European Aviation Safety Agency

Comment-Response Document 2014-23

Integrated modular avionics

CRD TO NPA 2014-23 — RMT.0456— 25.4.2015

Related Decision 2016/006/R

EXECUTIVE SUMMARY

This comment-response document (CRD) contains the comments received on notice of proposed amendment (NPA) 2014-23 (published on 10.09.2014) and the responses, or a summary thereof, provided thereto by the Agency.

The proposed ETSO-2C153 is different from the corresponding FAA TSO-153, the latter containing just basic minimum performance specifications for the various integrated modules avionics (IMA) hardware platform modules.

The specific objective of this ETSO-2C153 on IMA is to ensure a cost-efficient and transparent certification process for IMA by offering to IMA manufacturers the possibility to obtain ETSO authorisations at platform/module level, independent of aircraft.

The new ETSO-2C153 will be added to Index 2 (i.e. significantly different from corresponding FAA provisions) of CS-ETSO, through an amendment to said CS-ETSO.

It should be noted that the issuance of ETSO-2C153 constitutes just the first step that will be followed by:

(a) a proposal for an AMC 20-170, that will provide guidance on the incremental certification of IMA, starting with platform modules and culminating in their installation on aircraft (RMT.0622); and

(b) a proposal to update the CS-ETSO Subpart A, offering to integrators of aircraft functions on already authorised IMA platforms the possibility to obtain ETSO authorisations, independent of aircraft (RMT.0621).

Based on the comments on NPA 2014-23 and the responses thereto, Decision 2016/006/R was developed.

Applicability	
Affected regulations and decisions:	ED Decision 2003/10/RM (CS-ETSO)
Affected stakeholders:	— certification authorities; — IMA system integrators; — application suppliers; — platform and module suppliers; — ETSOA holders.
Driver/origin:	Efficiency/level playing field/technological
Reference:	Industry (ASD) comments on draft ToR RMT.0186 (ETSO.008)

Process map	
Concept Paper:	Yes
Terms of Reference (Issue 2):	24.10.2013
Rulemaking group:	No
RIA type:	Light
Technical consultation during NPA drafting:	Yes (initial drafting outsourced to ASD)
Publication date of the NPA:	10.9.2014
Duration of NPA consultation:	3 months
Review group:	No
Focused consultation:	Yes
Publication date of the Opinion:	N/A
Publication date of the Decision:	2016/Q1

Table of contents

1. Procedural information

1.1. The rule development procedure

The European Aviation Safety Agency (hereinafter referred to as the 'Agency') developed this comment-response document (CRD) in line with Regulation (EC) No 216/2008[1] (hereinafter referred to as the 'Basic Regulation') and the Rulemaking Procedure[2].

This rulemaking activity is included in the Agency's Rulemaking Programme, under RMT.0456. The scope and timescale of the task were defined in the related Terms of Reference (ToR) (see process map on the title page).

The draft ETSO-2C153 has been developed by the Agency based on the input of the Rulemaking Group RMT.0456. All interested parties were consulted through NPA 2014-23 which was published on 10 September 2014. 206 comments were received from interested parties, including industry and national aviation authorities (NAAs).

The text of this CRD has been developed by the Agency based on the input of various stakeholdes during focused consultations.

The process map on the title page contains the major milestones of this regulatory activity.

1.2. The structure of this CRD and related documents

This CRD provides a summary of comments and responses as well as the full set of individual comments (and responses thereto) received on NPA 2014-23. The resulting text is provided in the Annex to the ED Decision amending CS-ETSO.

[1] Regulation (EC) No 216/2008 of the European Parliament and of the Council of 20 February 2008 on common rules in the field of civil aviation and establishing a European Aviation Safety Agency, and repealing Council Directive 91/670/EEC, Regulation (EC) No 1592/2002 and Directive 2004/36/EC (OJ L 79, 19.3.2008, p. 1).

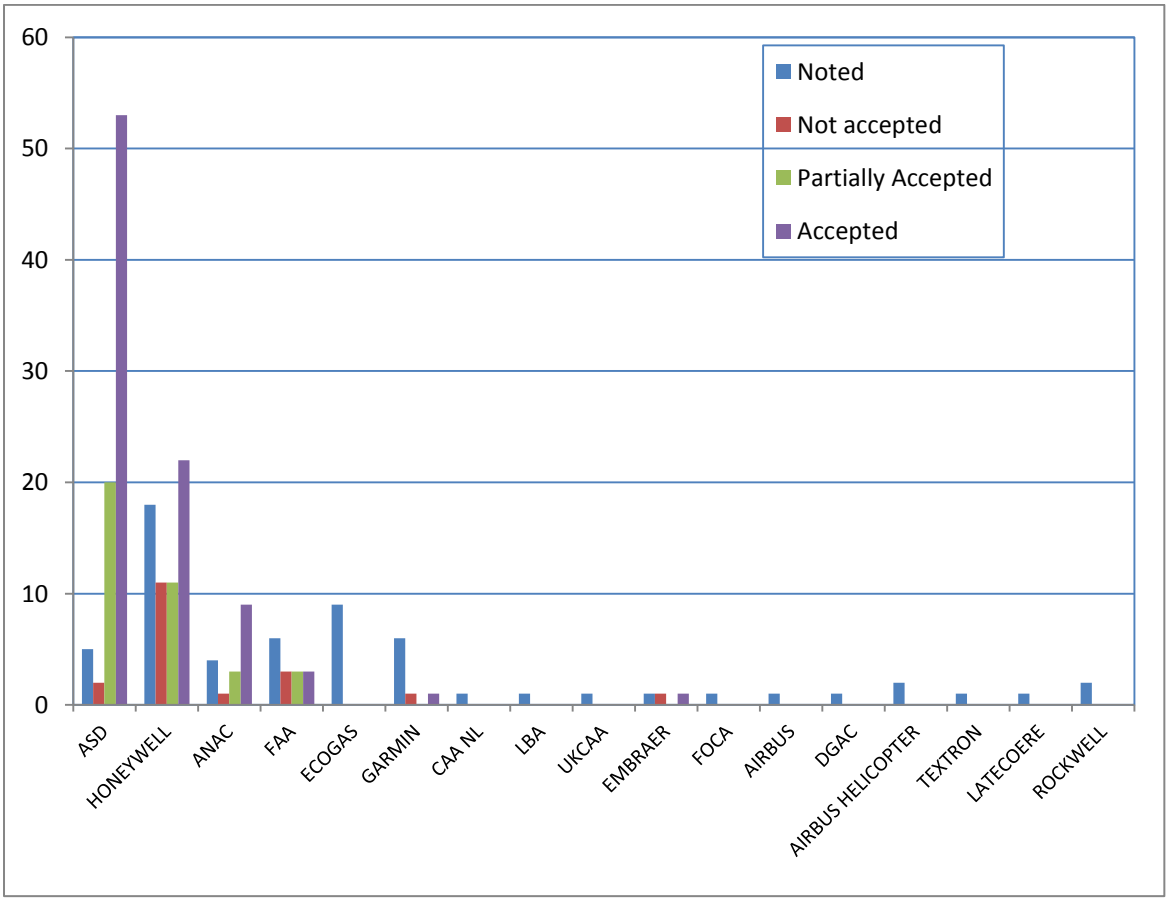
[2] The Agency is bound to follow a structured rulemaking process as required by Article 52(1) of the Basic Regulation. Such process has been adopted by the Agency's Management Board and is referred to as the 'Rulemaking Procedure'. See EASA Management Board (MB) Decision 01-2012 of 13 March 2012 amending and replacing MB Decision 08-2007 concerning the procedure to be applied by the Agency for the issuing of opinions, certification specifications and guidance material ('Rulemaking Procedure').

2. Summary of comments and responses

206 comments were received from 17 commentators. The majority of the comments were received from the following stakeholders: AeroSpace and Defence Industries Association of Europe (ASD): 80 comments, Honeywell: 65 comments, (National Civil Aviation Agency – Brasil (ANAC):17 comments and FAA: 15 comments. Other stakeholers have provided less than 10 comments each.

The following comments do not constitute an exhaustive list of the topics addressed, as various other changes were made. The full list of comments and responses is provided in Chapter 3.

The vast majority of the comments have been submitted by ASD and Honeywell. Some of the comments are interconnected; therefore, the responses provided thereto may include references to responses provided to other comments.



Disposition of the comment	Noted	Not accepted	Partially accepted	Accepted	Total
	58	20	37	91	206

In addition to the specific technical comments, various general comments were raised for example on the differences between the FAA TSO and the EASA ETSO. As further detailed in the CRD, although used for the same topic, the two standards are not equivalent. The numbering chosen for this ETSO as well as the titles are also different. ETSO-2C153 was included in the EASA ETSO Index 2.

Further questions were raised with regard to the installation requirements of the IMA.

Reponses were provided considering the need for ETSO-2C153 to contain detailed and specific minimum performance specifications (MPSs). The advantages of such an approach are further described in the CRD.

There should be, however, no contradiction between EASA ETSO-2C153 and FAA TSO-C153, which would prevent the certification of one piece of equipment according to both standards.

A summary of the changes made compared to the text proposed in NPA 2014-23 is provided in the explanatory note of the decision on 'CS-ETSO — Amendment 10'.

3. Individual comments (and responses)

In responding to comments, a standard terminology has been applied to attest the Agency's position. This terminology is as follows:

(a) **Accepted** — The Agency agrees with the comment and any proposed amendment is wholly transferred to the revised text.

(b) **Partially accepted** — The Agency either agrees partially with the comment, or agrees with it but the proposed amendment is only partially transferred to the revised text.

(c) **Noted** — The Agency acknowledges the comment but no change to the existing text is considered necessary.

(d) **Not accepted** — The comment or proposed amendment is not shared by the Agency.

(General Comments)	-

comment	*18* comment by: *Luftfahrt-Bundesamt* The LBA has no comments on NPA 2014-23.
response	Noted.

comment	*19* comment by: *UK CAA* Thank you for the opportunity to comment on NPA 2014-23, Integrated Modular Avionics (IMA). Please be advised that there are no comments from the UK CAA.
response	Noted.

comment	*21* comment by: *FAA* *ETSO Numbering* Comment: Draft EASA ETSO-2C153 on IMA components differs from the existing FAA TSO-C153 in content to the extent that the two documents may not be considered equivalent. In addition, with the very significant differences in content and philosophy between the draft ETSO and the existing FAA TSO C153, it is unclear as to how the two approaches for FAA TSO authorizations and EASA ETSO authorizations for IMA modules can be accepted under our existing agreements. Proposed Resolution: Change the number of the draft ETSO to a number other than 2C153 to emphasize the substantial difference between the ETSO and the FAA TSO-C153. This would provide an indication to the users that the two are "significantly different" from each other. A new ETSO number (that is, not 2C153) would provide a basis for future equivalence if FAA chooses in the future to mirror the EASA approach. FAA views this as potential for a collaborative effort to address the assurance of IMA systems. FAA proposes that EASA reassess the proposed approach to ensure harmonization and

	implementation of Validation programs for TSO/ETSO articles.
response	Noted. There are already ETSO/TSO where significant differences exist between the two versions (example 2C63c). When choosing the prefix number 2C in 2C153, it is clearly stated that there are differences between EASA and FAA (E)TSO technical requirements. If FAA chooses to mirror the EASA approach, a new ETSO/TSO number may be defined later.

comment	*22* comment by: *FAA* *Title* Comment: The title of the draft ETSO is "Integrated Modular Avionics". But, the ETSO only addresses IMA modules (Task 1 in ED-124/DO-297) See comment on Explanatory Note 2.1.2(b) for additional comment on this aspect. FAA experience is that some TC applicants have the erroneous idea that FAA TSO-C153, in combination with functional TSOs, allows TSOA for the entire IMA system, which is not true. In addition, a different title for the ETSO would help avoid confusion with the FAA TSO-C153 which only applies to hardware elements. Proposed Resolution: Change the title of the draft ETSO to focus on what the ETSO covers, that is, the IMA module and not the entire system.
response	Noted. The title of the ETSO-2C153(and not the one of the overall NPA document) is Integrated Modular Avionics Platform and Modules (see page 11 of the NPA).

comment	*31* comment by: *CAA-NL* Please be advised that the Netherlands supports this NPA and has no detailled comments.
response	Noted.

comment	*33* comment by: *FAA* *Terminology* Comment: ETSO-2C153 uses incorrect terminology in places, for example, it: 1. refers to a "certified IMA" whereas only products (aircraft, engines, propellers) are certified (A2.1-7) 2. uses "test" where "verification" should be used. (A2.2) Proposed Resolution: Correct terminology.
response	Accepted. 1. replaced by 'IMA is authorised' 2. replacement of 'test' by 'verification' has been performed where appropriate, in test procedures the notion of test is generally kept to reflect the necessity of test as opposed to

	Inspection, Demonstration or analysis method (to stay equivalent to other TSO/ETSO standards).
comment	*34* comment by: *FAA* Comment: ETSO-2C153 requires compliance with some objectives of ED-124 without related guidance recognizing the document as one acceptable means of compliance. Assumption is that the future AMC 20-170 will address installation. Proposed Resolution: Propose that EASA reconsider the current phased approach identified in the Executive Summary and section 2.(c), and delay release of the ETSO until after draft AMC 20-170 is released or release concurrently for comment. This would clarify EASA's approach, including any incremental aspects.
response	Not accepted. AMC 20-170 and ETSO-2C153 releases are not intended to be simultaneous in the EASA Rulemaking Programme, even though there is a technical link between the two rulemaking tasks. AMC 20-170 will address the different possibilities in certifying an aircraft using IMA system, ETSO-2C153 is one possibility covering the first step in the IMA integration process and remaining an optional path. In this ETSO standard, EASA has opted for applying Task 1 of ED-124, to define requirements for IMA modules and platforms. EASA considers that Task 1 of ED-124, is part of the minimum performance requirements of an IMA ETSO module/Platform, which can at a further step, host applications for performing aircraft functions. Other alternatives are not envisaged in this current ETSO standard.
comment	*134* comment by: *Embraer - Indústria Brasileira de Aeronáutica - S.A.* The document presents the classical concept of "Hosted Application", sometimes as "Hosted Application", most of the time as "IMA Application" and sometimes as "Application". The document gives only a definition for "Application". Embraer suggests to use only "Hosted Application" in the entire document, but if different meaning is aimed, definition and differentiation of the used terms shall be clearly stated.
response	Accepted. Applications or IMA Applications is replaced 'Hosted applications'.
comment	*160* comment by: *Federal Office of Civil Aviation FOCA* As a general remark, FOCA would like to express its doubts on the conformity of the suggested amendements with other already existing regulations. ETSO 2C153 is significantly different from the US TSO C153. Basically, an IMA is adequately defined under DO-297 (ED-124). The NPA reframes and renames modules and functions. It includes additional basic MPS and classes for the modules that will then need to be marked accordingly. The proposed changes will impose additional financial and administrative burden on the affected stakeholders as they differ from FAA standards.
response	Noted.

