PowerFLARM Portable Manual Version 25

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Introduction

A PowerFLARM™ device gets its position and movement information from an internal GPS receiver. The device calculates the predicted future flight path and transmits this information as a short, low-power digital signal burst up to twice per second together with a unique identification code. At the same time, the device receives similar signals from FLARM devices installed in other aircraft and within radio range, as well as from aircraft equipped with ADS-B Out (1090ES) or Mode-C/S transponders (if interrogated by ground radar or TCAS). The device compares the signals received with its own projected flight path. As an optional feature, the device can compare its own projected flight path with the positions of known fixed obstacles (e.g. cables, aerials, cable railways, avalanche detonation sites) held in the device's obstacle data base (license required).

If the device determines a conflict with another aircraft or obstacle, it warns the pilots of the most dangerous threat as per the internal calculation. Aural and visual warnings are issued. These signals indicate the time to impact, the direction from which it has been detected, and the altitude difference. For e.g. gliders during thermalling, a different calculation algorithm is applied from that used for powered aircraft in level flight. The GPS and collision threat data are also fed to the serial data port for use by other devices such as an external display and PDA. FLARM Compatible displays are available from several suppliers.

Warnings are issued based on the time to impact—not the geometric distance between the aircraft. The first warning is typically issued around 18 seconds prior to the calculated collision with aircraft or obstacle; the second is issued around 12 seconds before, and the third around 8 seconds in advance. Warnings are sustained as long as the threat remains relevant. Depending upon updated data and prediction calculations, the threat may be downgraded or deleted. Warnings are selective, i.e. they are only issued if the algorithms detect a high probability of a dangerous convergence in the immediate future.

PowerFLARM also warns about obstacles on the ground (cables, masts) if the respective database is installed. Databases are available for purchase on https://flarm.com/shop/.

Communications between PowerFLARM/FLARM devices employ a proprietary, copyright protected protocol in different frequency bands allocated by region. Effective range depends upon the position in which the device and antennas are fitted.

The communications system between devices is protected against unauthorised access. The design is patent protected. There is no public access to the protocol. Any unlicensed use, copying, distribution, conversion, replication, de-compiling, reverse engineering, or further transmission of knowledge so acquired relating to the system components or software, in whole or in part, is forbidden and will result in legal enforcement action. Technical data may be changed at any time and without prior warning. Some named functions are not provided in all versions of the device but may be provided at extra cost or for a recurring fee.

Installation

General Advice on Installation

Installation and operation is on a non-interference and non-hazard basis, and may not be allowed to endanger the safe operation of certificated equipment that is either necessary or required by regulation for safe flight. Installation must comply with official requirements.

The device must be so secured that the pilot can see the displays, hear the acoustic warnings, and operate the turning-button. The device must not obstruct the pilot in his operation of the aircraft (including emergencies); in particular at all times it must not obstruct his view of the sky, even in the event of serious vibration or acceleration. The device is not suitable for use in conjunction with night vision equipment or for night flying.

Ideally, the device will be fitted to the instrument panel glare-shield or cockpit sidewall. If the device internal display is in use, the rear face of the device with cable connectors must face the direction of flight. If the device is coupled to an external display with controls, it can be installed in another position or point in a different direction. Usually, this will require the use of separate communications and GPS aerials.

No antenna may be in contact with any object which might be the source of electrostatic discharge. Stub and whip antennas must not touch any object, e.g. the cockpit windscreen. The device will not operate properly in the absence of an antenna or if the antenna is not properly screwed tight; the device cannot self-test for correct antenna function.

For updates, configuration, and flight data evaluation it is helpful if the device is installed such that the data connectors and the microSD-reader are easily accessible or reachable with an extension cable. The serial number must be known for software updates.

It is advisable that the device is so fitted to the aircraft that the turn-button cannot be inadvertently pressed during entry to or egress from the aircraft. Should the device or any associated components be fitted to a part of the aircraft that will be jettisoned in an emergency, suitable break points should be incorporated to prevent any interference with the jettison sequence.

Cables must not be folded or placed under tension. Adequate space must be left for the cable connectors. Cables for data and external devices must be shortened as necessary: to prevent the occurrence of inductive effects they may not be coiled. Only a single device may be installed in each aircraft.

The device and any associated aerials should be located as far away as possible -- at least 30 cm (1 ft) -- away from any other GPS aerial and the magnetic compass.

After installation, an inspection must be made to ensure that the device does not interfere with any mechanical, electrical, electronic (radio) or magnetic (e.g. compass) system, and this fact must be recorded in the aircraft documents. In addition, the aircraft documents must bear a record of serial number and Software Version Number. If employed in a fixed installation, the Means of Compliance must be recorded in the aircraft documentation, and an AFM Supplement is to be carried on board the aircraft. The user must ensure that installation and operation comply with all applicable law in the usage location's jurisdiction.

In case of questions or problems, please contact your dealer directly.

Housing

The lower face of the polycarbonate housing has two threaded screw holes, so that the device may be easily secured using two metric M4 screws (max. 10 mm long). The device must be fitted to a flat surface and the housing not subjected to any mechanical stress. Several types of adapter fixtures are available.

