## Document status

| Published status | | Confidentiality status | |
|---|---|---|---|
| ☐ | Draft | ☐ | Internal |
| ☒ | Released | ☐ | NDA |
| ☐ | Canceled | ☒ | Public |

## Version control

| Ver. | Date | Summary of changes |
|---|---|---|
| **2.00** | 2016-06-24 | New format. Partially rewritten and restructured. Model and Version info added. Radio Communication. Editorial changes. |
| 2.10 | 2017-02-28 | ADS-B Alerts. Max supply voltage increased to 32 V. Editorial changes. |

# Table of contents

# 1    Abbreviations

| Term | Meaning |
|------|---------|
| **ADS-B** | Automatic Dependent Surveillance – Broadcast |
| **AMP** | Aircraft Maintenance Program |
| **ATC** | Air Traffic Control |
| **CB** | Circuit Breaker |
| **DC** | Direct Current |
| **ENL** | Engine Noise Level recording |
| **FAT** | File Allocation Table |
| **FR** | Flight Recorder |
| **GND** | Ground |
| **GNSS** | Global Navigation Satellite System |
| **GPS** | Global Positioning System |
| **H/W** | Hardware |
| **HEX** | Hexadecimal |
| **IGC** | International Gliding Commission |
| **LED** | Light-emitting Diode |
| **LNA** | Low-noise Amplifier |
| **MCA** | Minor Change Approval |
| **MFD** | Multi-function Display |
| **MTOM** | Maximum Takeoff Mass |
| **PDA** | Personal Digital Assistant |
| **PIC** | Pilot In Command |
| **RF** | Radio/Radio frequency |
| **RX** | Receive/Reception |
| **SSR** | Secondary Surveillance Radar |
| **TCAS** | Traffic Collision Avoidance System |
| **TX** | Transmit/Transmission |
| **VMC** | Visual Meteorological Conditions |
| **XPDR** | Transponder |

## 2 Parts List

PowerFLARM Core is normally shipped with the following parts:

- 1 PowerFLARM Core (golden metallic box)
- 1 FLARM radio antenna with 1m/3ft cable and SMA connector marked RED
- 1 GPS antenna with 2m/6ft cable
- 1 ADS-B/SSR antenna with 1m/3ft cable and SMA connector marked BLUE (only PowerFLARM Core ADS-B devices)
- 1 power/data cable D-Sub DE9 with 1m/3ft cable and one open-cut end
- 1 USB extension cable (deliveries after January 2014)

The supplied antennas are suitable for internal installation only (inside the aircraft). External antennas are strongly recommended for most aircraft. See section 5.4 for using external antennas.

PowerFLARM Core connects to a wide range of FLARM displays, display interfaces, PDAs, on-board flight computers, moving map applications, and MFDs.

The typical installation connects to a remote FLARM display. Suitable cables providing power and data are normally delivered with the display.

Cable extensions, antennas, and other accessories are available from FLARM dealers and avionics suppliers.

### 2.1 Models & Versions

The model and version of PowerFLARM Core can be identified from the Part No. The Part No. has the format FLAPFxnny, where x is the model designator and y the version designator. nn is the hardware version number.

There are two different PowerFLARM Core models:

**PowerFLARM Core Pure**      Communicates with other FLARM devices. Model designator: **D**

**PowerFLARM Core ADS-B**      Also receives ADS-B and Mode-C/S transponder equipped aircraft. Model designator: **C**

In addition, there are two versions of PowerFLARM Core. Each version works only in either of the two radio bands SRD860 and ISM, used in different parts of the world. The version can be identified from the last letter in the Part No. The letter **E** indicates an SRD860 version and the letter **A** indicates an ISM version.

## 3    Radio Communication

The FLARM system uses a data communication frequency in the SRD860 band or in an ISM band in different parts of the world. Both bands are free to use within prescribed limitations. The bands are however also free to use by anybody else who adheres to the requirements and limitations. Because of the limitations in power output, ground based use in these frequency bands does not have an effect on FLARM communication.

The radio transmission protocol employed by FLARM places no limit on the number of devices that may be operated within a given range. An increasing number of devices within range is only associated with a reduction in the probability that a particular coded signal will be received ("graceful degradation"). The probability is negligible that subsequent signals will not be received from the same transmitter.

The following frequencies are used within the specified areas.

| Area | Frequency | Version[*] |
|------|-----------|---------|
| **Africa** | 868.2 – 868.4 MHz | E |
| **Australia** | 917.0 – 926.6 MHz | A |
| **Europe** | 868.2 – 868.4 MHz | E |
| **Israel** | 916.2 MHz | A |
| **New Zealand** | 869.2 MHz | E |
| **North America** | 902.2 – 927.8 MHz | A |
| **South America** | 917.0 – 926.2 MHz | A |

[*] See section 2.1

The fact that a frequency or range has been assigned for a geographical area does not necessarily imply that the frequency is free to use in the whole area. Consult a FLARM dealer before using FLARM in a new country.

Communication between FLARM devices employ a proprietary, encrypted, and copyright protected protocol. The design is patent protected. Any unlicensed use, copying, distribution, conversion, replication, access, interception, de-compiling, reverse engineering, or further transmission of knowledge so acquired relating to the system components or software/firmware, in whole or in part, is forbidden and will result in legal enforcement action.

