ZANDER / SDI ZS1

Manual

Program Version: E 3029

Content: Page

Updates: www.zander-variometer.de

1. Overview

Glider Computer ZS1

Analog Unit ZS1R

The ZS1 system consists of the glider computer, an analog unit and a separate GPS flight data recorder which supplies GPS data to the glider computer. Additional options are magnetic compass, second operating unit or remote control from control stick.

The glider computer ZS1 has a graphic screen (160 x 160 pixel) which shows both text and graphic information. The display of information on the LCD screen is organized in pages selectable by the user. To control the ZS1 there are several push buttons and one turning knob around the screen.

To change an information on the page, the cursor (black square) can be moved to the information to be changed by "cursor up" and "cursor down" push buttons. Then value or a selection can be changed by turning the knob. The knob has 16 steps per turn. Turning to the right will increase a value, turning to the left will decrease a value. The values will be used by the computer as they are visible, so there is no futher action necessary like ENTER. The "Enter" button on ZS1 is used for other purposes.

Pressing the "Help" button puts explanatory text on the screen. The help text depends on the cursor position and page selected (context sensitive help function). The help text disappears and the previous page is restored if "Help" (or any other button) is pressed again.

The buttons "Enter" and "Menue" are used to switch the screen to other pages. With "Enter" pages are switched forward, with "Menu" the pages are switched back. If the "Menu" button is pressed once or twice, the screen returns to the menu page where all available pages are listed. After selection of one item and pressing "Enter" the desired page will be shown.

Pressing the button next to the speaker symbol will show a screen to set different volumes for both variometer mode and speed command mode. Pressing this button again will restore the previous page.

The function of button F1 can be programmed and so the function depends on the selection done on the page "Settings".

With button "ON/OFF" the power of ZS1 can be turned on and off.

2. Flight Page

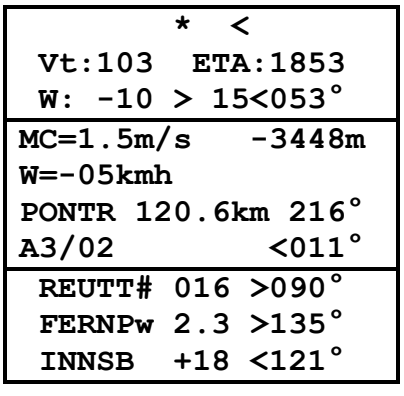
The main page during flight is the flight page which contains most of the information important for the progress of a flight. The page has three areas. The upper area shows three lines; each of the lines can be selected from a list of available lines (info lines). The information shown here can be changed by replacing lines.

The information shown in the middle part of the screen is generally fixed (with small changes possible). The information shown here is necessary always like MacCready setting, glidepath and GPS information.

The lower area shows again three info lines which can be selected from a list (similar to the upper area).

The flight page is available in two text fonts: standard size and large size (selected under "Settings"). If the large size is selected, the upper and lower areas show only two info lines each; the most upper and most lower lines of standard font are not shown.

If the standard settings are recalled, the flight page is arranged like this:



info line 1: heading error (graphic);
info line 2: travel speed and estimated time of arrival at end point of route;
info line 3: wind component, wind vector;

MacCready input, glidepath display;
wind component input for glidepath;
GPS target point, distance, bearing;
route number A3, leg 2, heading error: target point is 11° to the left;

info line 4: nearest airfield from airfield data base;
info line 5: nearest turnpoint from turnpoint list;
info line 6: nearest airspace.

To change MacCready setting, wind input or leg number on flight page:
move cursor to number and change number with knob.
Use "Help" button for further explanations after having moved the cursor.

The info lines can be changed by moving the the cursor to any info line and then turning the the knob. The "Help" button will give information on on any of the available lines selected.

During straight flight many directions shown are relative to the heading of the glider (shown by an right-left-arrow in front of the direction number). So the wind is shown as "15kmh from 53° left", which means nose wind from left (0° means straight nose wind, 180° means straigt tail wind). The nearest airfield REUTTE is 16km to the right, the nearest airspace point of INNSBRUCK is 18km to left rear (+ = outside, - = inside).

When circling, the directions are shown as absolute (270° = West). Then the right-left-arrow is not shown.

Special features of the flight page:

If one of the cursor buttons is pressed longer than 3 seconds, the cursor jumps to initial position at MacCready input.

If the cursor is located on one of the info lines, the info line can be changed by turning the knob.

If "Enter" is pressed, the page is switched to a new page depending on the cursor position on the flight page:

cursor position:	with "Enter" switch to page:
MacCready input:	"adjust before takeoff" page
wind component input:	wind page
name of GPS target point:	waypoint page
route / leg number:	route page

The same applies to the info lines. If an info line is selected by the cursor, "Enter" will display an according page. So the nearest airfields will be shown if the cursor was on the nearest airfield line or the airspace graphics is shown if the nearest airspace line was selected.

Pressing "Menu" returns to the flight page from the selected pages.

When ZS1 ist turned on, the flight page is shown and the cursor is located on the MacCready input. So the "adjust before takeoff" page is selected immediately by pressing "Enter" once after power-on.

Another way to get the desired pages is by using the menu page:

```
menu:
 Flight Page
 before Takeoff
 Waypoints
 Routes/GoTo
 nearest AFLD/WP
 Airspace
 Photo Sector
 Stop Watch
 FD Recorder
 Settings
        ▼
```

on flight page press "Menu" once
(from other pages: press "Menu" twice):

menue page appears

select item from list by cursor buttons or turning knob

press "Enter": the desired page will show up

back to flight page: press "Enter" once
or
press "Menu" three times

More about the flight page:

GPS function:

The glider computer ZS1 gets GPS information from the flight recorder GP941. If GPS reception drops out for a short moment, dashes are shown instead of the heading error number:

```
MC=1.5m/s   -3448m
W=-05km/h
PONTR 120.6km 216°
A3/02          ---°
```

GPS reception lost momentarily

If GPS reception is lost for more than 10 seconds, the middle part of the flight page will change to this display:

```
MC=1.5m/s   -3448m
W=-05km/h
PONTR       D=121km
A3/02       no GPS!
```

GPS off:
D = distance input by hand for glidepath calculator

Without GPS the distance D can be changed by hand and will be counted down during speed command mode according to airspeed and wind component input. The resulting distance will be used for the glidepath calculator. With GPS this distance is updated automatically, so if GPS fails, the distance shown is the last distance provided by GPS.

GPS is used to determine straight flight mode or circling flight mode within ZS1. This information is used for all directions shown: when circling all directions shown are absolute (270° = West), when flying straigt most directions are shown relative (<45° = left of nose).

The mode "variometer (VARIO) / speed command (SC)" is independent of straight and circling flight mode (if not selected otherwise under "Settings / Mode Switching VARIO / SC"). The VARIO / SC mode determines the audio function, the analog pointer function and the display of average climb and average netto climb.

Glidepath calculator:

The glidepath calculator uses the inputs for MacCready and wind component, the selected polar curve, the distance to GPS target point, actual altitude and elevation of target point. The arrival altitude above ground is shown (without additional security margin) which is the same as the deviation from glidepath. The glidepath altitude shown is total enrgy compensated to eliminate changes of glider altitude due to changing airspeed. Glidepath altitude calculation is done for an airspeed of 120km/h at the finish point. Glidepath altitude uses always the internal altimeter of ZS1, which must be adjusted to airfield elevation before takeoff.

Wind input:

The wind component input should be set preferably by hand. Normally one of the info lines shows the wind as component or as wind vector (direction and speed) or both. According to the wind shown and a good guess from the pilot, the average wind component from flying altitude down to the ground is set.

The wind input can also be controlled automatically by the wind measurement (see wind page), but this is not recommended, as the big advantage of TE compensated glidepath calculation would be lost in that case.

The TE compensated glidepath calculator shows very accurately altitude gained in lift or lost in sink. But this requires that the wind input stays constant during glide. With automatic wind transfer the wind input changes during glide and with it the glidepath altitude shown would change too. So gains and losts are no longer obvious.

Another reason for setting of the wind component by hand occurs if there is a critical glide home with zero MacCready input. To compensate for bugs and to add some safety into glidepath calculation, an additional head wind could be entered. So a glidepath margin of about 15% is added by setting 20km/h additional head wind.

If the vector wind (wind with direction and speed) on the wind page is set by hand or updated from time to time only, the automatic transfer of special wind components may be useful, as the transfered components may change only slightly. So the wind in direction of the GPS target point may be useful when flying around a landing field or the average wind for remaining distance may be useful in a long final glide around a turnpoint.

Switching to next leg of a route:

The leg number of a route is advanced by hand on the flight page. There is not automatical advance with ZS1. This makes it easy to do another departure in a competition, leave out waypoints or switch back to the home airfield at any time.

Remaining distance:

If one of the info lines shows remaining distance, the glidepath calculator uses this distance. Then the glidepath is calculated around the last or more turnpoints. Wind component input must then be the average wind component for all remaining legs which may have different components each. The average wind component is calculated on the wind page using the vector wind (compass wind or circling wind). The average wind component can be transfered from the wind page to the wind component input. The remaining distance is the distance to the next turnpoint plus all remaining leges up to the end point of the route (not the landing point !!).

Set and store a buoy:

If the cursor is moved to the name of the GPS target point and the knob is turned to the right, the actual GPS position is stored and the word "*BUOY" appears replacing the waypoint name. Now GPS distance and bearing are showing to this stored position. If the knob is turned to the left, the previous waypoint is restored.

If "Enter" is pressed while "*BUOY" is shown, the stored GPS position can be stored permanently. Normally the buoys are named and stored automatically in the user waypoint list from position 991 to 997, but they can be stored at other positions and they can be renamed.

The buoy just stored can also be implemented into the active route; the buoy can be inserted into the sequence of waypoints of a route or it can replace the active waypoint. Replacing is used, if the intended turnpoint is given up and the buoy represents the actual turnpoint. After that the route page shows the total and remaining distance of the modified route and the ETA page shows the new estimated time of arrival at the end point. This type of route modification is also used in AAT tasks to store the actual turnpoint in one AAT sector before flying to the next AAT sector.

