

# Certification Memorandum

## Acceptable Methods for Aircraft Electromagnetic Compatibility Demonstration

EASA CM No.: CM-ES-004 Issue 01 issued 26 June 2024

Regulatory requirements: CS 23.1301(d), CS 23.1309(a)(1)(b)(1), CS 23.1431(b) (up to CS-23 Amdt. 4)  
CS 23.2500(b), CS 23.2510(b) (from CS-23 Amdt. 5)  
CS 25.1309(a), CS 25.1353(a), CS 25.1431(c), CS 25.1707(b)  
CS 27.865 (b)(3)(ii), CS 27.1309(a)  
CS 29.865 (b)(3)(ii), CS 29.1309(a), CS 29.1353(a), CS 29.1431(b)

EASA Certification Memoranda clarify the European Aviation Safety Agency's general course of action on specific certification items. They are intended to provide guidance on a particular subject and, as non-binding material, may provide complementary information and guidance for compliance demonstration with current standards. Certification Memoranda are provided for information purposes only and must not be misconstrued as formally adopted Acceptable Means of Compliance (AMC) or as Guidance Material (GM). Certification Memoranda are not intended to introduce new certification requirements or to modify existing certification requirements and do not constitute any legal obligation.

EASA Certification Memoranda are living documents into which either additional criteria or additional issues can be incorporated as soon as a need is identified by EASA.

## Log of issues

Issue	Issue date	Change description
01 Proposed	28.08.2023	First issue.
01 Final	26.06.2024	Final Issue 1 Post Consultation process

## Table of Content

Log of issues.....	2
Table of Content .....	2
1. Introduction.....	3
1.1. Purpose and scope .....	3
1.2. References .....	4
1.3. Abbreviations.....	8
2. EASA Interpretative Material .....	9
2.1. Background.....	9
2.2. Acceptable methods of compliance .....	9
2.3. Who is affected by this Certification Memorandum .....	11
3. Remarks .....	12

## 1. Introduction

### 1.1. Purpose and scope

The purpose of this Certification Memorandum (CM) is to provide guidance on acceptable methods for demonstrating the Electromagnetic Compatibility (EMC) of civil aircraft, when showing compliance with the applicable certification specifications (see 'regulatory requirements' on the front page of this CM). This demonstration aims to show that any aircraft electrical and electronic equipment and systems can operate without adversely affecting, due to Electromagnetic Interference (EMI), the simultaneous operation of any other electrical or electronic unit or system required to operate the aircraft safely.

Consistently with the statement above and throughout this document, the term EMC is used when referring to the goal of the aircraft systems compatibility. The term EMI is used when referring to undesirable effects that occur when EMC has not been achieved.

The systems affected by this CM are part of the aircraft type design, or they are intended to be certified as part of it. They contain electrical and/or electronic components and equipment, with their interconnecting wiring. They can subsequently be possible sources and/or victims of electromagnetic emissions, intentionally or not intentionally generated, and they can potentially cause or experience unwanted interference.

Intentional Radio Frequency (RF) emissions are generated by RF transmitters on purpose to transmit useful signals, typically for supporting communication, navigation, or surveillance functions. The aircraft RF transmitters/receivers considered in this CM comprise the ones that are intended to transmit/receive RF signals to/from receivers/transmitters outside the aircraft, the ones that are installed in the aircraft and are intended to interface with portable wireless RF transmitters and receivers carried on board (referred to as Transmitting Portable Electronic Devices (T-PEDs)), and the ones that are intended to communicate with other RF devices that are installed in the aircraft.

Unintentional radiated and conducted RF emissions can result from the internal operation of any kinds of electrical and electronic equipment. They can propagate via radiation, or through the wiring utilized for the transmission of electrical power, signals, or data.

The scope of this CM covers the EMC of the systems defined above and will be further referred to as inter-system EMC.

The protection of the aircraft systems from electromagnetic interference that may be caused by external sources (e.g. HIRF, lightning, precipitation static), or by Portable Electronic Devices (PEDs) that are carried on board the aircraft but are not part of the aircraft type design is not within the scope of this CM. Specific guidance and acceptable means of compliance have been published to address those aspects, including (but not limited to) the following material:

- AMC 20-158A "Aircraft electrical and electronic system high-intensity radiated fields (HIRF) protection";
- AMC 20-136A "Aircraft electrical and electronic system lightning protection";
- AMC & GM to CS-23 "Acceptable Means of Compliance and Guidance Material to Certification Specifications for Normal-Category Aeroplanes" (see acceptable means of compliance with paragraphs 23.2515 "electrical and electronic system lightning protection" and 23.2520 "high-intensity radiated fields (HIRF) protection" of CS-23 Amendment 5 and later);
- CM-ES-003 "Guidance to Certify an Aircraft as PED tolerant".

