LK 8000

Tactical Flight Computer

Handbook

for version 3

last change, kli - 10/08/12

1 Preface

Preface for version 3

Since the release of LK8000 version 2.2 nearly a year has gone and the free navigational program further and increasingly delights the soaring community. Lot of suggestions from the community and the ideas of the developers led to a further rapid development which culminates in this intermediate version 3.0 but lots of new ideas are still there!

The art of program development is not to add endless features but to give the pilot **a true and easily to exploit help** at hand and this became real with version 3.
The fact that the program despite more functionality became smaller, more responsive and that it works without problems also on older hardware is the achivement of the small developer community and especially of Paolo, who led the project carefully and reliably (rem. Kli).

The new features are outstanding, the new airspace analysis and the logbook will please every pilot.
The usage of the program was improved again and became more intiutive.

Apart from useful default options lots of indivual choices can be made so that no one will be confronted with unwanted informations. But if one needs informations he can choose from a rich assortment.

The aids for the competition are refined and hence decisions can be made more reasonable again.

Paolo Ventafridda, Ernst-Dieter Klinkenberg

03/2012

Preface for version 2.2

Satellite positioning, and the availability of powerful portable computers have significantly influenced all forms of flying, including sporting flight. These technological advances allow pilots to have a large amount of flight information immediately available, which in turn helps improve both safety and performance.

The constant increase in available compute power has been accompanied by increasingly sophisticated flight software (programs) for assisting flight. As well as commercial software, free software has become available that have been developed through collaboration over the internet. The quality of this software has steadily been growing, such that it is currently at a high level. The constant exchange of experience and ideas between the user community, and the developer community (many of whom are themselves pilots) has been the foundation of the rapid improvement of such programs.

LK8000 is one such program, which is available as a free download over the internet, and which is constantly being improved by the developer and user communities.

Note (Kli): of course the involvement of contributors varies. ***Paolo Ventafridda*** *has made an outstanding contribution to LK8000, being the sole developer for versions 1.2 and 2.0.*

Version 2.2 of LK8000 is a mature "flight computer" program, which allows sailplane, parafoil and hang-glider pilots to enjoy both relaxed flying, and the more demanding competition flying for both ladder-style and event-style competitions.
Furthermore, experimental customisations have been started to accommodate pilots of General Aviation (GA) and microlight aircraft.

Paolo Ventafridda, Ernst-Dieter Klinkenberg

09/2011

2 Versions handbook

Handbook LK8000 version 2.2, 2011 (c) P. Ventafridda, E.-D. Klinkenberg
Handbook LK8000 version 3.0, 2012 (c) P. Ventafridda, E.-D. Klinkenberg
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Open tasks:

- Glossary, to be extended
- Index, to be extended

3 Content

4 Introduction

LK8000 [LK8000] is a navigation and flight planning program. Its roots lie in the open-source program called XCSOAR [XCSoar], which was developed especially for cross-country flying in sailplanes.
The quality of open source software is highly dependent on the level of engagement of the developers. However, differences of opinion on the areas requiring attention can lead to so-called forks in the code and in some cases to the spawning of new projects.
Paulo Ventrafridda [Ventaf], who had been an active developer on the XCSOAR project, was unsatisfied about the quality and the organisation of the project. So he started his own private effort, to re-work the XCSoar source code, re-factoring, partially correcting, and adding features. Early examples of Paulo's custom versions were initially only available to friends, but started to become an insider tip on the gliding and parascending scenes, due to the quality of the software. The success of these custom versions, and his differences of opinion with the rest of the XCSoar team convinced him to branch his developments into and independent project.
Up until version 2.0, **LK8000** has been a single person project, except for small contributions and internationalisation (language translations).
So what is special about this project? Paolo, himself an active sailplane pilot, wanted to develop a program for himself which would make good use of the capabilities of modern hardware and especially allow consistent usability in turbulent conditions. His guiding principle was and is:

„Cockpit software - NOT hangar software“

Consequently all information should be displayed appropriately in flight, and the software should not be difficult to use in flight (Note: DT – some software requires pushing small parts of the screen with a stylus to make adjustments or access information. It's amazing even during seemingly level and normal flight how hard it is to touch the right part of the screen – as required by some software out there, and not get jogged into clicking something wrong). It goes without saying that the software should have all the useful features of modern cross-country soaring programs.

There are many devices which are capable of running the software, most of which were not originally intended for use as flight computers: devices such as Personal Navigation Assistants (PNAs – typically car navigation devices), Personal Data Assistants (PDAs), and Smartphones. Appropriate hardware requires: a touch sensitive screen, an GPS-receiver, and the ability to interface to other devices (Note: DT – typically other flight information sources, such as FLARM for collision avoidance information and location of other aircraft, or variometers, which are capable of providing wind speed and direction).
Such devices tend to run on a Windows CE operating system or some Linux

derivative, such as Android.
Although the code is essentially portable, the program currently **only supports devices running Windows CE** or a desktop version of Windows (e.g. Vista, XP).
PNAs (simply 'car GPS' or just 'GPS') are a very popular amongst drivers, and the size and competition within the market has driven constant innovation and low prices. **LK8000** is principally targeted at these touch-sensitive devices, and optimised for landscape display.
This brings us to the question of what LK8000 actually does for pilots. That is pretty much the subject matter of this manual, but here is a summarised feature list.

Navigation

Map – with multiple configuration for positioning and movement
Waypoint selection, alternative waypoints, display of landable locations
Airspace
Heading, track, track correction
Wind strength and direction – internally calculated or available from external data-streams
Times and distances

Flight

Speed
Height, variometer, centring in thermals
Speed To Fly
Virtual instruments
Final glide

Information

Information pages
Information buttom bar
Alert tone configuration

Competition

Speed To Fly
Tasks
Logger
Real time optimization for OLC rules
Start gates and times
Flight analysis

Interfacing

FLARM
Loggers – with task declaration
Intelligent Devices (e.g. varios)
Condor flight simulator

Special functions for sailplane and hang-gliders

Permanent optimization of flight path

GA - Mode

Simulation Mode

IGC file replay
FLARM simulation
flight simulation

There is an underlying aspiration that all the above functionality should be accessible as simply and consistently as possible.

Further good ideas are always welcome!

5 How to use this handbook

This manual will never be fully complete and up-to-date, since it will always be lagging behind the development. Thus you can expect to see a few of these building site icons.

The icon will be used to denote parts of the manual which are in progress.

ALTERNATIVELY: please send additions, corrections, alterations to:
d.klinkenberg@gmx.net

The stop sign denotes important sections in the manual, the understanding of which is *essential* for the proper use of the program.

All software has certain gotcha's or pit-falls, and the general warning icon below is used to highlight these areas.

A few sections use diagrams to illustrate or explain points, and these are denoted by the information icon below.

6 Quickstart for the impatients

Requires prior knowledge!

To get a first impression of the software, it is probably best to run the Windows PC version. To do this you need to unzip the LK8000 download zip file, and place the contained LK8000 folder in the root of your windows home directory, and then run the *LK8000-PC.exe* executable inside that. The full path to the executable should be something like *C:\Documents and Settings\<user-name>\My Documents\LK8000\LK8000-PC.exe*. This path is important as the program uses path structures relative to your home director in order to find the data files which reside in its LK8000 directory.

The program is supplied ready-to-run with sample data. The sample data does not cover a large geographical area, and since there is no GPS receiver in most PCs, you will need to run the program in simulation mode.

Once you feel you are familiarized, you are ready to to install the software on your mobile device. This quick-start guide assumes you will be using the internal GPS receiver in your device, and **not** an external GPS-source.

6.1 Devices

The current requirements on devices are as follows:

- **Windows CE 4.2, 5** and **6** Operating System (OS) with some way of accessing the OS. (even using unlock...)
- a touch-sensitive screen
- an internal GPS receiver which is available to the OS on a (possibly virtual) serial (RS232) port (com-port?, Baud-rate?).
- Expanded file storage capabilities, say with SD or micro-SD cards

A good deal of the current in-car navigation devices (GPS to the punter) fulfil these criteria. For more complex set-ups, such as hooking up FLARM and intelligent varios; the Input/Output (I/O) capabilities (USB, Bluetooth, RS232) of your device become important. If you intend to interface to these external devices, then you should evaluate your device purchase carefully. The forums are a good source of information, as new hardware is often being discussed.

6.2 Needed files

The following files need to be installed:

The program itself (the zip file)

Data files:

Maps and Topology (.LKM and .DEM files)

Airspace (open air format)
Waypoints (cups, dat or compGPS)

All the above data files can be downloaded from the LK8000 homepage for various countries. For smaller regions you can possibly get higher-resolution maps.

6.3 SD-card

Since the software is generally installed on such flash memory cards, the speed and reliability of these cards is important. Slow memory cards have a marked effect on performance, and since 90% of all speed issues are with these cards you should not skimp in this area, and **get a fast card of a premium brand**.

6.4 Installation on SD-card

The best way of doing this is to copy the files over to the memory card using either a built-in card-reader, or a card reader which is directly linked (say over USB) to the PC.

Warning!!!

Writing files to the card whilst it is hooked up to your running device is error-prone!

The contents of the LK8000 directory are copied to the root of the memory card. The various data directories are available at the same level as the executables, so that in the same directory as you have the LK8000 PNA.exe you also have the following directories:

- _Maps, containing the maps and topology (.DEM and .LKM) files
- _Airspaces, containing the airspace files
- _Waypoints, containing the waypoints a.k.a. Turn-points
- _Polars, if you have a specific polar file for your glider (a selection is built-in to LK8000)

6.5 Programm start

If you have access to the file system then you can start the program directly from the memory card. For many devices especially PNAs it may not always be easy to get to the file system. As part of your preparation to use the software, you should find out how to access it on your device. There are tips on the internet on how to do this for almost every device, and often there are special “unlock” programs.
The program starts into landscape screen, more on graphics and supported resolution, in the **chapter** "Detailled installation".

6.6 Quick configuration

After starting the program in the device, open it in simulation mode, click Simulate, next click on the airplane icon (bottom right) and the main menu appears. Click on Config twice to reach Config 2/3. Next click on the SETUP System and the configuration pages appear.
On page 1 Site click on the “Language” field and choose the required language with a click (e.g. English.LNG). With a click on Select the choice is confirmed and the screen returns to Configuration page 1. After clicking on Close a confirmation of the selected language appears. After the restart the new language is set.

To continue with the configuration process, you must return to the system configuration page 1 Site via

aircraft symbol ▶ Config ▶ Config 2/3 ▶ SETUP System.

There, the originally selected demo-files are shown:

Map file	DEMO.LKM
Terrain file	DEMO.DEM
Waypoints 1	DEMO.cup
Waypoints 2	---
Airspace 1	DEMO.txt
Airspace 2	---

To change this demo-set up the files (map, airspaces, waypoints) for your area which you have downloaded previously. You have to click on each line e.g. Map file then click on required file to highlight it and click to Select.
Do this for each file to be changed and then click Close.

At configuration page **7 AIRPLANE** you select the main aviation mode [Glider, Paraglider/ Hanglider, GA-plane]. Polars for a large number of glider are also available be selected on this page. If neccessary, you can also load your own custom polar file which you placed before in the subfolder _Polars on the SD-card and in every case you have to set $v_{rough\ air}$, handicap and ballast dump time.
After you have set all the parameters and data you can save the airplane-profile.

The configuration of the internal GPS receiver can be set on configuration page **8 DEVICE**.

If the port number and baud rate shown in the configuration of the existing road navigation program. Try these first, before change these numbers.
If this does not work it can be a real pain(**!!!**) to find the required “com port number” and “baud rate”. Try first changing the number by trial and error

You can also try the provided program GPSScan.exe from the _System/CE Utilities folder. **But** again, in the internet (almost) all this information is available. The GPS interest groups are very active in this field. An inquiry in the LK8000 forum is also worth your while.

In configuration page **20 LOGGER** you can enter the pilots personal data and save the pilot-profile.
For a program test flight, these values do not need to be entered, the program is configured with default values.

As a last step you set the home airfield (or a temporary start place). For this you leave the system configuration and choose the home field via the waypoint list

aircraft symbol ▶ Nav ▶ Waypoint Lookup

Within the list you choose waypoint [Select] and then [Details][Next][Next] and [Set as new Home].

In simulation mode the glider symbol jumps immediately to the selected place.

For a simple flight the program is now configured, the default parameters are set. If you leave the program the configuration is stored. You can also save the configuration to a named file, more about this later.

After a restart the program you click on [Fly]-mode, and set the basic data with

aircraft symbol ▶ Config ▶ Setup Basic

Now, after the navigation device has obtained a GPS fix a flight to test LK8000 can be undertaken.

You can also test the program by taking a drive in a car (aircraft category: car).

7 Computers in recreational flying - What can you expect ?

With the GPS information the accurate **time (t**) and the current **position (s)** is available. The accuracy of location may vary and the difference can amount to several meters.

7.1 Time-dependent information

In conjunction with its flight computer, this means that all flight relevant times **t**, time difference **Δt** and time related information are available such as:

UTC time, local time
Sunrise, sunset
Take off time, landing time, flight time, flight duration
Rising time/duration rise time
Sinking time/duration
Engine running time, engine warm-up time, engine cooling time
Fuel remaining (with the known limitations)

7.2 Location-dependent informations

The GPS signal from 4 satellites delivers the three dimensional spatial information **s**

$$\vec{s}=\vec{s}(x,y,z)$$

giving the position above ground

$$\vec{p}=\vec{p}(lon,lat)$$

and the GPS altitude

$$h=h(z)$$

In conjunction with the chart this gives a ground position and the altitude can be estimated with a terrain height information.
But specifically with the altitude information consideration must be given to possible deviations !

7.3 Directly to calculate flight informations

Due to the constantly available real time site information

$$\vec{s}(t)=\vec{s}(x,y,z,t)$$

a number of kinematic and dynamic flight informations are directly available:

Speed through the air	$\vec{v}=\frac{d\,\vec{s}}{dt}$
Energy	$E=\frac{m}{2}\lvert\vec{v}\rvert^2$
Speed over the ground	$\vec{v}_g=\frac{d\,\vec{s}_p}{dt}$
Climb speed	$\vec{S}=\frac{d\,\vec{s}(z)}{dt}$
Load factor	$g=\frac{d^2\lvert\vec{s}\rvert}{dt^2}$

Since GPS signals are only available at discrete time steps are evaluated in seconds hence the flight information provided is not as exact as the values indicated by specialized instruments (airspeed indicator, vertical speed indicator, altimeter) and therefore informations from these instruments should be used if available.

7.4 Navigation functions

For navigation the following informations for calculations are thus available

Path	**s**
Position	**p**
Height	**h**
Speed	**v**
Ground Speed	$\mathbf{v_g}$
Climb rate	**S**

In addition following data are used

- an electronic map with topological markings
- terrain elevation profil
- airspace data
- airplane performance data

With these information and data, and known flight modes additional flight information can be calculated.

One of the most important of these is the wind direction and speed at the height of the flight.
These wind values can be calculated with various methods. Known is the usage of drift during circling flight but also the offset during a zig-zag flight can be used
In addition, a method is applied in LK8000 that uses the drift during a predetermined straight flight (TrueWind).

The **true course** to the target is developed from the way point coordinates on the map which stem from directly selected way points.
While the **position** is directly available from the GPS signals, can the wind driven **course corrections** be established with the specific Wind values, the true course, the course over ground and the speed with established calculations.
The estimated flight time and estimated time of arrival at the target are calculated with the position and ground speed.
The display on the high resolution moving map should be well readable and clear.

7.5 Flight tactical functions

For soaring flight or paragliding a number of additional parameters have to be considered.
Depending on the actual height together with the wind and the aircraft performance data a gliding radius can be established in which a possible landing field should be available.
In connection with the electronic map can the computer suggest for each position a known possible landing field and hence relief the pilot from looking for it.
If there are obstacles in the glide path the required height gain to cross such obstacle can be shown and if required an alternate route can be suggested.
Obstacles can be terrain obstacles or restricted airspace
When restricted airspace is approached this should be detected and the pilot be warned to take appropriate action.

For cross country flights the best **speed to fly** is calculated
If there are changes to the sailplane performace e.g. releasing water ballast a modified speed polar has to be allowed for.
The **final glide** mode is used for waypoints as well as for the goal.

The evaluation of information from a **collision warning** instruments can only take place in an informative way.

REACT IMMEDIATELY TO COLLISION WARNINGS!

7.6 Competition support

Navigation and tactical support is provided for competition tasks. The achieved times, remaining times and speeds are continuously available.
For the decentralized competitions a real time calculation of the expected flight results is possible and allows the optimization of the flight path.
The flight and partial flight data of other planes are for information available.
Team flying is supported through coding and decoding of position data.

7.7 Flight documentation

The flight computer also records the flight information. A program logger records the flight in IGC format.
In flight preparation check lists can be read back and other data like phone numbers are available.
After the flight the fundamental flight data can be logged into an electronic logbook.

7.8 Operation

Besides the required functionality an uncomplicated and logical operation is expected, in order to get a true help in the cockpit. Therefore optical as well as acustic information is provided.

Almost all above mentioned requirements are available in LK8000 or are in development !

8 Program start behavoir

The start up of LK8000 is for different hardware configurations nearly the same. But in practical usage occur differences through the coupling with external devices due to the additional available parameters. For the explanation of the program characteristics and the description of its use we start with the simplest configuration.

8.1 *Assumed hardware*

Figure 8.1: PNA WayteQ 950BT HD and accupack 5,2 Ah

In **fig. 8.1** the **minimum hardware configuration** is presented. A PNA and a battery pack, here an actual (2011) portable navigation assistant (PNA) Wayteq 950BT HD (Windows CE 6) and a lithium-polymer-battery pack 5V, 5.2 Ah. This PNA has a 5 inch display, a SIRF-II-GPS- receiver, a (micro-)SD-slot and an USB-port also for the connection of the battery pack.

The program and the required data must be installed **externally (!)** on the SD card. Then the SD cards is inserted into the PNA, with the program starting as LK8000-PNA.exe, on this device with a bypass directly from the SD card.
The program start up can be different on other devices. Help for specific devices can be obtained in the forum or through an internet search.

8.2 *Start up menu*

LK8000 starts showing a clickable selection menu, cf. **fig. 8.2**. The user now can select the required program modus or configuration options.

[Fly] will activate the internal GPS and the program will start with the last used profiles, (the last stored configuration).

[Profile] leads into a profile selection dialog, cf. **fig. 8.3** where the aircraft profile, the system profile and the pilot profile can be choosen, see **fig. 8.4.** After a profile is choosen, see **fig. 8.5** the start process can be continued via the [Fly] or [Simulation] buttons.
If now profiles are selected the last stored configuration will be used.

[Simulation] In this mode the GPS is disabled. One can use the internal flight simulation or make configuration settings, formulate tasks to familiarize with the program....as will be explained later.

[Exit] closes the program**.** The device returns to the starting point within the operation system.

Figure 8.2: Start menu

Figure 8.3: Profile menu

Figure 8.4: Aircraft profile selection

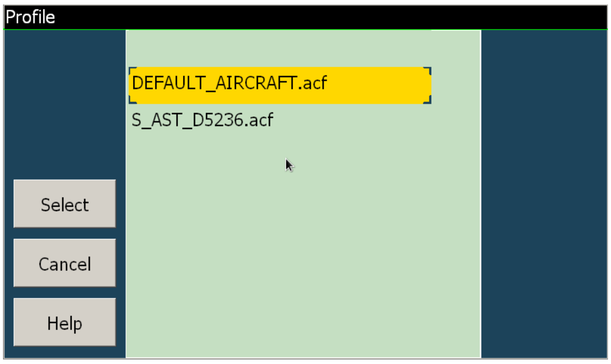


Figure 8.5: Choices of aircraft profiles

8.3 Program start up messages

After the profiles and the program mode are selected the program loads the required data, the loading will take several seconds depending on the data size.
The click to start the program is not required as it will start automatically after 3 seconds into the map mode, **fig.** 8.6.

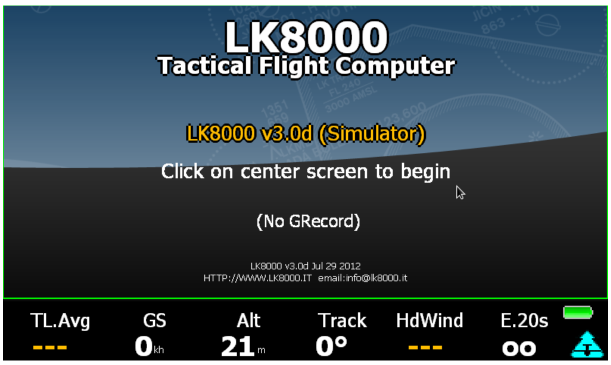


Figure 8.6: Start screen

8.4 *Start up protocol*

The whole program start up process will be logged into the file **RUNTIME.log** which is located in the LK8000 folder.
A regular start is hown below.

Content of the RUNTIME.log-file (example):

```
[000000571]
------------------------------------------------------------
[000000571] . Starting LK8000 v3.0a Feb 15 2012 PC
[000000572] . Free ram=2097151 K  storage=564320 K
[000000573] . InitLKScreen: 800x480
[000000574] . Language load file: <c:\windows\profiles\kli\Eigene
Dateien\LK8000\_Language\ENG_MSG.TXT>
[000000803] . Language load file: <c:\windows\profiles\kli\Eigene
Dateien\LK8000\_Language\GER_MSG.TXT>
[000000826] ... Fillup language MSG starting from pos.1648
[000000826] . Language fillup load file: <c:\windows\profiles\kli\Eigene
Dateien\LK8000\_Language\ENG_MSG.TXT>
[000000839] ... Fillup Loaded 9 missing messages
[000002697] . Loaded menu <c:\windows\profiles\kli\Eigene
Dateien\LK8000\_System\DEFAULT_MENU.TXT>
[000002715] . Loading polar file <c:\windows\profiles\kli\Eigene Dateien\LK8000\_Polars\Astir CS.plr>
[000002716] . Loading Terrain...
[000002716] . Terrain size is 3594240
[000002727] . ReadWayPoints
[000002728] . Unknown WP header, using format 2.  Header: <"Aac 1Zl
Aachen",AAC1ZL,DE,5048.850N,00611.483E,189.0m,1,,,,
>
[000002895] . Total 6285 waypoints
[000002897] . LoadRecentList: loaded 2 recent waypoints
[000002898] . open AirfieldFile <c:\windows\profiles\kli\Eigene
Dateien\LK8000\_Waypoints\WAYNOTES.txt>
[000002906] . HomeWaypoint set to <Purkshof Rostock> wpnum=4555
[000002907] . Loading terrain tiles...
[000002908] . Reading airspace file
[000002942] . Now we have 408 airspaces
[000002943] . No airspace file 2
[000002948] . Settings for 408 of 408 airspaces loaded from file <c:\windows\profiles\kli\Eigene
Dateien\LK8000\_Airspaces\AspConfig.LK>
[000002948] . OpenTopology
[000003115] . LKMAPS Advanced Topology file found
[000003115] . FlarmNet ids found: 0
[000003115] . OpenFLARMDetails: "[000003116] c:\windows\profiles\kli\Eigene
Dateien\LK8000\_Configuration\IDFLARM.txt[000003116] "
[000003117] . Local Flarm ids found=2
[000003117] . Device A is <Generic> Port=COM1
[000003117] . Device B is DISABLED.
[000003219] . ProgramStarted=InitDone
[000003640] . GCE_STARTUP_SIMULATOR
[000003641] . DefaultTask assigning Home (wp=4555) as default destination
[000003642] . ProgramStarted=NormalOp h21:27 (UTC 20:27)
[000003643] . Free ram=2097151 K  storage=564356 K
[000004139] . LoadNewTask <c:\windows\profiles\kli\Eigene Dateien\LK8000\_Tasks\Default.tsk>
```

(This content was written after a start of the PC-version in simulation mode.)

8.5 Start up map display

With the start up in the map display is the actual program start up finished. The internal and external communication is initialized, specifically the GPS data are awaited. If they are not immediately available the map for the area around the home field is displayed, here EDXC see **fig. 8.7.**

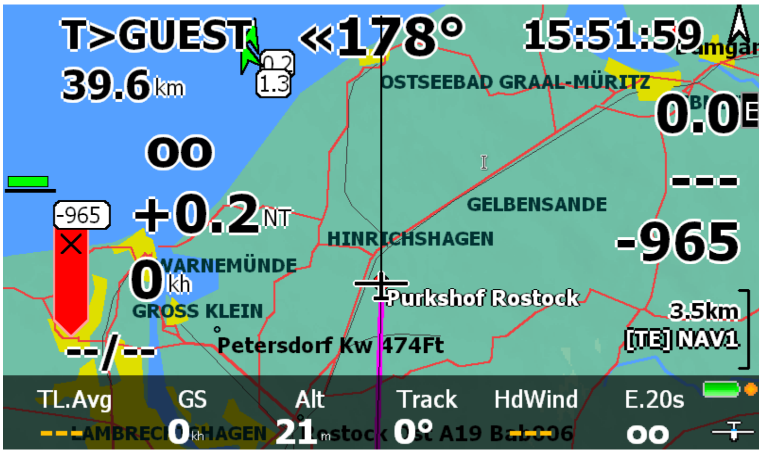


Figure 8.7: Start map screen, home field is displayed, here EDCX

The map display data are slightly moved as soon as the GPS data are available. As can be seen the plane is on the ground and some values are not set and still not available.
The standard display can be better explained with the display in flight, cf. **fig. 8.8.**

The touch sensitive map display is overlayed with a number of informations, a transparent foot bar, graphs, symbols and alphanumeric values. Their meaning one has to memorize. Regular abbreviation are at times further shortened e.g "km/h" becomes "kh". Important values are large and prominent displayed. Their colour can be inverted (explained later).
As display space, is needed for this, the information, in addition to the basic information, required by the individual pilot can be configured, (explained later).

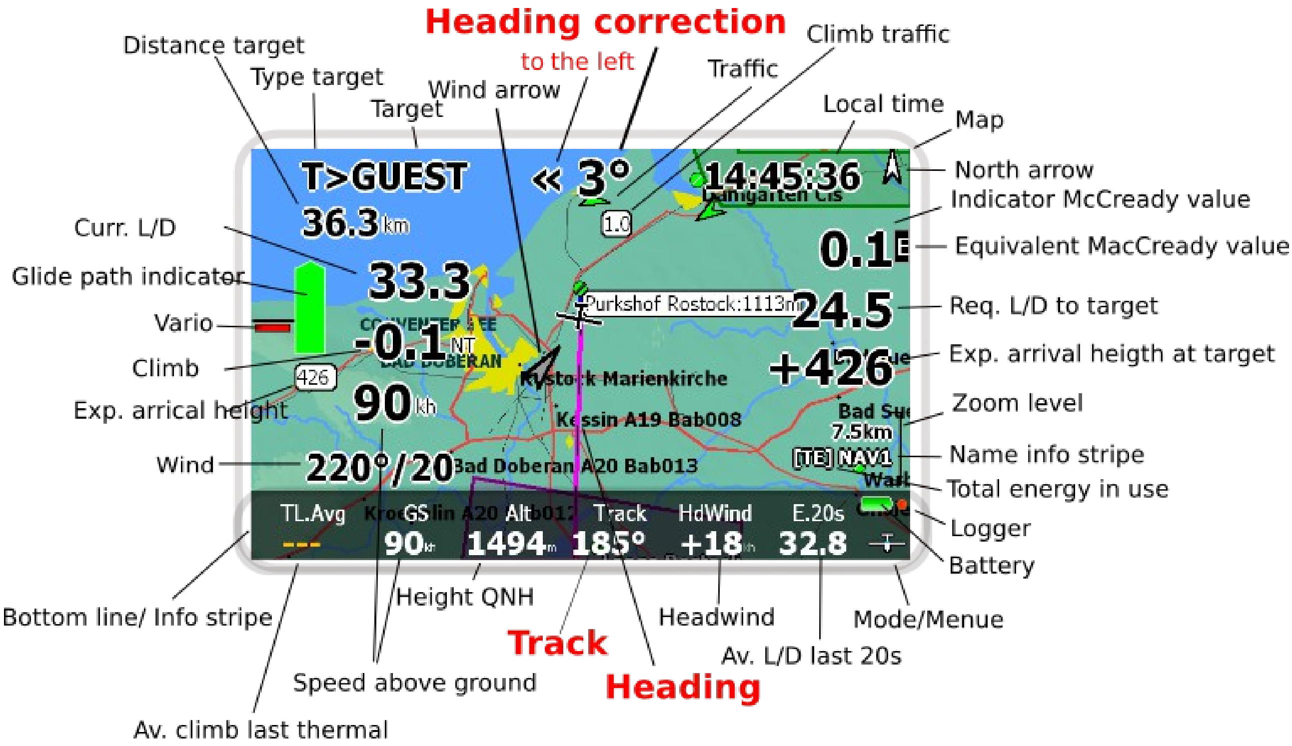
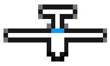


Figure 8.8: LK8000 in cruise mode

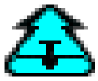
8.6 *Icons for different flight modi*

(same time soft key for the main menu)

Mode **Gliding *cruising,***
power plane, car

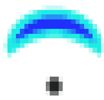


Mode **Gliding *final***
power plane, car

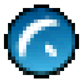


Mode **Gliding *thermaling***
power plane, car

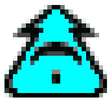
Mode **Paragliders/**
hang gliders *cruising*



Mode **Paragliders/**
hang gliders *thermaling*



Mode **Paragliders/**
hang gliders *final*



9 Turbulence safe operation

An important part during the development of the touch screen display of the LK8000 was to simplify the operation of the program in the cockpit. The aim was a quick and safe operation to obtain the required information which was found in a new user friendly concept.

The operation of the program is almost entirely based on touching the screen without the use of a stylus. Specific areas on the screen are used to obtain specific actions. The length of time of the touch or swipe are also considered as to the required action.

9.1 Display modes

The program has two main display modes, the map mode, see **fig. 8.8** and the information pages display, see **fig. 9.1**. These can be switched as required. The information mode consists of three main pages and several sub pages.

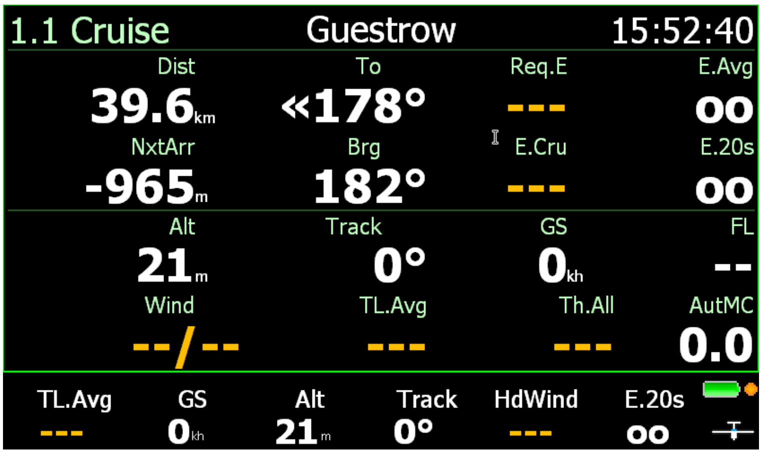


Figure 9.1: Information page 1.1

9.2 Screen display areas

In the map display are the touch sensitive display areas available as shown in **fig. 9.2**.

In the map display are touch sensitive areas, in the left and right upper corners two, in the centre two for zooming.
The four areas in the foot bar are always available, as the foot bar is available in all display mode.
Because of the large size of the areas is it possible to click them with the fingers, which is particular important during turbulent flight conditions.

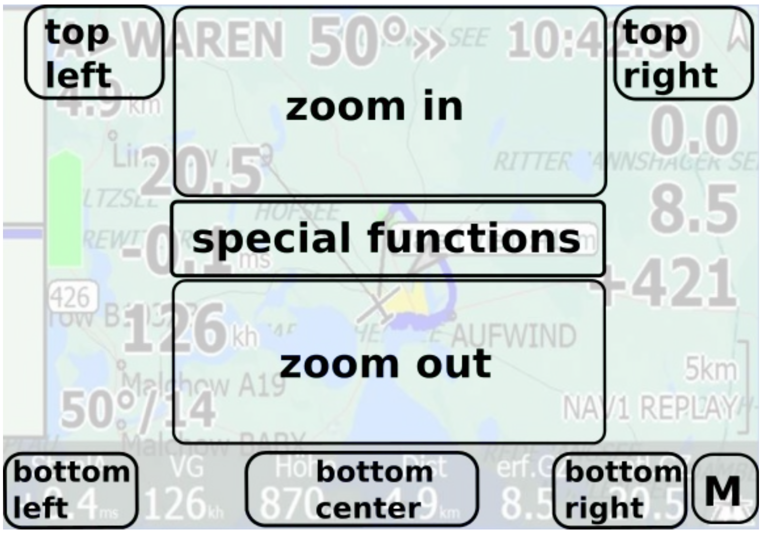


Figure 9.2: Touch sensitive areas in the screen mode

The smaller area "**M"** opens the menu which also leads touch sensitive areas but in a different layout.

9.3 Click types

Touching the screen is **clicken**, a short touch is a **click.** The length of the touch can be used to control the program.
Longer clicks take about 0.7 second, with the duration to be configured.

9.4 Gestures

Touching the screen and then stroking in one direction and then releasing the touch is called a gesture. Used gestures are the stroking from left to right and from top to bottom and vice versa.

9.5 Configurable touch screen displays

Some displays on the screen are configurable in other words required actions can be configured. For this longer clicks are used.

9.6 Blind clicks, acoustic scheme

Clicks are accompanied by specific sounds. As pilot one can by the type of sound determine at which program point the click occurred and with some practice one knows which program reaction is expected. Hence the acoustic scheme allows a blind operation.

9.7 Rotating information pages and map

With the middle touch point on the foot bar the rotation from the map through the information pages can be controlled, cf. **fig. 9.3**.

Figure 9.3: Rotating switching from map through the info pages

Through a different sound one knows if the display is on the map page or which info-page is displayed. By clicking on the middle part of the foot bar, the stack of information pages and the map rotate.
This method of rotating informations is being used on several occasions in the program.

10 Information delivery concept

The pilot can access informations

- in the **MAP display**
- **as flight parameters in the foot bar**
- on **information pages with sub-pages**
- in **analysis pages**
- **over the menue**
- through **blended in messages**
- through **sounds** and
- by **voice messages.**

The multitude of informations can also be differently configured via the system configuration which will be detailed explained in **chap. 25**.
Right now we will only show the available possibilities.

10.1 Map display

The map display exists in two different configurable modes
in **cruise/final, fig. 10.2** and **circling, fig. 10.1.**

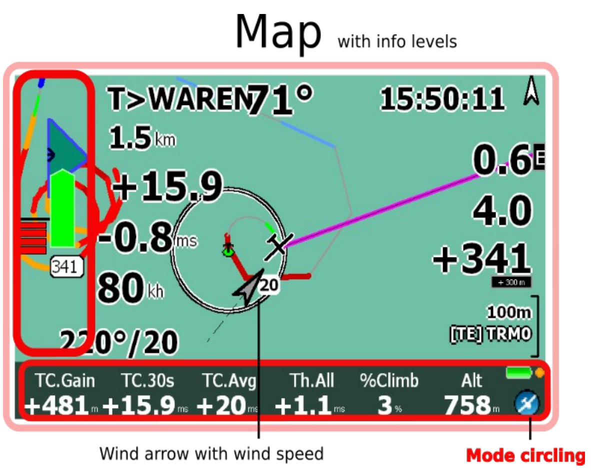


Figure 10.1: Mode circling

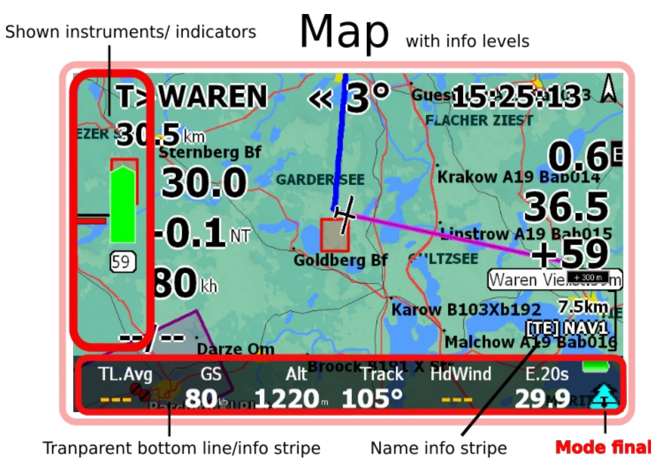


Figure 10.2: Mode final

The switch between the modes is automatic as the program identifies the flight condition by itself. The map fills the complete display but is overlapped from the transparent foot bar and from the configurable virtual instruments and displays.

The **orientation** of the map can be configured in the **direction of the course, north** and **smart north. "Smart North"** means that independent of the direction of the flight the map moves that it always maximizes the part of the map which lays in the direction of the flight. This of course does not occur while circling in which case the map always points to the north.

The map display can, if required, be configured with colours groups (**flatland**, **mountains**) and shading. If height information is not required, the terrain display can be switched off and only topology is displayed.

The amount of alphanumerical informations, which can called up is controllable by the selection of information levels. The preferred changes within the map display is worked over the large control surfaces, see **fig. 9.2.** One can zoom in or zoom out in the map.

A special map mode is the dynamic PAN-mode, cf. **fig. 10.3**.

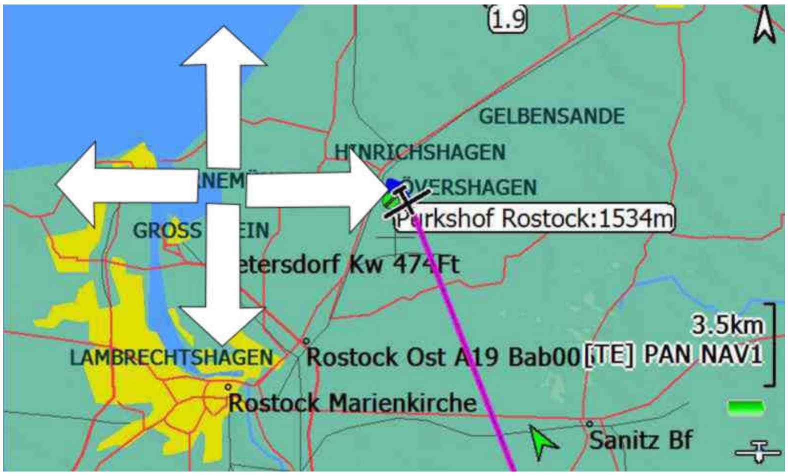


Figure 10.3: Dynamic PAN-map mode (full screen), the map will be moved by sliding gestures.

Within this mode, that can be full screen, the map can be moved by sliding gestures in all directions. Zoom in and out is possible by clicking the upper and lower map region.

A special (and historically inherited) change mode with the map is the **“Active Map”.** If activated one can click directly on way points and is informed about the way points in a sub window. But since it is difficult during the flight to click on way points is it no standard mode.

10.2 Foot bar info-stripes

The foot bar contains named groups of *flight parameters*, **info-stripes** which present a self contained Information file. Since the foot bar is almost always displayed are these informations constantly available. Switching between the info-stripes again takes place by clicking the specific touch areas, see **fig.10.4**.

At this point in time following info stripes are available **NAV1, ALT2, STA3, TSK4, ATN5, SYS6, CRU7, FIN8 and AUX9,** whereby Cru7, FIN8 and AUX9 are configurable. One stripe only available during circling is **TRM0**, which is also configurable (System Setup page 17).
Which info stripes to use is also configurable.

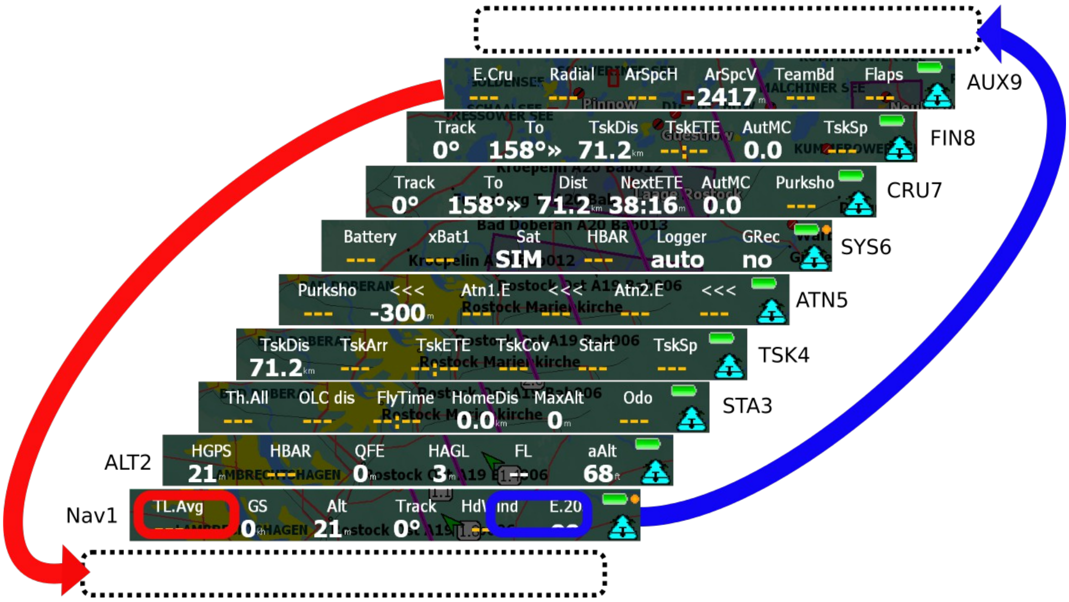


Figure 10.4: Rotating stack of info stripes

10.3 Information pages

By clicking on the middle touch pad of the foot bar one changes the map display to the display of the information pages, cf. **fig. 10.5**.
Information pages are a new concept to simply make informations available and at the same time display them on the large display to select and work with them securely.

At this time there are three groups of information pages with sub-pages available in LK8000

the flight parameter group 1	(6 Sub-pages)
the way point group 2	(2 sub-pages)
the common group 3	(2 sub-pages)

If a FLARM device is connected an additional group is available.

The groups 2 and 3 contain tables which can extend over several pages and which are partly sortable.

Figure 10.5: Structure of information pages

Switching between the groups of information pages is done by clicking the centre foot bar touch area and is **only possible in one direction. For instance** in order to get from info page group 3 to group 2 one has to go first to the map display and to group 1. But because there are only four (five) possibilities and with sound pitch changes at the same time, this is appears easy to accomplish.

To switch between sub-pages within a group one uses horizontal gestures. For Instance to switch from page 1.1 to page 1.2, one pushes on the touch screen on the left middle and moves the finger towards the right and releases the pressure. Then page 1.2 will be displayed. To get back to page 1.1 one does the same in the opposite direction. In other words the sub-page pile rotates in both directions, see **fig. 10.6.**

With a short click on the right or left side of the display also can be used to switch sub-pages, cf. fig. 10.7.

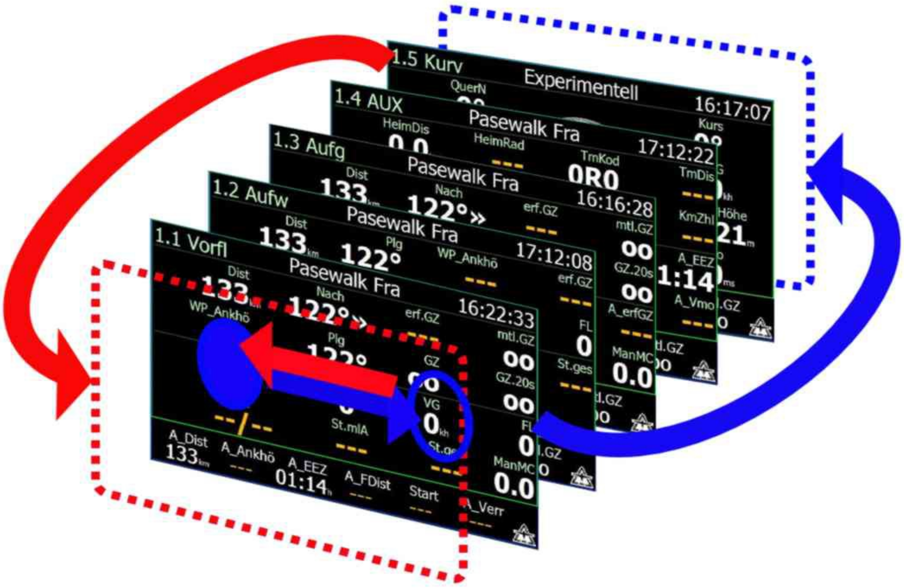


Figure 10.6: Stack of info-sub-pages with bidirectional switching

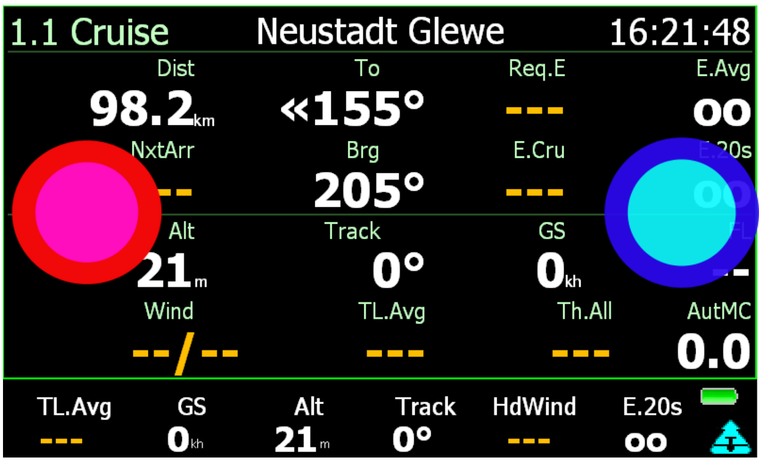


Figure 10.7: Click areas for switching sub-pages

The info page group 2 and 3 consist of multiple page tables which can be controlled with buttons on the top bar, **fig. 10.8**.

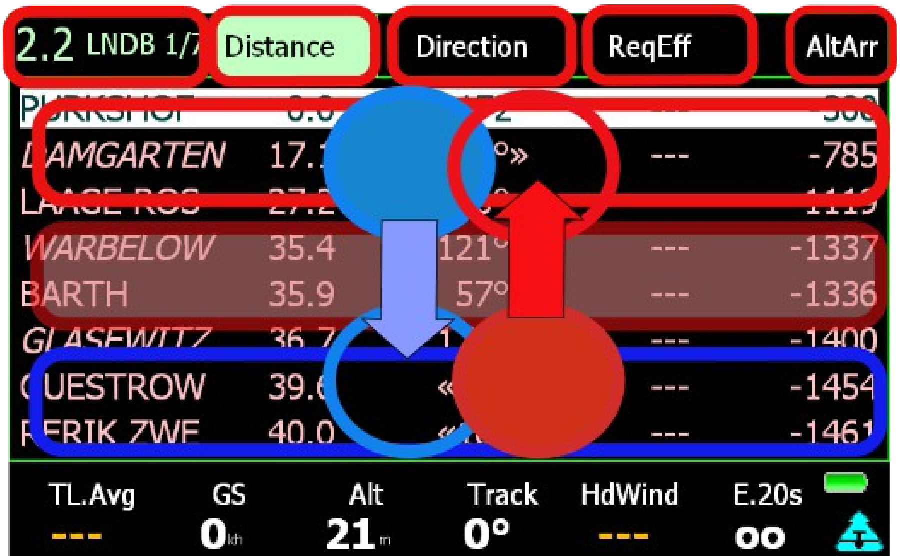


Figure 10.8: Control areas and table related gestures

This display is used to sort the table, to the steering direction of the cursor and to change the table pages. The sorting of the table can applyed using the control button on the top bar, see **fig. 10.9**.
If one clicks on the left table column with the way point names they will be sorted alphabetically. As a standard they are sorted by, column 2 distance. But one can also sorten the direction of the flight, column 3, etc.

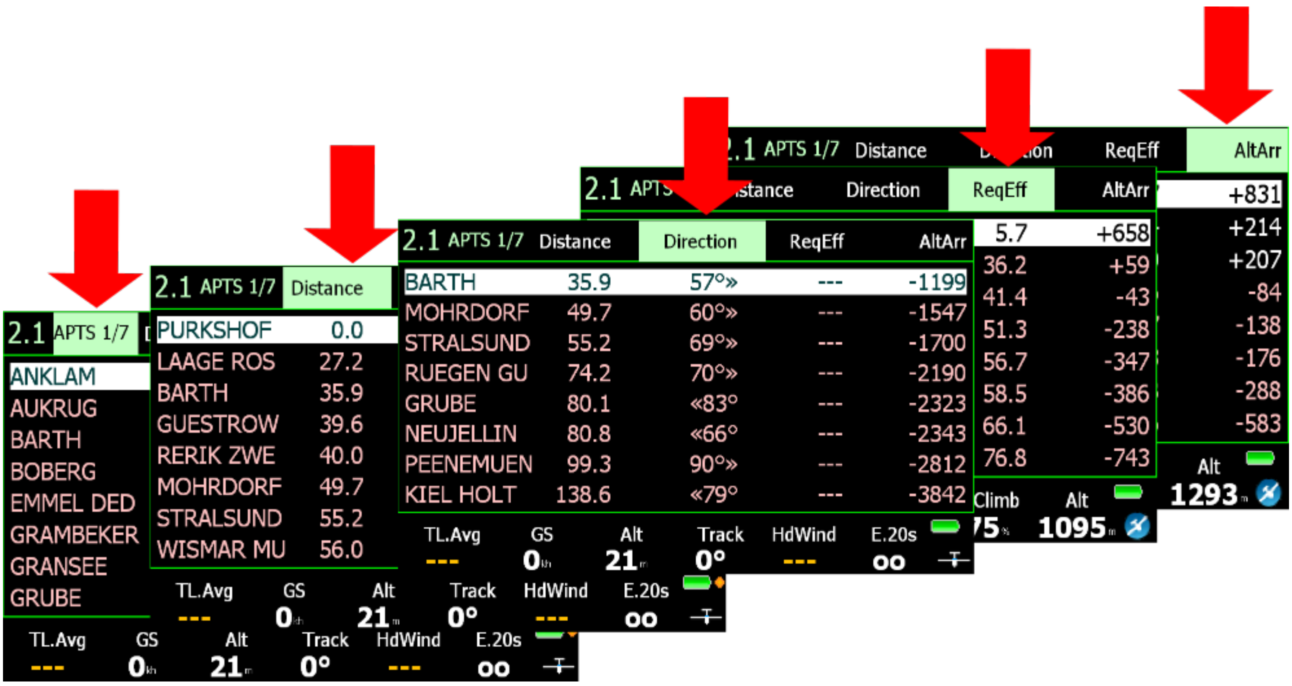


Figure 10.9: Possibilities to sorten tables by column criteria

For all table entries are additional information available. In order to view them, the table cursor, which can be recognized by the inverted line display, has to be switched to entry.

The control of the table cursor is again done via the display and is illustrated in **fig. 10.10.**

Figure 10.10: Control of table cursor

Table cursor **down**	- click blue framed area
Table cursor **up**	- click red solid area
Confirm selection	- click red shaded area

After the selection one gets a window with touch area and selects with the required display name the desired task.

As can be seen in **fig. 10.11** this table shows airfields at seven pages, displayed is page 1/7.

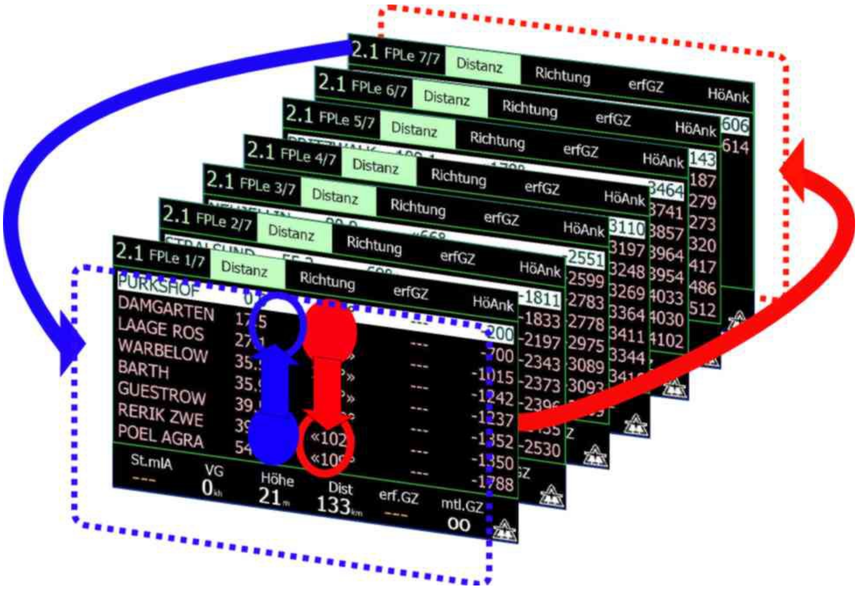


Figure 10.11: Bi-directional change of table pages

The table pages can be switched bi-directional with vertical gestures, cf. **fig. 10.11**.

10.4 Main menu

The program has a menu layed out in boxes, which can be accessed through a click on the plane icon, see **fig. 10.12**.
The operation of the menu is partly self explanatory, **fig. 10.13**.

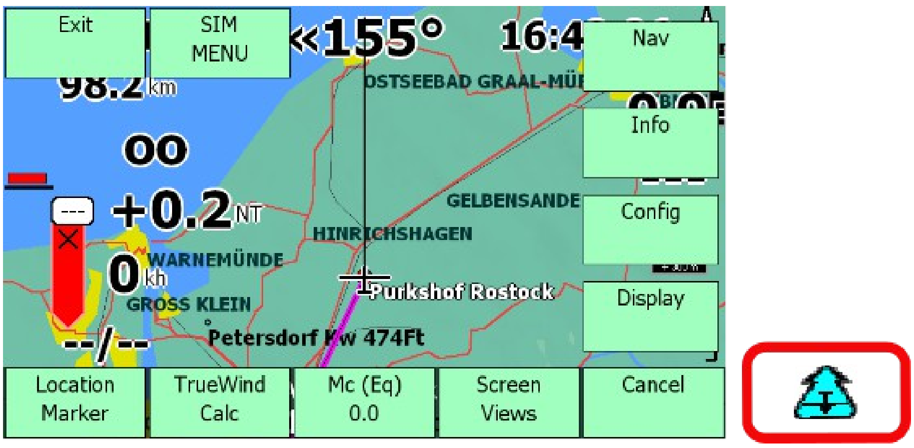


Figure 10.12: Main menu

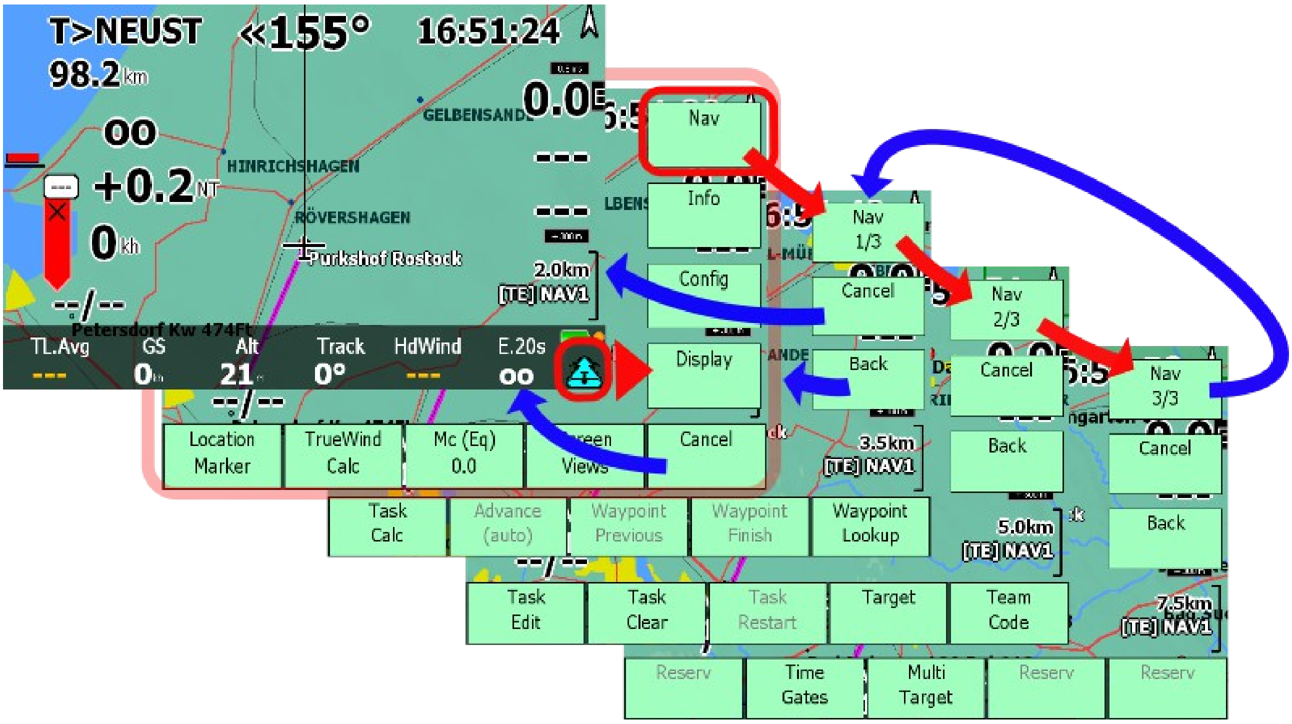


Figure 10.13: Menu operation

The touch boxes of the menu serve different tasks, these can be from the opening of a sub-menu to the incrementation of a value.
Unfortunately are these variable tasks graphically not to distinguish, therefore to operate them reliably will take some time.

