AIRCRAFT FLIGHT MANUAL SUPPLEMENT

for PowerFlarm Collision Warning Device

NC Make :	**Lightwing**
A/C Model:	**AC4**
NC SIN:	**005**
Registration:	**HB-WED**

This Supplement must be attached to the basic Airplane Flight Manual. It describes the operating procedures for a fix installed Power FLARM Collision Warning System and its interfaces in accordance with the FLARM/FLOICE Installation FOCA Policy 1.6 (42-00.02) or later versions.
The information contained herein supplements or supersedes the basic Airplane Flight Manual only in those areas listed herein. For limitations, procedures, and performance information not contained in this document, consult the basic Airplane Flight Manual.

This Flight Manual Supplement Revision is EASA approved under:
EASA CS STAN CS-SCO51b.

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SECTION 1 GENERAL

The general aviation has been confronted since years to dramatic mid air collision accidents. With the extreme fine shape and relatively high cruise speed of modem 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 required 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, ADS-B and FLARM NB) are located in the cockpit.

PowerFLARM will only give warnings of other aircraft that are likewise equipped with a compatible unit and from aircraft equipped with ADS-B-OUT (I090ES), Mode-C and Mode-S transponders (if interrogated by ground radar or TCAS). PowerFLARM is not detected by ACAS/ TCAS/TPAS or Air Traffic Control. Likewise PowerFLARM does not communicate with FIS-B or TIS-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.

SECTION 2

OPERATING LIMITATIONS

2.1 This POWERFLARM 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

2.2 Maneuvering must not be based solely on the use of the information presented on the PowerFLARM displays or aural annunciations.
PowerFLARM 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.

2.3 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.

2.4 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.

The PowerFLARM is powered by the aircraft electrical bus. In case of malfunction pull the dedicated PowerFLARM Circuit Breaker located in the CB Section of the aircraft

SECTION 4

NORMAL PROCEDURES

4.1 General
It is recommended to carry the PowerFLARM Operating Manual, current revision on board the aircraft. To make good use of the information contains 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 PowerFLARM.

4.2 Self-test
To switch on FLARM, the aircraft electrical power shall be available on the corresponding bus. After switching on, the system performs a self test routine and displays either error codes or version information.
When FLARM shifts to normal operation, it waits until it has acquired an adequate GPS position fix. When switching on the device after a long period or in a new location, this procedure can take several minutes. Without a proper GPS position fix, the system is not ready for operation.
Before departure, the pilot must ensure that FLARM has acquired a OPS fix and that no errors are shown (refer to the display manual).

4.3 Traffic Information Presentation
FLARM can show and warn about other aircraft, obstacles, and alert zones. When there is no threat, FLARM can show information about surrounding aircraft. The types of aircraft that are shown (FLARM/ADS-B/Mode-C/S, range limits, etc.) are defined in the settings during installation. When FLARM calculates a risk for an imminent collision, it will give visual and aural warnings. There are three levels of warnings, depending on time to impact. The different warnings start at approximately 185, 12s, and 8s respectively. The display will show the relative bearing and vertical angle to the intruder (Mode-C/S traffic will only be shown as approximate range and vertical

angle). When receiving a warning, immediately identify the intruder visually and take corrective action, if required. Never take corrective action based solely on collision warnings or displayed traffic.
If there are several threats, FLARM will only warn about the calculated most danger threat. Depending on 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 glider is circling, the system sensitivity is reduced. These models and processes have been optimized, but are nevertheless a compromise and may be wrong.
Obstacle collision warnings are always given without bearing, when there is an obstacle in the calculated future flight path. Warnings are only given about obstacles that are in the current database. The database should be update with the AIRAC cycle, or at least once per year.

4.4 Line of sight

Compatible FLARM/FLOICE/PowerFLARM units and Transponders 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 antennas, plus the relative positions of the two aircraft. Under optimal conditions, the system can give a range of well over 10 km. Normally, range should be minimum 3-10 km. The radio signals can only be received by line of sight. There is e.g. no FLARM communication between two aircraft on opposite sides of the same mountain. If there is only one FLARM antenna on top of the aircraft, the range directly below the aircraft will be zero or very limited.

4.5 GPS signal quality

PowerFLARM has to know its current position in order to operate. For this reason, PowerFLARM 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. PowerFLARM resumes operation as soon as the GPS reception quality is adequate.

4.6 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. PowerFLARM calculates the predicted flight path of the aircraft to which it is fitted for less than the next 20 seconds. This prediction is based on immediate past data, current position- and movement data, plus a movement prediction model that is optimized 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.

