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FLARM Technology Ltd Hinterbergstrasse 15 CH-6330 Cham		Document Number: FTD-077

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1.0	2020-11-10	Initial version
1.1	2020-11-27	Added note for RJ45 pin numbering. Conformity Declarations.
1.2	2021-01-21	FCC and IC conformity declarations. Added input power under full load. Added notes when connecting a display to the 12-32 V supply.

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1 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. Similar to 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. An intelligent 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 sensitive GNSS receiver. Based on those and other parameters, a precise projected flight path can be calculated. The flight path, together with additional information such as an identification number, is encoded before being broadcast over an encrypted radio channel twice per second. Flight models are available for most aircraft types, including piston-engine airplanes, jets, helicopters, gliders, hang gliders, paragliders, UAVs, etc.

PowerFLARM Fusion also incorporates an ADS-B and transponder (SSR) Mode-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 50,000 manned aircraft and many more 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.

In addition to annunciating collision warnings, many FLARM systems can also show nearby aircraft on a radar-like screen (CDTI). Similar to the use of weather radar

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to avoid thunderstorms, this can sometimes be helpful for short to medium term strategic planning in high traffic density situations.

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.

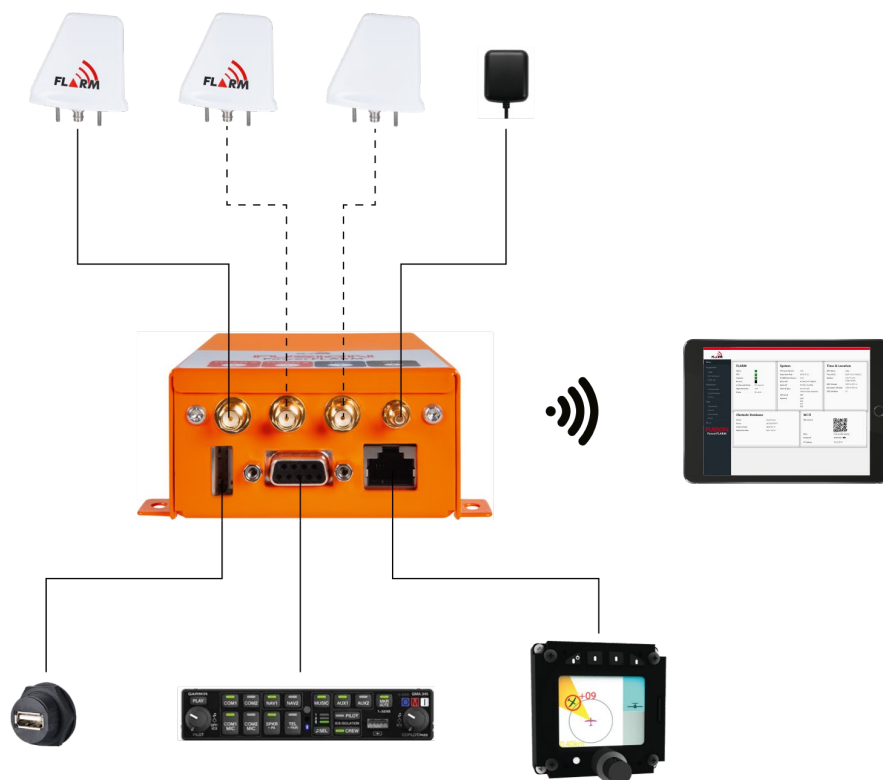
FLARM systems are available from many different manufacturers under different product names. A system normally consists of a remotely installed FLARM device, a panel-mounted *FLARM Compatible* display, one or two externally mounted FLARM antennas, and internally mounted GNSS and ADS-B/SSR antennas. There are also portable FLARM devices available (usually with an integrated display), as well as FLARM systems integrated into other avionics (e.g. EFIS-systems).

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 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.

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1.1 System Description

PowerFLARM Fusion is a modern FLARM device for installation in General Aviation aircraft. It is based on the latest PowerFLARM technology and features a novel web app called FLARM Hub. PowerFLARM Fusion has been designed for worldwide use and connects to a range of displays, including tablet apps via Wi-Fi or Bluetooth.



A FLARM system consists of several parts. PowerFLARM Fusion, or Fusion for short, contains the collision computer, radio circuitry, and peripheral communication subsystems. It is powered from the aircraft electrical system and connects to the following equipment and parts:

- One or two FLARM antennas. Installed antennas can be either external or internal. The choice depends on the antenna function and aircraft type. External antennas are mounted outside the aircraft fuselage (normally on top and below the aircraft). Internal antennas are mounted inside the aircraft fuselage (e.g. in the cockpit or in gliders also in the vertical stabilizer). The use of two antennas (antenna diversity) allows for an improved coverage.
- A 1090 ADS-B/SSR antenna (optional) for receiving Mode-S and ADS-B signals.
- A GPS antenna used by Fusion to determine its trajectory.

- A panel mount USB socket with extension cord for a USB flash drive.
- At least one FLARM Compatible display. These displays have been certified or validated to have implemented all essential functions.
- A number of complementary displays or accessories, parsing the FLARM data stream.
- An audio panel for feeding aural warnings into the aircraft's audio system (optional).
- An Electronic Flight Bag (EFB) or navigation app running on a mobile device (tablet or phone), connected through Wi-Fi or Bluetooth.
- A web browser running FLARM Hub on a computer or mobile device.