# 4    Working Principle

Based on GPS and a pressure sensor, FLARM predicts the short-term future flight path and continuously broadcasts this to nearby aircraft by a digital radio message. FLARM systems in nearby aircraft receive the radio message and return a similar message with the same set of data. FLARM is thus able to calculate conflicting flight patterns and issue collision warnings. In addition, many FLARM displays can display the relative position of nearby aircraft.

PowerFLARM Core ADS-B also receives data from aircraft with transponders (Mode-C and Mode-S) and ADS-B Out (1090ES), and uses these messages for traffic information and warnings.

If available, PowerFLARM Core ADS-B uses the barometric altitude from the own Mode-S transponder. In other cases, PowerFLARM Core ADS-B uses barometric altitude derived from the built-in pressure sensor. Barometric altitude is used for determining the relative altitude of SSR targets.

The effective range depends on the type and position of installed antennas. External FLARM antennas are recommended for most aircraft.

Collision warnings are issued depending on the time remaining to a potential collision, not the geometric distance between the aircraft. The first warning is typically issued between 19 and 25 seconds before the calculated potential collision with an aircraft or obstacle (time to impact). The second warning is issued 14 to 18 seconds in advance and the third warning 6 to 8 seconds in advance. Warnings are sustained as long as the threat remains. Depending on changes in the prediction, the threat may also be downgraded or cease. Warnings are selective, i.e. they are only issued if the calculation detects a high probability of a collision within the next 19-25 seconds.

FLARM also warns about obstacles on the ground (cables, masts, etc.) if the current database is installed. Databases are available for purchase on https://flarm.com/shop/ and should be updated at least annually.

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

## 4.1     ADS-B Alerts

ADS-B Out broadcasts have been designed for ground based surveillance by ATC for IFR separation purposes. The use of ADS-B for collision avoidance is often limited by factors such as:

- Absence of horizontal and/or vertical speed data, including heading/track

- Absence of GPS altitude data

- Erroneous or inaccurate transmission of position and/or velocity data

- Time lag in position data

Practical experience shows that warnings based on ADS-B can be useful to warn about traffic in cruise or during relatively flat turns such as standard procedure turns. However, ADS-B does not provide sufficiently precise data to warn about aircraft conducting aerial work or glider traffic with its frequent altitude changes and steep turns.

To ensure high alert quality, PowerFLARM Core does not use ADS-B data to compute alerts for targets which also have FLARM.  Instead, it will exclusively rely on the target's much more precise FLARM data. This requires that all aircraft which are equipped with FLARM *and* ADS-B Out correctly configure their ICAO 24-bit address in both FLARM and the transponder/ADS-B Out equipment. To ensure reliable alerts, it's important that aircraft equipped with ADS-B Out also have FLARM installed.

# 5    Installation

## 5.1    General Advice on Installation

Installation and operation is on a non-interference and non-hazard basis, and may not endanger the safe operation of certified equipment that is either necessary or required by regulations for safe flight. Installation must comply with legal requirements and may only be performed by competent personnel. Following installation in certified aircraft, a Certificate of Release to Service (CRS) needs to be issued by Part-66 certifying staff. Unauthorized installations will void warranty.

**For certified aircraft, an MCA (Minor Change Approval) or Standard Change installation with appurtenant documents is required. The official MCA for powered airplanes with MTOM not above 2.000 kg and gliders can be acquired from the following link:**

**https://flarm.com/shop/easa-minor-change-approval-mca/**.

**The documents that constitute the MCA are also required for a Standard Change installation. The documents include Installation instructions as well as Instructions for continued airworthiness.**

The installation must not obstruct the pilots in their operation of the aircraft (including emergencies); in particular, it must not obstruct outside view.

Only one single FLARM transceiver may be installed in the aircraft.

PowerFLARM Core should be installed at least 30cm/1ft away from the magnetic compass.

After installation, an inspection must be made to ensure that the installation does not interfere with any mechanical, electrical, electronic (radio), or magnetic (e.g. compass) system. The installation shall be recorded in the aircraft maintenance documents. The annual maintenance (see chapter 8) shall be added to the Aircraft Maintenance Program (AMP); see MCA documents for details. An approved AFM Supplement is to be carried on board the aircraft. An EASA approved AFM Supplement is available as part of the MCA.

After the first few flight hours, the installation should be verified by using the online range analyzer:

http://flarm.com/support/tools-software/flarm-range-analyzer/

See also the Quick Checklist for FLARM installations:

http://flarm.com/support/manuals-documents/.

## 5.2 Housing

The metallic housing is not waterproof and ingress of solid particles and liquids should be avoided. 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 warranty claim will be accepted for any device damaged by moisture or liquids. Should the device be suddenly cooled, this may result in the formation of condensation.

## 5.3 Connections & Cabling

### 5.3.1 Overview
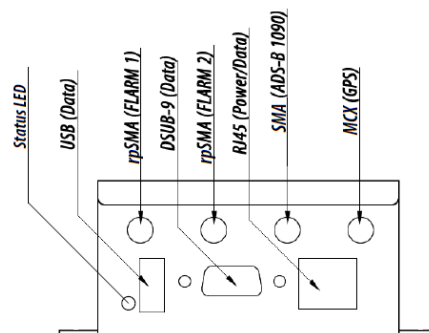


PowerFLARM Core has the following connectors:

- USB 2.0: Flight log readout, device update and configuration.