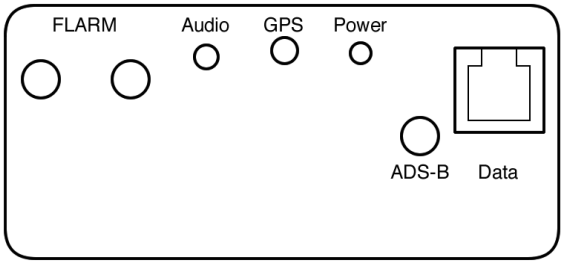
The housing can also be secured using 3M DualLock industrial fasteners, which can be secured and released several times. Users should note that the adhesive used on 3M DualLock is exceptionally strong and may not easily release. The adhesive tape should not cover the battery compartment lid but should be applied elsewhere on the housing.

The housing is not air or watertight and users should avoid the ingress of solid particles and liquids. Should the device get moist, it must be completely dried prior to further use. If the device becomes wet, it may be permanently damaged and rendered unusable; no guarantee claim will be accepted for any device damaged by moisture. Should the device be suddenly cooled this may result in the formation of internal condensation. The housing may only be cleaned using a slightly moist non-abrasive cloth without a chemical cleaning agent. The housing does not resist scratches or abrasion.

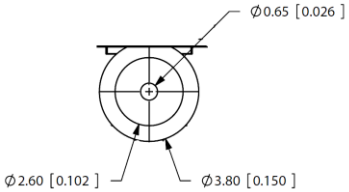
The plastic housing is black to reduce glare and has been tested in the temperature range -10 °C to +60°C. Care should be taken to avoid over-heating due to direct or indirect sunshine, in particular because the housing can become deformed at temperatures above +84 °C without any mechanical tension, and with mechanical tensions also at lower temperatures. The device must not be locally over-heated by exposure to focused sunrays, and care is required when cockpit doors or canopies have been opened (risk of fire to due lens effect). High temperatures significantly reduce battery runtime when rechargeable batteries are used.

Connections

Overview



Power Connector



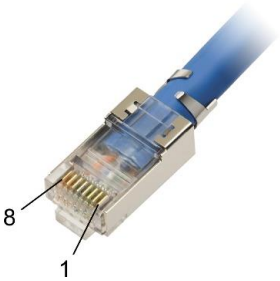
Supplied power must be 12 V DC nominal at 500mA (between 8V and 23V DC).

This power socket mates with a PP-012 connector (DigiKey part# CP-012-ND, Radio Shack Adaptaplug Tip „A“ 273-334). VDC(+) is on the inside, GND outside. A minimum of 12V is needed to charge the batteries (Radio Shack AC-DC Power Adapter 273-357)

Ensure any external power source is only connected in case no or only rechargeable batteries are in the device. External power might damage non-rechargeable batteries (risk of leakage).

Power and Data Port Connector (IGC standard)

The 8-pin RJ45-socket (8P8C) is in accordance with IGC GNSS FR specifications, except for pin 6.



1: GND
2: GND
3: RX, Portable receives (RS-232)
4: TX, Portable sends (RS-232)
5: GND
6: Portable supplies +3 V DC for display
7: +12 to +23 V DC power supply
8: +12 to +23 V DC power supply

Note: The pin numbering above follows international standard. The pin numbering in IGC documentation and early PowerFLARM manuals was reversed; however, the actual pin assignment is the same as in the older manuals. The pin numbering in different display documentation is mixed. See the picture above for correct pin assignments.

Do not connect more than one external application to the RJ45 port.

Do not use 6 or 4 pin RJ-12/11 connectors as it will cause permanent damage to the socket.

The (typically transparent) plug must be examined to determine the cable colour coding so the open cable end may be correctly configured. On patch cables the neighbouring wires of Pins 1/2, 3/4, 5/6 and 7/8 are usually twisted together. Neighbouring wires are usually of the same colour, though one of the two colours alternates with white.

On Pin 5, PowerFLARM can transmit a combination of GPS, traffic and alarm information to various types of devices (e.g., external display, flight computer, logger). The type of data output and the communication parameters (Baud rate) can be configured from the Menu or by commands on the Data Port itself.

PowerFLARM implements versions 3, 4, 6, 7, 8, and 9 of the Data Port specification with GPS/FLARM proprietary NMEA0183 or GARMIN®-TIS data. The connected display can select the protocol version it requires.

If you connect a display to the Data Port, make sure that the installation conforms to the requirements set forth in the Data Port Specification.

Do not connect more than one display at the same time.

Audio

The audio signal is a standard de-coupled aviation signal of no more than 1 V. The connector is a standard 3.5 mm jack plug.

Availability of the audio signal is subject to purchase and installation of the AUD feature license. Audio signal is not available while operating on batteries.

Communications Antennas

The primary communications antenna for the FLARM/PowerFLARM device communication must be connected to the socket labelled 'FLARM A'.

For proper operation of devices with PCAS/ADS-B receiver, the included ADS-B antenna (blue label) must be carefully and tightly screwed to the socket labelled 'ADS-B'.

Make sure the FLARM antenna and the ADS-B antenna (blue band) are not accidentally swapped!

The installation has a great influence upon both transmission and the reception range achieved, and thus requires careful consideration. The antennas must be vertical to ensure unimpeded emission especially to the front, and to the sides. Users are advised not to install the device within or under the instrument panel without external antennas. Horizontal or non-upright antenna presentation is unacceptable. No electrically conducting surfaces (e.g. metal, carbon fibre) should be located over or immediately alongside the antennas. The antennas must not be subjected to physical pressure and may not be bent. Ensure the antenna does not touch the cockpit windscreen.

If a second flat FLARM/PowerFLARM device communications antenna with the extension cable (used for reception of FLARM/PowerFLARM device signals only) is used, it should be connected to socket labelled 'FLARM B'; ensure it is located at least 0.6 meters (2 ft) from the device.

