PowerFLARM

FLEX

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1 General Description

1.1 System Description

PowerFLARM Flex is a modern FLARM device for installation in General Aviation aircraft. It is a self-contained unit with integrated display, antennas and power supply. PowerFLARM Flex has been designed for worldwide use and connects to a range of displays, including mobile apps via Wi-Fi or Bluetooth. A complimentary FLARM Hub app is available on both iOS and Android mobile devices for straightforward configuration and maintenance.

PowerFLARM Flex includes the following features:

- Fully integrated, stand-alone FLARM device
- Hybrid display for optimal readability in all lighting conditions
- Low-profile design for installation on the instrument panel
- Replaceable, rechargeable 18650 Li-Ion battery (optional)
- Fully integrated antennas, no cables required
- Portable and easily transferable between aircraft
- AMPS 2-hole mounting pattern, compatible with RAM mounts
- Compatible to the FLARM Hub native app (iOS/Android)
- InstaCARP range analyzer for instantaneous results
- Reception of 1090 MHz signals: ADS-B, Mode-C, and Mode-S
- IGC recording with cryptographic chip for enhanced security

1.2 Abbreviations and Definitions

Term	Meaning/Explanation
ADS-B	Automatic Dependent Surveillance — Broadcast
EFB	Electronic Flight Bag
FAQ	Frequently Asked Questions and answers
GNSS	Global Navigation Satellite System
GPS	Global Positioning System (NAVSTAR)
ICA	Instructions for Continued Airworthiness
ICD	Interface Control Document
IFR	Instrument Flight Rules
ISM	The ISM radio bands (FLARM uses ≈ 915 MHz)
RF	Radio Frequency/Radio
SRD860	The SRD860 radio band (FLARM uses ≈ 868 MHz)
SSR	Secondary Surveillance Radar
TAS	Traffic Advisory System
TCAS	Traffic alert and Collision Avoidance System
UAV	Unmanned Aerial Vehicle
VFR	Visual Flight Rules
XPDR	Transponder

1.3 General Overview

FLARM is the collision avoidance system and traffic awareness/electronic conspicuity technology used by General Aviation, light aircraft, and UAVs. It has been designed to support self-separation for both VFR and IFR in applicable airspace classes. Aircraft with a FLARM system alert the pilots when on a collision course with another aircraft. Like TCAS/TAS, visual and aural warnings indicate that a collision is imminent, requiring the pilots to take action. However, unlike TCAS, FLARM does not issue Resolution Advisories (RA), so pilots need to select the appropriate course of action themselves.

FLARM works by calculating and broadcasting its own predicted future 3D flight path to nearby aircraft. At the same time, it receives the future flight path from surrounding aircraft. A motion prediction algorithm calculates a collision risk for each aircraft based on an integrated risk model.

The system determines its position, altitude, and movement with a GNSS receiver (satellite-based navigation). Based on those and other parameters, a precise projected flight path can be calculated. The flight path, together with additional information such as the identification number and the type of the aircraft, is encoded before being broadcast over a radio channel twice per second. Flight prediction models are available for most aircraft types, including piston-engine airplanes, jets, helicopters, gliders, hang gliders, paragliders, UAVs, etc.

PowerFLARM Flex also incorporates an ADS-B and transponder (SSR) Mode-C/S receiver. This enables aircraft that are not yet equipped with FLARM to also be detected and included in the collision prediction algorithm. However, these aircraft will not be able to detect FLARM-equipped aircraft, so a reciprocal FLARM-installation is recommended for all aircraft.

FLARM was invented in 2004 following an increasing number of mid-air collisions. Research and accident investigations had shown that the see-and-avoid principle was insufficient to reliably detect approaching aircraft in time. It initially spread in the domain of non-powered aircraft but was soon followed by rapid expansion in powered airplanes and helicopters. Over 85,000 manned aircraft and UAVs already have a FLARM-system installed. In Europe, more than 50% of all General Aviation aircraft have FLARM (including nearly 100% of gliders). The technology has additionally spread to other parts of the world and is today also used most prominently in North and South America, Australia, New Zealand, South Africa, Israel, and some Asian countries.

FLARM can also warn about fixed obstacles like masts and power lines. Obstacle collision warnings are based on an optionally installed database, which needs to be kept up to date.

FLARM systems are available from many different manufacturers under different product names. Some systems consist of a remotely installed FLARM device, a panel-mounted *FLARM Compatible* display, one or two externally mounted FLARM antennas, and internally mounted GNSS and ADS-B/SSR 1090 MHz antennas. PowerFLARM Flex is a portable device with an integrated display. Additionally, there are FLARM systems integrated into other avionics (e.g. EFIS-systems).

In general, FLARM is approved by EASA and others for installation in certified aircraft and is recommended by many aviation authorities and organizations. The installation is normally a minor or standard change and can be done by any competent maintenance organization. Several General Aviation airports have started requiring FLARM for all aircraft. FLARM is also mandatory in France for gliders and a similar requirement for light powered aircraft is under investigation.

PowerFLARM Flex, if not installed permanently, does usually not require an approval.

1.4 Displays

PowerFLARM Flex can be connected to an external FLARM display. Displays originate from third party manufacturers implementing the FLARM Data Port protocol, an extension of NMEA 0183.

PowerFLARM Flex also supports connections to EFBs running on iPads or similar for supplementary displays and navigation systems over Wi-Fi and Bluetooth.

1.5 Radio Communication and Antennas

The FLARM system uses a radio communication frequency in the SRD860 band (≈868 MHz) or an ISM band (≈915 MHz) in different parts of the world. PowerFLARM Flex will automatically select the applicable frequency based on the GNSS position.

The following frequencies are used within the specified areas.

Area	Frequency
Africa	868.2 – 868.4 MHz
Australia	917.0 – 926.6 MHz
Europe	868.2 – 868.4 MHz
Israel	916.2 MHz
New Zealand	869.2 MHz
North America	902.2 – 927.8 MHz
South America	917.0 – 926.2 MHz

The internal antennas have been designed for worldwide use.

1.6 Additional Documents, Data, and Information

The following additional documents are available for download from

https://www.flarm.com/en/support/downloads/:

- FLARM Firmware release notes, FTD-037
- FLARM Hub Firmware release notes, FTD-081
- Application Note FLARM Antenna Installation, FTD-041
- Dataport Interface Control Document (ICD), FTD-012
- FLARM Configuration Specification, FTD-014

For questions, first consult the FAQ:

https://www.flarm.com/en/support/

For questions not answered in the FAQ, contact FLARM Technology:

support@flarm.com

2 Limitations

PowerFLARM Flex has been designed as a non-essential situation awareness only device, whose task is to support the pilot; it is not always able to provide a reliable warning. PowerFLARM Flex does not provide any resolution advisories. Under no circumstances does PowerFLARM Flex facilitate a change in flight tactics or pilot conduct. Operation of PowerFLARM Flex is solely at the discretion of the Pilot in command. The system may only be used after completing familiarization training.

The display of PowerFLARM Flex can only alert of the presence of other moving aircraft if the other aircraft is equipped either with a FLARM system, an ADS-B Out 1090ES device, or an interrogated Mode-C/S transponder. PowerFLARM Flex does neither interrogate transponders nor operate as a transponder and is thus not detected by TCAS or ATC.