- FLARM antennas A and B: When using a single antenna, connect to FLARM A. Antenna connector has a RED marking. Use of FLARM B requires a feature license.

- ADS-B/SSR: For receiving transponder signals. Antenna connector has a BLUE marking. (PowerFLARM Core ADS-B only).

- GPS antenna: Must be connected for proper operation.

- Data Ports #1 (RJ45) and #2 (D-Sub DE9): For connecting up to two independent FLARM displays/PDAs/flight computers. Also used for power supply of PowerFLARM Core. RX/TX on ports #1 and #2 can be configured and used independently.

### 5.3.2     General Advice

- Before connecting the cables for the first time, check all connectors with a continuity tester. Pay special attention to the power supply pins.

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

- Cables must not be cracked, excessively bent, or installed under tension. Adequate space must be left for the cable connectors.

### 5.3.3     Circuit Breaker

- Connect PowerFLARM Core (and if applicable the FLARM display) via a dedicated pilot-operated 1-3 A CB or combined CB/Switch.

- The PowerFLARM Core CB must be separate from other CBs of essential avionics.

- In flight, the pilots must be able to isolate PowerFLARM Core from the aircraft's electrical system without interrupting the power supply to other essential avionics.

### 5.3.4     Power Supply

- Supply voltage: 12 to 32 V DC.

- Typical current drain 165 mA @ 12 V, less for higher voltages, more if external components are supplied by PowerFLARM Core.

- Connect power either through the D-Sub (pin 7) or the RJ45 connector (pin 1 and 2); do not provide power to both!

### 5.3.5     Display

- Use only high quality shielded cables for the RX and TX connections.

- Up to 5m cable length are acceptable.

- In case the display requires 3 V DC operating voltage, the respective connection on the RJ45 or D-Sub connector may be used. Otherwise, the display should be connected to power according to section 5.3.3.

### 5.3.6 RJ45: Power and Data Connections

⚠️ **Connecting power to an incorrect pin will burn the circuit boards, make the device unusable, and void any warranty**

The 8-pin RJ45-socket is in accordance with IGC GNSS FR specifications, except for pin 3. Pin numbering follows IGC's convention (http://www.fai.org/gnss-recording-devices/igc-approved-flight-recorders ):
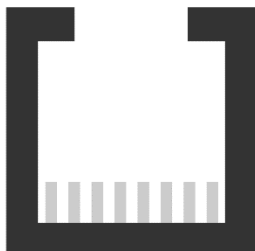
1: +12 to +32 V DC power supply
2: +12 to +32 V DC power supply
3: Core supplies +3 V DC for display
4: GND
5: TX, Core sends (RS-232)
6: RX, Core receives (RS-232)
7: GND
8: GND

Pin 1   …   Pin 8

Pin 5 transmits NMEA 0183 Version 2.0 data at a configured data rate (default is 19.2 kBaud). Further FLARM-specific data is available for connected devices (e.g. remote displays).

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

Maximum current on pin 3: 200mA @ 3 V DC.

**Note:** Pin 7 of the D-Sub connector and Pins 1 and 2 of the RJ45 connector are internally connected. So are the GND pins 5 (D-Sub) and 4, 7, 8 (RJ45).

### 5.3.7 D-Sub DE9: Power, Data and Audio Connections

⚠️ **Connecting power to an incorrect pin will burn the circuit boards, make the device unusable, and void any warranty**

The 9 pin DE9 connector is shown below. On the left side, the female socket on the PowerFLARM Core is shown. On the right side, the male plug (on the cable) is shown.



1: Audio OUT (referenced to GND; H/W versions >= 1.1 only)
2: TX, Core sends (RS-232)
3: RX, Core receives (RS-232)
4: Do not connect
5: GND
6: Do not connect
7: +12 to +32 V DC power supply
8: Core supplies +5 V DC for PDA
9: Core supplies +3 V DC for display

Pin 2 transmits NMEA 0183 Version 2.0 data at a configured data rate (default is 19.2 kBaud). Further FLARM-specific data is available for connected devices (e.g. remote displays).

Do not connect more than one external application to the RS-232 port.

Maximum current on pin 9: 200mA @ 3 V DC; independent of pin 3 of the RJ45 connector.

Maximum current on pin 8: 700mA @ 5 V DC; shared with the USB port.

Avoid using the 5 V DC supply from the USB port and the D-Sub port at the same time.

D-Sub cables shipped with PowerFLARM Core devices from 2016 are color coded according to the following table. These D-Sub cables are marked with "Art.-Nr 1420531". **DO NOT use the color coding if the cable is not marked accordingly**.

> ⚠ **The below color assignments are only valid for specific D-Sub cables which have been shipped with devices from 2016, as described above**

| | Color | Pin |
|---|---|---|
| | Grey | Pin 1: Audio OUT |
| | Yellow | Pin 2: TX, Core sends (RS-232) |
| | Green | Pin 3: RX, Core receives (RS-232) |
| | Brown | Pin 4: Do not connect |
| | White | Pin 5: GND |
| | Red | Pin 7: +12 to +32 V DC power supply |
| | Pink | Pin 8: Core supplies +5 V DC for PDA |
| | Blue | Pin 9: Core supplies +3 V DC for display |

