# Certification Memorandum

# FLARM system installations in CS-23, CS 27 and CS-29 aircraft

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## Log of issues

| Issue | Issue date | Change description |
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# 1. Introduction

## 1.1. Purpose and scope

The purpose of this Certification Memorandum is to provide guidance for classification, installation and compliance of traffic awareness equipment such as FLARM®[1] to typical applicable certification requirements for CS-23, CS-27 and CS-29 aircraft types.

## 1.2. References

The following reference materials may be used in conjunction with this Certification Memorandum:

| Reference | Title | Code | Issue | Date |
|---|---|---|---|---|
| CS 2x.1301<br>CS 23.2500 | Function and installation | CS-23<br>CS-27<br>CS-29 | --- | --- |
| CS 2x.1309<br>CS 23.2510 | Equipment, systems and installations | CS-23<br>CS-27<br>CS-29 | --- | --- |
| CS 2x.1322 | Flight Crew Alerting | CS-23<br>CS-27<br>CS-29 | --- | --- |
| CS-SC051b | Installation of FLARM equipment | CS-STAN | Issue 2 | 30 March 2017 |
| ED-14/DO-160 | Environmental Conditions and Test Procedures for Airborne Equipment | EUROCAE ED-14<br>RTCA/DO-160 | --- | --- |
| Part 21 | 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 | Commission regulation (EU) No 748/2012 | --- | --- |
| 21.A.804 | Identification of parts and appliances | Part 21 | --- | --- |

[1] Several FLARM® type of equipment exist in the market. Some, are designed and manufactured by the original equipment manufacturer and some under license. The total amount of equipment (sensors, CPUs, displays, aural warning generators etc.) providing information about future flight paths and collision risks are referred as ''FLARM® system''. It is not the intention to ''promote'' or ''advertise'' FLARM installations, but the naming is used to avoid linguistic characterisations, which may include certain attributes, thereby making the CM not applicable for aviation.

## 1.3. Abbreviations

| | |
|---|---|
| FLARM | FLight AlaRM, a traffic and obstacle awareness module predominantly used in sailplanes, general aviation and part 27/29 low flying aircraft. |
| FLARM® system | A number of equipment comprising from the basic FLARM CPU module alongside, sensors, display, aural warning generators, integrated or not, presenting traffic information and collision risks to the crew. |
| PiC | Pilot in Command |
| ACAS | Airborne Collision Avoidance System (referred to as TCAS as well) |
| ADSB | Automatic Dependent Surveillance Broadcast |
| VFR | Visual Flight Rules |
| VMC | Visual Metrological Conditions |
| IFR | Instrument Flight Rules |
| GPS | Global Positioning System |
| ELA | European Light Aircraft.<br>In particular 'ELA 2 aircraft' means the following manned European Light Aircraft:<br>(i) an aeroplane with a Maximum Take-off Mass (MTOM) of 2 000 kg or less that is not classified as complex motor-powered aircraft;<br>(ii) a sailplane or powered sailplane of 2 000 kg MTOM or less;<br>(iii) a balloon;<br>(iv) a hot air airship;<br>(v) a gas airship complying with all of the following characteristics:<br>- 3 % maximum static heaviness,<br>- Non-vectored thrust (except reverse thrust), |

| | |
|---|---|
| | - Conventional and simple design of: structure, control system and ballonet system,<br>- Non-power assisted controls;<br>(vi) Very Light Rotorcraft. |
| DQR | Data Quality Requirements |

# 2. Background & Risk Assessment

## 2.1. Background

“See and avoid” in the lower airspace has been for a long time entirely “on the shoulders” of pilots without the possibility of real time help in terms of confirming suspecting surrounding traffic. At the suspicion (or Air Traffic Control information) of traffic in a close-by area, pilots can spend a considerable amount of time trying to locate adjacent traffic. Areas of gliding activity or other traffic are very generally known without on board real time capability of verifying traffic information.

To improve the lack of information in the cockpit within an area of interest, systems were developed by European industry (and encouraged by local National Authorities), which made visual acquisition of surrounding traffic easy to confirm, at a reasonable cost.