Alternative offset antennas, external antennas and antenna extension cables (50Ω on normal SMA) can be obtained from retailers. The installation must be within a Zone 2A or 3 as defined by DO-160/F Section 23.

GPS-System

The GPS system in the device is subject to the limitations found in typical GPS applications. It is not aviation certified.

The device will not work without adequate GPS reception.

The device can be operated using both the GPS antenna within the housing and with an external GPS antenna (not supplied) connected to the MCX socket. Connecting an external antenna automatically deactivates the internal antenna.

Operation with an internal GPS Antenna

When operating with the internal GPS antenna, the device presentation must be unhindered to the sky ahead and sides. Further, the upper side of the device must not be covered.

Operation with an external GPS Antenna

The antenna should be located in an upright position such that it has an unhindered presentation to the sky, including when the aircraft is in a turn. There should be no electrically conducting surfaces (e.g. metal, carbon fibre) over or immediately alongside the antenna. Ideally, the antenna will sit atop the instrument panel coaming. Conducting surfaces under the antenna may have a positive effect upon antenna function. If more than one GPS antenna is present, it is recommended that they are at least 25 cm (1 ft) apart; the same holds good for separation from the PowerFLARM device communications antenna.

FLARM-Device Communication

The FLARM/PowerFLARM device radio communication is made using a license free frequency band known as ISM/SRD band. This means that the band is also used by other applications all of which must meet the same restrictions in transmission power, duty cycle, etc.). The device has no exclusive rights to use this frequency band, so there is no guarantee that reception will be free from interference by other users. Nevertheless, due to the low power nature of the devices in the frequency band and a sophisticated use of the transmission channel, interference is unlikely.

The use of unlicensed bands by aircraft is subject to a number of limitations, with some national differences. The pilot and user of the device are solely responsible for ensuring that the device is used in accordance with the current local regulations.

Essentially, the FLARM/PowerFLARM device communications protocol places no limit on the number of devices that may be contacted within the working range. However, a high number of devices within range leads to a reduction in the probability ('graceful degradation'), that a single signal report can be received. But the probability that the next signal from the same transmitter will not be received is generally small. The device is designed to simultaneously receive and process the signals from more than 50 aircraft within radio range. A large number of signals from other aircraft does not reduce the working range.

Audio

To make sure that an acoustic warning can be heard above loud ambient noise, the signal may be fed the Pilot's headset. To this end, there is a 3.5 mm socket for a jack plug on the rear side of the device.

The preferred way of installation is to connect the jack to an AUX or similar input of an Intercom or Audio Panel. Upon installation, make sure that your audio equipment correctly mixes the PowerFLARM audio signal with other audio sources in the cockpit (Radio, NAV, other headset microphones). Make sure that Audio

Out is set to ‘ON’ in the menu. PowerFLARM will beep on the buzzer and audio out on volume adjustment.

Depending on the audio equipment/headset, the audio out signal may be very loud could and damage a human ear. Upon installation, carefully adjust the volume to a comfortable level.

The device also has an integrated warning beeper. The housing front face has an outlet to improve sound release from the internal bleeper. This outlet must not be obstructed by any adhesive agent.

When set at high volume, the bleeper sound level could damage a human ear at close distance. The volume is adjustable.

Micro SD-Card

The device has a built-in microSD card reader, also compatible with microSDHC. The microSD card (also known as TransFlash) is not supplied but is in widespread use for mobile telephones and can be purchased from most camera or mobile phone retailers. The device uses the microSD card to update the software, optional obstacle data, to configure the device and download the flight logs.

microSD cards are smaller than SD cards or miniSD cards. However, for communication with a PC there are mechanical adapters for insertion of a microSD card in SD or a miniSD card. Such adapters are often sold together with the cards.

Note that the microSD card must be formatted to FAT16 or FAT32 system. If your card is not yet preformatted to one of these two formats, do so with your PC; the device does not format cards. Maximum size is 32GB (SDHC format).

Insertion and Removal

Hold the card with the metal contacts on the right and insert carefully into the slot; then, gently press with the fingertip until the card is retained with a slight 'click'. To remove the card, press the card gently into the device's SD-reader slot until a slight click releases the card, which can then be gently withdrawn. Do not use force.

Power Supply

The device can be operated using the aircraft's own electrical power system, disposable or rechargeable batteries.

Power Supply using the Aircraft's own Electrical Power System

If the device draws its electrical power through the Power/Data socket, there must be a direct galvanic link between the device and aircraft battery via a 1-3 A circuit breaker. This power supply must be separate from any other instruments that are essential for the safe conduct of the flight. In flight the pilot must be able to isolate the device from the aircraft's electrical power system without interrupting the power supply to any other important systems. Possible reasons might be a suspected fault in other on-board systems, the presence of smoke, the smell of smoke, or flying over a country where the operation of the device is not approved.

In spite of the integral electrical polarity guard, it is important not to confuse the power supply with the data cable. Ensure no non-rechargeable batteries are inserted in the unit.

Power Supply Using Batteries or Rechargeable Batteries

The device can be operated using different types of batteries or rechargeable batteries. The device requires six AA cells or compatible products:

- Nickel Metal hydride (NiMh) rechargeable batteries
- exceptionally also Alkaline batteries
  (Alkaline Manganese Cells)

The device should not be operated in conjunction with any other types of battery; other types may damage the device.

The battery type must be set under the settings menu. Never use disposable batteries when the battery type is set to “rechargeable”.