4.7 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 900 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 1800 from heading. Under such circumstances and when circling, the warnings given are unusable.

4.8 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 PowerFLARM makes a transmission, the signal also bears identification.

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

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

PowerFLARM also receives ADS-13 and Mode C/S Transponder signals.

The PowerFLARM traffic situation will be displayed on the Dynon Skyview Display located in the Cockpit Panel. The PowerFLARM will generate also audio messages. The PowerFLARM is connected to the aircraft intercom auxiliary audio input.
The PowerFLARM software and database can be updated via a USB Stick.

This aircraft is equipped with several antennas for the PowerFLARM System. One GPS antenna, one ADS-13 antenna and one or two FLARM (A I B) antennas.

The PowerFLARM system is electrically protected by a 2 Amp. Circuit breaker located in the CB panel labelled as FLARM.
Obstacle information stored has been simplified. For example, PowerFLARM 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 Radio transmission

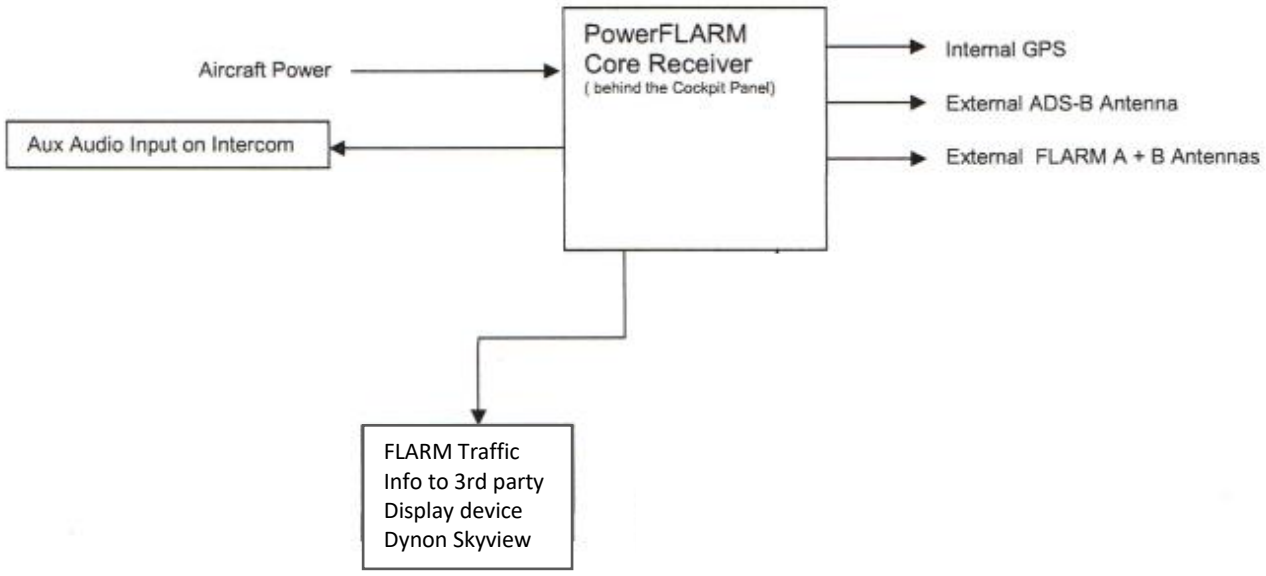
The PowerFLARM system uses a data communication frequency in the SRD860 band. This band is ruled tor European applications in the documents ERCIREC 70-03 annex I (f) and ERCIDECI (01)04. The band is free for any ground-ground applications and gets no official protection against external interferences. POWERFLARM 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 has granted this authorization for the FLARM/FLOICE/PowerFLARM application on the 23 March 2004. On the 29 May 2005 FOCA confirmed to BAKOM, that no Radio License will be required for FLARM/FLOICEJPowerFLARM.
The aircraft commander is solely responsible for ensuring that their use of PowerFLARM 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.

7.3 Electrical installation

This FLARM installation is electrically protected with a Circuit Breaker, which is provided with this installation to readily disconnect the PowerFLARM installation when required by Emergency or operational needs. The pilot must be confident with his electrical bus topology and the FLARM installation.

7.4 Personalized PowerFLARM System overview

Below a System overview installed in this aircraft. Detailed wiring interconnection 4410-00035-a-2 can be found in the aircraft maintenance records.


PowerFLARM
Core Receiver
(behind the Cockpit Panel)
Aircraft Power
Aux Audio Input on Intercom
Internal GPS
External ADS-B Antenna
External FLARM A + B Antennas
FLARM Traffic
Info to 3rd party
Display device
Dynon Skyview