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Swiss Confederation

Federal Department of the Environment, Transport, Energy and Communications DETEC

Federal Office of Civil Aviation FOCA
Design and Production

FLARM® and TR-DVS® Installation Policy

for

Aircraft, TMG, Helicopters, (Gliders)

1. Purpose

This guidance material does not constitute a regulation but sets forth an acceptable means to show compliance to the applicable airworthiness requirements for fixed “stand alone” installations of non TSO certified collision avoidance equipments in Touring Motor Glider (TMG), aircraft or rotorcraft that operate under VFR rules. Installation in glider should also consider this policy, but some simplifications are granted. It addresses the installation of systems like FLARM®, TRIADIS TR-DVS® audio alerter, or similar equipments accepted by FOCA.

This policy also gives guidance to the equipment manufacturers, to get their equipments accepted by the authority and listed in the Swiss avionics list.

2. Scope

Installation Approval of non-required systems normally involves an installation review to verify the equipment will not adversely affect existing equipment to perform their intended function(s) or induce a new hazard into the airplane.

This document describes conditions that FOCA considers necessary to establish for the certification of fixed installation that involves “stand alone” non TSO equipments. Here “stand alone” means not connected to any other equipment essential for safe flight and landing, with the exception of the power supply, the audio panel and mechanical fixation. It includes the collision avoidance system peripherals like remote displays, vocal synthesizers. It does not cover the approval for the use as or with Portable Electronic Devices (PED) where the guidance AC91.21-1 is applicable.

However, it is here necessary to emphasize that it is the installer’s responsibility to maintain the level of flight safety of the aircraft/rotorcraft and that no additional hazard to the flight crew is created.

3. Applicable requirements

FAR//CS 22, VLA, 23, 25, 27, 29.

561 Emergency Landing & occupant protection
773 Pilot compartment view
853 Fire protection passenger and crew
855 Fire protection other compartment
863 Flammable fluid fire protection
867 Electrical bounding and lightning protection
1301 Equipment function and installation
1309 Safety analysis (except GLD+TMG)
1321 Arrangement and visibility

1322 Warning, Caution and advisory lights
1327 Magnetic Direction Indicator
1351 Electrical System
1357 Circuit protective devices
1359 Electrical system fire protection
1365 Electrical cable and equipment
1367 Switches
1431 Electronic equipment interferences
1501 Operating limitations
1527 Kinds of operation
1529 Instruction for continued airworthiness
1541 Markings and Placards
1581 Airplane Flight Manual

4. Reference Material

(a) FOCA avionics list: http://www.aviation.admin.ch/themen/musterzulassungen
(b) JAA TGL Leaflet No 29 Use of Portable Electrical Devices (PED)
(c) FAA AC 91.21 Use of Portable Electrical Devices (PED) aboard aircraft
(d) RTCA DO 160-E Environmental conditions and tests procedure
(e) EASA and FAA certification requirements
(f) Part-21 Certification Procedures for Aircraft and related Products and Parts
(g) CS-22 Sailplane
(h) CS-23 Normal, Utility, Aerobatic and Commuter Airplane
(i) CS-25 Large airplane
(j) CS-27 Small Rotorcraft
(k) CS-29 Large Rotorcraft
(l) Swiss directive TM 02.020-20 Maintenance made by the operators
(m) Swiss directive TM 02.020-60 Changes on aircraft and elements of aircraft

5. Background

The gliding scene has been confronted since years to dramatic mid air collision accidents. With the extreme fine shape and relatively high cruise speed of modern gliders, the human vision has reached its limit of detection. Another aspect is the airspace restrictions to VFR that create an augmentation of traffic density in the lower layers. These have a direct impact on the probability of collision also affecting powered aircraft or rotorcraft operations.

New generation of light collision avoidance systems appears now on the market at reasonable prices. They are based on different detection technologies like the reception of transponder Mode A/C/S signals or dedicated radio modem communication protocol. In the near future, Automatic Dependent Surveillance Broadcast (ADS-B) based on Transponder ModeS long squitter, should additionally become available.

The authorities are actually facing a common discussion to accept the installation of non certified equipments, balancing the safety improvements by means of situational awareness with the additional risks generated by the new equipments (Toxic fumes, Fire, EMI, misleading information, etc…).

These equipments in the VFR general aviation are not required by technical specifications or by operation regulations, but they are recognized by the regulators as an important step to-

ward improved aviation safety. Therefore they are not considered as essential for VFR flight and may be used for “situational awareness only” on a non interference, non hazard basis.