FLARM firmware development was conducted in accordance with industry best practice for industrial electronics products. The use of public access license-free radio bands in the air is subject to several limitations, with some national differences. The pilot is solely responsible for the PowerFLARM Flex being operated in accordance with applicable regulations.

The use of PowerFLARM Flex is limited to flights in VMC (both VFR and IFR). PowerFLARM Flex may not be used for navigation.

3 Installation

This section explains how to properly install PowerFLARM Flex, including mounting, placement, power connection, and initial configuration. Both permanent and temporary mounting options are supported.

3.1 General Advice

PowerFLARM Flex must be installed in a way that does not interfere with certified avionics or compromise aircraft safety. Installations must comply with applicable regulations.

3.2 Mechanical Installation

PowerFLARM Flex supports both permanent and temporary installations. The M4 screw nuts feature an AMPS 2-hole pattern with M4 screws. Consult Mechanical Drawings (9.1.1) for details.

The screws must not protrude more than 4.9 mm into the device housing. Using longer screws may damage the device.

Permanent Installation: Use screws to secure the device to the aircraft structure.

Temporary Installation: Use a suction-cup-based RAM mount (or similar) on a clean, smooth cockpit surface. Ensure it is firmly attached and does not obstruct flight controls or visibility.

RAM RAP-B-166U is an example of a readily available set. The diamond mount fits the screw holes at the bottom of PowerFLARM Flex.

Alternatively, using a Velcro-style temporary attachment, for example 3M Dual Lock, is recommended.

3.3 Placement

Since the radio antennas are tightly integrated into PowerFLARM Flex, the correct placement of the device is crucial for optimal system performance. Thake the following aspects into consideration. Also, consult "Application Note FLARM Antenna Installation (FTD-041)" for more details.

Orientation

Install the device in a level, horizontal position to ensure optimal signal reception and transmission. The integrated FLARM and 1090 MHz antennas are specifically tuned for vertical polarization in the horizontal plane, meaning performance may degrade if the device is tilted or mounted at an angle. Additionally, the internal GNSS antenna requires a clear view of the sky to maintain a stable satellite fix. Avoid mounting under overhangs, dashboards, or other structures that could obstruct the GNSS view.

Radio Line of Sight

To maximize traffic awareness and collision avoidance capabilities, position the device where it has the clearest possible view in all directions. If visibility in all directions is not feasible, prioritize visibility to the front of the aircraft. Avoid installation in enclosed compartments, under metal structures, or behind panels, as these can significantly reduce the device's effectiveness.

Avoid Obstructions

Keep the device away from metal, carbon fiber, and other signal-blocking materials to the sides or above, as these can attenuate or reflect signals. However, a metal surface directly below the device can act as a ground plane, improving antenna performance.

Separation

Maximize the clearance between the device and other transmit antennas, avionics, or high-power electronic components. Ideally have a separation of 25 cm. This helps minimize electromagnetic interference (EMI), which could affect the performance of both the PowerFLARM Flex and surrounding systems.

Minimize Radio Reflections

Reflected signals can distort positional information and reduce system reliability. Avoid mounting the device near windscreens, metallic surfaces, or large structural components that can reflect RF signals. Ideally, the device should be in an open area within the cockpit where direct signals dominate, and multipath effects are

minimized. Proper placement helps ensure both the accuracy of received data and the effective transmission of your own position to nearby aircraft.

Visibility of the Display

Install the device so that the display is clearly visible and within the pilot's normal line of sight during flight. This ensures that traffic alerts and status information can be monitored without diverting attention from flying.

By following these placement guidelines, you ensure optimal performance.

3.4 External Display

PowerFLARM Flex can be connected to a compatible external display via the RJ45 port. External displays may provide additional viewing and control options and are particularly useful in permanent installations for twin seat aircraft.

When an external display is used:

- Ensure correct wiring of the RJ45 connector according to pin assignments in Section 3.5.2.2.
- Only one external display may be connected to the RJ45 port at a time.
- The display may draw power from the Flex device (250 mA max. at 3 V). Do not exceed this current limit. This reduces battery life.
- Set correct baud rate, dataport protocol and version.
- Display firmware should be kept up to date. Refer to the manufacturer documentation for update procedures.

3.5 Power

PowerFLARM Flex can operate in three different power configurations:

- **Battery-only operation**, using the internal rechargeable battery
- **External power-only operation**, via USB or RJ45 input
- **Combined operation**, where external power supplies the device and simultaneously charges the battery, allowing the battery to act as a buffer in case of power interruption

This flexibility allows the device to be used both in permanently installed and portable setups, with uninterrupted functionality during external power loss.

3.5.1 Battery

PowerFLARM Flex uses a replaceable, rechargeable 18650 Li-Ion battery (not included). It supports standalone operation or serves as a buffer during external power interruptions.

Only standard-sized 18650 cells (maximum Ø18.6 mm x 65.2 mm) may be used. The battery must meet the IEC 62133-2:2017 and/or UL1642 safety standards.

Recommended models:

- Panasonic NCR18650GA
- Molicel INR-18650-M35A

These models are high-capacity, high-reliability cells with integrated safety features and a strong performance record.

The battery is charged automatically when external power is connected via USB-C or RJ45.

Note: The battery level indicator requires a few (at least four) power cycles from completely charged to completely empty to correctly estimate the state of charge of an installed battery. During this process, the state of charge readings may be off. This has no influence on the factual battery life though. When the battery is swapped, the battery level indicator is reset, and the calibration process is restarted.

Important safety requirements:

- Use only standard-sized 18650 Li-ion cells (maximum Ø18.6 mm × 65.2 mm).
- The battery must meet IEC 62133-2:2017 and/or UL1642 safety standards.
- Do not use modified, oversized batteries, or incompatible chemistries.
- Ensure correct polarity when inserting the battery.
- Replace the battery immediately if it shows signs of swelling, leakage, discoloration, or physical damage.
- Do not expose the battery to temperatures below 0 °C or above 60 °C.
- Charge the battery only inside the device, using a compliant USB-C or RJ45 power source.
- Do not charge unattended or near flammable materials.

3.5.2 External Power

The device can be powered through either of its two external inputs: USB or RJ45. These can be used independently or simultaneously. If both are connected, the system manages power input automatically.

External power is also used to charge the internal battery when installed, ensuring the device is always ready for battery-powered operation when needed.

3.5.2.1 USB

The USB-C port accepts a standard 5 V USB power supply and supports both charging the internal battery and powering the device.

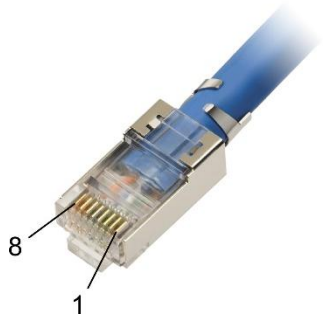
It can be connected to a wall adapter, USB outlet, or power bank. In portable setups, the device can be powered by a USB power bank without even a battery installed—useful for temporary installations.

When the battery is present, USB power charges it while also supplying the device.

3.5.2.2 RJ45

Connecting power to an incorrect pin will burn the circuit board, make the device unusable, and void any warranty.

