

FOCA APPROVED
AIRCRAFT FLIGHT MANUAL SUPPLEMENT
for
FLARM COLLISION WARNING DEVICE

Aircraft Registration: _____
Aircraft Make: _____
Aircraft Model: _____
Aircraft Serial Number: _____
Approval Reference & Date: _____

This document must be carried in the aircraft at all the times. It describes the operating procedures for a fix installed FLARM Collision Warning System and its interfaces in accordance with the **FLARM Installation FOCA Policy 1.6 (42-00.02)** or later versions. For Aircraft, TMG and Rotorcraft, this AFMS will only be valid when the installation has been approved by the authority.

The information contained herein supplements or supersedes the basic Flight Manual only in those areas listed herein. For limitations, procedures and performance information not contained in this document, consult the basic Flight Manual.

Swiss Federal Office of Civil Aviation approved

Date : **20. März 2006**

Signature :



TABLE OF CONTENTS

SECTION 1 – GENERAL 3

SECTION 2 – OPERATING LIMITATIONS 4

SECTION 3 – EMERGENCY PROCEDURES 5



SECTION 4 – NORMAL OPERATING PROCEDURES 6

SECTION 5 – PERFORMANCE..... 8

SECTION 6 – WEIGHT AND BALANCE 8

SECTION 7 – SYSTEM DESCRIPTION 8

LOG OF REVISIONS

REVISION	Page	Description	Date	FOCA Approval
Original	All	Original release	15.03.2006	 

Note:

Only the Section 2, 3 and 4 of this Aircraft Flight Manual Supplement (AFMS) have been approved by the authority.

SECTION 1 – GENERAL

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 creates an augmentation of traffic density in certain areas and the associated airspace complexity that request more pilot attention on the navigation material. These have a direct impact on the probability of collision also affecting powered aircraft or rotorcraft operations.

These equipments in the general aviation are not required by technical specifications or by operation regulations, but are recognized by the regulators as an important step toward improved aviation safety. Therefore they are not considered as essential for flight and may be used for “situational awareness only” on basis of non interference to certified equipment necessary for safe flight/landing and no hazard to the persons on board.

Correct antenna installation has a great effect on the transmission/receiving range. The pilot shall care that no masking of the antenna occurs especially when the antennas (GPS + COM) are located in the cockpit.

FLARM will only give warnings of other aircraft that are likewise equipped with a compatible unit. FLARM does not communicate with Mode A/C/S transponders and is not detected by ACAS/TCAS/TPAS or Air Traffic Control. Likewise FLARM does not communicate with FIS-B, TIS-B or ADS-B systems.

The software version must be regularly updated as per the instructions given in the installation manual. If a version mismatch exists, error information is displayed during the equipment power ON and the system will not become operational.

A unique switch provides ready disconnection of all equipments connected to the Collision Avoidance function (FLARM, TR-DVS and other parts used with the installation) from the electrical bus in case of fume, fire, interferences or when flying over territories where the SRD frequency is not available for air-air communication. This switch is labeled adequately.

Important Note:

Operation of FLARM is forbidden in aircraft in which one or more of the occupants resides in or is a citizen of the USA or Canada. Likewise, use of FLARM is forbidden if the aircraft concerned takes off from, makes an intermediate or final landing in the USA or Canada

SECTION 2 - OPERATING LIMITATIONS

1. **This FLARM installation is compliant for “situation awareness only”.** The following placard must be installed on the instrumental panel, at the proximity of the display:

For Situation Awareness only

2. **Maneuvering must not be based solely on the use of the information presented on the FLARM displays or aural annunciations.** FLARM does not give any guidance on avoiding action. The azimuth and height accuracy of the computed traffic cannot always provide reliable warnings and only the most threatening traffic is announced. Therefore it is the pilot responsibility to evaluate by any means the real traffic position and altitude, the obstacle shape, the terrain and the meteorological situation prior executing any evasion maneuver.

Under no circumstances should a pilot or crewmember adopt different tactics or deviate from the normal principles of safe airmanship.

3. **It is the pilot’s responsibility to verify prior entering any states territory that the SRD frequency is permitted for use in air-air communication.** When such an acceptance does not explicitly or implicitly exist, the equipment shall be turned OFF. This verification is part of the flight planning.
4. **The pilot shall not intentionally generate uncoordinated warnings that might frighten other aircraft’s pilot.** Any intentional maneuver of this kind has to be carefully coordinated and agreed in advance. Unexpected reactions might be especially hazardous when lateral, vertical or time separations are small.

