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LX20 v5.2

GPS Logger and glide path calculator

November 2003

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1 Introduction

1.1 About the LX20

The main function of the LX20 is as a GPS Logger. It is compliant with FAI regulations of October 1995 and certified as an FAI Flight Recorder. In addition to the logger function the device supports various navigational applications.

- Turn point data file
- Jeppesen airport and airspace database
- Near Airport function
- Glide path calculator
- Wind calculation

There are two different hardware versions of the LX20:
The version displayed below was produced until March 2000.



This version is no longer available. Its successor, the LX20-2000, is identical in usage and functions, but has a new housing and keyboard as well as different connectors. (For more information see chapter 5.2.)



1.2 Structure of the manual

Chapter 1 presents a brief introduction to the LX20's main functions and the structure of the manual. Section 1.3 features a ten-minute exercise for getting used to some basics in handling the device.

Chapter 2 provides a description of how to prepare the LX20 for flying, in detail:

Paragraph 2.1 explains all the steps necessary for entering the basic settings of the LX20. These settings are retained in memory (exceptions are described) and need therefore be entered only once, until a further change is desired.

Paragraph 2.2 describes the editing of a task directly on the LX20, beginning with the creation of turn points, the task itself and the declaration of this task. Examples are given for "normal" decentralised flights and for typical situations during centralised competitions. Please note that all examples in this manual are derived from the competition rules of today (December 2000) and changes can occur at any time. Due to cost reasons we are required to print a certain quantity of manuals, which are not thrown away with every change in the rules. Therefore chapter two of this manual can be updated when you receive it. Our website will always contain the most up-to-date version, **but you are reminded that in case of any doubt the rules of the Sporting Code and the special rules of the chosen competition apply!**

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Chapter 3.1 shows how to operate the LX20 with its navigational pages during flight.

Chapter 3.2 describes the possibilities for flight analysis directly on the LX20.

Chapter 4 deals with data transfer using the LXFAI, LXGPS (both DOS based) software or the new Windows 95/98 based LX-Explorer.. For a detailed description of how to use the software itself, please see the appropriate manuals.

Chapter 5 is provided as an annex. You will find a checklist for flight preparation, a technical reference and the FAI-Approval document.

You may notice that some things are explained several times within the chosen manual structure. This was deliberate because these functions are the most important ones.

1.3 Basic use

Handling the LX20 will be easy if you keep some rules in mind. The following paragraph will introduce you to these basics using practical examples. So, before reading on, you should take your LX20, connect it to the power supply unit and follow the steps explained in these examples.

1.3.1 Keyboard

1.3.1.1 Description of the keys

Agreement: If there's a key to be pressed, it will be written in rectangular brackets, e.g. [ENTER].



ON Switching the LX20 on.

OFF Hold this key for more than 5 sec. and the LX20 switches off.

CURSORS Arrow keys (left, right, up, down), move within a menu or input field, change between the navigation pages etc.

ENTER/MARK Confirm inputs, mark position (on the GPS-information page, see section 3.1.2)

ESC Return to the next menu level up, discontinues input while retaining all changes done so far

READ, VIEW, WRITE Start data transfer between LX20 and a PC or another LX-device. Analyse flights.

RTE, STAT, BARO View route, statistics and barogram of a selected flight
 EVENT Mark the position of certain events

1.3.1.2 Combination of two or more keys:

[VIEW/STAT] + [WRITE/RTE] Event-marker, works only during flight (required for the earlier version of the LX20 without a separate event-key. See section 2.1.1.7)

[READ] + [VIEW] + [WRITE] Hold down these three keys and switch the LX20 on. The memory will be completely initialised. During this process the LX20 displays MEMORY INIT PLEASE WAIT.

Warning: all data will be lost and all settings will be set to the factory default!!

1.3.2 A basic example

The most important keys are UP/DOWN [^]/[v], LEFT/RIGHT [<]/[>], [ENTER] and ESCAPE [ESC]. These are all the keys necessary for operating the LX20 during flight or changing settings. The handling of the device follows a certain pattern, as you will see in the following examples.

After switching on the LX20, the device will need some seconds for booting, during which the display will show the serial number, the current software version and Jeppesen database (this information is important if you want to order a new software update).

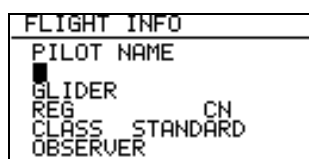
After booting, the page MAIN MENU will show up. All the settings of the device are done from here.



As a first example the logger will be set to a new pilot, a new glider etc (FLIGHT INFO). This will be done in the sub-menu of LOGGER. Choose this sub-menu by moving the cursor to LOGGER using the UP/DOWN [^]/[v] keys and hit [ENTER].



Now choose the option FLIGHT INFO following the same procedure. Now you will see the page below:



You can move the cursor with UP/DOWN [^]/[v] among the different fields (PILOT NAME, GLIDER...). Hit [ENTER] to change the contents of a field.

First select the field PILOT NAME and enter a name, for example your own. [ENTER] activates the field and the cursor starts flashing in the first position.

Now select a letter with UP/DOWN [^]/[v]. You can either confirm your input with [ENTER] or just move the cursor on to the next position with the arrow key right [>]. The effect will be the same. If you make a mistake, move the cursor to that position with LEFT/RIGHT [<]/[>] and make the necessary correction.

After you have finished your input, hit ESCAPE [ESC] to confirm the whole field.

Note:

At this point you should recognise a significant difference to the usage of an ordinary PC (DOS/Windows). There we are accustomed to [ESC] breaking off an input while discarding all the changes that have been done. With the LX20, [ESC] means breaking off an input while retaining all the changes done.

Now you can enter type of glider, registration number, competition number, competition class and the name of your observer (only necessary for record flights, Barron Hilton etc.).

```
FLIGHT INFO
PILOT NAME
STEINKE, LUCIA
GLIDER ASW15B
REG D-2311 CN J
CLASS CLUB
OBSERVER SEISCHAB
```

You can leave the option FLIGHT INFO and the sub-menu LOGGER with ESCAPE [ESC] and return to the main menu.

Note:

To enable the flight functions you have to leave all the sub-menus and work within the main pages (navigation, graphics, near airport etc.). This corresponds to the handling of a common PC, which doesn't allow other actions before closing the active window.

The described input method is a little wearisome. It's faster to prepare the flight info on a PC and transfer the data to the LX20 with LXFAL (for more information see Chapter 4).

However, for those situations when a PC is not available it's useful to have had some practice with these manual settings.

2 Preparing the LX20 for flying

2.1 Basic settings

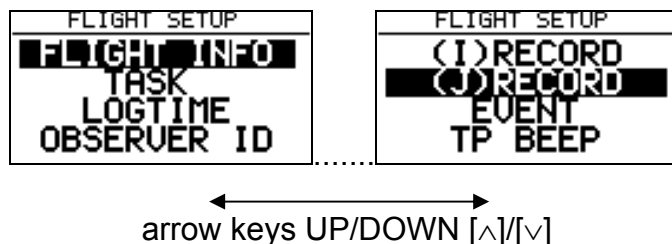
Paragraph 2.1 explains how to adjust some basic parameters for operating the LX20. Usually, these settings are not changed during the whole gliding season, unless you are not the only one using this LX20. In this case some settings may be changed more often, which will be pointed out in the appropriate paragraphs.

2.1.1 Logger-specific settings (LOGGER)

After the LX20 has finished booting it will show the main menu. The first option (where you also find the cursor) is **LOGGER**.



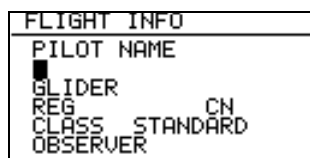
Hitting [ENTER] will lead to the menu **FLIGHT SETUP**, where nearly all the settings necessary for the logger functions can be done.



2.1.1.1 FLIGHT INFO

The **FLIGHT INFO** is one of the settings that may be changed quite often, depending on the number of pilots using the LX20 (maybe a single private pilot with his own glider or a complete club).

The method of changing settings of **FLIGHT INFO** has already been explained as an example in paragraph 1.3. Nevertheless a brief explanation can also be found here:



With [ENTER] you will reach the menu **FLIGHT INFO**. The cursor will be on the field below "PILOT NAME". Hit [ENTER] again and the first character of this field starts flashing. Select the first letter with UP/DOWN [^]/[v]. Confirm your input with [ENTER] or just move

the cursor on to the next character with the arrow key right [>]. With ESCAPE [ESC] you will finish the inputs and can move to the next field with the arrow keys UP/DOWN [^]/[v]. These settings are necessary for flights in decentralised competitions. For other competitions the sports committee may require different information.

Note

In paragraph 2.1.4.7 you will read about the glider polar, which can be adjusted for a proper final glide path calculation. There is no automatic relationship between the polar curve used for the final glide calculation and the glider type entered in the FLIGHT INFO. This is because many pilots choose to use a polar curve that is different to the published figures for particular gliders.

2.1.1.2 TASK

The menu item “TASK” is used for declaring a task with the logger. This procedure is similar to taking the photograph of the declaration paper. One has to use this item more often, at least every time that a new task is declared. Once declared, a task stays declared until a new task is selected (even if the task has been flown).

You shouldn't confuse this menu item with the item TP & TASKS in the main menu. The latter is used for creating and administering a turn point and task database.

[ENTER] will lead to the TASK MENU. Here you can find the options EDIT, COPY and DELETE:



EDIT makes it possible to change the currently declared task by selecting turn points from the TP & TASKS database, provided that this database isn't empty, of course.

COPY is used for declaring a prepared task from the TP & TASKS database. This menu item contains an additional edit mode that makes it possible to change the selected task.

DELETE removes the currently declared task and starts the edit mode.

Note:

A task remains declared in the LX20 until another one is declared (even after you have finished a flight!).

In the paragraph 2.2 these menu items will be explained in more detail. First we'll turn to some further settings.

2.1.1.3 LOGTIME

To understand the meaning of the different types of records here is a short explanation of the IGC nomenclature:

ICG has defined different types of records, which are obligatory for all types of Flight Recorders.

I-record:

The I-record contains the flight route information. It consists basically of time, coordinates, GPS-altitude and pressure altitude. Furthermore, some additional data can be recorded, like GPS accuracy, groundspeed and so on. More information on the additional data can be found in paragraph 2.1.1.5.

One important item of the I-record is the ENL (engine noise level), which must be activated when flying a powered glider.

Please note that any additional parameter needs memory and therefore shortens the maximum recording time.

J-record:

The J-record is identical to the I-record. It's intended to create a personal file where the pilot can record additional information. For example, if the sports committee of a competition doesn't want such additional data in the I-record, the pilot can choose to record them separately in the J-record. However, every additional record costs memory and therefore the J-record is disabled in the default settings.

B-record:

This record defines the sampling rate of the I-record (time interval between two recorded points). The shorter this time interval, the more accurate is the documentation of the flight.

K-Record:

Defines the sampling rate of the J-record.

Settings in the menu LOGTIME:

```
SETUP TIME INTERVAL
TOTAL MEMORY: 53.2H
B-RECORD INT.: 12s
K-RECORD INT.: NOPR
NEAR TP INT.: 2s
NEAR TP RAD.: 1.0%
```

TOTAL MEMORY:

In the first line you see the maximum recording time possible with the chosen record intervals.

B-RECORD INT.:

Sampling rate of the I-RECORD, minimum 1sec, maximum 60sec, default setting 12sec.

K-RECORD INT.:

Sampling rate of the J-RECORD, minimum 1sec, maximum 60sec, default setting is NOPR (not programmed). This means the J-RECORD is disabled when the device is delivered and therefore no settings are possible here. If you want to define the sampling rate for the J-record you first have to enable this record. But remember that an additional record needs more memory.

NEAR TP INT.:

It's possible to accelerate the sampling rate near a turn point, the start- or the finish- point to be sure to get a fix inside the sector even if you have been inside for only a few seconds.

NEAR TP RAD.:

Defines a radius around start point, turn points or finish inside which the LX20 will record at the sampling rate defined by NEAR TP INT.

With the default settings (B-RECORD 12sec, I-RECORD without additional parameters like ENL, J_RECORD disabled), the LX20 has a maximum recording time of 53.2 hours. If the B-RECORD INT is halved (6sec), the maximum recording time will be halved, too. Adding additional parameters also shortens the recording time, e.g. 42.6 hours with 12sec B-RECORD INT and enabled ENL.

The memory is designed as circular, i.e. if the maximum recording time is exceeded, the LX20 will start overwriting the oldest flights in the memory.

Note:

One usually doesn't spend a long time near a turn point and furthermore this time span can't be predicted easily. Therefore the accelerated sampling rate near turn points isn't considered in the calculation of the maximum recording time. Nevertheless, more memory will be needed here. So you shouldn't allow the maximum recording time to become too short when setting the sampling rate. Always take into account that you might happen to spend a longer time near a turn point or (more likely) in the start zone.

2.1.1.4 OBSERVER ID

This function is a relic from the early days of the logger. The IGC required an electronic sealing of loggers that would make it impossible to have access to the logger without the observer. With today's loggers a task is declared with an automatic electronic sealing, which makes the observer function redundant. But it can't be guaranteed that this sealing method will not be re-introduced by e.g. national aero clubs and so this function can still be found in the LX20.

To seal the logger the observer enters a number with four characters. To do so, he selects the menu item OBSERVER ID with [ENTER]. He enters a four-character number into the field (select the numbers with UP/DOWN [^]/[v], confirm with [ENTER]). It's important that he remembers this number in case of a later correction.



Now he's asked, "AUTOMATICALLY UNLOCK AT FLIGHT END?" If he chooses Y (yes), the seal will be deactivated automatically after landing. With N (no) the seal remains active until he enters the code again.

Note:

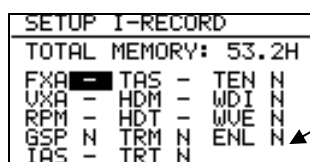
If your observer has forgotten his ID and the automatic unlock is active (yes), a little trick helps: Connect the LX20 to the antenna and a 12V power supply and put it into a car. Then drive a short distance. The LX20 then begins recording a flight and will stop the record 3 minutes after parking. Now the seal is disabled. If the automatic unlock has been set to NO, the only possibility to get the logger working again is to enter the password 99999 (PASSWORD in the SETUP menu). Unfortunately this procedure erases all the

flights in the memory (really vexing after finishing a good flight!). As mentioned above, this sealing procedure is no longer obligatory!!

2.1.1.5 I-RECORD

Here you can define additional information for the I-record. Time (UTC), coordinates, pressure altitude and GPS-altitude are always recorded. The following optional parameters also exist (although not all of them can be selected):

- FXA: momentary horizontal accuracy of the GPS
- VXA: momentary vertical accuracy of the GPS (altitude)
- RPM: engine speed
- GSP: groundspeed
- IAS: indicated airspeed
- TAS: true airspeed (corrected with respect to altitude)
- HDM: magnetic heading
- HDT: true heading
- TRM: magnetic track
- TRT: true track
- TEN: total energy
- WDI: wind direction
- WVE: wind velocity
- ENL: engine noise level (obligatory for powered gliders!!!)**



Y for powered glider!!!