10.5 Messages and sounds

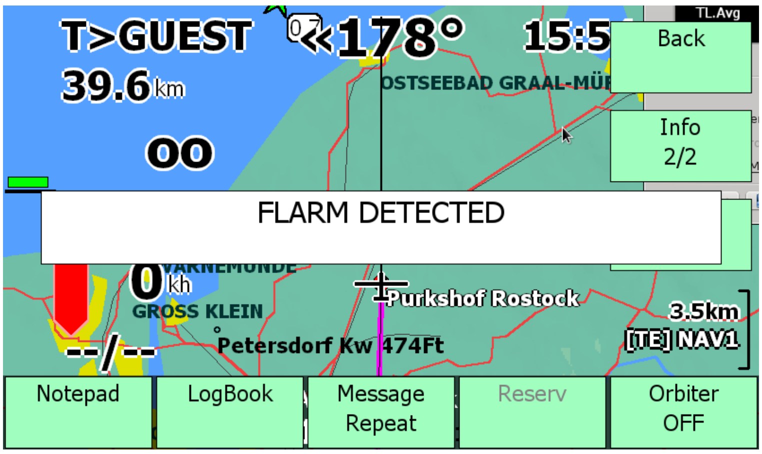


Figure 10.14: Blended in message

A further important Information elements are blended in graphic messages. Usually they are accompanied by a sound and indicate important occurrences.

These can be flight parameter, course,wind, landing options or instrument conditions (GPS Signal, battery condition) etc. A recognised FLARM device is indicated in **fig. 10.14**.
The accompanying sounds are characteristic e.g. Every specific occurrence is accompanied by a specific sound. With some experience the pilot will recognize what the computer tells him.

10.6 Custom keys

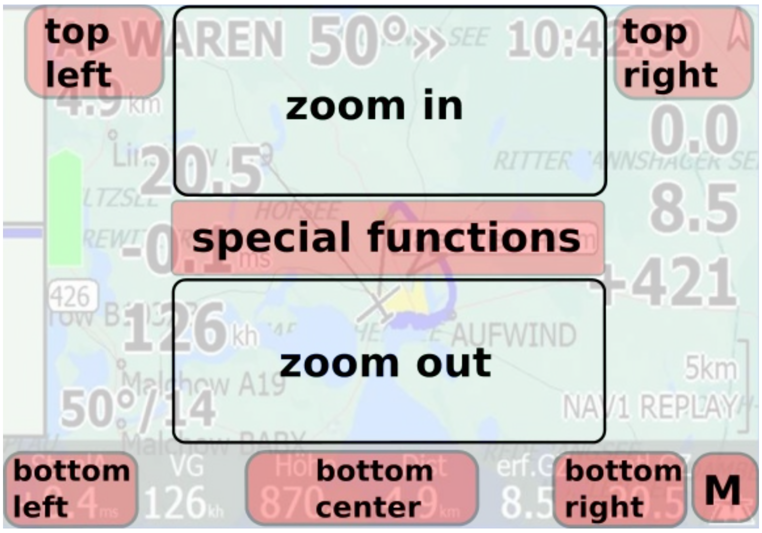


Figure 10.15: Custom key areas

In **fig. 10.15** the red display areas can be utilized as custom keys with user defined functions. These functions will be called by long clicks (0.7s). This way the program can be individually configured. The configuration is done via the system setup page 10 Interface.

11 Menu - short description

For the menu description are control surfaces categorized according to their reaction and colour coded.

Menu	With this control surface you obtain a sub-menu.
Procedure	This control surface starts a procedure
Option stack	Several clicks on this rotate an option stack.
Choice	Here **one** option is choosen.
Active	Choice of an option of several displayed options.
ON/OFF	simple ON/OFF switcher
Switch	Choose an option a switch it on.

Here only the menu options are give. A more detailled description follows in the later chapters. The main menu is already displayed in **fig. 10.12.**

Main menu

Nav	Navigation menu
Info	Information menu
Config	Configuration menu
Display	Display menu
Screen Views	Menu screen views
SIM MENU	Simulation menu
Location Marker	
TrueWind Calc	
MC	

Menu Procedure Option stack Choice Aktice ON/OFF Switch

11.1 Navigation menu

Nav Nav 1/3

- Task Calc
- Advance(Auto) A(Manual) A(Load) A(Load take off)
- Waypoint Previous
- Waypoint Finish
- Waypoint Lookup

Nav 2/3

- Task Edit
- Task Clear
- Task Restart
- Target
- Team Code

Nav 3/3

- Time Gates
- Multi Target
  - Task
  - BestAlt
  - Altern1
  - Altern2
  - Home
  - Thermal
  - Team
  - FLARM

Menu Procedure Option stack Choice Aktice ON/OFF Switch

11.2 Information menu

Info

- Info 1/2
  - Oracle
  - Nearest Waypoint
  - Nearest Airspace
  - Status
  - Analysis
- Info 2/2
  - Notepad
  - LogBook
    - LogBook List
    - LogBook Details
    - Reset Book
  - Message Repeat
  - Orbiter ON/OFF

Menu Procedure Option stack Choice Aktice ON/OFF Switch

11.3 Configuration menu

Config Config 1/3

- Setup Basic
- Setup Wind
- ActivMap ON/OFF
- AirSpace Below Inside All OFF All ON Clip Auto
- LOCK SCREEN

Config 2/3

- SETUP System
- SAVE System
- Logger Start
- Logger Replay
- NMEA Logger
- TEnergy ON/OFF

Config 3/3

- FLARM Setup
  - Normal flags
  - baud rate
    - Baud 4800
    - Baud 9600
    - Baud 19200
    - Baud 57600
  - LEDs and Sounds
    - Normal ALL ON
    - Led+Buz ALL OFF
    - Led OFF Buz ON
    - Led ON Buz OFF
  - Stealth mode
    - Stealth ON Stealth OFF
  - Radio Range
    - Lowest 2km
    - Default 3km
    - Average 10km
    - Average 15km
    - Highest 25km
  - Reboot FLARM
  - Normal NMEA
- Zero QFE
- Reset Comms
- Clear Marks
- Sounds ON/OFF

Menu Procedure Option stack Choice Aktice ON/OFF Switch

11.4 Display menu

Display Display 1/3

Labels WPTS Labels TOPO Labels ALL OFF Labels ALL ON

Topology ON/OFF

Terrain ON/OFF

AirSpace ON/OFF

VisualGld ON/OFF

Display 2/3

DspMode Thermal

DspMode Cruise

DspMode Final

DspMode Auto

Final Force

Display 3/3

Zoom Auto Zoom Manuell

Trail Short Trail Full Trail Long Trail OFF

Invert Text

Topo Back

Map Orient

North Up

Track Up

North circle

Target circle

North Smart

Menu Procedure Option stack Choice Aktice ON/OFF Switch

11.5 Screen view menu

Screen Views

- Zoom in
- Zoom out
- Set Map
  - North Up
  - Track Up
  - North Smart
  - << Left
  - Up
  - Center default
  - Down
  - Right >>
- Pan ON/OFF
- Invert Text
- Overlays ON/OFF
- Shading ON/OFF

Menu Procedure Option stack Choice Aktice ON/OFF Switch

11.6 Simulation menu

SIM MENU

- Speed
- Alt
- Turn
- [-]
- [+]

Menu Procedure Option stack Choice Aktice ON/OFF Switch

12 System configuration

All basic as well user specific settings are made in the system configuration which you get to over the system configuration.

Menu ▶ Config ▶ Config 2/3 ▶ Setup System

The system configuration is split into 23 numbered and named sub-pages. Each page contains several options.

LK8000 stores the number of the last used configuration page in other words having left the system set and is not satisfied with the set up and calls it up again, the last used page will be displayed.

12.1 How to use the system setup pages?

In **fig. 12.1** set up page 1 Site is shown. **All light coloured areas** are individual display touch areas!

Figure 12.1: System set up page 1

The side control boxes are on the lower left hand side on the display and are self explanatory. [Close] means that one goes back directly into the map display or info-pages.

12.2 How changes are made

A click on the display control area shows the available options. E.g. a click on the control surface "Airscace display" at system setup page 2 Airspace gives the options shown in **fig. 12.2**. If uncertain what to choose you can get help, cf. **fig. 12.3**.

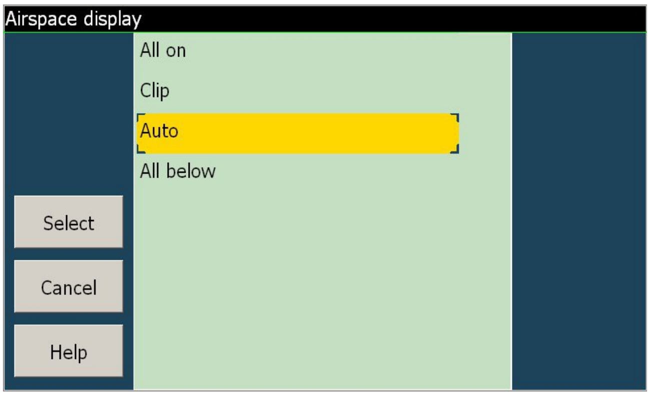


Figure 12.2: Options

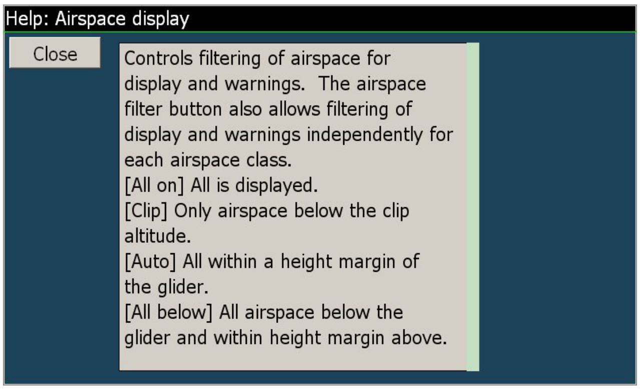


Figure 12.3: Help text

In case of many options a scroll control appears on the right hand side of the display, the desired option can be **highlighted** on the table and **select** clicked, **fig. 12.4**.

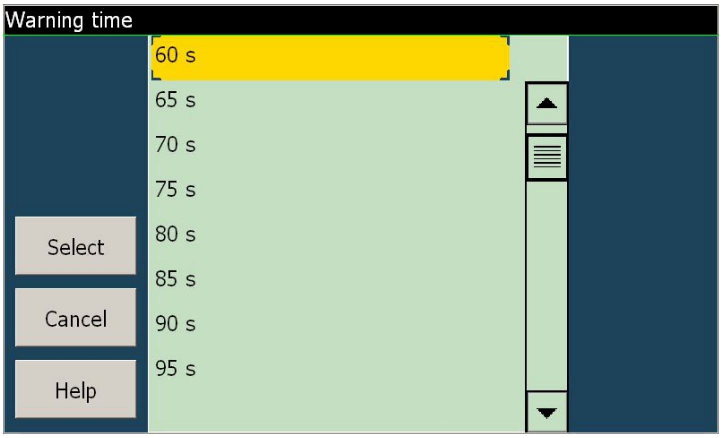


Figure 12.4: Parameters

12.3 How to use the virtual keyboard

To enter alphanumerical values in LK8000 one uses a virtual keyboard on the touch screen, see **fig. 12.5**.

Figure 12.5: Text-line editor

To enter somewhat one clicks simply on the letters or numbers on the screen, which then appear in the text line. For correction the **Delete** button on the screen must be clicked. When input is finished click **OK.** Due to display space restrictions the keyboard can not be drawn in the normal typewriter layout.

12.4 ASCII-filtering of name lists

If one has many options in a list, as e.g. listed waypoints names, the selection by slider moving and clicking would be time consuming. In such case the use of an ASCII-filter from the editor is quicker, see **fig. 12.6**.

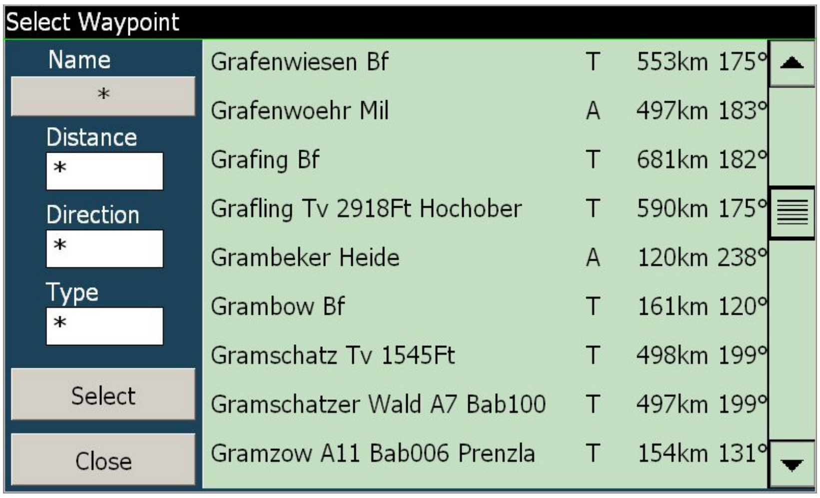


Figure 12.6: Waypoint selection by ASCII-filter

Just click onto the control display "Name" which will open the editor. If one enters up to three letters into the editor and clicks OK then a waypoint list with all waypoints starting with these 3 letters will appear. For instance if you enter "PUR" at the display changes showing "Purkshof Rosto", **fig. 12.7**.

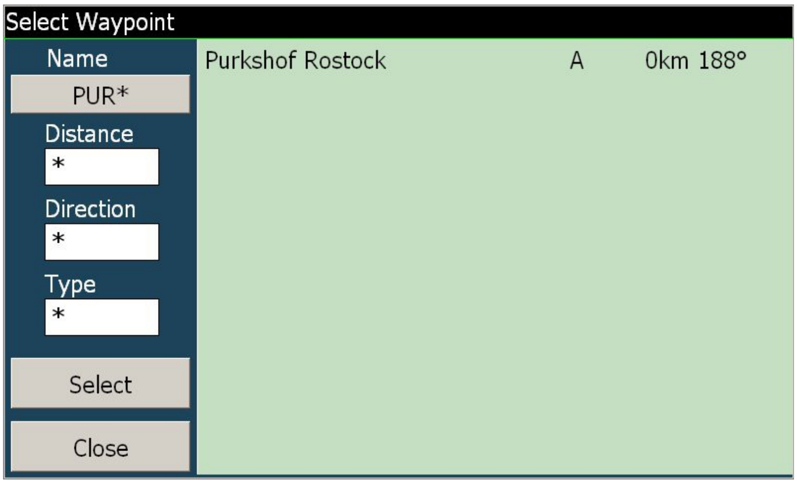


Figure 12.7: Waypoint, filter three letters

If you enter more than 3 letters e.g. "NEUSTA" changes the "Name" display to (NEUS) and shows a waypoint list with all the names which contain anywhere "NEUS" anywhere in the waypoint name, see **fig. 12.8**.

Figure 12.8: Waypoint filter, more than three letters

This concludes the basic operation of LK800 and the usage will be explained in the further chapters.

13 Pre flight configuration

Before the program can be used it must be configured **on the ground**! Some of the configuration options are basically used most of the time and some are nearly permanent. But others need to be newly selected before each flight.

13.1 Profiles

The storing of the configuration happens automatically into the file DEFAULT_Profile.prf, which is the standard profile and is saved into the program sub folder _Configuration.

If the device is used by different pilots, iflying n different planes the program configuration can be stored in several profiles so the system profile, the plane profile and the pilot profile are separedet.

Attention! The selection of these profiles can only be done at the program start up in the profile menu.

If the program is still not configured individually, default profiles are used. Here the default pilot is

Wolf Hirth, the famous glider pilot with the default sailplane
Standard-Cirrus D-1900

13.1.1 System profile

The named system profile collects all system configuration options
* the chosen maps, the airspace-data and the waypoints
* the selected informations to display
* the selected user specific functions (custom keys) and the
* map style

The named system configuration will be stored via

Menu ▶ Config ▶ Config 2/3 ▶ SAVE System

with a chosen name SYSTEMNAME.prf in the folder _Configuration.

The name of the system profile should be whise selected!

13.1.2 Airplane profile

The named plane profile can be saved on system configuration page 7 Aircraft, cf. **fig. 13.1**

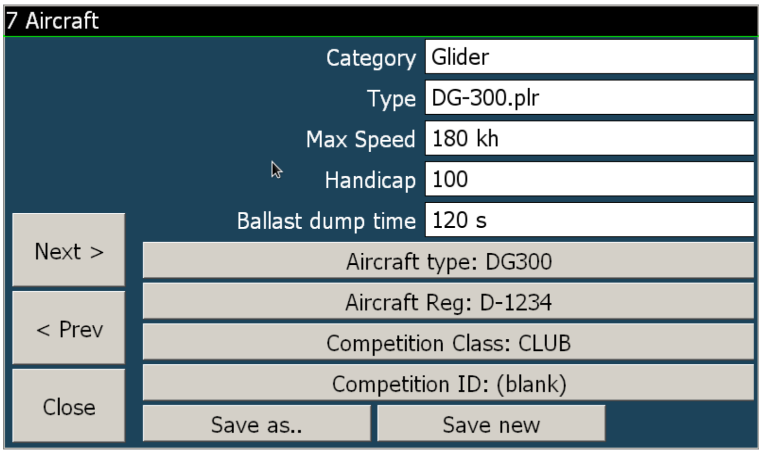


Figure 13.1: Save named plane profile

With the control area [Save as] on the screen it is possible to save a named plane profile e.g. glider_D1234.acf and via [Save new] it is possible to store a new profile.

At [Category] the options *Glider* and *Paraglider/Hangglider* are supported. The option *GA aircraft* has some initial functions and the option *Car* is used for testing purposes and can be really used at a car ride.
The polar of a glider can be selected in the control area [Type]. If you loaded your own polar file **NAME.plr** in the _Polars folder then it is possible to load it here. The polar file has its own format similar to the "winpilot"-format but additionally with the value for the wing area. An example for a polar file is within in the _Polar folder.
The control area [Max speed] indicates the manouver speed (unit km/h). The program uses this value to avoid unrealistic cruise speed suggestions. The [Handicap] is important for the OLC-competition and can be choosen according to the DAeC ranking. The [Ballast dump time] is used to re-calibrate the polar after dumping a part of the water ballast.

Polar-transformation:
The polar of a glider, as shown in the flight operation manual and which gives the speed/ sink ratio in still air is always based on a specific wing loading, If this wing loading is changed because of different loads(pilot weight, water ballast, partial release of water) Mass1 **M1** is altered to Mass2 **M2** which changes the Polar. These Changes can be entered with a transformation in the original polar [Reichm]:

$$V(M_2)=V(M_1)\sqrt{M_2}/\sqrt{M_1}$$

and

$$Ws(M_2)=Ws(M_1)\sqrt{M_2}/\sqrt{M_1}$$

With V (Speed) W_s (sink speed) and M_2 the new Mass a with M^1 the old mass are the polar axis narrowed (ballast release) or opened (higher wingloading). At higher altidutes must also be corrected according to the air density.

13.1.3 Pilot profile

Th pilot profile is established at the system configuration page 20 Logger, cf. **fig. 13.2**.

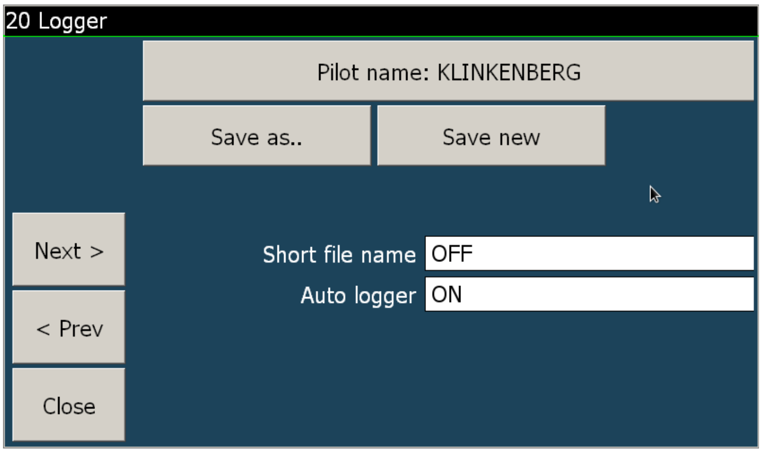


Figure 13.2: Pilot profile

13.1.4 Club mode

An interesting program feature is the "Club mode". If the program finds within the LK8000-folder a file named "CLUB" anyone can write new profiles but can not delete or overwrite, other profile files. With this all pilots of a club can use their profiles.

Serious Warning!

System-profiles are forbidden to copy to another device. They can contain incompatible hardware configurations!

13.2 Check list

Check lists have been useful in preparation to flights.
By

Menu ▶ Info ▶ Info 2/2 ▶ Notepad

a simple text file is shown in which one could prepare personal check list or notices.
This can be stored as NOTEPAD.txt in the sub folder _Configuration, cf. **fig. 13.3**.

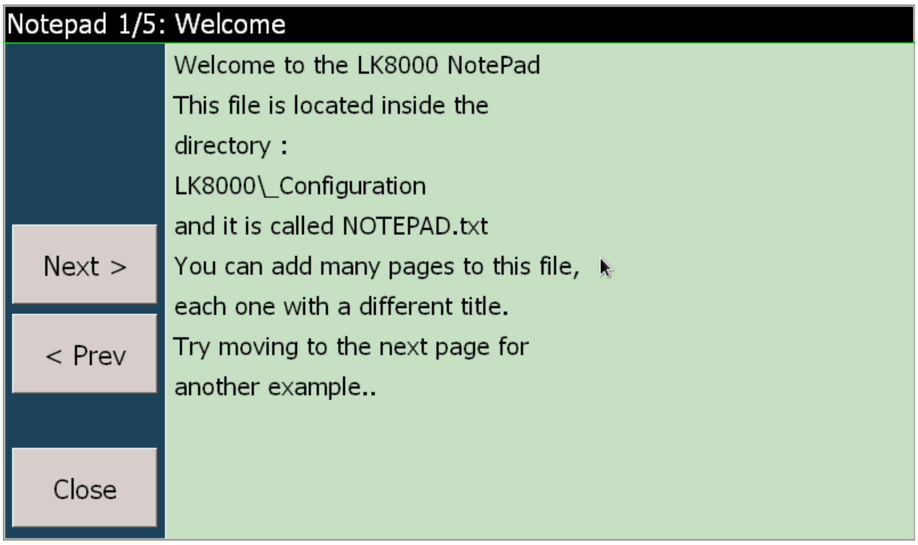


Figure 13.3: Notes example

This file can be structured pagewise. Every new page starts with a line "[page title]" and this page title will be displayed in the header of the page viewer like

[Welcome]

see **fig. 13.3**.
The page content can be reached fully by the page slider and the page stack can be moved by [Next>] and [<Prev].
The file has to be encoded "ANSI". A suitable free editor is "notepad++“ [notepp].

13.3 Pre-flight basic configuration

The correct data for changes in load are very important for realistic calculation which is made in LK8000 through the wingloading data, see **fig. 13.4**.

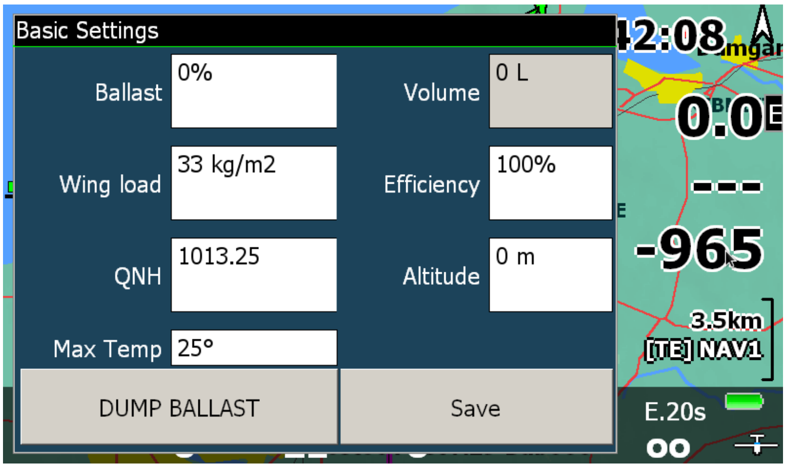


Figure 13.4: Basic pre-flight configuration

To this window you get with

Menu ▶ Config ▶ Setup Basic.

Empty weight of the plane, pilot weight, parachute weight, luggage and ballast determine the wing loading. Changes in wingloading by dumping water ballast is calculated and the dumped amount is indirectly measured with the dumping time, as the total dumping time was give, The Box [BALLAST RELEASE], starts the release time calculation and when [STOP RELEASE] is clicked the calculation is stopped.
During the time the ballast is released one can already read the changing wing loading.
But with this read out is the actual flight performance of the plane not completely established.
The read out 100% in the L/D box is based on a clean dry plane. The status of the wing surface due to Bugs contamination, water film or hoarfrost will be shown indirectly in percent in the L/D box.
With this information one can adjust, giving a safety margin, on final glides.

For GA planes is this information also valuable in particular in the case of an engine failure.

13.4 Logger

The Name of the pilot and the A/C registration etc can be entered for flight documentation purposes on the configuration page 20 Logger, see **fig.13.2**.

If the **Autom Logger is switched ON** the flight will be automatically recorded. The ICG logger date is filed in a sub menu and is OLC VALID only for engineless planes!

13.5 Safety parameters

In Configuration Page 6 Safety factors are safety values entered which are selfexplanatory see **fig. 13.5**. The standard values shown are ok but can be changed individually, by clicking on the respective lines the values can be selected.

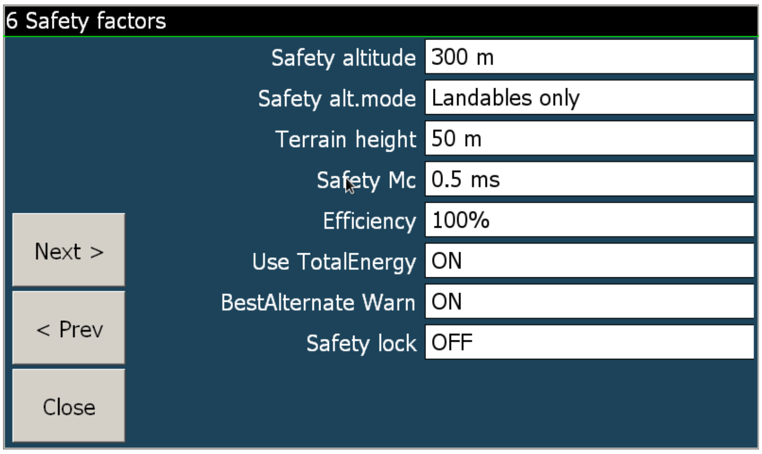


Figure 13.5: Configuration of safety parameters/factors

13.6 Waypoints

If the waypoint file is loaded the waypoints are available to program the next point of destination with

Menu ▶ Nav ▶ Waypoint Lookup

select waypoint and with GoTo your next destination is fixed.

When a new waypoint is required (which is not already in the file) enter it in the system configuration a page 21 Waypoint Edit, see **fig. 13.6**.

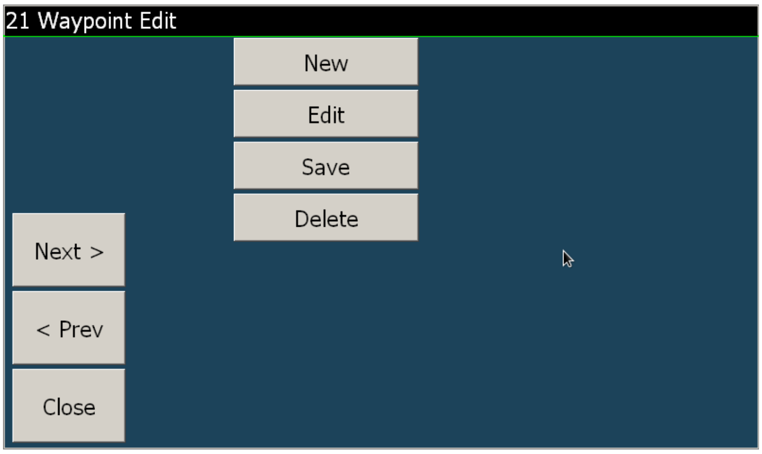


Figure 13.6: Waypoint editor

A NEW waypoint will always be written at the end of the first loaded waypoints file!

13.7 Airspaces

The airspace data are made available by the DFS through the DaeC as file (DaeC-LR). But they can also be found on the LK8000 Homepage or in the Internet : http://soaringweb.org/Airspace/Homepage.html. But one has to make sure that the local required airspace data is filed in the sub folder _Airspace. Which presentation is selected depends on the local situation.

13.8 Map set up

The **Map** is one of the **main information sources** for the pilot, one should take time and try the different setting possibilities to find the most optimum configuration for oneself.
The most important is to set it up so, that it is best readable in bright sunshine (Good Luck). Has one found the optimal set up, there is normally no further change required.
If there is also the possibility in your hardware to use the program in upright format, remember that the display is optimized for use in horizontal format!

Before you set up the map consider following:

Which map orientation do I prefer?
How much map do I want to see?
Do I need terrain height informations/shading?
Which blended in flight parameters do I need/want?

Which virtual instruments do I need?
Which information are readily available on info stripes or pages?

Resources to calculate these data are not the problem, the program is optimized so that the latest as well as older navigation devices can use the program without restrictions.
The map can be orientated in **north** or **course direction**, for the north orientation is also the **North Smart** mode available. The preferred orientation can be selected in System configuration 3 Map display and with this permanent available for the next program start ups, see **fig. 13.8, 13.7**.

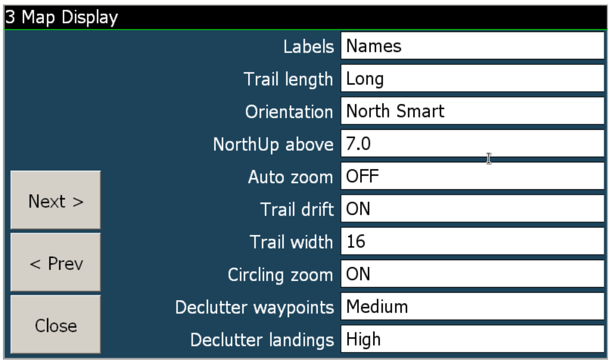


Figure 13.7: Map orientation North Smart

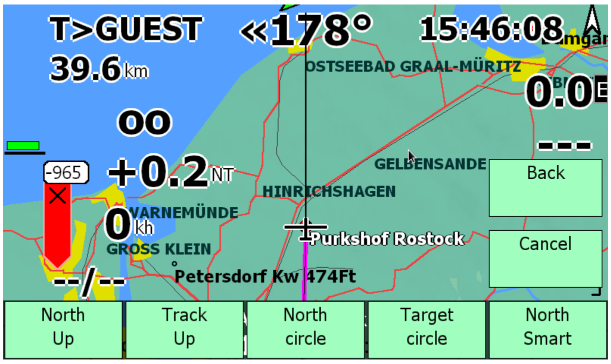


Figure 13.8: Map direction selection menu

The North Smart mode always presents the maximum map display in the direction of the flight, in other words if the flight direction is changed, the map will be moved so that the maximum map part lays in front of the plane, cf. **fig. 13.9, 13.10.** How large this map part is can be also configured.

Figure 13.10: North Smart, flight north direction

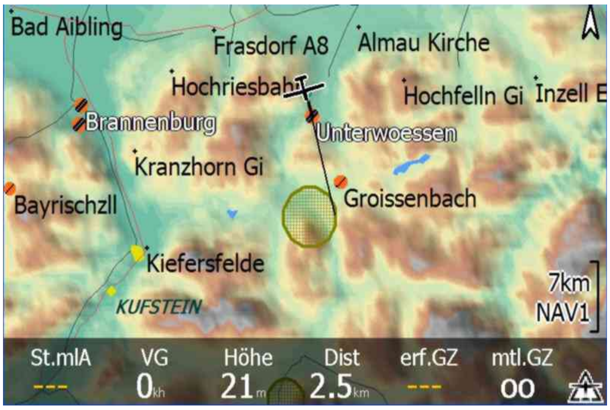


Figure 13.9: North Smart, flight south direction

The graphic configuration can be started in a minimalistic map, see **fig. 13.11, 13.12**.

Figure 13.11: Minimalistic map

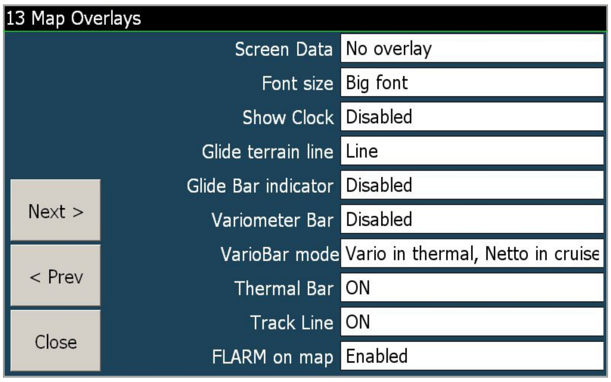


Figure 13.12: Configuration of map overlays

In **fig. 13.11** are neither flight parameters, instruments nor terrain height shown. Only the transparent foot line with parameters, the name of the info stripe, the scale and the north pointer are shown. The associated system configuration page **see** 13 Map Overlays , **fig. 13.12**. In addition in **fig.13.11** terrain was deactivated in the menu Menu ▶ Display ▶ Terrain OFF hence, only topology is shown. But with bearing and course line can already be navigated.

As can be seen in **fig. 13.13**, **13.14** exists by de-activated terrain height the possibility to adjust the background colour to one's liking. This can be adjusted with Display 3/3 ▶ colour background, the background colour changes by multiple operation of the control box.

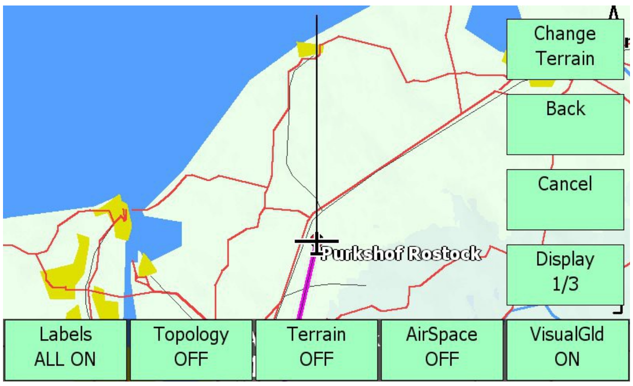


Figure 13.14: Terrain height deactivated

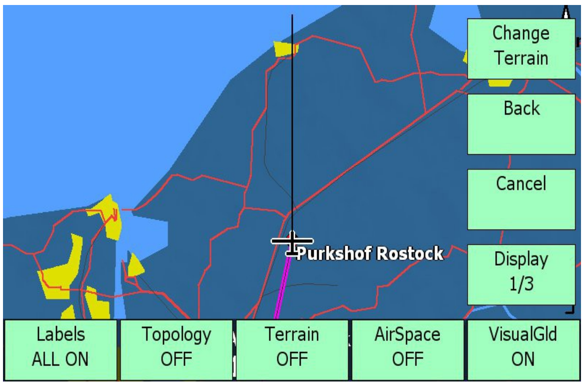


Figure 13.13: Changed background color

Areas of water are stored in the topology file. Shutting down the topology by example as in **fig. 13.13** leads to the drying out of the Baltic Sea!

While the terrain height is not absolutely necessary in flatland, it is in mountainous terrain of great advantage.
For a well recognizable mountainous terrain display exist several colour patterns, see **fig. 13.15**, **13.16** slope shading.

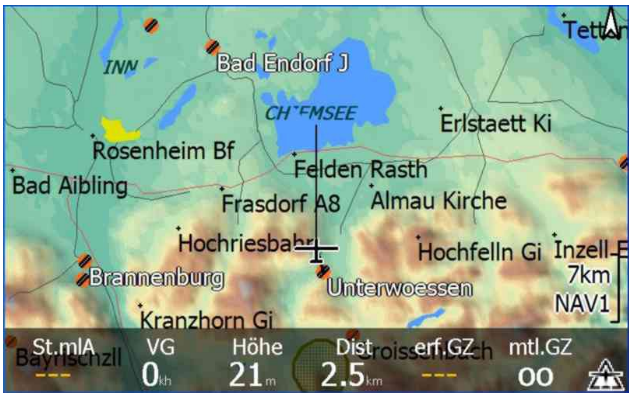


Figure 13.15: Color pattern for lower alps

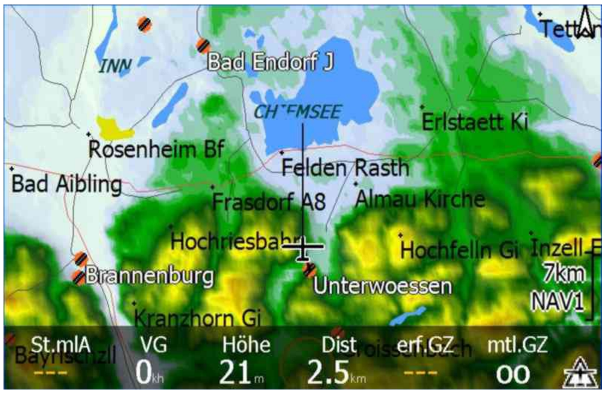


Figure 13.16: Color pattern with greater contrast

A special adjustment is the diurnal display of slope shades, which can be controlled over an adjustment in system configuration page **4 Terrain Display (fig. 13.17)** slope shading.
Pilots that prefer the SeeYou colour pattern can also select this.

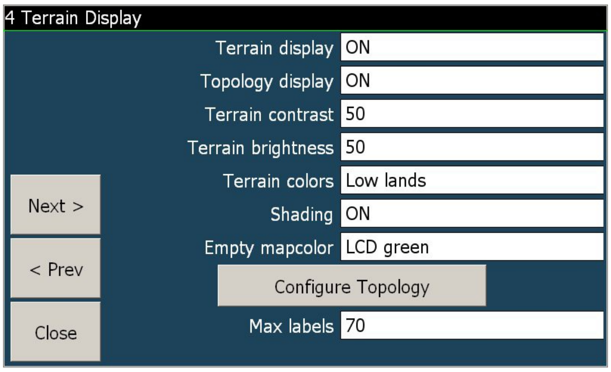


Figure 13.17: Fine adjustment map display

Figure 13.18: Configure topology: Topology-Zooming

In the control box **Max Labels** (**fig. 13.17**) can the maximum number of marks shown on the map be controlled. The decision if marks are displayed in reality are made by the program with a hierarchic de-clutter algorithms. In this have airfields/landing fields first priority ahead of topological markings
With the **de-clutter options** for waypoints and airfields in **(fig. 13.7)** can be chosen if all waypoint and airfields must be displayed. With low zoom and depending on the area too many marks could cover the map completely.
Which topology features, one wants to have displayed, in which zoom

level, this can be adjusted at system sub-page Configure Topology, see fig. 13.18.

To insert the **airspace**, there are again two possibilities

a) the configuration which is loaded in the program profile and therefore again available during the next program start.

b) a restricted configuration (ON/OFF) in the running program through the menu.

The "permanent" display configuration is done on the system configuration page 2 Airspace and there in the box **Airspace display (fig. *13.22*)**. There the options "All On", "Max Height", "Auto" and "All below the Airplane"are available.
"Max. Height" means that only airspace below a selectable height will be displayed. With "Auto" the height segment above and below will be displayed. And with "All Below Airplane", all airspace below the actual height flown will be displayed. The prior warning time and the configuration time are also able to be configured.

Through the display filter one can set up if a specific display and/or warning, **depending on airspace type,** if wanted (**fig.13.20**)
Switching between these choices is controlled, for the respective type of airspace, with clicking on the entry.

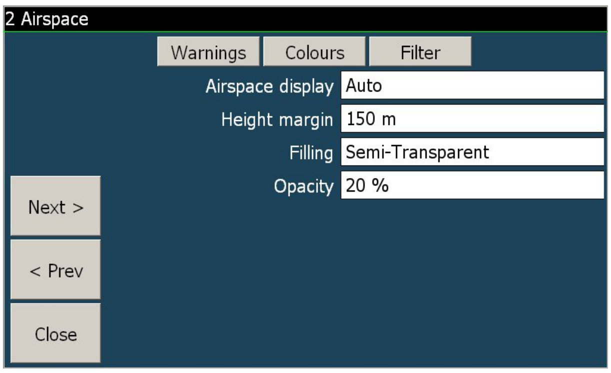


Figure 13.19: Airspace display

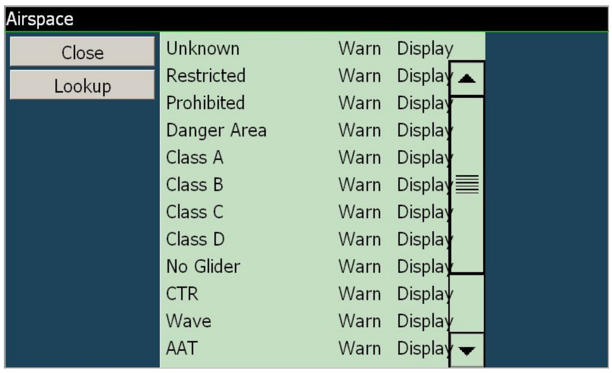


Figure 13.20: Filter: airspace specific options

On page 2 Airspace can also the graphic display of the airspace be set with the **display colours**, black outline and filling be selected, (**fig. 13.19**)
With the menu Menu ▶ Display can the display for airspaces be switched On/Off (**fig. 13.22**).

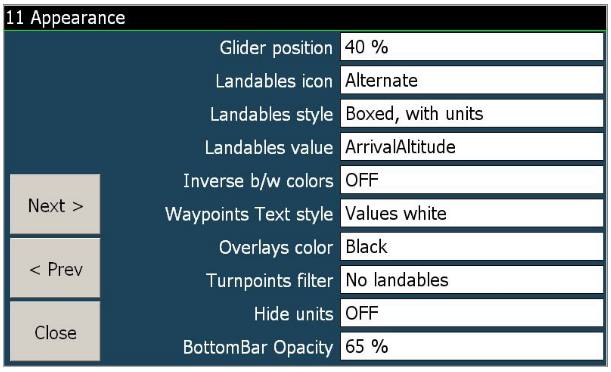


Figure 13.21: Map appearances

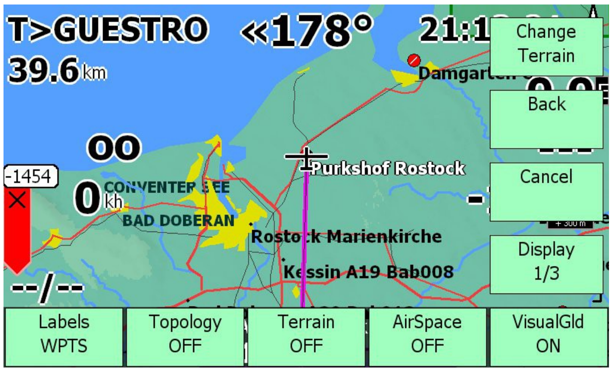


Figure 13.22: Menu-Display, AirSpace button ON/OFF

Further Fine Adjustments can be made on the System Configuration page **11 Appearances**, for instance inverted writing and/or similar the names of the display boxes are self explanatory (**fig.13.21**).
Sometimes it is of value to alter the font page 12 Fonts **.**

THE MAP itself is now configured the next step is to decide on the Parameters and instruments one wants to have displayed.

The flight parameters can be inserted on page 13 Map Overlays, **fig. 13.12**, in two steps

- **Half insertion** and
- **Full insertion**, **fig. 13.23.**

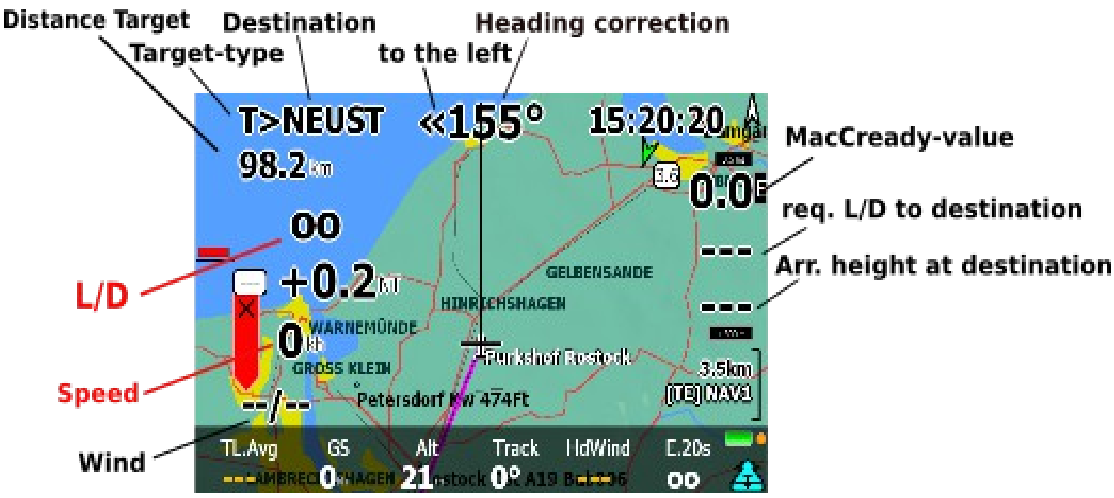


*Figure 13.23: Flight parameters **Half insertion** and **Full insertion***

The flight parameters shown by **Half Insertion** are displayed in Black and the parameters shown by **Full Insertion** are displayed in Red (as in the shown **fig. 13.23** the plane is still on the ground some parameters are not shown)

In addition virtual instruments can also be inserted

Glide path bar to finish

Variometer - vertical bar
Working area display (map mode circling)
Digital watch,

see **fig. 13.24**, **13.25**.

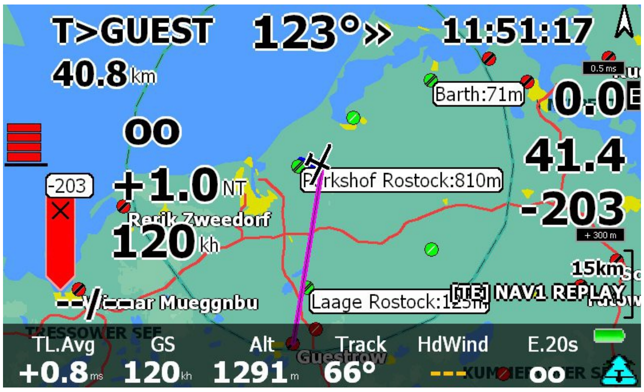


Figure 13.24: Bar variometer, glide path bar, digital watch

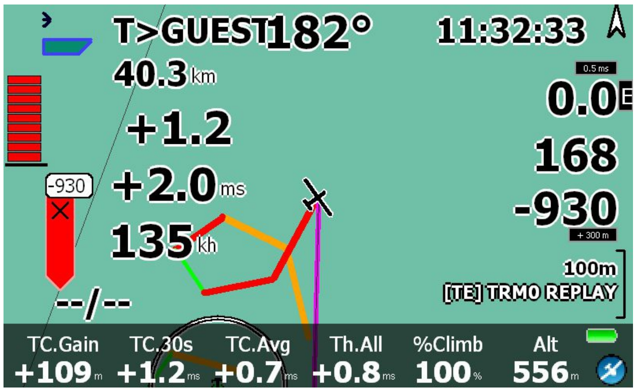


Figure 13.25: Working interval display

The use of the Bar variometer for circling is only of value if the real pressure altitude is available. The height changes indicated/calculated by the GPS are too slow.
In general is the usage of the virtual instruments (except the watch) a matter of personal taste.

13.9 Flight destination

The simplest way to select a point of destination is by searching for a waypoint over the menu

Menu ▶ Nav ▶ Waypoint look up

and by clicking **GoTo** to select this as destination, see **fig. 13.26**.

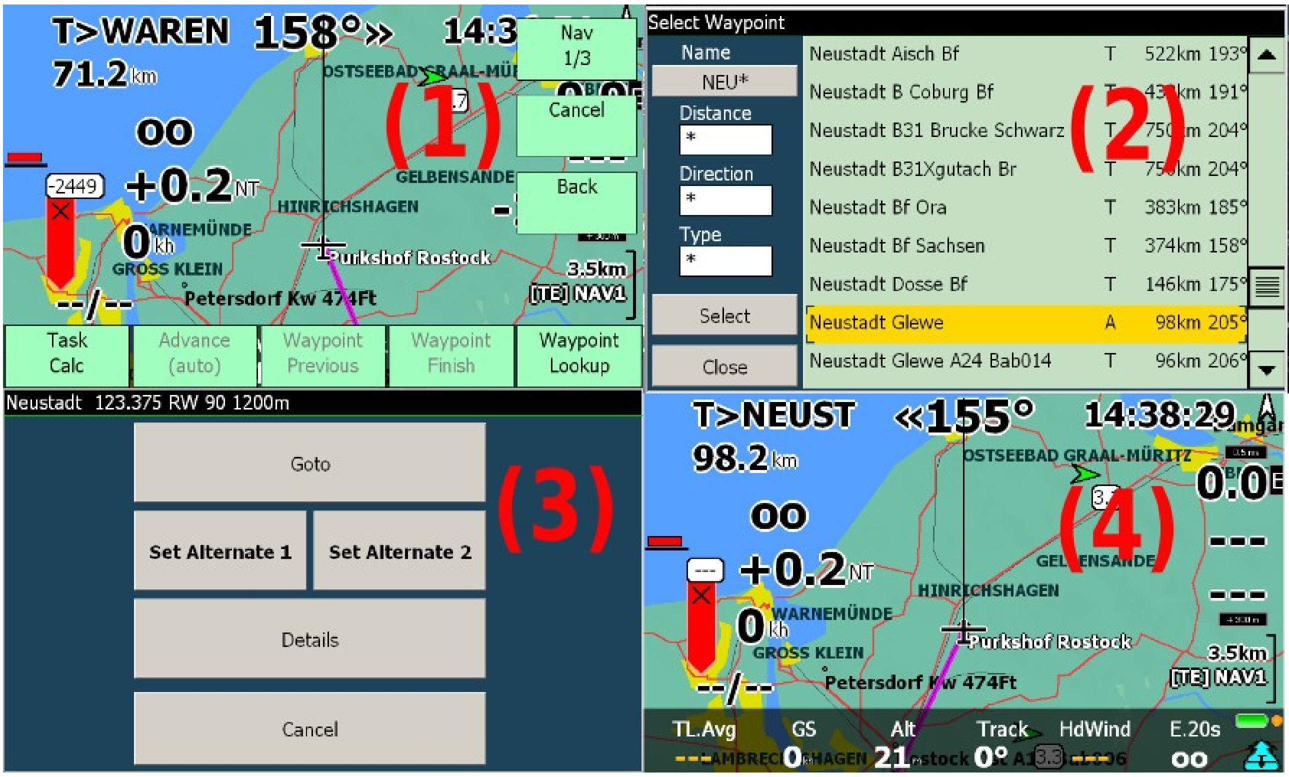


Figure 13.26: Choice of target from the waypoint list

As seen from **fig. 13.26** can the waypoint also be selected as destination alternative 1 and/or destination alternative 2.

In LK8000 it is possible to quickly change between pre- selected destinations by clicking in the upper left corner of the map display, see **fig. 10.2**.

These **pre-selected** destination and Pseudo destination are

- H> Home Airfield
- T > the task destination, the (next) destination
- B> the best landing alternative (calculated by the program)
- 1> Alternative destination (pre selectable)
- 2> Alternative destination2 (pre selectable)
- M> the position of the team mate
- F> the position of a FLARM point
- L> the position of the last used lift (auto stored by program)

Clicking several times on the touch point for stack rotation the display rotates. This quick selection function is also called Multi Target function. It can be also reached by a long click on upper right corner.

13.10 Task declaration

The formulation of tasks will be discussed in detail in **chap. 17**. Tasks can be stored in folders and when needed loaded and a declaration entered in an external IGC-logger, see **fig. 13.27**.

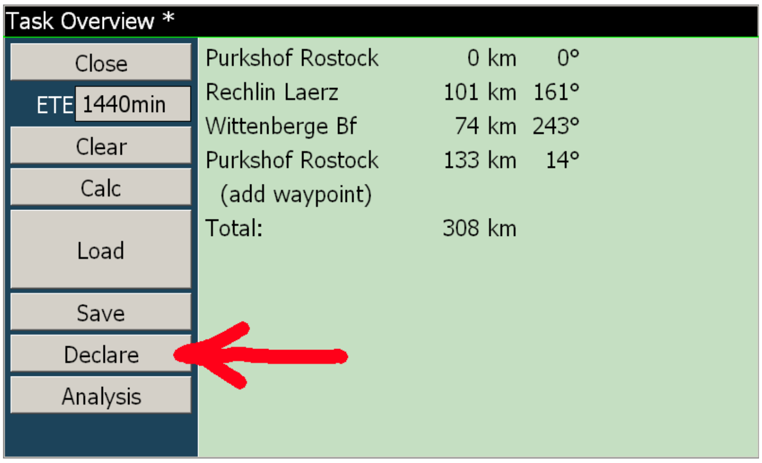
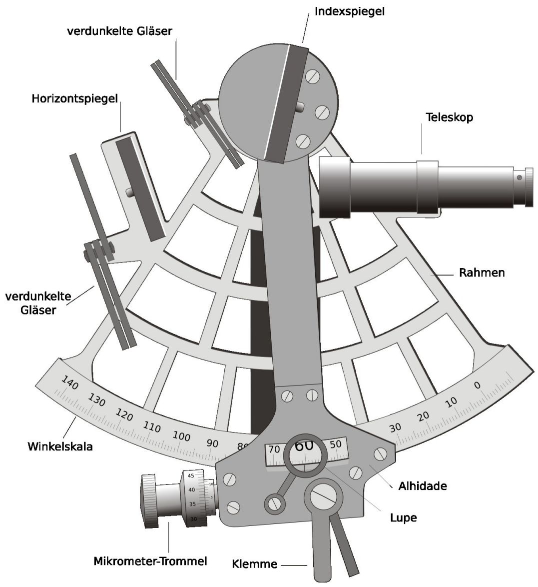


Figure 13.27: Declaration of a flight task; by clicking "Declare" it will be declared into an external logger

14 Navigation

Navigation is the "pilots art" in the water, on land or in the air to bring/steer safely the boat, ground vehicle or plane to the desired target. Two geometric tasks are required to fix the present position and to decide the best route to the destination.



This **Wikipedia** statement can be said more precise that the navigation task is to find the best possible and **allowed** route to the destination In addition to it is of interest also to know the estimated time of arrival.

The first task is already completed by receiving correct GPS data.

The requirement to obtain the answer to the second part is somewhat more difficult as it is necessary to know the most important flight parameters.

14.1 Basic flight and navigational parameters

If one flies a power plane the **airspeed**, and **wind** at the **flight level** flown are the most important parameters required.
With these parameters, the **position** and **course** is the steering course(**bearing**) determined which leads the plane on a straight line to the destination. With the speed over ground and the distance the time on route is determined.

14.2 Moving map

LK8000 supports navigation in several ways.
Without a pre-determined destination the position and a bearing line is displayed on the map.
This is enough for the first orientation, but if a destination is pre-determined and entered (**chap. 13.9**) the following will be displayed on the map, see **fig. 14.2**
a) Destination with name
b) Thick black line towards the destination
c) Course correction and the direction of correction
d) Under the destination name the distance to the destination (clock activated).

The flight time remaining to destination can be obtained on info stripe TSK4 through parameter TskETE (task remaining time) see **fig. 14.1**.

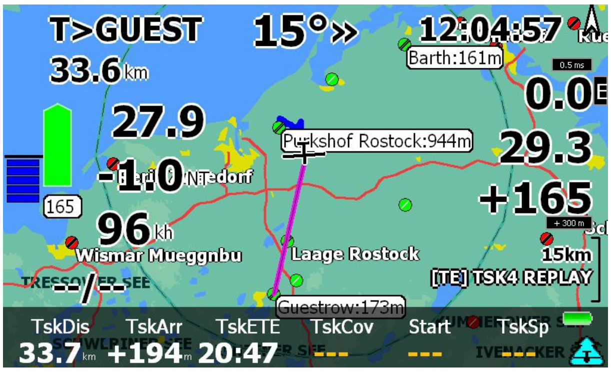


Figure 14.1: Time remaining to destination, TskETE

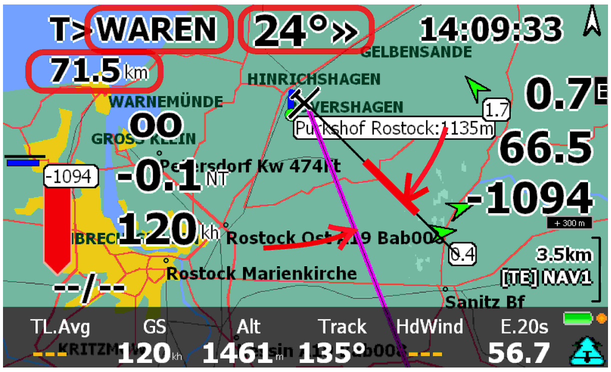


Figure 14.2: Course correktur and distance to destination

With this the simple navigation task is completed, when no obstacles (restricted airspaces or terrain obstacles) are located on the course.

A warning system exists in LK8000 for restricted airspaces. For terrain obstacles there is help in particular for gliders and paragliders which will be further discussed in **chap. 15**.
This help can also be used by power plane pilots but is of less value.

14.3 Waypoint markers

The current position can be stored by setting a marker as a virtual waypoint via

Menu ▶ Location Marker

It could be useful to choose a custom key for this. The marker itself will be displayed in the map as a little diamond with a label. The label consists of a two letter mark MK with a number extension. The number extension denotes the time the marker was dropped. MK163201 means the marker was dropped at 16:32.01 local time, see **fig. 14.3.**

The new virtual waypoint is registred as well in the waypoint-table (info-page 2.3) as in the table of common waypoints (info-page 3.1) and can be used without restrictions for navigational purposes.

In its detailed descrition the location is given in terms of "near" by well known waypoints, e.g. "near Purkshof".

All virtual waypoints are stored in a.cup-file with a name denoted LKYYYYMMDD.cup were YYYYDD is the full date (year, month, day)
Every flight day has so its own virtual waypoint file. This waypoint file can be used as a fully functional waypoint file for later days.

Markers can be deleted by the menu:

Menü ▶ Config ▶ Config 3/3 ▶ Clear Marks

ATTENTION, deleting markers means deleting all markers since the last start of the programm!

Figure 14.3: Dropped marker MK163201

14.4 Height alarms

LK8000 supports height indication alerts. It is possible to configure the flight elevation alarms (configuration page 15 Alarms). An alarm is given if the height is reached or passed.

14.5 Airspaces

Airspace is to structure the airspace in the "third dimension" to
- control the commercial/military and general aviation air traffic,
- control and restrict the fly over sensitive areas and
- to close dangerous 3D areas.

Airspace violation is not a peccadillo and can lead to sanctions against the pilot!

