



DATA PORT SPECIFICATIONS

preliminary

Status
Software version 4.04 (June 03, 2008)

© 2003-2008 FLARM Technology GmbH
Zurich-Switzerland
www.flarm.com
info@flarm.com

1. Welcome to FLARM

This document provides information how to read the serial interface from a PC terminal emulator, a PDA or any embedded device.

Note that this document as well as the interface described with it are proprietary and copyright protected. Any non-licensed use, dissemination, copying, implementation or reverse engineering of the FLARM data port communication protocol or parts of it is forbidden by law and will be prosecuted. FLARM is a registered trademark and can not be used without license.

The document assumes you are familiar with serial communication and the basics of the NMEA-0183 version 2.0 protocol¹. The NMEA-0183 Standard is a copyrighted document. The copyright is owned by the National Marine Electronics Association, Inc., 7 Riggs Avenue, Severna Park, MD 21146, USA. The NMEA-0183 Standard may be purchased from NMEA on-line at www.nmea.org. NMEA[®] is a registered trademark of the National Marine Electronics Association Inc. The NMEA Director agreed to this document on March 9, 2005.

The most recent version of the "FLARM Data Port Specification" document and test data streams are available on www.flarm.com. You can also subscribe to a developer email news-list in order to get first-hand information on the topic: https://lists.flarm.com/mailman/listinfo/user-list_flarm.com

Please let us know about your products and designs that use FLARM's data stream.

Suggestions to improve this document may be sent to info@flarm.com. Contact us if you require the documentation on IGC flight-data download, obstacle-data upload and boot-loader assisted firmware update.

2. Working Principle

FLARM utilizes position and movement information obtained from an integrated 16-channel GPS and an embedded barometric sensor. The future flight path of the glider is predicted and transmitted over low-power short-range radio as a very short digital message once a second. These messages are received by other FLARM units within the range and then compared with their own predicted flight path. Likewise the own flight path is compared with the stored fixed obstacles in the area (e.g. power lines, antennas, aerial railways, ...). If in either of the cases a dangerous approximation is determined, then FLARM warns the user of the possibility using its computation of the current most dangerous object. Warnings are shown via a buzzing sound and on a bright multi-LED display indicating the direction and danger level of the intruder. Directional advice is given in the horizontal and vertical plane.

In addition, the GPS and collision data are transmitted as serial data to be used in 3rd party applications (e.g. PDA, external displays). Several manufacturers of glider avionics and PDA software as well as ground-based applications use FLARM data in their applications.

FLARM's range is subject to the antenna installation in the aircraft but usually is around 2 km, with optimal antenna matching up to 5 km, sufficient even for high speed gliding. The effective range can easily be verified with an online tool². Alarms and the three alarm levels are issued depending on the forecasted time to impact, not a geometrical distance. The first alarm level is usually issued 18 seconds, the second one 13 seconds and the third one 8 seconds prior to the predicted impact and last as long as the alarm level is appropriate. Depending on the impact forecast, alarm levels might even go down or disappear. Alarms are highly selective, i.e. they are only issued when there is imminent danger. The alarm sensitivity can be configured. In an additional information mode called "nearest mode", the user can be informed about other aircraft in the vicinity even when not posing any elevated danger. Furthermore FLARM forwards available traffic information to the serial interface for use by other devices. This traffic information is limited to a configurable range (default is 3 km) and 500 m altitude difference. FLARM is designed to handle up to 50 aircraft inside its range and will experience graceful performance degradation with more aircraft in range.

To work properly, FLARM must have 3D GPS reception. Furthermore the radio broadcast antenna installation must allow a suitable range.

¹ The current version of the NMEA-0183 standard is 3.01.

² www.flarm.com/support/analyze

FLARM applies for the radio communication between the units a proprietary patent- and copyright-protected protocol. It is not public, but FLARM Technology offers a license contract where it is accessible in the form of a compatible core design ready for integration into 3rd party systems. These systems are officially declared as FLARM-compatible. Any non-licensed use, dissemination, copying, implementation or reverse engineering of the FLARM radio communication protocol, the FLARM hardware and software or parts of it is forbidden by law and will be prosecuted. FLARM is a registered trademark and can not be used without license.

3. Design Philosophy



FLARM cannot warn reliably in all situations. FLARM does not issue collision avoidance advice. FLARM can only warn of aircraft which are equipped with FLARM or a compatible device or of 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 user and pilot in command to decide upon the use of FLARM. FLARM Technology GmbH cannot be held liable under any circumstances.

When designing your own user interface on a device using the serial data provided on the data ports from FLARM, please strictly support this concept.

This means: Try to be as simple and as clear when presenting any data to the user. Use a presentation form and medium that are suitable for immediate comprehension of the danger level and constellation. We do not recommend the design of very fancy and colorful TCAS-style displays, as small aircraft pilots are not trained to use this kind of display. Do not give any resolution advice and make it clear that your user interface cannot be misinterpreted as such.

FLARM Technology therefore recommends simple voice alarms (“traffic 3 o’clock above”) and very simple large font text warnings. A graphical-only warning on a moving map projection might not be suitable, especially if the map is north up rather than track-up. Alarms must make the pilot look outside of the cockpit, not onto a display. Therefore whenever a warning is given, show only the warning with noticeable large fonts, icons and colors. In such a case, immediately stop displaying anything that is nonrelevant, e.g. aircraft around that do not represent a danger. In case of obstacles, do not plot any obstacles on a moving map based on warning information provided by FLARM. Inform your user when functionality is not available due to errors, especially when you intend an installation where FLARM is out of the pilot’s sight.

Make it clear to your users that they should under no circumstances rely on FLARM, FLARM’s serial output or your application using data coming from FLARM.

Users should not be disincentivised or punished to use FLARM. Especially in competitions, pilots might not want to be followed by other aircraft. The limited range and some special features in FLARM (e.g. a configurable stealth modus³ that can not be changed in-flight and prevents received data being shown on PDA’s and displays, low-range and message filtering) do ensure FLARM information cannot be abused to gain a competitive advantage. In this context, note that Section 5.3 of Annex A of FAI / IGC Sporting Code Section 3 does no longer prohibit usage of FLARM⁴.

By designing your own application using FLARM data, do not compromise the use of FLARM, e.g. in competitions. **Thank you for supporting above principles!**

FLARM Technology may publicly discourage use of applications that undermine safety by the inappropriate use of data obtained through FLARM devices.