Storing a GPS position and modifying the actual route can be done easier with button F1, if the buoy function is selected for F1under "Settings / Function of <F1>".

3. Info Lines

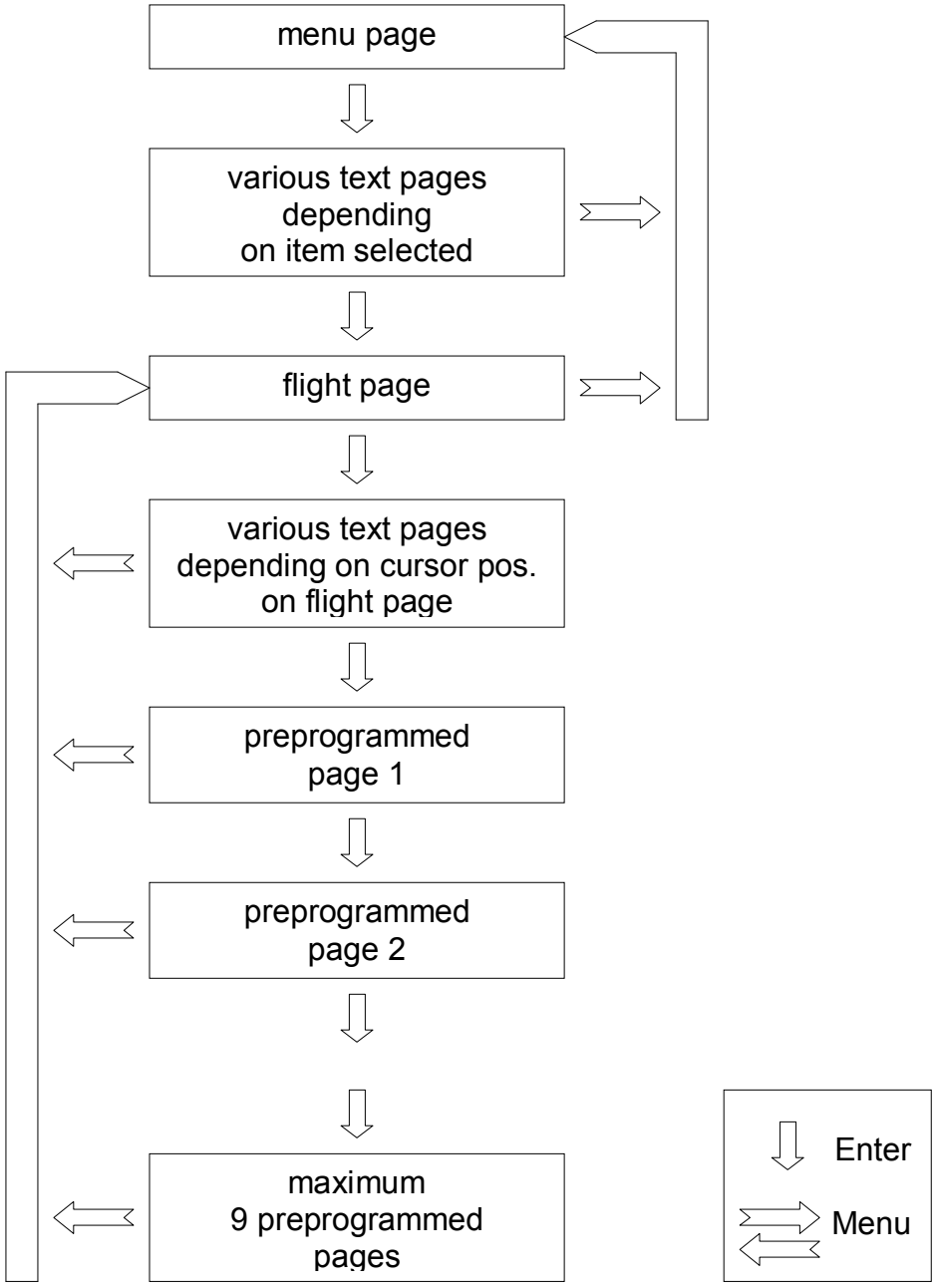
The upper and lower lines on the flight page can be selected from a list of info lines.

To change an info line on the flight page, mark the line with the cursor and then turn the knob to select the desired line. The "Help" button gives explanations to each of the selected lines.

14:23:14 (03:52)	time hh:mm:ss, stop watch (since start hh:mm)
Rem. Dist 0345km	remaining distance up to end point of route (not landing point !!); glidepath uses this distance if this line is shown
W: ◊ 217° 015kmh	vector wind with direction and speed ◊ = wind calculator mode: * = circling wind active > = straight flight wind active (= compass wind, avg. 120s)
217°◊15kmh >123°	vector wind: direction absolute, speed, direction relative * = circling wind active > = straight flight wind active (= compass wind, avg. 20s)
Wcomp: ◊ +009kmh	wind component (avg.10s)
W: +09 ◊ 15>123°	wind component and vector wind: speed, direction absolute when circling, direction relative when in straight flight (avg. 20s)
IAS: 123kmh	airspeed as measured by ZS1
GPS: 132kmh 030°	GPS speed and direction (relative to ground)
Vt:103 ETA:1723	travel speed (altitude related) estimated time of arrival at end point of route
Vmc: 123kmh	MacCready speed-to-fly (depends on MacCready input and selected polar curve)
av. L/D 043	average L/D (time constant 15s)
Mtot: +1.52m/s	total average climb since last switching from SC to VARIO
M vario +2.3m/s **M netto -0.6m/s**	average climb in VARIOMETER mode average netto climb in SC mode
mc=0: -0763m	glidepath with MC=0 (to be compared with glidepath with actual MC setting)
Temp: +13.5°C	outside air temperature
pTemp: +27.3°C	potential temperature (Temp related to sea level)
voltage: 11.5 V	voltage of 12V power supply attention: below 11.0 Volt this line cannot be removed!
Alt1 1248m MSL	altimeter meter MSL
ALT2 0923m GND	altimeter meter GND
Alt3 04092ft MSL	altimeter feet MSL
Alt4 03026ft GND	altimeter feet GND
Alt5 05231ft FL	altimeter feet FL (flight level) QNH must have been set correctly before takeoff!
Test: 00180	display of content of a test address (address set on page "Function Test ")

224° +0.8M >057° 000° +0.0M >000°	centering aid: direction to better climb, climb improvement possible centering aid not yet active
> * <	graphic display of heading error (on course, max. +5°/-5°) turn to left (about 10°)
HAHNW 175.7>096°	target point selected on GoTo page distance and direction (direction absolute / relative)
REUTT# 016 >090° REUTT_ 016 >090° REUTT? 016 >090°	nearest airfield from data base, distance, direction absolute / relative # = automatic GND calculation off _ = used for automatic GND calculation ? = if automatic GND calculation is on, but airfield has no elevation in data base
FERNPw 1.7 >133°	nearest waypoint (as shown on graphic page)
INNSB +18 >121°	nearest airspace (+ = outside, - = inside)
327 PONTRESINA	waypoint number and full name of GPS target point
INNSBr 286° 32nm	radial from (magnetic), distance in nautical miles

4. Arrangement of Pages



Three types of pages are used with ZS1: the menu page (= table of contents), the flight page (= front page) and text pages (= pages of a book). The text pages contain special information which can be in text format or graphics.

While on menu page, pressing "Enter" will show the the page selected from the menu list. While on the selected page, pressing "Menu" will return to the menu page. Pressing "Menu" again returns the cursor to item "Flight Page". With "Enter" or once more "Menu" the flight page is shown. "Menu" again returns to the menu page again.

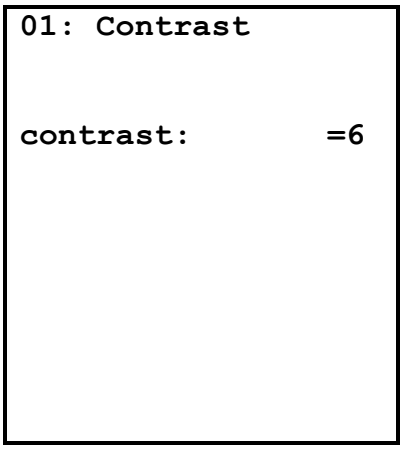
While on flight page, pressing "Enter" shows a text page which is associated to the cursor position on the flight page (context sensitive). "Enter" again switches to a sequence of text pages which can be preprogrammed under "Settings / Page Preselect". A sequence of up to 9 pages can be preselected. Pressing "Menu" returns to the flight page from all preselected text pages.

All text pages can be switched too by changing the upper left text page number by turning the knob.

5. Text Pages

The text pages show information on special items:

01: Contrast for ZS1 screen
02: Serial number and program version
03: Settings for ZS1
04: adjust before Takeoff
05: Stop Watch
06: Statistics of flight since departure
07: Travel Speed
08: Flight Log
09: Wind, transfer of wind
10: Temperature, supply voltage, indicated airspeed
11: Function Test with Simulator and Master Reset
12: Data transfer to/from flight data recorder
13: Waypoint List / show, edit waypoints
14: Routes setup, switch to GoTo function
15: Estimated Time of Arrival at end point (ETA)
16: nearest Airfields list
17: nearest Airfields moving map
18: nearest Waypoints list
19: nearest Waypoint moving map
20: AAT programming with AAT moving map
21: Airspace moving map
22: Altitude Alarm and conversion between FL (flight level), ft, m
23: Turnpoint moving map with photo sector



Contrast is located on the first text page to be able to change the contrast even if the text is not visible:

Select any text page, turn knob to left sufficiently, cursor down, change contrast with knob.

```
02: SerNum/Version

S/N:          123456

programm:      D3018
manual:      01/2004

airspace
loaded:    05.02.04

airfld data base
loaded:    13.01.04
```

The date shown for airspace and airfield data base reload is the date when the data bases are loaded from PC; these are not the dates the data bases are generated.

```
03: Settings

02= Units:

variometer      =m/s
altitude        =m
distance        =km
speed           =kmh
```

This text page is used to select all settings for ZS1. In line 3 various items can be selected and further down the apropriate settings can be done.

After having changed any of the settings, the settings should be saved with item "Personal Settings".