It is the pilots responsibility to strictly adhere to the airspace structure and the pilot must contact air traffic control to enter certain categories of airspace. It of course is best to **avoid controlled airspace** on his flight route altogether.

Airspace can represent different geometrical forms
- starting on the Ground up to a specified height/pressure level
- between two heights/pressure levels and starting

one above open but below from a level above ground.

Therefore one can fly into controlled airspace from the side, from above and from below.

The pilot has to be permanently orientated according to surrounding airspaces!
If someone is unintentionally nearing an airspace the programm gives a warning!

14.5.1 Dealing with airspaces by LK8000

LK8000 **version 3** handles airspaces in comparison to prior versions in a new way.
Therefore **FLY zones** and **NO FLY zones** are introduced
NO FLY zones are not allowed to fly in ☺. The system gives a warning if you are on track into one.
FLY zones can be flown in without restrictions and you get also a warning if you leave one.
A flight to a neighbouring FLY zone, e.g. through a corridor, is without a warning.

Airspaces may be defined within the airspace file via an AF-declaration but it is also possible to set airspaces by the UI.

Airspace warnings are given according to the **current** and **expected position**.
The expected position is calculated by the current ground speed, lift and flight mode (cruising, themaling) and the chosen time for advance warning.

The time for an advance warning is the time between the airspace warning itself and an expected airspace event.

There are different airspaces **warning levels which are color coded.**

Yellow warnings:
The current position is near to a NOFLY zone. It could be possible to fly in within the advance warning time (default 30s).
There are two warning situations:
(1) The fly in into the NOFLY zone is predicted.
(2) The predicted flight path is too close to a NOFLY zone.

Red warnings:
The current postion is "wrong" and violates an airspace. So you e.g. fly in into a NOFLY zone or leave an airspace.

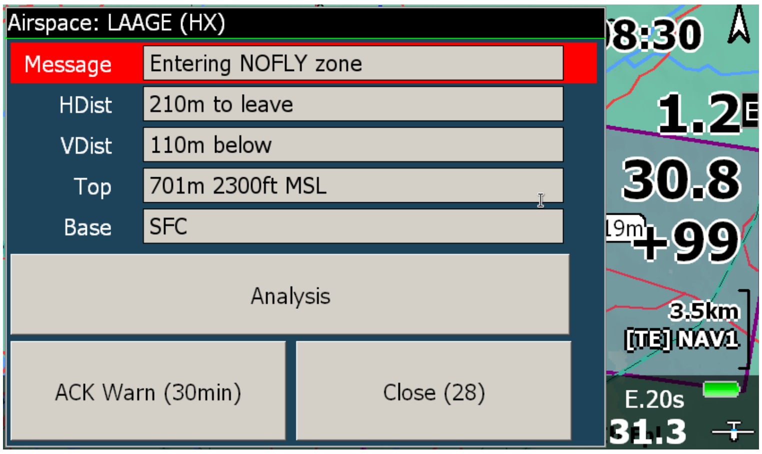


Figure 14.4: Airspace warning RED with possibility to acknowlegde and possibility to call the airspace analysis.

The airspace warnings show the warning reason, the warning level, the name of the airspace, the horizontal and vertical distance to the airspace border and the lower and upper airspace borders.

The messages are shown for a preconfigured time interval but can be closed by hand any time.
Within the message window the warning can be acknowledged for a pre-configured time, after which the message windows closes. The message itself is still available and can be recalled by

Menu ▶ Info ▶ Info 2/2 ▶ Message Repeat

An overview of the airspace situation can be requested by

Menu ▶ Info ▶ Nearest Airspace

which calls up the airspace sideview, more see **chap. 14.5.2**

Acknowledgements:
Every airspace has a warning level and a corresponding acknowledging level. The currently calculated warning level is based on distances to airspaces, speeds etc.

The **acknowledging level** is set by the user by acknowledging warnings. A warning is only shown if the warning level increases above the acknowledging level.

Some examples:

1. You are thermaling at a not critical position, drifting a bit. Then a yellow waning is given. If you do not acknowledge the warning you get in every circle

a new yellow warning because the warning level is higher than the acknowledging level. After acknowledging the warning it is hidden for the preconfigured time interval (default 120s). After this time the acknowledging level is reset to 0 and the warning message appears again.

2. A similar situation occurs if you are thermaling at the border of a NOFLY zone. With every half circle you get a recurrent change of yellow and red warnings. If you acknowledge the red warning you suppress the warning in every new circle.

Acknowledging of activation/deactivation of airspaces for a day
Airspaces can be deactivated in LK8000 till the next programm start. Therefore you long click on the airspace in the map and deactivate the airpace within the message window. Deactivate means no airspace warnings according to this airspace will be given and the airspace is hidden in the map.

The warnings:

"Predicted leaving FLY zone" (yellow)
Position within, predicted position outside a FLY zone.

"Near leaving FLY zone" (yellow)
Current position inside a flyzone, but you are too close to the border to leave it

"Leaving FLY zone" (red)
You have just left the fly zone.

"Predicted entering NOFLY zone" (yellow)
Current position outside, predicted position inside a nofly zone

"Near entering NOFLY zone" (yellow)
Current position outside a fly zone, but you are too close to the border to enter it.

"Entering NOFLY zone" (red)
You have just entered the nofly zone.

Messages are additionally given if
you leave a NOFLY zone and
enter a new FLY zone.

Within the airspace dialog you can mark the airspace of interest as "selected". For a "selected" airspace the horizontal and vertical distance **Hdist** and **Vdist** are given and the airspace border is blinking in the map.

The status of the airspaces is given on info-page 2.4, right column *::

E = Enabled

D = Disabled
S = Selected
F = Fly-In modality

If you fly **within** an airspace, instead of the distance "0" "IN" is shown.
If you fly near an airspace with a yellow warning the distance to the airspace is appended by "!".

On airspace info-page the distances to the airspaces are shown up to 100 km and colored according to the associated warning level (white, yellow, red). The configuration of this info-page are store at the program shutdown.

Airspaces can be drawn with borders and border shadows in the map. So you can easily see if you are in or outside of an airspace.
Shadow drawing is CPU demanding, use it with CAUTION.

Airpace details will be show at activated ActiveMap (default) by a long click on the airspace in the map.

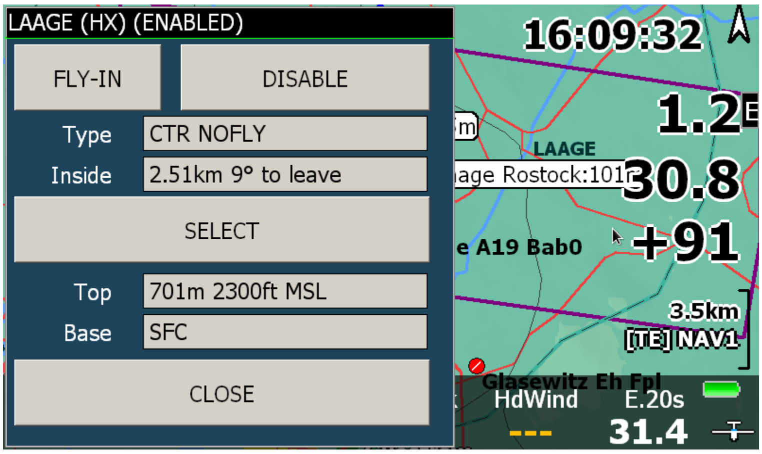


Figure 14.5: Airspace details with the possibilities to acknowlegde the fly in, to disable the airspace and to select the airspace for watching

Airspace warning are given at least one minute after the take off, that's why not to disturb the pilot in critical flight situations.

Optionally airspace warnings are drawn as colored marks at the plane symbol in the map showing the vertical distance to the airspace border, see **fig. 14.6**

black	- vertical distance o.k.
red	- vertical distance wrong for this NOFLY zone
orange	- vertical distance wrong for this FLY zone

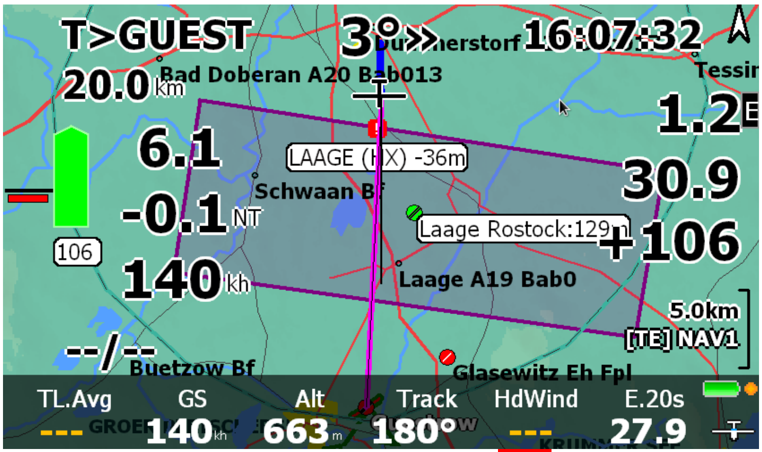


Figure 14.6: Warning symbol red in the map during approach to the airspace

14.5.2 Sideview with airspaces and SONAR

Text by Ulrich Heynen

Within the normal map view terrain heights are represented by colors. This way you get an impression about the terrain. This methods fail completely to display airspaces which are virtual obstacles and can be shown only in projection.

As an additional aid to imagine the own position relatively to the terrain and the surrounding airspaces LK8000 offers a **sideview**.

The sideview can be reached by

Menu ▶ Info ▶ Analysis

and browsing to the appropriate sub page.

Within the sideview are shown the glider (symbol) at its current height and the surrounding airspaces with name and type as well as the terrain profile. Detailed informations about the airspace can be again gained by a long click on it. At nested airspaces the information windows are stagged.

Within the sideview three different views can be choosen:

(1) Heading sideview
(2) Next waypoint sideview
(3) Next airspace sideview

(1) Heading sideview

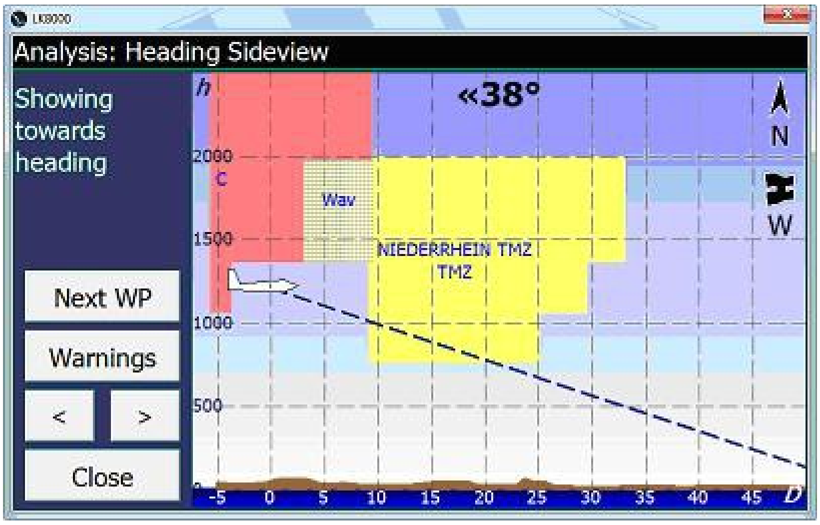


Figure 14.7: Heading sideview

The heading sideview shows the terrain profile and the airspaces for th next 50 km, see **fig. 14.7**. The blue dashed line represents the **expected glide path** according to the last 20seconds gliding. This view changes permanently at thermaling, the heading correction is also shown.

The **direction arrow** shows the heading (nearly N-orth here), the binoculars (drawn below) show that the view on the sideview is (nearly) from the W-est.

(2) Next waypoint sideview

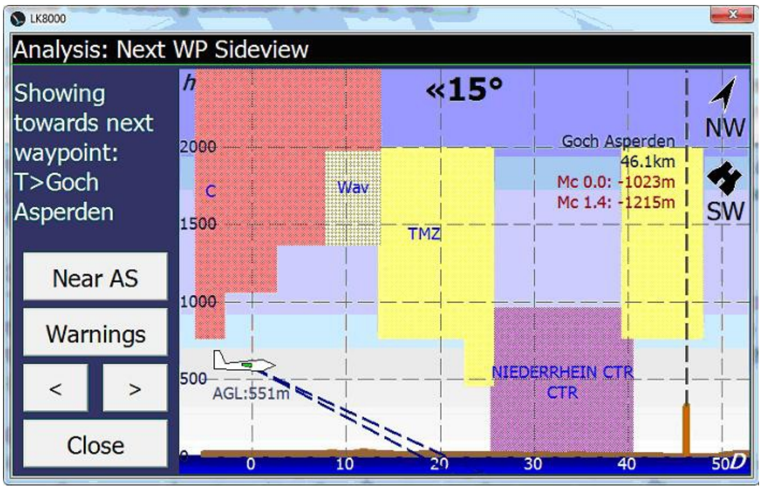


Figure 14.8: Next waypoint sideview

The next waypoint sideview shows the terrain profile, the airspaces, the plane with the expected glide path at current MC and MC=0 and the next waypoint with safety height bar (orange), if set.

Additionally the height above ground level at the plane symbol is given. The next waypoint is drawn at the right picture border and denoted with the distance, the arrival heights at current MC and MC=0. This way you can estimate how to glide over obstacles with different gliding strategies.
If the terrain is elevated, the waypoint elevation is also shown.

As the expected arrival height exeeds the safety height, the arrival height and the arrival bar are green colored.

(3) Next airspace sideview - Airspace SONAR

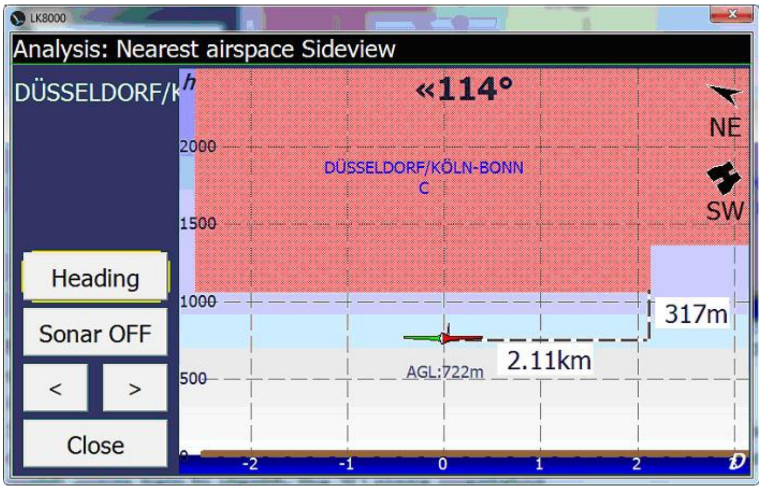


Figure 14.9: Position 317m below an airspace C, heading north east, view from north east to south west

This sideview contains the terrain profile and the airspaces too. In it the horizontal and vertical distance to the next airspace are shown.
Coming close to an airspace border (<1km horizontal, <1000ft vertical), the diagram is zoomed to an appropriate level. In order to navigate near an airspace without gazing at the screen an acoustic distance feedback is given (similar to a **Sonar**). It can be turned off with the **[Sonar OFF]-**button.

Attention:

If one flies into an airspace the Sonar assumes that it was desired and authorized and stops to "ping". The very next airspace will be calculated without taking the current into consideration und the Sonar now counts on this "outer" airspace.

The ping of the Sonar starts again
* if a new airspace is reached,
  i.e. also airspaces which are touching the current
* if an airspace is left,
  the ping tone and its frequency are decreasing

Plane symbol:

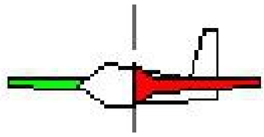


Figure 14.10: Plane symbol

Since this view does no more represent the heading, the airplane symbols changes depending on the angle relative to the waypoint. The elevator as well as red (left) and green (right) wings help to identify the 3D plane orientation. Please note that the plane symbol is not a true to scale model, it is much too big for the scale. So it might be drawn “into” a mountain.

North arrow (compass)

Figure 14.11: North arrow, north in front right of the plane, glider heading North West

On the upper left corner a (GPS) compass can be found, **fig. 14.11**. The north arrow is always pointing to the north (assuming the display being horizontally in front) while the letters underneath show the heading direction (N, NE, E, SE,...)

Binocular

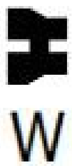


Figure 14.12: Binocular, looking from the East towards West

Normally the (turning) plane symbol is enough to identify your position relative to the obstacles. But in some cases we may want to know the viewing angle onto the sideview. Since the viewing reference is no longer the plane but a static point outside. In order to get that orthogonal point we have the binocular indicating the viewing angel relative to the geographic directions (north up). The letters underneath show the viewing direction (N, NE, E, SE,...).

Bearing difference

Figure 14.13: 5°left off waypoint direction

In the middle top of the diagram the bearing difference to the selected waypoint is shown. It has the same function like the overlay in the map view. This way it is easy to stay on track!
Please note that it will not be updated while circling!

Dynamic vertical zooming

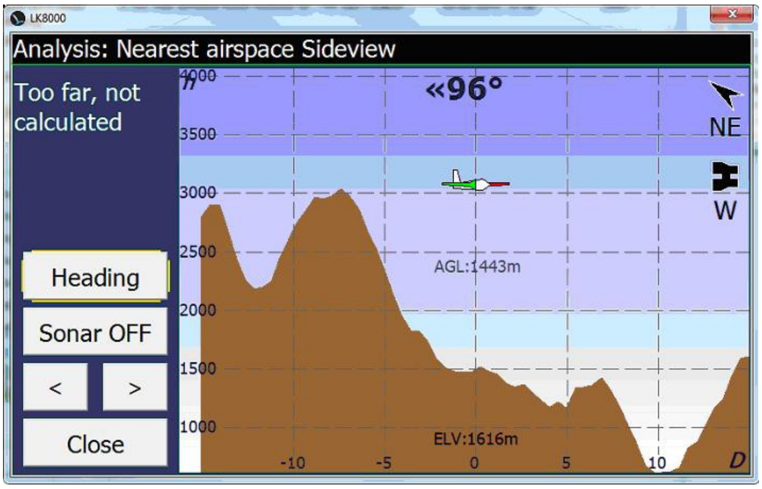


Figure 14.14: Scaled sideview at altitudes more than 3000m

The normal height of the sideview is from MSL to 2400m (8000ft). In case we climb higher the top of the diagram is increased to FL100 (3300m). If we even climb higher the base and the top are also climbing with a spread of 10000ft. If we are losing the 0m reference the (blue) sea level indicator will disappear.

An example: On the way to airfield Unterwössen (Alps, Germany)

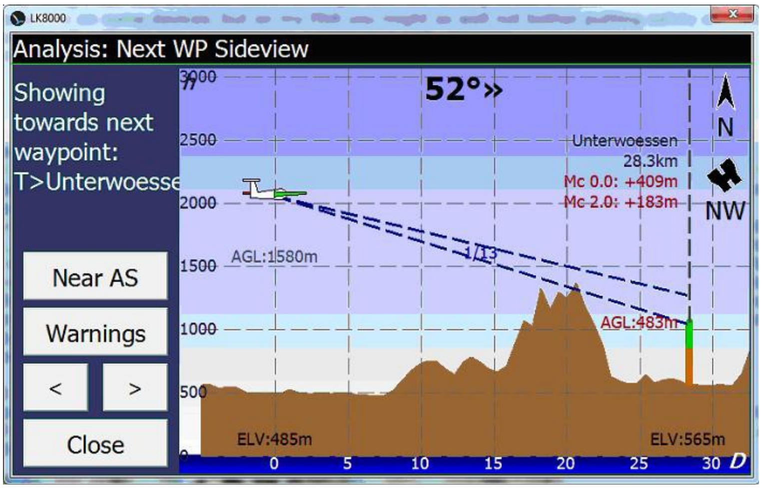


Figure 14.15: Flight to Unterwössen

No airspace will be crossed ☺
On the way to **Unterwössen** (Task **T>**) in **28,3 km** distance
Altitude: **2065 m** (ELV + AGL)
Terrain elevation at current position: **485 m** (ELV)
Height above ground: **1580 m** (AGL)
Heading exacts north **N**
Sideview from **SE** to **NW**
Target waypoint Unterwoessen **52°>>** to the right
Terrain collision if gliding with current **Mc=2.0**
Probably **no rerrain collision** if gliding with current **Mc=0.0**
Reaching Unterwössen in **483 m** AGL, **183 m above safety height @ Mc=2.0**
Reaching Unterwössen, **409 m above safety height @ Mc=0.0**
Terrain elevation in Unterwössen **565m**
Expected glide ratio **1/13** (as a result of Wind and Mc=2.0)

14.6 Wind

In glider flight the wind at the actual height is determined normally through the drift during circling or by the ZigZag Flight. LK8000 makes this calculation automatically and by choice.

At this point can a new method named **TrueWind** be introduced, with which LK8000 calculates the wind in straight flight with minimal directional changes, which is also interesting for the power plane pilot.

This idea is based on a pre determined directional vector and the actual flown directional vector above ground, which is determined by the GPS signal, to calculate the wind as a differential vector, see **fig. 14.16**.

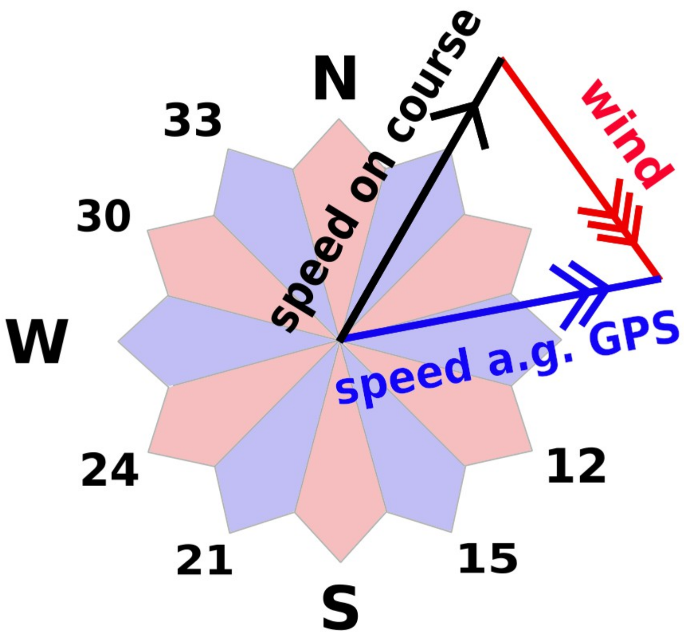


*Figure 14.16: **TrueWind** method*

Hence if it is possible to hold with the compass and the airspeed indicator only, in other words **independent of the GPS(**!) for a given time at the same speed and the same course, with the computer thencalculating knowing the directional vector, the over ground the wind direction and speed while in **straight and level flight!**
The so calculated wind value is for direction and speed and is displayed and/or used for the calculation of course correction.
The calculation of the wind by True Wind is an active procedure and has to be so selected by the pilot.

The kind of compass and airspeed indicator is of no importance but an intelligent air speed indicator which is connected to LK8000 would be preferable as in such case the choosen speed does not have to be entered into the program. A digital compass can not be connected to LK8000 currently.

The declination of the magnetic earth field, which is desirable, will be taken into account dependend of the current position !

Paragliders have a problem with this as they normally dont carry an airspeed indicator. More on this later.

It is important that the **TrueWind** calculation does not require any pre-action by the pilot. LK8000 registers what the pilot does and can calculate the wind immediatly on request, as the last minute of flight data is stored and can be used for the calculations with a resolution of a second.

A high accuracy of **TrueWind** was proven in simulations as well as in actual flight. True Wind is tolerant to in-exact steering and delivers even in turbulent flight useable data

14.6.1 TrueWind configuration

The configuration is done in system configuration page **5 Glide Computer, fig.14.17**.

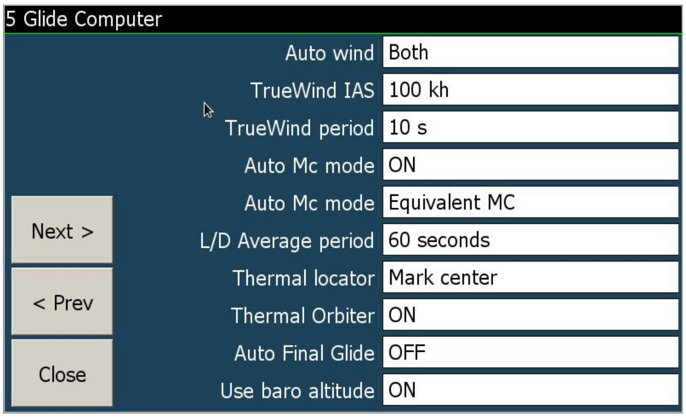


Figure 14.17: TrueWind configuration

TrueWind IAS (True wind indicated airspeed):
The TrueWind IAS value selected should be a speed which can be held in straight and level flight without problem

- The default value is 100km/h (54kt). This value can be changed but dont select a speed to low which cannot be maintained in turbulent air.

- You select a speed (IAS) which has to be held with the airspeed indicator at all altitudes

- Paraglider should use the basic speed (Hands Up Speed) of their chute.

- Before the TrueWind values are calculated one must hold this speed (true wind speed) constant for the TrueWind period, several seconds period (default 10s)

  By clicking on the TrueWind display field the speed to be used can be seen and also can be changed during the flight

TrueWind-Period:

On the TrueWind Period one fixes how long (in seconds) one must fly on course, straight and level before the TrueWind value can be calculated and requested. The default value is 10 sec. Values between 5 and 15 seconds are useable.
The TrueWind Period has a "tolerance" in case one cannot hold course/speed but a minimum of 70% of the true wind period must be correct.

14.6.2 Calculate TrueWind during flight

In order to calculate the TrueWind values in straight flight one has to complete 3 simple steps

Step 1 : Change your course

Look at your compass and change direction and hold course in one of following *principle TrueWind directions:*

0, 30, 60, 90, 120, 150, 180, 210, 240, 270, 300, 330 degrees.

Figure 14.18: Magnetic compass

On an analog compass this values are shown as:

N 3 6 E 12 15 S 21 24 W 30 33

Select a direction close to your course. For the calculation one has to change from the original course for a maximum of 15 deg and also only for the TrueWind period which is a useful maximum 15 sec.

Step 2 : Change your speed

As soon as on the principal TrueWind course, **stabilize your speed** to the TrueWind IAS, hold it and count the configured TrueWind period.
Attempt to fly this speed as exact as possible, LK8000 will calculate the average speed during for the configured TrueWind period.
Dont be too concerned for small errors but try your best to obtain a good measurement.

Step 3: CLICK ON THE DISPLAY AN GET THE WIND
After having flown the required configured true wind time go to

Menu ▶ TrueWind calc

and click onto one of the three TrueWind displays, specifically the one which contains the principal TrueWind direction which one has flown, **fig. 14.19**.

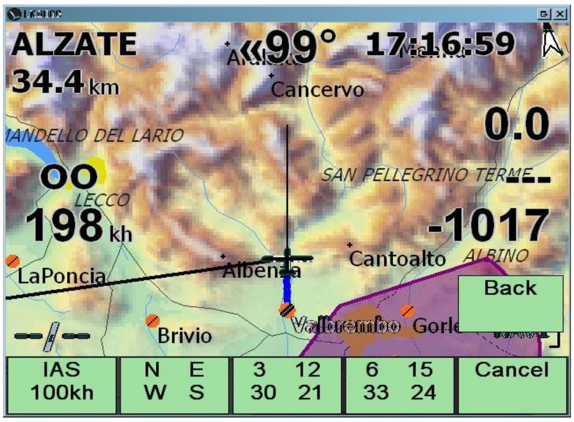


Figure 14.19: TrueWind-menu

A Window indicating wind speed and direction with a quality factor is then received requesting the pilot to confirm if these values should be used, see **fig. 14.20.**

Figure 14.20: TrueWind-Werteausgabe

Figure 14.21: TrueWind Fertig-Meldung

A Click on YES confirms that the new values should be used by the program, **fig 14.21.** With a click on NO will certain wind values be ignored

14.6.3 TrueWind messages and automatic recalculation

If one cannot hold course and speed for sufficient time, an error message, see below, **fig. 14.23**
But it is recommended that further tries should be undertaken.!!!

The computer will attempt with the TrueWind-algorithm during the following 20 seconds automatically to re-calculate the wind. As soon as sufficient data for a calculation are available a new wind message will be given.

Figure 14.22: TrueWind-error message: Too strong wind

Figure 14.23: TrueWind-error message: Keep speed longer

If the wind calculation is not successful within this interval no error message is given and one has to repeat the procedure.
If the wind is too strong that the track is deviating from the heading remarkably an error message is given too, **fig. 14.22**.

14.6.4 TrueWind quality

Depending in how well TueWind calculation requirements can be maintained, a TrueWind quality value given in percent.

Figure 14.24: TrueWind-quality factor

For instance, if the TrueWind period has been set to 10 sec and the course and speed could only be held for 7 seconds, a quality factor of 70% is given.

For information: The quality factor evaluates both, the *quality of speed* and the *quality of course* at the same time.
If the TrueWind period is set to 10 sec and the speed is held for 7 seconds and the course for 9 seconds a quality of 80% is given.

14.6.5 Accelerations and compass errors

One flies straight and level and wants to test the **TrueWind** the first time. One has to hold only direction and speed which appears simple.

One carries out the first step selects the course to the East. The plane flies directly east and does not roll.

Now for the second step. One wants to stabilize the speed to e.g. 100 km/h.

One applies elevator to adjust the speed to 100km/h and suddenly following happens. The compass direction does not show East anymore.! It moves away from the East direction !
How often you try the same procedure the same happens every time.
This is the **Acceleration Error** of the analog compass, **fig. 14.25.**

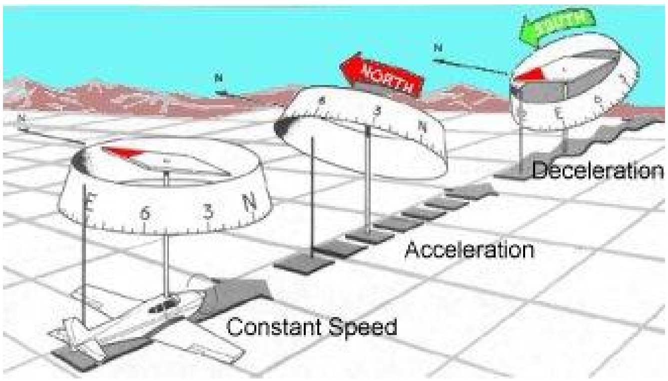


Figure 14.25: Compass acceleraton error

The magnetic forces and the inertia forces during acceleration and decelaration on East or West courses lead to indication errors on the magnetic compass

The errors are couse because of the pin mounting of the compass rose etc. see complete explanation in theory of flying books

What does one do with this acceleratiion errors?
One best ignores them!

Hence one carries out step 1 and step2, ignoring the compass and gives one's full attention to the speed.
If satisfied with step1 carry on with step 2 and request the result from step 3.

14.6.6 How well works the TrueWind procedure?

If one selects the principal TrueWind directions **N, E, W, S** (display in menu), one can assume that if (for instance) the course over ground is 020 and one wanted to hold 000 that the drift is 20deg because of the wind.
Or if as a further example, the course over ground is 070 on can assume that 090 (East) should be held with the compass. But if one selects a course over ground of 045 it is hard to decide if North or East was steered.
The “dead area” or the “unsafe area” is in this case between 035 to 055. For this reason are course areas 035-055,125-145,215-235 and 305-325 for the display areas (N, E, W, S) considered to be unusable. The same is also true for the other **TrueWind** displays.

If **wrong wind values** are noticed one should consider to calibrate the airspeed indicator and especially the compass!

14.6.7 TrueWind with a connected IAS-sensor

If speed is received from an intelligent instrument with integrated IAS wind sensor there is no need to enter the **TrueWind Speed** (TrueWind IAS) in the system configuration page 5. In this case one only has to fly the correct course and hold any speed you like.

14.6.8 TrueWind and the soaring simulator CONDOR

Since LK8000 version 1.20 the wind automatically set and actualized, by the values Condor sends via NMEA stream. Therefore one gets in real time the correct wind, hence there is no necessity to use TrueWind.

But the TrueWind calculation is still available. In case one wants to test the TrueWind with Condor one has to hold course and speed as described earlier without an IAS sensor. LK800 knows that Condor is used and when the true wind values are requested on gets them as in a real flight.

14.6.9 TrueWind for paragliders

Paragliders and hangliders normally have no compass, hence they do not know the steering course. Some multifunction instruments, like the **Garmin 76S** series have an electronic compass which only works if it is correctly placed. One can buy a good magnetic field compass which might be a good idea in case the GPS stops working.

The speed is available on some instruments like Flytec, Compeo andDigifly.
Otherwise it is best to use the “Hands Up Speed” of the Paraglider
The basic speed for competition paragliders is 39 km/h
Die **TrueWind** period should be reduced to 8 seconds.

14.7 Course

If one has its position(GPS) and course line calculated by LK8000, one only has to consider the wind in order to follow the correct steering course.

With LK8000 it is simple to stay on course to the target, one only has to follow the numeric given course corrections which were calculated with all the relevant data.see **fig. 14.2.**

Terrain obstacles on course which need to be avoided by flying around or over, are displayed on the map and will be discussed for gliders and para gliders in full later.

If one wants to oriented oneself about distances on course, the Visual Glide help can be used, see **chap.15.4** with this one can estimate absolute distances on the map.

14.8 Headings and Iso-flight areas for GA

GA navigation is additionally possible with a course scale (plane category GA aircraft), see **fig. 14.26**. In the upper middle of the map the current heading is shown additionally. The labels for the airspaces are valid. Within the figure all landscape areas which are higher than the current altitude are show in red, all below that up to 500 ft are in yellow.

This mode is optional and only for GA. Cruising downwards which is characteristic for gliders is not considered!

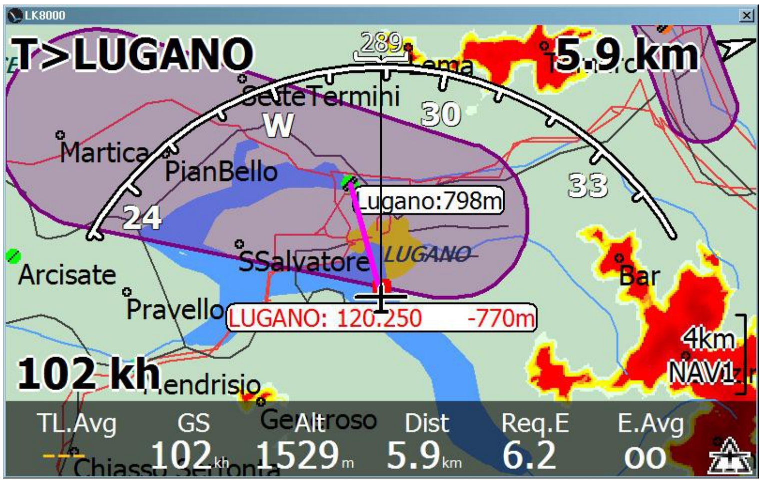


Figure 14.26: Course scale and iso-altitude areas

14.9 UTM Position for para- and hanggliders

In the **para and hanglider mode** the present position can be displayed in UTM format, with a **long click onto the upper right corner** of the map

Figure 14.27: UTM-Position

This function is considered for emergencies (localization of accident positions) and shows the actual position in lat/long exactly (deg/min/sec).

Para gliders must know how to determine their exact position, anytime, immediately!

14.10 Where am I? (the ORACLE)

If someone wants to give his position via radio, often something unclear can be heard. He tries very hard but if there is no landscape sign it is not easy to describe the own position.
LK8000 helps here with the ORACLE ...
With waypoints and topology in mind the ORACLE gives a position message which only has to be read into the radio, see the example in **fig.14.28.**

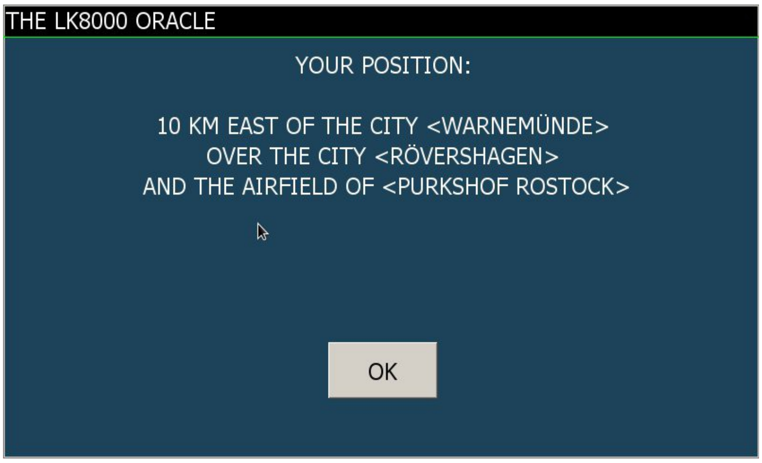


Figure 14.28: The ORACLE

The ORCALE can be ask by a long click on the map center, or, if an airspace "disturbs" there, by the menu

Menu ▶ Info ▶ Oracle

The language of the ORACLE is sometimes a bit strange, but keep in mind it is an ORACLE. ☺.

15 Gliding informations

For gliding it is necessary to know relatively more things, since including all other required information, one has to use the energy provided by the atmosphere as fuel to stay aloft. Parametric data, for example, Total Energy or Netto Climb are of no interest to the power pilot.

15.1 The most important gliding parameters

The more exact one can determine the required basic data, the more valuable are the values calculated thereof.
To achieve this are of course the in the plane installed specialized Instruments required. If intelligent instruments are installed they should be used and efforts made to connect these to LK8000.

Especially important are the basic flight parameters(data)

the **height** (pressure altitude)
the **speed**
the **lift**
the **wind**

Together with the knowledge of the planes performance data, in particular the polar, the position (GPS) and the terrain elevation
the available **glide range** and
the available **landing fields** within this glide range can be determined, and
the **glide path** established.

And together with the climb rates the optimum speed can be established.

15.1.1 Height - QNE, QHN, QFE

If the available NMEA data from an intelligent instrument with pressure sensor (Suunto, Casio, Flarm, LX, Zander,Cambridge etc.) gives the barometric height it should definitely be used and evaluated. For this use the system configuration page 5 option "Use Baro height", into the "On" position. The barometric height will then be internally used for all navigationial calculations.

QNE
This height is based on the **standard pressure p=1023.25 mbar** which is the assumed air pressure at sea level in the Standard Atmosphere. Each height relativ to the standard pressure is called QNE. All airspace and flight navigation are defined, relativ to the Standard Atmosphere and therefore use the Standard pressure(QNE) to define height.

QNH
As the air pressure changes all the time, the correction must be adjusted on the altimeter before flight commences. Normally is the displayed heigth corrected to the known airfield height (elevation) which results in the reference pressure being automatically shown on the altimeter, this is known as **QNH**.
In the configuration menu basic data

Menü ▶ Config ▶ Basic Setup

can one either adjust the airfield elevation or the QHN.

But first, the correct applicable barometric height must be known. This can be done in the plane on the airfield to adjust the altimeter to the airfield elevation on the dial, at this time the numerical pressure display also changes to give the QNH value. During the flight the pilot has to ask Flight Information Service via radio for the QNH. Then the altimeter will be adjusted to this value (QNH) which automatically recalibrates the height.

Automatic QNH calibration
LK8000 attempts, on take off, to automatically establish and set the QNH (actually the height/elevation).

Thee QNH-Autocalibration only functions if:

- Barometric pressure is available from an altimeter, E-Vario or FLARM
- GPS data are available
- The terrain height is configured and one stands on this terrain
- The plane is not moving
- It is the first attempt to set the QNH not after a landing
- The QNH has not been set manually, LK8000 does not change such settings.

The first attempt requires proper GPS data. LK8000 registers immediately the position and if near the home airfield (less than 2km) the home airfield elevation will be used. For this, it is of course required that the home airfield elevation has been entered. In which case, will the home airfield barometric pressure, in accordance with the home airfield elevation, be set.

If one's location is not close enough to the home airfield, LK8000 will attempt to use the terrain height based on the actual position. But this requires normally a re adjustment of the original configuration, as the terrain height is never exact, but averaged is over a larger area.

If the QNH auto calibration is configured, a message in the display will announce that in order to set the airfield height to (for example 229m) the QNH was set to 1021.3 mbar.

Procedure for the QNH automatic calibration:
A procedure to let the QNH set automatically, if a FLARM or another device is

connected, which gives a barometric height operates in following steps:

(1) Switch on FLARM or the other device with a barometric height and wait for a GPS fix,

(2) start LK8000.

LK8000 initializes and receices the barometric height and the GPS data. Delivers the device with the barometric height also the GPS data (like FLARM) the GPS data should be correct!

LK8000 receives the GPS Data, determines the Position, checks that this position is very close to the home airfield and the plane does not move. LK8000 also expects the plane is outside of the hangar on the ground at the home airfield.
At this point LK8000 changes the pressure value, so that the relative height is the airfield elevation.

QFE-automatic calibration
The QFE uses after pre-configuration the GPS height or the barometric height.
The QFE is on the ground **automatically** set at 0 (Zero).
But it will **NOT** be re-set to 0 (Zero) after landing.

> LK8000 uses a simple QFE usage. The QFE is being used by LK8000 as height difference depending on the availabilty either for the GPS or for the barometric height. For this reason does the QFE **not** alter, if the QNH is re-set during the flight.

QFE - Manual re adjustmenent
The QFE can be in menu Config 3/3 manually re-set. One will be asked to confirm this prior to the reset.

15.1.2 Speed IAS, eIAS

If an intelligent instrument is connected with LK8000 and the speed **IAS** (**I**ndicated **A**ir **S**peed)can be directly calculated, one is in a very comfortable position.
If this is not the case but at least a barometric height (e.g. from a FLARM) can be given to LK8000, LK8000 can attempt to estimate the airspeed which is also shown on the analog airspeed indicator.
To get this, first the speed over ground is corrected with the wind and thereafter with the air density in the actual height the plane is flying. This so calculated speed is shown as **eIAS** (**e**stimated **IAS**).

15.1.3 Climbing

The netto climb (netto vario) is approximately calculated by using the known sink from the sailplane polar at a given speed (IAS, eIAS) and adds this to the present climb.
As example, according to the polar of the DG300 at 100km/h it sinks with 1.4m/s and with an airmass rising by +0.6m/s the netto climb is -1.4m/s + 0.6m/s = -0.8m/s.

15.1.4 Total energy TE

The total energy (TE) also is being estimated, so that if on pushes or pulls on the stick the estimation of the netto climb deteriorates.
The total energy is of interest to the glider pilot, as it characterises the flight profil, as for instance a reduction of the speed reduces loss of height.

15.1.5 Wind

In addition to the already explained method to obtain the **TrueWind** in straight and level flight it can also be calculated from the **DRIFT during circling** or during **zig-zag flight**.

While the wind calculation through the drift during circling is always available and hence is standard, the wind calculation through Zig-Zag flight requires data from an IAS sensor. But no special flight manoeuvre except course changes in at least 40 deg segments are required.

15.1.6 Course values

Also in glider flight one can only navigate when one's **position** is known, and one has the wind corrected **bearing,** which gives the correct **course** over ground to the target and the flown **distances** are known. All these data are provided by LK8000.

15.2 Snail track

The track over ground during flight is drawn on the map as what we call **snail track**. When a zoom is used below 3 km this track is displayed in multi colour, **fig. 15.2**, otherwise it is displayed in blue.to make it more visible.

The used track colours correspond to climbing/sinking

- For gliders the netto-lift value is measured or estimated and used for the measurement of the Climb.Value.
- For paragliders or hanggliders the lift value (measured or calculated) is used.

The colours green, yellow and red show climbing. Blue violet and black indicate sink.
This is valuable on a slope as the best areas to initiate the turn around can be selected.

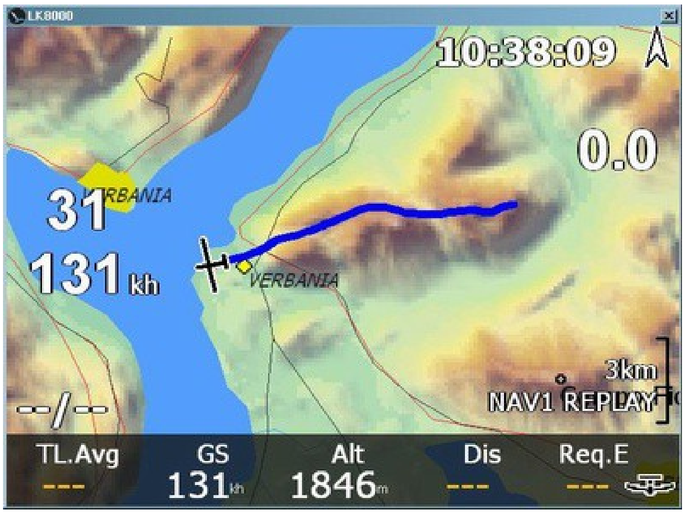


Figure 15.1: Snail track at lower zoom

With a high zoom the displayed area gets smaller, therefore a blue line is used as snail track, rather then the multi colour snail track which would become blurred and unreadable, **fig. 15.1**.

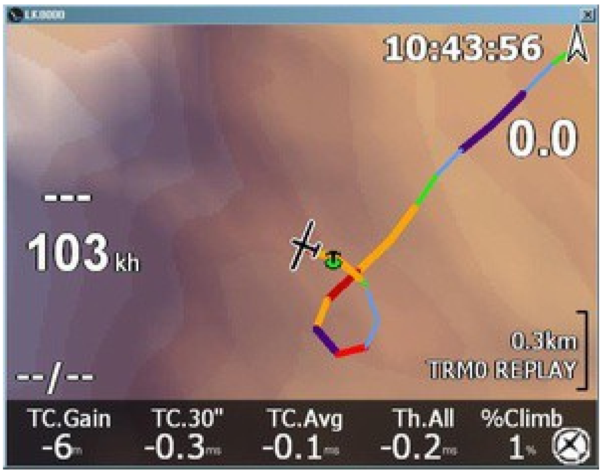


Figure 15.2: Zoom change during circling

If one starts circling the display is being changed into the circling mode with a different zoom and the multicoloured snail track re-appears.
The track colours during circling will also be displayed even at a higher zoom value, **fig. 15.2**.

The size of the snail track on the map can be configured during flight in menu Display 3/3 "Trail", short, long, complete or out.
The option completed does not display the complete track flown, but only the track flown within approximately the last hour.

15.3 Glide range

From the actual height, the speed, the polar and the terrain heights, LK8000 calculates the Glide Range and displays it on the map, **fig. 15.3**.

Figure 15.3: Glide range flat country

Fig. 15.3 shows the glide range display configured in such way that the available glide range is shown clear and the area lying outside the glide range is shown shaded.

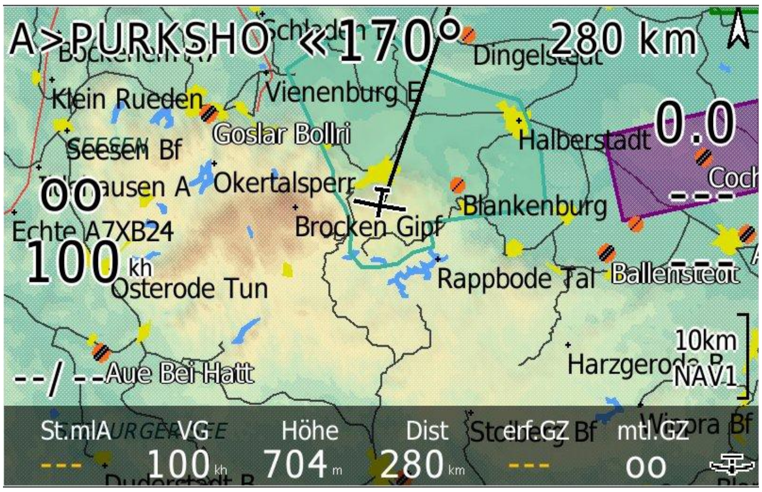


Figure 15.4: Glide range mountainous terrain

The difference in the glide range, in mountainous terrain, can clearly be seen. While in flat country the glide range is nearly round, in the mountains the influence of the topology is clearly visible, see shaded areas in **fig. 15.4**.

15.4 Visual glide assistant

The visual glide assistant (Visual Glide, VG) draws arcs on the map, **fig. 15.5**, with each representing a height loss and a distance.
One can initiate the visual glide assistant VisualGld in the menu Display 1/3
The actual height loss occurs in steps of **100m**(300ft) and is calculated with the **current L/D**.

Figure 15.5: Visual glide

This figure shows the usage of the glide assistant (VG) during the flight.

As an Example: The flight track leaves land and crosses a large lake

- How does one know where the next thermal trigger point will be?
- How large is the Lake?
- What will be the loss of height if one continues in this direction?

All this information can be obtained from the Visual Glide Assistant

One can read of the distance to the next mountain ridge/peak after the lake crossing, directly on the map which is the one after the third arc. On the second arc one can read 7 km and on the fourth which is only partially displayed 14 km. This gives a distance of 3.5 km between each arc.
Having these figures on now knows, that the Mottarone Mountain peak is approximately 12 km away. One also knows that the actual L/D is 36 (see large number left on the map)and that one looses to this mountain peak a little more than 300 m in height in the map.

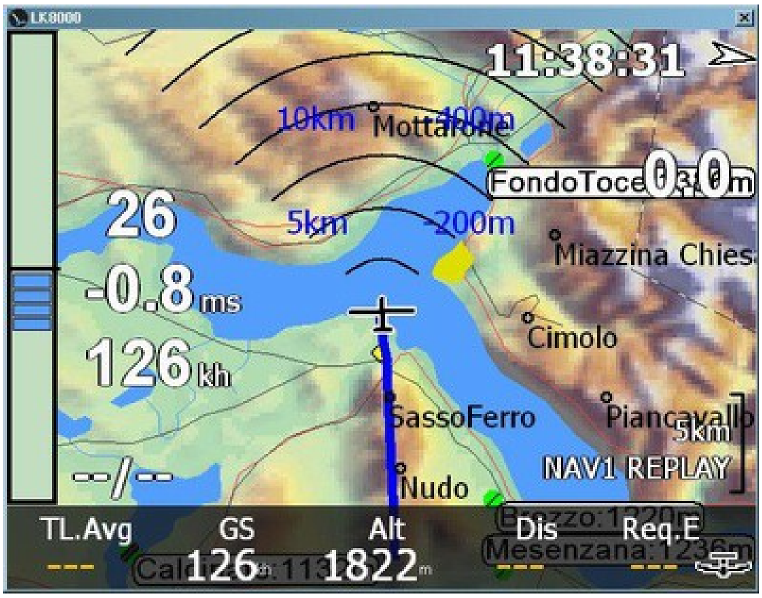


Figure 15.6: Visual glide assistant at changed L/D

When the actual L/D changes, it changes also the location and distance of the arcs together with their values, **fig. 15.6**.
Flying into the lee of the mountain the actual L/D is lowered to 26. With this L/D one would lose 400m to the mountain Mottarone 10 km away.
The used actual L/D can over a pre configured time be averaged. (pre configured average time 2 minutes)

Restrictions for the Visual Glide Assistant
The smallest actual L/D that can be shown, is 1/4 of the best L/D of the plane (in still air).As maximum L/D that can be shown, is the best L/D of the plane (in still air) accepted.

Even if, with a tailwind the plane would fly with a 30% better than best L/D of the plane in still air, is the VG limited to the best L/D of the plane in still air LK8000 gives on purpose conservative values without tailwind consideration or energy lines.

On the other hand, if one flies with a headwind or simply with a higher MacCready Value, the visual glide assistant will show and use the current L/D.

Please be aware, that the visual glide assistant shows the actual L/D without (!) any safety factors on the map. When one changes direction one has to be aware that the new L/D caused by wind influences will only be shown after the averaged time which has been configured in.

The visual glide assistant does not calculate with the wind. It uses the wind influence on the current L/D.

The visual glide assistant can also be used to estimate distances on the map. The distances are absolute values and shown in the map exactly.

15.5 Circling

Circling is by LK8000 explored in various ways.

- The virtual variometer displays climb in various modes. But in order to use the virtual variometer effectively for thermalling, it must evaluate real variometer-data and not only GPS data.
- The Info Page 1.2 Lift shows the important climb values numerically.
- As soon as circling is recognized, LK switches automatically in the map display mode circling. 
- The thermal height profil will be established and displayed.
- In the flight analysis, the glide range will be displayed in the barogram.
- The Orbiter gives acoustic help to center the thermal.
- The position of the last thermal is stored as virtual waypoint.
- The positions of the last thermals have their own info page and can be selected as targets.

15.5.1 Display mode circling

As soon as one starts circling the map display automatically switches into the circling mode, noticeable on the changed menu symbol.
At the same time will the zoom be changed to a useable size and the map will be altered to North accordingly, **fig. 15.7**.

The snailtrack because of the larger scale becomes coloured, with the climb values corresponding to the colours of the track (Red-Climb, Blue-Sink).

If configured, the thermal height profile is displayed in the upper left of the map, this is to indicate in which height level one should get the best lift (the graphic is somewhat on the positive side).

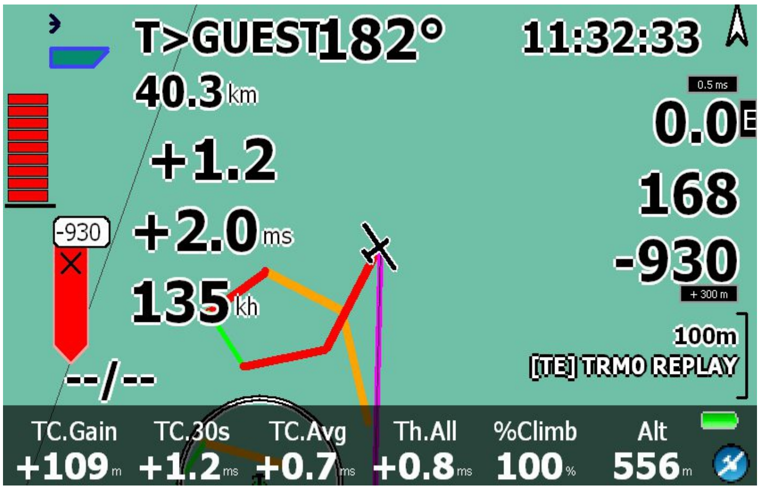


Figure 15.7: Circling mode

Only in the circling mode is the special foot bar TRMO active, this displays all the required Lift parameters:

TC.gain : Height gain in this thermal
TC.30s : Climb during the last 30 seconds
Should it be lower than the average climb in this thermal, leave it.!
TC.Avg : Average climb in this thermal.
Is it useable in comparison with the days climb values ?
TH.All : Average climb rate of the day
%Climb : Circling in %
He who circles, flys half the time backwards
Alt : Alitude QNH

15.5.2 Centering help - Orbiter

LK 8000 offers the pilot an assistant to centre thermals, named **“Orbiter”**, which can be activated in the System configuration page 5, Glide Computer. A simplified assumption is taken in this calculation, that the thermal has a diameter of approx. 400m (1300ft). When a circle is started in a thermal an approximate centre of the thermal is calculated which this marked by a buoy (centre point) with a 100m diameter circle displayed around this point.

This circle is considered as the idealized circle which should be flown by the glider and the pilot will be notified by an acoustic signal when it becomes necessary to flatten the circle for a short period (1 bell sound) or a bit longer (2 bell sounds) to maintain the correct circle around the centre.

This signal if required will be given when ever required in time to correct the circle.

Important! The orbiter uses the calculated thermal centre only 2 minutes after the circle is started. The time laps is required to ensure the best possible centre calculation. After a 500 m height gain the acoustic signals are stopped. The best results are achieved by flying a 40 - 45 deg bank 20 second circle.

This acoustic centering help, allows the pilot to maintain a constant watch of the airspace !!!

15.5.3 Virtual bank indicator

On info page 1.6 is a virtual **Bank Indicator** available, **fig. 15.8**.

Figure 15.8: Virtual bank indicator

Although the bank indicator is basically a technical toy which develops out of the evaluation of GPS data and is 2 seconds slower than the actual bank encountered, it still can be of help in problematic visibility situation.
Better this, then nothing!

15.5.4 Thermal history

On info page 3.3 THR a history of thermals is given, see **fig. 15.9**

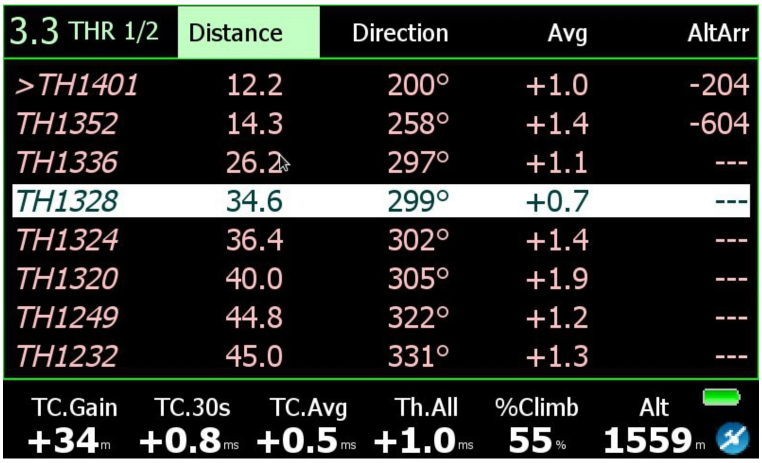


Figure 15.9:History of thermals, Avg =average climb of that thermal

The tested thermals of the day (max 50) are listed by order first in, first out and fully qualified waypoints for navigation.
The thermal name is constructed by "TH" and the start time of circling in it. By a long click on the display center one gets a detail window, see **fig. 15.10**. Within this detail windows the nearest waypoint to the thermal is shown additionally with some other useful informations like the team code for this thermal.

