Document status

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

Version control

Ver.	Date	Summary of changes
1.0	2020-09-15	Initial version

Scope and summary

This Instructions for Continued Airworthiness (ICA) is intended to be used by entities responsible for the continuing airworthiness of aircraft with a FLARM system installed. It is also intended to be used by owners of portable FLARM devices.

This document is general in scope and is applicable to all FLARM installations and devices listed herein.

FLARM, as all radio equipment, requires considerate care and maintenance for continued high performance. Failure to comply with this ICA may lead to the FLARM system deteriorating in performance or becoming inoperable.

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1 Introduction

FLARM is a traffic awareness and warning system for General Aviation. It provides increased situation awareness by actively warning the pilots of potential traffic conflicts. It is not required by any regulation, nor does an installation satisfy the requirements for any mandated equipment (e.g. TCAS). Like all radio equipment, it requires care and maintenance for continued high performance. This chapter describes the applicability of this Instructions for Continued Airworthiness (ICA) to different FLARM installations, systems, and devices.

1.1 Purpose

This ICA is intended to be used by those maintaining or responsible for the continuing airworthiness of aircraft with a FLARM system installed. It is also intended to be used by owners of portable FLARM devices used in aircraft. It can be used as the ICA, or as the basis for a more specific ICA, for all aircraft types.

Note: Portable FLARM devices, where parts of the system (e.g. antenna, power supply) are installed in the aircraft are regarded as installed systems.

1.2 Scope

This document is applicable to all FLARM systems and devices listed in Appendix E. If the manufacturer of specific equipment (e.g. FLARM device or display) has published Instructions for Continued Airworthiness approved by EASA or the national equivalent, those Instructions for Continued Airworthiness have priority over this document in applicable parts.

Since this document also targets owners of portable FLARM devices as well as owners of, and CAMOs for, aircraft with older FLARM installations, some parts of this document are written for those not familiar with continuing airworthiness procedures and for installations that might not be fully compliant.

1.3 Checklists

An Installation Verification Checklist is available in Appendix A. This checklist must be completed, in addition to the checklist in Appendix B, at the first annual maintenance where this ICA is used, as well as after modifications to the installation (e.g. change of display or antennas). For subsequent annual maintenance, only the checklist in Appendix B needs to be used.

1.4 Definitions

1.4.1 Abbreviations

Abbreviation	Meaning/Explanation
ADC	Analog-to-Digital Converter
ADS-B	Automatic Dependent Surveillance — Broadcast
AFMS	Aircraft Flight Manual Supplement
AIRAC	Aeronautical Information Regulation And Control
AML	Approved Model List
AMP	Aircraft Maintenance Program
CAA	Civil Aviation Authority
CAMO	Continuing Airworthiness Management Organization
CARP	Continuous Analyzer of Radio Performance
CDTI	Cockpit Display of Traffic Information
EEPROM	Electrically Erasable Programmable Read-Only Memory
EFB	Electronic Flight Bag
GNSS	Global Navigation Satellite System
GPIO	General-Purpose Input/Output
GPS	Global Positioning System (NAVSTAR)
ICA	Instructions for Continued Airworthiness
ICD	Interface Control Document
ISM	ISM radio band (≈ 915 MHz)
MCA	(EASA) Minor Change Approval
OEM	Original Equipment Manufacturer
RF	Radio Frequency/Radio
SRD860	The SRD860 radio band (≈ 868 MHz)
SSR	Secondary Surveillance Radar
TAS	Traffic Advisory System
TCAS	Traffic alert and Collision Avoidance System
UAV	Unmanned Aerial Vehicle
UI	User Interface
VFR	Visual Flight Rules

1.4.2 Terminology

Term	Meaning/Explanation
External antenna	Antenna mounted outside the aircraft fuselage (normally on top and below the aircraft).
FLARM Compatible	A FLARM display or other equipment that has been verified as having implemented all required systemic functions. See Appendix F for details.
FLARM device	A remotely mounted or portable FLARM avionics unit, comprising at least the transceivers and collision computer.
FLARM system	Comprises all necessary components for full FLARM functionality, including a FLARM device, one or more FLARM Compatible displays (may be integrated into the FLARM device), and appurtenant antennas. May be installed or portable.
Internal antenna	Antenna mounted inside the aircraft fuselage (e.g. in the cockpit or in gliders also in the vertical stabilizer).

