



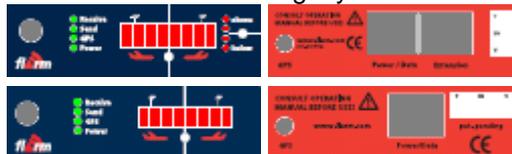
# INSTALLATION MANUAL FLARM COLLISION AVOIDANCE SYSTEM

Version 168 (December 18, 2016)

This manual only covers hardware version 3 resp.  
units with serial numbers F6●●●● / F7●●●● / F8●●●● / F9●●●●



For legacy units with serial numbers F4●●●● / F5●●●●  
Please also consult the legacy manual as well.



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## **1. Welcome to the FLARM user community**

Thank you for purchasing FLARM, a modern low-cost collision-warning unit for sailplanes and light aircraft. The main task for FLARM is to support the pilot, while he scans the airspace ahead with his own eyes. FLARM is simple to use and does not distract the pilot from the main business in hand.

 Sport flying is an activity that is associated with considerable risks for crew, passengers, third parties and other objects. **In order to make full and safe use of FLARM, it is absolutely essential to be fully aware of the risks, operating conditions, restrictions and limitations associated with the use of FLARM, ensure a proper installation and do regular firmware updates. This includes familiarity with and observance of the Operating Manual and the Installation Manual.** Additional configuration information can be found in the 'Data Port Specifications' document, e.g. how to suppress additional data at the serial port what might be required in international championships.

We always welcome suggestions for the improvement of FLARM.

The latest version of this handbook and other related documents can be found at the Website <http://shop.flarm.com>. This Website also has answers to Frequently Asked Questions. This Website also carries announcements when new firmware versions or functions are available.

 If you enter your name on the mailing list, you will automatically receive notification of changes as and when they happen: [www.flarm.com](http://www.flarm.com).

From the March 2015 update, every FLARM device needs to be updated with the latest firmware version at least once per year (rolling 365 days). Each update can be applied anytime during a one year period. This makes it easier to align FLARM firmware updates with the yearly aircraft maintenance process. It is also in line with the maintenance care that a safety system requires.

As the update cycle now becomes individual, no generic information will be sent out on individual firmware version expirations.

 **If the firmware update is not applied once per year, the device will no longer be operational and stop to operate!**

Use the free PC installation software (FlarmTool) available at [www.flarm.com](http://www.flarm.com). You need a PC with Windows 98 / ME / 2000 / XP / 7 with a serial port or a suited USB-serial converter plus a data-power cable like the one used for most IGC flight recorders. This cable connects the PC to FLARM and supplies FLARM with power. Ensure you have configured the correct PC COM-port, only use the Power/Data-port on FLARM (not the Extension-port) and know the printed device serial number. After completion of the firmware update, use the same PC software to load the most recent obstacle file to FLARM; this file is available on [www.flarm.com](http://www.flarm.com) as well. Then use the PC software to configure the flight recording functionality accordingly. In case of questions, contact your FLARM dealer.

## **2. How it works**

FLARM receives position and movement information from an internal 16 channel GPS receiver with an external antenna. An internal pressure sensor further enhances the accuracy of position measurements. The predicted flight path of a first aircraft - in which FLARM is installed - is calculated by FLARM and the information transmitted by radio, as a low power digital burst signal at one-second intervals. Provided they are within receiving range these signals are almost at the same time received by further aircraft also equipped with FLARM. The incoming signal is compared with the flight path calculated and predicted for the second aircraft. At the same time, FLARM compares the predicted flight path with known obstacle data, including electric power lines, radio masts and cable cars.

If FLARM determines the risk of dangerous proximity to one or more aircraft or obstacles, the unit gives the pilot warning of the greatest danger at that moment. The warning is given by a whistle sound (beep) and bright light emitting diodes (LED). The display also gives indication of the threat level, plus the horizontal and vertical bearing to the threat.