	ETSO-2C153 as incorporated in its naming convention, is differing from FAA-TSO. ETSO-2C153 will be issued 13 years after FAA TSO-C153 and benefits from years of experience in certification program. See as well answer to Comment 21. It is acknowledged that some requirements are more specific in the ETSO process, ETSOA is aimed to be completed independently from any aircraft installation – no concurrent STC/TC process is required. On the other hand we consider that the requirements at the aircraft installation level are harmonised. Beside the required qualification for the IMA system, this is well aligned with other environmental qualification requirements on the equipment level. The Agency has identified a minimum qualification that is considered necessary on specific modules to build up the incremental certification path. The Agency considers further, that there is no contradiction between the EASA ETSO-2C153 and the FAA TSO-C153, which would prevent the certification of one equipment to both standards.
comment	*171* comment by: *Airbus* Airbus participated in the preparation of the ASD comments and fully supports the ASD submission.
response	Noted.
comment	*174* comment by: *DGAC France* DGAC France has no specific comment on this NPA
response	Noted.
comment	*202* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* ASD is pleased to communicate to EASA their comments about NPA 2014-23. ASD thanks EASA, manufacturers and airframers for the efficient commitment, the level of expertise and the job performed to reach such level of maturity.
response	Noted.
comment	*203* comment by: *Airbus Helicopters* Airbus Helicopters fully supports comments posted by Aerospace and Defence Industries Association of Europe (ASD).
response	Noted.
comment	*205* comment by: *Poonam Richardet* Attachment #1 Dear EASA: Please find attached Textron Aviation's collective (Cessna and Beechcraft) response to the proposed, "EASA NPA- Integrated Modular Avionics (IMA ETSO-2C153)."

	Please contact us in case of any questions- Thank you for giving us the opportunity to respond to this NPA. Poonam Richardet Analyst Engrg Procedures, International Certification Regulatory Affairs Textron Aviation 316.517.5395 (Office) 316.218.8638 (Cell) PRichardet@txtav.com
response	Noted. ETSO-2C153 as incorporated in its naming convention is different from FAA-TSO C153 and since is issued 13 years after FAA TSO-C153, benefits from these years of experience in certification. See as well answer to Comment 21. It is acknowledged that some requirements are more specific in the ETSO process, ETSOA is however aimed to be completed independently from any aircraft installation – no concurrent STC/TC process would be required. Additionally, the Agency considers that the requirements at the aircraft installation level are harmonised. Beside the required qualification for the IMA system, this is well aligned with other environmental qualification requirements on the equipment level. The Agency has identified a minimum qualification that is considered necessary on specific modules to build up the incremental certification path. The Agency further considers that there is no contradiction between the EASA ETSO-2C153 and the FAA TSO-C153 which would prevent the certification of one equipment to both standards.

comment	*206* comment by: *ECOGAS/SVFB/SAMA* ECOGAS the organisation representing mainly, but not exclusively, SME's supports the content of this NPA. The general presentation and content are logically built and understandable.
response	Noted.

comment	*213* comment by: *ECOGAS/SVFB/SAMA* Finally, the whole NPA is a well designed lecture in the subject for which we commend the staff whom produced it.
response	Noted.

Process Map p. 1

comment	*104* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* Schedule (Major comment) The date mentioned for RMT 456 in the first page of the NPA are not consistent with the ToR IMA version 2 :Agency decision in 2016/Q1 shall be in 2015/Q1

response	Noted. The date in the explanatory note has been updated to reflect the actual dates.

Executive Summary p. 1

comment	*159* comment by: *ECOGAS/SVFB/SAMA* **ECOGAS** is representing mainly, but not only maintenance and there the majority of our members are SME's. The association has not the competence to go into the technical details of this very specialised NPA. Some of our members or specialesed associations will comment the details and are competent to do so. The general impression is that this NPA is built up logical and we could not find anything controvorsial, appart from one single recomendation: that harmonisation between FAA and EASA is especially in the thies field of AVIONICS of a high priority. It is worth to increase the efforts on both sides for full harmonisation the sooner the better. For some specific inputs see our few further comments.
response	Noted. EASA and FAA are working together to harmonise views on this topic, however, differences may remain at (E)TSO level.

2. Explanatory Note - 2.1. Overview of the issues to be addressed p. 6

comment	*25* comment by: *FAA* This comment also applies to content in the the Exective Summary. But it is only entered here to avoid duplicate entry. 2.1.2(c) Comment: This paragraph discusses a planned AMC 20-170, which is assumed to be comparable to the FAA AC 20-170. However, in absence of a draft AMC 20-170, the current ETSO wording leads to a variety of interpretations regarding the IMA system-level and aircraft-level acceptance processes (that is, how it will be shown to meet the airworthiness regulations during the TC/STC program). With approval of the IMA module design aspects being done via ETSO, of particular interest are issues and questions contained in the list below: 1. It is unclear as to who the ultimate IMA system integrator is to be. 2. How will the system integrator know enough about the internal design of the IMA

modules in order to complete all required DO-160, DO-178, and DO-254 objectives, as well as any required integration and installation activities defined in ARP4754A?
3. How will these incomplete items be documented such that the TC/STC applicant knows that they must complete those activities under the certification program?
4. How will all the elements of the system safety assessment be completed with design details, including all derived requirements, addressed by the ETSO authorizations?
5. What is the process that EASA will use to ensure that the required activities to approve and install the IMA into the aircraft will be completed?

Proposed Resolution:
Propose that EASA reconsider the current phased approach identified in the Executive Summary and section 2.(c), and delay release of the ETSO until after draft AMC 20-170 is released or release concurrently for comment. This would clarify EASA's incremental approach.

response

Noted.
Please see the response to comment 34.
All those questions are valid in the context of IMA. Nevertheless, some questions are referring more to AMC 20-170 than to the ETSO authorisation process. This NPA is only focusing on the ETSO. Please find herewith some detailed responses to your comment:
1- The ETSO authorisation is independent from the industrial organisation that will use the authorised article.
2- The data package described in Appendix 3 and in ED-124 Task 1 are defining the necessary information to be provided to the IMA module/platform user. In addition, the detailed achieved coverage of DO-160 is to be properly identified (see Appendix 4, Chapter 2.2).
3- See response to question 2- and particularly Chapter 2 of Appendix 3.
4- System safety process is out of scope of ETSO-2C153 and this question is to be addressed within AMC 20-170.
5- This question is to be addressed within rulemaking task RMT.0621 (AMC 20-170) and RMT.0622 (Functional ETSO using IMA platform).

comment

32 comment by: *FAA*

This comment is also applicable to b) of the Executive Summary. But it is only entered here to avoid duplicity.
2.1.2(b)
Comment:
Section 1 - Applicability of the ETSO says "This ETSO refers to IMA platforms and modules…"

The proposed EASA approach to allow ETSO of modules, platforms, and systems integration deviates from the basis upon which ED-124/DO-297 is based:
1. Reuse is allowed only for modules and applications whereas 2.1.2.b implies a yet-to-be-developed ETSO for the system level.
2. DO-297, sect 4.1 states that :The initial acceptance of a module, application, or IMA system should occur in the framework of an aircraft or engine certification program (TC) or modification project (STC). That is, IMA acceptance can only be proposed in the context of an actual certification project."

In addition, unlike other forms of reuse allowed by ED-124/DO-297, ETSOs bring in their own set of regulations which need to be considered.

	While individual articles can be evaluated and found acceptable to the ETSO's specified requirements, in absence of a draft AMC 20-170, the current ETSO wording leads to a variety of interpretations regarding the IMA system-level acceptance and aircraft integration processes. Proposed Resolution: Delay ETSO until after the AMC 20-170 is released.
response	Not accepted. Proposed resolution not accepted. 1- The explanatory note provides information on different rulemaking tasks. Section 2.1.2.b refers to another rulemaking task. 2- The Agency does not concur with this particular statement in DO-297, sect 4.1. Experience shows, that TSO'd platforms have been reused on other TC-STC projects, therefore, the link with the original TC/STC is no longer that pertinent. In the EASA system, ETSO authorisations are independent to the aircraft installation. This is deemed important for industry stakeholders, to have the potential authorisation on the IMA module, independently from each specific aircraft installation/hosted applications. In the drafting of this ETSO, the potential of multiple users/configurations has been a significant point of attention.

2. Explanatory Note - 2.3. Summary of the Regulatory Impact Assessment (RIA) p. 7-8

comment	*207* comment by: *ECOGAS/SVFB/SAMA* page8/83 last bullet, just above 2.4 >We support option 3, the preferred option >2.4.1. core section of proposed ETSO-2C153 Much emphasis should be invested into not only aligning FAA and EAA (EASA) regulation, but make it identical as far as possible. Each difference and be it only editorial, much more so if differences in content, add complexity (noise) and reduce user friendliness. It is worth a cooperative common investment in time and effort to get rid of "significant differences". In doing so, the result of one integrated solution should reduce complexity and improve user friendliness. This should be a master guiding principle in the cooperative effort of FAA and EAA.
response	Noted.

2. Explanatory Note - 2.4. Overview of the proposed amendments p. 8-9

comment	*135* comment by: *Embraer - Indústria Brasileira de Aeronáutica - S.A.* Embraer suggests "CLASS DH: Display head" removal from the scope of ETSO-2C153. Our concern is associated with the Display device, that we do not consider as part of the IMA

	System, as per "EUROCAE ED-124". Embraer considers that the part of the concepts presented on "APPENDIX 2.8 - CLASS DH: Display Head" would be better incorporated on "APPENDIX 2.4 - CLASS GP: Graphical Processing".
response	Not accepted. It has been identified that a display can be shared with multiple applications/systems and therefore it is justified to cover this function when being configurable/modular and shared as an IMA.

comment	*176* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* 2.4.5 : Typo error Replace "Finally, Appendix 3 of the proposed ETSO-2C153 contains requirements " by Finally, Appendix 4 of the proposed ETSO-2C153 contains requirements
response	Accepted. Text has been revised.

3. Proposed amendments - ETSO-2C153 p. 11-13

comment	*1* comment by: *Rodrigo Magalhaes (ANAC)* Paragraph 3.2.2.1: Since Table A-1 objective 8 is only partially applicable to an IMA module, is it correct the understanding that the proposed ETSO 2C153 does not cover all Table A-1 (Task 1) objectives from ED-124/DO-297? It would be missing the entire platform integration related to Task 1 to be covered under TC/STC, in the case of ETSO application to an IMA module. If this is correct, this point could be clarified in the text, either here or in the Appendix 3 Chapter 1 when the Table A-1 objectives are called out (3rd paragraph).
response	Accepted. Applicability of Table A-1 is now clarified to be on IMA module or platform. It is correct that for an IMA module the proposed ETSO 2C153 does not cover all Table A-1 (Task 1) objectives from ED-124/DO-297. In the case of an ETSO application to an IMA module, the entire platform integration has still to be completed at a further step. The further integration step of an authorised IMA module, is not in the scope of this ETSO. This ETSO covers nevertheless authorisation of IMA platform, where then the integration is covered.

comment	*39* comment by: *FAA* *Section 1 Applicability* <u>Comment:</u> This section implies that ETSO-C113 compliance is required for ETSO-2C153 Class DH authorization. C113 and the associated SAE document (AS) 8034B, have some application specific information that is not in the flavour of what was intended in the introductory sections limiting this TSO to resource sharing requirements. For example, the color for warnings is not resource sharing.

Proposed Resolution:
Proposed wording change:
An IMA module can be compliant with a combination of MPS classes. In this case, the IMA module will be marked with all the covered classes. However, as soon as a manufacturer voluntarily applies for ETSO-2C153 authorisation, all the classes for which the intended function is implemented shall be compliant.

Example: Single LRU platform will be authorised 'ETSO-2C153 CLASS PR + DS + IF' if the intended function of resource sharing is implemented on processing, data storage and interface.
~~For ETSO-2C153 CLASS DH authorisation, the IMA module shall be compliant with the requirements of ETSO-C113(*) 'Airborne Multipurpose Electronic Displays'. IMA module shall be marked with both ETSO-2C153 CLASS DH and ETSO-C113.~~
~~(*) Refer to most recent C113 revision applicable by CS-ETSO.~~
Depending on the choice of MPS classes, other ETSOs may be applicable but are not required to comply with this ETSO. For example, it may be necessary to use ETSO C113 if the DS is selected depending on what functions are implemented.

response

Partially accepted.
When an ETSO IMA article contains a resource sharing 'Display Head', not all the display features may be shared resources (such as the colour of a warning). Nevertheless, the article contains a display which shall comply with the MOPS of an Airborne Multipurpose Electronic Displays. It is accepted that some C113 requirements may not be applicable or completely demonstrated on the ETSO-2C153 IMA article, and in such case the applicant shall provide the additional activities to be performed by the user (see objective DH.f).
'An additionalnote has been added in DH.b) to cover the concerns raised by this comment, with another proposed resolution, C113 remaining the reference for Display Head MPS.

comment

42 comment by: *FAA*

3 - Technical Considerations, 2.2.2.1
Comment:
The second paragraph indicates that Table A-1 applies but it appears at the top of page 3 that there are qualifications. This is not clear in the text.