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 particular 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.

1.5 Additional Documents

In addition to manufacturer-supplied documentation pertinent to the specific equipment, generic documents for installation, operation, and support can be found under the following link:

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

1.6 ICA Revision and Distribution

This ICA will occasionally be updated. The latest version can be found under the link above. Updates will be communicated to official FLARM dealers, OEMs, 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/

2 Instructions for Continued Airworthiness

2.1 System Overview

FLARM is the traffic awareness/electronic conspicuity and warning system used by General Aviation, light aircraft, and UAVs. It has been designed to support self-separation 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. However, unlike TCAS, FLARM does not issue Resolution Advisories (RA), so pilots need to identify traffic and decide on 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 predicted 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 future flight path can be predicted. The flight path, together with additional information such as an identification number, is encoded before being broadcast over an encrypted radio channel up to twice per second. Flight models are available for most aircraft types, including piston-engine airplanes, jets, helicopters, gliders, hang gliders, paragliders, UAVs, etc.

Many newer FLARM devices, which are based on the improved PowerFLARM technology, also incorporate an ADS-B and transponder (SSR) 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 the FLARM-equipped aircraft, so a reciprocal FLARM-installation is recommended for all aircraft.

FLARM was invented in 2004 to complement the see-and-avoid principle and to improve situation awareness. It initially spread in the domain of non-powered aircraft but was soon followed by rapid expansion in powered airplanes and helicopters. Over 40,000 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 to avoid thunderstorms, this might 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 GPS 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. navigation systems).

Other FLARM-based products, to which this ICA is not applicable, are also available, including transmit-only devices without a display (for paragliders, hang gliders, UAVs) and EFB applications for situation awareness only.

The type of system and installation must be understood and documented since this affects e.g. the type of display needed.

2.1.1 Displays and Connections

When the FLARM device and display are not integrated (e.g. in a navigation system or a portable stand-alone device), they may originate from separate manufacturers. However, components in a FLARM system communicate using the same protocol (FLARM ICD), based on FLARM-specific NMEA 0183 sentences. To ensure that collision warnings and traffic information work correctly and that relevant status and error conditions are correctly annunciated to the pilots, this type of installation should be connected to at least one FLARM Compatible display. The display should be installed in the pilots' primary field of view, except if other warning annunciations are adequately installed. In aircraft with tandem seating, each pilot should have a display in its primary field of view. A list of displays verified as FLARM Compatible, as well as alternative means of compliance, can be found in Appendix F. Displays verified 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, some FLARM devices support connections to third party displays and navigation systems using other protocols such as Garmin TIS (over RS-232 or ARINC 429), ARINC 735, or GDL 90 (over cable, Wi-Fi, or Bluetooth). However,

this is normally an incomplete installation because these protocols support only a subset of the necessary functions. At least one FLARM Compatible display should thus always be installed as the primary display. In other cases, critical information may not be annunciated correctly (e.g. aircraft and obstacle collision warnings, status information, error conditions, firmware expiration, etc.). Alternative means of compliance can be found in Appendix F.

2.1.2 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. Some FLARM devices (e.g. PowerFLARM Core and Portable) are specifically designed for only one of these frequency bands and cannot be used outside the respective region. Other devices can be used in both bands.