After loading a new program version or after activating a master reset all settings are reset to standard. In that case the personal settings can be recalled with item "Personal Settings".

For more information on settings see **Settings**.

```
04: adjust before
    Takeoff:

wing load:   33kpm2
best L/D:    40

QNH:          1013hp
>H/ZS1:  00428m MSL
 H/GP:   00428m MSL
ELEV:    =0428m MSL

GND: 0428m = ELEV
```

This page is used for all settings and adjustments before takeoff.

Inputs for wing loading and best L/D will be changed on this page during flight too if necessary.

The best L/D setting determines, which L/D the glidepath calculator will use with MC=0 and no wind. The selected polar curve will be modyfied before use to achieve the desired L/D.

Bugs on the wing should be taken care of by a lower L/D setting on this page.

In competitions the QNH is set as published by the organizers, as this setting is important for calculation of flight levels for restricted airspaces.

If flight levels are of no concern, the QNH setting is not necessary with ZS1, as the altimeters of the ZS1 system are set to field elevation before takeoff anyhow.

Two different altimeters can be used for altitude display with the ZS1 system. One altimeter is part of the ZS1 glider computer, the other altimeter is from flight recorder GP941 used for pressure altitude recording.

Both altimeter displays H/ZS1 and H/GP must be set to field elevation before takeoff. The altimeter changed last will show a mark in front of the line. The marked altimeter will then be used for all altitude displays of the ZS1. In competitions this must be the altimeter of the flight recorder to see what altitude will be recorded when passing start or finish lines or when getting close to altitude limits within airspaces.

The glidepath calculator always uses the internal altimeter of ZS1 to get the advantage of TE altitude compensation.

For normal use there is no fixed relation between QNH setting and display of the internal altimeter of ZS1. The reason is, that it must be possible in competitions to set an official QNH (used for flight level calculations) and be able to set the altimeter to field elevation even if the QNH given is not correct.

If for some reasons a fixed relation between QNH and displayed altitude is desired, the QNH must be changed to minimum setting (960hp) and then adjusted to the actual number. This deletes any zero offset which are produced when adjusting the altimeter directly. After this procedure you must not change the altimeter setting directly but use only the QNH setting.

The field elevation ELEV is set once for the home airfield and is changed only when flying at another airfield. Attention: after loading a new program version or performing a master reset this setting is deleted and you have to set it again!

For GND displays with ZS1 or ZS1R you can select if the GND reading is in reference to the home airfield (=ELEV) or to the elevation of the nearest airfield from the data base (=AUTO). If elevation of nearest airfield is used, it is recommended to show the nearest airfield always in one of the info lines to see which airfield is used for GND calculation.

If function AUTO is used, it is recommended for security reasons, that the home airfield including elevation is part of the airfield data base. Otherwise AUTO should be switched back to ELEV when returning home.

```
05: Stop Watch

takeoff/departure:
distance   06.8km
altitude 0932m MSL

dep:  11:48:27 GPS
arr:  16:20:12 AIR

dur:  05:28:15

depart. MAN? =NO
```

The stop watch starts counting after takeoff, but can be restarted by some events. Departure time is the time, when the stop watch was started or restarted. At arrival time the stop watch is halted. Three letters besides the times show, which event has started or halted the stop watch.

The stop watch is started or restarted:
AIR = takeoff
GPS = crossing start line
MAN = manual restart on this page

Crossing the start line restarts the stop watch only if the departure point is selected on the flight page and if the departure point is less than 50km away (independent on the page shown).

Distance to departure point and departure altitude are stored when crossing the start line.

No contest: the restart of the stop watch when crossing the (unvisible) start line can be avoided, if the target point selected on the flight page is leg number 0 (takeoff point) or leg number 2 (first turnpont), but not leg number 1 (start point).

The stop watch will be halted:
GPS = crossing the finish line (if end point is selected on flight page)
AIR = after landing.

The stop watch is restarted manually by moving the cursor to the lower line and turning knob to the right. This stores the new departure time and actual altitude.

Elapsed time since departure can be shown in one of the available info lines on the flight page.

Evaluation of statistics starts with departure time and ends with arrival time. Calculation of travel speed starts with departure time too, but can be restarted separately at any time on the travel speed page.

```
06: Statistics
duration:     05:28
speed:     105.3kmh

circling:
percentage     036%
altit.gain 013610m
av.climb   01.92m/s

straight flight:
distance     0576km
average L/D     042
```

Statistic starts and restarts with stop watch and stops when the stop watch is halted.

Determination of circling flight / straight flight is done by GPS.

The distance covered in straight flight is distance over ground (effect of wind included).

Speed shown is covered distance divided by duration.

```
07: Travel Speed

  new start? =NO

since start:
elapsed time 02:36
start altit. 1132m
distance      283km
av.climb   02.23m/s

Vt:           112kmh
```

Travel speed is calculated from covered distance over ground in straight flight, elapsed time and difference to start altitude.

The achieved average climb since start and the altitude difference result in an amount of circling time which is added to or substracted from the elapsed time to display a travel speed related to altitude.

If the weather changes considerably, it is recommended to perform a new start. After a new start there must have been some circling time before a new travel speed can be calculated.

The travel speed shown here can also be shown in one of the info lines on the flight page (together with ETA).

```
08: Flight Log

flight no.= 123

date:      06.03:04
takeoff:      09:26
landing:      16:38
duration:     07:12

times:     = LOCAL

(date: always UTC)
```

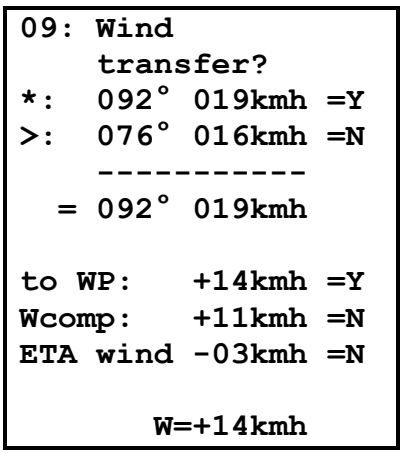
The flight log shows dates and times of the last 20 flights.

The flight numbers run from 001 to 999 and then start again with 001.

During flight, takeoff time and elapsed time are shown.

Takeoff and landing times can be shown later in UTC or local times.

The date is UTC always.



On the wind page various wind components are calculated which can be transfered to wind input of the flight page.

To calculate these components, a wind with direction and speed (vector wind) is required. Selection is available if circling wind, straight flight compass wind, both or none of them are used for vector wind.

If no wind measurement is selected for automatic transfer, the vector wind can be set by hand.

The measured wind can be transfered continuously (Y = yes) or can be transfered one time (with "Enter" or N>Y>N). If both measurements are selected for automatic transfer, then the circling wind will be transfered while circling and the compass wind will be transfered when flying straight.

The vector wind shown in the middle part of the screen will then be used to calculate the wind component in direction to the selected GPS target point (to WP) and the average wind component for the remaining distance to the end point of the route (ETA wind). The measuered wind component in direction of flight (which does not use either vector wind or compass) is also shown.

One of these three wind components can be transfered to the flight page wind input. Transfer can be continuous (Y = yes) or one time (with "Enter" or N>Y>N).

On the bottom line of the screen there is a copy of the flight page wind input to check transfer or set any value by hand.

If a wind component is transfered continuously to the flight page wind input, the wind input on the flight page is marked with "auto". On the flight page the countinuous transfer can be terminated with a change of the wind input by hand on the flight page.

Important:
The average wind component for the remaining distance shown here is also used for calculation of estimated time of arrival (ETA). If this number is changing due to changing wind measurement, the ETA shown will be changing too.

Note:
The disadvantages of continuous transfer of measured wind to flight page wind input is explained under "Flight Page".

```
10: volt temp IAS

outside air temp:
           +23.4°C

voltage:
         12.3 Volt

airspeed:
      IAS  135kmh
```

The results of some measurements ar shown here.

To improve airspeed measurement, a zero calibration is performed from time to time. A magnetic valve turns off the total pressure for a short time during calibration.

This calibration can be checked on the ground by moving the cursor to the IAS number and pressing "Enter".

If the airspeed shown after calibration is 10km/h or less, then the calibration is o.k.

```
11: Function Test

1= GPS

variation:    01°E

mode:          8
geometry:      9
signal:        5
```

This page allows some functional checks of ZS1 and provides means for a master reset if necessary.

In line 3 several submenus can be selected.

This page checks GPS functions and shows the magnetic variation delivered by the GPS receiver according to the GPS position.

The GP941 provides three modes:
0 = GPS off
7 = searching for satellites
8 = GPS o.k.

Geometry is not very important: 0 = bad, 9 = good

Signal strength may show a GPS antenna problem: 1 = bad, 5 = good

```
11: Function Test

2= wind/compass

IAS:          120kmh
TAS:          124kmh
GPS:          120kmh
Wcomp:       -004kmh

compass+dev:   237°
GPS:           227°
wind:  311° 021kmh
```

This page should be used to check the wind calculation and the function of the sensors used for it:

IAS: measured airspeed
TAS: calibrated true airspeed
GPS: speed over ground
Wcomp: difference TAS, GPS

compass signal corrected by deviation table
GPS: direction over ground
wind from GPS speed, GPS direction, TAS, corrected compass signal

```
11: Function Test

3= simulator =ON

vario:    =+02.0m/s
IAS:        =124kmh
compass:    =237°mh
GPS:        =120kmh
            =227°
set position to
0209= KOENIGSDORF°
              =NO
```

Various functions and displays can be checked with the simulator.

The input values for IAS and compass are corrected according to airspeed calibration and deviation table before they are used within the ZS1 program.

With the bottom line any waypoint coordinate can be used to simulate GPS positions to check airspace displays at interesting points for instance.

```
11: Function Test

4= Test

address:      =F1F1
byte:         =2
content:      00237

test no.      =0
test value    =+000
```

Variables within the ZS1 program can be selected via addresses and can be watched. The content also can be watched by an info line on the flight page.

Example: F1F1 = corrected compass reading (degrees)

Some test programs can be activated.

Example: test No. 9 checks with 0, -1, +1 the analog pointer and the audio generator.

```
11: Function Test

5= Master Reset


PIN:           1234

Master Reset =NO
```

If unusual behavior of the ZS1 is encountered, a master reset is recommended.