**Note:** There is no wire for Pin 6!

**Note:** Pin 7 of the D-Sub connector and Pins 1 and 2 of the RJ45 connector are internally connected. So are the GND pins 5 (D-Sub) and 4, 7, 8 (RJ45).
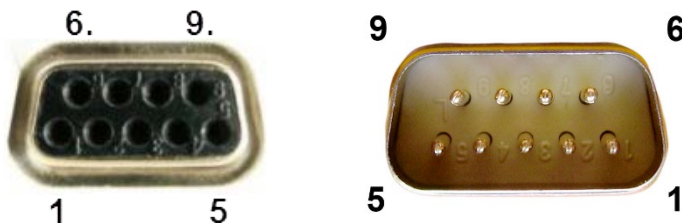
### 5.3.7.1 Audio OUT

Audio OUT (pin 1) is available for hardware version 1.1 (FLAPFx11y) and later, provided the corresponding feature license is installed. PowerFLARM Core emits 1kHz beeps on Audio OUT whenever dangerous traffic is detected. A test beep is emitted after power up.

Dedicated FLARM displays normally have their own sound generator (buzzer). Audio OUT is only necessary when the buzzer of the connected FLARM display is not loud enough to be heard in a high-noise environment.

Electrical characteristics:

- AC signal, 1.7 V peak-to-peak @ 1 kOhm

- Referenced to GND (pin 5), no DC bias

- Output impedance: 47 Ohm

- Output current (max.): 35mA

Connect Audio OUT to the audio panel or other amplifier with input impedance between 200 Ohm and 10 kOhm. The audio panel or amplifier should allow volume adjustment.

**Note:** Do not connect a passive headset or speaker directly to Audio OUT.

### 5.3.8 FLARM and ADS-B/SSR Antenna Connectors (SMA)



A-version devices (part No. FLAPFCnnA and FLAPFDnnA): FLARM A and B ports are reverse polarity female SMA connectors with a pin as center conductor. ADS-B is a standard female SMA connector with a female center sleeve.



E-version devices (part No. FLAPFCnnE and FLAPFDnnE): FLARM A and B ports are standard female SMA connectors with a female center sleeve. ADS-B is a reverse polarity female SMA connector with a pin as a center conductor.

⚠️ **Never swap the FLARM and ADS B antennas. Doing so may cause permanent mechanical damage to the device and will void warranty**

The difference between device versions is due to regulatory requirements.

Both FLARM and the ADS-B antennas must be mounted vertically.

### 5.3.8.1 FLARM Antennas (SMA Connector, RED Marking)

PowerFLARM Core has two separate FLARM radio transceivers: FLARM A and FLARM B. **FLARM A is used to receive and transmit and must always be connected to an antenna**. FLARM B is only used to receive and may be used for better reception performance.

Usage of FLARM B requires purchase of a feature license.

Ensure that the antenna cables are properly and fully screwed into the device. **Never swap the FLARM and the ADS-B/SSR antennas.** Use only little force when inserting and tightening (1 Nm max). Ensure the antennas are not in contact with any other object through which there might be a regular electrostatic discharge, e.g. the canopy. In case two FLARM antennas are used, ensure that they are separated by at least 2m/6ft.

In gliders, ideal locations for the internal FLARM antennas are:

- On the glare shield, in front of the compass (10 cm/4 inch min distance to compass)
- In the tail fin of the aircraft, if not metal or carbon. Use only approved aviation cables (see section 5.3).
- Behind the pilot's head in the fuselage (not in gliders with metal or carbon fuselage)

The FLARM antennas must be mounted vertically.

### 5.3.8.2 ADS-B/SSR Antenna (SMA Connector, BLUE Marking)

PowerFLARM Core ADS-B has one ADS-B/SSR receiver operating on 1090 MHz. Ensure that the antenna cable is properly and fully screwed into the device. **Never swap the FLARM and the ADS-B/SSR antennas**. Use only little force when inserting and tightening (1 Nm max).

This antenna should be placed at least 30cm/1ft away from the FLARM antennas. The FLARM antennas have priority over this antenna for best placement.

### 5.3.9 GPS Antenna (MCX Connector)

PowerFLARM Core contains a 50 channel GPS receiver, connecting to an external antenna. Ensure that the antenna cable is properly and fully screwed into the device. PowerFLARM Core will not work without good GPS reception.

The GPS antenna should be mounted in a horizontal position such that it has an unhindered view of the sky, including when the aircraft is in a bank. There should be no electrically conducting surfaces (e.g. metal, carbon fiber) 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 in the aircraft, it is recommended that they are at least 30cm/1ft apart; the same holds for separation from all other antennas connected to PowerFLARM Core.

## 5.4 External Antennas

The internal FLARM antennas provided with PowerFLARM Core are suitable for internal use only in glass fiber gliders. External FLARM antennas are required in other aircraft. External antennas for SSR/ADS-B are recommended for aircraft with MTOM above 2.000 kg, as well as lighter aircraft where installation of the internal antenna is not feasible. If external antennas are installed, follow the requirements below.

- Antenna cables shall be 50 Ω RG58, RG142B, RG142B/U, RG400, or equivalent.
- Minimize cable lengths to ensure maximum signal strength.
- Antennas should be spaced at least 30cm apart, including other antennas like COM/NAV, XPDR, etc.