The antennas should be designed for the frequency band applicable in the geographic area where the aircraft is being operated. Internally mounted antennas are normally designed for only one of the frequency bands. The external AV-75 antenna is designed for both frequency bands and worldwide use. Only antennas supplied or listed by the respective FLARM device manufacturer for the device in question should be used. In addition, the AV-75 antenna and other antennas as explained in Appendix C may be used as well. Inappropriate antennas, especially antennas without complete insulation, can damage devices and should not be used.

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

Many newer PowerFLARM-based devices can use antenna diversity, i.e. two antennas. 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.

2.2 Servicing Information

Most FLARM devices and displays can be repaired by the manufacturer or its authorized service partner. If the equipment is very old, the availability of spare parts may be limited. Contact the respective manufacturer or authorized service partner for details.

2.3 Removal, Replacement, and Addition of components

System components may be removed and replaced following the instructions from the manufacturer. If removing or disconnecting any component required for the operation of FLARM, the display (or the location were the display was located if removing the display) must be placarded with "FLARM INOP".

If the FLARM device is replaced, it must be updated to the latest firmware version, or it must be ensured that a current firmware version is installed. Configure the device as required during reinstallation. Always save the configuration file for documentation and future use. If not updating to the latest firmware version, it must be ensured that the next annual maintenance is completed before the firmware expires.

If the display is replaced, it must be configured e.g. for the correct baud rate. If the display is replaced with a different model, the FLARM device might have to be reconfigured as well. If any replaced or newly installed display was/is able to configure the FLARM device (e.g. as part of the start-up), ensure that all connected components are configured and operate as required.

If any part of the system is modified (i.e. change, addition, or removal of components), the Installation Verification Checklist in Appendix A must be completed after the change, even if the modification is formally not a change to the type certificate of the aircraft.

2.4 Annual Maintenance

Each FLARM system must be inspected and updated every 12 calendar months. This applies not only to installed systems but also to portable devices. A checklist for the annual maintenance is available in Appendix B. If following this checklist for the first time, the Installation Verification Checklist in Appendix A must be completed first.

For installed systems in certified aircraft, the annual maintenance must be part of the Aircraft Maintenance Program (AMP) or equivalent. For other (e.g. portable) FLARM devices, which are not part of an AMP, the owner must set up an individual reminder 12 months after the previous maintenance.

2.4.1 Mandatory Firmware Update

In order to allow global and synchronized changes to the FLARM ecosystem, every FLARM device needs to be updated with the latest 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 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 not be relied upon for scheduling updates.

If the annual firmware update is not applied, the device may no longer be interoperable with other FLARM devices and will stop to operate! If a FLARM Compatible display is not used, information about firmware expiration or non-operating status may not be annunciated.

In special cases, the firmware may be updated to a version that is not the latest version. If not updating to the latest version, it must be ensured that the next annual maintenance, or at least the next firmware update, is completed before the firmware expires.

To stay up-to-date with additional unscheduled updates and other important information, sign up to the newsletter from the FLARM website to ensure that important communication is not missed:

https://flarm.com/blog/

Alternatively, periodically check the firmware update page:

https://flarm.com/support/firmware-updates/

2.4.2 Obstacle Database Update

If an obstacle database is installed, the database and the associated license is valid for one year and needs to be updated as part of the annual maintenance. Obstacle databases are available for different geographic areas and can be acquired under the following link:

https://flarm.com/shop/

The databases are also available on request per the AIRAC system (every 28 days).

2.5 Pre-flight Inspection

Inspect the external and accessible internal antennas to verify that they are clean and not damaged. Power on FLARM and verify that no error occurs during the boot sequence. If an error occurs, check the severity and type of error (error code) to determine if the system can be operated for the flight. Error codes are listed in Appendix D. After power-on, the system should indicate GPS and TX (Transmit).

Note: The system will not indicate GPS and TX if the GNSS does not have a clear view of the sky (e.g. if inside a hangar).