³ use the PFLAC, PRIV sentence to change this mode (named ‘privacy’ in software versions lower than 4)

⁴ see www.fai.org/glidering/sporting_code/sc3a for the valid version of the Sporting Code; an earlier version of the Sporting Code ruled: *“External Aid to Competitors: [...] limitations are imposed so that the competition shall, as far as possible, be directly between the individual competitors, neither controlled nor helped by external aid. Radio [transmitters and transceivers] are for voice transmissions between team members and between them and the organisers only... Any other data transmission between competitors, or between them and the ground is prohibited, except as required: (i) by the organisers; or (ii) for safety purpose or; (iii) for anticollision warning...”* also see the related FAI newsletter, archived on www.flarm.com/news/igc_letter_to_delegates_050724.pdf. This ancient rule, applicable only to world and continental championships was written to restrict the transfer of data - such as from GPS units that would provide information about air mass and rates of climb, etc. - especially when gliders were out of sight of each other. The rules permit organisers to require all gliders to carry FLARM, for example, as a means of reducing the risk of mid-air collisions.

⁶ Check www.fai.org/glidering/gnss/tech_spec_gnss.pdf chapters 2.7.2.2.7.2 and 2.7.2.2.7.5 for details.

4. Hardware Setup, Port Differentiation and Settings

FLARM is built in a light plastic box (120g) of small dimension (7.5 x 2.5 x 11 cm) and can be mounted by either one of the two M5-screw threads or by industrial DualLock™ tape. As user interface a display, a button and a buzzer are included. FLARM includes an internal radio antenna and a 16-channel high-performance GPS-engine. The GPS-antenna is provided but must be externally mounted. FLARM draws about 60mA at 12VDC that must be provided from the aircraft's battery.

The back-side of FLARM offers some connectors for power and bidirectional data. FLARM hardware version 1 (shipped in 2004) has one RJ45 connector. FLARM hardware version 2 (shipped in 2005) and later versions have one RJ45 and one RJ12 connector. The RJ45 is the power/data, the RJ12 is the extension port. Both ports use the FAI/IGC pin specification⁶ for these connectors. An additional pin supplies 3V and 90 mA at maximum to 3rd party devices.

Both ports have a bidirectional serial interface (RS232) that can be used to work with the data as described in this document. There are some differences between these two ports described in this document. Simple 3rd party devices should normally be connected to the extension port (if available), advanced PDA-applications should use the data port (always available). The two ports are completely separated. The extension port (if available) must neither be used to supply power to FLARM nor for PC communication (update, download, configuration).

Both ports work with 8 data bits, no parity, no handshake, 1 start bit and 1 stop bit. The extension port works *only* with 4.8kBaud. The data port baud-rate can be configured by commands described in this document. It is therefore strongly suggested to implement automated baud-rate detection in any device connected to FLARM. If anything fails, pressing the button on FLARM for 20 s completely resets the device to the default configuration.

In principle, all sentences can be accessed on the data port. In contrast, the extension port is limited to PFLAU, PFLAE and PFLAV sentences, receiving PFLAU with a 1 Hz rate. Ignore other sentences on the extension port.



FLARM may interrupt RF communication and collision warnings for some seconds upon receiving NMEA commands. Therefore **sending sentences to FLARM is not recommended during flight.**

Note that instead of serial communication, all the sentences documented in this manual can also be written to a text-file named `flarmcfg.txt` and stored on the microSD card. If at power up a file named `flarmcfg.txt` is detected on the microSD card, it will be processed as configuration commands. The syntax is the same as on the serial data, except for PFLAC, , ID. This feature is especially useful for batch configuration or a pilot's individual configuration for shared aircraft.



5. Important notes on version 4.0

Protocol version 4.0 must be **explicitly activated after each power-up** or reset (e.g. with the command \$PFLAC,S,NMEAOUT,41). Additions to the protocol for version 4.0 are marked in **yellow**.

Users who activate v4.0 of the protocol **must** fulfill the following requirements:

- Accept changes from v3.11 as described in this document
- Process PFLAE messages at any time
- Accept added data-field to any message (to allow future extensions)

6. Sentence Composition

This document assumes you are familiar with the full NMEA-0183 version 2.0 specifications. FLARM allows input and output.

Sentences consist of NMEA-0183-standard GPRMC, GPGGA and GPTXT sentences and NMEA-0183-style proprietary sentences that start with PFLA, in addition to Garmin[®]'s proprietary sentence PGRMZ⁷. FLA has been officially assigned by NMEA as the FLARM manufacturer code on July 26, 2004.

All sentences must start with "\$" (0x24) and end with the checksum delimiter "*" (0x2A), followed by two checksum characters and <CR><LF> (0x0D0A). For matters of simplicity, the following document does *not* mention these characters although they must be provided in sentences to FLARM and are part of the answers given by FLARM.

Fields are delimited with the "," (0x2C), even when the field content is omitted. The field length might vary. Sentences must always include valid characters.

The sentences are not case-sensitive except where explicitly stated.

The maximum number of characters in a sentence is 82, consisting of a maximum of 79 characters between the starting delimiter "\$" and the terminating delimiter <CR><LF>.

Sentences not following this syntax must be ignored without further consequences by the receiving device. Design your application fault-tolerant.

⁷ See 'Garmin Proprietary NMEA 0183 Sentence TECHNICAL SPECIFICATION', part number 190-00684-00, revision B, April 2006. Garmin[®] is a registered trademark of Garmin Ltd.