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



1: GND
2: GND
3: RX, device receives (RS-232)
4: TX, device sends (RS-232)
5: GND
6: Device supplies +3 V DC for display
7: +12 to +32 V DC power supply
8: +12 to +32 V DC power supply

Note: The pin numbering above follows international standard. The numbering in some display documentation is reversed. See the picture above for correct pin assignments.

Do not connect more than one external application to the RJ45 port. See Section 9.2 for input and output current limits.

3.6 Configuration

The device must be configured, see Section 5 for more details. It is crucial to correctly set the ICAO address when swapping the device between aircraft.

3.7 Firmware Updates

PowerFLARM Flex has two separate firmware which are installed separately: one for the FLARM system (called *PowerFLARM firmware*) and one for FLARM Hub.

To allow global and synchronized changes to the FLARM ecosystem, every FLARM device should be updated with the latest PowerFLARM firmware version at least once per year (every 12 calendar months) as part of the annual maintenance. Firmware updates typically contain algorithm and protocol improvements and new features.

When the device is delivered, it might not have the latest firmware versions. Always update to the latest firmware versions as part of the installation.

See Section 5.3 for how to update firmware on PowerFLARM Flex.

3.8 Obstacle Database

The Obstacle Warning System in FLARM is an integral, but optional, part of the system. It requires a valid obstacle database with a license to work. There are different databases covering various geographical areas and use cases. An installed obstacle database should be renewed as part of the annual maintenance and before it expires. They can be purchased from our website.

See Section 5.3 for instructions on how to install an obstacle database on PowerFLARM Flex.

3.9 Installation Verification

After completing installation and configuration, the following verification steps must be performed to confirm system integrity and performance:

- **Power on the device** and check the integrated display and FLARM Hub for any error or warning messages. Errors must be resolved before flight (see Appendix B for guidance).
- **Confirm GPS lock**: The device should acquire a GPS lock within 15 minutes of power-on when outside with a clear sky view.

- **Check display output**: Ensure the display shows expected startup and status screens. If using an external display, verify correct communication and indication.
- **Confirm correctly configured ID**: In the Info section of the Menu, confirm that the transponder and ICAO address (if applicable) is correctly configured.
- **Run the Alarm Simulator** scenarios via the display menu or FLARM Hub interface to become familiar with visual and audible alerts.
- **Inspect for interference** with other aircraft systems

Note: Familiarity with the system's alerts is essential to ensure quick and correct pilot response during actual traffic encounters.

Confirm the sufficient performance with the range analyzer after a few flights.

4 User Interface

PowerFLARM Flex has a hybrid display, consisting of an LED ring on the left, and a small high-resolution LCD screen on the right. This hybrid display ensures optimal readability in all lighting conditions. The screen brightness is automatically set depending on the ambient light level.

The directional display with bright LEDs remains easily visible even in all lightning conditions. The bright LCD screen provides additional information about nearby aircraft and allows for user-friendly configuration. Additionally, a loud buzzer gives audio warnings.

The following colors are used for alerts:

- **Green:** No alarm, information only
- **Yellow:** 15 to 20s to impact
- **Orange:** 15 to 10s to impact
- **Red:** less than 10s to impact

Status messages and error codes are shown on the screen, with severity levels from 1 to 3:

- **Severity 1:** Informational only
- **Severity 2:** Reduced functionality
- **Severity 3:** Fatal error — FLARM not operational

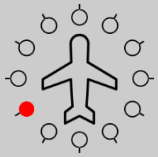
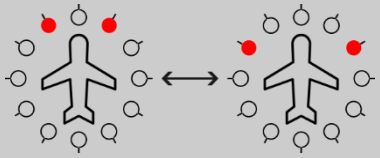
Error conditions also appear in the Hub App Status page. See Appendix A for a list of codes.

Only targets within the configured horizontal and vertical ranges (FLARM, ADS-B, and PCAS) are displayed. If these ranges are smaller than the current zoom level, aircraft outside of them may not appear on the display.

4.1 LED Ring

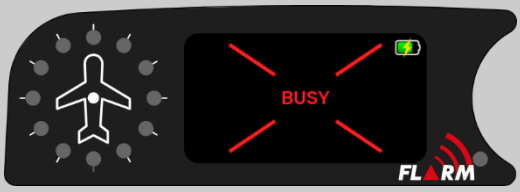
The LED ring gives a visual indication of the most important target and/or alert. Under normal (not alarm) conditions, the LED ring shows the direction of the nearest target.

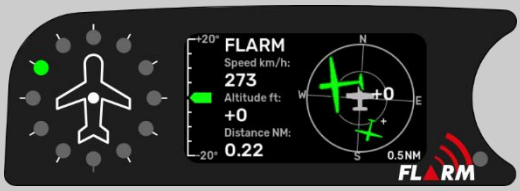
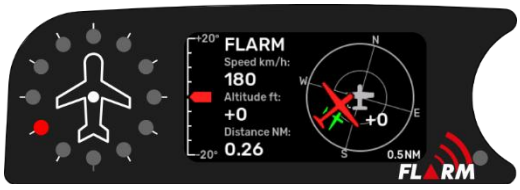
Elevated alarms are shown as follows:

Visual Indication	Description
	Directional alert from target approaching at 8 o'clock.
	Alert zone, currently flying inside zone.
	Obstacle alert.

4.2 LCD Screen

On the LCD screen, multiple types of views are available.

	Screen	Description
Notification View		*Busy:* PowerFLARM Flex is busy, e.g. during startup or a software update.
		*Error:* PowerFLARM Flex experienced an error; this might be intermittent or persistent. Connect to Hub or refer to Appendix A (Error Codes) to resolve.
		*NO GPS:* PowerFLARM Flex is acquiring a GPS position fix. Clear view of sky is required. If this persists for more than 15 min, move device.

Traffic View		Shows overview over all traffic in the vicinity. Nearest target is shown on LED ring and shown in large size on screen, with altitude difference indicated next to target. User interaction: • Rotate the rotary switch to adjust the zoom level. • Short press the rotary switch to switch to Detailed View. • Long press (2 seconds) to open the Menu. • Double press to register a Pilot Event.
Detail View		Detailed information for one selected aircraft. Available information: elevation angle, speed, distance, altitude difference, signal source/call sign. Zoom level is automatically adjusted. User interaction: • Rotate the rotary switch to cycle through visible aircraft and view detailed information for each. • Short press returns to Traffic View. • Long press opens the Menu. • Double press to register a Pilot Event.
Alarm View		Highlight aircraft causing alarm. Colors show alarm severity (LED and aircraft color). No user interaction is possible while raised alarm level exists.
Menu		Menu screen with essential configuration, range analysis. Allows configuration of screen-specific settings such as brightness, units, and color theme. User interaction: • Rotate the rotary switch to navigate between menu items. • Short press to enter a menu or submenu. • Rotate to change the setting. • Short press again to confirm. • To exit and return to Traffic View, select "back" and press the rotary switch. Note: Alerts are still shown on LED ring while in Menu.

5 Configuration

For correct operation of your FLARM device, the device configuration must be accurate and current. In particular, the important settings below must be configured to avoid nuisance alarms.

Other settings, such as the range for FLARM, ADS-B and PCAS (Mode-C/S), influence the way in which alarms are triggered by received signals.