These parameters will be recorded if Y (yes) was chosen (activate field with [ENTER], select Y/N with UP/DOWN [^]/[v]). A dash in this position indicates that the option isn't available for the LX20.

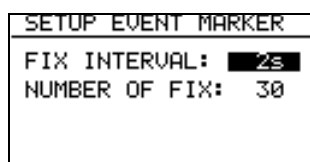
2.1.1.6 J-RECORD

As mentioned before, the J-record offers the same optional parameters as the I-record, but creates an independent file. To save memory, the J-Record is disabled in the default settings.

2.1.1.7 EVENT

The event marker is activated by the pilot. It makes the LX20 record some points in addition to the I-record. The evaluating software will mark these points so that they differ from the I-record. Their number and density can be adjusted in this menu:

- FIX INTERVAL: defines density of the points
- NUMBER OF FIX: number of points for each marked event



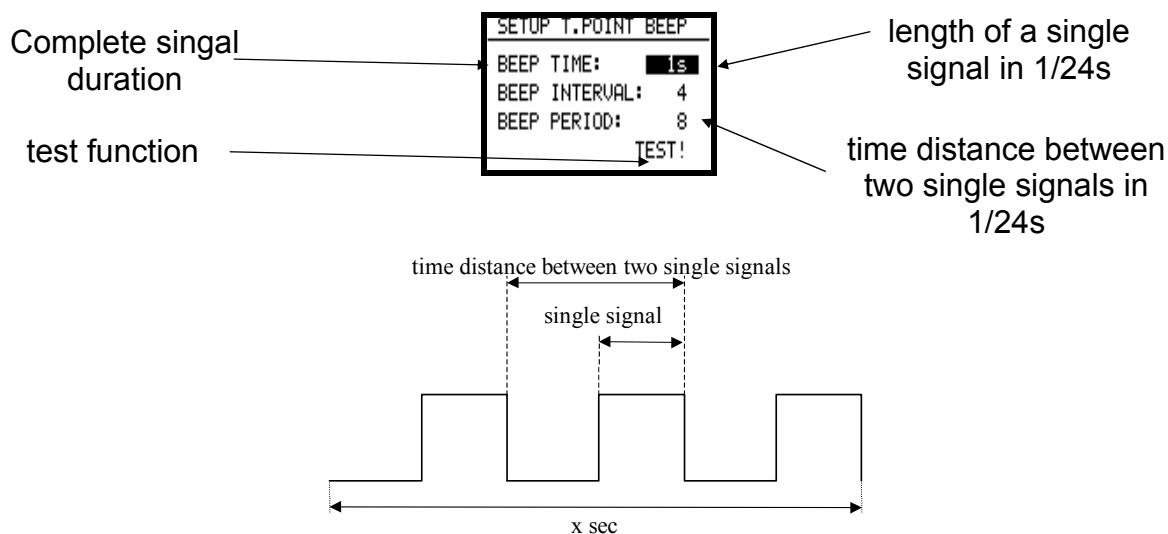
U 1999 the FAI/IGC required pilots in International competitions to mark their start with the event marker (otherwise it may be possible to cross the start line several times in a short time). This procedure is similar to the former start photo. Currently, this procedure is no longer obligatory; the last fix inside the start sector is taken as the start point (see FAI competition rules, October 2000). This feature may still be of use to indicate significant point(s) within the flight, to be identified during subsequent analysis on a PC.

Note:

The big ENTER-button on the earlier series of the LX20 consists of two keys. On request the left key can be programmed to work as an event-marker.

2.1.1.8 TP BEEP

Here you can adjust the total duration of the beeper signal as well as the length of a single beep (in steps of 1/24 sec) and the period between two beeps (1/24 sec).



In order to avoid the beeper working all the time when you are flying near for example the start point there is a break of three minutes after one signal. This break can be cancelled by marking an event.

Note:

To get a beep signal on the start-, turning points and the finish zone it's necessary to have at least one task programmed and declared!

2.1.2 Menu item SETUP

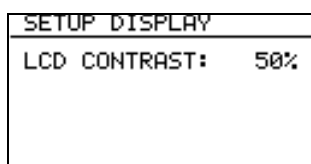
Various settings are created here, e.g. changing the display contrast, setup airspace display, programming sectors etc. Selecting the (last) item SETUP in the MAIN MENU, will provide the following four choices:



The descriptions regarding OBS. ZONE (programming sectors) and PASSWORD are lengthy and will therefore be discussed in separate sections (2.1.3 for OBS. ZONE and 2.1.4 for PASSWORD).

2.1.2.1 CONTRAST

The display contrast can be changed here in percentage values. Change the value with the arrow keys UP/DOWN [^]/[v]. Especially high or low temperatures inside the cockpit can require an adjustment of the contrast.



2.1.2.2 AIRSPACE

In the SETUP AIRSPACE menu the display of the airspace can be changed. The first item AIRSPACE enables one to either switch this function on or off completely.



Below this is a list of particular airspace groups, each group can be switched on, off, or by adjusting a distance this group will only be shown at certain ZOOM-values (see also paragraph 3.4). This last option is used for saving processor power and keeps a good overview on the display (so it won't look like the following graphic...)



E.g. if one sets the distance value to 50km, the corresponding airspace group will be displayed at a scale of 50km or greater (20km, 10km...). Above that value this airspace will not appear.

^

2.1.3 Editing sectors (OBS. ZONE)

Usually, these settings remain unchanged for a long time (e.g. for the whole gliding season or during a championship). For the declared task all sectors can be set completely free (even for the single turn points). This function is needed for the so called AAT's (assigned area tasks) (see chapter 2.2.2.3). You find this option in the sub-menu SETUP of the MAIN

MENU. Here you can choose between four items: CONTRAST, OBS.ZONE, AIRSPACE, and PASSWORD.

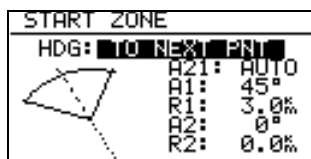


Selecting OBS. ZONE provides the following options (the other items are explained in paragraph 2.1.2 and 2.1.4):



2.1.3.1 START ZONE

To adjust the start zone, select the menu item START ZONE with [ENTER]. We get the following screen:



- HDG: Means orientation of the symmetry axis of the sector.
- A21: Direction of the symmetry axis (in most cases AUTO)
- R1: Radius of the sector, e.g. 3km for the FAI photo sector.
- A2: Like A1, used for creating combined sectors.
- R2: Like R1, also used for combined sectors

At first, this sounds very complicated, but some examples shall help you to understand the meaning of these settings.

Example 1:

In the default settings the 90°-FAI photo sector is set as start zone (see picture above), which means HDG is set to "TO NEXT POINT". The start zone is therefore symmetrical about the bearing to the next turn point.

A21 is set to AUTO, which is clear because the direction of the symmetry axis of the start zone is identical to the bearing to the first turn point. If A21 is set to AUTO, it's impossible to select this item and change its value.

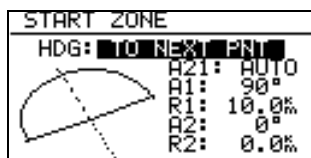
A1 is 45°, because the half-angle is entered.

R1 is 3km.

A2 and R2 are both set to 0, i.e. not programmed.

Example 2:

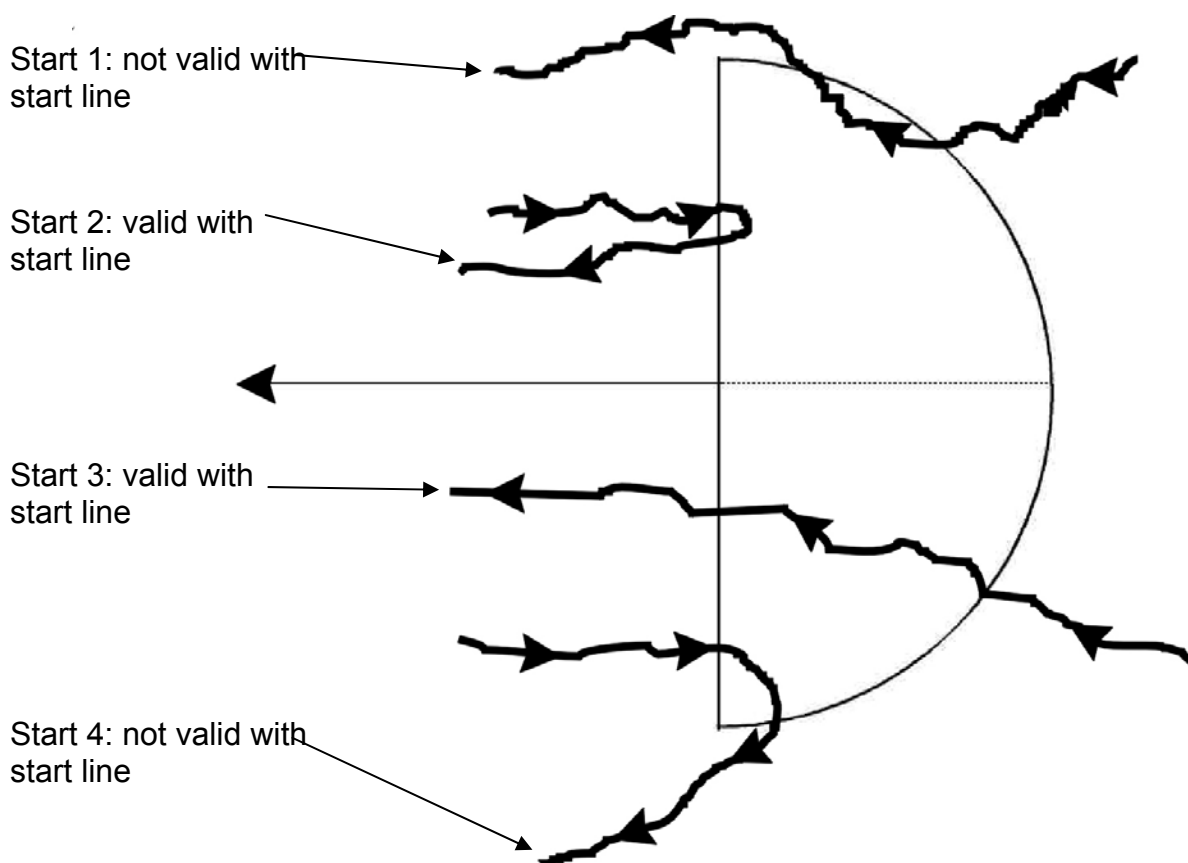
A 180°-start zone with 20km diameter is programmed the following way:



HDG: TO NEXT POINT
 A21: AUTO
 A1: 90° R1: 10km
 A2: 0 R2: 0

Note:

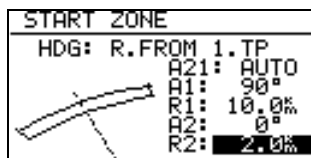
According to the IGC competition rules of May 2000 the current start sector for international championships is the classical start line. Because the LX20 can't deal with a simple start line but needs a start sector, you use the 180°-sector of example 2. The only disadvantage: For the LX20 it's sufficient to fly at least once into the sector so that the device accepts your start as valid. It makes no difference in which direction you leave the sector, but for the sports committee, it does!! You definitely need to cross the front line to get a valid start! (see picture below)



Therefore we recommend that you control your crossing of the line while observing the graphical page.

Further settings possible for HDG:

- **R.FROM 1.TP:** This sort of start sector was planned for the world gliding championships 1999 in Bayreuth. A radius is drawn around the first turn point through the start point and a radial segment of a certain length is cut out symmetrically around the start point. The advantage of this system is that a pilot starting far outside at the end of that line has to fly the same distance to the first turn point as a pilot starting in the "middle". This is contrary to the classical start line where the distance to the first turn point is increasing the more one starts further from the centre of that line.



- A21: is fixed here to AUTO
- A1: is without function, only R1, which defines here the length of the segment, is of interest
- R1: describes the half-length of this segment
- A2: has no function here
- R2: two radials from the first turn point to the ends of the segment are constructed and elongated with R2. A second segment is drawn through these two new points. Together this defines a start sector out of two segments

- **FIXED VALUE:** The direction of the symmetry axis of the sector is adjusted to a fixed bearing. This bearing is entered as A21. The setting FIXED VALUE is normally not used for start sectors, but sometimes for finish zones (see "FINISH ZONE").

Note:

Please be aware that all the examples are intended to explain the programming procedures and therefore cannot claim absolute accuracy and completeness. For each kind of competition different types of sectors and rules for the correct documentation of these sectors may apply, which can be found in the particular competition rules. In case of doubt, the rules pertaining are defined in the FAI Sporting Code section 3. E.g. For most of the national decentralised championships the start sector consists of the 90°-photosector combined with the 500m-cylinder, for FAI-badges, 1000/2000km-diplomas and Barron-Hilton-Cup only the 90°-photosector is allowed. For record flights a 1000m startline is used for recording the start time.

2.1.3.2 POINT ZONE

Now select the item POINT ZONE of OBS. ZONE. You will get the same options as for the START ZONE. The only difference is that you get more options for the settings of HDG. The current competition rules require a 500m-cylinder, so that the direction of the symmetry axis is not important. Nevertheless, all the possible settings shall be explained, because in decentralised competitions or for record flights other sectors are valid:

- **SYMMETRICAL:** The symmetry axis of the turn point sector is orientated symmetrically about the line bisecting the inbound leg from the previous turn point and the outbound leg to the next turn point.
- **TO PREV POINT:** The symmetry axis is

directed to the previous turn point. This option was intended for Cats Cradle and related tasks.

- **TO NEXT POINT:** The symmetry axis is directed to the next turn point. This option was intended for Cats Cradle, too.
- **TO START POINT:** The symmetry axis is directed to the start point. Again a Cats Cradle option.
- **FIXED VALUE:** The symmetry axis can be adjusted to any direction. This is the only option for which A21 is not set to AUTO.

Example 3:

We want to adjust the currently valid sector for the German decentralised gliding competition (DMSt). This is the 90°-photo sector combined with the 500m-cylinder:

HDG: SYMMETRICAL

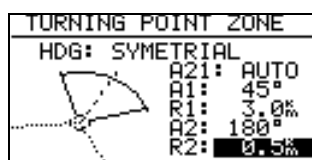
A21: AUTO

A1: 45°

R1 3.0km

A2: 180°

R2: 0.5km



Note:

Please note that combined sectors must be programmed with the smaller radius for A2 and R2 (R1>R2!!). It's therefore impossible to program the figure of example 3 in just the reverse order.

Note also:

For record flights, FAI badges, 1000/2000km-diplomas and for the Barron-Hilton-Cup only the 90°-photo sector is valid, not the 500m-cylinder!! For most of the national decentralised competitions the combined figure consisting of 90°-photosector and 500m-cylinder is valid.