7. Sentences

The following sentences are available and documented:

- **PFLAU:** **Operating status and priority intruder and obstacle data**
- PFLAA: Data on other moving objects around
- **PFLAE:** **Self-test result and operation errors**
- PFLAV: Version information
- PFLAR: Reset
- GPRMC: NMEA recommended minimum specific GPS navigation data
- GPGGA: NMEA GPS 3D-fix data
- GPGSA: NMEA active satellites and DOP
- GPTXT: NMEA text data (ignore)
- PGRMZ: Garmin®'s barometric altitude⁷ (only hardware version 2 and later)
- PFLAS: Debugging information
- PFLAC: Device configuration
 - PFLAC,, ID: RF-message device ID
 - PFLAC,, FREQ: RF-frequency
 - ~~PFLAC,, RFTX: Disable RF transmission on ground (discontinued)~~
 - PFLAC,, NMEAOUT: Disable NMEA-sentences
 - PFLAC,, BAUD: Baud-rate
 - PFLAC,, UI: Disable integrated display and buzzer
 - PFLAC,, PRIV: Activate Stealth Mode
 - PFLAC,, THRE: Speed threshold below which no alarms are issued
 - PFLAC,, RANGE: Maximum distance of received aircraft
 - PFLAC,, ACFT: Aircraft type
 - PFLAC,, LOGINT: Flight recording interval
 - PFLAC,, PILOT: Pilot name (flight recording header information)
 - PFLAC,, COPILOT: Co-Pilot name (flight recording header information)
 - PFLAC,, GLIDERID: Aircraft registration (flight recording header information)
 - PFLAC,, GLIDERTYPE: Aircraft type (flight recording header information)
 - PFLAC,, COMPID: Competition ID (flight recording header information)
 - PFLAC,, COMPCCLASS: Competition class (flight recording header information)
 - PFLAC,, NEWTASK: New task declaration (flight recording header information)⁸
 - PFLAC,, ADDWP: Add to task declaration (flight recording header information)⁷

The common sentence order in normal operations is as follows: GPRMC, (PGRMZ), GPGGA, {PFLAA}_n, PFLAU with PGRMZ only available on hardware version 2 and later, and n being an integer from 0 to higher values, dependent on the chosen Baud rate and the number of received other devices. When implementing a parser, do not expect the above order to be maintained all the time.



Do carefully read the meaning and usage given for each sentence on all subsequent pages.

There are user requests to include magnetic variation (in GPRMC), bidirectional text message handling (e.g. PFLAM), supplementary obstacle information (like an obstacle-ID, or PFLAO), absolute target positioning, enhanced ID tracking and constant length sentences for easy parsing. Later versions of the software and the specification might include such sentences.

⁸ IGC approved devices only

Sentence PFLAU

Syntax:

PFLAU, <RX>, <TX>, <GPS>, <Power>, <AlarmLevel>, <RelativeBearing>, <AlarmType>, <RelativeVertical>, <RelativeDistance>, <ID>

Meaning: Operating status and high priority intruder and obstacle data, especially on the most relevant target. This is the main sentence to be used for 3rd party applications and more or less shows what is being visible on the FLARM user interface. PFLAU sentences are not affected by user actions like a temporary suppression, mode or volume selection. This sentence is especially designed for 3rd party applications with very limited CPU performance. Do always track and parse this sentence as it is given the highest priority. Important information might be lost if you only parse PFLAA sentences. Obstacle warnings are currently only given in PFLAU. Note that no mode information is communicated from FLARM to 3rd party devices (e.g. warning vs. nearest mode, sound volume, suppression modes), i.e. 3rd party devices must maintain their own user dialogue for these settings and can do mode-switching regardless of FLARM's mode setting. Inform the user when PFLAU is not received regularly, i.e. not for more than 3s.

Input / Output: only sent by FLARM

Availability on the extension port: always available, no configuration

Availability on the data port: depending on configuration (PFLAC, NMEAOUT)

Periodicity: sent once every second (1.8s at maximum)

Values:

<RX>	Number of devices with unique ID's currently <i>physically</i> received regardless of the horizontal or vertical separation, an integer from 0 to 99. Because the processing might be based on extrapolated historical data, <RX> might be lower than the number of aircraft in range, i.e. there might be other traffic around (even if the number is zero). Do not expect to receive <RX> PFLAA sentences, because the number of aircraft being processed might be higher or lower.
<TX>	Transmission status, 1 (hex31) for OK and 0 (hex30) for no transmission
<GPS>	GPS status: 0 (hex30) for no GPS reception, 2 (hex32) for 3d-fix when moving and 1 (hex31) for 3d-fix on ground, i.e. not airborne. If <GPS> goes to 0, FLARM does not operate as warning device, nevertheless wait for some seconds to issue any warning to 3 rd party application's users.
<Power>	Power status, 1 (hex31) for OK and 0 (hex30) for under- or over-voltage
<AlarmLevel>	Alarm level as assessed by FLARM 0 = no alarm (used for no-alarm traffic information) 1 = low-level alarm 2 = important alarm 3 = urgent alarm >3 reserved, ignore
<RelativeBearing>	Relative bearing in degrees from the own position and true ground track to the intruder's / obstacle's position, an integer from -180 to 180. Positive values are clockwise. 0° indicates that the object is exactly ahead.
<AlarmType>	Type of alarm as assessed by FLARM 0 = aircraft traffic (used for no-alarm traffic information) 1 = silent aircraft alarm (displayed but no alarm tone) 2 = aircraft alarm 3 = obstacle alarm 4 = "INFO alert" >4 reserved, ignore
<RelativeVertical>	Relative vertical separation in Meter above own position, negative values indicate the other aircraft is lower, signed integer. Some distance-dependent random noise is applied to altitude data if stealth for the target is active.
<RelativeDistance>	Relative horizontal distance in m, unsigned integer.
<ID>	6-digit hex value (e.g. "5A77B1") as configured in the target's PFLAC, ID sentence. The interpretation is delivered in <ID-Type>

Example:

\$PFLAU,3,1,1,1,2,-30,2,-32,755*

FLARM is working properly and currently receives 3 other aircraft. The most dangerous of these aircraft is at 11 o'clock position 32m below and 755m away. It is an important alarm.

\$PFLAU,2,1,1,1,0,,0,,*

FLARM is working properly and receives two other aircraft. They are both out of range.

Sentence PFLAA

Syntax:

PFLAA, <AlarmLevel>, <RelativeNorth>, <RelativeEast>, <RelativeVertical>, <ID-Type>, <ID>, <Track>, <TurnRate>, <GroundSpeed>, <ClimbRate>, <AcftType>

Meaning: Data on other aircraft around, intended for 3rd party devices with sufficient CPU performance. This sentence should be treated with utmost flexibility and tolerance on a best effort base: Individual fields can be omitted. This sentence is only delivered if the data-port Baud rate is 19.2kBaud or higher. In case of serial port congestion or high CPU load this sentence may be omitted for several objects independent of the alarm level. Obstacle information is not delivered with this sentence. Use a combination of <ID-Type> and <ID> to track the same target, as it might not appear every second. Note that in case of many targets within range, individual targets including the most dangerous one might not be delivered every second, not regularly and maybe not even at all due to less strict priority handling for the PFLAA sentence. Always use PFLAU as primary alarm source. Usually, but not always, the last PFLAA sentence is the one causing the PFLAU content. The other PFLAA sentences are not ordered. Do not expect to receive PFLAU <Rx> times PFLAA sentences, because the number of aircraft being processed might be higher or lower. PFLAA sentences can be based on extrapolated historical data. PFLAA sentences are limited to other aircraft with a horizontal distance of less than the configured range (default is 3km) and a vertical separation of less than 500m. Non-moving aircraft are suppressed.