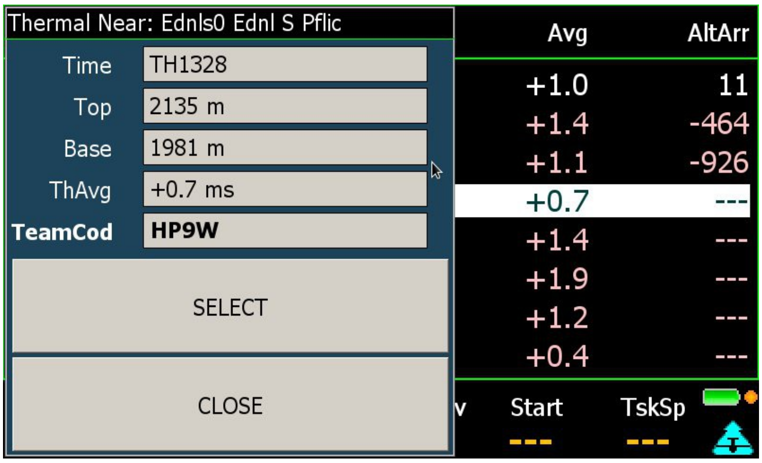


Figure 15.10: Thermal detail window

By choosing the thermal in the detail window it can be used via the multi target function **L>**, i.e. if the thermal does not move (often in the mountains) one can find it again.

15.6 Cruising

If one has sufficient height one can fly in a direct line to the goal/waypoint. How to proceed in order to arrive in the shortest time at the goal, can be mathematically explained.
For this we find the MacCready speed to fly theory [McCready] or a further development to this from Cochrane [Cochrane].

15.6.1 Speed optimization

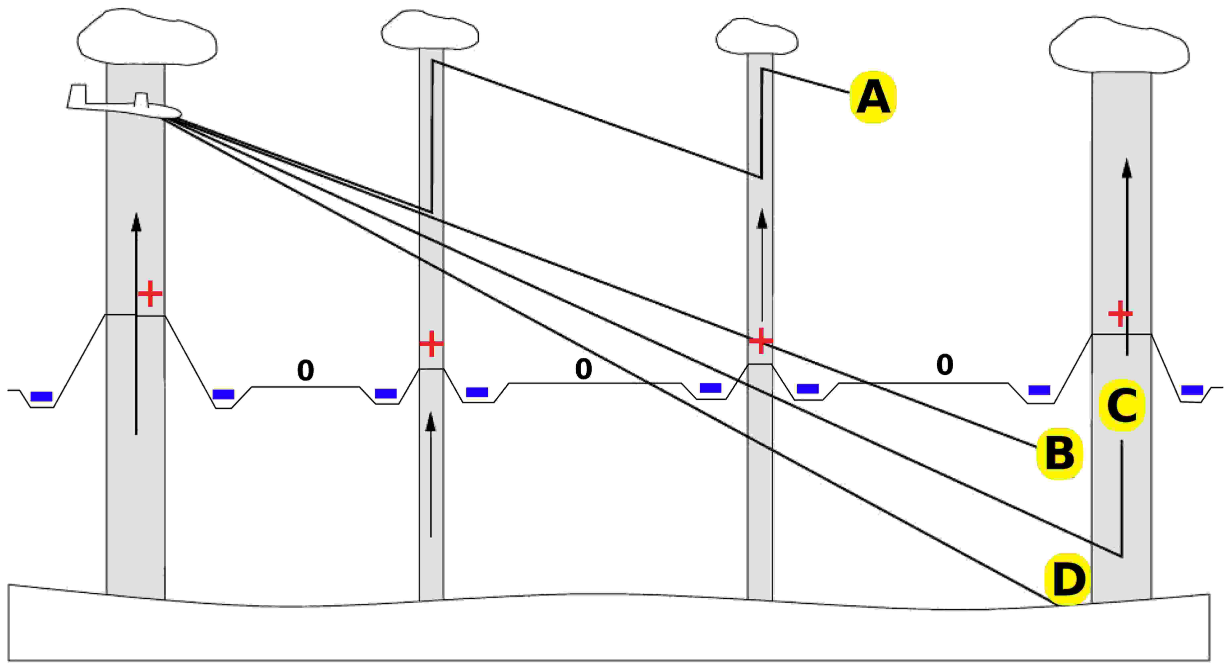


Figure 15.11: Speed optimization

In **fig. 15.11** the classic **Reichmann**-example is shown.
Four differently brave pilots (A- little brave to D-very brave) fly at the same time to the next expected thermal. Pilot A is slowest because he uses every weak thermal on the way, pilot B reaches the strong thermal soon. Pilot D does not reach the thermal at all, pilot C was the fastest his speed to fly was correct.

MacCready's speed to fly is based on the medium climb speed of the day, this is also provided by LK8000. But one can also use a MacCready value, which is continuously actualized in accordance with the current climb conditions, [eqMC].

As can be seen from the figure, the theory for the calculation of the optimal **Speed to Fly** is based on idealized models which again are based on the distribution of rising and falling air masses, which tend to lead to varying results. The performance of modern gliders allow at given conditions an airmass flying, the **Dolphin Flight**.and LK8000 calculates for this also suggested speeds, Speed to Fly Dolphin **(SFD).**

Rapeseed fields in flower in Mecklenburgia, photo by Stefan Tonk
(Airmen Club Rostock, Germany)

15.6.2 Terrain obstacles on the glide path range

If one configures in the setup system page **13 Map Overlay**, option "**Glide Terrain"** as **Line** or **Shade**, then any terrain obstacles will be displayed in the map.

> *The obstacle calculation works **only** during flight, not on the ground. But it does work in Simulation mode also on ground.*

If the goal is outside the actual glide path range obstacles are of course not displayed, simply because on cannot glide as far with the available height. The value for the arrival height is negativ which indicates that one has to climb.

Figure 15.12: Below glide range

In **fig. 15.12** the plane is 50km from the airfield (Caiolo). At 1829m QNH an L/D of 40.2 is required to reach the airfield. With a DG300 it shows that one has to climb an additional 77m in order to reach the field directly, without obstacles blocking the glide path. The alps block the glide path, but in the map nothing special is displayed.

Figure 15.13: Above the glide path with two obstacles

If the goal is within glide range and if one or more obstacle are located on the glide path, is, the arrival height and also the required L/D, displayed on the map in **RED**, **fig. 15.13**.

At 1929m QNH one is theoratically within glide range with an arrival height of +23m. But the mountains present an obstacle.
The required L/D and arrival height are, although the actual values are okay, displayed in **RED,** in order to warn the pilot in case of developing problems during the glide to the goal.
The first cross marks the first obstacle which would be met on a direct glide, 44m are missing, to be able to cross over the obstruction. The 44m indicate that the obstacle most likely is a steep mountain, as otherwise a smaller number would be shown or no number at all and only a red cross would be displayed.

The second red cross marks the second obstacle which would be encountered. The number shows that in order to cross it one has to climb another 1250m. For a 50 km glide this is a lot but the mountains in the area are really high. One can assume that the MacCready safety value is used on the flight to the obstacle, as in this case the MacCready value is set at 0.0 as one glides towards an airfield.

Figure 15.14: Above glide path, still two obstacles

At 3129m QNH one knows that height is still missing to reach the goal in a direct glide, **fig. 15.14**.
At these distances the values are rounded up so that errors in the calculation between the first and last obstacles can occur.

Figure 15.15: Clean glide path

At 3329 m QNH one finally has, as predicted, a **green symbol**. The goal is reached with a MacCready value 0.0 at 1423 m above ground, **fig. 15.15**.

Notes to obstacle calculation

If the distant obstacle can be displayed in the map, it will it be displayed together with the height difference which is needed to arrive above the obstacle. If the height difference is not diplayed then is its value smaller than 50m and one is still to far away from the obstacle. Any height difference value is rounded up to 50m.
The first obstacle will be displayed with a red cross the height difference only if its meaningful.
If one is less than 5km from the obstacle, the height difference will always be displayed, even if this height difference is only a few meters.

ALL CALCULATIONS for obstacles can on principle take into consideration the MacCready safety value, but it depends on how the safety factors are set in the system configuration. Is the safety height factor used only for landing field or also for waypoints?

If one glides towards a landable field, the MacCready safety value is used. If one glides towards a waypoint and has configured the MacCready safety value only be to used for landing fields, the calculation will be based on the current MacCready value.

Arrival heights above obstacles ALWAYS consider the terrain safety height!

15.6.3 Flap calculator

For glider with flaps there are different polars for different flap positions. The gliding behavior is according to these flap positions. For every speed range there is a favorite flap position.
If one has formulated an extended flap polar, see **chap. 27.2**, LK8000 calculates according to the current speed the appropriate flap position. Therefore the info-value flap can be placed within the info stripe **AUX9**.

15.7 Safety

The safety in gliding is supported by LK8000 through the function **Best Alternative** and indirect through **FLARM**.
The function **Best Alternative** searches within the glide range from the actual position continuously for landing fields and makes suggestions accordingly

The FLARM coupling delivers information about the actual traffic, but it is for principal reasons not used for collision warnings by LK8000.

15.7.1 Best Alternative

The function **Best Alternative** is always active and **tries to determine continuously the best landing possibilities based on the actual position.**
For this loaded landable waypoints and if possible terrain heights for obstacle determination are used.
The "best" landing possibility is not necessary be the nearest! Normally it is the home airfield or an airfield from which one can take off again by either winch or aero tow.
An airfield always has priority over an outlanding field. All these evaluations are taken in consideration with the L/D, wind, obstacles and, very important, high safety reserves. In particular in the mountains. The Best Alternative function searches continuously if in the area a good landing possibility exists and suggests such. Every minute (all 60 sec) is a new search is undertaken.

The information which are given in the info pages and in the foot bar, also are given, during these 60 seconds, with the actual required L/D and arrival height calculated.
In other words. The "Best Alternative" is once every minute calculated and displayed with the actual Best Alternative being determined in real time,
If the Best Alternative changes, a bell will sound and a notification blended into the map, see **fig. 15.16, 15.17**.

Figure 15.16: Best alternative height1

Figure 15.17: Best alternative height2

When the LK8000-sound is activated and the warnings for the **Best Alternative** are active, one has to watch for two sounds , which are also supported by a blended in notification on the map.

- One bell sound to advise that the **best landing alternative** has changed
- and two "Quack" sounds when one is too low to start a safe glide to a known landing field nearby or when no landing field is nearby!

These sounds will **only** be played when one is at least 250m above the safety height
If the safety height is set to 300m above the field, no sound will be played under 550m. One has to assume that the pilot is aware that he has height problems or that he just lands or takes off.

How does the Best Alternative "think"?

The **Best Alternative** attempts to make the best choice for a landing field intelligently. Similar, as the pilot would do during the flight.

1. LK8000 searches in the surroundings and lists internally all landing fields which can be reached with the best L/D of the plane minus the safety height.

Example: One is at **1300m**, the safety height is set at **300m**, the plane has a **L/D 40**.
The search area radius hence is **1000m x 40 = 40 km**.
This is only the approximate search radius in this case. The maximum search radius is limited to 100km.

Note: When one is more than 100km to the next available landing field, one can not expect the computer be of much use. The **Best Alternative** is on only a suggestion and can be wrong for many reasons, like errornous terrain data, a wrong QNH, an error in the waypoint list etc.

2. For each landing point LK8000 calculates the expected arrival height and considers therefore:
    - the current height
    - the terrain height of the landing point plus the safety height (safety height to be set on system configurationpage 6 Safety Factors)
    - the polar of the plane, wing surface cleanliness (bugs) and water ballast
    - A glide with a MacCready value, set at MacCready safety value (in Set up System page 6 Safety Factors). One should here set safety factor 0.5).
    - the wind
    - terrain obstacles

3. Even if one already considers a safety height and a glide with a MacCready safety value, one can still not accept an arrival height of 1m above safety height, That would be 2m from not achievable. Therefore on must better this value by 100m. Hence one should select a landing field which can be reached 100m above safety height. This is a safety height reserve which is called "OverSafety".

4. The list is sorted in the order of best landing field (with highest arrival height) to the worst. All landing fields are rated 1) 2) and 3). All that pass this list are to considered achievable.

5. For each landing field in the list, one calculates a required L/D (remember the wind was already considered in point 2). One sorts all landing fields for a L/D that is required, which is greater than 70% of the plane L/D in still air. (**plane L/D minus 30%**)

Example: For a plane with an L/D 40 an L/D of 28 will be set (safety L/D)
Now the Best Alternative from the list below will be selected:

a. If the home airfield is on the list and within reach with the safety L/D then choose it (HOME).
b. If HOME is not in the list choose a preferred airfield which can be reached with the safety L/D (“preferred see later)
c. If HOME and no preferred field is in the list choosen the next with safety height reachable airfield.
d. If no airfield is in reach with safety L/D, search for a good outlanding field which of course also should be reachable with the safety L/D
e. If NO landing field is reachable with the safety L/d, choose the best reachable landing field, suggested as in point 4.
f. If one has no luck with the selection as above, take a reachable landing

field without safety height reserve (the 100m arrival height)
g. And in the end, if nothing of above exists and there is nothing more to choose, one selects the last Best alternative. But then, one will be told that there is nothing reachable around.

Set **preferred landing fields** in the file **Waynotes.txt** in the sub folder **_Waypoints** of the LK8000 folder.

For careful consideration :

One sinks since two minutes and has most likely lost too much height. There was two minutes ago the possibility to glide in direction ***Best Alternative*** *but now it appears* ***too late*** *to turn around.*
The situation does not seem soo critical, one thinks ... until following message appears on the display:

Figure 15.18: No more landing fields!

Now one knows that a direct glide to an outlanding field does not exist anymore and there is a problem!

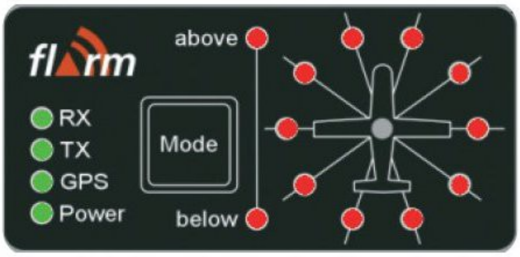
One should ensure, that this message does never appear on the display!

From time to time LK8000 displays a far away waypoint in a message window to advise that on could fly to this waypoint only to get 5 minutes later a message for another point that can not be reached anymore.
In other words, when nothing really important is to displayed in the map, LK8000 tries for **more than the obvious** information , showing available known landing fields!☺

Note:
For paragliders the **Best Alternative** is only available as multitarget if there

was an alternative during flight at all. If there are no landing places configured or determined during flight, the Best Alternative can not be selected as goal.

15.7.2 Utilizing FLARM



A connected FLARM is **automatically** recognized and its barometric height is also automatically available. The device type has to be set on "Generic" and "Use barometric height" must be "ON".

- If the connection has 4800 or 9600bps FLARM transmits **No** traffic information.
- If the connection has 19200bps or more Traffic information is also transmitted.

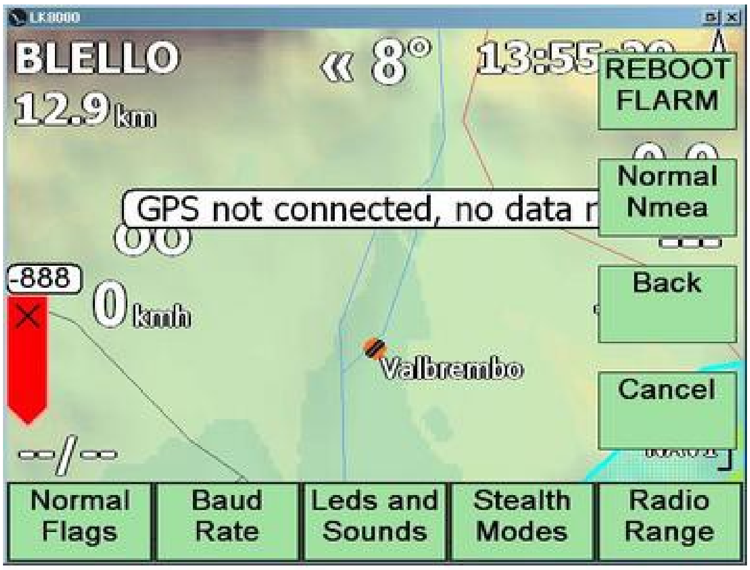


Figure 15.19: FLARM menu

LK8000 has its own FLARM configuration within the menu Config3/3 **but this sub-menu is only active when a FLARM is connected and recognised**. Some of the settings have to be done on the ground and are not available during flight.

- REBOOT stops FLARM and re starts it again automatically.
- "Normal NMEA" puts the FLARM onto the standard setting for NMEA Data, including the use of traffic information (as long as the connection is not slower than 19200 bps).

Baud rate menu

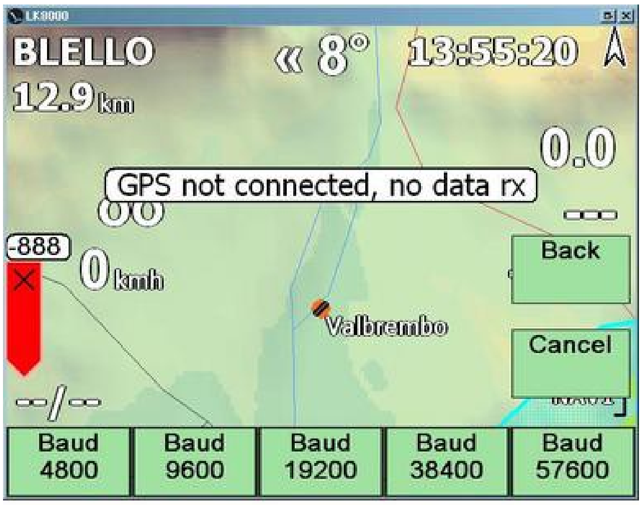


Figure 15.20: FLARM-baud rate-menu

If one sees this menu, FLARM is already connected to LK8000. This can be selected in different connection speeds, **fig. 15.20**. To get traffic informations choose at least 19200 Baud.

After the connection speed is set , FLARM starts with this speed and LK8000 gives out a warning about a faulty GPS connection. This is because the FLARM now works with this baud rate, **but** the device is listed with the old baud rate in the system configuration.
Therefore go into the LK8000 system configuration and set the speed of the FLARM ports to the corresponding rate then FLARM will again be displayed.

LEDs and sounds

Figure 15.21: FLARM sounds

In this menu one can set the required FLARM-LEDs and FLARM-sounds.

Stealth mode

Figure 15.22: FLARM stealth mode menu

In this mode only "Stealth ON" and "Stealth OFF" selections are available, **fig. 15.22**. The other functions are either reserved or closed as these require the Flarm firmware from other suppliers

In the stealth mode the number of transmitted telemetry data is drastically reduced as is the number of received data from other planes!

FLARM range

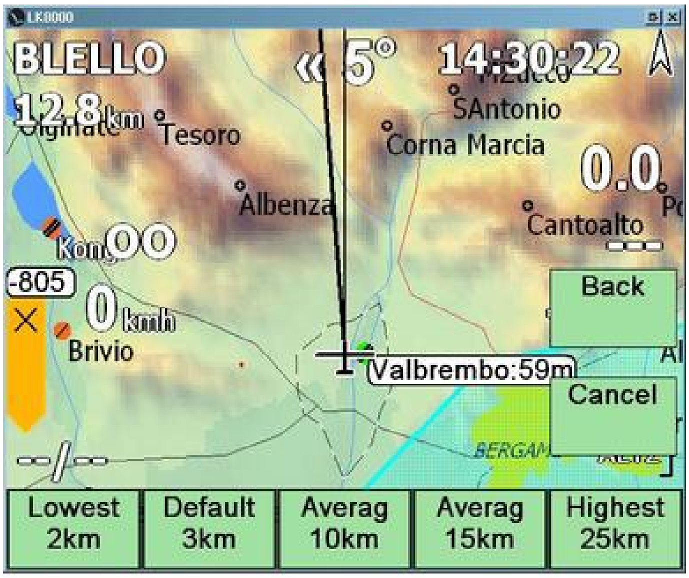


Figure 15.23: FLARM range menu

At default setting FLARM does not display traffic information which are farther away then 3 km. But FLARM can be set to widen the range up to 25km or im reverse reduced down to 2 km, **fig. 15.23**.
These settings can be made only while on the ground.

Traffic on the map
In the system configuration page **13 Map Overlays** the FLARM traffic data can be activated for display on the map. Traffic is then visible on the Map:

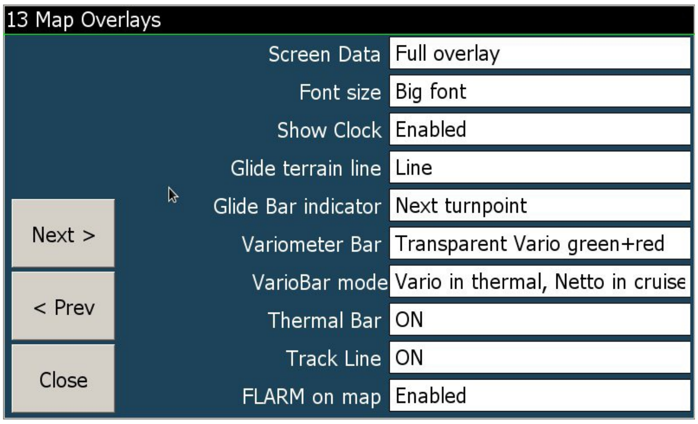


Figure 15.24: FLARM traffic configuration at the map

Normally, the setting **scaled objects** [ON scaled] is activated, without this setting the object display is too small in large map scales. After other planes are transmitted from FLARM to LK8000 they are displayed with a green or yellow symbol surrounding the position of the plane, see **fig. 15.24**.
The plane identification must be configured by hand.
The number 3.9 in **fig. 15.25** indicates the average climb of this glider.

Figure 15.25: FLARM traffic at the map

Real traffic, ghosts and zombies
FLARM transmits not all actual traffic information. As this information is sent in the NMEA Stream it is possible that this band width does not suffice and therefore there is no guaranty that all the traffic is transmitted from FLARM to LK8000!

Every time LK8000 receives information from another FLARM which can be identified by its own code, either through FLARMNET or the local data bank, will the last seen display be re-newed and reset to be shown as real traffic "**REAL**" .
This traffic remains **REAL** until 15 seconds after the last data reception. **REAL** traffic has a green symbol on the map.

After 15 seconds without new information this traffic becomes a „**GHOST**“.
This symbol is yellow on the map and in the text list it is displayed in light yellow and in "*italic*" font.
After an additional minute without a new code reception from the FLARM the **GHOST** becomes a **ZOMBIE**.

A **ZOMBIE** is not shown on the map. But it will be shown on the text list in the traffic page 4.1, in "italic" and light red.
After three more minutes without traffic information the **ZOMBIE** is removed from the list.

> **NOTE**: If a target which is a **ZOMBIE** has been selected, it will be marked and not eliminated from the list.

Limits of the traffic observation

LK8000 can manage up to 50 FLARM markings at the same time.

If new traffic is registered after 50 markings are listed

- the oldest ZOMBIE will be eliminated from the list.
- If there are no ZOMBIES on the list the oldest GHOST will be eliminated.
- **Warning!** If there are no ZOMBIES or GHOSTS on the list will the new traffic not be handled, will not be shown on the map and not listed on traffic page 4.1.

Display limitations of the traffic
In the map are up to ten traffic symbols displayed. If there is more traffic it will not be graphically displayed. In order to get information about additional traffic one has to use the traffic info-page 4.1, **fig. 15.23**.

Special info-traffic pages
If traffic is established an additional information page, **Traffic (TRF)** is available. One can reach this page the same way as the other Info-pages as fourth info-page. The info page traffic has at this time three sub-pages.

Information Page Traffic 4.1

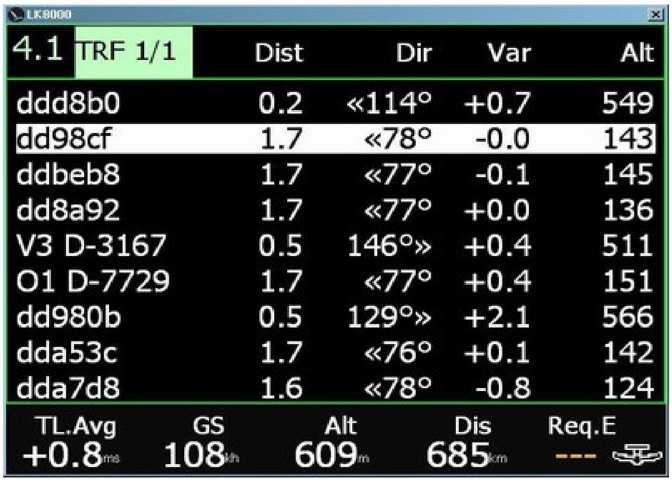


Figure 15.26: Info-page Traffic 4.1

This page is renewed every 5 seconds, same as Next-Target page. It can be sorted by name, distance, direction, climb rates and height. The name is either the FLARM-identification (e.g.dd98cf) or an identification belonging to a FLARMNET- (or FLARMIDS-) name (e.g. V3 D-3167).

The traffic list can consists of several sub-pages. For instance the designation TRF 1/4 indicates that the list consists of four pages.
These sub-pages can be changed with up and down gestures.
GHOST-traffic is displayed in light yellow, ZOMBIES in light red. The climb rates are averaged over 30 second periods.

Traffic details
With known gestures can the traffic lines be selected, e.g.O1 D-7729. The selected line will be highlighted and the selection is done with a long click in the middle of the line. After the selection a detailed sub-page is displayed, **fig. 15.27**.

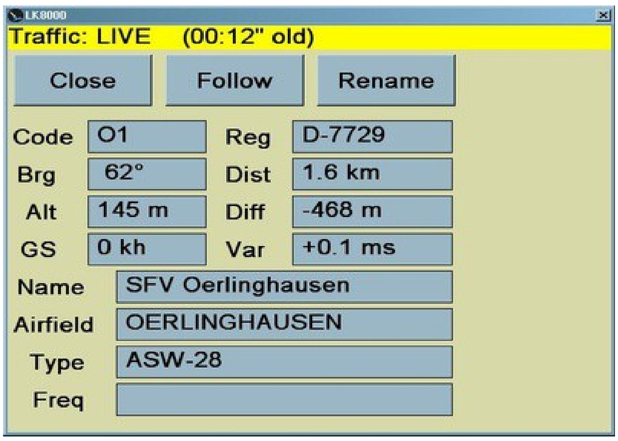


Figure 15.27: Traffic details

In the upper line "Traffic Life" one can see how old the Information is in regards to position, speed, height etc. In the example it is 12 seconds old which is very good.
For longer times, Ghost or Zombie together with the time of the last transmission will be displayed.

Display Rename
In order to put a readable name onto a FLARM Identification, one clicks onto the display button RENAME. After the assignment of a name, it will be saved automatically in FLARMIDS.TXT and is then available during other flights.

Display button Target Pursuit (Follow): Start the StarFighter mode
If one clicks on the target pursuit (FOLLOW) in the Detail-Page, LK8000 keeps the selected target under observation. This mode is called F104 StarFighter mode. ☺
LK reports “TARGET LOCKED” and uses on page 4.3 the Pursuit- Page.

StarFighter Pursuit-Page 4.3
The Starfighter page includes many information and presents a graphic display of what happens **in front** of the plane, **fig. 15.28**.

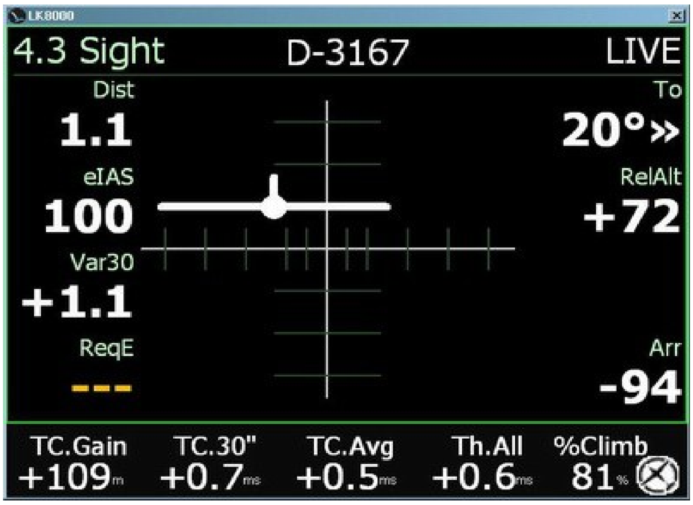


Figure 15.28: StarFighter mode

The target name and its status are displayed (LIVE, GHOST or ZOMBIE).

Dist - Distance to the target in km with one decimal place

eIAS - the estimated speed of the target, calculated with the speed over ground, the height depending on air density and the wind. The value is fairly exact!

Var30 - Average climb in the last 30 seconds

ReqE - Required L/D to reach the target in its height. **Very important!** If the target circles in a thermal 8km away, one knows quickly to how approximately to fly to get there correctly in order to use the same thermal.

To - Course difference to the target

RelAlt - Height of the target relative to DIR (and not reversed), with a positve value is the target higher and with a negative value is the target lower than onself.

Arr - Arrival height at the target estimated with the actual MacCready value, wind, ballast etc. The value is positiv if the estimate calls for higher as target arrival and negativ if lower.

The plane symbol represents the **actual height relative** to the target at the moment of arrival at its position. BUT one can **now** be higher than target but by the time of arrival at the target one can also be below it!

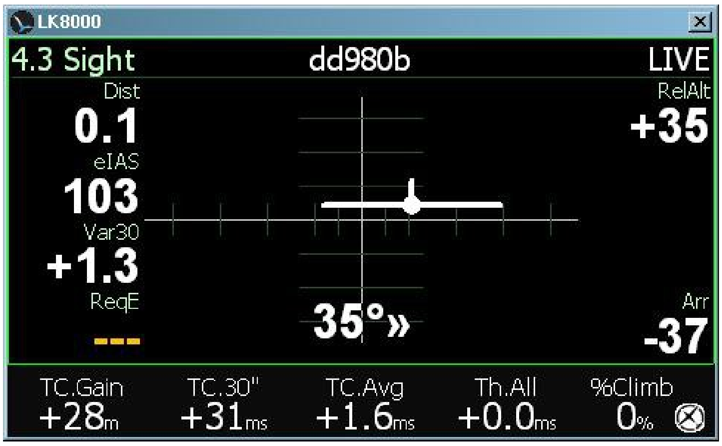


Figure 15.29: Course correction to the target

One can use the plane symbol in order to control the flight in the direction to the target. When the plane symbol is centred with the cross wires one will reach the position of the target in the shortest time, **fig.15.29**.

If the target is behind you, the plane symbol will disappear!

In future Versions an instructor mode will be available to enable the Instructor, to observe the position of the student he is followed by.

If the symbol changes to GHOST or ZOMBIE, its colour changes from white into yellow and red respectively as previous described.

StarFighter Traffic page 4.2

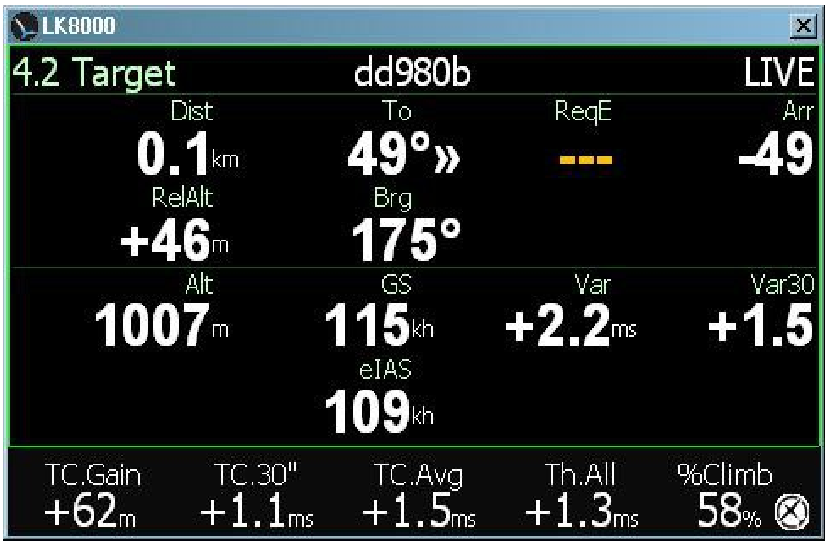


Figure 15.30: StarFighter Traffic page 4.2

This page consists only of text and no graphic. Therefore it provides more information of the target: ground speed, height, present (real time) climb rate (if available) and course, **fig. 15.30**.

Safety has first priority!

Traffic information one receives from FLARM-compatible devices, these data are transmitted as part of the NMEA-Data and with the GPS-data. Today many devices integrate the FLARM-functionality and provide the pilot with a simple and comfortable operation. For instance Butterfly Avionics provides a device with a colour display for FLARM, and with expanded functionality a "RADAR" view, for a reasonable price.

If LK8000 receives traffic information on either port A or B, they are used and automatically will open the traffic pages.

All FLARM devices have at least a small LED display, which is carefully designed, to give the pilot after a sound warning, clear optical information. The pilot knows within less than one second if the traffic is higher or lower than himself and direction to the location of the traffic. The pilot has then to search for the traffic visually and keep it under observation.
KEEP in MIND this is in reality **all** a collision warning system can provide!

Consider following: If GPS data are not provided for evaluation, its own position can also not be transmiited from FLARM to other planes. When flying on a slope where TV stations transmit with hundreds of kilowatt, the GPS receiver can easyly lose its position or the its own FLARM signal only a few milliwatt in strenght can disappear amongst the TV signals. **Caution!**

As **an interesting side effect** of traffic information, on a cross country flight or during a competition informations about other pilots nearby can be obtained. Who is this? On what frequency can he be called? Where does he come from? Is there any lift within 3 km? etc...

LK8000 handles such traffic-informations for this side effect
NOT FOR SAFETY !!!

It is highly recommended, that when FLARM gives a warning and some RED LEDs light up, that immediately with this FLARM information a VISIBLE SEARCH is initiated and one does NOT KEEP LOOKING at the PNA display!

Two planes, which are flying with 180km/h in different directions, have a relative (approach) speed of 360km/h. Their distance reduces 100m per second. FLARM has a range of approximate 2km.
Without obstacles between the planes are these planes on collision course **at best 20 seconds** apart before a possible collision occurs **BE WARNED.**

This is a fair amount of time!!! IF BOTH PILOTS after a few seconds which are needed to asses height and direction of the traffic displayed by FLARM. **Start to search the sky**. There is traffic from ahead in my height, **ATTENTION!!**

Let us assume that there is an **obstacle on the slope** or the slope line changes by 60 degree, In this case the FLARM range is drastically reduced. Out of **20 seconds** suddenly **become at best 10 seconds!**

You could be one of the two pilots. How would you find it if the other pilot instead of searching the sky, concentrates on his PDA using the valuable 10 seconds to look at the plane symbol on the display. **A display which is on principle 1 -2 seconds delayed and difficult to read?**

For this reason LK8000 does not issue collision warnings or safety warnings for traffic nd again:

FLARM safety advises are ignored by LK8000!!!

15.7.3 Safety height indicator

If one has configured a safety height for landing fields (at least 50m) so a little black box with the value will be shown in the map below the value of the glide path height. During flight it can be assumed that only the little black box will be visible [+300m], but it is a sign that the arrival height at the goal is calculated with the safety height, see **fig. 15.31**.

Figure 15.31: Indicator for safety height and safety MacCready value

But if the last thermal is choosen via the multitarget function the black box will not be shown.

15.7.4 Safety MC indicator

Flying with a lower MC-value than the configured MC-safety-value (typically +0.5m/s) this safety value will be also shown in a little black box [+0.5m] on the map, see **fig. 15.31**. I.e. there are "some" reserves in e.g. the final glide, which should not utilized.

15.8 Utilizing total energy (TE)

If one uses the total energy option via

Menu ▶ Config ▶ Configur 1/3 ▶ TEnergy ON

so LK8000 considers the additionally height, you gain if you slow down to the best gliding speed. Within the map [TE] will be shown at the right low margin, see **fig.15.32**.

E.g. flying with a Discus without ballast with a speed of 200km/h and slow down to 100km/h one gains height of course. This height will be added to all arrival heights.

For safety reasons this function if default OFF!

Utilizing the total energy in LK8000 does not influence L/D values, only arrival heights.

15.9 Final glide

Final glide means that one leaves the last climb before the target and then glides direct to the target. At this point we look at an **obstacle free** final glide. For a final glide with obstacles see **chap. 15.6.2**.

The final glide is supported by

calculating the **required L/D**
giving the expected **arrival height** and
by the **glide path bar**

Some pilots prefer the required L/D (**fig. 15.32** right middle) in order to estimate their L/D to the target. Other pilots prefer to get this information with the probable arrival height (**fig. 15.32** right down +61).

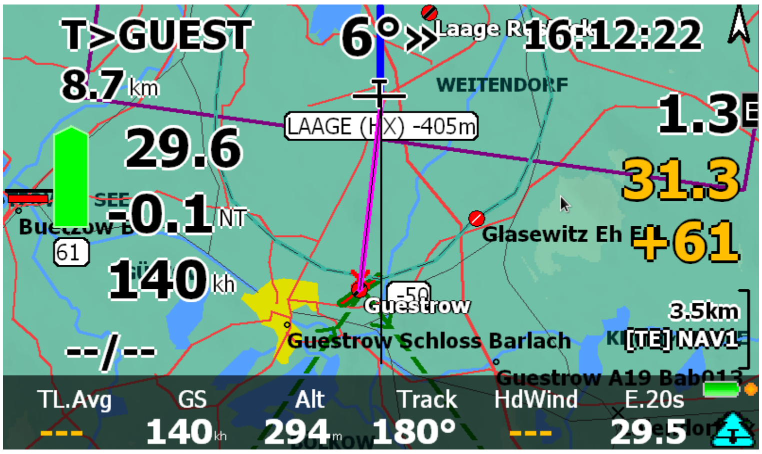


Figure 15.32: Parameter final glide

There is an important difference between the required L/D and the probable arrival height.

The **required L/D** is a geometric value, which is developed between height and distance to the target. This is only a number and the pilot has to decide by himself, if this number is a good or a bad value, for his plane, the actual wind, and the existing weather etc.
The required L/D to a landing field considers the safety height but not the wind.
With a head wind the required L/D remains the same, but the true L/D becomes less!

LK8000 displays on the info page 1.1 Cruise, four times the L/D values:

req.L/D	the required L/D
avg.L/D	the average L/D
L/D 20s	the L/D averaged over the last 20 seconds
L/D	the current L/D

With this values one is constantly informed about his L/D on the final glide and can, if required, initiate any corrections. The actual average L/D is also displayed on the bottom bar with the required L/D directly beside enabling the pilot to compare them instantly, see **fig. 17.24**.

The **expected arrival height** is contrary to the required L/D determined with a complicated calculation in consideration of the polar, the wind and the actual MacCready value. It is important to understand, that these calculations only deliver an estimated result and in addition, this result is also influenced by the pilots own MacCready-value-assumption.

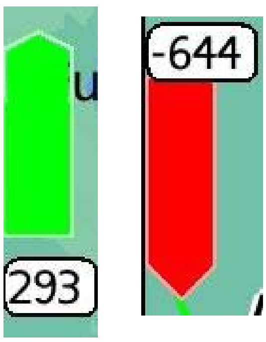
Therefore it is advisable to observe the **required L/D and actual L/D** with to estimate the **quality of the glide.**

The calculation of the arrival height:

- **The safety altitude** for the landing fields can be set in the system configuration page 6.
- The calculation of the arrival height for the landing fields uses the actual MacCready-value only when it is larger than the MacCready safety-value (meaning, when a higher speed has been configured). If not the MacCready safety value is used for the calculation.

The arrival height for landing fields is calculated at least with the MacCready safety value and always with the safety height.

- The **wind** is considered by all calculations
- The Total Energy **TE is NOT used** (meaning no speed compensation). So, one has normally still a few reserves when one flies with a high speed. LK8000 views the TE knowingly as extra safety reserve and does not make any optimistic estimates.
- **CAUTION! Using TE means NO RESERVES!**



The colour green and bar direction up, or red and the bar direction down indicate if the target can be reached or not.

A negative arrival height, indicates that one still has to climb accordingly in order to reach the target at the safety height

16 Task support

16.1 Task editor

16.1.1 Layout of an easy task (FAI triangle)

Tasks can be formulated on the task editor and can be stored in a task.file TASKNAME.tsk (8.3 file name format). The task editor will be called by

Menu ▶ Nav ▶ Nav 2/3 ▶ Task edit

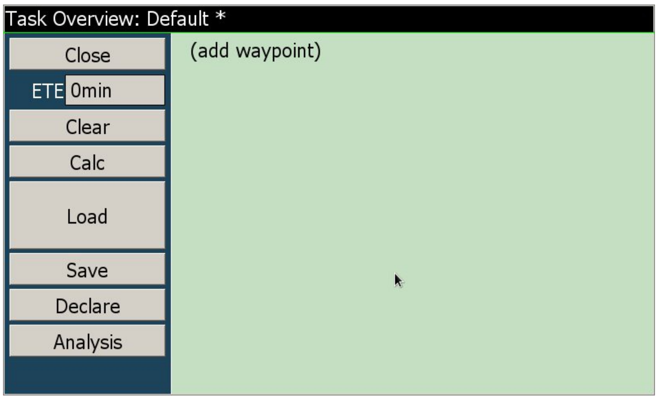


Figure 16.1: Task editor

Fig. 16.1 shows an empty editor. If a task is loaded it would be displayed. If a task file is already stored it can be loaded with (Load) and use/edit selected.

As example let us consider a **FAI triangle** with takeoff and landing in **Guestrow** with waypoints in **Gransee** and **Gorleben** (total distance slightly more than 300km). (Use waypoints from your waypoint file accordingly ...)

A click on the text "Add Waypoint" opens the waypoint selection then select **Guestrow A**. As the first waypoint is also the point of departure, the departure options have to be set, see **fig. 16.5**.

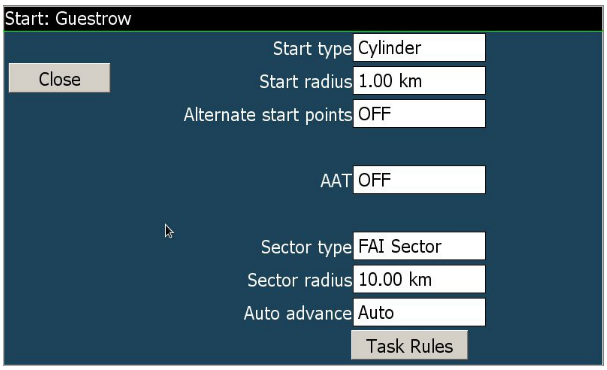


Figure 16.2: Start options

With this, the point of departure is set, see **fig. 16.3.**

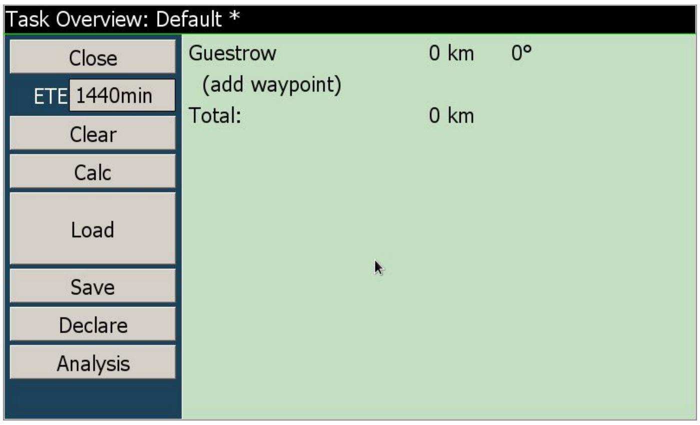


Figure 16.3: Point of departure

The two waypoints **Gransee** and **Gorleben** are now added by clicking on **(add waypoint)** and proceeding as for the departure point.
With this the courses and the complete track is as information available. At the end point **Guestrow** the goal option (**fig. 16.4**) must be set, and with this the total task is formulated(**fig. 16.5**), don't forget to [**Save]** it...

Figure 16.4: Target options

Figure 16.5: Formulated task, FAI-triangle, 338km

Now an optical check can be carried out, if one has defined a nice FAI-triangle. For this on clicks on [**Analysis]** (in **fig. 16.6** a part of the actual flown flight track can already be seen)

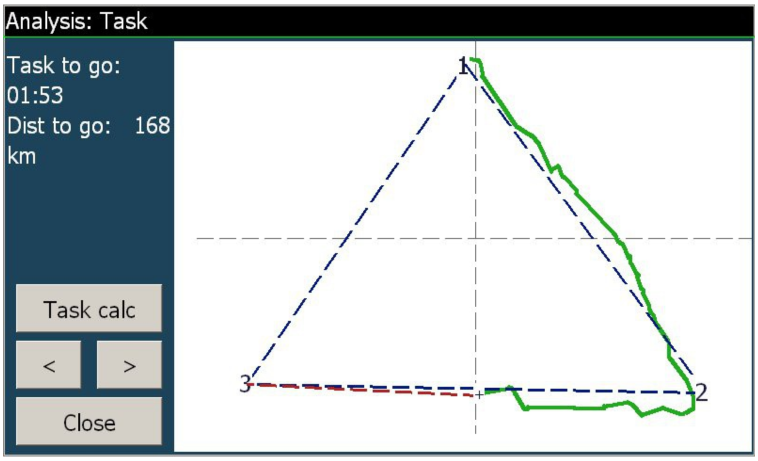


Figure 16.6: FAI-triangle

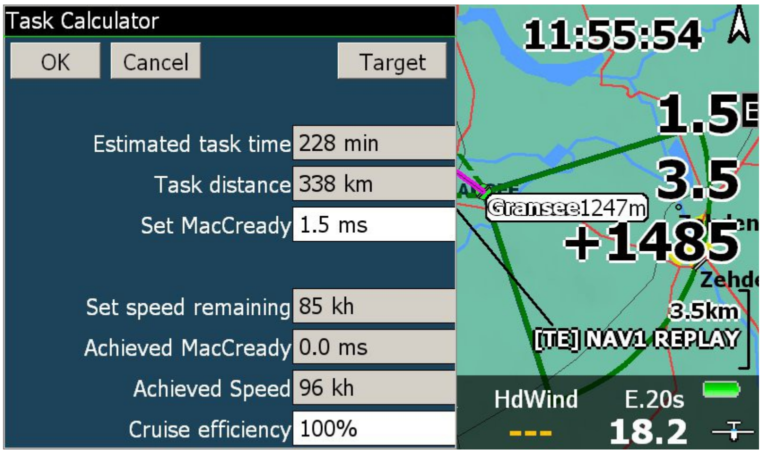


Figure 16.7: Task calculation

In addition are the times and speeds for the task available with [Calculation] . **Ensure to set the MacCready value!**. (**fig. 16.7**)

In the task editor, one can, in an existing waypoint list, either take out or add waypoints and move them in the list up or down. To do this, one has to click on the desired action and then select it, see **fig. 16.8**.

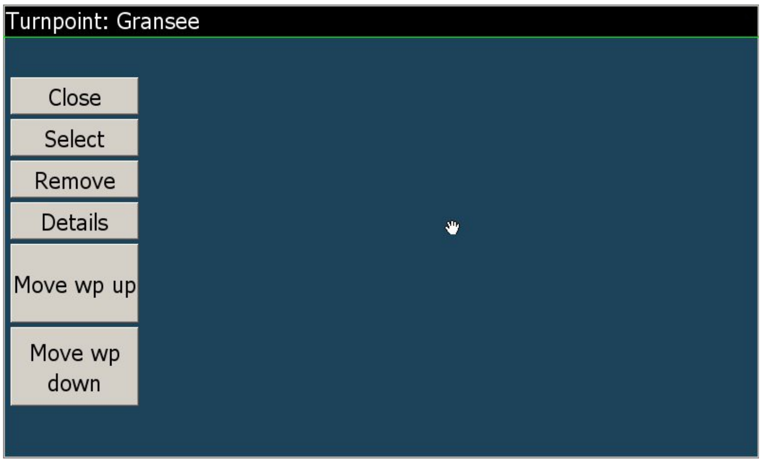
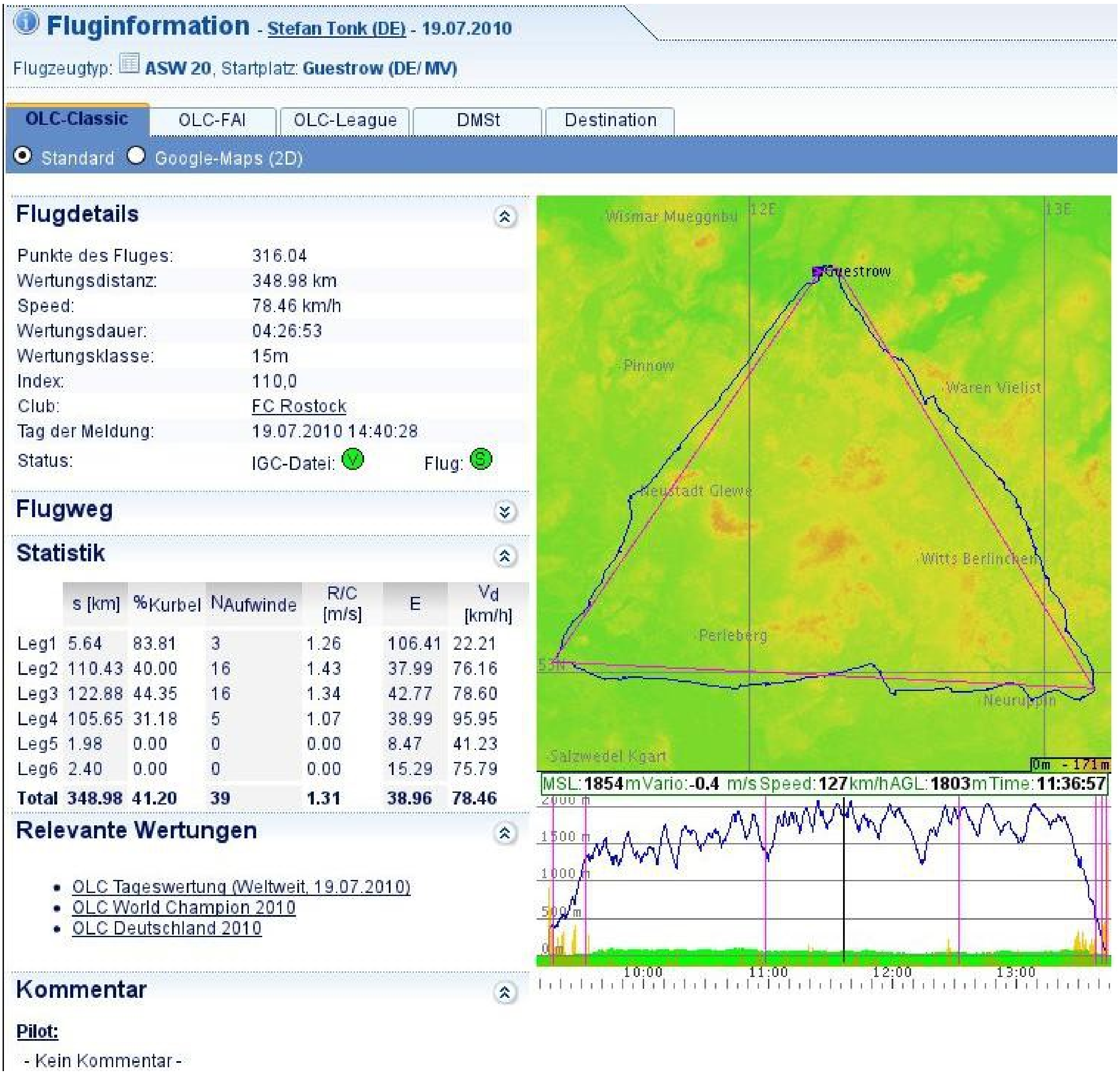


Figure 16.8: Waypoint editing options

Above task was in actual fact also flown, see below ☺.



Fluginformation - Stefan Tonk (DE) - 19.07.2010

Flugzeugtyp: **ASW 20**, Startplatz: **Guestrow (DE/ MV)**

OLC-Classic | OLC-FAI | OLC-League | DMSt | Destination

Standard Google-Maps (2D)

Flugdetails

Punkte des Fluges:	316.04
Wertungsdistanz:	348.98 km
Speed:	78.46 km/h
Wertungsdauer:	04:26:53
Wertungsklasse:	15m
Index:	110,0
Club:	FC Rostock
Tag der Meldung:	19.07.2010 14:40:28
Status:	IGC-Datei: Flug:

Flugweg

Statistik

	s [km]	%Kurbel	NAufwinde	R/C [m/s]	E	Vd [km/h]
Leg1	5.64	83.81	3	1.26	106.41	22.21
Leg2	110.43	40.00	16	1.43	37.99	76.16
Leg3	122.88	44.35	16	1.34	42.77	78.60
Leg4	105.65	31.18	5	1.07	38.99	95.95
Leg5	1.98	0.00	0	0.00	8.47	41.23
Leg6	2.40	0.00	0	0.00	15.29	75.79
Total	**348.98**	**41.20**	**39**	**1.31**	**38.96**	**78.46**

Relevante Wertungen

- OLC Tageswertung (Weltweit, 19.07.2010)
- OLC World Champion 2010
- OLC Deutschland 2010

Kommentar

Pilot:

- Kein Kommentar -

16.1.2 Layout of a task with different take off and starting points

The procedure formulating this task is different by the input of the departure and task starting point, see **fig. 16.9**.
One sets the option [Alternative starting points] to [ON] and gets a separate edition field [Edit starting points]. In this filed one can select an alternate task starting point, see **fig. 16.10.**

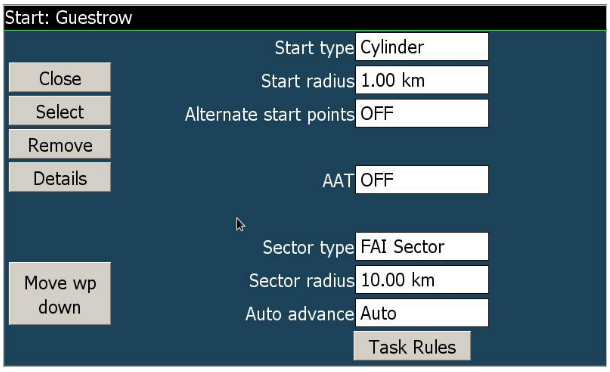


Figure 16.9: Alternative task starting points OFF

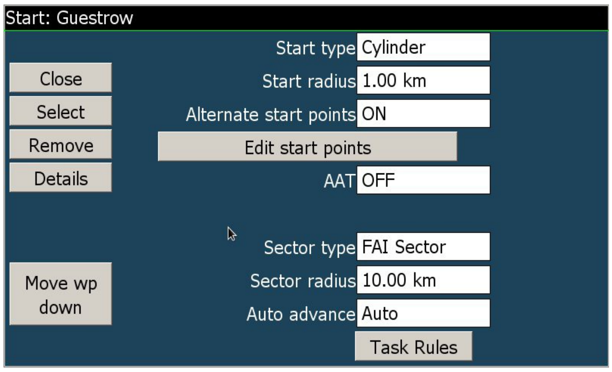


Figure 16.10: Edit alternative starting points

As an example a flight to **Güstrow** with departure and task start in **Purkshof** and with departure in **Purkshof** and task start in **Dammgarten** was formulated.

By the menu on can switch the tast starting points by

Menu ▶ Nav ▶ Startpoint Cycle

see **fig. 16.11**, **16.12**.

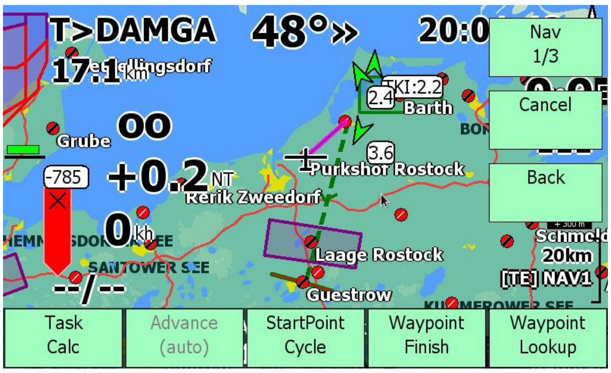


Figure 16.11: Flight to Güstrow, departure Purkshof, task start Dammgarten

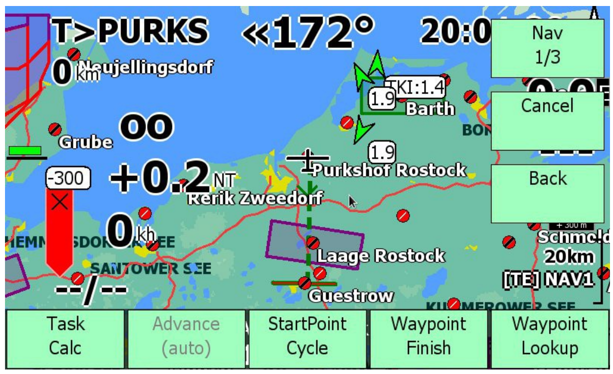


Figure 16.12: Flight to Güstrow, departure Purkshof

16.2 Declaration task for an IGC-logger

Declared tasks, are of course evaluated higher, than free tasks. But for declared tasks an approved IGC logger must be used.

The Logger has to be connected to the device then LK8000 transmits the data to the logger.

The transmision is initiated by clicking the [Declare] button in the task editor, siehe **fig. 16.13**.

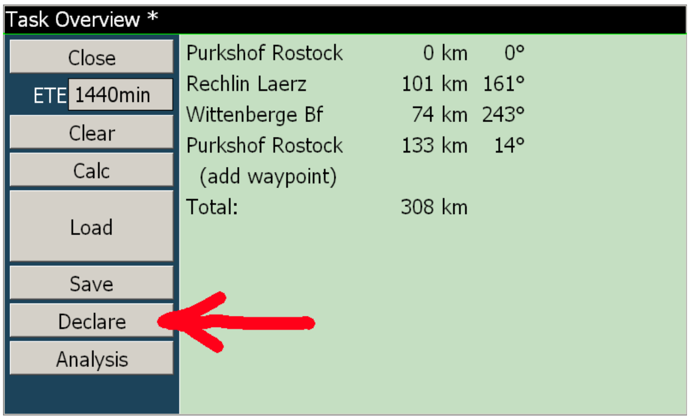


Figure 16.13: Declaration task for an external IGC-logger

At this time are following loggers supported by LK8000:

LX20
FLARM
LX Colibri
LX Nano,
Posigraph
LX5000
LX7000
Volkslogger

Important notice for a task declaration on a FLARM

Please, do not keep a SD card inserted in the FLARM during the flight!

If a SD card is loaded in the FLARM, FLARM will look at the declaration loaded on the SD card and overwrites the previously made declaration.
Also, should Voltage be lost and returned, during the flight, FLARM starts to write all stored flight data files on the SD card instead continuing to record the flight!!!