Master reset deletes all user waypoints, the flight log and all settings which are not yet saved.

Saved settings for different pilots, deviation table, airspeed calibration, airfield data base and airspace data stay unchanged.

PIN is always 1234.

```
12: FD Recorder

1= task    A3
   14.07.2003 UTC
   0723.5km

00= takeoff:
    KOENIGSDORF

declare flight?
             =NO
```

Data to / from GPS flight recorder GP941.

Several functions can be selected in line 3:

1. declare task within flight recorder
The task is same as active route.

2. Transfer waypoint list from flight recorder to ZS1.
Enter start position and end position of list in memory of flight recorder; enter first position of ZS1 list.

3. Transfer sets of routes from flight recorder to ZS1.
With a PC up to 5 sets of routes (each up to 8 routes) can be written into the flight recorder. With ZS1 these sets can be transfered from flight recorder to ZS1.

4. Transfer waypoint list from ZS1 to flight recorder.
Enter start position and end position of list within ZS1; enter first position of memory in flight recorder.

5. Declare name of pilot within flight recorder.
(possible only with GP941, not with GP940!)

```
13: Waypoint List

1= display only:

0209= KOENIGSDORF

Lat:   47 49 52 N
Lon:  011 27 48 E
Elev:   0601m

Info: "118.27 AF"
```

User waypoint management:

Show, edit, copy or delete waypoints.

User waypoints to be used in routes:	0001 to 0999
Airfield data base:	1001 to 7000

Line 3: various submenus for waypoint mangement..

Waypoint format:

Format within ZS1: waypoint name 12 characters, latitude degrees, minutes, seconds, N/S, latitude degrees, minutes, seconds, E/W, elevation 0001m to 9999m, info text (9 characters); elevation 0000 means: elevation unknown (elevation of home airfield is used instead). Negative elevations not allowed.

The first character of the info line is used to determine groups of waypoints:
"1" = reserved for airfields ("118.27 AF")
"*" = reserved for buoys (stored GPS positions)
"2" = recommended for outlanding fields
"#" = recommended for special points like cities, mountains, passes and special turnpoints (like Cats Craddle turnpoints).

Only these characters are allowed:

_ABCDEFGHIJKLMNOPQRSTUVWXYZ-/:#.0123456789* (_ means space)

To enter own waypoints by hand into ZS1: characters for name and info text can be set by turning the knob and stepping through the sequence of characters as shown above at all cursor positions for text input.

With the last submenu the displayed format for waypoints can be changed (degrees, minutes, minutes/1000). But this concerns only the display on the screen; in the memory of ZS1 the waypoint format is unchanged.

Submenues of waypoint page:

1= display only:

Data for any waypoint selected are shown. Selection is done by changing the waypoint number (= position in waypoint memory) or by changing the first two letters of the waypoint name. If cursor is set on third letter, the waypoints can be selected in single step mode forward and backwards (same as changing the last digit of the waypoint number up and down).

Waypoint numbers 0001 to 0999 are in the user waypoint area. These waypoints can be modified by hand and can be used to set up routes or with the GoTo function. If a new program is loaded or if a master reset is executed, these waypoints are cleared and must be entered again by PC or other means.

Waypoint numbers 1001 to 7000 show the content of the airfield data base. These waypoints cannot be used for routes but can be used with the GoTo function.

Waypoint number 999 has a special function: here the actual GPS position is shown or the last GPS position before the flight recorder was turned off or removed. Here you see the coordinates of the landing spot in case of an outlanding.

2= save buoy:

On the flight page the actual GPS position can be stored by moving the cursor to the waypount name and turning the knob to the right. This is like throwing a buoy from a boat to mark a position. The previous waypoint name is replaced the word "*BUOY". Turning the knob to the left while the cursor is on the waypoint name restores the waypoint shown before. Turning to the right again stores a new buoy position. The buoy position is stored temporarily under waypoint number 0998 and will be overwritten by the next setting of a buoy.

This submenu allows to save the last buoy set permanently to any waypount number within the user waypoint area. By default ZS1 suggests a waypoint number between 0991 and 0997, but these numbers can be changed if necessary. If one buoy is

saved at 0991, then the next buoy will be saved (by default) to 0992. After 7 buoys saved, number 0991 will be overwritten again.

The name of a buoy starts with "***P** ", a consecutive number from 001 to 999 (after that 001 again), day of the month and time (hrs, min): ***P013 091632**

Before saving, the line which will be overwritten, is shown.

After saving a buoy it can be implemented into the active route by overwriting the active waypoint of the route or being inserted before the active waypoint.

This submenu page is shown automatically if a buoy is set on the flight page and "Enter" is pressed.

3= edit waypoint:

This submenu allows to change user waypoints or write new user waypoints by hand.

To write a new waypoint by hand, first change the waypoint number until you find an empty line. Then write the name, the coordinates, elevation and info text.

To clear a waypoint line, change the first two positions of the name to spaces. This clears the whole line.

If the flight recorder is turned off or removed or if the simulator is turned on, the GPS position at 0999 can be changed for test purposes to simulate any GPS position to show airspaces at special places or to check other functions.

4= buoy / waypoint into route:

This submenu is used to implement buoys or waypoints into a route. The same can be done on the route page.

5= delete waypoints:

To delete waypounts, enter start address and last address. This is used to clear groups of waypoints.

6= copy waypoint:

One of the user waypoints (like a buoy) or one of the airfields from the airfield data base can be copied to the user waypoint area.

7= copy nearest airfields from data base:

If no user waypoint list is available, a selection of airfields can be copied to the user waypoint area to be able to set up routes with airfields. The number of airfields to be copied and the start address in the user waypoint area must be entered before the selection is started by switching to "YES". Then the nearest airfields to the actual or last GPS position are selected and written into user waypoint area beginning at the start address. This process may take several minutes and should be carried out preferably while on the ground.

If a selection should be done (before holidays) for another airfield: remove or turn off the flight recorder, switch to simulator, select the new airfield and copy it to the GPS position. Then the selection of nearest airfields will be around the new airfield.

8= WP format:

Two different formats can be selected for display: degrees, minutes, seconds or degrees, minutes and minutes/1000.

The second format is for display only. The format used in the waypoint memory of ZS1 remains unchanged.

Route page:

```
14: Routes / GoTo
       GoTo? =NO

route =A3  648.8km
1= delete all=NO

        leg =02
frm KOENIGSDORF <S
to
327=PONTRESINA  <T

190.3km 218° 29.3%
```

selection of route function or GoTo function;
(route function selected here)

selected: route A3, total length 648.8km;
submenu to edit a route;

selected: leg no. 2
from start point (<S)
to turnpoint (<T)

distance, course, percentage of total length

Routes are grouped into five sets of routes (A, B, C, D, E) with up to 8 routes each. So up to 40 routes can be prepared (A1 to E8).

Each route consists of the takeoff point (<A), the start or departure point (<S), up to 16 turnpoints (<T), the end or finish point (<E) and the landing point (<L). the total length of a route is the sum of the legs from start point to end point. Takeoff point and landing point are not included in total length calculation.

Enter new route:

Select set of routes and route number;
clear route with "1 = delete route: YES";
select takeoff point (leg no. 00):

set waypoint number if known
or search waypoint by changing first two letters, then step forward or back with cursor on third letter

when startpoint is found, try to move the cursor to 4th letter: this will advance the leg number automatically and the cursor is set on the first letter to search for the next waypoint.

now select the start point

try to move the cursor to 4th letter: this will advance the leg number and sets the cursor for next entry.

now select turnpoints, end point and landing point.

Very often the takeoff point and the start point, the end point and the landing point are the same. In this case the takeoff point must be entered twice at the beginning of a route and the landing point must be entered twice at the end of a route. Otherwise the start line at start point and the photo sector at the last turnpoint will not be shown correctly.

Replace waypoint in route:

Change leg number until the waypoint to be changed is shown in the lower line. Then change waypoint number or search for new waypoint name.

Remove waypoint from route:

Change leg number until the waypoint to be deleted is shown in the lower line. Then select "2 = delete WP: YES" to remove one waypoint from the route.

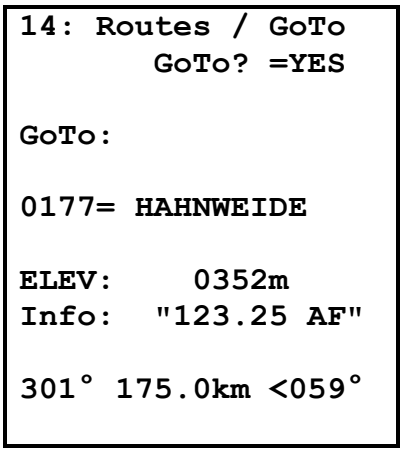
Insert waypoint into route:

Change leg number until that waypoint is shown in the lower line, which should get another waypoint inserted in front of it. Then select "3 = insert WP: YES" to insert one waypoint. The inserted waypoint will be the waypoint numbered 001 which must be changed / replaced as desired.

Use of special points in route:

Waypoint 999 is the actual GPS position as delivered by the GPS of the flight recorder. If waypoint 999 is used in a route, the length of the route will change with the GPS position. If the leg showing this waypoint is selected on the flight page, the remaining distance and estimated time of arrival will change according to the actual GPS position.

Waypoints 991 to 997 may contain stored buoys (marked GPS positions) or preselected AAT points. These point can also be used within routes to calculate actual route length with free turnpoints or to show preselected route length and ETA for AAT tasks.



Route page:

choice of route or goto function;
(GoTo function selected here)

All user waypoints (0001 to 0999) and all airfields of the airfield data base (1001 to 7000) can be selected as GPS target points.

bearing absolute, distance, bearing relative from present position to GPS target point.