SECTION 3 - EMERGENCY PROCEDURES

In case of **Fire, Smoke, electrical burning smells or Electromagnetic Interferences** follow the Emergency procedure of the basic AFM.

FLARM is normally installed on a non-essential bus. But on ancient aircraft it is possible that only an avionics bus or even only a main bus is available for all electrical consumers. The basic Emergency procedure might require this bus disconnection that will generate a total loss of Navigation, Communication and ATC detection. This is classified as a catastrophic failure condition under IMC condition.

The dedicated FLARM switch will help to rapidly determine if the FLARM installation is faulty or not, allowing to resume essential equipments as per the Emergency procedure of the basic Aircraft Flight Manual.

SECTION 4 - NORMAL OPERATING PROCEDURES

4.1 General

It is recommended to carry the FLARM Operating Manual version 3 or later on board the aircraft. To make good use of the information contained in this manual the pilot should know the hardware version, the software version, the serial number and the obstacle database name currently installed in the FLARM.

4.2 Self-test

To switch on the FLARM, the aircraft electrical power shall be available on the corresponding bus and the dedicated FLARM switch must be turned ON.

After switching on, the unit performs a self-test routine, quickly lights up all LED and displays either error codes or version numbers. The Operating Manual describes how errors and version numbers are being shown. If an error is being shown, the unit is not ready for operations.

When FLARM shifts to normal operation it waits until it has acquired an adequate GPS position fix. When switching on the unit after a long break or in a totally new location, this procedure can take *several minutes*. Without a proper GPS position fix, the unit is not ready for operation.

Before departure the pilot must ensure that the LED status is "operational" (refer to the Operating Manual).

4.3 Operation Modes

FLARM operates in two modes, *Nearest* and *Collision*. When switched on, the unit is in *Nearest* mode. The warnings given are identical in both modes, and generally relate to an immediate threat to which the pilot should have an immediate and appropriate reaction.

When operating in the *Nearest* mode, the unit also reports the presence of other aircraft operating in the vicinity, even though calculations indicate that they do not represent a threat. As soon as FLARM detects the risk of a collision it automatically switches to *Collision* mode, followed by automatic reversion to *Nearest*.

In both modes the pilot can suppress the display and the acoustic warning: after a double push FLARM will suppress all visual and acoustic signals relating to traffic, obstacles or other threats. While warnings are suppressed, FLARM nevertheless continues to transmit signals for reception by other aircraft.

4.4 Airborne and Alerts

In case other compatible units are within range, also the Receive LED is ON. The horizontal and vertical indicators show the direction of the most imminent threat with a flashing red display. The first warning level for another aircraft is delivered when less than **18 seconds** remains to the possible collision; the second warning level is delivered when less than **13 seconds** remains; the third level when less than **8 seconds** remains.

When a number of moving threats or fixed objects are within range, then FLARM gives warning only of the most dangerous in accordance with the threat calculation algorithm. The pilot is unable to call for presentation of further threats. The warning indicates the earliest likely collision that could happen.

Depending upon the phase of the flight, FLARM uses different movement models, forecasting methods and warning calculations to provide the pilot with the best possible support without causing a distraction. For example, when a sailplane is circling, the system sensitivity is reduced. These models and processes have been optimised, but are nevertheless a compromise.

The threat might also be an obstacle (e.g. cables, antenna masts, cable cars, avalanche dynamite wires, power lines). In the case of fixed obstacles, the unit does not signal a bearing. Obstacle warnings are dependent on the information having been stored correctly in the internal data bank. The unit cannot give warning of any fixed object that has either been incorrectly stored or not stored at all.

Whether and how avoiding action is taken is solely a matter for the pilot, who must base his decision on his own observation of the airspace.

4.5 Line of sight

Compatible FLARM units must be within range in order to provide a warning. The range is very much determined by the type, installation and position of the radio antennae, plus the relative positions of the two aircraft. Under optimum conditions the internal antennae can give a head-on range of up to 5 km; normally, range is about 2 km. The radio signals can only be received by line of sight. There is no FLARM signal between two aircraft on opposite sides of the same mountain.