1.2 Definitions

1.2.1 Abbreviations

Abbreviation	Meaning/Explanation
ADS-B	Automatic Dependent Surveillance — Broadcast
AFMS	Aircraft Flight Manual Supplement
AML	Approved Model List
AMP	Aircraft Maintenance Program
CAA	Civil Aviation Authority
CDTI	Cockpit Display of Traffic Information
CRS	Certificate of Release to Service
EFIS	Electronic Flight Instrument System
(E)TSO	(European) Technical Standard Order
FAQ	Frequently Asked Questions and answers
GND	Ground (Earth)
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)
MCA	(EASA) Minor Change Approval
RF	Radio Frequency/Radio
SRD860	The SRD860 radio band (FLARM uses ≈ 868 MHz)
SSR	Secondary Surveillance Radar
STC	Supplemental Type Certificate
TAS	Traffic Advisory System
TCAS	Traffic alert and Collision Avoidance System
UAV	Unmanned Aerial Vehicle
VFR	Visual Flight Rules
XPDR	Transponder

1.2.2 Terminology

The words **shall** and **must** are used to indicate a mandatory requirement.

The word **should** is used to indicate a recommendation, meaning that there may exist valid reasons in particular circumstances not to follow a specific item, but the full implications must be understood and carefully weighed before choosing a different course.

The word **may** is used to indicate that an item is truly optional.

1.3 Displays

PowerFLARM Fusion must be connected to a FLARM display. Displays originate from third party manufacturers implementing the FLARM ICD protocol, an extension of NMEA 0183. To ensure that collision warnings and traffic information work correctly and that critical status and error conditions are correctly annunciated to the pilots, Fusion should be connected to at least one *FLARM Compatible* display.

A list of displays certified as *FLARM Compatible*, as well as alternative means of compliance, can be found in Appendix C. Displays certified as *FLARM Compatible* can also be found in the Product Selector under the category "Primary Displays":

<https://flarm.com/products/powerflarm/product-selector/>

Fusion also supports connections to supplementary displays and navigation systems over Wi-Fi and Bluetooth.

1.4 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 Fusion 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

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The antennas should be designed for the frequency band applicable in the geographic area where the aircraft is being operated. Internal antennas, including the antennas that are shipped with Fusion, are normally designed for only one of the frequency bands. The external AV-75 antenna is designed for worldwide use. Only antennas supplied by FLARM Technology should be used. In addition, other antennas as specified in Appendix B may be used as well. Inappropriate antennas, especially antennas without complete insulation, can damage devices and should not be used.

Note: Fusion will not detect inappropriate antennas, including antennas for the wrong frequency band.

PowerFLARM Fusion can use two antennas concurrently for better coverage (antenna diversity). Normally, one antenna is placed on top of the aircraft and one below. In especially fiberglass gliders, they can also be placed inside the aircraft fuselage in a way that ensures 360° coverage. Antenna diversity is recommended for all aircraft and is strongly recommended for aircraft fuselages containing a lot of metal or carbon fiber.

Note: Communication between FLARM devices employs 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.

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1.5 Additional Documents, Data, and Information

The PowerFLARM Fusion User and Maintenance Manual (FTD-078) is an integral part of the installation and maintenance documentation and must be used for the installation where referenced. The User and Maintenance Manual also serves as the Instructions for Continued Airworthiness (ICA), unless replaced by an ICA as part of the Minor Change Approval or STC in applicable parts. The User and Maintenance Manual, together with additional documents for installation, maintenance, operation, and support can be found under the following link:

<https://flarm.com/support/manuals-documents/>

The EASA Minor Change Approval (MCA) and documents for a Standard Change installation can be acquired under the following link:

<https://flarm.com/product-category/approvals/>

Obstacle databases can be acquired under the following link:

<https://flarm.com/product-category/obstacle-databases/>

For questions, first consult the FAQ:

<https://support.flarm.com/hc/en-us>

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

support@flarm.com

1.6 Document Revisions

This document will occasionally be updated. The latest version can be found under the link to additional documents above. Always make sure that you are using the latest document. Updates will be communicated to official FLARM dealers, in the FLARM blog, and the official FLARM newsletter. Sign up to the newsletter from the FLARM website to ensure that important communication is not missed:

<https://flarm.com/blog/>

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2 Installation

2.1 General Requirements and Advice on Installation

FLARM is not required by any Certification Specification. Thus, there is no (E)TSO for FLARM, nor is one required. The installation is normally a minor change and must adhere to the Certification Specification applicable to the aircraft in which it is installed. The Certification Compliance List is an integral part of the minor change approval process (see Section 2.1.1). The installation may only be performed by competent personnel. Following installation in certified aircraft, a Certificate of Release to Service (CRS) must be issued by Part-66 certifying staff, or the national equivalent. The installation cannot be done as part of pilot-owner maintenance. Unauthorized installations will void any warranty.



For certified aircraft, an MCA (Minor Change Approval) or Standard Change installation with appurtenant documents is required. See Section 2.1.1 for details.

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

Only one single FLARM device may be installed and active in the aircraft.

PowerFLARM Fusion should be installed at least 30 cm from the magnetic compass.

As part of the installation, Fusion must be updated to the latest firmware version and the device must be configured correctly. See Sections 2.7 and 2.8 for details.

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 Section 2.9) must be added to the Aircraft Maintenance Program (AMP); see MCA documents for details. An approved AFM Supplement must be carried on board the aircraft. The 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 range analyzer. See Section 2.10 for details and the Installation Verification Checklist in Appendix D.

For additional guidance on FLARM installations (especially for rotorcraft), see EASA Certification Memorandum CM-AS-010.

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2.1.1 Minor Change and Standard Change

For certified aircraft, an MCA (Minor Change Approval) or Standard Change installation with appurtenant documents is required. The MCA covering many aircraft types, as well as required Standard Change documentation, can be acquired under the following link:

<https://flarm.com/product-category/approvals/>

The documents are also required for a Standard Change installation. This includes the AFM Supplement, Installation instructions, as well as Instructions for continued airworthiness. These documents can also be used for an individual Minor Change for other aircraft types.