NOTE: wireless systems and equipment that are intended to interface with transmitting PEDs and are part of the aircraft design need to be assessed for the aircraft inter-system EMC, which is within the scope of this CM.

## 1.2. References

It is intended that the following reference materials be used in conjunction with this Certification Memorandum:

N°	Reference	Title	Code	Issue	Date (first applicable issue in reference)
[1]	Regulation (EU) 2018/1139 of the European Parliament and of the Council	Regulation on common rules in the field of civil aviation and establishing a European Union Aviation Safety Agency ( the 'Basic Regulation')			4 July 2018
[2]	Commission Regulation (EU) No 748/2012	Regulation laying down implementing rules for the airworthiness and environmental certification of aircraft and related products, parts and appliances, as well as for the certification of design and production organisations		Last amendment	3 August 2012
[3]	CS-23 Book 1 and Book 2	Certification Specifications and Acceptable Means of Compliance for Normal, Utility, Aerobatic, and Commuter Category Aeroplanes	CS-23	Initial Issue to Amdt 4	14 November 2003
[4]	CS-23	Certification Specifications for Normal-Category Aeroplanes	CS-23	Amdt 5 and later	29 March 2017
[5]	AMC & GM to CS-23	Acceptable Means of Compliance and Guidance Material to Certification Specifications for Normal-Category Aeroplanes	AMC & GM to CS-23	Initial Issue and later	20 December 2017
[6]	CS-25 Book 1 and Book 2	Certification Specifications and Acceptable Means of Compliance for Large Aeroplanes	CS-25	Initial Issue and later	17 October 2003

N°	Reference	Title	Code	Issue	Date (first applicable issue in reference)
[7]	CS-27 Book 1 and Book 2	Certification Specifications and Acceptable Means of Compliance for Small Rotorcraft	CS-27	Initial Issue and later	14 November 2003
[8]	CS-29 Book 1 and Book 2	Certification Specifications and Acceptable Means of Compliance for Large Rotorcraft	CS-29	Initial Issue and later	14 November 2003
[9]	CS-ACNS	Certification Specifications and Acceptable Means of Compliance for Airborne Communications, Navigation and Surveillance	CS-ACNS	Issue 2 and later	26 April 2019
[10]	CS 27.865 (b)(3)(ii)	External loads	CS-27	Initial Issue and later	14 November 2003
[11]	CS 29.865 (b)(3)(ii)	External loads	CS-29	Initial Issue and later	14 November 2003
[12]	CS 23.1301(d)	Function and installation	CS-23	Initial Issue to Amdt 4	14 November 2003
[13]	CS 23.1309(a)(1) CS 23.1309(b)(1)	Equipment, systems and installations	CS-23	Initial Issue to Amdt 4	14 November 2003
[14]	CS 23.2500(b)	General requirements on systems and equipment functions	CS-23	Amdt 5 and later	29 March 2017
[15]	CS 25.1309(a)	Equipment, systems and installations	CS-25	Initial Issue and later	17 October 2003

N°	Reference	Title	Code	Issue	Date (first applicable issue in reference)
[16]	CS 27.1309(a)	Equipment, systems and installations	CS-27	Initial Issue and later	14 November 2003
[17]	CS 29.1309(a)	Equipment, systems and installations	CS-29	Initial Issue and later	14 November 2003
[18]	CS 25.1353(a)	Electrical equipment and installations	CS-25	Initial Issue and later	17 October 2003
[19]	CS 29.1353(a)	Electrical equipment and installations	CS-29	Initial Issue and later	14 November 2003
[20]	CS 23.1431(b)	Electronic equipment	CS-23	Initial Issue to Amdt 4	14 November 2003
[21]	CS 23.2510(b)	Equipment, systems, and installations	CS-23	Amdt 5 and later	29 March 2017
[22]	CS 25.1431(c)	Electronic equipment	CS-25	Initial Issue and later	17 October 2003
[23]	CS 29.1431(b)	Electronic equipment	CS-29	Initial Issue and later	14 November 2003
[24]	CS 25.1707(b)	Electrical Separation; EWIS	CS-25	Amdt 5 and later	5 September 2008

