Deviation Request ETSO-C115c#8 for an ETSO approval for CS-ETSO applicable to Airborne Area Navigation Equipment Flight Management Systems (FMS) Using Multi-Sensor Inputs (ETSO-C115c) 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 as amended by EASA Management Board Decision No 12-2007 products certification procedure dated 11th September 2007, 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-C115c#9 Airborne Area Navigation Equipment Flight Management Systems (FMS) Using Multi-Sensor Inputs

2.1   Summary of Deviation

Deviates from RTCA DO-283A Appendix H section H.2.4.4.3 by using a different vertical guidance compatible of the vertical constraints.

2.2 Original Requirement

RTCA DO-283A Appendix C

H.2.4.4.3 Flight Path Angle Paths:

A flight path angle path is defined by a 3-dimensional fix (latitude/longitude/altitude) and a flight path angle. The path extends rearward from the fix at the specified vertical angle. Both the fix and the flight path angle must be defined in the navigation database as part of the intended procedure.

If an FPA vertical path intersects the altitude of a preceding three-dimensional (AT or AT/ABOVE) fix after the constrained fix, the system shall compute a level segment until interception the FPA path (See Figure H-3).
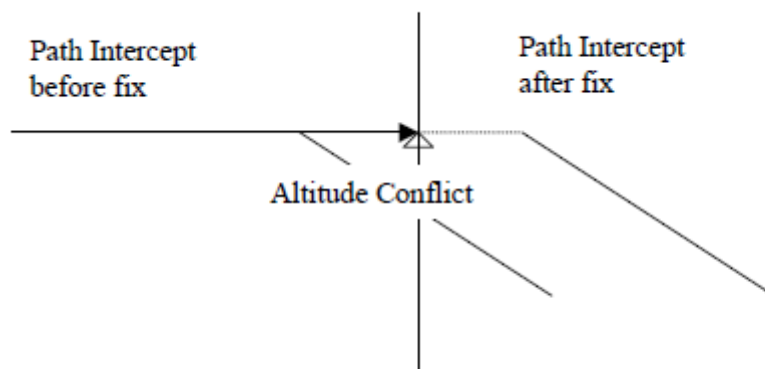

FIGURE H-3 **Waypoint with Vertical Constraint**

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2.3 Industry

The applicant FMS supports approach procedures including vertical path defined by a flight path angle. The FMS does not construct a level segment to intercept an approach glidepath. When a level intercept is intended, the applicant anticipates use of the autopilot altitude hold function. When approach mode becomes active, vertical guidance is to the extended glidepath, the same as for an ILS approach. The intent is that this results in operations similar to that of intercepting an ILS.

The situation depicted in figure H-3 of DO-283A (Figure A below) is handled by the applicant FMS by computing the actual crossing altitude of the flight path angle at the fix when the FAF constraint is an AT or ABOVE. If VNAV is used to fly to the point, the VNAV path is to the intercept altitude rather than the lowest altitude of the AT or ABOVE constraint.