### 5.4.1 FLARM A/B

- Total attenuation of the cable at 900MHz should not exceed 3dB.
- Suitable antennas: FLARM AV-75 (part. No. ANTCEFLA and ANTCEFLAB); EASA approved as part of the MCA.
- The primary antenna (FLARM A) should have good view upwards and into the direction of flight and normally be placed on top of the aircraft. FLARM B (if installed) should be placed to complement the field of view of FLARM A, normally below the aircraft.
- The antennas must be mounted vertically.

### 5.4.2    SSR/ADS-B

- Suitable antennas: RAMI AV-74, RAMI AV-22, TED 104-12, COMANT CI 105, COMANT CI 101.

- The antenna must be mounted vertically, normally on top of the aircraft.

### 5.4.3    GPS

- Use low-loss 50Ω coaxial cable. Attenuation values at 1.57GHz are relevant.

- Use a low-profile aviation GPS antenna with built-in preamplifier, e.g. Sensor Systems S67-1575-39 or S67-1575-49.

- Preamplifier gain minus cable attenuation must exceed 17dB.

- The antenna must accept PowerFLARM Core's 4.75 V supply and must not draw more than 200mA. DC resistance of the cable must be taken into account.

- The antenna should be mounted horizontally with a good sky view.

- Operation with an existing GPS antenna and an RF splitter may be possible provided the antenna has a high gain preamplifier and cable losses are not too high. A splitter with a DC block on one path must be used.

## 5.5    USB

Core has a built-in USB A 2.0 connector for a memory stick. The stick is used for device updates and readout of device information and flight records. See sections 6, 7, and 8  for details. Maximum size is limited by the FAT system (32GB).

For updates and configuration, the USB connector must be readily accessible via the supplied USB extension cable. The USB extension cable should normally be installed in the instrument panel.

**The USB stick must not be connected during flight**.

USB stick transactions take place automatically:

- Whenever PowerFLARM Core is switched ON with a USB stick connected.

- When triggered by a display or flight computer (e.g. readout of flight records).

Transactions when switching PowerFLARM Core ON are executed in the following sequence:

- Apply device configuration (FLARMCFG.TXT)

- Write device information (FLARMDEV.CSV)

- Updates: Firmware, obstacle database, licenses. (PowerFLARM Core restarts if any update is done (Status LED OFF for three seconds); this is to allow expedited updates of multiple devices.)

- Butterfly display firmware update

- Flight record readout

USB sticks should:

- Be formatted with FAT (FAT16 or FAT32) file system (NTFS or exFAT will not work)

- Have a capacity <= 32GB

- Be of USB 2.0 type (not USB 3.0; USB 3.0 connectors are typically blue on the inside).

Suggestions for USB stick usage:

- Use a dedicated USB stick for the PowerFLARM device (Exception: Updates of multiple devices to the same firmware and/or obstacle database).

- Leave flight logs (IGC files) on the USB stick during the flying season. This will reduce the time needed for readout, because files already on the stick are skipped.

- Sort IGC files by date on the PC. The last file in the list then corresponds to the most recent flight.

- If multiple firmware update files are on the USB stick, PowerFLARM Core will choose the most recent one.

- Do not keep multiple obstacle database updates on the USB stick.

- PowerFLARM Core will skip firmware, license, and obstacle database updates which are already installed.

## 5.6 Status LED Indications

The Status LED can show three different colors: GREEN, AMBER and RED.

Please note that AMBER may appear similar to RED in devices produced prior to 2016. The color during the first few seconds after startup is AMBER.

The meaning of the Status LED indications is as follows:

- GREEN: Core operates normally
- AMBER during up to 20s after power ON: start-up sequence
- Permanent RED: Error condition, no operation possible (e.g. no GPS reception, low voltage)
- Permanent AMBER: Warning condition, operation possible (e.g. obstacle database out of date)
- RED/GREEN flashing: on-going data upload/download with USB memory stick
- OFF: no power

Indications while reading FLARMCFG.TXT files:

- One long GREEN flash: USB stick detected
- One short GREEN flash for each command executed successfully
- One short RED flash for each command causing an error (verify FLARMCFG.TXT in that case)

## 5.7  Configuration

Prior to first use, PowerFLARM Core must be configured correctly.

**Failure to configure or a false configuration may lead to failure to alert, failure to operate, or cause nuisance alarms!**

To configure the device:

- Use the online Configurator tool to generate a file FLARMCFG.TXT: http://flarm.com/support/tools-software/

- Copy this file to the root directory of the USB stick.

- To update several 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 can be found on the device sticker. Example: Part Number FLAPFD11E, Serial Number 002217; Configuration file name should be CFD02217.txt

- Connect the USB stick to the device and power on the system.

- Wait until the system has completed the startup sequence.

The Status LED will issue a long GREEN flash to acknowledge the presence of the FLARMCFG.TXT file and a short GREEN flash for each configuration line executed. RED flashes indicate an error; please verify the FLARMCFG.TXT file in that case.

Use only FAT formatted USB 2.0 sticks; see section 5.5 for details.

The configuration is stored permanently in the internal memory.  During normal operation, the USB stick should be removed from the device.

All configurations can also be made via the RS-232 interfaces. Refer to the display or flight computer's documentation for details.

## 5.8  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. The values chosen depend upon the aircraft and *must* be changed before the device is used in another aircraft.

The following settings are mandatory for correct operation of the device.

### 5.8.1  Aircraft Type

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

### 5.8.2 Transponder type

Select the type of transponder that is installed in the aircraft, or No transponder.