Input / Output: only sent by FLARM

Availability on the extension port: not available, no configuration

Availability on the data port: depending on configuration (PFLAC, NMEAOUT and PFLAC, BAUD)

Periodicity: sent when available and port Baud rate is sufficient, can be sent several times per second with information on several (but maybe not all) targets around.

Values:

<AlarmLevel>	Alarm level as assessed by FLARM 0 = no alarm (pure traffic, limited to configured range (default is 3km) and 500m altitude difference) 1 = low-level alarm 2 = important alarm 3 = urgent alarm															
<RelativeNorth>	Relative position in Meter true north from own position, signed integer															
<RelativeEast>	Relative position in Meter true east from own position, signed integer															
<RelativeVertical>	Relative vertical separation in Meter above own position, negative values indicate the other aircraft is lower, signed integer. Some distance-dependent random noise, changing every second is applied to altitude data if stealth for the target is active.															
<ID-Type>	Defines the interpretation of the following field <ID> 1 = official ICAO aircraft address 2 = stable FLARM pseudo-ID (chosen by FLARM)															
<ID>	6-digit hex value (e.g. "5A77B1") as configured in the target's PFLAC, ID sentence. The interpretation is delivered in <ID-Type>															
<Track>	The target's true ground track in degrees. Integer between 0 and 359. The value 0 indicates a true north track. This field is empty if stealth for the target is active.															
<TurnRate>	The target's turn rate. Positive values indicate a clockwise turn. Signed decimal value in %/s. Currently omitted. Field is empty if stealth for the target is active.															
<GroundSpeed>	The target's ground speed. Decimal value in m/s. The field is forced to 0 to indicate the aircraft is not moving, i.e. on ground. This field is empty if stealth for the target is active while the target is airborne.															
<ClimbRate>	The target's climb rate. Positive values indicate a climbing aircraft. Signed decimal value in m/s. This field is empty if stealth for the target is active.															
<AcftType>	Up to two hex characters showing the aircraft type <table border="0" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 33%;">0 = unknown</td> <td style="width: 33%;">5 = drop plane for parachutes</td> <td style="width: 33%;">10 = flying saucer (UFO)</td> </tr> <tr> <td>1 = glider / motor-glider</td> <td>6 = hang-glider (hard)</td> <td>11 = balloon</td> </tr> <tr> <td>2 = tow / tug plane</td> <td>7 = para-glider (soft)</td> <td>12 = airship</td> </tr> <tr> <td>3 = helicopter / rotorcraft</td> <td>8 = powered aircraft</td> <td>13 = unmanned aerial vehicle (UAV)</td> </tr> <tr> <td>4 = parachute</td> <td>9 = jet aircraft</td> <td>15 = static object</td> </tr> </table>	0 = unknown	5 = drop plane for parachutes	10 = flying saucer (UFO)	1 = glider / motor-glider	6 = hang-glider (hard)	11 = balloon	2 = tow / tug plane	7 = para-glider (soft)	12 = airship	3 = helicopter / rotorcraft	8 = powered aircraft	13 = unmanned aerial vehicle (UAV)	4 = parachute	9 = jet aircraft	15 = static object
0 = unknown	5 = drop plane for parachutes	10 = flying saucer (UFO)														
1 = glider / motor-glider	6 = hang-glider (hard)	11 = balloon														
2 = tow / tug plane	7 = para-glider (soft)	12 = airship														
3 = helicopter / rotorcraft	8 = powered aircraft	13 = unmanned aerial vehicle (UAV)														
4 = parachute	9 = jet aircraft	15 = static object														

Example:

\$PFLAA, 0, -1234, 1234, 220, 2, DD8F12, 180, -4.5, 30, -1.4, 1*

There is a glider in the south-west direction, 1.7km away (1.2km south, 1.2km east), 220m higher flying on south track with a ground speed of 30m/s in a slight left turn with 4.5%/s turning rate, sinking with 1.4m/s. Its ID is a static FLARM-ID "DD8F12". There is no danger.

Sentence PFLAE

Syntax:

PFLAE, <QueryType>, <Severity>, <ErrorCode>

Meaning: Self-test results after startup and error information during operation, therefore always watch out for this sentence. The content shows only the biggest problem. Inform your user when functionality is not available due to errors, especially when you intend an installation where FLARM is out of the pilot's sight. We recommend not to query for this sentence during the flight.

Input / Output: bidirectional, i.e. can be requested

Availability on the extension port: always available, no configuration

Availability on the data port: always available, no configuration

Periodicity: sent once after startup and completion of self-test, sent when error occurs and sent when requested

Values:

<i><QueryType></i>	R = request FLARM to send status, disregard other fields then A = FLARM sends status (requested and spontaneous)
<i><Severity></i>	0 = no error, i.e. normal operation, disregard other fields then 1 = information only, i.e. normal operation 2 = functionality may be reduced 3 = fatal problem, device will not work
<i><ErrorCode></i>	Two digit hex value 11 = Firmware timeout (requires valid GPS information, i.e. will not be available in the first minute after power-on) 21 = Power (e.g. voltage < 8V, might occur during operations) 31 = GPS communication 32 = Configuration of GPS module 41 = RF communication 51 = Communication 61 = Flash memory 71 = Pressure sensor 81 = Obstacle database 91 = Flight recorder F1 = Other

Example:

```
$PFLAE,R
$PFLAE,A,0,0*
```

FLARM is asked on its status and returns that there is no problem.

Example:

```
$PFLAE,A,2,81*
```

FLARM reports during self-test after startup that there is a problem with the obstacle database (e.g. missing or corrupt) but that FLARM will continue to work with reduced functionality.

Example:

```
FLARM
Hardware v2.00, Software v4.01
Performing Selftest...
o.k. 16 Mbit FLASH memory
o.k. Obstacles
o.k. Logging Init
o.k. RF subsystem
o.k. Pressure subsystem
o.k. UART subsystem
o.k. GPS subsystem connection
$PFLAE,A,0,0
```

FLARM reports successful self-test after startup

Sentence PFLAV

Syntax:

PFLAV, <QueryType>, <HwVersion>, <SwVersion>, <ObstVersion>

Meaning: Version information after startup, allow at least 20s after power-on. It is recommended to pass version information to the 3rd party product user.