Proposed Resolution:
Proposed wording change:
In order to prepare the integration of the ETSO-2C153 IMA module, the development shall meet objectives of EUROCAE ED-124/RTCA DO-297 guidance related to task 1 (Table A-1 objectives) except as constrained below:
Table A-1 …

response

Accepted.

comment

110 comment by: *ASD - AeroSpace and Defence Industries Association of Europe*

Applicability - Major comment

"Equipment used to generate radio frequency signals for intentional transmitters" is

	explicitly excluded from the scope of ETSO-2C153. The same exclusion is included in FAA TSO-C153. It is understood that the precise reason is to exclude approval against radio-frequency regulation, which is highly specific and dependent on location. Therefore, the exclusion is not on the module, but on its radio-frequency emission characteristics. This should be more explicit. Suggestion is to rephrase the exclusion like: "The following is out of the scope of this ETSO-2C153: … - Approval of radio frequency characteristics for intentional transmitters."
response	Not accepted. This is out of the scope of the current NPA. EASA remains open to stakeholders' request if such a need is confirmed.

comment	*112* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* § 3.2.2.1 - Major comment To ensure consistency with future AMC 20-170 Replace "in order to allow the integrator to perform task 3 and 4 of the EUROCAE ED-124/RTCA DO-297" by " in order to allow the integrator to perform integration of applications hosted on IMA platform and IMA installation on aircraft as per applicable guidances".
response	Accepted.

comment	*130* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* The words "the use of special tools or equipments" should be precised as SW conf reporting need a software /tooling to retrieve SW PNR. Should be precised with the following sentence "it must be readily accessible without the use of special tools or equipment other than the ones approved for configuration access in the airfcraft"
response	Partially accepted. The proposed wording was the common wording adopted in the TSO standard. If additional precision is necessary, the wording should be clarified in CS-ETSO, Subpart A, paragraph 1.2.

comment	*147* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* "word" used should be replaced by "installed" Modify the text as following "Installation considerations Associated test procedures to check that the authorized IMA module is properly **<u>installed</u>**

	shall also be documented in the Installation Manual in order to allow the integrator to perform task 3 and 4 of the EUROCAE ED-124/RTCA DO-297."
response	Accepted. The text has been changed.

comment	*151* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* Out of scope list wording improvment : wording "IMA platforms consisting of multiple LRUs or LRMs (distributed platform – ED-124/DO-297 example D2) that have to be addressed at system level." should be replaced by "The bullet IMA platforms consisting of multiple LRUs or LRMs distributed inside the aircraft that have to be addressed at installation level."
response	Accepted. The text has been changed.

comment	*152* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* 3.2.2.1 : In consistency with future AMC 20-170, wording should be modify as following Replace "In order to prepare the integration of the ETSO-2C153 IMA module, the development shall meet objectives of EUROCAE ED-124/RTCA DO-297 guidance related to task 1 (Table A-1 objectives)." By "In order to prepare the integration of the ETSO-2C153 IMA module, the development shall use as guidance EUROCAE ED-124/RTCA DO-297 objectives related to task 1 (Table A-1)."
response	Not accepted. ETSO being an optional path, ED-124 Task 1 has been selected as part of the MPS related to the development process of an IMA module/platform. The text has been rephrased to avoid confusion between guidance and objectives.

comment	*153* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* 3.2.2.1 : Wording can be misunderstood. Precision is proposed : Replace : "partially applicable to IMA module, for intrinsic validation and verification activities." By: "partially applicable to IMA module, only for intrinsic validation and verification activities (ED-124 section 5.3 and 5.4)"
response	Partially Accepted. The text has been revised.

	See also response to Comment 1.
comment	*163* comment by: *Garmin International* ETSO-2C153 Page 1 Section 1 – Applicability Paragraph 1 This paragraph states "This ETSO gives the requirements that IMA modules which are designed to compose an IMA platform and which are manufactured on or after the date of entry into force of this ETSO must meet in order to be identified with the applicable ETSO marking." Per Section 2.1 of EASA NPA 2014-23, manufacturers are relying on the use of IMA as a method of certifying IMA modules and platforms outside of Europe. The regulatory motivation of this proposed ETSO is to provide a consistent method for equipment manufacturers to apply an ETSO pedigree to IMA platforms prior to the specific applications being defined for those avionics. Furthermore, this proposed ETSO is intended to allow IMA certification to be obtained at the LRU level which can then be claimed for credit at the aircraft level during (S)TC. Additionally, per Section 4.5.6 of EASA NPA 2014-23, the application of this proposed ETSO is voluntary. It is understood that the use of an IMA ETSO may benefit and harmonize the certification process for certain avionics manufacturers, system integrators, and airframe manufacturers. On the contrary, it must also be understood that these same benefits will not be realized by all members of industry and therefore the application of this proposed ETSO must be optional at all levels of the certification cycle. It must be made absolutely clear in the applicability section of ETSO-2C153 that the ETSO shall only be applicable to LRU(s) which have been defined by a manufacturer as IMA platforms and modules. A recommended wording for this section is *"This ETSO gives the requirements of Line Replaceable Units (LRUs), which are designated by the manufacturer to be Integrated Modular Avionics (IMA) modules, which are designed to compose an IMA platform and which are manufactured on or after the date of entry into force of this ETSO must meet in order to be identified with the applicable ETSO-2C153 marking. LRU(s) which do not claim ETSO-2C153 or meet the requirements of ETSO-2C153 will not be recognized as an approved IMA platform or module(s). Manufacturers not choosing to apply ETSO-2C153 to their LRU may still claim one or more ETSOs which are applicable to the function of their LRU."*
response	Noted. In the EASA certification policy, the ETSO path is optional. Conformity to ETSO standards can only be required by Part 21.A.305, which is not the case of IMA module/platform. If an applicant develops an IMA module/platform together with the intended aircraft function, (for example a modular processor platform integrated with a FMS application), then the applicant can apply for a functional ETSO (C115c in the example), without being mandated to apply ETSO-2C153. Now if the final product is further installed as an IMA platform, with the capability to host

	another aircraft function, then the capability of IMA will not be covered under the functional ETSO approval, and will need specific demonstration at installation level.
comment	*164* comment by: *Garmin International* ETSO-2C153 Page 1 Section 1 – Applicability Paragraph 3 This paragraph states "ETSO-2C153 authorization is an optional intermediate step to authorize IMA platform or IMA modules (independently of aircraft type approval)." It is important to ensure that the final version of this ETSO retains the word "optional" so as not to force a manufacturer into claiming this ETSO where the benefits of this ETSO would not be realized. Manufacturers that are able to claim one or more ETSOs with an LRU, where those ETSO(s) define(s) the function(s) of that LRU at the time of certification, must not be forced to claim ETSO-2C153.
response	Accepted. See the response to Comment 163.
comment	*165* comment by: *Garmin International* ETSO-2C153 Page 1 Section 1 – Applicability Paragraph 4 The paragraph includes the statement "This ETSO refers to IMA platforms and modules, which are appliances composed of hardware, core software or any embedded software module contributing to the intended function of resources sharing." Agree that this ETSO refers to IMA platforms and modules. Stating that "IMA platforms and modules … are appliances composed of hardware, core software or any embedded software module contributing to the intended function of resources sharing" is an incredibly broad term which could mistakenly be applied to avionics that are not truly IMA platforms or modules. The goal of this ETSO should be to clearly define IMA modules and platforms and a harmonious method to certify them. Creating ambiguities amongst whether an LRU or combination of LRUs constitute IMA would be an unfortunate side effect of this ETSO if there is not a clear definition. A more specific definition of IMA should be used here; possibly something from EUROCAE-ED-124 (RTCA/DO-297) such as those provided in Section 2.3 Key Characteristics.
response	Noted. For each module, the document requires the resource sharing capability for each class under

	ETSO-2C153 approval.
comment	*166* comment by: *Garmin International* ETSO-2C153 Page 1 Section 1 – Applicability Paragraph 5, bullet 1 The paragraph states "'Hardware only' module is acceptable if no further software module is needed to perform resources sharing." The way this is written, it could be interpreted that any LRU which performs resource sharing would fall under this ETSO. This bullet item should explicitly state that the "'harware only' module" has been designated as an IMA module.
response	Noted. The intent of this paragraph is to be more restrictive in the case of hardware only module aiming for 2C153 ETSOA. See also the reponse to Comment 163.
comment	*167* comment by: *Garmin International* ETSO-2C153 Page 1 Section 1 – Applicability Paragraph 5, bullet 2 The paragraph states "Single LRU platform (as per EUROCAE ED-124/RTCA DO-297), where the platform is limited to one Line Removal Unit (LRU), is acceptable." The way this is written, it could be interpreted that any single LRU which performs resource sharing would fall under this ETSO. This bullet item should explicitly state that the "single resource sharing LRU" has been designated as an IMA module.
response	Noted. See the response to Comment 163.
comment	*168* comment by: *Garmin International* ETSO-2C153 Page 2 Section 1 – Applicability Paragraph 9 The paragraph includes the statement "However, as soon as a manufacturer voluntarily applies for ETSO-2C153 authorisation …"

It is important to ensure that the final version of this ETSO retains the word “voluntarily” so as not to force a manufacturer into claiming ETSO-2C153 where the benefits of this ETSO would not be realized.

response

Noted.
The voluntary basis is clearly identified in this section. See also the response to Comment 163.

comment

169 comment by: *Garmin International*

ETSO-2C153 Page 3

Section 4.2 – Marking/Specific
Paragraph 1

The paragraph states “The part shall be permanently and legibly marked with the intended function class(es) as defined in paragraph 1 of this ETSO. This information shall be on the ETSO nameplate or in close proximity to the nameplate.”

Since IMA classes are meant to be incrementally certified, it may cause additional maintenance for a manufacturer and operators to update their ETSO nameplates whenever new classes are added to the installation. It may be more maintainable to require the initial ETSO and class(es) to be marked on the nameplate but if new classes are added to the ETSO after initial certification there should be an allowance to mark them in an easily updatable location (i.e. installation manual).

response

Noted.
Adding a new class is a change in the certification basis of the IMA platform/module, therefore, it is a new approval requiring a new identification.

comment

170 comment by: *Garmin International*

ETSO-2C153 Page 2

Section 3.2.1 – Failure Condition Classification
Paragraph 2 and 3

The paragraphs state:

“However, the module architecture and development will be driven by generic failure conditions. These can be considered as assumptions, which will drive the Development Assurance Level (DAL) allocation as per CS-ETSO Subpart A paragraph 2.4.

Assumed failure conditions and resulting DAL are characterisation items and shall be documented in the installation manual and Declaration of Design and Performance (DDP).”

The list of Failure conditions should not be considered a characterization item, and should not be included in the Installation Manual and Declaration of Design and Performance (DDP). A list of assumed failure conditions are usually captured in Preliminary Aircraft/System Safety

	Assessments process, defined in accordance with standards such as SAE ARP 4754A, Guidelines for Development of Civil Aircraft and Systems. These assumed failure conditions would be lengthy, considering the purpose of IMA platforms and modules are for shared resource design, generic, configurable, and host current and future applications, could potentially prohibit future module IMA system development and designs. It is suggested only to include the DAL levels which are derived by the safety assessment processes along with the other appropriate characterization items as defined in the Appendices. Suggest text below: "However, the module architecture and development will be driven by generic failure conditions. These can be considered as assumptions, which will drive the Development Assurance Level (DAL) allocation as per CS-ETSO Subpart A paragraph 2.4. ~~Assumed failure conditions and R~~esulting DAL ~~are characterisation items and~~ shall be documented in the installation manual and Declaration of Design and Performance (DDP)."
response	Not accepted. The failure conditions associated to the shared IMA function should be also identified.

comment	*193* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* chapter 1 : Typo error Replace "hardware qualification" and "software qualification" respectively by "hardware design assurance" and "software design assurance" where necessary in the ETSO proposal.
response	Accepted. The text has been updated.

comment	*204* comment by: *Airbus Helicopters* Location: ETSO-2C153 § 3.1.2 Comment: The text refers to CS-ETSO Subpart A for the environmental qualification standard. As a matter of fact, Subpart A § 2.1 allows the use of ED-14 / DO-160 from issue D change 3 to present issue G. However, qualifying modules or platforms according to old issues (like issue D change 3) may raise problems at aircraft installation level, where more recent issues may be called in the TC basis. Moreover, IMA modules / platforms will unlikely reuse old designed parts qualified to old issues of ED-14 / DO-160. Suggestion: Consequently, we suggest the following changes: • Replace existing text of § 3.1.2 by the following: "*Environmental qualification shall be performed according to Appendix 4, using the latest revision of EUROCAE ED-14 / RTCA DO-160*" • Remove first sentence of Appendix 4 ("*CS-ETSO Subpart A section 2.3 requires performing environmental testing according to EUROCAE ED-14/RTCA DO-160 appropriate releases.*")

NOTE: We also take the opportunity of this consultation to state that Subpart A of CS-ETSO should be further re-open to consider referencing the latest revision of EUROCAE ED-14 / RTCA DO-160, in the same manner as § 2.2 related to software development references "*the latest revision of AMC 20-115*".

response

Noted.
This proposal should be expressed in the frame of regular update of CS-ETSO, which is another rulemaking task. There is no reason to modify the qualification requirement for IMA ETSO -2C153 specifically, independently from all the other functional ETSOs.

3. Proposed amendments - ETSO-2C153 - APPENDIX 1 - Chapter 2 p. 14-16

comment *50* comment by: *FAA*

This comment is also applicable to Appendix 2.1, section 2.2, CO.hh. But, it is only entered here to avoid duplicity.
Chapter 2: Applicable definitions (page A1-2)
Comment:
The use of equivalence classes is not appropriate as they refer to sets of values in a functional mapping to an output set of values. And equivalence class use is meaningless with a lot of text to try to extend the meaning beyond its original intent. The ETSO wording already has a much better concept but it need to be modified slightly to be more robust.

Proposed resolution:

1. Remove the definition of equivalence classes as it will no longer be needed.
2. Change CO.hh as follows.

CO.hh) Engineering analysis from the design holder shall determine that the test software (not the target functional software) is representative of usage domain for the MPS classes ~~or valid equivalence classes~~ related to the verification procedures.

response

Partially accepted.

comment *105* comment by: *ASD - AeroSpace and Defence Industries Association of Europe*

Usage domain definition (Major comment):

The fact that "Usage domain" definition is no longer the one we have in ED-124 neither in current IM applicable to TC program can raised some issues during ETSO application.
We think that the introduction of "valid use case" notion has no real added value and is too prescriptive regarding some industrial implementation we have. It is one kind of usage domain but not the only one.