6. Identification of Issue and solutions

a) Non TSO equipment

These collision avoidance equipments are typically not certified and even no TSO standard exists today which would define the minimum operational performance standard (MOPS).

With the introduction of the JAR world it has been often interpreted that only TSO (Technical Standard Order) equipments with a Form One are suitable for the installation in JAR certified aircraft. This is not completely true as a TSO can be seen as a specific approved data package that qualify the hardware, the software, the environmental specifications, etc.. Therefore TSO certification facilitates the integration in the aircraft as the installer shall only demonstrate the delta of compliance to the applicable airworthiness requirements. But an installer can also provide the complete demonstration of compliance for any equipment. When an aircraft is limited to VFR operation, there are few types of equipment that are really essential for flight or for ATC control (FADEC, Engine Instruments, Speed indicator, Altimeter, Compass, VHF COM, and XPDR) and therefore this compliance demonstration is not necessarily exhaustive.

FOCA accepts these systems as fixed “stand alone” equipments with exception of a connection to the Power supply, audio panel isolated input or other non essential situational awareness system (Personal Digital Assistant (PDA), MFD in VFR, Situational awareness Moving Maps, etc..). Connection to MFDs in IFR operation where TAWS, TAS or Weather radar data are displayed is not permitted.

b) Equipment conformity

For the identification of product, a TSO equipment has clear frozen specifications that allow the authorities to verify the conformity to design of any part produced and ensure the continued airworthiness (Form One, Traceability, SB, ADs, etc..).

FLARM Technology and Triadis GmbH, will provide with equipment a Conformity Statement to an identified Master Drawing List. Each part must be appropriately marked with a Product name, Manufacturer, Part number and a Serial Number (S/N). This system will be equivalent to the EASA Part 21 Q (21A.804) identification of parts and appliances, but shall not include the letters EPA (European Part Approval) as the design data are not formally approved.

The equipment manufacturers shall provide a Declaration of Design and Performance (DDP) or an extensive datasheet to the FOCA. On the base of the DDP FOCA will evaluate the risk for example of toxic fumes, interference risks, fail safe design and if acceptable will grant the equipment in its National Avionics List (Refer 4.a) for installation on Swiss registrated aircraft only.

c) National authorization

The FLARM® system uses a data communication frequency in the free Non-Specific Short Range Device (SRD), sub band f, between 868.0 – 868.6 MHz and with an ERP power of less than 10 mW (duty cycle 1%). This band is ruled for European applications in the documents ERC/REC 70-03 annex 1(f) and ERC/DEC/(01)04. The band is free for

any ground-ground applications and gets no official protection against external interferences. It is definitively not considered as aeronautical mobile radio.

According the R&TTE Directive, the unit's class of equipment relates to class 1. According the EMC-standard ETSI EN 301-489-3 the unit is classified as a performance class 3 SRD devices. Equipment type is I. Power class is 9 (ERP 25 mW) according to ETSI EN 300 220-1/-3.

To be used for air-air application some countries require an authorization to be granted by each national communication authority. In Switzerland, BAKOM/OFCOM has granted this authorization for the FLARM application on the 23 March 2004.

On the 29 May 2005 FOCA confirmed to BAKOM/OFCOM that no Radio Concession will be required for FLARM®. Instead an Aircraft Flight Manual Supplement (AFMS) will be carried on board of Gliders, TMG, aircraft and helicopters with a limitation of use over territories that accepted this application.

A switch is required to turn OFF the FLARM® equipment when flights occur over territories where this SRD frequency is not available for air-air communication.

d) Antenna coverage

To respond to §1301 the equipment must function as per intended function when installed. Here the objective is to ensure the credibility of the global FLARM® network in making sure that the best possible coverage is provided for each installation. FLARM Technology already published clear limitations on the system performances in its Operating Manual, but the issue remains for the installer to verify the coverage quality of the antenna. The fundamental needs would be to achieve a 360° horizontal and 360° vertical HF visibility. This is not easy done on a large metallic airframe with only one antenna. Therefore the installer shall provide some pictures of the aircraft to document the antenna position/coverage and a coverage statement shall be given in the work report.

The installer shall provide a Ground test and/or a Flight test report demonstrating adequate antenna coverage and eventual limitations.

FLARM Technology shall provide a tool and/or assistance to the installer.

e) CS 1309, 1431: Interferences

DO-160E qualifications are usually not achieved, or sometimes only partially.