Input / Output: bidirectional, i.e. can be requested also

Availability on the extension port: always available, no configuration

Availability on the data port: always available, no configuration

Periodicity: sent once after startup and completion of self-test and sent when requested

Values:

<QueryType>	R = request FLARM to send version, disregard other fields then A = FLARM sends version (requested and spontaneous)
<HwVersion>	String with up to 6 characters (only numbers and one decimal point)
<SwVersion>	String with up to 6 characters (only numbers and one decimal point)
<ObstVersion>	String with up to 18 characters (any character, no special structure), field is empty when no obstacle database is present

Example:

```
$PFLAV,R  
$PFLAV,A,2.00,4.01,alps20080407_*
```

FLARM is asked on its versions and returns that it has h/w version 2.00, s/w version 4.01 and an obstacle database named 'alps20080407_'.

Example:

```
$PFLAV,A,2.00,3.04,*
```

FLARM reports that it has h/w version 2.00, s/w version 3.04, but that there is no obstacle database present.

Sentence PFLAR

Syntax:

PFLAR, <Value>

Meaning: Sends a reset command to FLARM, followed by the reset without any read-back.

Input / Output: only sent to FLARM

Values:

<Value>	0 = all settings will be stored and reloaded 99 = all settings will reset to default values, user configuration is lost
---------	--

Example:

```
$PFLAR,0
```

FLARM is asked to reboot and reboots.

Sentence GPRMC

Syntax et al.: see NMEA-spec

Meaning: Recommended minimum data, see the official NMEA-0183 specification. Currently, FLARM does not deliver magnetic variation. Note that the time is UTC, not GPS time.

Input / Output: only sent by FLARM

Availability on the extension port: not available, no configuration

Availability on the data port: depending on configuration (PFLAC, NMEAOUT)

Periodicity: sent once per second

Sentence GPGGA

Syntax et al.: see NMEA-spec

Meaning: GPS fix data, see the official NMEA-0183 specification. Geoid separation (undulation) and MSL altitude are calculated by the GPS, not measured by the pressure transducer. Note that the time is UTC, not GPS time.

Input / Output: only sent by FLARM

Availability on the extension port: not available, no configuration

Availability on the data port: depending on configuration (PFLAC, NMEAOUT)

Periodicity: sent once per second

Sentence GPGSA

Syntax et al.: see NMEA-spec

Meaning: Active satellites and DOP, see the official NMEA-0183 specification.

Input / Output: only sent by FLARM

Availability on the extension port: not available, no configuration

Availability on the data port: depending on configuration (PFLAC, NMEAOUT)

Periodicity: sent only on change of satellite configuration

Sentence GPTXT

Syntax et al.: see NMEA-spec

Meaning: other text coming from GPS or CPU, to be ignored.

Input / Output: only sent by FLARM

Availability on the extension port: not available, no configuration

Availability on the data port: depending on configuration (PFLAC, NMEAOUT)

Periodicity: sent only when required

Sentence PGRMZ

Syntax: (treat the following three versions as identical although FLARM *currently* only delivers the last one)

PGRMZ, <Value>, F, 3

PGRMZ, <Value>, F

PGRMZ, <Value>, F, 2

Meaning: Gives the barometric altitude in feet (1 ft = 0.3028 m) and can be negative. The value is autocalibrated with the GPS only if the situation permits.

Input / Output: only sent by FLARM

Availability on the extension port: not available, no configuration

Availability on the data port: depending on configuration (PFLAC, NMEAOUT)

Periodicity: sent once per second on hardware version 2 or later. The sentence is *not* delivered when no pressure device is present.

Sentence PFLAS

Syntax:

PFLAS,R

Meaning: Request debugging information in human readable form, answer consists of multiple lines of internal variables and other information. **Do not parse this information** as the structure and content are subject to frequent changes.

Input / Output: only sent to FLARM

Values: there are no values

Example:

```
$PFLAS,R
-----
Hardware v2.00, Software v4.01
Serial#           0508911865
ID                14516244  0xDD8014
Voltage           16.1
Pressure/Temp     951.0/24.6C
Baudrate          19200
Obstacle DB name: alps20080407_
                  creation date: 11.04.2008
-----
```

FLARM is asked to give debugging information and does so.

Sentence PFLAC

Syntax:

PFLAC,<QueryType>,<Key>,<Value>

Meaning: Configuration read-out and setting. Settings cannot be changed when the device is moving to prevent misconfiguration during a flight, unless stated differently. Applications should verify the acknowledge sentence of any configuration change. Settings are stored by FLARM and are reloaded at power-up, unless stated differently. Default values are underlined>. Factory preset values can differ from default values. Note that other devices might listen to FLARM as well, therefore only send the minimum required as you might configure settings necessary for other applications. If the command is not understood or the parameters are out of range, FLARM answers with PFLAC,A,ERROR

Input / Output: bidirectional, i.e. can be requested also

Availability on the extension port: usually available when on ground, no configuration

Availability on the data port: usually available when on ground, no configuration

Periodicity: sent when requested

Values:

<QueryType>	R = request to send content of <Key>, disregard <Value> field then S = request to set <Value> to <Key> A = FLARM answers request or setting with current content of <Key>
<Key>	see the following pages
<Value>	see the following pages

Example:

```
$PFLAC,HELLO,GLIDER_PILOTS
$PFLAC,A,ERROR*
```

FLARM is asked a configuration it does not understand and returns an error.

Sub-Sentence PFLAC, , ID

Syntax:

PFLAC, <QueryType>, ID, <Value>

Meaning: Device ID read-out and setting⁹. The ID cannot be changed when airborne, i.e. when moving. This is part of the radio-broadcasted data available to the outside world. **Do not** use this sentence on the SD configuration file!

Values:

<u><QueryType></u>	see above	
<u>ID</u>	-	
<u><Value></u>	<u><hex></u>	6 hex characters for official ICAO aircraft address ¹⁰ . Do never choose a value if not certain ¹¹ . Value must correspond to the aircraft where FLARM is used.
	<u>FFFFFF</u>	Constant ¹² and unique FLARM-ID

Example:

```
$PFLAC, S, ID, 4B3E60
$PFLAC, A, ID, 4B3E60*
```

FLARM is asked to set ID to 4B3E60 (ICAO aircraft address for HB-XQE) and returns that it has done so.