The operating range is very dependent upon the antenna installation in the aircraft. The typical range is 3 - 5 km. The effective range can easily be verified with an online tool<sup>1</sup>.

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<sup>1</sup> [www.flarm.com/support/analyze](http://www.flarm.com/support/analyze)

The GPS and collision coordinates of the other aircraft can also be made available for use in other systems (e.g. external display, speech synthesizer, PDA) via a serial data output. There are a number of manufacturers for such equipment.

In addition, FLARM operates as an IGC-file compatible flight recorder including the G-record. FLARM is optionally also available as diamond-level IGC-*approved* Flight Recorder, optionally with Engine Noise Level sensor (ENL).

FLARM applies for the radio communication between the units a proprietary and copyright-protected protocol in regionally different frequency bands. The radio communication is separately secured against unauthorized access. The design is protected by several patents. The radio communication protocol is not public, but FLARM Technology Ltd. offers a license contract where it is accessible in the form of a compatible core design ready for integration into 3<sup>rd</sup> party systems. These systems are officially declared as FLARM-compatible. Any non-licensed use, dissemination, copying, implementation, reverse engineering or decompilation of the FLARM radio communication protocol, the FLARM hardware and firmware or parts of it is forbidden by law and will be prosecuted. FLARM is an internationally registered trademark and can not be used without license. Technical specifications subject to change at any time without notice.



### **3. General Advice on Installation**

Installation and operation must be on the basis of non-interference with and no hazard to the existing suite of other certified equipment necessary for safe flying operation, or installed to comply with official requirements. Installation and operation must comply with official regulations and requirements. When FLARM is permanently installed in an aircraft in Switzerland, the installation must comply with the 'Installation Policy' published by the Swiss Civil Aviation Authority (FOCA). In Germany, an installation as portable device is possible in gliders and motor-gliders; if an installation in powered aircraft is considered, European Commission Regulation (EC) No 1702/2003 must be respected. Note that EASA has defined FLARM-type devices as standard devices for gliders and powered gliders<sup>2</sup>.

FLARM must be secured in such a position that the pilot has the display LEDs in direct view, and can hear the acoustic warning tone and operate the control buttons. FLARM must not obstruct the piloting operation (incl. emergency procedures, canopy-jettison and pilot bail-out) and in particular it must not hinder his field of view. These requirements must be maintained at all times during conditions of strong turbulence and acceleration. FLARM is not suited for use in conjunction with night vision systems, night flying (no dimmers) or in pressurised cabins.

Ideally, FLARM will be installed under the instrument panel on the central console or on the cockpit sidewall. If the internal display is used, then the rear face (cable connectors) of FLARM must face in the direction of flight. If FLARM is also equipped with an external display and operating unit, then it may be installed elsewhere and another orientation. Usually, such an installation requires an external radio antenna.

The installation must ensure that the internal radio antenna is properly and fully screwed down, standing free and unbent, i.e. that it does not touch other objects which might channel through electrostatic discharges on a regular base. As an example, the internal radio antenna must not have a permanent contact with the cockpit Plexiglas cover otherwise the radio transceiver in FLARM can be damaged. A missing or not fully screwed radio antenna prohibits a proper operation and cannot be detected by the system itself.

It is usually best to install FLARM in such a position that the power/data-socket and the microSD-card reader are easily reached from a PC with an extension cable. This simplifies downloading the latest obstacle data and firmware, and configuring the unit. When updating firmware, the user must know the unique FLARM unit serial number.

If possible, FLARM should be so installed that the pilot does not inadvertently touch the push-button during cockpit ingress and egress. If FLARM or components of it are connected to a part of the aircraft which must be dropped in case of emergency, predetermined breaking point must be created in order not to hinder the dropping.

Cables must not be bent or under stress. The installation must allow adequate space for cable connectors and the internal antenna. Power and data cables as well as cables to external displays and other devices must be shortened, i.e. they must not be coiled to avoid inductive effects. Only operate one FLARM per aircraft; however, many displays can be connected.