### 5.8.3 ICAO 24-bit Address

Enter the hexadecimal 24-bit ICAO address of the aircraft. This address is also known as the Mode-S Code. It is unique for each aircraft worldwide and issued by the local Civil Aviation Authority. In case a Mode-S transponder is installed, this is also the address transmitted by the transponder.

The ICAO address can be found in the aircraft documents. In some countries, the ICAO address is also published online:

- http://www.faa.gov/ (US; see 'N-Number Inquiry', use **Mode-S Code (base 16/hex)**; addresses start with 'A')

- https://www.bazl.admin.ch/bazl/en/home/specialists/aircraft/swiss-aircraft-registry.html (Switzerland; use **Aircraft Address (hex)**; addresses start with 4B)

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

Register the ICAO address for free at www.flarmnet.org.

### 5.8.4 Data Sentences

This setting affects the communication with the display. Recent FLARM displays are able to auto-configure PowerFLARM Core according to their needs. In this case, no changes from the defaults are required. Consult the display documentation for details.

Select Garmin TIS for TIS compatible devices (requires a feature license).

**Note:** Due to protocol limitations, traffic information using Garmin TIS may be too coarse for quick visual identification and no warnings may be given. A FLARM Compatible display should be used as the primary FLARM display.

### 5.8.5 Range Settings

We recommend ranges useful for collision avoidance, e.g. 600m for vertical and 5km for horizontal ranges.

FLARM Technology Ltd.
Lindenstrasse 4
CH-6340 Baar

**POWERFLARM CORE INSTALLATION MANUAL**

Date: 2017-02-28
Version: 2.10
Page: 23 of 34

Document Number:
**FTD-033**

### 5.8.6     IGC task declaration

Use the gliding computer or standard gliding software packages for declaring tasks.

## 6   Flight Recorder

In addition to providing traffic and obstacle warnings, PowerFLARM Core can operate as an IGC approved flight recorder.

Options for diamond-level IGC approval and for Engine Noise Level recording (ENL) are available; see section 7.

PowerFLARM Core has an internal memory for approximately 100 hours of flight recording at a 4s interval. Flight recording automatically starts when the aircraft starts moving and ends when the PowerFLARM Core is switched OFF or after more than 10 minutes without movement. When the memory is full, the oldest flights are overwritten first.

To read out the flights to the USB stick:

- Switch PowerFLARM Core OFF after flight (allow at least 2 minutes after landing to avoid losing data).
- Connect USB stick to PowerFLARM Core.
- Switch PowerFLARM Core ON.
- Observe Status LED (flashing RED/GREEN) or progress indication on display to verify that flights are being copied.
- Wait until system has started up normally after copying flights.
- Disconnect USB stick.

Some displays or flight computers allow reading out flights without switching the PowerFLARM Core OFF after the flight. Refer to the display documentation for details.

Use only FAT formatted USB 2.0 sticks. See section 5.5 for details and recommendations about USB stick usage.

# 7 Feature Licenses

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

- AUD: Audio output connection (available from Hardware version 1.1)
- ENL: Engine noise level sensor
- IGC: IGC approval
- TIS: Garmin TIS interface
- RFB: Antenna diversity (FLARM B)

Licenses can be obtained from https://flarm.com/shop/.

Each license requires a device-specific license key. Keys are stored in files named xxx.LIC and are installed via the USB port; see section 8.1 for details. Once a license is installed, it will remain in the device permanently. Nevertheless, make sure to keep a backup copy of the license keys.

## 7.1 Device Identification

In order to obtain licenses, the device type (PowerFLARM Core) and serial number is needed. The serial number has the form FLAPFxnny-nnnnnn, e.g. FLAPFC11E-001234.

PowerFLARM also writes essential device information to a file FLARMDEV.CSV whenever a USB stick is connected on startup. If the USB stick 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
- Hardware capabilities
- Installed feature licenses
- ICAO 24-bit address, call sign (if configured), aircraft type, and transponder type
- Selected internal system information

PowerFLARM writes the same information to IGC files.

Some displays and flight computers show the device identification on startup or on request. Refer to the display documentation for details.

| | POWERFLARM CORE INSTALLATION MANUAL | Date: 2017-02-28
Version: 2.10
Page: 25 of 34 |
| FLARM Technology Ltd.
Lindenstrasse 4
CH-6340 Baar | | Document Number:
**FTD-033** |

# 8    Device Update

Installation and update of PowerFLARM firmware, licenses and the obstacle database is via USB. The firmware of some FLARM displays (currently supported: Butterfly) can also be updated via the Core. Please use FAT formatted USB 2.0 sticks; see the USB section for details.

## 8.1    Firmware, License, and/or Obstacle Database Update

- Copy relevant file(s) (xxx.FW, yyy.LIC, zzz.OB2) to USB stick.
- Connect USB stick to PowerFLARM Core.
- Turn ON PowerFLARM Core.
- Verify status LED flashes RED/GREEN.
- Wait until LED turns solid GREEN (or RED in case of no GPS reception).

Some displays or flight computers will show a progress indication during the update. Refer to the display documentation for details.

## 8.2    Mandatory Firmware Update

In order to allow global changes to the FLARM system, every FLARM device needs to be updated with the latest firmware version at least once per year (rolling 365 days). Firmware updates contain general improvements, collision algorithm improvements, radio protocol improvements, and added features. The annual firmware update 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. See MCA documents for details.