Sub-Sentence PFLAC, , FREQ

Syntax:

PFLAC, <QueryType>, FREQ, <Value>

Meaning: Device frequency band read-out and setting. The operator of this device is solely responsible for operating it in a frequency band that is legal in the country of use. Restrictions for operating RF emitting devices above ground may exist in some countries.

Values:

<u><QueryType></u>	see above	
<u>FREQ</u>	-	
<u><Value></u>	<u>100</u>	Automatic, currently set to Europe
	<u>0</u>	Europe and rest of the world 868.000-868.600 MHz (SRD-F)
	<u>1</u>	North America around 915.000 MHz. <i>Do not use!</i>
	<u>2</u>	New Zealand 869.250 MHz
	<u>3</u>	Australia 921.000 MHz
	<u>101</u>	Automatic, currently set to North America
	<u>102</u>	Automatic, currently set to New Zealand
	<u>103</u>	Automatic, currently set to Australia

Example:

```
$PFLAC, R, FREQ
$PFLAC, A, FREQ, 0*
```

FLARM is asked to read-out the frequency band and returns that it is configured to value 0.

⁹ Please note that FLARM – as long as believed being on the ground (moving or not-moving) – will transmit the ICAO aircraft ID (when set) or the stable FLARM pseudo-ID regardless of the above setting.

¹⁰ Hex-value is printed on bottom line of your country's aircraft certificate of registration, else check with your country's FAA office, for Switzerland use the following link or check the last line of the "Eintragungszeugnis": www.aviation.admin.ch/themen/lfz/slfr/register/

¹¹ Devices with identical ID (intentional or by accident) will be treated as one single device by the receiving FLARM. This can cause false or suppressed alarms and must be avoided under all circumstances.

¹² The ID is related to FLARM's serial number. This 24-bit number is built up similarly to the ICAO aircraft address system described in chapter 9 of ICAO Annex 10 Volume III. FLARM *currently* uses continuous 24-bit serial numbers starting with 1101 1101 1 (0xDD8*** up to 0xDDF***). Other manufacturers must ensure the same numbering scheme in order to maintain worldwide numbering uniqueness. You must contact us for details whenever you consider developing compatible devices.



Sub-Sentence PFLAC, , RFTX (discontinued)

This command is no longer needed as alarms from aircraft stationary on the ground are always suppressed.

Sub-Sentence PFLAC, , CFLAGS

Syntax:

PFLAC, <QueryType>, CFLAGS, <Value>

Meaning: Configures special modes. Make sure to read this setting before modifying it, as otherwise previously set configuration flags could be overwritten. If you do not understand the concept of bit flags, do not use this command!

Values:

<i><QueryType></i>	see above
<i>CFLAGS</i>	-
	<u>0x00</u> No flags set
	<u>0x01</u> Disable "INFO Alerts"
<i><Value></i>	<u>0x02</u> Enable competition mode (reduced alarm distances and times)
	<u>0x04</u> Disable storing of transmission statistics in flight records
	<u>0x08...0xFF</u> Reserved

Example:

```
$PFLAC, R, CFLAGS
$PFLAC, A, CFLAGS, 4*
$PFLAC, S, CFLAGS, 5
$PFLAC, A, CFLAGS, 5*
*****
```

FLARM is asked on the current status of the configuration flags. It replies 4 as the "Disable storing transmission stat..." bit is set. The user wants to set "Disable INFO Alerts", too and therefore bitwise OR's the two values which results in 5. FLARM is then asked to set the new configuration with the two flags set and acknowledges the new value.

Sub-Sentence PFLAC, , NMEAOUT

Syntax:

PFLAC, <QueryType>, NMEAOUT, <Value>

Meaning: Configures which sentences are sent by FLARM on the data-port (verbosity level). It does not affect the extension-port. Please do not change the setting unless really required, as multiple devices may be connected to the same port.

Warning: Values > 3 are volatile and not stored in EEPROM. They will revert to <Value> - 40 at next powerup / reset. Example: 43 reverts to 3. This is to make sure that no FLARM accidentally runs version 4.0 of the protocol if non v4.0 capable devices are connected.

Values:

<i><QueryType></i>	see above
<i>NMEAOUT</i>	-
	<u>0</u> no output
	<u>1</u> GPRMC, GPGGA, GPPSA, PGRMZ plus FLARM proprietary sentences
	<u>2</u> only GPRMC, GPGGA, GPPSA, PGRMZ but no FLARM proprietary sentences
	<u>3</u> only FLARM proprietary sentences, but no GPRMC, GPGGA, PGRMZ
<i><Value></i>	<u>40</u> no output
	<u>41</u> GPRMC, GPGGA, GPPSA, PGRMZ plus FLARM proprietary sentences version 4.0
	<u>42</u> only GPRMC, GPGGA, GPPSA, PGRMZ but no FLARM proprietary sentences
	<u>43</u> only FLARM proprietary sentences, version 4.0 but no GPRMC, GPGGA, GPPSA, PGRMZ

Sub-Sentence PFLAC, , BAUD

Syntax:

PFLAC, <QueryType>, BAUD, <Value>

Meaning: sets the Baud rate of the data port¹³. FLARM will first send the acknowledge sentence, and then switch immediately to the new rate. Note that you might have to reconfigure your terminal to the changed transmission rate.

Values:

<QueryType>	see above	
BAUD	-	
<Value>	0	4.8 kBaud
	1	9.6 kBaud
	2	19.2 kBaud
	4	38.4 kBaud
	5	57.6 kBaud

Example:

```
$PFLAC, R, BAUD
$PFLAC, A, BAUD, 0*
$PFLAC, S, BAUD, 1
$PFLAC, A, BAUD, 1*
*****
```

FLARM is asked on the current rate. It answers 0 for 4.8kBaud. FLARM is asked to set the new rate to 1 for 9.6kBaud. Still transmitting at 4.8kBaud it answers 1 for 9.6kBaud as the new rate and then switches to 9.6kBaud. Because the terminal still is at 4.8kBaud the new data becomes unreadable.