In order to declare a task the FLARM has to be switched OFF and again switched ON (LK8000 does this with the FLARM automatically).

After FLARM is re-started by LK8000 one should, if one wants to declare a new Task, do not forget to load the new task for the declaration! ☺

16.3 Determination of free flight

Up to this point many flight navigation programs assumed the flight begins in tow at the point of take off, this is for soaring flight only conditional correct. The actual soaring flight only begins after release from tow.
If the winch tow, aero tow or own motorized take off is included
In the flight analysis it greatly distorts the values, in particular for the begining of the flight , which are calculated, for almost all flight parameters.

LK8000 recognizes the start of the soaring flight after take off, through a defined continuous sink rate and then corrects the tow values through reversing the statistical parameters.

As a side effect, the circling mode during the take off is also suppressed.

One can determine the free flight by himself if one e.g. wants to start a task again (engine flyers) by the function "**Free Flight start**". This function has to be connected prior to a custom key.

16.4 Waypoint rounding

During the flying of tasks it is a requirement to cleanly round task waypoints [turning points (TP)] and to take immediately course to the next task waypoint (TP).
LK8000 supports this with a course line towards the next waypoint (TP) and an automatic map enlargement in the vicinity of the waypoint (TP), see **fig.16.14**.

The continuous switching from task waypoint (TP) to task waypoint can be configured in several modes (Manual/Auto/Load/Load departure) via

Menu ▶ Nav ▶ Advance manual/Auto/Load/Load departure

Manual means that one has to switch each waypoint (TP) by hand,
Auto means the way point is automatically switched as soon as it is passed,
Load requires a pre-loading before switching and
Load Departure
means that only the departure point needs to be pre-loaded. And all other waypoints (TP) will be switched automatically.

Figure 16.14: Map zooming in the turn point area

16.5 Speed optimization

The speed optimization is supported for the task by a display of the speed to fly **STF**, see also **chap. 15.6.1**.

16.6 Optimizing of tasks for de-centralized competions

In particular for non declared tasks which one registers in de-centralized competition, one would like to optimize the task for the highest possible point count, and often attempts to make, still during the flight, decisions to make changes to maximize points which changes the original planned Task.

Lk8000 supports this, through a **Real Time Calculation**, a prognostic OLC-Plus-point count, assuming that one returns to the point of departure.

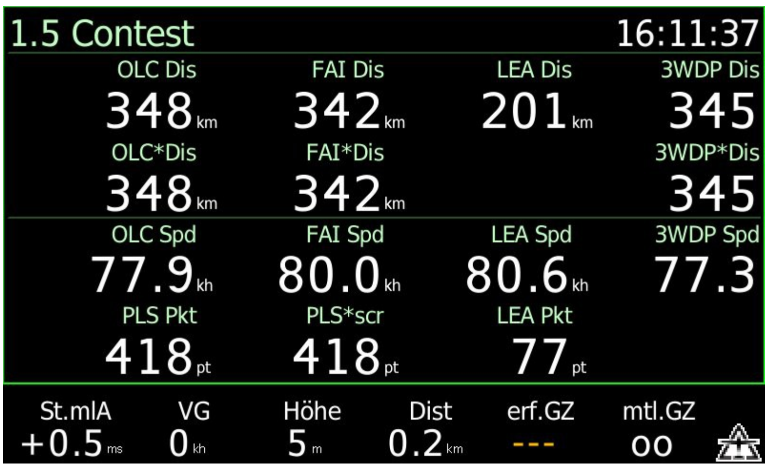


Figure 16.15: Flight scoring informations

On the info-page 1.5 Contest (**fig. 16.15**) are the most important scoring calculations for de-centralized contests displayed. These calculations are based on the actual contest rules (2012). Scoring markings annotated with * show prognostic result calculations with a return to the point of departure.

16.7 Tactical flight support

Flight support is given by markers, thermal markers, thermal history, real-time flight analysis, traffic informations and target mode via FLARM.

Marker can be placed on the track and used for navigation like waypoints, see **chap. 14.3**. Thermals have also waypoint qualities and can be used for navigation via info page 3.3.

The real-time flight analysis will be described in **chap. 20.1**.

An important flight support is given by the traffic informations on info page 4, see **chap. 15.7.2**. One gets the positions and among other informations the climb values of nearby gliders.

Target tracking by FLARM will be described comprehensively in **chap. 15.7.2**.

17 Support for central competition

17.1 Tasks in central competition

In the competition rules of the German Aero Club (DAeC)[WO2011] are two types of tasks for championships prescribed, the speed task with fixed turning points TP (waypoints) (Racing Task -**RT**) and the speed task with fixed turning areas (Assigned Area Task - **AAT**)

Racing Task - RT (speed task with fixed turning points)
The race is carried out around fixed turning points.
The scoring is done by speed and distance. Out-landers get only distance points, Finishers of the total course get points for speed and the full distance.

Assigned Area Task - AAT (speed task with fixed turning areas)
Races have to be done by rounding fixed turning areas in a given sequence and to be crossed in a minimum time.
The scoring is done by speed and distance. Finishers get distance points for the maximum flown distance. Out-landers only distance points.
If a competitor returns before the minimal time elapsed, his speed is calculated as if the minimal time was flown.

At **NON**-championships other types of tasks are also possible.

Examples:

PST (Pilot Selectable Task)
The flying to given turning point groups, there is no maximum time limit. The scoring is by total distance flown.

Cats Cradle
The rounding of a selection of turning points in a given maximum time limit.
The turning points can be freely selected and rounded by the pilot, but maximal ten turning points and the same turning point can only be rounded again after two other turning points have been rounded.
The scoring is by speed and/or distance.

17.2 Layout of an Assigned Areas Task (AAT)

*For layout of easy tasks see **chap. 16.1.1**.*

If one wants to layout a task of AAT type he has to choose within the task editor after selecting the starting point the options

AAT ON and
Advance manual

The manual advance allows a free flight path within the turnpoint cylinder without advancing automatically, see **fig. 17.1**.

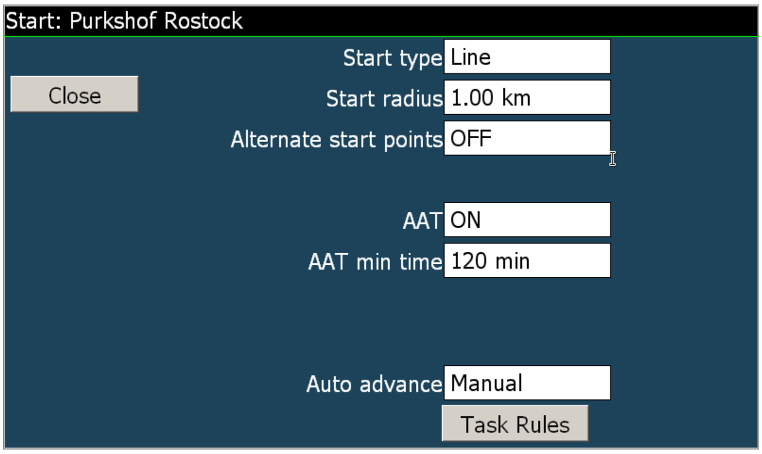


Figure 17.1: Task start options

If a turn to the next waypoint is desired the next waypoint will be choosen by manual advance.

The input of the other waypoints is like at the easy task layout only additionally the turning area (cylinder, sector) to be specified in size and the finish point has to be chosen, see **fig.17.2**.

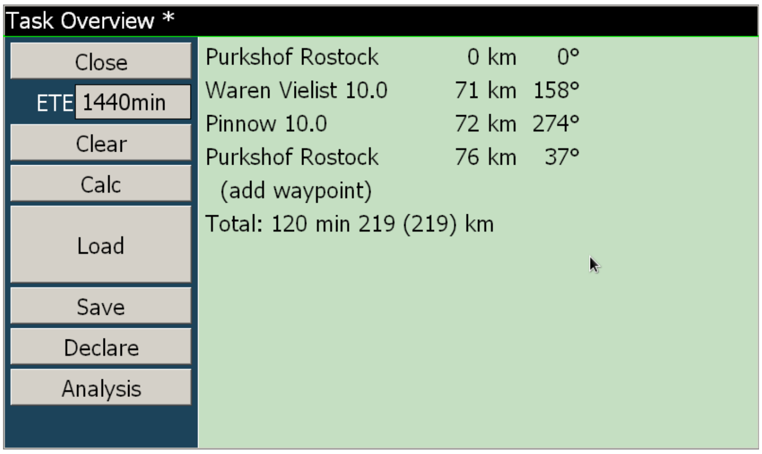


Figure 17.2: Task AAT with turnpoint cylinders of radius 10km round Waren and Pinnow

The task will be shown on the map with the selected turnpoint cylinders. Topology is partly but not totally hidden by the cylinders, see **fig. 17.3**.

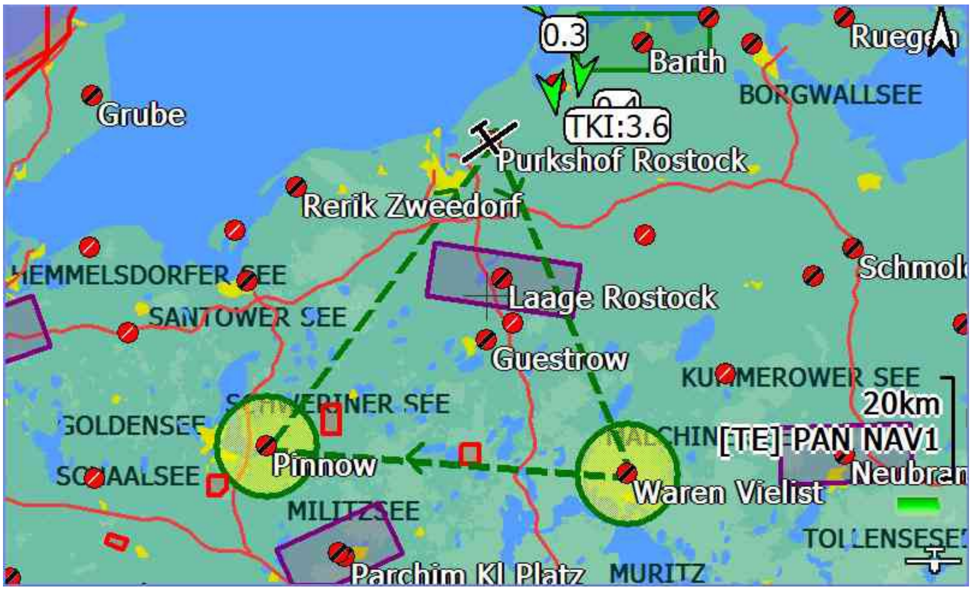


Figure 17.3 Task AAT show on the map

17.3 Analysis of the task

How far can LK8000 support the completion of these tasks ?
The **task Analysis** is a possible tool to be used.

It is strongly suggested to create a separate competition waypoint file and to load this file as a second waypoint file, and then to formulate the task with the waypoints from this **competition-waypoint-file**.
In most cases a competition waypoint file is made available by the competition management.

For **RT** tasks is the analysis less complicated.

One loads the departure area, the waypoints (TP) and the point of landing, with this, one gets distances and courses and with an assumed MacCready value, plus his own data and the planes polar, can have the times calculated.
With given wind data can its influence be estimated. A weather and terrain analysis must also be carried out.

Of course it becomes more difficult on tasks with turning areas like **AAT**. First one must be in a position, to display the **AAT-task** as shown in **fig. 17.5**.
This can be done very well with the task editor, if the task is a declared AAT-task.

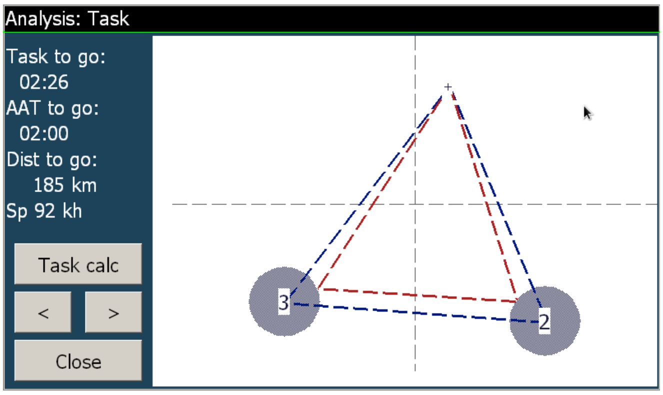


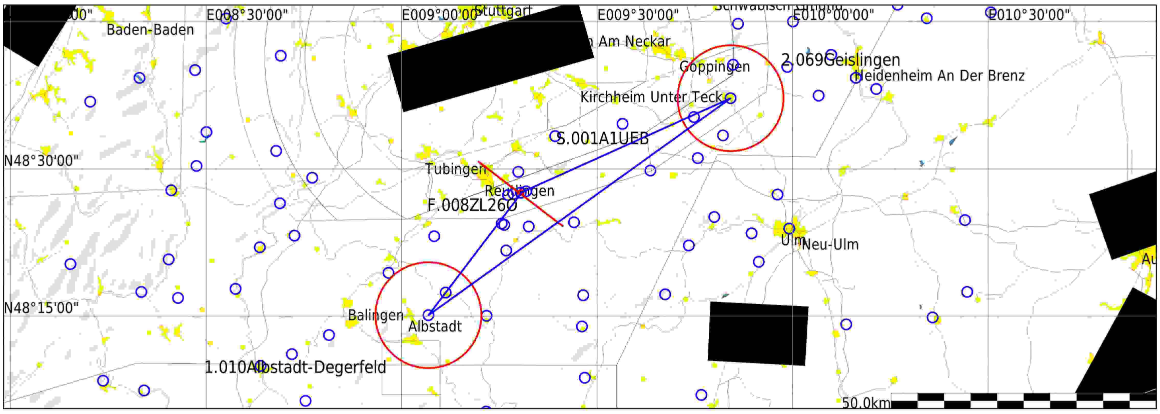
Figure 17.4: Analysis of an AAT, minimum distance

The competition management often gives the maximum and minimum distance (**fig. 17.4**), but LK8000 can also calculate this.

Aufgabeninfo *3. WT Clubklasse B*

Typ: Assigned Area Task (AAT) mit 2 Bereichen **3. WT Clubklasse B**
Aufgabenlänge: 102,7km/ 182,0km

Typ	Punkte	Breite	Länge	Dist.	Kurs
Startort	001A1UEB	N48°27'27"	E009°18'16"		
Abflug	001A1UEB	N48°27'27"	E009°18'16"		
1.Punkt	010Albstadt-Degerfeld	N48°15'06"	E009°04'08"	28,8km	217°
2.Punkt	069Geislingen	N48°37'12"	E009°50'30"	70,2km	54°
Ziel	008ZL260	N48°27'35"	E009°18'18"	43,3km	246°
Landung	001A1UEB	N48°27'27"	E009°18'16"		



ACHTUNG: ED - R 132 A Heuberg aktiv bis 14:15 UTC!!
ED - R 132 B Heuberg nicht aktiv!!

Radius Sektor Albstadt-Degerfeld - 10km!
Radius Sektor Geislingen - 10km!

Funk und Telefon:

Übersberg Wettbewerb - 123.150
Segelflug ATIS Stuttgart - 119.325
Telefon Übersberg - 07121 81861

Informationen:

Wasserballast	nein
Abflug über Linie	20 Km
Abflug frei	= Letzter Start + 20 min
AbflZeitSchl	= Abflug frei + 120 min
Eigenstart	max 1300m MSL
Vmax/Grund Abflugort	150 Km/h
Wertungsschluss	20:00 Lokalzeit
Wertungssystem	1000 Pkte DAeC

Maximalhöhen:

Abflug	- 1800m MSL
Überflug	min. 150m GND
QNH	1012 hPa

Achtung:

Sektor(en): ALB NORD, ALB SÜD, ALB OST, GÖPPINGEN, HAHNWEIDE, HORNBERG
Luftraum C, D: STUTTGART

Figure 17.5: Competition task, type ***AAT*** *(in german)*

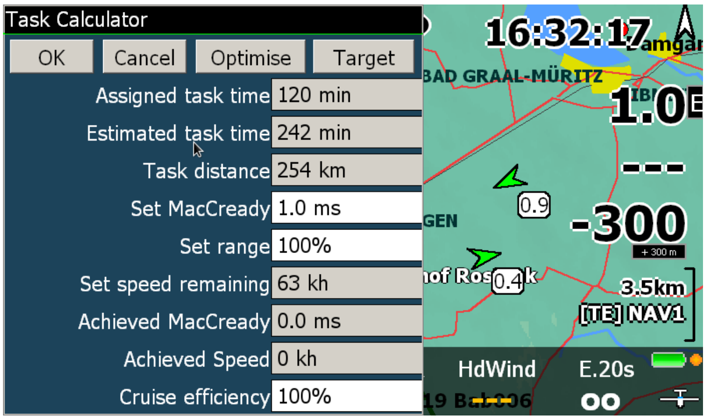


Figure 17.6: Task calculator

In addition it is possible to set the distance to -100% or +100%.
But remember to also set an appropriate MacCready value, **fig. 17.6**!

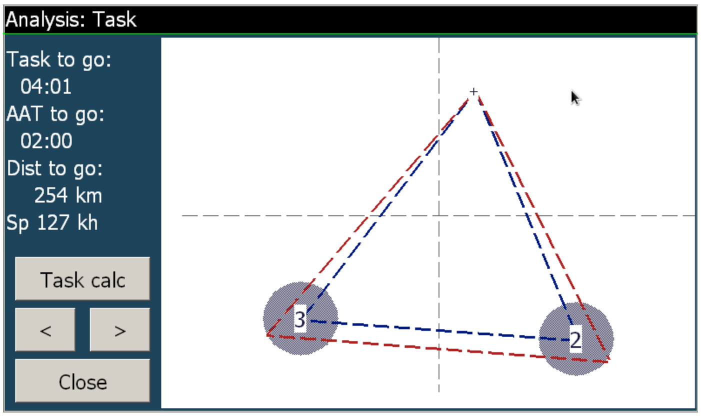


*Figure 17.7: Flight path optimization for competition task **AAT**, maximum distance*

With a changed distance remember that also all other calculated parameters change.

The tactical approach to the completion of a **AAT**-task is approximately as follows:
From minimum- and maximum distance and minimum time the limiting speeds can be obtained.
One then decides, which speed to select depending on your plane, your experience and the weather and based on this decides on the approximate flight path in consideration of the terrain.

17.4 Changing the turnpoint in a AAT-cylinder

Flying into an AAT- waypoint cylinder it is possible to adjust the turnpoint with the task calculator

Menu ▶ Nav ▶ Task calc

so, that the needed task time will be optimized.
Within the task calculator, see **fig.17.8**, one chooses [Target] (The next target is the cylinder.) and the graphical turn point editor is shown, see **fig. 17.9**.

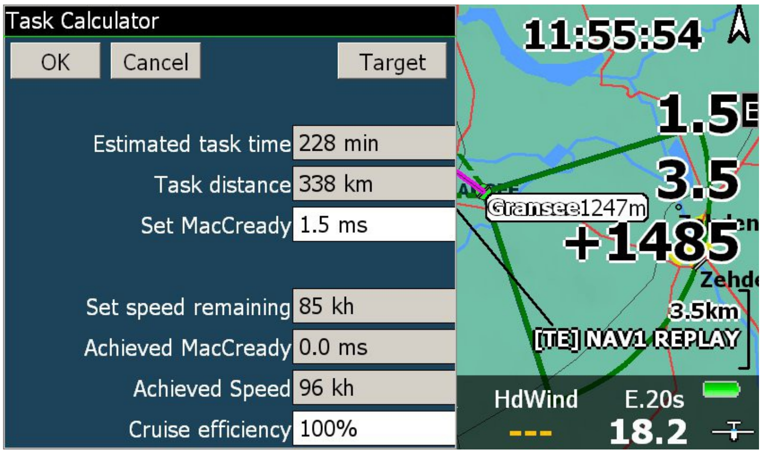


Figure 17.8: Task calculation

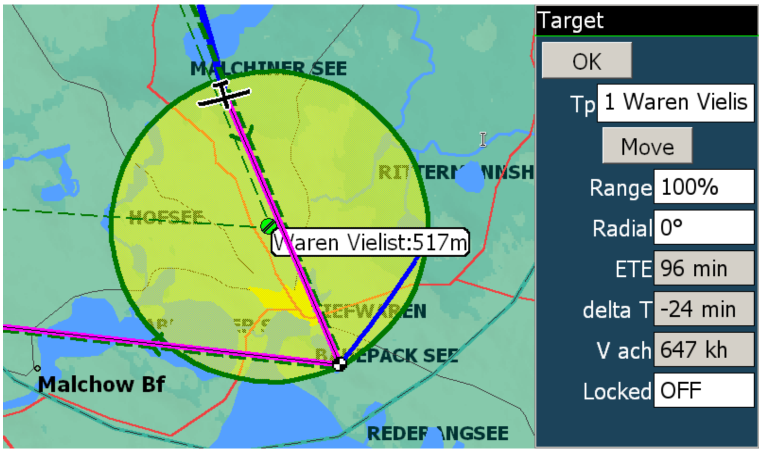


Figure 17.9: Turnpoint editor

Within this map a click moves the turnpoint to the place of the click in the map and time calculation is updated immediately!

17.5 Final glide

With enough height acording to fullfill the task the final glide mode will be activated also in that case if the last turnpoints is still in front. That means that LK8000 takes care of all competition turnpoints if they are within the task layout!

17.6 Team flying

To fly as a team can be advantageous, as the partners together, can better find and make use of the existing thermal conditions. But team flying requires to know the position of the team partners at all times.

In competition it is of course a requirement that only your own team profits from this knowledge!
Team flying in competition is supported by LK8000 through simple coding/de-coding of the positions. One exchanges via radio three to four digit alphanumerical codes, sample shown below

G4A3

This when set displays your own position and when received indicate the position of the team partner. The **coding of your own position** is done by calling up the team code window with

Menu ▶ Nav ▶ Nav 2/3 ▶ Team Code

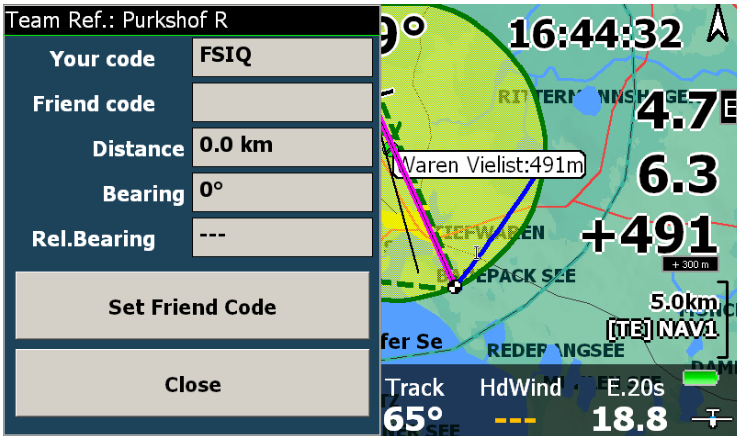


Figure 17.10: Team code window

Your own position is in **fig. 17.10**, coded with ***FSIQ***. In the box "Set Friend Code" one can write the position code of the partner within the editor and then receive the distance and bearing (relative bearing) to fly to the partner if so desired.

For this procedure to work it is a requirement, that a previously agreed waypoint as reference point has been set!

The display of the position is given relative to this team-waypoint!

A reference-waypoint or team reference can be set over waypoint selection in the navigation menu (see next to last option page), **fig. 17.11**.

Figure 17.11: Selection of the team reference waypoint

Changing this waypoint in a competition, e.g. at agreed times can be a tactical safety against being spied on. ☺

The team flight via FLARM- target locking will be described in **chap. 15.7.2**.

17.7 Start windows for paragliders

In a paraglider competition, a pilot is only allowed to cross the **start cylinder** at a set time or at the next **start gate**. The start time is not counted from the time of crossing of the cylinder but from the start at the start gate.

Glider pilots have something similar **in Grand Prix Races,** where the count is also only taken at the start from a single start gate.

Therefore it is very important that the pilot crosses the start line, only when the start time gate is open and this as soon as possible after it opens. Because every second later is counted in the final total time calculation!
LK8000 administers the time gate not only with a countdown until the beginning of the start gate, but also, and this is more important, it estimates the flight time to reach the start cylinder.
A pilot can with this, plan a start out of a climb several minutes before the opening of the time gate and in addition LK8000 warns the pilot in case it calculates that he arrives at the start cylinder too early.

With LK8000 – time gates, a pilot can plan a racing start exact to a second for the opening of the time window!. ☺

17.7.1 Configuring time gates

For paragliders exist for proper tasks time gates. This is for tasks with more than one waypoint and more than only one single and simple waypoint "GO TO". Time gates are in the system configuration in the paraglider-configuration page 23 available.

- This configuration is for all tasks
- Time gates work ONLY for start cylinders

Task gate is the number of the time gates and **0** means no gate, option deactivated, see **fig. 17.12**.

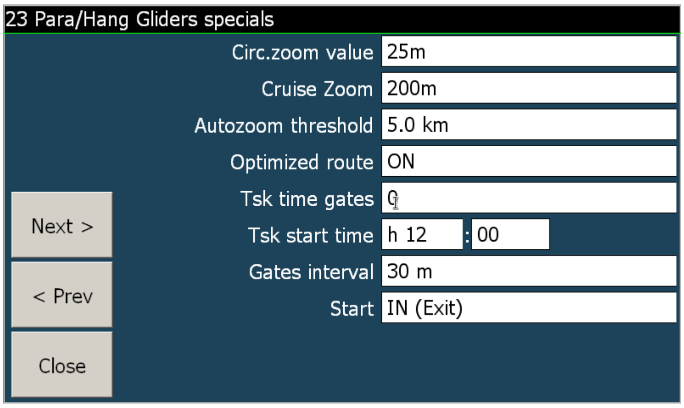


Figure 17.12: Configuration task gates

Task Start Time is the Start time(Opening time) of the first gate.

Gates Intervals gives the waiting time between the opening times of the start gates as well as the duration of the gate.
The last gate is open until this interval is completed. But after this, there are no more gates and the start gate is closed. No more starts will be recorded.!

Start indicates how the start cylinder has to be crossed.

- **OUT(Entry)**: One flies into the cylinder to begin the race.
- **IN (EXIT)**: One flies out of the cylinder to begin the race.

Some examples:

Example 1

The race starts at 13.00, only one unlimited time gate

Task time gates	:	1
Task start time	:	13.00
Gates Interval	:	480 min (means unlimited)
Start	:	OUT or IN

Example 2

A Race with a start gate, open at 13.00 and closed at 15.00. All pilots must have started at 15.00.

Task time gates	:	1
Task start time	:	13.00
Gates interval	:	120 min

Example 3
A contest with 4 time gates, starting at 13.00. The second gate opens at 13.20, the third gate opens at 13.40 and the fourth gate opens at 14.00.

Task time gate	:	4
Task start time	:	13.00
Gates interval	:	20 min

NOTE, that the last gate at 14.00 is open for 20 minutes
Hence the closing time is 14.20.

Example 4
If a pilot is specifically interested to take part in the competition and NOT to win, he also can start after all time gates are closed.
LK8000 will then indicate that all time gates are closed and no start is possible. In this situation one configures a higher number of time gates, so that one does "not run out" of time gates.

To obtain a **direct entry to the start gate menu** it is possible to configure a custom key, cf. user configurable keys (custom keys).

If time gates are configured, special information levels are displayed on the map, fig. 17.13.

All information are blended into the map and are, apart from a new start of the task which can be initiated with a click, set automatically. Messages and high sounds are given to keep the pilot constantly informed, for example, if he is on the correct side of the start cylinder etc.
After a **valid** start all special information levels are automatically blended out.

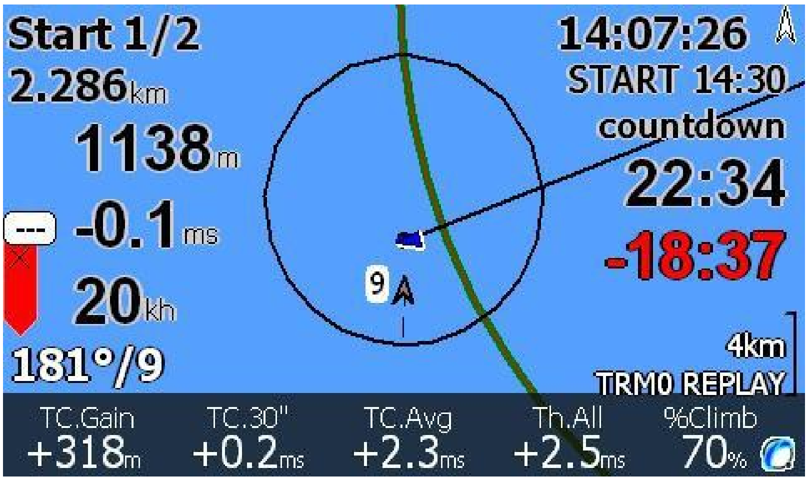


Figure 17.13: Start gate

In **fig. 17.13** start gate, the waypoint name is changed to **Start 1/2**, indicating that start gate 1 of 2 is available, start gate is displayed and running.

If one is flying on the **wrong side of the start cylinder** the **distance** to the cylinder is given below Start1/2 by a **red** number **in km** (2.286km)
This distance is given **relative to the start cylinder and not to the waypoint!**

The **start-time** on the right always shows that with the waypoint name corresponding time gate. In the example, time gate 1 of the two gates will be opened at 14.30.

The **"countdown"**- information is displayed below with the countdown counter. In the example, it is 22 minutes and 34 seconds to the start.
Below the countdown counter is an estimated time difference in relation to the countdown displayed (**-18:37**).
If this difference is **positiv**, it indicates, that one arrives **AFTER** the start of the time gate, in other words, **correct**. In the optimal case one should arrive at **+00:01 after the gate opens.**

If the difference is **negativ**, it is displayed in **RED** and indicates that one arrives **too early,** and the start is invalid.

The time difference will be calculated with actual MacCready value and the wind in direction to the cylinder.

If the pilot crosses the start cylinder in the correct direction through the start gate, the start of the task will be validated and the start information will be blended out, later more on this subject.

17.7.2 Time gate sounds and messages

10 minutes before a time gate is to open, appears the message "**10 minutes to Start"** in the display and the HI TONE-sound is played.

5 minutes before a time gate opens appears the message
"5 Minutes to Start" in the display and the HI TONE-sound is played.

1 minute before the start, **3 HI TONE-**sounds will be played but without a message in the display. This is done because the pilot would be busy to fix his position on the map, and a message would cover the map for a few seconds.

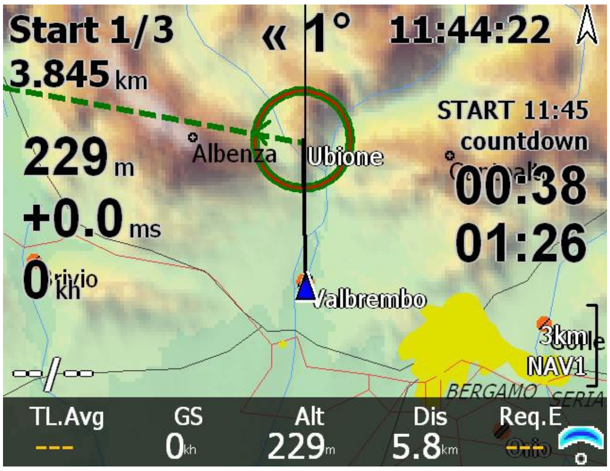


Figure 17.15: Start gate countdown

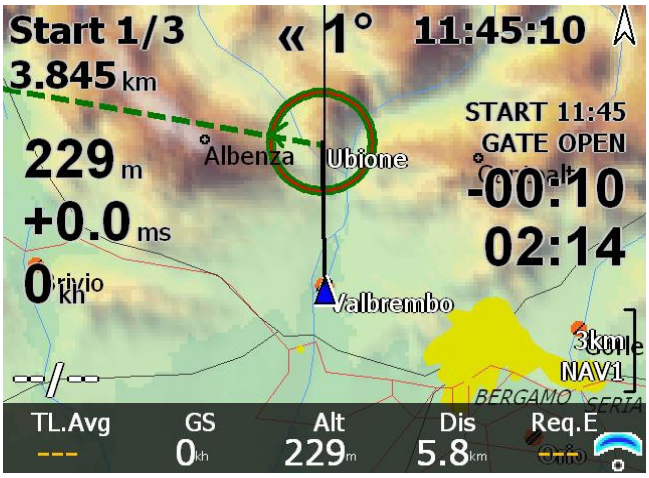


Figure 17.14: Start gate is open

When a **start gate is opened** a long HORN-Signal is sounded and the message **"Start gate Open"** appears in the display, **fig. 17.14**.

The message **"Start gate open"** also appears below the start time on the right side of the display, **fig. 17.14**.

The countdown-counter becomes **NEGATIV** (-00:10) and counts the time since the opening of the gate (in **fig. 17.14**, 10 seconds).
This is the time which is "lost", if one wanted to start the race really in this time gate. The lower this number the better it is.
The best possible value would be -00:01, this would mean that one started 1 second after the gate opened. It is better not to start at 00:00 as this is a borderline time.
In the example (**fig. 17.14**), LK8000 informs the pilot , that the start gate 1 of 3 is open since 10 seconds and he would be pass the start in approximately 2 minutes and 14 seconds.

Attention!

The **"Start Gate Open"** -text and the distance are displayed in **RED**, if one still is on the **Wrong Side** of the start cylinder!

Figure 17.16: Next start gate

Five minutes after the start gate opened, the "**Start gate Open"**-display, changes to the next start gate display **NEXT**.
With this the pilot knows ahead of time when the next start gate opens.
In the example **fig. 17.16**, 10 minutes and 10 seconds have past since the opening of start gate 3 and the pilot has at this point not crossed the start cylinder. LK8000 assumes, that the pilot considers the next time gate for a better start. Nevertheless, LK8000 still displays how much time has gone by. In this case, the pilot normally waits for the next gate which in this case will open in 5 minutes.

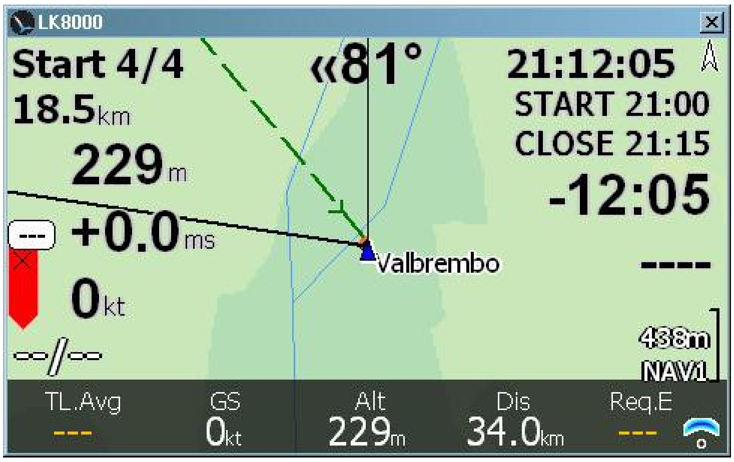


Figure 17.17: Start gate closing time

Are no more gates available and if the open gate is the last one available, its closing time **CLOSE** will be displayed. This will be the last possible time to start, **fig. 17.17**.

The countdown counter continues to count since the opening of the gate.

There are no messages or warnings for the closing time. If the time is over the waypoint name changes to **CLOSED** and in the right part of the display appears "**Gates Closed"** and "**NO TSK START"**.

If all gates are closed, the only way to start the task anew or to change is to deactivate or to set new, the values in the system config page 23, be careful!

If one decides, not to start in the presently open gate, one definitely need a new start of the task!
Until the new start of the task, the start gate for LK8000 remains open and the countdown counter displays the time since the window was opened and <u>not the time to the next gate.</u>
As a matter of fact, displays the start waypoint the still open gate and not the next gate (if available).
Also in case that the start cylinder is crossed and the start is valid and one nevertheless one wants to restart one needs a re start of the task, **fig. 17.18**!

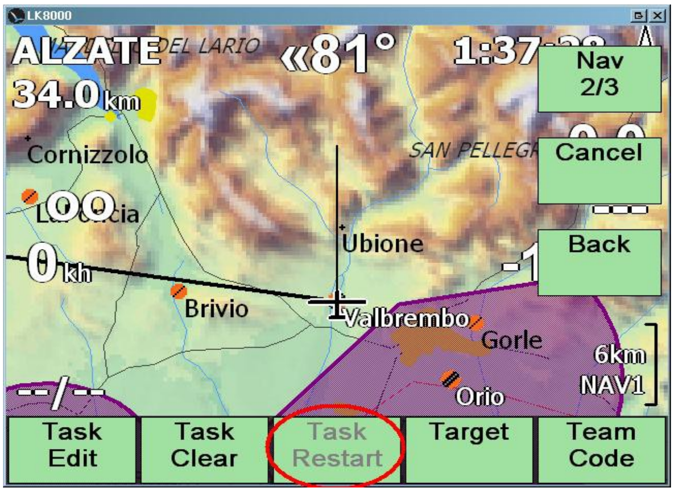


Figure 17.18: Restart task

For some pilots is this re-start of start a tactical manoeuvre.
The gate for the task re-start can be found in the menu NAV 2/3.
Be aware, that this gate is inactive if no task is running. The task new start jumps automatically to the next time gate, if available.

The next start gate "Next" is the time gate, which is not opened yet.

Please read this twice!

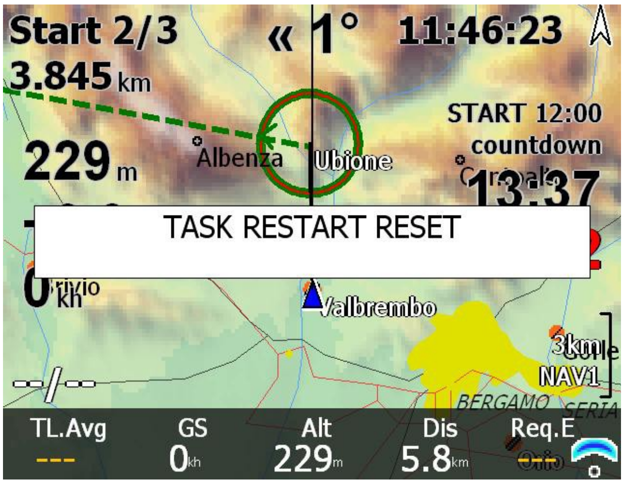


Figure 17.19: Message task restart reset

Figure 17.20: Option to restart the task

After the new start of the task one waits for start gate 2 of 3.
This start gate will be opened at 12:00. The countdown runs and there are still 13 minutes and 1 second to the start,**fig. 17.21**, and it is estimated that to arrive at the start cylinder in 10 minutes and 56 seconds which is at a distance of 3845m.

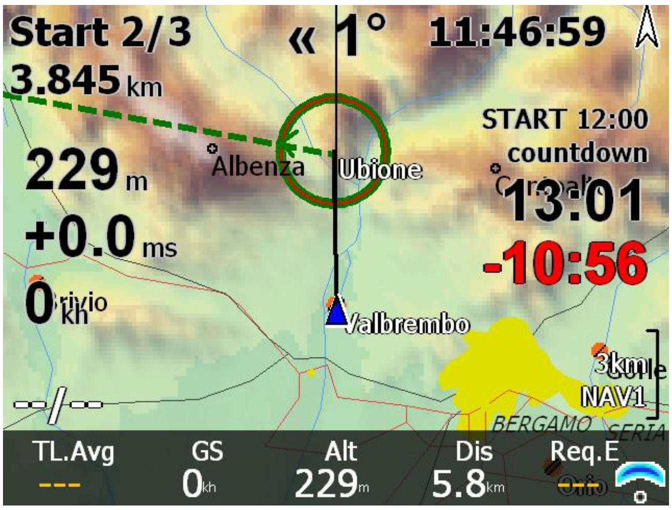


Figure 17.21: Expected arrival time at still closed start gate

As the time gate at this time is still closed -10:56 is displayed in red.

An alternative possibility to start a task new can be done with the UTM Button (long click on the compass symbol in the right upper corner). But this also means that the UTM function is not available for the start. This shortcut certainly requires a start confirmation.
The normal UTM-function (setting of coordinates) is available again only AFTER

the first waypoint AFTER the start.
Consider, one has a start cylinder and an inside cylinder as turn point: Then, before one passes the inner cylinder, one still can with the shortcut start the task anew.

17.7.3 Additional notes to time gates

The time based on the countdown-counter, will be determined by the set MacCready value and does not use the average speed. For the duration is also the wind in direction to the cylinder going in and going out taken into consideration.
If one is on the correct side of the start cylinder, one always will be aware when the time is right to cross the start cylinder. The calculation assumes that one flies in a straight line to the start without circling or course deviations. For example if one sees

01:09
00:08

It means that on has 1 min and 9 seconds to the start gate, if one at this time flies in the direction of the start with the set MacCready-value, one will then arrive 8 seconds after the opening of the start gate and therefore will have a valid start.
If one is on the wrong side of the start cylinder before the gate opens, the distance will be displayed in **RED** and instead of the countdown either **"Wrong Inside"** or "**Wrong Outside"** will be displayed: Meaning, it is wrong to be inside, because one has to fly in from the outside, or vice versa.

If LK8000 during a running task with start gates has started and a gate is already open, one has to re-start the task to get to the next start gate in order to see the countdown.
This is somehow looking complicated but normal, as one start gate is already open!

The automatic new start of a task does not function by re crossing of the start line, if time gates are configured.

The start gate system at this time does not allow to set a closing time past midnight.
E.g. one cannot set a start time of 21:00 and a closing time for 01:00.
The closing time will in any case be 23.59, but this should not present a problem as it is dark at this time anyway......

CAUTION: AT NIGHT TIME SIMULATIONS THE MIDNIGHT LIMIT WILL EXIST!!!

The start **outside**-mode does not function with several start points.
If one wants to test start gates in simulation-mode please remember that for the simulation mode to be able to make calculation, one has to start first!

17.8 Route optimization for paragliders

If one chooses at system configuration page 23 Para/Hang Gliders specials the option "Optimized route ON", see fig. 17.22, so LK8000 calculates the optimum entry point into the task-waypoint cylinder.

There are three possibilities to access the optimization:

- Via system configuration page 23 - the choice will be stored into the standard profile
- From the navigation menu Nav 3/3 it is possible to toggle the optimization on/off during the flight
- Configure a cuctom key for toggling

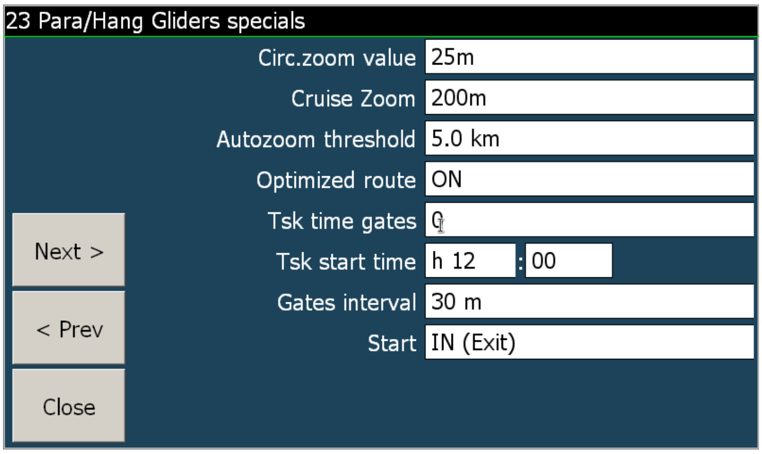


Figure 17.22: Switching on of the route optimization

The optimal cylinder entry point is marked by the CG-symbol and its name is given in difference to other points by a leading "!" letter, e.g. "!Bisbino" resp. "!BISB" in **fig. 17.23**.

Figure 17.23: Optimized cylinder entry point

Arrival heights and other data are calculated with the terrain height above the entry point.

In the example in **fig. 17.23** the center of the cylinder is located on a mountain and not reachabel (see gliding range), the optimal entry point is reachabel and located over te lake. The arrival height amounts to +806m to that point. If the turnpoint is not on the map or the terrain is not configured for the calculation of arrival heights etc. the height of the turning point will be used.

17.9 Task of type AAT for para- and hanggliders

Text by Bjørn Ole Haugsgjerd

To layout tasks of type AAT for para- and hanggliders first the route optimization has to be disabled.
Then the task will be formulated in the task editor

Menu ▶ Nav 2/3 ▶ Task edit

and there AAT will be activated after adding the first waypoint, see **fig. 17.24**.

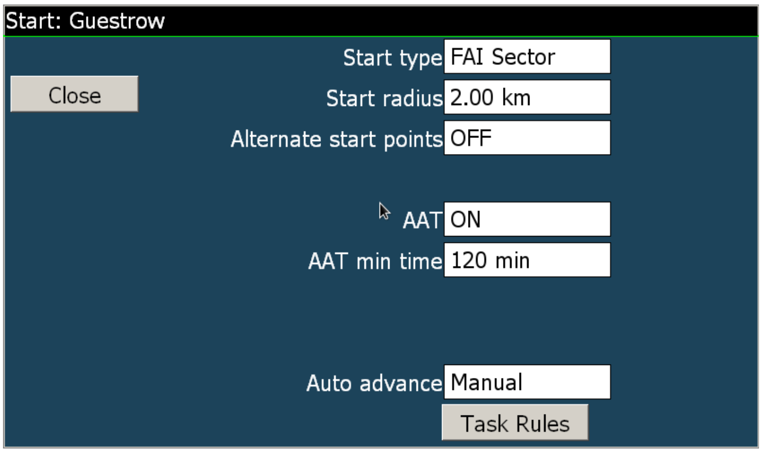


Figure 17.24: AAT for paragliders

To change planned distances within the cylinders/sectors one uses the task calculator

Menu ▶ Nav 1/3 ▶ Task Calc

The task distance is changed with "Set range".

Note: If you do not want to use route optimization and want to navigate to the center of the cylinder use value 0%!

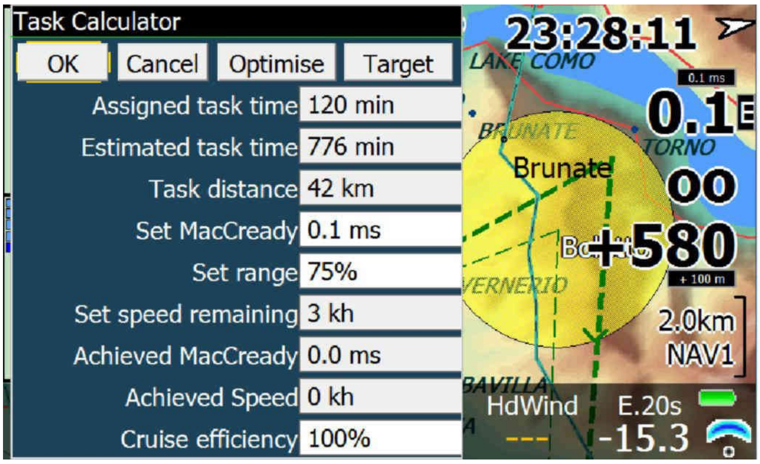


Figure 17.25: Track change within the cylinder

17.10 LK8000-competition version for the USA

March 1st 2012

The US Competition Rules Committee has requested that the following rules have to be respected, in any software used for flying a US competition:

No “Artificial Horizon” or “Turn & Bank” display from any data source.
To be acceptable for US competition, software that is released in versions supporting (1) must be released in a separate version without the prohibited functionality and:

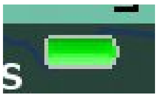
1. It must be obvious to the casual observer via the start up screen that the prohibited functionality is not present (something more descriptive that just a version number is desired to make it easier for non-technical contest personnel to monitor).
2. It must not be possible to enable the prohibited functions by changing any device setting or memory location (i.e. registry)
3. The release authority for the software must provide a statement to the RC that all versions prior to x.y are compliant and all version after a.b are compliant and how they can be identified

For this reason, we are delivering a special version called "**COMPETITION**".
It is called COMPETITION because it must be used in competitions, not because it has some special functions.
On the contrary, the "COMPETITION" version has no TRI info page 1.6 (the Turn Rate Indicator).
We hereby declare that any COMPETITION version of LK is

1. without TRI code inside (not simply disabled: there is no TRI code at all in it)
2. It is not possible to enable the TRI because of (1).

18 Energy

In the PNA/PDA-version the battery power is continuously monitored and indicated at the display lower right by a graphical battery symbol.
In dependence of the battery filling level the symbol is partly green (filled) or



red (empty).
"Energetically" needed warnings and messages are given.

- If a re-charger is connected or disconnected a message is given immediately.

The warnings are given on following occasions **only once** within 5 minutes respectively:

- The battery conditions changes from discharge to charge
- The battery is 100% charged
- The battery is discharged to 30%
- The battery is discharged to 20%
- The battery is discharged to 15%. This warning will be repeated every **two** minutes
- The battery is discharged to 10%. This warning will be repeated every minute and accompanied by a **QUAK** sound.
- The battery is discharged to 5%. The warning will be repeated every minute and is accompanied by a QUAK sound.
  (No frog on board, it is LK8000! ☺)

The battery manager does not work in the first 30 seconds of program start. In this time the battery conditions will be evaluated.
Hence if one connects or disconnects charger no warnings are given during this time period.
The message battery is charging "Battery Charging" is only received if the charging is in **actual** fact taking place.
If a charger is used and the battery is not being charged this means that either the charger has a problem or the battery itself is faulty and hence not re-chargeable.
All these messages relate to either the internal PDA or PNA batteries not the external battery packs. The conditions of the external battery packs can be obtained from the status displays xBatt1 or xBatt2.

Limiter of the battery warnings
The battery warnings are, except for critical warnings limited to a maximum of **15**.
Reason: In case of a faulty charging procedure or a defective device too many warnings would be given.

19 Flight documentation

19.1 Software-Logger

The flight documentation is done by writing a flight data file in IGC format by software logger [IGC-FMT].

This file contains amongst others:

Pilot name
A/C type
A/C registration
Competition class
Competition registration
Logger ID
GPS data
G-records

The personal data are to be entered in the system configuration page 20 Logger.
IGC-files which were written with a software logger are **not** acceptable for record flights but are valid for de-centralized competitions like **OLC**.

For paragliders LK8000 is accepted by the WXC of the FAI as an official logger!

If it was configured, the LK8000-logger starts recording, automatically at the take off and stops recording after the landing.
To be on the safe side wait a few minutes after landing before you switch off the device to ensure the landing was recorded.

For sailplanes take off and landing are determined as follows:

- The **take off** is recognized, if the plane is at least for 10 seconds faster than 40 km/h.
- The **landing** is recognized, if the plane is for a minimum of 60 seconds at a height of less than 300m AGL slower than 40km/h.

LK8000 recognizes the beginning of the free flight either after a winch tow, an aero tow or self start with engine. This, on the one hand is required to initialize the correct cross country flight parameter, but also for the new radius regulation for motorized gliders in the OLC sprint competition.

For para gliders the take off and landing is determined as follows:

- The **start** is recognized, if for a minimum of 10 seconds a speed of more than 5 km/h is recorded.
- The **landing** is recognized, if for a minimum of 10 minutes a speed of less than 5 km/h is recorded.

- The **landing** is also recognized if the logger is stopped while the speed is less than 5km/h.

The ICG-File is written in the folder _Logger in the LK8000-folder and can be extracted from there.
In the system configuration page 22, one can select if a long or short file name is wanted.

The documentation of the free flight start can be resetted during flight by the custom function "Free Flight start"!

19.2 Logbook

LK8000 contains an automatic logbook, which registers all flight even if the software logger is not active.
Therefore at every detected landing three text-files will be written into the folder **_Logger**:

- LOGBOOK.LST, a list of all flights, viewable in LK8000
- LOGBOOK.TXT, a detailed list of all flights, viewable in LK8000
- LOGBOOK.CSV, a csv-file with detailed data of all flights which can be viewed in an editor or spread sheet programm.

The logbook is called via the menu

Menu ▶ Info ▶ Info 2/2 ▶ LogBook

see **fig. 19.1**.

Figure 19.1: Logbook menu

Logbook list (file LOGBOOK.LST)

In this list all flights are written with data required for the personal logbook and the planes logbook as
date,
time of flight,
registration,
pilots name,
time of departure (local, UTC), place of departure,
time of landing (local/UTC), landing place.
Logged simulated flights are logged with the prefix "Simulation", this is also valid for replayed flights.
Via scroll bar one can move through the list. New flights will be appended to the list, see **fig. 19.3**.

The list can be deleted/reset from within the program, the program asks for confirmation.

Figure 19.2: Logbook flight list

Detailled logbook (file LOGBOOK.TXT)

In this file, flights are recorded more comprehensivly, as follows:

(SIMULATION)
pilots name
reg. sign (type of plane)
time of departure (local/UTC)
place of departure
free flight start
height QNH at freeflight start
tow time and release height(QFE)
time of landing (local/UTC)
place of landing
time of flight
OLC-distances (Classic, FAI-triangle)
gain of height
max height
total lenght of track (odometer)

The flights are displayed page by page and in chronological order. With [Next>] and [<Prev] one can move within the pages, see **fig.19.3**.

Hint: The last flight can be accessed by a single [<Prev]!

Figure 19.3: Detailled logbook

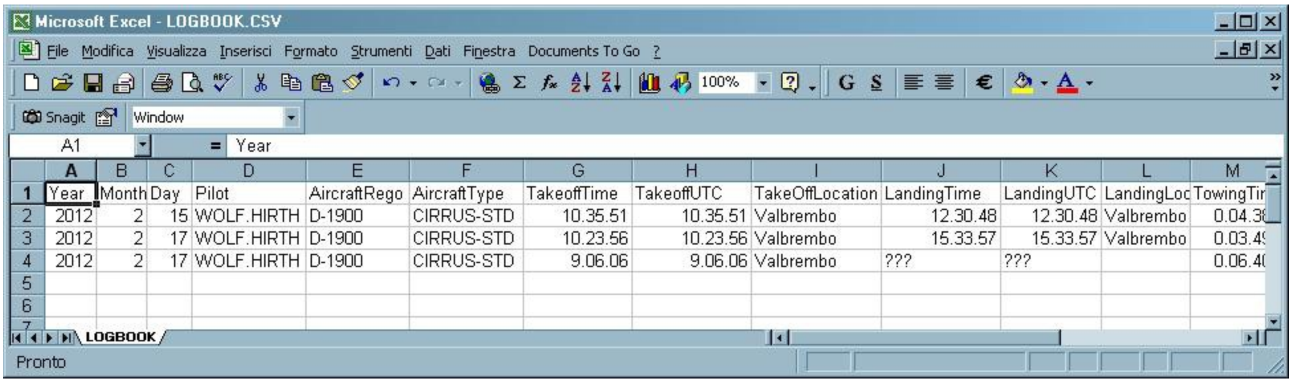
ATTENTION! The detailled logbook will be deleted/reset together with the short list! (but with confirmation question...)

The file LOGBOOK.CSV

This file will also be written in the _Logger folder but it can not be accessed from within the program. Only by direct access to the storage medium can it be worked.

Especially, it can not be deleted from within the program!

In this text file all reasonable flight data are stored. So one flight in one text line with data are separated by a comma from the next and so filed as a csv-file.
The file can be simply imported into a spread sheet program and all wanted calculations and data can than be worked on. see **fig. 19.4**.



Year	Month	Day	Pilot	AircraftRego	AircraftType	TakeoffTime	TakeoffUTC	TakeOffLocation	LandingTime	LandingUTC	LandingLoc	TowingTi
2012	2	15	WOLF.HIRTH	D-1900	CIRRUS-STD	10.35.51	10.35.51	Valbrembo	12.30.48	12.30.48	Valbrembo	0.04.3
2012	2	17	WOLF.HIRTH	D-1900	CIRRUS-STD	10.23.56	10.23.56	Valbrembo	15.33.57	15.33.57	Valbrembo	0.03.4
2012	2	17	WOLF.HIRTH	D-1900	CIRRUS-STD	9.06.06	9.06.06	Valbrembo	???	???		0.06.4

Figure 19.4: LOGBOOK.CSV-Datei imported into a spread sheet program

Important NOTE:

Start of the free flight
The free flight will be detected in heuristic manner by weighting different flight parameters during take off.
Which tow is also detected. But it is difficult to calculate an absolute accurate departure time.
If necessary one can himself determine the start of the free flight by hand via the menu of a custom key.

Motorized gliders certainly will need this start mode because the program can not access an engine noise sensor.

Furthermore:

- A flight will be added to the logbook as soon as a landing is detected
- A flight will be added to the logbook even at program shutdown. Landing time and landing place will get the value "???".
- PNA/PPC-program versions are adding flight to the logbook only in flight mode.
- The PC-version adds flights to the logbook also in simulation.
- Before adding a flight to the logbook the start and the landing have to be detected.
- Reminder; the landing is registered automatically **45 sec after** the real landing, SO WAIT SWITCHING OFF!
- **"touch and go" exercises can not be logged!**

20 Flight analysis

LK8000 records all flight parameters and makes them available for a thorough analysis.

20.1 Real time flight analysis

The real time flight analysis(!) can be obtained over

Menu ▶ Info ▶ Analysis

and following informations can be obtained:

- Barogram
- Climb rate
- Task Speed
- Wind profile at altitude
- Polar
- Temp
- Task
- Competition OLC Classic
FAI-OLC
OLC Classic(P)
FAI-OLC(P)

OLC League
FAI 3TPs
FAI 3TP(P)

- Sideview of Airspaces

Barogram

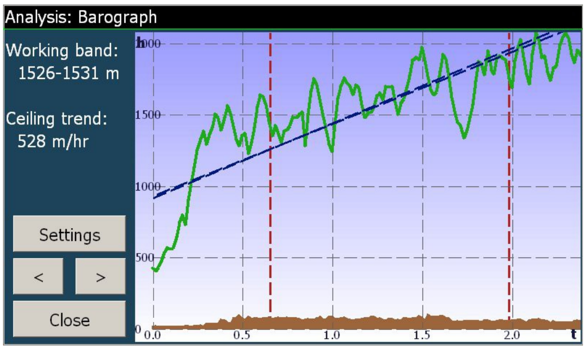


Figure 20.1: Barogram

From the barogram one can see the band of the working height immediately, see **fig. 20.1**.