Note: A Standard Change installation is normally more limiting than an MCA (e.g. limited to day VFR).

2.2 Housing

Mount PowerFLARM Fusion to a suitable mounting location. The orientation of the device is discretionary. Do not mount the device on the "hot" side (engine side) of the firewall. Common installation locations are behind the instrument panel or in the E&E compartment in larger aircraft. To ensure that the Wi-Fi and Bluetooth connection works for the pilots (if it is intended to be used), install Fusion in a location that does not hinder the propagation of the Wi-Fi and Bluetooth signal to the pilot compartment. The Wi-Fi and Bluetooth antenna is located behind the sticker indicated below:



Wi-Fi and Bluetooth antenna location

The metallic housing is not waterproof, and ingress of solid particles and liquids must 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

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rendered unusable. Should the device be suddenly cooled, this may result in the formation of condensation.

Mechanical drawings of the device are available in Appendix A.

2.3 Displays

PowerFLARM Fusion should be connected to a *FLARM Compatible* display as a primary means of collision avoidance. The display should be installed in the primary field of view of the pilots. In aircraft with tandem seating, each pilot should have a display in its primary field of view. Install the latest display firmware, if applicable. It can be acquired from the display manufacturer. See the Installation Instructions for the relevant display for specific instructions.



Many “FLARM displays” on the market have not been certified as *FLARM Compatible*. Certified displays carry the FLARM Compatible logo. Lack of certification may lead to the absence of collision warnings and error/status codes, including firmware expiration.

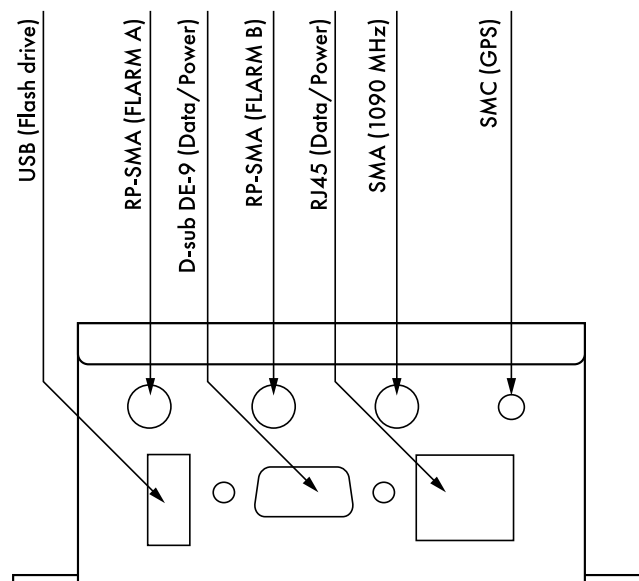
A list of displays certified as *FLARM Compatible*, as well as alternative means of compliance, can be found in Appendix C. Displays certified as *FLARM Compatible* can also be found in the Product Selector under the category “Primary Displays”:

<https://flarm.com/products/powerflarm/product-selector/>

In addition to the connection to a *FLARM Compatible* display, Fusion can be connected to a range of other displays, EFIS systems, and tablet applications. This can be accomplished either as a cable connection or using Wi-Fi or Bluetooth. See the User and Maintenance Manual for details.

2.4 Connections and Cabling

2.4.1 Overview



PowerFLARM Fusion has the following connectors:

- USB 2.0: Accepts USB flash drive for flight log readout, device update¹, and configuration.
- FLARM antennas A and B: When using a single antenna, connect to FLARM A. The internal FLARM antennas supplied with the device have a RED marking.

¹ The FLARM Hub Firmware cannot be updated using USB.

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- 1090 MHz: For receiving SSR transponder and ADS-B 1090ES signals. The internal antenna supplied with the device has a BLUE marking. This antenna is optional; however, without it, no traffic will be received on 1090 MHz.
- GPS antenna: Must be connected for operation.
- RJ45 (Data Port #1) and D-sub DE-9 (Data Port #2): For connecting up to two independent *FLARM Compatible* displays and power. Power must only be supplied on one of the connectors.

2.4.2 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 damage the circuit board, 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.

2.4.3 Circuit Breaker

Connect Fusion (and the *FLARM Compatible* display) via a combined 3 A circuit breaker/switch or separate circuit breaker and switch. The Fusion circuit breaker must be separate from other circuit breakers of essential systems.

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

Note: For example, the following circuit breaker can be used: Klixon 7277-2-3.

2.4.4 Power Supply

Supply voltage: 12 to 32 V DC. Typical current drain is 180 mA @ 12 V, less for higher voltages, more if external components are supplied by Fusion.

Connect power either through the D-sub (pin 7) or the RJ45 connector (pin 7 and 8). Do not provide power to both.

2.4.5 Display

See Section 2.3 and Appendix C for display requirements.

Use only high-quality shielded cables for the display connections. Up to 5 m cable length is normally acceptable.

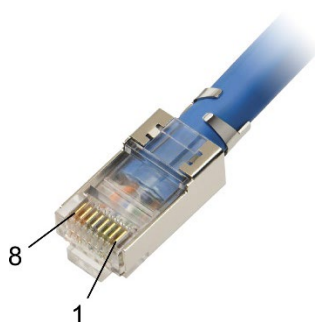
If the display requires 3 V DC operating voltage, the respective pin on the RJ45 or D-sub connector may be used. Otherwise, the display should be connected to power according to Section 2.4.3.

2.4.6 RJ45 – Power and Data Connections



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, Fusion receives (RS-232)
- 4: TX, Fusion sends (RS-232)
- 5: GND
- 6: Fusion 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 pin numbering in IGC documentation and the PowerFLARM Core manual was reversed. The pin numbering in different display documentation is mixed. See the picture above for correct pin assignments.