2.1.3.3 FINISH ZONE

Select the item FINISH ZONE and confirm with [ENTER]. Although you get the same screen as for the previous items, there are only two options for HDG here:

- **TO LAST LEG:** The symmetry axis is directed back to the last turn point. This is the usual setting for decentralised competition flights.
- **FIXED VALUE:** The symmetry axis can be set to any direction (see example 4).

Example 4:

In a competition the finish line is orientated perpendicular to the runway's direction, independent from the bearing to the last turn point. The airfield's runway has the direction 06/24.

We select HDG: "FIXED VALUE" and can enter either 060° or 240° for A21, depending on the direction of the final glide. For example for a final glide in the direction 240° we have to enter A21: 060°. Now the "flat side" of the sector is directed back to the last leg (see picture below), the glider will enter the sector crossing the line.

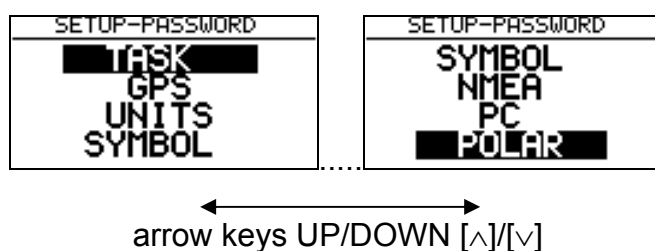


Note:

There are many ways to complete a flight. For decentralised competitions, record flights etc. the advice of the FAI Sporting Code should be enough. E.g. when flying BHC, badges, diplomas etc it is enough to land inside the airfield borders if the airfield is the finish point, while if one is using an external finish point, then the appropriate sector must be used (according the sporting code, the latter can be done in any case), but care should be taken to remember which one has to be used.

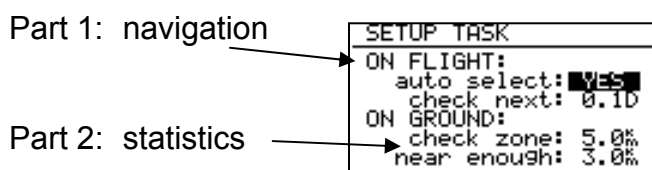
2.1.4 PASSWORD

The password for reaching the setup for some important parameters is 96990 (it is the same for nearly all Filser devices, and is our phone number). The following items become accessible:



2.1.4.1 TASK

This menu is divided into two parts:



- The settings found within **ON FLIGHT** are very important for the navigation functions.

auto select:

If confirmed with YES, the LX20 will, upon reaching a turn point, automatically switch the navigation data to the next turn point. The photo sector of the recent turn point will still be displayed.

check next:

This value defines the distance from a turn point at which the LX20 starts controlling the next sector, i.e. determining if a fix is inside that sector. The figure displayed is the proportion of that leg still to be flown, e.g. if the value is 0.30, the LX20 begins controlling the next sector, once 70% of the leg has been flown.

- The menu item **ON GROUND** defines parameters for the calculation of the after-flight statistics

check zone:

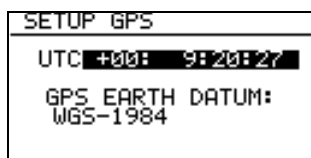
The LX20 uses a special algorithm to get a fast calculation of the statistics. This algorithm works with a strongly reduced set of position data. If, due to the reduction procedure, there is no data point in a certain area around a turn point, then statistics will be nonsense. In this case the value of the check zone should be increased.

near enough

If one has to abandon a flight before reaching a turn point (maybe due to bad weather) no statistics of the task will be available. The function "near enough" defines a distance that has to be reached to get a (rough) statistic for the task (e.g. for training purposes). This has no influence on the validation of the flown task, if the turn point is not reached then the task requirements have not been fulfilled, so when analysing the flight in your PC-program you will find this task as not completed.

2.1.4.2 GPS

Here one can only change the displayed time, e.g. change from UTC to European summer time.

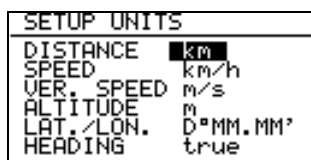


This change has influence only on the GPS information page, the recorded data (IGC-file) are always in UTC.

The GPS EARTH DATUM is no longer adjustable (in the earlier version 3.x this was possible). The FAI has now fixed the coordinate system WGS-1984 as the only valid system.

2.1.4.3 UNITS

Here the different units for the displayed values on the navigation pages can be chosen. Again these settings have no influence on the IGC-file.



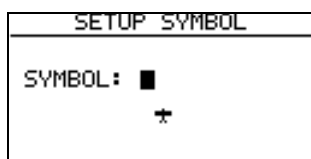
- **DISTANCE** in kilometres (km), nautical miles (nm) or statute miles (mi)
- **SPEED** in kilometres per hour (km/h), knots (kts) or miles per hour (mph)
- **VERTICAL SPEED** in meters per second (m/s) or knots (kts)
- **ALTITUDE** in meters (m) or feet (ft)
- **LAT./LON.** (coordinates) in degree, minute and decimal minute (D⁰ MM,MM') or in degree, minute and seconds (D⁰ MM' SS"). Please note that this setting is also active

when you are entering or editing turn points (see paragraph 2.2.1.1), so be sure that the format of your turn points is correct.

- **HEADING** true or magnetic. This function is no longer provided by the modern GPS modules, please leave this function on true.

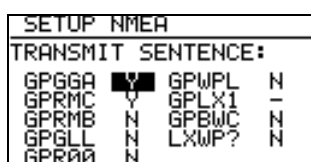
2.1.4.4 SYMBOL

Either a bigger or a smaller symbol is available for showing your position relative to the surrounding airspace. The reference point of the bigger symbol is the single pixel in front of the "plane", the smaller one has its reference point in the middle between the wings.



2.1.4.5 NMEA

The LX20 can provide GPS protocols to other devices which are connected properly to the NMEA-port. These protocols can be selected here. All names begin with GP followed by a three letter code pertinent to the type of protocol.



Once the protocol required by the external device has been determined, that protocol can be selected by setting it to Y (YES).

The most common standard protocols of GGA and RMC are set by default.

If one intends to use the WinPilot software (for details see <http://www.winpilot.com>) the protocols GPRMC and LXWP must be turned on, all others off.

For the cables needed see chapter 5, the annex.

2.1.4.6 PC

In this menu the communication speed between the LX20 and a PC can be set. Normally this is 19200bps. If one is using older PC models and in rare cases with Windows 95/98 it may be necessary to reduce the communication speed to 9600bps.



The communication speed is selected with the arrow keys UP/DOWN [^]/[v].

2.1.4.7 POLAR

The glider polar is an approximate quadratic equation, which can be written as:

$$y = ax^2 + bx + c$$

The coefficients a, b and c primarily denote form and position of the polar in the coordinate system.

GLIDER POLAR	
GLIDER:	ASW 15
a =	2.04
b =	-2.90
c =	1.66

Many polars are preinstalled on the LX20, and can be selected directly with the arrow keys UP/DOWN [^]/[v]. If your glider is not included in this list, you can calculate your own polar. The program POLAR.EXE contained in the LXGPS program package assists to estimate the a, b and c coefficients.

Measure from your polar three appropriate values of speed and associated vertical speed, where appropriate means that these values are flown in normal operation of the glider. E.g. it is no good idea to take the value of 220km/h for an old club class glider (like ASW15)...

Start the program POLAR.EXE and enter these three value pairs and the program will generate the three coefficients a, b and c. Now chose the USER polar in your LX20, confirm with [ENTER], provide a name for the polar and enter the three calculated coefficients.

Note:

The type of the glider selected or created in the polar will not be transferred into the FLIGHT INFO (see paragraph 1.3 and 2.1.1.1), because many pilots choose not to use published polars for their final glide calculations.

2.1.4.8 More passwords

Currently only the following passwords are available for the user:

96990	gives access to the parameters discussed in this paragraph
99999	deletes the contents of the logger only (that means all the flights)

2.2 Programming and declaring tasks

In this chapter you will learn how to create turn points and tasks, as well as declaring a task on your LX20. With this knowledge you can use the LX20 for complete documentation of any kind of championship and other flights. The use of the navigational functions is described in Chapter 3.

2.2.1 Menu item TP & TASKS

This menu item is used for managing the turn point and task files. It's possible to store up to 600 turn points and 100 tasks with 10 points each in the TP & TASKS file. In addition to that the Jeppesen database contains about 5000 European airfields, which can be used either as turn points or for navigation (e.g. "near airport" function).

Tasks from the TP & TASKS database can be declared in the MAIN MENU item LOGGER (→ submenu TASK).

Select the item TP & TASKS from MAIN MENU (UP/DOWN [^]/[v] and [ENTER]) and you get the following menu:



The first three items, NEW, EDIT and DELETE are used for creating, editing and deleting turn points. TASK contains a list of 100 tasks, which can be programmed here.

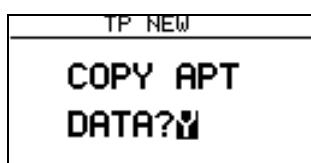
2.2.1.1 Creating new turn points

We start with an example in which we create a number of turn points that we want to use later to program a task.

These points will be:

1. Airfield Geratshof (near Landsberg/Lech)
2. Airfield Blumberg, EDSL (south of Donaueschingen)
3. Autobahn crossing Feuchtwangen-Crailsheim
4. Church Erpfting (4km north of airfield Geratshof)

- 1.) We select the item NEW in the TP & TASKS menu (UP/DOWN [^]/[v] and [ENTER]). Now the LX20 asks whether we want to "COPY APT DATA?" from the Jeppesen database.



We choose Y (YES) with the arrow keys (UP/DOWN [^]/[v] and confirm with [ENTER]) because our first point is an airfield. Now we can enter the ICAO registration of the airfield or – if we don't know the registration or the airfield doesn't have one (as the airfield Geratshof) - skip this input with ESCAPE [ESC]. Now we're asked to select the country (here: Germany) with UP/DOWN [^]/[v] and [ENTER] and then to select the desired airfield at the menu item APT.

```

APT SELECT
ICAO: ED..
      GERMANY
APT:  GERA
      GERATSHOF

```

This example shows ED .. selected as the ICAO name – should be blank?

To do so, we enter the first letters of the airfield's name (here: GERA for Geratshof) with UP/DOWN [^]/[v] and [ENTER] and get a list of all the airfields in Germany whose names begin with the same letters. The fewer letters you enter, the longer the search will take and the more airfields you'll get (e.g. if you don't enter any letter you get a list of all the airfields in Germany). Here we get as first airport GERA-LEUMNITZ. We search the list for the desired airfield (UP/DOWN [^]/[v]). Now we can hit [ENTER] to have a look at the airfield's name, coordinates and elevation.

```

APT SELECT
NAME  GERATSHOF
LAT   N 47° 59.62'
LON   E010° 50.52'
ALT   0632m

```

If necessary, we can change this data, e.g. if you want the coordinates of the hangars instead of the aerodrome reference point, hit [ENTER] again and you can change this data. ESCAPE [ESC] ends this procedure and the selected airfield will be added to the turn point file.

Note:

If you can't find an airfield in the list, this doesn't necessarily mean that the airfield is missing in your database. Sometimes you may find it under a different name (e.g. Lager Hammelburg instead of Hammelburg).

Note

Please remember that the coordinates in our examples are in the format degree⁰ min.min' (decimal minutes). This format is set in the LX20 as default. The LX20 is also able to work with the format degree⁰ min' sec", the change can be done in the SETUP menu (last item in MAIN MENU), there you'll choose PASSWORD and enter 96990. You will find the menu item UNITS, where the format change can be done (see also paragraph 2.1.4.3).

The program LXFAL, which is included in delivery, offers the possibility of working with both formats, while in the program LXGPS the format is fixed on the decimal minutes (please see the manual of both programs). Please make sure of the format of your data and adjust the LX20 and the PC-program accordingly. The conversion between both formats can be accomplished by the following formula

$$Sec'' \cdot \frac{10}{6} = decMin'$$

2.) The next turn point is the airfield Blumberg, of which we know the ICAO registration. We answer the question "COPY AIRPORT DATA?" with yes and enter the ICAO

registration EDSL for Blumberg (UP/DOWN [^]/[v] to select the letters, [ENTER] or LEFT/RIGHT [<]/[>] to go on to the next position).

APT SELECT	
ICAO:	EDSL GERMANY
BLUMBERG	

The LX20 searches directly for the ICAO registration and gives us the airfield Blumberg. [ENTER] again leads to the page with the airfield's coordinates and elevation. ESCAPE [ESC] adds Blumberg to the turn point file.

Note:

If you enter a non-existent ICAO registration or first letters that don't match any airfield name in the database, the LX20 enters the edit mode for turn points (see below).

3.) The third turn point is an autobahn crossing and therefore not found in the airfield database. So we answer the question "COPY APT DATA?" with no and receive a template where we can enter name, coordinates and elevation of our new turn point.

TP NEW	
NAME	FEUCHTWN
LAT	N 49° 12.18'
LON	E 010° 14.03'
ALT	0000m

We activate the first field with [ENTER] and enter a name consisting of up to 8 characters, e.g. FEUCHTWN (input as before, UP/DOWN [^]/[v] and [ENTER]). After that we move the cursor down to the next fields where we can enter coordinates and elevation. The necessary data for the autobahn crossing are:

FEUCHTWN, LAT: N 49° 12.18'; LON E 010° 14.03', ELEV 470m.

4.) The turn point Erpfting church can be programmed similarly. Its data is:

ERPFTING, LAT: N 48° 01.32', LON E 010° 49.52', ELEV 630m.

Note:

If a turn point name already exists, the LX20 will show the warning: "TP EXISTS" and stop the procedure. The turn point will not be stored.

2.2.1.2 Editing turn points

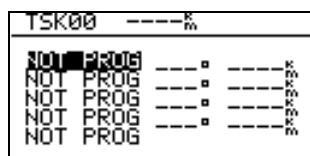
If you enter the wrong coordinates or elevation, or desire another name, the function EDIT allows you to change the data of a turn point already programmed in the TP file. Select the item EDIT in the menu TP & TASKS and hit [ENTER]. Now enter the first letters of the name of the turn point you want to edit. You will get a list of all the turn points beginning with the same letters. Select the desired turn point with UP/DOWN [^]/[v] and hit [ENTER]. This will lead to the edit mode. Select the field you want to change and hit [ENTER]. Now you can change the data in the same way as explained above. Please remember to use the correct coordinate format!

2.2.1.3 Deleting turn points

Select the item DELETE in the TP & TASKS menu. You select the desired turn point in just the same way as you did for the edit function. The only difference is the confirmation step about whether you really want to delete the turn point.

2.2.1.4 Programming a task

Select the last item, TASK, from the TP & TASKS menu. You will get the following window:



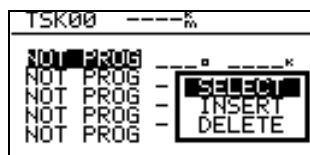
It's possible to save up to 100 tasks (numbered from 00 to 99) with 10 points each. You select one of these tasks with the arrow keys LEFT/RIGHT [<]/>].