Text should be aligned with ED-124 except for the word "characteristics that could be misleading.

Modify the definition of Usage domain : "A declared set of conditions for which it can be

	shown that: 1) The module is compliant to its functional, performance, and safety requirements as defined in the Module Requirements Specification. 2) The module meets all the assertions and guarantees regarding its defined allocate-able resources and capabilities. 3) The module performance is fully characterized, including fault and error handling, failure modes, and behavior during adverse environmental effects."
response	Partially accepted. The proposed text being more explicit with regard to ETSO. Most of the text is kept, nevertheless, the notion of 'valid use case' has been removed to avoid misunderstanding.

comment	*108* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* Appendix 1 - Major comment Missng definition of resources and shared resources. Use definition from Ed-124 Resource - Any object (processor, memory, software, data, etc.) or component used by an IMA platform or application. A resource may be shared by multiple applications or dedicated to a specific application. A resource may be physical (a hardware device) or logical (a piece of information).
response	Accepted. The text has been changed.

comment	*111* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* Definition - Major comment The definition of "module" starts with "A component or collection of components that may be accepted by themselves or in the context of IMA". This raises several issues: 1) The concept of module acceptance is not defined 2) As we are in the context of an ETSO, the only relevant acceptance concept is the ETSOA. Consequently, the concept of acceptance "in the context of IMA" is not relevant. 3) A module should be better defined by its characteristics than by the way it is accepted. Proposal :Limit the definition to: " A component or collection of components that may be hardware, or a combination of hardware and software, which provides resources to the IMA-hosted applications. Application and module configuration data are not covered by this definition. Modules may be distributed across the aircraft or may be co-located."
response	Accepted. Text has been changed.

comment	*118* comment by: *ASD - AeroSpace and Defence Industries Association of Europe*

	Useful definitions from TSO-C153 appendix3 to be added (Ex: Clearance Requirements) Proposal is to add definitions from TSO C153 in this chapter when the same word is used in ETSO 2C153
response	Accepted. The text has been changed.

comment	*125* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* Definition of Aircraft Function different between ED-124 and ETSO 2C153: Proposal is to aligned with text extracted from ED-124: "A capability of the aircraft that is provided by the hardware and software of the systems on the aircraft.
response	Accepted. The text has been changed.

3. Proposed amendments - ETSO-2C153 - APPENDIX 1 - Chapter 3 p. 16-18

comment	*20* comment by: *Ted Parker/Honeywell* 1.3.PR.1 Does the inclusion of interface units mean that this becomes also an IF Class module? Please clarify when the inclusion of interface units does and does not lead to classification requirement of IF module as well.
response	Accepted. The answer to the question is yes. ETSO should cover all the integrated functions for which the ETSO requirements exist.

comment	*35* comment by: *FAA* *Appendix 1, Section 1.3.PR.4* Comment: Allows for core software to be field-loadable (FLS). If FLS is allowed, then the guidance in ED-12C, section 2.5.5 applies. This should be made explicit. Among other items emphasized in that ED-12C section, what ensures that the safety-related requirements associated with the loading function are part of the system requirements? Proposed Resolution: Revise text to be explicit.
response	Noted. EASA agrees that the topic should be addressed. Nevertheless, the items presented are covered by the current NPA in the following manner: - ED-12C is referred in AMC 20-115C which is the acceptable means of compliance for software development, requested for any ETSO through CS-ETSO Subpart A §2.2. This is applicable for any software including field-loadable ones, which have then to follow the recommendation ED-12C section 2.5.5. - Safety related requirements are addressed for core software in paragraph CO.r) b.. Note: ED-12C cannot be made mandatory within ETSO-2C153, AMC 20-115C introduces the

	potential of re-using previous revisions of ED-12 standards.
comment	*36* comment by: *FAA* *Appendix 1, Section 1.3.PR.4* Comment: Since multiple articles will conceivably be marked as ETSO 2C-153 Class PR (for example), what will distinguish these individual articles if there is an issue with one of them? A user must be able to know if their article is affected. Proposed Resultion: Reconsider if part marking for ETSO article has been thoroughly explained.
response	Noted. As for any other ETSO article, each Hardware or Software Part is identified in the article configuration index referred into the article 'Declaration of Design and Performance document (record mandatory for ETSO authorization)'. The marking of the article has to be compliant with Part 21.A.807 (see Part 21.A.609). As for any other ETSO article, ETSO-2C153 Marking identifies a unique configuration of the equipment (here IMA platform/module), that refers to a unique Core Software (field-loadable or not). The applicant has to propose a marking that uniquely identifies the product under authorisation which is in this case the IMA module/platform (Hardware and core Software).
comment	*115* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* Memory can be persistent or not persistent. Proposal is to precise as following : "1.3.DS.1: IMA module contains memory (persistent or not persistent), interface component and potentially associated Core Software which constitute one or several Data Storage Unit(s).
response	Partially accepted. The concept of (volatile or non-volatile) has been preferred.
comment	*128* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* In PR.1), proposal is to replace "IMA module contains CPU component » by «IMA module contains processing unit component» to cope with large design cases.
response	Accepted. Test has been changed.
comment	*138* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* IF.2:Information can be exchanged with external peripherals Proposed correction : IF.2: …to share information between … components or non IMA peripherals"

response	Partially accepted. Text has been reworded as follows: 'The intended function of such IMA module is to share information between several aircraft functions or applications.'.

3. Proposed amendments - ETSO-2C153 - APPENDIX 1 - Chapter 4 p. 19-21

comment	*2* comment by: *Rodrigo Magalhaes (ANAC)* Appendix 1, Chapter 4, Example 1: Last sentence states that "If sharing of processing, memory, and I/O resources is implemented within the LRU, such single LRU platform will be eligible to CLASS PR, DS and IF". Although it is only an example it is understood that it could also encompass the CLASS PS due to the Power Supply inside this Single LRU platform. Therefore it is suggested to add the CLASS PS under the scope of this sentence to avoid confusion.
response	Not accepted. In this example, the LRU doesn't share the power supply between different (external) modules. As such, it doesn't constitute an IMA PS module, rather the embedded power supply is dedicated to the Hardware of this IMA module/Platform without any sharing capability.

comment	*3* comment by: *Rodrigo Magalhaes (ANAC)* Appendix 1, Chapter 4, Example 3: Since ETSOs are not required (the applicant could still present the data under the TC/STC scope), this module "LRM 4" could also represent a module that the applicant wants to approve under TC/STC only. This kind of situation is suggested to be clarified in the text. Also, even though this module "LRM 4" does not provide shared resources it may use the shared resources provided by the other modules, hence it could be considered as part of the IMA. This could also be clarified in the text to avoid the interpretation that no IMA guidance would be applicable to it.
response	Noted. The point here is to mention what can be an ETSO-2C153 IMA and what cannot be. The LRM4 can be approved via TC/STC but also through the corresponding functional ETSO (if any). AMC 20-170 will cover those aspects.

comment	*177* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* Chapter 4 : unclear wording : Replace "Which These can be completed by the example relating to Chapter 3 definition" by : "...Which can be completed by the Chapter 3 definitions"
response	Partially accepted.

comment	*178* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* Chapter 4 : unclear wording

	Replace :"Key such IMA system characteristics include:" by : "Such IMA system key characteristics include:"
response	Accepted. The text has been changed.

comment	*179* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* Exemple 3 : Typo error Figure 2 in Example 3 shall be "Figure 3"
response	Accepted. The text has been changed.

3. Proposed amendments - ETSO-2C153 - APPENDIX 2 p. 22-23

comment	*4* comment by: *Rodrigo Magalhaes (ANAC)* Appendix 2 ("Convention naming"): it does not include the word 'should'. However, 'should' is used in some of the MPS requirements. It is recommended either to define the word 'should' or to remove 'should' from the applicable requirements below.
response	Accepted. 'Should' has been added to the 'convention naming' paragraph.

comment	*5* comment by: *Rodrigo Magalhaes (ANAC)* Appendix 2 ("Verification Procedures"): the method "Demonstration (D)" is not clear. Also, it seems it is not used in the "Verification Acceptance Criteria" tables. Please confirm. Therefore this method is suggested to be removed. Also regarding the verification procedures, the definition of "X/Y" and "X+Y" include the expression "test method". It is suggested to change it to "verification method" to be more generic.
response	Partially accepted. Demonstration is a verification method generally recognised in ETSO compliance.

comment	*155* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* X/Y vs X+Y: ambigus notation. In logic, we use: A or B : A+B; A and B : A*B
response	Noted.

comment	*191* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* Appendix 2:Typo error Use "table" reference instead of "figure" to be consistent for all the document
response	Not accepted.

	The numbers used for figures/tables are, however, uniquely identified.

comment	*194* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* Appendix 2 : typo error Replace the wording “verification procedures” by “verification methods”
response	Accepted. The text has been changed.

comment	*196* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* appendix 3 : Error in Demonstration definition Replace "validated" by "verified" to reach following wording : "Demonstration is the method of verification where qualitative versus quantitative validation of a requirement is made during a dynamic test of the system/equipment. In general, software functional requirements are **verified** by demonstration since the functionality must be observed through some secondary media."
response	Accepted. The text has been changed.
comment	*208* comment by: *ECOGAS/SVFB/SAMA* 22/183 convention naming a) it would be good if such definition would be somewhere on top of the basic regulation in the definition section b) the FAA and EAA should use the sam convention naming.
response	Noted.

3. Proposed amendments - ETSO-2C153 - APPENDIX 2.1 p. 24-31

comment	*6* comment by: *Rodrigo Magalhaes (ANAC)* Appendix 2.1, paragraph 2.1, requirement CO.j: it is suggested to replace the word "shall" by "may" (or "should" if "should" is defined). Rationale: it may be acceptable to have only partial compliance with these standards.
response	Accepted. The text has been changed.

comment	*7* comment by: *Rodrigo Magalhaes (ANAC)* Appendix 2.1, paragraph 2.2, requirement CO.l: it should refer to Figure 3 instead of Figure 1.
response	Partially Accepted. The text has been changed.

comment	*8* comment by: *Rodrigo Magalhaes (ANAC)*

	Appendix 2.1, paragraph 2.2, requirement CO.z, subitem "e": it should explained what is expected by "category of the tool".
response	Accepted. The text has been changed.

comment	*9* comment by: *Rodrigo Magalhaes (ANAC)* Appendix 2.1, paragraph 5: it is not clear what the column "test under normal conditions" means. For example: what does it mean when the cell is empty? Does it mean that the test should be performed for both normal and robustness conditions? And if it is "Y", the requirement must be tested under normal conditions only? Maybe if that is the case, the column could be renamed to "test under normal conditions only" and a note could be added to explain this.
response	Accepted. 'Y' shows when the test is mandated. 'Test under normal conditions' are referring to the 'normal' environment, as opposed to environmental conditions where the test is expected over the full environment range.

comment	*13* comment by: *Rodrigo Magalhaes (ANAC)* **[Appendix 2.1, Page A2.1-8]** *"The following table [Table 2] gives verification method for each requirement."* Comment: The excerpt "nevertheless, an alternative method may be proposed to the certification authority" is missing in here. This excerpt is included in all the other similar tables (related to the other classes). Even though Table 2 concerns the "common class" verification methods, it is normally a good approach to leave some flexibility to the applicant to propose alternative methods and avoid being overly prescriptive.
response	Accepted.

comment	*37* comment by: *Ted Parker/Honeywell* Appendix 2.1 CO.b Is the intent of this requirement to disable AND reset for every detected failure, or to disable OR reset for every detected failure? This is unclear and I can imagine detected failures that it is better to do neither, but take another action. I recommend rewording to define the failure detection and reaction of the module so that upstream integration can take this into account. (comment from one of our Platform leaders) Should not specify mechanism verses desire function. Do they want the module to have fail passive capability (i.e.dsable)? Reset can be a software jump to the beginning or can be a chip level hardware commanded reset function or even a power cycle. Seems like they want a fault recovery mechanism and not necessarily a reset.
response	Noted. The intention is to provide the capability to:

a) disable
b) reset
and not to enforce a specific reaction but letting to the upstream integration to decide for the adequate reaction.

comment

38 comment by: *Ted Parker/Honeywell*

Appendix 2.1 CO.c and CO.d

One requirement shalls it shall exist and the next implies that it is optional. I suggest rewording CO.c to be optional as implied by CO.d.

Note: Health management reporting only possible if failure does not result in loss of module.

response

Partially accepted.
CO.d) has been clarified .
The capability of Health Monitoring is an essential feature of the IMA ETSO-2C153.

comment

40 comment by: *Ted Parker/Honeywell*

Appendix 2.1 CO.d

It is impractical for a module to anticipate all possible faults that could adversely affect a future unknown application. If this could be done then that module would likely be over designed. Using applications need to also protect themselves. A better requirement would be for the module to define what is does and make it available to the application such that it can decide on what it can rely on from the module and what it needs to provide itself for protection based on the characteristics of the application and its safety implications.