> ⚠️ **If the annual firmware update is not applied, the device will no longer be operational without any notification or warning!**

In addition, each firmware also has a fixed expiry date to avoid that devices which have not been updated are broadcasting obsolete data. If the expiry date is reached, the device will issue an error. If the firmware update scheme is followed, the expiry date will however never be reached. A FLARM device that is not kept updated will also cease to function (i.e. not be compatible with other FLARM devices) before the expiry date. The expiry date has only been implemented as a last warning and shall not be relied upon.

## 8.3     Butterfly (BF) Firmware/FlarmNET Update

- Copy Butterfly firmware file (.BFW) and/or FlarmNET (.BFN) to USB stick.

- Connect USB stick to PowerFLARM Core.

- Switch PowerFLARM Core ON with BF display knob pressed.

- Verify BF display goes into UPDATE MODE with 'WAITING', then 'LOADING'.

- Wait until BF display restarts (can take up to two minutes).

Multiple displays on separate Data Ports need to be updated separately: Press the BF display knob only on one display, then repeat the procedure for the other display.

**Note:** This procedure is only supported for displays directly connected to PowerFLARM, i.e. not via a 3rd party repeater or Y adapter. Y adapters and repeaters should not be used.

# 9  Technical Specifications

Technical specifications are subject to change without notice. Usage of some features requires purchase of a feature license.

| | PowerFLARM Core ADS-B | PowerFLARM Core Pure |
| --- | --- | --- |
| **Dimensions** | 120 x 80 x 41 mm | |
| **Mass** | 285 g | 250 g |
| **Power supply** | 12 to 32 V DC | |
| **Current consumption (no external consumers)** | 165 mA @ 12 V DC | 95 mA @ 12 V DC |
| **Supply for external devices** | 1 x 250 mA @ 3 V DC (D-Sub, RJ45)<br>1 x 700 mA @ 5 V DC (D-Sub, USB)<br>1 x 200mA @ 4.75 V (supply for GPS antenna LNA, MCX) | |
| **Data Ports** | D-Sub DE9 and RJ45; RS-232 connection, NMEA @ 4.8-57.6kBaud, TIS @ 9.6kBaud | |
| **Audio OUT (H/W versions >= 1.1** | AC, 1.7 V peak-to-peak @ 1 kΩ | |
| **GPS** | External 50 Ω active (LNA) antenna; MCX connector. Accuracy ≤ 5 m (typical) | |
| **Radio (FLARM)** | 2 channels, 868 MHz SRD band (E-version)/902 to 928 MHz ISM band (A-version) | |
| **Radio (ADS-B/SSR)** | 1090 MHz | None |
| **USB** | Connector for USB 2.0 sticks; FAT formatted, 32 GB max. | |
| **Operating temperature** | -40 to 85 °C | |
| **Detection range** | Depending on antenna and installation; >10km (typical) | |

# 10 Notes

## 10.1 Product Warranty & Terms of Use

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

## 10.2 Replacing Classic FLARM with PowerFLARM Core

The following considerations apply when replacing Classic FLARM with PowerFLARM Core:

- PowerFLARM has a longer FLARM radio range and can use a second antenna.

- PowerFLARM Core does not have a built-in display. Displays compatible with Classic FLARM are also compatible with PowerFLARM. However, not all displays support non-directional (SSR) targets. For details, contact the display manufacturer.

- PowerFLARM is not supported by the PC software FLARM Tool (for updating and configuring Classic FLARM). Use the online configurator instead (see section 5.7).

- Firmware update, IGC file download, and obstacle data upload is via USB only, not via the Data Ports. Functions in displays or software for flight download/obstacle data upload to Classic FLARM will not work with PowerFLARM. It's strongly recommended to install the USB extension cable in the instrument panel. USB data transfer is also faster than over the Data Ports.

## 10.3 Limitations

Operation of PowerFLARM is restricted to, and will only work in, the region it was sold for.

PowerFLARM 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, PowerFLARM does not provide any resolution advisory. Under no circumstances does PowerFLARM facilitate a change in flight tactics or pilot conduct. Operation of PowerFLARM is solely at the discretion of the PIC. The system may only be used after completing familiarization training.

A display attached to PowerFLARM can only alert of the presence of other moving aircraft if the other aircraft is equipped either with a FLARM-compatible system,

an ADS-B Out device/transponder (1090ES), or an interrogated transponder Mode-C or Mode-S. PowerFLARM does neither interrogate transponders nor operate as a transponder, and is thus not detected by TCAS or ATC.

PowerFLARM firmware development was conducted in accordance with industry best practice for industrial electronics products. The use of public access unlicensed radio bands in the air is subject to a number of limitations, with some national differences. The PIC is solely responsible that PowerFLARM is operated in accordance with applicable regulations.

The use of PowerFLARM is limited to flights in VMC. PowerFLARM may not be used for navigation.

## 10.4    Conformity Declaration

$C\!\!\in$

FLARM Technology Ltd., Lindenstrasse 4, CH-6340 Baar, Switzerland, declares that the product PowerFLARM Collision Warning Device in Hardware Version FLAPFC1*E and typical configuration, meets the requirements of the CE mark.

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.

FCC ID:
ZKUGC625162

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.