Battery endurance depends upon the type of battery, the temperature, the incidence of traffic and display brightness.

The battery life remaining is indicated above the battery symbol on the right upper corner of the traffic display.

Battery Insertion

The device has a battery compartment on the lower face and holds six AA batteries. The batteries are inserted by removing the compartment lid. It is essential to ensure that the batteries are inserted with the correct polarity, with no excessive application of force on the battery compartment lid.

Rechargeable internal Batteries

The device features an internal NiMH battery charger only active when the device is turned off. When the device is turned off and electrically connected to the vehicle or aircraft battery (either via "Power" socket or power pins on the RJ45 socket), inserted batteries will be charged if the ambient temperature lies within the allowed range for charging NiMH batteries.

If non-rechargeable batteries are fitted to the device, never connect your device to an external power source (e.g. aircraft or vehicle battery)!

The internal batteries may only be charged if the device is resting on a non-flammable, dry base. When the device is being recharged, never allow it to remain unsupervised.

The integrated charging circuit will only charge batteries at an ambient temperature of up to about 40 °C (104 °F). If possible, charge your batteries in a cool, dry environment.

Technical Data

Dimensions:

- Length: 94mm
- Width: 96mm
- Height: 46mm

User Interface:

- Integral turn/push button
- 2” transflective LCD display

Audio:

- Built-in warning beeper
- Output for Headset Audio
- Volume control

Communication:

- Internal RS232 NMEA0183 or GARMIN®-TIS
- Data output for Moving-Map units and external displays (only one user at a time!)
- internal 3V power supply for remote displays (max. 200mA @ 3V)

Sensors and GPS:

- Pressure sensor
- Microphone
- 50-channel GPS receiver with internal or external antenna

FLARM device communication:

- Dual 868-930MHz FLARM device transceiver

ADS-B-IN/XPDR:

- 1090 MHz receiver for XPDR Mode-C/S and ADS-B 1090ES signals

Antennas:

- Two 868-930MHz FLARM antennas (red marking): FLARM A (send/receive), FLARM B (receive only)
- ADS-B antenna (blue marking; receive only; non-``Pure'' devices)
- Integrated GPS antenna under top of housing
- Optional: External GPS antenna (MCX socket)

Memory:

- microSD card slot
- Software-update via SD card

Fixtures:

- Two threaded holes for M4 screws
- Adapter plates and holders (optional)

Display:

- New generation sunlight-readable Matrix TFT display
- Resolution 132 x 176 pixels
- 2-inch diagonal screen

Operation:

- Integral push/turn button
- Zoom and settings

Power:

- 12 V DC nominal (8-23V DC) external
- 6 removable rechargeable AA batteries (exceptionally also non-rechargeable
- Up to 7.5h battery runtime (depending upon traffic, temperature, and type of battery)

Operation

General Advice on Operation

Use

The PowerFLARM device is designed for use in non-essential conditions as a 'situation awareness only' device, only to support and assist the pilot. It cannot always be relied upon to provide a warning of collision threat. When using the device, under no circumstances should the aircrew adopt any change in flight tactics or modify the actions of the user or aircraft commander. Even though you have installed such a device, you remain personally responsible for the safe conduct of the flight, the safety of your passengers and other aircraft in the vicinity. Users do so entirely upon their own responsibility and that of the aircraft commander. The PowerFLARM device may only be operated by persons who are thoroughly familiar with the user instructions.

Compatibility

The device's warnings of the presence of other moving aircraft can only be given if the latter is also equipped either with a FLARM or other compatible device, or a compatible SSR-reply system (Transponder Mode-C/S). The device does not communicate actively with Mode A/C/S transponders and is thus not detected by ACAS/TCAS/PCAS or terrestrial air traffic control. Transponder signals are only received in presence of ground radar or TCAS interrogation.

Radio Range and Reception

If a warning is to be issued, compatible equipment must be located within range. This range is greatly dependent upon the type and position of the communications antenna installation on the aircraft, also the spatial relationship of the two aircraft to each other.

FLARM device signals between two aircraft are only possible in a line of sight; there can be no signal between two aircraft on opposite sides of the same mountain.

Position Determination

To operate correctly the device must be constantly aware of its own current position, for which reason it will only operate if there is good, three-dimensional GPS reception. GPS reception is greatly influenced by the correct installation and position of the GPS antenna and aircraft attitude. It also requires that the US GPS system is in full and unrestricted use. Especially when flying in a turn, close to hills or mountainsides, in areas where reception is known to be unreliable, or if the antenna installation is poor, the GPS signal quality may be degraded; this also causes rapid deterioration of height calculation. The device operates correctly again when the GPS signal quality is restored.

The movements registered by a GPS relate to a fixed system of terrestrial coordinates. When the wind is strong, the aircraft heading deviates from Track over Ground, and this has an effect upon the collision threat calculated. If the wind speed is one third of True Airspeed (TAS) and the aircraft heading is at 90° to the wind and with no drift, then the display has an error of e.g. 18°. If the wind is very strong the Track over Ground can deviate as much as 180° from the Heading. If the aircraft is circling, the calculation and thus collision warning threat are unusable.

In the event of poor GPS reception, for aircraft at close distance and at similar heights, the angle offset from the vertical is imprecise and irregular.

Flight Path Calculation

The device calculates its own predicted flight path for about the next 20 seconds. The prognosis is based upon immediate past and current vectors, plus a movement model that has been optimised for the respective user. This prognosis incorporates a number of errors that increase with the duration predicted. There is no guarantee that the aircraft will fly along the projected flight path. For this reason, a prediction may not be accurate in every case. In

light aircraft, flight path predictions of more than half a minute are unusable.