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<sup>2</sup> EASA decisions No 2006/13/R and 2006/14/R from Dec 20, 2006.

FLARM, the radio antenna (if the internal antenna is not used) and the GPS antenna should each be installed at least 25 cm away from the magnetic compass, more if possible.

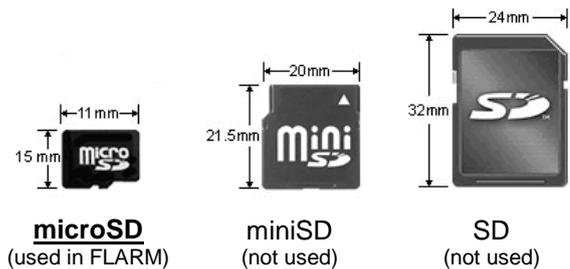
After installation, an appropriate entry should be made in the aircraft technical logs and a check made that the installation is in no way detrimental to the performance of mechanical, electrical or magnetic (e.g. compass) performance of other aircraft systems (e.g. radio). The unit serial number and firmware version should be recorded in the aircraft technical log. In the case of a permanent installation, the 'Means of Compliance' should be confirmed in the aircraft technical log, and an 'AFM Supplement' carried in the aircraft.

#### 4. Using the microSD card

FLARM has a built-in microSD card reader. The microSD card (also known as TransFlash) itself is not part of FLARM's delivery, but are widely used in mobile phones and available in most photo- and mobile phone stores. FLARM uses the cards for updating the firmware, updating the obstacle database, configuring the device and for downloading flight records, as a simple alternative to connecting the PC software.

*microSD* cards are smaller than *SD* cards or *miniSD* cards, but mechanical adapters exist to insert a microSD card in a *SD* or *miniSD* cards; these adapters are often provided with the cards.

Firmware versions 5 and higher handle micro SD cards of SDSC- and SDHC format with FAT16 and FAT32 file systems. Maximum size is 32GB (SDHC format).



#### Insertion and removal

Carefully **insert** the card upside-down (metal contacts on top), push with the finger until the card locks with a click sound. To **remove**, push the card with the finger into FLARM until it releases with a click sound, then carefully pull it out. No force should be required to insert or remove the card.



#### Updating the firmware

Download flight records before updating the firmware, otherwise data might be lost.

Firmware files for microSD card updates have the extension **.fw** and are available on the FLARM webpage ([www.flarm.com](http://www.flarm.com)). Copy the file to the top level directory, don't use sub-directories. Don't modify filenames. Delete files with the same extension. To start an update, insert the card into FLARM and interrupt power for at least 5 seconds. The update then takes about 50 seconds. The card may remain in the device after updating and during operation.

#### Updating the obstacle database

Download flight records before updating the obstacle database, otherwise data will be lost.

Obstacle database files for use with microSD and PC software have the extension **.ob2** and can be purchased on FLARM online shop (<http://shop.flarm.com>). Copy the file to the top level directory, don't use sub-directories. Don't modify filenames. Delete files with the same extension. To start an update, insert the card into FLARM and interrupt power for at least 5 seconds. The update then takes several minutes, depending on the size of the file; progress is shown on the display. The card may remain in the device after updating and during operation.

## Configuring the device

If at power up on the microSD card a file named `flarmcfg.txt` is detected, it will be processed as configuration commands. The file can be created with the FLARM Configurator:

<http://flarm.com/support/tools-software/>

Basic data entries and the SD-card configuration file can also be made with the free **FlarmTool** software.

For easy task declaration IGC-enabled units, use the free online-tool **FlarmCfg** (<http://www.segelflug-software.de/flarmcfg/>), using the microSD card.