(additional comment from Platforms Leader) Containment of faults is limited to the Fault Containment Boundary which for hardware faults is at the module level and SW is the Process or Partition.

response

Noted.
In the concept of IMA, the IMA developer should characterise the resources including the identification of the faults that could adversely affect the applications or the resources. A health management mechanism is required for the IMA 2C153 platform/modules. The proposal in the above comment is requesting the IMA users to define the IMA platform Health Monitoring features, which does not fit the concept of IMA.
See CO.h and the update CO.g that should cover the concern.

comment

41 comment by: *Ted Parker/Honeywell*

Appendix 2.1 CO.e

Partitioning includes the Operating System which may not be a part of the IMA Module, but loaded on aircraft. Could be provided by another supplier at integration and the module supplier may not know what it will be. This requirement would force a particular implementation. I would recommend a requirement that defines the protective mechanisms

	provided by the module in support of the partitioning and any areas that will require protection by another means. Note that it is highly desireable to have operating system loaded on aircraft so that minor changes do not require removal from aircraft of the hardware and return to repair station for update.
response	Noted. The IMA 2C153 module which aims for ETSOA shall contain all the Hardware and core software necessary to meet ED-124 task 1 requirements. It doesn't preclude the use of field loadable software.

comment	*43* comment by: *Ted Parker/Honeywell* Appendix 2.1 CO.f I am not sure this is even possible. Even so, as pointed out in above if the implementation does not include the Operating System this will be a problem. Again recommend this be addressed at the integrated level and not be a requirement of an IMA module.
response	Noted. EASA has already certified products with such design where robust partitioning is demonstrated at the IMA module/platform. Again the IMA module/platform should be complete, and meet requirements of task 1 of ED-124. See also the response to Comment 41.

comment	*44* comment by: *Ted Parker/Honeywell* Appendix 2.1 CO.g For above reasons above and practical limitations of the module, I am not sure it is possible to accomplish this task and very difficult to address "any breach" for verification purposes. I recommend that the requirement be written to define what breaches are detected and reported and the higher level integration resolve the sufficiency and how deficiencies are addressed. (comment from Platform Leader) IMA module can only detect partitioning errors designed for. This item start with "any breach" which implies that the module must be design to detect any?
response	Accepted. CO.g has been rephrased (also using ED-124 section 4.2.4 i).

comment	*45* comment by: *Ted Parker/Honeywell* Appendix 2.1 CO.h "concurrent items" is a vague term. Better to just specify the Fault Containment Boundary.

response	Noted. The term is already defined in Appendix 2.1, Section 1.

comment	*46* comment by: *Ted Parker/Honeywell* Appendix 2.1 CO.i Recommend that requirements that are optional be worded as to what is the requirement if the option is selected. I have no idea what to do to comply with this requirement if I make the selection to be configurable. Maybe this was intended as a Note rather than a requirement.
response	Accepted. CO.i has been deleted.

comment	*47* comment by: *Ted Parker/Honeywell* Appendix 2.1 CO.j If this is interpreted as needing to conform to an industry standard than this is overly restrictive of a requirement. It is possible that the standard is defined by the supplier or other integrator as a custom standard. Recommend that this be written to not imply an industry standard such as provide in example list a custom defined standard)
response	Accepted. See the response to Comment 58.

comment	*48* comment by: *Ted Parker/Honeywell* Appendix 2.1 CO.u I do not see it being practical to determine a failure rate for a broad definition of "erroneous behavior". I also don't see a definition for "shared resource element" (maybe in DO-297?) to know how to comply with this. I also don't understand why these are needed to make them a requirement for obtaining a ETSO. I recommend that the minimum requirement be the MTBF of the module only. If the integrator needs additional detail to support system level safety assessments they can work that independent of an ETSO.
response	Partially accepted. This step is required for the IMA user to perform its Preliminary System Safety Analysis. MTBF of the module will not provide the necessary information to perform Safety Analysis. 'Shared resource' has been defined in the definitions.

comment	*49* comment by: *Ted Parker/Honeywell* Appendix 2.1 CO.v No definition of how to calculate this in accurate or consistent way. Doing this for "all failure

	modes" is very excessive if even possible, especially if not needed to support higher level analysis. I recommend this being reworded to characterise the protective mechanizisms rather than rates - or eliminate this as a requirement.
response	Accepted. Text has been changed to state that the monitoring coverage rate has to be provided for the 'identified' failure modes.

comment	*51* comment by: *Ted Parker/Honeywell* Appendix 2.1 CO.w I don't see this as practical at the module level as much of this relates to the integration with the hosted application. Recommend eliminate as requirement or rewrite to something practical at the module level.
response	Not accepted. The IMA module developer needs to characterise the safety aspects, those are necessary inputs for the development of hosted application. The objective of the ETSO is to provide a step approach independent to the aircraft functions.

comment	*52* comment by: *Ted Parker/Honeywell* Appendix 2.1 CO.aa Not practical and this should be more of a system integrator role. We may not have information on other modules to know how to determine this. If modules/applications from multiple suppliers are used, whose process should be used to make the determination. Even if this was determined at time of ETSO application, changes to other modules after would make the information contained in the ETSOA data inaccurate and could lead to wrong conclusions. This should be a system integrator action and not a module level action. Recommend eliminating this as a module level requirement or rewrite to something that is practical and useful.
response	Not accepted. The IMA module/platform developer should document the compatibility and mixability (mixed allowed combinations) in order to provide the necessary information to the IMA User to develop the aircraft functions. These information are necessary input/guidelines for the system integrator. And this should be fully characterised.

comment	*53* comment by: *Ted Parker/Honeywell* Appendix 2.1 Figure 3, Page A 2.1-4 Inter-Element Interfaces. Inter-Element Connections. Confusing and overlapping with interfaces described in rest of table. Recommend being more precise as to what is being expected.

response	Accepted.

comment	*54* comment by: *Ted Parker/Honeywell* Appendix 2.1 CO.dd Two "shalls" for one requirement. The second one is superfullious as the following tables define the prefered verification methods. The statement seems like it should be a note as there is no way to show compliance to it practically.
response	Partially accepted. The text has been changed.

comment	*55* comment by: *Ted Parker/Honeywell* Appendix 2.1 Table 2, CO.d this will be impractical as verification of health monitoring will require forcing failures. This should allow verification by analysis as well.
response	Accepted.

comment	*56* comment by: *FAA* *2.1 CO.d* <u>Comment:</u> This implies that health management is an optional element. If it is optional then there is no need to specify what it should contain as the acceptability of its absence means none of the functions are required. If none are required, then the implementation of any of the functions is optional. <u>Proposed Resolution:</u> Either make the health management function required or delete CO.d.
response	Accepted. Actually, CO.c) requires the health management and reporting function, except for Rack Housing function (F1). In CO.d) the wording 'If existent' has been replaced by wording: 'Except for the Housing function (F1) of class RH (see Appendix 2.2 , paragraph **Error! Reference source not found.**'

comment	*57* comment by: *Ted Parker/Honeywell* Appendix 2.1 Table 2, CO.e Issue as stated in previous comments that partitioning may need elements not a part of the module and testing partitioning will require forcing failures. I would think that the guidance material of DO-178() for verification of partitioning would be applicable and be done at the integrated level. Evaluation of partitioning over environment seems excessive as well.

	(additional comment by SW Platform Chief) In addition to verifications testing of requirements, a rogue partition could be done to try to defeat partitioning. This was done for AT programs as a goodness test. Approach not recommended: Analysis would be the strongest method especially for the effort.
response	Partially accepted. The requirement to mandate test over environment has been removed, however some partitioning features (as for instance FPGA functions) should be tested over temperatures and voltage variations for completeness of verification. Analysis is allowed when test is deemed not possible.

comment	*58* comment by: *FAA* *2.1 CO.g* Comment: This requirement is not satisfiable. Consider that robust partitioning demonstration should show that there are no breaches. If one was to detect a breach, one would have to know about it. If one knew about it, then it would have been prevented. Consider the case where a sneak path exists through some memory definitions overlapping due to a configuration error. Clearly if the configuration error was known, it would have been prevented. If it was not known, then there is no reasonable way to detect when memory has been corrupted without taking up every available resource to examine every memory write and subsequent read to ensure that there is no corruption between the two. Not only is this impractical, the detection mechanism also postulates a breach which can then be protected against. Proposed Resolution: Delete C0.g.
response	Accepted. CO.g has been rephrased.

comment	*59* comment by: *Ted Parker/Honeywell* Appendix 2.1 Table 2 CO.g Error in Table? Verification method is shown as test, but no entries in columns under Normal and Environ. Columns Also, requirement is about breach of partitioning - how would this be accomplished? Seems to better addressed by analysis. Analysis is more robust approach.
response	Partially accepted. Testing is required in normal conditions.

comment	*87* comment by: *Ted Parker/Honeywell* Appendix 2.1 CO.gg (comment from M. Andreas) This statement leaves a lot to be interpreted. This relates to the "Functional Subset" in the "Verification Procedures" on the next page and the tables for Verifying other Functional

	Classes. As environmental testing would otherwise require full testing of all characterisitics, will this be interpreted such that (for just for example) the threshold voltages of each discrete input is not tested at each and every RF suscepetibility frequency? Or another example, testing all reset capability at each HIRF frequency. While technically feasible, horribly impractical.
response	Noted. It is similar to other equipment, where usually the applicant, being the developer, is defining the configuration that drives the test in worst case conditions or the most demanding configuration for a given environmental test. In the context of IMA, the applicant has not one single set of configuration but may have a flexible and modular usage domain that need to be covered over the required environmental range (by test or by similarity to a given subset of the characterisation items). CO.gg is not prescribing the given subset, but requests that the subset is representative of the full characterization items . Additionally the applicant may identify the test points that would be sufficient to cover the function over the environmental range, as it is today for a significant number of requirements of ETSO articles.

comment	*106* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* CO.j) (Major comment) CO.j) requirement should be suppressed and replace by a statement as following "the interface between the 'concurrent items' and the shared resource will conform to characteristics as described by a standard (ARINC specifications 653, 664, 600, for example)."
response	Partially Accepted. 'Shall' has been replaced by 'Should'.

comment	*107* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* CO.ee) Major comment the sentence "All use cases identified as valid of the IMA module shall be verified." is not clear regarding Usage Domain definition. In consistency with previous comment on Usage Domain definition, CO.ee) should be modified as following : "CO.ee) Each characterisation item of IMA modules and functions shall be verified in consistency with the Usage Domain defined as applicable to the future users"
response	Partially accepted. The focus is on verifying each characterisation item over the usage domain guaranteed by the IMA module/platform developer.

comment	*109* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* CO.p) Major comment

	User's guide is not a constraint. Proposal from ASG WG is to localised constraints for used into only two documents : Installation manual and Usage domain. CO.p) should be modified as following : "The characterisation shall provide all constraints in usage domain and installation manual (limitations and activities) to be respected by the users"
response	Partially Accepted. Text has been changed to be consistent with Appendix 2, and not overlapping the text of Appendix 3.

comment	*113* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* Major comment Test of CO.dd) under environmental condition In its draft, ASD has been proposed a selection of characterisation items in order to excite hardware resources. Proposal “the manufacturer has to perform a justified selection of characterisation items of IMA modules and functions, their associated attributes, their configurability and their performances to be monitored during EQT and define associated pass and/or fail criteria. This selection will be driven by the IMA module design. This selection shall be documented and justified into the EQT plan submitted to EASA
response	Accepted. Comment accepted but no change is foreseen, the comment is already covered in the document by the Note (1) applicable to column “Test Functional Subset(1) under environmental conditions.”

comment	*114* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* Major comment CO.o) should be (Y) under environment condition event if it is an Analysis with an (*) in order to precise that : (*) Usage Domain has to be taken into consideration during EQT in order to evaluate the robustness of the IMA module over the full Usage Domain (see Appendix 4 - Chapter 1)
response	Accepted.

comment	*116* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* "Reload" term is not clear Proposal is to modify CO.b) as following : "The IMA module may also implement the

	capability to reload hosted IMA applications, modules and/or components.
response	Accepted.

comment	*117* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* "part of" … not clear Proposal is to suppress "part of" and modify CO.r) as following " IMA module functionality, performance and safety requirements supported by the core software."
response	Accepted.

comment	*120* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* Access right consideration seems missing In figure 3, proposal is to modify text as following "Memory Size(s), Type(s), Access Right and Timing(s)"
response	Accepted.

comment	*122* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* the word "module" is missing in CO.s) Proposal is to modify the CO.s) as following : "When the IMA module is offering the capability to host software, the characterisation shall provide any data needed to...."
response	Accepted.

comment	*124* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* In the table 3, it is to possible to distinguish input and ouput in-rush Proposal is to modify the text as following "Maximum Start-up (Input In-rush and Output In-rush) Current Rating."
response	Accepted.

comment	*129* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* for CO.dd) the sentence “Test shall be preferred to other verification methods whenever technically possible" seems to Too excessive ? Proposed text is: "Test should be preferred to other verification methods nevertheless verification by Analysis method is possible for item that cannot be tested" Could be also valid in other parts of the document.
response	Accepted.

	See the response to Comment 54.

comment	*131* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* CO.m) "Quantifiable characterised item shall be quantified with minimum, typical (when relevant) and maximum values" ->missing accuracy part of the data -> missing influence of environmental conditions Proposed text : "Quantifiable characterised item shall be quantified with minimum, typical (when relevant), accuracy (when relevant) and maximum values. Influence of environmental or abnormal conditions should be considered when relevant"
response	Accepted.

comment	*132* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* CO.q) "The characterisation shall provide the list of types of shared resource elements, the associated attributes, their configurability and their timing and sizing performances." ->missing the “not to exceed” criteria Proposed text : "The characterisation shall provide the list of types of shared resource elements, the associated attributes, their configurability, their performances and associated limit of use"
response	Accepted.

comment	*133* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* CO.z) Missing : tools defect that affect tools qualification credit and require analysis from tools user. Tools OPR shall be identified in User guide or tools manuals Proposed text, add (f) : "f. (if any) Limitations and OPR on Tools that could affect the tool qualification credit and require analysis by the user"
response	Accepted.

comment	*136* comment by: *Embraer - Indústria Brasileira de Aeronáutica - S.A.* The "Figure 3: IMA module Characterisation Categories" seems incomplete. For example, it requires the "Latency Time" and "Bandwidth" information for analog signals, but does not have a similar requirement for digital communication. The characterization processing section is poor, as it does not require the characterization of important items, such as, processing power for Hosted Applications, partitioning and scheduler characteristics. Embraer suggests Figure 3 to be expanded to address these items.
response	Noted.