The headline shows the task's number and its size, rounded to whole kilometres. Below you find ten empty fields (NOT PROG). Move the cursor to the first empty field and hit [ENTER]. A menu box with three options (SELECT, INSERT, DELETE) will appear.

With **SELECT** you can select a turn point from your turn point file to be inserted at the cursor position. If there's already a turn point in this position, it will be overwritten.

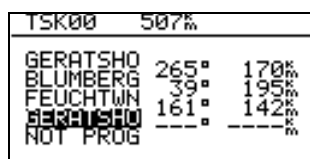
INSERT inserts a turn point at the cursor position. All the turn points at and below this position will be moved one place downwards.

DELETE deletes the point at the cursor position. All the points below will be moved one position upwards.



Now we're going to program TASK 00:

Move the cursor to the first point and hit [ENTER]. Choose SELECT (UP/DOWN [^]/[v], [ENTER]) and enter the first letters for the airfield Geratshof (right now the first letter is sufficient because we only have four points in our turn point file, so we haven't got too much choice). We confirm our selection of Geratshof with [ENTER], it is now the first point of our task. We repeat this procedure in the second position with the airfield Blumberg, in the third with the autobahn crossing Feuchtwangen-Crailsheim and in the fourth again with Geratshof. That's our 507km FAI-triangle:



Now we leave the programming mode with ESCAPE [ESC].

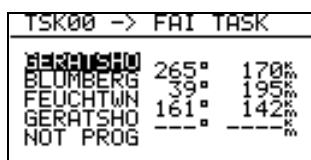
2.2.2 Declaring a TASK (under LOGGER)

Also see paragraph 2.1.2. Select the item LOGGER in the MAIN MENU, then select TASK. Now you can choose between three options:

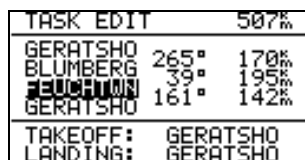


2.2.2.1 Transferring a task without further changes

For the next steps we'll select the option COPY. The following screen will appear:



You are offered to declare task 00 (TASK00 → FAI TASK). The task offered for declaration is the last one that has been edited or task 00 if no task was edited. You can select the task you want to declare with the arrow keys LEFT/RIGHT [<]/[>]. In our case the desired task was 00. We hit [ENTER], the screen changes and we reach the edit mode:



The upper part still shows task 00 but in the bottom of the screen the LX20 added the airfield Geratshof as TAKEOFF and LANDING. The reason for this is that FAI demands tasks to be declared with takeoff, start point, turn points, finish and landing. The tasks programmed in the TP & TASK file don't contain takeoff and landing and therefore the LX20 adds the first point as takeoff and the last one as landing when a task is declared. In our case we now leave the edit mode with [ESC]. We hit [ESC] again to leave FLIGHT SETUP. The LX20 is ready for takeoff now.

Note: Always run the LX20 on the main pages, i.e. when flying leave all the editing menus because otherwise no proper flight recording is possible.

2.2.2.2 Changing a declared task

We want to fly the 507km FAI-triangle from the previous paragraph (2.2.2.1) again. But now under conditions typical of competition flights, i.e. we have an external start point. Lets assume a competition on the airfield Geratshof and the external start point is the church of Erpfting, 4km north of the airfield Geratshof.

Again select TASK in the menu LOGGER. Then select COPY, choose the desired task and reach the edit mode with [ENTER]. If the task is still declared (paragraph 2.2.2.1), you

can use the edit function directly. In both cases you will get the task with takeoff and landing according to FAI. Takeoff and landing are correct, but not the start point Geratshof. Move the cursor to the first point of the task and hit [ENTER]. You get the box with SELECT, INSERT and DELETE again:



Choose SELECT, enter the first letters of the turn point Erpfting and confirm with [ENTER] or [ESC]. Confirm the suggestion ERPFTING with [ENTER] again and the start point Erpfting will appear as the first point.

Leave all editing menus with 2x ESCAPE [ESC]. Now the LX20 is ready for the desired competition flight.

Similarly, one can program Erpfting instead of airfield Geratshof as last turn point. The result is a task for decentralised competitions where an external start point has to be validated again at the end of the task.

Note:

The creation of turn points and tasks and transferring these to the LX20 is much easier and faster using one of the PC-programs included in delivery (LX E..., LXFAI or LXGPS). On the LX20 you then only have to declare the desired task (the program LXFAI also offers the feature of transferring a declared task, as a subsection of the FLIGHT INFO file). In addition, commercial software is also available that can export turn point databases in our (.da4-) format.*

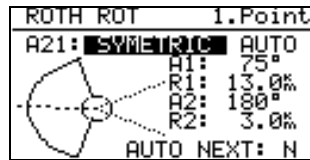
2.2.2.3 AAT ZONE-Function

Version 5.2 has been developed especially to support so called Assigned Area Tasks (AAT). The basic principle of this kind of task are big turn point sectors inbound these the pilot can decide freely when he will turn to enlarge or shorten the task. These sectors are created with the ZONE-function. The MOVE-function is meant for setting a virtual turn point inbound the sector. This point shall give important navigation and statistical advises for an optimal task length (The Move function is discussed in para 3.1.6).

Only the declared task can be modified in that way. The ZONE-function is used in common before take off during the declaration of the task. The pilot can assign an own sector of arbitrary geometry to each point of the task. Choose TASK EDIT in the declare modus. By pressing ENTER on the single points of the task a context box is opened up.



Choose ZONE and press ENTER.



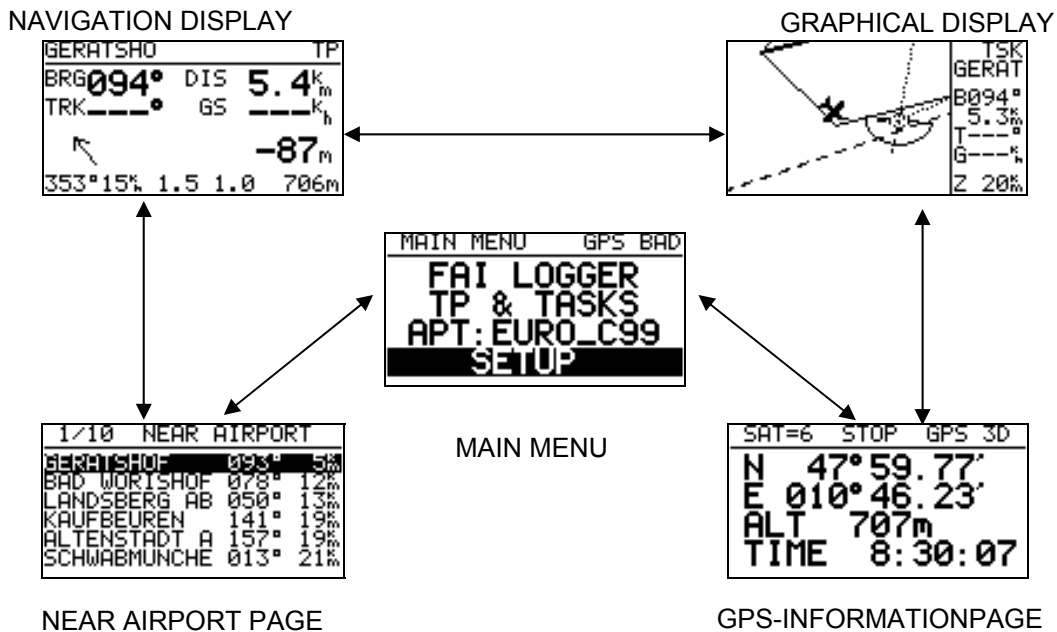
The input is completely analogous to the description in chapter 2.1.3 (OBS. ZONE). The item AUTO NEXT defines, whether the LX20 shall automatically switch to the next turn point's navigation data, when reaching the sector border. For an AAT N (No) is the better choice, the pilot now must switch over manually, as soon as he decides to turn.

3 Flying with the LX20 and subsequent flight analysis

This chapter provides a general view of the LX20's main functions and will explain how to use the device for navigation.

3.1 The main pages

The main pages are the most important ones and contain all the functions used during flight. The following scheme shows all the main pages at a glance:



You can shift from one page to the other by using the arrow keys LEFT/RIGHT [<]/[>].

3.1.1 Main menu

The main menu is the first page you reach after booting. It contains the following sub-menus:



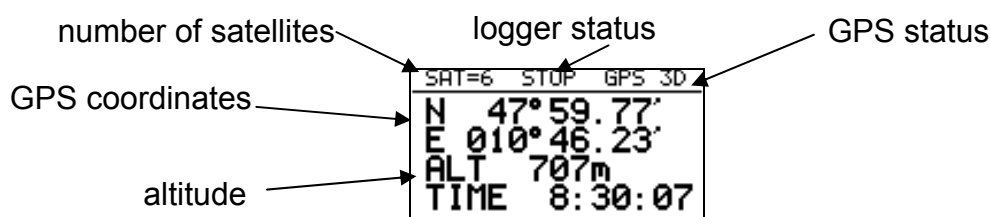
- **LOGGER:** Settings and functions of the FAI logger
- **TP & TASKS:** Turn points and tasks
- **APT:** Shows the current database version
- **SETUP:** Operation- and system settings

For more details see chapter 2.1.

The main menu is hardly used during flight. You may need it to change the display contrast, which can be adjusted in the SETUP menu under CONTRAST.

3.1.2 GPS information page

The GPS information page shows your current position as latitude, longitude and pressure? altitude. Furthermore, you find time and (after hitting [ENTER]) the date (shown for 3 seconds instead of time).



The logger status can show the following messages:

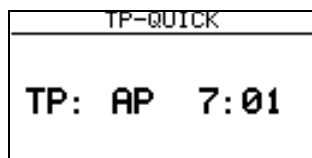
- STOP: Not flying, nothing being recorded
- RUN: Flying, recording flight
- FOTO: You are inside a sector.
- NEAR: You are near start-/turning-/finish- point.

The messages of GPS status mean:

- GPS 3D: GPS can calculate three-dimensional coordinates
- GPS 2D: Only two-dimensional coordinates possible
- GPS BAD: Reception bad or no reception at all (e.g. antenna not connected).
- GPS OFF: If voltage falls below 11V
- NO GPS: No signal from GPS-module ⇒ module probably defective, please send the device back!

3.1.2.1 Marking current position (TP-Quick)

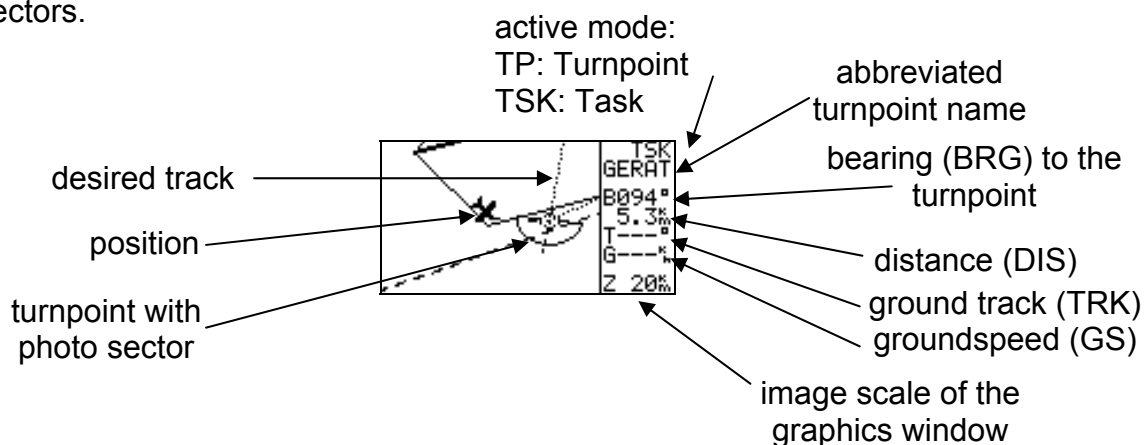
While viewing the GPS-information page, one can store the current position by pressing [ENTER] for approximately 3 seconds. This will work only when the LX20 receives enough satellites for position calculation, i.e. GPS status should show GPS 2D or GPS 3D. Pressing [ENTER] for approximately 3 seconds, one will get the following screen:



This position can be stored under the name AP (for actual position) with the time (UTC – I thought it was offset time?). Using [ENTER] again, you can edit that name, or ESCAPE [ESC] stores the position and time-name without any change. This newly created position can be treated like any other turn point and can be selected for navigation purposes. This function is valuable to mark positions for subsequent use e.g., good thermal or wave positions, or land out sites.

3.1.3 The graphical display

As long as you have GPS reception you see a graphical display of your position in relation to the surrounding airspace (if enabled) as well as an indication of the desired track and photo sectors.

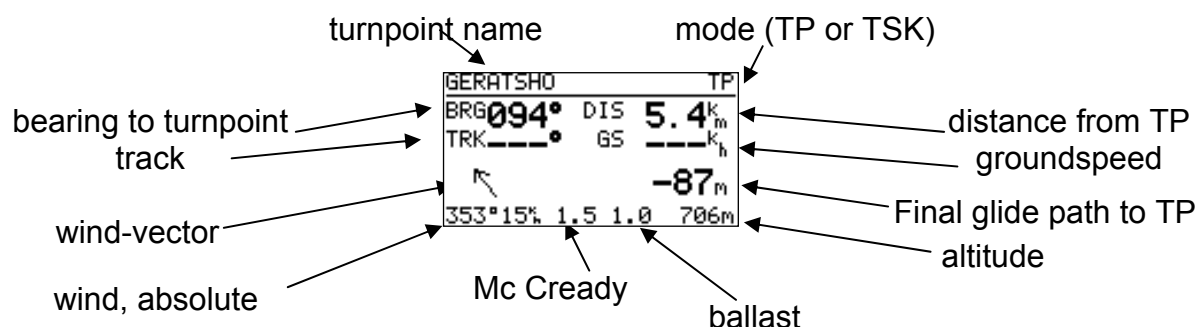


In the upper right corner of the screen the abbreviated name of the currently chosen turn point is shown. Above it you can see whether you're flying a declared task (TSK) or to any turn point (TP). Switching between these two modes is done with the [VIEW]-key. To cycle through your turn point list use the arrow keys UP/DOWN [^]/[v]. In the TP mode it's possible to choose between all the turn points in your list (sorted alphanumerical), in the task mode only the points of the programmed task are available. **The task mode can only be chosen if a task was declared before take off!! (see paragraph 2.2.2).**

The lower right corner shows the image scale of the graphics window. Hit [ESC] to zoom in and [ENTER] to zoom out.

3.1.4 Using the navigation display

The navigation page shows the currently chosen turn point. If you are flying in the task mode, the LX20 will switch-over to the next point automatically when you reach a sector. You can choose a turn point with UP/DOWN [^]/[v]. (This is identical to the graphic page: TP-mode: All turn points, sorted alphanumerical. TSK-mode: Only points programmed in the task and only if a task was programmed).