The corresponding offline-version ([http://www.segelflug-software.de/prod\\_flarmcfgtool.php](http://www.segelflug-software.de/prod_flarmcfgtool.php)), the free PDA software tools **SeeYou ConnectMe** (<http://www.naviter.si/products/connectme.php>) or **pocket\*StrePla-Connect** ([http://www.strepla.de/StrePla4/english/pS\\_connect/](http://www.strepla.de/StrePla4/english/pS_connect/)), and many of the other, partially commercial products on the market.

## 5. Housing

The lower face of the polycarbonate housing has two threads, so that FLARM can easily be secured by two M5 screws (no more than 12 mm long); don't use an electric screw-driver for this! This thread is in widespread use. FLARM should be installed on a flat surface so that the housing is not subject to any mechanical stress. Alternatively, the unit may be secured by the housing upper face.

The housing can be repeatedly fitted and removed using the DualLock® supplied with the unit. The unit comes supplied with two self-adhesive 12.5x25 mm fixtures. Care should be taken to ensure that the bonding strength is very strong on both halves and difficult to detach.

The housing lower face also has two Phillips screws holding the two halves of the housing together. These screws must not be over-tightened. By opening the housing, all possible guarantees relating to the equipment become null and void. Never ever open the IGC-version.

The housing upper face is not sealed and care should be taken not to allow ingress of solid particles or liquids. Should the unit become humid, it must be thoroughly dried prior to use. Wet devices can be damaged permanently. Condensation may occur if the unit is subjected to sudden massive cooling. The housing should only be cleaned with a slightly moist non-abrasive cloth without any cleaning agents. The housing can be damaged by scratches and abrasion.

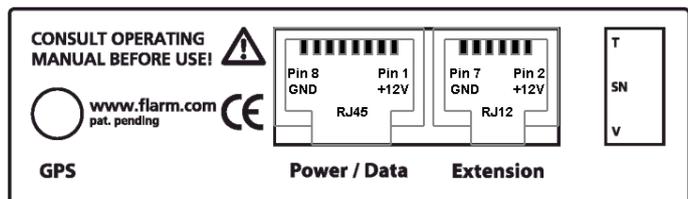
The plastic housing is black to minimise glare and has been tested at temperatures from -10 °C to +60 °C and should be protected from excessive direct or indirect solar heating. Even if not subject to mechanical stress, the housing may be deformed at temperatures upwards of +84 °C, and can also be deformed at lower temperatures in the presence of mechanical stress. The unit should not be exposed to strong locally focused solar radiation. Care should be taken when the cockpit canopy is open (lens effect fire hazard).

## 6. Sound Signal

The housing upper face has a number of holes to improve the transmission of sound from the internal emitter to the cockpit. These holes must remain unobstructed. There is no intercom connector. Third-party manufacturers have suitable intercom equipment that is compatible with FLARM.

## 7. Connectors

The red rear face has an MCX socket for an active GPS antenna, an RJ45 power/data socket and an RJ12 extension socket.



## 8. Power / Data

The eight-pin RJ45 power/data socket accepts an eight-pin connector (or provisionally also six-pin connector) which is locked in place. The pin connections are generally<sup>2</sup> in-line with those set out in IGC GNSS FR Specifications<sup>3</sup>, so that the same cables may be used both in the air and on the ground, as used for modern IGC compatible flight data recorders. The key to the connections is defined by the sequence from left to right, not the numbering<sup>4</sup>:

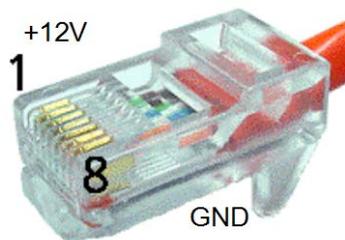
1. +8 to +26 VDC (recommended +12 VDC), linked with Pin 2 inside the unit
2. +8 to +26 VDC (recommended +12 VDC), linked with Pin 1 inside the unit
3. FLARM supplies +3 VDC
4. GND, with Pin 7 and 8 linked to the unit
5. Tx = FLARM transmits data (PC-side to SUB-D9 Pin 2)
6. Rx = FLARM receives data (PC-side to SUB-D9 Pin 3)
7. GND ('negative'), linked with Pin 8 inside the unit (PC-side to SUB-D9 Pin 5)
8. GND ('negative'), linked with Pin 7 inside the unit