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

Maximum current on pin 6: 250 mA @ 3 V DC.

Maximum current on pin 7/8: 200 mA @ 12 V DC, 80 mA @ 32 V DC.

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

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2.4.7 D-sub DE-9 – 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 DE-9 connector is shown below. On the left side, the female socket on Fusion is shown. On the right side, the male plug (on the cable) is shown.



Socket (device)



Plug (cable)

- 1: Audio OUT (referenced to GND)
- 2: TX, Fusion sends (RS-232)
- 3: RX, Fusion receives (RS-232)
- 4: Do not connect
- 5: GND
- 6: Do not connect
- 7: +12 to +32 V DC power supply
- 8: Fusion supplies +5 V DC
- 9: Fusion supplies +3 V DC for display

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

Maximum current on pin 9: 250 mA @ 3 V DC.

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

Maximum current on pin 7: 200 mA @ 12 V DC, 80 mA @ 32 V DC.

Note: If using 5 V DC (pin 8) and USB at the same time, the shared maximum 700 mA applies.

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

D-sub cables shipped with Fusion 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.** Use a continuity tester instead to determine the assignment.

	Grey	Pin 1: Audio Out
	Yellow	Pin 2: TX, Fusion sends (RS-232)
	Green	Pin 3: RX, Fusion 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: Fusion supplies +5 V DC
	Blue	Pin 9: Fusion supplies +3 V DC for display

Note: There is no wire for Pin 6!

2.4.8 Audio Out

PowerFLARM Fusion emits an intermittent 1 kHz waveform on Audio Out (Pin 1 on the D-sub connector) whenever a collision warning is issued. The frequency of the beep depends on the time to collision. In addition, a test beep is emitted during power-up if Audio out has been activated in the configuration.

Many *FLARM Compatible* displays have their own audio warnings. Audio Out only needs to be connected when the audio warning of the connected *FLARM Compatible* display is absent or not loud enough in loud cockpit environments.

Note: Audio Out is configured OFF by default. If connected, it must be enabled during configuration.

Electrical characteristics:

- AC signal, 1.7 V peak-to-peak @ 1 k Ω
- Referenced to GND (pin 5), no DC bias
- Output impedance: 47 Ω
- Output current (max.): 35 mA

Connect Audio Out to the audio panel or other amplifier with input impedance between 200 Ω and 10 k Ω . The audio panel or amplifier should allow volume adjustment.

Note: Do not connect a headset or speaker directly to Audio Out.

2.4.9 FLARM and 1090 MHz Antenna Connectors



FLARM A and B ports are reverse polarity female SMA connectors (RP-SMA) with a pin as center conductor. The 1090 port is a standard female SMA connector.

Ensure that the antenna cable connectors are properly and fully screwed into the device. Use only little force when inserting and tightening (max 1 Nm).

Note: If replacing a PowerFLARM Core E-version with PowerFLARM Fusion, the antenna connectors differ. See Section 4.3 for details.



Never try to swap the FLARM and 1090 antennas or use antennas with incorrect polarity (SMA vs. RP-SMA). Doing so may cause permanent mechanical damage to the device.

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2.4.10 GPS Antenna (SMC Connector)

PowerFLARM Fusion contains a 72 channel GNSS receiver, connecting to an external antenna. Ensure that the antenna cable is properly and fully screwed into the device. Fusion will not work without good GPS reception.

2.5 Antennas

The minimum number of antennas required for installation is one FLARM antenna and one GPS antenna. In addition, a second FLARM antenna should be installed for antenna diversity. The system can also optionally receive SSR transponder Mode-S and ADS-B 1090ES traffic on 1090 MHz using a separate 1090 antenna (recommended).

All antennas may be installed either externally (on the aircraft fuselage) or internally (inside the aircraft fuselage). External antennas are normally mounted on top and below the aircraft. Internal antennas are normally mounted on the glareshield or otherwise in the cockpit next to one of the side windows. In fiberglass gliders, internal antennas can sometimes also be mounted inside the vertical stabilizer. External antennas for FLARM A and FLARM B are strongly recommended for all aircraft for the best performance (range). For GPS and 1090, internal antennas are usually suitable in most light aircraft.

The antennas supplied with the device may only be mounted internally. Additional approved and acceptable antennas are listed in Appendix B.

Note: Except for the AV-75 antenna, FLARM antennas are made for either the SRD860 or ISM band, used in different parts of the world (see Section 1.4 for details). The antennas shipped with the device are for the band applicable in the country where the device was sold. Ensure that the correct antenna type for the intended area of operation is installed.

2.5.1 External Antennas

External FLARM antennas should be installed in most aircraft. An external 1090 antenna is recommended for aircraft with MTOM above 2,000 kg, as well as lighter aircraft where installation of the internal antenna is not feasible. For external antennas, follow the requirements below.

- Poor RF cables attenuate the radio signal and can lead to severely degraded range. Use only low-attenuation RF cables, especially if the cable is longer than 1.5 m. The total attenuation per antenna cable should be less than 3 dB.
- Minimize cable lengths to ensure maximum signal strength.

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- Antennas should be spaced at least 30 cm apart, including other antennas like COM/NAV, XPDR, etc.

Note: Installing external antennas on aircraft with a pressure cabin normally requires an STC.

In addition, the following requirements are applicable for the specific antenna installations. Approved and acceptable antennas are listed in Appendix B.

2.5.1.1 FLARM A/B

Use the AV-75 external FLARM antennas for most installations. 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 since the radio waves are vertically polarized (this is unrelated to the radiation pattern). Up to 15° tilt is normally acceptable.

If using other than the AV-75 antennas, the antennas must be insulated to protect against electrostatic discharges, e.g. from the human body. Otherwise, the device may be damaged.