One of such systems is FLARM®. FLARM® primarily uses GPS position determination, and 3-dimensional flight path prediction, being broadcasted via a low power transceiver, in order to provide awareness to all recipients equipped with the same system, about adjacent – potentially conflicting, traffic. In addition, FLARM® systems may contain static obstacle data as well as predictive functions, which generate traffic/obstacle alerts to the crew, when obstacles or traffic are being found in the future aircraft flight path. The installation of such awareness equipment for ELA 2 aircraft is accommodated under CS-STAN according to CS-SC051b. For other new design approvals, or for aircraft not falling into ELA 2 definition, this Memorandum provides some installation considerations.

The system has traditionally been used predominantly on sailplanes and light aircraft. This CM extends the installation of FLARM to CS-27 and CS-29 aircraft types and harmonises these considerations with the existing practices in CS-23 aircraft. In addition, as the system has not been used so much on helicopters this CM justifies a Minor classification for CS 27 & 29 types, under assumptions, but does not provide any guidance for credit against ADS-B or ACAS I/II standards.

## 2.2. Basic operating assumptions and classification of hazards

The first assumption is the use of the FLARM® system during VMC flight conditions (in both VFR and IFR flights). The Pilot in Command (PiC) is assumed to be exercising his responsibility for adherence to the rules of the air for traffic visual acquisition and clearance from the ground or obstacles (in VFR) and adherence to the standard IFR procedures in IFR flight.
In addition, the visual scanning for traffic is assumed to be at least within the “primary” field of view of the aircraft (covering well both heading and track directions in reasonable cross wind conditions).

 

The second assumption relates to how the PiC perceives the information provided by the FLARM system. Here, it is important to mentally separate what is traffic information upon which one can rely on and what is a "nice-to-have" information for situational awareness[2]. If not correctly implemented, mixing a variety of incoming traffic information on a single display may potentially result in confusion, increase the head-down time as well as reduce valuable time to appropriately scan the airspace for conflicting traffic.

Similar considerations apply to the integration of the aural alerting in CS 23, 27 and 29 aircraft that some of the FLARM systems may generate. Upon an aural alert the pilot is expected to confirm the disturbing traffic, if time permits, and/or apply appropriate airmanship practices for VFR flight. In terms of hazard classification, the aural integration is the most aggravating factor elevating the hazard assessment to a minor level.

Under the above assumptions the worst case failure condition (failure here includes malfunctions of the FLARM system) at the aircraft level can be classified as Minor provided that the guidance of section 3 is followed, therefore leading to a Minor change classification. Conversely, if the integration is not performed as per section 3 then EASA may consider the installation as being of a Major criticality and request further review, including a Safety Assessment to be provided.
It should however be noted that for CS-23, the installation of FLARM is considered to be a safety improvement and as such, considering the Net Safety Benefit approach, the discrepancy between the software design assurance level and the failure classification has been deemed acceptable. For rotorcraft, the Net Safety Benefit approach is still under consideration.

## 3. Guidance for compliance demonstration

In the previous section a Minor hazard classification of failure conditions was assumed. In this section the guidance supporting this classification is further analysed. However, like every guidance, the arguments below may not cover all possible installations and if the guidance is not followed, the minor (hazard and change) classification should be reassessed.

<u>Considerations for aircraft installation:</u>

a) If a display is used to depict FLARM "targets" it must depict the information in a "mentally separable" manner- without having to spend much time to consider which information is from FLARM and which from other systems. This is obvious for hardware-separated displays, but for integrated systems (e.g. a multi-function display) a distinctive, easily identifiable FLARM presentation is of paramount importance. More advanced applications, such as presentation of FLARM traffic on a Navigation Display (ND)[3] or in combination with synthetic vision on the Primary Flight Display (PFD) cannot be accepted without a robust assessment of the display containment mechanisms ensuring primary (as