Data Protection

The transmitter has no influence on what a receiver does with the data received. It is possible that this data might be logged by other airborne or ground stations and then used for other purposes. In many instances this could be to the user's advantage (e.g. automated flight log, flight tracking, and last position recovery): The data could also be used as evidence against the aircraft's airspace or height violations or collision avoidance actions. With each signal the device transmits a unique identification code relating to the aircraft or pilot.

Limitations

The use of the device is strictly limited to flights in VMC (Visual Meteorological Conditions). The device may not be used for navigation or during aerobatics. If used in a pressurized cabin, the aircraft must be equipped with a Mode-S transponder.

Certification

The device has not undergone the conventional aeronautical certification process. The software development is conducted in accordance with the usual standards and procedures required for industrial electronics products.

Transport and Storage

Store and transport the device without the batteries to avoid the device powering-on or the batteries leaking. Protect the display. Store the device in a dry and cool but not cold place.

Further Questions or Problems

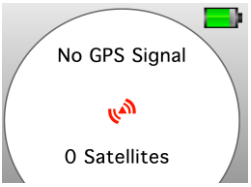
In case of questions or problems, please contact your dealer directly.

Start-Up

To switch on the device, the operating button must be pressed for at least three seconds.

A start-up display then appears.

If the disclaimer screen is not acknowledged by pressing the button within 5 minutes, the device switches off automatically to conserve battery.



After acknowledging the disclaimer, the displays how many GPS satellites have been found. As soon as GPS reception is sufficient to give a worthwhile determination of position, the device then switches to normal operation.

Fault Reporting and other Information

During normal operation the display advises the user on operational conditions. In addition, the device has a self-test function. Should it detect a fault, the device will display a fault report. Several types of reports might be displayed:

Serious Fault: Operation may not continue.

Caution / Fault: A fault has occurred and/or extra care is required.

Information: Simple information report, no fault.

Operation

The device is operated using the integral turn-button with push function.

Turn/push-button

The following table gives a brief overview of the most important push-button combinations.

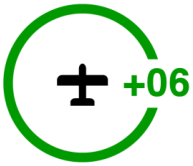
Brief push on button	Select / Enter
Longer push on button	Open/Close menu
Very long push on button	Switch On/Off
Turn button	Choose zoom depth, or select object in menu

Normal Operation

In normal operation the device shows signals received from other FLARM-device- or ADS-B-OUT 1090ES targets on a radar-like display. The user can select different zoom levels by turning the button.

The large aircraft symbol always indicates the nearest aircraft and its relative track. Above the arrow (or below if the nearest aircraft is below), the relative height in steps of 100 ft and a small arrow showing climb/descent information is given. For example: 300ft higher, flying from left to right descending.

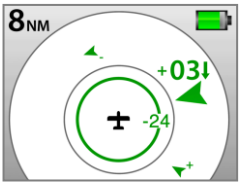
The small aircraft symbol gives the flight direction for distant aircraft. The sign indicates the relative position above or below you.



Dark green, orange or red circle: the circle show the approximate distance of the nearest aircraft not equipped with ADS-B-OUT or FLARM devices, i.e. aircraft with only Mode-C/S transponders and nearby interrogation. The height information is given in 100 ft steps and the circle symbolises the distance. (Example: 600ft above)

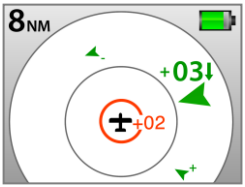
The distance to Mode C/S targets is estimated based on received signal strength and may be inaccurate. Do not rely on a Mode-C/S target being at the exact distance indicated. Always maintain lookout.

Sometimes, Mode A squawks are used which can be interpreted as a Mode C altitude reply. In this case, a Mode C target with incorrect altitude may be displayed. This is a limitation inherent to the passive interrogation technology used by PowerFLARM and other PCAS systems. To minimize the probability of false alarms, it is recommended to set the PCAS range values to figures useful for flight, e.g. 2000ft vertical and 4NM horizontal.



Aircraft in the vicinity are displayed as dark green symbols of different size. In the example, there is a target 300 ft above at 2 o'clock, heading towards you, descending; as well as two other more distant targets, one below ◂ -, one above ◂ +.

The nearest aircraft not equipped with ADS-B-OUT or FLARM devices, is indicated as a dark green circle, in the example, that target is 2400 ft below. The circle radius gives a distance estimation based on signal strength.



The circle turns orange, then red as the target closes in. In the example, the target is 200 ft above.

Operation with Mode S/C transponder

Mode C signals only carry altitude information, but no identification. To avoid that an the aircraft's own Mode C transponder is constantly displayed as a very close target, PowerFLARM identifies the strongest Mode C signal and suppresses it.

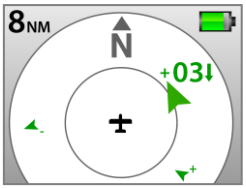
The suppression requires some time and sufficient Radar coverage. Therefore, PowerFLARM may only detect and suppress the own Mode C transponder a few minutes into the flight.

This also applies to Mode S transponders, because they also function as Mode C transponders in addition to Mode S (backwards compatibility).

If Settings -> PCAS -> Mode S Alt is selected, PowerFLARM will use the altitude signal of the aircraft's own Mode-S transponder, if available. This signal has the advantage of being based on static pressure and allows operation of PowerFLARM in pressurized cabins. The display will show an 'S' below the range whenever PowerFLARM is locked onto the own Mode S transponder.

