accommodate a tight certification schedule. The applicant bears the entire responsibility for the risk management resulting from significant changes between draft 5 of ED-36B (dated September 2006) and ED-36B. The latest draft (dated May 2007) currently being circulated by Eurocae for comments has been transmitted to the applicant which has assessed that the changes have no impact on its design.

Requirement in paragraph 3.5.2 of draft 5 of ED-36B is copied below:

[2] Cf. http://www.easa.europa.eu/doc/Regulation/reg_1702_2003.pdf COMMISSION REGULATION (EC) No 1702/2003 Subpart O 21A.601 to 21A.621

3.5.2 Validation Criteria during Acquisition

During acquisition a guidance signal frame shall meet the following validation criteria:

a. The signal as processed by the receiver must contain a properly encoded preamble timing signal and valid function identification.

b. The "TO" and "FRO" scanning beams or alternately the left/ right clearance signals are present and symmetrically located within 40 microseconds of the midpoint time.

NOTE : *the manufacturer will guaranty that a frame with a dissymmetry higher than 40us +10% is always regarded as not valid by the receiver, and that a frame with a dissymmetry lower than 40us -10% is always regarded as valid by the receiver."*

c. The received azimuth beamwidth is between 25 and 250 microseconds, the elevation beamwidth is between 25 and 150 microseconds.

d. The guidance signal exceeds any OCI signal by at least 4dB.

e. The signal being acquired exceeds any other signal meeting b. and c. above by at least 4dB.

NOTE*:* *At some locations, the ratios in d and e may allow a receiver to acquire false guidance signal during take off due to high multi-path environment.*

Industry:

Eurocae ED36B paragraph 3.5.2.c called by ETSO-2C104a requires to validate signals with a beamwidth higher than 0.5 degrees. The receiver does not validate azimuth or elevation signals whose beamwidth is lower than 0.84 degrees (worst case viewed by the receiver).

Operational effects:

With ground stations implementing azimuth or elevation beamwidth lower than 0.84 degrees, there is an availability issue since the receiver will never track azimuth or elevation functions. When the receiver is in presence of a MLS azimuth and/or elevation signal with a beam width lower than 0,84 degrees, the deviations LOC (localizer) and G/S (glide slope) remain NCD (No Computed Data).

Practically, actual qualified ground stations for cat II and cat IIIb operations are set with a beam at about 1,65 degrees for Azimuth, and 1,3 degrees for Elevation. Furthermore, when the receiver is tracking a signal, this restriction does not apply.

Proposed operational limitation:

- Equipment interoperable with MLS azimuth and elevation ground stations whose signal has a beamwidth higher than 0,85 degrees.

- Moreover, installation will be limited to aircraft family for which the manufacturer has assessed acceptability of those limitations on its design.

EASA:

For the requirement associated to this deviation, there is currently no difference between draft 5 of ED-36B (dated September 2006) and the latest draft of ED-36B (dated May 2007). However, the applicant will be required to demonstrate that the changes in the published ED-36B will not impact its design.

The applicant clarified that comprehensive information is always given in degrees. The relationship between time and degrees is given by the ground beacon scanning speed of 20 000 °/s. Consequently, 0,5 ° stands for 0,5[°]/20 000[°/s] = 25μs. The applicant agreed to indicate the original unit as in the requirement in the DDP.

Based on this conversion, the requirement draft 5 of ED-36B for:

- The azimuth beamwidth between 25 and 250 μs (microseconds) corresponds to an azimuth beamwidth between 0,5º and 5º;
- The elevation beamwidth between 25 and 150 μs (microseconds) corresponds to an elevation beamwidth between 0,5º and 3º.

The proposed operational limitation (0.85º or 42,5 μs) is compatible with the actual performance of the receiver. Based on the current characteristics of the MLS ground stations (1,65 º or 82,5 μs for Azimuth, and 1,3 º or 65 μs for Elevation), this problem is not likely to be frequently encountered by operators. Therefore, probability of exposure in operations is low.

EASA has reviewed this requested deviation and agrees that the above arguments are acceptable compensating factors providing an equivalent level of safety for the intent of ETSO-2C104a requirements. Therefore, EASA envisages granting the requested deviation to ETSO with limitations stated on the ETSO Authorisation, provided that the applicability with published Eurocae ED-36B is demonstrated.

Note 1 is also applicable to this deviation.