A particular care should be given to the interference created by these non TSO systems with any essential equipment as defined under the point a). It is the installer responsibility to prove the non interference during the installation. The installation manual shall particularly define the distance with other GPS or COM antennas that are adequate.

The same switch (refer point c) will allow the pilot to turn OFF the equipments (FLARM® and TR-DVS®) if any malfunction of essential systems appears (interferences or VHF COM failure).

f) CS 1322: Warning, Caution and advisory lights

The system FLARM® provides 2 levels of alerts: the nearest and the warnings. For simplification of the design of the first series FLARM Technology choose to provide only one red color annunciation for both levels.

FOCA has the following interpretation for these alerts: in the VFR operation the distance are always short, needing an immediate attention from the pilot to search for the convergent traffic. In this environment, the authority considers that the alerts are in fact always warnings and that the use of red only is acceptable and an amber level would not call for a different pilot behavior.

g) CS 1529: Instruction for continued airworthiness

As the collision avoidance equipment exchange data through the radio communication, it is of prime importance that all FLARM® get a valid software version to ensure proper protection. This is also true for the obstacle database that needs to be as accurate as possible with the latest data.

The FLARM® software is limited in time. During the self test the system compare a limit date with the actual GPS date and provides an error if time is expired. This shall make the owners aware that their equipments are not longer operating and that an upgrade with the latest software, available on FLARM Technology web site, is necessary.

It is acceptable that owners upgrade themselves the software version or the obstacle database as per the manufacturer instructions. A maintenance logbook entry is recommended. This will help the inspectors to give adequate advices when a software mismatch is discovered.

7. Installation procedure

Limitation / Obligation:

1. The installation of the FLARM®, TR-DVS® or similar system as listed and identified by part number in the Avionics list are authorized on Swiss registered aircraft only.
2. As per the FOCA avionics list, the original intention of these equipments is to provide situational awareness for the VFR operation. But they could also be installed on IFR aircraft/rotorcraft. This might be desired when the aircraft operates in both VFR and IFR or when the IFR operation is in airspace of Class E under VMC conditions. In this situation, FOCA will evaluate on a case by case basis if the change shall be classified as major, which will require authority approval. This might involve the authority to verify the compliance or to witness flight test.
3. Only licensed personal may proceed to installation in powered aircraft / TMG / rotorcraft. The TM/CT 02.020-20 regulates the installation made by the operators. On Gliders, it is acceptable that operators/owners install these equipments themselves.
4. A Notice of Modification (NoM) shall be sent to FOCA/STEH prior any installation on Powered aircraft, TMG or Rotorcraft. The NoM is to be classified as Minor Swiss until FOCA becomes a full member of EASA. There is no need to send a NoM for glider installations.

Hazard Assessment:

1. A Functional Hazard Assessment (FHA) may be performed to identify and classify failure conditions including determining probable combinations of failures. Guidelines and refer-

ence materials that can be used in performing a Safety Assessment and FHA can be found in FAA AC 23-1309-1C.

2. In order to show compliance with CS 1309, a safety assessment should be performed to determine the acceptable level of safety required including Software Development Assurance levels.

3. A CoC (Certificate of Conformance) is required with the delivery of equipment to be installed in powered aircraft/rotorcraft. It must be stored in the aircraft file. This will bind the equipment manufacturer to an accepted design and will ease the installer and the authority in verifying that no assumption for the compliance showing has changed. For example the compliance to toxic fumes, fire resistance or non interferences requirements. In gliders sufficient ventilation is available in case of fumes and the risk of electrical fire is considered as minor and remote, therefore no CoC is requested.

4. The installation must be designed to prevent hazards due to possible fire and smoke originated by the equipment in the event of a probable malfunction.

5. A zonal analysis is requested to ensure that no ignition of flammable vapor (fuel, hydraulic hoses and tanks, etc.) might occur during normal operation or after an emergency landing.

Note: Even if the fulfillment of the fire and smoke requirements can be met by the equipment qualification, a means should be provided to the crew to disconnect the equipment from its source of power. This has a particular importance in pressurized aircraft. Reliance on pulling system circuit breakers (CB's) as the sole means to remove equipment power would not be acceptable.