The menu on the internal display of PowerFLARM Flex allows configuring essential settings. For full configuration, use FLARM Hub, described later in this section.

5.1 Important Settings

The following settings must be configured.

5.1.1 Aircraft Type

FLARM uses collision algorithms specific to the aircraft type in which it is installed. If the wrong aircraft type is configured, this will have negative effects both for the own system as well as FLARM systems in other aircraft.

5.1.2 Transponder Type

The type of transponder installed must be configured, so FLARM knows how to interpret the data from the own transponder.

5.1.3 ICAO 24-bit Aircraft Address

If the aircraft has a Mode-S transponder or separate ADS-B Out 1090ES equipment, the 24-bit aircraft address must be configured. This ensures that receiving devices can correctly correlate the FLARM and transponder signals. Furthermore, this allows it to use the pressure altitude received from the own transponder instead of from the integrated barometric sensor. This produces more accurate altitude readings.

5.1.4 Protocol Version and Baud Rate

If an external display is connected on the RJ45 port, configure the highest supported protocol version and baud rate. This information is available from the display manufacturer. Higher protocol versions support additional features. Higher baud rates support a higher number of concurrent aircraft shown on the display.

Note: Some displays automatically set the required baud rate and/or protocol version during startup. Other displays may adapt to the already configured baud rate.

Note: Newer protocol versions transport more information than older versions. It is thus recommended to use the highest protocol version supported by the connected display. Similarly, it is recommended to use the highest supported baud rate to prevent loss of information due to an overwhelmed serial connection.

5.1.5 Aircraft information broadcast

The following configuration fields are periodically sent to other FLARM devices using FLARM Messaging, to be shown on displays in other aircraft:

- Pilot name
- Aircraft registration, e.g. HB-FLA
- Aircraft model, e.g. SZD 56 Diana 2
- Callsign

Correctly setting the above values is encouraged for a better experience. Broadcast is enabled by default but can be fully disabled. These settings can be set in the FLARM Hub app.

5.2 Display Menu

The internal display implements a menu, which shows important information about the device, and essential settings can be configured. You can enter the menu through a long press.

The menu has the following functionality:

- **Mute alarm** for 5 minutes. Alarms are still shown in the LED ring and LCD display.
- **Display** allows configuring important items such as volume, brightness, units or color themes.
- **Settings** allows configuring items related to the core FLARM functionality, such as aircraft type, ID, transponder, and ranges.
- **Wi-Fi & Hub** shows the Wi-Fi credential and QR code to connect the FLARM Hub App.
- **Info** shows crucial information, such as serial number and firmware versions, battery state and range analyzer.

5.3 FLARM Hub

FLARM Hub is an app that allows easy configuration and maintenance. It runs directly on mobile phones and tablets and connects to the Wi-Fi network of PowerFLARM Flex. The mobile app notifies users about new firmware releases.

5.3.1 Pairing

1. Install FLARM Hub App on mobile device
2. On the display, open the *Menu*, and navigate to *Hub & Wi-Fi*. A QR code appears.
3. On the app, add new device via QR code, and connect to PowerFLARM Flex.

Google Play

App Store

Alternatively, when access to the FLARM Hub App is not available, it is possible to manually connect to PowerFLARM Flex: Open a web browser and enter the address http://10.10.10.10/.

5.3.2 Web Interface

All dynamic information in FLARM Hub is live, i.e. it is updated automatically when the underlying data changes. Thus, there is normally no need to refresh the page or to push a button to commit changed settings to the device. If there is a connection problem, this will be indicated at the top of the page.

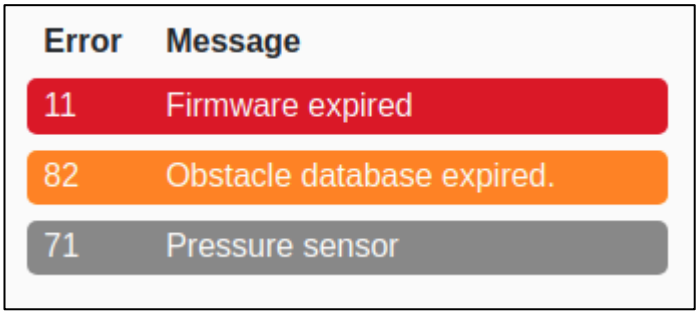
The language of the interface can be changed on the Configuration / FLARM Hub page.

Note: While we strive to ensure compatibility with a broad range of devices, some platforms and browsers, especially older ones, might only be partially supported or not at all. In case of issues, ensure that you are using a newer device running the latest OS version.

5.3.3 Hub Functionality

- **Status** page shows real-time system info, including device status, flight mode, battery status, error messages, and Wi-Fi details.

Errors are color-coded and remain visible until the device is restarted. See example below:



The severity level is indicated by the color and has the following meaning:
1 (grey): information,
2 (amber): functionality reduced,
3 (red) fatal error, device not functional

- **Configuration** pages to adjust FLARM, Wi-Fi/Bluetooth, and FLARM Hub settings or upload a config file. Changes are applied automatically and confirmed visually.
- **Maintenance** page for updates of firmware and obstacle database and IGC file download.
- **Tools:**
    - **Traffic Monitor** displays received traffic. It doesn't generate alerts and may not show all aircraft.
    - **Interactive Data Port** allows two-way communication with the device for advanced diagnostics, typically when requested by support.
    - **Range Analyzer** shows the measured reception in all directions around the aircraft. Reset the data after installation or annual maintenance.
    - **Alarm Simulator** plays predefined traffic and alert scenarios for familiarization with how alerts are presented. It helps verify installation but doesn't assess antenna quality.
    - **Support** for factory reset or creation of a support package with config and debug data, typically when requested by support.

6 IGC Flight Recorder

PowerFLARM Flex operates as an IGC flight recorder (GFAC approval pending). It also has Engine Noise Level recording (ENL).

Note: The pressure sensor is pre-calibrated when shipped, without a calibration certificate. If calibration is required for FAI/IGC purposes, this can be done by an appropriate third party.

PowerFLARM Flex has an internal memory for approximately 100 hours of flight recording at a 1 s interval. Flight recording automatically starts when the aircraft starts moving and ends when the device is switched OFF or after more than 5 minutes on the ground. When the memory is full, the oldest flights are overwritten first.

To read out the flight records in the IGC file format, use FLARM Hub.

7 Wi-Fi and Bluetooth Data Usage

PowerFLARM Flex can be connected to EFBs and mobile devices (tablets, smart phones) to stream traffic data. The connection can be made over either Wi-Fi or Bluetooth. The following modes are available:

- FLARM ICD on Wi-Fi (TCP, socket 2000)
- FLARM ICD on Wi-Fi (WebSocket)
- GDL 90 on Wi-Fi (UDP)

To use one of the Wi-Fi modes, the mobile device must be connected to Wi-Fi as described in Section 5.3. The host IP address is 10.10.10.10.

Please refer to FTD-115 for more information.

8 FLARM Theory of Operation

This section outlines how PowerFLARM Flex operates in flight. For details about external displays, refer to their respective manuals.

8.1 Display

PowerFLARM Flex uses its integrated display as the primary user interface for traffic awareness and collision avoidance. It shows nearby traffic, collision alerts, and system status, including error messages. It should be mounted within the pilot's primary field of view.