N°	Reference	Title	Code	Issue	Date (first applicable issue in reference)
[25]	AMC 20-19	Passenger Service and In-Flight Entertainment (IFE) Systems	AMC 20-19	Initial Issue	17 July 2020
[26]	AMC 20-136A	AIRCRAFT ELECTRICAL AND ELECTRONIC SYSTEM LIGHTNING PROTECTION	AMC 20-136A	Rev A	21 January 2022
[27]	AMC 20-158A	AIRCRAFT ELECTRICAL AND ELECTRONIC SYSTEM HIGH-INTENSITY RADIATED FIELDS (HIRF) PROTECTION	AMC 20-158A	Rev A	21 January 2022
[28]	EASA Certification Memorandum CM-ES-003	Guidance to Certify an Aircraft as PED tolerant	CM-ES-003	02	21 May 2024
[29]	EUROCAE ED-246	Process Specification for Wireless On-Board Avionics Networks	ED-246	Initial	July 2017
[30]	EUROCAE ED-248 / SAE ARP 60493	Guide to Civil Aircraft Electromagnetic Compatibility (EMC)	ED-248 / ARP 60493	Initial	January 2018/October 2017 (reaffirmed in June 2022)
[31]	PS-AIR-25-13-R1	Electromagnetic Compatibility Demonstration for Airplane Wireless Radio Frequency Networks	PS-AIR-25-13-R1	Cancels policy PS-ANM-25-13 of 9 December 2013.	23 June 2023
[32]	RTCA DO-313	Certification Guidance for Installation of Non-Essential, Non Required Aircraft Cabin Systems and Equipment	DO-313	Initial	2 October 2008

### 1.3. Abbreviations

AMC	Acceptable Means of Compliance
CS	Certification Specifications
EASA	European Union Aviation Safety Agency
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
EUROCAE	European Organisation for Civil Aviation Equipment
FAA	Federal Aviation Administration
HIRF	High-Intensity Radiated Fields
IEL	Indirect Effects of Lightning
PED	Portable Electronic Device
RF	Radio Frequency
RTCA	Radio Technical Commission for Aeronautics
STC	Supplemental Type Certificate
TC	Type Certificate
T-PED	Transmitting Portable Electronic Device



## 2. EASA Interpretative Material

### 2.1. Background

Electrical and electronic equipment and systems are extensively used in modern aircraft to implement a significant number of functions and have considerably increased in complexity during the last decades.

Industrial practices that were used in the past to demonstrate the aircraft EMC and were considered adequate according with the state of the art at the time may no longer be effective to address compliance of modern systems and technologies with high level of complexity and integration.

For instance, the electronic systems that are used in modern aircraft have potential sources of RF emissions from electronic oscillators and clocks that are very narrowband and stable. If multi-channel communication and navigation radio receivers were tested by operating them at one low, one high and one mid-band frequency only, it would be unlikely to find radio interferences that might occur at other frequencies within their operational frequency range. This practice is therefore no longer accepted by EASA, if not supported by further substantiation provided in accordance with the content of Section 2.2.

The EASA expectation is that the methods used to conduct the EMC demonstration should be commensurate to the severity of potential safety effects that may be caused by EMI and adequate for the level of integration and complexity of the affected aircraft architecture and systems.

The intent of this CM is the identification of methods that EASA considers acceptable for the aim of conducting the EMC demonstration.

### 2.2. Acceptable methods of compliance

EUROCAE ED-248 and SAE ARP 60493 [30] provide acceptable guidance and methods for conducting the EMC demonstration and comply with the EMC regulatory requirements that are applicable to the different aircraft categories. The technical contents of EUROCAE ED-248 and SAE ARP 60493 are identical. The following text will refer to EUROCAE ED-248 only for convenience, but either document can be used and is acceptable to the Agency.

The rigor and scope of the aircraft system EMC demonstration depend on the scope of the systems and changes, which should reflect the aircraft category, complexity of the change, and the severity of the impact it can have on safety.

The certification of a new aircraft, a derivative aircraft or a complex change to an existing aircraft typically requires a thorough EMC demonstration, supported by evidence achieved by tests at system and inter-system level. Acceptable approaches to demonstrate compliance and the characterization of a complex modification from an EMC perspective are described in Section 6.1 of EUROCAE ED-248.