The GoTo point selected here is also used for the GoTo info line shown on the flight page even if the route page is switched back to route function. So the GoTo info line may show to a point different from that selected by the route.

```
15: ETA Route A3

total:    0648.8km
done:     0542.3km
          05:28
          099.2kmh

RemDist:  0106.5km

ETA:          16:21
with     MC =1.0m/s
avrg. wind =+02kmh
```

Route statistics and calculation of estimated time of arrival (ETA) at end point of route.

total:	total length of route
done:	total minus remaining distance
duration:	since departure
speed:	for the distance done
RemDist:	distance to next waypoint plus all remaining legs up to end point
MC:	MacCready input (same on flight page)
average wind:	wind for remaining distance

To see the correct speed after landing, the remaining distance must show zero. The remaining distance will be zero if the landing point or the start point is selected on the flight page.

MC and average wind can be changed on this page to see the influence of combinations on ETA. If another page is selected, MC is used as shown on the flight page and the average wind for remaining distance is used as shown on the wind page.

The ETA calculation uses remaining distance to end point, average wind component for all remaining legs and MacCready input. The MacCready input should be set to the expected average climb for the remaining distance. ETA can be calculated with MC=0 only if the glider altitude is already sufficient for final glide.

Important: the ETA info line always uses the avarage wind as shown on the wind page and MC as shown on the flight page. If displayed ETA looks strange, check the wind page first!

List of nearest airfields (from airfield data base):

```
16: nearest
    Airfields:
1=ZELLHAUSEN      1
  003km 328° +396m
2=BABENHAUSEN     1
  006km 203° +238m
3=ASCHAFFENBUR    1
  008km 147° +189m
4=ALTENBACHTAL    1
  014km 127° +002m
5=HANAU           1
  019km 352° -129m
```

1= nearest airfield with name, first character of waypoint info text (identifier), distance, bearing and glidepath information (arrival height above ground).

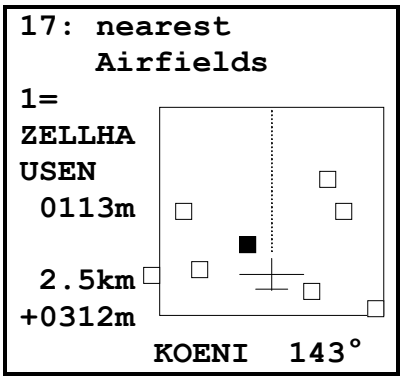
The glidepath is calculated with MC=1 (about 10% safety margin), but no wind assumed.

If the cursor is moved to the name and "Enter" is pressed, this airfield will be transfered to the flight page as GoTo point. There the glidepath will be calculated more accurate including wind.

On the flight page the previous waypoint can be restored by moving the cursor on the transfered airfield name and turning the knob to the left.

With cursor on "1=" the list may be rolled to see nearest airfields 6 to 9.

Nearest airfields (from airfield data base) on graphic display:



The 9 nearest airfielfds are shown on a moving map. In straight flight the orientation is nose up, when circling the orientation is in direction to next turnpoint.

The area shown is fixed: 70km x 70km.

In straight flight the position of the glider is marked by the glider symbol, when circling a small circle is shown.

The airfields are shown as squares. If the squares are outside of the border lines, distance and direction may not be shown correctly.

On the left side a single airfield can be selected (no. 1 being the nearest, no. 2 the second nearest). The selected airfield is marked with a black square.

For the selected airfield are shown: elevation, distance, glidepath (arrival height above ground with MC=1m/s but no wind).

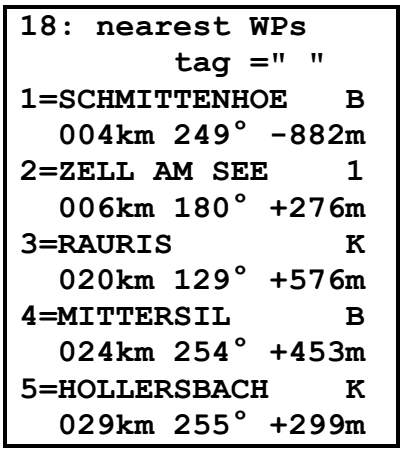
If the cursor is moved to the airfield name and "Enter" is pressed, this airfield is transfered to the flight page as GoTo point. There the glidepath is calculated more accurately including wind.

On the flight page the previous waypoint can be restored by moving the cursor on the transfered airfield name and turning the knob to the left.

If cursor is set on the airfield number and "Enter" is pressed, the waypoint page is selected showing more information about the selected airfield.

The bottom line shows name and direction of the GPS target point selected on the flight page.

Liste of nearest waypoints (user waypoint list):

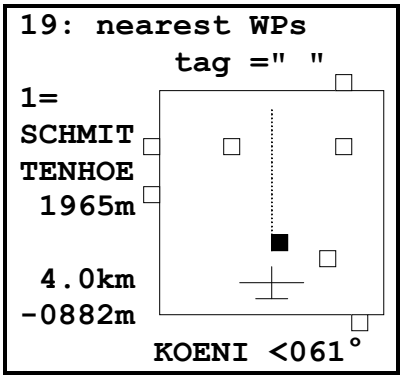


The waypoints shown can be restricted to group of waypoints having the same identifier or tag (first character of waypoint info text: 1, 2, #, *).

If no tag is selected, all user waypoints are used.

Display and functions are same as on "nearest airfield list".

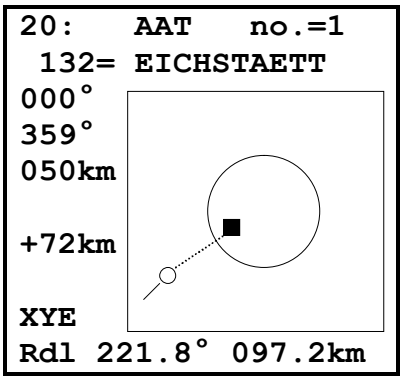
Nearest waypoints (from user waypoint list) on graphic display:



The tag function is the same as for "List of nearest waypoints.

The display functions are the same as for the "Nearest airfields on graphic display".

AAT page (Assigned Area Task):



Up to 9 AAT sectors can be preprogrammed. For each sector a reference point (center of circle) can be selected from the user waypoint list. The sector start radial end end radial have to be entered. For circles the start radial is 000° and the end radial is 359°. The radius of sector or circle has to be entered too.

The sector is shown on a graphic screen (north up). If the glider is located within the area shown, a small circle with a tail is shown. The tail shows the direction of flight. A dashed line is pointing to the next turn-point as selected on the flight page.

The distance shown is from present position to border of sector. If the distance is less than 10km, then 0.1km units are shown too. Plus sign means outside of sector.

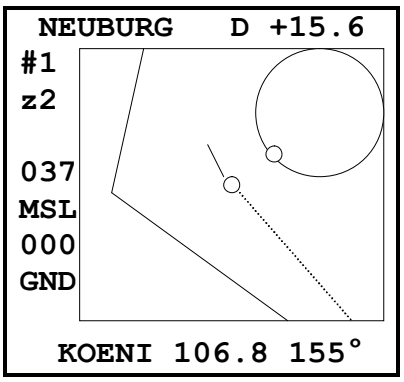
On the bottom line the actual position is shown as true radial with distance from the reference point. The direction shown has a resolution of 0.1° to get better information when being close to a sector border line.

With a cross hair any position within the sector can be marked and saved to the user waypoint list to make up a preliminary route for an AAT task before takeoff. This shows the intended length of a route for preflight planning. With cursor on "X" the horizontal position can be selected, with cursor on "Y" the vertical position is selected, with cursor on "E" and pressing "Enter" the selected position can be saved and then implemented into the active route.

When turning within a sector, the actual turnpoint can be stored by the buoy function and implemented into the active route to see the remaning distance to fly and to see the estimated time of arrival (ETA). The buoy function can be activated easily by pressing button F1 if the buoy function is selected for F1 under "Settings".

While in last sector, the active waypoint can be set to waypoint 999 (which is the actual GPS position). Then ETA and total length of route are calculated continuously according to the actual position. When turning for the final leg, the actual turning point should be saved again and implemented into the route by the buoy function for later evaluation of total length and speed.

Airspace page:



nearest airspace border with name and distance (plus = outside)

#1: airspace selection no. 1 to no. 9 (1 = nearest airspace)

z2: zoom factor:
z1 = 300km x 300km
z2 = 90km x 90km
z3 = 30km x 30km

upper limit of airspace: 037 x 100ft = 3700ft MSL
lower limit of airspace: 000 x 100ft = 0ft GND
limit altitudes are shown like FL (to save display space).
Limit altitudes may be GND (ground), MSL (mean sea level) or FL (flight level).

bottom line: GPS target point with distance and bearing.

If cursor is set on lower limit and "Enter" is pressed, the lower limit is transfered to the altitude alarm.

If cursor is set on bottom line, this line may be changed by turning the knob to show the actual altitude in several formats.

The position of the glider is marked with a small circle with a tail showing the direction of flight. A dashed line shows the direction to the next turnpoint. If the turnpoint is on the map, it is shown by a black square.

If GPS reception is interrupted, the tail disappears and the map does not move anymore.

The orientation of the map is always north up.

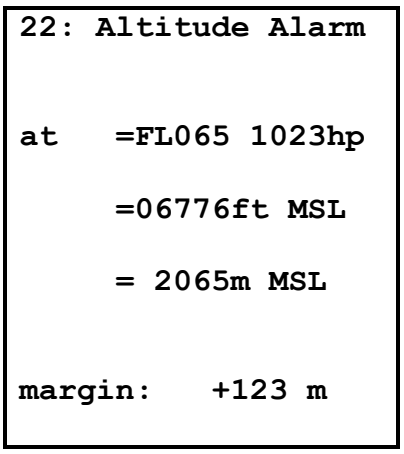
A blinking circle on an airspace border line shows which airspace is selected and which point is used for the distance shown.

After moving the glider to a new home airfield or after loading a new airspace data base, it may take several minutes before airspaces are shown correctly.

If cursor is in home position (upper line), the page can be switched to the altitude alarm page by turning the knob to the right or to the AAT page by turning the knob to the left.

An airspace alarm can be activated under "Settings". If the distance to an airspace gets less than the alarm distance set, an alarm signal sounds and the page is switched from any other page to the airspace page.

The alarm sounds when approaching the border from the outside or from the inside.