	The Agency agrees with the comment, however these processing module characteristics are described in more detail in Appendix 2.3 requirement PR.d). The Agency has opted for developing a particular requirement instead of updating the table that was originated in FAA TSO-C153.

comment	*137* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* CO.o) (Major comment) In consistency with Usage Domain definition, text should be modified as following ; "CO.o) The usage domain shall identify all the valid conditions for which it can be shown that: 1) The module is compliant to its functional, performance, and safety requirements as defined in the Module Requirements Specification (including Minimum Performances Specifications). 2) The module meets all the assertions and guarantees regarding its defined allocate-able resources and capabilities. 3) The module performance is fully characterized, including fault and error handling, failure modes, and behavior during adverse environmental effects."
response	Partially accepted. CO.o) has been updated by replacing 'valid use case' by 'valid usage domain'.

comment	*139* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* CO.g) the wording "any breach in robust partitioning shall be detected" can be misunderstood. Proposed correction is : CO.g) Except for class RH, any breach tentative by IMA application, modules or components in robust partitioning shall be detected by the IMA module. An appropiate process and means should be implemented to ensure that such failures which result or may result in an unsafe condition are reported.
response	Partially accepted. CO.g) has been updated as proposed.

comment	*143* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* Missing monitors for the Interfaces Analog + discrete, Missing startup sequence of the module and different operational modes (init, monitor, oper…) Proposed text: Add in the table 3 following lines 1) in section about analog and discrete : Add "Monitoring" 2) in section general info : Add "Startup sequence of the module and different operational modes (init, monitor, operational…)

response	Partially accepted. 'Monitoring' features are subject to other requirements. Section 'General information' has been revised has been revised as per the proposal 2) above.

comment	*144* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* The IMA module is potentially required to be operational in all environment condition in order to support critical functions. The intended function of the IMA module is to allow resource sharing and offer fault containment mechanism. As a consequence the mechanisms that contribute to fault detection / containment shall be verified in all environmental conditions. proposed text : • CO.b "Y" under environmental condition • CO.g "Y" under normal condition (typo error probably)
response	Partially accepted. For CO.b), the Agency believes it is too demanding to mandate those features over all required environmental testing. CO.dd) associated with CO.gg) are deemed sufficient.

comment	*148* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* CO.r) c) this part of requirement seems already taken into account by Item qualificiation (ED-12, ED-80,…) Rephrase CO.r): "c) external Interfaces and associated data coupling/control coupling information"
response	Accepted.

comment	*150* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* CO.n) : Intended funtion of the IMA module is shared resources the word "functions" should be replaced by "resources" Proposal is to modify CO.n) as following : The characterization of IMA module shall be correct and complete. Completeness is achieved when all avaliables features related to shared resources of the IMA module have been characterized
response	Partially Accepted. The text has been differently re-phrased.

comment	*154* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* CO.dd) wording "completely verified" is not correct. this depend on the assurance level of the development

	Replace "Each characterisation item of IMA modules and functions, their associated attributes, their configurability and their performances shall be completely verified." by: "Each characterisation item of IMA modules and functions, their associated attributes, their configurability and their performances shall be verified with a rigor commensurate to the DAL."
response	Partially accepted.

comment	*156* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* Typo CO.l) figure3 instead of figure1
response	Accepted.

comment	*172* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* Interfaces section in Table 3 : Proposal is to remove DAC speed for analog input, and ADC speed for analog output because there is no sense
response	Accepted.

comment	*200* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* CO.r) some characteristics required are relevant for IMA module composed of HW only Proposal is to change : "If IMA module contains a core software, the characterisation shall include at least the following characteristics of the core software: a. Identification of the core software component(s). b. IMA module functionality, performance and safety requirements supported by the core software. c. Interfaces and associated data coupling/control coupling information. d. Integration and loading procedure(s). e. Development assurance level(s)." into "The characterisation shall include at least the following characteristics: a. Identification of the core software component(s), if it contains Core Software b. IMA module functionality, performance and safety requirements c. Interfaces and associated data coupling/control coupling information. d. Integration and loading procedure(s). e. Development assurance level(s)."

response	Accepted.

3. Proposed amendments - ETSO-2C153 - APPENDIX 2.2 p. 32-42

comment	*10* comment by: *Rodrigo Magalhaes (ANAC)* Appendix 2.2, paragraph 1.2: under the note the second bullet states that there may be "non-IMA modules" inside the Rack Housing. It is suggested to further explain what is a "non-IMA module". For instance, if a module only uses the power supply from the rack, would it be classified as "non-IMA module" or not? Sometimes, a module may not share resources but may use resources from the platform, and therefore the platform supplier or the IMA system integrator needs to know the module is there to appropriately design the resources. Would they still be classified as "non-IMA modules"? Furthermore, the term "application specific hardware" should be used only for "avionics function specific" as described in Figure 2 of ED-124/DO-297. An example may help.
response	Noted. The chapter refers exclusively to 'Rack module' sharing the hosting functions of other modules whatever they are (IMA or non-IMA application specific hardware). To reply to the question embedded in the comment: if a given module is using an IMA power supply module from a rack, the given module is not necessarily an IMA module and may have a full developed aircraft function (such as radio, autopilot, FMS) without any sharing modular capability.

comment	*11* comment by: *Rodrigo Magalhaes (ANAC)* Appendix 2.2, Figure 4: why isn't the "Communication Module" a CLASS IF module? Although it is only an example, it is suggested to identify this "Communication module" as applicable to avoid confusion.
response	Accepted. The example has been changed.

comment	*60* comment by: *Ted Parker/Honeywell* Appendix 2.2 RH.e Do not agree that mechanical interfaces need to conform to an industry standard. This is forcing design implementaion that should not be the role of a ETSO MPS. This will force unnecessary deviations for existing systems if they are to apply. Standards may be guidance but shouldn't be required. Newer and better ideas will be blocked waiting for standards to catch up. This should be rewritten to allow custom interfaces as long as they comply with the environmental requirements.
response	Noted. The word 'should' leaves the possibility for alternatives.

comment	*62* comment by: *Ted Parker/Honeywell* Appendix 2.2 RH.j Not sure this is possible to predict what data will be needed for a populated rack. Recommend bounding the general "any data" to something more specific or eliminate requirement to be addressed at the integration level.
response	Accepted. Precision on the data has been added.

comment	*63* comment by: *Ted Parker/Honeywell* Appendix 2.2 RH.m Is this practical or even possible? Applicability of DO-160 section should align with later parts of the MPS for applicability as minimum.
response	Not accepted. Protection are mainly provided by the rack and may differ for each slot. Additionally, it is recognised that the rack may protect the embedded modules on certain ED-14/DO-160 sections only. This needs to be recorded by a 'X' category for such sections, while the level of protection brought for the other sections need to be characterised with the relevant category.

comment	*64* comment by: *Ted Parker/Honeywell* Appendix 2.2 RH.q 1. not practical to define if other supplier involved and would change after ETSOA so not useful. 2. Can be done, but why? The characteristics of the module are already defined - what value is it to identify a minimum as if the others weren't applicable? 3. no issue 4. How can this be determined except with a specific module inserted?
response	Partially accepted. 1. Not accepted. When a rack is developed for a specific list of predefined modules, it is important to characterise it. An applicant may find it interesting to limit its approval and demonstration of compliance for a specific list of modules. 2. Noted. The characteristics that are referred in this requirement are referring to the module to be installed and that are not under the approval of the rack. The text has been clarified to avoid the misunderstanding. 3. Noted.

	4. Partially accepted. It is determined by design and measured with a specific test module that should be representative to cover any module having the characteristics described in bullet 2. The text has been changed, taking into account other comments.
comment	*65* comment by: *Ted Parker/Honeywell* Appendix 2.2 RH.w should allow for a custom standard and this would imply otherwise
response	Noted. The word 'should' leaves the possibility for alternatives. It is important to have an exhaustive description of the characteristics with the same level of quality as the description of a standard.
comment	*66* comment by: *Ted Parker/Honeywell* Appendix 2.2 RH.x How will this be verified without a specific module being installed. This needs to be rewritten in the context of a bare rack and what can be verified at that level. Degradation can not be assured, but only define the interface such that the inserted module respects the interface to avoid degradation.
response	Not accepted. The full purpose of this Chapter 4.1 is when the rack is offering an interconnection capability. The degradation should be ensured for any module for which the characteristics are described in RH.q) bullet 2. and measured with a specific test module which is representative and presenting those characteristics.
comment	*67* comment by: *Ted Parker/Honeywell* Appendix 2.2 RH.y May be a desireable feature but why is this a requirement and I am not sure I even fully understand what it means and how to comply. Recommend rewriting or eliminating.
response	Accepted. The text has been rephrased.
comment	*68* comment by: *Ted Parker/Honeywell* Appendix 2.2 RH.ee How shall we determine regulation of temperature of a mounted hardware module without knowing the characteristics of the hardware module. Further requires control on a slot by slot basis will make for a complex and unnecessary design. This seems to be very restrictive for a feature that is optional to begin with. Cooling performance is a vague term and will be

	unable to guarentee anything for unknown modules. Recommend a serious rethink of the need for this requirement and simplify.
response	Partially accepted. The requirement is rephrased to better express the need for having a regulated temperature control per slot.

comment	*69* comment by: *Ted Parker/Honeywell* Appendix 2.2 RH.ii The only practical way to do this is consider totally loss of the feature. You will have no way to know what a modules performance will be for partial loss and too low performance. Practically the burden should be on the installed module to address implications of loss of cooling as this is an optional feature that may not exist. Recommend this requirement be deleted as impractical.
response	Accepted.

comment	*70* comment by: *Ted Parker/Honeywell* Appendix 2.2 RH.jj This performance of heat exchange will be dependent on the installed module. This can not be accomplished.
response	Noted. The requirement has been deleted, taking into account that the heat exchange characterisation is covered by RH.gg.

comment	*71* comment by: *Ted Parker/Honeywell* Appendix 2.2 Table 3, RH.a Inspection seems a better choice for a general slot number and permission type of vague requirement. You would have to have the intended modules to be installed to actually test the ability.
response	Partially accepted. In some simple cases , inspection might be sufficient In a more general manner, a test must be performed using modules representative of the characteristics described in RH.h) and RH.i), and has to be verified as well after DO-160 tests.

comment	*72* comment by: *Ted Parker/Honeywell* Appendix 2.2 Table 3, RH.b How does one test mechanical isolation especially without the specific modules to be

	installed?
response	Noted. A test can be performed using module representatives of the characteristics described in RH.h) and RH.i).

comment	*73* comment by: *Ted Parker/Honeywell* Appendix 2.2 Table 3, RH.c Inspection seems a better choice and impractical to test an infinite set of possibilities of unintended modules or innappropriate installations. Also, why test over environmental condition.
response	Noted. The purpose of a test is to test the means to avoid installation of unintended hardware module or inappropriate installation. The applicant has to define the most appropriate test conditions to verify the means.

comment	*74* comment by: *Ted Parker/Honeywell* Appendix 2.2 table 3, RH.d Test a marking of Part Number?
response	Accepted.

comment	*75* comment by: *Ted Parker/Honeywell* Appendix 2.2 Table 3, RH.e How does one test conformance to a mechanical interface standard?
Response	Accepted. For this requirement, 'T' is replaced by 'I/A' in the table.

comment	*76* comment by: *Ted Parker/Honeywell* Appendix 2.2 Table 3, RH.h Will be difficult to test airflow profile over environment. I recommend this be addressed by analysis instead.
response	Accepted.

comment	*77* comment by: *Ted Parker/Honeywell* Appendix 2.2 Table 3, RH.j How does one "test" a requirement for "any data" needed to evaluate mass and center of

	gravity for a populated or partially populated rack?
response	Partially accepted. The requirement has been updated, see also the response to Comment 62.

comment	*78* comment by: *Ted Parker/Honeywell* Appendix 2.2 Table 3, RH.m Do not see how this can be done by test practically without installed modules and then will only be specific for that configuration.
response	Noted. A test can be performed using module representatives of the characteristics described in RH.h) and RH.i).

comment	*79* comment by: *Ted Parker/Honeywell* Appendix 2.2 table 3, RH.q Do not see how this can be done by test practically without installed modules and then will only be specific for that configuration.
response	Accepted. A test is not required any longer for this specific requirement.

comment	*80* comment by: *Ted Parker/Honeywell* Appendix 2.2 Table 3, RH.s Test of all possible configurations especially under environment is not practical. Also these configurations may never exist.
response	Noted. The purpose of a test is to test if the rack housing is fulfilling its requirements in all possible configurations. The applicant has to define the most appropriate configuration to cover the full capability of the rack housing.

comment	*81* comment by: *Ted Parker/Honeywell* Appendix 2.2 Table 3, RH.u Do not see how this can be done by test practically without installed modules and then will only be specific for that configuration.
response	Noted. The interconnection capability is expected to be tested, for example, with a set of modules or with a specific tool. In any case, the test must demonstrate that it covers all the interconnection capabilities provided by the rack.

comment	*82* comment by: *Ted Parker/Honeywell* Appendix 2.2 Table 3, Note 1 I am having trouble understanding the intention of this note and difficult to propose wording improvements without this understanding. Suggest improving clarity of intention.
response	Noted. The Note 1 is referring to a Functional subset and refers to CO.gg) which clarifies: 'When demonstrating the performance of the IMA module, a subset of the characterisation items that allows guaranteeing the behavior of the complete IMA module over environmental testing shall be defined and submitted together with the Qualification Test Plan. Note that this functional subset should be detailed enough to sufficiently cover the complete IMA module performance.' The aim is that the applicant defines a subset of characteristics that are representative for the module and that would be a way to check the proper behaviour of the module during environmental testing (it is similar to the various SAE documents on functional ETSO where there is a subset of requirement to be verified during environmental testing). As here the module being an IMA, it is up to the applicant to define the subset.

comment	*126* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* Proposal is to modify RH.b) as following to avoid design oriented solution: The Rack Housing shall ensure the physical partitionning between the different mounted hardware modules.
response	Accepted. The requirement has been modified as suggested.

comment	*127* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* The terminology "Exchanging" for Power supply seems not relevant Proposal is to modify the text as following ""This interconnection allows exchanging data or distributing power supply"
response	Accepted.

comment	*140* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* Description of F3 can be interpreted as too much prescriptive. Proposed modification: - To replace "capacity is only composed…" by capacity may be only composed of…" - to replace "PS module needs to be mounted…" by "PS module may be mounted…"
response	Partially accepted. The first bullet has been deleted, second bullet has been changed as proposed.

comment	*141* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* RH.y) wording can be precised regarding current industry practices : Proposed modification is : - To replace "fault containment" by "design practices", - To replace "fault propagation" by "interferences between signals…"
response	Partially accepted. The text has been rephrased in a different manner.

comment	*157* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* Reference error : RH.aa) " provided in a) ...." which a) ?
response	Accepted. RH.u) a has been added.

comment	*158* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* Reference error Modify text as following "Applicable ED-14/DO-160 sections" in the header of the table page A2-2-10
response	Accepted.

comment	*161* comment by: *Latecoere Head of Airworthiness* Appendix 2.2 : Rack Housing 2.1 Functional requirements for ETSO-2C153 CLASS RH (F1): Housing RH.e) The external mechanical interface(s) of the Rack Housing module should conform to characteristics as described by a standard (e.g. ARINC600). Some characteristics of the slots may be configurable Could you please clarify the wording to define if the standard required (e.g. ARINC600) is for interface - between the Aircraft and the IMA rack or - between the IMA rack and the modules We suggest not to set a standard for mechanical interfaces between the A/C and the IMA rack , to keep A/C architecture sufficient degrees of freedom .