2.5.1.2 SSR/ADS-B 1090ES

The antenna must be mounted vertically, normally on top of the aircraft. Up to 15° tilt is normally acceptable.

2.5.1.3 GPS

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

Preamplifier gain minus cable attenuation must exceed 17 dB.

The antenna must accept Fusion's 4.7 V supply and must not draw more than 200 mA. DC resistance of the cable must be taken into account.

The antenna should be mounted horizontally or according to the instructions from the manufacturer and 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.

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2.5.2 Internal Antennas

For internal antennas, follow the requirements below.

- Use only the antennas supplied with the device or other approved or acceptable antennas as specified in Appendix B.
- Do not extend or interfere with the attached antenna cable. If the cable is extended or modified in any way, the relevant requirements in Section 2.5.1 apply.
- Give the antenna as much clearance as possible, from any material.
- Antennas should be spaced at least 30 cm apart, including other antennas like COM/NAV, XPDR, etc.

Note: In aircraft with an electrically heated windshield, the windshield acts as a Faraday cage and blocks radio signals. Internal antennas may not be mounted behind such windshields.

In addition, the following requirements are applicable for the specific antenna installations.

2.5.2.1 *FLARM A/B*

Note: The internal FLARM antennas shipped with the device have a RED marking.

The internal FLARM antennas for Fusion are suitable for internal use in fiberglass gliders only. External FLARM antennas should be installed in other aircraft. See Section 2.5.1 for details.

Ensure that the antennas are not in contact with or close to any other object through which there might be an electrostatic discharge, e.g. the canopy. When two FLARM antennas are installed, ensure that they are at least 30 cm apart.

In gliders where internal FLARM antennas may be used, ideal locations for the internal FLARM antennas are:

- On the glareshield, in front of the compass (minimum 10 cm from the magnetic compass)
- In the tail fin of the airplane, if not metal or carbon fiber. Use only low-attenuation RF cables (see Section 2.5.1).
- Behind the pilot's head in the fuselage (not in gliders with metal or carbon fiber fuselage)

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The antennas must be mounted vertically since the radio waves are vertically polarized (this is unrelated to the radiation pattern). Up to 15° tilt is normally acceptable.

The antennas must be insulated to protect against electrostatic discharges, e.g. from the human body. Otherwise, the device may be damaged.

When utilizing antenna diversity, ensure that the antennas complement each other in terms of the radiation pattern (fuselage shielding).



Connecting more than one antenna to one RF Port (e.g. via a passive splitter) is not permitted. This will most likely result in signals cancelling themselves out and/or severely degraded range.

2.5.2.2 SSR/ADS-B 1090ES

Note: The internal 1090 antenna shipped with the device has a BLUE marking.

Install the 1090 antenna on or around the glareshield with a forward view. It should be placed at least 30 cm away from other antennas. Where installation options are limited, the FLARM antennas have priority over the 1090 antenna for optimal placement.

The 1090 antenna must be mounted vertically since the radio waves are vertically polarized. Up to 15° tilt is normally acceptable.

2.5.2.3 GPS

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 next to the antenna. Ideally, the antenna should sit atop the instrument panel. 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 30 cm apart; the same holds for separation from all other antennas connected to Fusion.

2.6 USB Connector

PowerFLARM Fusion has a built-in USB A 2.0 connector for a USB flash drive. It can be used for PowerFLARM firmware updates, configuration, and readout of device information and flight recordings. The maximum supported size is 128 GB.

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Note: The FLARM Hub firmware can only be updated via FLARM Hub.

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.

Note: The USB flash drive must not be connected during flight.

For USB flash drive operation, see the User and Maintenance Manual.

2.7 Firmware Updates

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

In order to allow global and synchronized changes to the FLARM ecosystem, every FLARM device needs to 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.

In addition, each PowerFLARM firmware also has a fixed expiry date to avoid that devices that 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 never be reached. The expiry date shall never be relied upon for scheduling updates.

The FLARM Hub firmware can be updated in FLARM Hub. This should normally be done whenever updating the PowerFLARM firmware but is not mandatory. Any compatibility constraints will be noted in the firmware release notes.

When the device is delivered, it might not have the latest firmware versions and the PowerFLARM firmware may even be expired. Always update to the latest firmware versions as part of the installation. See the User and Maintenance Manual for details.

2.8 Configuration

During installation, PowerFLARM Fusion must be configured correctly for the specific aircraft in which it is installed. This normally also includes installing an Obstacle Database. See the User and Maintenance Manual for details.

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2.9 Annual Maintenance

Each FLARM system must be inspected and updated every 12 calendar months. For installations in certified aircraft, the annual maintenance must be part of the Aircraft Maintenance Program (AMP) or equivalent. For other installations, the owner must set up an individual reminder 12 months after the previous maintenance.

2.10 Installation Verification

After completing the installation, including configuration, verify that the device starts up normally without any errors. See the User and Maintenance Manual for details.

In addition, a range analysis should be conducted after a couple of flights to verify acceptable range. This is formally not part of the installation/change to the type certificate and the Certificate of Release to Service (CRS) may be issued before the range analysis has been completed. See the User and Maintenance Manual for details.

An Installation Verification Checklist is available in Appendix D and must be completed as part of the installation verification.

The Installation Verification Checklist must also be completed after modifications to the installation (e.g. change of display or antennas).