4.6 GPS signal quality

FLARM has to know its current position in order to operate. For this reason, FLARM will only operate in the presence of good quality three-dimensional GPS reception. GPS reception is greatly influenced by the installation and position of the antenna, and aircraft attitude. This is particularly true during turns, when flying close to mountain slopes and in areas known for poor reception. If the installation is poor the GPS signal quality may be reduced. In particular, there can be rapid degradation of height calculations. FLARM resumes operation as soon as the GPS reception quality is adequate.

4.7 Pressurized cabin

FLARM use an internal pressure sensor to determine the pressure altitude. This is an important element to verify the GPS positioning quality and to ensure an accurate and smooth altitude processing. When installed in a pressurized aircraft the FLARM system will not operate correctly until it is properly connected to an external static port.

4.8 Predicted flight path and accuracy

When close up, when two aircraft are at the same or similar height, or GPS reception is poor, the vertical bearing indication is imprecise and fluctuates.

FLARM calculates the predicted flight path of the aircraft to which it is fitted for less than the next 30 seconds. This prediction is based on immediate past data, current position- and movement data, plus a movement prediction model that is optimised for the respective user. This forecast is associated with a number of uncertainties that increase with an extension of the forecast time. There is no guarantee that an aircraft will actually follow the predicted flight path. For this reason, the warning issued will not be accurate in all cases.

4.9 Effect of wind

Movements calculated by the GPS relate to a fixed system of terrestrial coordinates. In strong wind there may be a substantial difference between aircraft heading and track, leading to a distortion of the threat bearing. If the wind speed is one third of True Airspeed (TAS) and the yaw-free aircraft Heading is 90° out of wind, then the threat indication displayed has an error of about 18°. If the wind is very strong, the Track can deviate up to 180° from Heading. Under such circumstances and when circling, the warnings given are unusable.

4.10 Data protection

The transmitter has no effect on what the receiver in the other aircraft does with the data. It is possible that this data may be captured and stored by other aircraft, or by ground stations, or used for other purposes. This opens up a range of possibilities, some of which may be in the pilot's own interest, (e.g. automated generation of an sailplane launch logging system, aircraft tracking, last position recovery), while others may not be (e.g. detecting tailing of other aircraft, airspace infringements, failure to take avoiding action prior to a collision). When FLARM makes a transmission, the signal also bears identification. The user can -- even though this is not recommended -- configure the unit so that identification is generated randomly and alters at one-minute intervals, making a back-trace difficult.