	5.1 Functional requirements for ETSO-2C153 CLASS RH (F4): Temperature control If the Temperature control unit is part of the IMA rack , this means that the IMA rack is not a passive device , but becomes an active equipment , with DAL tbd .
response	Noted. RH.e): By "external mechanical interface", it is meant to be the interface between the rack and the aircraft. EASA agrees that a standard should not be prescribed. This is why the word "should" has been used instead of "shall". 5.1: Noted. However, the ETSO-2C153 does not prescribe the DAL of any functions, which is to be determined by the applicant as a function of the supported FHA events for the intended installations.

comment	*180* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* Chapter 3 : Typo error in "Environmental isolation": "n" missing in figure 8
response	Accepted.

comment	*181* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* chapter 3.1 : typo error in figure 9 Typo in "Mechanical interface": "h" missing for 3 green boxes
response	Accepted.

comment	*182* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* RH.o) Typo error (To be confirmed) modify the text as following "."Appendix 2.2 paragraph 3.1" instead of "Appendix 2.2 paragraph 1.1"
response	Accepted.

comment	*185* comment by: *Rockwell Collins, Inc.* Page A2.2-5 Para 3, 3.1, 3.2 General Comment: These paragraphs do not provide clear requirements. Rationale for Comment: It is very difficult to equate the requirements in Section 3 with the verification methods of Table 3. They are not stated clearly as requirements. What is implied is difficult to measure, and in some cases it is not clear how the narrative in section 3 correlates to the verification method in Table 3. Recommendation: Please consider updating the text to provide better clarification of intended requirements and better correlation between Section 3 requirements and Table 3

	methods.
response	Noted. The requirement RH.n) has been removed.

comment	*187* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* Appendix 2.2 and 2.7 : information Definitions until Slot contains ":" e.g. "slot:", all others after contains "." e.g. "Hold-up capacity."
response	Accepted.

comment	*188* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* Appendix 2.2 and 2.7 : information Definitions Mounted and Slot are not exactly similar between App2.7 and App2.2
response	Accepted.

comment	*195* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* function RH F2 : Typo error replace “Lighting” effects by “Lightning
response	Accepted.

comment	*197* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* RH.o) and RH.z): the included reference seems incorrect
response	Accepted.

3. Proposed amendments - ETSO-2C153 - APPENDIX 2.3 p. 43-46

comment	*83* comment by: *Ted Parker/Honeywell* Appendix 2.3, Table 4, PR.b Analysis a better verification method. It will be difficult to develop test that could address all the ability to host all possible applications, etc.
response	Not accepted. The Agency expects the applicant to test that IMA PR module is able to host several applications in order for the IMA PR module to perform its intended function.

comment	*88* comment by: *Ted Parker/Honeywell* Appendix 2.3 PR.c (comment from M. Andreas) Why is it necessary to provide sharing of a processing resource to multiple applications? Whether or not to provide this capability should be up to manufacturer, as there might not be justification for this.
response	Not accepted. The capability to share a processing resource is the essential pre-requisite for a module aiming for IMA Processing Resource ETSO authorisation. It is explained as well in Appendix 1, Chapter 3 - Definition of Intended Function classes.

comment	*119* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* Error in the text regarding the last draft release delivered by ASD. "The IMA module shall be able to host IMA applications, modules and/or components Executable Object Code(s)"
response	Accepted.

comment	*149* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* Comment applicable to PR.d) + idem for all the other classes Replace "shared functions" by "shared processing ressource
response	Accepted.

3. Proposed amendments - ETSO-2C153 - APPENDIX 2.4 p. 47-51

comment	*84* comment by: *Ted Parker/Honeywell* Appendix 2.4 Figure 15 At top of figure are the words "Type C". This implies there are other types that may be valid as well. What is the significance of this Type C notation?
response	Accepted.

comment	*85* comment by: *Ted Parker/Honeywell* Appendix 2.4, GP.f This is not written as a requirement. Recommend maybe adding as note to CO.w.
response	Partially accepted. Text has been converted into a requirement.

comment	*89* comment by: *Ted Parker/Honeywell* Appendix 2.4 Figure's 16 and 23 Misspelling of THREAD om both figures
response	Accepted.

comment	*90* comment by: *Ted Parker/Honeywell* Appendix 2.4 Table 5 (comment from M. Andreas) Enviromental testing of GP.b), GP.c, GP.d Reads like would have to test software design in environmental. Only underlying hardware should have to be tested.
response	Not accepted. It is recognised that software must be verified, but this is enforced through the reference to Subpart A in the ETSO main text § 3.1.3. Nevertheless, we expect that the sharing performance is demonstrated also during environmental testing. Table 5 Note (1) the reference to CO.gg) permits the definition of functional subset to reduce the tests to the cases needed for demonstrating correct behaviour over the usage domain.

comment	*121* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* "Worst Case Graphical Elaboration Time" requirement in missing in class GP Proposal is to modify GP.e) adding "Worst Case Graphical Elaboration Time"
response	Accepted.

comment	*142* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* Add to GP.f) This requirement is applicable to all GP module fonctionalities including the implementation of external video flow supperposition.
response	Accepted.

3. Proposed amendments - ETSO-2C153 - APPENDIX 2.5 p. 52-54

comment	*14* comment by: *Rodrigo Magalhaes (ANAC)* **[Appendix 2.5, Page A2.5-2]** *"Functional requirements for ETSO-2C153 CLASS DS"* Comment: Requirements concerning level of data integrity and protection could be added in this section.

response	Noted. It is recognised that the level of data integrity and protection is of utmost importance. These aspects (also applicable to most of the modules) are intended to be covered by the generic requirements CO.u) and CO.w). Therefore, no additional has been added in this chapter.

comment	*91* comment by: *Ted Parker/Honeywell* Appendix 2.5 DS.b (comment from M. Andreas) Why must sharing capabliity be provided if sharing not required in the Application?
response	Not accepted. The capability to share a storage resource is the essential pre-requisite for a module aiming for a IMA Data Storage ETSO authorisation. It is explained as well in Appendix 1, Chapter 3 - Definition of Intended Function classes.

comment	*92* comment by: *Ted Parker/Honeywell* Appendix 2.5 Table 6 (comment from M. Andreas) enviromental testing of DS.b) and DS.c) should not be required in envrionmental. DS.a) should be enough. When testing DS.a) should be allowed to reduce amount of testing for loading data which only occurs on the ground. IE, don't test loading of geographic databases in HIRF conditions.
response	Not accepted. As mentioned in the response to Comment 90, the sharing function is expected to be tested as a subset covering the usage domain. In the particular case of the DS module, the DS module does not assume that database loading is limited to the loading occurring on the ground. Indeed, the DS module can be used for various databases, for example: for data retrieval which can occur in flight (charts, terrain, real time weather data, ...), for data storage (Health Monitoring System, Flight Operation Quality Assurance applications, ...). Testing is therefore needed to cover flight conditions, unless a specific limitation is proposed by an applicant on a particular project.

3. Proposed amendments - ETSO-2C153 - APPENDIX 2.6 p. 55-57

comment	*15* comment by: *Rodrigo Magalhaes (ANAC)* **[Appendix 2.6, Page A2.6-3]** *"IF.d) In addition to Common Requirement CO.w), the characterization shall address the safety aspects of frozen data."* Comment: Instead of limiting this to frozen data, this phrase could be revised to cover safety aspects in a broad scope (safety aspects of data corruption should be considered as well, for instance).
response	Partially accepted. CO.w) already covers data corruption aspects. This requirement IF.d) is additional to CO.w).

comment	*183* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* Chapter 1.2 : Typo error Software is not a physical component Replace "Interface unit: set of physical components (hardware and/or software)…". by : "Interface unit: set of hardware and/or software components…"
response	Accepted.

comment	*184* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* Chapter 1.2 typo error Replace "if so wished bytghe..." By "if so wished by the…"
response	Accepted.

3. Proposed amendments - ETSO-2C153 - APPENDIX 2.7 p. 58-61

comment	*86* comment by: *Ted Parker/Honeywell* Appendix 2.7 PS.c Why is it necessary to characterize efficiency? I would recommend eliminating this or rewording in terms of the charaterizing the outputs regardless of the efficiency of creating that output.
response	Accepted. The efficiency is not of direct interest. The useful information for the installer is the needed input power budget (voltage, intensity) as a function of the intended module configuration and the output power delivered by the PS module.

comment	*93* comment by: *Ted Parker/Honeywell* Appendix 2.7 1.3 correct "resource" --> "resource(s)" "of" --> "or"
response	Accepted.

comment	*94* comment by: *Ted Parker/Honeywell*

	Appendix 2.7 Figure 20 (comment from M. Andreas) "IMA Module - Class F": "F" is an error, Class "F" does not exist in this document. Should be "Class PS" to distinguish from other "IMA module"s in Figure which are presumably other than Class "PS".
response	Accepted.

comment	*123* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* Capacitive load is missing in PS.c) Proposal is to add in PS.c) "12 - capacitive load"
response	Accepted.

comment	*173* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* § 1.2 PS Class can be implemented into a rack itself. Proposal is to removed "mounted into a rack" in the definition using following wording " For ETSO-2C153, The IMA module, ~~mounted into a rack,~~ shall provide to hardware modules, mounted into the same rack, Power Supply Resource which is the capacity to deliver, while performing the regulation operations, a quantity of electrical energy from power supply unit(s) to the hardware modules thanks to power rails accessible through physical interface(s)."
response	Accepted. The text has been amended.

comment	*189* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* Appendix 2.7 Table is not referenced
response	Accepted.

3. Proposed amendments - ETSO-2C153 - APPENDIX 2.8 p. 62-64

comment	*12* comment by: *Rodrigo Magalhaes (ANAC)* Appendix 2.8, paragraph 2.1, requirement DH.b: it is recommended to add an explanation about when a partial compliance to MPS from applicable release of ETSO C-113 may be requested and may be granted. Furthermore, the note below that refers to the additional requirements in COMMON - Appendix 2.1 may be in the wrong place. Please check.

response	Accepted. A note has been added.

comment	*95* comment by: *Ted Parker/Honeywell* Appendix 2.8 DH.b (comment from M. Andreas) Correct text to proper format "ETSO C-113" --> "ETSO-C113" As a significant part of C113 is evaluation of symbols (for example line widths) the symbols evaluated would depend on whatever the test software generated. The actual symbols should be documented in the test report.
response	Partially accepted. ETSO-C113 has been corrected. No additional graphic requirement has been added as C113 is already considered sufficient to approve non-IMA displays.

comment	*175* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* Typo error: In figure 23 : Replace Tread by Thread
response	Accepted.

comment	*198* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* Appendix 2.8 chapter 1.2 : typo error is it not Display Thread instead of Display Head for concurrent items ?
response	Accepted.

3. Proposed amendments - ETSO-2C153 - APPENDIX 3 p. 65-68

comment	*16* comment by: *Rodrigo Magalhaes (ANAC)* **[Appendix 3, Page A3-2]** *"Chapter 2 – Specific User Guide and Installation Manual contents"* Comment: Consider including requirements recommendations for system security in the user guide.
response	Noted. The Agency prefers at this stage to formulate requirement recommendations for system security at aircraft level.

comment	*61* comment by: *FAA* *Chapter 1* Comment:

	This section states that a set of data shall be available or submitted to the competent authority for approval. This will be a harmonization issue as TSOA in the FAA is self-approved as to technical content. The data could be made available but with emphasis on the TSO applicant to make the evaluation to DO-297/ED-124 and the aircraft applicant to evaluate the data for correctness. Specifically, per the ETSO, the partitioning analysis (and other documents) must be approved by the competent authority for installation. While the proposed wording change makes the required data to be available late in the project, this is a business issue and not a regulatory issue. Proposed Resolution: Proposed wording change: The following data are included as part of the installation data ~~available (A) or~~ submitted (S) to the competent authority for ETSO-2C153 approval. While it is the responsibility of the type design installation process to seek approval of the following data, early coordination with the competent authority is recommended. The data to be made available to the type design installation process must be identified in the installation data.
response	Not accepted. The comment is addressing the use of the data as installation data, while in this CS-ETSO standard the purpose is on the availability of the data to the user: the defined set of data needs to be available for the ETSO-2C153 authorisation. This data will be assessed for correctness and completeness as part of the ETSO approval process. In the EASA system, there is no requirement that an installation process is concurrent to the ETSO process, and the intent is to keep the two processes interoperable but independent.

comment	*145* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* Robustness of the partitioning shall be demonstrated by tests, as Analysis is deemed inappropriate to demonstrate the robustness CO.e is well verified by test but table ED-124 App 3, A-3.1 is not consistent (in addition, should be referred to ED124 4.2.4i instead of 4.4.4.j in ED124) Add in the text an (*) in ED-124 table of the App3 / chapter 1 for Partitioning Analysis Data expliciting (*) This Partitioning Analysis shall rely on Test results performed for CO.e) compliance
response	Partially Accepted. The text has been rephrased slightly differently from the comment's proposal.

comment	*146* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* For consistency with MPS requirements, modify text in Appendix 3 - chapter 2 as followed: - Guaranteed behavior and characteristics as per CO.k) - Interfaces (inc. physical mapping of Interface) · Limitations and Open Problem Reports (includng tools) · Worst Case Execution Time (WCET) analysis elements ;

	- FMEA/ FMES values · Core Software (see Appendix 3 – Chapter 3); · Fault management and Health Monitoring (See Appendix 3 – Chapter 4); · Usage Domain (See Appendix 3 – Chapter 5) ; · Configuration Aspects (See Appendix 3 – Chapter 6); · Tools aspects (See Appendix 3 – Chapter 7); · Compatibility & mixability information (See Appendix 4 – Chapter 8); - identification of COTS (CEH & SW) implemented in IMA module. Rationale : A/C manufacturer has to assess the effect of issues at A/C level -Remining activities to be conducted by Module integrator to complete the IMA module qualification (Environment...) · Requirements recommendations for Applications (data for application qualification, service available for applications....) ; · Requirements recommendations for System Integration. Nota : it is important to note that explicit description of IMA module OPR root cause and effect is necessary because IMA mpdule user and A/C manufacturer will have to assess the OPR effect at system and aircraft level, without detailed knowledge of IMA module design. Modify Coy) as followed : " The authorised configuration parameters (including range, type and definition combined parameters) in the usage domain"
response	Partially Accepted. The text has been modified.

comment	*190* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* Appendix 3 - chapter 2 : Typo error Replace "Compatibility and mixability information (see Appendix 4 - Chapter 8)" by : "Compatibility and mixability information (see Appendix 3 - Chapter 8)"
response	Accepted.

comment	*199* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* Appendix 3 - chaper 2 :Miswording Replace eventually by possibly "Each item of the characterisation and functional requirements are addressed in the User Guide (or ~~eventually~~ **possibly** in the Installation Manual, if appropriate)."
response	Accepted.