In the upper half of the display you see (from left to right): The magnetic bearing to the turn point (BRG), the distance to the turn point (DIS), the magnetic track of the glider (TRK) and the groundspeed (GS).

Below you find all the information provided by the final glide path calculator as well as the wind vector. The arrow indicates the wind direction with reference to your current track. Therefore you can immediately see which direction the wind is blowing from.

If you hit [ENTER] while on the navigation display you can adjust the following values (move the cursor to the desired field (see graphic) with LEFT/RIGHT [<]/>] or [ENTER] and change the value with UP/DOWN [^]/[v]):

- **Mc Cready-value**
- **Ballast** –(actually a loading) is calculated the following way: Note change below:

$$Load = \frac{glider + pilot + ballast}{glider + pilot}$$

If you are flying without additional ballast, this value will be 1.0 and the LX20 will calculate with the glider's polar at 30 kg/m².

- **Altitude:** This setting is important for the final glide path calculator. Before takeoff, you should set the value to the airfield's elevation to calibrate the pressure sensor. If you prefer to have some altitude reserve for final glide path, subtract this reserve from the entered altitude, e.g. 200 metres. Disadvantage: The displayed altitude will then be 200 metres below the correct value (Watch out for airspace boundaries!).

In case of varying air pressure it's unfortunately not possible to enter a new QNH value to recalibrate the LX20. But you can convert the pressure change to a variation of altitude and enter a new altitude value during flight.

Rule of thumb: Caution in case of falling pressure! You need about 8 metres more reserve per mbar reduction (reduce altitude value).

If the pressure increases, your reserve will increase, too. So you won't have problems reaching home, but if you need an exact altitude indication you have to add 8 metres to the altitude value per mbar increase.

- **Wind calculation:** If you move the cursor to this field you can choose between two options (UP/DOWN [^]/[v]):

WIND CALC: The wind vector will be re-calculated continuously during flight, using the so-called groundspeed method. While circling, the maximum and minimum groundspeed is measured by the GPS. The wind-velocity is calculated from the difference of these speed values during circling, as the glider changes between flying with- and against the wind. This calculation method needs at least two fairly accurate

circles (if the LX20 is still lacking one or two circles for a first calculation, the message „WAIT1/2“ will be shown instead of a wind vector). Please note that a new wind vector can only be calculated while circling. If you fly straight for a longer time, the calculated wind might be obsolete.

WIND FIX: You enter a fixed wind vector. To do so, choose WIND FIX, hit [ENTER] and adjust wind direction and velocity. This wind vector remains unchanged until you enter a new one or activate the wind calculation function.

In which case might setting a fixed wind be convenient?

An example: Your altitude is 3000m and you still have 80 kilometres of final glide to the west. At your current altitude you have got moderate tail-wind. But you know that there's a wind shear at about 2500 metres, where the wind changes to strong head-wind, let's say 25 km/h, direction 270°. Because you don't want to circle on the final glide the LX20 won't re-calculate the wind vector but will use the wind measured at 3000 metres for your final glide path calculation. Consequence: Your reserve may not be enough even though the device claims it is.

Therefore you adjust WIND FIX 270°, 25 km/h and will you immediately see whether you've got enough reserve or need to circle one more time, given these wind conditions.

3.1.5 The Near Airport function

If you have GPS-reception the ten nearest airports are displayed here with bearing and distance:

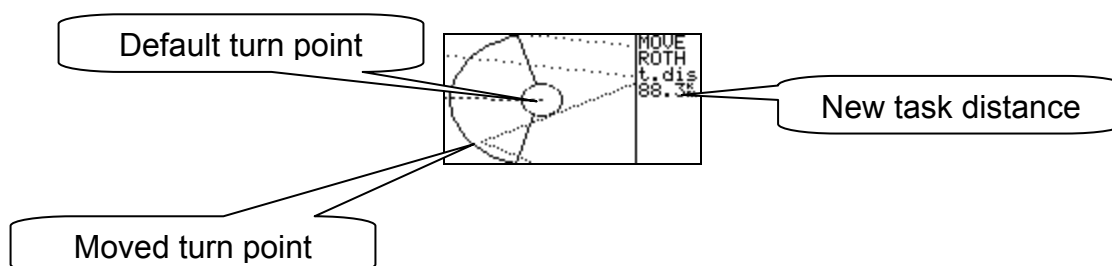
1/10 NEAR AIRPORT		
GERATSHOF	093°	5km
BAD WÜRZSHOF	078°	12km
LANDSBERG AB	050°	13km
KAUFBEUREN	141°	19km
ALTENSTADT A	157°	19km
SCHWABMÜNCHE	013°	21km

You can choose one of these airports with UP/DOWN [^]/[v] and [ENTER]. The LX20 will change to the navigation display and calculate the final glide path to the desired airport.

As soon as you select a different turn point with UP/DOWN [^]/[v] the chosen airfield will be replaced by this turn point.

3.1.6 AAT MOVE Function

The MOVE-function is used to set and move a virtual turn point inbound the AAT-sector (the point cannot be moved outside the sector). The sector stays unchanged together with the original turn point. The arrow keys ← ⇒ and ↑ ↓ are used to perform the movement. Pressing the buttons longer will enlarge the step width.



Important

To activate the MOVE-function during flight, one must use the READ/BARO key (Exclusively available from the graphics page). With ESC the MOVE function is left.

AAT in practice

After the briefing (an AAT has been set), the pilot shall declare the task and adopt the sectors according to the set AAT, using the EDIT modus. Eventually the pilot should use the MOVE-function before the take off to adopt the task to his personal (weather) estimation. During flight the sector cannot be changed (declaration in the air is not possible). The MOVE-function is activated by pressing READ/BARO, the active sector appears, the MOVE-function can now be used directly (\leftrightarrow ↑↓).

3.1.7 Calculating security

This is not a navigation page or any other kind of usable function, but the importance of this status message is of such a high level, that we'll describe this message in its own paragraph.

The LX20 continuously determines if the glider is still in flight, by checking firstly the groundspeed value derived from the GPS-data and second the variometer value, coming from the derivative of the pressure sensor. If there is no movement for more than three minutes and no variometer value is measured during this period the LX20 defines the flight as finished. Now the electronic security key for the last flight is calculated. During this time the message CALCULATING SECURITY is displayed. As long as this message is displayed the LX20 should not be switched off.

The calculation procedure will not be started if the LX20 is not receiving enough satellites (GPS BAD), because there is no possibility to decide whether the glider is still moving or not.

Calculating security is also started when the LX20 has been switched off for more than three minutes while recording and the GPS running.

If there are no data from the GPS-module (GPS OFF e.g. power supply disconnected, or NO GPS) the flight is invalidated according to the IGC rules.

Note:

After finishing a flight please delay switching off the device or pulling your glider into the hangar (if the LX20 is built in) until the security code is calculated. In very rare cases it can cause problems if the code is calculated the day after the flight.

3.2 Flight evaluation

When you have landed and calculating security is finished (see Paragraph 3.1.6) you can evaluate the flight directly on the LX20 without transferring the data to a PC. Set the cursor on the menu item LOGGER (in the main menu) and press [VIEW].

```

MAIN MENU  GPS BAD
-----
LOGGER
TP & TASKS
APT: EURO_H00
SETUP
  
```

[VIEW] →

```

FLIGHT VIEWER
-----
Flight: 2
  
```

→

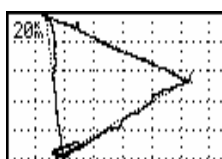
```

Flight: 0 13.07.96
PILOT: DEMO_FLIGHT1
GLIDER: NIMBUS_3/25
DURATION: 4:02:15
10:30:29 - 14:32:44
TASK: 306.6%
  
```

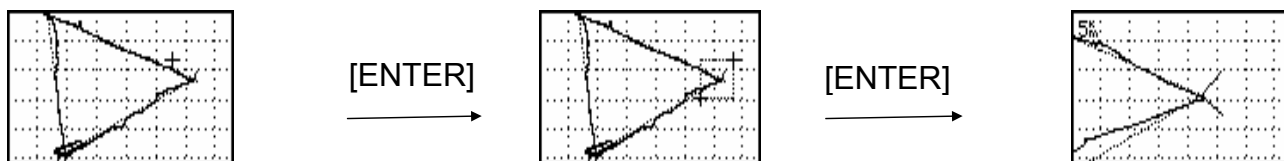
The LX20 now searches through its memory for existing flights. The last one is displayed by default. With the arrow keys LEFT/RIGHT [\leftarrow]/[\rightarrow] you can choose (if present) one of the previous flights. An overview of some general data of the chosen flight will be displayed, such as pilot name, type of glider, flight time and duration and (if declared!) the length of the task. Now the following analysis routines are offered by the LX20: flight route, barogram and statistics.

3.2.1 Route

Choose the desired flight and press [WRITE/RTE]. Wait until the complete flight is on the display (The procedure cannot be stopped).



The number in the upper left corner represents the scale (side length of the quadrates). To zoom in press [ENTER], a marker will appear. Move this marker with the arrow keys LEFT/RIGHT [\leftarrow]/[\rightarrow] and UP/DOWN [\uparrow]/[\downarrow] close to the area you want to zoom in and press [ENTER] again. A second marker will appear. With it's help you draw a window around the desired region and confirm with [ENTER], whereupon the zoomed area is displayed.



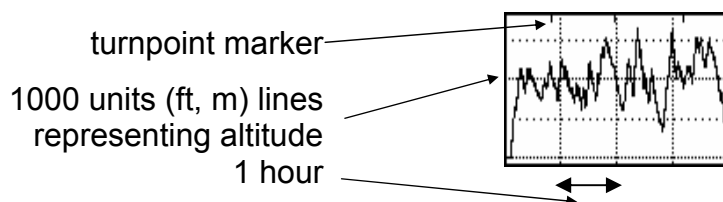
With ESCAPE [ESC] you can return to the last zoom level.

Note:

From any arbitrary deep zoom level back to viewing the complete task can be regained by setting both markers on the same point and pressing [ENTER].

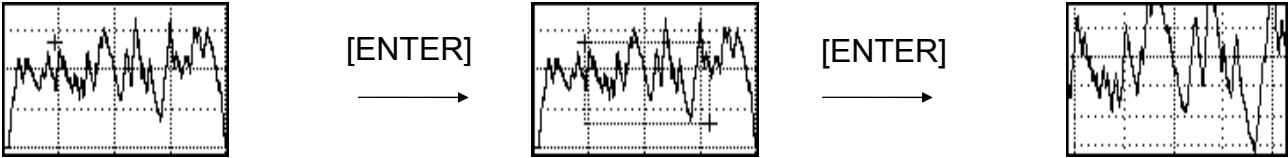
3.2.2 Barogram

Choose the desired flight and press [READ/BARO]. Wait until the barogram is displayed completely (the procedure can not be stopped).



The horizontal lines with more dots represent the x-1000m or ft altitudes, the vertical lines represent one hour.

To zoom in press [ENTER], a marker will appear (see also paragraph 3.2.1.1, ROUTE). Move this marker with the arrow keys LEFT/RIGHT [<]/[>] and UP/DOWN [^]/[v] close to the area you want to zoom in and press [ENTER] again. A second marker will appear. With it's help you draw a window around the desired region and confirm with [ENTER], whereupon the zoomed area is displayed.



3.2.3 Statistics

Choose a flight and press [VIEW/STAT]. The LX20 will now calculate the statistics of this flight (this will take about two minutes). The calculating procedure cannot be stopped.



Initially, statistics for the complete task are displayed, showing the length of the declared task, the average speed, portion of vario (flying thermals) and the distance flown. With [VIEW/STAT] again you can see the statistics for the individual legs.



You can select the different legs by using the arrow keys LEFT/RIGHT [<]/[>]. With the UP/DOWN [^]/[v] arrow keys you can switch between the statistic pages of each selected leg.


```

STATISTICS: LEG 1/3
KKDOR+ - DOBOZHID
11:21:03 - 12:28:28
Duration: 1:07:25
Distance: 101.9%
Speed: 90.69%
    
```

x. leg, turnpoint names
 Start time and arrival time at the turnpoints
 leg duration
 leg distance
 averaged speed of the leg

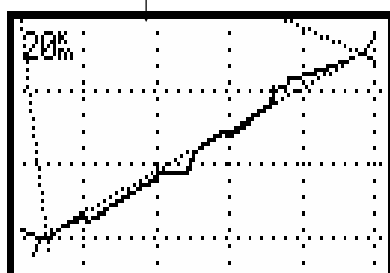
[UP/DOWN [^]/[v]

```

STATISTICS: LEG 1/3
KKDOR+ - DOBOZHID
972m - 1066m
Vario: 1.7% 29%
Track dist.: 112.0%
XC speed: 91.94%
    
```

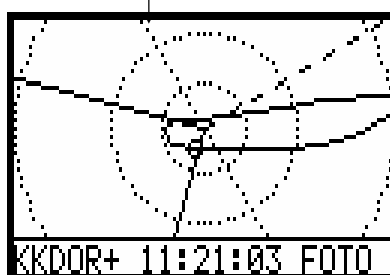
x. leg, turnpoint names
 Start altitude and arrival altitude at the turnpoints
 averaged vario and vario portion of the leg
 flown distance
 altitude corrected speed of the leg by using the averaged vario

[UP/DOWN [^]/[v]



graphics of the leg, e.g: here first leg

[UP/DOWN [^]/[v]



Sector graphics with flight path through the sector.

With ESCAPE [ESC] one returns to the main menu.

4 Communication with a PC

Included in delivery you will find a CD containing three programs. These programs are the DOS-applications LXFAI and LXGPS, as well as the program LX E..., which is a Win95/98 compatible combined version of both LXFAI and LXGPS. An installation routine for LX E... starts up automatically after inserting the CD into the CD-ROM drive. The DOS-applications must be installed "manually", i.e. one has to search on the CD for the appropriate programs (install.exe) and run them.

This manual describes the connection of the LX20 with the different programs, as well as some special procedures that are not included in the manuals of the programs. For everything else please consult the appropriate manuals.

4.1 Program LXFAI (DOS)

4.1.1 IGC rules

For reading data out of a GNSS flight recorder, the IGC requires three self-executing DOS-applications. They are named DATA-XXX.EXE, CONV-XXX.EXE and VALI-XXX.EXE, where the XXX is the three letter short form of the manufacturer's name, in our case FIL for Filser. DATA is used for reading out the binary flightlog from the logger (only the last flight can be read out!). With CONV this binary file is changed into the IGC-format, which is an ASCII code. VALI is necessary for proving the integrity of such a file. These programs must be freeware, and are provided on the IGC homepage (www.fai.org/gliding). The program LXFAI is a multifunctional DOS-application, e.g. it is possible to download more flights, flight evaluation can be done, TP-files can be transferred, etc.

Previously, it has not been permissible to download data from the LX20 with the LXFAI program- only DATA-FIL was permitted. At their last meeting the IGC discussed whether more programs can be used for downloading flights. The new resolution allows a more complex program to be used, providing the validation result is the same as a validation result carried out by a national aero club or the FAI/IGC with the latest version of VALI-XXX.