SECTION 5 – PERFORMANCE

No Change to basic flight manual

SECTION 6 – WEIGHT AND BALANCE

No Change to basic flight manual

SECTION 7 – SYSTEM DESCRIPTION

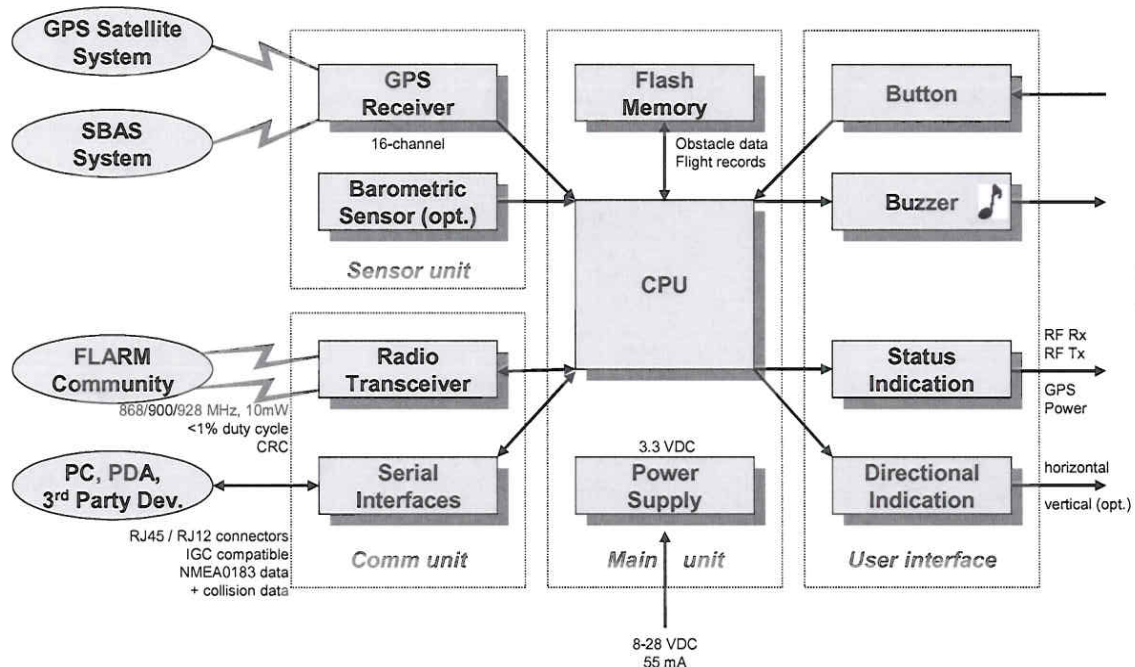
7.1 System description

FLARM receives position and movement information from an internal GPS receiver with an external GPS antenna. An optional pressure sensor further enhances the accuracy of position measurements. The predicted flight path is calculated by FLARM and the information transmitted by radio. Provided they are within receiving range, the signals are received by further aircraft also equipped with FLARM or compatible devices. The incoming signal is compared with the flight path predicted by calculation for the second aircraft. At the same time, FLARM compares the predicted flight path with known data on obstacles stored in an internal database.

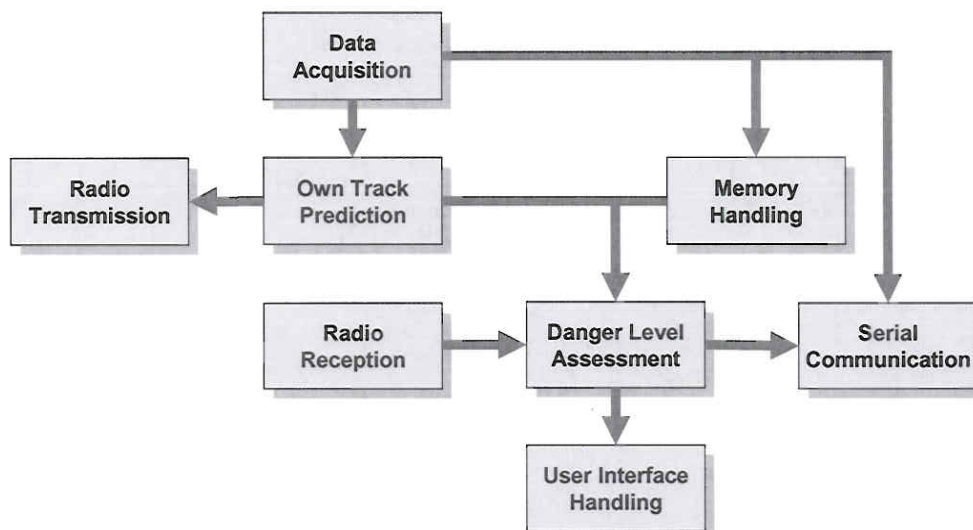
The GPS and collision information received from other aircraft can also be made available for third party equipment (e.g. external display, speech synthesizer, PDA) via a serial data output.

Obstacle information stored has been simplified; for example, FLARM assumes that a power wire is slung absolutely straight between two fixed points with no sag. Likewise, data for power lines does not include all intermediate masts.

7.2 Hardware scheme



7.3 In-flight software scheme



7.4 Radio transmission

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. ITU's recommendation for this band in region 1 is "mobile except aeronautical mobile". **FLARM is not considered as aeronautical mobile radio.**

There are national differences in frequency allocation and operating conditions between countries. 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 License will be required for FLARM. The aircraft commander is solely responsible for ensuring that their use of FLARM conforms to local regulations.

The radio transmission protocol employed places no limit on the number of units that may be operated within a given range. However, an increasing number of units within range is associated with a reduction in the probability that a single coded signal will be received ('graceful degradation'). The probability is small that subsequent signals will not be received from the same transmitter. FLARM is designed to receive and process signals from up to 50 aircraft within range. A high number of FLARM units within range has no effect on range.

7.5 Electrical installation

FLARM is requested to be installed on a non-essential bus. This is not always possible as certain older aircraft got only one avionics bus that is essential when flying under IFR rules. The FLARM installation is protected with a C/B. A dedicated power switch is provided with this installation to readily disconnect the FLARM installation when required by Emergency or operational needs. The pilot must be confident with his electrical bus topology and the FLARM installation.