8.2 Traffic Collision Warnings

PowerFLARM Flex issues traffic collision warnings from signals received from FLARM, ADS-B and Mode-C/S:

8.2.1 FLARM

FLARM issues collision alerts based on time to predicted impact. Warnings escalate in three levels, typically triggered at ~20, ~15, and ~10 seconds before a potential collision. Alerts may downgrade or cease if flight paths diverge.

The system triggers warnings only when there's a high probability of collision, factoring in aircraft size, speed, turn radius, and signal accuracy.

8.2.2 ADS-B

Aircraft with 1090ES are shown regardless of SIL/SDA. If FLARM and ADS-B data exist for the same aircraft, PowerFLARM Flex selects the better source.

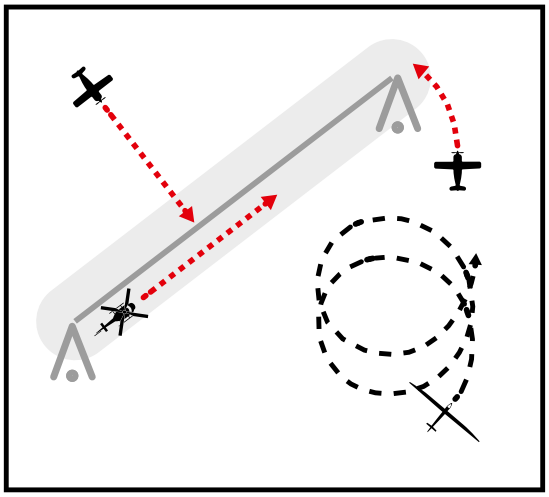
8.2.3 Mode-C/S

Requires third-party radar or TCAS interrogation. Only approximate range and altitude are available (no bearing), based on signal strength and received altitude. If no transponder altitude information in the own aircraft is available, PowerFLARM Flex uses its internal pressure sensor.

8.3 Obstacle Collision Warnings

With a valid obstacle database and license, the system warns of fixed obstacles (e.g. power lines, cable cars, towers).

Warnings are also issued for risky maneuvers near obstacles (e.g. sharp turns around line ends), but not for tight circling like thermalling near terrain. See graphic below for behavior illustration.



Obstacle alerts do not include bearing or altitude, they're always aligned with your predicted path.

8.4 Alert Zones

FLARM Alert Zones (e.g. skydive drop zones, UAV areas) use ground-based FLARM transmitters to define a protected airspace.

When entering such a zone:

- A 4-second warning is given every 12 seconds
- After 3 initial alerts, it repeats every 60 seconds while inside the zone

Both pilots and ground operators are alerted.

8.5 Traffic Information

In addition to collision warnings, PowerFLARM Flex provides additional information about proximate aircraft, such as position/track, ICAO address, aircraft type or ground/climb speed.

8.6 Radio Range

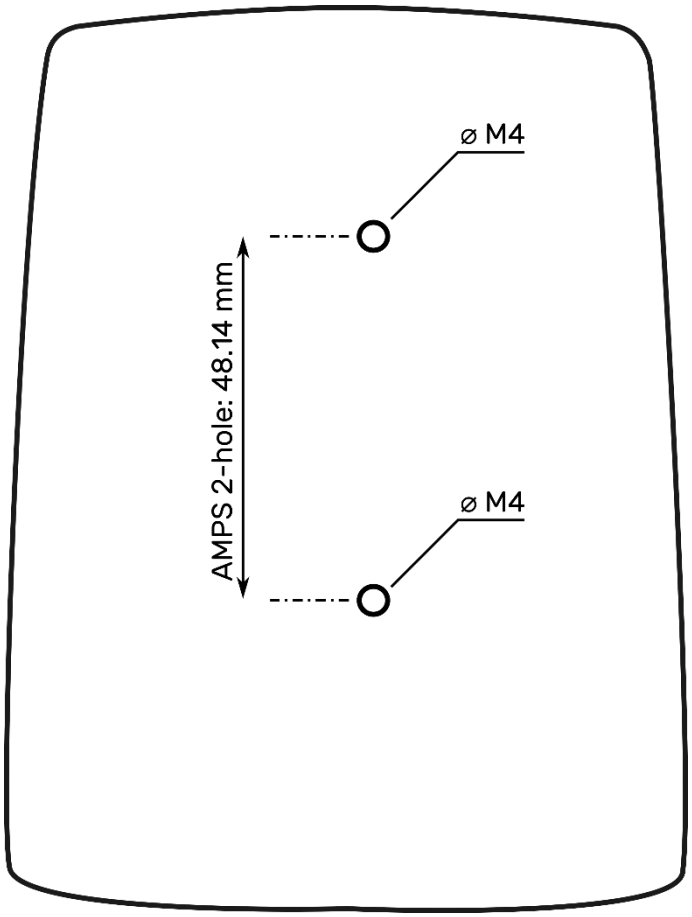
FLARM requires line-of-sight to detect nearby aircraft. Effective range depends on device placement. In optimal conditions, expect >10 km range. For head-on detection at 250 kt: ≥5 km required

Range may be reduced in certain directions (e.g. below the aircraft) due to shadowing from structures or occupants. For best performance, mount the device to maximize range in the forward direction of flight.