IC ID Number:
10154A-FLAPFC10

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

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

## 10.5    Maximum Antenna Gain

Currently, the maximum antenna gain for external antennas is limited to 2.0dBi 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 2.0dBi pour un fonctionnement en 902MHz à 928MHz par points à bandes. L'antenne gain doit pas être supérieure à maximum EIRP limites fixées par la FCC/Industrie Canada.*

## 10.6    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 licence-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.*

# Appendix A: Mechanical Drawings

## PowerFLARM Core
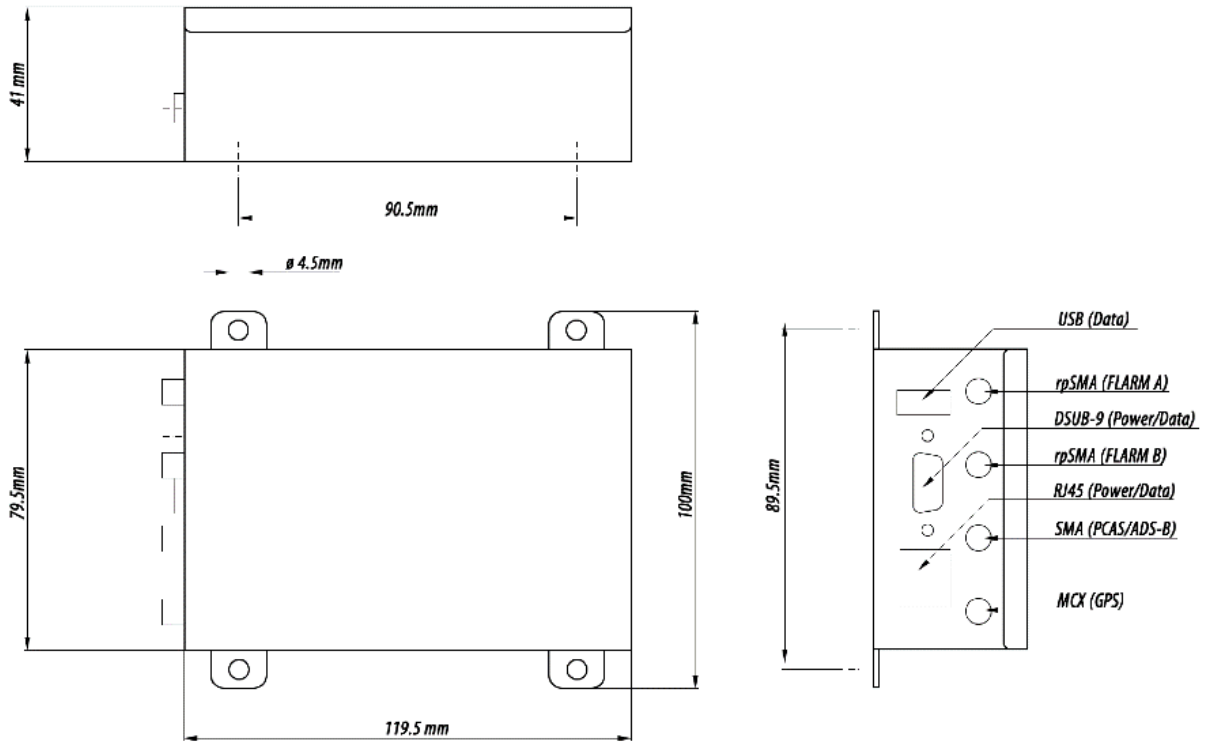
### FLARM and ADS-B/SSR antenna (internal)

Please see below for an indicative drawing of the FLARM and ADS-B antennas. The dimensions are approximate for the FLARM antennas for E-version devices. FLARM antennas for A-version devices and ADS-B antennas are slightly shorter.

# Appendix B: END USER LICENSE AGREEMENT (EULA)
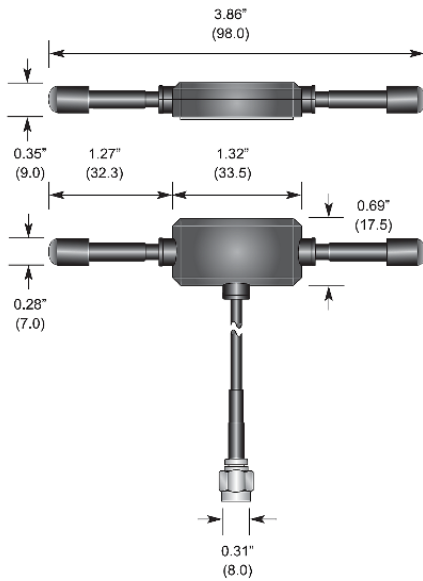
By purchasing or using a FLARM device or by downloading, installing, copying, accessing, or using any FLARM Technology Ltd. (hereafter "FLARM Technology") software, firmware, license key, or data, you agree to the following terms and conditions. If you do not agree with the terms and conditions do not 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, 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.
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 purposes and in addition for Search and Rescue (SAR) purposes.
   5.2. FLARM Technology may share data with its partners for aforementioned purposes. FLARM Technology may in addition publicly make available data from a FLARM device (Flight Tracking), unless the FLARM device in question has been configured to limit 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. FLARM Technology is not responsible for any third party device, software, or service receiving, collecting, storing, using, sending, broadcasting, or making publically 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. **Headings**. The Article and Section headings contained in this Agreement are included for reference purposes only and shall not affect the meaning or interpretation of this Agreement.

   7.4. **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.

   7.5. **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.

   7.6. **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.