Correct suppression of the aircraft's own transponder depends on the correct setting of transponder type and ICAO address (in case of Mode S).

Operation on ground



When on the ground, the 'radar' screen will operate provided there is adequate GPS reception. The screen image is then oriented to the North, symbolised in the screen by an 'N'.

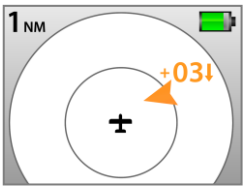
Collision Warnings

Warning Presentation

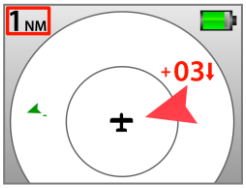
If a dangerous situation is recognised during normal operation, the device gives an appropriate warning. The target image displayed is adjusted in accordance with the nature of the threat. The display background flashes RED.

Large orange coloured aircraft symbol: this aircraft poses a threat of collision. The flight direction and height difference of the other aircraft are given to the nearest 100 ft, together with an indication of climb/descent. In this example: 300 ft higher, descending, flying from left to right.

Very large red aircraft symbol: there is an immediate threat of collision. In addition, the display gives an indication of the vertical angle to the other aircraft. The flight direction and height difference of the other aircraft are given to the nearest 100 ft, together with an indication of climb/descent. In this example: 300 ft higher, descending, flying from left to right.



In dangerous situations, aircraft posing a threat are presented in orange or red, depending on the urgency of the threat. An acoustic warning is issued in addition to the optical warning.



In very dangerous situations the zoom factor is automatically adapted to an appropriate value.

Depending upon the threat level, the acoustic warning varies the bleeper frequency.

Obstacle warnings are displayed by a symbolized mast or two masts connected by a cable (TBD: image). The symbols are at a fixed location on the screen. The actual location of the obstacle is not shown. The bleeper frequency changes according to the danger level.

Information about Warnings

If there are several fixed or moving objects within radio range, the device uses a mathematical algorithm to determine that which poses the most immediate threat, and issues a warning about this threat and none other. The pilot is unable to acknowledge the warning. However, in spite of a warning having been given for a single object it remains possible that several, or other objects simultaneously represent a major threat, or in effect are together more dangerous than the object for which the warning was issued. If the device simultaneously detects a threat from a moving object and a fixed object, then a warning is issued for that which represents the earliest threat of collision.

On the basis of calculation the device indicates the direction taken by the most dangerous object, and its current location. The device

does not indicate where the closest proximity may occur, nor what avoiding action is required. Whether and what avoiding action should be taken is the sole responsibility of the pilot, whose correct response must be based upon his own observation of the local airspace. In particular, he must observe the avoidance rules of the air, and ensure that the avoidance action does not endanger any other airspace users. Depending upon the flight phase, the device uses different forecast processes, movement models and warning calculations to provide the pilot with the best possible support without distraction. For example, sensitivity is reduced when a sailplane is thermalling. These models and processes are optimised, but always represent a compromise. As seen by the pilot, these models will issue 'unnecessary' warnings; in other words, the device may give a warning in situations where there is no subjective danger. It is also possible that the device will not give warning of the most serious threat or gives no warning at all.

Warnings are given at very short notice, normally up to 20 seconds prior to the closest calculated proximity. The intensity of the warning indicates the threat level (calculated collision time) but not the geometric distance. The device only issues a warning if it calculates and predicts a considerable threat of collision. It is thus possible that although a signal is received, that no report is issued about the presence of another aircraft.

Warnings are disabled if the own aircraft is considered taxiing or stationary on the ground.

ADS-B alerts

ADS-B OUT broadcasts have originally been designed for ground-based surveillance and collision avoidance by Air Traffic Control. The use of ADS-B for *airborne* collision alerts is often limited by factors such as:

- Absence of horizontal and/or vertical speed data
- Absence of GPS altitude data
- Erroneous transmission of position and/or velocity data
- Time lag in position data

Practical experience shows that airborne alerts based on ADS-B can be useful to warn about powered traffic in cruise or relatively flat turns.

However, ADS-B does not provide sufficiently precise data to warn about GA traffic with its frequent altitude changes and steep turns.

To ensure best alert quality, PowerFLARM therefore does not use ADS-B data to compute alerts for glider targets. Instead, it will exclusively rely on the target's much more precise FLARM data.

This requires that all gliders which are equipped with FLARM *and* ADS-B transponders to correctly configure their ADS-B out *emitter category* to **glider**. Please refer to your transponder's manual in order to make that configuration. To ensure reliable alerts, it is important that gliders equipped with ADS-B transponders also carry a compatible FLARM or PowerFLARM device and that both devices are configured to the same ICAO address.

Device information and configuration Menu

The menu is called up by extended push of the button. The user then navigates his way through the menu by rotating the button. A short push on the button selects the item that is currently highlighted.

On top of each menu, a push returns to the previous level. You may quit the menu by a long press of the button at any time.

Menu items covering PCAS/ADS-B functionality are removed in PowerFLARM Portable Pure.

Menu Structure

The following diagram shows the device menu sequence.