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3 Technical Specification

Dimensions	119 x 80 x 42 mm
Mass	250 g
Power supply	12–32 V DC $\pm 5\%$
Current consumption (no external consumers)	200 mA @ 12 V DC (Peak) 180 mA @ 12 V DC (Typical)
Current consumption (maximum load with external consumers)	850 mA @ 12 V DC (Peak)
Supply for external devices	250 mA @ 3 V DC (D-sub, RJ45) 700 mA @ 5 V DC (D-sub, USB) 200 mA @ 12 V DC (D-sub, RJ45), 80 mA @ 32 V DC (D-sub, RJ45) (see note)
Data Ports	D-sub DE-9 and RJ45 RS-232 connection NMEA ICD @ 4.8–230 kBaud
Wireless Data	FLARM ICD: Wi-Fi (TCP, WebSocket) and Bluetooth GDL 90: Wi-Fi
Audio Out	AC, 1.7 V peak-to-peak @ 1 k Ω
GPS	SMC connector External 50 Ω active (4.7 V) antenna Accuracy ≤ 5 m (typical)
Radio (FLARM)	RP-SMA Connectors (2x) 868 to 869 MHz (SRD860 band) and 902 to 928 MHz (ISM band)
Radio (SSR/ADS-B)	SMA Connector 1090 MHz (RX only)
USB	Connector for USB 2.0 flash drive FAT16, FAT32, or exFAT; 128 GB max.
Operating temperature	-15 to 70 $^{\circ}\text{C}$
Detection range	>10 km (typical) (Depending on antenna and installation)
Accessories	Internal antennas & cables (included) Adapter kit for PowerFLARM Core AV-75 external FLARM antenna

Note: When connecting an external device to the RJ45 or D-sub 12–32 V supply, a fast fuse must be used for protection. The fuse must keep the maximum power below 15 watts 3 seconds after power-up. For example: a Littelfuse 216 Series 315 mA fuse @ 12 V DC or a Littelfuse 216 Series 160 mA fuse @ 32 V DC conform to this requirement. For other voltages, an appropriate current limit must be chosen.

4 Additional Information

4.1 Troubleshooting and Error Codes

For troubleshooting including error codes, see the User and Maintenance Manual.

4.2 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 E.

4.3 Replacing PowerFLARM Core with PowerFLARM Fusion

The D-sub DE-9 and RJ45 connector pinouts on PowerFLARM Fusion are identical with PowerFLARM Core. In contrast to PowerFLARM Core, Fusion is available in only one version usable in all countries where FLARM operates. The FLARM A/B and 1090 antenna connectors are identical to the A-version of PowerFLARM Core but differ from the E-version. On Fusion, FLARM A/B are Reversed Polarity SMA (RP-SMA) and the 1090 connector is SMA. In addition, the GPS antenna connector is SMC on PowerFLARM Fusion compared to MCX on PowerFLARM Core. The differences are presented in the table below.

	FLARM A/B	1090	GPS	Upgrade Kit P/N
Fusion	RP-SMA	SMA	SMC	
Core, A-version	RP-SMA	SMA	MCX	ACCCA2F
Core, E-version	SMA	RP-SMA	MCX	ACCCE2F

If you are upgrading from PowerFLARM Core, upgrade kits with antenna connector converters are available for purchase. See the relevant Part Number in the table above.

4.4 Replacing Classic FLARM with PowerFLARM Fusion

The following considerations apply when replacing Classic FLARM or a Classic FLARM-based device with PowerFLARM Fusion:

- Fusion has a greater FLARM radio range. It also optionally supports a second antenna (diversity) and reception of Mode-S and ADS-B signals, which requires installation of additional antennas.
- Fusion does not have a built-in display. As a primary means of collision avoidance, Fusion must be connected to a *FLARM Compatible* display. See Sections 1.3 and 2.3 for more information.

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- Fusion is not supported by the PC software FLARM Tool for Classic FLARM. Firmware updates, IGC file downloads, and obstacle data uploads cannot be done via the data ports. Instead, they are done via FLARM Hub or with a USB flash drive. The USB extension cable should be installed in the instrument panel. USB data transfer is also faster than over the data ports. See the User and Maintenance Manual for details.

4.5 Conformity Declarations

4.5.1 CE

FLARM Technology Ltd, Hinterbergstrasse 15, CH-6330 Cham, Switzerland, declares that the product PowerFLARM Fusion FLAFUS10W, produced by Placetec AG, Industriestrasse 17, CH-4410 Liestal, Switzerland, is designed to comply with the following standards and norms: EN 62368-1:2014+A11:2017, EN 300 328 V2.2.2, EN 301 489-1 V2.2.3, EN 301 489-17 V3.2.4, EN 301 489-19 V2.1.1, EN 301 489-3 V2.1.1, EN 300 220-2 V3.1.1, EN 62311:2008.



4.5.2 FCC

Report Number:	T251-0695/20
Product:	Radio Module
Type reference:	PowerFLARM Fusion
FCC ID:	2AXJM-FLAFUS10W
Ratings:	12-32 V DC
	Operating frequencies: 902,6 MHz – 927,4 MHz
	Protection class: III
Trademark:	FLARM
Applicant:	FLARM Technology Ltd, Hinterbergstrasse 15, CH-6330 Cham, Switzerland
Manufacturer:	Placetec AG, Industriestrasse 17, CH-4410 Liestal, Switzerland
Testing method:	47 CFR Part 15, Subpart C (Clause 15.247) in conjunction with ANSI C63.10:2013

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.

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



Caution

To ensure that the radio transmitter complies with current FCC regulations limiting both maximum output RF power and human exposure to radio frequency radiation, a distance of at least 20 cm must be maintained between antennas and any person. The antennas must not be co-located or operating in conjunction with any other antenna or transmitter.

4.5.3 Industry Canada Notice and Marking

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

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

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

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

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This device complies with the RF exposure limits for humans as stated in RSS-102.