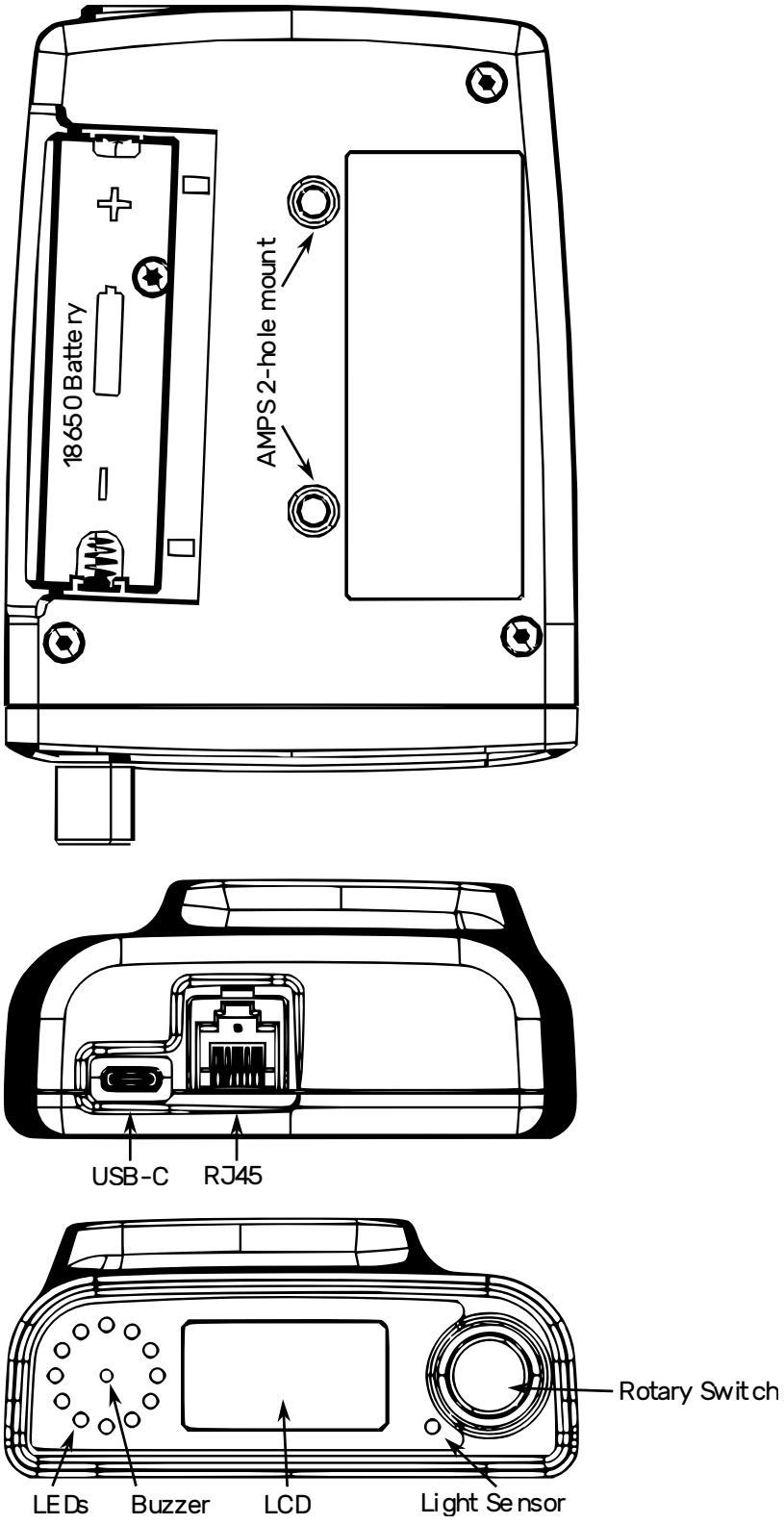
9 Technical Specifications

9.1 Drawings

9.1.1 Mechanical Drawings



9.1.2 System Drawings



9.2 Specifications

Mechanical	
Dimensions	Length 11.7 cm (13.3 mm including rotary knob) Width 8.8 cm Height 4.0 cm
Mass	225 g (with battery) 178 g (without battery)
AMPS 2-hole mount	*Distance* 48.14 mm *Screw size* M4, max 4.9 mm into housing
Electrical Connections	
USB-C	5 V DC
	Current Consumption (typ.) Nominal: 380 mA Charging: 1200 mA
RJ45	10 to 32 V DC
	Current Consumption (typ.) Nominal: 160 mA (12 V), 70 mA (32 V) Charging: 620 mA (12 V), 260 mA (32 V)
	Current Supply Capability (max.) 250 mA (3 V)
	Serial Protocols: FLARM Dataport, GDL90, Garmin TIS
18650 Li-Ion Battery	*Safety Standard* IEC 62133-2:2017, UL1642
	Size (max) Ø18.6 mm × 65.2 mm
Environmental	
Temperature	Nominal: -20°C to 70°C Battery: 0°C to 60°C
User Interface	
LCD	*Size* 1.47”
	Resolution 172x320 pixels
	Brightness 350 cd/m2
LED	12-segment RGB dimmable
Input	Combined rotary encoder + pushbutton
Apps	FLARM Dataport, GDL 90 for traffic FLARM Hub native App
Sound	Piezo buzzer
RF	
FLARM (In/Out)	868 MHz (EU, UK), 14 dBm 915 MHz (USA, Canada, Australia), 20 dBm
ADS-B (In)	ADS-B Mode-S Mode-C
2.4 GHz (In/Out)	Wi-Fi/Bluetooth LE, 14 dBm
GNSS (In)	10th generation u-blox receiver (multi-constellation capable)

10 Additional Information

10.1 Safety Information

10.1.1 Battery Safety

PowerFLARM Flex uses a replaceable 18650 Li-Ion battery to provide power during portable operation. While this battery type is widely used for its high energy density and reliability, improper handling can pose serious safety risks. Users must follow appropriate precautions when using, charging, storing, or replacing the battery.

Only standard-sized 18650 Li-Ion cells (maximum Ø18.6 mm × 65.2 mm) may be used. The battery must comply with IEC 62133-2:2017 and/or UL1642 safety standards. Do not use modified or protected cells that exceed standard dimensions, nor substitute batteries of different chemistries or physical sizes. Doing so may damage the device, cause malfunction, or create a fire hazard.

The battery must be charged inside the device only, using a compliant USB-C or RJ45 power source. Never attempt to charge the battery outside the device and never charge it unattended or near flammable materials. If the battery becomes excessively hot, emits a strong odor, or shows signs of swelling or deformation during use or charging, immediately disconnect the device and move it to a non-flammable area.

Handle the battery with care during replacement. Do not puncture, crush, short-circuit, or expose it to excessive shock or vibration. Always check the battery for signs of damage—such as dents, leaks, or discoloration—before installation. Batteries showing any of these signs must not be used and must be disposed of according to local hazardous waste regulations.

For long-term storage, it is recommended to remove the battery from the device and store it separately at 40–60% charge in a cool, dry place away from moisture and direct sunlight. Avoid exposing the battery to extreme temperatures, whether below 0 °C or above 60 °C, as this can permanently degrade performance and safety.

Proper use and maintenance of the battery will help maximize its service life, ensure safe operation of PowerFLARM Flex, and maintain compliance with regulatory requirements. Always follow local regulations for battery disposal and recycling.

10.1.2 General Safety Information

PowerFLARM Flex and its associated components must be installed and operated in accordance with this manual and applicable aviation regulations. Installation must be conducted only by trained and qualified personnel to ensure proper integration into the aircraft and safe long-term operation. Incorrect installation may compromise system performance or interfere with other onboard equipment.

10.1.3 Electrical Installation Precautions

When powering over RJ45 port, PowerFLARM Flex must be connected via a dedicated 3 A circuit breaker or switch, separate from essential avionics systems. This allows the device to be isolated in flight without affecting critical flight instruments. Power wiring must follow aircraft electrical standards and be protected against overcurrent. Ensure all connections are mechanically secure, free of corrosion, and safely routed.

10.1.4 User Responsibility

It is the responsibility of the operator to ensure that the device is installed, configured, and used under safe and compliant conditions. The physical installation, electrical connection, and environmental exposure must all meet the applicable requirements for the aircraft type and location of use. Following the guidelines in this manual will help ensure reliable performance and flight safety.

10.2 Warranty Information and Terms of Use

Any warranty is immediately void should the device be opened, misused, or installed incorrectly. EULA including Terms of use is applicable. The latest version applicable when this manual was published can be found in Appendix C .