Climb

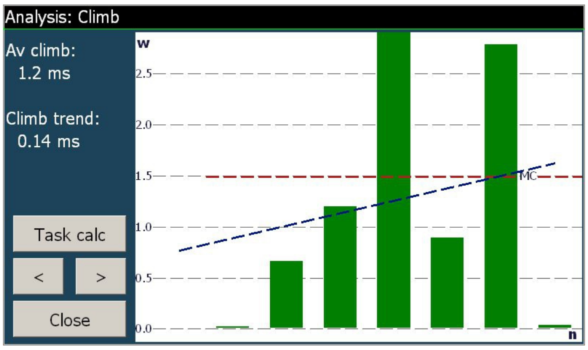


Figure 20.2: Climb

The Climb gives information about the diurnal development of the thermal activity, **fig. 20.2**.

Task speed

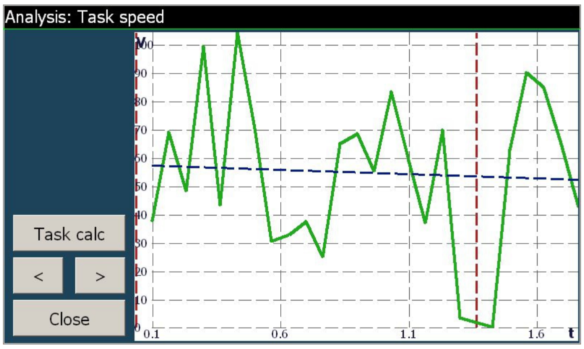


Figure 20.3: Task speed

One can read his speed trend, **fig. 20.3**.

Wind profil in upper levels

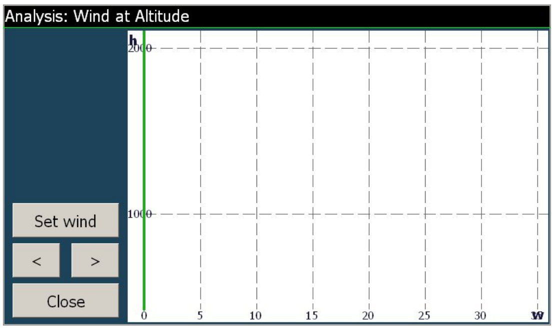


Figure 20.4: Wind profile at height

With the wind profile in the upper levels one can determine his flight altitude strategy, **fig. 20.4**.

Polar

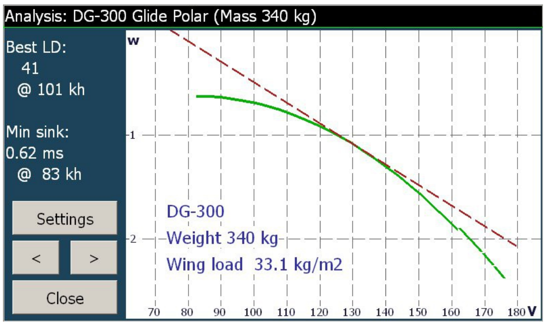


Figure 20.5: Polare

Polar, which is used for all calculations, **fig. 20.5**.

Temp/Sounding

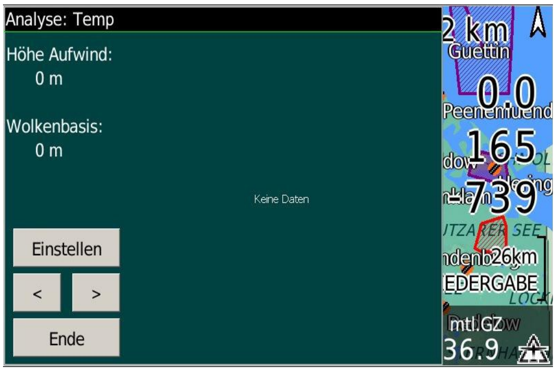


Figure 20.6: Temp

With the sounding analysis the convection base height and unstable layer can be determined, **fig. 20.6**. The temp will be only displayed if a temperature sensor is accessible!

Task

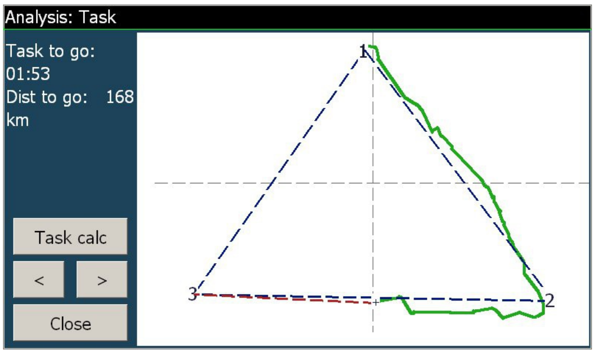


Figure 20.7: Task analysis

Determination of the remaining path of the task, **fig. 20.7**.

Contest OLC-Classic, OLC-Plus

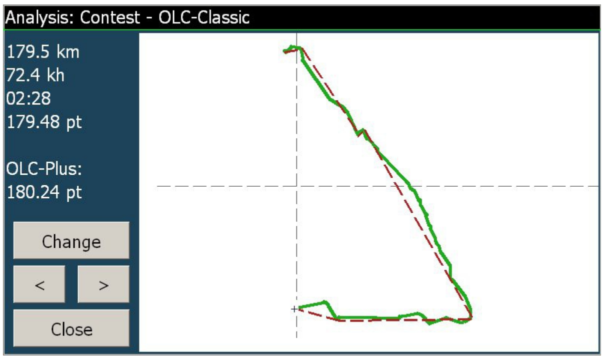


Figure 20.8: OLC-Classic

Real time scoring for OLC-Classic, OLC-Plus, **fig. 20.8**.

Contest FAI-OLC

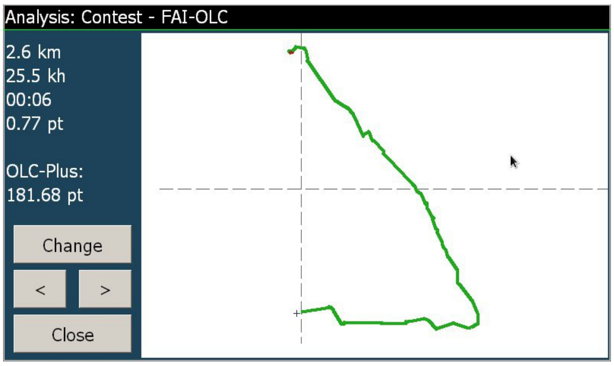


Figure 20.9: FAI-OLC

Real time scoring for FAI-OLC, **fig. 20.9**.

Contest OLC Classic(P)

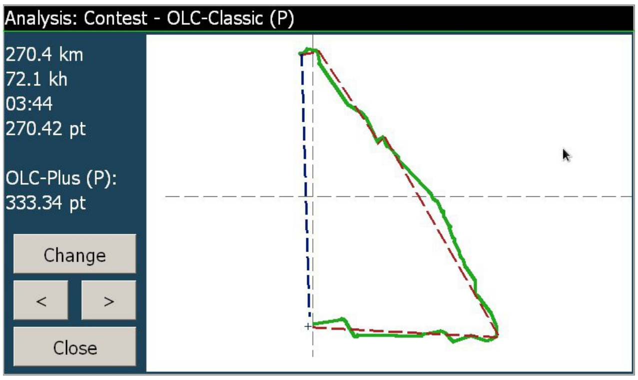


Figure 20.10: OLC-Classic Plus

Real time scoring for OLC-Classic-Plus, **fig. 20.10**.

Contest FAI-OLC(P)

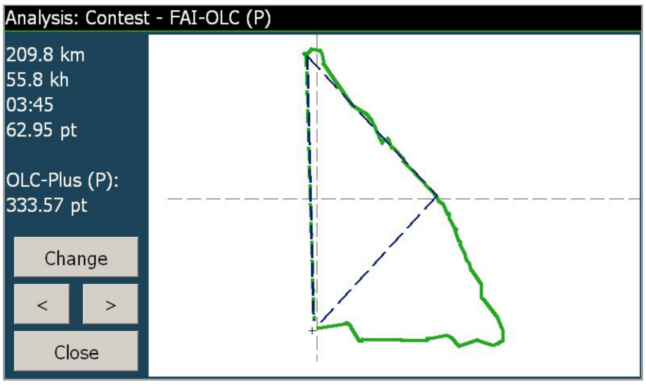


Figure 20.11: FAI-OLC-Plus

Real time scoring for FAI-OLC-Plus, **fig. 20.11**.

Contest OLC League

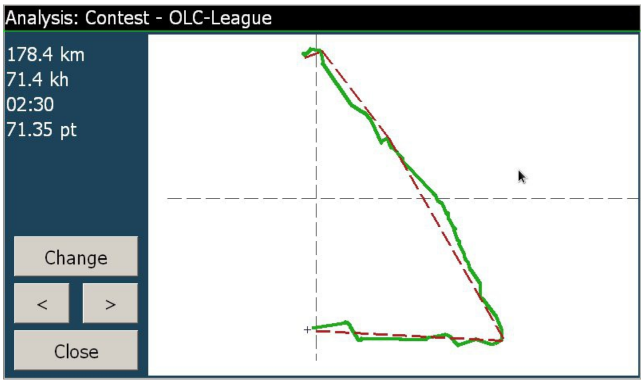


Figure 20.12: OLC-League

Real time point calculation for the OLC-League, **fig. 20.12**.

Contest FAI 3TPs

Figure 20.13: FAI 3WDPe

Real time scoring for the FAI-track around three turnpoints, **fig. 20.13**.

Contest FAI 3TP(P)

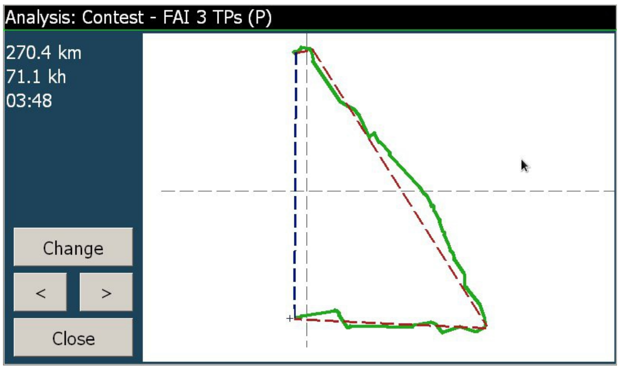


Figure 20.14: FAI 3WDPe Plus

Real time scoring for the FAI-track around three turnpoints (Plus), **fig. 20.14**.

Sideview airspace, see **chap. 14.5.2.**
Analysis of flight path in respect to airspaces in flight direction.

20.2 Replay/analyze IGC-file

A further interesting possibility for flight analysis exist by loading an IGC file, to replay the flight, and to have LK8000 calculate all flight parameters.

Menu ▶ Config ▶ Config 2/3 ▶ Logger Replay

During the replay, LK8000 behaves exactly as during the actual flight, in other words, all calculations, messages, and display switches are carried out.
One can check how well one was thermalling, to see the actual decisions made as to the route taken etc.

With the rate button one sets the replay speed 1x means normal speed, 4x means the display speed is 4 times the normal speed etc. Calculations are correct done up to a display speed of 8x, **fig. 20.15**.

The logger replay window can be closed during replay and called again from the menu.

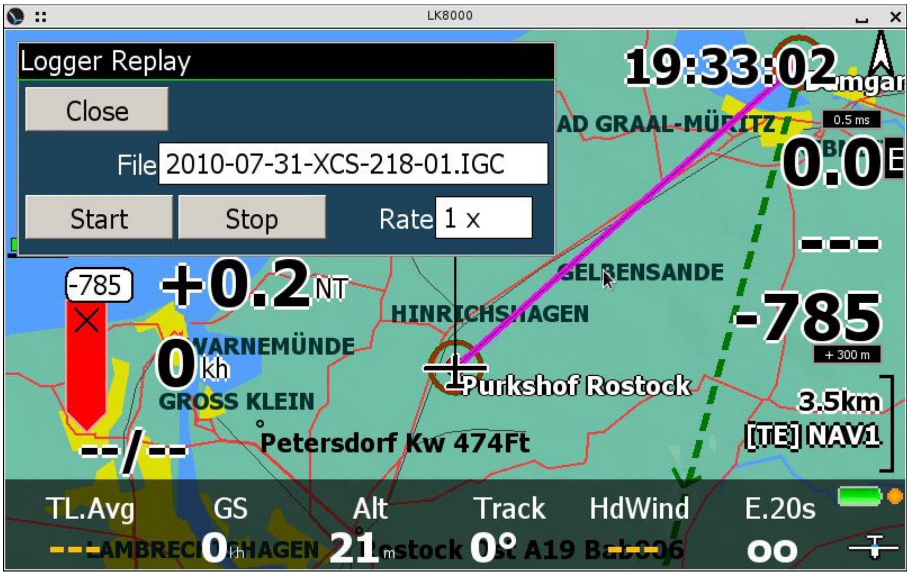


Figure 20.15: Replay IGC file

Another way is, for pilots who have SeeYou in their computer, to load the ICG-file into the flights-file in your computer and then into SeeYou and play and analyze it there.

21 Flight simulations

21.1 Coupling to external flight simulators

LK8000 can be used for flight simulations in different ways. So it can calculate with the delivered data from an **external simulator** or provide a simulation by itself.

The external simulator is usually a PC program. A good gliding simulator is "Condor" [Condor]. The speciality of Condor is that it can deliver a NMEA data stream to a serial port.
This data stream, if delivered to a virtual port, can be evaluated by LK8000 one the same computer or if delivered to a hardware port it can red from an external device running LK8000.
The connection to the hardware serial port can be done by serial cable, bluetooth or USB.

On both devices, the Condor-PC and the LK8000 device the same maps have to be used. At the LK8000 homepage Condor maps are hosted.
To fly a task the task layout has to match. This can be done by the free utility program **condor2nav** [condor2nav], i.e. the Condor-task is translated for LK8000 and be loaded afterwards.
LK8000 evaluates the NMEA-data as provided by a real source. Or in other words, all LK8000 functions can be testet with Condor.

21.2 LK8000 flight simulator

Something very different is the built-in **LK8000 flight simulator**.
If altitude, speed and heading are provided to LK8000 so all needed calculations can be done. If these data can be set by a simple user interface so one have the possibility to test all functionalities of the program on the own device in a simple manner.
Of course these data are somewhat constant (speed, heading) to the next input and the flight path is a bit boring, but for tests it is by far enough.

This user interface was realized in the simulation menu,

Menu ▶ SIM MENU

see **fig. 21.1**.

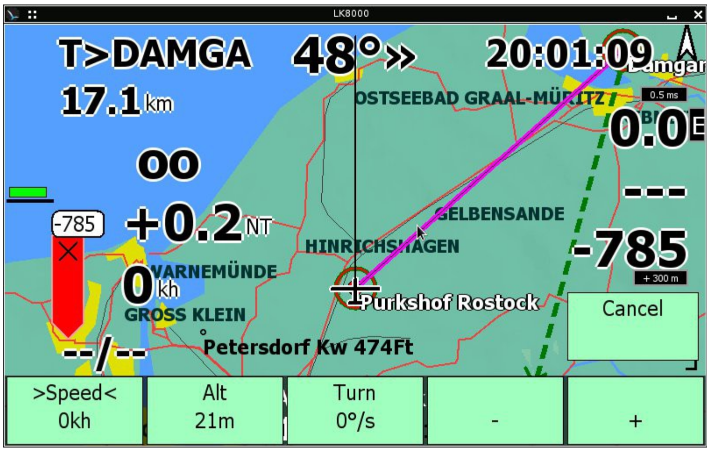


Figure 21.1: Simulation menu

The softkey the name of which is surrounded by >< i.e. >NAME< has the focus for the - - and + - softkeys, in the figure here speed. By the - + -softkeys the numerical value can be altered. The program knows that the values can be changed only after each other, so it becomes possible to climb to 1000m at speed "0" without any problems. The direction is chosen by a turning rate over time. To fly straight one has to switch back the turning rate to 0°/s.

The program displays normally the plane on its home field. But one sometimes wants to start the simulation from another field. It would be possible to define another home field but it is easier to move the planes position.
Therefore you switch to PAN map mode and click **long** on the desired position and the plane will be automatically moved to it.

To make the simulated flight more realistic the plane loses height according to its speed and polar.
Who likes to play can try to circle the hidden thermals (diameter 450m, max climb 4 m/s) and test so the thermalling aid, the orbiter!

The third flight simulation possibility is to replay an IGC file with all parameter calculations, see **chap. 20.2**.

21.3 FLARM-traffic simulation

If LK8000 recognises a connected FLARM device, the flight tactical and navigational possibilities are enhanced remarkably and that is why the program includes a FLARM-simulator which can be activated in the simulation mode.

The FLARM-simulator can be activated/deactivated on the system configuration page 13.
If it is active, four FLARM objects will be drawn around the plane on the map, one of which becomes thereafter a GHOST and another a ZOMBIE.
The FLARM objects move a bit, so experiments are possible. Info page 4 is

active and FLARMnet is used like in reality.

FLARM objects can be chosen as navigational targets by the multitarget function. If one selects a FLARM object as target, target tracking via info pages 4.2 and 4.3 is possible. So the optical target tracking on info page 4.3 can be practised.
Do not expect a video game because the FLARM objects are not moving normally.

22 Program user community

The development of an open source program depends on its community. The community are the **developers**, the surrounding **activists** which do the translations or take care for the website and the **users** which test the program, write error reports, help newbies and (very important!) deliver ideas for the further development.
Within a fruitful community the program gains quality in the shortest time.

22.1 Help for newbies

The help for newbies at first is help for self-help. If you mention the efforts of the newbie you are willing to help. In other words, before you start to ask you should use **all available** sources of informations and you should have done some tests by yourself which can be reproduced.

22.2 Discussions

The program is discussed in the website forum

http://www.postfrontal.com/forum/default.asp?CAT_ID=11

in several groups:

Deutschsprachige Ecke
german speaking users

Development updates
Here developer versions are announced, sometimes discussed and sometimes information data links are provided.

Hardware
suitable hardware for LK8000 and its exploitation

General support
discussions of all program aspects, all kind of help

Paragliders
specific paraglider discussions

Delta/Hang Gliders
specific hangglider discussionen

Bug reporting and solved list
bug reports and solved bug reports
Before posting a bug report make sure that you really found a bug!!!

Note: A real bug can be reproduced somehow! Give a procedure!

Changes request and new features list

Here change requests and new feature suggestions are made
This is the place for creativity!
(But think about the already reached quality level!)

Developers

developers discussions

The more objective and skillfully someone is discussing the more he will be respected! ☺
Do not forget the already matured state of the program, so that your contribution have to be at a level.
If not, you get some sarcastic comments, but do not care if your goal is serious.

22.3 α-, ß-tests

Alpha-tests are done by a proven user group, which is reached by email.

Beta-tests are announced in the forum and there are also the betas provided, so all interested parties can take part in testing.

By the forum group *bug reporting and solved list* bug report should be given.

22.4 Documentation

Program documentation is often a weak point of open source software. It is often true that a programmer does not write documentions. The source is available but often not understandable for non-programmers.
Paolo Ventafridda is an exception as programmer and documentation writer, so he provided the documentation for the LK8000 version 1.22 as a standalone work.

This handbook is a contribution to the project. Its weakness is that it can not keep up with the development and so it is advisible to follow the discussion in the forum.
At the project homepage also some lessons and articles can be found.

22.5 Translations

LK8000 has now translations into **16** languages and therefore it is used in over **40 countries**!
Because translations can be done by editing text files also non programmers can contribute!

The language specific files are UTF8-coded, so nearly all symbols and special letters like "**œ** "can be displayed. This way also greek, cyrillic and asian letters/signs can be used!

The developers try hard not to disturb existing translations. New functionality is introduced by default with english phrases which are also used if a token is still not translated.

23 Program development

LK8000 is an open source project, distributed under the GNU **GPL licence**.

23.1 Sources

The program sources are available on the GIT-server

https://github.com/LK8000/LK8000

There are hosted the current code and previous versions.

23.2 Tools

LK8000 is written in C and C++ and developed in a Linux environment. The Windows CE and Windows 32 versions are made by cross compiling with the Mingw-compiler und its tools.

For the ARM-platform the Mingw32ce-compiler is used.

On the Git-server the compilation of the program is described in a wiki in several articles.

23.3 Team

The current **international developer team** (3/2012):

Paolo Ventafridda	(ITA)	**Project founder and -leader**
Mateusz Pusz	(PL)	calculations, simulations
Kalman Rozsahegyi	(HU)	airspace calculations
Richard Pecl	(CZ)	
Oren Cohen	(IL)	GA-mode
Karim Trojette	(GER)	
Ulrich Heynen	(GER)	sideview, airspace SONAR
Lucas Marchesini	(ITA)	calculations
Bo Haugsgjerd	(N)	paraglider interface
Sérgio Da Silva	(CAN)	paraglider interface

Translators

German	Ernst-Dieter Klinkenberg, Berthold Bredenbeck
English	Paolo Ventafridda, Alan Broadribb, Frank Pennauer
French	Romaric Boucher, Dany Demarck
Greek	Thomas Manousis
Dutch	Rick Boerma
Italian	Lucas Marchesini, Enrico Girardi

Croatian	Zoran Miličić, Saša Mihajlović
Polish	Mateusz Pusz
Portuguese	João Rosa
Portuguese(Br)	Tales Maschio
Russian	Konstantin Goncharenko, Vyacheslav Kopchynskyy
Swedish	Patrick Pagden
Serbian	Aleksandar Cirkovic
Spanish	Hector Martin
Czech	Zdeněk Šebesta
Hungarian	Kalman Rozsahegyi

α-tester

Sasa Mihajlovic, Bjorn Ole Haugsgjerd, Michel Hagoort, Peter Lengkeek, Dave Salmon, Martin Gregorie, Andy Durbin, Berthold Bredenbeck, Karim Trojette, Marco Nierop, Al Macdonald, Pawel Roman, Thomas Weinberger

Documentation

German	Ernst-Dieter Klinkenberg, Berthold Bredenbeck, Ulrich Heynen, Merve Finke
English	Paolo Ventafridda, Alan Broadribb, Frank Pennauer
French	Bruno Cardon, Romaric Boucher, Dany Demarck
Italian	Mino Giolai
Serbian	Aleksandar Cirkovic
Czech	Jan Šebesta

Presentations

Romaric Boucher
Bruno Cardon
Aleksandar Cirkovic
Dany Demarck
Mino Giolai
Ulrich Heynen
Ernst-Dieter Klinkenberg
Matheusz Pusz
Kalman Rozsahegyi
Jan Sebesta

Webmaster & Public Relations

Sérgio Da Silva (Portugal-Canada)

23.4 Possible new functions

Already considered new functions:

- complete GA mode
- voice messages FLARM
- extended simulations
- detour navigation
- 3D-maps
- Viewing of approach charts
- RASP
- Android port
- ...

24 Detailed installation

The installation of **flight calculation program LK8000** consists of following steps;

- the selection of the physical device
- the program installation
- the device coupling with external devices
- the program coupling with the external devices
- the final configuration of the program

24.1 Device

Usable devices at this time

- are all devices with **Windows CE 4.2, 5** and **6** operating system and which are unlocked.
- which can be operated with a touch screen display
- which have an internal GPS receiver
- and have SD(microSD) card port

A great number of automotive PNAs, smart phones and also a number of older PDAs meet these requirements
The external interfaces of these devices are important for more complex configurations and one should consider such when selecting a device (USB, Bluetooth, RS232).
A further criteria during the device selection are **display size, a high resolution and sunlight readability**.

These devices should have
*a touch screen display with a resolution of up to 800x480 pixels and
a 4-5 inch(diagonal measured) screen
* a powerful high performance CPU with a 1GHz clock rate
* a large RAM
* a large internal ROM
* the possibility of increasing memory storage with a (Micro)SD card
* a sensitive GPS receiver (SIRF II)
* a UBS port (mini USB port)
* a bluetooth port
* a loudspeaker
* (a microphone)

In the LK8000-Forum new devices are constantly tested and evaluated.

At this time (07/12) the following navigation devices are favoured, **fig. 24.1**:

Holux C61 (outdoor-Navi, some internal GPS glitches)
Vertica C1 (good display, some internal GPS glitches
Mio MOOV M400
Wayteq 950BT HD (and family)
HP HX4700 (not more new to get ☹)

Figure 24.1: Assortment of PNAs and other navigational devices at sunlight

Before buying a devices one **has to check the name, serial number very accurately** because there are large device differences between the series!

Older devices like PDAs, which are not produced anymore e.g
HP IPAQ Series
Fujitsu Pocket LOOX N500
have the advantage of a trans-reflective possibly better **sun-readable** displays but unfortunately also have a too small display, a small storage capability and a slow processor. The GPS for these devices is a separate external device.

LK8000 runs on these devices without problems, but has a somewhat slower reaction which has to be accepted for a slightly better in sunlight readable screen.

The problem of the sunlight readable display will be solved (hopefully) in the (near) future. MIRASOL-displays which work on the interference basis of reflected light are promising, in stronger sunlight better to see displays which are now appearing on the market in the first devices, **fig. 24.2** [MIRASOL].

Figure 24.2: Mirasol-Display, photo Qualcomm

24.2 Initial programm installation

To set up the program one needs:

- the program itself (zip-file)
- the map and topology (LKM-files and DEM-files)
- the airspace data and
- waypoint data (dat, cups, compGPS)

For e.g. Germany all files are available on the LK8000 homepage, some maps for the own flying area can be downloaded with highter resolution.

In addition one needs information for the device as **how to directly access the operating system** in order to start a program.
On some devices in particular PNAs is such access not always simple. But this information is available for almost all devices and often also how to unlock devices by searching on the Internet.

It is of great importance to find information on the required **serial port** and the required **serial baudrate** to be able to access the **internal GPS-receiver**.

If can be a serious problem if port and baudrate are not available !!!

Hint*: Within the folder LK8000_System_CEUtilities the utility program GPSScan.exe can be found which tries to detect the GPS receiver port and its baud rate. If this utility does not help, try the internet for informations. Asking the forum may also help. If the device navigates otherwise you know the receiver is o.k. und you have to determine port and baudrate by trial and error. Sometimes the native navigation program show within the options also port and baudrate.*

As the program normally will be installed on an SD Card, make sure you have a **fast, high quality HD card** available.
Slow HD cards slow down the program and as 90% of all program run errors are due to defective SD cards, do not save on this item.

It is required to write the LK8000 program onto the SD card on a PC with internal or attached card reader.

WARNING!!!

The writing of the program with the SD card in the device which is connected with PC with a USB connection is error prone!

The LK8000-zip-file will be un-zipped into the **root of the SD card.**
Within the **LK8000 main folder** one also receives the sub-folders

_Airspaces
_Configuration
_Language
_Logger
_Maps
_Polars
_System
_Tasks
_Waypoints

24.2.1 Content of the program sub-folders

Within the folder **_Airspaces** airspace files are located. LK8000 can load up to two airspace files.

The folder **_Configuration** contains all configuration files and additionally the FLARM file, the FLARMnet file and the notize file.

Language specific files are located within the folder **_Language**.

The folder **_Logger** contains all stored IGC files and the logbook files.

Terrain and topologie files are located in the folder **_Maps**.

All polar files (own written files and system provided polars) are stored in the folder **_Polars.**

The folder **_System** contains the main program files and some useful Windows CE utilities.

Task files are located within the folder **_Tasks**.

Waypoint files are stored within the folder **_Waypoints**.

24.2.2 Installation of own data files

- The maps (DEM, LKM) have to be copied into the folder _Maps, how to get them see **chap. 28.**
- The airspace file has to be stored in the folder _Airspaces, how to get see **chap. 29**.
- The waypoint files (contains waypoints and airfields) have to be copied into the _Waypoints sub folder.
- Own polar files are stored in the _Polars folder.

Now you can start the program directly from the SD-card!

24.2.3 Profiles

LK8000 supports profiles. Profiles contain selected options which can be restored at program start up.

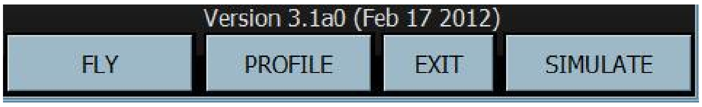


Figure 24.3: Start menu

Clicking at start up on button PROFILE, **fig. 24.3** the following profile menu, **fig. 24.4**, is shown.

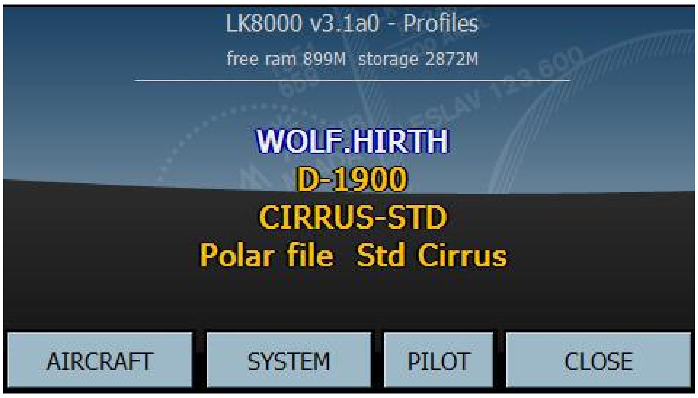


Figure 24.4: Profile menu

The display shows the following informations:

Name of pilot
reg. number of plane
type of plane
polar used

And the menu allows the profile choices:

plane
system
pilot

LK8000 has three kinds of profiles:
(1) Aircraft profiles
They contain the aircraft type, the reg. number, the used polar etc.

(2) Pilot profiles
Within a pilot profile currently only the pilots name is stored, which is given at system configuration page 20 Logger.

(3) System profiles
They contain all system parameters without plane parameters and pilot names.

It is possible to select profiles at start up.

During program start up every time the **standard profile** which contains all data will be loaded.

At shut down of the program ALL parameters AND profiles will be stored into the standard profile which is loaded next start up again.
This way the selected aircraft-,pilot- and system profiles are restored and valid!

Changing of pre-configured parameters at run time

It is easy to change parameters during runtime, e.g. kind of map display, etc. but these changed parameters are **not** stored into the configuration and therefore are called *runtime parameters*.

Changing a configuration parameter changes also the runtime parameter immediately.

The idea behind this is easy, runtime parameter are loaded with the values of the configuration parameters at program start up.

If one wants to change a parameter like e.g. efficiency % permanently it has to be done in system configuration!
If efficiency was set to 80% during run but it was stored in the configuration with 100% it will be set on the next program start up to 100% again!

Please remember: runtime parameters are not stored!

Loading of profiles during program start up

From the profile menu one chooses the appropriate button, fig. 24.5.

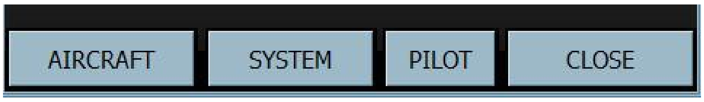


Figure 24.5: Profile-menu

AT the very first LK8000 start a standard profile is loaded with a DG300 and the pilot Wolf Hirth etc., fig. 24.6.

Figure 24.6: Profile choice

By clicking into the profile name field as profile list is shown and the wanted profile can be selected by clicking on it.

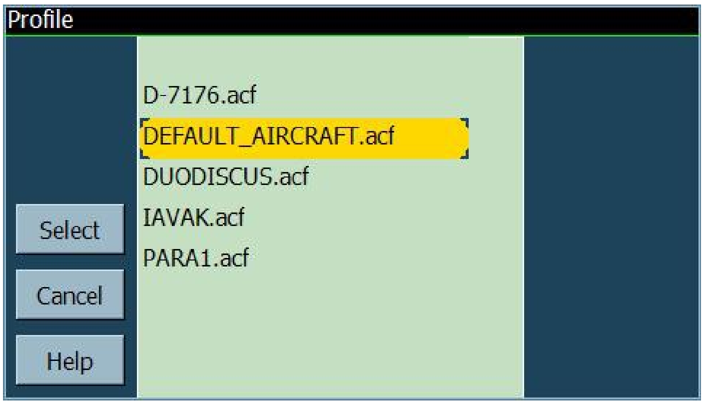


Figure 24.7: Profile list

After confirmation the profile is loaded with [Select] e.g. in **fig. 24.8** an aircraft profile of a DG300.

Figure 24.8: Profile informations

The same way one can load a system profile and a pilot profile.

But it is also possible to go back to the old configuration by choosing the default profile. After profile selection one can go back to the start menu.

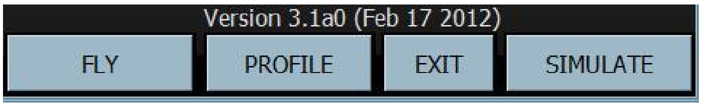


Figure 24.9: Start menu

The chosen profiles are now selected but still not loaded! To be loaded the flying or simulation mode has to be activated. Then the default profile stores the selections.

Reset LK8000 to initial state

If one want for some reasons to set LK8000 to its very initial configuration it can be done by selecting the "FULL RESET LK8000 PROFILE".

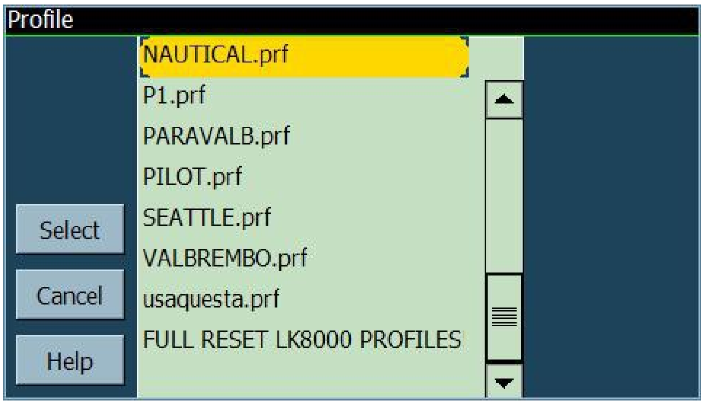


Figure 24.10: Profile list

It has to be chosen, see **fig. 24.11**

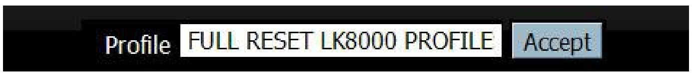


Figure 24.11: FULL RESET PROFLE

and confirmed, **fig. 24.12**.

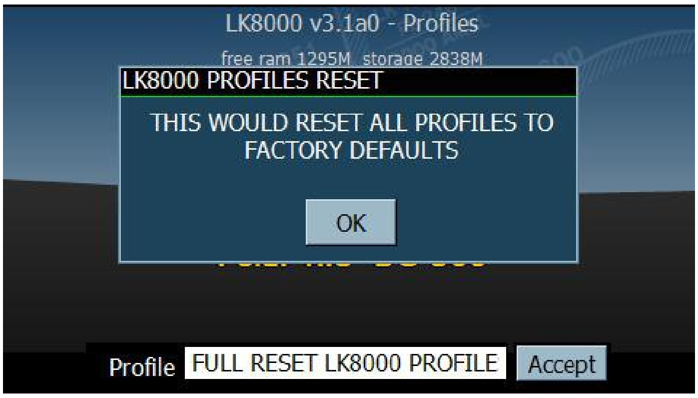


Figure 24.12: Confirmation of LK8000 RESET

After confirmation the display shows the RESET message within the profile menu, **fig. 24.13**.

Figure 24.13: RESET message

It is still now possible to change the system profile and to restore the default profile by clicking on the SYSTEM button, because nothing was really initialized yet. But if you close the profile menu now, you also get the RESET message in the start menu, **fig. 24.14**.

Figure 24.14: RESET confirmation

But there is still nothing initialized, only if the flight or simulation mode are activated the real RESET is executed, **fig. 24.15**.

Figure 24.15: RESET execution

NOTE: The formulated task will be not reset. Tasks are not part of the profile system!

Storing of profiles

The **system profile** is stored by

Menu ▶ Config ▶ Config 2/3 ▶ SAVE System

One can choose to store into a new system profile or to overwrite an old one, **fig. 24.16**

Figure 24.16: Storing options

The aircraft profile is stored in system configuration page **7 Aircraft**.
It is also possible to write a new aircraft profile or to overwrite and old one.

The pilot profile is stored same way on system configuration page **20 Logger**.

If configuration parameters are changed and **not** stored within the profiles they are nevertheless stored in the default profile!

24.2.4 Initial configuration

After the start of the program in simulation mode [Simulate] click on the airplane symbol (lower right corner) and in the appearing menu on the button [Config] click to the sub menu [Config2/3] Then click on the button [Setup SYSTEM] to reach the configuration pages.

On **configuration page 1 Site** first select the language. Click on the language field and then select the required language e.g ENGLISH.LNG or GERMAN.LNG etc then click [Select] this returns ones again to the configuration page 1. Then **click [Close]** one gets the confirmation in the selected language and **after the program is re-started** is the new language applied.

To continue with the configuration click again on the

Menu ▶ Config ▶ Config 2/3 ▶ Setup SYSTEM

There one selects the required files e.g. for Germany

Map file	GER.LKM
Terrain file	GER_1000.DEM
Waypoints 1	GE_Airports_2011_01.cup
Waypoints 2	...
Airspace 1	GER_Airspace_20110313.txt
Airspace 2	
...	

On c**onfiguration page 7 Aircraft** select the program mode

[Sailplane] [Paraglider/Hangglider] [GA Aircraft] [Car]

specifying your plane. For a great number of sailplanes polars are already loaded in the program, but on this page one can also load his own polar-file. Further data V rough air, Handicap, and Ballast dump time complete this page and the planes profile can be stored.

The configuration of the internal **GPS receiver** is done on **configuration page 8 Devices**

It can present a real problem if the information regarding port and baudrate are not available. But again in the internet are almost all of these informations are available. The GPS interest groups are very active in this respect. It is also worthwhile to check in the LK8000 forum for this information. The port and baudrate can sometimes be also found in the configuration of the road navigation program of the device.

If the device works properly on its road navigation program, it indicates that GPS receiver works correctly.

If the correct port/baud rate could not be obtained as by above, the only way open to try to find it by trial and error.
Try also the GPSscan.exe utility from the _System folder.

On **configuration page** **20 LOGGER**, enter personal data for the logger. After loading the Basic Data

Menu ▶ Configur ▶ Setup Basic

and after a **GPS fix** is obtained the program is ready to go, and further configuration work can be performed.

The system profile will be stored by

Menu ▶ Config ▶ Config 2/3 ▶ SAVE System

If you test the program on a PC, the program version file **LK8000-PC.exe** is located in the LK8000 folder, click on this file to open LK8000 in your PC.
One can also, for test purposes, load the different display resolutions. This can be done by writing the resolution as start parameter in the command line e.g.

LK8000.exe 640x480

Following resolutions are possible:

Landscape: 320x240, 400x240, 480x234, 480x272, 640x480, 800x480
Portrait : 240x320, 480x640, 480x800

A typical PNA resolution is 480x272.

24.2.5 Setting the home airfield/start place

The **home airfield** (or the temporary take off place) can be set if one has access to the waypoint details. Therefore the home field will be choosen from the waypoint list by e.g.

Menu ▶ Nav ▶ Waypoint Lockup

Within the details window of the waypoint you select [Details] and [Next>] [Next>] and choose [Set as new Home].
After closing the waypoint details window e.g. in simulation mode the plane jumps in the map immediately to the new home field (or selected take off field).

24.3 Coupling to external devices

External specialized devices record data which are not available from the GPS-signal, for instance

Pressure altitude(height), temperature, humidity, other air traffic, IAS and climb rate

and also deliver other data often more accurately and quicker than the GPS-signal.
If such Instruments are already installed in the plane, one should always attempt to connect these instruments with LK8000, as this always improves the information received and is a win-win situation.
The LK8000 developers continuously attempt to support more external devices, and requests for such from the user are welcomed by the development team.

24.3.1 Technical coupling to external devices

All PDA/PNA have interface ports. The existence **and** the usability of such interface ports should become a decision when purchasing a device.

For the coupling one uses the typical existing ports like

RS232,
USB and
bluetooth.

Real RS232-ports one finds today only in older devices which are not any longer produced. Devices produced today typically only use the USB and/or bluetooth interface. A preference should always be given to interfaces with cable connections. Bluetooth is okay but wireless transmission errors are a possibility.

At first we will look at the **coupling of a PDA/PNA with a FLARM device.** This a typical application case and manyfold advantageous.

A **redundancy** set up (FLARM-GPS-receiver, internal GPS-receiver) can be made.
One receives the **pressure height** and
the **traffic data** from FLARM.

The coupling can be set up with bluetooth or USB but unfortunately additional hardware for the connection is required, see **fig. 24.17** for the bluetooth connection.

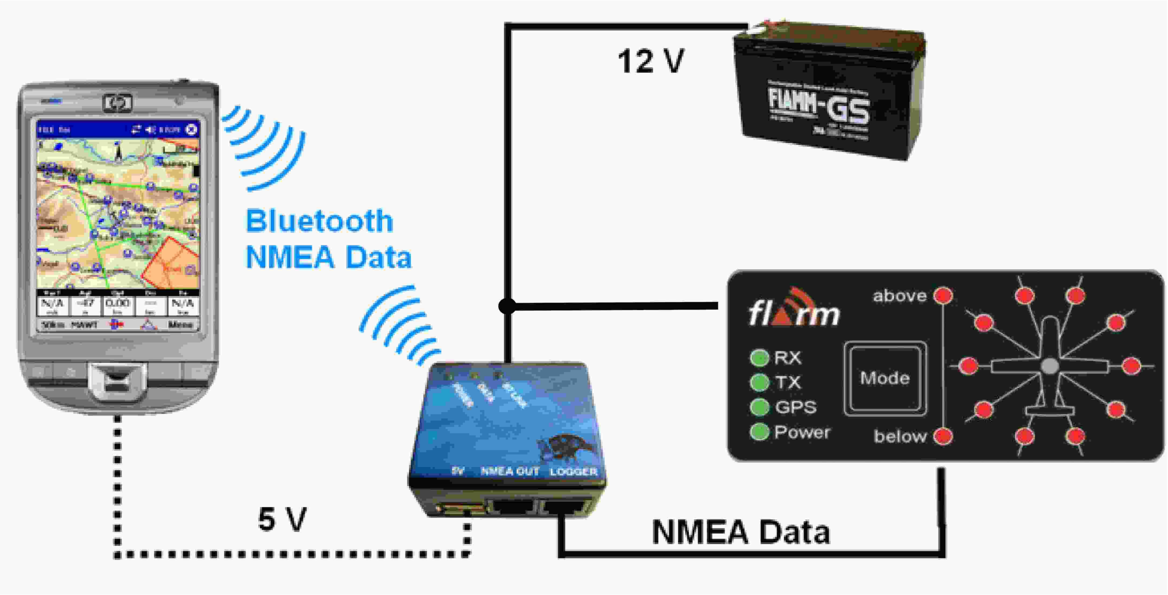


Figure 24.17: PDA-FLARM-coupling by bluetooth

The required bluetooth-coupling box is available from **Glidertools**
http://www.glidertools.com/products/bluetooth-modul-pro-spojeni-loggeru-a-pda/
or
from the K6-Team, the K6 BT Adapter for data transfer via bluetooth,
http://www.k6-team.de
look under "electronic parts".

These BT coupling boxes can be used at the same time as 12V to 5V power converters for serving the PNA/PDA.

Some bluetooth devices develop problems, when closing a serial connection. Therefore **LK8000 should always be closed before the external bluetooth device**.

Some bluetooth devives after closing the connection can not be reconnected, even if the COM ports are re-started by LK8000.
This is a known problem of the bluetooth-driver within the operating system.
The only solution is to close LK8000 and to de-acticvate bluetooth, then to re-activate bluetooth again and re-start LK8000.
One should always simulate what occurs when the bluetooth device disconnects, in order to know what can be expected when such unexpected disconnection takes place during flight.

If the external bluetooth-GPS only has the "SPP SLAVE"-mode problems can occur when the connection is lost. But on devices with "SSP MASTER"-mode the connection will automatically be re-established.

If one uses a PNA which has an internal GPS and bluetooth or RS232, the external GPS or the external E-Vario or both (as with FLARM) can be put on port 1 and the internal GPS on port 2 and achieve with this a GPS redundancy. In case the external GPS fails LK8000 will automatically switch over to the internal GPS.
If LK8000, in order to obtain good GPS data, switches between port 1 and port 2, a message will appear.
As there are now 2 GPS sources, it can happen that one of them looses reception for only a few seconds, but then establishes contact again, in which case LK8000 switches GPS data sources and everytime a message appears on the display.
After several such messages are given the message
“Going Silent - interface loss will not be reported”
If one resets the interface reporting manually via the menu, the message will be shown for some time again, but eventually it be suppressed.

If the FLARM coupling is done via an USB-interface an USB-RS232 level shift by hardware has to be made. This is because the USB interface works on 5V but the RS232-Interface on 12V.

Although such an electronic converter can be selfmade if one has the how to do knowledge, for the others it is advisable to buy a finished module from one the above mentioned suppliers **because they simply work**, see **fig. 24.18**.

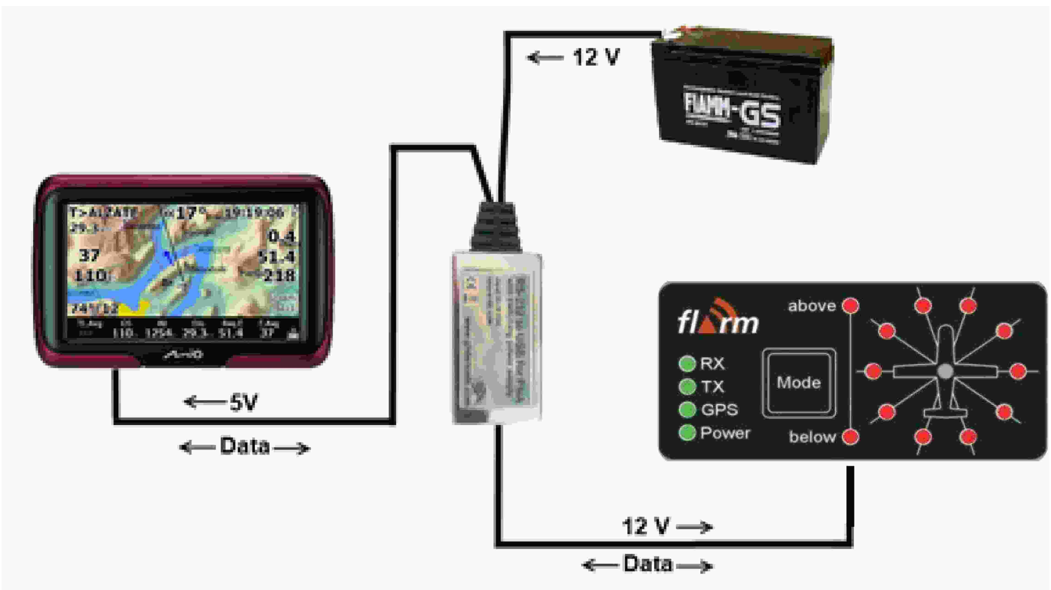


Figure 24.18: PNA-USB-FLARM coupling with level shifter

It becomes a bit more difficult if in addition to a FLARM one also wants to connect other intelligent instruments, like an E-variometer (IAS, climb, temperature) or for that matter that more than one external NMEA-sources are available.

Device(+LK8000)+FLARM+E-vario would be a luxurious combination!

In addition to the task of level shifting, additionally two data flows are sent to the USB interface. For this a Data Flow MULTIPLEXER is required.
Such a Data Flow Multiplexer for three individual NMEA streams is e.g. available from the K6-Team, **fig. 24.19**:
http://www.k6-team.de, ...see electronic parts

Figure 24.19: K6 Mux NMEA-multiplexer by K6-Team

With such a multiplexer the following coupling can be configured, **fig. 24.20**:

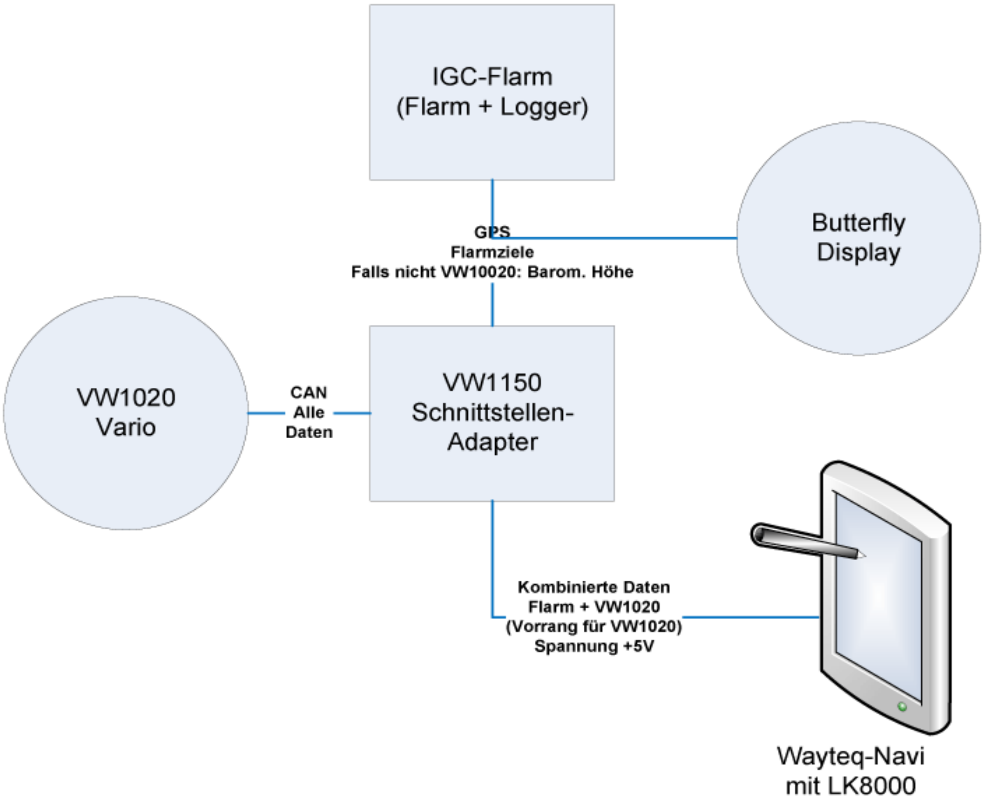


Figure 24.20: Couplng of PNA, FLARM and E-Vario by a multiplexer

Coupling suggestion by Arnulf Koch

http://lsc-kitzingen.de/Blog_Blog_46_kkmenue.html

In this coupling suggestion a specialized multiplexer VW1150 from Westerboer is used which also supports the CAN-bus of the Westerboer instruments. Within the figure an USB/RS232 level shifter for the PNA is missing.

When the hardware connections are completed, the software coupling has to be made.

24.3.2 Software coupling to external devices

In this handbook the software coupling to the following devices is decribed (whereas Condor is a pseudo device ☺):

FLARM
CONDOR
Digifly Leonardo Pro BT
Brauninger Flytec Compeo 5030
Flymaster F1
Westerboer 1150
Lx16xx

24.3.3 FLARM

Transmission rate

A FLARM-device can transmit NMEA-data with data rates limited by the available hardware. At less than 19200bps only GPS and barometric height but no traffic data are transmitted. That is why it is preferable to configure the port connected to the FLARM with at least 19200bps.
First one connect the FLARM with the default baud rate (4800 or 9600bps). If the FLARM was detected by LK8000 the message

"**FLARM DETECTED"**

appears on the screen.
Now from the FLARM configuration menu the baud rate can be set to 19200bps or 38400bps. LK8000 sends the necessary commands to the external FLARM.

The FLARM device does **not** acknowledge the commands, but mentions their execution because FLARM now does not respond to LK8000! In fact FLARM corresponds now with a new trasmission **but** LK8000 still uses the old one. That is why within the system configuration the FLARM connected port has been reconfigured with the new transmission rate and FLARM becomes visisble again.
The changed transmission rate will be stored within the FLARM and within the standard profile of LK8000.

FLARM range
If FLARM is switched on its traffic range is usually set to 3km. Better to configure FLARM so that all traffic at the widest range is transmitted.
With the button "Radio Range" in the FLARM menu it is possible to do this but the command will be carried out again without confirmation.

FLARMNET

What is FLARMNET?
Every FLARM device owns a unique serial number, which is transmitted together with the GPS data.
This identifier locks e.g "**dd1234**" and has no meaning to the pilot. But because these identifier is unique it can be used to assign plane signs, pilots or airfields to it and that makes it versatile.

FLARMNET is a free public database of FLARM signs, which is administered by **Butterfly Avionics** and can be downloaded from the internet.
In principle it is an encrypted text file. This file contains FLARM-IDs, the connected planes, clubs, pilots, commonly used frequences etc.

Every pilot can add data to the database via http://www.Flarmnet.org

A registration is easily possible, no password needed!

Using FLARMNET by LK8000

The current FLARMNET database can be freely downloaded from http://www.Flarmnet.org/. One chooses the WinPilot-format and saves the file as text file. Then it should be renamed to

FLARMNET.FLN or **DATA.FLN**

and be placed in the folder LK8000/_Configuration.
LK8000 searches within this folder for a file named FLARMNET.FLN or DATA.FLN.

The database will be loaded at the program start up and untill the first message five seconds can pass. Before loading the FLARMNET database the start up sound of LK8000 can be heart.
If you connect FLARM to LK8000 it is advised also to use FLARMENET!

Using a local database of FLARM IDs

It is also possible to use a local database which only contains a correlation between FLARM-ID and a string with the plane registration. For instance one gets instead of *dd1234* the plane registration "D-5678" or as another possibility "Paul".
This local FLARM-ID-string database is located in the folder _Configuration and has the name **IDFLARM.TXT**.
As a text file this database can by edited easily with a text editor. The file content itself are text lines

FLARM-ID=text string

e.g.

dd1234=D9876

or

dd1234=WOLFGANG

The allowed length of the string are ten characters. On the map are only three characters of the string shown, the first one and the two very last.
e.g *D-1234* is shown as *D34*.
The local database can hold up to 50 IDs. If you have more entries please consider to contribute to the FLARMNET database.

24.3.4 Configuration for the soaring simulator Condor

Within the system configuration the device A and B has to be set to "Condor". This way LK8000 can interpret all incoming data correctly and take actions like wind setting, sets heading, height, speed etc.
Note, the barometric height and GPS height are identical in Condor, that means the GPS height has no errors. So you can use the barometric height (system configuration page 5) in any case.

Very important! Within the device configuration the Geoid Altitude has to be "OFF" for correct reading of the GPS height. Or if GPS height does not mind one can use the barometric height as described.

24.3.5 DigiFly Leonardo

LK8000 supports the **Digifly Leonardo Pro BT** (Leo) with firmware version February 2010 completely. The telemetry data are transmitted by RS232 or serial bluetooth.

If bluetooth is used the serial cable has to be disconnected! If the serial cable is used bluetooth has to be deactivated on the device.
Within the configuration of the device one chooses for normal flight in "ADV SETTINGS" the telemetry mode FL1 with a sample-rate of 1Hz (one sample per second). FL2 can not be used with the current LK8000 version.
Please ensure not to use the car mode as in this mode no telemetry data are sent.

LK8000 gets from Leo the GPS position, the GPS height, the barometric height, the climb and battery informations.

If the device is optionally connected to external sensors, LK8000 can also get IAS and netto climb.
For calculating wind and L/D, LK8000 uses its own values and the Leo data.
So, you can get . independently calculated wind values from LK8000 and the Leo, the same applies for L/D.

The charging state of the battery is availabe via the info stripe values EXT.BATT.1 and EXT.BATT.2

- EXT.BATT.1 give the voltage of the primary energy source, the Li-ion-battery.
- EXT.BATT.2 gives the votage of the AA-reserve-battery.

The Leo read barometric height is compared to the corresponding QNH, if one uses Altimeter n.1. If one did not change the QNH on the Leo (it did not correct Altimeter n.1) LK8000 estimates with GPS help an averaged altitude.

If the GPS signal is missing or terrain is not configured in LK8000 a height estimation is not possible in LK8000 and the QNH is not set automatically.

After the first QNH setting (because the height in Altimeter n.1 was corrected or because GPS data became available and the terrain height was used) it will not be changed automatically. To change the barometric height one can use

Config ▶ Setup Basic

and change in there height or pressure as one prefers.

Note please, Leo does not send any telemetry data while in configuration mode!

24.3.6 Brauniger / Flytec Compeo 5030

LK8000 can read the Compeo specific NMEA sentences GPRMZ and VMVABD. The last one contains the barometric height, climb, speed and temperature.

As speed LK8000 guesses that it is IAS. Compeo does not inform in the transmitted NMEA stream which kind of speed is transmitted in the stream.

> The speed is guessed as IAS and NOT TAS. If TAS is transmitted IAS and TAS in LK8000 are wrong. LK8000 expects mandatory IAS vom Flytec!

The barometric height can be adjusted according to the QHN in the menu over Config ▶ Setup Basic.

24.3.7 Flymaster F1

LK8000 supports the device Flymaster F1 completely, including the battery informations (voltage of external battery 1 and 2 and voltage from the battery pack).

24.3.8 Westerboer VW10xx

The device VW10xx (1010, 1020, 1030) can be controlled by a PNA/PDA. With version 3.0 of LK8000 this can be done bi-directionally. Remember, the mixer VW1150 as an additional device for coupling is needed!

The MC-value, the ballast and the bug state (L/D %) can be changed either on the VW10xx or in the LK8000/PDA and is available after a few seconds.

In order to connect a VW10xx with LK8000 within the system configuration page 8 Devices "VW1150" has to be set as device.

To test the communication one can change the MC value which should also be available in LK8000. Then one can change in the basic setup

Menu ▶ Config ▶ Setup Basic

ballast and L/D% and these values should be available at VW10xx.
"Dumping" water in LK8000 the ballast value should change on VW10xx as well as the wing load.

Please note:
Value update can take time up to two seconds.
If one uses the auto-MC-function it is furthermore possible to change the MC value for both devices. The value will be automatically set as soon the auto-MC-function wants to change it and this depends on the flight history and the auto-MC parameter itself.

A new function of LK8000 V3.1x:
The VW10xx is able to transmit the mode, STF or Vario, and it can be used to switch in LK8000 the screen from cruising mode to climbing mode. Therefore one only has to set

Menu ▶ Display ▶ Display 2/3 ▶ DspMode Auto

Polar coefficients:
The polar coefficients of VW10xx and LK8000 are independent from each other. Therefore it is not possible to change the polar in the VW10xx device from LK8000 unintentionally and to use two different polars at same time.