Altitude alarm page:

input of alarm altitude as FL (flight level)

display of QNH as set on the page "adjust before takeoff"

Altitudes shown are calculated from alarm altitude (FL) and QNH.

altitude margin to alarm altitude (minus = too high)

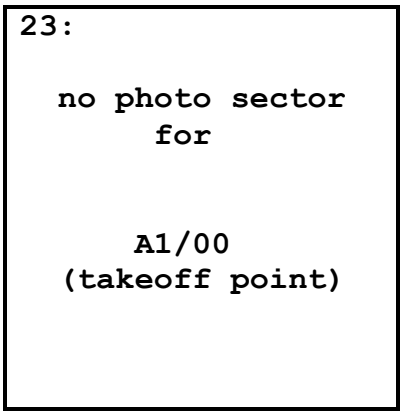
The alarm altitude is set as a flight level. Depending on QNH setting this results in alarm altitudes shown in feet MSL or meter (MSL).

When coming from below, an altitude alarm will sound when the margin gets below 50 meters and the page will be switched from any page to this altitude alarm page.

If the alarm altitude should be set as MSL, the FL altitude is changed until the correct MSL altitude is shown.

The altitude alarm can be turned of by setting the alarm altitude to FL 300.

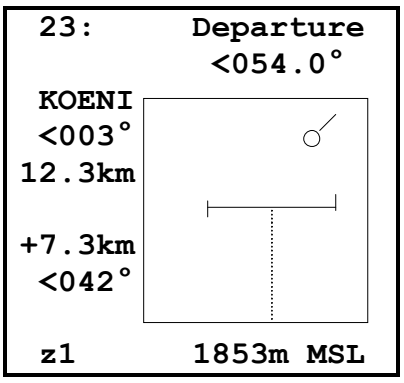
Photo sector page:



There is no photo sector for:

takeoff point of a route
landing point of a route

GoTo points



Departure with start line:

photo angle

start point (direction and distance)

distance from start line
heading error to first turnpoint

zoom test, altimeter

Different screens are shown for start point, turnpoints and end point. The orientation of screens is always fixed: departure from top to bottom, at turnpoints bisector towards the bottom, end point from bottom to top.

Under "Settings / GPS Alarm" the the start line function must be turned on to see the start line. Otherwise the start photo sector or the start circle is shown (similar to the turnpoint screen).

The start line shown is 2 times 10km in length and cannot be changed, but the distance to the start point is shown when crossing the start line. The start point is the center of the line. A dashed line shows the direction to the first turnpoint.

The departure screen is only shown if the start point (= leg 01) is selected on the flight page.

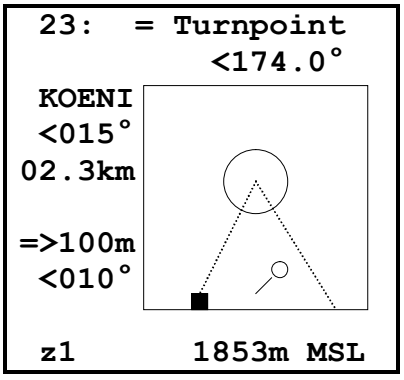
The photo angle shown is the angle from glider position to the center of the photo sector. On the photo sector border line 45° will be shown, when passing the start line 90° will be shown (useful when passing very long start lines).

The distance to start line is measured rectangular to the start line (or its extension for very long start lines).

When passing the start line, a beep sounds. Distance to start point , actual altitude and time will be stored on the "Stop Watch" page. This happens even if the the photo sector page is not selected, but the start point (leg 01) must be selected on the flight page.

The heading error to first turnpoint shows if the start line is crossed rectangular and direction to the first turnpoint.

Zoom test is used on ground to see the different screens for diferent zoom factors. In the air the zoom is switched automatically depending on the distance to the start point.



Turnpoints:

photo angle

turnpoint with name, direction and distance

displacement input for reference point
direction to reference point

zoom test, altimeter

The turnpoint screen is shown if a turnpoint leg is selected on the flight page. A black square shows the direction to the next turnpoint.

Under "Settings / GPS Alarm" photo sector or circle or both can be selected. The size of photo sector (3.0km) and circle (0.5km) are fixed, but for larger sizes the photo angle and distance to turnpoint can be used for information.

The photo angle is the angle between glider position and center line of the photo sector. In the center of the sector it would show 0°, on the photo sector border line it would be 45°. The arrow shows always to the middle of the photo sector.

If the heading error to turnpoint is used to get to the turnpoint, it may happen that the turnpoint will not be rounded correctly (when passing the turnpoint slightly inside of the triangle).

For that reason another methode of rounding is offered on this screen. Another reference point which is located just besides the turnpoint ist used for approaching the turnpoint. When reaching this point a 180° turn through the photo sector will always give a correct rounding.

The displacement and the side of the displacement is set before reaching the waypoint. Then the direction below the displacement is followed. If the direction to the turnpoint shows 90°, then the 180° should be initiated.

If enabled under "Settings / GPS Alarm", every 3 seconds there is a beep while in the photo sector or circle. This alarm sounds only , if this photo sector page is selected.

With the cursor set to the first line, the screen can be switched temporarily to end point screen if special rules in a competition require this (probably for Cats Craddle).

End point:

Normally not used as glidepath information must be available for final glide and information on flight page is sufficient for approach.

6. Settings

The submenu points of text page 03 are used for various settings and selections:

01= Directions shown are magnetic or true
02= Units for variometer, altitude, distance and speed
03= Analog Unit: properties of ZS1R
04= Audio: selection of style and function
05= Total Energy by TE probe or electronic
06= Time Constants (response times) for variometer, speed command, pointer ZS1R
07= G Meter with slow speed warning
08= Compass on/off and deviation table
09= Mode Switching of VARIO / SC by hand or automatically
10= Function select for key F1
11= adapt Remote Control Stick
12= Airspeed Calibration
13= Polar Curve selection
14= Time (UTC), Date, Local Time
15= Centering Aid
16= Fonts / Format for flight page: set letter size and select information shown
17= Page Preselect (programmable pages)
18= GPS Alarm for airspace and turnpoints; start line on/off
19= NMEA output on/off
20= Personal Settings save and restore

With ZS1G (second operating unit or independent GPS computer) only these settings can be changed:

01= Directions shown are magnetic or true
02= Units for variometer, altitude, distance and speed

03= Function ZS1G: second operating unit or independent GPS computer

09= Mode Switching of VARIO / SC by hand or automatically
10= Function select for key F1
11= adapt Remote Control Stick

13= Polar Curve selection
14= Time (UTC), Date, Local Time

16= Fonts / Format for flight page: set letter size and select information shown
17= Page Preselect (programmable pages)
18= GPS Alarm for airspace and turnpoints; startline on/off
19= NMEA output on/off
20= Personal Settings save and restore

The options underlined are the standard or default settings which can be reloaded as standard settings under "Personal settings" or which will be used after a new program was loaded or after master reset. The standard settings are the recommended settings.

Special function of "Enter" button on text page 3:
If "Enter" is pressed, the cursor jumps to the submenu position to be able to switch to next setting. When pressing "Enter" again, the cursor jumps to the start position (text number).

01= Directions:

all directions shown: = magnetic, true

Magnetic directions are using the local variation as delivered by the GPS receiver. These directions are comparable to the direction shown by the compass. This setting is standard in aviation.

True directions do not use variation and are comparable to directions as shown on a map.

02= Units:

variometer	=m/s, kts
altitude	=m, ft
distance	=km, mi, nm
speed	=kmh, kts

Units can be changed at any time, even in flight.

03= Analog Unit: (only on main unit ZS1)

Contrast	= 1 ... 6 ... 9
top line	= m MSL, m GND, ft MSL, ft GND, ft FL, time, GPS track, heading error;
bottom line	= m MSL, m GND, ft MSL, ft GND, ft FL, time, GPS track, heading error;
SCI	= in SC mode only, always;
marker	= all (V, R, N, S), not all (R, N, S), none;

in SC mode:	pointer	= variometer, relative, netto, speed command
	average climb	= netto, variometer

These settings are for analog unit ZS1R. Upper and lower line may show five diferent altimeter readings, time, track over ground, heading error or glidepath.

The SCI (speed command indicator) column can be shown while in SC mode or always.

The pointer shows variometer always when in VA mode. In SC mode it may show one of these signals:

variometer:	always variometer
relative variometer:	shows at any speed the climb rate at circling speed (= netto – 0.8 m/s)
netto variometer:	shows climb or sink of airmass
speed command:	shows deviation from correct MacCready speed (same as SCI column)

The average climb in VA mode is always averaged variometer signal. While in SC mode, the average climb may be netto (climb and sink of airmass) or averaged variometer signal.

Additional settings for pointer and SCI column are available under "Time Constants".

03= ZS1G Function: (only on ZS1G / second seat unit / GPS computer)

The ZS1G can be used as second operating unit to a ZS1 main unit (or SR940) or as independent GPS computer.

After loading a new program or after master reset the function "second operating unit" is selected.

If there is no data connection to ZS1 main unit, a warning is displayed and input is requested. Then the the ZS1G may be switched permanently to independent GPS computer, or may be switched only temporarily to independent GPS computer (to be able to read waypoints from the flight recorder GP941 for instance).

So if a connection from second seat unit ZS1G should be made to a GP941, then the main unit ZS1 must be turned off first. After few seconds the ZS1G will ask if it should work as temporary GPS computer. After "YES" the connection to GP941 will be set up and a waypoint list can be read from GP941. When ready the ZS1G is turned off and both ZS1 and ZS1G are turned on again and ZS1G will switch back to second operating unit mode.

04= Audio:

variometer tone: = steps;
intermittent when climbing;
intermittent (during climb only)

tone in SC mode:
= speed command (SC) tone;
in relative climb: variometer tone, in relative sink: SC tone ;
if relative climb > MC: variometer tone, otherwise SC tone

For very fast variometer settings the intermittent tone is recommended, as this reacts faster then the steps (staircase tone).

In SC mode the relative variometer may switch the audio to variometer tone temporarily: the switching to variometer tone may happen when the relative variometer signal is positive or when the relative variometer signal is larger than the MacCready setting.

05 = Total Energy:

compensation = TE probe, elektronic
correction = -25% ... 0% ... +25%

Two types of TE compensation can be used (which require different pneumatic connections).