Volume

Volume for warning buzzer and Audio out jack

Settings

Aircraft
- Type: Selection of aircraft type
- ICAO Address: Enter ICAO Address (hex Mode S Code)
- XPDR: Own transponder details

FLARM
- Range: Horizontal range for FLARM targets
- Vert. Range: Vertical range for FLARM targets

PCAS
- Range: Horizontal range Transponder Receiver
- Vertical Range: Vertical Range Transponder Receiver
- Mode C: Select/deselect processing of Mode C targets
- Mode S Alt: Select/deselect using altitude from own Mode S XPDR

ADS-B
- Range: Horizontal range for ADS-B targets
- Vertical Range: Vertical range ADS-B targets

Data-Port
- Baud Rate: Set data rate for RS232 data output
- Sentences: Selection of data issued

Brightness

Brightness Setting

Audio Out

Switch ON/OFF audio output (3.5mm jack; not available while operating on batteries)

Batteries

Battery type

Profiles
- Save: Save settings to a named profile
- Load: Load settings from a profile
- Delete: Delete a profile

Factory Reset

Return to factory settings (Note: There is NO confirmation screen)

Info

About

Version and hardware information

System

System parameters

Obstacle DB

Information about installed obstacle database (if any)

Licenses

Information about installed licenses

IGC readout
Copy IGC flight recordings to SD card
Update
Software, license, and obstacle DB update from SD card
Repair
Recovery sequence-use only for troubleshooting
Diagn. File
Write diagnostic data to SD card
Disp. update
Update of external Butterfly display (connected via Data Port)

Power Off
Switches device off

Essential Settings Prior to First Flight

There are a number of device settings that *must* be configured prior to the use of the device. These are aircraft-specific settings, that can be found under 'Settings > 'Aircraft'. The values chosen depend upon the aircraft and *must* be altered before the device is used in another aircraft.

These settings are mandatory for correct operation of the device.

Selection of Aircraft Type

This setting is required to specify the type of aircraft in which your device will be used.

Selection of Battery Type

Default is set to disposable Alkaline batteries, set to rechargeable type if that is used for correct battery level indication.

The integrated charging circuit does not know about the battery setting. It will attempt to charge any type of battery if the device is connected to a power source. Never connect the device to a power source when Alkaline batteries are installed.

Transponder

Select whether your aircraft has an operating transponder (any Mode) installed and switched ON, or not.

ICAO Address

Under this heading the user enters the hexadecimal ICAO address of the aircraft in PowerFLARM device, also known as Mode S Code. The aircraft address or Mode S Code is the aircraft-unique address assigned by your Civil Aviation Authority, regardless whether you have a Mode S transponder or not; in case your aircraft is equipped with a Mode S transponder, this is the address transmitted by the transponder.

The aircraft's ICAO address is found in the aircraft documents.

Make sure to use the 6-digit hexadecimal number, not the 8-digit octal number. Don't truncate the first 6 digits of an 8-digit octal address to the 6-digit hex address! In the US, addresses are always in the range between hex A00000 and AFFFFF (equivalent to octal addresses between 50000000 and 53777777).

Incorrect settings will result in false warnings or a failure of the warning function. This also applies to your Mode S/ADS-B transponder (if installed). Both PowerFLARM and the transponder must be set to the correct address.

Register your hex ICAO address for free at www.flarmnet.org .

You can also use the online Configurator tool at https://flarm.com/support/tools-software/flarm-configuration-tool/ to set up your PowerFLARM. To use this tool,

- Select your configuration parameters.
- Copy the FLARMCFG.TXT file to the root directory of a micro SD card.

  To update many devices using one USB stick, name each configuration file as follows: CF<Product Code><5 last digits of Serial Number>.txt, where Product Code is the 6th letter from Part Number (C, D, P, or Q), which you can find on device sticker.

  Example: Part Number FLAPFP24E, Serial Number 002217, Configuration file name CFP02217.txt
- Insert micro SD card into PowerFLARM.
- Switch ON PowerFLARM.
- Verify device confirms by 'Config loaded from SD card'.

Flight recorder

In addition to providing traffic and obstacle warnings, your PowerFLARM operates as an IGC file compatible flight recorder.

Options for diamond-level IGC approval and for Engine Noise Level recording (ENL) are available, see the section about Feature licenses.

PowerFLARM has internal memory for around 100 hours of flight recording at a 4s interval. Flight recording automatically starts when the aircraft starts moving and ends when PowerFLARM is switched OFF or after more than 10 minutes of standstill. When the memory is full, the oldest flights are overwritten first.

To read out the flights to the SD card:

- Insert SD card into slot.
- Select 'Info > IGC readout' from the menu.
- Verify flights are being written to the SD card.

Pilot and glider information as well as tasks can be declared via a FLARMCFG.TXT file or the Data Port.

Please use the online configurator to set pilot name, glider callsign etc. for the flight recorder. Please use your gliding computer or standard gliding software packages for declaring tasks.

Feature licenses

Some features of PowerFLARM require a license. These features are:

- ENL: Engine noise level sensor
- IGC: IGC approval
- TIS: Garmin TIS interface

Devices sold prior to Software version 3.00 have pre-installed 'grandfather' licenses for the features they were sold with.

Licenses can be obtained directly from FLARM or, in some cases, from your dealer.

Each license requires a device-specific license key. Keys are stored in files named xxx.LIC and are installed via the SD card, see 'Device update' below. Once a license is installed on PowerFLARM, it will remain there permanently. Nevertheless, please keep a backup copy of your license keys.

The menu item 'Info > Licenses' shows the licenses installed on a device.

Device identification

In order to obtain licenses, you'll need:

- The device type (PowerFLARM Portable or Core)
- The serial number

The serial number is the numeric part of the device identification on the sticker (e.g., 1234 for FLAPFP23A-001234). It is also shown in the 'Info > About' screen.