During flight operations at least Pins 2 and 7 must be connected. An 8-pole (or if necessary 6-pole) ribbon cable with an RJ45 push-fit connector, or an 8-pole twisted-pair patch cable with RJ45 adapter, are equally suitable. A suitable patch cable open at one end is supplied with FLARM unit<sup>5</sup> and must be configured to the aircraft connector in the aircraft. When using an 8-pole cable, Pins 1=2 must be joined. Likewise Pins 7=8. If the remaining wires are not used, they must be individually insulated and must not be soldered or twisted together -- not even in pairs.

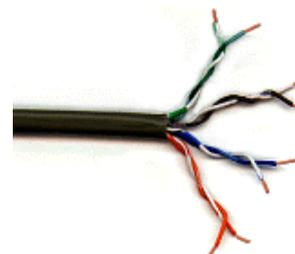
There must be a direct electrical connection between FLARM and the aircraft battery. This connection *must* be via a 500 mA fuse. Essential electrically-operated flight instruments must not draw their power through FLARM fuse. It must be possible for the pilot to interrupt the power supply to FLARM during flight by means of a switch or circuit breaker without affecting other essential aircraft systems. This might be necessary if the pilot suspects that FLARM may be interfering with another on-board system, the suspected presence of smoke, the smell of smoke, or flying in a country where the use of FLARM is not permitted.



In spite of reverse polarity protection, it is important to check for correct polarity during installation; in particular the power supply and data wires must not be interchanged. The transparent connector allows for a visual check of the cable colour codes, ensuring that the open end of the cable is correctly configured. When using patch cables, neighbouring wires on Pins Pin 1/2, 3/4, 5/6 and 7/8 are *usually* (but not always) twisted together. Neighbouring wires *usually* have the same colour, though one of the pair has a colour alternating with white.



Connector with pin numbers, tab down



Open ended patch cable

In normal configuration Pin 5 transmits the most important NMEA-0183 version 2.0 compatible GPGGA, GPRMC and GPGSA sentences at a configurable data rate in addition to Garmin proprietary PGRMZ sentences with barometric altitude information. Further codes are provided for third party applications (e.g. external displays). Details about sentences and configurations are described in the document 'FLARM Data Port Specifications'. To configure, you can also use the PC application or the microSD card.

After switching on and the self-test routine, the unit must first capture satellite signals to establish position. Even if the antenna has a clear view of the sky, this process can take up to few minutes. For this reason a glider tow / tug pilot should leave FLARM switched on during brief waiting periods between flights or the installations should have a separate wiring and circuit breaker; ensure the aircraft type configuration in FLARM is set appropriately for tug / tow planes, otherwise the warning priority might be compromised.

**Ensure that the device has the correct aircraft type configured; available options are tug plane, helicopter, powered plan and glider.** Use the PC-software for this.

<sup>3</sup> Chapter 2.7.2.2.7.2, www.fai.org/gliding/gnss/tech\_spec\_gnss.pdf

<sup>4</sup> FLARM uses pin numbering in-line with IGC specifications. The numbering is in reverse order.

<sup>5</sup> In the case of the cables bearing the legend BLACK BOX on cable and connector, the connections are *usually* as follows: **GND = orange / orange-white, +12V = brown / white-brown**. It is necessary to check the polarity prior to connection. When supplying two or more units, only one single cable will be supplied, to be cut in half.

The installation must be such that FLARM can be switched off during night flights because the display's brightness.

Only the power/data socket to the unit may be used for updating FLARM firmware or obstacle data from the PC. During this process FLARM must be disconnected from other equipment.

Only one single other device must be connected to the data port. Connecting multiple devices to one single port might damage the hardware and voids warranty.