Barometric heights

The VW10xx has a barometric pressure sensor and also transmits in the data stream the barometric height.
LK8000 will use a FLARM as GPS source and the FLARM also delivers the barometric height.
This way LK8000 has to handle two different barometric heights and it uses the more priorized height, in this case the barometric height from the FLARM.

Here follows a priority list for barometric height information in case more than one barometric height is available.

Please note that the barometric height from FLARM has the highest priority. To change this, one has to deactivate the NMEA-sentence with the not required pressure information ($PGRMZ) at the VW1150 multiplexer.

FLARM (**highest priority!**)
ROYALTEK 3200
TASMAN
HOLUX

ZANDER
COM760
WESTERBOER
VOLKSLOGGER
POSIGRAPH
LX_NANO
LX16xx
IMI
ILEC
GENERIC
FLYTEC
FLYMASTER F1
EW MICRO RECORDER
EW
DSX
DIGIFLY
CONDOR
COMPEO
CAI_GPS_NAV
CAI302
BORGELT500
Devices with NMEA RMC sentences except FLARM
Devices with NMEA GPS_RMZ (**lowest priority**)

24.3.9 LX16xx

The device LX166/LX1600 can be controlled by a PNA/PDA. Since version 3 of LK8000 this can be done bi-directionally.
The MC-value, the ballast and the bug state (L/D%) can be either changed on the LX or at the LK8000/PDA and is available on both devices after a few seconds.

LX16xx		**LK8000**	
Parameter	**Range**	**Parameter**	**Range**
MC	0.0 ... 10.0	MacCready	0.0 ... 10.0
Ballast	1.0 ... 2.0	Ballast	0..... 100%
Bug	0........50%	L/D%	50... 100%

It is a great advantage that the auto-MacCready-function of LK8000 can set the MC-value in the LX automatically.

In order to connect a LX16xx device with LK8000 it has to be set in the system configuration 8 Devices as "LX16xx".
To test the device communication change the MC-value on the LX16xx and see the change also in LK8000.
Then one can change in LK8000 in

Menu ▶ Config ▶ Setup Basic

the water and the L/D% and check them in the LX16xx.
Water "Dumping" in LK8000, should be seen on the LX16xx.

Please note:
Value update can take time up to two seconds.
If one uses the auto-MC-function it is furthermore possible to change the MC value for both devices. The value will be automatically set as soon the auto-MC-funtion wants to change it and this depends on the flight history and the Auto-MC parameters itself.

Barometric Height

The LX16xx has a barometric pressure sensor and also transmitts in the data stream the barometric height.
LK8000 will use a FLARM as GPS source and the FLARM also delivers the barometric height.
This way LK8000 has to handle two different barometric heights and it uses the more priorized height, in this case the barometric height from the FLARM.

Here follows a priority list for barometric height information for the case more than one barometric height is available.

FLARM *(highest priority)*
ROYALTEK 3200
TASMAN
HOLUX
ZANDER
COM760
WESTERBOER
VOLKSLOGGER
POSIGRAPH
LX_NANO
LX16xx
IMI
ILEC
GENERIC
FLYTEC
FLYMASTER F1
*EW MICRO REC*ORDER
EW
DSX
DIGIFLY
CONDOR
COMPEO
CAI_GPS_NAV
CAI302
BORGELT500
Devices with *NMEA RMC sentences except FLARM*
Devices with *NMEA GPS_RMZ* *(lowest priority)*

24.4 Final configuration of the program

The final configuration of the program contains amongst others

execution of external programs at run time,
the individual adoption of the user interface,
the definition of custom keys for direct access to preferred program functions,
the possible configuration of te CLUB mode and
setting the home airfield.

24.4.1 Execution of external programs

This explanation is thought for user with computer knowledge who knows which utilities they want to use when.

As user one can configure which utility programs to carry out immediately before starting up and shut down LK8000.
These utility programs usually have distinct functions like activation of bluetooth, screen rotation, backlight control etc.
They can be called up by LK8000 automatically in a distinct manner.

Therefore these utilities have to be copied to the LK8000 folder, e.g. the program rotate.exe (utility for screen rotation).
Care has to be taken that the needed DLLs are also available in this folder. So there are already the DLLs aygshell.dll and note_prj.dll which are used by LK8000 itself. The utilities can use (seldom) additional DLLs.

The executables of the utilities **have to be renamed** to one of the following names:

PRELOAD_00.EXE
PRELOAD_05.EXE
PRELOAD_30.EXE
PRELOAD_60.EXE
PRELOAD_99.EXE

ENDLOAD_00.EXE
ENDLOAD_05.EXE
ENDLOAD_30.EXE
ENDLOAD_60.EXE
ENDLOAD_99.EXE

PRELOAD-programs are executed before LK8000 start up, before LK8000 configures the screen size.
ENDLOAD-programs are executed immediately after LK8000 shut down.

If one want to use a utility function before LK8000 start up he has to use PRELOAD.
And if one wants to use a utility function after shutdown of LK8000 he has to use ENDLOAD accordingly.
So it is also possible to use both options together, e.g. one utility at startup and another at shutdown of LK8000.

This way, one can at start up rotate the screen from landscape to portrait and at shutdown rotate the screen back to landscape. One can activate, deactivate bluetooth this way etc.

The numbers in the names control the sequence of utility execution and sometimes their behaviour.

PRELOAD_00.EXE
is executed, if existent, first. LK8000 does not wait for the finish of this utility. Very important: **00 means no wait**. The utility continues working in the background and LK8000 continues starting up.

PRELOAD_05.EXE
is executed after PRELOAD_00.EXE, if existent. LK8000 waits 5s before continuing the start up sequence.
This holding time can be necessary for some screen rotating utilities that gives LK8000 the possibility to determine the geometry of the rotated screen.

The program names PRELOAD_30.EXE and PRELOAD_60.EXE result in 30s and 60s holding time during start up.

At the utility with the name PRELOAD_99.EXE awaits LK8000 the end of this program! **ATTENTION**, some programs like BlueSoleil for the HP314 are running in the background and can not be stopped, see below.

So one can use a command line interpreter like CECMD.EXE as PRELOAD_99.EXE, do some configuration, exit and then LK8000 further starts up.

The typical usage of PRELOAD_05.EXE is screen rotation and of PRELOAD_99.EXE command line execution (CECMD.EXE). LK8000 starts the utilies in the order of the numbers in the names 00 05 20 60 99.

ENDLOAD functions analog to PRELOAD but is executed immediately bevor LK8000 shutdown.

Special case HP31X-devices and BLUESOLEIL
One goes within the explorer to resident flash, then to IPAQ, then to bluetooth. Within this folder the communication program BlueSoleil.exe is found. The file has to be copied into the LK8000 folder and then one starts it. You check that bluetooth was activated and you got a connection and close it via CE-program bar.

Now one renames BlueSoleil.exe to PRELOAD_30.EXE (or 00 or 05 but NOT 99!!).
Then you start LK8000 and BlueSoleil works in the background. The blue indicator LED will light. If you want to connect devices by bluetooth one uses

PRELOAD_60 and connects the devices within the first minute of the LK8000 start up. After this minute LK8000 continues startup sequence.

24.4.2 Finetuning

The drawing of the terrain in the map can be adopted to the personal liking (colour scheme, label number, shadows).
The info pages and button info stripes can be selected according to the own information needs.
An info page with individually preferred flight values can be adopted.
Custom keys can be defined for short access to favourite flight functions.

For simulations an additional profile can be added.

24.4.3 Club mode

If there is a file named CLUB within the LK8000 folder it is possible to write new profile files but it is not possible to overwrite or delete existing profile files.
The behaviour is quiet useful for flying with club planes!

24.5 Error handling

Because there are no error free programs there will be errors within LK8000. The installation of LK8000 on a distinct hardware setup can hold some little hurdles.

Error handling consists first of error analysis and the following list of questions should be answered very carefully

Operates the PNA/PDA at all alone (without coupling to external devices) ?
 Memory OK?
 GPS-receiver works in native navigational program?
 Internal battery OK?
 External battery loaded?

Operates the device with LK8000 (very last version)?
 All DLLs in place?
 Right executable choosen?
 Access on GPS-receiver possible?
 Disturbing background programs active?
 What about interfaces?

Again, is the used memory card o.k.?
 ONCE AGAIN:
 Is the used memory card REALLY o.k.?

What contains the Runtime.log file? (To shorten it, delete it and then start LK8000 again)
 All necessary program parts are available and loaded?

Is the to connected device supported by LK8000 at all?
 The firmware-version counts!

Is the cabling o.k.? Is the cabling **really** o.k.?
 Pin-connections o.k.?

Are the serial port numbers and the transmission rates chosen correctly?

Is the configuration o.k so that the error could be a program bug?

Is it a re-producible program bug? Can you give a procedure to show it?

Bug diagnosis should be done very carefully. For obvious errors (cables etc.) help is not to expect. For some bigger projects like difficult hardware couplings skilled help can be expected in the forum.

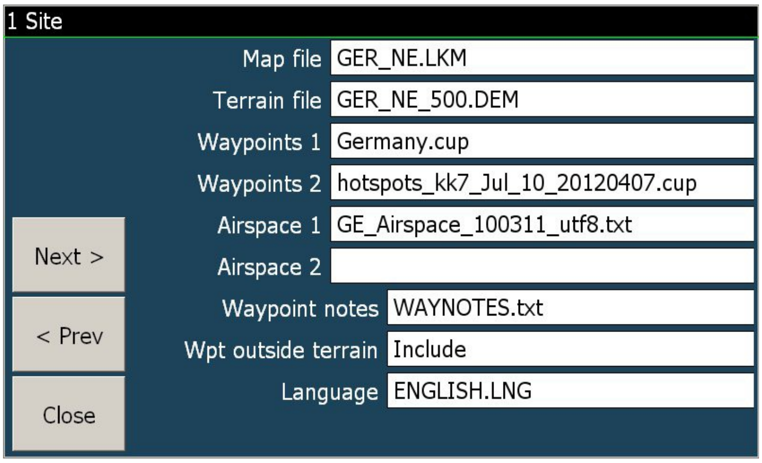
25 Detailed system configuration

The system configuration consists of 23 configuration pages which hold heading related options, these options can be selected with display buttons. The display buttons (boxes) are assigned different types of selection possibilities. These are:

a file selection
an option pack
a value selection
a switch

The value selection can contain either numerical or alpha numerical and graphic values.
Switches contain binary selection possibilities.

25.1 Page 1 Site



Map file: The Map file (LKM)contains topology, lakes, rivers and the sea. For several soaring areas of the world the map file is for download available from the LK8000-homepage.

Terrain file: The corresponding terrain height file (DEM) is also available from the LK8000 homepage in different resolutions. The files are also described.

Waypoints 1/2: LK8000 can load two waypoints files. These can be of different file formats.
Because of the two waypoint files, one can for instance be used as the contest waypoint file. The other for the normally used waypoints and for further waypoints for the contest area.

At present four waypoint formats are supported:

Winpilot		file ending	**.dat**
Naviter SeeYou		file ending	**.CUP**
Compeers	f	file ending	**.wot** and
OziExplorer		file ending	**.wpb**

The formats of the waypoint files can also be mixed up, for storage in LK

Newly configured/stored waypoints will be written to the end of the file which is loaded as Waypoint 1!

Airspace 1/2: The maximal two loadable airspace files based on the **OpenAir**-standard format can, for instance, for Germany be found on the home page of the German Aero Club [DAeC-LR].

Waypoint Notes: In the **Waynotes.txt** longer information on waypoints, details of airfields, etc. can be entered.

IMPORTANT!

If one declares a waypoint in this file as **home** e.g. [Purksdorf=home] then the program evaluates this waypoint which then becomes the Home Airfield!

Another possibility to set his home airfield exists in the waypoint file, by calling up the waypoint in the navigation menu and set the home airfield in the available options [Nav][Waypoint lookup][highlight waypoint][select][details][prev][set as new home]
This file is a text-file. The syntax is easy to understand, with an example shown in LK8000.

WP outside Terrain: If waypoints are loaded which are outside of the terrain of the current map they can be selected as follows

Use them always	**WP-Include**
Exclude them	**WP-Exclude** or
Question	**Ask** if they should be used

Language: With this button one can select the required language file e.g. [Language.LNG]. For each available Language exist three language files

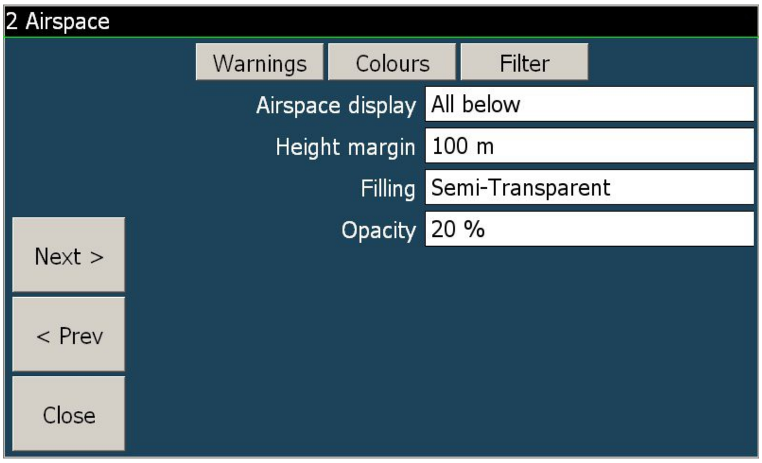
Language.LNG
Language_MESSAGE.TXT
Language_HELP.TXT

For instance for german GER.LNG, GER_MSG.TXT, GER_HELP.TXT.

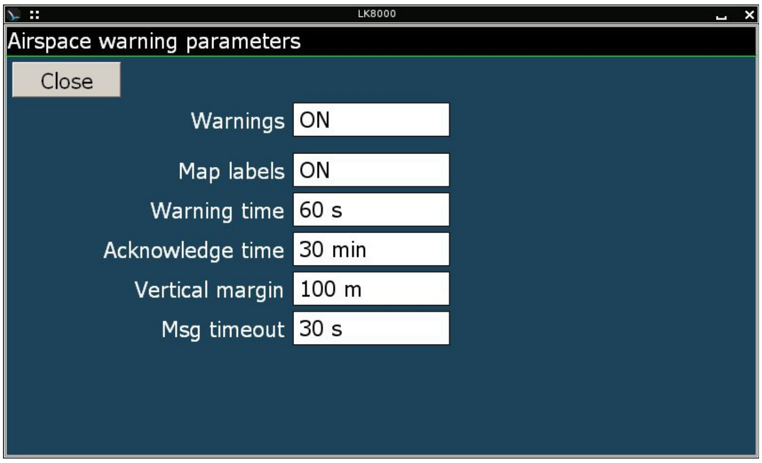
If for the selected language.LNG one of the other language files is not available, the english language file will automatically be loaded.

In addition if certain language phrases are not available, the english terminolgy will be used. With this procedure the development of the program will not be delayed by the progress of the translation. ☺

25.2 Page 2 Airspace



Warnings:



Warnings:
ON/OFF

Map labels:
Airspace map symbols ON/OFF
If the symbls are active, the airspace name and the vertcal distance will be displayed in the map.

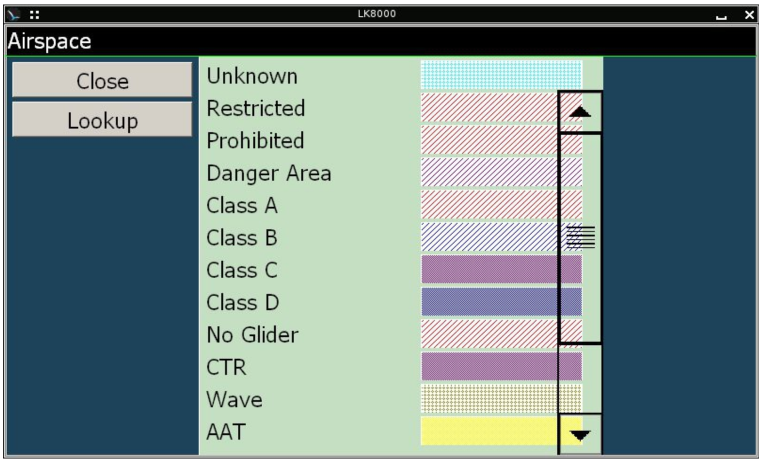
Warning time:
Warning time before an expected fly in, into an airspace according to the current heading and speed.

Acknowledge time:
Time interval without repeating a valid airspace warning.

Vertcal margin:
Vertical distance from airspace triggering start YELLOW airspace warnings.

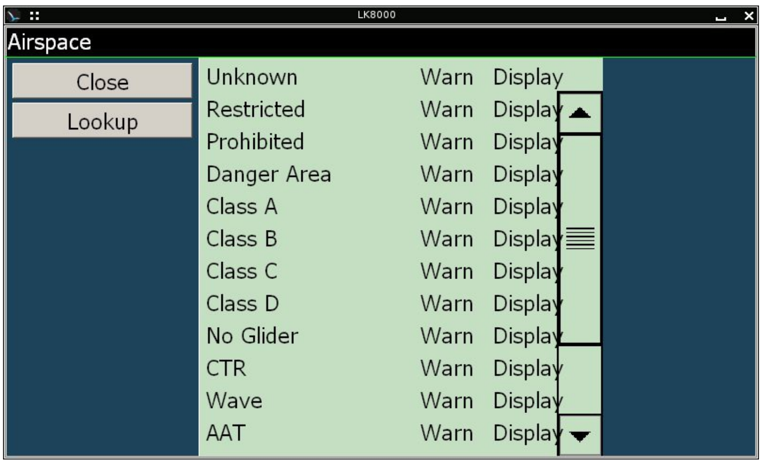
Msg timeout:
Airspace warning silencing time;
after it the warning dialog disappears automatically. Before disappearing a count down timer will be displayed.

Colors:
The different Types of Airspace can be displayed in different colors and graphic designs, see display above. It is suggested to keep the colours and graphics as close as possible to the ICAO map display.



With a click on the appropriate airspace type, one can set first the color and then the design.

Filter:
With the filter one sets which airspace type should be displayed or if a warning for this airspace should be given. The selection is carried out by a click on the airspace type and the options will then be shown.



Airspace display :
The airspace display has the options :

All On
Clip
Auto
All Below

Clip, means that all airspace below a maximal height are displayed.
With the option **Auto** one selects the display of airspace which are in a vertical distance band around the airplane.
*With **All below**, is airspace which is above the airplane not displayed!*

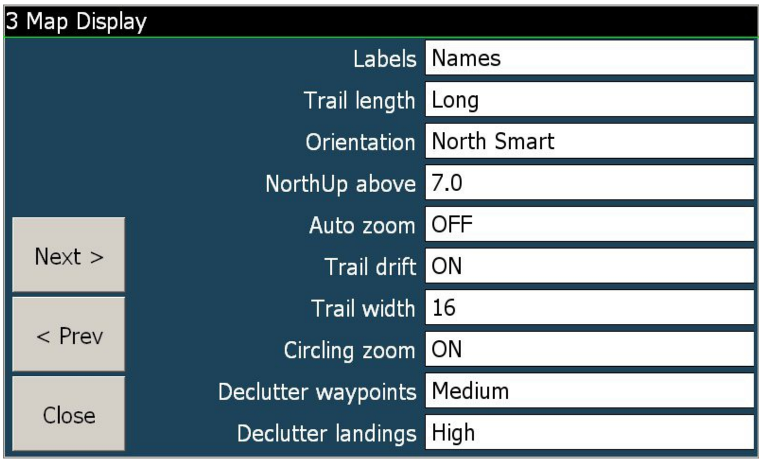
Filling:
The airspace can be displayed only with its border only, with a pattern or in transparent colors

[Outlines only]	Only the border of the airspace is displayed. Dangerous to use with high resolution displays and weak processors!
[Pattern]	The airspace is filled with the selcted pattern in the selected color.
[Pattern, only border]	The airspace border is filled with the selected pattern with the selected color. (warning see below)
[Semi-Transparent]	The airspace area is fille semi-transparent with the selected color, opacity is chosen by its option.
[Semi-transparent, only border]	The airspace border is filled semi-transparent with the selected color, opacity is selected by its option.

Only border mean no filling, *Pattern* is used for displaying the selected pattern and *Semi-Transparent* means colored transparent display with terrain to be seen. This is not supported by all devices and/or Windows CE version, so not by the HP314 with CE 5.0.

Opacity:
Defines how much transparent airspace area will be filled with opaque color, 0% means transparent, 100% means opaque.

25.3 Page 3 Map Display



Labels:
Determines how the waypoint Labels are displayed:

[Names]	the complete waypoint name is displayed
[Numbers]	the waypoint number is displayed
[none]	waypoints are displayed without a name
[Names in task]	only the names of waypoints in the active task and the home airfield are displayed
[first three]	the first 3 letters of the waypoint names are displayed
[first five]	the first 5 letters of the waypoint names are displayed

etc.

Trail length:
Determines if and in which length the trail of the flight path behind the plane is shown.
Options:

Off
Long
Short
Full

Orientation:
Determines how the map will be orientated:
[North up] the upper part of the map points always to North, the plane symbol will be turned in direction of the course.
[North Smart] the upper part of the map always points North, but depending on the flight direction a greater map area will always be displayed in front of the plane.
[*North/Track*] The map is in Course direction oriented.
[*North Circling*] The map points North, while circling and is in direction of the course oriented, while cruising
[*Target Circling*] Course up while cruising and on steering course to the next

waypoint while circling
[*North/course*] The map is north up while cruising and course up when circling.

North up above:
If the zoom level is greater or the same, this value changes the map orientation to north up
Below this value the selected orientation will be used.
If a high value is set this behaviour in practice is not activated.
The standard value is 10.

Auto Zoom:
The auto-zoom enlarges the map scale during the flight automatically, when an active waypoint is reached
After passing the waypoint the map scale will be automatically re- zoomed so that the next waypoint will be also displayed.

Trail Drift:
Determines if the trail of the flight path should drift with the wind during circling.

Trail width:
Sets the width of the graphic trail of the flight path.

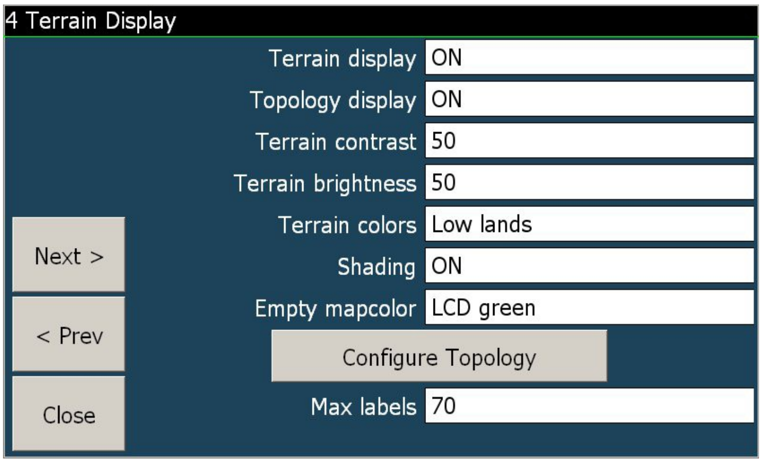
Circling Zoom:
If activated it will at the beginning of circling zoom in and at the end of circling automatically zoom out.

Declutter waypoints:
Waypoint designations have priority over topology designations.
Hence one can decide how close one wants to display the waypoint designations by de-cluttering.

Disabled, displays all waypoint even when overlapping.
Low, does not display overlapped waypoints, but fills the map to a maximum.
Medium and High leaves more room between the waypoint designations
and leaves room for topology designations
Very High increases the separation between the waypoints putting priority on the topology designations

Declutter Landings:
Disabled shows information about reachable and landable airfields and landable waypoints which are on the map
Low, shows no out-landing fields, if airfields are available
High, attempts also to avoid to display airfields which are on the borderline of the glide range.

25.4 Page 4 Terrain Diplay



Terrain display:
Displays the terrain heights on the map. If slope shading is activated luv-slopes are displayed lighter and lee-slopes darker.

Attention: Sun shading will only be shown, if the wind speed is below 6km/h (3.2kt). It is assumed that the sun by wind speeds below above speed, is the determining source of lift. Above this wind speed, the wind is the primary lift course and only the wind is used for the display of the shading.

Topology display:
Displays topological features on the map (streets, rivers, lakes), it requires a topology-file.

Terrain contrast:
Determines the amount of phong-shading in the terrain display. A large values emphasize terrain heights and therefore lower values should be used in mountains.

Terrain brightness:
Determines the brightness (white amount) in the terrain display. With this the average light intensity in the terrain display is controlled.

Terrain colors:
Determines the color group in the terrain display. Options:

Lowlands
Mountainous
Imhof 4
Imhof 7
Imhof 12
Imhof Atlas
ICAO
LKoogle Lowlands

LKoogle Mountainous
Foothills
High Mountains
YouSee
Large Contrast

Shading:
Activates or de-activates map shading

Empty map color:

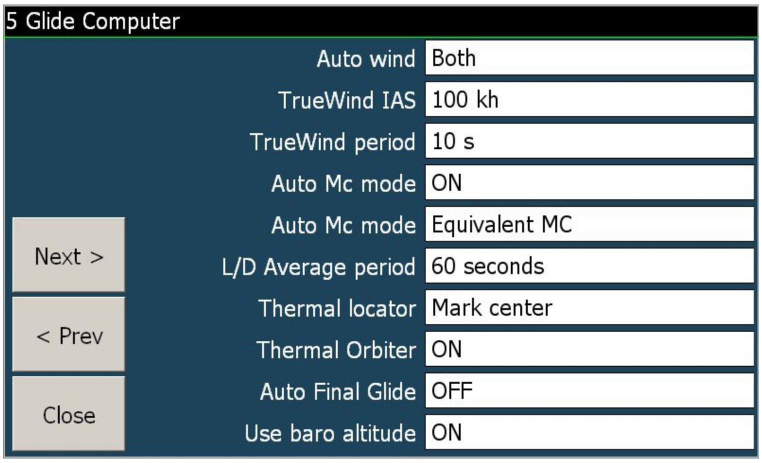
If no terrain display is used is this the background color.
Observe that some colors are suitable as back ground colors when the topology is displayed and others also without topology.
Options:

White
Light Gray
LCD Green
LCD Dark Green
Grey
Blue lake
Emerald Green
Dark Gray
Rifle Gray
Black

Configuriere Topology:
On this page one adjusts the Zoom levels from which zoom point the corresponding topology-features are to be displayed.

Max labels:
Set the highest number for the in the map to be displayed markings of topology, landing fields, and waypoints. The de-cluttering will look after a readable display. This setting provides for a quicker map display reaction by many topological features and waypoints with a **slow** processor.

25.5 Page 5 Glide Computer



Auto wind:
With this, the automatic wind determination can be switched ON or OFF. If it is switched OFF the pilot is responsible for the setting of the estimated wind.
[Circling] Requires only a GPS source
[Zigzag] requires an intelligent Variometer with speed output
[Both] use Zigzag and circling

True Wind IAS:
The indicated airspeed (IAS) must be held in cruise, before the true Wind-Calculation can be requested
One holds the course (N, S, E, W) and holds the speed with the airspeed indicator for s few seconds and then presses the special true wind button. If the speed indicator is not connected to LK8000, which records the speed, the program uses this value.
If an air speed indicator is connected, this value will not be used, as the wind is then automatically determined using the air speed indicator value.
The lowest speed value is 10km/h or 5 kt. The standard value is 100km/h or 54 kt.

TrueWind period:
In order to calculate the wind in cruise one has to hold the speed and course for several seconds
Here, you set for how many seconds the speed has to be held, Standard is 10 seconds
For a longer time it is difficult to hold a constant speed, but again a shorter time than 10 seconds provides unreliable results. The error can be as much as 30%.

Autom Mc mode(1):
Setting the MC values automatically: ON/OFF. This can also be switched during flight.

Auto Mc mode (2):
This option determines which automatic MacCready- calculation algorithm will be used
[*Final Glide*] Adjusts the MacCready-value for the fastest final glides. For OLC sprint-tasks will the MC-value be selected, that enables one to fly the furthest distance in the remaining time, to apply the rule initial height=final height for the sprint.
[L/D average Period] Sets the MacCready-value according to the average climb for the day.
[*Both*] Uses the MC-average value during the task and the MC-final glide value during the final glide.
[E*quivalent MC*] Uses the MC-value based on the actual average Speed

L/D Average period:
The average L/D will always be calculated in REAL TIME. Here one can set the time difference in which this calculation is made. The covered distance in this time will be divided by the height difference. As example: if one flies and after two minutes returns to the same point and has set 2 minutes as time difference, then the average L/D for the distance which was covered in this time is calculated, NOT the distance between the present position and the position 2 minutes ago, which in this case is Zero!!
For sailplanes are 90-120 seconds a good value, for paragliders 15 seconds
Lower values lead to momentary L/D,s while higher ones lead to
cross country L/D,s.
Other commercial instruments and programs use 90 seconds.

Thermal locator:
Displays the assumed center of the thermal in circling mode
Options:
[*OFF*] Marking of the thermal centre not shown.
[*Mark Center*] Marking off Thermal center shown
[*Pan to Center*] Marking of the Thermal centre shown with thermal centre being adjusted towards the centre while circling.

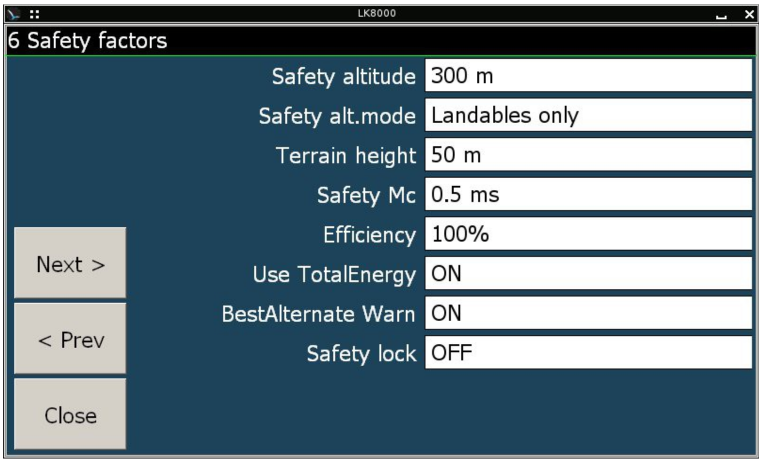
Thermal Orbiter:
If with activated thermal locator also the Orbiter is activated, one should as soon as a sound is heard, reduce the angle of bank (flatten) for approximately 2 seconds and then again return to the previous angle off bank (steepen) and continue circling.

Auto Final glide:
This option automatically activates the final glide mode when the plane is over the final glide path prior to reaching the penultimate waypoint.
The final glide mode can if required be forced to activate earlier manually on

the task menu

Use baro altitude:
If a barometric altimeter is connected and activated, it will be used for all navigational functions, if the GPS-height is not used.

25.6 Page 6 Safety factors



Safety altitude:
Arrival height above airfield for a safe landing

Do Not Set at ZERO!!!

A good value is 300 m.

Safety alt.mode:
Use the safety arrival height only for landing fields or waypoints.
If only for landing field then the arrival height over waypoints has **NO** reserve.
[*Landables Only*] Sets height reserve only for Landing fields, is standard.
[*Landables and waypoints*] Sets height reserves at arrival for all landing fields and waypoints

Terrain height:
Height above the terrain in final glide in order to overfly obstructions. A good value is 50 m.

Safety Mc:
The MacCready-value to be used for the calculation of the arrival above the landing field. A good value is 0.5m/s.

Efficieny:
Here a factor for overall quality of glider can be placed here, if the glider is not in perfect shape 95% will do it, weight your own.

Use ToalEnergy:
With is option ON the height gain slowing down to the speed of the best glide with be used in arrival height calculations.

BestAltern Warn:
The best alternative advises available landing field and warns if no landing field is reachable anymore. In order not to distract the pilot no warning is given below a critical height.

Safety Lock:
With this, one determines if the configuration is accessible during flight

25.7 Page 7 Aircraft

Category:
Type of aircraft, Options:

Glider
Paraglider/Hanglider
Car
GA aircraft

The program behaves in part based on the choice of plane type.
Certain configuration option will either be blended in or blended out.

Type:
File name of polar file which contains the data for the desired glider.
Polar file are stored in folder _Polars.

Max speed:
The manoeuvre speed (V rough air) needs to be entered on this field, in order to prevent the flight computer to issue unrealistic speed-values.

Handicap:
This is the DaeC (German aeroclub) handicap rating.

Ballast dump time:
Time in seconds to dump the total water ballast

Aircraft type:
With the editor here the string for the aircraft type is written.

Aircraft Reg:
With the editor here the string for the aircraft registration sign is written.

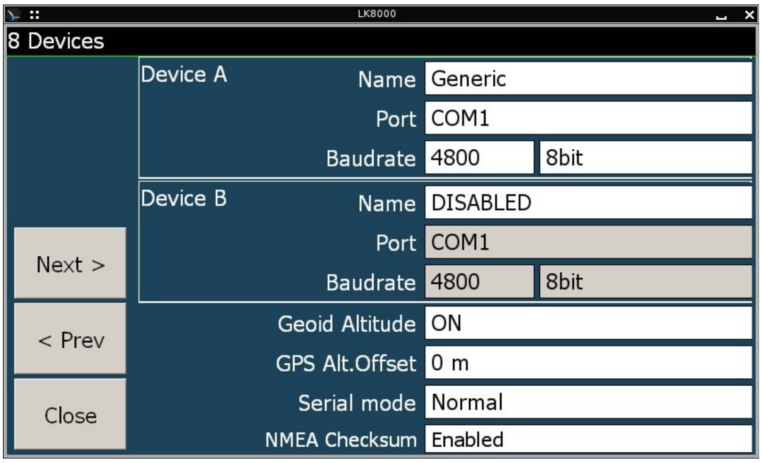
Competion Class:
With the editor here the string for the competition class is written.

Competition ID:
With the editor here the string for the aircraft competition ID is written.

Save as:
An existing aircraft profile can be overwritten.

Save new:
A new aircraft profile can be written.

25.8 Page 8 Devices



Device A:
Type of the first device. The first device has to be the most reliable GPS-data source.
Available devices at this time:

*Generic (also for original **FLARM**)*
Borgelt B50
Brauninger/Compeo 5030
CAI 302
CAI GPS-Nav
Condor
DSX
Digifly
EW Logger
EW Microrecorder
Flymaster F1
Flytec/FLYSEN
ILEC SN10
LK8EX1
LX
LX Colibri/Nano
NmeaOut
PosiGraph Logger
Volkslogger
XCOM 760
Zander

Device B:
Type of the second device.
The second device can be either a reserve GPS source (for instance the internal receiver) or another data source for data e.g. an intelligent variometer
The type "Generic" can be used for GPS sources including FLARM.

Geoid Altitude:
The MSL(mean sea level)-correction is only used for the GPS height and not for the barometric height. If one has a barometric height and uses it, this parameter is not important
If one has no barometric height, then one should check, if the GPS height being received is already MSL corrected or not.
If the GPS-height is constantly incorrect by 30-50m, the setting should be activated or de-activated, but if in doubt activated.
Some devices carry this correction out by themselves.
The standard setting is ON.

For the gliding simulator CONDOR this option has to be de-activated.

GPS Alt. Offset:
Corrects the GPS height around a fixed values.

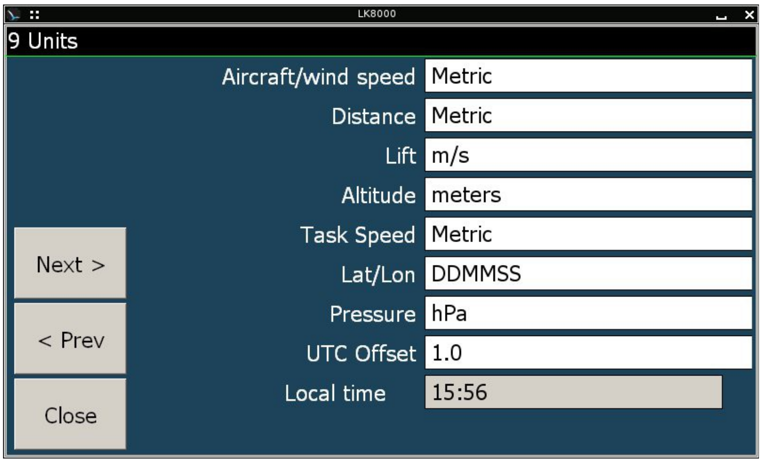
> **Attention**, the GPS-height will be corrected with this value **constantly** during the flight.

Before you change this value, check if the GPS correction has been applied correctly, the standard value is 0.
This value is stored in the profile.

Serial Mode:
If one notices the connection to the GPS-device slowing down or shortcut outs, try to set the **Polling** mode.
Standard is **Normal** and for the PC has this selection no effect.

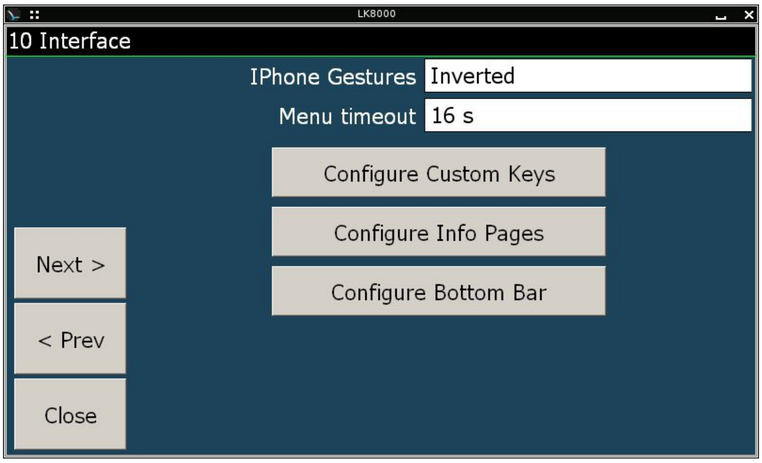
NMEA Check sum:
Standard setting Enabled, one can set on Disabled to ignore NMEA-errors and can continue to use the data

25.9 Page 9 Units



On this page one sets the required units and time to be used and displayed. Gliding uses mainly ISO units and GA mainly imperial units.

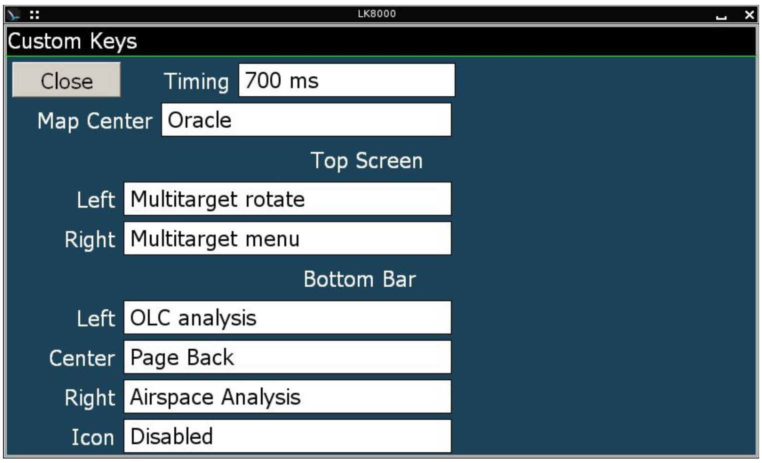
25.10 Page 10 Interface



IPhone Gestures:
Gestures are in LK8000 always activated, but one can select if the should be working like on the IPhone or inverted.
E.g. a gesture from left to right is PAGE CHANGE LEFT on the Iphone and similar devices.
The same gesture achieve otherwise a PAGE CHANGE RIGHT, standard is in difference to the IPhone INVERTED.

MenuTime Out
This time-value determines how long menus are displayed if the present open page remains unused.

Configure Custom Keys:



Timing:
Adjustable buttons are reached through a long click top screen or bottom bar. With a short click on the bottom bar the LK8000-pages will be rotated.

Here one can adjust, how long at least one has in order to reach the configurable function buttons instead of, for instance, to operate the page rotation.
This time is given in milliseconds and varies from device to device, hence one has to experiment.
Standard is 700msec, a good value for HP314 and some other devices.
If for adjustable buttons no action has been defined this parameter is not being used.

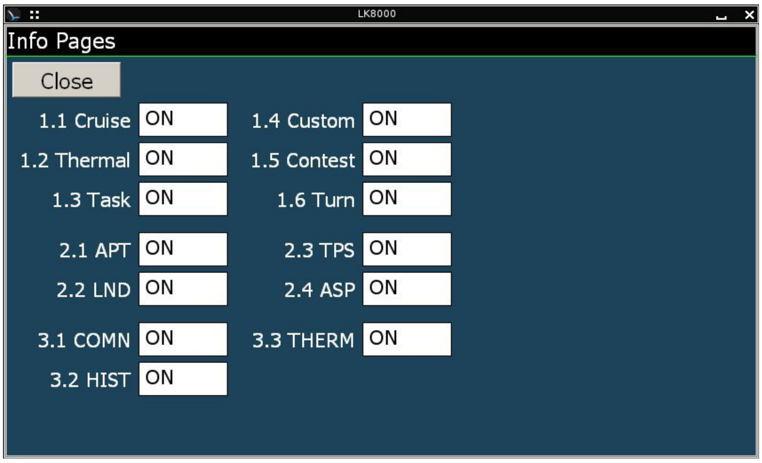
The configurable function buttons can be set for following functions:

ActiveMap On/Off
Auto Zoom On/Off
Free Flight start
GoTo -> Home
Basic menu
Common waypoints
Inverted colours
Landing fields
Airspace analysis
Drop marker
Main Menu
MultiTarget-Menu
Notices
Use total energy
Use HBar ON/OFF
Next airspace
OLC-Analysis
Orakel (Where am I?)
PG/HG Time Gates
MultiTarget rotation
SIMulation menu
Info page back
Lock screen
Team Code
Change terrain colour +
Change terrain colour -
TrueWind
Traffic
Change info pages
Change map <>Commons
Change map <> airspaces sideview
Change map <> landing fields
Change map <> traffic
Change map <> current info page
Change optimisation flight path
Zoom out
Zoom in
Zoom out further

Zoom in further
Oversight Zoom

Top-bar left: default rotate MultiTargets
Top-bar right: default multitarget-Menu
Bottom-bar left: as standard not activated, functions option
Center Bar: as standard not activated, functions option
Bottom bar right: as standard not activated inactive, functions option
Icon: as standard not activated, functions option

Configure Info Pages

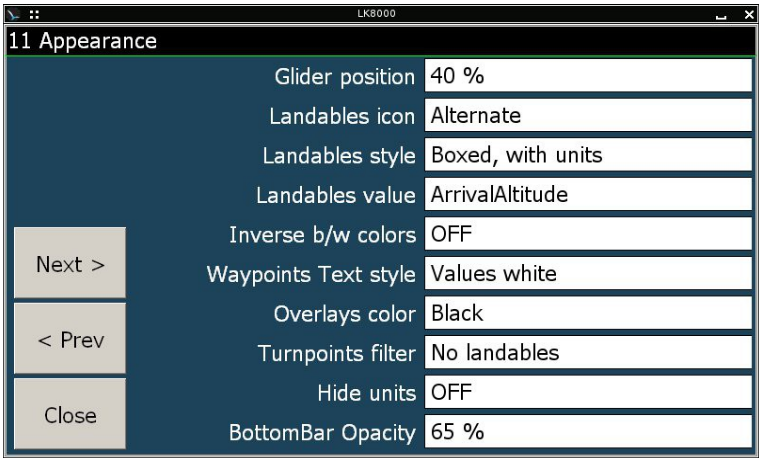


Here one can determine which info pages to show.

Configure Bottom Bar:

Here one can decide which info stripes to be shown in the bottom bar. If no one is selected, NAV1 will be shown as default.

25.11 Page 11 Appearence



Glider Position:
Determines the location of the plane on the map in percent from the bottom edge.

Landables icon:
Two styles are available: the WinPilot style (green and purple circles) or a highly recognizable style.

Landables style:
A choice of how the values for landing fields are displayed. With or without frame, with or without units (meter, feet), Options:

No Frame, no units
No Frame, with units
Framed, no units
Framed, with units

Landables value
Can display the arrival height above the safety arrival height or the required L/D to the arrival, above the Safety arrival height.

Inverse b/w colors:
If ON the bottom bar and the info pages will be displayed white with black text. The color of the blended in text will be inverted, if black is set, it will be become white.
The colors can be inverted with a button. Standard is OFF

Waypoint Text Style:
Changes the text color in the display: all black displays black for all values and names. All white displays all in white and also frames all, including out-landing fields and generic turnpoints.

Overlays color:
Selects the color of the map overlays. Standard is white and inverted black. Some colors can be inverted others not. One can experiment with combinations
Available colors:

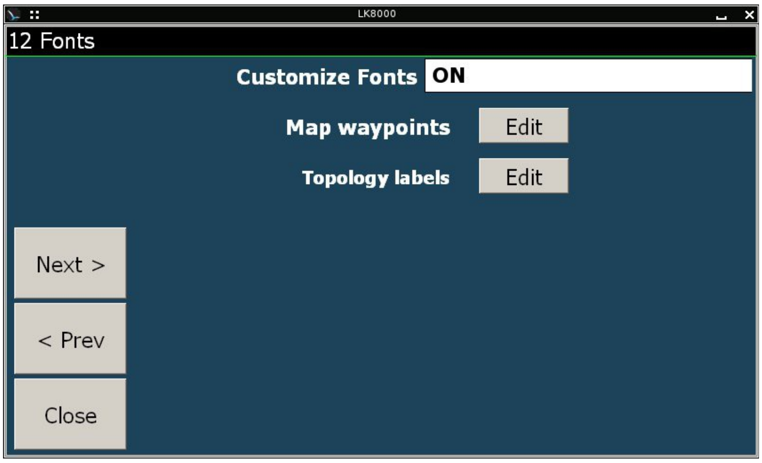
White
Black
Yellow
Green
Orange Cyan
Magenta
Gray
Dark gray
Light gray
Light green
Petrol

Turnpoint Filter:
LK8000 Info-page 2.3 lists the next turnpoints, here one can set what to list.
NO LANDING FIELDS neglects all landable turnpoints which are already listed on the pages 2.1 or 2.2. This is pre-set.
Option ALL WAYPOINTS includes also the landable waypoints listed on the pages 2.1 and 2.2
DAT Waypoints includes only waypoints with a T-ID. This is only for users of DAT-Waypoints, like SeeYou and CUP-waypoints all these have T-ID.
This filter influences no further functionality

Hide units:
Displays no units like km, ft etc. in the info fields and in the LK8000 mode.
On a display with a low resolution, in particular with 320x240 this provides more space.

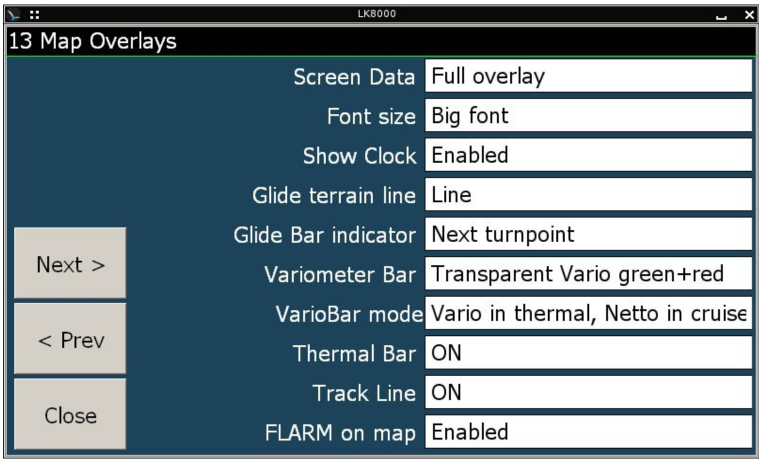
Bottom Bar opacity:
Value for the opacity of the bottom bar, a good value is 60%.

25.12 Page 12 Fonts



FONTS selection:
Map fonts and fonts for dialogues can if required be selected and set.
LK specific fonts can not be changed.

25.13 Page 13 Map Overlays



Screen Data:
Sets displayable values (overlays) on the map.
The half-overlay, displays in left upper corner the finish-waypoint- distance to. And displays in the right upper corner further information (MC, required L/D, arrival height difference)
The full-overlay shows also the clock, on the left side of the display.

Font size
Size of fonts for overlays

Show Clock:
Shows the clock as map-overlay

Glide terrain line:
This determines if the glide range will be calculated and as line displayed on the map
[*OFF*] NO display
[Line] draws the border of the glide range as line.
[Shade] Shades the area OUTSIDE the glide range.
If the glide range is displayed and the finish is within glide range and an obstruction lies on the direct glide path to the target a RED CROSS will indicate the position of the obstruction.
The obstruction will be displayed with a framed height value, which is the height which would have to be gained to clear the obstruction.
PLEASE NOTE: The glide range **outside** shading will only be shown during the flight and not on the ground.

Glide Bar Indicator:
The glide bar indicator can be displayed in reference to the finish or to the next waypoint or not displayed at all.

This bar will be blended in on the left side of the display.
The values are calculated for the actual MC-Value which is a task value: If one flies no task but only towards a simple target, this value can differ from the value for the waypoint arrival, because it is always calculated with the actual MC value, this also applies if it lays below the Safety-MC-Value. For Landing fields the Safety height will be taken into account as normal.

Variometer bar:
The variometer bar is blended in on the left side of the display. It is only usable if an electronic variometer or a fast barometric height determination device is connected to LK.
Display variations variometer:

Vario Rainbow
Vario black
Vario red+blue
Vario green+red
Transparent Vario rainbow
Transparent Vario black
Transparent Vario red+blue
Transparent Vario green+red

Vario Bar Mode:
The variometer mode has following options:

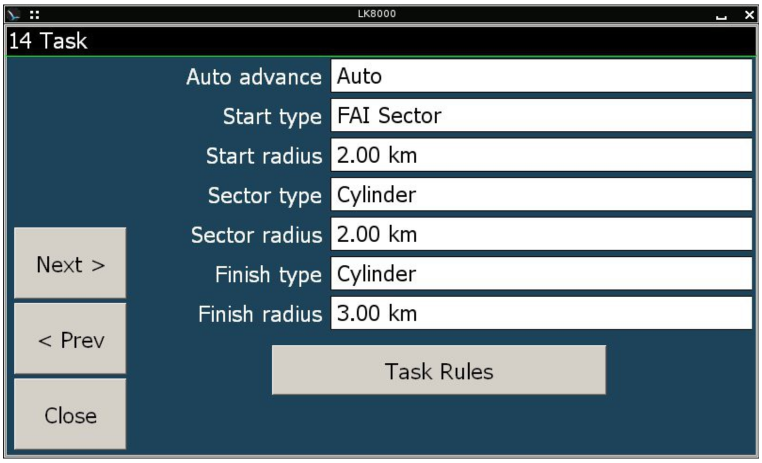
Vario while circling and in cruise
Vario while circling, Netto in cruise
Vario while circling and speed to fly in cruise

Thermal Bar:
A blue height band of the vertical thermal profile is displayed while circling, on the upper left side of the map.

Track Line:
The track line will not be shown at a low zoom level.

FLARM on Map:
This activates the display of the FLARM-traffic on the map.
[OFF] FLARM objects are not diplayed
[ON/fixed] FLARM objects are displayed in the map in their real time position.
[**ON/scaled**] FLARM-objects are displayed on the map, that the are still recognizable as targets at a high zoom level.
The scaled mode is insofar confusing as the objects around the plane are displayed, but not shown on their real position. It is advisable to use the fixed mode if in doubt.

25.14 Page 14 Task



Auto Advance:
Determines, how waypoints are switched to the next one, during a task
[*Manual*] One has to switch to the next waypoint manually.
[*Auto*] As soon as the waypoint is passed it will be switched automatically to the next (Cylinder, Sector or Line) including the start.
[*Arm*] One has to pre-load each waypoint (including start), before it will be switched. This setting is suggested for AAT-Tasks!
[Arm Start] One has to pre-load manually the start, all other waypoint will automatically switched.

Start type:
Type of start
[*Line*]: The task starts when the line is crossed. The line length will be set with "Start Radius".
[*Cylinder*] The task will be started when the plane leaves the cylinder. The cylinder radius will be set with "Start Radius".
[*FAI Sector*] Determines a 90 degree sector, the task will be started when the plane crosses the sector lines. The radius of the sector will be set with "Radius Sector".

Start radius:
Radius of the start cylinder or half length of start line

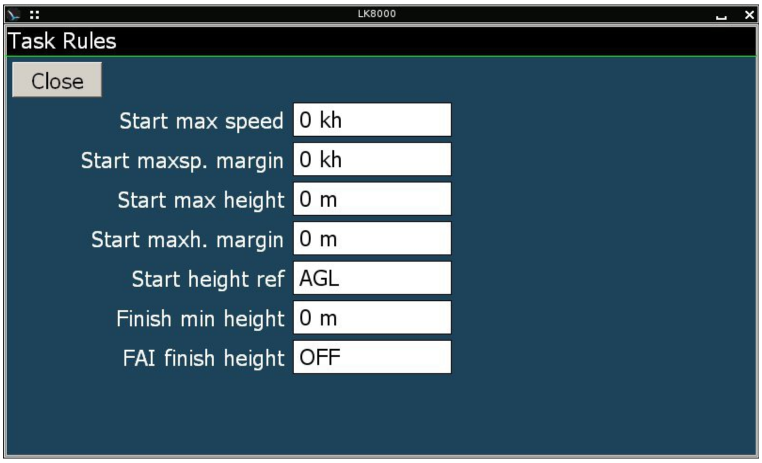
Sector type:
Type of sector for NOT AAT-tasks
[Cylinder] Straight cylinder with fixed radius
[*FAI Sector*] 90 degree sector centred around half with a fixed radius
[*DAe 0.5/10*] DAeC sektor-typ, equivalent to a cylinder with a 0.5km radius and a 10km FAI sector

Sektor radius:
Radius of the waypoint-sector for NON- AAT -tasks

Finish type:
[*Line*]: The task is ended with crossing the Line. The line length is set by the "Finish Radius".
[C*ylinder*]: The task is ended, with entering the finish cylinder. The cylinder radius is set by the "Finish radius".
[*FAI Sector*] Determines a 90 degree sector. The task is ended, when the sector line is crossed. The sector will be set by the cylinder radius.

Finish radius:
Radius of the finish cylinder or half the length of the finish line

***Task Rules*:**



Start max speed
Maximum speed in the start area. One sets 0 for unlimited speed.

Start maxsp. margin
Highest acceptable margin for maximum departure speed.
Set at 0 for no departure speed limit.

Start max height:
Maximum height above ground before the start. For departure without height limitation one sets the value 0.

Start maxh. margin:
Maximum allowable height difference of the maximum departure height. One sets 0 for no height difference allowed.

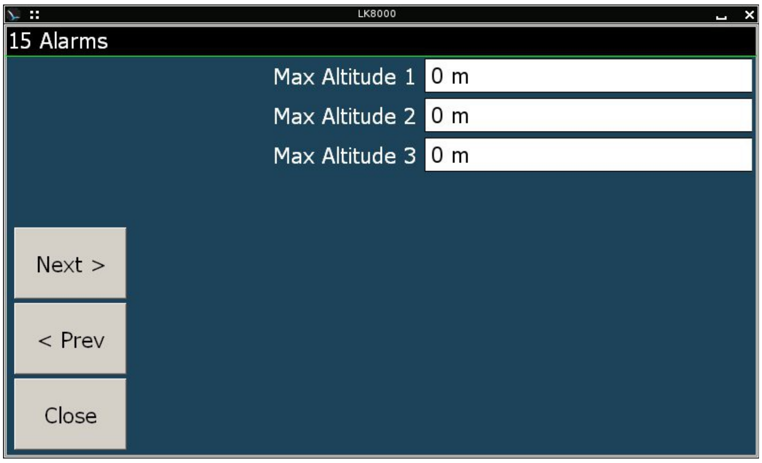
Start height ref:
Reference height for the max.departure height
[*MSL*] Reference level is the height above MSL.

[*AGL*] Reference level is the height above ground (AGL).

Finish min height:
Minimum height above ground for crossing the task finish sector.
One sets 0 for no minimum height.

FAI finish height:
If activated requires, that the minimum arrival height must be greater than 1000m below the departure height.

25.15 Page 15 Alarms



Max Altitude 1 (2,3):
Height for height alarm 1(2,3)
Every time when reached or climbed over this height an alarm is given but will not be repeated next 60s. After this minute the alarm will be triggered again.
To deactivate an alarm set it to 0.
The height utilized to trigger the alarm is set on system configuration page 5, option "Use baro height".

Manyfold alarms in the same height have no effect.
Glider pilots should not set alarms below the safety height to be not disturbed in critical flight phases.
Every alarm can be repeated up to 30 times then the alarm trigger is deactivated for this flight.
The alarm message on the screen disappears after 12s automatically.
Every alarm has its own sound, the file of which is located in the Sound subfolder of the _System folder and can be changed. The sound files have the names LK_ALARM_ALTx.WAV.
Standard is 0m (no alarm).

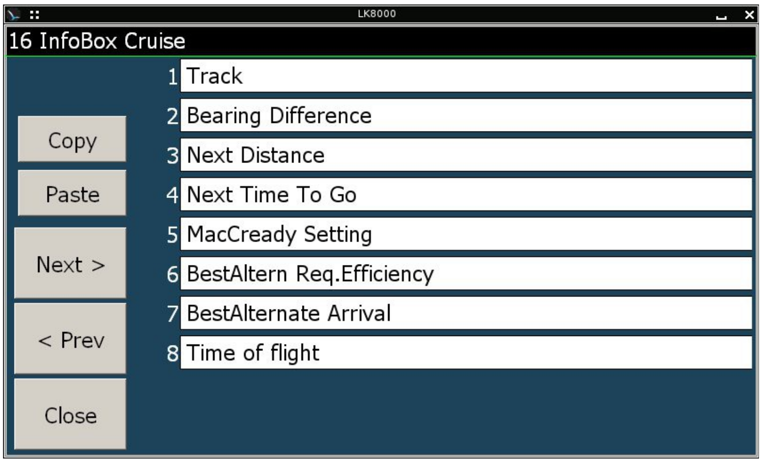
25.16 Configuration of info page 1.4 via system configuration pages 16, 17, 18, 19

Info page 1.4 can be configured via system configuration pages 16, 17,18 and 19 with flight data and additional informations.
The upper half of the info page is allocated with values from the Auxiliary infobox (system configuration page 19) and the lower half with values **dependent from the flight mode** configured for cruising, climb and finish (system configuration pages 16, 17, 18).
The sequence of the configured values will also be shown in the info stripes TRM0 (thermaling), CRU7 (cruising), FIN8 (finish) and AUX9 (user selected).