Compensation by probe:
is recommended as the most simple and reliable compensation. The probe is connected to port "TE / STATIC". The second port "PITOT" is connected with total pressure (pitot pressure). The quality of the ZS1 variometer depends on the TE probe only in this type of compensation.

Electronic compensation:
uses dynamic pressure (difference between total pressure and static pressure) for TE compensation. The "TE/STATIC" port is connected to a good static pressure, the port "PITOT" is connected to total pressure (pitot pressure). The quality of the variometer depends mainly on the static pressure, but also on the total pressure.

The amount of compensation can be adjusted. But experience shows that if a correction seems necessary, the probe should be changed (for probe compensation) or the static pressure source should be changed (for electronic compensation). So the correction should always remain at zero.

06= Time Constants:

variometer audio = 0.5s ... 3.0s ... 5.0s
filter type = 0 ... 2 ... 4

pointer ZS1R = 1.5s ... 3.0s ... 5.0s
SC signal = 1.0s ... 3.0s ... 5.0s

average climb = 10s ... 15s ... 30s

Time constants (response times) can be set independantly for various signals. With a setting of 3 seconds for variometer audio and pointer the response time is similar to usual 5m/s pneumatic variometers.

An additional filter is available for the variometer audio to reduce fast changes of the variometer signal. The filter setting depends on the quality of the pressure source.

Filter type: 0 = no filter
1 = weak
2 = standard
3 = strong
4 = very strong

The speed command (SC) time constant is used for SC audio, the SCI column and also for the pointer if the pointer shows speed command error.

The average climb signal is calculated similar to a very slow variometer. The information shown is a mixture from 70% climb of the last circle and 30% climb of the circle before the last. This technique shows a change in average climb due to recentering fast enough and therefore does not need a tendency information like other systems.

07= G Meter:

slow speed warning = OFF, ON

IAS limit at 32kp/m2 = 50kmh ...80kmh ... 120kmh

If slow speed warning is on, the variometer tone is twittering when the airspeed goes below a limit.

The limit input is set for a wing loading of 32kp/m2 and would be valid for a glider with 32kp/m2 in straight flight.

The speed limit is recalculated and displayed for the actual wing loading as set on page "adjust before takeoff".

This limit will be recalculated again using vertical g force measured by the accelerometer. The result is compared to actual airspeed and will initiate a change in the audio tone if airspeed is too low.

So the audio will change if the speed is too low or the g force is too hight compared to the speed.

On the same submenu page the accelerometer signal is shown for test purposes. On the ground and horizontal instrument panel it should read 1.00g.

08= Compass:

Compass =OFF / ON

The compass option is used with ZS1 to determine the wind with direction and speed in straight flight.

If the compass function is turned off, there will be no wind calculation with compass even if the compass is connected to ZS1.

The compass can be used only if a deviation table is done and entered into ZS1 (recommended: 1° accuracy).

Before making the deviation test, the compass sensor must be calibrated together with the compass.

sensor no. XXXX kalibriert? = YES / NO

Every compass sensor gets a serial number written on the 4-pin plug of the sensor cable. If the sensor number is already shown on this page and the number is correct, then the calibration was already done.

If the compass sensor or the compass are changed, then the calibration must be done again.

sensor no. XXXX calibrated? = NO

sensor no. = YYYY

calibrate:	1= at 045°	= NO
	2= at 135°	= NO
	3= at 225°	= NO
	4= at 315°	= NO

At first enter the sensor number (must be different from zero; is only used as reminder). Then the glider (or compass only) must be turned and aligned, so that the compass shows mechanically a heading of 045°. Entering "YES" will do the calibration and advance to the next direction command. Again turn glider (or compass only) for the next heading and enter "YES".

After all four directions were calibrated the calibration is ready. If there is still a message on the bottom line "calibration not ready!", then calibration is not possible for technical reasons.

When calibration is ready, change "calibrated? =NO" to "YES". Then the deviation test can be performed.

sensor no. XXXX calibrated? = YES

deviation table: 01= at 000°: =002°

from compass: 002°

The deviation test is done for different headings controlled by a reference system like the calibration compass available for ZS1 system. The electrical heading information as measured by ZS1 is entered into deviation table of ZS1 for each heading.

The electrical headings should be written down on paper before they are entered into ZS1, first to see any irregularities after test and second to have a backup if they must be entered again.

First the glider is aligned exactly to North (000°) by a reference compass. The glider must be in flying condition with canopy closed and locked. The heading shown at "from compass:" should be noted. This number will later be entered into ZS1.

Now the glider ist turned exactly to 015° and again the displayed heading is noted. This is repeated every 15°. Each alignment should be accurate by 1°.

If the heading error displayed is more than 15° or if the heading error changes from one direction to the next for more than 3 degrees, then the place used for the compass may not be usable.

When ready all measured headings are entered into ZS1 for each direction:

01= at 000° =002° (example)
02= at 015° =018°
03= at 030° =034°
....

Table entry:
If the cursor is set on position to enter a measured heading, then "cursor down" will change the entry line for next entry.

The deviation table is saved in a Flash Rom and cannot be deleted but overwritten only by new entries. Even after master reset the deviation table is still available.

Futher information on installing the compass, compensating and calibrating see **Installation Notes**.

09= Mode Switching VARIO / SC: = key F1;
flap switch;
remote control;
by airspeed;
by airspeed and GPS.

Variometer (VARIO) and speed command (SC) modes control the audio, the analog pointer and the switching between average climb and average netto climb.

Key F1 is a pushbutton on ZS1, flap switch is an external switch on the flap lever, and remote control is a switch on the remote control stick grip.

If mode switching is done by airspeed, a typical speed for a glider with 32kp/m2 is entered. This speed will be recalculated to actual wing loading as set on page "adjust before takeoff" and is also displayed. This calculated speed will be used for mode switching.

The speed input for 32kp/m2 has the advantage, that it is not necessary to change this setting if wing loading changes. Only the actual wing loading input must be changed accordingly.

If speed and GPS are used for mode switching, then variometer mode will be selected while circling or in slow straight flight. In fast straight flight the speed command mode is selected.

10= Function Key <F1>: = directions absolute;
buoy ito route;
no function

If key F1 is not used for VARIO / SC mode switching, then this key may have other functions:

All relative directions shown in straight flight may be changed temporarily to absolute directions while pressing the F1 key (example: wind direction in staight flight).

Save a GPS position and implement it into the active route. This will store an actual turnpoint when flying free tasks or AAT tasks.

11= Remote Control:

Toggle +F/-F = not present, +10 / -10, volume, VA/SC mode

VA / SC switch: = not present, pushbutton, switch

This submenu is used to adapt varios stick grip types to ZS1:

Plastic grip (black) for ZS1:	with toggle +F/-F no VA / SC switch
for SR940 type A (with VA/SC)	toggle +F/-F not available VA / SC mode by switch
for SR940 type B (with +10/-10)	with toggle +F/-F no VA / SC switch
Wood grip type SDI (for ZS1):	no toggle +F/-F VA /SC mode by pushbutton

12= Airspeed Calibration:

Test 1:	IAS: 090kmh CAS: =092kmh
actual test speed:	measurement for 089kmh = circling test CAS: +03kmh = straight flight test Wcomp: -07kmh

Airspeed calibration is important for measurement of wind component and compass wind in straight flight.

There are two types of calibration: in circling flight and in straight flight.

The circling calibration is suitable for slow airspeed and requires constant wind (direction and speed) over an area for the circles. This condition is very likely if there are no thermals.

Calibration in straight flight requires that the wind does not change to much with altitude.

The first step of calibration is done with circling test. The actual wing loading must be set on page "adjust before takeoff". Circling should be done with flaps in best glide position. The airspeed should be maintained so that "measurement for" shows 90 kmh. After one circle a CAS correction is shown. The CAS input for 90kmh should be changed until the CAS correction shown stays around zero. So calibration is done for 90kmh at 32kp/m2.

The second step of calibration is done in straight flight. The airspeed should be maintained so that "measurement for" shows 90kmh. The wind component shown will be used as a reference. Then the speed is increased until the "measurement for" shows 120kmh. If the wind component changes, the CAS input for 120kmh should be

changed accordingly until there is the same wind component shown for 90kmh and 120kmh.

Calibrations for 150km/h and 180km/h can be done similar to the test for 120km/h.

These calibration tests assume that airspeed errors depend mainly on angle of attack. So calibration is done at speeds depending on wing loading in straight flight and depending on wing loading and g forces in circling flight. So the commanded speeds may differ from the actual indicated airspeed and the commanded speeds may be even higher during circling test.

Note: if circling calibration was done at 90km/h, the CAS error on this page will show how fast and to which side a thermal is rotating when flying in thermals.

13= Polar Curve: = standard class
15m FAI class
18m class
open class
own polar curve

at 33kp/m2:
best L/D ideal
=42 at =096kmh
-2.0m/s: =167kmh

Typical polar curves are provided for four classes of gliders. A special polar curve which can be adjusted is available too.

The polar curves are formed by quadratic equations. The curves are determined by best L/D, speed at best L/D and speed at 2.0m/s sink rate.

The curves are provided for a wing loading of 32kp/m2 and are recalculated according to the wing loading set on the "adjust before takeoff" page. For test purposes the wing loading can be changed directly on this page and the properties of the new polar curve are shown.

The calculated polar curve is changed again before it is used within ZS1 to fit the "best L/D" input on page "adjust before takeoff". So the glidepath for zero MacCready and no wind uses the "best L/D" setting of page "adjust before takeoff".

14= Time, Date:

UTC: 14:32:17
Date: 27.07.04

LOC = UTC +02 Std

LOC: 16:32:17

UTC (Universal Time Constant) and date are set by GPS. So to see date and time, a flight recorder must be connected and turned on.

To see all times as local times, a local time offset can be entered. If all times are shown as local, dates are still UTC dates.

15= Centering Aid:

= beep off, beep with info, beep always

lead time = 0s ... 2s ... 9s
threshold = 0.0m/s ... 0.2m/s ... 0.5m/s

When circling the climb rate is checked around the circle. If climb is better on one part of the circle, an info line on the flight page may show in which direction to find better climb and how much improvement would be possible.