3. Proposed amendments - ETSO-2C153 - APPENDIX 4 p. 69-73

comment	*17* comment by: *Rodrigo Magalhaes (ANAC)*

	[Appendix 4, Page A4-2] *Figure 24: "Shock (Crash Safety) 7.3 Mandatory"* Comment: This qualification should be optional. Applicability depends on the place of installation in the aircraft and possibility of creating additional hazards to the occupants or to the aircraft itself (e.g. fire) during a crash event. In the unlikely situation this qualification is needed for an IMA system, it could be covered by the specific TC/STC.
response	Accepted.

comment	*96* comment by: *Ted Parker/Honeywell* Appendix 4 Chapter 2.2 (comment from M. Andreas) "Note: It is acceptable to perform the environmental qualification on the intended rack installation equipped with mounted IMA module(s)." Since certain Environmental Tests are required to be performed per a representative installation (such as DO-160 sections 19 through 22), these would be required to be performed in a rack housing.
response	Not accepted. The referenced Note represents only a portion of the text provided in the proposal. 'It is acceptable to perform the environmental qualification on the intended rack installation equipped with mounted IMA module(s). The 2C153 IMA module should be set in worst-case configurations.' The second phrase explicitly suggests how tests might be performed. In addition, DO-160 Sections 19 to 22 are not mandatory in general, only required for IMA module interfaces directly connected to aircraft wiring.

comment	*97* comment by: *Ted Parker/Honeywell* Appendix 4 Cahpter 2.2 (comment from M. Andreas) If the rack design allows IMA modules to be placed in multiple slots, determining "authorised configurations" could be quite burdonsome, as different slots might couple a given external environment (temperature, vibration, etc) in a different manner to an IMA module.
response	Noted. IMA modules are modular by definition and defining authorised configurations is referring to IMA modules/platform which have specific constraints of integration with other modules. When an IMA module/platform is modular and has multiple possible configurations, it is up to the applicant to define worst case(s) for qualification testing. It is described in the document as follows 'These documents should demonstrate that the considered configurations (which may be different depending on EUROCAE ED-14/RTCA DO-160 section) are the worst-cases for the set of authorised configurations of modules within the rack.'

comment	*98* comment by: *Ted Parker/Honeywell* Appendix 4 Figure 25 Table row for Temperature variation (comment from M. Andreas)

	The discussion in the draft 2C153 mentions that high and low temperatures experienced by the module will be influenced by the rack in which it is installed. But temperature rates are also influenced by the rack, which will tend to reduce the rate of temperature change experienced by the module. Any such test would have to be characterised the test report as to the actual temperature rate experienced by the module, and then surveyed when the module is used in an application.
response	Noted. The proposed text mentions the responsibility of the applicant to adapt ED-14/DO-160 (...) temperature variations cycle to the intended IMA module installation context. Appendix 3 mentions the need for the module supplier to document the 'Remaining activities to be conducted by Module user to complete the IMA module qualification (Environment...) ' - see also the reponse to comment 146, answering the concern.

comment	*99* comment by: *Ted Parker/Honeywell* Appendix 4 Figure 25 Table row for Vibration (comment from M. Andreas) The note seems to imply that vibration testing can be done by similarity. When it comes to vibration, similarity arguments are difficult. For one, the vibration response of the rack comes into play and may be different slot to slot. Distribution of mass within the card and other features such as location of attachment points can make a difference. To reused vibration qualification, the vibration test levels would need to be controlled or measured and then at least a vibration survey performed in the actual rack location.
response	Accepted. The note doesn't imply that vibration can be done by similarity. Some additional text in the note has been added. Vibration testing on the IMA module itself can only assess in a preliminary manner the robustness of the technology used (device package , soldering).

comment	*100* comment by: *Ted Parker/Honeywell* Appendix 4 Figure 25, Table row for Induced Signal Susceptability (comment from M. Andreas) As the DO-160 Induced Signal Susceptility tests includes Electric and Magnetic Fields coupled to the IMA module through the cabinet walls, then any such testing would have to be well characterised in the test report and analyzed in any application.
response	Noted. The test required to be performed are only referring to those IMA modules having the IMA module interfaces directly connected to aircraft wiring, for which the induced voltages are caused by the installation environment and determined by the section 19 category. The EMI/EMC coupling within the rack is expected to be addressed at the IMA system integration level, not in this ETSO.

comment	*101* comment by: *Ted Parker/Honeywell* Appendix 4 Figure 25 Table ro for Emmision of RF Energy (comment from M. Andreas)

should refer to "conducted emissions", not "susceptibility".

DO-160 does not have separate letters for conducted and radiated emissions as it does for RF susceptibility in section 20. What alphabet soup would be put on the qual form?

response | Accepted. Text changed.
ED-14G/DO-160G has removed the requirement for nameplate marking.

comment | *102* comment by: *Ted Parker/Honeywell*

Appendix 4 Figure 25 Table row Lightning Induced Transient Susc. (comment from M. Andreas)

Only the Pin Injection portion makes sense at a module level. This would need to be conducted in a representative rack.

response | Not accepted.
For IMA module, Lightning Induced Transient Susceptibility is only required for IMA module interfaces directly connected to aircraft wiring, and, according to the Agency,DO-160 section 22 is meaningful in this case.

comment | *103* comment by: *Ted Parker/Honeywell*

Appendix 4 Figure 25 Table row for Fire, Flammability (comment from M. Andreas)

Why mandatory for an IMA module and optional for "single LRU"? (see Figure 24)

response | Accepted.

comment | *186* comment by: *Rockwell Collins, Inc.*

Page A4-2: General Comment: Figure 24 indicates which ED-14/DO-160 environmental aspects are Mandatory and which are Optional. There is no correlation between 2C153 Mandatory and C153 Applicable.

Rationale for Comment: C153 identifies which environmental conditions are Applicable at the module level and which ones are Functional. Table 24 specifies either Mandatory or Optional, which could be interpreted to mean that all are applicable, with some being more applicable than others.

Recomendation:

Two options are proposed:

1) Provide better alignment between C153 and 2C153 in this regard or additional clarification on what applicants may show that would provide a harmonized response;

OR

2) Identify what might be done to provide improved alignment between ETSO and TSO regarding applicable DO-160() for a future TSO-C153 update.

response | Noted.

When drafting ETSO-2C153, the Agency reviewed the FAA TSO-C153 approach. In the EASA system the MPS requires a minimal environmental testing. For the qualification aspects, it is needed to distinguish the IMA module from the IMA integrated LRU. The NPA is illustrating the resulting minimal performance standard in order to authorise an IMA module/platform.

The Agency and the FAA will further work jointly on a global process with the aim of harmonisation. For the time being, none of the proposed options can be integrated immediately in the ETSO-2C153. Figures 24 and 25 are considered self-explanatory on the expected performances and qualification.
The Agency acknowledges that requirements are more specific during the ETSO process, which is aimed to be completed independently from any aircraft installation (no concurrent STC/TC process is required). On the other side, it is considered that the requirements at the aircraft installation level are harmonised. Beside the required qualification for the IMA system, this approach is well aligned with other environmental qualification requirements on the equipment level. The Agency has identified a minimum qualification that is considered necessary on specific modules to build up the incremental certification path. The Agency further considers that there is no contradiction between the EASA ETSO-2C153 and the FAA TSO-C153 which would prevent the certification of one equipment to both standards.

comment

201 comment by: *ASD - AeroSpace and Defence Industries Association of Europe*

Appendix 4 - chapter 2.1

Fire / flammability should be "Mandatory" for single LRU plateform.

response

Accepted. The text has been changed.

4. Regulatory Impact Assessment (RIA) p. 74-82

comment

28 comment by: *FAA*

4.6.1
Comment:
The referenced paragraph contains the following text:
Option 0 ('do nothing') has a significantly negative total score, while being also slightly negative from the safety perspective.

Option 1 (i.e. 'copy and paste' FAA TSO-C153, so not including minimum performance requirements) is the most negative in safety terms, *while it has … a slightly negative total score. Even if harmonised with FAA TSO, it is not even positive from the regulatory harmonisation perspective,* ***since it is diverging from the principles of the EU 'better regulation'.***

The FAA considers the highlighted wording in Option 1to be inappropriate and incorrect. Although we understand that this section is intended to show the different "scoring" for the four approaches considered by EASA, it also seems to indicate that EASA considers the current FAA approach of a TSO which provides a minimal minimum performance specification as somehow being *not safe*. The FAA is not aware of a single instance where an IMA failure or anomalous operation could be attributed to the approach

	used in TSO C153 and AC 20-170. Additionally, the FAA does not understand the EASA assertion that by adopting the current FAA approach would somehow be seen as "*diverging from the principles of the EU 'better regulation*". Also, it is incorrect to state that TSO C153 does not include any minimum performance specification. It does, as a TSO must include an MPS or otherwise there would be no reason to have a TSO. The FAA philosophy is to use the TSO for a minimum of items (DO-160 for EQT, DO-254 for AEH, and DO-178 for boot software). The EASA approach seems to be to provide a maximum of coverage with an ETSO, where the FAA approach is to have that activity covered in the TC/STC program. Given this assessment of the current FAA approach to IMA module TSO authorization and IMA system approval as laid out in DO-297 and AC 20-170, it is not clear as to whether EASA will accept future FAA certifications based on our current approach. <u>Proposed Resolution:</u> Provide clarification to FAA regarding EASA's assessment of the current approach as defined by TSO C153 and AC 20-170. Revise the text that implies the FAA approach has negative impact on safety. Revise the text that implies that TSO C153 does not contain an MPS.
response	Partially accepted. To Proposed Resolution 1: It is envisioned that validations of TSO-C153 approved equipment to ETSO-2C153 is possible, as long as some additional demonstration is provided, typically some of the data needed during the TC/STC process, but not part of the package required for TSO-C153. The FAA has set a precondition before granting the TSO-C153 authorisation This pre-condition is the evidence that an installation project is certifiable. Since in the EASA system the ETSO authorisation cannot be linked to such precondition, the ETSO-2C153 standard aims to cover these additional MPS. To Proposed resolution 2: The Agency apologises that the text, trying to be concise, leads to this interpretation. The intention was to state that this option (Option 1) does not have the same barriers to guarantee safety in EASA's system. The FAA has implemented a precondition, which is to have evidence that an installation project is certifiable before granting TSO-C153 authorisation. EASA system does not offer this precondition. Using, in the EASA system, the TSO-C153 without such a strong link to the aircraft certification (which brings in further design related requirements), would have had the risk (in the EASA system) to grant the ETSO authorisation to less safe systems. This is the fundamental reason to have included the MPS into ETSO-2C153. Therefore, it was not stated in the Regulatory Impact Assessment (RIA) that the FAA system, when using TSO-C153, is not safe. To Proposed resolution 3:

	The Agency agrees that the text describing Option 1 should rather be described as 'Basic MPS', since TSO-C153 contains general, mainly process related, requirements. The title of the summary of the RIA, which is produced as part of the Decision explanatory note, has been changed to 'Basic MPS'.

comment	*192* comment by: *ASD - AeroSpace and Defence Industries Association of Europe* 4.1.1 Typo error : Replace "...MaterialDuring..." by "...Material. During..."
response	Partially accepted. The text has been revised.

comment	*209* comment by: *ECOGAS/SVFB/SAMA* 75/183 Issues quote: "*due to the present inconsistencies of the two regulatory systems (FAA TSO 6C153 was published in 2002) which should be eliminated together by the two authorities.“* We fully support this statement and it should have a very high priority.
response	Noted.

comment	*210* comment by: *ECOGAS/SVFB/SAMA* 76/83 The follow up of option 4 in RMT.0621 may or may not be more efficient. However, eventually the valuation for all 4 options should have been presented in the analyse of impacts.
response	Noted.

comment	*211* comment by: *ECOGAS/SVFB/SAMA* 80/83 we appreciate very much that the impact on SME's has been dedicated an individual chapter. We trust that such a dedicated chapter will be present in all present and future NPA's.
response	Noted.

comment	*212* comment by: *ECOGAS/SVFB/SAMA* 81/83 Better Regulation: we hope that FAA and EAA will undersign to the finding of option (3) „ More modern than corresponding FAA provisions“…

response	Noted.

4. Appendix — Attachments

Integrated Modular Avionics (IMA ETSO-2C153).pdf

Attachment #1 to comment #205