2.6 Troubleshooting Information

Many problems and issues can be related to one of the following causes:

- Improper antennas or antenna cables used
- Incorrect antenna or antenna cable installation
- Incorrect configuration
- Aging or breaking of components under normal or abnormal wear (device, cables, antennas, connectors, connector pins)
- Not using a FLARM Compatible display (no, incorrect, or incomplete collision warnings, operation with error conditions, expired databases, etc.)
- No valid GNSS position (e.g. aircraft is inside a hangar)

Make sure all instructions have been followed. This includes the installation instructions as well as other instructions from the manufacturer and this ICA.

Some electronic components are sensitive and may be subject to aging and their performance may deteriorate over time when exposed e.g. to electric shocks. Especially Classic FLARM and Classic FLARM-based devices may thus no longer have sufficient performance and should be replaced at the next scheduled maintenance or at the earliest convenience. Additional improvements and advantages with PowerFLARM can be found under the following link:

https://flarm.com/products/powerflarm/

A list of acceptable antennas and cables is available from the FLARM device manufacturer. Other antennas that may be used are specified in Appendix C.

Configure the system using the tool supplied by the manufacturer. Several devices can be configured using the following online tool:

https://flarm.com/support/tools-software/flarm-configuration-tool/

Pay special attention to the 24-bit aircraft address, aircraft type, and FLARM/ADS-B/SSR ranges and target processing settings.

A list of verified FLARM Compatible displays can be found in Appendix F, as well as in the Product Selector under the category "Primary Displays".

If an error is indicated, a list of error codes can be found in Appendix D. Many issues can also be resolved by consulting the FAQ:

https://support.flarm.com/

2.7 Installation of a Mode-S Transponder or ADS-B Out Equipment

If a Mode-S transponder or separate ADS-B Out equipment is installed in the aircraft, it must be ensured that both the transponder/ADS-B Out equipment and the FLARM system is configured to the correct (identical) 24-bit ICAO aircraft address. Otherwise, FLARM may indicate ownship as another aircraft and/or systems in other aircraft may show duplicate aircraft.

Appendix A – Installation Verification Checklist

The following checklist shall be completed the first time this ICA is complied with as part of the annual maintenance, as well as after modifications to the installation (e.g. change of display or antennas). For subsequent annual maintenance, only the checklist in Appendix B needs to be complied with. See sections 2.3 and 2.4 for details.

#	Item	Description
1	Installation basis	A FLARM system that is installed in certified aircraft 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 is often available from the equipment manufacturer, which may have specific instructions and conditions for the system it is applicable to. Documentation for a generic Standard Change installation can be acquired under the following link: https://flarm.com/product-category/approvals/ **Note:** A Standard Change installation is normally more limiting than an MCA (e.g. limited to day VFR).
2	One operating device per aircraft	Verify that only one FLARM system/device is operating in the aircraft. E.g. if a PowerFLARM is connected to a navigation system that already integrates an old Classic FLARM-based system, the old system must be disabled.
3	Use of antennas	Ensure that only listed antennas are installed/used, or that the antennas are otherwise acceptable for the applicable installation and radio frequency characteristics. Ensure that antennas have complete insulation. In addition to antennas supplied by the device manufacturer for the specific device, acceptable antennas are specified in Appendix C.
4	Antenna cables	For remotely installed antennas, ensure that mainly low-attenuation antenna cables are used. The total attenuation should be less than 3 dB.

5	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, which is available for PowerFLARM-based devices.
6	Use of displays	For installations with a separate display, ensure that at least one display has been verified as FLARM Compatible and normally in the pilots' primary field of view (see section 2.1.1 for details). A list of verified displays can be found in Appendix F, as well as in the Product Selector under the category "Primary Displays". If the primary display has not been verified as FLARM Compatible, it can continue to be used if the deviations are understood and the resulting risks are acceptable or mitigated. See Appendix F for details.
7	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 the FLARM device.
8	Configuration	FLARM requires a configuration specific to the aircraft it is installed in. Many devices can be configured using the following online tool: https://flarm.com/support/tools-software/flarm-configuration-tool/ Manufacturers may provide their own solutions for creating and/or applying the configuration to their products. 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 file for documentation purposes and reuse. The resulting configuration file can normally be applied to FLARM either through the use of an SD card, a USB stick, or using the FLARM Tool software. Verify that the configuration file is accepted by the device. Manufacturers may provide their own methods; consult the manual for details. **Note:** Normally update the firmware to the latest version before making configuration changes.