10.3 Conformity Declarations

10.3.1 CE

Declaration of Conformity

Manufacturer:
FLARM Technology AG
Industriestrasse 49
6300 Zug, Zug, Switzerland

FLARM Technology AG declares under our sole responsibility that:

Product Name: PowerFLARM Flex, PowerFLARM Flex Pure
Product Model(s): FLAFLX10W, FLAFLY10W

Complies with the following European Directives:
2014/53/EU Radio Equipment Directive (RED)
2011/65/EU on the Restriction of Hazardous Substance (RoHS)

The following standards have been applied:

Safety & Health (Article 3.1a):
EN 62368-1:2014+A11:2017
EN 50663:2017 / EN 62479:2010

EMC (Article 3.1b):
EN 301 489-1 V2.2.3
EN 301 489-3 V 2.3.2
EN 301 489-17 V3.2.4
EN 301 489-19 V2.2.1

RF Spectrum Efficiency (Article 3.2):
EN 300 220-1 V3.1.1
EN 300 220-2 V3.2.1
EN 300 328 V2.2.2

Additional Compliance:
EN IEC 63000:2018

The technical documentation required to demonstrate that the products meet the requirements of the aforementioned directives has been compiled and is available for inspection by the relevant enforcement authorities.

Signed: Thomas Kaufmann
Title: CTO

Date: 15.04.2025

10.3.2 FCC Compliance Statement

Contains FCC ID: 2AC7Z-ESPS3MINI1

This device complies with part 15 of the FCC Rules. 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.

CAUTION: The grantee is not responsible for any changes or modifications not expressly approved by the party responsible for compliance. Such modifications could void the user's authority to operate the equipment.

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy, and if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

10.3.3 Canadian Compliance Statement

Contains IC: 21098-ESPS3MINI1

This device contains license-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada license-exempt RSS(s). Operation is subject to the following two conditions:

(1) This device may not cause interference.
(2) This device must accept any interference, including interference that may cause undesired operation of the device.

L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique 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;

2) L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

10.3.4 Supplier's Declaration of Conformity

47 CFR § 2.1077 Compliance Information

Product Name: PowerFLARM Flex, PowerFLARM Flex Pure

Product Model: FLAFLX10W, FLAFLY10W

Manufacturer:

FLARM Technology AG
Industriestrasse 49
6300 Zug, Zug, Switzerland

info@flarm.com
www.flarm.com

Modular Components Used:

NAME: 2.4GHz Wi-Fi & BT IoT Module

MODEL: ESP32-S3-MINI-1

FCC ID: 2AC7Z-ESPS3MINI1

This device complies with part 15 of the FCC Rules. 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.

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.

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

Appendix A List of Error Codes

The table below lists the error codes that can be indicated and their meaning. The hexadecimal value of the error code is shown. Some displays may instead indicate the decimal value and/or a text description. The possible error code range is from 0 to FFF.

Error Code (Hex)	Meaning
11	Firmware expired (requires valid GNSS information, i.e. will not be available during the first minutes after power-on)
12	Firmware update error
21	Power (e.g. voltage below minimum)
22	UI error
23	Audio error
24	ADC error
25	SD card error
26	USB error
27	LED error
28	EEPROM error
29	General hardware error
2A	Transponder receiver Mode-C/S/ADS-B unserviceable
2B	EEPROM error
2C	GPIO error
2D	Crypto Chip Error
31	GNSS communication
32	Configuration of GNSS module
33	GNSS antenna
41	RF communication
42	Another FLARM device with the same Radio ID is being received. Alarms are suppressed for the relevant device.
43	Wrong ICAO 24-bit address or radio ID
51	Communication
61	Flash memory
71	Pressure sensor
72	Inertial Measurement Unit
81	Obstacle database (e.g. incorrect file type)
82	Obstacle database expired
91	Flight recorder
93	Engine-noise recording not possible
94	Range analyzer
A1	Configuration error, e.g. while reading flarmcfg.txt from SD/USB
B1	Invalid obstacle database license (e.g. wrong serial number)
B4	License coherency error

100	Generic error
101	Flash File System error
110	Failure updating firmware of external display
120	Device is operated outside the designated region; the device does not work
F1	Other

Appendix B Annual Maintenance Checklist

The following checklist shall be completed during annual maintenance, i.e. every 12 calendar months.

#	Item	Description
1	Mechanical Attachment	Verify that the PowerFLARM Flex and any installed accessories (e.g., mounts, external display) are securely fastened with no signs of movement, wear, or mechanical stress.
2	Placement	Confirm that the device has an unobstructed view of the sky and a sufficient horizontal line of sight. Avoid placement near metallic objects or high-interference sources (e.g., avionics, antennas).
3	Wiring	Visually inspect all cables and connectors (USB, RJ45) for signs of wear, damage, corrosion, or water ingress.
4	Range analysis	After a few representative flights, use the Range Analyzer in FLARM Hub to verify acceptable radio performance. Omnidirectional range should typically exceed 5 km.
5	Reset CARP	Reset the Continuous Analyzer of Radio Performance (CARP) via FLARM Hub to start a fresh monitoring cycle.
6	Firmware update	Ensure that the PowerFLARM Flex firmware and FLARM Hub firmware are updated to the latest available versions. Updates are facilitated via the FLARM Hub App.
7	Display update	If a compatible external display is connected, update its firmware to the latest version provided by the display manufacturer.
8	Configuration	Review the PowerFLARM firmware release notes for any newly introduced or modified configuration options. If applicable, reconfigure settings using FLARM Hub. Pay particular attention to aircraft type, ICAO address, and transponder settings.
9	Obstacle database update	If the obstacle database is installed, update to the latest version available from the FLARM website.
10	Status/Error conditions	Power on the device and verify that no errors or warnings appear on the integrated display or in FLARM Hub. If any messages are shown, refer to Appendix A to determine severity and corrective action. Confirm GPS lock within 15 minutes of power-on, with the device positioned outside and in clear view of the sky. Ensure that all connected displays show normal status.

Appendix C End User License Agreement (EULA)

By purchasing or using a FLARM device or by downloading, installing, copying, accessing, or using any FLARM Technology Ltd, Cham, Switzerland (hereafter "FLARM Technology") software, firmware, license key, or data, you agree to the following terms and conditions. If you do not agree with the terms and conditions do not purchase or use the FLARM device and do not download, install, copy, access, or use the software, firmware, license key, or data. If you are accepting these terms and conditions on behalf of another person, company, or other legal entity, you represent and warrant that you have full authority to bind that person, company, or legal entity to these terms and conditions.

If you are purchasing or using a FLARM device, the terms "firmware", "license key", and "data" refer to such items installed or available in the FLARM device at time of purchase or use, as applicable.