[2] Situational awareness here is defined as the mental thinking process that the pilot makes in order to confirm his own aircraft position within the surrounding environment. It is also the mental analysis of the already visually acquired targets to determine whether it is necessary to take further action (e.g. determine if the acquired aircraft is on collision course, distance estimation, if there is a necessity to divert the flight path of his "own" ship, etc.)
[3] The terms PFD and ND are traditional naming conventions related to the information used for flight and not the ''box(es)'' themselves. For example, even if a single box (e.g. a single display with PFD and ND) was incorporating all the flight information in the cockpit they would still be named as PFD and ND «areas» or displays in the frame of this CM.

well as more important) information availability. Given such an assessment made (this is typically supported by the a/c design architecture), presentation of the FLARM information on a PFD or a ND may be accepted within a minor change classification per Part 21.A.91 for night VFR or IFR certified aircraft.

b) The colour philosophy of 2X.1322 should be demonstrated and justified.

c) A FLARM aural alert, if used in the aircraft, must be justified as to its prioritisation and appropriateness for the type of aircraft installed. Low priority of FLARM alerting in relation to aircraft alerts and radios is expected. This implies the ability for the low priority aural to be automatically interrupted by a higher priority one. If no sequential prioritisation provided the FLARM® must not be set at a volume level that may disturb the crew.

d) The FLARM equipment should meet the applicable chapters of the appropriate environmental qualification requirements (EUROCAE ED-14/RTCA DO-160, Environmental Conditions and Test Procedures. For Airborne Equipment, at the appropriate revision) or to comply with an EASA-accepted equivalent. In particular, sections 4.5.4, 'Operating High Temperature Test', Section 15 'Magnetic Effect', Section 16 'Power Input', Section 21 'Emission of Radio Frequency Energy' and Section 26 'Fire', apply. The flammability requirements of ED-14G/DO 160G or compliance to CS-25 appendix F should be considered. All those tests are tailored to demonstrate that no other aircraft functions are adversely affected.

e) The installation on the aircraft:

   1. Should be protected by its own Circuit Breaker or a separate circuit breaker and a separate switch. On newer aircraft installations encompassing bus architectures, the FLARM should be connected to an electrical bus that does not supply power to aircraft systems essential for continued safe operation.
   2. Can be rapidly disabled or disconnected in case of emergency (including its displays and sensors).
   3. Allows for adequate protection of all interfaced equipment.

f) Antenna installation should not produce large areas of failure(s) in detecting incoming traffic (e.g. due to masking, GPS accuracy or any other area coverage limitations). If any shortcoming is identified, this must be clearly documented in the corresponding section of the flight manual supplement. If antenna diversity is used then both antennas must be investigated for adequately detecting incoming traffic.

g) The applicant should produce a flight manual supplement adequately addressing the equipment and installation limitations – including normal, abnormal and emergency situations. In addition, it must be clearly stated in the flight manual that the approval of this equipment is restricted to the areas where telecommunication regulations allow the use of the transmissions on the used frequency[4]. Adequate instructions to the crew must be provided in the appropriate place (Flight or Operating Manual) in order to allow for correct use of the equipment.

h) The applicant should consider the need to install a placard restricting the use of this equipment to Situational Awareness purposes, in particular for IFR type certificated aircraft.

[4] The frequencies at which the equipment is working may need a licence from the responsible "telecommunication authority".

 

Other considerations:

a) When databases are included in the design, which are not becoming part of the certified aircraft configuration e.g. the obstacle data base, the data quality requirements (DQR) should be defined and a reference should be provided to the user.

b) The thresholds of cautions and warnings provided have to be justified, especially in changed or newly coded alerting envelopes. The proposed time thresholds must be justified either by tests, or by analysis, or by a combination of both. There needs to be adequate time margin for the crew to identify the incoming flight vehicle and to take timely reactions considering the performance characteristics of the own and target flight vehicle.

c) The design data shall allow the identification of parts and appliances belonging to the installation as required by Part 21 subpart Q (21.A.804).

# 4. Remarks

Suggestions for amendment(s) to this EASA Certification Memorandum should be referred to the Certification Policy and Planning Department, Certification Directorate, EASA. E-mail CM@easa.europa.eu.

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