A beep can be enabled which sounds when the glider is oriented towards the better climb. The beep sounds only if the possible improvement is larger than the threshold set.

As it takes few seconds to level a glider to be able to recenter, there is a lead time input to let the beep sound earlier.

The beep can be turned off or on, or may sound only if the info line is visible on the flight page.

16= Fonts / Format of Flight Page:

fonts = small, large

0 = GPS heading not shown
1 = GPS heading shown
2 = GPS heading and cross track error (XTE)

If small letters are selected, the flight page shows 6 info lines; with large letters the flight page shows 4 info lines.

The middle area of the flight page may show one or two additional informations: GPS heading (= track over ground), XTE (offset from course line).

17= Page Preselect:

total pages =1 ... 3 ... 9

page no. =1
text no. =03

page 1:
03: Settings

A sequence of pages can be preprogrammed which can be accessed easily from the flight page by pressing "Enter".

At first the number of preprogrammed pages is entered. Then for each preprogrammed page an appropriate text page can be selected. The bottom line shows the head line of the text page selected.

18= GPS Alarm:

airspace alarm = OFF
at distance =1.0km ... 2.0km ... 9.0km

turnpoint alarm: = photo sector (from radius 0.2km up to 2.8km)
cylinder (radius 0.4km)
photo sector and cylinder

start line? = NO, YES

If airspace alarm is turned on, an alarm signal sounds and the page is switched to airspace page if the distance to nearest airspace becomes less than the limit set. The alarm sounds when closing in from the outside or the inside.

Turnpoint alarm is a beep repeated every 3 seconds as long as the position of the glider is inside a photo sector or circle. The turnpoint alarm only sounds if the photo sector page is selected. The selection of turnpoint alarm type also determines the display on the photo sector page.

On the photo sector page the photo sector shown has a radius of 3.0km, the circle has a radius of 0.5km. So the turnpoint alarm will sound when the position of the glider is well inside of the area shown on the photo sector page.

With "start line = YES" a start line is displayed on photo sector page when departing.

19= NMEA:

NMEA output for PDA: = OFF, ON

The PC connection of ZS1 can be used to receive NMEA data from ZS1 for an external PDA. At pin 2 of the 9 pin SUBD socket these data are provided (pin 5 = GND):

$GPRMC,.... *cc cr lf	standard RMC sentence
$PZAN1,01234,123456 *cc cr lf	altitude in meter (plus only), serial number
$PZAN2,000,10000 *cc cr lf	airspeed km/h (True Air Speed)
	variometer signal cm/s (zero=10000)

If the ZS1 is equipped with option "NMEA input", the NMEA input can be turned on and off too. If turned on, a NMEA signal from an external GPS may be connected to the PC connection of ZS1 at pin 3 of the 9 pin SUBD socket (pin 5 = GND). The external GPS must provide the standard RMC sentence. All other sentences are ignored.

If NMEA input is used, pin 2 of the 9 pin socket must not be connected to the external GPS.

If both NMEA output and NMEA input are used, pin 3 of the 9 pin socket goes to the external GPS and must not be connected to the external PDA at the same time. Pin 2 is only connected to the external PDA.

For data transfer between ZS1 and PC it should be noted, that NMEA input and output are using the same connections as required for PC. Therefore the external PDA and the external GPS must be disconnected before the PC can be connected.

Both NMEA output and input must be turned off before PC data transfer may start or the ZS1 is turned off and later turned on again while the PC is searching for ZS1. Then the PC connection will get priority over the NMEA output and input.

20= Personal Settings:

data set no.	= 00	(no function)
	01	standard (default) setting
	02 to 21	settings for up to 20 pilots

data set no.	= 02
(name)	ANTON SCHULZE
read set?	= NO
PIN:	= 02
name:	FRANZ MUELLER
write to 02?	= NEIN
	(after YES wait until NO appears again (20 sec.))

All personal settings and personal selection of info lines of up to 20 pilots can be saved in nonvolatile memory.

The personal settings are stored in Flash Rom which cannot be deleted but overwritten only. After loading a new program or after master reset all personal settings can be recalled.

Settings which are not stored will be replaced by standard settings after loading a new program or after master reset.

To store personal settings, first search a data set number which is empty or may be overwritten. Data set no. 01 contains standard settings and cannot be overwritten. Then the PIN must be entered: it is the same number as the data set number. The name for the data set (pilot's name) should be entered at the line one before the last. Then the question on the bottom line is answered with YES. After about 20 seconds YES changes back to NO again and the data set is stored.

To recall a data set, change the data set number until the correct name is shown. Then answer question "read set?" with YES. The new name will appear in the line one before the last when all settings are transfered.

The name can also be used to be declared as pilot's name within the flight recorder GP941 (not possible with GP940).

7. PC Connection to ZS1

The PC used for data connection to ZS1 must be an IBM compatible computer with operating system Windows95 or later.

To install the PC programs, run the self unpacking file winzanXX.exe (XX = version number). The unpacked file will be written to folder C:\Programme\WinZANXX. So each version will get its own folder.

Important: change the link to WinZAN.exe on your desktop whenever a new WinZAN version is installed! Otherwise you may have a new version on your PC but you are still using the old version.

Note: Installation of WinZAN is not a real installation. All files are copied only, so all directories can be renamed, copied or deleted.

Data connection from PC to ZS1 is prepared for serial COM port. If no COM port is available, a special cable containing an USB-to-Serial converter may be used. This cable is available from computer stores. The CD delivered with the cable must fit to

the operating system of the PC. After installation the cable gets a COM port number visible at system / system manager.

As there are many other programs which may use the same COM port just after running up the PC, it is recommended to use the USB-to-Serial cable instead if problems occur with the existing COM port.

ZS1 is delivered with a PC connection cable which is used for external NMEA devices as well. All external devices must be disconnected before a PC may be connected.

The 9 pin SUBD socket may be mounted into the instrument panel without housing or may be tied with housing ton accessible place. The SR940 cable (15pin to 9pin) can also be used if no remote control is connected.

The cable to connect the PC with the 9 pin socket may be a standard 9 pin extension cable or the USB-to-Serial cable.

After program start of WinZAN.exe the COM port number must be set and the program language may be selected. Then various subprograms can be started. WinSR02.exe is used for connection to ZS1.

With WinSR02 new program versions, airspace data, airfield data bases, waypoints and routes can be loaded into ZS1.

Attention:

Before loading a new program version into ZS1, the personal settings should be saved, the waypoint list should be saved on PC and the flight log should be copied.

After loading a new program a master reset is initiated with next power on. Therefore the ZS1 power should be turned off and on before waypoints and routes may be restored.

When loading airspace data or airfield data bases there is no master reset involved; waypoints, routes and flight log stay unchanged.

8. ZS1G

ZS1G (short version of ZS1 without variometer, airspeed and altimeter sensors) may be operated in two versions. Under "Settings" there is a special submenu for ZS1G to select between "second operating unit to ZS1 / SR940" or "independent GPS computer".

Second operating unit:

If ZS1G is used with ZS1, both units must use the same program version.

Also user waypoint list, airspace data and airfield data base should be the same for both units.

Both units are operating independently.

Some data are transfered from ZS1G to main unit ZS1:
MacCready input, mode switching variometer / speed command, audio volume.

From main unit ZS1 to ZS1G these data are transfered:
Sensor signals altimeter, airspeed, outside temperature, supply voltage,
MacCready input, audio volume, wind, QNH

The ZS1G does not show all pages, settings and info lines. If information is not available, dashes are shown.

For data transfer from ZS1G to flight recorder GP941 the ZS1 must be turned off. After a few seconds a warning appears on ZS1G: "no connection to ZS1". If the question "connect with GP941?" is answered with "YES", then the ZS1G is switched temporarily to mode "independent GPS computer". Now The ZS1G has access to GP941 via the "FD Recorder" page. When ready the ZS1G is turned off and on again; this will switch back ZS1G to "second operating unit" mode and the main unit ZS1 may be turned on too.

If the main unit ZS1 would fail, it should be turned off. Now the ZS1G can be switched to "independent GPS computer" permanently and can give all GPS information required.

Waypoints and routes cannot be transfered between ZS1 and ZS1G. But waypoints can be written from one unit into GP941 and read by the second unit. Routes cannot be written into GP941.

If ZS1G is used together with SR940, the ZS1G can be used temporarily as independent GPS computer too, but the 25 pin plug of the SR940 must be removed from SR940 during that time (i.e. SR-TX and SR-RX must not be connected). Turning off power from SR940 is not sufficient.

Independent GPS computer:

If this mode is selected for ZS1G, it can be connected directly to flight recorder GP941. As there are no sensors for variometer, airspeed, outside air temperature and voltage, only those informations are shown which do not use these signals. Pressure altitude is transfered from GP941, so glidepath calculation can be done.

Variometer and speed command modes have no meaning for the independent GPS computer, so these modes cannot be changed.

If the independent GPS computer mode is selected, the flight recorder can be replaced by any other GPS unit which transmits NMEA data. Under "Settings" the NMEA input has to be turned on and pin 3 of the 9 pin socket for PC connection is connected to the NMEA signal source (Pin 5 = GND).

The external NMEA source must provide the standard RMC sentence and only this will be evaluated by ZS1G. There is no altitude information contained, so the glidepath calculator gives only the necessary altitude, but no longer the altitude difference. Other informations depending on altitude are not available too (like statistic, travel speed, ETA).

If ZS1G is connected to a PC, it should be kept in mind that NMEA input and PC connection are using the same connection. External units must be disconnected first. Then the NMEA input must be turned off or ZS1G is turned off and then on again while the PC is searching for the ZS1G. Then the PC connection will be established as PC connection has priority over to the NMEA connection during power-on.

Beeper:

A beeper can be connected to ZS1G (second operating unit or independent GPS computer) to hear airspace, altitude and turnpoint alarms. With a second operating unit the speaker of the main ZS1 unit will only give alarms originated by the main unit.

The nonmagnetic Piezo beeper is connected to row B of ZS1G. The audio volume is not adjustable, but with some tape the output area of the beeper can be reduced to decrease volume.

9. Flight Data Recorder GP941

see: GP941_01_e.pdf

10. Installation Notes

see: ZS1_Inst_d.pdf