For simple modifications, if adequately justified, the aircraft EMC demonstration may be based on the EMC qualification of the new or modified equipment being installed, along with the evaluation of the associated

installation. The characterisation of a simple modification in this context, the criteria for its determination and the acceptable means for showing compliance are provided in Section 6.2 “Simple Change to Existing Aircraft” of EUROCAE ED-248.

The following paragraphs provide reference to further guidance materials and standards containing supplementary information, which can be used in addition to the general guidance provided by ED-248, to develop the appropriate EMC demonstration strategy for specific features and installations.

Certification Guidance for Installation of Passenger Service and In-Flight Entertainment (IFE) and Non-Essential, Non Required Aircraft Cabin Systems and Equipment (CS&E).

In addition to the guidance contained in EUROCAE ED-248 [30], specific guidance for showing compliance with regulatory requirements of Passenger Service and In-Flight Entertainment (IFE) and Non-Essential, Non-Required Aircraft Cabin Systems and Equipment (CS&E) is provided by:

- AMC 20-19 [25], Section 6.2.3.2;
- RTCA DO-313 [32].  
In particular:
  - Section 3.13 – Electromagnetic Compatibility;
  - Section 4.3 – Wireless RF Cabin Systems Electromagnetic Compatibility;
  - Appendix C – Electromagnetic Compatibility Ground Test/Flight Test Guidelines for Installed CS&E Equipment.

Note: Section 4.3 of RTCA DO-313 [32] includes guidance for those cases where movable and portable wireless devices are provided as specific part of the wireless installed system and are therefore part of the aircraft type design to be certified (differently from PEDs, which are personal electronic devices that may be carried on board from passengers or crewmembers and are not part of the aircraft type design). They may include, but not limited to, remote controls or wireless handsets that are provided as part of the installed system.

On-board installed wireless RF systems that communicate with other on-board installed wireless RF transmitters and receivers.

In addition to the guidance contained in EUROCAE ED-248 [30], specific guidance for showing compliance with regulatory requirements of on-board installed wireless RF systems that communicate with other on-board installed wireless RF transmitters and receivers is provided by:

- EUROCAE ED-246 [29];
- FAA PS-AIR-25-13-R1 [31].

The following guidance issued by EASA and related to specific aircraft types or installations is reminded and referenced for convenience:

#### Electrical Equipment and Installations (large aeroplanes)

AMC 25.1353(a) provides a list of possible sources of interference that should be considered for the aim of showing compliance with CS 25.1353(a).

#### EWIS (large aeroplanes)

AMC 25.1707 paragraph 7 (CS-25 Book 2 from Amendment 5 and later) provides guidance regarding the design and installation of electrical wiring interconnection system (EWIS) to prevent interferences.

#### Global Navigation Satellite System (GNSS)

CS-ACNS [9], Subpart C (Navigation), Appendix C, paragraph 3.(c) provides guidance to demonstrate the lack of interference from on-board radio communication systems towards navigation sensors.

#### External loads (rotorcraft)

AMC 27.865 (CS-27 Book 2 from Amendment 6 and later) and AMC 29.865 (CS-29 Book 2 from Amendment 6 and later) provide specific guidance for small and large rotorcraft, regarding the protection of the hoist and the Quick Release System (QRS) for external loads from EMI and aimed at supporting the applicant in showing compliance with CS 27.865(b)(3)(ii) and CS 29.865(b)(3)(ii), respectively.

### **2.3. Who is affected by this Certification Memorandum**

This CM provides acceptable methods, practices and guidance material for applicants for a new type certificate (TC), a new supplemental type certificate (STC), or a change to an existing TC or STC of Large Aeroplanes, Normal-Category Aeroplanes and Small and Large Rotorcraft when the certification basis requires the applicant to address the certification specifications mentioned under 'Regulatory requirements' above (front page of this CM). Applicants for a European Technical Standard Order (ETSO) authorisation may also use this guidance when addressing equipment EMC qualification requirements.

### 3. Remarks

1. For any question concerning the technical content of this EASA Certification Memorandum, please contact:  
Name, First Name: Pagliarini, Mauro  
Function: Electrical Systems Expert  
E-mail: [Mauro.PAGLIARINI@easa.europa.eu](mailto:Mauro.PAGLIARINI@easa.europa.eu)