4.1.2 Functions of the program

- Programming turn points and tasks in the proprietary Filser *.da4-format (see also paragraph 2.2.1)
- Programming the flight info (see also paragraph 1.3 and 2.1.1.1)
- Writing the *.da4-files to the device and reading out such data from the device (LX20 and most of the other Filser products)
- Writing the flight info to the LX20 and reading it from the device
- Logger setup: setup logtime (2.1.1.3), event-marker (2.1.1.7), I-Record (2.1.1.5), J-Record (2.1.1.6), time zone (2.1.4.3), and NMEA (2.1.4.5). *Note: The possibility provided in the logger setup of setting the sector geometry either to photo sector or 500m-cylinder is disabled in order to protect the sectors programmed manually on the LX20.*
- Reading out flight logs from the LX20 and the following additional devices: LX21, Colibri, DX50SFAI, LX5000 (version 6.0 and higher), LX5000FAI and LX6000 as well as converting these files to the IGC-format.

- Analysis of these flights with respect to route, barogram, engine noise level, sectors, airspace and statistics.

4.1.3 Communication procedure with the LX20

- Connect LX20 and PC using the serial interface cable and switch on the LX20 (doesn't matter which is done first)
- Start up the program LXFAL
- Enter a "T" for transfer (opens up the TRANSFER menu) and then press [READ] or [WRITE] on the LX20, which should now display the following:



- The desired transfer action can be started now from the transfer menu.

If no connection can be established or the data transfer stops after some data blocks, please check the following points:

- Is the cable connection ok?
- Did you open up the transfer menu in the LXFAL program?
- Has the correct COM-Port (serial interface) been selected in the LXFAL program (COM1 or COM2)?
- Are the data rates the same in PC and LX20?
- Sometimes problems appear when using DOS programs in Windows 95/98. For the use of LXFAL in Win 95/98 please choose the exclusive mode or start up the computer in DOS only.

4.2 Program DATA-FIL

4.2.1 Program functions

- Reading out the latest flight from Filser/LX-logger systems
- In the latest version: automatic start up of CONV-FIL and conversion of the transferred flight

4.2.2 Communication with the LX20

- Connect LX20 and PC using the serial interface cable and switch on the LX20 (doesn't matter which is done first).
- Start up (possibly under "pure" DOS) the program DATA-FIL using the following syntax:
DATA-FIL -x, where x = 1 or 2 for the appropriate serial interface port. There are more options available, which can be displayed with the syntax DATA-FIL -h.
Now you get the message "WAITING CONNECTION"
- Press [READ] or [WRITE] on your LX20, where the following message will appear



- The desired transfer action can be started now from the transfer menu.
- Does this happen with DATA-FIL – I don't think there is a "transfer menu"

If no connection can be established or the data transfer stops after some data blocks, please check the following points:

- Is the cable connection ok?
- Is the syntax for the serial interface correct (COM1 or COM2)?
- Are the data rates the same in PC and LX20?
- Sometimes problems appear when using DOS programs in Windows 95/98. For the use of DATA-FIL in Win 95/98 please choose the exclusive mode or start up the computer in DOS only.

4.3 Program LXGPS

4.3.1 Functions of the program

- Changing and transferring the airport database (only **to** the LX20), password protected
- Transferring the airspace database (**to** the LX20 only), password protected
- Programming turn points and tasks in the Filser *.da4-format (see also paragraph 2.2.1)
- Writing the *.da4-files to the LX20 and reading out this data from the device
- Reading out flight logs from the following devices: LX500, LX400 (version 4.x), LX4000 (version 8.x), LX5000 (version 4.x and earlier) and LX6000.
- Analysis of these flights with respect to route, barogram, engine noise level, and statistics.

4.3.2 Communication with the LX20

- Connect LX20 and PC with the serial interface cable and switch on the LX20 (doesn't matter which is done first)
- Start up the program LXGPS
- Enter a "T" for transfer (opens up the TRANSFER menu) and then press [READ] or [WRITE] on the LX20, which should now display the following:



- The desired transfer action can be started now from the transfer menu.

If no connection can be established or the data transfer stops after some data blocks, please check the following points:

- Is the cable connection ok?
- Did you open up the transfer menu in the LXGPS program?
- Has the correct COM-Port (serial interface) been selected in the LXGPS program (COM1 or COM2)?
- Are the data rates the same in PC and LX20?
- Sometimes problems appear when using DOS programs in Windows 95/98. For the use of LXGPS in Win 95/98 please choose the exclusive mode or start up the computer in DOS only.

Note:

Programming of turn points may be more comfortable in the program LXGPS, because one can copy airports directly from the integrated database.

The program LXGPS is no longer the subject of further development, the successor is the program LX E... (see paragraph 4.4).

4.4 Program LX E...

This is a program running under Windows 95/98, which combines most of the functions from LXFAI and LXGPS. The integrated airport- and airspace database is password protected as it is in LXGPS.

In the latest version the functionality of both DOS-applications is available.

The program LX E... provides an online help.

4.4.1 Program functions

- Changing and transferring the airport database (only **to** the LX20), password protected
- Transferring the airspace database (**to** the LX20 only), password protected
- Controlling airspace on a map
- Programming turn points and tasks in the Filser *.da4-format (see also paragraph 2.2.1)
- Programming the flight info (see also paragraph 1.3 and 2.1.1.1)
- Writing the *.da4-files to the LX20 and reading out this data from the device
- Writing the flight info to the LX20 and reading it from the device
- Reading out flight logs from all Filser/LX-devices
- Analysis of these flights with respect to route, barogram, engine noise level, sectors, airspace and statistics.
- Logger setup: adjusting log time (2.1.1.3), event-marker (2.1.1.7), I-Record (2.1.1.5), J-Record (2.1.1.6), time zone (2.1.4.3), NMEA (2.1.4.5) and sectors (2.1.3)

4.4.2 Communication with the PC

- Connect LX20 and PC with the serial interface cable and switch on the LX20 (doesn't matter which is done first)
- Start up the program LX E...
- The program LX E... is constantly monitoring the serial interface. Press [READ] or [[WRITE] on the LX20 and LX E.. will automatically recognise the device type, serial

number, hard- and firmware version and chosen transfer rate. The LX20 meanwhile shows the familiar transfer display



- The desired transfer action can be started now from the transfer menu.
- Is this comment still valid for LX E.. ?

If no connection can be established or the data transfer stops after some data blocks, please check the following points:

- Is the cable connection ok?
- Has the correct COM-Port (serial interface) been selected in the LX E... program (COM1 or COM2)?

Note:

The program LX E... is the subject of continuous development. The latest version can be downloaded on our website:

<http://www.filser.de>

The program version of LX E.. is not coupled with the version of the database, which is different to LXGPS. Therefore you can always update and use the latest version of LX E... without affecting your password-protected database.

At some stage, it would be nice if the beeping that occurs during connection is disabled. It is annoying and has become more so with LX E.., because the beeping now continues during the whole connection, not just when transferring.

Solved with version 5.2

5 Annex

5.1 Preflight/postflight checklist

Flight data

- ◆ Flight info (pilot, glider, registration, competition class) correct?
- ◆ Sector geometries correct?
- ◆ Total (remaining) recording time enough for the estimated flight time?
- ◆ ENL sensor active? (essential for powered gliders!!!)
- ◆ Task declared? LX20 has to be operated on the main pages!

Navigation

- ◆ Task declared?. Otherwise no sectors will be shown and task navigation will not work (but the LX20 will still record the flight trace)
- ◆ Sector geometries correct?
- ◆ Correct polar defined (final glide calculator)
- ◆ Altitude adjusted (final glide calculator)
- ◆ Correct airspace (airspace enabled) (Version!!)

Before take off (important if LX20 cannot be seen during flight)

- ◆ LX20 connected to 12V-power supply?
- ◆ 12V-power supply enough for the estimated flight time?
- ◆ GPS antenna connected to the LX20?
- ◆ LX20 switched on?
- ◆ GPS-reception 2D or 3D? (Min. 3min before take off to produce a baseline)

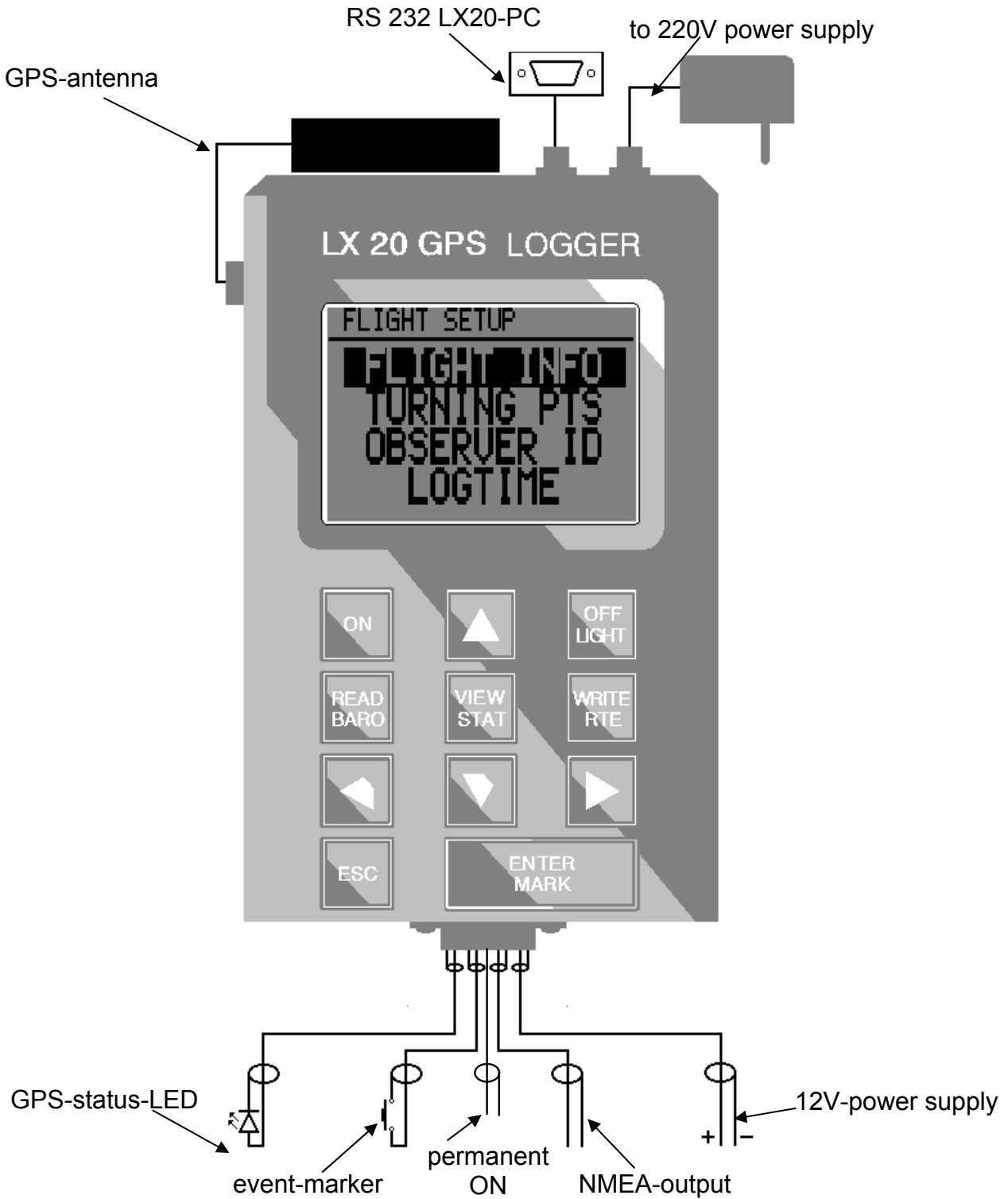
After landing

- ◆ Please wait until calculating security is finished.

5.2 Wiring and technical data

5.2.1 Earlier model range

5.2.1.1 Wiring and pin layout



Pin #	Signal	description
1	GROUND	ground
2	RS232 RXD	serial input RS232
3	RS232 TXD	serial output RS232 (= NMEA-output)
4	LED CATHODE	LED blinking, if GPS 2D or 3D, blinking more often near turn point. Steady green light: LX20 on but GPS BAD
5	GROUND	ground
6	Push Button	external event-marker
7	AUTO ON	If pin 7 is connected to pin 1 or 5, the LX20 is automatically turned on when power is connected.
8	LED ANODE	
9	+12V BATT	+(9-24)VDC power supply (e.g. on board accumulator)

Pin layout for the connector on the LX20's base

5.2.1.2 Technical data

power supply: 9 - 24 VDC
power consumption: ca. 150 mA
operating temperature: -20 - +60°C
dimensions: 142 x 90 x 45 mm (without connector)
weight (incl. mounting frame): 800g
GPS: 8 channel parallel
Built in 9V NiCad-battery for about 30 minutes operation (without GPS).

5.2.2 New model range

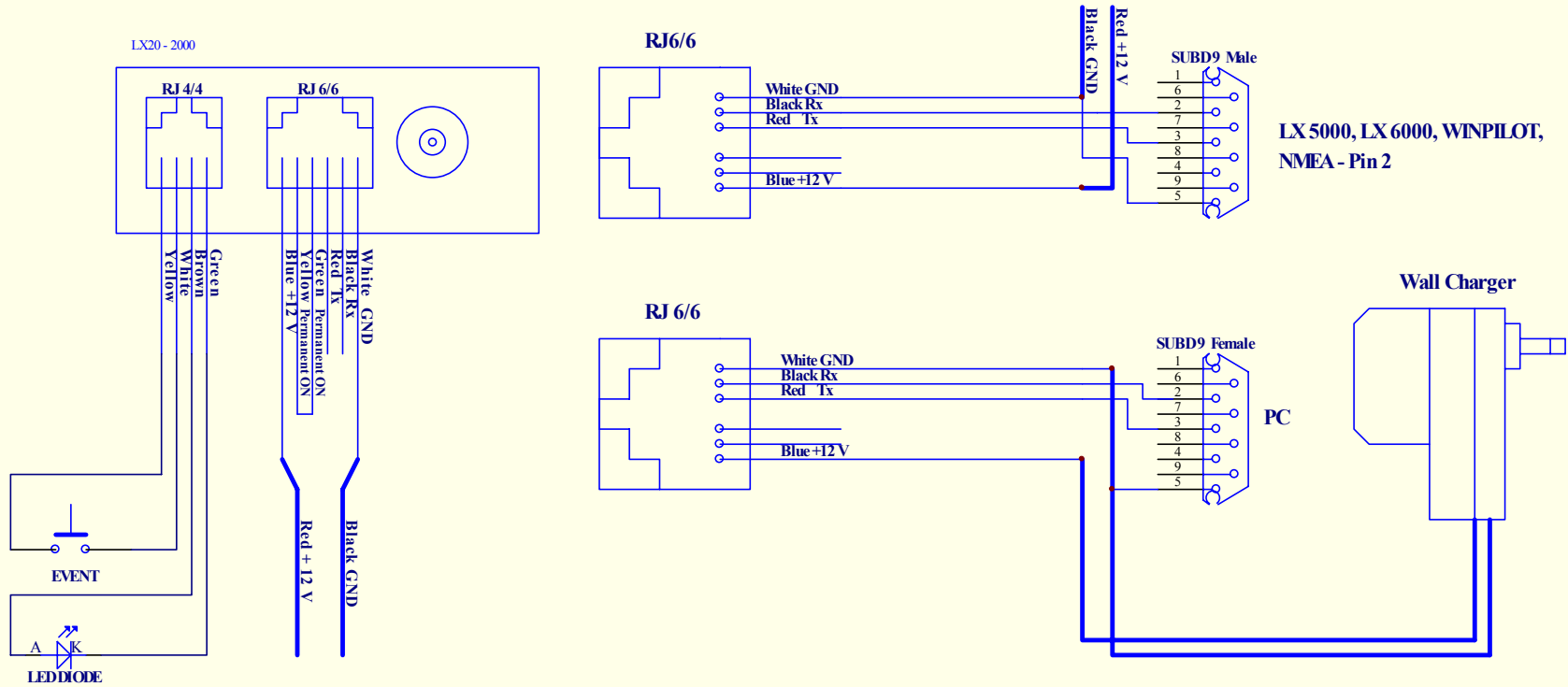
5.2.2.1 Technical data

power supply: 9 - 24 VDC
power consumption: ca. 150 mA
operation temperature: -20 - +60°C
dimensions: 131 x 88 x 39 mm (without connector)
weight (incl. mounting frame): 500g
GPS: 12 channel parallel
Built in 9V NiCad-battery for about 30 minutes operation (without GPS).