4. ETSO-2C104a#3 MLS Airborne Receiving Equipment

Deviate from ETSO-2C104a paragraph 3.1.1 with the deviation to use Eurocae ED-36B instead of ED-36A for the associated requirement in paragraph 3.9.3a of draft 5 of ED-36B.

Note 3 from section 3 above is also applicable to this section.

Requirement in paragraph 3.9.3 of draft 5 of ED-36B is copied below:

3.9.3 Performance in Presence of Multipath

For signals with a DPSK level of -20 dBm to -92 dBm the following specifications shall apply in the presence of scalloping frequencies between 0.05 Hz and 999 Hz.

a. In-Beam Multipath

A Multipath signal less than two beamwidths from the direct signal and with an amplitude of 3 dB below the direct signal shall not degrade the accuracy (CMN and PFE) of the angle guidance outputs by more than plus or minus 0.5 beamwidth. The receiver shall not lose track.

When the amplitude is reduced to 6 dB below the direct signal the error shall not exceed plus or minus 0.3 beamwidth. The receiver shall not lose track.

When the amplitude is reduced to 25 dB below the direct signal the error shall not exceed plus or minus 0.026 beamwidth. The receiver shall not lose track.

b. Out-of-Beam Multipath

Multipath signals coded more than 2 beamwidths from the direct signal and with amplitudes of 3 dB or more below the direct signal shall not degrade the angle guidance accuracy by more than plus or minus 0.02 beamwidth. The receiver shall not lose track.

When the receiver output is within a narrow sector (3.5° +/- 0.5° wide) around the centreline or around the selected azimuth angle, a multipath signals coded more than 2 beam widths from the direct signal and with amplitude of up to 10 dB above the direct signal and not distorting the direct beam shape as presented in Figure 1.3 shall not degrade the azimuth angle guidance accuracy by more than plus or minus 0.02 beamwidth and the receiver shall not lose track.

Industry:

Eurocae ED-36B paragraph 3.9.3.a called by ETSO-2C104a states that the receiver must not loose tracking during in-beam multipath. The receiver looses tracking of the signal (and so the protection against multipath signals) in presence of in-beam multipath for azimuth or elevation signals with a beamwith higher than 2.85 degrees (worst case viewed by the receiver).

Operational effects:

When In-beam and Out-Of-Beam effect are combined for beamwidth higher than 2.85 degrees (2.85 being a worst case value), the receiver can check that some Eurocae ED-36B criteria such as beamwidth are no more respected. In this case, the receiver discards the frame.

When this phenomenon repeats for at least 1 second, the receiver looses tracking. The deviations LOC and G/S become NCD if the phenomenon lasts more than 1 second, and the receiver may track an out-of-beam azimuth signal meeting Eurocae ED-36B criteria (at least 4dB over the direct signal) and output an erroneous azimuth deviation for ground stations emitting scanning beam higher than 2.85 degrees.

Practically, actual qualified ground stations for cat II and cat IIIb operations are set with a beam of about 1,65 degrees for Azimuth, and 1,3 degrees for Elevation. Furthermore, during approach and landing, such a phenomenon is not anticipated since sensible area are to be extended in order to decrease in-beam effect.

Proposed operational limitation:

- Equipment interoperable with MLS azimuth and elevation ground stations whose signal has a beamwidth lower than 2.2 degrees;
- Moreover, installation will be limited to aircraft family for which the manufacturer has assessed acceptability of those limitations on its design.

EASA:

For the requirement associated to this deviation, there is currently no difference between draft 5 of ED-36B (dated September 2006) and the latest draft of ED-36B (dated May 2007). However, the applicant will be required to demonstrate that the changes in the published ED-36B will not impact its design.

The proposed operational limitation (2.2º) is compatible with the actual performance of the receiver. Based on the current characteristics of the MLS ground stations (1,65 º for Azimuth, and 1,3 º for Elevation), this problem is not likely to be frequently encountered by operators. Therefore, probability of exposure in operations is low.

EASA has reviewed this requested deviation and agrees that the above arguments are acceptable compensating factors providing an equivalent level of safety for the intent of ETSO-2C104a requirements. Therefore, EASA envisages granting the requested deviation to ETSO with limitations stated on the ETSO Authorisation, provided that the applicability with published Eurocae ED-36B is demonstrated.

Note 1 is also applicable to this deviation.