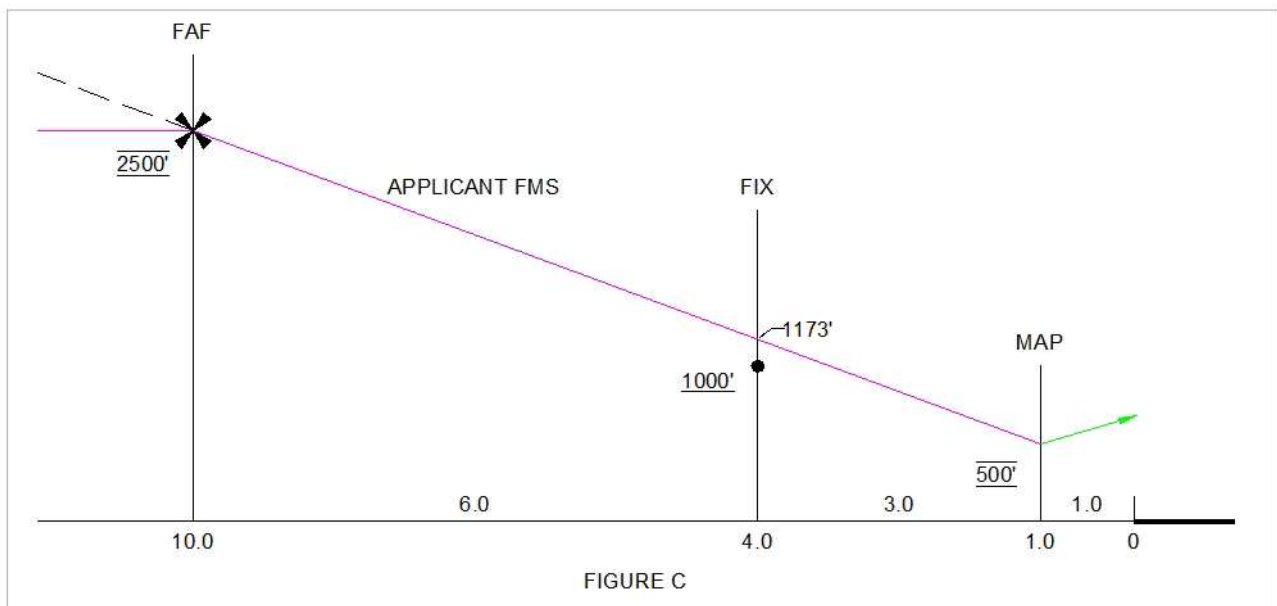FIGURE A

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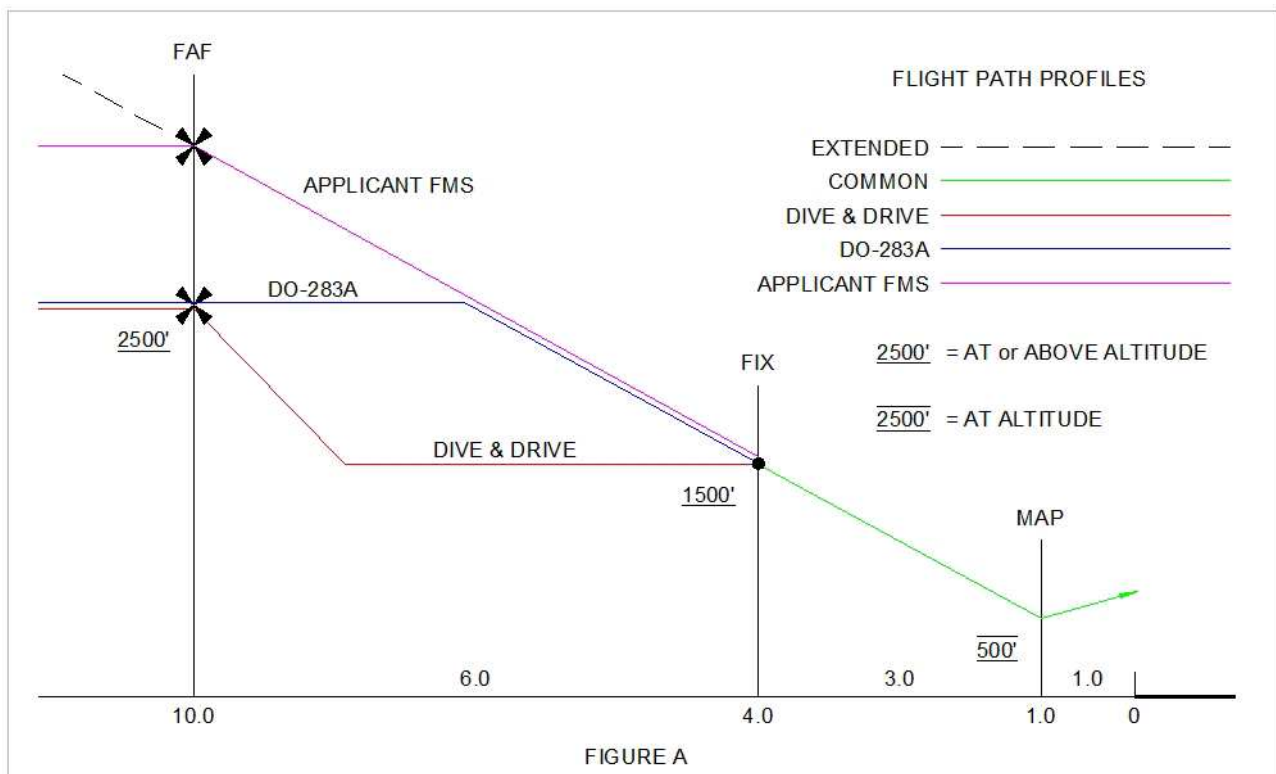
If the waypoint has an AT constraint (Figure B), the applicant FMS would construct the VNAV path to the next constraint as a geometric point to point path rather than as a 3 degree (or as specified) VNAV approach path.