In dependence of the screen resolution up to nine values can be displayed, so at e.g. screen resolution 840x400 that are six values.

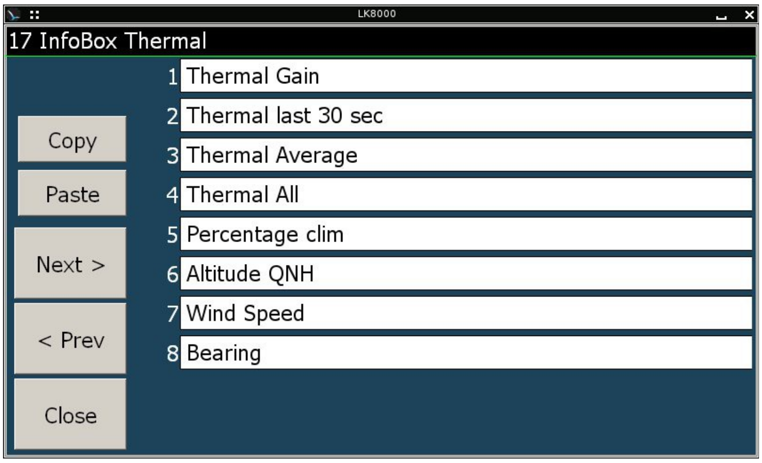
The soft buttons [Copy] and [Paste] are used to move a complete data stack from one system configuration page (16,17,18,19) to the other easily.

25.17 Page 16 Infobox Cruise



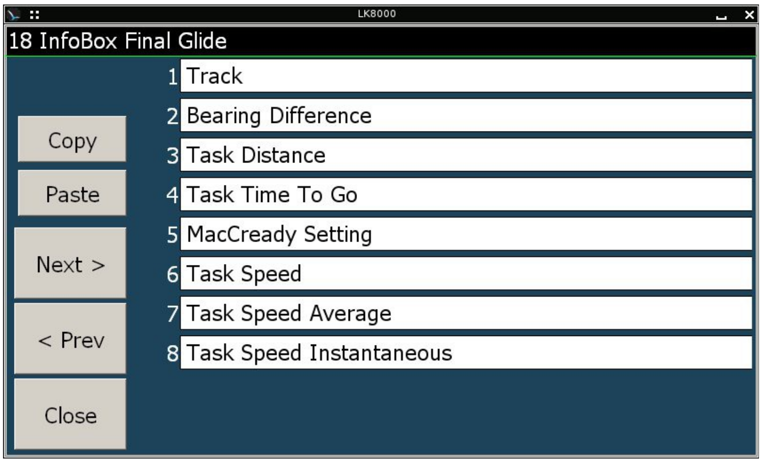
On this system configuration page required info data are reachable by a click on the individual lines (e.g. 1 Track/2 Bearing distance/3 Task distance etc.) can be selected and set.
The lower half of info page 1.4 is configured according to these data, see also **chap.25.16**

25.18 Page 17 InfoBox Thermal



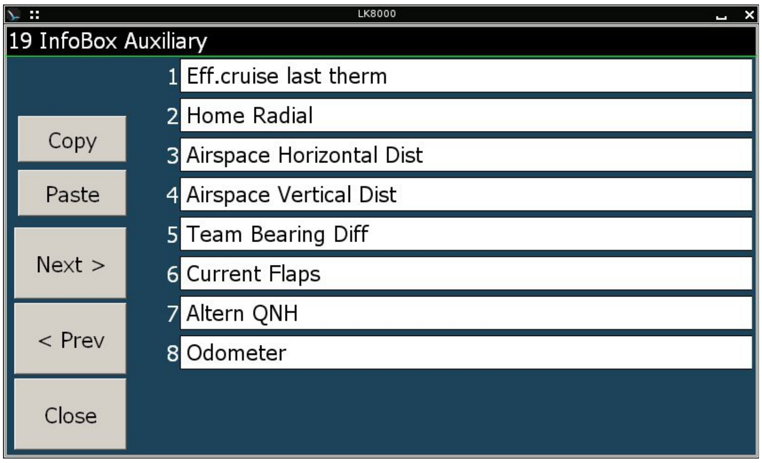
On this system configuration page required info data are reachable by a click on the individual lines (e.g. 1 Track/2 Bearing distance/3 Task distance etc.) can be selected and set.
The lower half of info page 1.4 is configured according to these data, see also **chap.25.16**.

25.19 Page 18 InfoBox Final Glide



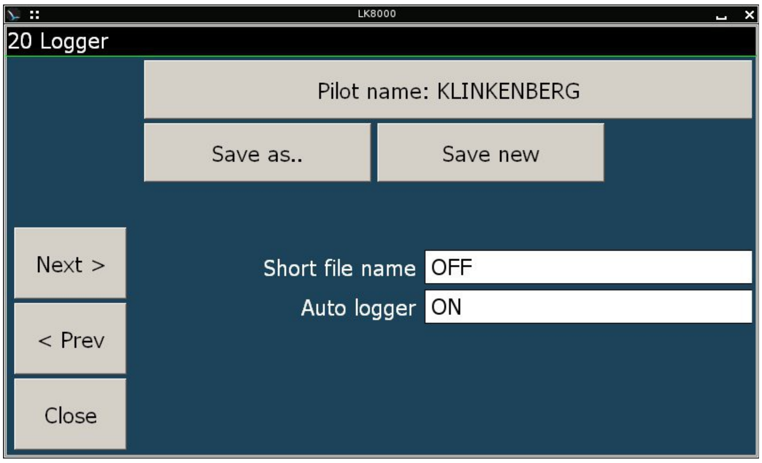
On this system configuration page required info data are reachable by a click on the individual lines (e.g. 1.Track/2.Bearing distance/3.Task distance etc.) can be selected and set.
The lower half of info page 1.4 is configured according to these data, see also **chap.25.16**

25.20 Page 19 InfoBox Auxiliary



On this system configuration page required info data are reachable by a click on the individual lines (e.g. 1.Track/2.Bearing distance/3.Task distance etc.) can be selected and set.
The upper half of info page 1.4 is configured according to these data, see also **chap.25.16**

25.21 Page 20 Logger

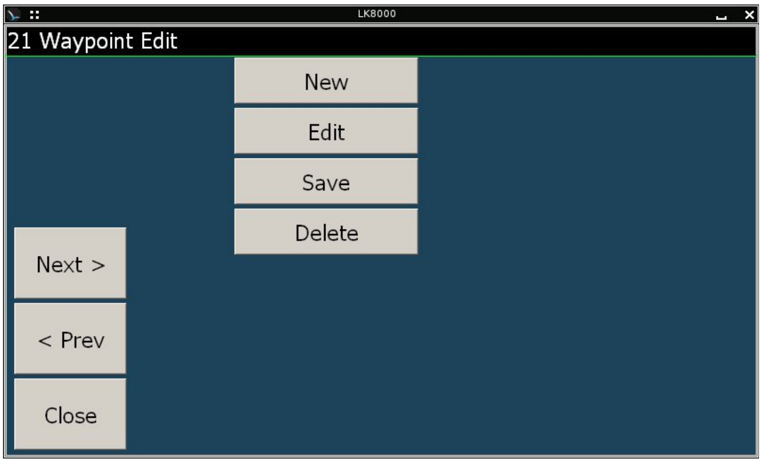


By clicking on the "Pilot name" selection line enter and set with the editor the pilots name, overwrite an existing and save a new pilot profile.

Short file name:
Determines if the logger should use a short or long file name
Example short name: 81HXABC1.IGC
long name: 2011-04-18-XXX-ABC-01.IGC

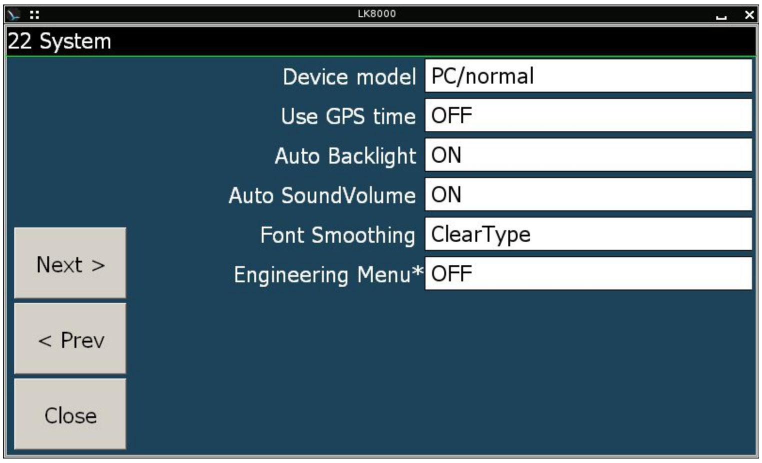
Auto logger:
Activates the automatic start or stop of the logger for start and landing.

25.22 Page 21 Waypoint Edit



See **chap. 30**

25.23 Page 22 System



Device Model:
If on the list select the PDA/PNA Model for optimal use of the device.

Use GPS-Time:
If activated, this option sets the program time with valid GPS data on GPS-time. This is only required if the device has no battery buffered real-time clock or if the time is lost due to frequent electric or other failures.

Auto backlight:
Only for HP31X sets the auto backlight maximum brightness without switch off if connected to an external battery pack, In all other devices the brightness will be reduced after 5 minutes to save battery power.

Auto Sound Volume:
Only for few devices can the automatic maximum sound volume be set.

Font Smoothing:
Font smoothing with the options:

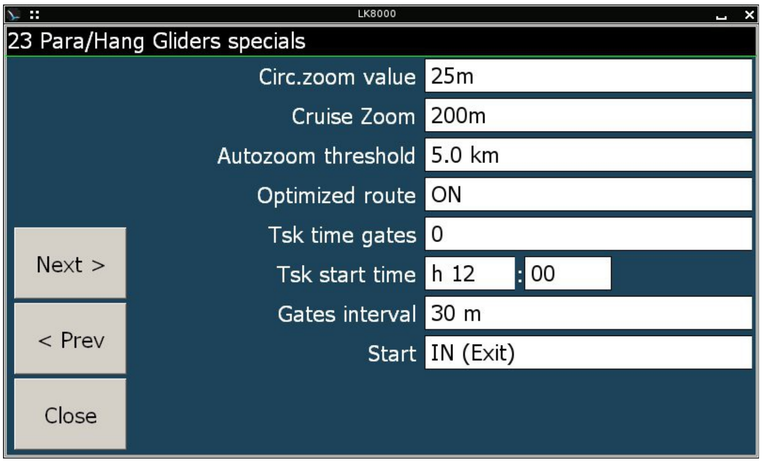
Cleartype
Anti Aliasing
Normal
none

Engineering Menu*:

This menu is for the program developers only andcan be set on or off.

THIS IS ONLY FOR USE BY THE PROGRAM DEVELOPERS!

25.24 Page 23 Para/Hang Gliders specials



Circ.Zoom Value:
Sets the zoom level for circling. One can change this setting also by hand during circling, with this selection being used again during the next climb.
Options:

More
Standard
Less
Lower
Higher

Cruise Zoom :
The standard zoom level for the cruise. Small values bring more zoom, larger values lower zoom.

Autozoom threshold:
Using autozoom in the paraglider/hangglider mode it only works if the next waypoint is near more than this distance.
Selecting e.g. 5km, autozoom start at 5km distance to the goal. It will be zoomed into the area and the zoom value is constant until reaching the waypoint.

Task time gates:
A time window is a fixed local time, which determines the start of the task. One sets it at 0 if no start time is fixed, set it on 1 if the task has a start time.

Task start time:
Enter the task start time.

Gates Interval:
If there are more than one start window, one can set here the time interval in minutes to the next window,

If there is only one start window which closes at a fixed time, one sets the time interval for the time difference.
If there is only one time window without a fixed closing time one sets the time interval at a very large value like 480 minutes.

Start:
Start IN (EXIT) If the pilot leaves the start sector or cylinder from inside to the outside.
Start OUT (ENTER): If the pilot flys into the start sector or cylinder from the outside.

26 Reference flight parameters

In the following table are all available parameters listet, which are handled by LK8000. If one chooses one parameter on system configuration pages 16, 17, 18, 19 one can get a detailed description via the help function.

Parameter	Abbrev.	Description/notes
AA Delta Time	AAdT	AAT difference time
AA Distance Max	AADmax	AAT maximal distance
AA Distance Min	AADmin	AAT minimal distance
AA Distance Tg	AADtgt	AAT remainig distance to target
AA Speed Max	AAVmax	AAT maximal speed
AA Speed Min	AAVmin	AAT minimal speed
AA Speed Tg	AAVtgt	AAT average speed to target
AA Time	AATime	AAT time
Airspace Hor Dist	ArSpcH	Airspace horizontal distance
Airspace vert dist	ArSpcV	Airspace vertcal distance
Airspeed IAS	IAS	Indicated Airspeed – by an intelligent variometer
Airspeed eIAS	eIAS	Estimated Indicated Airspeed – ground speed corrected for altitude and wind
Airspeed TAS	TAS	True Airspeed – by an intelligent variometer
Airspeed eTAS	eTAS	Estimated True Airspeed
Altern AGL	aHAGL	Alternative Altitude above ground level – ft/m
Altern QNH	aAlt	Alternative altitude QNH – ft/m
Alternate1 Arrival	Atn1Arr	arrival atitude alternative 1
Alternate1 Req.Eff	Atn1.E	L/D to reach alternative 1
Alternate1 bearing	Atn1Brg	Bearing alternative 1
Alternate1 distance	Atn1Dst	Distance alternative 1
Alternate2 Arrival	Atn2Arr	arrival altitude alternative 2
Alternate2 Req.Eff	Atn2.E	L/D to reach alternative 2
Alternate2 bearing	Atn2Brg	Bearing alternative 2
Alternate2 distance	Atn2Dst	Distance alternative 2
Altitude AGL	HAGL	Altitude above ground level
Altitude BARO	HBAR	Barometric height
Altitude GPS	HGPS	Height GPS
Altitude QFE	QFE	Altitude QFE

Parameter	Abbrev.	Description/notes
Altitude QNH	Alt	Altitude QNH
Average Efficiency	E.Avg	Efficiency Average
Battery Percent	Battery	Battery-remaining energy
Bearing	Brg	
Bearing Difference	To	
BestAltern Req.Eff	BAtn.E	L/D to reach BestAlternative
BestAlternate Arrival	BAtnArr	Arrival height at BestAlternative
BestAlternate bearing	(alt name)	Bearing Beste Alternative
BestAlternate distance	(alt name)	Distance to BestAlternative
Current Flaps	Flaps	Flap setting
Eff.cruise last therm	E.Cru	L/D reached since leaving the last thermal
Eff.last 20 sec	E.20	L/D of the last 20s
Ext.Batt.1 Voltage	xBat1	Voltage of the external battery 1, if available
Ext.Batt.2 Voltage	xBat2	Voltage of the external battery 2, if available
Ext.Batt.Bank	xBnk#	Voltage of the external battery bank#, if available
Flight Level	FL	
Forecast Temperature	MaxTemp	
G load	G	
Head wind speed	HdWind	
Home Alt.Arrival	HomeArr	Arrival altitude home
Home Distance	HomeDis	
Home Radial	Radial	
L/D vario	L/D vario	
Logger	Logger	Logger
MacCready	eqMC	equivalent MacCready

Parameter	Abbrev.	Description/notes
Equivalent		
MacCready Setting	MacCrea dy	
Max Altitude reached	MaxAlt	Maximal altitude reached
Max Height gained	Hgain	
Multitarget bearing	BrgMtg	
Netto Vario	Netto	Vario Netto
Next Alt.Arrival	NxtArr	Next Altitude Arrival
Next Alt.Required	NxtAltR	required altitude to reach the next waypoint
Next Arrival Time	NextETA	expected arrival time next waypoint
Next Distance	Dist	Distance next waypoint
Next Req.Efficiency	Req.E	Required efficiency to reach the next waypoint
Next Time To Go	NextETE	next waypoint expected time to go
Next Waypoint	Next	
OLC classic dist	OLC dis	OLC distance
OLC classic score	OLC scr	OLC scoring points
OLC classic speed	OLC spd	OLC speed
OLC classic pred dist	OLC*dis	OLC predicted distance
OLC classic pred score	OLC*scr	OLC Classic predicted score
OLC classic pred speed	OLC*spd	OLC Classic predicted speed
OLC FAI 3 tps dist	3TP dis	OLC FAI distance 3 turning points
OLC FAI 3 tps speed	3TP spd	OLC FAI speed 3 turning points
OLC FAI 3 tps pred dist	3TP*dis	OLC FAI predicted distance 3 turning points
OLC FAI 3 tps pred speed	3TP*spd	OLC FAI predicted speed 3 turning points
OLC FAI triangle dist	FAI dis	OLC FAI triangle distance

Parameter	Abbrev.	Description/notes
OLC FAI triangle score	FAI scr	OLC FAI triangle scoring points
OLC FAI triangle speed	FAI spd	
OLC FAI triangle pred dist	FAI*dis	OLC FAI trinagle predicted distance
OLC FAI triangle pred score	FAI*scr	OLC FAI triangle predicted score
OLC FAI triangle pred speed	FAI*spd	OLC FAI triangle predicted speed Geschwindigkeit
OLC league dist	LEA dis	OLC League distance
OLC league score	LEA scr	
OLC league speed	LEA spd	
OLC Plus score	PLS scr	
OLC Plus pred score	PLS*scr	OLC Plus predicted score
Odometer	Odo	
Outside Air Temp	OAT	
Percentage climb	%Climb	
Relative Humidity	RelHum	
Speed MacCready	SpMc	
Speed To Fly	STF	
Speed Ground	GS	Speed above ground
Task Alt Arrival	TskArr	task arrival altitude
Task Alt required	TskAltR	task required altitude
Task Arrival Time	TskETA	task expected arrival time
Task Covered distance	TskCov	
Task Distance	TskDis	
Task Req.Efficiency	TskReqE	task required efficiency
Task Speed	TskSp	
Task Speed Average	TskSpAv	

Parameter	Abbrev.	Description/notes
Task Speed Instant	TskSpI	task current speed
Task Time To Go	TskETE	
Team Bearing	TmBrng	
Team Bearing Diff	TeamBd	Team bearing difference
Team Code	TeamCode	
Team Range	TeamDis	Team distance
Terrain Elevation	Gnd	
Thermal All	Th.All	Climb all
Thermal Average	TC.Avg	Average climb
Thermal Average Last	TL.Avg	averaged climb in last thermal
Thermal Gain	TC.Gain	Altitude gain in current thermal
Thermal Gain Last	TL.Gain	Altitude gain in last thermal
Thermal Time Last	TL.Time	Circling time in last thermal
Thermal last 30 sec	TC.30	Climb last 30s
Time UTC	UTC	
Time local	Time	
Time of flight	FlyTime	
Track	Track	
Vario	Vario	Variometer value
Wind Bearing	WindB	
Wind Speed	WindV	

27 LK8000 polars

27.1 Program internal polares

Type	DAeC-Index 2012	Remark
1-26E		Index not in list
1-34		Index not in list
1-35A		Index not in list
1-36 Sprite		Index not in list
604	114	Glasflügel
Antares 18S	118	
Antares 18T	118	
Antares 20E	120	
Apis (13m)	92	
ASG29-15	113	
ASG29-18	119	
ASG29E-18	119	
ASH-25M 1	122	
ASH-25M 2	122	
ASH-25 (PAS)	122	
ASH-25 (PIL)	122	
ASH-26E	117	
ASK-21	92	
ASK-23	92	
Astir CS	94	
ASW-12	110	
ASW-15	97	
ASW-17	115	
ASW-19	100	
ASW-20	110	
ASW-22BLE	121	
ASW-24	107	

Type	DAeC-Index 2012	Remark
ASW-27 Wnglts	113	
ASW28-18	114	
Blanik L13	76	
Blanik L23	78	
Carat	93	
Cirrus (18m)	102	
Cobra (SZD-36)	102	
Delta USHPA-2		Hangglider
Delta USHPA-3		Hangglider
Delta USHPA-4		Hangglider
DG-100	100	
DG-200	107	
DG-300	104	
DG-400 (15m)	107	
DG-400 (17m)	109	
DG-500M PAS	100	
DG-500M PIL	100	
DG-500 PAS	100	
DG-500 PIL	100	
DG-600 (15m)	110	
DG-800 15m	113	
DG-800 18m Wnglts	118	
DG1000-20M(PAS)	110	
DG1000-20M (PIL)	110	
Dimona	68	
Discus A	107	
Discus 2a	108	
Discus 2c	108	
Duo Discus (PAS)	110	
Duo Discus (PIL)	110	
DuoDiscus T (PAS)	110	

Type	DAeC-Index 2012	Remark
Duo Discus XT (PAS)	110	
Duo Discus XT (PIL)	110	
EB 28	124	
EB 28 Edition	124	
Genesis II	107	
Glasfluegel 304	112	
Grob G-103 Twin II (PAS)	92	
Grob G-103 Twin II (PIL)	92	
H-201 Std Libelle	98	
H-205 Club Libelle	96	
H-301 Libelle	100	
IS-28B2 Lark 1p	84	
IS-28B2 Lark 2p	84	
IS-29D2 Lark	96	
Janus B (18.2m PIL)	102	
Janus B (18.2m PAS)	102	
Ka-6CR	82	
Ka-8b	76	
L-33 SOLO	86	
Lak17A-15	114	
Lak17A-18	117	
LAK-19 (15m)	108	
LAK-19 (18m)	114	
LS-1C	98	
LS-3	107	
LS-3 (17m)	109	
LS-4a	104	
LS-6-15	111	
LS-6-18W	116	
LS7wl	107	
LS-8-15	108	

Type	DAeC-Index 2012	Remark
LS-8-18	114	
LS-10s (15m)	114	
LS-10s (18m)	118	
Mini Nimbus	107	
Mosquito	107	
Nimbus 2	114	
Nimbus 3	122	
Nimbus 3T	122	
Nimbus 3D (PIL)	122	
Nimbus 3D (PAS)	122	
Nimbus 3DM (PAS)	122	
Nimbus 4	124	
Nimbus 4D PIL	124	
Nimbus 4D PAS	124	
Nimbus 4DM (PIL)	124	
Nimbus 4DM (PAS)	124	
Para Competition		Paraglider
Para EN A-DHV1		Paraglider
Para EN B-DHV12		Paraglider
Para EN C-DHV2		Paraglider
Para EN D-DHV23		Paraglider
Pegase 101A	102	
Phoebus C	100	
PIK-20B	102	
PIK-20D	104	
PIK-20E	104	
PIK-30M		Index not in list
PW-5 Smyk	84	
Russia AC-4		
SF27	88	
Speed Astir	105	

Type	DAeC-Index 2012	Remark
Std Cirrus	99	
Stemme S-10 PIL	110	
Stemme S-10 PAS	110	
SZD-30 Pirat	86	
SZD-36 Cobra	100	
SZD-38A Jantar 1	100	
SZD-42A Jantar 2	113	
SZD-48-2 Jantar Std 2	100	
SZD-48-3 Jantar Std 3	100	
SZD-50 Puchacz	84	
SZD-51-1 Junior	90	
SZD-55-1 Promyk	106	
SZD-56-2 Diana2	114	
SZD-9bis 1E Bocian	76	
Taurus	99	
Ventus B (15m)	110	
Ventus A-B (16.6m)	113	
Ventus CM (17.6m)	115	
Ventus 2C (18m)	118	
Ventus 2CT (18m)	118	
Ventus 2Cx (18m)	118	
Ventus 2CxT (18m)	118	
VSO-10		Index not in list
VT-116		Index not in list
Zuni II		Index not in list

27.2 LK8000 polar file

27.2.1 Standard polar

If one wants, one can load his **own polar file** into LK8000, its format is based on the Win-Pilot polars. But in comparison the LK8000-format has an additional data field for the wing area. The polar file is a simple text file with the extension **.plr**, e.g. **NAME.plr**.

The polar defines the sink rate of a plane at three different speeds in order to determine, through interpolation, an approximate sink rate for the current speed flown.

The polar is developed whereby the sink rates are measured for the plane with a fixed all up weight, this normally includes the plane with normal instrumentation and the pilot weight with a parachute, but no water ballast. It is therefore called "Dry all up weight" (DryAUW).

One can change this default total weigth of the plane (Pilot+parachute+additional equipment) except water ballast, simply by changing the wing loading. In which case the polar is correctly adjusted, showing the new applicable sink rates.

LK8000 polar file (expanded WinPilot polar file)

- Value field 1: **Total weight plane**, **without waterballast**
- Value field 2: **Maximum water ballast** which can be loaded
- Value field 3-4,5-6,7-8 are the **value pairs, speed** in km/h and **sink rate** in m/s. These value pairs are used for the calculation of an interpolated sink rate curve.
- Value field 9: **LK8000 specific!** Is to set the value for the **wing area (in m²)**

Here is an example of a polar for a sailplane:

330,90,75.0,-0.7,93.0,-0.74,185.00,-3.1,10.6
(Observe decimal points of the values, and field separator = comma)

- which during the test flight had a total weight **including pilot** of 330 kg
- that can load 90 litres waterballast
- that at a speed of 75 km/h, has a sink rate of 0.7m/s
- at 93 km/h the sink rate is 0.74 m/s
- at 185 km/h the sink rate is 3.1 m/s
- and it has a wing area of 10.6 m^2

With these figures a polar with a **wing loading** of **31.1 kg/m²** was calculated.

27.2.2 Flap polar

For a FLAP-polar one has to add to the standard polar one extra line, showing the planned gross take off weight and the flap settings with their associated airspeeds.

The flapsettings with the designations as shown in the plane can be used. e.g.
Numbers +8, +5 ,0 , -3, -5 , -7...
Letters S, F, ...
Codes S1, L1, ..

Example : Diana 2
The additional line for the flaps can for instance be:
350, 7, 0, 28, 75, 21, 80, 14, 87.5, 8, 109, 3, 156, 0, 188.5, -2
(mit TOW [take off weight] 350 kg, Flapsetting 7, 28, 21, 14, 8, 3, 0, -2)

In the Diana 2 example the flap settings are given in degrees. But one can also give them names like LANDING and FAST f, but the length of the name given is limited to 7 characters.

The complete Diana 2 polar as available in the program:
* LK8000 polar for: SZD-56-2 Diana 2
* DryGross weight[kg], MaxWaterBallast[liters], Speed1[km/h], Sink1[m/s],\
Speed2, Sink2, Speed3, Sink3, WingArea[m2]
 270, 250, 100.4700979, -0.557321508, 146.3286293, -1.146988324,\
185.6359405, -2.146055459, 8.66
350, 7, 0, 28, 75, 21, 80, 14, 87.5, 8, 109, 3, 156, 0, 188.5, -2

28 Maps - LKMAPS

LK8000 has its own maps for terrain and topology, LKMAPS
The terrain data are derived from the data of the NASA shuttle radar topology mission (December 2009).

LKMAPS terrain files have the ending .DEM
LKMAPS topology files have the ending .LKM

The geographic size of the files can differ, which means a topology file can extend over a larger area than the loaded terrain file.

Maps can be “ordered”from Paolo, one has only to fill in an electronic form and the map will normally be available on the web site within a few days.

In the meantime numerous maps are available, which are often for small but highly frequented areas in high resolution.

29 Airspace data

Airspace data for Germany are regularly available from the *Deutsche Flugsicherung* (DFS) as a text file in the OpenAir-format which can be downloaded from the website of the German Aero Club

http://www.daec.de/aul/luftr_d.php

But some caution is called for using these data!
This file is only a service file, officially valid are only the actual ICAO charts. In the past complaints have been received about the very accuracy of the digital information (arcs etc), which suggests that one should keep a safety distance between oneself and the airspace borders!

In other countries are other policies according airspace data presumably.

30 Waypoints

Waypoints for nearly all countries are available from the *World 2000 project*:

http://www.segelflug.de/vereine/welt2000/

There is no restriction on the number of waypoint that can be loaded. It solely depends on the available memory capacity of the device. But it is recommended not to load more than 5000 waypoints if one uses at the same time large scale maps and airspace data.

30.1 Waypoint names, waypoints of tasks, waypoint history

A waypoint is determined by a specific description

- Name
- Coordinates
- Type (Airfield, Landing field, Turnpoint).

Waypoints can have the same name, but are different, as long as they have different coordinates or are of different type.

If two waypoints differ only in their height or other small differences, an already loaded waypoint will be used and the other ignored.

If one loads a task file, the included waypoints are also loaded and added to the internal waypoint list. LK8000 compares the task waypoints with the already stored waypoints in the waypoint file.
If a waypoint with the same name and attributes already exists, this one will be used instead of the task waypoint. The user will normally not notice any difference.

But in fact, a small difference does exist: The task waypoint, even if it was changed, is not being stored in the current waypoint file. Task waypoints if they do not already exist as normal waypoints will not be accepted in the waypoint history (file).

In other words, **task waypoints** will be considered as **temporary waypoints** and only as part of the task.

But until the program is re-started, the task waypoints remain in the memory and are selectable in the waypoint search, even if they have the same name.
So, be cautious and do not use the same name for different waypoints!!!

Also, in case you use names like **START, FINISH** etc, consider this when loading several task files, that the existing temporary waypoints are **NOT** deleted until the program is re-started.

30.2 Waypoint file formats

30.2.1 WinPilot - .dat

WinPilot uses waypoint files in following line orientated waypoint format:

Id, Latitude, Longitude, Elevation, Type, Name, Comment *ZNN

ID: running Number of the waypoint (each waypoint requires a specific ID)
Latitude, Longitude : required format for coordinates
(dd=degrees,mm=minutes, ss=seconds)
dd:mm:ss;dd:mm:m; dd:mm;mm; dd:mm:mmm followed by N,S,E,orW
Elevation: height of the point in meters above MSL or if the number followed by F, in ft MSL
1623F = height 1623 ft MSL
1623 = height 1623 m MSL
Type: Waypoints in the file can have following attributes:
A = Airport (Airport, on the map displayed with a line)
T = Turnpoint (on the map displayed with a circle)
L = Non-Airport (Out-landing field)
M = Markpoint (Marking on the map displayed with a point)
H = Home (Home airfield here started the simulator)

Name: Name of the waypoint maximum 12 characters

Comment: Additional description of the waypoint (frequency,R/W direction etc.) maximum 12 characters.

***ZNN** (optional): NN gives the Zoom level (in km) , at which the waypoint should become visible(displayed)., example.:
16,39:00.000N,119:45.200W,4718F,ATH,Minden ,12/30 122.8 *Z50
This point will be displayed when the map width will be 50km or less.

The number of waypoints for each file is unlimited.[WinPilot]

30.2.2 SeeYou - .CUP

Naviter's **SeeYou - CUP-format** includes in comparison to the WinPilot-waypoint format additional informations on airfields like
R/W length and direction, frequency and comments

CUP files are treated as follows:

- All task lines (normally on the file end) to be removed

- The maximum character number in the field "Radio frequency" numbers 15, all characters above this number are considerd to be errors and ignored.
- The maximum characters in the "Code" field numbers 15 and all characters above this number are considered errors and ignored,
- Comments can consist of 150 characters above this they will be ignored.
- Waypoint names are limited to 30 characters (longer names will be shortened), although only shortened, depending on the display resolution, with 10 characters displayed

30.2.3 COMPEGPS - .wpt

COMPEGPS-Files are treated as follows:

- LK8000 version 1.22 can only load WGS84-LAT/LON-waypoints from the Compegs files. WPT-files with UTM-coordinates cannot be used in this version.
- All COMPEGPS waypoints will be loaded and stored as simple waypoints (No airports or landing fields)
- A COMPEGPS file should normally be loaded as a second file.
- It waypoints are stored, then LK8000 will remove all "w"-lines in the original file.
  SAVE a copy of the original file!
- The height in COMPGPS has a strange format with an accuracy of 1/1000000 meter.

30.2.4 OziExplorer - .wpb

LK8000 also supports the waypoint file format of the program OziExplorer.

30.3 Changing of waypoint files and the home waypoint

If one **changes a waypoint** and stores the changes via the system configuration page 21, LK8000 overwrites the waypoint file to which this waypoint had belonged. If, for instance the waypoint which was changed belonged to the waypoint file 2 and this is a CUP file, this file will be overwritten and the data for the changed waypoint will be placed at the end of the file.
If on pastes a waypoint in, it will, regardless of the format, always be written into waypoint file 1!

The Home waypoint will be stored in a fixed line number in the file.
If one changes the waypoint file, the Home waypoint could be lost.
Unless:

- **One loads a WinPilot file with the 'H' as ID.**

Example:
2521:50:04:17N,018:37:42E,285M,AT**H**,Rybnik,This is my Home field with **ID 'H'**

- **One loads a SeeYou file with the field 'LKHOME' as ID**

Example:

"Valbrembo",**LKHOME**,IT,4543.403N,00935.710E,229.0m,5,20,680.0m,"122.600",

- **One loads the file WAYNOTES.TXT** and has in it HOME declared. The WAYNOTES.TXT -file one finds in the Index_Waypoints and it is a simple editable text file.with explanations up front.
- **If one loads** new files, one of them includes also the HOME-Waypoint, which one already uses.

If one has assigned the LKHOME-ID for several waypoints. Only the **last loaded** Home waypoint will be used.

If one uses the WAYNOTES-File, the Home waypoint determined in it will **always** be used.

30.4 Virtual waypoint START and the HOME waypoint

On the ground, prior to take off a virtual waypoint "**Take Off"** will be generated and stored in the waypoint file.

This waypoint will be as long as the speed is lower than the start speed actualized for position and height.

The TAKE OFF waypoint will be considered a turnpoint and therefore all calculations for a turnpoint will be carried out. (MacCready.configured safety height etc.). The TAKE OFF waypoint will not be considered as a landing place. But it will represent a good Finish Point for the Final Glide, because the height is automatically set to the actual QNH and because at turnpoints the safety height does not need to be observed..

- **Sailplanes: <u>If no Home waypoint is declared, the TAKE OFF waypoint will automatically be set as HOME</u>.**

- **Paragliders and Hanggliders: The TAKE waypoint will automatically be set as HOME waypoint,** even if a Home waypoint already exists. Therefore Paragliders do not need to set a HOME waypoint as it will be overwritten anyway.

The TAKE-OFF waypoint will not be stored in the waypoint history

Hence **'TAKE OFF' should NOT be used as WAYPOINT_NAME.**

In order to declare a HOME-WAYPOINT manually, one has to use the detailed waypoint description and click on the control button 'SET AS HOME'. If one is in the simulator this position will be immediately displayed in the map.
If for any reason the TAKE OFF waypoint is set back, it will appear very far away from the actual position
The standard position for a set back TAKE OFF waypoint is the north pole. ☺

31 Configuration example for paragliders

The following configuration is a sample configuration, provided by ***Sergio Silva***.

At first select the system configuration page 7 and set flight mode to *Paraglider/Hangglider*

Page number in system configuration

3. Map Display
Labels: Names
Trail Length: Short
Orientation: Track Up
Auto Zoom: Off
Trail Drift: Off
Trail Width: 8 to 14 (12)
Circling Zoom: On
Declutter waypoints: Low
Declutter landings: Low

5. Glide Computer
Auto Wind: Circling
TrueWind IAS: 39 kh
TrueWind period: 8 s

Auto Mc mode: Both L/D average period: 15 Seconds Lift Center: Circle at Center Auto Force Final Glide: Off Use baro altitude: Off

7. Aircraft
Category: Paraglider/Delta
Type: Para EN A/DHV1, Para EN B/DHV12, Para EN C/DHV2, Para EN D/DHV23 or Para Competition, Delta USHPA 2, 3 , 4
V rough air: 60 Kh

9. Units
Aircaft/Wind Speed: Metric

Page number in system configuration

4. Terrain Display
Terrain display
Terrain display: Off Topology display: On

6. Safety Factors
Safety alt. mode: Landables
Safety MC: 0.5 ms
BestAlternate Warn: Off
Safety Lock: Off

8. Devices - Bräuniger Compeo, Flymaster F1, Digifly werden von LK8000 unterstützt

Device A
Name: Flymaster F1, Flytec/Compeo, Digifly *(Device A is used for external devices. If no external devices available one uses Generic for internal GPS receiver)*
Port: COM7
Baud: 57600

Device B Name: Generic (One uses Device B for internal GPS, if not existent use parameters from Device A) Port: COM7 Baud: 57600 Geoid Altitude: On Serial Mode: Normal or Polling (if there are difficulties with "normal")

10. Interface
Menu Timeout: 16s

Page number in system configuration

Distance: Metric
Lift: M/S
Altitude: Meters
Task Speed: Metric
Lat/Lon: DDMMSS

11. Appearance
Glider Position: 50%
Landables Icons: Alternate
Landables Style: Boxed. with units
Landables value: Arrival Altitude
Inverse b/w colors: On
Waypoints text style: Values White
Hide Units: Off

14. Task
Auto Advance: Auto
Start Type: Cylinder
Start Radius: 400m
Sector Type: Cylinder
Sector Radius
Sector Radius: 400m Finish Type: Cylinder
Sector Radius: 400m

17. Infobox circling
1. Thermal Gain (oder Average thermal strength)
2. Home distance
3. Next ETE
4. Task distance
5. Task Alt.Arrival
6. *Ext.Batt.Bank*
7. *Ext.Batt.1 Voltage*
8. *Ext.Batt.2 Voltage*

19. Infobox Aux
1. Ext.Batt.Bank
2. Ext.Batt.1 Voltage
3. Ext.Batt.2 Voltage
4. Altitude QNH
5. Speed ground
6. *Next Waypoint*
7. *Wind Speed*
8. *MacCready Setting*

22. System
Use GPS time: On
Autoback Light: On
Auto SoundVolume: On

Page number in system configuration

Virtual Keys: Off
Iphone Gestures: Normal
Map Locking: Off
Active Map: Off

13. Map Overlays
Screen Data: Full Map Overlay
MacCready **Value:** Enabled
Glide Terrain line: Shade
Glide Bar indicator: Next Turnpoint
Variometer Bar: Vario Rainbow
Thermal Bar: Off
Track Line: Off
FLARM on map: Off

16. Infobox cruise
1. Speed Dolphin
2. Home distance
3. Next ETE
4. Task Distance
5. Task Alt.Arrival
6. *Ext.Batt.Bank*
7. *Ext.Batt.1 Voltage*
8. *Ext.Batt.2 Voltage*

18. Infobox Final Glide
1. Speed Dolphin
2. Home distance
3. Next ETE
4. Task Distance
5. Task Alt.Arrival
6. *Ext.Batt.Bank*
7. *Ext.Batt.1 Voltage*
8. *Ext.Batt.2 Voltage*

20. Logger
Time step cruise: 1s
Time step circling: 1s
Short File name: Off
Autologger: On

23. Paragliders/Delta Specials
Circ. zoom Value: Standard
Cruize zoom: 5

32 Screen locking for paragliders and hanggliders

In paraglider/handglider flight mode there exists in the menu an additional button LOCK SCREEN which can be reached at Config 1/3 but only before take off!

Screen locking should help paragliders to concentrate on take off and not to be disturbed and unintentionally touching the screen.

LK8000 asks for locking confirmation and if positive the display shows the message "Screen locked until take off".

The **screen will be locked until 10 seconds after takeoff**. If for some reasons screen locking has to be removed it can be done by a double click.

Hardware buttons are never locked.

33 Tips and tricks

33.1 Utilizing alternative topology data

The LKMAPS are of a high quality but it can be that topology data is not the latest. This means a new highway or a railway is missing. If this is the case look for another newer data source.
It seems that available XCM files contains useable topology data which can be sometimes be used.

XCM files are zip-archives which can be opened with archive programs. Some filemanager like Totalcommander contain these unzippers.
Opening an XCM file and loocking for highways can be found in following files

roadbig_line.dbf
roadbig_line.prj
roadbig_line.qix
roadbig_line.shp
roadbig_line.shx

which we guess have to do with highways. The topology file e.g. GER.LKM is also a zip file and contains files with the same names ...

By experiment (at least at the time this was written) it can be shown that these files can be exchanged and the sometimes newer topology can be also used in LK8000. This way for the highway example it means that the missing highway A20 can be seen in the map, see **fig. 33.1,33.2.**

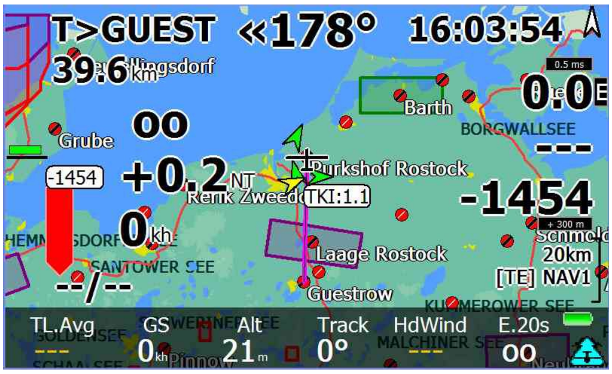


Figure 33.1: Original topology data

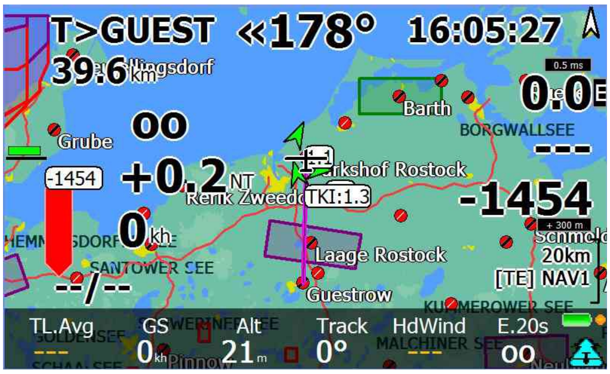


Figure 33.2: Modifyed topology data

33.2 Drawing of thermal activ map areas

LK8000 can load two independent airspace files. Usually, one only needs one file which is provided in e.g. Germany fortunately by the *Deutsche Flugsicherung.*
The second file is usally not allocated.
An interessting idea is now to use the second file for something totally different from airspaces, namely the indication of thermally active areas in the map.

The following is cited (and translated ☺) from the internet:

http://www.segelflug.de/vereine/riesa/?module=newstime&options=view;2011-03-14_11-54-12;1

> *For the WGC 2008 in Lüsse, Carsten Lindemann (a meteorologist from Lüsse) made a map of thermally active ares for the wider area around Lüsse,*

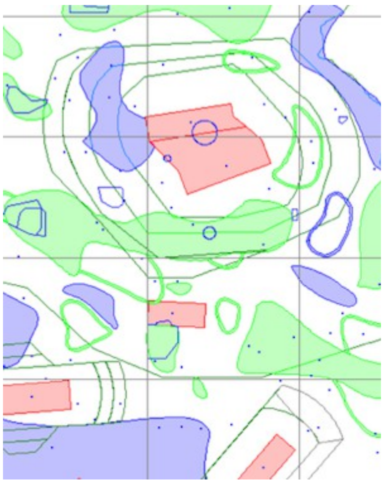


Figure 33.3: Map of thermally active areas

> *It contains thermally active areas in 4 qualities and gives the pilot a first orientation were to plan the flying path. This map is also available in electronic form for PC and PDA and can be used for planing purposes. Because most of the flight calculators do not serve thermal maps here the openair format was choosen. This map can be loaded and handled as airspaces and so thermal areas can be shown or not.*
> *Similar to the airspace file this file is named thermal space file and can be downloaded together with the file for 25 well known hot spots.*
>
> *The thermal space file is in the "Open-Airspace-Format" available and canc be loaded into the PNA or PC into SeeYou or Strepla.*
>
> *Place holder for thermal areas are still not used airspaces type A and B. Airspace A contains so the thermally good areas and airspace B the bad ones.The color in the display can be freely choosen but different from the regular airspace colors. This way thermal spaces can be switched ON/OFF*

during flight. Here an example in SeeYou, light green means good thermal area and light blue bad thermal area ...

The height of the thermal space was set to FL98-FL99 because most pilots flew with the option "Show all airspace up to FL100".
If you are extremely lucky and climb to FL98 you get an airspace warning but keep in mind that it is a thermal space warning.

This is intended for:

- *pilots with a fresh licence and XC beginners*
- *as orientation help at blue thermals*
- *for flight path planing in the morning*
- *for flight path decision in flight, when e.g flying an FAI triangle to plan the remaining flight path after the first turn point in a thermally active area*
-

The hot spots are stored in a separate file and can be used like other waypoint files. As symbol for a hot spot I have selected a cooling tower. Here an example:

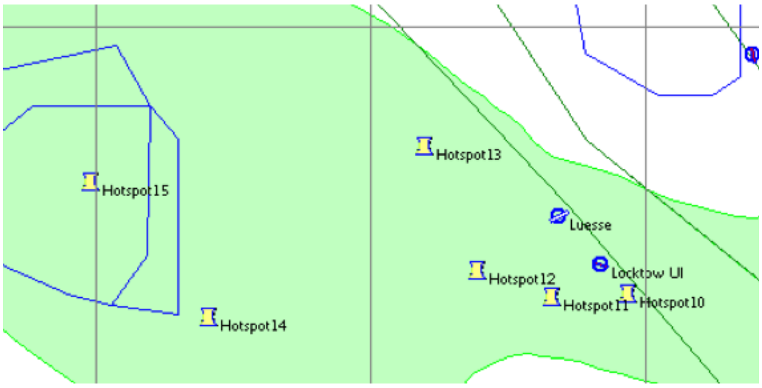


Figure 33.4: Hotspots

If you have more informations about thermally active areas e.g. for other german parts or want to add some hot spots, please write to me.
The code to transfer maps in thermal space maps can handle different map projection formats.

Questions, hints and suggestions please by email to:
Christoph Klein cirrus18m@gmail.com.

Downloads:

- *[Thermikkarte_Carsten_Lindemann_110313 (TXT, 67kB)]*
- *[Hotspots_110313 im Seeyou Format (CUP, 1kB)]*
- *[Hotspots_110313 im StrePla Format (ST2, 2kB)]*

In this case the second waypoint file was the hot spot file. The described files can be also used in LK8000, see **fig.33.5**. For proper usage one has to do fine tune of the graphic choices. ☺

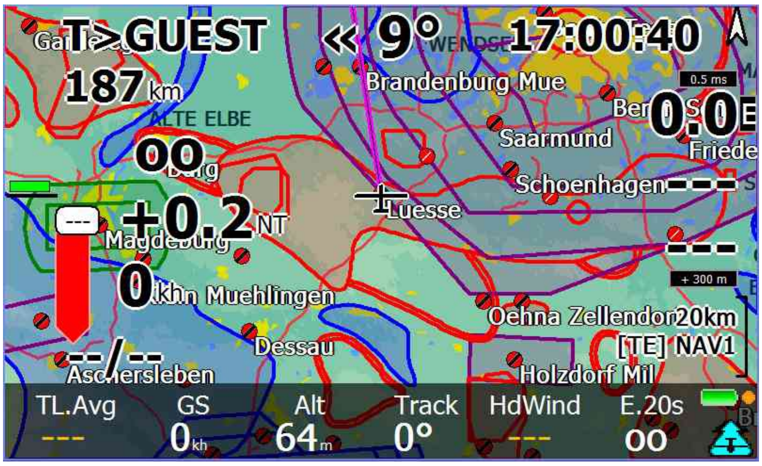


Figure 33.5: Thermically active areas and airspaces

33.3 Flight evaluation and flight replay with "igcreplay"

The free program *igcreplay* (http://ywtw.de/igcsim.html) allow on PCs with Windows OS to replay IGC files and uses for visualisation the free available program *Google Earth.*
This way a view from the cockpit with different perspectives can be realized, quite amazing and good for winter time.
But igcreplay can also provide a NMEA stream on a serial port which can be used to test your own LK8000-device **in flight mode**!

Most notebooks these days do not have a serial port (RS232, COM) but with the serial port emulator *com0com* (http://com0com.sourceforge.net) the total emulation can be done.

Try it this way:
igc replay streams the IGC-file and visualises it with Google Earth. The NMEA-stream goes to a port of com0com. LK8000 (PC version) is so configured that the GPS source is the com0com complemental port. This way LK8000 handles the NMEAS stream like from a real source and all LK8000 function can be tested in flight mode, see **fig. Fehler: Referenz nicht gefunden**:

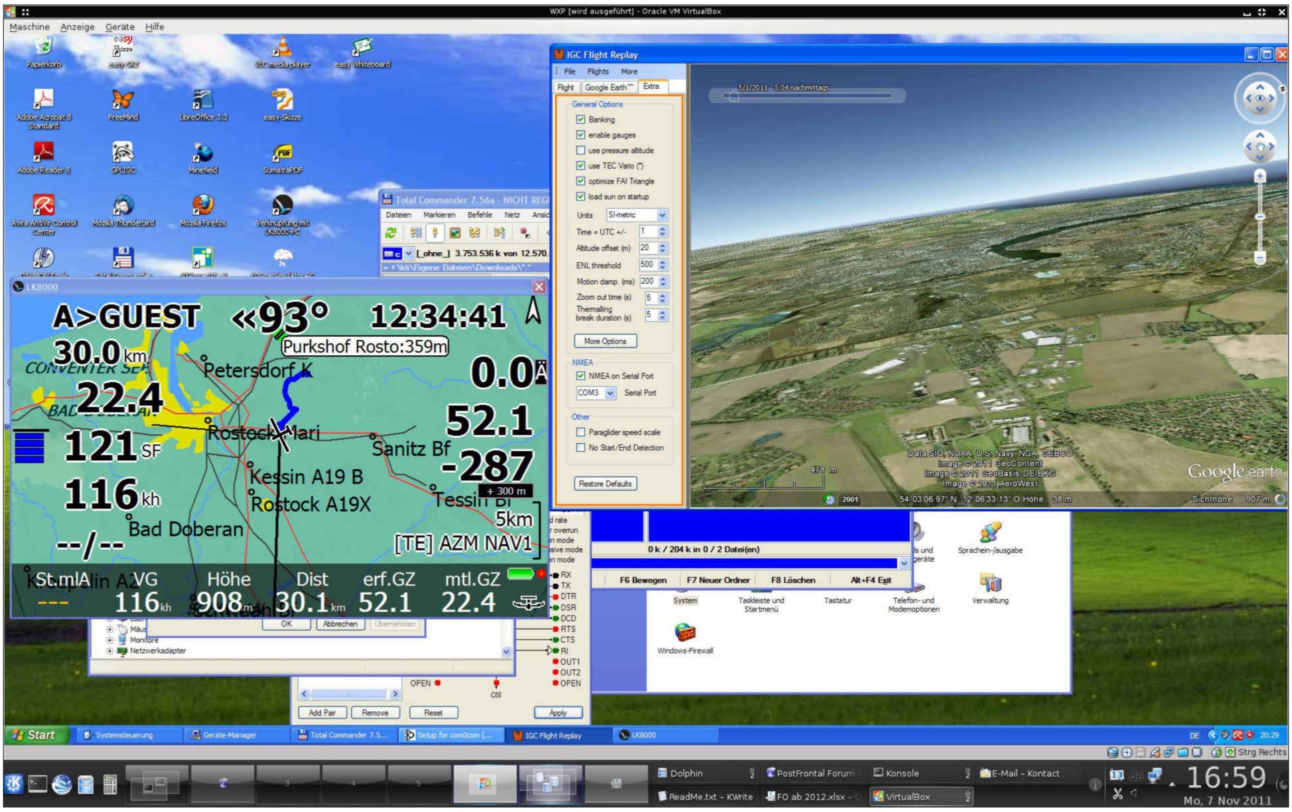


Figure 33.6: igcreplay, Google earth, com0com and LK8000

In above figure the simulation(LK8000-PC under igcreplay) is shown with the simulation (igcreplay in Google Earth), within the simulation (Windows under Linux). ☺

33.4 Configuration tips

Here some tips for a user specific configuration

A) Normally the stack rotation of the info stack (map and info pages) only forwards by a click on the center of the button line. Sound help to orientate but sometimes it can be handy to go back and so it is advisable to define the page back function as custom key and long click at the center of the bottom line.

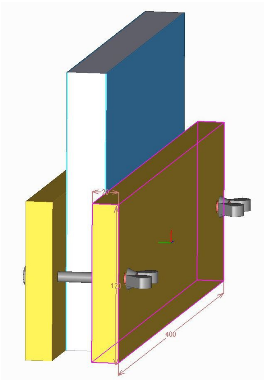
Short click forward, long click back .... easy to remember!

B) The **airspace sideview** is really helpful so a call up by a custom key is avisable.
Suggestion: **Long click on the right side of the bottom line** (not menu!)

C) If one wants to maximise the OLC score he should define a custom key for the **contest info page 1.5**.
Suggestion: **Long click on the left side of the bottom line**.

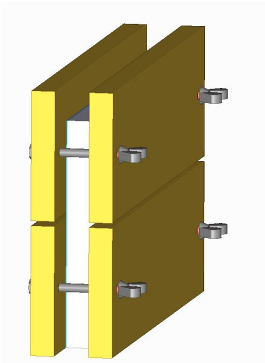
33.5 *Handbook bookbinding*

The double side printing of this handbook delivers a 2.x cm thick stack of paper sheets. Here is an easy and proven book binding to make a book from the handbook

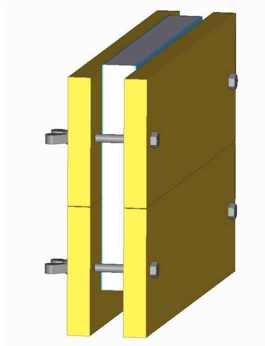


First one has to get thin carton (A4, 150g/m^2) for the front and back cover, best a leatherboard on which the Handbook logo can be printrd for the front cover with an inkjet printer (The toner of a laser printer does not adhere well on leatherboard...).

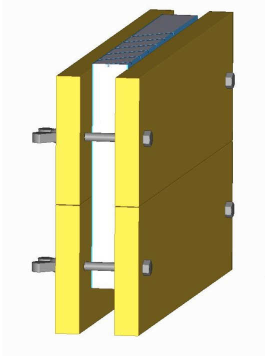
Next one prepares a simple book press from plywood (e.g. 400mm x 120mm x 20mm) and bolts (M8, lenght about 80mm) with wing nuts.
The paper stack will be clamped in the book press so that it is plane and straight.
The back of the book has to be facing down!.
Here one really has to pay attention(!)
If not the stack will be glued on the wrong side!!!



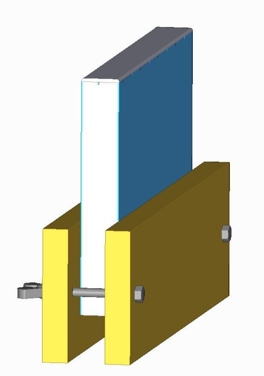
Both sides of the stacks should be covered by an empty paper sheet.
Now the second clamb holds the stack permanently. Between the clamps should be a gap of approx. 5mm.



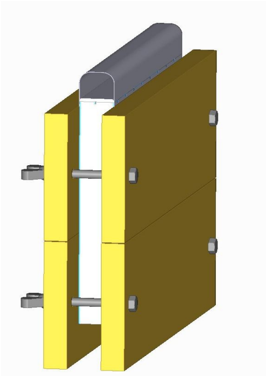
Then you turn all upside down, untighten the upper clamp and move it down a bit so that 3mm of the stack are over the clamp border.



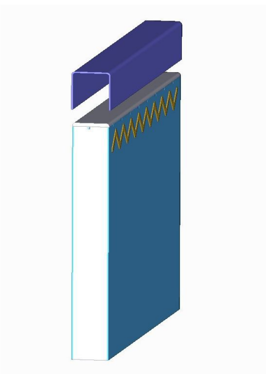
In the free standing part of the stack one saws **angular** slits (width 1-2mm) with a hack saw or a Drehmel.



Then one removes the upper clamp and spreads wood glue over the future book back l
The freestanding part of the stack should be moved a bit so that the glue reaches all paper sheet.
Do not make a mess with the glue on the book covers!



Place an empty sheet of paper over the glue so that the glue can not get onto the clamp . Fix the stack with the empty sheet of paper into the clamp.
After glue has dried (about 24h) and is hard you already have something like a book. Remove the unwanted glue rests with a sharp knife.



The missing book back will be also made from leatherboard and glued with some household glue.

Ias now already have a book press and the whole procedure only takes 30 min, you can make some handbooks for your flying buddies

If you work carefully you get a nice book which looks good on your book shelf.

34 Index of tables

35 Index of figures

Abbildungsverzeichnis

36 Glossary

AAT
Area **A**ssigned **T**ask – competion task type at central competitions

Arrival height
Height one arrives above the safety height

Working area
The sector of height levels between intended climb top and cruise low point

Baro height
Barometric height, pressure measured by a sensor which is assigned to a height.

DMST
Deutsche Meisterschaft – decentral competition for clubs in Germany

DSX
Collision warning device

FAI
Fédération **A**éronautique **I**nternationale – International air sports club

FLARM
Collision warning device

GPS-height
Height, determined by GPS-data

IGC
International Gliding Commission of the FAI

IGC-file
file containing mainly flight track data in a format determined by the IGC

OLC
On **L**ine **C**ontest – decentral competition available in many countries

PDA
Personal **D**igital **A**ssistant

PNA
Personal **N**avigation **A**ssistant

QFE
Height above starting place

QNH
Height above sea level

Waypoint
topologically distinct point often landing field or airport

Turnpoint
topological point where the heading is changed clearly

37 Literature, information sources

LK8000: http://www.lk8000.it
XCSoar: http://www.xcsoar.org
Ventaf: coolwind@email.it, ,
Reichm: Reichmann, Streckensegelflug, 2005
notepp: http://www.notepad-plus-plus.org
McCready: P. MacCready, An Optimium Airspeed Selector, 1954
Cochrane: J.H. Cochrane, McCready Theory with Uncertain Lift and Limited Altitude, 1999
WO2011: http://www.daec.de/se/downfiles/2011/SWO2011_AN0.pdf
IGC-FMT: http://carrier.csi.cam.ac.uk/forsterlewis/soaring/
Condor: http://www.condorsoaring.com/
condor2nav: http://sourceforge.net/projects/condor2nav/
MIRASOL: www.mirasoldisplays.com/
DAeC-LR: http://www.daec.de/aul/luftr_d.php
WinPilot: www.winpilot.de/manuals/wp_500dt.PDF

38 (to be extended) Index

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