5.2.2.2 Wiring

see next page...

LX 20 - 2000 WIRING DIAGRAM



5.3 Calibrating the barograph

Warning: This procedure should be done only by certified calibration institutes (e.g. in Germany the Akaflieds have calibration equipment).

A barograph calibration is a very simple procedure:

The running LX20 (12V-power supply connected!) is put into the pressure chamber and the measuring routine is simply started. The LX20 starts recording (even without GPS) when a variometer value of more than $\pm 1\text{m/s}$ is measured for more than 5sec.

When the measuring routine is finished, switch off the LX20 after more than 3min. After switching on again the "flight" can be transferred to a PC. The file is stored as usual in the internal binary format and in the IGC-Format. The barogram can now be printed.

Note:

In earlier versions a password had to be entered for starting the calibration process, this is no longer necessary.

5.4 IGC-approval

Note: In this approval are two minor errors, which will be corrected by the IGC as soon as possible.

- (1) Under Equipment → Hardware → Original LX20 the description of the connectors positions is wrong (see also paragraph 5.2.1.1)
- (2) Under Equipment → Hardware → Firmware: The **versions 2.0 and 2.4 listed there are no longer valid**. In the earlier model range one has to use at least version 3.0 or higher (in the new models version 5.x or higher)

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**THE FAI INTERNATIONAL GLIDING COMMISSION (IGC)
GLOBAL NAVIGATION SATELLITE SYSTEM (GNSS)
FLIGHT RECORDER APPROVAL COMMITTEE (GFAC)**

References:

FAI web site: <http://www.fai.org>

IGC web site: <http://www.fai.org/gliding>

IGC GNSS web site: <http://www.fai.org/gliding/gnss>

IGC GNSS site for software: <http://www.fai.org/gliding/gnss/freeware.html>

To:

- FAI for IGC email mailing list
- Internet newsgroup rec.aviation.soaring
- IGC GNSS web site under "List of Approvals"
- Copy: Manufacturer concerned

21. March 2000

VERSION 3 OF IGC APPROVAL FOR FILSER LX20 GNSS FLIGHT RECORDER

This is an updated version of the original that was dated 12 August 1996 and was amended on 25 March 1997 to add the ENL function.

This Version 3 replaces the earlier versions, adds the LX20-2000 model and generally brings the wording in line with other recent approval documents.

This document gives formal approval from the above date for the under mentioned GNSS FR equipment to be used for validation of flights under the FAI Sporting Code Section 3 (Gliders and Motor Gliders), subject to the conditions and notes given later. IGC reserves the right to alter this approval in the future.

GFAC tests are concerned primarily with data accuracy, security, data transfer, conversion to and conformity of the output data with the standard *.IGC file format. Other aspects of the equipment may not be tested and are a matter between the FR manufacturer and customers.

The attention of NACs, officials and pilots is drawn to the latest edition of the FAI Sporting Code Section 3 (Gliding) including its annexes and amendments. Annex A to this code (SC3A) deals with competition matters, annex B to the Code (SC3B) deals with equipment used in flight validation, Annex C to the Code (SC3C) consists of guidelines and procedures for Official Observers, pilots, and other officials involved in the flight validation process. Copies of all of these documents may be obtained from the FAI/IGC web sites listed above and links are provided from the IGC web site. A separate document published by FAI is entitled "Technical Specification for IGC-Approved Flight Recorders" and is available through the IGC/GNSS web site shown above.

It is recommended that a copy of this approval including its two annexes is kept with each unit of the equipment.

MANUFACTURER:

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EQUIPMENT:

HARDWARE

Version 1.0 or later of the Filser LX 20 GNSS FR.

Original LX20. The FR consists of a rectangular metal case about 200 x 90 x 45mm and weighs about 500gm. A 62 x 44mm LCD is on the side of 200 x 90 dimension, and below it are 3 rows of 3 buttons with an Escape and Mark button below (total, 11 buttons). Three connectors are on the 90 x 45mm end below the buttons; they are an antenna bayonet fitting, a 9-pin RS232 and a circular data transfer connector (see below under "permitted connections"). Early versions were fitted with the 11-channel Koden (Japan) FDK-GSU/14 GPS board, later ones with a 6 or 8 channel Motorola Oncore or the 8 channel Oncore GT board. The pressure altitude sensor is a Sensym SDX15A2.

LX20-2000. This FR was introduced in year 2000 and consists of a rectangular metal case about 130 x 87 x 39mm., weight is about 390gm. A 62 x 44mm LCD is on the side of 130 x 87 dimension, and below it are 3 rows of 4 buttons. Three connectors are on the 87 x 39mm end, below the buttons; they are an antenna bayonet fitting and two telephone plug-type connectors (see below under "permitted connections"). Two GPS boards are available, the Marconi (Canada) Superstar and the Ublox (Switzerland) GPS-MS1. The pressure altitude sensor is the Intresema (Switzerland) MS 5534A integrated pressure sensor which has a range from 1100 to 300 millibars.

National regulations. These may apply to electrical and electronic equipment, such as the EC "CE" mark for compliance with EC directives on EMC and voltages. Compliance with such regulations is not the responsibility of FAI. This equipment has the EU CE mark.

FIRMWARE

Version 2.0 or later. Versions 2.4 and later are required for Motor Glider engine recording, and version 5.01 or later for the LX20-2000. The version number is shown on the LCD on switching on.

SOFTWARE

Program file functions. The short program file DATA-FIL.EXE is for transferring flight data from the FR to a PC and produces a *.FIL binary file and an *.IGC file for each flight. The file CONV-FIL.EXE is for conversion of a *.FIL flight data file to the IGC format, if this has not been done before. The file VALI-FIL.EXE is for validation by NACs and FAI of the security and integrity of the *.IGC files. Also, for the same and wider purposes, for those familiar with the programme and menus concerned, the full LXFAI Software program, release V2.0 dated July 1996 or later releases.

Latest versions. It is recommended that the latest versions of the program files are used, obtained from the IGC GNSS site for software given at the beginning of this document. These program files are backward compatible to previous versions of the FR.

Free availability. The DATA, CONV, and VALI files are copyright of the FR manufacturer but are freeware, and the latest versions may be obtained from the IGC GNSS site for software or through the IGC/GNSS site through a link. See the site titles given at the beginning of this document.

CONDITIONS OF APPROVAL:

1. Permitted Connections to the Main (FR) Module.

1.1. Original LX20

1.1.1. External antenna to 9mm circular BNC bayonet connector on the FR case.

1.1.2. 9-pin RS232 connector on the bottom face below the keyboard, with connections for 12V external battery power, to a Pilot Event (PEV) button, a light indicating GNSS lock-on, and NMEA signal output to appropriate instruments.

1.1.3 PC to 4-pin circular data-transfer port. A PC must not be connected between the takeoff of the claimed flight and the transfer of data after flight.

1.1.4. A 3-pin circular port on a side face for a 12V battery connection if the RS232 is not used.

1.2. **LX20-2000**

1.2.1. External antenna to 9mm circular BNC bayonet connector on the FR case.

1.2.2. Data I/O and 12V power to 6-pin female 9.5 x 6.5 mm RJ12 socket on FR case, wired to the IGC standard for this type of socket.

1.2.3. Pilot event button and green light GPS status indicator to 4-pin female 7 x 6.5 mm RJ10 socket on FR case.

2. **Security of the Equipment**. GFAC is presently satisfied with the physical and electronic security of this equipment. See para 4 on security seals.

2.1. **Installation in a glider**. From a technical aspect, the FR may be fitted anywhere in the glider, subject to paras

2.2 (Motor Gliders) and 3.2 (sealing). However, the position of any displays and operating buttons and controls used in flight in single-seat gliders should not be remote from sight-lines used for pilot lookout and scan for other aircraft and gliders. If the GPS antenna is accessible to the crew in flight, no attempt must be made to inject data; any abuse of this may lead to a future requirement to place the antenna out of reach of the flight crew.

2.2. **Motor gliders**. When the ENL system is fitted, a microphone and frequency filter and weighting system automatically produces an ENL (Engine Noise Level) value with each fix up to a maximum ENL value of 999. The system is designed to emphasise engine noise but at the same time produce positive but low ENL values in normal quiet gliding flight. The FR should be positioned in the glider so that it can receive a high level of engine and/or propeller noise when power is being generated. GFAC has tested the FR in motor gliders with two-stroke and 4-stroke engines, but not with Wankel or electric power sources. For details of typical ENL values, see para B.4.

2.2.1. **Electric engines**. If an electric engine is to be used, GFAC should be notified beforehand so that tests can be carried out in order to establish ENL values in various cockpit positions.

2.3. **Sealing of data ports and plugs**: no present requirement, but no attempt must be made to pass unauthorised data into the FR.

3. **Check of Installation in the Glider**. There must be incontrovertible evidence that the FR was present in the glider for the flight concerned. The installation should be in accordance with this document. This can be achieved either by observation at takeoff or landing or by sealing the FR to the glider at any time or date before takeoff and checking the seal after landing.

3.1. **Observation of Installation before Takeoff or at Landing**. For observation, either a pre-flight check of the installation must be made and the glider must be under continuous observation by an OO until it takes off on the claimed flight, or an OO must witness the landing and have the glider under continuous observation until the FR installation is checked. This is to ensure that the installation is in accordance with the rules, and that another FR has not been substituted before the data is transferred to a PC after flight.

3.2. **Sealing to the Glider before Flight**. If para 3.1 cannot be met, the FR must be sealed to the glider by an OO at any time or date before flight so that it cannot be removed without breaking the seal. The sealing method must be acceptable to the NAC and IGC. Paper seals must be marked in a manner such that there is incontrovertible proof after the flight that seals have not been tampered with, such as by marking with the glider registration, the date, time and OO's name and signature. It should be possible for the OO

to recognise the seal markings afterwards. The use of adhesive plastic tape is not satisfactory for IGC-approved sealing because it can be peeled off and re-fitted. Gummed paper tape is recommended, as used for sealing drum-type barographs. The OO must seal the FR unit to glider parts which are part of the minimum standard for flight. It is accepted that such parts can be removed for purposes such as servicing; such parts include the canopy frame, instrument panel, and centre-section bulkhead fittings. If the FR is sealed to such removable part, if such a part is transferred between gliders, any FR seal for the previous glider must be removed.

4. Security Seals, Physical and Electronic.

4.1. **Physical Security.** A silver-coloured tamper-evident seal with the European "CE Mark" and the manufacturer's name, is fitted over one or more of the case securing screws. In addition, an internal security mechanism is included, that activates if the case of the FR is opened. On switching on, the LCD screen shows the version, unit serial number, memory available and other details. If data is waiting to be downloaded the LCD shows "CHECKING SECURITY" for a short time before the menu is shown. If the FR case has been opened, breaching physical security, the message "SECRET KEY NOT VALID" will be shown on switching on and an audio alarm will sound which can be cancelled by pressing "ESC".

4.2. **Electronic Security.** If the internal security mechanism has been activated (such as by opening the case), any data in the memory will be lost, settings will revert to defaults, and the electronic security algorithms in the FR will be trashed. Any flight data files subsequently produced will fail the VALI-FIL test for electronic security. This test will also fail if the *.FIL or *.IGC file has been altered in any way after downloading from the FR.

4.3. **FR found to be unsealed.** If either physical or electronic security is found to have failed, the FR must be returned to the manufacturer or his appointed agent for investigation and resealing. A statement should be included on how the unit became unsealed.

4.3.1. **Checks before re-sealing.** Whenever any unit is resealed, the manufacturer or agent must carry out positive checks on the internal programmes and wiring, and ensure that they work normally. If any evidence is found of tampering or unauthorised modification, a report must be made by the manufacturer or agent to the Chairman of GFAC and to the NAC of the owner. The IGC approval of that individual unit will be withdrawn until the unit is re-set and certified to be to the IGC-approved standard.

5. **Analysis of Flight Data.** Analysis should be through the use of an analysis programme which complies with IGC rules and procedures and is approved for this purpose by the relevant NAC. For a list of programs which are capable of reading and displaying flight data in the *.IGC file format, see the IGC/GNSS web site under the link button to SOFTWARE (the full web reference is at the beginning of this document). Before a Flight Performance is officially validated, the authority responsible for validation must check that the data in the *.IGC file has originated in a valid way from the Recorder concerned, and has not been altered after it was download from the Recorder to a PC. This is simply done by checking the IGC data file with an authorised copy of the VALI-FIL.EXE short program. The VALI program is on a single file relevant to the Recorder concerned, and the file must have originated from the current FAI/IGC web site for software at the beginning of this document. See Annex B for how to use the VALI program file with any IGC flight data file.

6. **Manufacturer's Changes.** Notification of any intended change to hardware, firmware or software must be made by the manufacturer to the Chairman of GFAC so that a decision

can be made on any further testing which may be required. This includes changes of any sort, small or large. If in doubt, notify the change so that the responsibility for any possible action passes from the manufacturer to GFAC.

Ian Strachan
Chairman, IGC GFAC

Annexes:

- A. Notes for owners and pilots
- B. Notes for Official Observers and NACs

Any Queries to:

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Annex A to Version 3 of IGC Approval, dated 21 March 2000

**NOTES FOR OWNERS AND PILOTS
PART OF IGC APPROVAL FOR FILSER LX20 GNSS FR**

To be read together with the main terms of approval to which this is an Annex. It is recommended that a copy of the approval document including annexes is kept with the equipment concerned, for the use of pilots and Official Observers.