1. **License and Limitation of use**
   - 1.1. **License**. Subject to the terms and conditions of this Agreement, FLARM Technology hereby grants to you a non-exclusive, non-transferable right to download, install, copy, access, and use the software, firmware, license key, or data in binary executable form solely for your own personal or internal business operations. You acknowledge that the software, firmware, algorithms, license key, or data and all related information are proprietary to FLARM Technology and its suppliers.
   - 1.2. **Limitation of use**. Firmware, license keys, and data may only be used as embedded in and for execution on devices manufactured by or under license from FLARM Technology. License keys and data may only be used in the specific devices, by serial number, for which they were sold or intended. Software, firmware, license keys, and data with an expiration date may not be used after the expiration date. Right to download, install, copy, access, or use software, firmware, license key, or data with an expiration date does not imply right to upgrade or extension of the license beyond the expiration date. No other licenses are granted by implication, estoppel or otherwise.
2. **Terms of use of FLARM**
   - 2.1. Every FLARM installation must be approved by licensed Part-66 certifying staff or the national equivalent. A FLARM installation requires an EASA Minor Change Approval or the national equivalent.
   - 2.2. FLARM must be installed according to the Installation Instructions and the EASA Minor Change Approval, or the national equivalent.
   - 2.3. FLARM cannot warn in all situations. In particular warnings may be incorrect, late, missing, not being issued at all, show other threats than the most dangerous or distract the pilot's attention. FLARM does not issue resolution advisories. FLARM can only warn of aircraft that are equipped with FLARM, SSR transponders (in specific FLARM devices), or of up-to-date obstacles stored in its database. The use of FLARM does not allow a change of flight tactics or pilot behavior. It is the sole responsibility of the pilot in command to decide upon the use of FLARM.
   - 2.4. FLARM may not be used for navigation, separation, or under IMC.
   - 2.5. FLARM does not work if GPS is inoperative, degraded, or unavailable for any reason.
   - 2.6. The most recent Operating Manual must be read, understood and followed at all times.
   - 2.7. The firmware must be replaced once per year (every 12 months). The firmware must also be replaced earlier if a Service Bulletin or other information is published with such instruction. Failure to replace the firmware may render the device inoperable or incompatible with other devices, with or without warning or notice thereof.
   - 2.8. Service Bulletins are published as a Newsletter by FLARM Technology. You are required to sign up for the Newsletter on www.flarm.com to ensure that you are informed of published Service Bulletins. If you are entering into this agreement in a form where your email address is available (e.g. online shop) you may be automatically signed up for the Newsletter.
   - 2.9. After power-up, FLARM performs a self-test which must be monitored by the pilots. If a malfunction or defect is observed or suspected, FLARM must be disconnected from the aircraft by maintenance before the next flight and the device inspected and repaired, as applicable.
   - 2.10. The pilot in command is solely responsible to operate FLARM according to applicable national regulations. Regulations might include, but are not limited to, airborne usage of radio frequencies, aircraft installation, safety regulations, or regulations for sports competitions.
3. **Intellectual Property**. No part of the software, firmware, license keys, data (including obstacle databases), the FLARM radio protocol and messages, and the FLARM hardware and design may be copied, altered, reverse engineered, decompiled or disassembled without an explicit and written approval by FLARM Technology. Software, firmware, license keys, data (including obstacle databases), the FLARM radio protocol and messages, the FLARM hardware and design, and the FLARM logos and name are protected by copyright, trademark and patent laws.
4. **Manipulation**. It is forbidden to intentionally feed artificially generated signals to the FLARM device, its GPS antenna or the external/internal GPS antenna connections, unless agreed with FLARM Technology in writing for limited R&D activities.
5. **FLARM Data and Privacy**
   - 5.1. FLARM devices receive, collect, store, use, send, and broadcast data to enable the system to work, improve the system, and to enable troubleshooting. This data may include, but is not limited to, configuration items, aircraft identification, own positions, and such data of other aircraft. FLARM Technology may receive, collect, store, and use this data for said or other purposes including Search and Rescue (SAR).
   - 5.2. FLARM Technology may share data with its partners for aforementioned or other purposes. FLARM Technology may in addition publicly make available data from a FLARM device (Flight Tracking). If a FLARM device has been configured to limit tracking, SAR and other services may not be available.
   - 5.3. Data sent or broadcast by FLARM devices may only be used at own risk and under the same conditions as the FLARM device itself, and is encrypted partially to ensure message integrity, system safety and provide protection for the relevant content against eavesdropping, namely by article 3 of the Budapest Convention on Cybercrime as signed and ratified by most countries respectively its national implementations. FLARM Technology is not responsible for any third party device, software, or service receiving, collecting, storing, using, sending, broadcasting, or making publicly available data regardless of whether legally or illegally.

6. **Warranty, Limitation of Liability, and Indemnification**
   - 6.1. **Warranty**. FLARM devices, software, firmware, license keys, and data are provided on an "as is" basis without warranty of any kind — either expressed or implied — including, without limitation, any implied warranties of merchantability or fitness for a particular purpose. FLARM Technology does not warrant the performance of the device, software, firmware, license key, or data or that the device, software, firmware, license key, or data will meet your requirements or operate error free.
   - 6.2. **Limitation of Liability**. In no event shall FLARM Technology be liable to you or any party related to you for any indirect, incidental, consequential, special, exemplary, or punitive damages (including, without limitation, damages for loss of business profits, business interruption, loss of business information, loss of data or other such pecuniary loss), whether under a theory of contract, warranty, tort (including negligence), products liability, or otherwise, even if FLARM Technology has been advised of the possibility of such damages. In no event will FLARM Technology's total aggregate and cumulative liability to you for any and all claims of any kind arising hereunder exceed the amount of fees actually paid by you for the device, license keys or data giving rise to the claim in the twelve months preceding the claim. The foregoing limitations will apply even if the above stated remedy fails of its essential purpose.
   - 6.3. **Indemnification**. You will, at your own expense, indemnify and hold FLARM Technology, and all officers, directors, and employees thereof, harmless from and against any and all claims, actions, liabilities, losses, damages, judgments, grants, costs, and expenses, including reasonable attorneys' fees (collectively, "Claims"), arising out of any use of a FLARM device, software, firmware, license key, or data by you, any party related to you, or any party acting upon your authorization.
7. **General terms**
   - 7.1. **Governing Law**. This Agreement shall be governed by and construed in accordance with the internal law of Switzerland (to the exclusion of Swiss Private International Law and of international treaties, in particular the Vienna Convention on the International Sale of Goods dated April 11, 1980).
   - 7.2. **Severability**. If any term or provision of this Agreement is declared void or unenforceable in a particular situation, by any judicial or administrative authority, this declaration shall not affect the validity or enforceability of the remaining terms and provisions hereof or the validity or enforceability of the offending term or provision in any other situation. To the extent possible the provision will be interpreted and enforced to the greatest extent legally permissible in order to effectuate the original intent, and if no such interpretation or enforcement is legally permissible, shall be deemed severed from the Agreement.
   - 7.3. **No Waiver**. The failure of either party to enforce any rights granted hereunder or to take action against the other party in the event of any breach hereunder shall not be deemed a waiver by that party as to subsequent enforcement of rights or subsequent actions in the event of future breaches.
   - 7.4. **Amendments**. FLARM Technology reserves the right, in its sole discretion, to amend this Agreement from time to time by posting an updated version of the Agreement on www.flarm.com, provided that disputes arising hereunder will be resolved in accordance with the terms of the Agreement in effect at the time the dispute arose. We encourage you to review the published Agreement from time to time to make yourself aware of changes. Material changes to these terms will be effective upon the earlier of (i) your first use of the FLARM device, software, firmware, license key, or data with actual knowledge of such change, or (ii) 30 days from publishing the amended Agreement on www.flarm.com. If there is a conflict between this Agreement and the most current version of this Agreement, posted at www.flarm.com, the most current version will prevail. Your use of the FLARM device, software, firmware, license key, or data after the amended Agreement becomes effective constitutes your acceptance of the amended Agreement. If you do not accept amendments made to this Agreement, then it is your responsibility to stop using the FLARM device, software, firmware, license key, and data.
   - 7.5. **Governing Language**. Any translation of this Agreement is done for local requirements and in the event of a dispute between the English and any non-English versions, the English version of this Agreement shall govern.