PowerFLARM also writes essential device information to a file FLARMDEV.CSV whenever a SD card is connected on startup. If the SD card is shared between multiple devices, each device appends a line with its own information to the end of the file.

The FLARMDEV.CSV file contains the following information:

- Device type, serial number, and region
- Device capabilities
- Installed feature licenses
- ICAO ID and callsign (if defined), aircraft and transponder type
- Some internal system information

PowerFLARM writes the same information to IGC files.

Device update

Installation and update of PowerFLARM software, licenses and the obstacle database is via the SD card. The software of some FLARM displays can also be updated via PowerFLARM.

Software, license and/or obstacle database update

- Copy relevant file(s) (xxx.FW, yyy.LIC, zzz.OB2) to SD card.
- Insert card into PowerFLARM.
- Select ‚Info > Update'
- Wait until device update finishes, acknowledging information as needed.

Notice: When updating from Software versions prior to 3.00 and if license or an obstacle database is to be installed, the above procedure has to be repeated after the first startup into version 3.00.

Notice: In some cases (e.g., when updating from a pre-2.00 version to 3.00), PowerFLARM settings will revert to the factory defaults. The device will inform you if this is the case.

Mandatory firmware update

In order to allow global changes to the FLARM system, every FLARM/PowerFLARM device needs to be updated with the latest firmware version at least once per year (rolling 365 days). If the PowerFLARM Portable is installed in the aircraft as a fixed installation, this has to be part of the Aircraft Maintenance Program (AMP). The entry in the AMP is to be made during installation. A new update shall be required within 365 days of the previous update.

Each firmware also has a fixed expiry date, to avoid that devices which have not been updated are transmitting obsolete data.

Legal Notes

Product Warranty

The warranty is immediately cancelled should the device be opened, misused, faulty installation, and any breach of copyright.

Limitations

Operation of PowerFLARM is restricted to the region it was sold for.

The device has been designed as a non-essential 'situation awareness only' device, whose task is solely to support the pilot; it is not always in a position to provide a reliable warning. In particular, the device does not provide any suggestions as to avoiding action. Under no circumstances does the device facilitate a change in flight tactics, user, or commander response. Even though you have installed the device, you remain responsible and liable for the safety of all passengers and other aircraft. Operation of the device is solely a matter at the discretion of the user and commander. The device may only be operated by persons who have made a careful study of the user instructions.

The device can only warn of the presence of other aircraft that are equipped with PowerFLARM devices or compatible equipment, and of obstacles that are recorded in the internal data bank. The device does not communicate *actively* with A/C/S transponders and is therefore not detected by ACAS/TCAS/PCAS or Air Traffic Control. Likewise, the device does not communicate *actively* with TIS-B, FIS-B and ADS-B (1090ES, UAT, VDL-4).

The device has not undergone the conventional aeronautical certification process. Software development was conducted in accordance with the usual standards and procedures required for industrial electronics products. The optional obstacle data bank in the device is not certificated. The use of public access unlicensed radio bandwidths in the air is subject to a number of limitations, with some national differences. The pilot and user of the device are solely responsible that the device is operated in accordance with the valid local regulations.

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In addition, FLARM Technology Ltd's current General Terms and Conditions of Sale apply.

FLARM Technology Ltd makes no warranties based on the accuracy or completeness of the contents of this document and reserves the right to make changes to specifications and product descriptions at any time without notice.

Conformity Declaration

FLARM Technology Ltd, Hinterbergstrasse 15, CH-6330 Cham, Switzerland, declares that the product *PowerFLARM Collision Warning Device* in Hardware Version FLAPFP2*E and typical configuration, meets the requirements of the CE mark.

CE

The communications conformity meets the requirements of EN 300 220 (power class 9), EMC- Conformity EN 301 489 (class 3 SRD-Device, equipment type I). The device is in accord with the requirements of the European R&TTE Directive.

This device complies with Part 15 of the FCC. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

FCC ID:
ZKUGC625161

Within the USA, the device may only be used in transportation vehicles such as aircraft or motor vehicles.

This Class A digital apparatus complies with Canadian ICES-003.

IC ID Number:
10154A-FLAPFP24

Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.

RF Radiation Hazard Warning

To ensure compliance with FCC and Industry Canada RF exposure requirements, this device must be installed in a location where the antennas of the device will have a minimum distance of at least 30 cm (12 inches) from all persons. Using higher gain antennas and types of antennas not certified for use with this product is not allowed. The device shall not be co-located with another transmitter.

Installez l'appareil en veillant à conserver une distance d'au moins 30 cm entre les éléments rayonnants et les personnes. Cet avertissement de sécurité est conforme aux limites d'exposition définies par la norme CNR-102 at relative aux fréquences radio.

Maximum Antenna Gain

Currently, the maximum antenna gain for external antennas is limited to 3.0dBi for operation in the 902MHz to 928MHz bands. The antenna gains must not exceed maximum EIRP limits set by the FCC / Industry Canada.

Actuellement, le gain d'antenne maximal d'antennes externes est limité à 3.0dBi pour un fonctionnement en 902MHz à 928MHz par points à bandes. L'antenne gain ne doit pas être supérieure à maximum EIRP limites fixées par la FCC/Industrie Canada.

Industry Canada Notice and Marking

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Credits

No track picture source: www.flaticon.com/free-icon/airplane-travel-around-the-world_48881 Original picture was changed: red sign was added.