Sub-Sentence PFLAC, , UI

Syntax:

PFLAC, <QueryType>, UI, <Value>

Meaning: 3rd party device configures FLARM to (partial) deactivation of visual and audio output.¹⁴ Please only use when you can be sure that your settings make sense. Consider the presence of other devices with contradictory instructions. This value is not saved, i.e. it is lost after each restart. Note that no mode information is communicated from FLARM to 3rd party devices (e.g. warning vs. nearest mode, sound volume, suppression modes), i.e. 3rd party devices must maintain an own user dialogue for these settings.

Values:

<QueryType>	see above	
UI	-	
<Value>	0	FLARM to work normal
	1	FLARM to switch off LEDs and buzzer
	2	FLARM to switch off only LEDs
	3	FLARM to switch off only buzzer

¹³ Note that the standard NMEA-0183 baud rate is only 4.8 kBaud. Nevertheless a lot of NMEA-compatible devices can properly work with higher transmission speeds, especially at 9.6 and 19.2 kBaud. As any sentence can consist of 82 characters maximum with 10 bit each (including start and stop bit), any sentence might take up to 171 ms (at 4.8k Baud), 85 ms (at 9.6 kBaud) or 43 ms (at 19.2 kBaud). This limits the overall channel capacity to 5 sentences per second (at 4.8k Baud), 11 msg/s (at 9.6 kBaud) or 23 msg/s (at 19.2 kBaud). If too many sentences are produced with regard to the available transmission speed, some sentences might be lost or truncated.

¹⁴ Please note that 3rd party devices can be connected to FLARM without the UI command being sent. In order to properly work with 3rd party devices just listening to FLARM, the NMEA output must be properly configured. Nevertheless because 3rd party devices can draw current from FLARM it is strongly recommended to properly configure the UI command so that FLARM switches off any internal current-drawing devices if they are no longer used. If not doing so, FLARM might not work properly. It is recommended to send this command every start-up. Even when all FLARM's own LED's and the buzzer are deactivated (UI, 1), 3rd party devices must never consume more than 90mA at 3.0VDC.

Sub-Sentence PFLAC, , PRIV

Syntax:

PFLAC, <QueryType>, PRIV, <Value>

Meaning: The stealth flag indicates whether the own broadcasted data shall be solely used for collision avoidance¹⁵, i.e. where not all the received information is forwarded to the serial data-port and therefore is not available to external, graphical displays or PDA's to prevent abuse in competitions. An activated stealth results in PFLAA and PFLAU sentences not carrying specific climb and cruise data while some random noise is applied to altitude data. We recommend not activating stealth! This is part of the radio-broadcasted data available to the outside world. To apply full reciprocity, a pilot who enables "Stealth mode" will get the information as if all other aircraft had enabled "Stealth mode", independent of their actual setting.

The status and any changes of the "Stealth mode" are recorded in the IGC file. Consequently a competition authority can easily enforce the use (or non use) if desirable. Manual changes to "Stealth mode" during flight are delayed by two minutes. If FLARM is rebooted during flight, other aircraft are treated as if in "Stealth mode" for the first two minutes, independent of their actual setting.

Targets with enabled "Stealth Mode" are only displayed in NEAREST, and are available on the serial data-port as a PFLAA message, only if they meet at least **one** of the following requirements:

- target is a threat
- target is within 100m horizontal and 50m vertical
- target is within 2000m horizontal and 300m vertical and within ±45° of own flight track.

If a PFLAA message is issued according to the rules above, all fields in *Italic* are empty:

PFLAA,<AlarmLevel>,<RelativeNorth>,<RelativeEast>,<RelativeVertical>,<IDType>,<ID>,<Track>,<TurnRate>,<GroundSpeed>,<ClimbRate>,<AcfType>

Furthermore, <RelativeVertical> in PFLAA and PFLAU is degraded with random white-noise in the order of magnitude of (distance / 32) , as long as target is not a threat.

Values:

<i><QueryType></i>	see above
<i>PRIV</i>	-
<i><Value></i>	<u>0</u> no stealth.
	1 stealth activated. <i>Not recommended to use!</i>

Example:

```
$PFLAC, R, PRIV
$PFLAC, A, PRIV, 0*
```

FLARM is asked on the current setting. It answers that stealth is set to the default, i.e. off. That's how it should be.

Sub-Sentence PFLAC, , THRE

Syntax:

PFLAC, <QueryType>, THRE, <Value>

Meaning: Sets speed threshold in m/sec below which the aircraft is treated as "on the ground". No alarms are issued and other aircraft are not warned about this aircraft.

Values: integer values from 1 to 10 are allowed, 2 is the default (2 m/sec)

Sub-Sentence PFLAC, , RANGE

Syntax:

PFLAC, <QueryType>, RANGE, <Value>

¹⁵ Note that this flag only represents a recommendation to devices manufactured by 3rd parties other than FLARM and official licensees. It is not ensured that any device receiving the own data will respect the stealth flag. It is notably possible that received data is stored and used against a pilot or a third party, e.g. when penetrating airspace or after collisions. Regardless of the setting, 3rd party devices might store the last position reports for any device for a post-flight last-position localisation in case of missing aircraft

Meaning: Maximum distance of aircraft to be processed, in meters. This affects alarms, NEAREST as shown on the integrated displays, as well as PFLAU / PFLAA messages over the data port.

Values: Positive integer values between 2000 and 25500 are allowed, 3000 is the default (3000m). The values will be rounded to the next 100m.

Sub-Sentence PFLAC, , ACFT

Syntax:

PFLAC, <QueryType>, ACFT, <Value>

Meaning: Configures the aircraft type broadcast by FLARM. This is part of the radio-broadcasted data available to the outside world. This setting *may* affect the internal algorithms, as FLARM's motion predictions are aircraft type specific. The aircraft type configuration in FLARM must be set appropriately for tug / tow planes, otherwise the warning priority might be compromised. The setting "tow / tug plane" results in a different behavior for gliders as long as a glider being towed is detected.