Pilot's Responsibility. It is the responsibility of the pilot to ensure or to note the following:

A.1. **Antenna** - That the antenna is positioned in order to give sufficient signal strength for IGC purposes. No deliberate attempt must be made to inject data via the antenna, and any abuse of this may lead to a future requirement to position antennas out of reach of the flight crew.

A.2. **Geodetic Datum**. Latitudes and longitudes recorded by the FR must be to a fixed Geodetic Datum of WGS84, or the flight data will be invalid for IGC purposes. In LX20 versions before V5.0, it is possible to modify the Geodetic Datum through a password system, and pilots must ensure that WGS84 is set. Once set, or in V5.0 and later, no pilot action is required except to ensure that other lat/long data such as for start, turn and finish points, is also entered to the WGS84 Geodetic Datum (IGC rule).

A.3. **Observing the FR installation in the glider**. The pilot must ensure that an OO has checked the place of the equipment in the glider and how it is fixed to the glider. If it may be difficult to obtain an OO immediately before takeoff, or to witness the landing, you should ask an OO to seal the FR to the glider, and **this can be done at any time or date before flight**. See para 3 in the conditions of approval.

A.4. **Takeoff** - The pilot must ensure that the time and point of takeoff has been witnessed and recorded for comparison with that recorded by the GNSS FR, see para B1.2.

A.5. **Connection to Ports**. Although this approval does not presently require sealing of any ports or plugs, no attempt must be made to pass unauthorised data into the FR. See paras 2.3 and 3 in the conditions of approval.

A.6. **Use in Motor Gliders** (including self-sustainers): The internal microphone and associated circuitry automatically records an ENL (Engine Noise Level) value with each fix. The ENL system is enabled by switching ENL to "Y" for yes in the I-Record screen. This screen is accessed by selecting "FAI LOGGER" and pressing Enter, 4 down strokes to access the I-Record screen, Enter. For more detail, see Annex B, para B.4. The FR must be placed so that engine noise is clearly received when the engine is giving power. It should not be covered or insulated, although even so, automatic gain should continue to ensure high ENL readings under power. Pilots should note that other cockpit noises will produce ENL readings, and avoid those which could be mistaken for use of engine. Generally the frequency filtering built in to the FR will avoid any problems, but it should be noted that side slipping with the cockpit DV panel open can produce a low-frequency sound (organ pipe note) which will register as high ENL, as will spins and stall buffet, particularly in Motor Gliders if the engine bay doors flutter. Flight close to powered aircraft should also be avoided, except for normal aero-tow launches. For ENL levels which have been recorded on GFAC tests, see B4.2.

A.7. **After Flight** - The pilot must ensure that the time and point of landing has been witnessed and recorded for comparison with that recorded by the GNSS FR (see para B2.1). Until an OO has witnessed the FR installation to the glider, the pilot must not alter the installation or remove the FR from the glider. The OO will carry out the actions given in para B2.3, and the OO's copy of the transferred flight data will be sent to the NAC. The OO does not personally have to transfer the data from the FR, but witnesses the transfer and takes or is given a copy on electronic media. Different rules may apply for competition flights, for which a central data transfer facility may be used, but for a flight to IGC record and badge rules, the above continues to apply.

A.8. **Calibration of Barograph Function**. Pilots are advised to have a barograph calibration carried out either by the manufacturer or by an NAC-approved calibrator before any GNSS FR is used for a claimed flight performance. For the procedure, see para B5. A valid IGC-format file showing the pressure steps used in the calibration must be recorded and kept (Sporting Code rule). Altitude and height claims require a calibration for the flight performance concerned, and speed and distance claims need a calibration for calculating the altitude difference of the glider at the start and finish points. Also, the NAC or FAI may wish to compare pressure altitudes recorded on the FR for takeoff and at landing, with QNH pressures for the appropriate times recorded by a local meteorological office.

Annex B to Version 3 of IGC Approval, dated 21 March 2000

**NOTES FOR OFFICIAL OBSERVERS AND NACs –
PART OF IGC APPROVAL FOR FILSER LX20 GNSS FR**

To be read together with the main terms of approval to which this is an Annex. It is recommended that a copy of this approval document is kept with the equipment concerned, for the use of pilots and Official Observers.

B1. Installation and Takeoff Records

B1.1. Installation in the Glider. An OO shall witness and record the position of the FR in the glider, the type and serial number of the FR, the glider type and registration, date and time. Before flight, if requested, the OO shall then seal the FR to the glider in a way acceptable to his NAC and to IGC, and such sealing may be at any time or date before flight. If sealing is not used, either a pre-flight check of the installation must be made after which the glider must be under continuous observation by an OO until it takes off on the claimed flight, or an OO must witness the landing and have the glider under continuous observation until the FR installation is checked. This is to ensure that the installation is correct, and that another FR has not been substituted in the glider before the data transfer (B2.3). See paras 2 and 3 of the Conditions of Approval.

B1.2. At Takeoff. The time and point of takeoff shall be recorded, either by an OO, other reliable witnesses, or by other means such as an Air Traffic Control or official Club log of takeoffs and landings. This will be compared to the FR takeoff data.

B2. Landing.

B2.1. At Landing. The time and point of landing shall be recorded, either by an OO, other reliable witnesses, or by other means such as an Air Traffic Control or official Club log of takeoffs and landings. This will be compared to the FR landing data.

B2.2. Checking the Installation of the FR. As soon as practicable after landing, an OO shall inspect the installation of the FR in the glider (including any sealing to the glider), so that this can be compared to the check described in para B1.1 above. The transfer of flight data shall then take place in accordance with B2.3.

B2.3. Transferring the Flight Data. If a portable PC is available, the flight data may be transferred at the glider without disturbing the installation of the FR; if a portable PC is not available, the OO shall check and break any sealing to the glider, and take the FR to a PC. If the OO is not familiar with the actions required, the pilot or another person may transfer the data while the OO witnesses the process. Security is maintained by electronic coding embedded in the FR which is then independently checked later at the NAC (and at FAI if the claim goes to them).

Method: Connect the PC to the main FR module's data port (4-pin circular connector in the basic LX20, 6-pin RJ12 in the LX20-2000), and use either a current version of the short program file DATA-FIL.EXE, available free from the IGC GNSS web site for software given at the beginning of this document, or through a link from the main IGC/GNSS site. Alternatively, use a current version of the manufacturer's full PC programme "LXFAI", following the instructions given in the menu. The program file DATA-FIL.EXE can be executed on either a floppy diskette or on the PC hard disk. The software version is shown at the top of the menu (see under software on page 1, which gives the relevant versions). This program file executes in the normal way such as either by typing at a DOS prompt "DATA-FIL, enter"; or by double-clicking "DATA-FIL" in a Windows file list (File Manager for W3x, Windows Explorer for W9x, W2000). If settings such as the COM port, Baud rate, etc. need to be changed, the help menu is accessed by typing the file name, space, hyphen, then the letter h. Finally, the FR has to be set to Connect mode in order to download data to the PC, this is done by pressing the WRITE button and the LCD shows the Baud rate and a 10 sec countdown during which the data transfer may start.

This process will automatically produce both a *.FIL binary format file and an *.IGC-format flight data file with the file name YMDCXXXF.FIL and YMDCXXXF.IGC, where Y=year, M=month, D=day, C= manufacturer, XXX = FR Serial Number/letters and F = flight number of the day (full key, Appendix 1 to the IGC GNSS FR Specification, copied in Annex C to the Sporting Code, SC3C).

OOs Copy. A copy of both the *.FIL and *.IGC files shall be retained securely by the OO such as by immediately copying them to a separate diskette or PC card, or by the use of the OO's own PC. These files shall be retained by the OO in safe keeping for later checking and analysis under NAC procedures.

Storage media. The OO may keep the required data files on a floppy diskette or other industry-standard portable storage media. The hard disk of a PC may also be used but the OO must be able to positively identify the flight data files as being from the flight concerned.

Competitions: Different rules may apply for competition flights, for which a central data transfer facility may be used, but for flights to IGC record and badge rules the above must be followed.

B3. Analysis of Flight Data Files. A Data Analyst approved by the NAC will then evaluate the flight using an analysis programme approved by the NAC concerned (list, see the IGC GNSS web site under SOFTWARE). In addition to checking flight data, an authenticated version of the file VALI-FIL.EXE shall be used by the NAC and by FAI (if the data goes to them) to check the electronic security coding, that the FR had not been interfered with, and that the flight data in the *.IGC file has not been altered since it was transferred from the FR. The version number of the VALI file is shown at the top of the screen when the file is executed. The latest version of VALI-FIL should be used and is available from the IGC GNSS web site for software given at the beginning of this document.

Method: at the appropriate prompt or run function, type VALI-FIL.EXE followed by a space and the name of the file to be checked. The message "Integrity is OK" should appear, not "Integrity is NOT OK" (in the latter case the NAC or other validating authority must investigate the reason). Both the *.FIL and *.IGC flight files should be checked by this method. It should be noted that GFAC tests include ensuring that the change of a single character in an otherwise-correct IGC file, cause the VALI program to fail as indicated above.

B4. Means of Propulsion (MoP) Record - Motor Gliders. The MoP must either be sealed or inoperative, or the built-in microphone system used. The microphone and filtering system records an ENL value with each fix up to a maximum of 999. ENL values recorded on GFAC tests are given below, in the sequence of a flight.

B4.1. ENL during launching. During winch and aero tow launches, higher ENL values are to be expected than when soaring (B4.3), typically up to ENL 300 for winch and 200 for aero tow. On one winch launch an ENL reading of 450 was recorded, probably a fast launch with sideslip.

B4.2. ENL during engine running. On engine running at powers needed to climb, an increase to over 700 ENL is expected. Over 800 is typical for a two-stroke engine, over 700 for a 4-stroke. An ENL value of 905 has been recorded with a two-stroke engine running at full power. During engine running, these high ENLs are produced for a significant time, and when altitude and speed are analysed it can be seen that substantial energy is being added, which can therefore be attributed to energy not associated with soaring. The values quoted above are for 2- and 4-stroke engines, Wankel (rotary) and electric engines have not been tested. There is no reason to believe that Wankel engines will not produce similar values to 4-strokes.

B4.2.1. Electric Power. If an electric engine is to be used, please contact GFAC as soon as possible so that tests can be carried out.

B4.3. ENL during gliding flight. ENL readings of less than 050 indicate normal gliding flight in a quiet cockpit environment. In a high-speed glide or in an aerodynamically-noisy

glider, ENL may increase to about 100. Short periods of higher ENL while gliding (up to about 300 ENL) may indicate aerodynamic noises such as due to airbrakes, lowering the undercarriage, sideslip, etc, and are normal before landing. Particularly, sideslip with the cockpit DV panel open can produce low frequency noise ("organ-pipe" effect) and ENL readings of up to 395 have been recorded. High ENL may also be recorded during stalling and spinning, particularly if the engine doors flutter or vibrate (move slightly in and out due to stall buffet, producing a clattering noise). A value of 477 has been recorded in a spin. Finally, where the engine is mounted on a retractable pylon, a high ENL reading will be shown if flying with the pylon up and engine not running, due to the high aerodynamic noise.

B4.4. ENL during the approach to land. ENL values are always higher on a landing approach due to aerodynamic noises such as due to airbrakes, undercarriage, sideslip, turbulence, etc. Short-term peaks due to specific actions such as opening airbrakes, lowering undercarriage, etc., will be noted as well as a generally higher level of ENL because the glider is no longer aerodynamically clean. ENL values of up to 400 have been recorded, although 200 is more typical in an aerodynamically noisy glider, and 50 in a quiet machine.

B4.5. ENL during landing. During ground contact during takeoff and landing, short-duration ENL readings up to about 550 have been recorded due to wheel rumble. Unlike engine running these last only for a short time, showing a short spike on the noise/time trace.

B4.6. ENL analysis. It is normally easy to see when an engine has been running and when it has not. Other data such as rates of climb and groundspeed, will indicate whether or not non-atmospheric energy is being added. Short term peaks in ENL (10 seconds or so) may be due to the other factors mentioned above such as undercarriage and/or airbrake movement, sideslip, open DV panel/sideslip, the nearby passage of a powered aircraft, etc. If in doubt, email the *.IGC file to the GFAC Chairman for further analysis and advice (see earlier for email address).

B5. Altitude analysis and calibration. The FR can be calibrated in an altitude chamber in the same way as a drum barograph. After the calibration, the data containing the pressure steps used, is transferred to a PC as if it was flight data (see B2.3 above). The IGC format data file for the calibration will then be analyzed and a correction table produced of true against indicated altitudes. This table can then be used to adjust pressure altitudes which are recorded during flight performances and which require correction for validation to IGC criteria. These include takeoff, start and landing altitudes for altitude difference and for comparison with independently-recorded QNH readings, and low and high points on gain-of-height and altitude claims.

B5.1. Original LX20 model. With versions up to 2.4, the password 36774 has to be inserted to start the unit recording without a GPS lock. From Version 3.0, no password is needed (although the password system is not disabled and can still be used) because recording starts when a pressure change is detected of 1 m/sec for 5 sec. When the pressure-change system is used, a normal IGC file header record is produced and the pressure altitudes are recorded at whatever GPS fix rate has been set. If the password system is used, pressure altitudes are recorded at one second intervals but an abbreviated header record is produced which does not include the FR type, and the serial number is translated into numerals from the 3-character serial in the file name. If the password mode is used, the missing details must be included in the written record of the calibration. Pressure altitudes are recorded up to 13 km (42,651ft). The maximum pressure altitude tested by GFAC was 40,000 ft (12,192m).

B5.1.1. GNSS altitude. This is recorded up to 60,000 ft (18,288m) with the Koden and Motorola GPS receivers.

B5.2. LX20-2000 model. No password is needed (although the password system is not disabled and can still be used) because recording starts when a pressure change is detected of 1 m/sec for 5 sec., and no GPS fixes are required for a pressure altitude trace to be produced. Pressure altitudes are recorded up to a pressure of 300 mb (30,030ft or 9153m). When the pressure-change system is used, a normal IGC file header record is produced and the pressure altitudes are recorded at whatever GPS fix rate has been set. If the password system is used, pressure altitudes are recorded at one second intervals but an abbreviated header record is produced which does not include the FR type, and the serial number is translated into numerals from the 3-character serial in the file name. If the password mode is used, the missing details must be included in the written record of the calibration.

B5.2.1. GNSS altitude. This is recorded up to 60,000ft (18,288m) with the Marconi Canada GPS receiver, and also to 60,000ft with the Ublox (Switzerland) GPS receiver.

5.5 Revision status

Date	Changes
30.11.2000	First Edition
07.12.2000	4.4 new
13.07.2001	2.1.4.5
22.11.2003	2.1.3; 2.2.2.3 new; 3.1.6 new.