FIGURE B
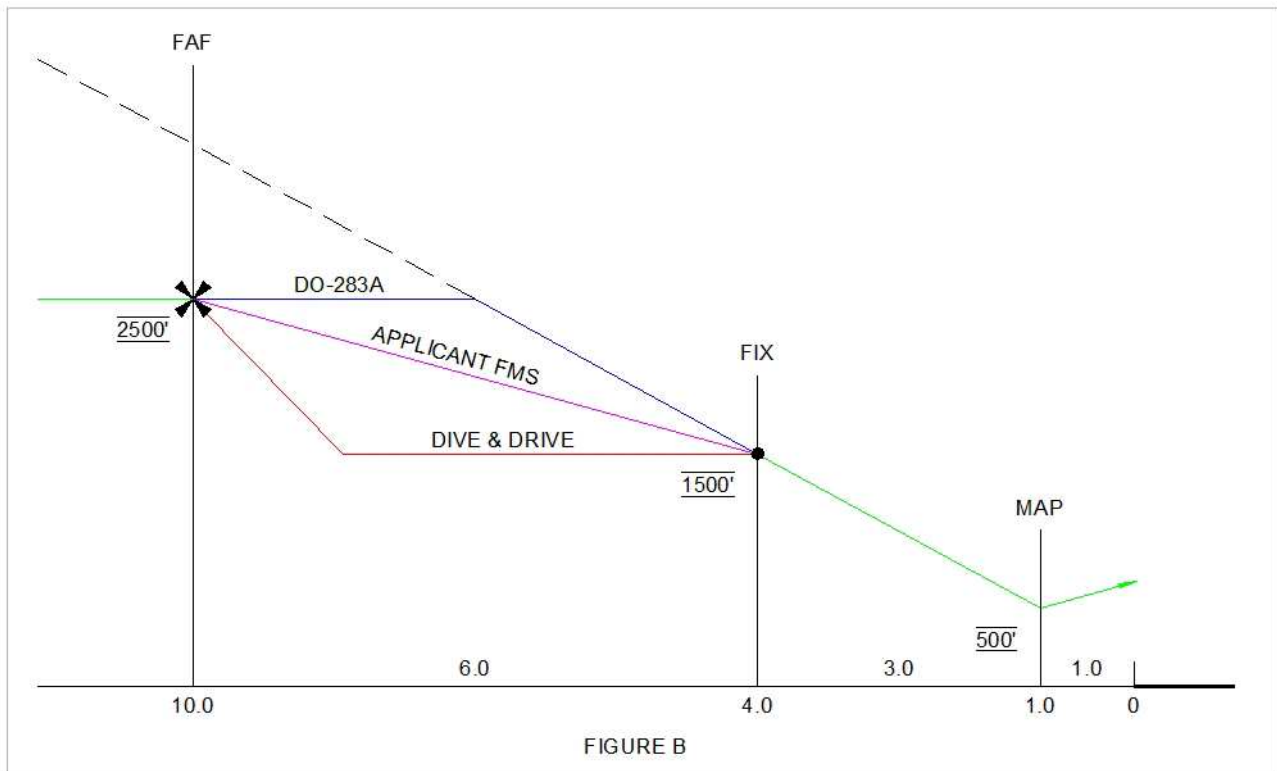
For the case where the flight path descent angle is not altitude referenced, such as for LPV approaches, the FMS makes the transition onto the geometric path prior to the FAF. It is assumed that for approach paths defined by vertical angles, the intercept is near the altitude constraint of the previous waypoint or the constraint is an AT or ABOVE. FMS VNAV is typically used for descent operations but not for level intercepts. Level intercepts are typically performed with the flight guidance system. The requirement to support flight path angle paths that violate the AT altitude constraints at a fix is problematic because the ARINC 424 database standard requires creating a flight path angle for approaches whether it is defined by the government source data or not. This leads to an ambiguity whether the path is defined by the government source as a flight path angle defined path or a geometric point to point path.

There are situations (Figure C) where step down fix altitude would be coded as "AT or ABOVE" causing them to be VNAV fly past waypoints. This situation typically occurs when the VNAV path (as defined by the FAF altitude and the MAP altitude) is calculated to be above the step down fix altitude. The FMS would then calculate a constant VNAV path honoring the minimum altitude at the step down fix and provide the flight crew with a constant VNAV path angle on the approach. This behavior has been in the applicant FMS products for a number of years now and has been evaluated extensively, and is consistent with typical industry implementations. In all cases, the applicant FMS honors step down fix published minimum altitudes.

FIGURE C

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2.4 Equivalent Level of Safety

The applicant FMS computes the crossing altitude for the Flight path angle path at the constraint location for the AT or ABOVE constraint case (Figure A). This clearly provides the equivalent safety as the level segment as the aircraft may follow VNAV guidance to this elevated point where ATC allows such an operation or use the flight guidance system to intercept level at the lower constraint altitude. For the AT constraint case (Figure B), the applicant FMS provides VNAV guidance to the path defined by the altitudes and waypoints. This is consistent with geometric point to point VNAV and is clearly understood by aircrews. The applicant FMS reasoning has been that on a typical approach with an AT altitude, aircrews were descending to the next constraint and then flying level (Dive & Drive), however, the FMS provides the path guidance to make the next constraint good. This has been the approach mode operation for many years.

DO-283A Appendix H is specifying a particular method of flying these paths that is attractive because of the continuous constant descent angle but is not necessarily safer than the continuous descent described by the geometric path which is safer than diving to the next successive constraint and levelling.

The Applicant FMS behavior is described in the operator manual.

2.5 EASA position

EASA accepts the deviation.