## **9. Extension**

Six-pin (or provisionally also four-pin) connectors may be inserted in the 6-pole RJ12 socket. The connections to the pins are the same as for Pins 2 and 7 described above. This socket is intended for use by *one* third party application (e.g. for *one* external display via an uncrossed cable) and is regulated by a constant 4.8 kBaud data rate. This socket must neither be used for power supply nor for PC-communication (update, download, configuration). Only *one* single other device must be connected to the extension port. Connecting multiple devices to one single port might damage the hardware and voids warranty; the same restriction applies to the Power / Data connector .



## **10. GPS**

The external GPS antenna supplied with the unit must be connected; FLARM will not operate without an adequate GPS signal. The cable length of the 50Ω RG-174U cable with MCX connector is about 2.5 m; cables of other length are not available from FLARM Technology. A specialist must undertake any shortening of the cable, which must never be cut to less than 0.5 m. Antenna splitters must not be used.

The antenna should be horizontal in straight flight and have a generally unobstructed view of the sky, including during turns. The antenna should not have any electrically conducting surfaces (e.g. metal, carbon fibre) above or immediately *alongside*. Ideally, the antenna will be located on top of the instrument panel. Electrically conducting sheet metal under the antenna may enhance its performance. Do not mount the antenna below or inside the instrument panel.

The antenna base contains magnets, but nevertheless requires additional attachments. The antenna must under no circumstances interfere with correct compass operation. If the antenna interferes with the compass, the magnets in the antenna base must be removed with a screwdriver and the metallic foil put back. The antenna does not work without the metallic foil.

If the aircraft is fitted with two or more GPS antennae, they should be separated if possible by at least 25 cm; the same holds good for FLARM radio antennae.



## **11. Radio Antenna**

The middle of the housing upper face has an aperture onto which is screwed an 86 mm long internal  $\lambda/4$  radio antenna onto a conventional SMA connector. The antenna must be fitted and removed with care. This antenna is required for operation of FLARM, and the correct installation has a considerable effect upon range for transmitter/receiver range, so the installation must be carefully considered. The antenna must be vertical, allowing generally unobstructed radiation to the front and sides. Do not mount the antenna below or inside the instrument panel. It is theoretically possible to use an inverted installation, but only when making exclusive use of an external display. Horizontal or inclined installation is not acceptable. In particular, there should be no electrically conducting surfaces (metal, carbon fibre) above or immediately alongside the antenna. The antenna must not be under stress or bent, e.g. by the cockpit canopy). When using FLARM in an environment with known static discharges we recommend applying a black heat shrink tube around the full length of the RF-antenna to protect the sensitive receiver.

FLARM Technology can supply alternative external dipole antennas with 1.0m and 2.5m feed cables, dedicated 12mm adapters, antennas for external installation and antenna extension cables (50Ω RG-174U on conventional SMA). No antennae or cables may be used other than those listed above. An external antenna must be adequately earthed to the airframe. Installation may only be in a Zone 2A or 3 as described in DO-160/F Section 23.



## 12. Limitations

FLARM is designed and built as a non-essential 'situation awareness only' unit to only support the pilot, and cannot always provide reliable warnings. In particular, FLARM does not give any guidance on avoiding action. Under no circumstances should a pilot or crewmember adopt different tactics or deviate from the normal principles of safe airmanship. Even with FLARM installed, you remain responsible for flying the aircraft and ensure the safety of passengers and other traffic. The use of FLARM is solely at the discretion of the commander and his crew. Operation must be preceded by thorough familiarisation by the commander or his delegated crewmember with the Operating Manual.

FLARM can only warn the pilot of the presence of other aircraft that are also fitted with FLARM or compatible equipment, or warn of obstacles that are stored in the internal data bank. FLARM does *not* communicate with Mode A/C/S transponders, and remains undetected by ACAS/TCAS/TPAS or Air Traffic Control systems. Likewise, FLARM does not communicate with TIS-B, FIS-B or ADS-B.