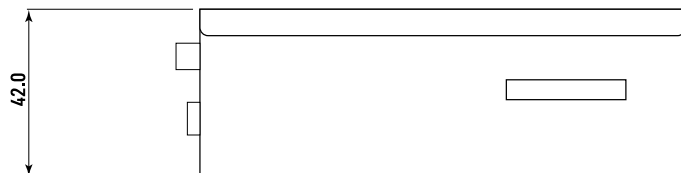
Cet appareil est conforme aux limites d'exposition RF pour les êtres humains comme elles le sont notifiées dans la norme RSS-102.

4.6 Maximum Antenna Gain

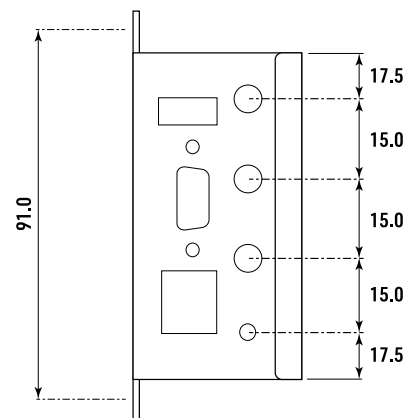
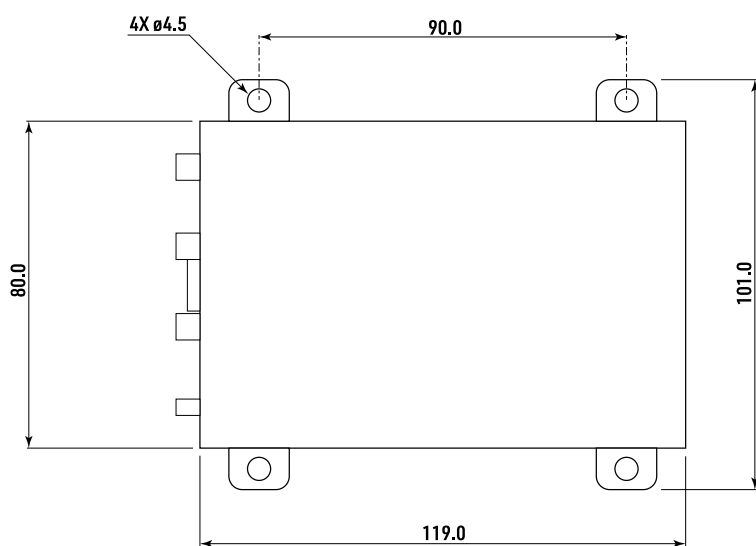
Currently, the maximum antenna gain for external antennas is limited to 2.0 dBi for operation in the 902 MHz to 928 MHz band. The antenna gains must not exceed maximum EIRP limits set by the FCC/Industry Canada.

Actuellement, le gain d'antenne maximal d'antennes externes est limité à 2.0 dBi pour un fonctionnement en 902 MHz à 928 MHz par points à bandes. L'antenne gain doit pas être supérieure à maximum EIRP limites fixées par la FCC/Industrie Canada.

Appendix A – Mechanical Drawings



All dimensions in mm
Tolerances: 0.5 mm



Appendix B – Acceptable Antennas and Cables

The antennas listed below are acceptable for installation and use.

If using other than supplied or listed antennas, it must be ensured that the antennas are acceptable for the applicable installation (e.g. environmental aspects) and radio frequency characteristics. Ensure that FLARM antennas have complete insulation and protection.

The radio frequency characteristics may be verified by performing a range analysis.

Note: The range analysis does not verify environmental aspects, insulation, or installation.



Damaged antennas (e.g. missing cap) or FLARM antennas with insufficient insulation can damage devices and may not be used.



Internal antennas

GPS Antenna	FLARM Technology: ANTFIGPS
FLARM Antenna SRD860	FLARM Technology: ANTFIGLASRD
FLARM Antenna ISM	FLARM Technology: ANTFIGLAISM
ADS-B Antenna	FLARM Technology: ANTFIGADSB

External antennas

FLARM Antenna, External	RAMI: AV-75/ANTCEFLA
SSR/ADS-B Antenna	RAMI: AV-74, AV-22 TED: 104-12 Cobham Comant: CI 105, CI 101
GPS Antenna	Sensor Systems: S67-1575-39, S67-1575-86, S67-1575-96, S67-1575-134, S67-1575-135, S67-1575-137, S67-1575-232 Cobham Comant: CI 401-460, CI 420-420, CI 428-410, CI 429-410 RAMI: AV-GPS

For remotely installed antennas using separate RF cables, low-attenuation RF cables should be used. The total attenuation should be less than 3 dB.

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Appendix C – FLARM Compatible Displays

PowerFLARM Fusion should be connected to a certified *FLARM Compatible* display. In addition, it is also possible to connect a secondary display for additional traffic information.

Displays that have been certified as *FLARM Compatible* can be either standalone or integrated into other avionics, e.g. navigation systems. Certified displays carry the FLARM Compatible logo (see depiction on the right). Certification ensures that all required systemic functions have been implemented and that the pilot interface complies with aircraft certification requirements. This includes collision warnings, status information, error conditions, obstacle warnings, documentation, etc.



If the primary display has not been certified as *FLARM Compatible*, it can continue to be used if the deviations are understood and the resulting risks are acceptable or mitigated. This should be done as a risk assessment. The Requirements for *FLARM Compatible* Displays is available from FLARM Technology ([document FTD-013](#)). The risk assessment should include at least the following items:

- How are collision warnings communicated and annunciated (aircraft, obstacles, and alert zones)?
- How is the installed firmware version and the obstacle database (area and expiration) annunciated or verified?
- How are status and error conditions from FLARM communicated and annunciated, both during startup and later (including the <Severity> property, i.e. whether the device still works)?
- How is a lack of communication between FLARM and the display annunciated?
- How is a lack of GNSS position communicated and annunciated?
- How are non-directional intruders visualized?
- How are pilots made aware of potential deviations and/or mitigation measures resulting from the risk assessment?