Electrical Architecture:

1. The equipment should be connected to an electrical bus that does not supply power to aircraft systems that are necessary for continued safe operation.
2. The equipment wiring should be protected against overloads and short circuits by suitable protective devices meeting the requirements of CS 1357.
3. A unique switch shall provide ready disconnection of all equipments connected to the collision avoidance function (FLARM®, TR-DVS® and other parts used in the installation) from the electrical bus in case of fume, fire or interferences. This switch has to be labeled as per CS 1367.
4. Complete set of electrical drawings shall be provided.
5. An electrical load analysis should be performed to show compliance with CS 1351. If the electrical consumption is negligible a statement in the work report might be sufficient.
6. Other installation considerations such as system interfacing should be addressed during the certification project to ensure the installation does not introduce conditions that could lead to degradation of those systems essential for continued safe operation.

Mounting:

1. Crashworthiness will need to be considered during the installation of the equipment. The unit (or its mounting structure) should not present a physical hazard to any occupant in the event of a hard landing, crash landing, or water ditching. Particular care should be given to auxiliary separate battery that might be installed for this collision avoidance function.
2. Complete set of mechanical drawings shall be provided for antenna positions and doublers construction. Photos might be acceptable on non pressurized aircraft.
3. On the human factors side, the position of the equipment must be demonstrated to satisfy the requirements of CS 773 “Pilot compartment view” and 1321(c) “Arrangement and visibility”.
4. Please care the access to the FLARM equipment in order to facilitate software updates. A connector could be reserved for this operation, when the system is difficult to access.

Human Factors:

The equipment should perform their function without distracting the pilot from safely operating the aircraft. It has been recognized the need to address human factors issues when such interconnected system (MFD, EFB, PAD, etc.) or aircraft are complex (usually large airplanes or helicopters). In this case flight testing may be necessary and generally be devoted to evaluate the following:

1. pilot's ability to safely operate the equipment (pilot interface)
2. acceptability of the placement of the equipment controls
3. determination if equipment operation interferes with the operation of required systems

Guidance to assist in this effort along with other human factors considerations are contained in FAA AC 27-1B, FAA Policy Statement PS-ACE100-2001-004, FAA AC 23.1311-1A, J/TSO C-113 and GAMA Publication No. 10. Note that this kind of change will be classified as major and will request an STC.

Ground and/or Flight testing:

1. GPS and Data communication antennas coverage shall be provided. A flight test might be necessary to demonstrate that the equipment performs its intended function.

2. An EMI test that shall at least cover the ECU, FADEC, VHF COM, XPDR or other operationally required equipment. The primary concern is that any device installed does not interfere with any of the required equipment. EMI tests should conform to RTCA Document DO-160E or equivalent standard to show compliance as part of CS 1309 or 1431 for Gliders (GLD) and Touring Motor Gliders (TMG).

3. Compass calibration or a demonstration of non influence.

4. A placard **"for info in VMC only"** shall be provided next to the equipment display, in all powered aircraft, TMG, rotorcraft.

5. Weight and balance.

AFMS:

1. For minor changes, a generic and for major change a dedicated AFM Supplement shall address any equipment operation limitations. For example, a collision avoidance system may be limited "for Situation Awareness Only".
2. A placard must be placed near the collision avoidance display which is an effective way of conveying limitations to the pilot.
3. The AFM Supplement is also the appropriate place to insert the operational instructions of the installed equipment. This information should give instructions to properly operate the equipment including any pre-flight test procedures, abnormal procedures and emergency procedure requirements. The AFM Supplement may also refer to equipment user manuals for more in-depth instructions on operating the equipment. FLARM Technology shall provide a generic AFMS, for all minor changes, that will be approved by FOCA.

Maintenance:

An Instructions for Continued Airworthiness (ICA CS 1529) is required as part of the data package. These instructions will be part of the installation manuals.

Aircraft documents:

1. Notice of Modification (Usually minor Swiss until FOCA is full member of EASA)
2. Drawings (mechanical – sketches or photo might be acceptable / electrical)

3. AFM Supplement (Usually completed generic with Registration, Model, S/N)
4. Compass swing report (if necessary)
5. Antenna coverage report.
6. No BAKOM/OFCOM radio concession is necessary.
7. Equipment list in the AFM.
8. FOCA equipment list for the aircraft file.
9. Weight and Balance report.
10. Certificate of Compliance (CoC)
11. Electrical Load Analysis.
12. Work report (FLARM part number and software version installed).

8. Final note:

This policy will need to be revised when FOCA will become a full EASA member. This is planned for mid-2006 ! After that date, the Swiss legal basis will change and FOCA shall work with a “sole code” EASA Part 21 for the approval of modification on not only Powered aircraft and rotorcraft but also on TMG and Gliders, what could drastically change the actual standard working practices.