9	Database installation	If an obstacle database is to be installed, procure the latest version under the following link: https://flarm.com/shop/ The database file can be installed analogously to the configuration file. Verify that the database is accepted by the device. Consult the manual for details.
10	AMP	For systems installed in certified aircraft, verify that the Annual Maintenance (Appendix B) has been added to the AMP or equivalent. For other (e.g. portable) FLARM devices, the owner must set up an individual reminder 12 months after the previous maintenance/firmware update.
11	Annual maintenance	Complete the Annual Maintenance checklist in Appendix B.

Appendix B – Annual Maintenance

The following checklist shall be completed during annual maintenance, i.e. every 12 calendar months (see section 2.4). If this is the first time this ICA is complied with, or if the installation has been modified (see section 2.3), the Installation Verification Checklist in Appendix A shall be completed before completing this checklist.

Note: This checklist does not replace or override the equipment manufacturer's maintenance instructions.

This checklist may be performed as pilot-owner maintenance if otherwise allowed by the AMP, where applicable.

#	Item	Description
1	Mechanical Attachment	Verify proper installation and secure mounting of installed parts.
2	Antenna status and placement	Verify that all antennas are correctly installed/placed. In particular, verify that antennas are vertical (FLARM RF is vertically polarized), 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 (see Appendix C for details).
3	Cables & wiring	Perform a visual check in order to verify that all antenna cables and wiring, including connectors, are undamaged, unbent, have no corrosion or signs of water, and are correctly installed.

4	Range analysis	Download all IGC flight recorder files from the device (see device manual from the manufacturer). This is normally done via an SD card or USB stick. Upload the most recent file(s) using the FLARM Range Analyzer: https://flarm.com/support/tools-software/flarm-range-analyzer/ Only upload flights completed after the last modification. **Note:** For PowerFLARM-based devices, only upload the single most recent file for a CARP analysis. Check the range to verify the functioning of the system. 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.
5	Reset CARP	Only for PowerFLARM-based devices: Reset the Continuous Analyzer of Radio Performance (CARP) using the display or configuration tool.
6	Firmware update	Update the FLARM firmware, normally to the latest version, according to section 2.4.1. It can be obtained from the device manufacturer.
7	Display update	Install the latest display firmware, if applicable. It can be acquired from the display manufacturer.
8	Configuration	If the FLARM firmware release notes indicate that configuration settings have been added or changed, reconfigure the device as required. See Appendix A, item 8 for details.
9	Database update	If an obstacle database is installed, update the database to the latest version: https://flarm.com/shop/

10	Status/Error conditions	Power on FLARM and verify that no error occurs during the boot sequence. If an error occurs, check the severity and type of error (error code) to determine the proper remedy. Error codes are listed in Appendix D. Verify that FLARM has GNSS 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. See the device and/or display manual for details. Verify that connected displays are showing normal indications. See the display manual for details.

Appendix C – Acceptable Antennas and Cables

In addition to antennas supplied or listed by the device manufacturer for the specific device, the antennas listed below are acceptable for installation and use.

Additionally, other than supplied or listed antennas may be used if it is 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 radiofrequency characteristics may be verified by performing a range analysis.