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The following FLARM displays have been certified as *FLARM Compatible* as of the date when this manual version was published. The approval is valid under the condition that the limitations listed below are adhered to. The approval is valid only for the latest display firmware/software that was released on the day this manual version was published, and any consecutive firmware/software versions.

Manufacturer	Model	Part No.	Limitations
ABOBA Elektronik	V3+Mm	V3+Mm	• Approved for displays manufactured before 2016-01-01 only.
ABOBA Elektronik	V4+M	V4+M	• Approved for displays manufactured before 2016-01-01 only.
Butterfly Avionics GmbH	Butterfly Display 57	B102	• Approved for day only.
Butterfly Avionics GmbH	Butterfly Display External	B101	• Approved for day only.
Garrecht Avionik	ATD-11	ATD-11	(none)
Garrecht Avionik	ATD-57	ATD-57	(none)
Garrecht Avionik	ATD-80	ATD-80	(none)
LXNAV	FlarmLED+	FlarmLED+	(none)
LXNAV	TrafficView	TrafficView	(none)
LXNAV	TrafficView57	TrafficView	(none)
Moving Terrain	MT VisionAir X MT VisionAir X ETSO	MTEX/SY-22-00 MTUX/SY-25-00	(none)

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Appendix D – Installation Verification Checklist

The following checklist shall be completed after the installation, as well as after modifications to the installation (e.g. change of display or antennas). See Section 2.10 for details.

#	Item	Description
1	Mechanical Attachment	Verify proper installation and secure mounting of installed parts.
2	Installation basis	A FLARM system that is installed is formally a change to the type certificate of the aircraft. The change is normally only a minor change and can be done as a Standard Change (CS-SC051 for ELA2 aircraft), or under an EASA Minor Change Approval (MCA) or the national equivalent. In both cases, the equivalent documentation is required, including e.g. the AFM Supplement (AFMS). An AML-based MCA, as well as documentation for a generic Standard Change installation, is available for PowerFLARM Fusion. See Section 2.1.1 for details.
3	One operating device per aircraft	Verify that only one FLARM system/device is installed in the aircraft. E.g. if PowerFLARM Fusion is connected to a navigation system that already integrates an old Classic FLARM-based system, the old system must be disabled.
4	Antennas	Ensure that only approved antennas are installed/used, or that the antennas are otherwise acceptable for the applicable installation and radio frequency characteristics. In addition to antennas supplied with the device, acceptable antennas are specified in Appendix B. Verify that all antennas are correctly installed/placed. In particular, verify that antennas are vertical (FLARM RF is vertically polarized; up to 15° tilt is normally acceptable), do not touch other objects, and are not close to or shielded by metal or carbon parts. Verify that the antennas and their insulation are undamaged.
5	Antenna cables and Wiring	For remotely installed antennas, ensure that mainly low-attenuation antenna cables are used. The total attenuation should be less than 3 dB. Perform a visual check in order to verify that all antenna cables and wiring, including connectors, are undamaged, unbent, and are correctly installed.

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6	No antenna splitters	Ensure that no antenna splitters are used for the FLARM RF. Antenna splitters connecting two antennas to the same transceiver will result in signals canceling themselves out or severely degraded range. Use antenna diversity instead.
7	Displays	Ensure that at least one display has been certified as <i>FLARM Compatible</i> and normally in the pilots' primary field of view (see Sections 1.3 and 2.3 for details). A list of certified displays can be found in Appendix C, as well as in the Product Selector under the category "Primary Displays". If the primary display has not been certified as <i>FLARM Compatible</i>, it may be used if the deviations are understood and the resulting risks are acceptable or mitigated. See Appendix C for details. Ensure that the latest display firmware, if applicable, has been installed.
8	Firmware version	Ensure that the latest PowerFLARM firmware version has been installed. See Section 2.7 for details.
9	Configuration	Ensure that PowerFLARM Fusion has been correctly configured. All FLARM devices require a configuration specific to the aircraft in which it is installed. See the User and Maintenance Manual for details. Pay special attention to the 24-bit aircraft address, aircraft type, and FLARM/ADS-B/SSR ranges and target processing. Save a copy of the configuration for documentation purposes and reuse. Verify that the configuration is accepted by Fusion. Note: Update the firmware to the latest version before making configuration changes.
10	Mode-S address	For systems installed or used in aircraft with a Mode-S transponder or ADS-B Out equipment, ensure that the correct 24-bit ICAO aircraft address (available from the local CAA) is programmed in both the transponder/ADS-B Out equipment and in PowerFLARM Fusion.
11	Obstacle database installation	Ensure that a valid obstacle database is installed unless one is not required. See the User and Maintenance Manual for details.

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12	Status/Error conditions	Power on Fusion and verify that no error occurs during the boot sequence using the LEDs and/or FLARM Hub. If an error occurs, check the severity and type of error (error code) to determine the proper remedy. Verify that FLARM has GPS reception at the latest 15 minutes after power-on. The aircraft/device must be outside with a clear view of the sky. The system should indicate GPS and TX (Transmit). In addition, RX (Receive) should be indicated if other transmitting FLARM-equipped aircraft are within range. Verify that connected displays are showing normal indications. See the User and Maintenance Manual and the display manual for details.
13	AMP	Verify that the Annual Maintenance has been added to the AMP or equivalent (see Section 2.9).
14	Range analysis	Perform a range analysis after a couple of flights to verify acceptable range. Omnidirectional range with external antennas should normally be at least 10 km, and with internal antennas > 5 km. Acceptable range is indicated by the range analyzer result graph. Note: This is formally not part of the installation/change to the type certificate and the Certificate of Release to Service (CRS) may be issued before the range analysis has been completed. See the User and Maintenance Manual for details.

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Appendix E – 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.

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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.