FLARM has not been certified in line with the usual aviation procedures, however tests in line with DO-160/F on high/low ops temperature, high/low ground survive temperature, pressure altitude, magnetic effects, emission of radio frequency energy, electrostatic discharge and flammability have been conducted. The FLARM firmware development is in-line with typical methods applied for industrial electronics. The FLARM obstacle data bank is not certified.

Air band radio frequency allocation and licensing conditions may vary from country to country. The aircraft commander is solely responsible for ensuring that FLARM is operated in conformity with the respective licensing conditions. No licence is required to operate FLARM in Switzerland.

FLARM Technology its associates, development team, suppliers, manufacturers and data suppliers accept no responsibility for any damage or claims that may arise from use of FLARM.

## 13. Technical Data

The following data are provided without guarantee and are subject to change at any time without notice. The warranty period end at latest 6 months after the purchase, but with immediate effect in the case of the following cases: any opening of the box, inappropriate operations or installation (see the restrictions in the Operating and Installation Manual) and intellectual property violations.

Height:	<i>25 mm housing (without internal radio antenna) 100 mm overall height (with internal radio antenna)</i>
Width:	<i>75 mm</i>
Length:	<i>111 mm housing (without cable connectors) 119 mm overall length (with push-buttons, without cable connectors, without IGC/ENL)</i>
Weight:	<i>125 g (with internal radio antenna, without cable, without GPS antenna)</i>
Power supply:	<i>external power supply 8.0 to 26.0 (peak voltage up to 28.0) V DC via RJ45, recommended value 12 V DC, direct galvanic link to aircraft battery via an essential 500 mA circuit breaker; this must be separate from other essential aircraft power systems FLARM has reverse polarity protection.</i>
Power drain:	<i>typically approx. 55 mA at 12 V DC, approx. 37 mA at 24 V DC (Normal operation without warnings or external display), a collision warning may double these values.</i>
Serial Data:	<i>bi-directional RS232, compatible with NMEA-0183 version 2.0, standard message format GPRMC, GPGGA, GPGSA, data rate 4.8 to 57.6 kBaud, additional NMEA proprietary sentences PFLA and PGRMZ (described in a separate document)</i>
GPS:	<i>16-Channel WAAS/EGNOS compatible GPS engine, external 50Ω active antenna with 2.5m RG-174U cable, MCX connector, 3.3V</i>
Radio:	<i>GPS-controlled automated frequency tuning, currently in following frequency bands: Europe/Africa SRD-F 868.0 - 868.6 MHz (frequency hopping), NZ 869.25 MHz, Australia 915 - 928 MHz (frequency hopping), USA 905 - 925 MHz (frequency hopping); less than 1 % Duty Cycle, Peak Pulse Power 10 mW (ERP), internal λ/4 antenna (screw-fitted to conventional SMA connector), Range typ. 3 - 5 km, depending upon antenna and installation</i>
Temperature:	<i>Operation: -10 to +60 °C, storage: -20 to +70 °C</i>
Intercom:	<i>not provided, suitable third party units are available</i>
Vibration:	<i>Use in conditions of strong vibration or turbulence should be avoided or subsequently checked prior to continued operation</i>
Country of Origin:	<i>Switzerland, Harmonized System Customs Code 852610</i>



### DECLARATION OF CONFORMITY

FLARM Technology Ltd., Haldenstrasse 1, CH-6340 Baar, declares that in typical configuration the 'FLARM Anti-Collision Warning Unit' hardware versions 1 to 3 meet the requirements of the CE Mark.

The radio conforms with the requirements of EN 300 220-3:2000 (Power Class 9). The EMC conforms with EN 301 489-3:2002-08 for a Class 3 SRD Device (equipment type I). The necessary tests and certification were undertaken by Ascom Systec AG (now ADAXYS SA), Hombrechtikon, Switzerland.

The units comply with the European R&TTE Directive. These documents may be inspected at the premises of FLARM Technology by arrangement through: info@flarm.com