<QueryType>	see above															
ACFT	-															
<Value>	Integer showing the aircraft type															
	<table border="0"> <tr> <td>0 = unknown</td> <td>5 = drop plane for parachutes</td> <td>10 = flying saucer (UFO)</td> </tr> <tr> <td>1 = glider / motor-glider</td> <td>6 = hang-glider (hard)</td> <td>11 = balloon</td> </tr> <tr> <td>2 = tow / tug plane</td> <td>7 = para-glider (soft)</td> <td>12 = airship</td> </tr> <tr> <td>3 = helicopter / rotorcraft</td> <td>8 = powered aircraft</td> <td>13 = unmanned aerial vehicle (UAV)</td> </tr> <tr> <td>4 = parachute</td> <td>9 = jet aircraft</td> <td>15 = static object</td> </tr> </table>	0 = unknown	5 = drop plane for parachutes	10 = flying saucer (UFO)	1 = glider / motor-glider	6 = hang-glider (hard)	11 = balloon	2 = tow / tug plane	7 = para-glider (soft)	12 = airship	3 = helicopter / rotorcraft	8 = powered aircraft	13 = unmanned aerial vehicle (UAV)	4 = parachute	9 = jet aircraft	15 = static object
0 = unknown	5 = drop plane for parachutes	10 = flying saucer (UFO)														
1 = glider / motor-glider	6 = hang-glider (hard)	11 = balloon														
2 = tow / tug plane	7 = para-glider (soft)	12 = airship														
3 = helicopter / rotorcraft	8 = powered aircraft	13 = unmanned aerial vehicle (UAV)														
4 = parachute	9 = jet aircraft	15 = static object														

Example:

\$PFLAC, S, ACFT, 3

\$PFLAC, A, ACFT, 3*

FLARM is set to helicopter type.

Sub-Sentence PFLAC, , LOGINT

Syntax:

PFLAC, <QueryType>, LOGINT, <Value>

Meaning: The value indicates the time interval in seconds between two data points of the flight recording. Consider that FLARM writes flight data to the memory about every 30 data points. When FLARM is switched off this period of the flight might not be stored. The higher the time interval between two data points, the longer is the period of the flight that is lost. Therefore do not use settings higher than 4s. FLARM should not be switched off immediately after an aircraft has landed. On the other hand the interval between two points also affects the overall recording capacity in terms of flight duration. The memory in FLARM is shared between the obstacle database and the flight recorder. The obstacle database defines the amount of memory available for flight recording. If the obstacle database is empty, FLARM can store approximately 96'000 data points of the flight. With the 4s interval this is an equivalent of more than 100 hours. Typically, about one third of the memory is available for flight recording, resulting in more than 30 hours at 4s interval. If the flight recording memory is full, old flight data is overwritten.

Values: integer values from 1 to 8 are possible, default is 4.

Sub-Sentence PFLAC, , PILOT

Syntax:

PFLAC, <QueryType>, PILOT, <String>

Meaning: The case-sensitive string defines header information (pilot name) for the flight recording. Default is empty. This can be part of the radio-broadcasted data available to the outside world.

Sub-Sentence PFLAC, , COPIL

Syntax:

PFLAC, <QueryType>, COPIL, <String>

Meaning: The case-sensitive string defines header information (co-pilot name) for the flight recording. Default is empty. This can be part of the radio-broadcasted data available to the outside world.

Sub-Sentence PFLAC, , GLIDERID

Syntax:

PFLAC, <QueryType>, GLIDERID, <String>

Meaning: The case-sensitive string defines header information (aircraft registration) for the flight recording. Default is empty. This can be part of the radio-broadcasted data available to the outside world.

Sub-Sentence PFLAC, , GLIDERTYPE

Syntax:

PFLAC, <QueryType>, GLIDERTYPE, <String>

Meaning: The case-sensitive string defines header information (aircraft type) for the flight recording. Default is empty.

Sub-Sentence PFLAC, , COMPID

Syntax:

PFLAC, <QueryType>, COMPID, <String>

Meaning: The case-sensitive string defines header information (competition ID) for the flight recording. Default is empty. This can be part of the radio-broadcasted data available to the outside world.

Sub-Sentence PFLAC, , COMPCLASS

Syntax:

PFLAC, <QueryType>, COMPCLASS, <String>

Meaning: The case-sensitive string defines header information (competition class) for the flight recording. Default is empty. This can be part of the radio-broadcasted data available to the outside world.

Sub-Sentence PFLAC, S, NEWTASK (IGC approved devices only)

Syntax:

PFLAC, <QueryType>, NEWTASK, <Task Description>

Meaning: Starts a new task declaration. Any old task declaration will be cleared by this command. Take-off location, waypoints and landing location have to be added by consequently issuing "ADDWP" commands. To activate a new task declaration, the device must be power-cycled.

Applies only to IGC certified devices.

<i><QueryType></i>	Must be set to "S". Task declarations cannot be read.
<i>NEWTASK</i>	-
<i><Task Description></i>	Text description of task, e.g. "500km triangle". Can be the empty string. Max 50 characters

Example:

```
$PFLAC, S, NEWTASK, My Task
$PFLAC, A, NEWTASK, My Task*
```

Sub-Sentence PFLAC, S, ADDWP (IGC approved devices only)

Syntax:

PFLAC, <QueryType>, ADDWP, <Latitude>, <Longitude>, <Waypoint Description>

Meaning: Adds a waypoint to the current task declaration. The first and the last waypoint added will be treated as takeoff and landing location, respectively. If no takeoff or landing location is to be given, zero coordinates should be entered (0000000N, 0000000E). The format closely follows the IGC file specification¹⁶.

The total data size entered through this command may not surpass 183 bytes when calculated as follows:
(Number of Waypoints * 8) + (sum of length of all waypoint descriptions)

<i><QueryType></i>	Must be set to "S". Task declarations cannot be read.
<i>ADDWP</i>	-
<i><Latitude></i>	Latitude of waypoint. Must be given the format "DDMMmmmN", where DD designates degrees, MM minutes and mmm 1/1000 minutes. All digits are required and have to be filled with zeros, if appropriate. The last character is either "N" for north or "S" for south.
<i><Longitude></i>	Longitude of waypoint. Must be given the format "DDDMMmmmE", where DDD designates degrees, MM minutes and mmm 1/1000 minutes. All digits are required and have to be filled with zeros, if appropriate. The last character is either "E" for east or "W" for west.
<i><Waypoint Description></i>	Arbitrary text description of waypoint. For declaration of area waypoints, see [ref]. page 36. Max 50 characters

Example:

```
$PFLAC, S, ADDWP, 5024200N, 00631440E, Some Airport
$PFLAC, A, ADDWP, 5024200N, 00631440E, Some Airport*
$PFLAC, S, ADDWP, 495900N, 00631440E, My Start Line
$PFLAC, ERROR*
```

The second request causes Flarm to issue an error, since the number format is invalid.

¹⁶ www.fai.org/gliding/gnss/tech_spec_gnss.asp