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

"Toothpick" antenna with cap intact

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

Internal antennas

GPS Antenna	**FLARM Technology**: ANTCIGPS
FLARM Antenna E-version/SRD860	**FLARM Technology**: ANTCIFLAEU
FLARM Antenna A-version/ISM	**FLARM Technology**: ANTCIFLAUS
ADS-B Antenna E-version/SRD860	**FLARM Technology**: ANTCIADSBEU
ADS-B Antenna A-version/ISM	**FLARM Technology**: ANTCIADSBUS

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.

Appendix D – List of Error Codes

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

Note: Some devices may not be able to show all error codes.

Error Code (Hex)	Meaning
11	Firmware expired (requires valid GNSS information, i.e. will not be available during the first minutes after power-on)
12	Firmware update error
21	Power (e.g. voltage below minimum)
22	UI error
23	Audio error
24	ADC error
25	SD card error
26	USB error
27	LED error
28	EEPROM error
29	General hardware error
2A	Transponder receiver Mode-C/S/ADS-B unserviceable
2B	EEPROM error
2C	GPIO error
31	GNSS communication
32	Configuration of GNSS module
33	GPS antenna
41	RF communication
42	Another FLARM device with the same Radio ID is being received. Alarms are suppressed for the relevant device.
43	Wrong ICAO 24-bit address or radio ID
51	Communication
61	Flash memory
71	Pressure sensor
81	Obstacle database (e.g. incorrect file type)
82	Obstacle database expired
91	Flight recorder
93	Engine-noise recording not possible
94	Range analyzer
A1	Configuration error, e.g. while reading flarmcfg.txt from SD/USB
B1	Invalid obstacle database license (e.g. wrong serial number)
B2	Invalid IGC feature license

B3	Invalid AUD feature license
B4	Invalid ENL feature license
B5	Invalid RFB feature license
B6	Invalid TIS feature license
100	Generic error
101	Flash File System error
110	Failure updating firmware of external display
120	Device is operated outside the designated region; the device does not work
F1	Other

Appendix E – Applicable FLARM Systems

This ICA is applicable to the FLARM systems and devices listed in this appendix. See section 2.1 for details.

Manufacturer	Device	Separate display required?*
AIR Avionics/Garrecht Avionik	AIR traffic AT-1	Yes
AIR Avionics/Garrecht Avionik	TRX-1500	Yes
AIR Avionics/Garrecht Avionik	TRX-2000	No
EDIATec	ECW100	No
Euroavionics	EuroNav 7	No
FLARM Technology	Classic FLARM F4-F9	No
FLARM Technology	PowerFLARM Core	Yes
FLARM Technology	PowerFLARM Portable	No
LX navigation	LX70xx	No
LX navigation	FLARM Eagle	Yes
LX navigation	FLARM Eagle Mobile	No
LX navigation	Mini Box	No
LX navigation	Red Box	Yes
LXNAV	FlarmBat	No
LXNAV	FlarmMouse	Yes
LXNAV	LX80xx	No
LXNAV	LX90xx	No
LXNAV	PowerMouse	Yes
Triadis	FLOICE 1xx	No

* Required for standalone FLARM devices. See section 2.1.1 and Appendix F.

Appendix F – FLARM Compatible Displays

FLARM devices without an integrated display should be connected to a verified FLARM Compatible display. In addition, it's also possible to connect a secondary display for additional traffic information.

Displays that have been verified as FLARM Compatible can be either standalone or integrated into other avionics, e.g. navigation systems. Verified displays carry the FLARM Compatible logo (see depiction on the right). Verification 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 verified 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 used when formally verifying displays is available from FLARM Technology (document FTD-013) and may be used as guidance. 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?

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

Manufacturer	Model	Part No.	Limitations
ABOBA Elektronik	V3+Mm	V3+Mm	• Verified for displays manufactured before 2016-01-01 only.
ABOBA Elektronik	V4+M	V4+M	• Verified for displays manufactured before 2016-01-01 only.
Butterfly Avionics GmbH	Butterfly Display 57	B102	• Verified for day only.
Butterfly Avionics GmbH	Butterfly Display External	B101	• Verified 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)